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Owners rate them
for comfort & savings

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light & lively '78s

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Lights, 14 mg. "tar," 1.0 mg. nicotine; Filter Kings, 16 mg. "tar," 1.1 mg. nicotine; Longs, 18 mg. "tar," 1.3 mg. nicotine, av. per cigarette, FTC Report Dec. '76

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Build a bunkbed, a coffee table, a T.V. stand or any of the practical ideas in Georgia-Pacific's new, fall Projects Booklet. It's full of constructive ways to have fun with your family. And it's free, in the Help Center, at your neighborhood Georgia-Pacific Registered Dealer.

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Popular Mechanics®

OCTOBER 1977

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Photo by Carroll Seghers.



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AS A SERVICE TO READERS. Popular Mechanics publishes newsworthy products, techniques and scientific and technological developments. Due to possible variance in the quality and condition of materials and workmanship, Popular Mechanics cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects resulting from plans published in this magazine.

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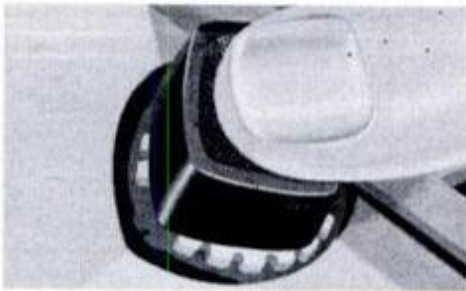
You can't buy another chain saw with all these features at any price.

Yeh, but can it swim?



The McCulloch Mac 140. Its features are its greatest feature.

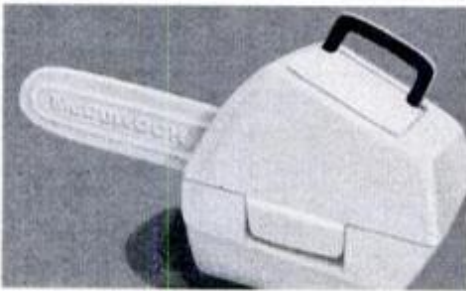
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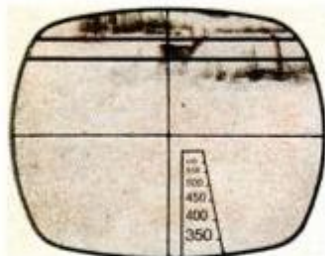


McCulloch Corporation, Los Angeles, California 90009

This One



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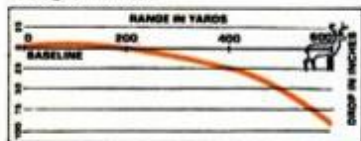
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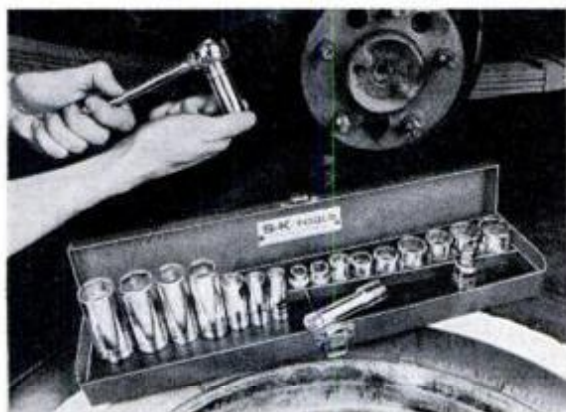


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20 pc. 3/4 in. dr. Socket Set with S-K ratchet. No. 4520-77. Great for tackling garden tractors, cars, outboard motors. Total value if purchased separately \$59.41.

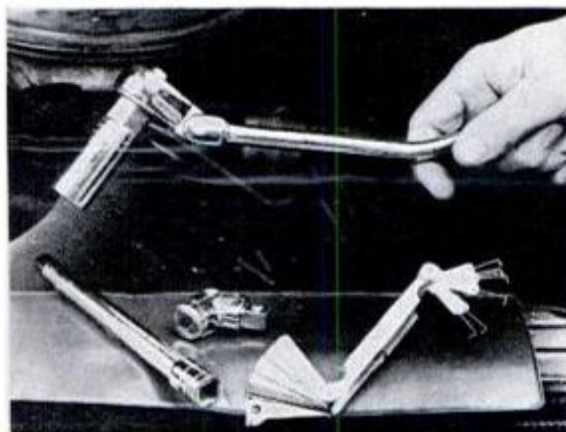
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Suggested User Price



SAVE \$13.06 OVER 43%*

13 pc. 1/4 in. dr. Socket Set with S-K ratchet. No. 4913-77. Fix cars, washing machines, small nuts and bolts jobs. Total value if purchased separately \$30.04.

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LETTERS TO THE EDITOR

Pumps—not drills

In the picture of the Rabbit Diesel (page 48, Aug. '77) you referred to the objects behind the car as oil drilling rigs. They are "pumping units" that pump oil from the ground; they are not used to drill for oil.

FRANCES A. CAMPBELL
JENNINGS, LA.

Inside or outside vapor barrier?

In your article on the "Energy Miser" house (page 88, July '77), I note that a heavy plastic vapor barrier is applied on the outside of the home. This appears contrary to all past procedures of insulation experts, heating experts, and seems to ignore all the past accumulation of vapor barriers applied on the inside of houses.

Isn't this 100 percent in variance with acknowledged past procedure? Is it proven? BERNARD F. MILLER
RACINE, WIS.

The Burt, Hill architectural office in Butler, Pa., designers of the energy-saving features of the ERDA houses in Mission Viejo, Calif., explains the switch:

"A vapor barrier should go on the side where moisture is apt to condense. In the northern part of the country we would recommend it be put on the interior side. But where airconditioning is used year round, you get a reversal of function.

"We know that it is an unconventional concept. No one ever tried it before to our knowledge. For the ERDA houses, it was used as a testing concept. The walls are filled with sensors and, after more than a year of operation, they indicate that we have achieved no perceptible improvement, and no detrimental effect—in that climate.

"The tests will continue for some time before we have a definitive report to make . . ."

Humid jet engine

Your *Speed Dash in a Homemade Jet* (page 102, June '77) states that Mr. Greenmyer intends to increase the density of the air entering the jet engine by spraying water into each engine intake. According to my pilots' handbook, as humidity increases, air density decreases if temperature and pres-

sure remain the same. Water vapor weighs approximately five-eighths as much as an equal volume of dry air.

Do these characteristics reverse themselves when speeds reach Mach 2.5 at altitudes of 125,000 feet?

DAN BERGMEN
SAN JOSE, CALIF.

The engineer on the 104 tells us that the exact water to air ratio is a carefully worked out secret. "Adding water to the air decreases its temperature by 120° F. due to the high latent heat of vaporization of water. The increase in density due to the decrease in temperature far overrides the decrease in density due to the increase in humidity."

PM's hutch at home

I thought you would be interested in the oak hutch I built from *Popular Mechanics* plans (page 102, June '75). The oak was old



PM's hutch in solid oak.

lumber. I made my own crown molding for the top. The hardware came from Penneys. The finish is Minwax provincial stain with antique oil finish. The unit blends nicely with a round oak table and chairs finished to match.

JAMES W. INGEMANSON
HOMEWOOD, ILL.

A photocopy of the PM hutch article with plans is available. Send \$1.25 in check or money order to

Popular Mechanics, Box 1014, Dept. D.D. Radio City Station, New York, N.Y. 10019

Ram pump roundup

Enjoyed your article on "ram" hydraulic pumps (page 57, April '77). You don't have to go to Oregon to get one. There's another company still producing them: Rife Ram Pump Works, 132 Main St., Andover, N.J. 07821.

H.C. QUACKENBUSH
WICKATUNK, N.J.

Your article on ram pumps sounded as if they are hard to get. We represent the John Black Ltd. Co. of England, makers of ram pumps since 1881, and will be glad to send information to interested parties who care to write Ar-Do Sales Co., 4322 Mount Vernon Rd. S.E., Cedar Rapids, Iowa 52403

ARTHUR PAGLES
CEDAR RAPIDS, IOWA

Many of your readers who are do-it-yourselfers might like to build a ram pump. It is suggested that they review the following articles containing information on how to build a hydraulic ram: *Popular Mechanics Shop Notes*, Vol. XXXIV, 1938: *Hydraulic Rams*, Part I, page 182 and *Ram From Pipe Fittings*, Part II, page 189. Or they might try *Popular Mechanics Shop Notes*, Vol. XXIX, 1933: *Inexpensive Hydraulic Ram*, page 23.

K.E. BREISCH
ARLINGTON, VA.

Solar flip-flop

The diagram of a "solar" window in the article on 101 ways to save energy (page 117, Sept., '77) is very confusing. Careful examination would indicate that maybe the arrows got turned around bottom for top and right to left. Could this have happened, or am I merely losing my mind?

JOHN BARRETT
SOUTH NATICK, MASS.

There's nothing wrong with your mind, Mr. B. Someplace between engraver and printer the red plate was flip-flopped. Unfortunately, the error wasn't caught until nearly half the press run was completed. It was corrected, but you were unlucky enough to get an early copy.

You've never tried Sebulex.[®] You still see dandruff. There could be a connection.

There's only one way to judge how effective a dandruff shampoo can be for you.

Try it.

You've probably tried the leading brands. But, if you haven't used Sebulex,[®] you may have overlooked the one shampoo that works best on your hair and scalp.

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When we asked over two hundred skin specialists what product they usually recommend for patients with dandruff or scaling of the scalp, the word came back—Sebulex.

Four times more than the leading dandruff shampoo.

Seven times more than the next largest selling dandruff brand.

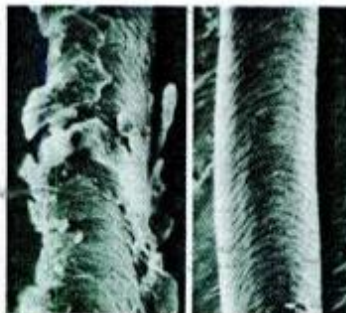
If you're out to control your dandruff, to help stop the oiliness and itching, use what more doctors recommend—Sebulex.

Sebulex cleans away everything in sight

Extra strength cleaning agents in Sebulex penetrate, peel and float away dandruff. They carry medication down to the scalp and follicles of the hair to quickly relieve flaking and itching.

You come away from a Sebulex shampoo with hair that's fresh and really clean, right down to the roots.

And with regular shampooing, it will stay that way.



Magnified hair before and after washing with Sebulex.



consistency of Sebulex right out of the bottle.

Sebulex builds to a concentrated, creamy lather that really gets dandruff off your back.



Clean, fresh scent

Some people think that a hard working medication can't smell good. Well, Sebulex has a clean, fresh scent that won't advertise that you're using a medicated shampoo. Even when you're up close.

The real proof

This Sebulex story is only proof for the inside of your head.

We'd like to prove it to you on the outside.

Buy Sebulex. Shampoo in the Sebulex medicated lather and look at your hair when it's dry.

That's where we shine.

A low pH factor

Sebulex has the lowest pH of the leading non-prescription dandruff shampoos.

That's because it contains a special combination of medicated ingredients. They could be the key to the dandruff control you're looking for. Try the medicated action of low pH Sebulex.

All you have to lose is your dandruff.

Effective dandruff control, pleasant to use

The first thing you'll notice is the thick, rich

Clean, green
sebulex[®]
recommended by
specialists

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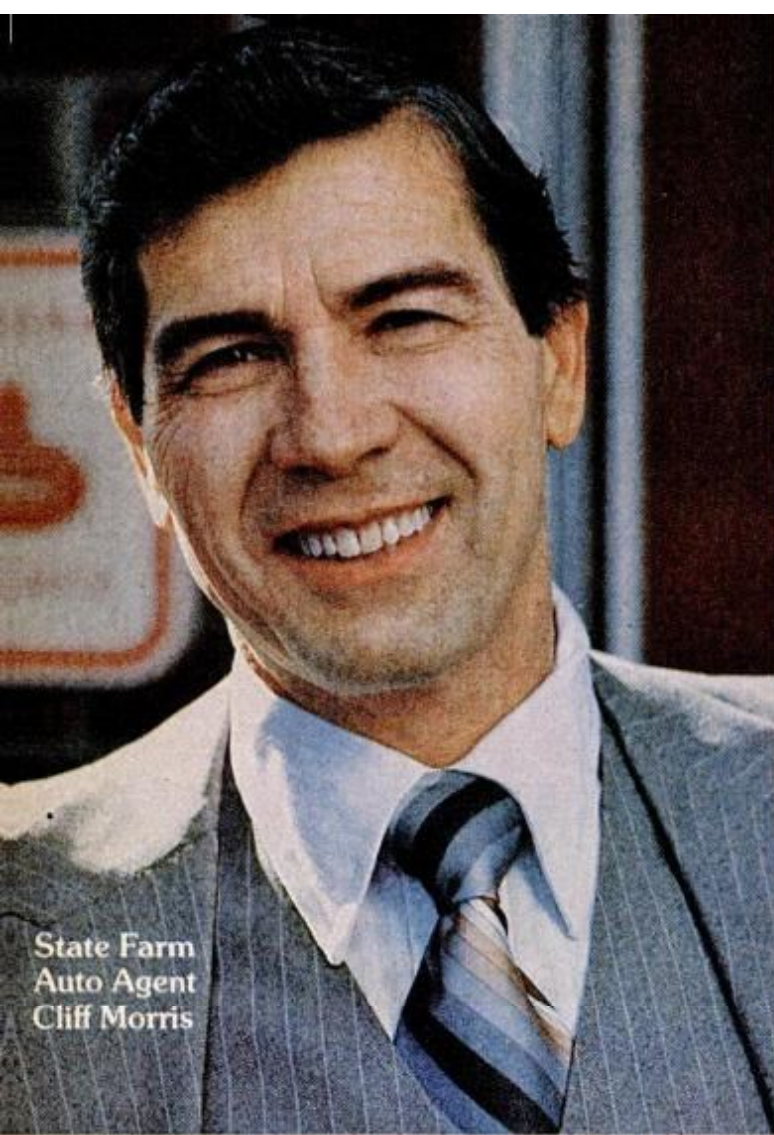
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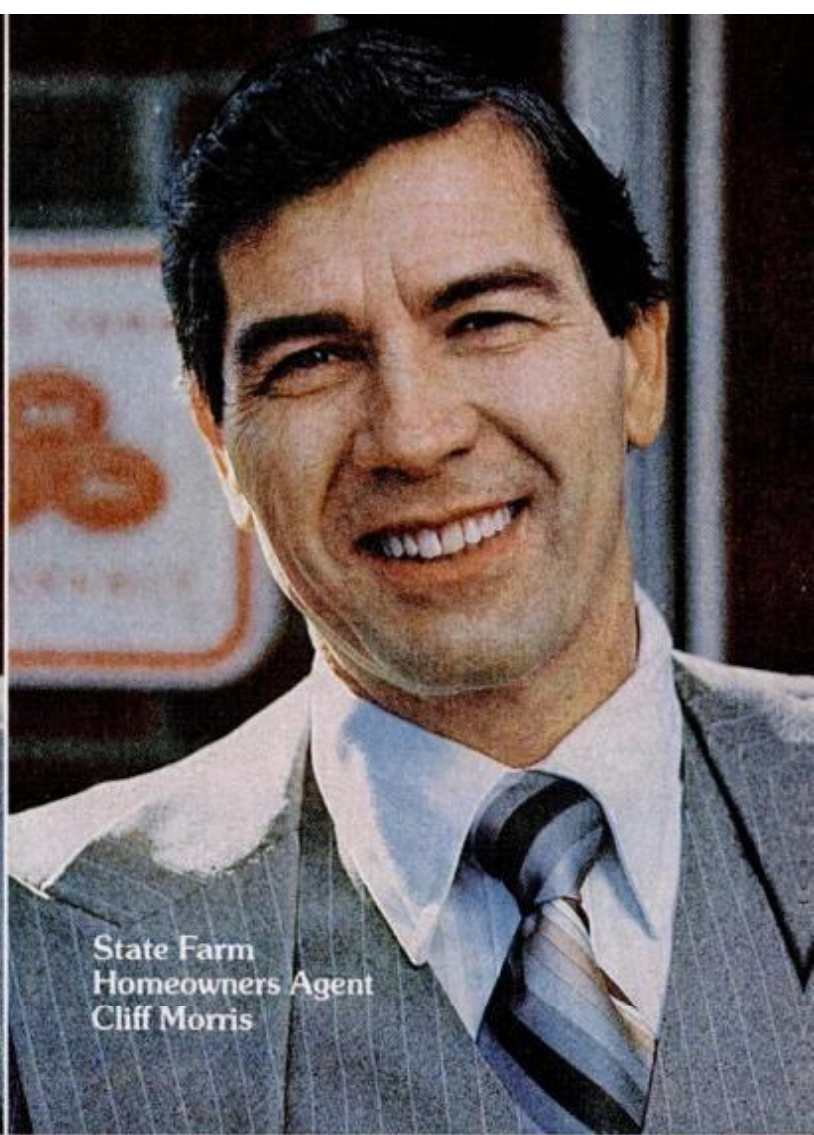
Veterans: Taken for career purposes, ICS Programs qualify for VA Benefits. Canadian residents use Scranton, Pa. address for service from ICS Canadian, Ltd. In Hawaii: 931 University Ave., Honolulu, Hawaii 96814.

Careers	Average annual job openings, 1972-85†	% increase new job openings, 1972-85†
Auto Mechanics	22,300	18.4%
Air Conditioning Refrigeration and Heating Mechanics	13,100	96.3%
TV and Radio Service Technicians	4,400	18.1%
Electricians (Construction and Maintenance)	20,900	30.0%
Engineering and Science Technicians	39,600	48.9%

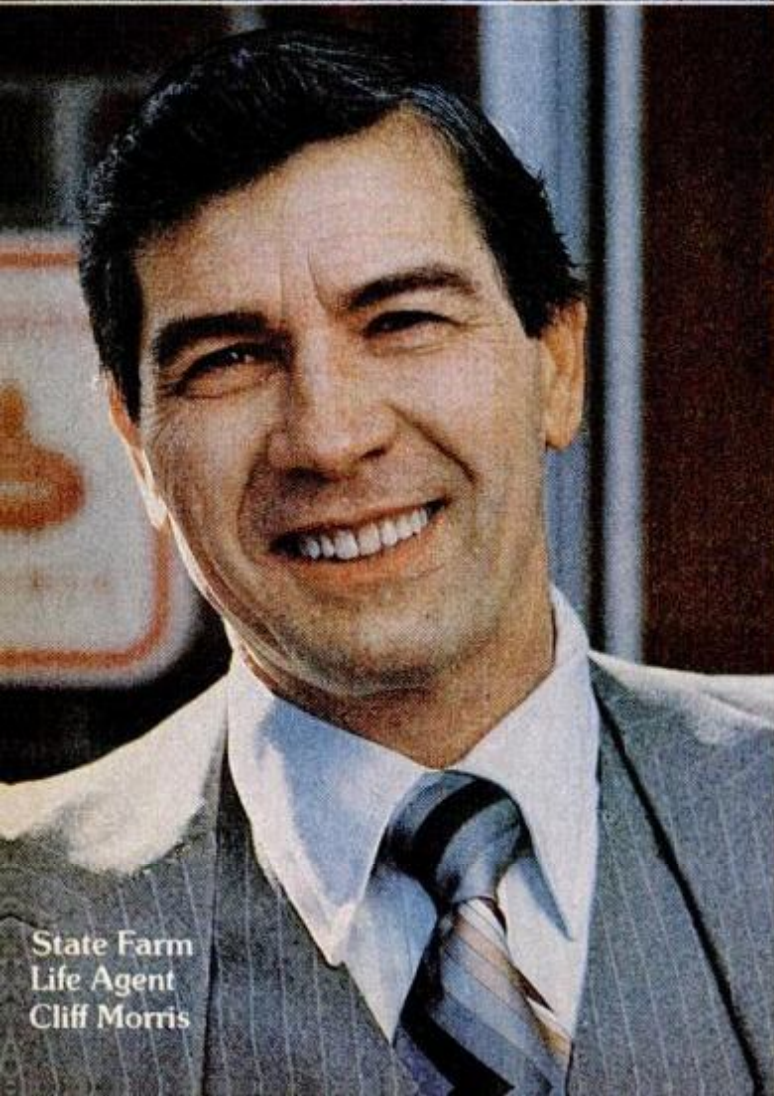
*Source: U.S. Office of Education publication, "25 technical careers you can learn in 2 years or less." †Source: 1974 U.S. Dept. of Labor Occupational Manpower and Training Needs



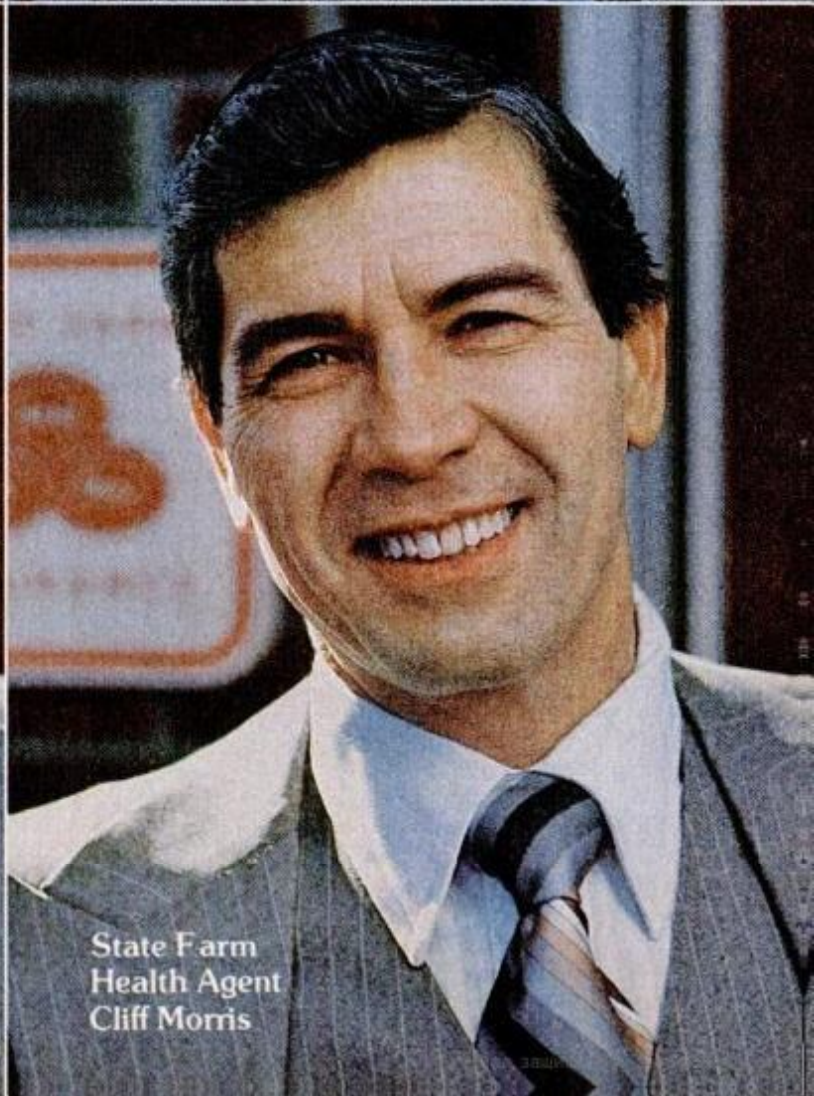
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Auto Agent
Cliff Morris



State Farm
Homeowners Agent
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State Farm
Life Agent
Cliff Morris



State Farm
Health Agent
Cliff Morris

Why a State Farm agent may be your best life and health agent, too.

The first time Ron and Helen Steinmetz of Sikeston, Missouri, called on Cliff Morris, it was about life insurance.

They'd talked to some other agents and wanted to see what State Farm had to offer.

"We discussed our financial situation and our future plans with him," recalls Ron, "and Cliff came back with the program we felt would do the most for us."

"It was comfortable talking to him," says Helen.

"I liked the way he explained things so clearly, and suggested we take all the time we needed to make our decision."

It was a sound decision.

As a State Farm agent,



Cliff Morris has undergone extensive training in all phases of family insurance. He's backed not only by America's largest insurer of cars and homes, but one of the country's largest life companies, too.

Later Ron and Helen bought State Farm policies for their home and car. So now, if they have a question about any of their family insurance, or a claim, they just call Cliff.

If you want someone who offers the outstanding protection and personal service the Steinmetzes enjoy, just check the Yellow Pages and call the State Farm agent in your neighborhood.



Like a good neighbor, State Farm is there.

STATE FARM LIFE INSURANCE COMPANY. Home Office: Bloomington, Illinois. In New York, Wisconsin and Connecticut, non-participating life insurance is offered through State Farm Life and Accident Assurance Company. Home Office: Bloomington, Illinois.

SCIENCE WORLDWIDE

New disease hits children

Mucocutaneous lymph node syndrome (MLNS) is the formidable name of a mysterious disease, first reported in Japan some years ago. Now it has hit 40 American youngsters, according to the American Medical Assn. Nearly 7000 cases have been recorded in Japan.

MLNS primarily affects young children, causing high fever, reddening of the mouth, throat, lips, palms and soles, and swelling of the hands and feet. The symptoms are sometimes mistaken for Rocky Mountain spotted fever. Although most patients recover satisfactorily, according to the AMA, they are quite ill for periods up to several months, and a small percentage develop heart problems.

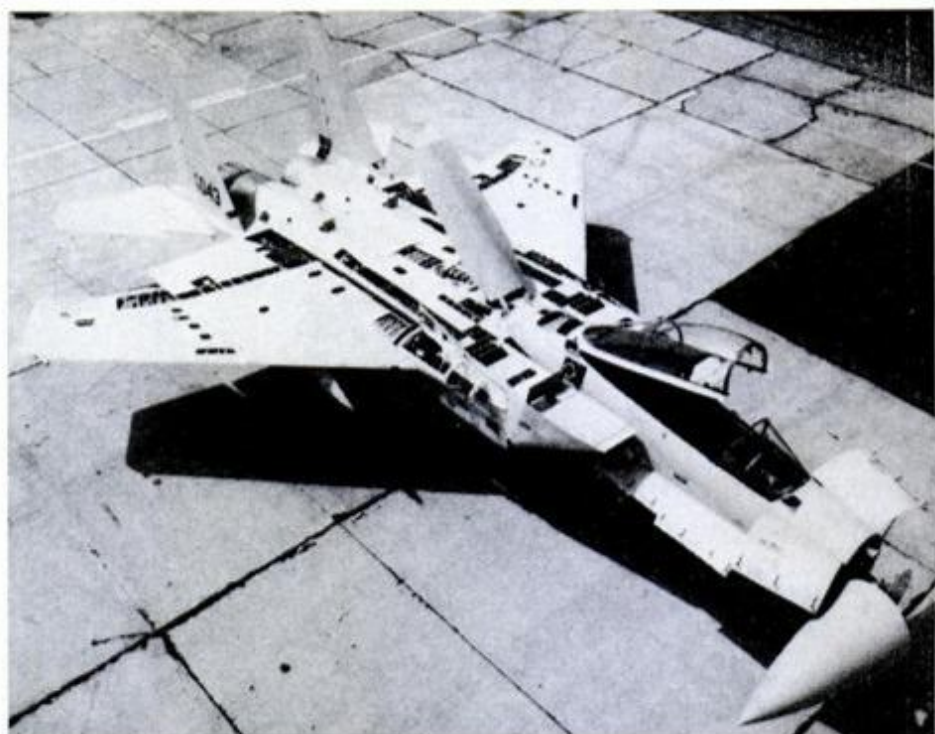
Strange star under observation

Though identified in the 1930s, the star catalogued as MWC 349 was recently revealed to have a strange



Disc-star MWC 349: Spawning planets?

nature. Using infrared telescopes, a team of scientists from the University of Arizona, Tucson, and NASA's Ames Research Center, Mountain View, Calif., found that 349 is surrounded by a white-hot gas disc (as shown in drawing) with a diameter about 20 times that of the central star. The scientists estimate the star is a mere 1000 years old and that planets may be forming in the cooler regions of the gas disc. The disc-star, located in constellation Cygnus, is thought to be some 10,000 light-years from Earth.



Work on F-15 is simplified by doors and panels. Nose swings aside for radar repair.

For speed: open door policy

Modern fighters not only have to fly fast—they must also be speedy when it comes to maintenance. The F-15 Eagle, the Air Force's new air superiority fighter, is a good example. It has 185 doors and panels, all of which seem to be in the open position in the photo, permitting ready access to virtually every system on the plane. Some 85 percent of the access openings can be reached without a stepladder. According to the McDonnell Douglas Corp., maker, the Eagle requires 61 percent less time for maintenance work between missions than the older F-4E Phantom.

The Eagle became operational in 1976, and about 200 are now in service in America, Europe and Israel. The plane boasts a top speed of better than Mach 2.5, is armed with Sidewinder and Sparrow air-to-air missiles and a rapid-fire Gatling gun. It can also carry air-to-ground bombs.

Beep heard 'round the world

Twenty years ago, the Space Age was ushered in with a beep from a small radio transmitter aboard Sputnik, the Earth's first artificial satellite. Launched on Oct. 4, 1957, the 184-pound Sputnik was a rudimentary affair compared with today's sophisticated communications, weather, "spy" and other special-

ized satellites. The Soviet accomplishment shook up the world and put added pressure on America's early space effort. The first satellite launched in the United States, the 31-pound Explorer 1, was orbited on Jan. 31, 1958.

Northwest could tap sunpower

Up to 35 percent of the Pacific Northwest's energy needs could be met with solar energy, estimates Kirk Drumheller, coordinator of solar energy research at the Battelle Pacific Northwest Laboratories, Richland, Wash.

Solar energy, he says, could replace much of the electric heating in homes, heat water and supply heat for industrial processes. Some uses would cost the same with solar energy as now; some would cost more. "But it's important to realize," Drumheller adds, "that we can do all those things now—without long-range technical breakthroughs." ★★



Feel the Real taste difference.

Real

The natural cigarette.
Low tar. Nothing artificial added.

Your cigarette enhances its flavor artificially. All major brands do. New Real does not. It doesn't need to.

We've discovered the way to keep natural taste in, artificial out. All the taste and flavor in Real is natural.

Of course Real's menthol is fresh, natural. Not synthetic.

You get a rich, satisfying smoke. Taste you can feel. Full, natural taste. So taste your first low tar natural cigarette. Taste Real...smoke natural.



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

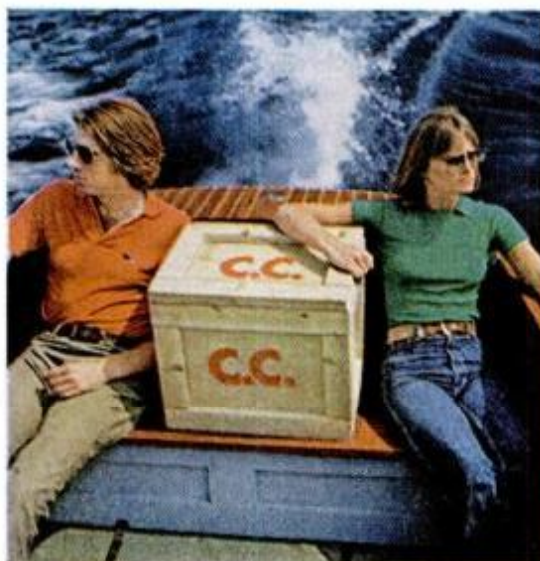
9 mg. "tar", 0.8 mg. nicotine av. per cigarette, by FTC method.

Материалы табачной промышленности



There's a free case of C.C. waiting for you on one of the Thousand Islands.

These clues will help you eliminate 999 of them:



Scattered along the St. Lawrence River, the Thousand Islands form a speckled boundary between Ontario and New York State. Since the early 1900's they've been a paradise for millionaires and a playground for sportsmen. And on one of them we buried a case of Canadian Club.

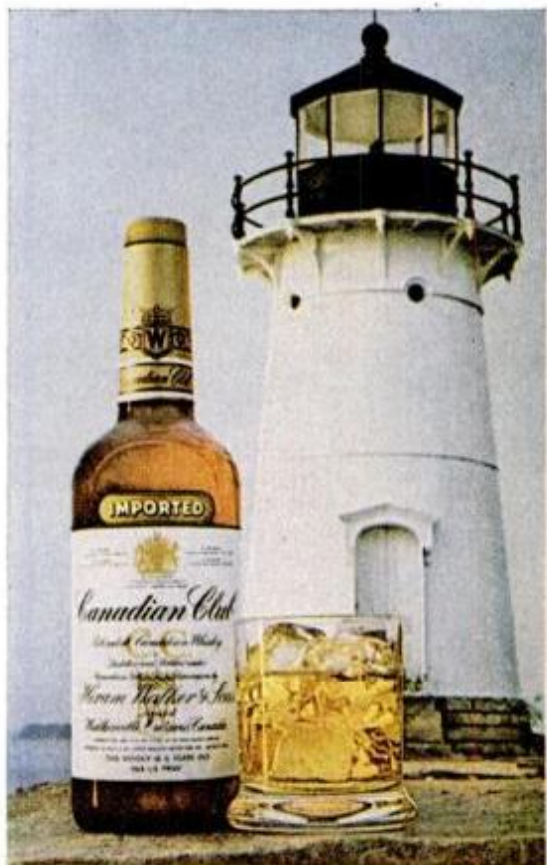
To get that C.C. out of the ground and into a glass, start your scenic search at the Shipyard Museum in the turn-of-the-century village of Clayton, N.Y.

Steer to the starboard side of the island that looks like it's got a big arrowhead sticking straight up from it. A couple of dozen islands later, you'll pass an anchor that looks like something hauled up from the *Sir Robert Peel*, a steamer that mysteriously went down in the St. Lawrence. As you round a bend, you'll sight a water tower looming in the distance. Head straight for it. If you spot some latter-day Huck Finns swinging far out on a rope cannonballing into the water...you've gone too far!

Canadian Club
"The Best In The House" in 87 lands.

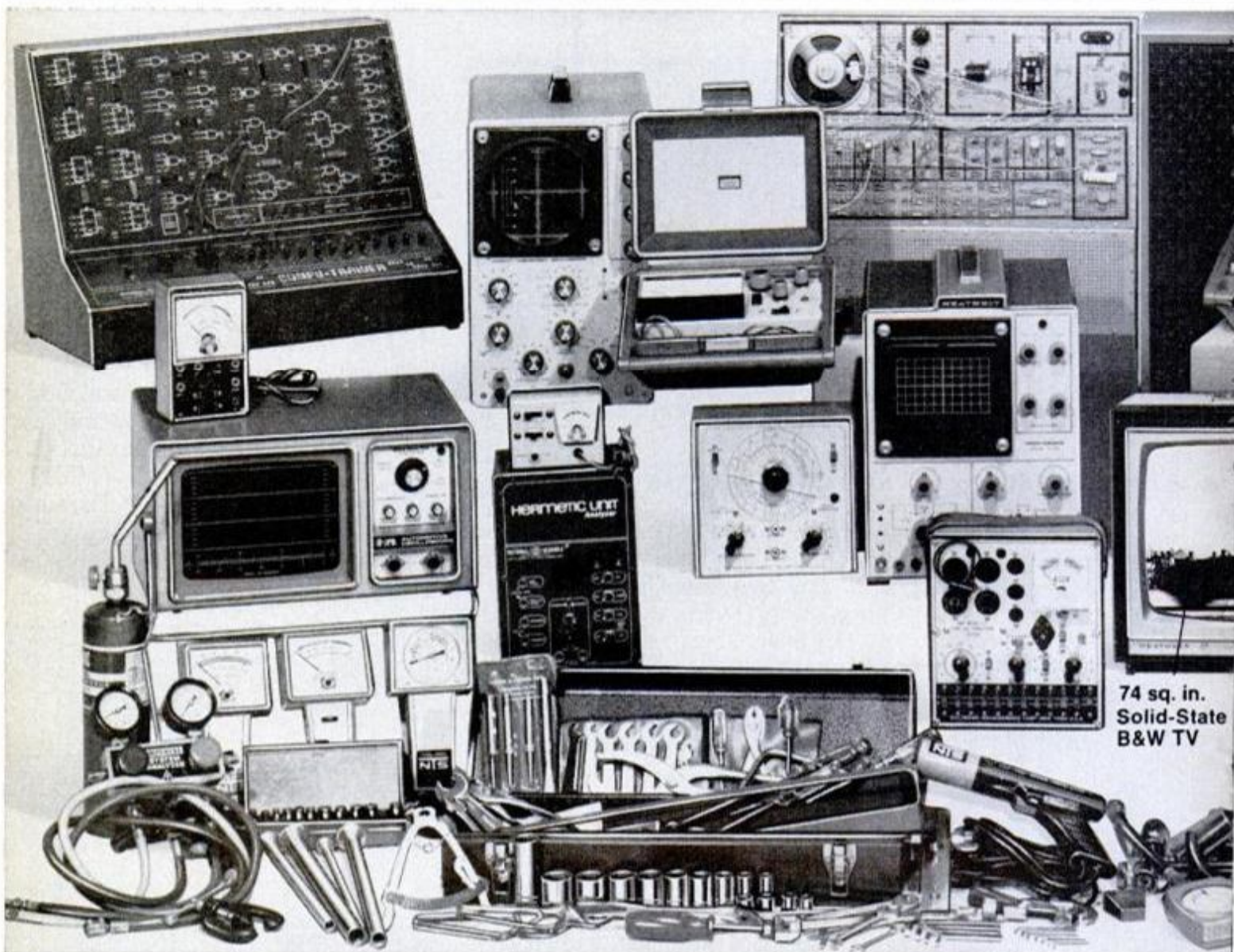
Now reverse your course and nudge into the second deserted cove you come to. Congratulations—you're now just a good angler's cast from the lightest, smoothest whisky in 87 lands. Walk toward the middle of a field exactly 119 paces (the same number of years people have been enjoying Canada's favorite Canadian). Now...dig!

But before you set out, remember to bring a few glasses and a big bucket of ice. Because the second your shovel smacks into that buried case, you're going to want to settle down and savor some C.C. right on the spot. And if you can't make it up to the Thousand Islands to go hunting for our buried treasure, why not just head down to the nearest tavern or package store and say, "C.C., please."



The better the training the better you'll

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Build and keep some of the finest technical equipment made when you train with an NTS Project-Method home study course. And it's usually the same type of equipment you'll meet in the field and use on the job. It will help you acquire first-hand experience and skill — help prepare you better for a variety of exciting technical careers:

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MECHANICS DIVISION: Learn engine diagnostics, motor overhaul, transmissions, automotive maintenance. Courses include 9 in. solid-state automotive oscilloscope, testers, tools, mechanic's steel tool box, & more.

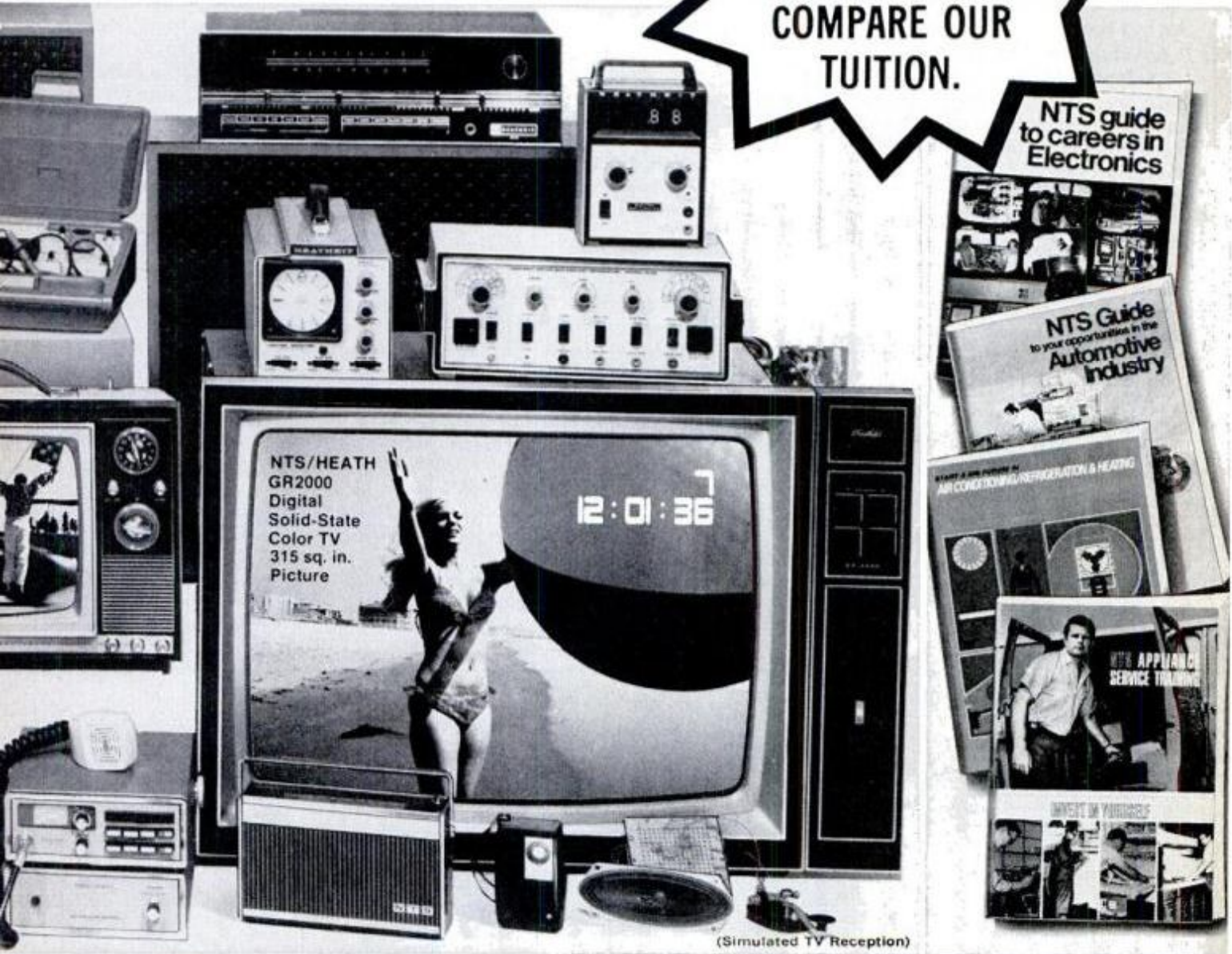
AIR CONDITIONING, REFRIGERATION/HEATING DIVISION: Learn servicing of commercial, industrial and residential heating and cooling equipment. Courses include hermetic unit analyzer, leak detector, charging testing-purging manifold set, tools and more.

HOME APPLIANCES DIVISION: Courses cover repair and maintenance of washers, dryers, ranges, smaller appliances. Equipment includes NTS Circuit-Trainer and professional multimeter.

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CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES

BY MORT SCHULTZ



Spring time

I bought my Chevrolet Vega in 1971. My problem is front tires that wear excessively on the inside. The car has received "umteen" front-end alignments, and new ball joints, wheel bearings, shock absorbers and tie rods. Now I'm told the spindles should be heated and bent down 1/4 to 3/8 inch. Is this wise?
—R. Putnam, Norfolk, Va.

Not wise, and I hope a Chevrolet shop didn't advise you to do this, because the company frowns on the practice which could weaken the spindles.

The toe-in setting for the Vega, as it is for other compacts (VW, for instance), is critical. The specification calls for 1/8-inch, and it must be right on the money or excessive inside tread wear could occur. Furthermore, if a weak part exists, tires may be kicked out of track, resulting in wear. You have mentioned most of the parts that could cause excessive tire wear with the Vega, but one is noticeable by its absence—the springs. If springs are weak, tire wear could result. Check on it.

Breaking a habit

My 1976 Pontiac Brougham has been a constant staller from Day One. Upon first ignition, the car will run a quarter to half a mile. Then, the stalling begins. Usually, after the eighth or ninth restart, the engine will emit a puff of smoke and that will be the end of my difficulties for the day. I have neighbors who have the same problem with similar model-year cars. Any suggestions?—George L. Pavelko, Coplay, Pa.

One in particular, George. It has become pretty much standard with late-model GM cars which stall that the choke vacuum break adjustment should be checked and calibrated. The vacuum break pulls open the choke plate just as soon as it's practical so that the engine won't discharge any more emissions than necessary.

Probably the vacuum break in your car is being overzealous in its effort to fight pollution. It may be set to pull open the choke plate too quickly; the cold engine can't cope with the lean mixture, so it stalls. Get the vacuum break adjusted exactly as the procedure specifies in the shop manual. I think your stalling will stop.

Poultry market

My 1977 Thunderbird has a 460-cu.-in. engine and four-barrel carburetor. Plenty of power, right? Wrong. It acts like a chicken with the heaves when I first start the engine—bucking, snorting and stalling. No one at the Ford shop can find the reason. I'm ready to trade in this turkey.—Frank Shapiro, San Francisco

Simmer down, Frank. There's a cause, and I bet I know what it is. Some Model 4350 4V carburetors in 1976 and 1977 Fords, Thunderbirds, Mercurys, Lincolns and Mark

Vs have come up with a case of choke plate-to-air horn interference. To find out if your Bird is a victim, remove the carburetor air-cleaner assembly and move the choke plate so that it is wide-open. Look for scrape marks on the inside of the air horn wall at each end of the choke plate.

Now, move the choke plate from side to side and check for free play. You should feel movement. Specifically, the total free play should be a minimum of 0.006 inch.

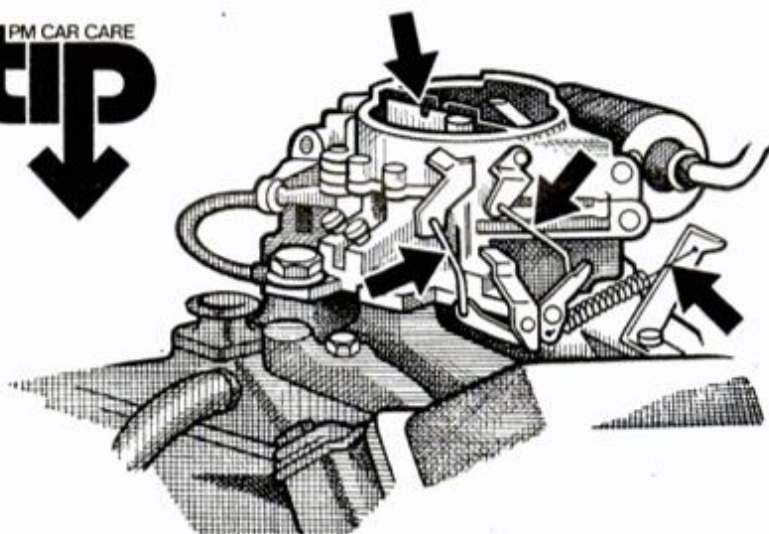
If there are scrape marks on the inside of the air horn walls or there is no noticeable side-to-side play, the air horn walls have to be expanded somewhat. This is done by lightly striking the inside of the air horn wall on each side with the choke plate closed. Use a flat end drift punch and eight-ounce hammer. The procedure is outlined in service bulletin 130.

Enduring

In July 1976 I purchased a '76 Datsun pickup model 620 with a 1952-cc engine. Immediately upon driving the vehicle I noticed a hesitation, primarily between 35 and 50 mph. I took it back to the dealer where I was told that with more mileage and after the car's 1000 mile service the problem would disappear.

It's 6000 miles later, and the condition prevails. The service department now says that the jets in the carburetor are made very small to comply with emission standards,

(Please turn to page 24)



A thing to remember

Often, the toughest problems are the easiest to solve if you don't insist on looking for strange things. Take fast idling, for example, or bucking or surging, or even stalling. All of these conditions may result from carburetor linkages and a choke valve shaft that are covered with crud and are sticking. A very simple solution can be effected with carburetor cleaner and an old toothbrush. Just spritz on the cleaner and scrub away dirt. It's as simple as that.

♪ Introducing the wagon that has America singing ♪

You guessed it.

After all, you don't find people singing about ordinary wagons. Just extraordinary ones. Which, we modestly propose, is precisely the category the 1978 Plymouth Volaré wagon fits into.

Reason number one is the most obvious. That cavernous space you see below. Where those kids could lug home about 60 bushels of shells, or fish, or something else suitably exotic. (Parental guidance suggested.)

Of course, the nice thing about lugging anything around in a Volaré is that you never lug around a lot of car. Because Volaré is a trim, compact wagon. Maneuverable. Easy to park. And, a pure joy to drive. Thanks to the Isolated Transverse Suspension. An ingenious system designed to keep life's bumpy

road as far away from you as possible.

Other comforts also abound in Volaré. Like a gas pressurized liftgate that opens part way on its own. And two optional lockable storage compartments to keep "out-of-sight" valuables out of sight.

Volaré. People have been singing its praises since the day we brought it out. So much so, in fact, that last year, they helped make it the No. 1 selling wagon in America.

And if we're hearing it right (ah, what a great sound) that's exactly where it's going to remain.

Buy or Lease a Volaré at your Chrysler-Plymouth Dealer today.



Plymouth



New 1978 Plymouth Volaré. The car with the accent on value.

CAR CLINIC

(Continued from page 22)

that the engine starves for fuel and I'll have to put up with it. But I don't know if I can. Please help.—Don Hodgson, Cerritos, Calif.

I'm afraid you will have to, Don. In states that aren't quite as finicky as California when it comes to emission standards, mechanics have been drilling out the low speed jet up to about 85-thousandths oversize in 5-thousandths steps, testing after each step to determine if the hesitation condition has been alleviated. I doubt that you will find any mechanic with integrity in California who will do this. Sorry.

Reverend Mort

My problem is an odd-ball, and I'll view your powers with reverence forever if you help solve it. My 1966 Chevrolet Travelall six-cylinder engine is fond of distributors. It has gobbled up four of them in one year.

Actually what happens is that the outer pins which hold the weights for the centrifugal advance shear off, causing the throws to hit the housing and jam the distributor. There has been no other trouble,

and the rig runs like a champ, but to install a new distributor every 3000 miles is a bit much. Do you have any ideas?—Jon Ormbrek, Ellensburg, Wash.

One. On the vacuum advance arm you will find a small rivet where the arm is attached to the plate. This small rivet has the job of impeding centrifugal plate action. If this rivet has any play in it at all, the plate will move too quickly against the weights, which could damage the pins that hold the weights. I suggest that youpeen this rivet and

take out all of the play.

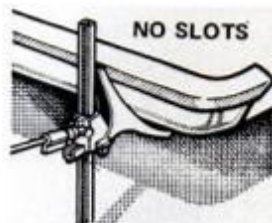
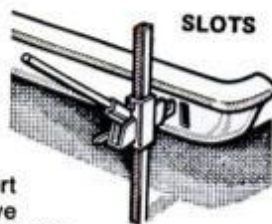
This problem may be a new one to you, Jon, but it's been around since '66.

Defiant differential

Sure as shooting a big chunk of my hard earned bucks will go for a differential overhaul unless you tell me otherwise. The car is a 1975 Chrysler, and it has the Sure-Grip rear which has started giving a ratcheting kind of chatter. Every so often I hear a real bang that scares me to death. Before I go to

Use the slots

I get the feeling when I see some people changing flat tires that they think those holes in their cars' bumpers are a manufacturer's practical joke. They are there to support the jack. Cars that don't have slots are frequently seen lying with their brake drums resting on the ground, because the bumper slid off the jack. But with these old cars you have no choice but to fit the jack under the bumper, lift and work as fast as you can, while praying that the jack and bumper don't part company. As long as you have a newer car with slotted bumpers, our advice is to use the slots when they are needed.



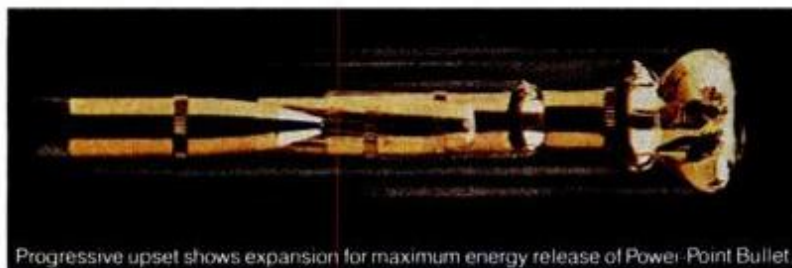
When it's the wrong bullet, a hit's as bad as a miss.

Use the wrong bullet and you're going to get a hit that may keep on going. Hunting bullets not only have to get there, but they have to do the right thing once they reach their target.

Winchester and Western hunting bullets are designed to do that job. Both our flat-shooting Silvertip® and our Power-Point® Bullets hit their

mark, penetrate and give you that controlled expansion you need to get a clean knock down.

And reloaders, because our hunting bullets are an exacting combination of accuracy and energy release you're going to get the same results from your hand loads as you get from Winchester and Western factory loads. And that's hard to beat.



Progressive upset shows expansion for maximum energy release of Power-Point Bullet.



Controlled expansion of Silvertip bullet at all hunting ranges: 100, 200, 300, 400, yards.



the mechanic, tell me what to expect, please.—Louis Gregg, Columbus, Ohio

I have some news for you that may pan out to be good. In practically every case of malfunction with the Sure-Grip differential, the problem can be corrected without tearing apart the unit. In fact, an experienced do-it-yourselfer could probably make the repairs himself. Here's what to do:

1. Drive the car so the rear axle lubricant gets warm.
2. Lift the car on a hoist so rear wheels can be turned.
3. Remove the axle cover and let lubricant drain. Rotate the differential to remove all lubricant. Discard old lubricant, and wipe accessible areas of the differential carrier clean.
4. Scrape off the gasket material from the cover and clean the surface thoroughly with mineral spirits. Then let the cover dry completely.
5. Apply a $\frac{1}{16}$ to $\frac{3}{32}$ -inch bead of Mopar silicone rubber sealant (part No. 3683829) along the bolt circle of the cover. As you come to each bolt hole, dip below the hole with the sealant.
6. Clean the cover's mating sur-

face on the carrier with mineral spirits. This part, too, must be allowed to dry.

7. Install the cover on the carrier and tighten the cover screws to 250 in.-lb. torque. It is important that the cover be installed within 20 minutes of applying the sealant. If this time limit is exceeded, the sealant must be removed and a new bead applied.

8. Refill the axle to a level right below the filler hole with Mopar Hypoil Lubricant (part No. 3744-4994).

9. Start the engine and engage the transmission in Drive or high gear with only *one* of the rear wheels turning. The other wheel may be locked by pulling one rear parking brake from below so the brake is applied to one wheel only. Run the car in this way at a speed equivalent to about 10 mph for 10 minutes. Do not exceed this slow speed. The action scrubs the clutch surfaces clean.

SERVICE TIPS

■ An interesting note from Cadillac this month warns that low or discharged batteries can be caused in some cars by incomplete return of a seat belt

into its retractor. An incompletely retracted belt can allow a 120-milliamp. battery drain, even with ignition key off and doors closed. In time, this can cut battery charge enough to cause a no-start.

■ The Rubber Manufacturers Assn. has revised its *Care and Service of Automobile Tires* manual to include illustrated puncture repair procedures, updated mounting/demounting procedures, and new load and inflation tables for P-type and metric-size tires. For a copy of this handy tire-care guide, send \$1 to RMA Publications, 1901 Pennsylvania Ave. NW, Washington, D.C. 20006.

■ Heed this, owners of 1975-77 FoMoCo products with 351M, 400 and 460-cu. in. engines. A rocker-arm squeak or chirp is caused by a defective fulcrum. A mechanic can find the bad part by using a stethoscope to listen to each fulcrum in turn. The repair is to replace the rocker arm and fulcrum with a new aluminum fulcrum (part No. D7AZ-6A528-B). ★★★

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.

"What I like best about Carpenter's Wood Filler is how it disappears on a finished job."

Dom De Filippo
Carpenter.

The image shows a man in a denim shirt and overalls, smiling and holding a can of Elmer's Professional Carpenter's Wood Filler. The background is a workshop with various tools and wood.

*as defined in the Federal Hazardous Substances Act

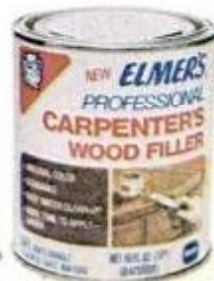
"Beautiful! You practically need a magnifying glass to spot where I used Carpenter's Wood Filler," Dom De Filippo reports.

Professional carpenters agree this new product is a major improvement. It goes on so smoothly you can't believe it. It has excellent shrink resistance, so there are no tell-tale depressions to spoil a finished job. And it's formulated to hold the natural stain,

without over-darkening.

It's a pleasure to use, too. Just clean up with water before it dries—then you can nail, drill, paint, shellac or varnish it. It's non-toxic, non-flammable,* practically odorless.

Take a tip from the pros. Try new Elmer's® Professional Carpenter's Wood Filler.



Elmer's. When results count.

APPLIANCE CLINIC

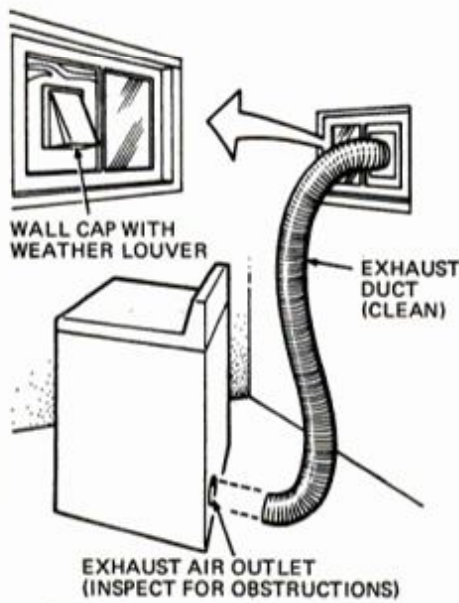
QUESTIONS ANSWERED BY PAUL MANN

Vent problem

We have a General Electric clothes dryer, model 520A1C. It's only a few years old. Most of the time it stops drying before the cycle has been completed, and won't start again until it cools down. I'm upset. What could be wrong?—John J. Johnson, Soldier, Iowa

Several things could be wrong, but one problem often occurs: a blockage that prevents the dryer from getting rid of excessive heat. Excess heat will cause the safety thermostat to kick out, which will pop the machine off.

Even if you clean out the lint trap after each use, lint can still build up in the exhaust duct to impede heat flow. The duct should be removed and cleaned. Be sure not to



Possible areas of heat buildup

overlook the weather louver under the outside wall cap at the end of the duct run (see illustration). This valve could stick closed, trapping heat.

Assuming restriction of heat is not the cause of your problem, then the operating thermostat probably is. If the thermostat sticks closed, it lets the temperature go the limit, which causes the safety thermostat to stop the unit. You can check the thermostat for continuity as follows:

1. Find the thermostat. Check the wiring diagram on the machine's chassis.
2. Let the dryer run until it kicks off.

3. Pull the power cord plug from the wall outlet.

4. Hook up the continuity trouble-light or an ohmmeter to the thermostat terminals.

If the light glows or you get a reading, it means the thermostat is still closed. Replace it.

Icemaker cometh

Ice cubes stick in the plastic tray in the icemaker of my Ward's Signature Model 2199 refrigerator. This causes a mess, because the incoming water flows over the tray and drains into the pan where a block of ice forms. I have installed a new tray, but without success. Can you tell me how to solve this problem?—Bill Wade, Lexington, Ky.

One way may be to turn down the temperature control in your freezer compartment. A common reason for ice cubes literally freezing to a tray is that the temperature is being maintained at too cold a level.

If you determine that you need to keep your freezer set at its present temperature, I suggest that you get a spray for automatic icemaker trays, such as that distributed by Fridigaire. You can get this spray from an appliance distributor. With this "lubricant," you can coat the tray and thus break the contact that exists between ice cubes and the plastic.

Gassin' about gaskets

How should I replace a door gasket in a Maytag Model 400 convertible dishwasher?—Tony Jennings, Annapolis, Md.

Here's the procedure, Tony:

1. To remove the old gasket, first remove the door panel. You'll see that a series of tabs holds the gasket in place.

2. Starting in the middle at the bottom of the door, pull each tab in order from its slot around the door, releasing the old gasket.

3. As you are removing the old gasket, soak the new gasket in hot water to soften it. This will facilitate reinserting the tabs into the door slots with the new gasket in place.

4. Start at the door bottom so the gasket ends are in the center of the door and install the gasket. Do make sure the gasket is completely seated.

5. Reinsert the tabs in the slots. They must be fully seated to prevent water leaking from around the gasket and to prevent possible gasket damage.

6. Reinstall the door panel.

Lady sings the blues

We have a Sears Lady Kenmore washer-dryer combination built in 1957. It's been just great, but three months ago the timer gave up the ghost. Since we are limited for space, I decided to overhaul the entire unit. As you know, no one is selling combos anymore. I took the machine apart piece by piece, replacing and repairing worn parts. I was able to get most parts from Sears. Others I made. But I've run into a problem. Sears can't get me four parts that I can't make. They are rubber valve 22281, thermostat 24059, 175° fixed thermostat 23840 and pin 98700. Could you tell me where I can get these parts? Why doesn't anyone manufacture combos anymore?—Arthur Dehar, Ojai, Calif.

I've located several major appliance parts distributors in California who should be able to help. Two in your 805 area code are Cal Sales Corp., 2945 West Fifth St., Oxnard (486-3553) and Genuine Appliance Parts Distributors, 127 East 18th St., Bakersfield (324-9891). If neither can help, try the Appliance Parts Co., 15040 Oxnard St., Van Nuys (213-787-9220), which is one of the biggest parts outfits in the state.

Finally, if you run into a dead end, a company in the East can get the parts for you. It is Jacoby Appliance Parts Inc., 57 Albany St., New Brunswick, N.J. 08901 (201-846-0300).

Usually when mail-order companies get a list of parts and numbers from a customer, they send prices and mail costs. The customer returns a check or money order and the parts are sent.

Combos aren't built because there wasn't a large market for them when they were made. ★★

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.

One of a kind.

Where others seek mere wealth, he searches for experience.

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Remember!

Whether you work on your car yourself, or have your service station do it, remember to check the radiator cap. It's the easiest component to forget, yet the easiest to replace. And regular replacement is vital. A faulty cap will not keep the pressure in the cooling system

within safe limits. So be safe. Install a Stant Lev-R-Vent® Pressure Cap ... the safest, most dependable radiator cap available anywhere. And for expert tips on cooling system care, write for "The Stant Cooling System Fact Book". It's free.

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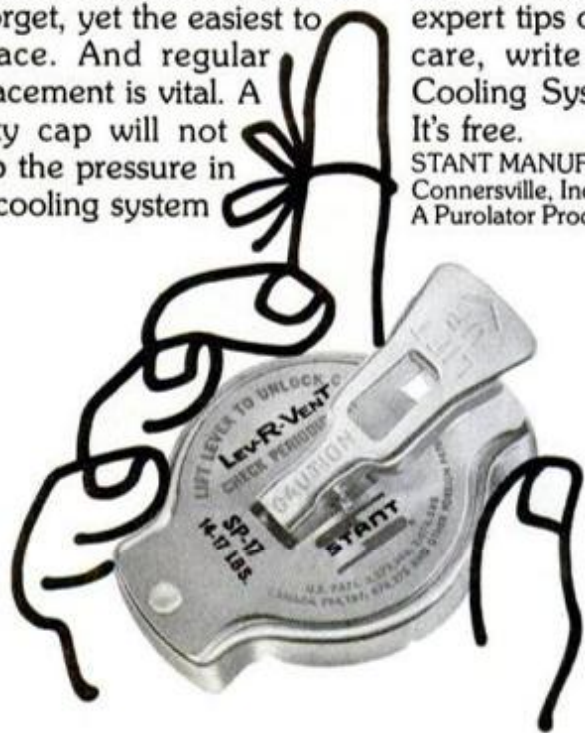


PHOTO HINTS FROM READERS

Camera cradle



The weight of a heavy flashgun attached directly to a camera puts a strain on both the camera body and the neck-strap lugs. You can eliminate this problem by making a "cradle" for the camera from aluminum bar stock bent to form a U shape around the body. Mount the gun on one side with an accessory flash shoe or adapter bracket and attach the neck-strap clips to the upper ends of the cradle instead of the camera. This removes all strain from the camera itself.

—Robert Hertzberg

Dot your eye



Ever wondered what kind of film was in your camera, or if the film already exposed was to be pushed during processing? You'll know if you use stick-on, peel-off label dots available from stationery stores. Use red to indicate high-speed color film, green for regular color, and white for black-and-white film. Stick the dot onto the camera when loading. Later transfer the same dot to the film cassette when unloading the camera.

—Dave Bryan

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HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Paint possibilities

I'm painting my house with acrylic latex paint. I'd like to use the same paint on the garage door which is made of fiberglass panels. Can I use acrylic latex, or should I use a different paint?—Robert Dilly, Matthews, Ind.

For a dependable, lasting finish, I'd suggest you use something else. You might try an exterior oil-base house and trim paint.

Another possibility would be to first roughen the surface of the fiberglass panels slightly with medium-grit sandpaper. Cover the panels with an oil-base primer, then paint them with a glossy house and trim latex. Follow the directions on the can.

Unruly water system

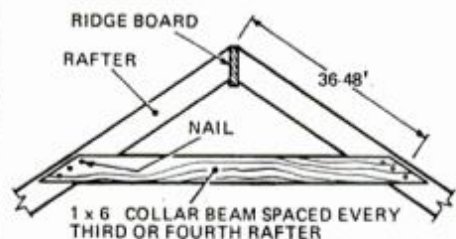
The plumbing in my mountain cottage is all copper tubing. Before winter I drain the system completely. However, when I turn the water on in the spring, I find one or more of the soldered fittings pulled apart with resulting leaks. The lines are wrapped with insulation and I use heat tape. What's the cause and how do I cure it?—Charles J. Pisch, Altoona, Pa.

I can't be sure at long range, but first, are there any low points in the system that are not completely drained before winter? Second, in spring, when you run cold water into the system, the lines will cool and contract. On long, straight runs especially, this could be sufficient to open soldered fittings. Filling the system slowly might overcome this possibility. Heat tape should be the type controlled by a thermostatic device which is activated only when the temperature drops below 40° F. for energy-saving purposes. I doubt that it would cause problems, and it's a must in the mountains. Have the system checked again by your local plumber with these possibilities in mind.

Ceiling bewilderment

We'd like to make an extra bedroom out of our attic. The flooring is finished and in perfectly good shape, but what can we do about the ceiling? How do we make it look more like a bedroom and less like a made-over attic?—L.E. Platt, Denver

Many people like the peaked effect of an attic roof. But to lessen the peak effect, you can install collar beams several feet below the ridge of the roof. These will serve as the ceiling joists. You can, for example, attach furring strips across the joists and install some acoustical tile.



Flashy idea is a no-no

I've been told that exhausted flashlight batteries are effective in removing soot from the fireplace chimney. I'm instructed to toss a battery or two into a blazing fire. What's your opinion?—Frank Spakofski, Westwood, Mass.

This procedure is a no-no, especially with any new-type batteries that carry a warning not to recharge or discard them in fire. Even if you use old-type dry cells, there is danger of starting a chimney fire that's hard to control. It's better to use a double handful of ordinary salt, rock salt in half-brick size or a prepared soot remover. When using the latter, be sure to follow all instructions.

