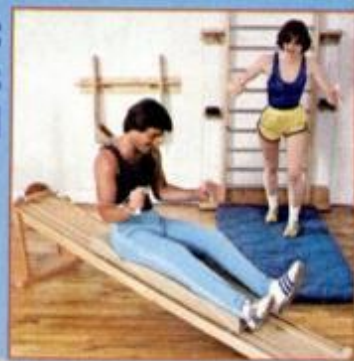


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Popular Mechanics

On the cover

Mike Ehrlie of Louisville, Ky., flies his Raven S-40 class (31,000-cu.-ft.) balloon belted to a seat mounted over his 20-gal. propane tank. One of the most active U.S. "hang-balloonists," Ehrlie promotes his dairy farm operation with envelope's motif. (Composite photo—large balloon by Clara Allen, smaller ones by Fred Krieg/Scorpion Productions.) See page 88.



AUGUST 1978

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POPULAR MECHANICS IS PUBLISHED MONTHLY by The Hearst Corporation, 224 West 37th Street, New York, N.Y. 10018, U.S.A. Subscription prices: United States and Possessions, \$7.97 for one year; \$14.97 for two years; \$21.97 for three years. Canada and all other countries, add \$6.00 for each year. Second-class postage paid at New York, N.Y., and at additional mailing offices. Authorized as second-class mail by the Post Office Department, Ottawa, and for payment of postage in cash. Registered as second-class matter at the Post Office at Mexico D.F., Mexico, June 20, 1950. © 1978 by The Hearst Corporation. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send Forms 3579 to Popular Mechanics, P.O. Box 10064, Des Moines, Iowa 50350.

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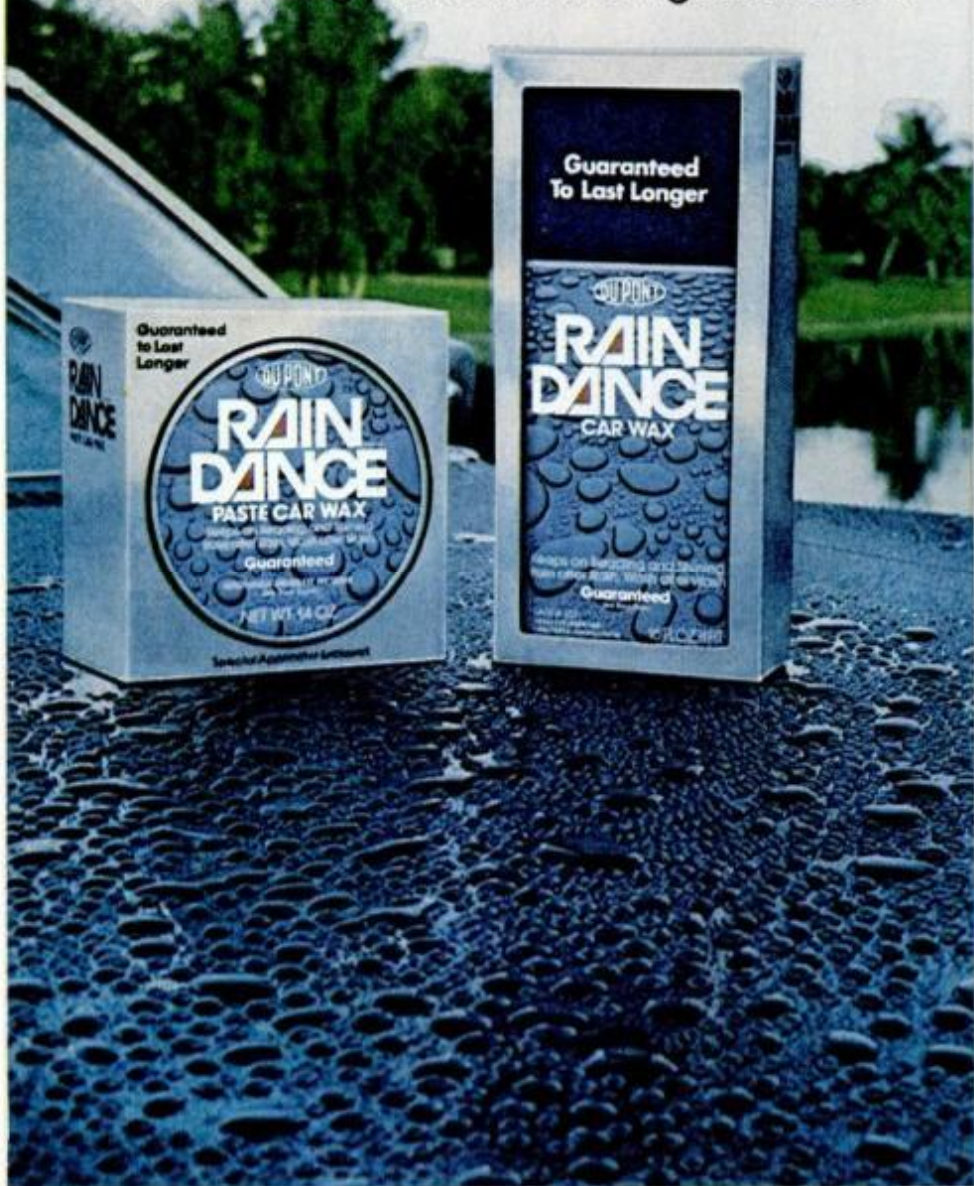
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POPULAR MECHANICS IS PUBLISHED MONTHLY by the Hearst Corporation, 224 West 57th Street, New York, N.Y. 10019, U.S.A., John R. Miller, President; Randolph A. Hearst, Chairman; Harrison A. Mitnick, Treasurer; Harvey L. Lipton, Vice President and Secretary. Hearst Magazines Division: Richard E. Deems, Chairman; Gilbert C. Maurer, President; Raymond J. Peterson, Executive Vice President, Advertising; K. Robert Brink, Vice President and General Manager; John F. D'Avolio, Vice President and Resident Controller; William S. Campbell, Vice President, Director of Circulation; Joseph F. Kern, Vice President for Popular Mechanics.

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There are times you just don't compromise.



You probably know as well as anyone that the wilderness can be unforgiving. Rarely gives second chances.

So, the question becomes whether an off-road vehicle should be a converted pickup, like a Blazer. Or, one designed specifically for the wilderness from the very start, like a Scout.

The differences are obvious.

The Blazer is stuck with the width of the pickup. Whereas the Scout is 9½ inches narrower. So there's less chance of getting stuck in a tight spot. But still has room for 5 man-size men plus all their gear.

The Blazer inherits the turning circle of the pickup. Whereas Scout remembers those dead end trails with a 3'-8" tighter turn.

Then there's a lower center of gravity than Blazer. A 12-degree better approach angle. Selective 4-wheel drive with all power teams. We could continue into next week. But why belabor things when you're starting to get the idea.

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IT'S NEW NOW



It's in the bag

The Pocket Bicycle is a truly lightweight foldup bike at 21 pounds. The custom-built frame is made of Reynolds 531 tubing with 3/16-inch stainless-steel cable bracing and cantilever brakes. Having 16-inch wheels, the bike is geared low for urban riding. Gearing, frame size and geometry, paint color and most components can be custom ordered. It's possible the Pocket Bicycle will go into mass production, but until then, a hand-built bike with carrying bag is about \$750 delivered. You can obtain it from the Bicycle Exchange, 3 Bow St., Cambridge, Mass. 02138.



Watch has long battery life

Seiko has introduced 24 analog quartz watches it claims can run five years without battery replacement. The FJ121M, \$185, is one of several models water-tested to a depth of 100 meters. Other features include day/date calendars and luminous hands and markers.



For unmatched ignition

This German-made gas igniter eliminates the need for matches and pilot lights. Pull the trigger on the pistol-shaped device and a piezoelectric element generates sufficient spark to light a burner or oven; no batteries are needed. It's guaranteed for 10 years and is about \$11 from Low Energy Systems, 63 Pearl St., Camden, Me. 04843.

Richard Petty says, "Check out NRI home training in Auto Repair."



Richard Petty, NRI Automotive Consultant

They give you the training and equipment you need to get ahead fast.

I sure know the importance of a good mechanic and the wide-open opportunities for well-trained men. That's why I'm glad to see good, solid training like NRI's. With NRI, you learn at home in your spare time. And get lots of practical experience while you do it.

Two Courses, Professional Equipment

NRI's Basic Course concentrates on popular services like tune-ups, brake service, and electrical systems. Equipment includes timing light, diagnostic tune-up instrument, brake tools, and more. The Master Course covers just about everything, valve and piston work, suspensions and steering, transmissions, air conditioning, even foreign cars. And you get extra tools like an ignition analyzer scope, air-fuel tester, vacuum test pump, wrenches, plus others.



Big Demand, Big Opportunity

A qualified mechanic can just about call his shots these days. And NRI's 60 years of home training experience can give you the head start you need. So send for their free catalog that shows all the lessons and tools. And check it out for yourself.

**RUSH CARD
FOR FREE CATALOG**
No Salesman Will Call

If you think you can't learn TV and audio servicing at home, I say, "BALONEY!"

Maybe you don't believe that we can actually teach you to service TV and audio equipment by mail.

Yet here at NRI, we're doing it every day. Helping people to bigger and brighter futures. Let me tell you why the NRI way works so well... and challenge you to put us to the test.

One of the secrets of the success of this school is the fact that its founder, J.E. Smith, was a teacher. So, when he originated his first course in radio over 60 years ago, it was carefully designed with training in mind. And that principle has guided us ever since. In every technical course we offer. Today, every aspect of our courses in TV and audio servicing are student-oriented to make learning as fast and as easy as possible.

Exclusive Training Methods

Right off, that means that you get far more than book learning. NRI gives you practical, hands-on experience as you progress. In our Master Course in TV and audio servicing, you actually construct a 25-inch diagonal solid state color TV. You start right with the basic parts and as you build it, you introduce and correct typical servicing problems, ending up with a complete unit, ready to use. That way, you get the actual bench time and intimate knowledge you need to handle real servicing problems. And before that, you even assemble some of your own electronic test instruments so you not only know how to use them, but how they work. That kind of training sticks with you... gives you extra confidence.

And Mr. Smith taught us something else, too. Not to go too fast. So, our courses have what we call "bite-size" lessons. That's another way of saying that they're easy to digest. Big enough to cover a specific subject thoroughly, but not so much that it'll overwhelm you. Written clearly, without a lot of gobbledegook. And we keep in mind that you're learning at home, so you take our lessons at your own pace. That way, you can learn in your spare time without interfering with your present job or eating up too much of your family life. Of course, if you want to move ahead faster, we're behind you all the way. The point is, it's your choice.

Professional Instructor/Engineers

One of the ways we back you up is with a fully-qualified staff of professional instructor/engineers. They're there to help you when you have a problem with any aspect of your studies... lessons, theory, bench training. And because most of them



John E. Thompson, NRI President

actually helped plan your lessons and designed your equipment, you'll get answers right from the horse's mouth, answers that are clear and to the point.

I might add that these are not a bunch of ivory-tower professor types. In between checking your lessons and giving you personal help, they're busy keeping up with the state of the art, designing new equipment and revising lessons to get you ready to handle even the latest equipment. As a case in point, take the audio equipment we added to our course recently. Not just stereo, but *four-channel*. Maybe a little exotic, but when a servicing problem like this hits your bench, you're ready for it. It's the kind of thinking and planning ahead our founder would have liked.

I Dare You To Do It

Now you might think I'm bragging a little too much on how good NRI is, and maybe I am. I'm mighty proud of our accomplishments. But the proof of the pudding is in the eating... how our training works in preparing people for actual jobs. So I'm inviting you to ask the only people who can give you a totally objective answer, professional TV and audio technicians. And here's my bet. Just look in your yellow pages for a couple of TV repair shops, ask to speak with anyone who actually does the repair work, and ask him what he thinks of NRI. I'll bet he says, "Do it!"

I'm not really sticking my neck out, because I know something you may not. Almost half the TV servicemen working out there have taken home-study courses. And among them, it's NRI more than three to one! Ask the pros on the firing line and three to one they'll recommend NRI to you as their first choice. I'll be happy to send you a copy of the national survey that proves it.

Why do the pros like us? Because NRI works. You take it at home so you don't have to go to classes. You take it in your spare time, so you can hold down your job while you get ready for your step forward. And you take it easy, because our

bite-size lessons make it easier, let you set your own pace.

Equipment Designed for Learning

And to top it off, NRI's equipment is exclusive. We design most of our own, so it's not somebody else's hobby kit or a stripped-down and mostly assembled commercial unit. It's designed so you really learn as you build, designed to give you lots of honest bench time, designed to give you the satisfaction of finishing up with a fully operable, top-quality unit that's comparable to any commercial set on the market. But you built it... you learned something on it! That's J.E. Smith's philosophy again.

It all boils down to the fact that we've aimed our training at a very practical goal... giving you the skills you need to move ahead in a rewarding career. Or even to have your own full- or part-time business.

Send for Free Catalog, No Salesman Will Call

There's lots more to tell about NRI training in TV and audio servicing and other courses, but not much space left to do it. So I'm inviting you to send for our free catalog of electronics courses. It contains a complete description of every course, including each lesson, training kits, and experiments. Full color photos show you exactly what your course will include in the way of test instruments, electronic components, and major kits like the 4-channel audio center and color TV.

No salesman will call on you, either. We don't work that way, never have. Our catalog shows you what we have to offer you, what we can do for you. Look it over, then think about it and make your own decision without outside pressure. J.E. Smith always felt that his best students were the self-motivated ones.

I can only add this. With over 60 successful years and more than a million students behind us, we must be doing something right. Just ask anybody we've helped along the way. So get started on your future. Send the postage-paid card and check the course that interests you. If it has already been removed, write me and I'll personally see that your catalog gets rushed to you. And thanks for listening to me.



John E. Thompson, President
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LETTERS TO THE EDITOR

On a bender

I am an electrician by trade and do my share of pipe bending. In your article *Build a Ladder for Your Travel Trailer* (page 57, Apr. '78) you use the term "electrical steel conduit." This is not very clear.

In electrical systems two types of electrical steel conduit are used. Electrical conduit is a very heavy-walled item, sometimes called rigid conduit (also, it must be threaded). The other type is called EMT or electrical mechanical tubing.

I would advise using EMT for the ladder, for ease of bending, rebending and weight, but it has to be treated or in a few years it will rust. Road salt will be its worst enemy.

Also, it is imperative that you use an EMT bender with EMT, not a pipe bender. Otherwise, it will kink immediately, with no chance of repair or rebending.

JACK MIAZGA
WARWICK, N.Y.

Dream deferred

I enjoyed the May *Car Care Guide* very much. As the owner of two cars whose combined mileage would reach from here to the moon, I can vouch for the value of your recommendations.

I believe you omitted one point which would help make the "dream garage" cost-effective for the car owner with a limited budget: The expensive but seldom-used items of equipment need not be purchased but can be rented when needed. The dream garage owner would be well advised to put his money into a good set of general-purpose hand tools, tune-up equipment and a good floor jack and to rent the items he expects to use only occasionally.

R. CARL MOOR
BOCA RATON, FLA.

Mistaken attribution

The article *Muscle-Controlled Electric Hand* (page 58, Apr. '78) stated that the myoelectric hand fitted to Navy Corpsman Richard Smith was performed by Navy doctors when in fact the surgery, the fitting of the substitute hand and the full rehabilitation process were performed by the surgical specialists, the prosthetics technician and the rehabilitation thera-

pists at the (Atlanta) Veterans Administration Hospital.

It is our wish that proper credit be given to the skilled staff at the Atlanta VA hospital.

CHARLES E. GRIM
ASSISTANT HOSPITAL DIRECTOR
VA HOSPITAL (ATLANTA)

Trained with the trestle

As a fan of your magazine, I was fascinated with the trestle desk in PM October '74 (*Build This Charming Colonial Trestle Desk*, page 77) and decided to make one.

I do not have a reliable table



Reader Kostink's trestle desk and chair.

saw, only some power hand tools, so I took a course in woodworking at the local high school and so got all the pieces cut and ready to assemble at home. I made a few mistakes but am very proud of the desk and the chair, of which I'm sending a picture.

As a kid I always liked to do fretsaw work, but I prefer to work with stock lumber. My husband has bought me a six-inch jointer and I hope to get a good table saw soon.

I just want to show you and your readers that woodworking is not necessarily only for men.

ZINA KOSTINK
100 MILE HOUSE, B.C.

Cutting remarks

I am involved in scientific research, and about 10 years ago some colleagues came up with this same idea of cutting glass under water (*Two Clever Ways to Cut Perfect Circles*, page 129, Mar. '78). So, we decided to do a little academic recreation with it.

We know that glass is very sensitive to surface effects. Water has a great effect (due to its surface tension and wetting prop-

erties) on glass. When cutting glass tubing in the chem lab you scratch it with a sharp instrument and then slightly wet the scratch before stressing the tubing.

Cutting under water can be helped by first warming the glass a little. The water should be as cold as your hand can take. We have even floated ice cubes in it.

We judged that plunging warm (not hot) glass into cold water adds the surface stress that makes cutting easier. If you don't finish with the first or second cut, remove the glass and dry and warm it thoroughly before continuing. Final trimming can also be done this way.

Old glass tends to shatter, and the glass to be cut should be very clean and dry to begin with—greasy or dirty glass (even with a few fingerprints) doesn't cut worth a hoot!

ALFRED E. SCHWANEKE
ROLLA, MO.

Welcome to the fold

We have been going to the Colorado River every year for the past five years and have "shot" the Colorado in homemade kayaks. We have used the plans to build these kayaks from your June 1963 issue (*Folding Kayak for \$15*, page 152) and I would say that in the past five years we have made about 200 kayaks. They have really withstood the pounding of the Colorado.

FRANK J. ANSTEAD
SAN DIEGO, CALIF.

It's good to know our 15-year-old design continues to stand up so well.

Photocopies of the folding kayak plans are available for \$1.25 from PM, Box 1014, Dept. TS, New York, N.Y. 10019.

In How to Use Your Wood Lathe Like an Expert (page 96, July '78) there is a typographical error in the caption for the photo labeled No. 1. Since the user is smoothing the piece in the lathe, he is using the skew chisel, not a gouge as stated. The gouge is correctly used to rough-round a cylinder as shown in the large photo on page 96.

THE BEGINNING OF YOUR HI FI SYSTEM SHOULDN'T MEAN THE END OF YOUR SAVINGS ACCOUNT.

A lot of people today are under the impression that in order to get a great sounding hi fi receiver, you have to be willing to spend a great deal of money.

Not people who've heard Pioneer's SX 450 receiver, however. Because for less than \$225,* the SX 450 can reproduce every note of music any instrument can play. And can do it as cleanly, clearly, and loudly as some receivers that cost hundreds more.

For those interested in specifics, the SX 450 produces a minimum of 15 watts per channel rms into eight ohms, from 20 to 20,000 hertz, with less than 0.5% total harmonic distortion. Which, in English, means that while the SX 450 won't be able to knock down walls, it will, if turned up, at least be able to offend the neighbors.

Equally important is the fact that when you buy an SX 450, you're not buying some cheap "house brand" component, or settling for an inferior sounding compact stereo. You're buying a piece of high

fidelity equipment made by Pioneer, the company that's number one today with people who care about music.

See your local Pioneer dealer for full details.

After all, we may have become number one today with people who care about music, but we've never forgotten that there are still an awful lot of people out there who care about money.



High Fidelity Components

PIONEER
We bring it back alive.

*U.S. Pioneer Electronics, 85 Oxford Drive, Moonachie, N.J. 07074

The value shown in this ad is for informational purposes only. Actual resale prices will be set by the individual Pioneer dealer at his option.

IT'S NEW NOW

Prosthetic can adjust for different gaits

Researchers at the Massachusetts Institute of Technology have developed a "tunable" artificial leg that uses a microcomputer to vary leg characteristics with changes in gait. The computer is slung over the shoulder of the user, but soon may be fit inside the leg itself.



Dual-control bike aids learning riders

The Safety-Cycle dual-control kit lets driving instructors ride with novices and take control in an emergency. It is designed to improve rider training, to reduce serious accidents. Safety-Cycle, 108 West Seventh St., Plainfield, N.J. 07060.

A tisket, a tasket, . . .

. . . a pair of folding baskets for your moped. Only 1 inch wide when folded, they expand to 8 inches and can each hold a full-size grocery bag. The chrome-plated baskets and frame bolt to luggage rack without drilling. About \$25 from Cosmopolitan Motors, Jacksonville and Meadowbrook Rds., Hatboro, Pa. 19040.



Sump pump jump

The ReservePower sump-pump system has two batteries to keep it going during blackouts. Pump, batteries and controls are \$995. Expert Mfg. Corp., 1754 North Paulina St., Chicago, Ill. 60622.



Another approach to big-screen TV

GE's Widescreen 1000 is a self-contained unit with a 45-inch diagonal screen. The WS1000 uses a standard GE modular solid-state chassis and a series of lenses and mirrors to achieve the one-piece design. The front surface of the viewing screen is treated with an abrasion-resistant coating to allow cleaning. The veneered wood cabinet measures 50x70x24 inches. Remote control and dual speakers are standard equipment. About \$2800.

MEASURES

PER

GASOLIN

With Holley Economaster carburetors, it's not a matter of inches, but miles. Extra miles to make a tank of gas last longer. Recent tests at the Holley emissions laboratories using Federal economy test procedures on typical vehicles showed fuel economy gains ranging from 3.2% city - 6.4% highway for a 1974 Ford Torino V8, to 14.1% city - 10.2% highway for a 1973 Dodge Dart 6 cylinder.

In all, 11 different Holley Economaster models were tested in everything from Chevys to AMCs, equipped with a variety of engines, 4, 6 and 8 cylinder, and automatic transmissions. Economaster carburetors: solid mileage improvement for your car you can easily bolt on yourself. See your local auto parts dealer or write for a where-to-buy list. Also available at NAPA stores as Holley Fuel Savers.

** Actual economy gains may vary depending on individual application and driving conditions.*



A complete Economaster applications listing can be found in Holley's 1978 Performance Parts Catalog, part no. 73000-8. Send \$1.50 allow 45 days for handling.

Holley® Economaster.

The carburetor that proves more highway can be packed into every gallon.

Colt Industries  Holley Carburetor Division

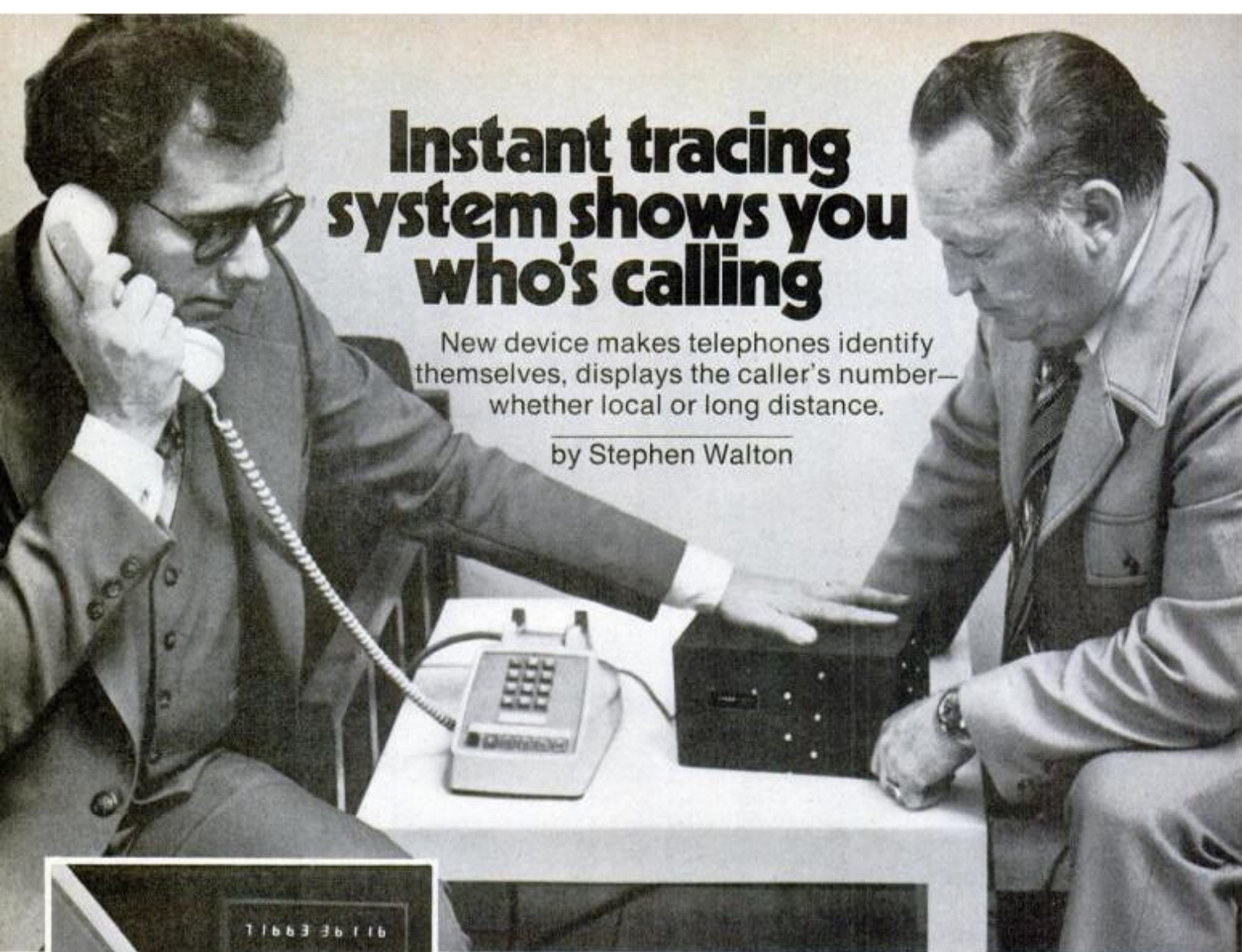
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Instant tracing system shows you who's calling

New device makes telephones identify themselves, displays the caller's number—whether local or long distance.

by Stephen Walton



Wayne Baldrige and Frank Kennedy of Sci Tech demonstrate tracing device for PM.

Suppose every telephone call could be instantly traced. The impact on our society would be immediate and overwhelming. It would make emergency services far more effective; it would virtually eliminate nuisance calls, and it would even let you decide whether you wanted to talk to a caller before you pick up the receiver.

That's the fantastic prospect offered by Scientific Technical Laboratories, a small firm that's now marketing its tracing technology to the telephone companies. It's a vast improvement over present tracing methods, which can take more than an hour on older exchanges.

Their device is *not* the long-rumored phone add-on that would work with calls from existing phones. The Sci Tech system requires the installation of a transponder on each telephone line—circuitry that identifies the phone number with a series of tones when it's interrogated by a pulse from the called phone.

The prototype was recently demonstrated for PM. Frank Kennedy and Wayne Baldrige of Sci Tech connected their transponder-and-

readout unit to a phone we provided in New York City, and had it called from similarly equipped phones on Long Island and in the Buffalo area. When the receiver at our end was picked up, about a second elapsed while our phone sent an "interrogate" tone and the calling phone responded with coded tones for its ID. Then the LED readout showed us all 10 digits of the calling phone's area code and number. That display remained until cleared when the receiver was lifted for another incoming call.

Kennedy says that the tones can be made inaudible to the telephone user. In addition, the transponder that identifies each phone line can be installed at the central-office level at a projected cost of less than \$10 apiece, after the prototype circuitry has been replaced by a few custom-made integrated circuits. He grants, however, that rigging even one city's phone system for instant tracing would be a major project.

Unlisted numbers, incidentally, can be preserved—they'll produce a coded number which the phone company would decode only if circumstances warrant it. **PM**



Caller's telephone number appears in display about a second after receiver is lifted. System can be made to provide coded number for unlisted phones.



Present version of unit is somewhat bulky, but large-scale integration can put its circuits onto chips, like those in foreground, that will fit inside telephone.



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Immediate Delivery

FEATURING AN IEEE-488 BUS

THE PET has become the standard for the personal computer industry. Consumer and business publications have lauded its discovery. POPULAR SCIENCE and PLAYBOY have given special tribute to the "mind-boggling" PET.

IN A LEAGUE WITH IBM, HP AND WANG MINICOMPUTERS

THE PET is a minicomputer and should not be confused with game products that hook up to household T.V.'s. What sets it apart from other computers is price. While others cost from \$11,000 to \$20,000 and more, THE PET, with similar power, costs only \$795.00.

Features an IEEE-488 Bus - like HP's mini and full size computers. This standard data and control channel permits direct connection to many peripherals. Over 120 pieces of compatible equipment such as counters, timers, spectrum analyzers, digital voltmeters and printer plotters, from HP, Philips, Fluke, and Tectronix, etc., are currently available.

ROM Magazine, January 1978, writes, "THE PET comes out of the box, plugs into the wall, and is ready to use." It is equipped with a CRT video display with reverse and blink features, an alpha-numeric keyboard with complete graphics and a built-in standard cassette tape deck.

THE PET has 8K bytes of RAM (user memory). Optional equipment permits expansion to 32K. And, it has 14K bytes of ROM (program memory).

THE PET COMMUNICATES IN BASIC. THE EASIEST COMPUTER LANGUAGE

If THE PET wants you to press a key, it will flash, "Press such and such", on the display. You speak back to it through its full size 73-key keyboard.

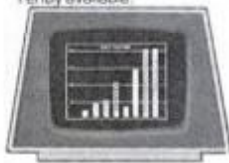
EXTENSIVE CHARACTER ORIENTED FEATURES

The unit features a 9-inch, high resolution, 1000 character CRT. Characters are arranged 40 columns by 25 lines on an 8 x 8 matrix for superb graphics.

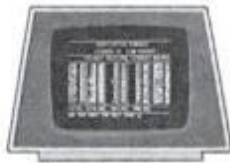
WHAT IS THE PET REALLY FOR?

It is the single most important teaching device for any computer related subject. It will entertain the most sophisticated data application, or the simplest inquiry/response assignment. **IN THE LAB** it handles instrumentation, process monitoring, and more. A number of Fortune 500 companies have already made it an integral part of their lab and general office system.

As a **BUSINESS TOOL** it will; Maintain ledgers. Keep payroll records. Create P & L's. Control inventory. Store and analyze sales data. Draw bar graphs. Issue invoices. Hook up to on-line computer system. **AT-HOME** it will; Compute state and federal tax returns. Make heat and insulation analyses. Keep Christmas lists. Keep checkbook and finances up to date. A variety of games, from Blackjack to Galaxy, is currently available.



Bar Graphs



Amortization Chart



Black Jack



Teaching Trigonometry

HIGH SPEED PET PRINTER

This powerful word processor prints hardcopies, invoices, computer correspondence. Faster than an IBM Selectric, THE PET Printer delivers 60 characters per second at a sustained rate - with upper and lower case capability. Characters are one-eighth inch tall and are printed in a 7 x 8 dot matrix. The printer uses a standard 8 1/2" wide paper roll. And, it is only \$599.95.

PERIPHERAL SECOND CASSETTE

This optional component expands storage and increases flexibility. Only \$99.95.

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Many programs are available now, including, "BASIC BASIC" which shows how to write a program. You can develop your own programs to meet personal requirements.

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High noise immunity, error detection, and correction
Uses standard audio cassette tapes
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Supports multiple languages (BASIC resident)
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Cassette file management from BASIC
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8K BASIC; 20% faster than most other 8K BASICS
Upward expansion from BASIC language
Strings, integers, multiple dimension arrays
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- Basic Basic-by Lodewyck and James

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TECHNICAL SPECIFICATIONS

MEMORY

Random Access Memory (user memory); 8K internal, expandable to 32K bytes

Read Only Memory (operating system resident in the computer); 14K bytes

8K-BASIC interpreter program, 4K-Operating system, 1K-Diagnostic routine

1K-Machine language monitor

VIDEO DISPLAY UNIT

9" enclosed, black & white, high resolution CRT
1000 character display, arranged 40 columns by 25 lines
8 x 8 dot matrix for characters and continuous graphics

Automatic scrolling from bottom of screen

Winking cursor with full motion control

Reverse field on all characters

64 standard ASCII characters; 64 graphic characters

KEYBOARD

9 1/2" wide x 3" deep; 73 keys

All 64 ASCII characters available without shift.

Calculator style numeric key pad

All 64 graphic and reverse field characters accessible from keyboard (with shift)

Screen Control: Clear and erase

Editing: Character insertion and deletion

CASSETTE STORAGE

Fast Commodore designed redundant-recording scheme, assuring reliable data recovery

WORKSHOP MINICOURSE

BENCH SAW BASICS

Whether you choose a radial or table saw for your first shop saw is a matter of personal preference. The major difference is that on a radial the blade moves and the work remains stationary. On a table saw you push the work against the spinning blade. The saw's capacity is determined by the maximum diameter blade it will hold. A 10-in. saw is handiest in most shops because it will cut through wood $3\frac{3}{8}$ in. thick. Arbor size is the diameter of bolt on which the blade mounts. **PM**



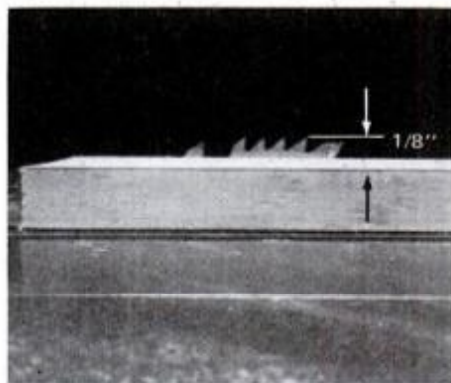
Disconnect power and hold block of wood against teeth to loosen arbor nut.



Put new blade on arbor, reinstall arbor washer that's provided with table saw.



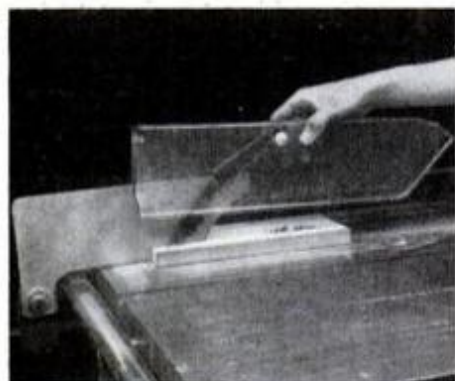
With block of wood against blade teeth at rear, install and tighten the arbor nut.



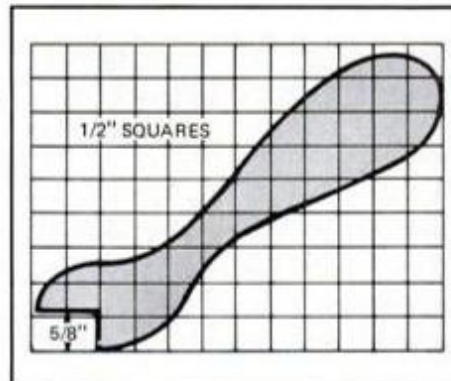
For safety, have minimal saw blade exposure; a $\frac{1}{8}$ -in. projection is good.



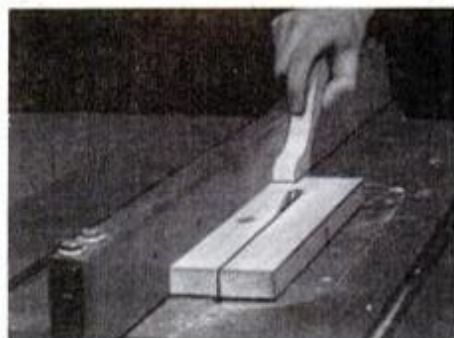
When using a rip fence to rip boards wider than 3 in., hook your last two fingers over the fence as shown above. For cutting narrow stock, see below.



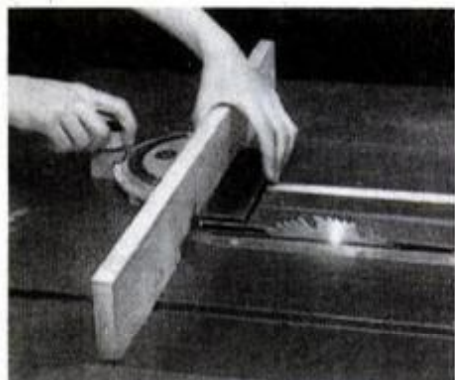
Workholding fingers inside the blade guard protect the user from a kickback.



Simple pushstick of $\frac{3}{4}$ -in. plywood can be cut out with bandsaw or coping saw.



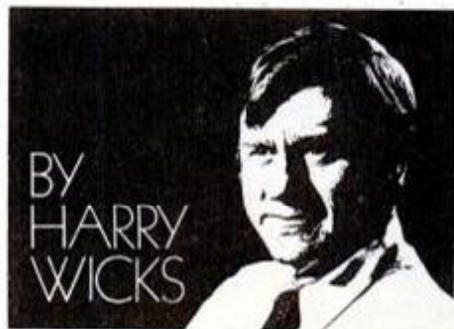
Use a pushstick to feed all work less than 3 in. wide between blade and fence.



Use a try square to check miter-gauge setting at the start of a work session.



Always use the miter gauge when cross-cutting—never crosscut freehand.



BY
HARRY
WICKS



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- J. Cash: Orig. Gold V. 1 ... 04024
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- Rush: 2112 ... 33716
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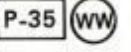
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RCA Music Service reserves the right to request additional information or reject any application.

How to install and use a standby generator

Put in your own emergency power plant and you won't have to leave home every time an electrical blackout hits your neighborhood.

by Harry Wicks
HOME AND SHOP EDITOR

When lights in your home flicker these days it's a pretty sure sign that a blackout or brownout will follow—no matter what season. In winter, ice, snow, wind and extreme temperatures can cause power line problems that mean power must be shut off for minutes—or days. Overloading causes most blackouts during the hot months; the utility companies simply don't have the power reserves to handle all the airconditioners in the country *at one time*. No matter what the reason for the blackout, your concern in winter is keeping the family warm and water pipes from freezing and bursting. And in summer, you can throw away a week's pay or more in spoiled food.

What's the answer? A standby generator—a unit that you can crank up to keep important branch circuits going within minutes of a power company failure. For my house I picked Homelite's Model No. HSB50-1 5000-watt unit that will run for eight hours on a five-gallon tank of gas. The cost, including the

(Please turn to page 18D)

How to do a professional installation



1. Generator sits on a 30x30-in. concrete pad. Use 2x4s, stakes for forming.



2. Tie rags on a stick to oil form inside to keep concrete from sticking.



3. Pad uses 2½ bags of Sakrete mortar mix; after pouring add bricks (aggregate).



4. Level poured concrete by pulling 2x4 across forms with back-and-forth motion.

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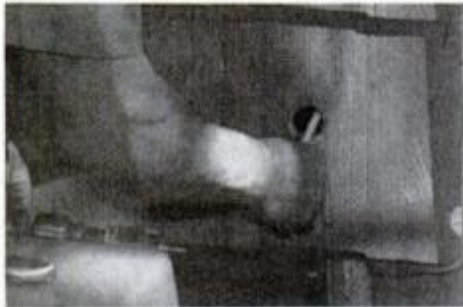


5. Next, surface is floated to fill voids left by straightedge and embed aggregate.



6. Let concrete cure for 24 hours, then "crack" forms by tapping with a hammer.

Hooking up to home power lines



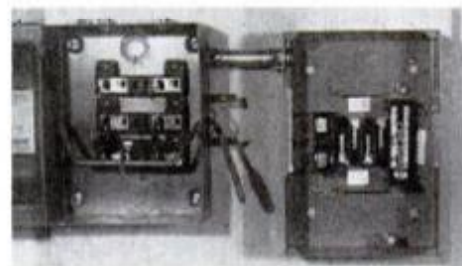
7. Electrician snakes wire through hole bored in house wall at box location.



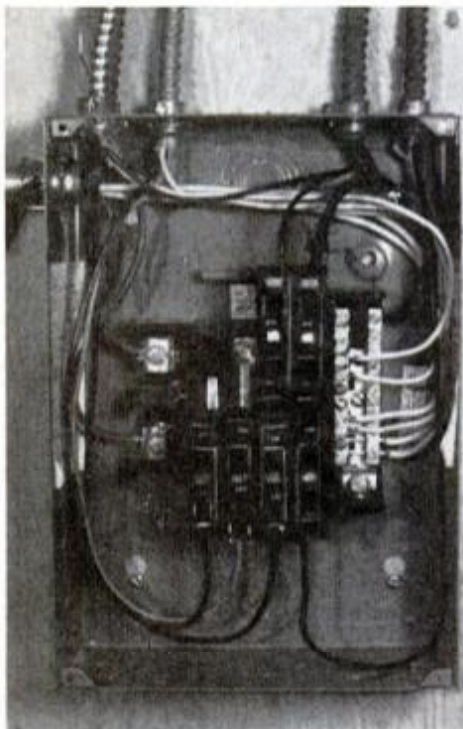
8. Box for generator main circuit breaker, mounted on house, takes 30-amp. breaker.



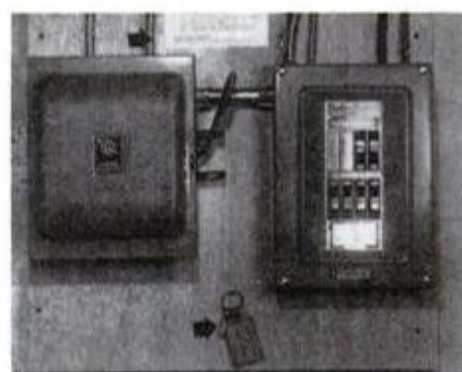
9. Branch circuit from house enters the generator housing through a conduit.



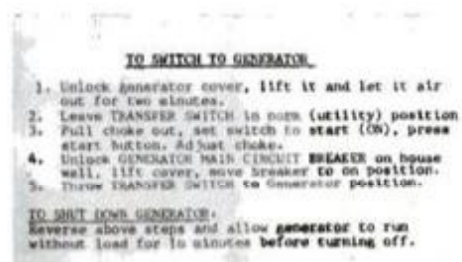
10. New boxes inside are for transfer switch (left), emergency circuits.



11. Emergency circuits handle heat, refrigerator, freezer, some lights, outlets.



12. Installation complete, house running on electric utility power; note handle.



13. Typed list of instructions on panel assures quick start-up in a blackout.

STANDBY GENERATOR

(Continued from page 18B)

electrical contractor, was about \$2000. But now we have adequate standby power to keep all important appliances running—oil burner, refrigerator, freezer—as well as sufficient lamps to spare us all that wandering around with candles and flashlights.

Figuring generator needs

The first step is to determine which equipment must be kept running. Next, determine the total amount of power which each appliance on your list will draw. To do it, read the nameplate of each appliance which lists the appliance power requirement in amperes and volts. Since some equipment runs on 120 volts while others are powered by 240 volts, you must calculate your requirements in watts. To determine watts multiply the number of amperes by the number of volts: For example, a 0.5-ampere appliance running on 120 volts has a power requirement of 60 watts (0.5 amps. \times 120 volts=60 watts).

An electric motor, regardless of voltage, requires much more power to start than run. Starting power surge is generally two to three times as great as the running power requirement, so make certain you compute starting power needs when figuring your generator load. Water pump owners should keep this in mind.

An installation extra that you

(Please turn to page 18F)



14. Generator and breaker-box locks are keyed alike; keys are kept on board.

IF YOU'RE GOING TO BUY AN EASY-TO-USE CAMERA, MAKE SURE IT'S REALLY EASY TO USE.

Like many of the new, compact 35mm reflex cameras, the Minolta XG-7 is automatic. You simply point, focus and shoot. The XG-7 sets the shutter speed up to 1/1000th of a second. And you get perfectly exposed pictures, automatically.

But easy operation is more than just automatic exposure. Here's what to look for when you compare cameras at your photo dealer.

Easy focusing. The XG-7's viewfinder is big and bright, even in the corners. Your subject snaps into critical sharpness.

It's easy to be creative. You can make the automatic exposure setting brighter or darker for creative effects.

An easy-to-understand electronic viewfinder. Light emitting diodes tell how the XG-7 is setting itself and warn against under- or over-exposure.

An easy-to-see electronic self-timer. The self-timer lets you get into your own pic-

tures. It's a large flashing light mounted on the front of the camera. The flashing speeds up when the picture is about to be taken.

An easier-to-use auto winder. It automatically advances film, as fast as two pictures a second. You attach the optional Auto Winder G without having to remove (or lose) any caps from the XG-7.



The easier-to-be-creative flash. The optional Minolta Auto Electroflash 200X synchronizes continuously with the winder. This feature allows you to take a sequence of up to 36 flash pictures in about 18 seconds.

The important "little" extras. The XG-7

has a window that shows when film is advancing properly. A memo holder holds the end of a film box as a reminder. There's even an optional remote control cord.

Fast, easy handling. The way a camera feels has a lot to do with how easy it is to use. Is it comfortable or awkward? Are the controls placed where your fingers naturally fall, or are they cramped together? The Minolta XG-7 is human engineered for comfort and smooth handling. It's quiet, with a solid feeling you find only in much more expensive equipment.

Easy-to-change lenses. Remove or attach lenses with less than a quarter turn. And a system of almost 40 different lenses, from fisheye to super-telephoto, makes the XG-7 a key to virtually unlimited creativity.

Try the Minolta XG-7. At your dealer. Or write for literature to Minolta Corp., 101 Williams Dr., Ramsey, N.J. 07446. In Canada: Minolta Camera (Canada) Inc., Ont.

MINOLTA XG7

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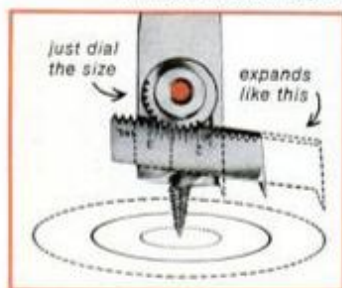
You can easily bore holes up to 1½" with the Irwin Speedbor® "88". This is the wood bit that cuts clean, fast, accurately. Puts more boring power at the working end of your ¼" electric drill.

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Just dial the size hole you want, up to 3 full inches. Taper square shank fits all hand braces. Machine-sharpened spur and cutters deliver clean, accurate boring action. No. 22 model (illustrated) combines 35 standard sizes in one precision-engineered wood bit, ⅞" to 3". No. 21 lets you dial 19 standard sizes, ⅞" to 1¾". Get an Irwin Micro-Dial soon.

Irwin Screw Starter

Marks hole, starts hole, threads hole for screw to easily enter wood and non-metal materials. Handiest hand tool in years for housewife and handyman.

Registered U.S. Patent Office

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at Wilmington, Ohio 45177, since 1885

STANDBY GENERATOR

(Continued from page 18D)

might consider installing (as I did) is a convenience outlet in the generator enclosure for periodic battery

charging. Failure to check and charge the battery regularly could mean you'll have a nonoperable generator when needed. Any standard 12-v. battery charger can be used. Among

(Please turn to page 146)

Generator startup procedure



Unlock the generator cover and the 30-amp. generator main-circuit-breaker box.



Lift cover and allow enclosure to air out; check that vents (arrow) are clear.



Pull dipstick and check the crankcase oil level. Replace the cap securely.



Open choke for cold weather start; choking may not be needed in warm weather.



Flip button to run, then push in start switch and hold it in until engine starts.



Raise cover on generator main circuit breaker box and flip the breaker to "on".



Power transfer switch connects the emergency circuits to power from generator.



To turn off generator, reverse above steps and press the stop button.



12-volt battery charger is an extra from Homelite, worth the \$40 it costs.



Author ran outlet into the enclosure for convenience when a charge is needed.



Pocket Yellow Pages

*Let your fingers do the data entry
with America's first computerized
pocket telephone directory.*

You're stuck. You're at a phone booth trying to find a phone number, and people are waiting. You feel the pressure.

To the startled eyes of those around you, you pull out your calculator, press a few buttons, and presto—the phone number appears on the display of your calculator. A dream? Absolutely not.

Space-age technology has produced the Canon Directory—a calculator that stores 20 of your most frequently called numbers in its memory and let's you recall them simply by entering the person's name or initials.

The keyboard has letters as well as numbers (like the touch-tone pad on a telephone), so it's easy to enter data and use. Want to call Jim? You enter J I M, and your display shows Jim's phone number. Even when you shut your unit off, it retains your complete directory in its large memory.

Ever forget to shut your calculator off when you slipped it in your pocket? No problem with the Canon Directory. The system was built like a liquid crystal digital watch. Its display can remain on constantly without draining the two long-lasting hearing aid batteries which you get with your unit. A low battery indicator also warns you well enough in advance when it's time to change batteries.

STORE IN CONFIDENCE

If you lost your little black book with all those confidential numbers, you might get in trouble. Not so with the Directory. Without knowing the specific initials or name, you can't access the numbers.

And then there's convenience. You carry your calculator with you anyway. Why not add the convenience of a telephone directory to a full-function calculator? When it comes to calculating, the Canon is no slouch either.

There's a fully-addressable memory, square root, and an add-on discount percentage system.

EASY TO OPERATE

Just enter the name and number you want stored and press a few buttons. That's all there is to it. Changing an entry is just as easy. You can also store credit card numbers, important serial numbers, birthdays, and anniversaries. For example, enter the next birthday or important date you should remember under "DATE." This date will appear each time you enter the word "DATE." By getting in the habit of doing that each week, the Canon won't let you forget. Or have you ever been stuck at a phone booth with no pen to write your messages? With the Canon, you can enter them directly into your unit—name and number.

The Canon Directory is a new breakthrough in recent calculator technology. The large-scale integrated circuit is programmable by the user—something nearly impossible just a few short months ago.

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Order the Directory. Quickly program it with your most frequently called numbers. (You'll be amazed at how many 20 numbers seem when you sort out your personal directory.) Then use it every day. Program those important dates, your social security number, the phone numbers of your favorite restaurants, airlines, or movie theaters. Test the batteries by leaving your unit on for a week.

See how easy it makes life. Then within 30 days, decide if you want to keep it. If not, no problem. Just slip it in its handy mailer and send it back. We won't be upset, and in fact, we'll thank you for at least giving our unique product a test.

JS&A is America's largest single source of space-age products—a substantial company which has been in business for over a decade. Canon is the famous company that manufactures quality cameras, calculators, and other precision quality instruments.

If service is ever required, just slip your three-ounce unit in an envelope and mail it to Canon's national service-by-mail center. It's just that easy. Service should never be required since practically all components are on a single integrated circuit, but we wanted to assure you that a service program is an established part of Canon's program. The unit is 2¾" x 5½" and only one centimeter thick.

To order your own Canon Directory, send **\$79.95** plus \$2.50 for postage and handling to the address below (Illinois residents, please add 5% sales tax), or call our toll-free number below. By return mail you will receive your unit, a handy wallet-style carrying case, and a one-year limited warranty.

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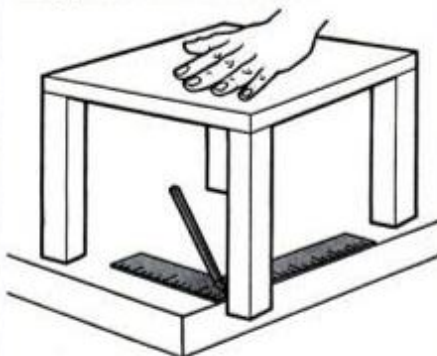
HINTS FROM READERS

Boring deep holes



Scrap wood and a marble can help you bore through wood that's thicker than the length of your drill bit. The marble should be the same diameter as the hole to be bored. First, clamp the scrap wood to drill press table and bore an indent where the marble will later rest. Then, with the scrap still in place, bore through the workpiece as far as possible. Remove work, place the marble on the indent. Invert the workpiece over marble to align hole for finish boring from opposite side.—Howard E. Moody

Stopping table wobble



When a table has one leg longer than the other three, here's a sure way to eliminate the shakes without repetitive cutting. Stand the piece on a level surface to determine which leg is the culprit. Suspend that leg over the edge as shown. Use carpenter's square and pencil to mark cutting line.—Howard E. Moody

Easy-fill for basketballs

To make the needle adapter that comes with a basketball easier to use, screw it into a tire valve extension. You'll have an effective check valve that won't be easily lost.—Clyde H. Schwanke

Scamp

Travel Trailer

85 lb. hitch wt., 950 lbs. overall. Fiberglass constructed. Sleeps 4. Many optional pieces of equipment.



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Skill.

"A skill is the art of knowing what you're doing. I always liked to tinker with things, rebuild engines, work on my bike. When I joined the Army, I became an Automotive Repairman. Here's the first place I ever saw a Detroit diesel—or had good tools. In the Army, you have to work on all different things. You're expected to think for yourself a lot, but there's always somebody there to help you. They teach you to get your skill down pat, no doubts in your mind. Dad called the other night. He'd like me to work on his car."

SP4 Jim Meizer, 1st Infantry Division, Ft. Riley, Kansas

**Join the people
who've joined the Army.**

HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Radiant heat cracks?

We love our electric radiant heat with cables buried in the ceiling plaster. However, in the summer, with the heat off, ugly cracks appear in the ceiling. When the heat is on, the cracks close tight. We've filled, taped and painted the ceiling to no avail. Would vinyl wall covering stick to this hot surface? No one seems to be able to supply an answer. Covering the ceiling of a 24-ft.-sq. room would be a bit expensive for experimentation.—William Schier, Three Oaks, Mich.

You've picked one of the most comfortable types of heating, so I don't doubt you love it. Your cracks sound more like stress cracks caused by overspanned joists or improper bridging, even though they may follow cable layout patterns. I've spoken to Proko Industries, one of the largest suppliers of this type of heat. Although they haven't experienced cracks due to heat in their installations, they do stock a self-adhering tape that's applied over the cracks and a special heavy, pliable paint to cover the tape. The combination may work in your case.

I would shy away from the vinyl wall covering. If the vinyl is applied in the winter, there's a strong chance of the cracks opening and causing it to tear. If it's applied in the summer, closing cracks may crimp the vinyl.

For product information, I suggest you write Proko Industries, Inc., Box 15788, 1910 Wall St., Dallas, Tex. 75215, attention W. Mansfield. You might also mention this article.

Loosening wood joints

I have to take some dining room chairs apart to make repairs. How do I loosen the glued joints?—Stephen Pinchot, Youngstown, Ohio.

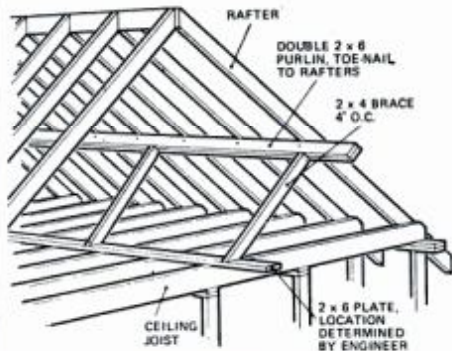
Since most queries regarding wood joints are just the opposite of yours, you've hit upon a good one! Methods I've used involve moisture and therefore must be done carefully. I loosened one joint by applying warm water with an eyedropper—four applications, about five minutes apart. But to avoid damaging adjacent finishes, take care to wipe up the excess water that spills out of the joint.

You can also boil water to create steam. Then hold the joint in the steam for several minutes. (Longer exposure could damage the wood.) Tap gently with a rubber mallet to hasten breaking the glue line. Perhaps our readers will have some alternative suggestions for loosening wood joints.

Eliminating rafter sag

Since the heavy snows, my 2x6-in. roof rafters seem to have sagged a bit. How can I get the sag out, and how can I keep this from happening again next winter?—Robert H. Blane, Verga, N.J.

If this is an unoccupied space, it is fairly easy to correct (see sketch). Nail purlins or strongbacks



Braces support rafters to eliminate sag.

(usually double 2x6s) to the rafters at midpoint. These purlins are supported about every 4 feet by 2x6 members fastened to a plate on top of the floor or ceiling joists. A licensed engineer should be consulted, as plates fastened to the joists in the wrong location could cause them to sag. In effect, you are transferring excess rafter load to the attic floor system.

Retiling

The grout around my bathroom tiles is so discolored I must either tear out the tiles, replace the drywall and retiling, or cover the tile with a durable finish made for the purpose. A while back you mentioned Formco as a covering to

be applied over existing tile. It mustn't have proven a success, as two of my letters to them were never answered.—B.C. Wallace, Stillwater, Okla.

A telephone call to Formco, Cincinnati, Ohio, proved they are alive and well. The company's product is Formica plastic laminate bonded to 1/8-in. high-density polystyrene foam covered both sides with kraft paper. It is fastened over existing sound tile walls with moldings and caps covered with matching material.

Since the foam backing provides good bridging over uneven surfaces, it should provide a durable, smooth finish without removing your old tiles. If your local supplier cannot obtain the material, call Formco, 513/891-8800.

Plastic sheet

I plan to replace my entire ceramic tile shower stall as dry rot has attacked the subfloor. Books from the library refer to a plastic sheet to be installed under the mortar mix for the shower pan. No one seems to carry this item. Also, what's a simple way to get the desired pitch for water to drain?—H. Lucas, San Carlos, Calif.

The plastic is polyethylene, such as you might buy for temporary storm windows or cold frames for your garden. Use a 6-mil thickness, but take care to fold it carefully at the corners; the material is somewhat stiff and could keep the mortar from filling the form.

Polyethylene is installed to prevent any water from penetrating and rotting the subfloor. The shower floor should pitch 1/4 in. per foot toward the drain outlet. With the bubble centered and one end of the level resting on the high point of the line, the clearance at the opposite end should be 1/2 in. for a 2-ft. level; 3/4 in. for a 3-ft. level and so on. **PM**

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



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ALL OUTDOORS

Bonus for a bayou

It's possible that one of America's largest and finest wetland basins and fishing holes, the 800,000-acre Atchafalaya Bayou of southern Louisiana, will not dry up as was thought. Many outdoorsmen are adding their influence to that of local Cajun sportsmen to protect it.

In the past, the U.S. Army Corps of Engineers has been accused of excessive damming and diversion of a number of waterways. However, Col. Early Rush of the Corps recently told us it was trying to develop multipurpose plans that provide flood control,

B.A.S.S. Champs fish-off demonstrated a healthy swing the other way. Two years ago, PM showed a bass chaser fitted out with almost everything then available, and costing an estimated \$20,000. Today, just the electronic gear could quickly top that figure. But while it's usually necessary to go afloat to reach the best fishing, a simple skiff can frequently boat as many as the budget buster.

To emphasize this, the B.A.S.S. Champs contest used 20 identical 16-foot aluminum johnboats priced well under \$5000. That includes boat, 35-hp outboard, trolling mo-

The museum displays Bob Cox's 1904 Motogodille, considered the oldest outboard motor extant in the United States, as well as other powerplant exhibits.

