

The WHAT'S NEW magazine

DECEMBER 1984

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Popular Science

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39 SATELLITE ANTENNAS YOU CAN BUY NOW



NEW-BREED U.S. SMALL CARS—built better than the Japanese?
ELASTIC PLUMBING—an expert's tips on doing it right



Forward

At last, a family car with the

When we developed Ford Tempo, we didn't forget your family's need for room, comfort and trunk space. But since we don't think that a family car has to be a boring car, we added some special refinements. One of which is Tempo's advanced aerodynamic shape.

Round vs. Square.

A round-object, of course, is much more aerodynamic than something square-shaped. And that's why Ford Tempo's lines are rounded rather than squared-off. This kind of forward thinking results in a distinctive design. And just as



importantly, it results in a functional shape that actually reduces lift for improved directional control and stability. In short, Tempo's shape improves the way it drives. Which brings us to the next paragraph which deals with handling.

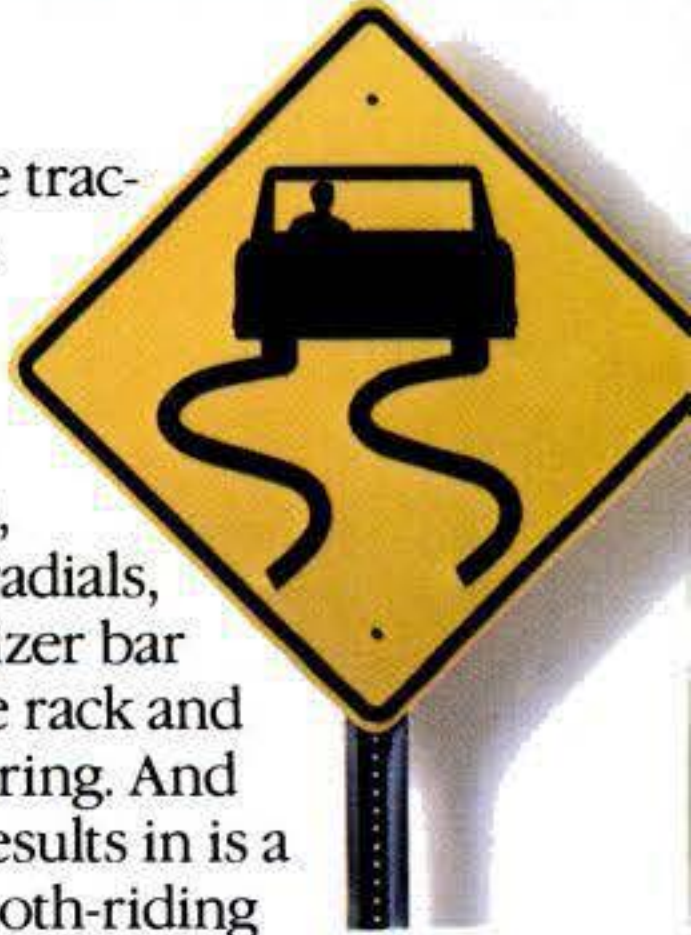
Excellent reflexes.

As you'd logically expect from a forward thinking car, Tempo offers front-

wheel drive traction. It also offers four-wheel independent suspension, front stabilizer bar and precise rack and pinion steering. And what that results in is a stable, smooth-riding car that helps the driver handle the idiosyncrasies of a winding road. Good news for the driver. And the passenger.

Forward thinking under the hood.

Tempo is powered by a specially



Ford Tempo

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Thinking like a driver's car.

developed 2300 HSC (High Swirl Combustion) engine. And to keep Tempo's thinking current, we've added electronic Fuel Injection this year. A forward thinking 2.0 liter diesel engine is available. And the optimum operating efficiency of your Tempo will be maintained by the EEC-IV Computer, a state-of-the-art microprocessor engine control system.



State-of-the-art thinking for five.

The end result is a five-passenger,

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Quality is Job 1.

"Quality is Job 1." This isn't just a phrase. It's a commitment to total quality, which begins with the design and engineering of our cars and continues through the life of the product. And the commitment continues for 1985. Ford is determined to build the finest cars in the world.



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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.

Have you driven a Ford...lately?



Get it together—Buckle up.

The forward thinking car.

The WHAT'S NEW magazine

Popular Science®

DECEMBER 1984 Founded in 1872/Vol. 225, No. 6

Highlights of this issue

93

44 satellite antennas you can buy now

TV dishes have become less costly and more sophisticated. Here's how to pick the right one.

22

PS car test: U.S. small-car champs

Can Detroit's new economy models challenge Japan's? The answer may surprise you.

86

Anyone can "fly" this deep-ocean rover

Even a novice can pilot this deep-diving vessel—and explore the sea floor in armchair comfort.

105

Plastic plumbing—tips on doing it right

An expert explains all you need to know about CPVC pipe, an ideal material for DIY jobs.

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The What's New Digest 62-76

Science and Technology

Science newsfront	10
What's new—products and technology	62
Beam magic creates new super-tough materials	80
Anyone can "fly" this deep-ocean rover	86

Computers and Electronics

Bits & bytes	42
What's new in electronics	73
44 satellite antennas you can buy now	93
IBM fights back	96
RCA Dimensia—the ultimate TV?	111

Cars and Driving

Detroit report	16
PS car test: U.S. small-car champs	22
Mitsubishi for '85: soft cruiser, little hot rod	34
What's new for your car	74
VW for '85: Golf and Jetta; biggest little cars	84
V6 Fiero: Now it's as fast as it looks	84

Energy News

Retrofit double glazing	61
New technologies fight wood-stove pollution	90

Recreation

Through the viewfinder	40
What's new in boating	76
Genius SLRs—programmed to think like a pro	102

Home, Shop, and Yard

Products	
What's new in home improvement	68
Vertical blinds—not just for windows	100
Plastic plumbing—tips on doing it right	105
Plans and Projects	
Easy-access woodshed	98
Build the door you can't buy	108
Home Energy Management	
Alternate-energy adventure: all-solar system	44
Tools and Techniques	
What's new in tools	67
Shop talk	112
Table-top router	122
Car Care	
"Say, Smokey—"	38
For convenience and safety: electric window de-icer ..	110
Taking care of your car	120

Additional Features

Readers talk back	5
What's news	79
Wordless workshop	114
Product information	134

Calgary. A rugged place for a smooth whisky to start.



ALBERTA, CANADA—The Calgary Stampede, the world's richest rodeo. It attracts the nastiest bulls, the most ornery broncs, and the best cowboys anywhere to ride them. There's a chuck wagon race that'll make your bones rattle and a motorized barstool race that'll leave you black and blue for a month.

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Round the world

The Voyager ["Rutan's Ultimate Flyer," Sept.] is certainly a magnificent aircraft, but it seems to lack some vital human necessities, such as food, water, toilet facilities, and privacy. How—and where—will they be provided?

Myer Ehrlich, Brookline, Mass.

Ben Kocivar replies: "Some space will be allotted for food and water, although Burt Rutan hasn't announced a detailed plan for storage. About toilet facilities, all Rutan would say was that the Voyager would be flying high over water for most of the journey."

Underground advantages

I'm sure you want to put the underground debate to rest ["Shop Talk," Aug. and Sept.], but I'd like to add a few comments.

As housing in our cities and suburbs becomes more crowded, we may realize that underground homes offer a number of features that conventional homes can't match. Underground homes may provide quality housing on otherwise unattractive sites. For security, underground homes have easy-to-control access routes, they're less easily marked as targets from the street, and they feature fewer places of concealment for those bent on doing no good.

The advantages don't stop there. Earth-sheltered homes are less prone to fires for those living in incendiary brush. Their thick walls and roof can attenuate noise from a nearby factory or highway to the point that the living space would be completely quiet. They might also eliminate shading caused by above-ground structures, perhaps permitting gardening that might otherwise not be possible.

Doug McCray, Maple Shade, N.J.

Floppies to flippies

People who use single-sided disk drives should be aware that there are diskette conversion kits that enable you to use the back side of diskettes. Because dealers can double their profits by selling you two boxes of single-sided diskettes, it isn't surprising that you don't see or hear about these kits too

often. I have already converted about 60 of my single-sided diskettes and encountered no problems whatsoever.

Willard Smith, Waban, Mass.

Farming city-style

In "High-Tech Farm—in New York City" [Sept.] you say that the plants "sit in C-shaped tubes." How does a plant sit in the tube? How long is the tube? How do the nutrients flow?

Winston Phelps, Spring Hill, Fla.

V. Elaine Smay replies: "The tubes are C-shaped in cross section, with the opening of the 'C' facing up. Nutrients flow through the tube and are delivered to the plant through an irrigation valve. The tube can be any length of PVC piping."

Pipe relief

In "Solar Workshop Heats His House" [Aug.] the diagram is a little confusing. Shouldn't the flow arrows at the top left-hand corner be pointing down?

Ernest H. Michaelsen
Hyannis, Mass.

I wonder whether George Hoague ["Solar Workshop," Aug.] takes into account the presence of an electrical-demand controller, which levels out peak demands. This device could account for a 50-percent difference between the author's cost of electricity and that of his neighbors.

Bill Olney, Littleton, Colo.

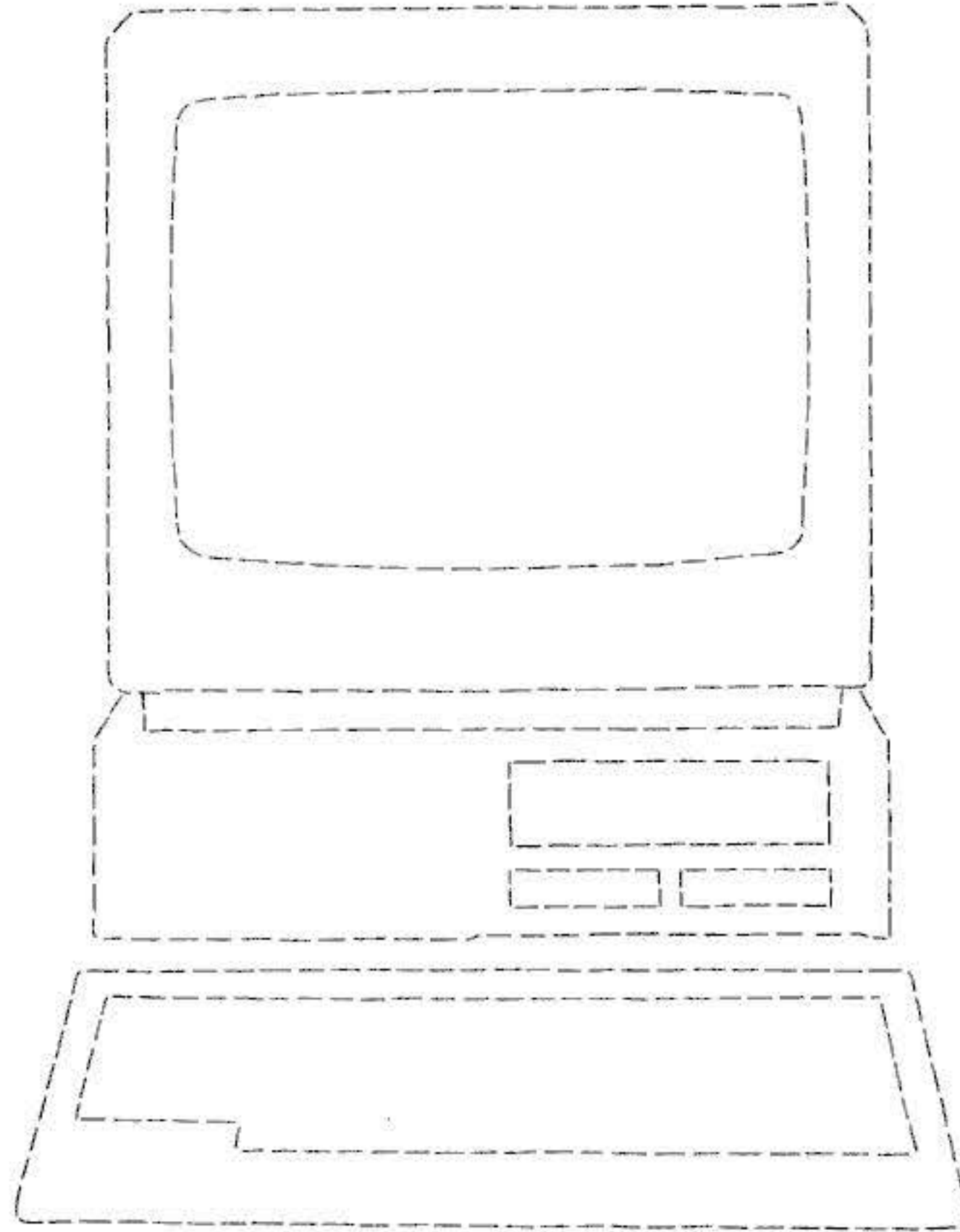
George Hoague replies: "The diagram depicts not flow arrows but relief valves set at 60 pounds per square inch. Although I have a demand controller, I have not used it since Sept. 8, 1981. As the article stated, most of the house heat is supplied by a wood stove. This dropped the electric usage enough to turn off the demand control. The comparison I made with neighbors was based on the same electric rate schedules."

Auto A/C

There are a few errors in "A Pro's Guide to Auto A/C" [July]. Recent research has determined that phosgene gas doesn't form when R-12 comes into

Continued

**Picture a computer under \$1000
that runs over 1000 of the best programs
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Now picture this.

There's a lot that's new about PCjr and it's all good news for you.

PCjr now has a lower price. A new typewriter-style keyboard.

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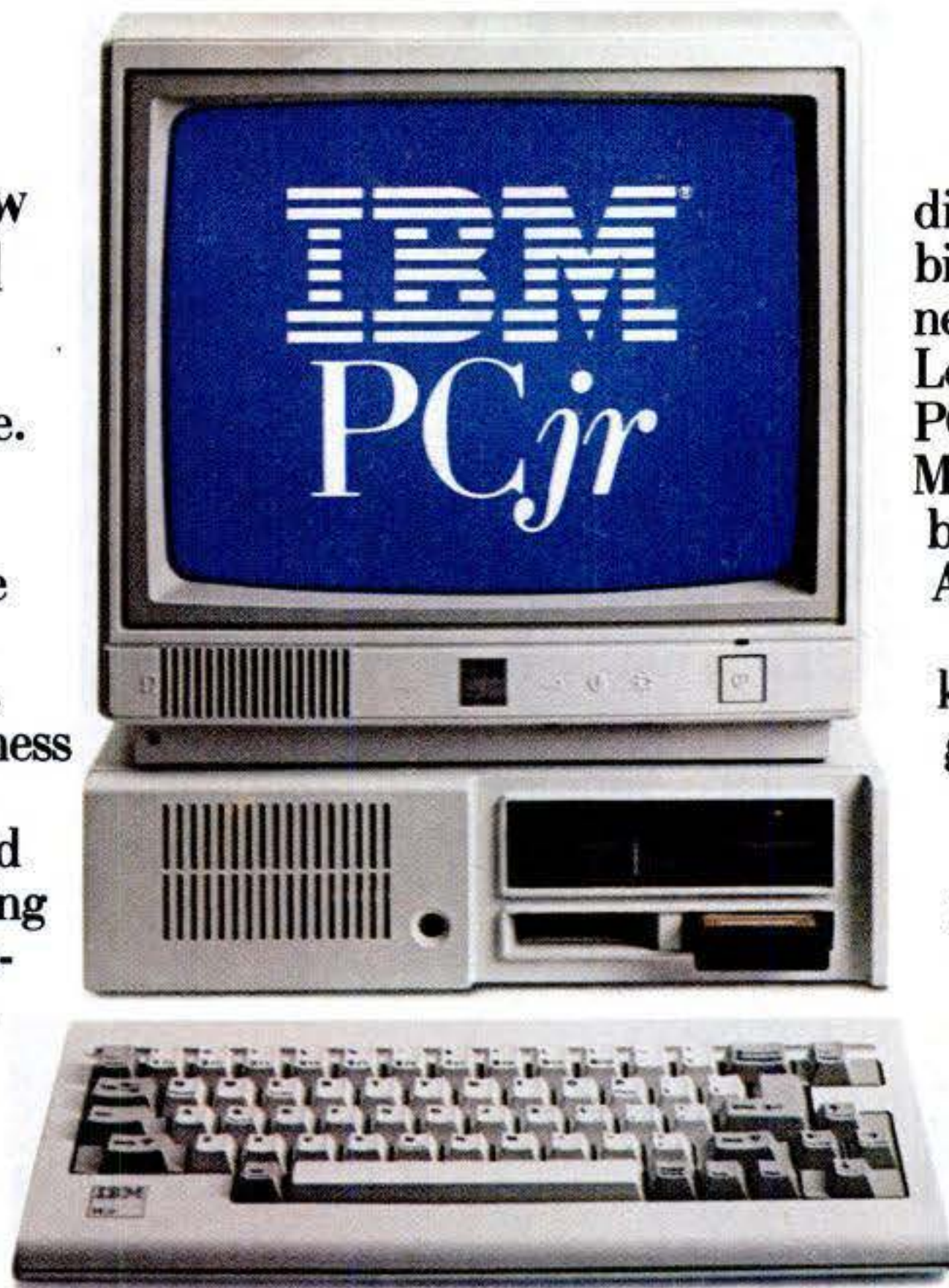
All of which can make PCjr the most useful computer a little money can buy.

It comes standard with 128KB of user memory — twice the memory of its most popular competitor. An advanced 16-bit processor. And a double-sided diskette drive that can store over twice as much information as most single-sided drives.

With all these features, PCjr can run over a thousand of the most popular programs written for the IBM PC. And with the new optional 128KB Memory Expansion Attachment,

it can run over a thousand more.

PCjr also runs a growing number of powerful cartridge programs. They work faster than



diskettes, and don't take up a bit of user memory. The three newest examples being Lotus 1-2-3,TM the fascinating PCjr ColorPaint and Managing Your MoneyTM by financial expert Andrew Tobias.

As its library of software keeps growing, PCjr keeps growing, too. By leaps and bounds. Because IBM designed it with 13 ports for add-on options. And a modular construction that will accept new capabilities down the road. Even those that haven't been invented yet.

All this in a

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Takes up just a bit over a square foot of desk space. And costs less than \$1,000[†],

without monitor.

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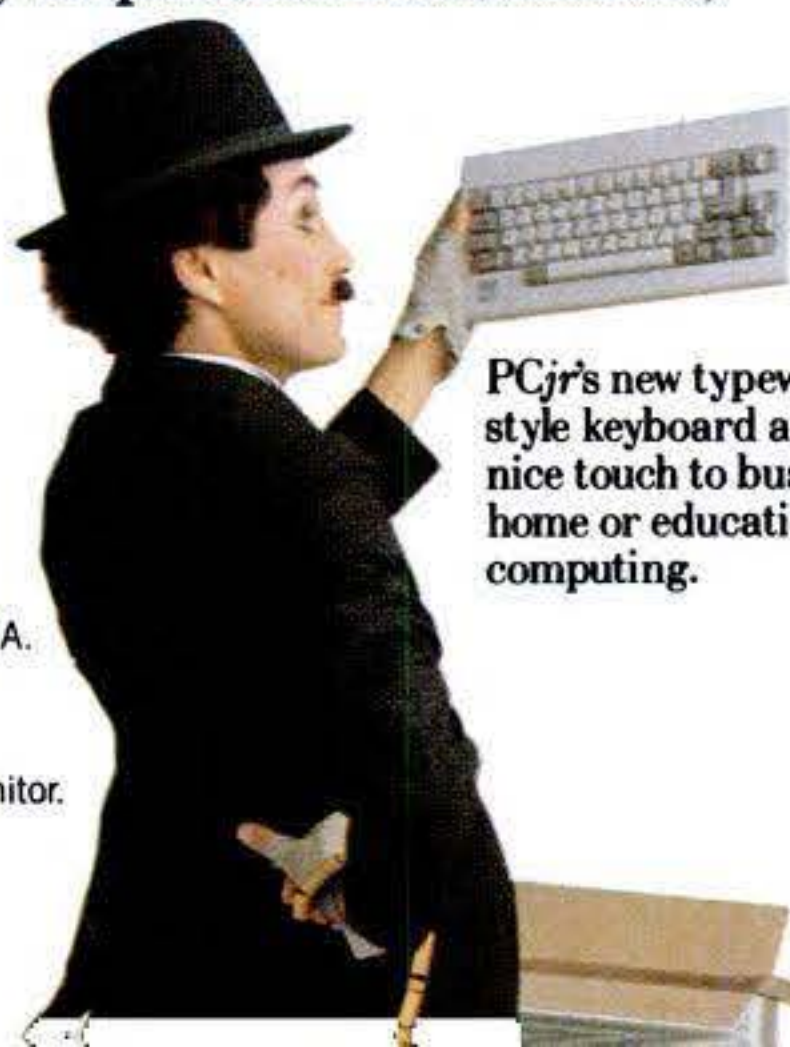
The new PCjr Memory Expansion Attachment can give memory a quick lift to 256KB. Or, along with a PCjr Power Expansion Attachment, all the way to a hefty 512KB.



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User Memory (RAM): 128KB (expandable to 512KB)	Runs over 1,000 programs written for the IBM PC
Permanent Memory (ROM): 64KB	Runs both diskette and cartridge programs
Diskette Drive	Display
Double-sided, double density	40- and 80-column
Capacity: 360KB	Resolution:
	4-color: 640h x 200v
	16-color: 320h x 200v
Processor	Expandability
16-bit 8088	Open architecture
Keyboard	Optional 128KB Memory Expansion Attachment(s)
Typewriter-style	13 ports for add-ons, including built-in serial interface
Detached; cordless	
Warranty	
1-year limited warranty	



PCjr's new typewriter-style keyboard adds a nice touch to business, home or educational computing.

IBM PCjr

Growing by leaps and bounds.

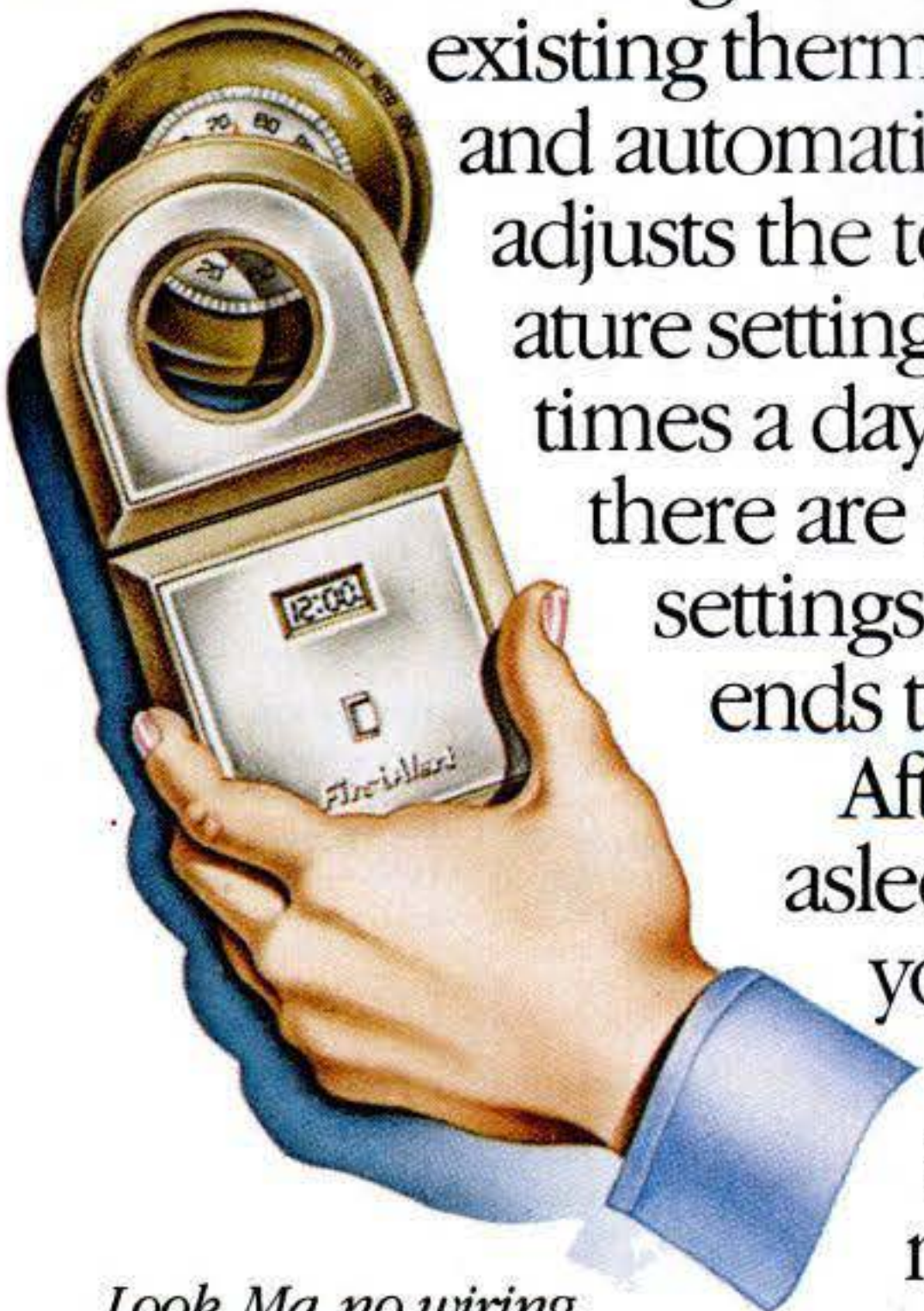
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*Weight does not include power pack and monitor. †IBM Product Center price.

Wake up to the warm new way to save.

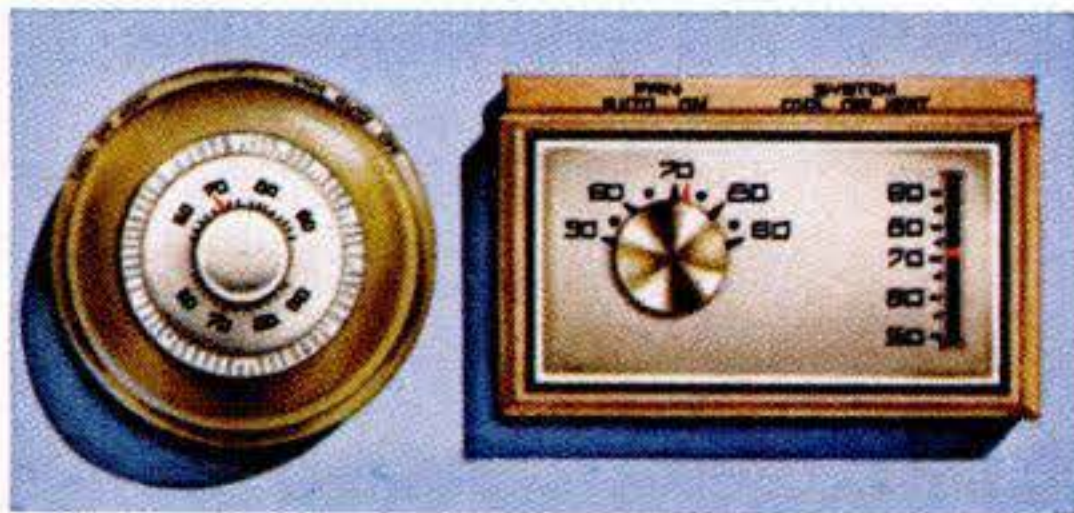
Autostat turns your thermostat into a money saver.

New Autostat fits right on your existing thermostat and automatically adjusts the temperature setting up to four times a day. And there are special settings for weekends too.



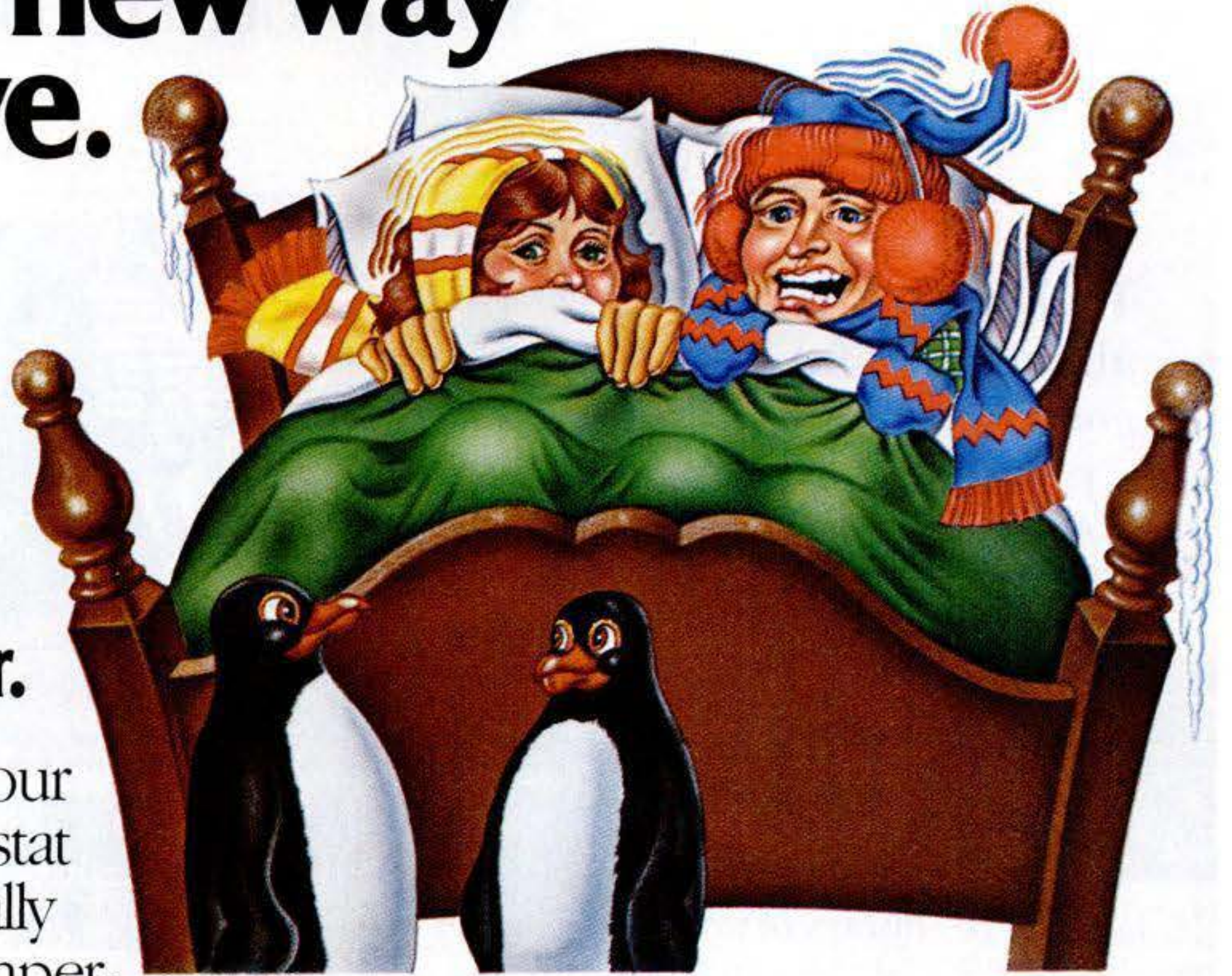
Look, Ma, no wiring.

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Now you don't have to suffer to save money.



Readers Talk Back

contact with an open flame. Other gases are formed, but these are only about five percent as harmful as phosgene. In addition, they give a strong, irritating warning of their presence.

The \$150 to \$200 for a manifold gauge set is three to four times above prices I've seen from normal tool sources. Also, mention should have been made of the old reliable halide torch, selling for \$30 or less, and the bubble-type leak detectors.

Donald P. Whyte, Hartsdale, N. Y.

Bob Cerullo replies: "Burning refrigerant gas does indeed form harmful gases, even if, as the research department at Du Pont says, phosgene is not among them."

"There is a broad price range for all service equipment. We priced three top-quality gauge sets with hoses, carry case, fittings, and the basic service valve tools needed to use gauges."

"The bubble-type leak detectors were not included because we find them the least efficient way to find a refrigerant leak on an automobile. The halide torch wasn't recommended because it produces an open flame, which is always a risk when working around storage batteries and gasoline."

Prizewinning panels

If you build the frame for a water bed as shown in "Results of the Eighth Annual PS/APA Panel Contest" [Aug.], the platform will sag, and sag badly. Standing on end, particleboard is strong, but used flat, for shelving or tables, it must be braced every 12 inches.

V. H. Block, Baltimore, Md.

Al Lees (PS Group Editor for Reader Activities and supervisor of the annual contest) replies: "Space does not permit us to show detailed assembly plans for the nine projects, but each prizewinner is rebuilt to make sure it is practical before being published: The plan for the water bed does indeed provide full support for the platform. Construction plans for the projects are available from American Plywood Assn., Box 11700, Tacoma, Wash. 98411, for \$2 apiece."

Video recorders

In August's "Through the Viewfinder" Everett Ortner states that Kodak was first on the scene with an eight-mm color video-recording system. In fact, Funico of Japan had a unit in production for some years, consisting of a 7½-inch color monitor and compact video-cassette recorder and player with AC-DC operation. One reason that this unit is a well kept secret: The price three years ago was \$1,795.

Ronald C. Wagener
Virginia Beach, Va.

Voltmeter settings

In August's "Taking Care of Your Car" the picture of the charging system check shows the voltmeter set at the four-volt range. I think you'll agree that to check a 12-volt charging system, the voltmeter should be set at 20 volts.

John C. Van Rooy, Macclenny, Fla.

Horsepower boost

The horsepower rating for the 1985 Dodge Lancer and Chrysler LeBaron turbos is given as 138 hp ["Chrysler for '85," July], and you state that this

is an eight-hp increase over 1984. Yet the '84 Lancer is rated at 142 hp. What's up?

Tom Tercheck III, Howell, Mich.

Jim Dunne replies: "The 1985 horsepower rating for both the Lancer and the LeBaron should have read 146, eight more than the '84 138 hp. As for your 142-hp number, horsepower ratings are difficult to pin down and can vary according to which report you read."

Corrections: In "Tiling an Entry Way" [Sept.] the recommended epoxy adhesive was identified as Latacreek. Its proper name is Latapoxy 210, from Laticrete Intl., Inc.

The weight given for the Honda Aero 80 ["Sleek Scooters," Aug.] was incorrect. The actual weight is 165.4 pounds. PS

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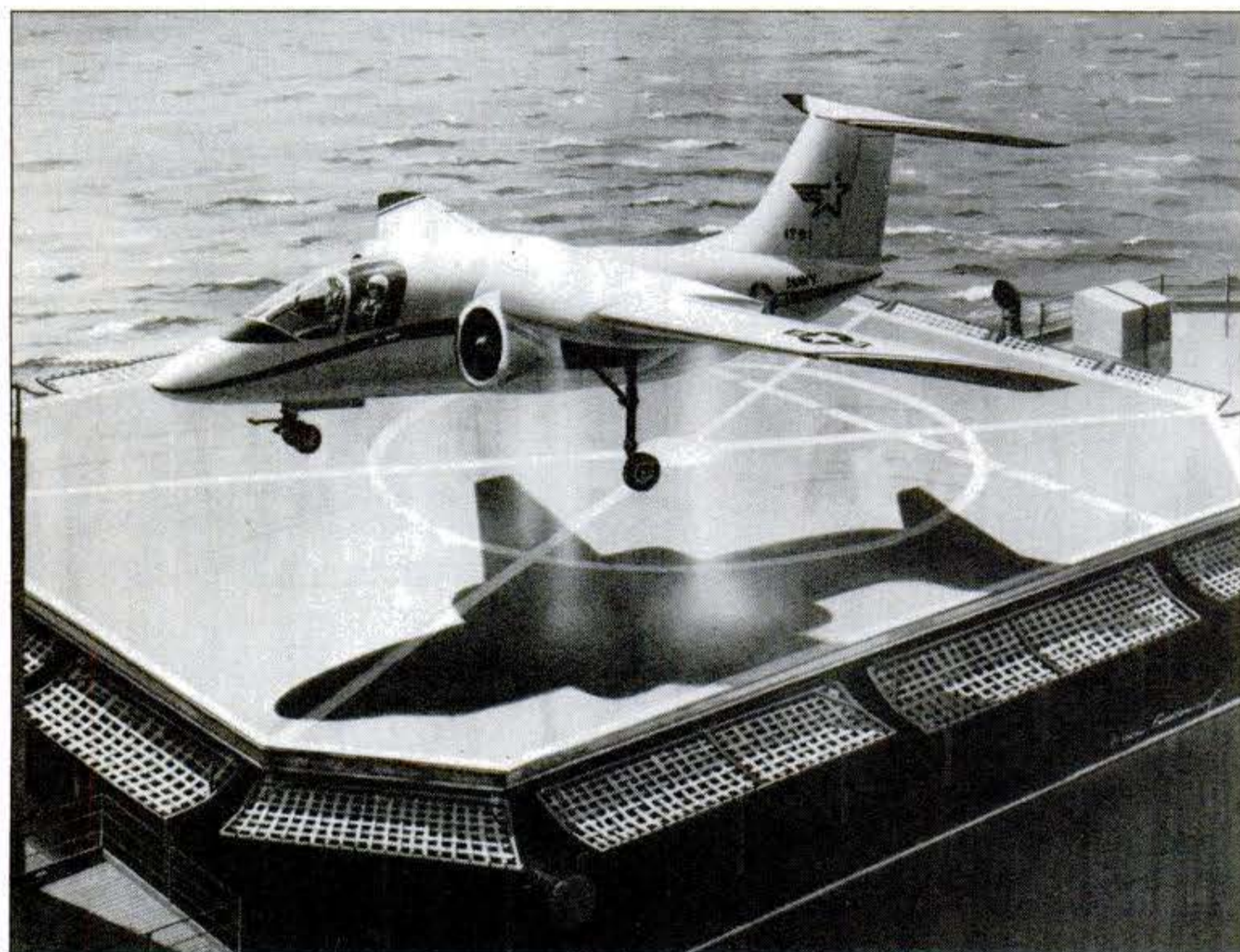
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Science Newsfront

By ARTHUR FISHER



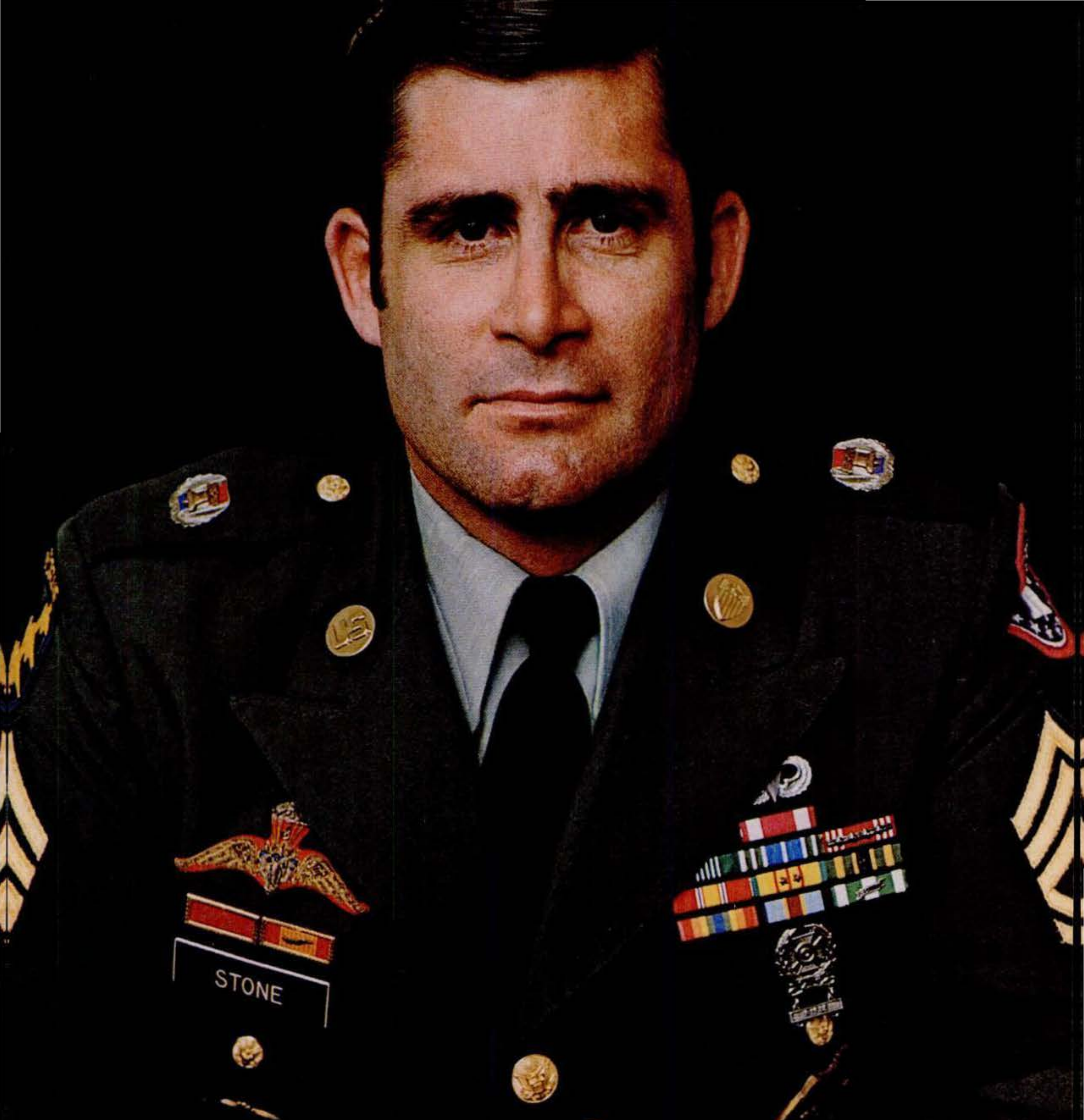
Cross-duct V/STOL

model of the propulsion system has been built by Lockheed for joint test-

that, in turn, could have profoundly negative results for life on Earth, because ozone serves as a shield against the most hazardous wavelengths of ultraviolet radiation. The outcome, among other effects, could be a rise in the incidence of skin cancers, including the most dangerous form, malignant melanoma.

Based on then-current models of atmospheric mixing and chemical interactions, the National Academy of Sciences (NAS) in 1979 predicted a long-term ozone loss from fluorocarbons of as much as 20 percent. But constantly refined models—still subject to revision—eventually reduced the NAS prediction to somewhere between two and four percent (made in February).

Now a University of California, Irvine, team led by Rowland has reported to the annual meeting of the American Chemical Society that atmospheric levels of fluorocarbons 11 and 12 have tripled since 1977. Rowland is concerned because, he says, although estimates of *total* ozone depletion have dropped, not enough is known about the effects of these chemicals on the lower atmosphere, which is “enormously sensitive to changes in the atmospheric models.” Moreover, total ozone levels dropped in 1983 by some five percent over most of the



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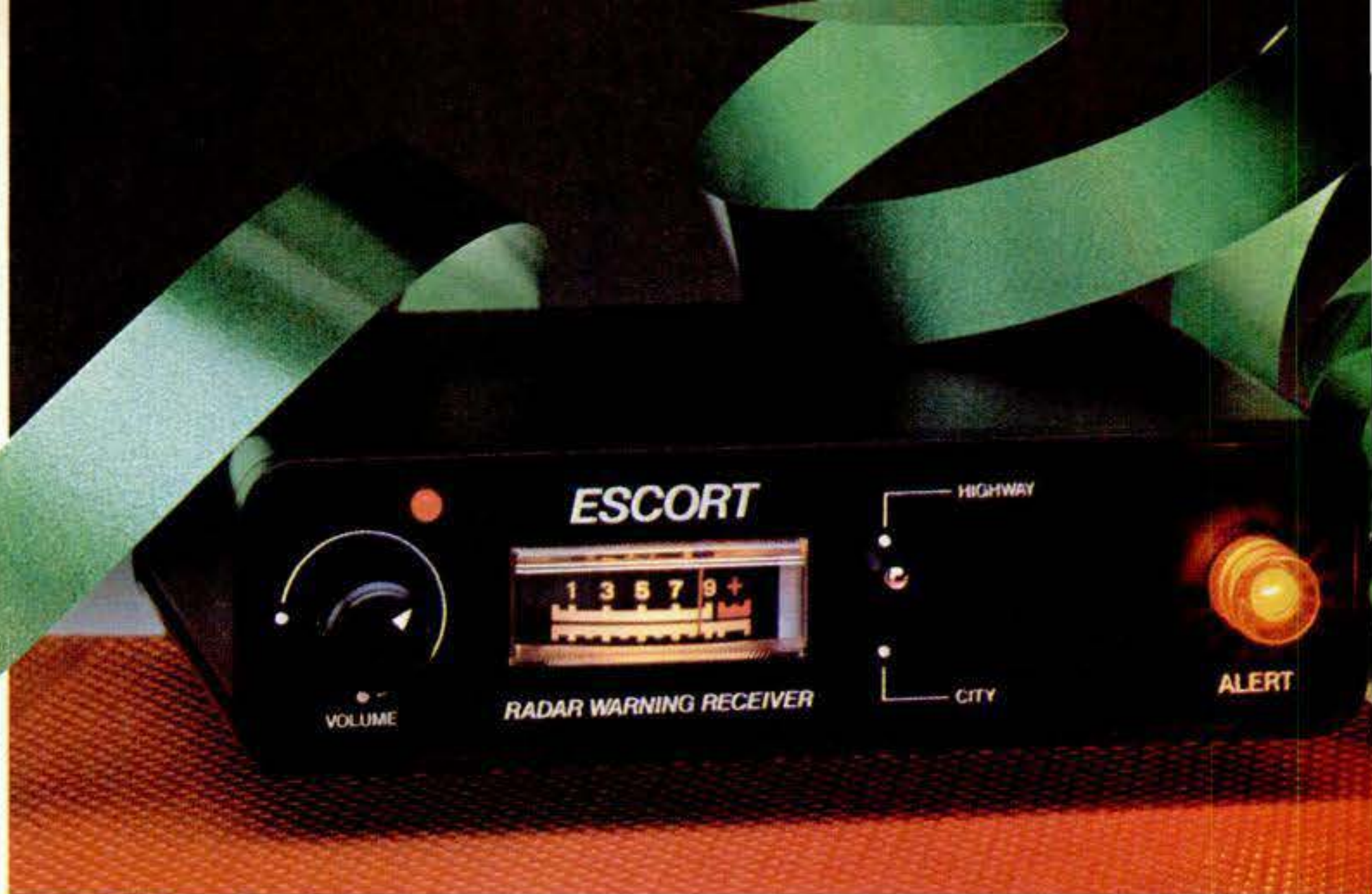
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PASSPORT offers ESCORT performance in an incredibly compact size.

All The Right Moves

Feature for feature, PASSPORT and ESCORT are unmatched. Both incorporate our unique three element warning system. Upon radar contact, the amber alert lamp lights and the meter shows radar signal strength (ESCORT uses an analog meter, while PASSPORT has a bar graph display with eight Hewlett-Packard LEDs). At the same time, you will hear an audio warning—pulsing slowly when the radar is weak, quicker as it

strengthens, then constant as you approach the radar unit. Both units have separate warning tones for each radar band: "beep" for X band, a more urgent "brap" for K band because you have less time to act.

PASSPORT adds a Mute/Dark switch to the system. In the Dark mode, the alert lamp and the bar graph meter are defeated—only the audio warning will be activated.

The Mute function is a momentary position on the switch. When you activate the mute, it defeats the audio alert for the duration of that radar encounter. After that radar signal ceases, the system automatically resets and the audio will alert you to the next radar signal.

Breakfast Of Champions

When it comes to performance, both ESCORT and PASSPORT are thoroughbreds. Both use our varactor-tuned Gunn oscillator, patented signal processor, and our Statistical

TECHNO-TALK

The compact size of the PASSPORT system was made possible only through the use of a remarkable technology:

SMD: Surface Mounted Device

Originally used exclusively in the hybrid integrated circuit industry, SMD technology is just now being incorporated in high end consumer electronics. PASSPORT is the first large-scale application of this technology to a radar detector.

The Basics

Surface Mounted Devices are micro-size transistors, capacitors, resistors, and diodes. These remarkable components are only a fraction of the size of conventional electronic parts. PASSPORT was made even more compact by mounting the SMDs on the underside of the circuit board, leaving the top surface for custom integrated circuits, microwave diodes, and other parts too complex to be reduced to SMD proportions.



Figure 1



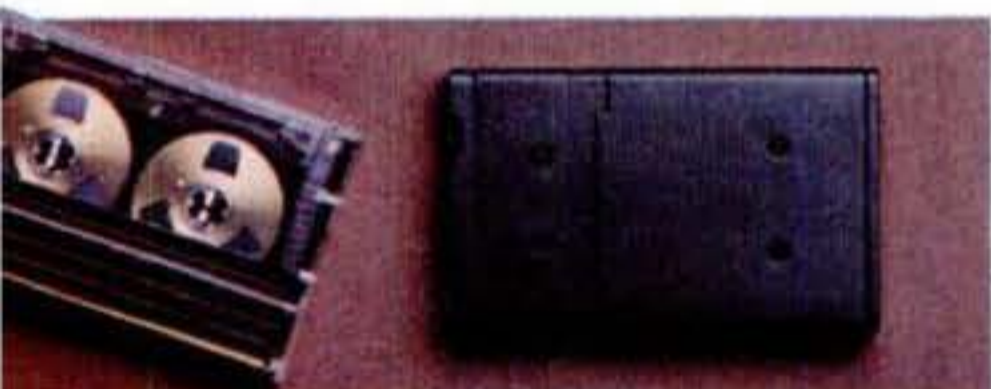
Tune in "Talkback with Jerry Galvin," America's new weekly call-in comedy talk show. Sunday evenings on public radio stations. Check local listings.

© 1984 Cincinnati Microwave, Inc.

operation Processor (ST/O/P™), which eliminates alarms caused by other radar detectors. And either PASSPORT or ESCORT will complement any car's interior. Both are constructed of sturdy aluminum and polycarbonate. ESCORT is finished in a glare-resistant polyurethane, PASSPORT is charcoal Nextel, a rich, non-glare finish that's as durable as it is elegant.

Apart From The Crowd

We've always felt that users of precision electronics are entitled to deal with experts. That's why we sell direct from our factory. There are no middlemen. When it comes to customer satisfaction, we take full responsibility.



PASSPORT is only 3/4" tall and 2 3/4" wide, about the size of an audio cassette box.

And while our system of factory-direct sales was not designed specifically for gift givers, it does offer some rather special benefits. For example, you needn't worry about buying a discontinued model still in

a store's stock. Your gift will never be seen marked down in the discount chains. More importantly, giving either ESCORT or PASSPORT shows you are concerned enough about quality to track down the only source. And there's one more advantage.



ESCORT and PASSPORT come complete with accessories.

Easy Shopping

ESCORT and PASSPORT let you do your Christmas shopping by phone and avoid the retail hassle. No searching for parking. No standing in lines. We're only a toll-free call and a parcel delivery away.

Most important of all, ESCORT and PASSPORT are guaranteed to please. Holidays or anytime, take the first thirty days as a trial. If you're not absolutely satisfied, return your purchase and we'll promptly refund your money and your mailing costs. We also back ESCORT and PASSPORT with a full one-year limited warranty.

Now you have a choice. ESCORT, the classic instrument of radar warning, or PASSPORT, pocket-size radar protection.

Order Today

By Phone: Call us toll free. A member of our sales staff will be glad to answer any questions and take your order, (Please have your Visa or MasterCard at hand when you call).

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(Phone M-F 8-8, Sat 9-5:30 EST)

By Mail: We'll need your name and street address, daytime phone number, and how many PASSPORTs and ESCORTs you want. Please enclose a check, money order, or the card number and expiration date from your Visa or MasterCard. (Personal or company checks require 18 days processing.)



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Seeing Is Believing

Figure 1 shows the amazing size difference between conventional components and their SMD counterparts. In fact, the SMDs are so small, prototype PASSPORTs had to be constructed with a steady hand and a tiny pair of tweezers. Hardly an efficient production technique.

A Serious Commitment

Although a sophisticated numerical control machine that can accurately mount SMD parts costs several hundred thousand dollars, Cincinnati Microwave is firmly committed to SMD technology. By the end of the year we will have three such machines in operation.

The machine places over one hundred SMD components on PASSPORT's epoxy circuit board, affixing them with a special adhesive. The circuit board then passes through an ultraviolet curing chamber, securing the parts for what lies ahead.

A 500° Bath

The circuit board is then passed through a flowing bath of molten solder. The SMDs are on the bottom as the board passes through this 500° bath of liquid tin/lead alloy. A small area of the finished board is shown in figure 2.

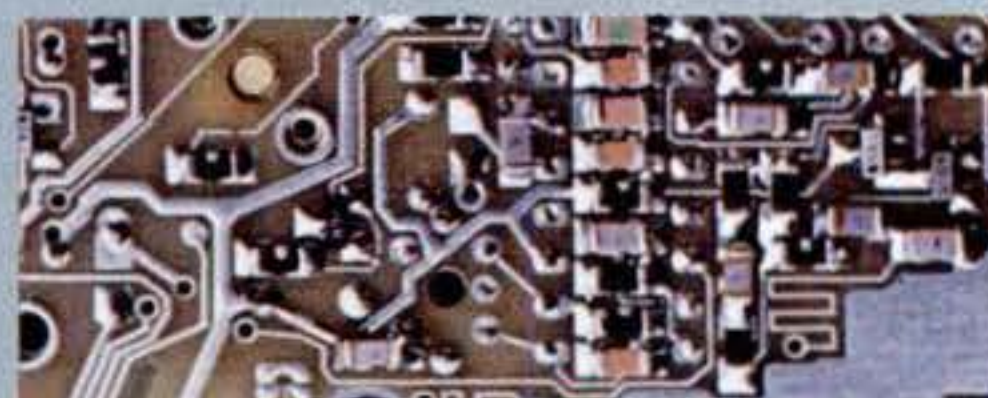


Figure 2

To Be Continued...

The revolutionary SMD components are only one part of the story that made PASSPORT possible. We'll reveal some of the other technology in future sections like this one.

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Seat belts help save lives and reduce injuries.

Yet seat belt usage is only about 15 percent.

General Motors thinks this too often results in tragedy. We want to do something to encourage more people to wear their seat belts.

This may help.

Effective April 16, 1984, every

new GM car and light truck delivered by a GM dealer in the United States comes with a one-year insurance certificate from MIC General Insurance Corporation, the insurance people from GM.

The certificate will be provided without additional charge, and every occupant wearing a seat belt in these cars and trucks will be covered by

this protection. \$10,000 will be paid to the estate of any occupant who suffers fatal injuries while wearing a GM seat belt.

Now there is even more reason to buckle up.



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Pontiac
Oldsmobile
Buick
Cadillac
GMC Truck

**Buckle your ~~seat belt~~
Life Belt**

Mitsubishi for '85: a soft cruiser and a little hot rod

Mitsubishi's two new 1985 additions to its U.S. lineup are studies in contrast. One is a plush freeway cruiser. The other is a low-cost hot rod.

The Galant (lower photo) is the plush four-door sedan, luxuriously ap-

pointed with good attention to detail. Its 102-inch wheelbase and 183-inch overall length make it one of the largest Japanese imports. The 2.4-liter (146.5-cu.-in.) engine, rated at 101 hp, is just adequate to handle the car's 2,778-pound curb weight. The major villain, I found, is a mushy four-speed automatic transmission that fails to deliver start-up acceleration. Unfortunately, it's the only transmission available for 1985 models.

An optional microprocessor-controlled automatic suspension system improves cornering. The only interior options are a sun roof and an electronically tuned stereo system. With the latter, Mitsubishi includes remote controls in the steering-wheel hub. Sticker price for the Galant will be about \$12,000, with another \$800 for

the automated suspension system.

At the low end, the subcompact 1.5-liter (91.5-cu.-in.) Mirage (top), a front-drive hatchback, will be base-priced at about \$5,400. With the optional 1.6-liter (97.6-cu.-in.) turbo engine the price goes up to \$7,700. But then the boxy little car has the heart of a lion, delivering 102 hp in a body that weighs less than 2,200 pounds at the curb.

The base Mirage is available with a four- or five-speed manual or a three-speed automatic. Turbo buyers can choose the five-speed manual or the automatic. Whether in traffic or on empty straightaways, Mirage is nimble and quick. One quirk: At slow speeds, heavy steering makes parallel parking or backup maneuvering an upper-arm chore.—*Jim Schefter*



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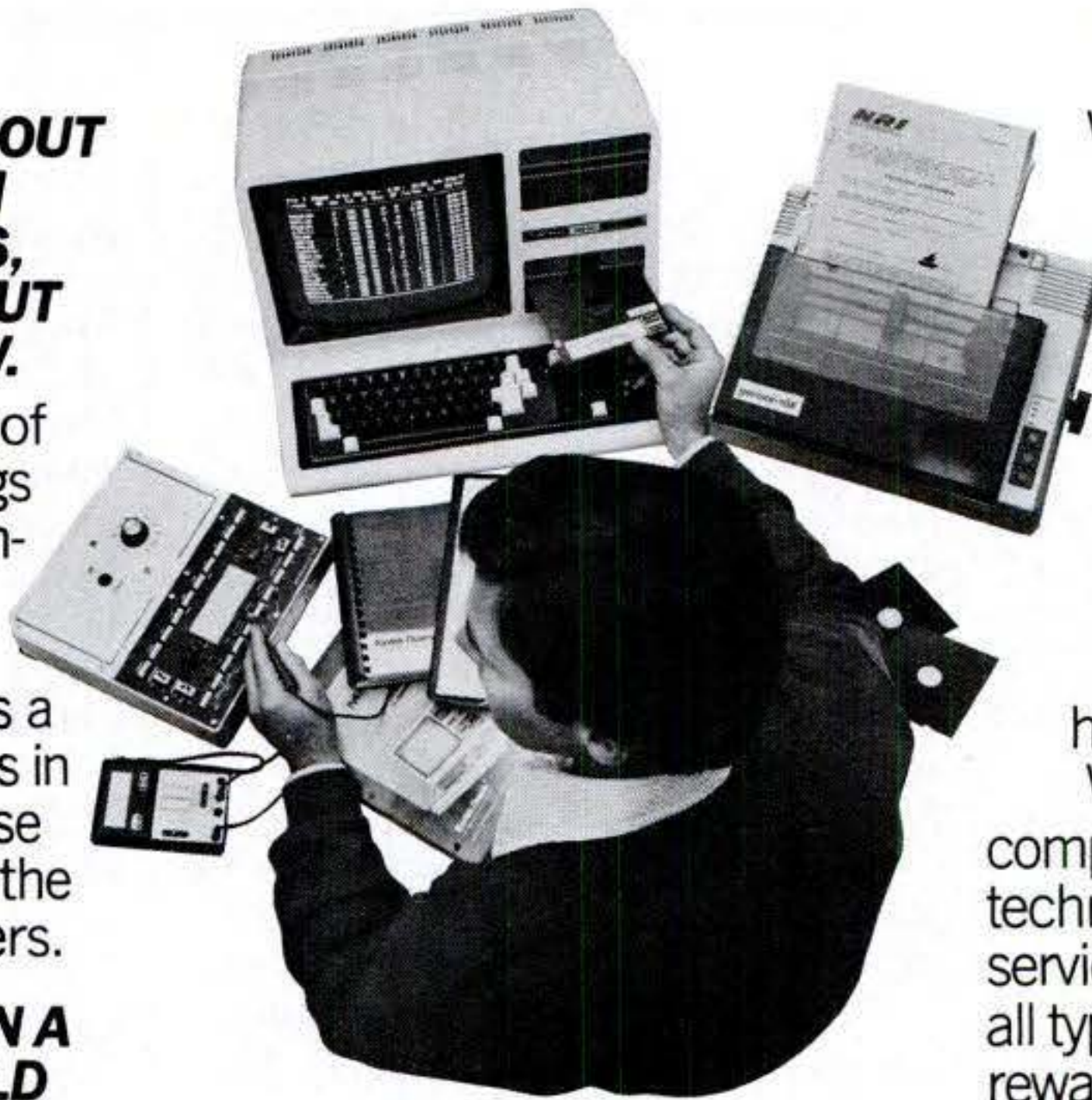
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"Say, Smokey—"

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Pings when cold

My 1983 Chevrolet S-10 pickup with a V6 engine pings when cold under moderate to heavy acceleration. After about five minutes the pinging stops. I've tried various brands of regular and premium unleaded gasoline, but the noise persists. When the dealer retarded the spark, the problem became worse. I've tried every mark on the crankshaft pulley to no avail.

Doug Henderson, Columbus, Ohio

Your engine has a "trapped" spark: When you accelerate, the spark is held, or trapped, at an advanced setting by a check valve in the distributor vacuum line. The extra amount of spark helps drivability, but it also encourages pinging. There is an air bleed that leaks the spark off in time, but in your case it's happening too slowly. Be sure that the EGR is working; it helps suppress detonation. With this information you should be able to work out a plan to conquer the pinging.

Hazardous engine

I have a problem with my 1979 Dodge Aspen with the Slant Six engine that bothers my light-footed wife and daughters more than it does heavy-footed me. The engine dies when you slow down at low speeds or let up on the accelerator when turning a corner. It restarts right away. If you pump the accelerator when cornering, the engine almost never dies, but pulling into traffic can be plumb hazardous to your health.

John H. Barton, Saco, Mont.

The odds are that you'll have to remove and examine your carburetor. You're likely to find the metering rods and accelerator pump way off spec; the plastic arm that controls the high-speed metering rods and accelerator-pump metering is either loose or broken.

Erratic idle

My 1982 Honda Accord with automatic transmission hasn't idled properly for some time. At first it would idle smoothly at one stoplight and roughly at the next one; other times

it would be OK for a few days and then have trouble the following day. The dealer checked everything to spec, and the only problem he found was that the air-filter control valve was opening at random; this caused heated air to enter the carburetor. Now after I drive 130 miles or so, the car still idles roughly when I stop for a light. The dealer doesn't seem to know what to do.

Leslie L. Blanton, Montgomery, Ala.

It sounds like a hot carburetor fuel bowl and boiling fuel. Don't use gasoline with alcohol in it. The vapor pressure of fuel is important, especially in warm weather. Change gasoline vendors, and use premium fuel. If you use fuel with a low vapor pressure, direct air into the carburetor area, and insulate critical parts with heat shields wherever possible.

A good test is to let the car idle until the engine begins to sputter. Spray the fuel bowl with water from a garden hose; if the problem clears up, you've got it. (Don't put lots of cold water on a hot exhaust manifold, though.)

Demagnetize a van?

My father-in-law's van was struck by lightning while parked under a tree. Now the compass points west all the time. As an ex-Ford dealer, he says that he's demagnetized speedometers, but never an entire van.

Joan Bray, Des Moines, Iowa

How about a TV-repair shop using a degausser on the roof and sheet metal of the van? It just might do the trick. TV service people use degaussers to demagnetize TV sets; they're pretty powerful machines.

Wants quietest car

I have an unusual need in a car, but it's important to me and my family. I have severely noise-damaged ears; the resulting tinnitus—ear ringing—means that I must travel in the quietest-possible car. Our 1981 Buick Century Limited was the quietest car we could find at the time, but it's not quiet enough for me to travel very far. My primary concern is noise from wind, road, engine, and equipment

such as air conditioning; A/C is a must because the windows cannot be rolled down. What is the quietest car available for less than \$25,000?

Susan Hobart, Cypress, Calif.

I believe you'll find the answer to your problem in a Lincoln Continental or Ford Thunderbird.

Turbo or big engine?

I'm confused about turbocharged gasoline engines for passenger cars. What are the advantages of a small-displacement turbo engine over a larger-displacement non-turbo engine of equal horsepower? My main concerns are durability, resale value, serviceability, and performance.