Presoak cedar shingles?

I've been told that cedar shingles used at the ridge and valley of the roof should be presoaked in water before installing. Otherwise, they are likely to split when they're nailed in place. Your comment, please.—F. Irby, Ventura, Calif.

On the contrary, the soaking of cedar shingles will cause them to expand. Shingles may split at the nail points as they dry in the sun and contract. Proper nailing will prevent the splitting in most cases.

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 orders to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.

Prevent moisture with plastic

In winter the north foundation wall of the crawlspace in my home drips moisture. The floors and heating ducts are insulated. There are eight vents in the foundation walls which I close in winter. I plan to cover the earth floor with polyethylene. Will this cure my trouble?—Ed Pinkowski, Brooklyn, Mich.

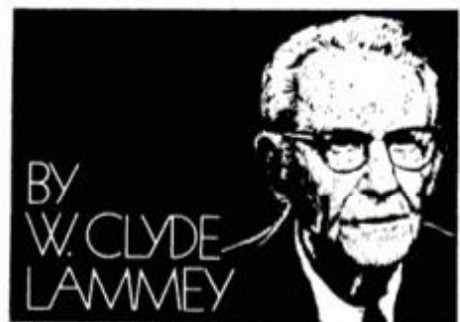
The plastic membrane should prevent the rise of moisture from the ground, but will do so only if you make sure to extend it up the foundation walls to the sills. Leave some openings in the membrane at the vents and keep the vents open throughout winter and summer to provide for air circulation under the floor.

Cabinet spots and tile scuffs

I have kitchen cabinets stained cherry with no protective finish. Cabinets over the stove have grease spots on them. Also, my vinyl tiled floor is scuffed and has black marks. How can I solve these problems?—Joseph Sanko, Dayton, Ohio

If the cabinets are stained and have not been finished, any household cleanser that's intended for use on grease should remove the spots, but it may also lighten or completely remove the stain. Thus, you may find it necessary to restain the surfaces before applying a final finish. Use two coats of polyurethane finish (one that carries the same manufacturer's brand as the stain you use) for the final finish to seal out and protect the surface.

Commercial vinyl tile cleaners are available. But if the scuffs are below-the-surface gouges, you may not remove the marks completely with these cleaners, and damaged tile may have to be replaced. Be sure you test a small inconspicuous area before applying cleaner to the entire floor. ★ ★ ★



Before you buy a color TV make sure it can use this VIR signal.



Cabinet of genuine hardwood solids, pecan veneers, simulated wood accents, with inlay parquet top. Simulated TV reception.

General Electric VIR sets read this signal to give you color automatically adjusted by the broadcasters themselves.

Inside this GE set is advanced computer-like circuitry that uses this VIR signal. To let the broadcaster automatically adjust all of the color on many programs. Flesh tones. Background colors. The entire color picture. All automatically. 60 times a second. VIR Broadcast Controlled Color. See a demonstration today.

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DETROIT LISTENING POST

GM's plan to save the van

Good news for van fans. GM is shooting for 25 to 30 miles to the gallon for the new van-type vehicle it will bring out two years from now. The reason it's good news is that vans must meet the same fuel economy standards as passenger cars and, with one exception, none of the vans around today will be able to meet the mpg requirements of the 1980s.

Vans are notorious gas gulpers and the machines on the market now will get the heave-ho during the next few years if they don't make spectacular gains in mileage. The exception is VW's bus, the granddaddy of all vans. VW's mileage is so good the company could go on making the current product until 1981 without any improvement in fuel economy. GM hasn't confirmed that it is shooting for 25 to 30 miles a gallon for the new van job. However, the company would not tool for an all-new vehicle if it thought it wouldn't be able to meet or beat the mileage minimums coming in the 1980s.

Chrysler's super van

Speaking of vans, I had the loan of a one-of-a-kind for two weeks courtesy of Chrysler. It was a Dodge Maxivan. Standard mechanicals, but with special trimmings on the inside—refrigerator, fold-out table, storage closet, sofa bench against one wall, linoleum floor, padded ceiling and paneled walls. Put a couple air mattresses on the floor and you've got the next best thing to a mobile home.

Chrysler worked the job up with the thought it might appeal to hunters and fishermen. But they never put it in production. Not yet, anyway. I didn't check the mileage because that would have taken the fun out of driving it. After being cooped up in so many small cars, it was a good feeling to drive a really big rig.

Mpg goals worry Detroit

The Department of Transportation has put Detroit in a pickle on the 1980 cars. The auto firms will be in trouble if the government adheres to the mpg standards it has ordered for 1981 through 1985 cars. The problem: Starting with the '78s, cars must give a specified num-

ber of miles to the gallon. The figure advances year-to-year, from 18 mpg on the '78s to a top of 27.5 in 1985.

The companies have worked out complicated programs to meet the mileage goals and thought they were in pretty good shape to toe the line. Mileage would increase gradually one year to the next, with the big jump coming between 1984 and '85. But the government has accelerated the timetable for the '81 through '84 cars. The end goal hasn't changed—it's still 27.5 by '85. But Uncle wants Detroit to get there faster than the firms planned on between '81 and '84.

So how do you handle it? Well, you can kill off the gas guzzlers earlier than you planned. You can go back to the drawing board and do a second round of downsizing. You can regulate production so you sell more small cars (easy on gas) and fewer big cars (heavy on gas), thereby increasing mileage on an averaging-out basis. Or you can do a combination of all those things, plus. Carmakers will sweat their way out of the problem—they always do—but at the moment they are up to their necks in pickle brine.

Keeping mechanics honest

The Automotive Parts & Accessories Assn. has put out a book that will give you a fighting chance if you come up against a greedy grease monkey. It's called *Summary of Auto Repair Legislation and Regulations of the 50 States*. It tells you what your rights are and what mechanics can and can't do. Price of the book is \$4.50. It's a good investment if you do much traveling away from your home state. The address is APAA, 1025 Connecticut Ave. N.W., Washington, D.C. 20036.

The same organization puts out a now-and-then column called *Tips for the Novice Automechanic*. No charge except for a stamped, self-addressed envelope. Same address as above.

Chrysler tightens inspection

One of the things you pay for when you buy a new car is a final check by the dealer to see that everything is okay. It's called dealer make-ready or dealer prep and it's included in the price of the car. You pay for it whether you get it or not.

The practice with many dealers is

to give the car a fast run through the wash, kick the tires and eyeball it to see if anything fell off in transit. This isn't much of a check. The dealer figures why bother with it. If something should be wrong, you will bring the car back and have it fixed under the warranty.

Chrysler has come up with an idea to force dealers to do a better job on makeready. The company sends out a "new vehicle preparation certificate" listing all the checks the dealer is supposed to make before turning the car over to the customer. This includes a road test. The dealer has to complete the form, sign it and return it to the factory.

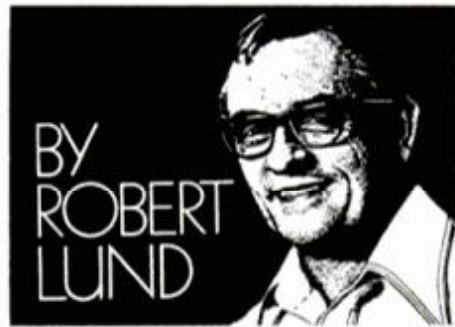
There's been beefing from Chrysler dealers about the added work. But it's a good shake for buyers of Chrysler cars and an idea the other companies might well follow.

Air bags vs. passive belts

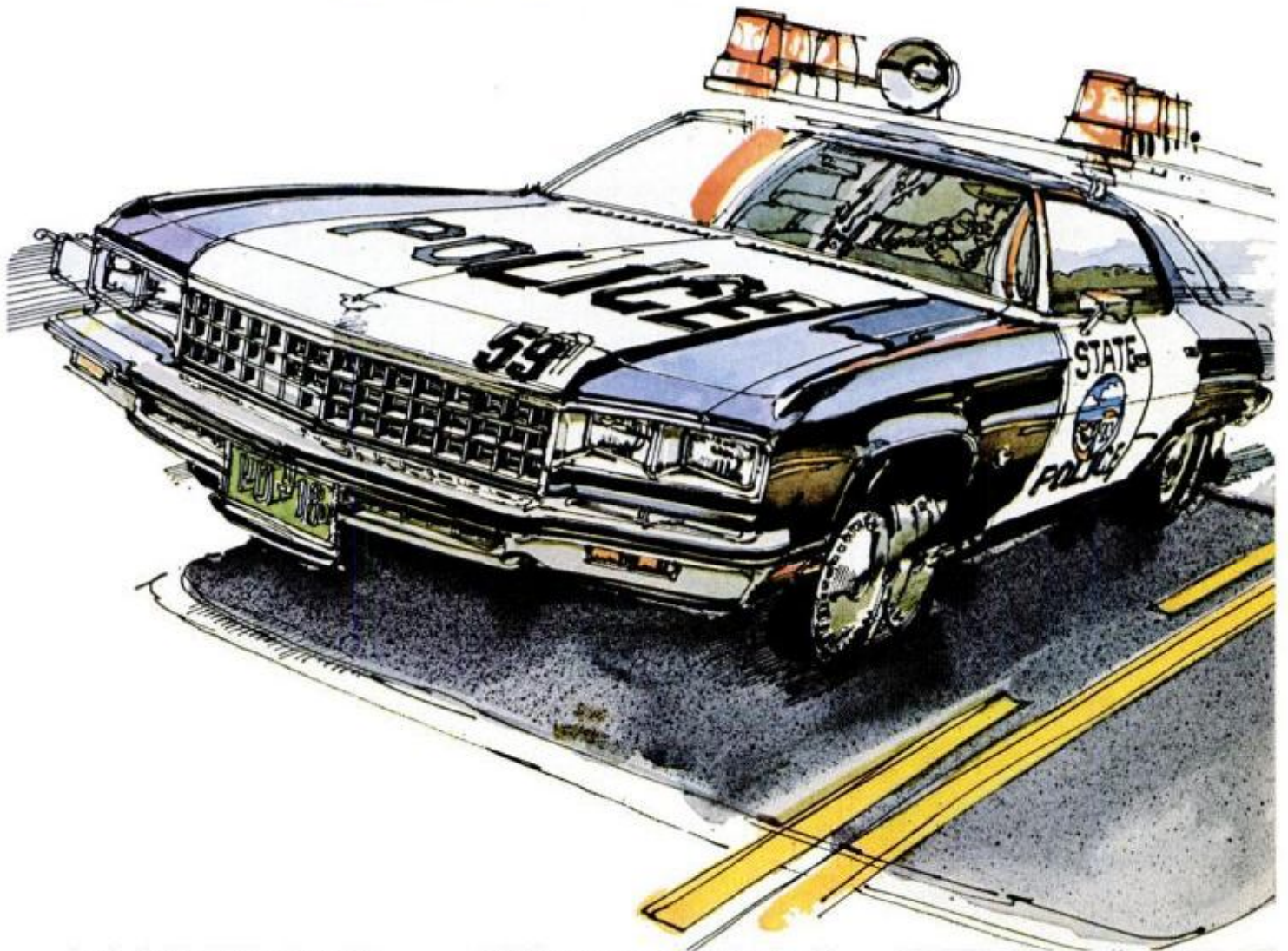
The government now says passive restraints—air bags or something else—must be installed in all cars by 1984. Big cars will get the equipment in 1981, medium-sizers in 1982 and small cars in 1983.

The auto companies still argue that air bags aren't as safe and effective as a combination lap belt and shoulder strap. Bags are also more expensive, about \$300 versus something under \$50 for an automatic belt/strap. The law doesn't specify air bags. It calls for passive restraints.

The betting around Detroit is that the companies will use both air bags and a passive belt system. The high-price cars will get air bags. The lower-price cars will be equipped with passive belts. Volkswagen has an automatic seat belt that qualifies as a passive restraint and Detroit is expected to "borrow" the VW harness for small cars. All the companies are conducting field tests of passive belts patterned after the VW design. ★★★



CHANGE YOUR OIL WITH HAVOLINE AND PROTECT YOUR CAR LIKE A TROOPER.



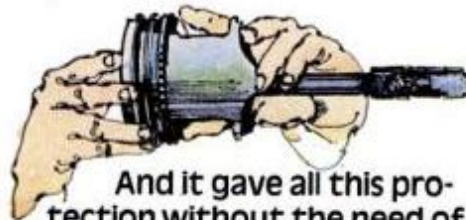
A state trooper gives his car a rough time.

Which is why we had more than 90 trooper cars with Havoline Super Premium All Temperature Motor Oil driven a total of over 4 million tough miles—4 million miles of all kinds of driving in all kinds of weather—from standing starts to high speeds in a matter of seconds.

And often, the same car was driven round the clock—24 hours a day.

These state trooper cars were driven almost as many miles in 6 months as the average car is driven in 3 years.

Yet there wasn't a single oil-related failure of Havoline-protected parts.



And it gave all this protection without the need of any extra motor oil additives.

So the next time you change your oil, protect your car like a trooper with competitively priced Havoline Super Premium. It provides all the protection your car needs.

Ask for Havoline wherever they sell motor oil.



PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

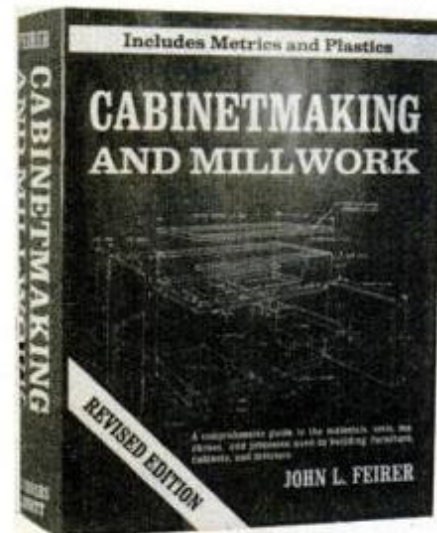
More efficient chain saw

Latest announcement from Stihl is that the firm now offers a full line of chain saws with electronic ignition. According to Blake Stretton, Stihl's vice-president, "They start fast and stay running in any kind of weather." The breakerless system of no moving parts utilizes solid state components to provide correct switching, and the sealed module never requires adjustment or maintenance. The bottom line, according to Stretton, is that "the sparkplug lasts longer and high-voltage energy is always maximum."

The system is available on seven different chain saws, including three homeowner models—015, 020 and 031—as well as the larger semiprofessional and professional models.

Workshopper's bible

The original version of this book has probably been imitated by more would-be how-to writers than any other do-it-yourself book. Feirer's revision, happily, still makes this



Must reading for real do-it-yourselfers, book is especially handy for reference.



The book is profusely illustrated with quality photographs and line drawings.

the one to be emulated. Though thorough, the book is still easy to read. *Cabinetmaking and Millwork*, by John L. Feirer, Chas Scribner's Sons, New York, \$27.50.

Government publications

Working with more than 24 agencies, the Consumer Information Center of the U.S. General Service Administration encourages the development and release of timely, useful consumer booklets. To learn what booklets are available (and their prices) send for the Consumer Information Catalog, issued quarterly. Write Consumer Information Center, Washington, D.C. 20405.

Two-wire cord set

New from General Electric is this two-wire outdoor cord set for use with double-insulated tools only. Since it is unsafe to use the cord



Bright orange cord for insulated tools.

with tools having three-wire line cords, the connector is constructed with extended faces to prevent accidental chance of a plug-in. Prices start at \$5.50 for a 25-footer.

Unique clamping

I recently tested these clamps while drilling metal on a drill press. They held the work secure to the table, and their pivoting jaws—which act



like a built-in V-block—did a superb job of holding round stock. Prices start at \$5.25 for a 2-in. clamp. Clamp Manufacturing Co. Inc., 1503 Adelia, South El Monte, Calif. 91733.

Macrame furniture

Each of the handsome pieces shown below can be built in a single work session because the furniture comes in kit form. Each kit contains the necessary jute, predrilled precut



Quick assemblies: magazine-record rack (left), 24 and 14-in. furniture stands.



dowels, beads and complete instructions.

Prices (including postage) are \$18.45 each for the record-magazine rack and two-ft. furniture stand; and \$13.20 for the 14-in. furniture stand. Macramania, Box 923, Dept. PM, Bellmore, N.Y. 11710.

Stained-glass pattern book

Stained glass buffs will love this book—it features 48 varied patterns for windows. It's available



Book offers materials lists for projects.

for \$3 from Whittemore-Durgin Glass Co., Box 2065, Hanover, Mass., 02339.—Harry Wicks, Home and Shop Editor

Merit Cigarette Sets New Taste Standard.

Tests confirm low tar MERIT delivers flavor of higher tar cigarettes.



There is a way to get real taste from a cigarette without high tar.
Technology created it.
Taste tests proved it.

Smokers are confirming it. In fact, 75% of all MERIT smokers are former high tar cigarette smokers—the toughest taste critics of low tar smoking.

MERIT—the cigarette packed with 'Enriched Flavor' tobacco—seems to be solving the smoker dilemma of having to choose between high tar or low taste. If you smoke, you'll be interested.

Tests Prove Taste

MERIT and MERIT 100's were both tested against a number of higher tar cigarettes. The results proved conclusively that 'Enriched Flavor' tobacco does boost taste without the usual increase in tar.

Overall, smokers reported they liked the taste of both MERIT and MERIT 100's as much as the taste of the higher tar cigarettes tested.

Cigarettes having up to 60% more tar!

Only one cigarette has 'Enriched Flavor' tobacco.

And you can taste it.

© Philip Morris Inc. 1977

Kings: 8 mg.'tar,' 0.5 mg. nicotine av. per cigarette, FTC Report Dec.'76
100's: 12 mg.'tar,' 0.9 mg. nicotine av. per cigarette by FTC Method.

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

MERIT

Kings & 100's

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Photograph by
Valerie Taylor

THE GREAT WHITE SHARK!

One of the killers you'll encounter in DANGEROUS SEA CREATURES

The great white . . . most feared of the ocean's predators. He grows to a length of 21 feet, and to a weight of three tons. His teeth measure a full two inches, and are replaced, when damaged, within 24 hours. His acute sense of smell can detect one ounce of fish blood in one million ounces of water. His nerve endings can pick up erratic vibrations — such as those of a swimmer in trouble — at a distance of 600 feet.

The great white claimed the lives of thousands of shipwreck victims during World War II . . . yet most attacks take place in waist-deep water! You've heard the myths about the great white shark . . . now, read the stranger-than-fiction truth about the deadliest of all sharks in *Dangerous Sea Creatures*. It's your first volume in the WILD, WILD WORLD OF ANIMALS library, based on the popular TIME-LIFE television series.

The great white is only one of the terrifying inhabitants of the deep. In *Dangerous Sea Creatures*, yours for 10-day free trial, you'll discover:

• an electric ray, capable of stunning its prey with a charge of up to 200 volts

• the nurse shark, which can clamp its jaws so tightly on its victim that the body can only be dislodged by killing the shark

• a jellyfish that grows to a length of eight feet, with stinging trailers extending up to 100 feet

• the sea wasp, whose venom is so potent, it can paralyze the heart of a man within minutes after entering his bloodstream

• the giant grouper, reportedly capable of swallowing a diver whole!

• the barracuda, whose barely-detectable approach and needle-sharp teeth make him more feared than the shark in some parts of the world

Embark on an action-photo tour of the treacherous undersea world. More than 125 incredible full-color photographs (many of them taken by famed photographer Ron Taylor who has actually survived a white shark attack) give you a close-up view of the ocean's monsters second in drama only to actually confronting them. Send for *Dangerous Sea Creatures* for a 10-day free examination today — and begin a perilous journey to the ocean's floor.



Razor-edged tooth of a great white



The Zambezi shark of South Africa stalks its prey . . .

Discover the action-photo excitement of

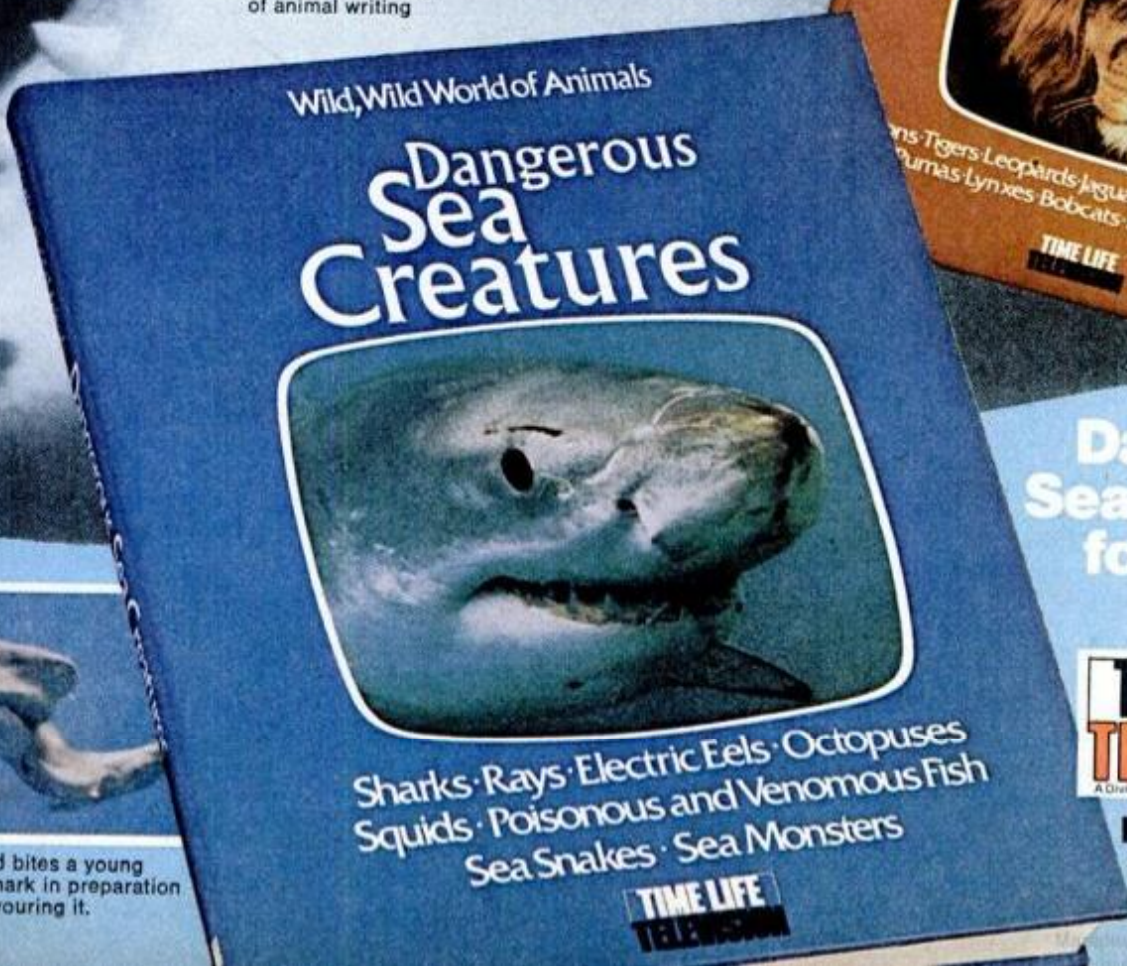
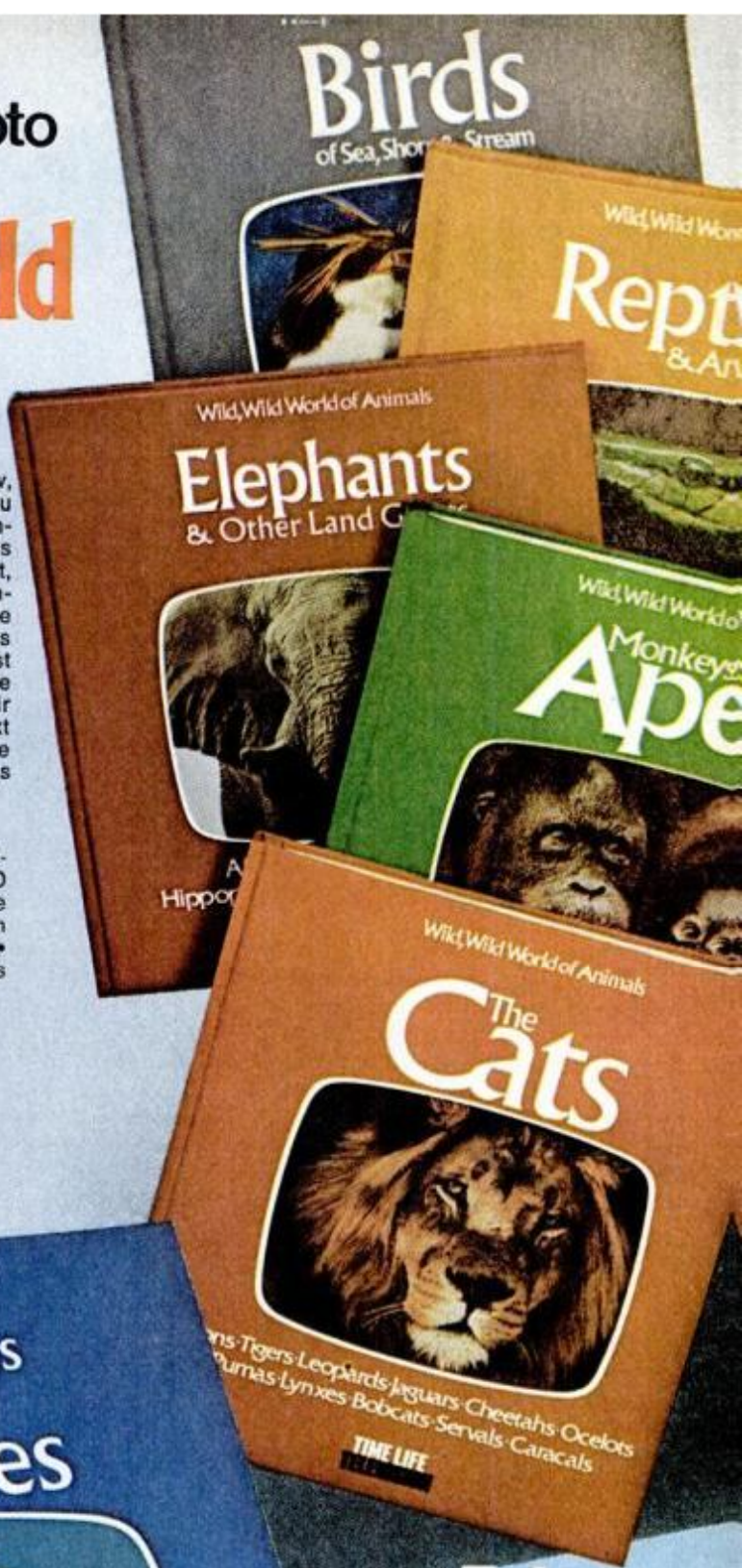
Wild, Wild World of Animals

Based on the award-winning TIME-LIFE TELEVISION show, the WILD, WILD WORLD OF ANIMALS library takes you on an astonishing photographic safari to the most action-packed places on earth. You'll roam jungles and plains in *The Cats* to watch cheetahs, leopards and lions hunt, fight and struggle for survival. You'll learn the astonishing secrets of man's closest kin when you enter the world of *Monkeys and Apes*. Future volumes in the series will introduce you to all of the animal kingdom's most fearsome and fascinating creatures. Each will feature 125 brilliant, full-color action close-ups of animals in their natural habitats, as well as a thoroughly-researched text that will reveal their habits as never before. To examine your first volume, *Dangerous Sea Creatures*, for 10 days free, mail the attached postage-paid card today!

Dangerous Sea Creatures, your introductory volume in the WILD, WILD WORLD OF ANIMALS, will bring you face-to-face with: Sharks • Rays • Skates • Sawfish • Octopuses • Squids • Electric Eels • Sea Snakes • Sea Monsters • Poisonous and Venomous Fish

Each volume in the series will include:

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- 128 pages, beautifully hardbound in large 9¼ by 10¾ inch format
- More than 125 full-color photographs
- Extensive anthology of animal writing



Enjoy
**Dangerous
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 for 10 days
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 Chicago, Ill. 60611

... and bites a young gray shark in preparation for devouring it.

New energy monitor lets you keep track of electrical costs

You're loafing along at a mere 14.3 cents per hour. Then one of the kids turns on a hair dryer, and you move up to 22.5 c.p.h. That's a moderate cruising rate—but then your wife floors the self-cleaning electric range, and you shoot up to 78.2 c.p.h., speeding for sure.

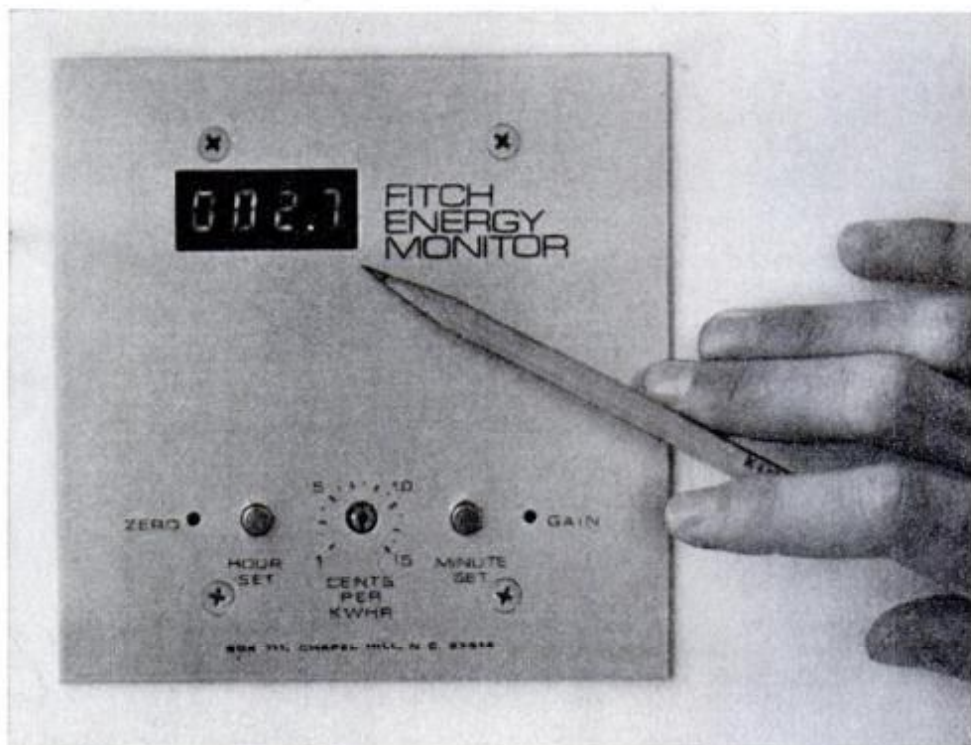
What's happening? You're keeping track of the rate at which electric energy is used in your home, watching an LED digital display like the speedometer in a new luxury car. The Fitch Energy Monitor senses the flow of electricity at the house service panel, measures the quantity and translates it into money terms using your utility's rates. It incidentally serves as a wall clock, displaying the time of day every four seconds.

The device was developed for Roy B. Fitch Jr., an energy-conscious builder-developer who had found that the most important factor in reducing home energy consumption is the homeowner himself. Awareness of the use of electricity is apparently the first step in its conservation, and the energy monitor is a means to that awareness.

How it works

Although its function is simple, the energy monitor is a high-technology device. Here's how it works: Two small transformers straddle the main power cables in the house's distribution box at or near the service entry. Current in the cables induces a low-voltage current in the transformers and the wiring that connects them to the wall-mounted monitor components. This a.c. current is converted to d.c. by a linear rectifier, and its voltage is translated into the frequency of a train of pulses. The pulses are counted by a CMOS circuit, and the wattage value resulting is multiplied by the price of electricity (cents per kilowatt-hour) to give the figure for display.

The intermittent clock readout, for two seconds at four-second intervals, actually gives the circuitry the time to do its pulse-counting. Thus there is a lag of a few seconds between the time a light or appliance is switched on and the time its share of total electricity consumption shows up on the LEDs. The clock, settable for 12-hour or 24-hour dis-



Monitor shows the amount of electricity in use at the moment anywhere in the house, translated into cents per hour at the rate the electric company charges. Figure shown, 2.7 cents per hour, indicates 771 watts of electric consumption at 3½ cents per kwh.



Entire device, except for transformers that act as sensors, mounts flush in wall, usually near thermostat, to make a total energy control center.

play, is regulated by the a.c. line frequency.

The monitor can measure current up to 300 amperes, more than most houses draw, with a maximum readout of 99.9 cents per hour. Accuracy is plus or minus 3 percent. Units are available for foreign electrical systems, and a version for large buildings, able to measure greater total amperages, will be out on the market soon.

Installing the energy monitor is said to be about as complicated as

putting in a doorbell system. It's a task the electrically-advanced do-it-yourselfer might attempt, but local codes may require hiring a licensed electrician, and the manufacturer suggests that a qualified person do the job.

A wall-hanging, rather than built-in, model, only 1 in. deep, is to be offered in the near future at the same \$125 price as the original version.

Savings depend on use

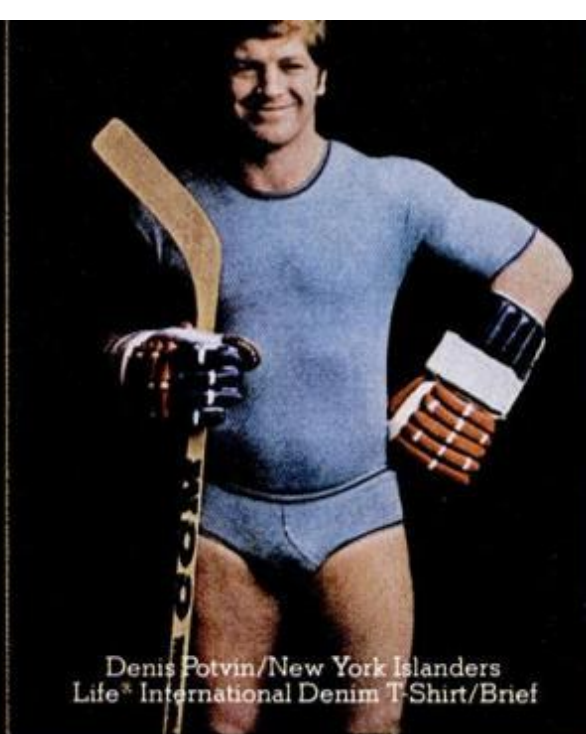
What about results? How much the monitor can save you depends on how—and whether—you use it. A rough estimate is that the device can pay for itself in eight months to a year under average conditions. If you live in an area where electricity is costly, and you teach the whole family to pay attention to this energy-speedometer, that payback time could be shortened. What about the electricity the monitor itself uses? Negligible. Cost of operation should average a modest 25 cents a year.

The Fitch Energy Monitor is \$125 postpaid from Fitch Creations, Inc., Box 111, Chapel Hill, N.C. 27514.

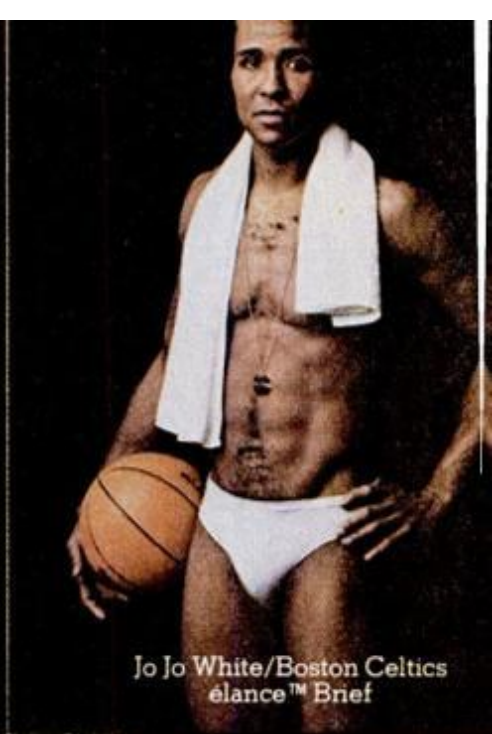
—Stephen Walton



Jim Hart/St. Louis Cardinals
Life® A-Shirt/Slim Guy Boxer



Denis Potvin/New York Islanders
Life® International Denim T-Shirt/Brief



Jo Jo White/Boston Celtics
élan™ Brief

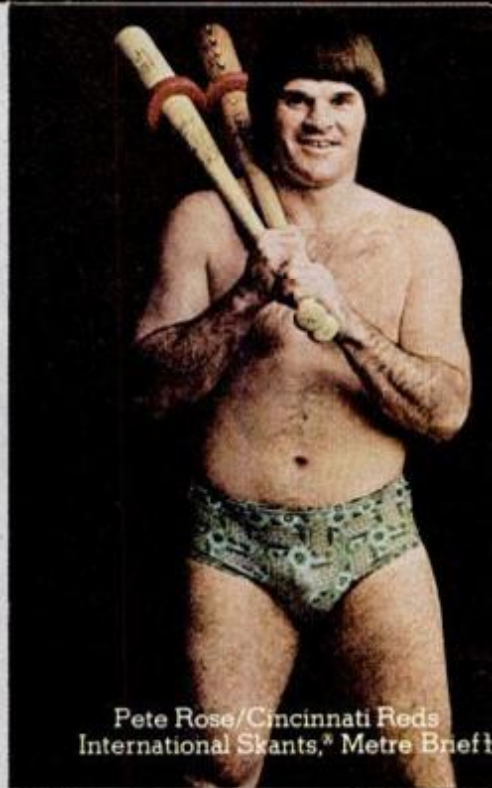


Steve Carlton/Philadelphia Phillies
Nylon A-Shirt/Brief

TAKE AWAY THEIR UNIFORMS AND WHO ARE THEY.

JOCKEY
INTERNATIONAL

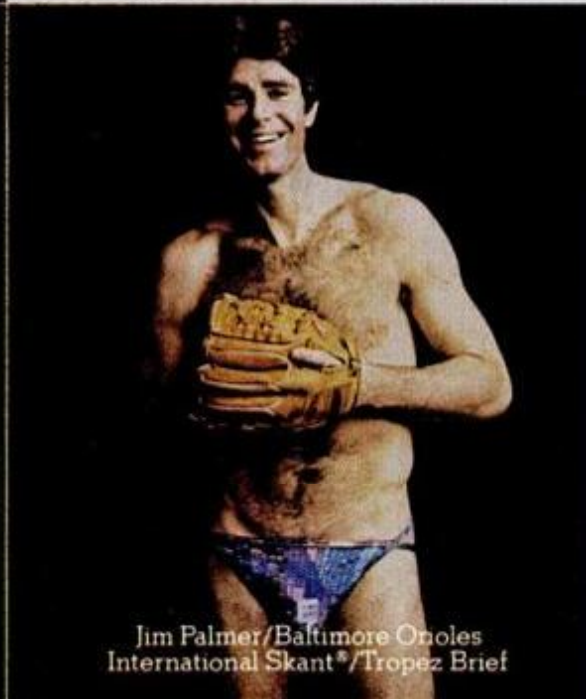
Jockey International, Inc., Kenosha, Wisconsin 53140



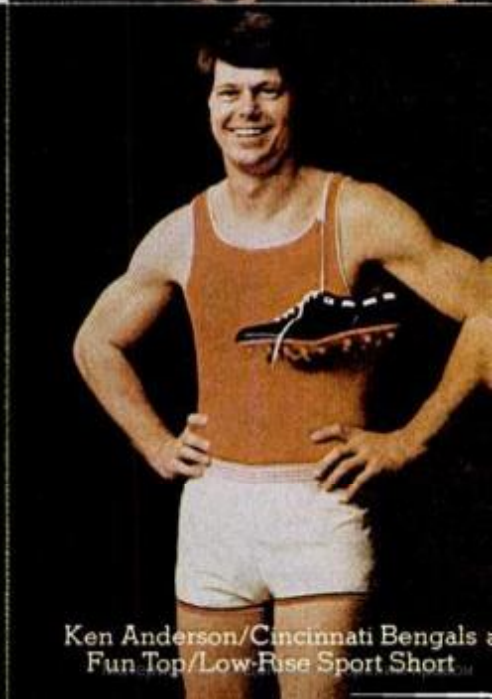
Pete Rose/Cincinnati Reds
International Skants® Metre Brief



Jamaal Wilkes/Golden State Warriors
Man-In-Motion™ Fun Top/Sport Short



Jim Palmer/Baltimore Orioles
International Skant®/Tropez Brief

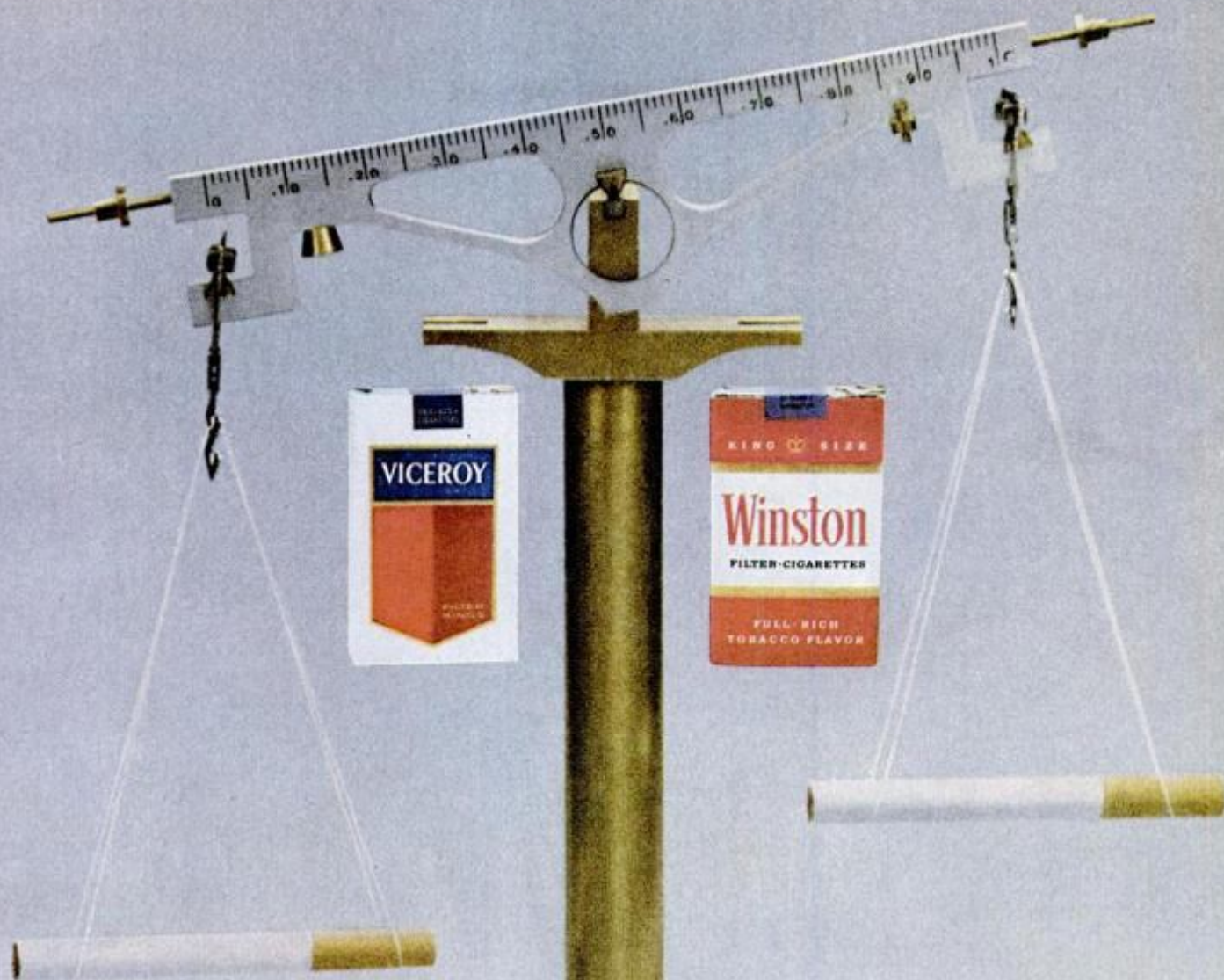


Ken Anderson/Cincinnati Bengals
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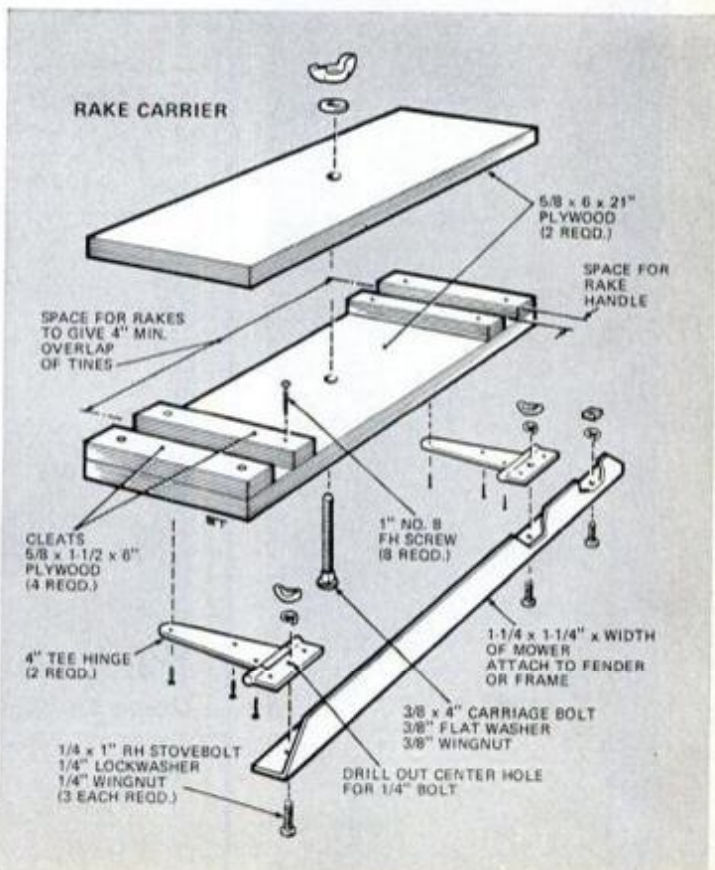
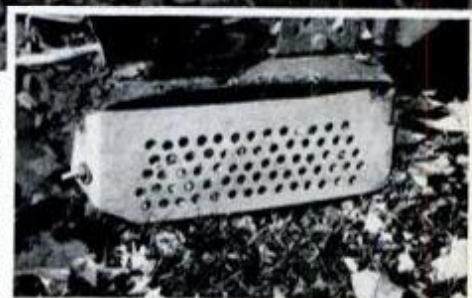
Homemade "power rake" speeds springtime cleanup of twigs and leaves. Handle clears fender of mower to permit dumping.

If your lawn is large enough to require a riding mower, these simple attachments will save you many hours of hand labor each fall and spring.

The leaf mulcher—an accessory *not* available for most mowers—is a plate fastened over the discharge chute that keeps leaves churning against the blades until thoroughly pulverized. It makes raking unnecessary. I used $\frac{1}{16}$ -in. sheet aluminum with $1\frac{1}{2}$ -in. tabs bent at the ends to allow mounting with $\frac{1}{4}$ x 1-in. roundhead stovebolts, with lock washers. Perforated plates work a little better than solid ones; you might try a piece of expanded metal instead of drilling $\frac{3}{8}$ -in. holes at $\frac{3}{4}$ -in. intervals as I did. Note that leaves will pulverize only when completely dry.

Rake-attachment details are at right. Use only good steel rakes with reinforced teeth, adjusted to ride at 30° to 35° to the ground. One handle is cut short; the full-length handle is lifted to apply pressure, lowered for dumping.—*Ralph S. Wilkes*

Contrast of background with area to be cleaned shows what mulcher add-on can do. In right photo it's held on mower deck with stovebolts. Holes are $\frac{3}{8}$ -in. dia.



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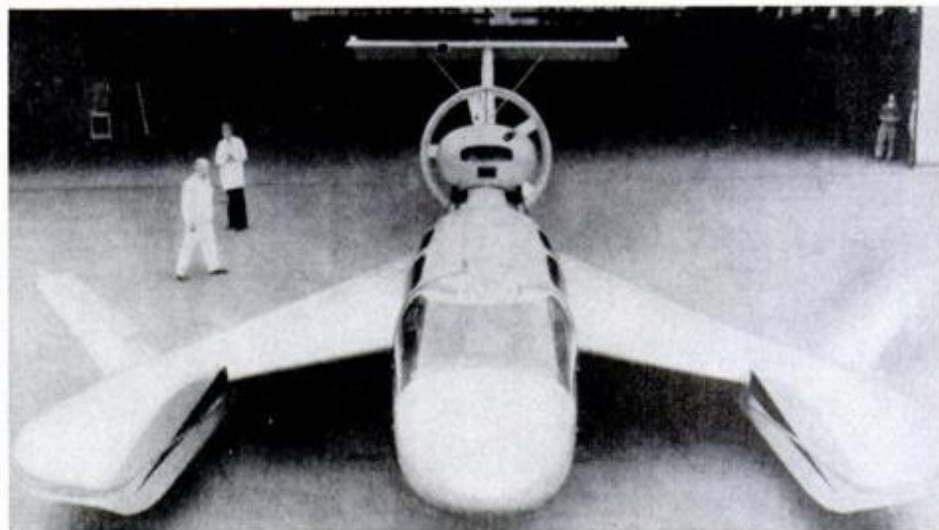
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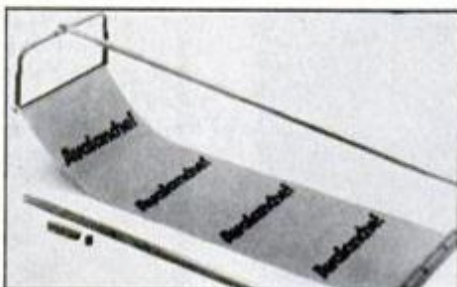


IT'S NEW NOW



Versatile 'what's-it' floats, hovers, flies

VW-Fokker's new X-114 six-seater airfoil boat took to its water-air medium in West Germany recently. The unique craft can float, hover a few inches above land or water, and fly like any normal airplane when it reaches higher altitudes.



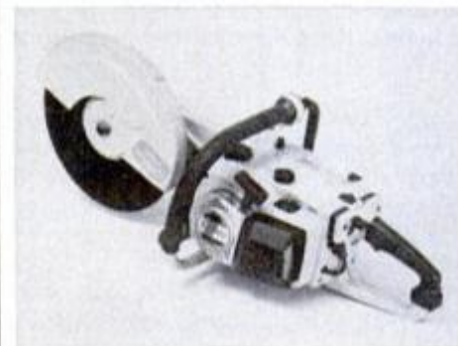
Roof snow-remover with a reach

Snow slides off the roof with this long-armed tool that operates from the ground. The Avalanche remover slips under the snow on wheels; snow chutes down a plastic slide. About \$35. Avalanche Co., 131 Burnside Pky, Burnside, Minn. 55337.



Quick switch for bowstrings

Bowmen in the field now can change worn or broken strings in two minutes. Pocket changer locks cord under tension. \$5.50. Bonnie Bowman, 1919 Abram Court, San Leandro, Calif. 94557.



Stone-metal-concrete slicer

New cutoff attachment for Echo chain saws enables owners of five models to make horizontal or vertical cuts through materials such as concrete, asphalt, stone, brick, steel and other hard metals, including cast-iron pipe. The 12-inch wheel is easily mounted. About \$100. Echo Div., Kioritz Corp., 350 Wainwright Ave., Northbrook, Ill. 60062.

ALL OUTDOORS

Where it's at

Today's successful outdoorsman—who gets in the least trouble and has the most fun—is often the one who has done his homework, knows where he's going, and is properly equipped and trained for it.

Recently, Dr. Abner Delman of Cardio-Metrics in New York City pointed this out while giving me a stress test to see if I was in shape to test snowmobiles above 10,000 feet in the Rockies. "Many people aren't in shape for sudden excessive outdoor exercise," he noted as I jogged up a steep motorized treadmill and he monitored electronic gauges showing oxygen consumption and heart and muscle condition.

"The smart sportsman will check with his doctor concerning his condition and the best program to get and stay in shape, since each person is different," the doctor advised.

Preparations are part of the fun.



World record of 26 adult water-skiers behind an outboard, a Johnson 175, at Cypress Gardens, Fla., tops Australia's 21.

Maps and charts can be ordered for study before a trip. Touring information is available from bookstores, libraries, tourist information bureaus and travel agents. Finding just the equipment you want, however, for your favorite form of hunting, fishing, camping, boating, off-road travel, hiking, climbing or skin diving isn't always easy at a local sporting goods store.

Mail-order suppliers like those in PM's general and classified advertising pages are one answer. Sources I've used include Eddie Bauer, Third and Virginia, Seattle, Wash. 98124; L.L. Bean, Main St., Freeport, Me.

04033; Eastern Mountain Sports, 1047 Commonwealth Ave., Boston, Mass. 02215; Herter's, Mitchell, S.D. 57301, and Recreational Equipment Co-op, Box 22090, Seattle, Wash. 98122.

But then there are those specialty items you've seen, heard about, or know must be available somewhere. Here are some leads:

■ You'll be driving a dusty off-road timber trail and don't want grit to get into your camera, film and binoculars. Or, you're planning a canoe trip and know there must be some way to keep your gear dry. Write Voyageur Enterprises, Box 512, Shawnee Mission, Kans. 66201. It has canoe, kayak and expedition Camp-Paks and Pak-Guards. They are extra-strength waterproof bags that can give extra flotation as well as keep you, gear and boat afloat if you flip or get swamped.

■ You've heard about Hovercraft, the machines that fly inches off the ground, water, marshes, whatever, and you'd like to know more about them and see some in action. Contact the HoverClub of America, Box 234, Uniontown, Ohio 44685.

■ A friend has found an ancient outboard motor in his uncle's barn and has asked you if it is a valuable antique, if it's worth fixing up, and where you could ever find the missing parts. Refer him to the Antique Outboard Motor Club, 1431 Kings-tree Lane, Houston, Tex. 77058. They might be able to help.

■ You're fascinated by old pleasure boats, have read all the great Chappelle books and the rest, and would like to see samples of the real thing? Places like South Street Seaport in New York City and the Mariner's Museum in Hampton, Va., have outstanding mementos of commercial shipping. But for small craft as well, make it a point to visit the Mystic Seaport, Mystic, Conn., and the excellent old examples at the Thousand Islands Shipyard Museum at Clayton, N.Y.

■ Want to go hunting but you don't know where you can go? The National Shooting Sports Foundation, 1075 Post Rd., Cos Cob, Conn. has a listing of many of the private shooting preserves available.

■ Hooked on muzzle loader shooting and have heard your state may have an extra season for the black-powder boys? (Every state allows muzzle loaders to shoot during regular seasons.) Connecticut Valley

Arms, Haddam, Conn. have supplied their dealers with lists showing the 29 states that have special muzzle-loading seasons, plus the addresses to get more hunting dates and details for every state.

■ Looking for a location for a canoe trip? See a Grumman Canoe dealer even if you don't want to buy one. He has lists of canoe rental outlets around the country, plus places to go.

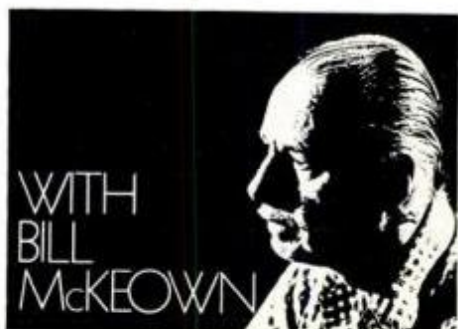
■ Heard about the great strength and lightweight advantages of DuPont's new Kevlar 49 Aramid and want to experiment with it instead of fiberglass? Or want Monel staples or spinnaker pole fittings or almost any other marine accessory? Try Defender Industries, 255 Main St., New Rochelle, N.Y. 10801.

■ Been collecting old fishing lures and want to sell or swap? The National Lure Collector's Assn., c/o Dr. John Goodwin, Box 71, Point Lookout, Mo. 65726, might put you in touch with other interested fishermen. They recently met in Dowagiac, Mich., home of the James Heddon's Sons Co., the country's oldest lure makers.

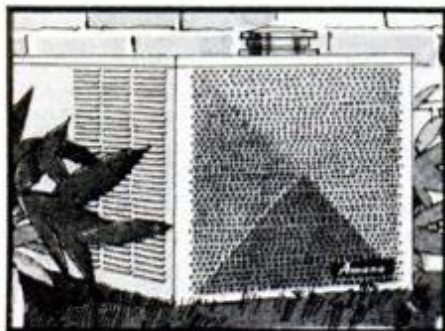
■ You remember a tip on pitching a tent, choosing climbing gear, installing a cabinet in an RV, building a scuba submarine. You read it in *Popular Mechanics*, but you can't recall just when. That's easy. PM's excellent Bureau of Information, 224 West 57th St., New York, N.Y. 10019, will have the answer.

What it's worth

Think you've been offered a good buy on a used boat but you're not quite sure. There's an expensive source book for dealers, but you can buy it too—and cut the \$35 cost by splitting it with friends or your boat club. The *BUC Used Boat Directory* lists 200,000 power and sail craft back to 1921, and can be ordered from BUC International, 1881 Northeast 26th St., Fort Lauderdale, Fla. 33305. ★★★



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For example, up to 26% in warm climates like Atlanta, Georgia. And up to 22% in

colder areas like Syracuse, New York and Minneapolis, Minnesota.

Reduces power consumption up to 25% for cooling.

Compared to a standard efficiency cooling system, the Amana High Efficiency Electric/Gas Cooling-Heating Unit can save you up to 25% on electricity. This figure is based on operation at the 95°F Air Conditioning Refrigeration Institute rating point.

This unit gives you true High Efficiency central air conditioning with extra high Energy Efficiency Ratios of up to 8.9 Btuh/watt. (The higher the EER, the more efficient the cooling system.)

The Amana High Efficiency Electric/Gas Cooling-Heating Unit is a one-of-a-kind energy saver. The kind of home comfort system that makes the most sense for today's energy environment.

Call your Amana home comfort dealer or write Amana Refrigeration, Inc., Dept. C-252, Amana, Iowa 52204 for further information.

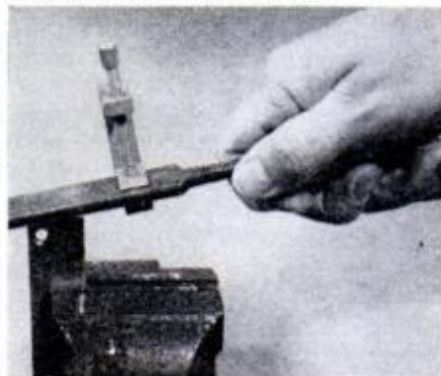
**Amana gives you
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HINTS FROM READERS

C-clamp hand protector



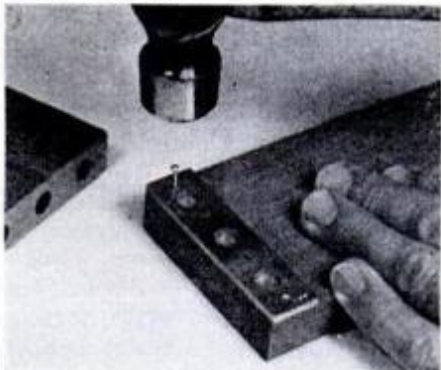
Prevent rapped knuckles when you sharpen with a file. Place a C-clamp in front of the handle to act as a stop in case you stroke the file too hard.—*Ken Patterson*

Silicone spray lubricates



To help pull an entrance cable through a conduit (90° elbow), lubricate it slightly with silicone spray. When line gets stubborn, repeat spray.—*G.S. Wing*

Doweling jig



For precise alignment of parts to be dowel-joined, make a simple jig. Tack it in place. Bore pilot holes so the attaching nails fit snugly and prevent plate movement when you drill for dowel holes. It's best to make the jig of bar stock, but plywood or sheet acrylic also work.—*Kenneth Wells*

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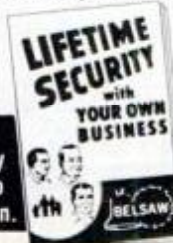
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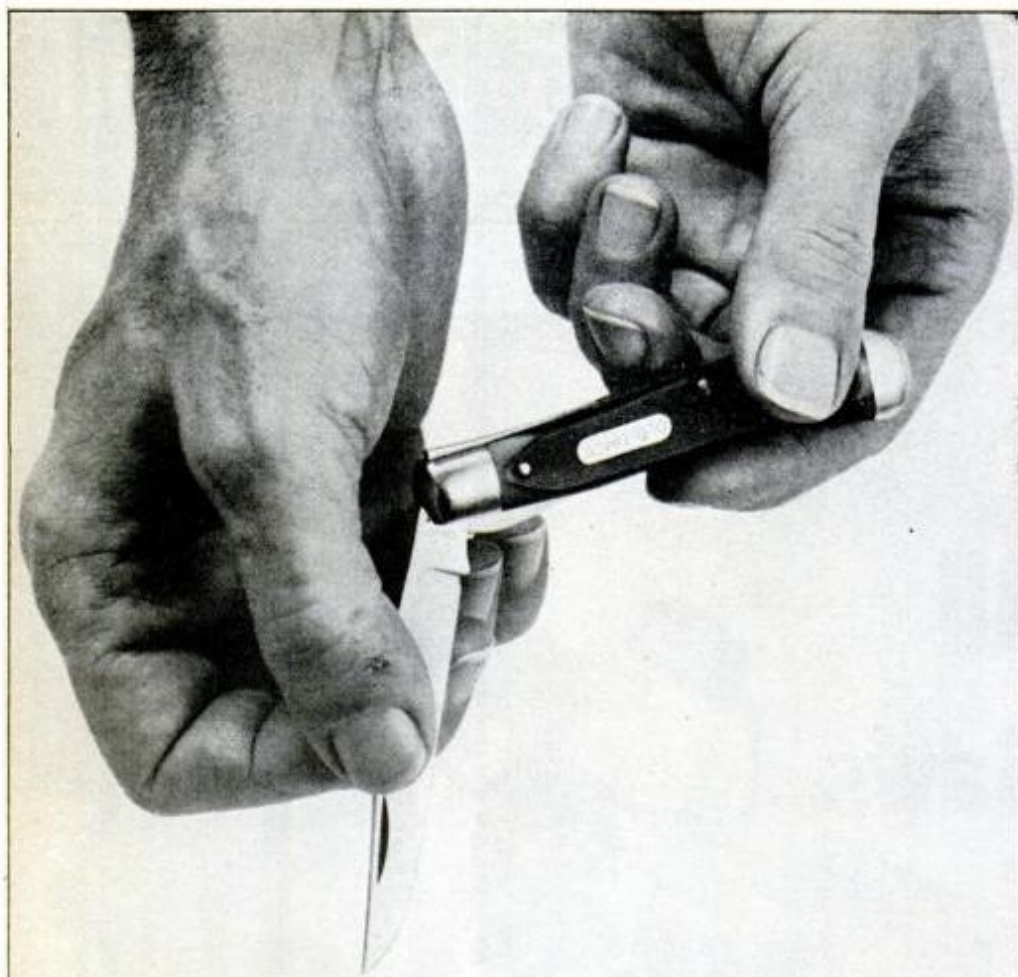
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 TRUE FALSE
- ③ You should always change oil when the seasons change.
 TRUE FALSE
- ④ As soon as your oil looks dirty, you should change it.
 TRUE FALSE
- ⑤ Oil can get "worn out" even if you haven't driven thousands of miles with it.
 TRUE FALSE
- ⑥ You need to put special "break in" oil in a new car.
 TRUE FALSE
- ⑦ The higher the viscosity grade, the thicker the oil.
 TRUE FALSE
- ⑧ When choosing a motor oil, you should consider the way you drive.
 TRUE FALSE

Turn the page for correct answers
and scoring instructions.



THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS BY THE EDITORS

Super switch

If you've abandoned dull family sedans for the joys of trucks and RVs, you're probably already tuned to the whole new world of hardware associated with these vehicles. Bolt-ing on grille guards and roll bars is easy, but installing auxiliary lights, winches and other electrical accessories takes a lot more savvy. Too



Warn Industries' Battery Isolator.

many owners learn the hard way about loading down an electrical system. One battery can't handle the load placed on it, so dual battery systems are the way to go. Even with a two-battery setup, however, you have to be careful. It's easy to jerk the juice out of both and be up the creek. That's why you should know about battery isolators. They let each battery be used and charged independently. The Warn Battery Isolator is an automatic solid-state device designed to eliminate voltage surges that could damage your alternator. \$22 to \$50. Warn Industries, 19450, 68th Ave. South, Kent, Washington 98031.—B.H.

Peek-a-goo

There's nothing like see-through underhood containers to make your



Golden Rod No. 480 See-Thru filter.

life easy. Hydraulic brake fluid, engine coolant, windshield washer fluid and other liquids can be checked in a glance when translucent reservoirs are used. And it's easy to check fuel and keep it clean with the Golden Rod No. 480 See-Thru filter. \$13.50. Dutton Lainson Co., Hastings, Neb. 68901.—B.H.

What's up, jack?

Getting out and getting under has always been an ordeal for car owners. Some home garages have pits, but most Saturday mechanics use a variety of contraptions to get under their cars, including crawlers, ramps . . . and don't forget the old bumper jack and cinder blocks. Better than these is this hydraulic lift with mechanical lock for safety. Ease and speed are the advantages of the Home Auto Lift, \$90 or \$165 for two. With two lifts, you can put four wheels in the air in three minutes. Jacking one side of the car, as



Home Auto Lift from Easy Lift Co.

shown here, lifts both wheels off the ground which makes radial-tire rotation a snap (since you don't criss-cross radials). Easy Lift Co., 185 Pleasant Way, Penfield, N.Y. 14526.—B.H.

Tilting trailer

Trailer your wheeled and track vehicles like dirt bikes and snowmobiles can be a hassle. You need new driving skills, you have to register, insure and maintain the thing, and so on. Then there's the problem of wrestling those bikes and snowmobiles on and off the trailer, usually with detachable ramps of some sort. Now you can eliminate the wrestling: The Bear Tilt Bed Kit is a trailer of 1100-pound capacity with 72x96-inch bed dimensions. The trailer pivots at the axle so you can run your vehicles right onto the bed, lash them down and take off. \$319; Bear Industrial Trailers, 4301 Bluffton Rd., Fort Wayne, Ind. 46809.—B.H.



Tilt Bed Kit by Bear Industrial Trailers.

Slop stopped

Spilled liquids around the garage are usually messy at best and dangerous at worst. Oil, solvents, anti-



Easy Flow Pour Spout.

freeze and other fluids make a mess, and acids and volatile liquids like gasoline threaten life and limb if mishandled. That's why it's important to have the right types of funnels and pour spouts around the garage. The neat feature of this spout is the cone-shaped head that fits snugly in openings up to 1½ inches in diameter. The flexible rubber spout reaches tight spots where funnels won't go. The Easy Flow Pour Spout can be found in many retail establishments, or send \$2 to Sal Rubber Products, 44465 Grand River, Novi, Mich. 48050.—B.H.