Owners of classic Chris-Crafts will gather for their first annual rally at the museum and adjoining waters of the St. Lawrence River on Aug. 25 to 27. Boatmen interested in old craft can take advantage of the museum's archives and research by becoming a member for \$10. Write the Shipyard Museum, 750 Mary St., Clayton, N.Y. 13524.

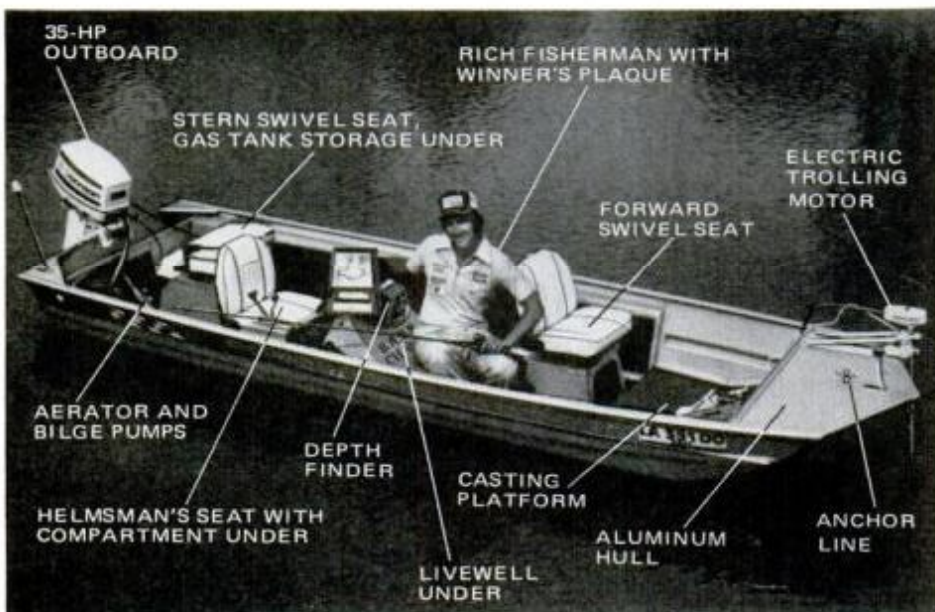
Dog-day pep

It's no secret that this month's hot weather seems to slow everything down, but the performance engineers at Mercury outboards tell us they can read it off their dynamometers. The Engine Test Code of the Society of Automotive Engineers (SAE) standardizes horsepower computations for corrections to dry air at 60° F. (16°C.) with a barometric pressure of 29.92 inches. That would be equivalent to pleasant spring conditions, and comparative tests in hot, humid August air show a horsepower loss of as much as 14 percent. As a result, a propeller picked for full rpm in the spring may now no longer be right and cause even more speed loss.

There is no way to regain this loss caused by this month's weather, but you can pick up speed by reproping to less pitch to regain recommended full-throttle rpm.

NHF day

While everyone talks about aiding conservation efforts, endangered species and the natural environment, the outdoorsman does more than all others combined and next month's National Hunting and Fishing Day, Sept. 23, is a good time to take the time to tell people how we do it. **PM**



Is this the poor man's bass boat?

respect property rights and can preserve the natural environment here, all at the same time.

This spring's B.A.S.S. Champs Tournament picked the Bayou to show what a fishing mecca it can be. As we trolled the narrow channels arched with Spanish moss and teeming with crawfish and bass it was easy to see why thousands of anglers come here for some of the country's finest fishing. The Corps feels it can keep the Bayou as a huge relief valve for a flood-stage Mississippi without the channelizing that would wreck the bayou as a wildlife habitat. Hopefully, fishermen for years to come will still be able to head south to Louisiana to applaud the conservation effort.

Bass for the masses

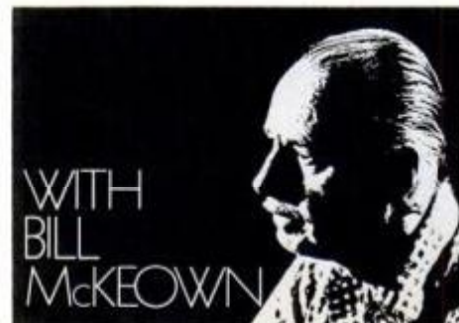
Bass boats continue to get more elaborate—and expensive—but the

tor, all extras shown here, plus a custom trailer—everything you need except luck.

Skill still helps, and Champs winner Larry Nixon of Hemphill, Tex., in the photo, has won \$25,000 at tournaments in the last two years. New rules keep making B.A.S.S. contests tougher but better for the fish. All fish must not only be returned alive to the lake, but must be over 14 inches long.

Best old boats

For a look at the finest in antique boats, our favorite is the Shipyard Museum, in the Thousand Islands, at Clayton, N.Y., and the choice time to visit is the third weekend of this month, Aug. 19-20, for the annual boat show and parade. One week earlier, Aug. 11 to 13, the Antique Outboard Motor Club, will hold its yearly national meeting on the Shipyard Museum grounds.



WO



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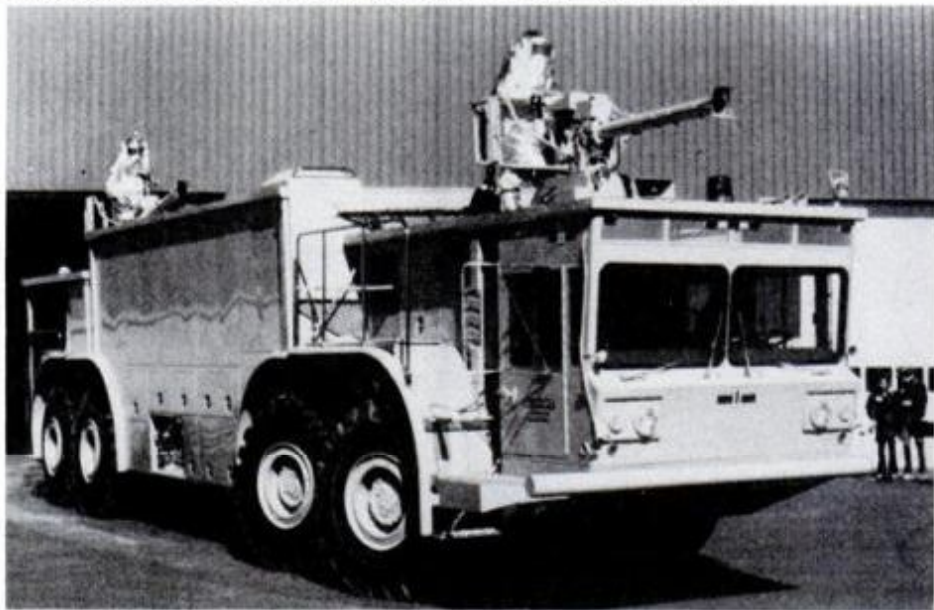


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Recycled pay phone

You can have a dial-type coin telephone, replete with dents, scratches and graffiti, in your home. Phone comes with standard plug; coin mechanism has been disconnected. Compatibility with all phone systems is claimed. About \$60; Long Island Phone Co., 121 Lakeville Rd., New Hyde Park, N.Y. 11040.



You auto hear this

Advent's EQ-1 speaker system includes a built-in amplifier with equalization designed to enhance frequency response inside a car. The unit is made to be mounted on the rear shelf and can be used with any car radio or tape source. A pair is \$180. Advent Corp., 195 Albany St., Cambridge, Mass. 02139.

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With the Tele-Ektra 2 camera and 400 film, you can stop action outdoors. Indoors, too—just by attaching a lightning-fast electronic flash. Or switch the Tele-Ektra 2 camera to the "EX" position and you can get beautiful pictures in dark shade. Ask your photo dealer to show you all the things the new Tele-Ektra cameras can do.



New Kodak Tele-Ektra cameras. From less than \$28



Price is subject to change without notice.
©Eastman Kodak Company, 1978.

DETROIT LISTENING POST

New Cutlass/Century for '79?

It's common knowledge in Motor City that GM's Buick and Olds Divisions are less than pleased by slow sales of their controversial fastback intermediate Cutlass and Century models. So they have requested, and should receive from GM management, their own versions of the more popular notchback body now shared by Chevy and Pontiac. Watch for the notchback Cutlass/Century as early as this fall—possibly replacing the fastbacks altogether, but more likely as additions to the intermediate lineups.

Ironically, the '80-model downsized GM compacts (now probably delayed from next spring until late '79 due to hassles with the EPA and other setbacks) will feature notchback bodies for Olds and Buick and fastbacks (with hatches, which the '78 intermediates should have had in the first place) for both Chevrolet and Pontiac lines.

Super Pinto for '81

Ford is planning a high-performance version of its front-drive Pinto replacement for the '81 model year. Reports indicate that the engine will be a turbocharged version of Ford's upcoming 1.6-liter Four with an aluminum cylinder head and Honda CVCC stratified charge three-valve combustion chambers.

Although the turbocharged 2.3-liter Four originally scheduled for introduction next month as a '79 Mustang/Capri option (see page 82) may be delayed for some weeks as a result of continuing durability development, Ford has already signed a contract with Garrett AiResearch Corp. for 200,000 turbo units to be supplied in 1979-1981. Garrett will deliver 60,000 turbochargers per year with the first 20,000 coming this year.

Other engine news:

Chrysler will drop its Lean Burn system in favor of more sophisticated digital electronic controls for most of its engines in '79; three-way catalysts with exhaust gas sensing and either electronic carburetor feedback control or intake manifold fuel injection will

be phased in engine-by-engine beginning next year.

Nearly everyone's working on four-cylinder passenger-car diesels. Chevrolet is testing a diesel version of its '81 model 1.8-liter Four, Pontiac is trying both diesel and turbodiesel variations of the current 2.5-liter, and Chrysler is playing with a dieselized version of the 2.2-liter it plans for the early 1980s.

Finally, Ford, as part of its massive four-cylinder and V6 future engine development program, is reportedly investigating all-aluminum 2.3-liter gasoline Fours for lightweight cars of the '80s. Porsche's supersophisticated (and expensive) 928 sports car boasts an aluminum V8 that saves weight, so don't belittle the Ford effort.

AMC to build Renault 18

With VW already cranking out Rabbits in Pennsylvania, Honda planning full-scale assembly operations in Ohio, and Nissan (Datson) combing the country for a suitable plant location, it seems



Renault 18 will join AMC/Renault lineup.

the United States' Big Four will soon become the Big Seven.

However, Renault of France, one of the world's largest vehicle manufacturers, but still one of America's smallest automobile importers, has apparently chosen a far different route toward American production of its cars. While contract details, legalities and technicalities of the arrangement had not been finalized at press time, it seems certain that the big French-government-owned car-builder will enter into partnership with financially-troubled American Motors Corp. to build and sell its products in this country. (Franco-American Motors?)

Although the first Renault car to appear in AMC showrooms this

winter will be the stubby but perky and efficient Le Car, the first American-built Renault is likely to be the all-new R-18, which was introduced in Europe in April. The 2000-pound, front-wheel-drive (fwd) four-door sedan will probably get a new name for this market by the time its production in AMC's Kenosha, Wis., plant begins late next year or early in 1980, but it will wear Renault insignia and possibly AMC identification as well.

The car, not to mention the deal, seems to be just what AMC needs to stay competitive. While French cars are known much more for comfortable interiors and soft ride than for their styling (retired GM chief designer Bill Mitchell once said most of them "look like they were designed by French pastry chefs"), the R-18 is a very attractive little number by anyone's standards. And its excellent fuel economy should go a long way toward helping AMC meet the dreaded CAFE (Corporate Average Fuel Economy) regulations for 1980 and beyond.

Chrysler spending millions

Chrysler Corp., which has been losing money almost as fast as it builds cars these days, seems unfazed by the losses as multibillion-dollar plans to upgrade, expand and add to its plant facilities begin to unfold.

First off is a recently announced plan to build an all-new, 3800-acre proving ground at Wittman, Ariz., northwest of Phoenix. The new facility will be three years in construction and will include high-speed tracks, traffic test roads, a brake-test water bath, test grades of up to 30 percent, endurance roads and a 15,000-sq.-ft. garage and office building. It will be used as an all-season facility to supplement the existing Chrysler Proving Ground at Chelsea, Mich.

Other plans include three-month renovations of Chrysler's Lynch Rd. and Jefferson Ave. assembly plants in Detroit, the former to build the new '79 big cars (Chrysler New Yorker and Dodge St. Regis) and the latter for production of Dodge pickups.—Gary Witzenburg

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SCIENCE WORLDWIDE

Saran Wrap solar cells?

What may be the forerunner of a whole new class of electronic materials has been developed by scientists from the University of Pennsylvania and the Tokyo Institute of Technology.

The material, doped polyacetylene, resembles plastic food wrap and can be varied in electrical conductivity from insulator to semiconductor to conductor. No other organic material has that wide a range, the scientists say. The conductivity is changed by adding tiny amounts of impurities, or dopants, to the polyacetylene.

Compared with silicon-based semiconductors, the potential production cost of doped polyacetylene is low. This may be a particular boon to the manufacture of low-cost solar cells.

Fibers in your future

Fiber optic telecommunication systems have completed their first in-use trials with good success, thus paving the way for larger-scale installation.

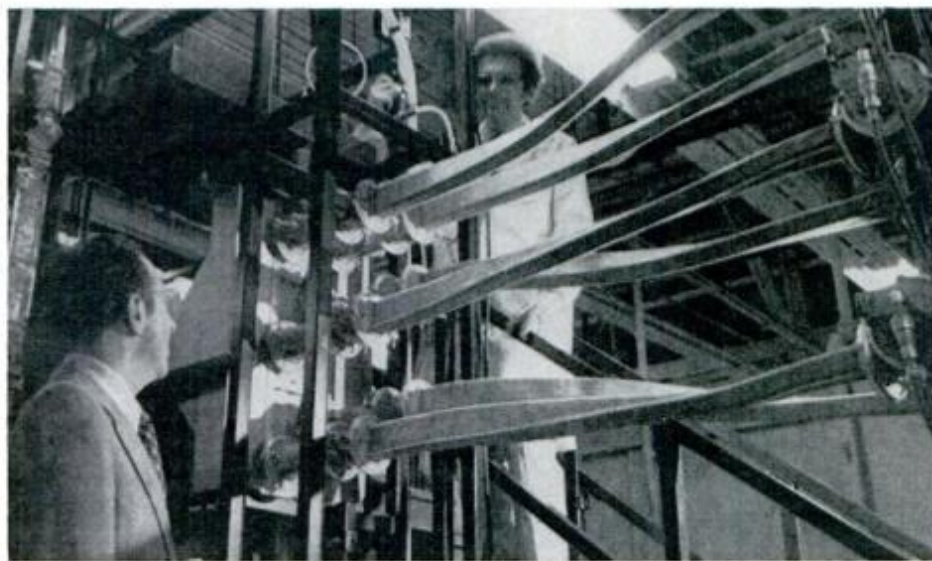
An experimental fiber optic telephone link has been in operation for a year in Chicago and has performed even better than expected, according to Bell System officials. The 1.5-mile link carries voice, data and video signals on pulses of light through thin glass fibers. Advantages of the system include immunity to electromagnetic interference (like that from lightning or CB radios), lower transmission losses and greater transmission capacity.

Bell plans to have a trunk route link between two switching offices in regular service by the end of 1980. Meanwhile, the Harris Corp. is installing a 32-mile fiber optic system in Alberta, Canada, that is slated for completion in the fall of 1979.

Microwaves zap pollutants

The tentacle-like objects in the photo above are microwave waveguides that are part of a device built by Lockheed that decomposes toxic waste materials like PCBs and Kepone.

Six 2.5-kw. power supplies feed microwave energy through the waveguides to the microwave applicator and reactor on the left. The microwaves are evenly dis-



Lockheed scientists inspect microwave-energized pollutant detoxifier.

tributed by the applicator through the quartz-walled reactor. Oxygen at low pressure in the reactor absorbs energy from the microwaves and becomes a so-called "cold plasma" of perhaps 500-1000° C.

The oxygen, now extremely reactive, combines with the component elements of the substance to be decomposed, thereby forming harmless oxides and water.

The device is expected to handle 10 to 30 pounds of material per hour. An added benefit in some cases has been the recovery of heavy metals present in the toxic substances.

Lied about their ages

Those old folks in Ecuador, Soviet Georgia and Pakistan who claim to be 120 or even older may not be so old after all, according to a story in a recent issue of *Medical World News*.

A Berkeley anthropologist who was drawing up family trees of some Ecuadorian "centenarians" as part of a study of their bone densities discovered that families used the same names over and over. By checking godparents' names on birth records, researchers found no one over 96. Apparently the Ecuadorians were systematically exaggerating their ages.

This casts some doubt on, but by no means disproves, the age claims of other alleged centenarians.

Weed wonders

A sleeping weed gathers no herbi-

cide, or very little anyway, according to research done by the U.S. Department of Agriculture at the University of Minnesota.

Velvetleaf weeds were sprayed with herbicide at night and early morning during the plants' "sleep cycle," when their leaves were curled down. As few as 28 percent of the weeds were killed as a result.

When sprayed during midday when the leaves were upright, however, all the weeds were killed. While only velvetleaf was studied, scientists expect to find similar patterns with other weeds. The results suggest that more carefully timed application of herbicides could increase their efficiency and reduce the amounts required.

Race against depression

Jogging could someday replace psychotherapy for some moderately depressed people, a University of Wisconsin pilot study suggests.

The study randomly assigned 24 moderately depressed patients to time-limited psychotherapy, or running therapy. Running patients were not started on a heavy running schedule but were brought along at their own pace.

To quote from the study, "... running was at least as effective in alleviating depression symptoms and target complaints as either time-limited or time-unlimited psychotherapy." The study also found running up to four times as cost-effective as psychotherapy in this instance.—Tom Sahagian

IMPORTS & MOTORSPORTS

Fast and frugal

Mercedes C-111-3 made record-breaking runs to dramatize diesel potential.



What'll she do, you ask? Oh, about 200 mph for 12 hours. That's speed and endurance enough to set nine new world records. And if that's not impressive enough, those Mercedes-Benz engineers—such show-offs—are quick to emphasize that this turbocharged diesel C-111-3 averaged 14.7 mpg for the day's



The C-111-3 test car weighs 2742 pounds.

outing at the high-speed test track at Nardo, Italy, April 30.

Performance and economy, that's the story. By averaging 195.4 mph for 12 hours and doing some hot laps over 200 mph, Mercedes was making sure that if you were not already convinced that the diesel is an engine to reckon with, you are now.

Mercedes, you see, just added a turbodiesel passenger car to its lineup and it would rather you buy this or another of its fuel-efficient diesel models, than a less economical gasoline-engine Benz. That's the only way Mercedes will be able to maintain a Corporate



Midships-mounted, five-cylinder diesel is turbocharged for 230 hp SAE net.

Average Fuel Economy (CAFE) high enough to continue to sell cars over here. CAFE, remember, must hit 24 mpg in 1982, 27.5 in 1985. With their diesels, Mercedes is practically there—as we found driving the new 300SD turbodiesel car coast to coast. See page 80 for the 23.05-mpg story.

Fuel-injected cat

"I say, old chap, aren't those quaint twin pots on your Jag the devil to tune?" If that's the line you've been using to needle friends with Jaguars, watch it—they might one-up you. You'll be putting your foot in it if you don't know that the XJ6 is now fuel injected with a Lucas/Bosch L-Jetronic system. The '78 models, with their 4.2-liter, double-overhead-cam, in-line Sixes, get a boost in hp to 176 (SAE net) with fuel injection. The system also uses a three-way catalytic converter with



Jaguar XJ6 sedans are now fuel-injected.

exhaust-system oxygen sensor to maintain precise air/fuel ratio.

Got the sports car yen?

When we reported on the new Mazda RX-7 rotary engine sports car in May (page 34) the car was just going into production and was not yet priced. Nevertheless, Mazda speculated \$6000 for the S and \$6600 for the GS. With many apologies to us it followed up with a revise (due to dollar-vs.-yen fluctuations) and the car went on sale in May for \$6395 (S) and \$6995 (GS). Pretty close, we think. Also close are the workmanship and finish of the production-run models that are arriving here—close, that is, to the hand-

crafted preproduction models we saw and drove in Japan.

But let's get back to those prices and add a few words about the facts of life that you should know before visiting your local dealer. Sports-car enthusiasts are banging down his door right now and will be for the foreseeable future. One dealer, who was requesting \$500 deposits from RX-7 prospects, received over 50 orders. Since the initial allotment of RX-7s was two cars per dealer and future allotments are to be keyed to sales volume, this dealer was back-ordered for at least a year. Then he raised the deposit to \$1500, but only one person took back his \$500 and went shopping elsewhere. So be prepared to wait.

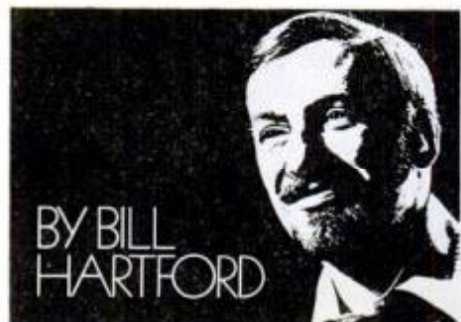
And the going price on dealer prepared RX-7s is not \$6395 or \$6995. The cars are loaded with options, rustproofed and primed by the dealer so that the price skyrockets. Prices as high as \$11,000 are reported from California. (All car dealers are independent businessmen, remember. They buy a car from the manufacturer.)

Highest bid we've heard of so far came from a motorsports fan who spotted a silver RX-7 at Lime Rock, Conn., for the Camel GT. The car was a test vehicle owned by Mazda Motors of America and didn't belong to the ad agency person driving it at the time. "Give ya \$14,000," begged the anxious fan. "It's not mine," said the adman with a wince.

PM



Rotary engine coupe ready for loading.



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Front quad shock option



Choice of part-time 4WD



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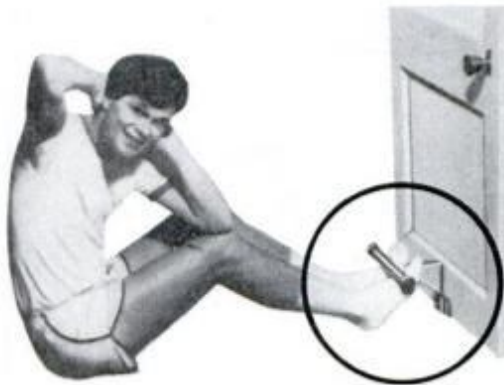
More exercise paraphernalia



Exercise your entire body on the Exercycle machine by using swimming, rowing, other motions. Pump the handlebars as you pedal. Three models start at \$885 from Exercycle Corp., 2074 Park St., Hartford, Conn. 06106.



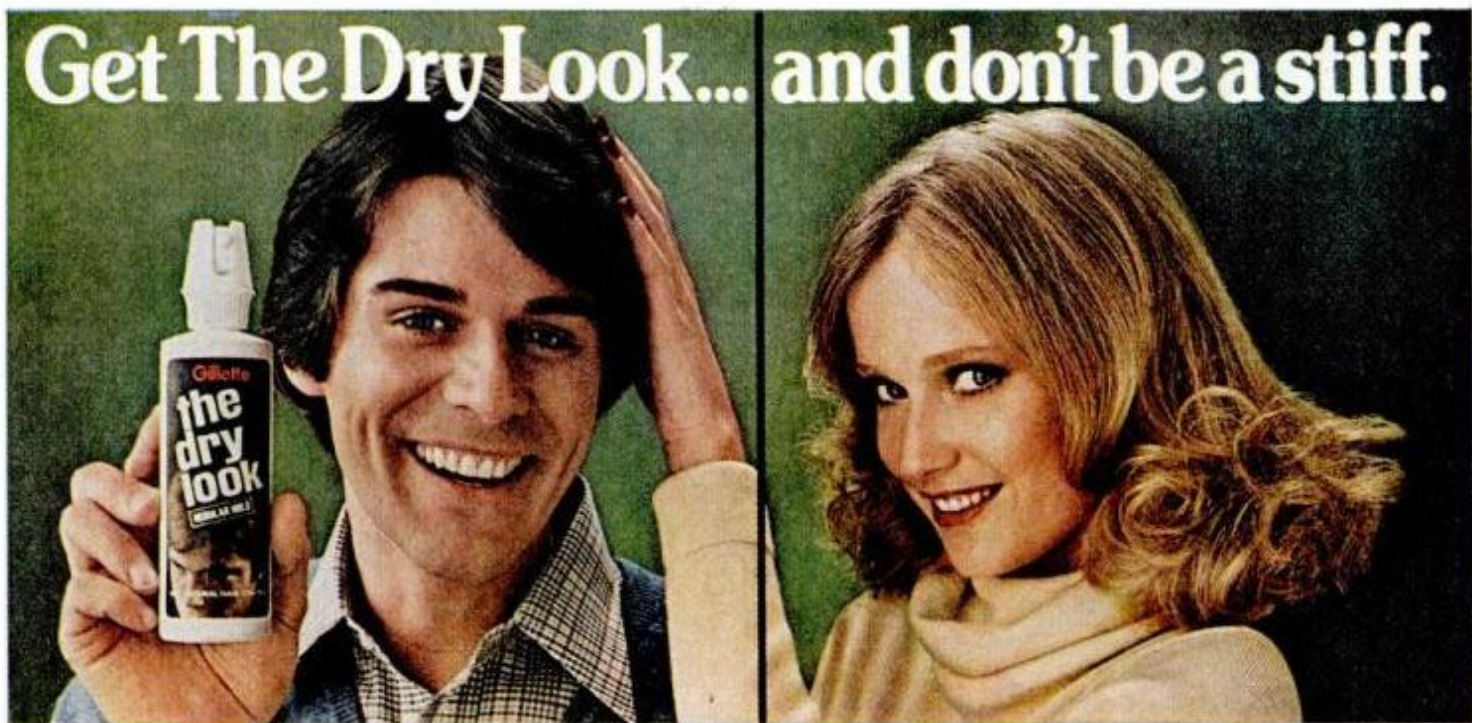
The bike converter (above) attaches to most 20- to 27-in. bikes and turns them into exercise cycles. Priced at \$18, it works on bikes of all speeds. Adjustable tension control regulates wheel drag. Knee support on the incline board (below) helps you attain proper position for bent-knee sit-ups. Knee and ankle supports and 16x48-in. board are foam-padded. It's priced at \$25. Both are available at J.C. Penney.



You can attach the Sit-a-shape bar to most doors without using tools. It holds your feet in position for sit-ups; or you can hold onto it and do leg-ups. It's available for \$10 at Sears, Roebuck stores.



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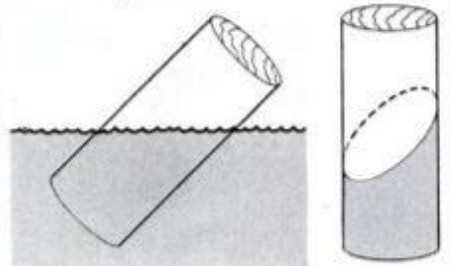
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HINTS FROM READERS

Mark a cylinder



To mark a cylinder for cutting at an angle, dip it in water at the desired angle then draw a guideline along the watermark.—*Robert Tom*

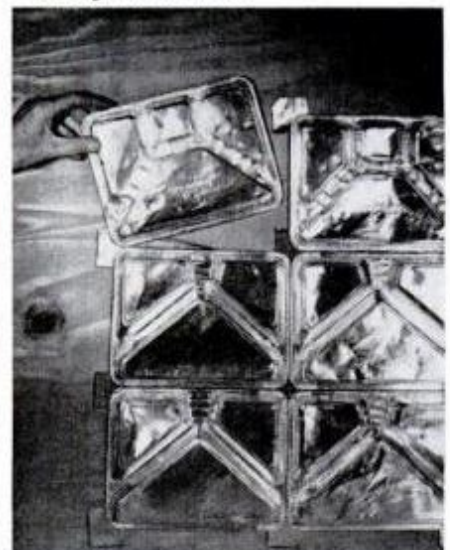
Two-prong remedy

If the smallest nudge can cause an electrical plug to loosen in the wall outlet, use a small screwdriver to spread the plug's prongs apart. The plug will then remain secure.—*F.W. Young*

Before you salute

To keep the pulley atop a flagpole from squeaking, put motor oil in a plastic bag and run it up the pole. When the bag passes through the pulley, it will break and oil will spread.—*Henry Mayo*

TV tray insulation

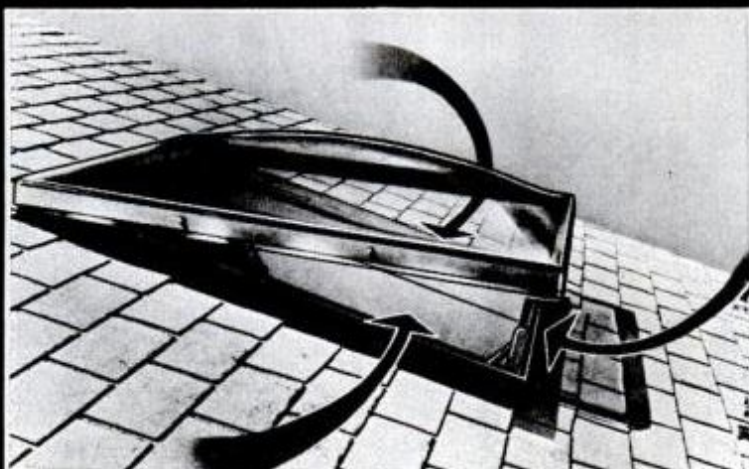


TV-dinner trays nailed bottom-side-out to a wall can help insulate against heat loss. The bright aluminum surface of the tray reflects radiant heat and the food compartments become dead air spaces. Use 2d box nails at the tray corners to attach them to garage, workshop, darkroom and other walls.—*S.J. Alexander*



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injected, two-liter engine which gets an estimated 25 mpg on the highway, 17 in the city, according to 1978 EPA estimates. Of course, actual mileage may vary depending on how and where you drive, optional equipment, such as automatic transmission and the condition of your Campmobile.

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IT'S MORE FUN TO TAKE THE BUS. THE 1978 VW CAMPMOBILE BUS.

THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS BY THE EDITORS

Electronic ignition tester

Pocket-size electronic testers are here. PM Garage checked out one electronic ignition tester in the March '78 issue, and now we're on our second.

This new one intrigued us because of its completely different principle of operation: It substitutes for the pickup coil in the distributor and, drawing power from the car battery, sends out a substitute signal to the ignition coil and electronic control unit. So you can give the ignition system a live test with the engine off.

The tester comes with a special two-piece ignition coil secondary wire. The two pieces are held in a block of clear plastic, with a gap of about 3/16 inch between their



Electronic ignition tester displays spark.

ends. When you connect the tester and install and ground the special coil wire, the electronic ignition system will operate with the engine off. You can (or should) see a steady spark jumping the gap in the piece of plastic. If you don't, you know something is wrong with the ignition coil or electronic control unit.

You can leave the system operating this way as long as you want to, to check for a failure that might not occur until the system has been running for a while. You may induce a heat-caused failure by applying heat with a hair dryer to the electronic control unit, coil, and so on.

The tester also does voltage and continuity tests, so you can check the ignition coil separately, the

resistor and most pickup coils. The tester will not check out a light-chopper pickup, used on some add-on systems, but it does enable you to eliminate other correctly working components, and therefore expose a defective pickup coil as the culprit. The spark test is a check of the ignition coil and electronic control unit, so if they provide a spark, the pickup is almost surely the problem if you have an ignition primary circuit failure.

We checked out the tester by simulating a variety of defects, and the tester identified them all. We must admit that being able to see the system produce a spark was an appealing visual touch that put a stamp of reality on the whole thing. Light-emitting diodes are nice—and this tester also has a few—but there's nothing like seeing a spark. Price is \$60 list, from K-D Tools, Box 1767, Lancaster, Pa. 17604.—B.H.

Gas pump

If you're like us, you run out of gas for lawnmower or snowblower in the middle of a job. Then it's either struggle with a siphon or head off with the jerrycan. Now, you can get a lightweight pump that plugs into a cigaret lighter and pulls out a gallon in about two minutes. It has an on-off switch, 18-foot electric cord and 10 feet of hose.

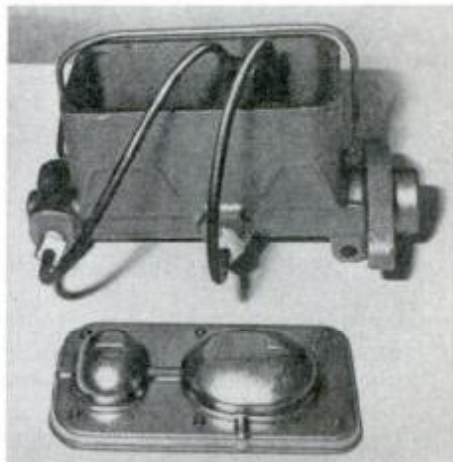
If you're also the type that runs out of gas with your car far from service stations, keep the pump in your car. Perhaps you can talk a good samaritan into letting you pump out some from his tank. The pump lists for \$20, but should be far less when it hits the discount houses. From Facet Enterprises, Elmira, N.Y. 14903.—B.H.



Lightweight pump beats siphoning gas.

Master cylinder bleeder

Although you may be able to bleed brake lines in your sleep, master cylinders are another matter. When you're installing a new or rebuilt master cylinder, you should bleed it before connecting the lines from the wheels. The traditional way is to install hoses over the outlet fittings, aim the hoses into the cylinder reservoirs, and



Easy bleed with cross-drilled fittings.

squeeze and release the hoses while a helper pumps the pedal (squeeze when pedal is released to prevent air from being sucked in).

A rebuilder (Autoline Supply Co., 840 West 31 St., Chicago 60608) has just introduced a simpler answer that provides automatic one-man bleeding. On its rebuilt master cylinders, the outlet fittings are cross-drilled and as with the traditional way, you fit the hoses over them and aim into the master cylinder reservoirs.

Mount the master cylinder and pump the pedal a few times. No need to have someone squeezing and releasing. When you pump, the aerated fluid is forced out through the cross-drilled hole (it pushes out against the wall of the rubber hoses). When you release the pedal, the hose walls flex back, thus preventing air from being drawn back in.

Autoline is not nationally distributed, but the company will be offering the cross-drilled fittings in a kit, probably through a specialty tool company. Distribution details should be announced by the time you read this. Look for it. We tried it and it's a good one.—B.H.

PM WORKBENCH

PM EXAMINES PRODUCTS & SERVICES

Project plans

Nine complete do-it-yourself home projects with step-by-step instructions, detailed drawings and photos are now available in a book from Stanley. The easy-to-follow plans include: Butcher-block table and bench set, outdoor kitchen, window greenhouse, anything chest, three-way hobby horse, adult and child workbenches, doghouse, dollhouse, and a handybench. Materials lists are included. To obtain the book, send a check for \$1 to Stanley Tools, Dept. PIDPM, Box 1800, New Britain, Conn. 06050.—H.W.

Leather/vinyl conditioner

What I liked about this nontoxic, nonflammable conditioner when I used it recently was the ease with which it wipes off. I squirted some on my auto seats then wiped with a clean cloth. Now the seats literally squeak as you slide across them. It also worked well on an old photo-gadget bag. An 8-oz. pump-type bottle is \$2.25 at department stores. For nearest dealer, write T.R. Industries, Box 1533, Lynwood, Calif. 90262.—H.W.



Leather/vinyl conditioner comes in a pump-style bottle and is easy to use. Simply squirt liquid on small area to be worked, wipe off with clean cloth.

New shapes for shaping

Disston's Abraders are the latest tools for shaping and sanding in one operation. The three shown below are available in both coarse and fine grades and are priced at \$6.99 for the square shape, \$7.99 for rectangular, and \$4.99 for

trowel-shaped. Not shown are the full-round (\$8.99) and half-round (\$9.99), which come in the coarse grade only. Available at hardware stores and building materials dealers. Disston, Danville, Va. 24541 makes them.—H.W.



Disston Abraders boast shoe (inset) which can be cleaned with brush and water.

Mini-version of popular screwdriver

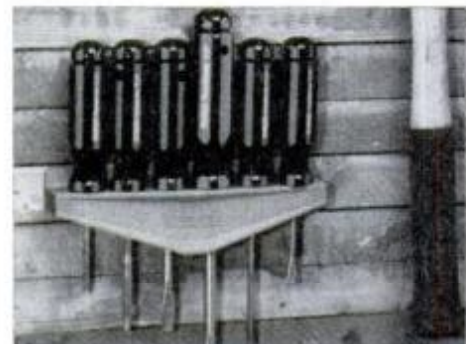
Creative Tools, Inc., of 309 County St., Bennington, Vt. 05201, recently introduced this scaled-down version of its popular Easydriver ratchet screwdriver. Like its big brother, its ball handle is made of GE's Lexan resin so that it will fit

your hand comfortably. Its spherical shape makes it easy to drive and remove screws. A handy driver to carry in your car's toolkit or for use in those tight-spot jobs around the house, it's priced at \$15.95.—H.W.



Drivers with rack

The latest Handyman screwdriver rack from Stanley quickly found a home in my shop—over my primary workbench. The unit has six screwdrivers—4- and 6-in. standard blade and tip; 3- and 6-in. light blade cabinet tip; and Nos. 1 and 2 Phillips tips. Extruded handles also have hang-holes for individual hanging. At hardware stores, set goes for \$6.99. Stanley Tools, Dept. PID, Box 1800, New Britain, Conn. 06050.—H.W.



Wall-mounted rack keeps six commonly-used screwdrivers in easy reach.

Seven & Seven. Great taste you can count on.

Put the great taste of Seagram's 7 and 7-Up together, and you've got a classic: Seagram's 7 & 7. Just pour 1½ oz. Seagram's 7 over ice in a tall glass and fill with 7-Up. Great taste you can count on!

Seagram's 7 Crown
Where quality drinks begin.



SEAGRAM DISTILLERS CO., N.Y.C. AMERICAN WHISKEY—A BLEND. 80 PROOF.

APPLIANCE CLINIC

QUESTIONS ANSWERED

Butterfingers

I have a small Sears desk calculator that my daughter dropped, breaking the glass. When I asked at Sears, I was told I'd have to get an assembly consisting of a printed circuit board and glass crystal. Cost: \$16. The thing new cost \$25. What's my alternative?—F.L. Kerschner, Sterling, Colo.

Only to chuck the unit and buy a new one if you don't mind the \$9 difference in price. This is a liquid crystal display. Kill one part and you kill the entire display.

Information please

Sometime ago (Appliance Clinic, page 26, Oct. '77) you ran an article concerning a sticking problem with icemaker trays. You mentioned a spray that resolves this. What's its name?—Jerry A. Jenkins, Cypress, Tex.

The name's Slipicone, Jerry. It's packaged by Whirlpool in 16-ounce cans and costs \$8.85. Whirlpool parts distributors carry it.

But don't expect miracles if the trays are bent out of shape. Replacing one will cost about \$3.

Ready! Set! Stop?

The blower fan of my General Electric Fashionette 6000 air conditioner groans, but doesn't revolve on "Lo Cool." When I switch it to "Hi Cool," the fan revolves but only after I repeatedly spin it by hand. What can I do, if anything, to lubricate the bearings and free the fan shaft?—Sidney M. Hunn, Greenlawn, N.Y.

Don't bother. From what you say, it won't do any good. The start-winding of the fan motor sounds as if it's shot. You'll have to replace the fan motor.

Cut out the kinky stuff

We had a problem like Mrs. Todd's (Lint 'May Tag' You, March 1978). Our washing machine was leaving lint on clothes, too. My wife found that there was a crimp in the drain hose which was causing the lint to be trapped. The fellow who had installed the machine put on a hose that was too short. When my wife pulled the machine out to clean behind it and pushed it back against the wall, the hose kinked. We were about ready to call the repairman when the crimp was

noticed. A new hose the right length took care of the matter. What about that?—Ralph M. Crass, Johnson City, Tenn.

Super!

It won't make waves

Our Hotpoint model RE923 countertop microwave oven has developed the annoying habit of tripping the circuit breaker. But:

■ It doesn't matter what time of day it is. It does it at least once a day or every other day, but never twice in succession.

■ The oven is rated at 13 amps. It's protected by a 20-amp breaker. There's nothing else on the line.

■ The breaker has been replaced.

■ A repairman went over the unit from front to back. No loose wires, no shorts, no nothing. The oven's in great shape.

■ My friend has the same problem with a Hotpoint.

■ The unit worked fine until we moved across the state.

Help.—John Wiechman, Ottawa, Kans.

To be certain, I double checked with GE-Hotpoint to determine if this unit has been having trouble. The company says, "No!"

So what's the matter? Maybe nothing more serious than an initial surge of power when you turn the unit on. The surge may be in excess of the energy that the circuit breaker can handle. GE suggests you replace the present breaker with a "slow-blow" breaker that will take an initial surge without tripping, but won't compromise the protection you need.

Such crust

The oven of our Frigidaire range/oven unit (model RBE 539N Compact 30) isn't level. As you know, the range is mounted on a countertop, and the oven is suspended below. Both the countertop and rangetop are level. However, the oven is about $\frac{3}{8}$ in. lower on the right side than on the left. You can see that the space above the oven door is wider on the right than on the left. The tilt is making our baked items thicker on one side than on the other. How can I level it?—E.Z. Michelson, Sylvania, Ohio.

You can't "adjust" the oven to make it level. The oven is sus-

pended from the counter and doesn't possess leveling legs. If the countertop is level, the oven should be level unless it's damaged. If the trouble has existed from the day you bought the unit, it was probably damaged in transit. Maybe the frame was bent.

If the trouble appeared suddenly, then perhaps the fasteners holding the oven to the counter on the right side have popped loose.

Finally, "tilted" baked goods will occur if the rack isn't straight; you may have checked this.

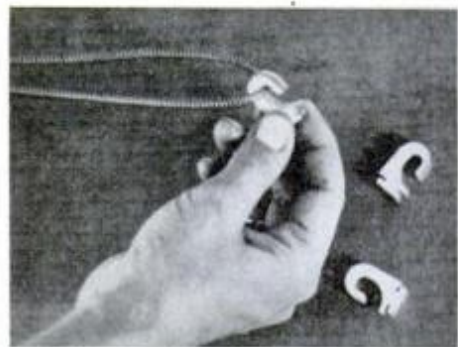
Old sog

I have a 1976 model Speed Queen washing machine that is emitting a terrible odor. Yes—I do dry out the tub and put a towel under the cover so the tub ventilates when not in use. How do I eliminate the smell?—Ginger Zisa, Woodcliff Lake, N.J.

Suppose a sock, panty hose, handkerchief or some other small item of clothing got trapped between the outer and inner tubs by way of the Clothes Guard. Phew. Find out by lifting the top of the machine.

SERVICE TIP

The white gadgets you're looking at (photo) are insulators similar to those that support heating elements in large waffle irons, broilers and space heaters. If these appliances don't get hot enough,



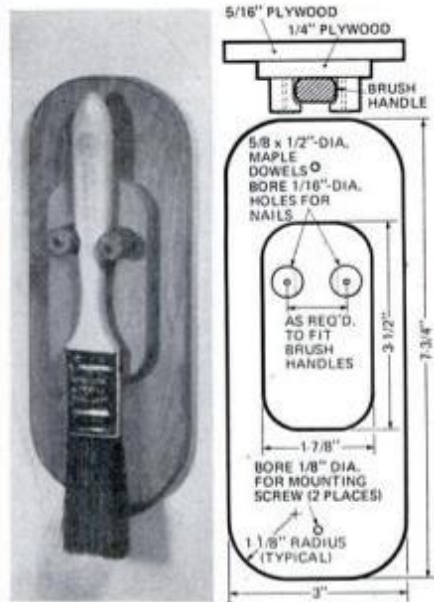
Insulator supports heating element.

one reason is a cracked or broken insulator. Another reason is a broken coil. The two work together, so inspect both when the appliance isn't plugged in. **PM**

If you have a question about any appliance, send it to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

HINTS FROM READERS

Dust brush in holder

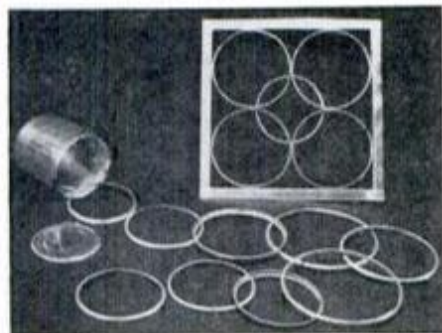


A brand new 1-in. paintbrush makes a handy duster. It's great for removing dust from the crevices of carved moldings, other intricate surfaces and tight places. Keep the brush handy in a holder mounted on the kitchen or shop wall.—*Walter E. Burton*

Drilling stainless steel

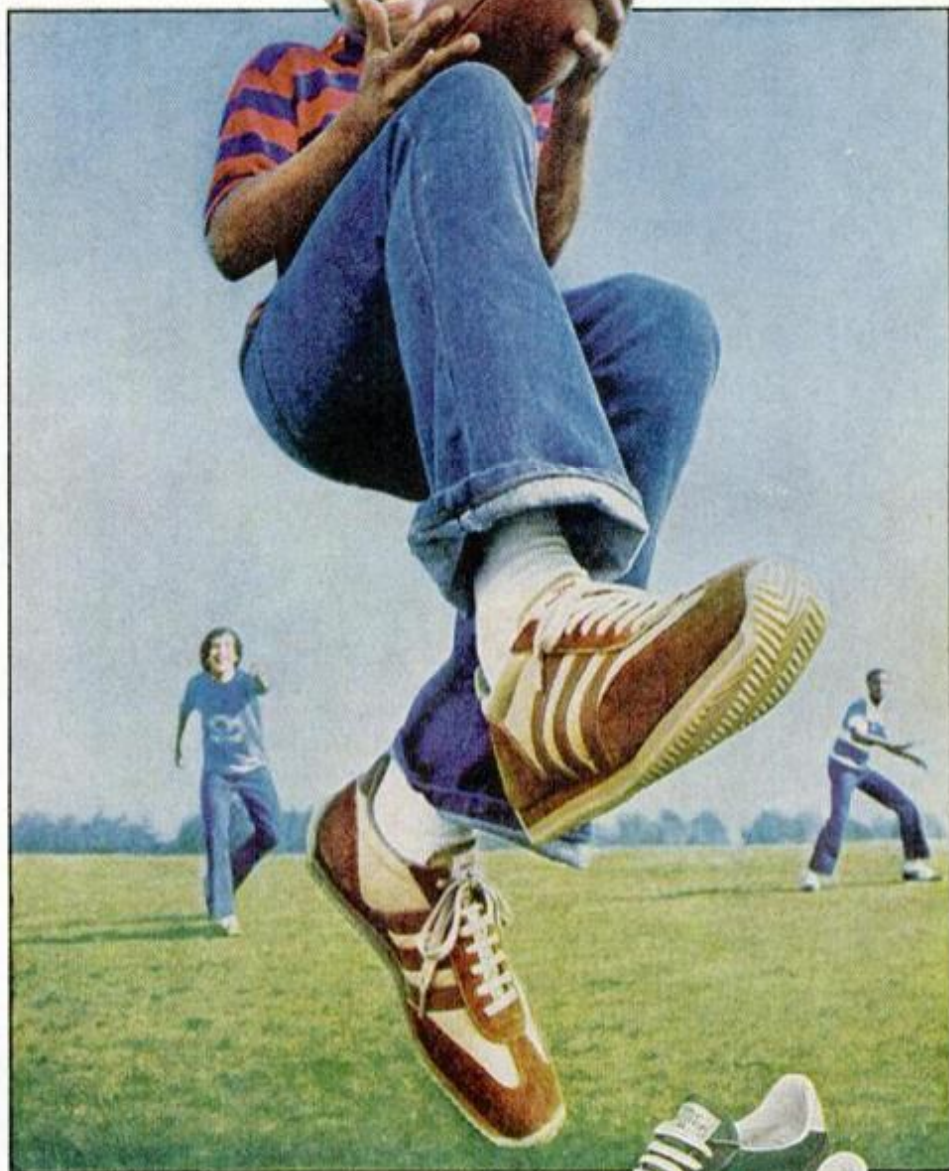
Drilling stainless steel can be a tedious chore when chips clog the flutes of the drill bit. This can occur even if you use a cobalt bit and apply lubricant made for the purpose. Using WD-40, or a similar liquid before you drill makes your job faster and cleaner, even with a high-speed twist bit.—*Myron H. Maynard*

Tin can rings



Neatly cut the rims off used tin cans and solder them together to make decorative grilles, wall-hangings or trivets. Use a hammer to flatten sharp ridges made by the can opener. Sand or file to reduce roughness. Paint or leave the rims natural.—*E.F. Hewlett*

Get the feel of a WINNER.



The Winner II Sportshoe

Nylon with split-suede trim upper. Padded tongue and collar. In blue, beige, red and green. See the entire line of Winner II Imported Sportshoes at The Shoe Place.

Sears

©Sears, Roebuck and Co. 1978



Shark Tooth



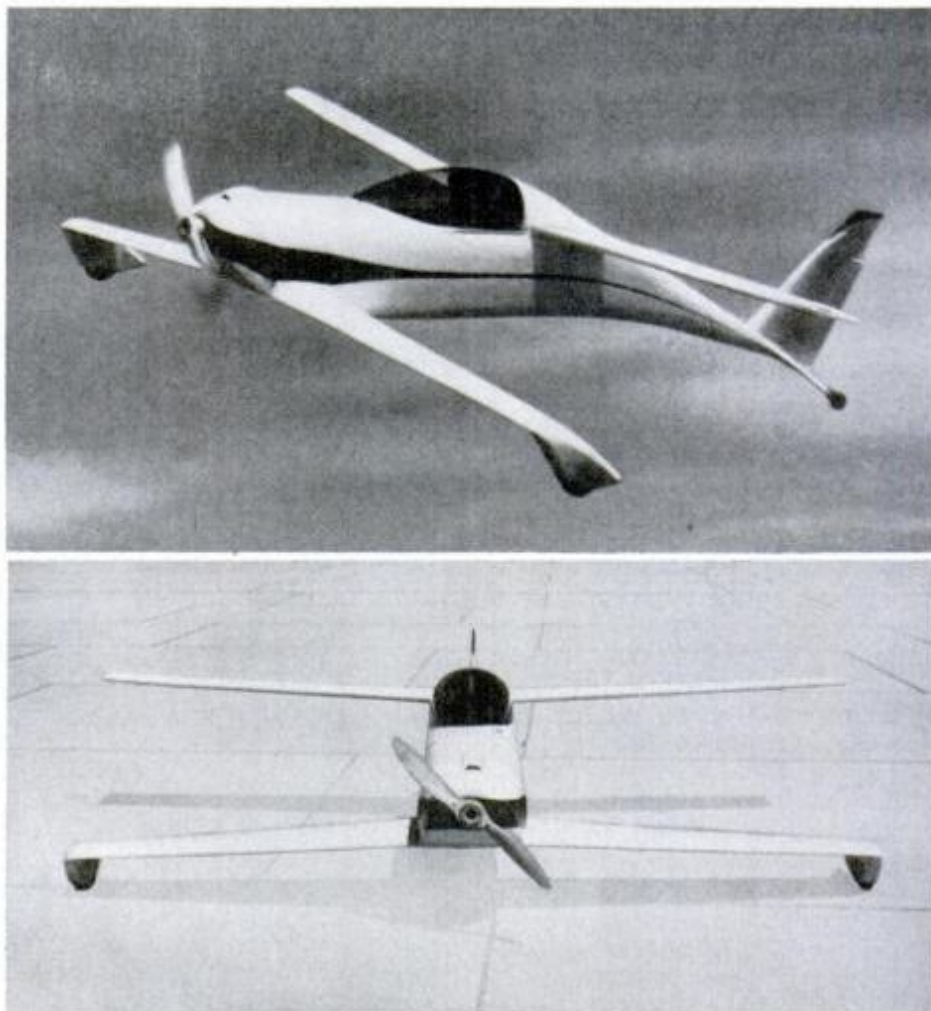
The Case Shark Tooth. Supreme American craftsmanship in every detail, from the polished laminated hardwood handle to the 5" hand-honed blade of high-carbon, surgical steel. Complete with sheath. Available with other lock-blade and pocket knives at hardware and sporting goods stores.



The world's finest cutlery.

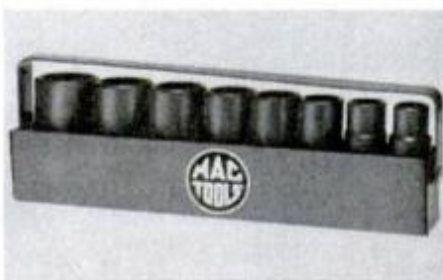
W.R. Case & Sons Cutlery Co.
Bradford, PA 16701

IT'S NEW NOW



Tricky Quickie

From Burt Rutan, designer of the VariEze, comes the Quickie. Scheduled to be officially unveiled this month at the Experimental Aircraft Assn. Oshkosh (Wis.) Fly-in, this homebuilt claims a top speed over 110 mph with only an 18-hp engine. At a cruising speed of 90 mph, fuel economy is said to be about 90 mpg. Projected cost of the 480-pound craft is \$3000. An information package on Quickie is \$6 from Quickie Enterprises, Box 786, Mojave, Calif. 93501.



Thin-skinned impact sockets

These 1/2-inch-drive thinwall impact sockets allow application of high torque where clearance is limited. Set includes eight intermediate-length, six-point sockets from 1/2-inch to 15/16-inch, plus tray. About \$40 from Mac Tools, Washington Court House, Ohio 43160.



TV tuner for home hi-fi

The TVX-9500 tuner plays the audio portion of a TV signal through a home stereo, taking advantage of the recently improved fidelity of TV sound. It receives all channels and is compatible with cable systems and VCR units, the maker says. It's \$250 from Pioneer Electronics, 85 Oxford Dr., Moonachie, N.J. 07074.



If you want jeans as great as Steve Cauthen's, remember what his horse is wearing.

When Steve Cauthen is out of silks, he's into DICKIES. You can be, too. Just remember to look for the horseshoe on the DICKIES label, and you'll be getting the best two-legged winner in town. Fine fit, fabric, and low prices are affirmed. Made with Fortrel polyester. Williamson-Dickie Apparel Mfg. Company, Fort Worth, Texas.

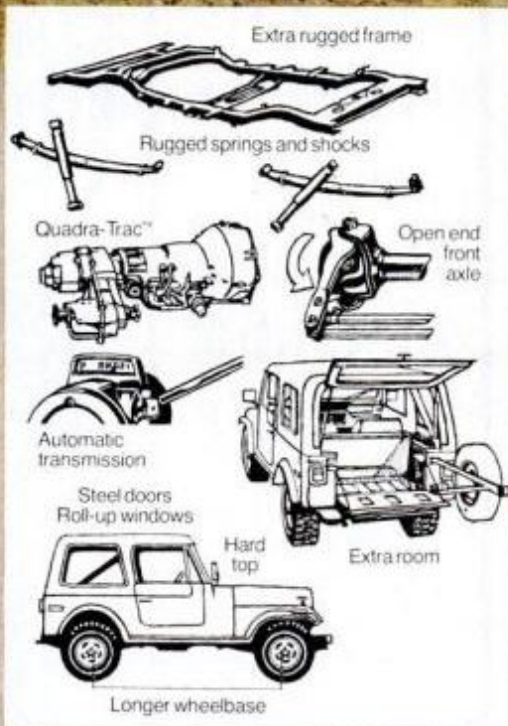


IT'S FORTREL
That's all you need to know.

Jeep CJ's Built this tough for the fun of it



The rugged Jeep CJ's. Famous for their ability to handle the roughest terrain. And now available in CJ-5 and the extra convenient CJ-7. Both built with Jeep's classic 4-wheel drive know-how. So they work hard and play hard — and here's how they do it. **Extra rugged frame** with **six cross members** — for the strength and durability you depend on in rough driving situations. **Wide spaced springs and shocks** — for excellent lateral stability and control. **Quadra-Trac™**, Jeep's exclusive automatic 4-wheel drive — the system that's unsurpassed by the competition — is optional on the CJ-7. So you get traction and



power when you need it, automatically. No more locking hubs!

Open-end front axle designed to give the CJ exceptional control in tight situations. Comfort options on the CJ-7 — **removable hard top** with **steel doors** and **roll up windows**.

Automatic transmission is available on the CJ-7. **Longer wheelbase** on the CJ-7 — for a smoother ride in the rough and on-pavement. **Extra room** — The CJ-7 offers the space you need to handle more of your gear. The Jeep CJ's. Tough, rugged and durable, and with the advantages that make them better than ever — for the fun of it!

Jeep Corporation is a subsidiary of American Motors Corp.



Jeep wrote the book on 4-wheel drive .

CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES

BY MORT SCHULTZ



Buzz off

What causes my starter motor to hesitate? The vehicle is a 1977 F-150 pickup (300-cu.-in. engine and standard transmission). The hesitation has been with me since the truck was new. The starter will roll the engine over once. Then nothing. I have to turn the key off and then to "Start" again to get a response. The starter has been replaced and circuits checked. Nothing. Help.—Paul Dexter, Kent, Wis.

You may be the victim of some innocent hanky-panky by shop personnel who went over your truck before you took delivery. Or maybe you're causing the problem yourself. The condition is not uncommon to 1977 FoMoCo cars and light trucks.

The lack of starter response can come about by starting the engine with the driver-side door open, allowing the key warning buzzer to operate. The buzzer creates what Ford calls "electrical transient voltage spikes" that trigger the ignition module prematurely during starting, causing starter motor hesitation or slow cranking speed.

If you are trying to start the truck with the door ajar, close it. If damage has already been done to the ignition module, you may want to replace the module. The new module has built-in "transient suppression"—another Ford term.

Starfire's flameout

I'd appreciate your comments relative to a peculiarity with my 1976 Oldsmobile Starfire (231-cu.-in. V6 engine and four-speed transmission). Since it was new, the car has had reverse hesitation (my term for it). As I start reducing power in conjunction with disengaging the clutch to upshift, the engine momentarily loses most of its power, but then quickly regains the proper power level. Neither ambient nor operating temperature is a factor.

I've checked vacuum hose con-

nections and EGR valve operation. Timing is correct. Dealer response has been to blame emission controls. Your comments, please.—Dan Witt, New Freedom, Pa.

Timing correct? Maybe, according to the book's 12 to 14° BTDC specification. But I have it straight from a GM spokesman that if timing isn't set exactly on that 14° mark, momentary power loss on deceleration could occur.

Another reason: a carburetor float level that is slightly out of spec. Look into this, too.

Rewriting the manual

Listen to what the Ford shop manual tells me to do to remove the starter motor of my 1975 Mustang (four-cylinder):

- Remove the ground cable from the battery.
- Raise the car on a hoist and remove four bolts retaining the crossmember under the bell housing.
- Remove the flex coupling clamping screw at the attachment point to the steering gear.