Paul Erickson, Albuquerque, N.M.

A turbocharged engine provides more power than does a normally aspirated engine of equivalent size. I'd prefer a small turbo engine over a larger conventional engine of the same horsepower; although the turbo's durability is still not up to par, it's getting better all the time.

But before you charge off and buy a turbo-equipped car, check out what's on the market; some are bad news. Resale varies with the make; naturally, good ones have higher resale values. Good service? That's a problem, and I'd say it's a local situation. The turbo-charger itself is simple, but turbo fueling is complex. Turbo engines need to be designed from a clean sheet of paper; retrofits are spooky.

Cold clatterer

My 1983 Ford F150 with the 300-cu.-in. six clatters when the engine is cold. After I drive about four blocks under load, the noise disappears. Retarding the timing helps, but then the engine hesitates. Is there a cure for this?

Lawrence Westcott
Crystal Falls, Mich.

There is a Ford service bulletin—article number 83-23-14-S, dated February 28—that deals with this problem under steps A and B. Step A involves the EGR and is pretty easy. Step B, however, means replacing the pistons with bigger and better ones. Some cases can be solved without step B. See your Ford dealer for more details.

Got a car problem? Send it to "Say, Smokey—," POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. All letters are read; and those of widest interest are answered in this column. Due to the large volume of mail, Smokey cannot reply to letters not selected for publication.

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Through the Viewfinder

By EVERETT H. ORTNER



Relaxing case

I wouldn't ask you to sit on anything that I hadn't first checked out with my own 200-plus pounds. And, although I don't own the rump in the photo above (it belongs to PS Associate Edi-

tor Stuart Brown), I have sat on that camera bag and can testify to its comfort—for a camera bag, that is. The clever design consists of a folding metal frame supporting the bag by wide loops. The bag, of nylon with a reinforced vinyl base, is an ample nine by 13 by 9½ inches. Two zippered side compartments hold film, filters, and other accessories.

It's fine for resting, of course. But I like the bag for another reason: When I'm shooting from a low angle with my camera on a tripod only a couple of feet from the ground, I can sit in comfort while I'm peering through the

viewfinder. Spiratone (135-06 Northern Blvd., Flushing, N.Y. 11354) calls the bag a Photo Seat/Case and sells it by mail order for \$34.95. However, the company also offers it as a premium: Buy \$75 or more from the Spiratone catalog, and you pay only \$10 for the bag.

The crystal ball

You get a lot of interesting admissions and speculations when you're interviewing people for an article, as I did in writing "Genius SLRs," which you'll find elsewhere in this issue. They fall into several categories. For instance:

- Grudging admissions (from representatives—"Don't use my name, please"—of camera makers whose SLRs lack the features in question): Yes, it's likely that many—perhaps most—coming SLRs will have built-in motors; possibly will have built-in flash; almost certainly will include an autofocus system; surely will use more liquid-crystal displays; and of course will be able to read the coding on films so they can set film speed automatically.

- Reluctant admissions (from makers whose cameras *have* these fea-

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tures): Yes, liquid-crystal displays can become hard to read after a time—say, five years—and will need to be replaced by the maker's service department. Yes, those built-in lithium batteries that maintain a camera's memory, even when you remove the removable batteries, last only about five years and also can be replaced only by the maker's technicians.

• Off-the-record rumination (by a camera-company executive): "There is a lot of work going on in liquid optics. Your eye changes focus by changing its pressure and causing the muscles to contract and expand. Well, think about the application of that technology to some kind of lens in your camera—a solid lens with no moving mechanical parts."

• Thoughtful listing of future possibilities (by another executive): 1) SLRs with noninterchangeable lenses of modest zoom range to make autofocus more feasible. Long-zoom-range lenses would be too heavy for most people to carry, but auxiliary lenses would increase the utility of the standard lens; 2) solid-state imaging—i.e., more cameras like the Sony Mavica [PS, Dec. '81] and the new Canon camera, which depend on electronics rather than film and chemicals; 3)

more LCDs, even ganged arrays, which have a low power drain and might be used to show graphically the metering pattern being used.

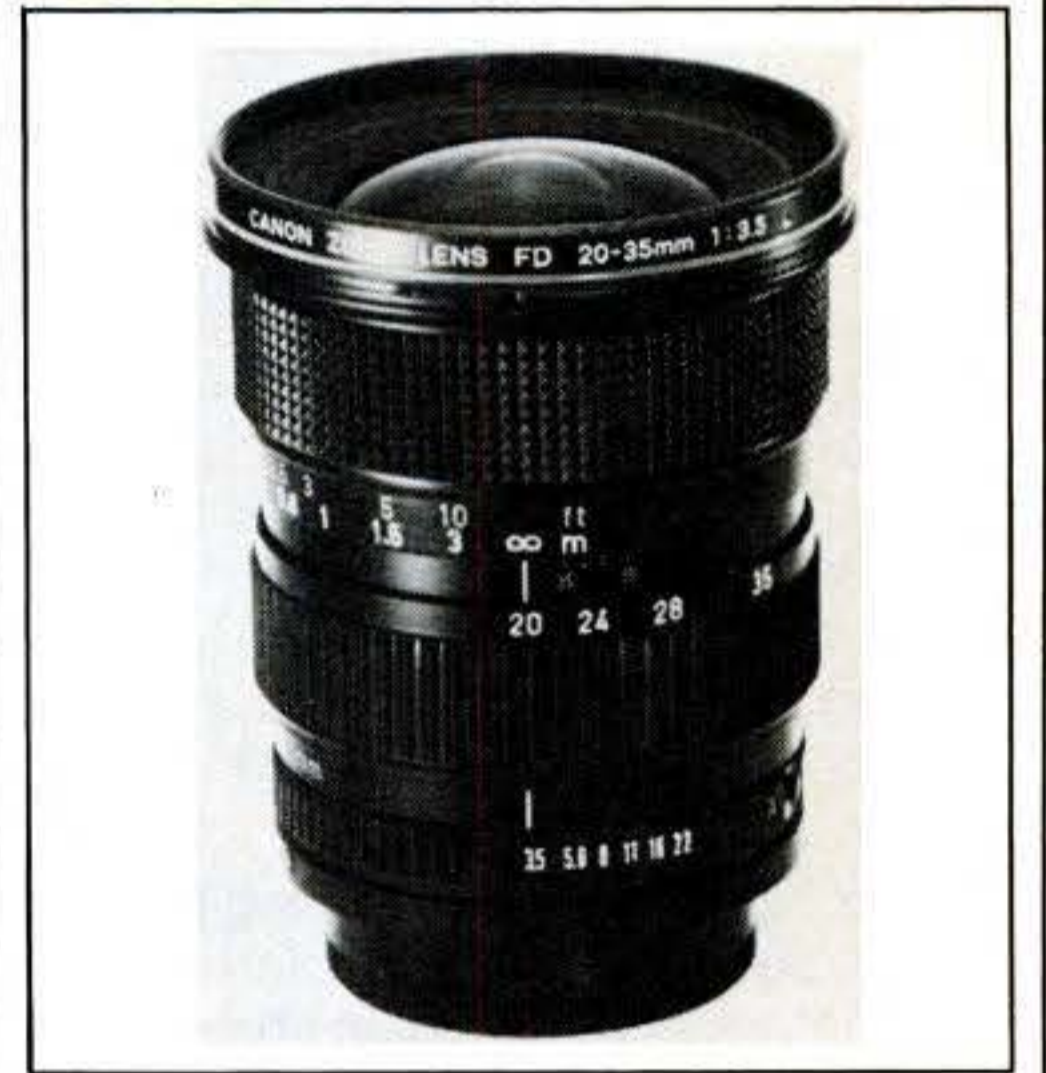
Super-wide zooms

"We've got it," said the note on my desk. Underneath the note—from Lyman Gaylord of the Canon camera people—was a press release and a picture (below, right). Sure enough, there was the 20–35-mm super-wide-angle zoom lens I mentioned in my column in August. It had appeared in Japan,

and I wrote: "When will we see it in the U.S.? Canon's not saying."

Now Canon is saying. The new FD 20–35 f/3.5 is here and lists for \$860. It has separate zoom and focusing rings, and it weighs 16.5 ounces.

But which is the "world's first super-wide-angle 'one-touch' zoom lens"? Sigma says the title belongs to its 21–35-mm f/3.5-4.2 17-ounce lens (below, left). One ring both zooms the lens and focuses it. The snap-on lens hood the lens is wearing is designed to eliminate flare without causing vignetting. List price: \$600. PS



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Most big tillers were designed to just till (but many now offer clumsy "add-on" attachments as an attempt to justify their high cost). The Mantis was designed from the beginning to precisely match a small, powerful engine to a variety of useful attachments for your yard and garden.

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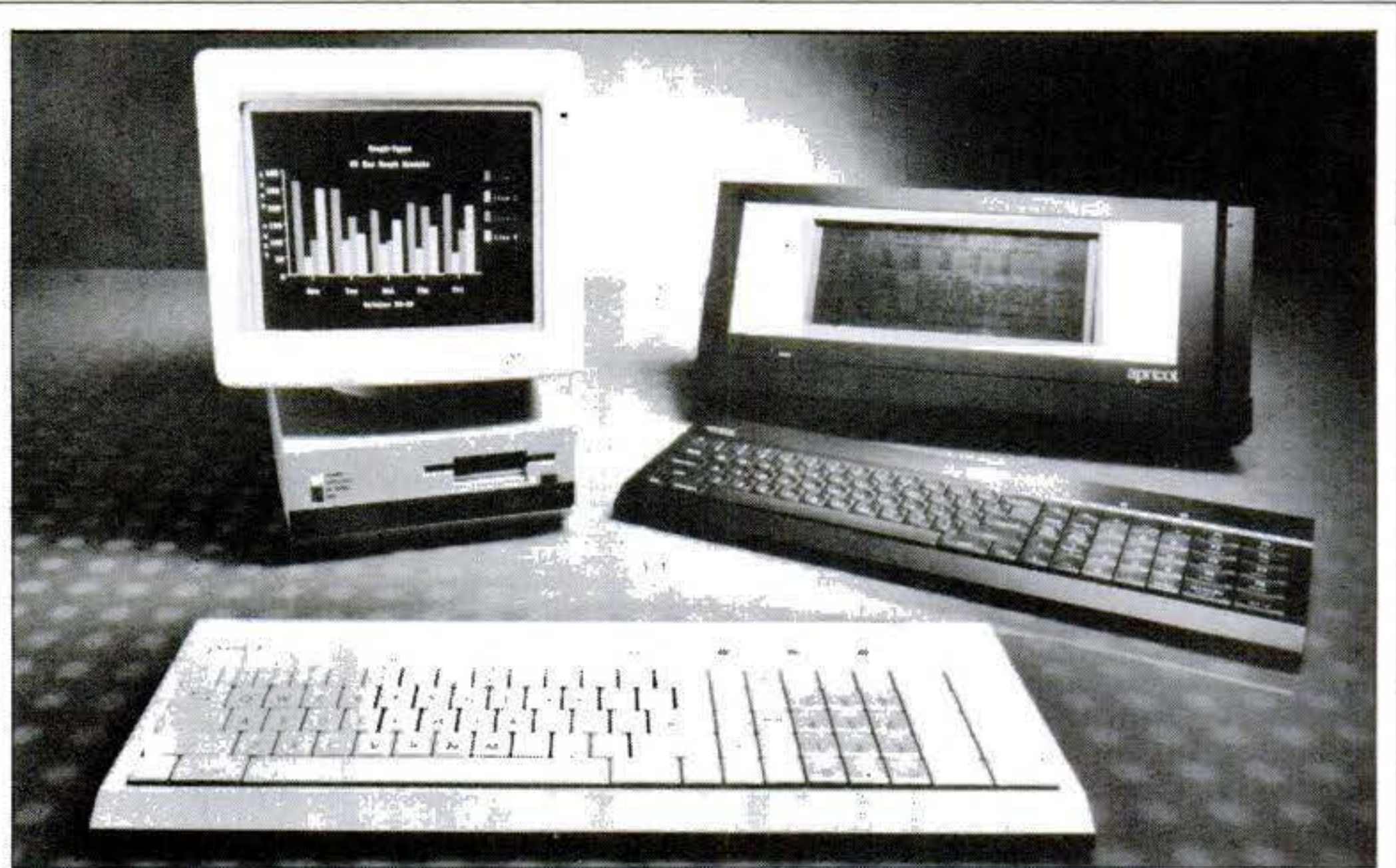
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Bits & Bytes

By JOHN FREE



A portable that listens

Speak to the Apricot Portable—it has a vocabulary of 4,096 words, 64 of which can be used at any one time—and you can operate many functions orally. The 13-pound British import (above, right) from ACT (North America) Inc. (3375 Scott Blvd., Santa Clara, Calif. 95051) features voice recognition and a 25-line-by-80-column LCD screen (640 by 256 dots). A double-sided 720-kilobyte (K) 3.5-inch disk drive and 256K of RAM (expandable to one megabyte) are standard. The \$2,695 portable (\$3,195 with color electronics for an outboard monitor) has a cordless infrared keyboard and an infrared combination mouse and trackerball that rolls about or works statically in your hand.

ACT's new desk-top Apricot F1 (above, left) has a similar disk, user memory, and infrared keyboard, plus standard color electronics. The F1 is \$1,595; an optional 10-inch color monitor is \$650. Both MS-DOS-based computers operate with up to 32 other Apricots on optional local-area networks, and both include several software packages.

Smarter smart modem

Smart modems put your computer online with other computers by automatically answering the phone or dialing a number. They're clever, but now there's a new modem with a much

higher IQ: Watson, from Natural MicroSystems (6 Mercer Rd., Natick, Mass. 01760). It's a PC-compatible plug-in board that contains a microprocessor, software, and an analog-



to-digital system for voice recording and playback (photo above). Result: It also allows your computer to communicate with humans.

For instance, it can become a phone-answering machine. Using the telephone, you record general or individual phone messages (saved on disk). Watson gives the general message to everyone who calls; individual ones to specific callers who identify themselves by entering a code number on a push-button phone. Watson also takes messages over the phone, calls you at home to remind you of appointments, and keeps an electronic phone book. Price: \$849 for the 300-baud model; \$998 for 300/1200-baud. **ES**



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With this memory bank watch you can store 50 separate sets of personal information you want to keep on hand. Each set can contain up to 6 letters and 12 numerals. It's ideal for storing timetables for flight and train schedules or daily appointment schedules for each day of the week. Or other information such as telephone numbers, bank accounts, credit card numbers, anniversaries, birthdays, postal codes, price tables and telex codes.

This computer-on-a-wrist will edit each of the 50 separate information displays for you. With a touch of a button, you can easily retrieve the programmed information in alphabetical order. Unused pages will not appear. It's your miniature personal record book and file cabinet.

THE COMPUTER THAT NEVER FORGETS

This electronic genius also has an extraordinary organizing talent. It reminds

you of important dates — as they approach — by sight and by sound.

You can program it months in advance. Events like meetings, appointments, birthdays, and anniversaries (yes, this timekeeper sees to it your anniversary is remembered *before* someone special has to remind you).

When that special date arrives, this CASIO reminds you with an alarm, date and 6-letter message. What's more, you can program this multi-talented timepiece for daily events. To wake you up. Catch your bus. Program it for any minute you choose.

Or set it to beep-beep you every hour on the hour. And because of the AM/PM indicator, you won't be setting it for the wrong time of day.

PRECISION STOPWATCH AND COUNTDOWN TIMER

This precision timepiece also boasts a full-function stopwatch and countdown timer alarm. With a press of a button you can set the fiercely talented stopwatch into motion. Record split times, 1-2 finishes (up to 24 hours), or freeze the figures anytime to 1/100 second accuracy.

The countdown timer alarm can be set from 1 minute to 60 minutes and times to 1/10 second accuracy. When you reach zero, the alarm sounds and the pre-entered time is automatically retrieved.

TIME, ELECTRONIC CALENDAR AND THREE GREAT STYLES

This intelligent timepiece also gives you hours, minutes, seconds, am/pm, year, month, date and day. And you can change over from 12-hour to

24-hour formats with a touch of a button. All with uncompromising accuracy to 1/2 second per day.

Other distinctions? You have your choice of sporty lightweight black polysulfone model **DB-50** for **\$49.95**, dressy chrome/stainless model **DB-500** for **\$59.95**, or gold-plated model **DB-500G** for **\$79.95**.

OUR DOUBLE GUARANTEE

ON THE RUN is America's source for innovative timepieces and we back this watch with our double guarantee.

First you get the included warranty: One-year parts and labor (in the rare event repair is needed you'll find this service-by-mail feature very convenient). Secondly, we guarantee your satisfaction. If not delighted with your new CASIO, return it in new condition within 30 days for a full refund.

We're one of the largest timepiece dealers in the United States and we're as close as your phone. Orders are accepted 24 hours a day, 7 days a week. We almost always have the watch you want in stock. Shipments are generally made within 48 hours from the day we receive your order.

Order now and be delighted.

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Credit card holders may use toll-free numbers below, or send check or money order **plus \$2.50** for each watch. Add an additional \$2.00 for U.P.S. **BLUE LABEL** air delivery. North Dakota residents add 4% tax.

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On The Run

107 Roberts St., Dept. PS-12
P.O. Box 67, Fargo, ND 58107
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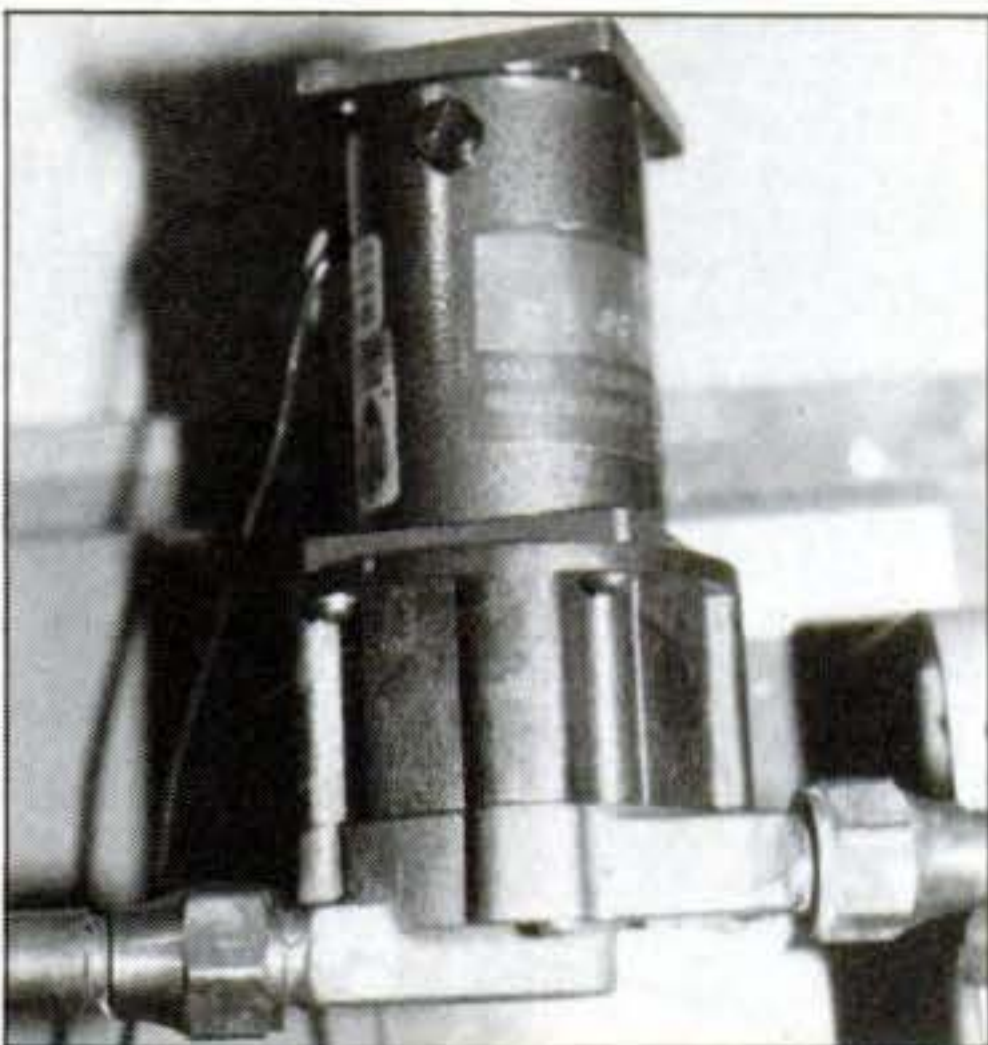
TUFOIL® CUTS THE COST OF OWNING A CAR.

Adventures in Alternate Energy

All-solar system heats and pumps water



Reliability and simplicity of operation are the goals of Allen Kagel's system.



Solar system's control module (top) in basement incorporates an efficient DC pump motor (above) connected directly to photovoltaic panel on roof.

To make his home less reliant on energy from utility companies, Allen D. Kagel, a Newark, Del., dealer in built-in vacuum-cleaner systems and solar heating equipment, retrofitted a photovoltaic panel and a high-efficiency DC pump unit to his rooftop solar water-heating system. The system eliminates the need for purchased electricity to circulate a heat-transfer solution to and from the solar collectors. The modification also permitted him to eliminate the original system's electromechanical differential control module—a device he says is prone to reliability problems. Kagel spent \$800 on the 37-watt photovoltaic panel from Arco Solar Inc. (Box 4400, Woodland Hills, Calif. 91365) and a model 809HS 12-volt DC pump made by March Mfg. Inc. (1819 Pickwick Ave., Glenview, Ill. 60025). In retrospect, he says, a 20-watt panel would have sufficed, and the project could now be completed for less than \$500.

Kagel estimates that the all-solar system will pay back its own cost within five to seven years (with state and federal tax credits) and should have low maintenance costs owing to its mechanical and electrical simplicity. The photovoltaic array (center in top photo) faces four degrees more eastward than the twin collectors so that the pump begins circulating solution in the morning while the collector panels are warming up. This arrangement also shuts the pump down before the collectors can dump heat into the evening air. Kagel will answer specific questions from readers who send a self-addressed, stamped envelope to him c/o Cyclone Dist., Box 432, Bear, Del. 19701. —S. F. Brown

Your idea can bring you \$250

Every other month, **POPULAR SCIENCE** presents a reader-submitted project that demonstrates an innovative method to replace or conserve fossil fuels. To enter your alternate-energy project, send black-and-white photographs, a sketch, and a written description to Energy Adventure, **POPULAR SCIENCE**, 380 Madison Ave., New York, N.Y. 10017. We will pay \$250 on acceptance. Materials cannot be returned unless a stamped return envelope is enclosed.

HOLIDAY GIFT IDEAS



Many fine companies have arranged to have their suggestions for exciting holiday gifts in this special 16-page section.

You'll find dozens of outstanding products for giving—and receiving.

Hint: Circle or check the item you'd like, and pass it along to the one you love for her gift to you.

Our best wishes for a Happy Holiday!

Shopping Ideas for the Holiday Season

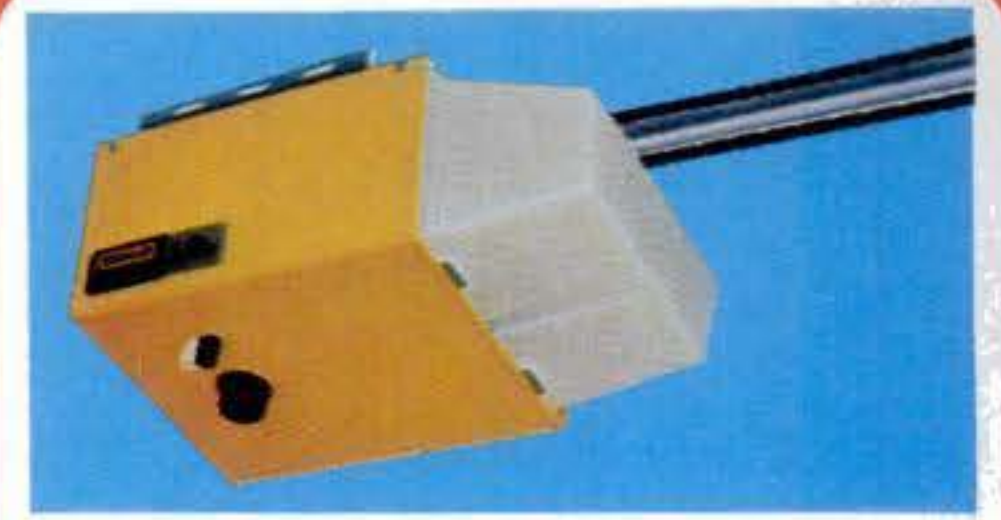


The Shape of Things To Come.

Introducing a revolution in power tool technology: the M47 Series™ drill. From Black & Decker. This remarkable tool is a completely new design—streamlined and powerful for increased performance. It's got straight sides for more accurate drilling. Center pistol grip for better balance. Flat back for applying greater hand pressure directly in line with the bit. And an optional rotating side handle for tighter control, with a compartment for storing bits. (Side handle *free* with purchase of 3/8" variable speed reversing drill—model #7144—thru 12/31/84.)

Full 2-year home use warranty.

This holiday season, put someone's workshop in great shape. With a Black & Decker M47 Series drill.



This Christmas, give your loved ones the security and convenience of a Stanley U-install® Garage Door Opener. It's designed for easy do-it-yourself installation in a single afternoon, and they will appreciate the proven steel-drive dependability, solid-state controls, and easy-to-change digital codes. Stanley Garage Door Openers are maintenance-free and built to last by the Do-It-Yourself Company.™ Everything needed—from the heavy-duty power unit to the tiniest screws and hanging brackets—is included right in the carton. Get a bonus gift—a free digital keyless entry with each Stanley Premier or Deluxe opener purchased through December 31, 1984. Look for our ad in this gift section. Stanley helps you do things right.®



With the Ready-Lite rechargeable light from First Alert, you'll never be left in the dark.

It's better than a flashlight because it's always fully charged, hanging right where you can find it. And only Ready-Lite has an adjustable beam width and a swivel head to shine the light just where you want it.

But best of all, Ready-Lite shines 50% longer on a single charge than the other leading brand. Ready-Lite by First Alert, because your family comes first.

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UHF and "T" public service bands; both the 70 cm and 2 meter amateur bands; plus, for the first time ever, both the military and federal government land mobile bands. Both automatic and manual search, lockout, scan delay, direct channel access. Even a liquid crystal display. Flexible antenna, ear-phone, AC adapter/battery charger and carry case are included.

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See your Uniden® Bearcat® Dealer now for a demonstration of the amazing Bearcat®100. Get complete information about the world's first hand-held, no crystal scanner.

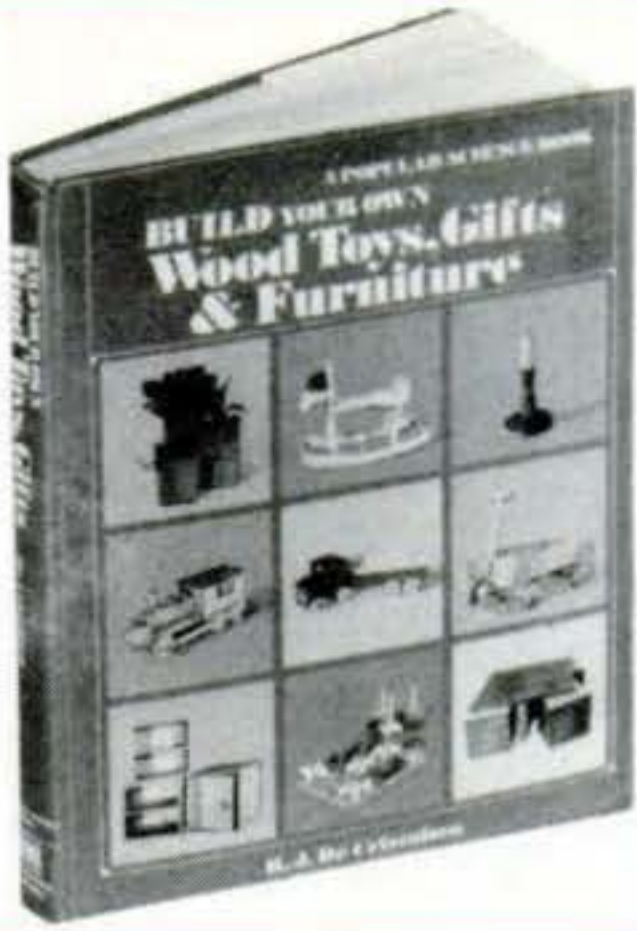
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Shopping Ideas for the Holiday Season



How to build 70 projects just for fun... **BUILD YOUR OWN WOOD TOYS, GIFTS & FURNITURE** by R.J. DeCristoforo. Step-by-step how-to, materials lists and measured construction drawings for building toy cars & trucks, a kiddie car and rocking horse. Bud vases, candlesticks, a butcherblock table, corner shelf, coffee table, much more. Order Book #0176. Send \$24.95 + \$2.39 delivery & hdg. to Popular Science Books, Dept. P4ZP, Box 2018, Latham, NY 12111. (Res. of AZ, CA, CO, FL, GA, IL, MI, NY, OH, PA, SC, VA, VT, WI add sales tax.)



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Shopping Ideas for the Holiday Season



The Wagner® Power Stripper™

lets you remove paint and varnish in little time and with little trouble. The Power Stripper has two temperature settings, so you can quickly remove several layers of paint, thaw pipes, soften adhesives and more. The Power Stripper also has a range of tips for use on intricate woodwork as well as large flat surfaces.

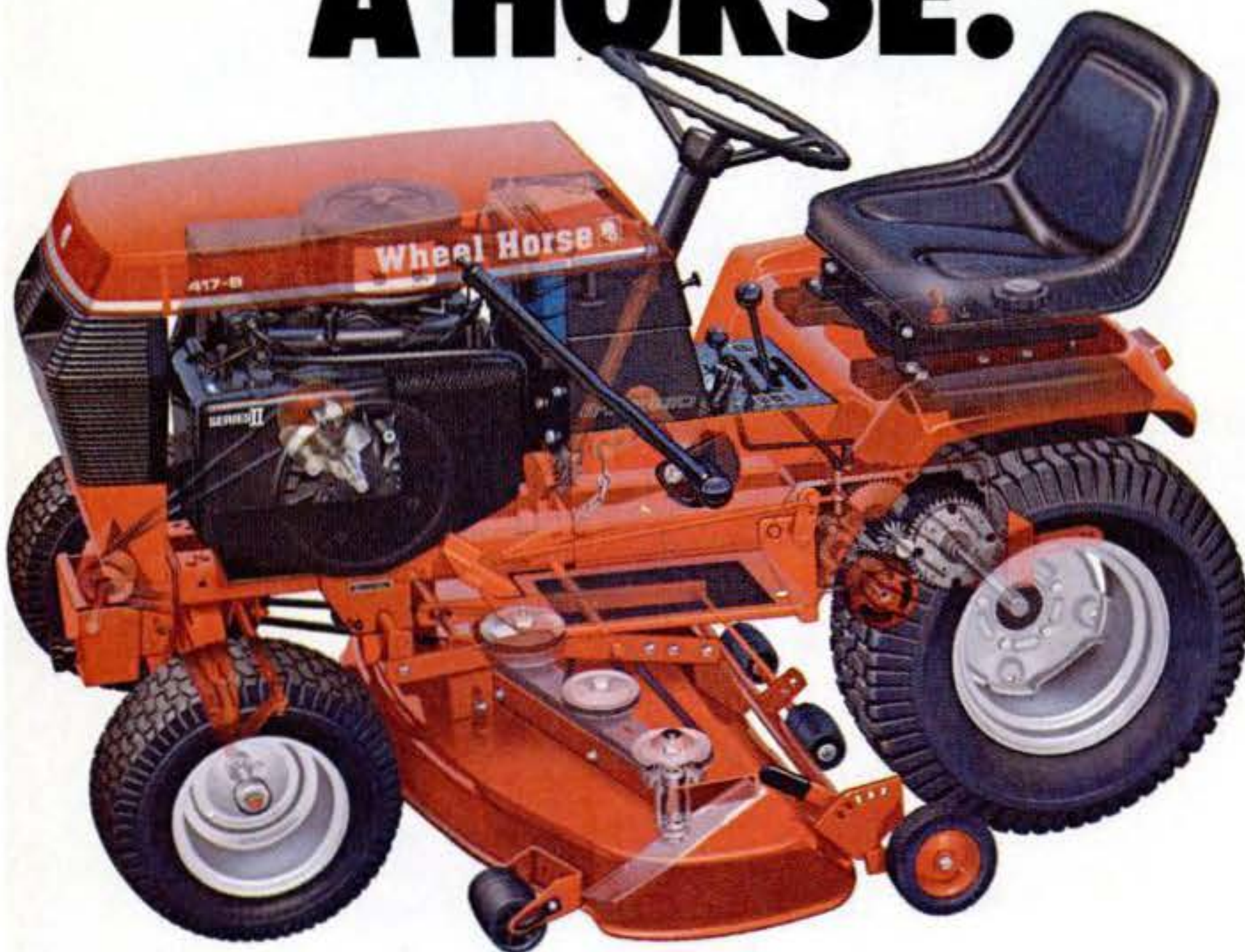


Introducing Black & Decker's Grip-It™ screws, the all-in-one anchor and fastening system. It's perfect for masonry, concrete, and brick. And in drywall, the Grip-It anchor threads right in with just a screwdriver. It's incredibly fast, and easy. Plus, Grip-It works in wood and sheet metal, too.

The Grip-It kit comes complete with everything you need for any home fastening job.

So drop a hint for Grip-It this holiday.

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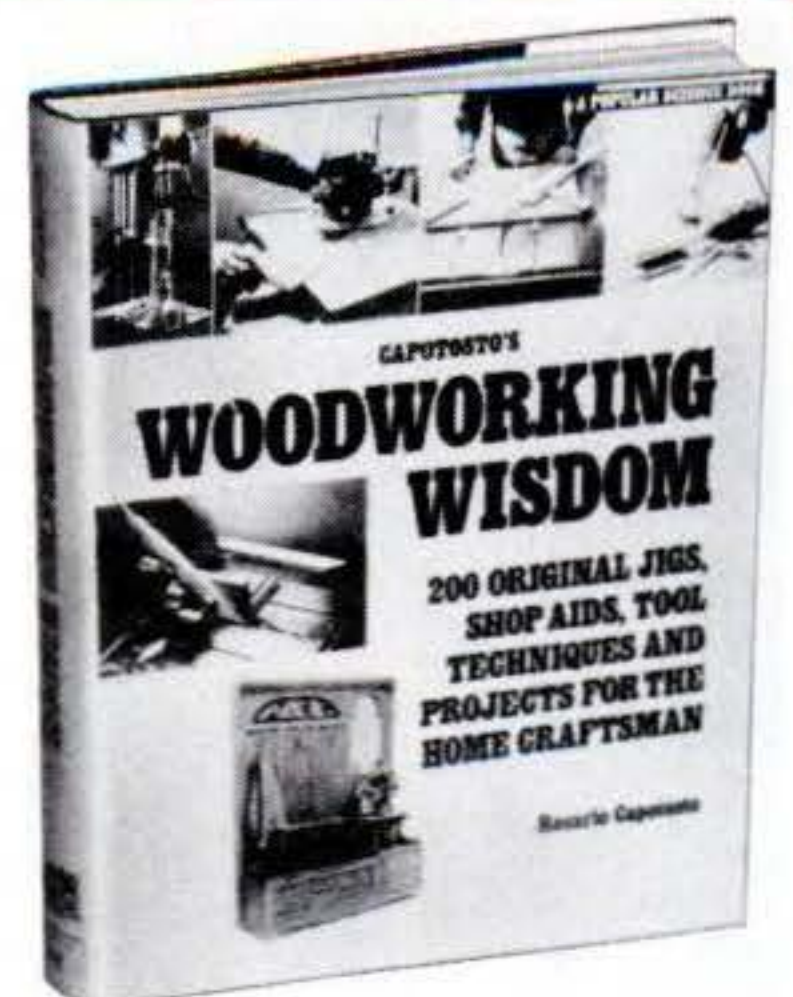


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How to build 80 ingenious jigs to extend power tool use. Scores of innovative, problem-solving secrets. Plus projects that demonstrate additional techniques. All from a woodworking wizard. Order Book #0192. Send \$30.50 plus \$2.39 to cover delivery and handling to Popular Science Books, Dept. P4ZP, P.O. Box 2018, Latham, NY 12111. (Residents of AZ, CA, CO, FL, GA, IL, MI, NY, OH, PA, SC, VA, VT, WI add sales tax.)



GE TAKES THE KITCHEN RADIO TO NEW HEIGHTS.

INTRODUCING THE GE SPACEMAKER® RADIO.

The GE Spacemaker Kitchen Companion Radio mounts right under your kitchen cabinet. So you can listen to bright, clear AM or FM radio without giving up an inch of kitchen counter space. And without adding to your kitchen chores, because its "touch pad" controls are easy to use, better yet, easy to clean.

It helps with the cooking, too.

The Spacemaker Radio is more than just an entertaining addition to your kitchen. It also lends a hand with the work.

With a programmable timed appliance outlet that lets you control kitchen appliances even when you're not in the kitchen. So now your coffee can be ready when you are. And it even has a countdown timer that helps with your cooking and baking.

It's never in the way.

Best of all—it's always out of the way. Mounted simply and neatly under your cabinet, it proves that your love of music needn't interfere with the joy of cooking.

We bring good things to life



Shopping Ideas for the Holiday Season



The Yule Fuel and Tool Gift.

Stihl's sturdy new ToolKan™ does double duty. It carries a gallon of 2-cycle engine fuel and provides space for tools and other items you need. The Stihl ToolKan™ is one of the handiest gifts you can give this Christmas. And at \$19.95 suggested retail, it's not just a bargain, it's a Stihl. See Yellow Pages for your nearest dealer, or call toll-free 1-800-528-6050, Ext. 1430 (in AZ 1-800-352-0458, Ext. 1430).

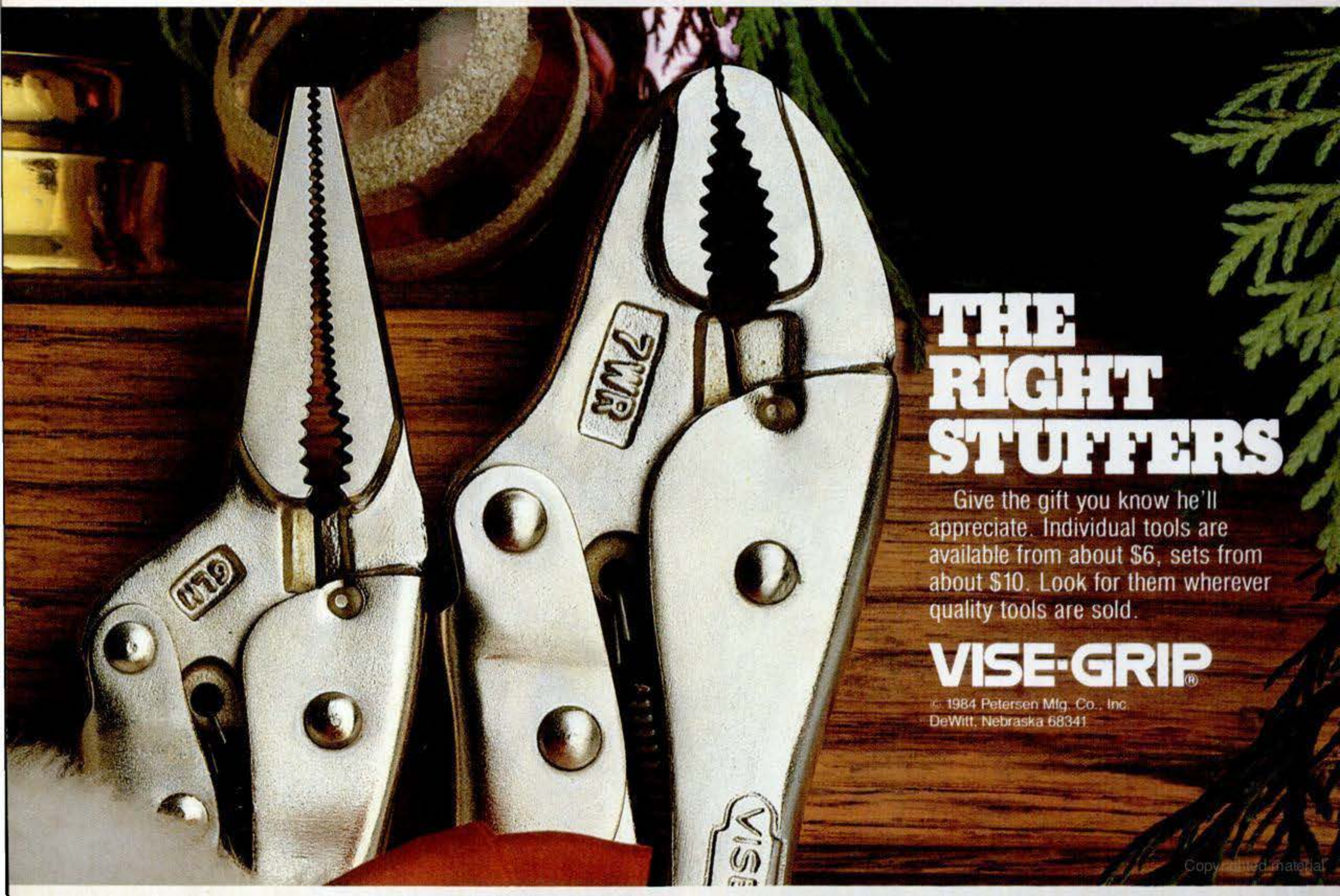


Nikon Compact Autofocus Cameras.

With the Nikon One-Touch and Nice-Touch, anyone can get Nikon 35mm picture quality without focusing. They're totally automatic for point and shoot simplicity. Both offer easy film loading with motorized advance and a built-in flash. (The One-Touch flash even pops up automatically in low light.) Plus, you can use the latest high speed color films. Just point, shoot and enjoy great Nikon pictures.



Computer control and contemporary styling go hand in hand with the new Regency Z30 scanner. Use the 30 preprogrammed frequencies or enter your favorite public service frequencies with the push of a button. The digital display flashes messages to make operation easier and it even has a quartz clock with a programmable alarm. Other features include permanent memory, priority and scan delay. For additional information contact Regency Electronics, Inc., 7707 Records St., Indianapolis, IN 46226. (317) 545-4281.



THE RIGHT STUFFERS

Give the gift you know he'll appreciate. Individual tools are available from about \$6, sets from about \$10. Look for them wherever quality tools are sold.

VISE-GRIP®

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Shopping Ideas for the Holiday Season



Regency invites you to enter a whole new world of entertainment with a Regency SR5000 satellite receiver. It features the latest in satellite receiver technology and design, including a full function wireless remote control. You can control everything from volume and channel selection to satellite positioning from the comfort of your chair or sofa. Other features include block down conversion, permanent memory and a large easy-to-read display. For more information contact Regency Electronics, Inc., 7707 Records St., Indianapolis, IN 46226. (317) 545-4281.



Enjoy comfort and convenience while you save energy, too.

Autostat from First Alert automatically moves the temperature setting on your home thermostat to the temperature you program in, at the time you program it for—up to four times a day. Autostat is the only product available that fits with your existing thermostat, rather than replacing it. Installation is simple, with no wiring needed. And, models are available for most round and rectangular thermostats.



Introducing Colt's 1911 A1 Government Model forged in stainless steel.

Colt's standard 1911 A1 Government Model is now available in stainless steel. This Mark IV Series 80 with the new firing pin safety, also features a newly designed, high-profile, fixed, combat-sight system. The new 1911 A1 Government Model forged in stainless steel. Perfect for all-weather shooting. For more information, contact Laurie Cummings, Colt Firearms, Department PS, Hartford, CT 06012.



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A DURABEAM® flashlight is one bright little gift idea.

It's tough. Dependable. With a casing made of the same material as a football helmet. A shatterproof lens. And a switch that's guaranteed for life.

A Durabeam is so rugged, it'll survive a drop onto concrete

at 0°F. So weatherproof, that come snow or rain, it'll still shine. And it's much brighter than an ordinary flashlight.

What's more, all Durabeam lights come with long-lasting DURACELL® batteries.

Which should keep Dad's face lit up for quite a long time.

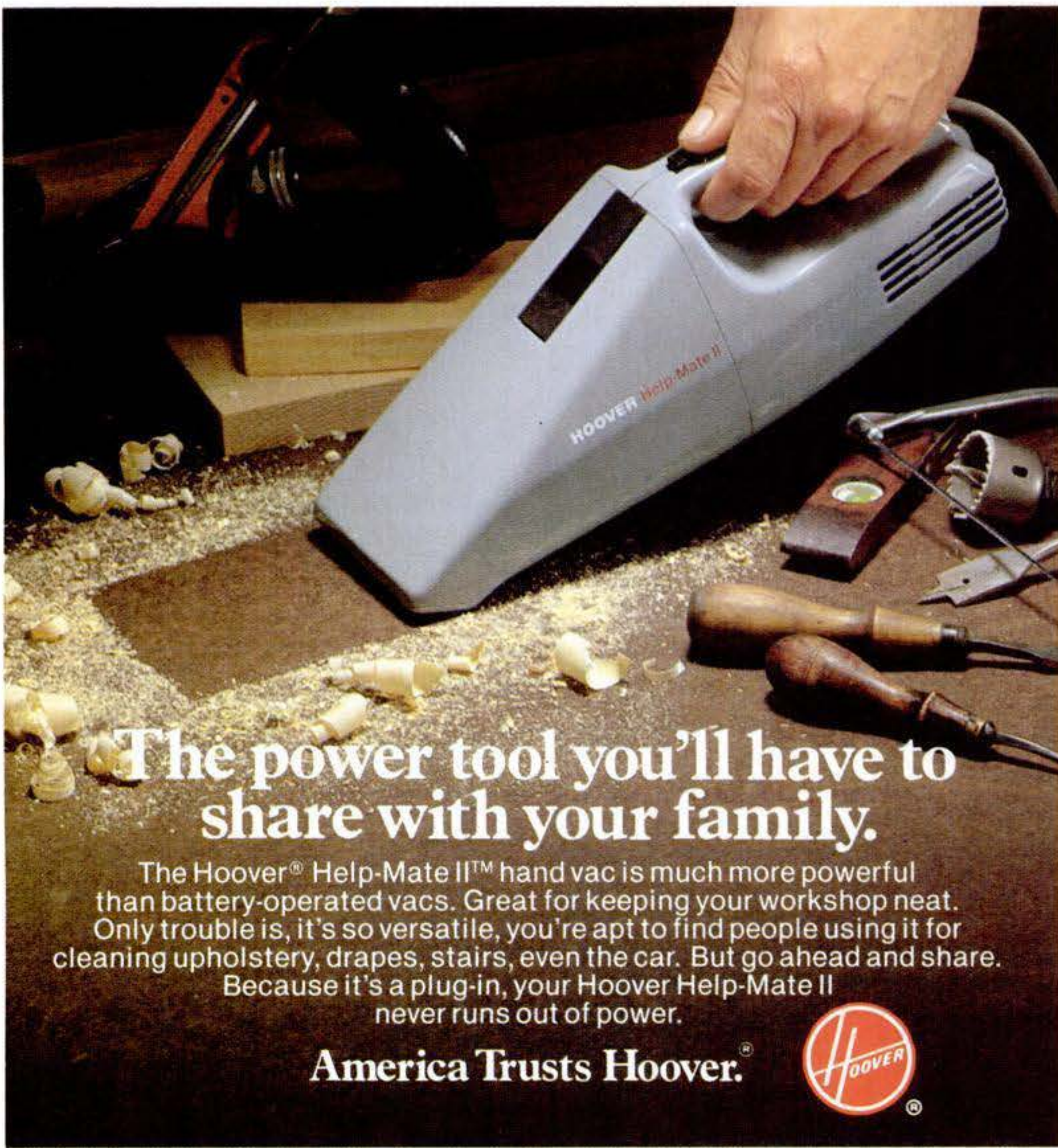


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The power tool you'll have to share with your family.

The Hoover® Help-Mate II™ hand vac is much more powerful than battery-operated vacs. Great for keeping your workshop neat. Only trouble is, it's so versatile, you're apt to find people using it for cleaning upholstery, drapes, stairs, even the car. But go ahead and share. Because it's a plug-in, your Hoover Help-Mate II never runs out of power.

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Gift Ideas



Scanner Radio Features Patented "Service Search."

With its "Service Search" feature, the Uniden® Bearcat® 300 scanner radio completely eliminates the need to know the frequencies for the most-listened-to services. Service Search covers police, fire, marine, "ham," mobile phone, emergency, government, forestry, business, ground transportation, and even air-to-ground aircraft channels. In all, there are 2,138 frequencies pre-programmed into the Service Search memory to assure that active channels for any local area are covered. Call 1-800-SCANNER for where-to-buy information.

THE GIFT THAT SHINES YEAR ROUND.

- The newest design in high-tech quartz-halogen fog and driving lights
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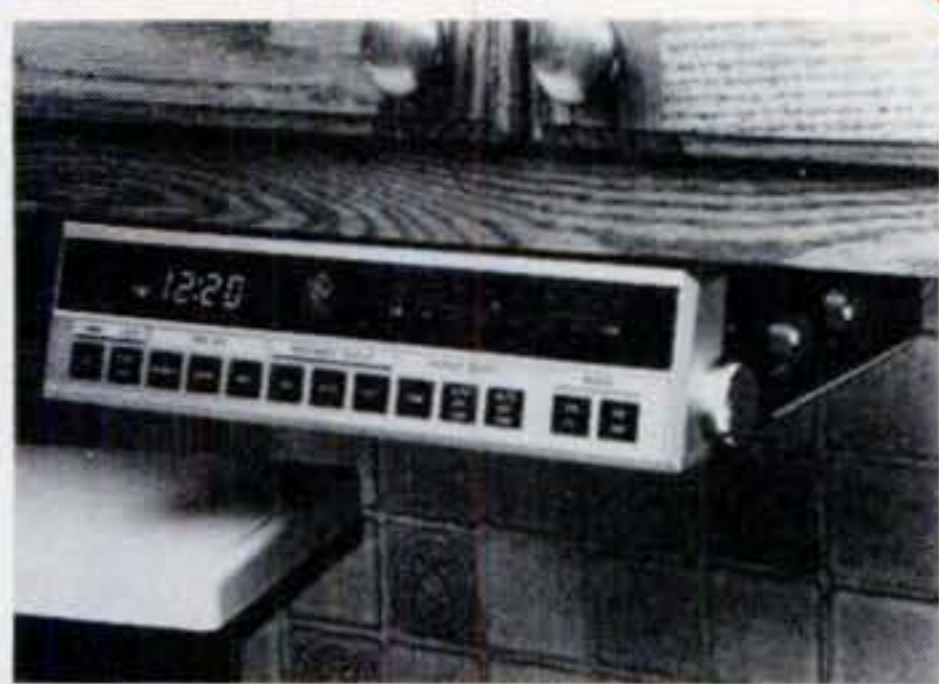
LUMENATORS™



A new Christmas Gift Set

features two popular CHANNELLOCK tongue-and-groove pliers nested in a colorful box. Included are the No. 420, 9-inch, 1½" jaw capacity and the No. 426, 6-inch, 7/8" jaw capacity. Both pliers are equipped with blue dipped-plastic comfort grips. CHANNELLOCK, Inc., Meadville, PA 16335-0519.

Gift Ideas



"Kitchen Companion" Clock/ Radio with Appliance Timer.

General Electric's "Kitchen Companion" Radio provides entertainment and convenience for the kitchen environment. This unit features an FM/AM clock radio with a programmable timed appliance outlet and countdown timer. Designed to eliminate counter-top clutter, the "Kitchen Companion" Radio comes equipped with brackets for easy mounting under the kitchen cabinets. The radio section features a 5-inch bottom-fired dynamic speaker and 700mw RMS output power for natural sound reproduction. General Electric's "Kitchen Companion" Radio has a manufacturer's suggested retail price of \$89.95.



GE "Kitchen Companion" TV/ Radio Doubles as a Portable.

General Electric's "Kitchen Companion" TV with FM/AM Radio serves as a total kitchen entertainment center and doubles as a portable TV unit as well. It is designed to be mounted under a kitchen cabinet to reduce counter-top clutter and comes equipped with an adjustable mounting bracket that swivels for wide-angle television viewing. The television features a 5-inch black and white screen. For portability, the unit slips out of its mounting bracket giving access to a fold-down carrying handle. General Electric's "Kitchen Companion" TV with FM/AM Radio has a manufacturer's suggested retail price of \$199.95.

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The new Stihl® 024 AVEQ is tough enough for professional use, so you know it'll stand up to your biggest cutting jobs. It features superb balance, an excellent power to weight ratio, and at only 11.9 lbs., it's easy to handle. So if you're serious about cutting and need more than just a chain saw, Stihl's the One.

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Shopping Ideas for the Holiday Season



Over the years, **VISE-GRIP® locking pliers** have earned the title of "The World's Most Useful Handtool." And as gifts, they're the world's most popular handtools, appreciated by handymen, sportsmen and tradesmen alike. This Christmas, a variety of offerings are available, including individual tools from about \$6 and sets from about \$10. Look for them wherever quality tools are sold.

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Nothing Works Like a Horse— Wheel Horse...of course!

With prices starting at \$999, a Wheel Horse is the ideal gift for anyone. And, depending on the model (we offer 16 models), a Wheel Horse can help year-round with mowing, bagging grass, tilling, snow removal and more. It's not only durable, dependable and affordable—it's a wise investment. Write today for a catalog and the dealer nearest you. Advertising Department, Wheel Horse Products, Inc., 515 W. Ireland Road, P.O. Box 1649, South Bend, IN 46680.



Arrow T-50K Staple Fun Kit— A Perfect Gift Item.

Ideal for home do-it-yourself handymen, handywomen for fastening jobs, insulation, ceiling tile, screening, re-upholstering, 1001 fix-it fastening jobs. Kit includes: Arrow's famous T-50 Staple Gun, 1250 staples, wiring attachment and screening attachment, packed in styrofoam tray with molded compartments for neat, permanent storage. Available at home centers, hardware, building supply, discount, department stores and mass merchandisers everywhere. Made in America by Arrow Fastener Co., Inc., Saddle Brook, New Jersey 07662.

**\$10
REBATE**

WORKMATE.® THE EXTRA PAIR OF HANDS.

With rebates on WORKMATE® Work Centers, The Extra Pair of Hands, now's the best time to buy one. Or give one. And let Workmate Products help you hold onto a few extra dollars.

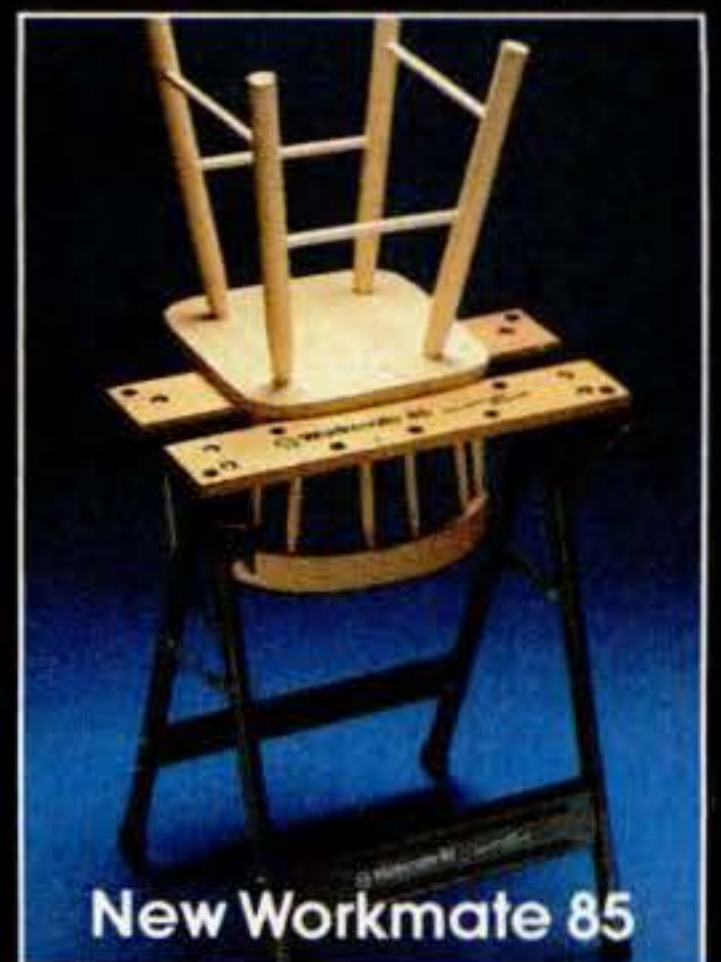
Get \$10 back on the Workmate 400, 300 and 200. And \$5 back on the Workmate 100, Bench Tops and Quick Vise.

Or if that doesn't grab you, try the new Workmate 85 at an even lower price. And it even has a \$5 rebate.

And remember, people always appreciate it when you give them a hand. Or a pair. So pick

up The Extra Pair of Hands for someone else this holiday. Or drop a hint for yourself. Because with rebates and new low prices, there's no better time for the present.

Workmate® The extra pair of hands



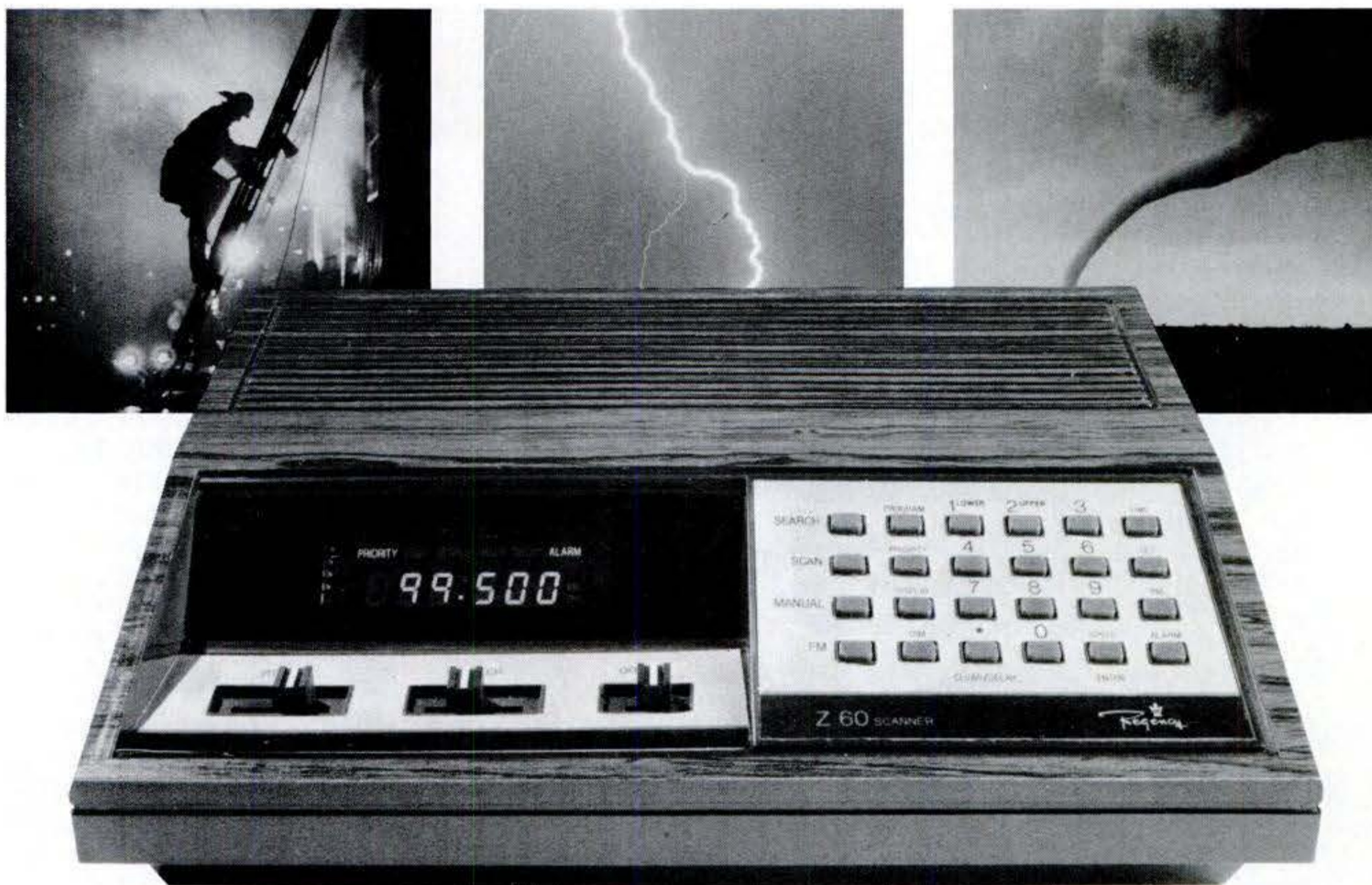
New Workmate 85

B-D Black & Decker®

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Regency Scanners

bring you all the action... as it happens!



Regency Scanners bring you the local news . . . as it happens. From bank hold-ups to three alarm fires. It's on-the-scene action. While it's happening, from where it's happening . . . in your neighborhood.

You can even listen to weather reports, business and marine radio calls. Plus radio telephone conversations that offer more real life intrigue than most soap operas. And with some models, there's even more.

The Z family

Introducing the Z series scanners from Regency. Four exciting new programmable scanners that offer you a variety of options to fit your personal needs.

First, there's the Z 10, a basic ten channel scanner that covers the six public service bands. It lets you hear your choice of over 15,000 frequencies at the touch of a finger. Or, if you prefer, locate new,

active frequencies using the search function.

If you like the Z 10 but need more channels, step up to the Z 30. It gives you all the same features with a thirty channel memory and, surprise, a programmable alarm clock that stays on even when the power switch is turned off.

For the guy who wants to tune into the aircraft and tower transmissions, we've got the Z 45. It's got the same coverage as the Z 30 with the addition of the aircraft band with forty-five total channels.