Get a whiff of this!

Maybe this isn't such an off-beat item for PM Garage. Who knows? Mr. Turt'e could become as well known here as Bibendum, the pneumatic man that Michelin uses as a trademark, is in France. Turtle Wax's Mr. Turtle freshens the air in your car with a bouquet of evergreen, lavender and apple, and that could be very welcome if one of the young'uns whoopsied in the car on your last outing. That's an extreme case of air pollution and would be a tough assignment for Turtle. Easy work are cars that reek of tobacco smoke. He's about \$2. Turtle Wax Inc., 5655 West 73rd St., Chicago, Ill. 60638.—B.H.



Turtle Wax Air Freshener.

ANSWERS

❶ FALSE

Where the crude oil comes from has very little to do with the quality of the finished product.

The key things that make one oil better than another are how well it's refined and the additives that go into it. Those are the things that make Shell's high-detergent motor oils good enough to meet and exceed all U.S. car makers' tough requirements.

❷ FALSE

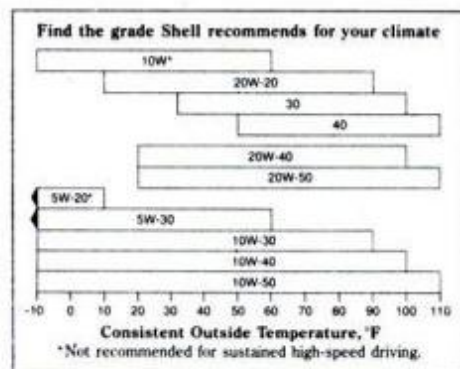
Changing brands is perfectly alright as long as the new oil meets the requirements for your car.

For U.S. cars and most foreign cars, that means an oil that meets API Service Classification "SE." You'll find the "SE" on every can of Shell X-100®, Shell X-100® Multigrade, and Shell Super X® 10W-50 Motor Oil.

❸ FALSE

A change in the temperature *might* require changing to a different viscosity grade of oil. It depends on what kind of oil is in the car.

Check the chart below to see what temperatures the different viscosity



grades will protect in. If the oil in your engine is okay for the temperatures you're expecting, ignore the seasons and change it as you normally would.

❹ FALSE

Just because your oil looks dirty doesn't mean it needs changing.

High-detergent motor oils like Shell's can hold about a pound of dirt in

suspension before they need changing. So don't rely on what the oil looks like. Stick to the oil change schedule in your owner's manual. Don't change more often — or less often — than recommended there.

❺ TRUE

Your owner's manual recommends changing when you reach a certain mileage or time, whichever comes first.

If you reach the time limit first, it probably means that you're doing a lot of short trip driving. That's hard on an oil. In a short trip the oil never gets fully heated, so sludge and acids build up faster.

❻ FALSE

Just run on the oil that came in your new car until your first oil change. Then put in the right oil for your car, climate and how you drive.

❼ TRUE

An oil with a low viscosity grade (like SAE 10W) will flow freely to help a cold engine start. An oil with a high viscosity grade (like SAE 40) is thick enough to protect a hot engine.

Multigrades do both. Shell Super X 10W-50 has the widest multigrade range you can buy.



❽ TRUE

How and where you drive determines how hard your oil will have to work.

If you want the advantages of a multigrade and do a lot of heavy-duty driving like trailer towing, try Shell Super X. Its 10W-50 rating is the

widest multigrade range you can buy. That means excellent high-temperature protection combined with good low-temperature startability.

YOUR SCORE

6-8: INFORMED

And that's good. Knowing the right answers can only help your engine.

3-5: AVERAGE

Chances are you have a few questions you'd like answered.

0-2: HAZARDOUS

What you don't know could hurt you. Or your car. Shell can help.

Get more money-saving answers in Shell Answer Books. Free.



At present the series includes *The Early Warning Book/The Breakdown Book/The Gasoline Mileage Book/The Car Buying and Selling Book/The 100,000 Mile Book/The Rush Hour Book/The Driving Emergency Book.*

They're 8-page, full-color booklets, packed with useful information about cars and driving. You'll get advice on automotive economics, guides for do-it-yourselfers, and facts to help make you a smarter buyer.

To get one or all, free, write Shell Answer Books, P. O. Box 61609, Houston, Texas 77208.

Come to  **Shell for answers**

IT'S NEW NOW



TV games

By plugging in optional cassettes, your home TV set provides a variety of games with a new entertainment center console. Cassette programs allow four to play at once, thanks to a four-function, 10-memory printing calculator. Sports, educational and strategy games available, with more added continually. For information on Bally Professional Arcade, write Robert Wiles, Midway Mfg. Corp., 10750 Grand Ave., Franklin Park, Ill. 60131.

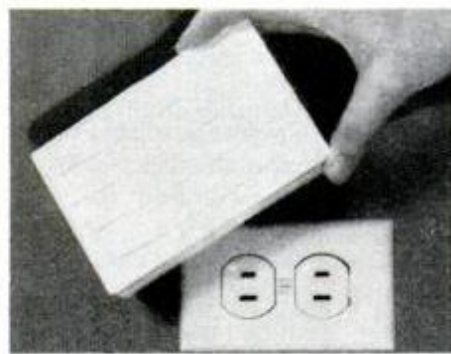


Shell trap for reloaders

Hunters who reload shells can now catch them in a Shot Shell Retriever holding 18 12-gauge cases in zippered pouch. \$9.95. Morris Mfg., 2001 North Henderson, Stuttgart, Ark. 72160.

Double-duty plug cap

It hides tempting outlets from youngsters; doubles the service with invisible receptacles cleverly concealed in the case. Cost is \$3.50. From Hide-a-Plug Co., Box 389, Toledo, Ohio 43691.



85-mph bathtub

Cast-iron bathtub on wheels, built by Tom Preacher at Southern Technical Institute, is powered by a motorcycle engine, has CB radio for pit crew contact. Tom logged 85 mph in tubmobile race.

600-foot optical ruler

Hold viewfinder to your eye like a camera, adjust focus, then read the scale and you have the precise distance between you and anything from 50 to 600 feet away. Under \$50. Ranging, Inc., 90 Lincoln Rd. N., East Rochester, N.Y. 14445.



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Start a career in Air-Conditioning, Heating & Refrigeration.

Well over a hundred thousand new technicians will be needed in the field of air-conditioning, refrigeration and heating by 1985. NRI can train you at home in your spare time for one of these career jobs.

Master course includes your own Air-Conditioner System for training

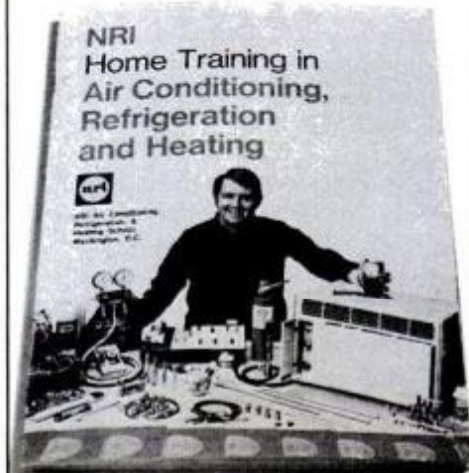
NRI's Master Course in Air-Conditioning, Refrigeration and Heating comes with a window air-conditioner for hands-on experiments. You get bite-size lessons, fine professional instruments and expert instruction every step of the way. A Circuit Demonstrator, Control Simulator, tubing and joint-making demonstrator, leak detector, and system analyzer are included.

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Graduates of the Master Course may take advanced work at the world-famous York Institute Resident School at no extra charge. You'll get practical experience equal to months of on-the-job work.

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Where do the pros get their training?

Almost half of the successful TV servicemen have home study training, and among them, it's NRI 2 to 1! A national survey* performed by an independent research organization showed that pros named NRI most often as the recommended school and as the first choice by far among those who had taken home study courses from any school.



Why? NRI's 62-year record with over a million students . . . the solid training and value built into every NRI course . . . and the designed-for-learning equipment originated by NRI are part of the answer.

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NRI training is aimed at giving you a real shot at a better job or a business of your own. You learn at home, with "bite-size" lessons. "Power-On" kits, designed to give you practical bench experience, also become professional instruments you'll use in your work.

Includes 25" Diagonal Color TV and Quadraphonic Stereo

As a part of NRI's Master Course in TV/Audio Servicing, you build a 25" diagonal solid state color TV with console cabinet. As you build it, you perform "Power-On" experiments that demonstrate the action of the circuitry. And, you



also build a 4-speaker Quadraphonic System! Instruments include a triggered sweep 5" oscilloscope, digital integrated circuit color TV pattern generator, a CMOS digital frequency counter, and NRI's electronics Discovery Lab. You get both TV and Audio training for hundreds of dollars less than the combined cost of courses at another school.

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. . . or you can learn Computer Technology with a real programmable digital computer; Citizens Band Radio; Communications; Aircraft or Marine Electronics; Mobile Radio, and more. Send the free postage paid card for our free catalog. See for yourself why the pros select NRI two to one! If card is missing, write to:



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*Summary of survey results on request.

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IMPORTS & MOTORSPORTS

Would you believe 69 mpg?

The VW Rabbit—fast, fun and functional with its gasoline engine—may become the hottest thing on wheels—outstripping the record and reputation of the venerable Beetle. Reason: It's such a darn good car to begin with, because GM "advertises" it as better than its Opel and because Chrysler too, endorses it, needing Rabbit drive-

back Rabbit that's also a safety vehicle designed to get you through a 40-mph head-on crash.

Living up to its name, the Rabbit has a few offspring in advanced stages of gestation. A convertible is about to be born, and the maternity ward at the new VW plant in Pennsylvania is rumored to be getting ready for production of a diesel-powered pickup truck version of the Rabbit.

Stalking the good life

The Peugeot logo is a lion, but the 604, like the fog, comes and goes on little cat's feet . . . smoothly, stealthily and so subtly you hardly know it's there. When you've got it (\$13,000) and don't want to flaunt it, this is the car; when, at last,



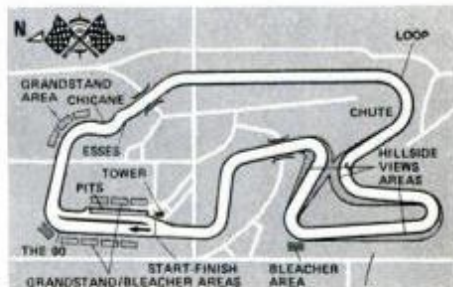
Driver's-eye view of the Peugeot 604.

you've achieved the means to motor through life in the lap of luxury, this is *the* car; when you're mature enough to go motoring minus the macho, this is *Le Car!*

I spent two weeks cradled in the comfort of this V6 French feline and found it like traveling incognito: It's the *only* luxury car that isn't styled to call attention to itself. Using alternately, the electric sunroof or the airconditioner, depending on the temperature, and sunk in the rich leather, I cruised through village and dale enjoying my first opportunity to drive this car since it was introduced here (see *Imports & Motorsports*, page 98, Aug. 75). I found the steering wheel position uncomfortable, acceleration slow getting off the line (with the automatic transmission) and the engine compartment crowded (it's the first time I needed the owners' manual to find the dipstick!). But all that's mewling and nitpicking because the 604 is . . . the cat's meow.

Go, go, Mario!

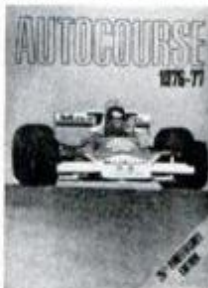
This may be a very exciting year for fans of Grand Prix racing, but not as exciting and dream fulfilling



U.S. GP is at Watkins Glen Oct. 2.

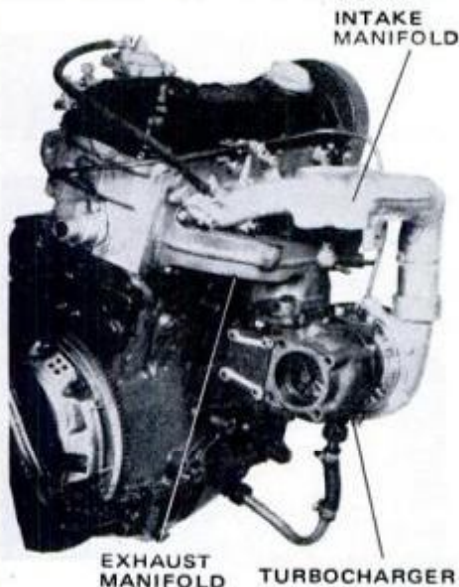
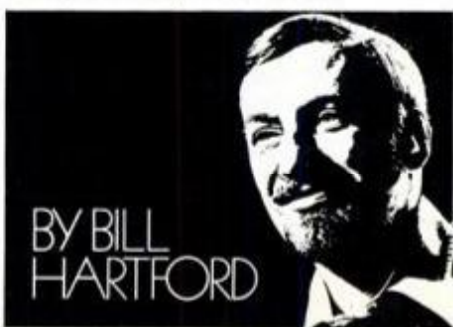
as it would be for Mario Andretti—in third place at this writing, close behind Jody Scheckter and Niki Lauda. To become World Driving Champion is more important to Mario than any other achievement. It would mean more to him, says he, than his '69 Indy win. For we fans, to have Mario 1977 World Driving Champion would mean an American world champ for the second time ever, the first and only being the affable Phil Hill in 1961. There have been wins for Dan Gurney (4), Peter Revson (2) and Richie Ginther (1), but no performances to rival Mario's this year in his Colin Chapman Lotus.

The competition is as close this year as it was last when James



Hunt's championship wasn't decided until the last race in Japan (which Mario won). This year the super scenario would have Mario winning the championship with a win at

Grand Prix book. Watkins Glen Oct. 2. The first U.S. GP at the Glen, by the way, was in 1961, the year of Phil Hill's championship. If you're really into statistics, lap records, DNF reasons and so on, the book to have for race-by-race GP facts is *Autocourse*. It's \$23 and published in February following each season. Motorbooks International, Box 2, 729 Prospect Ave., Osceola, Wis. 54020. ★★



Volkswagen's turbocharged diesel engine.

trains to run its new Omni and Horizon cars. The clincher in its success story will surely be VW's diesel-engine program. The demand for diesel Rabbits, which went on sale this past summer, is running high, and already VW has announced a second generation engine that will surely see production: a turbocharged version. A turbocharged diesel-powered Rabbit (with five-speed transmission) gets 69 mpg highway, 55 mpg city and 60 miles per gallon combined. Flat out, say VW engineers, it gets only 21 mpg, but at a steady 30 mph



VW Rabbit convert with removable roof.

it's good for an incredible 80 mpg. It's experimental right now and powers a Rabbit that has just been sold to the U.S. Department of Transportation. Called the IRVW for Integrated Research VW, the car is basically a two-door hatch-

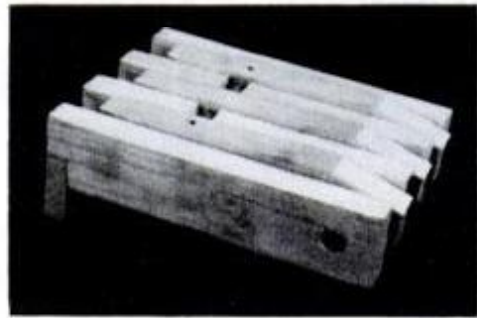
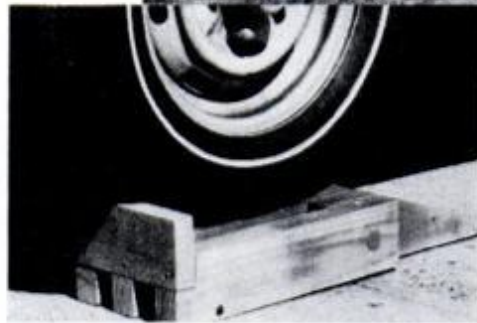
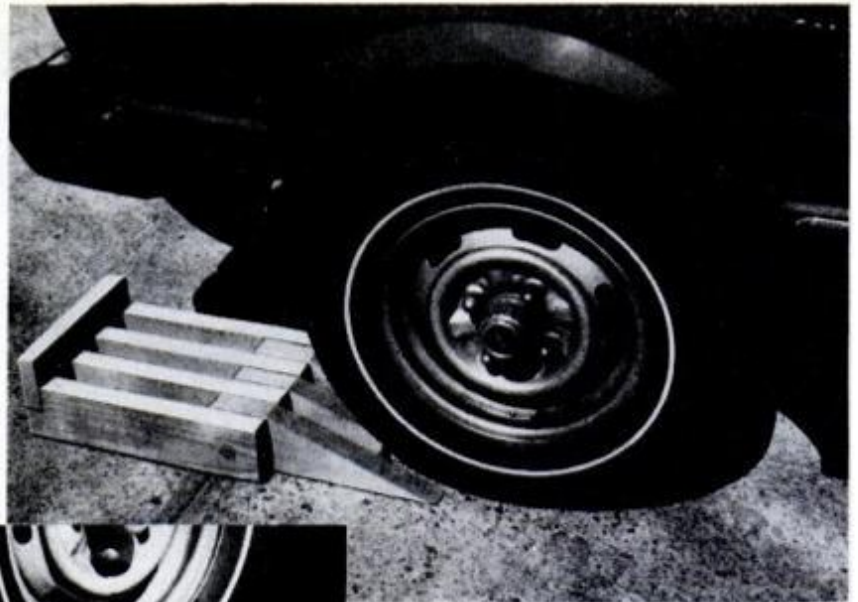
Build your own folding car ramp

When you service any car, a pair of car ramps has the advantage of safety as well as convenience over the usual wedge-under-a-board setup. Those shown were made with stock 2x4s, perfect for the job.

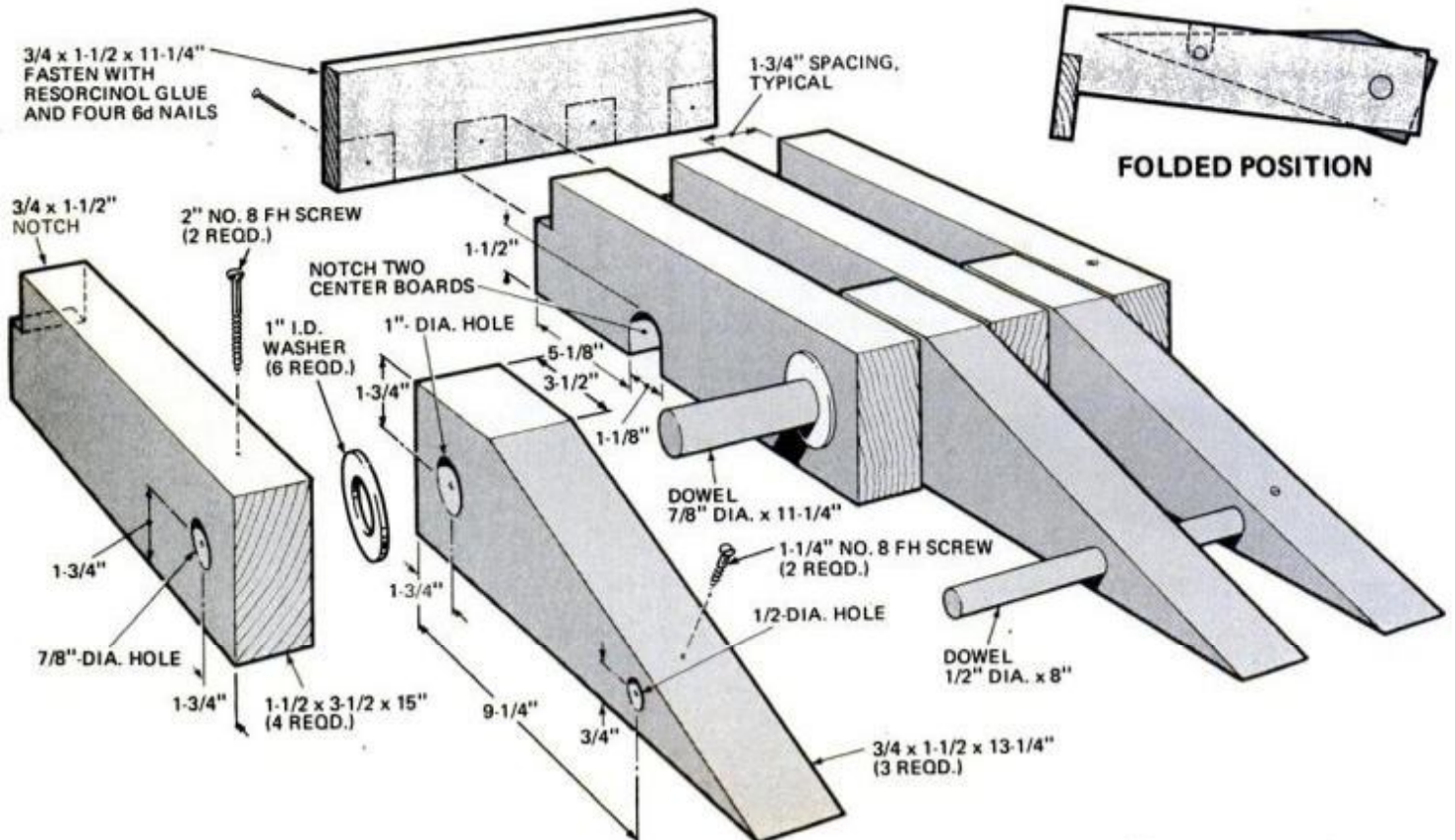
Mark and cut out the eight wood pieces needed for each ramp. Cut a notch to hold the end crosspiece in each 15-in. length. Then notch center boards to accept the smaller dowel when the ramp is folded. Bore the 7/8-in.-dia. holes for the larger dowel in these and the angled wood pieces. Locate and bore 1/2-in.-dia. holes for the smaller dowel.

Assemble the pieces as shown using washers on the larger dowel. Fold to test for sufficient clearance in the "hinge" and respace the pieces on the dowel if necessary. Secure the dowel with screws. Fasten the end crosspiece in place. Then insert and secure the smaller dowel.

Have a guide direct as you drive up the ramps. Apply the parking brake and place stones behind the rear wheels.—*P.J. Howerton*



Time for an oil change? Ramps make it easier to slide under your car and work. They fold for easy, compact storage.





Come to Marlboro Country.



**Marlboro Red or
Longhorn 100's—
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18 mg. "tar," 1.1 mg. nicotine av. per cigarette, FTC Report Dec. '76

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

Trumpeter Mountain, British Columbia, Canada

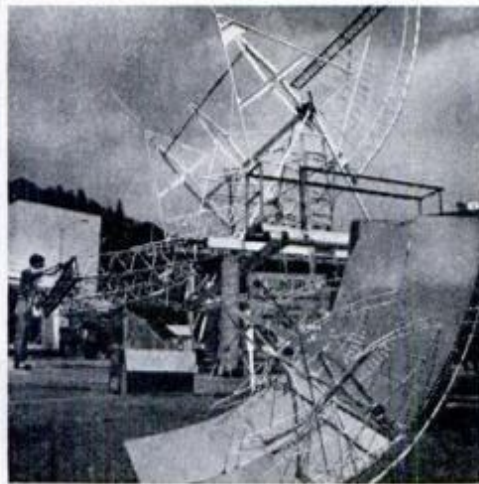
Canada at its best.

Enjoy the light, smooth whisky that's becoming America's favorite Canadian.
Imported Canadian Mist®

Share some tonight.



IT'S NEW NOW



"Sunfire" power for Pitcairn

Using parts from old military aircraft, cars and other scrap, Pitcairn Island students are building a giant sun-tracking solar collector. Final unit will produce steam to drive generators to power island. U.S. Jet Propulsion Lab is advising.

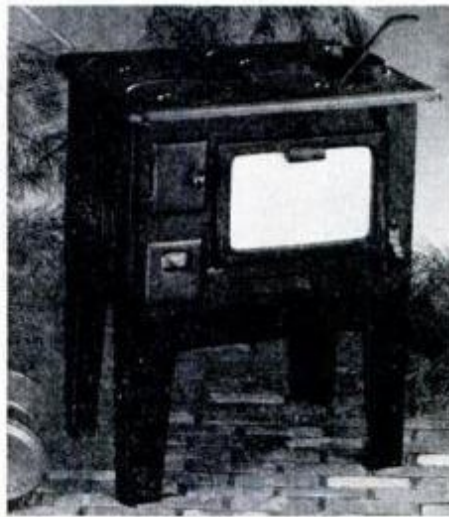


"Beep-beep, over here..."

If your R/C model lands in the rough, this 1½-inch, one-ounce Remocall puts out a signal audible hundreds of feet to your receiver. Just follow the sound to the plane. \$25. Model Rectifier Co., 2500 Woodbridge Ave., Edison, N.J. 08817.

Cooktop woodburner

Besides space-heating, a new version of an old ranch stove has an oven and a cast-iron top for cooking (the rest is sheet steel). \$147 from United States Stove, South Pittsburg, Tenn. 37380.



Ten-ton split

Portable log splitter with a single stage hydraulic pump delivering 10 tons of splitting force features semi-pneumatic tires and pin-type hitch on I-beam frame for hauling it to and from work sites. Four-hp gasoline engine drives ram. Model shown (LMF) takes 19-inch-long logs; has a 25-second cycle-time. \$555. Didier Mfg., Box 163, Franksville, Wis. 53126.

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Here's a new way to get authentic goods from the North Country... items that are not readily available in local stores.



Imported
Canadian Mist
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Chamois Cloth Shirt. Long sleeves and long tuck-in tails. (Ladies' has squared tails.) Warm, durable and machine washable. Colors: Forest green, Tan, Navy, Bright red. Men's sizes: 14½ to 19. Ladies' sizes: 10 to 20. \$12.50



Early American Trapper Blanket. 85% wool, 15% nylon for durability. 72" x 90". Machine washable. Patterns: White with candy stripes, Red with black stripes, Green with black stripes. \$26.75



Old-fashioned Scarlet Union Suit. For active outdoor men and women. Duofold soft cotton inside with wool, cotton and nylon outer layer. Sizes: 34-36-40-44-48. \$17.50

Special Offer: Include Canadian Mist® cap liner (except ½-gal./1¼ liter) and deduct \$1.00 from each order. (Offer valid only in states where legal—not CA, KY, MD, ME, MO, NJ, OR)

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 P. O. Box 637 Brunswick, Maine 04011

Don't electrocute your car battery



Make this under-\$10 gadget that tells what's going on in your electrical system.

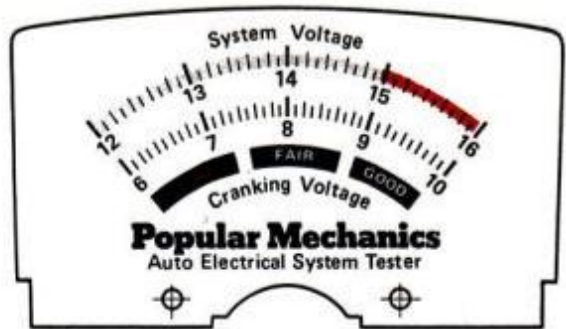
by Jeffrey Sandler

The ammeter supplies more useful information at a glance than any other instrument in your car. Unfortunately, the ammeter is going the way of the passenger pigeon.

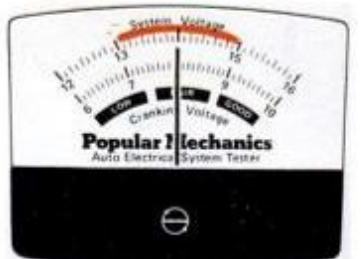
You are driving blind when you rely solely on warning lights. If you really want to know what's going on, build the auto electrical-system tester. This simple meter plugs into your car's cigaret lighter and supplies all the information of an ammeter and some extra.

An auto battery isn't just a black box that puts out exactly 12 volts until it dies. During normal car operation, it may vary from 12 to 15 volts depending on whether it is being charged or discharged. Hidden in small voltage shifts is plenty of information about the electrical system. A single volt can be the difference between

(Please turn to page 70)

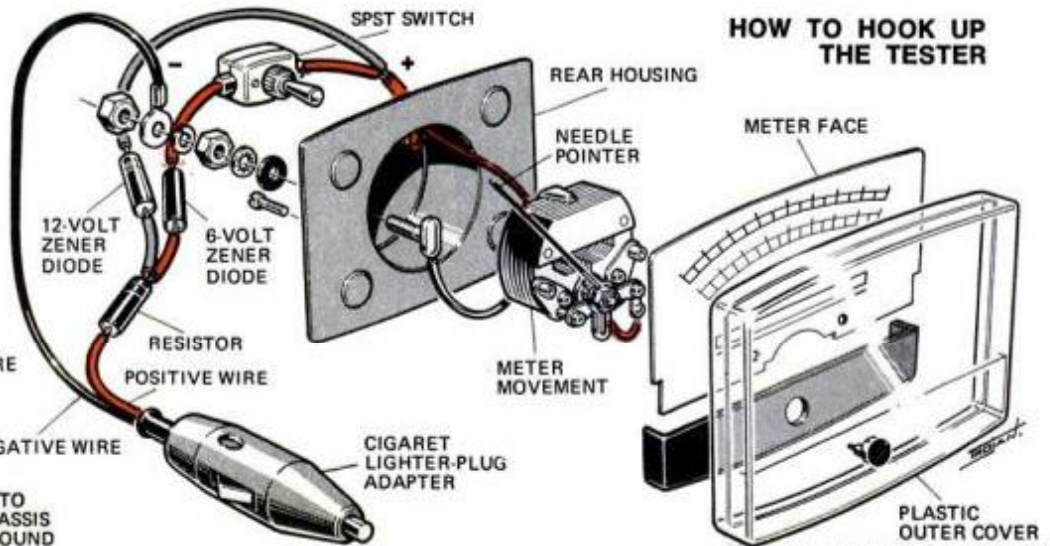
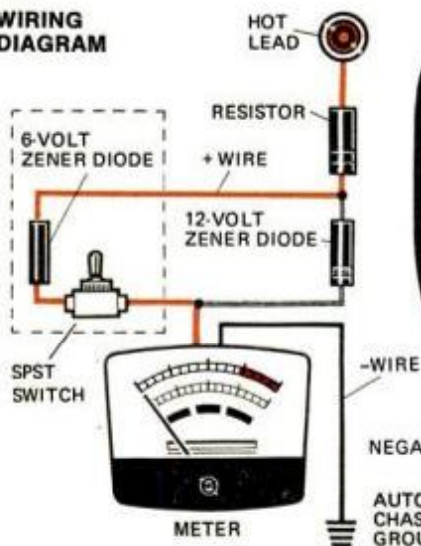


Customize your tester. Pop the clear cover from a Radio Shack 0-1 millamp. No. 22-052 meter. Paste on the exact-size replacement face (above). Don't bend the pointer needle.

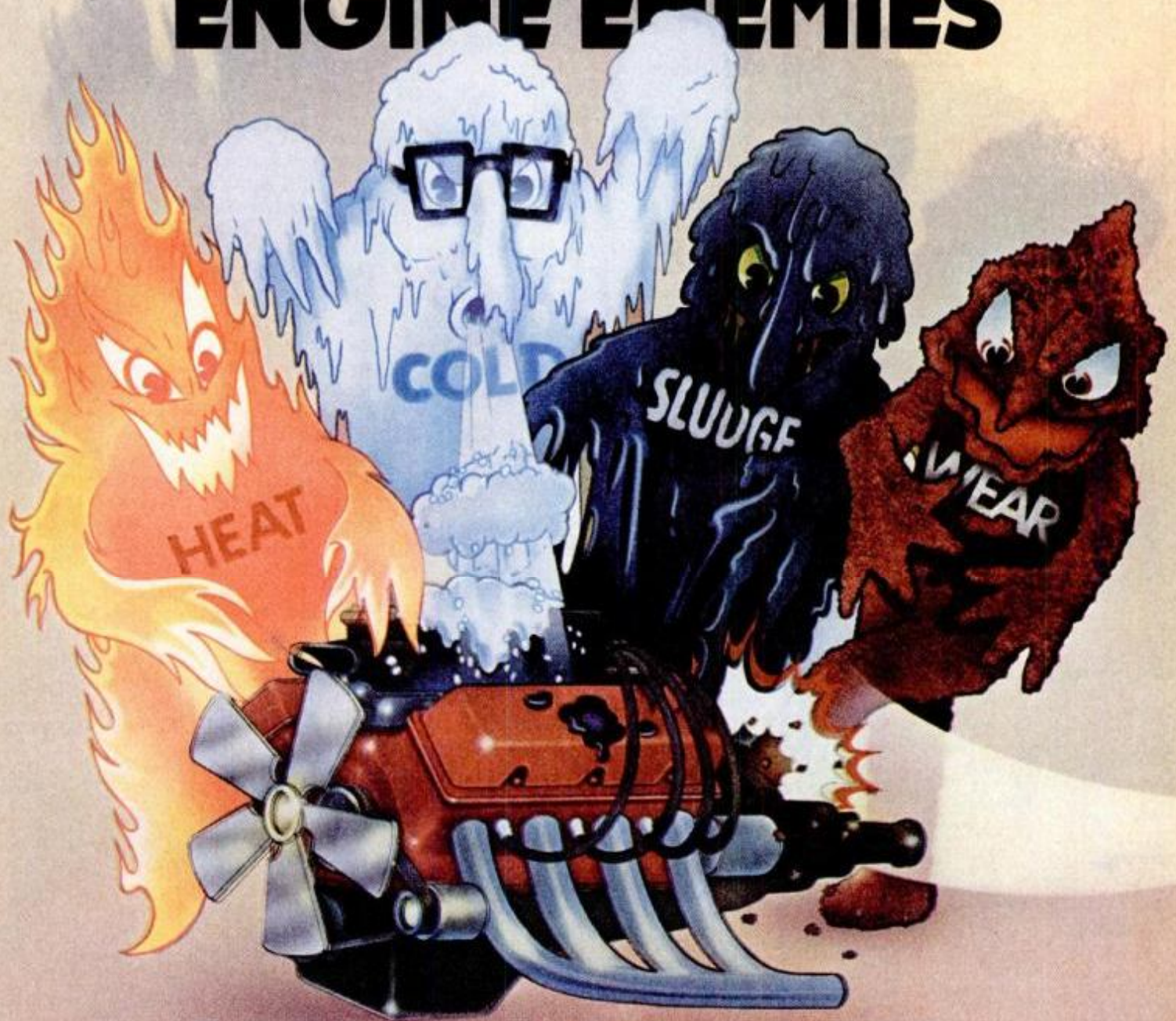


Test readings: 12-12.8 (top left) normal volts with no use of battery; 12.8-13.8 (top right) undercharging, fast idle; 15.1-16 (middle left) overcharging, fast idle; 12-12.6 (middle right) engine off but lights on; 12.1-13.9 (bottom left) generator car at idle; 13-15 (bottom right) alternator car at idle.

WIRING DIAGRAM



STP MOTOR OIL FIGHTS ENGINE ENEMIES



FOR 15,000 MILES BETWEEN OIL CHANGES.

Your engine needs protection from engine enemies — wear, sludge, heat and cold. And STP Motor Oil gives your engine the protection it needs to fight engine enemies for 15,000 miles between oil changes... 15,000 miles or one year, whichever comes first,

under normal driving conditions. That's extra protection. That's STP Motor Oil.

STP Motor Oil is a specially formulated 10W-50 all-season oil. It has been laboratory tested, and proven for hundreds of thousands of miles in cars like yours. Now you can



buy STP Motor Oil in stores near you. Get 15,000 miles of protection — that's extra protection. Get STP Motor Oil.

**STP Motor Oil.
It keeps on fighting
for 15,000 miles.**

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New ideas to help you do more with the products you have around the house.



3-IN-ONE Household Oil
Makes things work better... last longer

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PREVENTS RUST & TARNISH

WINDOW MOVER!

STICKY WINDOWS SLIDE EASIER IF YOU PUT A FEW DROPS OF 3-IN-ONE HOUSEHOLD OIL ON THE RUNNERS. GREAT FOR SLIDING DOORS, TOO.

TAR REMOVER!

VERSATILE 3-IN-ONE HOUSEHOLD OIL ON A RAG DISSOLVES ROAD TAR FROM CAR BUMPERS, FENDERS & ROCKER PANELS. WON'T HARM PAINT OR CHROME

APPLY IT!

NEXT TIME YOU USE A SAW, WIPE 3-IN-ONE HOUSEHOLD OIL ON THE BLADE. YOU'LL BE AMAZED HOW IT MAKES SAWING EASIER, FASTER.



TRY IT!

TRY PUTTING A DROP OF 3-IN-ONE HOUSEHOLD OIL ON SCREWS AND NAILS. THEY GO INTO WOOD A LOT EASIER.



BUY IT!

GET A CAN FOR YOUR BICYCLE. 3-IN-ONE HOUSEHOLD OIL ON WHEEL AND PEDAL BEARINGS, SPROCKETS AND CHAIN MAKES PEDALING EASIER.

CAR-BATTERY CHECKER

(Continued from page 68)

a running car or one stuck somewhere with a fried battery.

Let's change the scale on a meter to spread the range of 12 to 15 volts over its face. Use a meter which normally reads 0 to 1 milliamp. (Radio Shack No. 22-052; \$6.95) to display the automobile's voltage.

Our electronic trick is to get the meter to display a voltage range between 12 and 15. To make our magic, we'll use a *zener diode* (Radio Shack No. 276-563; 89 cents) that will not conduct any electric current until there is a certain voltage across its leads. Our expanded meter will not indicate until voltage reaches 12. Then it reads correctly from 12 to 16 volts.

You'll also need a cigaret-lighter plug (Radio Shack No. 274-331; 89 cents) and a 3900-ohm resistor (19 cents).

In a properly working car, before the car is started, with everything turned off, the meter reads about 12.5 volts. Open a car door and the meter will drop a notch due to the current drain of the dome light. The meter falls below 12 when the engine is cranked due to the tremendous current drain of the starter. The battery can fall as low as 9 volts. Remember, our meter scale starts at 12 volts.

At low rpm, generating is greatly reduced, sometimes below the needs of the car. The battery makes up the difference. The meter can fall below 12.5. Don't let your car stay in this high-current-drain state very long. Alternator-equipped cars, which generate more when their engines are idling, are less prone to have such voltage fall-off.

After an hour of driving the battery is fully charged. When the engine is shut off, the meter might read 13.8, but over several hours will drift back to 12.5.

Here are pitfalls to avoid:

Dead meter

If the meter is below 12.8 and doesn't move in response to changes in engine speed, don't sit there and watch the needle fall. Get the car off the road immediately. But, don't shut off the engine yet. Check to see if your fan belt is broken. If so, stop the engine right away.

If you have an intact fan belt, the charging system is dead and the battery is powering the electrical devices in the car. The coil is the first thing to die as the battery runs down. Don't waste time. Turn off all electrical accessories and head for the nearest service station.

At the service area, check to see if the alternator or generator is putting out juice. If it is, check the voltage regulator. Finally, check to



A one-piece plug-in version of the auto electrical system tester is made by taping or gluing the cigaret lighter plug onto the back of a smaller 0-1 milliamp. meter.

Once the car is started, the generating system supplies its electrical needs. System voltage is brought up to 14 to 15 volts.

Around 14.5 volts the battery will charge up enough to replace what is withdrawn without overcharging or undercharging. As you drive, the meter hovers between 14 and 15 volts regardless of electrical accessories turned on. Some cars fall to 13.5 to 14 volts as regulating circuits warm up with the engine.

see if there are any loose connections in the wiring.

Loose belt

If heavy electrical use makes the meter drop below 14 to 15 when the engine is going faster than idle, watch out. In severe cases, the meter never reaches 14 or 15 volts.

As the generator or alternator is called on to deliver more power, it drags harder on the fan belt. A loose

(Please turn to page 190)

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Great saving! Easy doing!

EMPEROR'S MODEL 120-K DO-IT-YOURSELF CASE KIT

SOLID 3/4" BLACK WALNUT

104⁵⁰ FACTORY DIRECT SALE PRICE

When purchased with movement (extra).
Or, case kit alone \$114.50
Reg. Factory Direct \$149.50

COMPARE YOUR FINISHED CLOCK WITH THOSE RETAILING UP TO \$850.

SAVE NOW... BELOW FACTORY DIRECT PRICES

Build your own Emperor grandfather clock! The saving is great because you buy direct from the factory of the world's largest manufacturer of grandfather clock case kits. . . no middlemen, no salesmen. And if you order today, during this limited-time sale, you can build Model 120-K at a cost below our regular factory direct price.

MODEL 120-K IS PRE-CUT, EASY TO DO

The doing is easy with Emperor's Model 120-K. It comes to you in easy-to-assemble kit form, with all pieces completely pre-cut from highly-prized solid 3/4" black walnut. All kit pieces pre-sanded smooth on all sides for accurate fit. All miters, mortises and tenons pre-cut. (For those who prefer, kits may be ordered unmitered.) Divided swan neck and finial, waist and dial face doors, dial frame and sculptured basefront pre-assembled. Complete assembly instructions and all hardware included. No woodworking experience or special tools needed. Each piece may be reordered separately.

DETAILS AND FEATURES OF MODEL 120

- Stands a full 6'2" tall
- Four full-turned hood columns
- All frames dowel constructed
- Built-in floor levelers
- Deluxe brass-finished hardware and more

MONEY BACK GUARANTEE

If for any reason you are not completely satisfied, return in original shipping carton within thirty days for prompt refund. . . no questions, no excuses.

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Made in West Germany of Solid Brass

EIGHT DAY • WEIGHT DRIVEN • WESTMINSTER CHIMES

Choose from two dial versions of Emperor's 100-M movement: Tempus Fugit (Time Flies) or Moving Moon with lunar calendar. Both versions sound the Westminster chimes each quarter-hour and a Big

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MOVEMENT CARRIES A ONE YEAR WARRANTY

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	13238	Model 120-K Solid 3/4" Black Walnut Do-It-Yourself Case Kit with purchase of either movement (priced separately below)	49	\$149.50	\$104.50	
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	11463	Model 100-M Movement complete with Tempus Fugit Dial, Westminster Chimes for Model 120-K	33	\$119.50		
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Model 120-K
Solid 3/4" Black Walnut
74" x 16-3/4" x 10"



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WORLD'S LARGEST MANUFACTURER
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VISIT OUR FACTORY SHOWROOM MON.-FRI. 8 A.M. TO 5 P.M. EMPEROR INDUSTRIAL PARK, FAIRHOPE, AL.

INTRODUCING THE DEPENDABLE MERCURY BLACK MAX V-6 OUTBOARDS FOR 1978.

OUTBOARD ENGINEERING TO
RIVAL THE MOST DISTINCTIVE
STANDARDS OF AUTOMOTIVE
ENGINEERING.



*One of these symbols is famous
the world over for the ultimate in
automotive engineering achievement.*

*The other is carving out the
same excellent reputation in out-
board engines.*

*Black Max. Symbol of the new
Mercury® Black Max Series of out-
boards with compact 60° V-6 design.
The meanest, toughest, most beautiful
machines we've ever built. And the
most dependable.*

SIX YEARS IN THE MAKING.

The Black Max concept goes
back to 1971, when Mercury engi-
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V-6. The basic powerhead
now used in Black Max was initially
developed for this engine. The
racing version operates in the 8,000
to 9,000 rpm range and develops
250 horsepower.

On the rugged racing circuits,
this engine proved its performance,
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winning 18 straight races.

THE NEW BLACK MAX® SERIES.



V-1500 150 HP

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V-1750 175 HP

**ENGINEERING WITH A
PURPOSE: PERFORMANCE
PLUS DEPENDABILITY.**

From this beginning, through

six years of refining, testing and
proving, the first production model
of Black Max came into being.

Today there are three Black
Max outboards, representing the

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highest standards of engineering excellence in performance, dependability and durability for long engine life.

**60° V-6 ENGINE DESIGN:
MORE POWER IN LESS SPACE.**

The Black Max engines are exceptionally compact for V-6 engines in their horsepower range. We set the cylinder banks 60° apart instead of the usual 90°, resulting in an engine that is slimmer, lower and 36 pounds lighter than comparable V-6 outboards.



**GREATER EFFICIENCY WITH
LOOP CHARGING AND
POWER-PORTED PISTONS.**

Loop charging uses two opposing intake ports in the cylinder wall. The fuel/air mix, or "charge," collides and "loops" to fill the chamber.



At the same time, a third port in the piston itself pushes additional fuel/air mix into the chamber at right angles to the other ports.

The result is better engine performance utilizing the maximum charge of fuel/air mix. You get faster acceleration, more pulling power, and easy cruising on less fuel.

**IGNITION TUNE-UPS ALL
BUT ELIMINATED.**

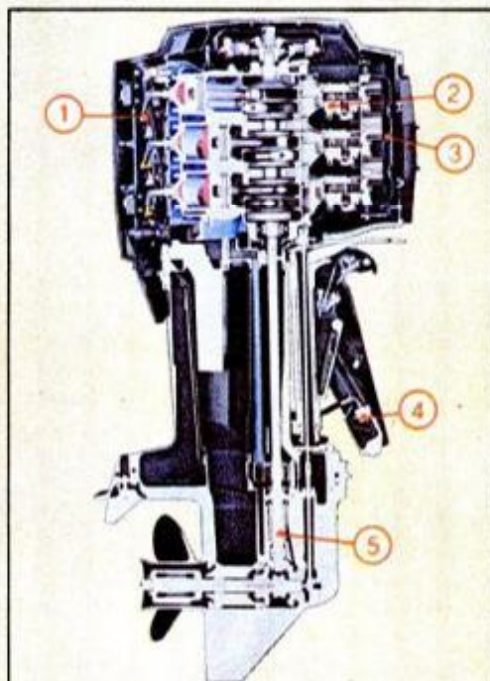


Thunderbolt® CD sealed ignition creates a spark so hot (up to 40,000 volts) it burns away combustion by-products. The Perma Gap® spark plugs have a short electrode positioned in the middle of a circular electrode.

So even if a bit of fouling should occur, the spark can fire hot and clean on any other part of the circle. And Perma Gap spark plugs last not just for months, but for seasons.

With Thunderbolt sealed ignition and Perma Gap plugs, you get quick starts and smooth running, and you spend more time on the water and less in the shop.

**THE MEANEST, TOUGHEST
MOST BEAUTIFUL MACHINE
WE'VE EVER BUILT.**



(1) Thunderbolt CD sealed ignition for reliability — separate coil for each cylinder — separate ignition system for each bank of cylinders — there's no distributor. (2) Three dual-throat carburetors for better fuel distribution — one barrel for each cylinder. (3) Computer-tuned air intake silencer for a quieter operating engine. (4) Built-in Power Trim adjusts boat attitude for greater efficiency, economy and smoother ride. (5) Stainless steel shift shaft, drive shaft and prop shaft to combat corrosion.

**A BACK-UP SYSTEM TO KEEP
YOU GOING: INDEPENDENT
ELECTRONIC IGNITION
SYSTEMS FOR EACH BANK
OF CYLINDERS.**

The Black Max V-6 engine has two banks of three cylinders. Each cylinder bank has its own independent ignition system, consisting of separate solid-state switch boxes, circuits, and coils. Should one system fail to operate, the engine will continue to run on the other bank, so you won't be stalled on the water.

**REMARKABLE FUEL
ECONOMY WITH THREE FIXED
JET CARBURETORS.**

The back-drag carburetor reduces fuel consumption up to 37% over conventional carburetors at cruising speeds. Fixed jets precisely meter the proper amount of fuel, without adjustment, over the entire rpm range.

The Black Max engines have three back-drag carburetors with dual barrels — one for each cylinder — for more efficient fuel distribution.

**BLACK MAX MAKES EVERY
MERCURY A LITTLE BETTER.
SEE THEM ALL AT YOUR
MERCURY DEALER.**

The same engineering excellence achieved with our Black Max series is built into every Mercury outboard for 1978.

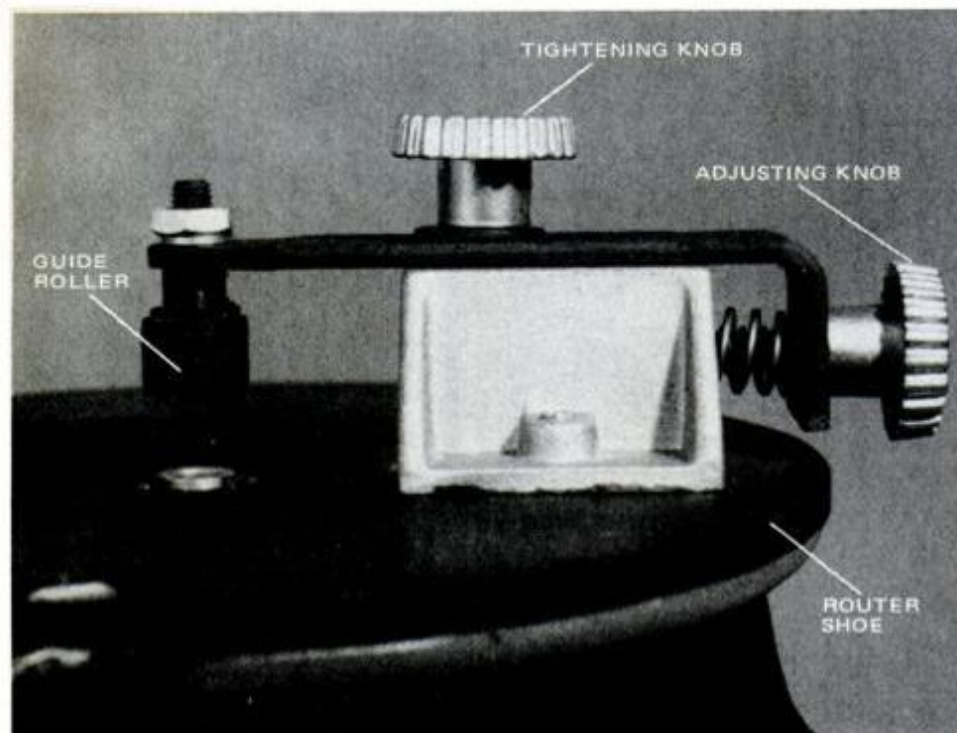
From the seven mid-range Mercs® — 140 hp to 40 hp — right on down to our smallest fishing engine, Black Max technology makes every Mercury a little better.



MID-RANGE MERCS

Your Mercury dealer will help you choose the Merc that's right for you. See him soon.





Few workshoppers need convincing that a router is one of the most enjoyable tools you can have. With it you can quickly master the secrets of professional-looking projects—with surprisingly little effort. And once you are turned on to a router's advantages, it's an almost sure bet you will take on the high-pressure laminates (such as Formica and Nevamar) to turn out an even greater variety of projects.

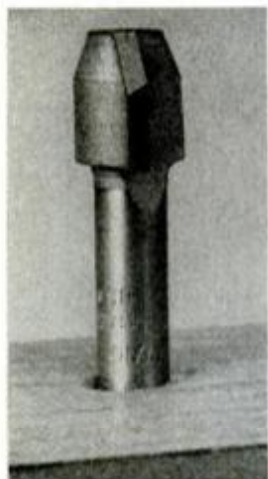
When you decide to go that route, you are well advised to consider adding a laminate trimmer to your router box. This one comes complete for trimming and beveling laminated plastics because the cutter can produce either a straight or bevel cut.

The attachment comes with its own shoe; its screw holes are aligned so that the unit can be used with all Sears routers. After fastening the shoe to the router, insert the carbide bit in the collet and adjust its depth-of-cut as desired. It makes sense to practice on scrap first. You *will* need some test runs to gain familiarity and control of the tool's adjustments. This is easily learned because good directions are packed with the tool. You will quickly produce professional edges on laminates, as I did. A fine tool at a fair price.—*Harry Wicks, Home and Shop Editor*

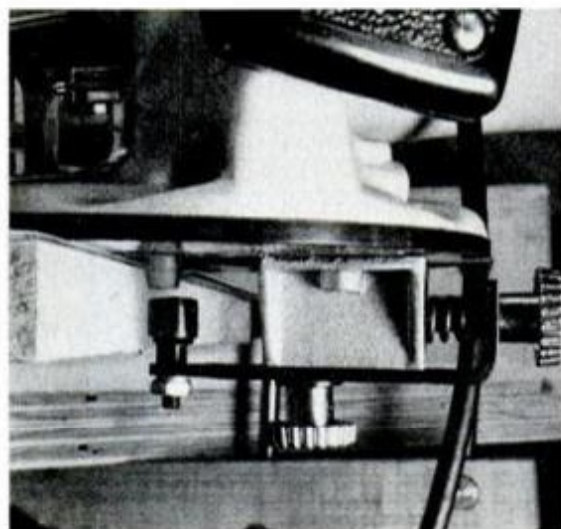
MANUFACTURER'S SPECIFICATIONS PLASTIC LAMINATE TRIMMER Model No. 9 H 25732

Micrometer-type adjustment.
Unit includes subbase (shoe) and carbide (straight and bevel) cutter.

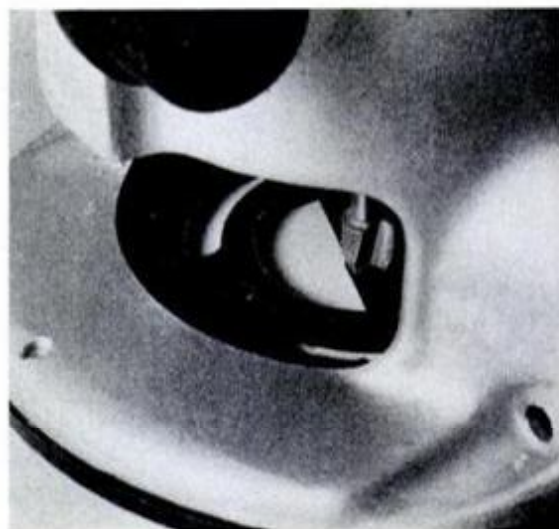
Price: \$14.99.
Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60684. Available through catalog and at local Sears stores.



Cutter's straightedge is used to trim overhang and its bevel portion for final trimming.



Overhang is quickly trimmed once attachment is properly adjusted. Author liked performance.



Final trim, with bevel edge of cutter, is made by raising the cutter and readjusting guide roller.



**How come
I enjoy smoking
and you don't?**

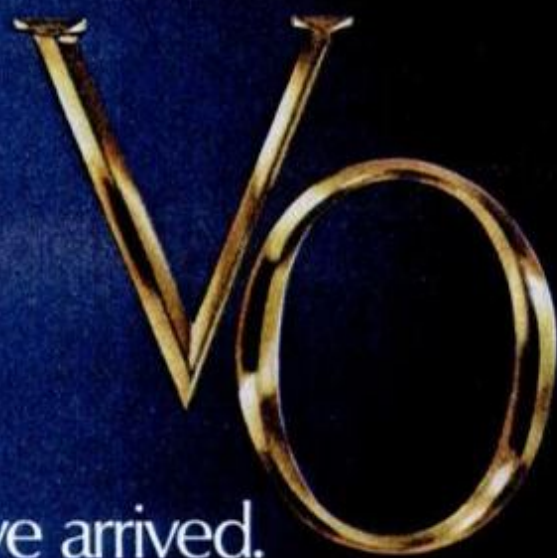
Salem's why. Great taste. Fresh menthol.
Switch to Salem for enjoyment.

Salem King & Salem 100's.

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

KING, 100's: 18 mg. "tar", 1.2 mg. nicotine, av. per cigarette, FTC Report DEC. '76.

There are signs that tell you where to go
and how to go.



This sign tells you that you've arrived.

Seagram's V.O.

Bottled in Canada. Preferred throughout the world.

КАНАДИАН ВИСКИ. А ДИЖИЛ ДЕ КАНАДА. СЕГРЕМ ВИСКИ. В МЕСКО ДИ Д. ОУ В ВОЛЛЕ. СЕАГРАМ ПИСТИТЕД. Р.О. М.У.Р.

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Giant miners for a new coal age

Squadrons of new clanking rock-chompers are gouging coal from deep mines at record rates, aimed at doubling output by 1985.

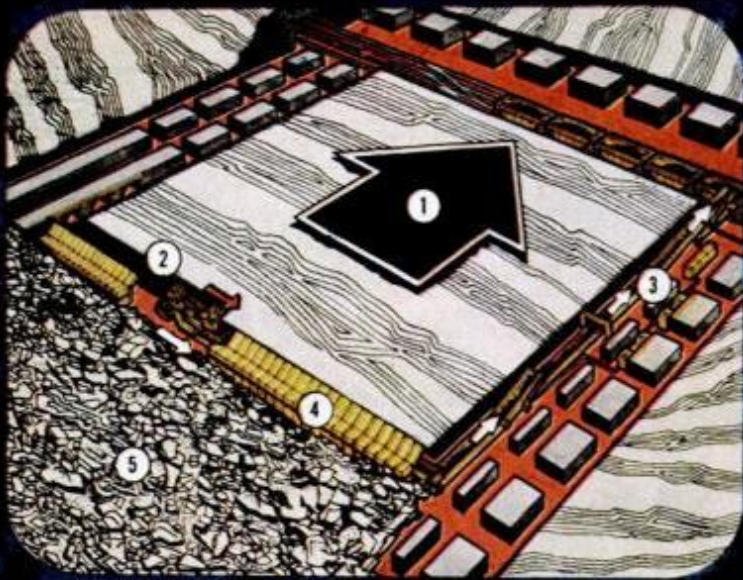
by Bill Kilpatrick

Down on my haunches some 400 feet underground, and more than three miles into an Ohio coal mine, I heard the guy say, "Bet you've..." Then, the sound of his voice was drowned in a maelstrom of noise.

The beam from my miner's lamp lighted his sooty face. I could see his lips moving but couldn't hear a word. The pulsating, thumping racket emanated from a low-slung black hulk off to my right. I turned and watched as the machine's transverse-mounted cutting drum reached up and tore into a seam of soft coal. Whirling and glistening in a

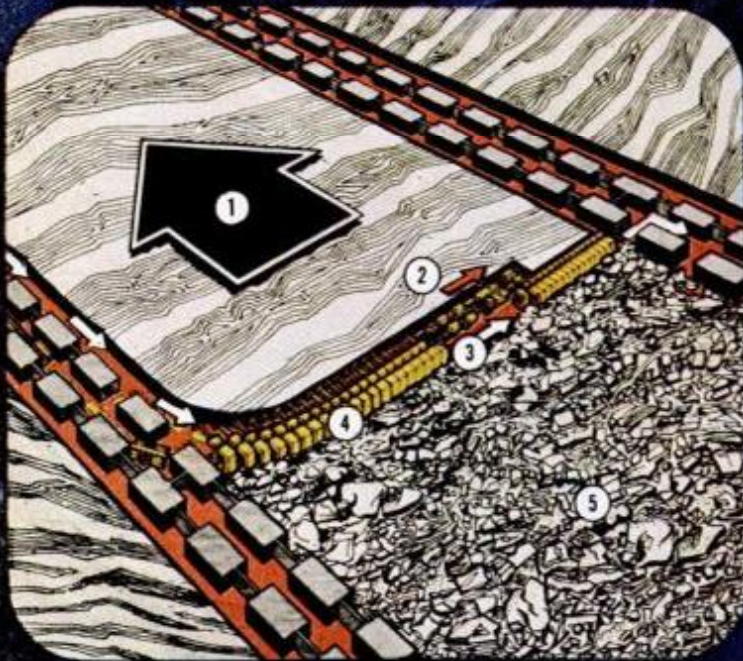


V A L I G R E K Y



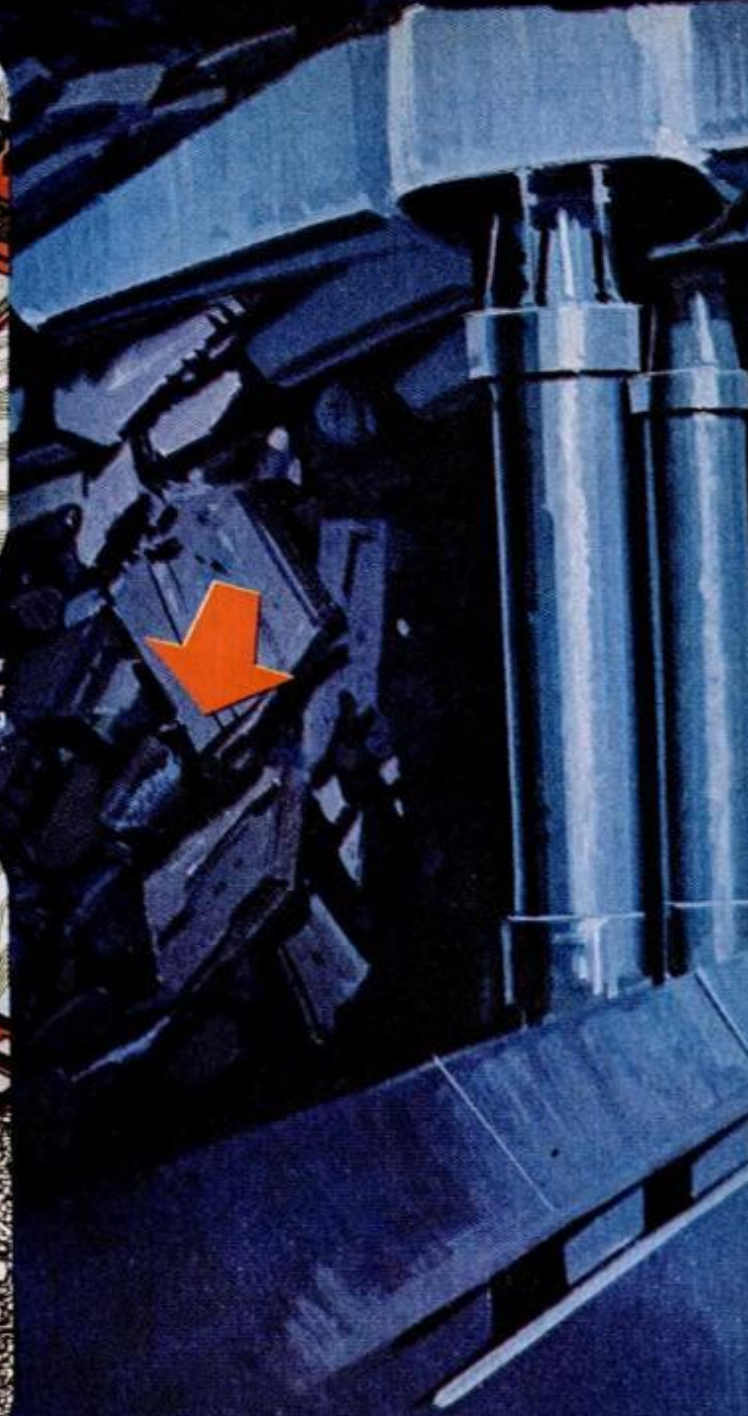
LONGWALLING

Giant shearer moves back and forth along seam face in a corridor first opened by a continuous miner, which also carved tunnels for moving coal to surface. As machine and supports progress, ceiling collapses behind them as "gob." 1. Mining direction. 2. Shearer. 3. Conveyor. 4. Supports. 5. Gob.



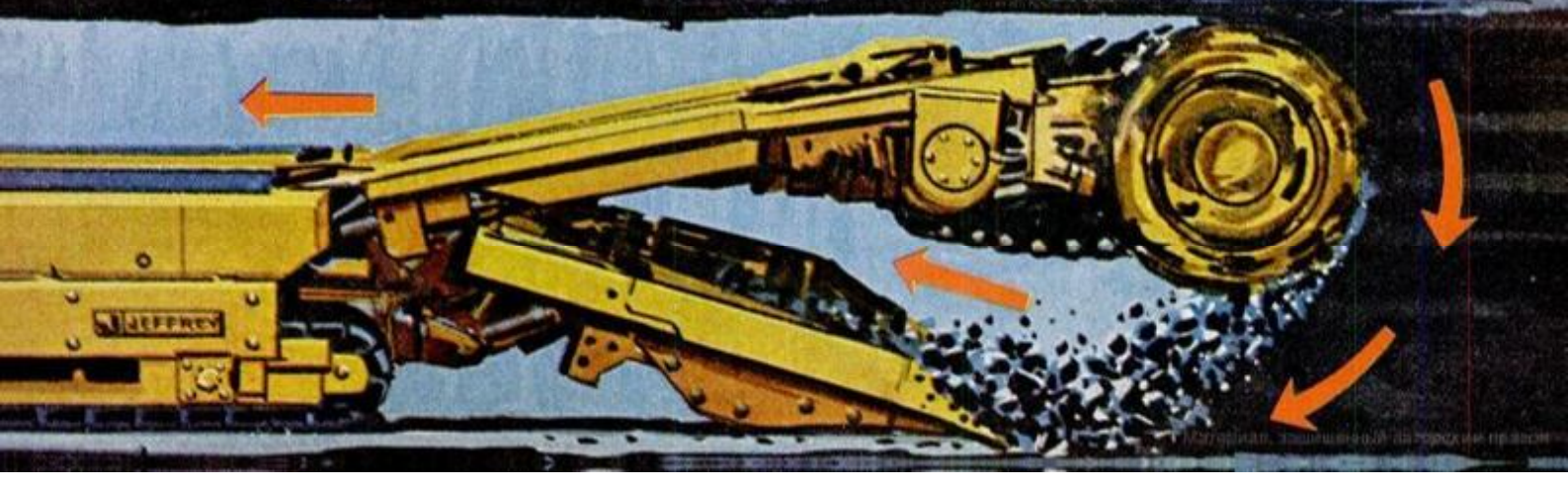
SHORTWALLING

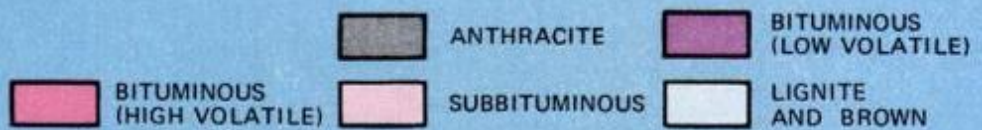
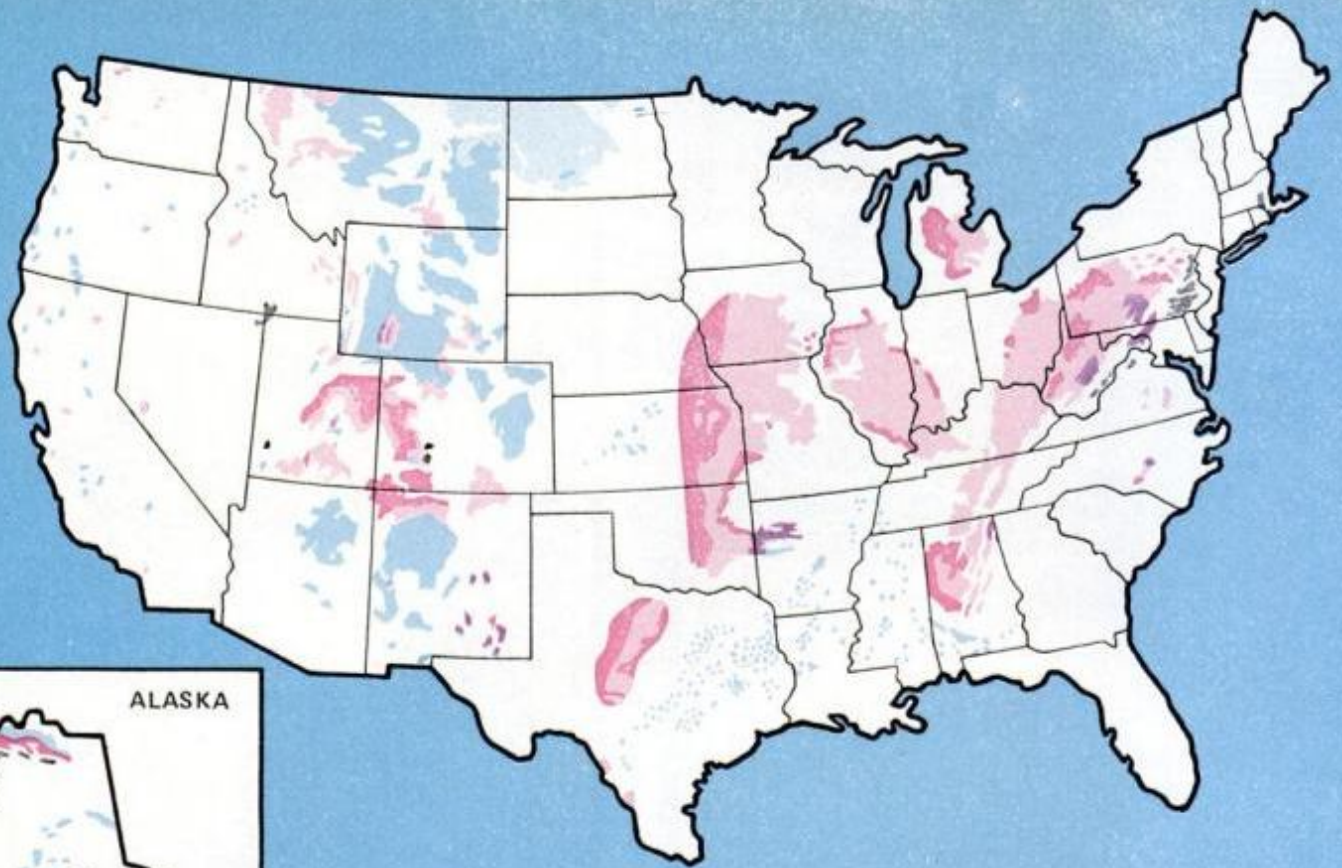
Low-slung continuous miner has rotating head that can reach to the ceiling of a thick seam. It grinds one way along face of seam, then backs off for another go. Again, the ceiling collapses behind it as hydraulic roof supports ram forward. 1. Mining direction. 2. Miner. 3. Conveyor. 4. Supports. 5. Gob.