- Remove the three nuts and bolts that attach the steering gear to the crossmember.

- Disengage the steering gear from the flex coupling and pull the steering gear down to provide access to the starter motor.

- Remove the starter motor bolts and remove the motor.

Phooey. Rather than take half the car apart to get at that buried starter, I disconnected the exhaust pipe at the manifold (two nuts), moved the pipe aside and pulled the starter out through the top. It seems to me the people who write manuals ought to get out from behind their desks and find simpler ways of removing components.—Nelson Beck, Joliet, Ill.

No comment, Nelson. You said it all.

Hitting high notes

In cold weather, the steering column of my 1973 Jeepster Commando squeaks like a soprano when I turn the steering wheel. Why? Does the column need lubrication? If so, how? There aren't any grease fittings that I can see.—John Bostonian Jr., Hartsdale, N.Y.

This steering column has a roller bearing in the top of the column, below the steering wheel. It also has a bushing at the bottom of the column, just above the upper universal joint that connects the intermediate shaft to the steering column. The squeak can be coming from either, or both, spots.

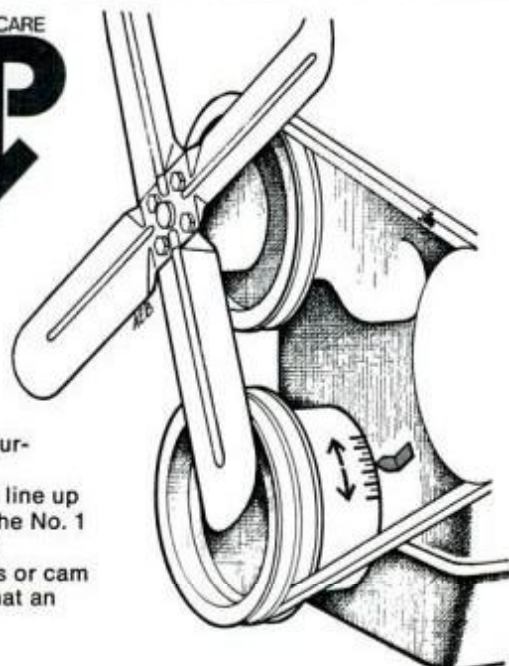
You will have no trouble reaching the bushing. It is accessible from under the hood, so lubricate

(Please turn to page 52)

Double duty

Did you know that your timing light can be used quickly and conveniently to let you know whether a distributor is in good shape? To check ignition timing, you attach the trigger wire from the light to the sparkplug or sparkplug cable of the No. 1 cylinder. Now, switch the trigger wire from that cylinder to the fifth cylinder in the firing order of a V8 engine, the fourth cylinder in the firing order of a six-cylinder engine, or the third cylinder in the firing order of a four-cylinder engine.

The timing mark and pointer should line up in the same position as they did with the No. 1 cylinder. If there's a variation of a few degrees, the distributor-shaft bushings or cam lobes may be worn, which indicates that an overhaul is needed.



CAR CLINIC

(Continued from page 51)

it with a few drops of SAE 40 oil.

If the squeak continues, the steering wheel will have to come off to lube the roller bearing. This is a tough job, requiring a steering wheel puller. Once the steering wheel is off, the bearing can be lubed with SAE 40 oil.

Do you have an option? You can live with the squeak. But be aware that it may eventually work itself into a case of loose steering.

Floating a loan

I have a 1973 Plymouth Satellite (318-cu.-in. engine and two-barrel carburetor). The trouble is that it hesitates and sometimes dies when I turn a corner. The problem was not solved by replacing the choke, setting up the idle, adjusting the mixture, tuning up the ignition, replacing the PCV valve and inspecting all vacuum hoses. It happens when the engine is warm and cold. I would be indebted to you for your suggestions.—Mike Schackel, address omitted

Suggestion, Mike—just one. Examine the carburetor float for damage, and then set the float

level and drop exactly to specifications. One sure sign of a damaged and/or misadjusted float is an engine that balks on turns.

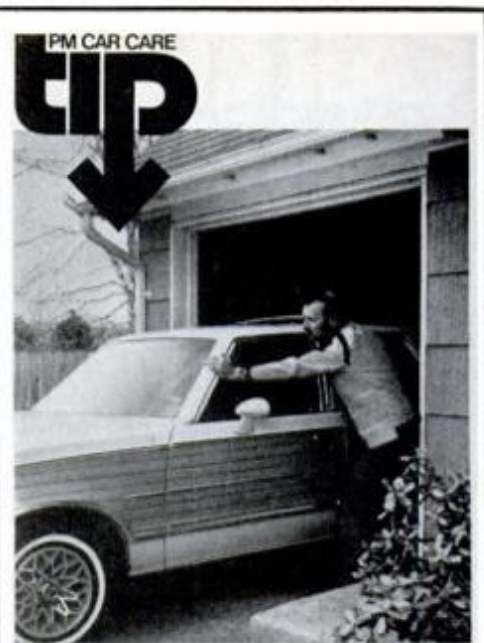
Killing a sale

I own an F-150 Ford pickup truck, and I have an alignment problem. My right front tire is wearing and cupping on the outside, and steering is pulling to the right. The local dealer says he can only adjust toe-in as the manual tells him to, and doesn't know how to correct the problem. Camber and caster are fixed. Should I sell it?—Roy Valentine, Crewell, N.C.

Sure, Roy—if you've got a good deal going. But not because of this.

The procedure your dealer is following may not be the procedure he should be following. You don't mention the model year of your truck, but front-end alignment procedures and specifications for all 1976 vehicles equipped with twin I-beam front suspension were changed. Whatever the year, your dealer should consult service bulletin 111 (5/6/76), article 1474.

The procedure outlines preliminary checks and adjustments which, if they don't prove out, could throw alignment out of kil-



Want longer engine life?

Minimizing the number of cold starts you inflict on your engine will prolong its life. So, don't start the car every time you have to move it—push it. Pushing it out of the garage so you can putter on a Saturday morning means one less cold start and less raw gas and condensation dripping into your crankcase. Of course, this is a dubious tip for owners of 4000-pound cars—unless you have more muscle than brains.—B.H.



With Elmer's Glaze-Tuff you don't need a pro's hands to give it the pro's touch.



You'll do a faster, better glazing job with Elmer's® Glaze-Tuff™ acrylic latex glazing compound. Because its fast-drying formula goes on smooth and easy straight from the can. At temperatures as low as 40°F.



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Coupon is non-assignable, void where prohibited, taxed or restricted by law. Consumers must pay any sales tax. Send to: BEECHAM PRODUCTS, P.O. BOX 1721, CLINTON, IA 52732. Cash value 1/20¢. LIMIT ONE COUPON PER PURCHASE.

B-PM878

ter. It also provides the right way for checking toe-in, caster and camber, and what to do if an angle cannot be set to specification. Just because caster and camber are pre-set doesn't mean your hands are tied. Conditions that affect caster and camber can be controlled to assure the correct angles. The service bulletin discusses all this.

Hare-tight case

I recently developed trouble with the catalytic converter in my 1976 Volkswagen Rabbit. When I took the car back to the dealer, I was told that the Environmental Protection Agency has approved removal of the catalytic converter and a special way of tuning the engine. This was done. A friend of mine in another city has told me that when his dealer removed the catalytic converter from his VW, the filler neck restrictor was also removed so the car could run on regular gasoline. My dealer says the EPA has not approved this. If there is no longer a catalytic converter in the car, why should the EPA insist that the Rabbit be operated on unleaded gas?—Paul Spray, Oak Ridge, Tenn.

The EPA has not approved re-

moval of the catalytic converter or fuel filler neck restrictor from the VW Rabbit. In fact, the EPA is prosecuting dealers who have done and are doing this.

Warm weather friend

With cold weather around the corner, I'm worried that I'll have the same problem with my 1976 Pontiac Astre (140-cu.-in. L4 engine) that I had last year. Only when it's cold do I have to pump the accelerator eight or 10 times to start the engine. Otherwise the engine starts promptly. I've installed a stronger battery and new plugs, and have had the car to the dealer several times, but there's no improvement. What's my trouble?—George W. Ault, St. Clairsville, Ohio

I'd say that the automatic choke isn't unloading, which means that the choke plate isn't closing all the way. If the correct unloading procedure is not followed, the choke won't set properly. Push the accelerator pedal to the floor as hard as possible and let it up. Wait a second or two, and repeat. Wait another second or two, and start the engine.

There is the possibility that

something is keeping the choke from unloading. Maybe the floor mat is bunched up under the accelerator pedal, restricting travel. The choke linkage may be binding.

SERVICE TIPS

■ In case you haven't heard, 1977 and 1978 BMW 320i and 320iA models manufactured through Feb. 28, 1978, are recalled to remedy an engine stalling problem because of vapor lock. The first sign that the trouble is starting is a high-pitched buzzing noise from the fuel pump. When it becomes available—probably later this fall—a newly designed fuel pump will be installed by BMW. You will receive notification. Meanwhile, an external dual-pump modification kit should be installed to prevent the trouble. There is no charge. See your BMW dealer.

■ Chrysler Corp. inflates all tires 35 to 45 p.s.i. at the factory. This includes the spare. The dealer is supposed to bring pressure down to proper specification before delivering a car. But suppose he forgets. Get me? Double check—the spare, too. **PM**

GOT A PROBLEM WITH YOUR CAR?

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

DYNAMITE SHINE.

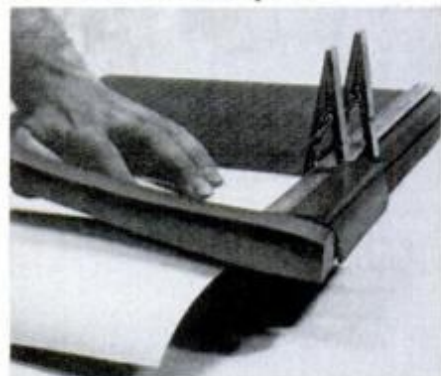


IT'S SO EASY.

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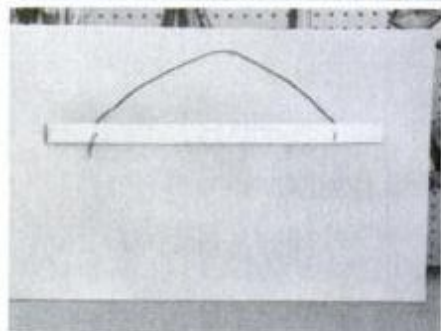
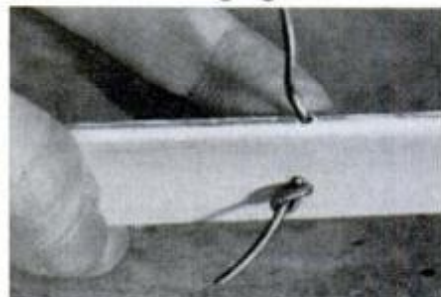
PHOTO HINTS

Trim with clothespins



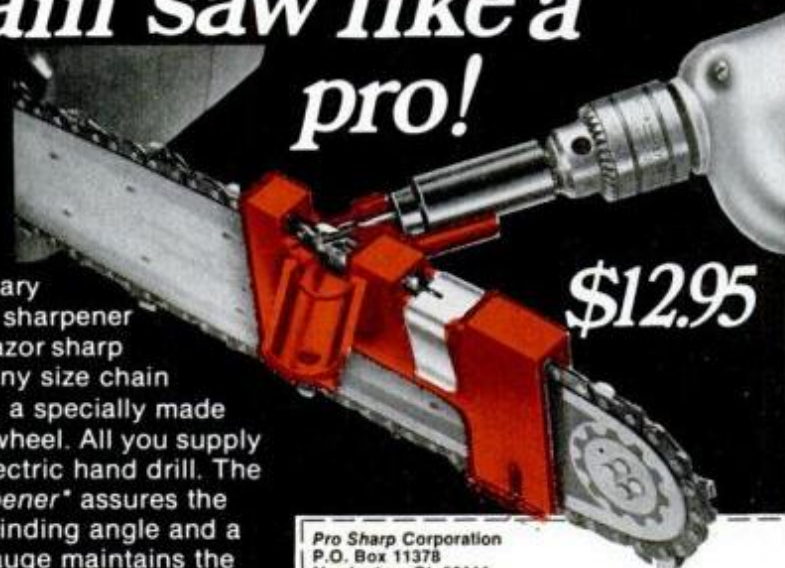
Clothespins clamped to ruled edge of your trimmer make guide stops for cutting printing paper. Use two to cut a sheet in four equal pieces; trim to smaller dimension first.—*John Koncewicz*

Frameless hanging



Borderless, frameless display prints are popular, but hanging them can be a problem. Try this way of sandwiching picture wire to the backs of your dry-mounted photos: Cut a piece of lattice 1 to 3 in. shorter than the photo's horizontal dimension and groove it about 1 in. from each end, just deep enough to accommodate picture wire. Drill a small hole through each groove center; thread ends of wire through and knot them. Glue strip to photo, its center about a third of the way down from the top edge, grooves facing the photo.—*Erwin V. Cohen*

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This revolutionary chain saw sharpener grinds a razor sharp edge on any size chain saw using a specially made grinding wheel. All you supply is a 1/4" electric hand drill. The *Pro Sharpener** assures the correct grinding angle and a built-in gauge maintains the proper guide height.

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*Patents pending

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Saw Model: _____

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PM8

Don't Compromise When You Economize.



**Don't give up
room for six.**

**Don't give up
comfort.**

**Don't give up
big car ride.**

**Don't give up
hip room.**

**Don't give up
leg room.**

**Don't give up
style.**

**Don't give up
economy.**

You're probably convinced that, with a compact wagon, you have to give up what you've come to expect from a bigger car. That's why you

**Volaré. America's
first choice in wagons.**

should see the Plymouth Volaré wagon, America's first choice in wagons over the past two years.

With Volaré wagon you don't give up room for six. Its special suspension system means you don't give up a bigger car ride. And, you don't give up economy.*

Volaré has traditionally been among the leaders in resale value. So why would anyone consider

compromising in order to get economy? We give up.

25/18*
MPG HWY MPG CITY

\$4408**

*EPA estimates based on 225, 1-bbl. engine with manual transmission. Your actual mileage may differ, depending on your driving habits, the condition of your car and its optional equipment. Mileage lower, optional automatic transmission mandatory in California.

**Sticker price including optional custom exterior package and luggage rack. Excluding taxes and destination charges, optional white sidewall tires and deluxe wheel covers (\$82 extra).

Don't Give Up.
Get a New Plymouth Volaré



Wherever you go, it's making a splash. What's behind its super success? Super lightness, superb taste. If that's what you're looking for, set your course for Lord Calvert Canadian.

Follow the Canadian Superstar.

Of some 10,500 objects launched into orbit by mankind since the Space Age began in 1957, more than half have returned to Earth. Most re-entries go unnoticed.

Our growing junkyard in space

Nearly 4500 man-made objects, from golf-ball size to the 170,000-pound Skylab, were in orbit as of midyear. Between working satellites and plain junk, they form a sizable hazard. Here's what we're doing about it.

by Richard F. Dempewolff

When the bits and pieces of Russia's Cosmos 954 satellite, powered by a nuclear reactor, spattered across the Canadian wilderness last January, a lot of people were considerably shaken. What else "up there" might come cascading down on us?

The fact is that there's a skyful of space trash—as well as useful, functioning satellites and

space probes—orbiting the Earth or the moon, or looping around in vast elliptical orbits somewhere out in the solar system.

Since the penetrating *beep-beep* of the first Russian Sputnik stung American pride in 1957, more than 10,500 objects have been launched into orbit by humans. More than half of them already have fallen out of orbit (decayed) and come burning back through the outer atmosphere, blazing fiery streaks across the sky like shooting stars. Space professionals insist that all but a few vaporize and vanish en route. But some re-entries *have* thudded into back yards and towns. In 1970, one scattered white hot metal over Texas, Oklahoma and Kansas, stampeding a herd of Texas cattle. And in 1961 a 40-pound chunk of a United States space probe impacted in Cuba, killing a cow—the

TELEOPERATOR RETRIEVAL SYSTEM (TRS)

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TRS'S FORWARD,
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AND ATTITUDE
THRUSTERS

4 STRAP-ON
PROPULSION
KITS TO MOVE
SKYLAB

SHUTTLE
IN PARKING ORBIT

TRS SELF-EJECTS
FROM CARGO BAY

8 ROCKET ENGINES
FOR PROPULSION KITS

Y A W I C U R E K Y



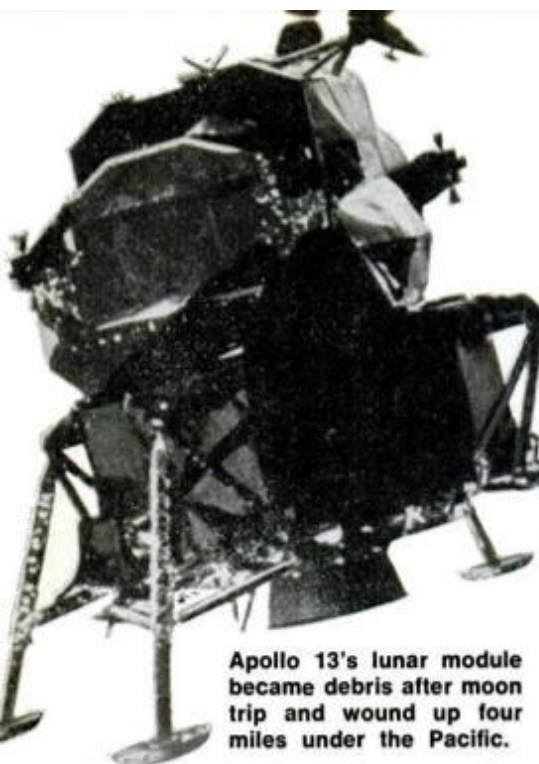
SKYLAB

DOCKING MODULE

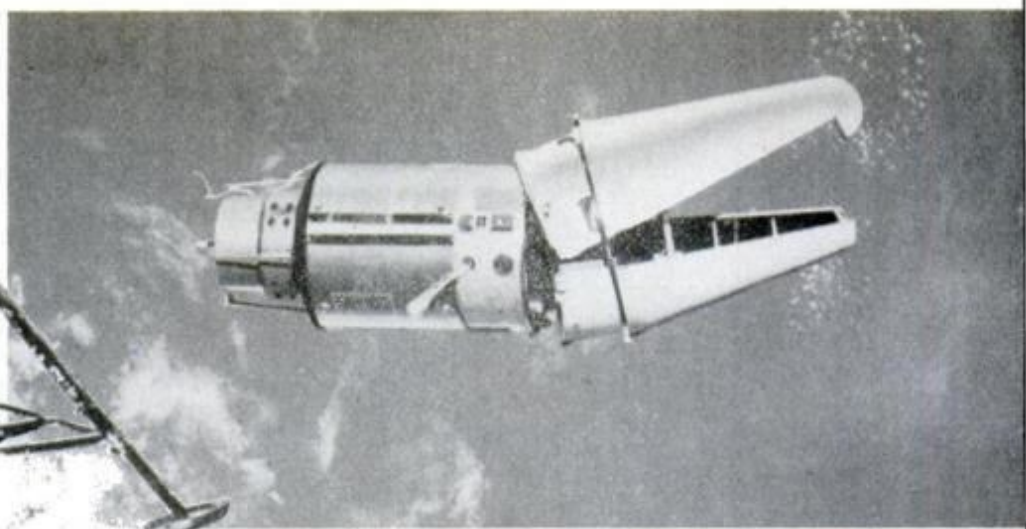
Largest item in the orbiting satellite boneyard is our Skylab. Plans already are in the works to send up a remote-controlled booster on the first Space Shuttle flight, which will attach itself to the big satellite and send it to safe orbit.

TRS, using its own attitude thrusters, will home in on the satellite's docking module even though Skylab may be tumbling, rolling or coning. Using TRS's TV eyes and telemetry a shuttle crewman will control the booster package.





Apollo 13's lunar module became debris after moon trip and wound up four miles under the Pacific.



Named "The Alligator" for shroud that did not eject, Gemini IX joined the parade of space junk for about a week until it finally re-entered and plunged into the sea.

only known fatality. Most returning junk that hits Earth, however, plunges into our world's vast oceans and wilderness.

As of last spring, more than 4500 objects still were in orbit, some 2900 of them U.S. property. Russia can claim some 1450. The rest belong to about six other nations. Most orbiting objects are not satellites, but lost or discarded items from space ventures—plastic containers of human waste and actual garbage that would, indeed, be completely vaporized before reaching Earth's surface; booster rocket shells; nuts, bolts and pieces of orbiters that have broken up. Someplace up there is a perfectly good Hasselblad camera, lost by a space-walking American astronaut who had something more important

to think about when it came loose.

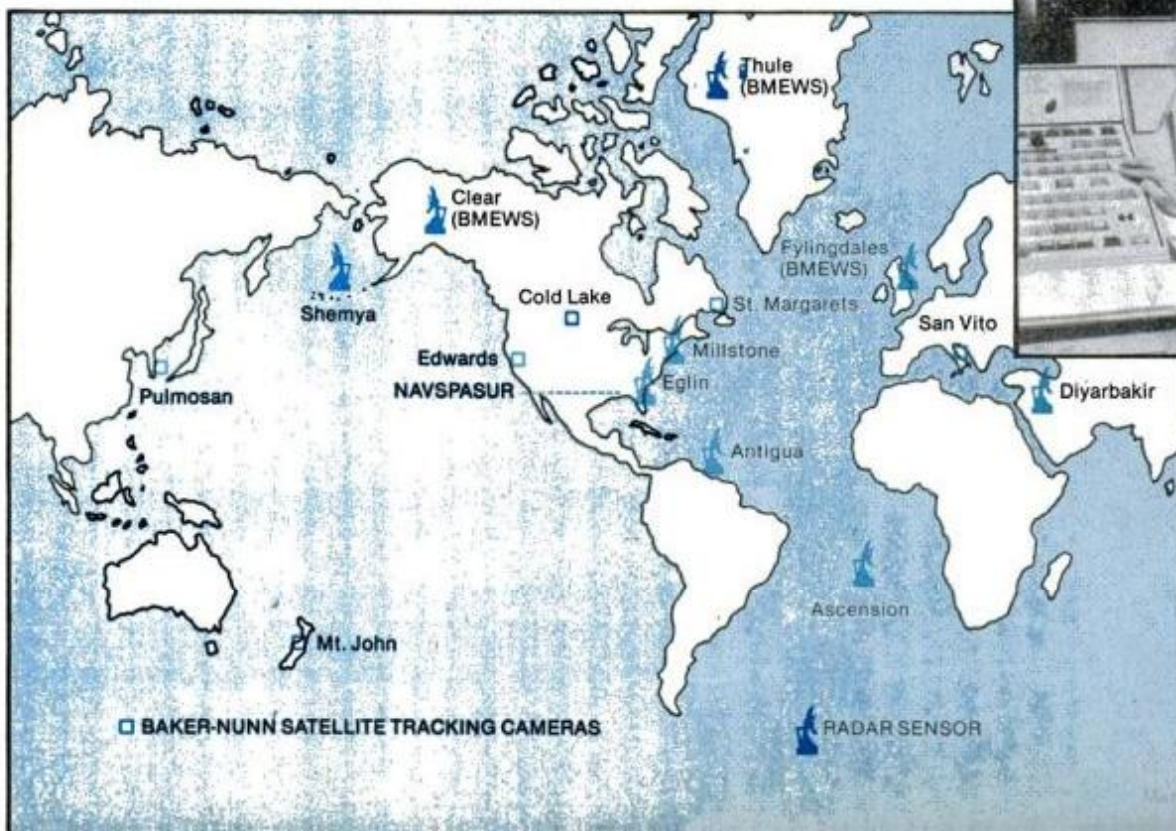
What about that radioactive material? Russia is believed to have put about 16 uranium-fueled satellites in orbit, each with an estimated 110 pounds of the fissionable material powering its systems. These satellites were designed to do their job, then to eject their expended, but still dangerously radioactive, fuel into higher "permanent" orbit. Cosmos 954, one of this series, "goofed."

As of this writing, the United States has nine nuclear-powered satellites in orbit. Eight of them use plutonium sources—nuclear material with a higher hazard potential than uranium. Should the orbit of one of these U.S. or Russian satellites decay and send it crashing to Earth, however, there is virtually no way it could result in a nuclear explosion, space experts are quick to point out, since it takes a highly specialized configuration to detonate a nuclear

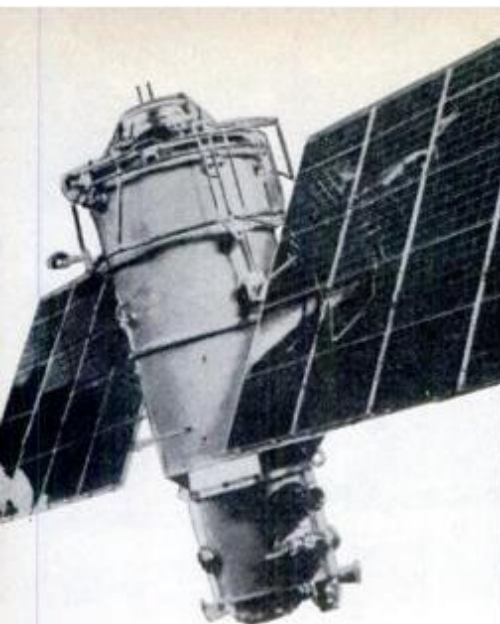
bomb. Actually, three U.S. satellites with plutonium reactors already have splashed in oceans. Though designed to withstand land impact, radiation release could be serious if one ruptured in a populated area.

Largest non-nuclear re-entry expected in the near future is our 85-ton Skylab, launched about five years ago. If left for its orbit to decay under natural forces, the huge satellite—about the size of an eight-story cylindrical section in a grain elevator—will start to enter the Earth's outer atmosphere a year from this autumn. That's five years ahead of schedule. It wasn't supposed to come down for many decades.

Before the last astronauts left in 1974, the satellite was boosted to an orbit designed to keep it up there at least until 1983, when the Shuttle



NORAD's web of radars, cameras and radios makes 25,000 tracking observations daily to keep tabs on all orbiting man-made objects. Data is fed to computers for orbital changes. On the screen (above) radar traces Skylab orbit. Baker-Nunn camera (opposite) can "shoot" a basketball at 20,000 miles.



Russian satellite of the Cosmos series (left) is similar in configuration to one that crashed in Arctic Canada. A NORAD official (right) holds part of Soviet gas bottle recovered in New Zealand.



would be making regular runs. Plans called for the Shuttle to dock with Skylab periodically so crews could install new boosters that would send it to higher orbit on successive 10-year cycles. Only in case of trouble would they direct it to controlled re-entry for a safe mid-ocean demise.

"What happened," a National Aeronautics and Space Administration (NASA) official explained to *Popular Mechanics*, "was a sudden increase in sun spots and solar storm activity, which increased solar radiation. That, in turn, caused the earth's atmospheric molecules to expand higher into space. Hence, the satellite was being subjected to much more drag than NASA scientists first anticipated. What makes it worse is that Skylab isn't orbiting in a nice, neat fore-and-aft posture. One end is tilted upward relative to Earth's surface. On part of every



Service module of Apollo 13 (above) damaged by exploding tank was jettisoned by astronauts and impacted Pacific Ocean.

Launch rockets usually take a trajectory path, return to earth promptly, like 17-foot booster (left) from Gemini VII. Soviet metal spheres (above) found in Spain.

orbit the satellite's entire length is presented to a thin stream of atmospheric gas. That slows it even faster, giving gravity more grip on it."

Presently North American Air Defense Command (NORAD) and NASA scientists are huddled over computers programming new inputs for the satellite's probable re-entry date.

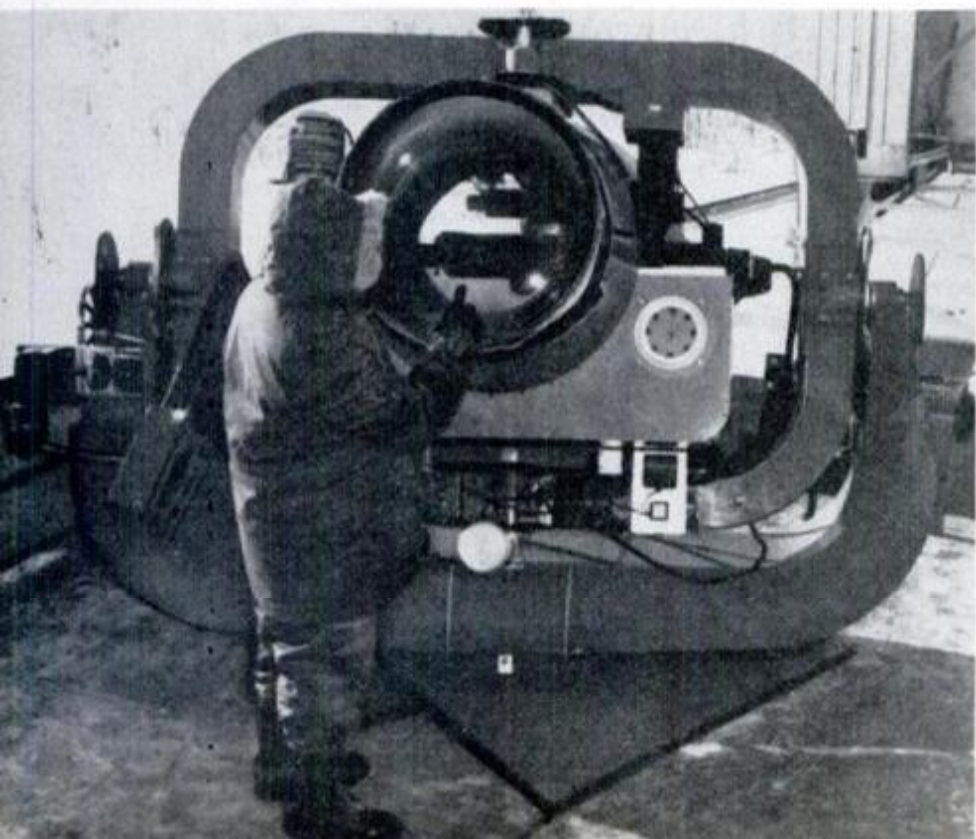
"We came up with different estimates," says a NASA official. "NORAD's people calculated that even if nothing is done at all, there's a 90-percent chance it will still be up there in May of '79; 50-percent in July; 13-percent in December. NASA scientists figure its chances at about 50-50 by October '79."

The same spokesman admits that original plans for the Shuttle to make its first orbital flight next March have run into "slippage" problems—not unusual in the space business, where only perfection is passable. Turbine blade failures, inability of fuel-handling components to operate properly under the required pressures, and other soluble but time-consuming technical problems have plagued the project. But it should be off by October at the latest, according to NASA. And a number of things are in work that may extend Skylab's orbit by many months.

Where will skylab strike?

Why all the concern? While there are no nuclear materials aboard Skylab, the space scientists know that a satellite of its size will not burn up

(Please turn to page 118)





A great house for a keep-fit family

Designed with today's energy-conscious homeowner in mind, this contemporary beauty features space for maintaining family fitness.

Physical fitness has become such an important part of America's modern lifestyle that the demand for exercise opportunities far outstrips public facilities. Our solution—a special PM house design featuring a built-in mini-gym with full workout equipment, plus emphasis on overall conservation of heating/cooling energy.

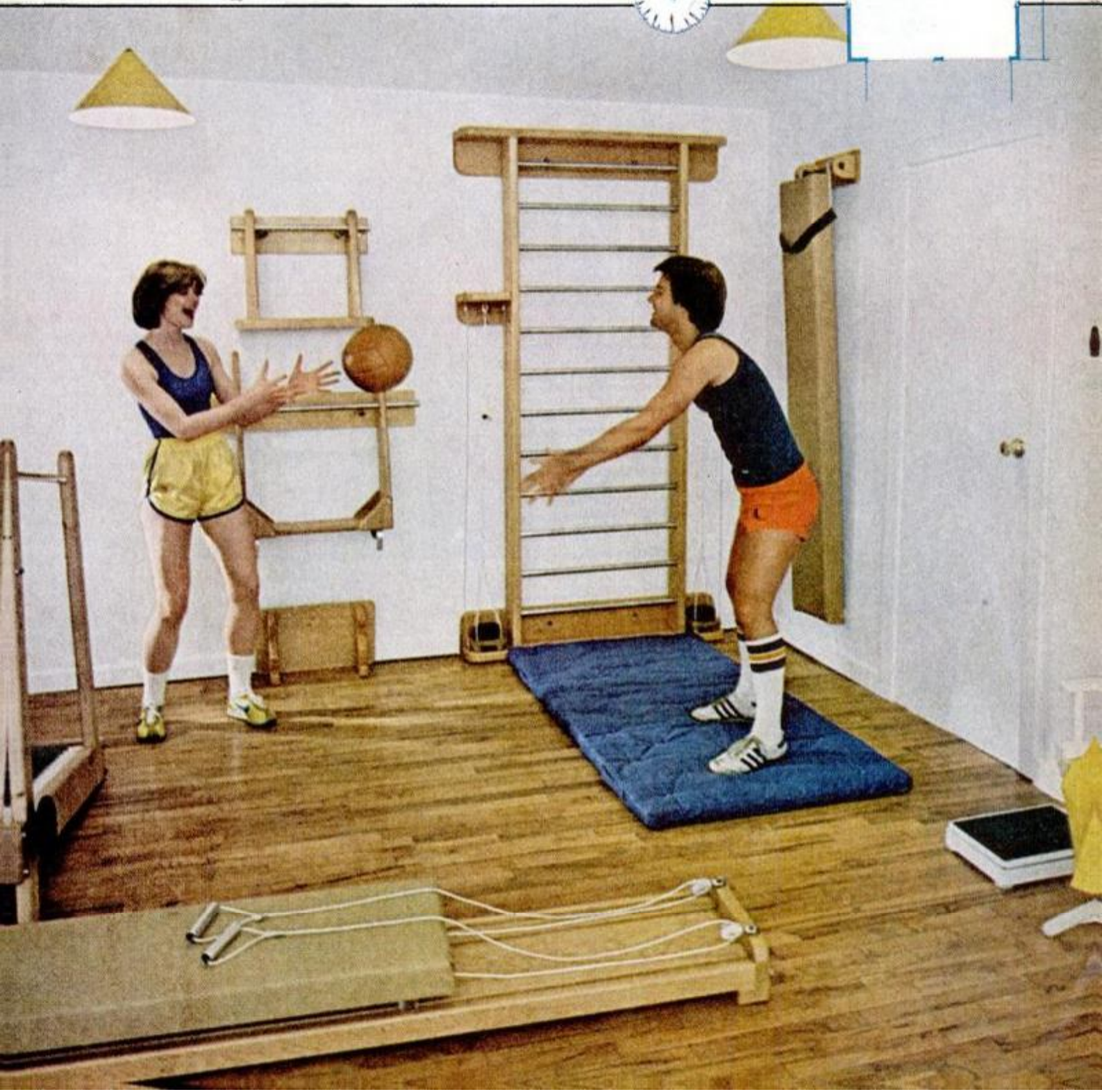
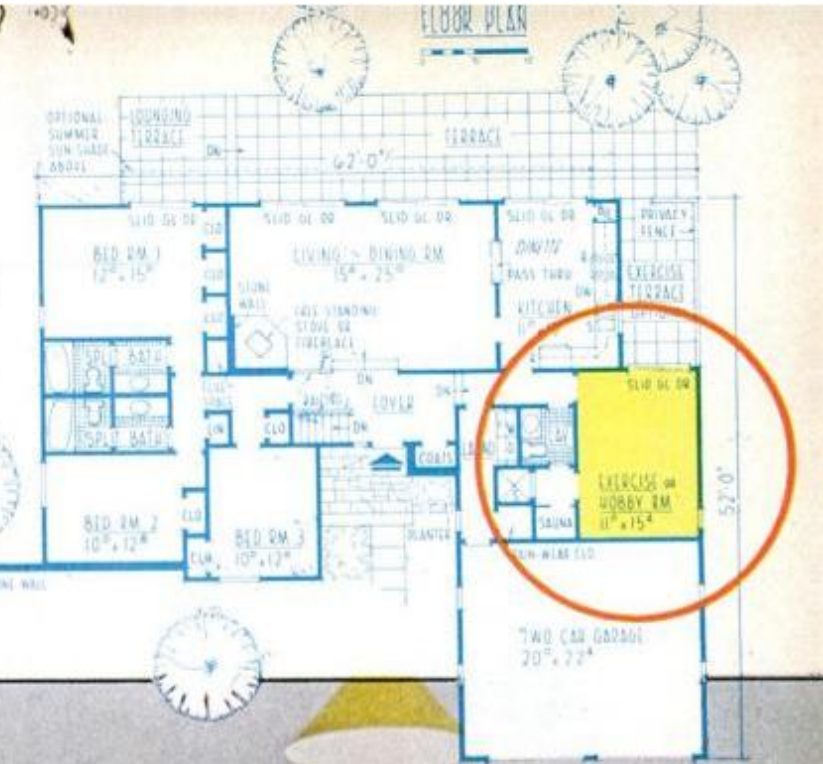
The large workout room that opens onto a private exercise terrace encourages the family to get the kind of physical activity needed to be healthy, fit and trim. The adjoining sauna/shower is an added inducement to use the exercise room. The house has a number of energy-saving features. It is insulated to meet all local building and utility company requirements. Insulating glass is used in all places where glazing is specified. Flat ceilings in all rooms keep warm air close to the floor. Wide roof overhangs reduce penetration of the summer sun's high-angle rays into the house—but allow

House exterior is contemporary in design, utilizing rough-sawn plywood siding and other materials compatible with a natural setting. You can get a view of the wrap-around terrace and back-yard scenery from all major living areas—master bedroom, living-dining room and kitchen (see plan, top right). The house features an exercise room (right) that two persons can use comfortably together. You can build the exercise equipment shown in your home workshop. Full directions begin on page 65.



PM PLAN OF THE MONTH

Four complete sets of 1/4-in.-scale working drawings (including foundation, first-floor plans; front, right-side, left-side and rear elevations; construction section and plumbing diagram), plus specifications, work progress chart and miscellaneous construction details, are \$69; additional sets, \$15 each. (New York residents add sales tax). Add shipping costs: \$2, UPS (where available) or parcel post; \$3, airmail (Canada, \$6); \$2 more for special delivery or c.o.d. To order PM Keep-Fit plans, send check or money order to York and Schenke, Architects, Dept. PM, 226 7th St., Garden City, N.Y. 11530.





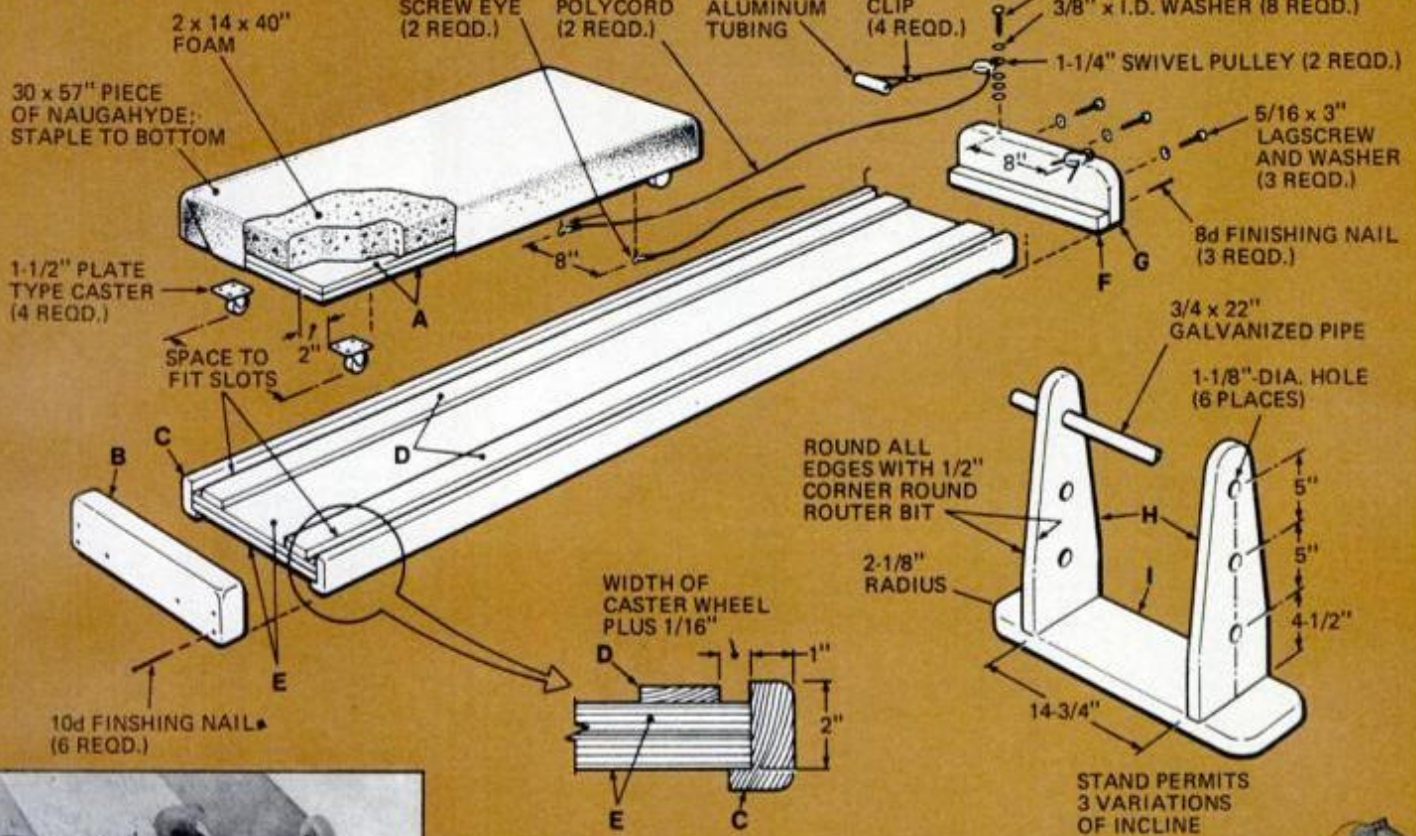
1. In this exercise room a person can use the stall bars unit while another uses rowing machine. 2. Jog on the level or remove the rear support and jog uphill. 3. Use inclined board and bars to do sit-ups, or . . . 4. to lift pulley-weights. 5. Chinning bar also attaches to the unit. See plans for building the equipment on following pages.



the lower-angle winter rays to enter. Other features give the house special appeal for an active family. All rooms are located off a main corridor for efficient traffic flow. There is a corner fireplace or stove in the living-dining room. The dinette-kitchen has windows on two walls and a pass-through to the living-dining room to give it an open, airy look. The house also contains three bedrooms with plenty of closet space, two full baths, one half-bath, a two-car garage and an optional recreation room below bedrooms 2 and 3.

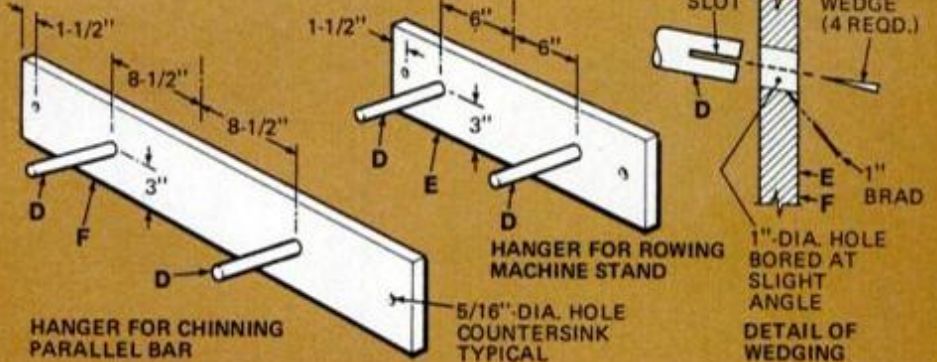
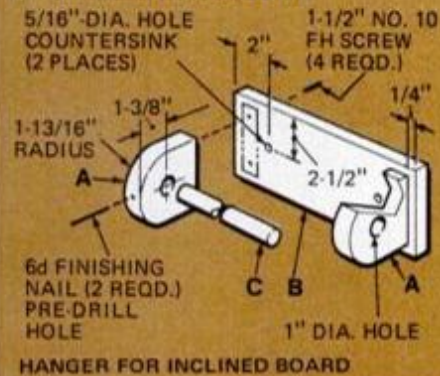
PM photos: Harry Hartman
 Room styling: Gabe Herrick
 Exercise equipment: designed and built by Rosario Capotosto
 Exercise mats and medicine ball: courtesy Gem Sporting Goods, New York.

ROWING MACHINE



Install casters on the dolly (left) so they'll seat perfectly flat. The completed rower (above) is ready for a trial run.

EQUIPMENT HANGERS



MATERIALS LIST—ROWING MACHINE

Key Pcs.	Size and description
A	2 1/2 x 14 x 40" plywood
B	1 1/2 x 3 1/2 x 14" fir
C	2 1 1/2 x 2 1/2 x 84" fir
D	2 3/4 x 1 3/8 x 84" (use waste cut from C)
E	2 3/4 x 12 x 84" plywood
F	1 1 1/2 x 1 1/2 x 14" fir
G	1 1 1/2 x 5 1/2 x 14" fir

ROWING MACHINE STAND

Misc.: 2x14x40" foam cushion; 30x57" piece of Naugahyde; 4 medium-duty, plate-type casters; 2 1/4 x 1 1/2" screw eyes; 14' polycord; 1" O.D. x 10" aluminum tubing; 4 cable clips; 2 1 1/4" swivel pulleys; 2 3/8 x 4 1/2" lag screws; 11 3/8" washers; 3 5/16 x 3" lag screws; 3/4 x 22" galvanized pipe; finishing nails; white glue.

Indoor exercise equipment lets your family stay fit rain or shine. Here are plans for building your own rowing machine, jogger, and stall bars with inclined board and

MATERIALS LIST—EQUIPMENT HANGERS

Key Pcs.	Size and description
A	2 1 1/4 x 3 3/4 x 3 3/4" pine
B	1 3/4 x 5 x 14" pine or fir
C	1 1"-dia. x 13 1/2" dowel
D	4 1"-dia. x 6 3/4" dowel
E	1 3/4 x 6 1/2 x 22" pine or fir
F	1 3/4 x 6 1/2 x 36" pine or fir

Misc.: brads, finishing nails as required; white glue.

chinning-parallel bar attachments. Hangers to store the inclined board, chinning bar and rowing machine stand are also included.

To attach the equipment to the wall, use hefty toggle bolts or install a wooden cleat spanning a pair of studs. Most of the wood used is kiln-dried fir, except where the strength of hardwood is required.

Rowing machine

The rowing machine consists of a sturdy bed, a dolly on casters and an

JOGGER

BEARING, 3/4" DIA. MAPLE
1/4" THICK, 1/4" DIA. HOLE
(32 REQD.)

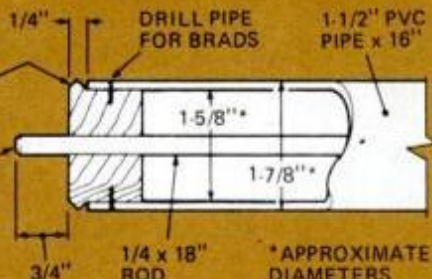


3/8" DIA. HOLE, 1" DEEP
3/4" COUNTERBORE,
1/4" DEEP

DETAIL AA

PLUG A,
SAND OFF
CORNER

BEVEL
ROD ENDS



DETAIL BB, TYPICAL ROLLER (17 REQD.)

5/4" HARDWOOD STOCK

1-5/8" DIA., APPROXIMATELY, TO
MATCH I.D. OF 1-1/2" PVC PIPE

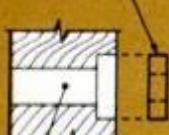


PLUG A, 1/4" DIA. (34 REQD.)
PLUG B, 3/8" DIA. (2 REQD.)
(COUNTERSINK SLIGHTLY)

PROFILE DETERMINED BY
DRILL FLY CUTTER

DETAIL OF PLUGS

BALL BEARING
3/8" I.D., 7/8" O.D.
1/4" THICK
(2 REQD.)



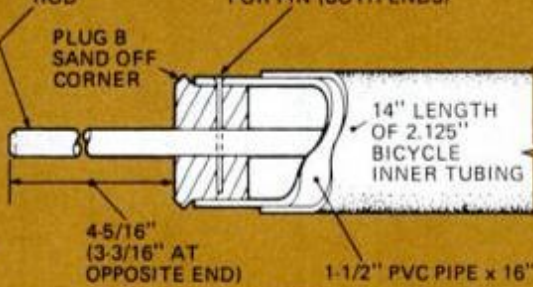
1/2" DIA. HOLE
7/8" COUNTERBORE
1/4" DEEP

DETAIL CC

3/8 x 24" ROD
PLUG B
SAND OFF
CORNER

DRILL AND USE NAIL
FOR PIN (BOTH ENDS)

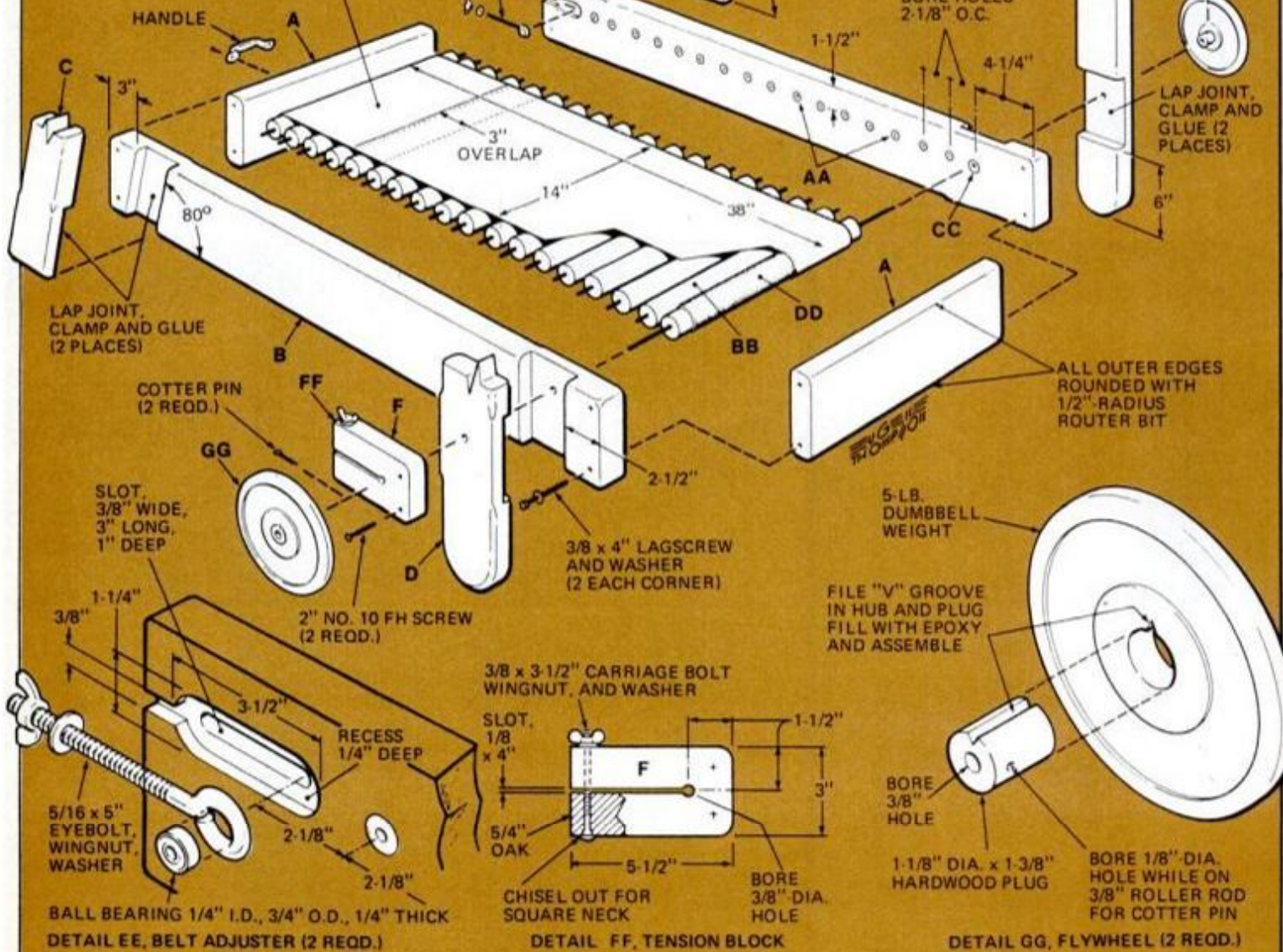
14" LENGTH
OF 2.125" BICYCLE
INNER TUBING



DETAIL DD, FRONT ROLLER

TREADMILL BELT, HEAVY DUTY
COTTON BACKED VINYL, SEW WITH
COTTON COVERED POLYESTER THREAD

HANDLE



3" OVERLAP

14"

38"

1-1/2"

4-1/4"

BORE HOLES
2-1/8" O.C.

80°

3"

LAP JOINT,
CLAMP AND GLUE
(2 PLACES)

3/8 x 4" LAGSCREW
AND WASHER
(4 REQD.)

COTTER PIN
(2 REQD.)

GG

LAP JOINT,
CLAMP AND GLUE
(2 PLACES)

6"

ALL OUTER EDGES
ROUNDED WITH
1/2" RADIUS
ROUTER BIT

5-LB.
DUMBBELL
WEIGHT

FILE "V" GROOVE
IN HUB AND PLUG
FILL WITH EPOXY
AND ASSEMBLE

BORE
3/8" HOLE

1-1/8" DIA. x 1-3/8"
HARDWOOD PLUG

BORE 1/8" DIA.
HOLE WHILE ON
3/8" ROLLER ROD
FOR COTTER PIN

2-1/2"

3/8 x 4" LAGSCREW
AND WASHER
(2 EACH CORNER)

2" NO. 10 FH SCREW
(2 REQD.)

1-1/4"

3-1/2"

RECESS
1/4" DEEP

5/16 x 5" EYEBOLT,
WINGNUT,
WASHER

2-1/8"

2-1/8"

3"

1-1/2"

SLOT,
1/8
x 4"

5/4" OAK

CHISEL OUT FOR
SQUARE NECK

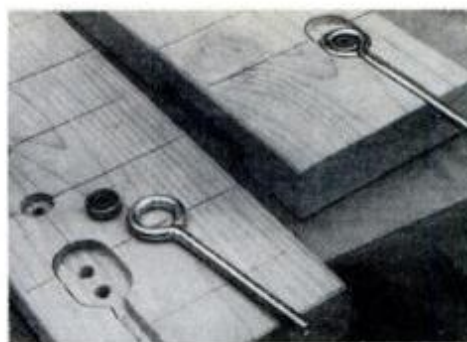
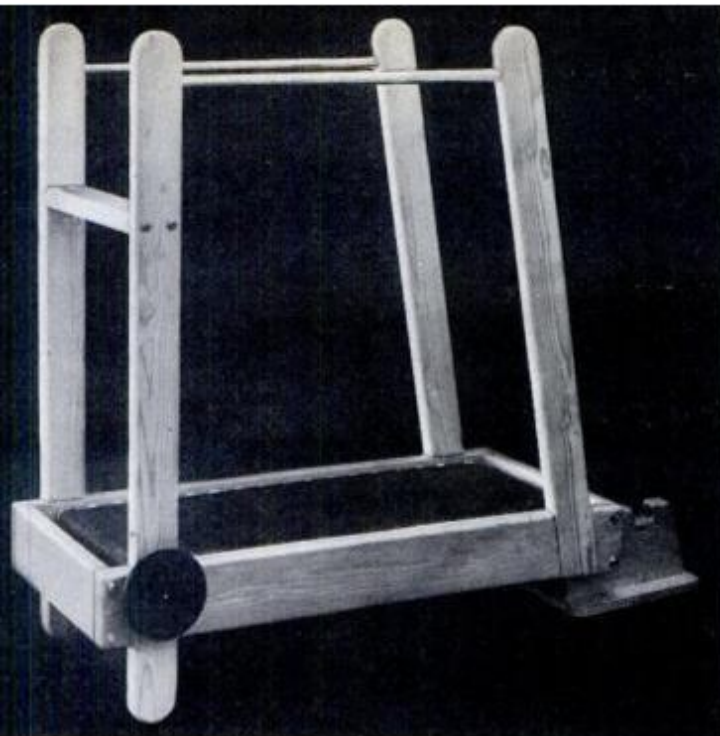
BORE
3/8" DIA.
HOLE

5-1/2"

DETAIL EE, BELT ADJUSTER (2 REQD.)

DETAIL FF, TENSION BLOCK

DETAIL GG, FLYWHEEL (2 REQD.)



Belt on the finished jogger (far left) must fit tightly because it will loosen slightly with use. The small clearance holes (shown at left and in Detail EE) must be elongated to form a slot. You can do this by drilling overlapping $\frac{3}{8}$ -in. holes.



Bearings are made by slicing $\frac{1}{4}$ -in.-thick pieces bologna-style from $\frac{3}{4}$ -in. maple dowel. Use minimum glue to avoid excess squeeze-out) to fix bearings in counterbores. Bore $\frac{1}{4}$ -in. centerholes in bearings, using simple jig (see text). Use awl to keep slices secure.



adjustable stand that varies muscular effort. You can build the unit for about \$36.

Begin by gluing boards together to form the bed. You can do this without using clamps by driving $1\frac{1}{4}$ -in. nails slightly angled from both sides. If you don't have a table saw to make rip cuts to form rabbets for the side rails, glue a $\frac{1}{2}$ x $\frac{1}{2}$ -in. strip to a piece of 2x3. Compression cable clips secure the loose ends of the knotted nylon or polypropylene (poly) cords.

Apply two coats of a satin-finish varnish such as Pierce and Stevens Wood Lore. Between coats sand lightly, dust and tack off.

Jogger

Build this unit for about \$65, and jog in your home. Jog without the accessory stand on a 6-in. incline for maximum challenge. Rest the rear of the unit in the low notch of the stand for a 3-in. incline, or in the top notch for level jogging.

Rollers are PVC plastic water pipe that is strong and easy to cut. Front and rear rollers turn on ball bearings; all the others ride on maple dowel bearings. Hardwood end plugs and steel rod combine with the plastic pipe to make an efficient roller.