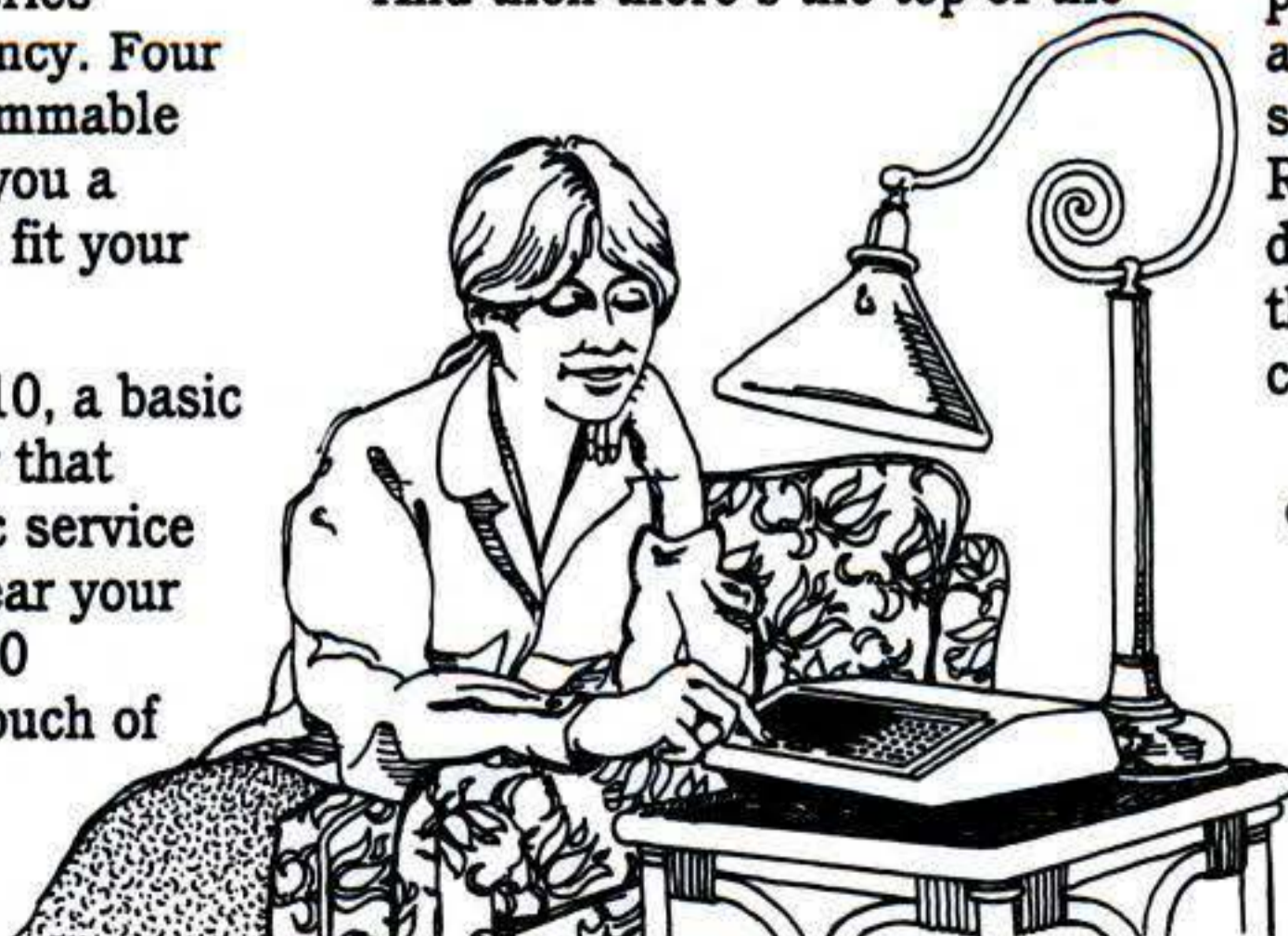
And then there's the top of the

line Z 60. It covers all the public service bands plus aircraft and FM radio broadcasts with sixty total channels.

Common to all the Regency Z scanners is a contemporary simulated wood grain cabinet and a bright, easy-to-read vacuum fluorescent display with prompting messages. They even come preprogrammed with frequencies so you can scan "right out of the box".

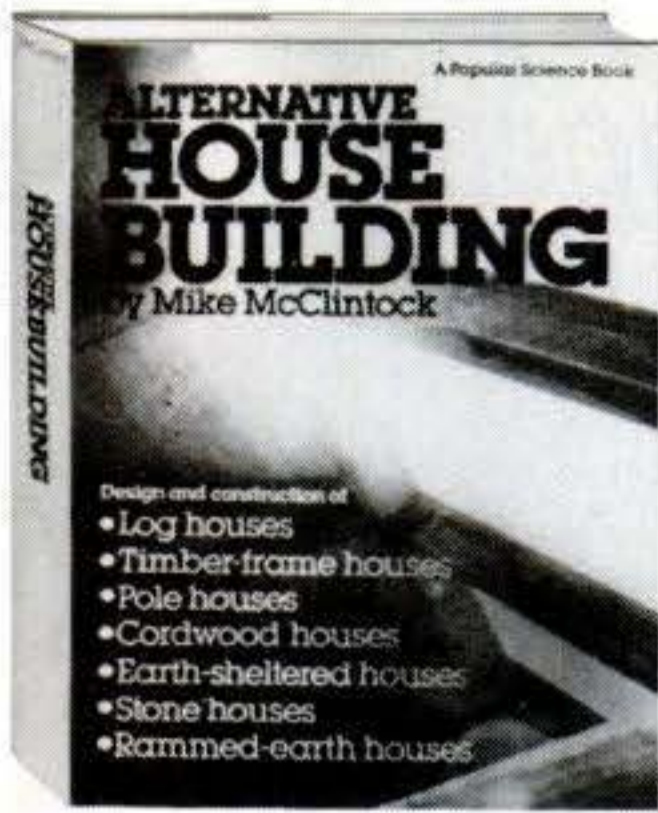
Backed by Regency

Regency stands behind the Z family with a full one year parts and labor warranty. And a tradition of building great scanners. So stop in your Regency dealer today for a demonstration, or write us at the address below for a full line color brochure.




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Shopping Ideas for the Holiday Season



How to build top-quality houses...

ALTERNATIVE HOUSEBUILDING by Mike McClintock.

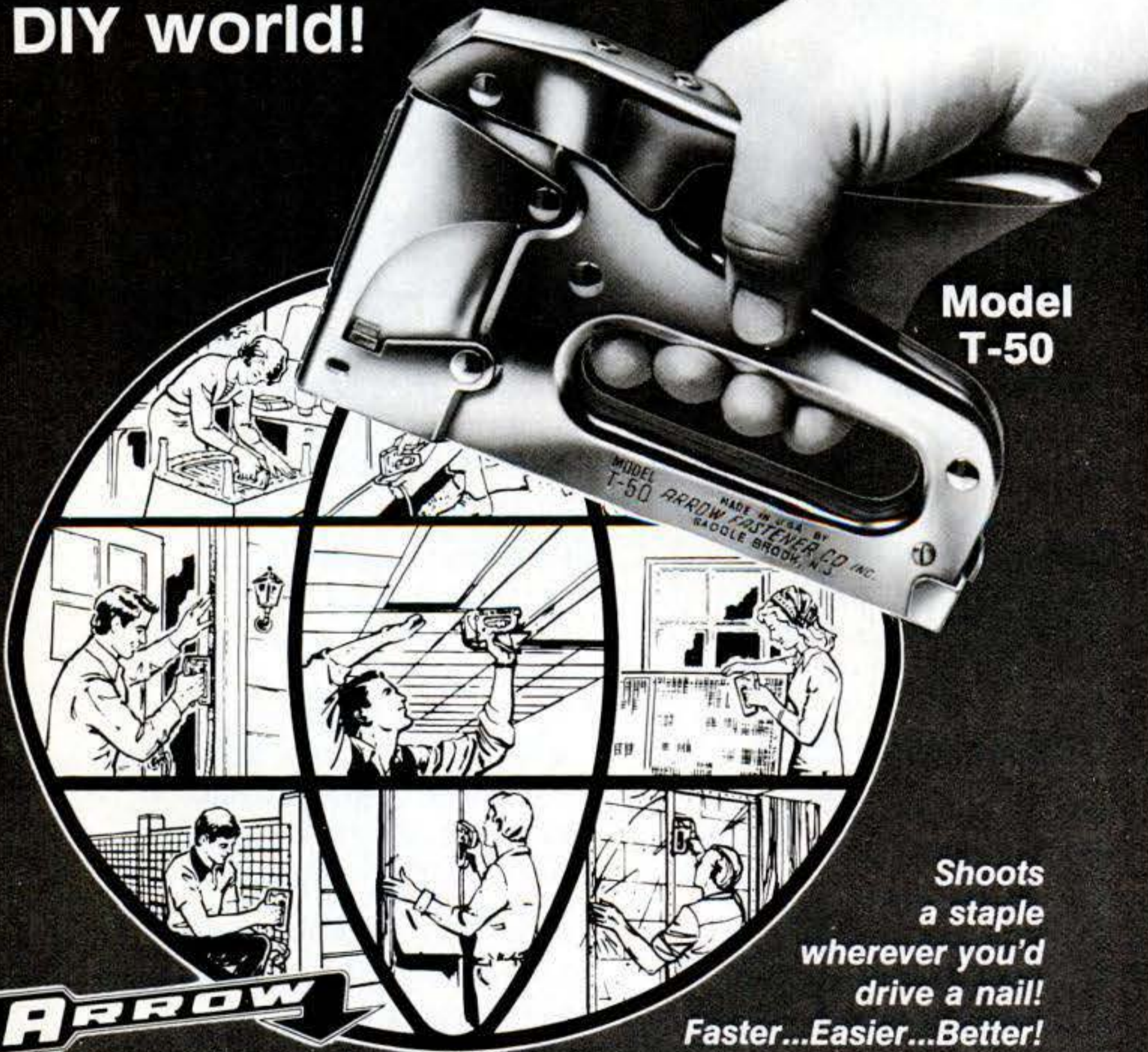
Step-by-step instructions for timber-frame, log, pole, cordwood, masonry, stone, earth-sheltered and rammed earth building techniques. These houses can cost less and be easier to build than conventional houses. Order Book #0194. Send \$32.95, plus \$2.99 to cover delivery and handling, to Popular Science Books, Dept. P4ZP, P.O. Box 2018, Latham, NY 12111. (Residents of AZ, CA, CO, FL, GA, IL, MI, NY, OH, PA, SC, VA, VT, WI add sales tax.)



General Electric's Mainfone™ Speakerphone for Hands-Free Operation. Model 2-9350 offers hands-free conversations from anywhere in the room it's installed in. Ideal for kitchen as it allows activities such as cooking or eating to be conducted without interruption. The phone has a sensitive built-in condenser mic so conversations can be conducted without even facing it. General Electric's Speakerphone is equipped with a full featured corded handset which offers switchable Tone or Pulse dialing and 12-number memory including three one-touch emergency buttons for police, fire and medical assistance. Other features include one-touch redial of first number called and mute buttons for both the handset and condenser mic enabling private conversations without the other party on the line overhearing.

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Model
T-50



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a staple
wherever you'd
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Shopping Ideas for the Holiday Season

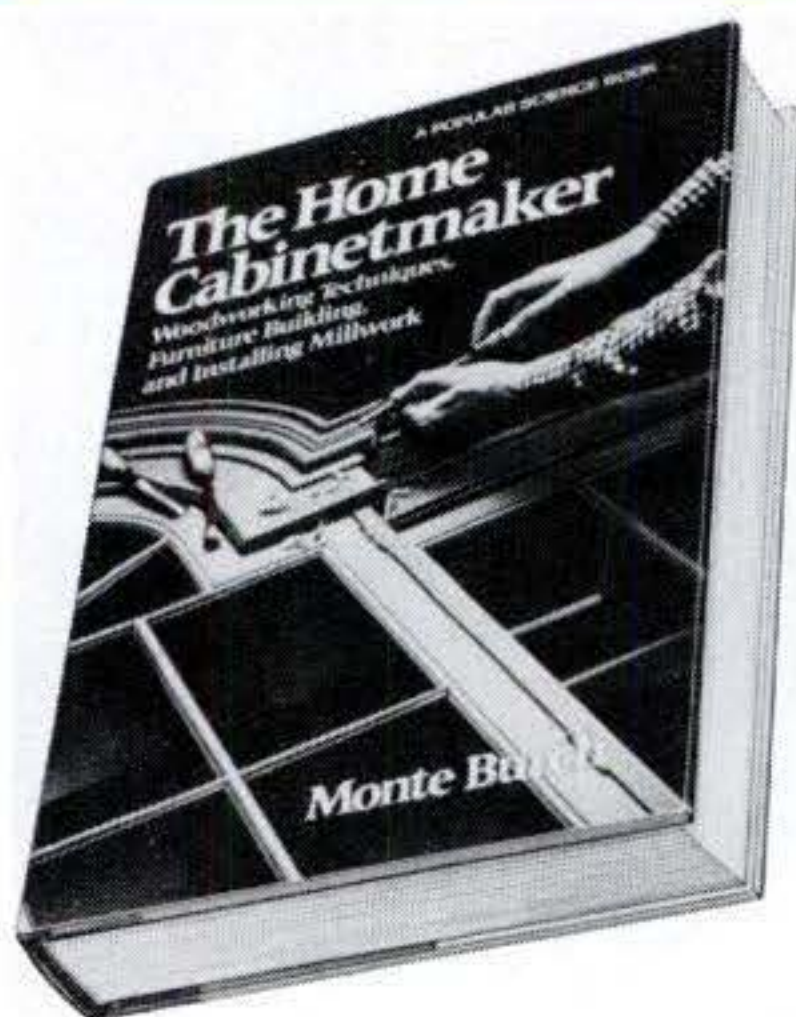


GE MainFone™ 16-Number Memory Phone with Auto Busy Callback.

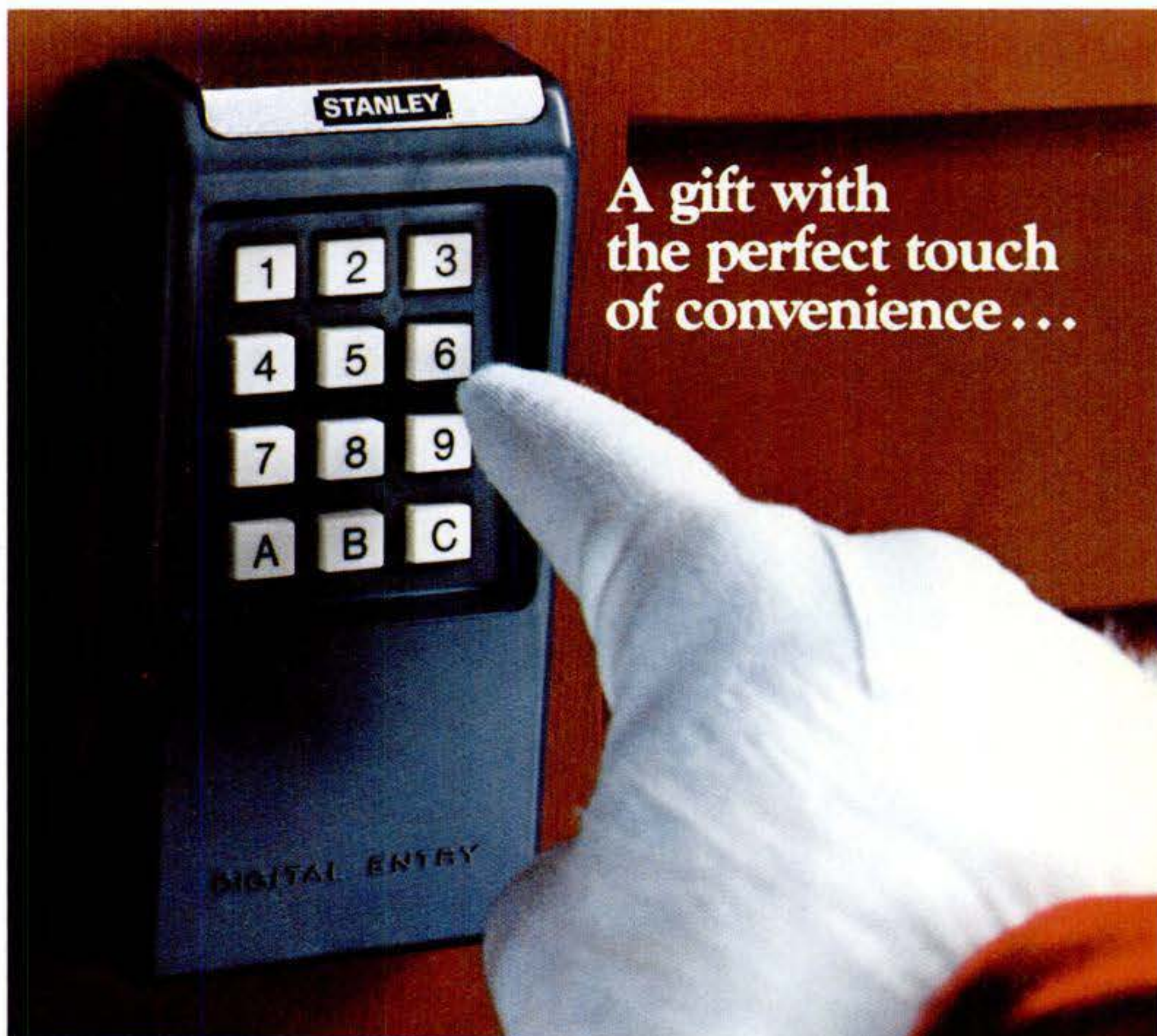
General Electric's MainFone 16-number Memory phone with Auto Busy Callback combines today's most popular performance and convenience features. Designed to serve as a household's primary telephone, this model offers Tone/Pulse switchable dialing and 16-number one-button memory calling including three emergency numbers for police, fire or medical assistance. The Auto Busy Callback feature provides continuous dialing of busy numbers every 30 seconds with the touch of a button.



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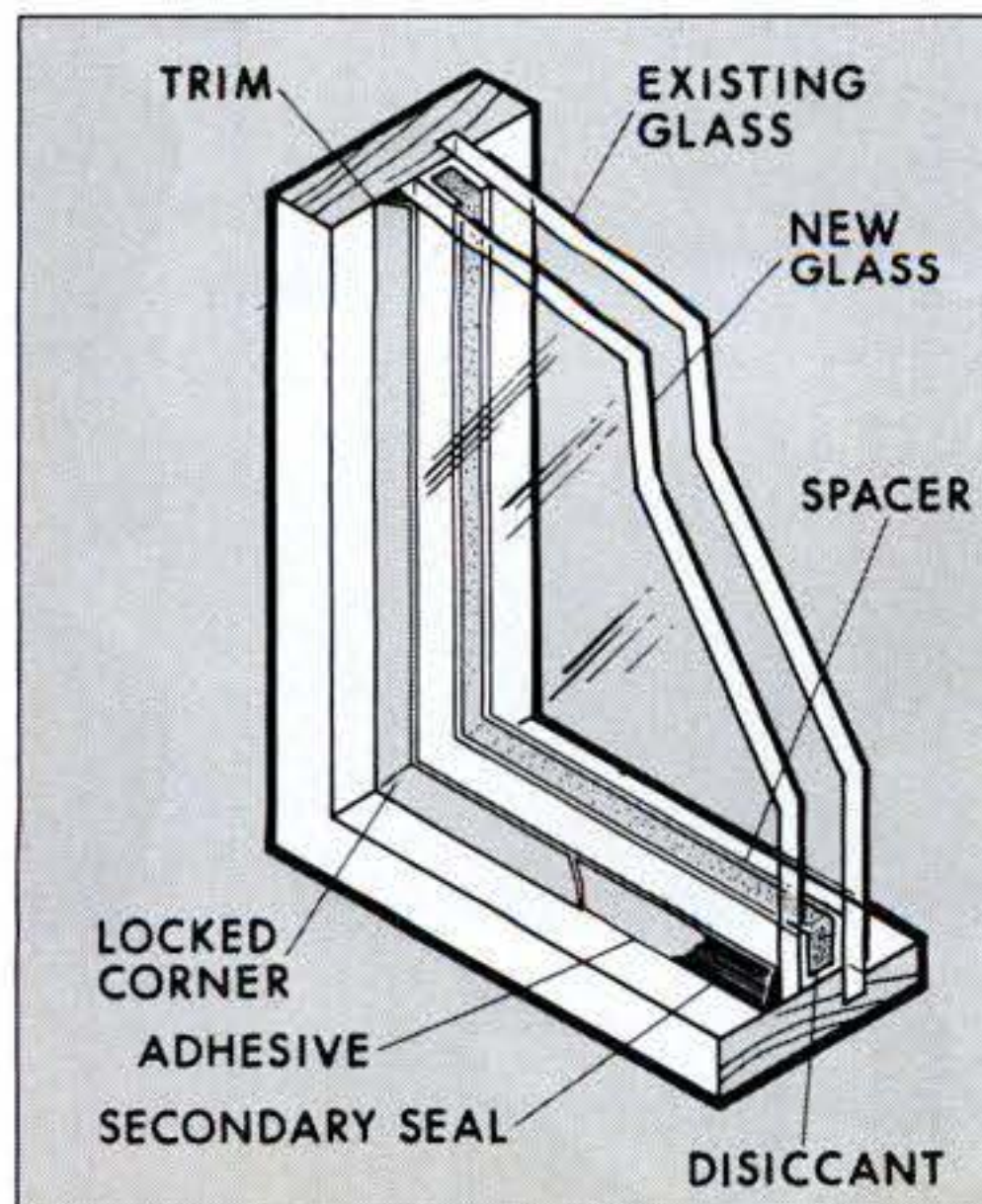
Retrofit double glazing

Single-glazed windows are the number-one source of heat gain and loss in many houses. But until recently, saving energy by double glazing meant replacing old windows with factory-assembled units. And in some cases installation costs guarantee an uneconomic payback period.

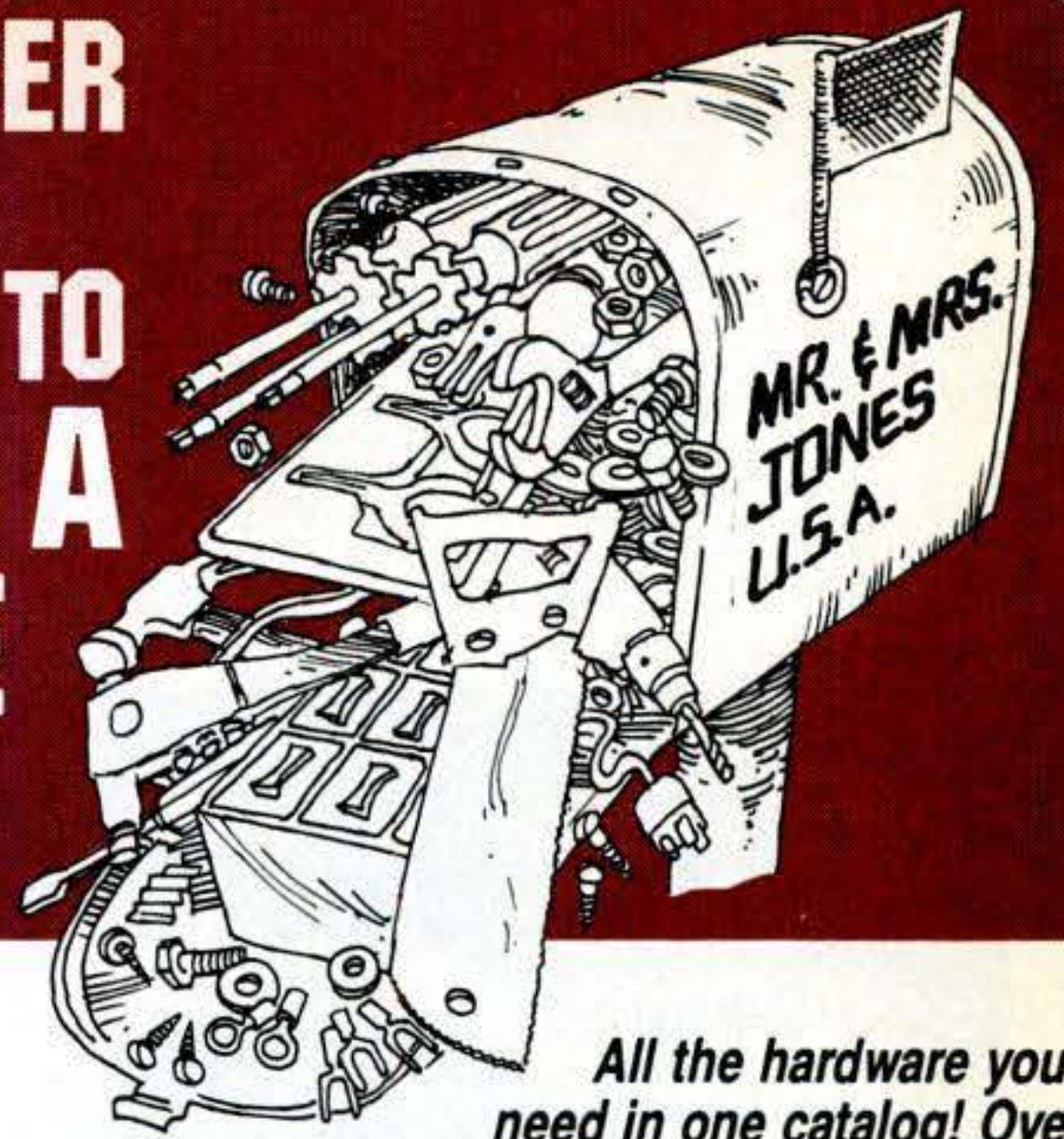
Now the Thermetic System—a method developed by Thermetic Glass, Inc. (1615 W. Candletree Dr., Peoria, Ill. 61615), for retrofitting double glazing—can turn your windows into thermally efficient units for about \$225 each. That's about half the price of new installation. Retrofitting is done by professionals on site, using the glass of your choice and the existing window frames. There is no change in the way your windows operate, and this system won't alter the aesthetics of the window—an important feature if your house is under landmark- or historic-preservation control.

Most homes can be retrofitted in a day or two, according to Thermetic Glass. The new pane for each window is cut 1/4-inch smaller than the frame and is installed in front of the original glass. Metal spacers coated with desiccant to prevent condensation separate the panes and help hold the added pane in place.

The small gap between glass and frame allows a thin aluminum wire to be inserted between the panes. Electric current is used to heat the wire to about 200 degrees F, eliminating moisture between the panes. The wire is then removed and the window sealed with silicon caulking to isolate the glass from stresses due to expansion and contraction.—Richard Layne



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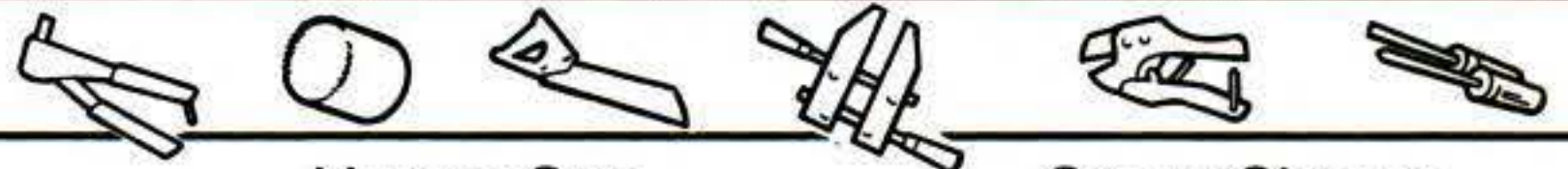
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What's New

products/technology



Gold-medal bike

Aerospace technology helped produce the 13-lb. bicycle Steve Hegg rode to a gold medal at the '84 Summer Olympics. An aluminum alloy developed for the space shuttle forms the Raleigh Technicum's frame. Its tear-drop-shape tubes are joined similarly to the shuttle's tiles.

Sleek scuba rig

A one-piece pack with built-in weight holders liberates skin divers from cumbersome weight belts and complicated harnesses. Steel inserts molded into polyurethane-rubber shoulder rests support the pack's weight. CUDA Intl., Box 15675, San Antonio, Texas 78212; \$595.



Convertible Celica

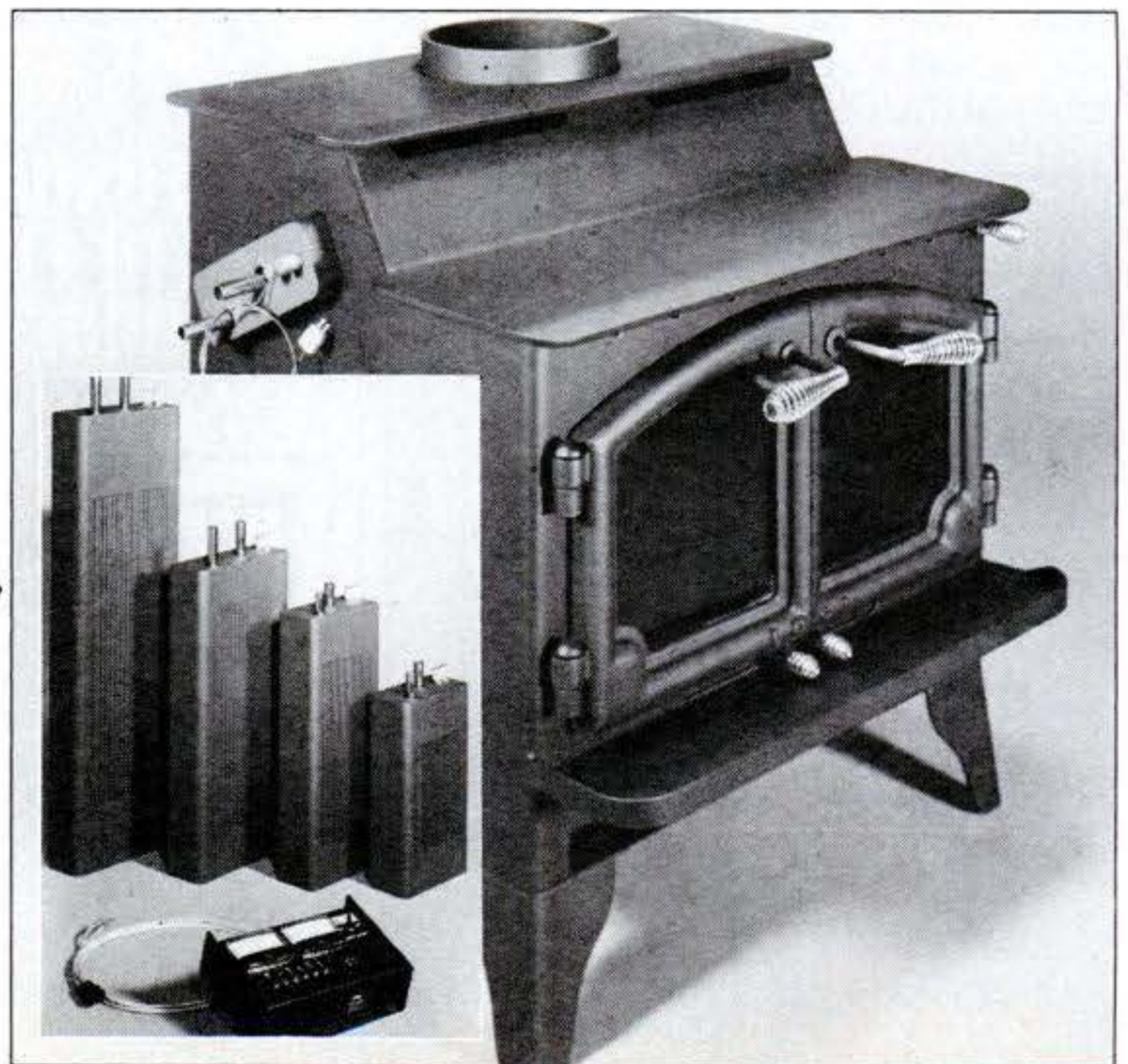
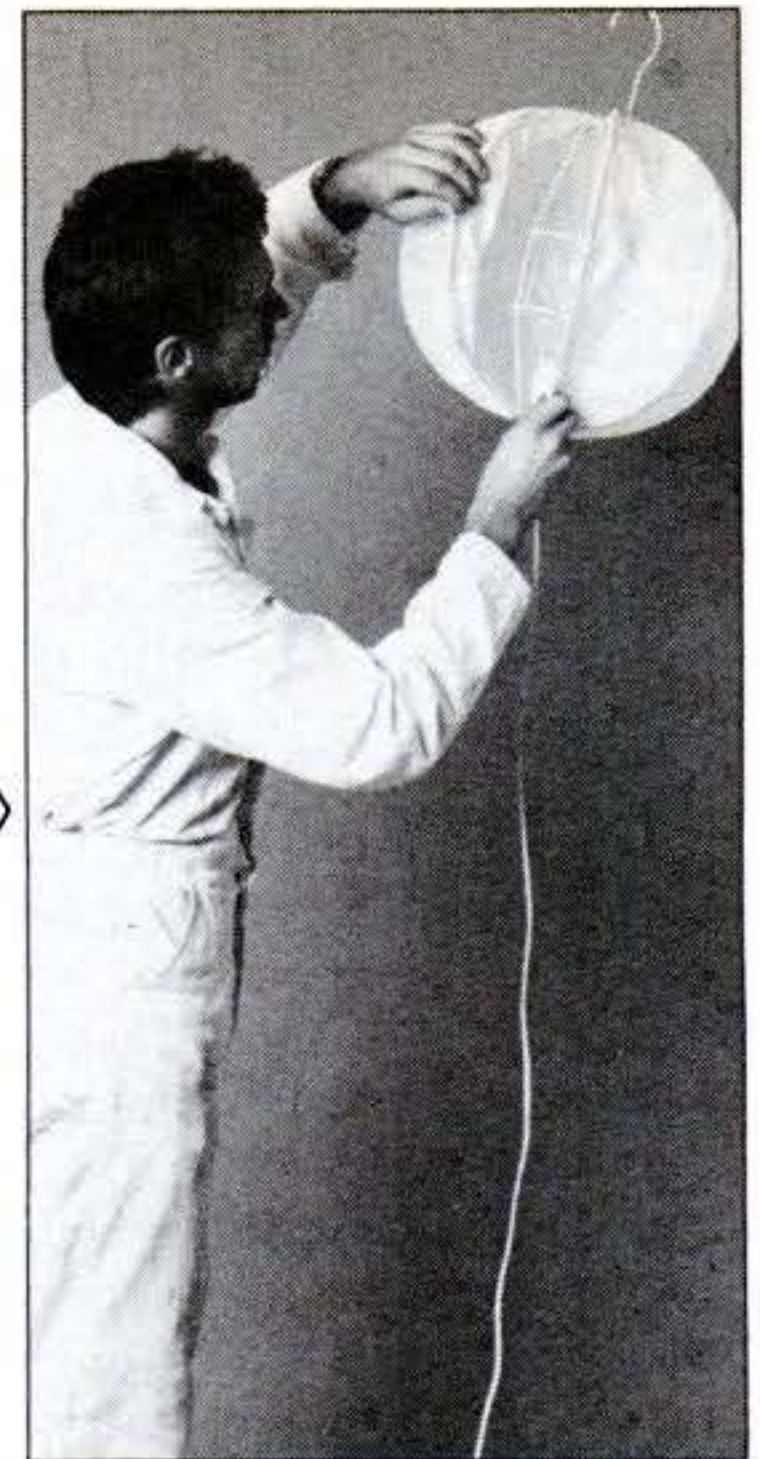
To lower the top on the Celica GT-S, you push a button. Not surprising. But as the top folds down, the rear seat pivots forward so top plus glass rear window can slide behind. With seats back in place there's more rear-seat room than in any similar convertible, says Toyota.

Stove generator

Mounted inside a wood stove, the Thermovolt makes heat flow across a semiconductor, generating electricity. The large 80-W unit (inset) produces 1.3 kWh of emergency power a day, says Photic Corp. (2668 S. Memorial Hwy., Traverse City, Mich. 49684). Price: \$3,500.

Light sphere

The hang-anywhere Ergonomi lamp holds a 300-W bulb shaded by a nylon-covered, wire-ribbed round frame. The glare-free light has top and bottom ventilation holes, and the frame is collapsible. Ergonomi Design, Box 140-21, 161 14 Bromma, Sweden. Price unavailable.



Watertight tank

Charging through water and over rough terrain, the armored Valkyr handles like a sedan, says Vickers Defense Systems (Scotswood Rd., Newcastle NE99 1CP, England). Automatic transmission and power steering ease handling; a 180-hp turbo diesel produces 60-mph speeds.



Readout reel

Fish, beware. A microcomputer in the PT 10E fishing reel tells the angler casting distance, water depth, how much line was out when a fish was hooked, and other information. Maker: Daiwa, 7421 Chapman Ave., Garden Grove, Calif. 92641. It costs about \$180.



Versatile projector

It focuses like a slide projector and uses a standard screen. But Sony's Vidimagic produces a projection-TV picture from 30 to 200 in. in diameter. The key: A single bright picture tube replaces the standard three lenses. The 35-lb. unit also has a built-in VCR. \$2,995.

Sky searcher

Stargazers celebrate! The Sky Sensor (\$599) from Celestron (Box 3578, Torrance, Calif. 90503) is the first telescope computer for amateur astronomers (inset). It works with an automatic motor mount to find any known stellar object and attaches only to Celestron scopes.



Space-saving rack

Tapered slots with built-in locking bars secure any type of bicycle, claims Peco, Inc. (Box 02159, Portland, Ore. 97202). The 45-in.-long polyethylene Handi-Stand (\$150) mounts with nonremovable belts and can be installed on the ground or on a wall.



Phone holder

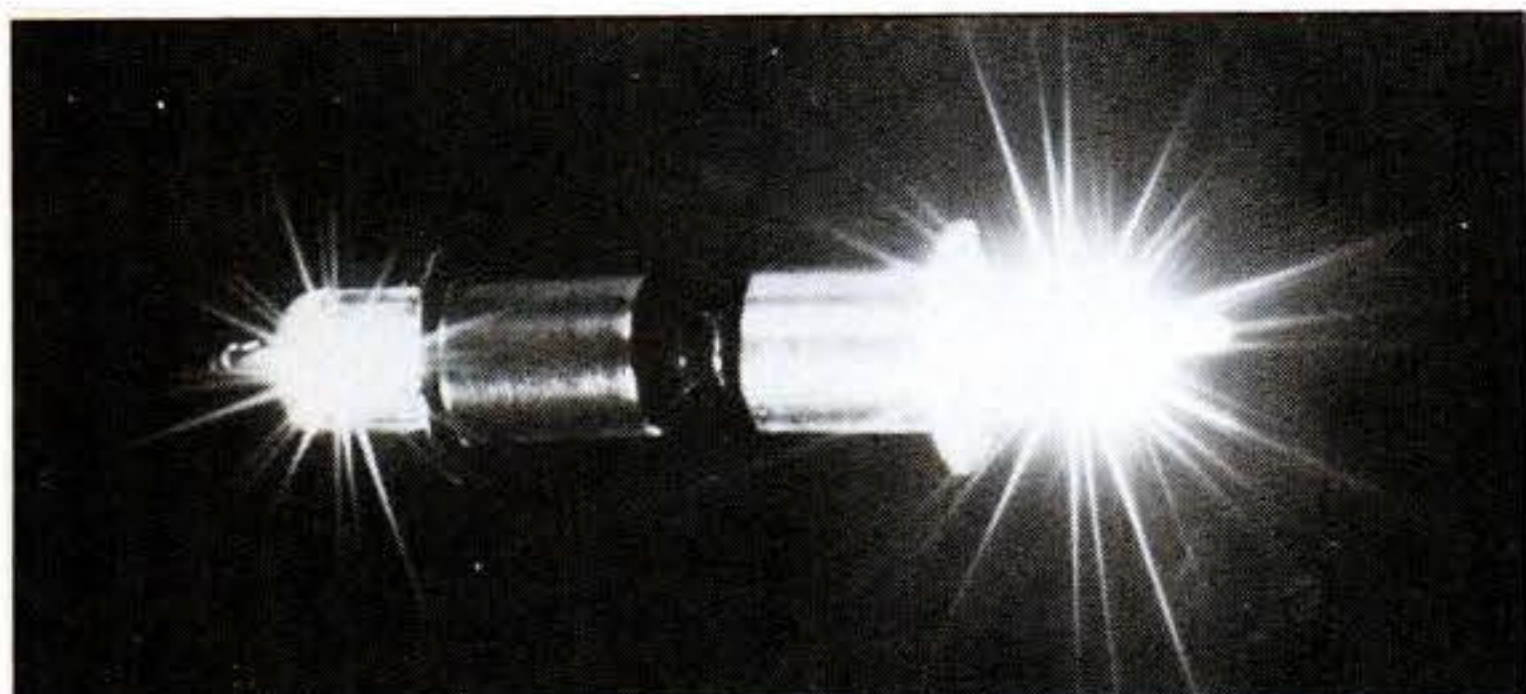
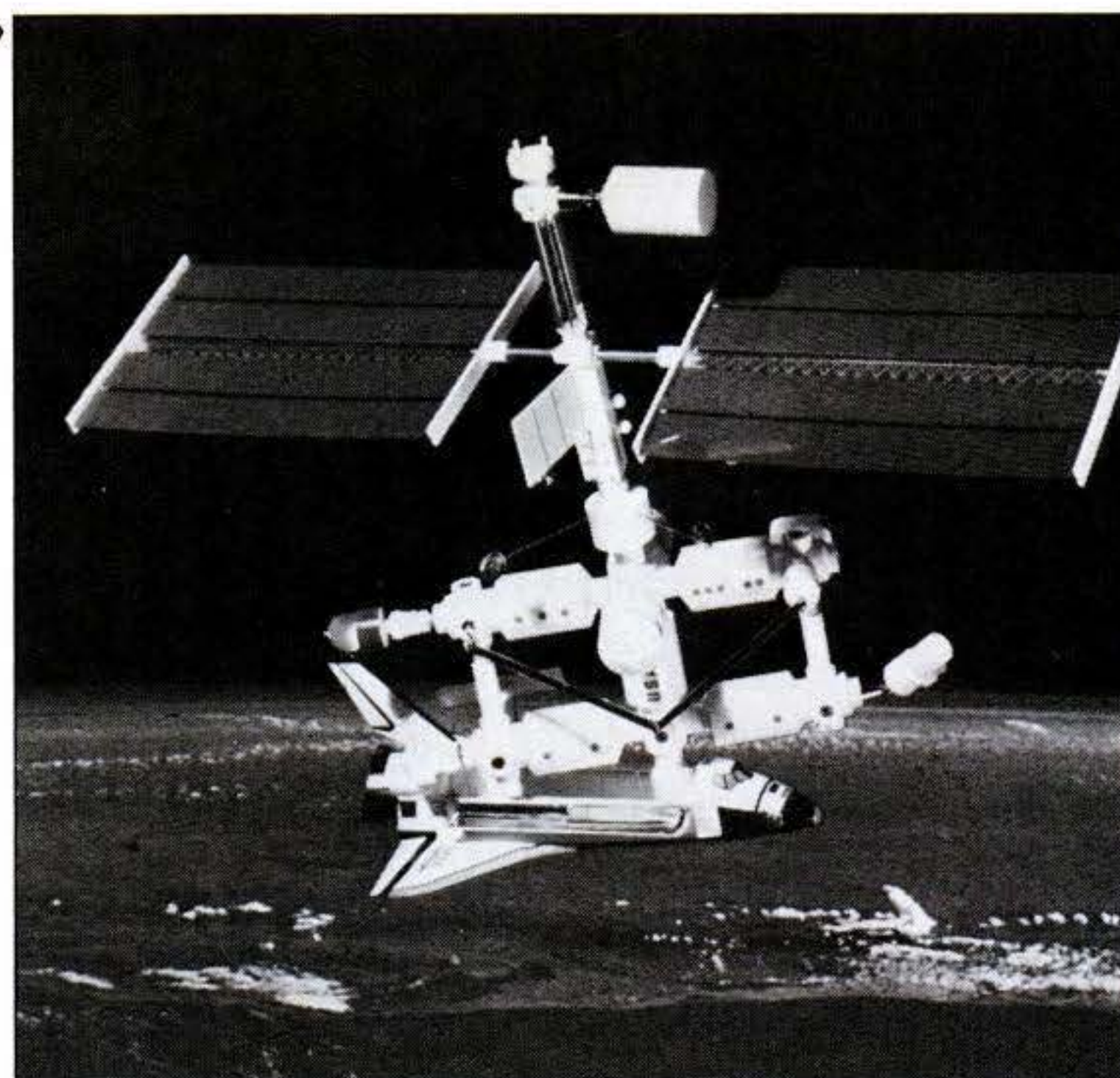
You'd like hands-free phone conversations, but you don't like those clumsy-looking receiver rests. The unobtrusive Tele-Grip nonskid, nontoxic plastic strip fixes the receiver firmly on your shoulder, says Vaportek (Box 17227, Milwaukee, Wis. 53217). It's priced at \$1.49.



What's New

Mail call

The space shuttle unloads supplies to an orbiting lab conceived by McDonnell Douglas Co. The eight-man station is proposed for the 1990s. It would have five modules: two for repairs and labs, living space, a control center, and a 90-day food-and-oxygen-supply center.



Miniature spotlight

The beam of a flashlight bulb (above left) is eclipsed by Nova—a halogen bulb designed for standard flashlights. The lamp is four times brighter and will last four times longer than ordinary bulbs, says Streamlight (1030 W. Germantown Pike, Norristown, Pa. 19403). \$7.95.

British copter

Mate advanced-design composite rotor blades with twin Rolls-Royce Gem 60 engines, and you get the Lynx 3. It's agile and swift, with a maximum speed of 190 mph, says Westland Helicopters of Somerset, England. Advanced electronics permit antisubmarine warfare.

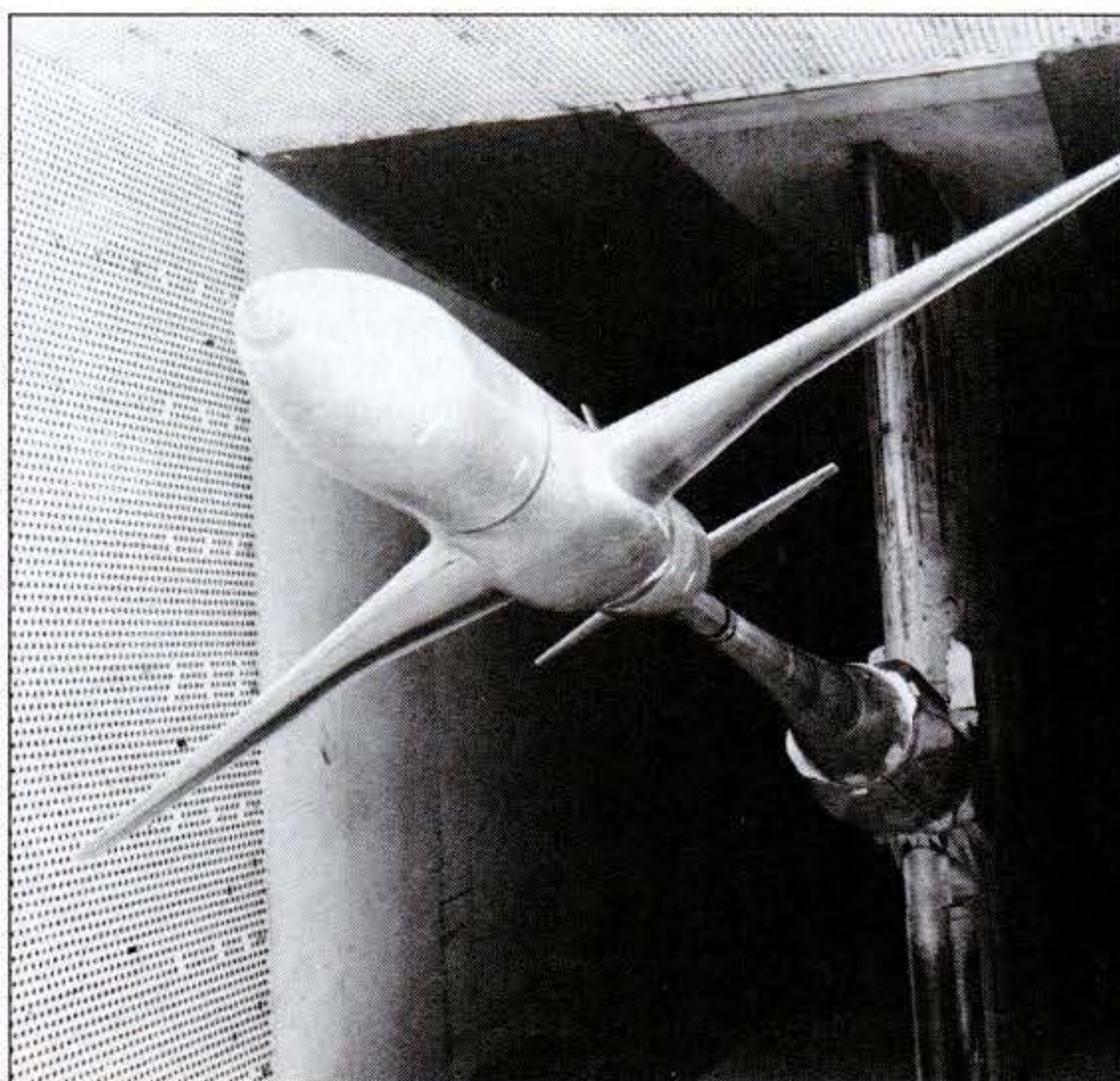


Alfa 4WD

Super traction on sand, mud, and snow—that's the handling expected from the Alfa 33 4x4 Station Car. But the car's not an off-roader: The live rear axle is engageable on the move and makes for normal fuel mileage and tire wear. It has a 1.5-liter (92-cu.-in.) four-cylinder engine.

Advanced airliner

In wind-tunnel tests this model of the 150-passenger Airbus A320 reached a cruising speed of 559 mph. The European-built liner will be the first with transonic wings—airflow on the upper surface hits supersonic speeds, and that on the lower surface, subsonic speeds.



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*Side handle will be included FREE with purchase of the M47 Series 3/8" Variable Speed Reversing Drill (model #7144), thru 12/31/84.

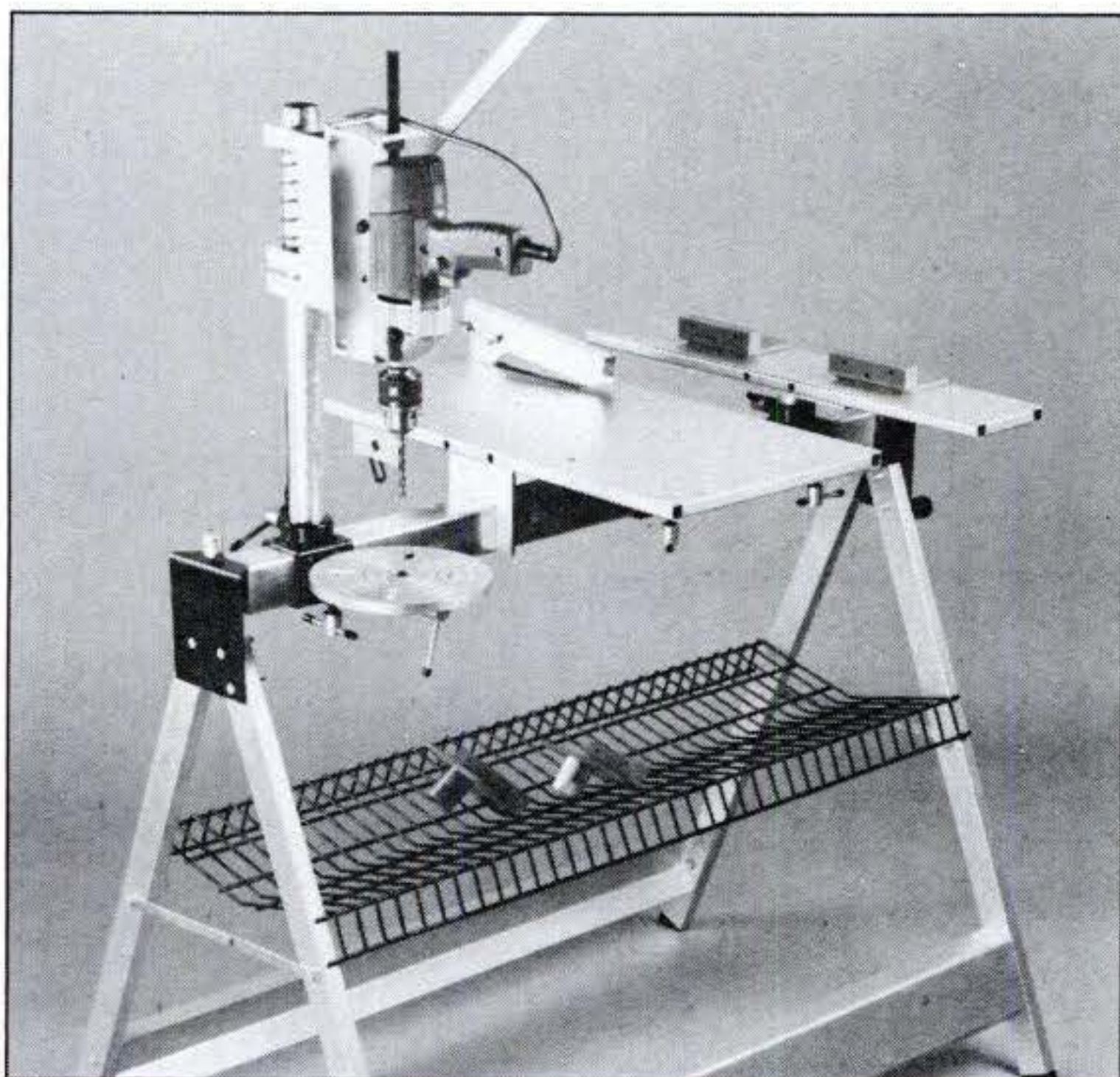
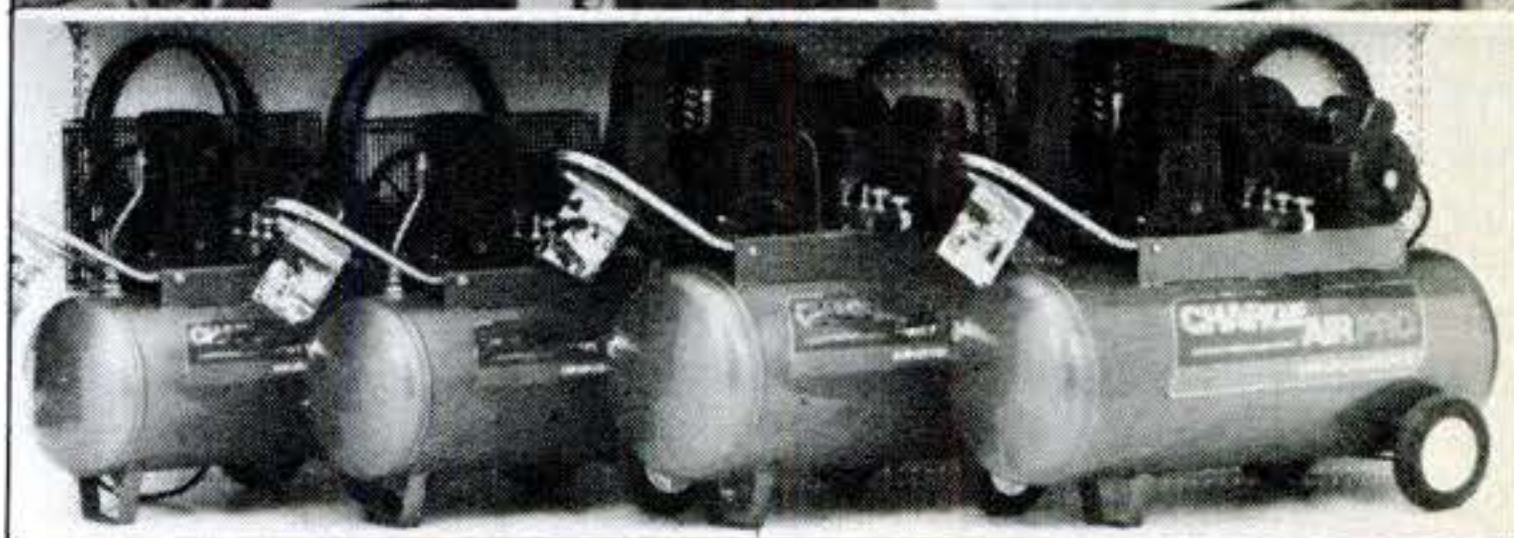
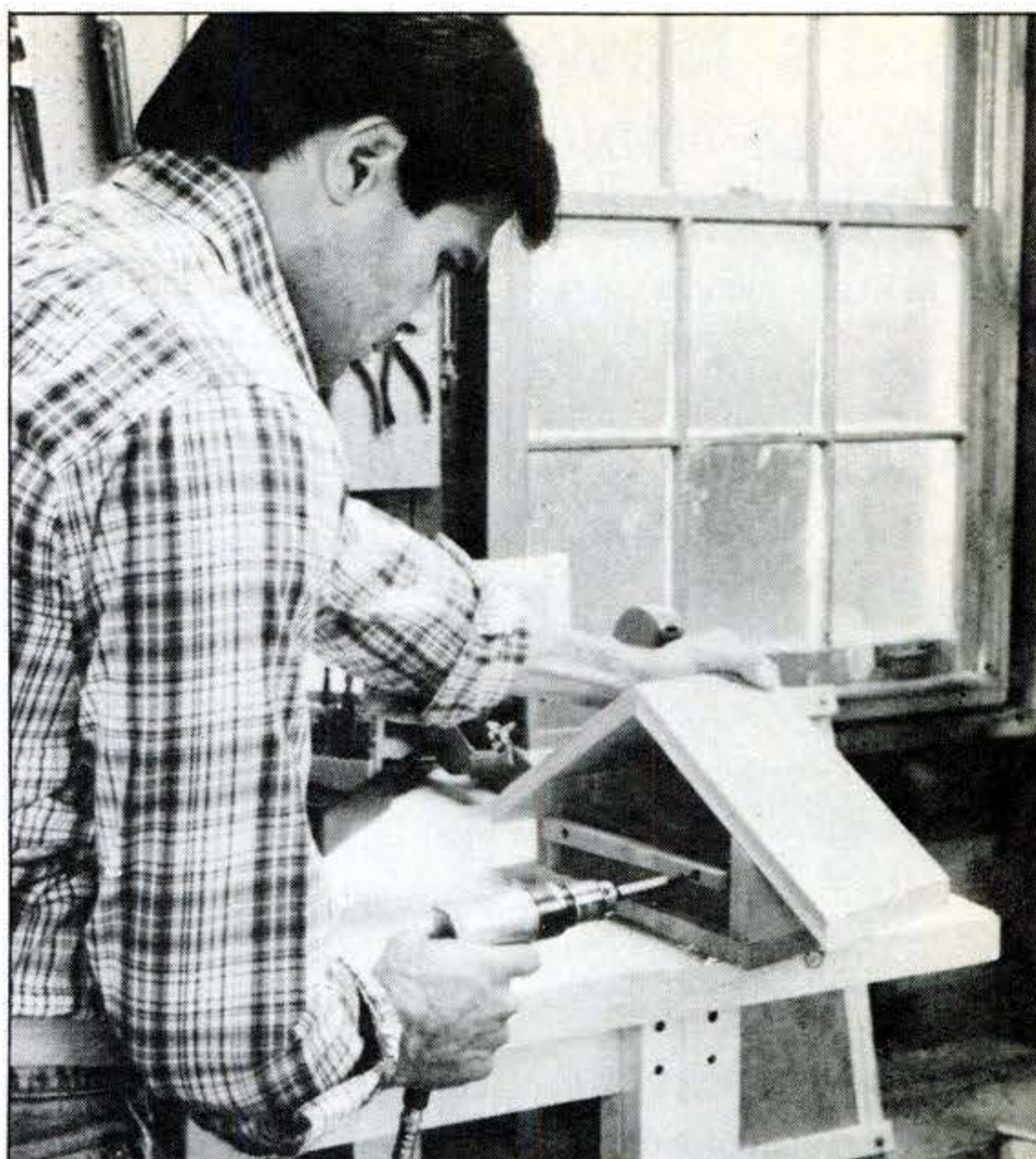
M47 Series™

What's New in Tools

BY V. ELAINE SMAY

Air power

Five home-sized electric compressors (¾ to three hp), two gasoline models (three and five hp), and air tools (such as the ⅜-in. drill shown) are new from Ingersoll-Rand (253 E. Washington Ave., Washington, N.J. 07882). Charge-Air Pro compressors: \$400 to \$950; tools: \$39 to \$69.

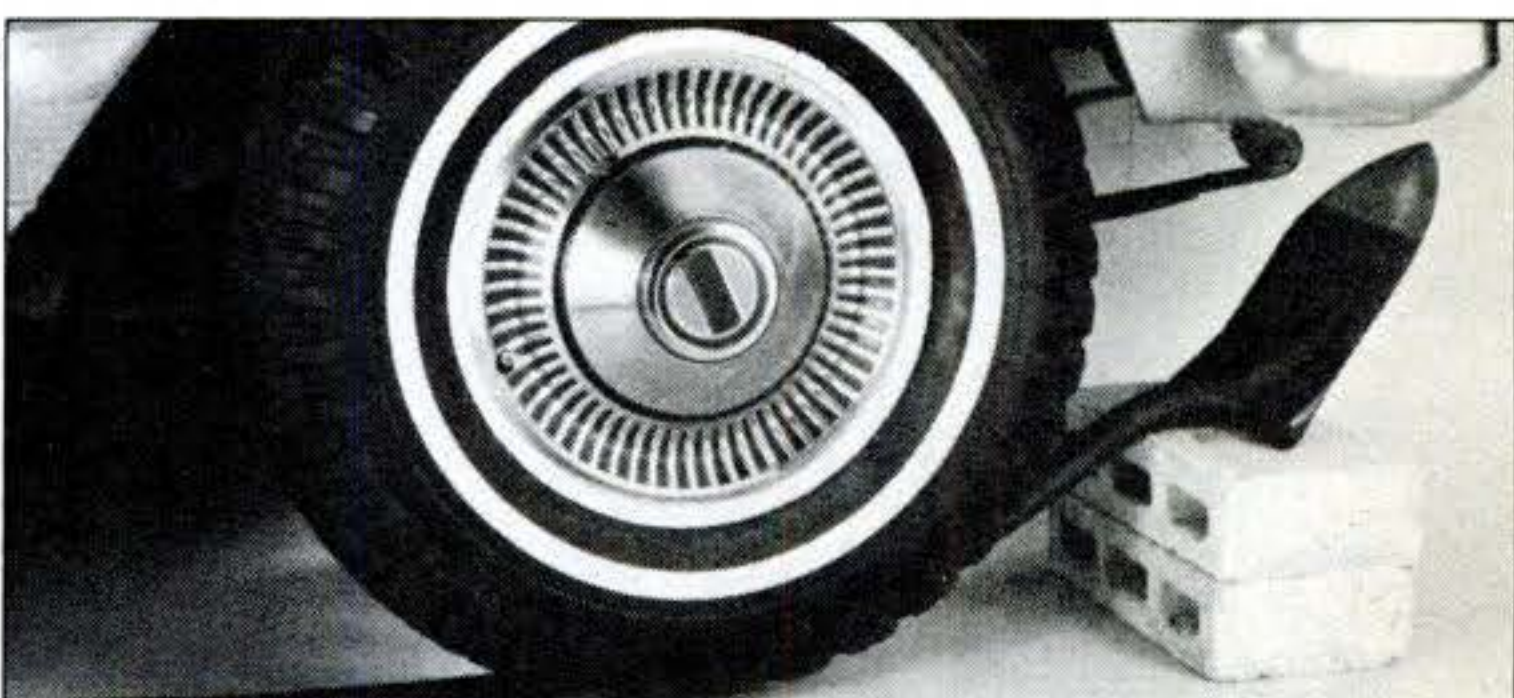


Tool horse

Portable tools mounted on this British rig make it a drill press, lathe, table saw, and more. Tools attach to three sliding saddles on the main beam, which can be rotated through 360 deg. and locked in any position. J. & C. R. Wood, 303 Hull Rd., Hull HU4 7RZ, England.

