



This One



AXNP-NYC-KBKQ

Get it together. Buckle up!

More Bauer to you!

Ford Bronco and Bronco II—not one but two tough 4-wheelers for '85—both with Eddie Bauer style. They're all dressed up with everywhere to go!

Now Ford offers you a choice of big Bronco (seats 5 or 6) or trim-size Bronco II (seats 4) in special Eddie Bauer editions. Both have a lot of good things in common—besides Ford toughness and Bauer class.



More power to you.

Both have plenty of power on tap. Power that eases you through hard off-road going and makes

all driving more fun. Bronco II's 2.8L V-6 gives you power no other small V-6 4-wheeler can top. It's standard at no extra cost. Bronco starts with a big high-torque 4.9L Six, standard. Adds a 5.0L V-8 with new electronic fuel injection. Plus a 5.8L High Output V-8 with 4-barrel carb—and 27% more horsepower than Blazer's biggest engine.*

Unique suspensions.

Both Broncos have

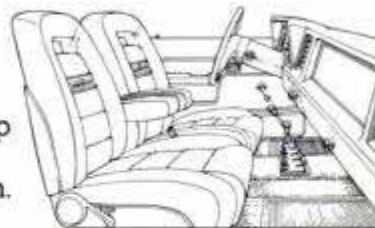
independent front suspension to absorb off-road jolts so you don't have to. And to help keep wheels glued to the ground for solid traction.

Both give you a proven 4-wheel-drive system with a choice of manual or optional automatic locking hubs.

And now both offer you the special looks and luxury of Eddie Bauer editions.

The Bauer Broncos.

These unique 4-wheelers have high-styled interior and exterior trim. They include dual Captain's Chairs, floor console and much more. Plus Eddie Bauer gear bag, travel blanket and visor organizer. And, to top it all, "Ford Care" extended maintenance



and limited warranty program. One beautiful package!

Best-Built American Trucks.

At Ford, Quality is Job 1. A 1984 survey established that Ford makes the best-built American trucks. This is based on an average of problems reported by owners in the prior six months on 1981-1983 models designed and built in the U.S.

Lifetime Service Guarantee.

As part of Ford Motor Company's commitment to your total satisfaction, participating Ford Dealers stand behind their work, in writing, with a Lifetime Service Guarantee. No other car companies' dealers, foreign or domestic, offer this kind of security. Nobody. See your participating Ford Dealer for details.

*Optional; not available in California or with manual transmission. Horsepower based on SAE Standard J1349.



"My Ford Bronco & Me."

"My Bronco II & Me."

AMERICA'S
TRUCK **BUILT FORD TOUGH**



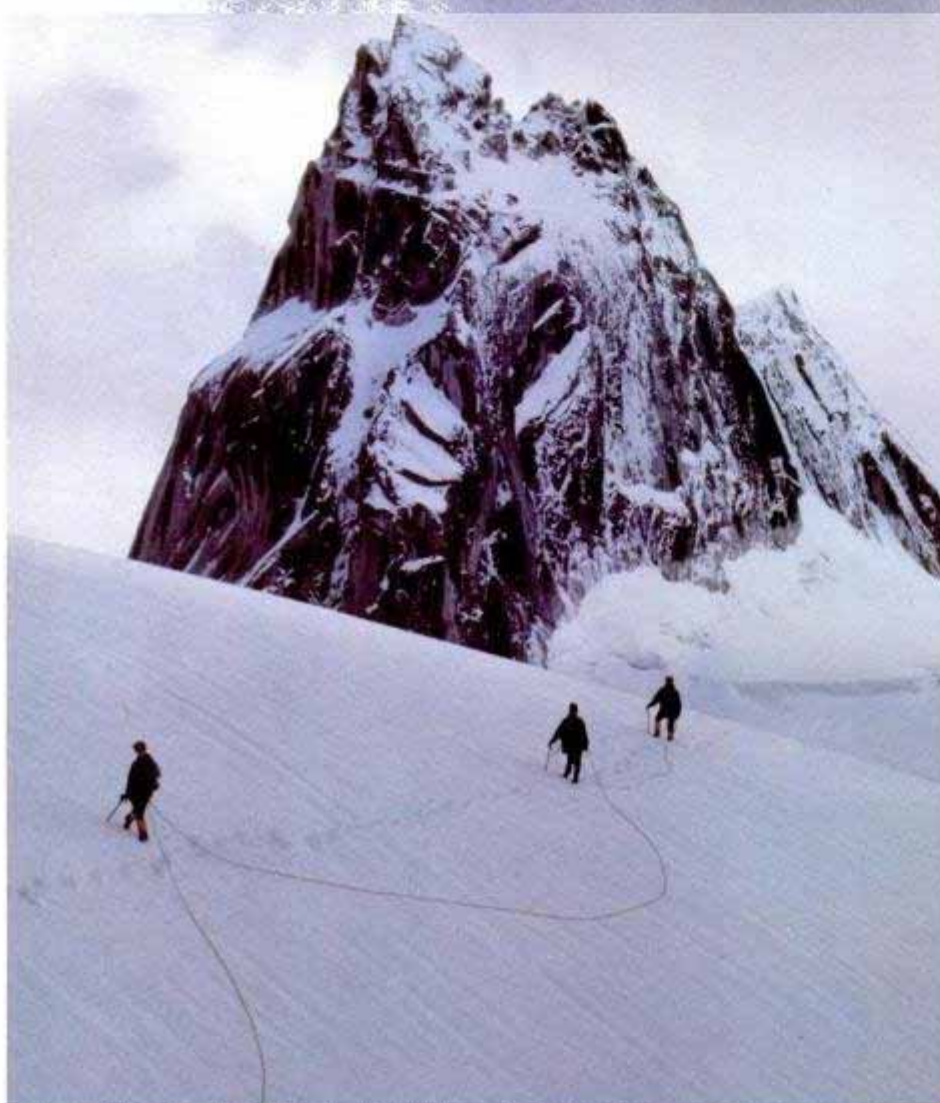
Ford Bronco



Get it together. Buckle up!

Ford Bronco II

Purcell Mountains.
A rugged place for
a smooth whisky to start.



WESTERN CANADA—The hardest part of the climbing is just getting enough air. I gulped it in. Icy. Thin. And then we stopped, and looking around took my breath away all over again.

Later, thawing out by the fire, we knew we'd been someplace we could never forget.

Over Windsor Canadian, we talked about it all night long. That's some smooth whisky.

It's made from water that runs down from the glaciers. They use the local rye. And that high, clean air must have something to do with the way Windsor Canadian ages.

Rugged country. Smooth whisky. Both unforgettable.

WINDSOR
CANADA'S SMOOTHEST WHISKY.



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ON THE COVER

Loving care by Michael and Joseph Gallipani has kept this 1955 Buick Special convertible in like-new condition for 30 years. You can do the same for your car. PM shows you how in our big 60-page Car Care Guide that begins on page 123.

—PM photo by Bill Ashe

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True Value
HARDWARE STORES®

TOOL VALUE OF THE MONTH



Your choice
4.97
each



SERVESSE™

Shovel or Rake

Welded steel rake has 14 curved teeth, round-point shovel has 12" heat-treated steel blade. Both have long handles! Hurry! Offer good from April 10 only while supplies last, at participating True Value Hardware Stores. 138685/139550

**HARDWARE
VALUE
OF THE MONTH**



5.88

Master
ELECTRICIAN™

60' Extension Cord

Heavy 16-ga. 3-wire cord for power tools, indoor & outdoor appliances that need grounding. Buy a spare now! Offer good from April 20 only while supplies last, at participating True Value Hardware Stores. 239335

CHARGE IT at participating True Value Hardware Stores. For store nearest you, see "Hardware" in the Yellow Pages.



EDITOR'S NOTES

Among the very earliest arrivals at Japan's Expo '85 were PM's Dennis Eskow and photographer Brian Wolff. Their mission was to let PM readers know about the new technological wonders the Japanese are going to be offering to the world in the next few years (see *Tsukuba: Japan Struts Its Stuff*, page 102). Other than that, we gather, they acted like any other fairgoers and took their turn at the novelties and rides—such as a robot snail one rides like a horse and a mini wind tunnel (right) in the Children's Park. Dennis even managed to become the first American to pilot Japan Air Lines' new maglev train. . . . **How'd you like to cruise around** in that beautiful '55 Buick on our cover? Certainly seems like the right way to go, doesn't it, with spring in the air and all that. The cover car is a great example of a fun-to-drive



Judy Wolff and PM's Dennis Eskow at Japan's Expo '85: Just blowin' in the wind.



A convertible is fun, even in a studio, claim PM's Bryan Canniff and Ira Herrick.



Here's the classic Buick as it appears in real life—all white and in regular use.

vehicle that was given a new lease on life by dedicated enthusiasts. Michael and Joseph Gallipani bought the Buick from a man who, hoping to find time to restore it, had stashed it away for some 20 years. The Gallipanis spent five months bringing it back to its original condition. Incidentally, the Buick is really all white, as it appears in the photos at left. The two-tone, yellow and white paint job came by way of darkroom magic to make it a more colorful subject for the cover. . . .

Freelance writer Harry Jaffe told us he was skeptical when he first heard about the use of nuclear waste to run airport and highway lights. But as he investigated several experiments under way, skepticism slowly turned to belief. Jaffe

says experimental runway lights powered by tritium are brighter than conventional runway lights. And his talks with medical scientists convince him that the lights pose no danger to humans. Runway lights and other uses of nuclear residue are the subject of *The (Slightly) Glowing Future of Nuclear Waste* (page 91). . . . **If you're shy about taking to the dance floor**, you might take your lead from a dancing robot. Not only does he dance, he arrives on site in a UFO. You can read more about him in *Technology Update* (page 67).

John A. Siblett

CAMEL FILTERS

It's a whole new world.



Today's
Camel Filters,
surprisingly smooth.

16 mg. "tar", 1.2 mg. nicotine av. per cigarette by FTC method.

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

LETTERS TO THE EDITOR



Book wall finds a good home

During a recent remodeling of the residents' lounge in our nursing home, I was asked to come up with plans for a bookcase unit to span a full wall. After considerable searching for ideas, I came across your excellent design (*Redecorate With A Bookcase Wall*, page 106, Feb. '84).

I followed your drawings very closely, using birch veneer plywood for the shelves and doors and solid birch for the trim. I have received many compliments on the results. Thanks for publishing such good plans.

LARRY PETERS
HEALTHWIN HOSPITAL
SOUTH BEND, IND.

Thanks for letting us know. We're glad that the design worked out well for you. Photocopies of the bookcase plans are available for \$3 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.



PM's combination bookcase/storage wall built for South Bend's Healthwin Hospital by reader Larry Peters. It gets lots of use.

More on 'first' cars

In your article *American Cars: The First Century* (page 78, Dec. '84), you said the first gasoline-powered American car was built by Charles and Frank Duryea in 1892. We here in Ohio like to think that the first was the Lambert, made in Ohio City in early 1891—a year before the Duryeas' appeared. This is borne out by sworn statements and a photograph of the car in the Smithsonian Institution.

ROBERT G. HEINFELD
ADA, OHIO

I think you should have included the Reese Special, a gas-powered automobile built in Plymouth, Pa., sometime between 1884 and 1887.

JULIUS DRAHEIM
BOWIE, MD.

You said the 1936 Lincoln Zephyr introduced styling trends that lasted into the '50s.

My choice would be the 1934 Chrysler Airflow, which beat the Zephyr by two years and was the first car to have a slanted windshield. I owned one and it was way ahead of its time.

BYRON F. ASHTON
ALBANY, GA.

Biking the rails

I enjoyed your article *Biking The Nubian Desert* (page 94, Feb. '85). We made similar rigs here to let us ride our bikes on old abandoned railroad tracks. It was a surprise to learn that you need an outrigger wheel riding on the opposite rail. Without that wheel, you can't keep

your balance even though the rail is guiding you straight as you ride.

W. E. VORECK
SPARTA, N.J.

No, you did it right

I guess I've been doing it all wrong. When our car got stuck in sand, we used to let air out of the rear tires to increase their footprint and give them better traction.

Now you say that *increasing* the air pressure expands a tire's footprint, improving traction (*Technology Update*, page 61, Jan. '85). You've got me really confused.

C. E. MCMURRAY
CROWLEY, TEX.

Sorry for the confusion. The tires we were referring to are of a special design having an accordion construction. They stretch as air pressure is increased, thus expanding their footprint to give better traction.

Those variable-pressure tires may be the first in America, but they aren't new. While in Lithuania in 1972, I saw firetrucks equipped with similar tires so they wouldn't get stuck in mud and snow. We're not always first.

ARTHUR R. PETRICK
ELKA PARK, N.Y.

Better late than never

In *PM's Time Machine* (page 178, Jan. '85), you noted that your issue for January 1935 carried a story about the invention of the first backup light for automobiles.

It's a bit late to correct that issue now, but I think you should know that my 1930 Packard had a backup light—and that was five years earlier.

SAMUEL W. AVERETT
CHATHAM, N.J.

I remember purchasing a combination stop/backup light as an accessory for my dad's 1926 Buick. It became standard equipment a few years later.

R. NOEL
NORWALK, CALIF.

A lot of boat

I was really impressed with your Water Sportster project (*PM's Water Sportster*, page 80, Feb. '85). I like the idea of a multipurpose boat that can be used for fishing, water skiing or family cruising, and your craft was crammed with lots of nifty boating accessories.

JASON SAWYER
SOUTH BERWICK, ME.

There's a good side, too

I must commend you for your fine article on attack helicopters (*No Longer Sitting Ducks: Now Helicopters Shoot Back*, page 86, Feb. '85). The Apache is certainly an awesome machine, but it's sad that such brilliant technology must be used solely for killing purposes.

WAYNE BRILES
LOS ANGELES

As with all of our high-tech weaponry, the real hope is that it will never be needed in battle. Thus, it serves as much as a deterrent to war as a machine of war.

PM



WHEN YOU CAN'T PREDICT WHAT'S AHEAD OF YOU, THERE'S ONLY ONE OUTBOARD TO HAVE BEHIND YOU.

Part of what makes boating enjoyable is the unexpected.


But sometimes the unexpected can be a little more than you bargained for.

That's when it's good to have a Mariner outboard behind you. Mariners are rugged. Reliable. And more predictable than the weather.

Mariner Outboards from 4 to 200 horsepower have CD ignition for quick starting. And to make sure they keep running, we build them with rugged lower units and internal components that undergo the industry's toughest testing. So

you can concentrate on enjoying yourself, instead of wondering whether you'll make it home.

A Mariner will also squeeze the most out of every drop of fuel.

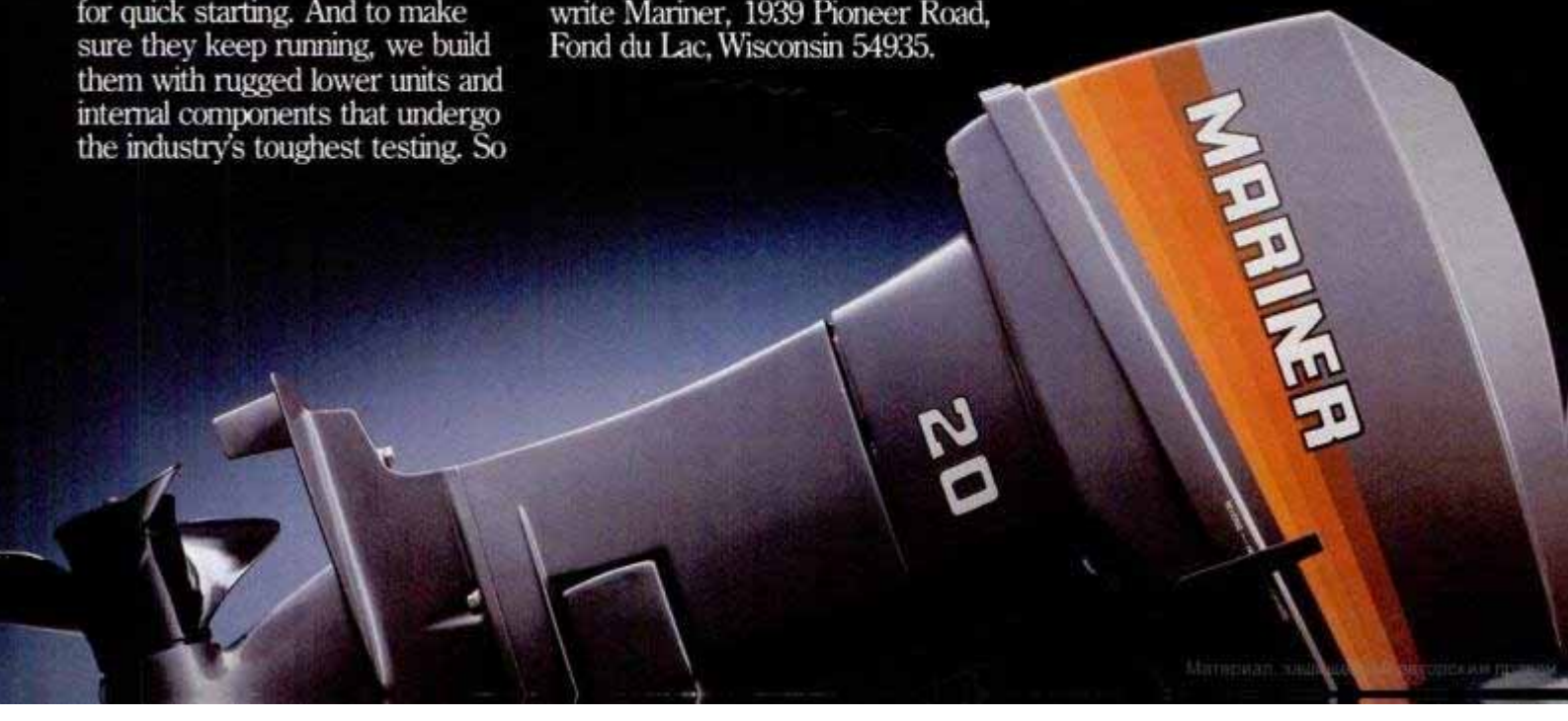
And with our exclusive  MMAC financing option, a Mariner-powered rig is easier to own than ever before.

See your dealer for a catalog showing our complete line, or write Mariner, 1939 Pioneer Road, Fond du Lac, Wisconsin 54935.

And find out why Mariner is one of the things about boating you can always count on.



MARINER
OUTBOARDS
BETTER IN THE LONG RUN.



IMPORTS & MOTORSPORTS



What a wagon!



Volvo 740 Turbo station wagon has sports-car handling and 160 hp—not to mention space.

Station wagons are not supposed to be exciting, but Volvo's are. We found out just how fast, road worthy, quiet and impeccably put together a wagon can be on a several hundred-mile drive, trying five variations of the new 740/760 Volvo.

On fast, paved Arizona highways—and driving just as fast on rippled desert roads—we tried to shake, rattle or roll the luxurious haulers. No go. Not knowing you're driving a wagon is the best thing about these 740/760s. The 740 GLE with its 2.3-liter, four-cylinder, fuel-injected, 114-hp Four starts the lineup at \$19,360. The intercooled turbo version of the 2.3 engine is rated at 160 hp and pegs the price of the 740

Turbo model at \$21,340. The same strong engine is mounted in the 760 Turbo (\$23,440), but this wagon is better appointed than the 740—sunroof is electric rather than manual, for example.

Finally, the 740 and 760 turbodiesel models (\$20,760 and \$23,660) come with the inline Six, 2.4-liter turbodiesel. Again, the difference is in comfort and convenience options. It's nice driving a wagon that feels and handles like a sports car—even nicer when it has 160 responsive horses at your bidding. That makes a 740 or 760 Turbo our choice of a wagon that you sure can enjoy playing with—and it's probably pretty good at working, too.

'86 Stanza wagon

Nissan's new station wagon is as unique in its layout as Volvo's is conventional. Topped off with a high greenhouse, making it a cross between a minivan and wagon, the Stanza has dual sliding doors—one on each side of the body. It's also pillarless (no B-pillar), which means that when the hinged

front doors and sliding doors on both sides of the wagon are open, there's just wide open spaces running right through the wagon from side to side. The seats aren't removable, but the rears fold down to give a flat cargo area that's 80 cu. ft. The '86 wagon is based on the Prairie, which has been on sale in Japan for several years, and will be in

the \$10,000 price range. That price includes power steering, cruise control, AM/FM and more. Power for the fwd Stanza is 97 hp from Nissan's fuel-injected 2-liter Four; five-speed is standard. Major options are but two: automatic overdrive transmission and sliding steel sunroof.



Stanza wagon has a sliding door on the driver's side, too.

The Yugos are coming

If importer Malcolm Bricklin can hold the line, a Yugo GV will cost \$3,990 and be the lowest priced car you can buy here. The little Yugo—from Yugoslavia, of course—is made by Zavodi Crvena Zastava and should go on sale this month at about 300 dealers.

The two-door hatchback is not as crude as you might expect from the price. The design is basically Fiat 128 and the car has front-wheel drive, transversely mounted ohc Four with four-speed, rack and pinion steering, independent suspension, radial tires and front-disc brakes. Displacement of the Four is a scant 1.1 liters, but the base model GV is very decently appointed: reclining front seats, rear



Yugo will arrive here at \$3,990, it's hoped.

window wiper and washer, locking gas cap, grab handles, opening front vent windows, full carpeting and the like. Unlike early Beetles, it has a fuel gauge—and even a low-fuel warning light. The GV (for Great Value) will be accompanied by a GVX (Extra Great Value) which will be closer to \$5,000 with its sport alloy wheels, larger 1.3-liter engine and other add-ons.

Spying on Audi

If Audi were to do a coupe version of the 5000, we'd expect something special—very spacious and fast. A high-speed, two-door, four-passenger grand tourer with four-wheel drive and a couple hundred horsepower would be a fitting addition to the line. With smooth bodywork shown below, the coupe and the super-successful 5000 sedan would be quite a dynamic duo. **PM**



Likely look for 4wd coupe version of 5000.

IT'S EASY TO SEE WHAT SOME STORES THINK OF HARDWARE.



Some stores carry so many different products they have to hang an index from the ceiling. And too often, hardware gets buried under gifts and wraps.

At a Sentry Hardware store, the only sign you have to see is the one hanging out front. Because hardware is what we sell.


Advice from our people can save you time when you come in, and even more time when you get home.

Next time, look for the Sentry sign. It's the easiest way to find all the hardware you need.

And now join the Sentry Silver Jubilee Sweepstakes. You could win a Buick Electra 300. See your participating Sentry dealer for more information.



Where hardware isn't a sideline.

 Check the Yellow Pages under Hardware for the Sentry store nearest you. Sentry Hardware Corporation, Cleveland, Ohio 44113. Merchandise shown in this advertisement is available from participating dealers only. Offer expires May 31, 1985. All Sentry dealers own their own stores. They select their merchandise and set their own prices. There may be variations in products, available quantities and prices in individual stores.

GOTT®
18-Qt. Sportsman Cooler
(18198) \$15.44

shop-vac®
6 Gal. Vacuum
w/Free Accessories
(700-02-62) \$52.99

McCULLOCH
Gas String Trimmer
(MAC60A) \$99.88

HANSON®
13-Pc. Drill Bit Set
(60134) \$8.88

VERMONT AMERICAN®
7-7/8" Carbide Tipped Saw
Blade (M44714) \$5.44

Lufkin®
30' Unilok Tape
(8430) \$8.44

Kwikset®
Single Cylinder Deadbolt
(660CPX3) \$7.44

WAGNER®
Power Stripper
(0263001) \$39.88

TRUE TEMPER®
SWOE Cultivator
(SWS) \$7.99

Black & Decker®
3/8" VSR Drill
w/Free Side Handle
(7144) \$29.99

SAVOGRAN®
One Gallon
Strypeeze®
(01103) \$7.44

Warp's®
10' x 25' Coverall, Clear
or Black (4-4CH10) (4-4CH108)
Your Choice, \$4.44

DOW CORNING
Clear Silicone Sealant
(08641) \$2.99,
99¢ after \$2.00 Rebate

SKIL®
Cordless
Screwdriver
w/Charging Stand
(2305) \$32.99

THE PM WORKBENCH



Pick a drill press

Craftsman offers two full-featured, affordable drill presses for the home workshop. First is the top-of-the-line 17-in., $\frac{1}{2}$ -hp drill press (model No. 21387). This light-industrial-duty tool features 16 speeds ranging from 240 to 4,800 rpm, a permanently mounted speed selection chart and a 14 × 14-in. worktable. The 10 × 18 × 66 $\frac{1}{2}$ -in. high drill press has a $\frac{1}{2}$ -in. Jacobs chuck and can drill to the center of a 17-in.-wide workpiece. It's about \$550.

The second drill press is a $\frac{1}{2}$ -hp benchtop model for limited-space shops. The 8-in. drill press (No. 21372) has three speeds—700, 1,500 and 3,000 rpm—and a $\frac{1}{2}$ -in. chuck. The tool measures 7 × 12 × 23 $\frac{1}{2}$ in. high and costs \$149. For details on both drill presses, contact Sears, Sears Tower, Dept. 703-PM, Chicago, Ill.—J.T.



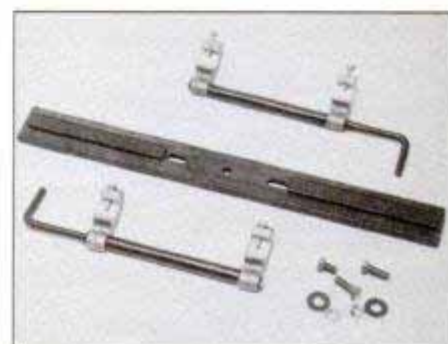
Sears' top-of-the-line, 17-in., 16-speed drill press (left) offers high performance and accuracy. Bench top model (right) delivers power in a space-saving unit.

Traveling vise clamp

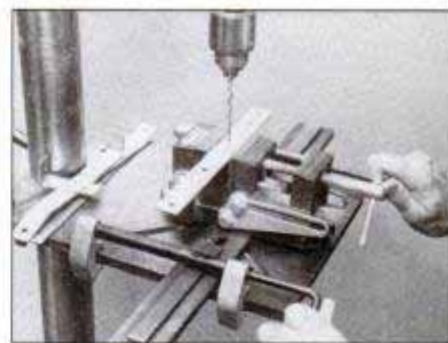
Now you can add convenience and versatility to your drill press with this easy-to-install Traveling Vise Clamp. The ruggedly built accessory consists of a 20-in.-long steel mounting bar and two locking cams.

Simply bolt a drill press vise, up to 4 in. wide, to the mounting bar and attach the locking cams to the drill press worktable, as shown.

To position the vise, turn the locking cam handles upward, shift the vise into



The traveling vise clamp consists of a 20-in.-long steel mounting bar and two locking cams that fit onto the worktable.



Lift up the two cam handles and shift the vise into position. Turn the handles down to lock the mounting bar and vise in place.

position and then turn the handles downward to lock the mounting bar and vise in place. This accessory permits quick setups without having to fuss with C-clamps or nuts and bolts.

It's available at Sears stores and through the Sears tool catalog for about \$40. For details, contact Portalgn Tool, Box 80547, San Diego, Calif. 92138.

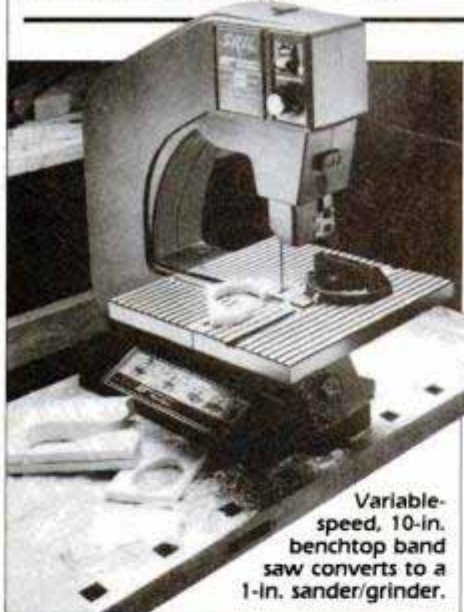
—Rosario Capotosto

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

A band saw plus

Skil's versatile benchtop band saw not only performs standard band-sawing functions, it also converts to a 1-in. sander/grinder to finish-sand workpieces and sharpen hand tools.

The 10-in. band saw (model No. 3104) has a powerful $\frac{1}{2}$ -hp, 4.2-amp, variable-speed motor. The 62-in. blade is driven by three 7-in.-dia. rubber-surfaced wheels at speeds from 500 to 2,000 ft. per minute. The saw can handle cuts up to 10 in. wide and 4 in. thick at 90°. Features include a 13 × 14-in. tilting worktable with miter gauge and a removable key to prevent unauthorized use. The band saw sells for about \$195. For details, contact Skil, 4801 West Peterson Ave., Chicago, Ill. 60646.—J.T.



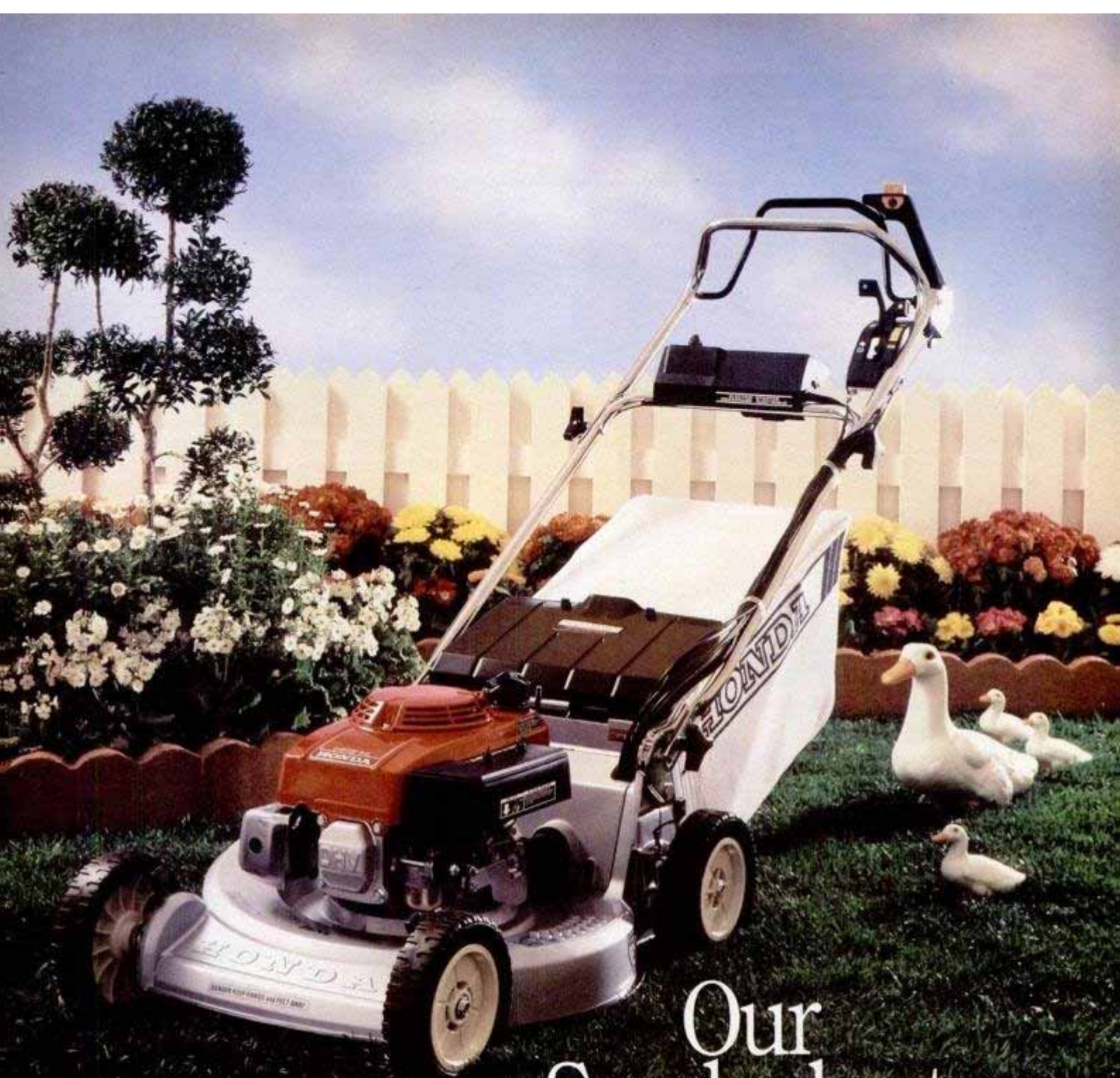
Variable-speed, 10-in. benchtop band saw converts to a 1-in. sander/grinder.

A seeing-eye saw set

When sharpening a handsaw, it's important to reset the teeth to ensure proper alignment. Stanley's new saw set (model No. 15-640) features a built-in magnifying lens that makes it easier to check the teeth alignment and to detect chipped teeth. It can be used on crosscut and rip saws, backsaws and panel saws with from four to 12 teeth per in. The saw set sells for about \$13. For more information, contact Stanley Tools, Dept. PID, Box 1800, New Britain, Conn. 06050.—J.T.



Pistol-grip saw set features a built-in magnifying lens that offers a clear view of the saw teeth alignment and condition. Use it on saws with from four to 12 teeth per inch.



Our Sunday best.

The Honda HR214. It's the world's most advanced rotary lawn mower. With a whole list of features you've come to expect from Honda.

Starting with starting. An electric starter fires up at the turn of a key. And a maintenance-free sealed battery comes standard.

The 4-stroke OHV engine

is our exclusive design. It's smaller and lighter than comparable engines, while providing unmatched durability, fuel efficiency and reduced maintenance.

For added convenience, Honda's exclusive Roto-Stop™ system allows you to stop the blade without stopping the engine. So you don't have to

re-start each time you empty the grass bag.

Pick up a Honda mower. And give your lawn our best.

HONDA
Power
Equipment

It's a Honda

For optimum safety and performance, we recommend you read the owner's manual before operating your Honda Power Equipment.

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ALL OUTDOORS



Riding the roof

How about a van that doubles as a boat? Designed to offer extra headroom in standard size vans with cutout



roofs. Boat Top can be had with a variety of options for row, sail or outboard power. The broad tri-hull design offers stability, and foam flotation ensures level floating when swamped. The 12-foot craft weighs 200 pounds, will take up to a 1 hp motor and can carry up to 725 pounds. Installation is best handled by a van conversion outlet. Boat Top costs \$995. An electric loader option that swings into position atop the van costs \$495. Sky Hook, Box 379, Mayo, Md. 21106.

Boat Top doubles as a van roof and a lightweight boat. Sail package is an option.

Hot tote



This 12 oz. mini-stove fits inside a cookset.

While we're waiting for someone to develop a mini-microwave for backpack use, we'll settle for this 12-ounce, quiet-operating gas stove. The Whisper-Lite will boil a quart of water in less than four minutes and folds up to fit inside a cook set. The stove sells for less than \$40 at sporting goods stores. It's made by Mountain Safety Research, Box 3978, Terminal Station, Seattle, Wash. 98124.

Camping pad

Sometimes, the best part of camping is having a comfortable place to lie down after a long day of backpacking. A more comfortable alternative to conventional air mattresses and foam pads is a hybrid design called Camp Rest. Made of a waterproof nylon skin bonded to an open-cell foam, the pad self-inflates by turning a valve. Air is trapped within the foam and is then pressurized by your weight. The air supports you off the ground and minimizes foam loft so you get the greatest possible insulation effect.

Unlike air mattresses, which have no insulation, Camp Rest has four times the insulation of closed-cell foam pads. The rolled-up size of the pad is 26 x 6 inches. Inflated, Camp Rest measures 25 x 77 x 2 inches. Weight is 3½ pounds. Camp Rest is manufactured by Cascade Designs, 4000 First Ave. S., Seattle, Wash. 98134



Self-inflating air mattress is extra insulated.

Bow constrictor

Air pressure device attaches to bow, converting it to exercise machine or air gun.



If you want to sharpen your archery skills, the Air-Bow may be just the ticket. The device lets you practice your draw and release without the damaging effects to compound bow components caused by dry firing. The Air-Bow air-pressure, shot-absorbing mechanism temporarily attaches to any bow and converts the energy of the bow to air pressure and heat. You can use your bow as an exercise machine or add an attachment that projects BBs or regular air darts. The complete Air-Bow system is \$45.95 from Indoor Archery Inc., Box 361653, Melbourne, Fla. 32936.

Trailer tongue stand

Here's a fast, easy way to support your trailer tongue when the trailer is unhitched. The Roto-Stand trailer tongue installs quickly on most 2½-inch or 3-inch square tongues for a fixed support height of 26 inches. When unhitching, you simply rotate the unit 90° from its horizontal locked position to the vertical support position—a two-second, one-hand operation. The Roto-Stand, with a list price of \$29.95, will handle tongue weights up to 250 pounds, and is available from First Products Inc., Box 1425, Tifton, Ga. 31794. **FM**

Tongue stand rotates 90° out of the stowed position into the locked vertical position.



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There are a lot of smokeless tobaccos out there, but for a lot of guys there's only one. Copenhagen. For one good reason.

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PM ELECTRONICS MONITOR

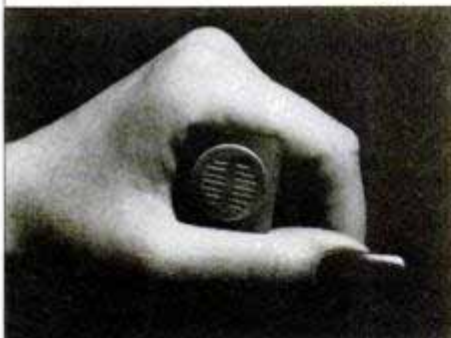


Dial-less phones, and typewriters that can spell

LAS VEGAS—There's more to the Consumer Electronics Show than the entertainment products mentioned in last month's column. Utilitarian but equally high-tech items such as computers and typewriters also made January debuts. The show's also a magnet to new technologies such as voice recognition, which came to town in a robot and new telephones.

Compared to simple voice-activation, in which sound triggers a device to begin operating, voice-recognition products are programmed to respond to human language. This enables them to differentiate commands and execute the ones you request.

To achieve this, the voice-recognition



Sawafuji's tiny, nonmagnetic speakers promise better sound in smaller products.

device analyzes your voice-print and commits it to memory during the programming stage. Any subsequent command is compared against the prints, and when the device finds one that matches, the command is executed.

This is the principle behind the Hearoid robot and dial-less telephone introduced by TTC, a California company. Hearoid recognizes simple commands from 12 different voices. For more complicated tasks, program a cassette and insert it in the robot's tape deck.

The battery-powered Hearoid costs \$400—about the same as TTC's dial-less telephone, which recognizes four voices and memorizes up to 80 phone numbers. Just call out the name of the party you're phoning and say "dial."

Though these current applications for voice recognition are simple, more



Hearoid, an 18-in.-tall robot, will respond to voice commands.

sophisticated products should emerge as the price of computer memory drops. In fact, price and memory dominated the news of personal computers in Las Vegas.

Atari's new 130ST (\$400) and 520ST (\$600) use the same powerful 16/32-bit Motorola 68000 chip that provides the sophisticated graphics and processing capabilities for Apple's Macintosh computer. The 130ST has 131,000 bytes of random access memory (RAM); the 520ST boasts about 524,000. Pricewise, an Atari 130ST system with disk



Lightweight, portable electronic typewriters from Panasonic (top) and Casio also function as computer printers.

drive and color monitor should retail around \$800—about half the cost of a similar Macintosh package. Commodore meanwhile launched its \$250 Commodore 128, a more versatile and powerful successor to the popular Commodore 64. With 128,000 bytes of RAM, the new model is in a class with IBM's PCjr and Apple's IIc—and it can



Atari's new ST computer line will pose tough price competition for Apple's Macintosh family.

be expanded to hold 512,000 bytes. It also can run the huge base of programs developed for the Model 64.

Not quite computers, but getting smarter all the time, are electronic typewriters. The latest Smith-Corona models have a built-in dictionary that



This dial-less telephone from TTC is made possible by voice recognition technology.

alerts you instantly to any misspelling of 30,000 frequently used words. Panasonic's first portable, the RK-P400 (\$350), has built-in programs that produce graphs in four colors. It also stores two pages of text and can be used as a computer printer. So can the \$400 Casiowriter 30, which stores 12 pages.

One noteworthy technological breakthrough is the tiny, nonmagnetic piezo crystal loudspeaker developed by Japan's Sawafuji. They can be used where magnet-driven speakers would cause interference (as in TV sets). This, plus their small size and low power requirements, will bring decent sound to highly miniaturized products. **PM**

THE NATIONAL GREAT OUTDOORS SALESM

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1985 CHEVROLET ASTRO VAN




FIRST PRIZE
16' STARCRAFT FISHMASTER
WITH 40 HP JOHNSON
OUTBOARD MOTOR

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FIRST PRIZE. Or you may win a rugged, high-quality 16' Starcraft Fishmaster and trailer plus a 40 HP Johnson® Outboard Motor.

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Nothing to buy. Nothing to write. Enter before May 31, 1985. Sweepstakes subject to Federal, State and Local laws. Void where prohibited by law. All prizes will be awarded on a national basis.

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\$1.00 "reBAIT"

Whether they're hitting on the surface or underwater, here's your chance to fill your stringer fast and save money doing it.

For top water action, tie on the Jitterstick, a new floating bait with fish-attracting splash and flash front and back.

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Put these new Arbogast Bait of Champions in your tackle box and the Arbogast rebate in your pocket. It's such a good deal, you'll want to get several for yourself and your fishing friends. Rebate details printed on the package.

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Prizewinners will be determined in a witnessed random drawing of entries received by HBM/CREAMER, Inc., whose decisions are final.

The Grand Prize Winner (1) will receive a 1985 Chevrolet Astro Van. The First Prize winner (1) will receive a 1985 Starcraft 16' Fishmaster Fishing Boat with a 40 HP Johnson Outboard Motor. Other prizes will be awarded as listed in store displays, and on the last page of this section. All prize winners will be notified by mail. Prizes are non-transferable and non-redeemable. Taxes are the sole responsibility of the prizewinner. The odds of winning a prize will be determined by the number of entries received. All prizes will be awarded on a national basis.

Sweepstakes open to residents of the U.S. and Canada. Ohio residents can mail entries to address below. Employees and their families of the Chevrolet Division of General Motors Corporation, NASGW and their advertising, sales and production agencies are not eligible.

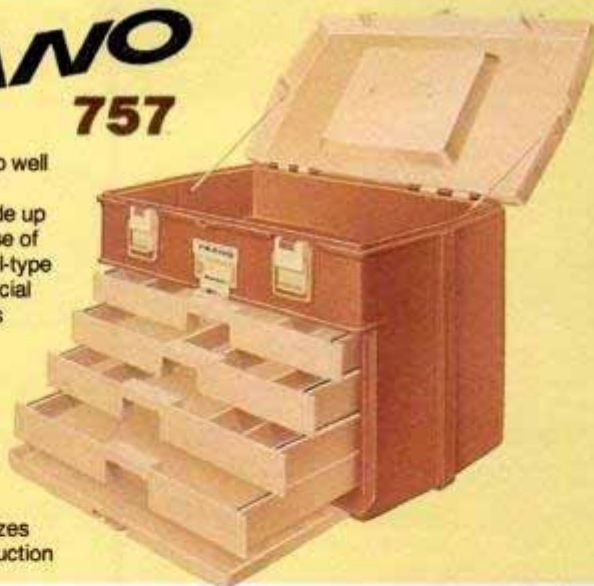
A list of major prizewinners may be obtained by sending a stamped, self-addressed envelope to NATIONAL GREAT OUTDOORS SALE SWEEPSTAKES, Box 328, Pittsburgh, PA 15219.

No purchase necessary. Simply fill out and deposit an entry coupon at a participating retail store before May 31, 1985. Entries must be received before June 30, 1985.

NEW PLANO 757

Lift-back cover, 3½" deep well in top... four 1¼" deep wormproof drawers provide up to 40 compartments by use of movable dividers. Two bail-type latches for top cavity. Special latch for door that protects drawers from weather.

- Ideal for cramped areas... takes less than 16"
- Rugged recessed handle
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- Hi-impact plastic construction



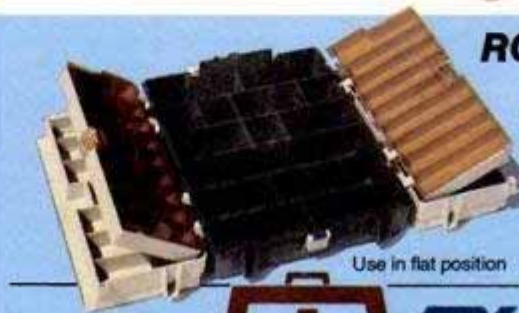
ROOMY, VERSATILE

767

No other bait box of this size can, with dividers, offer up to 56 compartments.

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Use in flat position



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The finest we've ever built.



Introducing Garcia graphites. Six new reels designed to outlast and outfish anything you've ever owned.

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Ambassadeur® 4600 Plus and 5600 Plus. With our exclusive lifetime warranty and Glide-lok® magnetic braking system for casting control without backdash.

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These new Garcia reels are power-matched to Garcia Conolon® graphite rods. High-Modulus Graphite gives you greater sensitivity and uniform flex from butt to tip.

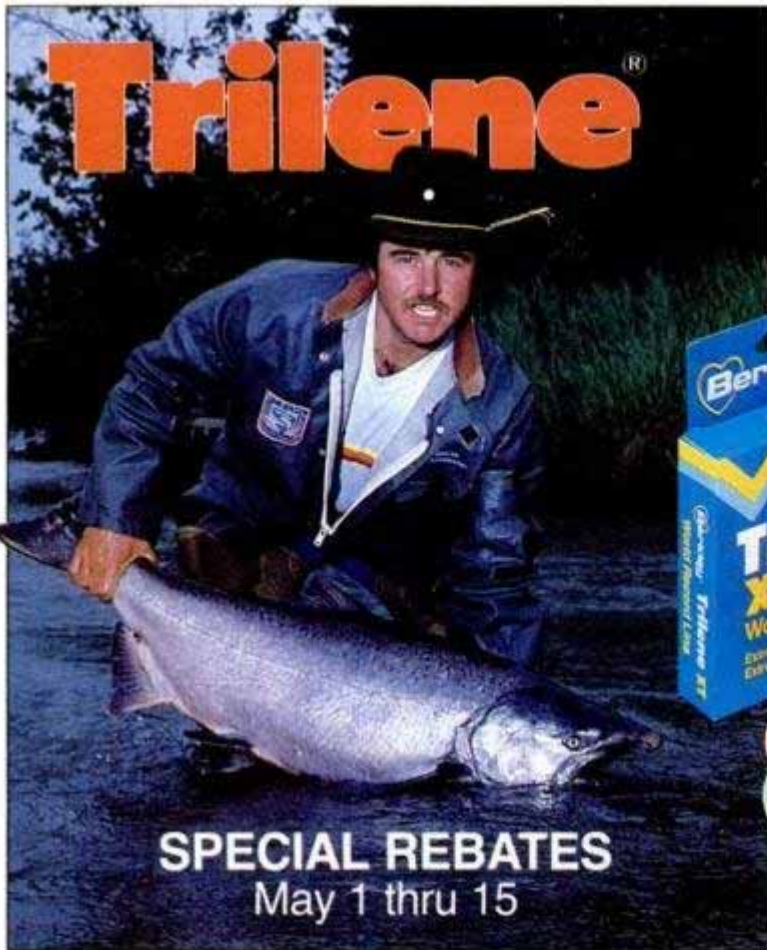
The new Garcia graphites. Six new reels with a flair for action. And craftsmanship to go the distance.



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Performance you can depend on.





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Special rebate savings on America's strongest premium monofilament fishing line!

Independent laboratory tests prove that Trilene is up to 20% stronger and over 355 new IGFA World Records in less than 10 months back it up! Now May 1 thru 15 you can put the extra strength of America's #1 selling line on your reel for less with a \$2.00 Rebate on Trilene Filler Spools and a whopping \$5.00 Back on the new 1000 yard Trilene Economy Pak!



Extra Strong



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PENN'S PERFECT PAIR . . .

The 210 & Mag Tuned™ 10 Hi-Speed Level Winds

These reels bring it all together . . . level wind convenience, fast 4-1 gear ratio, and ball bearing reliability. And the Mag Tuned™ 10 offers magnetic spool control for backlash-free casting. Both reels

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PENN REELS® The Great American Reel Company

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3028 W. Hunting Park Ave.
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210
350 yds./20 lb. mono
(Stainless steel spool.
Anodized aluminum also avail.)
Wt. 21 oz.



Mag Tuned™ 10
275 yds./15 lb. mono
(Lightweight anodized
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Save NOW on Fenwick® Boxes

The most expensive tackle box shown below costs about \$25. The rest a lot less. Little enough for a quality-built, feature-filled Fenwick box designed by "pro fishermen"



to organize and protect your valuable fishing gear. Pick one up at participating dealers during The National Great Outdoors Sale. They're A Sign of a Good Fisherman!

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- 26 compartments, some adjustable
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- includes removable 6-compartment utility box



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- 1 tray, 6 compartments
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- 4 sturdy latches



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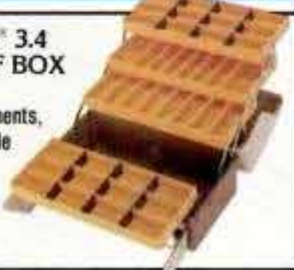
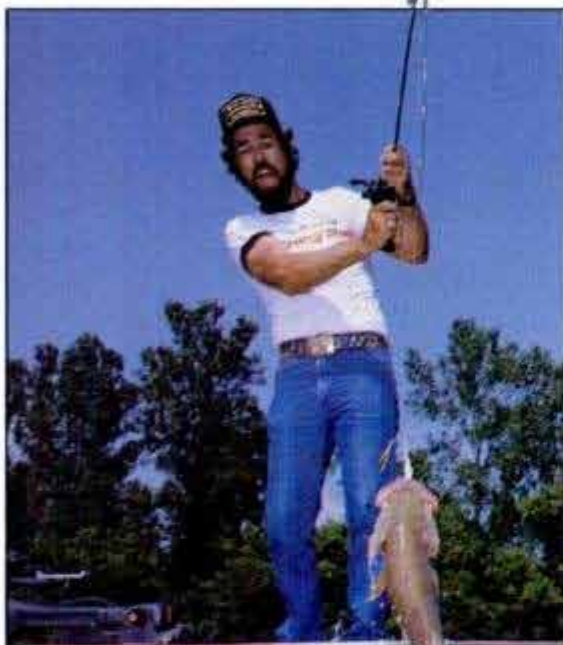
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Gott cooler chests have extra-thick insulation in the sides, top and bottom. Other coolers don't compare.



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Buy a Strike Gold™ rod and reel and get \$30 back. No catches.

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But if you buy both at the same time, you'll get a whopping \$30 back from Daiwa.

No catches. No loopholes. No kidding. Just look for the rebate form that accompanies Strike Gold rods and reels.

Of course, we don't want price to be the only reason for buying Strike Gold. So here are a few more reasons. Graphite construction. Rear drag. Autocast®. And Sensor™ graphite rod and handles for remarkable sensitivity.

Pick up a Strike Gold rod and reel. A great duo, now with a triple rebate.

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\$10
Rebate
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\$10
Rebate on
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graphite spinning
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Rebate
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NOW

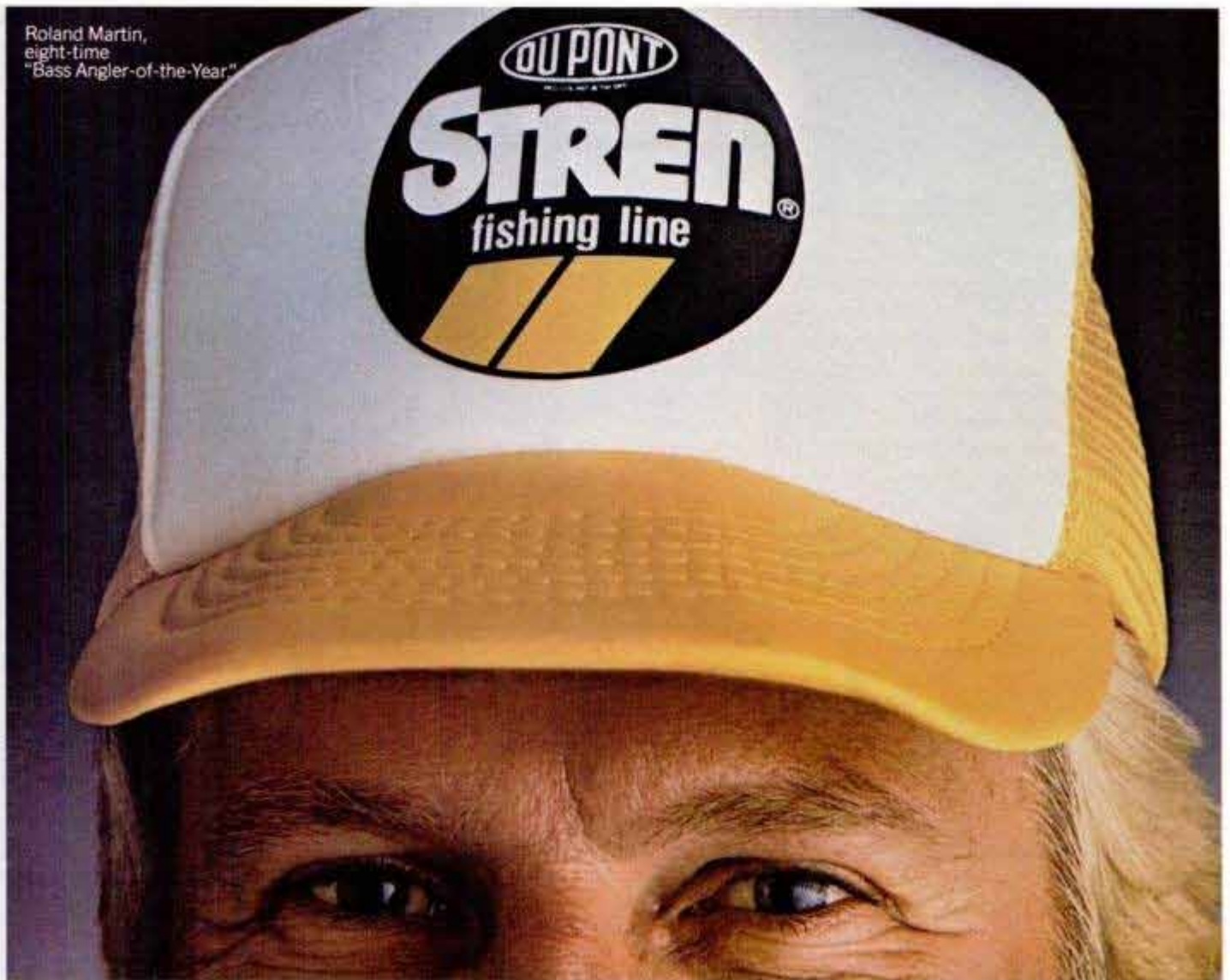
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It's the Stren Vacation Special.

Buy any two reel-fill paks of premium Stren or new Stren Class Line between April 25 and May 25, 1985 and DuPont will send you an official Stren fishing team cap. Free.

It's a fine quality cap. And it makes an even better value of America's favorite line. Choose any two. Premium

Stren in Clear/Blue, Golden or Clear. Or new Stren Class Line, the line designed for landing record fish.

Get your order form where you buy Stren. Or use the coupon here.

Look for the Vacation Special display at your Stren dealer. And cap a great fishing season.



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I HAVE ENCLOSED:

- Original dated cash register receipt with purchase price circled
AND
 The words "reel-fill pak" clipped from 2 Stren packages.

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CITY _____ STATE _____ ZIP _____

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I FISH:

- 5-14 days a year mainly freshwater
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PME05FC*

Limit one Fishing Cap per customer.
Offer good only on Stren purchased April 25 through May 25, 1985 in the U.S.A. Allow six to eight weeks for delivery. Subject to state and local regulations. Void where taxed, restricted or forbidden by law. Request must be postmarked by May 25, 1985.



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Three tough outdoor products designed for fishermen! Our 1566 and 2713 Tackle Boxes feature sensible ideas, like trays that hold lots of sizes and shapes, and dividers that customize the trays. Plus.... handles, latches and hinges that last a lifetime. The 901T Trolling Bait Bucket is designed for one hand operation, no buttons or levers to fool with, keeps large and small bait alive and kick'n and will always right itself in the water. A lot of smart features!

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Don't forget the

CUTTER



CREAM, SPRAY AND STICK ARE AVAILABLE IN ORIGINAL AND EVERGREEN SCENT

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Reasons to Switch.



Quantum. Quality Defined.

Quantum baitcasting and spinning reels. Two reels that have advanced to a level of performance quality that'll give you all the reason you need to switch.

In baitcasting, the reason is DynaMag™ magnetic cast control. The spool control is calibrated to 280°, twice the range of most reels. It'll let you throw anything in your tacklebox, thumbs-off, into the wind, with complete authority and perfect control.

In spinning, the reason is Magnum Drag™ With 600%

more working drag surface than conventional rear drags, it has enough precision, range and sensitivity to make a big fish show respect for light line. Translation: you'll land more of the ones you hook.

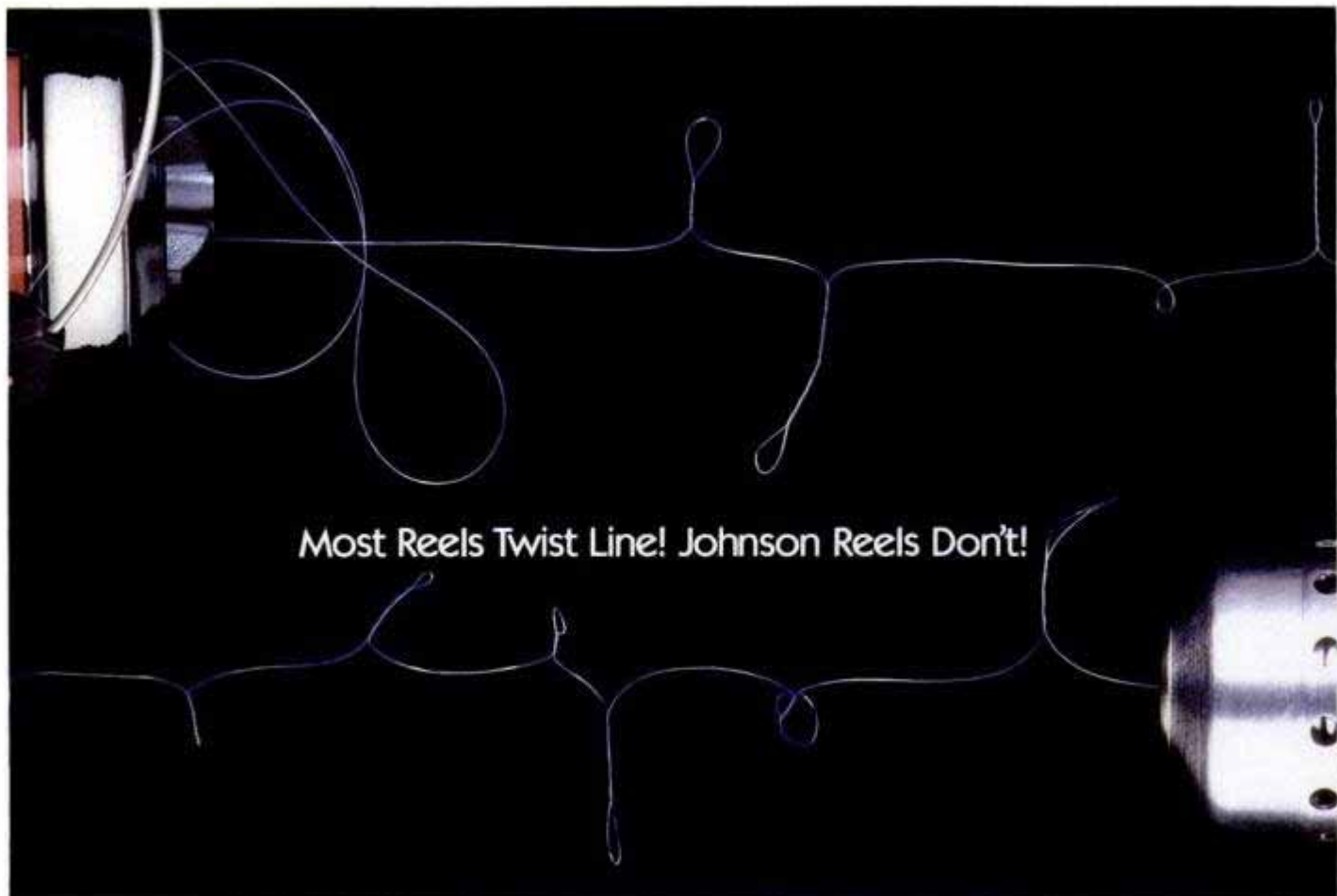
Quantum baitcasting. Quantum spinning. More casting control. More fish-fighting control. More reasons than ever to switch.

For the name of the Quantum dealer nearest you, call toll free, 1-800-USA-REEL.

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Box 270, Tulsa, OK 74101

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Most Reels Twist Line! Johnson Reels Don't!

REPLACE YOUR LINE TANGLER!

Straight line casts farther, retrieves more smoothly, *catches more fish!* (How many fish have you caught while you were trying to untangle your line?).

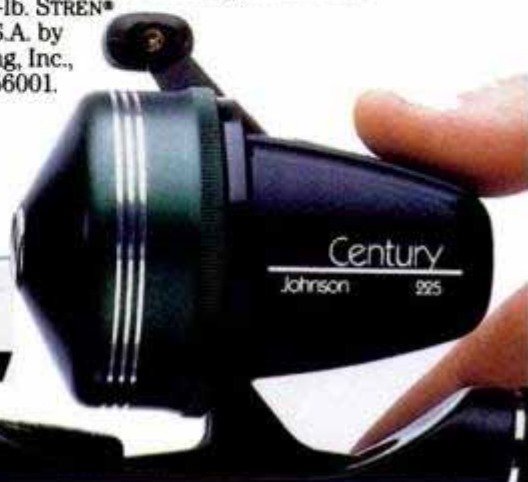
Try the Twist Test with your reel: Tie the line to a guide, crank a dozen turns against the drag, then push the button or open the bail. If you get twists, you have a line tangler!

Johnson Reels can't twist line because they've replaced the slipping spool with a DriveTrain™ drag system. And their patented CamDrive™ gives you extra retrieve power to land the big ones. Replace your line tangler now...

Three sizes: *Century*, with 10-lb. STREN®; 710, with 14-lb. STREN®; and the freshwater, light saltwater *Sabra*, with 17-lb. STREN®

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TANGLE FREE REEL



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Bridges the gap between flashers and charts.

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- 4 models to suit your needs and budget

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PRICED LIKE A FLASHER!



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The Campstove-Fryer That Is 3 1/2 Times More Powerful Than The Average Campstove... It Even Deep Fries!

35,000 BTU burner cooks any meal in minutes. Use with either refillable propane tank or disposable cylinder.

SAVE \$10
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400,000 Candiepower! 10 times more powerful than car headlight. Penetrates fog, rain and snow. Visible over 20 miles. Floats and works under water. Operates from any 12-volt source.

SAVE \$3
on the purchase of a Q-Beam® Black Max™



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The Unbreakable soft thermos™ That Goes Wherever You Go!

Patented inner pouch with built-in gel pack keeps your favorite beverages hot or cold for hours. No ice needed! Floats even when filled with liquid. Convenient "hands-free" carrying.

SAVE \$2
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Recharges Wherever You Are!

Built-in AC/DC chargers plug into car cigarette lighter or home wall outlet. Adjustable beam from spot to flood. Super II reflector boosts candlepower by 50%. Floats. U.L. listed.

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MAXLITE™ 5-3-2

The World's Finest Flashlight!

The Powerful 5-Cell Flashlight That Converts To A Versatile 3-Cell Or A Compact 2-Cell Flashlight.

• Machined Aircraft Aluminum
• Waterproof
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The Ultimate Weapon Against The Dark.

SAVE \$5
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Qwiklite™ Lantern & Stove

Lights Instantly With The Push Of A Lever!

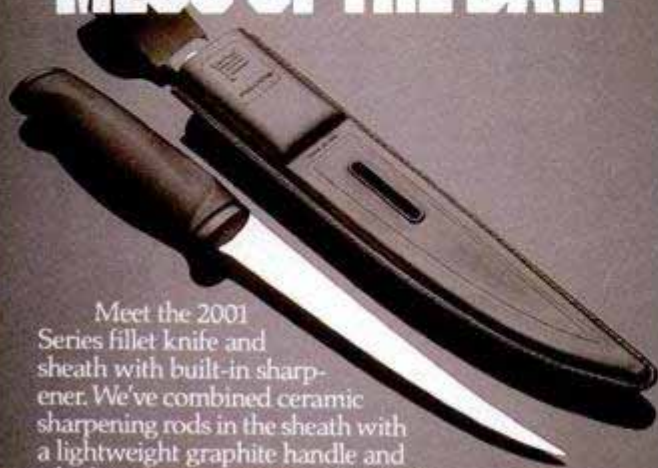
No matches needed! Automatic Piezo Quartz Ignition. No pumping or messy liquid fuel. Spillproof, disposable butane cartridge lasts up to 10 hours. Easy To Start, Easy To Use, Easy To Re-Fuel.

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To Qualify and Obtain Your Rebate: MAIL: (1) this ad, (2) Proof-of-Purchase (model number cut from display carton), and (3) dated sales receipt. NO LATER THAN JULY 15, 1985 TO: Great Outdoors Sale, P.O. Box 809003, Dallas, Texas 75380. • Not redeemable in stores. • Not valid in combination with any other promotional offer. • Void where prohibited, taxed or otherwise restricted. • No mechanical reproductions accepted.

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BECOME THE
MESS OF THE DAY.**



Meet the 2001 Series fillet knife and sheath with built-in sharpener. We've combined ceramic sharpening rods in the sheath with a lightweight graphite handle and a high carbon stainless steel 6" blade.

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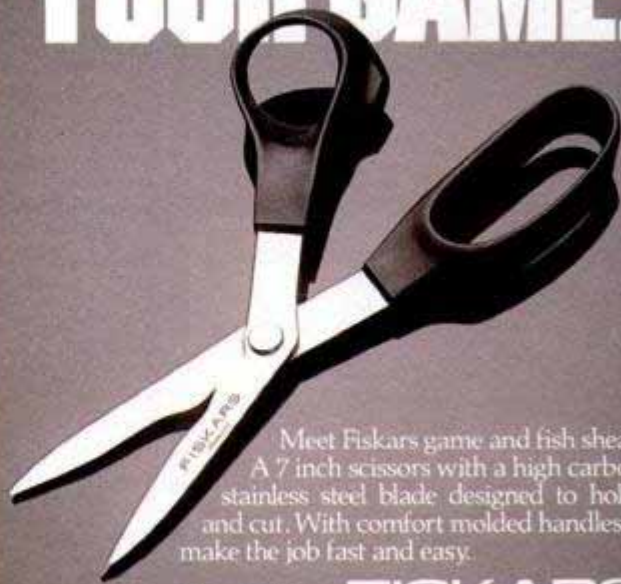
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**CLEAN UP
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Meet Fiskars game and fish shears. A 7 inch scissors with a high carbon stainless steel blade designed to hold and cut. With comfort molded handles to make the job fast and easy.

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THE PM GARAGE

Computerized mechanic



Computer Mechanic software gives basic guidance for diagnosing car ailments, and can even calculate loan payments for a new car if the diagnosis for the old one is terminal.

Everyone knows the Commodore 64 computer is great for games. But the other day, I fired mine up for a practical purpose—troubleshooting my car's rough idle. What transformed the Commodore into an electronic Mr. Goodwrench was a program called Computer Mechanic.

After loading the program, the main menu appeared on the screen, and I chose the diagnostic section. Computer Mechanic led me to the source of the problem in less than a minute—a loose sparkplug wire. Could I have solved the mystery without Computer Mechanic? Sure, but probably not quite as logically. Of course, Computer Mechanic is no substitute for a shop manual. The program includes sections on brakes, suspension, tires, transmission, engine, cooling system, fuel and emissions. Computer Mechanic can also keep tabs on maintenance, and record car expenses in up to 40 categories. The price is right: \$26.95 for Commodore 64 and Atari, \$49.95 for IBM. Write to Softsync Inc., 14 East 34th Street, New York, N.Y. 10016.—*Bob Berger*

X marks the spot

To accurately mark metal that has to be drilled, there's no better tool for spotting hole locations than a Skidmore optical center punch. The tool has three



The optical center punch by Skidmore offers pinpoint accuracy for neater metalworking.

parts—a magnetic base, a magnifying lens with crosshairs and a hardened steel punch. To put your drillwork right on target, start by applying layout dye to the metal parts and scribing intersecting lines. Then, all you do is insert the magnifier into the base and move the base until the cross hairs match up with the layout lines.

With its strong magnet, the base will stay put while you withdraw the magnifier and insert the punch. One light tap with a hammer will put the punch precisely where you want it, and you'll be ready for drilling. The price is \$40. Order the optical center punch from Skidmore Engineering Co., 5130 Richmond Road, Cleveland, Ohio 44146.

—*Bob Berger*



Motorist's best friend

My car isn't big enough to carry all the tools I might need on the road, but with a RoadPal, at least I can carry a 200 psi air compressor along with a trouble light and emergency flasher. Its 12-foot cord plugs into the cigaret lighter for



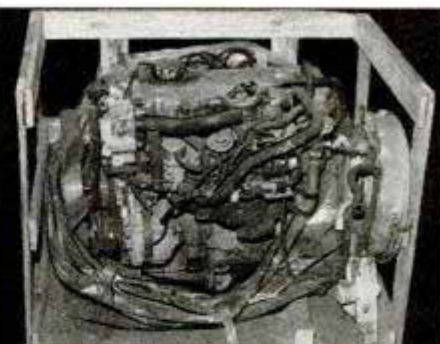
RoadPal combines light, emergency flasher and air compressor; plugs into lighter.

power. RoadPal costs \$39 in the auto section of discount stores, or get it from Campbell Hausfeld, 100 Production Drive, Harrison, Ohio 45030.—*N.S.M.*

Engine connection

If the engine in your Japanese car or truck is gone, but the rest of the vehicle is good, how about another engine? Rebuilts may be too rich for you, but how about \$295 (and up) for a used engine with a 90-day guarantee?

The imported engines have run 30,000 to 40,000 miles, and they come

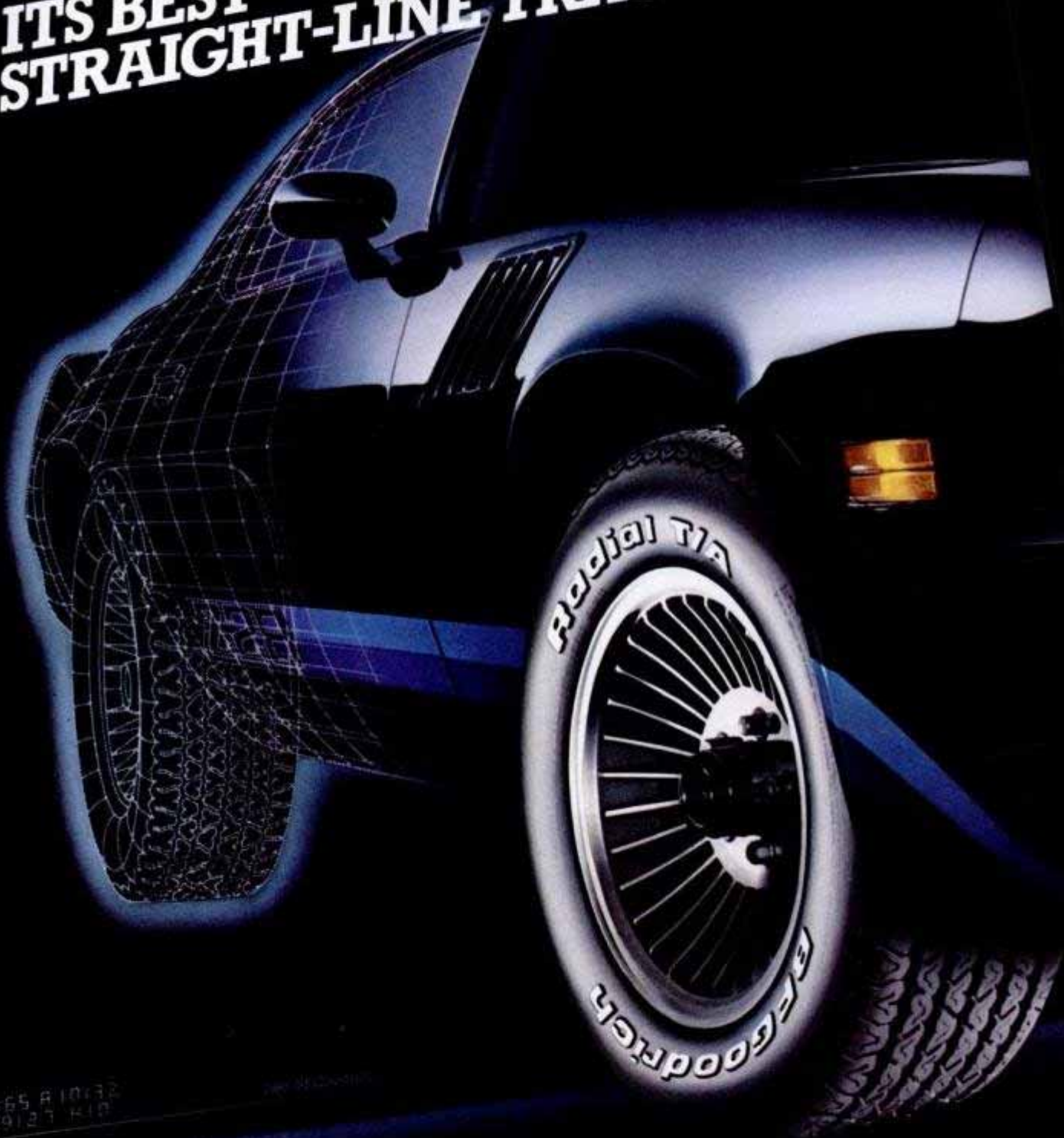


Used engines are shipped from Japan to United States with a 90-day guarantee.

in wooden crates, wrapped in heavy plastic. Currently, engines are available for Dodge Colt, Datsun, Honda, Mazda (piston engine), Subaru and Toyota, plus Chevy Luv and Ford Courier trucks. Coverage is from 1978-80 for all makes, plus some back into the 1960s.


For more information, contact ByRite Engines, 14209 Southwest 142nd St., Miami, Fla. 33186.—*Pete Warren*

IS YOUR CAR ACHIEVING
ITS BEST
STRAIGHT-LINE TRACTION?



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The right choice of tires can improve the straight-line traction of your car, even if its engine develops a high amount of torque. While no tire can promise you the ultimate in any performance characteristic, it is a fact that the BFGoodrich Radial T/A[®] was designed to optimize grip applied to road pavement. This offers you excellent power applied to the ground under acceleration, as well as remarkable braking power—even in the rain.

The same computer-aided technology used in building the Radial T/A (in 50, 60, and 70 aspect ratios) was applied to the entire family of BFGoodrich T/A[®] Radials. The result is a complete line of high-performance car and truck tires in many sizes, designed for a wide variety of performance needs and driving styles.

THE BFGOODRICH RADIAL T/A[®]

- A. Reduced hydroplaning and excellent wet traction are achieved by high void-to-rubber ratio and special tread compound.
- B. Excellent cornering, handling, and dry traction result from race-proven radial construction.
- C. Remarkable tread life is due to special belt configuration and dual compound tread.
- D. Predictable steering response results from a combination of sidewall and belt construction.

The BFGoodrich Radial T/A was designed to provide remarkable straight-line traction, even on cars with rear suspensions that tend to deliver power to the pavement in high peaks. This can cause surges of acceleration or deceleration in wet weather that require a tire tread with a high void-to-rubber ratio and a special tread compound like that of the Radial T/A to assure the driver of excellent traction.



WE MAKE CARS PERFORM[™]

HOMEOWNERS' CLINIC



Is aluminum wiring safe?

We bought a 13-year-old house that has aluminum wiring throughout. Can you tell me if this wiring is safe?—Emmet Rathbun, San Marcos, Calif.

That depends on whether corrective measures were taken by the previous owner. The U.S. Consumer Product Safety Commission says that houses with aluminum wiring are a potential fire hazard. During the period between 1965 and 1973, because of the shortage and high cost of copper, aluminum was used to wire about 1.5 million homes. Although aluminum wiring

was approved by the National Electrical Code, it was later found that there was dangerous overheating in 15- and 20-amp. branch circuits at some of the connections between the aluminum wires and outlet receptacles, switches, fixtures and appliances. Anyone who has aluminum wiring should be alert for the following trouble signs:

- Cover plates on outlets or switches that are warm to the touch.
- Sparks, arching or smoke at outlets or switches.
- Strange odors, especially the smell of burning plastic, around outlets and switches.
- Outlets, lights or entire circuits that don't work.

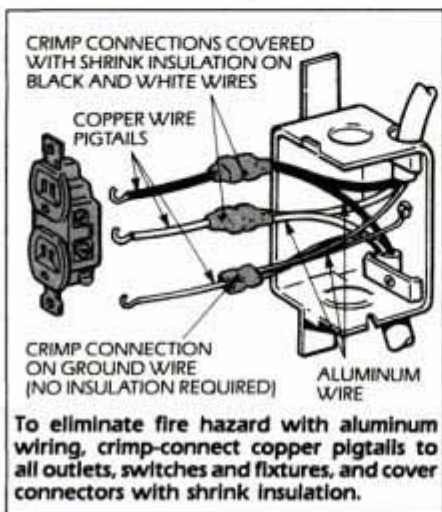
Iron-stained fixtures

I have a problem I hope you can solve. We recently purchased a house that had water with a high iron content. There are iron stains in the sinks, bathtub, toilet and washer.

Is there a product on the market that will remove these stains? We corrected the water to lower the iron content, but the stains remain.—Thomas F. Sell, Gwinn, Mich.

Try cleaning the stained areas with Zud. Zud is a heavy-duty cleanser that contains oxalic acid, which bleaches and then dissolves embedded rust

Even though you may not find any of these trouble signs, the potential for a fire may exist. It can even occur at an outlet that has nothing plugged into it.



Correcting the problem does not require rewiring the entire house. The method recommended by the Consumer Product Safety Commission requires connecting a short piece of copper wire to the end of the aluminum wire by using a special compression-type crimp connector. The copper wire is then used for connection to the outlets, switches, fixtures

and appliances. The special connectors, called Copalum Compression Connectors, and the crimping tool are manufactured by AMP Special Industries, Valley Forge, Pa. 19482.

The corrections described should be made by a licensed electrician who has this equipment. Connecting the copper pigtail to the aluminum wire using a wire nut is not an approved method. You can check your outlets and switches to see if the wire terminations were pigtailed prior to your purchasing the house, but take precautions against electrical shock. If the aluminum wiring in your home has not been corrected, you should take care of this problem as soon as possible.

stains. Zud is available at hardware stores as well as some supermarkets, and will cost approximately \$2.40 for a 1-pound can.

If the rust stains in the tub or sinks are the result of water dripping from the faucet over a long period of time, you may be unhappy with the surface finish even after removing the stains. Continuous water dripping on a porcelain surface over a period of time will eventually erode the finish. In this case, even though the fixture is functional, you may want to resurface it for cosmetic reasons.

Faded black mortar joints

My concern involves the black mortar used on the brickwork of my 10-year-old home. This mortar was used to accent the bricks we used.

When it was new, the mortar was very black. However, after the first year it turned gray. Now, after 10 years, the sun and weather have turned the mortar almost natural.

Is there anything I can do to restore the black? In every home I've seen with similar mortar, it has become faded. Please let me know if there's anything I can do about this.—Michael Kissel, Summerhill, Pa.

Although nothing can be done to restore the black in the original mortar, there is something you can do to produce black mortar joints.

You can either stain the joints or tuckpoint them. Both of these methods are tedious and labor intensive, so unless you do the work yourself it can be quite an expensive undertaking.

According to the people at the Portland Cement Assn., the original mortar mix probably had carbon black to produce the black color rather than a mineral oxide. They say that carbon black is sensitive to ultraviolet light, not stable, and has a life of about seven months to a year.

If you want to tuckpoint, you will have to grind out the existing joints to a depth of about 5/16 in. and then fill them with a new mortar containing a black mineral oxide pigment.

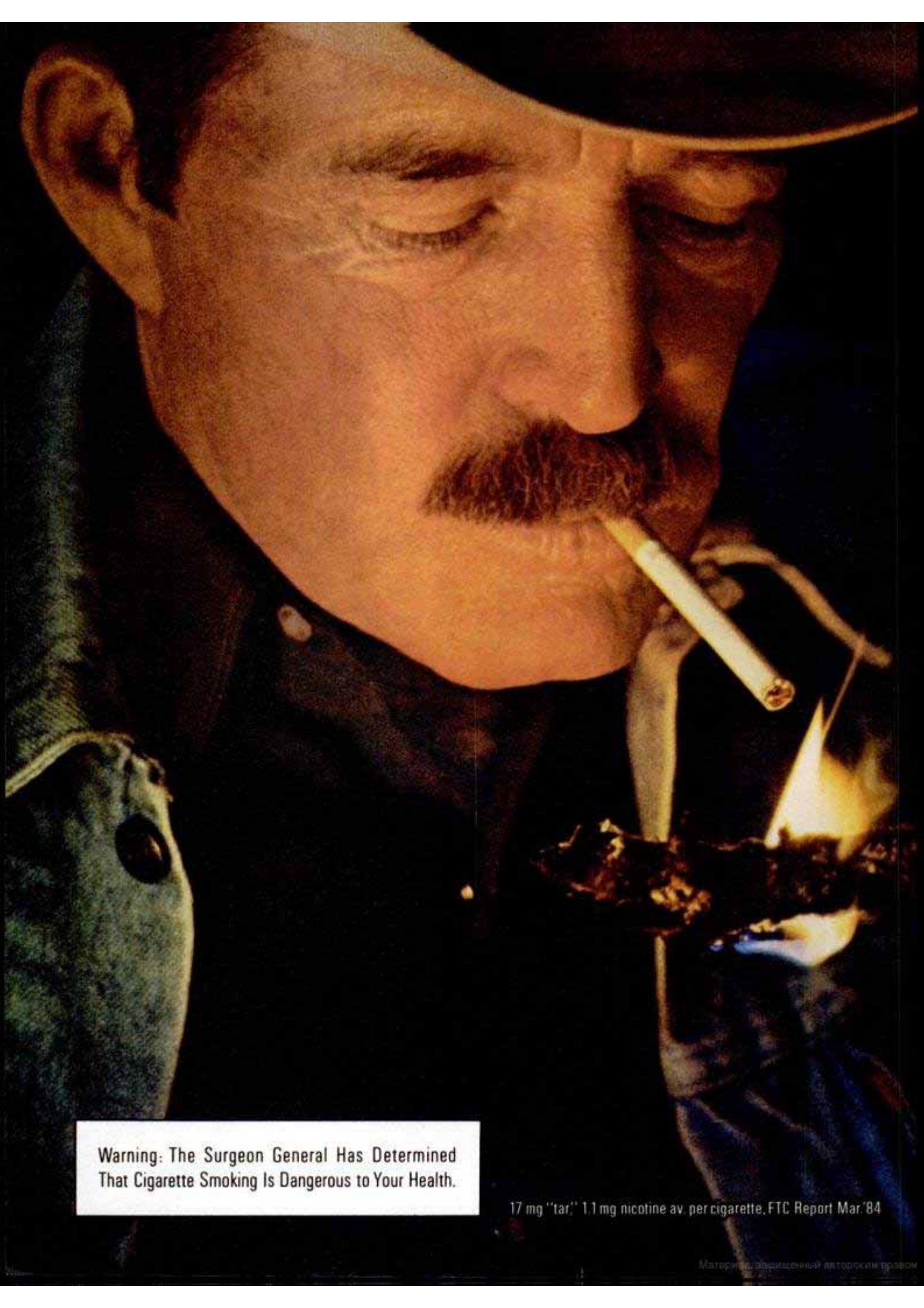
The other method for producing black joints is to stain them using a water-repellent, penetrating masonry stain. The stain can be applied using a 1/2-in. brush. You must work carefully, however, so as not to smear stain on the bricks.

The Charger Corp., 1011 Dixwell Ave., Hamden, Conn. 06514, will make up penetrating stain of any color if you provide them with a color sample. Giulio Fraenza of Charger says that a two-coat application of their stain will last for 10 years.

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

A black and white photograph of a man wearing a cowboy hat and a long-sleeved shirt, rolling a cigarette. He is standing in a field with a herd of cattle in the background. The lighting is dramatic, with strong shadows and highlights. The man's hands are the central focus as he works on the cigarette. The overall mood is rustic and traditional.

**A hundred years ago,
if a man wanted a good smoke, he had to roll his own.**



Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

17 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report Mar '84



Today, you just light up a Marlboro.

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DETROIT LISTENING POST



Intercooled Buick turbo for '86



Shown here is the prototype Buick Regal Turbo built by ASC/McLaren to test Buick Engineering's intercooler project for 1986. The McLaren Regal is a parts-bin special, as prototypes often are. Underhood, it's a mass of conduits, with thick tubing running forward and dropping down to an air intake under the grille. Turbo lag was interminable, making the car scary for even an experienced driver. Negotiating a fast turn is an exercise in guesswork, wondering when boost would occur. A driver risks the very real possibility of power-induced oversteer at a bad moment, causing a nasty spin.

However, we just returned from a ride in a production intercooled-turbo with a Buick engineering group. The cars were stock '85 Regal T Types with the '86 powertrain. The difference between these and the McLaren was night and day.

The production cars have an efficient ram air duct dropping from the intercooler to a scoop in the front air dam. Turbo lag is negligible through the use of a "free-flow" Garrett T3 turbo with a large compressor housing and radically lightweight turbine wheel. Buick will advertise 220 hp and 330 lb.-ft. of torque for the '86 turbocars (all of which will be intercooled), up from the '85 figures of 200 hp and 300 lb.-ft. Peak power may be as much as 245+ hp and 360 lb.-ft. torque, according to Buick sources.

These '86s are hot. After a few tries, I did a 0 to 60 mph run of 6.65 seconds! The car flat embarrassed an '85 Corvette in a short drag race. If the McLaren exercise helped Buick management get to this, more power to them!

Prototype turbocharged Buick Regal with intercooler (above and below) is one we drove last fall. After recent drive of production car, we find it smoother.



Chevy GTZ

We're awash in prototypes this month. Displayed here is the Chevrolet GTZ done by Jerry Palmer and friends, of Chevy's own design group. The concept car demonstrates advanced aerodynamic principles extrapolated from a standard Z28 Camaro.

It's difficult to find a sharp or angular part on the car. NACA ducting in the bodywork forward of each wheel provides air for brake cooling. Two rows of hood slots, Chevy says, offer improved engine cooling and aid the relief of underhood air pressure. The entire hood/fender clip is a single piece, similar to the Corvette's.

Camaro GTZ is now on the auto show circuit sporting iridescent yellow paint.



Alloy wheels are shod with the Corvette's V-rated 255/50VR16 Goodyear Eagles. The GTZ is powered by a 4.3-liter, 90° aluminum V6 in essentially race trim. Larger, splayed valves and

Big Three racing

Everybody knows that General Motors' long-standing policy is that none of its divisions go racing. This is not to say that the divisions aren't *in* racing.

Seen in corporate exhibits at the Detroit Auto Show, for example, was an exotic IMSA Corvette GTP in the Chevrolet section, a Buick-powered CART Indy car in Buick's display and more. The reason Detroit is becoming more visible at the nation's race tracks is that the nation's car buyers are becoming more visible there.

According to a race-attendance study compiled by Goodyear Tire & Rubber Co., 1984 saw almost 250,000 more spectators at America's racing venues than 1983. For 223 races of all kinds, total attendance topped 4.7 million people.

NASCAR stock car races have been the weekend retreat for Detroit car-makers and engineers for years. Only in recent years, with the resurgent public demand for better-performing cars, have domestic automobile makers sought to enhance their visibility at non-NASCAR events where race cars look like street cars.

Chevy, Buick and Pontiac have always had *de facto* competition departments for racers willing to use "back door" parts. Only Ford Motorsports has a public attitude that factory racing builds sales, though if that isn't the case, Ford isn't going to tell us.

The only decreases in attendance, according to the study, were in those

(Please turn to page 36)

Pickup your life.

A full-size pickup from GMC will pick up your life, and a whole lot more.

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Option-wise, you can get your full-size GMC pickup with two-wheel or four-wheel drive, a six- or eight-foot cargo bed, in 1/2,

3/4 or 1-ton models. The new Vortec 4.3-liter V-6 engine is standard for 1985. It offers the highest horsepower and torque rating of any standard V-6 in the industry. Or you can pick up the pace with optional V-8s. There's even a hearty 6.2-liter diesel available.

Best of all, a GMC pickup offers the options and comforts you're accustomed to in a nice car. Making it one nice truck, indeed.

Buckle up and pick up a full-size pickup at your GMC dealer. (He's in the Yellow Pages.) Give your life a lift.

For a free copy of GMC's 28-page "How To Live Comfortably With A Truck," please write to: GMC Truck Merchandising Headquarters, Drawer 30093, Department D42 Lansing, MI 48909.



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GMC full-size half-ton pickup.



GMC light-duty trucks are equipped with engines produced at facilities operated by GM car and truck groups, subsidiaries, or affiliated companies worldwide.

DETROIT LISTENING POST

(Continued from page 34)

racing series that held fewer events last year than the previous year.

Trans Am wagon?

Well, yes, there is one, but no, it isn't slated to be a production car at this time. Remember the Trans Am sport wagon show car that Pontiac did in 1978? The 1985 F-car sport wagon, however—based on the new Firebird Trans Am—is even slicker.

The backlight hatch has been removed and replaced with a sort of

"cap," which operates as a liftback. The station wagon Trans Am features immovable side windows, unlike the gull-winged glass of the '78 concept car, but the rear glass "cargo door" flips up and out of the way.

This car is a *natural* as a sport wagon, its roofline flowing gracefully into the fiberglass cap-hatch. Cargo space inside is increased only slightly over the standard hatchback. Pontiac marketing chieftains believe they could sell only about 3,000 Trans Am sport wagons per year—if it were to be built. To evade cost penalties inherent in certifying a new vehicle under federal guide-

lines, the car would likely be assembled at an aftermarket conversion house.

Ear to the ground

Where? According to U.S. Census Bureau analysis, the city with the highest percentage of vehicle ownership is Casper, Wyo., with 795 cars for every 1,000 residents. Who said Detroit is the car capital?

Olds rocket '87: Oldsmobile engineers are working up a *hot*, 150-hp, 16-valve Four, with turbocharging, for the 1987 GM20/N-car (Buick Somerset Regal, Olds Calais, Pontiac Grand Am). The 2.3-liter unit will go into the Olds first. Says one insider at a sister division, "That's one *slick* engine."

Reatta redux: General Motors' BOC Group will spend up to \$106 million to convert a Lansing, Mich., axle plant to *assembly operations for a front-drive passenger car*. Reports suggest that the car will be Buick's two-seat Reatta (see *Detroit's European Connection*, page 83, Jan. '85).

New Daytona: Chrysler will put a new Daytona Z on the street in '87 powered by a 220+ hp intercooled turbo Four. As indicated here previously, the 2.2-liter engine comes from the Chrysler Shelby Performance Center in California.

Fiero canceled: Not here, but for Europeans. Opel has shelved a proposal to *sell Pontiac Fieros in Europe*, a deal which might have brought Opel Asconas to the United States.