Gigantic horizontal auger on Bunyanesque hydraulic arm of longwall miner (above) can crumble 12,000 tons a day from face. Continuous miner (below) though limited to forward travel, can burrow into deposits.





Vast, untapped reserves of coal in the United States far exceed all the oil in the Americas as well as the Persian Gulf. Map above shows types of coal that exist in this country, and where the known deposits are located.

water spray to hold down dust, the drum's spiraling row of tungsten-carbide teeth raked the face of coal from top to bottom. The ripped-down stuff cascaded to a moving belt and was conveyed along the machine's back and off its rear end onto the bed of a waiting and equally low-slung shuttle car.

The noise stopped as abruptly as it had begun. The loaded shuttle car pulled away with a muffled rumble and disappeared in the darkness. From start-up to shutdown, the entire process had taken little more than 30 seconds.

"Really something, isn't it?" the fellow hollered, moving closer. "Bet you've never seen anything like it."

He was right. To me, as perhaps to most people, the underground mining of coal was a vaguely realized, unworldly business involving exploited, dirty-faced men wielding picks and shovels, spavined mules lugging overloaded tram cars, and caged canaries destined to keel over dead when the concentration of gas in the air approached lethal density. But this incredible machine—less

than 30 inches in height and not much wider than a standard car—that zapped through coal like it was butter, was a long way from my antique concepts.

Continuous miner

"It's called a continuous miner," my companion said. "It cost about \$300,000, and the man operating it gets \$63 a day, so it isn't exactly a nickel-and-dime setup. A number of companies make them, but that particular one's a Jeffrey 120. It weighs better than 77,000 pounds

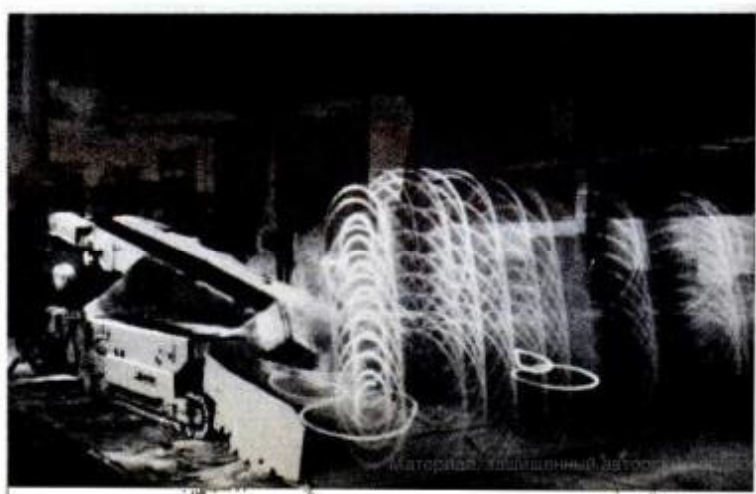
and it's powered by a couple of 225-hp electric motors. That big cable you see trailing back next to the water hose is hooked up to a power distribution center farther back in the mine.

"All this equipment down here runs on electricity. It comes in from up top. We mine the coal that gets sold to the power company to generate the juice we have to buy to mine the coal."

"How much coal did that machine just rip down?"

"About five or six tons," he said.

Head-on time exposure of a continuous miner in action on coal face illustrates the auger-like action of the big spiraling cutter head when it chews its way into the solid material at the working front of a soft coal deep mine.



"Hell, it'll chew it out of here better than ten, maybe twelve tons a minute."

Some quick figuring, and that added up to a production potential of more than 5000 tons per eight-hour shift; 15,000 tons a day!

The machine I'd been watching is one of several types of Bunyanesque monsters that will be gouging into our vast coal reserves to meet soaring quotas as gas and oil supplies dwindle. Newest, and even more formidable than the continuous miner is the "longwaller"—a roaring giant with a side-winding auger some six-to-eight feet in diameter, known as a "shearer." This unit rumbles back and forth along the face of the coal seam, its whirling, toothed auger slicing a couple of feet off the face at every pass. As the machine progresses into the deposit, a long row of hydraulic roof supports pulls itself along behind it, allowing the mine roof to collapse into the mined-out area.

10-story 'walking' draglines

Gargantuan of the mining business, of course, are the 10-story-high "walking" draglines with scoops big enough to swallow a three-bedroom house and attached garage. The biggest can scoop up to 200 cubic yards of overburden at a single pass (the average 10-wheel dump truck that carts fill from construction sites holds about 12 yards). Armies of such draglines already are at work opening the yawning canyons of our burgeoning strip mines.

More about all these fantastic machines presently. Together, they form the clanking, roaring, humming battalions of weaponry that will help us embark on our second coal age—a renaissance that, in terms of tons produced, will make the last one seem like kids on a beach with tin shovels and pails. President Carter has called for coal output to nearly double—to 1.2 million tons a year—by 1985.

Coal comprises 90 percent of our total fossil fuel reserves—a resource far richer than all the known oil in Alaska, the Persian Gulf, the North Sea and Latin America combined. The President's goal would bring coal's share of our total energy needs to about 29 percent, and cut back our need for foreign oil to the 15 percent we imported back in 1973 when the Arab oil embargo went into effect. Without that boost in coal output, we'll be up to 60 percent oil imports by 1985.

It will take a heroic effort to achieve that 535-million-tons-a-year increase in nine years. Are the ma-



More than half the bituminous (soft) coal now mined in this country is strip-mined. Colossal "walking" draglines like this—with housings as big as a 10-story office building—scoop 200 cubic yards at a bite to clear overburden from the 150-foot-deep canyons they dig to expose coal.



chines heroic enough to make it? Very likely, even with their limitations.

Shuttle-car bottleneck

Actually, that 15,000-tons-a-day potential I'd calculated off the top of my head for the continuous miner doesn't happen in day-to-day operations. My companion in the mine noted that the term "continuous miner" is misleading. "It can't mine coal more than two hours each shift," he informed me. "Mostly, it has to wait on the shuttle cars. They haul about six tons each trip. There's only room for so many, and they can go only so fast back and forth between loading up here at the face and unloading at the nearest conveyor. If nothing breaks down, we can get 500 tons or so out of here each shift."

"What does a ton of this coal sell for?"

"Well," he said, "that depends on the contract with the individual customer, and on how far and how difficult it is to get the coal to where the customer wants it. In general this kind of coal retails for about \$18, maybe \$20 a ton."

"How much of that is profit to the coal company?"

"You got me," he said. "There are a lot of variables in pricing coal. I've heard some fellows say the company's making \$5 a ton, and others say the profit on a ton of coal isn't

much more than a couple of bucks. Look, here comes the other car."

I watched as the double-ended shuttle car slipped out of the darkness into the dancing light of the work crew's lamps. The semiprone operator eased it up under the continuous miner's conveyor, and again the rhythmic thumping and grinding racket drowned out all conversation.

Despite the production bottleneck caused by the need to utilize shuttle cars in most deep mines, continuous miners will rip out well over 60 percent of the approximately 280 million tons of bituminous (soft) coal to be mined underground in the United States this year. Such machines, of which the Bureau of Mines estimates some 2500 to be in use, represent by far the most commonly used method of deep-mining soft coal.

The traditional method of mining both soft and anthracite (high-carbon hard coal used mainly and, these days rarely, in home heating) consists of cutting out big blocks with mammoth chain saws, then drilling and blasting the blocks into loadable chunks. The method, still widely used, accounts for over 30 percent of America's annual bituminous production from underground mines. And, despite widespread mechanization of deep mining over the past century, a few million tons of coal

(Please turn to page 136)



BRIGHT NEW GEAR

Roughing it is now a matter of choice rather than chance for the outdoorsman who's fitted out with the latest in equipment. It'll keep him warm and dry, well-oriented and highly visible to other hunters.

by Bill McKeown OUTDOORS EDITOR

When Rod Harrison got back to Casper, Wyo., from his first October outing last year, he was ready to swear "Never again." New to the West, he thought he should try mountain hiking by himself (his first mistake) so he wouldn't look foolish.

With new rucksack and mild-weather gear, he set out into the foothills on a warm weekend. His stiff new boots gave him blisters quickly. Then a little wading by mistake after he slipped into a



1. Safety orange rucksack
2. Propane catalytic heater
3. Scarlet rucksack
4. Lined Baxter State parka
5. Red chamois-cloth shirt
6. Lever-action rifle
7. Johnson guide pants
8. Danner elk hunter boots
9. Versa Tarp ground cloth
10. Moccasin boots
11. Bush pants, down mitts
12. Camo chamois-cloth shirt
13. Down cap
14. Plaid shirt
15. Reversible down vest
16. Twill pants
17. Hunting shoes
18. Waterproof lantern
19. Scarlet felt hat
20. Down sweater
21. Auto .22 rifle
22. Moleskin pants, Calhoun boots
23. Customized Dodge van
24. Gun case, shell belt
25. Orange down cap
26. Blue Go jacket
27. Bama Sockets
28. Belt pouch, reel
29. Silva compass
30. Knit G.I. cap
31. Auto 12-gauge shotgun
32. Flexnet parka
33. Thermo-ply Cahill waders
34. Red felt hat
35. Red Go suit
36. Foul-weather parka
37. Flexnet match-up pants
38. Thermo-ply Traileaze boots
39. Three-way rod



Best equipment for hunting and fishing appears above and left. Below: Sears vest, Remington shotgun and Hawkeye Shooting Coat make for better scores on the range.



From Eddie Bauer, Seattle, Wash.: 5, 11, 12, 13, 24b, 25. L. L. Bean, Freeport, Me.: 1, 2, 3, 4, 7, 8, 10, 14, 15, 16, 17, 18, 19, 22a, 24a, 28a, 29, 30, 34. Coleman, Wichita, Kan.: 2. Griffolyn, Houston, Tex.: 9. Lew Childre, Foley, Ala.: 28b. Peter Storm, Norwalk, Conn.: 36. Recreational Equipment, Seattle, Wash.: 20. Remington Arms, Bridgeport, Conn.: 31. Sears Roebuck, Chicago, Ill.: 39. Travco, Mt. Clemens, Mich.: 23. Uniroyal Red Ball, Washington, Ind.: 22b, 26, 27, 32, 33, 35, 37, 38. Winchester, New Haven, Conn.: 6, 21.

FOR SAFER HUNTING

stream he was trying to cross produced soggy socks, pants and sleeping bag. He took the wrong turn down a steep ravine and, without a map, spent extra hours finding his way out. Next, a sudden wet snow blanketed his overnight campsite. Finally some hunters didn't recognize his brown pack as he worked his way down a rocky slope and took a shot at him that fortunately missed. Rod figured he was lucky to get back.

Yet none of his troubles, he now

admits, were really necessary. After discussing that weekend, we made a list of much of the equipment shown here, and Harrison now reports his recent camping has been fun after all.

This fall there are many new ways to avoid old reasons for getting in trouble outdoors. Some of the possibilities now have fancier names — disorientation, hypothermia, hunter misidentification — but they still mean old-fashioned getting lost, getting cold and getting

shot. Fortunately, new fashioned solutions are available at most sporting goods stores and all can be ordered by mail. Consider the following for your section of the country.

Getting mistaken for an animal is reckless carelessness and, in most areas, illegal as well. If you're old enough to head for the woods and fields, you're smart enough to wear high-visibility orange jackets, hats, vests, parkas, even hunting

(Please turn to page 154)

OWNERS TELL ALL ABOUT LIFE IN

AN EXCLUSIVE SURVEY BASED ON

What's it really like to have the newest kind of place in the sun—a solar-heated home? I asked 150 owners, virtually everyone in the nation who spent last winter with solar heat, and got answers from a whopping 40 percent. Their candid comments on the realities of today's solar heat reveal the pleasures and pitfalls of energy pioneering, and may help you decide on solar heat for your home.

Sun-heated homes are not merely toys for the rich who live where the sun always shines or seems to. True, there are many solar-heated homes in Arizona, New Mexico and California with systems that cost \$20,000 or more. But there are satisfied solar homeowners in seemingly unlikely places: Mansfield, Ohio; Lewisburg, Pa.; Pomona, N.J.; Princeton, Mass.; Lincoln, Neb.; Portland, Ore.; Bozeman, Mont... the list goes on. Some of these people built and installed their solar heating systems for as little as \$1000.

More comfortable last winter

The grim "Winter of '77" provided

The home of Robert Sheppard, Asheville, N.C., incorporates a liquid solar system—collectors on roof—with a swimming pool for heat storage. Water-to-air heat pump moves the heat from pool to living space.



a solid test for solar heating. Our respondents' systems passed it, and many of them may have been warmer than you were. Several solar dwellers said they were more comfortable in their sun-heated homes than ever before.

Architect James Sudler, for example, has an air solar system in his home in Denver—not a tropical climate—that provides 70 percent of space heating and domestic hot water for an area of 5800 sq. ft. He finds that solar heat is more even

throughout his house than heat from his gas-furnace backup system.

Sudler's natural gas bill for January and February, 1977, came to \$15.54. His March bill was \$14.45, but he says this was due to a lot of cloudy days. He calculates that \$4.81 worth of gas per month goes just for the pilot lights on the backup furnace and water heater.

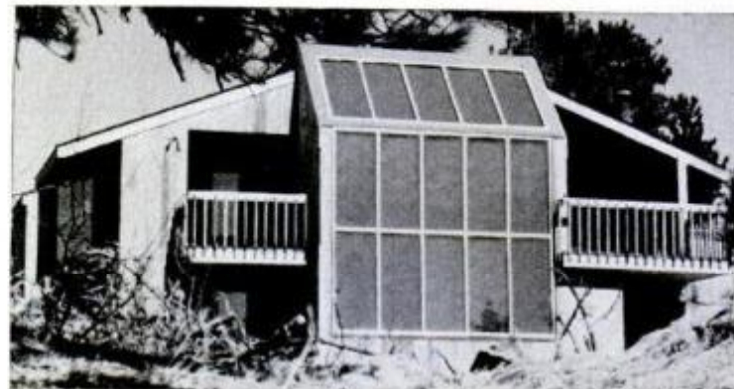
It will take quite a few years of low gas bills to pay back the \$20,000 Sudler put into his system, but 5800 square feet is a lot of home to heat. There's no doubt this figure is at the high end of the homeowners' cost spectrum.

Much of the cost of a solar system depends on the house, size, the percentage of heat to be provided by solar energy, controls and instrumentation used and amount of insulation and other conservation measures built into the house.

Even with the same basic system, the disparity in price can be great. Roger Smith, a Fort Collins, Colo., engineer, has an air system similar to Sudler's in his 1500-sq.-ft. home. It cost \$8000.



William Bishoprick of Salem, Ore., had an air-type solar system built in his home (left) at an additional cost of \$5500. He figures that it will take about 10 years for the system to pay for itself.



Another example of the good looks that are possible with solar: \$7000 Solaron air system in Murray Watts's Golden, Colo., home.

SOLAR-HEATED HOMES

by Victor D. Chase

THE EXPERIENCES OF 60 HOMEOWNERS



Herb Wright talks about collectors on roof of his home in Petaluma, Calif. His \$8000 system heats, pool, living space, domestic hot water.

Charles Thomsen of Lincoln, Neb., here working on ducting, installed his system for \$2500 in materials. It handles 44 percent of hot water, heating loads.



The way system cost can increase is shown in the case of Douglas Boleyn, an electrical engineer, in Gladstone, Ore. He and his wife were planning to install a solar system when their utility, Portland General Electric, found out and asked to get involved. PGE offered to pick up the tab for the system if the Boleyns would let it be used as a demonstration project.

That tab came to \$30,000, but Boleyn notes, "You can get the same-size system installed for \$8000 to \$10,000." The added cost was due in part to complexity of monitoring apparatus the utility installed and also to the fact that the system was "carefully and conservatively designed." The engineer's home, 10 miles from Portland, has a liquid system with 430 square feet of collectors, providing about half the space heat and hot water needed.

Getting into solar has worked out well for Boleyn. Not only did he get a free solar system and a 50 percent cut in his utility bill, he also got a job out of the deal.

"As a result of my interest and expertise in solar, I was hired by PGE as a solar consultant," says Boleyn, who now advises area homeowners planning solar systems. He is "very satisfied" with his system, but adds, "We don't recommend that anyone install a system like this (as costly) in the home."

Great majority satisfied

There have been problems even with this \$30,000 system: one pipe leak and—unexpectedly—algae. Boleyn now plans to add water treatment to the system to keep the algae from coming back.

Boleyn's pleasure with his system

was typical. Of the 38 homeowners and two commercial-installation operators who provided detailed information, 35 said they were satisfied with their systems. Some were "very pleased" and had found their sun-powered devices operated better than expected. Four homeowners said they were not satisfied, but most explained that they felt their systems could do better—not that they had become antisolar.

While many homeowners designed and built their systems for \$1000 or less, almost half the respondents' systems were in the \$5000 to \$8000 range, and the average cost was \$6735. Outputs of the systems ranged from a modest 20 percent of the space-heating and/or hot-water load to as high as 95 percent, with the average a healthy 50 percent.

Getting into solar energy obviously isn't a nickel-and-dime proposition, but it needn't be out of a homeowner's financial reach. A system like Laurence Carr's, in San Luis Obispo, Calif., is a good example.

Four years ago, Carr retrofitted his home with a liquid space and hot-water system he designed and built

for \$1000 in materials. He says it "paid for the materials in the first three years. This fourth year it has started to put me ahead." Specifically, it is putting him ahead to the tune of \$324 per year.

Then there's R. Joseph Barraclough of State College, Pa., who designed and installed an air solar system for an additional cost of \$1500, in a house he built in 1975. Going by current local electricity prices, he figures the system will pay for itself in five years. He recently sold this solar home, and is now planning another, for which he predicts higher efficiency.

While living in this home, Barraclough saved about \$40 a month during the heating season. "Local utilities projected a winter monthly heating cost of \$100. My average heating bill was about \$60," he said.

Carr decided to use water as a heat-transfer medium because his house already had hot-water heat. He mounted 800 square feet of collectors on a hillside about 25 feet away. Water is pumped through black polyethylene tubing in the collector array when collector temperature exceeds 110° F., then is

John Kusianovich of Albuquerque, N.M., chose to use an array of concentrating collectors that track the sun for his system.





Heightened awareness of the country's present and future energy problems got Bruce Robinson into solar heating—he made his decision while energy chairman of the Sierra Club. The air-type system in his Morrison, Colo., home cost \$7000.

routed through copper tubing embedded in the concrete slab on which his 1600-square-foot house stands. Heat radiates through the floor into the living space.

"I never really had any bugs in the system," Carr says. "A few leaks in the plastic pipe connections is about all."

With a retrofit, Carr was able to make exact comparisons of fuel consumption with and without solar. "We burned 800 gallons of propane before 1973, and 200 gallons per year since then, so the sun gives 75 percent of our heat."

System maintenance cost has been \$20 a year, for annual replacement of a polyethylene collector cover.

"We are very satisfied," Carr says. "We are more comfortable than before. It has operated so well that I have been afraid to change anything. Sometimes I think up a way to eliminate the present small usage of propane, but after more thought I always decide to let well enough alone and make no substantial change."

Even so, he says he would do it differently next time. "I would set it up with a passive system for a large part of the solar heat, and then probably have an air collector with rock storage for heat when the sun was not out."

Liquid or air?

Carr's preference for air, while he's using liquid, points up the push and pull going on between proponents of these system designs. Some experts like liquid for higher efficiency. Others like air because leaks will do less damage. Rock storage for air is more cumbersome than a liquid storage tank, but air systems are said to be easier and cheaper to maintain, as well as lower in first cost.

Among our solar homeowners, air has the edge—58 percent who specified system type. One choosing air was Charles Thomsen, a principal in

The Clark Enerson Partners, a Lincoln, Neb., architectural and engineering firm.

"I considered many designs, some of them liquid types, before settling on this design." His reasons? "Simplicity of construction, freedom from freezing problems and leakage problems, lower cost."

Thomsen added solar space heating and hot water to his home in January 1976. He spent \$2500 on materials and estimates another \$2500 for the time he put in. As he sees it, "The materials will be paid back in nine years, and the total of material and labor in 13 years."

During its first year, Thomsen's system provided 44 percent of his heating and hot-water needs.

Barraclough said he chose air because "my comparisons showed that equal efficiency could be achieved at lower costs using air." He built 400 square feet of collectors for the 1200-sq.-foot house. Air is blown over a corrugated aluminum absorber sheet coated with black latex paint. Warmed air is routed to 28 tons of stone in a bin in the basement. On demand, air is blown over heated stones and sent throughout the house. The backup system is electric-resis-

Laurence Carr of San Luis Obispo, Calif., built his liquid system four years ago for \$1000. It has since paid for itself and is providing savings of \$324 per year. Its 800 square feet of collectors are mounted uphill from the house (below, right). Array has polyethylene-film cover that Carr removes in summer to prevent heat damage.



tance heat installed in the air ducts.

Heat storage for air systems is still literally in the stone age, as Richard Hartzell of Flagstaff, Ariz., found out.

Hartzell's new solar home was completed in March 1976. Solar added some \$7000 in cost, and now provides 60 to 70 percent of space heating and 20 to 50 percent of hot water, depending on season. Hartzell estimates 8 to 10 years for pay-back. "Our natural gas bills have been roughly one-half those of our neighbors in winter and one-fifth theirs in summer," he says. His highest bill to date was \$58 last December. His nearest neighbor with virtually the same size house paid \$120. Despite this seeming success story, Hartzell notes that "storage has been a disappointment in that we have used the back-up system more than we expected." Storage is in 11 tons of dense fire brick.

If he had it to do over, Hartzell says, "The only major change would involve using water as the storage medium instead of brick. This would be accomplished by using a heat exchanger to convert hot air to hot water, which is more easily stored."

Ron Splittgerber of Fort Collins, Colo., and his brother are doing just that in the duplex townhouse they built with a single solar system of their own design. Each dwelling unit has its own gas-fired furnace and water heater for backup.

The Splittgerbers' design is really a combination air-and-liquid system. It uses air-cooled collectors, rock storage and a 500-gallon water storage tank. Ron says they opted for this design because "it's hard to store high-temperature air in rocks. You lose a lot of it." The brothers' rock-pile is also a storage medium for cool air which they bring indoors on summer nights, then circulate during the daytime.

The system, which added \$6100 to



SOLAR HOME OWNERS' EXPERIENCE

STATE	SYSTEM TYPE/LOAD(S)	% SOLAR ¹	SYSTEM COST (\$)	ESTIMATED PAYBACK TIME (YR.) ²	MANUFACTURER(S) AND INSTALLERS ³	OWNER SATISFIED?
Ariz.	Air/space ⁴	50	800	8	DIY ⁵	Yes
Ariz.	Air/space, DHW ⁶	60-70 space 35 DHW	7000	10	DIY	Yes
Calif.	Liquid/space, pool, DHW	70 space 100 pool 90 DHW	8000	7	Collectors: Sungrabber Controls: Suntrader Installer: Solar System Sales	Yes
Calif.	Liquid/space, DHW	75 both	1000	3	DIY	Yes
Calif.	Air/space	75	500	NA ⁷	DIY	NA
Calif.	Liquid/space, DHW	67 both	3500	15	Installer: Natural Heating Systems	Yes
Calif.	Air/space, DHW	70 both	20,000	NA	Solaron	Yes
Calif.	Air/space, DHW	75 both	7000	NA	Solaron	Yes
Calif.	Air/space	40	7000	Perhaps never	Contract: Deko Lab	No
Calif.	Air/space, DHW	70 both	6100	NA	Installer: DIY Collectors: Solaron	Yes
Calif.	Air/space ⁸	70	8000	7	Solaron	Yes
Calif.	Air/space, DHW	NA	8000	very few	Solaron	Yes
Calif.	Air/space, DHW	50 both	7000	5-70	Solaron	Yes
Calif.	Air/space, DHW	70 both	10,000	10-12	Solaron	Yes
Calif.	Air/space, DHW	100 space 90 DHW	8400		Solaron	Yes
Conn.	Liquid/space, DHW	50-75 both	NA	NA	Sunworks	Yes
Fla.	Air/space	50	5400	5	Solaron	Yes
Mass.	Air/space, DHW	30	1200	7	DIY Sol. Inc. kit system ⁹	Yes
Mass.	Liquid/space, DHW	70 both	5000	10	Design: Thomason Solar Homes, Inc.	Yes
Mass.	Passive/space	65	NA	NA	Partial DIY	Yes
Mass.	Liquid/space, DHW	NA	15,000	never	Collectors: Gaystar Controls: Rho Sigma Installer: New England Solar Systems ¹⁰	No
Neb.	Air/space, DHW	44 both	2500	9	DIY; controls: Rho Sigma Motors: Erie Mototrol	Yes
N.H.	Liquid/space	70	2500	10	NA	No
N.H.	Air/space	50	11,000	20-25	Collectors: Kaiwall Controls: Natural Power, Inc. Builder: CHI Housing	Yes
N.H.	Passive/space, DHW	80 space 85 DHW	1000		Builder and system design: Tule Foundation, ASB	Yes
N.J.	Air/space	30-70	1500	NA	DIY	Yes
N.J.	Passive/space	75	8000	10-11	Partial DIY	Yes
N.M.	Liquid/space, DHW	NA	4270	NA	Collectors: Albuquerque Western Industries	NA
N.M.	Passive/space	30	2000	NA	DIY	No
N.Y.	Air/space Liquid/DHW	50 space 80 DHW	12,000	10-20 space 3-5 DHW	Sunworks	Yes
N.Y.	Liquid/space, pool	75	10000	5	Collectors: Sungrabber Controls: Rho Sigma Installer: A-River Solar Systems	Yes
Ohio	Air/space	30	5000	25	DIY; collector covers: Kaiwall Controls: Barber-Coleman Electronic	No
Ore.	Liquid/space, DHW	50 both	30,000	NA	Collectors: Revco Controls: Rho Sigma	Yes
Ore.	Liquid/space	50	650	6	DIY	Yes
Ore.	Liquid/space	95	1347	NA	DIY; Controls: Deko Lab	Yes
Ore.	Air/space, DHW	50 both	5500	10	Design: owner Controls: Rho Sigma	Yes
Ri.	Liquid/space, DHW	60 both	15,000	15	Collectors: RSC Industries	Yes
Pa.	Air/space	33	1500	5	DIY	Yes
Pa.	Air/space	70	1300	7	DIY; controls: Heliosys General	Yes
Wis.	Air/space, DHW	50 both	12,000	20-30	Solaron	Yes

NOTES

1. Percentage of heating load or loads carried by solar system.
2. In most cases, these are rough estimates. Some respondents based their answers on present fuel costs, while others took projected fuel-price increases into account.
3. Manufacturers include makers of components and makers of complete systems. Installers may be specialists or general contractors.
4. Space heating.
5. Do-it-yourself.
6. Domestic hot water.
7. Not answered.
8. Commercial building (not included in averages for homes).
9. Homeowner is a principal in the company.
10. Despite dissatisfaction with system, homeowner said installer was "very good."

the cost of the duplex, works amazingly well. "We love it," Ron raves, estimating that it provides 70 percent of heat and hot water.

Backup for diapers only

Both Splittgerber homes are on a single gas meter, and their highest bill so far was \$15. "On the domestic hot water, the only time the heater comes on is when we have three or four loads of diapers to do on a cloudy day," Ron notes.

The one major problem the brothers had was rock storage—they had hired consultants to tell what size rock to use. First the engineers said 2-inch. Then they changed their minds and said pea gravel, so the brothers removed the rock and put in 30,000 pounds of pea gravel. As they were finishing out the house, the

(Please turn to page 134)



Architect James Sudler's 5800-square-foot Denver home has an air system that provides approximately 70 percent of the space heat and domestic hot water needed. The total bill for this large-scale system came to approximately \$20,000.



MAST to the rescue

They fly choppers over mountains, deserts, open water and snow-covered waste to rescue victims of train wrecks, explosions, dam disasters, birth traumas, heart attacks, skiing or mountain climbing accidents—you name it.

by Jack Galub

It was shortly after midnight in the small town of Mathis, Tex. Drawn up around the 150-foot water tower jutting into the night were highway patrol cars, fire trucks and an ambulance, their flashers blinking through the dark. Now and again the lights picked out dim figures around the sides of the tank that topped the high tower.

Shut down for maintenance, the tank was being cleaned and refinished. A painter had been inside all day, working in a concentrated cloud of fumes. Finally the toxic vapors had overcome him and he collapsed, tumbling 40 feet to the bottom. There he lay, half conscious, with a brain concussion and a fractured wrist.

The problem: Ease the stricken man off the tank bottom and out of a tiny three-foot-square hatch without compounding his injuries.

At that point the *whomp-whomp* of a helicopter reverberated through the night sky above the rescuers. Traveling at 90 knots, a U.S. Army "Huey" swung past the water tower and sat down on the airstrip to the east. Help had arrived from a unique rescue service known as MAST—Military Assistance to Safety and Traffic.

Army pilot Gene Knapp relates what happened. "With that conical roof we couldn't put the chopper down on the tank," he says. "And the idea of just dropping a metal hoist into the tank was out. It might have struck a spark which would have set off a vapor explosion and ripped everything apart. We had to get our

man to the top and then lift him off."

Climbing down the tank's interior, two local fire department rescue volunteers put a monkey harness on the injured man. Then came a grueling, hand-over-hand climb up the work ladder inside. Semiconscious at times, the victim fought his rescuers as they struggled against heat and lack of oxygen, finally draping him over the edge of the tank hatch.

Back up in the Huey, Gene Knapp battled wind gusts over the South Texas plains to position the chopper above the hatch. At last a rope could be dropped and tied to the victim's harness. Now Knapp gingerly increased power, lifting the Huey and the limp accident victim. Then, he slowly crabbed it sideways about 300 yards to open ground, where he gently lowered the painter into a waiting rescuer's arms.

Minutes later the chopper medic and crew chief had loaded the gasping man aboard for a fast trip to San Antonio's Bexar County Hospital. Gene Knapp and his crew then returned to Fort Sam Houston to find another job waiting: moving a premature baby to a medical center.

MAST helps many regions

Knapp and his crew are part of a group of skilled pilots, medics and crew chiefs who fly MAST missions from 24 U.S. Army and Air Force bases. Assigned to lifesaving duty, they wait for the disaster phones to ring—to signal the scramble.

Using helicopter ambulance techniques perfected in Vietnam, the MAST program gives crew members

actual experience with disaster. More important, MAST gives many small-town and rural residents a fighting chance when accidents, illness or natural disaster strikes. Any area within 100 miles of a unit, and not already served by commercial helicopter service, is eligible.

Pilots fly their choppers over mountains and deserts, open waters and snow-covered wastes under all conditions. The medics must hone classroom and hospital skills to deal with victims of traffic and hunting accidents, train wrecks, dam disasters and floods, heart attacks, birth traumas, explosions—name it.

When a young girl skier, high on the snow-covered slopes in a rugged region above Cloudcroft, N.M.—part of a rugged region covered by the Fort Bliss unit—spilled and fractured a lumbar vertebra, MAST went into action.

The crew scrambled, flew through unpredictable mountain air currents to a precarious landing, gave the victim emergency treatment and delivered her to the El Paso hospital in two hours. A similar ambulance trip would have taken 10 hours.

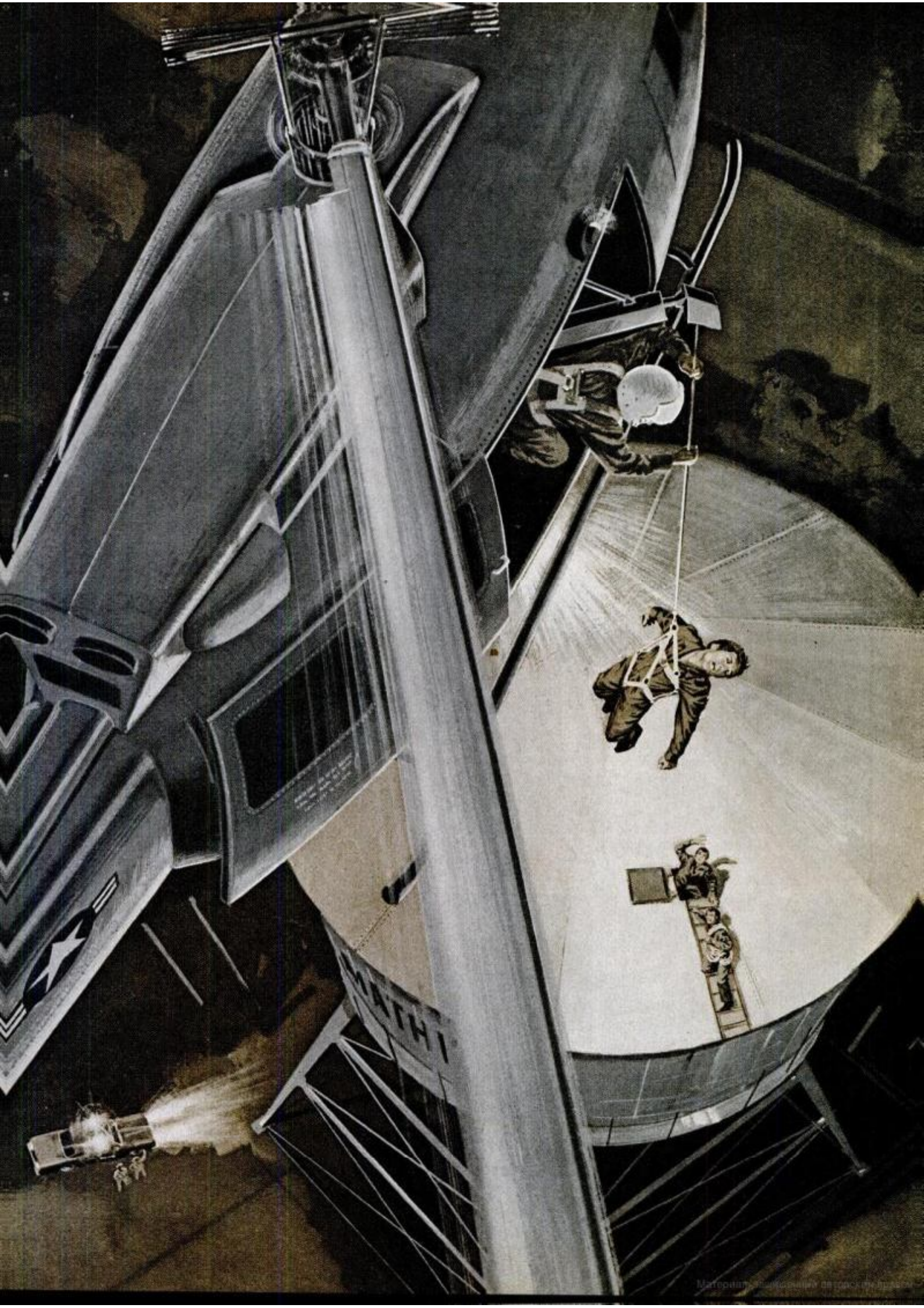
Another example of MAST capabilities involved five college students engaged in "tubing." The tuber sits inside an inflated truck inner tube and lets himself roll down a snow-covered slope. Because the tubes are uncontrollable and build up breathtaking speeds, injuries—concussions, lacerations, fractures, broken necks—are rife.

"This group had formed a chain of inner tubes," Capt. John R. Shields of Fort Bliss recalls. "Unfortunately the leader went off the ski lane and took the others with him. They slammed into a pile of rocks. They needed a hospital—fast. The Huey choppered into a narrow pass to evacuate all safely in record time."

Desert rescues, mostly involving dune buggy and off-trail motorcycle riders, also are common. Vehicles overturn, bikes spill or riders are thrown from buggies moving at movie-stunt speeds. The small towns in the area have few medical facilities, so local police turn to MAST.

The Organ Mountains north of El Paso are deceptively attractive to climbers. At a distance they look smooth and accessible. But in many places the 7000-foot cliffs are steep and treacherous. Too often climbers lose their footing and fall hundreds of feet onto rock. Violent updrafts

Battling gusty night winds over South Texas plains, Army chopper pilot Knapp jockeyed his "Huey" over a tiny water tower hatch to rescue a worker who had fallen to the tank bottom.





Traffic accident victim airlifted by MAST Plattsburgh unit, from Adirondack side of Lake Champlain to Burlington (Vt.) Hospital, is wheeled into receiving room in 20 minutes. Author, who accompanied flight, says ambulance would have taken three hours.

proved too much during a recent flight to rescue an injured climber. As the chopper came in close to put down near the victim, drafts forced the ship away. The pilot could get no closer than 6 to 10 feet above the ledge where the climber lay. Finally the medic jumped off to give first aid. The chopper lowered a hoist and lifted the victim aboard. Then the medic—safe after his daring leap—was hoisted up.

Choppers bring hospitals closer

Doctors often call for helicopters even when ambulances are standing by. A medical team at the Elizabethtown (N.Y.) Hospital decided that a heart attack victim needed open heart surgery. The closest facility for the operation: the Vermont Medical Center in Burlington. An ambulance would have had to carry the patient around the foot of Lake Champlain and then north to Burlington, about 75 miles. Air distance is 26 miles.

Minutes after a call to the Plattsburgh Air Force Base, a MAST chopper took off for Elizabethtown, picked up the patient and landed him at Burlington.

I accompanied a Plattsburgh MAST crew on a similar flight, carrying an auto accident victim with a cranial fracture. We flew aboard "SAVE 72"—the helicopter's call sign. (All Air Force flights use SAVE followed by the last two digits of the chopper's registration number; the Army call signs begin with "DUSTOFF").

Lifting from Plattsburgh, we headed west and south at 1500 feet, flying through a break in the 2200-foot ridges of the Adirondack foothills. Twenty minutes later we were on the Elizabethtown Hospital landing pad.

Accompanied by the pilot and crew chief, the medic entered the trauma room and conferred with the attending physician. The patient was wheeled out and loaded; minutes

later we sat down in Burlington and hospital aides wheeled our patient into the receiving room where an emergency surgical team was standing by.

Sometimes local medical facilities are so burdened that mass evacuation by chopper is needed to save lives. When a runaway bus filled with the Gunnison, Colo., high school football team, coaches and students hurtled two miles down Monarch Pass before overturning and slamming to a smoking stop, the hospital at nearby Salida was overwhelmed.

Eight teen-agers and a coach were killed outright, six more died at the crash scene and three were dead on arrival at St. Luke's Hospital in Denver 112 miles away. The last three were among the 15 worst injured and were transported to Denver by three MAST helicopters from Fort Carson, near Colorado Springs. The choppers came in and hovered until a power line could be moved so they could land beside the wreck. Grisly as the death toll was, it was lessened by evacuation and the care given victims en route by MAST medics.

Search and rescue missions

While MAST is restricted to pick-up and evacuation of patients at designated sites, the same units also take part in search and rescue flights when needed, under the direction of the Aerospace Rescue and Recovery Service (ARRS). Primary job of ARRS is combat rescue, but it also helps search for lost hunters, wandering children and downed aircraft.

Fort Lewis's MAST choppers flew search-rescue when three climbers were missing for four days on 14,000-foot Mount Rainier. The three had left their car at the 4000-foot level and were believed to be using the treacherous northern approaches



Premature babies are routine missions for MAST crews. Infants are transported in wheeled, portable isolettes like the one shown here. Rolled out to pad, they're loaded aboard for a quick trip to the nearest hospital with proper facilities. Volunteer medic crew member (above) accompanies the flight to make sure everything works.

Rescue of lost hikers, mountain climbers or snowbound campers in isolated areas usually is accomplished with harness, rope and winch, unless injuries make it necessary for pilot to "sit down." The Huey hovers while the victim fastens harness around himself. Then he's hoisted aboard to waiting crew as pilot lifts the craft and heads for home.



along Liberty Ridge. They had not registered their climb with park rangers, which made it illegal and complicated the search.

At first, downdrafts made it impossible for the Hueys to climb to the top reaches of the mountain. One managed to lift a group of Seattle rescue volunteers to 9000 feet. Another started combing the approach. The crew of the second chopper finally spotted the climbers at the base of Willis Wall, a vertical stretch of rock 4000 feet high.

Battling 90-mph winds and downdrafts that pushed it away from the mountain, the Huey clawed its way up to 14,000 and sat down. The crew got out to help, but both rescuers and climbers had to fight their way frantically back to the chopper through waist-high snow as it began sliding

(Please turn to page 169)

Besides providing signals and signs for wilderness survivors, MAST suggests that campers and hikers carry smoke flares, readily seen against snow from above.



VISUAL EMERGENCY SIGNALS

NEED MEDICAL ASSISTANCE—URGENT Used only when life is at stake	ALL OK—DO NOT WAIT Wave one arm overhead	CAN PROCEED SHORTLY—WAIT IF PRACTICABLE One arm horizontal	NEED MECHANICAL HELP OR PARTS—LONG DELAY Both arms horizontal
USE DROP MESSAGE Make throwing motion	OUR RECEIVER IS OPERATING Cup hands over ears	DO NOT ATTEMPT TO LAND HERE Both arms waved across face	LAND HERE Both arms forward horizontally, squat and point in direction of landing. Repeat
NEGATIVE (NO) White cloth waved horizontally	AFFIRMATIVE (YES) White cloth waved vertically	PICK US UP—PLANE ABANDONED Both arms vertical	AFFIRMATIVE (YES) Dip nose of plane several times
			NEGATIVE (NO) Fishtail plane

Visual signals shown here are used to communicate with rescue craft. Body signals (above) should be executed in the open and repeated until the pilot understands. He'll dip a plane's nose if he does, or fishtail it if he doesn't. Choppers land, if given sufficient space. Other signals (below) can be laid out on snow, a meadow or bare ground, using debris to improve contrast.

Search craft are attracted in many

ways. The simplest is a smoky fire. Save flares until the craft is in sight. In open areas an SOS is laid out. Fill the letters with debris for visibility. In desert or mountain country have a CB radio plus extra batteries. On desert, map coordinates or a landscape fix helps the rescuers. If some of them go for aid, one should stay with the injured. Learn how to make a shelter and always dress for the worst possible weather conditions.

GROUND-AIR VISUAL CODE FOR SURVIVORS

REQUIRE DOCTOR SERIOUS INJURIES	I	REQUIRE FIRE ARMS AND AMMUNITION	V	AM PROCEEDING IN THIS DIRECTION	↑	REQUIRE FUEL AND OIL	L
REQUIRE MEDICAL SUPPLIES	II	REQUIRE MAP AND COMPASS	□	WILL ATTEMPT TAKE OFF	↳	ALL WELL	LL
UNABLE TO PROCEED	X	REQUIRE SIGNAL LAMP WITH BATTERY AND RADIO	I	AIRCRAFT SERIOUSLY DAMAGED	L	NO	N
REQUIRE FOOD AND WATER	F	INDICATE DIRECTION TO PROCEED	K	PROBABLY SAFE TO LAND HERE	△	YES	Y
NOT UNDERSTOOD	JL					REQUIRE MECHANIC	W
				SOS			

IF IN DOUBT, USE INTERNATIONAL SYMBOL

Everyman's home computer is here

by Anthony R. Curtis
ELECTRONICS EDITOR

Versatile inexpensive home computers are here today from consumer giants: Radio Shack, Sears and Heathkit. These electronic wonders will do just about anything you can think up!



Complete do-anything Heathkit microcomputer system includes H9 video-display and keyboard terminal so you can talk to the computer and it can answer; H8 computer itself, with intelligent front panel including keyboard to enter data and display for you to read data from computer; and H10 paper tape reader and puncher, also for talking with computer. System, from Heath Co., Benton Harbor, Mich. 49022, is a general-purpose computer, excellent for beginners, expandable for experienced hobbyists.

Here it is! We've talked about it for at least the last 10 years. Books and articles have predicted its arrival. Super-sophisticated calculators, TV games and other formerly fantastic electronics pointed to it. Now we have it: the computer for every home.

Giant nationwide merchandisers—Radio Shack, Sears, Heathkit—are past the predictions. They have hardware on their shelves, ready to tackle your family budget and finances, health and nutrition records, education, music, business and games.

For \$600 you can get Radio Shack's wonderfully small, yet powerfully versatile TRS-80. It's available off the shelf in many of Radio

Shack's 6000 stores and by special order from the rest. By the way, you can save \$200 if you make use of an old TV set rather than buying the ready-made video display terminal.

Sears has its microcomputer in stores in six major cities and available from headquarters in Chicago for everybody else. It's also about \$600.

Heathkit, which sells mail-order from its electronics catalog, has the full line available. The basic computer with video-display terminal, a similar line-up to the Radio Shack and Sears systems, is about \$900.

Hardware

Computer system hardware con-

sists of four things: input, output, memory and microprocessor.

Input usually is a keyboard through which you type messages to the *microprocessor*. The microprocessor follows your instructions, makes calculations, sorts information, checks out old data you have given it and turns up new. It stores your instructions and data in *memory*. And when it has completed a task you have assigned, it responds to you through its *output*.

Radio Shack's input is a typewriter-style *keyboard* or a standard inexpensive audio *cassette recorder*. You can either type instructions and data into the microprocessor on the keyboard or play it in from a pre-recorded cassette tape.

Radio Shack gives you a prerecorded tape, with the TRS-80, which will instruct the microprocessor in how to play the games of blackjack and backgammon. They'll sell you other tapes which will *program* the machine to keep your family budget; balance your checkbook; organize kitchen menus and recipes; store your Christmas-card list; convert all sorts of dimensions, weights and sizes; teach your kids math; and handle your business payroll.

Using prerecorded cassettes, you don't have to know anything about the *basic language* understood by your computer. The tape is ready-made to program the microprocessor.

Using the keyboard, on the other hand, you can program the machine yourself following simple words Radio Shack uses in the basic computer language.

Software

Hardware is nothing without a program—the instructions from you to the microprocessor. The program tells the computer what to do with *data* you give it.

Let's say you want your computer to keep family financial and health records. Before you give it a peek into your checkbook or its own chair at the dining table, you tell it what you want it to do and how it would do it. That's the program.

Later, you feed it data on your monthly expenses and nutrition habits. If you've asked for such an answer, it will tell you how many movie tickets you can afford next month and how much popcorn you should eat at the theater.

Extra memory

The bigger the job you give your microprocessor, the more complex the information it has to absorb and the more memory you need to hold all instructions and data.

It might not take much information-storage space to hold one month's budget numbers. But it will take more to store your expenditures for a year so the machine can calculate your income tax next April. Calories counted for a month wouldn't take up as much memory space as when you add carbohydrates, protein and other diet nutrition data.

Bytes

A computer's words are composed of *bits*. Most home computers under-

(Please turn to page 192)



Radio Shack TRS-80 home computer lets you keep family budget, finances and health records (above), teach school subjects (below) or play games like backgammon. System (below, left) includes TV video display terminal, keyboard with computer built in, audio cassette recorder to store information and wall-plug power transformer.



If a bridge is too tricky for piers,
try tying it to a wire sculpture.

Hanging a bridge with a bend

by Michael Lamm



Designer of more than 1000 railroad bridges in China, Dr. T. Y. Lin now operates an international engineering firm in California that's famed for solving knotty bridge problems.



It might be a gigantic piece of modernistic sculpture, but it's not—it's a bridge. "People look at it and think we did it for aesthetic reasons, but we did not," says world-famous bridge-builder Dr. T. Y. Lin of San Francisco. "We took a scientific approach. When a bridge is done properly, the curves come out rhythmic, artistic and beautiful."

He was talking about this latest creation—a unique design for the "Ruck-A-Chucky Bridge," named for the canyon it will span on the middle fork of the American River, 15 miles east of Auburn, Calif.

What makes the Ruck-A-Chucky Bridge something special? First, it is a curved suspension bridge—all others are straight. Further, it's suspended not from massive concrete piers, but from the rocky canyon walls.

Why curved? That way, the approach roads could run along the canyon walls in natural cuts that climb gradually to the top on each side. A straight bridge would have required great cuts or tunnels in the cliff walls at a cost of some \$12 million.

Conventional methods are out

And why suspend the bridge from the canyon walls? "The simplest, most logical design seemed to be an arch," Dr. Lin observes. "But after the planned construction of Auburn Dam downstream, the canyon will be filled with water, and part of the arch would be under water. That didn't seem right." Dr. Lin and his consultants pondered the problem for six months.

Traditional suspension was eliminated because it wouldn't permit the

roadway to curve. Hanging the cables off piers was also out when it developed that even four piers costing several million dollars each wouldn't be enough to stabilize such a curved bridge.

"Finally," recalls Dr. Lin, "I decided to hang the arc from some 30 points of attachment on each canyon wall, anchored directly in the rock. We would use high-strength steel cables to hold either concrete or steel box-girder sections."

Cars, people—and horses

The design calls for a main span of 1300 feet, curved on a 1500-foot radius. The 50-foot-wide deck will carry two lanes of car and truck traffic, a sidewalk for pedestrians and a 10-foot-wide equestrian path for horseback riders along the inside curve of the span.

How do you put up such a bridge? In conventional suspension systems, massive main support cables are first strung between towers, then the bridge decking is simply hung from the cables, one section at a time. But in the Lin design, there are no anchoring towers and no way to string support cables first. Since the cables do not span the canyon but attach directly to the bridge decking, the bridge must be in place before the cables can be rigged.

The answer is a special trusslike structure, cantilevered out over the water, that supports the decking while the cables are being attached. As each section is anchored, the truss will be moved forward to hold the next section in place. Dr. Lin plans to

use two such truss arrangements, one working from each side of the canyon.

If construction bids determine that steel is least expensive, deck strips 10 by 15 feet will be trucked in and lashed together into 50 by 50-foot segments. If concrete is used, it will be poured in 30 by 50-foot forms. In either case, the same cantilevered truss system will be used to support the segments during anchoring.

The cables holding the bridge radiate out and upward in four separate arrays to attachment points on the canyon walls. While the cables are actually straight, they are staggered and crisscrossed in such a way that they appear to twist in graceful spiraling planes, creating an effect much like that found in intricate wire sculpture.

Built to take anything

On the cliff walls, the cable ends will be spaced about 25 feet apart and cemented into angled holes drilled deep into the rock. About 4 inches in diameter, each cable is rated to withstand a pulling force of 270,000 pounds per square inch. Actually, the design load of the bridge requires only 100,000 p.s.i., but the extra margin is insurance against earthquakes and other unforeseen stresses.

Exact construction dates are not yet definite as they hinge somewhat on decisions still to be made about the Auburn Dam. If the dam is delayed or abandoned, as some think possible, it could affect the timing of the Lin bridge. Still the bridge is a beautiful engineering achievement—whenever it comes. ★★★

New outboards— new horsepower race

Off and running for the lead in muscle power, the latest kickers for '78 claim to harness up to 235 hp.

by Bill McKeown BOATING EDITOR

The contest to build the biggest outboard is on again. It looks as if the winners are going to be boatmen. Soon you can hang a couple herds of horsepower on your transom if your boat and your budget can take it. The new big outboard motors, like cars, are now introduced six months ahead of time (we'll cover the small mills as they come out early next year). And "big" for 1978 will mean more muscle inside the same-size compact package.

But won't big motors gulp more scarce and expensive gasoline? The answer is yes—and no. If you've got a large offshore fishing rig, pontoon deck boat, outboard cruiser, houseboat or other hefty hull that takes real muscle to get up on plane over the water rather than pushing it out of the way, you probably already use a mill of 100 hp or more, or perhaps a pair of them. It's no secret that boats can guzzle gas at full throttle, and backing off to cruise setting can save a lot. The new models make sense when a 200 can throttle back to give the same speed and gas consumption as a wide-open 150, and have power to spare or, better still, can do the work with less fuel and cost than a pair of smaller twins astern. And for buyers of less potent kickers, the benefits of the big ones spread out as top-of-the-line refinements filter down to improve the smaller motors that the rest of us will be using.

Who's got what?

So who's on first for '78? Outboard Marine, big daddy of Evinrudes and Johnsons, leads the fleet right now with the announcement of their 235-hp leader, up 19,250 ft.-lb. from this year's 200. Mercury has a bigger Black Max with 200 horses, a bonus 25 over the 175 of '76-77. Chrysler jumps to 140, produced by a compact 103-cu.-in. displacement. Newcomer Mariner will check in with a new six-cylinder in-line 115 model as the latest member of the 100-plus horsepower league.

Refinements of the Evinrude and Johnson 149.4-cu.-in. displacement block are credited with their horsepower boost from this year's 200. Modifications of the exhaust tuning now give each of the six cylinders an equal-length megaphone to fully exploit the power potential. A new "Fuel-Saver" carburetor is claimed to be more economical at the mid-range settings used for cruising, while "pulling through" more gas for full-throttle operation.

Other models in the Johnson and Evinrude lines for next year will include horsepower ranges of 2, 4, 6, 9.9, 15, 25, 35, 55, 70, 75, 85, 115, 140, 175, and 200, plus electric trolling models of 12 and 24 volts. Long and extra long shafts for lower units, suitable for mounting on high transoms of sailboats, are among options available.

Mercury will have five new models next year in its line of 16 different horsepower ranges. Added to the big 200 will be a Merc V-1500 of 150 hp which will provide choices of 150, 175 or 200 hp in the V6 Black Max series.

The other new models are a 140-hp Merc 1400, an in-line six-cylinder Merc 900 of 90 hp, and a Merc 800 at 80 hp for the big bass boat market. Mercury models will start with an improved Gnat of 4 hp, and go up through 4.5, 7.5, 9.8, 20, 40, 50, 70, 80, 90, 115, 140, 150, 155XS, 175, to the new 200. Mercury also has various shaft-length options and will provide Thruster electric fishing motors with 12-volt or 24-volt models with either deck or transom mounting brackets.

New from Chrysler

Chrysler's new models are the big four-cylinder 140 plus new 6-hp and 8-hp motors and 6-hp Sailor 150 rated at 150 pounds of thrust forward, plus a useful 120 in reverse for stopping and maneuvering a sailboat or large displacement hull. The reverse capability is claimed to equal that of an average 20-hp motor. Chryslers will



come in 4, 6, 8, 10, 15, 25, 35, 45, 55, 65, 75, 90, 105, 115, 120, 135 and 140 hp.

But there are a lot of outboard makers besides the big boys. All are worth considering if you don't need the extra push of a muscle machine. Flyweight and work-horse models like Aquabug, British Seagull, Clinton, Eska, Honda, Montgomery Ward, Mighty Mite, Sears, Spirit and Volvo Penta are 10 of them. Some lesser-known brands you'll find may also be made by these. All are established makes that should give you reliable service.



Biggest now available for clamping on a transom, the 235 Johnson motor (left) can handle large offshore rigs and should replace many twin-engine installations.



Evinrude's 235 line-leader, also a 149.4-cu.-in. V6 mill, uses refinements such as tuned exhausts to up this year's 200.



Mercury's new 200-hp V6 Merc V-2000 weighs 15 pounds less than this year's 175 and has 142.2 cu.-in. displacement.



New compacts from Chrysler are a water-cooled 6 and the 8, shown. Both claim fuel economy with fiberglass-nylon props.

The question always is: Which do we recommend? Actually, that's easy. If your motor choice has the horsepower rating, the reputation for performance and reliability, the good looks, options, servicing ease and price you want—pick it with the help of the best local dealer. He's the one you'll be going back to for warranty tune-ups and the rest. He's the man you'll want as a reliable friend for the years you own the motor.

It's likely in fact that you may go back to that dealer in a season or so if a 250 or 300-hp kicker should appear. ★★★



Chrysler's biggest production engine is the new 140, a four-cylinder long-stroke lightweight with 103-cu.-in. displacement.



Power for sailboats is a feature of the new Johnson long-shaft 4-horse Sea-Horse (above) and a new Sail Master 9.9 model.



Watch one TV show, put another on tape. Everybody gets to see what he wants.



Record your favorite TV shows, even if no one at home cares to watch them.



Make instant memories with fast replay. Videotape parties, other family events.

TV recorders: Have the best of both shows

Even if two of your favorite shows are on TV at the same time, you can watch both.

by Anthony R. Curtis
ELECTRONICS EDITOR



Sony Betamax lets you play back home movies instantly, unlike film movies which require chemical processing.

Click. Whirr. Gremlins and goblins cavort for your camera as you grind three minutes of film through. The cartridge exposed, you set your camera aside moments before a tiny witch takes a tumble into the apple-bobbing bucket. You missed the best shot at your Halloween party!

Too bad you couldn't set up a camera, let it run through the whole Halloween party and cap the evening with a review of the best costumes, the sharpest tail pinned on your boy's donkey and that soaked witch.

Now you can do just that. You can capture the fun and games of a party, Thanksgiving dinner, the opening of every box under your Christmas tree, even a pool full of bikinis next summer. A home videotape recorder, with its own television camera, can record two-hour chunks of whatever you like. And it will do it silently with instant replay at your fingertips.

Time-saving machine

Hook up your video recorder to any make or model of TV set and you can do four things:

- Record anything on TV for later playback.
- Make your own TV schedule by recording, for example, an 8:00 p.m. program for viewing later, when you want to see it.
- Leave home without regrets by having your recorder stand by to pick up and store your favorite shows while you are away.
- Make those instant home movies like the Halloween party.

Ever wish a program weren't over when it ends? Now you can capture it on a two-hour videotape cassette.

Do your kids want to watch *Nancy Drew* when you want *60 Minutes*? Don't fight! Record your program and play back after Junior hits the sack.

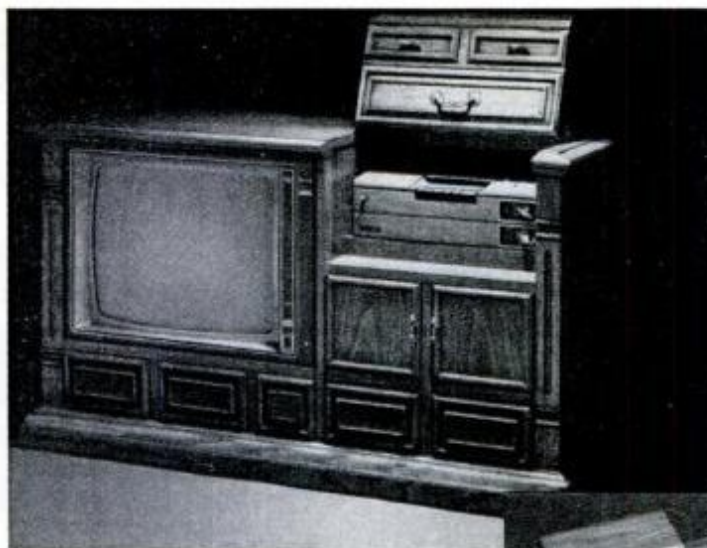
Been called out after hours just long enough to miss your show? Or do you work 4:00-12:00? No problem when you can record programs and look at them later.

Memory machine

You can build a library of home movies and old programs for your own personal satisfaction. The cassettes are the size of a hardbound book so lots of memories can be stored on a shelf. Take them down for instant browsing whenever you like. It'll be faster than setting up your film projector and screen since you'll likely have the video recorder ready to go beside your TV all the time.

TV recorders have clocks built in and separate channel tuners so you

(Please turn to page 166)



Zenith's Video Cassette Recorder comes as a deck (below) or console (left) with built-in TV. It can tape two hours of programs on one channel while you watch different shows on other channels. It produces live or recorded movies with an optional camera or mike. Deck works with any TV.



Camera with electronic viewfinder and zoom lens is option for JVC Vidstar (left). Adapter (center) works color camera. Typical video tapes (right) come in half-hour, one-hour and two-hour lengths.



Neither Beta format nor Video Home System, Sanyo V-Cord II has stop-action and sound-dubbing capabilities; digital clock to start recording within one second of desired time; end-of-tape shutoff; for use with any TV. Sanyo will have Beta machine soon.



Laser beam senses TV programs in Videodisc

Philips/MCA Videodisc plays 30-minute prerecorded color show from special LP but doesn't record. Laser scans disc which lasts years with no physical contact between light beam and surface.

'78 CARS

Driving the 1978 Chevrolets, Pontiacs, Buicks, Oldsmobiles and Cadillacs

GM, with its all-new intermediates, most significant of the '78 cars, opens this special 12-page section.

by Michael Lamm WEST COAST EDITOR

The 1978 blockbusters from General Motors include a set of totally new A-bodied intermediates and specialty coupes.

They replace last year's Chevelle, Monte Carlo, LeMans, Grand Prix, Cutlass, Century and Regal. These new cars are all on a 108.1-inch wheelbase instead of last year's 112 to 116-inch chassis.

Then, too, there's a new Airesearch turbocharger for Buick's even-firing V6; a diesel 350 V8 for Oldsmobile's big cars and the Chevy pickup; an upsized, redone El Camino and a new four-door Chevette.

GM's huge gamble

Last year, you'll recall, General Motors tightened up its full-sized cars—shortened the "big" B- and C-bodied 1977 Chevys, Pontiacs, Oldsmobiles, Buicks and Cadillacs by an average of 8.5 inches.

Then GM held its corporate breath, because nobody had any inkling at

that time whether Americans would go for *smaller* big cars. The public, fortunately, did, and the men on the 14th floor of the General Motors Building in Detroit breathed a mutual sigh of relief.

Now, for 1978, GM has gone the next round and downsized its A-bodied intermediates; also the A-specialty coupes.

It's Phase Two of GM's colossal \$15 billion downsizing program—a gamble that makes the \$250 million plunked out by Ford for the Edsel look like penny-ante peanuts.

General Motors, along with all automakers, is under the gun from Washington to boost fuel economy. For 1978, GM needs to hit a corporate sales-weighted average of 18.0 mpg. By 1985, this shoots up to 27.5 mpg.

The only way GM can hope to meet those figures is by downsizing—mak-

QUICK-SERVICE DASHES FOR INTERMEDIATES

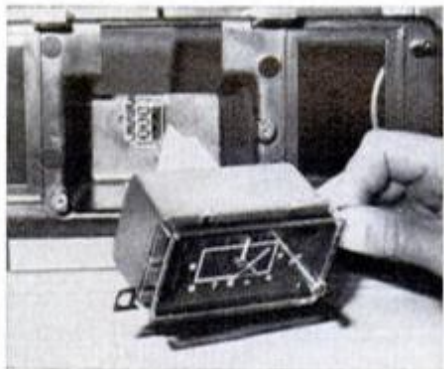
The dashboard on GM's new downsized intermediates sets serviceability standards that should delight a Saturday mechanic.

■ All switch assemblies and the instrument cluster are plug-in components. You unscrew a simple trim plate or applique and unplug the component.

■ All wiring harness connectors are caged in the instrument panel backing plate (also called the carrier), so the unplugging is simple.

■ The speedometer outer cable also is caged (and cushioned) in the carrier, so you don't have to reach up behind the dashboard.

■ Although harness connectors are



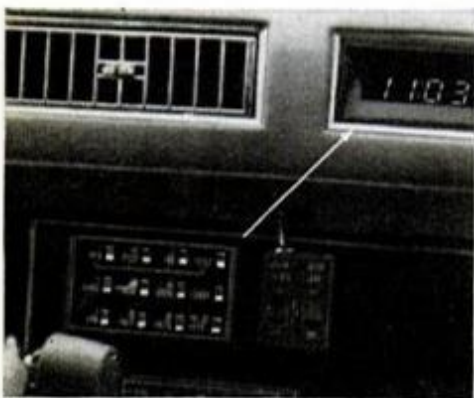
Clock and other dashboard assemblies unplug and are removed from the front.

caged, they're easily disengaged from the back of the carrier if necessary. Disconnecting an individual wire from a multiconnector, however, might be another matter, for to insure good connections, a double-locking arrangement is used.

■ The glove box is a bin-type box that pulls out from the top and is easily disengaged completely, so it hangs down out of the way. This provides a huge opening into the area behind the dashboard on the passenger's side. With the glove box hanging, you have good access to heater controls (including some on the ductwork) and the radio.

1978 SCORECARD

Model	Wheelbase (in.)
Chevrolet Chevette 3-door	94.3
5-door	97.3
Chevrolet Monza/Pontiac Sunbird/Buick Skyhawk/Olds Starfire	97.0
Chevrolet Corvette	98.0
Chevrolet Camaro/Pontiac Firebird	108.0
Chevrolet Malibu, Monte Carlo/Pontiac LeMans, Grand Prix/Buick Century, Regal/Olds Cutlass	108.1
Chevrolet Nova/Pontiac Phoenix/Buick Skylark/Olds Omega	111.0
Cadillac Seville	114.3
Chevrolet/Pontiac/Buick/Olds full size	116.0
Buick Electra/Olds 98	119.0
Cadillac Fleetwood, de Villes	121.5
Oldsmobile Toronado	122.0
Cadillac Eldorado	126.0



Tripmaster computer information center is optional on Cadillac Seville. Digital readout of info, displayed in panel indicated by arrow, is initiated by pressing keyboard switches. You can display rpm, engine temperature, system voltage, time of day, average and instantaneous fuel economy, remaining driving range on current fuel supply, miles to destination, total elapsed trip time, estimated arrival.