Traction between the front roller and the treadmill is achieved by stretching a piece of bicycle tire tube over the primary roller (which would otherwise be too smooth). Two 5-lb. weights serve as flywheels. A friction adjustment on the front axle controls the tension of the jogger. Tightening wingnuts on the bearing rods at the rear tightens the belt and controls tracking.

Begin by cutting the side rails and verticals. Test fit as you mark the rails to bore for bearing holes. A jig made of scrap wood permits precise boring of the maple dowel bearings. Bore a $\frac{3}{4}$ -in.-diameter hole $\frac{1}{8}$ in. deep in scrap wood clamped to the drill press. Then change bits, insert dowel slices in the recess and bore center holes.

Use a band or circular saw to cut PVC to length and sand the edges to remove fuzz. Cut pipe plugs and steel rods.

Test-assemble rollers to mark the belt for sewing. Install the belt before you attach the verticals.

When tightening the lagscrews of the side rails, don't glue the joints. This will let you disassemble the jogger if needed. Attach the tension block without glue as well, then add the fly wheels. Make the stand as shown. Then apply two coats of a clear satin-finish varnish.

If you have trouble obtaining bearings send \$7 (postpaid) to Ca-

(Please turn to page 148)

MATERIALS LIST—JOGGER

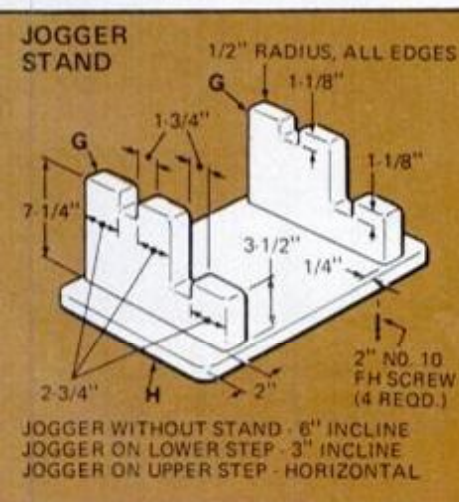
Key Pcs.	Size and description
A 2	$1\frac{1}{2}$ x $5\frac{1}{2}$ x $16\frac{1}{2}$ " fir
B 2	$1\frac{1}{2}$ x $5\frac{1}{2}$ x 44" fir
C 2	$1\frac{1}{2}$ x $3\frac{1}{2}$ x $43\frac{1}{2}$ " fir
D 2	$1\frac{1}{2}$ x 48 $\frac{1}{2}$ " fir
E 1	$1\frac{1}{2}$ x $3\frac{1}{2}$ x $16\frac{1}{2}$ " fir
F 1	$1\frac{1}{16}$ x 3 x $5\frac{1}{2}$ " oak

JOGGER STAND

G 2	$1\frac{1}{2}$ x $7\frac{1}{4}$ x $11\frac{3}{4}$ " fir
H 1	$\frac{3}{4}$ x $12\frac{1}{4}$ x 20" plywood
Note: All fir should be kiln-dried.	
Misc.: $\frac{3}{4}$ "-dia. maple dowel for bearings; $5/4$ " maple for plugs; 25' of $1\frac{1}{2}$ " PVC pipe (schedule 40, thick-wall type); 2.125"-dia. x 14" bicycle inner tubing; 56" x 1"-dia. aluminum tubing; metal cabinet door handle; 30x54" heavy-duty cotton-backed vinyl; 1 $\frac{3}{8}$ "-dia. x 24" steel rod; 17 $\frac{1}{4}$ "-dia. x 18" steel rods; 2 5 lb. barbell weights; 2 ball bearings $\frac{3}{8}$ " I.D., $\frac{3}{8}$ " O.D., $\frac{1}{4}$ " thick; 2 ball bearings $\frac{1}{4}$ " I.D., $\frac{3}{4}$ " O.D., $\frac{1}{4}$ " thick; 2 cotter pins; 12 $\frac{3}{8}$ x 4" lagscrews; 1 $\frac{3}{8}$ x $3\frac{1}{2}$ " carriage bolt; 3 $\frac{3}{8}$ " wingnuts with washers; 6 2" No. 10 fh wood screws; 2 4d finishing nails; 68 $\frac{1}{2}$ " wire brads; epoxy.	



Press plugs into pipe ends using a bar clamp, or tap the plugs in with a mallet.



In search of the ultimate back-yard barbecue

The back yard can be a perfect retreat for lounging and casual entertaining during the dog days of August. Whether you plan to entertain a few friends or the neighborhood there's an outdoor grill that's right for the job and accessories that can add to the success of the event.

An outdoor barbecue where the cook is part of the party and everyone has a hand in helping with

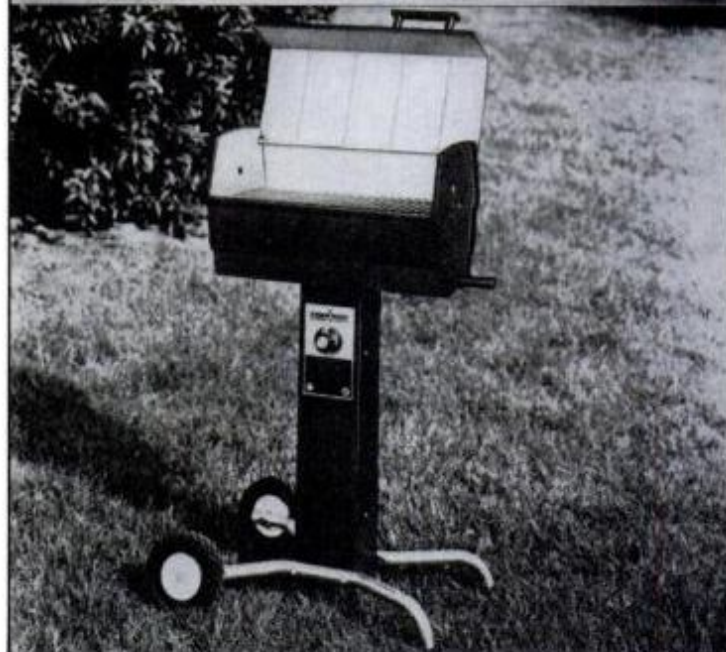
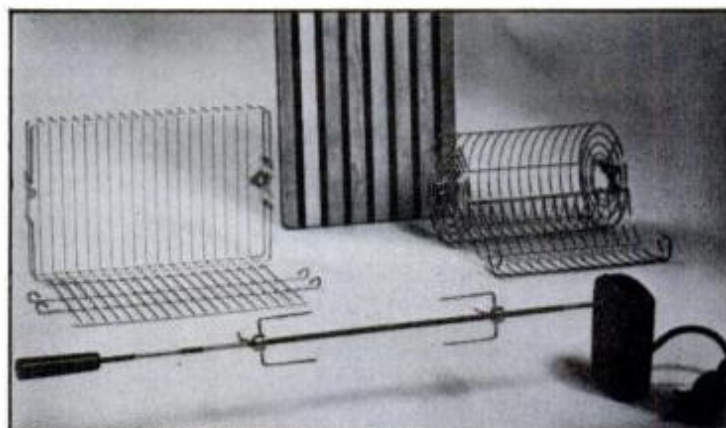
the meal is enjoyable for all. Using a brazier, a few basic tools and some supplies, you can prepare a variety of foods.

The best brazier for you depends on the time you want to spend preparing the food, the amount of food you usually cook and the accessories you want. Your choice of braziers ranges from a simple charcoal unit that's a fire bowl and a cooking grid to the gas and electric

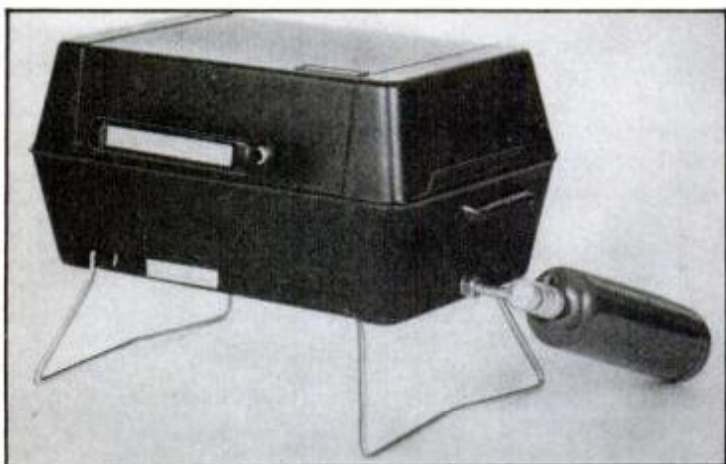


Barbecue, smoke, roast, steam and cook shish kebabs in Mr Meat Smokers. Charcoal unit (front) is \$55; electric one is \$100. Smoker Products, Box 7007, Dallas, Tex. 75209.

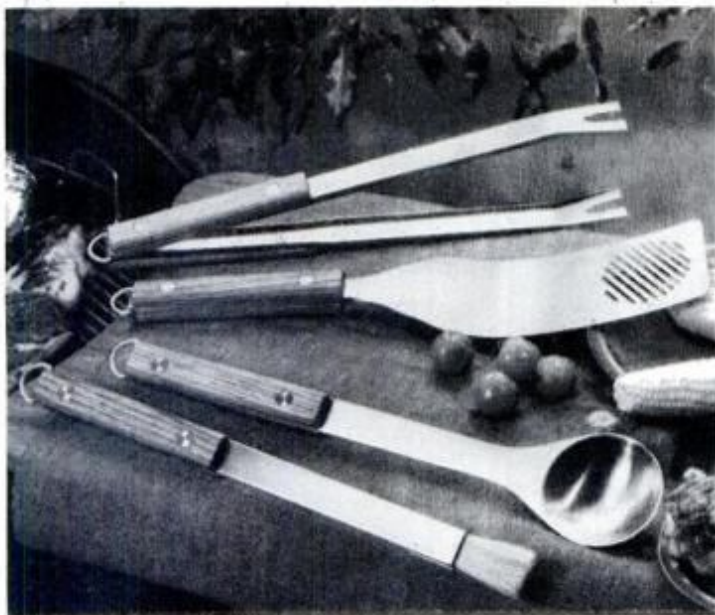
The king-size Mecco model 7048 porcelain gas cooker has a 20-inch square cooking grid that holds up to 30 hamburgers. Priced at \$222, it is designed for use with LP or natural gas. From Mecco, Box 3005, Greeneville, Tenn. 37743.



Cook outdoors conveniently with the new gas grill accessories (above) from Arkla. The rotisserie is \$28, flat and round tumble baskets are \$9 each and hardwood shelf-cutting board kit is \$30. The new Tag-Along gas grill (directly above) is a single-burner model priced at \$80. It conceals a propane bottle in its base and has a chrome-plated 9x17½-in. cooking grid. Arkla Industries, Box 534, Evansville, Ind. 47704.



You can cook efficiently for a small group with this tabletop propane gas grill. The grid has 168 sq. in. of cooking area. Heat-radiating permanent volcanic rock comes with the unit. Cost is \$60 from Structo, Freeport, Ill. 61032.



Handsome and sturdy barbecue tools made of brushed stainless steel with oak handles and aluminum hanging rings are 18 in. long. They're sold individually for \$8 to \$10 or in sets at a savings. Fork and grill-scraper tools also available. Accessories include safety matches, fire lighter and bag of hickory chunks. Christen, Inc., 59 Branch St., St. Louis, Mo. 63147.



Enjoy your patio free of mosquitoes with the Screen-a-brella, a nylon screen with vinyl border that drapes over 5- to 9-ft. diameter umbrellas. Rods to extend screen diameter included. Cost is \$50 from M-P Corp., 6466 Chene St., Detroit, Mich. 48211.

braziers that have many optional accessories. All types of braziers—charcoal, gas and electric—have models that range in size from tabletop units to oversize ones.

Smoke ovens are a type of charcoal brazier that incorporate a water pan positioned over the charcoal. Once set up, you can leave these charcoal-water cookers for several hours depending on the meat you use. A disadvantage of charcoal is that it takes at least half an hour after lighting to heat for use.

Gas grills initially can be more expensive than charcoal ones, but

are generally less expensive to operate. They come with permanent volcanic rocks that cook food by radiant energy. Speed is the feature attraction of these grills. In 10 minutes or so the rocks are hot enough to cook food. Clean-up is easy; there is no messy charcoal.

Electric grills cost more to buy but less to operate than charcoal units. The electric units also come with lava rock which heats quickly. The major drawback is that an outdoor electrical outlet must be handy.

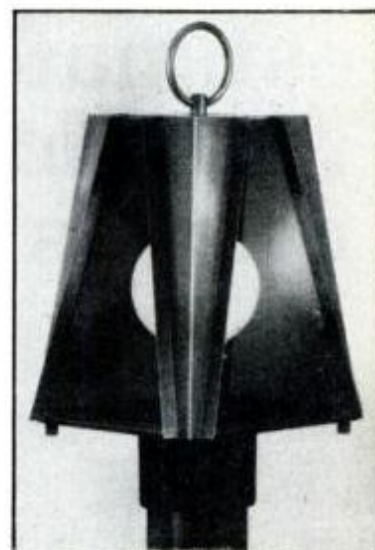
A set of outdoor cooking utensils stored together is a great convenience.

Long-handled tools are particularly good. A meat thermometer, skewers, asbestos mitt and basting brush are also helpful. Heavy-duty foil is invaluable for lining a charcoal pit, making drip pans and wrapping food for grilling. A handy work surface—simply a pair of sawhorses topped by plywood—where you can place food, seasonings and utensils is another aid.

Good food and friends make a successful barbecue. Keep surroundings simple, have good seating and light for night parties, and your gatherings will be memorable. **PM**



Turn a gas lamp into an electric one to go on at dusk, off at dawn with Intermatic's photo control kit, \$20. Run an electric line to light, remove the gas mantle and fixture (left), add control, bulb (top). Intermatic, Inc., Spring Grove, Ill. 60081.



Light your patio in a contemporary way with this sculptured lampost lantern by Thomas. Solid brass lantern, ticketed at \$73, has smoked glass panels and black post. Thomas Industries, Inc., 207 East Broadway, Louisville, Ky. 40202.

It's old hat by now, but the EPA again promises more gas mileage than cars actually deliver.

In this instance, 18.5 percent of the Pontiac LeMans owners we surveyed said they had expected better fuel economy, based on predictions by the EPA.

Not that the LeMans guzzles gas. Most owners reported around 20 mpg on the highway. For a car of this size and power, that's not bad. But the Environmental Protection Agency projects an average of 25 mpg highway.

The disappointment of lower-than-expected mpg is more than overshadowed by good feelings for the car.

As always, we surveyed 1000



Pontiac styling sold most owners on LeMans. Size ranked a close second.



owners, chosen at random from the R.L. Polk registration lists. For an accurate look at how LeMans owners feel, we'll review 12 representative responses to the survey.

First, a Wisconsin municipal employee, aged 29, owner of a Safari wagon with the 231-cu.-in. V6: "I bought the LeMans wagon because I like the styling and the fact that this is a fairly heavy small car. Also, the deal from the dealer was excellent. I've had no mechanical problems so far but know this dealer and would rate his service department as average—it usually takes a couple of trips to get something fixed right. Workmanship rates good, but if

you really look at this wagon you'll see a lot of little things overlooked—trim, paint, etc. I particularly like the fact that this is a heavy, sound car; also the ride and styling. I'm not overjoyed with workmanship; also would appreciate roll-down rear side windows. But overall it's a good automobile. . . ."

A Michigan graphic designer, 56, driver of a LeMans sedan with the 305 V8: "I was attracted to the



Good rear and side protection come via moldings that circumscribe body.

car because of its new and elegant overall design; also because of its downsized scale. Unfortunately the car came with several defects, among them a broken rocker-shaft stud that could have caused total engine failure. The dealer also had to replace the battery and fix the speedometer cable, which broke twice. I'd call

BY MICHAEL LAMM WEST COAST EDITOR

If only EPA mileage estimates were more realistic . . . muse owners

Over half our respondents ordered the 305-cu.-in. V8, reported good performance.

Wraparound lamps front and rear make sidemarkers unnecessary.

Standard disc brakes give excellent stopping power, say owners.



Photos by Bill P. Maduros



Despite LeMans downsizing, interior roominess has been increased for '78.

the dealer's service department average, but the sales staff is excellent—very courteous and helpful. I find comfort very good front and rear—it's quite a roomy car. However, the digital clock is too far from the driver, and I'd rate workmanship poor. Even so, you can't beat the LeMans's appearance, the design, the size, and the two-tone color scheme."

A Colorado store manager, 48, the owner of a 305 V8 sedan:

"I've always liked Pontiacs and was attracted to the new mid-range GM size. No repairs needed yet, and service work was completed fine. Am getting 18 to 22 mpg so can't complain on that score. Dealer is good at scheduling. Quality and workmanship are excellent. Everything seems solid, very quiet-running, no road noise. If I could change the car, I'd get rid of the Mickey Mouse spare tire and put in roll-down windows. But



Rear quarter panes flip open to aid airflow, may be ordered with power.

the LeMans really comes through in terms of comfort, economy and appearance."

An Indiana housewife, 46, again with the 305 V8 in a four-door sedan: "I bought this LeMans because my previous one rarely needed to be repaired. Also I like the way this new car's seat fits my back. My only complaint is that I would like a wider choice of colors for the interior, specifically white. But I've had no mechanical troubles and rate the dealer excellent, although not as good as he was several years ago. I particularly like the LeMans's low maintenance, its comfort and silence, good styling, lots of headroom and that it's easy to park."

A Wisconsin secretary, 31, owner of a LeMans coupe with the 305 V8: "I bought this car because I wanted more room than a compact, but not a full-sized car. The LeMans has nice styling, in my opinion.

"The dealer seems average—very polite, but not anxious when it comes to warranty work. I've had no repairs so far. Workmanship is average; you surely don't get a quiet-riding car. On my car, the windows leak, there are rattles, and the paint seems thin. But I'm basically satisfied. What I espe-

A NATIONWIDE SURVEY BASED ON 1,229,307 OWNER-DRIVEN MILES

Many grumbles centered on fixed rear side windows.

Owners praise trunk capacity but would prefer conventional spare tire.

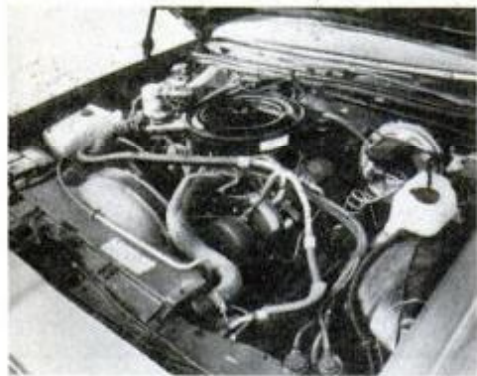


Shorter wheelbase and less overhang lops a foot and 500 pounds off last year's LeMans sedan specs.

cially like is the sweet way it runs, the classy styling inside and out, and the handling. From outside, the LeMans looks like you're driving a smaller car. From inside, it feels like a big one—very roomy."

Next a retired lowan, 72, with the 301 V8 in a coupe: "I've owned 34 other Pontiacs and found them all to be okay. This LeMans has an excellent engine and fair bodywork. Dealer had to take out some dings and do some painting before I took delivery. His service department is excellent. I'm not much for these plastic grilles and plastic tail-lamp guards. They don't help in a collision and cost a lot to repair. But the car performs beautifully in the city or country, gets 15 to 20 mpg now and will do better after I put on more miles."

And a Texas computer operator, 29, with a 305 coupe: "The LeMans has a more original design than other midsized cars. We've always



Access would improve if unused space ahead of engine could be alongside.

had good luck with Tempests and LeMans—this is our fourth one.

"Of mechanical problems, the plastic flywheel cover warped, hit the flywheel and put the car out of commission. The dealer tends to be average. I've had the car in four times to correct a wind whistle, but it's still there. Despite these ills, I'd say workmanship is excellent. Everything functions very well and is well placed. Comfort is very good up front and good in the rear seat, too. I'd suggest no changes—let's leave a good car alone. I've got no complaints other than the wind whistle, and as for praises, the car handles extremely well in traffic, it's easy to park, has excellent pickup for a small V8, runs quietly and idles smoothly."

An Alabama electronics technician, 65, with a 305 sedan: "I bought this car after taking one look at the interior. It's got the best, plushiest inside finish of any car in its class.

The windshield leaked when I got the car, but the dealer fixed it

(Please turn to page 140)

PM's 8000-mile Safari

PM photo: Chris Hartford



Optional on the Grand LeMans Safari: woody trim, cast-aluminum wheels

After logging 8000 miles on 504.3 gallons of lead-free and two quarts of SAE 10W-40, we, too, got some impressions of our Grand LeMans Safari with 305-cu.-in. V8, 2-bbl. and automatic transmission.

The average mpg for our mix of urban and suburban and some interstate driving was 15.86 (best run was 19.68 mpg for 224 miles at a steady 50 mph). Compare these figures to 15.7 and 20.5 mpg our survey owners got from their 231-cu.-in. V6s with manual transmissions. The result convinced us that you should get the smooth and powerful V8 powerplant while GM is still making it. With the V8 option (\$150) the wagon is a sporty machine indeed, and if you're hitched for trailer, you'll have no worries about the strain of towing.

Our Grand LeMans, hardly a fusty family wagon to begin with, started down the assembly line as a reasonably priced \$5264.78 Safari, but took on \$3158.12 worth of options—including AM/FM/CB (which alone is \$571), bucket seats, console and other comfort, convenience and trim groups. The result proved a knockout with every man jack we know—and quite a few ladies, too—who likes cars with style.

Indeed, the wagon's style or, rather, its overall *design* is what prompted us to try this resized GM intermediate, which we borrowed from Pontiac Motor Div. We found that, at last, an American car-builder is making a wagon that's compact in size, but intermediate—almost full-size—in ride and comfort, and one that is available with the most luxurious of appointments. The Safari proved smooth on Interstates and (with the RTS rally handling package) nimble on narrow twisting roads.

Although we, like LeMans owners, had hoped for better mpg, we consider the fuel economy reasonable for a wagon equipped with V8, automatic transmission, air-conditioning and power everything. In Florida we found the air-cooling capacity more than adequate and the automatic temperature control a luxury. Ventilation is superb, and we back GM in their decision to go with fixed glass in the rear doors.

Our complaints about the car are confined to nit-picking about things that are easily remedied (glovebox jammed closed due to sticky catch, wind whistle from improperly seated rear quarter windows . . .). We experienced no mechanical troubles and found paint, trim and assembly quite



Interior option is same as on Grand Prix.

good. Facia design of the AM/FM/CB is poor, since it's impossible to see the CB channel indicator from the driver's seat.

After thousands of miles of jump-in-and-go, trouble-free driving, we grumbled at having to drop the car for its only required service—an engine oil change at 7500 miles. They really are making 'em better than they used to, you know.—B.H.

New rigs for outback action

Work trucks that can play are among our newest RVs.

When the action's out beyond the end of the pavement, what should you drive? A lot of today's auto shoppers seem to think their next set of wheels should ride like a car, look like a truck, and double as a work-play vehicle.

It doesn't necessarily need the four-wheeled footing of a mountain goat, but it should be able to lug an oversize load of cargo or tow a big trailer that might strain some new little compacts. This is the message of booming light truck sales.

Sometimes a station wagon is the answer, or a hatchback that can open extra wide to take a load of gear. Look at Pinto, Volare, Aspen or the imports for mini-wagons to carry oversize objects. The bigger sub-urbans and station wagons—like Chevy Malibu, Ford Fairmont and LTD, Pontiac Safari, Olds Custom and Cutlass Cruisers, AMC Hornet Sportabouts, Dodge Sportsman and Maxi-wagons and Ford Econoline and Super Wagons—show the ways you can ride in something that looks like a passenger car outside



Chevy's Silverado seems like a full-size pickup until it parks beside Euclid's Offroad 100-ton "pickup" (18x18x34 feet and only \$390,000).

showing up in pickup trucks. For small-size cargo needs, mini models like Courier and Luv, Datsun's Lil' Hustler and Subaru's new Brat are among models to be considered. Standard pickup trucks for bigger loads also have the necessary heavier suspension. On smooth pavement, most trucks give a similar ride. Turn off onto gravel, dirt or woodland logging roads, however, and a big truck without a load can give a stiff-legged ride that rattles the teeth. Too much gross-vehicle-weight capacity makes little sense if you're never going to use it, and the compact size would also meet your needs.



Ford has stretched its Econoline Vans and Club Wagons. Super Van and Super Wagon (above) have 14-foot cargo floor, can seat 15 passengers, carry 5025 pounds or tow trailers weighing 10,000 pounds.

Even small rigs are adding passenger space; the Datsun King Cab has reclining bucket seats; standard-size club cabs can seat you plus four. Small in capacity but large in traction are the four-wheel-drive (4wd) Jeep, Blazer, Toyota Land Cruiser, Bronco, GMC, Scout and Ram Charger, plus Jeep and Scout 4wd pickups,

but can seat 15 or carry a Boy Scout troop's camping gear.

Panel trucks and vans fixed up for recreation are not new, but plush options—shag carpets, stereo, airconditioning and reclining seats—are now

Dodge and Plymouth 4wd Champion and Charger vans. Full-size pickups can also sport 4wd—and enough roll bars, exhaust stacks and such to put them among this year's sportiest rigs. —Bill McKeown, RV Editor

Cargo rigs get smaller, too; the little Pinto panel delivery wagon can haul equipment during the week, camping gear on weekends; has regular Pinto options and four-cylinder power.

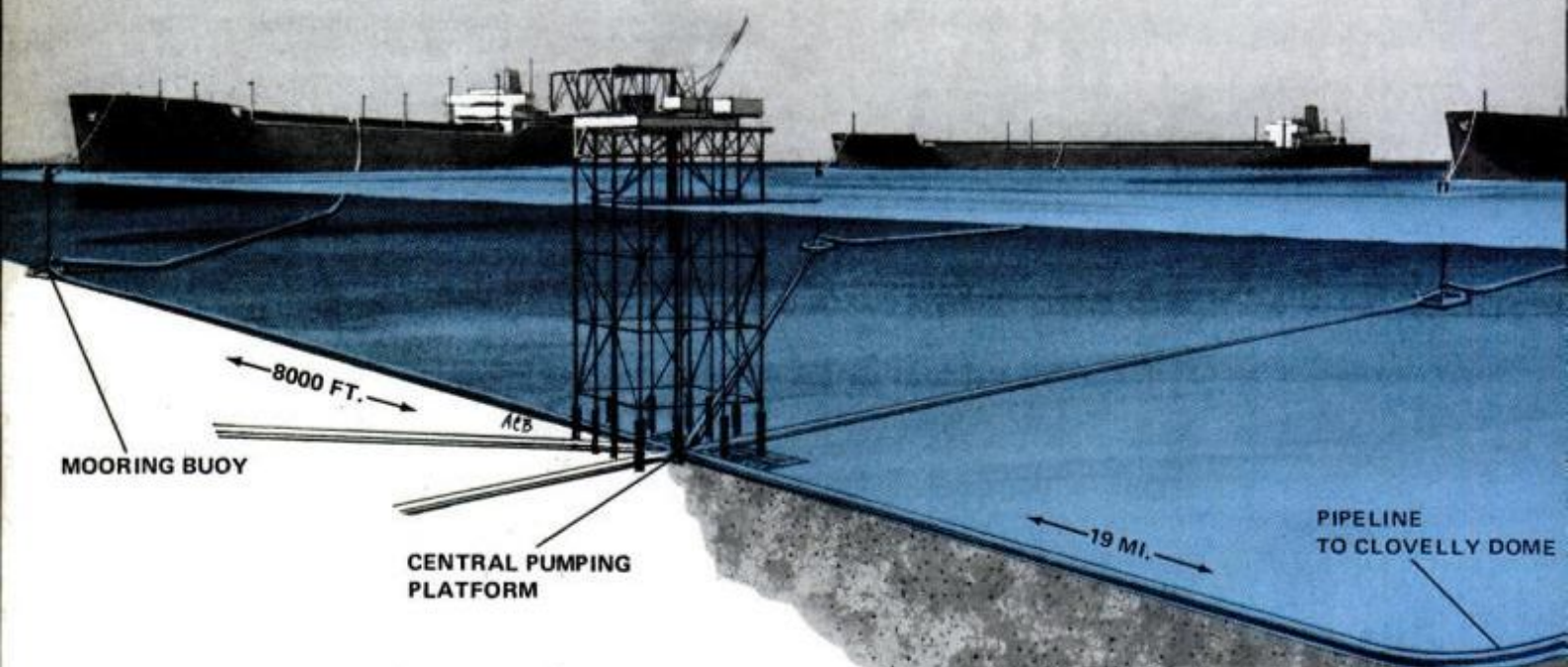


The sportiest pickup, Chevy's El Camino, has a new "Black Knight" Super Sport option package in black with gold striping, hood decal, sport mirrors, front air dam, rally wheels in gold.



What a Ford Bronco XLT, International Scout Terra, Jeep, Chevrolet and Ford pickup (from right to left) have in common are

Uniroyal Laredo offroad tires. Goodyear, Firestone and General are also producing rugged rubber for this growing market.



Our first 'oil port' will go to sea

Not only that—we'll take petroleum from supertankers and put it back into the ground

by Richard Petrow

Sometime in the fall of 1980 the first supertanker to use America's initial offshore oil port will slow to a stop in the warm waters of the Gulf of Mexico, some 19 miles off the coast of Lafourche Parish in southwest Louisiana.

Under directions from a mooring master, specially trained in maneuvering supertankers in restricted waters, the mammoth ship, 12 stories tall and more than three football fields in length, will inch toward one of three special mooring buoys.

Thus will start a new phase in the delivery of crude oil to the United States, for when Louisiana's Offshore Oil Port (LOOP, as it's called by oilmen), goes into operation, giant supertankers will be able for the first time to transport Mid-East oil directly into a U.S. port.

Larger than the biggest aircraft

carriers, capable of transporting from 160,000 to 320,000 tons of oil, these supertankers which are officially classified as VLCCs (for very large crude carriers), are today barred from all American ports. Not one is deep enough for them.

For years we have talked about building offshore oil ports for supertankers. For years, however, the VLCCs have had to continue off-loading their oil in one of two ways: Either they discharge it at terminals in the Caribbean, where it is transferred to smaller tankers for delivery to U.S. ports, or they transfer the oil at sea into smaller tankers—a procedure known as "lightering."

Now, after five full years of study, construction has finally been started on the Louisiana offshore superport. When completed, LOOP's marine terminal will stand in water more than 100 feet deep and be able

to handle new deep-draft tankers as big as 700,000 tons—the Ultra Large Crude Carriers (ULCCs)—far larger than anything now afloat.

Salt dome for oil storage

Once in operation, LOOP and its connecting pipelines and storage facilities will reduce the cost of importing crude oil from the Mid-East by as much as a third—or 10 to 50 cents per barrel.

In addition, the system will make oil-industry history by using one of the awesome underground salt domes of Louisiana to store huge quantities of crude oil.

The offshore complex will not look particularly imposing. The port's hub will be a control platform similar to existing large offshore oil platforms. Twenty-five workers

(Please turn to page 152)



BRINE RESERVOIR

1500 FT

CRUDE OIL

BRINE

SALT DOME STRUCTURE

Drawing shows how offshore oil port system will offload a supertanker's crude oil into a pipeline feeding the unique storage cavities leached from Clovelly Salt Dome.

IF YOU'RE DROWNING... Here are brand-new ways to save your life!

Startling discoveries by experts indicate about a third of the country's 'drowning' victims didn't drown, and that many such victims declared dead initially are not!

by Richard F. Dempewolff



Hunters and fishermen falling overboard from boats are prime hypothermia victims. Demonstration (right) shows how waders will float a fisherman who lies still.

Near Jackson, Mich., last winter, an 18-year-old college student driving alone "lost it," went sideways off the road and plunged through the ice of a deep pond. The rolling car eliminated any hope that air might be trapped in the passenger compartment. The youth struggled, took on water and lost consciousness.

Luckily a following driver spotted the accident and alerted the authorities. It was 38 minutes later, how-

ever, before rescuers pulled the victim from the water. There was no apparent pulse; no signs of life. He was declared "dead at the scene."

While the body was being loaded into the ambulance, however, the "dead" man gasped. Startled rescuers immediately began revival efforts. At the University of Michigan Hospital in Ann Arbor, Dr. Martin J. Nemiroff and a team of colleagues worked over the boy for two hours. After 13 more hours of

respiratory support, the student "woke up." He instantly recognized his mother, who was at his bedside.

Brain-damage protection

Attendant doctors, who had expected brain damage in anyone deprived of oxygen for more than four minutes, were even more surprised when the same lad picked up his college career and completed it with A grades.

The apparently "unusual" case, it

turns out, isn't so unusual at all. Today, after several years of scientific investigation prompted and encouraged by the U.S. Coast Guard and the Michigan Sea Grant Program, investigators know that sudden contact of the head and face with "cold" water (anything below 70° F. is classified as "cold" by the Coast Guard) may touch off a primitive response in humans known as the "mammalian diving reflex."

The frigid water triggers complex physiological responses that shut down the blood circulation to

most parts of the body except heart, lungs and brain. Though the blood contains only a limited amount of oxygen, it can be enough, investigators have learned, to sustain life and prevent damage to brain tissue for considerable periods of time, once the body's internal temperature has dropped. A cooled-down brain needs less oxygen than one at normal temperature.

Even whales do it

The latter phenomenon has long been known to researchers as the



HELP position can extend survival time.



Marked areas lose body heat to cold water.



Don't gun it while standing near transom.

one that permits deep-diving mammals like whales, porpoises and seals to remain active at frigid depths for long periods.

In humans, unhappily, the phenomenon is not quite that convenient—despite the unique life-extending time it may provide in rare cases.

Hypothermia a threat

"Hypothermia," the medical term for dropping the body's internal temperature below its normal 98.6° F., can produce a number of disastrous results. While it may take 10 to 15 minutes before the "core" temperature starts to drop, surface

HYPOTHERMIA MEDIAN LETHAL EXPOSURE SURVIVAL TIME VS. WATER TEMPERATURE

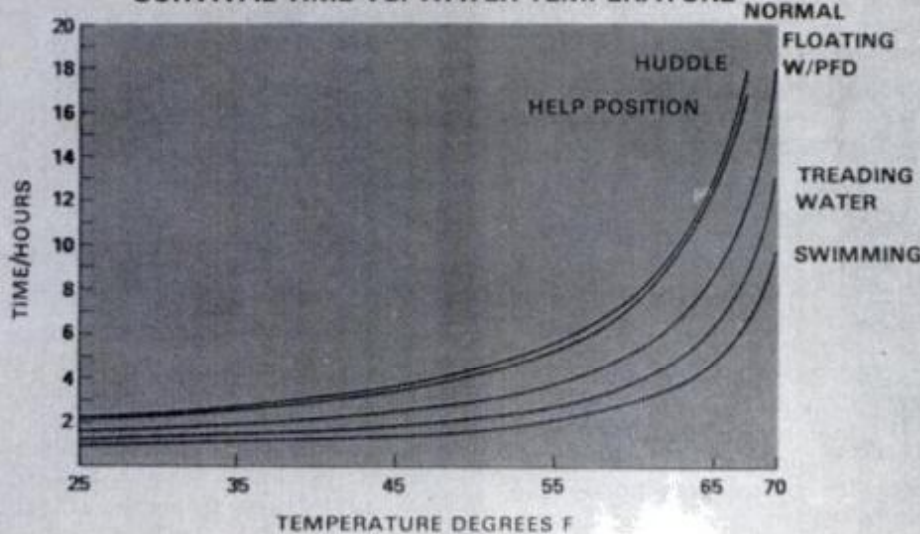


Chart indicates survival time lost in cold water through swimming and other exertion.



Improperly worn life vests lift out of water, wedge noses, lose buoyancy value.

New hunting jacket PFD insulates body, floats. Hood warms the vulnerable head.



Foam belt pad protects thorax from cold, keeps head high, is worn under clothing.

Ski belt pads are not approved as PFDs since they provide too little buoyancy.



tissues cool quickly. A victim may experience labored breathing and stiffness of limbs and hands.

As core temperature drops to 95° there will be violent shivering; at 90° to 95°, mental faculties cloud; at 86° to 90° there's muscular rigidity and loss of consciousness. Below

86° comes diminished respiration and possible heart failure. Below 80°, respiration becomes almost undetectable and death is imminent.

Investigators now believe that something like a third of all the boating drownings reported in one recent year, according to best avail-

able estimates, probably were not drownings at all but deaths due to hypothermia. Even more tragic, they suspect that in some 20 to 30 percent of those cases, the victim probably was not dead when found, even though there was no discernible pulse, no apparent breathing, eyes were dilated, color was bluish and rigidity had set in—all usual signs of death in familiar warm-water drownings.

Threat to hunters

For the past few years, Lt. Cmdr. David S. Smith, state liaison officer for the U.S. Coast Guard's Second District headquarters in St. Louis, has been traveling the country spreading a new gospel about these discoveries and what people can and should do about them. Recently, he pointed out to *Popular Mechanics* that the primary cause of deaths in autumn hunting accidents is not gunshot wounds, but "drowning," and that many of those so-called drownings are death from hypothermia.

"Some victims don't even have water in their lungs," he reveals. "We lose all kinds of them every year. They make a blind out of a 14-foot boat, stand up to shoot, lose their balance and go over the side. Water in many lakes seldom gets above 60°, even in summer. During spring and fall floods it may get down to 40°. "Worse, those guys usually are hypothermic to start with from sitting there on a cold morning waiting for the ducks. On top of it, they've been drinking to keep warm. The birds come over, the nimrods stand up, stiff and wobbly, fire, and over they go. The cold water hits them and that's it."

Another favorite gaffe, Smith points out, is to reach over with one hand, while standing, goose the outboard throttle, and get pitched over the transom when the boat surges ahead.

Actually, it isn't even necessary to be in the water to become lethally hypothermic. "Just last spring," Dave Smith recalls, "we had a young canoeing ace who spilled on a practice run. He was wearing a T-shirt and jeans, and was in the water 10 minutes before we fished him out and put him back in the canoe. He paddled a bit, then he passed out and fell backward. On the beach we checked his pulse and finally picked up a heartbeat—once every eight seconds. We rushed him to the hospital where they treated him for hypothermia and brought him around."

How do you protect yourself in

(Please turn to page 130)

What about 'drownproofing'?



The principles of a procedure known as drownproofing undoubtedly have saved many lives in shallow, sun-warmed lakes and pools where water temperature climbs above 72° F. in summertime. The technique involves floating almost motionlessly for long periods, relying on the natural buoyancy of the body and its tendency to hang in a semi-vertical position in water, head just breaking the surface. Potential drowning victims tend to thrash around in futile efforts to "climb on top" of the water, but the drownproofing concept teaches them to stay alive through maximum conservation of energy.

Instruction in the technique usually begins at poolside, practicing the correct position—head forward, arms down, legs together. With a friend to help at the pool's shallow end (top), the student kneels on the bottom and tilts head back to bring nose and mouth above surface to inhale fresh air, then tilts head forward to exhale. Final step (center) finds student hanging suspended (arms and legs positioned as in the bottom photo) in deep water by herself—nose and mouth above the surface where they can take air as needed—without need for exertion. At that point, the student has been "drownproofed."

In water below 72° F., however, forget drownproofing, says the U.S. Coast Guard—unless you're caught with only bathing attire and no flotation gear. In cold water, the greatest body heat loss is from the head and neck. Since drownproofing requires immersion of those areas, the onset of hypothermia, followed by death, can be brought about with distressing swiftness.

If you are unfortunate enough to go overboard without attire containing some insulative or buoyant potential, then drownproofing, treading water or swimming may be your only chance.



by Bill McKeown

BOATING EDITOR

While cars are getting smaller and more compact, boats are making changes another way. Hulls get less safe and seaworthy if they package too much in too small a size. So the most interesting and versatile new models are sprouting ingenious accommodations, more durable construction, and new materials that, as in cars, will make them lighter, stronger and faster.

Sailboats, and even some power cruisers, are finding extra cabin space by stowing bunks under the cockpit seats and deck. And quarter berths that fit aft can turn a day-sailer into an overnighter.

Lighter plastics, like Kevlar and ABS, are being used for hulls that float higher, have to push less water out of the way, and burn less fuel to go faster.

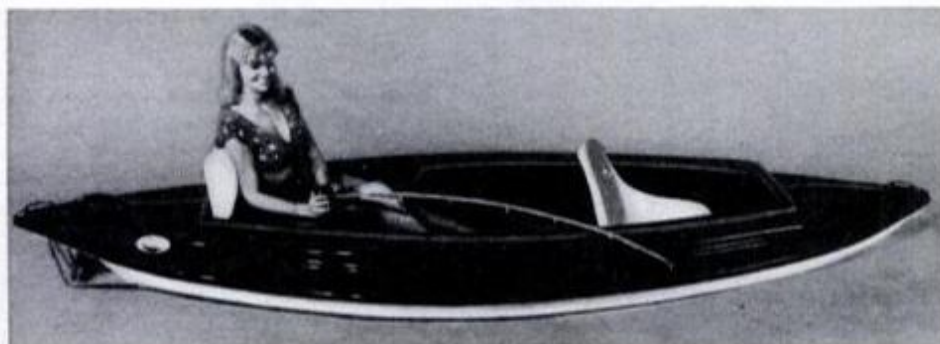
Quality inflatables are using highly durable and abrasion-resistant fabrics (synthetics and PVC coatings) that add little weight but longer life. A good inflatable will cost as much or more, today, than a same-size rigid hull, but can outperform it and still stow in a closet.

Finally, small boats, with add-on cockpit enclosures, can now become cruisers or, with enough bolt-on power, tow-boats for skiers. **PM**

New action-packs for boatmen



Overnighting for four in full-size bunks is possible aboard a 19-foot Tangerine 570 (\$4000 with trailer). PPI, Box 22010, Ft. Lauderdale.

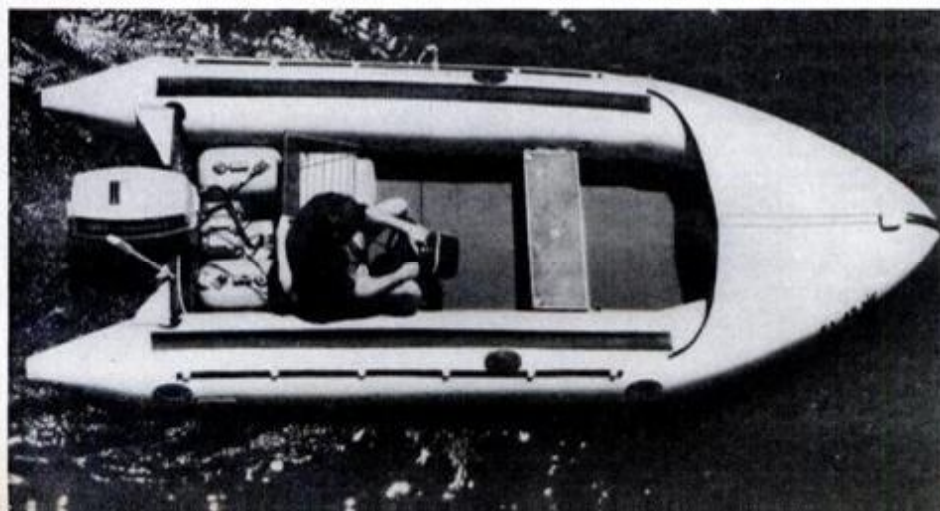


Fiberglass electric-powered copy of the hollowed-log pirogue, the 67-pound Pro Classic 2000 comes in several colors (\$530); Fin & Feather, Box 179, Marshall, Tex.

From a line of notable inflatables, Brute 500, 16½ feet for 60 hp, \$2150, and Brute 400, 13 feet for 45 hp, \$1495, are all-purpose models. From Bonair, Lenexa, Kans.



New from the makers of the Dyer Dinghies is the Dyer Duck, a 9½x4½-foot inflatable at \$595, 55 pounds, rated for 4 hp, by the Anchorage, 57 Miller St., Warren, R.I. 02885.



Center-console fisherman with a salty look, Pilot House, at \$11,420 from Shamrock Marine, Cape Coral, Fla., has 20-foot skeg-keel.

SPECIAL TURBO SECTION

With a whoosh the turbo engine has charged from racetrack and truck stop to family garage. In this section PM presents an update on the proliferating passenger-car turbo: Owners of turbo Buicks report on their V6s; PM drives the '79 Mustang and Capri which get a turbo Four this year; and we whip from California to New York at 23 mpg in the new, five-cylinder, turbodiesel Mercedes. Hang on!

Coast to coast in the 300SD...

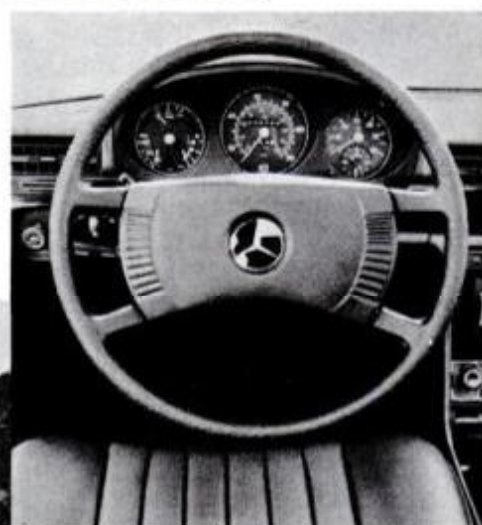
DIESEL MERCEDES WITH MUSCLE!

by Bill Hartford
AUTO EDITOR

Nice work if you can get it, driving coast to coast, seeing Mother Country in a Mercedes-Benz—especially when the Mercedes is a brand-new model, the first turbocharged diesel passenger car in the world. Work? A trip like this is no more work than racing across the country was work to Cannonball Baker.

Some auto assignments promise travel and adventure and this was one of them. It was also one that this desk jockey had to lay on a driver with time enough to hit the road for a week or two. We found a volunteer: freelance photographer Irv Dolin would whisk the car from West Coast to East Coast, risk speeding tickets and record his impressions on tape along the way. As we put together the technical story of the 300SD in a stuffy office, our driver was setting out from Pebble Beach (where Mercedes-Benz of North America unveiled the car to the press) for his trip cross-country. His remarks are those that appear in italics throughout the story.

It was appropriate that PM's 4093-mile test of the German-built Mercedes began in California: That's where the very heart of the car is manufactured. Without the Garrett AiResearch turbocharger



Mercedes-Benz 300SD is a full-size sedan (112.8-in. wheelbase, 205.5 in. overall) with a five-cylinder, turbocharged, diesel engine. (The naturally aspirated, five-cylinder 300D is an intermediate.) Instruments (above) are easily read. Three-pointed star on hood reflects sunlight (left) near Sierra Blanca, Tex.

PM photos: Irv Dolin

there would be no 300SD. Incredible as it may seem, there is no supplier in Germany that has reached the state of the art achieved by Garrett. It designed and produced the miniature, 2-inch-diameter turbines and compressors that spin up to 110,000 rpm and transform a standard, 77-hp five-cylinder Mercedes diesel (as used in the 300D sedan) into a 110-hp turbodiesel that really pumps iron. Garrett and Mercedes worked together for five years readying the

turbodiesel for production.

"You can feel the boost reach maximum just as the specs say: within three seconds after flooring the pedal and at 2000 rpm—it's not the kind of acceleration that tears your head off, but it's strong and smooth."

The torque increase is a hefty 53 ft.-lb. (or 168 for the 300SD compared to the 115 ft.-lb. for the 300D). The weight penalty of the turbo unit plus the engine changes made to

Acceleration of the 300SD is tested (far right), and 15.5 seconds is clocked for 0 to 60 mph (compared to maker's specs of 21.2 for 300D and 25.5 for 240D). Performance compares to that of 280SE with dohc Six gas engine. Photographer Irv Dolin and PM Auto Editor Bill Hartford (right) confer after 4093-mile cross-country trip.



withstand the higher thermal and mechanical stresses is only 33 pounds. The 300D, remember, is built on the intermediate-size (W123) body, whereas the new 300SD shares the luxurious full-size (W116) body with the 450SEL, 280SE and 6.9 sedans.

"It's really nice to have a trunk that's large and carpeted the way this one is. It's like using an office: I can spread out my cam-

(Please turn to page 142)



Big rigs at a truck stop in Las Cruces, N.M. (above), are backdrop for 300SD which averaged 23.05 mpg while crossing country at "flow-of-traffic" speeds. The 3-liter Five (left) is seen from the right side where the Garrett AiResearch turbocharger is mounted.

SPECIAL
TURBO
SECTION



1979 Mustang three-door, here in its Cobra trim, should be quicker with the new turbo Four than with the 302-cu.-in. V8.



Three-door Cobra has a slippery, low-drag profile.

Notchback Mustang will be in the model lineup for those who prefer formal roofline and a trunk.



Back door of the fastback Mustang hinges upward, has a large glass area for excellent visibility.



Capri for '79 shares Mustang body but Lincoln-Mercury Division adds its own trim.

Sportiest of the Capris is the R/S with Michelin TRX radials and special suspension.



Driving the new Mustang/Capri

An all-new Ford Mustang and a U.S.-built Mercury Capri kick off Detroit's 1979 model year.

by Gary Witzenburg

DETROIT AUTO EDITOR

From the moment you approach one of Ford Motor Co.'s new sporty-car twins, Ford Mustang and Mercury Capri for '79, you'll recognize their surprisingly tasteful blending of European and American design philosophies.

Except for the Mustang notchback, which bears a suspicious resemblance to Mercedes' \$30,000 450SLC sport coupe (I can see the ad now: "Can you tell the Mustang from the Mercedes?"), the new cars' styling owes little to any existing car—and there's no family resemblance to any past Mustang or the German-built Capri II they replace.

Borrowing a good idea from GM's Camaro/Firebird, both front and rear ends are of the soft-faced bumper type. Dual rectangular headlamps flank a box-shaped grille opening filled either egg-crate-style (Mustang) or with clean-looking horizontal bars (Capri). Large, rectangular taillamps carry out the theme around back—with vertical ribs on the Ford and horizontal ones (à la Mercedes) on the Mercury.

Turbo on the way

The notchback body (Mustang only) has the most pleasant roofline to my eye, but the sweeping hatchback design looks as aerodynamic as it is convenient. All have nonfunctional louvers behind their rear quarter window to reduce the visual effect of rather fat "C" pillars, but low beltlines and the resulting large glass areas are in keeping with the cars' European heritage. Distinctly American, however, are the Mustang/Capri's extra-wide stance and nostalgic "power" bulges on the turbocharged models' hoods. (Not quite ready for driving at press intro time, the turbo option should become available by year's end.)

The body's aerodynamic look is not only for appearance: Ford engineers and designers spent a good deal of time in the wind tunnel with the new shape. As a result, the hoodline is more sloped than the packagers originally intended, corners are rounded throughout, and there's a small aerodynamic spoiler integrated into the front bumper. The drag coefficient is a respectable 0.49 (compared to 0.36 for the Mazda RX-7), which will pay off in terms of gas mileage and side-wind stability even at legal speeds.

Cockpit

After looking over these sleek new bodies from every angle, you'll not be disappointed when you settle

into the cockpit and rest your eyes on the full instrumentation and European-style, stalk-mounted controls. What Ford calls "command position seating" means that you sit high and fairly upright for good visibility and easy access to everything on the panel.

While the Mustang/Capri's instrument cluster is an adaptation of that on the Fairmont/Zephyr, its contents and layout are far more sporting in appearance, not to mention more functional. Everything's there that should be on a car with sporting intentions, including a large, round, easy-to-read tachometer next to the matching speedo.

The seats (not usually Ford's long suit) are surprisingly comfortable buckets with side support befitting a European sportster—but their American origin is quickly apparent when you try to adjust the backrest angle. Unfortunately for the quasi-Continental image Ford and Lincoln-Mercury would like to project with these cars, the company tightwads still won't pop for the real reclining buckets those of us who have owned imported cars don't care to do without.

Not for long-legged drivers

Also on the minus side, Ford packaging planners have short-changed us again in terms of front-seat fore-aft travel. Apparently in order to make the back-seat legroom figures look better on paper (they're measured with front seats all the way back), they have limited front adjustment to the point where a long-legged 6-footer like myself just can't get enough leg and arm stretch-out room to be comfortable. Tall do-it-yourselfers can relocate the seat tracks themselves, but I wish Ford would give us long-stemmed drivers enough room in the first place.

The new interior does offer a

large improvement in shoulder and hip room over the old Mustang and Capri, however, due to both the '79 cars' Fairmont/Zephyr origin and a thin-shell door design. Luggage capacities are also significantly larger.

Engine/drive train

Turn the key on the base 2.3-liter, four-cylinder, overhead-cam engine and there are no surprises in store. We've seen this sturdy motor before in Pintos and in last year's Fairmont/Zephyr. With the standard 3.08:1 rear axle, don't expect much in the way of performance—but *do* expect gas mileage in the mid to high 20s.

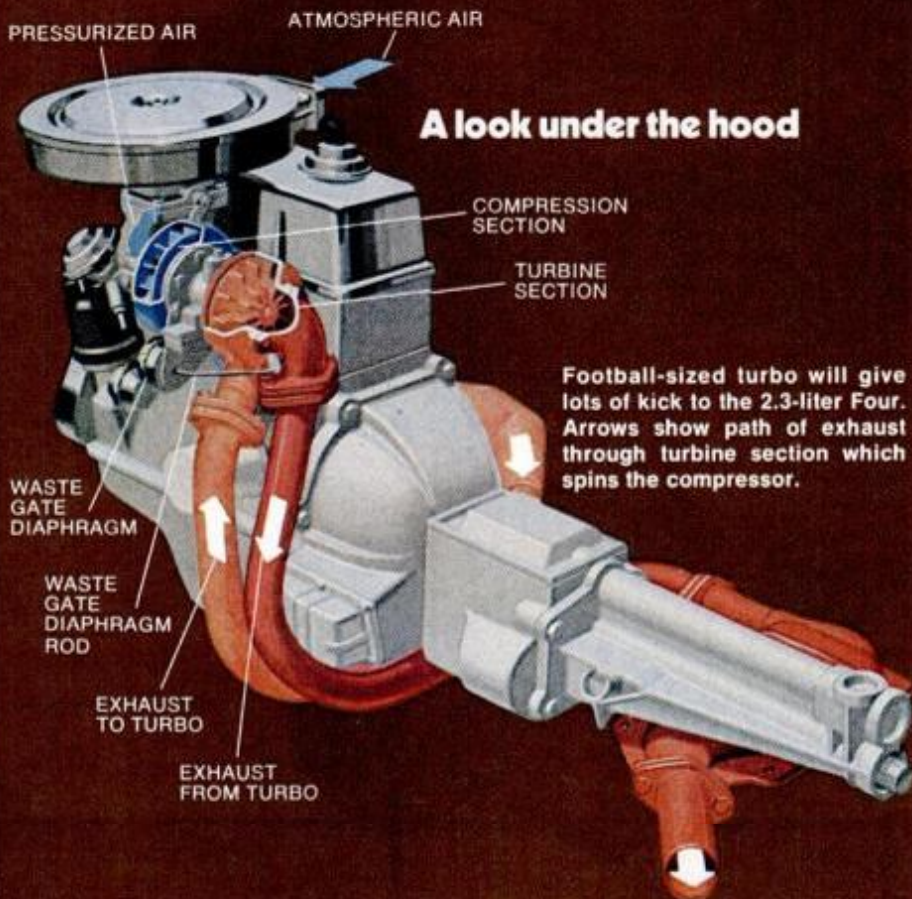
But it's all uphill from there. The optional 2.8-liter V6 comes with a livelier 3.45:1 axle (except in California) and propels the 2500-plus-pound car surprisingly well, but it's offered only with automatic transmission. (A V6/manual shift combination would provide the best performance/economy/handling compromise for the dollar for those of us who like to shift our own gears).

Another few bucks will put Ford's spirited 5.0-liter (302-cu.-in.) V8 in your Mustang/Capri, which (like the Four) is available with either a four-speed manual or optional automatic shifter. The V8 Mustang I drove (a four-speed with the 3.08 rear end) was a lively steed indeed, able to record consistent 0-60 mph times in the low-eight-second bracket—almost like in the good old days.

On the other hand, the V8 gives the car an extreme front-heavy bias that's great for freeway stability but not so great for bending it around corners. Slalom freaks should either opt for the V6 or the turbo Four (we're getting to that!), or prepare for some healthy chassis mods to overcome the strong understeer inherent in the V8. The four-

(Please turn to page 134)

TURBOCHARGING THE MUSTANG



A look under the hood

Football-sized turbo will give lots of kick to the 2.3-liter Four. Arrows show path of exhaust through turbine section which spins the compressor.

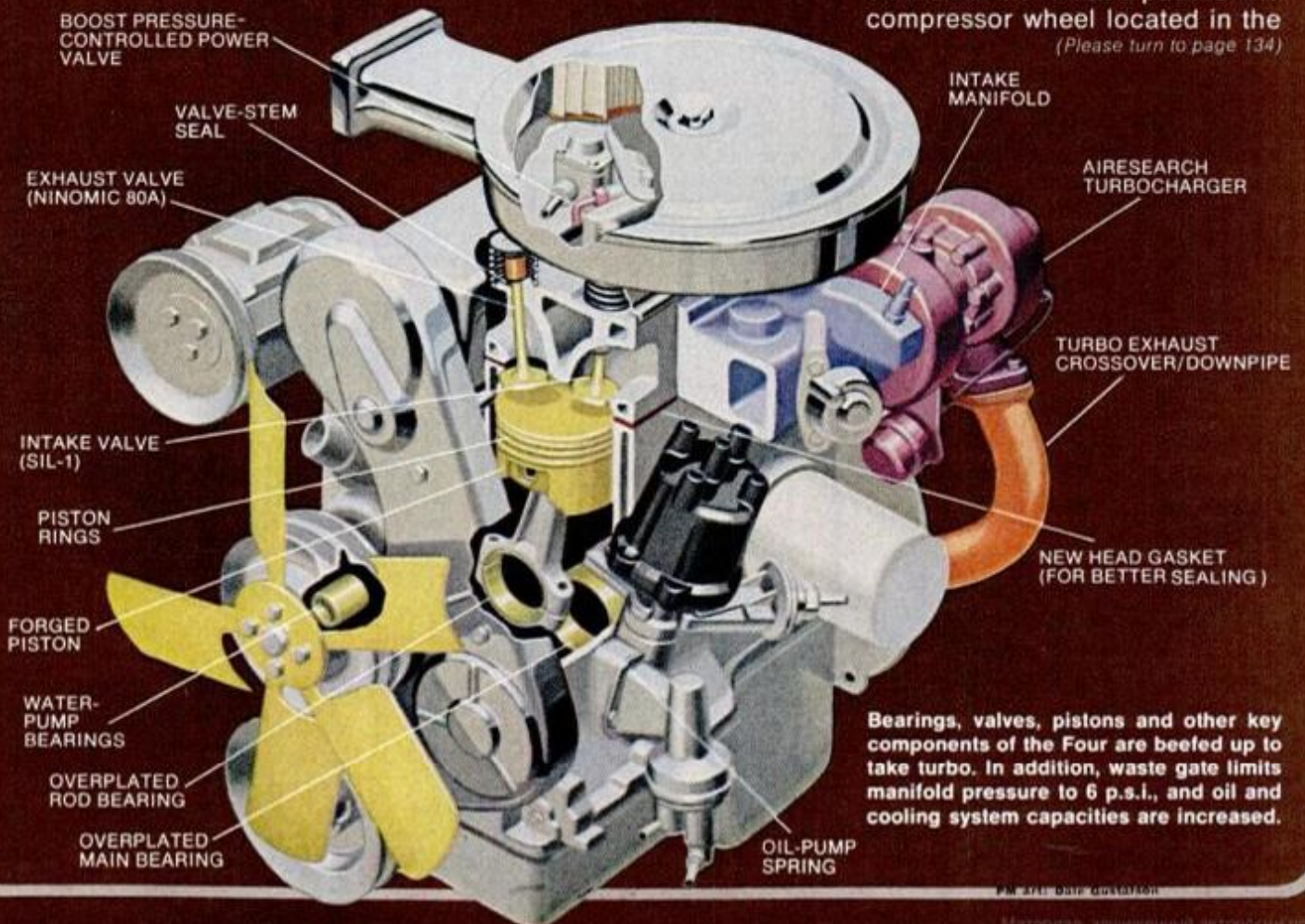
That magic performance figure—one horsepower per cubic inch—which seemed destined to become a historical curiosity as emission controls took hold, is back in 1979 on the new Mustang and Capri, thanks to the turbocharger.