Sayonara CJ: AMC/Jeep/Renault is working on a *totally redesigned CJ-7*. The new version of the venerable and classic off-roader will be ready in time for the 1987 season.

Short drives: The *Plymouth Reliant* this year is much better looking, with a subtle rounding of sheet metal corners, a new grille and plush interiors. Cold-start driveability was poor on the 2.2-liter Four we drove, though when warm it runs reliably.

Detroit wins: The Detroit Grand Prix IV won the 1984 FOCA (Formula One Constructors Assn.) Trophy for the best-organized grand prix race. Last year's season saw 16 races. The '85 race will be held on June 23.

Your's too? According to a survey by Champion Spark Plug, one in four U.S. cars *failed to start* at least once during the '83 winter.

You will shift! If you think "upshift" lights are a nuisance, German engineers have come up with a computer-controlled device that tickles your feet when you're supposed to shift! The computer monitors road speed, rpm and fuel consumption. When it's time to shift, a motor on the gas pedal causes "a tingling sensation." The driver then knows it's time to shift... or buy athlete's-foot powder. **PM**

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Sector-and-pinion steering and tight turning radius for easy handling.

Completely enclosed transaxle with large beveled gears for longer life and better transfer of power.

Heavy-duty axle shaft for greater capacity on tougher jobs.

High-torque 12.5-hp engine for more efficient mowing in long thick grass and extra power for work on hills.

Dash-mounted electric PTO switch for quick engagement of PTO-run attachments.

Hydrostatic drive for one-lever control of speed and direction without shifting or clutching.



Full-length welded steel frame for added strength and durability.

Gauge wheels provide smooth cut, and guard against scalping.

Optional 6.5-bushel rear-bagger for more efficient handling of leaves and grass. (Also available is a front blade, dumpcart, lawn sweeper, thatcher and snow thrower for year-round versatility.)

Large steering spindles and ball-bearing wheels for longer life.

Deep contoured mower deck for improved airflow, smoother cut and uniform discharge of clippings.

Disc brake for added stopping power.

Nothing Runs Like a Deere[®] because nothing's built like one.

You can see it wherever you look. From the reliable engine up front to the heavy-duty rear axle, John Deere lawn tractors are built to last. With proven designs. Quality materials. And features you won't find on competitive brands. In fact, John Deere probably sets more standards than anyone else in the field.

With John Deere, you also get a good selection. The seven models range from the 8-hp 108 to the 16-hp 116H. Each one can handle several optional attachments. And each one is backed by a new 2-year limited warranty.

So if you'd like to get the most tractor for your money, take a good look at the John Deere line. Once you see how they're put together, you'll know why they don't come apart.

For more information, or the name of the dealer nearest you, call 800-447-9126 toll free (1-800-322-6796 in Illinois). Or write John Deere, Dept. 59, Moline, IL 61265.



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Needle in a haystack

The owner's manual for my 1981 Chevrolet Malibu says that the 229-cu.-in. V6 engine holds 18½ quarts of coolant. When I drain the system (engine hot—thermostat open), I get only eight quarts out of it. I can find no drain plugs on the block—just a drain cock on the radiator. I'd like to know how to drain all the old coolant so I can refill the engine with a fresh ethylene glycol and water solution in the correct proportions.—James E. Dunlop, South Weymouth, Mass.

There's a ¼-in. × 18 hexhead drain plug on the left-hand side of the engine, right in front of the filter boss above the pan rail. Don't feel too bad. The drain plug is easily overlooked.

Removing the plug will allow 18 or so quarts to drain because there's a low spot just below the drain plug, so a little of the old coolant will stay in the engine. However, the amount is insignificant and will not adversely affect the new coolant.

Hung up on hangers

Ever since I bought my Oldsmobile Firenza in early 1984, it's had a bad vibration that I feel in the accelerator pedal. It's most pronounced between 48 and 52 mph and is worse when the air conditioner is on.

The car has been to the dealer 10 times. Have other owners of GM's J-car complained to you about this? Is there a solution to this problem?—Corbett Parker, Greenville, S.C.

Yes to both questions. Your dealer didn't have the solution for you because it wasn't forthcoming until the very day that I'm writing this. Have him replace the center exhaust hanger with a new one having part No. 25521686. He should also get the specific hardware to mount the hanger—two bolts (part No. 25509534) and two washers (No. 11500323). In addition to replacing the center exhaust hanger, have the dealer loosen and retighten the air-conditioner mounting bolts.

Give 'em a break

My car, a 1980 Oldsmobile Omega, has trouble with a sticking choke plate. The dealer cleaned and tried to adjust it, but this didn't help. The problem occurs with the engine cold. I have to put a wedge between the choke plate and the side of the carburetor to keep the plate open, so I can get the engine started. Then I have to sit to let the engine get warm enough so the choke plate will stay open by itself.

This, to put it mildly, is inconvenient. What's wrong?—Sharon Nelson, no address given.

Look for a choke vacuum break diaphragm that's leaking and is therefore not operating.

If that's not the problem, check to see

that the linkage connecting the vacuum break to the choke plate is adjusted properly. The job of the choke vacuum break is to open the choke plate partially when a cold engine is started to prevent engine flooding.

If the vacuum break system is working properly, make sure your mechanic is using the right tools and procedures when adjusting the choke mechanism. A choke valve angle gauge is needed for many choke adjustments on late-model General Motors carburetors. Some mechanics still try to fly by the seats of their pants.

MoPar pinging

I have a 1984 Dodge Diplomat with a 318-cu.-in. V8 engine that's had a bad spark knock (pinging) almost from the first day I got the car. The dealer says the only solution is to use premium unleaded fuel in the car. Is there any other remedy for this problem?—Howard Ritzler, Goshen, Ind.

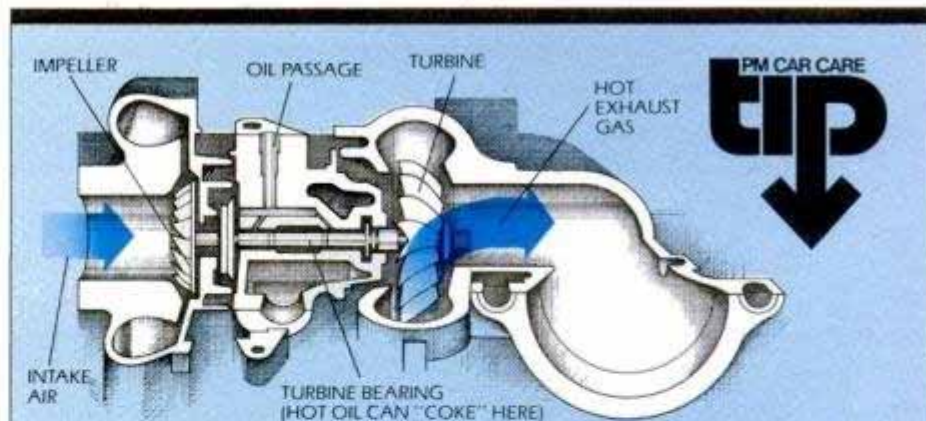
Check your owner's manual and you'll find that the dealer gave you good advice. Chrysler suggests using premium unleaded fuel in the 318-cu.-in. engine.

However, if this doesn't solve your pinging problem, further diagnosis will be necessary.

For very minor spark knock, (a slight rattle on the 2-3 upshift under heavy load), a slight adjustment of ignition timing should help. Chrysler specifications allow plus or minus 2° from the timing spec listed on your vehicle information label. Setting timing to the minus end of this range might solve the problem.

If the revised ignition timing doesn't cure the pinging, check for a clogged EGR valve, a heated-inlet-air door in

(Please turn to page 40)



Tips for turbos

You have to pay for pleasure, right? So it is with a turbocharged four-cylinder or V6 engine that gives the power of a V8 without the penalties in fuel economy. Payment comes due, though, with more frequent maintenance. Oil, oil filters and sparkplugs have to be changed more frequently than in nonturbo engines, so check your owner's guide. Also, there are these nagging operational "payments":

- After a cold start, drive at a speed not to

exceed 35 mph for 5 miles to give the engine oil time to warm up fully. The turbo needs the maximum lubrication benefits that are provided by fully warmed up oil before you cut loose.

- After a fast run, don't shut off the ignition immediately. Allow it to run for a couple of minutes to let heat dissipate. If heat isn't allowed to dissipate, oil can "coke," producing residue that blocks turbo lubrication passages.



An all-terrain tire that's so good you may never hear one of its best features.

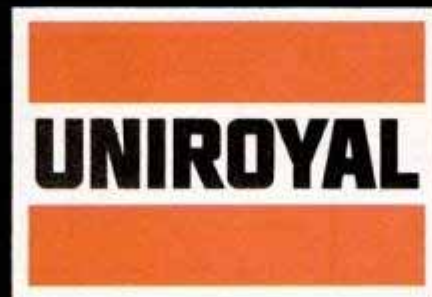
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You may never need a tire this good. Laredo S/R.

CAR CLINIC

(Continued from page 38)

the air cleaner snorkel which is staying closed when the engine warms up, and cooling system malfunctions which might cause overheating. (For more on solving spark-knock problems, see *Saturday Mechanic: Silencing Spark Knock*, page 51, Aug. '84.)

Should none of those leads bring an answer, ask the dealer to replace the automatic transmission torque converter lockup spring with one having part No. 4202672. The spring is part of a driveability package, but you'll only need this part.

The new spring will raise the lockup speed to about 35 mph, reducing engine load and the possibility of spark knock as the vehicle is accelerated.

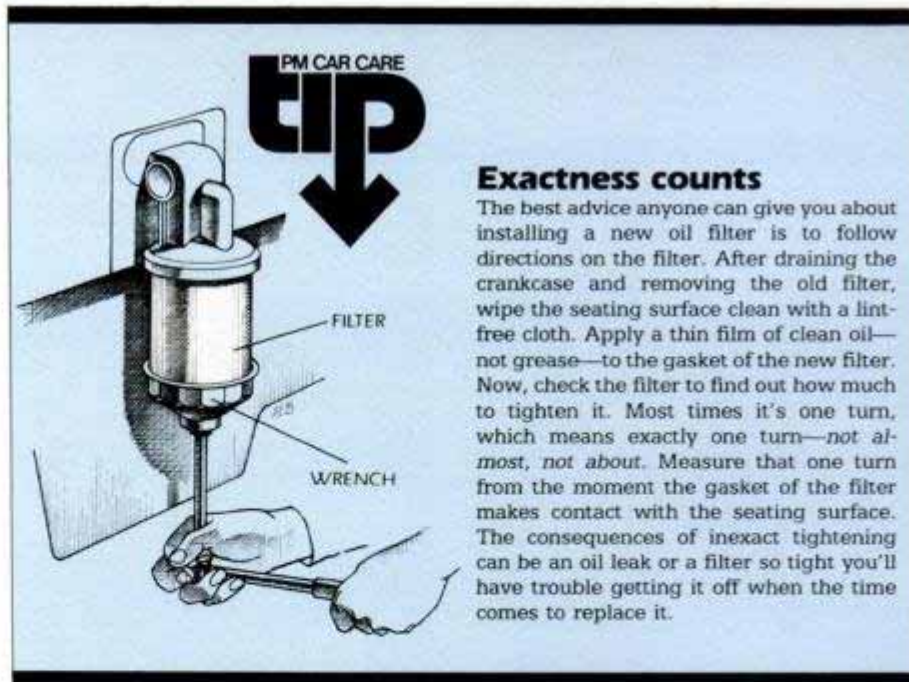
LTD (for limited) gas gauge

The gas gauge of my 1984 Ford LTD has been consistently erratic since I bought the car a year ago. I have to depend entirely on the odometer to know when to stop to add gas.

My dealer has changed the gas tank,

DO YOU HAVE A CAR PROBLEM?

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



Exactness counts

The best advice anyone can give you about installing a new oil filter is to follow directions on the filter. After draining the crankcase and removing the old filter, wipe the seating surface clean with a lint-free cloth. Apply a thin film of clean oil—not grease—to the gasket of the new filter. Now, check the filter to find out how much to tighten it. Most times it's one turn, which means exactly one turn—not almost, not about. Measure that one turn from the moment the gasket of the filter makes contact with the seating surface. The consequences of inexact tightening can be an oil leak or a filter so tight you'll have trouble getting it off when the time comes to replace it.

wiring harness, sensor and gauge. He tells me many Ford and Mercury models have this trouble. I'd like to know when there will finally be a solution.—C. Roger Olab, Belleville, Ill.

Keep your fingers crossed. The solution may be here.

There are two parts to this story. The

first involves only the fuel tank in 1984 LTDs and Marquis. A fuel gauge in one of these cars may drop and return slowly to correct position after the vehicle maneuvers. This occurs because of the design of the reservoir in the fuel tank.

If this is what you're describing as

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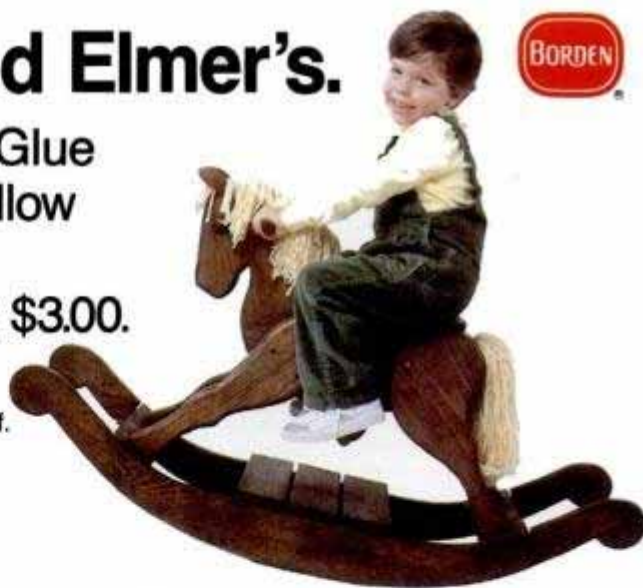


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"consistently erratic," then a new fuel tank having a modified reservoir should alleviate the trouble. The part number of the tank for sedans is E5DZ-9002-A; for station wagons it's E5DZ-9002-B.

From the way you describe the problem, though, I don't think a new fuel tank will fix your trouble. True, gas gauges in cars not having the newly designed tank are sluggish, but you can rely on them. They certainly offer no reason for having to use the odometer to judge fuel supply.

Therefore, your problem may be covered by the second part of this story. It has to do with the sending unit. The same trouble can affect all 1984 FoMoCo models.

The original sending units are being affected by methanol or ethanol that is contained in some brands of gasoline. The alcohol makes the sending unit material expand, so the cross shaft binds against the case. This makes the fuel gauge stop at the reading at which the binding occurs—FULL, $\frac{3}{4}$ tank, $\frac{1}{2}$ full or whatever. All of the original sending units have now been removed from supply. Have your dealer install a new fuel sender. The chances are good that it will solve the problem. These new sending units are not affected by fuel that contains alcohol.

What's in a name

Please clear up a question that's been a subject for argument between my friends and me. What are the differences between a Chevrolet and GMC pickup truck, and are the parts interchangeable?—Richard Barroso, Houston, Tex.

The differences are cosmetic—hub caps, logo, grille design, horn button cap. Stuff like that.

However, the guts of Chevrolet and GMC trucks—all of them, not only the pickup trucks—are the same. And so are the prices. Yes, parts are interchangeable. In fact, trucks

of both brands are made in the same assembly plants.

Now that you know this, you may want to know why GM markets the same trucks having two separate nameplates. It has to do with the franchise agreements between GM and its Chevrolet and GMC dealers.

There are about 6,000 Chevy truck dealers, and about 1,200 GMC dealers. Therefore, one of every five trucks coming off the assembly line has the GMC name. The other four carry the Chevy name. **PM**

SERVICE TIPS

■ Several 1985 GM C-cars (Buick Electra, Olds 98, Cadillac DeVille) may have a wind noise because of partially sealed joints where the center pillar meets the side roof rail and where the door frame meets the inner panel reinforcement. Refer your dealer to the TSB issued by his division. You can use Buick TSB 85-10-5 as a reference.

■ Rust in the fuel system of a 1985 Dodge Caravan, Dodge Ram Van or Plymouth Voyager may be the cause of hard starting, rough idle, hesitation on acceleration or poor wide-open throttle performance. Take a fuel sample or inspect the fuel filter or fuel tank sock. If rust is present, have the fuel system flushed and cleaned according to TSB 14-04-85, and replace the fuel tank, fuel tank sending unit and fuel filter.

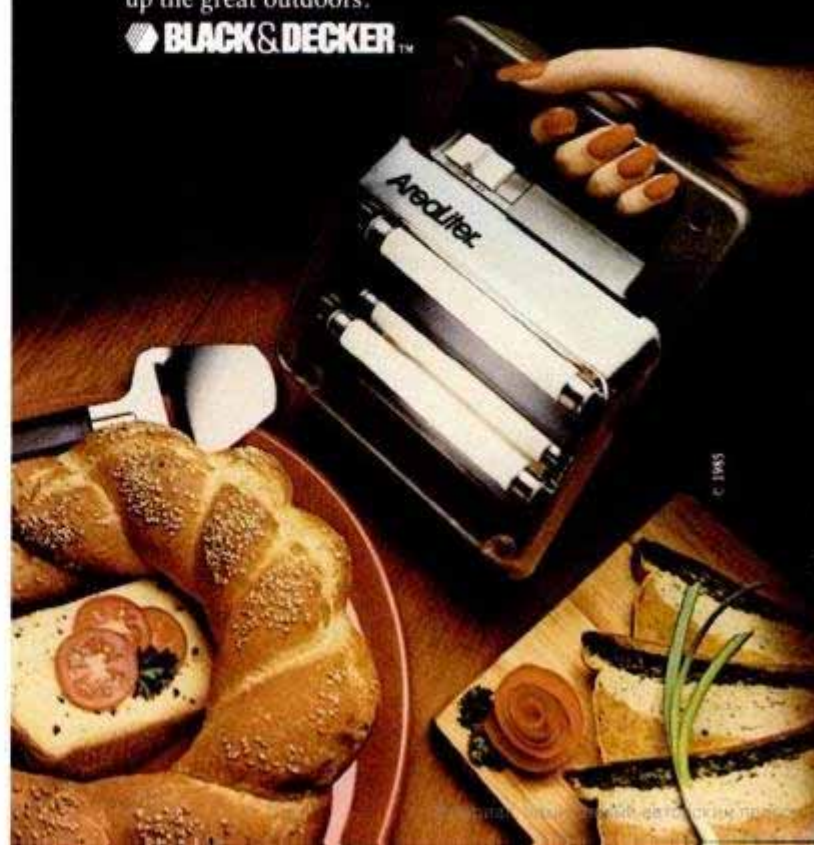
■ If the five-speed transmission in your 1981-'83 Honda Civic is making noise or slipping out of gear, the cause may be too much main shaft end play. To fix the trouble, replace the main shaft fifth gear bearing, main shaft fifth gear bearing snap ring and the fifth gear housing.

■ Hesitation and stalling of 1983 $\frac{1}{2}$ -'84 Ford Rangers and Bronco IIs at ambient temperatures between 30° and 40°F. may be caused by carburetor icing. As called for by TSB 84-26-5, a new air-cleaner shroud (part No. E5TZ-9A603-B), air duct and valve assembly (E5TZ-9A626-A) and duct and valve assembly gasket (E1SZ-9E691-A) should stop this.

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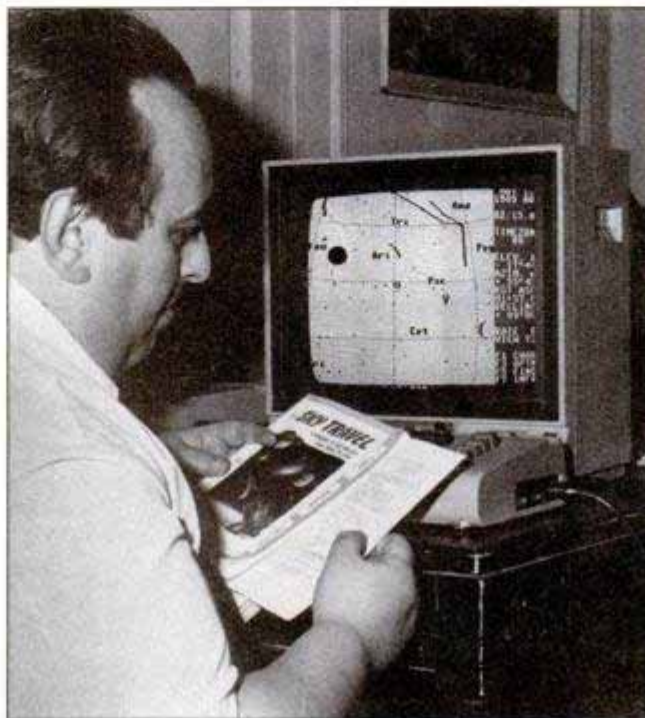


SCIENCE WORLDWIDE

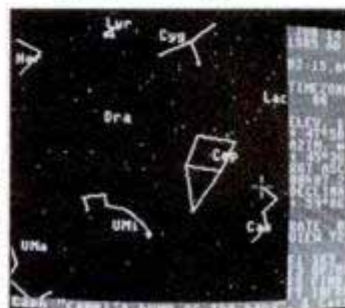


Halley's path appears on computer

Naked-eye viewing of Halley's comet won't be possible until early January. But the excitement is mounting. Amateur astronomers will be photographing the comet this summer, and many of us already have been plotting the best times and viewing locations. By August, most Americans who own 3-inch or bigger telescopes will be able to spot Halley just before dawn. To plot the exact location in the sky, I'm using a software package from Commodore called "Sky Travel." It's designed for the Commodore-64. Sky Travel comes with a detailed manual. A world map lets you program in your location. Then, using general sky maps and detailed star charts, you can pinpoint Halley for any time of any day.



World map (above) lets you program location to get detailed star chart (left) for Halley search.



Sky Travel star map (above) is less detailed than star chart. But it lets you find Halley.

Comet commentary

Even if you don't own a computer, you'll have to do some computations to locate Halley before it's visible to the naked eye. An excellent help will be *The Science Digest Book of Halley's Comet* (Avon, \$9.95). The book includes excellent chapters on the history of comets in general and Halley's in particular. It also comes with a chart to help locate the heavenly object.

Pentagon is discovered

A crystal is a substance that has a definite geometric pattern on the sub-microscopic level. A glass has a random pattern when viewed at similarly high magnification. Recent studies at the National Bureau of Standards suggest there may be yet another form of material in what science calls the "solid state." The material would be called "quasi-crystal." No one knows yet what the properties of such a crystal material would be. It might be a good semiconductor with the hardness of metal. For now, the scientific community is excited just to have found a new type of matter. The NBS researchers discovered the quasi-crystal state looking at quickly cooled aluminum/iron

alloy under an electron microscope. They hoped to find interesting crystalline structures. What they found instead were rows of pentagons scrunched together with irregular spaces between them.

Upgrading Shuttle's brain

One reason for last year's loss of two satellites by the Space Shuttle may be a weakness in the programming NASA uses in its computers. Penn State mathematician Goong Chen has proposed changes in the NASA software to make it more flexible. Chen and researchers from across the nation are meeting this summer to develop a program to prevent such mishaps in the future.

Wowed by winter

If you've had a hunch that recent winter weather has been peculiar, you're in good company. Computer studies by the National Oceanic and Atmospheric Administration indicate that average temperatures for the continental United States have been higher or lower than normal for six of the past eight years. Some scientists believe rising carbon dioxide put in the atmosphere by industry is at least partly responsible.

Backward beepers

An experiment being conducted in Japan places radio pagers in the pockets of senior citizens. Instead of beeping to alert them, these devices set off a beep at a control center in Tokyo whenever a Golden Ager moves from one place to another. The Japanese are trying to cope with the problem of mildly senile people who wander from nursing homes or hospitals.

Back to basics

We all "feel it in our bones," but now an Australian research team has developed solid evidence that modern living is a killer. University of Melbourne researcher Kerin O'Brien took 10 middle-aged diabetic aborigines who lived in Melbourne and convinced them to relocate to the wild. Part of the deal was that they could eat only what they could hunt, fish or gather. Fatty kangaroo meat was even on the menu, if the subjects could hunt it.

After the first two months in the wild, all 10 men showed reductions in blood sugar levels and three were able to come off medication. The university will continue the experiment through the end of 1986. **PM**

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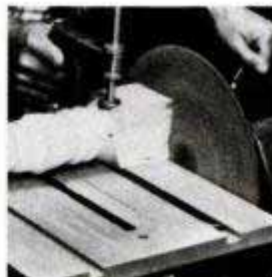
2 It's a 16-1/2" Vertical Drill Press with locking quill feed for accurate depth control.



3 It's a Horizontal Boring Machine that makes doweling operations a snap.



4 It's a 34" Lathe with 16-1/2" swing capacity for turning table and chair legs, or large bowls.



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APPLIANCE CLINIC



Universal refrigerator door gasket

Other readers may have the same frustration I have had in obtaining the rubber gasket for a refrigerator door. Can you possibly list a name or two of a distributor that stocks them? My refrigerator is a Welbilt, serial No. 6802060386, class T, 4.6 cu. in., type 0130. Thanks for your help.—Bob Myers, Fairport, N.Y.

I contacted Welbilt Corp. with your problem. They tell me that you have an older refrigerator and they have discontinued supplying the door gasket for this model.

All is not lost, however. Gem Products Inc., Santa Monica, Calif., markets a universal magnetic vinyl door gasket kit. The kits are designed for universal replacement on refrigerators and freez-

ers when a manufacturer's replacement gasket is not available. The kits are furnished in four L-shaped sections with factory welded corners. A roll of magnetic material also is furnished with the kit. Both materials can be cut easily to the required size.

When ordering the kit, you will have to furnish the length and the width of your existing gasket and the clearance between the door and the cabinet body.

The price of the kits range from \$25 to \$38, depending on size, plus tax and shipping. They are usually available through Gem Line distributors or local appliance stores. Or contact National Parts Distributor, 4279 Frankford Ave., Philadelphia, Pa. 19124; telephone 1-800-523-3620.

Leaky dishwasher door

Our Sears Kenmore dishwasher, which is model No. 587-702200, serial No. 100.27790981, leaks water from the door—anywhere from a few drops one time to a cupful the next. The door gasket has been replaced twice and the water valve once. The door never leaked a drop the first two or three years. Can you help?—Howard K. Ray, Aztec, N.M.

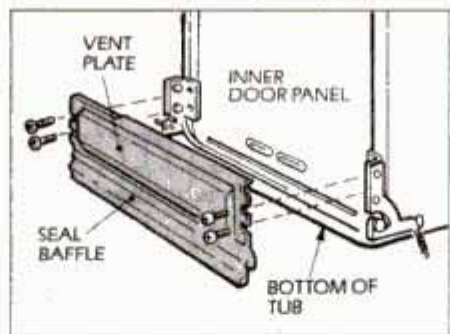
One possible cause of your water leak is a malfunctioning lower stainless-steel spray arm. If the arm is binding, it could throw a steady stream of water against the door. This can be checked simply by spinning the spray tower.

More likely, however, the vent plate and seal baffle on the inside bottom of the dishwasher door is where your problem is located. When the door gasket was changed, the vent plate and seal baffle should also have been replaced. This applies to Sears dishwashers that were made between May 1969 and August 1980.

The part number for the door gasket with the vent and baffle assembly is 808070 and it costs about \$20. The vent plate and seal baffle is available alone under part No. 808369. It costs about \$8 and can be purchased at any Sears repair parts center. The vent plate and seal baffle fits in front of the door liner and has a vinyl gasket that runs across the bottom and seals against the bottom of the tub gasket.

This part determines how well the

door seals with the tub, and it may be the culprit causing the water leak. If the baffle vent holes become clogged or if the baffle doesn't fit properly, a portion of the water that enters the vent holes on the bottom of the door won't drain



Vent plate and baffle assembly seals the joint between dishwasher tub and door edge. The assembly must be replaced when a new door gasket is installed.

properly back into the tub. The water can then leak out the front of the door onto the floor.

To install the vent plate and baffle, disconnect the power to the machine. Open the door, then remove the Phillips-head screws that hold the outer door panel to inner panel. Remove the panel. The baffle will be visible at the bottom of the door. Remove the four screws which hold the assembly to the inner panel—two on each side.

Then remove the baffle. Clean out any soil buildup in the area. Screw the new baffle in place and assemble the dishwasher.

Squeaky clothes dryer

I have a Westinghouse electric clothes dryer, Model DE500PX, that has an intermittent, high-pitched squeak. I've noticed some very fine black substance (like soot) that comes out of the back in the middle, from what looks like a small steel marble. Is there a bearing that needs to be lubricated? How do I get the dryer apart to get at it?—Tom Wherry, Anoka, Minn.

It sounds as if you need a new rear bearing as well as a basket support. Apparently, the bearing has worn down to a point where the basket support shaft is now rubbing against the metal bracket which holds the bearing in place. This metal-to-metal contact is probably causing the noise.

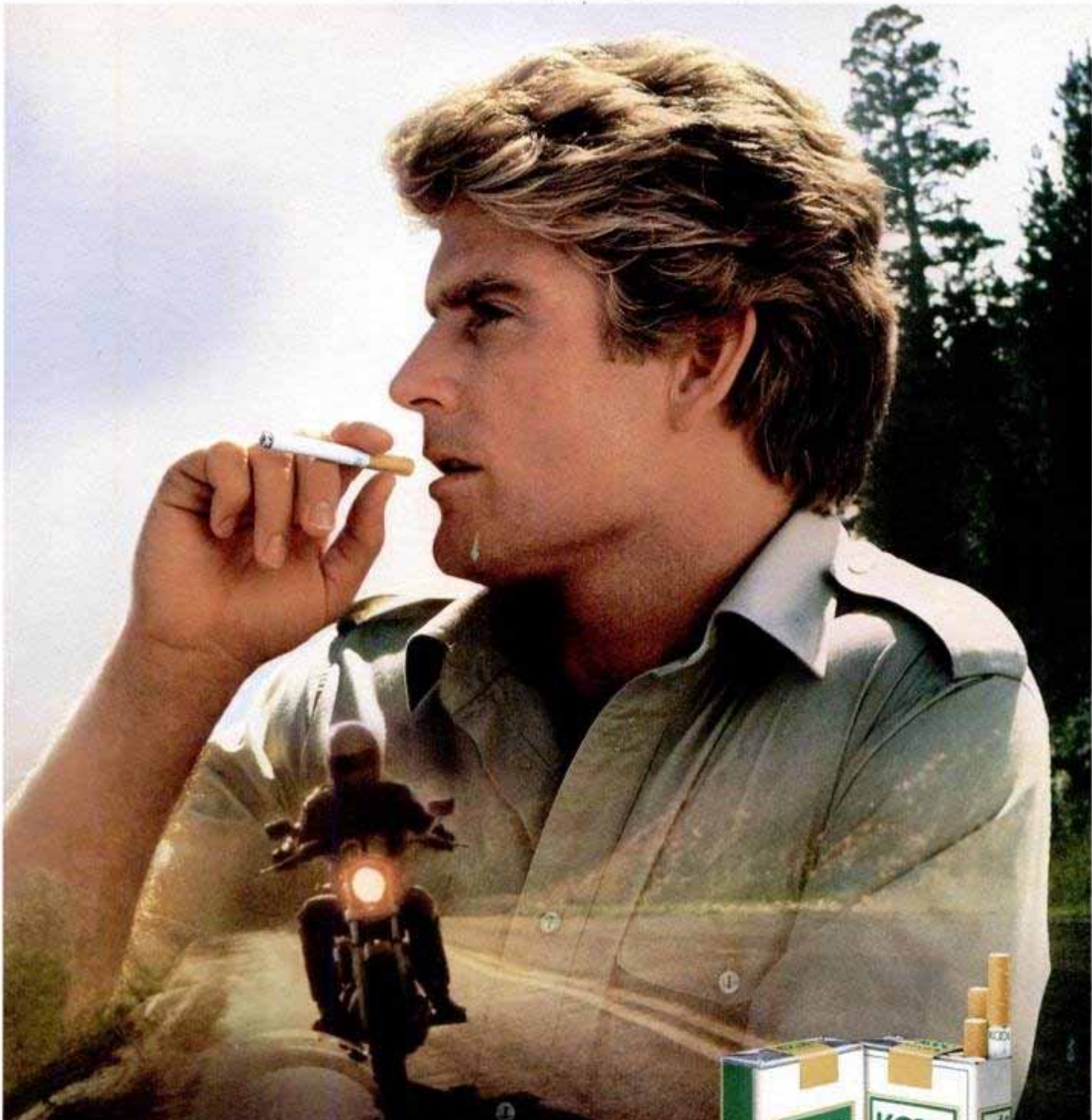
The bearing and basket support shaft can be purchased in kit form with instructions and lubricant from any White-Westinghouse parts center or appliance parts store in your area. The part number is Q-14285; it costs approximately \$30 plus tax. The instructions that come with the kit explain how to disassemble the dryer and install the bearing and shaft.

Microwave clock motor

We own a Sharp microwave, model No. R-6780, serial No. 17667, with a terribly noisy clock motor. I removed the motor and tried to purchase a replacement. I was told that I have to buy a complete clock unit at \$58. Do I have to buy the entire unit?—Robert E. Smith, Delton, Mich.

I checked several of my sources to try to locate a motor for your microwave oven. I had no success. According to Sharp, the clock motor is not available as a separate part. It is only available as part of the complete clock assembly. The part number for the assembly is FSWTE 009BY0. The cost is \$54.24 plus tax and shipping. The part can be purchased at any Sharp parts distributor in your area. Possibly one of our readers may know of a company who remanufactures clock motors and may be able to help us. See also our clock maintenance article on page 229 of this issue. **PM**

If you have a problem with any appliance, send your question, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.



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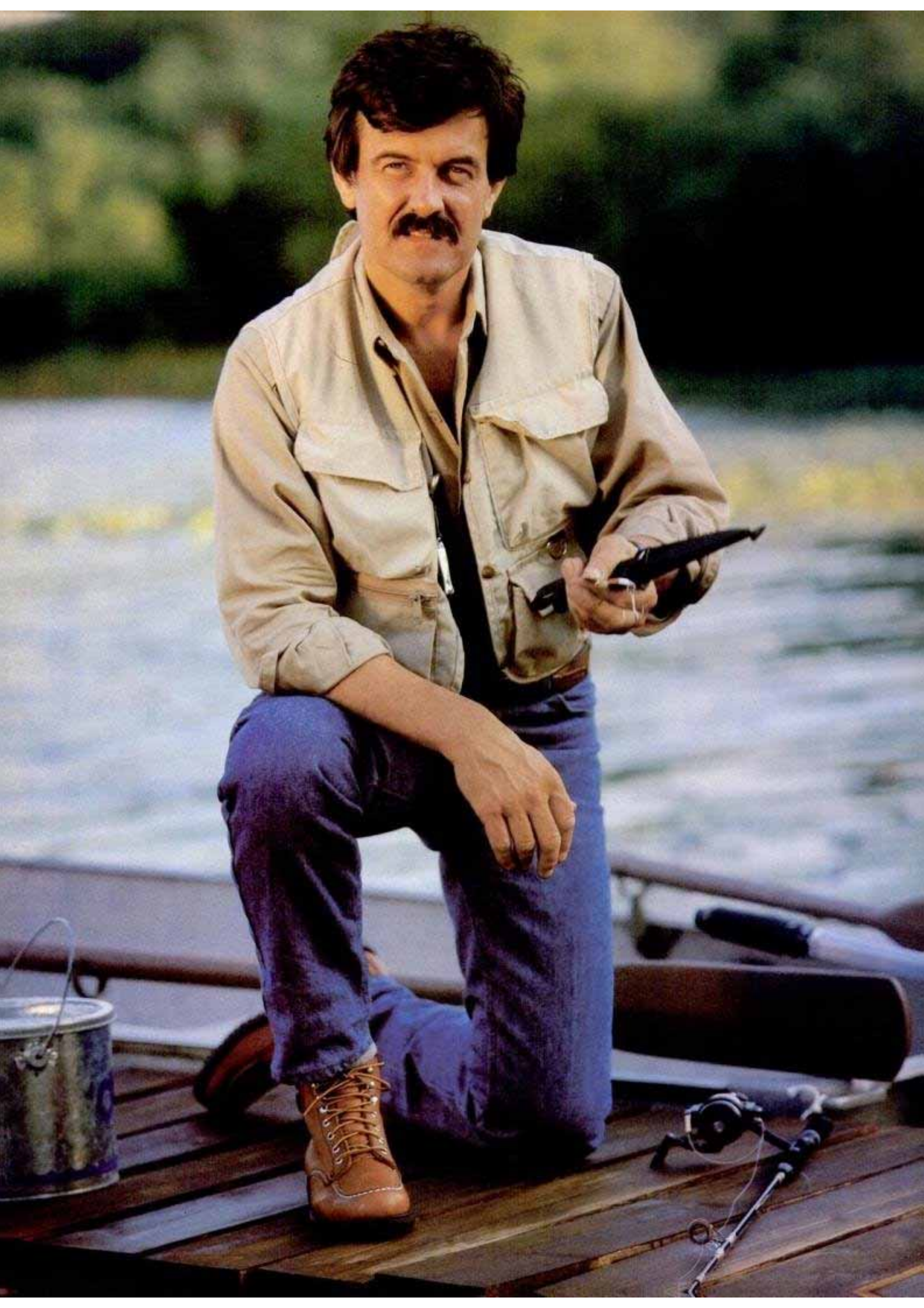
Kool gives you extra coolness for the most refreshing sensation in smoking.

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Milds Kings, 10 mg. "tar", 0.7 mg. nicotine; Filter Kings, 16 mg. "tar", 1.0 mg. nicotine av. per cigarette, FTC Report Feb. '85.



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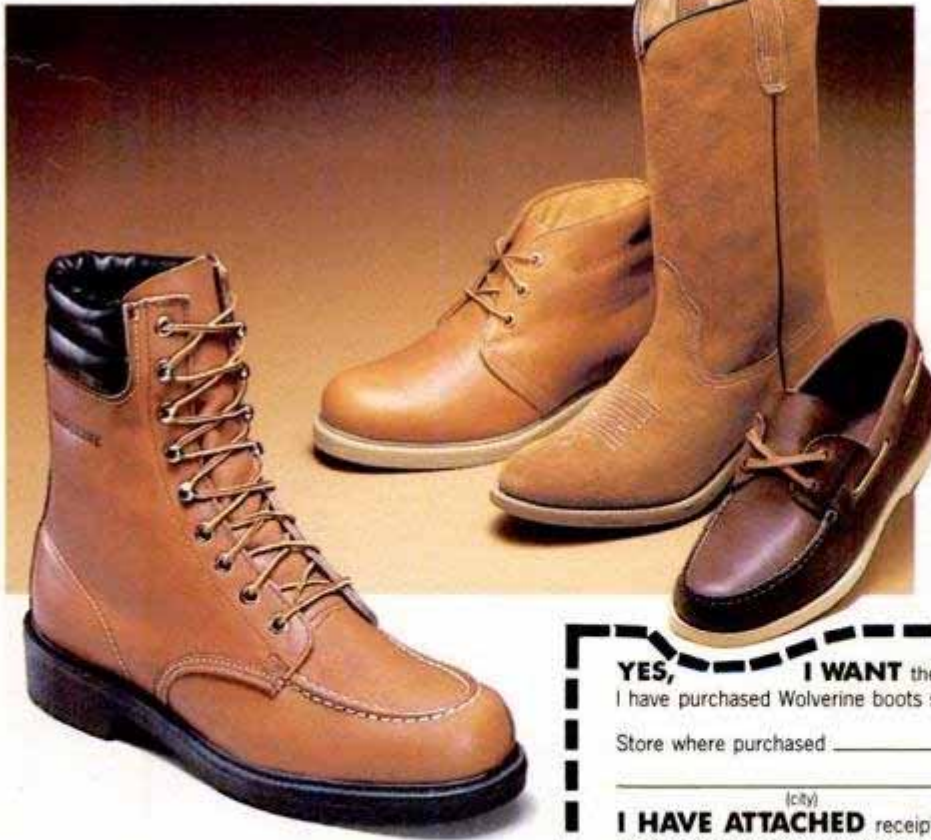
"It's that simple.

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You might prefer the sport-styled padded collar work boot like I'm wearing. The rugged leather upper and long-wearing, slip-resistant Work-Lites™ bottom make it a great all-purpose boot, and a natural for fishing.

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Since our string trimmers also edge grass, they make all yard work almost no work at all. And all our trimmers feature electronic ignition for quick starts and less maintenance.

Along with a tough 2-cycle McCulloch gas engine that's mounted in the rear for better balance and easier handling.

Both the MACTM 60-A and 80-A have a semi-automatic feed head that trims the right amount of line when you tap the cutting head on the ground.

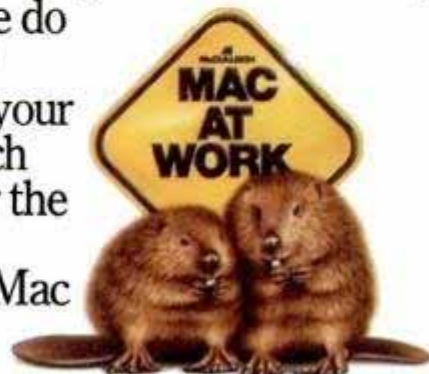
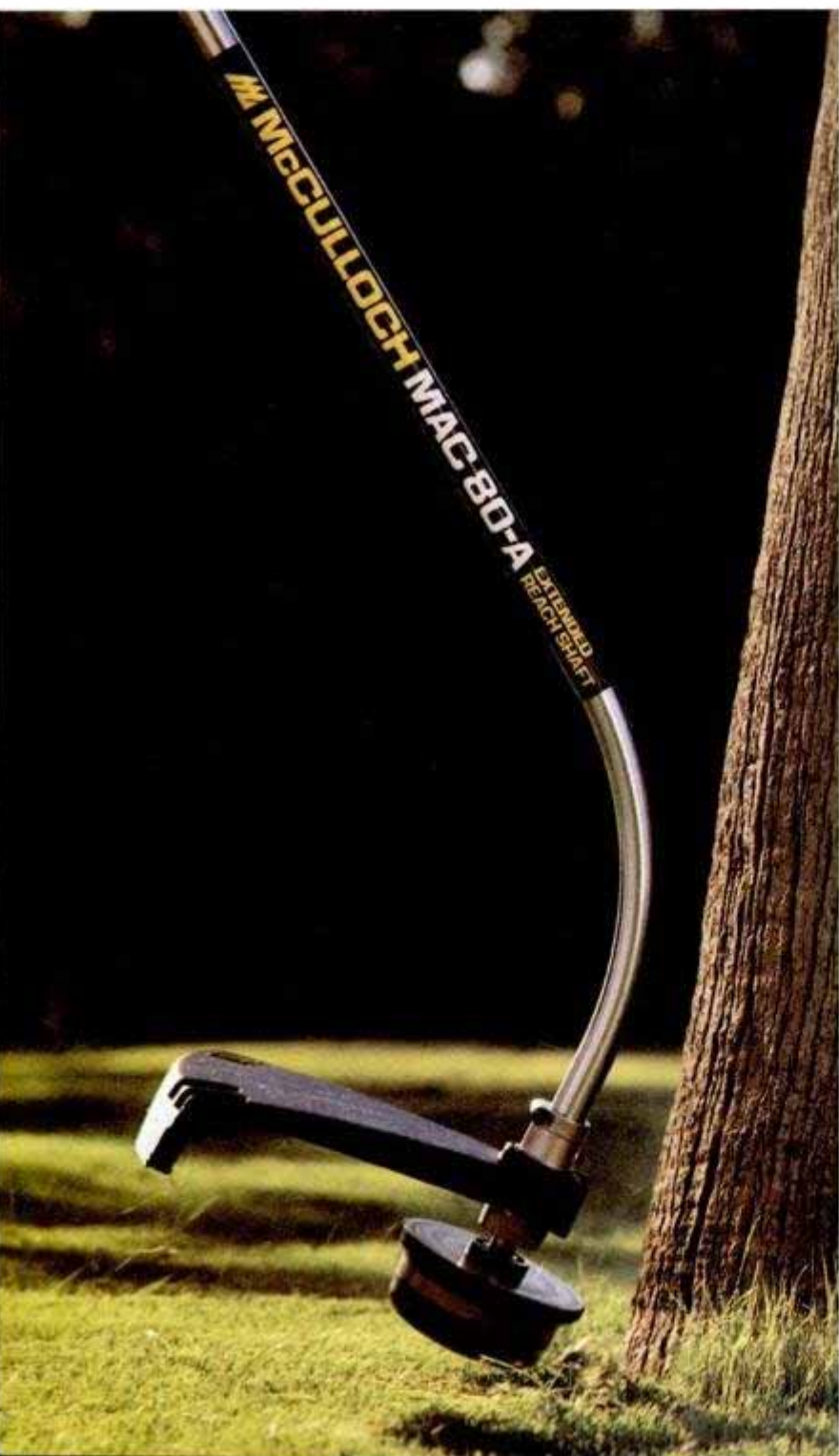
It's all part of the simple, functional engineering you expect from a company that's been pioneering new ideas in outdoor power products for 39 years.

But you're still left with a slight problem. With five models to choose from, including two brushcutters, which one do you buy?

See your McCulloch dealer for the answer. And put Mac to work.



Spend less time on your knees.



McCULLOCH

Install a little sunshine

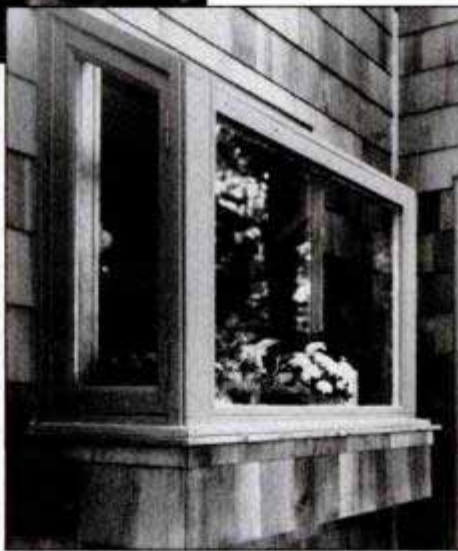


Create a mini-greenhouse in any room with the Sun Bay window (left). Four glass surfaces provide plenty of sunlight and side windows open to provide ventilation. Once installed, the unit projects about 18 in. from the house (below).

You can bring more of the great outdoors, indoors with the new Sun Bay window by Marvin Windows, Box 100, Warroad, Minn. 56763. Because of its glass "roof," the unit captures more sunlight than conventional bay or bow windows. The two side windows open for ventilation.

The Sun Bay is constructed of Ponderosa pine and features energy-efficient double-pane insulating glass. Triple-glazing is optional. The unit can be installed as a replacement window or in new construction.

It's available in five sizes ranging in price from \$955 to \$1,123.



Party sink prepares drinks

This cleverly designed fixture combines a sink with a blender in one compact unit. Made by Elkay Manufacturing, 2222 Camden Court, Oak Brook, Ill. 60521, the 15 × 25-in. unit features a satin-finished, stainless-steel sink equipped with a high-arc, dual-handled faucet. A built-in NuTone power unit runs the blender. It's available with the sink on the left (No. 2515-LC) or on the right (No. 2515-RC) for about \$626.



Full-size stacking laundry unit



Speed Queen introduces the Ultra-Mate laundry system—a full-size washer and dryer in a space-saving stacked unit.

The Ultra-Mate's exclusive tilt-open, top-loading washer features a stainless-steel tub that won't rust, chip or corrode, according to the maker. The dryer has an eye-level door and a 5.79-cu.-ft. drying cylinder. The 120/240-volt unit measures 26⁷/₈-in.-wide × 28 × 79-in., requiring less than 6.5 sq. ft. of floor space. The system sells for about \$1,200. For details, contact Speed Queen, Ripon, Wis. 54971.

Chain-saw drill attachment



Stihl offers an accessory that converts a chain saw into a powerful, cordless drill. The Model BT-310 accessory fits 10 different Stihl chain saws.

Simply remove the saw's bar and chain to attach the drill accessory. The saw sprocket drives the drill with a cutterless chain.

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STEERING

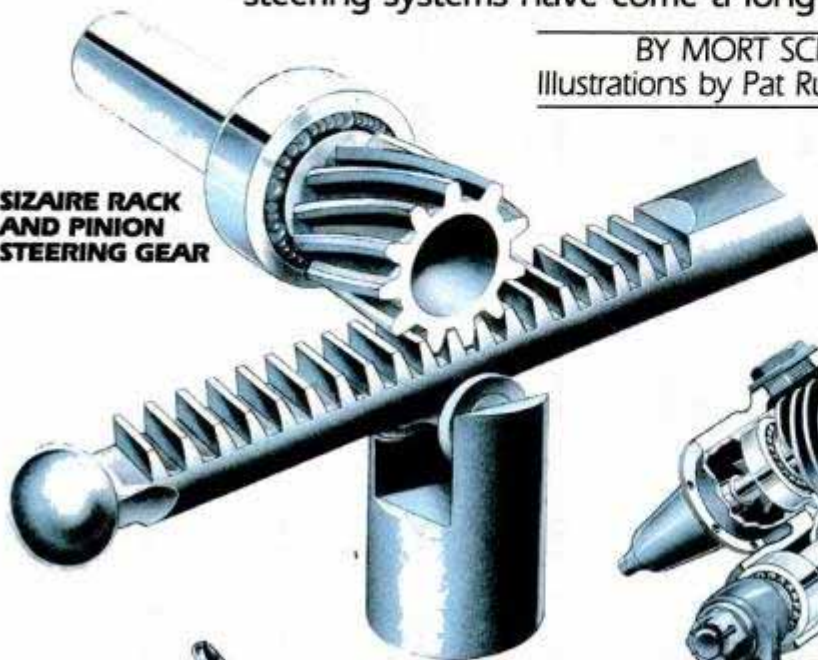
A CENTURY OF PROGRESS

100 YEARS

From tillers to computer-controlled power assist, steering systems have come a long way.

BY MORT SCHULTZ
Illustrations by Pat Ruggero

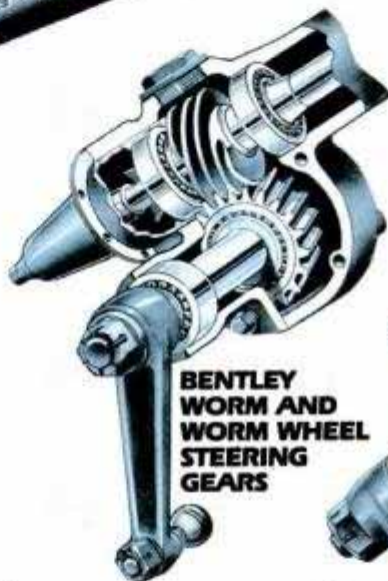
SIZAIRE RACK AND PINION STEERING GEAR



SUNBEAM WORM AND NUT MECHANISM



BENTLEY WORM AND WORM WHEEL STEERING GEARS



SINGER EPICYCLIC STEERING GEARS

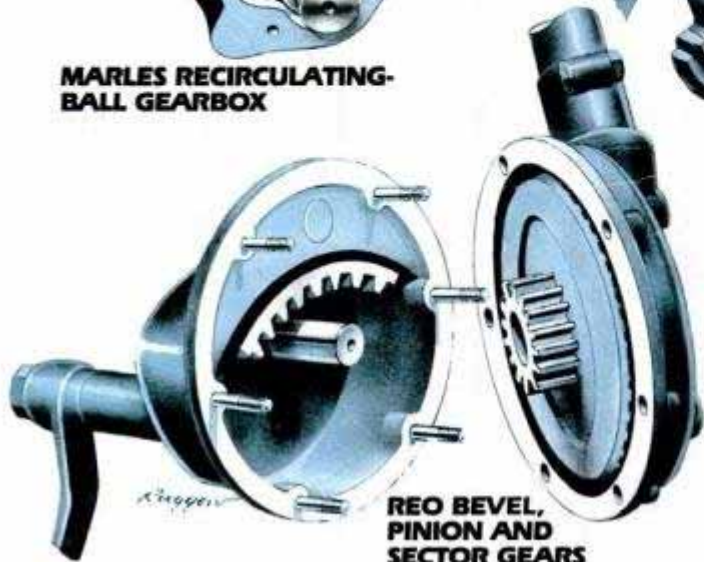


WORM GEAR

LAVINE WORM AND NUT STEERING



MARLES RECIRCULATING-BALL GEARBOX



REO BEVEL, PINION AND SECTOR GEARS

WORM GEAR
HARDENED STEEL NUT

PITMAN ARM

By 1923, every steering gear we know today (and a few we've forgotten) had been used. The "modern" rack and pinion design goes back to 1885. Many American cars use variations of the worm and the recirculating-ball designs. The Singer and REO designs are real oddballs.

In 1896, Frederick Strickland persuaded his friend, A.J. Drake, to put a marine steering column and wheel on a new Daimler Phaeton. Strickland built steam launches for a living; Drake directed the Daimler Co. Ltd. of Great Britain. Other Daimler Phaetons—indeed, practically every car sold on both sides of the Atlantic—were equipped with a tiller.

Previous attempts at putting steering wheels on motor vehicles hadn't met with acceptance. The first one tried on a motor vehicle with a gas engine was in 1872 by Charles Randolph of Scotland. The first motor vehicle to have a steering wheel was probably the 1857 Dudgeon Steamer.

(Please turn to page 56)

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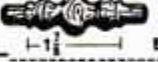
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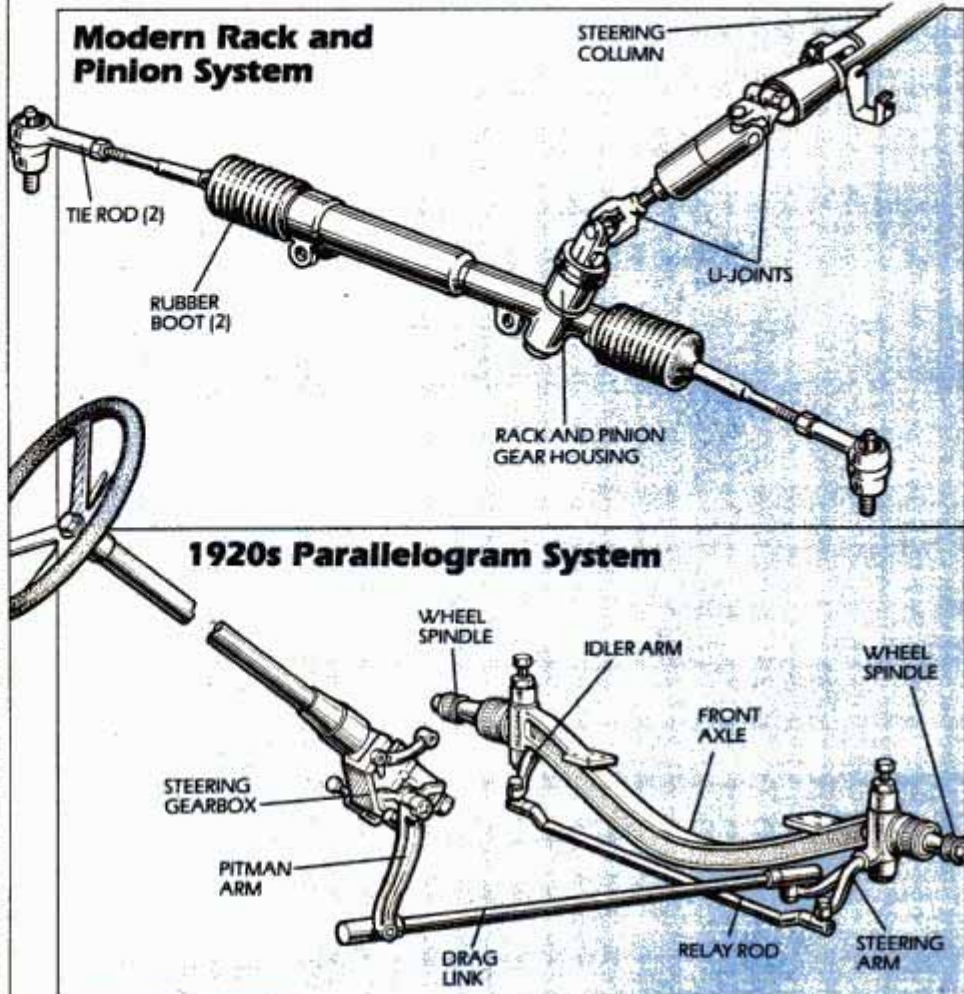
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STEERING: A CENTURY OF PROGRESS

(Continued from page 52)



Simplicity of the rack and pinion system (top) is obvious when compared to the parallelogram system on a Pierce-Arrow. Modern systems eliminate the drag link and axle.

Like these early experiments, it looked like the steering wheel on the Phaeton was destined for oblivion. Perched atop a vertical column, the wheel came almost to eye level. Anyone 5-foot-5 or shorter had trouble seeing over or around it.

In 1897, Strickland's Phaeton, still sporting its steering wheel, was taken to the Daimler works in Coventry for a complete overhaul. This required separation of the car's body and chassis. As the body was being slung back into place, the sling suddenly slipped and the body fell across the steering column. The impact bent the column several degrees out of perpendicular. A worker got into the driving seat and immediately found that the new angle of the column and wheel were a great improvement. As a result, the 1900 Daimler Parisian became the first production car to be equipped with an inclined column and wheel.

The first horseless carriages had their front axles and wheels joined in a one-piece unit that pivoted about a single point at the center of the axle. A

post was attached to the axle midpoint and extended up through the floorboard. A tiller was fastened to the post to steer the vehicle.

This system served well enough as long as motor vehicles didn't travel faster than horses. But as speed increased automakers looked for a system that would permit cars greater steering accuracy and would reduce the scuffing effect that caused tires to wear out in 100 miles. They found what they were looking for with a theory that had been formulated in 1818.

The idea came from a German named George Lenkensperger. He developed an axle that allowed the front wheels to swivel independently of the main axle. It involved placing wheels on spindles (or steering knuckles), which were pinned to and pivoted on the front axle.

The Lenkensperger principle was adopted by the young auto industry, but poor Lenkensperger never gets credit for it. That goes to Rudolph Ackermann, a London bookseller and publisher, who probably didn't know a spindle from

(Please turn to page 58)



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spinach. Lenkensperger gave Ackermann the rights to his invention in Great Britain and Wales, and Ackermann's name stuck.

Another man who never seems to get credit for making a significant contribution to the development of the modern steering system is Jeantaud, a French carriage builder. In 1878, he invented the first parallelogram steering linkage, although he didn't call it that.

The Jeantaud linkage moved the steering axle's pivot point to the side. Jeantaud attached a rod to the spindles with two connecting pieces. Today we call that rod the relay rod. The two connecting pieces are now called the Pitman and idler arms.

He connected the end of the steering column to the Pitman arm. As the steering column turned, motion was transmitted to the wheels via the Pitman and idler arms, relay rod and wheel spindles.

At the start of the 20th century, as cars became heavier and faster, and pneumatic tires replaced solid tires, the necessity to reduce steering effort became apparent. With the steering column attached directly to the steering linkage, it was difficult to turn the

wheel. Drivers who were strong enough to steer vehicles often overdid things and ended up in a ditch.

To ease the effort of steering, engineers placed a reduction (steering) gear between the steering wheel and linkage. And so it's been ever since.



The 1914 Cadillac had a tilt-away steering wheel. The idea goes back at least to 1903.

The earliest reduction mechanism consisted of a worm gear. Attached to the end of the steering column, it drove another gear (either a worm wheel or a roller) that turned a shaft connected to the Pitman arm. The worm gear and worm wheel were placed in a cast-iron box that was attached to the frame.

The basic worm gear and worm

wheel reduction mechanism has served the auto industry for many years, with a couple of noticeable exceptions. One was in 1908 with the launching of the Model T by Henry Ford. It had a steering gear that still is one of a kind.

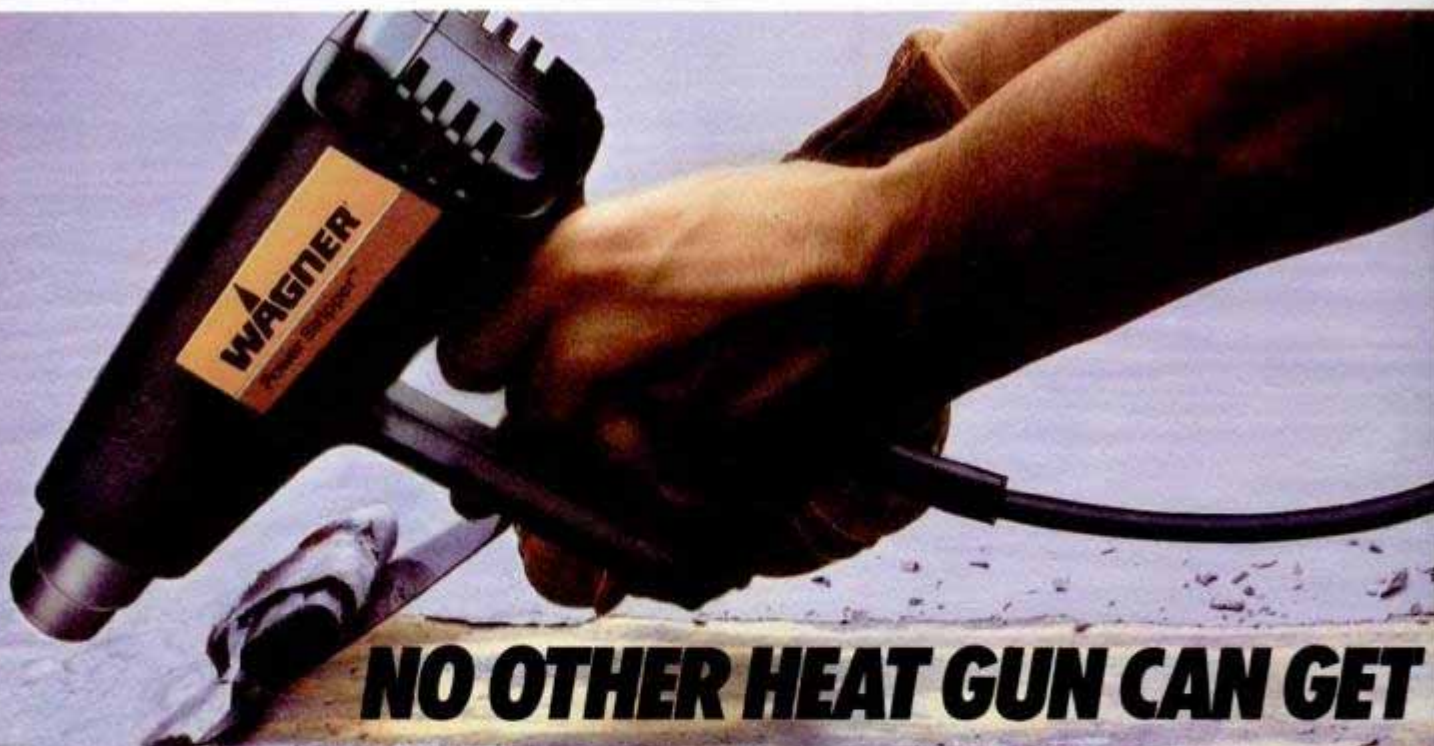
Ford placed a set of epicyclic, or planetary, gears in a small box directly beneath the steering wheel. The planetary gear set drove a main gear that Ford fastened to the steering shaft. This put the steering gear under the driver's hands, at the top of the steering column, rather than the bottom.

Another exception to the basic worm and roller steering gear came along in 1923. To reduce the rubbing contact between the worm gear and roller, Henry Marles of Detroit placed ball bearings between the two. This type of steering gear has become known as the recirculating-ball steering gear, and is still used on many large American and some Japanese cars.

The first use of a "modern" rack and pinion steering gear was in the 1885 Benz. It was also used in the 1905 Cadillac and in many other makes from 1911 to 1920.

The need for power

Despite the adaptation of the steering gear, steering cars was still not an easy task. As cars got heavier and



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steering got tougher, drivers started demanding a better way. It was time to reintroduce an innovation that had been around for three quarters of a century—power-assisted steering.

In 1954, Cadillac was the first manufacturer to make power steering standard on cars. However, the history of power assist goes back way before that.

The first power-steering system ever fitted to a vehicle was in 1876 by a fellow named Fitts, but little is known of it. There's more data available about the power steering system put on the 1903 Columbia 5-ton truck. The truck used an electric motor to drive the steering mechanism.

Commenting on the Columbia power steering system, a 1905 edition of *Motor Age* said: "This simple device is said to make it possible to run the truck as fast as 18 miles per hour and hold to a true course." One wonders what other 5-ton trucks were doing!

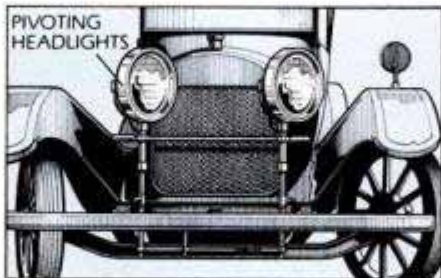
From 1903 onward power-assisted steering mechanisms kept cropping up, primarily for use on trucks. Some were operated by vacuum and some by compressed air.

In 1928 the first practical hydraulic power-steering system, developed by Francis W. Davis, was manufactured by the Vickers Co. It set the standard adopted by the auto industry 26 years

later. First, though, it had to prove itself, which it did during World War II in armored vehicles and large trucks.

Where steering is heading

As you may have realized by now, the development of parts that make up today's steering systems date back to even before the existence of the motor car itself. Even the tilt steering wheel,



Steerable headlights are older than the '68 Citroen or '48 Tucker. This 1920 aftermarket kit did the trick on Model T Fords.

which many may think is a relatively modern innovation, was first tried on a 1903 Marr Runabout. It was called the "fat man's wheel" for obvious reasons.

There really hasn't been much new in steering for a long time—just improvements of old ideas. But that's changing because of electronics.

The 1985 Toyota Cressida is the first

production model whose steering assist is controlled by a computer. Toyota calls the system Progressive Power Rack-and-Pinion Steering.

A sensor in the transmission monitors vehicle speed, sending signals to the computer. The computer operates a solenoid flow control valve placed in the hydraulic circuit that supplies high-pressure fluid to the steering rack.

At highway speeds, when less steering effort is needed, the computer signals the flow control valve to reduce hydraulic pressure and firm up steering. When parking or turning while the car is moving slowly, the computer signals the control valve to increase hydraulic pressure. This makes it easier for the driver to turn the steering wheel. Other variable-assist systems without computers change boost according to engine speed, not road speed. Boost may be cut at fast idle or when the transmission is in low gear.

If matters regarding steering system development hold true to form, you can tell your grandchildren or great-grandchildren that you lived during a historic era. Computerized steering may well be the only new steering invention for another 100 years. **PM**

PM thanks the research library of the Motor Vehicle Manufacturers Assn. (MVMA) for its help in preparing this series of articles.

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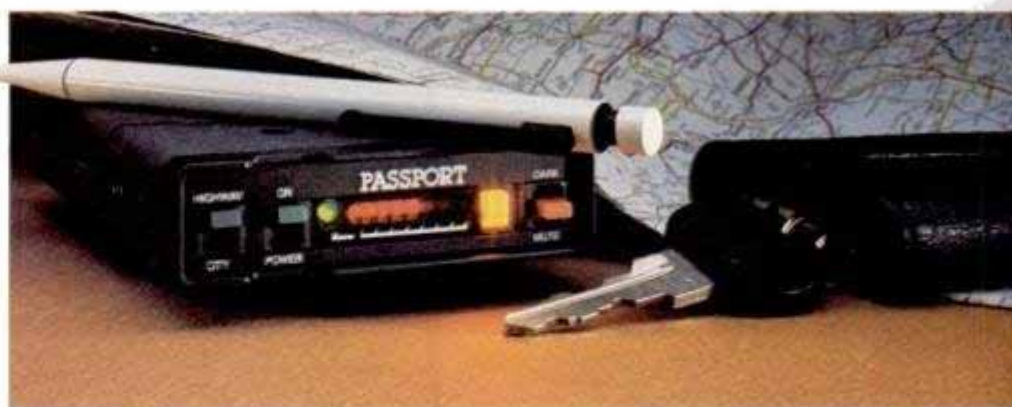
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BUILD OUR TWO-DRAWER CHERRY TABLE

Classic drop-leaf table serves as a night stand or living room piece.

BY RALPH S. WILKES



This versatile table is crafted from solid cherry and has two drop-down leaves. The design is a copy of an 1850s museum piece.

Small tables with one or two drawers have been around since the Colonial period, reaching their height in popularity during the early 19th century. Today, antique shops do a thriving business with them.

The real antiques were most often made of cherry, although some were of walnut, pine, maple or oak. Our "antique" is a copy of a New York State museum piece built around 1850.

Start with legs

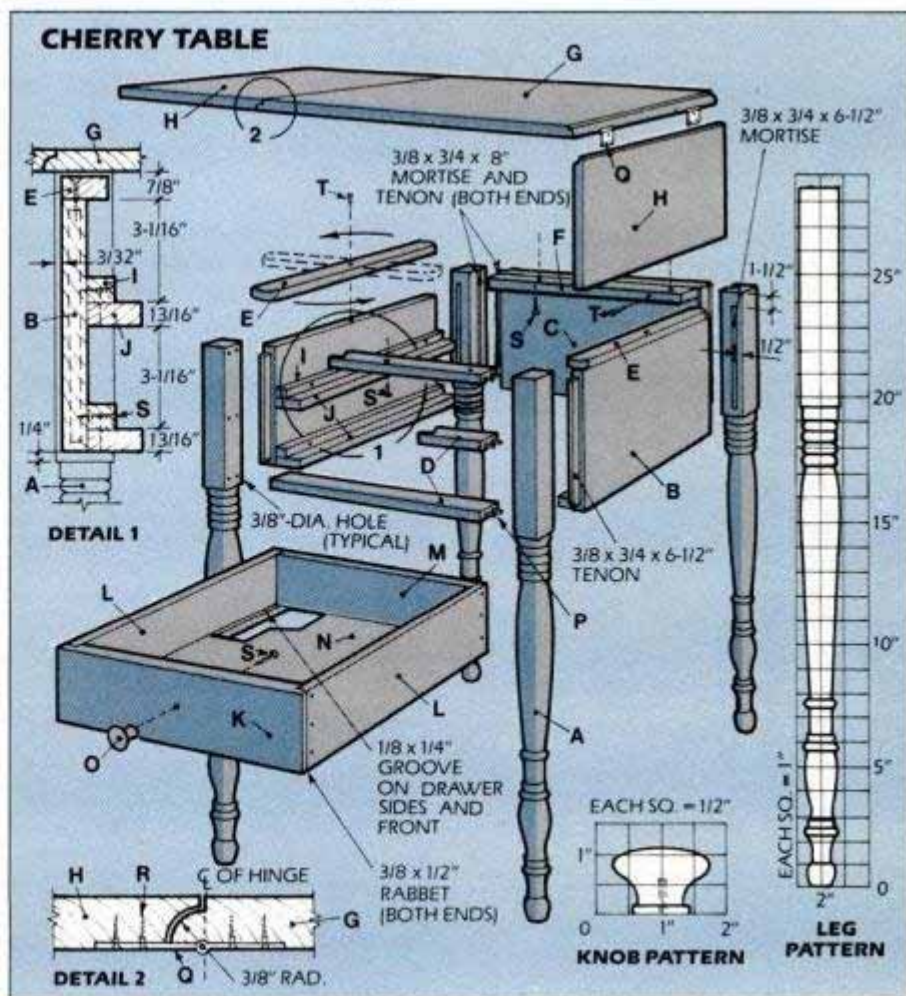
Begin by shaping the legs from stock measuring $1\frac{7}{8}$ -in. square. Finished legs are $28\frac{1}{2}$ in. long, so the turning blanks should be about 30 in. to allow for waste at the ends. Leave at least $9\frac{1}{2}$ in. of the leg square, to be cut off later to $8\frac{7}{8}$ in. Turn the rest of the leg to a $1\frac{13}{16}$ -in. cylinder.

With the lathe running, mark the major cuts on the cylinder with a pencil and proceed with the shaping. Use rule and caliper to check your progress. Turn the first leg to the shape shown in the drawing pattern, then sand at low speed, first with 120-grit, then 220-grit sandpaper. Mount the first leg behind

(Please turn to page 62)

MATERIALS LIST—CHERRY TABLE

Key	No.	Size and Description (use)
A	4	$1\frac{7}{8} \times 1\frac{7}{8} \times 28\frac{1}{2}$ " cherry (leg)
B	2	$1\frac{3}{16} \times 7\frac{3}{4} \times 17\frac{1}{2}$ " cherry (side)
C	1	$1\frac{3}{16} \times 8\frac{3}{4} \times 14$ " cherry (back)
D	3	$1\frac{3}{16} \times 1\frac{7}{8} \times 12\frac{1}{2}$ " cherry (front dividers)
E	2	$1\frac{3}{16} \times 1\frac{3}{4} \times 16$ " cherry (leaf support)
F	1	$1\frac{3}{16} \times 1\frac{1}{4} \times 12\frac{1}{2}$ " cherry (back cleat)
G	1	$1\frac{3}{16} \times 17\frac{1}{4} \times 20\frac{3}{4}$ " cherry (top)
H	2	$1\frac{3}{16} \times 9\frac{1}{2} \times 20\frac{3}{4}$ " cherry (leaf)
I	4	$1\frac{3}{16} \times 1\frac{5}{16} \times 16$ " cherry (drawer guide)
J	4	$1\frac{3}{16} \times 1\frac{1}{2} \times 16$ " cherry (drawer runner)
K	2	$1\frac{3}{16} \times 3 \times 12\frac{3}{8}$ " cherry (drawer front)
L	4	$\frac{1}{2} \times 3 \times 18\frac{1}{4}$ " pine (drawer side)
M	2	$\frac{1}{2} \times 2\frac{5}{8} \times 11\frac{3}{8}$ " pine (drawer back)
N	2	$\frac{1}{4} \times 11\frac{7}{8} \times 18\frac{1}{2}$ " plywood (drawer bottom)
O	2	$1\frac{1}{4}$ "-dia. $\times 1\frac{1}{4}$ " cherry (drawer knob)
P	12	$\frac{3}{8} \times 1\frac{1}{2}$ " hardwood dowel
Q	4	$1\frac{1}{4} \times 2\frac{1}{8}$ " Stanley No. 810 table hinge
R	24	$\frac{5}{8}$ " No. 8 fh screw
S	14	$1\frac{1}{4}$ " No. 10 fh screw
T	4	$1\frac{1}{2}$ " No. 10 fh screw



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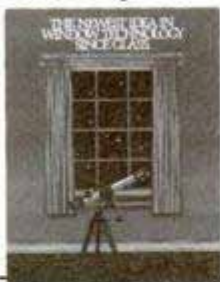


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TWO-DRAWER CHERRY TABLE

(Continued from page 61)

the lathe and refer to it while making three exact copies. Be sure to select the two legs with the most attractive grain for the front.

Mortise the legs with a mortising chisel in a drill press; or simply bore out the waste with a standard drill bit and square the mortise with a sharp chisel. Cut mortises slightly more than $\frac{3}{4}$ in. deep, and center them $\frac{1}{2}$ in. from the outer edge of the leg as shown. Cut the matching tenons on a table or radial-arm saw. Trim as required to fit the mortises.

The front dividers, mounted flush with the fronts of the legs, are secured with $\frac{3}{8}$ -in.-dia. \times $1\frac{1}{2}$ -in. dowels. Bore holes in the ends of the three dividers first, then use dowel centers to transfer the hole locations to the legs.

Test-fit joints

After test-fitting all joints, glue and clamp the sides and legs together. When dry, glue and clamp the dividers and the back in place. Check to make sure this assembly is square.

Cut the two leaf supports and counterbore their screw mounting holes so the sides of the supports will be flush with the sides of the table when closed. Round the end corners of the supports so they turn without hitting the legs.

Select stock for the tabletop, and edge-glue pieces to produce a panel that will overhang $\frac{1}{2}$ in. beyond the

legs in both directions. Then, cut the drop-down leaves to the size given in the materials list. Cut the rule joint with a router and a $\frac{3}{8}$ -in. bead and quarter-round bit for the table edge, and a $\frac{3}{4}$ -in.-dia. core box bit for the leaf edge. Make test cuts on scrap material first.

Attaching the hinges is critical. They must be positioned, as shown in the photo below, with the barrel into the table, and the long side of the hinges toward the leaves. The hinge pivot is directly below the upper line of the rule joint. Use a sharp chisel to cut the hinge leaf and barrel mortises.

For the drawers, use $\frac{1}{2}$ -in. pine for sides and back. Rip a $\frac{1}{8} \times \frac{1}{4}$ -in.-deep groove for the drawer bottoms in the sides, and front pieces. The bottom of these grooves should be positioned $\frac{1}{4}$ in. above the bottom edge of the sides and fronts.

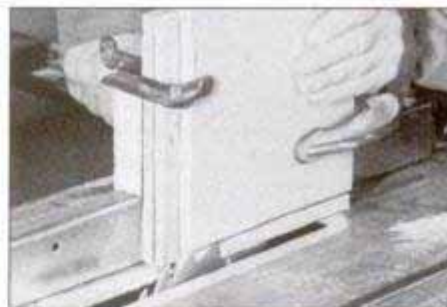
After sliding the bottoms into place, join the drawer sides front and back with glue and a few 4d finishing nails. Prebore clearance holes to prevent splitting the wood.

Turn the drawer pulls from table leg stock and attach them from the back of the drawer front with $1\frac{1}{4}$ -in. wood screws. Finish-sand the table with 220-grit paper, and ease the corners just enough to remove sharpness.

Use a natural finish, or if you prefer to darken it slightly and bring out the grain, apply a coat of oil stain such as Minwax cherry (No. 235). Follow this with two or three coats of polyurethane, sanding lightly between coats. **FM**



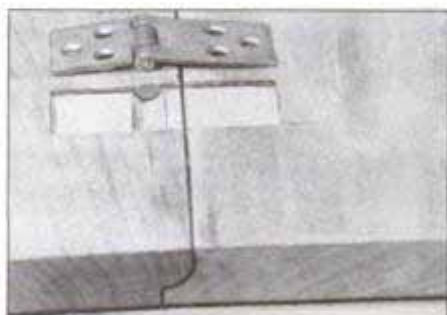
Turn the first leg to size, following the pattern on the drawing. Then, place the leg on a holder behind the lathe and turn others, comparing diameters with a calliper.



Cut tenons on the ends of the sides and back using a table saw and the clamping arrangement shown above. Tenons can also be cut using a dado blade in a radial-arm saw.



Use a router and a $\frac{3}{8}$ -in.-rad. bead and quarter-round bit (left), and a $\frac{3}{4}$ -in.-dia. core box bit (right) to cut the rule joint between the tabletop and leaves.



Allow $\frac{1}{32}$ -in. space between top and leaves to prevent binding. Cut hinge mortises with a chisel. Pivot point should fall directly below the upper rule-joint edge.

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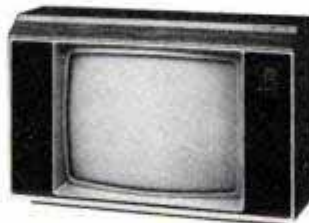
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Dancing robots

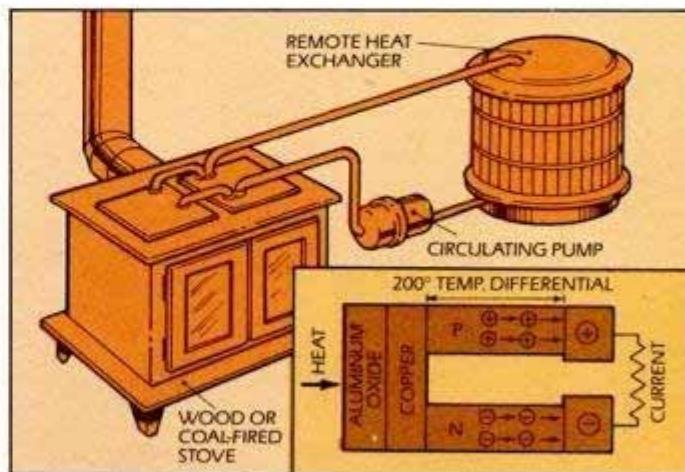
Can man learn to live with his machines? Even to the point of dancing with robots? The answer seems to be yes, from the throngs showing up at two high-tech discos—one in Saugus, Mass., the other in Philadelphia. Both are creations of George Hayward, a science-fiction special-effects designer. At Pulsations in Philadelphia, the dance floor ice is broken by a robot who exits from the belly of a laser-lit spaceship that descends on a wire-rope rigging. At Genisis in Saugus, the floor rumbles and tables shake as the theme from *2001* (it's called *Also Sprach Zarathustra*) builds to a tremendous crescendo over a 16-channel loudspeaker rig. At Genisis the main feature is the Maximus, a hex-wing fighter craft right out of *Star Wars*. Relay panels on board operate a low-voltage panel from a control booth. The wings swivel on four rotators, providing a real sense of flight. The show shares the floor with the disco crowd. Hayward is planning several similar discos for other cities.



Robot dancer descends from spaceship. System controls (inset, above) make ship's wings flap and swivel (right).

Hot electrons shed new light

The Ovonic Thermo-Electric Generator (OTEG) fits in the palm of your hand and provides enough power to light the natural gas pump shown in our photo (right). When a 200° temperature differential is created between OTEG's outer sheath and inner copper core, current flows. By 1990, American Natural Resources hopes to make a wood stove with four OTEGs on top. With a heat pump to maintain the differential, the OTEGs would light four rooms. Power cost: 4 cents per kilowatt.



OTEG generator provides light from heat in natural gas field (left). By 1990, the system, which gives current when 200° temperature differential is applied across it, will light four rooms.

ENGINEERING

Reorder in the court



As 7,000 basketball fans file out of Madison Square Garden after a Knicks' game, a crew of 22 moves in on the court to transform it into an ice hockey rink. Four fork lifts move to the court's four corners as men pull apart the jigsaw puzzle pieces that make up the court. A layer of ice suddenly appears from below. Crewmen move in with hoses, lightly spraying water atop the ice. It hardens within minutes with help from refrigerant flowing below the primary ice layer.

When the top layer is hard and smooth, the boundary lines are sprayed on the ice and the team emblem decals layed down with plastic stickum. In 40 minutes, the rink is ready for the skaters. The act is repeated three times a week in 18 arenas across the United States and Canada.

The Garden system has given rise to a portable stage icing rig used by the John Curry Ice Skating Co. The portable rig's only failure led to the first opening night cancellation in 100 years at New York's Metropolitan Opera last fall. The Curry stage is a layer of plywood under insulation sandwiched between thin plastic layers. Hundreds of capillary tubes supply glycol to the surface to help freeze a thin sheet of water applied to the top. Several refrigerant tubes ruptured at the Met and the show had to be postponed until the next day. Curry has since had more than 40 openings with no problems.



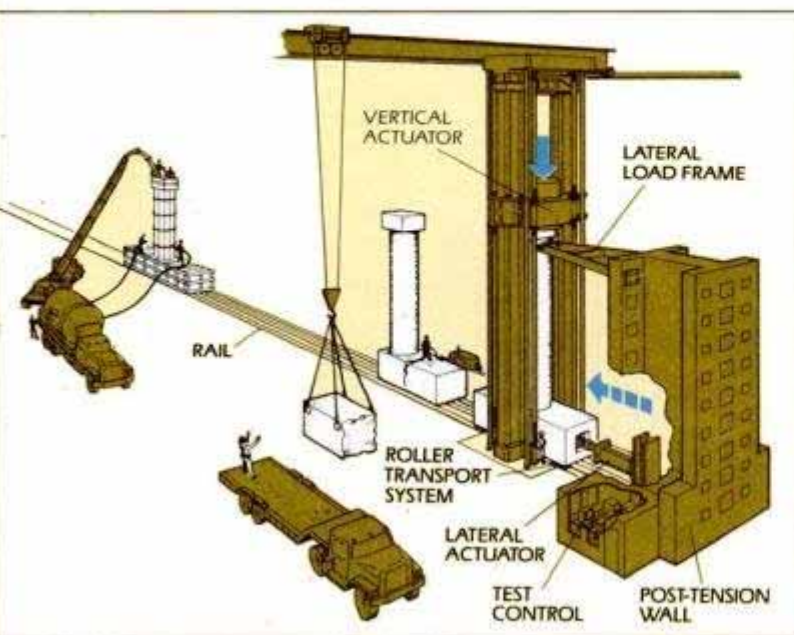
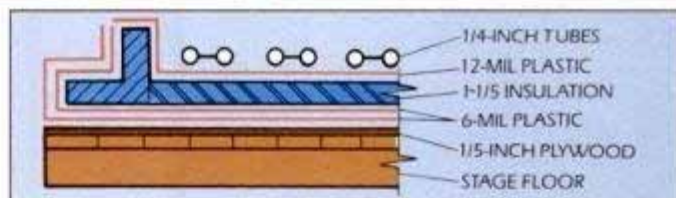
Fork lift carries pieces of basketball court to make way for hockey.



PHOTO BY FRANK LUK



PHOTO BY JOHANN BERBER



Machine that shakes buildings



The National Bureau of Standards is simulating earthquakes at its new Large Scale Seismic Facility. Up to three 30-foot reinforced concrete columns can be tested at once. Each is rolled by flatcar on a rail to a vertical actuator, and the downward motion produces 12 million pounds of force. A computerized post-tension wall with a lateral actuator then pushes and pulls at the column, simulating a major earthquake. The NBS facility is expected to develop earthquake standards for new bridges. By next year, it will start work on standards for skyscrapers.

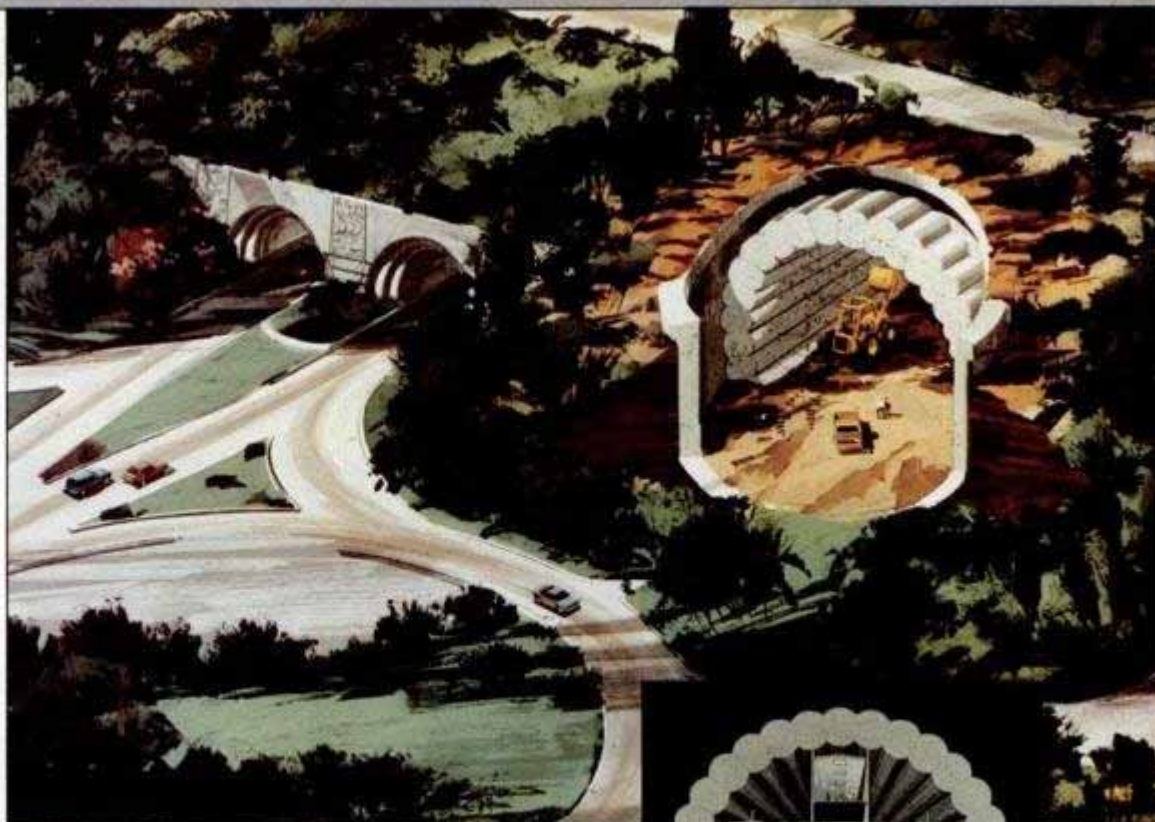
Inside-out tunnel

Engineers planning a new vehicular tunnel to speed traffic into and out of Seattle, Wash., had an unusual problem. The glacial deposit through which they had to bore, which is known as Mount Baker Ridge, contained not stable rock, but a loose mixture of clay, silt and sand.

Normally, this mixture would seem to be an advantage, but it's actually more difficult to dig through soft ground than hard because the tunnel walls keep falling in faster than you can shore them up.

The solution: Forget the main tunnel. First dig a series of little tunnels in the shape of a ring, fill them with concrete to form a rigid, self-supporting shell, then dig out the middle and your tunnel walls are already in place. The shell consists of 24 separate concrete "logs," each 9½ feet in diameter and shaped like a horseshoe so that it interlocks with the one below it.

The daring scheme, devised by the Washington State Department of Transportation, will result in an enormous tube 82 feet in diameter and 1,332 feet long—the world's largest excavation in soft material. The new tunnel, depicted at right, above, will supplement two smaller tunnels built in the 1930s and no longer of sufficient capacity to handle Seattle's present-day traffic. It will have three levels—two for vehicles and a third at the top for pedestrians and bicycles. The \$38.2-million project is scheduled to be completed by mid-1986.



Cross section above shows how ring of concrete "logs" encases three-level tunnel. At left, a 55-ton boring machine digs perimeter tunnels.



Well-grounded pesticide rig

Putting pesticides into the ground is tricky business. You don't want to splash the chemical on the surface, and you do want to concentrate it in one spot.

Britain's M&C Agriculture company has designed a "micro-granule applicator," which is manufactured to run on a small tractor in a way that avoids splashing. A series of 8-inch nozzles mounted on rotary cultivator lines injects pesticide into the soil just below the root surface area. The chemicals are thus concentrated at a location where they don't pose any danger to animals or the plant roots.



The plane facts are emerging

The Agriculture Department's experiment to collect insect larvae and pollen with a small remote-control plane has opened the door to a new technology. The biplane has been used to drag thin nets over treetops at 30 to 60 mph. The object was to collect large samples for study.

However, scientists now report that adding insecticide spray to the plane has achieved a 90 percent kill rate or better. That's as good as a full-scale plane, but the small biplane requires much less fuel and no pilot. The biplane may be used by large agribusinesses by next year.

AVIATION



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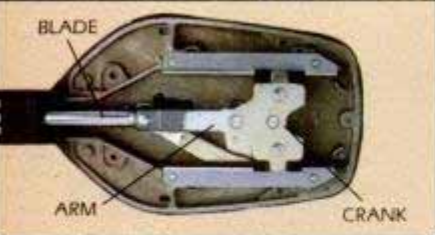
My, what a big nose you have

If prizes were given for funny-looking airplanes, these big-nosed oddballs would surely win. But to anyone concerned with national security, they're a pretty sight.

Their bulbous extensions, which are packed with sophisticated electronic surveillance gear, are designed to provide Airborne Early Warning (AEW) protection against sneak enemy attack.

The British AEW Nimrod is a large, expensive plane similar to our own AWACS E-3A Sentry. The other three airborne tracking stations are low-cost versions based on small, modified civilian airliners. The AEW Defender and CASTOR Islander are both derivatives of the British-built Pilatus Britten-Norman Islander. The AEW Challenger is a specially equipped Canadair Challenger 601.