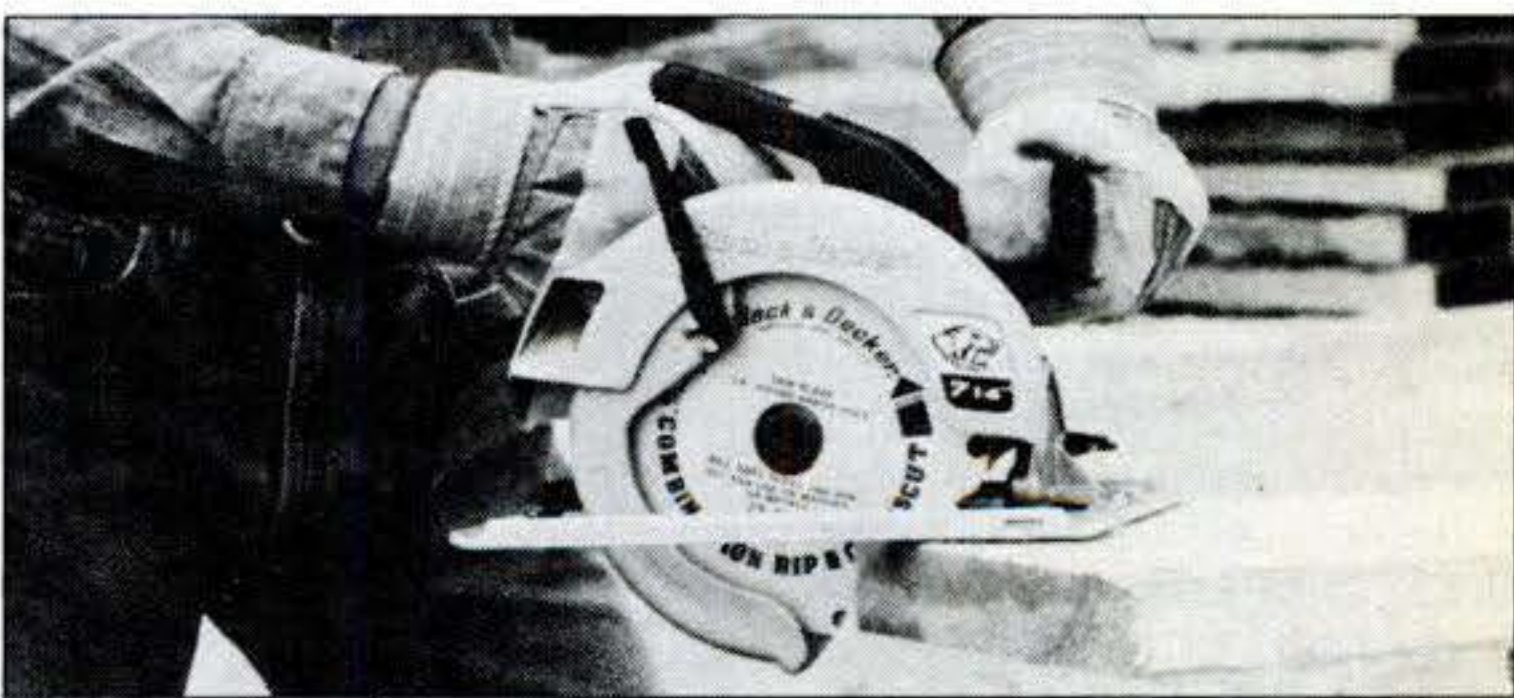
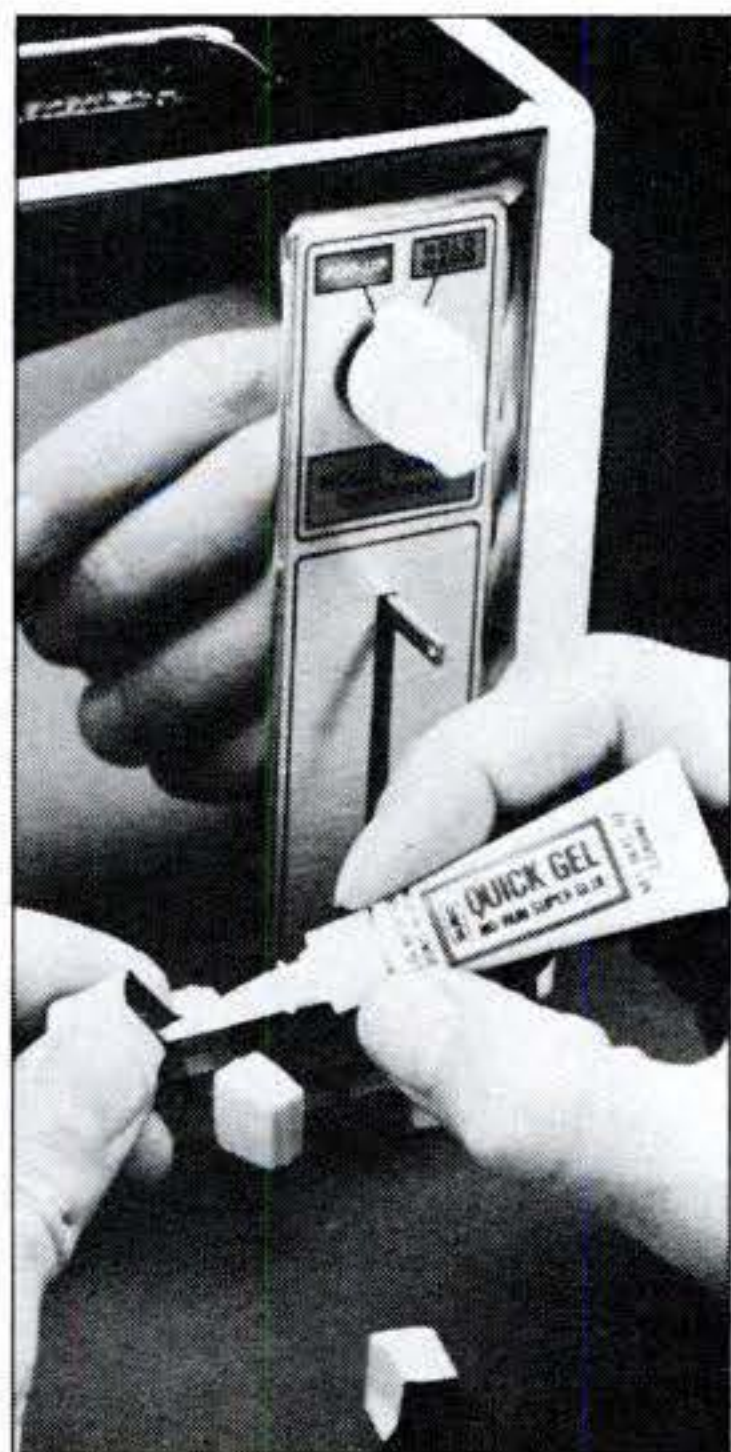
Eternal tools?

"Our tools will never break," says Last Time Tool (100 Galleria Pkwy., Atlanta, Ga. 30339). The handles of the shovels (shown), axes, mauls, and hammers are made of a copolymer that springs back from the toughest torture test. The handles are molded to the tool heads.



Toothy saw

Unique "wing" teeth sever the wood fibers beside the cut so that the saw chain's raker teeth can easily remove the wood. The chain cuts faster and stays sharp longer, says Kolve Sawchain Co. (Box 1270, Gresham, Ore. 97030). To sharpen, you file each tooth straight across.



Super gel

Cyanoacrylate—instant glue—bonds on contact, but it drips, runs, and can't fill gaps. That's why Loctite introduced Duro Quick Gel, a no-drip formula that's ideal for vertical and even overhead surfaces. It fills gaps and bonds porous and non-porous materials.

Quieter cutter

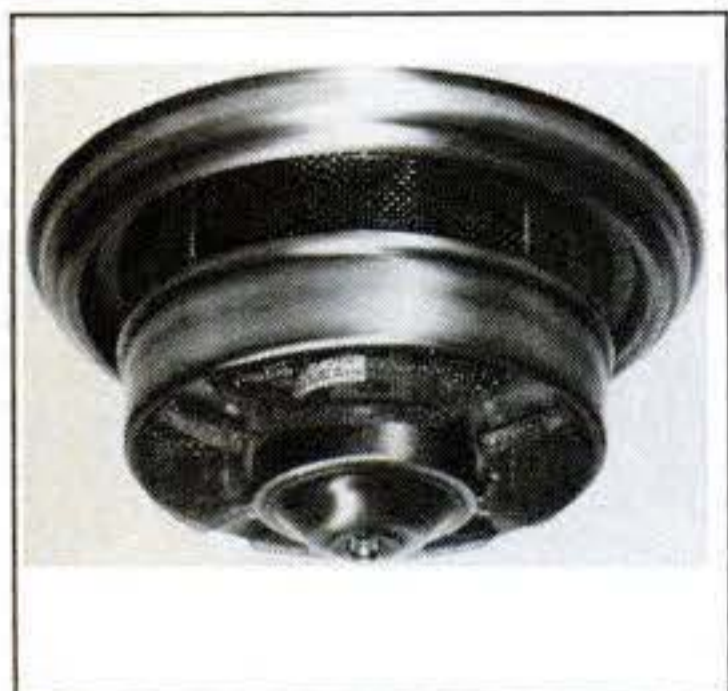
Helical (instead of spur) gears make the 13-amp, 7¼-in. SawCat from Black & Decker's Professional Products Div. quieter and less fatiguing to run, B&D claims. The \$155 saw's locking lever allows quick depth adjustment; a 90-deg. shoe lip makes guide following easy.

What's New in Home Improvement

BY SUSAN RENNER-SMITH

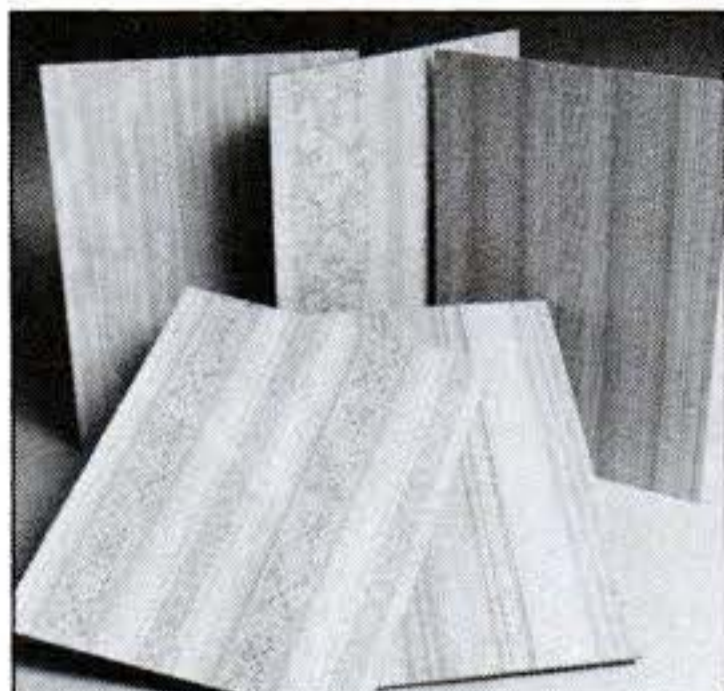
Floor fixer

No more sanding down to bare wood. Gillespie's Restore Your Wood Floor kit renews wood finishes without stripping, says Klean-Strip (Box 1879, Memphis, Tenn. 38101). The \$15 kit includes a solvent wood cleaner and the one-step restorer, a blend of stain, resins, and wax.



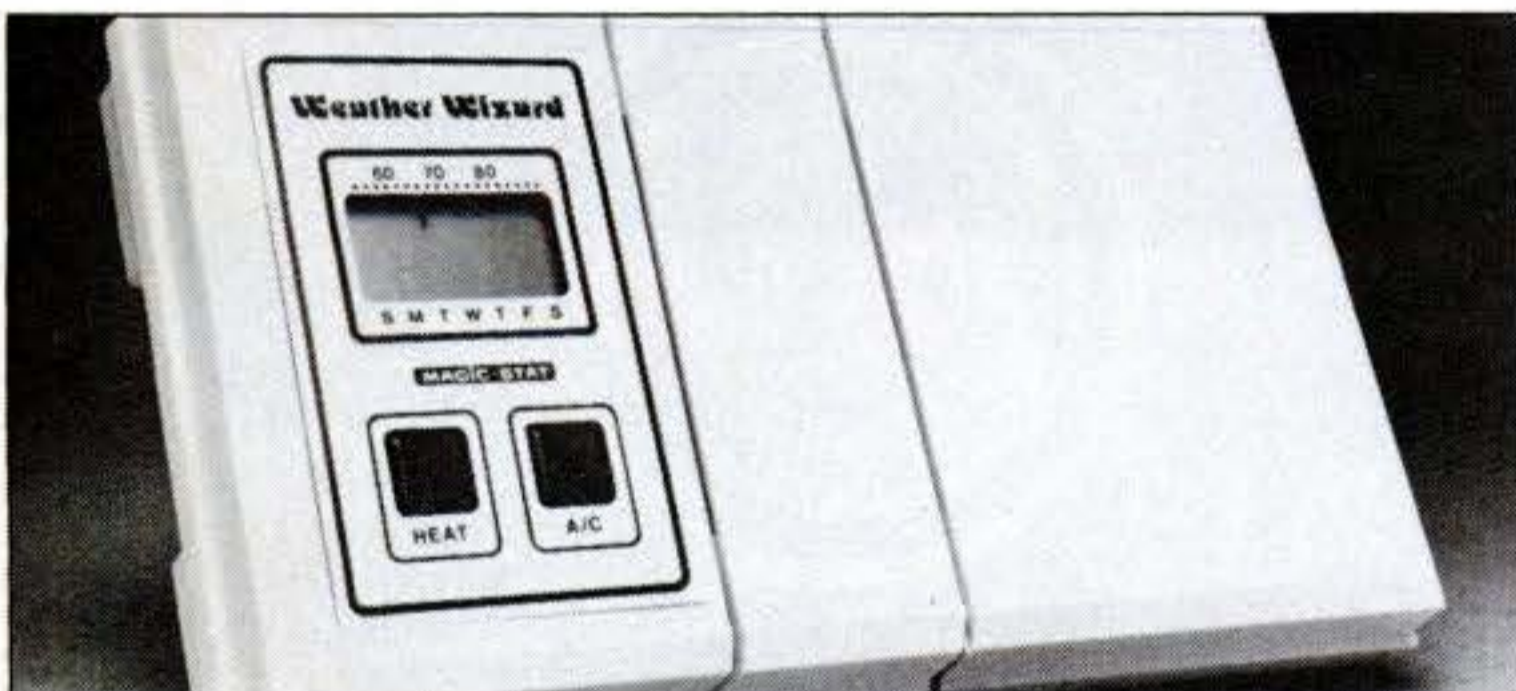
Low-ceiling fan

A small screened paddle fan keeps air moving in rooms with low ceilings. Air sucked up by the nine-in.-dia. Comfort Zone mixes with ceiling air for all-season comfort, says DuPlex Lighting (Box 379, Hamilton, Ohio 45014). The \$120 fan accepts most light fixtures.



Wallpapered wood

Use wood paneling on the walls, and your room looks, well, wood paneled. But Weyerhaeuser's prefinished plywood panels look like heavy, elegant wallpaper. Texture Wall (available east of the Rocky Mountains) costs about \$20 per four-by-eight-ft. sheet.



Friendly thermostat

Mate a thermostat with a microchip, and you can create confusion. Weather Wizard's battery-powered memory lets you work out a program (with the help of prompts) of six daily settings for a year—before installation. Quad Six (3753 Plaza Dr., Ann Arbor, Mich. 48104); \$100.

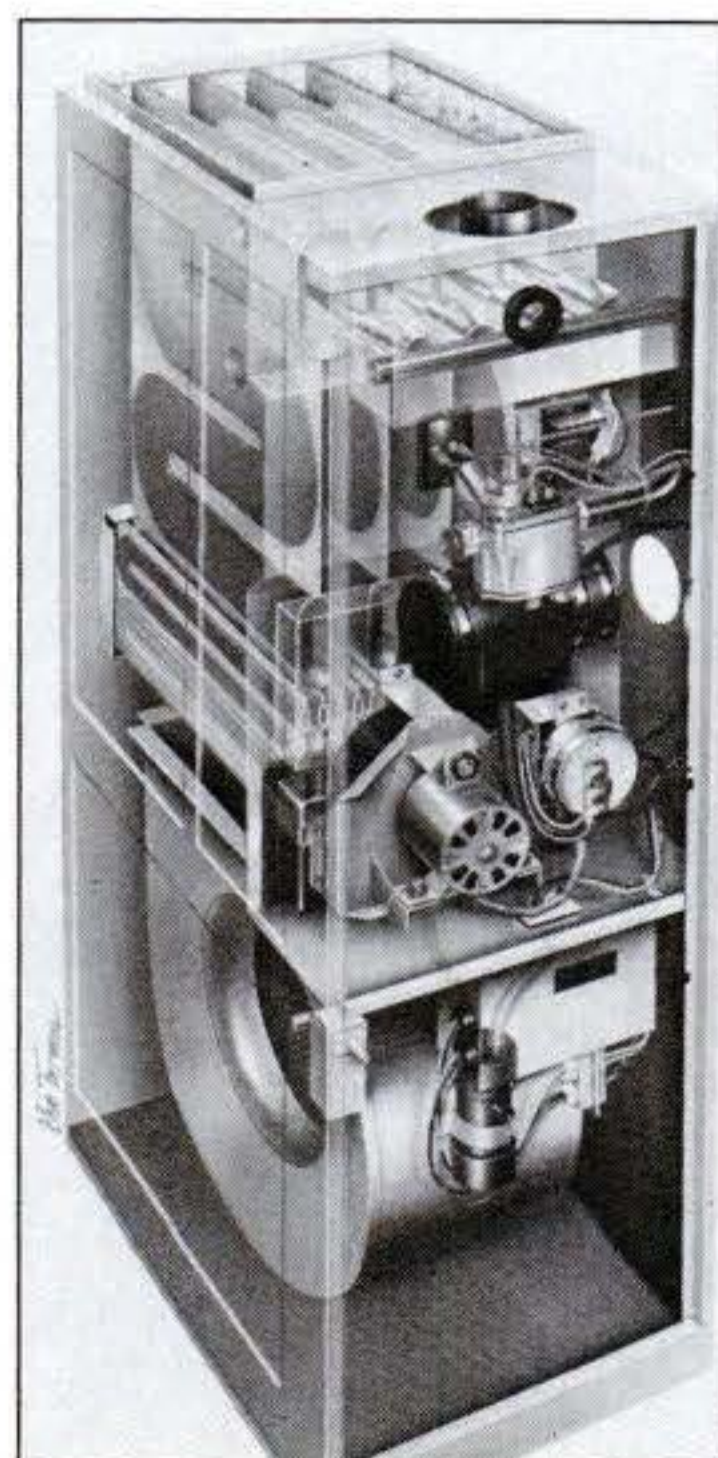
Furnace monitor

Worried about pipes freezing while you're away? Plug a lamp into Home Gard, and recruit a friendly neighbor. If the house temperature drops below a preset level, the lamp lights, alerting the neighbor. Robertshaw Controls (100 W. Victoria St., Long Beach, Calif. 90895); \$15.



Airfoil cap

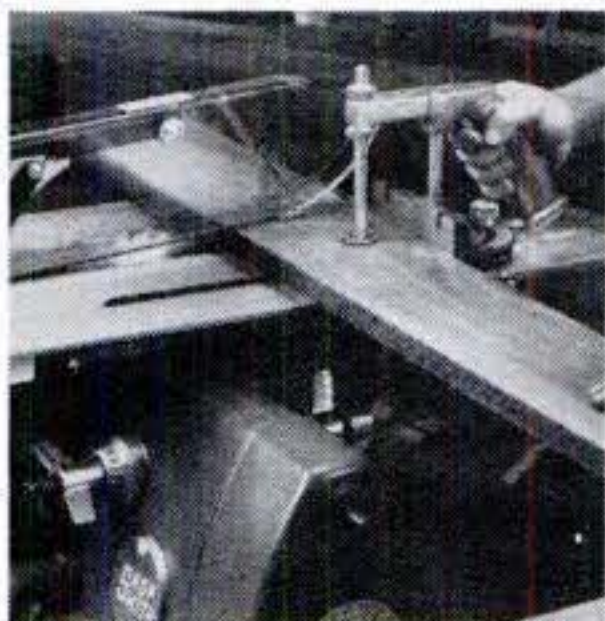
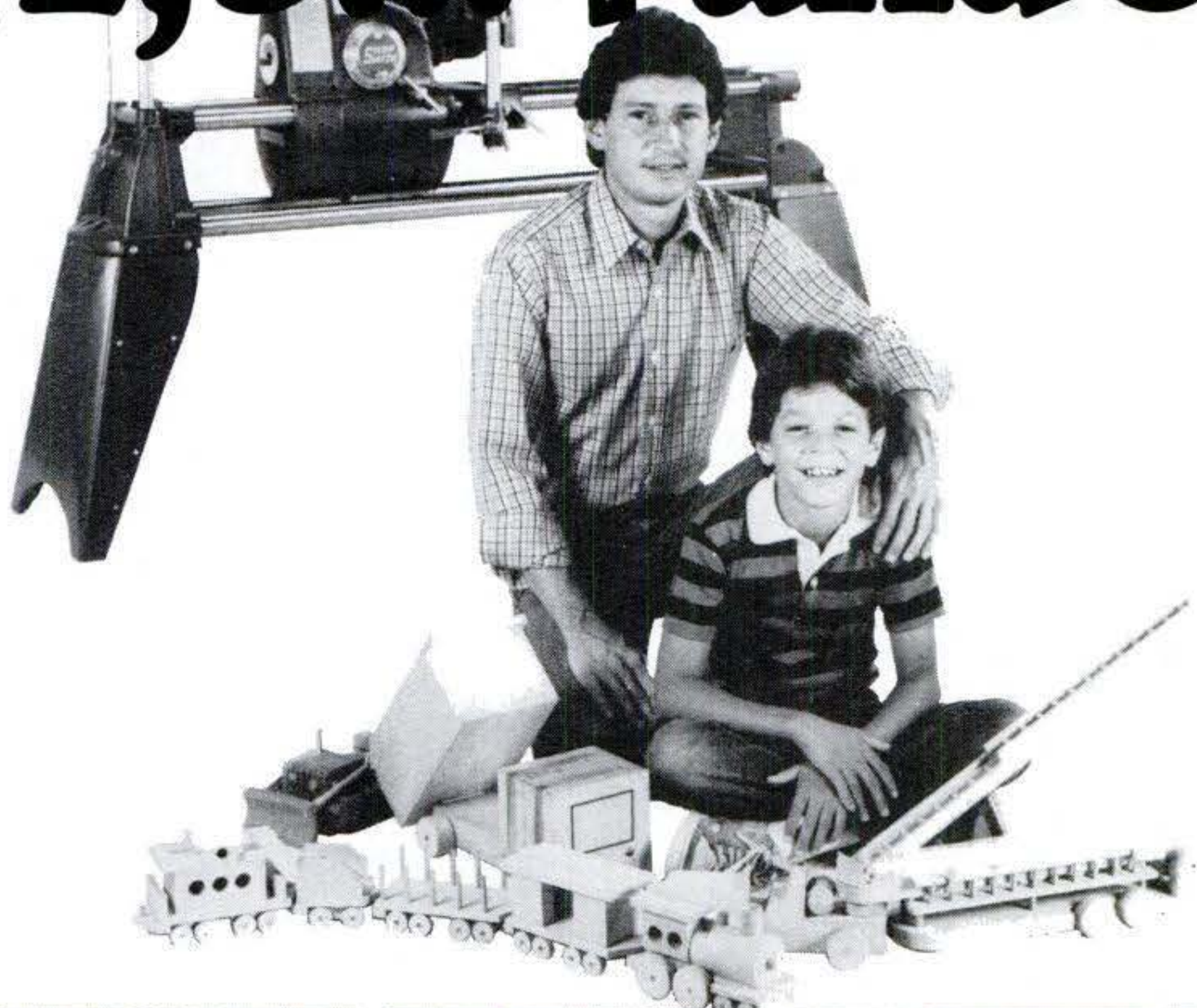
Aerocowl improves chimney draft—and combustion efficiency—without using a fan. Three vanes direct wind flow across an airfoil to create a low-pressure zone that's said to draw out flue gases. Maker: Z-Flex, Box 4035, Manchester, N.H. 03108. Price: about \$100.



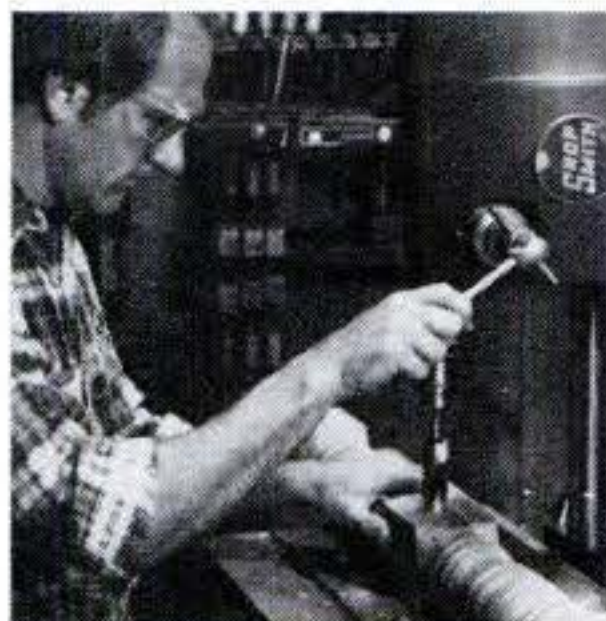
Condensing furnace

Outside combustion air flows directly to the Plus 90's combustion chamber. This keeps particle-laden laundry-room air from corroding the heat exchangers—a problem with high-efficiency condensing furnaces, says BDP Co. (Box 70, Indianapolis, Ind. 46206). Price: about \$2,000.

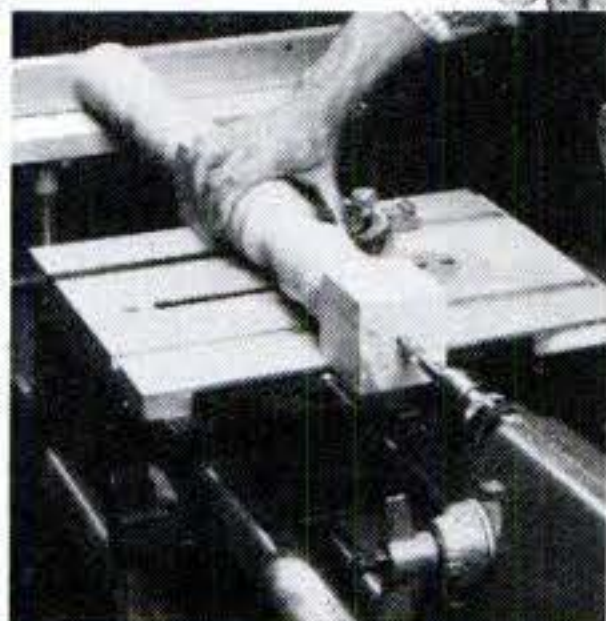
As easy as 1, 2, 3... 4 and 5.



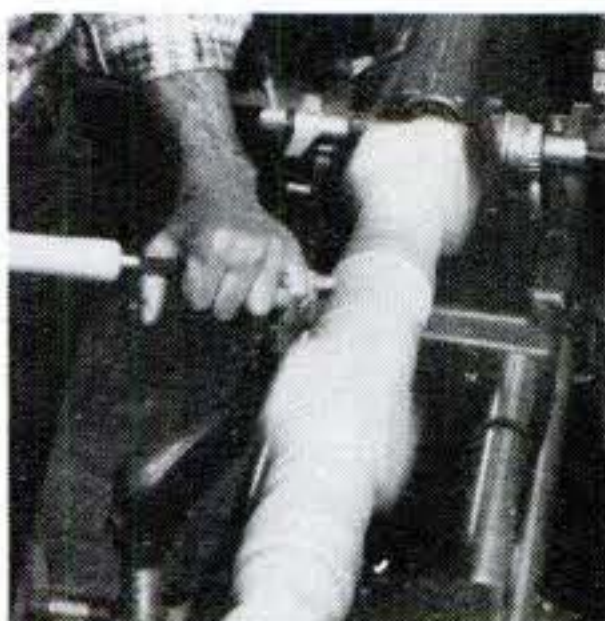
1 It's a 10" Table Saw with 3-1/4" depth-of-cut and huge 48" ripping capacity.



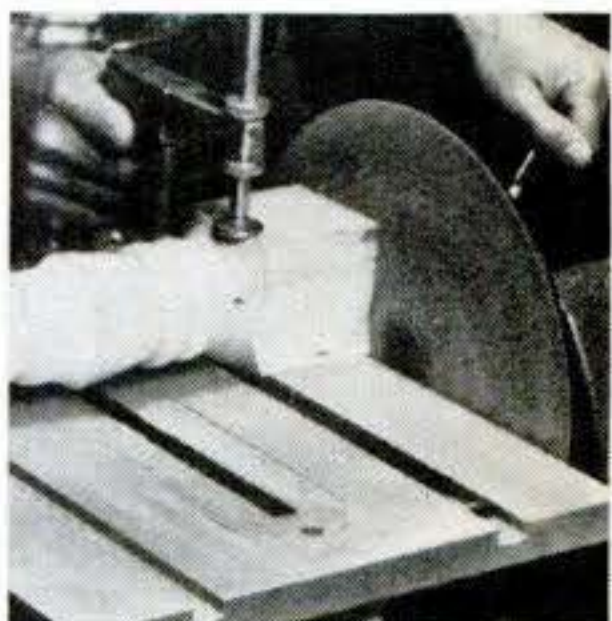
2 It's a 16-1/2" Vertical Drill Press with locking quill feed for accurate depth control.



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.



5 It's a 12" Disc Sander with 113 sq. in. of sanding surface to reduce stock up to 6" thick in a single pass.

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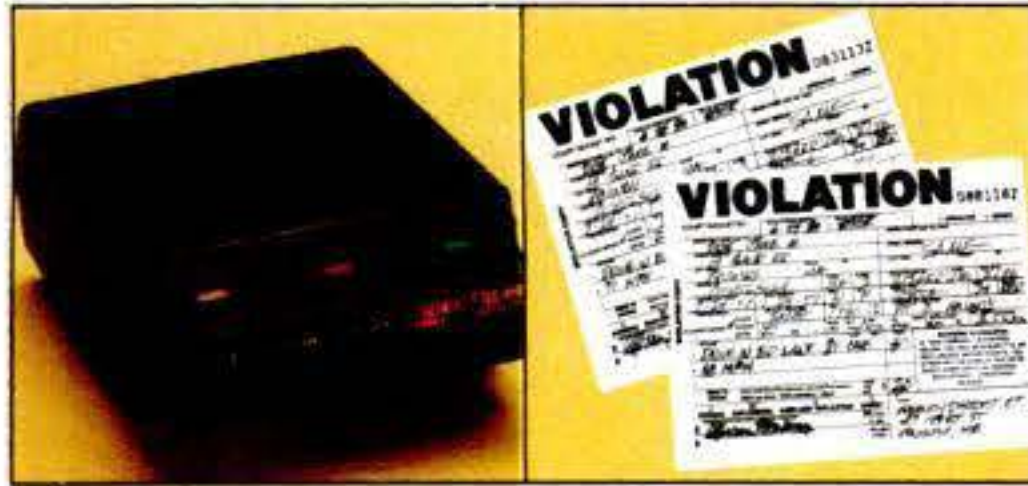
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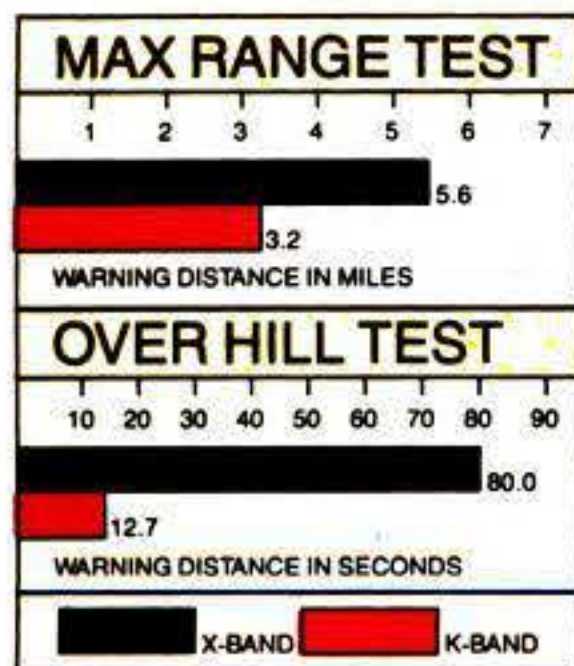


This... instead of these.

Last year, more than 8 million* citations were issued for driving over 55 mph on US highways.

If you were unfortunate enough to receive one of these tickets, maybe it's time to protect yourself. With the Whistler® Spectrum™ radar receiver.

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, Auto-week, 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.



Filter Mode for city driving.

The Spectrum Dash/Visor model is portable 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.



Remote receiver hides behind car grille.

The Spectrum Remote gives you the same great radar protection. But it's hidden from view. The weather-proof receiver installs behind your car grille. And the small console fits handily in, on, or under the dash. You can install the Remote in about 30 minutes. After that, you're in operation every time you turn on the ignition.

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Or visit Direct Response, Inc., in Nashua, and pick up your Spectrum in person.

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Ask for Operator 60



Dash/Visor



Remote console

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

What's New in Electronics

BY WILLIAM J. HAWKINS

Safer dialer

Driving and phone fumbling don't mix. The British Telecom (2-12 Gresham St., London EC2V 7AG, England) car phone permits on-hook, one-button dialing of up to 80 numbers. A speaker lets you hear completed calls before you pick up; a display shows number dialed.

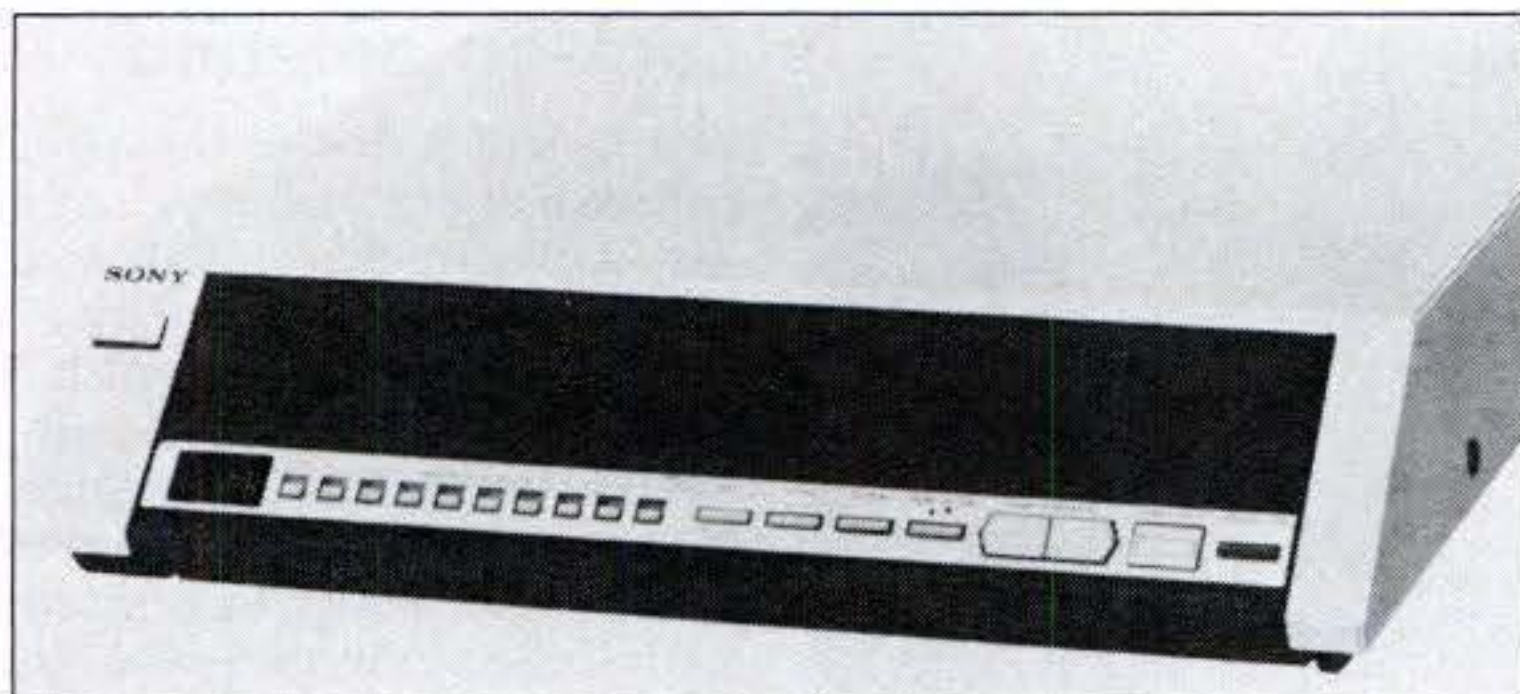
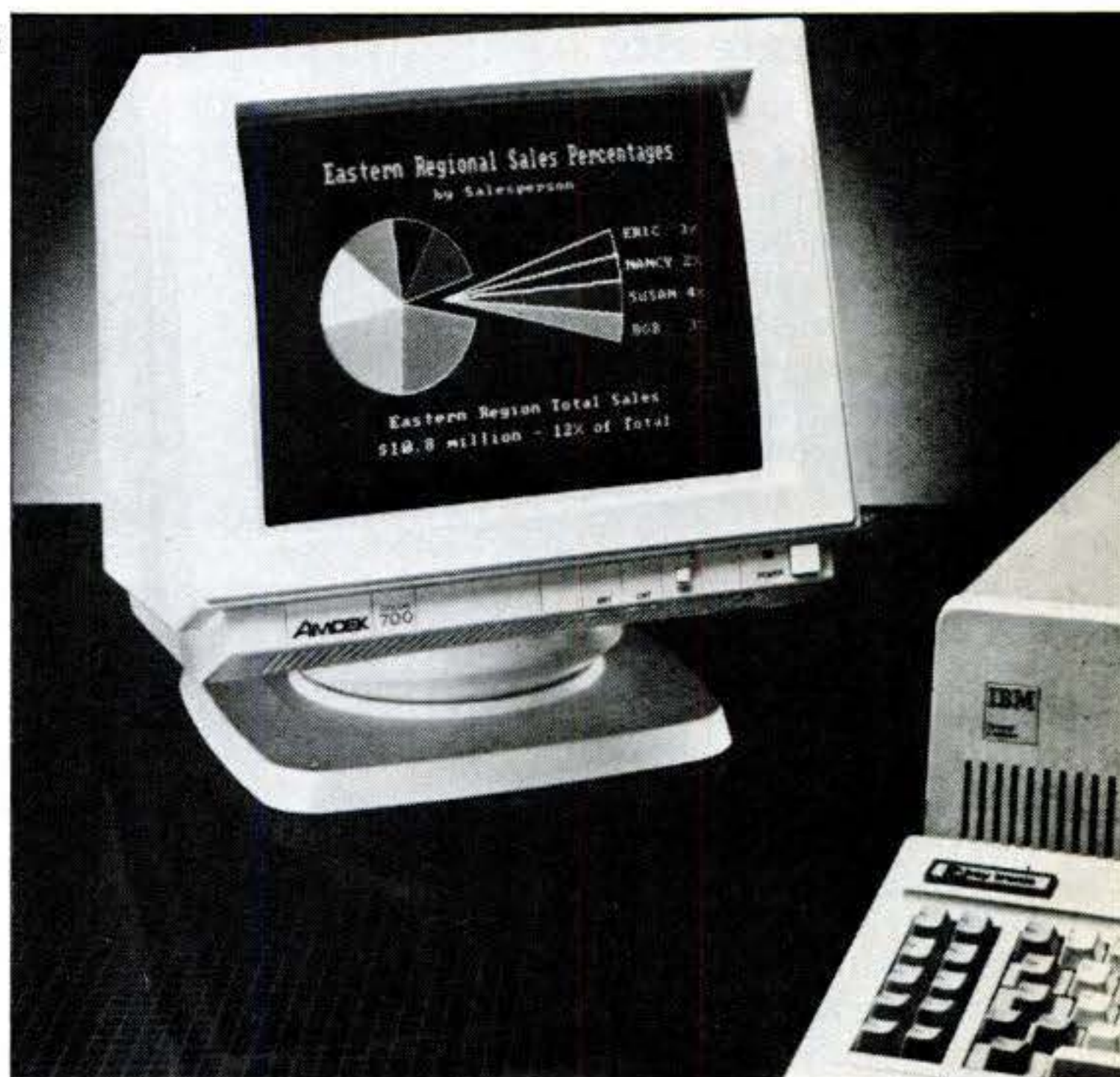


Digital baby grand

It's called the Kurzweil 250 digital keyboard. A music synthesizer? Hardly. It uses a pattern-recognition technique that gives it the feel and sound of a grand piano, claims Kurzweil Music Systems (411 Waverley Oaks Rd., Waltham, Mass. 02154). The price is grand as well: \$10,700.

Versatile monitor

The Amdek Color 700 red-green-blue monitor displays 96 columns by 25 lines of text or uses its high resolution (720 dots by 240 lines) for vivid color graphics. It reproduces all 16 IBM or Apple graphics colors. Screen color can be changed from white to green for text. Price: \$749.



Stackable turntable

A front door opens to accept a record; an infrared sensor cues up the cuts you want and plays them in the order you choose. All operations are automatic in the Sony PS-FL9 linear-tracking turntable—and its front-load design allows you to stack 40 pounds of gear on top. \$350.

Portable drive

Install a disk in the front, connect a battery pack in the back. Result: a portable floppy-microdisk drive that stores 320K. Made by NEC (1401 Estes Ave., Elk Grove Village, Ill. 60007), the eight-lb. unit hooks into the firm's PC-8200 portable computer. \$899 with battery.



Humidity meter

Forget the wicks and tables: This hygrometer uses a thin-film capacitance sensor and instantly displays relative humidity. The \$280 meter shows temperature, too. It's made by Brooklyn Thermometer (90 Verdi St., Farmingdale, N.Y. 11735).



Pocket computer

Store up to 1,000 names for instant recall, calculate numbers up to 200 digits long, or determine currency-exchange rates with the Organizer. It has plug-in memory packs for programming and data saving. Psion, 40 Linderman Dr., Trumbull, Conn. 06611; about \$130.



What's New for Your Car

BY JACK KEEBLER

Pickup unloader

You can unload up to 3,000 lbs. of cargo in one minute with The Un-Loader, a 12-V one-way conveyor belt, says Burke Equipment (Box 25283, Kansas City, Mo. 64119). An optional 10-ft. cable and remote switch make unloading even awkward cargo child's play. Price: \$695.



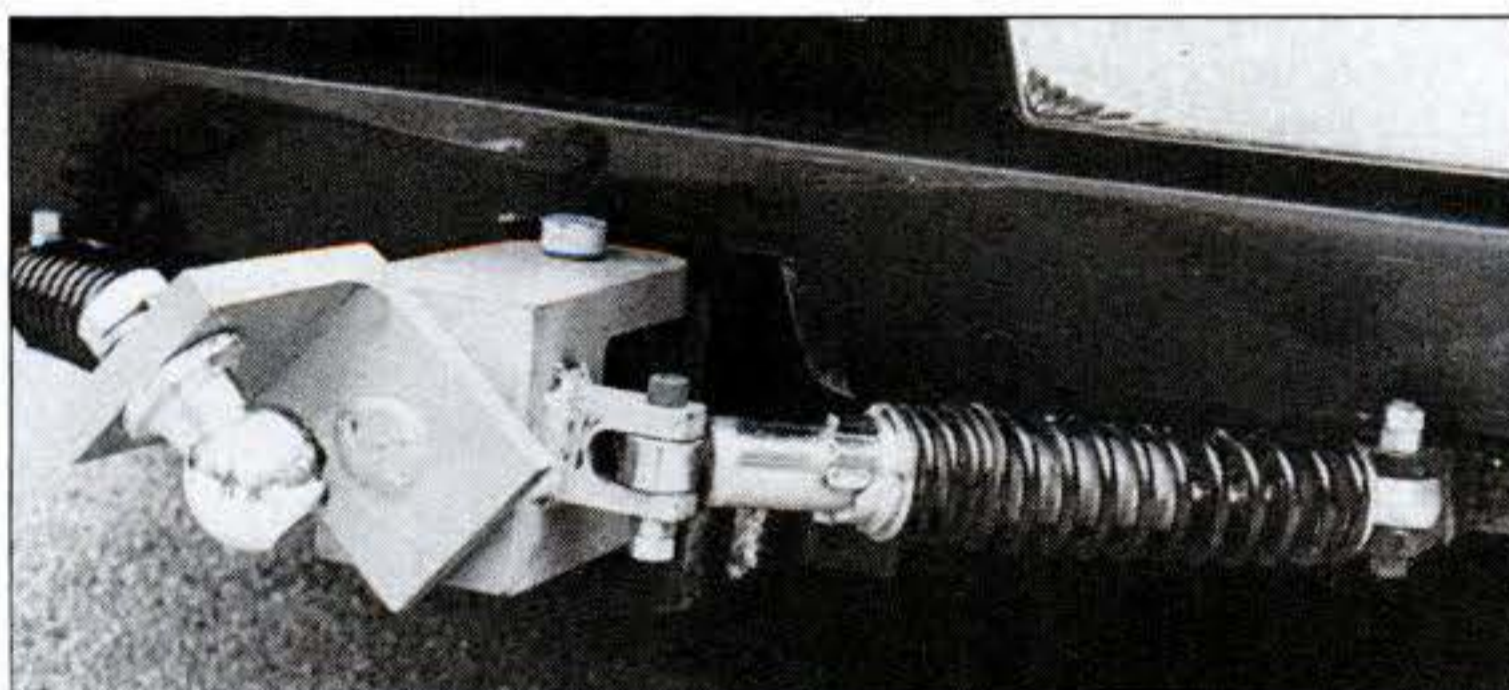
200-psi compressor

Plug RoadPal's 12-ft. cord into your vehicle's cigarette lighter to deliver up to 200 psi, claims Campbell Hausfeld (100 Production Dr., Harrison, Ohio 45030). A built-in trouble light-flasher and a locking valve-stem connector ease roadside repairs. Price: \$40.



Safer hitch

An unyielding hitch can lock the tow vehicle to its trailer, possibly resulting in vehicle roll-over. This prototype hitch, developed by an Ohio University dean, provides improved trailer stability with shock-like dampers and a rotating hitch. It is presently unavailable.

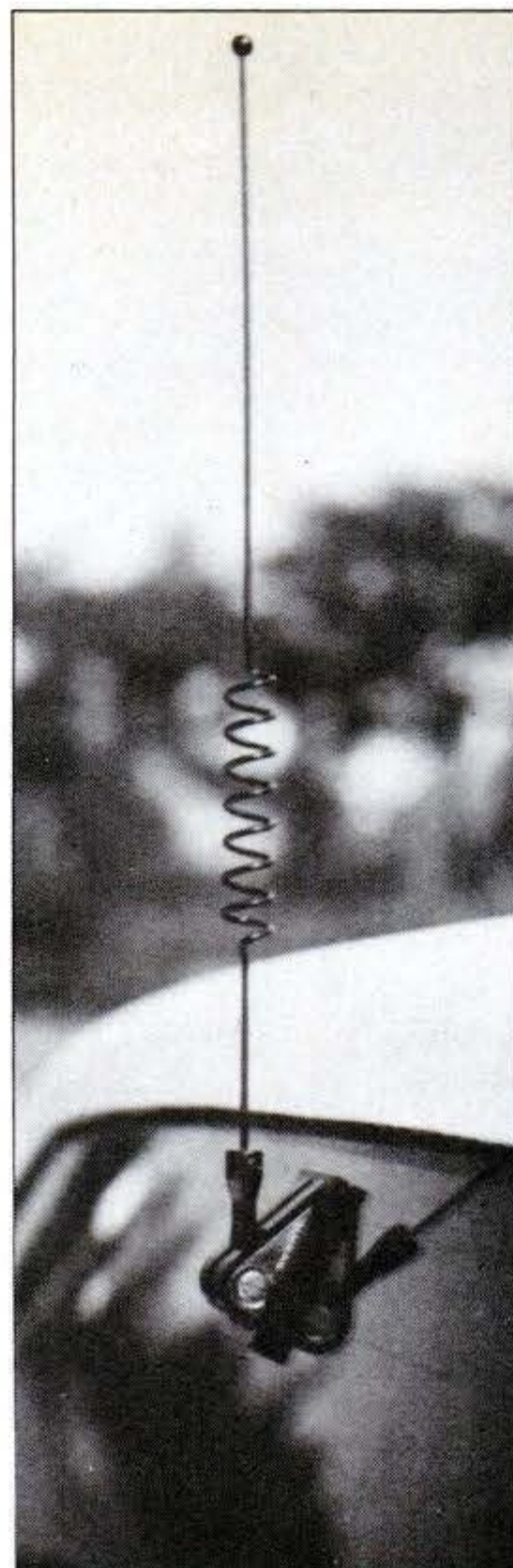


Performance tires

Bridgestone Potenza RE91 wide-tread radial tires feature unique straight-slant groove treads; a softer tread compound for strong handling, particularly in wet conditions; and a VR (130-mph) speed rating. An extra-hard rubber bead enhances stability. Price: \$268 to \$346.

Snow grip

Lightweight molded-nylon Snow-Claws provide extra traction for slippery emergency situations, claims Viatek Industries, Inc. (Box 237, Berlin, N.J. 08009). A simple one-piece locking mechanism secures the emergency-only device to the wheel with no tools. Price: \$9.95 a set.



Stick-on antenna

Don't drill holes to install a cellular-phone antenna, says The Antenna Specialists Co. (12435 Euclid Ave., Cleveland, Ohio 44106). Double-sided tape and a silicone adhesive bond this antenna's foot and coupling box to the glass. The whip is coated with Teflon polymer. \$54.50.

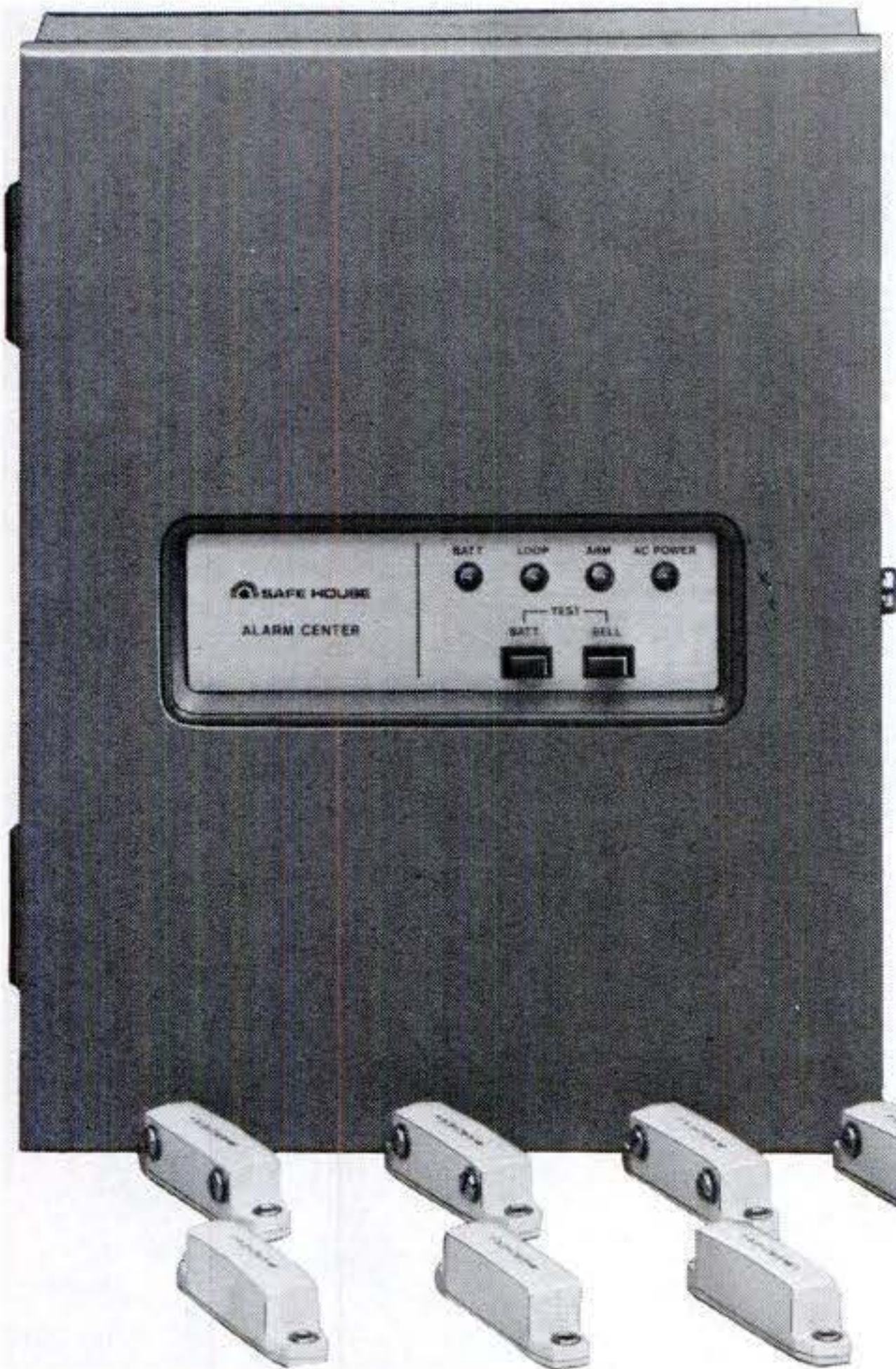


Electronic wrench

Tap the desired torque into the pressure-sensitive keyboard of the Sears 44481 wrench to set the LCD display. A buzzer sounds when the reading is reached. A memory mode retains and displays the highest torque applied. It's accurate to plus or minus two percent. \$80.

Security Sale!

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System Price
129⁹⁵

Reg. Separate Items 146.30



Safeguard your loved ones and your valuable possessions with this perimeter system for professional home security. It includes all you need for easy do-it-yourself installation. You get an alarm system panel with comprehensive manual on planning, installation and operation, 100 feet of wire, high-security key lock, four magnetic switches for windows or doors, and an electronic siren. You can always expand your coverage with the addition of Radio Shack's other security devices. You can even add up to ten arm/disarm key switches for different entrances. The system has two loops. One activates the alarm instantly,

the other provides adjustable 0-45-second entry and exit delays. Alarm shuts off after five minutes, then resets automatically. An always-armed "Panic" circuit lets you trigger the alarm in emergencies. Four LEDs show system status. Power-on and arm/memory LEDs assure you that the system is armed and working. Battery and bell test buttons and battery-low indicator, too. A loop indicator lets you know if a window or door was left unprotected. U.L. listed AC operation with automatic battery backup. Come in and save! And see our entire security line while you're there. Bring your Radio Shack/CitiLine card.

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What's New in Boating

BY SUSAN RENNER-SMITH

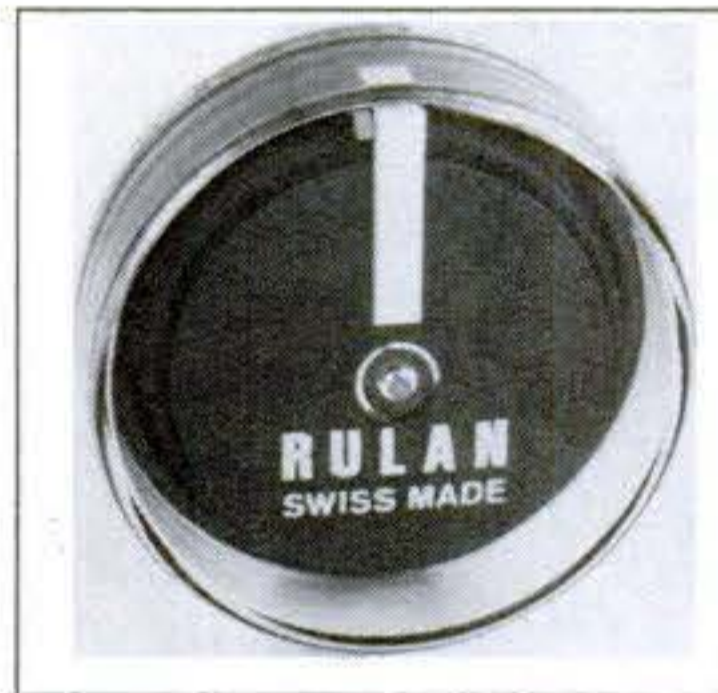


Cat bracket

A small outboard would be handy when your cat is becalmed—but where to mount it? A 1.2-hp motor bolted to its cast-aluminum bracket weighs 17 lbs. in all, and the \$140 bracket doesn't affect trim or tiller movement, says Cheata (Box 1234, Hobe Sound, Fla. 33455).

Portable helm

The hand-held Bridge Master gives remote control of throttle, shift, and steering. Simple wiring links engine and microprocessor controls to multiple plug-in stations, says QuenTron (8225 44th Ave. W., Mukilteo, Wash. 98275). A single-engine system costs \$1,960.



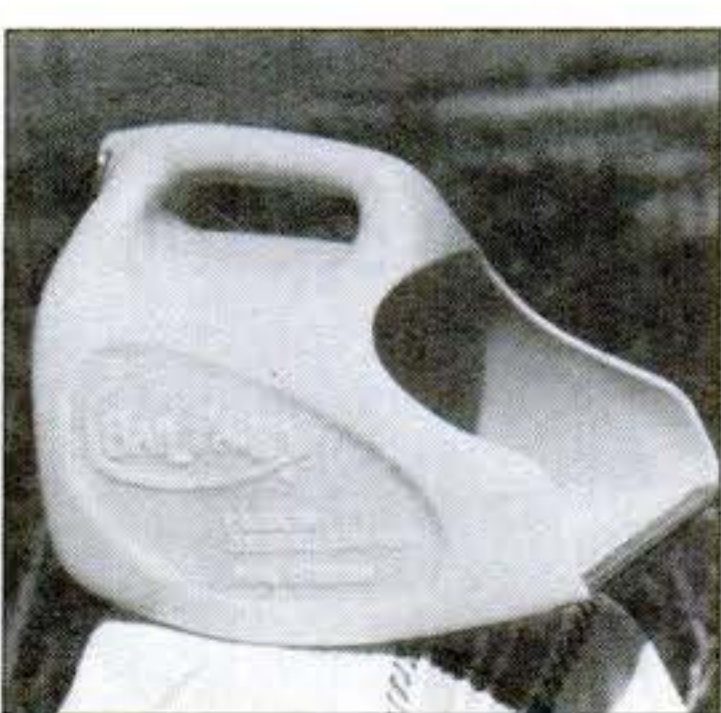
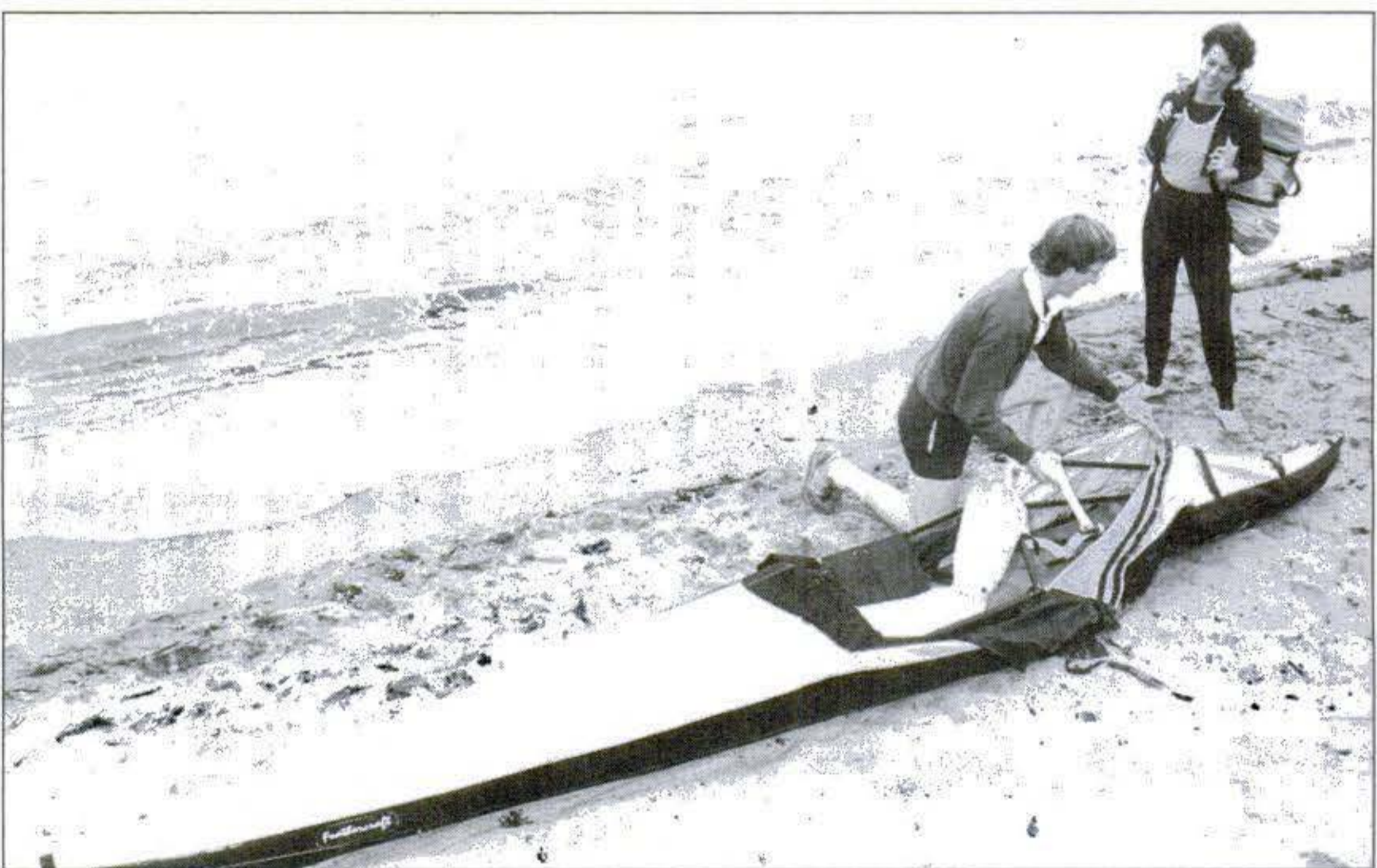
Rudder indicator

To track rudder position, the wheel-mounted Rulan pointer's rotating base is linked via a central shaft to weighted epicyclic gears. These rotate the pointer 30 deg. for each full turn of the wheel. Acqua Reality (Box 466, 8200 AL Lelystad, Netherlands) makes the Rulan indicator.



Boat glue

Bostik 920, a urethane adhesive designed for boat repair, adheres to common boat materials and cures to form a tough, flexible, weather-resistant seal, says Bostik (Emhart Chemical, Boston St., Middleton, Mass. 01949). \$5.46 for a 10.5-oz. cartridge.



Super scoop

Sturdier than a homemade bailer, the heavy-plastic Bail Pail holds 1.5 gallons. A curved bottom and slanted sides make for fast bailing in tight spaces. The scoop stands upright to double as a bait holder. Price: \$16.95 from Bail Pail (Box 754, Centerville, Utah 84014).

Folding kayak

From a 38-lb. backpack unfolds a 16-ft.-long touring kayak. Assembly time is 20 minutes, says Feathercraft (1334 Cartwright St., Vancouver, B.C., Canada V6H 3R8). Aircraft-quality aluminum tubes covered with a nylon-rubber laminate comprise the \$2,000 craft.

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*Use these figures for comparison. Your mileage may vary with speed, weather, trip length. Actual highway and California figures lower. '85 figures not available at printing.

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What's News

If you've driven through the countryside lately, you must have noticed that satellite TV antennas are sprouting everywhere. Estimates are that at least a million people are now tuning in satellite transmission directly. And the number is growing rapidly.

To check on the state of the art, PS Senior Editor Susan Renner-Smith went to a conference in Nashville, Tenn., where many of the country's manufacturers were showing their gear. As she reports, she was startled by the quantity of equipment available. New companies are coming along almost daily. One result: The cover of this issue says that we are reviewing 39 satellite antennas. But the article—which goes to the printer later—says 44. New ones we wanted to include came to our attention. That's not all: The piece could have been titled, "144 Satellite Systems You Can Buy Now," and we still wouldn't have covered them all. But the enclosed list is a representative sample of what you will find on the market.

If you are ready to take the big plunge, just remember that this is a very young and very volatile field. Companies are going into—and out of—business every day. So pick your company and dealer carefully.