The exhaust-driven blower gives the 2.3-liter, (140-cu.-in.) four-cylinder Ford powerplant a rating of 147 horses at six grand, compared to only 101 at 5500 rpm on the normally aspirated engine (ratings both are without fan and accessories). If you're already into the metric system, the turbo delivers nearly 64 horsepower per liter. Torque rating is 154 lbs./ft. at 3500 r.p.m. for the turbo, compared with 122 at 3400 for the standard engine.

The turbocharger is a Garrett AiResearch unit, very similar to what Buick is offering on its V6. Exhaust flows from the manifold through a pipe into the turbine chamber. Before continuing into the exhaust system, it spins the turbine, which is firmly mounted on the same shaft as a paddle-like compressor wheel located in the

(Please turn to page 134)

Strengthening the engine



Bearings, valves, pistons and other key components of the Four are beefed up to take turbo. In addition, waste gate limits manifold pressure to 6 p.s.i., and oil and cooling system capacities are increased.

SPECIAL TURBO SECTION

Almost all the Regal turbo owners we surveyed ordered the four-barrel version of the Buick exhaust-supercharged 231-cu.-in. V6. That engine puts out 165 brake horsepower (bhp)—10 more than the 350-cu.-in. V8 in this year's Riviera and Estate Wagon.

Buick's turbocharger, from Ai-Research, boosts net horsepower to 150 with a two-barrel carburetor and 165 bhp with a four-barrel. The turbo itself delivers 8.5 p.s.i. maximum boost at around 140,000 rpm! You can tell a turbocharged Buick by a high-pitched whine during deceleration.

Turbocharging sounds to some skeptics like a free ride: V8 power from a small V6, but with V6 economy. Is it really that simple? Or are there pitfalls?

To check, we went directly to the drivers most intimately familiar with America's newest turbocharged automobile. We asked for their likes, dislikes, problems, and sug-

gested changes. What attracted the buyers? Among the replies:

"I wanted a small, compact car with some get-up-and-go."—Texas turbo owner. "Bought my Turbo Regal to get better gas mileage and to have good acceleration when I need it."—Indiana driver.

Michigan bus driver: "I had owned a turbocharged Corvair previously and enjoyed it. My wife liked the Regal coupe's styling. We had also read favorable re-

PM OWNERS REPORT: TURBOCHARGED BUICK REGAL SPORT COUPE

ports." Illinois stockhandler: "My previous car was a 1975 Century with the 350 V8. I wanted a more fuel-efficient, better-handling car. The dealer didn't have to sell me.



Styling and economy were lures to the Regal turbo owners we surveyed.

All I was shopping for was price. They did slice \$725 off list and gave top dollar for the Century."

What do owners praise most?

A retired Floridian: "I am particularly pleased with the Regal's handling around curves, its comfort, the pickup and acceleration when I want to pass another car, styling of the sport coupe."

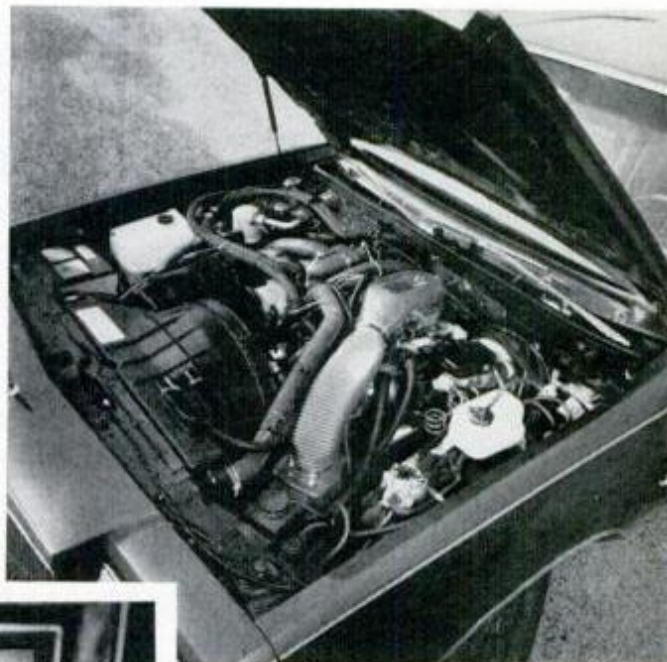
Michigan plant operator: "I appreciate the roominess of the car, especially considering that it's smaller than last year's model. Also the sport coupe's handling. I have driven a '78 Camaro LT, Regal's handling is very close to it."

A New York enthusiast: "There's power when you need it. It's a sharp-looking car; very sporty. I like the dependability of a Buick automobile, and also the Regal's ride and handling."

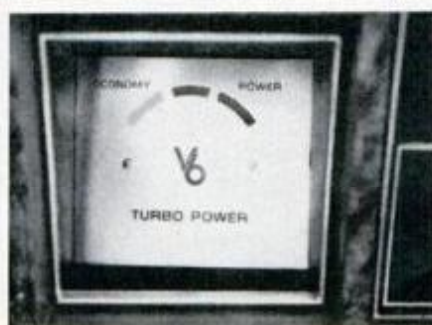
Wisconsin dentist: "It is quiet—

by Michael Lamm WEST COAST EDITOR Nationwide survey based on 1,569,307 owner-driven miles

Regal's turbocharger pulls more horsepower from 231-cu.-in. V6 than is offered by Buick's base 350 V8. Turbo freewheels until the driver floors accelerator; gives its main boost above 20 mph. A few owners are grumbling that underhood clutter makes even a minor tune-up a chore. Aluminum hood and deck lid tend to dent easily. Turbo vacuum gauge, although a bit imprecise, indicates economy driving. Black box (Control Center) retards the timing under hard acceleration, when the turbo boost increases the compression ratio and would otherwise cause severe pinging.



Photos by the author



SPECIAL TURBO SECTION

really excellent insulation. It's also nimble and moves quickly and responsively. The Regal steers and tracks beautifully, with good cornering."

Illinois motorman: "It's got sports-car performance with six-cylinder efficiency and the power of a 350 V8. It also has good styling, road-handling suspension, a comfortable interior and plenty of trunk space."

What were owners' complaints? In fairness, 19.7 percent had none. About 20 percent listed lower-than-expected fuel mileage as their No. 1 gripe. Government EPA ratings had led them to expect better economy—a disappointment experienced by many new-car owners of nearly every make. Here is a cross section of specific complaints:

Michigan draftsman: "Engine clutter hampers access to spark-plugs on the passenger side. I would also prefer panel lights behind the various switches. The big windows induce wind whistle. And there's a slight engine hesitation when cold. But even so, I think this is the engine of the automotive future."

Michigan nuclear engineer: "I have two major gripes. The first is cost. The car costs too much. They all do. The second is thin metal on the hood and door panels. This results in dings and small bumps in the surfaces from under-body welds."

Florida elevator mechanic: "The aluminum hood and deck lid can be bent by unknowing service people. They must be told to be careful."

Wisconsin ceramics retailer: "Because of the poor gas mileage, not acknowledged by EPA, the fuel tank should be larger."

And a Wisconsin salesman: "The turbo doesn't give me the zip I thought it would! I got better response from the old 350 V8. The turbo represents a very expensive piece of equipment, which isn't really worth the money. The economy just isn't there! And there's a pinging when the car accelerates. The dealer blames it on the gasoline." (High boost raises compression ratio, and Buick has compen-



Regal shares GM's A-Special body with Monte Carlo, Grand Prix, Olds Cutlass.

sated by retarding the timing at full throttle. Sometimes the ignition retard isn't enough, though.

We next asked owners to rate the Regal's workmanship. Nearly 70 percent marked it *good to excellent*. "Compared with other cars I have owned and looked at, I rate the Regal's quality as excellent," says an Illinois scientist. A retiree from Illinois agrees: "Good trunk, hood and door clearances. No draw marks nor metal strain. Even paint on corner trim."



Not all owners are happy with seats; some want a four- or five-speed stick.

And a North Carolina maintenance mechanic: "Workmanship and quality on the interior is wonderful. I love it. The instrument panel and all panels outside fit very well. The paint had some chipped spots, and there was a little glue mess, but nothing major."

On the other hand, the 5.9 percent who rated workmanship *average* echoed the tone of a North Carolina realty man, who feels, "After owning a BMW and a Toyota, I am appalled at the poor quality of assembly and finish on the Regal. At a sticker price just over \$8,000, this is no inexpensive

car. Detroit should be able to do better."

We next asked owners for their thoughts on the Regal's comfort—

Idea whose time has come

Oldsmobile introduced America's first turbocharged production car—the F-85 Turbo Rocket—back in 1962. Olds bolted a Garrett AiResearch turbo onto its 215-cu.-in. aluminum V8, and the blower helped draw 1 hp per cubic inch of displacement. Even at that, the AiResearch turbo was restricted to about 5 pounds pressure per square inch by a built-in wastegate.

In February 1962, Chevrolet announced a TRW turbocharger option for the Corvair. Corvair's blower eventually squeezed 180 bhp from the 161-cu.-in. opposed Six. Some 60,000 turbocharged Corvairs were sold before Chevy dropped the option in late 1966. TRW's turbo product line was absorbed by Rajay in 1969.

The turbocharged Corvairs and F-85s ran well enough, but the turbochargers for cars were viewed as oddities—bolt-on hot rod items for engines that couldn't grow. Olds and Chevy discontinued their turbos for lack of demand. Even so, big diesel trucks, heavy construction equipment and prop-driven aircraft had used turbochargers successfully for years. So had all-out racing cars, sometimes in dual applications.

The turbocharger was originally conceived by Alfred J. Buchi, a Swiss engineer, in 1905. By 1909, diesel engines were being turbocharged. Buchi's greatest success came in turbocharging military aircraft engines. The need to turbocharge passenger cars—except for the 1962-63 F-85, the 1962-66 Corvair and a special high-altitude 1964 I-H Scout—was never really felt. Until recently.

Today, as government fuel-economy demands go up, turbocharged cars are coming on strong. The government's 27.5 mpg corporate average fuel economy (CAFE) target will shrink engine sizes, and turbocharging is one practical way to regain lost power without dramatically increasing fuel consumption.

both in the front and rear seats.

"Surprised to have so much room," testifies an Oregon office manager.

A Texas engineer: "Excellent comfort all around, but the hatch roof has severe rattles."

"More space and comfort than my 1977 Regal, which was bigger outside," says an Idaho accountant.

And a New Hampshire owner says, "I'm 6-8 and have ample headroom in the front seat. I haven't had any rear passengers yet."

When we asked owners to cite mechanical problems they'd had nearly 60 percent put down *none*. That's admirable compared to other cars reported recently.

We also asked owners to rate their dealers—on service and sales practices. Here's a cross section response:

A Wisconsin materials handler writes, "The dealer has been very cooperative in fixing little annoying flaws. The sales department, too, was cooperative. They even washed the car after servicing."

A New York data processor: "I've had little contact with the dealer so far, thank goodness—only one service call for an oil change and repair of rear defroster switch. These were done promptly at no charge."

A Michigan owner: "The car had a spark knock when I took delivery and a leak in the power-steering reservoir. The service department took care of both the same day—they seem to be fast and understanding. The dealer's salesman gave me a low price initially, with no sales pitch. It was straight talk, and I like that."

And a happy owner from Texas: "The car had several minor prob-

lems. Repairs took all day. I was loaned a Buick Regal demo while my car was being serviced. I consider the dealer's service staff very courteous. It's been a real pleasure doing business with them. Since delivery, the salesman has called twice to ask if I was having any troubles."

We traditionally ask owners to suggest how their cars might be improved. We received these suggestions:

From a tool and die shop supervisor in Indiana, "I would like a four- or five-speed manual



This year's Regal has more luggage capacity despite tighter dimensions.

transmission. Now the automatic is the only one listed."

A Texas aerospace engineer: "The ride feels a little harsh. Perhaps the suspension should be halfway between the standard Regal and the Regal sport coupe."

"Four-wheel disc brakes," suggests an Illinois accountant.

"Change the instrument panel lights so they don't reflect in the windshield at night."—New Hampshire computer market manager.

A Georgia food company manager: "The only change needed would be a conventional spare tire instead of this new, thin type."

A West Virginia coal mine superintendent: "I'd reposition the radio and controls that hang down off the center of the instrument board. This pod is in the way of anyone trying to sit in the center of the front seat or slide across."

"A little better fuel economy, such as the sticker suggested (17 city, 25 highway, 20 overall)," bemoans a Texas tool company executive.

Viewed as a total car, though, the Regal got very good marks from the great majority of owners. The following comments sum it up for the rest.

"All in all, I am very pleased with my new Regal. It is considerably quieter inside than my previous 1973 Buick, has fewer rattles, and is very snappy when properly warmed up."—New York telephone craftsman.

A Wisconsin corporate treasurer: "My Regal has been through one of the coldest and snowiest winters on record, and I encountered no starting problems. I can walk to the garage or company parking lot on the coldest evening, confident that the car will always start and be on its way quickly. That's saying a lot."

And finally, this comment from a Texas mechanic: "I like the Buick Regal for a number of reasons. The size just fits me—I can reach the center of the hood and trunk when washing the car. It gets good gas mileage, is easy to handle, has vinyl seats that are easy to keep clean, and I enjoy the cruise control. It's just a good, good car." **PM**

SUMMARY OF 1978 BUICK'S TURBOCHARGED REGAL OWNERS REPORTS*

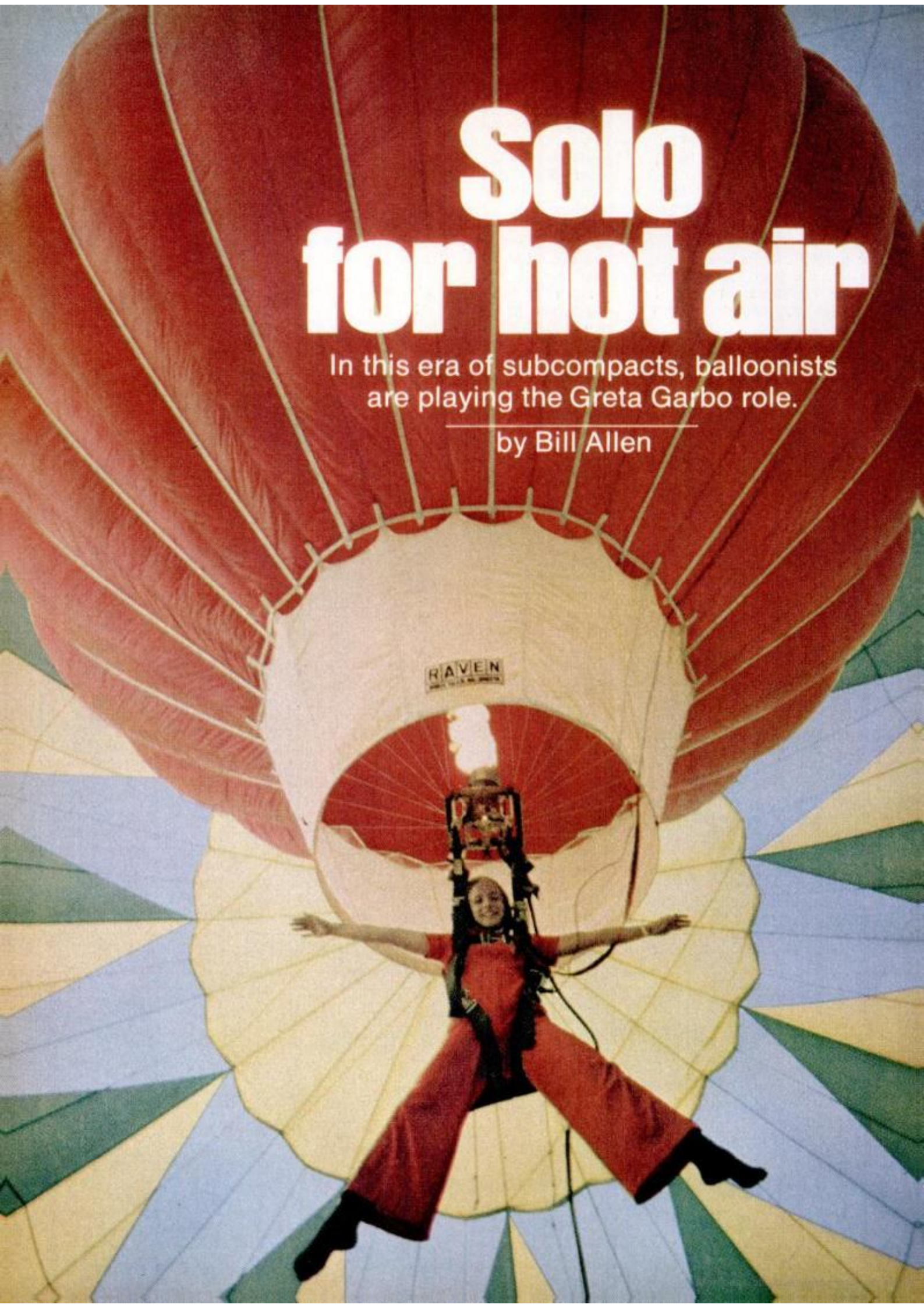
Total miles driven	1,569,307	Poor workmanship	11.3	Very good	38.4	Good	36.2
Average miles per gallon		Quality of materials	7.1	Good	25.9	Average	16.6
In town	16.0	Rattles	6.1	Fair	10.4	Fair	8.3
Long trips	20.0	What changes would you like?		Poor	2.7	Poor	12.0
Carburetor choices:		No changes	17.5%	Had any mechanical trouble?		Number of vehicles owned:	
Two-barrel with turbo	5.5%	Different seat shape, angle	7.7	No	57.9%	Turbo Regal only	40.5%
Four-barrel with turbo	94.5	Better gas mileage	7.7	Yes	42.1	Two cars	43.0
Why did you choose this car?		Better workmanship	6.4	What type of trouble?		Three cars	14.0
Economy	45.1%	Better quality of materials	5.4	Electrical	13.4%	Four or more cars	2.5
Styling	38.1	Workmanship opinion:		Transmission	13.4	Makes of other cars owned:	
Added horsepower	23.5	Excellent	25.8%	Oil leaks	9.0	Chevrolet	36.6%
Performance	21.0	Good	43.8	Carburetor	6.7	Buick	24.1
The turbocharger	14.3	Average	17.1	Turbocharger	4.5	Ford	11.5
Specific likes:		Fair	5.9	Did you repair it yourself?		Pontiac	10.5
Handling	52.2%	Poor	7.5	No	96.3%	Oldsmobile	6.8
Styling	47.8	Comfort opinion (front seats):		Yes	3.7	Age distribution of owners:	
Performance	31.5	Excellent	43.6%	Dealer repairs satisfactory?		15-19 years	25.4%
Power	30.9	Very good	37.1	Yes	57.7%	30-49 years	45.9
Gas mileage	30.3	Good	13.4	No	42.3	50-plus	28.8
Specific dislikes:		Fair	5.0	Dealer service opinion:		Would you buy another Turbo Regal?	
Gas mileage	21.3%	Poor	0.9	Excellent	26.9%	Yes	76.0%
No complaints	19.7	Comfort opinion (rear seats):				No	24.0
		Excellent	22.6%				

*Percentages may not equal 100% due to multiple responses, rounding or insufficient data.

Solo for hot air

In this era of subcompacts, balloonists are playing the Greta Garbo role.

by Bill Allen



The newest concept in the fast rising sport of hot-air ballooning is the one-person model "hang-balloon"—so named because pilots often hang in parachute-type harnesses, seats, or even lawn chairs. Not to mention horizontal propane cylinders ridden "bareback"!

Easier to transport, launch and recover, lower in cost, and more ideal for homebuilding than traditional larger craft, hang-balloons are becoming the sports cars of the ballooning set.

Actually, hot-air ballooning got its big push in the early 1960s with similar—now mostly outmoded—small designs. Larger versions carrying two to six people have more recently become standard, due both to advancing technology and desire to share the view and the champagne with friends or family.

As a result, most of today's balloons require crews of four or more, including at least two of them assigned to a large recovery vehicle—often a 4WD truck. Finding and hauling a 300-to-450-pound balloon and several people in rough country is no small project.

Now some can be backpacked

However, the newer hang-balloons, weighing 70 to 230 pounds, can be carried by subcompact car or backpacked, hitchhiked, bicycled and wheelbarrowed back to civilization by the pilot alone. Nylon envelopes can even incorporate a built-in tent and sleeping bag for ultimate self-reliance. Launches are easily accomplished by pilot and one helper, or done solo on some designs, such as the Cameron Z-31.

The Federal Aviation Administration (FAA) recently ruled that hang-balloons must fly under regulations pertaining to conventional ballooning, including aircraft and pilot licensing. This fostered agitation from balloonists for status similar to the self-regulated sport of hang-gliding. "Equal treatment under the law," implores noted aeronaut and manufacturer Don Piccard, who would, however, go along with strict controls on manufacturing.

Having your own balloon can reduce the rental portion of instruction cost. Learning otherwise runs \$1000-plus before obtaining a pri-

World record holder Donna Wiederkehr flies her hang-balloon inside one of her father's much larger AX-7 designs. To see how this photo was made, turn to page 130.

Parachute in reverse

Enthusiast Brian Boland designed an extremely small (12,000-cu.-ft.) hang-balloon with an envelope that fits entirely into a backpack storage bag that also serves as his harness seat. One five-gallon propane tank is used for preflight inflation, the other fuels the flight. Boland feels that backpack balloon rigs should be made to look "as interesting as possible." The reason: to attract rides when hitchhiking home after a flight.



His backpackable hang-balloon is already inflated and overhead (above) as Brian Boland adjusts instruments hanging from burner before flight (top right).



vate pilot's license (less if you already have a heavier-than-air rating to your credit).

Leading spokespeople of the sport, which they call "aerostation," advocate taking first lessons in larger craft. These can carry an instructor, have more elaborate controls than some one-man models and, with more mass, respond more smoothly. A 31,000-cu.-ft. balloon, largest of the "hanging" variety, holds captive nearly one ton of air. Training balloons of 56-77,000 cu. ft. contain about 1.8 to 2.5 tons of air—enough inertia to take from 10 to 30 seconds for response to control inputs.

Hot-air balloons have only two direct controls—heating and cooling. To float in the atmospheric

ocean, air inside is heated to more than 100° F. above outside temperature. Being lighter than the atmosphere displaced, the craft rises.

Propane burners yielding 2 to 11 million B.T.U.s/hour (more in large aerostats) provide heat to climb. This comes in long, raucous blasts during inflation, and roughly 6-to-12-second bursts once airborne.

Cooling to descend is done simply by not heating, or more quickly by venting. Rip-out panels release all hot air upon landing.

One homebuilder is developing a charcoal/wood-chip burner. It has gravity feed, ember screens, and a man-powered fan for temperature control—a sophisticated approach to the oldest ballooning method. If

(Please turn to page 126)

Balloonists—you can go home again

To the observer, balloons appear to have no control over the direction in which they fly, only their altitude. Indeed, many accomplished pilots revel in accepting the whims of wind.

Winds, however, usually change direction over any given spot on the ground as altitude increases. Skilled balloonists can adjust altitude to make navigational use of these variations, sometimes reaching planned goals or even reversing course for a round trip.

In the northern hemisphere, the earth's rotation normally shifts winds *clockwise with altitude* (Coriolis effect). So aeronauts *climb* to alter course to the right, and *descend* to hook a left. They may have 10 to 60° of choice while headed downwind of takeoff. The largest variety of changes usually occurs within 2000 feet of sea level, but one might go above 10,000 in search of something better.

Occasionally, balloonists stumble into low-level jet streams, much smaller and slower than their famous big brothers. Unforseeable, dramatic changes often result from confrontations between different air masses, ranging from local situations to huge weather fronts. Near the ground, wind is influenced by channeling or deflecting topography, plus the heat sink effects of vegetation, inhabited areas, and large bodies of water.

Ballooning is often practiced in

peaceful sunrise conditions. The lightest and most diverse winds appear during the changeover from night to daytime in micrometeorological systems. Ground-hugging inversion layers (in which air becomes warmer with altitude instead of cooler) are common at night. At dawn these layers calm the surface winds and separate them from conditions higher up. Downward airflow from high ground (catabatic cooling) produces winds until slightly after daybreak.

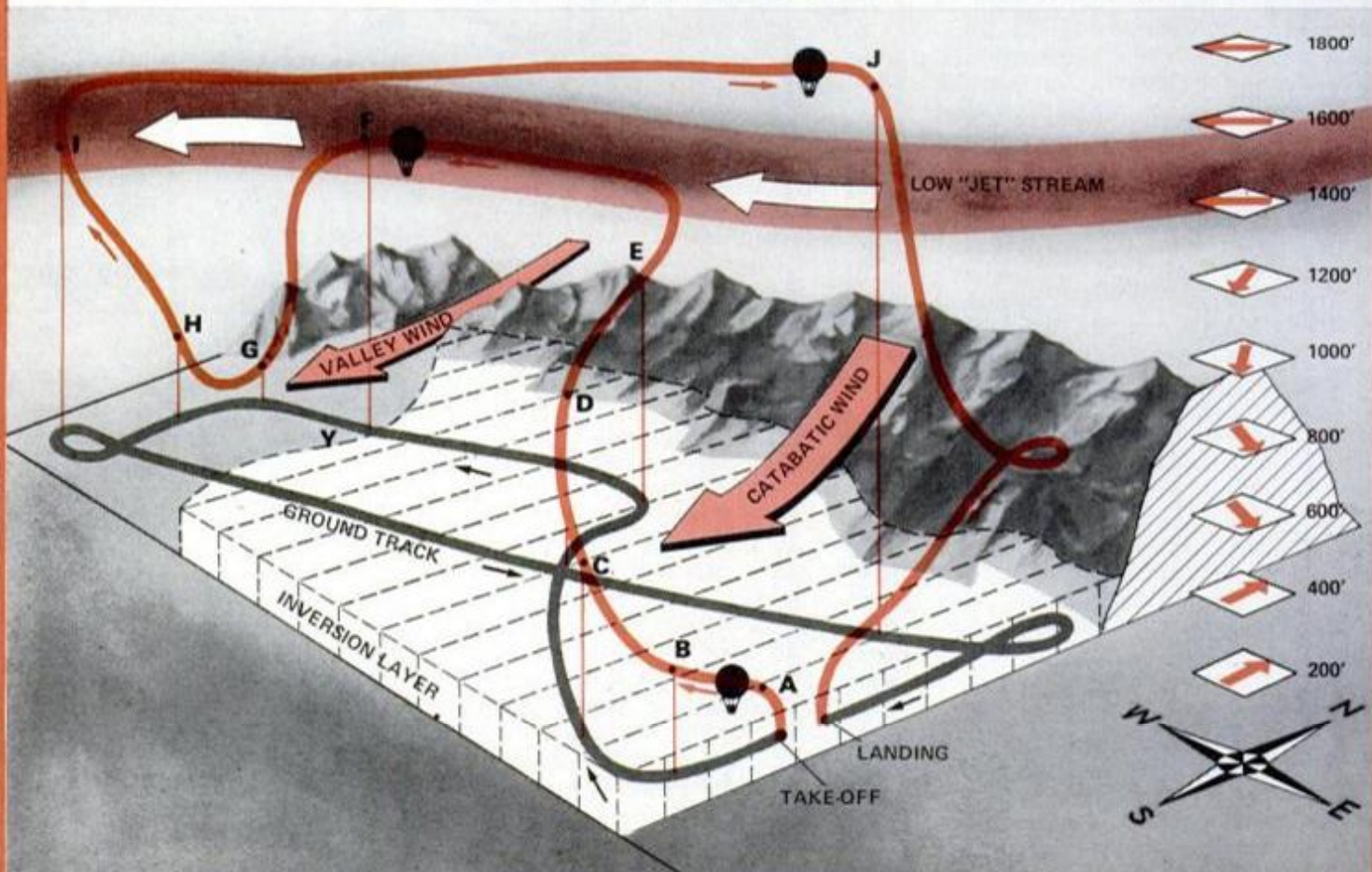
Before flight, aeronauts may release small gas balloons to detect winds aloft. Once airborne, the only way to discover what's happening upstairs is to climb some more. Winds below can be observed by releasing toilet paper strips (yes, it's okay to stream the Charmin). Watching other balloons also helps.

Clearly it takes four-dimensional thought to steer a balloon, but there's plenty of time to think things over. Aerostation is indelicately leisurely compared to other forms of flight. Small course corrections can even be made by dropping a towline to someone, or by pulling your way hand-over-hand through treetops. Or try sinking six inches into a handy river and simply ride downstream a way. True, that's not flying—but it sure is ballooning.

For more conventional navigation, consider the diagram below: It shows a

hypothetical—unusually good—flight at sunrise. (In wind roses at right, arrows point toward oncoming winds at 200-foot altitude increments.) An inversion layer becalms air movement below 200 feet, while cool air descends from nearby mountains to produce local "catabatic wind" at 200 to 400 feet, sliding over the inversion layer. More cool air slips down a valley west of takeoff. At 1200 feet to the north, a river of air slinks past.

Our aeronaut ascends in zero wind until encountering catabatic flow around 200 feet (A). By 400 feet (B), he has entered general large-scale air movement which swings him to his right as he clears 600 (C) and 800 feet (D). At 1500 feet (E), he finds an unexpected low-level "jet-stream" moving west between winds coming from the east, and centers the balloon at 1500 feet to ride westward. At point (F) he decides to go back and purposely sinks quickly into a valley to seek suspected wind from north-northeast. Course changing to his left, he finds the valley flow at 100 feet (G) and at (H) executes a steep climb. Coming around to the right at 1800 feet (I) he locates wind from west-southwest to go home. Another steep descent (J) drops him around to his left and finally into catabatic wind for final leg. This lucky flight might have covered about 10 miles and taken 1½ hours.—B.A.



Extend your growing season

Use this hotbed to ward off killer frosts in the fall, or start seedlings in spring. It features an automatic, solar-powered vent system.

by Joseph R. Provey

ASSISTANT HOME AND SHOP EDITOR

I love to raise my own vegetables—and this year, I've come up with a way to continue growing them late into the fall. Next spring, I'll have my first garden-grown salad earlier than ever before.

I call the unit which performs these feats a "season-extender," because it extends both ends of the growing season. In the fall, it will protect a patch of vegetables from the sudden killer frost that cuts off

much of my garden production in its prime. The mild days which normally follow won't be wasted this year.

Similarly, the unit will enable my plants to tap the early sunshine of next March and April without the risk of being stunted by cold nights and the vagaries of spring weather. And it incorporates hardware that even veteran gardeners may want to add to an existing hotbed, cold frame or greenhouse.

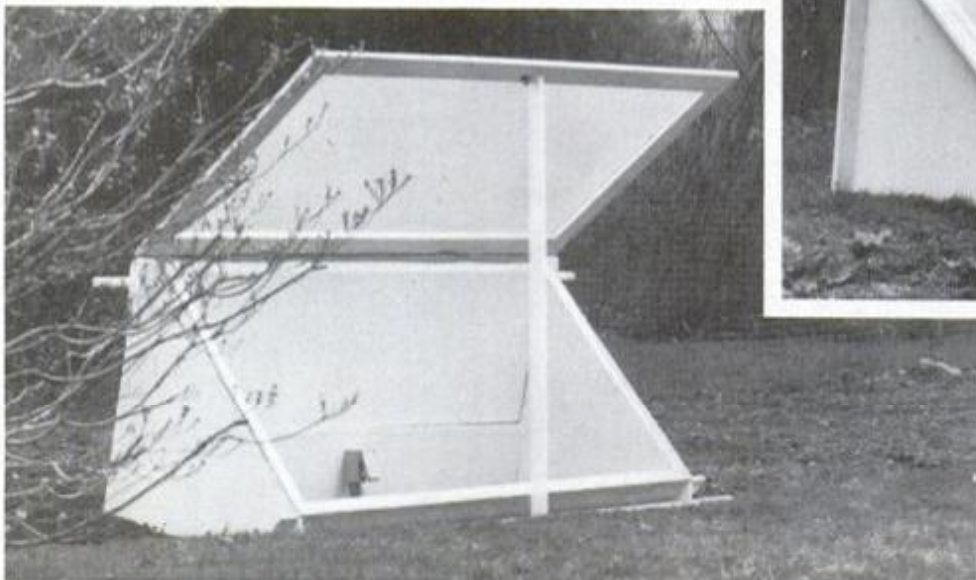
The main difference between the season-extender and a conventional cold frame is an automatically controlled lid to assure proper ventilation. The Thermoform vent control eliminates the possibility of forgetting to raise or lower the lid. Ventilation is important because solar radiation, even when the air temperature outside is cool, can quickly raise the air temperature inside the

season-extender to a dangerous level for young seedlings. The reverse is also true. A quick drop in air temperature can stunt seedlings and slow their growth.

The unit's walls are insulated with 1-in.-thick rigid Styrofoam panels to help retain heat. The lid is covered with AirCap, a translucent plastic with closed-cell air bubbles that reduce the rate of heat loss through the lid by about 50 percent (over commonly used plastic films and window glass). Vinyl foam weatherstripping tape assures a tight seal between the lid and frame.

Knockdown design permits compact, off-season storage. Interlocking corner joints make the entire frame easy to disassemble.

The season-extender can be used in at least four different ways. This fall, you can extend the growing season of a specially-planted, fall-



MATERIALS LIST—PM'S HOTBED

Key Pcs.	Size and description (use)
A 2	3/4" plywood—see plans (sides)
B 1	3/4 x 38-5/16" x 7' plywood (back)
C 1	3/4 x 7" x 7' plywood (front)
D 1	1 1/2 x 1 1/2 x 73" fir (mounting cleat for Thermoform)
E 2	1 1/2"-dia. x 8' fir closet pole (lifters)
F 2	3/4 x 4 x 46 3/8" clear pine (lid framing)
G 2	3/4 x 4 x 78" clear pine (lid framing)
H 1	4 x 7' (approx.) heavy duty, C-240, AirCap
I 2	1/4 x 1 1/8 x 41 3/8" pine (lattice)
J 2	1/4 x 1 1/8 x 78 1/2" pine (lattice)
K 3	1" x 2' x 8' Styrofoam (wall insulation)
L 2	3 1/2 x 3 1/2" loose-joint, loose-pin steel hinges
M 1	Thermoform unit assembly, mounting hardware
N 1	3/4 x 4" x 6' plywood (prop)
Misc:	6 2" No. 10 fh wood screws; 16 3/4" No. 8 fh wood screws; 3/8" staples; 1 1/4" brads; Dow's Mastic 11; resorcinol glue; 1/2 x 3/4 x 21' foam tape weatherstripping; ext. white gloss, alkyd or urethane type paint; ext. white gloss latex paint.

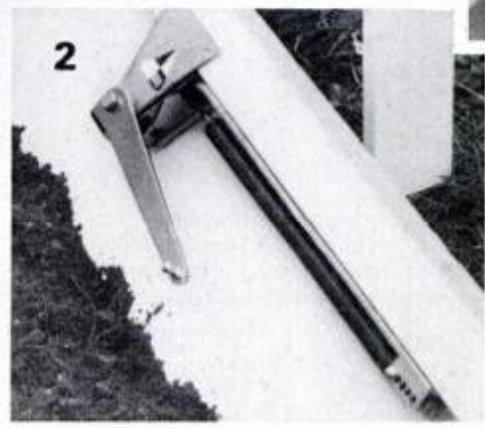
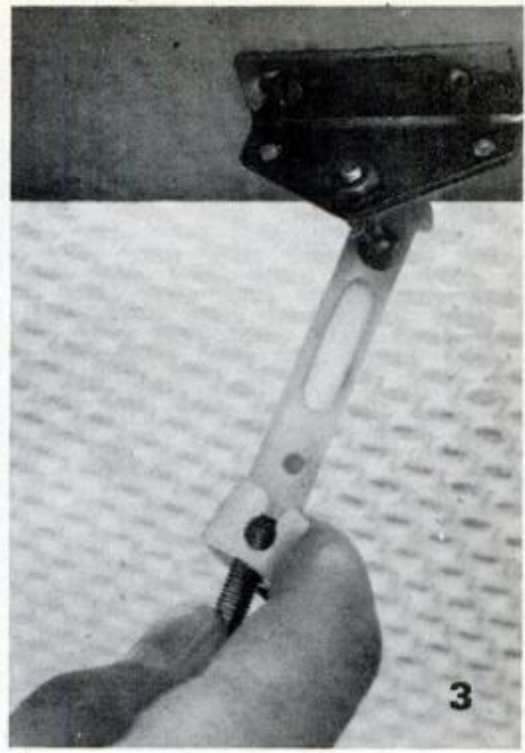
Note: All plywood is 3/4" AC or CD exterior grade.

Hotbed or "season-extender" (top left) holds enough seedlings for typical 250-sq.-ft. vegetable garden, with room left over to start several trays of flowers. Photo above shows south-facing unit with lid partially opened by automatic vent control. Prop with notch (left) holds lid open for watering or while you work in the bed. For extensive bed preparation, you simply move the unit aside temporarily.

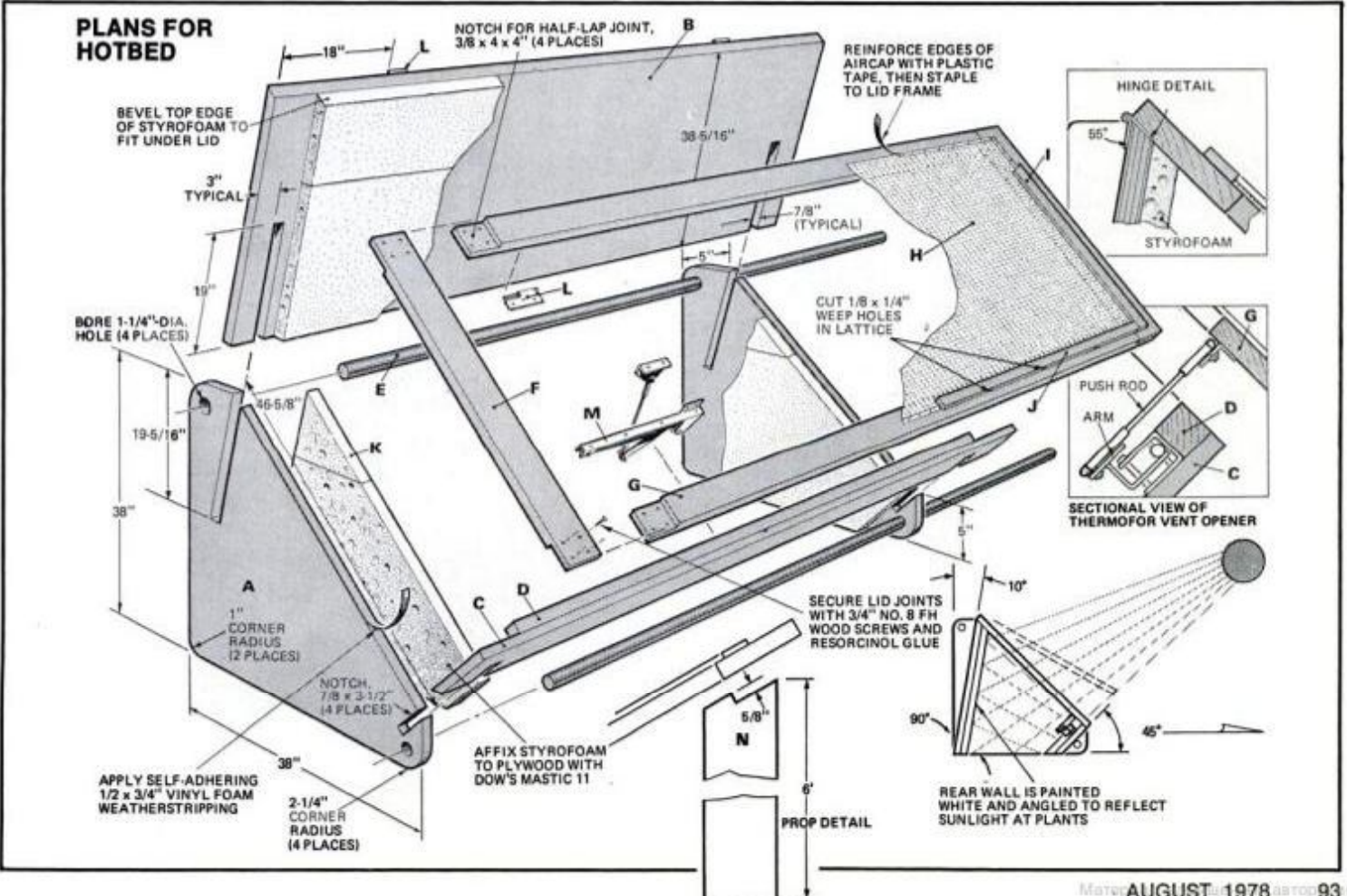
with PM's hotbed



- 1** As growing needs change, move season-extender and use in a new location.
- 2** Automatic Thermoform vent control is activated by expansion of heat-sensitive compound inside black cylinder.
- 3** Push rod connects arm to lid bracket at ball-and-socket joint. Retaining cuff slides over joint to secure it.



winter crop if you build the bed now for an August planting. Include rutabaga, bush beans, peas, radishes, lettuce, spinach and any other cool-weather crop that can fit within a 33x76-in. area. Plant the taller varieties in the back where they have more room to climb and will not block the sunlight from low-growing vegetables. When the nights begin to turn cold in October, position the season-extender over



the bed and see how much longer this patch will produce than the rest of the garden.

Next spring, use the unit as a hotbed to start seedlings early. A hotbed requires a heat source other than the sun, such as decomposing manure or soil-heating cables. I chose cables because they last many years and produce even, thermostatically controlled heat. Bury the cables in the ground now (as shown at right) before it freezes.

Instead of a hotbed application, you may choose to make the most of the frame's portability by using it as a "direct-plant" cold frame in the spring. Put it in the garden as soon as the ground can be prepared and sow hardy crops like spinach, lettuce, cabbage, broccoli, cauliflower, Brussels sprouts and radishes. When the patch is well established, move the extender and use it to give a bed of less hardy plants like tomatoes, zucchini, melons or peppers an early start.

With this method, your transplanting chores are cut down, and even though you can't put your whole garden under it, a few early beds should provide greens for your table at an exceptionally early date.

Finally, an extender abutted to the south wall of a house and provided with soil-heating cables can be used as a miniature greenhouse to winter over many house, patio and yard plants. If your climate is mild, you may be able to use the season-extender to continue growing vegetables throughout the winter. For cold weather use, disconnect the automatic vent and provide a glass or clear plastic lid in addition to the AirCap material. The rigid lid material is required to protect the plastic bubble film from tearing under snow loads.

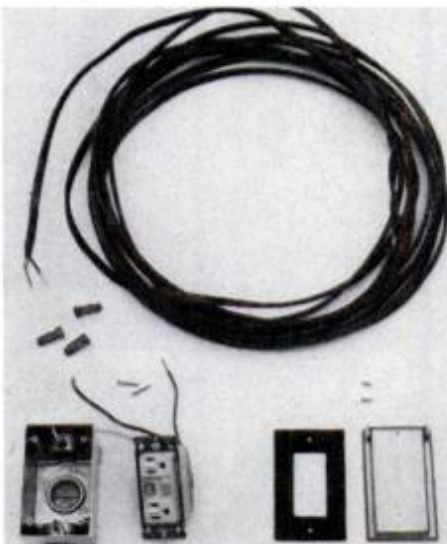
Begin building the season-extender by cutting out the four walls and prop from two 4x8-ft. sheets of plywood. Lay out completely before you start cutting. Cut notches as shown in the plans, using a handsaw or circular saw to make parallel cuts and a chisel to knock out waste. Bore holes for the lifters and use a sabre saw to round off the corners. Next, center the Thermofor mounting cleat (D) on the front wall and fasten with 2-in. No. 10 fh wood screws.

To insulate, first transpose the dimensions of the inside wall surfaces onto the Styrofoam. Use the inner edges of the notches as guides. Shorten the length of the back sections by 2 in. in order to form corner butt joints. Use a hollow-ground blade in a sabre saw for

(Please turn to page 138)

HOW TO MAKE A PERMANENT HOTBED INSTALLATION

If you don't have an outdoor receptacle, think about installing one for use with your hotbed—and for any other yard tasks requiring electrical power. If you're locating the unit near the house, choose a south-facing wall and mount the outlet on the structure. If installation is away from the house, mount it on a pipe as shown below. Dig a trench and bury UF cable; pass cable through a hole in the



For safe yard/garden outlet you need: a UL-listed outdoor junction box, G.F.C.I. receptacle, weatherproof coverplate with gasket and direct-burial cable.



Use plastic tape or insulated tacks to hold soil-heating cables in parallel loops. Maintain 3-in. intervals throughout.

basement wall or header joist. Connect circuit to the nearest inside junction box that can handle additional load.

The National Electric Code requires ground-fault circuit interrupter (GFCI) protection for all outdoor installations. GFCIs are available at electrical supply houses and must be installed according to manufacturer's directions. Check with your town electrical inspector before you begin. Call in a licensed electrician if you doubt your wiring ability.

Laying soil-heating cables

Begin by digging a 10-in.-deep pit with the same dimensions as the bottom of your season-extender. Spread a 4-in.-thick layer of pea gravel and sand. Then make an insulated floor with the leftover scraps of Styrofoam. Attach heating cables (see below) with thermostat to insulation and cover with 1 in. of a soil-humus mixture, hardware cloth and more planting medium until the pit is full. Grade the planting surface slightly to slope southward.

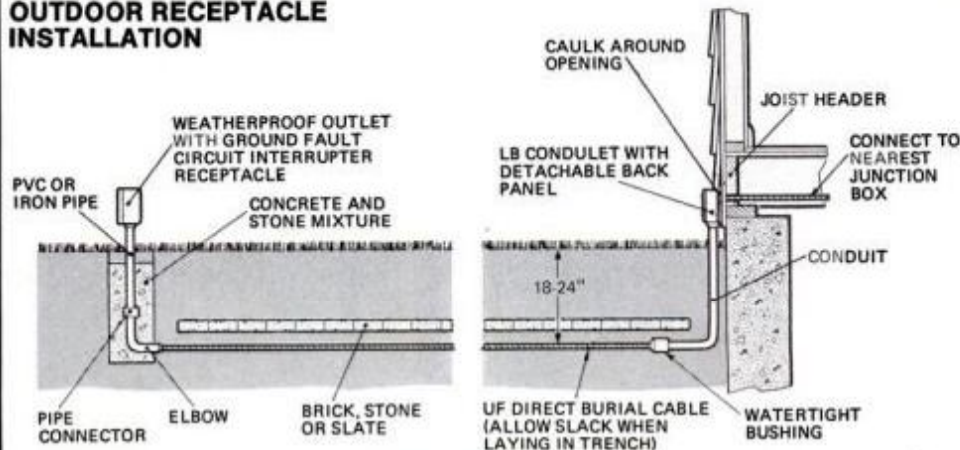


PVC may be used for conduit. To join, clean off dust and burrs, pretest fit. Give ¼-in. twist after applying cement.



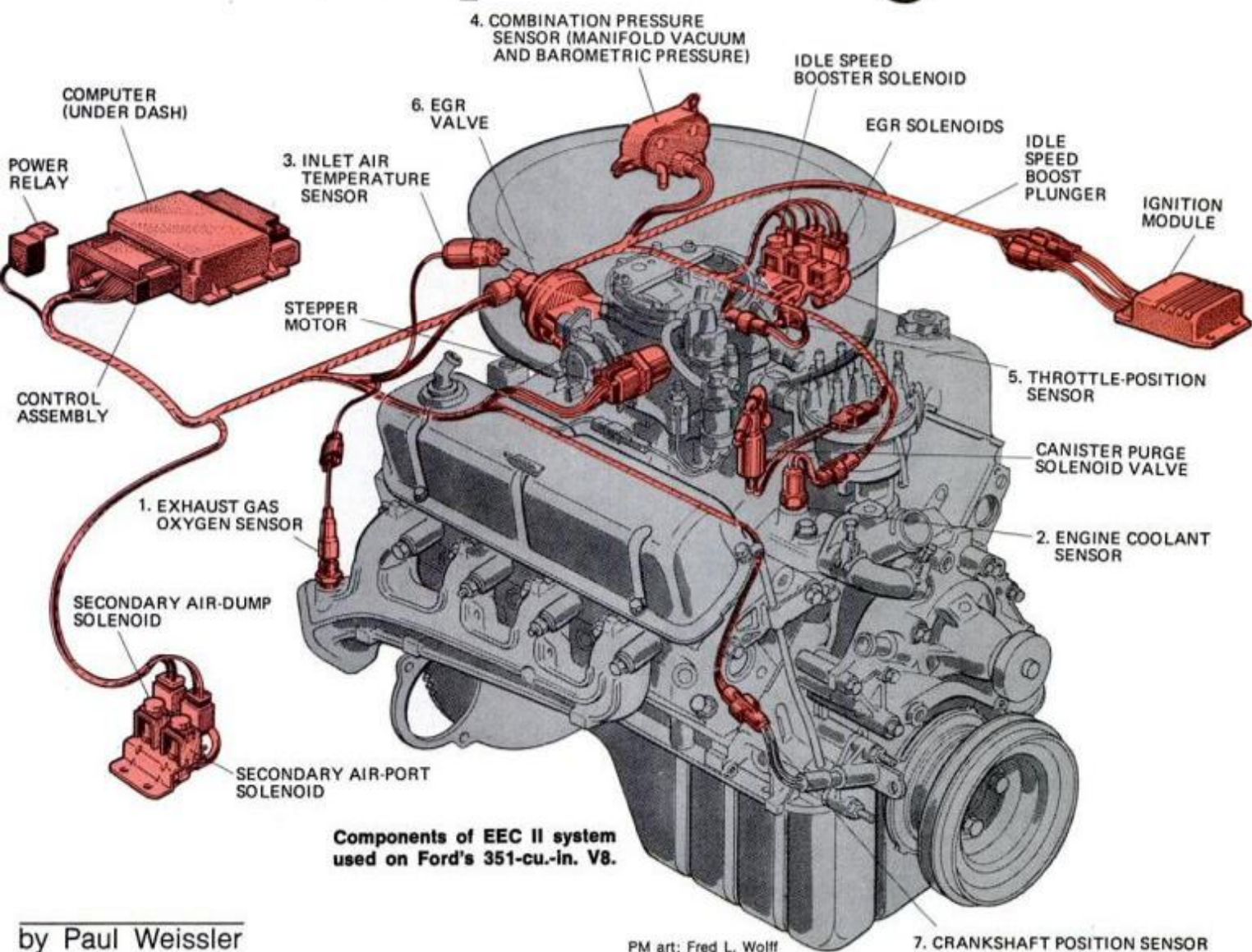
Cover heating wires with 1-in. layer of sand or soil; add hardware cloth for protection from misdirected spade.

OUTDOOR RECEPTACLE INSTALLATION



FORD'S ELECTRONIC ENGINE CONTROL II-

How it works and how to keep it working



Components of EEC II system used on Ford's 351-cu.-in. V8.

PM art: Fred L. Wolff

by Paul Weissler

The on-board computer, after a year of basic training, gets a real command post on many 1979 Ford cars. The black box, which will go into all 1979 Mercurys with the 351-cu.-in. V8 and the California-bound 351 Fords, will control fuel and ignition systems, fuel vapor, a three-way catalyst system, idle speed, exhaust gas recirculation and air pump.

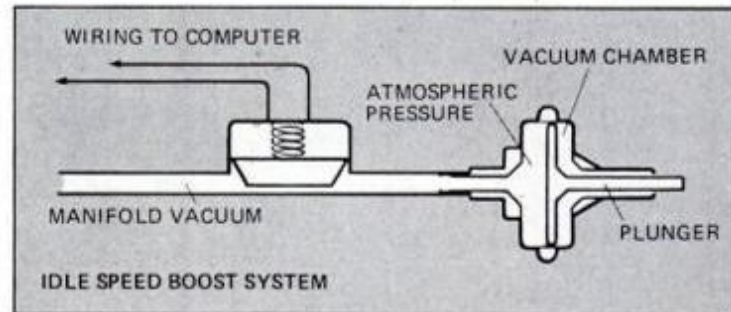
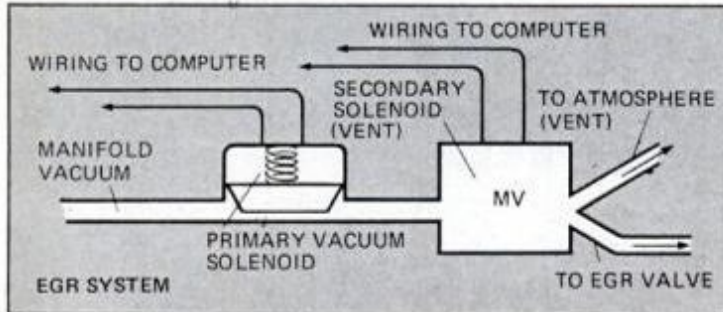
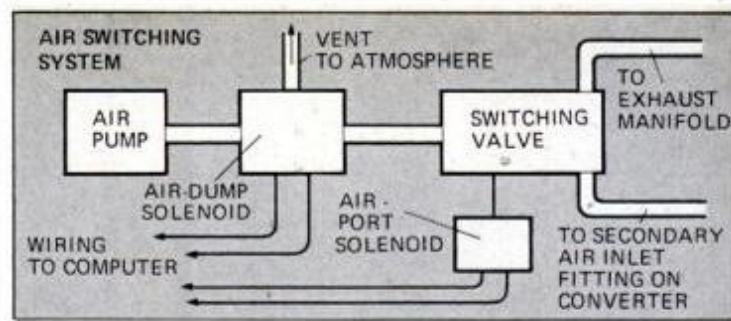
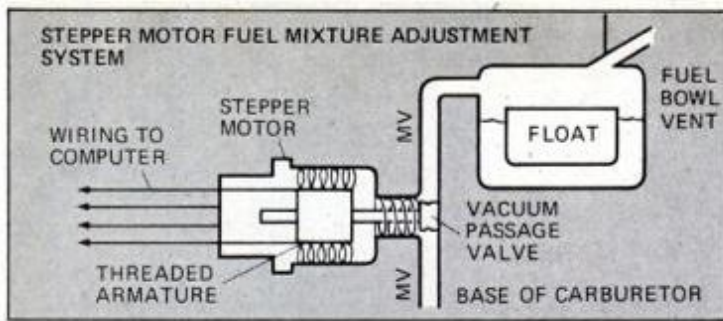
Ford calls the system Electronic Engine Control II, and it repre-

sents a substantial increase in computer control over EEC I, which was introduced last year (and continues this year) on the Lincoln Versailles.

EEC II sounds like a Saturday mechanic's nightmare, but if you focus on each segment, you'll understand it and be able to isolate any routine trouble it may develop. The overall design makes the system fail-safe; that is, even if computer and/or actuating devices fail, you'll

be able to start and run the car, and the expensive catalysts will live. Performance and gas mileage, however, will drop while emissions increase.

Ford's reason for introduction of the new system on '79 models is the need to gain some experience with computer control of the three-way catalyst system before new regulations go into effect that require lower emission levels of oxides of nitrogen (NOx). NOx reduction



calls for an additional catalyst, and to make it work the carburetor must operate with a precise air/fuel ratio of 14.7:1, which means continuous mixture adjustment. As originally field-tested on some California Pintos and Bobcats last year, the extra catalyst and carburetor adjustment system was controlled electronically, but not by a computer, which is more economical in the long run.

Sensors provide information

The computer is programmed to act according to information it receives from seven sensors:

1. Exhaust oxygen. The amount of oxygen in the exhaust is an indicator of the air-fuel mixture going into the cylinders. An electronic sensor that superficially resembles a sparkplug is threaded into the exhaust manifold and is fed an electrical current by the computer. Depending on the ratio of free oxygen in the exhaust, it modifies that current, creating a "feedback" signal that the computer interprets to indicate air-fuel mixture. If the

computer realizes the mixture is lean, it adjusts the carburetor to richen it; if the mixture is too rich, it leans it out.