AUTOMOTIVE



Solo wiper

A record 86 percent of the windshield on the upcoming Mercedes-Benz 300E is cleared by a single huge wiper blade, thanks to a clever crank mechanism. The wiper sweeps through an arc of nearly 180° with a pumping action that flattens out the arc at the top. This allows the blade to sweep the whole windshield without overlapping onto the roof. Look for the new type of blade on American cars within two years.

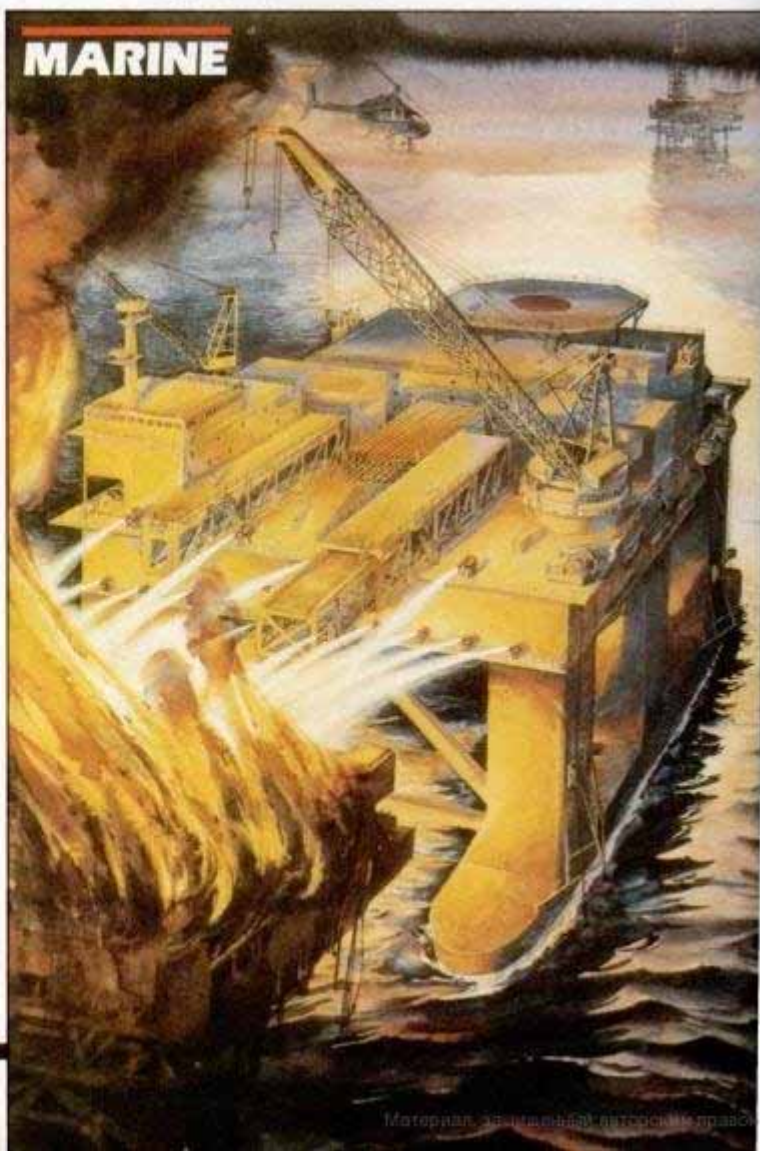
Firefighting oil rig

How do you fight an oil-rig fire? You fight it with another oil rig. A new firefighting vessel designed by Bethlehem Steel is itself shaped like an oil rig to give it the necessary height to reach the tops of tall platforms. In addition to fighting offshore fires, the self-propelled and semisubmersible structure will also serve as a tender that will provide supplies and maintenance for fixed rigs.

While it's under way, its twin pontoon-like hulls ride on top of the water. Once it's in position, the hulls are flooded to submerge them, providing stability against violent winds and waves. Eight jet thrusters in addition to its main propellers enable it to remain precisely on station without requiring anchor lines.

Editor: Dennis Eskow
Contributors: Sheldon M. Gallager, Stan
Lowen, Jack Hammond, Fran
Whitford, Golden, Steve Elmore,
Frank Lutz, Coleman Mobley,
John Sandberg, Wade Host

MARINE



Nimble jet

Fighters in wartime must be able to operate from runways shortened by bomb damage. A modified McDonnell Douglas F-15, fitted with movable engine nozzles and canard mini wings, will soon determine just how small a runway space a jet will be able to land and take off in.

Tilted downward, the nozzles produce upward thrust which, along with added lift from the canards, reduces landing and takeoff distance to as little as 1,000 feet.

Also on the way is a head-up display (inset) that will show a pilot how much landing room he has between bomb craters.

MILITARY



Modified F-15 will land and take off in 1,000 feet, a fraction of the mile or more normally required. Head-up display (left) tells pilot if he has room to land on bomb-cratered runway.



Flying blind

Future combat helicopters may fly into battle blind. To test out this radical concept, Boeing Vertol has rigged a chopper with two complete cockpits, a normal one in front and a hidden one in back. A safety pilot sits up front, but the real pilot occupies a windowless compartment surrounded by TV screens (inset). Displayed on the screens are instrument readings, navigation plots, target coordinates and video views of the terrain ahead, even in total darkness—more information, in fact, than a pilot could ever acquire using his own eyesight alone.



Big jets get a big lift

The cumbersome-looking engines above are actually designed to give heavy cargo transports greater lift and agility. Mounted above the wing, they blow their jet exhaust across the top of the wing, generating added lift. Called a blown wing, the system increases a plane's payload and enables it to make steep, STOL-like landings and takeoffs in fields too short for conventional transports.

At bottom is Russia's twin-jet An-72, which can land and take off in less than 4,000 feet. At top is a four-engine Japanese version requiring only 2,370 feet.

How to make a missile miss

Heat-seeking anti-aircraft missiles have one-track minds. To score a hit, they must be able to lock onto a plane's infrared radiation. Now an ingenious new Infrared Countermeasures (IRCM) system prevents this, making an aircraft virtually invulnerable to enemy missiles of the heat-homing type.

The threatened aircraft sends out decoy jamming signals so similar to those processed by the missile's own tracker that the missile can't make up its mind which signals are the right ones. It becomes confused and flies off harmlessly in another direction, missing its target.

The IRCM system was developed by Loral Electro-Optical Systems of Pasadena, Calif., and is being adopted by both the Navy and Air Force.



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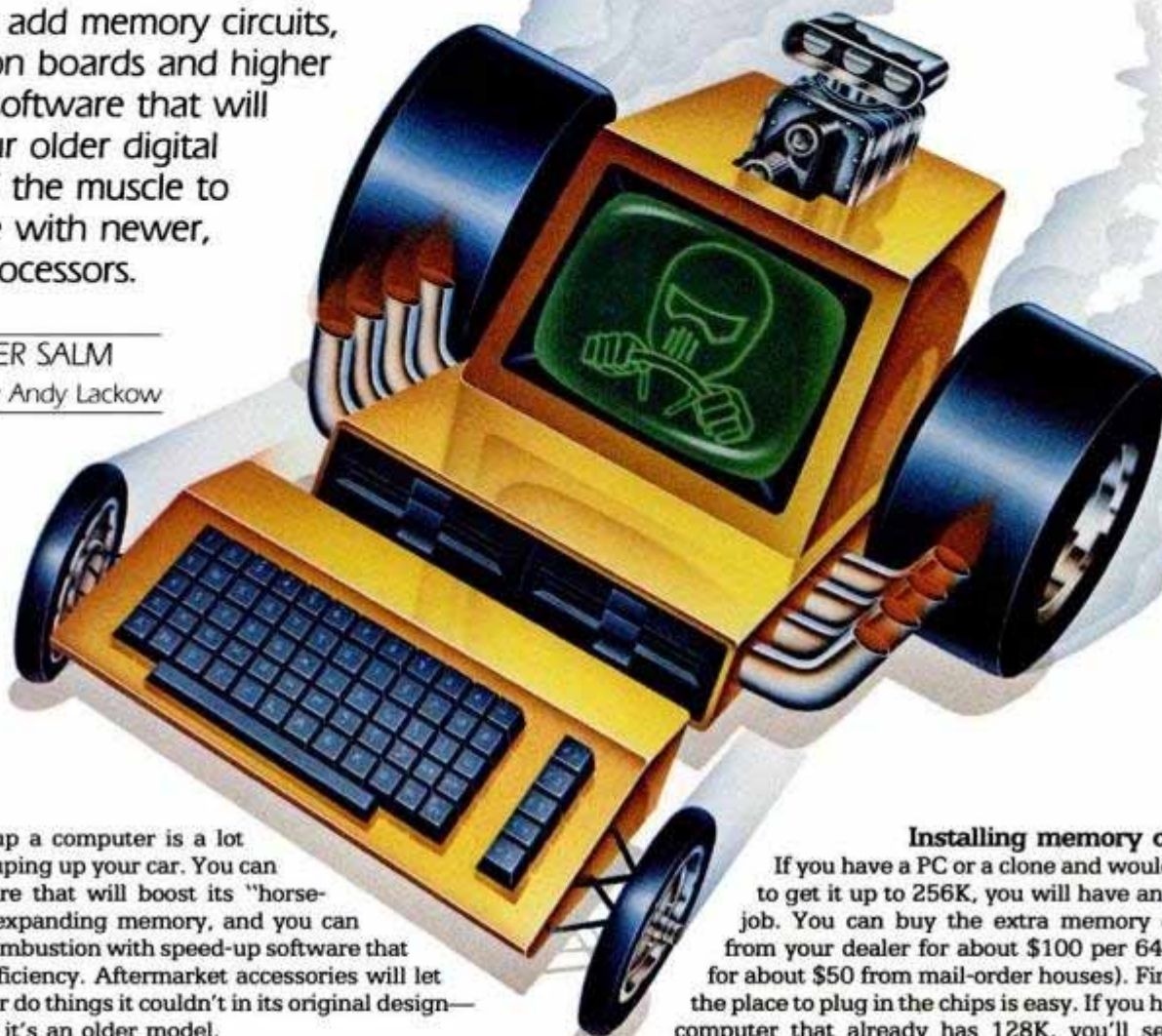
© 1985 Wagner Spray Tech Corp.

SOUP UP YOUR HOME COMPUTER

You can add memory circuits, expansion boards and higher octane software that will give your older digital Model T the muscle to compete with newer, faster processors.

BY WALTER SALM

Drawing by Andy Lackow



Souping up a computer is a lot like souping up your car. You can add hardware that will boost its "horsepower" by expanding memory, and you can get better combustion with speed-up software that increases efficiency. Aftermarket accessories will let the computer do things it couldn't in its original design—especially if it's an older model.

Let's look at memory first. It's the easiest to work on, and a lot of software programs are really memory-hungry.

Memory, or RAM (Random Access Memory), comes in special integrated circuit chips—typically type 2164. All eight-bit computers are memory-limited: They are capable of using a maximum of 64K (64 kilobytes, or 64,000 characters) directly.

Unlocking the extra memory

When you have more than 64K of RAM in an eight-bit computer, the extra memory can only be used if you have software (a program) that knows the extra memory is there, and has commands in the program that will access (or unlock) that extra memory. This extra memory has to be selected one bank at a time (a bank is a block of 8K of RAM), and this process is called bank switching.

Computers that use eight-bit microprocessors (6502, 6510, Z-80 and 8080) include Apple, Atari, Commodore 64, VIC-20 and others. The IBM PC and many of its copycat clones use a fake 16-bit circuit chip called the 8088.

IBM-type computers such as the PC come with 64K or 128K built in, and have enough room (consisting of empty memory-chip sockets) on the mother board (main circuit board) to hold a total of 256K.

Installing memory chips

If you have a PC or a clone and would like to get it up to 256K, you will have an easy job. You can buy the extra memory chips from your dealer for about \$100 per 64K (or for about \$50 from mail-order houses). Finding the place to plug in the chips is easy. If you have a computer that already has 128K, you'll see 18 identical empty sockets on the mother board—nine in a row. This is where the extra chips go. Figuring out which way to point the chips—telling where pin No. 1 goes—is also easy. You'll notice that all integrated circuits have a tiny half-moon indentation in one end. Face this the same way as the other memory chips that are already installed.

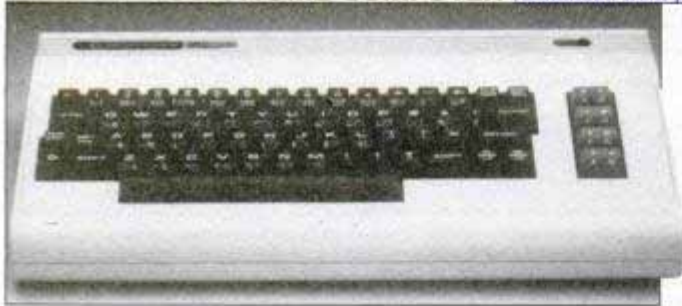
Once you have the chips plugged into their sockets, you have to change some of the DIP (Dual Inline Pin) switch settings. These are tiny blocks of eight switches, each mounted on the mother board. Your computer's manual will show you the proper switch settings.

Even more memory

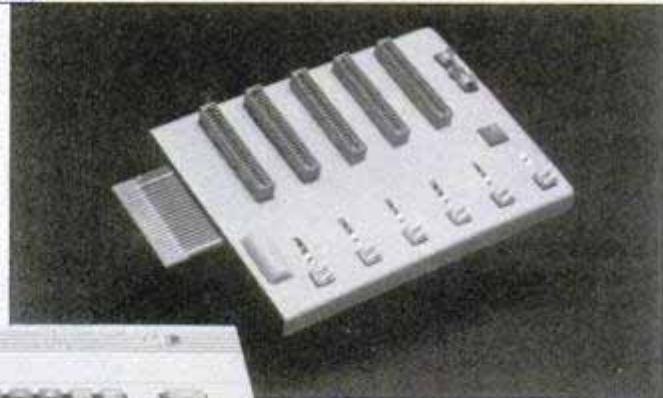
To add more memory beyond the 256K on the IBM (and clone) mother board, you have to use one of the plug-in cards that goes into an expansion slot. You can buy these cards with brand names such as STB, Quadram and many others. Most of them are multifunction—squeezing several operations into one card—because usually there are only three expansion slots in an IBM-type computer.

Very often, to keep the retail price down, these cards are offered "unpopulated" or "partially populated." The extra memory isn't there, but consists of empty sockets so you can

(Please turn to page 74)



The Commodore VIC-20 (above) can be more than a 16K game computer. Add-on boards and memory cartridges give you a powerful word processor. The versatile Commodore 64 (right) is faster and capable of more operations with aftermarket upgrade boards.



Cardco's slot expansion interface (above) is one of several add-ons that can increase the applications for the Commodore 64. Atari's discontinued 16K Model 600XL (below) was designed to take a 64K external memory expander. Now, you can boost its brains to 80K with an internal board.



build memory any time you have the cash for the chips. The 2164 memory chips for the IBM are identical to those used in the Apple: Each chip contains 8K of RAM. (Confusing things, engineers sometimes refer to these as "64K" chips—because they contain 64 kilobits. Since it takes eight bits to make a byte, each chip is 8 kilobytes.)

The Apple connection

To add 64K to the Apple, you need eight chips. For the IBM type you need nine chips per 64K because the two machines count differently: The IBM needs one extra bit for every byte, and calls this a parity bit.

The Apple has no empty IC sockets to fill. Adding memory is simply a matter of plugging an expansion card (or a special-purpose card such as the 80-column board or CP/M board) into one of the expansion slots. These boards usually have an extra 64K of memory on them, and you really need the extra RAM for some of the operations you perform with these circuits. If you have an Apple with only 48K, plug in a 16K memory board.

Commodore—on board

Adding memory to the Commodore VIC-20 is easy.



Adding memory to the Commodore 64 is almost impossible. The 16K VIC-20 really needs more memory. The C-64 has plenty built in, so this isn't a terrible problem.

Extra memory for the Commodore VIC-20 comes in neat, game-like, plug-in cartridges that hold either 8K or 16K. They go into the game/expansion port in back of the computer. But, if you insert a memory cartridge, how do you plug in anything else, like a game or a word processor?

Easy. You use a plug-in expansion board, often called a mother or mini mother.

A typical expansion board from Cardco called the Card-

(Please turn to page 76)

HIGH-OCTANE, SPEED-UP SOFTWARE

Software can be an important part of souping up your computer. Some software can really be useful in making things happen faster and easier. Here are three programs that we found were real time savers.

■ **Kwik-Load!**—This \$19.95 disk from DataMost for the Commodore 64 contains a set of programs that makes formatting and copying disks really easy. Most important is the Kwik-Load! program which makes the C-64 load files from disk at lightning speed. The Commodore disk drive is notoriously slow. We timed file loading in normal mode and then using Kwik-Load! Typical time for a hefty file (25K long) without the special software: 59 seconds; time with Kwik-Load! in place: 19 seconds. It actually worked *faster* than the advertised claims.

■ **PC-Accelerator**—This software item doesn't speed up processing, but it sure saves time. The most important feature is print spooling, which means that you don't have to tie up your IBM-type computer while the printer is running. PC-Accelerator is \$59.95 from STB Systems, and in addition to spooling (it assigns a part of the PC's RAM to act as a

printer storage buffer), it provides RAM-disk operation, keyboard commands to pause the printer, and a stop-list control for slow-motion viewing of the computer screen. PC-Accelerator is well worth the price, even if all you want to do is print spooling or RAM-disk operation.

■ **Xeno-Copy**—This program lets you read "foreign" disks—mostly from 8-bit computers into your IBM-type system. It's great for copying word processing and data files that are essentially the same for both 8-bit systems and for the quasi 8-bit IBM. Xeno-Copy from Vertex Systems runs fast and flawlessly, saving tons of time and money when you consider the alternatives for doing file transfers. The basic Xeno-Copy costs \$99.50 and reads disks from over 50 different computers into the PC-DOS/MS-DOS format. The "Plus" version (\$149.50) will also create foreign disk formats and write files to them from the IBM-type disks. The "Plus Advanced" version (\$199.50) does the same, but for a total of 83 different computer formats. In use, it successfully transferred files from Kaypro, Osborne, Otrona and Sanyo disks that we had on hand.



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HONDA

SOUP UP YOUR COMPUTER

(Continued from page 74)

board 3S retails for \$39.95, has three plug-in slots and a DIP switch for selecting the right slots. With this in place, you can plug in a 16K memory expander (\$79.95) and the Write-Now! word-processor cartridge (\$39.95) to end up with a complete word-processing system on a computer you thought was only good for playing games. Write-Now! does something else: It lets you plug in two of those 16K expansion RAM cartridges—giving you more text storage space, as much as 38K.

Added memory for Atari computers depends on which model you're working with. The old Model 800 (and even the flat membrane-keyboard Atari 400) lend themselves to adding lots of extra memory. Before we discuss how, let's ask why. As with other eight-bit computers, what can you do with all this extra memory?

The most practical application—one you can use with the Apple and IBM types as well—is to create something called RAM disk. If you add 128K extra memory, you can assign this RAM to become an electronic disk drive. With this kind of storage, you can "save to disk" instantaneously, instead of waiting for the time it takes for files to be

recorded properly on the disk.

Many computer buffs, particularly people who write a lot of programs, like to use a RAM disk because it runs lightning-fast. You can always transfer the contents of the RAM disk to a conventional floppy disk—and that's a good idea. Power failures, surges and spikes can destroy this volatile memory.

Die-hards who may still have an old Atari 400 or 800 are really in luck, since there are ways of souping up these machines that are not possible with the

later XL series of Atari computers.

Behind the "barn door" that opens to hold program and game cartridges is a memory expansion section with four memory slots. If you have a typical 48K Atari 800, all four of those slots are filled with ROM and RAM cartridges. These cartridges are vastly different from the program cartridges. They're wider and look something like the plug-in cards for the Commodore VIC-20.

Two wing latches lock the cover in

(Please turn to page 212)

The old Apple II computer is easy to soup up. There are no empty IC pockets to fill. Instead, you plug an expansion card or board with 64K into an expansion slot.



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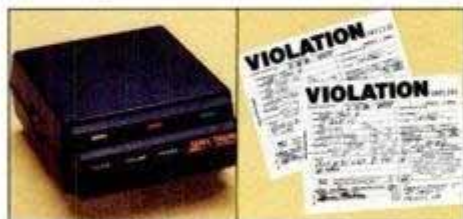
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Gives you earliest possible warning of police radar.



© Motor Trend, Aug. 1983

When Direct Response, Inc. started looking for a radar detector to offer our customers, we went to the experts first: car magazines. Their opinion was nearly unanimous. **Motor Trend, AutoWeek, and BMW Roundel** had all recently completed independent, comprehensive tests of all the leading radar detectors. And all had picked a winner: the Whistler Spectrum. **Motor Trend** said "The Whistler Spectrum resides at the top of the list. A world-class radar detector."

Whistler is also first choice of truckers and other professional drivers. Whistler

Spectrum detects all kinds of speed radar. Stationary - moving - trigger - even pulsed radar. On the straightaway - from behind - over hills and around curves. If there's police radar in the area, Spectrum lets you know. Long before radar can lock onto you.

Spectrum cuts down on annoying false alarms.

Unfortunately, the FCC authorizes some security systems and traffic signals to also operate on police frequencies. And any sensitive radar detector will report these signals.

That's why Spectrum developed two features not available in any other radar detector: The **Filter Mode™** and **Pollution Solution™**. Both features cut down on false alarms.

For city driving (where microwave intrusions are frequent) switch to the **Filter Mode**. You'll get the same early warning - but it will be quieter, less urgent. When the microwave signal reaches a critical speed radar level, you'll see the amber warning light switch to a flashing red. And hear the soft tone gear up to a high-frequency, geiger-effect sound.

Most other radar detectors give off false signals. Spectrum's **Pollution Solution**, built into each unit, can tell the difference between these signals and real police radar. Spectrum automatically screens the polluters out.

Dash/Visor or Remote model.

You have your choice of two top-line Spectrum models - both reliable performers.

The Spectrum Dash/Visor model is port-

able and compact. It plugs into the cigarette lighter socket, and mounts easily on dash or visor. It's quickly removed for use in another car, or to prevent theft.

The Spectrum Remote gives you the same great 360° radar protection. But it's hidden from view. The weather-proof receiver installs easily behind your car grille. And the small console fits handily in, on, or under the dash.



Remote receiver hides behind car grille.



Filter Mode for city driving.

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Order your Whistler Spectrum - Dash/Visor or Remote - from Direct Response, Inc., for just \$249 plus \$5.95 shipping and handling.

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Dash/Visor



Remote console

*Source: Speed Limit Enforcement Certification Data. October 1, 1982 through September 30, 1983.

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* Look for special price-reduction promotion on 028S with 16" bar at participating Stihl dealers. For sales and service, see the Yellow Pages or call 1-800-528-6050, Ext. 1430. © Stihl Inc., 1985 (570-038)

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HINTS FROM READERS

Capillary gluing

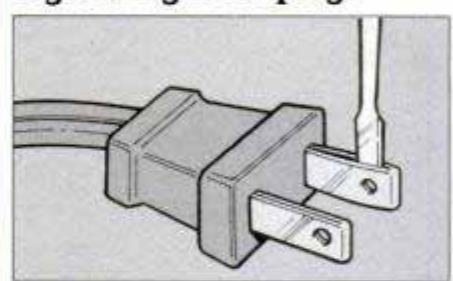


Instant-setting cyanoacrylate glues can sometimes set too quickly to permit accurate positioning of pieces. Try applying the glue *after* the joints have been assembled.

Join all the larger pieces and hold them securely together with tape applied at intervals along the break. Apply glue sparingly to untaped portions of the joints. Enough glue will be drawn into the cracks by capillary action to produce a bond. The adhesive is applied to remaining sections after the tape has been removed.

Wipe excess glue from the surface before it dries using a cloth moistened with lacquer thinner. Glue small fragments in place after the larger pieces have set. If both inside and outside surfaces of the object can be reached, apply glue to both sides of the break. Hardened glue can be removed with a razor blade.—Walter E. Burton

Tightening loose plugs



Bending the prongs is the usual quick remedy for loose-fitting electrical plugs. But that can damage the insulation or cause misalignment that makes them difficult to insert into receptacles. A better way is to spread the leaves of each prong with a small screwdriver or a sharp knife blade.—Wayne Fugate

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Popular Mechanics Magazine, January 1982

"With \$25,000 engines generating in excess of 3000 HP, you don't take chances. Tufoil... I wouldn't run without it."

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"Lubrication engineer Franklin Reick succeeded where everyone else had failed... TUFOIL is a unique, different, but safe kind of Teflon/oil additive."

Motor Age Magazine, April, 1982

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White water brought David Garrison and Jason Bateman closer.

Garrison's move

If you watch the NBC sitcom *It's Your Move*, you will recognize David Garrison as the all-too-laid-back writer. When summer comes and the filming season is over, David makes an unusual move of his own. He's a whitewater rafting guide for Fast Water Exploration on the Colorado River. On a recent trip, he took along his impish co-star, Jason Bateman. "The whitewater experience has brought us closer together," David says.



Garrison runs the white water on the Green River off-season.

"We've been through something exciting together and it helps the show."

Kar kan kope

Spell Kustom Kar with a k and the name George Barris pops up. George invented the term and he is the supplier of custom-built autos to such hit TV shows as *Knight Rider*, *Hardcastle and McCormick*, and *Magnum P.I.* The latest Barris concoction is a special Corvette (never mind the Ferrari badges)

rigged as a stunt car. It appears in dozens of chase scenes on TV this year. The Vette designed for driver Ed Consalves is a 1969 stock Corvette that can run up to 200 mph. The dash houses a color TV monitor connected to a rear-end camera and a computer. Barris says the car fulfills a stunt driver's wildest dreams.



George Barris shows off the stunt Corvette (top). The rear-mounted camera (left) gives stunt driver total picture of the scene with help of dashboard TV.

Doctor of wines

In medical circles, David Johnson is one of the foremost experts on human glandular ailments. But, when the University of Arizona physician doffs his white coat, he often puts on the apron of a winemaker.

In fact according to Johnson, amateur winemaking is one of the top 10 pastimes for doctors. "Like medicine, winemaking involves an interaction with natural biological processes using a small number of instruments, your wits and your senses," Johnson says.

The fall guy

Doug Barr, who is Lee Majors' sidekick on the ABC adventure series *Fall Guy*, admits to having been a bit of a fall guy himself recently. Doug and his bride-to-be, Claire Kirkconnell, purchased a handyman's special house in an older section of Los Angeles' Hancock Park. The two-story, 18-room wood colonial needed a lot of work, but Barr had restored an old house in upstate New York several years ago and felt confident he would be able to get the reconstruction job done.

Doug took possession of the house two months before the wedding day. The

wedding ceremony was supposed to take place in the back yard, so all the work on the house had to be finished right on time.

"I hired contractors for the building and electrical work I couldn't do and took off for Australia on business," Barr recalls. When he returned a month later, the work was far from complete.

"I've learned my lesson," Barr says. "The contractor did a good job, but these guys take on several customers at once to make a living. The ones who are home to watch contractors closely are the customers who get their work done."

Spock the hacker

The fourth *Star Trek* motion picture will be released later this year. We recently talked with Leonard Nimoy, director and co-star of the film, who told us the newest *Star Trek* movie will feature more computer technologies than ever before.

Nimoy, who just started using a computer last year, says his work with Human Engineered Software (HES) on game development inspired him for the movie set. "Now that I've used a computer, I can relate more of its quality to the audience," Nimoy says.

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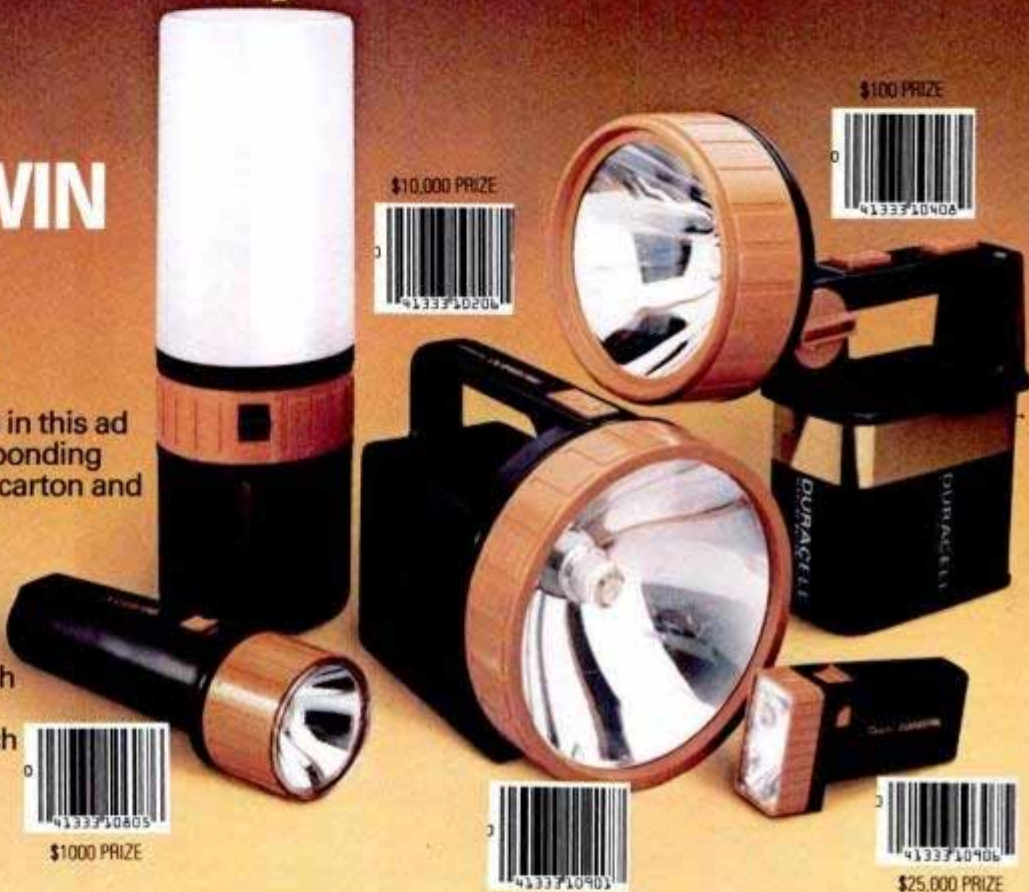
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2. The official game pieces are also available by sending a self-addressed, stamped envelope to DURABEAM Match 'N Win \$25,000 Sweepstakes, P.O. Box 1125, Grand Rapids, MN 55745 (Washington State residents need not affix stamp). Limit one request per envelope. Requests must be received by no later than 7/31/95. Ohio residents can send for a list of DURABEAM Lighting Products UPC codes by sending a self-addressed, stamped envelope to DURABEAM Match 'N Win \$25,000 Sweepstakes, P.O. Box 1125, Grand Rapids, MN 55745.
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8. Winners must agree to the use of his/her name and/or photograph in any Duracell advertising or publicity associated with this Sweepstakes without any additional compensation. The winners of the Grand, First, Second and Third Prizes will be required to sign and return an affidavit of eligibility.
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Patching And Sealing Blacktop

An asphalt driveway needs regular maintenance to protect and preserve it. Cracks invariably develop and must be filled. The entire surface should be sealed every year or two.

Before you patch cracks or holes, it's important to remove loose gravel and bits of asphalt. Clear weeds and dirt from the area with a wire brush or trowel, followed by a shop vacuum or leaf blower. To remove dust, hose down the area. Then let it dry.

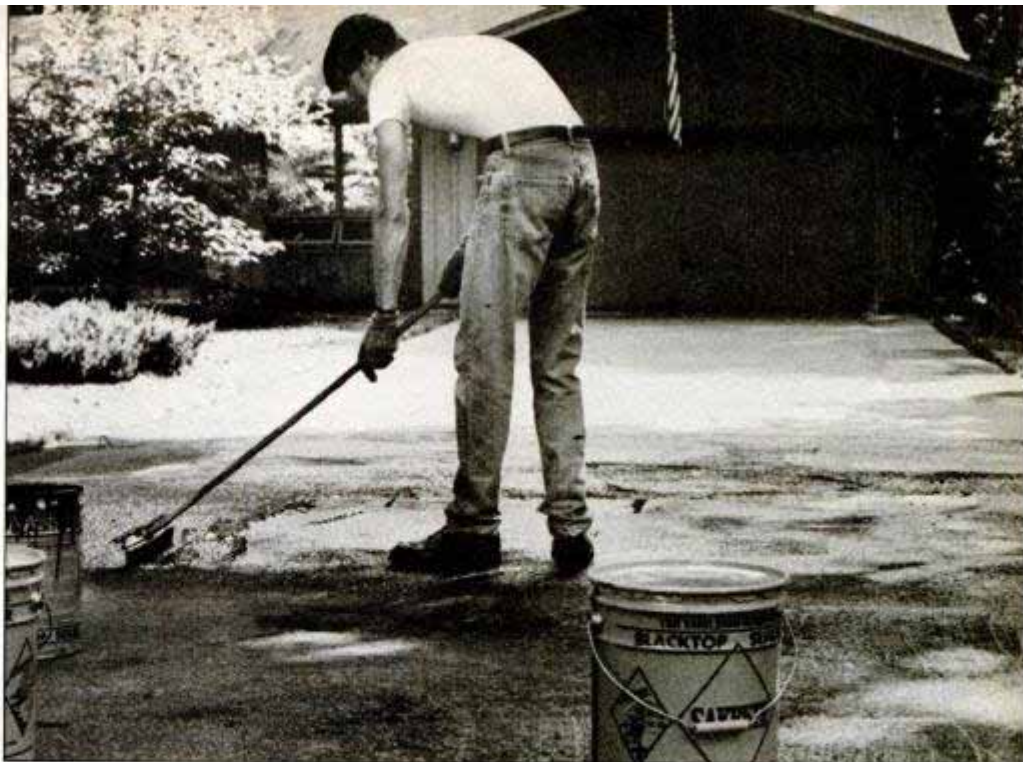
Filling cracks

You can fill wide cracks and potholes with blacktop patch, a prepared asphalt sold in 60-pound bags. Sakrete is one such product. Fill the prepared hole about halfway with blacktop patch and compact it before filling it the rest of the way. Mound the material slightly. Then tamp it down hard with a shop-made tamper—a piece of scrap plywood or particleboard fastened to a length of 2x2. Use a flat shovel to cut away excess so the patch will be level with the surrounding surface. Freshly filled spots should cure for about 90 days before they are sealed. I usually patch in spring and seal in late summer.

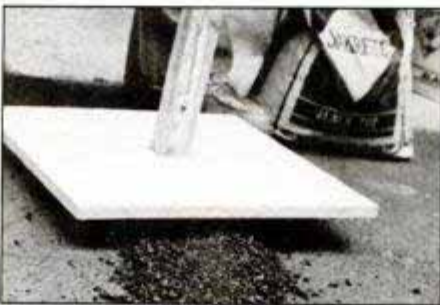
As an asphalt driveway ages, narrow cracks develop along the edges. To repair these cracks, clean them with a wire brush and vacuum the loose material. Then fill them with an asphalt crack filler that pours from a bottle. This leaves a patch resembling tar strips on an old highway. However, you can subdue the effect by brooming a small amount of fine sand into the filler.

Sealing the driveway

There are three types of sealer for a blacktop driveway. An asphalt base sealer, the most expensive, should be used only on new asphalt or on a surface that has been previously sealed with the same material. Tar emulsion sealers are the least expensive and probably the most popular because they seal against gasoline, oil spills and drips. A third kind is a tar base sealer which contains fine black aggregate to give it extra body. This is used to fill large areas of cracking and to provide traction on steep drives. A 5-gal. can of sealer will cover about 350 sq. ft.



Sealing a blacktop driveway regularly protects it from weather and wear. Holes and cracks should be patched and allowed to cure before the sealer is applied.



Patch potholes such as this caved-in chipmunk tunnel (top) with asphalt patch in a bag. Tamp the asphalt patch with a shop-made tamper to compact it. Patch cracks 1/8 in. wide or less with a liquid filler (above). Eliminate any tar stripes by sweeping some fine sand over the filler.



Cut away grass that grows over the edges of the driveway (top). Then sweep and hose away clippings. Brush the sealer completely to the edge of the blacktop surface. Use a tar base sealer with fine aggregate on worn asphalt (above, foreground) to fill cracks and smooth areas.

You can mix fine sand with standard tar base sealer to give it body. However, the surface will take on a salt-and-pepper appearance as the sealer wears.

The outside temperature should be at least 60° F. when you apply sealer. The drive must also be prepared before application. Cut away grass that grows over the edges so the sealer can cover them. Sweep the drive clean, concentrating on dished areas where rainwater and dirt collect. Hose the drive.

Look for water beads on the surface that indicate oil or gasoline. Remove softened material from these spots and replace it with blacktop patch. You can

work around the patch when you apply sealer to give the spots time to cure. If there is no softening, use strong detergent or trisodium phosphate and hot water to scrub away oil or gas residue. Rinse the area well.

If you use the more expensive asphalt sealer, make sure the pavement is dry before beginning the application. If you use tar-base sealer, keep the pavement damp. Spread all sealers as thinly as possible using a squeegee and then a brush. Two thin coats are better than a heavy one. You should be able to walk on the drive after 12 hours and drive on it after 48 hours.—William Beyer

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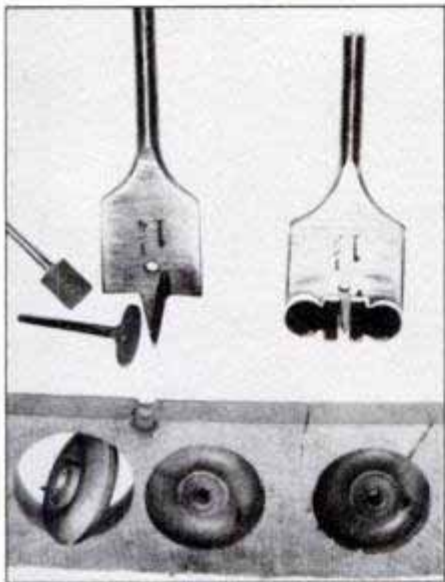
HINTS FROM READERS

Wheel cutter

Small wooden wheels for toys, including the contours of the tire and hub, can be cut on a drill press with a reground spade bit.

The cutting edge of the 1 1/2-in. bit shown here was shaped using small grinding wheels in a high-speed drill. A drawing of the desired shape was used as a guide during grinding. Maintain the same bevel as on the original cutting edge of the bit. To reduce vibration while cutting the wheels, cut off 2 in. of the spade bit shank.

Use straight-grained hardwood 1/16



Toy wheels up to 1 1/2 in. dia. can be cut with spade bit. Cutting edge of bit is shaped with small grinding wheels held in a drill.

in. thicker than the wheel hub. Clamp the workpiece to the drill press table and cut from one side until all parts of the wheel are outlined. Then turn the piece over, clamp, and bore in the same center hole until the bit completes all but 1/16 in. of the cut. Now, using a sharp knife, cut the wheel free from the hardwood stock and sand the tire edge smooth.

Any size small wheel up to 1 1/2 in. dia. can be made using this method. Spade bits range in price up to \$4. The small grinding stones, which come in various shapes and sizes, will cost approximately \$3 each. Both bits and grindstones are available at most hardware stores.—Robert Tupper



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PONTIAC GRAND AM



Owners praise its style and performance but find the interior awkward.

BY MICHAEL LAMM
West Coast Editor

Great-looking car, and basically a good one, but lots of little things. That, in a nutshell, sums up Pontiac's new Grand Am as owners see it.

First to the little things: A do-it-yourself Ohio fireman said, "The oil filter's a real bear to get at." And a grumpy New Jersey police lieutenant snapped, "What a stupid place to put the ashtray! I just burned a hole in my \$350 coat."

The power-window switch location, also on the console, came in for criticism from 16.1 percent of our respondents. A North Carolina housewife suggested, "Relocate the electric window controls to the door. I cannot get at them with

"For the price, I got a bargain."
—MISSISSIPPI COMPUTER PROGRAMMER

"This car can challenge the Japanese."
—NEW JERSEY MANAGER

"A precision, well-made auto."
—RHODE ISLAND CIVIL SERVANT

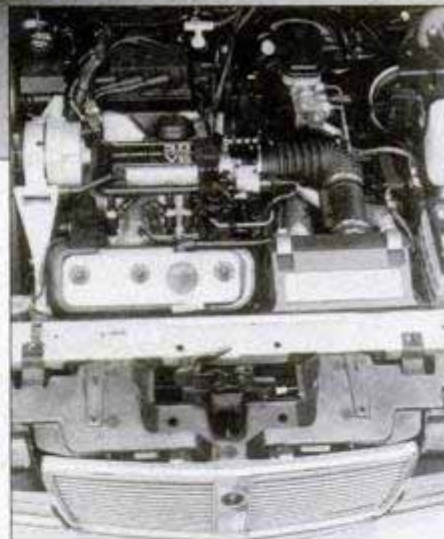
"Glove box is even too small for the owner's manual."
—MINNESOTA SUPERVISOR

"Can't see the heater controls at night."
—WISCONSIN ACCOUNTANT

"Get rid of that goofy speedometer."
—MARYLAND TRAVEL ADVISOR

the armrest folded down and cannot see them at night."

A Wisconsin accountant went on to mention a problem brought up by 7.2



Grand Am styling won over most buyers. Less than 10 percent ordered 125-hp V6, but some four-cylinder buyers wish they had.

A NATIONWIDE SURVEY
BASED ON 820,211
OWNER-DRIVEN MILES

percent of the owners we surveyed: "The [optional] digital instruments
(Please turn to page 89)

Many people live and die and never know how much power is locked deep inside their brains. **THEY'RE LOSERS. YOU CAN BE A WINNER.**

How Much Do You Know About Subliminal Stimulation?

Read This Notice and You'll See How It Can Change Your Life. Take fifteen seconds to read and answer three questions:

1. Why do 95 of 100 people who diet and finally get their weight down ultimately put most of the weight back on?
2. Why can't most people remember names and phone numbers? Their brains have plenty of capacity.
3. Why do people who should be self-confident in business and sex lose confidence for no good reason?



Subliminal Problem-Solvers Can Stay With You Longer—and You Can "Replenish" Them

Fat people think of themselves as fat. Those with poor memories think no one can remember a thousand phone numbers. Individuals without self-confidence give up instead of improving.

Some folks spend many hundreds of dollars undergoing hypnosis to solve the problems they don't (and can't) have the willpower to handle. Hypnosis alone is short range. Soon most of these people slip back.

That's where *Subliminal Stimulation* has challenged the established opinions of prominent psychologists.

Can *Subliminal Stimulation* re-direct hunger pangs so they actually disappear? Many who once were skeptical say it can.

Can *Subliminal Stimulation* give you superior mental strength and powers? Ask those who have tried it.

Can *Subliminal Stimulation* add sexual confidence that shows up in performance? Many satisfied husbands and wives say it can.

What It Is and How It Works

Scientists only now are beginning to understand and appreciate the power of the human mind.

Through advanced electronics, we can embed messages in the pleasant sound of ocean waves. Your conscious mind probably can't hear them, but your *subconscious* does. You don't have to sit and listen, or even pay particular attention.

The messages are locked in your brain. Your own mind obeys its own commands. You gain confidence because you tell yourself you're confident. You lose weight because your brain says you don't want to eat.

You *quickly* can train your mind so you'll fall asleep quicker and deeper; be more

assertive; unleash more mental energy; worry less; and solve personal problems (see list of cassette topics, below).

It's fun, it's harmless, it's the *new* way to learn without work. You'll be among the first to benefit from *Subliminal Stimulation*—the self-help technique of tomorrow.

Subliminal Messages on Cassettes—Play Them, Loan Them to a Friend, Use Them Over and Over Again to Refresh and Rebuild Mental Strength

This is a completely natural learning technique. No one but you is involved, although couples often play them together. You don't have to learn anything special, do anything special... just play the tapes; your own brain does it all.

- Each beneficial message is embedded within the pleasant sound of ocean waves—a soothing background to whatever you may be doing. Go about your regular activities. You'll "hear" the message even without realizing it.
- These are standard audio cassettes. Play them at home, in your car, anywhere.
- No surprises. The introduction on each tape lets you know the exact wording of the subliminal messages.
- On the reverse side of each tape is a separate, audible hypnotic session. Play this relaxing "reinforcement" tape as you go to sleep at night.

READ THIS ABSOLUTE MONEY-BACK GUARANTEE

Keep and use any tapes for two full months. If at any time during this trial period you decide you don't want them or they aren't working for you, send them back and we'll refund every cent you paid. We'll even add \$2 to pay for shipping them back to us. This guarantee is absolute, and it's here in writing as proof: the tapes will help add to your peace of mind and personal happiness or we don't want your money.

RUSH the *Subliminal Stimulation* cassettes checked below, at the special introductory price of \$9.95 each. I also get one FREE cassette for each three I buy, so if I have indicated four, I pay for only three; if I have indicated eight, I pay for only six.

A1102 **MEMORY IMPROVEMENT**
 A1104 **PINPOINT CONCENTRATION**
 A1316 **SELF-ESTEEM: Feel Good About Yourself!**

A1202 **WEIGHT LOSS**
 A1412 **SEXUAL CONFIDENCE**
 A1101 **READ FASTER**
 A1214 **ENJOYING EXERCISE: Have Fun Getting in Shape**

A1310 **STRESS RELIEF**
 A1301 **HIGH-ENERGY & ENTHUSIASM**
 A1508 **SUCCESS NOW! Get Ahead Fast**
 A1317 **SELF-ASSERTIVENESS**
 A1402 **IMPROVING RELATIONSHIPS**

A1106
 A1303

A1203
 A1309
 A1105
 A1507
 A1304

A1320
 A1206
 A1208
 A1306
 A1315
 A1302
 A1411
 A1401
 9001

UNLIMITED MENTAL POWER
DYNAMIC SELF-CONFIDENCE: Overcoming Shyness
STOP SMOKING
MAGNETIC PERSONALITY
BETTER STUDY AND EXAMS
PROSPERITY: Financial Success
DECISIVENESS: Stop Procrastinating!
WINNING SELF-IMAGE
RESTFUL SLEEP: No More Insomnia
SLIM THINKING
FREE YOURSELF FROM WORRY
THINK POSITIVE!
CREATIVE PROBLEM SOLVING
MORE ENJOYMENT IN SEX
ATTRACT LOVE/Make Contact
PANASONIC SLIMLINE CASSETTE RECORDER \$39.95

SAVE!

SPECIAL INTRODUCTORY OFFER
 (Order Before June 14, 1985)

- \$5.00 off every cassette
 Regular price ... \$14.95 each
 Limited offer \$9.95 each
- **FREE BONUS TAPES!** For each three you buy at the special low price order a fourth tape and get it **ABSOLUTELY FREE!**

Don't Waste One More Day! Pick The Subliminal Tapes You Want

(You can't lose with our Money-Back Guarantee) and order by toll-free phone: **1-800-227-3800, extension 1146** or use the coupon below.

If You Have a VISA Or MasterCard

Call right now for immediate shipment. Operators are on duty 24 hours a day: **1-800-227-3800, extension 1146**

... or indicate which *Subliminal Stimulation* cassettes you want, each with our absolute two-month Guarantee, and mail the Coupon with payment or credit card information.

Subliminal Stimulation Cassette Tapes are available direct from **Advanced Learning Systems, Inc.**, 7236-D Owensmouth Ave., Dept. PM55, Canoga Park, CA 91303 ©1984 Advanced Learning Systems, Inc.

Hurry! The regular price of each cassette tape is \$14.95. You save \$5.00 each—your special price is \$9.95—if you order before June 14, 1985.

SUBTOTAL _____

California residents add 6 1/2% sales tax _____

POSTAGE & HANDLING (Any size order) 2.00

Outside USA—add \$1.00 per item (US Funds) _____

Cash Check Money Order **TOTAL** _____

VISA MasterCard Exp. Date _____

Card Number _____

NAME _____

ADDRESS _____

CITY, STATE, ZIP _____

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Regular, aromatic Pipe-Aroma and refreshing Menthol.

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OWNERS REPORT: GRAND AM

(Continued from page 86)

aren't adjustable for brightness without turning on the headlights. In the daytime, they're usually either too bright or too dim.

Taking that a step further, several

drivers complained that at dusk the lit-up instruments fooled them into thinking they'd turned on their headlights when they hadn't. So the always-on digital instruments can be a hazard as well as an annoyance. The analog instruments share this problem.

Nor was a North Carolina salesman

alone in noting, "When I took delivery of my car, the automatic transmission leaked due to the pan bolts being torqued too tight. The dealer replaced the pan gasket under warranty." Oil leaks plagued 13.8 percent of those who answered our survey, and another 13.8

(Please turn to page 204)

SUMMARY OF 1985 PONTIAC GRAND AM OWNERS REPORTS*

Total miles driven 820,211	Economy 37.9	Comfort 27.8	Riding qualities 24.2	Comfort opinion:	Average 9.9	Poor 6.2
Average miles per gallon	Specific dislikes:	Power windows unhandy 16.1%	Ashtray location 9.4	No complaints 9.4	Instrument lights won't turn off 7.4	Glovebox too small 7.4
2.5-liter gasoline ohv Four	What changes would you like?	No changes 26.7%	Reposition power window switches 11.1	Reposition ashtray 7.8	Instrument lighting control 7.2	Larger console 3.9
In town (EPA 25 mpg) 24.7	On the highway (EPA 33 mpg) 31.1	Bigger glovebox 3.9	How much did you pay?	Average \$10,835	Range \$8,600-\$13,000	Workmanship opinion:
3.0-liter ohv V6	In town (EPA 20 mpg) 21.7	On the highway (EPA 26 mpg) 26.5	Engine choices:	2.5-liter gasoline ohv Four 90.3%	3.0-liter ohv V6 9.7	Transmission choices:
Three-speed automatic 94.7%	Five-speed manual 5.3	Why did you choose this car?	Styling 84.8%	Handling 22.1	Price 19.6	Economy 18.6
Size 17.2	Specific likes:	Styling 72.7%	Handling 51.5	Dealer repairs satisfactory?	Yes 76.3%	No 23.8
Had any mechanical trouble?	No 58.4%	Yes 41.6	What type of trouble?	Electrical 14.9%	Brakes 13.8	Transmission 13.8
Wipers 13.8	Front-end alignment 5.7	Dealer service opinion:	Excellent 32.9%	Good 50.9	Number of vehicles owned:	This car only 38.8%
Two cars 34.0	Three cars 15.3	Four or more cars 11.9	Makes of other cars owned:	Chevrolet 33.6%	Pontiac 28.9	Ford 25.0
Buick 14.8	Oldsmobile 10.9	Would you buy another Grand Am?	Yes 59.7%	No 5.8	Maybe 34.8	Would you buy another Pontiac?
Yes 66.0%	No 5.9	Maybe 28.1	Age distribution of owners:	Under 29 years 41.6%	30-49 years 42.2	50-plus 16.3

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

The Dry Look holds today's look all day.



Available in pump or aerosol

Today's hair styles are neater, shorter and more natural. That's THE DRY LOOK® look. And THE DRY LOOK has a special 12-hour holding formula so you can keep that well-groomed look all day—even if you have fine or thinning hair. THE DRY LOOK hair spray. It keeps today's look looking good all day.

The Dry Look.
12-hour holding power.

OUR SCHOLARSHIP HELPS YOU BEGIN YOUR CAREER AS A LEADING ENGINEER.

An engineering degree will take you far in today's high-tech Army. And with an Army ROTC scholarship, earning that degree can be both less expensive and more valuable.

The scholarship not only pays your entire tuition, regardless of the amount, but also required fees, an amount for books and supplies, and up to \$1,000 each school year for living expenses.

It's an excellent scholarship. And it gets you a lot more than an engineering degree. Along with your regular courses, you'll take Army ROTC classes and learn about motivating people, analyzing situations, making confident, informed decisions, and reaching defined goals. In short,

you'll learn leadership and management skills that can't help but enhance your opportunities in the future.

And you'll put your skills to work right away, because you're commissioned in the Army as a second lieutenant when you graduate.

If you'd like an education in leadership and management to go along with your engineering degree, find out more about Army ROTC. Write: Army ROTC, Dept. JT, P.O. Box 9000, Clifton, NJ 07015.

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Material: Army ROTC, Clifton, NJ 07015

The (Slightly) Glowing Future Of Nuclear Waste

Conception of a navigation buoy powered by strontium 90. Heat from the isotope would be used to generate power to keep the light on continuously.

Nuclear wastes are lighting runways and processing food. And science is looking for other safe uses of atomic byproducts.

BY HARRY JAFFE

It was New Year's Eve and a howling snowstorm brought everything to a frozen halt in the town of Central, Alaska. Even the volunteer fire department couldn't dig its way through the mounting piles of snow. A tough break for Aners Bergssen, whose home was burning to the ground. He raced heroically around the property trying to stop the fire, but pretty soon the house was a heap of burning em-

bers. Bergssen collapsed in the snow, overcome by smoke and tormented by pain from burns over most of his body.

Neighbors had come to Bergssen's aid, and now they were radioing Fairbanks for a medical evacuation vehicle. Visibility was zero and the town's runway had no electricity—it had gone out in the storm. But the rescue plane from Fairbanks, a Piper Cherokee, took off anyway. The pilot knew that the run-

way glowed with experimental lights powered by nuclear waste—tritium. They would glow even through the blizzard. If he could handle the winds he could find the airport. Within a little more than an hour, the plane put down in Central, a feat made possible only by the tritium lamps. The lamps were installed as part of an experiment to find peaceful and safe uses for various forms of nuclear waste.

Most experts agree that nuclear waste is a pressing problem and a primary pollutant of our time. After all, it can remain lethal for 250,000 years. It's piling up at nuclear reactors across the country, but the government is spending billions of dollars searching for a safe method to get rid of it. In a small corner of the Energy Department, a corps of radioactive waste boosters is finding beneficial uses for nuclear plant byproducts. Government scientists have found at least four ways to put nuclear waste to work.

- The Air Force and Alaska are experimenting with self-luminous runway lights powered by tritium.
- The Energy Department has financed a pilot program using cesium to sterilize sewage sludge.
- The Food and Drug Administration is clearing the way for food processors to irradiate fruit, vegetables and meat as a means of preservation.
- Spaceflight engineers have relied on radioactive strontium to power generators on spacecraft, and other scientists are researching ways to bring the technology down to earth.

Lights from radioactive sources are the closest thing to magic lanterns since

the days of Merlin. Besides shining up to 10 years without external power or maintenance, they emit an unearthly blue-green light that you might expect to see around a witch's brew.

The essential ingredient that powers these self-luminous lights is tritium, a form of hydrogen. In a concentrated form, tritium is a component of hydrogen bombs, but in radioluminescent lights, radioactive levels are harmless, according to government scientists.

Radioluminescent (RL) lights have been in use for at least 30 years in buildings such as hospitals, which require constant, uninterrupted low-level lighting. Even commercial airliners use tritium RL exit lights for backup systems. While these early versions were fine for indoor uses, producing light equivalent to a 40-watt bulb, scientists over the past five years have redesigned the lamps to come up with the intensity levels for airfield lighting.

The new tritium lights work on similar principles as a television picture tube. In a TV set, a high-voltage gun aims an electron beam at the inside surface of the picture tube, which is coated with a phosphorescent chemical. The electrons excite the phosphor and cause the chemicals to light up.

With radioluminescent lights, tritium gas or another radioactive substance, such as krypton, provides the electrons. Sealed inside a 10-inch-long tube, the radioactive tritium gradually decays and emits electrons which strike a phosphorescent zinc-sulfide coating on the inside of the tube. As in the television example, the phosphor glows.

The runway lights were ready for

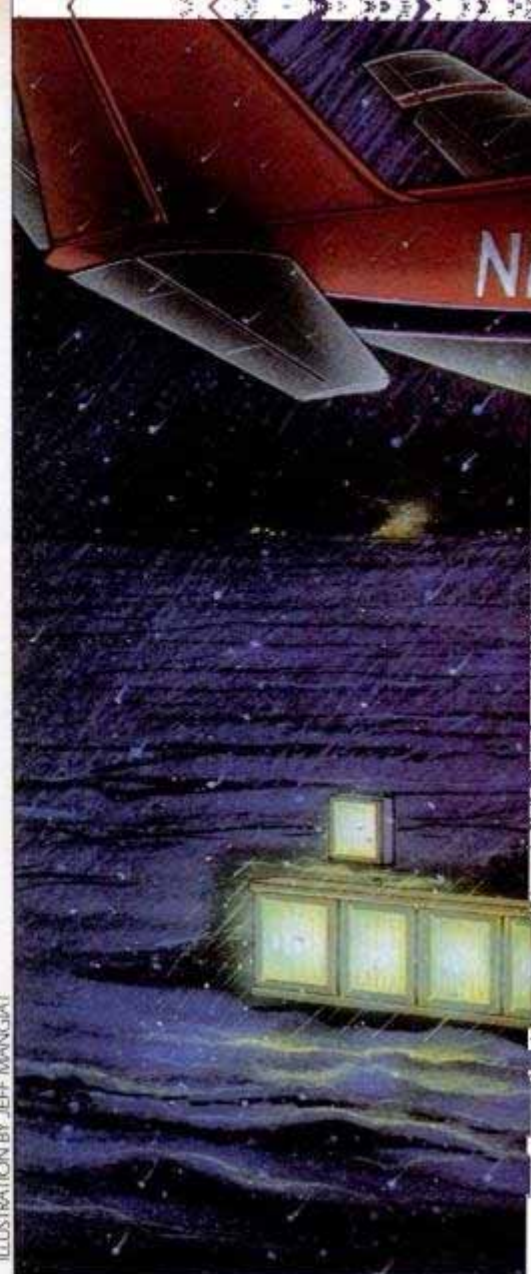
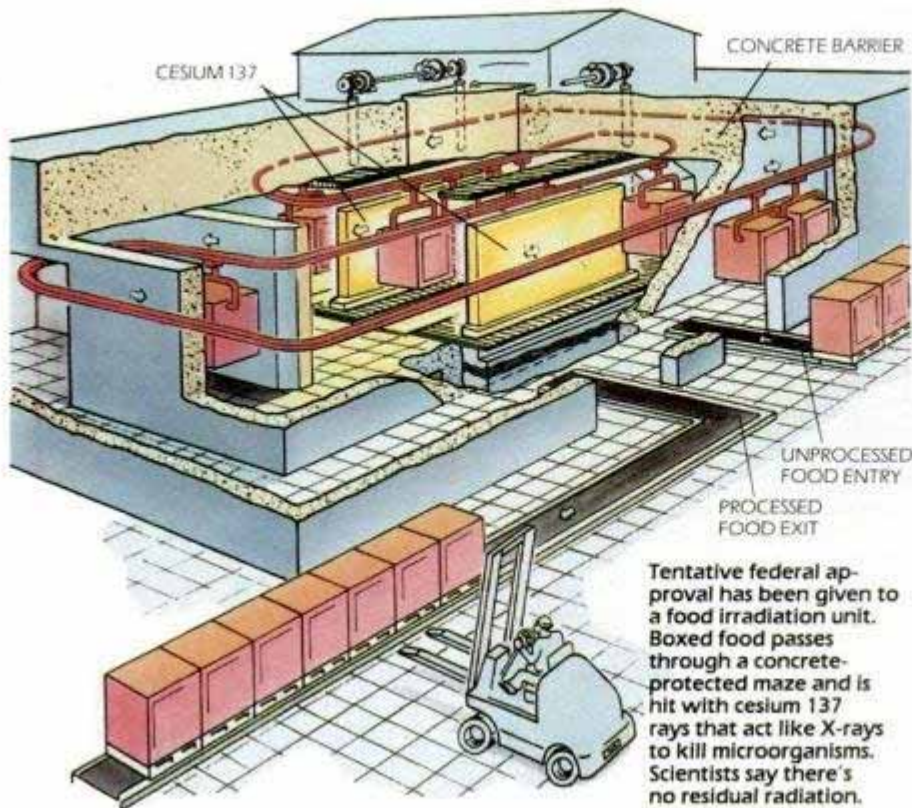


ILLUSTRATION BY JEFF MANGIAT



demonstration in 1980, and one of the first signs of interest came from rural Alaska. In winter, when days are short and scarce electricity comes from generators, air traffic is often the only contact for remote villages. Bush pilots flying in the afternoon darkness would be guided by intuition or the headlights of villagers' cars. Last winter's rescue proved the lamps are worthy of further consideration.

Another recent inquiry came from Florida transportation officials who want to see if radioactive lights can solve the problems caused by high water tables. Along the Alligator Highway and in nearby airports, the salty water corrodes wiring and the lights keep going out. The Department of Energy is negotiating with state officials to begin a pilot project and install a set of tritium lights.

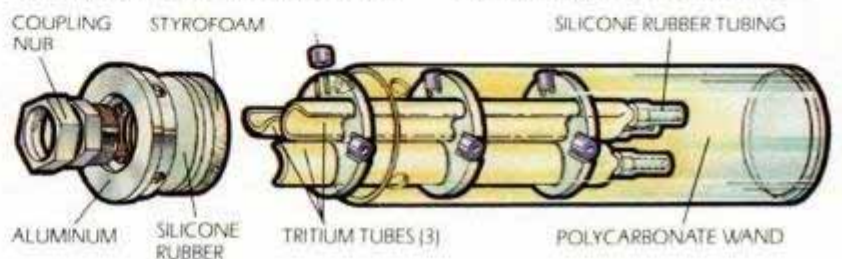
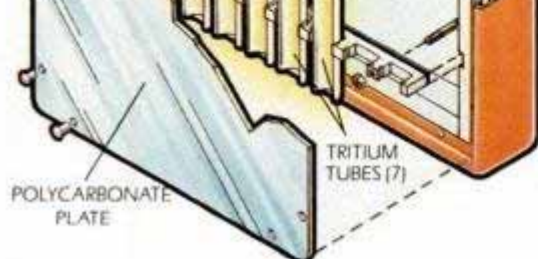
But what happens if a motorist rams into a tritium light? No problem, says George Jensen, RL project manager with the Energy Department's Pacific Northwest Laboratory. "The light

(Please turn to page 213)



Rescue plane (top) lands in Central, Alaska, thanks to tritium lights shown above. Cutaway of the lamp shows sheet-metal sheathing over Styrofoam protective layer. Seven tubes filled with tritium provide perpetual light. Tubes are sealed Pyrex.

Another tritium device, the three-tube light wand (below) would be used to light Florida highways. The sealed Pyrex tubes are capped by silicone rubber tubing and set inside a polycarbonate wand. The wand, in turn, is sealed with Styrofoam.



BOATING '85

SMALL BOATS WITH BIG-BOAT IDEAS

There's more variety, more features and a lot more specialization in this year's crop of small boats.

BY FRANK SARGEANT

Boats that fish, boats that go fast, boats that cruise six in comfort—you'll find all that and a lot more in the bevy of new boats for '85. But you probably won't find all those attributes in one boat.

Nineteen-eighty-five has turned into the Year of Specialization for small-boat manufacturers. So, while you'll find a bass boat that could very well be the ultimate small fishing machine, it won't be very comfortable for your family cruise. And, while you'll find small boats with high-performance hulls capable of ripping through the water at kidney-pounding speeds, they won't be very practical for a day of fishing.

So, this is the year you'll really have to make up your mind if you're in the market for a new boat. What do you really want?

On the other hand, most of the boat manufacturers are adding features to their smaller 16- to 22-foot boats that were once found only on larger models. Items like full bow rails, live bait boxes, cuddy cabins and luxurious fully color-keyed upholstery and carpeting were once the domain of big 30-foot-and-over boats. Now, you'll find such amenities on smaller boats as well.

You can thank the marketing departments of all the boat manufacturers who want to make sure they have something in their line to appeal to you.

Bass boats continue their evolution

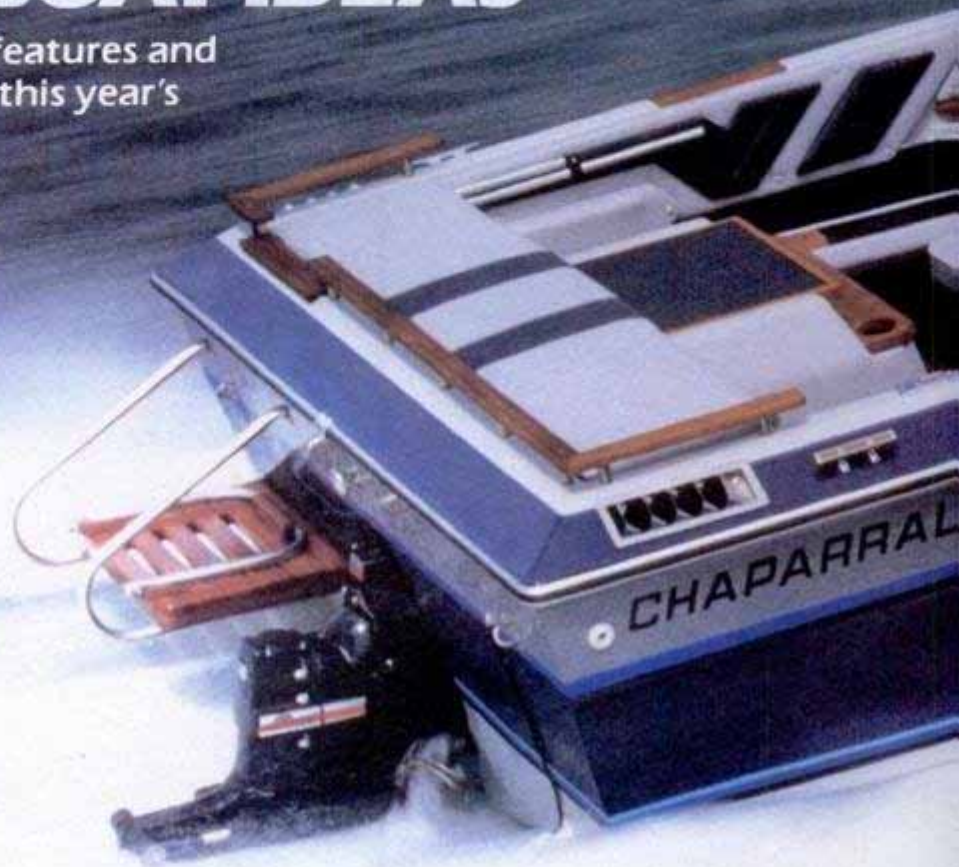
into the most convenient fishing machines ever. Big, safe fiberglass hulls like the Ranger 392, a 20-footer, continue to dominate the field with their good looks, comfort and speed.

Aluminum hulls, such as the new bass boats from Grumman, are also becoming more popular. The firm offers four semi-V models up to 18 feet long, in addition to their full line of runabouts on deep-V hulls. All of the boats are exceptionally light and provide excel-

lent performance with mid-range outboards. Our own project boat (see *PM's Water Sportster*, page 80, Feb. '85) is based on the Grumman Skidaddle.

Aluminum boats are also beginning to appear on the saltwater scene and on the Great Lakes. The Mariner 220V from Starcraft is a good-looking 22-foot center console with a full V-bottom to flatten tough seas and more than enough freeboard to keep spray out of

(Please turn to page 215)



Bayliner's package boats include boat, motor and trailer, all hooked up, wired, and ready to put in the water and run.



PM's Water Sportster project boat is based on a 16-foot aluminum hull Grumman Skidaddle. Power is by a 75-hp Mariner.



Chaparral's line of stylish runabouts offers high performance, good looks and sterndrive power.



Achilles SR-140 is an inflatable with a rigid hull for a more comfortable ride. Boat moves out even with a small outboard.



The 22 Walk-Through from Boston Whaler allows easy access to bow for fishing. Cuddy cabin provides weather protection.

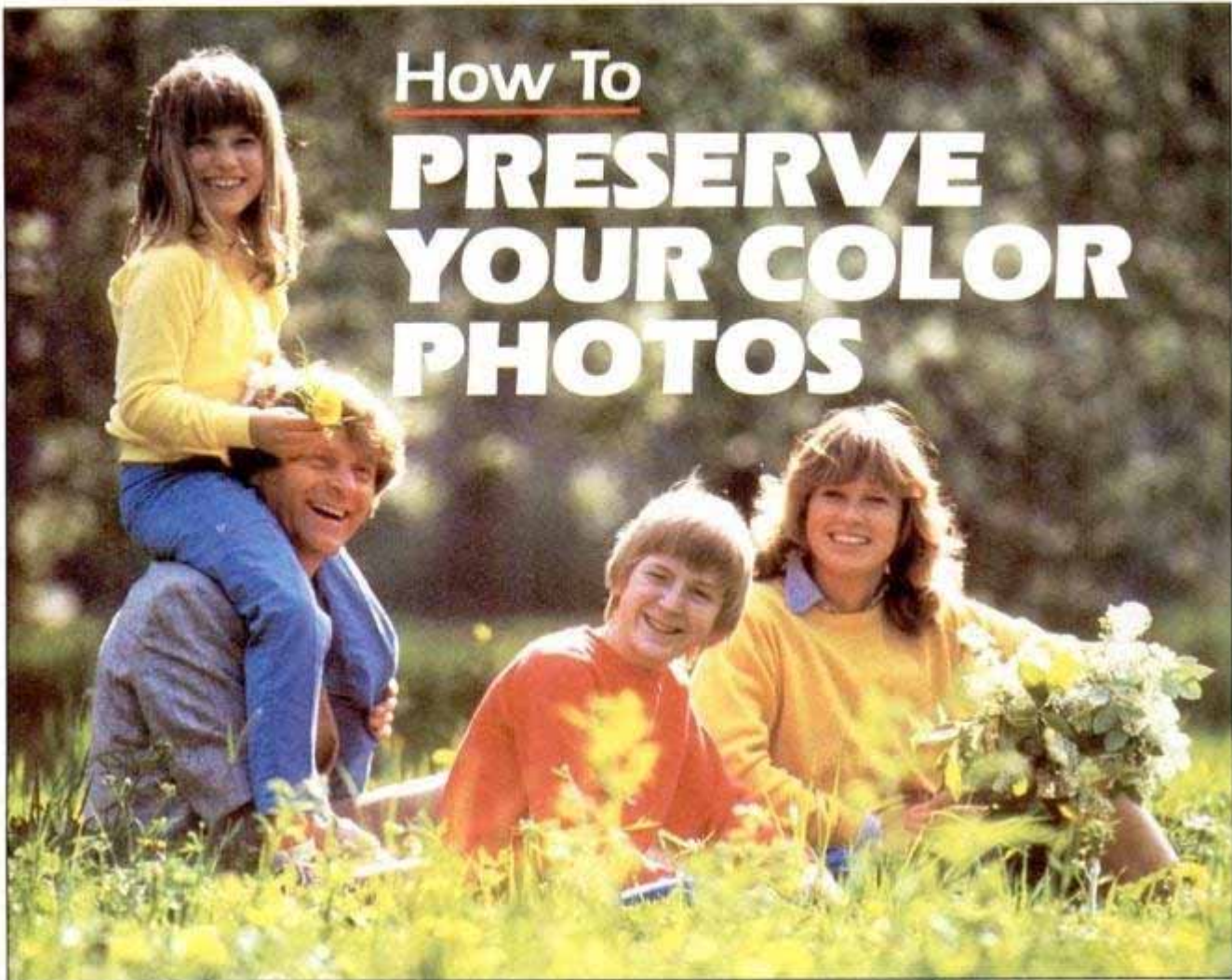


The new Hobie Power Skiff is the perfect entry-level powerboat. Almost any outboard can make it a deep-V high performer.



Sea Ray's Seville series packs luxury and big-boat amenities into smaller packages ranging from 20 to 24 feet.

How To **PRESERVE YOUR COLOR PHOTOS**



INDEX STONE

Color pictures can fade, but careful handling and new materials help your photographic memories last longer.

BY STEPHEN A. BOOTH, *Electronics Editor*

Cloudless skies blessed your wedding day, the maid of honor wore frosty pink and carried white rose buds. Yet the photograph above your mantle depicts a haze-veiled afternoon, and the maid's gown nearly matches her bouquet. As you flip further back through the years, the grass seemed greener than your graduation picture shows, and mom's dress, you recall, was royal blue, not violet.

Your recollections probably are correct. Though memory can deceive and even fade over time, so too can color photos that haven't been stored and displayed with special care.

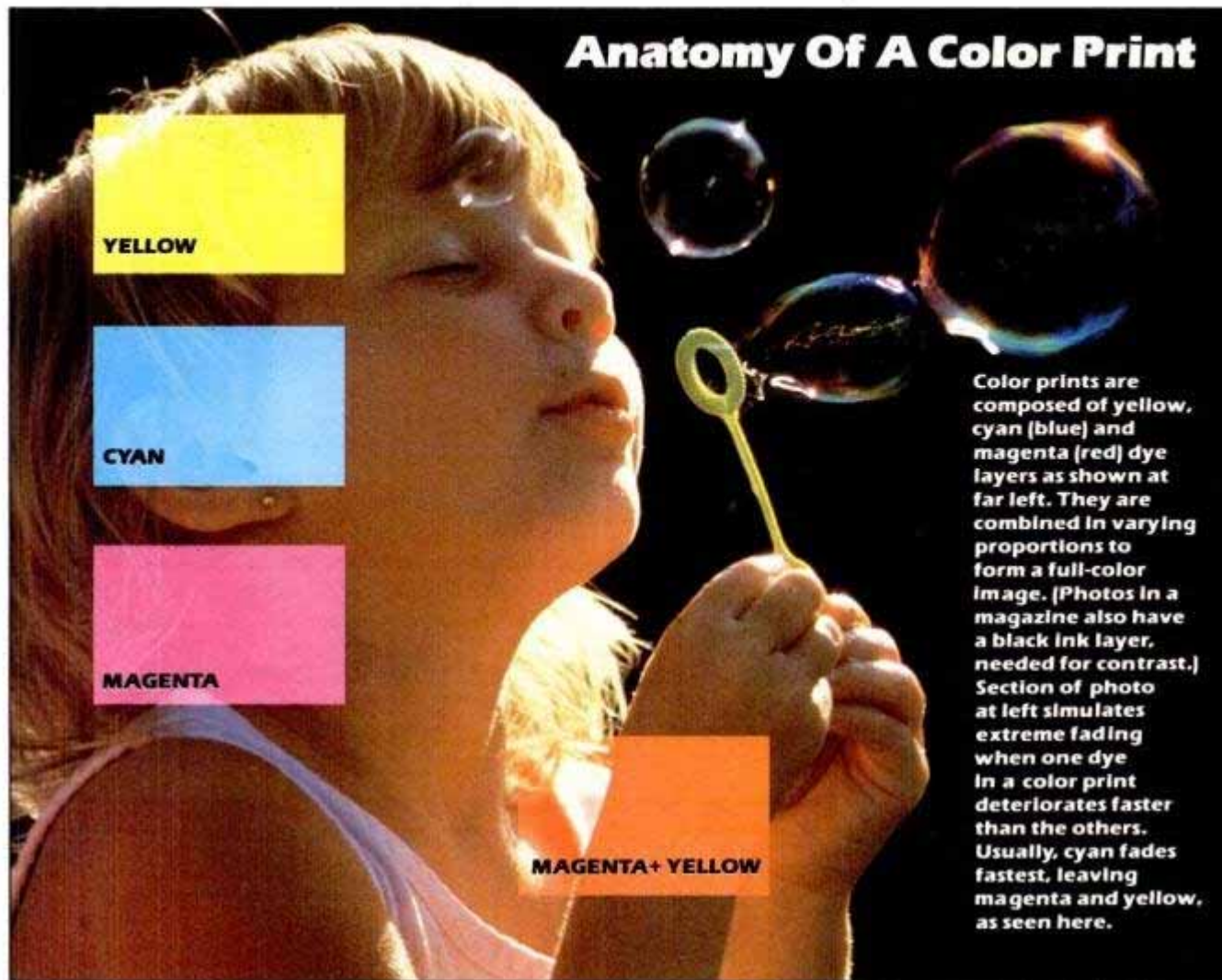
It's sad but true. Those color prints and slides we create as permanent records for posterity are as vulnerable to the ravages of time and chance as life itself. Animal, vegetable or mineral—dyes fade. This unpleasant fact shouldn't come as shocking news. Kodak's packaging, for example, has carried a prominent disclaimer regarding color-dye instability for nearly 50 years. No such disclaimer is needed for black-and-white photos, which have no dyes to fade.

Should you give up your current photo collection for lost, or resolve never to spend another dime on color photography? No. You can extend a color photo's longevity indefinitely with careful storage and display methods. There's hope even for prints, slides and negatives that already have begun to deteriorate.

Additionally, the latest films and printing papers now coming on the market have improved color stability compared to their predecessors. And once you understand the causes of color fading and can relate these to your household's environment and display requirements, you'll be able to judge whether to invest in very complex and expensive processing techniques that can bestow virtual immortality on that very special photograph.

Before we discuss the causes and prevention of color fading, let's describe what it is. As the experts explain it, fading—like beauty—is in the eye of the beholder. Each of us has different expectations, or levels of quality acceptance. For some, the subject or event captured in the photograph is more important

Anatomy Of A Color Print



Color prints are composed of yellow, cyan (blue) and magenta (red) dye layers as shown at far left. They are combined in varying proportions to form a full-color image. (Photos in a magazine also have a black ink layer, needed for contrast.) Section of photo at left simulates extreme fading when one dye in a color print deteriorates faster than the others. Usually, cyan fades fastest, leaving magenta and yellow, as seen here.

INDEX STONE

than the colors, or even the sharpness of focus.

What's acceptable? Minute losses of color density that can be measured in a lab might evade an untrained eye. Even greater losses often pass undetected unless the photo is compared against an unaltered copy of the original. One thing is certain. Balanced fading, where all colors suffer equal losses

in relation to one another, is less noticeable than unbalanced fading, where one color deteriorates to a greater extent than the others. It's also less objectionable. Here's why:

All color photographs contain three dye layers—cyan, magenta and yellow. These correspond to the primary colors of light—red, green and blue—which



Open display caused cyan fading and yellowing of the paper in this 1963 photo of Wyoming's Teton Range. The new print (right)



shows acceptable color balance but some loss of contrast from the original slide. Original was stored without precautions.

may be combined to form any of the many subtle tones and shades in the visible color spectrum.

Balanced fading is a matter of color *quantity*. There might be less overall color in the picture than originally, but what colors do remain are in natural proportion to one another. If a red swimsuit has lost some color depth, so has the suntan it adorns, and so has the green surf and blue sky that silhouette it. Though somewhat washed out, each visual element retains a clue to its original color value.

Unbalanced fading, by comparison, is a matter of color *quality*. If one of the three dye layers deteriorates before the others, it will affect all the tonal combinations in which it plays a part. This can result in a blue sky gone violet, or lush green foliage that appears brown from drought. Quite simply, one or more elements in a picture appear unnatural.

Technically speaking, yellow dye is the first to go. Physiologically, losses of cyan and magenta are more apparent to the eye. Emotionally, people are most sensitive to the fidelity of flesh tones in a photograph. So, a color shift in this critical area is what usually raises the temperature most. The latest photographic films and papers available tout color-balanced stability as one of their virtues.

The invisible enemy

It's no secret that color photos will fade from exposure to light. But they'll also deteriorate in the dark from the effects of heat, humidity and airborne chemical fumes. This means a hot attic, damp basement or, for that matter, a garage isn't the ideal place to store photos.

These conditions affect color prints, negatives, slides and instant prints of the Polaroid type, though in different ways. For example, whereas fading under light will cause losses in both color density and contrast (sharpness), dark fading consists mostly of contrast losses.

Even if you've got an ideal storage location, the materials in which you store your photos can hasten

fading. Cardboard boxes, certain types of envelopes and album papers, adhesives used to affix the prints and the so-called protective overlays and lacquers that cover them might contain chemicals that react harmfully with color dyes. Finally, an area over which you have little control, but which can affect dye stability, is the quality of film development and picture processing.

Light, especially natural and fluorescent, contains ultraviolet radiation which can break down color dyes

Colors can fade even when prints are stored in the dark. Heat, humidity and airborne fumes will do it.

Save Photos Electronically

Want to deep-freeze your photos for posterity's sake, but have instant viewing access for yourself? It's easy to put your slides and prints in a "video album" for viewing on TV. If you've got a videocassette recorder and access to a videocamera, all you'll need to get is an accessory called a teleslide converter or negative-positive adaptor.

These devices attach to your videocamera's lens. At the business end is a receptacle for your slides. You simply aim the camera at a light source, focus until the photo's image is clear on your TV screen (or camera's viewfinder), then put your VCR into the record mode for the desired length of time. If your videocamera has a polarity reversal switch, you'll be able to run print negatives through the converter/adaptor and get positive images with natural colors on your videotape.

Besides helping you preserve your photos, transferring to videotape lets you compensate for photo fading through your videocamera's color-correction circuitry. You can crop photos by using the camera's zoom



A teleslide converter, such as the Ambico unit here, attaches to a videocamera and costs less than \$100. Kodak's \$50 adaptor (background) for 8-mm camcorders has clips to handle several slides or negatives at once.

lens to focus on a specific image in the picture. Or, you can position the converter's slide holder so that just a portion of the image is recorded. Finally, trick lenses enable you to add special effects, and you can dub a soundtrack on the tape if you wish.

What does the electronic future hold? Before long, you'll be able to shoot photos on a small magnetic disk, display and crop them on your TV and make prints right at home. Japan's Hitachi plans to market this filmless camera system next year, priced around \$2,000. Canon, Panasonic, Sony and others won't be far behind. The camera part of these prototype electronic systems operates

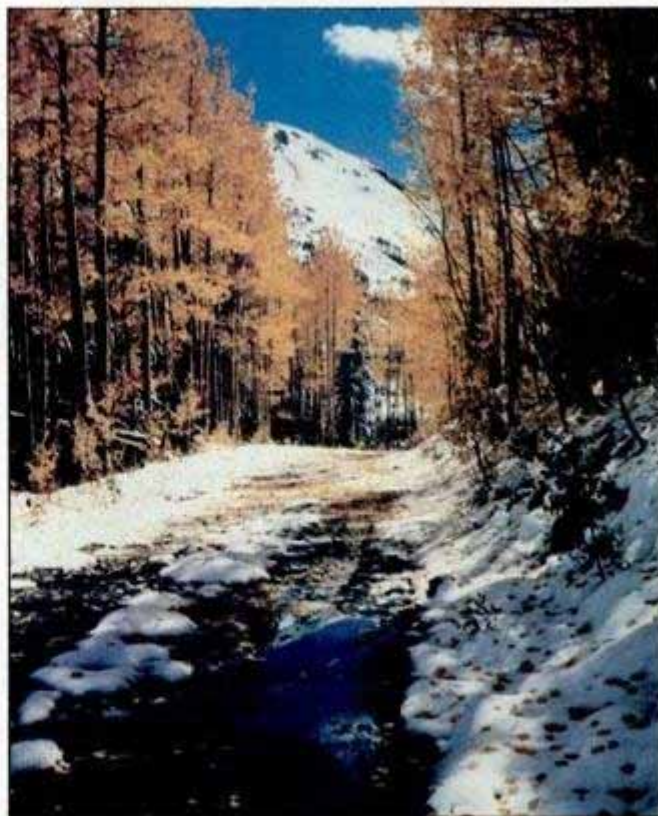
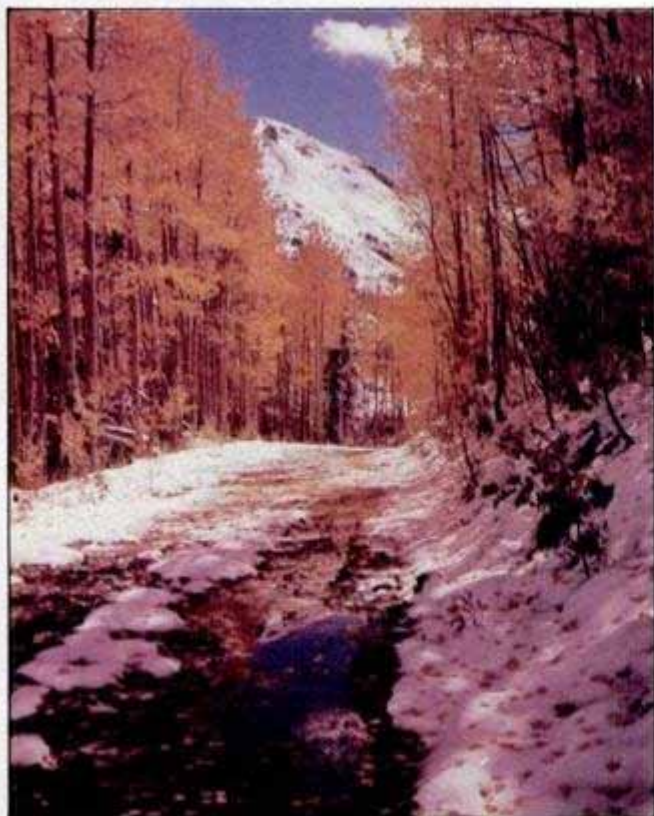
much like a conventional 35-mm film camera. The pictures themselves are made with three-color thermal dye-transfer printers that are able to give near-photographic copies in 90 seconds. But right now, thermal prints have limited color stability.

Meanwhile, in Japan today, Fuji will copy conventional photographs onto the 2-inch disk for viewing on a television set through a \$210 playback machine. The service costs \$8 for up to 50 images, and means you can put your photographic originals on ice.

What's farther down the electronic line? Direct, digital image-recording on laser disks.—S.A.B.



Electronic cameras like this Panasonic unit take pictures on magnetic disks (right) instead of film.



over time. The most vulnerable object is the displayed color print. Negatives and slides needlessly exposed to ultraviolet bombardment will bleach, too. Instant prints suffer badly from light. But because their dye structure is different from conventional prints, they have better color stability under dark storage conditions.

Heat and humidity, in light or dark, will accelerate the otherwise natural aging process dyes undergo—more so if chemical fumes are present. High humidity, moreover, may breed mold or mildew. Generally speaking, a warm, dry storage location is better than a warm, damp one or even a cool, damp one.

Chemical gases and fumes carried in the air are the toughest photo destroyers to dodge. These include not only intruders from outside, such as industrial and auto emissions, but homegrown forms of pollution from gas stoves, paints, wood-finishing compounds, solvents, cleaning solutions, mildew inhibitors, insecticides including mothballs, and even foam-in-place wall insulation. These pollutants affect otherwise-stable black-and-white photos, too.

For long-term storage, perhaps

(Please turn to page 217)



There's hope for faded slides and negatives. Above left is a print from a faded Ektachrome slide before reconstitution (right) of original color balance through a Kodak technique. Heavy magenta cast below (right) shows the effects of heat on a 17-year-old negative. Approximation of original color balance, keyed to flesh tones, was achieved by New York's Zoref Color Labs. Puppy (left) was taken on magnetic disk with Hitachi's electronic camera. Thermal dye transfer print has near-photographic resolution, but little long-term stability.





Baron Von Sinkofen (above) was one of few one-man entries in '84 event. At right, Atroycious Horse and School of Mudsharks battle neck and neck up steep hillclimb. Below, The Force uses clever retractable floats to give it amphibious operation.



Huge 1,500-pound Atroycious Horse (above) needs help from pushers in shallow water. Horny Toads (left) had rough going in mud, but managed to finish third. Potential Motion (below) is paddled to second-place win.



World's Wackiest Race

You have to be crazy to enter, lucky to finish, and the winners get little—but oh, what fun!

BY SHELDON M. GALLAGER
Photos by Michael Lichter



Their names sound like rock groups: Celestial Transport, Sick Humor, Buzz Bombers, Rotten to the Core, School of Mudsharks, Horny Toads. Actually, they're contestants in one of the wildest, wackiest off-road rallies ever conceived. Early this month, they and many others like them will descend on the normally sane and quiet city of Boulder, Colo., bringing with them an odd assortment of vehicular contraptions as outlandish as their names.

This strange annual frolic, now in its sixth season, is aptly called the Kinetic Sculpture Challenge, reflecting the fact that its participants look more like surrealist art creations than serious racing machines. What sets them apart from more practical forms of transportation is that they are propelled solely by human power, engines being outlawed.

The "conveyances," as they are quaintly referred to, must be both roadable and seaworthy and are cobbled up from bicycle parts, barrels, inner tubes,

old bathtubs—anything that will roll or float and hopefully do both. Those shown here are from last year's race. The upcoming competition will bring out many of the same entries, back for another try, along with a fresh crop of challengers eager to outdo their predecessors in new heights of inventive nonsense.

What they'll be up against is a seven-mile, serpentine obstacle course (see map) that includes three separate water legs across Boulder Reservoir, narrow trails through tall grass, a steep hillclimb, and a perilous trek over vehicle-trapping mud flats ankle deep in muck. The mad scramble that results has been described as a cross between the Indy 500 and the Woodstock rock festival held in the La Brea tar pits of California.

The rules are simple. In addition to being muscle-driven, all entries must have functioning brakes, as much for the protection of innocent bystanders as for their own safety. Beyond this, virtu-



Winning team, The Kawasaki Kops and Kons (above), pedaled to victory in record one hour, 10 minutes. Celestial Transport (left) looked imposing at start, but fell apart, dunking teammates. Below, disabled entry is gamely walked across finish line.



To Nowhere

ally anything goes. Most rigs are designed around some form of bicycle drive, using a combination of pedal power on the land legs and paddle power on the water legs. Some look like old-fashioned sternwheelers with pedal-driven sternwheels. Others have clever retractable pontoons that can be raised or lowered as the course dictates.

Many are elaborate affairs costing as much as \$2,000 to \$3,000 to build and weighing several hundred pounds. One of last year's more ambitious efforts, a huge replica of the mythical Trojan Horse called the Atroycious Horse, used two 20-foot canoes for floats combined with wheels and bicycle drives and

weighed 1,500 pounds. It did well on water, but met its nemesis in mud.

Pushing is legal, but is somewhat discouraged by the stipulation that no team can have more pushers than it has riders and no more riders than its conveyance will physically carry without collapsing or sinking. Since extra manpower can often spell the difference between victory and defeat, this provision tends to spawn enormous monstrosities accommodating as many as a dozen crewmembers. Lest this be carried too far, the rules also contain an ominous warning that any entry so overloaded it appears to be in danger of sinking will run the risk of being rescued—sufficient grounds for instant disqualification.

The Kinetic Sculpture Challenge is [\(Please turn to page 220\)](#)

Imaginative design didn't help this giant snail creation. Like many other ill-fated entries, it came to grief on a mud bank.



EXPO '85 AT TSUKUBA:



JAPAN STRUTS ITS STUFF

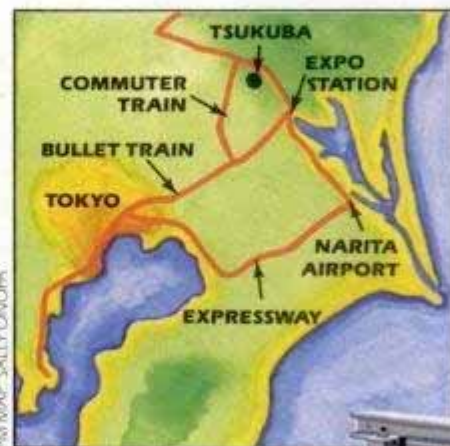
With oriental subtlety, Japan is unveiling future technology at its \$250 million Expo.