More wafer-scale integration

Two months ago, I reported in this space that an audacious multimillion-dollar attempt by Trilogy Systems to build a very large—so-called wafer-scale—integrated circuit had failed. Now, Britain's bold electronics pioneer, Sir Clive Sinclair (who brought the world the Sinclair and QL computers, tiny flat-screen TV, and other wonders), says he will succeed where others have failed and will have such a circuit on the market in late 1985.

The device will be used as what Sinclair calls a "solid-state Winchester." He gets that name from the fact that he intends to use it with his QL computer in place of the micro-disk drives now in use. The wafer would hold

about a half-megabyte of information with an access time of 10 microseconds—1,000 times faster than a disk and using only about one-tenth the power.

The wafer, about four inches in diameter and 1/8 inch thick, is based on a principle patented by inventor Ivor Catt 12 years ago. The wafer contains a large number of serial registers connected in a network with a small amount of additional switching and control logic. When it is turned on, it quickly checks through the circuitry and puts together a chain of functioning registers, which can then be loaded like a disk memory. In effect, it tests and—if necessary—repairs itself every time it is switched on. This makes it almost immune to the big problem that has shot down other wafer-scale attempts: Their complicated circuitry was sensitive to failure within individual circuits, and it seemed impossible to manufacture wafers containing millions of circuits without faults.

Better battery

Why haven't electric cars become popular? Because it's impossible to pack enough energy into a light, compact set of batteries. A lot of research over the years has been aimed at solving that problem [PS, Feb. '79; April '81; Feb. '82].

Now, a step in the right direction. The Peugeot 205 Electric is demonstrating remarkable performance in the streets of Paris. The secret: a nickel-iron battery of the type E. F. Lindsley described in his February 1979 piece.

The new device stores about twice as much energy per pound as a regular lead-acid battery. This gives the Peugeot a top speed of more than 60 mph and a city range of 100 miles. All batteries are under the hood, so the car has a trunk for luggage. That's unlike most other electrics, which have hood and trunk space crammed with batteries. Finally, the nickel-iron batteries have a life expectancy of 125,000

miles and at least 1,500 recharge cycles—several times the performance provided by conventional batteries.

But there are problems, too. Recharge time is 10 hours, and battery cost is high and likely to remain so.

So work goes on. The British government is still financing research. Clive Sinclair (is there any field he isn't involved in?) has announced ambitious plans for an electric car. A Swiss company is active. And in this country, Ford is still working toward a really practical electric vehicle. Someday, maybe.

Stirling-engine progress

The U.S. Army is buying 10 Stirling-engine motor-generator sets to test as tactical mobile electric-power sources. That may be an important development because the Stirling engine—despite many apparent advantages—has been looked at for a variety of applications over the years only to be passed over.

However, the potential advantages could be significant. For example, the Stirling is an external-heat engine, with gas alternately heated and cooled in sealed cylinders to move pistons back and forth. The heat can thus be supplied by a steady, economical, low-pollution flame or even by solar energy. Its burner can be designed to use any fuel available.

Now, a version developed by Stirling Power Systems of Ann Arbor, Mich. [PS, Jan. '82], will be used to power a five-kilowatt field generator for the Army. If it proves successful, perhaps earlier work to make the Stirling into an automotive power source [PS, April '76] will be resumed, and the promise of the Stirling as a car engine yet realized.


Editor-in-Chief

Beam magic

creates new super-tough materials

Beams of ions and laser light can dramatically change the surface properties of materials—toughening metals or ceramics against wear and corrosion, for example. Evolving beam-treatment techniques for industry can conserve energy and strategic materials. And laboratory researchers, altering atomic structures in ways that are still not completely understood, are creating exotic new materials that are impossible to produce using any other method.

By JOHN FREE

OAK RIDGE, TENN.

Dodging cabinets glowing with red instrument lights, oscilloscope carts, and other gear cluttering the lab, Bill Appleton strode toward a junction of high-vacuum ion-accelerator tubes that crisscrossed at knee level.

The 47-year-old physicist seemed at ease amidst the high-tech plumbing. He first began probing matter with ion beams as a doctoral student in the mid-1960s. Now, heading the particle-solid-interactions section of the Solid-State Division of Oak Ridge National Laboratory (ORNL), he witnesses some of the most remarkable transformations of materials ever devised.

Appleton's mustached face appeared above several gleaming tubes. "A sample goes in here," he said, tapping the vertical junction, "and we alter its properties by implanting it with ions." Virtually any element can be implanted in any solid with a stream of ions—charged atoms—often dramatically changing the solid's physical, chemical, electrical, or optical properties.

"For example, we can extend the life of a metal alloy for artificial hip joints up to 1,000 times," said Appleton. "But because a hip joint already lasts 10 years," he added, "a tenfold improvement is more than adequate."

Nearby, a closet-size ion generator, source of the metal-toughening magic, hummed in its blue cabinet. The generator poured an invisible stream of ions down a tube into a metal test sample. A small window at the sample junction lets scientists alter materials with another form of energy: extremely brief but powerful bursts of laser light. Both laser and ion beams used alone or together can produce new properties in materials that "fool Mother Nature," says Appleton.

Among its remarkable abilities, beam magic can:

- Toughen metals and ceramics to reduce wear and corrosion.
- Modify solids without changing their dimensions.
- Conserve dwindling strategic materials.
- Eliminate toxic wastes from some metal treatments.
- Avoid energy-consuming heat treatments that warp metal components.

Until recently, these powers have been of mostly academic interest, restricted to laboratory experiments. But now beam technologies that enhance the mechanical properties of materials are gradually being adopted by industry. In years to come, widespread ion implantation may lead to everything from longer-lasting razor blades to car-engine parts that outlast their owners. Beam technology could put a dent in the estimated \$90 billion annual expense in the U.S. caused by wear and corrosion. And a variety of new metal alloys developed through ion and laser technology, such as superconductors and so-called amorphous metals ["Metal Magic," PS, Dec. '82], may lead to a variety of energy-saving improvements.

Computer chips to drill bits

At least one beam technique has already found a comfortable niche. Some 2,000 ion implanters are in use—often around the clock—in this country. The semiconductor industry uses them to implant ions in silicon wafers. These discs are then sliced into tiny chips for electronic circuits. Ion machines for semiconductors, however, demand exceptional precision and purity to avoid ruining microcircuits.

But hardware for another promising use—toughening metal—doesn't need such precision. Pioneering work on this type of ion implantation began in the 1970s at Harwell, England, the British equivalent of ORNL here. Britain's atomic-energy lab now licenses ion hardware and modifies metal as a business.

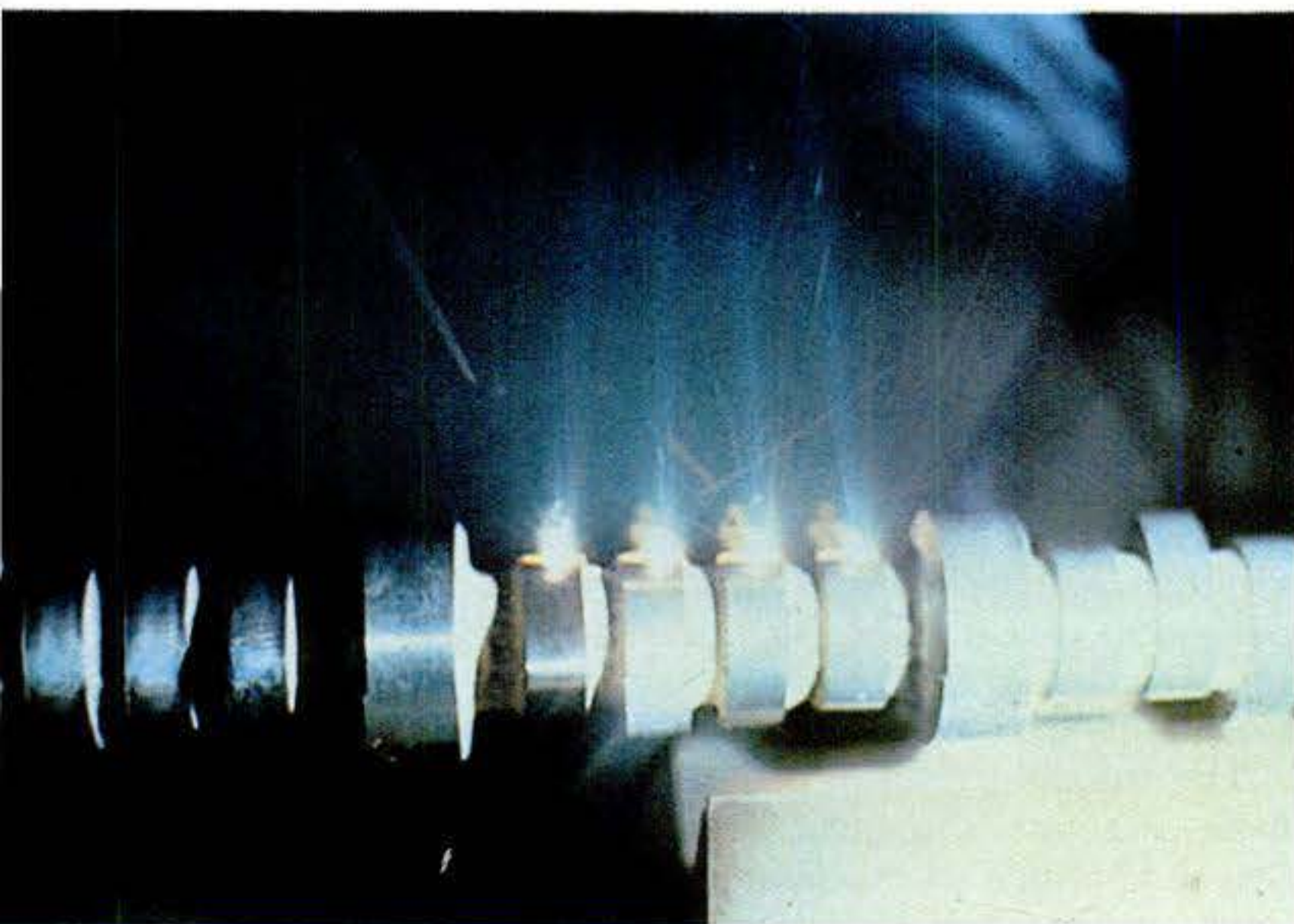
Earlier this year, Zymet, Inc., a small Danvers, Mass., firm, introduced the first metallurgical ion machines in the U.S. Zymet's Z-100 implantation system has a relatively small (one-by-1.5-foot) vacuum chamber.

That space limitation, plus a half-hour cycling period for each load, severely limits ion-beam processing now. "You need to treat high-value real estate," says Jim Hirvonen, Zymet's research director. Some examples: precision tungsten-carbide tooling—punch sets that cost tens of thousands of dollars—bearings, or metal bone-replacement implants.

Zymet's \$150,000 implanter uses nitrogen ions to toughen metals, although other ions work, too. Accelerated by high voltage, nitrogen ions penetrate the surface region of an object. The ions "stitch" together atomic-level



Nitrogen ions beamed into surface of titanium-aluminum alloy used for artificial hip joints transform the metal, making it exceptionally resistant to corrosion. Untreated sample, left, degrades in solution simulating body fluids.



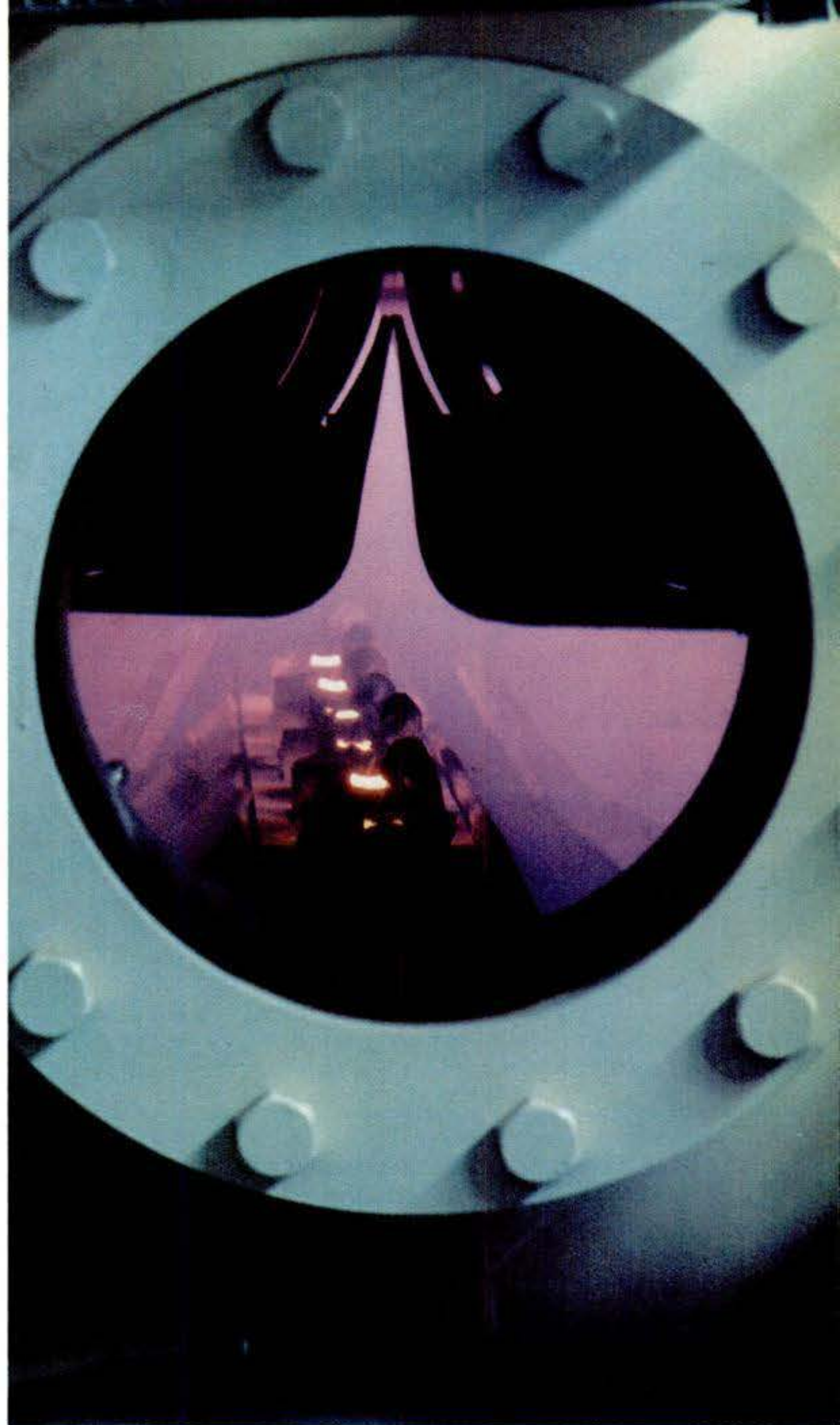
A computer-controlled electron beam flicks back and forth over V8-engine camshaft lobes at GM's Allison gas-turbine plant in Indianapolis. The mass-production vacuum-chamber process selectively hardens wear surfaces.

defects in metals and strengthen the surface in other ways (see box).

Scientists are still mystified about some interactions that occur during and after implantation. But results—even spraying nitrogen ions into a microinch-thin surface layer of ordinary steel—amazed Hirvonen several years ago when he worked at the Naval Research Laboratory in Washington, D.C.

Hirvonen recalled an experiment he and co-workers conducted: Cylinders of low-carbon steel, shaped like finger-size hourglasses, were implanted with nitrogen ions. Then the cylinders were put on a fatigue-test jig; weights compressed and stretched the samples as they spun at high speed. As expected, untreated cylinders snapped after one million test cycles. But before the ping of broken metal was heard from several ion-implanted samples, they had lasted 100 million cycles.

Nitrogen ions can transform the surface of metals in another way. By enhancing corrosion resistance, ions will soon benefit medicine. Metal corrosion, curiously, is becoming a growing health problem: This year, as an example, a 58-year-old patient—call him Jim Mitchell—visited his doctor complaining of soreness and swelling around his hips. Walking was difficult. Eight years earlier, suffer-



A vacuum chamber fills with aluminum and argon ions as aluminum wire fed from spools contacts white-hot heaters (center). SPS Technologies (Newtown, Pa.) uses this ion-vapor deposition process to coat aerospace fasteners.

ing from a degenerative bone disease, Jim had been surgically implanted with ball-and-socket artificial-hip joints. More than 75,000 such operations take place each year.

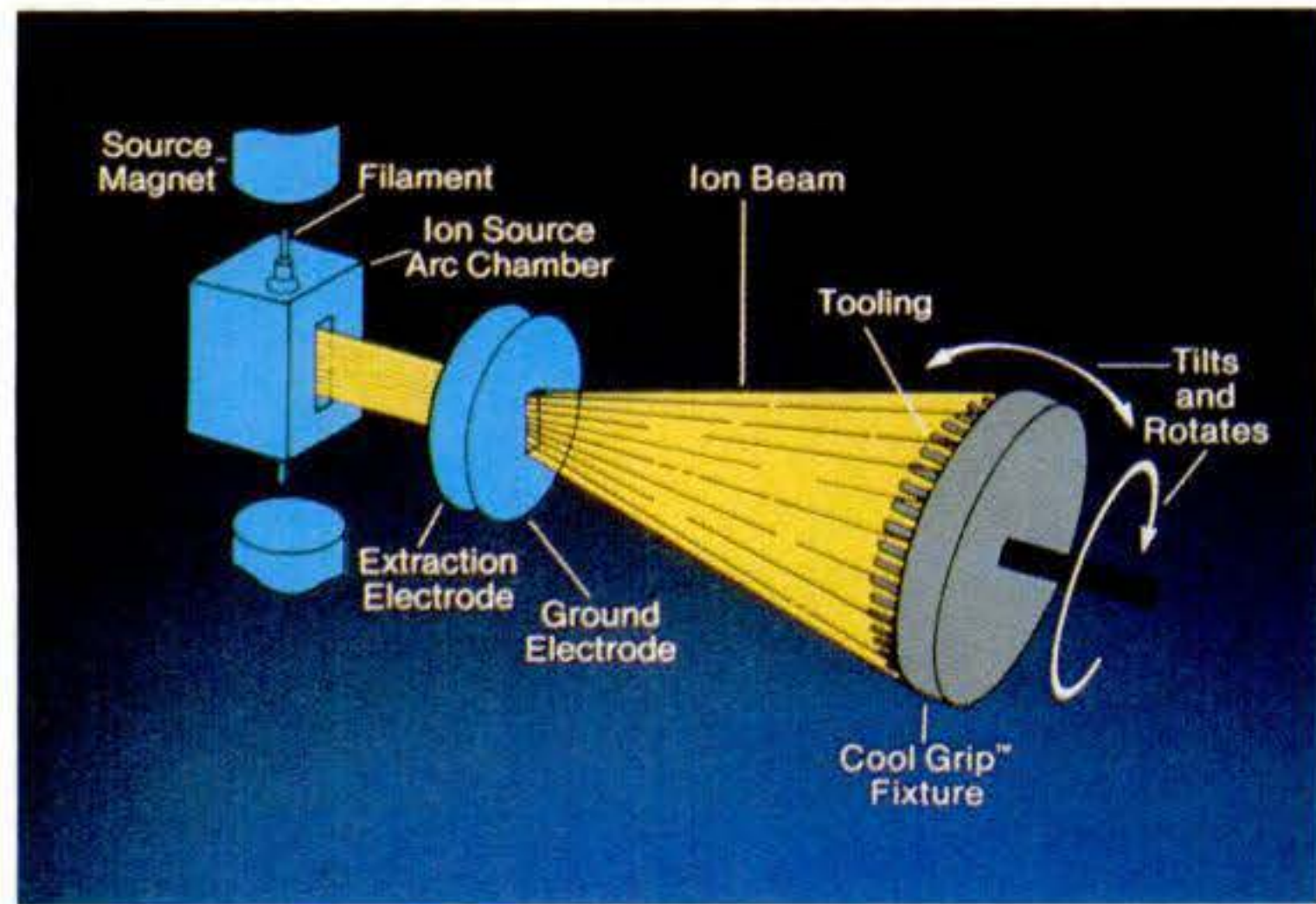
Jim's problem: His body fluids were corroding the titanium-alloy balls cemented into his upper legs. Bits of metal were flaking off the pitted alloy and seeping into his blood. These particles were also abrading his plastic hip sockets. The cure? A second major operation to replace the corroded implants with new ones.

"Physicians often tell us these balls look black when they're removed from patients," said Appleton. The color, scientists suspect, is from oxidized titanium and polyethylene material. ORNL researchers, using small titanium-alloy cylinders pressed between plastic pads and simulated body fluids, discovered that nitrogen-implanted alloys resisted corrosive wear 400 to 1,000 times longer than untreated alloys.

"We've had strong encouragement from the Department of Energy to get this development into the hands of medical people," Appleton told me. ORNL is cooperating with the University of Alabama medical school to obtain Federal Drug Administration approval for ion-implanted hip joints.

Continued

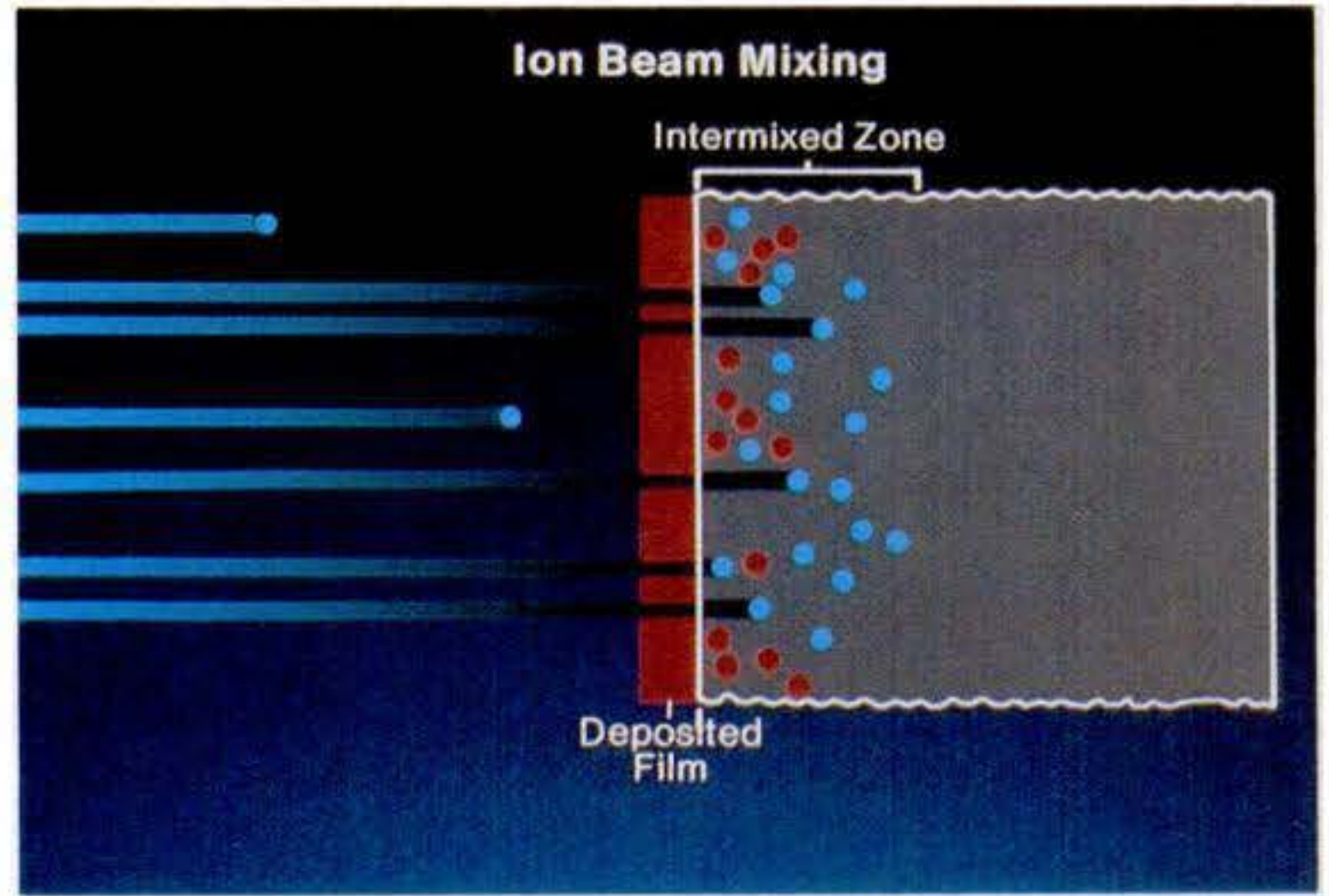
Toughening metals with ions



Ion implantation requires that objects be positioned in line with a beam. In Zymet's machine (left) items such as drill bits or punches are placed in an eight-inch water-cooled holder. Nitrogen serves as an ion source. To create ions, a hot tungsten filament produces high-velocity electrons that collide with nitrogen atoms and molecules in a vacuum, stripping off electrons and forming ions. The charged ions are electrostatically extracted from the source, focused into a beam, and

accelerated in a 100,000-volt field. When these high-energy ions strike a metal surface, they penetrate about one micron (0.00004 inch) beneath the surface. Dimensions remain unchanged.

Nitrogen ions strengthen metals by "anchoring" small defects in crystalline structures that can grow into micro-cracks and cause wear. Ion bombardment, similar to shot peening, compresses the surface and minimizes surface cracks. Nitrogen ions bonded with steel



alloys also form minute quantities of hard nitrides and help maintain oxide coatings that reduce surface friction. Ion mixing, another implantation technique (right), first deposits thin films of materials on a substrate. Then an ion beam, which may be argon or neon that will evaporate from the substrate, drives the coatings into the surface, producing an alloy. The technique forces metals to combine that would not do so with conventional alloying.—J. F.

Fighting corrosion is also a major element in the effort to prolong automobile life. Robert Chance, Monte Walker, and others at General Motors' Warren, Mich., research labs have been studying ways of protecting the steel used on vehicles so as to minimize the need for critical metals such as chromium. One experiment sought other elements that might be effective ion-implanted corrosion fighters. Chance and Walker decided to implant arsenic, phosphorus, and antimony ions into dime-size discs punched from sheets of low-carbon steel. Different exposure times altered the ion concentrations; 60,000- and 190,000-volt potentials varied the ion-penetration depth.

To test for corrosion, they immersed the discs in acids and applied gradually increasing voltages to them. When a given voltage is reached—the breakdown potential—the metal breaks down and permits a sudden surge of current. Higher breakdown potentials mean better resistance to corrosion.

Phosphorus provided remarkable results. With the phosphorus-implanted steel, the researchers watched their instruments climb dramatically. Ordinary steel broke down at only 0.05 volt. But phosphorus-implanted discs held up until the voltmeters registered almost one volt.

"We're not trying to prove any particular element is the 'right' one for implantation," stresses Walker. "However, phosphorus clearly demonstrates the beneficial effect of surface-treating metals." Chance and Walker believe a wide range of vehicle applications is possible and that the technology will reach automobile plants.

"Ion implantation may never replace conventional methods of corrosion protection," cautions Chance, "but it would offer a new dimension. If ion implantation ever did replace such methods," he says, "the initial applications would be highly specialized—mainly small components where high standards of performance are essential for safety or other purposes."

The search for candidate elements for ion implantation continues. Both automobile manufacturers and petroleum

companies such as Exxon have investigated the metal-toughening properties of numerous oddball elements. Experiments revealed, for example, that yttrium ions beamed into diesel-engine fuel-injection pumps boosted wear resistance 100 times as compared with chromium plating.

The unusual talents of ions in these techniques stem from some metallurgical facts of life. First, blasting ions into a solid is a so-called nonequilibrium process: In ordinary equilibrium metallurgy, alloy elements are melted together and cool slowly. Metallic crystals grow in predictable structures as atoms settle into equilibrium. But many alloy combinations—silver and copper, for example—aren't possible. That's because the alloy components aren't soluble (won't dissolve completely) in each other.

That's irrelevant in nonequilibrium processes. "With ion implantation you can implant any atom in any substance to any concentration you like—whether Mother Nature likes it or not. You can just force it in," Appleton pointed out.

Furthermore, a companion technology called ion-beam mixing (see diagram) makes a staggering number of alloy combinations feasible. With this technique, a thin coating of material is deposited on a substrate. The coating is applied with conventional techniques: evaporation, chemical vapor deposition, or sputtering—using ions to knock atoms from one material onto another. An ion beam then drives the coating into the substrate surface. "The beam adds a lot of energy to the surface—it stirs everything up," says Zymet's Hirvonen.

Stitching ceramics into engines

Both Hirvonen and Appleton anticipate important ion-mixing applications. "GM and other car manufacturers would like to make a car engine that can run at high temperatures without lubrication," Appleton said. "But the only materials that will stand up to that kind of thing are high-temperature ceramics. And the trouble with all ceramics is that, like glass, they break," he said ["The

Coming Age of Ceramic Engines," PS, March '82; "Ceramic Diesels," PS, Dec. '82].

Appleton paused before some graphs pasted to cardboard sheets in one of ORNL's surface-modification labs. The graphs, labeled with ceramics formulas plus experimental ion-implant elements—tungsten, indium, gallium, copper, titanium—recorded the latest progress in toughening ceramics.

"To change the surface properties of high-temperature ceramics, we're trying to find the right elements, how much to use, and where to put them," Appleton said. ORNL's goal is to make better bearing and wear materials for adiabatic-diesel engines.

"The hardest thing with any coating is getting it to stick," Appleton said. He described how chemical-vapor deposition might coat piston-cylinder walls with ceramic material, then be "stitched" into place with an ion beam so it wouldn't break off. ORNL researchers have already doubled the surface hardness of ceramics with ions and boosted their fracture strength up to 30 percent.

Laser beams at ORNL also produce amazing changes in materials: "That's a short-pulse ultraviolet gas laser," Appleton said, showing me a coffin-like white case atop a bench. Researchers use ultraviolet- and visible-light ruby lasers to melt the surfaces of samples with brief, powerful bursts of energy.

The pulsed-laser processing, which involves rapid heating and cooling of surfaces, is still largely experimental. Like ion implantation, it's a nonequilibrium process: Cool-

“With ion implantation you can implant any atom in any substance to any concentration you like—whether Mother Nature likes it or not”

ing occurs so rapidly that atoms don't have time to settle into their normal equilibrium states. The technique can be used in combination with ion implantation and shows promises of making highly efficient solar cells ["Laser Blasts Speed Solar Cell Production," PS, April '82]. Laser pulses can instantly "heal" the crystalline surface of semiconductor materials that have been damaged when ions crash into them. In normal processing, prolonged baking at temperatures that can warp silicon wafers is needed.

Appleton believes that within five years laser and ion beams could also replace the technique now used to make glassy or amorphous metals. These metals, which promise significant energy savings by boosting the efficiency of electrical-power transformers, have a noncrystalline glass-like structure. Glassy metals are now made by splat quenching: pouring pre-alloyed molten steel onto a spinning drum that cools it very quickly.

"Laser and ion beams give you *much* wider latitude," said Appleton. Because laser-pulsed metals cool 100 times faster, alloy combinations are possible that couldn't be achieved with splat quenching. Slower conventional cooling causes some alloy elements to precipitate out of the molten metal. Also, with beams, glassy metals could be formed on any substrate instead of the thin foils necessary with splat quenching.

Ion and laser beams have also been used to develop new superconducting materials. (Superconductors lose their resistance to current at very low temperatures.) One appli-

cation: making compact but extremely powerful motors or generators. The beams solve a problem inherent in superconducting materials.

"If you find a combination of elements that makes a good superconductor, a wire made with it is often so brittle that you can't wind it into a motor," Appleton told me. Laser- and ion-beam techniques make it possible to form a thin superconducting layer on the surface of flexible copper wire for winding.

Measuring with atomic billiards

As ion implantation and lasers alter the atomic structure of materials, extraordinarily sensitive instruments are needed to measure the results. In one corner of a lab I spotted such a measurement in progress. Appleton pointed to an ion-beam tube that emerged from a room housing a 2.5-million-volt Van de Graaff accelerator. It poured a beam of lightweight helium ions into a silicon-crystal sample implanted with antimony.

"What we measure are the number of particles that scatter from the atoms in a solid and their scattered energy," Appleton said. He compared this ion-scattering analysis to bouncing marbles off billiard balls: The helium ions (marbles) scatter with different energies from silicon than from antimony (billiard balls), and detectors register this energy difference.

"These measurements allow you to find out exactly how much antimony there is, how far it is below the surface, and what the composition as a function of depth is," Appleton said. The results of these measurements appeared as a slowly developing graph on a computer-graphics terminal before us. "The beauty of this is that nothing happens to the sample," he said. "It's a nondestructive analysis."

Is industry ready for such high-technology metallurgy treatments? At Carnegie-Mellon University in Pittsburgh researchers reviewed surface-treatment technologies that might reduce U.S. vulnerability for strategic materials. They concluded that if technical barriers—current low-power machines, for example—could be overcome, ion implantation would help trim the demand for chromium and many other strategic materials.

Engineers, however, are slow to adopt new metallurgy technologies, although GM has used "conventional" electron- and laser-beam processing in a few plants for years. These beams selectively heat and surface-harden portions of vehicle components, eliminating the need to heat—and often warp—the entire part. Still, these are really just high-tech versions of conventional metal-glazing treatments.

Before ion-implantation is adopted for large-scale metal toughening, larger vacuum chambers and more-powerful beam generators must be brought together.

Such equipment exists already—for other applications: Monster ion-beam generators have been built for experimental nuclear-fusion power sources and "Star Wars" space weapons [PS cover story, July]. And recently at a McDonnell Douglas aircraft plant in St. Louis, I peered into a vacuum-chamber tank 12 feet long and six feet in diameter. Violet clouds of ionized argon gas and aluminum ions swirled about inside, coating aircraft parts mounted on racks in the tank. This decade-old ion-plating Ivadizer technology (see photo, previous page) is less costly than ion implantation but is nevertheless limited largely to aerospace applications.

Despite the problems of running assembly lines through a vacuum chamber, Appleton and others are convinced that bringing beam magic into factories isn't prohibitively expensive. Said Appleton: "What we're talking about are technologies that will be standard practice 10 to 15 years from now." PS

Golf and Jetta: biggest little cars on the road

The styling changes are small but significant. VW's new Golf and Jetta are roomier, faster, and more aerodynamic than previous models.

By JACK KEEBLER

LEXINGTON, OHIO

When the 1985 Volkswagen Golf and Jetta hit U.S. streets with the rest of the traffic next spring, most people won't know them from the older models.

That may be unfortunate—for both car buyers and VW. Although completely redesigned, the conservative re-skinning of the new models hides an increase in interior volume, greater power, and, as a result of wind-tunnel tuning, better fuel economy than the cars they replace. In fact, my several-hundred-mile test drive and laps on the Mid-Ohio Sportscar Course convinced me that the standard-setting interior volume, performance, and quiet of these vehicles will take many small-car makers a long time to match.

The Golf, named after the Gulf Stream (*Golf-Strom* in German) and successor to the ubiquitous Rabbit, is

4.7 inches longer and two inches wider, and it sits on a 2.6-inch-longer wheelbase. The rear luggage space has been enlarged by almost 30 percent. Closely molded to the underbody of the car, a 14.5-gallon plastic fuel tank provides increased range.

Golf's sibling, the Jetta, has grown four inches in length and two inches in overall width. These enlargements, together with an interior redesign, have increased Jetta's interior volume by 14 percent. Jetta will also have a 25-percent-larger trunk. As a result, the EPA has reclassified both the five-passenger Golf and Jetta as compacts rather than subcompacts.

A peppy 1.8-liter (109-cu.-in.) four-cylinder gasoline engine is standard in the Golf (a diesel is optional; see spec table). VW boasts that gasoline-engined Golfs with the close-ratio five-speed manual transmission will accelerate to 60 mph in 10.3 seconds.

The standard engine in the Jetta is a 1.6-liter (97-cu.-in.) diesel. In preliminary EPA estimates, the diesel Jetta will be rated at 42 mpg in the city and 59 on the highway. Jetta's impressively quiet optional turbo diesel delivers plenty of power, which meant less shifting during my test drive on the rolling Ohio terrain. Lower engine

speeds also helped provide a remarkably quiet and vibration-free ride.

Considering the seemingly modest change in exterior appearances, Golf and Jetta's aerodynamic improvements are remarkable. The drag coefficient for the Golf was chopped from a lackluster 0.42 to 0.35; Jetta's plunged from 0.43 to 0.36. That means the new Golf and Jetta are, respectively, 17 and 16 percent more aerodynamically efficient than the models they replace. PS

DIMENSIONS AND SPECIFICATIONS

Wheelbase (in.)	97.3
Length (in.)	158.0 (Golf) 171.7 (Jetta)
Width (in.)	65.5
Height (in.)	55.7
Track, F/R (in.)	56.3/56.0
Engine type	In-line 4 gas In-line 4 diesel In-line 4 turbo diesel (Jetta)
Displacement (cu. in./cc)	109/1,780 (gas) 97/1,588 (diesel, turbo diesel)
Compression ratio	8.5:1 (gas) 23.0:1 (diesel, turbo diesel)
Net hp @ rpm	85 @ 5,250 (gas) 52 @ 4,800 (diesel) 68 @ 4,500 (turbo diesel)
Net torque (ft.-lbs.) @ rpm	98 @ 3,000 (gas) 71 @ 2,000 (diesel, turbo diesel)
Transmission	5-speed manual 3-speed automatic (gas)
Front suspension	MacPherson struts, coil springs
Rear suspension	Torsion-beam axle, shocks, coil springs

V6 Fiero: Now it's as fast as it looks

No more "yes, buts," or "if onlys"; the 1985 Pontiac Fiero with the 2.8-liter (171-cu.-in.) V6 engine is just what the critics asked for. With under-nine-second zero-to-60-mph capability, important transmission improvements, a beefier suspension, and careful exterior tweaks, Fiero finally takes its place as a world-class sports car.

The V6 I drove at General Motors' Milford Proving Ground in Michigan was wonderfully matched to the smooth-shifting four-speed transmission and overcame most of the deficiencies noted in previous reports on the Fiero [PS, Feb.]. (An in-depth report will have to wait until production cars

are available for testing at the PS Bridgehampton, N.Y., test site.) In the pre-production model I drove, torque was strong through all the gears with no compromises for economy except for the tall fourth gear.

The fuel-injection-equipped 2.8-liter V6 runs to 5,500 rpm smoothly and idles quietly with little hint of shake. In all-out acceleration, the Goodyear Eagle GT tires spin away from the line and chirp strongly at the one-two shift point. But stoplight starts at more than 3,700 rpm provoke severe axle hop.

Fuel economy for the manual V6 I tested is 22 mph in the city and 26 on

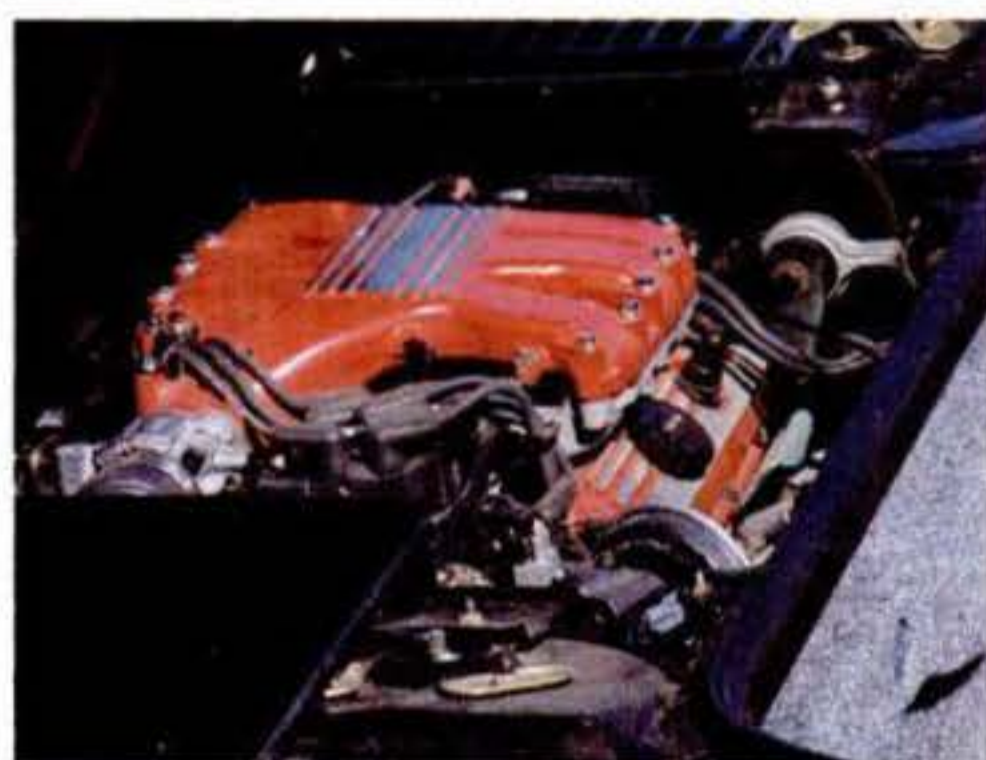
the highway, according to the EPA. That could mean frequent stops for fuel with the smallish 10.2-gallon fuel tank. (Pontiac engineers say a larger tank is on the way.)

Tom Kalush, administrator for the Fiero project, pointed out some of the exterior changes: "In designing the Indy Pace Car we noticed that the front end became light when we hit 130 mph, so we lowered the front fascia to cure that problem and kept it as a styling change for 1985. The airfoil on the engine compartment does the same job for the rear wheels."

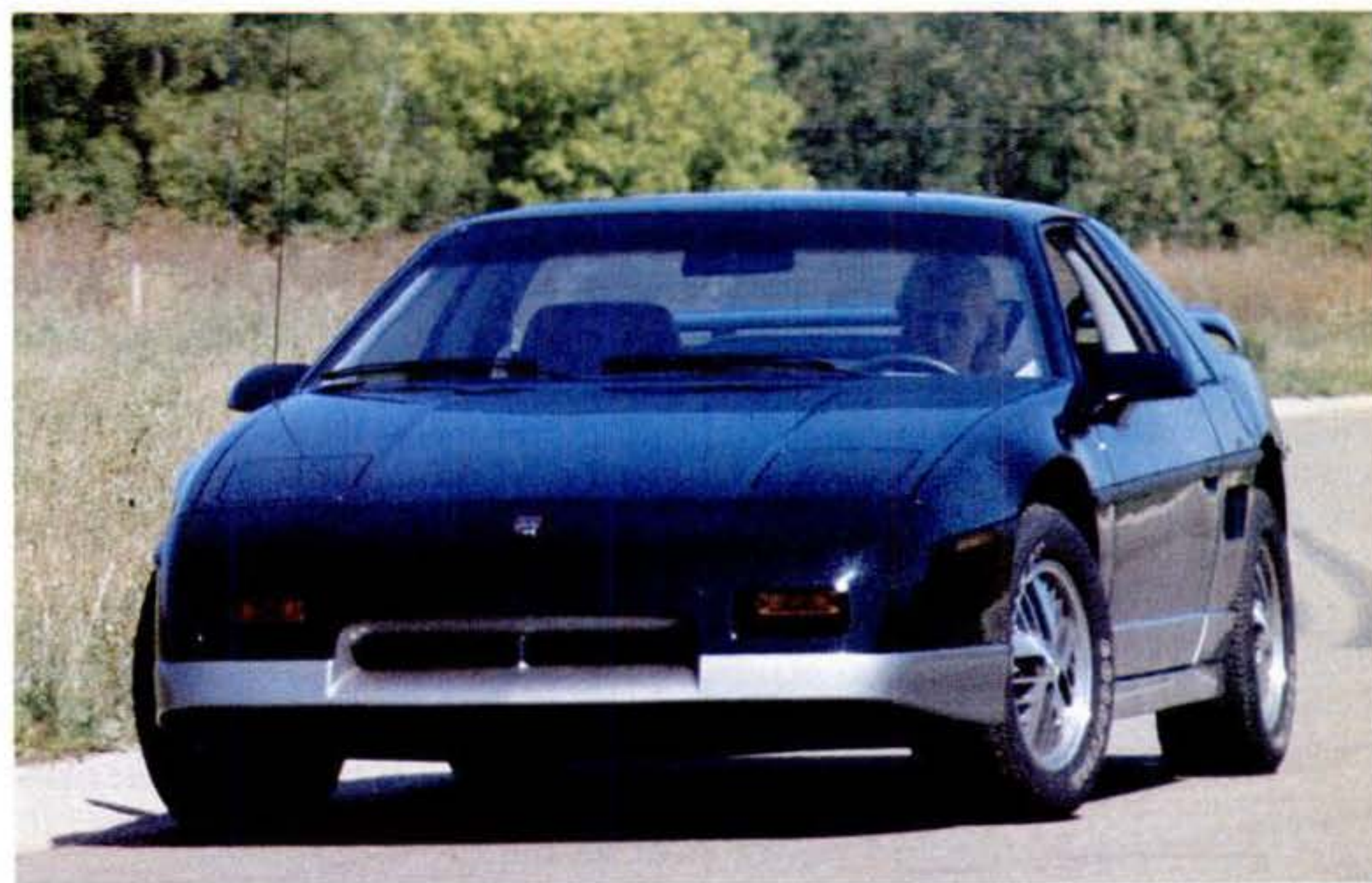
Fiero will be available in red, white, black, and silver.—*Jim Dunne*



VW Golf (above) clips the corner during track testing. Below: Note Jetta's flush headlights and lack of rain channels.



Additional power in the form of a 2.8-liter high-output V6 bulges out of a 1985 Fiero's engine bay (above). A bright-red low-restriction intake manifold and multi-point fuel injection help the engine breathe easier. Fiero gets a second color trim along the rockers and lower fenders (right) as part of the dress-up package for '85.



Anyone can "fly" this

An acrylic-bubble undersea habitat called Deep Rover will take oceanographers and oil-rig technicians to depths of 3,200 feet, where they'll work at sea-level pressure—in near-living-room comfort. The vessel "flies" like an underwater helicopter and has a set of manipulators that can lift 200 pounds apiece—or cradle an egg.

By **PETER BRITTON**
Photos by the author

HALIFAX, NOVA SCOTIA
British inventor Graham Hawkes stroked the aluminum seal that joins the two acrylic hemispheres of Deep Rover and traced the line of the rubber O-ring that ensures its watertightness. "If you can drive a car, you can fly Deep Rover," he said.

And before long there I was, a car-driving journalist sitting in the driver's (or pilot's) seat of this latest Hawkes-designed diving machine, an incredibly sophisticated see-through submersible. A huge crane hoisted the 6,800-pound machine skyward and lowered it gently. Suddenly, the greenish water of Halifax Harbour washed over the sphere, and it came to rest just below the surface. A wet-suited diver swam over and unhooked the crane's line above my head.

From a formidable array of buttons I found the ones marked THRUSTER ENABLE and switched them on. Now the armrests, the controls for Deep Rover's four thrusters, were activated, ready to propel the diving vessel in three dimensions as though it were an underwater helicopter.

Tentatively, I applied forward pressure with my right arm. The right-hand thruster filled the cockpit with a soft, watery whir as Deep Rover turned to the left. I pushed both arms forward, and the craft accelerated forward to three knots (3.45 mph), its maximum speed. Then, moving one arm forward and the other back, I sent Rover into a spin, twirling in a com-

plete revolution with liquid smoothness. Hawkes was right: With no experience or qualifications I was "flying" Deep Rover.

Ease of operation was one of Hawkes's fundamental goals in designing this submersible. Earlier one-person diving vessels—Jim and Wasp [PS, May '83] and Mantis (the latter two are also Hawkes's designs)—require up to 30 hours to master. Even so, they have revolutionized work in underwater oil fields and have given oceanographers new tools for underwater research. The reason: They are atmospheric diving machines, meaning they keep the operator at sea-level pressure (14.7 pounds per square inch) and breathing air at that pressure, however deep he goes. Deep Rover does that, too, but it is far more comfortable, offers far better vision, can dive deeper, and has a pair of manipulators far more capable than any that have come before.

Job pressure

Though some underwater work can be done by remotely operated vehicles (ROVs) [PS, Dec. '83], much of it requires the presence of human beings. But the ocean is cold and dark. Much worse, the deeper you go, the higher the pressure. Divers wearing wet or dry suits must breathe air (or other mixed gases) that is pressurized to equal the pressure of the water around them. Some gases dissolve in their body fluids under pressure, and when the divers ascend, the gases expand and can form bubbles, just as carbon dioxide does when you jerk the cap

Continued

From inside Deep Rover, author photographed ROV and scuba diver hovering in water nearby (right). Marine biologist Sylvia Earle (far right, top) got one of the first test rides, as did Can-Dive's Phillip Nuytten (far right, bottom), who plucked a piece of kelp with Rover's manipulators.



deep-ocean rover



off a bottle of soda. The result in divers: decompression sickness, better known as the bends.

To prevent the bends, divers must ascend at a controlled rate and in some cases decompress near the surface. If they stay very deep for very long, they must work from a pressurized diving bell and decompress for days in a hyperbaric chamber. This is an inefficient, hazardous operation that can require up to 80 tons of topside equipment and cost more than \$50,000 a day.

The hulls of Jim, Wasp, and Mantis—and now Deep Rover—are built strong enough to withstand the external water pressure. Thus the operator can stay at sea-level pressure and breathe air at that pressure throughout the dive. That eliminates the need for a pressurized diving bell and a hyperbaric chamber, reduces personnel and space needs, and knocks the cost down to the neighborhood of \$5,000 a day.

Though Deep Rover is expected to

find much of its work in offshore oil fields, it was a marine biologist, Dr. Sylvia Earle, the noted oceanographic curator of the California Academy of Sciences, who planted the idea in Hawkes's mind. Three years ago she challenged him with a question: "Why can't we dive in comfort to the bottom of the ocean?" Having logged more than 4,500 hours underwater, she had the right—indeed, the need—to know. Some time later Hawkes, Earle, and Phillip Nuytten (president of Can-Dive, a Canadian company that furnishes diving support for offshore oil fields) met for dinner in Seattle. Hawkes, responding to Earle's scientific and Nuytten's commercial inputs, produced an elegant napkin sketch of the plans for Deep Rover.

Civilized sub

The completed submersible, owned by Can-Dive, is a craft of astonishing civility and adaptability. Says Hawkes, now president of Deep Ocean Engineering, based in Oakland, Calif.: "If there

is a key to the success of Deep Rover, it is that the machine allows total sensory input to the pilot. He can see, hear, touch, evaluate, and respond to what is in front of him without the discomfort, danger, and distraction of cold, pressure, and the like. This personal quality is lacking in remotely operated vehicles, diver systems, and other submersibles."

That includes Hawkes's own Wasp and Mantis, the direct ancestors of Deep Rover. Both have limitations in addition to the learning time a diver needs: They are not free-swimming—they must be tethered to the support ship at all times. They cannot go deep enough for many jobs; Mantis, the deepest rated, goes to only 2,300 feet. Their manipulators are limited in dexterity and strength. The pilot can see only in front of him. And keeping warm is difficult; the insulation provided by the metal vessels is practically nil. But perhaps their greatest drawback is operator discomfort. He must maintain the same position,

"Manips": the human connection

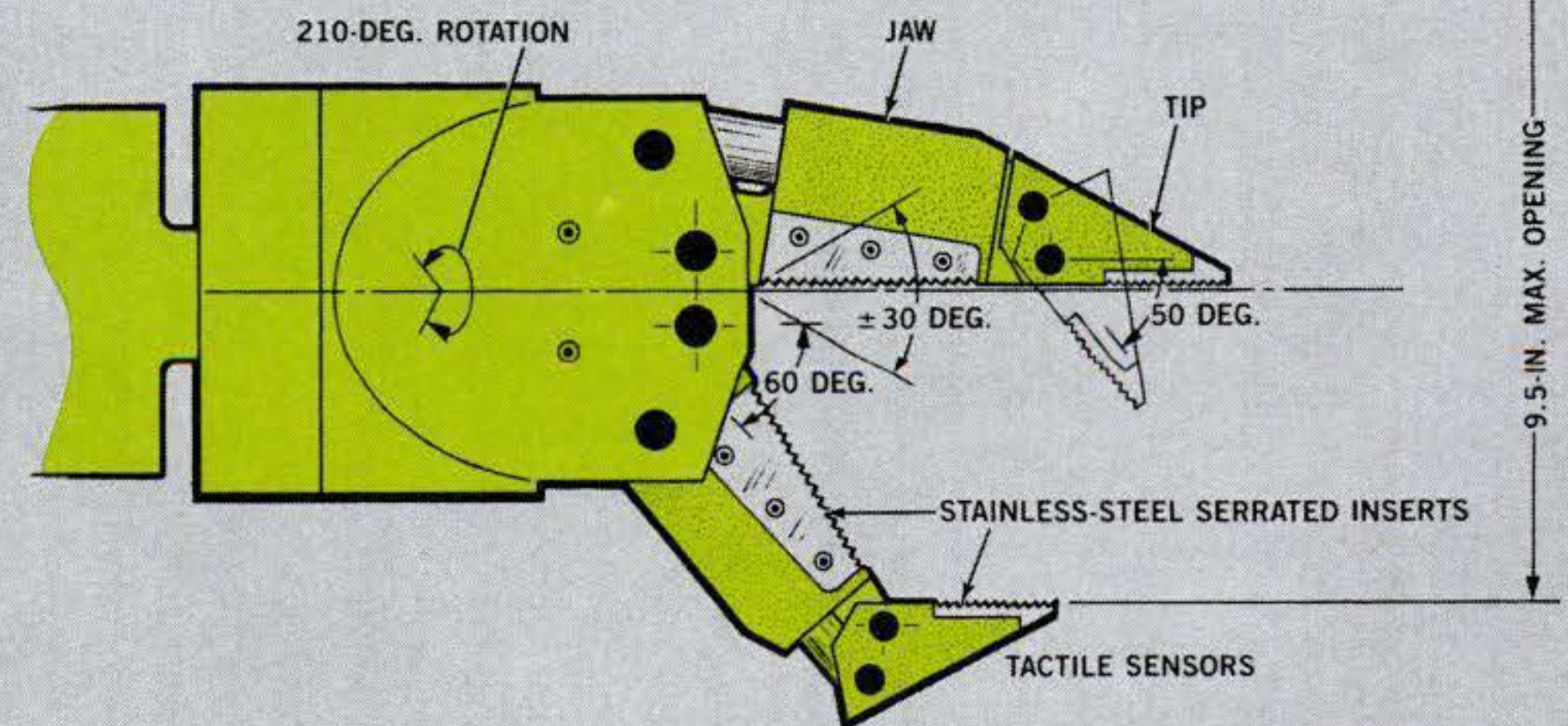
Graham Hawkes describes his work as "simplicity through complexity." Deep Rover's elegant manipulators reflect that philosophy. The official name for them is the Sensory Manipulative System. Hawkes calls them the "manips."

Their object is to extend the pilot's reach and use his unmatched combination of intelligence, experience, depth perception, and eye-hand coordination. "We rely on the human brain rather than a computer to operate the system," says Hawkes. "If the pilot's hand is trembling, the manip will tremble in sympathy, down to about five cycles per second," he adds. The manipulators are of such dexterity and response that NASA is considering them, along with a Deep Rover-like vehicle, for excursions and work from the space shuttle.

Made of aluminum, stainless steel, and graphite-loaded nylon, the modular manipulators can vary in length from 5.6 to 7.5 feet and weigh up to 150 pounds. Each carries a light and a low-profile television camera.

An analogy with the human arm and hand is useful in grasping the concept of degrees of freedom, and hence what the manipulators can do. An extended arm can (A) move up and down and (B) move from side to side. It can (C) bend at the elbow. The wrist can (D) move up and down, (E) move from side to side, and (F) rotate. And the hand can (G) open and close.

The complementary manipulator motions are activated through the handgrip by moving it backward and forward (resulting in action A), side to side (B), and by rotating it (C). A thumb switch on top is moved up and down (D) and side to side (E) to control the wrist. Two buttons rotate the wrist clockwise or counterclockwise (F), and a trigger opens and closes the "hand" (G).



The four-function "hands" each have two large jaws and two tips. When the serrated edges of the large jaws touch an object and close on it, the force is instantly transferred to the tips, which then also close. When a four-point contact is achieved, a steady grip occurs.

The manips employ five elements of sense (some details of which are proprietary): sight, motion, force, sound, and touch. For the manips the tactile sense is the most important. But it is not touch as we know it.

Hawkes explains: "Robots generally are designed to recreate a sense of touch by sensing remotely in the manipulator and conveying that sense to the pilot through electrical readouts. But the readouts mean nothing by themselves and must be translated. What we do is translate the tactile sense into an audio signal and feed it to the pilot through his ears.

"We're using accelerometers, and we get a sense that is analogous to the sound that comes from scraping a brick with a fork. However, we pick up not sound but accelerations in the jaw tips—vibrations, if you like."

In operation, a pilot could probe below the

mud line with the manips and correctly identify whatever material he "touched," be it plastic, metal, wood, or concrete, through the sound from the cockpit speakers. A trainee, according to Hawkes, can learn this new "language" in about two hours.

This function operates in real time, and Hawkes designed the manipulators to respond quickly—through a combination of electronics and hydraulics—so that the pilot can take full advantage of it. When the pilot commands a manip through the handgrip, he activates a motion switch built into the controller. An electrical signal goes from the controller to a power amplifier, which puts out an electrical signal that drives an actuator outside the hull. There is one actuator for every function on each manipulator.

The actuator converts the electric signal to hydraulic power through a gearbox and a linear/rotary ball-bearing unit, which causes the displacement of a piston. This forces hydraulic fluid out of the actuator and into the manipulator, where a joint is moved—or a jaw is clenched. Withdrawal of the fluid causes a motion in the opposite direction.—P. B.

which quickly becomes tiring and distracting.

By contrast, Deep Rover is surprisingly roomy and comfortable. Its five-inch-thick acrylic hull offers 360-degree vision and is a fine insulator. And the little sub can dive, either tethered or free-swimming, to 3,200 feet.

Future versions will go deeper. Deep Rover II, to be made of a sphere of glass (less compressible than acrylic), is planned for excursions to 20,000 feet (97 percent of the world's oceans are within this depth). And Deep Rover III—perhaps built for two, or “mated,” for safety and company—will have a structural-glass hull that will withstand the 16,883 pounds per square inch of pressure at the bottom of the deepest ocean trench: 35,810 feet.

The current Deep Rover is only 8.2 feet long, 7.8 feet high, and 6.3 feet across. Its framework, structures, panels, and fairings are made of aluminum, stainless steel, glass-reinforced plastic, acrylic, and graphite-loaded nylon. The hull has been pressure-tested to 5,000 feet (it will collapse at 12,000).

Each of the four propeller-type thrusters produces 1½ hp and a total forward thrust of 450 pounds. The two near the center of the sphere can be rotated to the vertical for up-and-down maneuvering. (Gross vertical movements are controlled by a variable-buoyancy system. To descend, the tank is filled with water; for ascent, the water is displaced by compressed air.) The thrusters are driven by 24- and 120-volt-DC lead-acid batteries housed in pressure-compensated external pods. The batteries also provide 26 kilowatt-hours of power for lights, cameras, and other action—in all, six hours of steady operation plus 150 hours' emergency power and life support. A hard-wire system provides communication with the surface when Deep Rover is tethered; an acoustic through-water system will be used when the sub is free-swimming.

The two acrylic sections are positioned against a central aluminum-alloy support ring 63 inches in circumference. “There are no penetrations in the acrylic itself,” explains engineer Dirk Rosen, who carried out most of Hawkes's design demands. “All are made through the aluminum.”

Protruding from the front of Deep Rover to a maximum distance of about seven feet are the brutishly powerful yet sensitive manipulators (see box). They can hold a 200-pound weight at full length, cradle an egg, and manipulate a variety of tools.

Every aspect of Deep Rover is engineered with a minimum three-to-one

safety factor. Should the craft become inextricably caught, the pilot can jettison the battery, frame, thrusters, and manipulators. In this “hull rollout” maneuver the acrylic bubble physically tears loose from all electrical, air, and hydraulic fittings. A strap in the back lets it swing free and rise to the surface, thanks to the sphere's 1,400 pounds of buoyancy. At the surface a pinger, strobe, and radio guide the mother ship in for recovery. Should the craft float away undetected, the 150 hours of life support—or whatever is left—is available.

But what if the pilot should become incapacitated? Can-Dive project manager John Compton-Smith, himself an experienced Mantis operator, points out that in offshore oil work such craft dive in pairs (or at least have a ROV of equal depth rating on hand). This way a line could be attached and the craft retrieved.

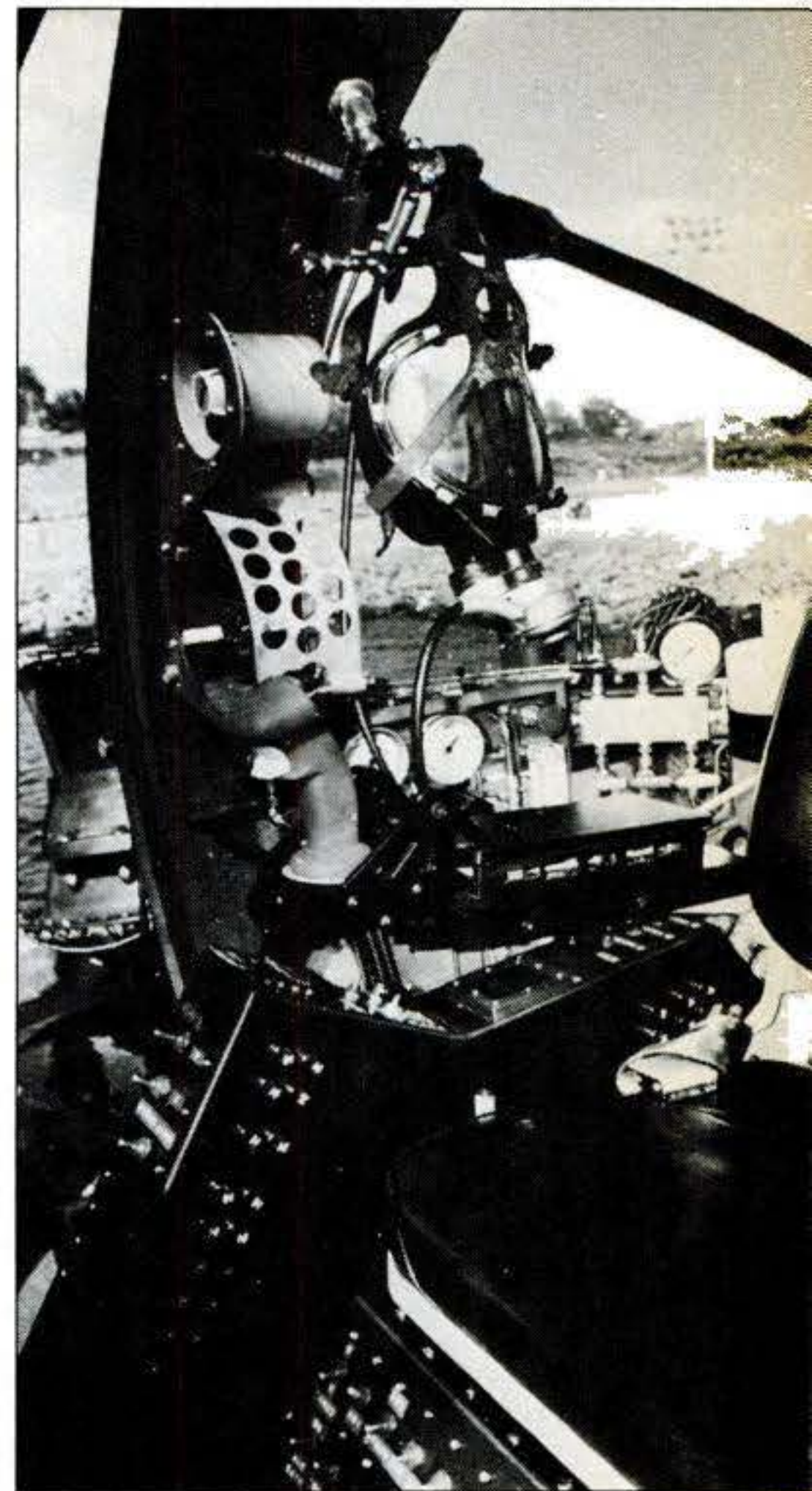
Flying lesson

For my pre-dive instruction I sat in the pilot's seat and Rosen explained the switches for left and right manipulator power, thruster power, lights, and the like. He pointed out that oxygen was flowing in at a normal consumption rate, maintaining the cockpit at sea-level pressure. And the carbon dioxide I exhaled was being “scrubbed” by a silver tank near my left ear. Behind my right ear hung the air mask for emergency life support.