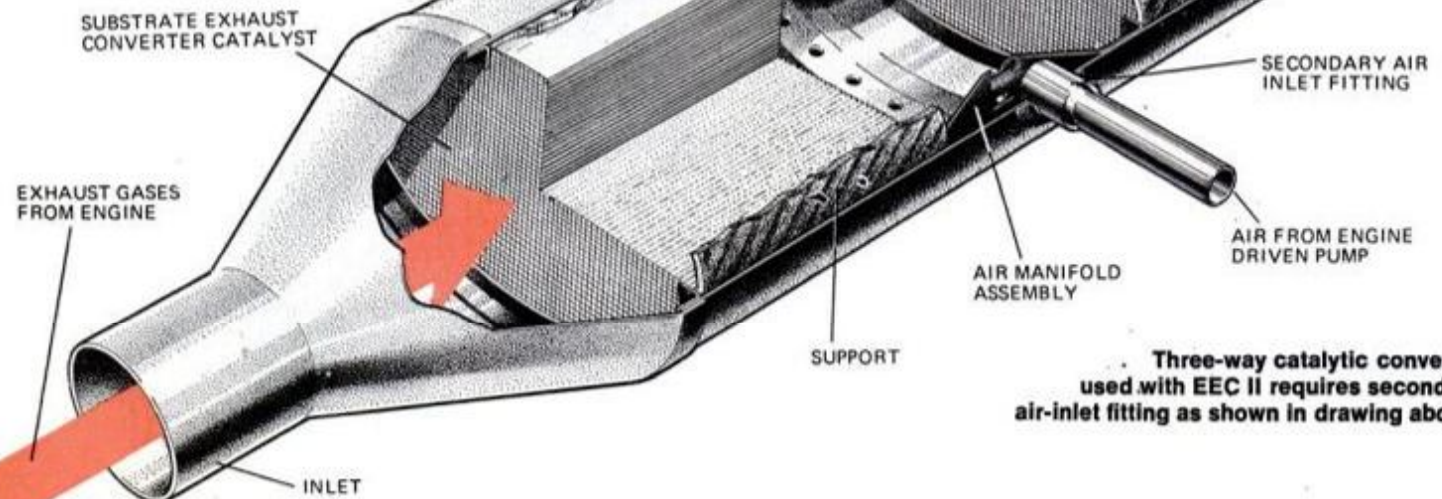
2. Engine coolant temperature. The engine needs a higher idle speed and greater ignition advance when cold. The coolant temperature sensor, operating much like a sending unit for dashboard gauges, provides the temperature information for the computer.

3. Inlet air temperature. The temperature of the engine compartment air is a factor in fuel mixture and ignition timing. The inlet air-temperature sensor (in the air cleaner) provides this information.

4. Manifold vacuum and barometric pressure. The vacuum in the

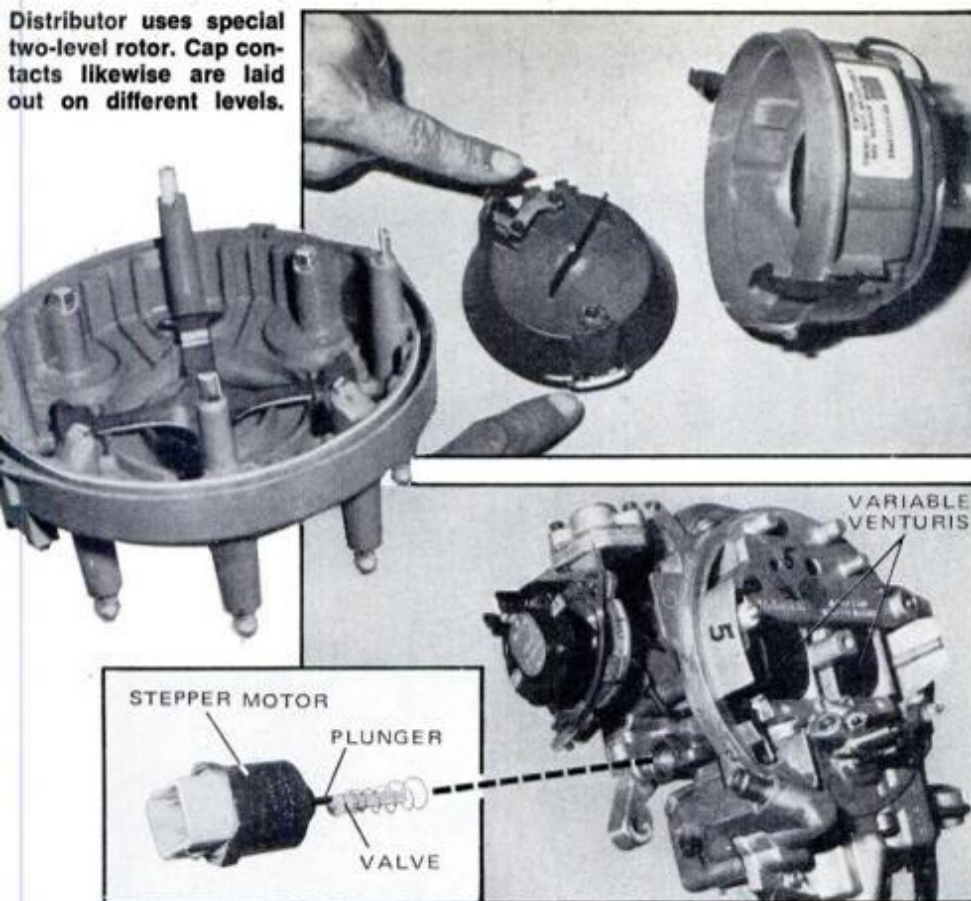
Four major systems of EEC II are shown in the block diagrams above.

intake manifold is an indicator of engine load, and both spark advance and carburetor must be adjusted as load changes. As altitude changes, the air thins out, and for optimum operation, mixture and timing adjustments also must be made. A combination all-electronic sensor does the job, and in both cases it measures pressure (lower than atmospheric in the manifold because of the vacuum). On EEC-I there were two sensors, one electronic for



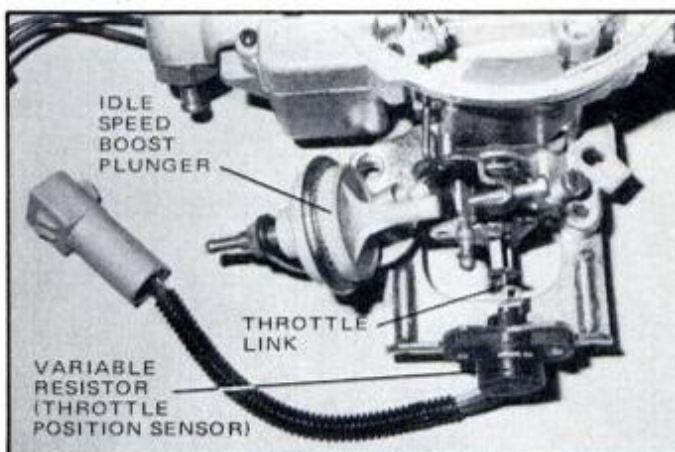
Three-way catalytic converter used with EEC II requires secondary air-inlet fitting as shown in drawing above.

Distributor uses special two-level rotor. Cap contacts likewise are laid out on different levels.



Stepper motor (above) is removed from carburetor to show parts details.

Idle-speed boost system uses a special plunger as a key component.



the intake manifold, one electromechanical with a barometric bellows for atmospheric pressure. Ford wanted some experience with electronic pressure sensors, is satisfied and now is going with one all-electronic design.

5. Throttle position. How hard you mash the gas pedal also is important, affecting what both fuel mixture and ignition timing should be. The throttle position sensor is a variable resistor. As you press down on, or lift your foot from, the gas pedal, the resistance changes, and the computer translates the resistance value into a determination of throttle position.

6. EGR valve: a variable resistor, which changes resistance according to EGR-valve stem movement, enables the computer to read the valve opening.

7. Crankshaft position: the computer must know where the crankshaft is, in order to accurately fire the ignition system. This information comes from an electromagnet sensor close to a four-tooth ring on the front of the crankshaft. The teeth trigger the sensor.

The computer takes all the information from the sensors, and decides when to trigger a variety of devices that operate engine systems. Here's how the computer manages to get the engine to respond to its commands:

Ignition. When the computer wants to fire a sparkplug, it transmits a current to the transistorized ignition control unit (same basic one that's been on the cars for years). The control unit then triggers the ignition coil, which fires the plug. With this system, the

distributor is a shell with just a spinning rotor inside—no mechanical or advance units, no pickup coil. Ford uses a two-level rotor which fires on opposite sides, into a specially-designed cap.

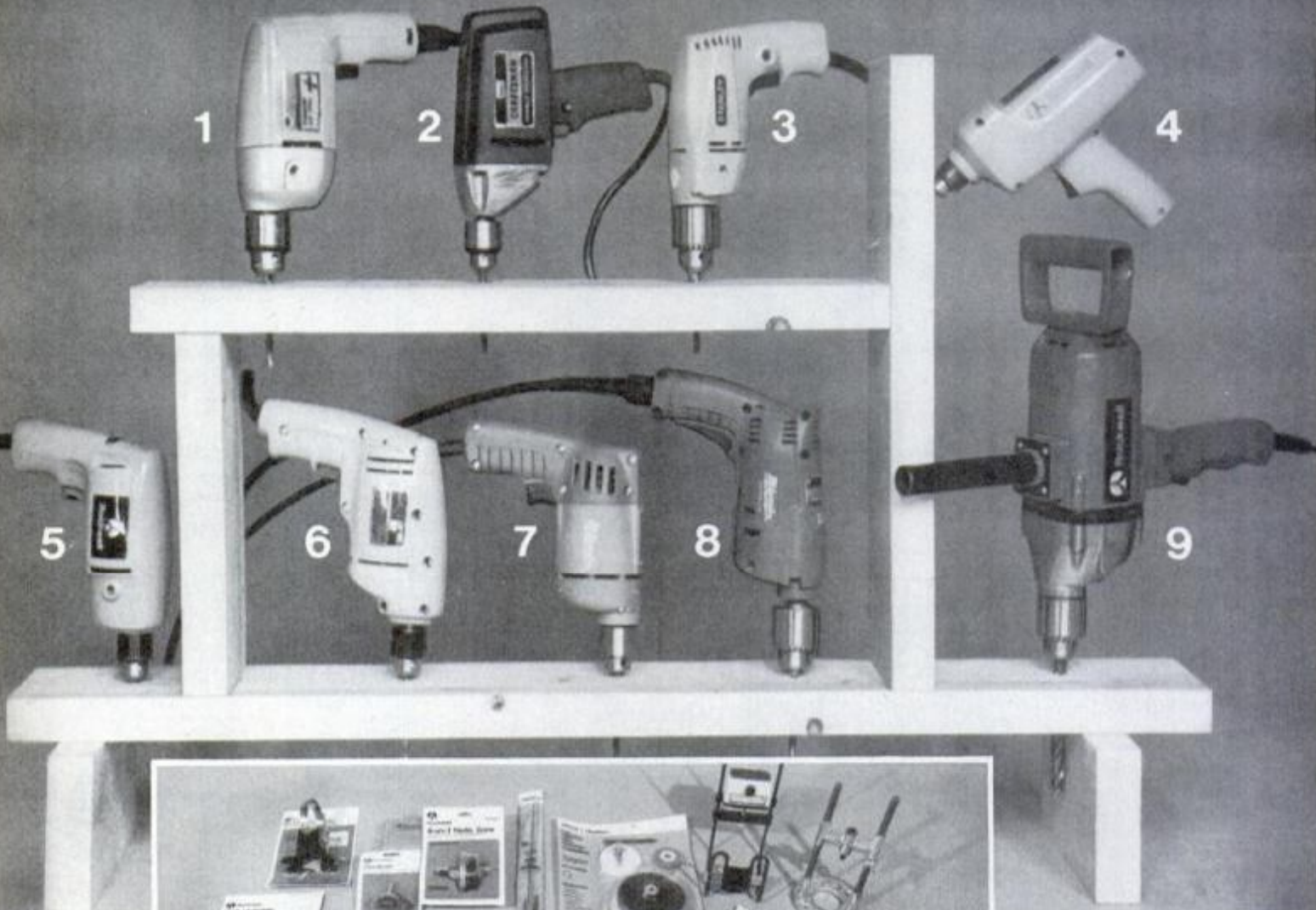
Fuel mixture control. To change the fuel mixture, Ford changes the air pressure (normally just vented to atmosphere) in the top of the carburetor fuel bowl. When the air pressure on the top of the fuel is reduced, so is the fuel flow, leaning out the mixture. The air pressure is reduced by allowing some manifold vacuum into the bowl, by means of a tiny spring-loaded valve in a vacuum passage from the carburetor base. The valve is controlled by a "stepper motor" a tiny electric motor with a plunger that bears against it. The motor has four field coils, each wired separately and connected to the computer, and an armature that runs through a threaded bracket. Depending on which coils the computer activates, and in which sequence, the motor can run forward or backward, and be stopped in any one of 100 positions. This system, built into the variable-venturi carburetor, is easily adaptable to any other design. It compares with the electronically-controlled vacuum solenoid and in-carburetor vacuum diaphragm (controlling a fuel jet) that is used on EEC I.

Air-switching system. This is perhaps the most complex part of the system. As on other cars, an air pump is used to supply pressurized air to help the chemical reaction inside the converters. With two converters, one of which may not need the extra air, a switching system controlled by the computer is used. If both converters need air, it is discharged into the exhaust manifold, ahead of the two of them. If only the second converter needs air (the more common situation) the air is pumped into the exhaust just before it. If neither needs air, the pump vents to the atmosphere. The computer activates the controls, but to understand why, you must understand the air circuit.

The air circuit runs from the pump to a solenoid valve called the air dump. If the computer does nothing, the normally-open solenoid valve will vent the pressurized air to the atmosphere. If the computer acts, it supplies current to this solenoid, closing the vent. The air passes into a switching valve controlled by a second solenoid, called the air port. If the computer wants the air to go from this switching valve into the exhaust manifold, it

(Please turn to page 131)

You can do almost anything with a drill... and the right accessories



A selection of quality drills: 1—Black and Decker ½-in. Single Speed Reversible; 2—Sears ¾-in. Variable Speed Reversible; 3—Stanley ½-in. Variable Speed Reversible; 4—Rockwell ¼-in. Cordless; 5—Rockwell ¾-in. Variable Speed Reversible; 6—Skil ¾-in. Variable Speed; 7—Milwaukee ¼-in. Single Speed; 8—Milwaukee ¾-in. Variable Speed Reversible; 9—Rockwell ½-in. Single Speed Reversible.

A few of the vast number of accessories that make an electric drill an everything tool.

by Rosario Capotosto

PM photos by the author

Because it can perform so many functions, an electric hand drill is one of the most useful tools you can have in your home or shop. A power drill bores holes in wood, plastics, metal and masonry—practically any material—with ease,

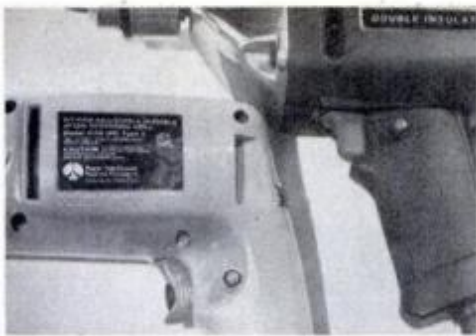
speed and efficiency. With accessories it does much more.

Combined with the proper attachment, a drill sands, grinds, polishes, files and shapes. It also cuts sheet metal, pumps water, mixes paints, drives nails, and turns screws and nuts.

A drill is identified by the maximum capacity of its chuck: ¼-, ⅜- and ½-in. This is the same figure as the maximum diameter of the

drill bit shank that the chuck holds. Generally, the chuck capacity indicates the maximum size hole that can be bored in steel without undue strain.

There is a direct relationship between size, speed and power of a drill. As the chuck size increases the rotation speed (rpm) decreases while torque (twisting power) increases. Therefore, a ¼-in. drill delivers more rpm and less power



Variable-speed triggers control rpm. Most makers offer at least one model with it.



Reversing switch lets you back out screws and nuts—useful in freeing jammed bits.



Some drills have detachable cords that are stored conveniently in your tool chest.



Four-position D-handle on this heavy-duty drill gives the user maximum tool control.



Side handle should be used on any high-torque drill for protection against twist.

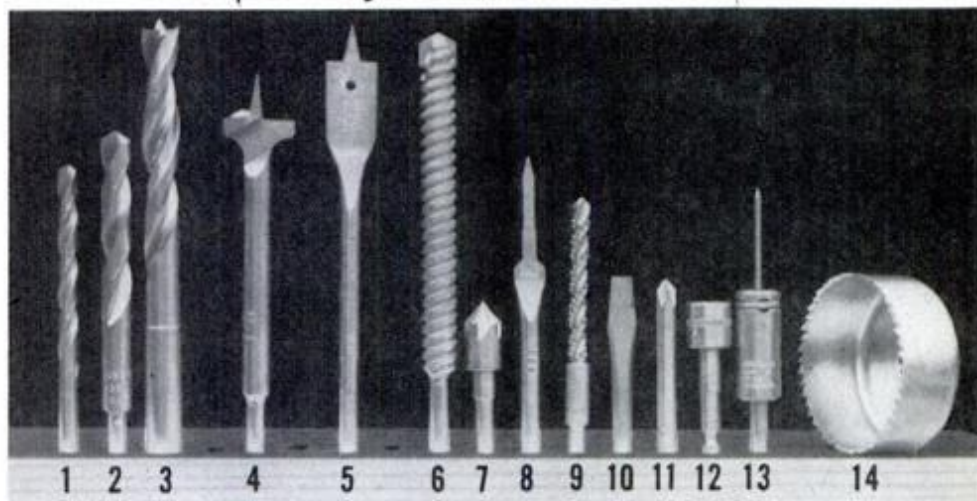
than a 1/2-in. tool. The 3/8-in. drill performs between the two—often a most desirable compromise.

Horsepower (hp) rating also relates to the workload capacity of a drill. A particular drill with insufficient hp will not properly do the job indicated by its chuck size. Usual specs are 1/4, 1/2, 1/2 hp for 1/4-, 3/8- and 1/2-in. drills respectively. If you

plan heavy-duty drilling you would do well to invest extra dollars for a high-hp-rated tool.

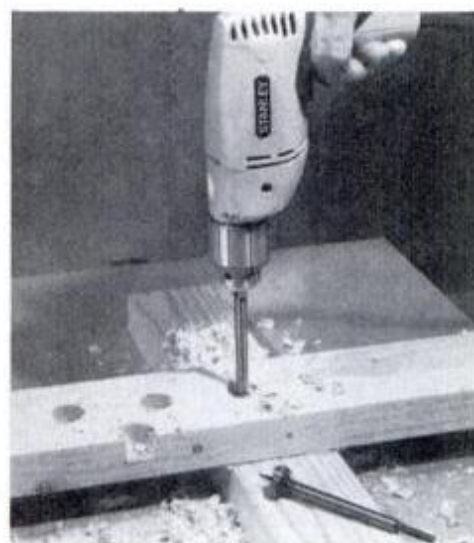
Some operations such as light-duty drilling, sanding and polishing are better accomplished with drills having high rpm, in the range of 1200 to 2500. Drilling tough materials such as thick ferrous metals or masonry requires slower speeds

Bits and accessories you should know about

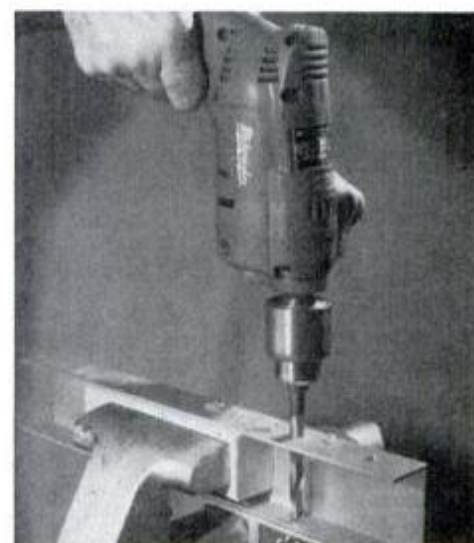


This lineup of bits and accessories is: 1—high-speed twist; 2—high-speed twist bit with reduced shank; 3—brad point spur bit; 4—flat-bottom spur; 5—spade;

6—masonry; 7—countersink; 8—wood screw pilot bit; 9—wood rasp; 10 and 11—slotted Phillips screwdriver bits; 12—nut driver; 13—nail spinner; 14—hole saw.



Full-circle flat bearing surface of Stanley's power bore bit gives stability, and a perfect circle every time.



To bore holes in metal, hold work firmly in vise. Grasp tool with both hands to stop side whip when bit breaks through.



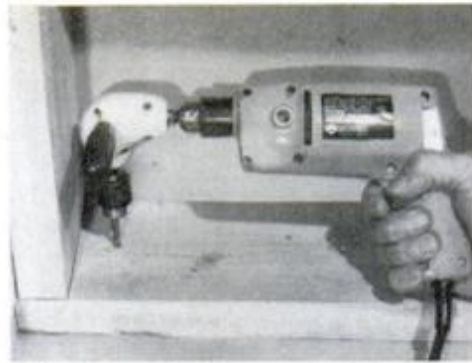
Bore masonry with a heavy-duty drill, carbide bit; use water to keep bit cool.



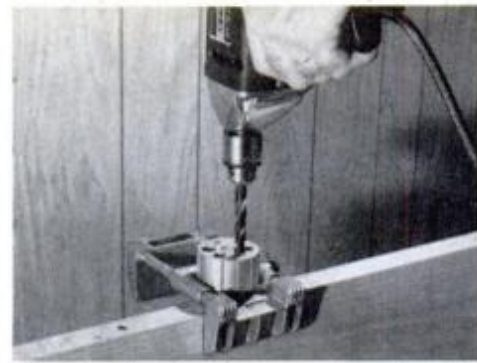
Cut holes up to 2 1/2-in. diameter with a hole saw, slow speed. Pilot bit centers cut.



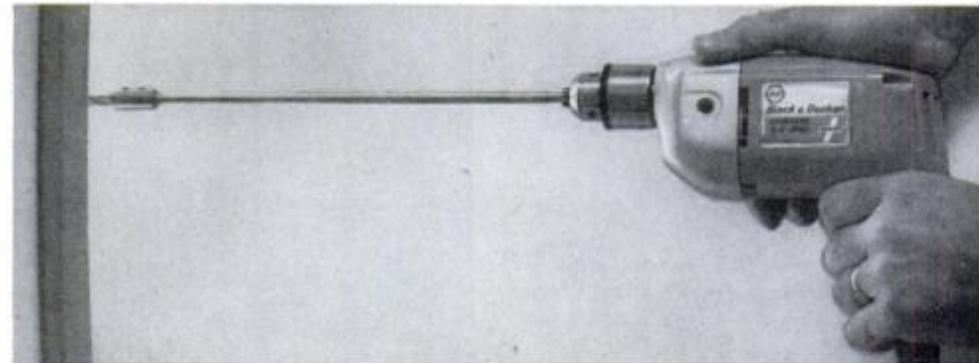
Plastic collar tightens at any position on the bit to control depth of the hole.



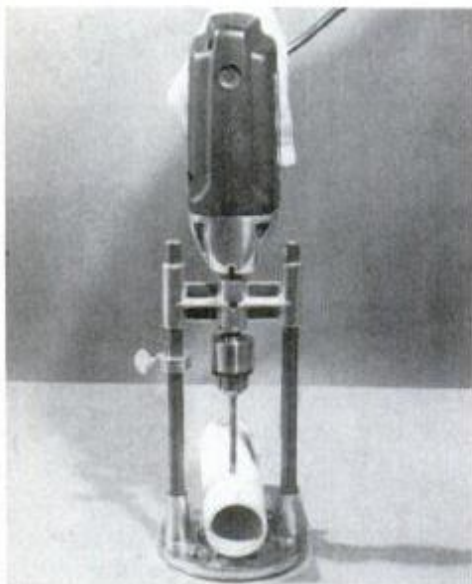
This right-angle drive permits boring holes in tight quarters. Auxiliary handle on the drive helps to steady the bit.



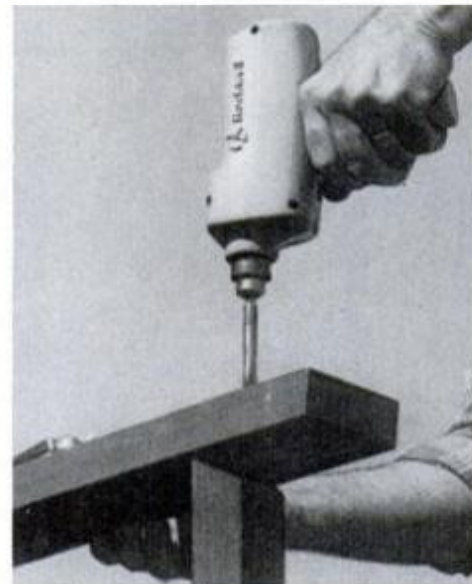
The doweling jig clamps on the edge of a board. Adjustments are locked in to assure exact duplication on mating piece.



The power bit extension is handy for reaching into otherwise inaccessible areas.



The Portalign drill guide provides automatic centering when drilling round stock.



Cordless drill with rechargeable battery is a must when outlet isn't available.



Black & Decker's sharpening attachment lets you sharpen a dull bit quickly.



Drum sanders, available in several sizes, are great for smoothing inside contours.



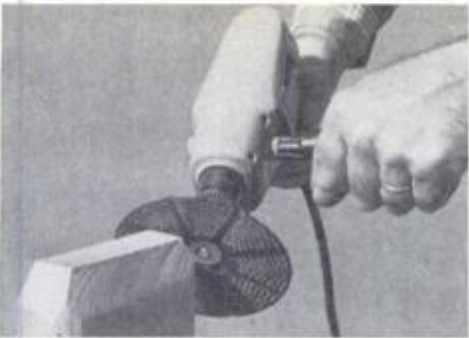
A leather holster totes the drill safely, keeps it ready to use when you need it.

that range between 300 to 500 rpm.

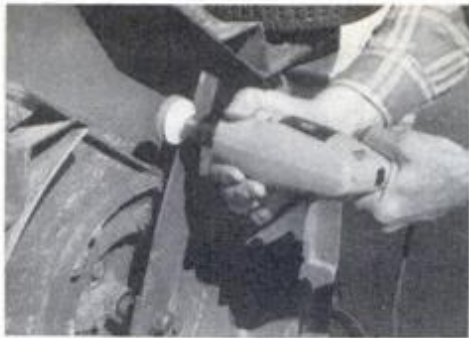
The variable-speed drill allows infinite rpm variation from 0 to maximum speed simply by a squeeze of the switch in the handle. You can choose a speed to suit the job. Some models have preset knobs so you can preselect the desired speed.

Practically all drills have locking buttons that lock the tool "on" for continuous use. A reversing switch is an additional feature which is handy for backing off screws and nuts and for removing jammed drill bits from the work.

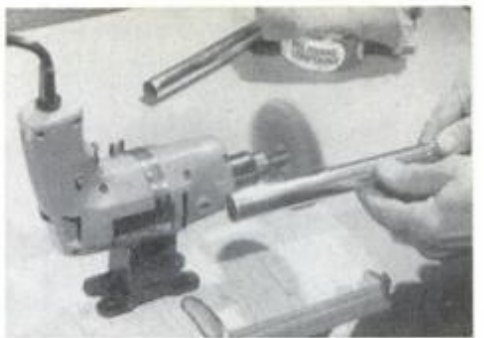
Shockproof insulated construction is an important feature of any



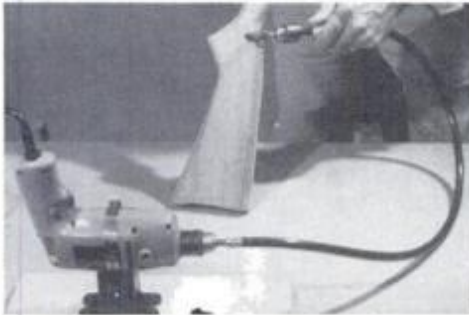
Disc rasp removes rough stock fast, won't clog and far outlasts abrasive paper.



A lawnmower sharpening attachment lets you work on a blade without removing it.



A horizontal drill stand with adjustment clamp converts a drill into a bench unit.



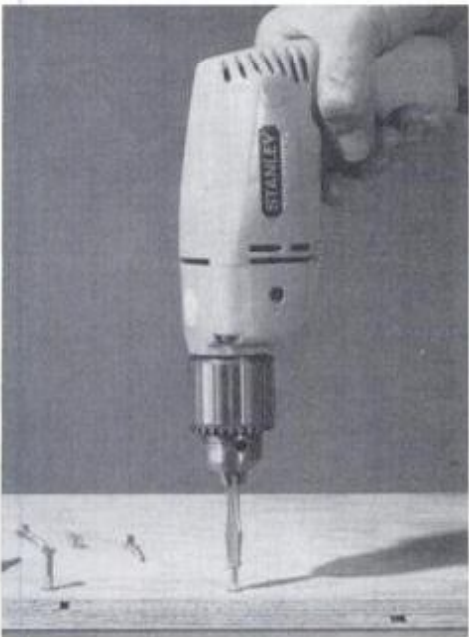
Rotary rasp combines with flexible shaft to perform irregular shaping operations.



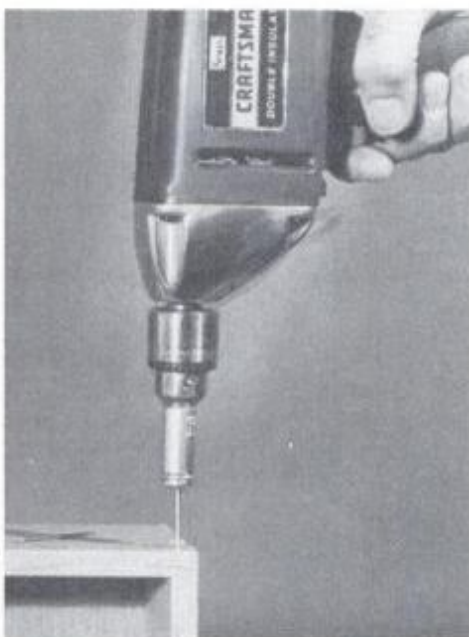
A shear head assembly fits the Milwaukee 1/4-in. drill to precisely cut sheet metal.



Rugged, twisted-end cup brush quickly removes rust, scale and carbon from steel.



Screwdriver bit in a variable-speed, reversible drill will drive and remove screws.



A nail spinner sets-in finishing nails without predrilling, minimizes splits.



Swivel-jointed polishing pad and bonnet flexes to 30° angle, follows contours.



Drill pump is useful for draining plugged sinks. Never use it on volatile liquids.

drill. Insulated tools protect against electrical shock while eliminating the need for grounding.

A cordless electric model is particularly handy when working outdoors where electric outlets aren't available. They run on built-in, 6-volt rechargeable batteries.

Accessories

The number and variety of drill accessories is even larger than the number of drills available. Several items are designed to help you do precision boring. Others use the drill's rotating power source to perform other than drilling operations.

For most jobs precise accuracy isn't essential, so freehand drilling is satisfactory. A try square placed beside the drill and used as a guide can help you while drilling free-hand.

For precision work, such as making doweled joints, drilling through the centers of round stock or installing lock sets, several special accessories are worth having: a doweling jig, the Portalign drill guide and a drill stand. These enable you to bore holes perfectly perpendicular to the surface of the work.

If you're still using a manual brace and bit or eggbeater drill, it's

time to add it to the antique collection—electricians do more jobs easier, quicker and better. **PM**

Manufacturers of drills and attachments

- Black and Decker Manufacturing Co., 701 East Joppa Rd., Towson, Md. 21204
- Milwaukee Electric Tool Corp., 13135 West Lisbon Rd., Brookfield, Wis. 53005
- Portalign Tool Corp., 4903 Pacific Hwy., San Diego, Calif. 92110
- Rockwell International, Power Tool Div., Suite 600, Poplar Towers, 6263 Poplar Ave., Memphis, Tenn. 38138
- Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60684
- Skil Corp., 4801 West Peterson, Chicago, Ill. 60646
- Stanley Power Tools, Box 2217, West New Bern Station, New Bern, N.C. 28560

Back into your garage door!



Off-target car approach resulted in jamb being shoved to rear. Track was knocked out of alignment, brick veneer separated from sheathing.

A nudge from your car can keep the overhead door from operating. Here's how to undo the damage.

by Steven Brett

Because most overhead garage door openings are framed to accept an eight-foot-wide door, it is not that uncommon for a driver to miscalculate space and bump into the jamb. When this happens you are likely to be left with an overhead door that functions poorly—if at all. On these pages we show you how to patch the damage and get the door working again.

Caution: Before you can patch the damage, the first step is to detach the tension spring so you can remove the steel garage-door track. Wedge two lengths of 2x4 under the door bottom to prevent the door from dropping when the spring is removed. Once the springs are released, enlist the aid of a helper if you have to lower and raise the door.

While you're at it

Sometimes a minor accident is the perfect excuse to correct other jamb problems. If your garage door jambs pass through the concrete slab to the ground below (as many do) take this opportunity to replace both vertical members with termite- and decay-resistant pressure-treated lumber. At the very least, the bottom 6 in. of the jamb material should be soaked for 24 hours in creosote or an equivalent, equally effective wood preservative. **PM**



1 Twisted steel track makes it difficult—often impossible—to close door.



2 Damaged brick is removed by wrecking bar. Safety glasses are a must.



3 Next, twisted section of garage door track is unbolted; save hardware.

Here's how to fix it



4 Mallet is used to gently ease salvageable door jamb back into position.



5 Realigned jamb is then checked for plumb and nailed to the framing.



6 Heavy-duty pliers, muscle straighten the creased edges of the steel track.



7 Hand sledge is also handy. Make certain work rests on a solid surface.



8 Finally track is returned to original position and refastened to angle iron.



9 Measure distance from plumbed surface in several places for alignment.



10 Pull overhead door down, test fit. Finish renailing jamb to framing; set all nails and fill with putty.



11 Replacing the brick veneer is still to come—but at least owner can now close and lock the garage door.

PM photos: Irv Field

How to pick the right painting tool for the job

What to look for when you select paintbrushes, pads and rollers—with some tips on how to use them and how to make them last.

by Joseph R. Provey
ASSISTANT HOME AND SHOP EDITOR

When it comes to a paint job that isn't just a whitewash, quality painting tools in the hands of a person who knows how to use them are just as important as the quality of the paint used. Yet, when it comes to cutting costs, the first item most people skimp on is the paint applicator.

Well-chosen tools, even if initial cost is significantly higher, are a wise investment. Unfortunately, it is not always easy to recognize a quality product. Superficial features and useless gimmicks can mislead. Study the notes, drawings and photos on each of the three basic applicator types—and the next time you're pondering an addition to your painting tools, you'll know exactly what to get.

The primary job of any painting tool is to apply paint quickly and easily, leaving no unwanted marks, dust, lint or filaments. Rapid cov-

erage will depend on three things: (1) how much paint a tool can pick up and hold; (2) how much can be transferred to the surface and (3) uniformity of the flow or discharge rate.

A well-designed paint tool is also comfortable to use. Check for balanced weight. The correct handle on a brush, for example, counterbalances paint-loaded bristles and makes the tool easy to control, less tiring to use.

Look for innovations which make life simpler. Some pad applicators, for instance, have knob-type grips which pivot freely or float to permit strokes that don't have to be interrupted often for grip changes.

Always choose tools suited to you. A jumbo, 9-in.-long roller or 6-in. wall-coating brush might be too heavy for you to manipulate effectively—while it might help someone else get the job done faster.

Finally, a good applicator is easy to clean and, when properly cared for, can be used over and over. Disposable applicators may or may not work well, but in the long run cost more.

Brushes, pads, and rollers each have definite advantages—and disadvantages. Choosing one over

another depends on how large the job is, how quickly you want to get it done, and personal preference.

Brushes are well suited to all surfaces. They pick up paint well and are neat, easy to use and come in a variety of shapes for every purpose—and with proper care last indefinitely.

Rollers for all surfaces also get large jobs done rapidly but they often leave a texture on either painted or stained surfaces. They tend to shed and they create a fine mist of paint which can be tedious to clean off unprotected floors. Minimize misting by using a slow rolling rate and not applying too much pressure. Padco's shielded No-Spray roller or Arisco's Rapid Roller with spin-retarding, snap-on roller cartridges also help to solve the misting problem. A roller cover should be replaced when its pile loses resiliency or when its core weakens.

A paint pad does not pick up as much paint per dip as either brush or roller—but does let you get the paint on quickly with relatively little expertise. The correct pad is particularly effective on smooth interior surfaces and for applying stain to shakes and siding. Textured surfaces, however, will often separate pad laminations.

THREE KINDS OF PAINTING TOOLS IN ACTION



Oval sash brush is great for painting window trim—also mullions, scrollwork, moldings, any irregular surface.



Foam roller is shaped for painting inside corners. Use to start job; then do trim with 3-in. roller, wall with 9-incher.



Pad-type edger is kept off stained molding by plastic wheels. You get sharp edge without use of protective tape.

Painting tool manufacturers

The brushes, rollers and pad applicators in this article are at local hardware and paint stores. If you can't locate an item write the maker for the nearest dealer:

Elder & Jenks, Inc., 148 East Fifth St., Bayonne, N.J. 07002. Paint and varnish brushes, specialty brushes, roller covers and frames.

PPG Industries, Inc., One Gateway Center, Pittsburgh, Pa. 15222. Brushes and rollers.

Prager Brush Co., 730 Echo St. N.W., Atlanta, Ga. 30318. Brushes and rollers.

The Wooster Brush Co., 604 Madison Ave., Wooster, Ohio 44691. Brushes and rollers.

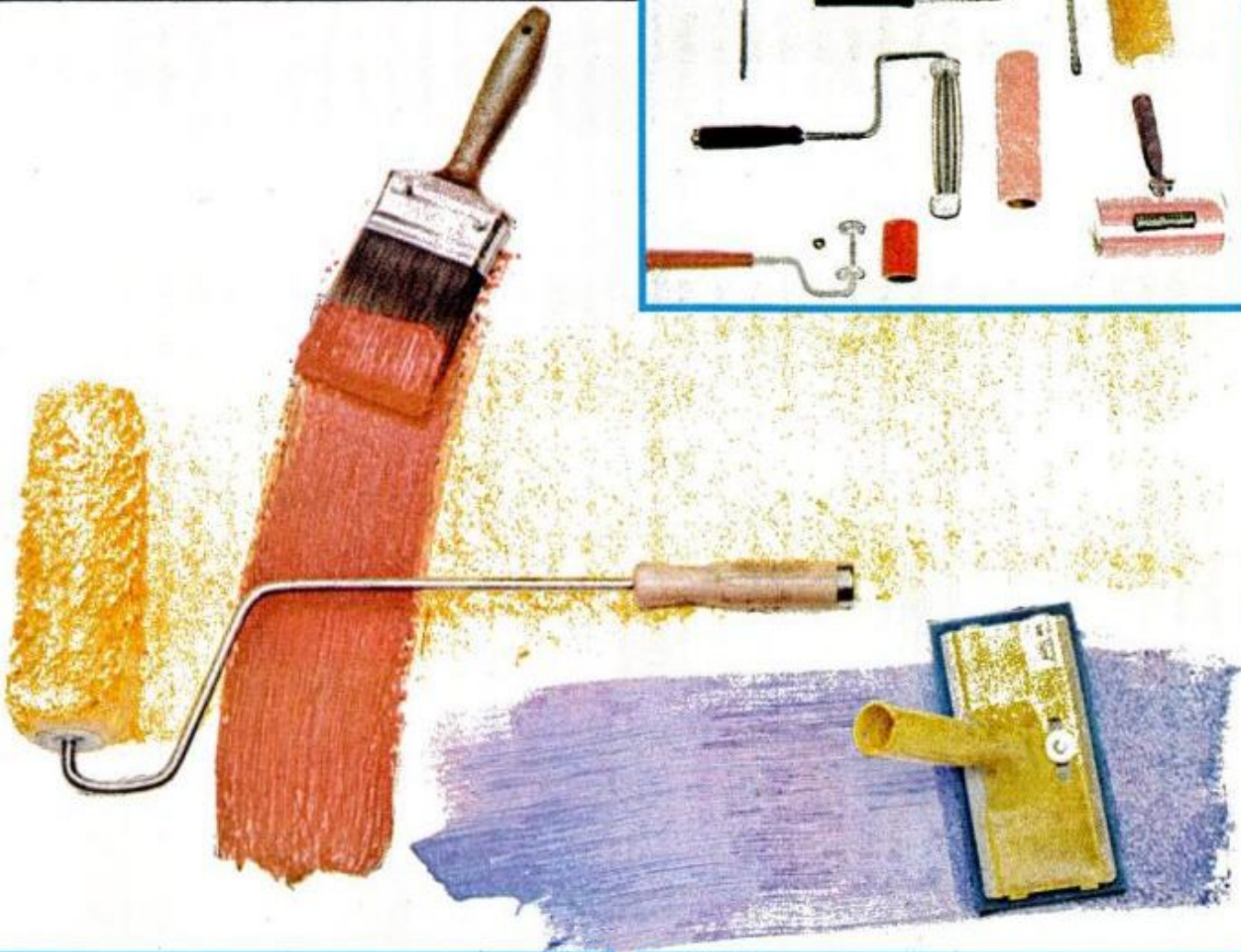
Arsco International, 870 West 25th St., Hialeah, Fla. 33010. Snap-on cartridge

roller system with lightweight roller frames, accessories.

Padco Inc., 2220 Elm St. S.E., Minneapolis, Minn. 55414. Paint pads for interior and exterior use; telescoping extension poles; shielded, No-spray rollers.

Shur-line Manufacturing Co., Inc., 80 Drullard Ave., Lancaster, N.Y. 14086. Pad applicators with rotating handles, edgers, foam brushes.

Paint tool design continues to evolve. Roller systems (right) include snap-on, birdcage, end-cap-frames. Foam corner and shielded rollers eliminate paint misting (see text).

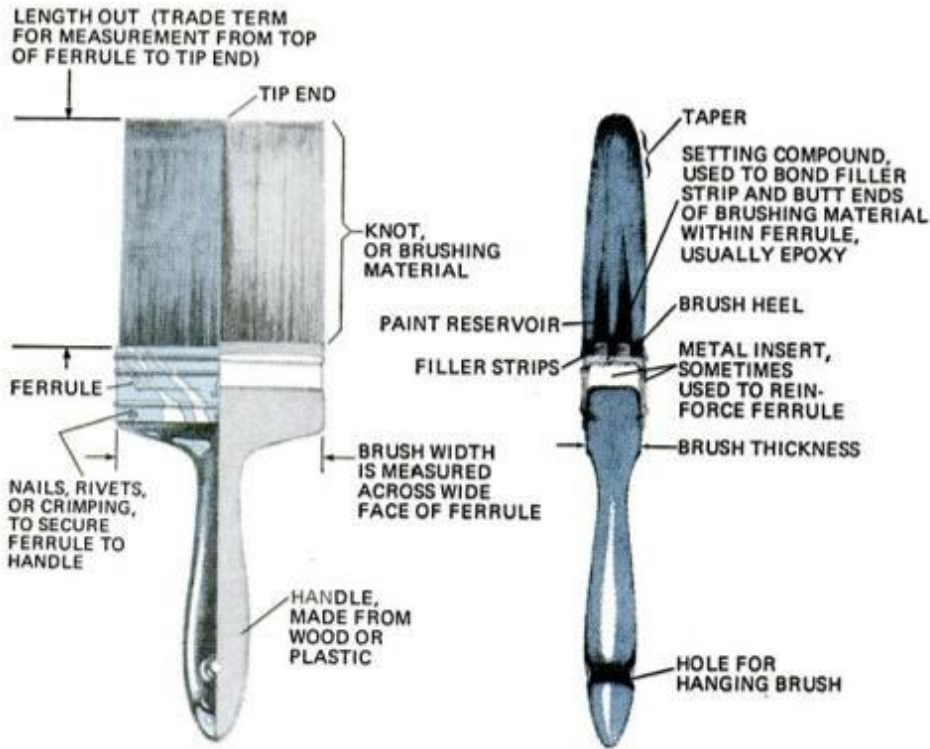


Brushes (left to right): oval varnish, oval sash, enamel, varnish/wall, wall, wall-coating; (bottom) flat and angular sash.



Pad family includes minipad, sash painters (right); edgers (center); replacement pads (on pan) and 9-in. applicator.

WHAT TO LOOK FOR IN A BRUSH



To avoid rust stains in paint and on job, stainless-steel ferrule is best, brass, nickel plate next, tin for throwaways.

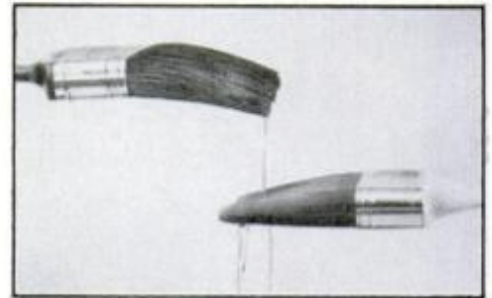
If you decide on a brush, first check it for fullness. It shouldn't feel skimpy. Filler strips, which create reservoirs for paint, should not be too large. Second, the knot should be tapered, to make the brush thinner and more flexible at its tip. This means fewer brush marks and a brush

edge which releases paint gradually, with less effort. Flags (the split ends) also help to pick up, hold and release paint more evenly. Be sure at least 50 percent of the brushing material is flagged.

Finally, choose a brush shaped to suit your task. Wall-type brushes are for large, flat areas; oval brushes for irregular or contoured surfaces and smaller trim and sash brushes are for close work around windows, doors, molding and on furniture. Use natural bristle for varnish, enamel, shellac—and polyester or nylon for almost any coating. Note: nylon is not recommended for use with shellac.



A brush with varied bristle lengths picks up and releases paint better. Examine brush for shorter lengths as shown.



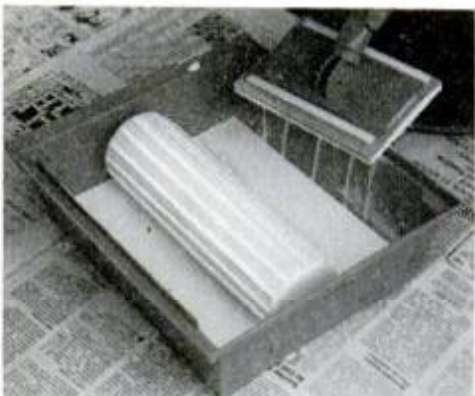
Natural bristles (top) lose shape and stiffness after soaking in water. Stiffer synthetic filaments (bottom) will not swell or weaken in water-based paints.



Good brush handles are made of beech, birch, hard maple or solid plastic. Length, weight, neck diameter, shape are suited to the recommended use of brush.

TIPS ON USING PAINT PADS EFFECTIVELY

If you choose a pad applicator, never paint with its heel. This is where separation from the pad backing usually starts. Your stroke

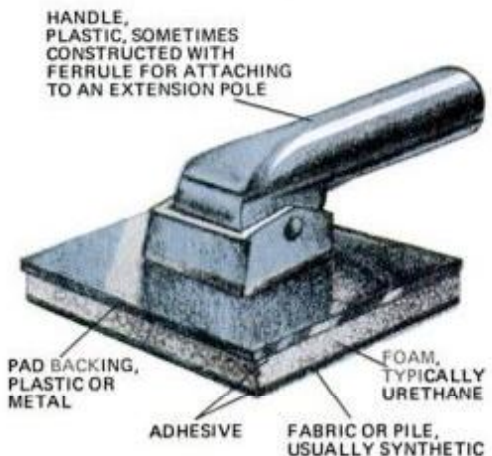


To load, rotate cylinder with pad. Draw across back edge of pan to remove excess.

should begin with the top edge of the pad touching the work surface. As you progress, gradually bring more pad into contact. When you finish the stroke, the pad should be almost flat against the surface. Always stroke toward wet paint (as with any painting tool). This will help to avoid unsightly lap marks. Wipe the pad edges with a rag occasionally during use to prevent dripping.

Choosing the right pad speeds the job. Use 6- to 10-inch-wide siding and shake applicators outside, 5- to 11-in. pads inside. Cut in at borders with special edging tools and use trim pads for sash, molding and the like. Wand-type pads are for painting or varnishing small objects and pieces of furniture.

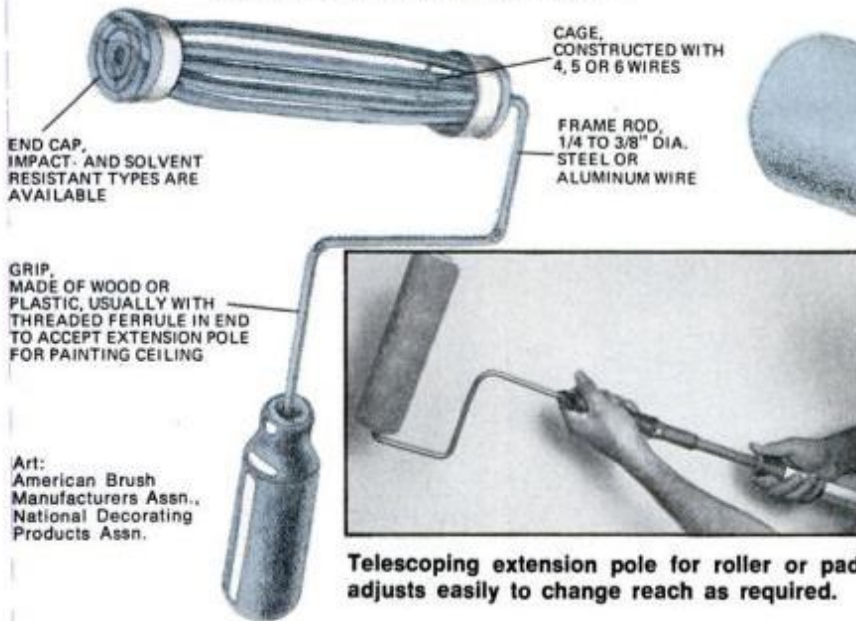
PAINT PAD, OR FLAT APPLICATOR



REPLACEABLE PAD NORMALLY LOCKS INTO POSITION

CHOOSING THE RIGHT ROLLER

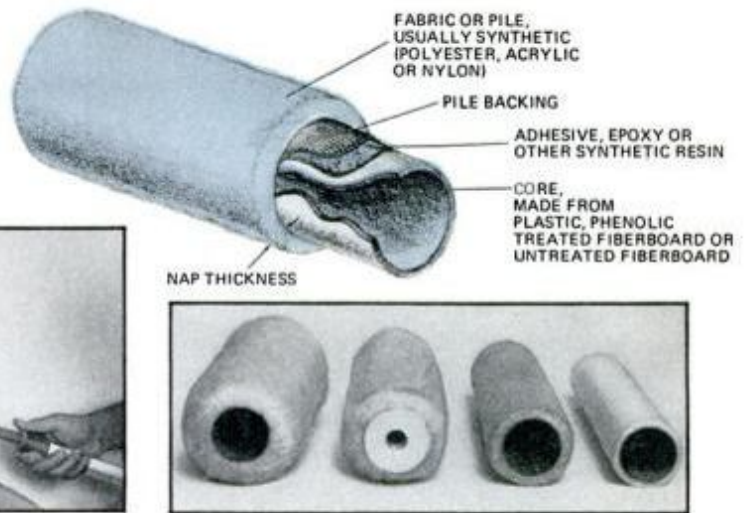
CAGE-TYPE ROLLER FRAME



Art:
American Brush
Manufacturers Assn.,
National Decorating
Products Assn.

Telescoping extension pole for roller or pad adjusts easily to change reach as required.

ROLLER COVER REPLACEMENT



Use thick-nap cover on rough surfaces; shorter naps are for smooth and gloss finishes.

Most roller covers today are synthetic—and do a good job with both latex and oil-based paints. Nap thicknesses of $\frac{1}{8}$ to $\frac{3}{8}$ in. are for smooth surfaces, $\frac{3}{8}$ to $\frac{3}{4}$ in. are for

semi-rough surfaces like sand finishes and cement block, while $\frac{3}{4}$ to $1\frac{1}{4}$ in. are for rough surfaces like cinder block, stucco, brick, and chain fence. Use special $\frac{3}{16}$ -in. nap

to apply all textured wall coatings. A good roller cover sheds little lint, has beveled ends and smooth, even seams. The best cores are of phenolic-treated fiberboard or plastic.

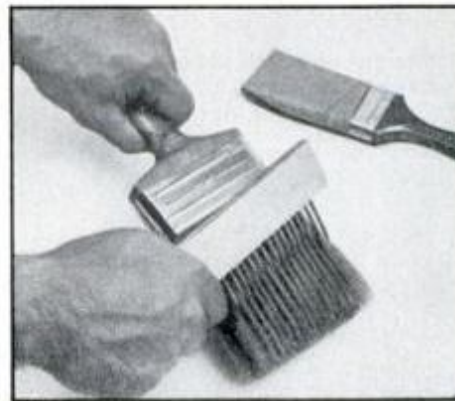
GENERAL RULES FOR PAINT TOOL CARE

- When using latex, rinse tool every few hours to keep free of hardened deposits.
- Wrap tools in plastic or foil to keep them from hardening during work breaks.
- Use only cleaning solvent, and solutions recommended by the paint maker.
- Tools used with latex paints that contain alkyd resin or emulsified oil need to be cleaned with paint thinner between water and soap rinses.
- Don't let brush, roller or pad rest on bristles or nap while drying or storing.
- Wrap pads and rollers in foil or plastic after cleaning.
- Keep two sets of tools—one for oil-based paints, the other for latex.

Preventive brush maintenance

Brushes can represent a sizable investment and are particularly susceptible to damage in use. Never dip more than $\frac{1}{2}$ to $\frac{2}{3}$ of total length out. Al-

ways tap a brush to remove excess paint—wiping it on the can's edge may cause flaring. Your stroke should be compatible with the brush shape—don't, for in-



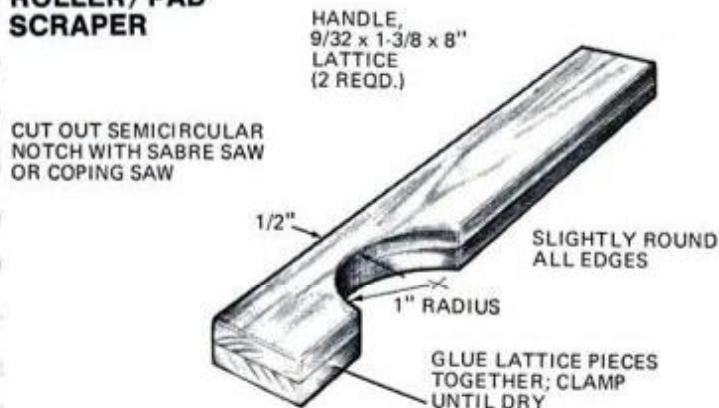
Combing removes residue, separates filaments. Wrap brush to retain shape.

stance, poke into corners with a wall brush. When finished, clean the brush as soon as possible. Don't soak overnight or the handle may swell. **PM**

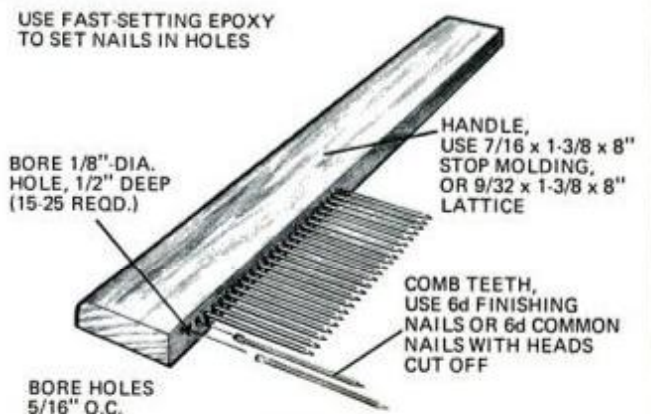


Roller scraper removes much of excess paint to make washing fabric easier.

ROLLER/PAD SCRAPER



BRUSH COMB





Pottery making for everyone

No need for a potter's wheel: Flatten clay on fabrics for varied texture.

by Penelope Angell
ASSISTANT HOME AND SHOP EDITOR

The simple method used to make this decorative pot is one you can learn in an afternoon: On various textured fabrics you roll clay into slabs, cut them to shape and combine the pieces. A craftsman's touch is essential in choosing complementing fabric textures to imprint the clay and in joining, to create pleasing shapes.

The clay should be moist as you work. Knead it until smooth and free of air bubbles when cut in half. Smooth seams with a moist sponge. Each time you seam pieces together, set the work aside for an hour or two until the clay stiffens slightly but is still moist enough to seam with the next section. Cover the completed piece with a plastic bag several days so it dries slowly. Remove the bag and air the clay several more days until it's dry to the touch, then fire it.

When you fire the kiln, rest it on fireproof bricks or concrete floor. After firing, *don't open until it is cool* (at least six hours with the kiln shown). The pot needs two firings in the kiln shown—a bisque firing for 1½ to 2 hours at about 1873° and a glaze firing of 2½ to 3 hours at 2174°.

Gradually cover the kiln as it heats. This may take 45 minutes.

MATERIALS AND TOOLS LIST

3 lbs. moist, de-aired stoneware clay (clay with air pockets can explode in the kiln).
Vinegar (to help pieces adhere).
Red iron oxide colorant; pin tool to cut clay.
Commercially prepared glaze, compatible with firing temperature of clay, to waterproof pot.
Grog (fired and ground clay) or sand for texture.
Rolling pin, textured fabrics, fork (to score clay).
Workboard (to turn piece when it's wet).
Small paintbrush (to apply vinegar).
6½-in.-dia. and 3½-in.-dia. templates to use as cutting guides; i.e., pail or jar.
Small kiln with firing cones. Make sure you follow the instructions carefully.

(If pottery supplies aren't available locally, write: Eagle Ceramics, 11264 Wilkins Ave., Rockville, Md. 20852.)



1. This pot is an excellent first project. Roll the clay to a ¼-in.-thick slab somewhat like rolling a pie crust.

2. Use any round object with a 6½-in. diameter as a template to cut a circle from the clay for bottom of the pot.



3. Hand shape a 1½-in.-dia. clay coil. Sprinkle grog (or sand) on canvas to give the clay texture and roll it flat.



4. Trim the slab edges straight to a 2½-in. width. This slab wraps around the pot bottom to begin forming its sides.



5. Score the edge of the pot bottom with a fork to aid adherence. As you work score all points where the two slabs meet.



6. Also aid adherence by brushing pure vinegar on all seam edges. Wrap slab around pot bottom, overlap ends, seam.



7. After seams are pinched together, press a decorative clay button on the side seam. Let this dry for an hour or two.



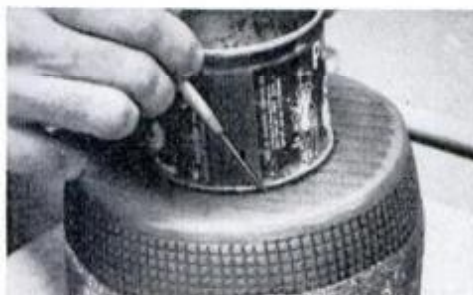
8. Shape a 3/4-in.-diameter coil, roll it on a fabric to get texture and gently peel it off. Trim it to 1 1/4-in. width.