BY DENNIS ESKOW, Science Editor; Photos by Brian Wolff

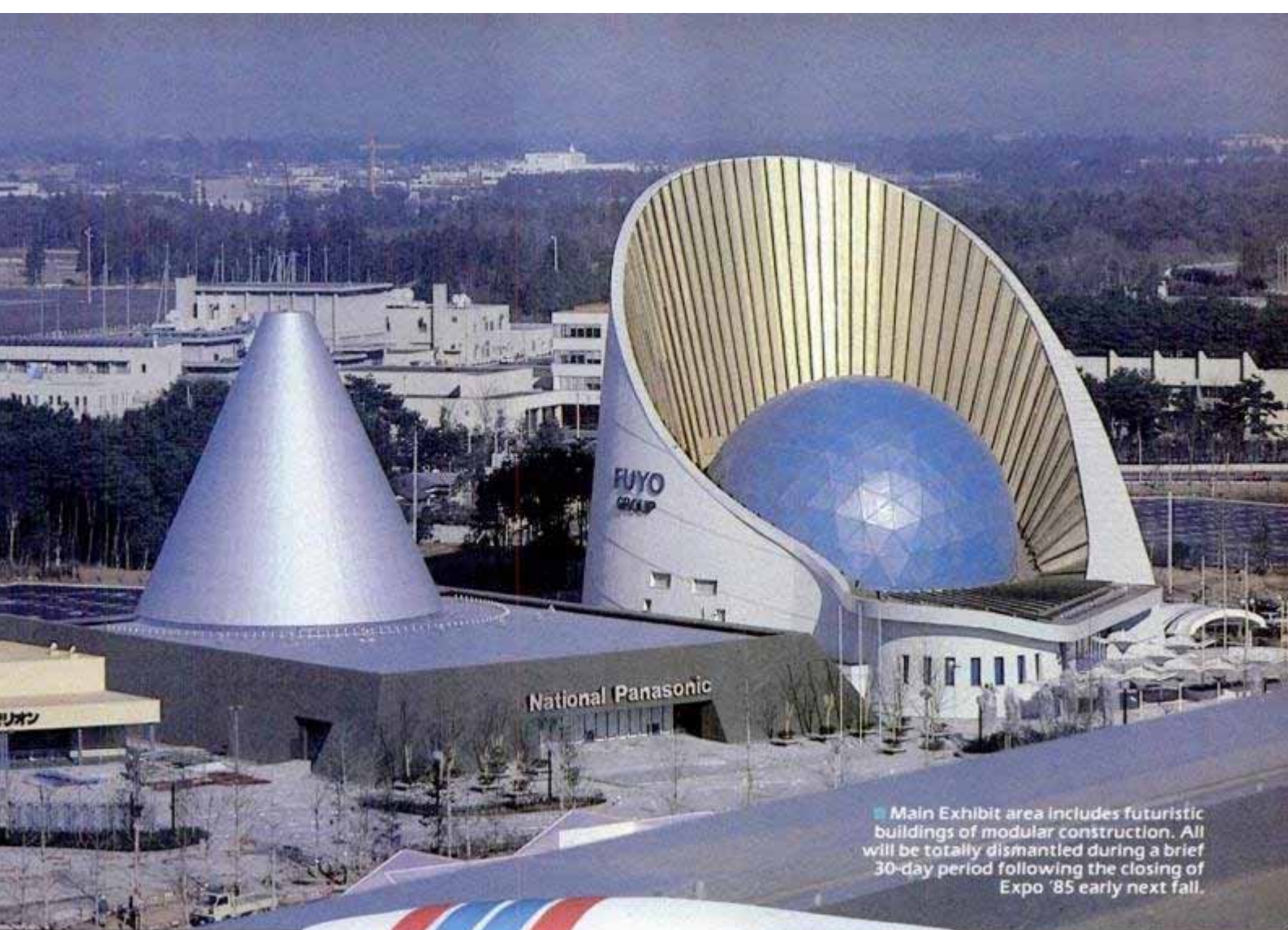
My hand trembled as I reached for the dashboard shifter of the train that literally rides on air. I pushed it to the first stage and the 12-ton car rose slightly off the track, perhaps less than an inch. Another push on the shifter and we floated off—me, the *untenshu* (motorman) and 40 passengers who didn't know I was the driver. Silently, smoothly, we glided away, following the track to the terminal, a little over 1,000 feet away.

"Be ready," the *untenshu* grunted from his seat behind me. "Okay, now push again...we go down." I pulled back on the lever and we glided smoothly into the terminal, setting down as lightly as rice paper on the track. Here I was, almost at the end of my visit to Expo '85, Japan's version of a World's Fair, and I had become the first American to operate the Japan Air Lines maglev train.

Maglev, like many of the other 45 main exhibits at Expo '85, is Japan's subtle statement to the world. The fair, located about 25 miles from downtown Tokyo, is a quarter-billion-dollar wonder that will be transformed into a new Science City in the town of Tsukuba (pronounced *scooba*). "When the fair



■ Tsukuba is 25 miles north of Tokyo. Current bullet train, commuter train and expressway routes between Tokyo, Expo '85 and the airport are shown at left. A maglev train (right) from the airport to Tokyo will cut to 20 minutes a trip that currently takes autos anywhere from 1½ to 3 hours.



National Panasonic

FUJYO GROUP

■ Main Exhibit area includes futuristic buildings of modular construction. All will be totally dismantled during a brief 30-day period following the closing of Expo '85 early next fall.



HSST

ELECTRIFIED TRACK

AMPLIFIER

MAGNET

■ Japan Air Lines' HSST maglev train runs on a cushion of air just above the track. The electrified track has a magnetic field oppositely charged to that of the magnet attached to the train. An amplifier built into the car's undercarriage creates magnetic pulses to move car.

PM ART DALE GUSTAFSON

■ Sony's spectacular JumboTRON color TV screen is 65 ft. high and 110 ft. wide. It's made up of 6,300 units, each containing 24 fiberoptic light-emitting cells (inset).



is over, all the buildings you see will come down in one month and you will see research buildings in their place," said Katsuichi Ikawa, commissioner general of Expo '85. "We already are talking with some 20 high-tech companies about setting up their research sites here."

Unlike the last two World's Fairs held in America—in Knoxville, Tenn., and New Orleans—Tsukuba opened in March with few expectations for its financial success and little fanfare about its technologies. The organizers hope to accomplish three things with Expo:

First, they want to show the world where Japanese technology is heading. Second, they intend to transform Tsukuba into a major research center. And last, they hope to draw about 20 million Japanese visitors and some 2 million foreigners to the fair before it closes this fall.

Judging from the array of exhibits, the first point is well established. Maglev, for instance, is no longer a drawing-board dream of the future. With its High Speed Systems of Transport (HSST) car on display, Japan Air Lines is giving Expo visitors a preview of things to come in the 1990s.

"By then, we hope to have an HSST running from Narita Airport into central Tokyo," said Morris Simoncelli, JAL's American spokesman. Currently, the bus or auto ride from Narita to Tokyo runs anywhere from 90 minutes to three hours, depending on traffic conditions. When maglev trains begin operations, it will take under 20 minutes.

The advantage of maglev trains is the fact that they levitate and ride above rather than on the track (see *Coming: The Fastest Train In The West*, page 90, Nov. '83). This allows them to move at demonstrated speeds well over 150 mph while drawing no more power than an ordinary subway train.

The model being shown at Expo '85 is an aluminum shell sitting on alumi-

num alloy spars. The car travels above an electrified track shaped like an upside-down U. Extending across the bottom of the car is an amplifier that carries electric pulses to a U-shaped superconducting magnet. The train's linear induction motor provides power for the pulses.

The train's magnet is oppositely charged from the rail so that the maglev car rides above the rail. As the amplifier is pulsed on and off, the changes in magnetism push the train on its course.

The technology has been in development since the 1970s and now appears ready for everyday use. The last obstacles in the way of an airport-to-city system include smooth track switching and easy braking at high speeds. The Japanese believe these will be solved within the next five years.

The JAL maglev takes you from a spot near the Expo entrance to a back gate area. From there, you can walk the 250-acre park easily in one day. From the outside view, Expo is an update of Disney's Epcot Center in Orlando, Fla. You have to get behind the scenes to get the full impact of the hottest technologies.



■ Learning with laughter: In the Expo's Children's Park, youngsters can stroll across a relief map of the world, or they can amuse themselves by playing with scientific gadgets.

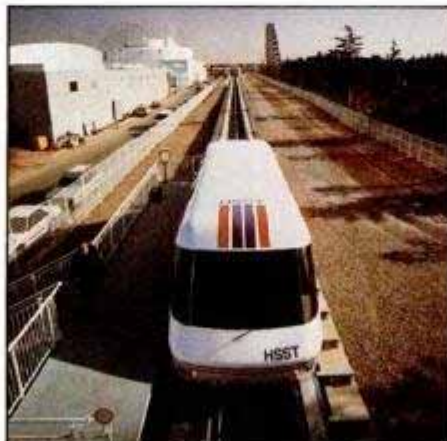


Sony dazzles visitors with its 65-foot-tall, 110-foot-wide JumboTRON color TV screen. It's stunningly sharp and the colors are true to life. You might think it's nothing but an overgrown TV set. But in the panel behind the big screen sits the future of video technology.

Instead of building a mammoth vacuum tube—which would have been impossible—or using a system of light-emitting diodes, which would have produced a faint picture, Sony created a new technology for JumboTRON. The screen is composed of 6,300 units, each containing 24 three-color light-emitting cells. Each is connected by fiberoptic cable to a computer station beneath the screen.

By plugging thousands of cells into a central computer, yet giving each one an individual output line, the JumboTRON screen can produce hundreds of shades of each color for a remarkably realistic picture. The outdoor display screens you see in sports stadiums today have a resolution of about 70,000 pixels. But JumboTRON has a resolution of over 400,000 pixels, about the same as the TV in your home. The new technology may be miniaturized in the next decade for use with large-screen household television sets.

The Japanese also are showing off their latest robots and computer technologies. In the Fanuc exhibition, an 8-foot-tall robot that runs on a 256K computer uses a set of 16 servomotors to do all sorts of chores. It can lift over 200 pounds or work so delicately that it can build an 11-inch replica of itself in a



■ The single-car maglev (magnetic levitation) train carries passengers around Expo.



■ Workers put final touches on musical water fountain outside main pavilion. Inside the Fuyo Robot Theater, producer Shuichi Kanno (left) sits atop one of his buggies to be driven by robots.



■ Fanuc Man is an 8-ft.-tall robot whose steel and servo-motor make-up provides great strength and dexterity. Fanuc man lifts over 200 pounds and builds 11-in.-high replicas of itself.

few minutes. This is the shadow of a factory to come, where the robot assembles, packs and loads merchandise.

In the computer field, Expo is featuring an "intelligent" system that can translate Japanese and English conversations. The software is designed to translate the most difficult idiomatic expressions by first searching for the literal meaning of the words in the sentence, then testing for the logic of the word order, then matching illogically ordered words with a lexicon of clichés and idioms.

"The Japanese word for delicious is *umai* and the word for hand is *teh*," explained Hiroaki Eguchi, a researcher for Fujitsu. "If the computer reads a sentence that calls something an *umai teh*, it recognizes that delicious hand makes no sense. These words are then matched against a catalog of idioms and the computer learns that *umai teh* means a good idea. It all takes 20 to 30 seconds."

If the high technology aspects of the fair are hidden behind the scenes, so are many of the engineering technologies. The buildings are constructed of modular lightweight aluminum steel panels and prestressed concrete blocks on jacks that allow for easy moving.

It doesn't dazzle the eye, but it staggers the imagination to realize that all this is coming down to make way for the new Tsukuba Science City.

Where Expo now stands, more than a dozen electronics and engineering firms are expected to erect research and development centers early next year. The excitement is building up at Tsukuba.

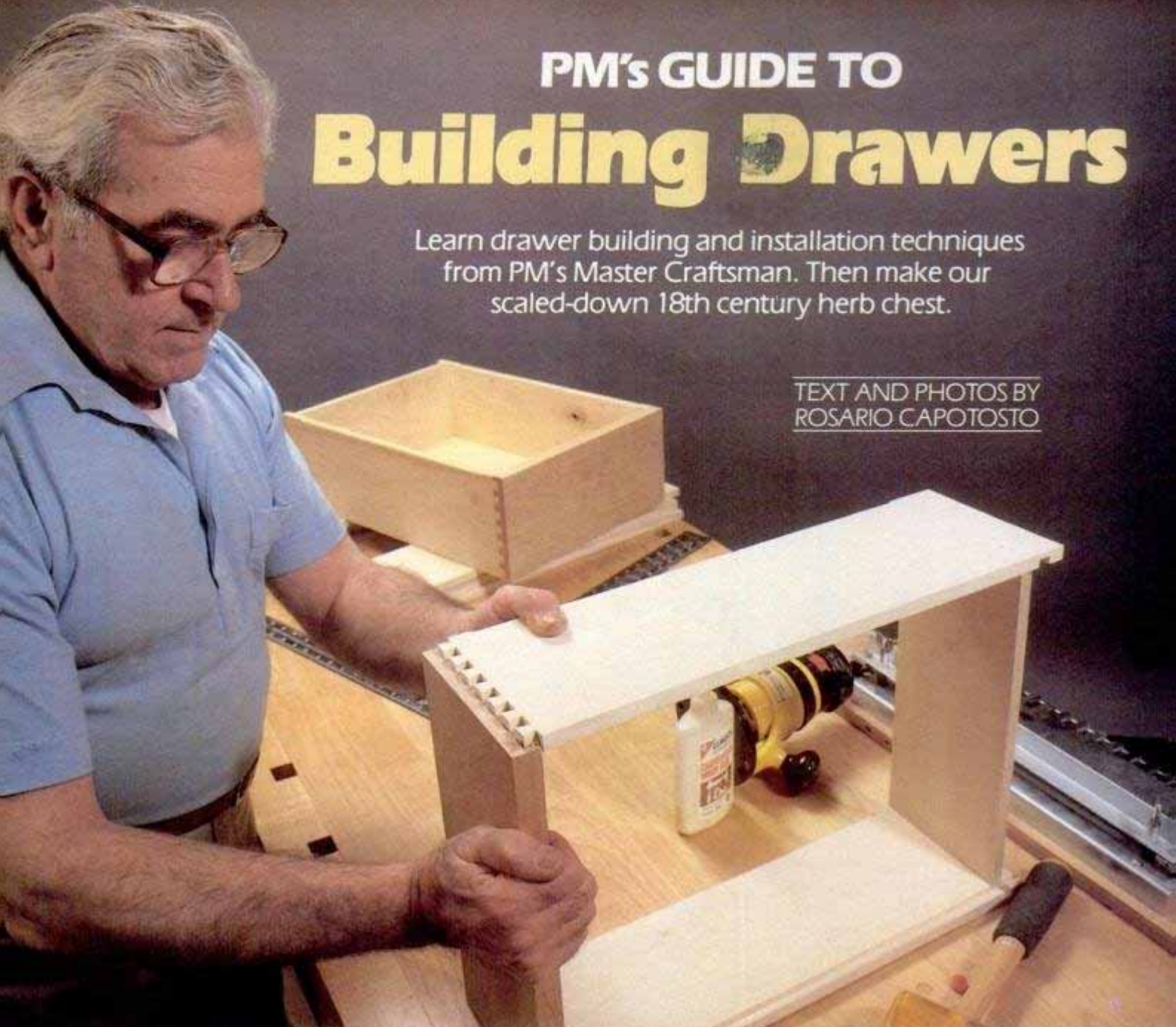
More than 4 million Japanese travelled abroad last year, and the Expo backers are hoping that much of that trade will be kept home this year. And, if you ever thought about visiting Japan, Expo '85 might be the best excuse you'll ever have. That's what the Japanese are hoping.

FM

PM's GUIDE TO Building Drawers

Learn drawer building and installation techniques from PM's Master Craftsman. Then make our scaled-down 18th century herb chest.

TEXT AND PHOTOS BY
ROSARIO CAPOTOSTO



Here you'll discover several different ways to build and install cabinet drawers. The drawer construction technique you choose will depend on many factors, including the following: the drawer size; the method used to guide the drawer in and out of the cabinet; the cabinet style and function; the amount of use the drawer will be subjected to; and the load the drawer will be carrying—light or heavy. The construction techniques shown will satisfy nearly every drawer-building need.

Half-blind dovetails

One of the strongest and most attractive joints used in drawer construction is the dovetail joint. But, cutting true, through dovetails by hand (see *Workshop Minicourse*, page 72, Mar. '85) can become very time-consuming when you're building several drawers. The solution is to cut half-blind dovetail

joints using a router and a dovetail template. We used a Porter-Cable template (model No. 5008), which is designed to permit cutting two mating drawer parts simultaneously.

First, secure the template to the workbench and then clamp the two drawer parts in the template, as shown. Note that the drawer side is held vertically and the drawer front is held horizontally. Next, moving the router from right to left, make a shallow cut about $\frac{1}{8}$ in. deep at each dovetail position on the workpiece. Then, make a second pass to cut the full depth of each dovetail and socket, but this time, move the router from *left to right* to utilize the proper bit rotation. This two-step cutting procedure eliminates the chance of splintering the drawer side, which may occur with a single, full-depth cut. Now, rout half-blind dovetails into the other drawer side and in the opposite end of



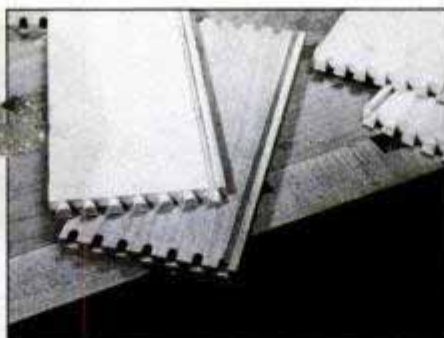
Cut half-blind dovetail joints with a router template (above). Template allows routing two parts simultaneously. Assemble the tight-fitting joint with glue only (top).

the drawer front. Half-blind dovetails could also be used to join the drawer sides to the back, but we opted for a simpler dado joint.

After cutting the four corner joints, saw a groove in the drawer sides and front to accept a $\frac{1}{4}$ -in. plywood bottom.

If the groove in the drawer front falls between two sockets, then execute a blind cut (one that is contained within the piece) so the groove isn't visible when the drawer is assembled. The drawer side grooves aren't as critical, they will be hidden by the drawer front.

Next, rout the top edges of the drawer sides with a 1/4-in. rounding-over bit. Then, apply glue to the half-blind dovetail and dado joints and assemble the parts using a mallet. Now, nail the back into the dados, slide the bottom in place and nail it to the bottom edge of the drawer back.



Groove drawer sides and front to accept drawer bottom. Align drawer front groove with socket so it won't show after assembly.



Shape top edges of the drawer sides with a 1/4-in. rounding-over bit. Stop cut 1 in. from end so it doesn't interfere with the joint.

HERB CHEST

Build our scaled-down 18th century herb chest for storing herbs and spices. The nine-drawer pine cabinet can also be used for organizing sewing accessories, hobby collections and small parts used in modelmaking and handicrafts.

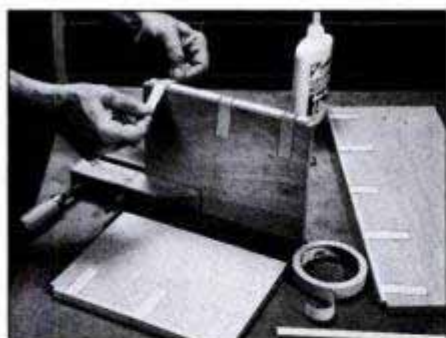
First, cut the cabinet parts according to the materials list on the next page. Next, glue 1/4-in.-thick pine strips to the front edges of the four birch plywood dividers. Then, cut the dados and rabbets, as illustrated, in the cabinet sides, top and bottom. Now, cut edge-lap joints into the dividers using a 1/2-in.-wide dado blade. The edge-lap cut length must equal half the width of the divider, so the 7 1/2-in.-wide dividers receive a 3 3/4-in.-long edge-lap cut.

Next, glue 3/4 x 3/4-in. pine pieces to the front and sides of the cabinet top. Then, use a 5/32-in. roman ogee router bit to shape the crown molding. Now,

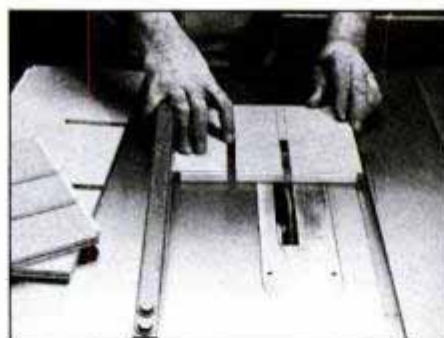


This nine-drawer pine cabinet is a scaled-down version of an 18th century herb chest.

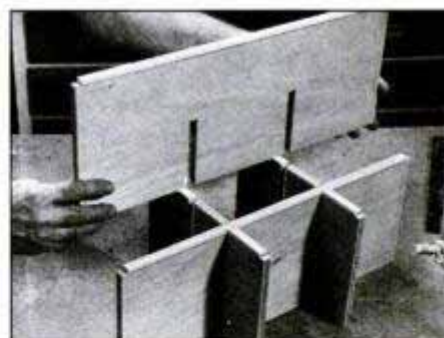
PHOTO BY GEORGE ANCONA



Glue and tape pine trim to the front edges of the four plywood dividers. Position the trim 1/8 in. from the end of the divider.



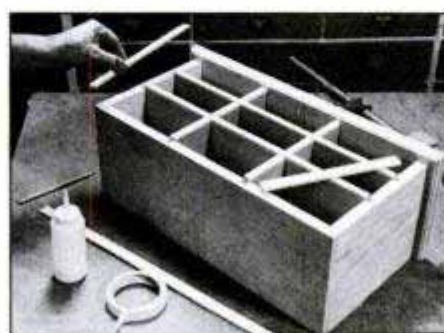
Cut edge-lap joints in the dividers with a 1/2-in.-wide dado blade. Glue edge trim to vertical dividers before cutting the joint.



Be sure to cut edge-lap joints in the back edge of the horizontal dividers and in the front edge of the vertical dividers.

assemble the cabinet using glue and clamps. Use nails to fasten the bottom to the sides and to attach the cabinet back only. Glue 1/4-in.-thick pine trim to the front edges of the cabinet sides and bottom. Then, shape the base molding with a 5/32-in. roman ogee router bit and glue it to the chest.

Next, build the drawers using 1/2-in.-thick pine for the fronts and backs and 1/4-in. birch plywood for the sides and bottoms. Assemble the drawers with glue and 5/8-in. brads. Finish the chest with three coats of orange shellac. The drawer interiors are left unfinished.

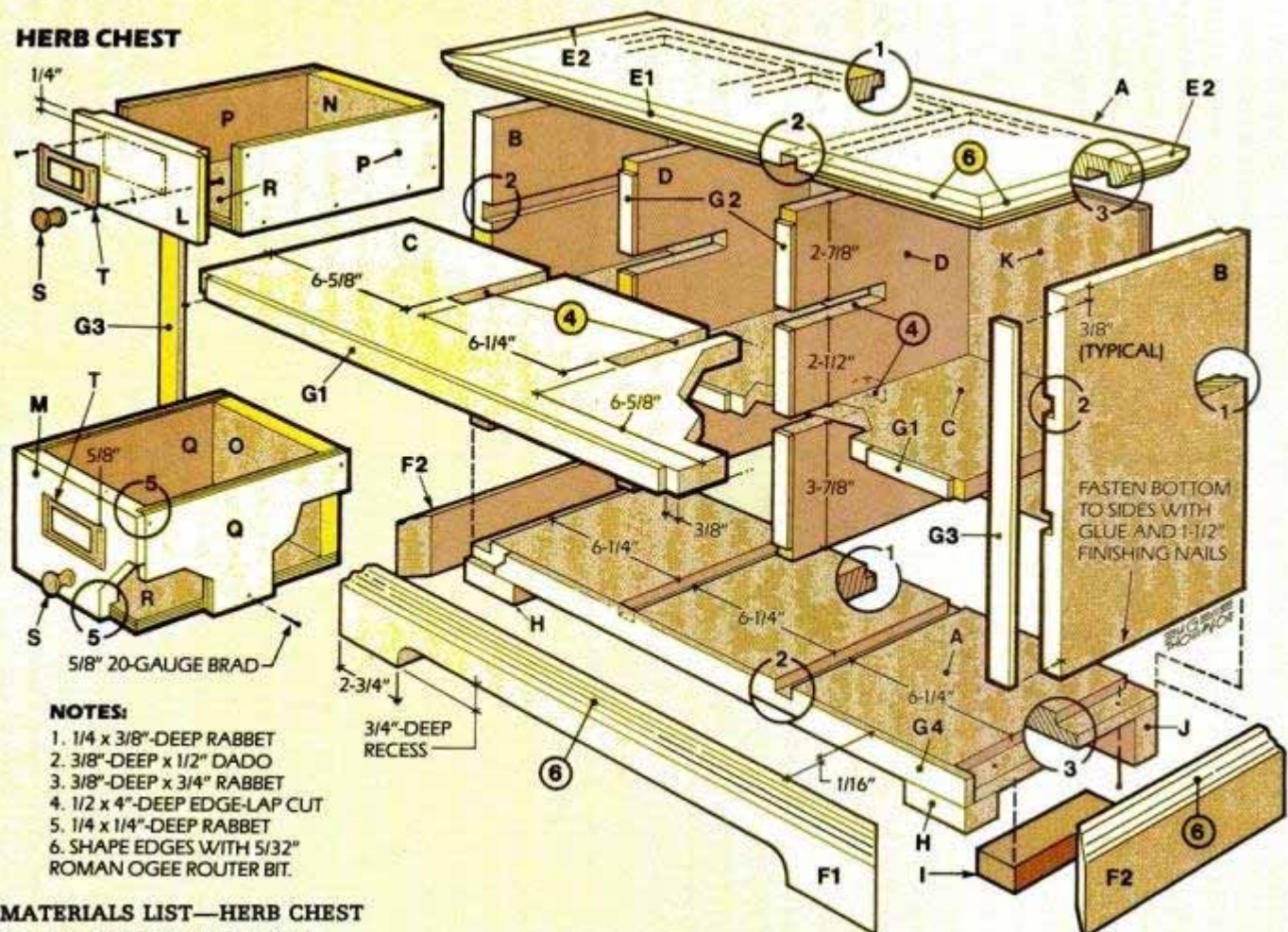


Glue pine trim to the edges of the cabinet sides and bottom after the chest is assembled. Then, attach the cleats and base.



Assemble the drawers with glue and 5/8-in. brads. Fronts and backs are 1/2-in. pine; sides and bottom are 1/4-in. plywood.

HERB CHEST



NOTES:

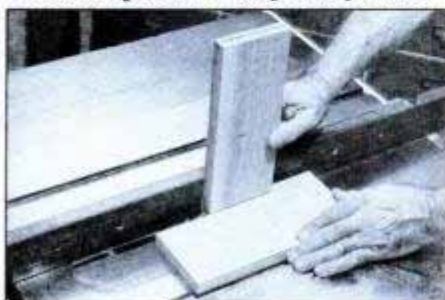
1. 1/4 x 3/8"-DEEP RABBET
2. 3/8"-DEEP x 1/2" DADO
3. 3/8"-DEEP x 3/4" RABBET
4. 1/2 x 4"-DEEP EDGE-LAP CUT
5. 1/4 x 1/4"-DEEP RABBET
6. SHAPE EDGES WITH 5/32" ROMAN OGEE ROUTER BIT.

MATERIALS LIST—HERB CHEST

Key	No.	Size and description (use)	G4	1	1/4 x 3/4 x 21 1/4" pine (edge trim)	P	12	1/4 x 2 3/4 x 7 3/8" birch plywood (small drawer side)
A	2	3/4 x 7 3/4 x 21 1/4" pine (top and bottom)	H	2	3/4 x 1 x 2 1/4" pine (cleat)	Q	6	1/4 x 3 3/4 x 7 3/8" birch plywood (large drawer side)
B	2	3/4 x 7 3/4 x 10 1/4" pine (side)	I	2	3/4 x 1 x 5" pine (cleat)	R	9	1/4 x 5 5/8 x 7 3/8" birch plywood (drawer bottom)
C	2	1/2 x 7 1/2 x 20 1/2" birch plywood (divider)	J	1	3/4 x 1 1/4 x 21 1/4" pine (cleat)	S	9	3/4"-dia. wood knob
D	2	1/2 x 7 1/2 x 10 1/4" birch plywood (divider)	K	1	1/4 x 10 1/4 x 20 3/8" birch plywood (back)	T	9	Brass label holder
E1	1	3/4 x 3/4 x 22 3/4" pine (crown front)	L	6	1/2 x 2 3/4 x 6 1/8" pine (small drawer front)	Misc.		Carpenter's glue, 5/8" 20-gauge brads, 1 1/4" finishing nails, orange shellac, Butcher's wax. Wood knobs and label holders from Constantine's, 2050 Eastchester Rd., Bronx, N.Y. 10461.
E2	2	3/4 x 3/4 x 8 1/2" pine (crown side)	M	3	1/2 x 3 3/8 x 6 1/8" pine (large drawer front)			*Glue edge trim G2 to dividers D before cutting the edge-lap joint.
F1	1	3/4 x 2 x 22 3/4" pine (base front)	N	6	1/2 x 2 1/8 x 5 5/8" pine (small drawer back)			
F2	2	3/4 x 2 x 8 3/4" pine (base side)	O	3	1/2 x 3 3/8 x 5 5/8" pine (large drawer back)			
G1	2	1/4 x 1/2 x 19 3/4" pine (edge trim)						
G2	2	1/4 x 1/2 x 9 1/2" pine (edge trim)						
G3	2	1/4 x 3/4 x 9 1/2" pine (edge trim)						

Flush rabbet joint

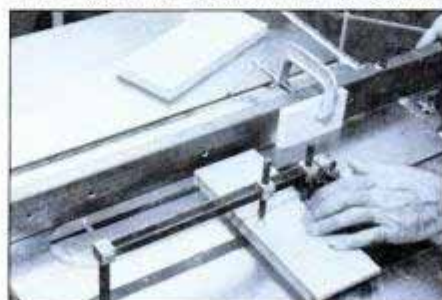
The easy-to-make flush rabbet joint is a popular choice for joining drawer fronts to drawer sides. It can be used to assemble drawers built of hardwood, as shown, or plywood. The flush rabbet joint isn't as strong as the joints that lock the drawer parts together, such as the double dado or the dovetail dado, but it is strong enough for drawers that aren't subjected to very heavy loads.



Use a notched push block to guide the drawer front over the saw blade. Be certain to keep your thumb well clear of the blade.

First, cut the drawer front, sides and back to size. Next, make the drawer front end cuts on the table saw. Adjust the saw blade height to equal the rabbet width. The distance between the saw fence and the blade determines the rabbet depth. Be sure to keep the same drawer front surface against the fence for each end cut.

Then, place the drawer front face up and make the second cuts which re-



Make the second cuts using the miter gauge. Wood block clamped to fence provides clearance for the cutoff waste to fall free.

move the waste and form the rabbets. Clamp a wood block to the saw fence, as shown. Position the drawer front against the block and make the cut. The wood block provides clearance between the saw fence and blade to allow the waste to fall free.

Assemble the joint with glue and finishing nails. You should drive the nails through the drawer sides and into the ends of the drawer front.



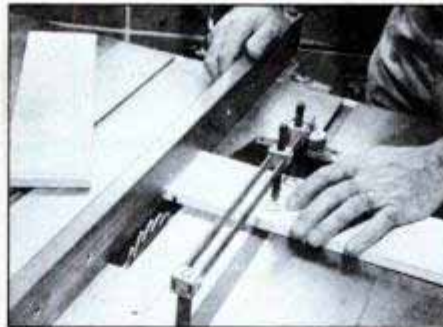
Assemble the rabbet joints with glue and finishing nails. Then, sand the drawer front ends flush with the drawer sides.

Double dado joint

A double dado is not only a strong drawer joint, it's also one of the easiest to make. For best results, use on hardwood drawers with $\frac{1}{2}$ -in.-thick sides and $\frac{3}{4}$ -in.-thick fronts.

First, cut a $\frac{1}{4} \times \frac{1}{4}$ -in. dado in the drawer sides using a dado blade. Position the dado $\frac{1}{4}$ in. from the front end of each side. Then, prepare to cut the drawer front dados. Adjust the $\frac{1}{4}$ -in.-wide dado blade height to $\frac{9}{16}$ in. ($\frac{1}{2}$ in. for the drawer side thickness and $\frac{1}{16}$ in. for end overhang). Position the fence $\frac{1}{2}$ in. from the *outside* of the dado blade. Now, keep the drawer front's inside surface against the saw fence and cut a dado in both ends.

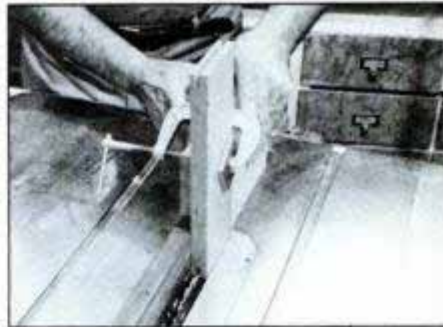
Install a standard table saw blade and prepare to make a second cut on the drawer front dados. Adjust the depth-of-cut to about $\frac{3}{8}$ in. and position the saw fence $\frac{5}{16}$ in. from the *outside* of the blade. Then, place the drawer front face up and pass each end over the saw blade. Assemble double dado joints using glue only.



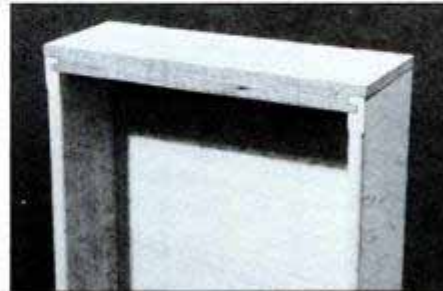
Cut a $\frac{1}{4} \times \frac{1}{4}$ -in.-wide dado in each drawer side with a dado blade. Position the dado $\frac{1}{4}$ in. from the front end of each side.



Use a standard table saw blade to trim the back of the drawer front dados. Use the miter gauge to ensure safe, accurate cuts.



Clamp drawer front to a homemade tenoning jig and cut end dados. Keep the drawer front's inside surface against the saw fence.



Assemble the tight-fitting double dado joint with glue only. Sand the ends of the drawer front flush with the drawer sides.

Box joint

Attractive box joints, also known as finger joints, are cut easily on a table saw, as shown, or with a router (see *Perfect Joints From Your Router*, page 75, Jan. '84).

First, attach an auxiliary wood fence to the miter gauge and then install a $\frac{1}{4}$ -in.-wide dado blade. Adjust the blade height to about $\frac{1}{16}$ in. more than the drawer stock thickness. Next, pass the

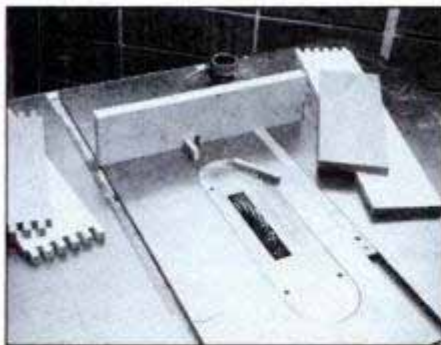
fence over the dado blade to form a $\frac{1}{4}$ -in.-wide notch. Then, shift the fence $\frac{1}{4}$ in. to the right and make a second pass. Now glue a hardwood guide block into the *first* notch, allowing it to project about $1\frac{1}{4}$ in. from the front of the fence.

Butt one drawer member against the guide block and offset the mating member an amount equal to the guide-block thickness. In this example, $\frac{1}{4}$ in.

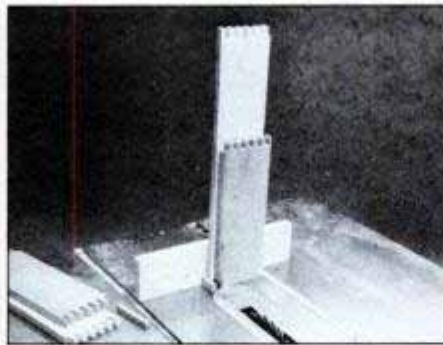
Hold the drawer parts in this position

and make a pass over the blade. Now reposition the drawer parts, placing the previously cut notch over the guide block. Make a second pass. Repeat this procedure until all notches have been cut. Continue cutting box joints on the remaining drawer parts. Next, groove the parts on a router table to receive the drawer bottom. Assemble box joints with glue only.

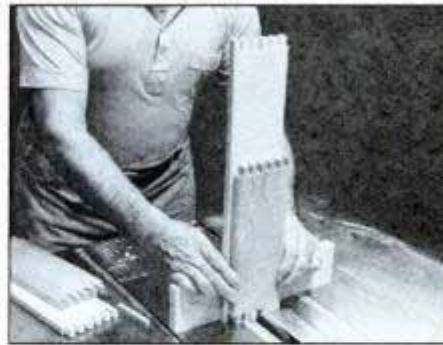
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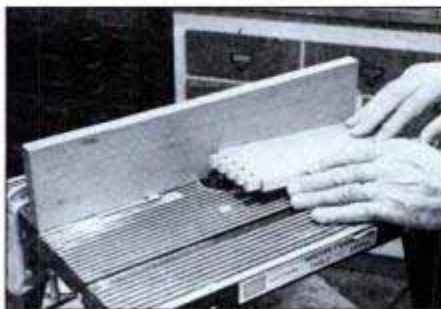
Attach an oversized auxiliary fence to the miter gauge. Cut a notch with a dado blade to accept the hardwood guide block.



Butt one drawer part against the block and offset mating part a distance equal to the block thickness. Make the initial cut.



After each pass over the dado blade, reposition the drawer parts, placing the previously cut notch over the guide block.



Rout blind grooves to receive the drawer bottom. Lower work slowly onto the bit. Mark start and stop points on the fence.

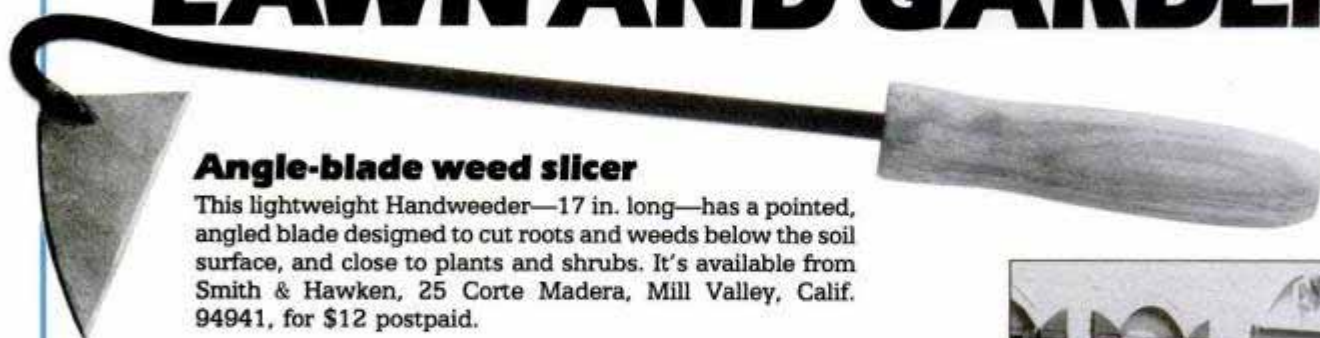


Note how the blind groove is contained within the piece to prevent it from being visible when the drawer is assembled.



Assemble box joints with glue only. These joints often are used to join both the drawer front and back to the sides.

20 TOOLS FOR A NEATER LAWN AND GARDEN



Angle-blade weed slicer

This lightweight Handweeder—17 in. long—has a pointed, angled blade designed to cut roots and weeds below the soil surface, and close to plants and shrubs. It's available from Smith & Hawken, 25 Corte Madera, Mill Valley, Calif. 94941, for \$12 postpaid.

Garden shredder

This electric shredder from Black & Decker, 701 East Joppa Rd., Towson, Md. 21204, turns garden and household waste into useful mulch or composting material. A 1-hp motor drives two sets of blades—one for precutting, the other for fine shredding. A separate feeder opening will take branches up to 1 in. thick. The electric motor automatically disengages in the event of overload. The Garden Shredder is available at hardware stores and home centers for about \$150.



Multipurpose cultivator

A versatile cultivating tool, the Swoe has three working edges that can be used for hoeing, cutting furrows for seeding, aerating and weeding. The shape of the laminated steel blade permits cutting weeds at root level and working subsurface soil without disturbing the top layer of mulch. Made by True Temper, Box 3500, Shiremanstown, Pa. 17011, the Swoe sells for about \$10 at hardware stores and home centers.



Water broom

The Squirt Water Broom attaches to an ordinary garden hose and provides a 2-foot-wide swath of high-pressure spray for washing down your driveway, sidewalk, patio, garage floor or deck. Its steel frame holds four water jets, and rolls on dual-wheel nylon swivel casters. It can also be used in a horizontal position for washing siding or misting shrubbery and flowers. It's sold for about \$25 by American Water Broom, 3565 McCall Place, Atlanta, Ga. 30340. Phone: 1-800-241-6565.





One-wheel cultivator



A rediscovered and refined workhorse of premotorized farming, the Wheel Hoe has adjustable handles and fork to fit your body size and the attachments being used. The wheel serves as a fulcrum to regulate depth of cultivation, and allows use of leg and back muscles as well as arms. The Professional Wheel Hoe sells for \$152.50 postpaid. Fur-

rower (shown attached) is \$30; 5-in. goose-foot knife (left) is \$23.50; 10-in. oscillating knife (center) costs \$27.75; 3-tine cultivator (right) sells for \$26.75. The attachments are secured to the Wheel Hoe chassis by just a single bolt. The Wheel Hoe and its attachments are available from Green River Tools, Box 1919, Brattleboro, Vt. 05301.



Backpack sprayer

This power sprayer weighs just 16½ pounds, is supported by two adjustable shoulder straps and holds 23 quarts of liquid chemicals. Its wand has a pistol-grip flow control that is available with either two, four or seven nozzle heads, including a long-distance unit, that give fingertip selection of spray pattern and flow rate. High pressure regenerative pump permits spraying up to 35 ft. vertically. The 20-cc gasoline engine has electronic ignition and a vibration-dampening mounting system. Made by Echo Inc., 3150 MacArthur Blvd., Northbrook, Ill. 60062, the SUR200E sprayer unit is sold through authorized Echo dealers for about \$300.



Narrow-track cultivator

This easy-handling cultivator and tiller rolls on 16-in. semipneumatic tires. The 12-in.-wide tines mounted on a forward-projecting drive arm permit weeding between rows, and reaching into, under and around plantings and objects in the garden. Wheel position can be shifted to the rear to redistribute weight and enable tilling to a depth of 6 in. The Cultivator-Plus, manufactured by Troy-Bilt, is powered by a 3-hp engine and weighs under 100 pounds. List price is approximately \$500. For further information or literature write to Garden Way, Dept. P51, 102nd St. and 9th Ave., Troy, N.Y. 12180, or you can call 1-800-833-6990.



Tools with finger power

Lightweight cultivating tools have finger grip on handle bottoms and thumb depression on tops. The configuration increases leverage, prevents slipping and allows a natural grip that reduces hand and wrist fatigue, according to the manufacturer. One-piece, high-tensile, polished aluminum alloy will not rust, and resists breaking or bending. Tools are available from Brookstone Co., 127 Vose Farm Rd., Peterboro, N.H. 03458, and cost approximately \$5 each.



Gasoline hedge trimmer

This gasoline-powered hedge trimmer from Stihl has a 24-in., two-sided cutter blade and weighs 11½ pounds.

Moistureproof electronic ignition, antivibration handle, and an intake silencer and baffled muffler aid user comfort. Sold through Stihl dealers, it lists for \$269. For further information write Stihl Inc., 536 Viking Dr., Virginia Beach, Va. 23452.

Utility garden hauler



This 17-pound cart has 3 1/2-cu.-ft. tub capacity, semipneumatic tires, and it dumps easily with one hand. Manufactured by Radio Steel & Mfg. Co., 6515 West Grand Ave., Chicago, Ill. 60635, the cart sells for approximately \$25 at hardware, garden and home centers.



Flexible yard house

Aluminum-frame screenhouse and greenhouse is also ideal for pool cabana, hot-tub enclosure or potting shed. The standard greenhouse comes with translucent corrugated polyethylene panels and costs approximately \$500. Optional solar screen sides with a Velcro fastening system are interchanged easily with panels. Screens cost an additional \$250. The kit includes hardware, fasteners and foundation anchors and requires only a screwdriver for assembly. For further information, contact Flex Pak Co., 25330 Interchange Ct., Farmington Hills, Mich. 48018.



New way to sow

Reduce the risk of germination failure by starting seeds in a liquid germinating gel. Mix seeds and gel and place them in the calibrated tray, which measures the amount of mix needed according to furrow length. After seeds begin to germinate, pour the mix into the dispenser and sow it into the furrows. Gel protects against cold, and supplies moisture to the germinated seeds. It also helps to properly space tiny seeds such as carrots, beets and parsley. A squeeze plunger on the dispenser regulates the gel flow and a revolving spool measures the furrow length as you go. Complete system includes powdered gel—enough for several years for a family-size garden, calibrated germinating tray and the dispenser. The system is available for \$29.95 postpaid from Gardener's Supply Co., 133 Elm St., Winooski, Vt. 05404.

Portable greenhouse



Low-cost greenhouse has a tough woven polyethylene skin that supposedly admits 90 percent of the sun's light and diffuses the light to prevent burning and uneven plant growth. The structure is 6 ft. high, 12 ft. wide and has zippered doors at each end. It comes in three lengths and can be moved intact from one spot to another. No foundation is required. Optional earth anchors are available to hold the greenhouse fast in heavy winds. The frame and fasteners are zinc-plated steel, and the skin is reinforced at frame points. List prices from Gardener's Supply Co., 133 Elm St., Winooski, Vt. 05404, are: 6-ft. unit, \$219; 12-ft. unit, \$275; 18-ft. unit, \$375; plus an 8-percent shipping charge for each unit.

Mower starter

An adapter and drive coupling transform cord-pull mowers into electric starters using a 3/8-in. electric drill. Spin Start installs easily, ends hard starting and provides a backup to battery-equipped engines. From Specialty Design Inc., Box 8505, Sugar Creek, Mo. 64054, the adapter, postpaid, is \$21 for vertical-pull engines; \$22.50 for side-pull Briggs and Stratton engines.



Electric mower

A streamlined 20-in. rear-discharge electric mower from Sears Roebuck and Co., Sears Tower, Chicago, Ill. 60684, has a low-profile plastic deck and weighs 69 pounds. The motor has two speeds, and wheels adjust to nine different heights. Vacuum action lifts grass for a clean cut and efficient discharge. Mower operates up to 100 ft. from electrical outlet. Price of \$270 includes polyethylene catcher. The mower is sold at larger Sears stores and through its general catalog.





Sit-down gardening

Wheel instead of kneel in your garden with this back-saving Garden-Scot. The unit is simply a steel frame with swiveling seat, mounted on two 10-in. rubber-tire wheels. The price is \$54.95, postpaid, and it's available from Eastern Atlantic Gift Co., Dept. 4761, Box 21, Monmouth Beach, N.J. 07750. The Garden-Scot is also available in a three-wheel version that costs \$70.95, postpaid.



Outdoor speaker

The Ground Speaker is designed to be planted permanently in the ground, and withstand rain and freezing temperatures. Plastic case, aluminum screening and a foam ring keep dirt and moisture away from the 8-in. JBL omnidirectional speaker. Price is about \$100 per speaker, including 50 ft. of underground cable. For further information, write Comar Enterprises, 1528 N. Pepper St., Burbank, Calif. 91505.

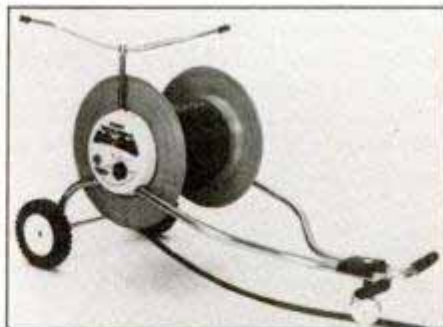
All-purpose machine

Gas-powered, 1-hp utility tool, called The Green Machine, has five attachments that can be interchanged in seconds, according to the manufacturer. The power head along with a string trimmer sells for about \$240. The weeder-cultivator (\$100) has twin reciprocating blades that move at 2,000 cycles per minute. The edger (\$70) has adjustable blade depth. A power blower (\$50) air-streams leaves and clippings into piles. Snow thrower (\$110) clears a path 12 in. wide by 7 in. deep. The Green Machine and Expand-It units, made by HMC, 20710 Alameda St., Long Beach, Calif. 90810, are sold at garden stores and home centers.



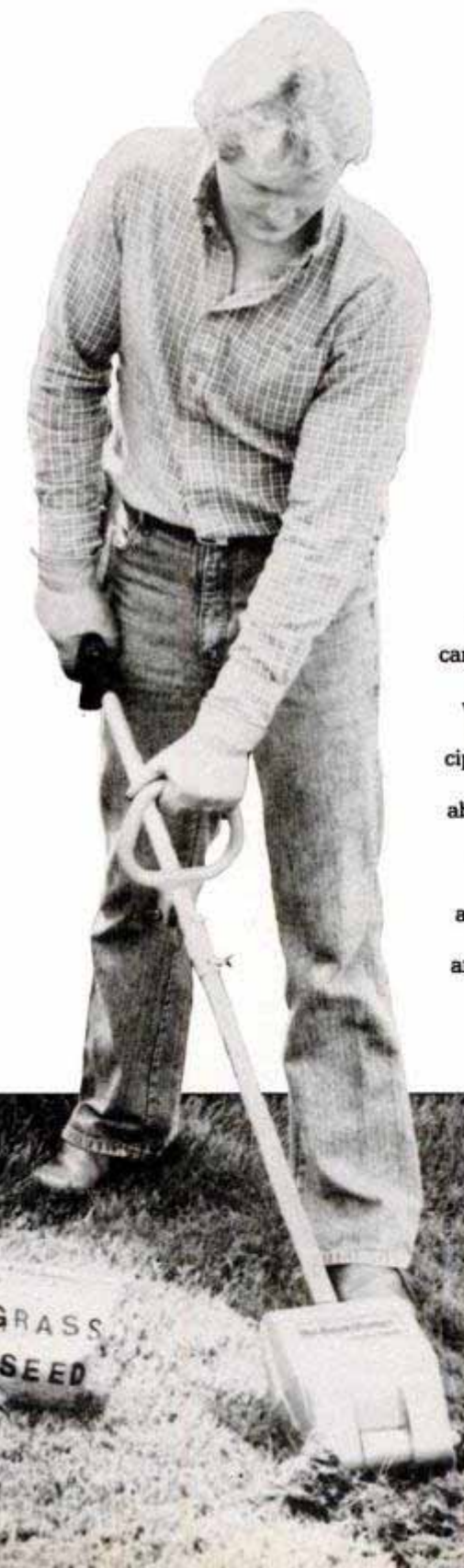
Soil reworking fork

The U-Bar is a rugged but lightweight garden fork for reworking compressed planting beds. Previously cultivated soil is lifted and crumbled without turning it over and inverting established soil layering. Available with either 8-in. or 10-in. tines, it sells for \$60, postpaid, from Smith & Hawken, 25 Corte Madera, Mill Valley, Calif. 94941.



Traveling sprinkler

Automatic sprinkling system waters up to 20,000 sq. ft. of lawn in one setting. Lay out the hose in a prearranged pattern across the lawn, and the sprinkler will automatically reel in the hose as it waters and shut itself off when finished. Melnor Travel-Matic, Model 3803, has adjustable nozzles to control diameter of spray area up to 54 ft., and controls for fast, slow and stationary sprinkling. It holds 325 ft. of 1/2-in. hose. The sprinkler is sold by lawn and garden stores and home centers for about \$210. For further information, write Melnor Industries Inc., 1 Carol Pl., Moonachie, N.J. 07074. **PM**





A Classic Windsor Chair

You can build
this graceful
armchair out of
poplar, maple and ash.

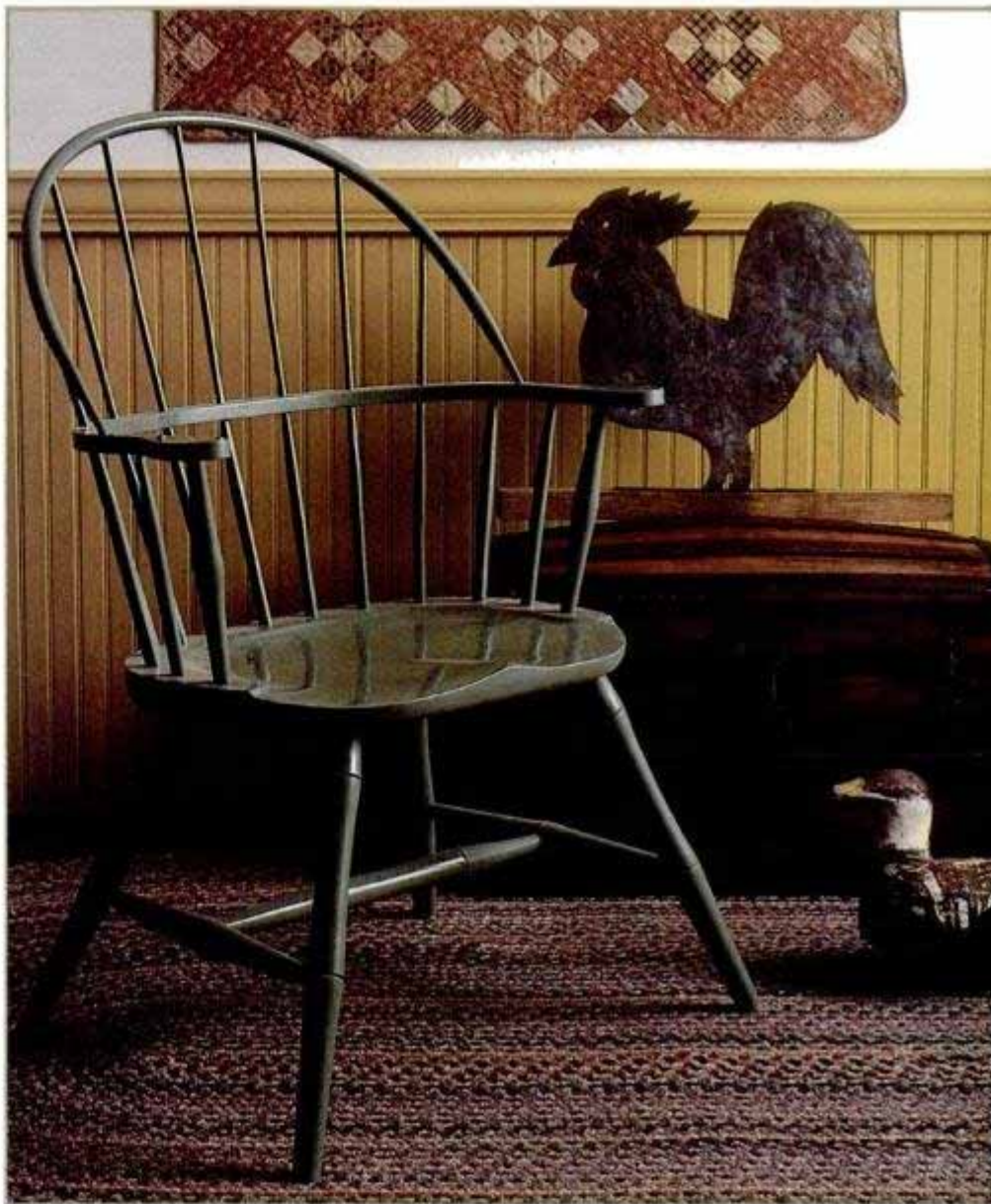
NEAL BARRETT

Sack-back Windsor chairs first appeared in America at the beginning of the 18th century. By the middle of the century, they were in widespread production, particularly around Philadelphia. Originally, they were designed in England during the 1600s, and were prized for their graceful lines and lightweight but sturdy construction.

These chairs are built of three different woods. The seat uses a soft wood like pine or poplar because it can be carved easily. The legs, stretchers and arm posts are generally made of maple because the density of this wood allows clean, crisp lathe turnings. And the spindles, arm rail and bow are made of hickory or ash, chosen for their flexibility and strength. Our chair has a poplar seat, maple turnings and ash spindles, arm rail and bow.

Because of the multiwood construction, Windsor chairs were traditionally painted to mask the differences in grain and color. Many were black, brown, red or white. But historically, the favorite color seems to be green because the chairs frequently were used for garden or porch furniture.

Building a chair like this is a real woodworking challenge. Much of the work must be done with hand tools, and the fit of various parts relies as much on trial and error—and a good eye—as it



This sack-back Windsor chair is an American classic based on traditional English garden chairs. Building it will challenge any woodworker's skill with hand tools and joinery.

does on rigidly following a specific plan. But, in fact, much of the Windsor's charm is in the building, using traditional methods to create a one-of-a-kind furniture piece for yourself.

Seat construction

Begin by edge-joining 8/4 stock to form a slightly oversized seat blank. Then, using the drawing as a guide, mark the position of the axis lines, spindle and leg holes, spindle rail and seat outline. Next, cut the seat outline using a band saw.

Keep in mind that each hole in the seat must be bored at a specific compound angle. The arrows on the drawing refer to the direction these angles must take relative to the top of the seat.

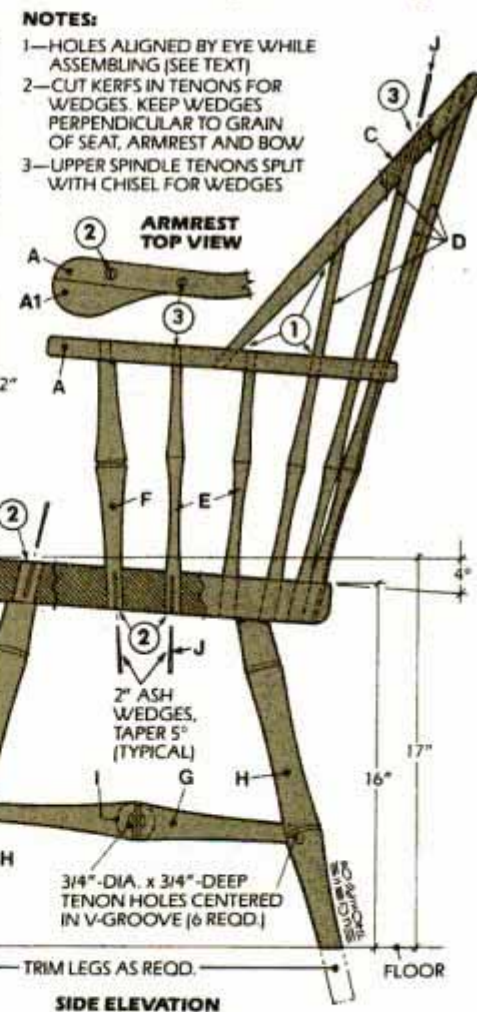
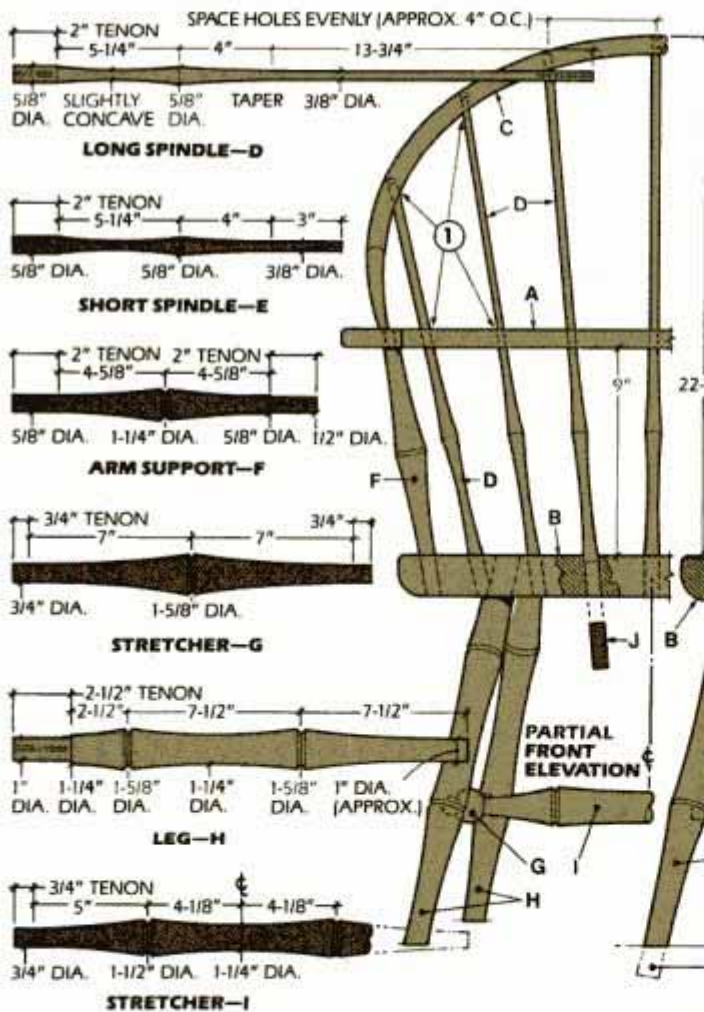
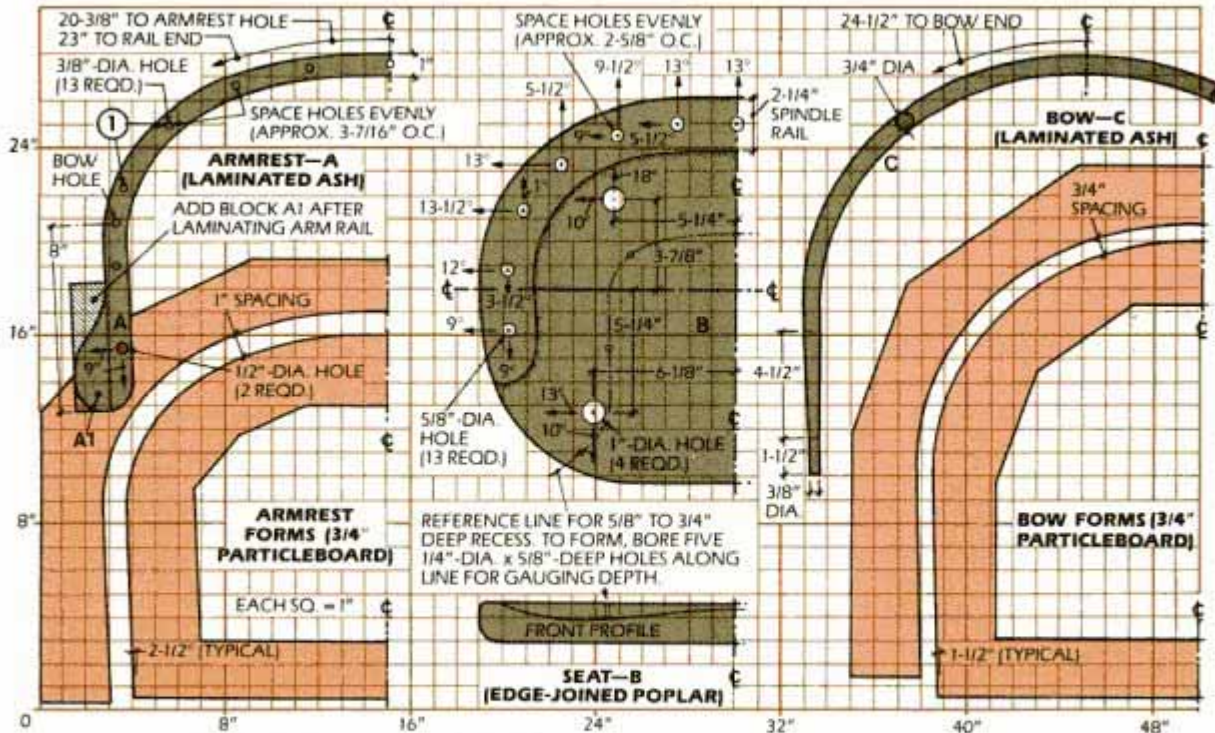
Black and white photos: Neal Barrett
Color photo: Harry Hartman
Photo stylist: Gabe Herrick
Wall hanging, rooster, decoy: Gene Reed
Antiques, Nyack, N.Y. 10960

The best way to bore these holes is with the aid of a drill bit guide block cut to match each hole's angle.

To make the guide blocks, cut 2-in. square blocks out of scrap 8/4 stock. Then, using a table saw, cut the two angles given for each hole on adjacent sides of the block. Next, clamp the guide block onto the spindle rail so the square sides are parallel to the axis marks and so the edge where the two angles meet just touches the hole's circumference. Bore each hole as shown in the photo on page 116, letting the drill bit follow the corner of the block. Proceed slowly and be sure that you place a scrap board under the seat so the bottom won't splinter when the bit breaks through.

When the holes are complete, transfer the front profile of the seat from the drawing onto the blank. The drawing also shows the proper position of a

WINDSOR CHAIR



MATERIALS LIST—WINDSOR CHAIR

Key	No.	Size and description (use)	E	4	5/8"-dia. x 14 1/4" ash (short spindle)
A	1	1 3/16 x 1 x 54" ash (arm rail)	F	2	1 3/8"-dia. x 13 1/4" maple (arm support)
A1	2	1 3/16 x 1 1/2 x 5 1/2" ash (arm rail block)	G	2	1 3/4"-dia. x 15 1/2" maple (side stretcher)
B	1	1 3/4 x 16 1/2 x 22" poplar (seat)	H	4	1 3/4"-dia. x 20" maple (leg)
C	1	3/4 x 1 3/8 x 54" ash (chair bow)	I	1	1 1/2"-dia. x 19 3/4" maple (center stretcher)
D	7	5/8"-dia. x 25" ash (long spindle)	J	30	1/2 x 2" ash wedges, trimmed to fit

A CLASSIC WINDSOR CHAIR

reference line that marks the deepest excavation required on the seat. A good way to establish this depth is to bore the five 1/4-in.-dia. by 3/8-in.-deep holes shown, on each side of the seat, to act as clear depth gauges when you are carving out the waste.

Keep in mind that the seat shape gradually slopes down from the flat spindle rail to the 5/8-in. to 3/4-in. depth line, then rises again at the front center. Carve slowly, using a 3/4-in. or 1-in. gouge and wood mallet. As you approach the finished profile, test the shape by sitting on it. It is more important that the seat be comfortable for you than to have it correspond to the pattern precisely. When the rough carving is complete, use a compass plane or scraper to remove the gouge marks. Then, finish shaping with a disc sander using 120-grit discs. Turn over the seat and,

using a block plane, spokeshave or rasp, round the bottom edges of the seat. Again, you should use the disc sander to smooth the edges.

Legs, stretchers, arm posts

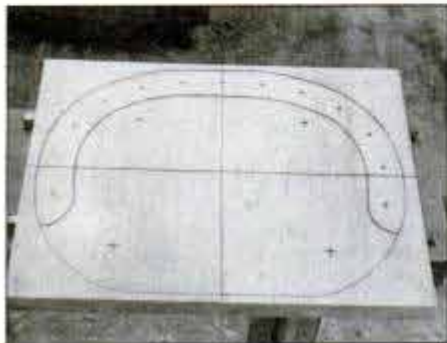
Rip 8/4 stock to 1 3/4-in. square for the turnings. Then, crosscut these pieces 1 in. longer than the finished length. Begin by turning the legs on a lathe to match the shape given on the drawing. Cut the overall shape with a gouge and the V-grooves with a skew chisel. Be sure to use a caliper to check your progress. Remove the toolrest and sand the piece while it's turning with 120- and 220-grit paper. Follow the same basic procedure for the stretchers and arm posts.

When turnings are complete, cut off the waste at the ends. Then, slide the leg tenons into the seat bottom. Next,

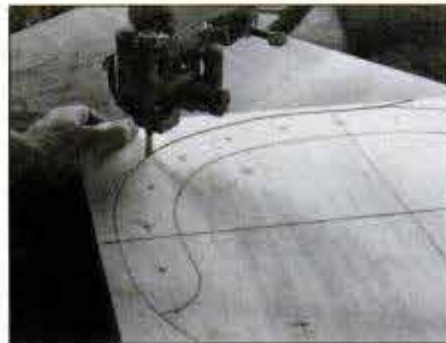
using a 1/2-in.-thick piece of wood as a guide, trace the angled shoulder for each tenon at the top of all legs as shown. Label the position of each leg on both the leg and seat. Then, mark the end of each tenon with a line perpendicular to the grain of the seat. These lines are for the kerfs that will receive wedges later. Remove the legs and cut the tenon shoulders with a backsaw. Then, using a sharp chisel, pare away the waste from each tenon.

Slide the legs into the seat again and clamp a straightedge between each pair of side legs, just below the lower V-groove. You should use the straightedge as a guide to bore a straight 3/4-in.-dia. x 3/4-in.-deep hole in each leg, centered in the V-groove.

Next, partially remove the legs so the stretchers will fit into their respective holes. Then, gently tap the legs back



Glue up oversized seat blank, then transfer shape of seat and spindle rail onto blank. Also locate spindle holes and axis lines.



Cut entire outline of seat using a band or sabre saw. Keep blade on waste side of line and use slow feed rate for cutting accuracy.



Cut angled guide block for each seat hole. Then, clamp each in place next to hole. Bore hole using corner edge of block as guide.



Transfer seat profile from drawing onto front edge of blank. Then, carve rough shape using mallet and 3/4-in. or 1-in. gouge.



When seat feels comfortable, use disc sander to remove gouge marks and smooth surface. Gooseneck cabinet scraper will also work.



Finished seat ready for assembly has flat spindle rail, concave top with center rise, and rounded edges on perimeter of bottom.



Carve seat legs, stretchers and arm supports on lathe using a gouge for general shaping and skew chisel for the V-grooves.



Mark position of angled shoulder for each leg tenon by scribing circumference of leg with pencil resting on 1/2-in.-thick block.



Clamp leg in vise. Then, carefully cut angled shoulder using dovetail or backsaw. Pare waste from tenon using sharp chisel.

into position. When the joints are tight, clamp the straightedge between the two side stretchers and bore holes in them to receive the middle stretcher. Disassemble the legs and stretchers. Then using a backsaw, cut a wedge kerf in each leg tenon to within $\frac{1}{4}$ -in. of the shoulder.

Spindles

Rip $\frac{1}{4}$ stock to $\frac{3}{4}$ -in. square for the spindles, then crosscut the pieces at least 2 in. longer than their finished size. Although the spindles are round, it will be difficult to turn them on the lathe due to their slender profile. Instead, the spindles should be formed using hand tools.

First, make a gauge to test the large and small diameters by boring a $\frac{3}{8}$ -in. and a $\frac{5}{8}$ -in. hole in a piece of scrap wood. Then, clamp each spindle blank

in a vise and, using a block plane or spokeshave, rough out the shape to match the drawing pattern. Turn the spindle frequently and test the diameter with the gauge. The fit should be snug but allow the gauge to pass over the spindle without using excessive force. Smooth each piece with a cabinet scraper followed by 120- and 220-grit abrasive paper. Then, cut a $1\frac{3}{4}$ -in.-deep wedge kerf in the bottom of each using a backsaw. The tops will be split with a chisel later.

Arm rail and bow

The traditional way to bend the arm rail and bow is with steam. But this is a difficult process. We achieved the same curves using bent lamination, which is done more easily in a small shop.

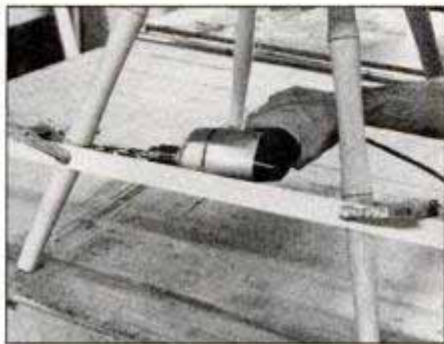
Begin by making the forms for the arm rail and bow shown on the draw-

ing. We used $\frac{3}{4}$ -in.-thick particleboard for the forms, but plywood can work as well. Trace the patterns onto the stock and cut out the forms using a jigsaw or band saw. Because the bent wood will directly reflect the shape of these forms, accurate cutting is crucial. The faceted cuts on the interior of the forms provide clamping surfaces only, so precise cutting is not as vital for them.

Once the shapes are cut and sanded smooth, apply Mylar packing tape, wax or silicone spray to the mating edges to prevent the wood parts from being glued to the forms.

The arm rail and bow are made by gluing up thin strips of stock each $\frac{1}{12}$ in. thick. Cut these from $\frac{1}{4}$ stock to a length of 56 in. Use a planer blade for a smooth cut and a featherboard to hold the work against the fence. Rip a total of

(Please turn to page 211)



Clamp straight board to legs. Use it as alignment guide to bore socket holes for stretcher in middle of bottom V-grooves.



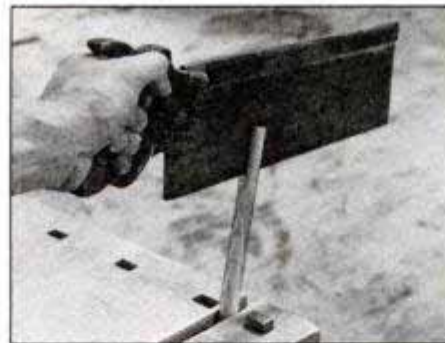
Use a backsaw to cut a kerf in each leg tenon perpendicular to direction of wood grain in seat. Kerf will receive wedge later.



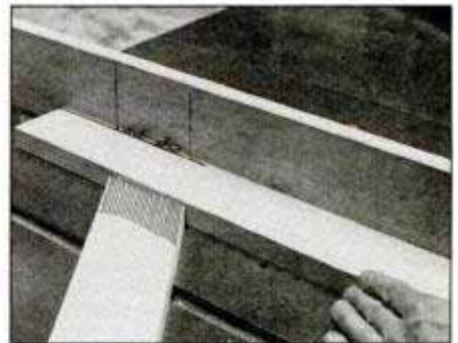
Clamp spindle blank in vise. Then, carve to shape using spokeshave or block plane. Turn work frequently for round shape.



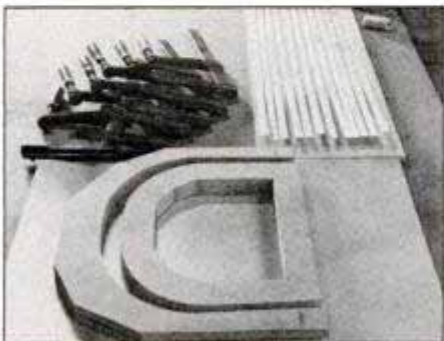
When carving spindles, check progress with tape measure and diameter gauges. All spindles must be exactly the same.



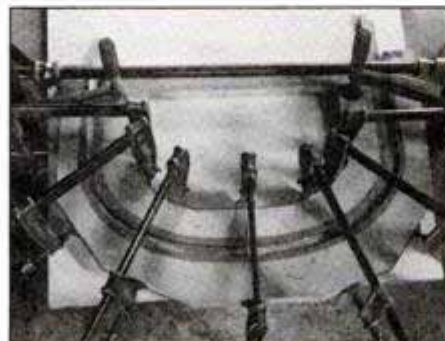
Once all spindles are shaped and sanded smooth, cut $1\frac{3}{4}$ -in.-deep kerf in bottom end of each using dovetail or backsaw.



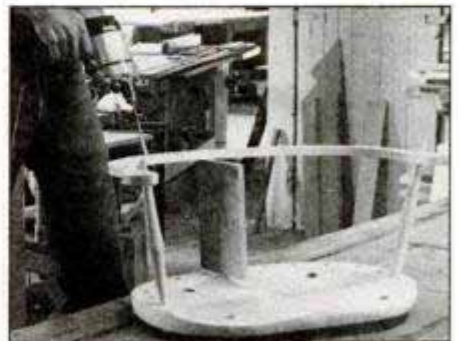
Cut thin wood strips for curved arm rail and bow from $\frac{1}{4}$ stock. Use table saw with featherboard clamped in place.



Bending forms are made from double layers of $\frac{3}{4}$ -in.-thick particleboard. Mating surface on both must be sanded smooth.



Apply sealer to form edges. Then, glue and clamp strips between forms. Make sure all gaps between strips are closed.



Support rear of arm rail with scrap block. Then, bore spindle holes in rail by aiming drill bit toward matching holes in seat.

4 Accessories For The Home METALWORKER

Here are four shop-tested metalworking projects designed to make the home machinist's life a little easier. Three are lathe accessories that will make precision metal turning easier.

They include a distortion-free ring-turning technique, a setback toolpost for turning sphere-shaped pieces and a lathe hand crank for nonelectric, manual lathe operations. The fourth fixture is an

easy-to-make extension accessory that doubles the measuring capabilities of a conventional micro-meter. The accessories were designed to work on a 9-in. metal lathe, but the dimensions shown in the

TEXT AND PHOTOS BY WALTER E. BURTON
Technical art by Ed Lipinski

drawings can be altered, if necessary, to accommodate most other lathe sizes. Be certain to observe standard metalworking safety precautions during the manufacture and use of these accessories.

Distortion-free ring turning

The common practice of turning ring-shaped workpieces seldom results in truly circular rings. The reason is that the clamping pressure exerted on the turning blank by the lathe chuck jaws distorts the ring's shape. Although the lathe tool cuts a true, round ring, when the chuck jaw pressure is released, the ring will have three or four (depending on the number of chuck jaws) high spots where the jaws gripped the blank.

To prevent such distortion, mount the turning blank on the headstock spindle without using a jawed chuck.

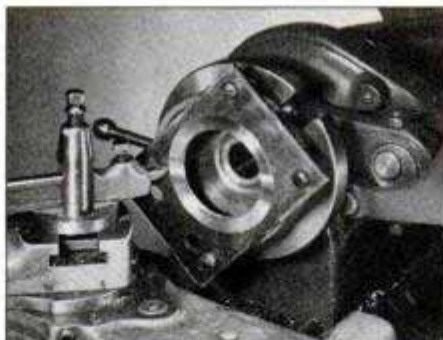
The technique shown produces perfectly round rings quickly and safely. Simply solder the turning blank to a support plate that is bolted to a faceplate. Then, mount the faceplate on the headstock spindle.

Start by rough-cutting the ring blank to its approximate finished diameters. Next, make the ring-support plate to fit on the faceplate. The support plate

shown is 1/8-in.-thick brass, but steel could be used, too. To provide tool clearance for cutting the blank's inside diameter, install a 3/4-in. spacer ring between the support plate and the faceplate. Now bolt the support plate to the faceplate, with the spacer between them, and mount this assembly on the lathe. Next, make very shallow facing cuts on the support plate to provide a clean, even soldering surface. Then, unbolt the assembly and solder the ring blank to the support plate. Wire the two



Here are the components needed to turn distortion-free rings (clockwise from upper left): faceplate, spacer ring, turning blank and support plate with mounting bolts.



Make shallow facing cuts on the support plate to produce a clean, even soldering surface. Plate centerhole must be smaller than the inside diameter of finished ring.



Use an electric hotplate to solder the blank to the support plate. Place flux and solder pieces around the blank. As the solder melts, it will be drawn between the parts.



When the soldered joint cools, bolt the support plate to the faceplate separated by the spacer. Use a boring tool to cut the centerhole to the desired inside diameter.



After machining the outside diameter of the blank, remove the ring from the plate and mount it in a jawed lathe chuck. Take shallow cuts to remove any residue solder.

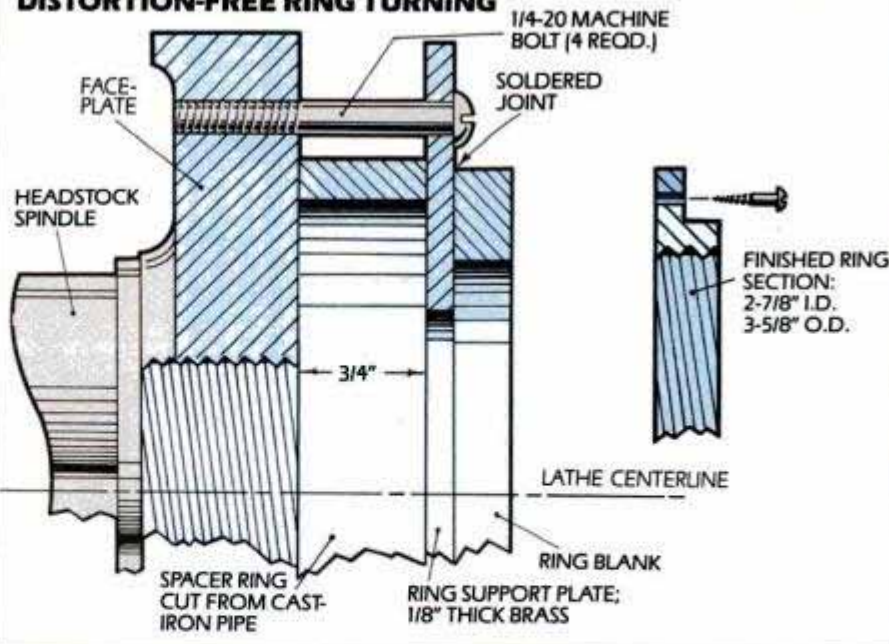


Here's the completed ring (left) and the support plate. Before reusing the support plate, bolt it to the faceplate and take very shallow cuts to clean the soldered surface.

parts together and set them on an electric hotplate with several small pieces of solder and flux around the blank. As the solder melts, it will be drawn between the parts.

After the soldered joint cools, bolt the support plate and spacer ring to the faceplate and mount the assembly on the lathe. Using a boring tool, enlarge the inside diameter of the blank and support plate to the desired finished dimension. Now cut threads on the inside of the ring, if desired. Next, machine the outside diameter of the ring to the finished dimension. Then, remove the support plate and return it to the hotplate. When the solder softens, separate the finished ring from the support plate. Finally mount the ring in a jawed lathe chuck to clean residue solder from the ring back surface. Take shallow facing cuts to obtain a smooth, even surface.

DISTORTION-FREE RING TURNING



Micrometer range doubler

This accessory increases the capabilities of a standard 1- to 2-in. micrometer to permit measuring from 0 to 1 in. It attaches to the anvil end (the end opposite the adjustable spindle) of the micrometer and can be removed easily, when it is necessary.

First, machine the body section from $7/16$ -in.-dia. cold-rolled steel rod. Then, drill into one end of the body deep enough to accept the micrometer frame end, a $1/4$ -in.-long threaded plug, $1/16$ in. for anvil projection and about $3/32$ -in. clearance. Next, machine the bottom of the hole flat with an end mill. This permits the micrometer anvil to sit squarely in the body. Now drill and tap the other end of the body, as shown, to accept the anvil extension.

To enable the range doubler to be slipped over the micrometer frame end, cut a slot into the body, as shown. First, mill a $3/32$ -in.-deep recess about $1/16$ in. longer than the micrometer frame width. Next, cut back the inner edges of the slot using a rotary file until the micrometer fits into the slot. Then, you should install a $1/4$ -in.-long, press-fitted, internally threaded plug into the body end, as shown, to accept a knurled-head locking screw.

Make the anvil extension from $1/4$ -in.-dia. drill rod. Cut $1/4$ -28 threads on $3/8$ in. of one end. On the unthreaded end, machine and polish the anvil end flat and square. File the anvil extension sides flat, if desired, to accommodate a wrench. Now screw the anvil extension into the body and lock it in place by using a $1/4$ -28 hexnut.

To use the range doubler, first lock it onto the micrometer by tightening the knurled-head screw. Then, adjust the

spindle until the micrometer scale reads 0. In this position, the distance from the spindle to the micrometer's original anvil is 1 in. Next, unscrew the anvil

extension until it's flat against the spindle. Then, tighten the hexnut. Now the micrometer is ready to measure items between 0 and 1 in.

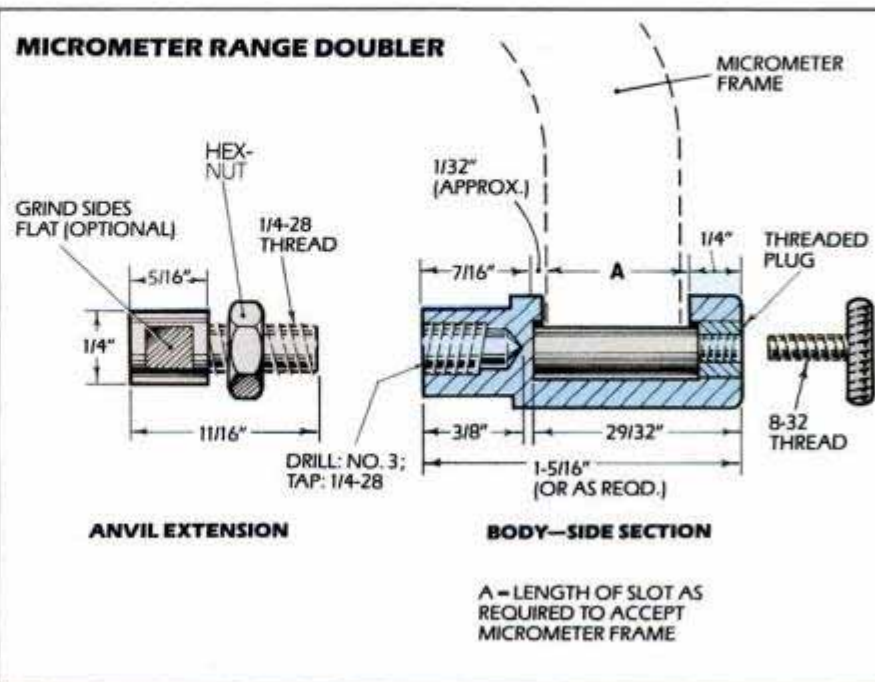


Disassembled range doubler is shown with a 2-in. micrometer. Parts are (left to right): anvil extension, hexnut, body, threaded plug and knurled locking screw.



With the range doubler attached to the micrometer frame, you increase the measuring capabilities of a 1- to 2-in. micrometer to allow measuring from 0 to 1 in.

MICROMETER RANGE DOUBLER



Spherical turning

A lathe equipped with a compound toolrest is capable of machining sphere-shaped workpieces. The compound rest pivots at an angle to the cross-feed travel. Position the cutter bit from the pivot point at a distance equal to the radius of the desired sphere. Make the cut by swinging the compound rest slowly into the rotating stock.

Here's the proper procedure for turning a sphere on the end of a round steel bar. First, face off the bar end smooth and cut a 45° chamfer to one-half the bar diameter. Next, stop the lathe and loosen the compound rest locking screws. Then, use the cross-slide crank to move the compound rest pivot point directly under the bar centerline. Be sure to check the pivot point position with a machinist's square.

Now position the bit so that its cutting point is directly above the compound rest centerline. With the compound rest at a right angle to the lathe bed, turn the crank to advance the cutter bit until it touches the side of the bar. This position determines the radius of the cut. Crank the carriage hand wheel to move the cutter past the end of the bar. Next, swing the compound rest 90° to the right until it's parallel to the lathe bed. Move the carriage to the left until the bit touches the bar end. Lock the carriage by tightening the binding screw. Finally, start the lathe and swing the compound rest slowly to the left to cut the sphere.

It's often necessary, and safer, to make several shallow passes. After positioning the compound-rest pivot point under the bar and moving the bit against the bar side, make a reference mark, noting the position of the compound rest feed screw on its micrometer collar scale. Now back the bit off and make a shallow cut. Continue taking progressively deeper cuts until the original bit position is reached.

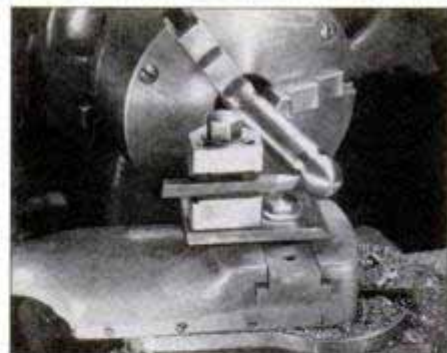
Some lathes can't perform sphere-turning techniques when using a standard toolpost because the bit can't be held far enough from the compound rest pivot point.

The solution to this problem is to make a setback toolholder, as shown in the drawing. The setback toolholder will turn a 2-in.-dia. sphere on a 9-in. lathe. Use shims under the bit to adjust the cutting edge even with the spindle centerline. To permit swinging the compound rest without hitting the lathe chuck or the headstock casting, allow the workpiece to project from the lathe chuck a few inches. To prevent wobbling, which may occur when turning small-diameter stock, use a tailstock center to support the stock end.

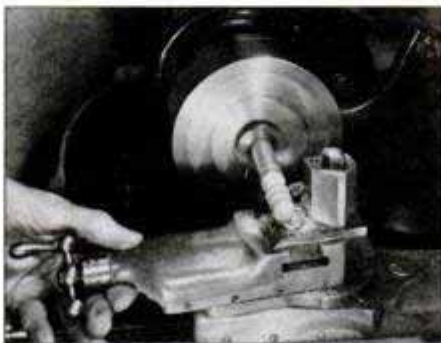
Original spherical-turning technique submitted by Wesley Luckstead.



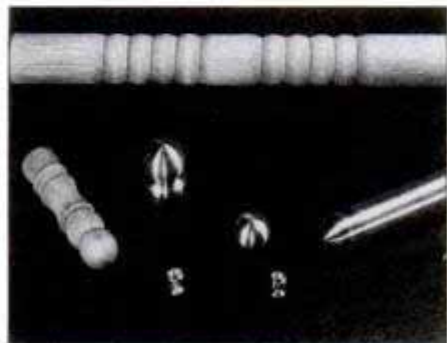
Disassembled setback toolholder is shown with two shims and a 1/4 × 1/4-in. bit. Long bolt fastens toolpost to setback plate; short bolt mounts plate to clamping bar.



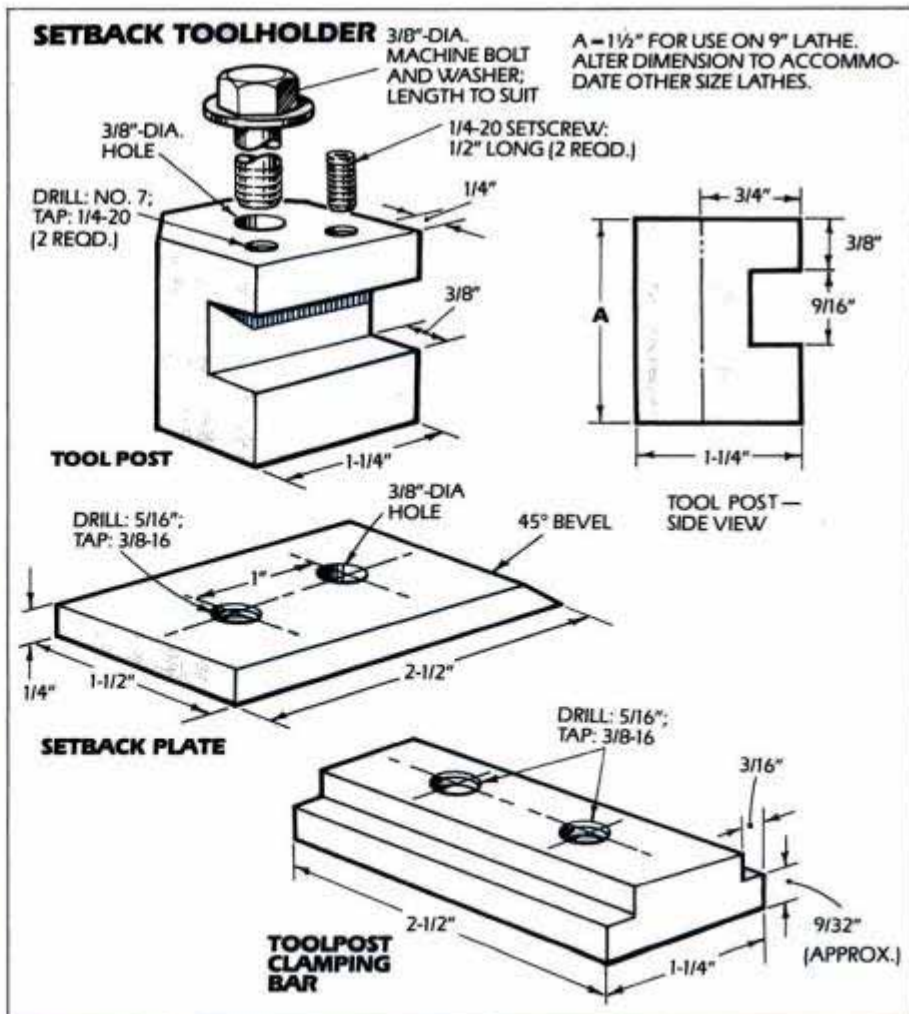
Setback toolholder bolts to a compound toolrest for turning sphere-shaped pieces. Note that round bar projects from the chuck enough to permit turning a ball end.