Rosen indicated the gyro compass and depth gauge, the latter calibrated to 3,500 feet. He showed me the controls that regulate the ballast tank. He pointed out the vent that would release any excess pressure prior to reopening the capsule. And he introduced me to the simple-to-operate but complicated-to-engineer controls of the thrusters and manipulators. Off-the-shelf, airplane-type handgrips can set the manipulators twisting, pulling, gripping, tilting—seven functions in all. They are hydraulic and designed to use water pressure to function optimally; consequently they're difficult to operate above 200 feet—too deep for a greenhorn like me, so I wouldn't get to try them.

After Rosen completed his instructions, a Can-Dive technician applied a compressed-air gun to the threaded bolt-and-lug arrangement that drives Rover's two halves together. As the halves met, the cockpit filled with the low, steady hum of the carbon dioxide scrubber. Then the crane lifted Deep Rover (and me) up and swung us out over the dock and into the dark water.

My “flight” lasted about 10 minutes. Too soon it was over, and I had to surface. I maneuvered the Rover di-



Armrests control thrusters, which propel craft back and forth, up and down, and around. Handgrips control manipulators. Air mask, which hangs above, is for emergency life support only.

rectly under the crane's hook—rather like parking a car. As I cut the thruster motors I saw a diver approach and, behind him, the two bright lights of a ROV called Mini-Rover. I had seen it on the dock in its large aluminum suitcase. It flew up to within a few feet of me and gave me a vivid demonstration of Deep Rover's optical advantage: Objects are seen life-size, not one-third larger as conventional divers see them (because water has a different refractive index than that of air). Deep Rover's dome is optically contoured to counteract that distortion.

The pint-sized ROV hovered, taking color television shots of a journalist in full control (more or less) of the world's newest and most advanced one-person, one-atmosphere submersible. Then we were plucked from the water and lowered onto the dock. The air gun opened the hull, and fresh air rushed in, along with a few drops of water. I brushed these off and reluctantly slid out, knowing that I had been for a moment a member of a threesome that represents the present and near-future of diving: diver, ROV, and deep-diving manned submersibles with human-like manipulators. **ES**

New technologies fight **wood-stove** *pollution*

Slow-burning fires in popular airtight wood stoves belch huge amounts of smoke that can hang as a pall over whole communities. In certain smoke-plagued areas, wood burning has been restricted. But some new technologies offer a solution for cleaning up noxious wood-stove emissions.

By **GARY TURBAK**
Drawings by Adolph Brotman

In the posh new community of Beaver Creek, Colo., a few miles west of Vail, every fireplace in every house, townhouse, condominium, and hotel room has a small red light above it. When the light is aglow, fires are prohibited. If you ignore the light and feed the fire anyway, a heat sensor in the chimney tattles on you, and you may be fined—up to \$500 for a third offense.

The mountain community of Missoula, Mont., has no red lights or tattletale sensors, but when the pollution count reaches 150 micrograms of particulates per cubic meter of air, only the poor or those who have no other source of heat may burn wood. That happened 18 times last winter.

The State of Oregon has decreed that after June 1986, only the most clean-burning wood stoves may be advertised or sold in that state. Colorado is expected to institute similar regulations, and other states are almost certain to follow suit.

From east to west and north to south, many communities—especially those in mountain valleys—face a growing threat to their air quality—not from factories or power plants, but from wood stoves. Ironically, many wood-stove users turned to these homey appliances as a matter of conscience as well as economics. After all, burning wood conserves nonrenewable fuels. It helps obviate the need for new nuclear or coal power plants. It reduces our dependence on foreign oil.

But it fouls the air, not only because

of the boom in wood burning, but also because of the way we burn it. Most wood stoves are airtight models, and for comfort and convenience we adjust the damper to restrict the airflow to the firebox. Thus, wood stoves burn slowly over an extended period. That produces a smoldering, air-starved fire—and huge amounts of smoke, which may hang like a shroud over an entire city. But there's good news, too. Clean-burning solid-fuel appliances are available today and will doubtless replace the polluters—eventually. More on that later.

Problem: more than aesthetics

In Missoula (metropolitan population about 62,000), where I live, when I and a lot of my neighbors fire up our stoves, the air often becomes dirty and dangerous. Wood smoke contains, among other things, carbon monoxide, nitrogen oxides, formaldehyde, and particulates (solid unburned hydrocarbons). According to the Oregon Department of Environmental Quality, a typical stove emits about 20 grams of particulates per kilogram (0.3 ounce per pound) of wood consumed. That makes wood about 220 times more polluting than oil and 460 times dirtier than natural gas.

The worst pollution occurs during severe temperature inversions, when an upper layer of warmer air traps a layer of colder air in a valley. Naturally, the wood smoke gets trapped, too. Sometimes visibility drops to $\frac{1}{10}$ mile in Missoula. In the winter our TV weathermen give pollution levels alongside the day's temperatures. On days of severe pollution, people with

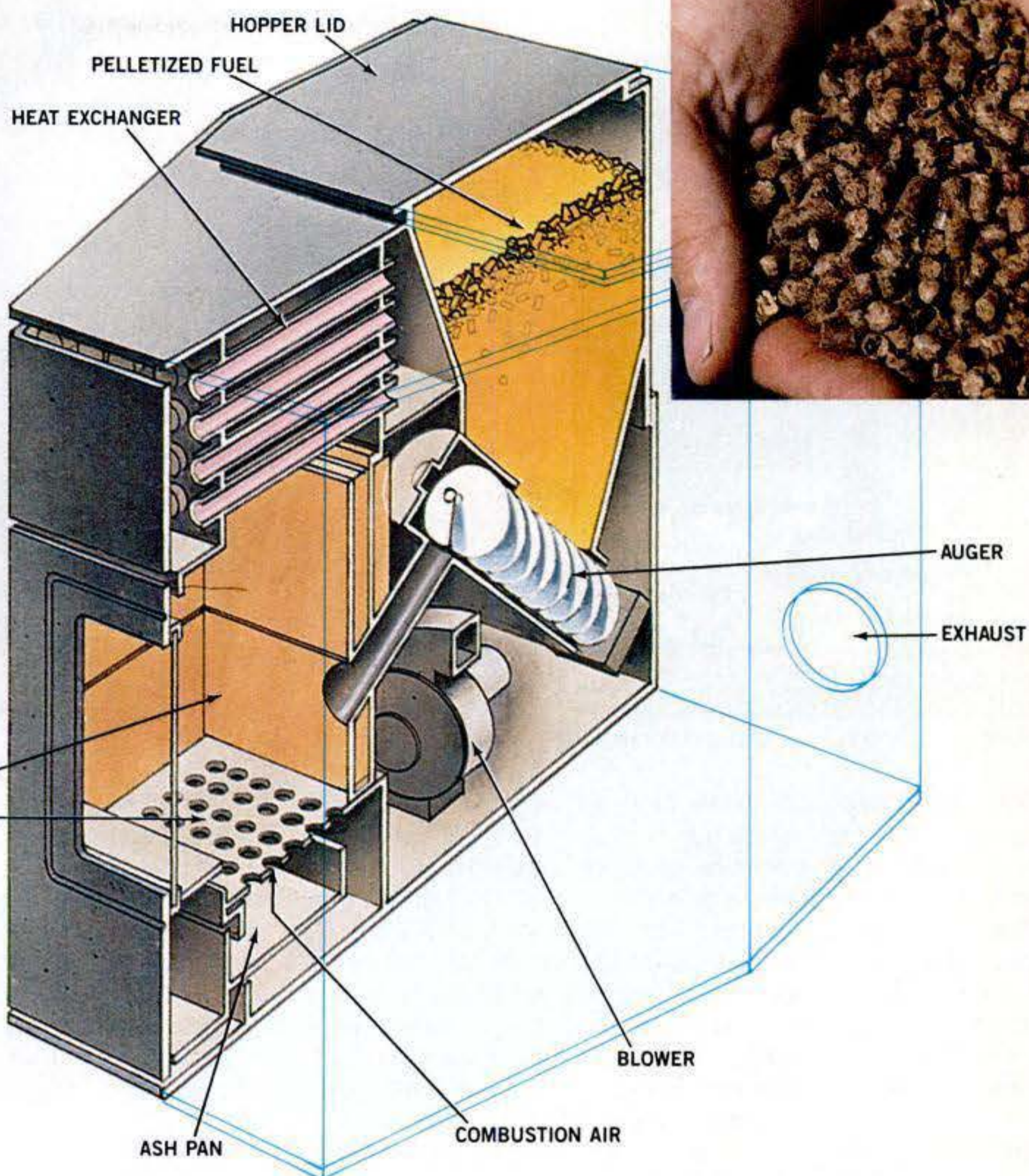
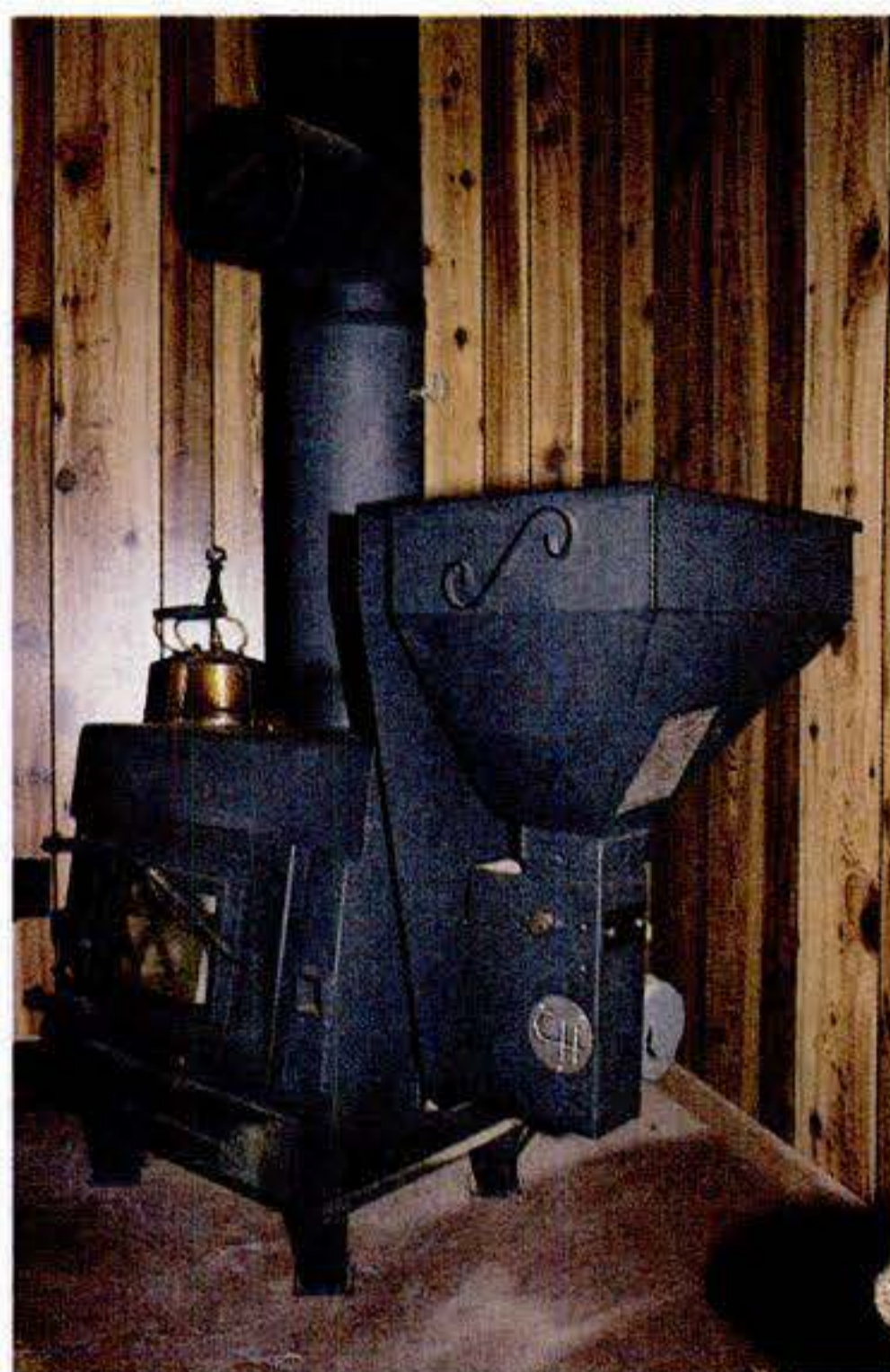
respiratory problems are urged to stay indoors, schoolchildren do not go out for recess, and we're told to keep our home fires extinguished. If we don't, we face a \$100 fine. Next, Missoula may follow Oregon's example and restrict the type of wood stoves homeowners can install.

Beaver Creek has banned wood stoves altogether and has installed those little red lights over fireplaces to put teeth in its anti-pollution laws. Near the center of the village is a small but sophisticated air-monitoring station. When air-quality and meteorological conditions warrant, the attendant flips a switch, and the red lights come on all over town—2,500 of them. "Sure, we've had complaints about 'Big Brotherism,'" says Cliff Simonton, environmental coordinator for the development, "but some people need to be educated about wood-smoke pollution. That's what this system is all about."

Clean machines

More promising than legislation and education are the new-technology stoves and retrofit devices that produce relatively clean exhausts by burning the wood smoke itself. Two fringe benefits are the extra heat extracted from the wood and delivered to the house, and the reduction in creosote deposits in chimneys.

Wood smoke will burn when the temperature gets hot enough (1,000 to 1,200 degrees F), but at that level in a conventional airtight stove the blaze would need nearly continuous feeding, and the temperature in the room would be unbearable.



Pellet-burning stoves, such as the Whitfield (diagram) from Pyro Industries, burn very small, very hot fires—hot enough to consume the smoke. A hopper in the rear of the Whitfield holds about 55 pounds of pellets, enough to fuel the stove for eight to 30 hours. (Feed rate is adjustable.) Gravity and an electric auger continuously feed pellets into a firebox that measures only six by six by 14 inches. A blower forces air up through a grate in the bottom of the firebox. Another blower distributes heat from the heat exchanger to the room.

Pellet stoves burn so cleanly, and the exhaust temperature is so low, that a three-inch exhaust port (as used to vent gas furnaces)

replaces a chimney. Pellet stoves begin at about \$1,200, but they may be cheaper to install than wood stoves because no chimney or triple-wall pipe is needed.

The add-on Collins Hopper (photo left) converts a wood stove to a pellet burner. The entire apparatus—a bin for pellets, an electric auger, and a blower—mounts on the stove's side. The hopper costs about \$400; dealer installation (about \$40) is recommended.

Fuel pellets (photo right) are made of wood waste, peat, or agricultural products [PS, Jan. '80]. The material is pulverized, dried, and compressed into pellets ¼ to ½ inch in diameter and about an inch long. Sometimes

an adhesive is added. "A ton of pellets has about the same heat value as 1½ cords of wood," says Loren Collins, the hopper's inventor, "or about 8,580 Btu per pound, which is comparable to coal." They are clean, lightweight, and easy to store, he points out.

Pellets are produced at plants in Minnesota, Wisconsin, Montana, Oregon, Idaho, Florida, Tennessee, North Carolina, Washington, and Quebec. They're generally competitive with cord wood in price, and they're cheaper than natural gas, according to Collins. "Coal is hard to compete with in price," he adds, "but pellets will blow the socks off coal as far as emissions are concerned."—G. T.

The newest type of stove engineered to consume its own smoke burns pelletized wood (see sidebar) instead of logs. Precise amounts of air and fuel are continuously fed to the firebox. Pellet fires are hot enough to burn the wood smoke, but they are so tiny that they don't turn your house into a sauna. "Our stove can produce 45,000 Btu of heat per hour, and the exhaust is completely invisible to the naked eye," says Jerry Whitfield, president of Pyro Industries (Box 123, Montlake Terrace, Wash. 98043) and designer of the pellet-burning Whitfield stove.

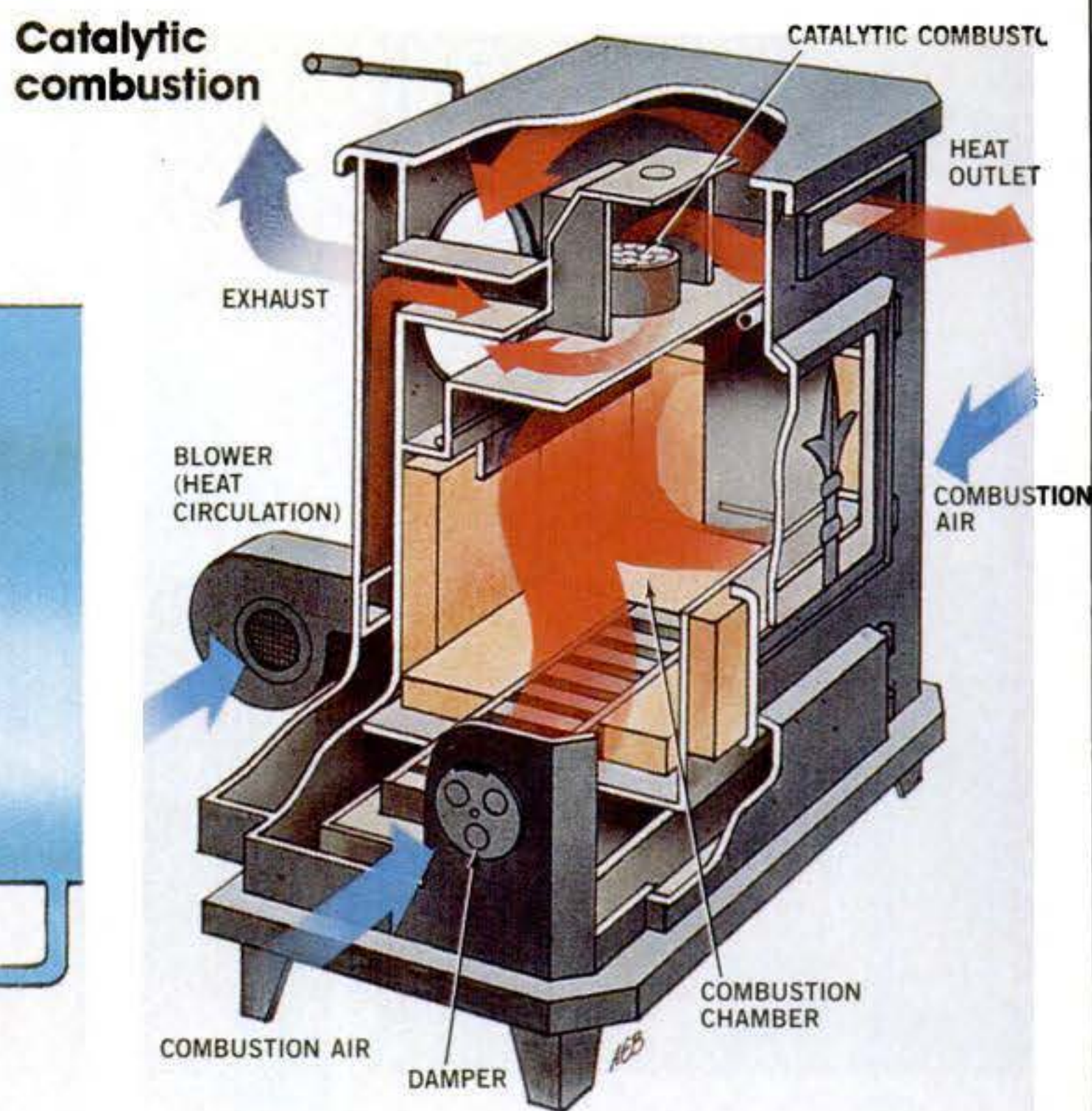
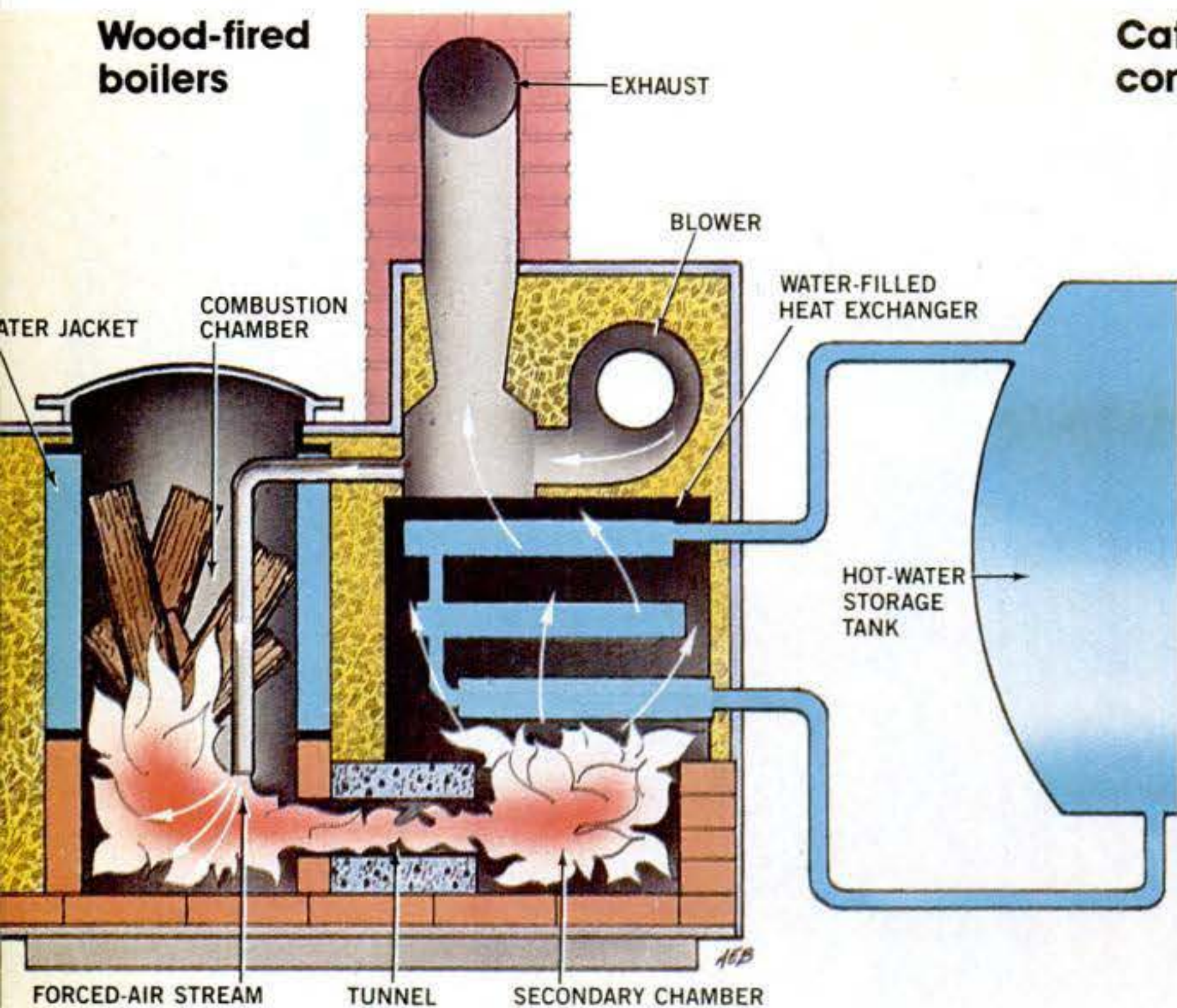
"We think pellet burners hold a lot of promise for reducing wood-stove emissions," confirms Barbara Tomblason of the Oregon Department of Environmental Quality.

There is also an add-on device, the Collins Hopper (Collins Enterprises, Box 3686, Bozeman, Mont. 59772-3686), that can turn most traditional wood stoves into pellet burners. At an energy show in Portland, Ore., Loren Collins, inventor of the hopper, demonstrated a hopper-modified stove. Its chimney rose four feet and stopped about 18 inches below a white canvas

awning. After three days of burning, the canvas above the chimney had turned just slightly gray.

The catalytic stove [PS, Jan. '82 and Oct. '82], the most widely heralded answer to the wood-smoke problem, takes a different approach to burning smoke. The catalytic combustor, a ceramic honeycomb cylinder mounted high inside the firebox, is coated with a noble metal such as platinum or palladium. The metal acts as a catalyst and causes the smoke to burn at a much lower temperature than normal.

Continued



Wood-fired boilers are made to be fired up—with a large, hot fire—a few times each day; the fire heats a large volume of water, and heat is delivered to the house on demand.

The Tempest boiler diagrammed here has a vertical combustion chamber surrounded by a water jacket. A blower (above the water-filled heat exchanger) delivers the quantity of air needed for combustion through a tube to the base of the fire. That creates a turbulent, very hot blaze. The combustion chamber and the tunnel connecting it to the secondary chamber are made of heat-retaining refractory materials that become incandescent and reach temperatures of about 2,100 degrees F. Thus, combustion products stay hot long enough to ensure complete combustion of the smoke. Then the high-temperature exhaust gases travel through the water-filled heat exchanger, transferring their heat to the water. Flue gases exit at about 250 degrees F, according to the company. A sensor automatically turns off the blower when the wood is burned.

Water from the water jacket and heat exchanger circulates to and from a large storage tank. The hot water provides heat for the house, either through a hot-water or forced-air distribution system. A copper coil in the heat-storage tank provides domestic hot water.

Each 1,000 gallons of water can store about 584,500 Btu of useful heat, according to Dumont. If the heat load of the building is 30,000 Btu/h, the interval between firings is 19.5 hours, the company notes.

Wood-fired boilers are strictly for heating purposes, not aesthetics. Typically, they and the attendant water tank go in a corner of the basement. Some can be adapted to burn oil or natural gas as a backup fuel. Prices begin at about \$7,500.

At the heart of a catalytic stove is the ceramic-honeycomb catalytic combustor. It is coated with a noble-metal catalyst, usually platinum or palladium, which causes the smoke to burn at a lower-than-normal temperature.

Typically, the catalytic combustor is located at the top of the firebox, as shown in the Russo catalytic wood stove (Russo, 87 Warren St., Randolph, Mass. 02368) diagrammed here. To exit the stove, smoke must pass through the honeycomb combustor. In the presence of the catalyst, some gases ignite at about 150 degrees F. At 500 degrees, the catalyst operates at peak efficiency, consuming most of the smoke that would otherwise pollute the air. As the catalyst works, it may glow reddish-orange. Many catalytic stoves

have a glass-ceramic viewport to let you see the combustor at work. A bypass path is provided to prevent a back draft when the stove door is opened.

In the Russo stove, combustion air is drawn in through the adjustable damper. The blower (optional) circulates room air up the double-wall back of the stove and through two heat-exchanger tubes, one on each side of the top chamber. Leaving the combustor, exhaust gases first pass to the front of the stove, then reverse direction and head for the exhaust port, passing over the heat-exchanger tubes and transferring heat to the circulating air. The heated air passes through the heat outlets into the room.

Add-on catalytic combustors (not shown) are housed in a steel shroud and mounted between the flue collar and the chimney [PS, March '82].

All catalytic combustors must be replaced, usually every few years. Catalysts can be "poisoned" when anything other than wood or newspaper is burned in the stove. Wrapping paper, painted wood, artificial logs, garbage, lighter fluids, and chemical chimney cleaners are all taboo. A catalytic combustor adds about \$200 to the cost of a new stove, and add-ons cost \$100 to \$200.—G. T.

According to Tombleson, a traditional airtight wood stove puts out about 32 grams (1.1 ounces) of particulates per hour. One catalytic stove tested by her agency in Oregon, the Blaze King (Box 1195, Bozeman, Mont. 59715) was shown to emit only 1.2 grams (0.04 ounce) per hour.

Add-on catalytic combustors are also available. Add-ons don't gobble up as much smoke as built-ins, but tests have shown them to be effective in reducing emissions. "The great advantage of add-on catalysts is that they can help clean up the hundreds of

thousands of polluting stoves that people already own," says Eric Hutchinson, vice-president of the Catalytic Damper Corp. (Conway, Ark. 72032), maker of the Intensifire add-on catalyst. "Concerned homeowners don't need to throw out the stove they've been using," he adds.

Wood-burning boilers offer another way to burn wood smoke without overheating the house or requiring frequent refueling. In these devices, a hot fire is lighted one to three times each day and used to heat a tank of water. The hot water then provides space

heating (and domestic hot water) on demand. With a forced-draft system and a secondary combustion chamber, wood-fired boilers can reach temperatures of about 2,100 degrees F—high enough to consume nearly all potential emissions. "Our stove is virtually pollution-free," says Dick Vermeulen, an engineer with Dumont Industries (Monmouth, Maine 04295), which makes the Tempest boiler. "All the pyrolytic gases are converted to water and carbon dioxide. About all that ever comes out the chimney is a little steam." [PS]

44 satellite TV systems you can buy now

Tuning in to TV signals broadcast from space is now routine. And while the technology has advanced, equipment prices have plummeted to \$1,000 and lower. But buyers of satellite equipment should be knowledgeable about essential features and desirable options. And even the most costly system can be useless if the antenna is improperly installed.

By **SUSAN RENNER-SMITH**
Drawings by Eugene Thompson

NASHVILLE, TENN.

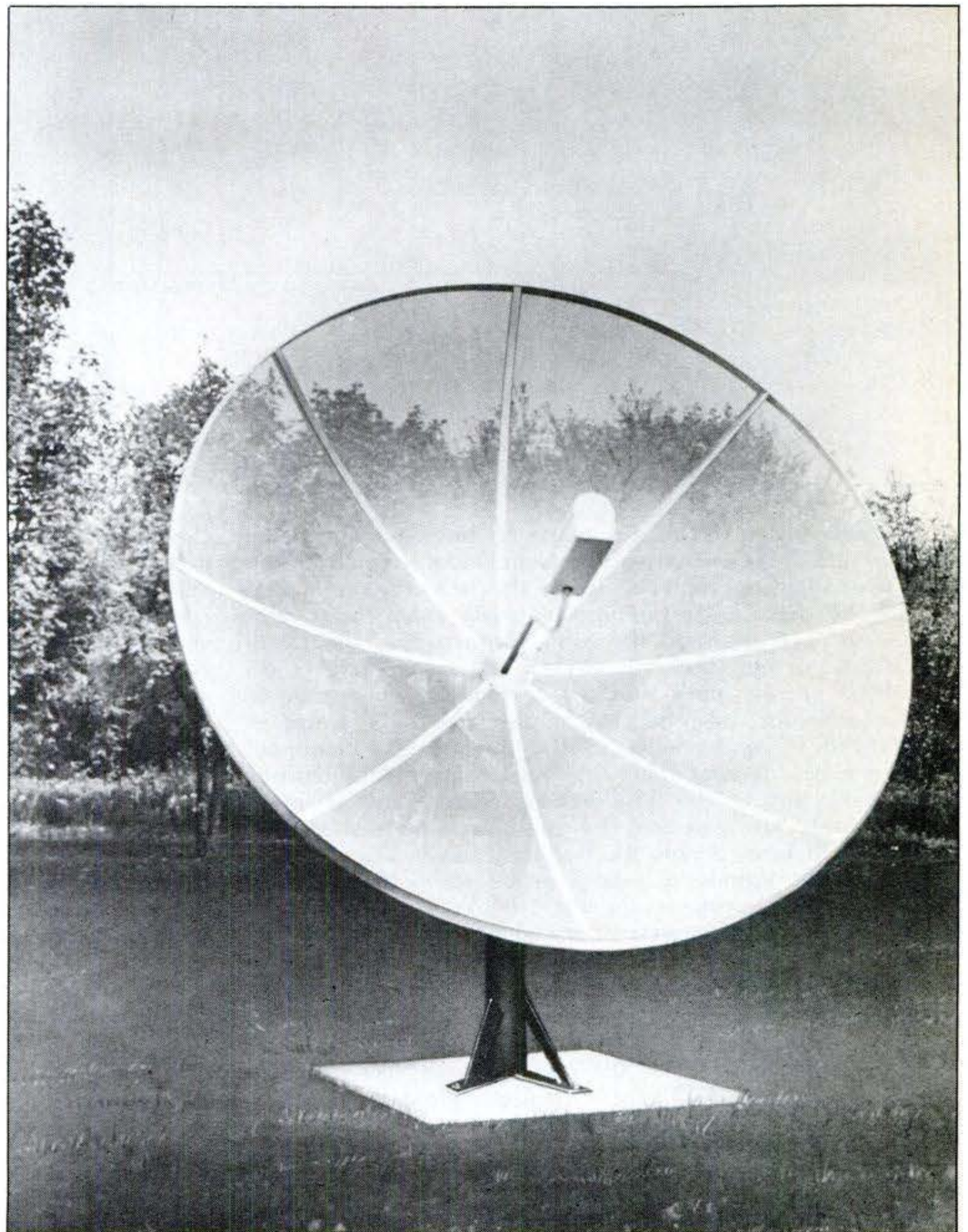
A forest of dish antennas glinting in the bright sun filled the giant parking lot at the Opryland Hotel here. All faced south. In the hotel exhibit hall, hundreds of TVs flickered—all without a sound. The scene was surreal.

I'd come to the Satellite TV Technology Exposition to check on a field PS has covered for five years [PS, March '78; March '80; Nov. '81; June '83; July '84]. Still, I was astonished by what I found. Tiny, four-foot-diameter dish antennas pulled in signals broadcast by satellites more than 22,000 miles away. Computers mated with receivers produced on-screen menus of satellite programs. Remote controllers moved dishes that were 1,000 feet away.

But advanced technology wasn't all I found. There are controversies about everything from the size of the dish to the tuning of the receiver, as well as about other components that make up a complete system (see "Tuning in TV from Space" box for details on components and system operation). Prices also vary considerably, with complete systems ranging from less than \$1,000 to more than \$4,000. Obviously, a less expensive system will not include all the features of the high-end systems (see table). I'll discuss the differences later.

About one million backyard antennas are now aimed at a band of 15 satellites in geostationary orbit 22,279 miles above the equator. There, a satellite's speed in orbit matches Earth's rate of rotation, so the satellite seems

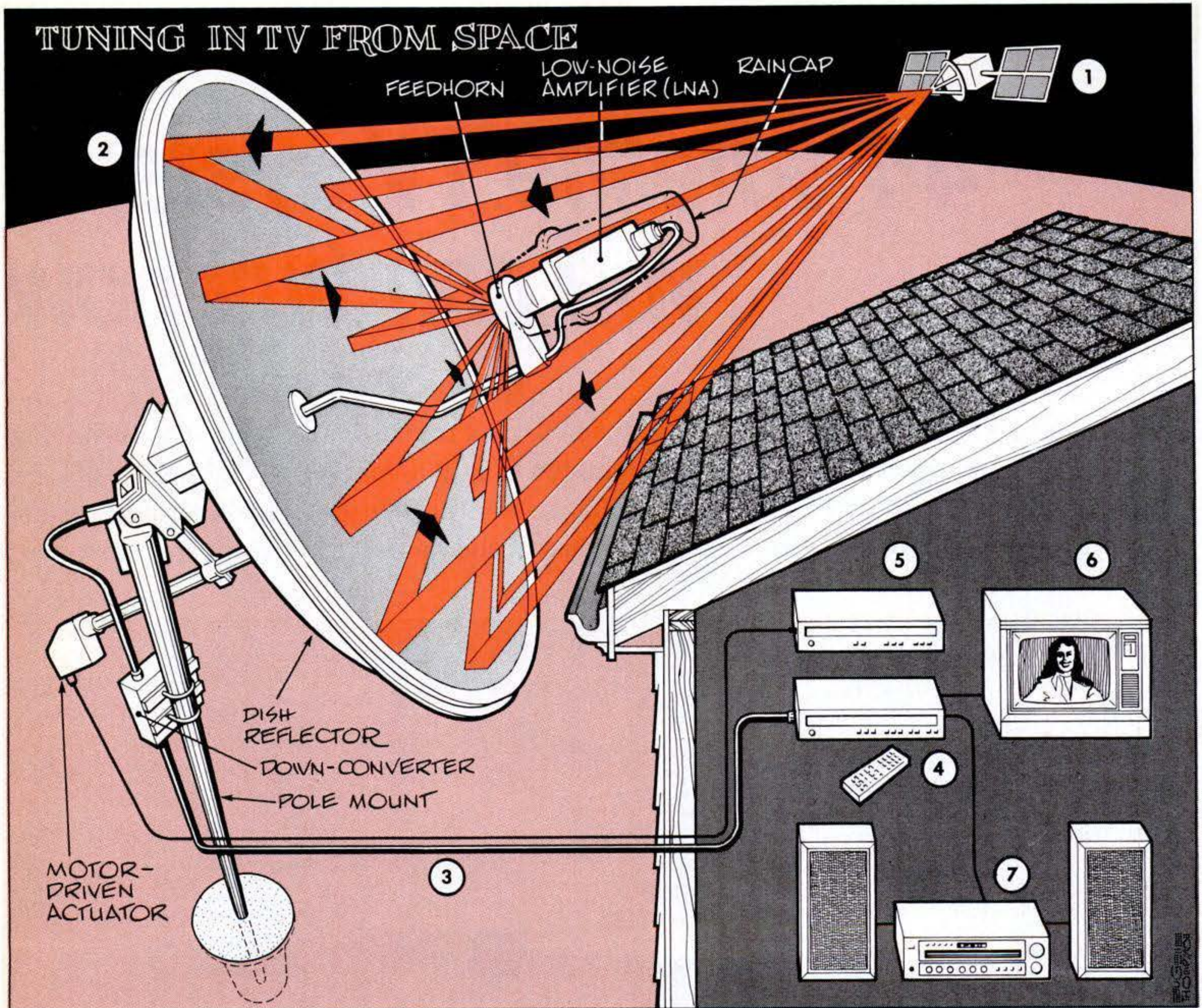
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See-through antenna: Winegard Satellite System's 10-ft., 92-lb. perforated aluminum dish, said to be as rugged as a

solid dish, blends in with its surroundings. Montgomery Ward offers a Winegard satellite TV system.

TUNING IN TV FROM SPACE



TV signals broadcast to a satellite (1) hovering above the equator are rebroadcast by 12 transponders, each transmitting two separate channels. To do this, the satellites polarize the TV signals, transmitting alternate channels at right angles to each other so the same frequency in the 3.7-to-4.2-GHz band can be used twice. (The transponders also broadcast one or more "audio subcarriers," which can be stereo sound for the broadcast or unrelated radio transmissions.) The TV-receive-only (TVRO) antenna (2) is mounted on a concrete footing. The antenna's polar mount permits it to track any of the 20 C-band satellites. The satellites' faint signals are gathered by the parabolic dish-shaped reflector and focused onto the feedhorn; this is a wave guide that feeds the signals to a small probe, the actual antenna, just inside the low-noise amplifier (LNA). The feedhorn is usually mated with a servo-operated polarity switcher that twitches the antenna probe 90 deg. to align it with the incoming signal. Polarity switching can be done electronically, as well. The LNA amplifies the signals about 100,000 times.

Costly low-loss microwave cables carry the signal to the down-converter—part of the receiver but mounted at the antenna to cut cable runs. Here the microwave signal is converted to a lower frequency (usually 70 MHz) that travels, via buried coaxial cable (3) to the receiver (4) for processing. Both the LNA and down-converter should be protected by a weatherproof cover or sealed housing. (Tuning-tracking signals and power for the LNA and the motorized antenna drive are carried by the same cable.) The remote control for the antenna motor (5) usually comes in a separate unit, though some high-end receivers include it. An infrared remote-control pad tunes in the signal at the receiver and, in some systems, even points the antenna at different satellites. Once the receiver processes the signal, it's sent to an RF modulator (usually part of the receiver) for transmission to channel three or four of a conventional TV set (6). Though some high-end receivers have a built-in stereo amplifier, most stereo-equipped receivers have a processor that readies the signal for transmission to a stereo system (7).

to stay in one spot above the planet. These are C-band satellites transmitting in the 3.7-to-4.2-gigahertz (GHz) wave band. They serve as low-power (about five watts per channel) microwave repeater stations. The satellites now transmit about 125 channels of movies, sports, news, and special-interest programs.

These TV signals are free, but is it legal to tune them in? Yes, says the satellite TV industry. Piracy, say major programmers such as HBO. Bills before Congress may soon resolve the question in favor of the consumer. (For a full discussion of the legal question, see PS, July '84, p. 85.)

If you're thinking of a C-band sys-

tem, step into your backyard and look south. Do you have a clear view of the horizon? Hills, tall buildings, and trees can block high-frequency microwave signals. Even if the view is fine, you may have an unseen problem: microwave interference from land-based transmissions.

"If you take a dish out to the site,

you'll learn only what the interference situation is at the time you tested," says Fred Hopengarten, president of Channel One—a pioneer dealer. "At 5 o'clock your local bank may turn on its

data flow to headquarters for the rest of the evening—and the signals could be passing right across your dish."

Though Hopengarten says an experienced dealer may have studied local

interference paths, you can't be absolutely safe unless you spend \$350 or so to have signal paths of all transmitters in your area mapped.

Although a few makers I talked with asserted that microwave interference is not a problem for a high-quality receiver, most agreed it can be serious. And interference can be expensive to fix—filters to eliminate it run from \$200 to several thousand dollars. "The smart dealer says in small print that he can't guarantee against interference," Hopengarten says.

PS sampling of satellite TV systems: from bare bones to bells and whistles

Name ¹	Price (\$) ²	Dish specs				Microwave electronics					Satellite receiver				Remarks
		Size (ft.)	Type ³	Certif. ⁴	Drive ⁵	Type ⁶	Noise ⁷	Rotor ⁸	Housing ⁹	Cables ¹⁰	Tuning ¹¹	Auto. ¹²	Remote ¹³	Stereo ¹⁴	
Birdview (M)	2,495 2,990	8.5	A			LNB	90	E	•	CC	D	•	IR	•	Dual LNAs for receiving 24 channels on up to four separate receivers
Channel Master (M)	1,495 3,995	6.3 12	F		•	LNA	120	M		CC	D	•	IR		Best used in Midwest, says maker Stereo unit planned
Channel One (D)	1,800 4,250	10 12	M			LNA	100	M		CC	K		W		First U.S. satellite TV dealer
Delta (M)	995 4,000	6 12	A			LNA	90	M			C		IR	•	
Dockery (D)	1,995 3,895	9 10	P	•		LNA	75	E	•	DB	C		IR	•	
DownLink (D)	1,299 2,525	6 12	M		•	LNB	100	M	•	DB	C		IR	•	Detailed instructions included Receiver has stereo amplifier
Excalibur (M)	2,495 4,295	8 11	F	•		LNA	100	M	•	DB	C		IR	•	Diamond-shaped, high-gain antenna
Francis (D)	975 2,700	8 11	S		•	LNA	120	E		CC	K		IR		Stereo adapter available
Galaxy (M)	1,495 1,695	4 4	A			LNB	85	M	•		K		IR	•	Fixed-mount antenna, aimed at Galaxy 1; for urban rooftops
GFI (M)	1,325 2,400	11 11	M	•		LNA	120	M	•	DB	K	•	IR	•	Tripod-mount, steel-mesh dish; 40 hrs. assembly, including footings
Horizon (D)	1,800 3,000	8 10	A		•	LNC	100	M		CC	K		IR	•	
Intersat (M)	1,250 3,995	7.5 11	A			LNA	70	M			C		IR	•	Programmable with on-screen "menus"
Janeil (M)	1,100 2,500	6 10	A	•		LNA	120	M			C		W		Usable in most areas, says maker
KLM (M)	2,395 3,495	11 11	M	•		LNA	120	M	•		C		IR		Quartz-synthesized; RF modulator extra
Paris Mtn. (D)	2,595	10	F	•	•	LNA	90	M	•	CC	D	•	IR	•	Detailed instructions included; price includes shipping
PCM (D)	940 2,585	8 12	F		•	LNA	120	M		CC	C		IR	•	
Regency	995 1,995	4.5 7.5	A		•	LNA	95	M	•		C		IR		"Deep-dish," high-gain antenna Remote volume control
Satelink (D)	3,495	11	F	•	•	LNA	65	M	•	DB	D	•	IR	•	
Sat. World (D)	995 2,900	7.5 11	F		•	LNA	120	M	•		C		IR	•	
Starview (M)	1,797 2,895	8 10	F		•	LNA	100	E		CC	K		IR		Dish not recommended for all areas Detailed instructions included
Uniden (M)	1,420 2,627	8 11	A		•	LNA	100	M	•		K	•	IR		Receiver-front switch for local TV
USAS (D)	1,113 3,369	6 12	F		•	LNA	100	M		CC	C		IR	•	Dish not recommended for all areas
Winegard (M)	1,695 3,550	6 10	P	•	•	LNA	100	M	•	CC	D		IR		

¹Table lists features of lowest and highest priced systems provided by a sampling of manufacturers (M) and dealers (D); ²uninstalled—prices are approximations only and may vary considerably, and system specifications are also subject to change; ³steel (S), aluminum (A), aluminum mesh (M), fiberglass-coated metal (F), perforated aluminum (P); ⁴maker certifies that antenna will discriminate between signals from satellites spaced two deg. apart; ⁵remote-controlled motor drive, called an actuator, points the dish at different satellites; ⁶low-noise amplifier with separate down-converter (LNA), a combined amplifier-converter (LNC), or a low noise block converter (LNB) that processes the signal from the entire frequency band transmitted by one satellite; ⁷in degrees Kelvin—the lower the figure, the better the signal-to-noise ratio; ⁸a motor (M) twitches the small antenna probe 90 deg. when signal polarity changes, or amplifier polarity is switched electronically (E); ⁹the down-converter is mounted in a sealed, weatherproof housing; ¹⁰cables, if provided: standard coaxial cables (CC) that should be threaded through plastic conduit, which is usually not provided, or direct-burial (DB) cables with a protective sheath—standard supply is 125 to 150 ft.; ¹¹click-stop knob (K), continuous tuning, (C), or digital push button (D); ¹²antenna probe is automatically aligned with signal polarity when channel is selected; ¹³hard-wired (W) or infrared (IR) remote control; ¹⁴receiver processes stereo signals for playback on separate stereo system

Choosing a system

If your site is suitable, you face the next problem: how much to spend. Do you want a satellite TV system that's as easy to use as a regular remote-controlled TV set? One that pulls in brilliant, studio-quality TV pictures and stereo sound? One that tunes in all channels on all satellites? Or will a standard broadcast-quality picture with about 20 channels of cable programs satisfy you, even if the system is less convenient to use? The answers to these questions determine whether you look at high- or low-end systems. (See the table at the end of the article for a sampling of systems at both ends of the price scale.)

Satellite dishes come in a range of sizes and materials. The dish's curved surface collects the satellite signals and reflects them to a central focal point (see drawing). The smoother the dish's surface and the more precise the parabola, the better. Solid-metal and fiberglass (with metal embedded below the surface) dishes hold their shapes better than mesh dishes, say most experts. Perforated aluminum, the newest dish type, combines the see-through benefits of mesh with the stability of solid metal.

Before you buy, examine the dish's curvature carefully. Sight along one edge of the dish; you shouldn't be able to see the other edge projecting. Check whether panels bolt together smoothly. Run your hand over the dish surface to see whether there are bumps or other irregularities that might scatter the signal.

Ease of assembly is important. "Two men, two hours." That's what they all say," grumbled a consumer I met in Nashville. "It took us more like 24 hours to assemble that dish."

The size of the dish you buy depends, first, on where you live. Most U.S. communications satellites are aimed at the Midwest. The satellites' signals are much like the cone of light cast by a flashlight—stronger in the center and weaker around the edges. Because the dish's job is to gather as

[Continued on page 116]

IBM fights back

Competition has forced Big Blue to flex its muscle again. IBM has replaced the PCjr's button-type keyboard and offers features that make it a powerful, PC-compatible home machine. The new PC AT serves three users at once and runs programs three times faster than the PC or PC XT. And a network link has office PCs "talking" to one another.

By WILLIAM J. HAWKINS

It's been three years since IBM introduced its first PC personal computer—and successfully battled a well-entrenched industry of brands and standards.

All has not been perfect, however. Stiff competition from the newer generation of "clones," PC compatibles that are faster and have better graphics, has caused IBM to cut prices by as much as 23 percent to stay in the running. And the PCjr, IBM's home version of the PC, has received mixed reviews due to its poor keyboard and inability to run all PC software. But now the gloves are off in a flurry of new introductions:

- PCjr enhancements. The button-type keyboard is gone. Up to 512 kilobytes (K) of random-access memory (RAM) is available for complete PC compatibility. And the PCjr can talk with a new speech synthesizer.

- The PC AT (for advanced technology), a high-speed computer that's PC-compatible and can serve more than one person at a time. It's designed for professional use, but has a personal price tag of just \$3,995.

- PC Network, which can combine up to 72 computers, printers, and storage devices on one coaxial line.

- New software, including XENIX for the AT. It's an operating system based on UNIX, one of the most popular operating systems used by professionals. And there's TopView, a software program that allows IBM PCs to perform concurrent operations and "windowing" with conventional MS-DOS programs.

I recently saw these new products at work in IBM's New York headquarters. Here are the details:

Jr's new look

"People can now take their office work home," says Philip Estridge,

president of IBM's Entry Systems Division. "Virtually all programs and data from the PC will work in the PCjr."

The PCjr has always been PC-compatible. But its limited memory (128K) and single disk drive restricted its use. Many popular business programs, such as the Lotus 1-2-3, that require more than 128K of memory or a second disk drive could not be used. Now that's changed.

Up to three 128K memory boards (at \$325 each) can be added to the PCjr through its side expansion connector. That gives it up to 512K of RAM—more than enough for all PC software. One minor drawback: You'll have to give the PCjr a bit more desk-top space for the outboard additions and power cables.

Though a second disk-drive option is not available for the PCjr, IBM offers a special program that transforms the extra memory into an "electronic diskette." The program allocates a section of the extended memory for data storage and retrieval, but it's used by the disk-operating system to simulate a second disk drive. Result: A program requiring two disk drives will work. When it asks to save data on the second disk drive, for example, the electronic-diskette program shuffles the data into memory.

The electronic diskette works well, but the data in memory are not permanently saved as on a real disk. So if you want to retain data held by the simulated disk drive, you must remember to copy its contents onto the first—real—disk drive before turning off the power.

Another option: speech. An add-on speech synthesizer (\$300) allows the PCjr to say any of 196 pre-programmed words. With the addition of a microphone, the system will digitally record your voice on disk. Then, by using a program you write, it can be played back later. A cartridge program

called ColorPaint is also available (see caption).

The PCjr's most obvious—and most welcome—addition is its new keyboard. Even after months of using the original button-type keyboard, I could not get accustomed to it. Its hard-to-press keys and lack of tactile response make touch typing impossible. But the new 62-key typewriter-like keyboard is excellent, comparable to the feel of any high-quality keyboard. Like its predecessor, it uses infrared light for wireless operation, or it can be connected to the computer via a cable.

PC compatibility, speech synthesis, new software, high-quality keyboard, and a price that's lower than the PC—won't that let the PCjr cut into PC sales? Probably. But, says a smiling Estridge, "We don't care."

PC AT—the senior

The AT is Big Blue's new senior member of its personal-computer line (see caption). The heart of the AT is a new Intel 16-bit 80286 microprocessor, a cousin to the 8088 used in other PCs. The difference: It runs three times faster than the 8088 and is capable of addressing up to three megabytes (M) of internal RAM instead of just 640K.

Compatibility with the 8088 lets the AT run many existing PC programs—only faster. (Certain graphically oriented software, such as Flight Simulator, won't run on the AT, however, because they are written specifically for the PC.) For single-user work, PC-compatible disks can be read directly by the AT's high-density floppy-disk drive; disk operations are controlled by the new \$65 version 3.0 of PC-DOS. (Similar to PC-DOS version 2.1, it can use the AT's hard disk and additional RAM.)

The AT also can use many plug-in-board options available for the PC. And IBM has introduced two new boards: a math processor for high-

[Continued on page 119]

- *full-size PCjr keyboard*
- *high-speed AT models for pros*



PHOTOS: IBM

The PC AT personal computer (above) comes in two versions. A \$3,995 basic model includes 256K of RAM and a high-density, 1.2M, 5.25-in. floppy-disk drive. The \$5,795 enhanced version adds another 256K of RAM (for a total of 512K), a built-in 20M hard disk, and a serial-parallel interface board. Both versions accept additional 512K memory cards (\$1,125 each) for a maximum of 3M of RAM, and an additional 20M hard disk (\$1,595) for up to 41.2M of storage. The \$999 PCjr (right) comes with a new typewriter-like keyboard and 128K of memory. Its memory can be increased to 512K with optional plug-in boards. The ColorPaint cartridge program (\$99) allows you to draw objects on the screen with a mouse and "paint" them with selections from a 16-color palette. The program is similar to Apple's MacPaint.



Easy-access Woodshed

No more braving the elements to scoop up fuel for the fire. An add-on woodshed brings firewood as close as the door to your deck. And you can build it in a weekend.

By **BERNARD W. POWELL**

How many cold winter nights have found you scurrying out to the woodpile to grab fuel for a dying fire, hoping that the logs weren't soggy and swearing with every step that there must be a better way? There is, and it's as close at hand as your deck.

This easy-to-build woodshed occupies an end of a deck, offering easy access from your house and proximity to your fireplace. The woodshed not only stores firewood within arm's reach, it also keeps it dry through the winter.

But the bonuses of this woodshed don't stop at non-soggy logs and convenience. Because the woodshed uses

the deck's railing as framing members, you save money on material and you save time: One weekend is all you will need to build and stock it.

Firewood is often a nesting place for insects such as carpenter ants and powder-post beetles. Though your firewood will be in contact with your deck and adjacent to your house, you can stave off infestation by treating the



deck and the lumber for the shed with preservative. If your deck is raised, you have all the protection you need against termites, which make their homes in mud.

Deck widths and railing heights vary, of course, but here are guidelines and a materials list necessary to build a woodshed 12 feet long, 5½ feet high (at the peak), and four feet deep—large enough to hold about one-third of a cord of wood.

You'll need about 75 feet of 2×4 for posts, beams, and rafters, and a 12-foot length of 2×6 for the ridge piece. I recommend fir, which is excellent for framing, or pine. You'll also need four four-by-eight-foot sheets of ¾-inch exterior-grade plywood and a roll of 15-pound building paper. Any wood destined for outdoor use should be protected from the elements. The two most common methods are painting and staining, although I chose to protect—and dress up—the front posts of my shed with shingles.

Roofing and siding are a matter of choice, though you might want to match the shed's roofing and siding to that of the house. If you shingle the whole woodshed, as I did, plan on five bundles of shakes and use 1½-inch shingle nails. Actually, I used panels of Masonite imitation shakes left over from a roofing project. Asphalt shingles keep costs down, but

using them sacrifices looks. Total cost of the woodshed: \$200, with \$125 going to the shingles alone.

Building it

Construction is fast and easy—you don't have to cut many pieces of lumber, and of those cut, many are the same size. Also, much of the framing is already in place because the deck rail forms the back wall and outer end frame of the shed.

The rest of the frame is built from posts made of two 2×4s nailed together and 2×4 beams and rafters. To finish framing, butt one end post against the house, leaving a slight air gap for circulation, and set the front posts parallel with the existing rail posts. A long mason's level is a reliable, fast way to check the level of the framing. Use 16d nails (all hardware on an outdoor project should be galvanized to prevent rust) to anchor the posts and beams in place.

I figured my rafter angles just by eye and then cut a sample pair to fit. If you prefer to measure the rafters, keep in mind that you'll want rain and snow to slide down the backside of the roof, away from deck and house. A steep-pitched roof in the front and a longer rear slope calls for an off-center roof, which adds to the shed's appearance.

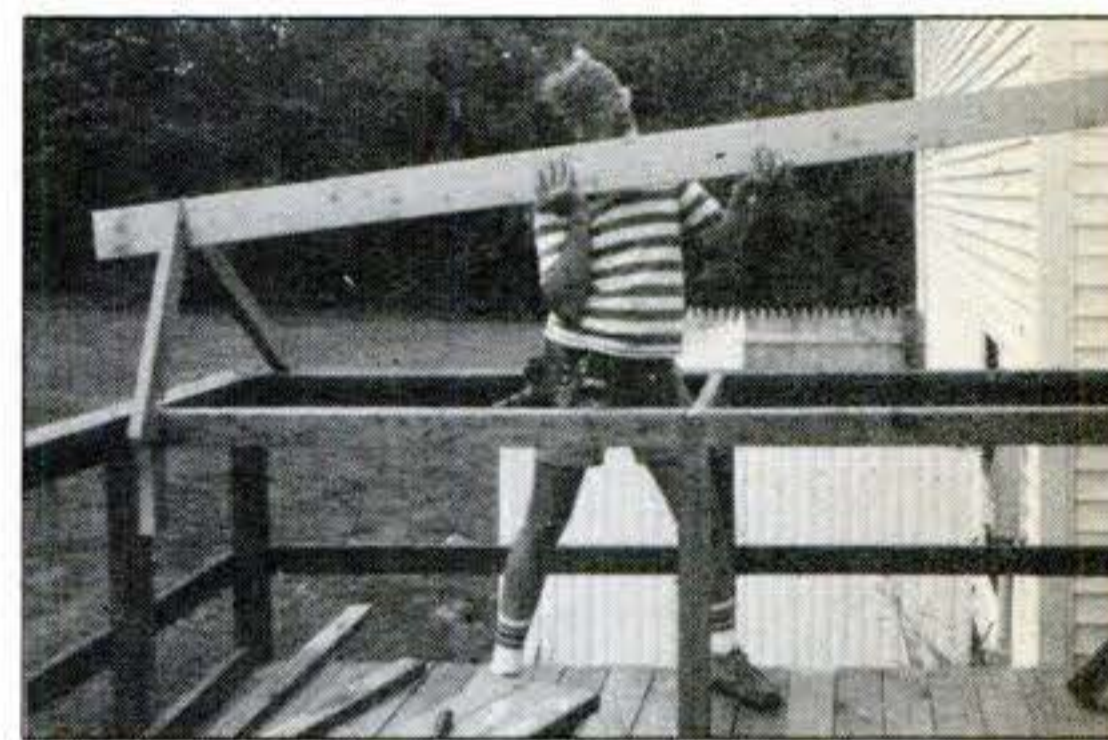
The first set of rafters I cut served

as templates for the other rafters. Although rafters are usually 16 inches on center, I used eight pairs and varied the spacing from 15 to 18 inches on center to correspond as closely as possible with the overlap of the posts and beams.

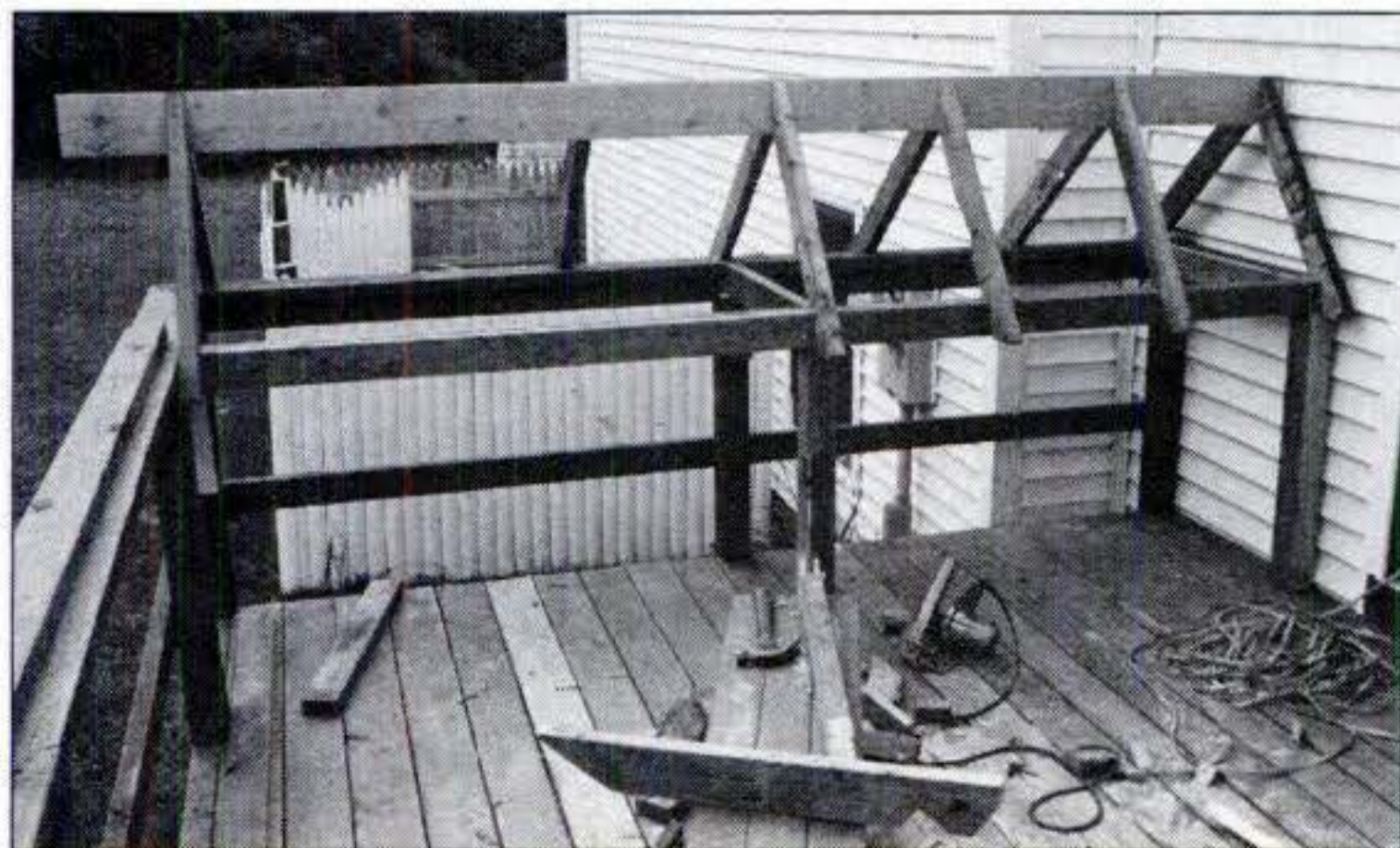
When the rafters are cut, use a circular saw to make quick work of notching them. You can knock out the wedge left by the kerfs with a hammer and chisel. Attach rafters at opposite ends of the ridge piece with 10d nails, and lift the ridge into place. Toenail the rest of the rafters, and enclose the shed with plywood boards anchored with 16d nails. I chose to have one side of my woodshed overhang the deck, so I had to notch the plywood (and shingle) to fit over the railing.

Shingles require an underlay of building paper, but I decided to tack down a sheet of polyurethane—another remnant of projects past—which has worked just fine. The imitation shakes I chose, unlike real shingles, don't require a double course. Instead, strips of shingles are nailed along the eave line, and the panels are then laid in courses upward—just like conventional shingles. The shakes go up quickly. As a finishing touch, I decided to add a dash of style to my woodshed by nailing the last row of shingles into a Boston cap.

PS



Begin by toenailing 2×4s in place (left). Nail rafters to both ends of the 2×6 ridge pole, and lift the beam into place (above). Nail remaining rafters in place (below left), and enclose with plywood. Tack paper in place before adding roofing and siding (below).