Fastbacks dominate Buick and Olds versions of downsized, A-bodied 1978 intermediates. Century four-door (right) and Cutlass (below) boast greater leg, knee, head and trunk room despite smaller exterior dimensions than in 1977. All of these '78s weigh from 500 to 800 pounds less this year. Base V6 engines come in 196, 200 and 231-cu.-in. sizes, with 260, 301, 305 and 350 V8s optional. Cutlass offers five-speed overdrive; Buick's Regal Sport Coupe has a turbocharger.



All new GM intermediates share one wagon (Pontiac LeMans Safari is shown above). Full-width tailgate admits 4-foot-wide plywood. Back glass lifts and the gate drops down. Rear-door windows in all sedans and wagons are fixed, but little flipper panes in the C-pillars open outward. Chevy Malibu (right) replaces last year's Chevelle and shares notchback sedan bodies with Pontiac LeMans.



ing its best-selling cars lighter, their engines smaller, raising rear-axle ratios, and lowering wind rolling and sales resistance.

That's what GM planners have been doing with a vengeance these past four years. They'd committed themselves to building smaller cars even before the 1973 oil crunch. It took them three years to bring out their rescaled B- and C-bodied full-sized cars for 1977.

And way back when GM still didn't know whether the auto-buying public would accept their shrunken 1977 "big" models, they also committed themselves to downsizing their A-bodied intermediates and specialty coupes. That's what we're seeing this year.

And then for *next year*—for 1979—it'll be GM's X-bodied compacts that come down in size. They'll be front drive models and will span a wheel-base of approximately 103.5 inches.

Meanwhile, 1978 marks another confusing season for names and sizes. There's no more Chevelle; it's been renamed Malibu. All Vegas are now Monzas, and Astres are Sunbirds. And the Venturas have become Phoenixes.

And then there's the confusion over what's bigger than what. In 1977, you'll recall, GM's intermediates had about the same dimensions as their big cars. Well, for 1978, what we've come to regard as GM's compacts (Nova, Phoenix, Omega and Skylark) actually have *longer* wheelbases than what we now consider GM's intermediates: 111 vs. 108.1 inches.

Driving GM's new A-bodies

Question is: What's it like to drive GM's new A-bodied intermediates, as well as the much smaller specialty coupes and the turbocharged Buick V6?

Answer: Great! General Motors has done it again—put together another set of good-feeling, good-handling, sophisticated, spunky, fairly roomy, well appointed, marvelously smooth and quiet cars.

First, though, one bad point.



Chevy Monza sports models have soft front facia and rectangular headlights.

V6 ENGINES: CHEVY VS. BUICK

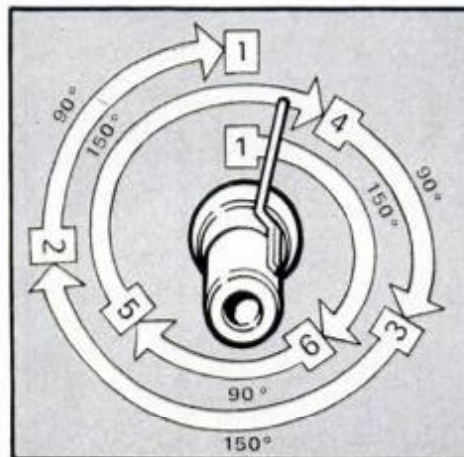
Chevy's new 200-cube V6 engine, designed by chopping the front cylinders off the venerable small-block V8, looks as if it takes a back seat to the Buick V6 in smoothness. "Absolutely not," says a Chevy engineer. "There's more than one way to get almost anywhere, and our V6 is every bit as smooth."

The question arose when Buick, which also designed its V6 (years ago) by chopping a V8, finally switched from an odd-firing design, in which cylinders fired at different degree intervals (90-150-90-150-90-150) to even-firing (120° apart)

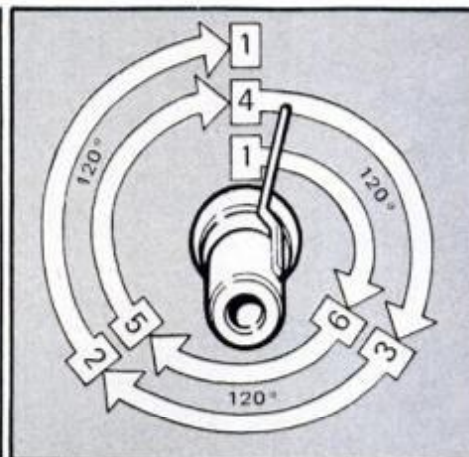
Buick finally got around to designing a new crank with a separate journal for each rod, and with other modifications got a big improvement in crankshaft smoothness.

At Chevrolet, a special crank was designed for the V6, with a journal for each cylinder. However, the engine is odd-firing (132-108-132-108-132-108).

It was no mistake, Chevy engineers say. The odd-firing is not severe, for the cylinders are only 12° each (24 total) from even-firing, and this small difference only affects horizontal engine



ODD FIRING DESIGN



EVEN FIRING DESIGN

as shown. The change was made on some engines late in the 1977 model year, but really comes on stream in '78.

For Buick, the odd-firing was pure economics. The original V6 crankshaft was an adaptation of a V8 design, in which each crank journal held two connecting rods, mandating odd-firing when applied to a V6.

movements, which are not difficult to dampen with other modifications. At the same time, the engine with its slightly-odd-firing action has a low vertical vibration, which can be very difficult to tune out.

The result is a smoothness equal to an even-firing V6, even if it's hard to believe.

I couldn't believe my ears when they told me the rear windows in all A-bodied sedans and wagons are stationary. They're fixed! They don't roll down.

"It's to save weight and to give more elbow room," explained GM's body engineers. To me this has cheapened these otherwise fine cars and makes expensive airconditioning almost mandatory.

True, sedans and wagons have little rear flipper windows behind the back doors. These flipper panes open outward about an inch. Again, there's a power option for these, and again, power becomes nearly a necessity. The flippers do make for good flow-through ventilation.

But anyone with kids and dogs knows the value of roll-down rear glass. So I say fie on GM for taking away first our front ventipanes and now for stealing our roll-down rear windows.

What impresses me most about

these A- and A-specialty cars is their ride and handling. They're extremely smooth and pleasant at any speed, yet their suspensions don't allow any lean or wallow in hard cornering. Handling is very predictable. I found good power with all engines except the smallest V6s to keep control when hanging out the tails of these cars. Not that that's a common situation, but GM had set up handling courses for previewers like me, one object being to wring out the vehicles and see what they could do under stress. They do extraordinarily well. Even the wagons handle and corner beautifully.

Bodies and engines

The normal A-bodied intermediate coupes and sedans come in four basic body configurations: two- and four-door notchbacks and fastbacks. No single line carries all body styles—the Century and Cutlass come only

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Материал, защищенный авторским правом



Specialty coupes are on same 108.1-inch wheelbase as the intermediate sedans and wagons. Chevrolet Monte Carlo is shown (top left); Olds Cutlass Supreme (top right); Pontiac Grand Prix (above) and Buick Regal Sport Coupe (right). The turbocharged V6, exclusively Regal, combines performance with economy. The 3.8-liter turbo V6 is a production version of turbocharged V6 that was first used in 1976 Indy pace car.



Chevette five-door hatchback joins the Chevette three-door for 1978. The five-door is built on a wheelbase 3 inches longer than the three-door and rear-seat legroom is 5 inches greater. Cargo volume is up 1.5 cu. ft. New 1.6-liter Four replaces last year's 1.4 giving an additional 5 hp. Standard is a four-speed manual gearbox and a three-speed automatic transmission is optional. AM radio is also standard equipment. Rear seat folds flat as in the three-door and car is extensively rustproofed.



FIRSTHAND REPORT

Driving the 1978 Chryslers, Plymouths and Dodges

by Bill Hartford AUTO EDITOR

'78 CARS

Halfway around the quiet, wooded Chrysler Proving Grounds in Chelsea, Mich., driving the new Diplomat station wagon, I had already counted a half dozen small, pastel-colored cars on adjacent test roads. At first I'd see one here, then one there and soon, zipping around as thick as rabbits, were . . . well, Rabbits. The VW kind. Some were marked "Economy Test" and others, "Emissions Test." I was witnessing the testing of the drive trains of the long-awaited, front-wheel-drive Chrysler homebuilts—the Dodge Omni and Plymouth Horizon!

Rabbit mechanicals will be in-

beaten out the other competitors (see Nov. '76, page 73). It went by like a shot and all was quiet again, insulated as I was in an extraordinarily comfortable, luxurious wagon.

Diplomat and LeBaron wagons

The station wagon is identical in wheelbase to the sedans introduced earlier this year (see *Firsthand Report*, May '77, page 44), and handling is fully equal to that of coupes and four doors as reported in that test. Moreover, there is no sacrifice



Dodge Magnum XE is a racy intermediate with 318 Electronic Lean Burn V8.

of luxury, comfort or style to pay for the tremendous utility of this wagon. Options, including leather seats and varieties of fully carpeted and color coordinated interiors, let you custom tailor the Diplomat wagon to the luxury level that meets your taste and pocketbook.

The same goes for the Chrysler LeBaron Town and Country wagon, but it's even more distinctive with its full "woody" treatment including the two-tone wood grain with verticals giving the wagon a nice, so-round, so-firm, so-fully-packed appearance lacking in the slab-sided Diplomat.

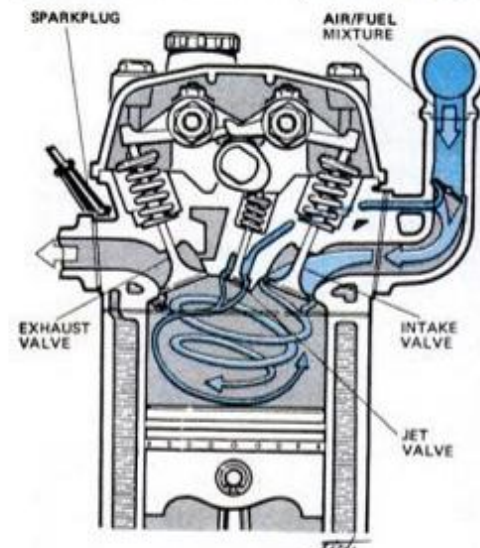
LeBaron and Diplomat, introduced with the 318 V8 as the only engine, now offer the 360 V8 and 225 Six as well. The 225 lets you have your luxury and economy too, but only if you're a feather-foot and don't tow. The 318 is the better choice.

The Diplomat/LeBaron models for '78, elegant sedans, sporty coupes and

extremely handsome wagons, as full size as anyone could want, offer the most luxury for the least outlay of those hard-earned dollars, as your own comparison-shopping trip will confirm. The Town and Country badge, now on the LeBaron wagon, you'll remember, was formerly used for the full-size (oversized would be a better description) Chrysler wagon. It's discontinued for '78 as are Plymouth Grand Fury, Chrysler Newport sedan and Dodge Royal Monaco.

Challenger and Sapporo

In the subcompact-size class, comfort and luxury, with a touch of style, is also the theme. Chrysler's new captive imports, Challenger and Sapporo, are a pleasure to look at, and you become more impressed when



Jet-valve system is used on 1600 and 2600-cc Fours (see MCA-Jet System).

you open the door and slide in. Every car owner should expect, indeed demand, that the catbird's seat be adjustable enough (including seat-back angle) to give a good driving position with full access to controls, and still be comfortable. These seats

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1978 SCOREBOARD

Model	Wheelbase (in.)
Dodge Colt/Plymouth Arrow (station wagon)	92.1
Dodge Challenger/Plymouth Sapporo	99.0
Dodge Aspen/Plymouth Volare (four-door, station wagon)	108.7
Dodge Diplomat/Chrysler LeBaron	112.7
Dodge Magnum XE, Charger SE, Monaco/Chrysler Cordoba/Plymouth Fury (four-door, station wagon)	114.9
Chrysler Newport, New Yorker	117.5
	123.9

stalled in the noses of these new cars, but, alas, I caught no glimpse of the body that will be used. The L-bodied cars are still not ready, and probably won't be until January 1978 (when we'll have a full report).

I began to ignore the Rabbits and went back to enjoying the Diplomat. However, one more interruption was in store. An olive drab Army tank crashed out of the brush and disappeared in a cloud of dust down one of the unpaved roads. Another drive-train test! This time it was a prototype of the XM-1 Chrysler is developing for the U.S. Army, having



Dodge Challenger, a new, sporty coupe that joins the Colt lineup, is conventional in layout as shown in the phantom view below. The Plymouth version (left below) is the Sapporo, named after the city in Japan where the '76 Olympic games were held. Both cars are made in Japan for Chrysler by Mitsubishi. New 2+2 coupe's standard powerplant is a 1600-cc Four with five-speed transmission. Displacement is a liter more with the optional 2600-cc Four. Both engines feature Silent Shaft design and clever lean-burn, jet-valve system as detailed on the opposite page.



Chrysler LeBaron Town and Country station wagon (right) and Dodge Diplomat wagon (above) join the two and four-door Diplomats and LeBarons introduced earlier this year. The smooth-riding, mid-size wagons, on a wheelbase of 112.7 inches and 202.8 inches overall, are comfortable, roomy and luxuriously trimmed. Woody treatment on the LeBaron is reminiscent of the Town and Country of the '40s and '50s . . . but no varnishing is necessary! Standard engine is 225 Six; 318 and 360 V8s optional.



Driving the 1978 cars from American Motors

'78 CARS

by Michael Lamm WEST COAST EDITOR

American Motors Corp. enters 1978 by upgrading and renaming Hornet. It's now called the Concord, and it's quieter, more luxurious and considerably refined.

Also of note: You can now get a V8 in the Pacer for the first time. AMC has likewise redone the AMX, glamorized the Gremlin, extended the Barcelona package to the Matador sedan, and made some subtle changes in the Jeep lines.

Driving the Concord & AMX

AMC invited the automotive press to preview its 1978 cars at Michigan International Speedway, which was probably a bad choice of locations because the track surface had just been all chewed up and was undergoing repaving. It had some bad waves and dips in it that didn't show AMC's cars in their best light.

I drove the new Concorde with two different engines—the two-barrel, 258-cu.-in. Six and the 304 V8. The Six is much smoother and quite a bit quieter, but the V8 predictably gets the car up to cruising speed sooner.

On smooth surfaces, the Concord's ride is extremely pleasant and silent. You'd never guess you were in a 108-inch-wheelbase compact. But the speedway's wavy sections showed up some weak shocking that left the Concord porpoising and going to the

extremes of its suspension—something that wouldn't have happened on GM's proving grounds.

I understand the Concord uses the same rear springs as the Pacer. A sway bar is standard, but the Concord could benefit, I feel, from the AMX's suspension calibration.

The new AMX has noticeably tighter shocks and gives a firm but comfortable ride. Its standard DR78 x 14 steel-belted radials help it corner with the best. There's very little body lean, but then the Concord's no slouch either when it comes to fast cornering.

Standard in the AMX is a manual four-speed gearbox that's fun to use and has long, long gears. With the optional 2.53:1 rear axle, the engine will turn less than 2000 rpm in high. I was driving the AMX with the two-

1978 SCORECARD

Model	Wheelbase (in.)
Gremlin	96.0
Pacer	100.0
Concord	108.0
AMX	108.0
Matador	
coupe	114.0
sedan and wagon	118.0

barrel 258—a good all-around combination for performance and fuel economy.

Appointments inside the Concord make it more elegant than the 1977 Hornet. The difference is truly impressive. Two- and four-door Concord sedans have plush velveteen upholstery, while the Concord hatchback and wagon get soft-feel vinyl seats. Recliners are again optional. The instrument panel is new for both the Concord and AMX: It's attractive, complete, and easy to read.

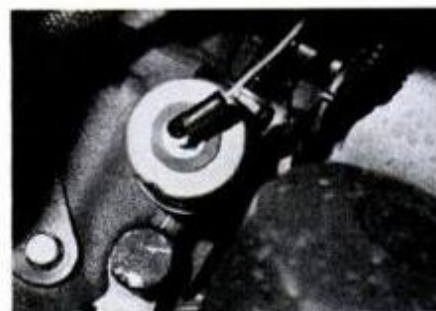
The V8-powered Pacer weighs 200 to 250 pounds more than the Con-

(Please turn to page 178)

AMC SERVICE TIPS

■ The "cat" really is king in Detroit in 1978, as AMC installs the catalytic converter across the board. Some AMC sixes were the last of the noncat engines in 1977, although they still required unleaded fuel to pass 50,000-mile emission certification tests.

■ A blown dashboard circuit fuse on some '78 AMC cars could affect gas mileage. Here's why: Some AMC V8s will have an electric choke fed through a switch (see photo) wired into the oil-pressure sending unit, instead of the



Switch for the electric choke is on the oil pressure sending unit.

traditional tap off the voltage regulator. This is because a solid-state regulator with no tap is in some models. If the fuse controlling the oil-pressure sending unit circuit blows, the choke won't get electricity to warm up quickly. Thus, it will come off very slowly and short-trip gas mileage will be reduced.



Racy AMX has four-speed manual transmission standard, new instrument panel.



Matador Barcelona coupe sports padded landau top and a custom interior.



1978 Concord derives from AMC's Hornet series, spans same 108-inch wheelbase, uses very similar unitized body. New grille, pillar treatment, rectangular headlamps, egg-crate grille and tricolor taillights distinguish the exterior. Inside, there's a revamped instrument panel, more insulation and more luxurious appointments. It's a refined car to drive and comes with a choice of two Sixes and the 304-c.i.d. V8.

Pacer for 1978 shares AMC's 304 V8 for the first time, also gets a taller grille for better cooling. Wide interior gives comfortable seating for four, and when the rear seat is folded there's a large cargo deck. The wagon shares the changes.



'78 CARS



Ford Fairmont and Mercury Zephyr are the pride of the Ford Motor Co. on its 75th anniversary year. All-new lineup of models includes two- and four-door sedans and station wagons, and later this year, a sport coupe—the Fairmont Futura and Zephyr Z-7. All are on a 105.5-inch wheelbase and 193.8 inches long (197.7 for Futura and Z-7). Engines are 2.3-liter (140-cu.-in.) Four, 3.3-liter (200-cu.-in.) Six and 5-liter (302-cu.-in.) V8. Weight is under 3000 pounds.

Ford Fairmont two-door model is shown above and right; Mercury Zephyr four doors and Villager station wagon below. Fairmont and Zephyr fill gap left by discontinued Maverick and Comet, but it's hardly fair to call them "replacements." Fairmont and Zephyr are compact outside, mid-size inside, and this sensible or "European" (brags Ford) design blurs the meaning of the old classifications: full size, intermediate, compact, subcompact. Stripped models with a Four are vastly different from loaded V8 cars in comfort, performance and dollars. With station-wagon, Ford now competes with hot Aspen/Volare wagons. Tailgate lifts high to save your scalp.



Mercury Cougar XR-7 two-door hardtop in full battle dress contrasts sharply with more pacific Fairmont and Zephyrs. The heavy cruiser's V8 firepower is 302 cu. in. standard, 351 and 400 optional.



Driving the 1978 Fords, Lincolns and Mercurys

by Bill Hartford AUTO EDITOR

How you greet the new Fairmont and Zephyr depends on where you've been. If you've been at the wheel of a Maverick or Comet for, lo, these many years, they'll knock your hat off they've got so much more headroom and visibility; if you've been easing an LTD II or big Cougar around town, you'll delight in their maneuverability; if you've grown accustomed to the charms of a European sedan, with its space and fuel efficiency, you'll be amazed at how nicely Ford has copied it; if you've been ruling the road in your scarlet Lincoln Continental, you, frankly,

these cars, and indeed it's hard to describe them without resorting to comparisons with European sedans, notably Volvo, which these cars resemble to an extraordinary degree. For one-half to two-thirds the price of such imports, though, Fairmont/Zephyr offer many of the same features.

Here are some of the things you can look for on the F/Z models.

- Lightweight, strong, unitized body. Compare, for example, the space-saving door design to that of the '77 Maverick: it's 1½ inches thinner, 15 pounds lighter and just as strong.

- Rack-and-pinion steering, with variable-ratio system optional. Note the light, cast-aluminum gear housing.

- Strut-type front suspension with stabilizer bar (see *Under the Hood of the Fairmont/Zephyr*, page 110) and four-bar-link, coil-spring rear suspension.

- Front discs and coolant recovery system.

- Precedence of interior space requirements over brash body styling. Compare, for example, the fantastic trunk capacity (16.8 cu.ft.) and the inside dimensions to that of other compacts.

- Good instrumentation and controls (many stalk-mounted on steering column) and excellent visibility.

- Careful attention to aerodynamics

SERVICE MADE SIMPLE

The heater in Fairmont/Zephyr models represents a big improvement in serviceability over such models as the Pinto. Heater-core nipples project through the firewall so you can replace a heater hose working easily in the engine compartment instead of struggling under the dashboard.

The heater core on non-AC models looks as if it were inspired by a TV set design ("works in a drawer"). Once the hoses are disconnected, you just remove some retaining screws and pull out the core as if you were pulling out a drawer.

1978 SCOREBOARD

Model	Wheelbase (in.)
Ford Fiesta	90.0
Ford Pinto/Mercury Bobcat	94.5
Ford Mustang II	96.2
Lincoln-Mercury Capri	100.9
Ford Fairmont/Mercury Zephyr	105.5
Ford Granada/Mercury Monarch/Lincoln Versailles	109.9
Ford Thunderbird/Ford LTD II/Mercury Cougar	114.0
Four-door	118.0
Lincoln Mark V	120.4
Ford LTD/Mercury Marquis	121.0/124.0
Lincoln Continental	127.2

won't give a darn about these efficient new compacts.

We'll continue to call Fairmont and Zephyr "compact" cars only because their outside dimensions put them into that size classification. For cars of their wheelbase (105.5 inches), they are better described as marvels of space efficiency, and the lightest and liveliest cars (Fiesta excepted) ever to come from Ford.

They can be had with Lincoln-like luxury (with V8 and loaded), with better-than-Maverick miserliness (a Four and stripped) or with qualities somewhere in between with Six and selected add-ons like the European Sports Option (ESO). FoMoCo itself emphasizes the European approach to design that is embodied in

for every possible mile-per-gallon.

- Full range of handling, comfort and convenience options, and accessories with tasteful designs.

With the Fairmont/Zephyr cars Ford has further closed the tremendous gap that has existed between American and European cars. With mature automotive design as shown in these new compacts, we're getting the best of both worlds.

The emphasis is on Fairmont/Zephyr this model year with the other cars in the lineup getting various mechanical and cosmetic refinements and new options.

Ford Fiesta

This whizbang of a car was discussed in depth just before its Au-



Zephyr Z-7 (above) and nearly identical Fairmont Futura are special, two-door, sport-coupe versions of the new compacts. Introduction of these sporty models won't take place until later in the model year, or early in January 1978.

gust introduction here (see July '77, page 54).

Ford Pinto/Mercury Bobcat

The winners in the long battle (begun in 1970) against now defunct Vega. Millions on the road and going strong. Split, fold-down rear seat and feedback carb (see *Ford's New Feedback Carburetor*, page 111) are new for '78.

Ford Mustang II

Choice of hardtop, Ghia, 2+2 and Mach I. Like F/Z, offers engines from the 2.3-liter Four to the 5-liter V8. King Cobra and Fashion Accessory groups help dress up this Mustang, but it just doesn't have the charisma of its predecessors.

Lincoln-Mercury Capri

This German Ford, sold here by L-M dealers, is unchanged since its introduction in 1977 form this past spring. It's smashing in its Le Cat Black "S" trim, but has got tough competition from over the other ocean: Zs, Liftbacks, et al.

Ford Granada/Mercury Monarch

The make-believe Mercedes still looks smart and fresh and gets only a little touch-up for its fourth year. Two-doors get a gimmicky "Twindow," a split opera window. (Profile of Futura and Z-7 is pretty close to this twindowed two door.) New engine choices are 250 Six and 302 V8. Scratch 200 Six and 351 V8.

Ford Thunderbird

Lots of icing for the Bird on Ford's 75th birthday. Diamond Jubilee frosting heads the list of the cosmetic gook. Underneath it all, though, the mechanicals purr. With big 302, 351 or 400 V8s, air, sound, power everything and crushed velour body cloth, it's bionic and embryonic bliss. Ditto for Cougar XR-7.

Ford LTD II/Mercury Cougar

Practically unchanged, these intermediates will seem like pterodactyls next to GM's scaled-down intermediates for '78.

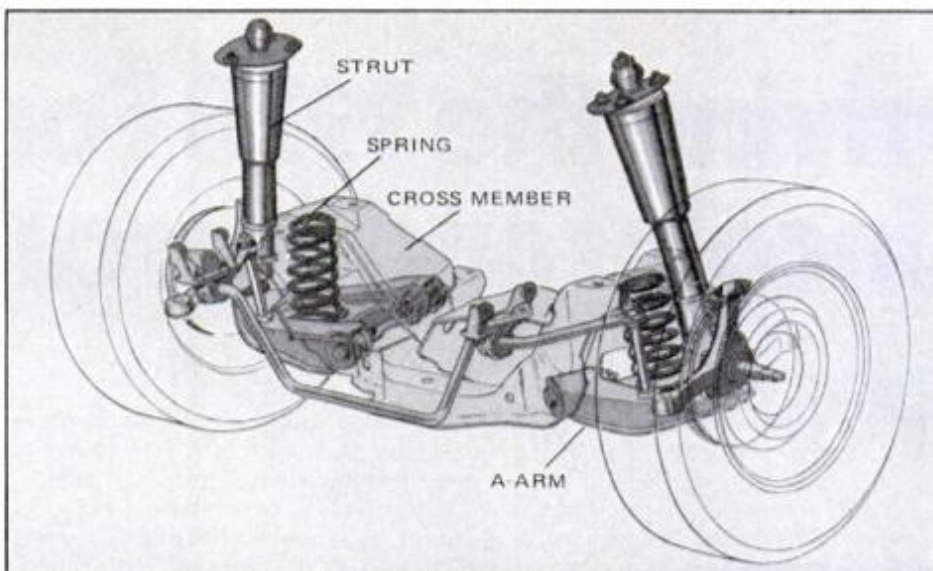
Ford LTD/Mercury Marquis

Aerodynamic refinements (like front bumper spoiler and rear floor pan deflector) help a bit on these full-sized old favorites, but they're doomed to extinction in the battle for more mpg.

Lincoln Continental Mark V

Old-time luxury complete with spare-tire trunk lid, coach lamps, beveled-glass opera windows which get the crowning touch of '78: a simulated diamond chip laminated into

UNDER THE HOOD OF THE FAIRMONT/ZEPHYR



Front suspension is modified MacPherson with strut and spring side-by-side.

The front suspension on Ford's new Fairmont and Zephyr is a modified MacPherson strut. Struts are supposed to increase space in the engine compartment by combining coil spring and shock absorber into one unit and eliminating the upper control arm. Ford, however, has separated spring and shock, putting them side by side.

The coil spring is mounted inboard of the shock (between control arm and cross member) which changes the leverage and permits a very short spring to do the job. The short spring design intrudes on the engine compartment, but it does so at the very bottom, an area where space isn't overly valuable. The intrusion of the shock section into the upper part of the compartment, however, is reduced. Where it really counts, the compartment is several inches wider.

Moving the spring from the shock strut also reduces friction on the upper strut mount. This means Ford doesn't need a ball-bearing upper mount to ease manual steering, but can use a rubber mount, which absorbs road vibrations better.

For Saturday mechanics, however, the extra room is the big news. Obviously it helps a lot on V8 models, but it also makes a difference on the in-line six-cylinder, which is expected to be the top-selling engine. The left side of the compartment is where all the frequent service items are located, and they're wide open. On the right side are the low-service-priority items, so there's a bit of clutter there, but thanks to the extra few inches of space provided, serviceability is tolerable.

The alternator and airconditioning compressor are among the items on the busy right side, which leave the power steering pump all alone and mounted low on the left side. Result: the power steering pump belt is supereasy to adjust, and the pump is out of the way of a clear view to the timing marks. As the marks on more and more cars get buried by accessories, the Fairmont/Zephyr Six is a nice change.

■ **Accelerator pump.** If you buy an F-Z Six with manual transmission, the one-barrel Carter carburetor has a built-in feature for better acceleration in all kinds of weather. It's a temperature-sensitive accelerator pump that increases the amount of fuel pumped in cold weather, reduces it in hot, and it works this way:

Inside the carb is a temperature-sensitive bimetallic disc valve that covers a fuel vent passage in the accelerator pump discharge circuit. In cold weather, the bimetallic disc closes off the vent, and when you mash the gas pedal you get maximum fuel discharge into the air horn. In hot weather, the bimetallic strip flexes the other way and opens the vent. When you hit the pedal, part of the fuel escapes through the vent passage and flows back into the fuel bowl.

If the bimetallic disc misbehaves, you can tell when you accelerate. If it sticks in the hot position (reduced fuel discharge), you'll get engine stumble on acceleration with a cold engine, particularly in very cold weather. If it locks in the cold position (maximum fuel pumped), you'll encounter "pump slugging," a stumble from richness, in hot weather. Slugging is like the hesitation you sometimes encounter with an automatic transmission, in which the engine suddenly seems to catch up and from then on runs smoothly.



Heater core pulls out as if it were a drawer; it makes service simple.

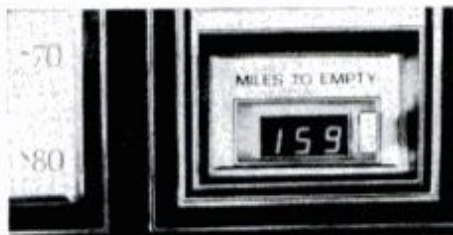
MARK V'S BUILT-IN FLIGHT ENGINEER

Would you spend about \$100 for a computer-controlled dashboard digital readout that tells you how many miles the car will go until you run out of gas? If you're buying a Continental Mark V, you might.

Ford has gone to great lengths to design a new in-tank sending unit that is extremely precise, and capable of measuring changes in fuel level under almost all types of road conditions.

It sends this information to a microprocessor, a quarter-inch square 3600-transistor computer in the dash. The microprocessor, which also picks up road-speed and miles-traveled data from a sensor spliced into the speedo cable, computes fuel consumption and compares it with fuel remaining in the tank. Press a dashboard button and a digital display lights up, tells you how many miles to empty.

The computer makes its changes slowly, over several minutes, to minimize fluctuations from driving conditions, such as climbing a hill. However, you



can still get some pretty wide variations from changes in driving conditions, so the numbers really don't mean much.

In any case, it's a dashboard toy and Continental Mark V buyers are the best potential customers for \$100 toys. The dashboard computers get a low-volume field test and engineers get someone to pay for ongoing development costs.

Most Lincoln buyers, including those who can only swing for a plain Continental, will get a dash light (fed by a sensor in the container) that tells when fluid level in the windshield washer reservoir is low. Versailles customers will not get this worry-eliminator.

FORD'S NEW FEEDBACK CARBURETOR

The '78 Ford Pinto and Mercury Bobcat with the 2.3-liter Four sold in California, will have a new emission-control system. It features a twin-catalyst and a carburetor with a variable fuel-mixture system, plus an electronic control unit and a host of sensors and vacuum valves.

The catalyst design is the key to the system. One catalyst section, a control for hydrocarbons and carbon monoxide, is the type of converter used on most U.S. makes since 1975.

The other converter cuts nitrogen oxides (NOx). Unfortunately, the NOx catalyst works well only when the air-fuel ratio going into the cylinders is very close to 14.7 to 1, and such numbers as 15.0 to 1 are not considered even close. This means there must be some way to keep adjusting the carburetor to keep the fuel mixture just right.

The control system begins with an oxygen sensor threaded into the exhaust manifold. It's just a monitor. Any change in air-fuel ratio changes the amount of oxygen in the exhaust gases, and the oxygen sensor responds to this with a variable electrical signal, which it transmits to an underhood electronic control unit.

The electronic control unit supplies current to a solenoid-actuated vacuum valve. This device receives engine vacuum, and the current from the control unit will operate the solenoid long enough to pass an amount of vacuum in proportion to the change in fuel mixture required.

The vacuum passes into a diaphragm chamber in the carburetor, where it moves a diaphragm attached to a needle and seat valve. If the mixture is too lean, the correctional vacuum pulls the diaphragm and draws the needle off its seat, letting more fuel flow (richening the mixture).

When the mixture is rich enough, the

computer chops current to the solenoid, stopping the vacuum flow and the diaphragm springs back, pushing the needle back into the seat. Because the carburetor can vary its mixture based on information fed back by the oxygen sensor, it is called a feedback carburetor.

An air-switching arrangement also is part of the system. When the engine starts, the air pump supplies air to the exhaust manifold, where it flows into both catalyst sections, warming them quickly. The NOx section, however, can't use the extra air for long, because it would lean out the exhaust, thus defeating the feedback carburetor system.

An air control valve, therefore, is added to the air-pump system. When the engine is nearly warmed up, this valve (triggered by a temperature sensor) stops the airflow into the exhaust manifold and switches it to a point midway between catalyst sections, so it can flow only into the hydrocarbons-carbon monoxide converter, where it is helpful. The air pump has a dump valve, with temperature and vacuum controls, to vent this second airflow to atmosphere as needed. This dump valve is nothing new; it is a standard part of the system.

The only scheduled maintenance on the feedback carburetor system is replacement of the oxygen sensor at 50,000 miles. It can be replaced like a sparkplug.

If this sounds familiar, it is (see *Driving the Lambda Sond Volvo*, page 57, July.) The Lambda Sond system is less complex because it uses Bosch fuel injection which lends itself more readily to mixture changes.

Ford's design is the first application of feedback to a conventional carburetor and will be introduced later this year as a running '78 change.

the glass. Only in America. Miles-to-empty readout is neat (see *Mark V's Built-in Flight Engineer*, left).

Lincoln Continental

The Big One. It can't get bigger, but it can get better: Maintenance-free battery, more efficient automatic transmission torque converter, electronic voltage regulator and some add-ons like windshield washer fluid-level indicator and illuminated outside thermometer are new for '78.

Lincoln Versailles

Nice, sensible luxury car—on the scene since April (see page 112, April '77). Among other refinements, it gets a new rose tint for Moonroof, astronomy fans. Under the hood is the first application of Ford's new Electronic Engine Control (EEC), which bears a closer look.

Getting technical

"My black box knows how to do more than yours" is the computer game in Detroit now, and the newest entry is EEC. Like the pioneer, Chrysler's Lean Burn, and GM's MISAR, the Ford black box controls spark advance electronically, but for an edge Ford added circuitry to also regulate the exhaust-gas recirculation valve and the air-pump system.

Ford's system, which makes its debut on the '78 Lincoln Versailles with the 302 V8, is the first one that completely eliminates adjustment of ignition timing. If timing isn't right, a component is defective and must be replaced.

Spark advance

Here's how the spark-advance portion of the system works. A computer with a plug-in module (calibrated for the particular car) makes the decisions, based on information from these sensors:

- Inlet air-temperature sensor in the air-cleaner housing.
- Coolant temperature sensor in the engine block.
- Throttle angle position sensor on the throttle-linkage shaft. It's a rotary variable resistor that changes its current-flow signal to the computer according to throttle opening.
- Barometric-pressure sensor. It's a barometric bellows that controls a variable resistor, to provide automatic compensation for changes in altitude.
- Intake-manifold absolute pressure sensor. It measures intake-manifold pressure, which is somewhat less than atmospheric, because of the effect of engine vacuum, so it gives an indication of engine load. Ford

(Please turn to page 164)

The pick-em-ups go pretty

New color and comfort come to the latest work-and-play muscle machines.

by Bill McKeown
OUTDOORS EDITOR



You can pack this International Suntanner for family work or fun.

"Keepon truckin'" say the bumper stickers, and in a *Popular Mechanics* preview of automotive manufacturers and users we find more and more people agree. The popularity of those light panel trucks called "vans" has been no secret. But now sales of the high-spirited workhorse—the pickup—are booming, too. Detroit's question: Can they be built fast enough to satisfy everyone today who wants the rig with the open cargo space behind? It is estimated that already more than half of all pickups purchased are being used for fun as well as work—they're the newest pleasure car.

For years, a pickup owner has been able to enclose the cargo bed behind the driver's cab with a canvas tarpaulin or tonneau cover, or hardtop it with a cap-

Roll bar and sex-appeal paint job are among tip-offs identifying new Dodge Macho Power Wagon.



Материал, защищенный авторским правом



Take a versatile basic rig like Ford's F-100 Flairside pickup, let Turtle Top of Goshen, Ind., customize it with high-riser exhaust and truck cap, and attractive result for '78 is above.



Jazzed-up Jeep version of the J-10 four-wheel drive, high-styled Honcho pickup features name on side, body stripes, cargo-bed roll bar, 258-c.i.d. standard engine or 360 V8 option.



Two-door club cabs, like the Dodge D-150 with diesel option, seats behind the driver, and four-door D-300 crew cabs will be available for more passengers or larger families next year.



Ford's 1978 Flairside Model 150 pickup offers optional four-wheel or standard drive, also comes as Styleside flush-fender, is easy to sport up with a roll bar mounting quartz lights.



A straightforward workhorse with a capability for customizing, the Jeep J-20, like the Wagoneer, has a standard 360-c.i.d. V8 engine and choice of AMC's 401 V8 for its four-wheel drive.



The 1978 Silverado C-10 Fleetside pickup from Chevrolet also can be bought next year with 4wd or new diesel power for two-wheel drive. Appearance is similar to some GMC pickup models.

cover box of metal or plastic that frequently sports side windows and a door in back. You can get fancier with a fold-out tent, a telescoping crank up-and-down enclosure, or a big slide-in camper body that carries a double-bed bunk out over the driver's cab.

Latest pickups, like those shown here, however, are taking on the accessories of the off-road and beach-buggy clans. You'll see high-riser chromed exhaust stacks that jut up tractor-trailer style behind the cab. There are roll bars mounted in the cargo bed, and fifth-wheel trailer hitches. (The pickup trucks, in fact, may be the new trailer-tow answer if standard cars keep getting smaller, lighter and weaker.) Flashy pickup paint jobs can now rival vans, though they have less space for murals. Plush-lined, airconditioned and

stereod truck cabs, often of the four-door, club-cab variety for more passenger space, are more in evidence. You can spend \$10,000 or more for a fancy rig.

Even the little Japanese import pickups, like Datsun's, rate cap covers, camper bodies. The four-wheel-drive rigs can enclose the front seats only to leave a mini pickup box in back. International's new Sun-tanner (see facing page and front cover), based on the Scout Terra pickup is a three-way convertible—vinyl top, fiberglass hardtop or wide open with or without a matching tonneau cover over the pickup bed—take your pick. The rough and ready denim-type work look in sport clothes seems to be catching on in cars. In pants or pickups, we'll be getting more versatility and durability.

★★★

How to maintain your moped

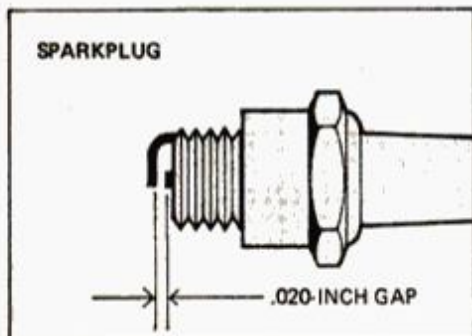
by Eugene A. Sloane

Mopeds are fun to whiz around on, until they start coughing, sputtering and giving other signs of coming down with the two-stroke croup. If you want to keep your moped zooming through the bright sunny days, dark of night and gloom of winter, here's what you'll need to know to do routine maintenance.

Instructions that show you how to tear down the motor and do major repairs would fill a book, so I'll cover what you should do every few thousand miles.

Ignition maintenance

While you will probably need to replace the points and condenser



Gapping sparkplug is basic moped maintenance job; gap's usually .020 inch.

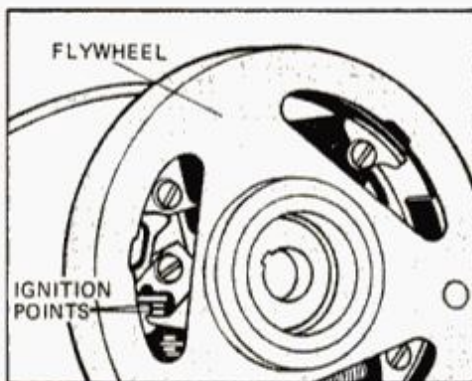
every 3600 miles or sooner, you may find your moped refusing to start for a number of reasons not related to the points. So, eliminate the more common causes first.

For example, on many mopeds a burned-out taillight or defective switch that shorts when brakes are applied, will kill ignition. So check lights; then the stoplight switch.

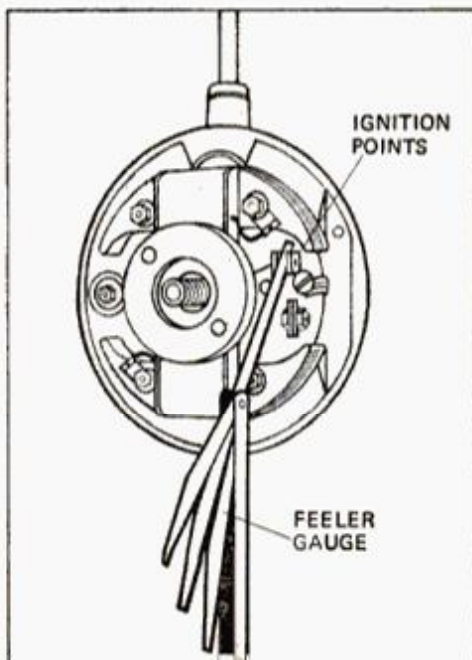
The "kill" switches on most mopeds are flimsy. Check to make sure they work. Use a test light or ohmmeter to test continuity of switch circuit.

If you still have no spark at the sparkplug wire (test by kicking over the engine with plug wire about 1/4 inch above the motor block and observe spark, if any), you can have a defective coil or zener diode, in which case you have a shop job for the dealer to handle.

Make sure the sparkplug itself is



Ignition point gapping can be tricky: access is through hole in flywheel. Feeler gauge (below) is used to adjust points to spec: Loosen screw on movable contact.



clean. If you have used too much oil, the plug will foul quickly. Symptoms are stalling motor at stoplights, hard starting. Clean plugs every 500 miles, replace every 3600 miles. Some plugs look clean, even spark when laid on top of an engine block, but won't fire under compression. You need only one plug, so change it if in doubt.

Whether installing cleaned or new plugs, make sure they are gapped to specs, usually .020 inch.

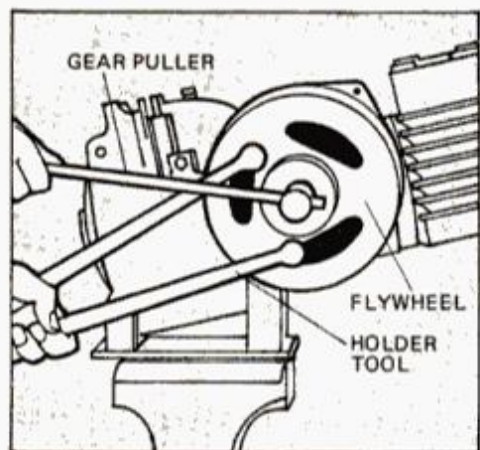
Checking points

To check points, you will need to remove the flywheel cover, underneath which you can see the points through slots in the flywheel. The flywheel cover is usually plastic or light metal and is easily removed.

If points are pitted, badly burned or corroded, they should be replaced. If they are not pitted or burned, you can clean them with very fine emery cloth, followed by a piece of paper. Point gap can then be readjusted to the normal .014 to .018 in. by using a feeler gauge through the flywheel hole and adjusting gap by loosening the point-fastening screw and moving points the correct way.

Timing the ignition

Whether you clean and regap points, or install new points and condenser, you will have to retime the engine. The theory is that a sparkplug should ignite gas/air mixture while the piston is coming up to top dead center, to cushion the



Flywheel is removed to change points. Special tools are holder and gear puller.

piston mass travel before it hits top dead center. Most moped specs call for the sparkplug to fire at 23° before top dead center (23° BTDC). You won't be able to measure when the piston is at 23° BTDC directly, so various makes of mopeds provide alternate methods of telling when the points open at this position.

The Motobecane mopeds, for example, use a plug with a traveling

rod with white and blue marks on it. The plug screws into the spark-plug hole. When the piston rises and pushes the rod up to the blue mark, the piston is at the correct BTDC value. At this point the points should just begin to open, as evidenced by a test lamp lighting or an ohmmeter needle deflecting when connected between the primary (blue or red) lead from the magneto coil and ground.

To correct the timing, the magneto stator base plate is held by two fixing screws. To correct retarded timing, loosen these screws,

see that these marks line up while the engine is running. *Remember, anytime you change point gap you have to check engine timing.*

Changing points

If points are pitted or burned, you will have to change them. Always change the condenser while you are at it. To change points you

wheel is loose. Remove flywheel, being careful not to lose the small Woodruff key.

With the flywheel off, the points are right there in front of you, held in place by two screws. Remove the point wire, the two screws, replace points and the wire.

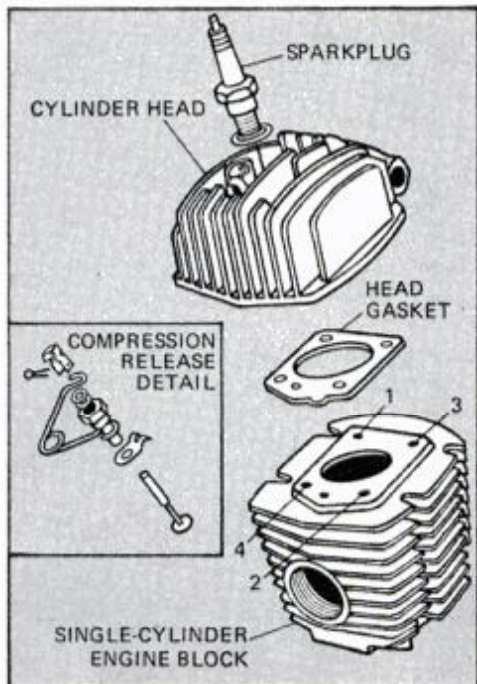
To regap points, remove the spark-plug, turn the engine until points are open fully, check that gap is between .014 and .018 in. with feeler gauge. Replace flywheel and check timing as above.

Decoking the head and muffler

Because all mopeds are two-stroke, oil must be mixed with gas (fuel) to lubricate the piston and, in some cases, the crankshaft assembly. Since oil carbonizes, it will eventually coat the cylinder head and muffler insides with carbon or "coke" as it's sometimes called. These parts, then, must be decoked or decarbonized occasionally.

Symptoms of an engine which has excessive deposits and requires decoking are hot running and loss of power. This occurs so gradually you may not realize how much power you have lost. If the moped acceler-

(Please turn to page 186)



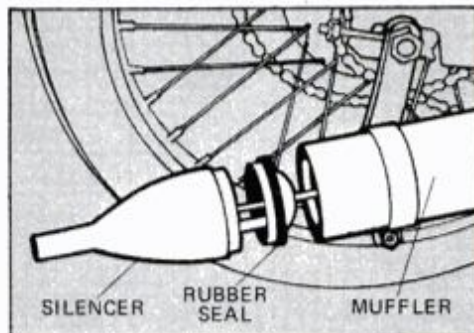
Engines like the one shown here have a compression release in head (insert). When replacing head, tighten head bolts in diagonal order shown (1, 2, 3, 4).

turn the plate counterclockwise and vice versa.

Other makes require you to screw a dial indicator into the sparkplug hole. (This indicator is an expensive instrument, and isn't worth buying unless you have two or three mopeds of the same make engine in the family.) To use the dial indicator, rotate the motor until the dial needle just begins to change direction. Points should open when the dial indicator reads between .032 and .048 in. (0.8 and 1.2 mm). If not, correct the timing by moving stator plate as noted above.

Other makes have marks on the flywheel and engine casing indicating the correct piston BTDC location and point opening. As you rotate the engine clockwise, the points should begin to open (as shown by a test lamp or ohmmeter) when the arrows or marks line up.

Another way to check this timing is to use a timing strobe light to



Rubber seals are used between sections of some mufflers; replace after decoking.

will need two special tools to remove the flywheel cover: a flywheel holder and a gear puller that fits your make moped. Hold the flywheel in place with the holder, remove the flywheel nut, screw in the gear puller, turn the gear puller shaft until the fly-

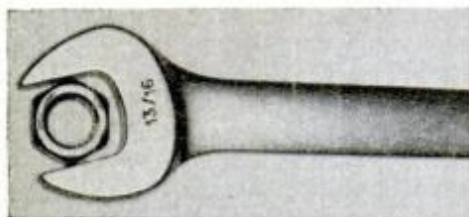
TYPICAL MOPED MAINTENANCE SCHEDULE*								OPERATIONS TO PERFORM
FREQUENCY								
(After... miles)			(Every... miles)					
300	600	900	600	900	1800	3600	7200	
●			●					Check tire wear and condition
	●					●	●	Adjust throttle cable
		●		●		●	●	Check gearbox oil level
	●			●		●	●	Clean and lubricate chain
	●				●	●	●	Clean air filter
	●					●		Change gearbox oil
	●	●		●		●	●	Check sparkplug
						●	●	Decarbonize engine
					●	●	●	Clean exhaust baffle
	●				●	●	●	Retighten screws and nuts
	●					●		Clean gasoline petcock and lines
	●				●		●	Clean carburetor
	●				●		●	Adjust idle speed
	●					●		Check ignition timing
	●					●		Adjust clutch
	●			●	●	●	●	Check brakes/linings
	●					●		Check/lubricate hub bearings
	●						●	Adjust/lubricate steering bearing
	●			●		●	●	Lubricate control cables

NOTE: Above time schedule applies to moped use on dry paved surfaces. If moped is used in wet, muddy or sandy areas, maintenance should be more frequent. Always check controls and lights before any trip. *May vary slightly from make to make. Please check owner's manual or shop manual.

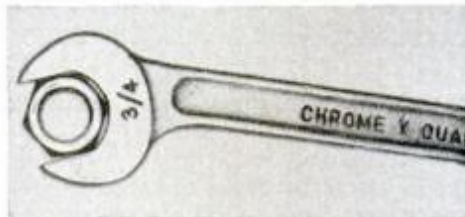
How to crack 'impossible' nuts

Nuts! That's the mildest of exclamations when frozen fasteners prevent you from doing a job on your car. Here are some tips for loosening those nuts and bolts.

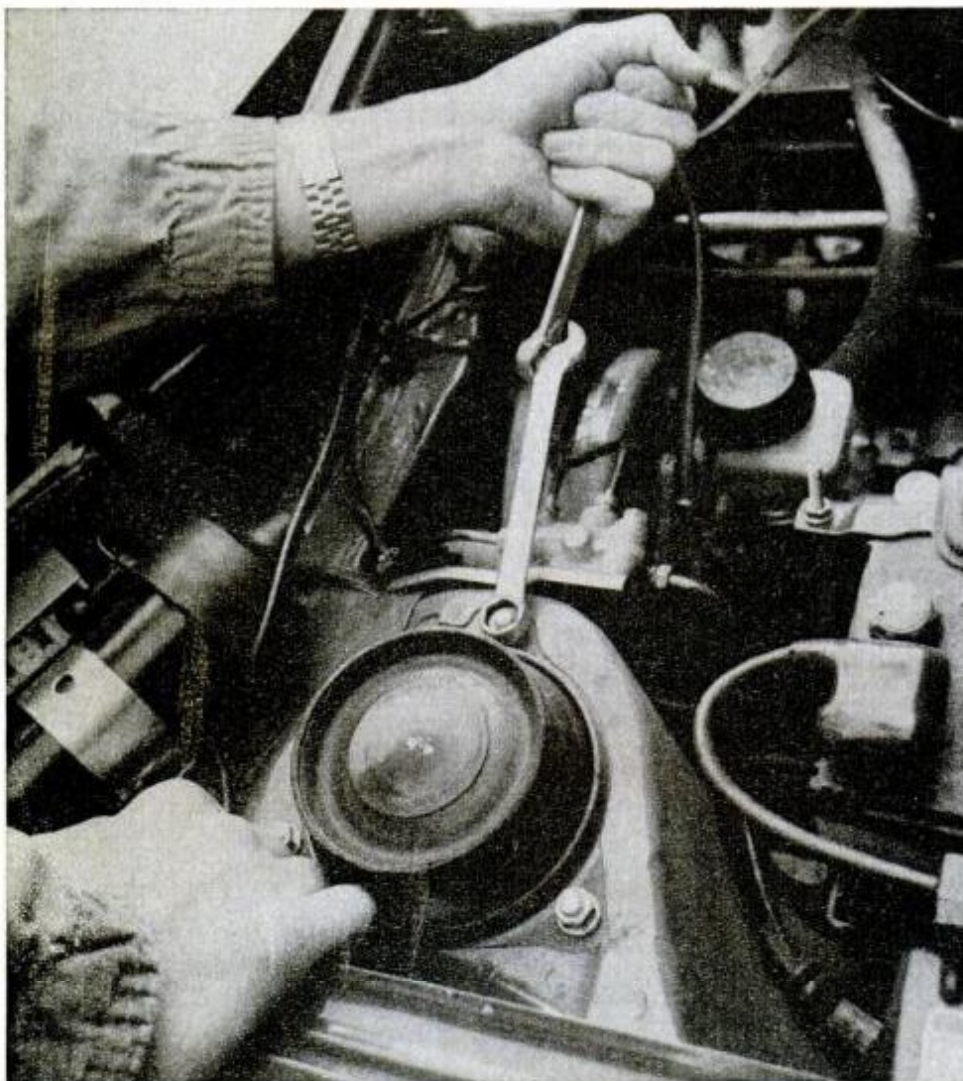
by Doug Richmond



Open-end wrench must fit perfectly or it will slip and round the nut as shown here.



Correct-fitting open-end wrench grips only two sides so it may not loosen tight nut.



Combination wrenches may be too short to loosen tight nuts. One way to "cheat" is by hooking the box end of a cheater wrench over open end of the work wrench.

Most service manuals start out: "To remove the head (or manifold or valve cover or whatever) remove the nuts securing it. . . ." The problem is these manuals never say one word about what you are supposed to do if the nuts or screws are rusted, galled or seized!

When you encounter these "tough nuts," first apply penetrating oil liberally to the nuts and any projecting threads. Lacking penetrating oil, any thin oil will do. Even hydraulic transmission fluid will help. Allow the oil as much time as possible to work its way down through the rust and along the threads before you reach for the wrenches. Many foresighted professional mechanics try to arrange their work so that the oil can soak overnight.

The next thing, of course, is to apply sufficient torque to the nuts to unwind them, using the right tool.

The common open-end wrench is the poorest wrench to use on hard-to-turn nuts inasmuch as it is designed solely to be convenient and fast in light-duty use. It contacts a nut or hex-head screw on only two corners and under severe stress the jaws have a tendency to give just enough to allow them to ride over the corners, rounding them off in the process.

Put a hex on them

For this reason the most popular tool in the mechanic's box is the combination wrench, the kind with an open end and a box end at opposite ends of the same tool. The box part may be either hexagon or "6-point," or double-hexagon or "12-point." The sole advantage of the 12-point is that a new "bite" only requires 30° of handle movement, whereas the 6-point takes 60°. To put it another way, the 12-point can be manipulated in somewhat closer quarters.

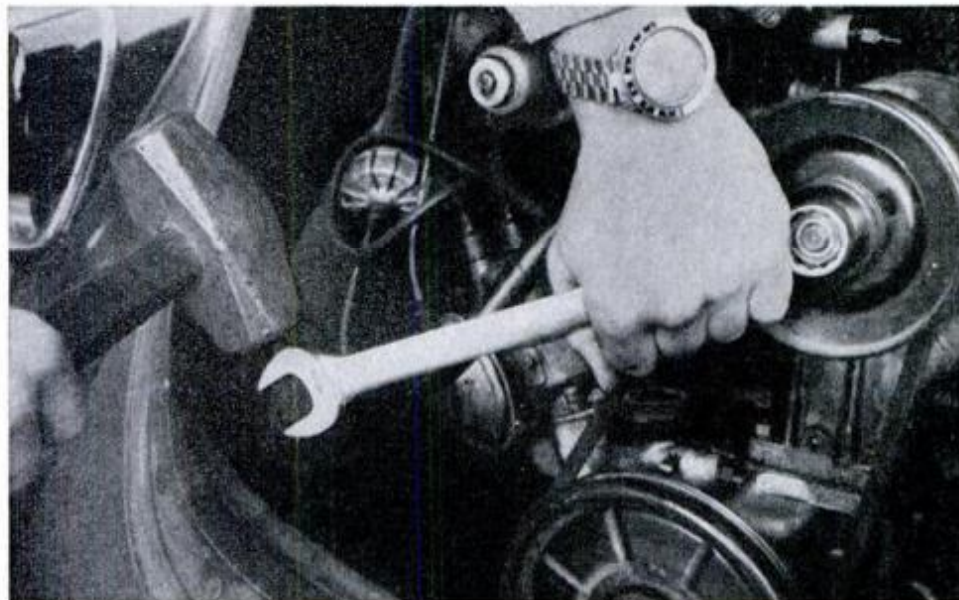
But for applying maximum torque to stubborn fastenings the hex wrench wins hands down. On badly rounded, soft or extremely rusted fastenings, it contacts a larger area and has much less tendency to ride over and round the corners than a 12-point.

Getting more leverage

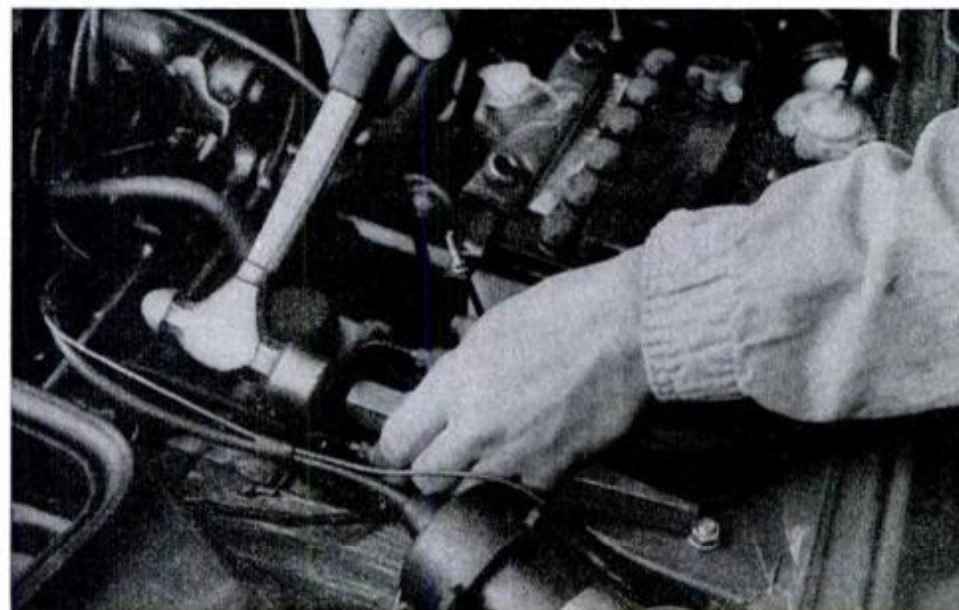
Most combination wrenches are too short to get enough leverage to loosen really tough nuts. But this is easy to overcome by "cheating": hooking the box end of another combination of about the same size in the open end of the wrench that is actually doing the work. Modern combinations are so well made that it is extremely rare to break one used this way.



A "cheater pipe" is the best way to get additional leverage. It's important for the pipe to slide all the way over the handle to the ratchet as shown here.



Striking sharp blows with a heavy hammer is another way to cheat. The combination wrench here is being used on the generator nut of a VW Beetle to adjust the drive belt.



Single blow of sharp cold chisel often will expand a nut enough to be turned when torque alone is not enough. Hold the chisel against flat of the nut parallel to bolt axis.

Another method of cheating on a combination wrench is to strike the open end with a fairly heavy hammer. Use a heavy hammer because a light one simply wastes its energy by bouncing back due to the spring in the wrench.

Socket and ratchet

If there's room, use a socket wrench, not a combination, because it is usually stronger and designed to exert more torque than an equivalent combination wrench. As with combination wrenches, sockets come in 6 and 12-point configurations. For heavy-duty work the 6-point is by far the best.

Sockets are most conveniently turned with a ratchet, especially in restricted places. Most manufacturers supply ratchets with several handle lengths. Most of the time a short-to-medium handle is perfectly adequate. But for the occasional nasties the modern professional mechanic carries a "cheater pipe" that at the very least doubles the length of the ratchet handle.

Using a cheater pipe

A good cheater pipe has a snug fit over the handle and is long enough so that it can slide down to the head of the ratchet, leaving adequate length for the task at hand. If the cheater bears only on the grip of the ratchet there is much greater risk of damaging the tool. The very best cheaters aren't really pipes at all—they're made of seamless steel tubing used for high-pressure hydraulic systems.

If it is possible to reach the other end of the fastening you are working on, it often helps to rap it smartly while applying torque. This is the standard technique for removing rusted-on bumper mounting bolts. But *do not* hammer on a stressed socket or the box end of a combination wrench itself. This is a good way to break the tool and doesn't aid the task at hand in the least.

Occasionally the bolt or stud will twist before the nut moves. If the bolt is easy to replace, as in an exhaust-pipe clamp, then it may be easier to go ahead and twist it off than to take the trouble to salvage the parts.

Hammer and chisel

You will find that some nuts simply won't budge, no matter how hard you try to turn them. This is where hammer and chisel come into play. In the old days mechanics were often called "nut-busters" and the term was in no way used in a negative sense.

A nut may be "busted" from the end or side. Many times only a shal-

(Please turn to page 168)

3 versatile sawhorses you can make



Despite fragile looks, this design produces an extra-rigid sawhorse that's great for heavy sawing. Strength is assured by out-of-sight shelf brackets.



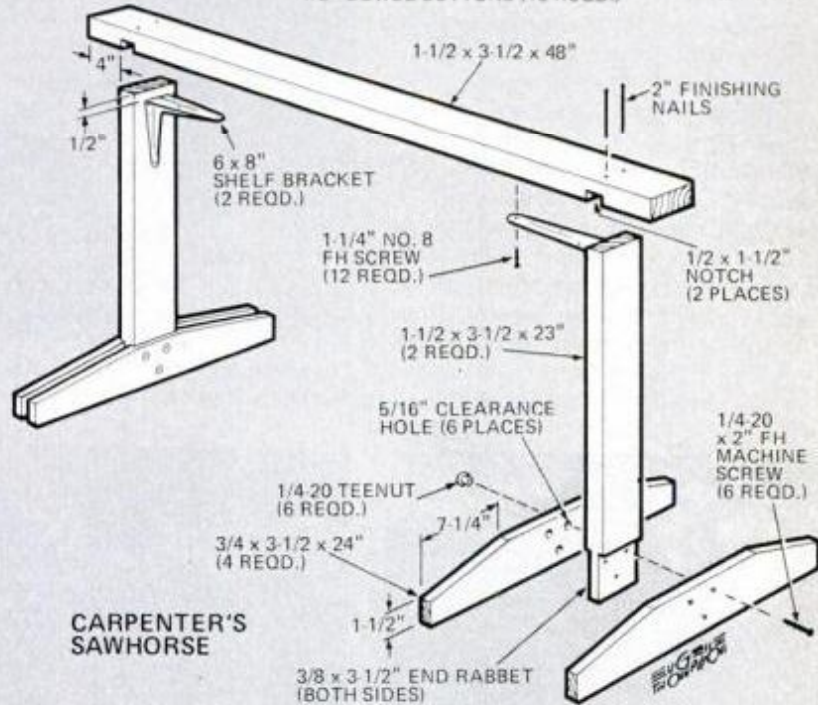
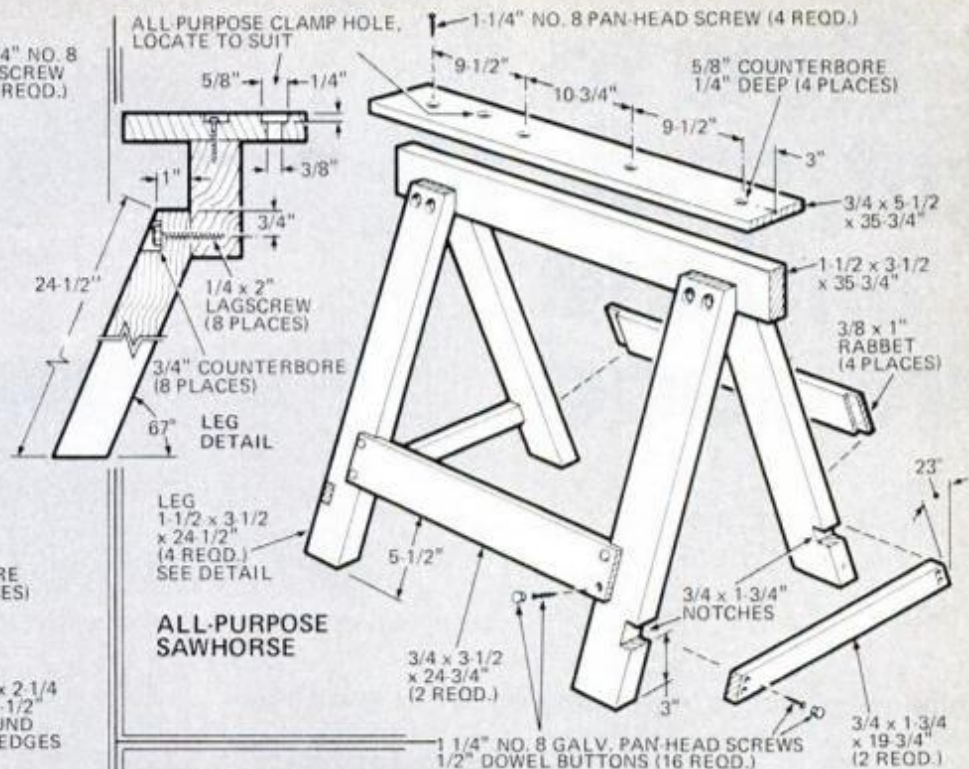
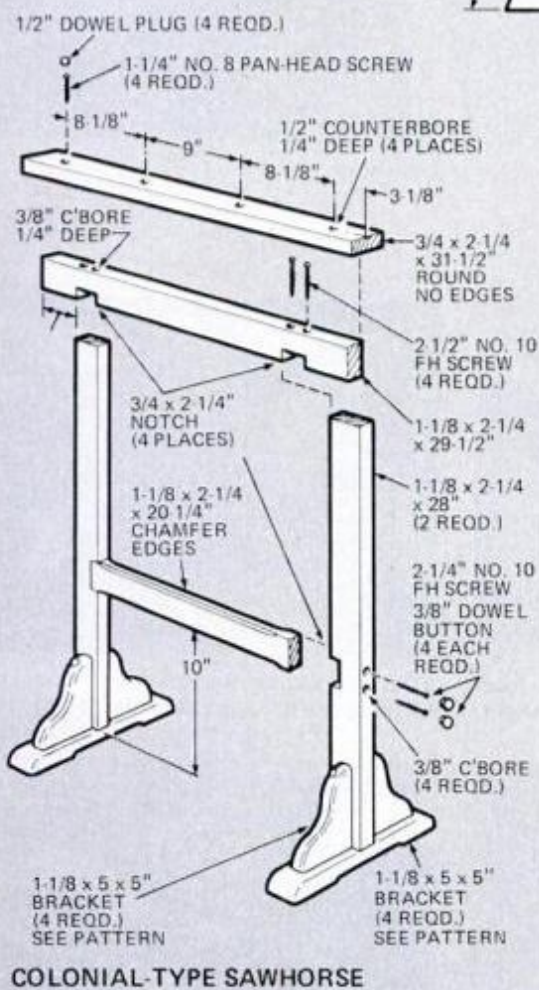
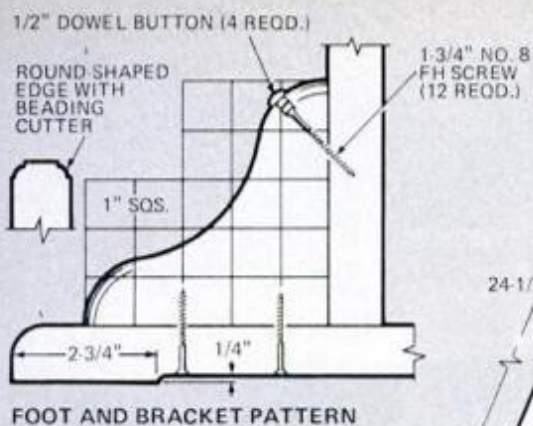
Inspiration for these sawhorses came from Shaker-style clothes rack. Great for light-duty tasks.