Cut concave surfaces with the setback toolholder positioned behind the stock. Be certain to invert the bit in the toolpost and run the lathe in a forward rotation.



Sphere-turning samples include a ringed wood spindle (background), wood finial, round drawer knob, steel ball, rod with hemispherical end, two miniature goblets.



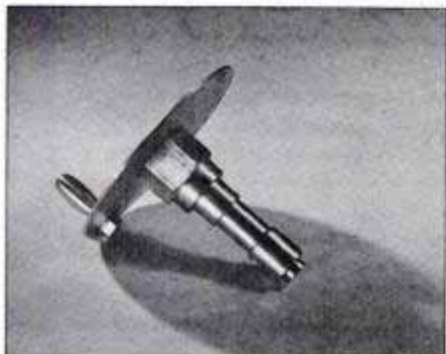
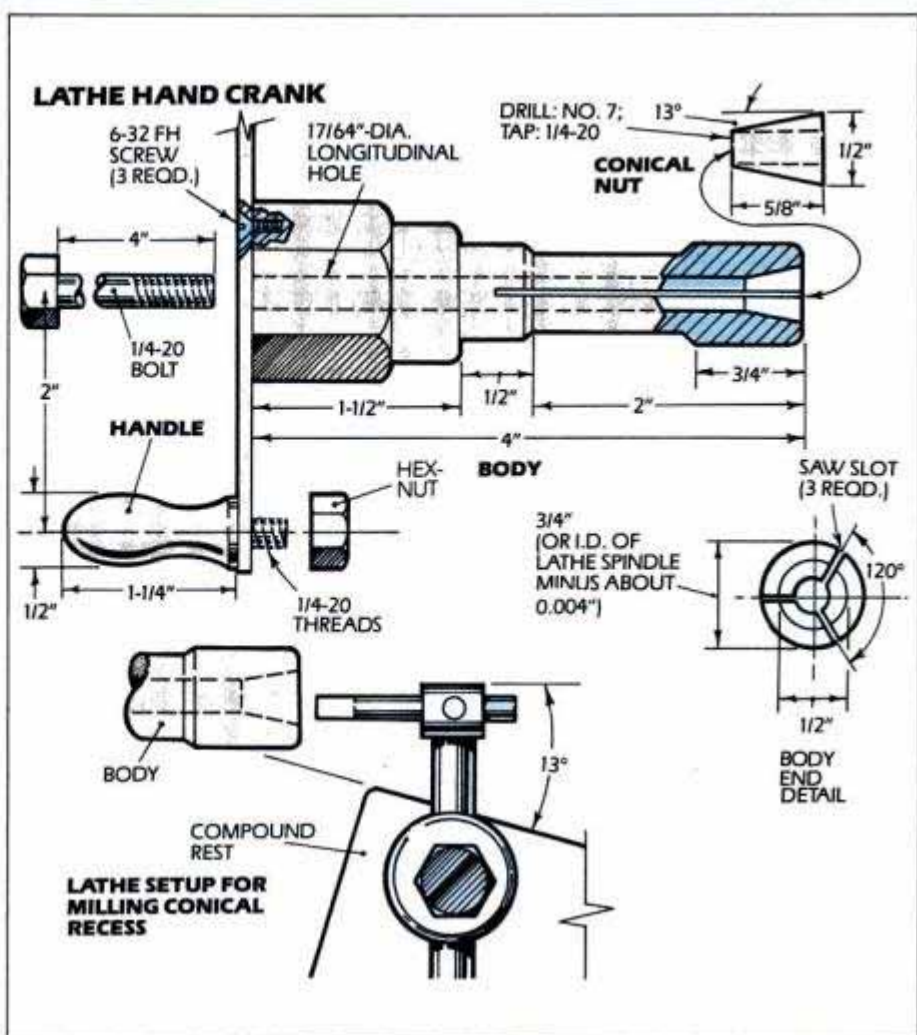
Lathe hand crank

Sometimes, a lathe motor is more of a hindrance than a help. For example, when cutting fine threads that run up to a shoulder, stopping the cut before the bit jams against the shoulder is tricky. A safe, easy solution is to operate the lathe manually using a hand crank.

First, machine the body from a 1 1/8-in.-dia. hexagonal cold-rolled steel bar. Next, drill a 17/64-in.-dia. axial hole through the bar. Then, form the conical recess in the body end with a boring bit mounted on a compound rest. Set the compound rest at 13° to the lathe centerline and control the bit with the compound feed screw. Now cut three 2 1/4-in.-long slots in the body end using a milling machine or a hacksaw. The slots allow the body to expand when the conical nut is tightened.

Make the 4 1/2-in.-dia. disk and handle. Then, drill and tap the body end to accept three 6-32 mounting screws and machine the conical nut from 1/2-in.-dia. steel rod. First, drill through the rod with a No. 7 bit and tap 1/4-20 threads to match the 4-in.-long drawbolt. Turn the conical shape using a compound rest set 13° to lathe centerline.

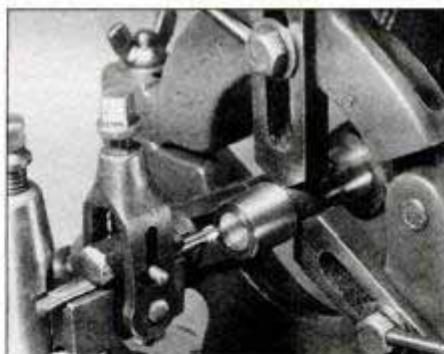
To use hand crank, unplug the lathe, insert the body into the headstock spindle and tighten the drawbolt. Now turn the handle to advance or reverse the lathe. Remove crank before resuming power lathe operations. **PM**



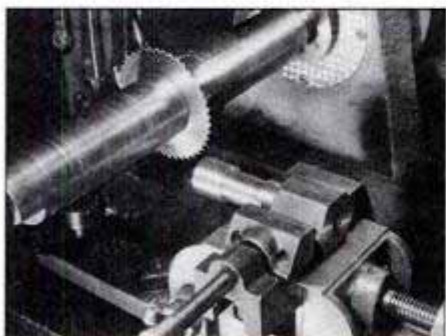
Completed lathe hand crank is shown ready for use. Dimensions given are for a 1/4-in.-dia. headstock spindle bore. Alter the body diameter for other size spindles.



The body was machined from a 1 1/8-in.-dia. hexagonal bar, but a round bar could be used, too. Note that the tailstock center is used to steady the end of the bar.



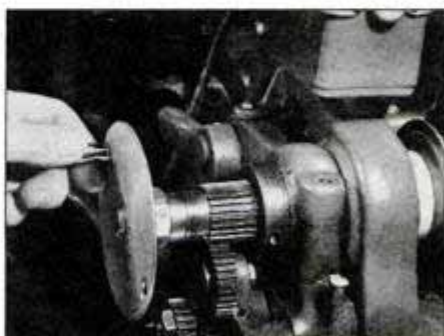
Use a boring tool on a compound rest to cut the conical recess in the body end. Set the compound rest at 13° to the lathe centerline. A steady rest prevents wobbling.



Cut slots in the body using a milling machine and a slitting saw. A hacksaw could be used, instead. The slots allow the body to expand inside the spindle.



Hand crank components are shown above. Disk was made from a round electrical junction box cover plate. Drill disk center to accept drawbolt and mounting screws.



Insert the hand crank body into the headstock spindle and tighten the drawbolt. As the conical nut is drawn in, the body expands and locks in the spindle bore.

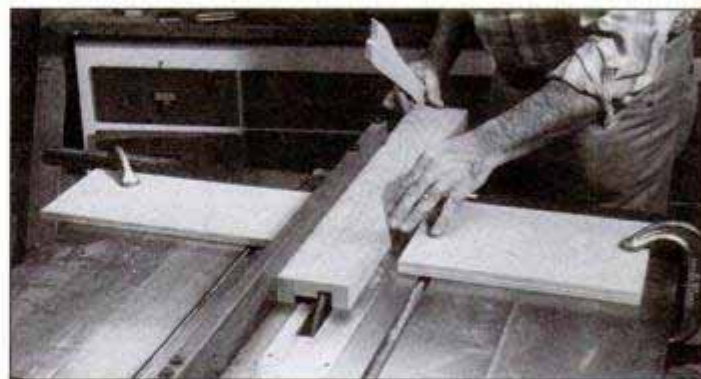
WORKSHOP MINICOURSE



Using dado blades: Part 2

Last month, we discussed the two most common dado blades—the “wobbler” and the more conventional multi-blade set—and showed you how to use them for cutting basic rabbets, dados and grooves. Each has its advantages. The wobbler can be adjusted on the saw arbor for quick width changes without removing the blade. The multiple blades, on the other hand, can be spaced apart for cutting tenons and tongues as shown below. All the techniques shown here work all on the table saw. Next month, we'll feature the radial-arm saw.

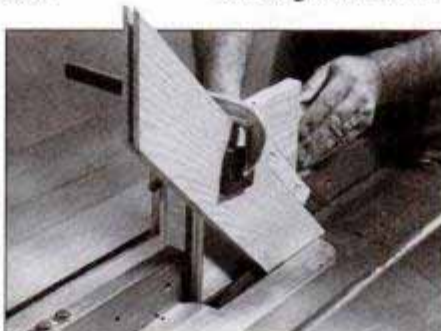
Because these blades remove so much stock in one pass, the possibility of kickback is great. Always hold the stock firmly, feed it slowly and make deep cuts in several passes, particularly in hardwood.—Rosario Capotosto



Make wide and deep cuts in several passes, moving the fence after each cut is made. Clamped boards serve to maintain precise side to side alignment when the depth of the cut is increased.



To cut blind rabbets, clamp stop blocks to fence. Then, butt work against rear block, lower into blade, push to front block.



Cut spline grooves in mitered ends using improvised U-shaped tenoning jig. Center board in jig must be same thickness as fence.



For precise cuts, make notch in miter gauge fence and transfer cut lines to top of board. Align marks with notch and push into blade.



To make repeated stopped dados of consistent length, clamp stop block to table in front of blade then push stock to block.



Commercial tenoning jig makes fast work of cutting open mortises. Two dado blades butted together cut a 1/4-in.-wide slot.



Tenons can be cut in one pass using dado blades separated with spacers. Here, two outside and two chipper blades were used.



To cut notch across corner of square work piece, use cradle jig. Make jig from two sections of 2 x 4 stock, each with 45° bevel.



When cutting angled dados, work tends to creep “downhill” from blades. To prevent this, tack-nail stock to miter gauge fence.



Dado blades can be used to form decorative lattice. Make cuts on each side slightly deeper than one half of the stock thickness.

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Fun For Car Buffs

We call them 'Everyday Classics.'

Call them collector cars, special-interest autos, vintage cars, antiques, hobby cars—whatever. They seem to be lurking in back yards, carports, barns and garages all over America. We're not talking about \$100,000 museum pieces here, but older cars that are somehow special and worth keeping. They range from Model T Fords to 454 Corvettes, and their common denominator is fun. People buy them, trade them, fix them up or just squirrel them away in garages as projects for a rainy day.

Most owners don't use their self-proclaimed gems as daily transportation. They save them for weekends and nice weather, then take them out for that American institution, the Sunday drive. Other popular employments are hometown parades, auto shows and club meets.

There are all sorts of clubs for car buffs, ranging from such generic

organizations as the 48,000-member Antique Automobile Club of America to single-model groups like the 85-member Morgan Three-Wheeler Club.

Car clubs are the lifeblood of the hobby. Their newsletters are full of information: cars for sale, repair instructions and sources for "impossible-to-find" parts like vacuum-operated windshield wiper motors.



Out for more than a Sunday drive, Ron Bauman won \$5,000 in The Great American Race in his '34 Chrysler.

Club meets vary widely in size, too, from informal get-togethers of a dozen people who'll shoot the breeze at a member's house, to huge conclaves like the AACA's fall meet in Hershey, Pa., which attracts over 200,000 people.

A nice feature of some clubs is that you don't have to own a particular automobile to become a member; you just have to be interested in such cars. What kind of people own old cars? You'd be surprised. Few are glassy-eyed fanatics. Most are just ordinary people with a soft spot for a particular car. And no matter what the car, they'll all tell you: "They don't make 'em like that anymore."

Take Andrea Herrick. In 1979, she saw a 1961 Studebaker Hawk with a "For Sale" sign in front of a second-hand clothing store in Denver. She bought it for \$1,800 because: "I loved it. And it came with a mechanic who had serviced the car since it



Shelby Cobra owners admire one another's mid-'60s roadsters during an informal meeting at a club member's house in White Plains, N.Y.



PHOTO BY RANDI KORN

Andrea Herrick used her '61 Studebaker Hawk for daily transportation in Denver before moving back home to the Big Apple.



Mustang coupes like this 1966 GT are sure classics-to-be, and are available in clean, driveable condition for about \$3,500.



Fitted with authentic accessories of its era, Jack Quigley's 1960 Pontiac Ventura is a hot item on the drive-in circuit.



Proud owner of a '59 Edsel Ranger takes part in a Columbus Day parade in New Haven, Conn., with a portrait of the explorer.



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was new." When she moved to New York, she drove the 289-cu.-in. V8 through a blizzard. Now that she lives in the Big Apple, the Hawk is kept at her parents' suburban home and taken out for a spin only on pleasant weekends.

John Sheally II of Virginia Beach, Va., shows his '35 Morgan Super Sports MX-4 in *counours d'elegance* (beauty contests for cars). Five years ago, on the 70th anniversary of the Morgan Motor Co., John drove the tiny three-wheeler coast-to-coast, covering 3,328 miles in 5½ days.

Ron Bauman of Riverside, Calif., drove his 1934 Chrysler Airflow from Los Angeles



British sports cars of the '50s and '60s take a lap of the Indianapolis Speedway (top) during a meet of the Milestone Car Society. Detroit Iron rests in the infield.

to Indianapolis in last year's Great American Race (which is actually an old-car rally). He finished a respectable eighth, winning \$5,000 for his nine-day, 3,000-mile effort. In the '83 event, Ron won the \$50,000 second prize in a '41 Mercury. This year's Great Race will start in Los Angeles on June 24 and finish in New York, July 4. Open to 1936 and older cars, trucks and motorcycles, this year's rally offers a first prize of \$100,000.

Pride of ownership

Even if your "classic" is a '65 Chevy that wins nothing more than a glorified bowling trophy in a local car show, it's the pride of ownership that will mean the most. That, and seeing the look that comes over admirers' eyes as they see your car and mumble, "Wow! Uncle Ed used to own one just like that."

If you just want to get to the train station, a Chevette will do the job. But if you want to have fun, consider giving a home to an Everyday Classic. **PM**

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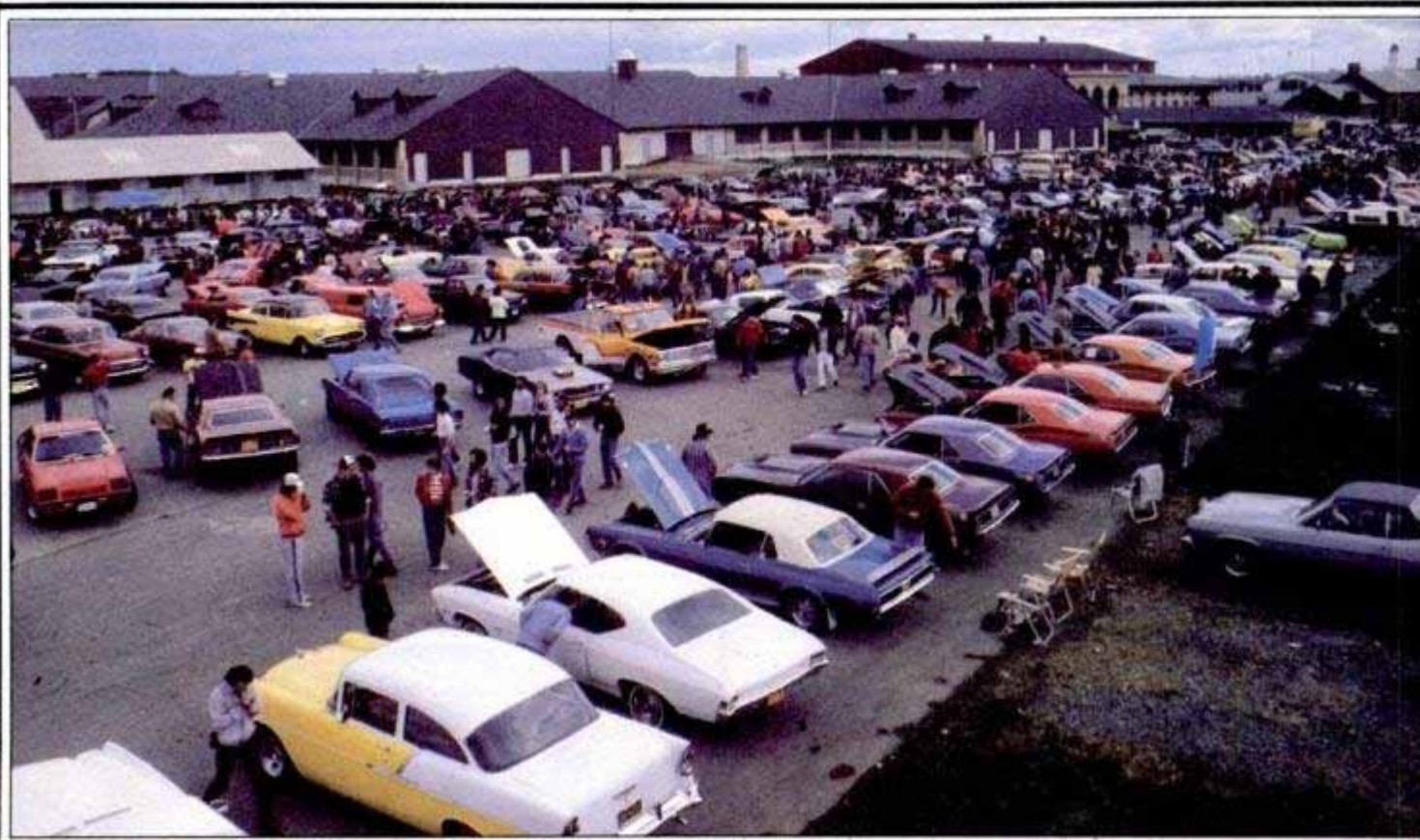
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Where To Find Your Classic

Buying a collector car, or getting parts for it, is easy if you know where to look.

BY MICHAEL LAMM, WEST COAST EDITOR

Ready to buy a car you can play with and be proud to drive? A car that'll hold its value and maybe even turn a profit? Well, hang onto your hat—it could be a wild ride.

I've been tinkering with, buying and selling cars as a hobby for 35 years. Some of those cars I roundly hated, most I loved; some I made money on, most I didn't. I've owned maybe 100 collectible cars in all, and I still admit to being a novice.

Let's say you've spotted a 1953 Ford Mainline Fordor sedan, the one just like your dad used to own. It's parked behind a neighbor's house. The fond memories well up inside you: all those miles you spent in that car. You're dying to buy it, but how smart would that be? How much should you expect to pay? And what pitfalls should you look out for?

If you're like me, you'll have two feelings working against each other: emotion vs. reason. You've fallen in love, and that's fine. But when you step back from this object of your affections, you'll see that it

needs a lot of work. At this point, you've got to ask yourself the three most serious questions in auto hobbydom: First, what's this car really worth? Second, are you prepared to be tough in haggling? And third, how much will it cost you in time and money to put the car into the condition you ultimately want?

You also have to decide whether you're after just a driveable project car or an all-out show-winner. Most budgets can handle a "driver," but a show car? No way.

To determine the cost of reconditioning or restoration, figure out: which parts are missing; what safety items will have to be replaced (tires, muffler, brakes, lights, suspension parts, etc.); and what the car will need in terms of mechanical, electrical and cosmetic repairs.

Factor into this equation how much of the actual work you can do yourself, because if you have to farm out mechanical and electrical repairs, bodywork or upholstery, you might find yourself in deep financial waters.

Okay, now let's take a slightly different tack. Suppose you've decided to pass up that Mainliner in your neighbor's back yard—let's say it's too rusted or too far gone mechanically to bring back into practical use at a reasonable cost. But you'd still like to find a nice '53 Ford, maybe even the Sunliner convertible that your dad couldn't afford. Where do you begin your search, and how much should you reasonably expect to pay?

To ferret out any particular car, keep an eye out for the car itself on the street. I often leave my business card on cars I'm interested in buying. I scribble a note on the back saying, "When you get ready to sell this car please call me. Save this card and give me first dibs." I've bought half a dozen cars that way, often at very reasonable prices.

Check classified "Collector Car" ad sections in local newspapers and Penny-savers. Go to local swap meets. Talk to people who have cars like the one that you're looking for. They often know where



Car shows like the huge Car Craft Street Nationals (opposite page) are a good place to find old cars, but look in the parking lots, not the show itself. Auctions can be expensive: Harrah's Automobile Collection in Reno sold this '29 Chevy Phaeton (left) for \$20,000! Price guides are only one kind of specialized publication for the old car hobby (above). *Hemmings News* lists cars and parts for sale; *Vintage Auto Almanac* has car club addresses, sources for parts and services, lists of museums, salvage yards and car publications—it's a regular Yellow Pages of the old car hobby.

you'll be able to find just what you're after.

Also go to local *concours* and car shows, but instead of expecting to find your dream car in the show itself, check all the surrounding parking areas. Again, leave your business card under any candidates' wiper blades.

Buy as many pertinent hobby magazines as you can lay your hands on. These are always good investments, not only to find the car you want but to learn about condition and asking prices. *Hemmings Motor News*, *Cars & Parts* and *Old Cars Weekly* have the best general old-car classifieds, but you'll also discover publications that specialize in specific makes. For example, if you lust after an XK Jaguar or a vintage Mercedes or an older Corvette, there are classified-ad publications just for those makes alone.

And be sure to try the car clubs. Before joining, you might want to write for sample copies of club magazines (there's usually a charge). Nearly all of them carry classified ads for cars and parts. These also are good background on asking prices.

Old-car auctions have enjoyed a certain vogue in recent years, and you can *sometimes* pick up a good deal at one. I've always considered auctions better for sellers than buyers, though, because you rarely get a chance to talk to the car's owner at an auction. And you almost never get to drive a car before it goes on the block. Eyeballing a car isn't enough. The test drive is more important with any used

automobile than it is with a new one.

If you absolutely have to have a certain make and model car and you haven't been able to find it yourself, you might think about contacting one of the many car brokers or locators around the country. You'll find them listed in the *Hemmings' Vintage Auto Almanac* under "Appraisals." Be sure to establish the fee before you assign someone to look for your dream car.

Never buy a car sight unseen. It's too great a gamble. I know people who've had collector cars shipped over from England or South America, and they've had terrible grief. You're almost always better off traveling long distances and then rejecting a possible purchase than "saving" travel costs. You do have to factor in travel and transportation in any deal, though. If the car you're buying is across the state, across the country or overseas, calculate your own travel expenses, time lost from work, plus shipping the car home. A commercial haulaway can easily run \$1,000 if you have to ship a car between coasts.

Once you've found the car you've been yearning for, how do you know what to pay? Several published value guides exist and if you've studied the classified ads, you'll already have a fair feel for prices. The trick is to pit condition against asking price. Condition is all-important. You're usually much better off paying another \$1,000 to \$2,500 for a really good, solid car than fixing up a dog. You'll find that \$2,500 doesn't go far in a restoration. A really

good paint job costs nearly that much.

What do you do when your hobby car goes kablooey? Finding parts for most older cars has, oddly enough, become easier in recent times. Today, I'd have very little trouble finding the water pump that made me park my mint 1931 Hudson Greater Eight 35 years ago. Back in the early 1950s, I tried desperately to find a new or rebuilt water pump for my Hudson but had absolutely no luck. I finally had to sell the car dirt cheap.

There's now a network of clubs, publications and swap meets that didn't exist then. This modern network makes finding restoration parts and information relatively easy. To track down my '31 Hudson water pump today, I'd write a few letters and maybe make some long-distance phone calls, but within a week I'd have the pump—most likely NOS (for "New Old Stock"), meaning it's an original unused part, saved through the years. There are also "repro" or reproduction parts, built recently, usually but not always to factory specs.

Begin any search as near home as possible. I can still buy lots of brand-new parts for my 1967 Camaro from our local Chevy dealer. The parts man has to special-order them, but that's no big deal.

If parts are no longer in stock, get on the phone to local auto dismantlers. If one yard doesn't have a certain part, the counter man often knows who in the area might carry it. Be sure to ask. He can also

CAR • CARE • GUIDE

get on the hotline and track down the item.

Failing that, go nationwide. The strongest link in the national old-car network is a monthly magazine called *Hemmings Motor News*. It consists of nothing but ads—thousands of them in every issue: cars, parts, literature for sale, to swap, wanted to buy, whatever.

Another tremendous aid in the search for hard-to-find parts is an annual publication, called *Hemmings' Vintage Auto Almanac*. It lists parts sources by make of car, by state and by category (carburetors, ignition and wiring supplies, and so on). It

also lists car clubs by make and often by model (Ford, then Ford Model T, Model A, early V8, Thunderbird, Mustang, and so on); salvage yards, restoration shops, platers, re-spokers, research archives, libraries, museums and more.

The more popular old cars have spawned companies that sell parts specifically for those makes and models. For instance, if you've just bought an early MG, you'll soon discover—among many others—Moss Motors in Goleta, Calif., and Scarborough Faire in Pawtucket, R.I. Both offer catalogs and have toll-free phone

numbers. Similar parts companies specialize in Corvettes, Camaros, 1955 to '57 Chevrolets, Stovebolt Chevys, Firebirds, Mustangs, Model T and A Fords, V8 Fords, MoPars, Packards, Studebakers, Rolls-Royces, Mercedes, Porsches, Panteras and just about anything else that enjoys a strong following.

If you're into some of the more rarified collectibles like vintage Hudsons, Peerlesses, Willys-Knights, Moons or Franklins, catalogs don't exist and you'll probably be best joining one of the dozens of clubs devoted to those brands. Fact is, clubs make good parts and information sources in any case. A complete list of club addresses is published in the *HVAA*, where it takes up 56 pages!

What I usually do when I'm looking for a hard-to-find part is write to likely sources

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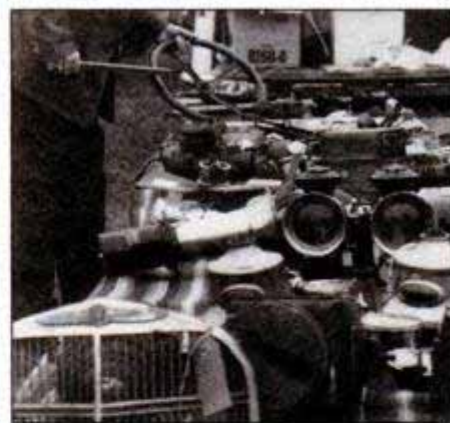
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Gabriel

SHOCKS & STRUTS



Parts shoppers at the Hershey swap meet can browse among literally miles of old car parts. Sandwich boards are worn by some shoppers until they get tired (above).

all over the country. I find their names in *Hemmings* or the *HVAA*. When I write, I always include a stamped return envelope. That's important. In my note or letter, I ask each source to list the price of each item. That way, I can compare prices at the same time I discover who's got what.

Be sure to find out what condition the parts are in and whether they're NOS or repro. Even NOS parts can deteriorate with time; just because a vendor tells you it's still in its original factory box, the part might

not necessarily be in perfect condition.

The final and most enjoyable way to find parts is to frequent old-car swap meets. You'll find time-and-place listings in most hobby publications as well as the "Collector Car" section of your hometown newspaper's classified ads. Regional chapters of car clubs usually hold swap meets on weekends throughout the spring, summer and fall, the largest being the gala Antique Automobile Club of America fall meet in Hershey, Pa. "Hershey," as it's fondly called, takes place each year in early October. This huge event attracts hundreds of thousands of car hobbyists from all parts of the world. Vendors trailer or



Want an authentic old license plate to match your old car? Go to a big swap meet.

truck in literally millions of vintage parts, set up tents or open booths along 5 to 8 miles of walk-along aisles and, for the better part of a week, old-car nuts like me can stroll around in heaven.

The week before Hershey, there's a smaller meet at Carlisle, Pa., some 30 miles west of Hershey. Carlisle caters to owners and buyers of later-model cars, especially those of the 1950s and '60s. Other important annual meets around the country include those at Englishtown, N.J.; Portland, Ore.; and the Rose Bowl in Pasadena, Calif.

Now, I know you're still wondering about the prices of hobby-car parts. The rule of thumb is this: The rarer or more expensive the car, the more expensive the part. For example, a replacement water pump for a Mercedes 190-SL will set you back around \$140. The same item for an MGA sells for \$30, and for my 1967 Camaro I can still buy a rebuilt at most local parts houses for \$20.

The secret, though, is that there's often not a set price on any given part, especially when you spot one at a swap meet. Also, when you have a number of suppliers selling the same or similar parts (like Moss and Scarborough Faire), competition keeps a lid on prices. **PM**

Addresses for the publications and swap meets mentioned in this article are listed under Sources on page 155.

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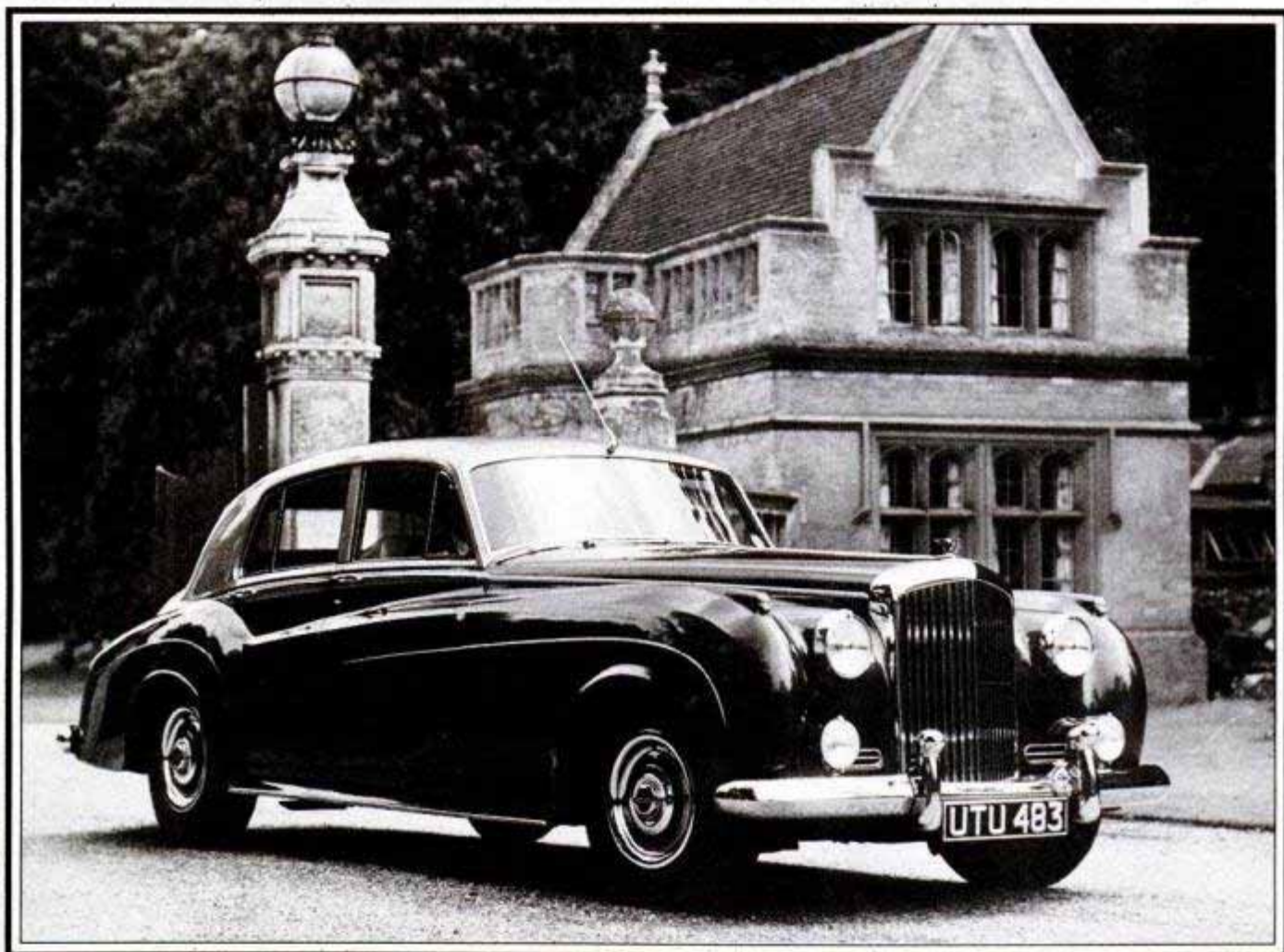
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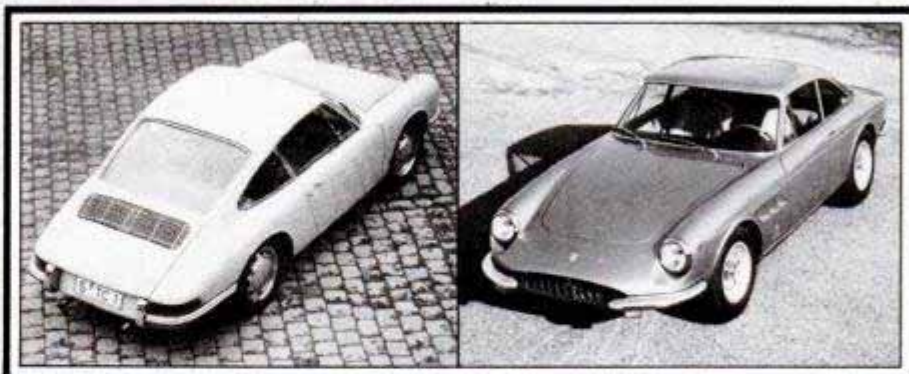
The house may not look like yours, but you can have a stately Bentley S2 in your driveway for less than the cost of a Chevy.

You can own an exotic import at a price that will fool the neighbors.

BY RICH TAYLOR

I was driving down Beach Boulevard in Huntington Beach, Calif., not long ago, when I passed the ultimate automotive status symbol. It was a huge British limousine—two tones of silver, block-long hood, triumphant grille. This wasn't a designer edition Rolls-Royce, but a 20-year-old Austin Princess. The average person can't tell the difference between a Princess and limousines like a Rolls-Royce Phantom (a special-order Rolls for heads of state).

There's a price difference, though. A new Phantom costs \$250,000—a good used one between \$50,000 and \$100,000.



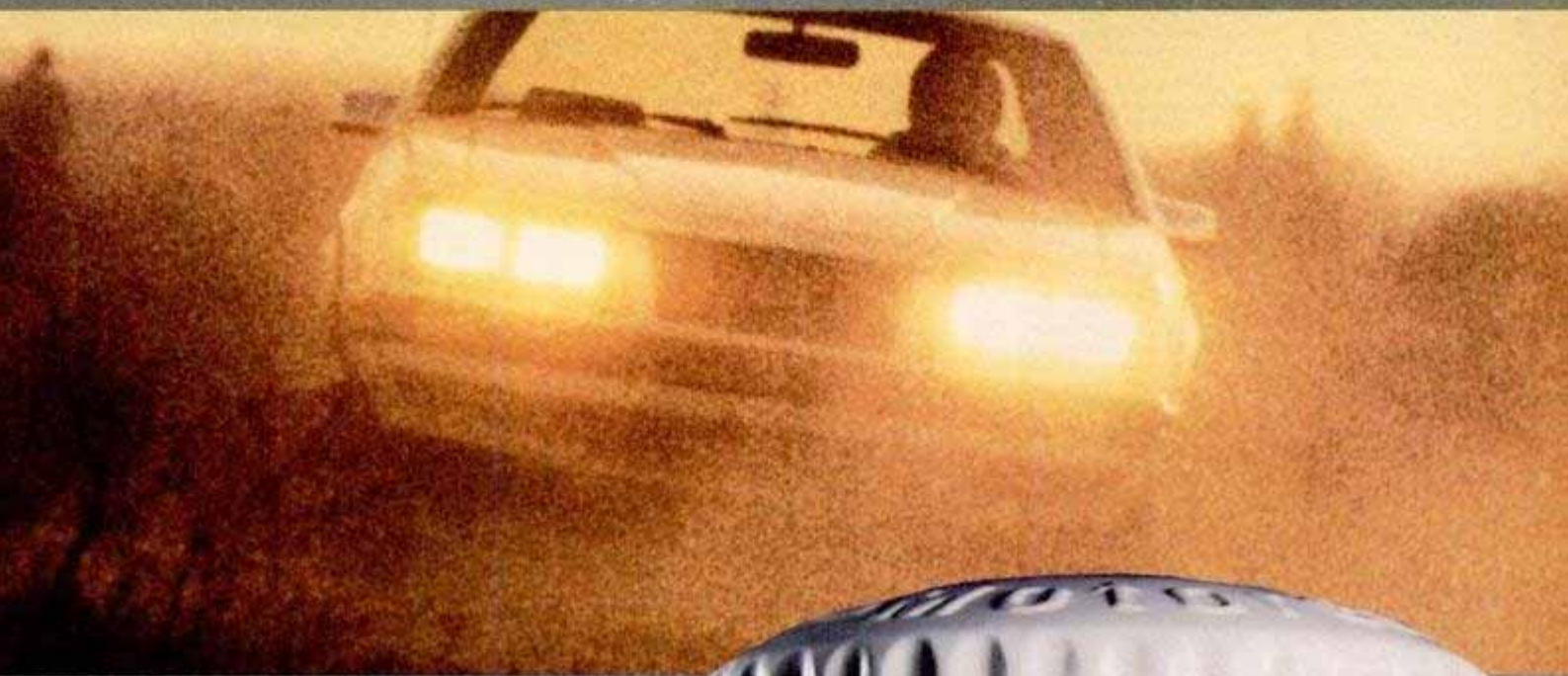
Porsche has been building its 911 model (left) for 20 years; older ones start at \$6,000. Genuine V12 Ferrari 330 GT 2+2s are priced in the \$10,000 to \$15,000 range.

You can buy an Austin Princess for under \$5,000, and \$10,000 will get you a superb one. You can have all the panache of a Rolls for less than a Honda Civic. Talk about an affordable dream!

Maybe your particular dream has always been to drive a really exotic sports car, a

Porsche or Aston Martin, perhaps. Or maybe you'd rather have a high-performance sedan like a Jaguar or Mercedes. Believe it or not, these dreams are affordable too, for less than the price of a new Chevrolet. There are two secrets here that, if you understand how they work, will allow you

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to own and drive that affordable dream.

One is that small companies like Jaguar, Porsche and Aston can't justify frequent model changes, so even a 20-year-old Porsche looks just like a new one to most people. The second is that the average person logically assumes that all Porsches and Jaguars are expensive, while collectors know that some are better than others, and priced accordingly.

For example, a new Aston Martin V8 costs \$110,000. But the very same car has been in production since 1968. You can buy an early model for \$15,000 to \$20,000, and nobody can tell the difference.

You can do the same thing with a 1973 to '77 Mercedes-Benz 450SL roadster. The new 380SL is literally the same car, with a price tag of \$44,420. But you can buy a mint 1973 Mercedes 450SL—with better performance than a new 380SL—for under \$20,000 if you shop around.

The bargain Mercedes is the fabulous 6.3. They built only 1,000 of these in the late '60s/early '70s. With a 6.3-liter V8 in a

so. The same car with a Bentley grille is called a Mark VI or R-type, and these can be found for even less. Really excellent R-types can be had for \$12,000.

From 1955 through 1965, Rolls-Royce sold the Silver Cloud (with a different grille; it became the Bentley S-Type). This is the car that most people think of when you say Rolls-Royce, and to most people, it's more impressive than the boxy Volvoesque sedans Rolls-Royce sells today.

Finally, there's the ultimate dream of every auto enthusiast—a Ferrari. To me, a



Older Jaguar XJ6 sedans, though prone to engine trouble, look the same as '85 models.



This \$20,000 Aston Martin V8 is a dead ringer for the \$110,000 Volante model.

lightweight sedan body, the 6.3 will outperform nearly any sedan ever built. You can buy one for \$6,000 to \$12,000, depending on condition. The nearest equivalent new Mercedes is a 500SEL, for \$52,200.

Porsche has been building the 911 for two decades; a new one costs \$32,000, an old one \$6,000 to \$9,000. Only a Porscheophile can tell the difference. Same goes for the Jaguar XJ6. The 1985 edition costs \$32,250; the identical-looking 1968 to '78 edition runs \$3,000 to \$10,000, depending on how much work the engine needs.

Then there are the overlooked models of really top-flight cars. For example, you can buy a genuine Rolls-Royce for less than the average 1985 compact. You even have your choice of two quite different models. From 1949 through 1955, Rolls sold the Silver Dawn. A standard Silver Dawn four-door sedan looks like a miniature Phantom—which is to say, just like everybody's dream of what a Rolls-Royce should look like.

A Silver Dawn is one of the most reliable and economical Rolls models to own, and a genuine delight to drive. Prices start around \$10,000, and go up to \$20,000 or

new mid-engine Ferrari V8 is a wonderful car, but somehow, it's not a real Ferrari. I want the engine in front, and I want it to have 12 cylinders. Trouble is, I simply can't imagine spending \$100,000+ for a 275 GTB/4 or Daytona. For that much money, I expect four bedrooms and two baths.

But look at the Ferrari 330 GT, 330 GT 2+2 and 365 GT 2+2. This run of similar cars covered the decade of the '60s, and all have superb Pininfarina bodywork, essentially the same chassis as the more expensive Ferrari models and, of course, the wonderful big V12 engine.

These 2+2 Gran Turismo models are pure Ferrari through and through, yet Ferrari die-hards dismiss them because they don't have the ultimate performance and racing record of the more expensive models. Why, they even have air conditioning and power steering!

You can buy a magnificent 330 GT Ferrari for under \$15,000; a so-so one for under \$10,000. Of all the affordable dreams, this has to be the best—inexpensive, marvelous to behold and truly inspirational to drive.

Every car I've mentioned will go up in value while you own it. Cars like these are genuine collector cars, sure-fire investments. They just cost less than the more expensive museum pieces that you'd be afraid to drive on the road.

There is only one caution I have for you: Buy a good, honest car that is in decent shape. In this league, bodywork, leather upholstery and complex mechanical rebuilding are wildly expensive. And that could turn your affordable dream into a costly nightmare.

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Affordable Dreams



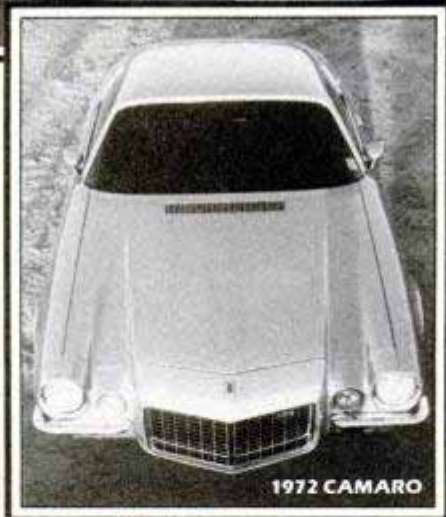
1965 MUSTANG



1969 TRANS AM



1967 PONTIAC GTO



1972 CAMARO

Don't call them 'used cars.' They're the classic cars of the future!

BY RICH TAYLOR

Have we got a deal for you. How about a fabulous old classic, guaranteed to increase in value, for \$6,500? Too much? How about one for \$3,500? \$1,500? How about they pay you to come tow it away? There are classic cars out there literally for the asking. It's just a matter of being in the right place at the right time.

For example, last fall I got a letter from my Aunt Dorothy. She knows I like old cars, and she wanted me to buy her old Buick. I checked *Hemmings* for a fair value, and paid her \$2,000 for a 1965 Riviera with 34,000 miles. It cost me another \$1,300 to replace the worn-out tires, brakes, shocks, springs, exhaust system, wheel bearings and battery.

What did I get for my \$3,300? Well, I got a Certified Milestone car, one of the best designs from the drawing board of Bill

Mitchell. I got incredible luxury I couldn't afford in a new car—bucket seats, Buick ride and styling that still stops the crowd in its tracks. Kids young and old enjoy watching the hydraulic headlight covers open and close like chrome-plated clamshells.

I got performance—you forget what 425 cu. in. can do, unfettered by emission controls. And finally, I got incredibly cheap transportation. Even at 15 mpg on regular, my gas bills aren't outrageous. And my insurance bill is \$85 for the year. I don't have the \$400 insurance bills, \$100 tune-

ups or the depreciation of a new car. Early Mustang coupes sell for \$1,500 to \$4,000, but decent convertibles start at \$8,000. The first Trans Am had a 335-hp Ram Air V8; a good one costs under \$4,000. Good looking early GTOs are available for \$3,000 to \$4,500. Second-series Camaros are among the best looking cars ever made in America; a '72 is worth \$2,000. All prices are for cars in "good," not "excellent," condition.

There are dozens of deals like this if you look around. My neighbor just sold a 1965 Buick Grand Sport convertible—original, one owner—for \$1,500. Another let go a '67 Cougar with 45,000 miles for only \$500. The guy down the street just bought a Karmann Ghia to restore in his spare time. Would you believe he paid only \$200, including a spare engine? In the past year, my friend Jon has had an \$800 '65 Mustang GT, a \$1,600 '67 Mustang GT, and a \$2,500 '74 Camaro Z-28.

If you're beginning to see a pattern here, you're right. All these cars are between 10 and 20 years old, and they're American—if you don't count Volkswagen, which is more American than a Chevy when it comes to parts and service. While they're all limited-production specialty cars, they're based on standard components that are

used in millions of more mundane models.

This is very important. There's no point in getting a great deal on a terrific old Maserati, just to find that the only mechanic who can give it a tuneup lives in Bologna. My idea of a cheap classic is something that not only costs a minimum to buy, but can be rebuilt by anybody using parts from the local parts store.

You have to get into the proper mindset for collecting at this level. You don't want to buy a \$1,000 Mustang, for example, then spend \$3,000 on a paint job, \$1,500 to rebuild the motor and \$2,000 for a new interior. That defeats the whole purpose of Everyday Classics. The goal is not only a low initial price, but a low price, total.

Rebuild the mechanicals yourself. Buy a



A 1965 Buick Riviera with 425 V8 like the author's is a good investment at \$2,000.

reproduction interior and install it yourself; they're available for almost every popular collector car. And so what if a \$200 enamel paint job isn't as glamorous as a \$3,000 coat of acrylic lacquer? From 10 feet away, nobody can tell the difference.

Even better, buy what the classified ads call a "good original" car like my Riviera that doesn't need any major work. It won't win any *concoirs d'elegance*, but I've had more fun driving my \$3,300 Riviera than any of the more expensive classics I've owned over the years. Panicking over every stone chip, rust spot and oil globule on a \$50,000 investment can get tiresome pretty quickly.

What do I recommend in a cheap classic? Well, it depends on what you like and what you can afford. If you want a real antique, nothing beats a Ford. And surprisingly, you can buy a Model T or Model A Coupe, Sedan or Touring for under \$4,000. It won't be a show car, it won't be a roadster, but it will be a good, clean, driveable, no-rust four-cylinder Ford from the '20s. And happily, reproduction parts for early Fords are both inexpensive and easily available.

If you'd rather have a V8, there's nothing sweeter than a 1937 through 1940 Ford Tudor or Fordor sedan. They've been favorites of collectors and hot-rodders alike ever since they came out. If you look around, \$3,000 will buy a decent one.

Then there's the '55 to '57 Chevy. This is another of the great cars—a classic that's never gone out of favor. It's the first modern V8, with timeless styling and an appealing honesty that's rare. You can buy a perfectly decent '55 to '57 Chevy sedan for

less than \$2,000. You won't find the restorable hulk of a convertible or Nomad wagon for that, and showcars are knocking on \$20,000. But for a car to drive and enjoy, there isn't any cheaper fun than an old Chevy sedan.

Around \$2,000 seems to be the magic figure for a car that's in good shape and driveable without a lot of work. If you can afford that, a whole world of interesting cars opens before you. There are old American luxury cars like my Riviera, or virtually any Cadillac, Lincoln or Chrysler from the same era. I'm partial to the Riviera/Thunderbird/Grand Prix type of "personal-luxury car" from the '60s because they combine high quality with surprising performance.

Then there are the "pony" cars. You can still find one-owner '65 to '68 Mustang notchbacks for \$2,000, or second-series '70 to '73 Camaros. Second-series '65 to '69 Corvairs are another buy. Corvair prices start at around \$7,000 for *concoirs* showcars, then level off at approximately \$1,000 for a "driver." A fellow in the next town is offering a '65 coupe for free if you'll give him \$100 for his other one.

Finally, there's the Volkswagen Beetle family of fine, cheap collector cars. Kar-



Despite Ralph Nader, old Corvairs are fun. Because of Ralph Nader, they're also cheap.

mann Ghias of all years are under \$3,000, even for a really decent one. Beetle convertibles start at \$1,000 and go up, depending on which year they were built and what condition they are in. Even better is the ultimate VW specialty car—a dune buggy. Listen before you laugh.

Remember when Bruce Meyers first presented his Manx? The car magazines went nuts. Here was this silly-looking fiberglass bathtub that would pull 1.0g on the skidpad and brake test, if you put good tires on it. With a hot VW or Corvair engine, you could hit 0 to 60 in less than 6 seconds. That was world-class performance then ... and now.

You can buy a decent dune buggy for between \$500 and \$1,500 and have the time of your life. It won't impress your neighbors like a Ferrari or Rolls-Royce, but you'll be too busy enjoying yourself to pay them much mind. So what if serious collectors have more invested in their paint jobs than you have in your whole car? They're fussing about paint nicks ... you're having fun. Isn't that exactly what Everyday Classics are all about? **PM**

SOURCES PRICE GUIDES

Actual Cash Value (selected cars, 1945-'80; annual, \$10): Sandoro Publications, 24 Myrtle Ave., Buffalo, N.Y. 14204; (716) 855-1931.

C.A.R. Values (auction price reports; annual, \$14.95): P.O. Box 1399, Bloomington, Ind. 47402; (812) 334-0581.

CPI Value Guide to Cars of Particular Interest (selected cars, 1945-'83; quarterly, \$15): P.O. Box 11409, Baltimore, Md. 21239; (301) 252-5759.

The Gold Book (1955-'78 cars; quarterly, \$36): 1462 Vanderbilt, El Paso, Tex. 79935; (915) 592-5713.

NADA Official Older Car, RV, and Motorcycle Guide (1968-'78 vehicles; quarterly, \$40): NADA Appraisal Guides, P.O. Box 7800, Costa Mesa, Calif. 92628; (800) 622-6232.

Official Price Guide to Collector Cars (1885-1978; annual, \$12.45): House of Collectables, 1904 Premiere Rd., Orlando, Fla. 32809; (305) 857-9095.

Old Cars Price Guide (1900-'77 cars; quarterly, \$9): Krause Publications Inc., 700 State St., Iola, Wis. 54990; (715) 445-2214.

Old Car Value Guide (1897-1954 cars; annual, \$12.45): 1462 Vanderbilt, El Paso, Tex. 79935; (915) 592-5713.

PUBLICATIONS

Cars & Parts (monthly magazine, ads plus photo stories; \$18 a year via second-class mail, \$40 first class): Box 482, Sidney, Ohio 45365.

Hemmings Motor News (ads only; monthly, \$15.50 a year via third-class mail, \$42.50 first class): Box 380, Bennington, Vt. 05201.

Hemmings' Vintage Auto Almanac (annual directory, \$9.95): Box 76R, Bennington, Vt. 05201.

Long Island Cars (monthly magazine, ads plus articles on cars of the '50s-'70s; \$15 a year): Box 567, Holbrook, N.Y. 11741.

Old Cars Weekly (weekly newspaper, ads plus hobby news and events; \$17.50 a year): Iola, Wis. 54990.

Special Interest Autos (bi-monthly magazine, ads, articles and Drive Reports; \$12 a year): Box 196, Bennington, Vt. 05201.

SWAP MEETS

Englishtown, N.J., collector car and hot rod swap meet, April 26-28, 1985; Sept. 27-29, 1985; Admission: Fri. \$2, Sat.-Sun. \$3, children under 12 free. Saturday meets feature custom cars, hotrods and vans; Sunday meets antiques, classics, pre-'72 production cars. Contact: Raceway Park, Pension Rd., Englishtown, N.J. 07726.

Carlisle, Pa., collector car flea market, Oct. 3-6, 1985; Admission: \$2. Contact: The Flea Marketeers, 1000 Bryn Mawr Rd., Carlisle, Pa. 17013.

Hershey, Pa., antique auto national meet, Oct. 10-12, 1985; Admission: free. Contact: Antique Automobile Club of America, 501 West Governor Rd., Hershey, Pa. 17033.

Rose Bowl collector car and hot rod swap meet, Pasadena, Calif., Oct. 27, 1985; Admission: \$5 for adults. Contact: R.G. Canning Attractions, Box 400, Maywood, Calif. 90270.

Portland swap meet, Multnomah County Exposition Center, April 12-13, 1986; Admission: \$1. Contact: John Adams, Box 23722, Portland, Ore. 97223.

TOOLS AND MATERIALS

Bodywork And Welding Supplies

The Eastwood Co., Box 296, Malvern, Pa. 19355.

Pull Rods

Full set, \$27 postpaid: SAM'S Auto Supply, 1701 Hastings Way, Eau Claire, Wis. 54701.

Do-it-yourself plans, \$3 plus self-addressed, stamped envelope: Thomas Heyd, 1120 Cedar St., Eau Claire, Wis. 54703.

Taillight Repair Kits

Form-A-Lens, Loctite Corp., 4450 Cranwood Ct., Cleveland, Ohio 44128
Lens-Fix, Flex-Hesive Co., Box 26612, Philadelphia, Pa. 19141

Vacuum Wiper Motors

Windshield Wiper Supply Co., Box 11, Babylon, N.Y. 11702.

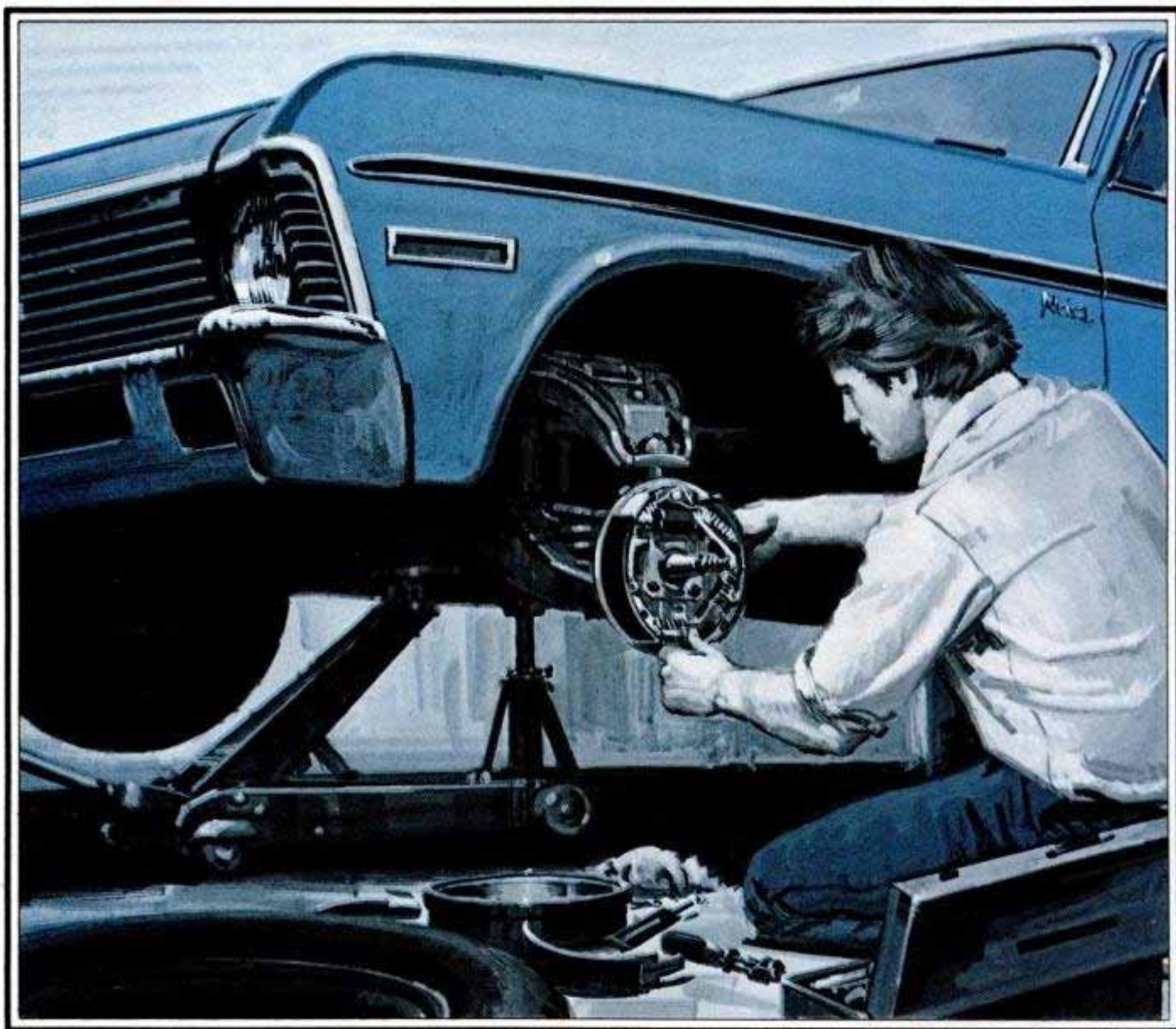
REPAIR MANUALS

MOTOR Auto Repair Manuals

Vintage Car Editions, Vol. I, 1935-'53, 23 models, 850 pg., \$30; Vol. II, 1953-'61, 31 models, 1,149 pg., \$35.

8th Early Model Edition, 1974-'79 models, 1,300 pg., \$21.50.

1985 Edition, 1979-'85 models, 1,100 pg., \$21.50. All from MOTOR Publications, 555 West 57th St., New York, N.Y. 10019.



Treat Your Car Like A Classic To Make It Last

New or old, any car will live longer with tender loving care

For most enthusiasts, a large part of the joy of owning a hobby car lies in getting their hands dirty. If you really want to develop an intimate relationship with a machine, we know no better way than to crawl under it and over it, to take it apart and put it back together, to clean it and polish it.

But the benefits of doing it yourself are

more than spiritual. If you live with a car long enough, you'll eventually come to know it so well that even the most insignificant faults will immediately be recognizable, and you'll be able to anticipate the need for repairs before serious problems develop.

The key to establishing this kind of relationship with your car is a systematic

Besides saving money, the do-it-yourself mechanic learns the workings of drum brakes and every system in his car.

approach to maintenance and repair. In the following pages, we'll outline a plan for car care that will help whip any car into shape and keep it there.

A helping hand

Before you even think about diving under that prized hunk of iron, you should equip yourself with as much information as possible. Ideally, you should obtain a copy of the vehicle manufacturer's service manual for your hobby car. Some manufacturers have a considerable supply of early-model manuals. We recently purchased a shop manual for a 26-year old European car. However, others may only have more recent issues.

If you can't obtain the factory book for your car, general service manuals, which cover most domestic makes, are available for early-model cars. Motor Publica-

SOUND ADVICE: TURN ON EQUALIZER V AND TUNE UP YOUR NEW GM VAN.

Nothing harmonizes with the new Chevy Astro and GMC Safari vans quite as well as a Delco Equalizer V Music System—an exceptional option available on exceptional new vehicles.

The Equalizer V system—speakers, receiver and graphic

equalizer—is designed into the vans on the drawing board. So it's tuned to their unique acoustical environments.

Up to six Delco Sound™ speakers, specially designed to take the show on the road, give the music concert-hall dimension.

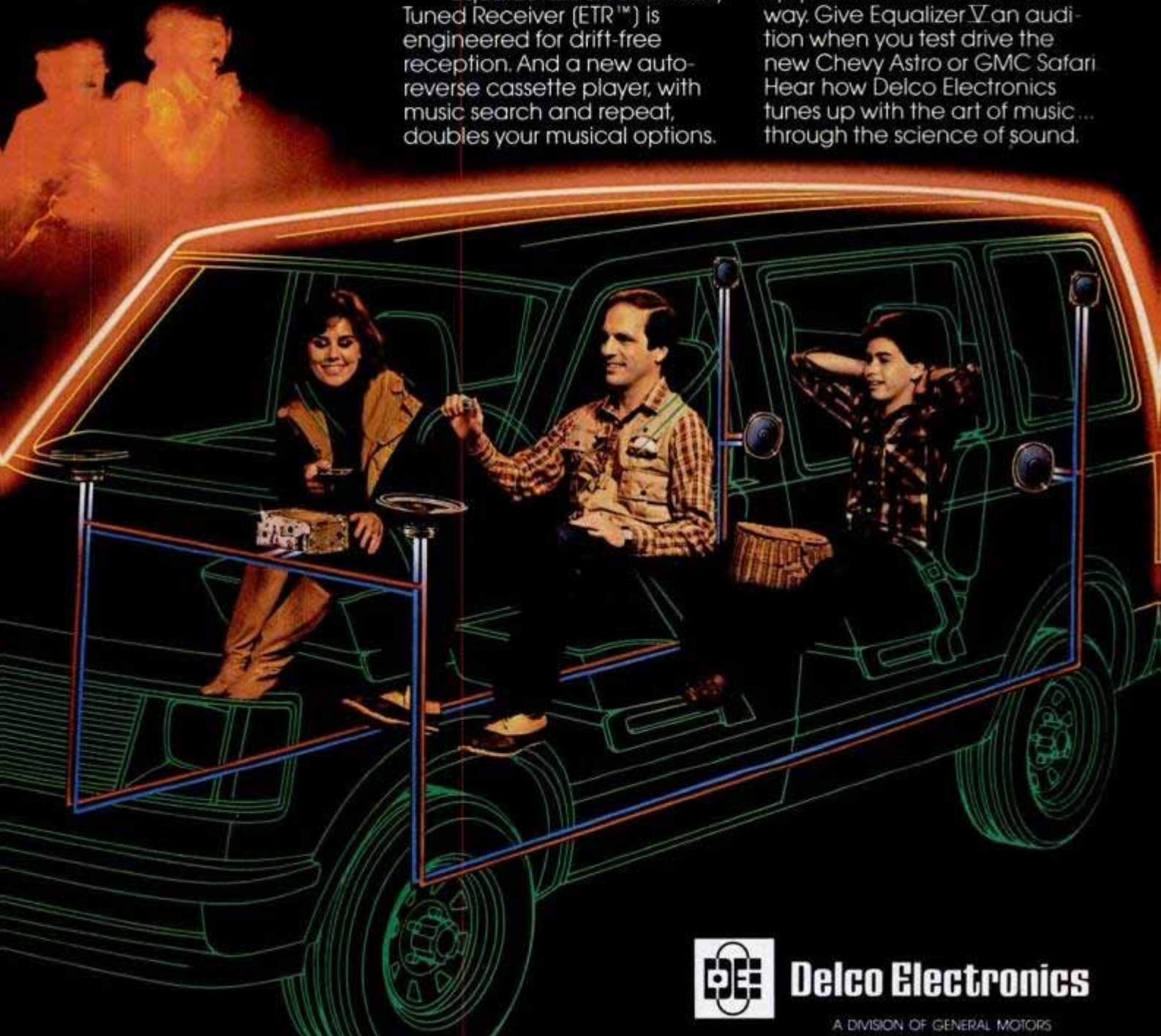
Equalizer V's Electronically Tuned Receiver (ETR™) is engineered for drift-free reception. And a new auto-reverse cassette player, with music search and repeat, doubles your musical options.

The system's graphic equalizer lets you conduct a quintet of bass, midrange and treble controls to score the music to your individual taste.



Equalizer V

The sum of the parts tunes up your van in a whole new way. Give Equalizer V an audition when you test drive the new Chevy Astro or GMC Safari. Hear how Delco Electronics tunes up with the art of music... through the science of sound.

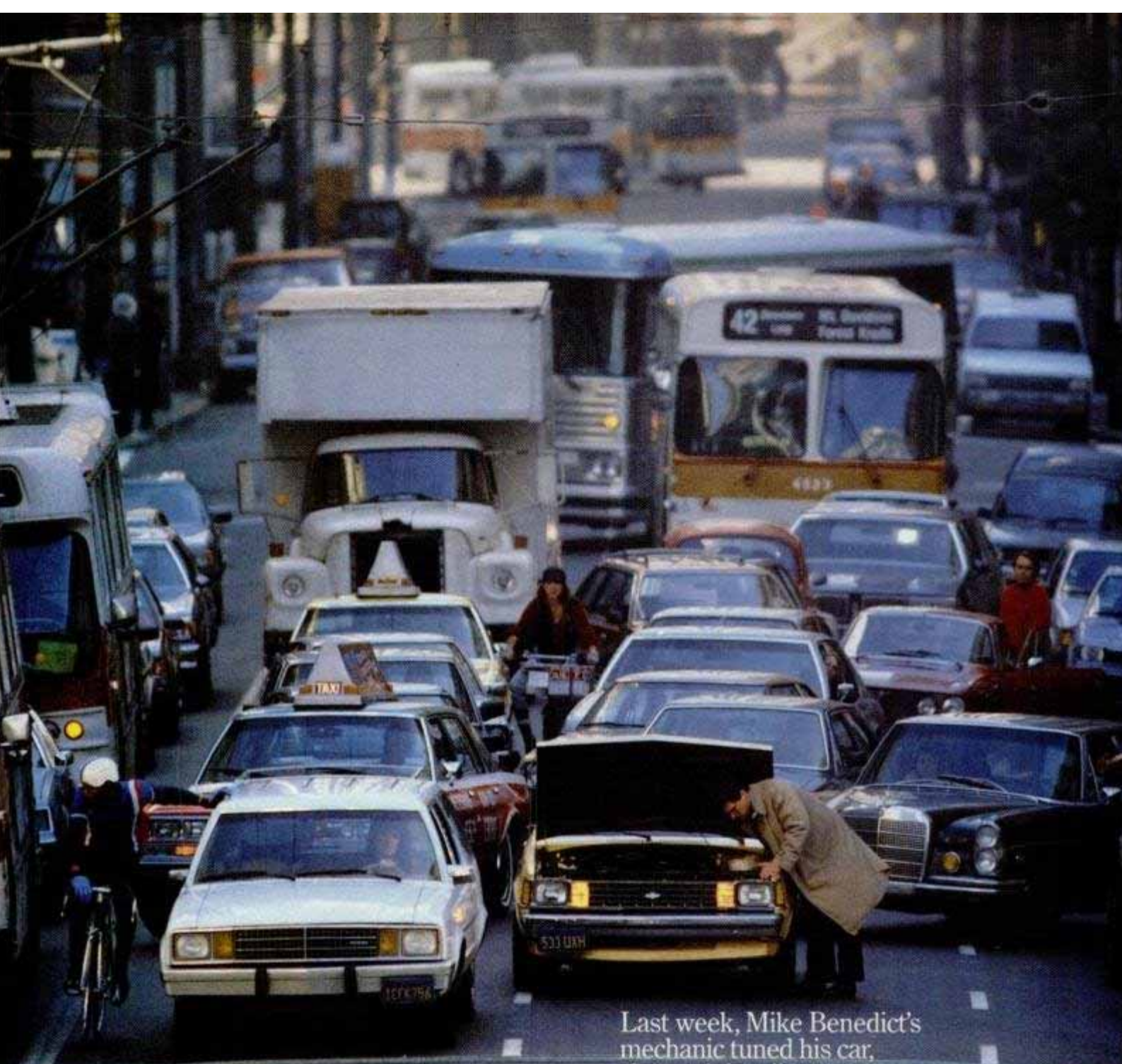


Delco Electronics

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BRINGING YOU *THE ART OF MUSIC* THROUGH THE SCIENCE OF SOUND.

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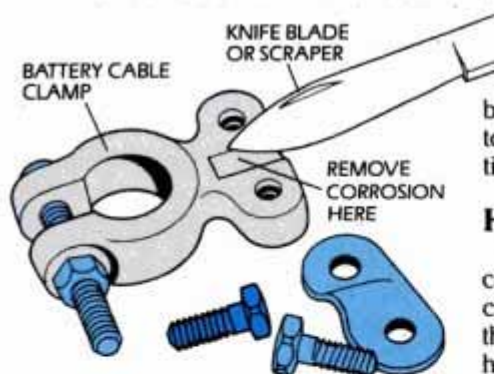
Last week, Mike Benedict's
mechanic tuned his car,
changed the oil and
replaced the filters.
He overlooked one thing.

The fan belt. Almost everyone overlooks engine belts, because they don't show wear the way they used to. But after four years on today's higher-revving engines, even the best belts can break anytime. So if your car is four years old or older, change the belts now. And ask for Gates. We made the first; we still make the best.



The Gates Rubber Company, Denver, Colorado. Brantford, Ontario.

Материал, защищенный авторским правом



1 Battery cable terminals must be kept corrosion free to ensure reliable starting.

tions (555 West 57th St., New York, N.Y. 10019) publishes the *Motor Auto Repair Manual, Vintage Car Edition*. Volume I covers cars produced from 1935 to 1953. Volume II covers 1953 to 1961. Other editions cover newer models up to the present. For more on repair manuals, see the *Sources* listing on page 155.

Battery

A battery checkup is a good place to begin the initial hobby car maintenance service procedure. This check should be repeated at 15,000-mile intervals or when a problem arises. The battery cleanup part of the procedure should be performed every time you change oil.

Begin by removing the battery terminals, negative cable first. Then, use a small brush to clean all parts of the battery and terminals with a paste made from baking soda and water. Remove corroded metal inside the terminals and from the battery posts using a small knife or a battery-post cleaning tool. A three-cornered bearing knife works better than a flat-bladed knife.

If the terminals are attached to the cable by means of screw clamps, disassemble each clamp and clean it and the bare cable end with the paste and brush (Fig. 1). Scrape any corrosion from the terminal. This type of terminal is particularly subject to corrosion and must be cleaned at regular intervals. Your best bet is to replace a cable that has a screw-on terminal with one that has a conventional molded terminal.

If your battery is of the standard type—as opposed to a maintenance-free battery—remove the caps and check the electrolyte level. If it's not up to the indicated FULL level, add distilled water. If you add water when the temperature is below freezing, you must drive the car for at least 20 minutes.

Check the other ends of the cables—where the negative attaches to ground and where the positive connects to the relay or starter motor. Make sure that all connections are tight and free of corrosion. If not, disconnect the cable end. Clean it, and the post or bolt it was

attached to, with the paste and brush. Reconnect all cables, starting with the ends that are not attached to the battery. Then connect the positive cable to the battery *before* connecting the negative.

Hydrometer checks

If your battery is equipped with filler caps, you can determine its state of charge by checking the specific gravity of the electrolyte solution with a battery hydrometer. The hydrometer reading must be corrected for temperature. If readings vary by more than .05, the battery should be replaced. See the instructions for your hydrometer.

Many maintenance-free batteries have a built-in hydrometer that indicates approximate state of charge by changing color. In most cases a green eye indicates fully charged, a dark eye indicates a

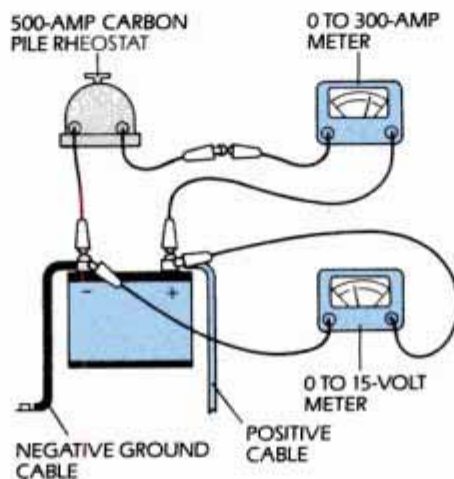
battery, turn the lights on for 15 seconds before measuring voltage.

If your hydrometer check or voltage test indicates that the battery is not fully charged, connect a trickle charger for several hours or until you get a fully charged indication. Some maintenance-free batteries that have been almost fully discharged have to be charged with a high-amperage service station type charger for a long period of time. If any battery won't eventually come to full charge, it's defective and must be replaced.

If your voltage check or hydrometer reading indicates that the battery is charged, it should be load tested to determine its cranking capability. Ideally, you should use an adjustable carbon pile to load the battery while you take a voltage reading (Fig. 2). The amount of load that a specific battery should be able to handle can be found in the service manual. In most cases, it will be between 150 and 270 amps.

If you don't have a carbon pile, load the battery by cranking the engine with the coil wire removed and attached to ground. On GM cars with HEI ignition, disconnect the wire that is attached to the distributor's BAT terminal. The battery should be able to provide 9.6 volts while cranking the engine for at least 15 seconds at 70° F. At 30° F, you should measure at least 9.1 volts, at 0°, 8.5 volts.

If the battery is not able to maintain voltage under load but appears to be fully charged when the load test begins, it's worn out and must be replaced. Batteries are not supposed to last forever. Four years is about the limit for most.



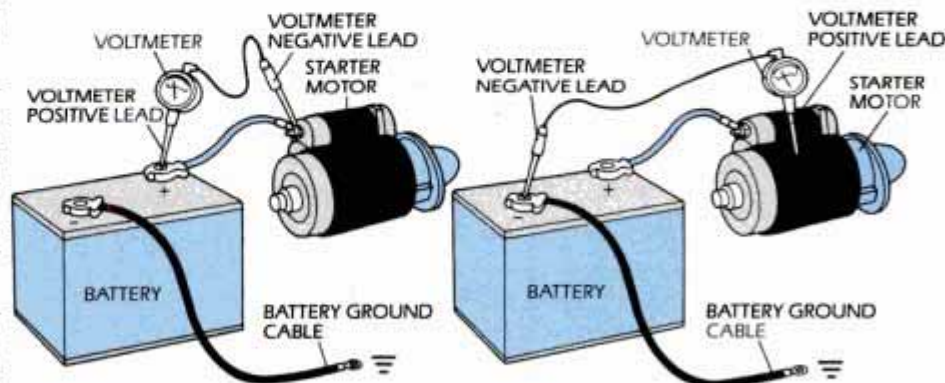
2 To test a battery under load conditions, an adjustable carbon pile should be used.

discharged condition, and a clear or white eye indicates that the battery is bad and cannot be charged.

If you don't have a hydrometer, you can get a general idea of battery charge level by measuring voltage. With the engine off, the battery should store at least 13.5 volts. If you've just charged the

Resistance tests

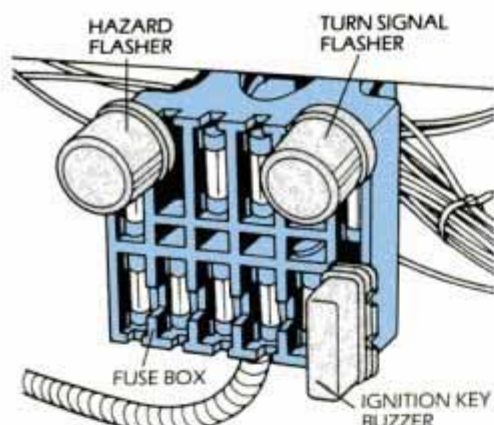
If you find that your battery does produce enough voltage during the cranking test but the engine still doesn't turn fast enough to start, check for excessive circuit resistance (Fig. 3). To check positive-circuit resistance, connect a voltmeter's lead to the positive battery post and



3 If the battery passes a cranking capacity test, but the engine still cranks slowly, check both the positive and negative starter motor circuits for excessive resistance.

its negative lead to the relay terminal or to the starter motor's positive terminal (the big one). The meter should read less than 0.5-volt. Check ground circuit resistance by connecting the negative voltmeter lead to the negative battery post and positive lead to the starter housing. Voltage should be less than 0.2-volt. If either voltage check exceeds maximum, there is too much resistance in that circuit, probably due to a bad cable. Replace suspect cables and check connections again.

If the resistance test does not reveal a problem, either the starter motor or the solenoid/relay is defective. If both prove to be okay, the engine is suffering from an internal problem that makes it hard to turn. Should the battery take a charge and pass the load test but discharge while driving, there's trouble in the charging system. Further testing will determine whether the alternator, regulator or wiring is to blame. Consult a manual for troubleshooting procedures.



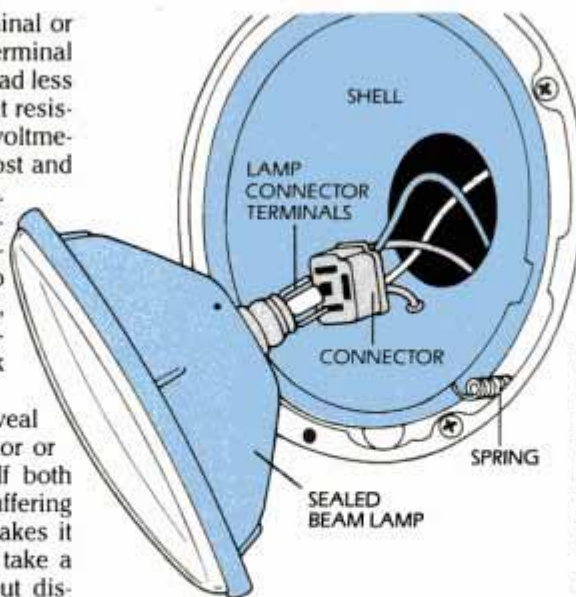
4 Turn signal and hazard flashers are usually mounted under the dash, in fuse box.

Lights and accessories

Once you've determined that the starting circuit functions as it should, check the brakelights, taillights, turn signals, headlights and other electric accessories to make sure they operate. It's a good idea to check operation of all lights every time you change oil. Check other electric accessories as problems arise.

If you find that a single bulb is out, remove it and check the filament visually, with a test light or with an ohmmeter. Clean the bulb contacts before installing a new one. Should that fail to solve the problem, check for voltage at the light socket connector and ground. If it's lacking, trace the wire, checking for voltage at various points with a test light needle probe by piercing the insulation.

Maybe the taillights and brake lights work but turn signals don't. Try replacing the flasher unit. In most cars, it's a small metal can that can be found under the



5 When replacing a headlamp, clean both the lamp and connector terminals.

dashboard or in the area of the fuse box (Fig. 4). In cases where all brakelights, taillights or turn signals are out, check the fuses. If just the brake lights are out, replace the brake light switch. On most later model cars, it's a mechanical switch near the brake pedal. Earlier models have a hydraulic switch at the end of the master cylinder.

Headlight problems

If one headlight is inoperative, replace the unit, clean the connector and tighten (Fig. 5). If lights are dim, check the connection between the headlight mount and body ground.

When both headlights are out or flash on and off, check for a loose connection at the dimmer switch and the headlight switch. You say that doesn't help? Check for voltage at the dimmer switch with a test lamp. If the test lamp lights only on the switch side (hot wire side) of the dimmer, replace the dimmer switch. Should the test lamp fail to light on the hot side of the dimmer switch, check wiring from the headlight switch to dimmer with a test lamp. In the event that there's still no voltage, check the hot wire terminal on the headlight switch for voltage. If the test lamp does not light, repair the wire from the battery to the switch. There may be a fusible link in this wire that is the source of the problem.

If you find that voltage is available on the hot wire side of the headlight switch but not on the output side (with the switch turned on), replace the headlight switch.

In cases where the headlights flicker after a few minutes of operation, there is probably a short to ground in the circuit between the battery and the headlight

switch. The flickering may be accompanied by a clicking noise from the headlight switch. Repair any shorts in the wire from the battery to the light switch and check the lights again. If they still flicker, the circuit breaker in the headlight switch has been damaged by the short and the switch must be replaced.

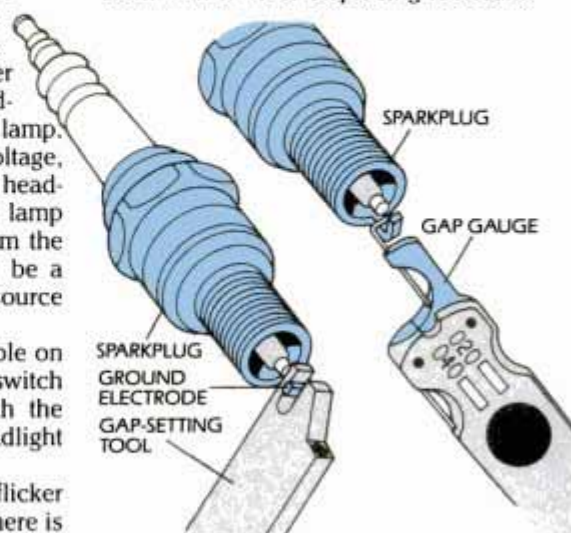
Troubleshoot other failed electric components in a similar manner. After checking fuses, test for voltage at the component. If no voltage is available, trace back along the wire with your test light until you locate the source of the trouble (either an open circuit or a defective switch). If voltage is available at the component, the problem, of course, is in the device itself.

Engine cleanup

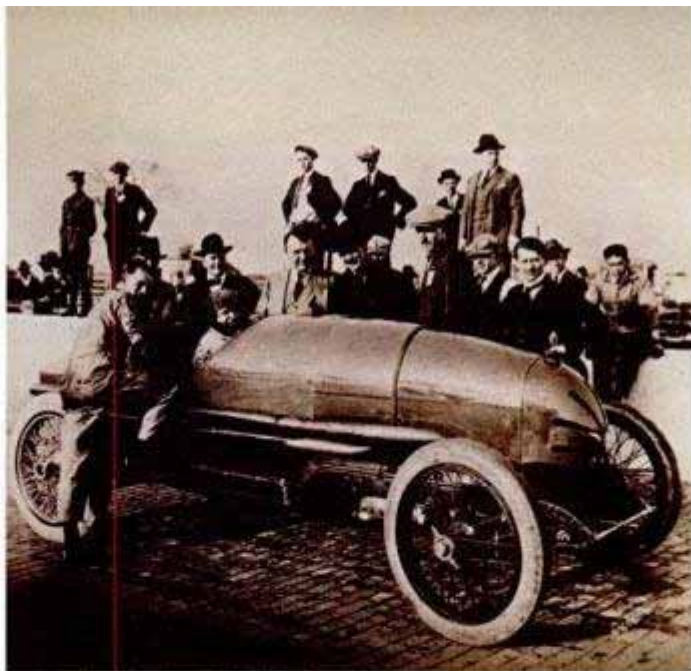
To make it easier to service your car, clean up the engine compartment. Buy two cans of aerosol-spray engine cleaner, available through most auto parts stores. If possible, take the car to a self-service car wash with high-pressure hot water wands, or use your garden hose attached to a hot water tap.

Cover the alternator, distributor cap and coil with plastic bags, securing them with string. Remove air cleaner and cover the carburetor in a similar fashion. Following the directions on the can, spray the cleaner liberally all over the engine and engine compartment, avoiding electronic or electric components. Allow it to soak in a few minutes, then hose it off. If the engine is not clean, repeat the procedure using a small brush to work the cleaner into particularly dirty spots. Don't allow the cleaner to come into contact with your skin.

If the engine won't start when you've finished, clean any moisture from distributor and coil wire cables, then spray them with a water displacing lubricant.



6 Check spark plug gap with a wire gauge. Adjust by bending the ground electrode.



1921 Indy winner, Tommy Milton (with Barney Oldfield and Louis Chevrolet) in the Champion-sparked Frontenac Special.

Champion. The spark of success at Indy since 1921.

The Brickyard, 1921.
Tommy Milton drives the Louis Chevrolet-built Frontenac Special to the "incredible" speed of nearly 90 miles per hour.

It was Tommy's very first Indianapolis 500 victory. It was also the first Indy win for Champion spark plugs.

Today, Champion has sparked more Indianapolis 500 winners than all the other brands combined.

Last year was another success for Champion.

1st, 2nd and 3rd on race day. 1st, 2nd and 3rd in qualifying (including Tom Sneva's record-setting, 210 mph run for the pole.)

When you need spark plugs, get the brand that's Number One at the Brickyard. Number One in the world.

Champion. The fastest moving plugs on earth.

1984 Indy winner, Rick Mears setting a new average speed record on his way to victory in the Champion-sparked Pennzoil Z-7 Special March/Cosworth.



Photos courtesy of Indianapolis Motor Speedway.



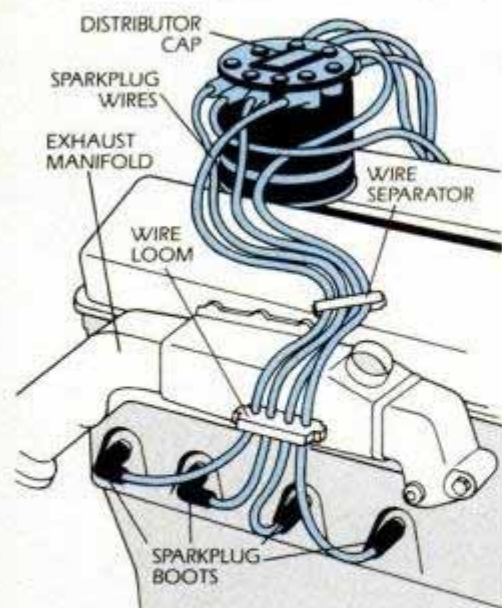
CHAMPION

**NOTHING
SPARKS
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CHAMPION

PM's CAR CARE GUIDE



7 Keep spark plug wires away from hot manifolds with wire looms and separators.

Engine tuneup

The complete powerplant maintenance procedure should be performed when you first purchase a car and at regular intervals thereafter. For cars with contact breaker (points) ignition, plan on doing this service at 10,000-mile inter-

vals. For cars with high-energy electronic systems, perform the service at 15,000 to 20,000-mile intervals.

Some enthusiasts replace all high-wear items when they first purchase their classics. This strategy will give you a baseline for future reference—you'll know just how old these components are. Maintenance items include air filter, PCV valve, sparkplugs, fuel filter, distributor cap and rotor, ignition cables, and, in cars with contact breaker ignition, points and condenser.

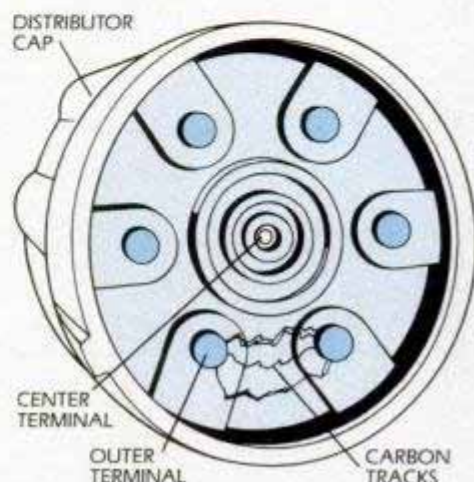
Begin the maintenance tuneup by removing all of the sparkplugs. Carefully note the condition of the old plugs. Depending on type of fuel used and model year of the car, their color can range from white to gray to light brown. However, it should be clear that all of them were operating. None should be markedly darker than the others and all of them should be dry.

Compression testing

If some of the plugs look wet and oily, you should perform a compression test. Before you can test compression, you have to arrange some means of holding the throttle and the choke open. Then, disconnect the negative wire from the

coil and cover its terminal end with a piece of electrical tape. On GM HEI systems, disconnect the wire from the BAT terminal of the distributor.

With a compression gauge held firmly in place or threaded into the No. 1 sparkplug hole, crank the engine five revolutions or until the gauge goes no higher. Write down the compression reading and move on to the next cylinder, cranking the engine the same number of



8 Replace the distributor cap if any signs of carbon tracking are found inside.

Turn your car into an

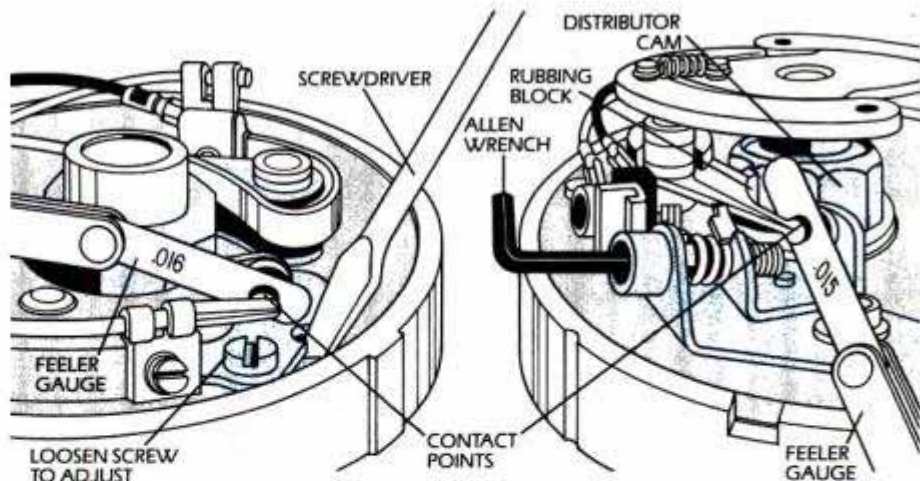


revolutions. Continue until all cylinders have been tested, and compare your readings. All should be within 75 percent of your strongest cylinder and each should at least reach the minimum pressure found in the spec table of your repair manual. If readings are not up to spec, further diagnosis will be necessary to determine the cause.

If your car has high-energy electronic ignition and if the plugs look okay and are no more than 15,000 miles old, you may want to clean and regap them. Check for rounding of the sharp edges on both inner and ground electrodes. If they look good and are all nearly the same color, clean them with a wire brush and a sharp awl or knitting needle. Use the awl to clean any deposits from around the insulator. Take care not to break the ceramic insulator body. On cars with contact breaker ignition, sparkplugs should be replaced at 10,000-mile intervals regardless of condition.

Replacing the plugs

Before installing the plugs, check the gap with a wire sparkplug gauge (Fig. 6). Use the gap tool to bend the electrode if the gap is not to specs. Don't try to close the gap by hammering the electrode. You



9 Set contact point gap with a feeler gauge after positioning the rubbing block on the high point of the distributor cam. Adjust with a screwdriver or Allen wrench.

could crack the insulator.

Reinstall the plugs, starting each one by hand to make sure it doesn't cross thread. If possible, tighten them to 20 ft.-lb. with a torque wrench. In any case, don't overtighten them. If you can't reach the sparkplug hole easily, try slipping a length of rubber hose over the terminal end of the plug. This will act as an extension handle.

Inspect the plug wires for checking,

cracks, burns, brittleness or other visible damage. Clean any corrosion from the terminals. The boots must fit securely on both the plugs and the cap. Replace the set if any are damaged.

Install new wires one at a time as the old ones are removed. Take care to use all looms and separators. This can be extremely important in cases where the exhaust manifolds are close to the plugs (Fig. 7). Premium grade hypalon-type or

SU 2000® performer.

Give it Shell SU 2000® Super Unleaded gasoline. A patented, high-octane performance gasoline. It's designed for smooth, quiet power and it fights critical engine deposits that can cause knock.

Get Shell SU 2000 Super Unleaded gasoline.