Vertical blinds— not just for windows

These upended Venetian blinds can take the place of screens or folding doors—and they couldn't be easier to install.

By AL LEES

Because verticals are the most versatile closure system yet devised—and much simpler to install than any folding or sliding door—they can be pressed into unexpected service. The vanes rotate 180 degrees, adjusting to any angle for precise control of light and ventilation. They stack compactly at the end of the track and are so light you need no massive overhead support. And since they hang vertically, the vanes catch less dust than slats. If a few strips become soiled, it's easy to detach them for cleaning.

Verticals have other advantages over Venetian blinds. For the closures shown here, mini-blinds would be out of the question because they'd be too heavy. You'd have to hang them in several sections—a nuisance to open—and you'd always have those heavy

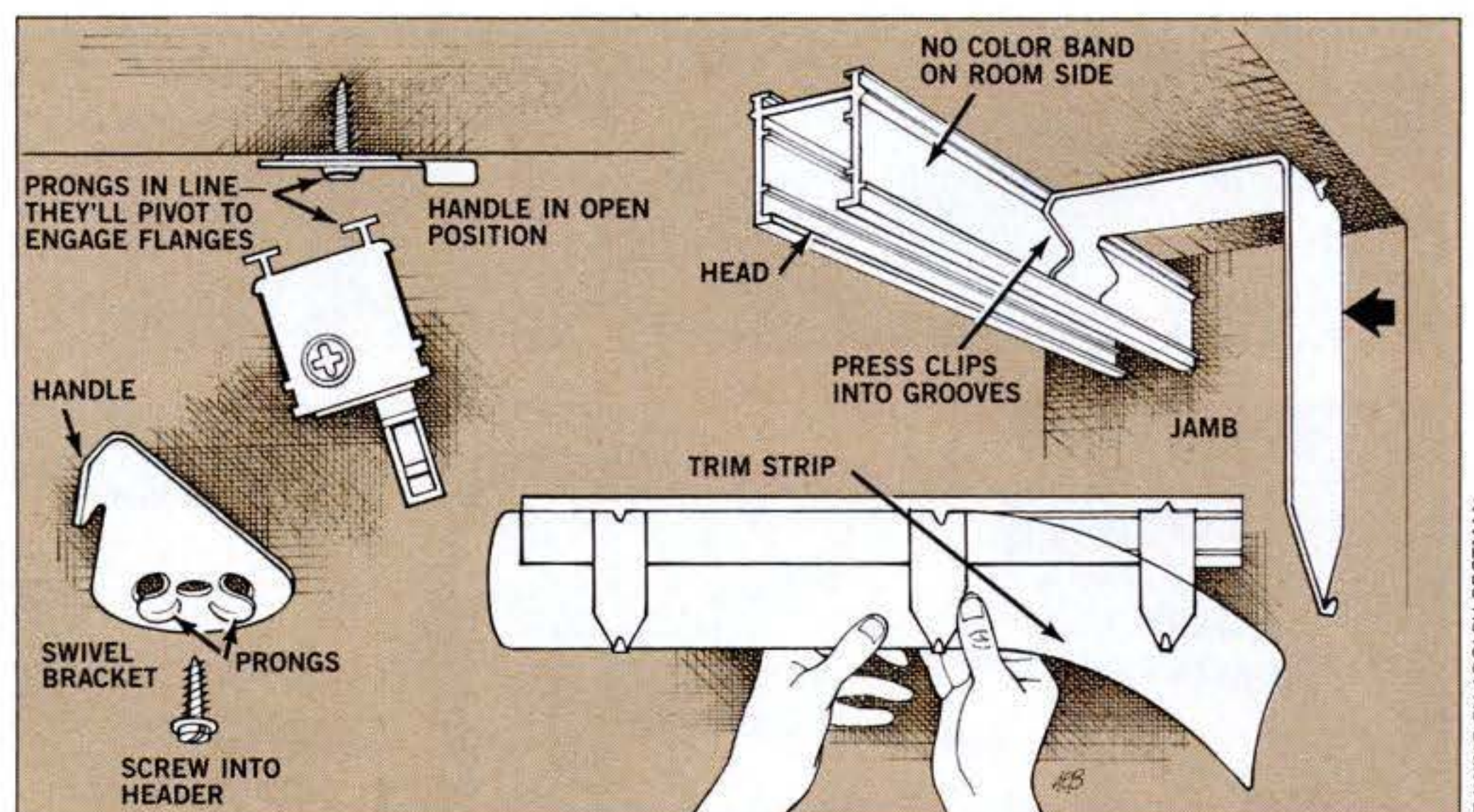
stacks overhead when they *were* open. Closed, they'd sway.

All three examples on the next page require simple inside measurements—wall to wall, ceiling (or beam) to floor. All the blinds shown are made of fabric, but vanes also come in vinyl, aluminum—even wicker. Opaque materials are best for these non-window uses. As with mini-blinds, verticals are packaged in ready-made standard sizes or can be custom ordered. All materials on these pages came from Levolor, but other makers include Louver-Drape, Flexalum (Hunter Douglas), Graber, Clopay, and Newell (see this month's "Shop Talk" for addresses).

Fabric vanes come with a hemmed bottom pocket into which you insert a flat weight. Small tabs protrude at each end to take a chain that keeps the vanes from swaying and tangling. A wand controls rotating. **PS**



Custom blinds arrive ready to assemble: Top photo shows everything needed for first two installations on facing page. Left to right: tracks for exact inside dimensions, with vane clips in place; packages of hem weights and sway chains; rolls of different-length vanes (alcove's at top, storage area's in foreground); and folded valance strips of stiffened fabric. Above: Insert vanes into clips one at a time.



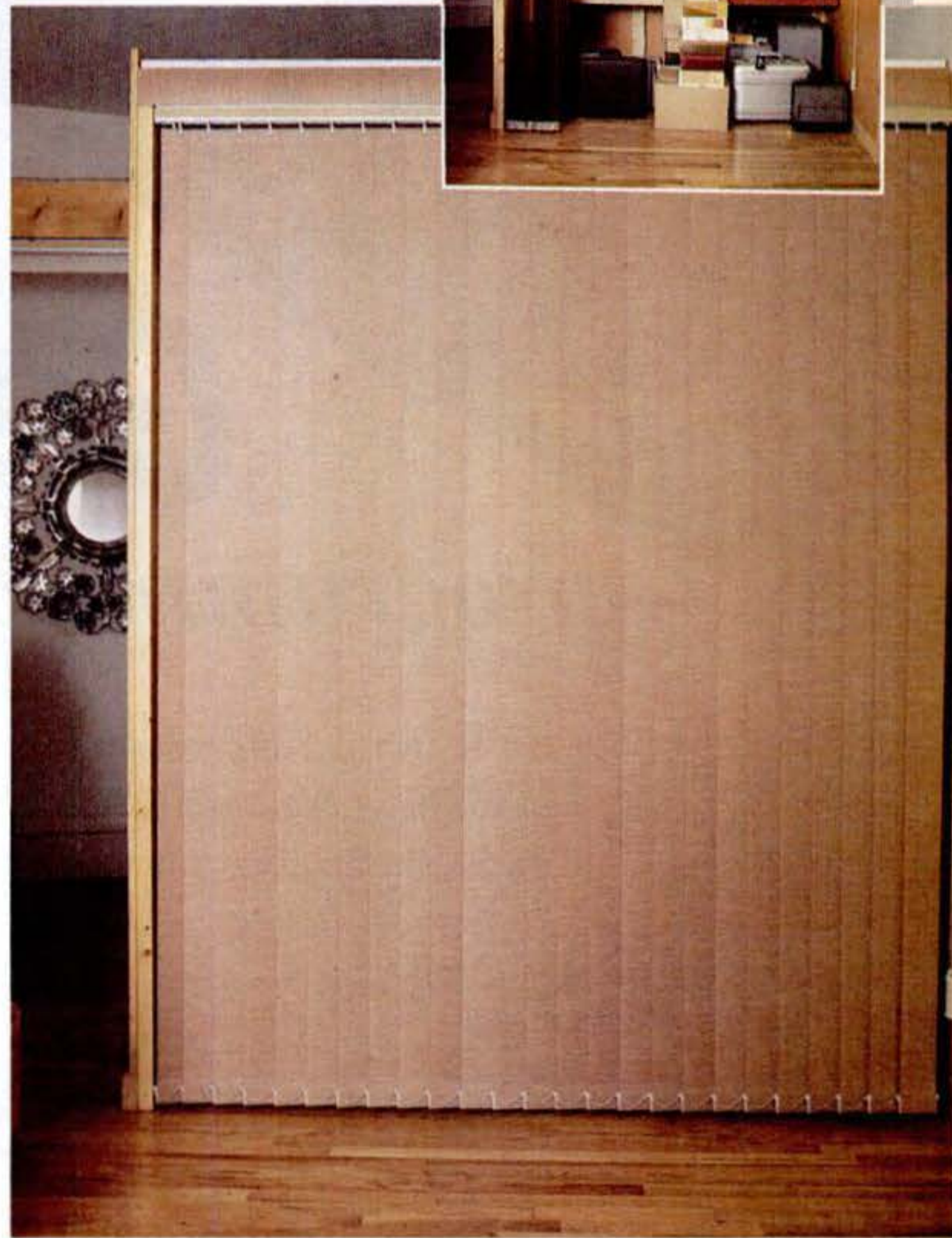
Installation sketches above, adapted from Levolor's instructions, are typical. Screw swivel brackets to ceiling (or header beam), no less than two in. from each end of track and equally spaced.

Position handles so prongs are in line. With helper, press track against brackets, and push handles against track. Snap-on valance clips mask gap between track and vanes, if desired.



STORAGE AREA

WORK ALCOVE



Here's what they can hide

No "box room" for luggage and bulk storage? Partition off one end of a room with vertical blinds. As shown above, if the ceiling's too high, just bridge the space with a floating beam: The one here is a 2x8 set in a pair of joist hangers. At right, I erected a work alcove. To mask the jumble from the rest of the den, I hung verticals of a textured weave. Below: Mismatched windows and an obtrusive air conditioner are swept behind a unifying wall-to-wall screen.

UGLY WALL





Canon T70 has built-in motor to transport and rewind film. It has no dials; a slide (far left) and buttons set ASA and exposure mode. LCD screen on top shows virtually all information a user might want. Two AA cells supply power; five-year lithium cell powers backup memory that retains settings.

Genius SLRs

—programmed to think like a pro

Built-in microprocessors give this new brainy breed of cameras the ability to make increasingly complex exposure decisions. And, at the same time, the cameras give you more control over those decisions.

By **EVERETT H. ORTNER**
Photos by *Greg Sharko*

"How to use the multi-spot measurement mode," said the line at the top of the page in the instruction book. "Aha!" I said, and with the camera at my eye, I pressed three times on a button marked "spot." Each time, a diamond flicked to life in the viewfinder, and a line, indicating shutter speed, darted across the bottom, lengthening or shortening as I pointed the Olympus OM-4 at bright or dark subjects.

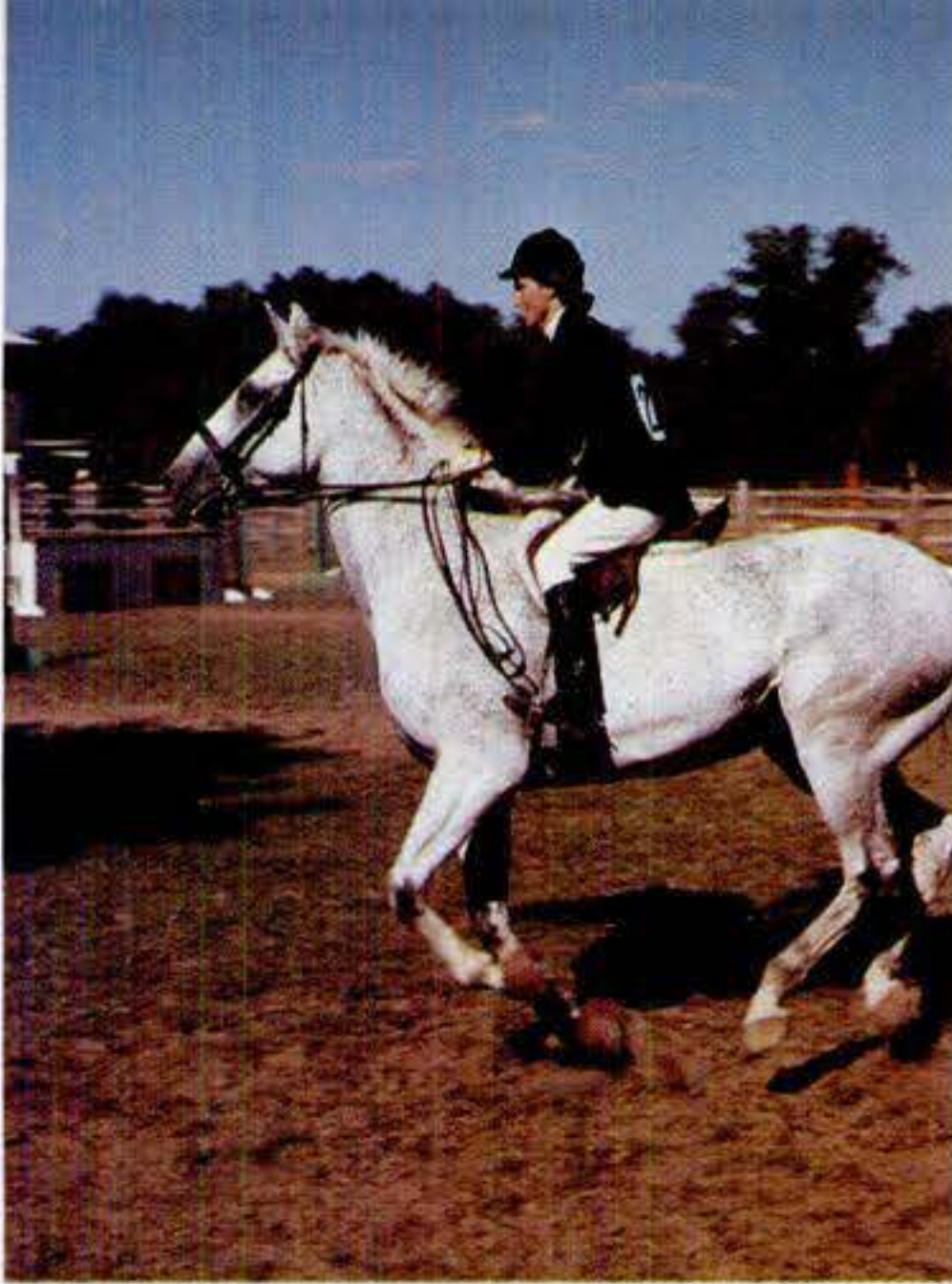
Each spot reading represented two percent of the picture-frame area. I could have pressed the spot button as many as eight times as I centered the viewfinder microprism on different parts of the scene, and the camera's computer would have integrated each of those readings into one final exposure setting. It's the kind of thing a professional photographer does with his expensive spot meter—perhaps less accurately.

Chinon CP-5 (below) has clever finger grip (bulge at right) that holds power supply: three AAA cells. Audible signals alert user to over- or under-exposure, and correct exposure. On automatic, shutter speeds to 30 seconds are available. CP-5 has built-in contacts for optional autofocus lens.



Leica R4 offers a choice of aperture- or shutter-priority automatic exposure, plus programmed and manual exposure—along with a spot-reading choice (Leica calls it "selective measurement"). An elaborate viewfinder display, with LEDs along the bottom and one side, informs the user of mode and exposure data.



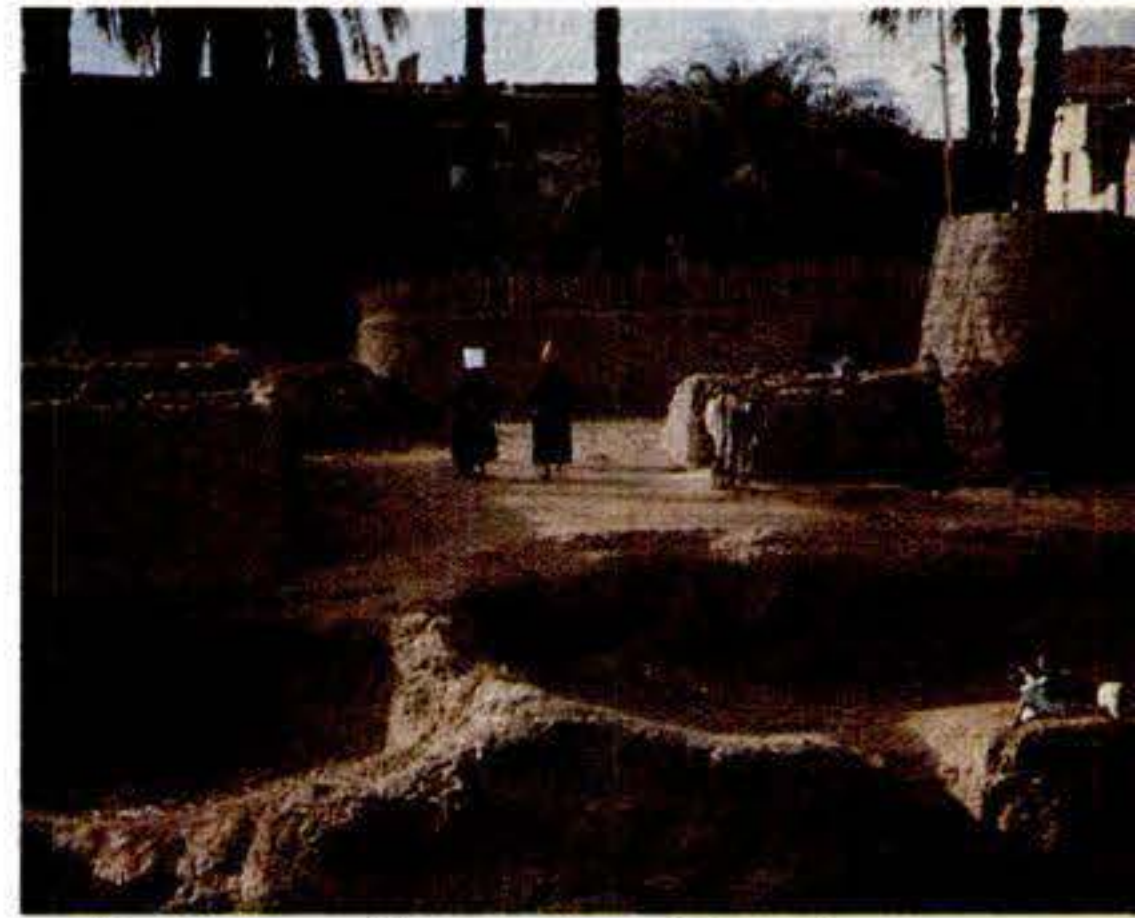


In multi-program auto mode, although the camera decides on lens opening and shutter speed, you can bias that decision in advance (to adapt to spe-



cial conditions). For the horsewoman, you'd program for action and a fast shutter speed. For portraits and that Philippine Jeepney bus (center), you'd

PHOTOS BY THE AUTHOR



select normal exposure. For close-ups and scenic shots such as the tranquil scene on the Nile at right, you'd want the program to favor depth of field.

"The programmability of the modern camera is unlimited," says Al Parker, manager of technical services for Ricoh of America. With a built-in computer in virtually every single-lens-reflex (SLR) camera made today, the only limits to what a camera can do seem to be cost and the customer it's aimed at—advanced photographer or amateur. Ricoh's latest product, the XR-P ["Through the Viewfinder," PS, June] is an example of the kind of programming—"multi-programming," the camera makers call it—that is typical of one new breed of genius SLRs. Would you like to shoot in the programmed mode—that is, let the camera make all decisions about lens

opening and shutter speed? Easy. Just set the XR-P's program selector to the "P-normal" position. Want an action picture? Try "Pa" for programmed exposure biased toward a faster shutter speed. Or how about a close-up or a scenic shot with programmed exposure biased toward depth of field? Try "Pd." And besides the programmed modes, the XR-P offers standard auto-exposure modes—either aperture- or shutter-priority—and even manual.

The Canon T70 ["Viewfinder," PS, June] offers similar programmed modes but calls them standard, tele, and wide. And it has a few slick tricks all its own. Look down at the top deck of the camera, for example, and you see

a screen with a liquid-crystal display that shows mode, frame number, battery check, film-load check, and film speed. Where's the film-advance lever? Gone. A built-in motor has eliminated it. The T70 also offers a choice of metering patterns: center-weighted or partial (11 percent of the format).

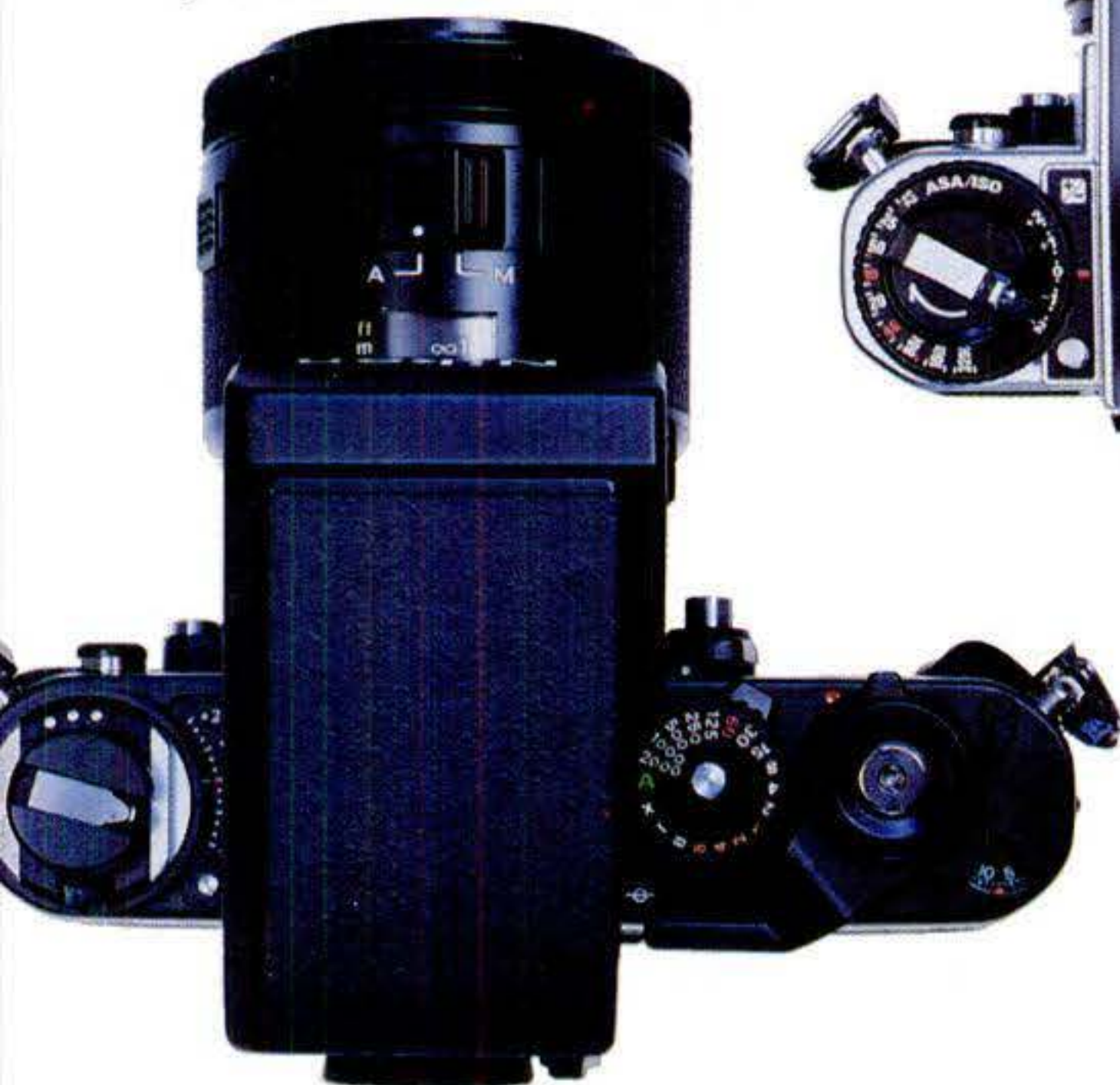
OK, but which is the only SLR with programmed off-the-film metering? Answer: the Olympus OM-2S, which has a silicon-blue-cell sensor aimed at the film in the camera for maximum speed and accuracy in adjusting to light changes. That's particularly useful with flash; the camera itself cuts off the flash when exposure is right on the

Continued

Nikon F3AF (below) is based on heavy-duty F3. It offers autofocus with 80-mm and 200-mm Nikkor AF lenses, and autofocus (via TC-16AF converter) or focus-aid operation with other Nikkor lenses. Exposure is via aperture-priority automatic or manual control.



Nikon FA offers aperture- and shutter-priority auto exposure, manual control, and a dual-program mode. In last, telephoto lenses of 135 mm or longer activate faster shutter speeds. Unique multi-pattern metering enables FA to cope with special lighting situations.



Olympus OM-4 (right) features aperture-priority auto exposure, with speeds from 1/2000 second to a minute, plus manual control. With spot metering (and times to four minutes), eight readings can be integrated into auto system, with further bias control through shadow and highlight buttons.





Advanced electronics in Leica R4 (above left) and Olympus OM-4 (center) make possible alternative metering systems: center-weighted or spot-

reading. You dial in your system with R4, press a button with OM-4. With OM-4 you can get still further emphasis by pressing highlight or shadow

button. Pushing slide of Nikon F3AF lens to "A" position (right) puts it in autofocus mode. A pro can follow the action without concern for focusing.

nose. Like its more professional brother, the OM-2S offers spot metering, but not with computerized integration.

Leica, which started the 35-mm madness just six decades ago, has its own genius SLR. Spin a ring at the top of the camera, and letters in a window tell you whether you have aperture-priority auto exposure (either center-weighted or spot-metered), shutter-priority auto exposure, fully programmed auto exposure, or manual. Viewfinder LEDs give you complete status information.

The Big Five SLR makers (Canon, Minolta, Nikon, Olympus, and Pentax) won't be happy to see this in print, but the first multi-program SLR was the

Chinon CP-5 with dual programmed auto exposure: P1 for most shooting, including action, and P2 for scenics and close-ups. And how about this: With the optional Chinon IR AF zoom lens, the shutter won't release until the lens is in focus.

Nikon also has some geniuses in its family—the FA and F3AF shown here, for example. The FA has a unique programmed mode that goes beyond center-weighted exposure control. Instead, its computer breaks up the picture into five areas and makes a judgment, based on computerized experience, of what the final exposure should be. It can compensate automatically, for instance, for backlighting. The F3AF, a

specialized version of the rugged professional F3, offers both automatic focus (by means of a motor in the lens) and focus-aid operation (indicator arrows light up in the viewfinder). Nikon also offers a motorized teleconverter, the TC-16AF, that not only multiplies the focal length of Nikon AI lenses by 1.6 but gives them an autofocus capability.

What about Pentax and Minolta? Right now, Pentax has its SuperProgram camera, offering six modes, but is rumored to be working on a multi-program camera. And a reliable source predicts that Minolta will soon introduce an "astonishing new camera that works on a truly new principle." **PS**



Olympus OM-2S (above) is the only SLR with programmed exposure control based on readings made directly off the film as the picture is being taken. OM-2S also offers aperture-priority auto exposure and manual control. With the latter, spot metering is available as well as center-weighted metering.

Pentax SuperProgram (below) has LCDs both on top deck and in viewfinder. Information includes aperture, shutter speed, and mode selected (there are six): programmed, aperture-priority, or shutter-priority auto; manual; automatic flash; or programmed auto flash.



Ricoh XR-P offers three-way multi-programming (action, normal, and depth of field); aperture- or shutter-priority auto exposure; manual; and even a mode to photograph TV screen. The self-timer button is also the left-hand shutter release. A memory button locks exposure reading.



Plastic plumbing

—an expert's tips on doing it right

CPVC tubing is a perfect material for do-it-yourself plumbing. Here, an expert tells you what you need to know about CPVC planning, fitting, measuring, and other installation requirements when using this popular rigid thermoplastic piping for remodeling a kitchen, adding a bath, or plumbing a new house. With proper installation, a CPVC system should last for many years.

By **RICHARD DAY**

Illustrations by Carl De Groot

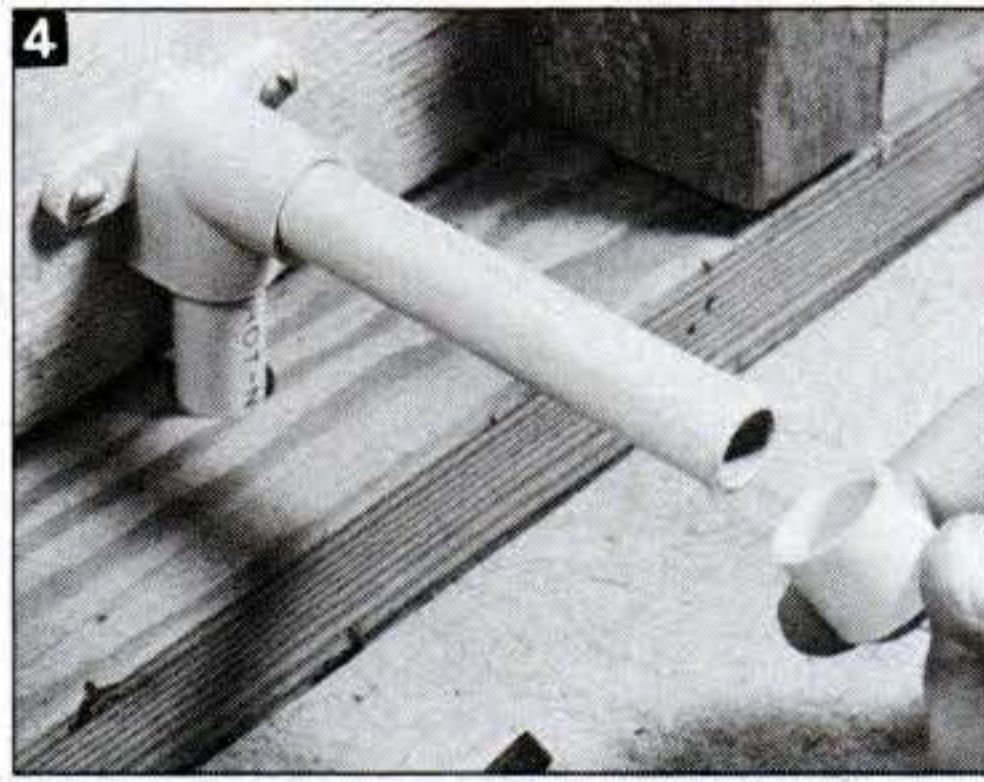
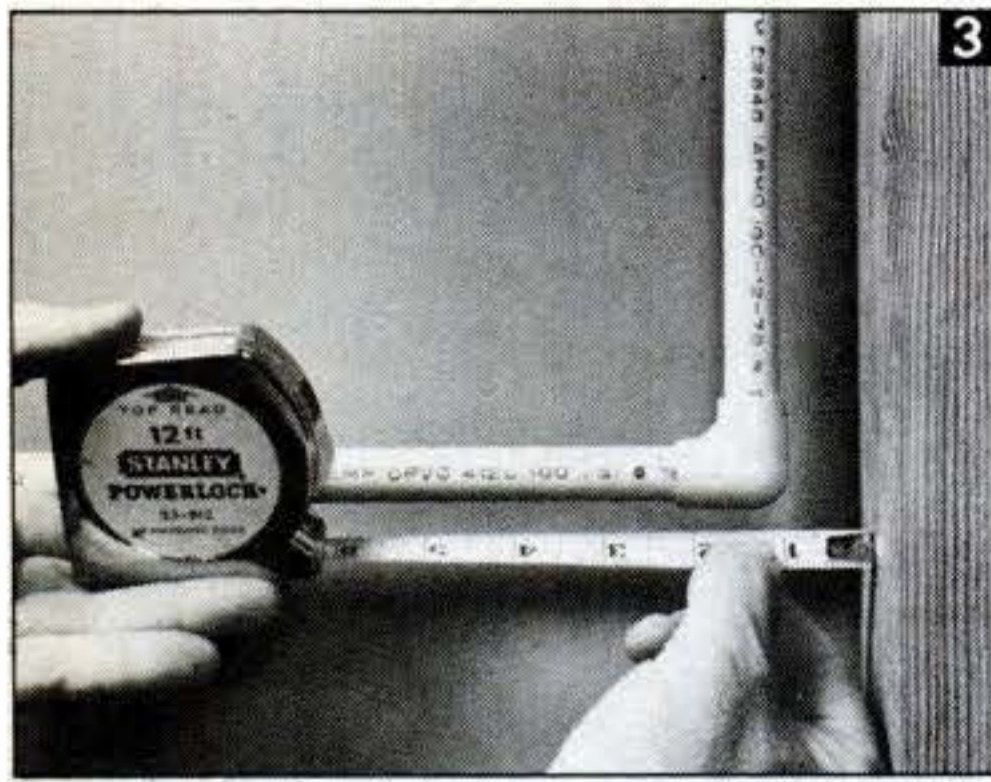
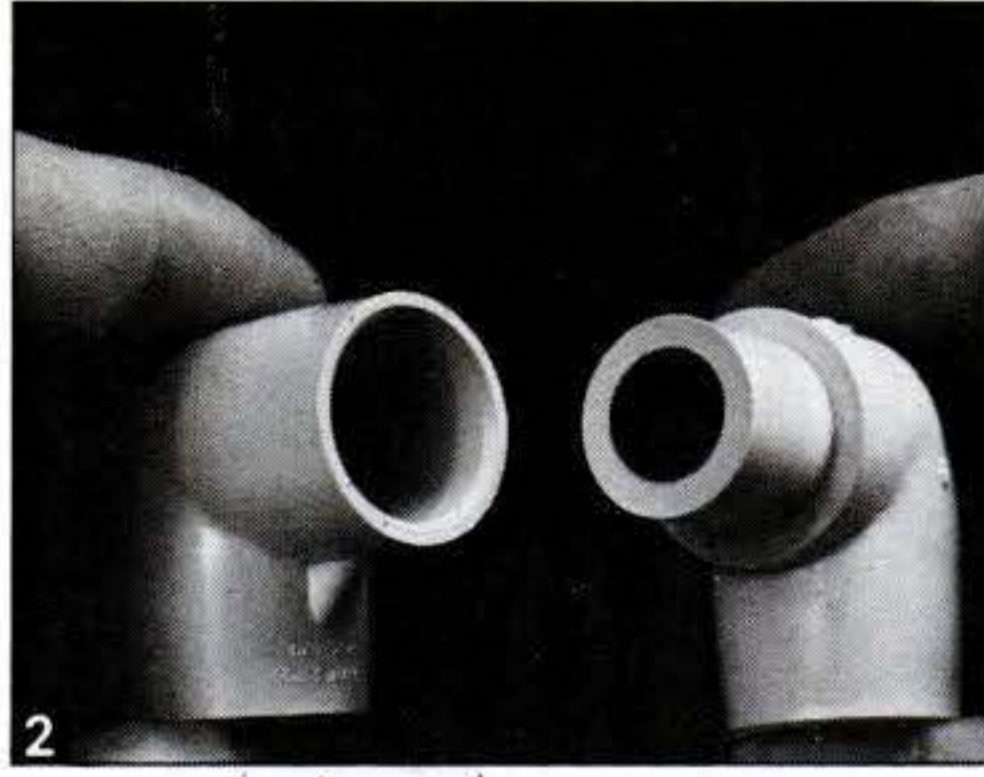
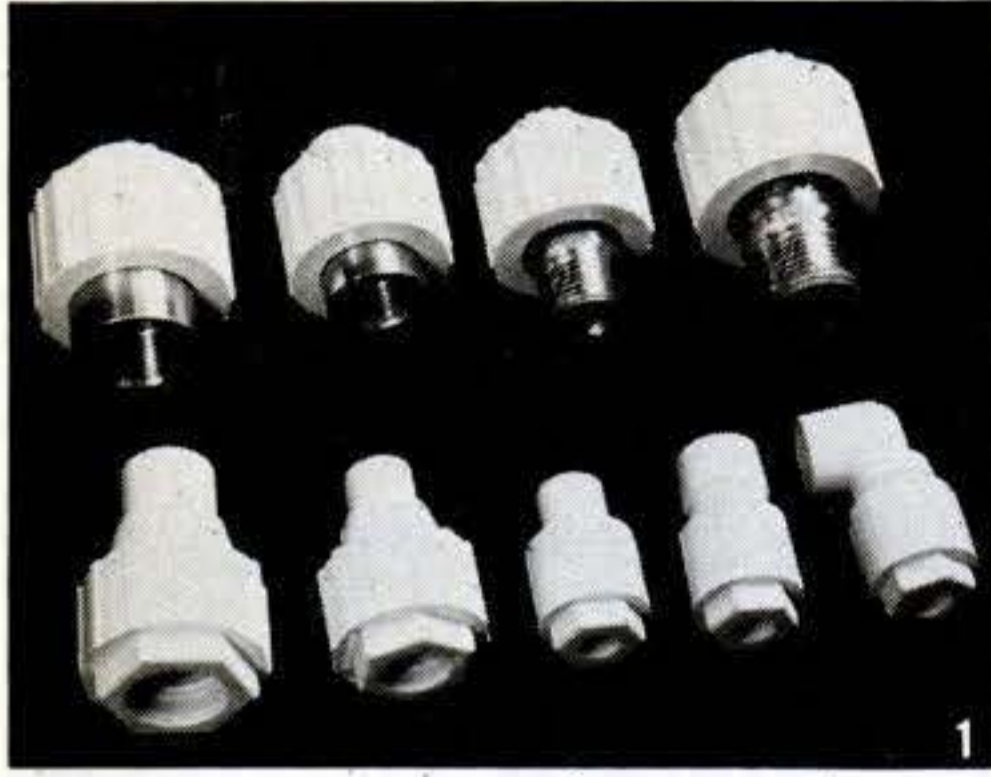
Are you planning a major remodeling job, complete with plumbing? You can make the job easier—assuming your local codes permit (as most do)—by using chlorinated polyvinyl chloride (CPVC) tubing. CPVC is ideal for most water-supply plumbing work, and its versatility makes the job easier than it seems. CPVC has revolutionized home plumbing in recent years, making most jobs possible for the do-it-yourselfer. But to avoid hassles, you still need to know exactly how to plan and install a run in your home. Here's what I've learned from the many plumbing jobs I've tackled.

CPVC tubing generally comes in ½- and ¾-inch nominal sizes and in 10-foot lengths. It can be cut with any fine-toothed saw or with a tubing cutter that has a plastic-cutting wheel. Tubing and fittings are joined by sol-

Continued



Accurate measurement makes for a trouble-free plumbing system. No piping should be installed in unheated spaces unless it can be drained.



■ Shown are transition unions (top, left to right): 3/4- and 1/2-in. female, 1/2- and 3/4-in. male fittings to adapt street (tubing size) CPVC to PB and copper. Bottom row: 3/4-in. street to 7/8-in. OD, 1/2-in. street to 5/8-in. OD, 1/2-in. street to 3/8-in. OD, 1/2- to 3/8-in. OD, 1/2- to 3/8-in. angle. ■ One end of street elbow (right) is same

size as tubing so that it fits into the socket of another fitting. ■ Because of expansion, space CPVC at least one in. from frame. ■ Wing elbow screwed to headers supports stubout pipe for fixture. The temporary cap closes the supply system for pressure testing (CPVC withstands 100 psi at 180 degrees F).

PS pipefitter's guide—CPVC fitting measurements

Fitting*	Fitting gain—in. (mm) (center to tubing end)		Makeup—in. (mm) (socket depth)	
	1/2-in. pipe	3/4-in. pipe	1/2-in. pipe	3/4-in. pipe
90-degree elbow, tee	3/8 (10)	9/16 (15)	1/2 (12)	11/16 (17)
45-degree elbow	5/16 (8)	3/8 (10)	1/2 (12)	11/16 (17)
90-degree street elbow (street side only)	1 (25)	1 3/8 (35)	1/2 (12)	11/16 (17)
Coupling	1/8 (3)	1/8 (3)	1/2 (12)	11/16 (17)
Universal line valve	1 (25)	1 3/16 (20)	1/2 (12)	11/16 (17)
Union	5/8 (16)	9/16 (15)	1/2 (12)	11/16 (17)
3/4 x 3/4 x 1/2-in. reducing tee	3/4 (19)	1/2 (12)	1/2 (12)	11/16 (17)
3/4 x 1/2 x 1/2-in. reducing tee	1/2 (12)	1/2 (12)	1/2 (12)	11/16 (17)

*Genova brand fittings; for other fittings take actual measurements.

vent welding—you use an all-purpose solvent cement in a two-step process ["Solvent Welding Simplifies Plastic Plumbing," PS, Jan. '81].

First, plan your system based on the direction of water flow. Position the fixtures first, then the tubing necessary to serve them. Space hot- and cold-water lines a reasonable distance apart so that heat is not transferred to the cold line, and never cross-connect a potable-water line with a source of potentially contaminated water, such as a lawn-sprinkler system. Use an air gap or an approved backflow-prevention device.

If you use isometric paper to lay out

the system, you can plot each pipe direction along a different set of lines, showing the system clearly. I recommend that you simply sketch out the system, but not necessarily to scale. Show all pipes and fittings, and label each one.

Although initially it might seem bewildering, don't allow the characteristics of the material to confuse you. Consider, for instance, tubing sizes. All CPVC materials designed for domestic hot- and cold-water lines are sized the same as copper tubing—that is, they closely follow the nominal sizes of copper for inside diameter. The two sizes of CPVC commonly used for

domestic-water supply are: 1/2-inch tubing, which measures about 1/2 inch ID and 5/8 inch OD, and 3/4-inch tubing, which measures about 3/4 inch ID and 7/8 inch OD.

In general, here's how to size your system to avoid flow problems: Use 3/4-inch tubing for the water-service entrance. CPVC may be buried below-ground (be sure to test the system for leaks before backfilling).

Use 3/4-inch tubing to supply the water heater, for the hot and cold mains, and to serve the water softener. You should branch to fixtures with 1/2-inch tubing, but bear in mind that a 1/2-inch branch should serve only one fixture.

A shower or tub-shower is the place where plumbing flow problems are most noticeable, so make sure that 1/2-inch hot- and cold-branch tubing run untapped from the 3/4-inch mains to the fixtures. Fittings such as shutoffs are permissible, but no tapoffs. Treat a shower with great deference.

Make 1/2-inch taps from 3/4-inch hot and cold mains with 3/4-inch reducing tees. Two kinds are available—3/4-by-3/4-by-1/2-inch and 3/4-by-1/2-by-1/2-inch. The latter splits a 3/4-inch main into two 1/2-inch branches at its end. [Note: Tees are described with the two run diameters given first, followed by the branch diameter.]

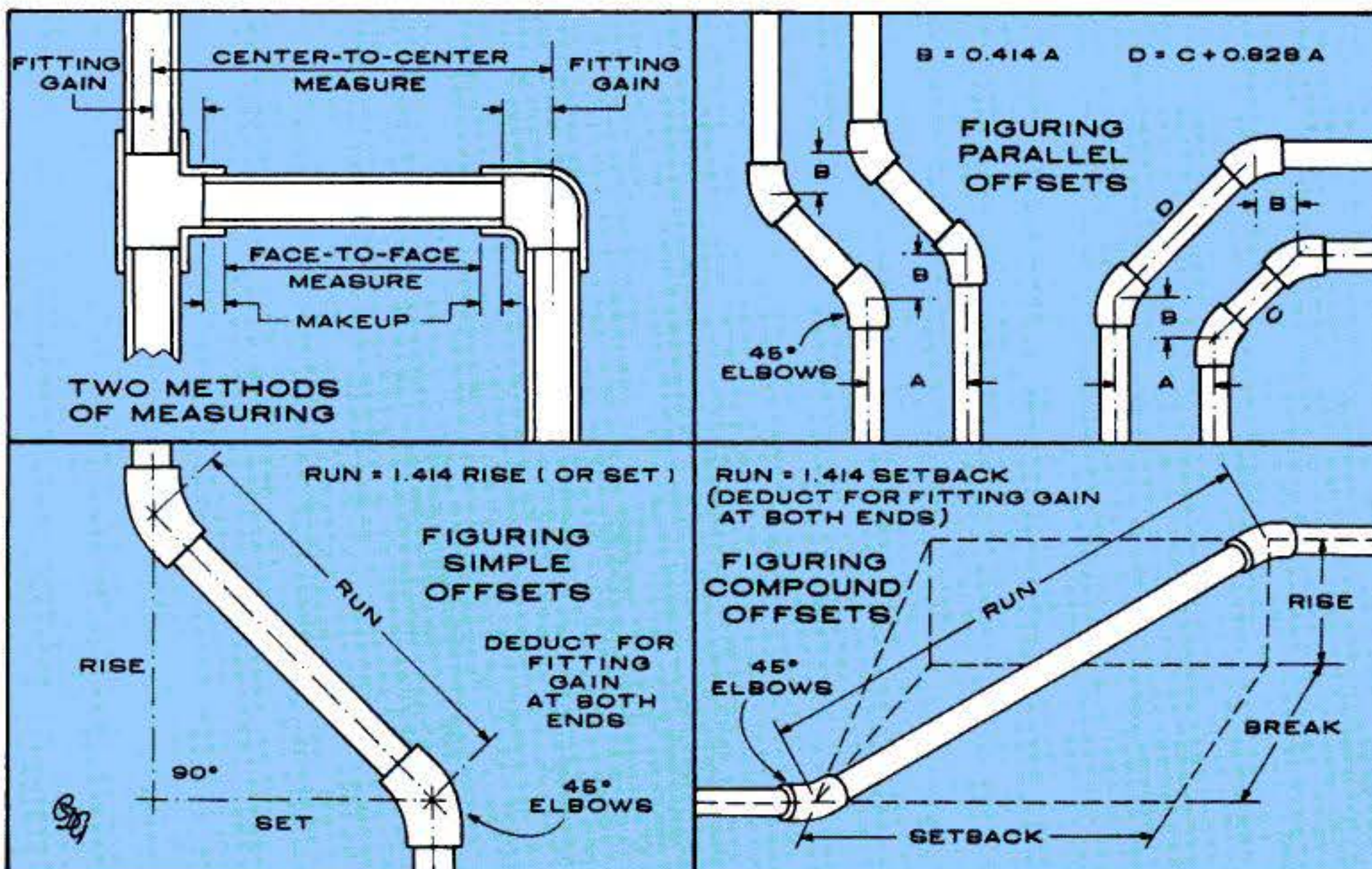
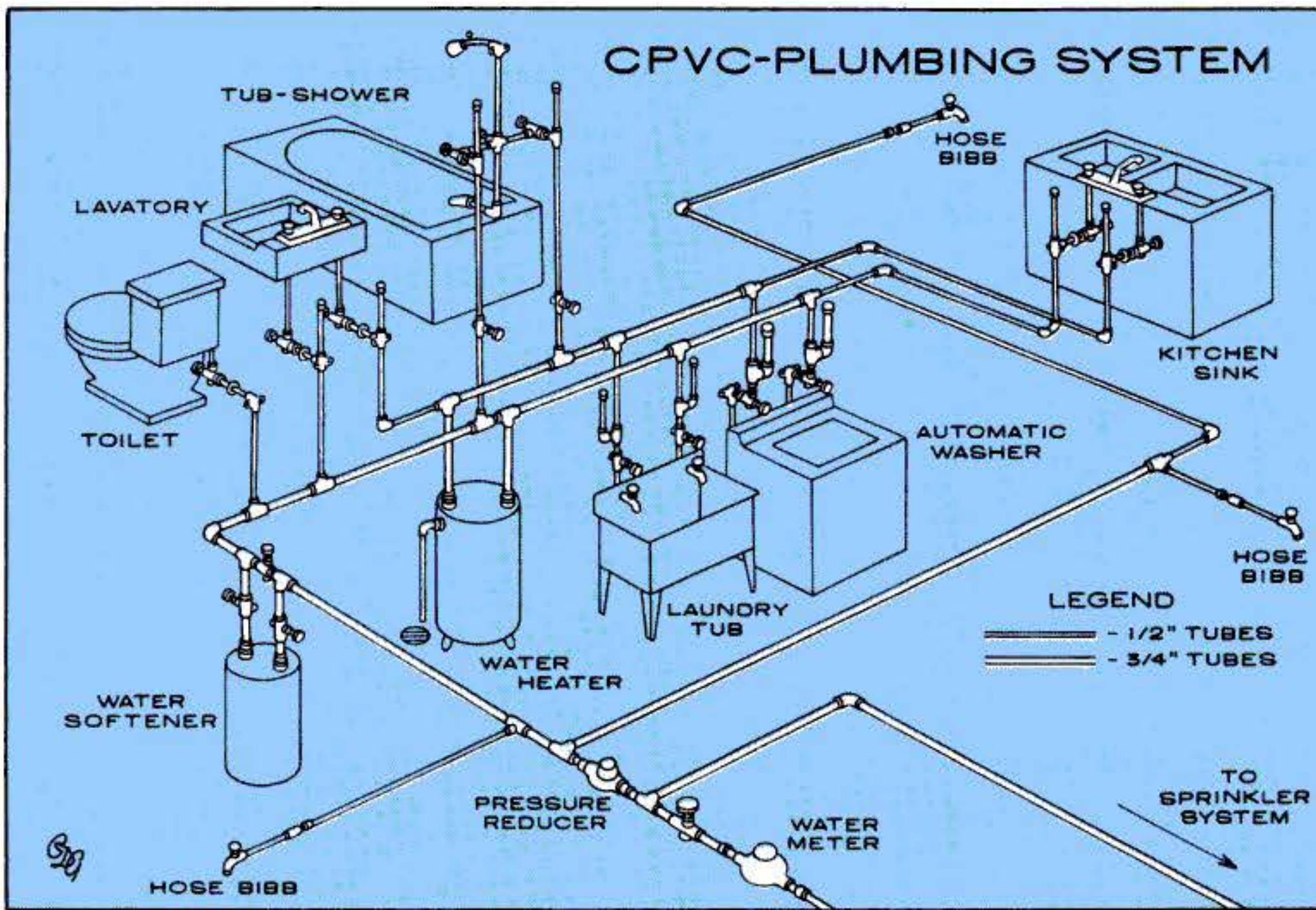
You can fashion other kinds of reducing tees by solvent welding 3/4-by-1/2-inch bushings inside the 3/4-inch tee sockets to be reduced. But remember, once you've reduced the tubing size from 3/4 inch to 1/2 inch, you mustn't go up in size to 3/4 inch again. That is a plumbing misdemeanor.

To keep garden-hose use from stealing too much water pressure from house fixtures, make hose-outlet runs with 1/2-inch tubing. If a branch is to serve two hose bibbs, make it with 3/4-inch tubing—but use 1/2-inch tubing for the bibb runs. Try to tap hose-bibb runs from near the service entrance. Minimize or, better yet, don't install end-of-main hose takeoffs, which could cut down on water flow through the house cold-water main.

If your house water pressure exceeds 50 psi, install a 3/4-inch pressure-reducing valve after the water meter. Adjust the regulator to about 50 psi. Outdoor water taps may come before or after the pressure reducer, depending on how much pressure you want them to have. Remember, though, that water running at high pressure through house piping creates noticeable sounds.

There are a great many CPVC fittings. They include couplings, caps, 45- and 90-degree elbows and street elbows, reducing bushings, reducing

Planning your water system and calculating measurements



Plan your supply system carefully, taking into account the sizes of tubing needed for each branch (top). There are two ways of measuring (upper left). Most plumbers prefer center-to-center measurements because there's no need to deduct for fitting gain; a too-long tube can simply be cut a bit and used. With face-to-face measurements, if you forget to add makeup length, the tube will be too short, i.e., wasted. To make neat parallel 45-degree offsets (upper right), find distance B by multiplying distance between tubes (A) by 0.414.

To make a parallel turn with 45-degree elbows, first figure distance B, as above. Find length of D by multiplying distance between two tubes (A) by 0.828 and adding results to length of C. Fitting gain is not a factor except in positioning the first fitting. You can calculate lengths of 45-degree offsets (lower left) by multiplying distance from center line to center line (rise or set) by 1.414. Deduct for fitting gain before cutting tubing. To find the run in compound or rolled 45-degree offsets, multiply the setback by 1.414.

tees, unions, and male thread adapters. For secure mounting of faucets and fixture stubouts, there are wing elbows and new wing tees.

Transition unions are also available for adapting threaded metal fixtures and appliances (transition unions are required on pressurized hot-water connections to prevent leaks that can be caused by thermal movements). For

instance, use transition unions to connect CPVC to the threads of your water meter, pressure reducer, water softener, water heater, and tub-shower mixing valves. Simpler, lower-cost male adapters may be used at hose bibbs, T and P valves, and for non-pressurized shower risers.

Threaded CPVC male adapters used to join with female metal fittings

should be used for *cold water only*. Be careful not to overtighten, which could strip the threads or crack the fitting. Use a good pipe dope, silicone rubber sealant, or Teflon plumber's tape or Teflon paste on the male threads before making up the joint. When tightening the threaded adapter, turn hand-tight, then give a full turn further with a wrench. A correctly sized adapter should have some thread showing when properly tightened.

You can make piping measurements two ways: center-to-center or face-to-face. Center-to-center measurement has the advantage of letting you easily figure piping offsets using trigonometric-based factors (see illustrations). You then simply subtract the fitting makeup (the distance that the tubing extends into the fitting at each end) before you cut the tubing (the lengths vary with the fitting; see table).

With face-to-face measurement you have to remember only two figures: Add one inch to 1/2-inch tubing, and 1 3/8 inch to 3/4-inch tubing for fitting makeup at both ends.

Figuring piping offsets in which only 90-degree water-supply fittings are involved is simple. You can determine the length of 90-degree offsets by measuring directly, either face to face or center to center.

If calculations get confusing, simply lay the fittings out on the floor and take actual measurements face to face. Add for makeup, and cut the tubing.

In any case, it pays to assemble the parts of a subsystem dry (without solvent cement) to see that everything fits. You can then take it apart and solvent weld. If you make a mistake with CPVC tubing—and this is one of the virtues of the material—you can just saw out the incorrect portion and replace it with a correctly made section, using two couplings to join new to old.

CPVC tubing expands and contracts about 1/4 inch for every 10 feet of length—don't restrain the tubing. Instead, leave space at the ends of runs. Make foot-long doglegs on runs more than 35 feet long. Taps off mains should be free for at least eight inches before they are restrained. This lets the main expand and contract. Holes drilled for tubing should be extra large: 7/8 inch for 1/2-inch tubing, and one inch for 3/4-inch tubing.

Support CPVC tubing every 32 inches (every other joist) using straps designed for CPVC. The straps hold the tubing firmly to the framing yet permit the pipework to slide with thermal movements.

Build the door you can't buy



A fancy entry door made from an eye-catching hardwood such as purpleheart adds distinction to any house. And the door's tongue-and-groove, threaded-rod construction makes it a massive security panel.

By **RICHARD MARMO**

You've spent hours rejuvenating your house indoors and out, but what's the first design feature that guests and family see as they come up the walk? A bland, dull entry door that could be found on any house, anywhere.

You can personalize your home by building a unique entry door from exotic, eye-catching hardwood that will make visitors and family alike take notice—and feel safe inside. With double-glazed windows and good weatherstripping, this door is also energy efficient.

There are dozens of exotic hardwoods that are well-suited for exterior use because their natural oils protect against warpage. I chose purpleheart, an extremely dense Brazilian wood. Other hardwoods, such as moradillo, teak, and mahogany, are less dense and thus easier to work.

Purpleheart's almost metallic density means you'll need patience and some inventive techniques to drill holes for threaded rods and a backset and to cut openings for windows. Use only carbide-blade tools. The weight of the door persuaded me to reinforce the jamb and invest in two pairs of six-by-4½-inch brass-plated-steel ball-bearing hinges, specially ordered from Stanley Works for \$600. These hinges,

along with the intricately designed Louis lockset from Schlage (\$500), account for most of the \$1,400 cost of this project. The lumber was only \$200. A less dense wood—which won't require special hinges—and a more conventional lockset would cut the cost.

Start building the door by cutting each board to the correct length and width. Use a slow speed for maximum torque and to prevent burning the wood. The planks will be joined tongue-and-groove fashion (and then doweled with threaded rods), so keep in mind that a tongue reduces a board's width by $\frac{3}{4}$ inch.

To rabbet the tongues, first set the

saw blade for a $\frac{1}{2}$ -inch-deep cut. Then place the board flat on the saw table so the blade falls $\frac{3}{4}$ inch in from the edge. Duplicate the cut on the opposite face. Then reset the saw blade depth to $\frac{3}{4}$ inch and the rip fence to $\frac{1}{2}$ inch. Set the plank on edge and rip it. Turn the board around and repeat the cut.

For cutting the grooves, the plank stays on edge. You want to leave the outer $\frac{1}{2}$ -inch edges intact while hogging out the center $\frac{3}{4}$ inch. Cut the boundaries of the groove first, then plough out the middle with multiple passes.

Tongue-and-groove joints glued with resorcinol are sufficient to hold

together most hardwood doors, but if you're using purpleheart, I recommend inserting four $\frac{1}{4}$ -inch-thick threaded rods, spaced about 14 inches apart.

Do a trial assembly of the planks, and outline the position of the windows, lockset, and backset before determining the spacing of the rods. Then take the door apart, and drill $\frac{1}{4}$ -inch holes through each board for the rods.

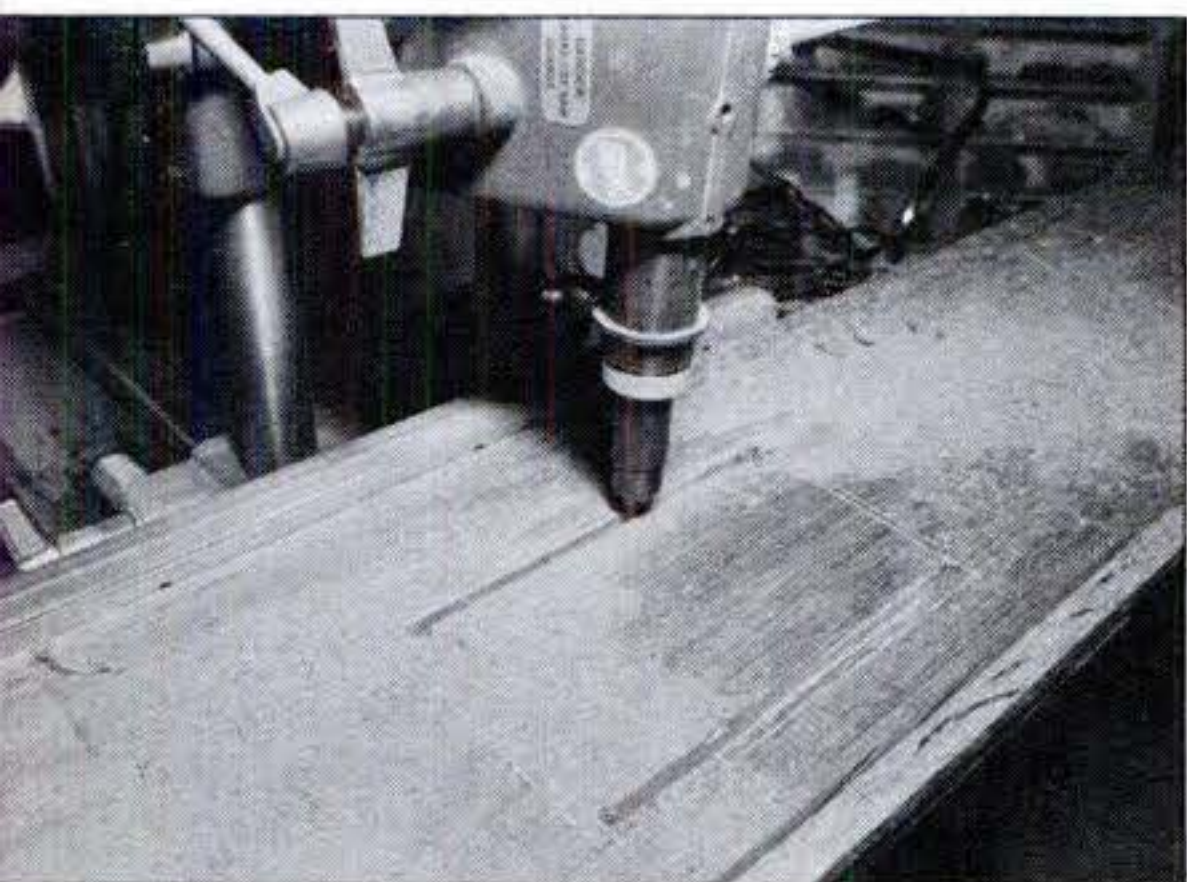
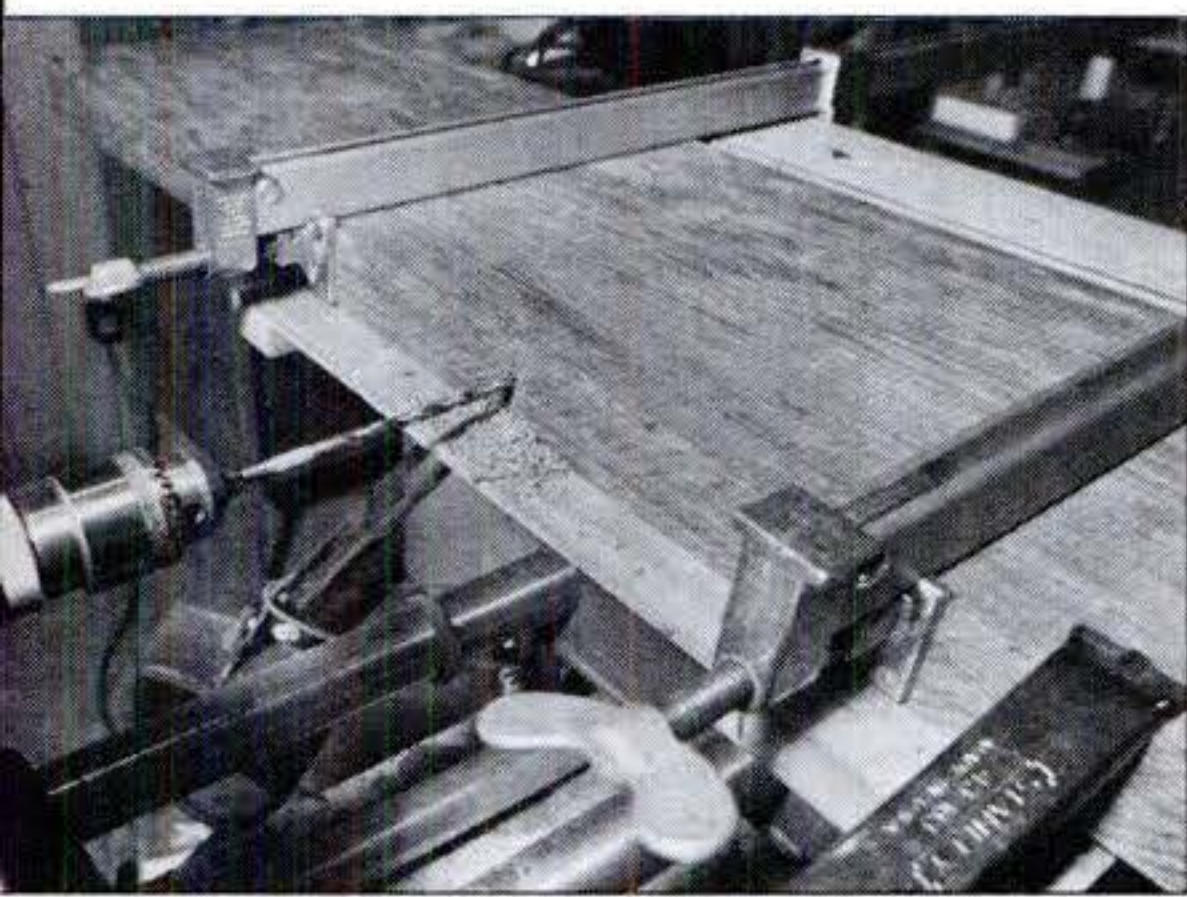
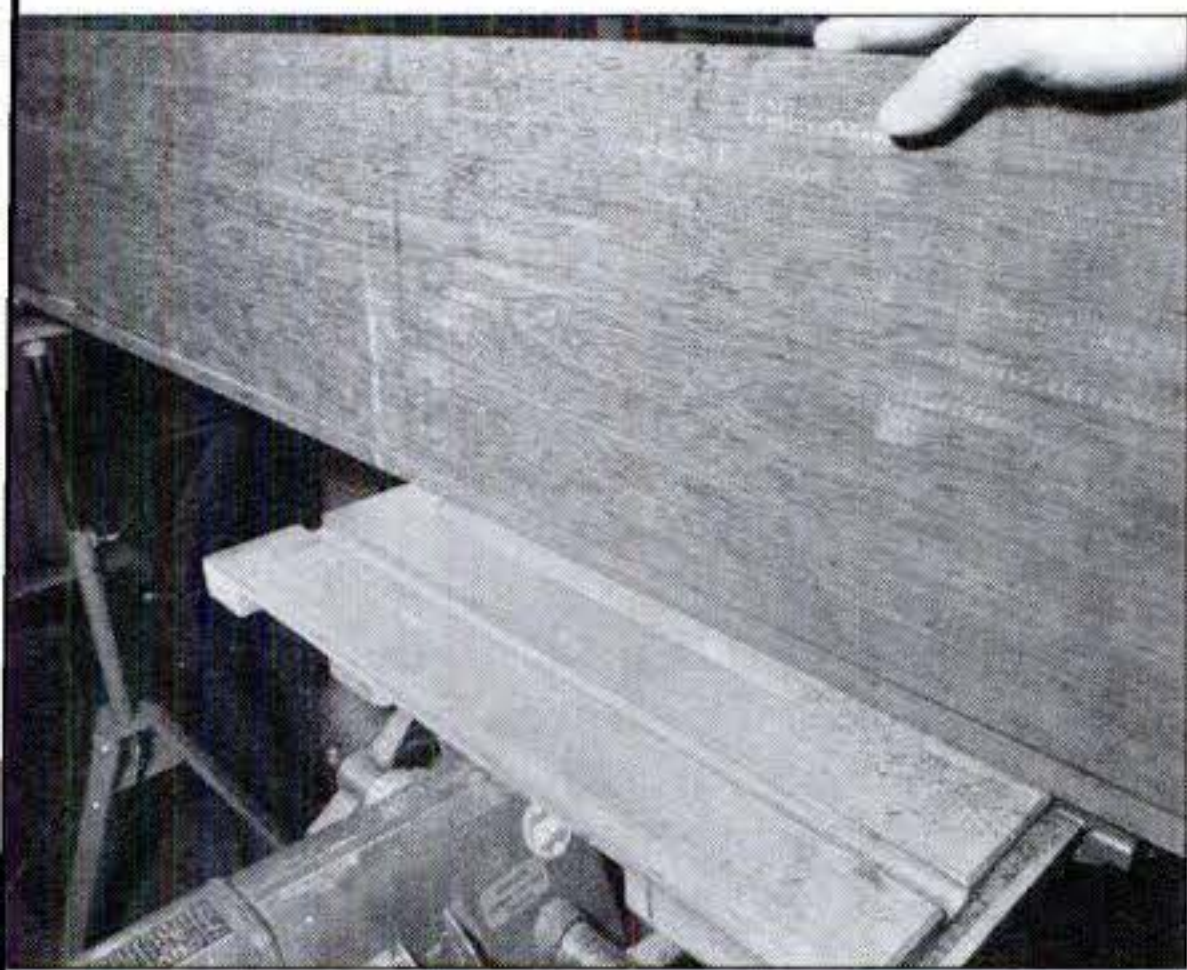
Drill horizontally at very slow speed, and use only the pressure necessary for the bit to bite. Even with an extra-long bit you may need to turn the board end-for-end to finish drilling (don't flip it over). To countersink the rods' washers and locknuts, drill $\frac{3}{4}$ -inch holes $1\frac{1}{2}$ inches deep in the door's edges.