9. Score the pot at the seam, brush on vinegar on all seam edges. Wrap slab around pot bottom, overlap ends, seam.



10. After rolling a top slab on fabric for more texture, gently peel off slab. Place pot upside down on slab; cut top.



11. After the top of the pot is treated and seamed, cut the top opening using a 3 1/2-in.-diameter template; let pot dry.



12. Roll a 1/2-in.-dia. clay coil to use as the neck of the pot. Flatten it, then trim to 1-in. width and attach.



13. Use a pin tool to prick decorative holes in the pot neck. Then flatten a pencil-sized coil around the neck seam.



14. Shape two 3/8 x 1 x 3-in. handle supports. Cut the handle holes. Score, apply vinegar and attach the supports.



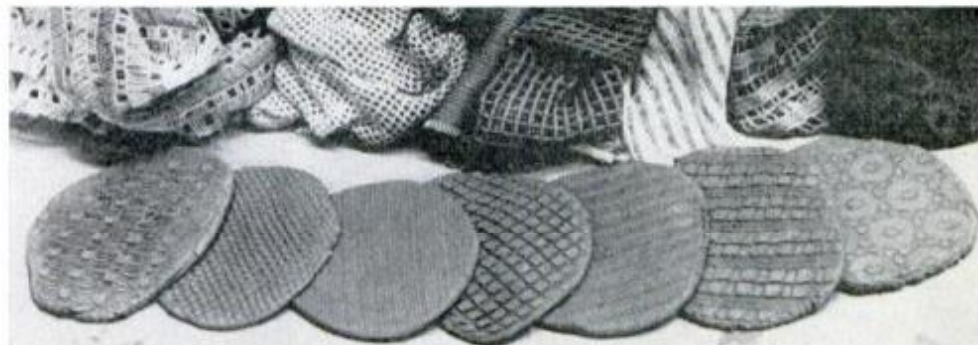
15. Roll handle coil, place it through the support holes and add a pea-sized handle stop near each handle end.



16. Place dry pot and a cone in the kiln. Be sure that the cone is visible in kiln window. Kiln is \$80 from Eagle Ceramics.

The correct firing temperature is reached when a 1-in.-high cone, placed on a pad of clay inside the kiln, droops over. Use a No. 06 cone for bisque firing and a No. 6 for glaze firing. A melting cone is a sign to turn off the heat and cool.

After bisque firing, sponge on a red iron oxide wash (one rounded teaspoon to one cup water) to darken the recessed area. Rub it off after two minutes. Pour a coat of glaze in the pot to waterproof it; glaze-fire. **PM**



Each clay sample was rolled on the fabric behind it to acquire a texture. Experiment with materials—try grasses and leaves—to get desirable, complementing patterns.

RADIO CONTROL FROM THE GROUND UP



You needn't be a master modeler to fly, drive or sail RC—but there's still a right way to learn.

by Peter Barmonde

The action isn't all in the air—you can drive a sophisticated electric car like this 1/12-scale Ferrari for \$59, or sail a boat like the 36-inch Peapod Charlie Pears from scratch.

The gleaming blue-and-white Cessna arced out of the sun and dived toward the ground. I pulled the stick back and fed in a touch more throttle. The ship instantly shot skyward.

"Don't overcontrol," Norris Sacker, my instructor, prodded gently. "Take it easy. We'll fly her around the field one more time. This time I want you to execute a series of slow left turns on my command. Just use your ailerons and remember to keep the nose up." His voice was soothing.

I relaxed my white-knuckled grip on the stick and slowly pushed it over to the left. The ship went into a gentle bank and started to come around. Feeling cocky, I fed in more aileron. Suddenly she went belly up and the nose dropped. I





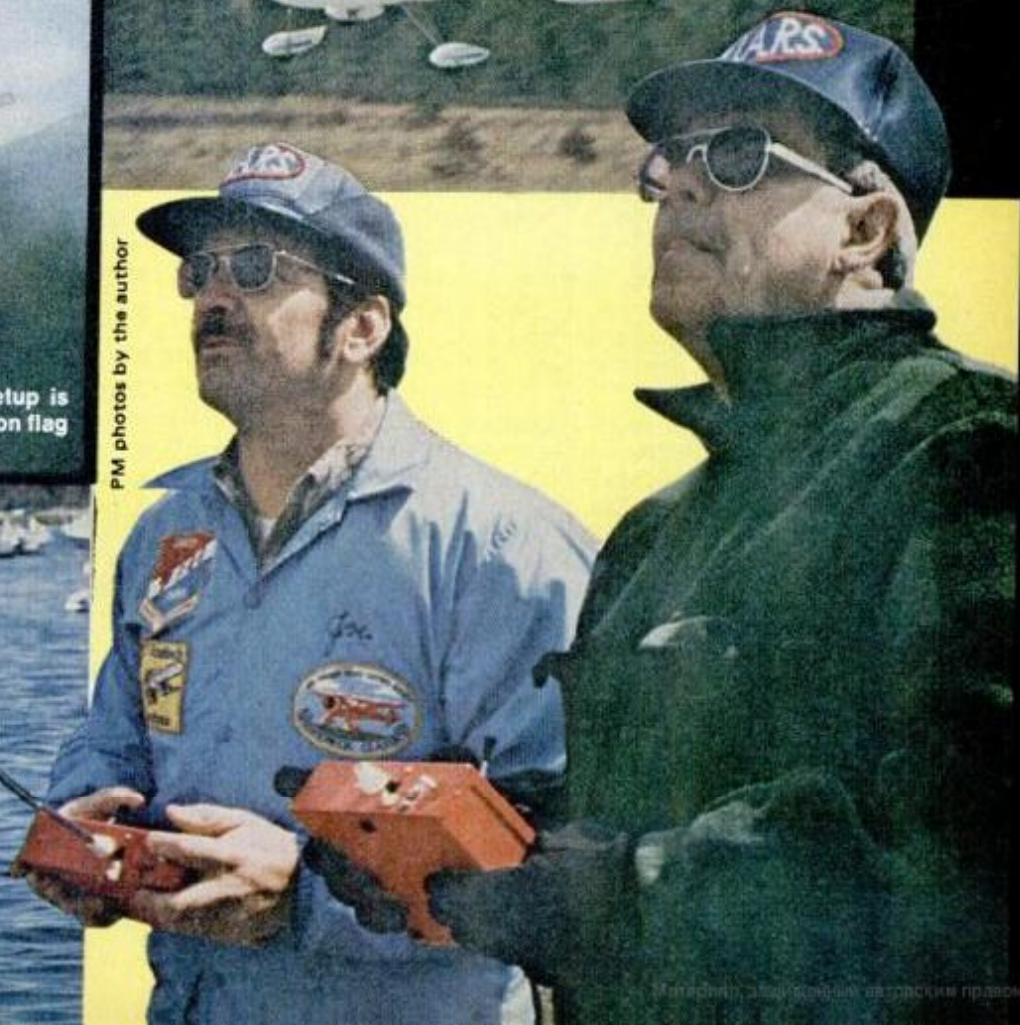
F4U Corsair fighter in 1/4 scale (above) is combination of \$79 kit and 600 hours' work by builder Mike Gross. Cherokee Archer and Cessna Cardinal 177 (below) come ready to fly from MRC—they're ideal for pilots who aren't modelers. The Cessna in flight is a stable training ship.



Andrews Aeromaster biplane sports smoke generator.

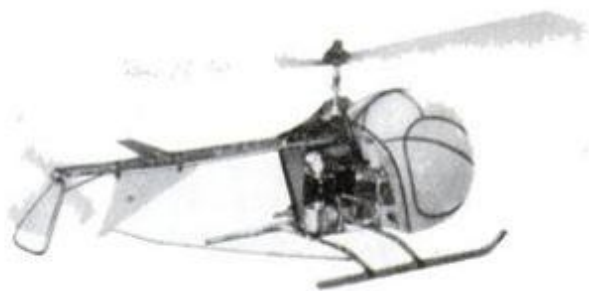
"Buddy box" dual-control setup is best way to learn to fly. Ribbon flag displays frequency in use.

PM photos by the author





Simple two-channel trainer is hand-launched. Construction of this Cox ready-to-fly model is lightweight, easy-to-repair plastic foam. After crashing into shape shown below, the plane was fixed and flown again.



RC choppers like Schluter Heli-Baby require the utmost in flying skill. There's no margin for error, since model 'copters don't autorotate.



froze. Fortunately, Sacker was way ahead of me. He had taken control of the plane as soon as she flipped, and now deftly trimmed her and brought her in. I finally released my futile grip on the stick as the ship taxied to our feet.

"You know," he said, "without the buddy box, you would have plowed up the field, especially if I'd had to wrestle that transmitter out of your hands."

The buddy box, a second radio-control (RC) transmitter linked to mine by cable and provided with an override switch for the instructor, had kept this flying lesson from ending in a crash. I had experienced spatial disorientation, a phenomenon known to all beginning RC pilots and the cause of most crashes. It's the apparent left-right reversal as the plane is coming toward you.

Experts say RC flying is more difficult than full-scale. There's no seat-of-the-pants feel to tell you what the aircraft is about to do. With only sight to rely on, you must concentrate intensely and make your control movements precise if you're to maneuver successfully.

Whether you're coming from full-

scale or starting with miniatures, you're well advised to join a club. There are no lone eagles in RC for good reason: inept flying is dangerous, and people have been maimed and killed by out-of-control RC planes. "The hobby thrives because people pay attention to safety and cooperate with one another," says Frank Ritota, RC product manager for Model Rectifier Corp.

RC clubs are chartered by the Academy of Model Aeronautics, which is the publisher of *Model Aviation*, a leading enthusiasts' magazine, and sanctions all RC flying competitions. It also provides \$1-million liability insurance coverage for members.

Flight-training programs

Clubs usually rent flying fields, and don't let non-AMA members use them. Most clubs have rigorous flight-training programs, and won't let a novice solo until he's checked out by a flight instructor. At the Long Island Aero Radio Society, Norris Sacker provides a buddy box and trainer plane for new students.

If you want to fly RC, attend a few club meetings as a guest before you invest in any equipment. At the very least, go to a knowledgeable dealer. For clubs in your area, write the AMA at 815 15th St. N.W., Washington, D.C. 20005.

An amateur radio license, requiring code proficiency and knowledge of radio theory, used to be necessary for RC operation. Today, all you need to fly on two of the

three available bands is a Class C license; just file the application packed with your transmitter (or request Form 505 from the FCC)—no tests, no fee.

Most new RC equipment operates on the 72 MHz band, which incorporates seven spot frequencies. The other bands are increasingly unpopular, 50-54 MHz because it still requires a ham license and 27 MHz because it's vulnerable to CB interference.

Modern sets have a range of more than half a mile; never operate your transmitter within range of another transmitter on the same spot frequency—you could "shoot down" the other guy's plane.

Today's RC systems provide two to eight control channels for \$100 to \$850. Most come complete with transmitter, receiver and servos, ready for simple installation (though you can get kit systems from Heath). Each channel is an independent path for control information to an individual servo, the motor that actuates a control surface through a pushrod.

A two-channel set will give you rudder and elevator control. With three channels, you can add throttle control and a steerable nose wheel linked to the rudder, so you can taxi and take off from the ground. A fourth channel adds ailerons and gives you what enthusiasts call full-house aircraft. Adding still more channels plugs you into the more esoteric aspects of RC modeling—

(Please turn to page 114)



11 mg "tar," 1.0 mg nicotine av. per cigarette. FTC Report Aug 77

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



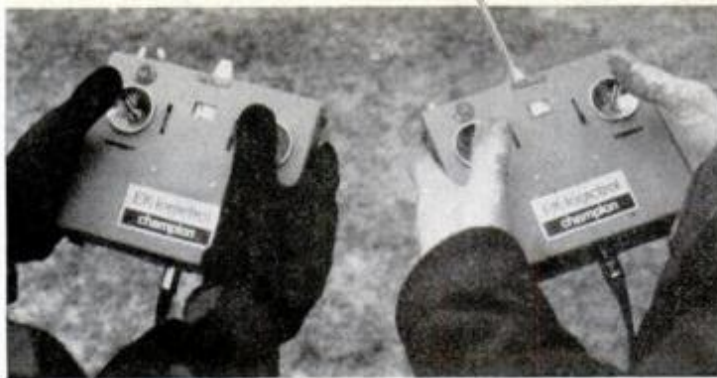
RADIO CONTROL

(Continued from page 112)

you can install retractable landing gear, flaps, strobe lights, bomb releases and even parachutists.

Start with a simple plane

Experts advise you to start with a simple, easy-to-fly, inexpensive plane—but buy the most radio you can afford—at least four channels, even if your first plane is set up for two. Makers like MRC, Cox/Sanwa, RS, Futaba and Kraft offer four-



Typical flight caddy (far left) keeps fuel, battery, starter, tools together. Electric starter (far left, below) preserves fingertips. Buddy-box set-up (left), like dual controls in a car, lets instructor (with transmitter at right in photo) take over controls instantly when the student pilot makes a mistake.

channel systems for around \$200.

Choosing your first plane can be frustrating. Buy a complex kit if you must—but put it on the shelf. Then get a stable high-wing trainer, one that's nearly indestructible, and get dealer or club assistance in installing the radio.

If instant flying is your aim, MRC and Cox make ready-to-fly styrene foam Cessna trainers complete with engines; all you do is fit radio components into premolded compartments and connect pushrods to servos. Assembly is less than an hour; if you crash one, you can epoxy it back into flying shape.

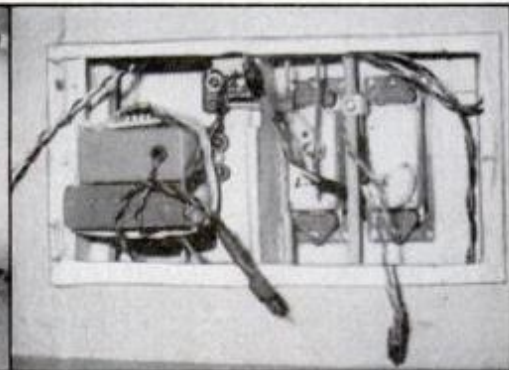
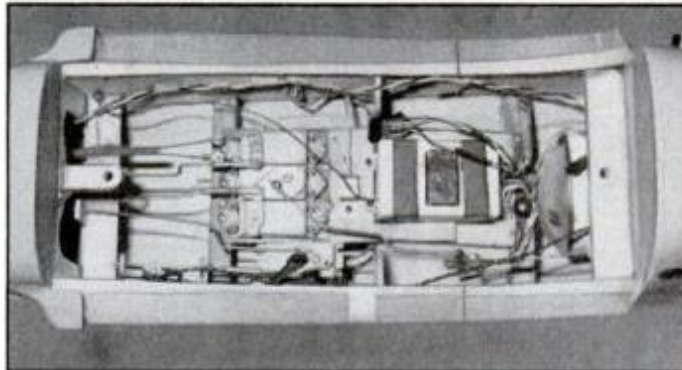
The Cox Cessna Centurion, designed for the compatible Cox/San-

wa two-channel radio system, sells for \$160 with radio. More sophisticated is the three-channel MRC Cessna offered in two versions: glow-engine powered and rechargeable electric, with a 15-minute charge from your car's cigaret lighter good for five minutes of flight. Prices are \$98 for glow, \$198 for electric, both without radio.

You can save by getting an almost-ready-to-fly (ARF) foam kit. Midwest has a Cessna Cardinal with four-channel capability for \$29.95. Almost all major kit makers sell at least one low-cost, quick-build foam trainer. ARF kits have no engine, fuel tank or control link-

(Please turn to page 116)

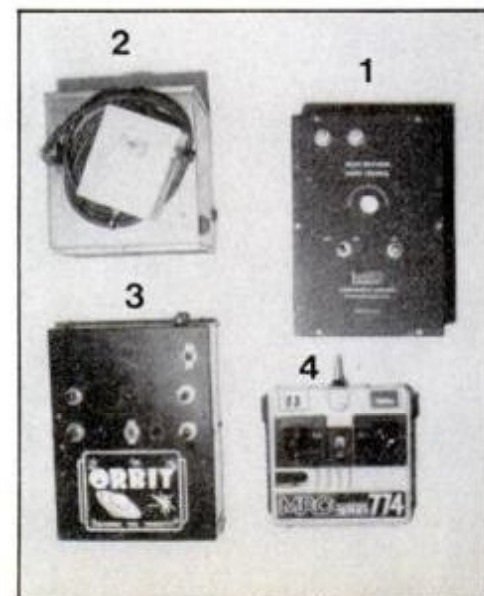
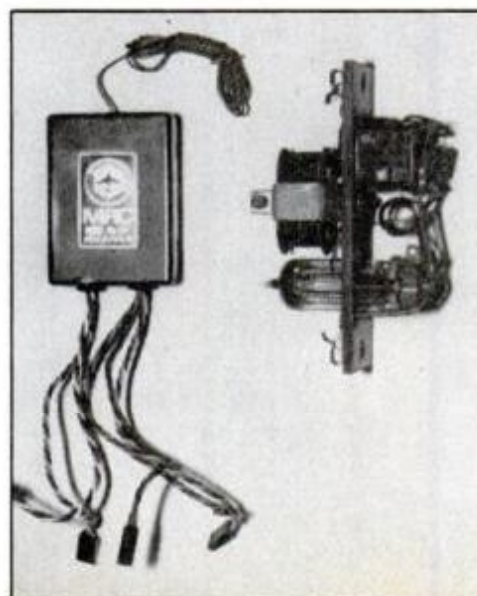
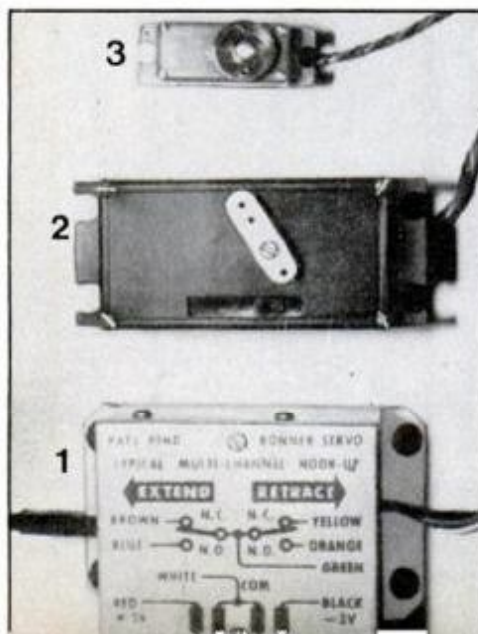
Servos are the muscles in standoff-scale P-47 Thunderbolt built by Roy Vaillancourt. Three in fuselage (right) operate throttle, rudder, elevators. Three more in wing assembly (far right), actuate ailerons, flaps, landing gear. Switches tripped by servos turn on landing lights when flaps go down, drop main gear when tail wheel lowers.



1. Mechanical servo, vintage 1956. 2. Early transistorized servo. 3. Modern Kraft miniservo that produces same torque.

Modern four-channel receiver packs three more functions into less space than 1946 tube receiver took, is tougher, too.

Transmitters: 1. 1946 one-channel. 2. Controls, transmitter in two boxes. 3. 1956 four-function. 4. Modern full-house.



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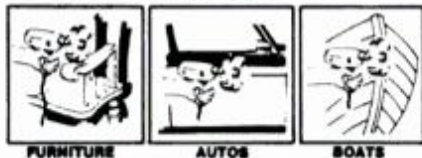
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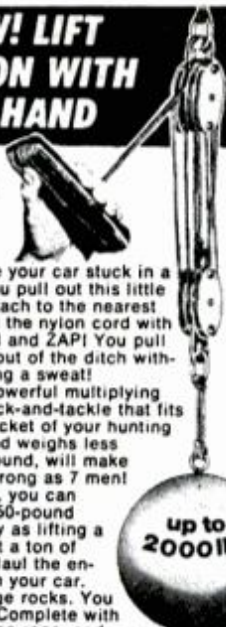


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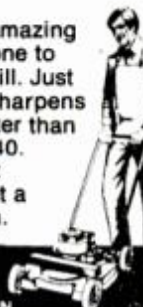
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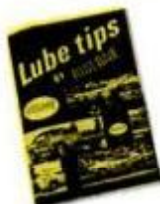
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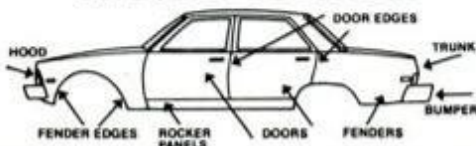
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RADIO CONTROL

(Continued from page 114)

ages; get these from your dealer.

If you're going first class in ready-to-fly, buy MRC's four-channel, semi-scale Cessna Cardinal or its medium-performance Cherokee Archer and have the best-looking ship on the field your first day out. These flawlessly finished fiberglass ships are docile enough to learn on, yet capable of giving you a thrill once you've soloed. Cost is about \$300 each, without radio.

Take time for your dream kit

Once you solo and decide to build your dream kit—take your time. RC modelers as a group are free with advice and will divulge their construction tricks to anyone interested. Read *RC Modeler*, *Flying Models* and *Model Aviation* for more tips and product reviews.

Flying, too, has plenty more to offer than just orbiting the local field. The AMA sanctions competitions in both performance events—like pylon races at up to 160 mph—and aerobatics—called pattern flying. Local clubs sponsor "fun flies," with events like balloon bursting and landing contests for novices.

Powered airplanes dominate RC aviation, but radio-controlled sailplanes and helicopters have their own enthusiasts. The choppers are expensive and exceedingly difficult to fly—not for beginners.

Although aviation accounts for 95 percent of RC activity, car and boat models are technically sophisticated and run in organized competition.

Modern RC cars have independent suspension, servo-operated transmissions, semipneumatic tires and powerful gas and electric engines. Most kits require two-channel radio systems to control steering and throttle. Electric models are very popular for indoor running.

The International Model Power Boat Assn. conducts hydroplane races and scale competitions. Makers like Dumas Products offer a wide range of powerboat kits.

Probably the most relaxing kind of RC operation is model sailing—just you and your boat, with no crash landings to worry about. But model-yacht racing can provide the same kind of challenge and excitement as the real thing. Most RC sailboats use two-channel radios, for rudder and mainsheet, and a high-torque servo to trim the sails.

Modern radio-control technology gives the enthusiast of every taste power to set his personal Lilliputia in motion. Your own imagination and skill are the only limits. **FM**

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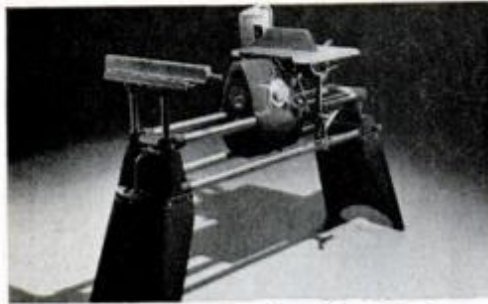
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OUR GROWING JUNKYARD IN SPACE

(Continued from page 61)

completely on re-entry. Parts of the huge structure, along with many internal parts—such as spherical fuel containers, lead boxes and titanium components, will survive the searing plunge and crash to Earth. Where and when this may happen is anyone's guess at the moment. As the satellite brushes the atmosphere's outer surface it will skip, like a flat stone sent skimming across calm water. Considering its posture, it probably will tumble as well. The combined forces imposed as it digs into atmospheric resistance will break it up into thousands of pieces that will spread themselves "... in a pattern over several thousand miles," according to NASA.

With such an abundance of white-hot metal raining from the skies across such a wide area, it's too much to hope that all of it will plunge into remote oceans.

No one in official Washington is eager for such an uncontrolled re-entry to happen. Coming, as it does, soon after Cosmos, makes matters even more worrisome. Incidentally, no radioactive debris from Cosmos ever was found. Early reports of readings, it was later acknowledged, were due to a faulty counter.

In any case, a number of interesting projects are in the works, designed not only to extend the Skylab orbit by several months, but also to boost it to a higher orbit out of harm's way once its life has been stretched to fit the Shuttle timetable.

The last astronauts to leave Skylab turned off everything except one receiver left on solar power.

On March 6, a team of NASA engineers began manipulations to contact the satellite from Bermuda. The angle of sunlight in the sky there would hit Skylab's solar panels more directly than at other locations. As team members activated equipment in the big tracking center, monitor screens glowed, control panels blinked and scientists prepared to "talk to" the satellite.

The first inquiry signal drew no response from the long idle equipment in space. A second try got through. Skylab responded with a carrier signal for two minutes, went off, cut back briefly near the end of the pass and turned itself off. Calculations quickly indicated that the satellite was rolling every six minutes, providing only three minutes of power from its solar cell arrays with every revolution. But at least engineers could communicate with it at calculated intervals.

On its next pass, Skylab was ordered to charge its batteries.

"Within two days one battery was charged and others were coming on stream," recalls a dedicated NASA booster. "Next night engineers told it to transfer power to the ATM computer—vital for ground commands. Bingo! They had telemetry, and soon learned that all vital systems on board were operable."

On June 1, they began feeding a new program to Skylab's on-board computer. When fully stored—by mid-June, according to plan—it would direct the satellite's attitude-thruster control system to fire its little jets and maneuver the craft into a fore-and-aft posture parallel with the Earth's surface, aligned with its own flight path. Then gyros would be activated to keep Skylab there.

As you read this, all of those things should have been accomplished successfully. If so, Skylab's unwanted re-entry could be delayed until sometime between 1979 and mid-1980. In the meantime the spacecraft will be monitored on a daily basis, with additional attitude corrections as necessary.

With Skylab's present orbital life extended, there will be time to carry out either a re-boost or controlled deorbit in late '79.

'The TRS' to the rescue

The device being developed to accomplish either mission is a creation known at NASA as "The TRS" (for Teleoperator Retriever System.)

Using design concepts produced back in the mid-60s by NASA engineers, the unit now is under development by the Martin Marietta Corp. in Denver. In simple terms, TRS is a self-propelling, remote-controlled booster-rocket package. Its central core houses guidance, navigation, control, communications and data management systems, along with a propellant tank for its own 24 thrusters (three on each corner for three-axis control plus forward and backward). Up to four strap-on propulsion kits, each carrying 3500 pounds of hydrazine, can be mounted around its four sides to provide a total of up to 800 pounds of thrust—enough to boost Skylab to a much higher orbit.

A docking system mounted on the forward end of the core, along with a pair of TV cameras, will enable TRS to be remotely guided to the docking or lock-on mechanism of almost any functioning satellite.

The entire TRS, including strap-ons, would fit in a one-car garage with room left over. It is designed to be mounted on a special rack in

(Please turn to page 120)

Kodak introduces

Colorburst™ instant cameras

Instant color by Kodak. You get it only from Kodak instant cameras.

Now, there's a low-priced, motorized instant camera that gives you what no other motorized instant camera can—bright, brilliant, bursting color by Kodak. And it's so simple. Just press the button and out pops a clean, white print that turns to magnificent color right before your eyes. Like magic. It's completely automatic, no timing, no peeling apart, no mess.

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Kodak's "zooming circle" helps you get sharp, clear pictures of your favorite people because it lets

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All Kodak instant prints have an elegant, textured Satinluxe™ finish that protects them from mudges, smears, fingerprints. You can even wash spills off with water.

Electronic flash pictures.

Colorburst instant cameras use a tipflash or electronic flash. The Kodak electronic flash has an electric eye that gives you correct exposures automatically. Great for fill flash outdoors when the sun is be-

hind or on the side of your subject. And you can buy a Kodak Colorburst 100 instant camera in a handy kit that also contains a Kodak electronic flash.

Only Kodak instant cameras give you vertical or horizontal instant pictures.

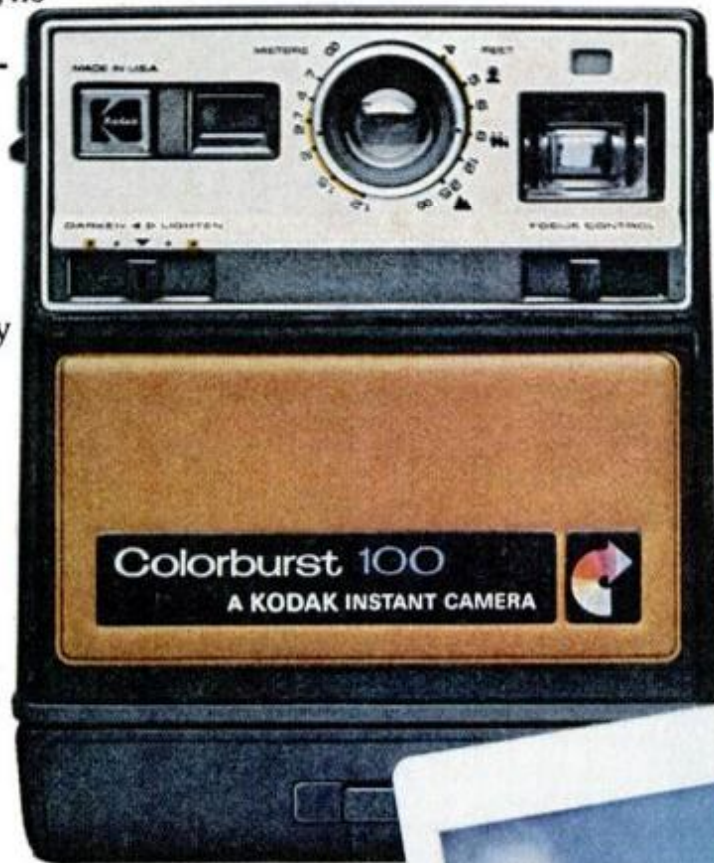
All you do is change camera

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Easy-to-use cameras—lovely-to-look-at prints.



Colorburst instant cameras are comfortable to hold with just enough weight for shooting stability. Best of all, Kodak instant cameras give you what no other motorized instant camera can—bright, brilliant, bursting color by Kodak. And after all, isn't color the way to choose an instant camera?



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OUR GROWING JUNKYARD IN SPACE

(Continued from page 118)

Shuttle's cargo bay, for launch from the NASA Kennedy Space Center.

Future space workhorse

TRS was not conceived just to rescue Skylab from death by spontaneous re-entry, however. With an eye to the future, designers envision its use as a basic workhorse module for the assembly of large structures in space; emergency repairs to limping satellites in orbit; retrieval of unstable objects or space debris, and retrieval of spacecraft at much higher orbits than Shuttle is designed to achieve. But the rescue of Skylab may well provide a dramatic test run for the craft. Here's how the flight plan will read, according to NASA.

With TRS tucked away in its cargo bay, Shuttle will lift off, head for Skylab's orbit and park in the vicinity of the satellite. TRS then will self-eject from the cargo bay. A Shuttle crew member, sitting before an array of monitors and telemetry equipment in the Orbiter's TRS command station control center on the aft flight deck, will use special hand controls and telemetry to control TRS's maneuvers remotely. He'll be guided by its TV eyes and other sensing equipment.

The TRS system is designed to dock with other orbiting craft even though they may be in what those in the business like to call "moderate dynamic motion." In short, they may be tumbling, rolling or "coning" (one end static while the other describes a circle). With docking complete, the TRS core thrusters will be used to maneuver Skylab into proper attitude for reboost to higher orbit, or to send it into a trajectory that will bring the big satellite's remains to Earth within a closely defined area above one of the ocean deeps.

At that point, rockets of the four strap-on kits will be fired. Two burns of about 13.5 minutes each will be required for the re-boost mission; one long burn of about 27 minutes will send it to Davy Jones.

Mission accomplished, TRS will separate from Skylab and be accelerated to a storage orbit for pickup on a later Shuttle flight.

So much for Skylab. What about all those other satellites and their debris still circling the Earth? Where is it all? When and where might it fall in, and is anyone watching so people won't get bonked?

Computers tracking space debris

In a vast chamber carved from the granite interior of Cheyenne Mountain in the Rockies, near Colorado Springs, the whole world of near

space (out to some 3000 nautical miles) is under constant surveillance. Housed in a steel building deep inside the mountain, banks of computers receive a steady flow of data on the movement of nearly every piece of the thousands of man-made objects circling the Earth.

Here, in an electronic glow, the military gnomes who man this eerie underground Space Center for NORAD oversee the maintenance of a computerized catalogue of all space objects. Information comes from a network of advanced radars, huge telescopic Baker-Nunn cameras, U.S. Navy and Air Force surveillance networks and other satellite-watching systems spotted around the world (see map, page 60). The net is known as "SPADATS" (Space Detection and Tracking System) and is composed of U.S. Air Force, Navy and Canadian forces' sensors in such spread-out locations as Turkey, Alaska, Italy and New Zealand. Technicians need only push buttons for instant readout on the current position of any object "out there"—right down to that 1500-mile-high, golf-ball-size chunk from a USSR Cosmos launched in 1971. SPADATS is still tracking it.

Across monitor screens glowing with outlines of world maps, cathode rays provide instant plots of present or future orbital paths of any object—on demand. Silent computers forecast time and location where any item will re-enter the atmosphere.

Actually, some three quarters of all objects now in space are on the "debris" side of the box score: the bolts, cables, separation springs, despin weights and things that go into orbit along with launched satellites, as well as the fragments from in-space breakups of larger objects. Some will be in orbit for thousands of years, like the U.S. Telstar I, which is "Go" until 7561. Others crash back hours after launch. Right now, the rate of objects returning is about one a day, according to NORAD's celestial mechanics people.

From some 25,000 SPADATS observations made every day, the center keeps tabs on all but the smallest bits. Nothing gets launched or decays anywhere in the world that isn't picked up instantly by the network. Last year 136 satellites joined the orbiting swarm—down 25 from the year before. If a satellite breaks up, each of its parts becomes a separate orbiting identity logged as such, along with its orbital characteristics.

In May 1977 the Soviet Cosmos 838 broke up into 75 pieces. A few

(Please turn to page 124)

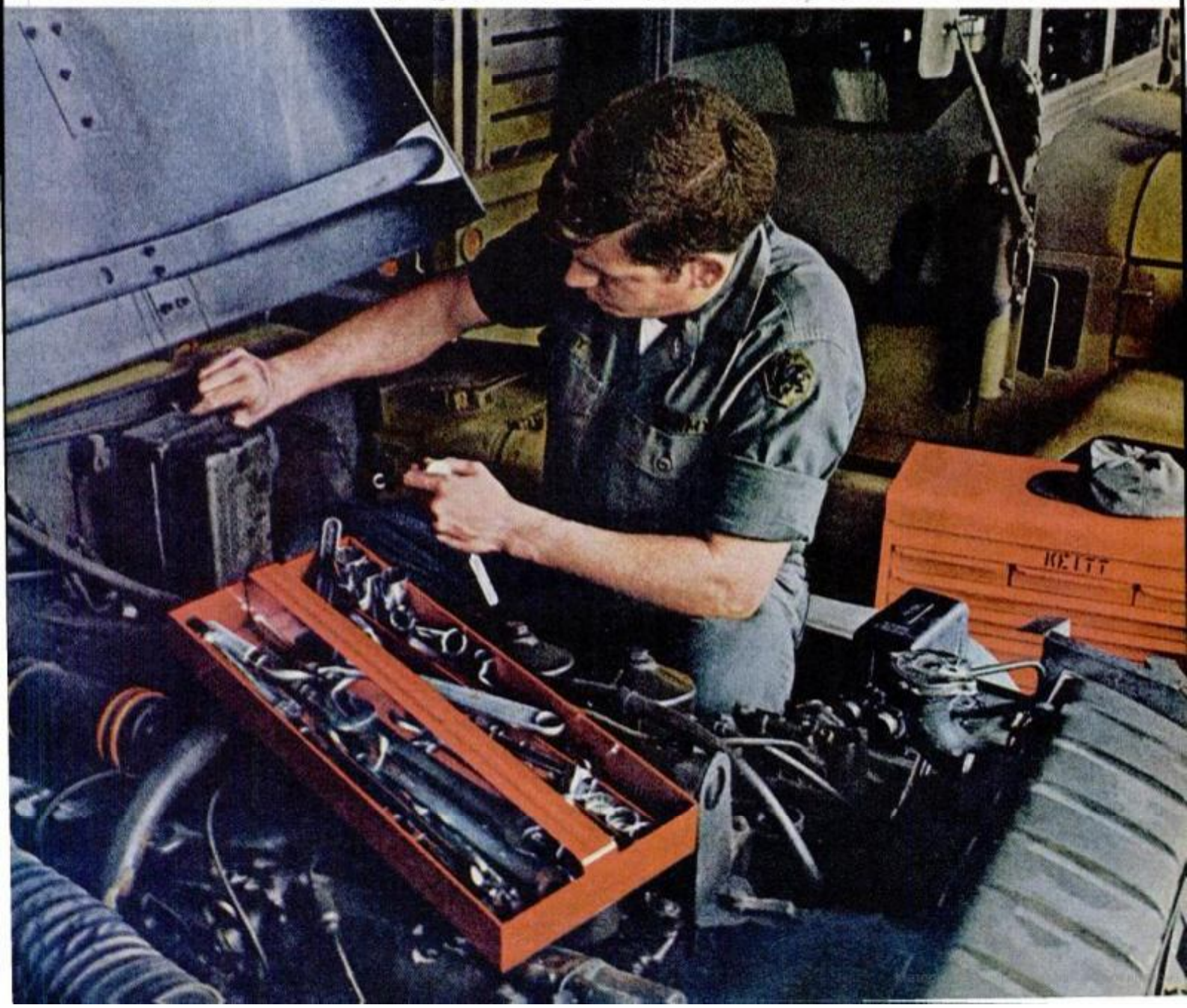
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GROWING JUNKYARD IN SPACE

(Continued from page 120)

months later, a rocket body used by the United States to launch a meteorological satellite for Japan shattered into 180 fragments. Another U.S. rocket body for a new TIROS came apart in December.

Such breakups on top of the new launches produced 902 new pieces of man-made stuff in space last year. Tracking that debris all the way through to decay is a vital SPADATS function. For one thing, a United Nations space treaty makes each country responsible for damages caused by its returning satellites. Far more important, however, is the trajectory information about re-entering satellites that is flashed to NORAD ballistic missile detection radars. Without such alerts, a simple piece of junk returning earthward could trigger a false alarm in the missile attack warning networks.

Even such small pieces? The grim fact is that most of some 50 or more space objects that have impacted and been reported are not trifling bits. Typical are the rocket motor and propellant tank pieces that dropped on Cuba from a Thor booster in 1960. Less bulky but more

exciting, perhaps, was a 21-pound cylindrical chunk of metal from Sputnik IV that landed on a street intersection in Manitowoc, Wis. Just as interesting was the debris from Apollo 11's Saturn booster that plunked down on the deck of a German ship in 1969. Luckily, the big chunks hit the water alongside. Or how about the unidentified scraps that impacted a highway near Winter Haven, Fla., three years back; or the 20-pound spheres that thudded in near the Ohio towns of Marietta and Lowell in recent years?

Many large parts of U.S. and Soviet launch-vehicle propellant tanks and shells have been reported in such places as Africa, Australia, South America and Scandinavia. Three large metal spheres found near Seville, Spain, are believed to have been part of a Soviet Luna 8 rocket stage. So it goes. Up to now we've been lucky.

Right now, analysts at NORAD estimate that by Oct. 4, 1997, the number of objects in space that their detection and tracking systems can see will number 19,661.

Watch for space collisions

As collisions become more probable, keeping track of everything up

there will be even more important. Some visionaries see "fringe" space vehicles, such as advanced SSTs, requiring radar computers that will plot paths instantaneously to predicted impact points with decaying satellites, and calculate instant course changes. The same sort of thing may well be needed for future manned space flights.

For the near future, we're more likely to see implementation of something called Ground-Based Electro-Optical Deep Space Surveillance (GEODSS)—a device that looks like something a university would put in its observatory. The system combines a highly sophisticated telescope with electro-optics, a TV camera and a digital computer.

Now undergoing tests at White Sands Missile Range, N.M., the prototype unit may be the forerunner of a five-station world net for night surveillance of deep space, according to NORAD.

This, in conjunction with satellite-borne long-wave infrared sensors, could give our skywatchers complete coverage of the skies to 20,000 nautical miles and beyond.

"That," says one emphatically, "is the goal required for the Department of Defense—by 1980." **PM**



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successful, he'll suffer neither the noise nor the expense of propane (50 cents to \$1 per gallon), not to mention the smell of damp straw and offal which were mixed for balloon fuel two centuries ago.

Using the winds

Absolute directional control comes only from highly skilled use of changing wind conditions (see diagram, page 90). But many aeronauts prefer simply to accept any treetop wind while cruising serene-

ly, watching and listening to wildlife, and occasionally yelling down at the earthlings below.

Small balloons, by international class designation, go from the 31,783-cu.-ft. maximum for AX-4 to 21,188 (AX-3), 14,126 (AX-2) and 8,829 (AX-1). The last, seldom used, stands approximately 32 feet high with a 26-foot diameter. It requires about 230 sq. yds. of fabric for its envelope, not including wastage. AX-4s use nearly 535 sq. yds., measuring 46 by 40 feet.

Ripstop nylon, weighing $\frac{3}{4}$ to $1\frac{1}{2}$ ounces/sq. yd., usually costs \$1.20 to \$2.50/sq. yd. Rented industrial sewing machines are often used by homebuilders.

One company (HARE Balloons) sells full-size AX-4 envelope "gore" patterns for \$100 (also kits for complete balloons at about \$3000, or components). All envelopes can be calculated and painstakingly laid out from the three-volume *Build Your Own Balloon* (\$50 from Assn. of Balloon and Airship Constructors), a must for homebuilders.

Several balloon manufacturers sell fully sewn envelopes from proprietary patterns. Two AX-4 envelope quotes I heard recently were \$1800 and \$3700, ready for attaching hardware.

Burners range from \$400 to \$775; propane tanks \$90 to \$465. Harnesses and swing seats go from \$35 to \$100 at hang-glider shops.

Some balloonists prefer not being tied to the balloon. Mark Semich uses a lawn-chair-type seat without belt. Piccard rides his horizontal fuel cylinder "bareback," reducing design detail and weight. Both cite tricky landing experiences, with cactus and such, where immediate abandonment of ship was called for. Most balloon pilots, however, opt for solid attachment.

Landings on one's feet must be straight ahead or backwards with any wind velocity (preferably below 15 mph). Maneuvering vents can rotate some balloons for landing. Semich uses an orienting drag line. Homebuilder Frank Colver has a swing seat which rotates inside a tube structure which protects against abnormally hard landings.

Construction safety

It is vital to note that all hardware and materials must be of aircraft quality for reliability and strength, and must be assembled in time-proven ways. Harnesses must meet parachute standards, and envelopes be double-stitched. Gas lines must be flexible and these and fittings protected.

One often hears homebuilding horror stories like that of a person filling a net with helium weather balloons and trying to control altitude with sand ballast and a pellet gun.

Complete, ready-to-fly AX-2s and AX-4s have \$3000 to \$6100 base prices, with wide variety in capabilities. Most sell as custom orders without an FAA Airworthiness Type Certificate. This requires, as

(Please turn to page 128)

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for homebuilts, "experimental category" registration with various possible limitations. For comparison, the very popular Raven model AX-6 two-man Rally, sells already ATC'd for \$6400.

What can you do with small balloons? Not much if compared with world record flights of 337.2 miles distance, 45,836 ft. altitude, and 18:56 hours duration for larger models. There have been no record claims for AX-1s. AX-2s have ac-

complished only 11.2 miles, 1953 ft. and 2:40 hours duration, while AX-4s have gone 85.4 miles, to 21,250 ft. altitude and stayed up more than five hours.

Record holder at 14

One 0° F. March day in 1975 in Michigan, 20-hour student Donna Wiederkehr, 14, took an AX-2 and broke 14 world records. (Her entrepreneur father owns 13 balloons, and sister Denise is probably the

world's only rated female airship captain ever.)

Colder days permit better operation, with greater inside/outside temperature differential and heating further below envelope maximums. Flying at the speed of the wind, there's no chill factor. In such weather near sea level AX-4s can carry two people, but at 5000 feet (in Denver, for instance), may not even get off the ground with one on a warm day.

One foot-launched thrill is "moon walking." Heat the balloon only until you "weigh" 10-30 pounds and go bouncing across open country in a mild wind, stepping 50 feet high over 80-foot distances, clearing trees and buildings—avoiding utility lines and TV antennas. It takes practice, much physical exertion, and can be extremely hazardous. (Mark Semich's Semco firm has made ultrasmall, helium "French jumping balloons." One was once hop-hopped about five miles while tethered to a motorcycle.)

Fabric that cuts heat loss

Lighter-than-air genius Brian Boland soon will attempt to break numerous small balloon records with a fresh design approach. He's using new, lighter, nylon ripstop fabric coated against heat loss. The envelope has four separate layers for insulation and a large dead air space in the crown.

Frank Colver is flying a new electric ignition system which appears to be simpler, less fuel consuming, and safer than current pilot lights. And there's the aforementioned unflown wood-chip burner.

Hang-ballooning is not only bringing more fun, variety, and people to aerostation, but it also is testing a number of improvements in design that will benefit all sizes of balloons.

Where to write for balloon information

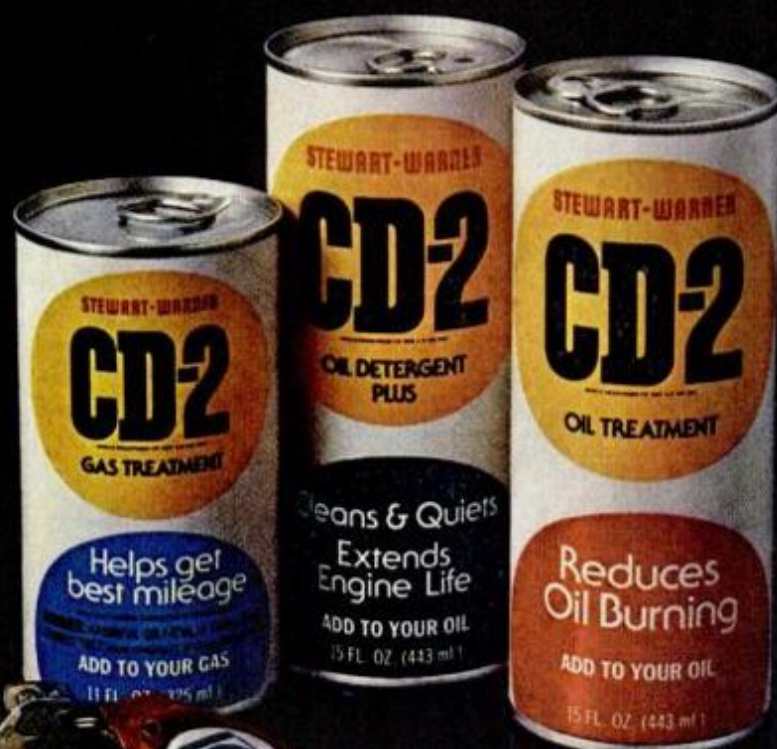
Assn. of Balloon & Airship Constructors, Box Seven, Rosemead, Calif. 91770; annual fee of \$10 includes quarterly publications.

Balloon Federation of America, 806 15th St. NW, Room 610, Washington, D.C. 20005; \$10 per year for quarterly color magazine.

(Send SASE or \$1 to the following unless an info kit price is given.)
 Brian & Kathy Boland, Pine Dr. RFD, Burlington, Conn. 06013
 Cameron Balloons USA, 3600 Eliza-

(Please turn to page 130)

Most shade-tree mechanics begin here.



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2. Biggest engine in its class. Courier's optional 2.3 litre engine is the largest engine available in any compact pickup.

3. Super interiors. For '78, Courier's XLT option offers a stylish exterior plus an outstanding level of interior comfort for a compact truck.

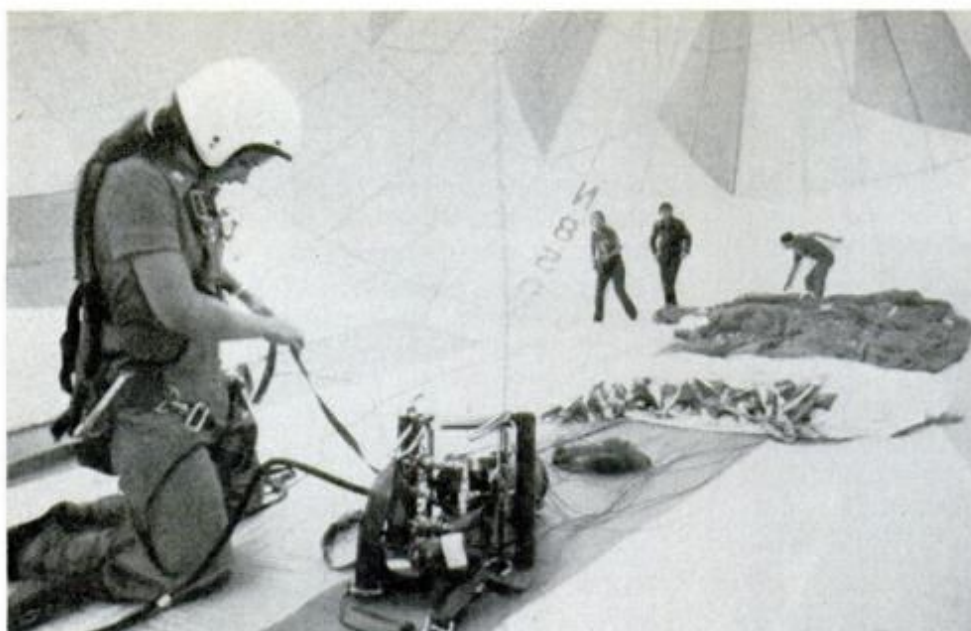
And in '78, Ford continues to offer the popular Free Wheeling Courier option. A tough machine that gives you everything from Accent Tape Stripes to Cast Styled Aluminum Wheels.



Free Wheeling Courier

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FORD DIVISION





To get the picture shown on page 88, Donna Wiederkehr waited while her father's Raven AX-7 balloon was inflated with cool, ambient air and lay on its side. Dragging her much smaller AX-1 balloon along, she crawled in. A few blasts of hot air later, with some 30 feet of available "altitude," she was aloft. Photographer Rick Souther used an extreme wide-angle lens.



SOLO FOR HOT AIR

(Continued from page 128)

beth Rd., Ann Arbor, Mich. 48103
Frank Colver, 3076 Roanoke Lane,
Costa Mesa, Calif. 92626

HARE Balloons Ltd., 331 North
Rampart, Los Angeles, Calif.
90026; \$5

Semco Balloons, Inc., Route 3, Box
514, Griffin, Ga. 30223.

LERC Windrifters Balloon Club,
1459 North Irving Ave., Glendale,
Calif. 91201

Don Piccard Balloons Ltd., Box
1902, Newport Beach, Calif.
92663

Raven Technology Div., Box 1007
Sioux Falls, S.D. 57101 **PM**

IF YOU'RE DROWNING . . .

(Continued from page 78)

cold water? For boatmen, the Coast Guard emphasizes "personal flotation devices" (now the preferred term for lifejacket). "And you don't just carry them along," says Dave Smith. "You wear them." In tests, Smith has found that even experts sometimes take 10 minutes trying to climb into a lifejacket in the water.

The commander and his crew have been running tests on a new family of PFDs, scientifically designed for flotation and warmth in cold water. "The medical people," he says, "have found several body areas extremely vulnerable to the

cold—head, sides of thorax and the groin (diagram, page 77).

Insulation vital

One new PFD is an insulated, hooded hunting jacket with built-in flotation. A strap goes around the crotch so it can't ride up. Other new devices are foam plastic pads laced in place beneath outer garments. Both types will keep a man's head well above water; the hooded jacket protects it from weather.

Though not as insulative, approved life vests are even a help in an emergency. "Unfortunately," Smith observes, "most people don't

know how to put them on properly. In tests, even Coast Guard personnel didn't know kids' from adults' sizes, and one Academy instructor tried to put on an approved vest inside out."

Actually, ordinary woolen clothing will provide flotation if the person in the water doesn't panic and force the air from the fibers, Smith says. And despite what you may have heard, a fisherman's chest waders will pop his feet up and float him if he doesn't thrash.

Cold water dos and don'ts

DO:

1. Wear a float coat, a PFD or several layers of clothing when you're hunting or fishing in a boat. When the water temperature is 50° F., a clothed person can survive an average of three hours in a PFD.
2. Try to keep lungs filled with air to maintain buoyancy.
3. Use minimum movement to prevent the escape of trapped air in your clothing. An average person who is treading water or swimming in a PFD will lose body heat about 35 percent faster than he would when holding still.
4. Take advantage of floating objects, such as boats, paddles and so forth for added buoyancy.
5. Maintain HELP (Heat Escape Lessening Posture—see diagram on page 77) until help arrives. If two or more people are in the water, huddle.

DO NOT:

1. Panic. Most victims are conscious when they enter the water; most drownings happen only 10 feet away from safety; action taken in the first 10 seconds can mean survival or death.
2. Struggle. You'll squeeze out air trapped in your clothing. Ingesting of cold water may constrict the breathing passages and induce "dry drowning."
3. Swim for land that's over a mile away.
4. Remove clothing.
5. Use so-called "drownproofing" techniques in water that's colder than 72° F.

FURTHER INFORMATION

On hypothermia: Dr. John Hayward, Dept. of Biology, University of British Columbia, Victoria, B.C.
On resuscitation in hypothermia: Dr. Martin J. Nemiroff, Pulmonary Div., University of Michigan Hospital, Ann Arbor, Mich. 48104.
Slide lectures: Second Coast Guard District, 1430 Olive, St. Louis, Mo. 63103, attention of Lt. Cmdr. D.S. Smith.

FORD'S EEC II—HOW IT WORKS

(Continued from page 97)

activates the air-port solenoid, which pulls on a diaphragm inside the switching valve and opens a port through which the air flows into the manifold. If the computer wants the air to go only to the second converter, it deactivates the air-port solenoid (or does not activate it to begin with), and the diaphragm springs back and closes off the port to the exhaust manifold. This results in airflow only to the second converter.

Exhaust gas recirculation. The Ford EEC I makes use of air-pump pressurized air and two solenoid valves to operate an air-type EGR valve. EEC II is back to the more conventional manifold vacuum to operate the EGR valve, but the control system is similar to that for air. The two solenoids remain, connected as before in series with hoses. Engine vacuum enters the first solenoid, which is normally closed, stopping the flow right there. If the computer wants some amount of exhaust gas recirculation, it activates this solenoid, and vacuum passes through, into a second solenoid, called a vent, which is normally open. Some of the vacuum is vented through the second solenoid, but the rest of it passes through and partly activates the EGR valve.

If the computer wants maximum EGR, it activates a second solenoid, closing the vent, so full vacuum passes through to the EGR valve. The variable resistor on the EGR valve (operated by the valve stem) tells the computer how much the valve is open, and once the computer determines that the position should be held, it simply deactivates the first solenoid, which causes it to close and lock the vacuum to the EGR valve.

Idle-speed control. The object on all late-model engines is to keep idle speed low, for better fuel economy, but without stalling the engine. EEC II permits a low idle (500 rpm or even less) because it can use the computer to boost the idle if necessary, such as when the airconditioning is on, if you're at high altitude, and when the engine is just restarted.

The automatic idle-speed increase is handled by a vacuum solenoid valve connected by a hose to a vacuum diaphragm with plunger. When the computer wants to boost the idle speed, it activates the solenoid valve, permitting vacuum to pass through to the plunger diaphragm. The plunger is ejected,

against the throttle linkage, pushing it to crack the throttle open a bit further. The computer is programmed to give the boost long enough to make sure the engine is comfortable. Once the coolant is warm, the boost continues for at least a couple of minutes. Even if the engine is fully warm, the boost will be on for at least 10 seconds after a restart.

Fuel vapor control. The hose from the charcoal canister to the air cleaner has a normally-open, canister-purge solenoid valve spliced into it. When you start the engine, the computer decides whether or not purging the canister will make the air-fuel mixture too rich. If it so determines, it activates the solenoid valve, blocking the vapor flow to the air cleaner. When the canister can be purged without making a too-rich mixture, the computer chops current and the solenoid valve opens.

Troubleshooting

Troubleshooting EEC II can be done without special tools. First, if the engine doesn't start, and there's no spark, don't blame EEC. The problem is in the transistorized control unit or other parts of the ignition system. If it starts but runs poorly, even with the engine warmed up, test EEC II.

Begin by checking ignition timing at the two engine speeds recommended by Ford. If the timing doesn't change at all, you've got a computer problem. If it changes, but not to the values listed on your underhood decal, the likely problem is with a sensor.

The sensors that normally have the most significant effect on engine operation are those that control the coolant temperature, the intake manifold pressure and throttle position.

If the engine runs poorly when cold or only when warm, perhaps the coolant temperature sensor is bad. With the engine at the problem temperature, disconnect the wire from the sensor. For a correct cold temperature signal, leave it disconnected. For a warm engine signal, jump the wire-connector's terminals. Get a performance improvement? If you do, you should replace the sensor.

The pressure and throttle position sensors can be checked with an ohmmeter and the readings compared with specifications. In the case of the throttle-position sensor, there should be a different resistance reading between throttle open and throttle closed.

To check the EGR controls up to

(Please turn to page 132)

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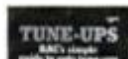
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FORD'S EEC II—HOW IT WORKS

(Continued from page 131)

the valve, disconnect the hose and feel for some vacuum as you blip the throttle with the engine warm. If there is none, check for vacuum at the first solenoid, and if it goes through that, see if it's coming out the second one. You also can troubleshoot solenoid vacuum valves by removing and reattaching the wiring connectors. If the solenoid is on, you'll hear a click as you reattach. If a solenoid doesn't click, check for current at the connector with a test lamp. If there's current but the solenoid doesn't click, you've apparently got a defective solenoid.

Check the air-switching system with the engine cold. There should be air going through the outlet port of the switching valve to the exhaust manifold. Disconnect the wiring from the air-port solenoid and the airflow should switch to the other port.

If you don't have airflow at all, go to the start of the air circuit—the air pump, and make sure there's air coming out. Next go to the air-dump solenoid, and see if air is coming out or being vented. If the solenoid is venting at cold idle, and not coming on, it's either because of a bad solenoid or a poor wiring connection.

The key to the fuel-mixture control—the stepper motor—may produce some noise you can hear when you blip the throttle (the early ones we saw were audible when operating). If you can't hear it and want to check it, unthread it from the carb, thread a plug into the carburetor as a temporary seal, and play with the throttle while you look at the motor's armature tip, to see if it moves.