CLEAR GUARD™ **LETS THE NATURAL BEAUTY** **SHINE THROUGH.**



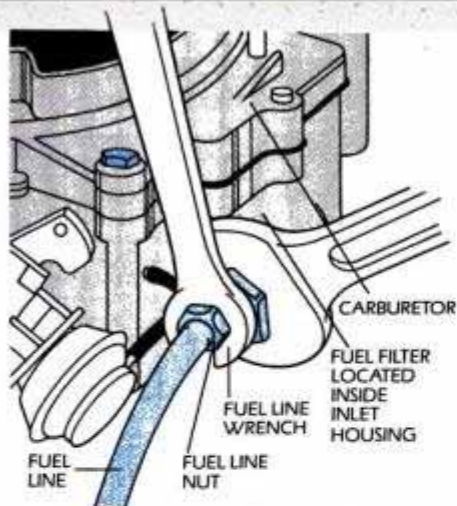
Leading brand sprays on cloudy.

New Clear Guard™ sprays on clear, stays clear to let natural beauty shine through.

Introducing new Clear Guard™ from Turtle Wax®... a clear new challenge to Armor All®.

Now there's a clear choice in a vinyl, leather and rubber beautifier/protectant. New Clear Guard™ protectant from Turtle Wax® has a revolutionary 100% active (no water) formula that is completely clear. Sprays on clear, stays clear, to let the natural beauty shine through. No milky or cloudy residue. Protects and conditions as it shines. Try new Clear Guard™ today and see for yourself what a clearly superior product it is.

Save \$2.00 with our introductory rebate offer.
Details at your favorite retail store.



10 When disconnecting a fuel line for service, use two wrenches to prevent damage.

silicone rubber jacketed plug wires—such as those used on high-energy ignition applications—offer far better heat and current-leakage protection than conventional wires.

Checking the cap and rotor

Once the wires are installed, remove the distributor cap and clean the inside with a dry rag. Look for cracks, fractures or any evidence of carbon tracking (Fig. 8). Carbon tracks are lines running from one outer terminal to another or from one terminal to the center terminal. If tracking or physical damage is noted, replace the cap. If the cap looks okay, clean all corrosion from the terminals. If it cannot be scraped from the terminals with a small knife, replace the cap.

Remove the rotor and examine it. It should be replaced if it is cracked, chipped or carbon tracked. Clean corrosion from the tip with a knife. If the rotor is to the point where it cannot be cleaned easily, it should be replaced.

On cars with electronic ignition, the distributor service ends here, assuming of course that there has been no ignition-related performance problem. If an ignition problem is affecting engine operation, diagnostic procedures must be performed. This differs from car to car, and in some cases substitution testing with known good parts is part of the procedure. Therefore, you may want to let a dealer or large independent service facility handle such problems. They're also equipped with an oscilloscope, which can confirm the presence of an ignition fault.

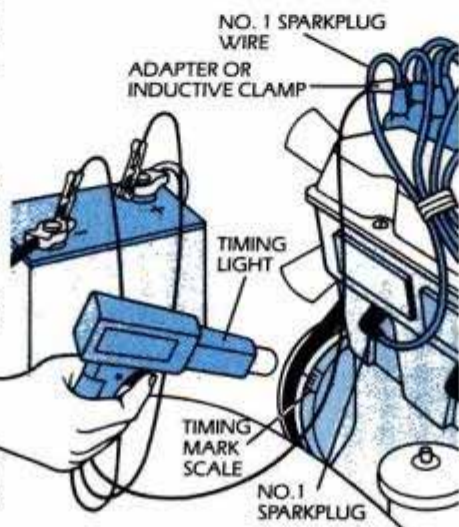
Replacing the points

If your car has a contact breaker ignition system, replace the points and condenser. Begin by rotating the engine until the rubbing block of the points is on the high point of the distributor cam. Disconnect the distributor's primary wire and

the condenser wire from the points before removing the points and condenser. Don't drop the screws or you may have to spend hours recovering them. On many cars, the screws that hold the points need only be loosened for removal.

Install the new points and condenser and attach both wires to the points. With the rubbing block of the contact set touching a high point of the distributor cam, adjust the point gap to specification using a feeler gauge (Fig. 9).

Lubricate the distributor cam with a small amount of cam lubricant or white lithium grease. A very small amount is enough. Don't overdo it. If the distributor is equipped with a lubricating wick that touches the cam, don't attempt to oil it. Replace it instead. Reinstall the distributor rotor and cap. If you have a dwell



11 Check spark advance setting with a timing light wired to number one plug.

meter, start the engine and check point dwell. Readjust if necessary.

Choke adjustment

Remove the air cleaner and check the filter. If it appears dirty, replace it.

Replace the fuel filter. On most cars, it's in the fuel line or behind the inlet fitting on the carburetor (Fig. 10).

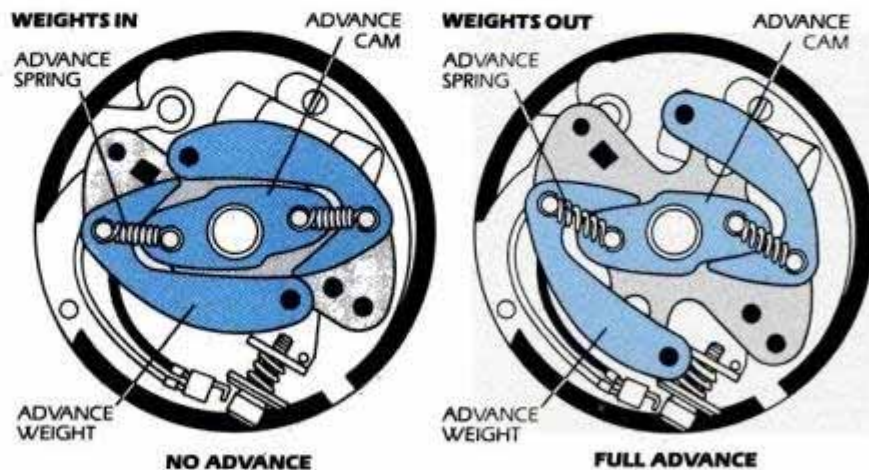
Clean the choke mechanism and carb linkage with carburetor cleaner. Then, start the engine and observe the operation of the choke. If the engine is cold, the choke should snap closed and the throttle should come to rest on the fast idle cam when you open and close the throttle. If it doesn't, adjust the choke and fast idle according to manufacturer's specs. As the engine warms, the choke should gradually open and when you rev the warm engine, the idle speed should drop. If the choke system doesn't permit the cold engine to run without hesitation or stumbling, adjustment is necessary.

Checking the timing

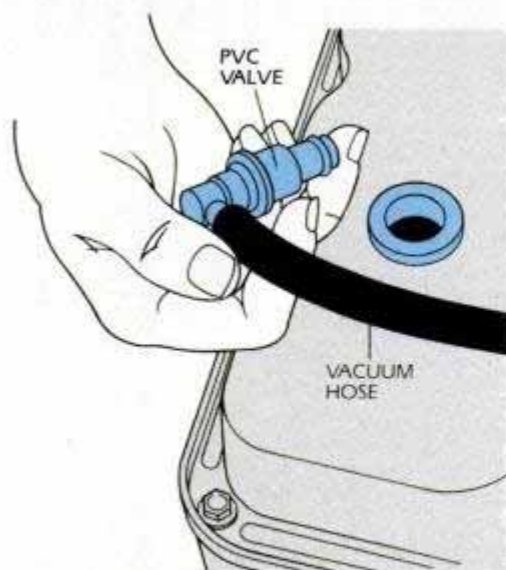
Warm the engine and check ignition timing with a timing light. (Fig. 11). On late model cars, you'll find specs and general instructions on the vehicle information label under the hood.

Once you've checked initial spark advance, check vacuum advance by accelerating the engine to 1,500 rpm. Then, while holding it at this speed, connect the vacuum advance line to the distributor. Timing should advance. If not, replace the vacuum diaphragm unit.

Disconnect the vacuum advance line and check centrifugal advance by accelerating the engine to 3,500 rpm while watching the timing marks with your light. Timing should advance. If it doesn't, remove the distributor cap and check the centrifugal weights for binding on applications where weights are located directly under the rotor (Fig. 12). Where weights are not located under the rotor, the distributor will have to be removed and disassembled to service the centrifugal advance mechanism. The latest engines have no vacuum or centrifugal advance, as a computer controls engine timing.



12 If a check of centrifugal advance shows that timing isn't advancing as the engine is accelerated, check for binding or sticking of the distributor advance weights.



13 With engine running, check PCV system by feeling for vacuum at valve end.

PCV valves

Replace the PCV valve and the PCV filter every 30,000 miles. Check and clean them every 15,000 miles. To check the PCV valve, remove it from the intake manifold or rocker cover and start the engine. Check for vacuum at the end of the valve with your thumb (Fig. 13). If you feel nothing, the valve or hose is clogged. Replace any hoses that don't look good. If vacuum is present and the hoses look okay, shut off the engine and remove the valve. Shake it. You should hear the needle rattle inside. If it doesn't rattle, the valve must be replaced.

Before you call your maintenance tune-up complete, you should check the condition and connections of all vacuum hoses. If they're cracked or brittle, replace them. A vacuum leak will make the best tuned engine idle roughly.

Lube service

If you want to prolong the life of the engine and suspension parts, you should change your oil and lube your chassis at 3,000-mile intervals. While some manufacturers recommend far longer oil-change intervals, most mechanics will tell you that the best thing you can do to make your engine last a long time, particularly with an older car, is to change the oil frequently.

Warm the engine completely before changing the oil. Drive the car for at least 20 minutes. Idling it in the driveway won't make it warm enough. Once the engine is warm, shut it off and raise the car on jackstands or ramps. To do the job correctly, the car must be level. This means you'll have to lift the front and rear. Getting the car up in the air will also allow you to inspect the chassis components and other undercar parts.

Place a drain pan under the car that is large enough to hold all the oil. Use a socket wrench or box wrench to remove the drain plug. If the plug has a square hole in its center, use the square drive of a ratchet to loosen it. Allow the warm oil to drain completely.

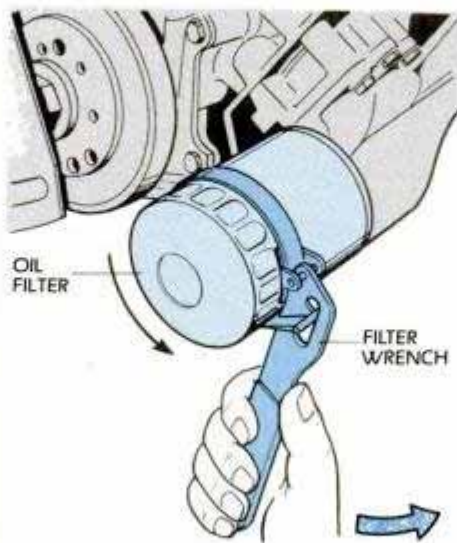
While the oil is draining, remove the filter. If your drain pan doesn't extend to the area of the filter, use another pan to catch the filter spillage or wait until the oil has drained. Don't shortchange the drain time, though. Make sure the oil has stopped dripping from the plug hole.

Air filter removal

Use a filter wrench to loosen the canister-type filters which are found on nearly all late-model vehicles (Fig. 14). Make sure the old gasket comes off with the filter. Clean the filter mounting area and partially fill the new filter with some of the oil that will be used to fill the crankcase. Lube the filter gasket with the clean oil as well (Fig. 15). Install the filter, tightening it according to the directions printed on it.

Cars that are more than 20 years old may have a cartridge-style oil filter, contained within a metal can. The can is held onto the mount by means of a bolt through its center. Remove the filter by loosening the bolt. Dump the old cartridge into your drain pan, and clean the can thoroughly with solvent and a brush. Install the new filter element in the can and lube the gasket with engine oil. Make sure that the old gasket has been removed, and reinstall the filter can.

Once you're sure that the oil has drained completely, reinstall the drain plug. Tighten it with moderation. Use a wrench no longer than 10 in. and *don't* make it as tight as you possibly can.



14 A band-type oil filter wrench grips securely to make removal clean and simple.

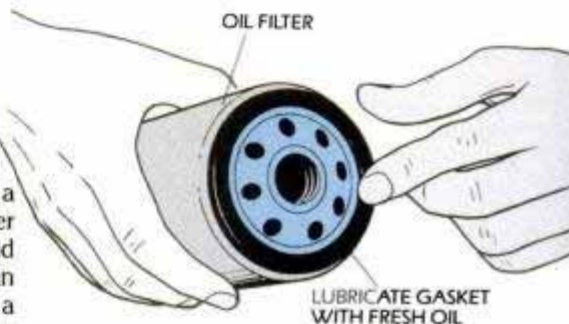
Choosing an oil

Check your owner's manual to determine proper refill oil if your car is relatively new or under warranty. Carmakers recommend SF grade oils for the latest gasoline engines and SF/CC or SF/CD oils for the latest diesels. Some, most notably General Motors, prohibit use of certain viscosities. For older high-mileage cars, use an SF 10W40 multigrade oil in winter and an SF 20W50 in summer. If your car has a new engine, use SF 5W30 in winter and SF 10W40 in summer.

Fill the crankcase with the correct amount of oil and run it for a few minutes, checking the leaks from the filter or drain plug. Shut it off and check oil level on the dipstick.

Chassis lubrication

Lubricate all steering and suspension joints with water-resistant EP chassis lube (Fig. 16). If the chassis parts are not equipped with grease fittings, you may be



15 Before installing a new oil filter, lubricate the gasket with fresh engine oil.

able to install them in some components by removing the screw-in plug (Fig. 17). If a part doesn't seem to be taking any grease, wiggle it a bit. Continue pumping in grease until the dust cover of the suspension joints swells.

Check the level of differential lube and manual transmission lube. Differential lube and transmission lube levels usually are checked by removing a plug from the side of the unit. Most cars use hypoid-type lube in the rear end. Some cars that are equipped with limited-slip type rear ends require special lubricants. For most rear-drive cars, the lube that is used in the rear end is also used in the manual transmission. Check your shop manual or owner's manual. Manual transaxles in front-drive cars generally are lubed with automatic transmission fluid.

Automatic trans service

Check the fluid level in automatic transmissions after driving for about 10 minutes. Idle the engine and leave the trans lever in the PARK position. If the fluid level is low, make sure you use the recommended type of automatic trans-



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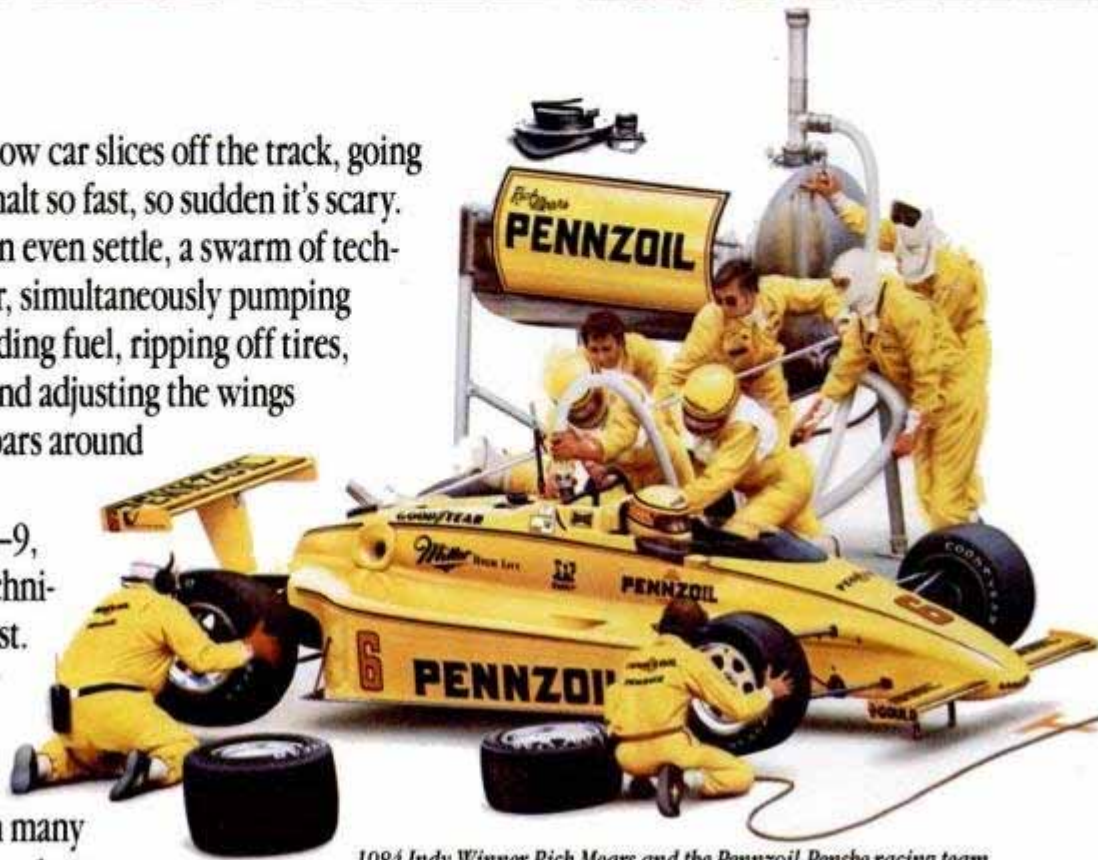


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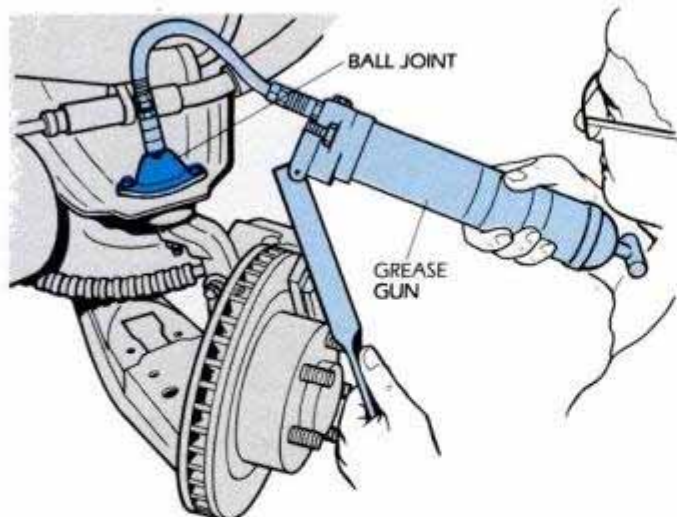
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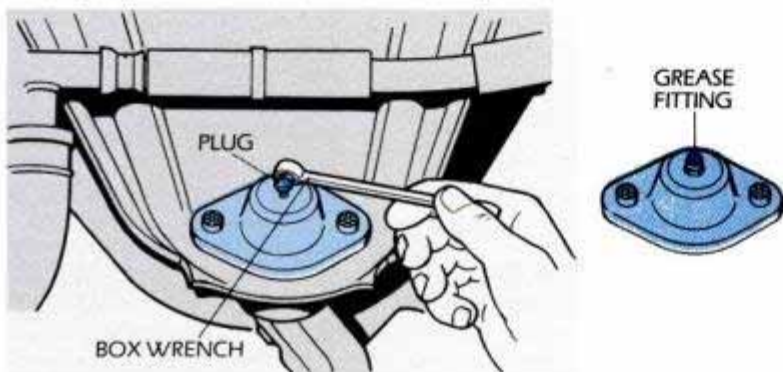
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16 Snap the coupling of the grease gun onto the grease fitting and pump grease in until the dust boot begins to swell or until grease is forced out the bottom of the joint.



17 On some vehicles, chassis joints may be fitted with plugs rather than grease fittings. Remove the plugs with a box wrench and thread grease fittings into place.

mission fluid for your brand of car.

Change the automatic trans fluid and filter at 30,000 mile intervals. If your trans pan is not equipped with a drain plug, remove all bolts except one and allow the fluid to drain from a corner of the pan.

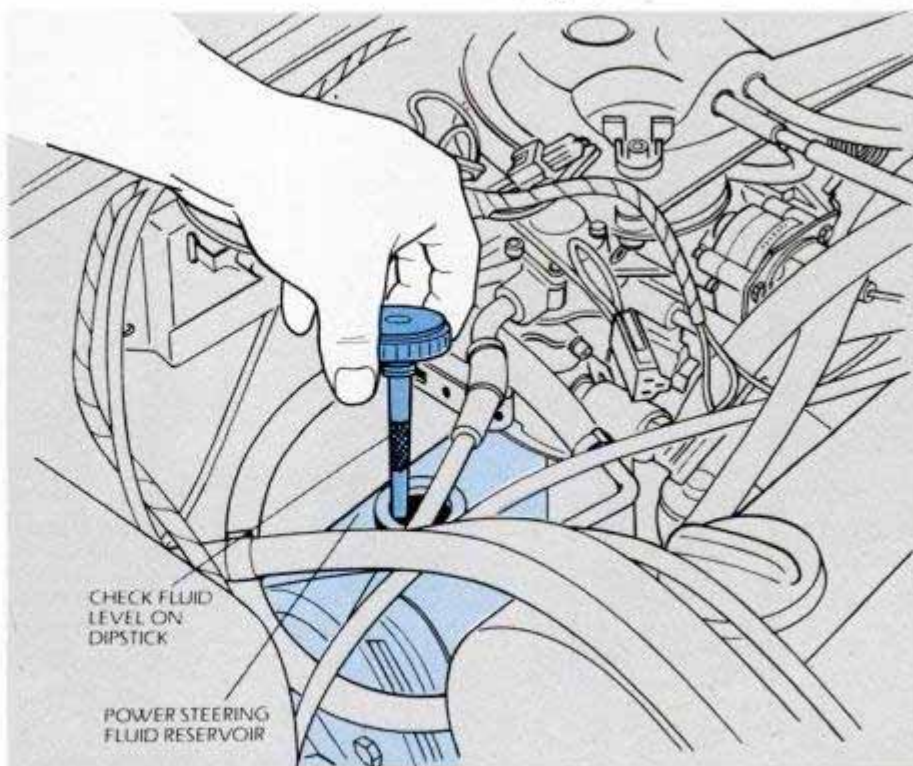
Lube other moving parts under the car, like gearshift linkages and parking brake mechanisms, with a few drops of engine oil. Use a small squirt can.

Open the hood and lube the accelerator linkage and hood hinge mechanism with engine oil. Clean the hood latch mechanism and apply a light coating of lithium grease.

Use engine oil to lube the trunk lock and hinge mechanisms. Lightly coat the door latch mechanisms with lithium grease. If the hinges squeak, apply a few drops of the engine oil.

Check the level of the power steering fluid, and top it off if necessary (Fig. 18). Most older power steering pumps take automatic trans fluid. Some newer units require special power steering fluid.

Check the brake fluid level in one or both master cylinder reservoirs. Use only DOT 3 fluid to top it off. Make sure that the can of fluid you use is fresh and tightly sealed.



18 Power steering fluid level is read on a dipstick, usually attached to the fluid reservoir cap. Clean the surrounding area to keep dirt from entering and ruining the pump.

Undercar inspection

Every time you have your car up on jackstands for an oil change, you should perform at least a basic undercar inspection. Check all exhaust system components for possible leaks or deterioration. Make sure all the hangers are intact and in good condition.

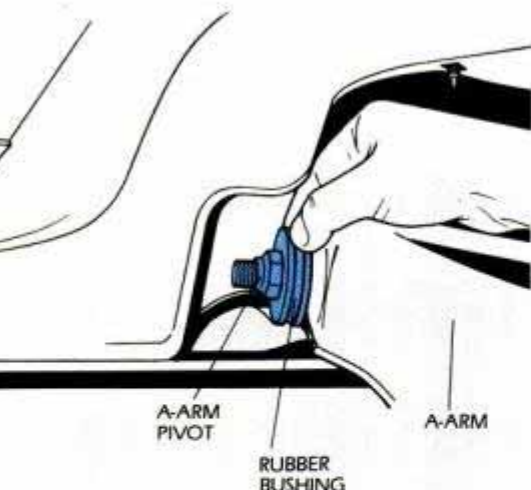
Look for areas where the undercoating has fallen off. Remove any dirt, sand off any rust and recoat the area with aerosol can undercoating, which is available at auto parts stores.

Check all rubber bushings and dust boots for obvious deterioration. Pay particular attention to those bushings found at each end of front or rear sway bars, as well as those that hold the center of the sway bar to the frame. The bushings used on front and rear control arms are also potential problem areas (Fig. 19). If bushings have shrunk or shredded, handling will suffer and in many cases the component will produce a lot of noise.

Check engine and transmission mounts for looseness or cracking of rubber parts. A broken engine mount that allows the engine to rise up from its proper location can be more than an annoyance. In some cases it can make the throttle stick open.

Inspecting ball joints

Every 15,000 miles your undercar inspection should include a check of steering and suspension components. Begin by checking ball joint condition. Cars with upper and lower control arms have



19 Inspect all rubber suspension bushings for drying, cracking or shredding.

both loaded and unloaded ball joints. Most mechanics check the condition of the loaded joints only. If these are okay, the unloaded joints should be okay as well. Of course, if the loaded joints have been replaced, they could be in better shape than their weak sisters.

The loaded ball joint is the one that carries the spring. If the spring is mounted on the upper control arm, then the upper joint is the loaded joint. If the spring is on the lower control arm, the lower joint is the loaded joint. To check a loaded ball joint for looseness, the load must be relieved (Fig. 20).

On cars where the coil spring is

mounted on the lower control arm, relieve the load by placing a jack under the control arm as close to the joint as possible. On vehicles where the spring is mounted on the upper control arm, a block of wood should be wedged between the control arm and the frame, and the car should be lifted at the cross-member until the wheels just leave the ground. Jackstands must then be located on the frame to support the car.

Check axial (up and down) movement of either type of joint by inserting a pry bar between the bottom of the tire and the floor, then lifting the wheel. The joint should allow the wheel no more than 0.05-in. free movement. You can measure axial movement precisely by mounting a dial indicator so its stem rests against the bottom surface of the wheel's knuckle. The stem must be parallel to the imaginary line that runs through the center of both joints. However, most mechanics forego the dial indicator. If there's a noticeable amount of axial movement, it's probably well in excess of 0.05-inch.

If you're not sure about how much axial movement the joint allows, check radial movement by pushing the bottom or top of the tire in and out (depending on which joint is the load carrier). More than 1/4-in. of movement at the far edge of the tire is excessive.

Wear-indicator joints

Some cars produced after 1973 were

equipped with wear-indicator ball joints as standard equipment (Fig. 21). Wear-indicator joints have a collar around the grease fitting that protrudes from the lower surface of the joint. As the joint wears, this collar sinks below the surface of the joint, indicating that replacement is necessary.

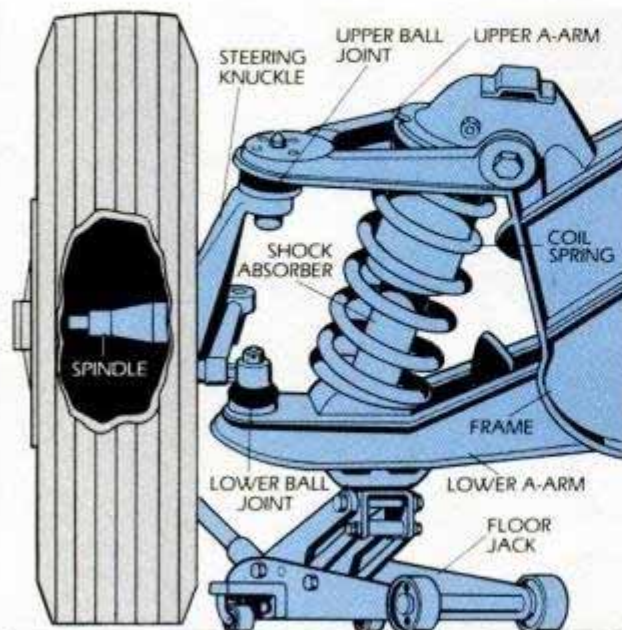
There are no specific recommended procedures for checking tie-rod ends, Pitman arm and idler arm—the parts that constitute the steering linkage of most cars (Fig. 22). But a little common sense is all that's required.

One good way to check these parts is to block the front wheels, completely prohibiting their movement, and have an assistant turn the steering wheel while you watch the steering linkage for movement at each joint. If a joint is sloppy, the component or rod end must be replaced.

Another way is simply to grab the tie rod pieces and shake them as hard as you can (Fig. 23). The idler arm and Pitman arm should show little or no vertical movement, while the tie rod ends should not show unrestricted looseness. A torn dust boot on a tie rod end or other joint is reason for replacement.

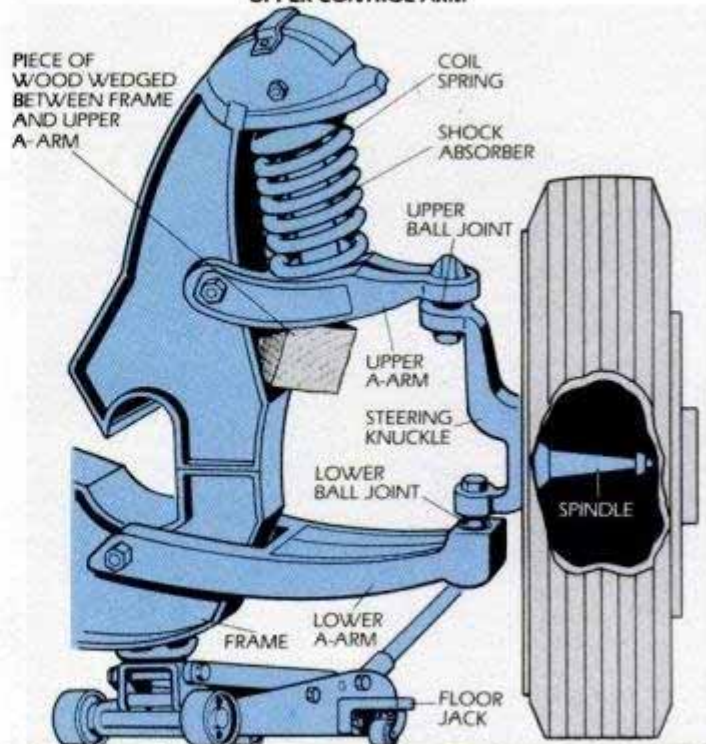
On front-wheel-drive cars, check all CV joint dust boots for visible damage. Generally, unless a torn boot is discovered immediately, the joint will have to be replaced along the boot, since CV joints that are not protected from dirt deteriorate rapidly.

COIL SPRING ON LOWER CONTROL ARM

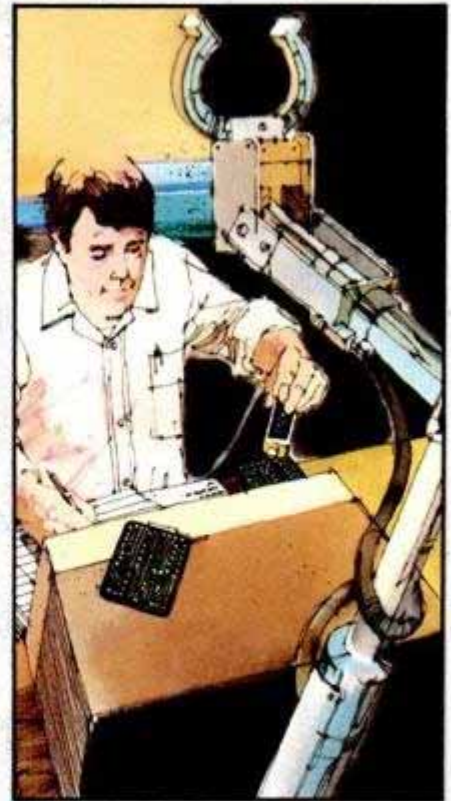
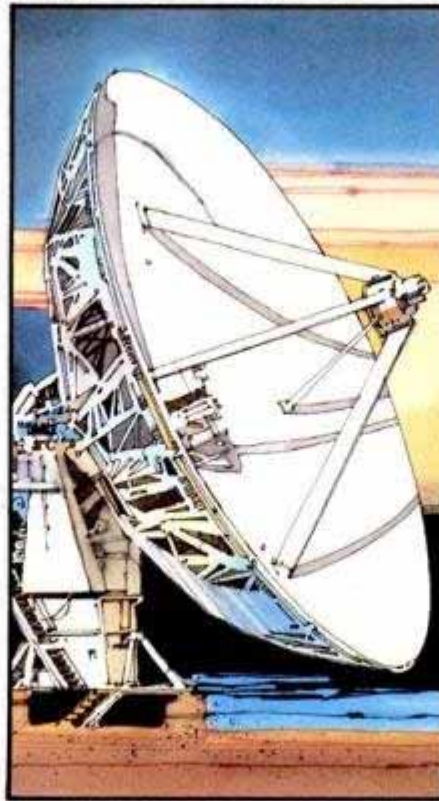
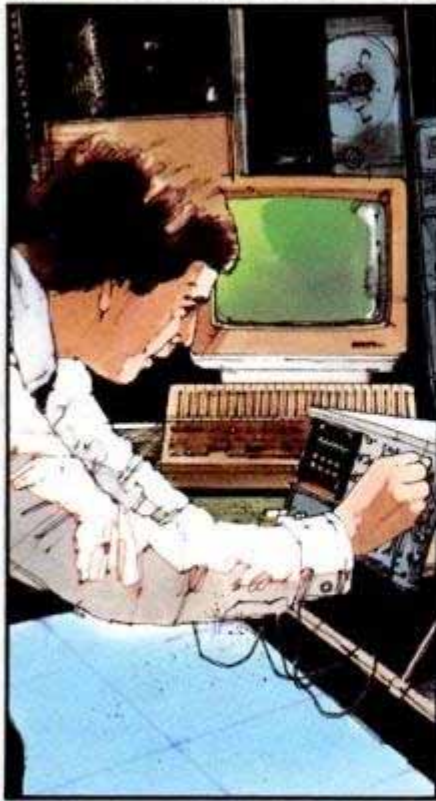


20 Check for play in loaded lower ball joints by jacking up the lower A-arm, placing the jack as close to the joint as possible.

COIL SPRING ON UPPER CONTROL ARM



Relieve the weight from loaded upper ball joints with a wedge between A-arm and frame, then jacking car up at crossmember.



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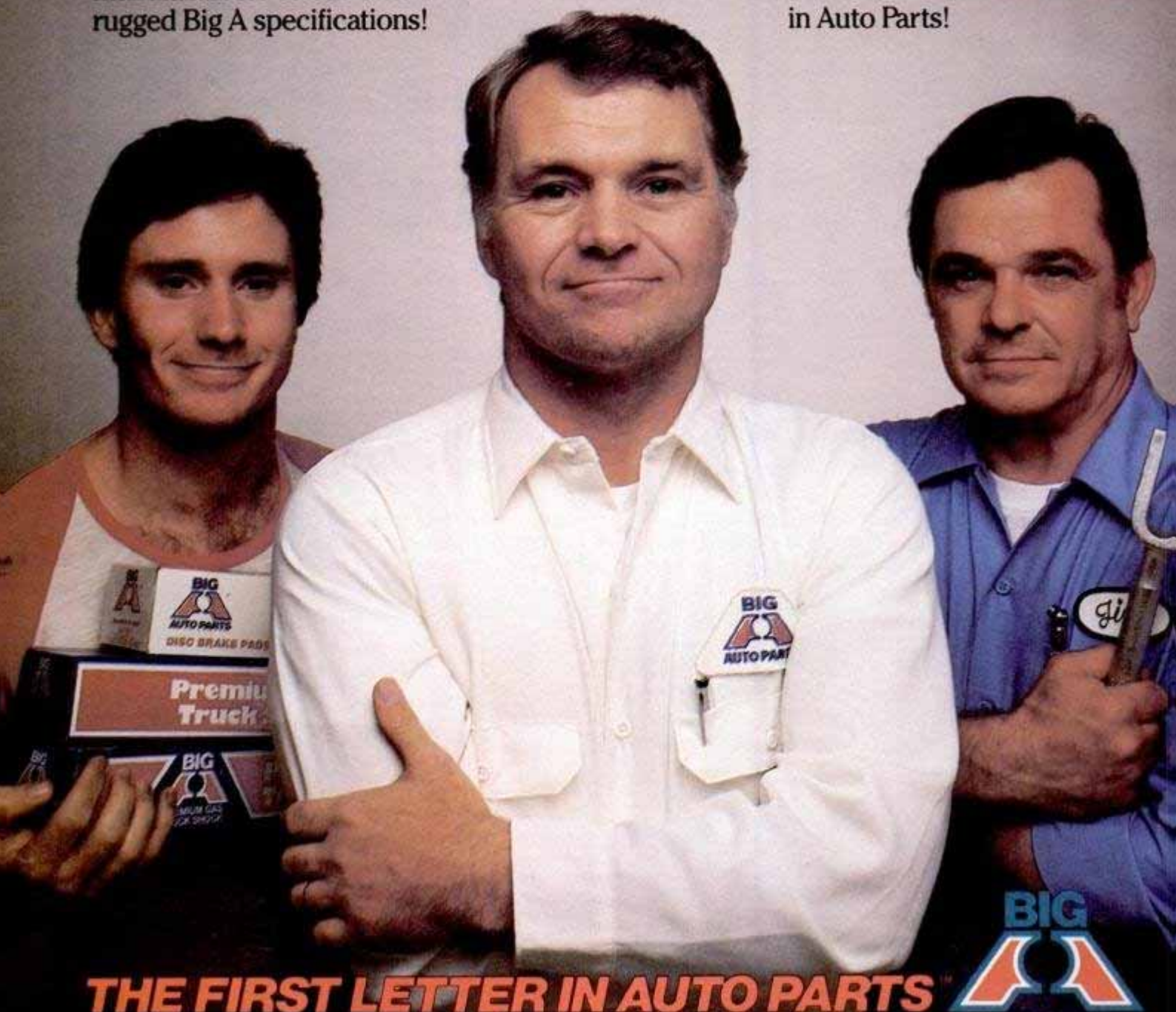
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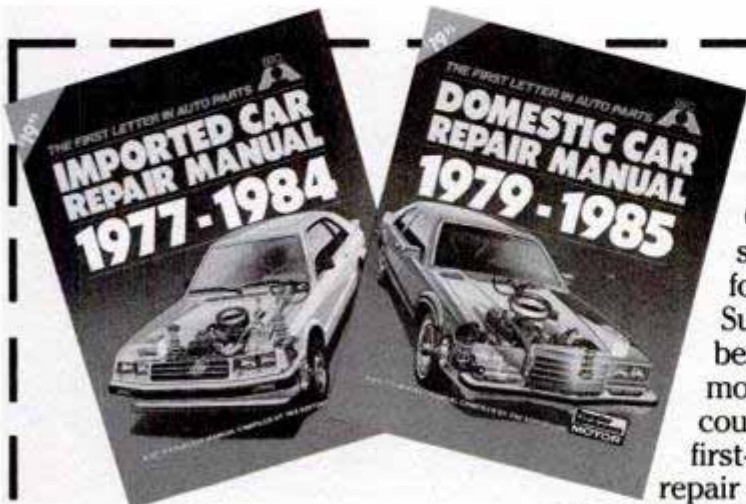
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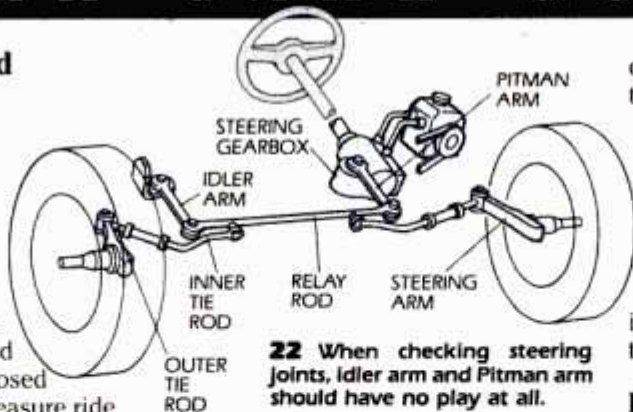
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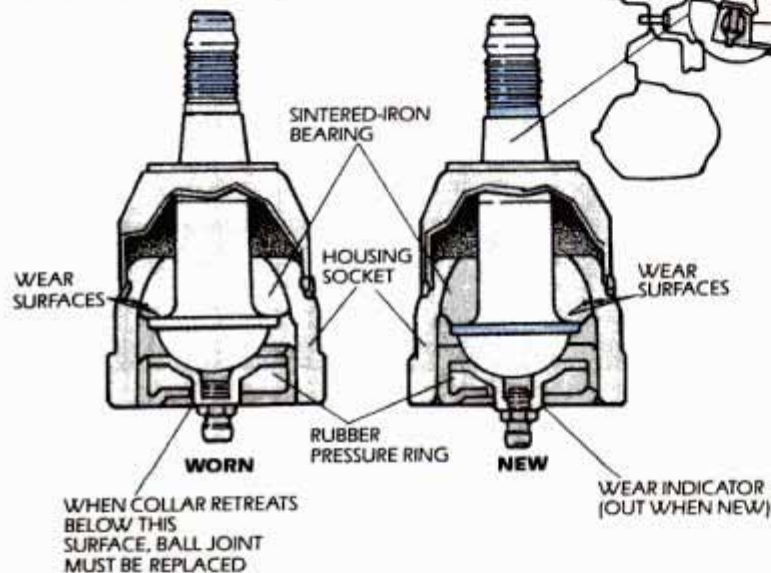
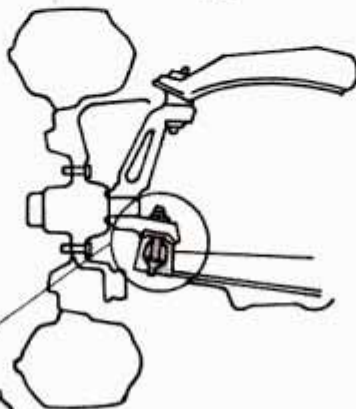
Shock absorbers and springs

Because they can cause a vehicle to handle erratically, worn springs and shocks can be as dangerous as they are uncomfortable.

To check spring condition, you have to determine if the car's body and frame are as high above the rear axle and front spindles as they're supposed to be. To do this, you must measure ride height. Measurements are taken at each end of the car. The exact method varies, but usually you have to measure from a spot on the rear axle to a snubber or other component on the frame and from a point on the front spindle to a specific location on the frame or unibody. These measurements are compared to manu-



22 When checking steering joints, Idler arm and Pitman arm should have no play at all.



21 Some late model cars are factory equipped with wear-indicator ball joints. When the collar supporting the grease fitting retreats as shown, replace joints.

facturer's specs to see if they fall in the acceptable range. If not, coil springs must be replaced and leaf springs must be replaced or rearced. Once ride height has been corrected, wheel alignment must be checked.

Shock absorber condition is best determined by the way your car behaves on the road. If it bounces every time you hit a bump or dips and sways as you corner, it needs new shocks.

Cooling system service

Some motorists who take very good care of the rest of their car ignore the cooling system completely—except perhaps for a yearly check of antifreeze protection level. This is unfortunate because the radiator and various other cooling system components will deteriorate rapidly if coolant is not renewed at regular intervals. Furthermore, if the system is not flushed periodically, cooling capacity will be lost as passages clog

with contaminants.

Most manufacturers recommend yearly inspection and pressure testing, accompanied by a backflush and refill every two years. However, for the do-it-yourselfer who doesn't have access to backflushing equipment, a yearly drain, flush and refill is a good idea.

Before draining coolant, check the condition of all belts and hoses. Look for cracking, swelling and oil or grease damage to hoses. Pay particular attention to the area just behind the clamp. Sometimes the clamp will dig its way into the hose. Black flecks in the coolant are an indication of internal hose deterioration. Tests indicate that most hoses last no longer than three or four years, so regular replacement is a good idea regardless of the outside appearance.

The same is true of most conventional V-belts. It's difficult to judge belt condition on the basis of appearance. Of course, any belts that are cracked, glazed

or shredded must be replaced, even if they are less than four years old.

When replacing belts, it's best to tension them using a gauge that is designed for this purpose. However, a little push with your thumb in the center of the belt's longest span is better than no tension check at all. If you can deflect the belt more than 1 in. while applying moderate pressure, it's too loose.

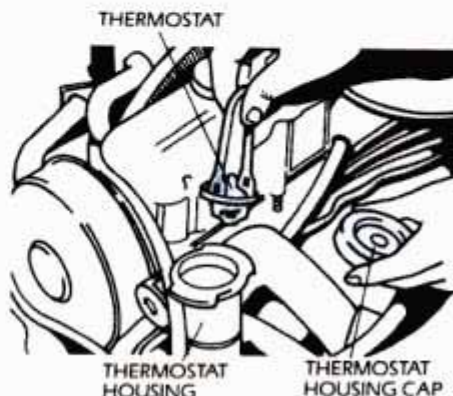
Flushing the system

Once you've examined all the belts and hoses, remove the radiator cap, run the engine until it's hot, and drain the coolant by opening the petcocks in the radiator and engine block. If you can't loosen the petcock valves, drain the engine and radiator by removing the lower radiator hose.

You can flush most of the dirt from the system by alternately filling it, running the engine until the thermostat opens, and draining it. Continue in this manner until the water runs clear. Make sure the



23 Tie rod ends should move some when wiggled, but not have excess freeplay.



24 Some GM Fours locate the thermostat under a radiator-cap type housing cover.



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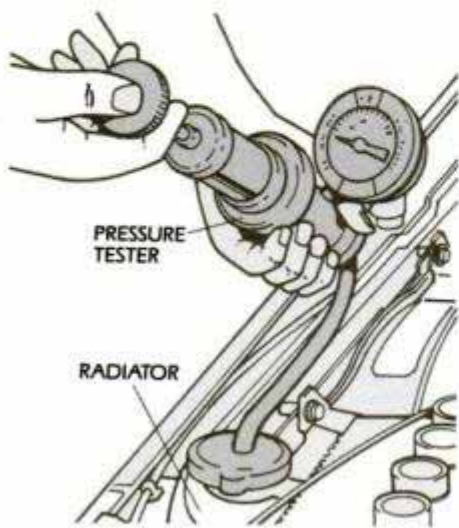
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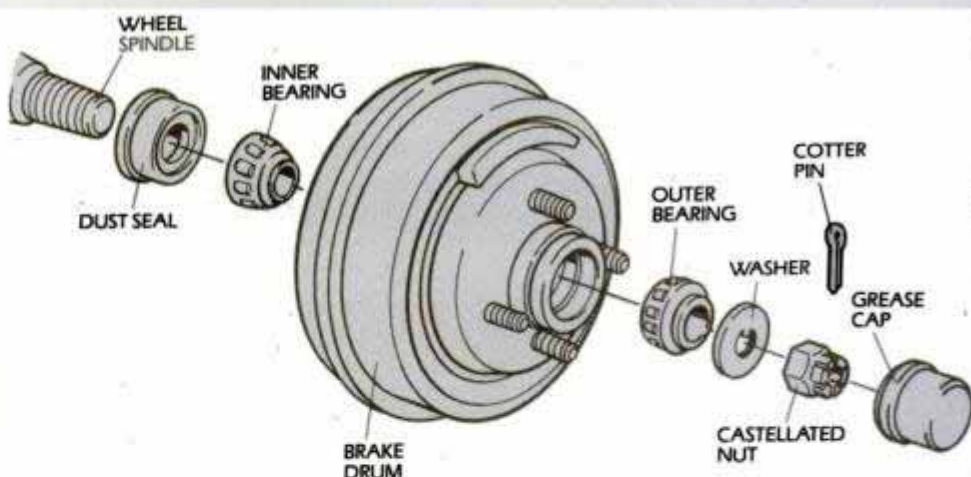
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heater is turned on. You can probably do a better job if you install a flushing tee in your upper heater hose. This device is available at auto parts stores, and it allows you to connect a garden hose to your cooling system. With the hose connected to the tee, run water through the system until it flows clear.

If your heater has not been performing as well as it should or if your car has been



25 Check for cooling system leaks by pumping it up with a system pressure tester.



26 Wheel bearings should be inspected and repacked whenever brakes are serviced. The grease cap on the hub can be removed with a large pair of adjustable pliers.

running hot, you should check the condition of your thermostat. It is most often found under the housing attached to the upper radiator hose. To remove the thermostat, loosen the two bolts on the base of the housing. Some newer models locate thermostats in a housing sealed by a cover that looks just like a radiator cap (Fig. 24).

To test the thermostat, hang a thermometer in a pan of water and place it on the stove. Suspend the thermostat in the

water. Heat the water, noting the temperature at which the thermostat begins to open. If the thermostat does not open at the temperature stamped on its body, it is defective and must be replaced.

Pressure testing

If you have a pressure tester, you should check the system for leaks once it has been flushed completely. To do this, fill the system with water, make sure the heater is turned on, and attach the pres-

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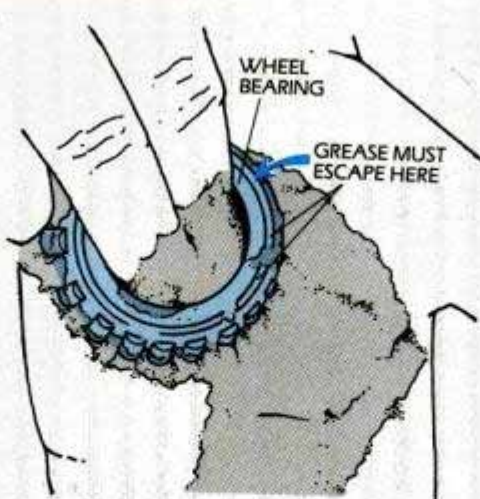
sure tester to the filler neck of the radiator (Fig. 25). Pump up the system to the pressure specified in your service manual. If the system won't hold pressure, there is a leak. Carefully check all connections, the radiator, heater control valve and thermostat housing.

If you can't readily find the source of a pressure leak, use a flashlight and mirror to check the water pump's vent hole and seal. To check engine block core plugs for leakage, support the car on jackstands and take a look at the various plugs in the side of the block.

If your pressure test shows that there are no leaks, refill the system with enough antifreeze to provide at least a 50 percent antifreeze/water solution. Do not allow the concentration of antifreeze to exceed 70 percent, as freeze protection deteriorates above this level. Make sure you fill the recovery tank, if your car is so equipped, to the COLD FULL level.

If your car has an aluminum radiator or aluminum engine parts, you must use an antifreeze that's formulated for use in engines with aluminum components.

Before reinstalling the radiator cap, check it with your pressure tester to make sure it will maintain pressure at the specified level. If you don't have a pres-



27 When repacking bearings, be sure to force grease all the way through rollers.

sure tester, examine the cap seals for any signs of damage or excessive wear. Replace the cap if the seals don't look good.

Wheel bearings and tires

The front wheel bearings of rear-drive cars and the rear wheel bearings of front-drive cars should be checked whenever brake drums or brake rotors are removed for brake inspection (Fig. 26). Brakes should be inspected every 15,000 miles

or whenever trouble is suspected.

Clean the bearings in kerosene or solvent, and examine them and the bearing races, which can be found within the hub, for signs of pitting or other surface damage. Some minor discoloration is normal. If the bearings are okay, repack them with a high temperature multipurpose EP grease.

To repack, place a substantial amount of grease in the palm of one hand, cup your hand and push the side of the bearing cage into your palm with your other hand (Fig. 27). Make sure you force the grease past the rollers. Continue until it begins to ooze out of the top of the cage. Rotate the cage, pushing each uncoated area into the grease. Make sure all rollers are covered completely.

Reinstall the bearings along with a new grease seal. Tighten the hub nut to about 20 ft.-lb. while rotating the wheel. Back the nut off to release the load on the bearing and then bring it back up to finger tight. Position the hub nut lock or the castle nut slot so that it aligns with the hole in the spindle and install the cotter pin. When you're finished, there should be less than a noticeable amount of end play (about 0.001 to 0.003 in.), and the wheel should spin freely.

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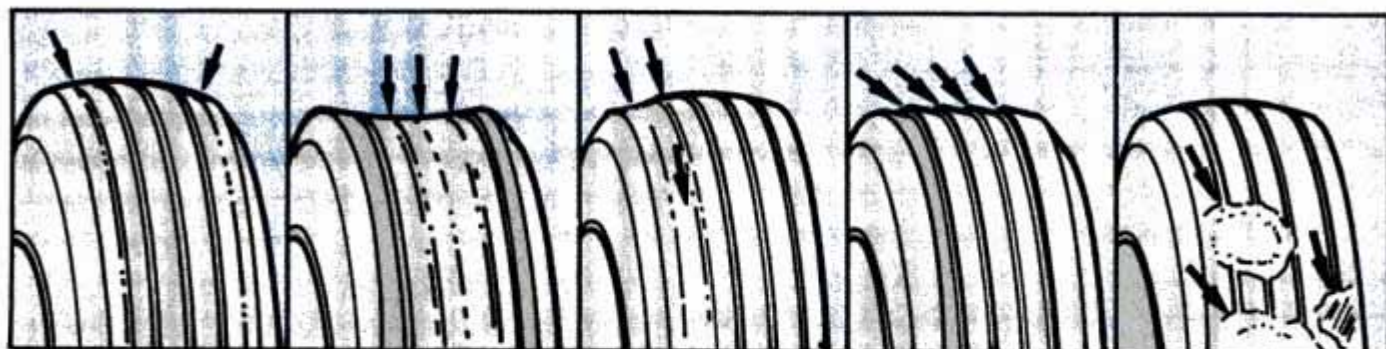
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WEAR ON ONE SIDE

FEATHERED EDGE

BALD SPOTS

28 Tire wear patterns are an excellent indicator of how well front end alignment and wheel balance have been maintained.

Radial tires, however, do not show the traditional patterns due to under- or overinflation.

Tire check

Check tire pressures every time you check oil, which means at every other gas fillup. It's a good idea to keep your own tire pressure gauge in the glove box, as you may find a wide discrepancy from one service station gauge to the next.

Keep an eye on your tires for excessive tread wear or unusual wear patterns (Fig. 28). Excessive tread wear has occurred when less than 1/16-in. of tread-groove depth remains.

Most tires have tread wear indicators that become visible when tread wear exceeds normal limits. Molded into the bottom of the tread grooves, these indicators appear as 1/2-in.-wide bands across the tire tread.

Unusual wear indicates incorrect inflation or wheel alignment problems. On bias-ply tires, wear that occurs only on both outer edges of the tread is a sign of underinflation. Wear that occurs only in the center of the tread is a sign of overinflation.

This doesn't apply to radials though, since their stiff tread construction tends to retain its shape over a wide range of inflation pressures. Excessive camber, a wheel alignment adjustment, causes one side of the tread to wear more than the other side. Incorrect wheel toe-in or toe-out causes the edges of the tread to feather. Cupping, scalloping or bald spots are generally due to unbalanced tire and wheel assemblies and/or failure to rotate tires.

Rotating tires

Tires should be rotated every 10,000 miles, following a conventional cross rotation plan (Fig. 29). When a spare is included in the rotation, the left front goes in the trunk, the spare goes on the right rear. The right rear goes to the right front, the right front goes to the left rear, and the left rear goes to the left front.

When reinstalling wheels, tighten the lug nuts with a torque wrench as illustrated here (Fig. 30). You'll find a spec for wheel torque in your service manual.

Torque each one to half of the recommended figure the first time around, then bring each to full torque. If you can't find a spec in your service manual, torque 1/2-in. wheel lug nuts to 85 ft.-lb., torque 7/16-in. lug nuts to 70 ft.-lb.

Brake system inspection

Check your brakes at intervals of approximately 15,000 miles, unless prior experience indicates that less frequent

inspection will suffice. Begin by looking for hydraulic fluid leaks at the master cylinder, calipers, wheel cylinders and at every junction or valve in the hydraulic system. If you find hydraulic system problems, you may want to seek professional help. At the very least, you should be equipped with a complete service manual and any required tools before attempting to rebuild or replace calipers, wheel cylinders or a master cylinder. In fact, because the safe operation of a car's brakes depends on the hydraulic system, even advanced do-it-yourselfers often leave hydraulic component rebuilding to professional mechanics.

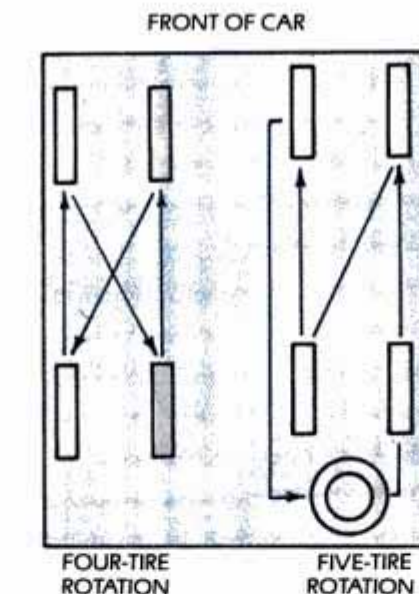
If the hydraulic system checks out okay, inspect disc brake pads and drum brake shoes to make sure that the lining has not worn to the point where replacement is necessary.

If you know for sure that your disc pads are of the bonded type, rather than of the riveted type, you might be able to inspect the lining thickness through an inspection hole provided for this purpose in the top of many calipers (Fig. 31). If the pads are bonded, the thinnest section of the friction material should be at least as thick as the pad backing plate.

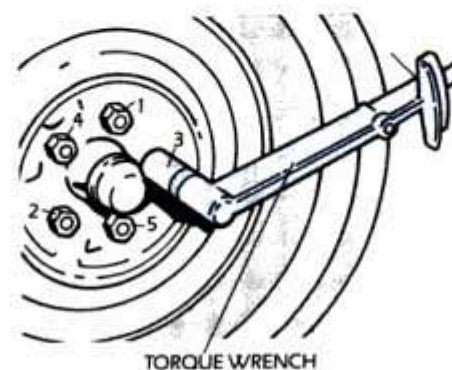
If you don't know whether the pads are bonded or riveted, you'll have to remove the caliper to check pad thickness. In most cases, the job is not very difficult. Exceptions would include some rear wheel disc brakes that incorporate parking brake mechanisms.

Once the caliper has been lifted off the rotor, check the friction material. If it's of a nonmetallic type, the pads must have more than 1/16 in. of material above the rivets (Fig. 32). Semimetallic friction material should be at least 1/32-in. above the rivets.

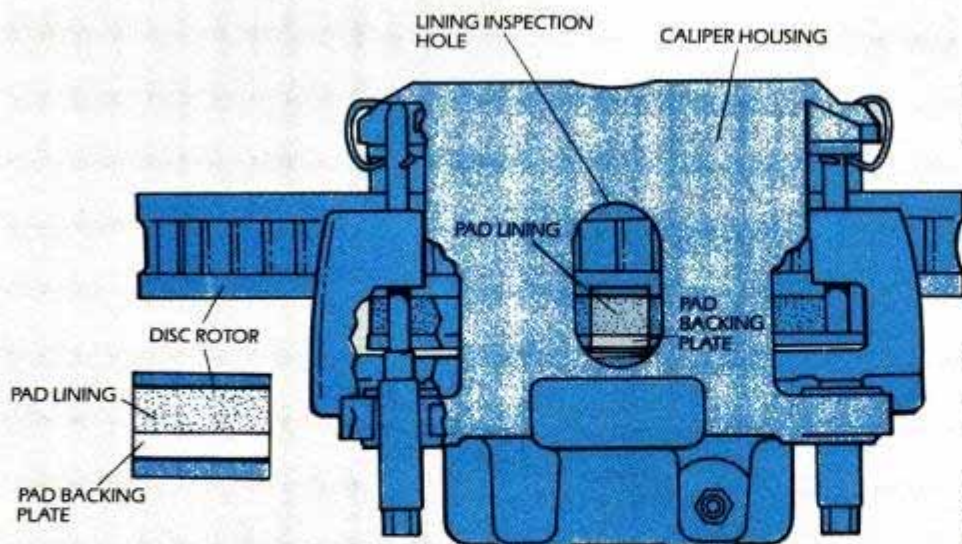
While you're at it, check the rotors for excessive discoloration or any heat cracking. If the rotors are damaged, they'll have to be machined or replaced and the pads will have to be replaced. If everything looks okay and there's plenty of friction material on the pads, you can



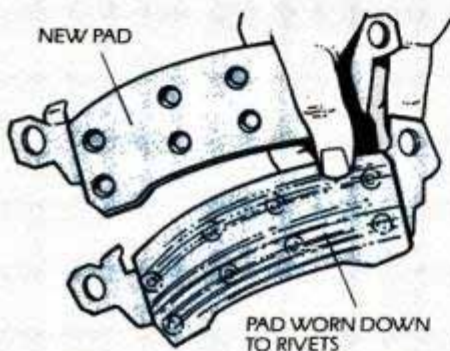
29 Tire rotation every 10,000 miles will prevent abnormal tire wear patterns.



30 For correct seating, install and torque wheel nuts in the order shown above.



31 When bonded-type brake pads are used, check wear by comparing thickness of lining to that of backing plate by looking through the caliper inspection hole.



32 Riveted brake pads must be replaced when lining wears to $\frac{1}{16}$ in. above rivets.

go ahead and bolt it all back together.

Drum brake inspections

To check the linings of drum brake vehicles, the drums must be removed. In most cases, the shoes will have to be retracted before the drums will come off. To retract the shoes on most vehicles with self-adjusting brakes, locate the adjusting slots, which are either in the backing plate (most likely) or in the drum. The slots should be filled with rubber insert plugs. On cars with slots in the backing plate, reach into the slot with a very small screwdriver and lift the self-adjusting lever away from the star wheel. Insert a brake adjusting tool in the slot alongside the screwdriver. Engage the brake adjusting tool in the star wheel and turn it to back off the adjustment. Often, you'll have to move the brake-tool handle upward to retract the shoes.

If the slots are in the drums, use a hook to hold the adjusting lever away from the star wheel for most applications. Insert the brake tool next to the hook to turn the star wheel.

Once the shoes have been retracted, cover your mouth and nose with a breath-

er mask like those sold in automotive paint stores, and remove the drum. Inspect the friction material and drums for visible damage. If the drums are scored, they'll have to be remachined. If they are heat cracked or discolored, they'll have to be replaced.

Check the lining for excessive wear. Bonded linings should be replaced when they have $\frac{1}{16}$ in. or less of friction material. Replace riveted linings when they wear to within $\frac{1}{32}$ in. of the rivets.

Keep it shiny

The best thing you can do to protect the painted exterior of your car is to wash it on a regular basis. This will remove the industrial pollutants, bird droppings and other substances that can eat their way through the paint.

The best choice for washing a car is one of the carwash soaps sold in auto parts stores. In respect to other soap products, there is widespread disagreement on what's okay and what's not. If you can't see your way to spending a little extra for carwash soap, use a mild solution of any other commercial detergent.

Don't wash your car in full sunlight. You could end up spotting it permanently. Have the garden hose standing by, ready to rinse off. Begin by washing the roof, using a sponge or soft cloth, and work your way down the car so that dirt from one area won't be rinsed onto parts already washed.

After a thorough rinsing, dry the car with a chamois. Soak the chamois in water and wring it out before using it. Continue wringing out the chamois as it becomes saturated.

Once you've finished washing, check the painted surface for bug or tar spots. Solvents to remove these substances are available through auto parts stores.

If the surface appears lightly scratched or spotted after washing and a solvent treatment, you should polish it with a light polishing compound before waxing. If it is extremely oxidized or faded, machine compounding may be necessary. Apply fine polishing compound to small areas using a damp cloth or rubbing pad. Rub only until the scratches or blemishes disappear. If you overdo it or rub extensively on an edge, you'll end up with a bare spot.

Final wax and polish

When it comes to application of a final wax and polish, you have a number of options. The newest polymers, offered in both basic configuration and rather expensive kit form, provide the longest lasting protection. However, many detailers contend that polymers can't produce the lustrous sheen a conventional wax and silicone product can. In general, the more wax a product contains, the brighter the shine. A high concentration of silicone, on the other hand, offers longer lasting protection.

Most products that offer a combination of wax and silicone also contain some abrasive for the removal of very minor scratches or stains. Sometimes these are offered in two-component systems, one being a cleaner, the other a wax. Some of the one-component polishes do not contain abrasives.

When applying a wax, work only in the shade or on a cloudy day. Apply the product to one small area at a time. Most wax manufacturers recommend working in areas of about 2 sq. ft. at a time. When you've finished waxing, wash the car with lukewarm water and a soft rag to remove polish residue. Polish caught in crevices can attract moisture, which leads to rusting.

Use wheel polish to clean and shine custom steel or aluminum wheels. A vinyl dressing will clean and protect plastic exterior and interior parts.

Carpet Cleaning

To clean interior carpeting, vacuum the interior thoroughly, then scrub with carpet shampoo. You can use the same shampoo that you use in the house or purchase carpet shampoo through an auto parts store. The handiest type for use in cars comes in a brush-applicator bottle. Instructions usually tell you to apply the shampoo, scrub until foam disappears, allow to dry and then vacuum up the residue. The final vacuuming is an important step. If you don't do it, the dirty residue will be left at the bottom of the carpet piles. Vacuuming on a regular basis will help keep the carpets clean between shampoo treatments. **PM**

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The \$32.95 Kel Arc spot welding gun, used with any arc welder that can be turned down to 50 amps, does basically the same job as megabuck body shop tacking equipment. It's sold by the Eastwood Co., Box 296, Malvern, Pa., 19355. We tried it on various types of patches, and found that it works well once you get the hang of it by practicing on some scraps. Even if you burn through the metal, which we did frequently, the welds hold and the holes are easy to fill (you have to finish off any welded repair with plastic, anyway).

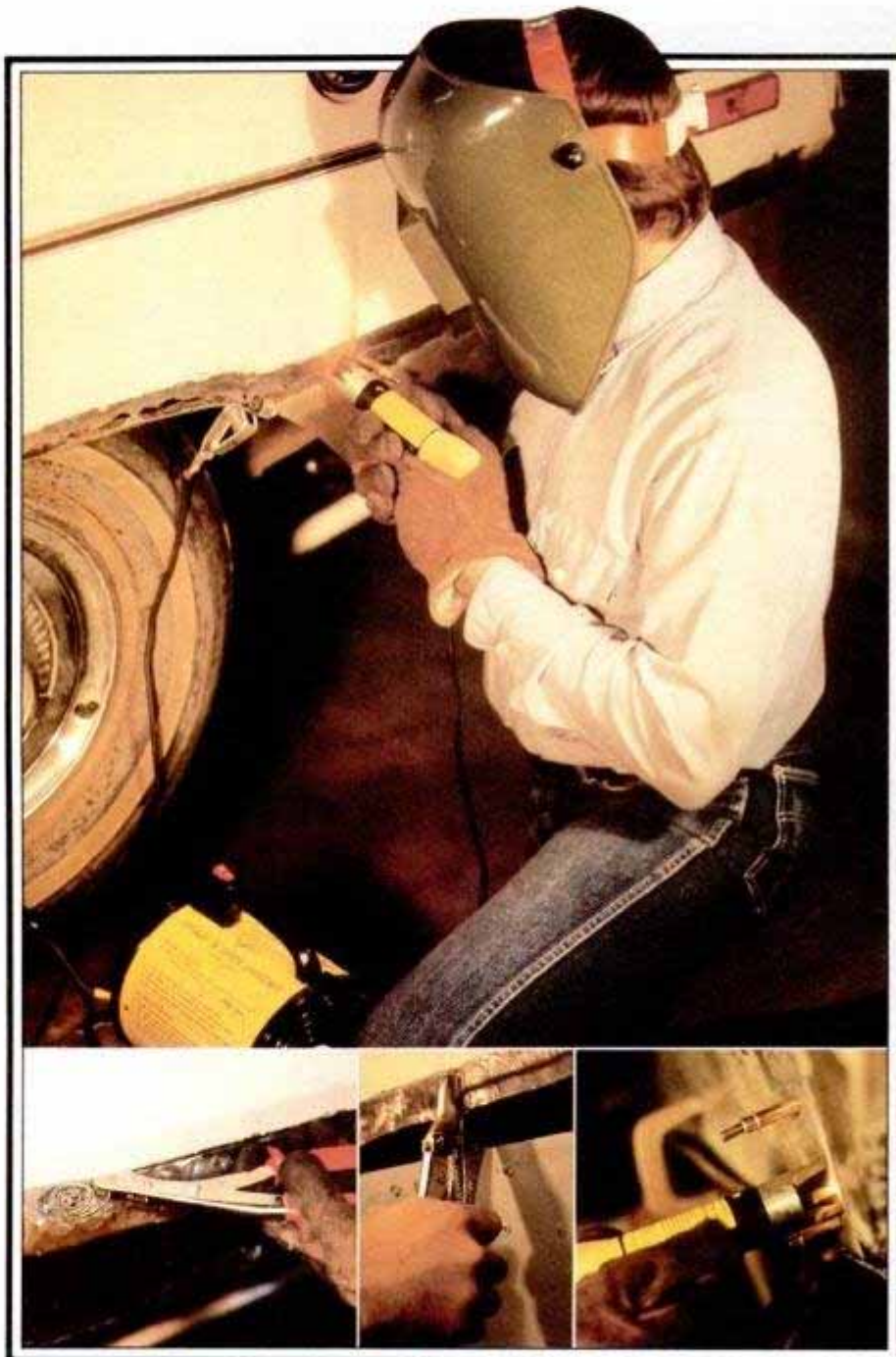
Once the joint seams are ground clean and the patch is clamped tightly in place, the procedure is simple: Lower your face shield, pull back the unit's trigger to retract the electrode, press the head prongs against the patch, release the trigger to allow the rod to contact the metal for two or three seconds, then slowly pull the trigger to form an arc.

After another few seconds, break the arc by drawing the electrode all the way back. The tighter the joint, the less apt you'll be to burn through.

One of the welders we used was a neat little unit from the same source that cost \$169, including the spot gun, arc welding attachments, carbon arc brazing torch, face shield, rod assortment and instructions. It puts out a steady 50 amps and has a 100 percent duty cycle, which means that it can work nonstop without overheating or blowing fuses.

To see if we could eliminate the burn-through situation by using less power, we also tried a Sears Model 113.201556 welder that's adjustable through a range of 20 to 70 amps. This machine, even with its 20 percent duty cycle, is a bargain at \$99, but we liked the 50-amp setting best anyway.

Other helpful bodywork products from Eastwood include a panel flanger (\$29.95); a shrinking hammer that pulls stretched



A good body shop will cut away rusted area and weld in a new panel. Now you can do the same job with these mail-order tools. Spot welding gun (top), used with a low-powered 110-volt arc welder, lets you tack-weld replacement panels in place. Nibbler (left) makes neat, easily-controlled cuts in a

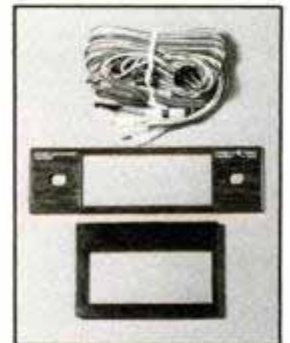
rusted area without distorting the metal. Use the panel flanger—locking pliers with special jaws—(center) to crimp the edge of your cut so the patch will lie flush with the surrounding bodywork. Spring-loaded panel holders (right) clamp pieces together, leaving both hands free.

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CRANE Cams

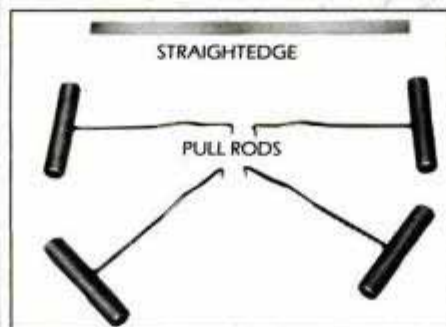
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steel together (\$39.95); a sandblast gun that actually works from a bucket of sand (it's \$35.95, but you'll need a 1-hp air compressor); a panel-holding system (\$32.95) that includes both side and blind springloaded holders to keep panels in place while you weld; and Oxy-Solve, a rust dissolver that leaves a zinc phosphate coating that retards further corrosion, but won't hamper welding or painting (\$8.95 for 16 ounces).

Pulling dents

The traditional tools used to pull dents flush with the surrounding bodywork—slide hammers or sheet-metal screws and Vise Grips—often leave the sheet metal stretched, distorted or brittle. That's why many body shops today use pull rods.

Pull rods are available from professional auto parts stores that specialize in body-



A typical set of pull rods consists of a straightedge and four pull rods (shown), two pick pulls and a 1/64-in. drill bit.



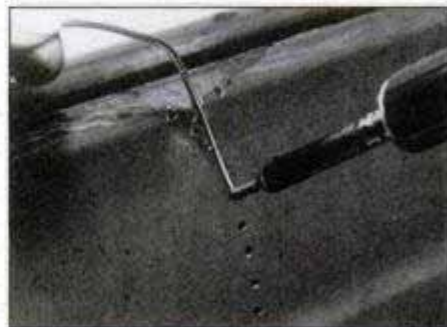
Drill holes 1/4 in. apart in the deepest part of the dent. Insert two or more rods into the center of the dent and pull gently.



Use a hammer with a taped face to tap the surface near a crease while pulling at a right angle to the bodywork. Don't pry.

work supplies. A typical set consists of four pull rods (you can use two in each hand), two pick pulls, a 1/64-in. drill bit and a straightedge. Pick pulls have a fine point that is used to separate panels that have been jammed together. Pull rods have a specially shaped tip that distributes pressure over a wide area, plus a bent shank that acts as a shock absorber.

Begin by cleaning the surface with wax remover. Place a light at an angle to the surface so you can easily see low spots. Drill holes 1/4 in. apart through the deepest



When the dent is removed, use a soldering gun to fill the holes. Solder will stick only to bare metal inside the holes.



Properly done, solder will flow around the tip of the gun and form a glob on both sides of the hole. Sand and repaint.

part of the dent. If the ridge of the dent is sharp, drill holes here, too; these holes help the metal bend without distortion.

Insert rods into the deepest section of the dent and gently pull it up, using your straightedge to make sure you don't pull too much and transform a dent into a bump. Always pull at a right angle to the panel; don't pry. Work slowly from the deepest part of the damage to the shallowest. Go back repeatedly until the panel is smooth.

When the dent is eliminated, brush liquid flux over the holes. Insert a sharp-tipped soldering gun (tip 22-212) into each hole and apply acid-core solder to the tip. After a second or so, slowly withdraw the tip, while still applying solder. Done slowly enough, solder will fill the hole, leaving an anchoring glob inside and out.

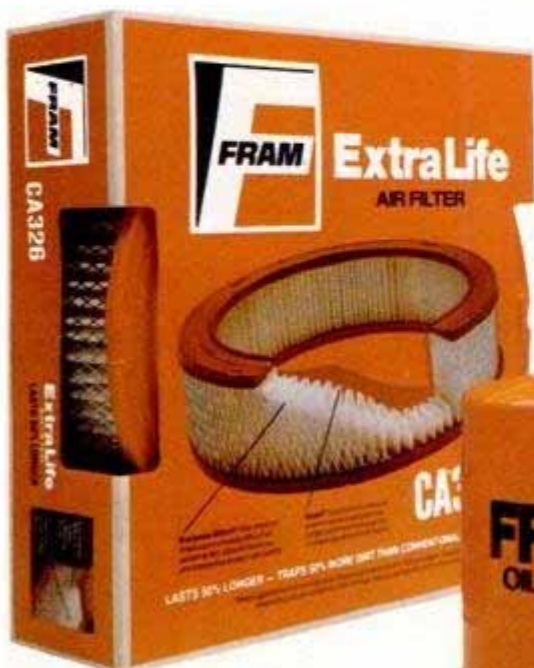
When all holes are filled, file the surface smooth. Fill any remaining low spots, clean, prime and paint.

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The author's 1975 Gold Duster (left) and '76 Duster were restored to their original splendor for 25 percent of the body-shop cost.

Tech School Car Repair

*Don't have time to do it yourself?
A vocational school can fix your car. It's slow but cheap.*

BY CLARENCE C. TRUESDELL

When my beloved 1976 Plymouth Duster got hit for the third time, I had to start thinking about a new car. After all, the car now had over 190,000 miles on it and the front end, rear end and left side were banged in. My reliable slant Six had given me no cause to look at new cars, so I had been out of the market since 1976, when I bought my Duster brand new for \$4,000.

Sticker shock does not begin to describe what I felt when I started looking at new cars. The stickers looked like real estate prices to me, and the banker never cracked a smile when he said car loans weighed in around 16 percent.

Estimates on the bodywork and paint for my Duster came in around \$2,800, with one at \$3,400. Finally, I woke up to the fact that some new cars might not be as trouble-free and reliable as my Duster had been. All I really needed was a face-lift for my old Plymouth.

I work in a small school on Cape Cod in Massachusetts and each year some of our students go on to the Cape Cod Regional Technical High School. One day, a student asked me about the shop programs at Tech. He specifically wanted to know about the auto body course. That did it! A big bulb lit up in the back of my skull and I promised the boy that I would personally go over to Tech that very

afternoon and check out the auto body program. My eagerness surprised the kid.

The teachers at Tech were great, and so were the students. Much to my delight, instead of calling my Duster a rolling junkyard, the body shop teacher just walked slowly around my car, all the while rubbing his chin thoughtfully. After a long pause he said: "There's a lot of good education in that old car."

The good news was that they would charge only for materials. No charge for labor! That meant a paint job for about

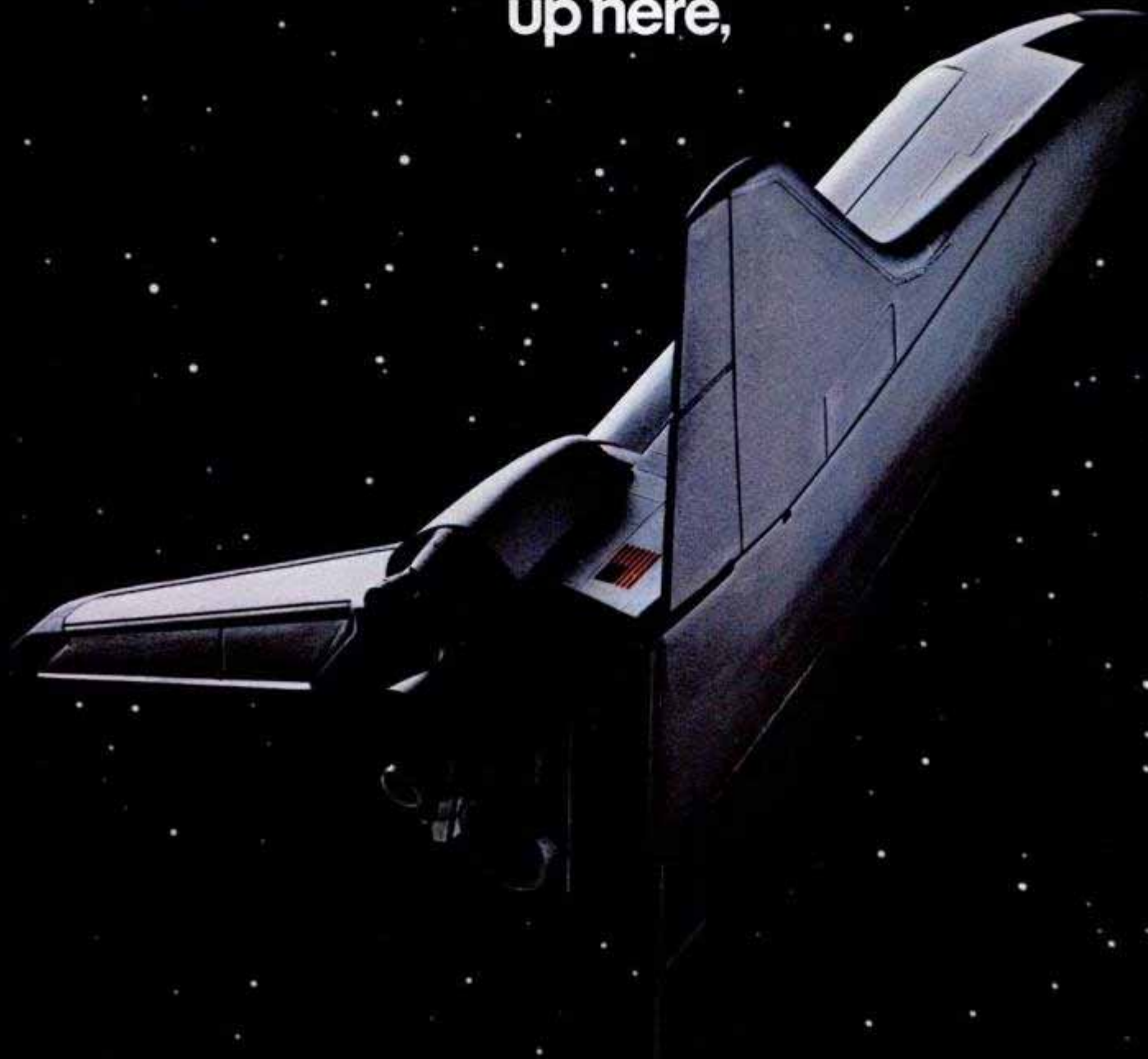
\$100, with bodywork almost free.

Unfortunately, there were a lot of cars scheduled ahead of mine, so it would be a good three months before they could fit me in. Because education, not car repair, is their main purpose, my car might be in the shop for two to three months. Renting a car for that long would wipe out most of my savings. This dilemma was solved when the parents of one of our students drove up in the most beautiful '75 Gold Duster V8 I have ever seen. It was all there: wheel covers, white walls, lizard



Tech school instructor Kurt Carlson shows his students (left) how to prepare the author's car for its first paint job. Student Richard Garbitt diligently removes trim adhesive.

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top and not a serious scratch on it. They wanted to sell it because they had just taken delivery of a new Chevy. It didn't take long for us to settle on the book price of \$800. I now owned two Dusters.

Thanks to conscientious teachers, the students at Tech did a beautiful job on my original maroon Duster, and then they painted my Gold Duster as well. For some reason, the idea of a guy owning two Dusters brought out the best in them. Now both cars look great.

At one point my maroon Duster was



Budding body man takes a torch to a Camaro with professional elan at Cape Cod Tech.

freshly painted and looked good to me, but the teacher wouldn't let me take it out of the shop. He insisted that his students sand it all down and paint it again, due to some insignificant defects. It took another week or so, but their job is education, not production. You have to accept that.

I now have two beautiful Dusters. Total cost for the work on both cars came to about \$700, which included a new grille and some other body parts that were needed. It also included all of the bodywork on both cars, and a new paint job each. The work is first rate. In fact, I recently turned down an offer of \$2,300 for my Gold Duster!

As long as I have two cars and live near a tech school, I see no reason to carry expensive comprehensive insurance. If one car gets banged up, I'll take it to the school and leave it as long as necessary. My insurance savings make it possible to drive two Dusters about as cheaply as one, and it's a lot more fun. The little V8 really moves the Gold Duster, so I save it for Sunday driving. It will blow the doors off all kinds of fancy turbo stuff, and it's a real power trip after commuting behind a sluggish Six all week.

You might live near a tech school that has a first-rate auto body shop. Check into it. It's a bit like trusting your head to a barber college, but unlike a haircut, a beginner's paint job can always be redone until it's perfect. **PM**

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Cheap insurance

Stop worrying about someone prying the new stereo out of your dashboard. The Decoy is a molded plastic insert which covers the dial/cassette door of the stereo and looks like the most basic AM car radio. Only \$2.49 from Kustom Kreations, 19316 Londeilus, Northridge, Calif. 91324.



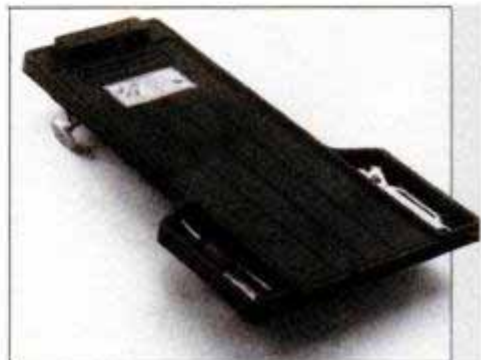
Wood accessory kits

Dress up the interior of your Pontiac Firebird or GM S-truck with attractive wood paneling for dash, glove box and console. The imported and finished woods are moisture resistant and carry a 12-month, 12,000-mile guarantee. Each kit comes complete with simple installation instructions and all mounting hardware. The kits sell for \$275 to \$425, and are made by Cars & Concepts, 12500 East Grand River Ave., Brighton, Mich. 48116. You can call 1-800-227-7016 for the nearest retail outlet.



Rustproof

POR-15 rustproofing coating can be painted directly over rust. Unlike ordinary paints, POR-15 is strengthened by moisture, and forms a finish which is much harder and more flexible than paint to better protect metal from scratches and stone chips. POR-15 costs \$21.95 a quart and is available from Stan Coleman Inc., 320 South St., Morristown, N.J. 07960.



Mechanics' creeper

The Kangaroo one-piece polypropylene mechanics' creeper will support 450 pounds and has two pockets for parts and tools. The creeper has no screws and comes with 360° swivel steel or molded casters and built-in headrest. The undercarriage and wheel sockets are reinforced. The Kangaroo Creeper, is \$16 from Koller-Craft, 1400 South Highway 141, Fenton, Mo. 63036.



Auxiliary heater

Superheater will make any van, truck or RV toasty warm with its 20,000 B.T.U. output and versatile overhead, side or underseat mounting. You install the unit in about 20 minutes. Superheater costs \$129.95 and is from Concepts Marketing, 1077 Empire Blvd., Rochester, N.Y. 14609.



Back support

Backsaver II lumbar and kidney support cushion provides support with an inflatable inner bladder and foam pads. A hand pump inflates the cushion to the desired firmness. Backsaver II costs \$39.95 and is available from Foremost Designs, 522 Broadway, Lorain, Ohio 44052.



Suspension kits

Koni's Rallysport Suspension Kits help custom-tune your car's ride and handling. Available as components or as a package, the kits include regular or gas shocks, special coil springs and antisway bars. Prices range from \$750 to \$1,100 from Koni America, Box 40, Culpeper, Va. 22701.



Dash cover

An alternative to patching or replacing cracked or split dashes is to re-cover the entire dash. The Insta-Dash provides a precise fit on a wide variety of domestic and foreign models. It sells for \$39.50 to \$112 from Insta-Dash, 1539 Linda Way, Sparks, Nev. 89431.

Super storage

TrukMate cross-bed pickup truck utility storage boxes offer 9 1/4 cubic feet of weather-protected storage space. The blow-molded polyethylene boxes have the impact strength of 7-gauge steel and are resistant to chemicals, fuels, lubricants and salt spray. They're temperature-engineered to perform well in warm and cold climates, and can never rust, dent or chip. The boxes come with removable sliding tool tray, security locking systems and safe-seal lids. Low-profile styling allows for unrestricted driver visibility. The storage boxes cost \$139.95 and are available from Delta Inc., 4800 Krueger Dr., Jonesboro, Ark. 72401.



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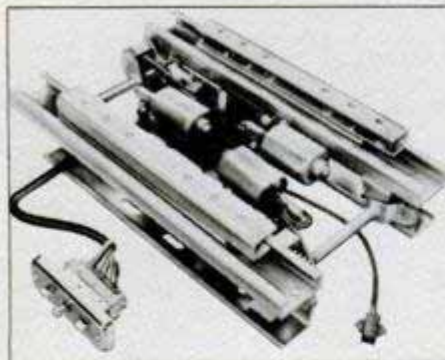
And remember, though other vacuums may look like Shop-Vac, the similarity ends there. We're the original wet/dry, so if it doesn't say Shop-Vac[®]—keep shopping.

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shop·vac

Picks up where the others leave off.

Shop-Vac[®] is a registered trademark of Shop-Vac Corporation, Williamsport, PA.



Power seat system

Delco's power seat system for vans and RVs adds six-way adjustability to original equipment seats: front tilt and rear tilt, forward and back horizontal movement, plus raising or lowering the seat to accommodate all sizes and shapes of drivers. Three separate motors control the RV-600 system, allowing greater comfort and convenience for drivers. It installs with simple hand tools, and requires no modifications, cutting or spot welding. The power unit mounts directly on the existing seat pedestal. The RV-600 Power Seat System sells for less than \$300 and will be available from selected van/RV pedestal and seat suppliers.



Pickup bed mat

The Kargo King rubber pickup bed mat has a raised diamond design to cushion loads, absorb shock, prevent dents and allow air-flow underneath the mat. Installation requires no trimming or gluing. The mats range in price from \$100 to \$130 and are made by Crossville Rubber Products Inc., Drawer 729, Crossville, Tenn. 38555.

The Sevin® guide to insect trouble spots around your yard

When summertime comes, so do insect pests that can infest your lawn, trees, shrubs, flowers, and garden plants. Spotting a problem early is the key. A few telltale signs to watch for:

In your lawn

That brown patch in your lawn could be a calling card from culprits like sod webworms, armyworms, or chinchbugs.

What to do: Use a hose-end attachment or pressure sprayer to apply SEVIN® brand insecticide wherever you see a problem. SEVIN® brand insecticide stops most common turf pests. Quickly. Easily. And you don't need special protective clothing to use it.



In your trees and shrubs

Look for leaves that are wilted or brown. Perforations or other signs of chewing could mean Japanese beetles, bagworms, caterpillars, or gypsy moths. What to do: to catch destructive foliage feeders in the act, spray trees, shrubs and other outdoor plants with SEVIN® brand liquid or wettable powder insecticide according to label directions. Used properly, SEVIN® brand protects from chewing pests without harming plants.



In your flower and vegetable garden

SEVIN® brand carbaryl effectively controls over 200 insect pests that can plunder your garden. And SEVIN® brand is biodegradable in the environment. For most vegetable and flower pests, a light spraying or dusting every week or so with SEVIN® brand liquid or dust should be all you need.



Whatever's bugging you

SEVIN® brand is the one outdoor insecticide you can feel comfortable using just about anywhere around your yard.

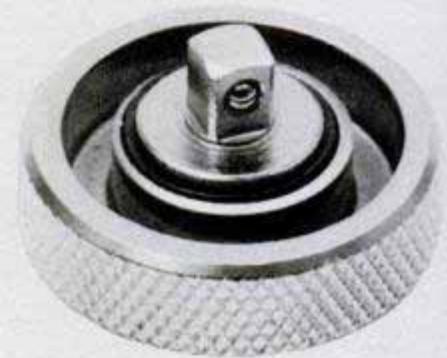
You can even use it on your pets, to help keep them free of fleas and ticks. And unlike some insecticides, SEVIN® brand has no harsh smell.

This summer, look for the SEVIN® brand name on the label when you're choosing an outdoor insecticide. In dust, wettable powder or convenient liquid, you'll find a SEVIN® brand insecticide wherever lawn and garden supplies are sold.



SEVIN® stops tough outdoor pests.

SEVIN® is a registered trademark of Union Carbide Corporation for carbaryl insecticide. As with any insecticide, always follow directions on the label. Copyright ©1985 Union Carbide Agricultural Products Company, Inc.



Fingertip ratchet

To reach fasteners in really cramped quarters, try the Fingertip Ratchet. The ratchet has 1/4-in. drive and is manufactured with a knurled edge for a firm, comfortable grip. The ratchet sells for \$10.95 and is available from D-J Tools Inc., 3170 Molinaro St., Santa Clara, Calif. 95054.



Corrosion control

The ACPD (Automotive Cathodic Protection Device) reduces up to 75 percent of corrosion and rust by impressing a d.c. current from the car's battery on the vehicle's chassis. This current stops the destructive electrolytic reactions that occur between metal parts. The \$190 system is made by A C Technology, Box 1971, Altoona, Pa. 16603.

NOT A WAX . . NOT A POLY . . NOT A POLISH . . BUT AN ACRYLIC



AFTER 5 YEARS, PROVEN BEST BY MILLIONS OF CAR OWNERS!

ORIGINAL PLASTIC COATING
GLO-SHIELD™
MAKES WAXES AND POLISHES OBSOLETE

AS SEEN ON TV

NOT SOLD IN STORES

Plastic Coat Your Car In Less Than 1 Hour FOR ONLY \$9⁹⁵

NEW CAR DEALERS CHARGE UP TO \$200

NEW POLYMER ACRYLIC FORMULATION ACTUALLY RESURFACES AND RESEALS IN ONE SIMPLE STEP. GIVES YOUR CAR "SHOWROOM" BRILLIANCE THAT LASTS FOR THREE YEARS—GUARANTEED!