All-purpose sawhorses are built of redwood, can be converted easily to barbecue buffet simply by adding a plywood top.

One of the first tools that every home handyman needs is one he can build himself—a sturdy pair of sawhorses. There is an almost endless variety of types of sawhorses you can build—many craftsmen design horses that carry and store tools as well as serve as a workbench, for example. But we've narrowed our selection to three designs that are easy to build, nice to look at and rugged. The carpenter's sawhorse far left was designed by Stephen Peterson; the other two concepts were created in the PM Workshop by Home and Shop Editor Harry Wicks.

General building hints

All three sawhorses are built using standard construction techniques and



stock materials available at the lumberyard. All can be built using hand tools only, but a table saw makes it a lot easier to rip boards to desired widths, create rabbets and make angle cuts. Shaped brackets on the colonial-style horses are made by cutting with band or sabre saw and then shaping with a beading cutter in the router. If you do not own a router, simply cut brackets in triangular shape and round-over the exposed edges using either block or Surfform plane.

The all-purpose horses can also double as legs for an outdoor buffet table. The top shown on the facing page is simply a 36x60-in. piece of 3/4-in. exterior-grade plywood that is

reinforced with furring-strip framing below.

No matter which design you decide to build, test-assemble the horse without glue after all parts have been cut. When satisfied with fit, disassemble the horses and sand all parts smooth before final assembly.

All-purpose sawhorse

For looks, the horses shown were constructed of redwood. Start by cutting four legs for each horse. Make the two angle cuts at top end of each leg, then set the saw blade at 23° and make the leg bottom cuts. To assure that all legs will be exactly the same length, clamp a stop to your miter gauge when making leg cuts.

To assure accuracy, hold the workpiece securely as it is fed into the spinning blade and use a slow feed rate. Next, lay out and cut notches for the leg spreaders.

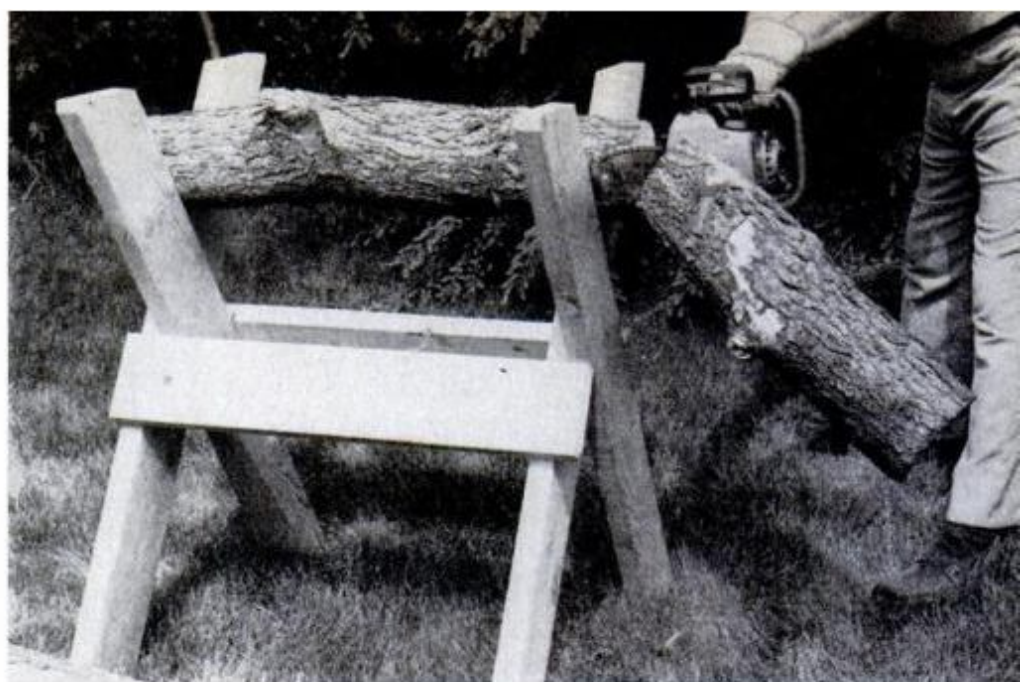
Use clamps when assembling legs to the top rail; legs must be held in a fixed position while holes are bored for lagscrews. After legs are attached, install the 1x4 rails to keep legs immobile. Then add the spreaders at both ends using resorcinol glue and 4d galvanized nails.

Finally, attach the 1x6 top piece which makes it easier to handle work on the horse. The hold-down clamps are optional but welcome when you need a third hand. The redwood

(Please turn to page 177)

How to cut, stack and use firewood

This winter burn more wood. It's economical heat when fuel bills run high.



Cut-off part of the log should hang outside the sawbuck.

PM photos: Rosario Capotosto

A chain saw makes log-cutting go faster and easier

A glowing fire in a fireplace is a welcome sight especially if fueled with relatively low-cost wood you've cut yourself. Wood is a heat source that helps reduce your fuel bill.

The best firewood is hardwood such as hickory, locust, maple, oak or beech. It burns slower and with fewer sparks than softwood from such needle-bearing trees as pine, fir or spruce. Softwood also leaves flammable substances (pitch) on chimney walls. But fast-burning softwood sticks are great for kindling.



Fuel your chain saw at a distance from the work area so spills won't be a danger.



Start cut with saw bumper against log, bar tilted upward. Open throttle totally . . .



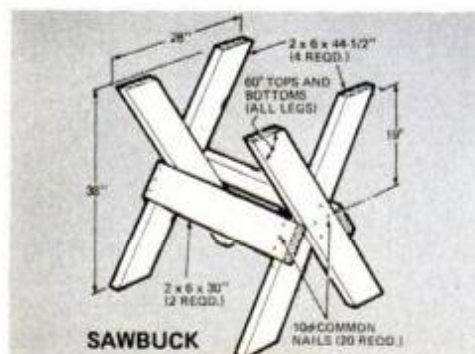
. . . then touch chain to log. Keep bumper in contact with the log as saw penetrates.



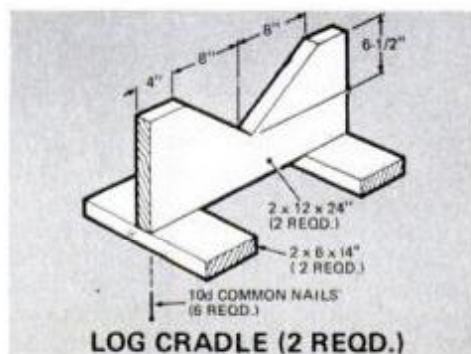
If you must cut within the sawbuck, lay a 2x4 under the log to support it safely.



The antikickback device on this bar tip prevents accidents if object is touched.



You should have a sturdy sawbuck to cut logs safely and efficiently.



A pair of log cradles is helpful for cutting logs that are too heavy to lift.



When using cradles, release the throttle as soon as the chain cuts through a log.

First felling cut determines the direction



Cut a notch 1/3 trunk diameter. Make lower cut first. Back cut is 2 in. higher.



Cut the back cut 2 in. short of the notch; then push or drive wedge in the backcut.

Split logs to size before you stack them



Split small logs with an ax. Keep your legs out of the line of swing.



Use a splitting wedge and heavy sledge to halve large logs. Do wear eye goggles.



One-hand sledge (maul) is easier to use when splitting the log in quarters.

Where to get firewood

If you're resourceful, there are several ways to gather a season's supply of free firewood. Thinning out an overwooded site on your property will give you firewood, as well as reduce competition for soil nutrients among the remaining trees. Also, when you prune add the cut branches to your woodpile.

An occasional trip to the town dump will pay off with discarded tree trunks and limbs. Other potential sources are curbs and sidewalks after a storm. Scout your area after heavy storms and you'll be well paid for your time and effort.

On the far extreme from free wood is cut wood you can purchase from several sources. Often you can find good firewood bargains at tree service companies. They usually make available their accumulations of tree trunks and limbs at reasonable prices.

The most direct approach to purchasing firewood is to go directly to a firewood dealer. He sells logs by the cord—a pile measuring 4x4x8 ft. The cost of a cord of wood varies with the locale and species, but for hardwood in an average suburban area today it's \$60 to \$80. Sound expensive? During the height of the fuel shortage several years ago the average was \$95.

The least expensive way to purchase firewood is to cut it yourself. National, state, county and city forests often section off portions of forest or mark trees that can be cut. You can usually cut them for free or a minimal charge. Besides cutting equipment, you'll need a truck to carry the wood.

Cutting firewood

The tools that you'll need to cut and split firewood most efficiently include a chain saw, ax, small and large sledgehammers and splitting wedge. Goggles and gloves are safety musts. You'll also want a sturdy sawbuck and perhaps a pair of ground level cradles for heavy logs.

Cut the logs to a length that will fit your fireplace easily. Small logs of a few inches diameter don't have to be split to be stored for drying. Logs of about 4 in. diameter should be split in half with one good ax blow. Split, then quarter, larger-diameter logs using small and large sledgehammers as well as the splitting wedge.

(Please turn to page 122)

Proper stacking shortens the air-drying process

Although bad fireplace design can cause poorly burning fires, just as frequently a cause of an unevenly burning fire is green wood that has neither been dried nor properly seasoned.

Wet wood doesn't burn as well as dry wood; the entrapped water cools the fire and prevents complete combustion. Wet wood is difficult to ignite, it will go out more quickly and it's more likely to smoke than dry wood. Splitting large logs after they've been cut helps assure proper seasoning by exposing as much log surface as possible to the air to accelerate drying time.

Even then the air-drying process takes at least six months if it's done properly. This entails stacking the wood as shown so the air can circu-

late readily throughout the pile.

First lay two lengths of 2x4 on the ground for a base. Then place two logs spaced about 18 in. apart across them. Next, place two logs equally spaced and at a right angle to the first two. Continue building upward, alternating the position of log pairs until the pile becomes shaky. Then begin building a similar pile next to the first one. If the logs are about 24 in. long, you can easily stack from 75 to 80 split logs per 8-ft. base. After the logs have dried, they can be restacked close together to conserve storage space.

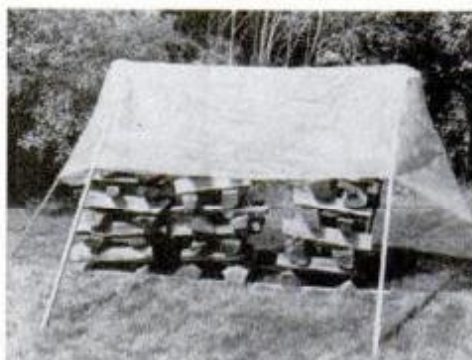
The drying process will take longer if the logs aren't protected from rain and snow. You can make a shelter for the piles by ripping 2x4s down the center and lashing them

together tepee-style with the bottom ends set 10 in. in the earth. Then tack a plastic sheet over the top as shown in the photo.

To check the wood for dryness strike two logs together. A dull thud indicates moisture. A sharp ringing sound tells you that the wood is dry and ready to be burned.



To stack logs, first lay down two 2x4s. Pile log pairs alternating at right angle.



An easily-made tent keeps rain off the wood, yet allows good air circulation.



Strike two pieces together. A thud says wood's moist; clear sound means it's dry.

A well-built fire made with dry materials should give you a blaze in minutes

Lighting a fire is easy work if it's built properly. Before you begin, be sure that the damper is open. It's good to have an inch or two of ashes on the fire box floor to keep the heat in the coals.

Start by placing several sheets of crumpled newspaper on the bottom between the andirons or under the center of the fire grate—whichever you have. Crisscross some fast-burning kindling, such as pine or other softwood, over the paper.



Light paper under open damper to create updraft; then light kindling under grate.



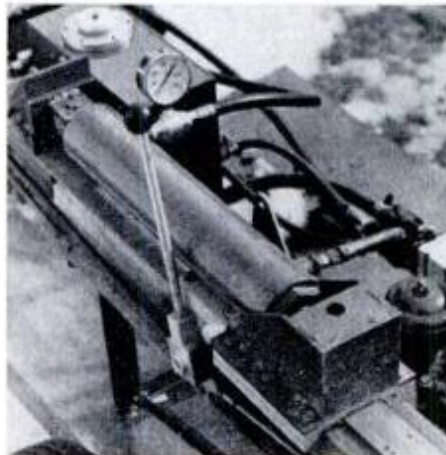
Well-seasoned wood should look like this 10 minutes after lighting.



Move lever to split the log, remove the split halves and toss them on the pile.



A two-wheel trailer makes a good bed for the splitter and lets you tow it as well.



The lever operates the ram which forces a log against the splitting wedge.

PM's log-splitter takes the ache out of splitting wood

Splitting firewood by hand is tough work—just the thought of it deters many from tackling the chore. Here's a build-it-yourself, hydraulically-operated splitter that changes that picture. A powerful ram pushes the log against a fixed wedge and pop! The log is split—and it's all done by merely moving a lever.

The machine's hydraulic cylinder exerts about 10,000 lbs. of pressure. That's enough to split 2-ft. ash or maple logs.

The backbone of the splitter is a 6-ft. I-beam where the ram rides. Automatic transmission fluid under pressure drives the cylinder by way of a pump and control valve. A 3-hp or greater gas engine provides the power.

Parts for the log splitter are readily available. You can make the parts not easily found by welding and bolting together steel plate.

To get a complete set of plans and detailed instructions for building the log splitter, send a check or money order for \$8.95 to Log Splitter, Popular Mechanics Plans Library, Box 1014, Radio City Station, New York, N.Y. 10019. Allow two to four weeks delivery for third-class mailing. For first-class mailing, include 75 cents extra.

If you have a fire grate, place three logs with their split side down on the grate, the largest one at the rear, the smallest in front and the remaining one on top of the others to form a triangle. Give them plenty of room.

In the case of andirons, after you've placed the paper and kindling between them, lay two logs on the andirons. One log should be close to the fireback and the other should be near the front of the andirons. Place more kindling on top of the two logs and a third log over the kindling.

To get a good thermal updraft, crumple some newspaper, light it and hold it up near the throat of the

fireplace. Then light the paper under the kindling. If your logs are seasoned, you should be rewarded with a roaring fire in a short time.

If the logs are burning and you want to extinguish them, stand the logs on end against the fireback. The fire should die soon afterward.

Fireplace safety measures

A glowing fire is such a comfort that it is easy to forget fires can also be dangerous. A few precautions can lessen their potential for harm.

Be careful about what you burn in your fireplace. Resinous woods can line the flue with a coating of tar and

increase the danger of a chimney fire.

Don't throw household trash in the fireplace. Even though it's a fast way to get rid of gift wrappings at Christmas time—don't do it. Many plastics give off toxic fumes when they burn.

Every fireplace should have a fire screen. It keeps the sparks from shooting out into the room and prevents people from inadvertently backing into the fire.

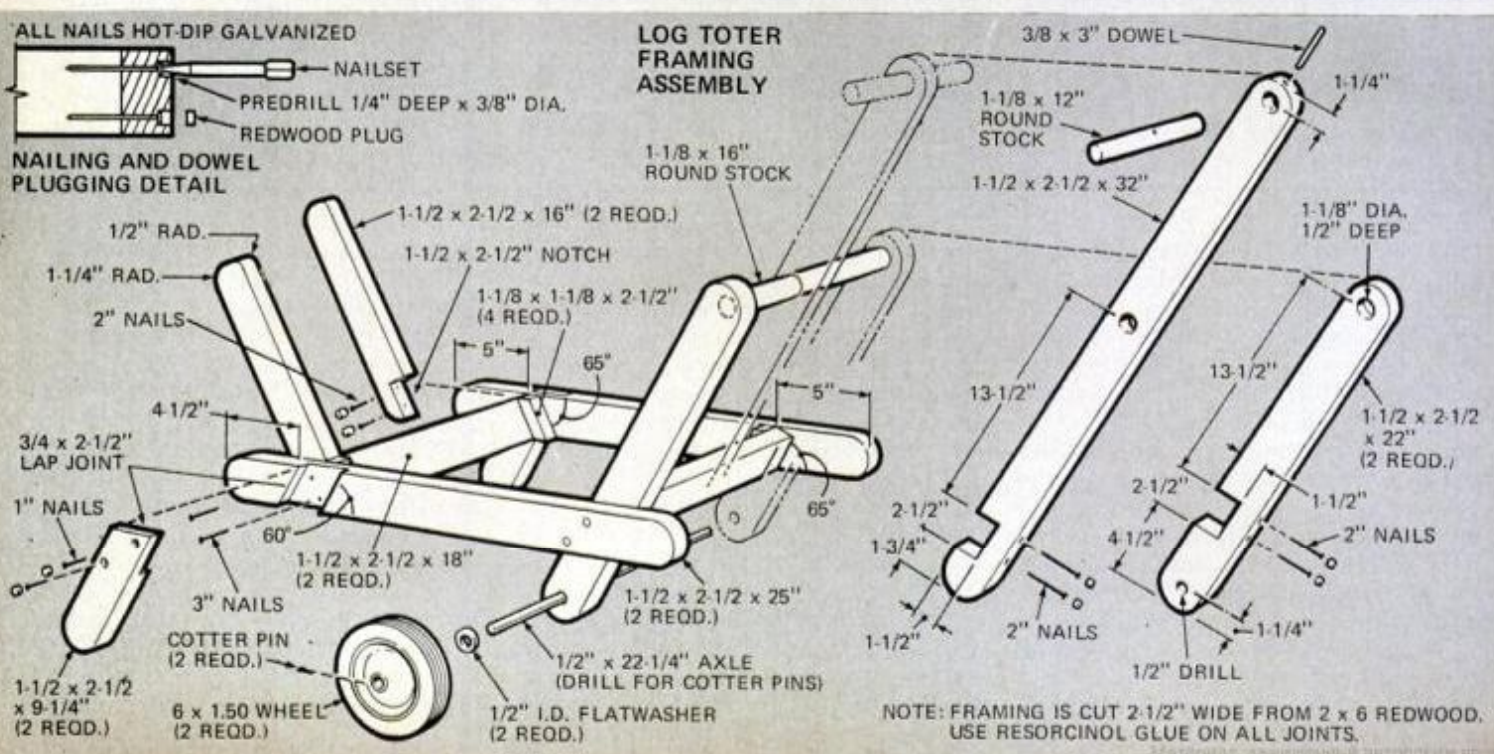
When fire is going, don't use fans in the house. They can set up a draft pattern that pulls the fire outside the fire chamber into the room, bringing smoke and gases with it. ★★



3

Firewood projects you can build... toter...weatherproof bin...log box

by Harry Wicks
HOME AND SHOP EDITOR





For convenience, park log bin by back door. It keeps dry an evening's supply of wood.



Colonial fireside box blends with all types of decor. Of pine, it's stained and varnished.

The high price of natural gas, oil and electricity makes it just about a certainty that Americans will burn more firewood this winter than ever before. To help you store and move the firewood that you've cut and split, *Popular Mechanics* offers designs for three projects you can build yourself.

The first is a log totter that lets you haul a healthy supply of fireplace-sized logs from woodpile to back door. The second project is a log bin that permits you to store an evening's supply of firewood to assure its being dry and ready for use. Wood from

the log bin is hauled inside and deposited in a practical, yet handsome, colonial fireside box that holds a good supply of wood.

The outdoor log-bin design is by courtesy of the Georgia-Pacific Co. while the totter and fireside box creations are a joint effort by Rosario Capotosto and the author. Each project was constructed in the PM workshop to assure accurate plans for our readers to follow.

General directions

Sound building principles were used to achieve strong construction.

Though all projects could be made with hand tools alone, certain power tools do make the task much easier. We avoided intricate and exotic methods of joinery. Our aim was to present projects that both skilled and beginning woodworkers could duplicate with relative ease.

Make certain you use glue on all joints. On the outdoor projects use weatherproof resorcinol glue; on the fireside box yellow carpenter's (aliphatic resin) glue works fine.

Use hardware as specified for the various units on the drawings. For log totter and bin, make certain you use only aluminum or hot-dipped galvanized nails for assembly so that wood surfaces will not be marred by ugly rust stains.

Building the projects

■ **Totter.** For looks, the totter shown was built of redwood. Use of this wood simplifies finishing because two coats of outside varnish are adequate. You can, if desired, use less expensive pine, fir or spruce; then seal and prime the piece and finish with a coat of exterior paint.

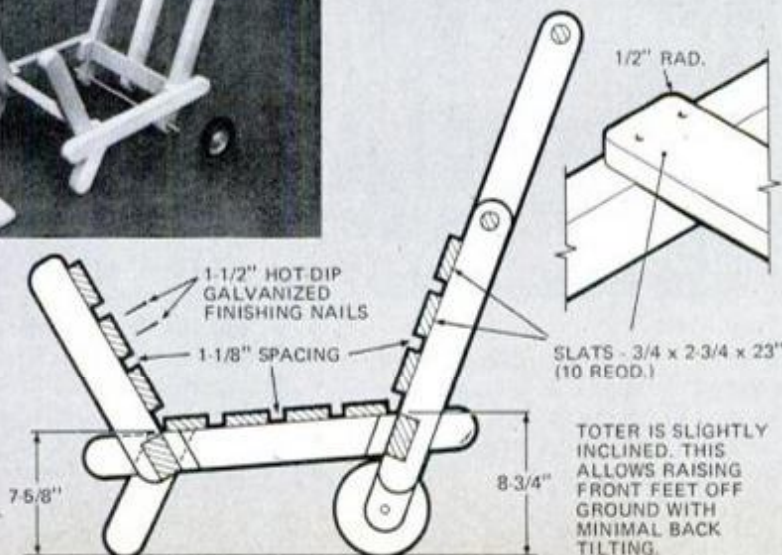
The totter is simpler to build than a quick look might imply. Start by cutting all parts to size and shape, marking each part lightly for quick assembly later. Tack the pieces together to be sure you are satisfied with fit, then assemble the cart permanently using waterproof glue and galvanized nails as shown.

Notice that nails are well set in predrilled holes. While the piece is

(Please turn to page 140)



NOTE: SLATS CUT FROM 1 x 6 CLEAR ALL-HEART REDWOOD. USE RESORCINOL GLUE ON ALL JOINTS.

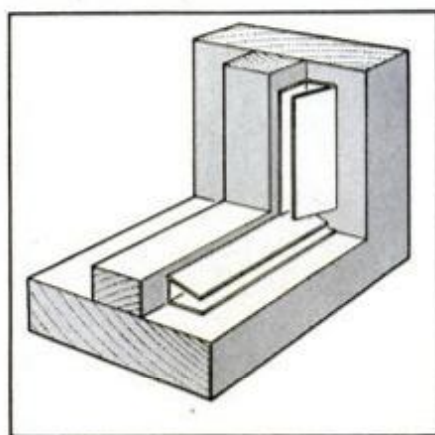
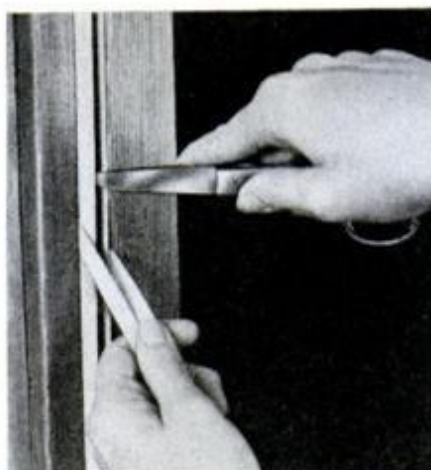


NEW ENERGY-SAVING PRODUCTS



Instant hot-water dispenser

Add this Kenmore hot water dispenser to your sink, or in a handy place on the countertop near the sink, and you can have hot water instantaneously. The dispenser is said to use one-third less energy than heating water on the range by heating only the water used. It dispenses up to 60 cups per hour. For \$74.95 from Sears.



Do-it-yourself sealing strip

This sealer for inside and outside doors seals off heat loss, noise and weather. Measure the length needed, cut with scissors and press the adhesive backing to the jamb. The Polyflex seal comes in tan, black and white. Sealing strip for one 36-in.-wide door is \$4.99. Schlegel, Weather Seal Group, Box 197, Rochester, N.Y. 14601.



Louvered aluminum screen

A louvered aluminum window screen called ShadeScreen, developed by Kaiser Aluminum, is said to reduce solar heat gain to save cooling costs. The panels fit into standard screen frames. Available at window and screen shops. About \$2 per square foot framed. Kaiser Aluminum, 300 Lakeside Dr., Oakland, Calif. 94643.



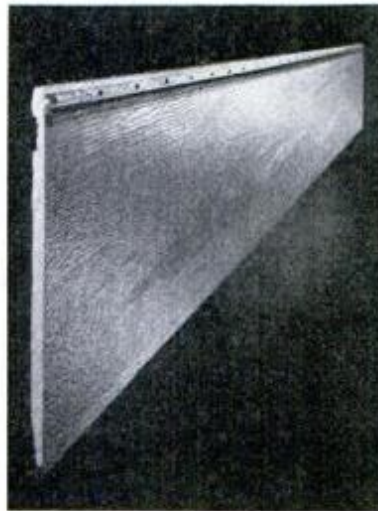
Bronze reflective glass reduces cooling costs

The new window glass Solarcool, by PPG Industries, reflects solar radiation to reduce the cost of cooling your home. It's a bronze reflective glass that has a mirror-like coating. You can use it on windows and patio doors. The cost is about 40 percent more than conventional double-strain clear window glass; at hardware stores.



Interior panels insulate

Foil-back Sheetrock panels by U.S. Gypsum cut costs in several ways. The aluminum foil often eliminates the need for a separate vapor barrier. The panels also add extra insulation value. They come in 8 to 14-ft. lengths and $\frac{3}{8}$ to $\frac{5}{8}$ -in. thicknesses. Cost averages about \$100 per 1000 sq. ft. At building supply dealers.



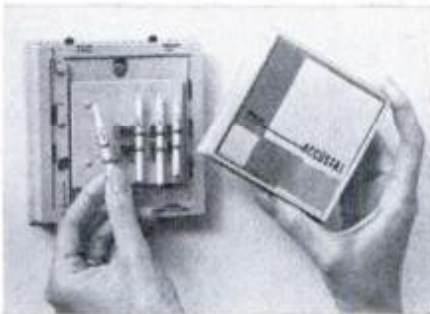
Aluminum siding with built-in insulation

Latest aluminum siding from Reynolds comes with a polystyrene backing to help insulate homes. Weep holes prevent moisture buildup. The siding comes in smooth, rough wood or shadow grain patterns in acrylic or vinyl finish. The cost is said to be only 10 percent more than that of siding without backing. From Reynolds Metals Co., Richmond, Va. 23261.



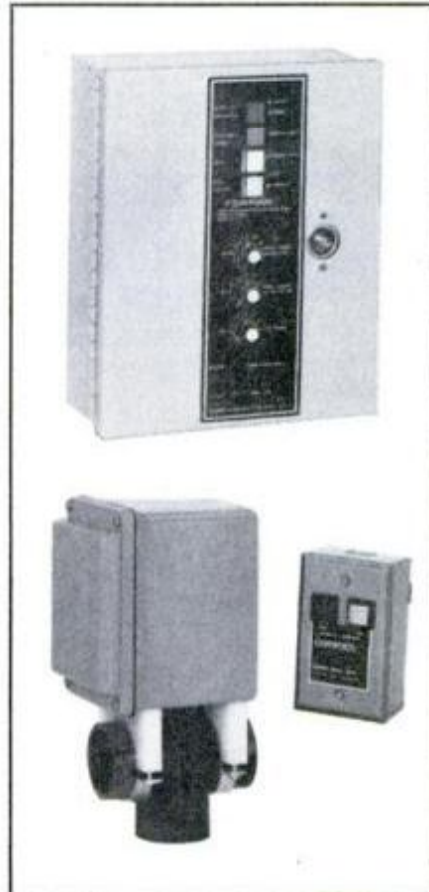
Reflector bulb in miniature

This 25-watt, 120-volt light bulb is the Mini-Reflector made by Westinghouse. Because of its efficient reflector design, it can direct light by itself without other fixtures or lenses. All it needs is a socket. Use it to light art objects in track lights and for close work. Cost: approximately \$3.25 at hardware stores.



Precise-control thermostat

Accustat is a solid-state thermostat with mercury sensor that responds immediately to temperature change. Cost is from \$20. PSG Industries, 1125 Tunnel Rd., Perkasie, Pa. 18944.



Automatic thermostat control

This thermostat can be set to lower the room temperature automatically during the night when you're sleeping and raise the temperature before you awake. It's the Comfort-Set thermostat made by the White-Rodgers Div. of the Emerson Electric Co., available at local heating and cooling contractors. Cost is about \$85.

Swim pool heating control

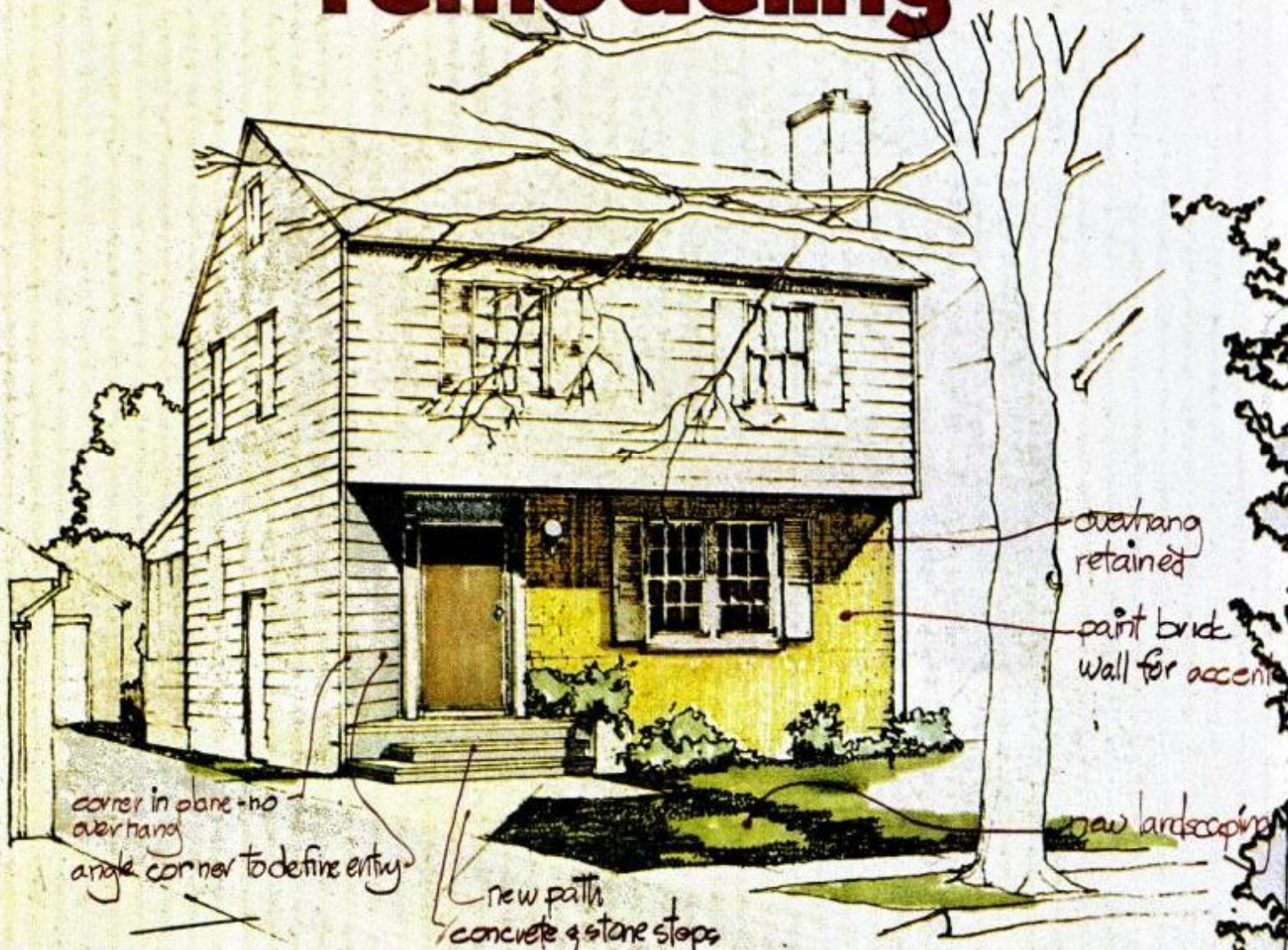
An automatic, remote-control system called Compool coordinates energy from solar panel and backup gas heater to maintain swimming pool functions. Control center is \$329; valve operator, \$124; complete system, \$822. One-year warranty is included. Bajka Engineering, 333 Fairchild Drive, Mountain View, Calif. 94043.



New gas-saving range

The oven of this gas range operates by convection to save energy. A stream of heated air is forced back into the oven instead of being vented into the kitchen. Burners are operated by electric ignition to eliminate the need for pilot lights, thus reducing gas consumption. Cost runs from \$539.95 at Montgomery Ward.

How to remodel your entry without remodeling



Entry now defined

This recent-vintage house is of the style often called stockade—because the second level overhangs the first as in stockade construction. Though neat-looking and trim, it lacks drama because there's no visual center of interest. Grandberg achieves this by painting the brick wall a pastel yellow, extending the corner (left of doorway) to be in the same plane as overhang, and installing siding on the diagonal. Wide steps replace narrow, side-railed ones at this corner and extend to an ample-size planter. Grass replaces the old front walk to give an illusion of more yard space. For all construction details, see page 146.

Renderings:
Ira Grandberg, AIA

An architect tells his secret to PM: Concentrate on landscaping rather than those costly structural changes. Here's how he treats five popular home types.

by Harry Wicks HOME AND SHOP EDITOR

“You don't have to spend a bundle to modernize your house front,” says architect Ira Grandberg, AIA. “Dramatic changes can be made by simply concentrating on front-yard landscaping.” There are two big advantages to upgrading a house front mostly through landscaping:

■ Almost all such improvements can be handled by do-it-yourselfers. Not having to call in a professional means saved dollars.

■ In most cases, the project can take place in stages—you needn't finish the entire job in one shot. For example, you might put in new steps and walkway this year; add a planter and light, next.

In some cases, carpentry is required. The ranch home, for instance, is greatly enhanced by the front-door makeover. But it is not a must—the landscaping alone provides dramatic visual change.

PM's editors selected the five homes shown because they felt each one was representative of a great number of homes across the country. Thus,

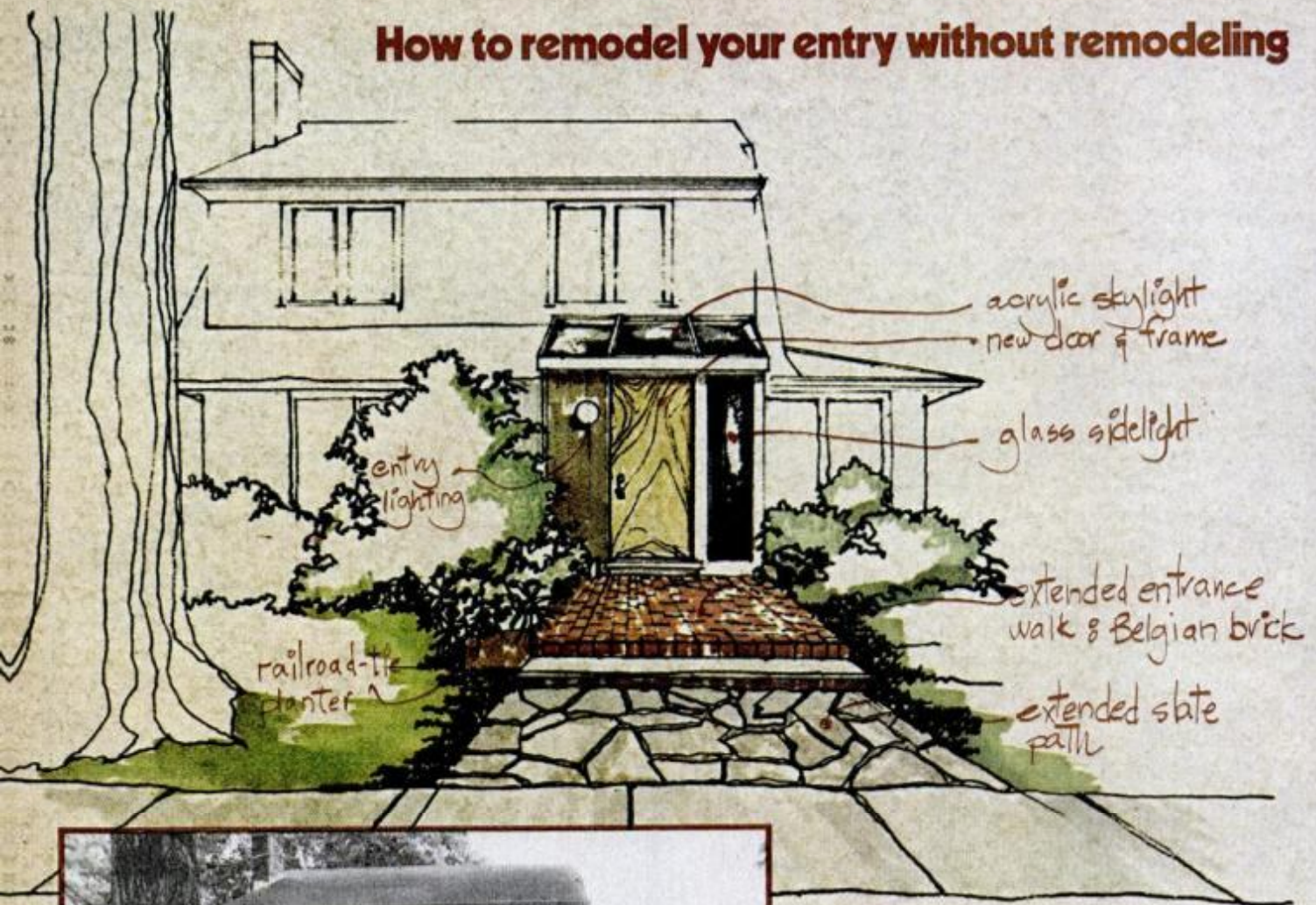
(For more details, please turn page; text continues on page 146)

Retain existing charm

This marvelous country home has a lot going for it, but its front entry is not clearly defined. Here PM's architect extends the front porch for function as well as esthetics. Seating is built into the deck for outdoor living and large step area is placed to direct attention to the front door (which can be painted for emphasis). The extra-wide, brick-in-sand walkway adds to the house's rural charm. The lamp, though contemporary, blends well. The challenge here was to avoid losing the home's interesting architectural details.



How to remodel your entry without remodeling



Remove a mismatched roof

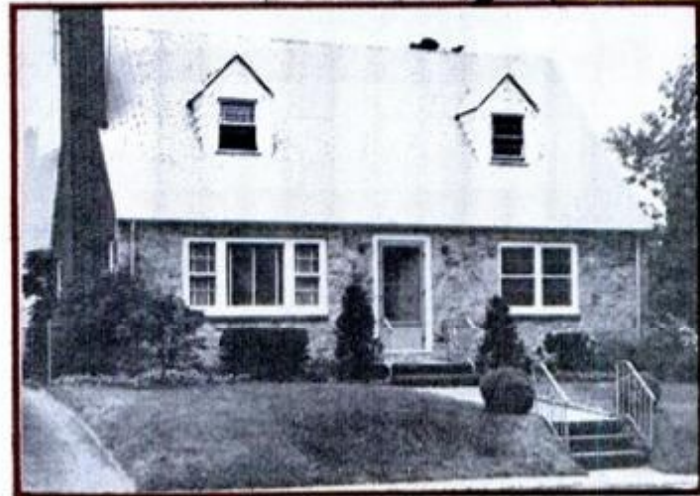
Changes here start with carpentry on the entry module. Original detailing is typical of better-built homes in the '20s. But for the '70s Grandberg replaces the A-roof with one pitched to match the slope of the main roof. For dramatic natural-light effect inside, he suggests using sheet acrylic rather than sheathing and shingles overhead. He accentuates the greenhouse look with a glass side-light to the right of the door. Greenery contained in railroad-tie planters replaces large bushes in front. A new walk built of Belgian block retains the home's connection to earlier years.

Let there be light

This ranch house is only 20 years old, but it also needs some front-entry re-thinking. The home immediately "plugs into its surroundings" when railroad-tie planters and plants carefully selected to emphasize the entrance replace oversize shrubbery. For the owner who opts to go all the way, windows at right are converted to sliders and some carpenter surgery is performed on and over the door. The glass side-light, clerestory window and sheet-acrylic skylight look great from the outside, give that "open" feeling from the inside. Notice that wider steps are now in line with the front plane of the house.

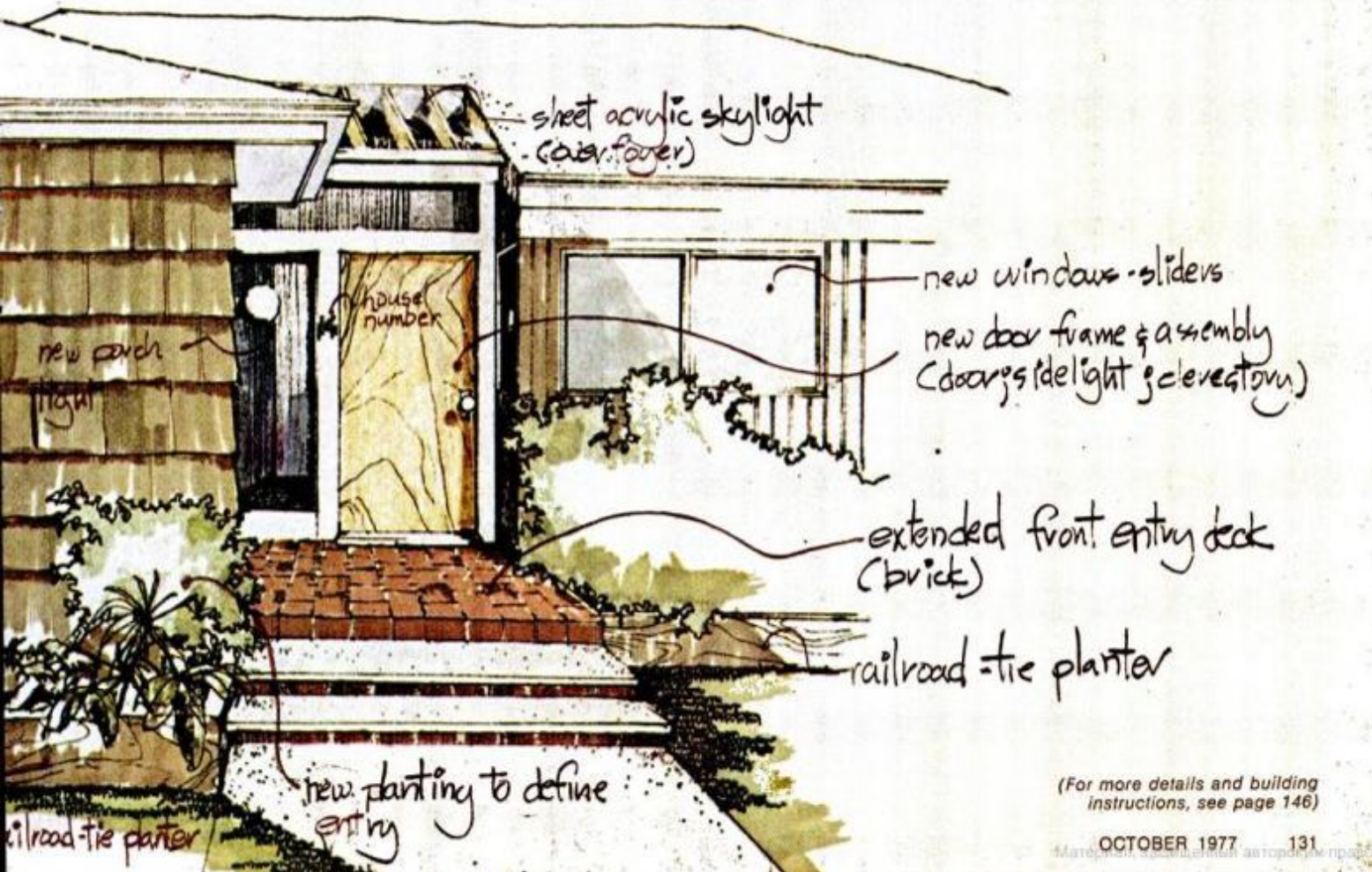


step lighting
 new paving stones
 new front entry



Rejuvenate a Cape Cod

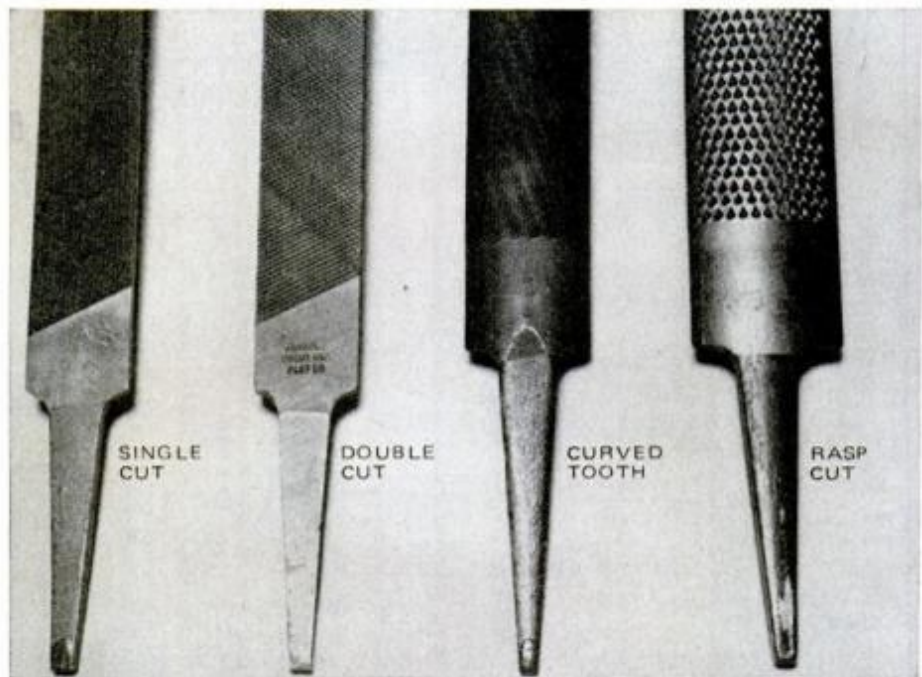
The standard Cape Cod with front-to-back roof was, perhaps, the most challenging overhaul. Any house changes would not have been minor cost items, so architect Grandberg confined himself to landscaping ideas. He relocated the front walk to make the property appear larger, placed low plantings along the walk to direct a viewer's eye to the front door, put in a new paving-stone walk to retain the Early American flavor and added a light at the steps to assure the user's safety and convenience.



(For more details and building instructions, see page 146)

WORKSHOP MINI-COURSE

FILES AND RASPS



General-purpose files shown are the ones that most do-it-yourselfers should own.



Taper file narrows toward its point (end); a blunt file tapers in thickness only.

It is reasonably safe to say that the ordinary hand file is one of the most mistreated hand tools in both amateur and professional workshops. I have seen professionals carelessly store files by tossing them into a drawer. Such mishandling is a sure way to shorten the usefulness of any file because of the damage to teeth when one file rubs another. Here are some of the basics of file use to help you get the most out of your files:

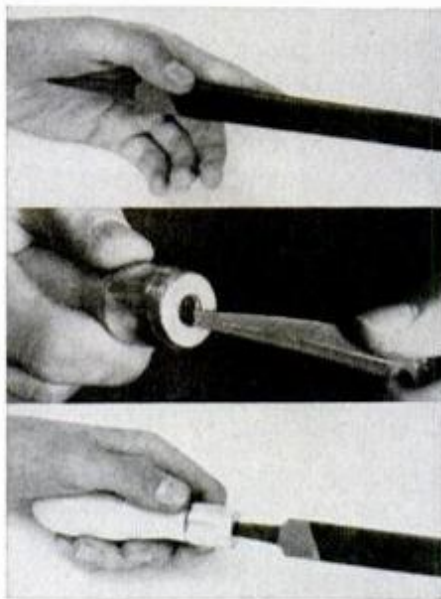
■ **Types of files:** Although there is an almost unlimited number of files available, the kinds that you are most likely to need are the flat, mill, half round, circular and triangular. Keep in mind that every file is designed for a specific job.



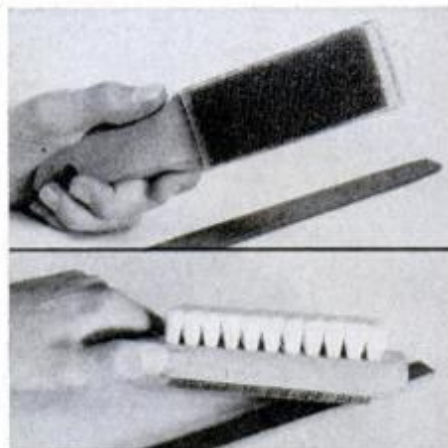
File's length is the distance between its heel and opposite end (dashed lines).

■ **Cut:** This refers to the character of a file's teeth—single, double, rasp and curved. The coarseness of cut is broken down into four categories—coarse, bastard, second and smooth cuts.

■ **Single-cut files** should be used with light pressure to create smooth finishes on cutting instruments such as knives and shears. Double-cut



Never use a file without a proper-fitting handle—there's too much risk of tang puncturing palm. Screw-type handle (center), simply turned on tang, creates its own threads on file. Another handle type uses clamp action to hold file fast.



Do invest in a file cleaner. This type has a file card for general cleaning of file teeth and a file brush for use on the finer-cut files. Use it often.

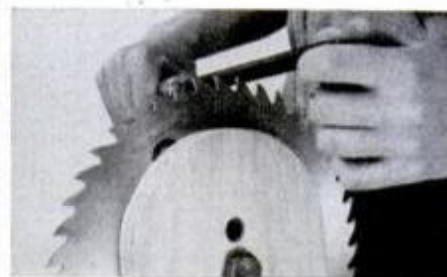
files are for use under heavier pressure for fast metal removal. A rasp cut, unlike the other file cuts, is a series of individual teeth that produce a very rough cut. Rasps are used mostly on wood and other soft substances.

■ **Keep your files clean:** Be aware that chips or filings collect between the teeth during use. After several



Rasps have individually formed teeth, are intended for use on soft substances.

strokes, lightly tap the file on the workbench to clear chips. Keep a file card handy for frequent brushing during use—and always clean the file before storing it. Unlike those careless types noted earlier, do hang the files separately—don't toss them in a drawer.—*Harry Wicks, Home and Shop Editor*



To file a circular saw, use a slim taper. Be sure to maintain original tooth shape.

When is an ad worth \$20,000?

(When it's a Windsor Canadian ad and you enter it in Windsor's Smooth Canadian Sweepstakes.)

This Windsor advertisement may make you \$20,000 richer. There's nothing to buy, and it's easy to enter. Here's all you do:

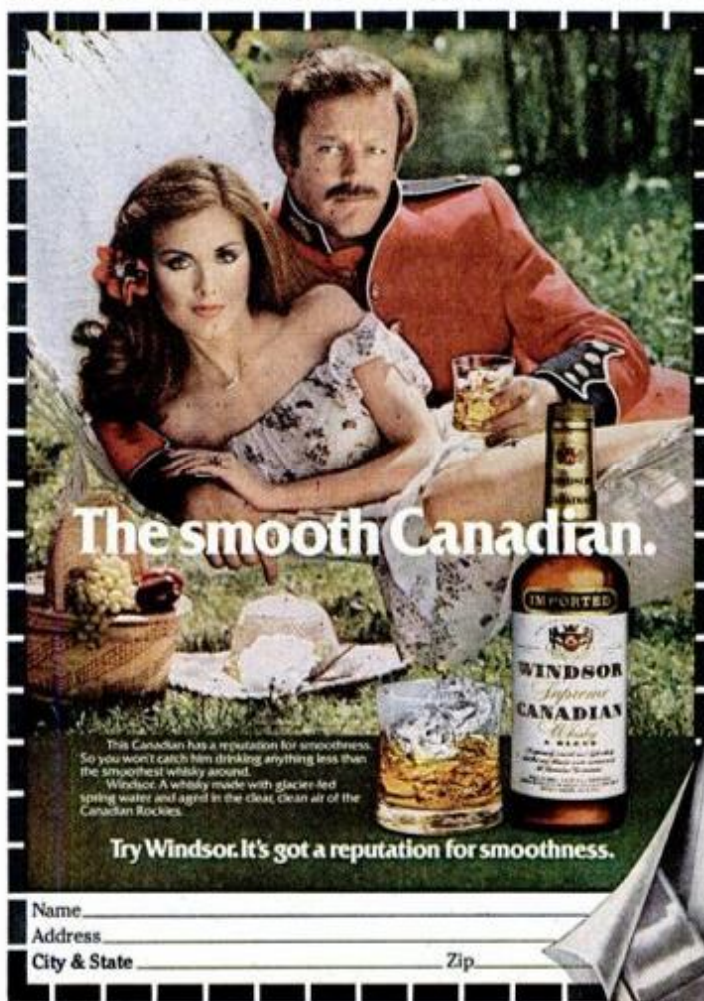
One: Cut out this ad or any Windsor Canadian ad from any magazine or newspaper. **Or** cut out any liquor store's newspaper ad that features a Windsor Canadian bottle.

And while you're cutting out the ad, why not sip some Windsor Canadian. And savor the taste of the smoothest whisky ever to come out of Canada.

Two: Print your name and address clearly on the ad or on a 3" x 5" piece of paper. Attach it to the ad and send it in an envelope to:

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postmarked by December 31, 1977, to be eligible for the drawing. Photocopies of Windsor ads are not acceptable. The winner will be notified by mail after February 15, 1978.

• **Entrants must be of legal drinking age under the laws of their home states.**

• This sweepstakes is void in those states where prohibited by law.

• The winner will be selected by random drawing under the supervision of Marden-Kane, Inc., an independent judging organization, whose decisions are final.

• All applicable taxes are the sole responsibility of the prize winner.

• The Windsor Canadian Sweepstakes is open to residents of the United States. Employees and their families of National Distillers and Chemical Corporation, its advertising agencies, its wholesalers, retailers, all liquor licensees, distributors and their salesmen, and Marden-Kane, Inc., are not eligible.

• All federal, state and local laws and regulations apply.

Odds of winning will be determined by the number of entries received. The more times you enter, the greater your chances to win.

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Solar system in the home owned by the Douglas Boleyns of Gladstone, Ore., was installed as a demonstration product by Portland General Electric at cost of \$30,000—much of this was accounted for by monitoring equipment and conservative design.



Charles Marsh of Pomona, N.J., spent \$1500 to add air-cooled collectors to a vertical wall of his home. The system takes care of one-third to two-thirds of his space-heating needs.

engineers came back and said 1-to-1½-in. round rock was necessary. "So," Ron recalls, "we had to tear out the floor and a window to get out the pea gravel. The final size is what my brother and I would have guessed in the first place."

A novel approach to heat storage is that of Robert Sheppard of Asheville, N.C.—he uses liquid-cooled collectors, a water-to-air heat pump, and his swimming pool. He estimates the solar system added \$5000 to the cost of his house, but figures it will pay for itself in five years. "My bill for January was \$65. Other houses in the same area, with the same square footage, paid from \$250 to \$300 for January."

Some dissidents

Not all respondents were content with their systems, though. One who was not is R.L. Katzenstein of Hingham, Mass. He paid \$16,000 for a liquid space-heating and hot-water system last December. So far it's providing 30 percent of the space heating and 90 percent of the hot water. He estimates it provides 50 percent of his home's total heating requirement, but feels it will never pay for itself "unless oil goes over \$1 per gallon."

Katzenstein, who says he added solar to his home out of patriotism, advises others not to do the same "unless you are an engineer" or

"until the hardware is better." He has had trouble with snow accumulating on collectors and with a water leak, and finds that "thermal recirculation at night loses 80 to 90 percent of gain during the day."

Several air-system owners have also cited leakage—air seeping from collector-to-storage ducts can make portions of the house uncomfortably warm, especially in summer when only the hot-water mode is working.

Pioneering motives

Why do homeowners go solar? The reasons they give are varied, but the thread of individualistic self-sufficiency runs through them.

Troy Erwin of Roseburg, Ore., says bluntly he's making "an effort to get something for nothing." He has come close—the liquid system he built for his double-wide mobile home cost \$650, saves \$100 a year in utility bills and will pay for itself in about six years.

"I was energy chairman of the Sierra Club," says Bruce Robinson of Morrison, Colo., "had spent a great deal of time studying energy and had come to a very strong position favoring solar energy and opposing the use of nuclear power. So, it was a combination of ideological commitment and perhaps a better understanding of what was going to happen to energy prices."

Hartzell based his decision on hard

economics. When planning his new home he didn't think he could get a natural gas hookup.

"Alternatives available were fuel oil and electricity; both are expensive methods of space heating. I had been interested in the idea of solar heating for a long time, but an analysis of the projected cost of traditional heating methods convinced me the expense was justified."

Barraclough typifies the pioneering spirit of solar homeowners: "I got downright vehement about an unjustified power increase and projected rises in power consumption on a national level.

"I felt a certain obligation to effect a change to both standards. I therefore took a year off from 'work' and built my home in an attempt to become a bit less dependent on the power companies, and, hopefully, less manipulated by their economic and political power structure."

Carr says: "I like to do things rather than just talk about them, and saving energy seemed to be an area where I could take some direct action that would be effective in conserving our limited supply of fuel."

John Kusianovich of Albuquerque, N.M., adds: "My system was also like buying a boat or a camper. There is a lot of pleasure to be derived even if the economics cannot always be rationalized."

Advice is varied, too. Many pioneers called for insulating homes to the maximum, and only then going solar.

"Investigate new architectural concepts that combine both passive and active systems to minimize energy use," says Bruce Robinson. "Also, don't forget to crank in healthy fuel-cost increases for the future. Comparing solar-system installation costs with payback calculations using today's energy costs is totally unrealistic."

Thomsen, in Nebraska, says: "Carefully determine the best of the available systems for the particular situation, then go ahead and put it in. If everyone waits for all the bugs to be eliminated, they never will be."

And, finally, Barraclough advises you to "avoid the majority of manufacturers and employ as many of your own methods as possible, ignoring the majority of that which is printed on the topic by major manufacturers or interested utilities.

"Read the textbooks briefly, throw them over your shoulder, lick your fingers and hold them to the wind. Then begin, confident that you know as much as anyone else on the subject of solar home heating." ★★★

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GIANT MINERS FOR A NEW COAL AGE (Continued from page 81)

mined in this country each year are extracted (usually from very shallow seams) by hand-loading methods little more sophisticated than those used by the Romans.

Most soft coal mined in the United States, however, is brought up from strip mines—huge canyons in the landscape that this year will yield almost 390 million tons of the estimated 670 million tons to be mined. West of the Mississippi, in fact, 90 percent of all coal mined is from "surface" operations. In the east and central regions, production is about 55 percent underground, 45 percent surface.

Monster draglines

Yet here, too, as with "continuous" miners, the term "surface" is somewhat misleading. Much of the coal being extracted by the strip-mining technique is found 150 feet or more below the surface. Reaching such deposits involves removing staggering amounts of what is called overburden, or spoil—earth and rock (the latter usually blasted) drawn out and piled by monster draglines whose size and cost approach the unbelievable. Some—like those already mentioned—that scoop out about 200 cubic yards of spoil at a clip, cost as much as \$40 million.

Although comparatively quick and straightforward as a mining technique, the economics of surface extraction of coal—and government-mandated requirements to restore land thus mined to a condition approximating the original—more or less preclude going after seams much more than 150 feet down. Also, even though much of this country's awesome reserves of coal lie fairly close to the surface, overall ecological considerations are forcing mining companies to more extensive utilization of underground mining methods.

The U.S. coal industry is thus faced with long-range priority considerations: On the one hand, President Carter's energy goals and, on the other, no one (mining companies included) wants to ravage the earth's surface any more than is consistent with America's overall energy needs. So the solution—assuming the industry can recruit and train enough personnel to work the mines, and can somehow surmount its chronic labor troubles—seemingly lies in more extensive and conscientious land reclamation efforts and in more and deeper underground mining.

Longwalling and shortwalling

Fortunately, two relatively new

(to the United States) methods of mining deep-seam coal are coming on strong—*longwalling*, long used in Europe, and *shortwalling*, a fairly recent Australian development. Of the two, *longwall* mining holds out the greatest promise of not only fulfilling expanded production goals, but also of achieving maximum extraction of available reserves.

In mining methods such as cutting and blasting coal, or in ripping it out with continuous miners, most mine development plans call for something called "room and pillar" mining. Under such systems the seam to be mined is laid out in a grid system, like a city's "blocks." The "streets" and their offshoots are the "rooms" of mined coal; the "pillars" are the "buildings" of coal left standing to support the overburden. Drawbacks include the need to support the "roof" in the area mined. This usually is accomplished with "mushroom" bolts anchored every five feet in all directions, five or more feet up into the rock formations above the coal seam.

Often 45 to 50 percent of the coal is left behind in permanent supporting pillars when a mine is deemed exhausted. Were these pillars also recovered, the entire overburden, right up to and including the surface, would sooner or later collapse, sinking by as much as the height/depth separating the exhausted mine's roof and floor—a disaster not unknown in mining country when city streets and buildings are "up top." In longwalling, such collapse of overburden is deliberate; in fact, it's necessary, and surface conditions are considered.

A longwalling plan usually calls for a continuous miner to penetrate about 3000 feet into a seam, then make a right-angle turn and cut a passage 400 to 500 feet long, make another right-angle turn, and so on until it has cut a wide corridor around a huge block of solid coal. Such passageways hacked out by the continuous miner provide ventilation, entry and exit access to the face to be mined.

That done, the continuous miner is finished and a different machine will take over once everything is in readiness.

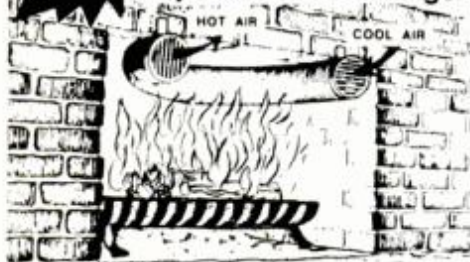
Roof-support devices

First, at the farthest end of the block of coal, a row of hydraulically-operated roof-supporting "shields" or "chocks" are set up along the entire length of the face. These powerful, [-shaped support devices serve

(Please turn to page 138)

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GIANT MINERS FOR A NEW COAL AGE (Continued from page 136)

roughly the same engineering function as does a bracket supporting, say, a shelf of books. They are hydraulically self-advancing, and their thick overhead steel roofs or canopies can be raised and lowered.

A jointed, slightly flexible continuous conveyor system is then set up along the length of the face. Depending upon the coal's "friability" (how easily it crumbles) the device doing the cutting will be either a complex of rigid tines called a plow, or the powered shearers, upon which are arranged a spiraling row of tungsten-carbide teeth. The appropriate machine is mounted on tracks or hooked onto a special haulage chain built into the conveyor system. The cutting device works back and forth, ripping the coal out and directing it down onto the conveyor. The conveyor then feeds coal to another conveyor set up at the entry end of the face. This one runs the length of the access passageway to a rail line of tram cars, or other transport, that moves the mined coal to the surface by means of ramps, lifts and so on.

The roof-support devices are coupled by hydraulic rams to the bottom length of the face conveyor system. As the cutter tears down the coal and moves past the supports, operators lower canopies and extend the rams forward to shove the flexible conveyor track up against the bottom of the newly exposed face. The rams then retract, pulling the support devices up snug against the newly positioned conveyor. Canopies are then raised to support the newly exposed roof. The process is repeated all down the line as the cutting device moves along the face.

Controlling 'overburden'

While all this is going on, the overburden behind the supports is supposed to be falling down at a controlled rate. If for some reason it doesn't (encountering high-density overhead rock, for example), it has to be drilled and blasted. It can't be left standing because it creates untenable stress forces on the face block, and because eventually it will collapse. When it does—depending upon how much falls—the resulting concussion can be fatal, as well as destructive to both mine and equipment. This collapsing of overburden, called "gob" in an underground mine, sooner or later causes a subsidence of the surface—a fact that restricts use of this technique to seams lying beneath open country.

In spite of high installation costs (\$3 to \$4 million to set up one face) the longwall system of roof supports,

cutters and conveyors is about as close to the concept of truly continuous mining as engineers so far have been able to come. It is not only a comparatively safe system of mining, but if everything goes well, prodigious amounts of coal can be extracted in a short time. Last year, for example, a single longwall face in West Virginia set a world record by mining 12,395 tons in a 24-hour period. Three-shift outputs of 5000 or more tons are fairly common in longwall mines. What's more, longwalling makes it possible to extract 90 percent and more of a mine's potential.

With the exception of lower production figures, the advantages of longwalling also apply to the mining method called shortwalling. The principal difference is that in shortwalling a self-propelled continuous miner, rather than a plow or shearer, is used to hack down the coal. But the miner can cut only in one direction. When it reaches the end of a pass, it has to back the entire length of the face and start over. Otherwise, the same complex of conveyors and roof-supporting devices is used.

Ventilation simplified

Because neither method carves out and creates a maze of mined-out corridors, both simplify mine ventilation problems. Fresh air can be drawn in from up top, and then blown straight across the face, reducing and removing dust and dissipating emissions of deadly and explosive methane gas, or damp. Created geologic eons ago as the earth's then-luxuriant plant and animal life decomposed to form carbon coal deposits, damp is an energy resource that has been allowed to dissipate in the atmosphere. Longwalling and shortwalling, because of their better ventilation and controlled fall of gob, also eliminate the need to dust newly mined areas with powdered limestone, a safety technique employed to snuff out possible explosions of coal dust.