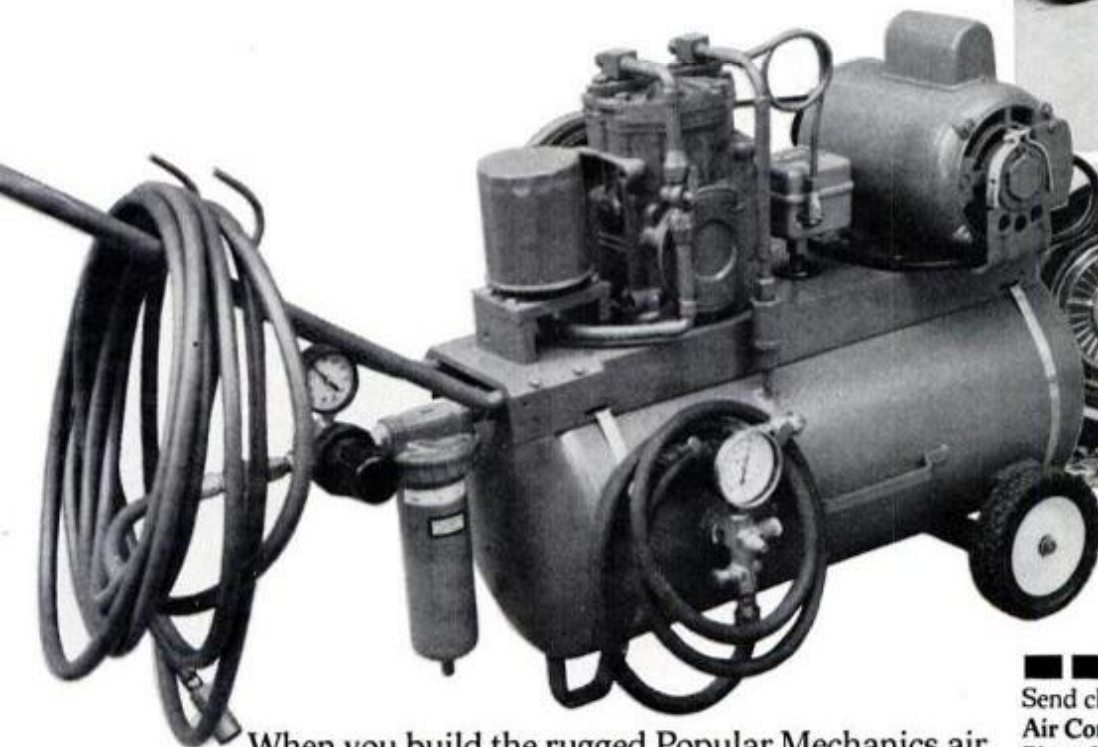
The idle speedup system can be quick-checked just by turning on the airconditioning, or if you haven't got it, by starting a cold engine, and looking for plunger movement. Doesn't move? Check for vacuum at the hose end, and if there isn't any, the vacuum solenoid valve or a hose connection elsewhere in the circuit is the problem.

Computer systems here to stay

These new computer control systems, and that includes Chrysler's Lean Burn and General Motor's MISAR, are not going away. We gaped at a schematic for computer control of the programmed-combustion (Proco) stratified-charge engine Ford is planning for the 1980s, and you can bet EEC is the wave of the future. This is definitely the time to get acquainted.

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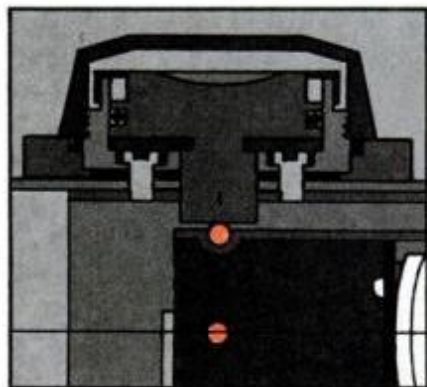
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DRIVING THE MUSTANG/CAPRI

(Continued from page 83)

speed, incidentally, is not available in California with the 302 engine due to that state's tougher emissions standards.

Did I say, "turbo-Four"? That's right, sports-car fans. You can be first on your block to own a genuine turbocharged Ford or Mercury, courtesy of a group of Ford engineers who believe strongly that these new cars should have some real excitement to go with the looks and image. The turbo will not come cheaply—nearly every part in the 2.3 engine is "sweetened" or beefed to take the extra heat and pressure of turbocharged combustion (see page 84), not to mention the cost of the Garrett turbo unit itself—but it will make your Mustang/Capri think it has the V8 at the stoplight, the V6 at the gymkhana, and the base Four at the gas pump.

Because the turbocharger doesn't come on until about 3000 rpm, the V8 is quicker *popping* off the line; but the "blown" Four really hauls once underway. Look for under nine seconds 0-60 and fuel economy in the mid-20s if you drive it right.

Chassis

Like the body, the '79 Mustang/Capri's chassis is hybrid Euro-American in design, yet much closer to European in performance. Basically identical to the equally-good Fairmont/Zephyr in concept, the new sportster's MacPherson strut front and four-link, live-axle rear suspension (with coil springs all around) performs admirably on the test track even in base-car form.

For the more adventuresome, there's an optional "handling suspension," complete with rear stabilizer bar and special springs, shocks and bushings to give the car a genuine European feel. And then there's the ultraspecial TRX package, a joint Ford/Michelin effort available only with unique Michelin TRX low-profile, high-pressure tires mounted on specially-built Michelin light-alloy wheels. Believe me, a TRX Mustang or Capri is just what the skilled driver needs to drive circles around the next smug Porsche pilot he sees. **PM**

TURBOCHARGING THE MUSTANG

(Continued from page 84)

air-fuel intake between carburetor and intake manifold. The faster the engine turns, the greater is the exhaust flow and the faster the turbine and compressor wheel spin. The spinning of the compressor

forces extra air-fuel mixture into the cylinders and the engine produces more power.

Buick is using the turbocharger merely to restore an acceptable performance level—about 0.7 hp per cubic inch (which is what the standard 2.3 already delivers). The Mustang/Capri turbo cuts in at about 3000 rpm and provides maximum boost at 4500. The engine meets emission control standards because the turbo doesn't come on during most of the Federal test cycles. In fact, you won't get any boost in fourth gear at legal speeds, and precious little (above 50 mph) in third gear. Of course, a little high-revving action in the lower gears is another matter, and the engine should do well in traffic-light drags. The turbo will do 0-60 in eight to nine seconds, compared with 13-plus for the standard 2.3-liter engine.

The Mustang/Capri turbo also has minimal effect on the Disney World gas mileage numbers the government generates. Ford engineers expect it to come in with a combined gas mileage rating of 20 to 22 mpg, compared with 23 to 25 mpg for the standard engine.

Engine modifications

Forcing extra air-fuel mixture into the engine raises the effective compression ratio well above the nominal 9:1, and Ford made many changes to enable the 2.3 to live safely with a turbo. The pistons are forged aluminum, not cast, and feature a number of other design changes. Main and rod bearings are modified for greater load-carrying and heat dissipation. There's a new cylinder-head gasket for better sealing, new valves and stem seals for heat resistance. The oil and water pumps and the radiator are changed, so lubrication and cooling are improved. A heavy-duty clutch is standard. You'll even be able to get the turbo in California, although it will have a three-way catalyst system and feedback-control (oxygen sensor) carburetor. The other 49 states get a Stage 2 Holley-Weber carburetor with a power valve modified to respond to boost pressure instead of the normal manifold vacuum.

Because turbos raise the effective compression ratio, there's a limit to the amount of boost that can be applied before the engine is overtaxed and the gasoline starts to detonate (particularly unleaded, 91-octane). Like the Buick, the Mustang/Capri turbo has two controls.

One limits boost to 6 p.s.i. in the intake manifold. When that pressure is reached, a spring-loaded diaphragm is pushed, moving a rod that

opens a bypass—called a waste gate—in the turbine chamber. Exhaust gases flow through the open waste gate into the exhaust system; they do not pass over the turbine.

The high-performance crowd willing to take chances can shorten the diaphragm rod, which will increase boost by delaying the waste gate opening. This voids the warranty and could do the same to the engine. If it's really humid, however, or the engine is equipped with water injection, it may not detonate and could accept some overboost.

Spark retard

The other control is a spark-timing retard system to prevent detonation with 91-octane unleaded. Unlike Buick, which uses a detonation sensor, Ford has simple, two-stage pressure switching connected to the intake manifold. When boost hits 1 p.s.i., the switching signals an electronic control unit to retard timing 6°. When boost hits 4 p.s.i., the switching sends a second signal, to retard timing an additional 6° (12° total). To check out this system, disconnect and plug the hose from switches to manifold and apply prescribed air pressure directly to the switches; (do not exceed 8 p.s.i. or switch damage may result). Aim a timing light at the marks and you should see the spark timing retard. Do this with the engine running at warm idle for results you can see.

Instrumentation

Ford hadn't completed the dashboard instrumentation at PM press time, but it was planning to have a green dashboard light go on the instant there is some boost, and a red light for overboost (over 6 p.s.i.).

In theory there should be no overboost if there are no field modifications, but Ford engineers were trying to be realistic. They were also thinking of adding a warning buzzer to signal overboost.

Although in theory and test the oil temperatures should be no problem, Ford is concerned about them. An oil cooler at the front of the car (and an extra half-quart of oil in the system), seemingly would provide the needed protection. But if you overload, anything can happen. Ford will strictly forbid the use of any trailer, to prevent oil and coolant overheating.

The 2.3-liter standard engine also is the base powerplant for Fairmont, and Zephyr; both have sporty-looking models. If the turbo on Mustang and Capri is greeted with the enthusiasm Ford expects, you don't have to guess hard where it's going next.—Paul Weissler



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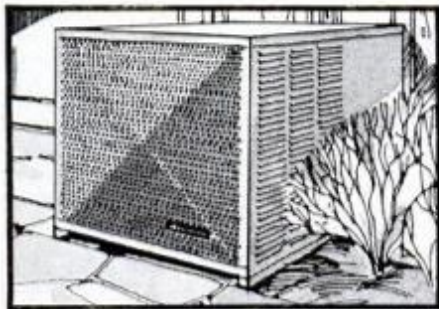
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HINTS FROM READERS

Tightening nuts



When a nut is in an enclosed area so it can't be tightened with a socket wrench, bore a small hole near the corner of each nut face. Tighten nut by placing a center-punch in holes; tap with hammer. —Fred A. Brandt, M.D.

Home-grown tool handles

Handles for files, small saws and other tools are free for the making from tree branches, large rose-bush stems and shrub trimmings.

Season the wood before shaping by leaving it in an open area where air circulates around it. Done properly the drying process may take six months. Use only pieces that aren't decayed. In some cases a slightly curved tree-branch handle will add comfort.

After seasoning, cut wood to desired length, smooth it and bore a hole for the tool tang or shank. Leave the bark if it's tight; otherwise peel it.

To make a ferrule that prevents splitting, cut a length of metal tubing or solder a few wire turns together. Insert the tang with ferrule loosely around it; secure ferrule. Finish with lacquer or boiled linseed oil.—W. E. Burton



From front: hickory handle with bark partially peeled; hobbyist's razor-saw with unpeeled hickory handle, brass ferrule; peeled-hickory file handle, wire ferrule; rosebush, hickory blanks.

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I plan to do all part none of the work.

PM'S HOTBED

(Continued from page 94)

cutting the Styrofoam. Insulating the low, front wall is optional—in any case, do not allow it to interfere with the operation of the Thermo-for unit.

Next, build the lid frame. I ripped 4-in. boards from one 12-ft. length of 1x10. Cut half-lap joints and assemble as shown.

A protective finish on all wood members is extremely important. Fill all gaps and knotholes with wood putty and exterior paint. I used three coats of Flecto's White Gloss Varathane. Sand and recoat with paint every other year or as needed.

The Styrofoam insulation should also be painted. It deteriorates after prolonged exposure to sunlight. Use water-based exterior latex paint only. (Solvent-based coatings will dissolve insulation.) White gloss is best for maximum reflection of sunlight off the back and sides, and onto the plants.

Before slipping the unit together, use a candle stub to apply a coating of wax inside notches to prevent sticking. With walls assembled, affix pieces of rigid insulation to the plywood walls with Dow's Mastic 11 or with a suitable water-based adhesive. Do not use petroleum-based adhesives.

Assemble the lid with screws and resorcinol glue. The AirCap should be installed with bubbles down.

You may substitute a double layer of transparent plastic film for the AirCap. In either case, keep the edges from tearing by lining the inside edges of the lid with plastic tape, stapled in place. Nail lattice strips over the tape and staples, using 1¼-in. brads, 16 in. apart (16 in. on centers). Finish construction by installing hinges, weatherstripping and the Thermo-for unit. You might use the leftover plywood to build an inside divider so one section can be used with heating cables, the other without, if desired.

SHOPPING INFORMATION

Thermo-for unit is available from Brameh Co., Inc., Box 70, Salem, Mass. 01970, or Garden Way, Charlotte, Vt. 05445. It has a five-year warranty and costs \$49.50 postpaid.

Write to Sealed Air Corp., Park 80, Plaza East, Saddle Brook, N.J. 07662 for address of nearest AirCap distributor. Or look for it at greenhouse plant supply houses where it's used as a packaging material. Buy extra for replacement as required.

Gro-Quick cables are made by Wrap-On Co., Inc., 341 West Superior St., Chicago, Ill. 60610. Available at garden centers in several lengths with attached thermostat. A 48 ft. cable costs about \$10.50 and is replaced free if it fails.

PM

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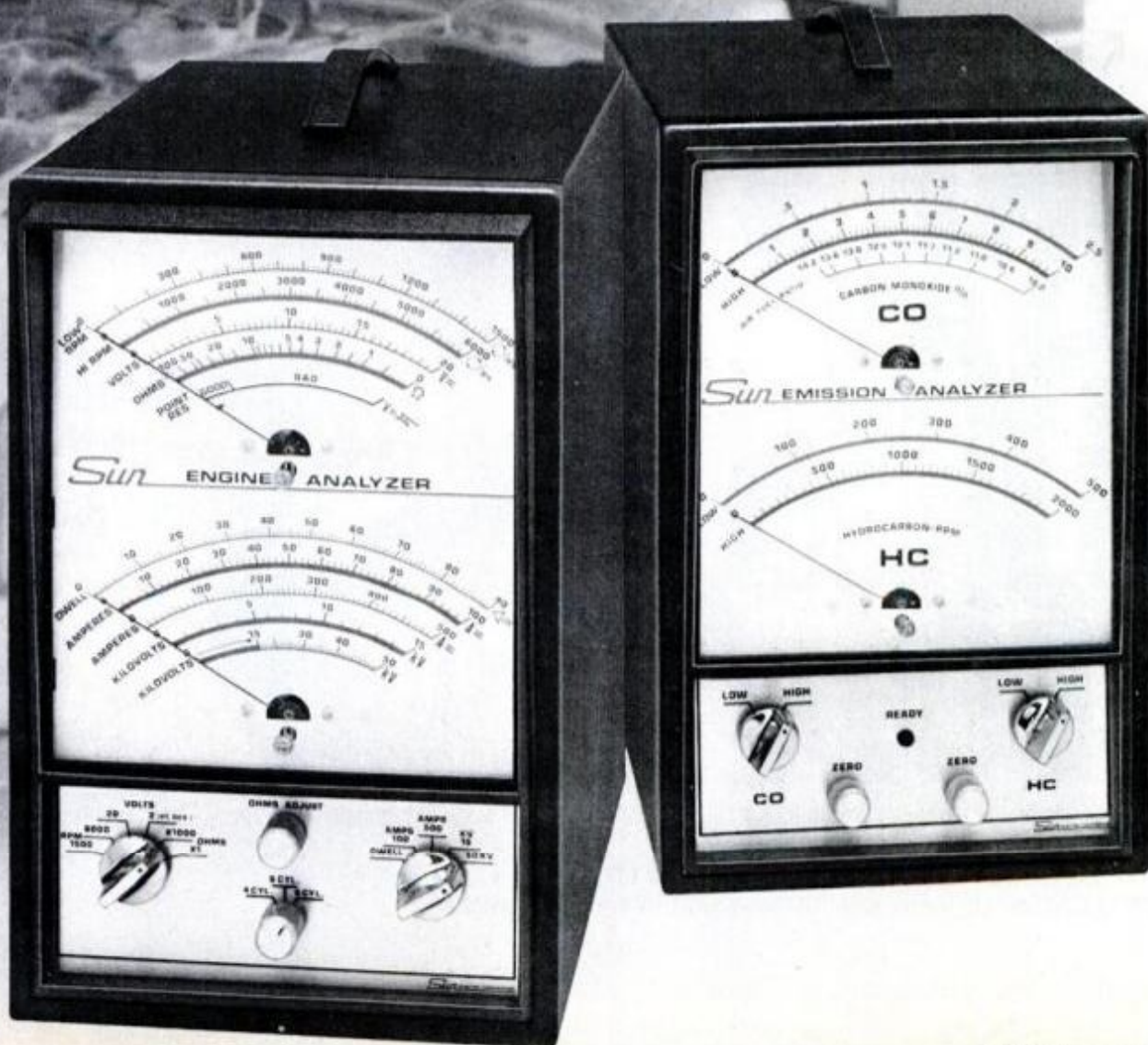
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at the 2000-mile checkup. He's got all modern facilities, with a real large service department, all well laid out. He's excellent, courteous, personable. . . .

"The LeMans quality and workmanship on the interior is outstanding. Paint and exterior aren't that good. The paint has some air bubbles, but the area isn't noticeable. The gas mileage isn't as good as I'd hoped, but at 17 to 21 mpg, it's hard to complain too much. I particularly like the LeMans styling, handling characteristics and general quietness."

A North Carolina tax auditor, 32 years old, with a Safari wagon and the 305 V8: "It's a very stylish and good-performing auto. Those were the qualities that attracted me initially. Workmanship is good, although the paint job leaves a little to be desired in places. Overall the wagon feels tight and well constructed.

"No mechanical troubles in 5032 miles, and the dealer seems very competent and helpful. My major complaint is that gas mile-

age is atrocious: 13.5 to 15.5 mpg. It better improve! It's a comfortable car, though—stylish, very good in performance and handling, with ample power."

An Indiana stockbroker, 49, sedan with 231 V6: "Our family of four needs a car with room and good gas mileage. We were impressed with the LeMans's ride



Station wagon owners like the arrangement of lift glass and tailgate.

and had owned a 1969 GTO, which we liked.

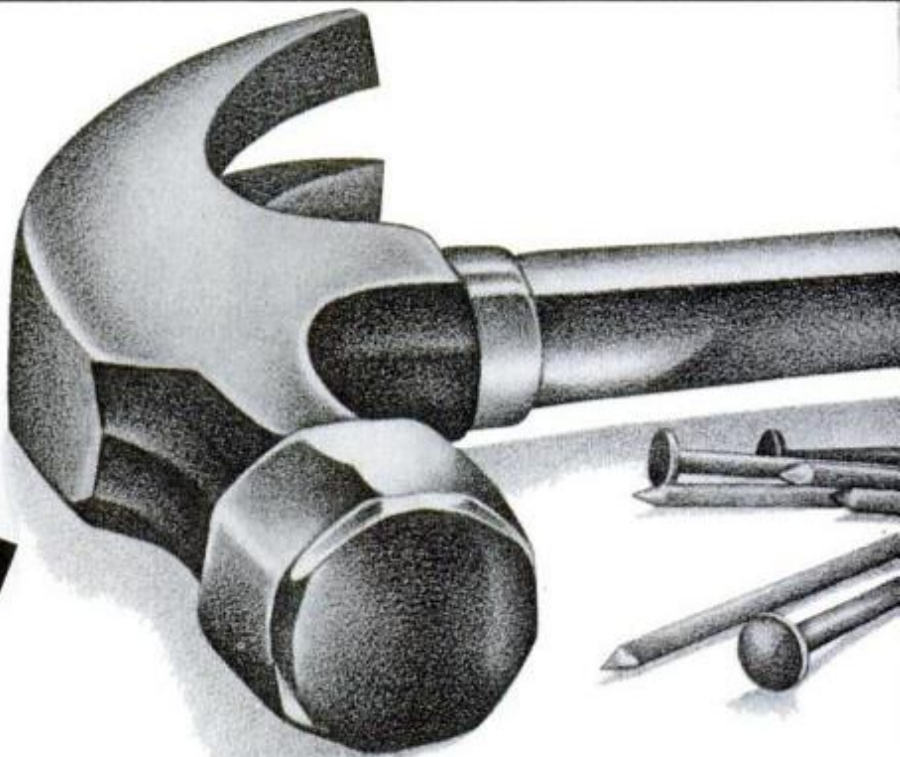
"A defective cruise control was replaced under warranty. We found the dealer's service department very friendly and courteous. They fixed it right away—no appointment, no waiting.

"Workmanship is excellent—we found no defects upon delivery. My only major complaint is that a buyer should be able to order the handling package, rally instrumentation, and bucket seats with the basic LeMans. Presently one must buy the Grand LeMans to get these options.

A New York engineer, aged 27, with a 301 coupe: "Except for a faulty voltage regulator, no problems. Dealer doesn't always fix everything the first time. I bought this car for Pontiac's reputation, the 1978 GM intermediate size, the LeMans appearance and handling.

"Attention to detail is good, as are quality and workmanship. The car sounds and looks solid. No suggested changes except per-

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haps make the engine more accessible for sparkplug replacement, etc. Gas mileage isn't what it's supposed to be, but I appreciate the car's handling, size, styling, and riding comfort."

And finally, a 22-year-old Tennessee college student, owner of

a four-door sedan with the 305-cu.-in. V8:

"No problems, really, but one fuse keeps blowing. It's a short somewhere. Dealer is excellent, both on service and sales. The only change I'd like to see in this car is the dimmer switch—put it

back on the floor where it belongs. The rear windows might also roll down. But other than that, it's attractive, with comfortable seats, excellent stereo, a smooth ride and lots of quiet on the road. Would I buy another LeMans? You bet!" **PM**

SUMMARY OF 1978 PONTIAC LEMANS OWNERS REPORTS*

Total miles driven 1,229,307	Transmission choices:	Workmanship opinion:	Dealer repairs satisfactory?
Average miles per gallon:	Automatic 99.0%	Excellent 17.8%	Yes 60.6%
231-cu.-in. V6	Three-speed manual 0.7	Good 39.8	No 39.4
In town (EPA 16 manual) 15.7	Four-speed manual 0.3	Average 19.4	
Long trips (EPA 28 manual) 20.5	Why did you choose LeMans?	Fair 11.2	Dealer service opinion:
301-cu.-in. V8	Styling 40.9%	Poor 11.8	Excellent 29.6%
In town (EPA 18 autom.) 15.3	Size 31.5	Comfort opinion (front seats):	Good 30.3
Long trips (EPA 25 autom.) 19.0	Past experience 22.5	Excellent 46.4%	Average 22.7
305-cu.-in. V8	Economy 19.8	Very good 32.6	Fair 8.7
In town (EPA 17 autom.) 15.3	Comfort 7.4	Good 17.4	Poor 8.7
Long trips (EPA 25 autom.) 19.4	Specific likes:	Fair 2.6	Number of vehicles owned:
350-cu.-in. V8	Handling 49.1%	Poor 1.0	LeMans only 46.4%
In town 13.0	Styling 42.6	Comfort opinion (rear seat):	Two cars 42.4
Long trips 18.6	Comfort 32.6	Excellent 26.7%	Three cars 8.6
Body style choices:	Ride 25.4	Very good 35.2	Four or more cars 2.7
Two-door coupe 39.3%	Economy 23.4	Good 26.4	Makes of other cars owned:
Four-door sedan 38.0	Specific complaints:	Fair 8.1	Pontiac 25.8%
Four-door wagon 22.7	Mileage lower than EPA 18.5%	Poor 3.7	Chevrolet 25.2
Engine choices:	Poor workmanship 16.3	Had any mechanical trouble?	Ford 12.9
231-cu.-in. V6 30.6%	No complaints 14.9	Yes 52.0%	Oldsmobile 11.7
301-cu.-in. V8 10.8	Rattles 6.2	No 48.0	Buick 8.0
305-cu.-in. V8 54.9	Want conventional spare 5.8	What type of trouble?	Age distribution of owners:
350-cu.-in. V8 3.8	What changes would you like?	Transmission 18.7%	15-29 years 19.2
Carburetor choices:	Better gas mileage 10.7%	Electrical 13.5	30-49 years 32.3
Two-barrel 92.0%	Different styling 10.3	Speedometer cable 11.6	50-plus 48.6
Four-barrel 8.0	No changes 9.9	Carburetor 8.4	Would you buy another LeMans?
	Better workmanship 9.2	Oil leaks 6.5	Yes 73.3%
	Conventional spare tire 9.2	Brakes 6.5	No 26.7

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



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DIESEL MERCEDES WITH MUSCLE!

(Continued from page 81)

eras and equipment . . . there's no danger of anything falling into a crack or being damaged by a sharp metal edges . . . and the rubber molding over the rear trunk edge is a thoughtful idea."

Weight of the 300SD is just under two tons, or 3890 pounds to be exact. When you consider this weight together with the performance of the car (we tested 0 to 60 mph at 15.5 seconds, and top speed at 103 mph), its fuel economy becomes truly extraordinary. Imagine, California to New York, cradled in the lap of luxury, clicking off a patriotic 23.05 mpg! That was with the air conditioner compressor working almost all the way and at speeds at which fuel consumption is greater than it is at 55 mph.

"Another hot day. Air conditioner doing its job. On freeway ramps you accelerate into traffic and think you're up to road speed, but the needle's at 70-75 . . . the ride, insulation, powerful brakes make 80 seem a secure cruising speed."

Mercedes' fuel economy curve (mpg plotted against speed) indicates consumption at 80 mph is 20 mpg. It's pretty much a straight line up to 30 mpg at 55 mph. (EPA rates the 300SD at 29 highway, 24 city and 26 combined.)

In the 300SD, we see the two approaches Detroit will apply, in spades, to minimize the amount its cars will have to shrink in size to meet future fuel economy standards: diesel engines and turbo-charging will be in wide use in cars of the '80s. GM, for example will be tripling its diesel engine output for '79 (and next month in our Owners Report feature we'll be hearing from diesel Oldsmobile drivers, who are most enthusiastic with a record 97.4 percent saying they'd buy another if they had to do it again).

Diesel car ownership does present its unique concerns . . .

"It is absolutely essential that you have a list of service stations dispensing diesel fuel. And don't expect the royal treatment at the pumps, some of which are marked "trucks only" and many of which stand in a sea of grease and oil. Trucks get top priority as we found out in Arizona sitting at a pump interminably waiting for service. The previous customer at my pump was a 'good' one: \$65.91 for 127 gallons were on the pump."

But the fuel price is right:

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(Please turn to page 144)

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DIESEL MERCEDES WITH MUSCLE!

(Continued from page 142)

ranged from a low of 50.9 cents at a self-serve in Tyler, Tex., to 64.9 cents in New Orleans. Average cost per gallon worked out to 56.6 cents. Average miles between fuel stops was computed at 431 and we took on one quart of oil after 2570 miles on the road (3788 miles on the odometer)."

Among the modifications to the five-cylinder diesel, to handle the turbo's increased power output, is an increased oil capacity—up a quart to nine quarts total. The additional oil supply is needed to cool and lube turbocharger bearings and engine pistons. The oil pump and filter have a larger capacity and the oil cooler is bigger. API SE-CC oil is specified and oil and filter change interval is 4000 miles.

The 300SD is much more than a simple "bolt-on" operation (300D owners take note: You can't dive under the hood with a Garrett AiResearch TA 0301 retrofit kit!). Modifications to the basic engine include changes to the block, cylinder head, crankshaft and bearings, piston and connecting rods, lube system and fuel-injection system. The changes go right down to the exhaust system which has a higher capacity.

"There's no hesitation or lifelessness that you associate with a normal diesel... on the Interstates you move past slower traffic quite easily. On these rural, two-lane roads outside of Bossier City, La., though, you get a mixture of people driving at various speeds and it's here where the car shows its excellent passing ability. One annoyance with the car is the lack of a clicking audible enough to tell that the directionals are still on after passing."

Transmission on the 300SD is the same four-speed automatic used on non-V8 Mercedes models, but with changes (wider brake band, four-disc clutches) to accommodate higher torque. The manner in which the transmission shifts to first gear as soon as the accelerator is depressed (after it has been idling in second gear) is unique. Other models start in second, unless L is selected or you "kick down" to first.

We found that the 300SD is indeed the last word in a diesel passenger car—smooth, fast, luxurious—and fuel efficient. It has a price to match its quality, of course—\$23,878. At a price like that, there may not be a Mercedes in your future, but your next car may very well be a turbo, a diesel, or both.

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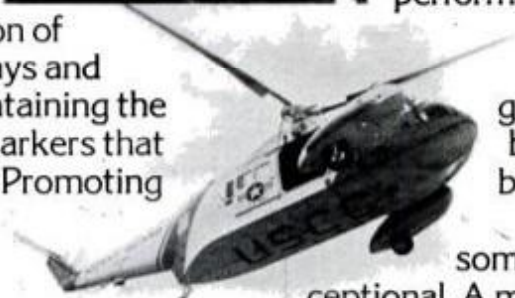
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STANDBY GENERATOR

(Continued from page 18F)

other precautions I took were the use of keyed-alike padlocks on the generator and generator-circuit-breaker box: One key unlocks all three padlocks. I also pasted a typed list of simplified startup instructions on the panel on which the

transfer box and emergency branch circuits are mounted.

About installation

Make no mistake about it, you should have your installation done by a licensed electrician. All electrical work should be in compliance with local electric codes and ordinances. Make certain your contrac-

tor reads installation instructions of the generator maker. He should also test the completed installation.

For more information about the generator shown on preceding pages, write to Homelite, Marketing Dept. HSBPM, Box 7047, 14401 Carowinds Blvd., Charlotte, N.C. 28217.

For a list of other generator makers, see the chart below. **FM**

MANUFACTURER	HOMEOWNER PRODUCT LINE GENERATORS/ALTERNATORS	DESCRIPTION	COST
Ag-tronic Inc., 364 Airport Rd., Kearney, Neb. 68847	Three series of portable units having output from 1250 to 6000 watts.	Model 535005, 4500 watts, 38/19 amps., 120/240 volts, 10 hp; supplied with carrying handle and spring feet.	\$792
American Honda Motor Co. 100 W. Alondra Blvd., Gardena, Calif. 90247	Six models from 400 to 3500 watts.	Model Es-3500, 3500 watts max., 30.4 amps., 115-230 volts.	839
Generac Corp., Box 8, Waukesha, Wis. 53186	Portable units, 1350-5000 watts; stationary, air- and liquid-cooled units.	TXP 45 stationary, air-cooled, 4500 watts, 120/240 volts a.c., 16 hp; liquid-cooled models from 8000 watts, 66.7/33.3 amps., 120/240 volts a.c., 16 hp; (gasoline, propane, natural gas).	1275
Harrison Equipment Co. Inc., 1616 McGown St., Houston, Tex. 77001	Diesel-powered units of 4000 and 7000 watts.	Model 4.OPAW-3P, 4000 watts, 120/240 volts a.c., 33.3 amps: at 120 volts, 16.7 amps; at 240 volts, 7.2 hp; Model 7.OPBW-3P, and 7000 watts, 120/240 volts a.c., 58 amps. at 120 volts, 29 amps. at 240 volts, 13.2 hp.	2104 3157
Majol Portable Power Systems Inc., 6 Orchard St., Nanuet, N.Y. 10954	Range of power equipment.	CR automatic, 4000 watts, 34.8 amps., 115 volts, 16 hp, automatic weekly recharge.	2900
McCulloch Mite-E-Lite, Wellsville, N.Y. 14895	Four models of portable units; output 1200 to 3300 watts.	Model RA 330, 3300 watts, 30/15 amps., 110/220 volts, 8 hp; electric start is available.	600
Onan, 1400 73rd Ave. N.E., Minneapolis, Minn. 55432	Series P portable units from 2000 through 5500 watts; Series CCK stationary units, 500 watts.	5500-watt portable model, 120/240 volts, 22.9 amps.; stationary units installed outdoors; gasoline or natural gas fuel.	1018 1330
Rockwell International 400 N. Lexington Ave., Pittsburgh, Pa. 15208	Eight portable models from 2000 to 6000 watts.	6000-watt model, 120/240 volts, 50/25 amps., 16 hp.	
Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60684	Models from 1200 to 4500 watts.	4500-watt model, 10 hp, oversized muffler, manual or electric start; unit runs 6 to 24 hours depending on load.	900



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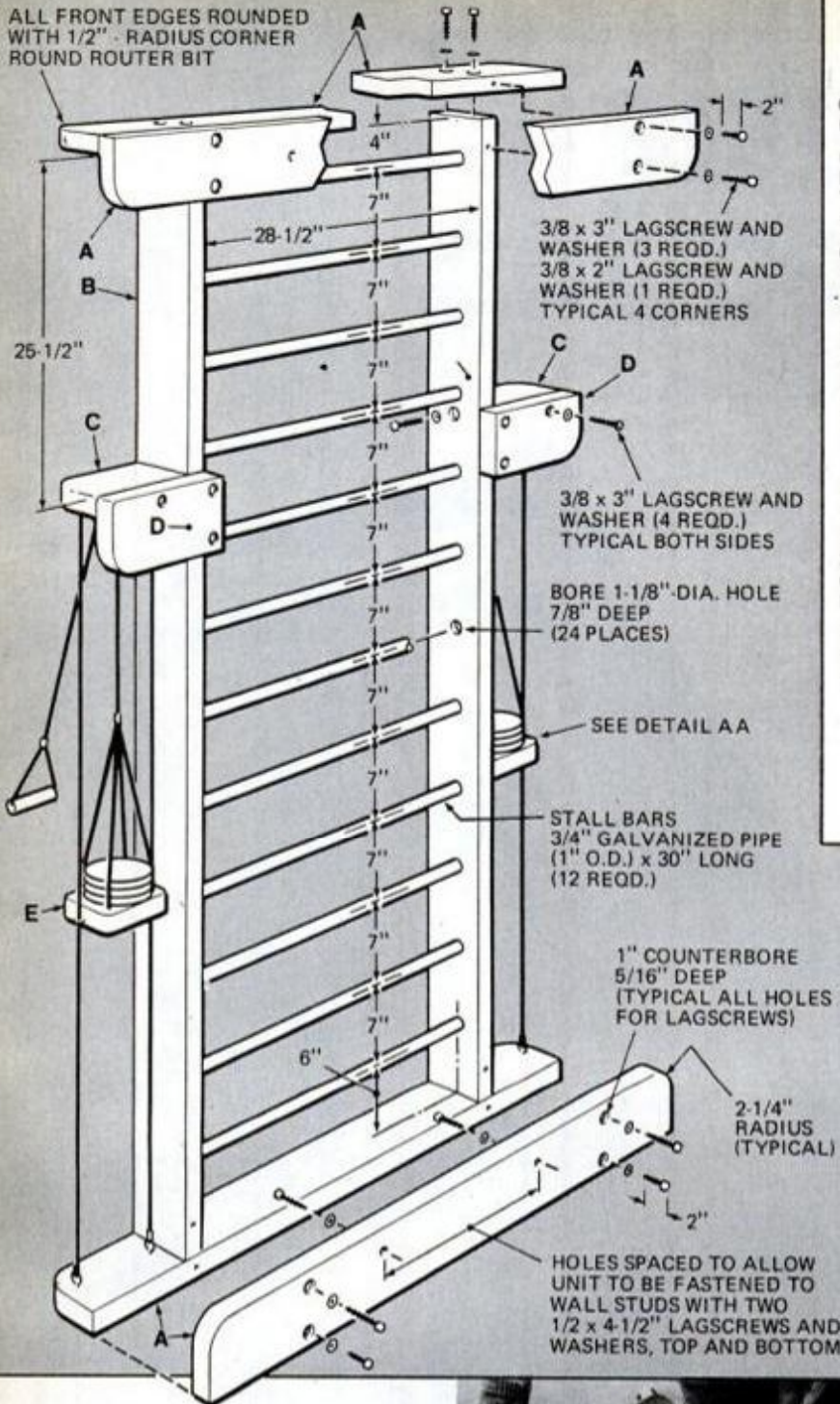
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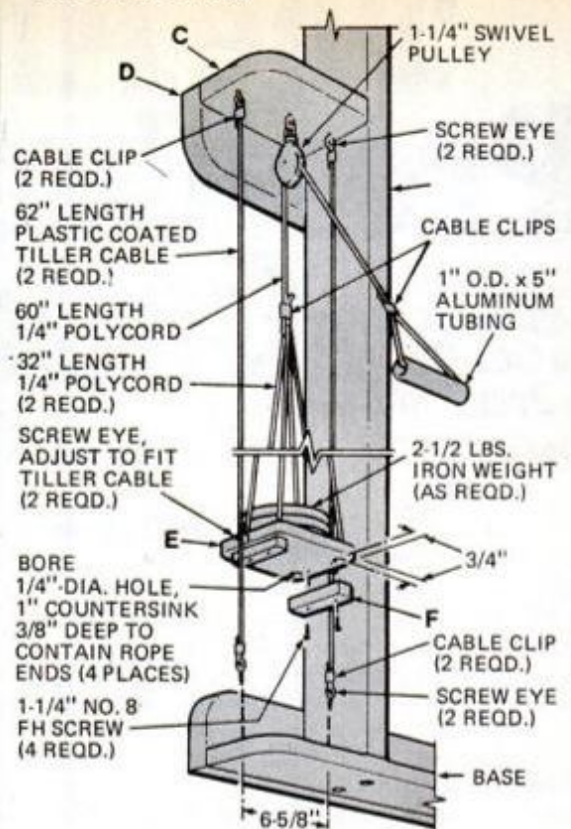
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STALL BARS, REAR VIEW

ALL FRONT EDGES ROUNDED WITH 1/2" RADIUS CORNER ROUND ROUTER BIT



VIEW FROM BOTTOM



DETAIL AA, PULLEY ASSEMBLY (2 REQD.)

HOUSE FOR A KEEP-FIT FAMILY

(Continued from page 67)

pro Craft, Box 18, Greenlawn, N.Y. 11740 and receive four bearings.

Stall bars

This wall unit combines with the chinning-parallel bar and the inclined board and has built-in weight lifts.

The cost of building the unit should run about \$115. In addition 2 1/2-lb. iron barbell weights (unit can hold up to six on each side) cost 75 cents per pound.

The bars are 3/4-in. inside dia.

(Please turn to page 150)



Polish the galvanized pipe by buffing with a soft cloth and a commercial rubbing and polishing compound. The pulley-weight system for curling exercises located on the stall bars (above) is guided by tiller cables. As you build the unit, temporarily assemble and reassemble it laid out on the floor to mark holes for attaching hardware and cross members. Before disassembling, mark pieces with a code (i.e., letters) to simplify the job of reassembly.

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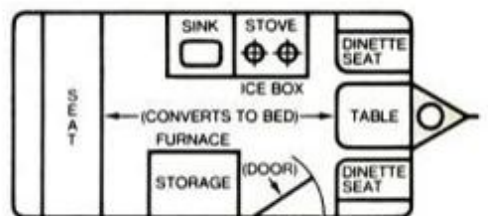
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(Continued from page 148)

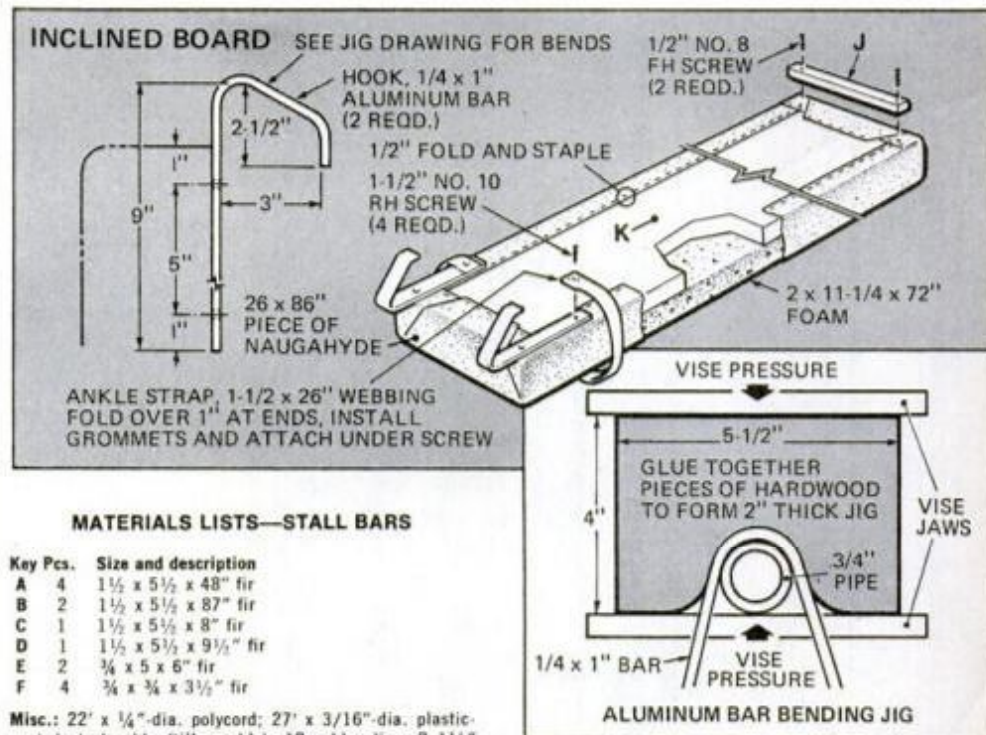
(I.D.) galvanized pipe. You can polish them to a high sheen using DuPont rubbing and polishing compounds. Before final assembly, finish wood with two coats of satin-finish polyurethane varnish.

Inclined board and chinning-parallel bar

For maximum durability, use a length of 2x12 to make the inclined



Leave one vertical member of the stall bars unattached, slanting outward. When pipes are in place, glue and screw unit.



MATERIALS LISTS—STALL BARS

Key Pcs. Size and description

A	4	1 1/2 x 5 1/2 x 48" fir
B	2	1 1/2 x 5 1/2 x 87" fir
C	1	1 1/2 x 5 1/2 x 8" fir
D	1	1 1/2 x 5 1/2 x 9 1/2" fir
E	2	3/4 x 5 x 6" fir
F	4	3/4 x 3/4 x 3 1/2" fir

Misc.: 22' x 1/4"-dia. polycord; 27' x 3/16"-dia. plastic-coated steel cable (tiller cable); 12 cable clips; 2 1 1/4" swivel pulleys with screw eyes; 8 1/2 x 1" screw eyes; 10" x 1" O.D. aluminum tubing; 12 30" x 3/4" (1" O.D.) galvanized pipe; 20 3/4 x 3" lagscrews; 4 3/8 x 2" lagscrews; 24 3/8" washers; 2 1/2 lbs. iron weights; 8 1 1/4" No. 8 fh wood screws.

CHINNING—PARALLEL BAR UNIT

G	2	1-1/16 x 7 1/2 x 28 1/2" oak or maple
H	1	1-1/16 x 7 1/2 x 24" oak or maple
I	4	1-1/16 x 5 1/2 x 5 1/2" oak or maple

Misc.: 2 1/4 x 1 x 18" aluminum bars; 1/4 x 1 x 2 1/2" aluminum bar; 3/4 x 36" galvanized pipe; 8 No. 10 x 3" fh wood screws; 4 3/8 x 3" lagscrews; 4 3/8 x 2" cap-screws; 2 3/8" nuts; 8 3/8" washers.

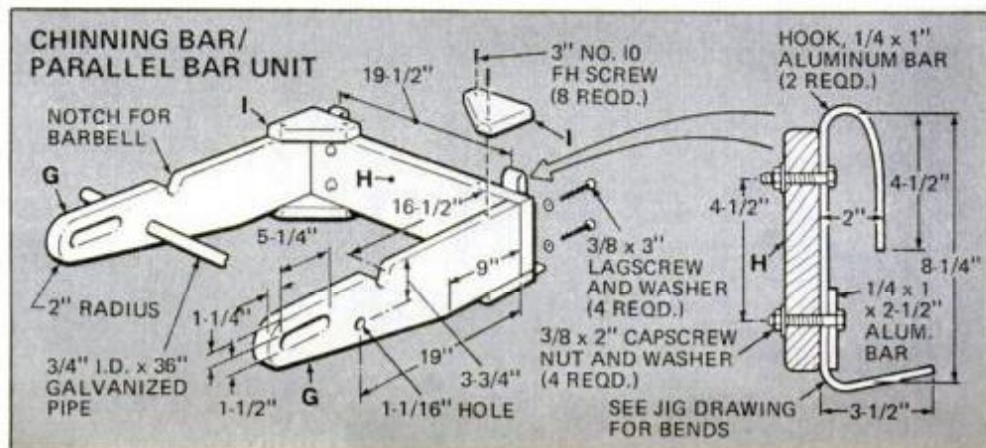
INCLINED BOARD

J	1	3/4 x 1 1/2 x 10" fir
K	1	1 1/2 x 11 1/4 x 72" fir

Misc.: 2 1/4 x 1 x 14" aluminum bar; 2 x 11 1/4 x 72" foam cushion; 26 x 86" Naugahyde sheet; 1 1/2 x 26" strap; grommets; 3/4" staples; 2 No. 8 x 1 1/2" fh wood screws; 4 No. 10 x 1 1/2" rh wood screws.

board. A 2-in.-thick foam pad covered with cotton-backed vinyl gives added comfort. Fold the ankle-strap ends and grommet them to the vinyl to prevent tearing at holes.

After the parts of the hardwood support for the chinning-parallel bar are cut, clamp sides to back to facilitate boring screw holes. Bore two holes and saw the waste between them for a handle grip. Form aluminum bar hooks for the support (and slant board) with a block and scrap of 3/4-in. pipe as shown. **PM**



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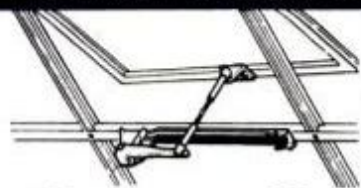
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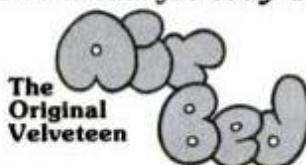


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'OIL PORT' WILL BE AT SEA

(Continued from page 74)

can live on the platform . . .
manning its weather station, pumps
and control room.

How LOOP works

Fanning out from the platform will be six buried pipelines of 56-in. diameter (three to be in operation by 1980), leading to six single-point-mooring buoys, each more than 8000 feet from the platform and each 6500 feet from its nearest neighbor—no one wants the VLCCs swinging too close to each other.

Although the single-point-mooring concept has been used for some time overseas, LOOP's will be the first in the United States. Tankers will tie up to the buoys with bow lines only. Each buoy will swivel at its base, so a tanker will be free to rotate in a full 360° circle like a weathervane, always riding in the optimum position with respect to changing sea and wind conditions.

Once moored, the tanker can discharge its oil directly into flexible oil transfer hoses leading to a buried pipeline. This, in turn, carries the crude to the pumping station platform and from there to shore through another pipeline.

A land-based booster station will then push the oil on its way toward what will be the most unusual oil storage compound ever built in the United States—the Clovelly Farms Salt Dome Storage Terminal.

Geologists have long been fascinated with these underground salt deposits. Salt, itself, is a peculiar substance—a solid which has a liquid's tendency to "creep" or flow. Millions of years ago great bodies of salt water along what is now the Gulf Coast were trapped by changes in the Earth's crust. In time, the waters of the trapped salt seas evaporated, leaving vast layers of dry salt. As one geological upheaval followed another, layer upon layer of sediment, rock, sand and shale was built up over the salt.

Rising columns of salt

Eventually the weight of these layers created such pressure that the solid salt began to flow. When it found avenues of lesser resistance in overlying strata, the salt rose toward the surface of the Earth in gigantic columns. These are the great salt domes sprinkled across large areas of Louisiana and portions of neighboring Texas, Mississippi and Florida.

Oil has been stored in salt mines for some years, primarily by the French and Germans. Most of the

existing salt/oil-storage cavities, however, were originally mined for their salt and, consequently, are often irregularly shaped and spaced. LOOP's salt-dome storage facility, on the other hand, will be solely created for storing crude oil.

The size of the Clovelly Dome is typical of the awesome dimensions of many domes. Its underlying column of salt goes to at least 40,000 feet below ground level. The dome itself, shaped like one of those sand-pail castles that children build at the beach, thrusts up from that depth in a solid trunk of salt, with an upper diameter of approximately 3000 feet. The dome's top is approximately 1500 feet below the surface of the bayous and marshlands of Lafourche Parish. In this mass of solid salt LOOP engineers will eventually create 14 tremendous cylindrical cavities, each with a diameter of 230 feet, a minimum depth of 750 feet, and each capable of storing 4,000,000 barrels of oil, for a total storage capacity of 56,000,000 barrels.

Leaching out the cavities

Right now, drilling rigs are pushing pipes deep into the bowels of the salt dome in preparation for the day when LOOP engineers get the go-ahead to begin leaching out the proposed storage cavities by flooding the domes with fresh water. The resulting brine solution will be pumped into the Gulf of Mexico.

Before that happens, however, the State of Louisiana has ordered a full year of environmental studies. The special affinity between oil and salt rests on two points: While salt is readily soluble in water, it does not dissolve in oil. And, oil and water do not mix, even oil and salty water.

Therefore, oil stored in a salt cavity will not pollute itself by dissolving the salt. And oil and brine can safely be placed into the same cavity.

So on that day when the first barrel of Mid-East oil reaches Clovelly, the oil will be injected into the salt storage cavities by high-pressure pumps. It will displace an equal volume of brine. Being lighter, the oil will float on top. A sharp interface will always separate the brine from the oil.

As that oil is being pumped into the cavity, the displaced brine will be forced upward through pipes, out of the cavity and into a 200-acre above-ground brine storage reservoir. Later, brine will be pumped back into the cavity, thus displacing the oil, which will be pumped via another

(Please turn to page 154)

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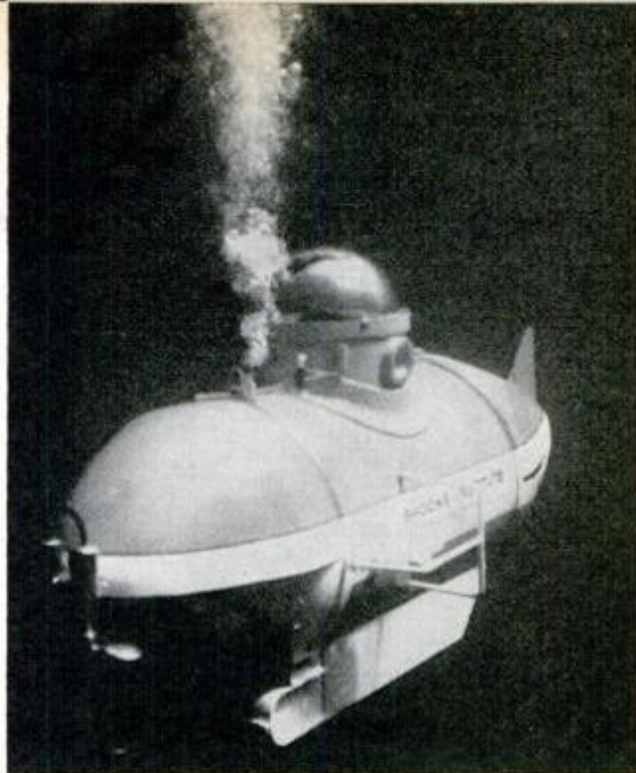
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PIPELINE WILL GO TO SEA

(Continued from page 152)

pipeline to a terminal in St. James, La. There, the Mid-East oil which entered through LOOP will go via pipeline to refineries in such cities as St. Louis, Chicago, Detroit and Buffalo.

The overall project is slated to cost \$1 billion. Five companies—Marathon Pipeline Co., Texaco, Shell Oil, Ashland Oil and Murphy Oil—will share in construction costs and in potential profits. LOOP, however, will be a common carrier, open to all oil companies, and its profits will be limited by federal regulations.

William Read, a former Marathon executive, now LOOP's president, explains the project's timetable:

"We plan to have phase one in operation by 1980. That means three offshore buoys, one pipeline from the offshore terminal to the Clovelly Dome, and one pipeline to St. James. That will give us a capacity of 1.4 million barrels a day."

By 1989, he continued, LOOP expects to have a capacity of 3.4 million barrels a day, using six off-loading buoys, three pipelines into the salt dome, and two from Clovelly to St. James. In its final stage, LOOP will be able to process enough crude oil to serve 22 percent of America's present refining capacity.

How safe is LOOP?

Because of LOOP's novel technology, questions have been raised about possible dangers in building such a system in southern Louisiana, which is regularly buffeted by hurricanes and storms. LOOP officials point out that the offshore terminal will withstand 70-foot waves and storms of greater magnitude than any ever recorded in this part of the Gulf.

And passage of oil through the pipelines will be computer monitored. The second the computers show that less oil is coming out of the pipeline's check point than went in—an indication that would suggest there is a break somewhere in the line—the flow of oil will be immediately cut off.

As for the innovative salt-dome storage facilities, industry spokesmen say they will probably constitute the safest oil storage system possible. While above-ground storage tanks could fall victim to hurricanes, the salt caverns, more than one quarter mile under the surface of the Earth, will be almost immune to natural disasters.

PM

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After more than 10 years of very extensive and costly research, Roger Riehl, noted expert in solar energy, integrated circuitry, and computer chip technology, has developed the beautiful High-Performance SUNWATCH, which is now the most advanced watch available for sale to the public.

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Because of an Exclusive and Important Calibration Breakthrough, the SUNWATCH is the FIRST WATCH IN HISTORY THAT IS ACCURATE TO 1 SECOND PER MONTH! (That's 5 Times Better Than The Latest Quartz Accutron).

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• Exclusive "C/MOS Brain" Computer-On-A-Chip displays the correct month and date, PLUS it automatically adjusts the watch calendar for long and short months AND Leap Year until 2100 A.D.!

• Continuous Seconds Display — Useful for Pulse-taking, Stopwatch timing, etc.

• Miniature Solar Cells are automatically charged by sunlight, daylight, even ordinary light bulbs — they last virtually forever. You never need to replace batteries. This advanced Power Storage System is of the same type installed in Communication Satellites.

• Magnetically Operated Slide Bars activate SUNWATCH's many functions, including hours, minutes, seconds, day, date, month, speed control, seconds countoff, leap year.

• Permanently Sealed Lexan Module, protected by U.S. and Foreign Patents until 1992, encapsulates all energy cells, solar panels, quartz crystal, Computer-On-A-Chip, Readouts, etc. This makes SUNWATCH the MOST INDESTRUCTIBLE WATCH EVER!

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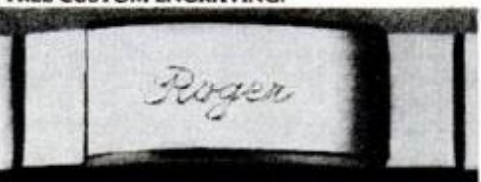
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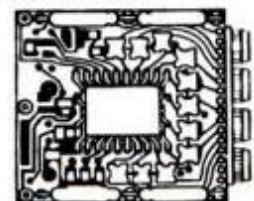
The Sun Watch is covered by a 2 year limited warranty issued by Riehl Time Corporation (Manufacturer of the Synchronor 2100), and included with your watch. A copy of the warranty may also be obtained free of charge by writing to Starshine Group, 924 Anacapa St., Santa Barbara, Calif. 93101. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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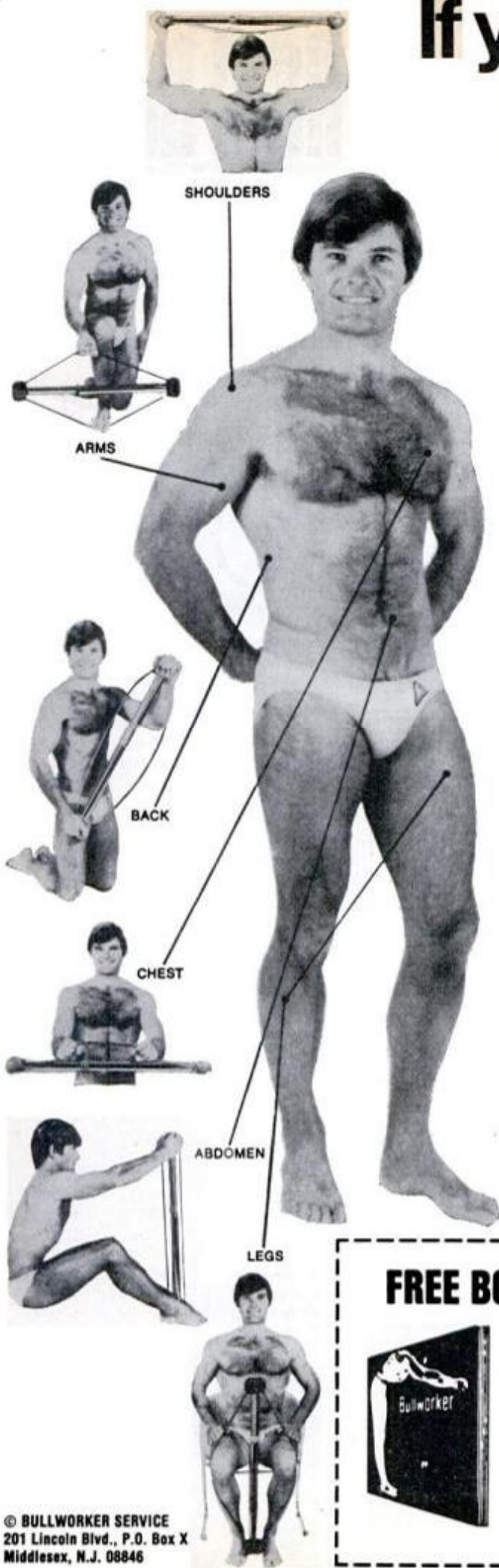
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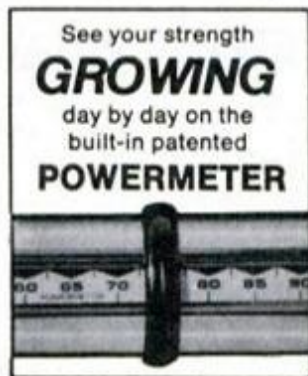
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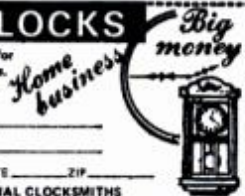
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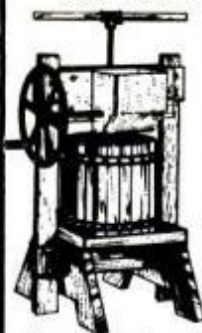
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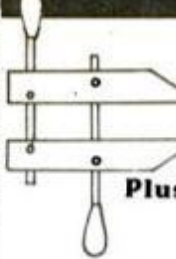
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(Continued from preceding page)

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