Put an end to corrosion, chalking, rusting, dulling, and pitting of your car's finish. GLO-SHIELD protects your car's finish and restores it, too! You can bring back that new car look in less than one hour with hardly any effort at all!

GLO-SHIELD is the miracle polymer plastic sealant that's guaranteed to protect and/or restore your car's finish for a full 3 years. It revitalizes and restores dull, oxidized finishes . . . just wipe on—wipe off! Do away with compounding . . . dead paint is chemically removed. GLO-SHIELD removes old waxes, tar stains, tree sap, road film, dirt, bird deposits, grime, grease, gasoline streaks, rusting, even tarnish. It deposits a plastic film that fuses to the surface and fills the pores to give your car a hard, high lustre, mirror-like finish.

NOTHING LIKE ANYTHING YOU'VE EVER USED BEFORE

Don't confuse GLO-SHIELD with any wax or polish. It is a clear, transparent liquid that, after stripping old wax and grime, deposits a

film similar to the acrylic lacquer with which your car was originally painted. And, it works even if your car was painted with enamel. Acrylic sticks to anything . . . but nothing sticks to acrylic. Not tree sap, not road salts, not grime or dirt, not bird droppings, grease or gasoline . . . not even paint.

—ACRYLIC IS THE SECRET!—

- DO NOT CONFUSE GLO-SHIELD ACRYLIC PRODUCTS WITH IMITATIONS!
- NO RUBBING . . . NO BUFFING!
- CLEANS, COMPOUNDS, POLISHES, SEALS!
- USE ON ANY PAINT FINISH
- FAST, ONE STEP WIPE-ON, WIPE-OFF!

All you do to keep the finish beautiful is a light hosing . . . even a light rain, and road dirt, salt and grime roll right off, and dries streak-free. GLO-SHIELD is detergent proof (OK in car washes), contains no abrasives, invisible, non-yellowing, peelproof and crystal clear.

BONUS! GLO-SHIELD works its magic on all painted and plated surfaces . . . chrome bumpers, mag wheels, appliances, motor cycles, fiberglass boats, formica, marine hardware, brass, plexiglass, stainless steel, aluminum, etc.

3 YEAR GUARANTEE

If after using GLO-SHIELD you are not delighted, return unused portion, anytime up to 3 years, for a pro-rata product refund.

CONSUMER NOTICE!

Beware of cheap imitations and the scare tactics of High Price Sealants. Only GLO-SHIELD is made with ACRYLICS . . . the same ACRYLIC that's on your car's original paint. GLO-SHIELD is a one-step operation . . . you do it yourself easily . . . in less than an hour.

CREDIT CARD BUYERS, CALL:
(718) 784-4005 5 5

SATISFACTION GUARANTEED OR MONEY BACK

GLO-SHIELD, Dept. 1451
10-10 44th Ave., L.I.C., NY 11101

Please rush me GLO-SHIELD. I understand that if I am not delighted in every way, I can return the unused portion for a pro-rata refund, exclusive of postage & handling.

- One bottle only \$9.95 plus \$1.00 pp.&hdg.
- SAVE!** Two bottles only \$18 plus \$1 pp.&hdg.

Enclosed is \$_____ check or M.O.

OR, charge to my VISA MASTERCARD

Acct. # _____ Exp. _____

Name _____

Address _____

City _____

State _____ Zip _____

N.Y. RESIDENTS ADD SALES TAX

ACCEPTED & PROVEN FOR PLANES & BOATS, TOO!

GLO-SHIELD is used by America's leading aircraft and boat builders. Desert Sunshine Labs report amazing results. Especially effective while operating in a salt water environment and highly recommended for use on all boats, including fiberglass.

Eastwood Auto Restoration Tools

Eastwood's Three Easy Ways To Kill Rust



Eastwood's Sandblaster Eliminates Rust Fast

When rust cuts deep, the only way to get it out **completely** is with a sandblaster. With thousands sold, our sandblaster is field-proven and cost-effective. This tool will let you do the jobs you once had others do: Dispose of rust, scale, paint and corrosion in minutes.

The Eastwood professional sandblaster package includes our all-metal, power gun (same as used on our larger units), ten-foot hose, 14" pickup tube, spare nozzle and detailed instructions. Just hook up to a one H.P. compressor, insert the pickup tube into dry sand or other abrasive and you're ready to go. The blaster's suction head draws abrasive easily. No surging. No skipping.

Three operations in one: Sandblaster, liquid blaster, air gun. With degreasing solutions, you can use it to remove buildup on engines and parts. Also get a high-velocity flow of air to dry or clean parts. All spare parts are available through our catalog.

- #8532 Sandblast Gun \$30.95
- OPTIONAL: Sandblast hood with replaceable lens.
- #9536 Sandblast hood and lens \$19.95

FREE 70 PAGE CATALOG WITH EACH ORDER

Oxi-Solv: Removes Rust Without Harming Good Metal

Fast acting. Oxi-Solv removes rust and corrosion on any metal. Just spray, dip or brush your parts and see this product work! Oxi-Solv is non-flammable, non-toxic, non-caustic and odorless.

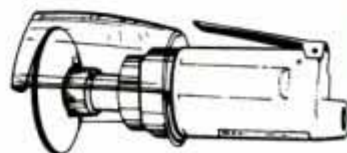
Another plus: After the part is completely clean, Oxi-Solv chemically bonds a zinc phosphate coating to the metal to make your paint adhere better. Oxi-Solv is reusable. Pour it back and store it for your next project.



- #3430 Rust Remover, 16 oz. \$ 8.95
- #3432 Rust Remover, 1 gallon \$24.95
- #3436 Rust Remover, 5 gallons \$99.00

Slice Through Rusty Sheetmetal Like Butter

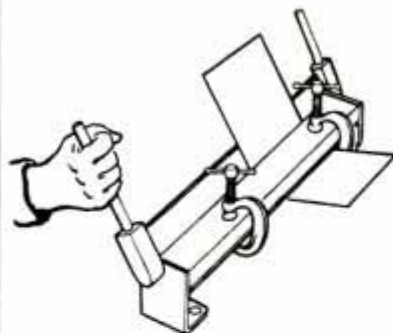
This cut-off tool lets you slice through sheetmetal, rusty muffler clamps, hose clamps, bumper bolts — even steel rods up to 3/4" thick! Uses a 46 grit abrasive cutoff wheel which spins at 20,000 RPM for fast, precise cuts in tight spots. Very maneuverable. Has 1/4" air inlet and uses 4CFM at 90PSI. Works on your 1HP or larger compressor.



- #3848 Utility Cutoff Tool \$49.95
- #3848A 2 7/8" Cutoff Wheels, Box of 6, 46 grit wheel \$ 9.95

Eastwood's Home Bodyman Tools for Panel Repair

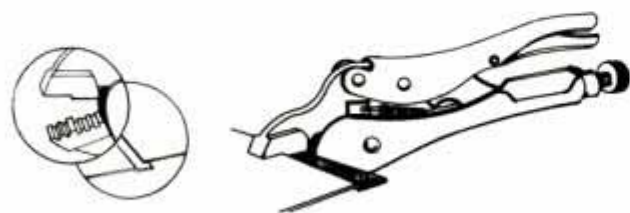
Sheet Metal Bender For Panel Fabrication



This is a scaled-down model of an industrial brake for fabricating sheet metal parts requiring clean, smooth bends. Will form 90° angles in 20 gauge up to 18" wide. Bends heavier gauge metal in smaller widths. Great for reproducing body panels, boxes, covers, etc. All-aluminum construction. Bolts or screws to your workbench.

- #6260 Sheet Metal Bender \$29.95
- #6261 Set of Clamps \$ 4.50

Flangers Make Patch Panels Fit Flush

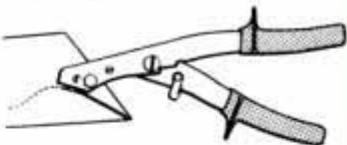


Just adjust tool to metal thickness, flange repair area and lay in patch panel. Your weld will be flush with body metal, which minimizes grinding and uses less filler. Works in tight areas to make sharp curves. Requires little effort for perfect flanges.

- #6286 Panel Flanger \$29.95

Eastwood Nibbler Cuts Body Metal Fast

Our nibbler cuts straight lines, curves—any shape you need. Leaves a flat, no distortion, burr-free finish. Uses less effort than ordinary snips. Chromed steel construction with cushioned vinyl grips. Cutting jaws made of heat-treated tool steel. Will cut up to 18 gauge steel and 16 gauge aluminum. Jaws replace easily after long, hard use.



- #6281 Nibbler \$28.95
- #6284 2 Replacement Blades \$ 9.95

Body Solder: The Permanent Panel Repair



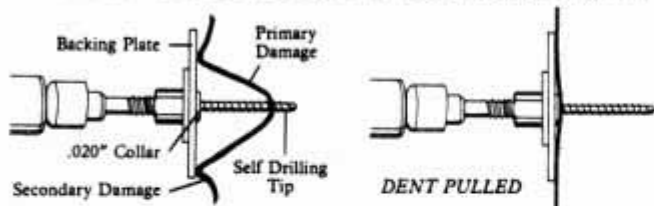
Body solder makes a permanent professional-quality repair that won't crack, lift, or shrink. Easy to apply with a household propane torch and can be shaped to any contour. Great on patch panels, seams, and edge work. Accepts paint just like sheetmetal. Far more durable than synthetic fillers. The craftsman's method still used today by the best body shops, restorers — even by auto manufacturers. The complete kit includes four 1/2 lb. sticks body solder, 2 paddles, 1 lb. tallow, 1/2 lb. tinning butter, 14" body file with holder, and FREE instruction book "Auto Body Solder" containing 50 pages, with over 50 illustrations (the most complete source of body solder techniques available!).

- #6730 Home Craftsman Body Solder Kit \$58.00
- #6400 Extra Sticks 30-70 Body Solder 1/2 lb. \$ 3.50 ea.

Call Eastwood 1-800-345-1178

In Pennsylvania
(215) 644-4412

Take The Guesswork Out Of Dent Repair



IF YOU CAN DRILL A HOLE YOU CAN FIX A DENT

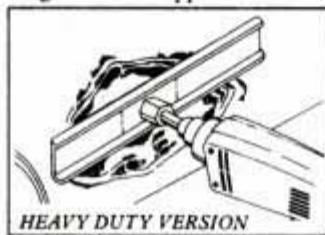
The Eastwood **BODY-MAN** tool replaces expensive, hard-to-use body tools. It lifts out dents and saves hundreds of dollars in repair bills. The unique all-metal design uses a self-drilling tip combined with a backing plate; automatically pulling damaged metal (with a vise-like pressure) back to original shape.

FAST, PROFESSIONAL RESULTS THE FIRST TIME

Simply install the tool in your 1/8" power drill. Place the self-drilling tip in the deepest damage area. By starting the drill, the point enters the metal and threads onto the tip. Each drill rotation brings the damaged metal closer to the backing plate. While the tip pulls out the main dent, the backing plate pushes in secondary damage. The tool knows exactly how much to pull and when to stop. When the dented metal returns to its original shape, the tip will release automatically. A .020" collar on the backing plate insures space for body filler to cover the 1/4" hole left in the metal.

WORKS FROM ONE SIDE EVEN ON LARGE DENTS

No need to remove door panels or work around inner panels. Repairs any automotive sheet metal—even pickup tailgates. The heavy-duty version straightens dents up to 12" wide; basic unit has a 4" range. On larger dents secondary damage must be tapped flat with a hammer; multiple holes may be necessary (complete instructions included). The **BODY-MAN** dent removal set comes complete with basic tool for small dents (parking lot dings and hail damage) and heavy-duty 12" model for larger collision damage, package of 10 replacement tips and complete operating instructions.



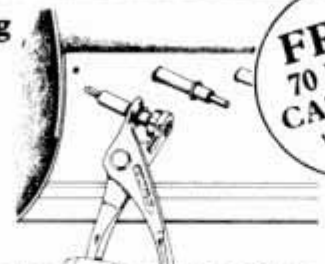
HEAVY DUTY VERSION

- #6799 Body-Man Tool Set \$29.95
- #6796 Replacement Tips, pkg of 50 \$8.50

Eastwood Panel Holding System Clamps From One Side

The easy way to hold patch panels while welding. Leaves you free to concentrate on the job. Eliminates pop rivets and awkward "C" clamps. Works from one side; simply drill 1/8" hole through both pieces and insert fastener. Forged steel compression tool opens fasteners for easy use. When released, the fastener expands, holding parts with 19 lbs. pressure in a 1/4" work range. After welding, just remove fasteners for reuse.

- Kit comes with compression tool and 10 blind style holders.
- #1288 Eastwood Panel Holding System \$24.95



FREE
70 PAGE
CATALOG
With Each
Order

High Temp. Stainless Paint for Exhaust Systems

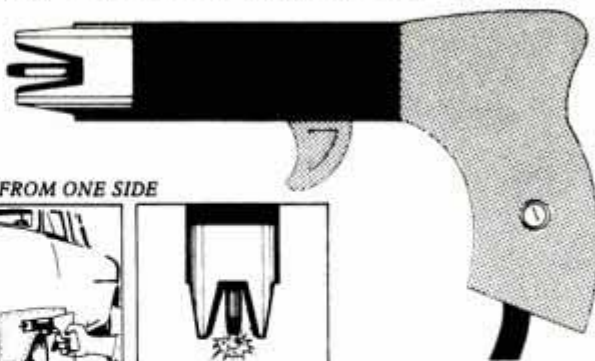


Imagine your rusty manifold looking new again. Our high temp. paint (up to 1200°F) gives a natural metallic finish similar to a newly sandblasted part.

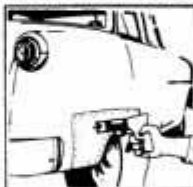
Easy to apply, just clean the part with a wire brush or sandblast. No primer necessary. Can be brushed or sprayed, dries in 60 min., and cures in use.

- #1256 High Temp. Stainless Paint, 1 pt. can. \$11.95

Spot Weld Perfectly In Just 6 Seconds



WELD FROM ONE SIDE



ARC FUSES METAL

MAKE FAST DISTORTION FREE WELDS

Spot welding has some distinct advantages. It's very fast - a few seconds for a sound weld. Because the heat is confined to a small area (the 1/4" dia. electrode) it avoids warpage or distortion. Allows for accurate control that lets you make consistently uniform welds.

EASY TO USE - EVEN FOR BEGINNERS

Become a pro in just a few minutes. Hook it to the electrode holder of your arc welder (set at 50 amps) and ground to car body. Just pull back the trigger to retract electrode, line up weld point and press head against the metal. Metal must be free of paint, rust or grease. Release the trigger and allow the electrode to contact the metal and glow for 1-2 seconds. Then raise the electrode with the trigger and allow an arc to form a molten puddle of metal (always use welding goggles or shield). Each weld takes about 5-6 seconds. Automotive manufacturers used spot welds to build your car and you can restore it with the same authentic technique.

CONVERTS AN ARC WELDER TO A SPOT WELDER

It welds any steel between 18-26 gauge. (Auto body steel metal is between 18 and 22 gauge). Ideal for welding replacement panels, floors, brackets, clips, braces, channels, etc. Welds from one side so it can even do blind panels that ordinarily can't be spot welded. Comes with two pressure heads — four prong for control on flat areas and two prong for reaching into edge and recess work. Proper replacement electrodes available through Eastwood. Gun comes complete with connection wire, spare electrode, 2 pressure heads and complete instructions.

- #4355 Spot Weld Gun \$35.95
- #4321 Package of 10 extra electrodes \$9.75
- #4367 Welding Goggles \$6.95

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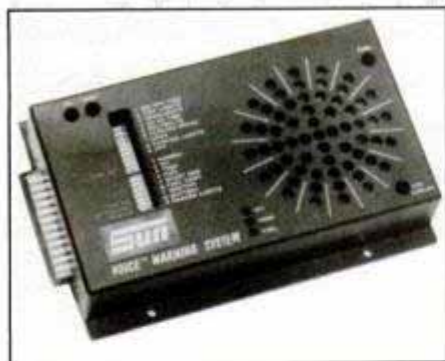
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EASTWOOD COMPANY (PA residents add 6% sales tax)
147 Pennsylvania Ave., Box 296, Malvern, PA. 19355 (215) 644-4412



Audible warning system

When idiot lights and gauges aren't enough, the Auto Alert Voice Warning System uses state-of-the-art voice synthesis electronics to tell you to "check engine oil," "parking brake set," "check engine temperature," plus 12 other critical and safety functions. An intelligence feature built into the electronics prevents you from being bothered by needless repetitive information. The system is easy to install on any foreign or domestic car, van or truck and carries a one-year warranty. The Auto Alert Voice Warning System, which costs approximately \$180, is manufactured by Sun Electric, 1560 Trimble Rd., San Jose, Calif. 95131.



Protective molding

Extra protection against parking lot chips and dings is offered by Ding Bats and Body Guards—impact-absorbing, magnetic vinyl molding tubes. The protective molding strips are attached to the vehicle when parked and removed when ready to drive. The strips range in price from \$27.95 to \$29.95 and are manufactured by Auto-Magnetics, 1331 East Edinger Ave., Santa Ana, Calif. 92705.

Which gas shock do you need?

"I'm looking for road control."



KYB's Gas-a-just is the shock you need. Its patented high-pressure construction provides the extra pressure that adds up to unsurpassed road control. No wonder Gas-a-just is America's best-selling monotube gas shock.



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KYB's 2-tube gas is the shock for you. Its low-pressure gas construction and patented valving result in riding comfort you can feel and at a price you won't. Comfort and value—a great combination.

Only KYB offers a choice in gas shocks. So, for the right gas shock for you...

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Pioneers in gas shock technology

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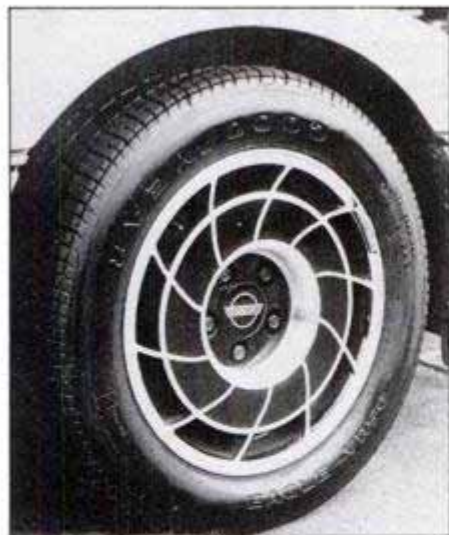
Car rack

Here's an ultralight, highly portable car rack that fits cars and vans with or without roof gutters. The Shadrack installs and is removed with just a flick of the wrist. The rack's aerodynamic design minimizes wind resistance. Priced at \$34.95, the Shadrack carries everything from fishing rods to bicycles. It's made by Allshop, Box 23, Bellingham, Wash. 98227.



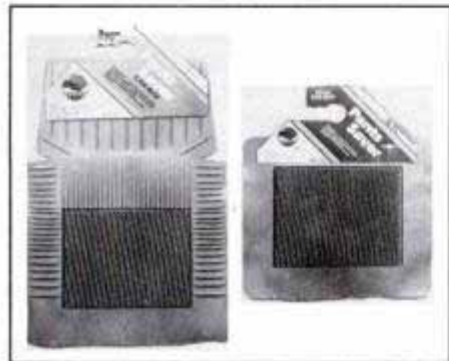
Polish/wax system

A two-step polish and wax system uses an ultrafine polishing cleaner and natural Brazilian carnauba waxes to achieve deep, rich color and protection. The cost is \$23.35 from Malm Chemical Corp., Box 300 BX, Pound Ridge, N.Y. 10576.



Wheel graphics

Spyder Mag wheel graphics decal for '84-85 Corvettes is easily installed in five minutes on stock wheels and will not chip or peel. Cost is \$49.95 (set) from Promotion Marketing, P.O. Box 448, Bronx, N.Y. 10475.



Car mats

Pants Saver car mats are designed with ridges and grooves that channel water, mud and snow into a 16-oz. central catch pan. They're \$10.99 to \$17.99 from F.P. Feature Products, Sperry-Univac Plaza, 8600 West Brynmawr, Suite 200N, Chicago, Ill. 60631.



12-volt polisher

The Black & Decker 12-volt car polisher uses a "hand rubbed" random orbit action that prevents swirl marks. The polisher plugs into most 12-volt cigaret lighter receptacles and comes with an 18-foot cord. Also included are two foam bonnets for wax application and a polishing bonnet. The Black & Decker polisher sells for \$38.95 and is available at discount department stores.

Suspension bushings

Del-A-Lum solid bushing kits replace soft rubber parts in control arms, trailing arms, suspension links, rear leaf springs and shackles kits. The bushings reduce suspension deflection for improved stability, cornering and control. The Del-A-Lum material has a long service life and doesn't cause the ride harshness and road noise that's normally associated with solid suspensions. Built-in grease fittings eliminate squeaks so common to other high-performance bushing designs. Tire wear also is improved. The kits cost \$50 to \$300 and are available from Global West, 5650 Arrow Hwy., Unit A, Montclair, Calif. 91763. **PM**



a new concept in Staple Gun fastening

ARROW[®] XPANDO[™]

T-50XP
staple gun

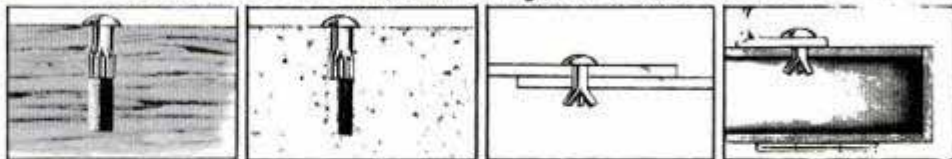
ATTACHMENT

Instantly converts the Arrow T-50, T-50M, T-55 Staple Gun into a multi-purpose fastening tool!

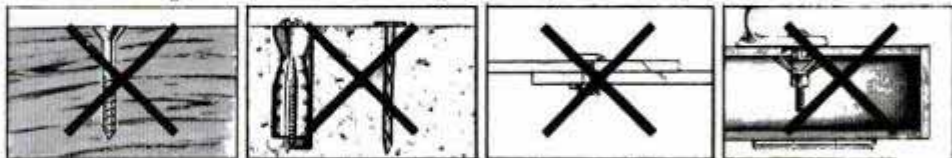


Slips on front of Staple Gun!

Fastens into wood, masonry, metal, hollow doors



Replaces screws, nails, rivets, anchors



Shoots an Xpando Fastener for multi-purpose uses.



Available at all leading Hardware, Home Center, and Discount Department Stores everywhere.

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GM Truck 14 Bolt 73-81 19123 \$9.95
Datsun 44 79134 \$9.95



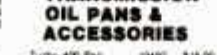
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Fuel Line (3/8" x 2) 19610 \$2.50
Fuel Line (Double Pumpers) 19620 \$2.50



ALTERNATORS

300254 Chevy 11 AMP 19495
336570 Chevy 15 AMP 19496

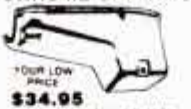


CHROME TRANSMISSION DIPSTICKS

Dodge Turbo 400 19421 \$4.95
Dodge Turbo 350 19420 \$4.95
NOTE: Dipsticks & Tubes are universal fit & may not be same as some O.E. items.

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UNASSEMBLED 350 CHEVROLET 4 BOLT MAINS

9 or 10:1 COMPRESSION RATIO

SHORT BLOCK KIT

350 4 bolt main block bored oversized, mated for Molly Rings. Decked, line honed, polished intake. Piston/bushings outside factors orange. Piston Cam bearings & cross heads plugs. Forged T-R-W pistons fitted to PAW Heavy Duty connecting rods with A-R-P chrome Molly rod bolts. Chrome Molly rings, camshaft custom ground on rod & main journals. Micro polished with Chevrolet 77 rod & main bearings for perfect fit. Double roller timing chain set, your choice hydraulic or solid camshaft Assembly, balanced for maximum performance.

SHORT BLOCK KIT - YOUR LOW PRICE \$995.00

LONG BLOCK KIT

As above with cylinder heads, performance valve job. New gaskets 1.34 heads & 1.30 exhaust. In-performance springs, HD locks. Chrome Molly push rods, lifters, 1/2 volume oil pump. Complete gasket set & long slot rocker arms.

LONG BLOCK KIT - YOUR LOW PRICE \$1395.00



OPTIONS AVAILABLE

For 11:1 Compression Ratio ADD \$100.00
For Steel Crankshaft ADD \$150.00
For Cylinder Heads with 2.02 & 1.86 valves ADD \$175.00
For Cylinder Heads with 2.02 in. valves & gudgeon pins ADD \$60.00
For Bow Tie heads with screw in studs & guide plates 2.02 & 1.86 valves ADD \$550.00
For Main Stud Kit & 2.02 & 1.86 Bolt Main For Head Stud Kit ADD \$25.00

STREET/STRIP RVCOMPETITION

ON SALE

ACTION SERIES WEIAND MANIFOLD SPECIALS

SP180 SINGLE QUAD SPLIT PLENUM RPM RANGE 650 TO 6000

As Low As \$79.95

8004 S 8 Chevy \$79.95
8005 B 8 Chevy G P \$114.95
8006 289 302 Ford \$175.95
8010 351M 400 2V \$114.95
8007 S 8 Mopar \$114.95
8008 383-400 Mopar \$119.95
8009 413-426 440 Mopar \$119.95

These Manifolds are Non E.G.R. We have E.G.R. Manifolds please phone for price.

ON SALE

S.B. CHEVY WEIAND MANIFOLD SPECIAL

OPEN PLENUM RPM RANGE 2900 - 6000

7546 Your Low Price \$69.95
S 8 Chevy

ON SALE

HOLLEY PERFORMANCE CARBURETORS



Brand New Seconds No Rebuilds

4 BARREL UNIVERSAL VACUUM SECONDARY Manual Choke

600 CFM 1850 \$96.95
750 CFM 3070 \$107.95

Electric Choke

390 CFM 8007 \$149.95
600 CFM 9634 \$132.95

2 BARREL UNIVERSAL VACUUM SECONDARY

350 CFM 7446 \$109.95
500 CFM 4432 \$99.95

DOUBLE PUMPS

600 CFM 4776 \$107.95
650 CFM 4777 \$109.95
700 CFM 4778 \$109.95
750 CFM 4779 \$109.95
800 CFM 4780 \$219.95
850 CFM 4781 \$239.95

CHEVY SPREAD BORE QUADRAJET REPLACEMENTS

330 CFM 6219 Mec Sec. \$183.95
350 CFM 9879 Vac Sec. \$182.95

CARTER AFB CARBURETORS

Your Low Price

9035 625 CFM Chevy \$156.95
9036 625 CFM Mopar \$156.95
9037 625 CFM Ford \$156.95

CARTER THERMO-QUAD CARBURETORS

Your Low Price

9810 800 CFM Chevy \$197.95
9811 800 CFM Mopar \$197.95

CARTER PERFORMANCE FUEL PUMPS

MECHANICAL STREET & OFF ROAD Produces 6 psi @ 80 GPH \$74.95

ELECTRIC STREET & OFF ROAD Produces 5.25-7.25 PSI \$76.95

CAM DYNAMICS ENERGIZER CAMS

SMOOTH IDLE - STRONG LOW END AND MID RANGE POWER.

Kit Includes Camshafts-Lifters-Springs \$139.95

PREMIUM QUALITY PISTON RINGS

Your Low Price

Iron Compression \$4.95
Chrome \$9.95
Moly \$9.95

FLAT TOP PISTON SPECIALS WITH RINGS

Available Std. 030-040-060

Chevrolet 305-350 99.00
400 119.00
F 3 7 302-351W 99.00
351C 351M 400 114.00
Mopar 318-340-360 99.00
For More Rings, ADD \$15.00

NEW STOCK REPLACEMENT CAMSHAFT-LIFTERS SPRINGS KIT

Available for most V8 & 6 cyl Domestic engines. Ford-Chevrolet-Mopar

Your Low Price \$119.95

GASKET SETS

S 8 Chevy \$14.95
S 8 Ford \$14.95
S 8 Mopar \$14.95
S 8 Mopar \$14.95
S 8 Mopar \$14.95
S 8 Mopar \$14.95

ISKENDARIAN SUPER CAMS

Economy/Hi-Torque/IV Kit Includes Camshafts-Lifters-Springs \$139.95

HI PERFORMANCE LONG SLOT ROCKER ARMS

S 8 Chevy 30.00 set 16
S 8 Chevy 59.95 set 16
Kit Includes Arms, Bolts, Nuts

ROCKER ARMS

FORD S 8 Ford 289 302 351W \$69.95 Set Of 16
State Rear Rail to Non-Rail \$60.00
350 Ford 429 \$96.00 Set Of 16
Adjustable Kit w/ Arm-Bar Nut 390-427-428 \$82.00 Set Of 16
Adjustable Rockers

PONTIAC V8 1.5 Ratio \$59.95 Set Of 16
V8 1.8 Ratio \$59.95 Set Of 16
Kit Includes Arms, Bolts, Nuts

We have Rocker Arms for a engine. Phone for your low price.

ENGINE OVERHAUL SPECIAL

Kit Includes

CL77 Rod Bearings
CL77 Main Bearings
STD 010-20-030
Piston Rings
STD 030-040-360
Gasket Set
Available for most V8 and 6 Cyl Engines & Save

Your Low Price S 8 CHEVY \$69.95
All Others \$79.95
ADD \$15.00 for Molly Rings

TRW FORGED FLAT TOP PISTON & RING SPECIAL

Available Std. 030-040-060 (CALL)

Chevrolet 283-327-350 119.00
454 219.00
Ford 289-302 119.00
351C 351M 154.00
390 144.00
Mopar 318-340 165.00
360 169.00
440 209.00

ADD \$15.00 for Molly Rings

TRW WATER PUMPS

Your Low Price

CHEVROLET Small Block from \$29.95
Big Block from \$34.95
FORD 289-302 3VW from \$39.95
351C 400 351M from \$42.95
429-460 from \$45.95
360-428 from \$48.95
CHRYSLER Small Block from \$29.95
Big Block from \$29.95

We have Water Pumps for all domestic models. Phone for your low price.

FREEZE PLUG KITS

Steel \$2.95
Brass \$6.95

HIGH VOLUME OIL PUMPS

20% More Volume than stock pump

S 8 CHEVY \$19.95
ALL OTHERS \$24.95
Chevrolet Mopar Ford Pontiac

HI-PERFORMANCE TIMING CHAIN SETS

Steel Gears \$18.95
S 8 Chevy \$18.95
All Others \$24.95

PERFORMANCE LIFTERS

Solid Hydraulic \$36.95
S 8 CHEVY \$36.95
OTHERS \$39.95
Set of 16 Most Cars Available for most Popular Domestic Engines

CHROME MOLLY PUSH RODS

S 8 Chevy \$36.95
Others \$39.95
Available for most Popular Domestic Engines

HI-PERFORMANCE DOUBLE ROLLER CHAIN SETS

S 8 Chevy \$19.95
Others Four Low Price
S 8 Chevy 29.95
S 8 Mopar 29.95
S 8 Ford 29.95
351C 400 Ford 30.95
429-460 48.95
360-428 29.95
Oldsmobile 29.95

ENGINE CLEANING BRUSHES

12 Engine cleaning brushes covering sizes 1/4 inch up to 5 1/8. A must for all engine builders.

Your Low Price 12.50

SUPER SPECIAL

S.B. CHEVY DELUX ENGINE REBUILD KIT \$99.95

Kit Includes

- PISTON RINGS
- CL77 ROD BEARINGS
- CL77 MAIN BEARINGS
- ENGINE GASKET SET
- CR. PUMP
- TIMING CHAIN SET

Options Available
Molly Rings ADD \$15.00
S 8 CHEVY ONLY
For Double Roller Chain Set ADD \$3.00
Note: Bar-Sub intake gasket not included where applicable.

WHY ARE P.A.W. PRICES LOWER? WE BUY DIRECT, WE SELL DIRECT & THAT SAVES YOU MONEY. POPULAR NAME BRANDS AT WHOLESALE PRICES.

California residents: Items in this ad are Not legal for sale or use on pollution controlled motor vehicles in California; Legal in California only for racing vehicles which may not be used on highways

WE CARRY A COMPLETE LINE OF MECHANICAL ENGINE PARTS FOR ALL APPLICATIONS. STOCK REPLACEMENT, HI-PERFORMANCE & RACING. WE SPECIALIZE IN ENGINE PARTS & THAT SAVES YOU MONEY. IF YOU DON'T SEE IT, PHONE FOR YOUR LOW PRICES.

SUPER STOCK PISTON KIT



PISTONS & RINGS
PISTON RINGS
ROD & MAIN BEARING
PERFORMANCE GRIND
CAMSHAFT

Kit includes:
 • PISTONS & RINGS
 • PISTON RINGS
 • ROD & MAIN BEARING
 • PERFORMANCE GRIND
 • CAMSHAFT


Your Low Price
CAST FORGED PISTONS PISTONS

AMC	199-232-256	158.00	204.00
	197-290-304-317	208.00	258.00
	405-401-425-430-435	215.00	274.00
	343-360-411	209.00	251.00
	386	309.00	
BUICK	231-18	163.00	204.00
	305-340-350	206.00	274.00
	305-350-360	206.00	274.00
CADILLAC	405-401-425-430-435	215.00	274.00
	390-429-472-500	283.00	344.00
CHEVROLET	194-230-250-262	154.00	204.00
	265-283-327	154.00	184.00
	305-307-360	154.00	184.00
	396-425	184.00	214.00
	402-427-434	184.00	214.00
FORD	144-170-200-250	154.00	204.00
	390-289-302-314-360	154.00	204.00
	361C-351M-400	189.00	214.00
	362-386	189.00	214.00
	394-395	184.00	214.00
	428-460	208.00	248.00
MOPAR	170-196-225	154.00	204.00
	313-316-360-380	184.00	214.00
	361-383-413	208.00	238.00
	440	234.00	274.00
OLDSMOBILE	239.00	238.00	
	394-400-425-445	248.00	288.00
PONTIAC	154.00	204.00	
	320-290	154.00	204.00
	326-350-389-400-450	208.00	278.00

Platons available in all popular sizes and stock compression ratios. 9:1 and 10:1 standard. Camshaft's are available upon casting in single performance cam. Small section of stock camshaft will be substituted.

10:1 Intake & Springs add \$10.00
 For Motor Rings add \$10.00
 10:1 Supermax substitution add \$24.00

SUPER STOCK CRANKSHAFT KIT



PISTONS & RINGS
CONNECTING RODS
CAMSHAFT
LIFTERS-SPRINGS
CON ROD & MAIN BEARING
CRANKSHAFT

Kit includes:
 • PISTONS & RINGS
 • CONNECTING RODS
 • CAMSHAFT
 • LIFTERS-SPRINGS
 • CON ROD & MAIN BEARING
 • CRANKSHAFT


Your Low Price
CAST FORGED PISTONS PISTONS

AMC	199-232-256	328.00	344.00
	197-290-304-317	349.00	386.00
	343-360-411	349.00	386.00
BUICK	231-18	303.00	344.00
	305-340-350	349.00	414.00
	305-350-360	349.00	414.00
CADILLAC	405-401-425-430-435	423.00	484.00
CHEVROLET	194-230-250-262	294.00	344.00
	265-283-327	294.00	344.00
	305-307-360	294.00	344.00
	396-425	344.00	428.00
	402-427-434	344.00	428.00
FORD	144-170-200-250	294.00	344.00
	390-289-302-314-360	294.00	344.00
	361C-351M-400	318.00	368.00
	362-386	318.00	368.00
	394-395	318.00	368.00
	428-460	348.00	388.00
MOPAR	170-196-225	248.00	288.00
	313-316-360-380	296.00	368.00
	361-383-413	348.00	378.00
	440	374.00	418.00
OLDSMOBILE	239.00	238.00	
	394-400-425-445	368.00	398.00
PONTIAC	154.00	204.00	
	320-290	208.00	248.00
	326-350-389-400-450	349.00	419.00

Platons available in all popular sizes and stock compression ratios. 9:1 and 10:1 standard. Camshaft's are available upon casting in single performance cam. Small section of stock camshaft will be substituted.

10:1 Intake & Springs add \$10.00
 For Motor Rings add \$10.00
 10:1 Supermax substitution add \$24.00

SUPER STOCK MASTER KIT



PISTONS & RINGS
CONNECTING RODS
CAMSHAFT
LIFTERS-SPRINGS
CON ROD & MAIN BEARING
CRANKSHAFT
VALVE PUMP
CAM BEARING
GAUSET SET

Kit includes:
 • PISTONS & RINGS
 • CONNECTING RODS
 • CAMSHAFT
 • LIFTERS-SPRINGS
 • CON ROD & MAIN BEARING
 • CRANKSHAFT
 • VALVE PUMP
 • CAM BEARING
 • GAUSET SET

Your Low Price
CAST FORGED PISTONS PISTONS

AMC	199-232-256	457.00	504.00
	197-290-304-317	509.00	548.00
	343-360-411	509.00	548.00
BUICK	231-18	403.00	
	305-340-350	457.00	504.00
	305-350-360	457.00	504.00
CADILLAC	405-401-425-430-435	585.00	664.00
CHEVROLET	194-230-250-262	416.00	504.00
	265-283-327	416.00	504.00
	305-307-360	416.00	504.00
	396-425	494.00	528.00
	402-427-434	494.00	528.00
FORD	144-170-200-250	416.00	498.00
	390-289-302-314-360	416.00	498.00
	361C-351M-400	479.00	518.00
	362-386	479.00	518.00
	394-395	479.00	518.00
	428-460	509.00	548.00
MOPAR	170-196-225	416.00	498.00
	313-316-360-380	458.00	524.00
	361-383-413	508.00	538.00
	440	538.00	572.00
OLDSMOBILE	239.00	238.00	
	394-400-425-445	508.00	538.00
PONTIAC	154.00	204.00	
	320-290	208.00	248.00
	326-350-389-400-450	349.00	419.00

Platons available in all popular sizes and stock compression ratios. 9:1 and 10:1 standard. Camshaft's are available upon casting in single performance cam. Small section of stock camshaft will be substituted.

10:1 Intake & Springs add \$10.00
 For Motor Rings add \$10.00
 10:1 Supermax substitution add \$24.00

O.E.M. REPLACEMENT IGNITION PARTS

TOP QUALITY TUNE-UP KITS FOR POINT TYPE IGNITION



Available for Most Domestic 6 CYL & V8 Engines
KIT INCLUDES
POINTS-ROTOR-CONDENSER & DISTRIBUTOR CAP

YOUR LOW PRICE
\$5.95

ELECTRONIC IGNITION KITS

Available for Most Domestic 6 CYL & V8 Engines.
KIT INCLUDES
ROTOR & CAP

YOUR LOW PRICE
\$8.95
\$3.95

IGNITION PARTS

VOLTAGE REGULATORS

AMC	63-64	VR710	\$ 7.95
	75-81	VR723	\$ 5.95
	76-78	VR730	\$ 7.95
GM	63-74	VR710	\$ 7.95
	74-82	VR723	\$ 3.95
FORD	43-78	VR730	\$ 7.95
MOPAR	61-68	VR706	\$ 5.95

(DELCO ALY)

IGNITION COILS

UNIVERSAL 12V CHRYSLER

FOR DOMESTIC 6 CYL and V8 ENGINES

AMC	75-82	CR3	\$10.95
FORD	74-82	CR3	\$10.95
MOPAR	75-82	CR3	\$11.95

CRANKSHAFT KIT SPECIALS

CUSTOM CRANKSHAFT SPECIAL

377 - 383 - 388
 STD BORE O30 OVER O60 OVER

CUBIC INCHES FROM YOUR 350 CHEVY

Kit includes:
 • FORGED PISTONS
 • HOLLY RINGS
 • CONNECTING RODS
 • CON ROD BEARING & MAIN BEARING
 • CUSTOM GRIND CRANKSHAFT

YOUR LOW \$399.00 PRICE

NOTE: THE ABOVE KIT WILL REQUIRE HARMONIC BALANCER AND FLYWHEEL FROM 400 CHEVY

SPECIAL

UNASSEMBLED 289-302 FORD

Your Choice 9 or 10:1 COMPRESSION RATIO

SHORT BLOCK
 Seasoned Block, forged, oversized compression honed forged pistons, chrome moly 2-bolt rings, connecting rods, forged chrome moly rod bolts, crankshaft custom ground for precision tolerances with matching bearings. Your choice of solid or hydraulic camshaft. Double roller timing chain set. Balanced for maximum performance.

LONG BLOCK
 As above with cylinder heads, compression valve job, 10:1 performance valve springs, chrome moly push rods, HD rock, flywheels of duct, niters, gasset set.

Your Low Price **\$995.00**
 Your Low Price **\$1395.00**

MANLEY O.E.M. REPLACEMENT VALVES



1.72 Intake 1078 1.75
 1.84 Intake 1470 2.85
 2.02 Intake 1650 4.50
 1.50 Exhaust 1077 2.85
 1.50 Exhaust 1549 5.95

Big BLOCK CHEVY

2.06 Intake 1652 3.55
 2.19 Intake 1654 6.35
 1.72 Exhaust 1651 4.45

S.B. MOPAR

1.58 Intake 1778 3.55
 1.60 Exhaust 1721 3.55

B.B. MOPAR (WEDGE)

2.08 Intake 1218 3.35
 1.74 Exhaust 1265 3.65
 1.74 Exhaust 1711 4.55

S.B. FORD 289 (Non Rail)

1.78 Intake 1628 3.35
 1.48 Exhaust 1567 3.85

S.B. FORD 302 (Rail)

1.78 Intake 1732 2.95
 1.48 Exhaust 1711 4.50

351C 4 BL HEAD FORD

2.02 Intake 1762 4.05
 1.72 Exhaust 1763 4.55

351C 2 BL HEAD FORD

2.04 Intake 1754 4.50
 1.48 Exhaust 1765 4.35

351W FORD 68-74

1.84 Intake 1760 2.85
 1.56 Exhaust 1761 4.05

351W FORD 75-77

1.78 Intake 1830 3.00
 1.48 Exhaust 1831 3.95

352-390-428 FORD

2.03 Intake 1418 2.45
 1.68 Exhaust 1385 3.85

429-460 FORD

2.07 Intake 1730 4.05
 1.65 Exhaust 1731 4.10

WE HAVE VALVES AVAILABLE FOR MOST DOMESTIC ENGINES. PHONE FOR YOUR LOW PRICE.

ACCEL BREAKERLESS ELECTRONIC IGNITION DISTRIBUTORS



Mechanical Advance

Chevy V8	89.95
Ford 289-302	99.95
Ford 351C-400	99.95
Ford 429-460	99.95
Mopar 318-360-380	99.95

Vacuum Advance

Chevy V8	99.95
Ford 289-302	109.95
Ford 351C-400	109.95
Ford 429-460	109.95
Mopar 318-360-380	109.95

ON SALE

ACCEL DUAL POINT DISTRIBUTORS



Mechanical Advance

Chevy V8	45.95
Ford 289-302	51.95
Ford 351C-400	51.95
Ford 429-460	51.95
Mopar 318-360-380	51.95

Vacuum Advance

Chevy V8	89.95
Ford 289-302	79.95
Ford 351C-400	79.95
Ford 429-460	79.95
Mopar 318-340-360	79.95
Mopar 383-440	99.95

MALLORY DISTRIBUTOR DUAL POINT



Mechanical Advance

Chevy V8	48.95
Ford 289-302	51.95
Ford 351W	54.95
Ford 351C-400	51.95
Ford 429-460	54.95
Mopar 318-340-360	54.95
Mopar 383-440	51.95

Dual Point Vacuum Advance

Chevy V8	69.95
Ford 289-302	79.95
Ford 351W	79.95
Ford 351C-400	79.95
Ford 429-460	79.95
Mopar 318-340-360	79.95
Mopar 383-440	79.95

UNILITE

Mechanical Advance

Chevy V8	89.95
Ford 289-302	99.95
Ford 351W	99.95
Ford 351C-400	99.95
Ford 429-460	99.95
Mopar 318-340-360	99.95
Mopar 383-440	99.95

EDELBROCK PERFORMER MANIFOLD SPECIALS



At Low As **\$84.95**

Small Block Chevy

2131 AMC V8 70	134.95
2101 58 Chevy	84.95
2181 40 318 Chevy	139.95
2170 58 Mopar	134.95
2191 440 Mopar	129.95
2121 58 Ford	129.95
2181 351W Ford	129.95
2161 351M Ford	129.95
2196 460 Ford	139.95
2105 390-428 Ford	184.95
3171 350-403 Olds	184.95
2156 Pontiac V8	134.95

EDELBROCK PERFORMER PLUS CAMSHAFT KITS



Kit includes: CAMSHAFT-LIFTERS-LUBE

AMC 304-401	\$144.95
Buick 76 up 231	\$124.95
S.B. Chevy up to 350	\$136.95
S.B. Chevy 400	\$136.95
S.B. Chevy 460	\$136.95
S.B. Mopar 318-360	\$148.95
S.B. Mopar 413-440	\$162.95
S.B. Ford 289-302	\$144.95
351W Ford	\$152.95
351M 428 Ford	\$142.95
390-428 Ford	\$145.95
429-460 Ford	\$160.95
Pontiac 400-455	\$149.95

PAW T Shirts

Just \$5.50

The Fabulous P.A.W. Logo Block Motor in 3 Colors Front & Back On A Quality, Heavy Beely 1/2 Shirt. Available SM, M, L, XL Size Size

Catalog & T-Shirt Just \$10.00

OUR LATEST GIANT CATALOG

FREE with an order from this ad.

OR SEND **\$4.00**

SPECIAL MALLORY BREAKERLESS Conversion Kits

Make the next time you change your points the last time. Available for most domestic 6 cyl & V8's

Your Low Price **\$49.95**

WIRES



3mm Yellow Silicone - \$ 95
 3mm Yellow Silicone - 15.95
 Straight or angle boots, copper or suppressed wire.

ON SALE SUPER COILS

Accel Superior **\$28.95**
 Accel Superior HEI **\$28.95**
 Accel Yellow Superstock **\$14.95**
 Mallory Voltmaster **\$14.95**
 Chrome Coil & Bracket **\$14.95**
 Mallory Pro-Master **\$24.95**
 O.E.M. Universal **\$14.95**
 Replacement 12V **\$ 6.95**

AUTOQAGE PERFORMANCE STREET TACH'S



Your Low Price **\$27.95**
 \$250.00 Set in Black **\$29.95**
 \$230.00 Chrome

ZOOM CLUTCH SPECIALS



Available for all popular Engines with 10" flywheel

Cover Assembly	\$59.95
Disc	\$25.95
Slate diameter & spline size when ordering	
Throwout Bearing	\$14.95

Buy All Three & Save
 Your Low Price **\$99.00**

WE ACCEPT MASTERCARD & VISA

TECH LINE & PHONE ORDERS

818-998-6000

8:30 am to 5:30 pm Pacific Time Monday thru Friday

How-To Engine Building BOOKS

HOW TO REBUILD BOOKS

Ford 351C-351M-400-429-460	\$9.95
S.B. Ford 289-302-351W	\$9.95
S.B. Ford F18-390-428	\$9.95
Ford 1.3, 1.6 & 2.0 GMC	\$9.95
S.B. Chevy	\$9.95
S.B. Chevy	\$9.95
S.B. Chevy	\$9.95
S.B. Mopar	\$9.95

HOW TO HOT ROD BOOKS

S.B. Chevy	\$9.95
S.B. Chevy	\$9.95

CARS ETC!

Holley Carb & Manifolds	\$12.95
Holley 4150-4160-4 BL	\$4.95
Holley 2300-2 BL	\$4.95
Holley 3200-2 BL	\$4.95
Rockwell Carb	\$9.95
Torco Carb	\$12.95

PERFORMANCE AUTOMOTIVE WHOLESALE, INC.

21122 Lassen Street, Chatsworth, CA 91311.

How To Order

State, Make, Model, Year & Engine Size. Send at least 50% deposit by Cashiers Check or Money Order, no personal checks accepted or use your Mastercard or VISA. All Overseas & Canadian orders must be paid in full. No C.O.D. on truck freight shipments. C.O.D. on UPS only. All Engines & Master Kits must be paid in full. Customer responsible for all shipping charges.


Print Name _____
 Address _____
 City _____ State _____ Zip _____
 Make _____ Model _____ Year _____ Engine Size _____

NOTE: P.A.W. is not responsible for typographical errors in pricing or applications, including all contents of this advertising.

DON'T REBUILD YOUR ENGINE WITHOUT CHECKING OUR PRICES. WE SUPPLY ALL CORES - EXCHANGE IS NOT REQUIRED.

California residents: Items in this ad are not legal for sale or use on pollution controlled motor vehicles in California. Legal in California only for racing vehicles which may not be used on highways

Rustproof Your Own Car And Save \$200.00 In 30 Minutes

 **SealCoat™** effectively penetrates and neutralizes rust on used cars as well as protecting new cars.

THE PROBLEM - RUST

Next year it'll cost the public an estimated \$13 billion dollars while it destroys one of your family's largest investments. It's rust. And every year it gets worse. Because every year its prime causes get worse. Like air pollution, acid rain and road salt.

WHAT CAUSES RUST

Rusting is a natural process - the chemical change of the element iron to its more "stable" form, iron oxide or rust. Rust begins as soon as steel is forged. Moisture and salt are the two most common causes of rust.

Fact 1 (Road Salt): Nationwide over 10 million tons of road salt will be spread in the winter of 1985.

The use of road salt has increased 500% over the last decade.

Fact 2 (Sheet Metal): Due to Detroit's quest to manufacture more fuel efficient cars, the thickness of the sheet metal used on current autos is about 40% thinner than it was 10 years ago. This trend of more road salt and thinner sheet metal is continuing, and it's getting worse all the time.

Fact 3 (Air Pollution): Air pollution is causing acid rain throughout the country. Acid rain is a prime cause of rust.

Fact 4 (Salt Air): If you live near the Atlantic or Pacific Oceans or the Gulf of Mexico, you know that salt air is stealing your hard-earned dollars by causing your car to rust.

While the environment is doing its best to destroy the average family's second and third largest investments, namely the family automobiles, we at **AUTO SAVE INC.** are pleased to present you with a new chemical solution.

THE SOLUTION - SEAL COAT™

We are excited to present a revolutionary **new** do-it-yourself kit which will allow even a **novice** do-it-yourselfer to rustproof his or her own automobile (new or **used**) in approximately 30 minutes and save up to \$200.00. Our research shows the vast majority of the motoring public will be able to use this easy-to-apply kit.

CHEMICAL COMPOSITION

The chemical formulation has been specifically designed to be effective in rustproofing **used cars** as well as new cars. The formulation contains an exclusive penetrant which neutralizes rust that has already developed as well as completely protecting all unaffected metal surfaces. **SEAL COAT™** has been tested and found to be **700% more effective than undercoating.**



SEAL COAT™ is also Thixotropic (Self Healing) and has maximum creep tendencies so it will seek to cover seams and cracks where ordinary products won't reach.

SEAL COAT™ was developed under the guidance of a company which has been manufacturing rust proofing compounds for the last 67 years. This chemical contains special properties that never dry completely; therefore, it won't chip, crack, peel or flake off.

INVENTOR

The kit has been developed by a former top executive with the largest auto dealer rustproofing company in the country.

He has been involved in the automotive chemical industry for over 15 years and has been responsible for the development of several other famous do it yourself products.

EASY APPLICATION

Detailed instructions guide you to all areas to be sprayed. In many cars, no holes need to be drilled because of access holes left by the manufacturer. Otherwise all that needs to be done is drill hole, insert specially designed wand, spray material and seal hole with plugs. The whole process can be finished in 30 minutes.

We hesitate to add this because the kit is so easy to use, but if you feel unsure about your ability to use the kit, we suggest you buy it and have your local gas station mechanic apply it. Their charge should only be around \$20.00 and you will still save a considerable amount of money.

KIT CONTENTS

1. **SEAL COAT™** chemical formula in convenient pressurized cans.
2. Five ft. rigid spray wand with 360° spray tip.
3. Three ft. flexible spray wand.
4. Plastic rustproofing plugs.
5. Detailed illustrated instructions.

6. Decal to prove car has been rustproofed.

COST - \$49.95

SEAL COAT™ protects your automobile investment now and pays for itself when you sell it or trade it in. The entire cost is only \$49.95 and 30 minutes of your time. **You might be interested to know that \$49.95 is just about what it costs a car dealer to apply rustproofing to your car, but they charge \$249.00.**

Now who needs that \$200.00 more, you or the car dealer?

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If you are not 100% satisfied with **THE SEAL COAT™ RUSTPROOFING SYSTEM** return it in its original unused condition within 30 days. We will mail your refund immediately.

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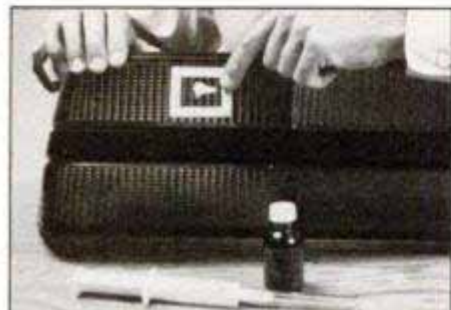
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1. Cover the damage with release film and tape supplied in the kit. If outer surface is textured, apply modeling clay first.



2. Place damaged lens flat with its outside surface facing down. Mix the repair materials, following instructions in kit.



3. Apply repair material to the inside of the lens and allow it to cure. Repair material is available in red, amber and clear.

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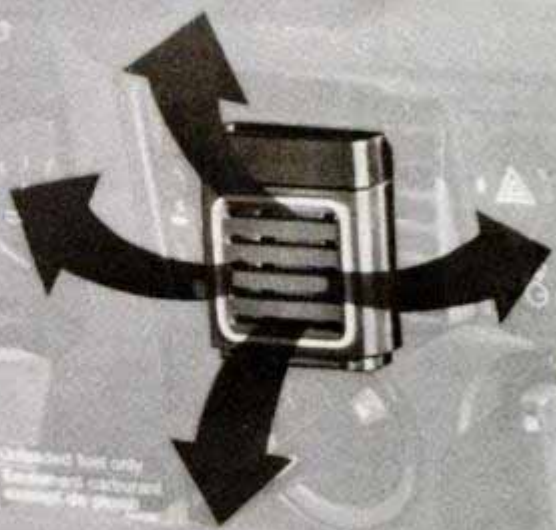
These products are available where automotive products are sold.

AND RECEIVE UP TO \$400 BACK BY MAIL

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OWNERS REPORT: GRAND AM

(Continued from page 89)

percent mentioned brake problems, though in many cases the front discs were just squeaky.

In fairness, though, the Grand Am has a much brighter side, and complaints paled beside the tributes.

Most Grand Am owners—84.8 percent—hung their initial buying decisions on styling.

A Michigan housewife said, "Pontiac's got a winner in the Grand Am. Before buying, I checked out the Olds Calais and Buick Somerset Regal as well. Pontiac has by far the better design . . . much more innovative . . . no chrome but black, sportier trim." The Calais and Somerset Regal are mechanically identical to the Grand Am but cost about \$500 and \$1,000 more. The Grand Am has been outselling its cousins by 11 and 18 percent, respectively.

But styling wasn't the Grand Am's only long suit. "Lots of power for a 2.5-liter engine," said a Wisconsin manager. A New Hampshire telephone rep added, "I just love this car. It has great pep and moves right out into traffic. Also, the front-wheel drive makes it wonderful in snow." Most of our owners bought the Four, with only 9.7 percent opting for the V6.

Performance, though, is more than straight-line acceleration. A Michigan heavy equipment operator observed, "This Grand Am is the best handling automobile I've owned since my 1975 MGB." A Montana insurance executive is also pleased: "I have the Y-99 Rally suspension, which is excellent on the highway and not even too harsh in town—a great combination."

While most owners agreed that their Grand Ams had superior maneuverability and handling, a few felt those same traits demanded a slight compromise in ride. A Texas clerk pointed out that: "It's a highly maneuverable vehicle, but you pay the price in ride stiffness."

Turning now to workmanship, a Michigan nuclear engineer had this to say: "General Motors' quality control has improved since I bought my 1978 Monte Carlo. The Grand Am is a very sturdy, quiet car." And a Michigan factory worker: "I've been at Buick for over 22 years, 15 of those on the final assembly line, sometimes as an inspector. From this experience, I've learned what to look for in a new car. I feel the Grand Am is extremely well built. Mine has no rattles, very good sheet-metal fit, and good paint. Everywhere I go, people stop and look at the car." A very high percentage—96.6—rated overall workmanship good to excellent.

To sum up, most owners agree that the Grand Am's pluses outweigh the minuses by a wide margin. **PM**

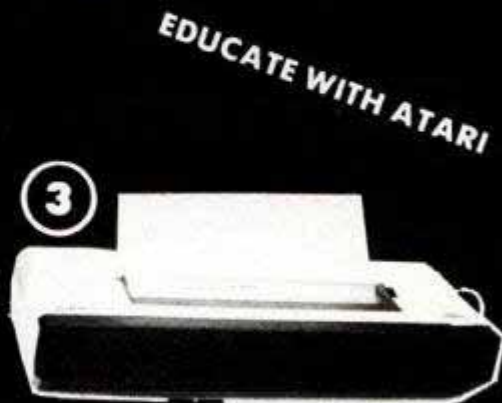


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Dovetail dado joint

When you need to build superstrong drawers—very large drawers or drawers subjected to heavy loads and constant use—choose dovetail dado joints. The joint consists of a long dovetail that is locked into a dovetail-shaped dado. As with all interlocking wood joints, the dovetail dado components must fit together snugly. Light tapping with a mallet should bring the parts together.

Dovetail dado joints can be cut on a shaper, router table (as shown), or with a homemade, bolt-on router guide (see *10 Ways To Join Legs To Rails*, page 116, Mar. '84). Start by cutting dovetail dados in the drawer front. The dados are formed with a 1/2-in. dovetail router bit, but it's good practice to first cut a straight dado to remove some of the waste. This way, there will be less strain on the bit and on the router motor. Remember, the dovetail dado must be cut in a single pass.

Next, cut a matching long dovetail on one end of each drawer side. Form each dovetail with two passes. Pass the drawer side between the router table fence and the dovetail bit to cut one surface. Then, rotate the side 180° and cut the opposite face. Be sure to make test cuts on scrap wood before routing the drawer sides.

Now cut the back-to-sides joint. If dovetail dados are used, cut the dados in the drawer sides' interior sur-



Cut the dovetail dados in the drawer front using a router table and a dovetail bit. Guide the work with the miter gauge.



Cut the grooves for the drawer bottom with a 1/4-in. straight bit. Note that drawer front groove is contained between dados.

face and rout matching dovetails on the drawer back ends.

Groove the drawer front and sides to receive the 1/4-in. plywood drawer bottom. Note that the drawer front groove



Use a tall auxiliary fence to support the drawer sides while cutting the dovetail. Make two passes to form each dovetail.



Although it's assembled with glue only, the dovetail dado joint is one of the strongest joints used in drawer construction.

is contained within the two dovetail dados so that the groove isn't visible after the drawer is assembled. Now you should assemble the drawer joints using glue only.

Add-on drawer face

All the drawers discussed so far have integral drawer fronts. But often, the cabinet design will require drawers with add-on drawer faces. That is, finished drawer faces that are made separately and then mounted to the front of the assembled drawer. This add-on technique commonly is used for drawer faces that are made of hardwood-veneer plywood or those covered in plastic laminate.

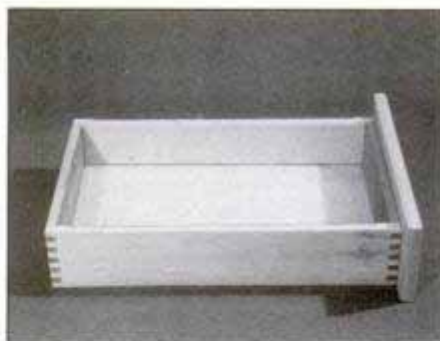
Design your own custom drawer faces by adding store-bought or shop-made molding to the face, as shown. Cut the molding to fit the drawer face using miter joints at the corners. Then, glue and tape the molding in place. Attach the finished drawer face to the drawer by screwing through the drawer front and into the face. Be certain that



Create your own custom drawers by adding wood molding to the add-on faces. Attach the molding with glue and masking tape.

the screws aren't long enough to go through the face.

Add-on drawer faces are made larger than the drawer front so that they overlay the cabinet stiles and rails. The



Screw through the drawer front and into the face. Make the add-on face large enough to overlay the cabinet stile and rail.

oversized face will conceal the drawer guides and will provide an automatic stop when you close the drawer. Add-on drawer faces are also easy to refinish and replace.

Drawer installation options

There are almost as many ways to install a drawer as there are ways to build one. Shown are eight common, and not so common, installation options. The technique you choose will depend on the drawer size, the avail-






able space around the drawer and the cabinet construction. The two most popular and efficient ways to guide a drawer in and out of a cabinet include the runner-and-dado and the metal drawer slide.

There are two variations of the runner-and-dado drawer guide. One variation requires cutting a dado in the cabinet side. Then, screw a hardwood runner to the drawer side, as shown.

(Please turn to page 208)



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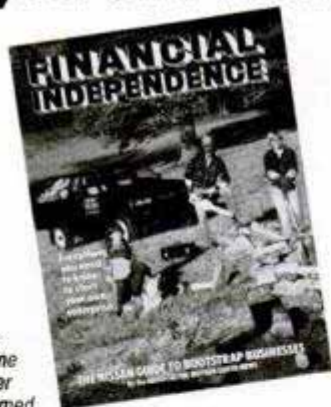
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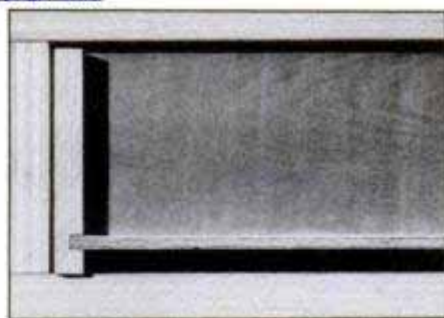
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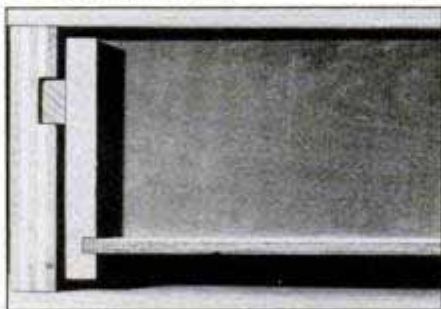
BUILDING DRAWERS (Continued from page 206)

For the alternative method, dado the drawer side and fasten the runner to the cabinet interior. Both runner-and-dado systems work well for nearly every size drawer.

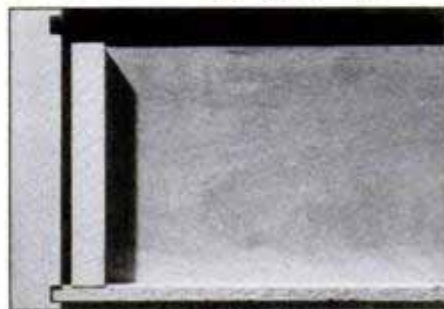
Metal drawer slides come in a variety of sizes and load-carrying capacities. Models are available for mounting over and under the drawer, and to the drawer sides, too. Drawer slides come in two styles: standard and full extension. The costlier full extension slides allow the entire drawer to extend from the cabinet for easy access. **PM**



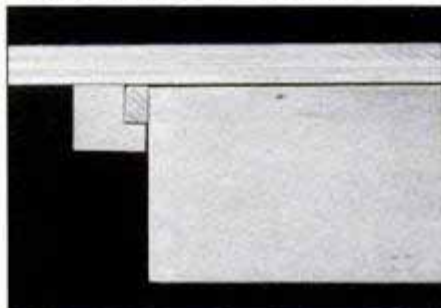
This drawer is guided within the structure of the cabinet itself. Minimal clearance prevents drawer from tipping when opened.



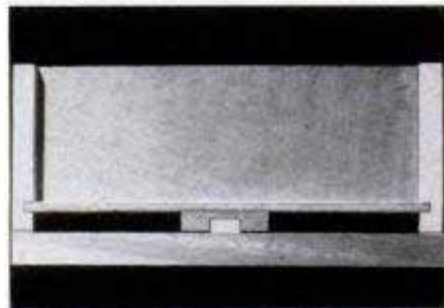
Hardwood runner screwed to the drawer side rides in a matching dado cut in cabinet interior. Wax the runner to cut friction.



Extended drawer bottom slides in a dado cut in the cabinet side. Use this method for light- and medium-duty drawers only.



Attach a rabbetted cleat to the underside of a cabinet top, as shown. Then, screw a hardwood runner to the drawer side.



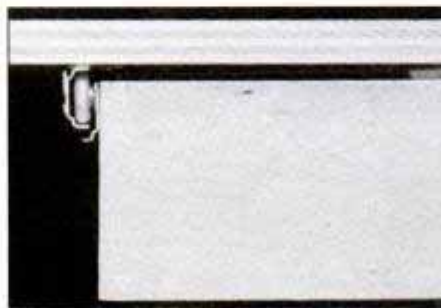
Fasten the center-grooved wood guide to the underside of the drawer bottom. Screw a hardwood runner to cabinet frame.



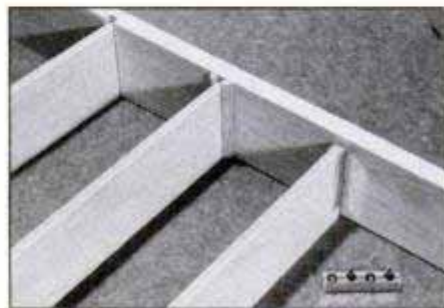
Mount L-shaped blocks to the cabinet interior on both sides of the drawer. Cabinet rail keeps open drawer from tipping down.



Most side-mounted drawer slides need 1/2 in. to operate, so make the drawer 1 in. narrower than the cabinet opening.



Use top-mounted drawer slides when installing a drawer where no cabinet sides exist, such as under a countertop or desktop.



Here are three simple ways to install drawer dividers (left to right): dado, wood cleats and barbed metal channels.

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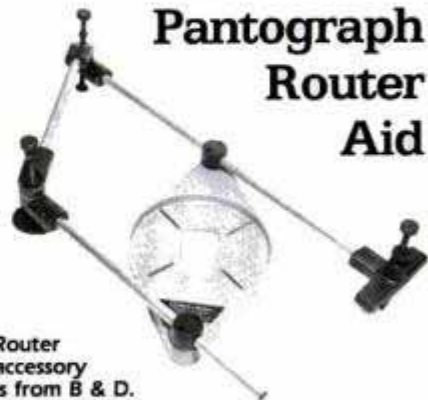


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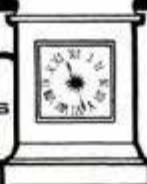
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A CLASSIC WINDSOR CHAIR

(Continued from page 117)

21 strips. Set aside 12 for the arm rail, and nine for the bow.

Start by laminating the bow. Liberally coat one side of each strip with glue using a small paint roller or brush. Stack the strips, leaving an unglued surface on both top and bottom.

Then, take the stack and bend it into the outer form. Pull the inner form against the stack and tighten the forms together with a clamp placed in the center of the arc. Add clamps in both directions until the entire piece is squeezed within the forms. Make sure the laminations are aligned vertically as you work. Allow the assembly to set for 24 hours before removing the clamps. Bend the arm rail the same way using 12 strips instead of nine.

Cut each assembly to finished length, measuring from the center of the arc to each end, so the symmetry of the curves is maintained. Since the finished arm rail must flare out at the ends to form handrests, glue additional blocks to the ends of the rail. When the glue has dried, plane the entire arm rail to a finished $\frac{3}{4}$ -in. thickness. Then, cut the handrests to the shape given using a jigsaw or band saw. Shape the bow by hand, like the spindles discussed earlier. You should keep in mind that the ends taper to $\frac{3}{8}$ -in. dia.

Next, bore the $\frac{1}{2}$ -in.-dia. arm post holes in the arm rail according to the dimensions and angles given in the drawing. Then, place the arm posts in their seat holes and slip the arm rail onto the post tenons. Mark the shoulders on the arm post tenons the same way you marked the leg tenon should-

ers. Also mark the tenons for their wedge kerfs. These should be perpendicular to the wood grain in the seat (for the bottom tenons) and the wood grain in the arm rail (for the upper tenons).

Disassemble and cut the shoulders and wedge kerfs using a backsaw. Next, cut the wedges for all the joints. We used ash, but any hardwood will do. Each should be about 2-in. long, have a gentle taper—between 5° and 10° —and be the same width as its tenon.

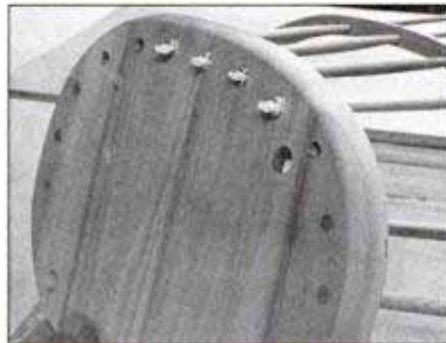
Assembly

The parts should be assembled in the following order: arm rail to seat, legs to seat, bow to arm rail and seat. Begin by laying out the locations of the spindle holes in the arm rail. They should be spaced equally, about $3\frac{7}{16}$ in. apart. Next, glue the arm posts into the seat so

(Please turn to page 212)



Glue and wedge arm posts and short spindles to seat from below; to arm rail from above. Cut ends flush with dovetail saw.



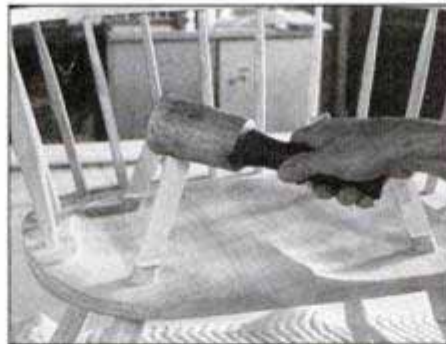
Insert long spindles through bottom of seat, then up through arm rail. Glue lower ends to seat. Then, drive in wedges.



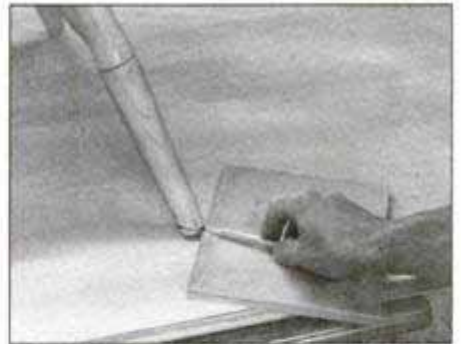
Glue center stretcher to side stretchers on flat surface so all parts align in one plane. Then, use single bar clamp at joints.



Glue stretchers to legs and legs to seat. Using a mallet, progressively tap bottom of legs until tenon shoulders hit seat.



Turn chair over and drive wedges into leg tenon kerfs. Cut off most of tenon with backsaw; trim rest flush with wide gouge.



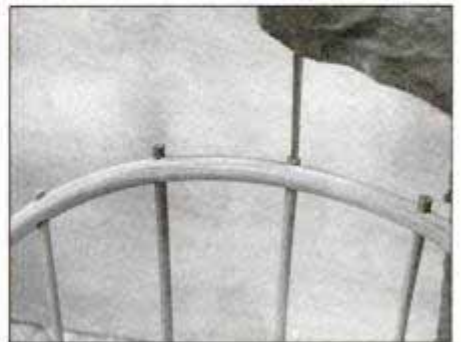
Place chair on flat surface. Using pencil and $\frac{1}{2}$ -in.-thick block, scribe bottom of each leg. Cut off waste with backsaw.



Weave bow through spindles, keeping ends outside arm rail. Center bow over seat and mark rail where ends intersect.



Align spindles against bow with even spacing. Mark the bow. Bore spindle holes by aiming drill bit toward arm rail holes.



Glue bow into arm rail and over spindles. Then, split spindles perpendicular to bow grain with chisel. Drive wedges into splits.

A CLASSIC WINDSOR CHAIR

(Continued from page 211)

their tenon kerfs are perpendicular to the grain in the seat. Then, turn the seat upside down, spread glue on the wedges and drive them firmly into the kerfs using a mallet. Trim the protruding tenons flush to the seat bottom using a dovetail saw.

Turn the seat upright, clamp it to the bench, and place the arm rail over the arm posts. Place a 9-in. support block between the rail and the seat. Then, bore the spindle holes in the arm rail. Use a $\frac{3}{8}$ -in.-dia. pilot bit and aim it toward the corresponding hole in the seat below. Stop when the pilot bit comes through the arm rail. Be sure to clamp a scrap block under the hole to keep the rail from splitting as you complete the hole.

Glue the arm rail to the arm posts and wedge the tenons as before. Slide the short spindles in place through the seat bottom. When they are 2 in. short of their final position, spread glue around both ends. Drive them in the rest of the way and wedge them in place as before. Now you should trim the tenon ends flush with the seat bottom and sand smooth. Then, turn the chair upright and using a sharp $\frac{3}{8}$ -in. chisel, split the spindle ends perpendicular to the grain

of the arm rail. Wedge these joints and trim flush.

Leg-seat assembly

Begin the base assembly by joining the center stretcher to the side stretchers using glue and clamps. Then, support the seat upside down on the corner of the bench so the arm rail will clear. Next, glue the stretcher assembly into the legs and the legs into the seat. Gently drive this whole assembly downward, using a wood mallet. Proceed slowly, alternating legs.

As the legs slide into place, the leg-stretcher joints should draw tight as well. If one binds, gentle pressure with a bar clamp at the problem joint should bring it snug. After all tenons are seated firmly, turn over the chair, wedge each leg tenon and trim flush to the seat. Using a $\frac{1}{2}$ -in.-thick scrap block, scribe a line around each leg bottom. Cut off the waste with a backsaw.

Next, place the bow in its approximate position on the chair. Slide the long spindles in place so they fall alternately in front of and behind the bow as shown. The bow ends should rest just outside the arm rail. Mark the angle of intersection for the bow and arm rail on the inside edge of the arm rail. Remove the bow and, using this mark as a guide, carefully bore the two $\frac{3}{8}$ -in.-dia. tenon

holes. As before, clamp a scrap block below the arm to prevent splitting.

Replace the bow, sliding its end tenons into the arm-rail sockets. Adjust it as required to achieve a symmetrical arc. Where the center spindle intersects, the bow should be about $22\frac{1}{2}$ in. above the seat. The other spindles should fan out evenly as they rise from the seat. To align them, step back from the chair and carefully look at the pattern. For this procedure, your eye is more accurate than measuring because of all the curves involved. When satisfied with the spindle and bow placement, mark where each spindle intersects the bow. Then, using a $\frac{3}{8}$ -in.-dia. pilot bit, carefully bore the holes by aiming toward the corresponding hole in the arm rail below. Trim the spindle ends $\frac{3}{8}$ in. above the bow.

Remove the bow and spread glue in the spindle and arm-rail holes. Slide the bow over the spindles and into the arm-rail holes. Gently tap the bow until the arc is adjusted properly, using a mallet. Then split, wedge and trim flush the spindle ends. Turn over the chair and do the same to the bow ends.

Carefully inspect the chair for any scratches or nicks resulting from assembly. Sand smooth as required, then prime and paint the chair with an oil-base paint of your choice. **PM**

SOUP UP YOUR COMPUTER

(Continued from page 76)

place. Open the barn door and turn the latches outward. Then, the top cover will lift, revealing a 10K ROM cartridge in the first slot, and three 16K RAM cartridges in the other three slots. A simple upgrade replaces the last (back-most) 16K cartridge with a 64K RAM plug-in, which gives your old Atari a total of 96K of memory.

The upgrade kit, called 64K Select by Mosaic Electronics, costs about \$170 from mail-order houses. If you're serious about using RAM-disk, you can put in three of those boards for a total of 196,608 bytes of RAM in your Atari 800. You'll then have an extra \$500 or so invested in your computer, but that RAM-disk will make it superfast.

Mosaic also makes a 64K expansion module for the Atari 600XL—the discontinued model that comes with just 16K of RAM. Retail on this internal memory board is \$140—so you might want to think twice. That's more than the total cost of the current, highly discounted Atari 800XL, which has 64K of RAM already in place.

There's also something new for Commodore 64 users. Mosaic recently introduced the first-ever memory expansion for this difficult-to-upgrade computer—it's a 64K plug-in cartridge priced at

\$199.95. You get a bonus of some applications software on a disk, and several software companies are now writing new programs that will use this extra memory capacity.

If you'd rather just improve the basic Commodore 64 system without adding memory, the same price will get you the Bus Card from Batteries Included. This particular product adds so much capability that it's mind-boggling. For one thing, it lets you hook up parallel-driven disk drives to the C-64—and these are inherently faster than the C-64's regular serial drive. With this item, you can also run two disk drives. Adding a second disk drive to the C-64 is a big time saver if you're doing a lot of programming, running utilities or productivity software.



IBM's Personal Computer comes with 64K or 128K of memory, but has room for 256K.

The Bus Card will also run just about any kind of printer from the C-64, and it gives you a new version of BASIC called BASIC 4.0 that has lots of extra functions and commands. It plugs into the expansion port, and has another port for whatever strikes your fancy.

Probably the most exciting soup-up we tried was adding a small, hard-disk drive to our IBM clone—the Turbo-TAVA. Using an \$800 kit from Kameron Labs, we increased the system's speed and usefulness hundreds of times over. The hard disk has a huge capacity—10 megabytes and up. Once you install it, you'll wonder how you ever got along without it. **PM**

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FUTURE OF NUCLEAR WASTE

(Continued from page 92)

source contains from 40 to 100 curies of tritium, depending on its size," says Jensen. "These small amounts of tritium would pose no safety hazard to humans even if they were standing next to a light and it broke. If all the runway lights were shattered, a person standing several hundred feet downwind would receive no more radiation than he would on a cross-country commercial airline flight."

So far, the Oak Ridge National Lab has designed and fabricated about 1,000 tritium runway lights. The cost is low and the safety factor is high, according to the government scientists, but whether these radioactive magic wands become an accepted feature of airports remains to be seen.

While Oak Ridge researchers make light from radioactive tritium, their counterparts at Sandia National Lab in New Mexico are using another byproduct of atomic reactions to preserve food and sterilize sewage. "Two of society's problem children are nuclear waste and sewage sludge," says Rod Geer, a spokesman at Sandia. "We figured we could combine the two and come up with beneficial uses."

The radioactive element in this process is cesium 137, byproduct of nuclear fission. A large hunk of cesium would wither an elephant, but in tiny doses, measured in "millirads," radioactive rays kill microorganisms and pass through the food, leaving it untainted.

Irradiating food and sewage

The process is essentially the same for irradiating both food and sewage. Microorganisms and insect larvae can find homes in meat or fruit, hasten spoilage and render it unfit for human consumption. Similarly, sewage sludge is full of potentially harmful bacteria. Exposing them to radioactive rays should kill the organisms without effecting the food or sewage in the same way that a chest X-ray can penetrate your skin without destroying cells or organs.

One of the first uses for radiation as a sterilizer was to kill bacteria on the Viking spacecraft without exposing it to heat. Following that success on an unmanned mission to Mars, the Energy Department asked the scientists at Sandia to investigate further uses of radiation. The result is a pilot sewage irradiation plant that passes dried sewage sludge under a cesium 137 radiation source. The cesium is shielded in a water bath. It is lifted out automatically during use to expose the sewage.

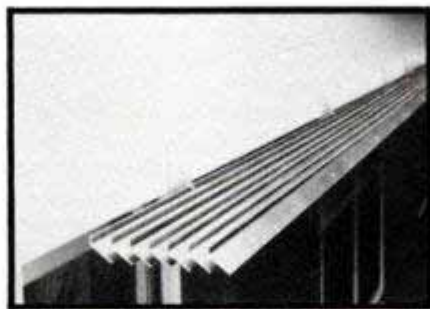
"If you zap it with radiation," says Sandia's Geer, "you kill the pathogens. It's just like a tooth X-ray. It passes

(Please turn to page 214)

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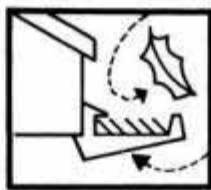
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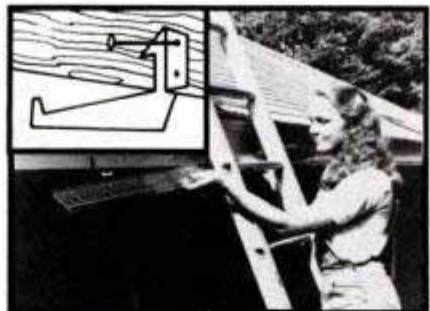
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FUTURE OF NUCLEAR WASTE

(Continued from page 213)

through and doesn't leave any residual radioactivity."

Meanwhile, agriculture researchers at the University of New Mexico have taken the process one step further. They take the zapped sludge, form it into pellets and feed it to sheep and cattle. So far, the animals are thriving.

Irradiating food would work the same way: Trays of meat, fruit or vegetables would be placed on a conveyor that would pass under a cesium 137 source inside a metal structure.

For example, pork processors believe irradiation would work against the trichina worm, an age-old human parasite. The worm larvae live in pork, and if the meat is undercooked, the worms can be transmitted to people. At the moment, heat is the only way to make sure the larvae are dead. But a dose of radiation could kill the worms, since the rays affect living organisms.

Bugs present similar problems in preserving fruit, vegetables and grain, but here chemicals serve as pesticides. Again, the irradiation logic says a dose of rays would kill the living organisms and reduce pesticide use.

At least two years away

A number of foreign countries have been using irradiation as a preservative, and the Energy Department has a unit working at Sandia. Before irradiated food shows up on supermarket shelves here, however, the Food and Drug Administration will have to authorize its use. The agency, which has given initial approval to irradiation, is reviewing regulations to allow food processors to irradiate their products. It will take at least two more years for irradiated food to reach consumers.

While tritium and cesium are useful because they emit beta and gamma rays as they decay, a third nuclear waste byproduct is valuable because of its heat. Strontium 90 is highly radioactive and must be encased in lead capsules, but it still gives off steady amounts of heat through the case.

Government scientists harnessed the heat back in 1961 in a thermoelectric generator powered by plutonium. Since then, these constant power generators have been used in spacecraft and made exploratory missions to the planets possible. However, using strontium 90 from nuclear waste is relatively new.

Once the strontium 90 is encapsulated safely, it functions in a generator like other heat sources. For example, in the latest radioisotope thermomechanical generators (RTMG), heat from the decaying strontium 90 isotope boils a fluid which drives a piston that in turn runs a turbine to produce a.c. power.

The military is interested in RTMGs to power radar, but the Energy Department envisions many civilian uses. In addition to powering lights in navigation buoys, straight strontium 90 could be used as a heat source in oil recovery, water lines and sewage lines, according to the Energy Department.

In explaining this new technology, Energy Department officials list public acceptance as a potential stumbling block, especially since it involves radioactivity. Even the minute amount of information that has leaked out about the beneficial nuclear systems has attracted concern and criticism.

While tritium lights might soak up some nuclear waste, they won't make much of a dent in the pile of radioactive material that has built up over the last 40 years. At the end of 1982, there were 9,000 metric tons of spent fuel rods from commercial nuclear plants in temporary storage. Military high-level nuclear waste is believed to be even more plentiful. Reprocessing some wastes to glean tritium, cesium and strontium is complicated and expensive and uses up only minute amounts.

The wary public

Many people are wary of anything that has to do with radioactivity. When the Food and Drug Administration asked for comments on its regulations to allow food irradiation, this response came in from Rick Burcham of Van Nuys, Calif.: "Has someone lost his marbles? I'm sure once the public is informed, this idea will be stopped."

Bob Alvarez, a nuclear expert with the Washington-based Environmental Policy Center, says there's enough radioactive material in the environment at the moment without adding more sources. "The proliferation of these beneficial uses will increase the number of places that handle radioactive materials," says Alvarez, "and that's where people are really put to risk."

Alvarez cites the example of a paint factory in Tucson, Ariz., that used tritium to make figures on watches glow. Tritium was released from the factory and contaminated the city's public school food storage warehouses across the street. Nevertheless, Energy Department officials insist the technology is safe when under proper controls.

"You can design the irradiation facilities and the power generators so they're so foolproof that no one can get hurt, even if they want to intentionally," says Bill Remini, who coordinates the Department of Energy's nuclear by-product utilization program.

So the federally sponsored research continues, and officials are sure that the next generation of Americans will routinely use nuclear waste as a source of light and power.

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SMALL BOATS

(Continued from page 94)

the cockpit. Alumacraft has introduced four new models for '85, including a center console Sportsman 180, a 17-foot, 6-inch fishing boat made to tackle large lakes and coastal waters. Like other aluminum trailer boats, it's easy to tow, and gives good fuel economy due to minimal displacement.

An interesting trend among builders such as Bayliner is the move toward package boats—complete boat, motor and trailer packages that may include everything right down to trolling motors and CB radios, all rigged at the factory. Component costs are cut due to mass purchases, and rigging costs are lowered thanks to standardized assem-



Chris Craft's 230S Scorplon is quick, yet it has a cuddy cabin and plenty of comfort for family cruising. The V-hull can handle rough water at speed.

bly. The result is lower prices for the consumer. Like Bayliner, Bass Pro Shops has had considerable success with packaged rigs, primarily aluminum bass boats, and now offers package pontoon boats and a larger fiberglass basser as well.

With the continuing availability of gasoline at lower prices, ultra-high-performance boats are on a real roll this year. Fast, sexy machines like the Chaparral 198C XL can safely handle the biggest outboards in the industry—up to 290 horses. The 198 comes with twin V-bunks and a Porta Potty for overnights. Chaparral also builds a complete line of high-performance fishing boats to 25 feet long.

Another firm building boats for white-knuckle speed freaks is Wellcraft, with its sleek Scarab 1, a fitting little brother for its larger offshore racing models. The 21-footer is rated for up to 260 horses, and could be an outstanding ski boat. The Nova is a slightly larger hull (23 feet long) that may give up just a bit in performance, though not one iota in eye appeal, in return for more creature comforts in the roomy cuddy. Wellcraft also builds a complete line of fishing, cruising and performance machines, all the way up through the awesome Scarab 45, which

(Please turn to page 216)

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SMALL BOATS

(Continued from page 215)

can be equipped with up to three 370-horse Mercruiser sterndrives.

Chris Craft is also heavy into the performance scene with machines like the 314S Stinger, designed to handle up to 400 outboard horses, and the 230S Scorpion, a quick cuddy boat with lots of vee to take on rough water at speed. Chris Craft also builds a fast bowrider, the 168BR SL, nice for skiing families; and, of course, 70 other models.

Sea Ray has a complete line of smaller but fast family cruisers and runabouts on tap this year. The Seville series is an affordable collection of bowriders and cuddies ideal for smaller inland waters, while the larger 230 and 250 cuddy cruisers should appeal to offshore fishermen and overnight cruisers as well.

Mako and Boston Whaler, two of the best-known names in fishing boats, have also expanded their lines this year: Mako with a giant 28-footer, Whaler with 22- and 25-foot cuddy models with walk-through windshields that make it easy to get to the bow for casting or anchor handling.

At the other end of the scale, Hobie Cat, long known for its line of extremely lightweight sailing craft, has just introduced the Hobie Power Skiff. The Power Skiff is a 15-foot deep-V hull made of foam core composite material that can take up to a 50-horse outboard, although 20 to 40 hp is recommended. At an ultralight 385 pounds, the Hobie Power Skiff should fill the bill for an individual or family looking for an affordable entry-level powerboat.

Inflatable fun

Inflatable boats are continuing to pop up like helium balloons all over the country, and with good reason. They weigh less and carry more payload than any other type of watercraft. And, when the day's fun is done, you can deflate them and store them in the trunk of your car or the closet of your apartment.

Achilles, Avon and Zodiac, three of the better-known builders of inflatable boats, even offer trailerable models with deep-V fiberglass bottoms attached to deflatable side tubes, designed to eliminate the often rough ride you get in flat-bottom inflatables in choppy water (see "Rigid Inflatable," *All Outdoors*, page 34, Mar. '85).

In short, whatever your boating desires, somebody somewhere has a boat waiting for you this season. And, with interest rates moderating and many banks willing to finance for five or even seven years, you'd better have lots of willpower if you expect to walk out of a marine dealer without having bought yourself a boat.

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PRESERVE YOUR PHOTOS

(Continued from page 99)

the best protection against airborne pollutants is the same remedy for light, heat and humidity—an airtight dark, cold and dry enclosure.

Because of the many variables involved, no one can predict exactly how long a photo's color will last. What is known is the relative rate at which heat and humidity will affect longevity. Kodak, using dark storage at 40 percent relative humidity and 75°F. as a starting point, says a photo stored at 86° will fade twice as fast, while one stored at 66° will hold color twice as long. A picture stored at 45° will last 10 times longer than at 75°, and 100 times longer at 14° above 0.

This might suggest that your refrigerator or freezer is ideal for color photos. But household refrigeration has higher humidity than the optimal 35 to 45 percent for photos.

Accordingly, refrigerator-bound photographs should be sealed in an airtight package. But since such an enclosure will trap any moisture present in the air at the time of sealing, it's wise to dehumidify the package for several hours before sealing. An air-conditioned room, which tends to have drier air than normal, will do the trick. If you live in a particularly humid area, add a packet of silica gel to the package during the acclimatization process. Be sure to remove it before sealing.

Foil-laminated pouches suitable for long-term refrigeration storage are available from photography companies and can be purchased at photo supply stores, also your source for silica packets, or you can make your own cold-storage pouch from several layers of household aluminum foil. Use moisture-proof tape to cover the seams, and press out all the air before final sealing. Should you need to open a refrigerated package again allow it to reach room temperature first. This will prevent damaging condensation when the cold, dry materials become exposed to warmer, moister air.

Open display

Long-term dark storage might preserve a photo for all eternity, but much of the joy in photography comes from viewing. Mounting in a properly constructed album will protect your photos from constant exposure to light. All the better if the album is kept in a cool, dry place. But what about the pictures you want to display?

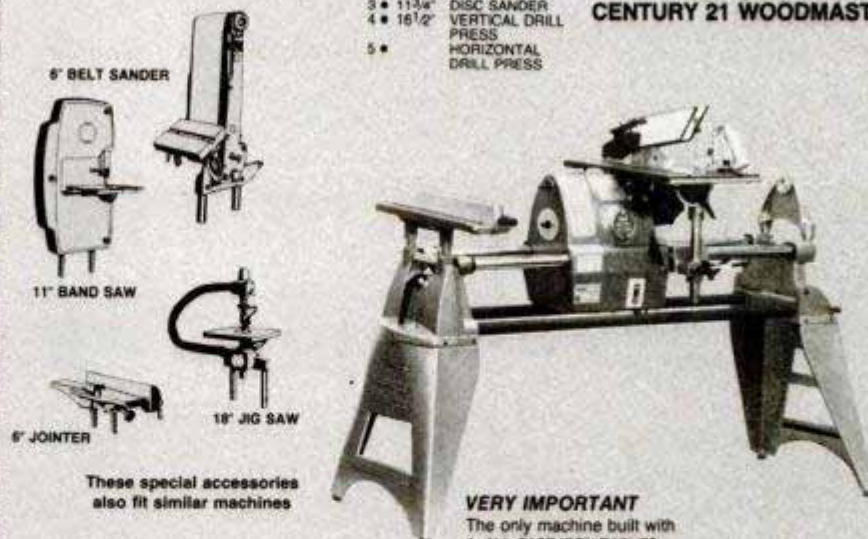
If possible, never display a photo where it's directly exposed to sources of ultraviolet radiation—sunlight or fluorescent light. Incandescent lighting is less damaging. But wherever you locate

(Please turn to page 218)

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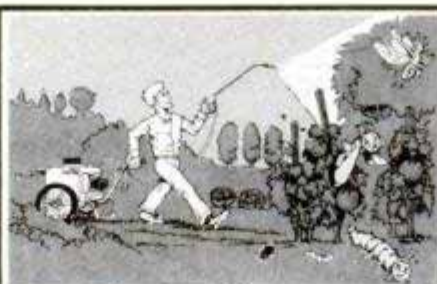
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PRESERVE YOUR PHOTOS

(Continued from page 217)

the picture, house it in a sealed frame. A glass covering will filter out some ultraviolet light, but a better choice is Lucite, Plexiglas or similar plastics that have been manufactured specifically to absorb ultraviolet. Use a mounting mat to maintain a slight separation between the print and the transparent covering. Should you use a transparent lacquer spray to protect a print, framed or not, from soiling? Probably not. And this brings us to the touchy area of mounting and storage materials.