Finally, longwalling at this point looks like the best bet to keep pace with the demands of a coal transport concept in which the industry now is showing interest. What it boils down to is a network of pipelines through which a slurry of pulverized coal and water is pumped. At the consumer end of the line, the water is extracted and the remaining coal burned for whatever purposes. If implemented on a broad scale, pipeline systems will demand huge outputs of coal. Only longwalling so far appears capable of producing the outputs from underground mines required to meet the demands. ★★★

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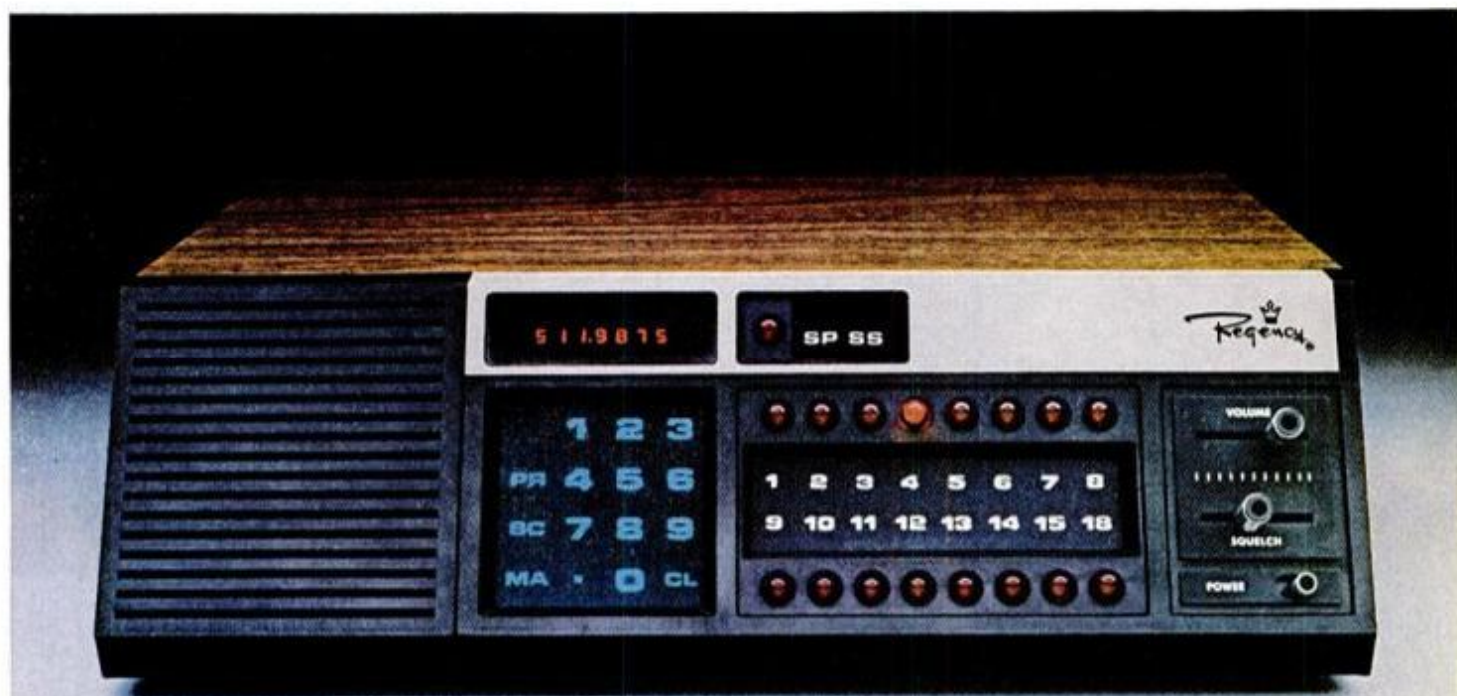
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3 FIREWOOD PROJECTS

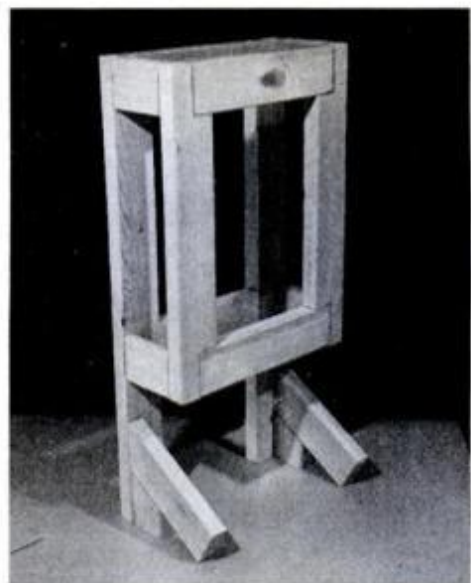
(Continued from page 125)

tacked together, affix clamps so parts won't move when you withdraw tacks to bore holes for the dowel buttons (that cover all nailheads). Use a stop on your drill bit to make certain holes are no deeper than $\frac{3}{8}$ in.

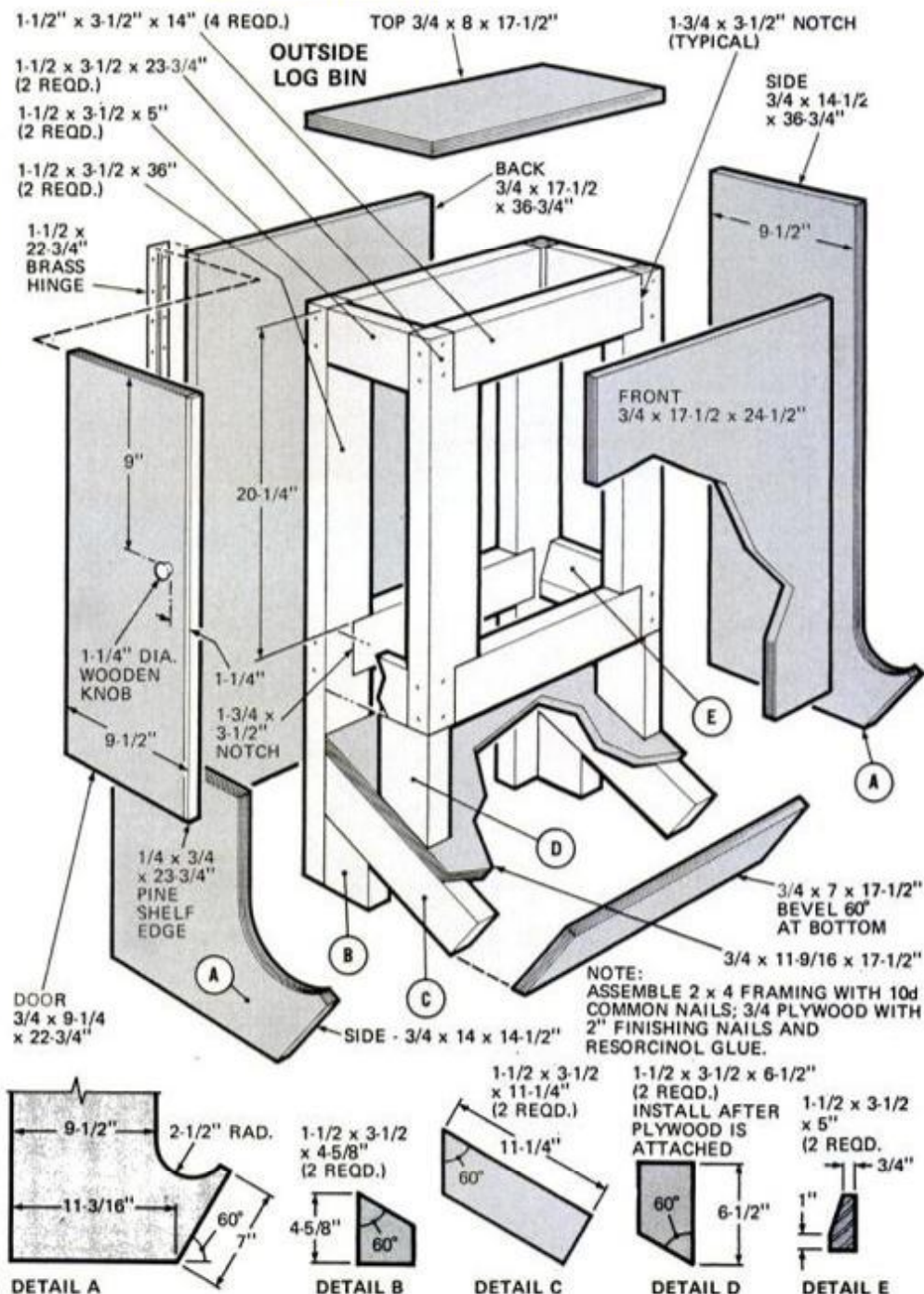
Mark the location of the three holes for the axle. (Note: The axle stock is a standard hardware item, as are the wheels we used.) Bore the holes to receive the wooden round stock at top and insert the top round and the handle. Secure both parts with glue and pins as shown.

■ **Log bin.** Ours is constructed using $1\frac{1}{2}$ x $2\frac{1}{2}$ -in. framing stock but 1 x 3 stock can be substituted without any real sacrifice of structural stability because the outside is cov-

(Please turn to page 144)



Log bin is framed using 2x6s ripped in half (or use 2x3s) and galvanized nails.





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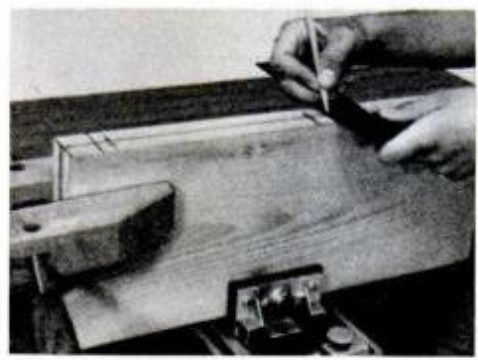
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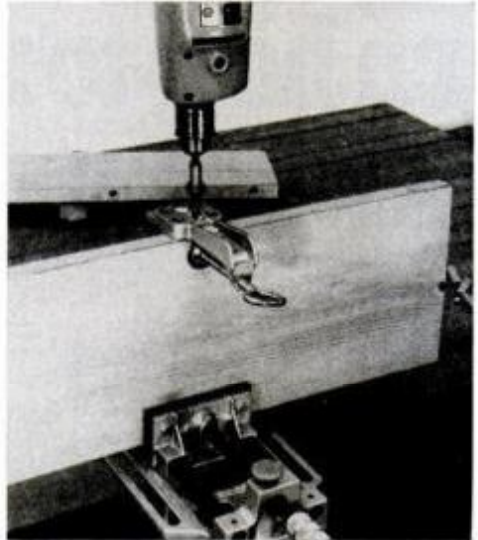
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3 FIREWOOD PROJECTS *(Continued from page 140)*



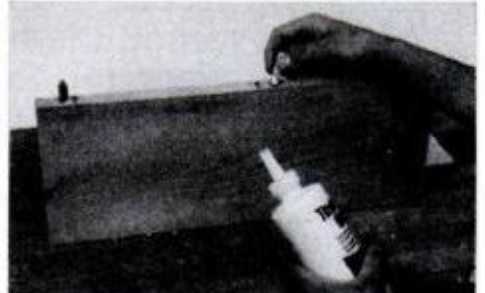
To edge-join boards for sides, clamp and mark mating pieces with pencil, square.



Next, use doweling jig and drill to bore dowel holes. Use stop for correct depth.

ered with 3/4-in. exterior-grade plywood. Use house paint—both primer and finish coat—for the bin and a brass continuous hinge to hang its door.

■ **Colonial log box.** This project is constructed to simulate primitive Early American furniture. For that reason, corners are joined using 4d common nails which are set with a heavy nailset. The box sides are edge-joined with dowel as in the photos on these pages. The bottom is quickly put together using Skotch connectors (or corrugated nails). To finish, apply stain, following manufacturer's directions. Rub a small amount of burnt umber pigment over nail holes and in corners; let this dry and apply a coat of water-thin shellac. When dry, finish with a coat or two of semigloss varnish. ★★★

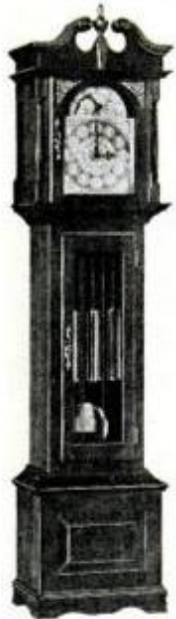


Boards are joined using glue and grooved dowels. Clamp boards until glue dries.

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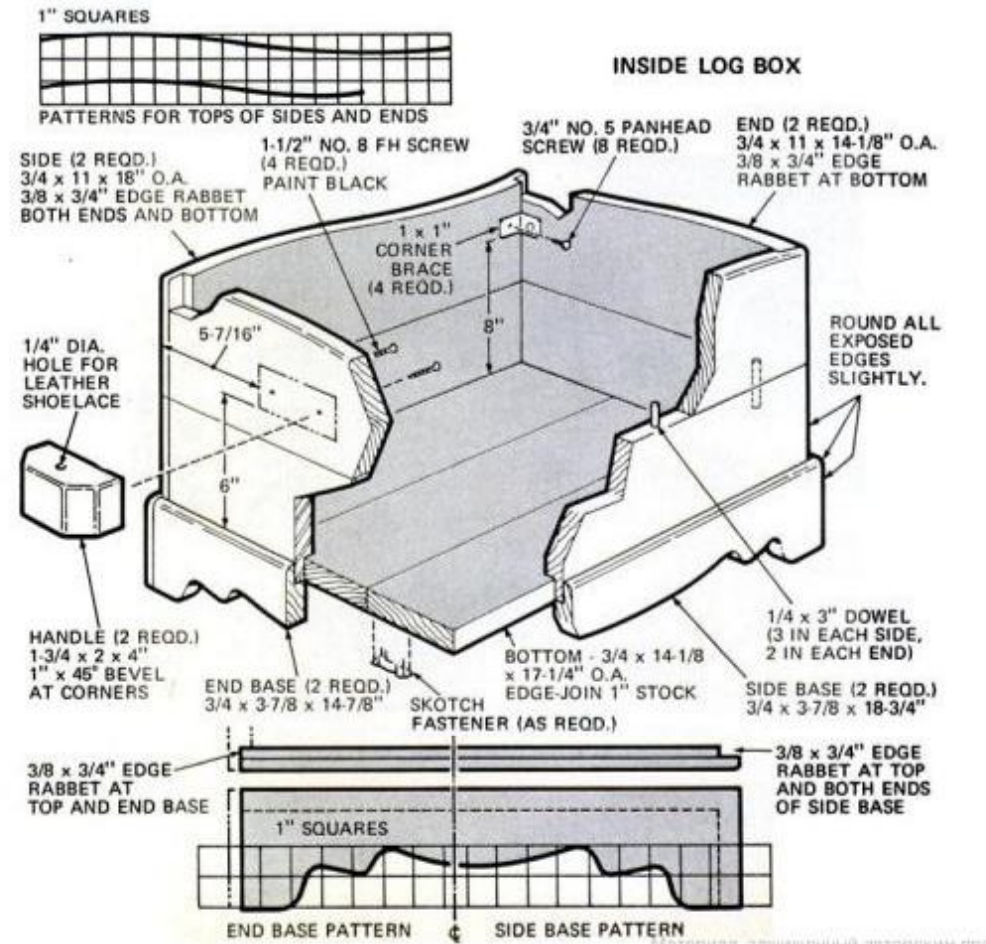
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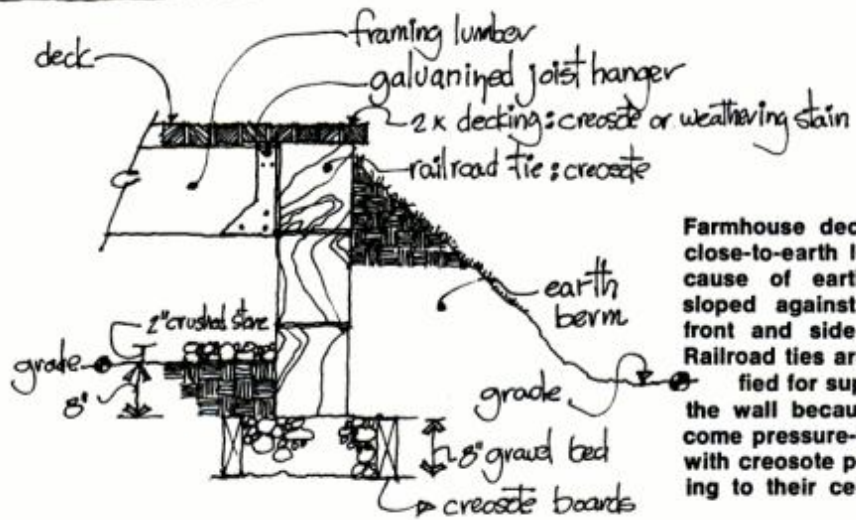


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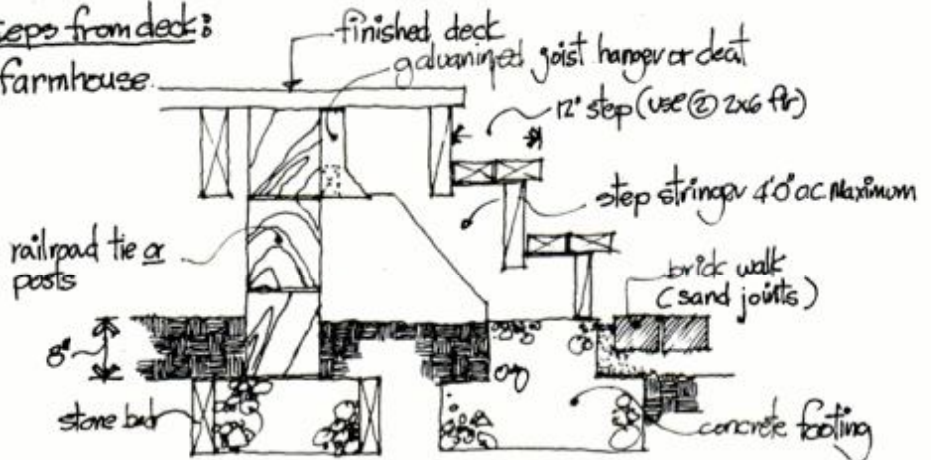
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Deck @ earth berm: farmhouse



Farmhouse deck gains close-to-earth look because of earth berm sloped against deck's front and side edges. Railroad ties are specified for supporting the wall because they come pressure-treated; with creosote penetrating to their centers.

Steps from deck: farmhouse

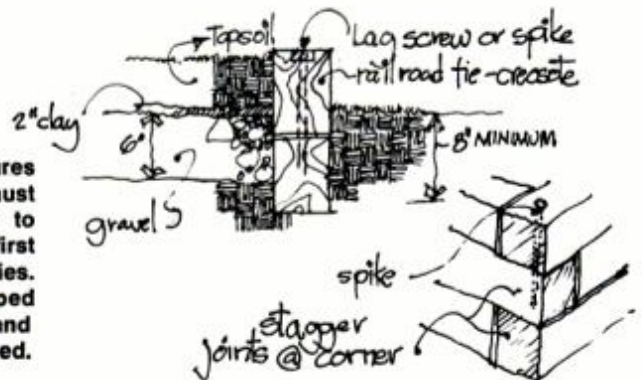


Stairs are of 2x6 stock. These are creosote-coated after installation. The 1/2-in. spacing between the tread boards elimi-

ates the need for a step pitch. If stairs are installed in a climate subject to freezing, install concrete footings as shown.

Planters

Planters are made by stacking ties as shown. The gravel below the layer of clay assures good drainage, which is a must for healthy plants. In order to spike ties together, you must first bore pilot holes through the ties. To do so, use a carbide-tipped bit and a bit extension, and bore at a slow drilling speed.



HOUSE-FRONT IMPROVEMENTS

(Continued from page 129)

the original house-front remodeling ideas offered here can be duplicated wholly or partly by the greatest number of readers. The challenge we presented Ira Grandberg, AIA, was to develop sensible changes that were attractive and low-cost.

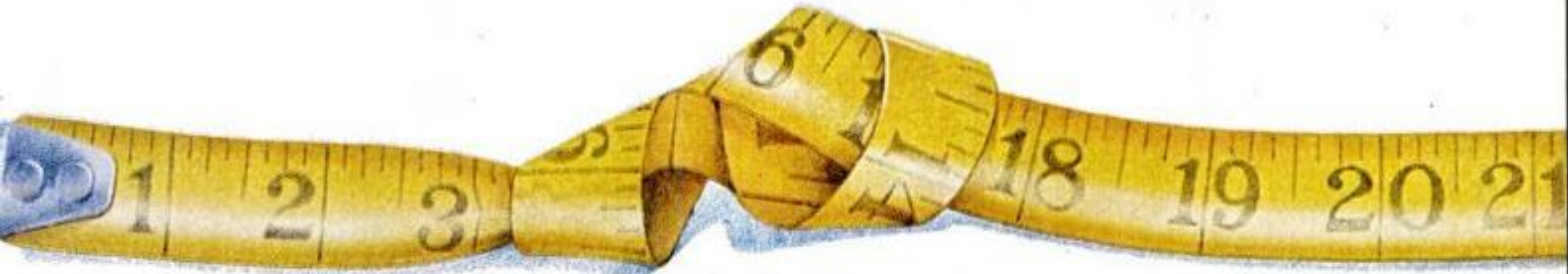
In all of these home types you can accomplish a quick improvement merely by doing some landscaping. This work, of course, can be a 100-percent do-it-yourself effort to keep cash outlay to a minimum. On the other hand, if your house front is in

sore need of a remake, and your budget and time allow, you can consider making one or more of the carpentry changes shown on pages 128 to 131.

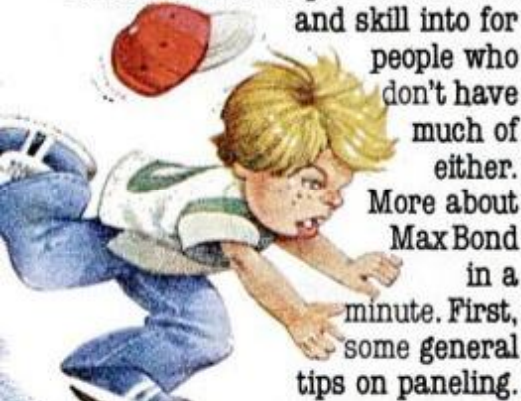
Most building and design experts agree that the principal shortcoming in many home designs is the lack of a center of interest on the house front. The ranch house on page 130, while of fairly recent vintage, lacks this feature to the same degree (if not more) than the century-old farmhouse on page 129. Thus in all example homes, the challenge was to create focal centers using various design devices—that readers could use on

(Please turn to page 148)

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one you're working on, lie down until the urge goes away. Get the one room done; then, no matter what happens you're finished with it.

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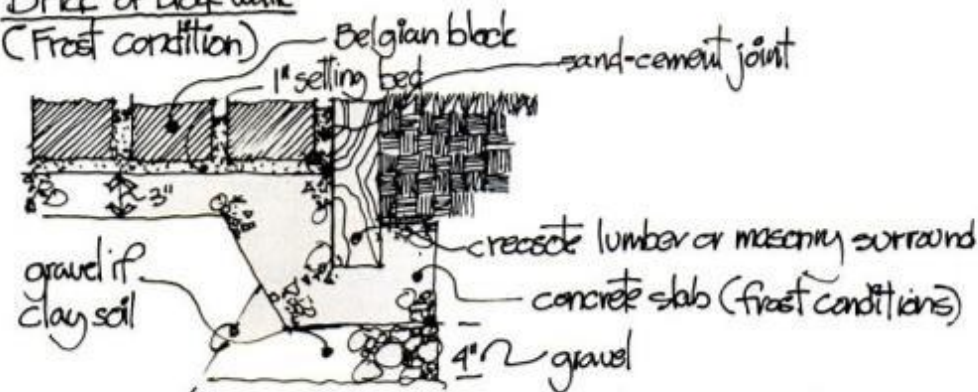
Side walk & path details:

Stone path



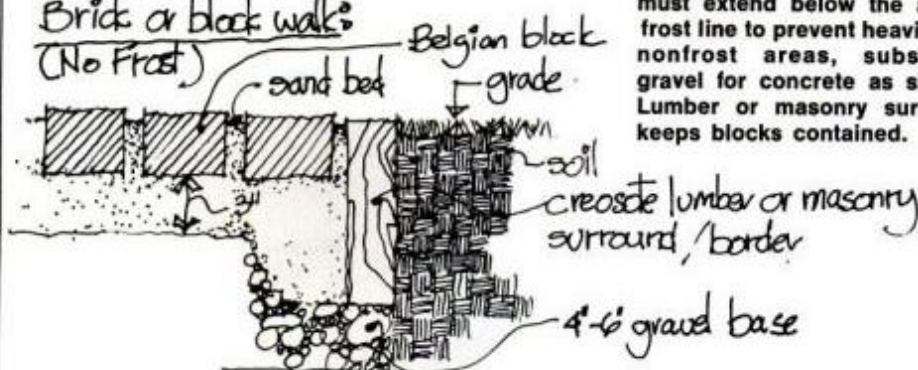
Flagstones are simply set into soil, more is added in joints to lock stones in place. If soil in your area is frequently muddy, remove soil and use 3 in. of tamped mason's sand over the gravel instead.

Brick or block walk (Frost condition)



If your walk is laid over concrete, footings along perimeter must extend below the area's frost line to prevent heaving. In nonfrost areas, substitute gravel for concrete as shown. Lumber or masonry surround keeps blocks contained.

Brick or block walk (No Frost)



HOUSE-FRONT IMPROVEMENTS

(Continued from page 146)

their homes, no matter what style.

If your house closely approximates one of the homes shown, it is simply a matter of more or less duplicating what you see. Or you can customize the suggested changes so they reflect your personal preferences. If your house doesn't match any of those we renovated on the drawing board, study the sketches so you will know exactly what it takes to create a visual focal point.

Here's a quick rundown on suggested changes for the houses shown:

■ **Stockade house.** This typifies those homes built in many suburban areas during the postwar boom. It is clean-looking, trim and without any unnecessary frills or gingerbread. If it is located in a tract of, say, 50 homes, it is one of perhaps three or four models the builder offered. This means that in the immediate vicinity,

there could be 15 or so look-alikes.

One way to effect an immediate and handsome change is by directing attention to the front entry. Here the left front corner could be extended forward so that it is in the same plane as the overhang corner above. The corner is framed as shown and then clad with the same siding that covers the overhang.

Along with the corner change, the existing narrow steps are replaced by wider, more elegant ones. The old walk to the front—which visually breaks up the small front yard, is removed and a new walk is installed from steps to driveway. The final touch is to paint the brick veneer a pleasing pastel color for accent.

All changes channel your attention to the entry with the result that the house now has a focal center of interest.

■ **Farmhouse.** Though this dwelling is situated in the country, homes

(Please turn to page 151)



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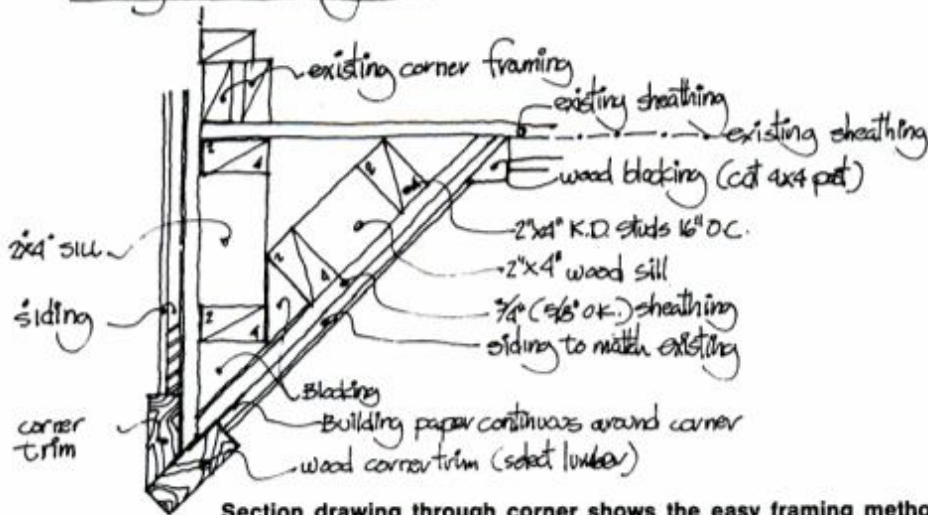
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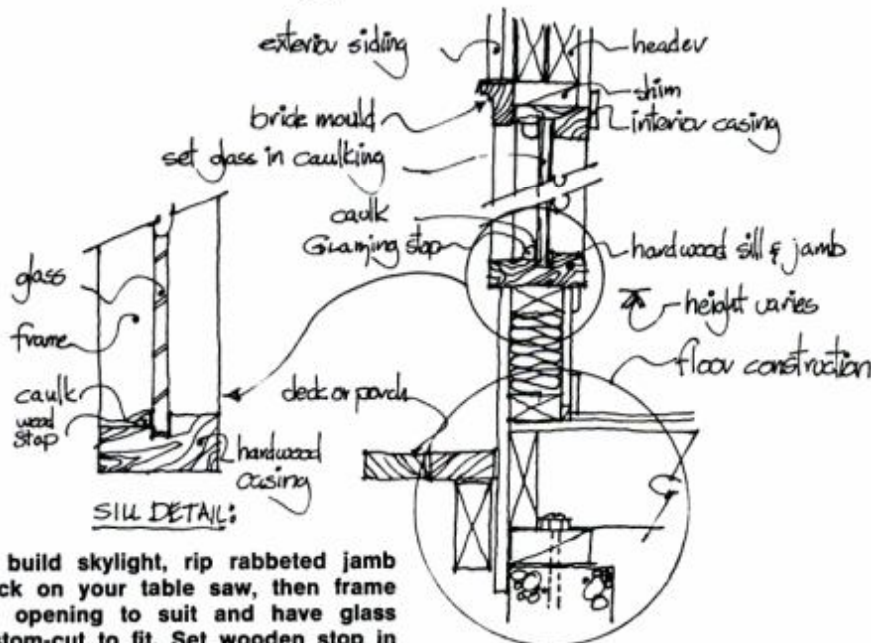
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Entry corner framing details STOCKADE HOUSE



Section drawing through corner shows the easy framing method used to create the diagonal corner on stockade house. Use select pine for the corner trim and galvanized nails for all fastening.

Glass sidelight details DUTCH COLONIAL; RANCH HOUSE



To build skylight, rip rabbeted jamb stock on your table saw, then frame the opening to suit and have glass custom-cut to fit. Set wooden stop in caulk for draft and waterproof joints

HOUSE-FRONT IMPROVEMENTS

(Continued from page 148)

of this type of architectural styling abound in small villages and towns—especially in the northeastern part of the United States. As can be seen in the photo, this old-timer has been expanded at least once in its lifetime. The smaller, dormered section at left is about 125 years old. The gabled structure was probably added about 75 years ago.

When renovating a house that possesses all the charm of this one, it is important to give a lot of thought in advance to what *should not* be changed at all. For example, the feeling achieved by the various design elements is good: Dormers are interesting, windows are well placed

and the porch adds a charm that you would be hard-pressed to improve. As a result, our suggested "changes" aren't really changes, but add-ons.

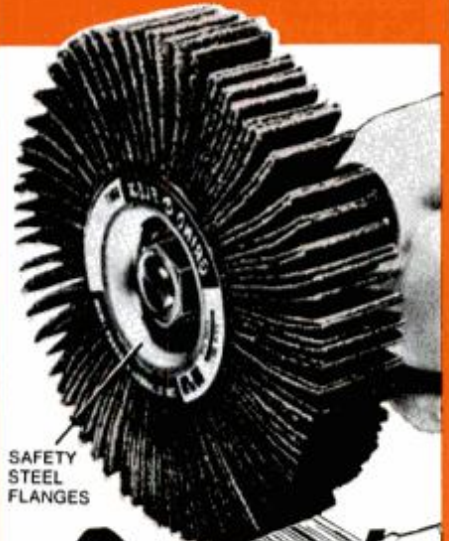
A wooden deck is added at the front right at the same elevation as the existing porch. Instead of having the porch underpinnings exposed, an earth berm gently slopes up to cover ties. Grand-scale steps added to deck and porch direct the eye to the front door—which heretofore was anonymous, thus hard to spot. Again the change is simply a matter of routing attention to the front entry.

■ **Two-level colonial.** You needn't be an architect to realize that the front entry on this house is not the best match possible with the house proper; its oversize A-roof line visually fights the other two roof lines. The new plantings and walkway here make an impressive change all by

(Please turn to page 152)

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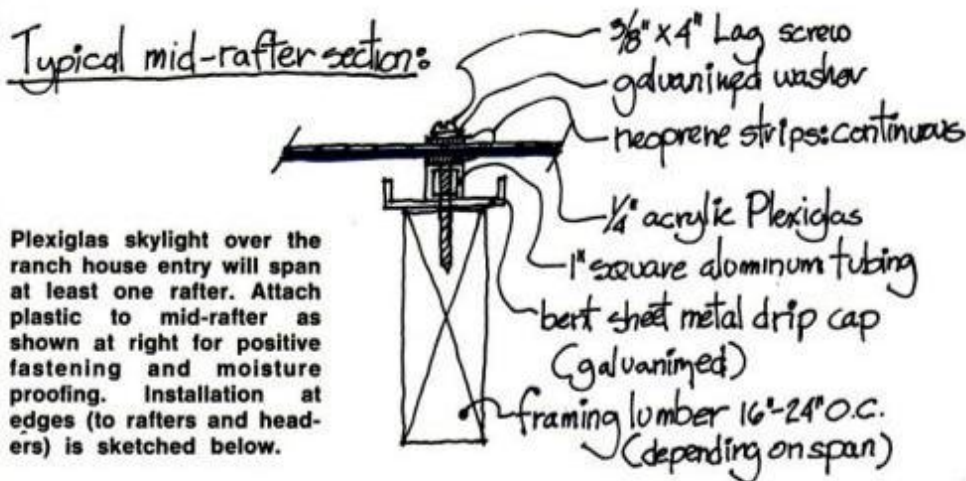
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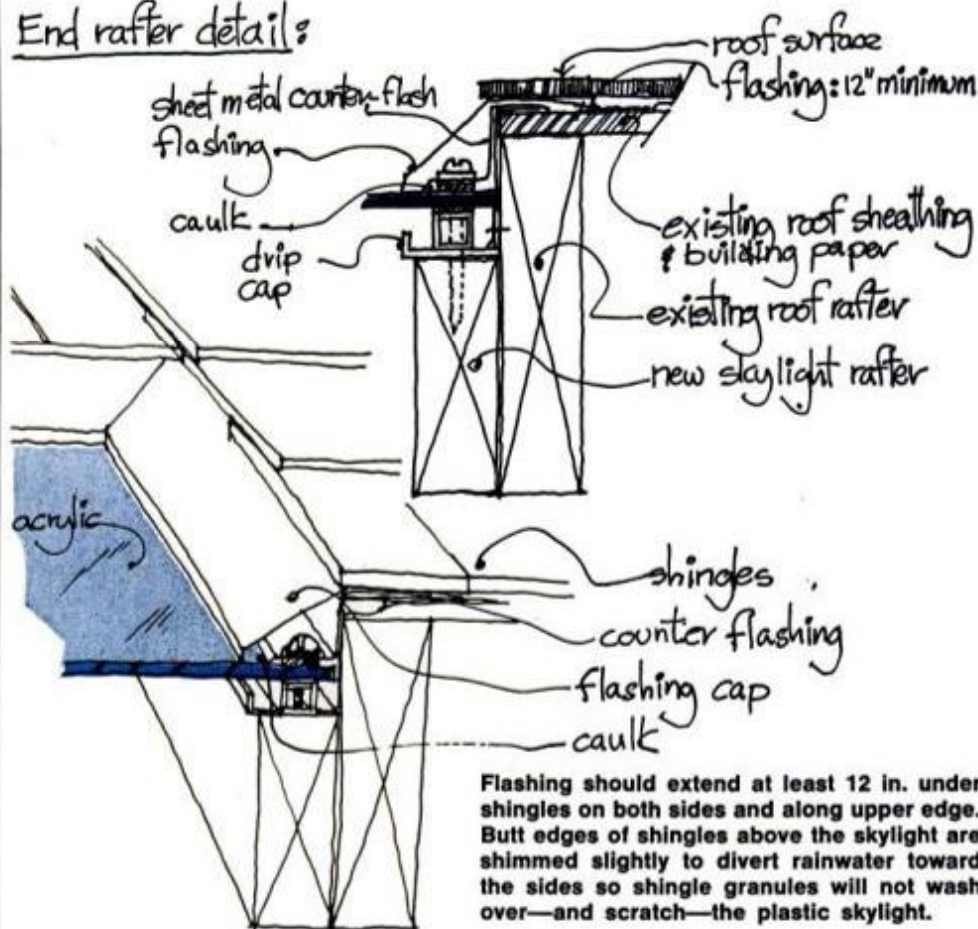
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SKYLIGHT DETAILS: RANCH HOUSE

Typical mid-rafter section:



End rafter detail:



Flashing should extend at least 12 in. under shingles on both sides and along upper edge. Butt edges of shingles above the skylight are shimmed slightly to divert rainwater toward the sides so shingle granules will not wash over—and scratch—the plastic skylight.

HOUSE-FRONT IMPROVEMENTS

(Continued from page 151)

themselves. However it might be a good idea to consider modifying the entry's roof along the style shown here. In PM's version the A is replaced with a shed-type roof. The shingles disappear and in their place we find sheet-acrylic plastic installed to give a greenhouse effect. A rectangular flush door replaces the old one (with its half-moon top) and a sidelight complements the skylight.

■ **Ranch house.** This home is improved almost instantly with some common-sense plantings and planters. For many, these changes would suffice. Others, however, may elect to

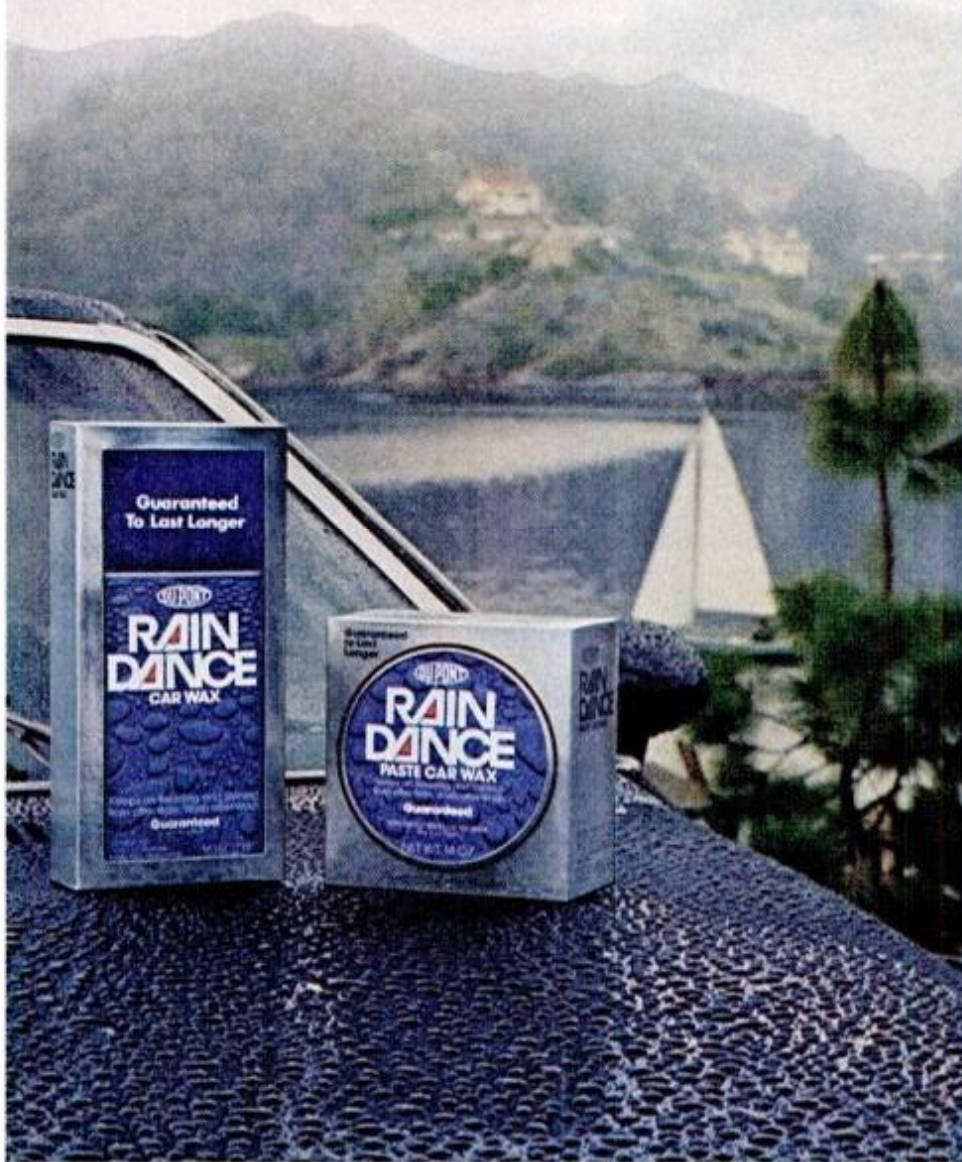
go all the way and install a sidelight and skylight as shown.

As can be seen in the before photo, the front entry is dark and receding—really just the opposite of what a good entry is all about. The three areas of change—carpentry to the house, new landscaping and a large front step moved in line with the house front plane, changes that look by 180°.

■ **Cape Cod house.** Changes suggested for this cozy and familiar house all have to do with landscaping. Here it is a matter of rerouting the front walk—to make the yard appear larger—and to add plantings that blend with the house and serve to direct the viewer's eye. ★★★

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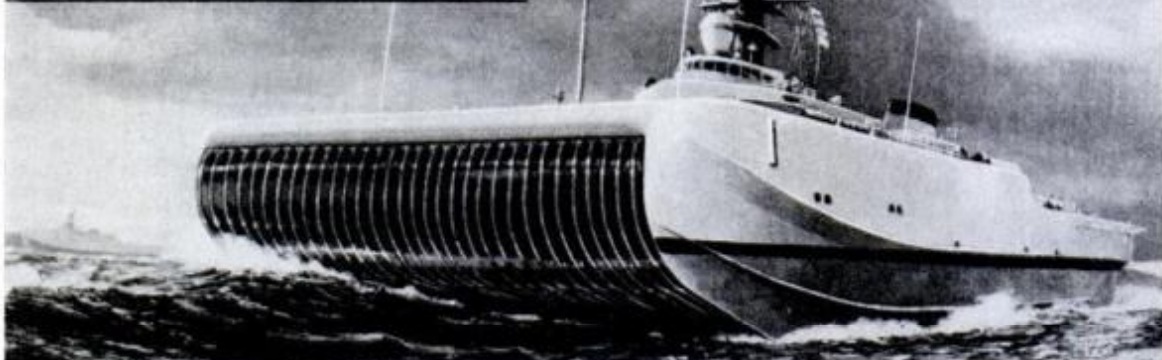
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IT'S NEW NOW

World's fastest cargo ship flies

Traveling several feet above water on an air bubble, a new aluminum-hull Navy surface effect ship (SES) will go three times as fast as the fastest cargo ship. The 3000-ton vessel, 270 feet long, 105 abreast, will carry a crew of 125. Gas turbines will run waterjet propulsors. The unique craft, being built by Rohr Marine, California, has been prototyped in a 101-ton version (insert), that hit 103 mph in the Gulf of Mexico last year.

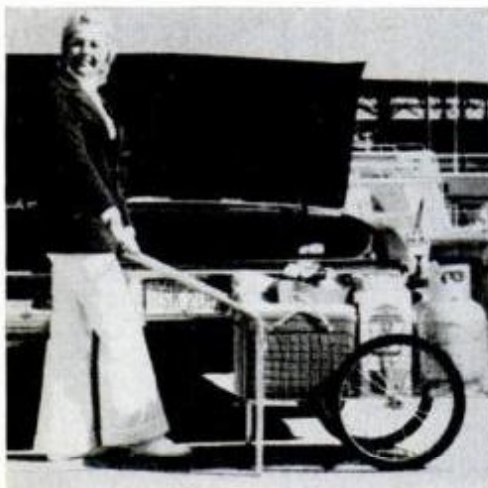
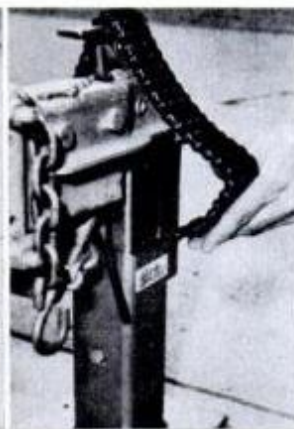
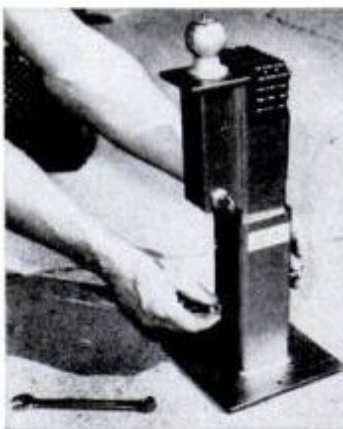


Wake to radio or tape

Compact portable recorder also has AM/FM radio with frequency control. It records from radio; has tape shutoff and timer for use with tape or radio. GE Model 3-5221 about \$150 at retail stores.

Tough trailer anchor

Hitch your trailer coupler to a welded steel stand, and take off for town (or highway help) in the tow vehicle without worries. Hitch ball on stand is available in all coupler sizes. Case-hardened chain secures coupling. Adjust post to vehicle hitch level by removing hitch bolt (left). About \$90. Gilco. 3715 Minnehaha Ave., Minneapolis, Minn. 55406.



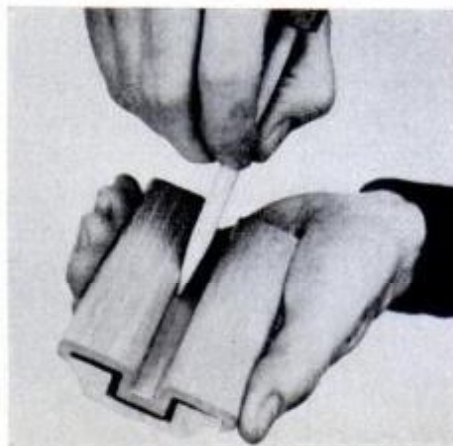
Carry-all carts collapse to stow

Haul groceries, leaves or garden produce in a cart that fits the car trunk. Collapse-O-Carts come in 23x36-inch or 22x30-inch sizes with straight or bar handles. From \$94. Eric Knebel Co., 5147 Burlingame Dr., Atlanta, Ga. 30360.

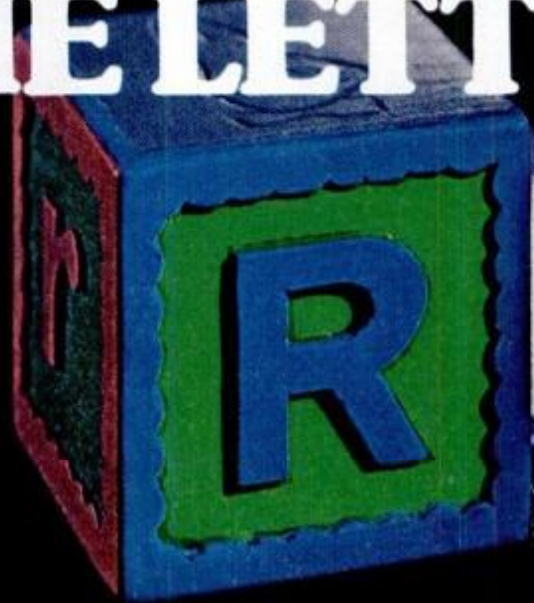


Talk turkey

Produce gobbles, yelps or purrs with a new turkey call by drawing a striker through groove of call. Yelp to call; purr to bring him close. \$7.95. Penn's Woods Products, Delmont, Pa. 15626.



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When you investigate insulation for your home, start by comparing R values. They're the standard means of measuring insulation's effectiveness per inch of thickness. A product's R value expresses its ability to resist the natural tendency of hot air to flow toward cold surfaces. A poorly insulated home lets in unwanted heat in summer and loses expensive heat in winter.

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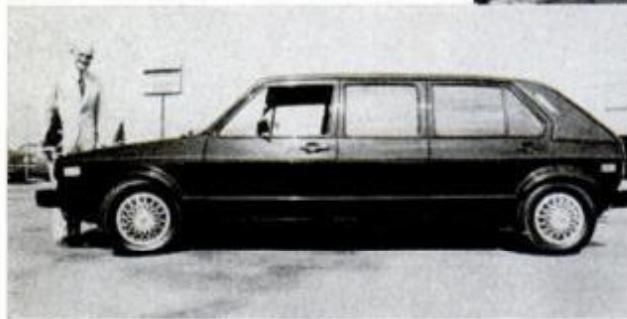
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Smart digital stopwatch

If you have to clock racing cars, boats, horses, swimmers or track contestants, a new digital stopwatch with built-in memory is designed to meet the need of almost any timing situation. Thanks to this feature, you can time each individual lap of a race, then bring in overall time of the event by flicking a finger. LEDs are readable even under brightest sunlight. Cost is \$125 (\$80 without memory). Auto World, 701 North Keyser, Scranton, Pa. 18508.



Wrench with a tight bite

Serrated jaws of a versatile new wrench stay parallel as they close in on hex nuts, round pipe or any object up to an inch across. Ratchet action is imposed by a vinyl-coated handle. The chromed Jak-Lok tool costs \$9.75. Educational Products, Box 606, Mineola, N.Y. 11501.



From can to cookpot

Now you can cook canned foods in the can over open fire or stove. A vinyl-coated, heat-resistant Kan Handle latches on any opened can; releases by lever on handle. \$1.95. Dick Cepek Co., 9201 California Ave., South Gate, Calif. 90280.

Bike fun for doctors

Now they've combined a stationary exercise bike with an electronic brain for the doctor's office. You'll get to ride it, maybe, when you go in for your annual physical. The computerized bicycle exerciser, known as the Dynavit, automatically measures the rider's heartbeat as he pedals; even counts calories burned away during the "ride." The machine, a diagnostic tool, was demonstrated by the young lady shown at a recent Design Engineering Show in Chicago.



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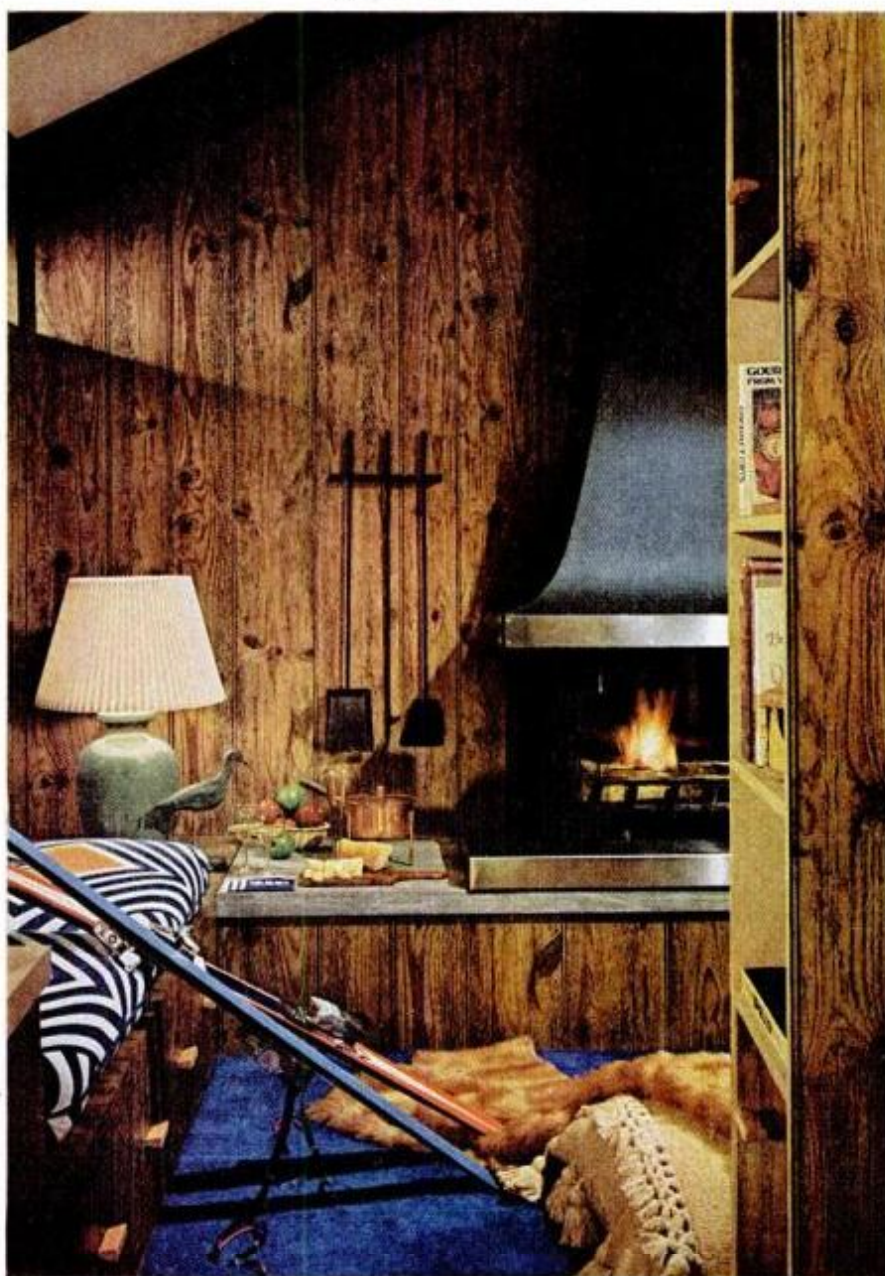
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High Noon

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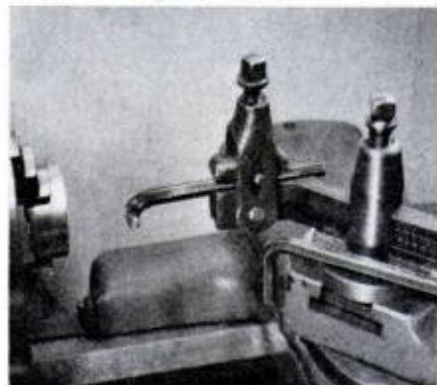
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HINTS FROM READERS

Internal boring tool



Make an internal boring or threading tool for a lathe with a good quality Allen wrench. Cut off as much of the short end as needed, depending on size of hole to be bored. Shape on a grinder to proper angle. If it is to be a threading tool, shape it to the conventional 60° angle.—*L.J. Bourgeois*

Heat restores ball-point pen



A soldering iron or gun applied to the cartridge of a dried ball-point pen will cause the ink to flow again.—*Ken Patterson*

Ceiling texturizer



Make a ceiling texturizer by attaching a handle to plywood with two long screws and mounting long-pile carpet to the plywood with screws. Dip the texturizer into a bucket of topping-type joint compound and spread it over an area of 10 to 20 sq. ft. Then go over the area again, working the tool vertically to get texture.

—*E.S. Rugg*

DRIVING THE 1978 CHRYSLERS, PLYMOUTH AND DODGES

(Continued from page 104)

are all of that and more. They have a lumbar support and a "memory" that allows them to be moved up for rear-seat access and then automatically go back to their set position on the track. Furthermore, their form rivals their function: All seat-adjustment levers are integrated into the seat frame itself—a beautiful bit of industrial design.

The rest of the interior is also well executed. There's an overhead console with digital clock, excellent instrumentation, inside deck-lid release, inside adjustment for left- and right-hand mirrors and more. Under the hood is a 1600-cc or 2600-cc Silent Shaft Four (single two-barrel) with Jet-Valve design (see description below), and choice of five-speed or automatic.

Dodge Colt station wagon

Also new for '78 among Mitsubishi models sold here by Chrysler is a

restyled, four-door Colt wagon that's larger than its predecessor. It's shown on page 160. Like Omni and Horizon, it won't be on sale until January '78. The wagon is shown with optional Estate Package, including wood-grain exterior panels, special interior and trim.

Plymouth Arrow

This gorgeous little machine, in base, GS and GT series, gets a new, sporty Arrow Jet package for '78. Lots of flat black, stripes and things, but done nicely—no cheap chic treatment for this winner.

Dodge Magnum XE

The Dodge boys lay it on thick here with the mucho macho Magnum—for the man on the make. Dual rectangular headlights, side by side, behind stylish shades of clear polycarbonate plastic, dominate the

(Please turn to page 160)

MCA-JET SYSTEM (MITSUBISHI CLEAN AIR)

Conventional wisdom says you need a rich mixture right around the sparkplug to fire the lean mixtures in today's emission-controlled engines. It also says that although exhaust gas recirculation is an evil thing for fuel economy, it must be used to reduce nitrogen oxides emissions.

The Japanese have defied the conventional wisdom with a new engine modification—an air "jet" valve. The relatively simple design has boosted gas mileage 14 percent on 49-states models (to 41 mpg) and a whopping 44 percent on California cars (to 36 mpg). This is the second time in two years Mitsubishi engineers have done the unconventional. Last year they proved a four-cylinder could run as smoothly as a V8, using balancing shafts in the Silent Shaft Fours.

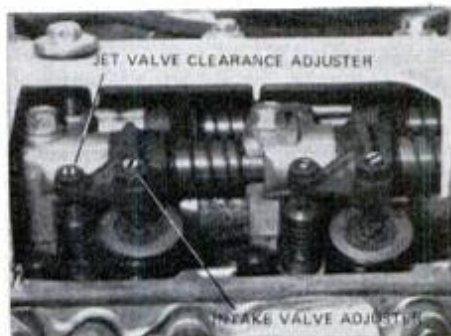
The air jet is an additional intake valve, a little part the size of a 10-penny nail. It's operated by a tab on the intake valve rocker, so it opens and closes at the same time as the intake valve.

When it opens, an air stream from just above the throttle plate rushes through a port into the combustion chamber. It sweeps across the sparkplug and sends the remainder of the air-fuel mixture into a rapid swirl, which promotes very even mixing of a super-lean mixture (18-1 ratio, compared with 15 to 17-1 for what Detroit calls lean). When the plug fires, the swirling mixture around the plug is anything but rich.

Mitsubishi has found the engine actually likes a fair amount of exhaust gas recirculation. Give it a mixture containing about 5 percent exhaust gas and fuel economy goes up, apparently because the gas helps lean out the mixture in a

relatively uniform manner. At 10 to 15 percent exhaust gas, however, the engine starts to suffer.

The only special service requirement on the engine is adjusting clearance on an extra set of valves. It's done at the



Jet valve is an additional intake valve and it will also need an adjustment.

same time as the intake valves and the same way, with a feeler gauge.

Can this jet valve be used on U.S. engines? No one at Chrysler knows, because the Mitsubishi is an overhead cam, hemi-head with crossflow (intake valves and ports on one side, exhaust on the other). You can be sure some embarrassed Chrysler engineers are trying to find out.

A Chrysler engineer looked at the Mitsubishi design with undisguised admiration and a touch of jealousy. "It looks simple but it takes a lot of time and money to check it out. If one of us came up with an idea like that, and tried to get a budget to test it, there'd be some old-timer who'd say 'It can't work' and that would be that."

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DRIVING THE 1978 CHRYSLERS, PLYMOUTHS AND DODGES

(Continued from page 159)

front end. Stripped, in its innocent unoptioned setup, it's racy enough. But with the Open Road package it's downright lascivious—fender flares, fat GT radials, engine-turned instrument panel and more.

Dodge Aspen, Plymouth Volare

These successful coupes, sedans and best-selling wagons get the required nose powdering—new grille and taillamps are the giveaway to a '78. A single series replaces last year's basic, Custom and Special Edition series. It's supposed to simplify the lineup and give you the flexibility to mix or match the new Custom and Premier interior and exterior trim packages along with present popular options, such as the Landau or T-bar roof, and new options. It'll still be tricky to price that new Aspen or Volare on the big day.

The big ones

Dodge Charger and Monaco, Plymouth Fury and Chrysler Cordoba, on a wheelbase of 114.9 inches or 117.5 inches, also get obligatory freshening.



Dodge Colt station wagon for '78.

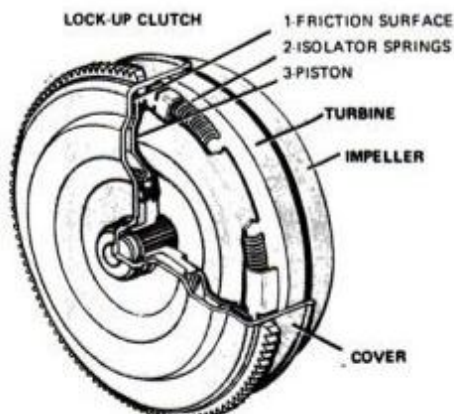
New Yorker Brougham, Newport

Lineup is two and four-door hardtops in both series with 400-cu. in. V8 lean-burn engine. Lockup torque converter boosts mileage.

(For service tips, please turn to page 162)

FUEL-SAVING LOCKUP TORQUE CONVERTER

Twenty-odd years ago, a big heavy Packard with the Ultra-Matic automatic transmission got about 5 mpg in city driving, but turned in some dazzling figures—18 mpg or so—on the highway. Its secret was a system that locked up the torque converter with a friction clutch plate. As the car cruised down the road, it operated as if it had a manual clutch. This was obviously more efficient than trying to transmit power through oil, as is done in the ordinary converter. Chrysler's resurrection of the lockup converter is expected to improve highway fuel economy by up to eight percent, and city mileage by two percent. Every little bit helps.



The Chrysler design is much different from the old Ultra-Matic, which had a separate clutch plate. The Chrysler clutch has a friction surface in the converter front cover. Next to it is a king-size piston attached to the torque converter's turbine wheel, which is mechanically linked to the transmission.

Oil is pumped into all parts of the torque converter, including both sides of the piston. This keeps the piston in a

balanced position, away from the clutch surface. If the oil pressure between the piston and clutch surface were relieved, the pressurized oil on the other side of the piston would automatically push it into contact with the friction surface, engaging the clutch. That's exactly what is done, and here's how:

The transmission has a component called a governor mounted on its output shaft. The governor helps control shifting of the transmission by developing an oil pressure signal that is proportional to road speed (actually the speed of the output shaft), and this signal is also transmitted to a valve that is in the oil supply passages to the lockup piston. At the appropriate output shaft speed, with the transmission in high gear, governor pressure is applied to the valve, moving it to open a vent hole, which relieves the pressure between the piston and friction surface.

The opening of the vent occurs when output shaft speed is 850 rpm on V8s (about 27 mph) and 1100 rpm on Sixes (about 31 mph), with the transmission in high gear. If you have a heavy foot on the gas pedal and the transmission upshifts at high speed, the lockup clutch vent valve is moved simultaneously with the upshift.

The engagement of the clutch is very smooth, but you can be sure the system is working with this simple test: Get the transmission into high gear (road speed at least 35 to 40 mph) and hold it there, with light throttle pressure. Next, moderately mash the pedal, enough for something to happen but not hard enough to kick down the transmission. You should feel a lugging of the engine, as if the car had a manual transmission and were in high gear, not the easy speedup of the engine as is typical with a conventional torque converter.

In chain saws, as in everything else, you get what you pay for.

"Bargain" chain saws are fine as long as you don't give them a lot of hard use.

But if you use a chain saw often, and you use it for tough jobs, it pays to spend a little more for a John Deere.

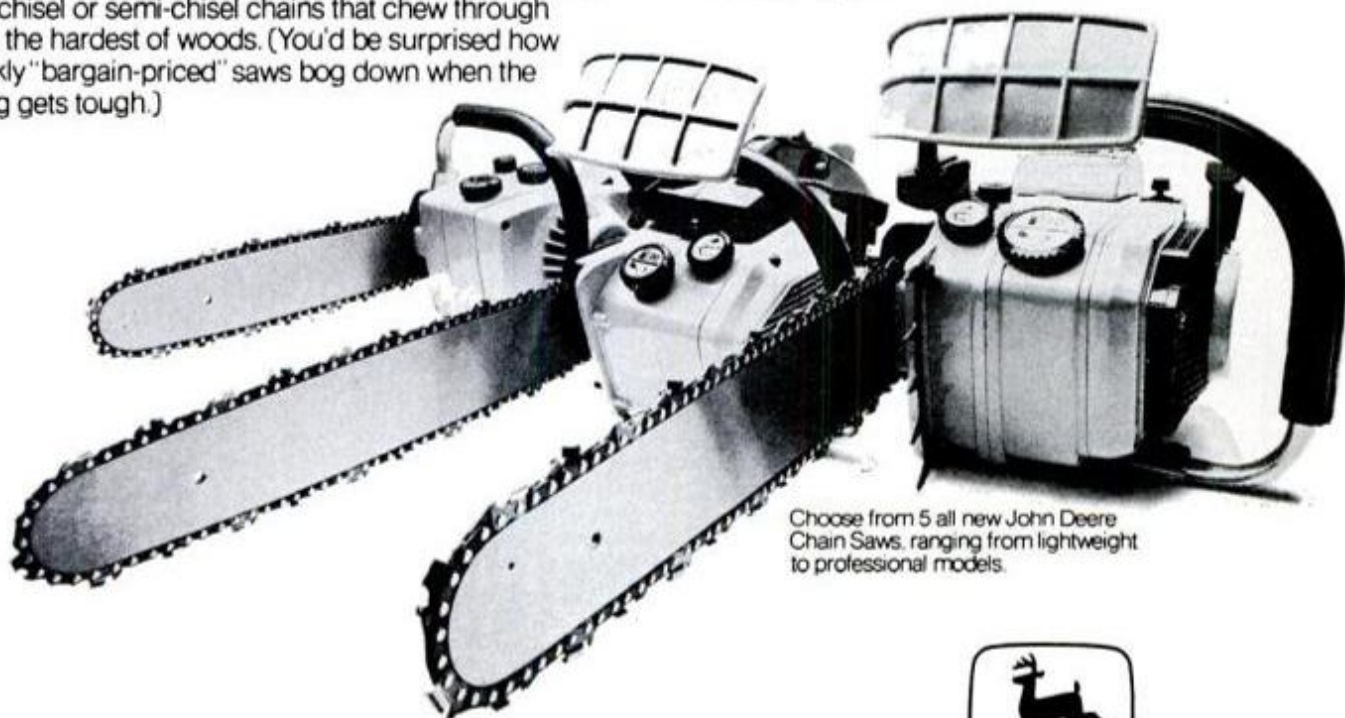
For example, all Deere chain saws (except the 30) have isolated engines that reduce vibration and make your cutting job easier and less tiring.