After drilling pilot holes through the door at the window corners, I used a router bit chucked in my Shopsmith Mark V's vertical drill press to cut the openings—a slow method, but a saber saw will bind in wood this dense. To form a ledge for each acrylic window-pane to butt against, cut the opening $\frac{1}{4}$ inch undersize, then rout around the original outline to a depth of $\frac{1}{2}$ inch on both sides of the door.

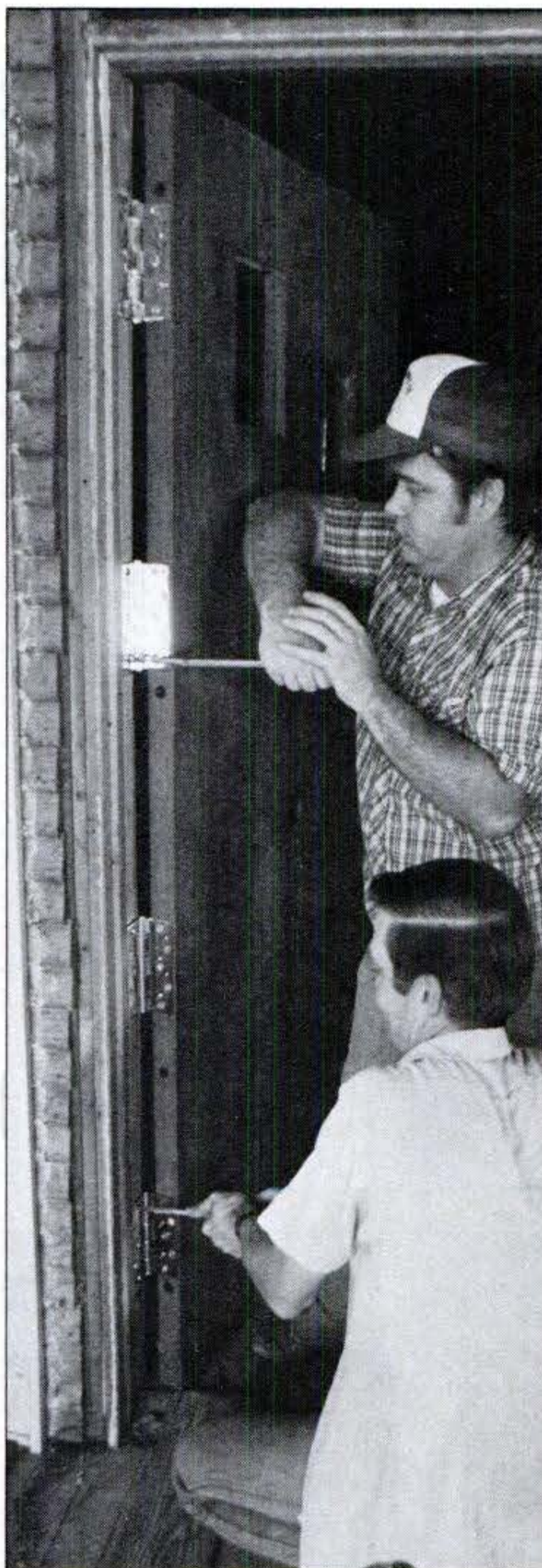
Next, drill the hole for the backset. I used a centrally positioned 16-inch lockset that required a one-inch-diameter hole through each plank. I needed a drill extension and then a long, skinny lathe chisel to tunnel out each hole. Don't rush through this step—a backset is easily triggered and must be installed in a straight, smooth hole.

Assemble the door again, and insert the threaded rods. Attach the washers and locknuts, and plug each hole with matching hardwood. Before you hang the door, reinforce the jamb with 2×4 s, as needed, secured with six or eight 20-penny nails. Cut the latch and hinge mortises, then use a hole saw to cut the large opening for the lockset.

When the door is in place, wipe it down with several coats of teak oil, then install the lockset, backset, and related hardware. To install the acrylic windows, nail down the outside retainer strips, but use screws to secure the inside strips—this allows access when moisture accumulates in the space between panes. PS



Cut tongue-and-groove joints (top), and then drill $\frac{1}{4}$ -in. hole for threaded rods (middle). Drill pilot hole at each corner of window location, then cut opening with router bit chucked into drill.



Reinforce door jamb before installing ball-bearing hinges needed to swing finished door, which weighs almost 300 lbs. Each hinge leaf is fastened with five No. 14 flathead screws.

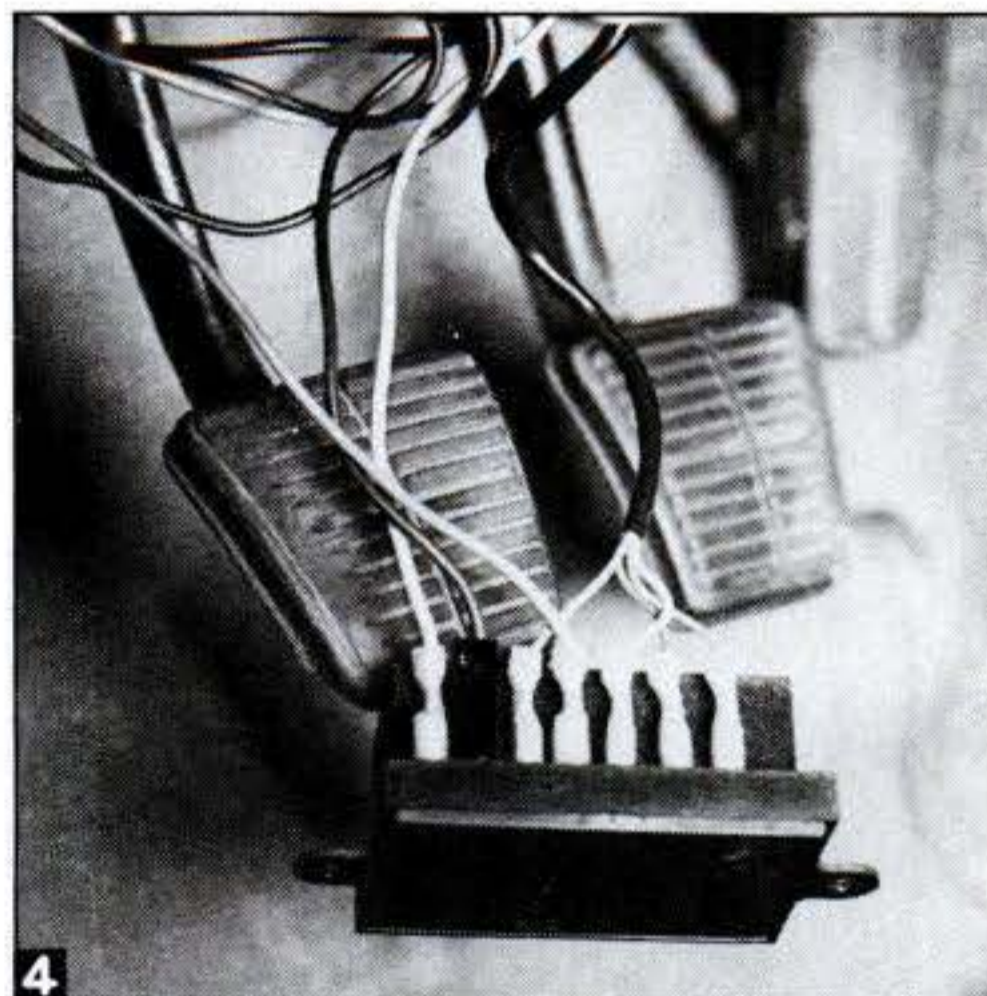
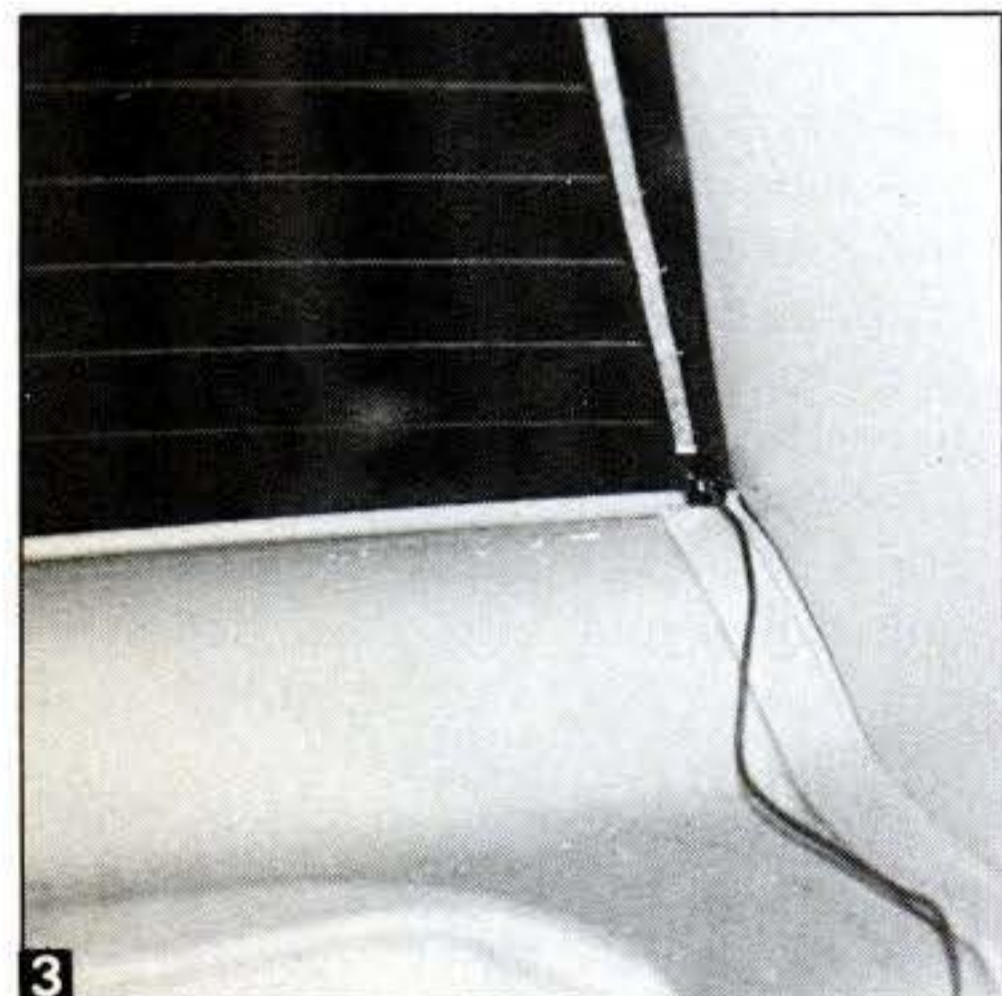
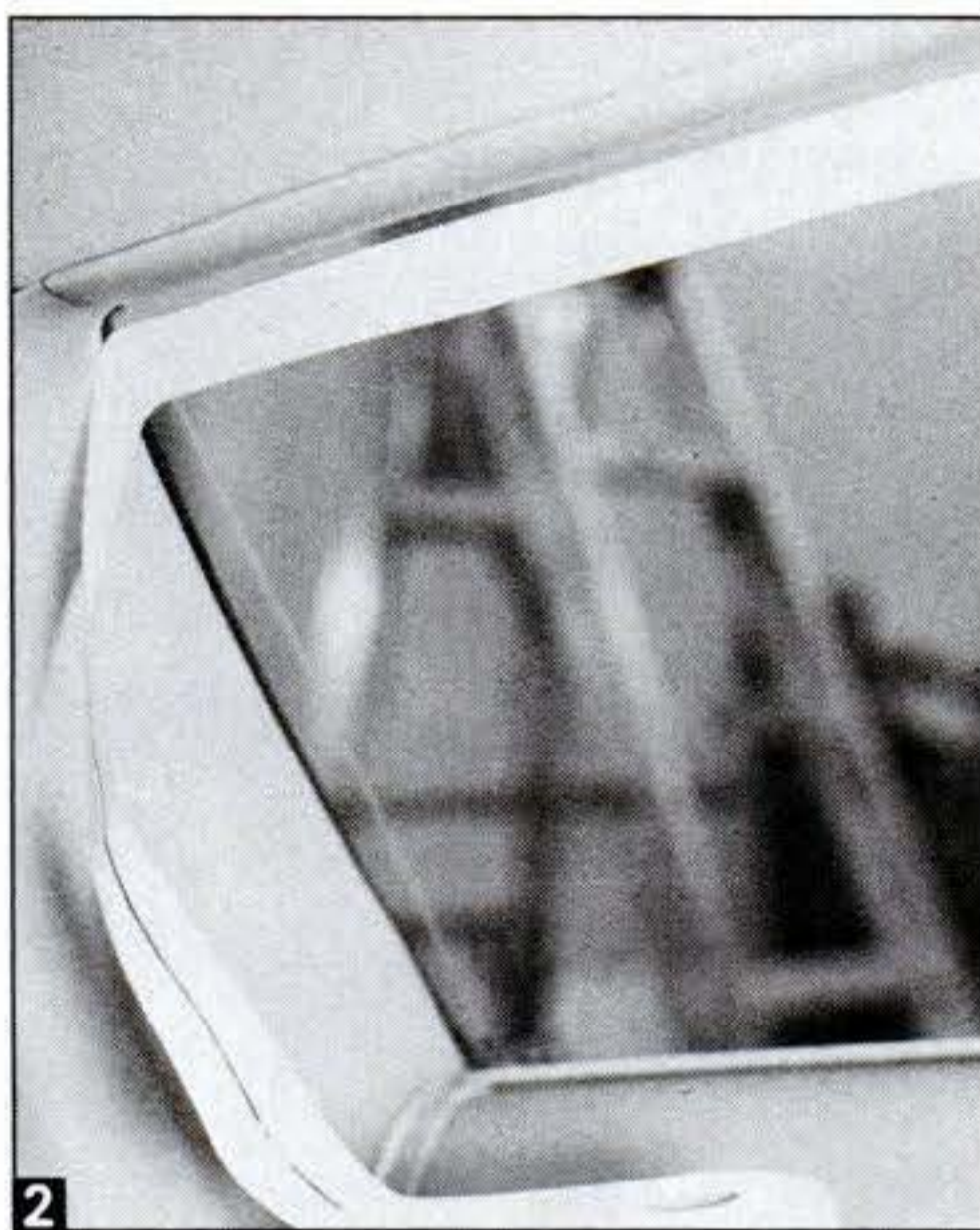
MATERIALS SOURCES

Door lock: Schlage Lock Co., P.O. Drawer 3324, San Francisco CA 94119 (D53PD Louis lockset, XC03-069, 16-in. backset link, and B480 latch); **Glazing:** Du Pont Co., Wilmington DE 19898 ($\frac{1}{4}$ -in.-thick dark-bronze super-abrasion-resistant acrylic sheet); **Hardwood:** Frank Paxton Lumber Co., 2900 Bryan Ave., Fort Worth TX 76101 (purpleheart); **Hinges:** The Stanley Works, 195 Lake St., New Britain CT 06050 (FBB168 six-by- $4\frac{1}{2}$ US3 ball-bearing, brass-plated steel); **Sealer:** Watco-Dennis Corp., 1756 22nd St., Santa Monica CA 90404 (Watco Marine Teak Oil)

For convenience, for safety: Add an electric window de-icer

Ice, snow, and mist will disappear in minutes from your car's rear window. And installing a de-icer/defogger is an easy do-it-yourself job if it's done with care.

By GEORGE SEARS



Installation begins outside car: Chalk horizontal markers at required distances from top and bottom of window (see text); vertical markers 1/2-inch from left and right edges (1). Working inside car, unroll heat tape, and align element with top horizontal marker (2). Allow three in. of tape to overhang each side; cut excess. Butt or overlap remaining rows to maintain gap. Use roller to remove air bubbles. Slowly peel tape from heating elements. Press left and right overhangs into included contact channels (3). Connect one channel to ground; run wire from other channel to dash. Install timer (4) and dash switch (5); connect as required.



It's cold. It's wet. But you're not leaving until your car's rear window is clear. Pull out the scraper? No. Push in a button. An electric de-icer/defogger does the work for you.

Most new cars have this feature, but older models don't. De-icer kits, such as the Dana model I tried, are easy to install and well worth the \$30 investment. The photos show the basics of how it's done. But there are some pointers I learned that may not be covered in the instructions.

- The window must be *super* clean. Wash it with ammonia and water (soap and window cleaner leave a film), and swab with rubbing alcohol. Don't dry with rags or paper towels; use a lint-free cloth.

- Use only the recommended number of heating elements. Exceeding that number could blow a fuse or damage the timer. And if you use fewer elements, the necessary amount of heat will not be created.

- A template might be included for aligning the elements; however, the one I tried would not lie flat, making it difficult to use. Another way: Calculate the spacing between elements based on the number of elements and the window size. Mark the top starting position and bottom ending position, centering the pattern on the window.

- Finally, press the elements firmly in place. If one comes up when you peel off the tape, press it back down with a wallpaper roller.

De-icer kits are available locally through major department stores and auto-supply dealers. Or you may write for more information from distributors such as: Dana Corp., Precision Controls Div., Hwy. 74 Bypass, E. Laurinburg, N.C. 28352; Interdynamics Inc., 80 39th St., Brooklyn, N.Y. 11232; and The Protector Corp., Box C-1000, Elmhurst, Ill. 60126. **PS**

RCA Dimensia— the ultimate TV?

It's not unusual for audio and video components to be combined in one home-entertainment system. But with the RCA Dimensia, a microprocessor makes possible total one-button remote-control operation and on-screen status displays. The price: \$5,350.



By WILLIAM J. HAWKINS

LAS VEGAS, NEV.
As I watched, an RCA official pressed the "phono" and "play" buttons on the remote control. Twenty feet away, a monolith of electronic gear buzzed to life. I heard music. Then he lowered the volume, started a cassette deck to record the sound, turned on the 26-inch TV set, and cued up a videotape to watch later. A system status report momentarily flashed on the screen, then was quickly replaced by a stereo TV broadcast on a channel he chose at the push of another button.

I was listening to—and watching—the RCA Dimensia audio-video system. Like other brands, this ultimate all-in-one home-entertainment center consists of separate components. With Dimensia, however, there's a difference. Each component is controlled by a microprocessor inside the TV monitor. The microprocessor does all the thinking for you. For example, press the "CD" and "play" buttons on the infrared remote control, and the tiny com-



IR remote controls up to 13 components. Push a button to change channels, switch to music, or scan videotapes.

puter turns on the compact-disc player, cues a disc, turns on the 50-watt audio amplifier, switches it to the CD input, and, if necessary, adjusts the volume. It's all automatic.

A complete \$5,350 Dimensia system consists of a 26-inch flat-tube TV monitor (\$1,300), VHS stereo VCR (\$1,550), 50-watt audio amplifier (\$300), AM-FM tuner (\$250), auto-reverse audio tape deck (\$350), linear-tracking turntable (\$250), CD player (\$600), three-way speaker system (\$400), and a rack

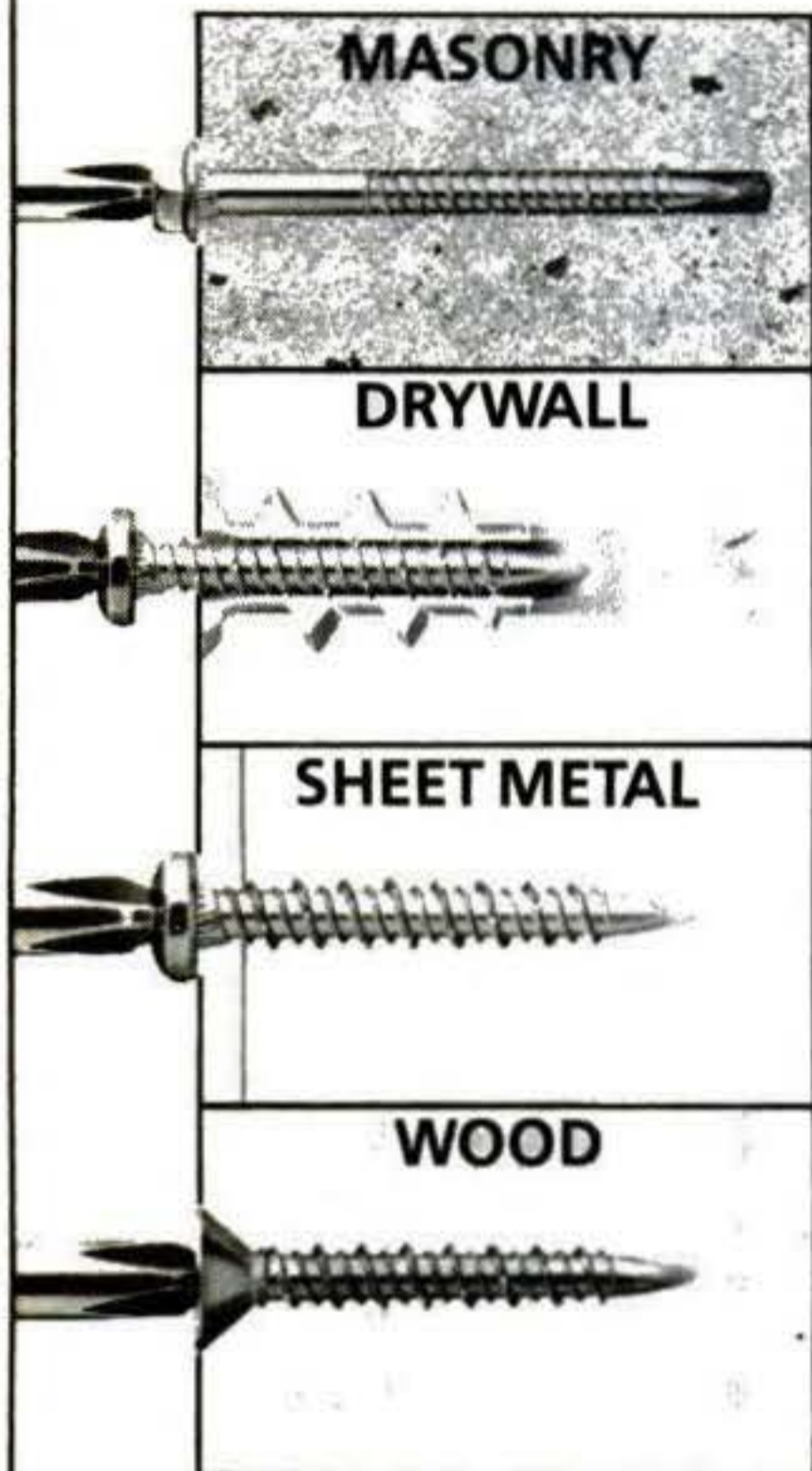


Screen display shows the status of system as you give commands, or you may see it by pressing a remote button.

(\$350) to store the components in.

Although there are rear jacks for connecting other-brand components to the system, they will not be computer controlled; you'll have to operate them manually. Only Dimensia components equipped with the special computer interface connector will work completely with the remote control. So to get the full effect of one-button remote-control operation, you'll need to replace your present components. Worth it? It is—if you want the ultimate TV set. **PS**

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Shop Talk

By AL LEES



Wrappable dozen

Books of special interest to readers of this magazine make useful gifts. Here's my pick of recent titles (shown above):

- Two solar handbooks from Rodale Press. *Solar Air Heating Systems*, by Steve Kornher and Andy Zaugg (350 pp., \$17.95 cloth), shows how to assemble an air-heating system sized for one room or for an entire house—from designing the collector to installing duct systems and thermal storage. *The Passive Solar Construction Handbook* (328 pp., \$29.95 cloth) collects sketched details and construction notes on all types of passive systems, to be used singly or in combination, with specs from a variety of built houses. Valuable supplementary material helps you compute energy-use and economic analyses.

- Four books on building rustic homes: *Complete Guide to Building Log Homes*, by Monte Burch (Popular Science Books, 406 pp., \$29.95 cloth), is an all-inclusive guide to this revived technique—whether you fell your own trees or assemble numbered logs from a kit. It's generously illustrated with informative sketches and photos. *Log Homes*, by John R. Kupferer (Home Buyer Publications, 136 pp., \$13.50 paper), is a magazine-type guide to buying, building, and maintaining, with ads as well as articles on all types of log structures. Also included: directories of log-home packagers, builders, trade associations, and schools. *How to Afford Your Own Log Home*, by Carl Heldmann (East Woods Press, 138 pp., \$10 paper), says the secret lies in being your own contractor—and the author should know because he is a contractor, specializ-

ing in log homes and offering invaluable professional advice. *Timber Frame Construction*, by Jack Sobon and Roger Schroeder (Garden Way Publishing, 204 pp., \$13 paper), is a sprightly manual on post-and-beam building techniques, well-illustrated with sketches and photos. A tribute to joinery skills of that era before home building changed from a craft to an industry, this book will inspire you to tackle the tool shed for which plans are provided.

• Two on clocks: *Repairing and Restoring Pendulum Clocks*, by John Plewes (Sterling Publishing, 224 pp., \$13 paper), is a step-by-step bench manual for working on old pendulum clocks, including full instructions for restoring dials and cases as well as movements. *Clocks: Construction, Maintenance & Repair*, by Frank W. Coggins (Tab Books, 241 pp., \$13.50 paper), has a broader focus, covering all clocks, including kit and specialty types. There's even a chapter on plastic parts, and the book has many photos.

The four remaining titles are self-explanatory; each is the best new book I've seen in its field. *The Consumer's Guide to Earth Sheltered Housing*, by Mary Rollwagen (Van Nostrand Reinhold, 163 pp., \$25.50 cloth), is subtitled: "A Step-by-Step Workbook for Prospective Owners." *The ToyMaker's Book of Wooden Vehicles*, by Ralph S. Buckland (Van Nostrand Reinhold, 148 pp., \$25.50 cloth), has dimensioned plans for 32 toys. *Constructing and Maintaining Your Well & Septic System*, by Max and Charlotte Alth (Tab Books, 240 pp., \$12.50 paper), is for anyone building or buying in fringe areas beyond existing sewer and water lines. *Your Wind Driven Generator*, by Benjamin Lee Wolff (Van Nostrand Reinhold, 208 pp., \$15 paper), tells how to set up an individual unit.

PUBLISHERS' ADDRESSES

If you can't find these titles in local bookstores, most publishers will mail you a copy for the price shown. Here are their addresses (in the order in which the books are listed above):

Rodale Press, Inc., Emmaus PA 18049; Popular Science Books, Box 2018, Latham NY 12111; Home Buyer Publications Inc., Box 2078, Falls Church VA 22042; East Woods Press, 429 East Blvd., Charlotte NC 28203; Garden Way Publishing Co., Charlotte VT 05445; Sterling Publishing Co., 2 Park Ave., New York NY 10016; Tab Books, Inc., Blue Ridge Summit PA 17214; Van Nostrand Reinhold Co., 135 W. 50 St., New York NY 10020

Who makes vertical blinds?

If my article in this issue tempts you to try vertical blinds as screens or doors and you want further data from manufacturers, send a stamped, self-addressed envelope to Shop Talk, POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017, for a list. **PS**

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44 satellite TV systems

[Continued from page 95]

much of the weak signals as possible, conventional wisdom has been: the bigger the dish, the better. The larger the dish, the higher the gain—the amount of signal it can collect.

"An eight-foot dish works well... in Kansas," says one manufacturer. "A 10-foot dish is probably overkill in most parts of the country," says another. "It depends on receiver threshold—the ability to filter noise out of the signal," a third says. "The lower the threshold, the smaller the dish you can use."

In the Nashville exhibit hall, where all the signals were degraded somewhat by a 1,000-foot cable run from the parking lot, I noted a range of picture quality but found no snowy, "ghosty," or otherwise unviewable pictures. Picture quality was generally, but not invariably, related to dish size. But Tennessee is in a good reception area for most satellites, and many of the smaller dishes were tuned to Galaxy 1, one of the newest and most powerful C-band satellites. (It transmits the most popular cable programs at about nine watts per channel.) In many parts of the U.S. even the smallest dish will pick up acceptable signals from this satellite. In fact, some systems are designed to be aimed only at Galaxy 1. "We're serving the urban homeowner," Blair Gilbert of Galaxy Broadcasting Services says. "He can't put a 10-foot antenna in his backyard." Galaxy sells a four-foot-diameter dish that it claims is better suited to urban rooftops.

Before you decide to buy a small dish for use with Galaxy 1, however, consider these points:

- A satellite's signal weakens with age (useful lifetime is about seven years). A small antenna may not have enough gain for a weak signal.

- A small dish may not be able to discriminate between signals from closely spaced satellites. Current spacing is four degrees (about 1,800 miles) apart. To make room for more satellites, the Federal Communications Commission has ruled that orbital spacing must eventually narrow to two degrees. This will cause interference unless the commission also requires neighboring satellites to transmit polarized signals. No one knows whether this will happen.

- Major broadcasters using Galaxy 1 may scramble their signals and offer decoders to home-dish owners. HBO has announced plans to scramble in 1985. I was told off-the-record by several antenna manufacturers that both HBO and Warner-Amex (producers of Showtime and The Movie Channel) have discussed plans for Galaxy 1 decoders. According to Gilbert, the

circuitry of most receivers is incompatible with current decoders. Modifications could be costly.

Alphabet soup

The microwave amplifier that boosts the satellite signal comes in three versions. The basic low-noise amplifier (LNA) is rated according to the amount of noise its own circuits add to the signal. The lower the noise figure, the better—especially for small dishes.

The low-noise down-converter (LNC) is an LNA combined with a signal processor. The combination means one less cable run to install.

The low-noise block down-converter (LNB) processes the entire frequency block transmitted by a satellite—all 24 TV signals instead of only one. If your family wants to watch different satellite TV channels on different sets or record a program on a videocassette recorder while you watch another, you need an LNB.

The next costly decision is whether to invest in a motorized antenna. Low-cost systems have a crank on the dish's polar mount to aim it at a satellite. To tune the picture you need two people: one outside at the dish and one inside by the TV. High-end systems have a remote-controlled motor for armchair satellite tracking. This is practically a necessity if you want to scan all channels regularly.

"It's almost impossible today to buy a bad LNA, and it's harder and harder to buy a bad receiver. But dish mounts and motorized controllers can be garbage," says Channel One's Hopen-garten. "Look for mechanical integrity, and check for galvanized or stainless-steel hardware. Check the mount—if it's zinc-plated, it's going to rust out in three years."

Also, check the controls. Some motor mounts simply swivel the dish; you must spend considerable time moving the dish back and forth until you pick up the satellite signal. Other motor systems are programmable, so you need find each satellite only once and lock its position into the motorized memory.

Receivers: plain or fancy

The least costly receivers have continuous tuning via a radio-type dial. Some have signal-strength meters. Receivers with click-stop, or detent, knobs tune the way most TVs do, with positive action. This is an easy method, but the receiver should also have an adjustment for fine tuning.

Top-of-the-line receivers usually have push-button digital tuning and automatic polarity switching; when you switch from an odd to an even

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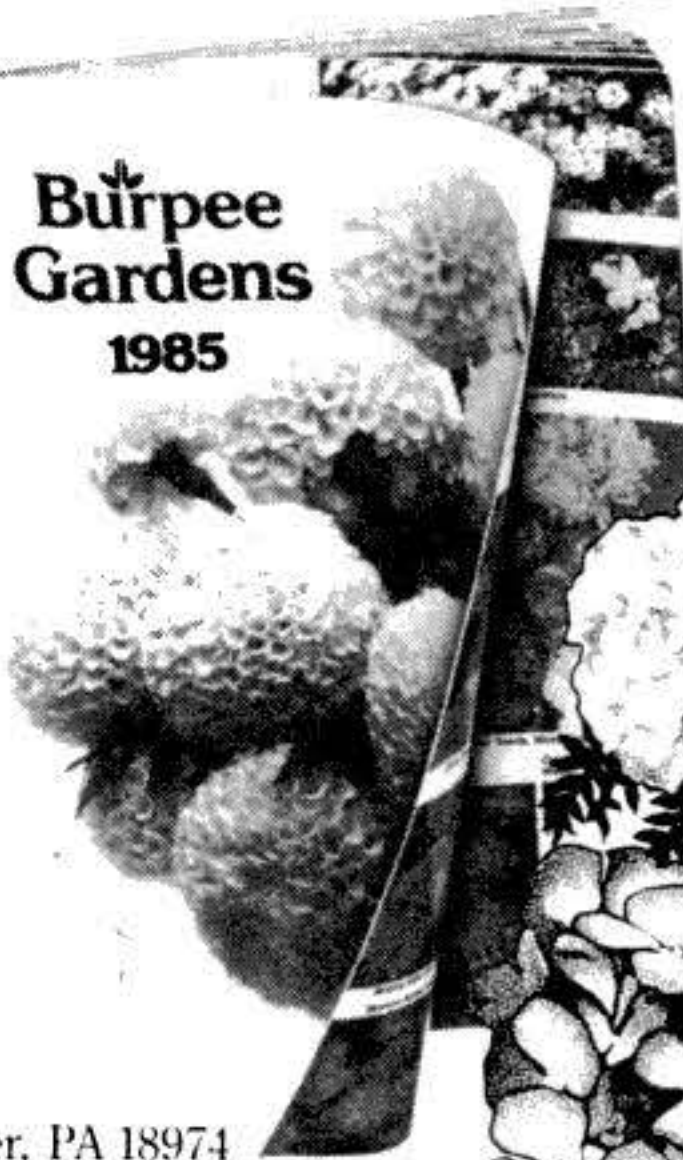
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44 satellite TV systems

channel, the receiver automatically signals the antenna probe to flip 90 degrees. On low-end receivers you must push an extra button to adjust polarity before you can tune in the channel.

Most advanced receivers process stereo sound, and many also tune audio subcarriers. "You can listen to the opera and watch a football game at the same time," says Bruce Weston of Intersat Corp. The Intersat IQ 160 receiver is one of the most advanced receivers I saw. Its microprocessor lets you aim at satellites and tune in channels by moving a cursor around a menu displayed on the TV screen.

The final decision: Should you install the satellite system yourself? Installation is costly—I've had price quotes ranging from \$400 to \$2,000. Some dealers, such as Birdview Satellite Communications, lower the fee if you do the digging and cable trenching, pour the concrete footings, and install the pole. But pole installation is also tricky.

"The accuracy of the polar mount is based on that pole being absolutely level and plumb," Satellite World's Rick Bradshaw says. "But the hardest part isn't making the mechanical connections. The hardest thing is aiming the dish."

Some manufacturers are working on this problem. "We include an aiming device and instructions with the six-foot Junior antenna," says Bob Deschene of Janeil Corp. "With it, any novice can get a polar arc [set the proper angle for tracking the satellites] within 20 minutes. And getting that arc used to be the hardest part for the consumer." **PS**

FOR FURTHER READING

Easton, Anthony T. *The Satellite TV Handbook*. Indianapolis: Howard W. Sams & Co., 1983.

Long, Mark, and Jeffery Keating. *The World of Satellite Television*. Box 310, Mendocino, Calif. 95460: Quantum Publishing, 1984.

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Birdview Satellite Communications, Box 963, Chanute KS 66720; **Channel Master**, Ellenville NY 12428; **Channel One**, 79 Massasoit St., Waltham MA 02154; **Delta Satellite Corp.**, One Echo Plaza, Cedarburg WI 53012; **Dockery Satellite**, Osage Shopping Ctr., Warsaw MO 65355; **DownLink Intl.**, Box 518, Glide OR 97443; **Excalibur Satellite Systems**, 700 Huron St., Memphis TN 38107; **Francis Enterprises**, Box 906, Poplar Bluff MO 63901; **Galaxy Broadcast Services**, Box 349, Kulpville PA 19433; **Ghost Fighters, Inc. (GFI)**, Box 9108, Missoula MT 59807; **Horizon Satellite Mfg.**, R.R. 1, Brookston IN 47923; **Intersat Corp.**, 1000 Lake Saint Louis Blvd., Suite 300, Lake Saint Louis MO 63367; **Janeil Corp.**, 6860 Canby Ave., Suite 113, Reseda CA 91335; **KLM Electronics**, Box 816, Morgan Hill CA 95037; **Paris Mountain Group**, 3 Manly Dr., Rte. 9, Greenville SC 29609; **Power Consultants Microwave (PCM)**, 3700 Harold, North Little Rock AK 72118; **Regency Electronics**, 7707 Records St., Indianapolis IN 46226; **Satelink**, Box 45, Kiowa KS 67070; **Satellite World**, Box 640, Cuyahoga Falls OH 44222; **Starview Systems**, Box 103 G, Pocahontas AK 72455; **Uniden Corp. of America**, 15161 Triton Lane, Huntington Beach CA 92649; **United Satellite Antenna Systems (USAS)**, Box 577, Deville LA 71328; **Winegard Satellite Systems**, 3000 Kirkwood St., Burlington IA 52601

IBM fights back

[Continued from page 96]

speed math computations (number crunching), and a video-output board to produce high-resolution graphics.

Along with PC compatibility and higher speed, another advantage of the AT is its "multi-user" capability—more than one person can use the computer at the same time. To accomplish that, IBM offers PC XENIX, a \$395 Microsoft version of the popular AT&T UNIX III operating system used by professionals on larger mini-computers. With XENIX, up to three people (one at the keyboard and two others on remote terminals or computers) can simultaneously use the AT.

At present IBM is not offering any application programs for XENIX. However, because of the amount of software already available for UNIX, many programs, such as a MultiPlan program I saw, will be available early next year once the conversions are made.

Communications and windows

"I'm sending electronic mail," the demonstrator told me as he pressed a key on a PC in front of him. Moments later a message appeared on another PC across the room.

Connected by a single coaxial wire, the two computers were part of IBM's new PC Network, a relatively low-cost communications system that allows up to 72 computers, printers, and storage devices to work together. Each computer on the network requires a \$695 communications board and a \$75 PC Network program. (Each group of eight also requires a \$595 network translator unit.)

PC Network is available for all PCs except the PCjr. But surprisingly, it will not work with an AT running XENIX. Though IBM doesn't see that as a problem, it could be a serious limitation for office-system planners.

Another surprise is a \$149 software program called TopView, available for all PCs except the PCjr. TopView allows conventional PC programs to run concurrently, share files, and be simultaneously displayed on the screen using windows. Why the surprise? Because TopView allows individual programs to be used simultaneously, the trend to expensive all-in-one packages (word processing, data base, and spread sheet, for instance) may change. And because it comes from IBM, TopView may dash competitors' hopes for sales of similar products that are designed to allow concurrent operation, such as Microsoft's Windows and Digital Research's Concurrent PC-DOS.

But then, the gloves are off—and IBM has dashed competitors' hopes before.



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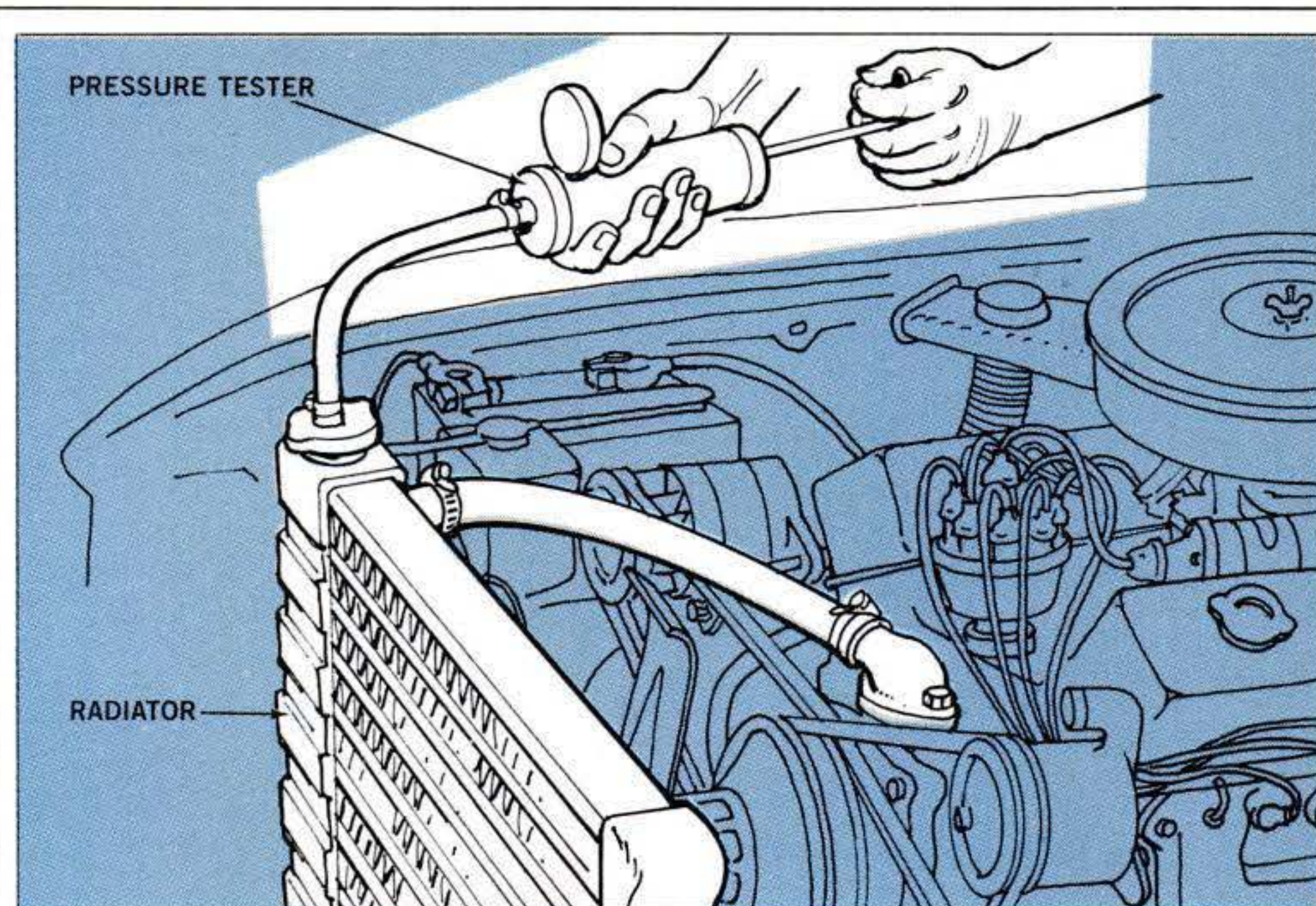
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By STEVE MERCALDO

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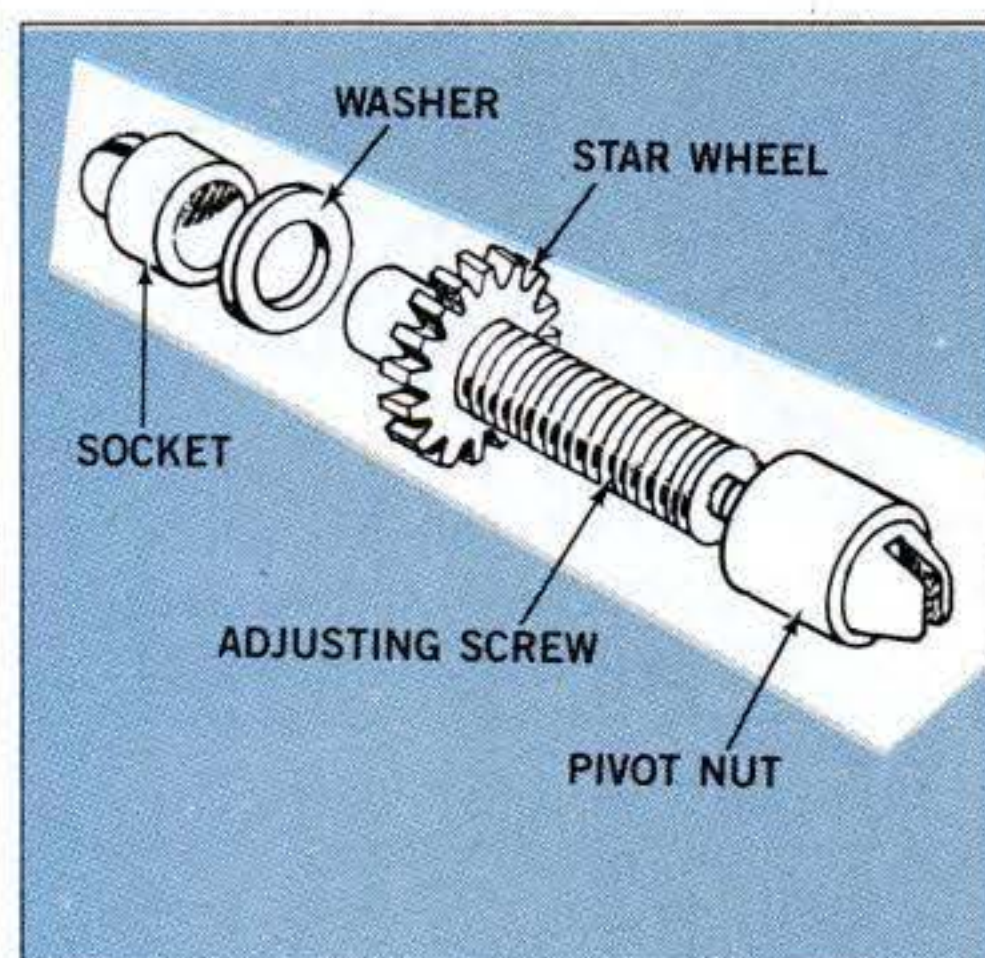


Leak detective

Pressurizing the cooling system with a pressure tester can help pinpoint even the smallest coolant leak. The tester, a hand-operated pump and gauge, clamps onto the radiator neck. Once the maximum recommended system pressure is reached, it's easy to spot an external leak in a hose, radi-

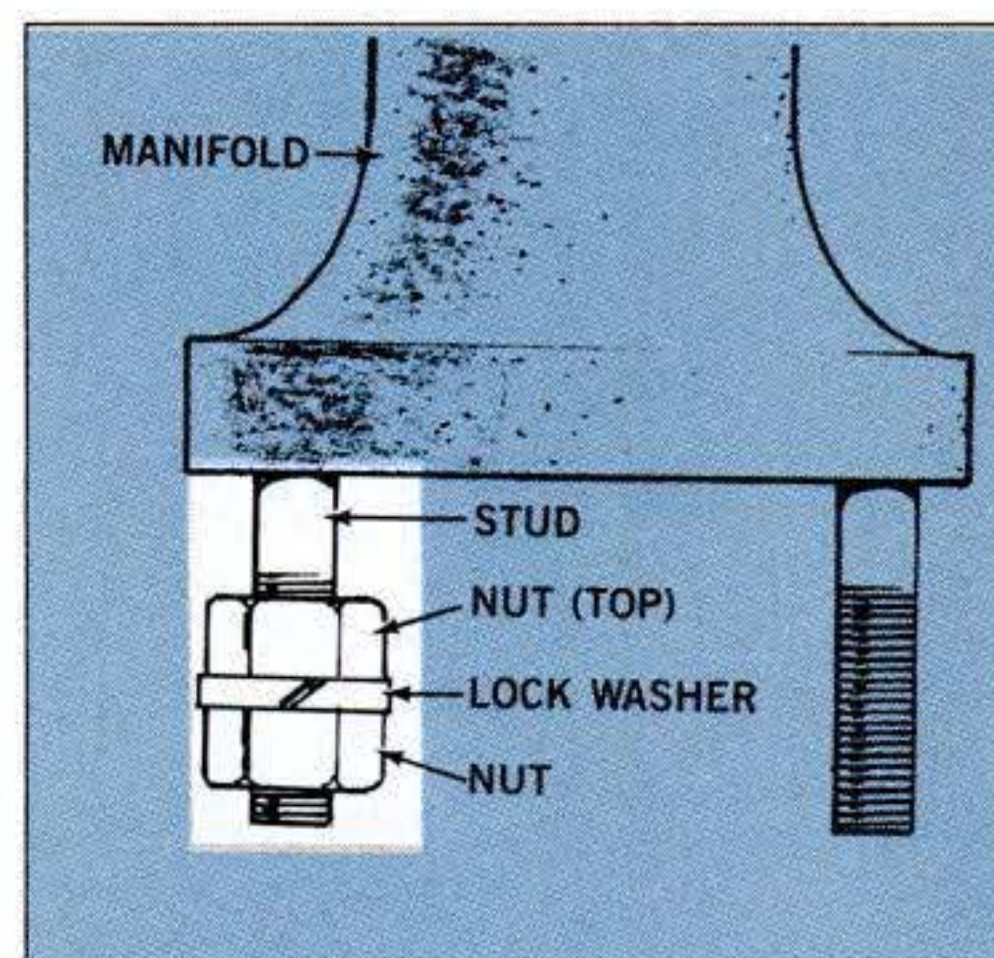
ator, water pump, thermostat housing, or heater core.

If no external leaks are evident but the gauge refuses to hold pressure for at least two minutes, there may be an internal coolant leak. It's best to have a professional mechanic take over if evidence points to this.



Brake tip

The star-wheel adjuster on a self-adjusting drum brake is equipped with a special flat washer. Its job is to provide the adjuster socket with a seal and bearing surface. When servicing the adjuster, don't forget to apply a thin coat of white lube to the washer. Otherwise the adjuster may fail, resulting in a low brake pedal.



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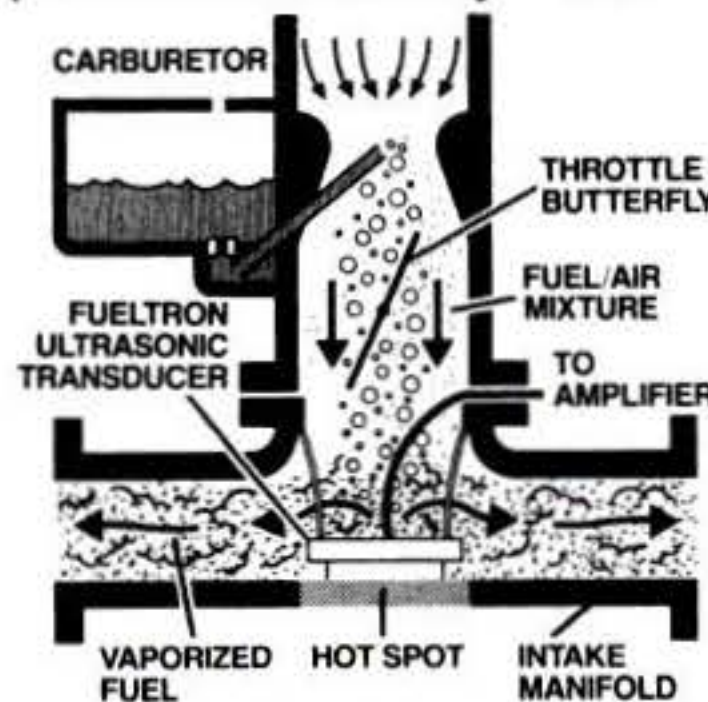
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1206 Personal-Computer Tips This detailed color brochure from CompuServe, America's largest information service for personal-computer users, tells you how to obtain access to its vast data banks for reference material, news wires, an encyclopedia, financial and travel information, electronic mail, fantastic games, and lots more. Free

1207 Radar Detectors A Controlonics brochure describes Spectrum and Spectrum Remote speed-radar detectors, the most sensitive and selective units on the road, which filter out non-radar signals. Included is the new Whistler. Free

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1211 Grandfather Clocks A full-color catalog from Emperor Clock describes its line of ¾-inch solid-hardwood grandfather clocks. Easy-to-assemble kits and fully assembled clocks are available at low factory-direct prices. Free

1212 Building Energy Analysis Enercomp introduces Micropas, a microcomputer program that allows professionals to estimate the energy efficiency of a building during the design process. Free

1213 Storm Windows This booklet from Energy Arsenal offers information on how to stop cold-air infiltration and increase R-value—an easy, fast, and low-cost method that saves on heating bills. Free

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1216 Aluminum Boats A brochure from Fisher Marine, an established manufacturer of aluminum johnboats, describes its new line of semi-V-hulled aluminum fishing craft. Free

1217 Carbide-Tipped Blade A 20-page booklet from Forrest Mfg. describes its saw blade/dado for serious woodworkers. It cuts all wood materials flawlessly smooth and eliminates sanding, says Forrest. \$1

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Please send the items checked below. I am enclosing \$1 handling charge (any number of items) plus amount required for priced items.

- | | | | | |
|-----------------------------------|-----------------------------------|-------------------------------|-------------------------------|-----------------------------------|
| <input type="checkbox"/> 1201 | <input type="checkbox"/> 1205 25¢ | <input type="checkbox"/> 1209 | <input type="checkbox"/> 1213 | <input type="checkbox"/> 1217 \$1 |
| <input type="checkbox"/> 1202 | <input type="checkbox"/> 1206 | <input type="checkbox"/> 1210 | <input type="checkbox"/> 1214 | <input type="checkbox"/> 1218 |
| <input type="checkbox"/> 1203 \$3 | <input type="checkbox"/> 1207 | <input type="checkbox"/> 1211 | <input type="checkbox"/> 1215 | <input type="checkbox"/> 1219 |
| <input type="checkbox"/> 1204 | <input type="checkbox"/> 1208 | <input type="checkbox"/> 1212 | <input type="checkbox"/> 1216 | <input type="checkbox"/> 1220 \$1 |

I AM ENCLOSING

\$ _____ for priced items

\$1 for handling

\$ _____ TOTAL REMITTANCE

Name (please print) _____

Address _____ City & State _____ Zip _____

Please send cash, check, or money order made out to POPULAR SCIENCE. No stamps or foreign currency. Allow approximately six weeks' delivery.

POPULAR SCIENCE DECEMBER 1984

Pickup your life.

Just pick up a pickup from GMC.

A truck, you say? Yes, but no ordinary trucks, these. We're talking cream-of-the-crop pickups from GMC. When "trucks" is your last name, you have to do trucks very well. We do.

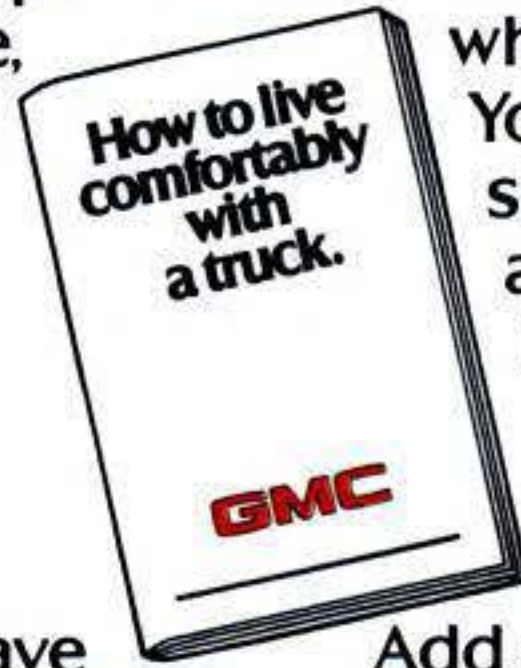
Our little S-15 is as stylish as can be. You can dress one up with distinctive new custom two-tone paint schemes, reflecting your own colorful personality. And equip it with the optional luxuries and amenities you'd expect in a car.

An S-15 is a useful second vehicle to have around. It's available in either two- or four-wheel-drive models. An optional off-road package available on the S-15 4X4 has Delco-Bilstein gas-charged shock absorbers

that provide impressive off-road agility and improved ride, on or off the pavement. So you can feel very comfortable in an S-15 . . . wherever you go.

You can equip an S-15 to haul a boat or snowmobile or other stuff. Or convert to a camper. And be generally helpful. Look in the Yellow Pages for the GMC truck dealer nearest to you. Buckle yourself into a little fun, a little spirit, a little something you've been missing.

Add a little pickup to your life. 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 43 C, Lansing, MI 48909.



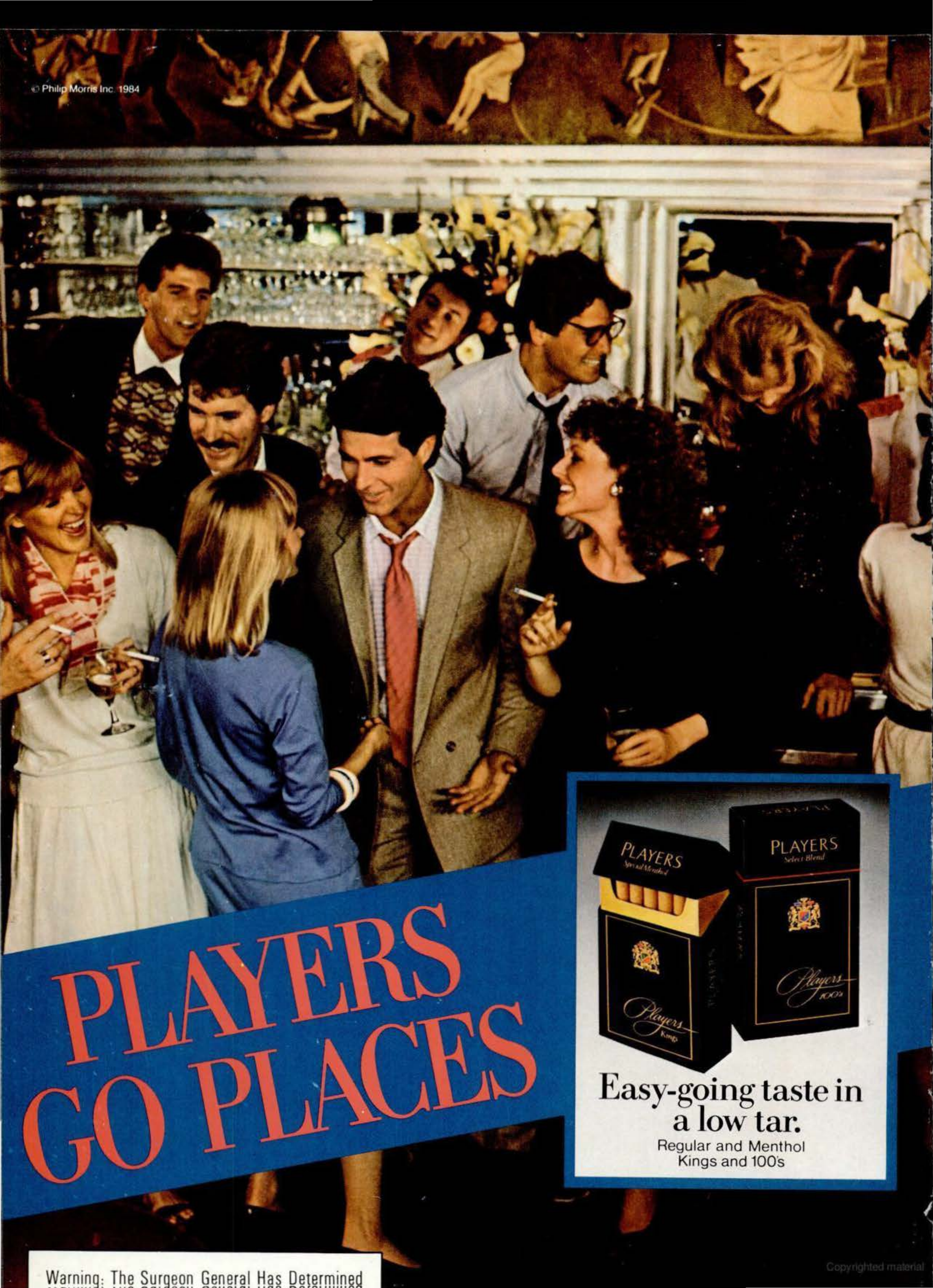
GMC

A truck you can live with.



GMC S-15 4X4 pickup.





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Easy-going taste in
a low tar.

Regular and Menthol
Kings and 100's