Mounting substances

Generally speaking, the less you do to a photograph, the better. According to photography manufacturers such as Kodak and Polaroid, some storage, mounting and display products contain substances that can be harmful to color photographs. Because the compositions of these products vary from item to item and brand to brand, the photo companies only specify the substances that are harmful, or the conditions they create. Lacquers are a case in point. Kodak states that some are good. But those whose solvents create a peroxide formation are not recommended.

In the absence of specific recommendations or a degree in chemistry, you'll have to read the contents information on materials packages, or stick to products positively guaranteed by your local photo supply store.

Among the types of storage and display materials recommended by the photo manufacturers are albums, boxes and envelopes made of acid-free paper or board, polyethylene, polyester, cellulose acetate and acrylic plastics. Glass, porcelain, aluminum, stainless steel and metals coated with baked enamel are also on the approved list.

Materials to be avoided include ordinary cardboard; paper with high sulfur content (found in the most inexpensive black-paper albums); and brown paper (such as that used for grocery bags). Glassine envelopes, or any envelope whose glued seam runs down the center, should be shunned. Ditto for plastic coverings made from polyvinyl chloride and polystyrene. Unfinished and unaged woods can emit fumes. So can recently finished woods, and plywood and particleboard, which contain glues. In fact, glues and adhesives such as rubber cement, white pastes and glues and mucilage, shouldn't be applied directly to photographs. Neither should inks. Confine writing to the borders, in pencil.

Professional help

Knowing how to keep your future photos safe offers little consolation for

pictures that have deteriorated already. Yet there's hope for all but the most faded slides and print negatives.

A custom photofinishing lab, the type used by commercial photographers, advertising agencies and magazines, can use a technique developed by Kodak to analyze the losses in a slide or negative, and reconstitute the picture by keying in on the most important colors in the scene—skin tones, for example.

This is a time-consuming, cut-and-try process that requires a significant amount of personal attention. It might cost you \$20 or more for the first slide or 8 x 10 print. Because high-volume photofinishers such as the one-hour services and mail-order labs use automated processing equipment geared for fast turnaround, they usually do not handle this type of work.

For the same reason, it also might be worth your while and money to entrust that special roll of film to a custom lab. The quality of the original processing can effect the long-term stability of prints, slides and even negatives.

Although all types of photographic labs use basically the same printing papers and developing chemicals, adherence to the manufacturer's processing instructions may vary. Custom labs work for demanding clients, so they're set up to pay individual attention to the work. They're also equipped to perform some very complex—and very expensive—processing that can give photos an indefinite lifespan.

One of these processes, the dye-transfer print, takes an experienced operator days to create and costs hundreds of dollars. A less expensive alternative is the Cibachrome print. These are made on a unique dye-impregnated paper marketed here by Ilford Inc. Average cost is around \$30 for an 8 x 10. The catch? Cibachrome prints can only be made from slides.

Lowest cost alternatives

Perhaps the least expensive way to preserve your color photos is to have a black-and-white copy and negative made from the original. Since black-and-white photos don't fade, you can use them for display, or simply file them away for posterity. This is a particularly good alternative for photos where the subject is more important than the print's color.

If there's a color photo you want to display, have several print copies made when the original is processed. That is, while the negative or slide is still in top condition. And since Polaroid-type instant prints have no negative, it's wise to have a conventional photographic copy and negative made. With extra prints, you can display one until it fades. Meanwhile, you'll have the duplicate copies on ice. **PM**

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RACE TO NOWHERE

(Continued from page 101)

traditionally held on the first Saturday in May and is jointly sponsored by Boulder's KADE-KBCO radio station and the Wano Co., a local Coors beer distributor. The event regularly attracts as many as 80 contestants and 35,000 to 40,000 spectators.

A pageant it's not

A prerace publicity release offers this bit of hopeful hyperbole: "The Challenge is widely known for its amazing array of human-powered vehicles capable of traveling over land and water with parade-like pageantry."

Well, not exactly. Some entries sink or capsize before they're barely under way. Some collapse under their own weight. Some become hopelessly mired in mud. And some just slowly fall apart along the way, spewing a trail of bits and pieces behind them.

Finishing first is not the only way to win. Most contestants consider it fortunate to finish at all, and never mind how long it takes. The current course record is one hour, 10 minutes, a feat accomplished last year by a three-man team in pink jailhouse stripes called the Kowasaki Kops and Kons.

Since speed is not one of a Kinetic Sculpture's major attributes, other factors are taken into consideration. Entries are awarded points according to originality of design, which may or may not have anything to do with practical engineering. Crewmembers are judged on the creativity of their costumes—usually the more bizarre, the better—and on their ability to cope with catastrophe in a spirit of exuberant bravado. There are also a number of special awards, such as for the ugliest entry, the funniest, the craziest, the last to finish and the one suffering the most ignominious disaster.

Prizes are modest and are usually in the form of gift certificates to local shops and restaurants.

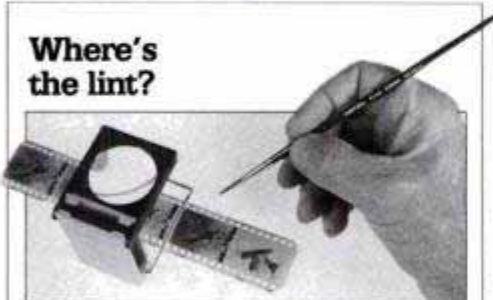
A West Coast import

Not surprisingly, this appealing foolishness first got its start on the West Coast, where zany crazes are taken for granted. In 1969, Hobart Brown, a metal sculptor in Ferndale, Calif., created a weird-looking, five-wheeled cycle for his son. Friends and neighbors, intrigued by its looniness, rushed out to concoct their own equally outrageous contraptions. A competition was soon held and proved so popular it became a yearly event.

In 1980, the kinetic craziness found its way to Boulder and there it's been ever since. Everyone agrees it's silly, but nobody cares. They're having too much fun.

PM PHOTO HINTS

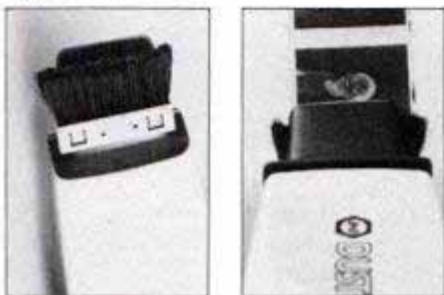
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— Kenn Oberrecht

Speck-buster



Here's another way to clean lint and dust. The accessory snoot for the Dust-buster vacuum is fitted easily with a Staticmaster film brush. Cut the handle off the Staticmaster, and secure the brush with pop rivets.—William J. Frazier

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FIRSTHAND REPORT



Supercharged Volvo 760 is part of Comprex's million-mile test fleet.

PM DRIVES THE Comprex Diesels

Here's one more way to turn up the pressure on tomorrow's diesels.

BY JAN P. NORBYE

Turbocharging is great. For passenger-car gasoline engines, it currently has no equal. But for diesels, from now on the turbo will have to face competition from the pressure-wave supercharger, judging by the Comprex-supercharged Volvo 760 we drove recently in Europe.

The turbocharged Volvo six-cylinder diesel is highly civilized as diesels go. But the Comprex-boosted version is something else. At one point in our test drive, we found ourselves at the bottom of a steep grade, the engine turning a mere 1,100 rpm in fifth gear. Without downshifting, we floored the accelerator, and the car instantly began to gain speed. The Volvo could take hairpin turns at 15 mph in third gear just by flooring it and letting the supercharger pull us on through.

Was this really a diesel car? Yes. Just stop and let it idle. The typical diesel clatter lets you know immediately. But under way, the additional power underfoot makes the car an entirely different driving experience.

Though the Comprex device is belt-driven by the engine, you'd be mistaken to consider it a positive displacement supercharger. And despite the fact that it uses exhaust gas energy to pressurize the intake charge, you can't accurately call it a turbocharger, either.

The trade name Comprex is a combination of the words *compression* and *expansion*, chosen by the Swiss firm of Brown, Boveri & Co. (BBC). The Comprex principle was tested on gas turbine engines as far back as World War II. Every major carmaker in Europe is testing the Comprex, though Opel has the only one already on the market.

BBC proposes its pressure-wave superchargers for diesel engines only, although

Ferrari used Comprex compressors on its Formula One racers a few years ago. BBC says Comprex is not suitable for spark-ignition engines because they are throttled and run with a constant air/fuel ratio. The diesel runs without throttling of the intake air supply.



Installation of Comprex system is bulky, requiring a drive belt, intercooler and hookups to intake and exhaust manifolds.

What advantages does the Comprex have over the turbo? Start with instant response to the accelerator, higher torque at low rpm and the potential to regear the car for higher road speeds at any given engine rpm.

But can the Comprex do the same job as turbocharging in terms of specific power output? Absolutely. On Opel's 2.3-liter Four, which delivers 65 hp at 4,800 rpm in normally aspirated trim, the Comprex boosts output to 95 hp, at a reduced 4,200 rpm. Torque jumps from 84 lb.-ft. to 143.

In emissions tests, a Comprex-equipped 2.3-liter Opel engine easily met all 1985 federal emissions standards except for particulate levels, a

problem that could be solved with new-design particulate traps.

Neutralizing complaints

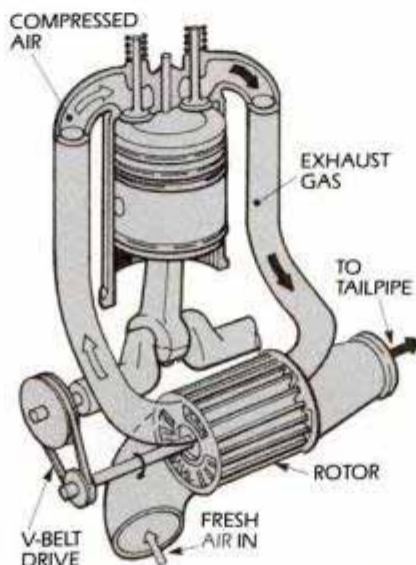
Drawbacks most frequently cited for the Comprex are high cost, bulky installation package, increased weight and excessive noise. BBC has worked to neutralize those complaints. The Comprex comes within 2 percent of matching the cost of a turbo installation and, in smaller engine applications, weighs within a half-pound of a turbo. In the vehicles we drove, the Comprex had been fitted without making power bulges in the hoods or stealing interior space. And we can report no objectionable noise levels. **PM**

How It Works

Think of it as an aerodynamic compressor. Instead of vanes or pistons, gases do all the work. The core of the Comprex pressure-wave supercharger is a cylindrical rotor, whose shaft is belt-driven from the engine crankshaft at four to five times the engine speed. The power drain is 1/2 hp at full speed.

One side of the rotor housing has ports to the fresh-air intake and intake manifold. On the other side, there are ports to the exhaust manifold and tailpipe. Straight, open-ended channels running through the rotor serve as gas passages where the fresh air, at atmospheric pressure, faces the exhaust gases, still pressurized by their expulsion from the cylinders. Pressure waves are formed when the exhaust gas bumps into the intake air.

Formation of the pressure wave, which does all the work, is due strictly to the porting on the rotor housing. Along with the rotor rotation, the porting deter-



Belt-driven Comprex connects to exhaust, but pressure waves do the actual pumping.

mines the flow of exhaust gas and fresh air into and out of each channel. Thus, the process that occurs in the channels is simply a transfer of pressure from the exhaust gas to the fresh air. Unfortunately, this also has the effect of heating up the air, making intercooling almost a necessity.

Unlike a turbocharger, the Comprex supplies a high charge-air pressure even at low engine speeds. Since the energy exchange occurs at the speed of sound, the throttle response doesn't lag like turbochargers, either.

The Comprex provides a boost pressure range of 10.3 to 14.7 psi. Boost pressure is regulated by a wastegate. The Comprex also needs a cold-starting valve to bypass the blower until the engine is running under its own power.



Channels in rotor (front) align with ports in exhaust and fresh-air housings (rear).

mines the flow of exhaust gas and fresh air into and out of each channel.

Using exhaust gas to compress fresh air is possible without any mechanical means of separation, because when two fluids of unequal pressure meet, the first thing that occurs is an equalization

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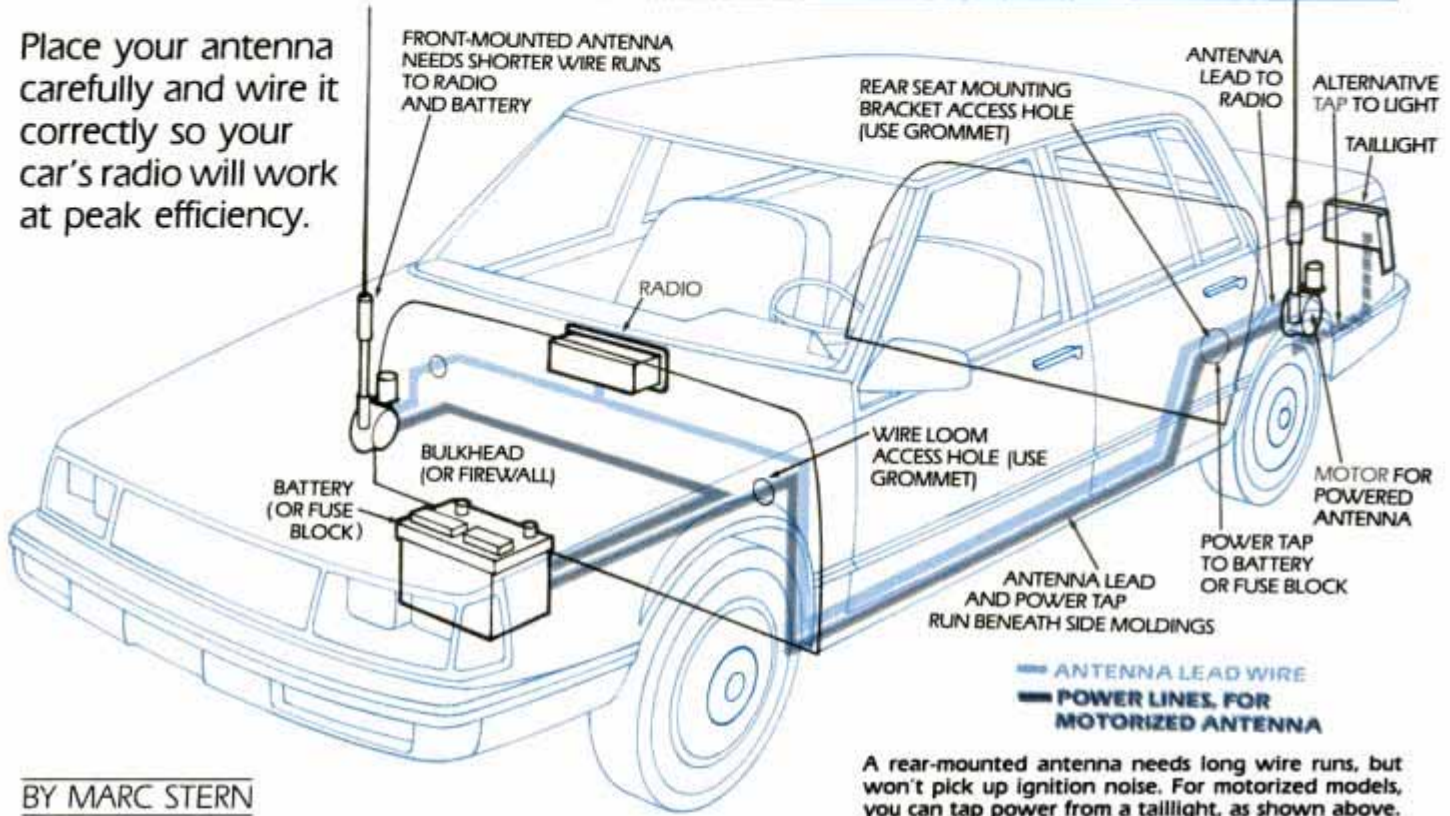
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HOW TO INSTALL YOUR OWN Car Antenna

Place your antenna carefully and wire it correctly so your car's radio will work at peak efficiency.



BY MARC STERN

Garbage in, garbage out. That axiom of computer programming applies equally well to car radios.

No matter how expensive your car's tuner is, the sound it puts out can't be any cleaner than the signal it receives from the airwaves. To deliver the clearest possible signal to your tuner, you need a properly installed antenna, one that's at least 31 inches tall. After reading the instructions that come with the antenna you choose, line up the proper tools: a hole punch or keyhole bit for your electric drill; wire ties; a snake to pull the antenna cable through the bulkhead into the passenger compartment; slip-joint pliers and flat-bladed and Phillips screwdrivers. A good crimp tool and connectors, file, and soldering iron and solder should also be on hand.

Before you get to work, think carefully about the antenna's location. Ideally, it should be dead center on the roof for best reception. But since this often is impractical, your next best choice is one of the fenders. If you intend to install a motorized antenna, you'll have to find a spot with enough room for the

antenna/drive-motor assembly. This assembly also includes a tube through which the antenna travels up and down. In today's smaller cars, the most likely location is the trunk because there's usually not enough clearance in the front fender panels.

On the rear fender

A rear mounting location means you'll have to snake the antenna cable through the car to the radio. Whether you install a motorized antenna or not, rear-fender mounting might prove worth the extra work. You'll be placing the antenna away from ignition wires, electric motors and computer modules that could add noise to the radio signals.

Once you've selected an antenna location, take the appropriately sized punch or keyhole bit and make the hole for the antenna base. Be sure to deburr the edges so it is smooth.

If you are using a nonpowered antenna, mount the weather-sealing grommet or shield first. Feed in the coaxial cable, and insert the antenna's threaded base. If you are mounting a powered

unit, you will have to set up the antenna/drive motor and brackets first.

If the antenna is nonpowered, you'll have to get inside the fender or trunk and install a lockwasher first and then a large hexnut. A powered unit will have the same lockwasher, but it will be mounted externally. In this case, a trim nut will be used instead of a hexnut.

To this point, the installation has been fairly easy, but now it becomes more complicated because you must run the coaxial cable to the rear of the car's radio.

If you have chosen a front fender panel, the job isn't very difficult because you are dealing with a short run of cable to the radio. Simply route the cable from the antenna to the bulkhead and find an access hole to the passenger compartment. One of the holes through which the major wire bundles go should do nicely. The most difficult problem probably will be getting the cable through the hole, because most of it will be taken up by the wire bundle. Use the snake to get the cable into the passenger compartment. Once the cable is

inside, simply run it to the rear of the radio and insert the antenna connector.

In routing the cable through the engine compartment, keep it as far away as possible from interference sources—electric motors, ignition wires or computer modules. This will minimize stray noise pickup. So will the use of a good double-shielded cable. Be sure that any bends in the cables are smooth. Sharp bends will decrease system efficiency. Secure the cable with wire ties wherever possible to keep it from flopping around and possibly chafing.

Rear mounting poses a different set of problems. For this, you'll need the snake to get the cable into the passenger compartment through the access holes in the rear-seat mounting bracket. Be sure to use a grommet in the access hole to keep the cable from chafing. Inside the car, the easiest route to the radio is along the base of the door line. Loosen the moldings and run the cable underneath. Try to keep the run as straight as possible.

Power for the antenna

If you are installing a powered antenna in the trunk area, you'll need to locate a power source. Solving the power connection to a front fender-mounted electric antenna is simply a matter of routing power cables from the battery. One possibility for a rear mount is taking a tap off the electrical lines feeding the rear lights. You should use a heavy-gauge wire, 16 or 14, for the power feed.

If you can't use this method, you'll have to run cables directly from the battery or fuse block. To do this, attach color-coded wires to the positive and negative terminals of the battery. Run them through the bulkhead, then through the passenger compartment, under the appropriate moldings and out through the rear seat area. You can also use the fuse block for power. This will shorten the length of cable while eliminating the necessity of taking power from the battery.

Wiring the unit

With a powered antenna, the most important consideration is wiring up the unit properly. If you use color coding, you simply have to hook the red wire to the positive terminals on the battery and antenna motor. The black wire will connect the negative terminals at each end.

When you've finished installing the antenna, be sure to tune your radio to the antenna. You'll find the tuning information in your radio's manual, but simply, it involves tuning the radio to a weak AM station, then adjusting a trimmer capacitor to the point where the signal comes in the loudest. That's all there is to it. **PM**

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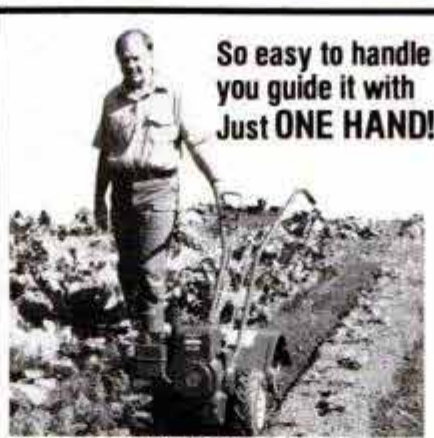
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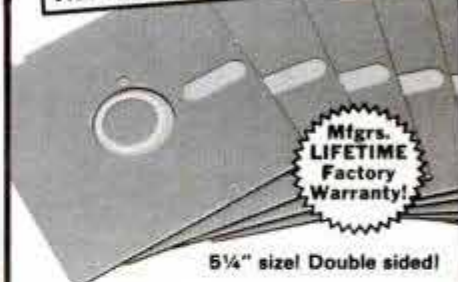
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NEW INDY ENGINES

FROM DRIVEWAY TO SPEEDWAY

Buick, Chevrolet, Renault and Porsche are all headed for The Brickyard. Can the Japanese be far behind?

BY STEVE POTTER

At the Indy 500 this year there's one thing you can pretty much count on: The race will be won by a turbo-charged Ford-Cosworth DFX engine. The British-built racing engine, winner of the past seven Indy 500s, is a development of the normally-aspirated Cosworth DFV that dominated Formula One racing from 1967 through '82.

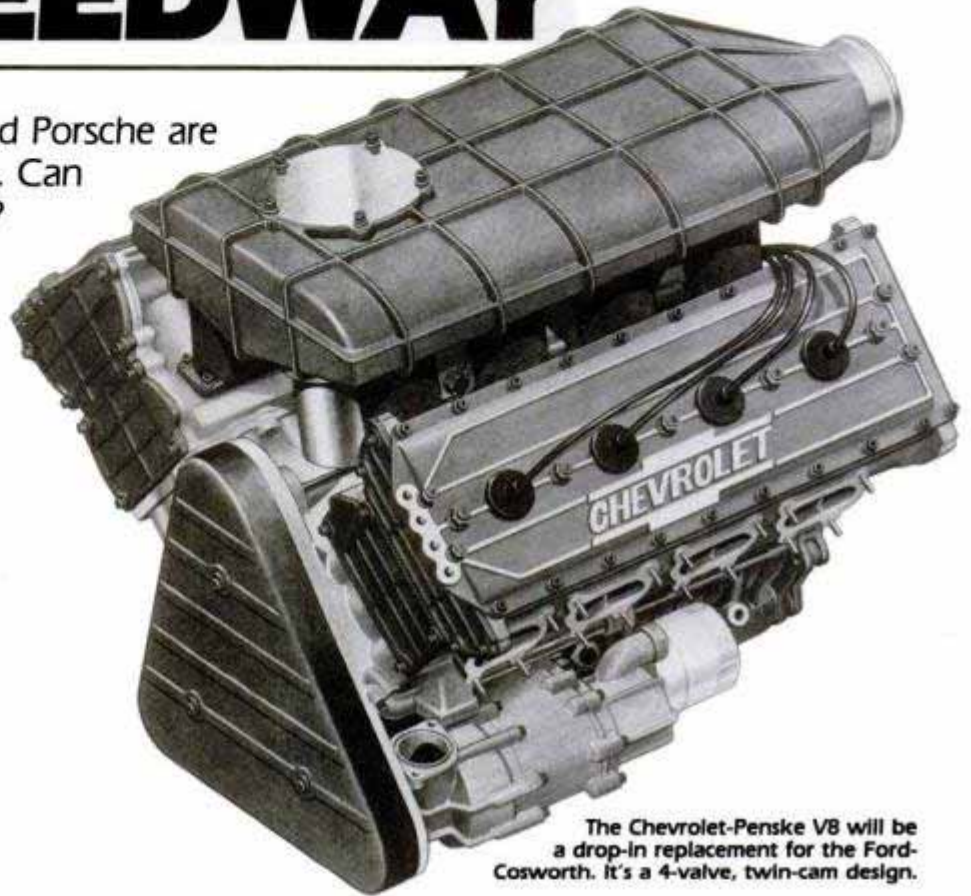
But after this year, all engine bets are off at Indy. Buick and Chevrolet have stock-block V6 turbo efforts that have already powered racing cars, and the big news at last fall's giant Specialty Equipment Manufacturers Assn. show in Las Vegas was that Chevrolet would sponsor the development of a new "pure" racing engine for the 1986 Indy car racing season.

Other major manufacturers have publicly stated their interest in America's most important race, and privately even more carmakers admit they are taking a hard look at Indy.

Why car makers race

The Cosworth Formula One engine, whose development was sponsored in the mid-1960s by seed money from Ford, was eventually made obsolete by newer powerplants designed by Renault, BMW, Ferrari/Fiat, Honda and Porsche. The same factors that enticed major automobile manufacturers into Formula One—enormous public visibility and the hope of enhancing their engineering reputations—is drawing American, European and perhaps even Japanese carmakers toward Indy.

Manufacturers have always found the Indy 500 a good way to polish their company's reputations. In the 1930s, Ford commissioned the construction of a dozen flathead V8-powered, front-wheel-drive Indy cars by Harry Miller, that generation's American race engineering genius. Despite a massive effort, the cars didn't win. But they did



The Chevrolet-Penske V8 will be a drop-in replacement for the Ford-Cosworth. It's a 4-valve, twin-cam design.

put Ford's name in the spotlight, and helped establish a reputation for the company as the premier domestic supplier of hot rod technology.

As late as 1952, when one of its entries was the fastest qualifier for the 500, the Cummins Diesel company installed modified versions of its truck engines in a variety of racing chassis. That pole winner a third of a century ago marked the first use in automotive competition of the turbocharger.

In the same year, Ferrari sent a larger engined version of its World Championship grand prix winner to Indy. The effort failed when one of the car's wire wheels collapsed.

In the mid-'50s, Chrysler explored the possibility of an Indy car with a modified version of its production-line Hemi engine. Chrysler engineers went so far as to install an engine in a Kurtis Indy roadster chassis for "tire tests." The hybrid went fast enough to scare the Indy sanctioning body into rewriting the rules, eliminating the displacement advantage that overhead-valve

rocker arm engines enjoyed over the Meyer-Drake Offy four cylinder—a traditional racing engine with overhead cams and four valves per cylinder.

Stock-block handicap

That was a handicap Mickey Thompson faced when he brought a Buick-powered mid-engine car to Indy in 1962. On its return to Indy the following year with Colin Chapman's Lotus team, Ford tried to solve the problem of less horsepower by making fewer pit stops. The strategy didn't work, and for 1964 Ford's engineers whipped up an overhead-cam, four-valve conversion for their production-based V8.

Since then, the rulemakers have tried to encourage stock-block participation at Indianapolis by reviving the displacement advantage they'd formerly enjoyed over pure racing engines.

Production-based engines have been able to make the starting field, but except on road courses where mid-range torque is important for acceleration off the corners, the normally-aspi-

rated rocker arm engines haven't enjoyed much success.

So far the turbocharged stock blocks haven't done much better, despite a 209 to 161-cu.-in. displacement advantage over blown racing engines. Ten years ago, when turbocharger boost wasn't limited by the rules, Jerry Grant drove the most powerful car ever to appear in Indy car racing, a turbocharged American Motors V8-powered Eagle. The engine was overweight, so the car didn't corner well. But with 1,100 hp, the old Eagle simply flew down the straights.

V6 contenders

Since then, both Chevrolet and Buick have tried to develop the racing potential of their small-block V6s.

West Coast engine whiz Ryan Falconer started his development program on the Chevy V6—with financial support from Chevrolet Engineering—in 1980, just as the political battle for control of Indy car racing between the United States Auto Club and Championship Auto Racing Teams was at its height. These days CART runs the PPG Indy Car World Series, and controls all the races—except Indianapolis, where USAC is the Speedway's captive sanctioning body.

USAC has tried to encourage the participation of major car companies while CART, whose members are mostly budget-conscious car owners, hasn't been eager to see new technical developments that might make its members' current engines obsolete. At Indy, in addition to their displacement advantage, overhead-valve engines have an 18-percent boost advantage over pure racing engines. Even after five years of development, the Chevy and Buick V6s need the boost advantage to match the peak 750 hp of a Cosworth DFX. Some teams claim that the V6s are now peaking at 810 to 830 hp in Indy trim,

but so far they haven't been able to do so for a full 500 miles.

Chevy's 4-cam V8

Chevy's involvement with the pure racing engine that will bear its name is mostly financial. Roger Penske put the deal together, and the engine will be developed by a new company in England—Ilmor Engineering—owned by Penske and former Cosworth engineers, Paul Morgan and Mario Ilien.

The Ilmor Chevy will, like the Cosworth, be a 90° V8 with a typical racing engine's 4-valve cylinder head configuration. It won't see competition until 1986.

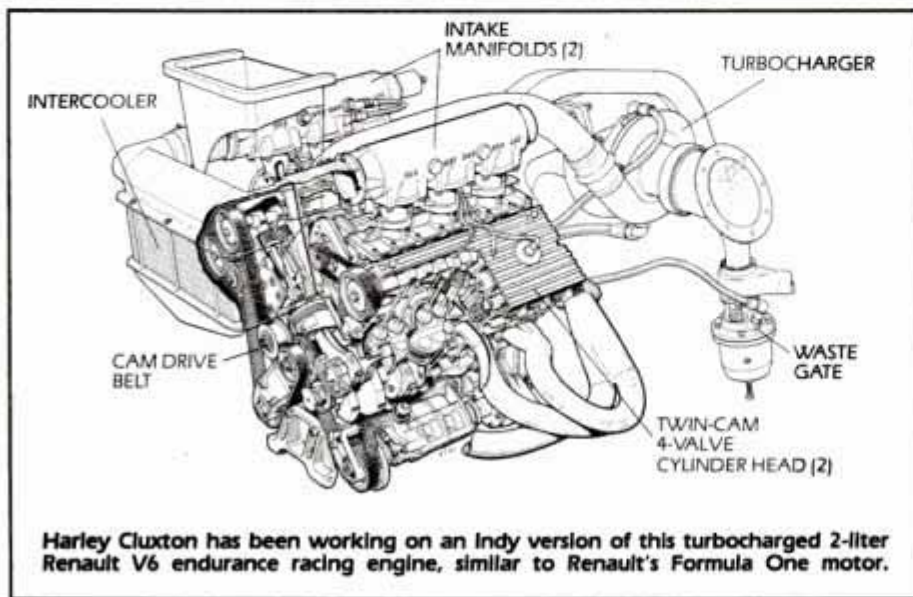
Buick has given a stronger commitment to its Indy V6, and in practice last year Pat Bedard achieved some fast laps in a Buick-powered March before crashing. Over the past winter, Buick feels it has made so much progress with the engine that it will be able to compete on even terms with the Cosworth, even under CART rules. Look for several teams to run the Buick this year, while A.J. Foyt may run the Chevy V6 in a second car.

Imported powerplants

Foreign manufacturers also see the publicity value of participating at Indy. Five years ago, Porsche was poised to enter the fray. The German manufacturer went so far as to unveil an Indy car chassis fitted with a 2.65-liter version of its venerable flat Six, equipped with water-cooled four-valve cylinder heads. But that was in the middle of the CART/USAC war, and political machinations led to last-minute rules changes and the abortion of the Porsche project.

Recently Al Holbert, Porsche's new North American racing boss, admitted that the German company is again keen on Indy. The fact that Porsche sells half of its cars in America, and has a new

(Please turn to page 228)



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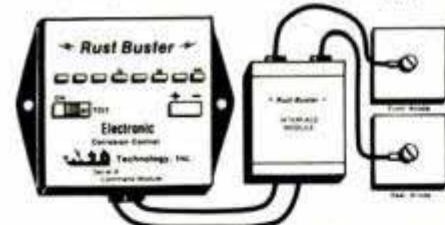
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DRIVEWAY TO SPEEDWAY

(Continued from page 227)

American president, may have tipped the scales.

Renault also admits to an interest in Indy, but officials of the French company say there won't be a Renault at Indy until the yellow, white and black cars have won the Formula One world championship. For the time being, American Harley Cluxton is working on a backburner project to adapt for Indy the Renault turbo V6 engines he ran in his Mirage endurance racing cars at Le Mans in the late '70s.

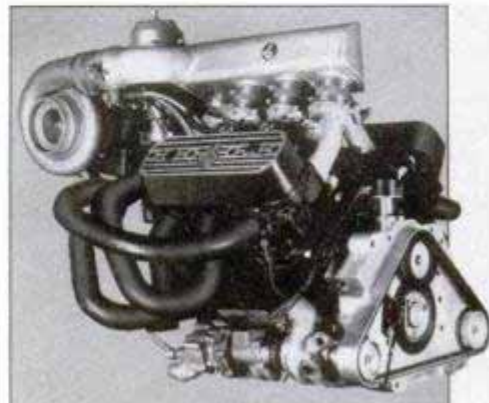
Enzo Ferrari recently told a visiting American journalist that he was interested in racing at Indy, but he gave no timetable or other details.

The Callaway HH V8, discussed in PM (*Is This The Next Great Indy Engine?*, page 184, May '84) a year ago is no closer to being fitted to a race car than it was then. The problem is money.

Callaway, who makes some of the best aftermarket turbocharger and hop-up kits available, has been unable to find the kind of sponsorship needed to complete final development of his dyno-tested racing engine.

And then there are the Japanese. There have been published rumors that Toyota is quietly preparing an Indy engine. But Dan Gurney races Indy cars and serves as Toyota's main racing man in North America. Gurney's engine man, John Caldwell, who is preparing a turbocharged four-cylinder Toyota for road racing, says he doesn't know anything about a Toyota Indy engine.

Still, Toyota has the capability to produce such an engine, as do Honda and Nissan. American Don Devendorf, a longtime Datsun racer, recently won a contract from Nissan to develop the company's V6 turbo for worldwide racing applications. The first will be a prototype road racer for the North American Camel GT series. But much of the basic technology could be applied to Indy. Perhaps Indy will be the site where the best of America, Europe and Japan will meet. **PM**



Buick's stock-block V6 is reportedly producing over 800 hp thanks to liberal Indy rules.

BE A **TIMESAVER**

Appreciate your fine clocks more by learning to repair and maintain them yourself.

BY KEVIN K. JONES

We all have clocks in our homes, from the ornate grandfather, to the mantle clock over the fireplace and the everyday kitchen clock. They usually work so well, we really don't think about maintaining them until they begin to malfunction.

Most repairs and clock maintenance can be done by anyone with reasonably good hand skills and a few tools. For the repairs and maintenance covered here, you'll need the following tools: straight blade and Phillips screwdrivers; set of jeweler's screwdrivers; regular and needlenose pliers; tweezers; clock oiler (see your clock dealer or supply house); pencil and paper.

To give yourself the best chance for success, set aside enough *undistracted* time to do the job right. Prepare a clean, well-lighted workplace with plenty of elbow room. Make the most accurate sketches you can of parts location and put all small parts aside where they won't be knocked onto the floor.

Grandfather clock

Grandfather clocks are extremely popular for their handsome appearance and resonant tones. To work on them, you'll have to remove the movement:

1. Remove the pendulum and weights with a paper towel to prevent leaving fingerprints.

2. Remove the hands by unscrewing the nut or pulling out the holding pin. Watch for a small washer. Pull off the hands with your fingers.

3. Move the clock so you can take off the back—either by sliding clips to the side or by removing screws (see photo of clock with back removed).

4. Remove the chime rod assembly.

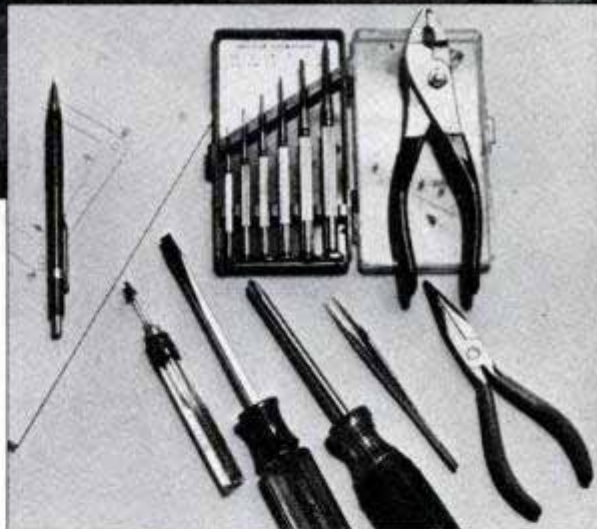
5. Remove the two long knurled bolts holding the movement to the base, and the four steel pins positioning the movement to the dial.

6. Pull the movement out of the case carefully, lifting the chains out, too.

Lubrication—The basic principles of lubricating a grandfather clock movement are the same as for all other



Hour hand should turn smoothly without rubbing the dial. Repair tools (inset) are from top left; pen and paper, set of jeweler's screwdrivers, pliers; bottom left, clock oiler, straight blade and Phillips screwdrivers, tweezers and needle-nose pliers. A small level also helps hang clocks straight.



clocks. Any variations for other clocks will be covered later.

Clock oils have been made for hundreds of years. Lately, synthetic oils are becoming more popular than mineral-based types. Chemically, clock oils differ from motor or sewing machine oil in that clock oil must be cohesive (stick to itself), and not flow away from the bushing and pivot. Motor oil must flow everywhere, to lubricate everything. Never lubricate any clock with sewing machine oil, silicone spray or lubricant not meant for a clock, and don't over-oil the parts. If a clock oiler was not supplied with your clock, you can get

one at a furniture store or from a clock parts supplier.

In all clocks, the shaft pivots that carry gears must be oiled. Two drops are sufficient. Other parts and their lubrication points are: four escape-wheel teeth (one drop), hammer pivots (two drops), rubbing surfaces on crutch (one drop), weight pulley shafts (two drops), and main (largest) wheel shaft (two drops).

Never oil: gravity or spring-driven lever pivots; chains or cables; gear or pinion teeth; the floating balance (on mantle and wall clocks).

(Please turn to page 230)

BE A TIMESAVER

(Continued from page 229)

You'll notice that some pivots are obscured by levers or other gears. These hard to reach points can be oiled from between the plates.

After lubricating the movement, replace it in the reverse order you removed it. Be sure to pass the chains or cables through the slot in the support base. Then replace the chime rod assembly and back.

Adjusting the chimes—In grandfather clocks, there are usually two rows of hammers and chime rods. In the example shown, the left side is for chiming on the quarter hour, and the right side strikes the hour. The most common ailments are: chimes playing the quarter-after melody when it's actually quarter to the hour; the strike sounding at the wrong time; and the

chimes either sounding buzzy or not sounding at all.

Most modern grandfather clocks have a mechanism that self-corrects quarter-hour chimes. To orient the hands on such clocks, place the chime and strike weights on their appropriate hooks, and put the minute hand on its arbor. Turn the hand slowly until the clock chimes, continuing until it strikes the hour, counting the number of times it strikes. Now, remove the minute hand and push the hour hand on the arbor (without rubbing the dial) so it points to the correct hour. Replace the minute hand so it points to 12, and fingertighten the knurled nut to hold the hands in place.

On clocks with no self-correction mechanism, stop the clock, note at which quarter-hour the hand should point according to the chimes, remove the nut or pin and reposition the hand to

the correct quarter hour. Then wait until the appropriate time of day, and restart the clock.

If the hour strike is off, stop the clock, move the hour hand to the hour it strikes and again restart the clock when time catches up.

Chime buzzing or missing also are an easy fix. Grip the bottom of the hammer rod with needlenose pliers and bend the rod with your fingers so the hammer striking surface is no more than $\frac{1}{8}$ in. away from the chime rod. You can use the same procedure to put the hammer in line vertically with the chime rod. This procedure is used for all clocks discussed in this article with chime rods, gongs or bells.

Setting the clock in beat—When the clock is in beat, the movement is providing an equal impulse to the pendulum on every tick. This keeps the clock

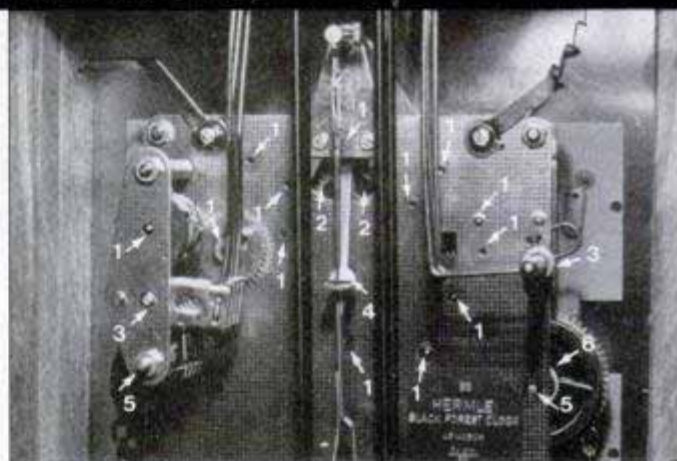
(Please turn to page 232)

GRANDFATHER CLOCK



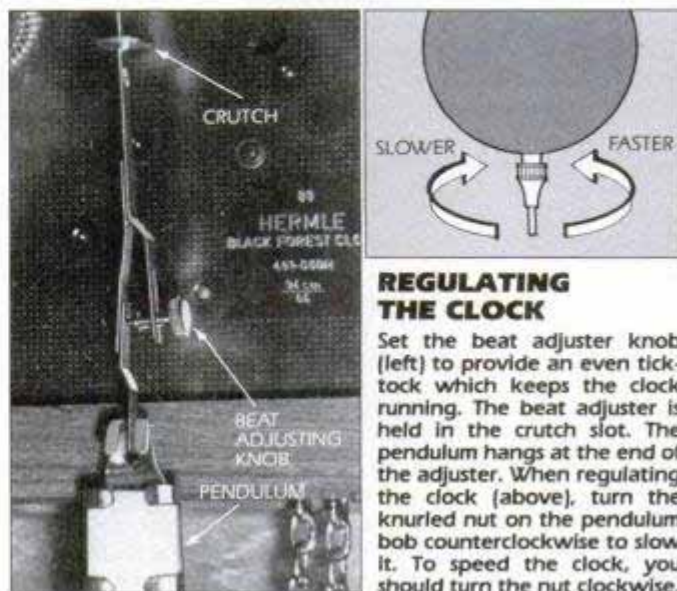
REMOVING THE MOVEMENT

After you remove the pendulum, weights and clock hands, take off the back as shown so the movement can be removed. Next, unscrew the chime rod assembly. Then, unfasten the two movement bolts and four dial pins. Last, take out the movement. Chime rods and hammers on left play the Westminster chime tune.



LUBRICATING THE PARTS

The lubrication points are shown above: 1) gear shaft pivots; 2) four escape-wheel teeth; 3) hammer pivots; 4) rubbing surfaces on crutch; 5) weight pulley shafts; 6) main (largest) wheel shaft. After many years, a professional may have to repair worn pivots and bushings. Yearly oiling keeps clock in shape.



REGULATING THE CLOCK

Set the beat adjuster knob (left) to provide an even tick-tock which keeps the clock running. The beat adjuster is held in the crutch slot. The pendulum hangs at the end of the adjuster. When regulating the clock (above), turn the knurled nut on the pendulum bob counterclockwise to slow it. To speed the clock, you should turn the nut clockwise.

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BE A TIMESAVER

(Continued from page 230)

running, and as efficiently as possible. Remove the weights, turn the clock around near its final resting spot and leave room to get your hand into the back of the case.

To set the beat, first place the middle, or time-keeping, weight on its hook, and use a small level to make sure the clock is level on the floor, horizontally and vertically. If it's not, simply adjust the feet or shim under the case corners.

Most modern grandfather clocks have a beat adjuster thumbscrew as shown in the photo. On older clocks, the crutch slips on its shaft, allowing you to perform the same function.

Attach the pendulum and tap it sideways to start the clock. If it is in beat the ticks and tocks will be evenly spaced. If it is out of beat, and your clock has a beat adjuster, simply turn the thumbscrew one way or the other until the clock is in beat.

Most older clocks don't have a beat adjuster. You have to use your finger to move the crutch. As you listen to the ticks and tocks, imagine a line vertically through the center of the case. Notice on which side each sound falls. Then, gently move the crutch in small amounts until the ticks and tocks are of equal duration. Finally, remove the pendulum and weight, replace the back of the case, and move the clock to its permanent home and level it. Replace all weights and the pendulum, and set it so it runs.

Regulating the clock—To slow the clock, turn the knurled nut on the bottom of the pendulum bob counterclock-

wise. This lengthens the pendulum. To speed the clock, turn the nut clockwise, shortening the pendulum.

Mantle and wall clocks

Although smaller, many mantle and wall clocks have the same type of movements as grandfather clocks. While most are spring-driven instead of weight-driven, the repair and maintenance procedures for these types of clocks are essentially the same.

To remove the movement:

1. Remove the weights or wind the mainspring until it clears the case with room to spare.
2. Remove the hand nut or holding pin, and pull off the hands.
3. Remove the pendulum.
4. Lay down the case and remove the back. Then, remove the screws holding the movement to the case.
5. Lift the movement out of the case (remove the chime rods or spiral gong only if necessary in order to get at the movement).

Lubrication—Oil the movement according to the instructions for grandfather clocks. The one exception is the floating balance escapement part which controls the speed and regularity of a clock. This shouldn't be oiled. Its maintenance is covered further in the *Regulating the clock* section. After lubricating, return the movement to the case and replace the hands and back. To adjust the chimes, again, follow the instructions for grandfather clocks.

Setting the clock in beat—Mantle and wall clocks with pendulums don't have beat adjusters. But setting the clock in beat is the same, in many respects, as with grandfather clocks. Read through

those instructions. Then, place the clock on the mantle or wall and make sure it is level. Attach the pendulum and start the clock.

If the clock is out of beat, put your fingers into the back and gently bend the crutch until you hear an even tick-tock. If your clock has a floating balance, the beat was set at the factory. This type of escapement is less sensitive to being out-of-level than the pendulum-type clocks.

Regulating the clock—As with all pendulums, turn the nut on the bottom counterclockwise to slow it, and clockwise to speed it. Many mantle clocks have a small arbor located at the 12 on the dial, with an S (slower) and an F (faster) on either side. Using the small end of your winding key, turn the arbor as needed.

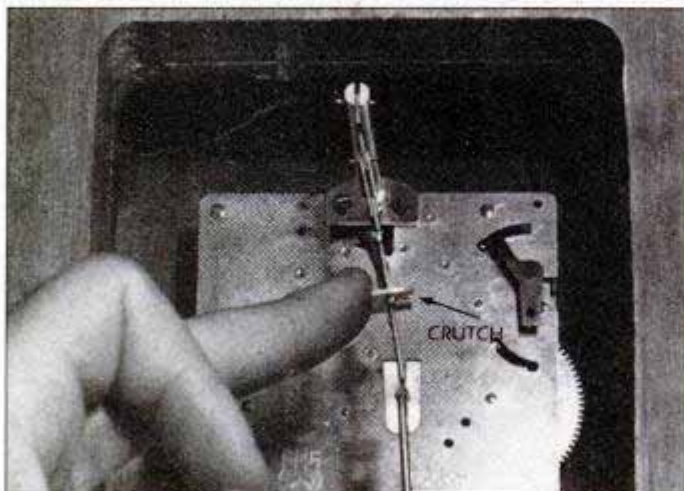
Many modern clocks have a floating balance escapement. A coiled spring on the top of the balance wheel keeps it floating, so that the only friction is on the small-diameter, tightly drawn wire that goes through the balance shaft and jewels.

To regulate this type of escapement, gently place your finger under the balance and hold it still. Then, use your tweezers to move the adjusting tab toward the "+" mark to speed the clock, or toward "-" to slow it.

Electric clocks

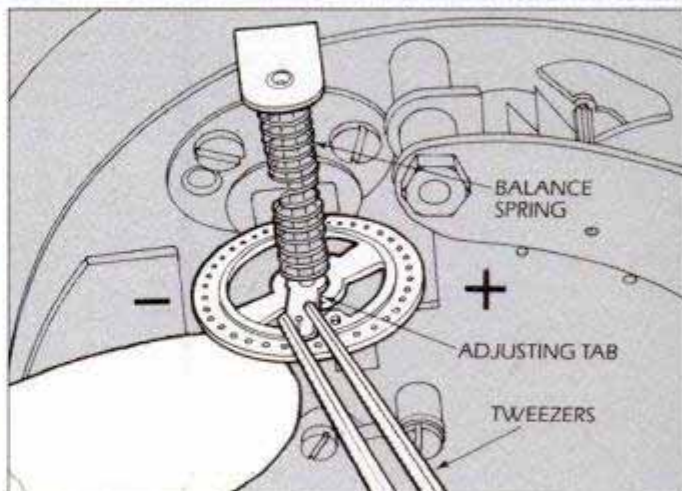
These clocks are all around us—in stoves, alarm clocks and kitchen clocks. They are not made or priced to be repaired, but here are some checks you can make on a malfunctioning clock to see if a simple adjustment might be all that is required.

WALL AND MANTLE CLOCKS



SETTING THE CLOCK IN BEAT

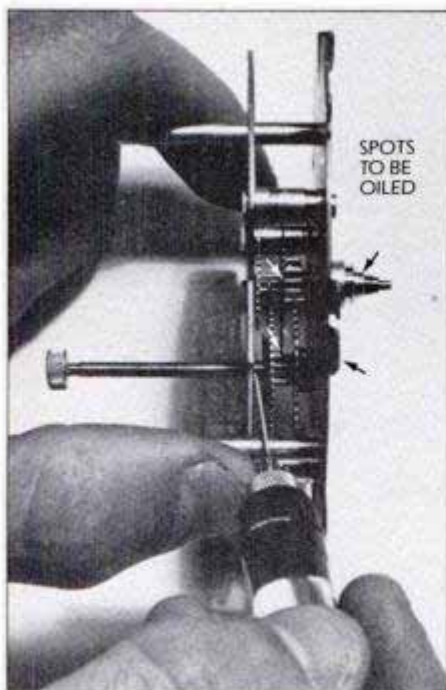
When working with wall or mantle clocks without beat adjusters, bend the crutch as shown to get the clock in beat. Hold the clock upright and level when you make this adjustment. Gently bend the crutch until you hear an even tick-tock. If your clock has a floating balance, the beat was set at the factory.



REGULATING THE CLOCK

A floating balance escapement (part which controls speed and regularity of a clock) doesn't utilize a pendulum. The movement often is spring-driven so it can be put in a small case. To regulate, gently put your finger under the balance to still it. Then use tweezers to move the adjusting tab to + or -.

ELECTRIC CLOCK

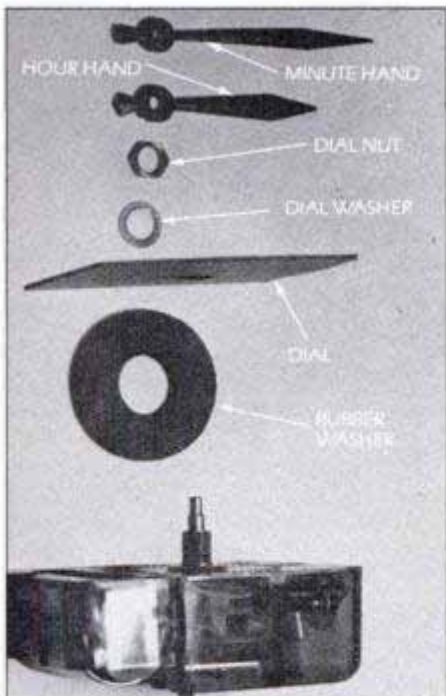


SPOTS
TO BE
OILED

LUBRICATING THE GEARS

If the motor is riveted to the movement of an electric clock, you must lubricate the gear pivots through the plates (arrows). This movement, from an ordinary kitchen clock, has all-metal gears. Many such clocks have plastic or fiber composition gears that wear out much sooner than do metal gears.

BATTERY CLOCK



REMOVING THE MOVEMENT

As you disassemble your battery-powered clock, lay out the parts in the order that they're removed. The large rubber washer not only separates the dial and the movement, it also damps the sound produced. Replacement movements are available with or without a second hand.

With the clock unplugged, inspect the wiring to make certain that a wire didn't break or burn through. If there is a damaged wire, splice the bad spot and wrap it with electrician's tape.

If the clock makes a grinding noise, chances are good that the gear teeth are badly worn, and the entire movement must be replaced. If, however, you would like to try oiling the gear train, here's how:

Remove the movement by popping off the plastic cover. Pull off the hands, then remove the screws that fasten the movement to the case. The motor, a sealed unit, is either held to the movement by screws or by rivets. If the motor is held by screws, remove them and oil the gear pivots as described earlier. If the motor is riveted to the movement, oil the pivots through the plates. Reattach the motor if necessary and return the movement to the case in the reverse order of procedures you used to take it out.

Battery clocks

Commercial battery-powered clocks are extremely low in price and just not worth repairing. In fact, these types of clocks are made to be discarded when they break down.

Battery-powered clock movements are extremely popular, however, because of their versatility. They can be used in any number of decorative cases and often are included in clock kits. If a battery-powered clock breaks down, you may want to replace the movement. Be sure to check the battery first.

If it's not the battery, here's the proper procedure:

Removal and replacement—To take out the movement, remove the cover and pull the hands off with your fingernails. Next, remove the nut and washers holding the movement to the dial.

To get a new movement, take the worn-out unit and hands to a hobby shop, or order one from a mail order source. When ordering, be sure to get a movement and hands the same size as the originals. All of the other hardware will be supplied.

Install the new movement in the reverse order that you removed the old one, add a fresh battery and the clock should work.

Adjusting the chimes. Some battery-powered clocks have chimes just like those in mechanical clocks. The procedure for adjusting the chimes on these clocks is the same as for mantle, wall and grandfather clocks.

Regulating the clock—Battery movements are regulated at the factory. However, an adjustment is provided on the back of the movement. Simply use a small screwdriver that fits the slot, and turn to "+" to speed up and to "-" to slow down the clock movement. **PM**

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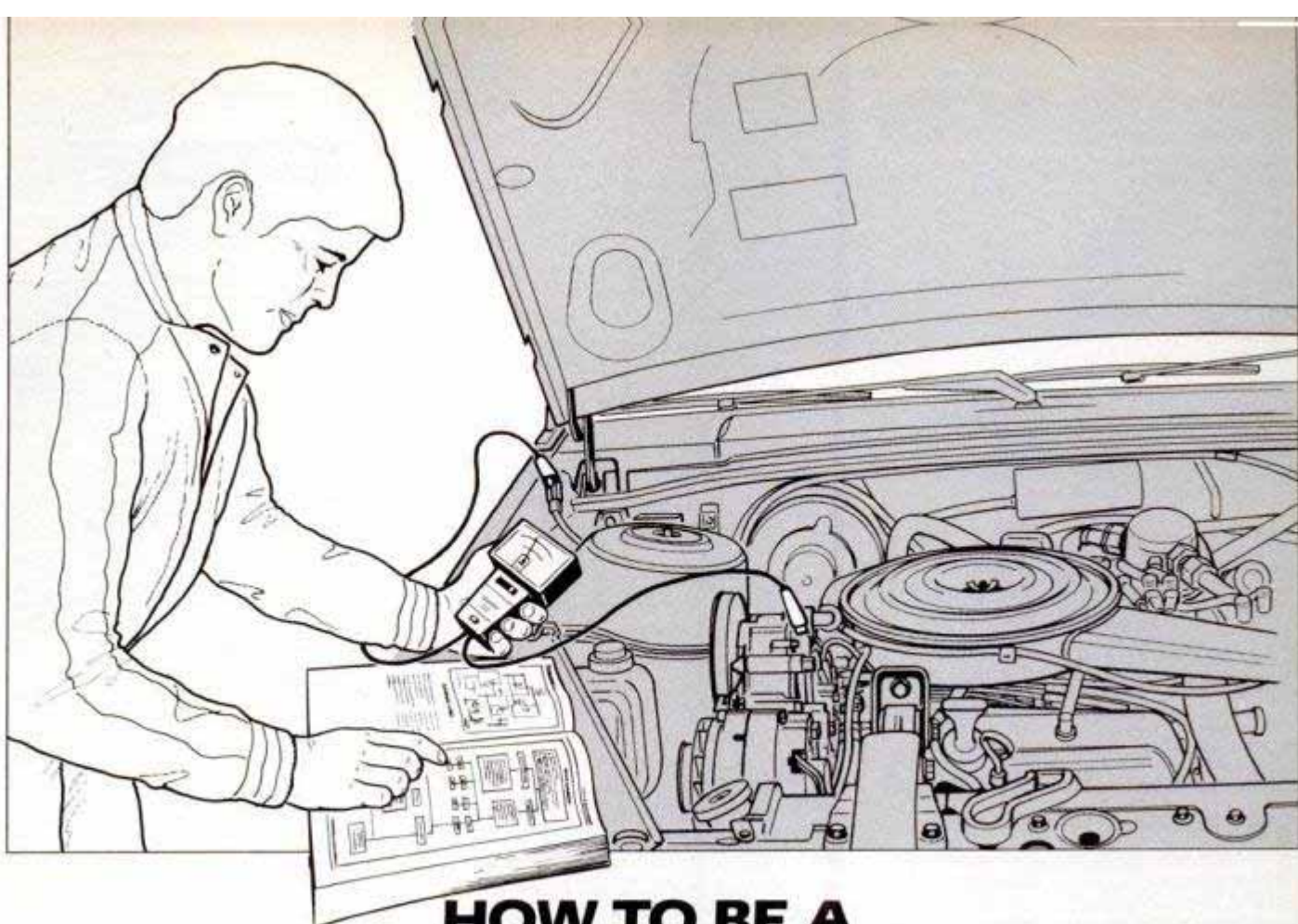


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HOW TO BE A BETTER MECHANIC THAN A PRO

You can do many jobs as well as a professional auto mechanic, maybe better, and the more complex the car the more this may be true. "Aw, you're kidding," you say. Well, we're not matching you up against those mechanics who have given up lunch hours, evenings and weekends to learn all the changes in the new cars. We're talking about the other mechanics.

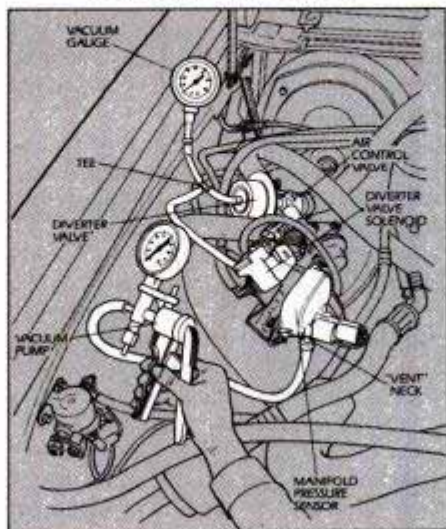
Sure, the independent professional auto mechanic can do all the routine stuff, but so can you. And if you've been doing it a while, you're probably every bit as good. He may be faster, but because you take a little longer, you may end up with better work.

However, beyond the routine jobs, many of the men who call themselves professional auto mechanics are in deep trouble. Not only haven't they kept up, but their very nature makes it almost impossible to do so.

In the past, an auto mechanic has learned by doing. When something new came out, he went to a training session. A day or two was spent actually taking a component apart and putting it back together. He didn't learn the job from a

By learning the manuals, you'll be the expert on the car you own and drive.

BY PETE WARREN



Ford EEC III computer trouble codes can be read with a simple vacuum gauge hookup.

book. He may even be looking at this page and laughing, remembering the bewildered Saturday mechanic who brought him parts in a carton.

Learning *only* by doing isn't realistic on the complex new car systems. A computer may look the same from year to year, but the workings will change completely.

If you've learned how to do jobs on your car and home by reading *Popular Mechanics*, you've got a key advantage over many professionals: the ability to learn how to do things by reading.

What's more important, the new electronic systems have few things to take apart and fix. If a component is bad, it's generally replaced, not repaired.

Of course, the big job is finding out what part is bad—that requires reading service manual procedures. It used to be difficult for a Saturday mechanic to get the manuals, but no more. All the major car manufacturers make them available (see list following article).

On newer models, the car itself may be able to tell you what's ailing. All of the computer systems have some form of on-board diagnostics, to provide trou-

ble codes and in many cases, additional information. On General Motors cars with Computer Command Control, you can trigger the diagnostic circuit with a paper clip inserted into an under-dash-board plug. This triggers the dashboard's Check Engine light to flash out trouble codes.

On Chrysler fuel-injected cars, turn the ignition switch on and off very quickly three times, and the dashboard



Late-model dashboards are going "front-service," for repairs from the driver's seat.

light will pulse out the trouble codes.

On Ford products with Electronic Engine Control (EEC) III, tee a vacuum gauge into a hose from an air pump circuit solenoid, then apply vacuum to the vent neck of the barometric/manifold pressure sensor with a manual vacuum pump. The engine will go into a diagnostic mode and produce trouble codes you read by counting pulses on the vacuum gauge needle.

On Fords with EEC IV, hook up an analog (needle-and-dial) voltmeter to a six-terminal plug and a jumper wire from a terminal on the plug to a self-test connector. Turn on the ignition and an engine-off test begins. Follow a second procedure for an engine-running test. In each case the voltmeter needle will pulse to indicate trouble codes.

You may have heard that the trouble codes often do not pinpoint a problem, but refer you to a "diagnostic tree," which is a step-by-step procedure for tracing the problem. The tree uses ordinary meters.

One key test on the GM computer can be made with the dwell scale on an analog tach-dwellmeter.

Test equipment

It's true that you may be able to save time on today's cars if you have more sophisticated test equipment. One example is the computerized testers used for diagnosis of the GM Computer Command control. At \$200 to \$300, it's not a small purchase, but it does cover all GM computers except Cadillac, and the manufacturer updates it periodically with a low-cost program chip. If it saves you one trip to the dealer, it can pay for itself the first time.

Other testers are even less expensive. Electronic ignition testers are un-

der \$60, electronic cruise control testers are under \$50. At the rate on-board diagnostic systems are being upgraded, however, you may soon need little or nothing additional.

Cadillac is the pioneer in this regard, and for several years has had a computer system that allows you to check all sensors and switches from the driver's seat. Push the OFF and WARMER buttons on the automatic temperature control to trigger the diagnostic mode. Then you press dashboard buttons to call up trouble codes on the digital temperature readout. The computer even operates underhood switches, relays, valves and motors.

The checkouts can be somewhat complex to make, but look at it this way: You have one car that isn't going to change in the seven years you have it (average term of first ownership). You only need one set of service manuals. You don't get different models mixed up. Your test equipment doesn't need updating until you buy a new car.

You may run into a problem where you have no choice but to go to the dealer. However, if you develop the expertise on your car, it won't be often.

It's also true that dealer mechanics work primarily on late-models. When your car develops trouble at the age of six or seven, a lot of dealer mechanics



Cadillac self-diagnostic system is triggered through a/c controls, displays trouble codes.

have forgotten much of what they learned years back.

What about special tools? The truth is that dealers resent buying these as much as anyone, and there's a lot of pressure on the factories to reduce special tool requirements. Where a common job requires a special tool, you may find auto parts stores carrying independent versions at modest prices. Many expensive tools, such as strut spring compressors, can be rented.

One of the things a dealer mechanic (and some independent mechanics) can do is pull a part and substitute a new one to see if it cures a problem. A bit of trial and error is undoubtedly useful, but it may lead to some diagnostic sloppiness. It also may lead to a tendency to leave new parts in place even if they didn't cure the problem, and just charge the customer for the part (at list

(Please turn to page 236)

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BE A BETTER MECHANIC

(Continued from page 235)

price) and labor. Even if you use this technique, you won't pay for labor and often will pay far less for the part.

Although the new car generally is perceived as more complex, there are many areas that continue to be straightforward, such as struts, hoses, belts and gaskets. Do the job yourself and you'll be able to save a bundle on labor and a chunk on parts.

The new cars also display some engineering-for-service. Virtually all dashboards are front-service, which means you can change bulbs, gauges, switches and control panels from the driver's seat, using nothing more than screwdrivers and small wrenches.

Some cars, particularly GM models, have easy-to-service heaters, so this can be a new addition to the Saturday mechanic's repertoire.

As a Saturday mechanic, you'll have to do a lot of reading to learn new systems and about useful new tools and testers. However, you'll be the ultimate specialist—one make, model and year to fix.

PM

SERVICE MANUALS

- American Motors service manuals: Myriad Co., Customer Service, 8835 General Dr., Plymouth, Mich. 48170. Bulletins available in late 1985.
- Chrysler service manuals: Dymet Distribution Service, 21026 Progress Dr., Strongsville, Ohio 44136. Chrysler service bulletins: Must be requested by specific number. See your dealer to determine which bulletin covers your specific problem. Free from Owner Relations, Chrysler Corp., P.O. Box 1718, Detroit, Mich. 48288.
- Datsun/Nissan service manuals: Pendant Industries, P.O. Box 387, Harbor City, Calif. 90710.
- Ford service manuals: Helm Inc., P.O. Box 07150, Detroit, Mich. 48207. Ford bulletins (on any service fix that costs more than about \$150 at average dealer prices) are free from Ford Customer Information System, P.O. Box 95427, Atlanta, Ga. 30347, or call 800-241-3673.
- General Motors service bulletins: Call 800-551-4123 or write for bulletin order form, which provides option of ordering individual bulletins from index or annual subscription. Specify make of car, to GM Product Service Publications, P.O. Box 9011 North End Station, Detroit, Mich. 48202.
- GM Diagnosis and Repair manual: Somewhat general pictorial diagnosis and service manual on late-model GM cars, from GM D&R Manual Headquarters, Advertising and Promotion Dept., 201 King of Prussia Rd., Radnor, Pa. 19089. Send money order for \$19.70 (\$20.78 for Pa. residents).
- General Motors Divisions
 - Buick service manuals: Tuar Co., P.O. Box 354, Flint, Mich. 48501.
 - Cadillac service manuals: Helm Inc., P.O. Box 3617, Highland Park, Mich. 48203.
 - Chevrolet service manuals: Helm Inc., P.O. Box 7130, Detroit, Mich. 48207.
 - GMC service manuals: Adistra Corp., 2020 Belaire, Royal Oak, Mich. 48067.
 - Pontiac service manuals: Helm Inc., P.O. Box 3518, Highland Park, Mich. 48203.
- Oldsmobile service manuals: Lansing Lithographers, P.O. Box 14067, Lansing, Mich. 48901.
- Honda service manuals: Order from dealer. Supplies limited.
- Mazda service manuals: Order from dealer.
- Toyota service manuals: Allied Graphics, 750 West Victoria St., Compton, Calif. 90220, or call 213-639-2621.
- Volkswagen: Order from dealer or Robert Bentley Inc., 678 Massachusetts Ave., Cambridge, Mass. 02139.
- Additional guide: Book of 500 bulletins covering 1980-83 domestic models, indexed by symptoms. From Motor Publications. Call 800-228-2028 (ext. 64), in Nebraska 800-642-8300 (ext. 64).

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PM LOOKS AT...

Mark V Planer Attachment

Just when you think you've seen every possible accessory for your Shopsmith Mark V, another one appears. This time, it's a \$699 manual-feed planer attachment that can be upgraded with a power feed for another \$200. You can also buy a power stand for \$200 that allows the planer to operate independently of the Mark V.

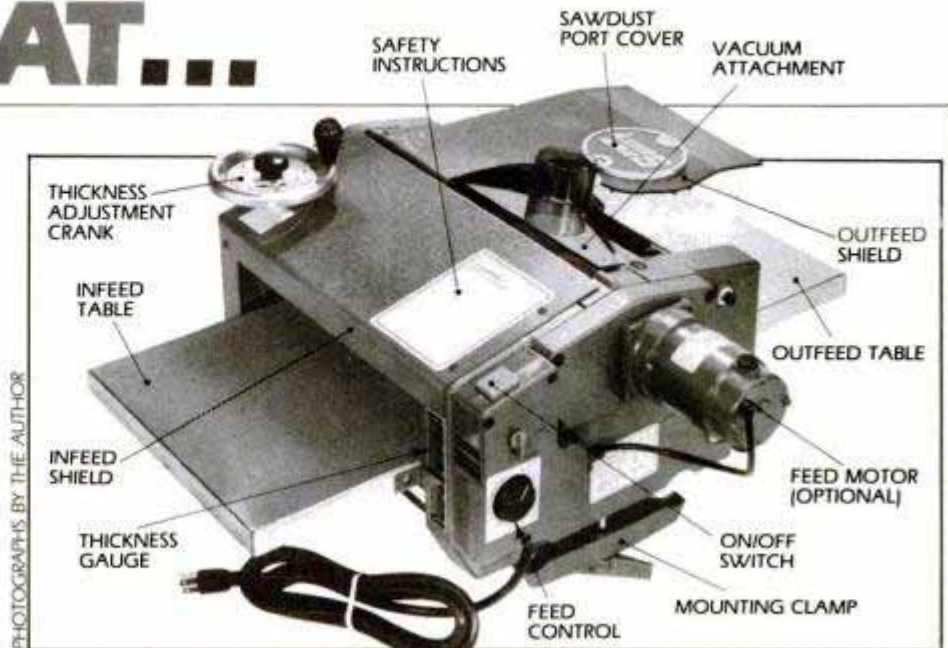
A professional planer for homeowners does only two jobs: It planes the surface of a workpiece smooth and flat, and cuts any number of boards to precisely the same thickness. The planer attachment for the Shopsmith Mark V does this exceptionally well, as you can adjust both the speed of the planing knives and the rate of feed to suit hard or soft woods.

I gave my planer attachment the ultimate test—I smoothed a 2 x 7-in., extra-hard piece of rough-sawn hickory. Then, I planed some 1 x 8-in. white pine boards to 1/2- and 3/8-in. thicknesses to make drawer parts. At my lumberyard, a piece of 1 1/4-in. clear white pine costs half as much rough-sawn as finished. A few passes through the planer not only doubled its value, but also gave me the precise size I needed.

The scale on the feed side has accurate calibrations to indicate finished board thicknesses. The depth-of-cut control lets you shave off as little as 1/128 in. or as much as 3/32 in. on softwood boards. The 1 1/2-hp, 110-volt motor handles the optional power feed. A shop vacuum hooks up easily to your planer at the sawdust port. After swinging the port cover aside, the 2 1/2-in.-dia. vacuum hose plugs right in.

The 72-page Shopsmith manual covers every aspect of setting up, maintaining and using the Mark V 12-in. thickness planer. A wood planing guide gives tips for various wood species and hardnesses, as well as speed and feed rates.

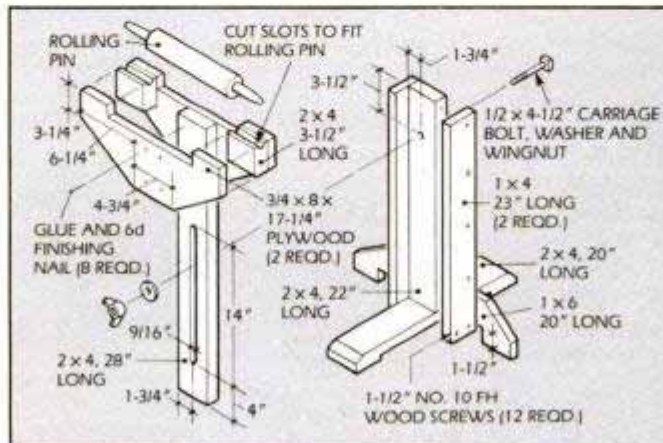
The Shopsmith Mark V and its attachments, including the 12-in. surface planer, are available from Shopsmith Inc., 6640 Poe Ave., Dayton, Ohio 45414.—John Gaynor



The thickness planer drives a 12-in. rotary cutter over the table to finish rough boards.



Wear mask (left) when planing lumber to keep dust out of your lungs. Some hardwood species produce toxic sawdust. A shop vacuum attachment (top, right) catches dust to avoid this problem. Mounting clamps (above, right) secure the planer on the way tubes of the Shopsmith Mark V. Spin clamp handles snug, then tighten a quarter of a turn.



This roller support stand will improve the finish and the accuracy of thickness planing.

'86 PREVIEW



FORD'S RADICAL NEW FAMILY SEDANS

Taurus and Sable bring the new ultra-aerodynamic look to the full-size family car market.

BY MICHAEL LAMM, West Coast Editor



Sleek Mercury Sable is Ford's up-to-the-minute replacement for the LTD/Marquis series. Available dashboards include standard or sport analogs, LCD digital.

Hold the phone! If you're thinking about buying a mid-sized family sedan or wagon, don't. Not yet. Ford's new Taurus and Mercury's Sable are on the way, and they are *fan-tas-tic!*

The twins bow this fall as 1986 models. They'll replace the Fairmont-derived Ford LTD and Mercury Marquis and will be available as four-door sedans and wagons (coupes may come later). Not only will the Taurus/Sable be less expensive than the LTD/Marquis, they'll be smaller on the outside, bigger on the inside and more economical. T/S prices run from \$8,200 to \$12,500.

Taurus/Sable styling derives from Ford's European models and continues the aero look pioneered by the Mark VII, Thunderbird, Tempo and Topaz. The Taurus and Sable look like a slightly pumped up Tempo/Topaz with an Audi 5000S upper: They have flush glass, blacked-out pillars, full wrap-

around headlamps, roof-cutout doors . . . in other words, the works!

The Taurus sedan registers an amazingly low 0.29 Cd. The base Taurus carries a Tempo-like slatted grille, but up-option models have just the blue Ford emblem floating in an oval on the car's nose. The Sable comes with a

straight-across parking lamp between the headlights in place of the grille.

Both nameplates will be built together in two plants: Atlanta and Chicago. When production begins on July 29, the mechanically identical vehicles will use modular construction, meaning all major components will be subassembled

COMPARATIVE SPECIFICATIONS

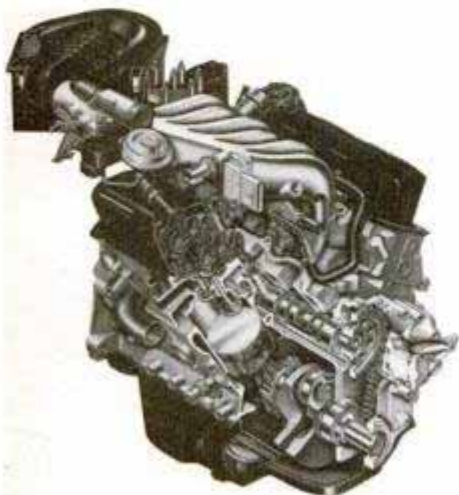
CAR	BASE PRICE	DRIVE WHEELS, ENGINES	BASE AND TOP HORSEPOWER	WHEEL-BASE (in.)	OVERALL LENGTH (in.)	CURB WEIGHT (lb.)
1986 Ford Taurus/ Mercury Sable	\$8,200*	fwd/4 V6	105-140	106.0	188.4	2,966
1985 Ford LTD/ Mercury Marquis	\$8,874	rwd/4 V6, V8	88-165	105.6	196.5	3,000
1985 GM A-Cars (Celebrity, Ciera, Century, 6000)	\$8,288	fwd/4 V6	92-112	104.9	188.3	2,775
1985 Chrysler H-Cars (LeBaron, GTS)	\$8,788	fwd/4	99-150	103.1	180.3	2,600
1985 Audi 5000S	\$17,710	fwd/5	100-140	105.8	192.7	2,965

*Projected.
Data are for base four-door sedans.

off-line and brought to the main assembly point for final mating.

Easy-service engine

The Taurus and Sable use subframe unit construction with front-wheel drive, and at first only an all-new, 3-liter, 140-hp V6 and four-speed overdrive automatic transaxle will be avail-



The port-injected 3-liter V6 is an all-new design that puts out 140 hp at 4,800 rpm.

able. Later, a 2.5-liter Four with five-speed manual will come onstream. The pushrod "Vulcan" V6 uses direct port injection but is conventional otherwise. It appears to be easy to service, as does the Four. Ford calculates that, during the first 50,000 miles, routine T/S maintenance and servicing will be around \$230. This compares with \$1,100 for the first 50,000 miles in a comparable 1973 Ford product.

Suspension is all-independent: MacPherson struts up front, and two different systems in the rear—one for the sedan and another for the wagon. The wagon's rear suspension has upper and lower A-arms and coil springs, like the front suspensions of earlier cars. All use articulated stabilizer bars.

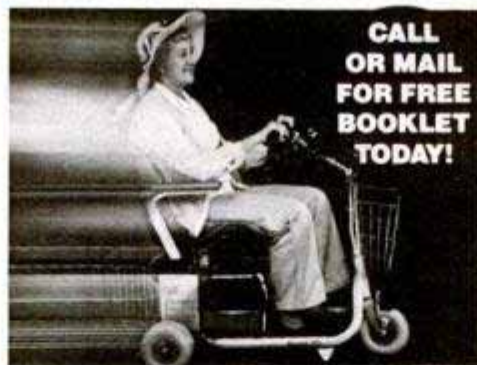
Instrument panels are unique to each nameplate. There are three versions: base analog, sport analog and digital.

Tremendous trifles

Among those important details that Ford's T/S project manager Lew Veraldi calls "tremendous trifles" are an easily adjustable roof rack for the wagon, full-width seat tracks covered in vinyl to give rear riders maximum foot room, amber markings and instructions on all underhood service items, a rear picnic tray for the wagon, sunvisors that deploy from the front and side simultaneously, and a lot more. These are extremely well thought out vehicles.

All in all, they set a new standard in family cars for the rest of this decade and probably into the 1990s. The Europeans and Japanese will have to go to some lengths to beat them.

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Charlotte L. Raffensberger
 Princeton, New Jersey


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A jointer-planer

The Belsaw Model 684 is a relatively new version of the basic planer-molder with a logical added function: a jointer capability. This combination makes good sense because planing and molding operations often must be preceded by jointing.

If you've never used a thickness planer, you may think that it can straighten a warped or cupped board. It won't because the pressure from the feed roller flattens the board before it reaches the cutterhead. When the board is released after the cut, it simply springs back to its original shape.

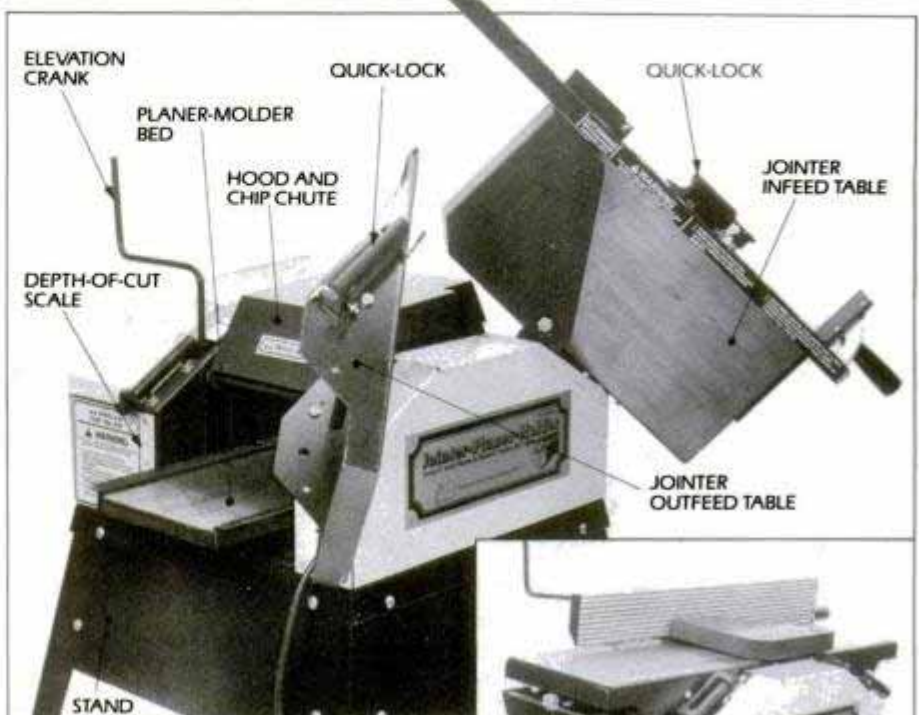
A jointer enables you to obtain one flat surface before planing to a specific thickness. This jointer handles stock up to 6½ in. wide and can make a ⅛-in.-deep cut. Its cleverly designed tables swing outboard to convert to planing and molding operations in seconds.

The planer will handle stock up to 8 in. wide and 4½ in. thick. A 1-hp motor rotates the cutterhead at 6,000 rpm, which means 12,000 knife cuts per minute. This results in smooth cutting.

Moldings are cut easily and efficiently by inserting a single cutter in the head. A variety of 1-in.-wide bits are available for small profile work, and heavier pattern knives are used for cutting large moldings. Single-pass test cuts in soft wood with both types of knives produced good results. But, when using the larger cutters on hardwood, make two passes.

If your interests lie in fine woodworking, you might well consider buying a jointer-planer. The unit shown is priced at \$749, plus shipping, from Foley-Belsaw Co., 95014 Field Bldg., Kansas City, Mo. 64111. A planer-molder without the jointer costs \$549.

—Rosario Capotosto



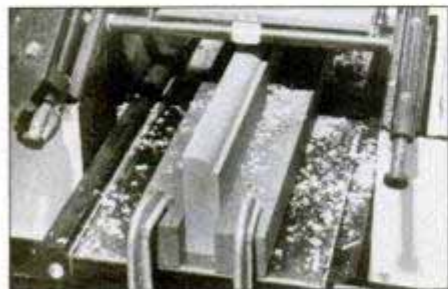
Components of the machine (labeled above) are set up for planing and molding operations. The jointer infeed and outfeed tables fold in (right) for jointing operations.



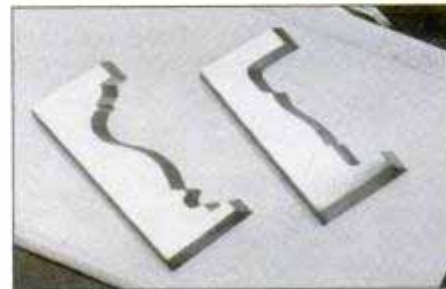
Jointer infeed and outfeed tables create a stable 36-in.-long surface for long stock. Fence tilts over to 45° for beveling jobs.



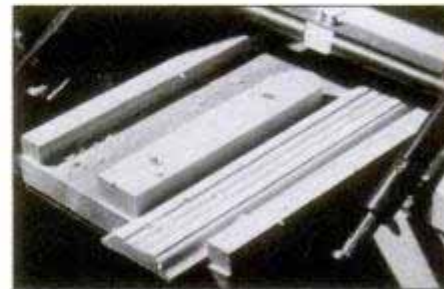
When planing, machine moves board through at rate of 28 ft. per minute. For best cut, support stock on outfeed side.



When cutting edge molding, be sure to clamp guide blocks to machine bed to create a straight path for stock through cutters.



Manufacturer makes a wide variety of molding cutter shapes. The heavy-duty cutters (above) are made of ⅜-in.-thick steel.



Comprehensive operator's manual tells how to make jigs and guides for specialty work, like cutting wide surface molding shown.

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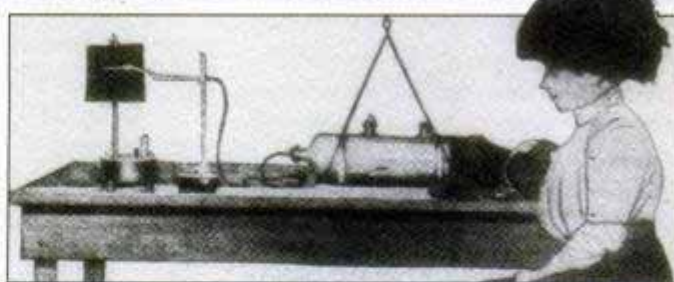
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PM'S TIME MACHINE

75 YEARS AGO: May 1910

Freezing a disease

English physician Sir Edwin Durning-Lawrence suggested if "sleeping sickness" parasites were removed from their warm climate and transferred to a cold climate, they would expire even though they had entered the host's bloodstream. The Liverpool School of Tropical Medicine tested this by installing a refrigerator unit in a hospital ward. A patient sat for hours in a room cooled to 12° to 15° F. Diseased animals were also kept in the room. Today, arsenic-based drugs are used to cure African sleeping sickness.



Measuring emotion

John A. Larsen would not invent the polygraph until 1921, but University of Pennsylvania psychologist Dr. Arthur Holmes built a working copy (above). He used his apparatus to gauge the affections of people by recording the heart rate.

Adventurer's fate

The *Thrilling Race to the South Pole* described how English explorer Capt. Robert Falcon Scott tried to reach the pole before the Germans and Americans. He made it in 1912 but died on the return trip after finding Roald Amundsen had won.



Cure for sleeping sickness.

50 YEARS AGO: May 1935

Mile-a-minute boat

Hull design improved when speed boat designer Leroy Malrose used an aircraft fuselage as a model for his mile-a-minute outboard. No-Vac. He eliminated speed-reducing vacuums by giving his craft a narrow hull with a small stern barely wide enough for the motor. The new stern decreased the vacuum. Triangular-shaped planes in the bow decreased the area of wetted surface and cut wind resistance. In November 1977, *The Spirit of Australia*, an unlimited hydroplane of similar design, reached 345 mph.



Talking novelty

A pull of the tape produced words from a "talking" box, made to amplify the tape. PM noted that it would be marketed as a novelty. Later, millions of dolls would "talk" with the pull of a string.

Brain waves charted

It was an improved version of a most useful diagnostic device—the electroencephalograph. It incorporated technology similar to that used to measure electrical changes in the heart muscles. Changes in electrical activity on the detectors' surfaces were transmitted to an instrument that looked like a radio and used vacuum tubes to amplify brain waves. The waves registered on an oscillograph as a wavy line corresponding to changes of electricity in the brain. Hans Berger developed the first EEG in 1929.



NoVac: a mile a minute.

25 YEARS AGO: May 1960

Annual getaway tips

A *Special Vacation Section* listed "10 Unusual Vacations." It proved to be timeless. The 10 ideas still are interesting: 1. "Flight-seeing" in Alaska (touring Alaska by air); 2. Camping in forests and parks; 3. Railroading to Hudson Bay; 4. Rock hounding in the Sierra Nevada; 5. Exploring the border wilderness (camping on the Canadian-American border); 6. Farm vacation in Ohio; 7. Sailing out of New England; 8. Steamboating on the Mississippi; 9. Rent a yacht in Florida; 10. Amateur archeology in Yucatan.

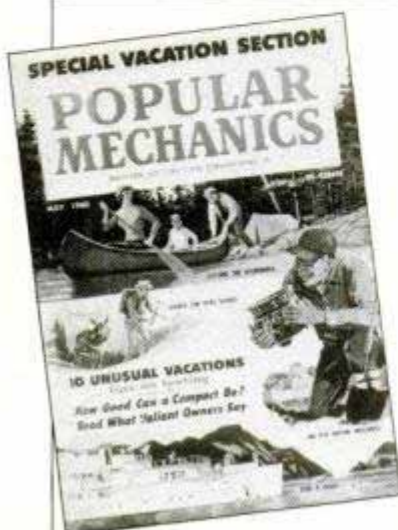
Home on land or sea

The "Amphibious Home" was the ingenious creation of a Florida dentist. The 49-foot, 16-ton craft could thrive on land as well as sea. Dr. S. W. Johnston built the houseboat-trailer home in his backyard, one mile from the nearest tributary. The most unique feature of the boat home was its hand-cranked hoisting system: Four steel-pipe legs descended from the boat and lifted it from the ground. A flatbed trailer could be backed under the hull and it could be transported to the harbor or to a trailer park.



Tub-side TV

A British firm designed this panel for the "bathroom of the future." Bathers could watch front and back doors on monitor screens. A phone amplifier permitted conversation with callers. A third screen enabled the bather to watch TV shows. **PM**



Tips for unusual vacations.

"Two days deep in no-man's land you don't want surprises with your ATV. Like finding out your Sampson of the showroom is really the Wimp of the woods.

"So be prepared, guys. Count on a 4-wheeler that's not going to crater on you. Like a new Bayou 185.

"Kawasaki's rugged pathfinder is up to any trek you're up to. And it's outfitted with lots of great outdoors features that'll put you in its camp to stay.

"Bayou climbs with the agility of a mountain goat. The strength of one, too.

"And check these items from Bayou's survival kit. Independent front suspension. Shaft drive. Five speeds. Reverse. And automatic clutch.

"If the Bayou 185 can get you there, it can get you back. So take a hike on down to your Kawasaki dealer and look 'em over.

"Your call of the wild should be 'Bayou!' Not 'Help!'"

Kawasaki
TAKING IT TO THE LIMIT

TAKING IT TO THE LIMIT.

**"THE 4-WHEELER THAT TAKES YOU
DOWN THE TRAIL SHOULDN'T LEAVE
YOU UP THE CREEK."**

—Catherine Bach

*"You won't
catch me
on anything
else."*



For off-road use only. Specifications subject to change without notice. Availability may be limited. Always wear a helmet and appropriate apparel. Protect the environment and obey laws and regulations that control the use of your ATV.

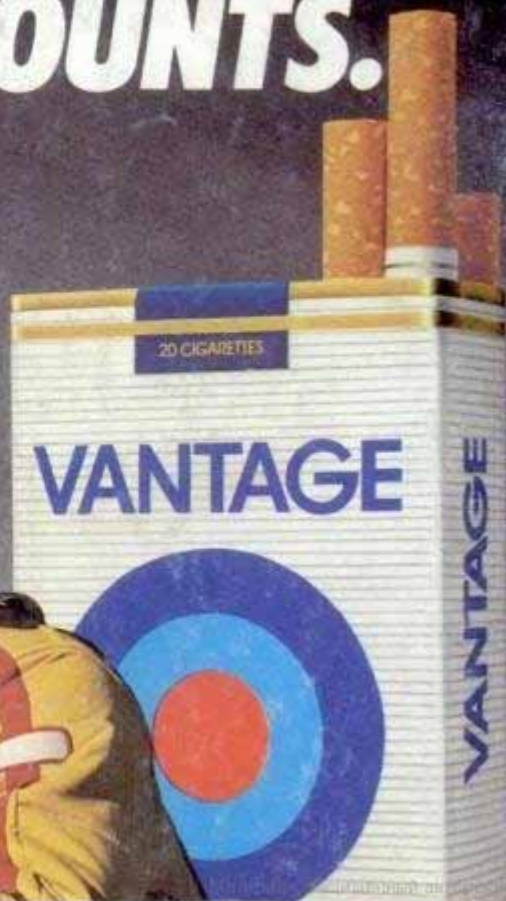
9 mg. "tar", 0.7 mg. nicotine av. per cigarette. FTC Report FEB. '84.

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