Our solid sprocket-nose guidebars come equipped with chisel or semi-chisel chains that chew through even the hardest of woods. (You'd be surprised how quickly "bargain-priced" saws bog down when the going gets tough.)

You also get a powerful air-cooled engine. Automatic oiling. Plus, on the four larger saws, extra safety features like a molded plastic handguard, a special "chain-catch" to protect you if the chain should break, and a throttle interlock lever.

Naturally, it costs a little more to build in all these professional quality features.

But in chain saws, as in everything else, you get what you pay for.



Choose from 5 all new John Deere Chain Saws, ranging from lightweight to professional models.



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DEALER INQUIRIES INVITED

DRIVING THE 1978 CHRYSLERS, PLYMOUTH AND DODGES

(Continued from page 160)

SOME CHRYSLER SERVICE TIPS:

■ A lightweight, all-metric Japanese air-conditioning compressor makes its debut on '78 Chrysler Corp. cars. If it ever needs service, however, skip the dealer, for the compressor is the same unit that has been marketed with retrofit airconditioning systems by independent U.S. companies for several years. Now called the Sankyo, the compressor used to be known as the Abacus. Any independent airconditioning shop should be able to service it and rebuilt replacements should be readily available at independent parts suppliers.

■ When is cast iron lighter than steel? The answer is when the steel is a dense piece of machined metal and the cast iron is a simple, hollow design. In the case of the '78 Chrysler 100-amp. alternator, a cast-iron pulley is half-a-pound lighter than the machined steel part it replaces—also lots cheaper to make. Unfortunately, it takes a new special puller to remove it.

■ Chrysler's '78 six-cylinder cars get a weight-saving aluminum brake master cylinder with plastic fluid reservoir. You can replace the sealing cups if they don't hold pressure, but if the cylinder bore is pitted, honing is a no-no. Reason: bore has a special surface treatment and hone would remove it, adversely affecting component performance. Find pitting? Replace the part.

■ When Aspen and Volare were introduced in '76, one nicety was a super-quick-pull instrument cluster. Speedo cable housing was caged to the cluster holder, so you didn't even have to reach up in back of dash and disconnect it. Unfortunately, holding the cable this way led to some dashboard noise, and quiet is the magic word today. So for '78 you've got to reach up and disconnect the cable before pulling the cluster. There's a passable access slot for your hand, even on cars that are equipped with airconditioning.

■ If you use your automatic-transmission-equipped Chrysler product in heavy-duty service, you should change the oil more often on '78s (and some late '77s) than previous models. Chrysler dropped the drain plug from the torque converter, as a late-'77 running change, so you can drain only half the oil, just the amount that comes out when you pull the pan. Recommended interval is lowered from 24,000 to 15,000 miles. No fluid change is specified for so-called "normal" service.

■ Many '78 Chrysler products will have a new, lighter radiator, with a single row of tubes, instead of the usual double row (cooling for both). If you have to get a replacement, the two designs are physically interchangeable, so get what's easily available and/or cheaper.

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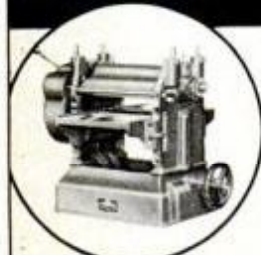
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THERMOQUAD SERVICE TIP

There are tough new standards covering fuel evaporative emissions for '78 models, and they're leading to some more strange underhood gadgetry.

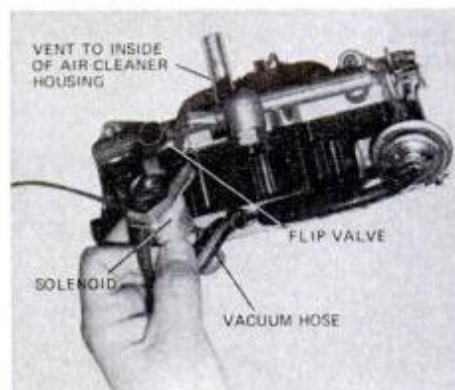
One that could give an unknowing Saturday mechanic a whole weekend of troubleshooting distress is a vacuum-electric fuel bowl vent on the four-barrel Carter Thermoquad, used on many Chrysler products.

The device—a flap valve—is screwed into the top underside of the carburetor. It vents the carburetor fuel bowl only to the charcoal canister when the engine is off, and only to the inside of the carburetor air-cleaner housing when the engine is running. This is the way fuel-bowl venting is supposed to be done.

When the engine starts, manifold vacuum pivots the valve to close off the line to the charcoal canister, open the vent to the inside of the air cleaner and hold it in that position.

When the throttle is opened wide, as during acceleration, manifold vacuum drops. The flap would swing back, but an electric solenoid takes over.

Although the solenoid isn't strong enough to move the vent flap (hence the use of manifold vacuum), it is capable of holding the flap in place. This is



Hesitation-on-acceleration may require troubleshooting evaporative controls.

important, for the vent otherwise would go to the charcoal canister, which is very close to atmospheric pressure, measurably higher than the pressure inside the air cleaner. Higher pressure on the fuel in the bowl would increase the fuel flow. The mixture would suddenly go excessively rich and the engine would hesitate during acceleration.

If you get a '78 Chrysler product with the Thermoquad, keep this in mind. A malfunctioning solenoid, perhaps an inadvertent disconnection of the solenoid wiring connector, could cause that hard-to-find performance problem.

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Mennen Anti-Perspirant Spray lasts 3 times longer than aerosols.



DRIVING THE 1978 FORDS, LINCOLNS AND MERCURYS

(Continued from page 111)

could just measure manifold vacuum, but finds it gets a better signal for its computer by checking pressure. Sensor contains a variable resistor to convert pressure changes into an electrical signal for the computer.

- Engine speed (signal from electronic ignition control unit).

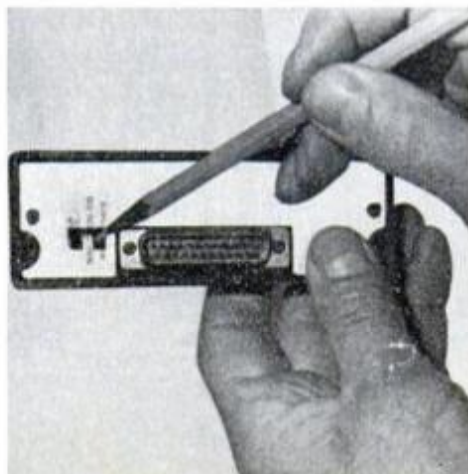
- Crankshaft position sensor. This is a magnetic probe positioned at the rear of the engine, where it is triggered by a disc mounted on the rear of the crankshaft. The disc has four teeth, 90° apart from each other, and when a tooth lines up with the sensor, it tells the computer the exact position of the crank. GM's MISAR uses a similar setup, with a disc at the front of the engine, but the GM sensor is adjustable to set ignition timing.

The computer uses a lot of juice, so during cranking it's out of the picture, so starting is not impaired. The electronic ignition system automatically triggers the ignition coil at 10° before top dead center.

Once the engine starts, the computer is supplied with current through a relay. If the computer

fails, the timing automatically goes to 10° BTDC, which enables the engine to run and that's about it. In the computer-failed mode, the engine performance and gas mileage are terrible, so the motorist knows something's happened.

The computer is under the dash, but you should normally never have to touch it. To make a basic check of the system, start the engine and



Small switch on EEC calibration module allows adjusting ignition timing $\pm 2^\circ$.

with a timing light, see if the marks at the front of the engine and crank pulley are aligned, in accordance with the specs on the underhood decal. Then rev the engine up to a high-speed rpm given on the decal, and timing should advance per specs, also on the decal.

The Ford calibration module does have a little switch that permits changes in ignition timing of two degrees plus/minus. This gives the system enough flexibility to correct for production tolerances and any changes necessary for emission control. The access slot to the switch is sealed, however, and it takes a government okay to remove the seal and make even the minor change.

EGR control

The exhaust-gas recirculation system with EEC is no longer the simple little vacuum-controlled diaphragm valve. It's operated by air pressure, supplied by the air-pump system, and it has a variable resistor built into the valve stem.

As the stem moves, the resistance changes, and changes an electrical signal to the computer, which tell the box the exact opening of the EGR valve at that instant.

The computer then makes adjustments if necessary by activating or deactivating either or both of a pair of solenoids mounted on the left side rocker cover of the 302 V8.

The first solenoid in the circuit is normally open; it will pass air pressure unless current from the computer closes it. The second solenoid is an air vent, normally closed. That is, when the current is chopped, its air vent closes and it will pass air to the EGR valve. When current is supplied to this vent solenoid by the computer, the solenoid will open and vent the pressurized air to the atmosphere.

If the computer wants maximum EGR, it does nothing, and compressed air flows through both solenoids to the EGR valve. If it wants to stop EGR completely, it supplies current to both solenoids. The first one closes to stop the airflow from the pump; the second opens to vent the air pressure in the line to the atmosphere, so the EGR valve closes.

If the EGR supply is just right, the computer supplies current only to the first solenoid, which closes, trapping the air in the line and holding the EGR valve in position.

When the computer wants to provide only partial EGR, it opens the vent solenoid. Full air pressure still flows through the first solenoid, and only part of it escapes through the vent in the second solenoid, so the EGR valve is partly opened.

To make a basic check of the EGR system, warm up the engine, disconnect the hose at the valve and put a finger over the hose end. With the engine idling, you should feel nothing. Rev the engine and you should feel some air pressure. The design of the EGR valve does not allow visual inspection of valve stem movement.

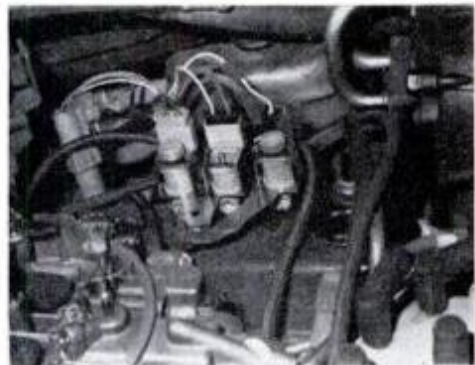
Air pump control

The air pump system control also is done with a solenoid, mounted on the left side valve cover next to the EGR solenoids. When the computer wants the pump to send air into the exhaust system, it activates the pump solenoid, which closes off a valve to atmosphere. To stop the airflow, the computer cuts off the juice, deactivating the solenoid, and the vent valve opens.

The valve should not be venting when the engine is idling, therefore the solenoid should be activated. To check, remove the connector from the solenoid, then reconnect with a hand on the solenoid body. You should feel the solenoid click as you reconnect.

Reduced maintenance items

A 10,000-mile oil change, 52,500-mile coolant drain, a "lifetime" PCV valve and no-lube ball joints are among the major reductions in maintenance on various '78 Ford prod-



Three solenoids in EEC system are for EGR vent, pressure and thermactor control.

ucts. As you might expect, they're controversial.

Ford tried to promote the "cars that take care of themselves" in the mid-1960s, and it didn't work because the cars couldn't. There are outside engineering sources that claim Ford products still can't, but Ford is confidently taking the plunge.

■ Oil change. The 10,000-mile (or 10 months) oil change was specified only for the four-cylinder and V6 in 1977 but in 1978 it also applies to the 250-cu.-in. in-line Six. This means that virtually all of the new Fairmonts and Zephyrs (except the few with V8s) will carry the 10,000-

What every stubble bum should know.

The closer you cut your stubble, the longer it takes to grow back. The longer it takes to grow back, the less likely you will look like a stubble bum

before you have to shave again. Which brings us to Mennen Skin Bracer® Pre-Electric Shave Lotion. It tightens your face, conditions your stubble so you can shave extra close. It even helps lubricate your razor head, and it's got that clean Skin Bracer fragrance. Congratulations. You are soon to join the ranks of the ex-stubble bum.



mile recommendation, which previously was listed only for Pinto, Bobcat and some Mustangs. A filter must be replaced at the same time.

This recommendation isn't as drastic as it seems. Since the switch to unleaded gas, which reduces oil contamination, oil change intervals have increased to 7500 miles (or six months on all U.S. cars, with a filter change every 15,000 miles. The change-both-at-10,000 is not that much different.

■ Coolant drain. The coolant drain interval for 1978 is 52,500 miles on V8s, 50,000 miles on all other engines, with a three-year time maximum. This compares with 40,000 on fours and V6s, 45,000 on all others (also three-year maximum) in '77. Ford has been gradually lengthening coolant drain intervals, thanks to overflow reservoirs, which minimize coolant loss. GM and Chrysler have been recommending flush-and-refill every two years.

Ford admits it has no new technology to justify the change, only statistical data that says it will work. The company, however, still recommends an annual coolant inspection, and a drain-and-refill at that time if the coolant is dirty or rusty.

■ PCV valve. Listing the positive crankcase ventilation valve as a lifetime item is surprising. Only the four-cylinder engines are exempted (replacement interval is 20,000 miles).

Life-of-car is a strong recommendation, but of course that doesn't say the valve will last that long, and if it stops working before the rest of the car, you'll still have to replace it. Don't expect Ford to pick up the tab unless you're still within warranty, which is unlikely.

■ No-lube ball joints. The same applies to the "lubed for life" ball joints, which are only on the new Fiesta. Just because they have no grease fittings or plugs doesn't mean they'll never wear out, or even that they'll last as long as ball joints with fittings that are periodically greased.

Ford has picked a perfect design on which to make the no-lube gamble, which it also made in the 1960s. Then, it enriched manufacturers of replacement ball joints and the shops that installed them. The Fiesta, however, has only two ball joints in its strut suspension system, and it's no coincidence they're bolted in place.

They may well be the easiest ball joints in the world to change, so even if they wear out, the change should be a quick, cheap job. ★★

TV RECORDERS

(Continued from page 99)

can record one show while watching another on your set.

Giants do battle

There are at least three different electronic systems now being sold for home videotape recording:

■ Video Home System made by Matsushita and Victor Company of Japan.

■ Betamax, also known as the Beta format, made by Sony Corp.

■ The Great Time Machine, an earlier recording system made by Matsushita, sold by Quasar.

The Video Home System will be offered by RCA, Panasonic, Magna-

vox, Hitachi, Sharp and Mitsubishi.

Beta format is sold by Sony, Zenith, Toshiba, Sanyo, Pioneer, Aiwa and TEAC.

These giants have taken sides in a pitched battle for the millions we'll spend for video recorders. Lines were drawn sharply last spring when two-hour machines appeared. Four-hour versions are expected soon.

Not interchangeable

The Sony and Matsushita machines use half-inch tape cassettes. But they are incompatible. Cassette box sizes, tape speed and other major specs differ. Sony owners will not be able to use Video Home System tapes and vice versa.

Beta format and Matsushita format machines will be priced just above \$1300. Black-and-white or color cameras and automatic cassette changers are extra-cost options. A color camera, for example, will add more than \$1000.

Victor Company's camera can be equipped with a Telecine attachment which couples the camera lens to an 8-mm movie projector. Like magic, you'll be able to transfer your old Super 8s onto new magnetic tape.

Film gear may be cheaper now but tapes can be erased and used over



TV camera makes electronic home movies on Quasar's video tape recorder.

and over. They give top TV-quality images instantly.

With the race for supremacy on full force, the consumer should come out the ultimate winner. Manufacturers believe mass production will bring prices so low we'll buy lots of VTRs (video tape recorders). And, competition among manufacturers will help slash prices. There will even be lower priced portable recorders for use out-of-doors. It's going to be lots of fun building a library of memories! ★★★



Sony PCM (pulse code modulation) peps up sound in Betamax video recordings.

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PM TOOL TEST: Low-vibration sander

Skil's direct-drive, orbital finishing sander, one of two models the company introduced last year, surprised me by its low level of vibration. But I found that unless you hold the tool firmly in contact with the work, it has a tendency to "stutter."

What I liked about the Model 459 was the way it deposited most of the sanding dust in ridges on the work and not in the air. You can do flush sanding on three sides of the pad. The need to bear down to make the abrasive cut is virtually non-existent. Two strong spring clamps hold the 3 $\frac{1}{2}$ x 9-in. abrasive paper with a bulldog grip. A hole for oiling the motor is located in top of the handle.

My pet peeve is short cords on tools; I wished that the 5-ft. cord had been a foot or so longer. That would have kept me from pulling the plug out of the wall to cover the far corners of the surface I was test-



sanding. A dust-collecting attachment sold separately plugs into most tank-type shop vacuum cleaners. Generally, the sander is well made with a nice feel.—*Wayne C. Leckey*



Sander utilizes strong spring clamps at both ends of pad to hold abrasive paper.

SPECIFICATIONS: High-speed orbital sander

Bearings: 2 ball bearings and 1 oil-impregnated bronze flange bearing
Capacity: 3 $\frac{1}{2}$ x 9-in. sandpaper
No-load speed: 10,000 orbits per minute
Ampere rating at 115 v.a.c.: 2.0
Motor: 2-amp., burnout-protected, double-insulated
Prices: Model 459 a.c. only (1/16-in. orbit) \$29.99
Manufacturer: Skil Corp., 4801 Peterson Ave., Chicago, Ill. 60646.



Save \$100 now on the latest Craftsman 10-inch radial saw. With features like spring loaded, single control for one-handed, one-step miter arm releasing, indexing and locking. Plus extra large, extra legible miter gauge and 26-in. rip capacity, more than any other 10-in. radial saw we sell. Add the complete line of available accessories and you've got the versatility to do a variety of jobs, including routing, drilling, buffing and sanding. And since it's our best 10-inch radial, you get easy to operate bevel and miter indexing and a 1 $\frac{1}{2}$ H.P. ball bearing motor that develops 2 $\frac{1}{2}$ H.P. By the way, ask about Sears credit plans.

Full One Year Warranty on Craftsman Radial Saw.

If, within one year from the date of purchase, this Craftsman radial saw fails due to a defect in material or workmanship, contact Sears and Sears will repair it free of charge.

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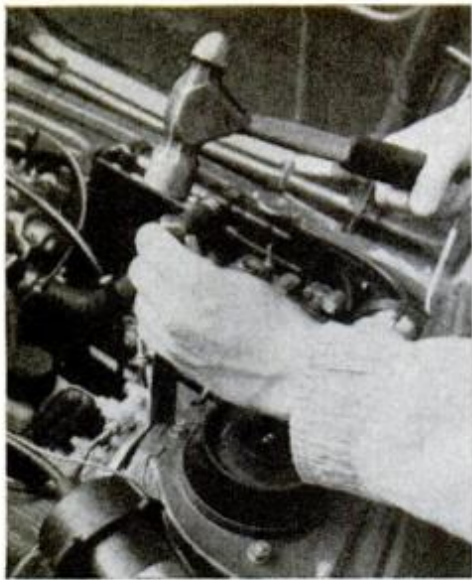


*Based on regular separate prices from 1977-78 Power and Hand Tool Catalog. Prices higher in Alaska and Hawaii.



Tools that have earned the right to wear the name.

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When chisel-bursting nuts from the top, be careful not to damage threads of bolt.



Tubing wrenches are used in pairs and are squeezed together to loosen nuts.



Tapping screwdriver while turning often will loosen tight slot-head screws.



Impact driver will work when twisting and tapping won't loosen tight screws.

the corners to the point where the correct wrench will be unable to get a grip. Badly rusted fastening nuts often will not allow the proper size wrench to slip over them with ease, and there is a temptation to go to the next larger size, say an $1\frac{1}{8}$ inch instead of the $\frac{5}{8}$ inch called for. Don't! Instead tap the correct wrench over the fastening or fitting with a hammer.

Slot-heads and Phillips

Screws, both slotted-head and Phillips, are used from one end of a car to the other for trim, striker plates and carburetors, and most of the time they present no problem. Slotted-head screws are easily damaged by a dull screwdriver when it slips out of the slot. For tight slotted-head screws, especially the small ones such as hold the top of the carburetor to the body, the trick is to take a sharp-cornered screwdriver and catch the corner of the screw slot. Then tap the handle lightly with a small hammer and the screw can usually be "walked" around until it's loose enough to permit removing it conventionally.

But some screws are intended to be tight. The Phillips-head screws that hold the striker plates on most cars are a prime example. At the factory they are installed with power equipment; removing them with a hand screwdriver may be impossible.

Impact drivers

This is where an impact driver will pay for itself. They are usually around \$15 and include a few heavy-duty screwdriver bits. They are available to take either $\frac{3}{8}$ -inch or $\frac{1}{2}$ -inch drive attachments, and most mechanics prefer the $\frac{3}{8}$ -inch drive size. To use the impact driver, install the correct size bit, insert it in the screw and rotate the tool in the direction you wish to turn the screw. Strike it sharply with a medium-weight hammer—about 16 or 20 ounces. The force of the hammer blow not only causes the handle of the driver to rotate due to the cam action but also forces the bit into the slot. After each hammer blow rotate the driver in the direction of desired rotation as the handle will often rotate enough to cause it to reverse. As the impact driver is an inertia tool, a hammer that is too light or too heavy will not work properly. And it is vital that sharp, fast blows be struck.

In reassembly, use petroleum jelly to prevent rusting and galling and seizing. A good grease may be used, or even oil. But put *something* on the threads; later, you won't have much trouble getting them apart! ★★

CRACKING 'IMPOSSIBLE' NUTS

(Continued from page 117)

low cut will be needed at the middle of the flat to expand the nut enough to allow it to be wrenched off with ease, so the trick here is to cut into the nut a little bit and then try the wrench again.

Cutting down into the nut parallel to the threads will accomplish the same thing now and then, but mostly the nut will have to be opened up almost all the way to the bottom. If care is used, the bolt or stud threads will be undamaged.

Tubing wrenches

Tubing fittings can be a particular pain. Usually it is impossible to use a conventional box wrench, and an open-end wrench will either collapse the fitting or round its corners. Actually, the average tubing fitting really isn't seized; it's just tight, except for

hydraulic brake fittings, and it is here that the tubing wrench pays for itself. This is a heavy box wrench with a section cut out to permit it to slip over the tubing which is always smaller than the fittings themselves. As these are quite expensive and entirely too fragile for ordinary nut-turning only buy the ones you actually need. As with other wrenches, a single-hex does the best job when the going gets rough.

Much of the time tubing wrenches are used in pairs on parts that won't stand a lot of stress, such as the union that connects the gas line to the carb. Rather than pull on one wrench while holding with the other, try to use the wrenches like scissors, squeezing the ends together with one or both hands.

It is vital that the wrench fit the nut or fitting. An oversize wrench rides over the corners with the greatest of ease, in some cases rounding

MAST TO THE RESCUE

(Continued from page 91)

toward a crevasse. They clambered aboard in the nick of time, and the winds that fought the rescue helped lift the Huey away from the mountain as it raced to the Good Samaritan Hospital in Puyallup.

The would-be conquerors of Mount Rainier had lived in ice caves for three days awaiting rescue. Amputation of limbs would have been required to save their lives had the choppers been further delayed.

Cooperation makes it work

Civilian-military cooperation makes MAST tick smoothly. The military provides the helicopters, crews and standard equipment. Special medical supplies—isolettes for premature babies, stretchers and oxygen equipment—come from civilian localities, plus FM transceivers for communicating with hospitals, police and local rescue groups, and beepers for alerting MAST unit members that a mission is in progress.

Chopper landing areas must also be furnished by hospitals served by MAST. A number build sophisticated pads; others simply empty parking lots when a mission is announced.

Often outlying hospitals and their communities lack sophisticated medical facilities and depend on MAST flights. Often the choppers transport supplies of whole blood in emergencies, organs for transplant, or even entire surgical teams when patients cannot be moved. Premature babies owe their lives to the use of isolettes and MAST flights from rural areas to large medical centers.

Fortunately, not every mission ends in a grim race for time. Plattsburgh AFB crews still chuckle when they recall how they scrambled to search for a couple reported missing after their empty canoe drifted ashore. Above Lake Champlain, they choppered in over a small beach—and there was the boatless pair. The girl raced for the cover of nearby woods while her friend frantically tried to wave off the intruding helicopter.

Regardless of the nature of each call, the MAST record is impressive. A single unit saved 114 lives last year. Since the program's inception in 1970, the Hueys have flown more than 9000 missions from 17 Army and seven Air Force bases. When a resolution commending the Plattsburgh unit passed the Vermont legislature unanimously last spring, an old-timer remarked dryly that it probably was "... the first time in history that the legislature was able to agree on anything." ★★

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"I've been a planer man 44 years and now retired. The Belsaw has earned me \$60,000 in eleven years with the only expense being \$7.50. For the initial cost, it's the best investment I ever made."
Robert Sawyer — Roseburg, Oregon

"This machine pays for itself making money out of scrap boards. It is a very well built machine and I confess it is more than I really expected for the price. It does everything you say it will."
Stephen Schultz — Orangeville, Penna.

"I bought a batch of walnut in the rough, and after planing it on the Belsaw I figured I saved enough money to pay for two-thirds the cost of the Planer. It really does a good job."
R. S. Clark — Springfield, Ohio

"I make furniture, grandfather clocks and many other things. My Belsaw does nice work and I couldn't do my job without it. I really like it."
W. W. Robinson — Flat Rock, Illinois

...and from this well known authority —
"I recommend the Belsaw as the most useful shop tool any craftsman could own. We use one every day in the Workbench model shop... couldn't get along without it."
Jay Hedden, Editor
Workbench Magazine



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DRIVING GM'S 1978 CARS

(Continued from page 102)

as fastbacks; Malibu and LeMans only as notchbacks. Then all lines have specialty coupe versions and wagons.

The sedans and wagons give excellent visibility in all directions, thanks to narrow pillars and lots of glass. I must say I do appreciate the rear flippers, because they not only improve ventilation but, with them open, you can hear traffic coming up from behind.

These cars are ultra quiet; extremely well insulated. That's due partly to one-piece molded headliners and partly to one-piece molded car-

peting extending under front seats.

All As offer V6s standard, with V8s optional (except on Pontiac's really great new Grand Am, which uses the 301 V8 as its base engine). The smallest V6s are Buick's 196 in the Century and Chevy's 200 in the Malibu.

Then there's a spate of even-firing 231 V6s in every division, followed by V8s of 260, 301, 305, and 350 c.i.d. The 350 is optional in El Caminos and wagons only.

The 196 and 200 V6s tend to be a little weak in my estimation, especially with the very high axles GM runs in these cars. But they ought to get fine gas mileage (no EPA

(Please turn to page 172)

UNDER THE HOOD OF THE OLDS DIESEL

The Olds diesel 350 V8 is based on the gasoline engine, but the differences may be greater than the similarities. To begin with the air cleaner: It's kingsize and has a giant bulge in the snorkel to accommodate a resonator. Reason: the diesel runs on unthrottled air (no throttle plate) and the airflow can be noisy. A resonator reduces sound to tolerable levels.

Because the diesel uses a lot of air, the king size of the filter must be augmented by a double-design—an outer wrap of polyurethane foam over a



Air cleaner for the V8 diesel is king sized to handle diesel's demand for air.

pleated paper element. Replacement interval for the paper is 30,000 miles, but a more frequent inspection (and cleaning the poly wrap in solvent if necessary) is a good idea.

Oil and filter change interval is only 3000 miles (and seven quarts of oil come out, not the typical four). This compares with a 7500-mile interval for the VW diesel. "We know what VW recommends, but we can't get away with anything that long because of the way diesel fuel contaminates oil, and we don't really see how VW can either," said an Olds engineer.

Olds is buying off-the-shelf fuel injection hardware, the Roosmaster pump and Stanadyne injector. Tools, parts and service for these components have been readily available nationwide for years.

Hard cold-weather starting is an old diesel bugaboo. Olds installs two 12-volt batteries (in series) to help the situation

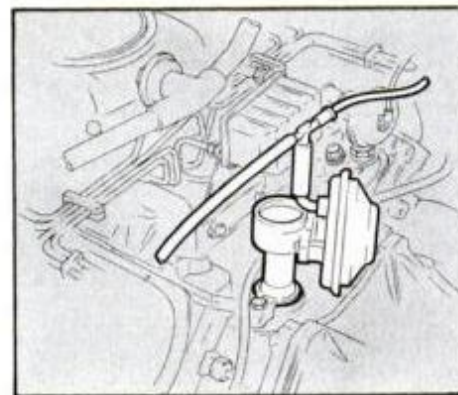
and makes a coolant heater (plugs into household current) available as an option.

For compression testing, Olds pulls the glow plug and inserts a compression gauge adapter. VW, by contrast, takes out the injector.

Like VW, Olds has a vacuum pump in what is the distributor hole for the gasoline engine version. Diesels don't develop manifold vacuum because there's no throttle plate, but they need vacuum for certain accessories, particularly air-conditioning.

Unlike VW, Old does not offer a vibration sensor or anything else to power a standard shop tachometer, to compensate for the absence of an ignition system. You can buy a photo-electric tach for \$200, but there's also a sneaky-Pete way to go on the Olds engine.

Get a 350 V8 HEI distributor from a wrecking yard, temporarily install in place of the vacuum pump and apply 12 volts to the distributor cap's battery terminal. Run the engine and connect



Vacuum pump is necessary on diesel since no manifold vacuum is developed.

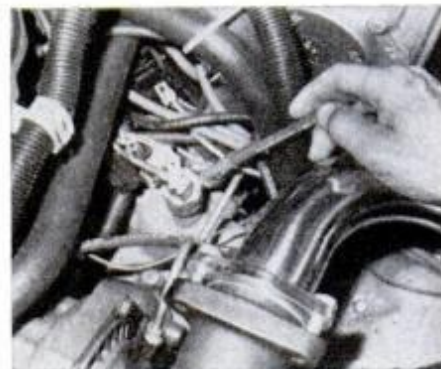
your standard tach to the tach terminal of the distributor cap!

The Olds diesel does impose some changes in service on the owner, but there are no sparkplugs to replace, and subcompact gas mileage in a big Olds 88, 98 or wagon should make the diesel a good investment.

UNDER THE HOOD OF THE BUICK TURBO

Ever get the urge to whack a malfunctioning engine with a hammer? On Buick's new turbocharged V6, you not only get the chance, but also the blessings of the factory, for you'll be performing a key test procedure. Here's the why and how.

If you drive the turbocharged engine hard, the effective compression ratio goes way up because the turbocharger rams in so much extra air-fuel mixture. Under heavy acceleration in particular, detonation could occur.



Electromechanical accelerometer is threaded into turbo's intake manifold.

To prevent this, the spark timing must be retarded whenever the engine is about to encounter detonation.

The turbo, therefore, has an electromechanical accelerometer threaded into the intake manifold, where it senses change in engine vibration from the start of detonation. It signals these changes to an electronic control unit, which delays the discharge of spark by the ignition coil via an instruction to the electronic ignition module inside the HEI distributor. The detonation control unit retards spark up to 20°, 4° at a time. Changes can be made instantaneously.

If the accelerometer or control unit fails, severe engine damage could result. So, periodically—certainly if you hear pinging—test the control system.

Run the engine at idle with a timing light connected and aimed. Have a helper read the timing while you take the pleasure of whacking the intake manifold with a hammer, close to the accelerometer. Actually, you'll have to use a long drift, and hammer on the drift, because there's no swing room in the manifold area for the hammer alone. Give the drift good, sharp hits. The accelerometer should sense a change in engine vibration, and signal the control unit, which should retard spark timing at least 4° for an instant.

The oil and filter change interval is 3000 miles for each, compared with 7500 for oil, 15,000 for filter on normally aspirated V6s. "We're seeing a lot more oil contamination on this engine," admitted a Buick engineer. "The engine probably would be okay with a 5000-mile interval, but we don't want to take chances."

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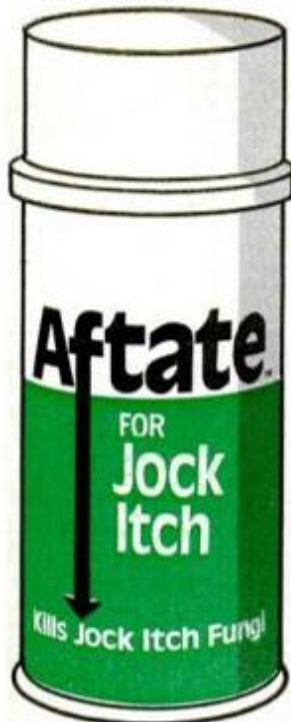
better than Cruex. Much better.

Because the medication in Aftate is more effective in killing Jock Itch fungus (*Tinea Cruris*) than the medication in Cruex.

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Aftate is odorless, too.



Read and follow label directions.

Aftate™

The Jock Itch Killer.

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DRIVING GM'S 1978 CARS

(Continued from page 170)

figures were available to us at the present time, and we couldn't run any mileage checks at the GM proving grounds).

Buick's turbocharged 231 V6 becomes the most tantalizing performer in this group. It's available in the Regal and LeSabre Sport Coupes only. This supercharged V6 delivers 150 bhp with the two-barrel turbo or 165 with the four-barrel, both at 3800 rpm. That's compared with 105 horses from the unblown 231 V6 and 155 bhp from Buick's 350 V8.

The turbo comes only with an auto-

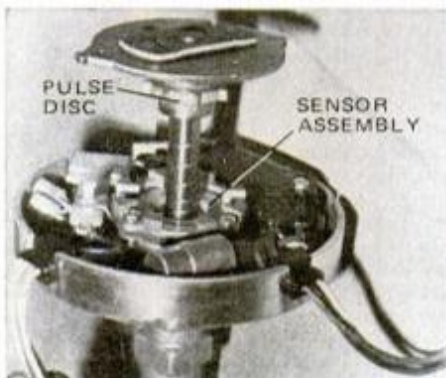
GM SERVICE TIPS

- You'll see lots of '78 GM cars, and some of other makes, equipped with the large rectangular headlamps, just approved for two-eye systems. If you've got one of the plastic portable headlamp aimers, be prepared to spring for a new set of rectangular adapters.
- The GM test socket, already on Chevette and top-line GM cars, is not being installed on the downsized intermediates. Unless dealer enthusiasm surfaces, the money for sockets and extra wiring will remain in GM coffers.

UNDER THE HOOD OF THE OLDS TORONADO

The Olds Toronado's Micro-Processed Sensing and Automatic Regulation (MISAR) System, GM's answer to Lean Burn, was introduced only last year. For 1978, this computer-controlled spark-timing system takes what seems like a step backward.

Appearances are deceiving—while the new design is more conventional in appearance, no sophistication is lost and



Pulse disc and sensor assembly are housed inside the distributor for '78.

MISAR should be more reliable and easier to service.

In 1977, its first year, the digital computer received the critical crankshaft position signal from a sensor mounted on a bracket at the front of the engine. The sensor itself was triggered by a 72-tooth pulse disc on the front of the crank next to the pulley (the passing of each tooth triggered the sensor).

This was an expensive setup and timing adjustments were difficult, so for '78 that pulse disc and sensor are miniaturized and placed inside the distributor.

Of 72 teeth on the old disc, only four (spaced 90° apart) supplied truly important information. The new in-distributor disc, therefore, has only eight teeth (because the distributor shaft turns at half crankshaft speed).

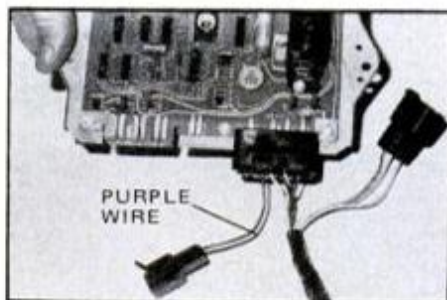
Result: ignition timing is once again adjusted by turning the distributor body, rather than adjusting the sensor at the front of the engine.

Why make provision to adjust timing

at all? For example, Ford's new electronic engine control is basically non-adjustable; if timing is off, a component is defective and must be replaced.

GM's answer: mass production engines still have varying octane requirements and there is some variation in gasoline quality, with the chance that some unleaded gas could be below the 91 research octane specified. Considering these factors, the prudent approach is to retain the provision for timing adjustment.

Ford also is using its computer to trigger solenoids for control of the air pump and exhaust gas recirculation. What about GM? The unofficial answer: "When we're ready, our controls for those items will be a lot neater, and we'll use the computer to operate a lot more, including idle speed, fuel mixture, maybe even automatic transmission shifting. All the present systems are just the beginning, but putting in the additional control cap-



New connector attaches to circuit board; purple wire is for timing check.

ability and hardware is a lot closer than you may think."

The '78 MISAR also gets a new connector arrangement at the computer. Instead of plugging the wiring connector into a connector mounted on the circuit board, it goes directly onto the board itself, which has been reshaped. This not only cuts costs, but makes for a more reliable connection.

You'll still find an unconnected purple wire hanging down from the electrical connector at the computer. Ground the wire's terminal with a jumper before making a basic timing check.

matic transmission at the moment, but a four-speed option might be added later. Other Centurys do offer four-speeds.

Punch off the line with the turbo is very strong. There's a bit of lag at first, as with any turbocharger, but acceleration gets stronger as revs increase. The Airesearch turbo itself spins at up to 130,000-150,000 rpm. Max boost is about 8.5 p.s.i. And as you know, a turbocharger taps an engine's exhaust flow to drive its impeller.

It all adds up to big V8 performance with V6 fuel economy. The nice thing about a turbocharger is that it doesn't boost intake pressure until you need it. For ordinary driving, it freewheels, so fuel mileage is about the same as in cars without one. If the price isn't too high, I see turbochargers as Detroit's next hot-selling accessory.

Buick introduced its even-firing V6 in mid-1977. Before that, U.S. V6s ran mighty rough. By offsetting adjacent crankpins 30°, though, Buick finally tamed the prickly V6. It's a smooth engine now, although if you strain you can still feel each firing impulse at idle. Most people won't notice.

Chevrolet's V6 is a little different in that its crankpins are offset 18° instead of Buick's 30°. I feel the Chevy V6 runs just as smoothly, if not a tiny bit smoother than Buick's counterpart.

Oldsmobile is the only division to offer a five-speed manual gearbox in its A-bodied cars. Optional in all Cutlasses, this five-speed has an over-drive fifth, and it's a real delight to drive. Cruising at 55 mph means the engine is turning only 1800 rpm in fourth or a mere 1400 rpm in fifth! To pass at that speed, you drop into third.

Another A-body option worth mentioning is the compact spare tire. It's skinnier and 20 pounds lighter than a conventional spare, and it's good for about 2000 miles of normal driving. It adds a cubic foot to the trunk (or gas-tank volume), can get you to the next service station, and it's standard in all A-bodied GM cars except the El Camino.

GM's other 1978 cars

We reported on the Olds diesel V8 in the July issue, so we won't repeat here except to say that I found the new engine amazingly smooth, amply powerful and pleasantly silent. It shows plenty of power in the Olds 88 and Chevy pickup, but the Olds 98, weighing 500 pounds more, seems

a bit too heavy for the diesel engine.

Olds expects to build some 55,000 diesel engines for 1978, and fuel mileage is projected at 25 percent above the gasoline 350 V8 in the same vehicles. Here's one diesel, for sure, that deserves some serious consideration.

Chevette gets a four-door this year—a welcome and well-planned addition. With three inches more wheelbase, there's ample room in the rear seat. The previous 1.4-liter Four gives way to a 1.6 with five more horses, and an AM radio becomes standard in the Chevette. I found the car perky, underrated and fun to drive.

The 1978 El Camino pickup, while on a one-inch-longer wheelbase, tends to be slightly smaller than last year in all other dimensions. It's classed as an A-bodied vehicle, but it's bigger than the rest, and the one I drove was considerably more luxurious than any previous El Camino I've seen. With the 350 and four-speed, it's a real goer!

Camaro and Firebird get slightly revised fronts, rears and trim. The 1978 Corvette has a wraparound backlight. Toronado, Eldorado and Riviera stay pat, but the Toro is returning to a conventional roof instead of the bent glass it had used for 1977.

In the Monza/Sunbird/Starfire/Skyhawk series, Chevy's version goes to round headlamps and an extensively redone grille. Base engine for all lines becomes a new 151-c.i.d., cast-iron, in-line Four, which is replacing the 1977 aluminum 140-incher. Then there's the 231 V6 and the 305 V8 available in some nameplates.

In the X-bodied compacts, again there are just cosmetic and package revisions for Nova, Phoenix, Omega and Skylark. The Omega, though, offers Oldsmobile's five-speed over-drive transmission.

All full-sized GM cars continue with minor facelifts: Chevrolet Caprice and Impala; Pontiac Catalina, Bonneville and Safaris; Oldsmobile Delta 88, Custom Cruiser and 98; Buick LeSabre and Electra; and the junior and senior Cadillacs.

The big news, then, lies with the A- and A-specialty cars this year and, for 1979, it looks like the X-bodied fwd compacts are the cars to watch. With that generation, General Motors will get back to a lineup of car sizes with no (or very little) overlap, but which is extensively downsized, and will be doing its share to conserve resources. ★★

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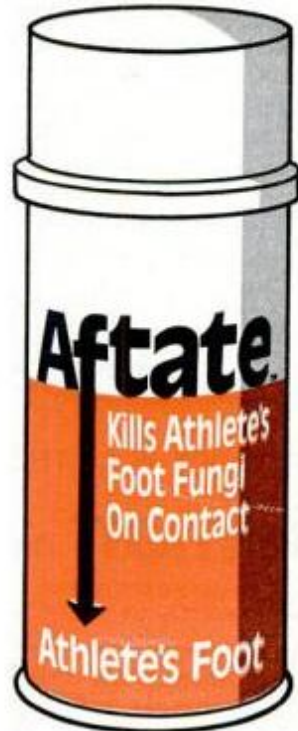
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Aftate is odorless, too.



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ZIP _____ © 1976, Damart, Inc.

HINTS FROM READERS

Beeswax lubricates



Beeswax from a toilet flange seal is inexpensive and an excellent thread lubricator. It is soft and will not slough off the threads. Use it as is, or melt and store it in a container.—*M.V. Bruner*

Dogproof garbage can

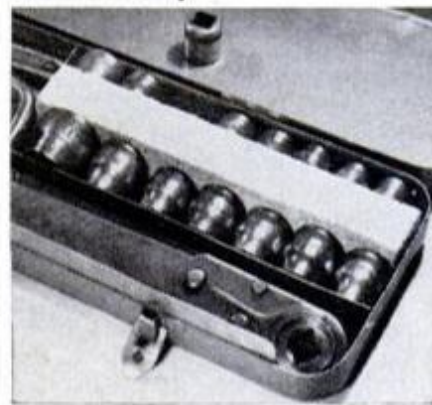
STRETCH CORD HOLDS LID IN PLACE



To keep dogs from scattering garbage, secure the lid to the can with a rubber stretch (bungee) cord available at bike shops.

—*Robert L. Bailey*

Socket lineup



To keep wrench sockets in order in your toolbox, place a divider of plastic foam in the tray. You can easily remove the sockets as needed, and just as easily return them to their proper place in the tray.—*Ernest V. Jacobs*

3 VERSATILE SAWHORSES YOU CAN MAKE

(Continued from page 118)

horses shown were finished with two coats of spar varnish.

Carpenter's sawhorse

The ones we made in the PM shop are of kiln-dried 2x4 fir. Start by cutting the legs and top rail to length. Install the dado head on your table or radial saw and cut the rabbets in both sides of leg bottoms as shown. Then make the dadoes in the underside of the top rail to receive the legs with a snug fit. Assemble the legs in the dadoes using weather-proof glue and 8d galvanized finishing nails. Then install shelf brackets.

Next cut the 1x4 to length; you need four per horse. Clamp feet to legs and bore three 5/16-in.-dia. holes per leg to receive the machine screws. Remove feet, apply glue and permanently fasten feet with machine screws and Teenuts. Note length of screws (2 in.) which will just grab Teenut and not protrude from the other side.

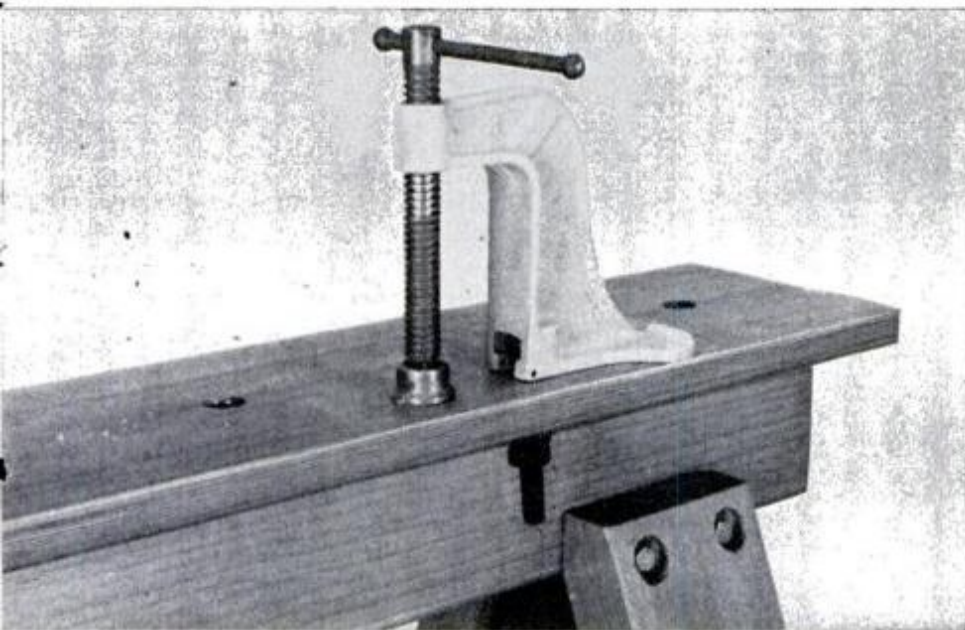
Since these horses are intended for carpentry, you needn't apply a finish. If desired, however, you can rub in

several coats of boiled linseed oil to protect wood.

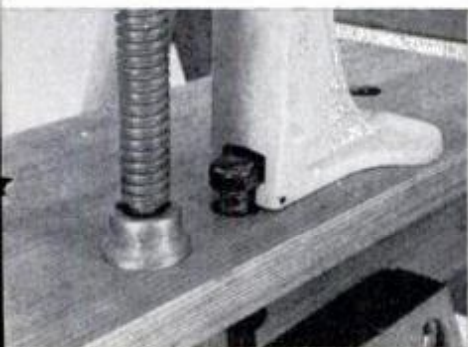
Colonial-type horses

I keep a pair of colonial sawhorses in my workshop for such light chores as staining and finishing projects; they are also great for wallpapering when I lay a plank across them. Constructed entirely of clear pine, the fragile-looking horses get their strength from the joinery used (i.e., notches). Cut all parts and test-assemble them using 4d finishing nails only. When satisfied with fit and squareness, permanently assemble horse with glue and screws.

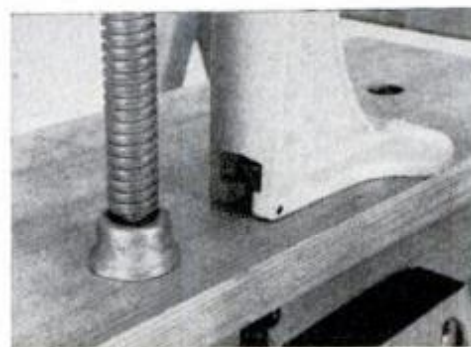
Foot brackets are made on the bandsaw and then shaped with router and beading cutter. The best way to install them is with the horse clamped in your bench vise. First bore and install the screws from beneath, then rotate the piece 180° and install the diagonal screw and dowel button. Repeat for all legs. Finish the horse with stain and two coats of semigloss varnish.—*Harry Wicks, Home and Shop Editor*



Hold-down clamp, Model 16 from Jorgensen, features easy adjustment and secure hold.



With bottom nut loosened, bolt head can be raised and base of clamp positioned.



Nut is tightened to hold clamp, cotter pin can be inserted to keep clamp in place.

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the protein it needs
today to look its best.**

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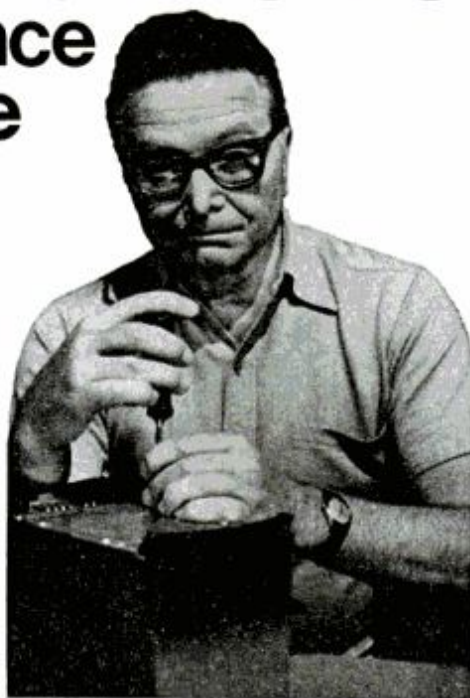
**Protein 29
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**Do something about
the next 10 years.**



HENRY MORGAN SAYS:

“Good appliance repairmen are scarcer than doctors who make house calls.”



Did you know that there are over a billion appliances in use in the United States today? And three repairmen. At least that's the way it seems when one of mine goes on the blink. With more than two dozen electrical gadgets in my house going snap, crackle and pop, I finally got tired of trying to locate a guy with enough ambition to take my money and I decided to learn how to make the repairs myself.

When a well-aged comic like me decides to go back to school, you can bet the family jewels it won't be back at P.S. 93. I'm going to learn at home, or not at all. So I sent away for NRI's home study course in Appliance Repair . . . and I took the course.

With a mechanical aptitude slightly below that of King Kong, I needed a course that started at the beginning and didn't move ahead too fast. Well, NRI did just that. They started with electricity—what it is and what it does—and went from there. You proceed at your own rate of speed. Whip through it if you want to, or take your time. What counts is the fact that you learn, in a way that it sticks with you.

You learn two things: how to repair appliances—from little one cylinder gas engines to refrigeration and air conditioning equipment; and how to get started in your own appliance business. That can mean money for you either way. If NRI can turn old ten thumbs Morgan into a reasonable facsimile of a repairman, think what they could do for you!

NRI's no fly-by-night outfit. They've been training men for more than sixty years . . . and they've had over a million students. It's the oldest and largest home study school in the field of electronics and electricity, so they know it better than anyone else around.

The NRI course is really easy to understand . . . with lots of pictures to show you what they're talking about. They even send you a professional appliance tester at no extra cost.

With the tester and a few basic tools you probably have already, you're ready to service most electrical appliances. After a few months, you'll be fixing your own appliances like I do, or you can start earning spare time money fixing them for your friends and neighbors. Before you know it, you can have your own full-time business and be independent.

Take my advice and clip the coupon. Even if you don't know which end of a screwdriver is the handle, they can give you real professional training that'll help you break into the appliance repair field. It's one of the few things I've ever sent for that was even better than they said it would be . . . so why not invest a postage stamp to see if it's right for you. The NRI catalog is free and there's no obligation. No one will knock at your door or bug you at home. NRI doesn't use salesmen. They don't need them.

Take it from Henry Morgan, the appliance repair field could sure use some good men. Now.

Henry Morgan

Henry Morgan

DRIVING THE 1978 AMC CARS

(Continued from page 106)

cord V8, so with the same 304 powerplant and identical gearing, it's bound to be a trifle slower off the line. Even so, the V8 represents a noticeable performance improvement over the 258 Six.

Driving the Pacer V8

One nice thing about all these 1978 AMC vehicles is that there's no lag nor hesitation when you tromp the gas pedal. In years past, superlean carb calibration and smog equipment have left not just AMC's but all Detroit cars bogging down off the line. The 1978 models don't do that, and it's a pleasant change.

All in all, the Pacer V8 feels good. It's not especially nose-heavy, although there's a predictable amount of understeer on very hard cornering. The engine has ample power to hold the rear end out on sweepers, and the tail lets go gradually, so it comes as no surprise when that happens.

At high speeds, there's some wind noise with the windows rolled down, but with airconditioning that's taken care of, and the Pacer turns out to be a very solid, quiet, good-riding car. And driver visibility is first-rate.

Steering by rack and pinion makes the Pacer more positive than other AMC cars, yet its overall steering action is a tad slower than the recirculating-ball system used in other American Motors lines. In other words, for minute steering corrections, the Pacer's r-and-p has no mush, but for bigger maneuvers like rounding a corner you have to turn its steering wheel a little farther.

The other AMC lines

The 1978 Gremlin remains basically unchanged except for a new Custom four- and six-cylinder version that makes the four-speed manual transmission standard. The Custom also dolls up the Gremlin with new vinyl buckets, chrome wheel-lip moldings and the like.

The 1978 Matador sedan borrows the Matador coupe's Barcelona package, which consists of individually reclining velveteen crush seats, padded landau top and color-coordination throughout.

American Motors remains the only U.S. automaker to offer an unlimited warranty on all its products. The Buyer Protection Plan carries over from 1977—12,000 miles or 12 months, during which free loaners are provided for repairs taking longer than a day. The plan also pays up to \$150 a day for food and lodging if

(Please turn to page 180)



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DRIVING THE 1978 AMC CARS

(Continued from page 178)

your car breaks down when you are 100 miles or more from home and

same-day repairs aren't possible.

All in all, then, AMC enters 1978 with good prospects—a nice selection of spunky, thrifty, more elegant cars. Fortunately, AMC has placed

its main emphasis on size and price classes that count nowadays for volume sales. Everyone inside and outside the industry hopes AMC will begin to prosper. ★★★

AMC PACER: V8 ENGINE INSTALLATION

Since the engine sits higher, a bulge was provided in the hood to allow clearance for the air cleaner. From the styling angle, the bulge looks as if it belonged there all the time.

The V8's carburetor is somewhat to the rear of where it is with the six-cylinder engine so the air cleaner housing is smack up against the firewall. No problem for a factory. Just reshape the rear of the air cleaner housing. Do it carefully, as AMC did, and the same filter element as on other 304 two-barrels will fit.

Even though the V8 engine was installed as high as it could be, the oil pan had no real clearance between it and the front cross member. New oil pan needed? Yes.

No room at the right-side front of the engine compartment for the battery? Got some room on the left side? Right: one new battery box and battery cables coming up.

Left-side exhaust manifold intrudes on the space you need for the steering? Modify the exhaust manifold so that it clears and also does the job of feed-

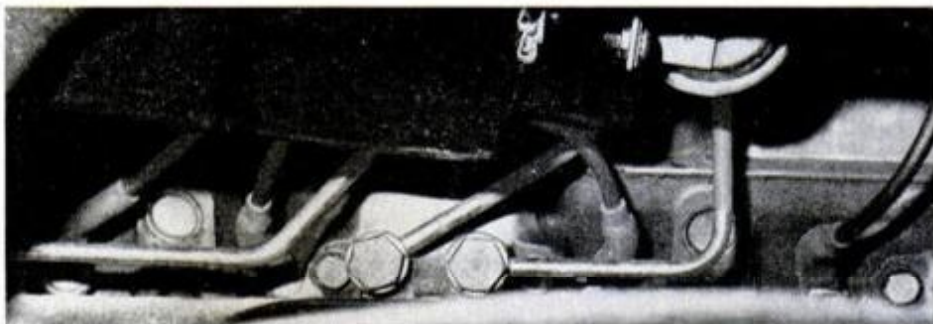
ing the exhaust gases into the system.

All this may make a factory engine swap sound very easy. Actually it's much more difficult than when a Saturday mechanic does the job, because the factory swap not only has to look professional, but it has to work on all cars in the production run.

The car is required to perform safely and meet federal safety and emission standards. However, it's still nice to have engineering and manufacturing staffs behind you.

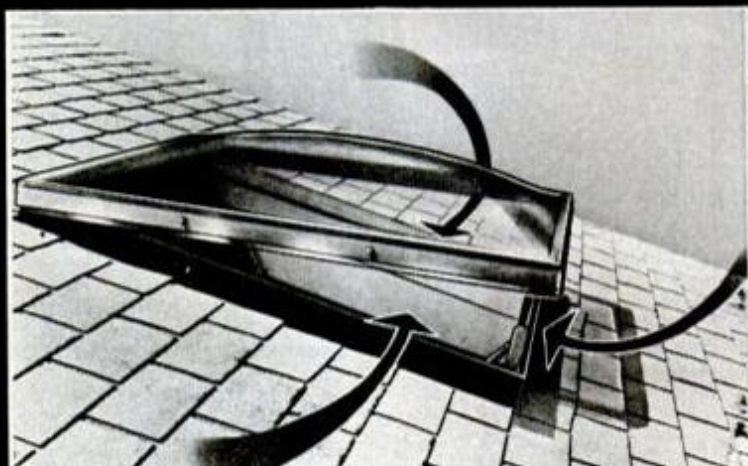
How did the swap turn out? Very well, for the 304 V8 is much shorter than the in-line Six, so there's no problem reaching the rear of the engine, such as for valve cover removal (which is a toughie on the Six).

Right-bank sparkplugs look hard to reach, but if you work through the fender well, they're wide open (see photo). The engine compartment is moderately wide, because it was designed for a fat, round GM Wankel that never came; not for the skinny Six that has been used.



Reach the right bank sparkplugs on a Pacer V8 through the wheel well.

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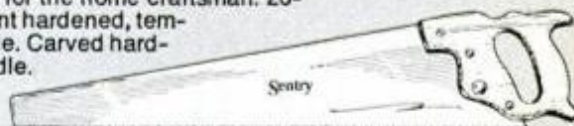


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OCTOBER 1977 181



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NEW GEAR FOR SAFER HUNTING

(Continued from page 81)

jackets, hats, vests, parkas and hunting license holders. They make it easy for hunters or a search crew to spot you—but no more obvious than usual for color-blind animals. Any game warden, or operator of a store that sells hunting and fishing licenses can tell you the size of blaze orange required in your area.

New clothes

Many items of clothing are reversible with the bright color on one side and dull or camouflaged pattern on the other for those times of year during waterfowl or turkey seasons when unobtrusive colors are so important. Camouflaged chamois-cloth shirts, jackets, hats and even down-filled shooting mitts with trigger-finger opening are available to keep you warm and unseen during long waits.

New insulation

A lot more is now known about the



Winter aids like duffel bag for gear (top) and (clockwise) down jacket in stuff bag, sheath knife, thermal underwear, LP heater, signal flare, orange license holder, rifle sling, first-aid kit, Gorp and Lurp energy foods, foot and back warmers (center) add to cold-weather safety, comfort.

perils of lowering body temperature through exposure, and subfreezing temperatures aren't necessary to cause a fatal chill. New synthetics, however, are being used in clothing, boots and sleeping bags to retain body heat, particularly in damp weather. Duck and goose down are still the most popular, fashionable, efficient and expensive insulators, but down loses its superiority when it gets wet and compresses. Take a thoughtful look at products filled with DuPont Fiber-fill II and Celanese PolarGuard, as well as wool shirts,

(Please turn to page 184)

Nobody likes a snow job

If you've spent long winter hours with only a shovel between you and heavy wet snow — this message is for you.

Ariens makes five rugged Garden Tractors — 16 HP to 10 HP — that put power and an efficient 48" two stage Sno-Thro between you and that white stuff. All you do is drive and relax, while snow is chewed up and thrown away at distances up to 30 feet.

Superbly engineered, Ariens Gar-

den Tractors give you year-round power with other attachments like a rotary tiller, mower blade or a wide range of garden implements.

Or, if your snow removal job doesn't call for all the power of a tractor, look closely at Ariens complete line of walk-behind Sno-Thros.

This winter, let Ariens help you with those tough snow removal jobs. You'll find your Ariens Dealer listed in the Yellow Pages.



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NEW GEAR FOR SAFER HUNTING
(Continued from page 182)

pants and underwear. All can help keep you warm while wet or dry.

New foods

Consider also high-energy foods like the Gorp and Lurp mixtures, and jerky such as the Slim Jim sticks of dehydrated meat. Many supermarkets and sport stores carry them, plus high-energy breakfast bars and candy bars. Hikers' tropic-pack bars are less likely to melt, however, in a pocket and the expensive but useful freeze-dried foods are well known.

New heaters

Warmth from external sources is also worth considering, particularly if you are operating near a recreational vehicle or hunting blind or cabin where a catalytic heater can be used. Remember that though these remarkable stoves don't pose the threat of carbon monoxide or open flame, they do burn oxygen so a window or vent must be kept slightly open.

Cold and wet

Not every fall day is sunny so it's important to pack along the necessary extras for changing weather. Often that simply means more of a good thing—a full supply of duplicate shirts, pants, socks, gloves, underwear, hat and boots to wear when the first set gets wet. Peel down if you are about to get sweaty to forestall damp, cold clothes later in the day, but if it is rain or snow that's soaking you, be sure you have sturdy foul-weather gear plus your duplicate set to wear while the originals are drying overnight.

You don't have to fall overboard to get a severe moisture chill; even ashore hypothermia—that dangerous cooling of your body temperature—can set in and destroy your judgment and speed drowsiness and, eventually, death. Afloat, the Coast Guard considers hypothermia more of a threat than simple drowning as a cause of boating fatalities; if cold water has numbed you, even your life preserver may not help, making new flotation jackets that retain body heat particularly worthwhile.

Even a little chill can spoil your fun and outdoor skills. Check new gear like the leather shell rifleman's coats from Hawkeye Sports of Des Moines for waiting at the range firing line. Outdoor women should examine foul-weather gear and waders, like those from Royal Red Ball, newly cut to fit the female shape and keep it comfortable and dry while boating, hunting or fishing. ★★

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- ⑤ Wire Crimper

It strips wire without damaging the conductor. Cuts machine bolts without damaging threads. Cuts wire with a clean, scissors action. Crimps both insulated and non-insulated wire to make permanent, solderless connections. Its lean plier-nose pulls wire, loops wire ends, loosens and tightens small nuts. Blue dipped plastic cushion grips are kind to hands. Tough, durable, precision made to CHANNELLOCK standards. Length 8 1/4 inches.

The No. 908G WIRE TOOL by CHANNEL-LOCK. Ask your tool supplier for it. Write for free catalog information. CHANNEL-LOCK, INC., Meadville, Pa. 16335.

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In Profitable Sparetime Business of Your Own

Sharpening SAWS

with Professional Accuracy

The need for precision sharp saws and tools by industry, contractors as well as handymen, is creating exceptional opportunities for the man who wants to have a business of his own. You don't have to quit your present job because you can run this service in your sparetime, on weekends, or in the evenings.

Foley Sharpening Equipment Lets You Sharpen Variety of Saw Blades

Here's what others say

"... Started in sparetime. Last year with fully equipped sharpening shop did over \$30,000 in business."

F.B. New York

"An accident almost crippled me for life but thanks to Foley equipment and the training I received at your school I now have a profitable business which proves 'You can't keep a good man down'."

J.H. North Dakota

"The Foley Filer handles all my needs. For what customers were demanding of me I thought I'd need extra machines and equipment. Not so, the Foley Filer takes care of everything I need."

H.F. Pennsylvania

"Your equipment is built to last. It'll outlive me (and outwork me)"

C.W. Iowa

"I'm a 'retired farmer' at 68 but my Foley equipment keeps me busier than ever—and it's profitable too!"

L.J. Minnesota

"I started a small sharpening operation in my garage. I now have 2 other branches and several people working for me. My gross income is in the five figure bracket."

L.G. Chicago

"Who says a woman can't succeed in supposedly a man's business. I did and today I'm doing business with many industries. I just finished sharpening 55 ten food band saws."

A.A. Wisconsin

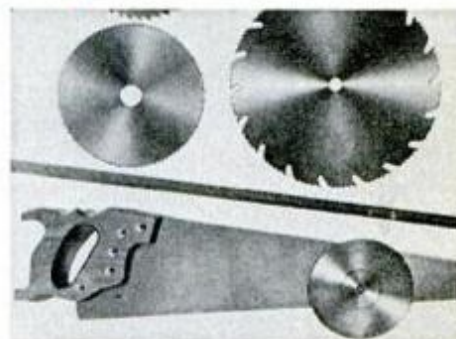
"Looking for a snow plow, I stopped in at a rental outlet. Browsing around, I noticed a power chain saw and it dawned on me that rental shops could mean extra profits for my sharpening business. Now I have extra business all of the time from rental outlets."

M.S. Vermont

"The Quality of Foley equipment has guaranteed me repeat business because I can turn out quality jobs every time. You might say, I've built my reputation on Foley's."

C.D. Colorado

You can sharpen combination (rip and crosscut) circular saws, band saws, hand saws, crosscut circular saws as well as Carbide-tipped saw blades—and do a perfect job every time without experience or special training. The precision Foley sharpening equipment does it for you automatically! Set up in basement or garage, work your own hours in your own way and earn big sparetime profits.



use our truck to pick up saws in five nearby towns. With a family to support and plans for building to our house we had to pick up business fast and already sharpen an average of 15 to 20 saws a day. Business for the future looks even better as good machine filing is our best advertising."

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Dick and Jo Ann Koester after being in business less than a year wrote: "We have acquired another Foley Saw Filer and for the past two months we have been in full-time operation. As we live in a small town of 150 population in a farm area we have had to pick up business fast and already sharpen an average of 15 to 20 saws a day. Business for the future looks even better as good machine filing is our best advertising."

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HOW TO MAINTAIN YOUR MOPED

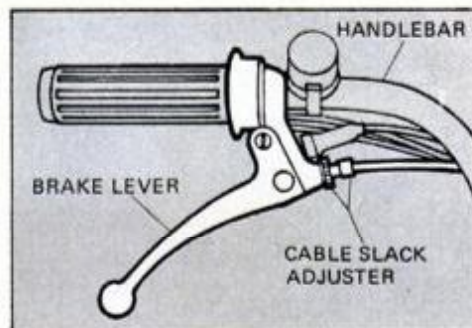
(Continued from page 115)

ates so slowly from a standing start you find yourself pushing off with both feet, chances are your little engine needs decoking.

A word about oil

As you know, your owner's manual tells you to use a lot more oil during the break-in period than afterward. If you overdo the oil/fuel ratio spec on the theory that overoiling means less wear, you'll need to decoke the engine a lot sooner than normal. This also applies after break-in.

There are two types of oil formulated for two-stroke engines—natural and synthetic. Use one of them, and not the ordinary motor oil you use in your car. Two-stroke oil is designed to mix well with gasoline



Brake levers have adjusting nuts where you can take up slack in brake cable.

and to burn with a minimum of deposits on plug, engine head and muffler.

Of the two types of two-stroke oil, I prefer the synthetic because it is cleaner burning and therefore leaves less deposit, thus extending decoking and sparkplug cleaning intervals. Also, you can use about half as much synthetic oil as natural two-stroke oil.

For example, if your owner's manual calls for 40:1 ratio (40 parts of gas to one part of oil) you can use an 80:1 ratio if you use synthetic two-stroke oil (after break-in). You can use synthetic oil with oil injection systems. *But, never mix natural and synthetic oil in the same batch!* If you have a five gallon can of natural oil/gas mixture use it all up before switching to synthetic. Synthetic, by the way, also burns cleaner which reduces smoke emissions from the muffler, and it also prevents ring sticking.

Decoking the head

To decoke the head, all you need do is remove the cylinder head, scrape out the accumulated carbon from inside the head and from the

(Please turn to page 188)

CONOCO'S CURE FOR THE UNCOMMON COLD

It's Polar Start, the cold weather lubricant that flows even when the temperature drops to 55 below zero, long after ordinary motor oils begin to jell. You can simply use it as a replacement for your conventional oil.

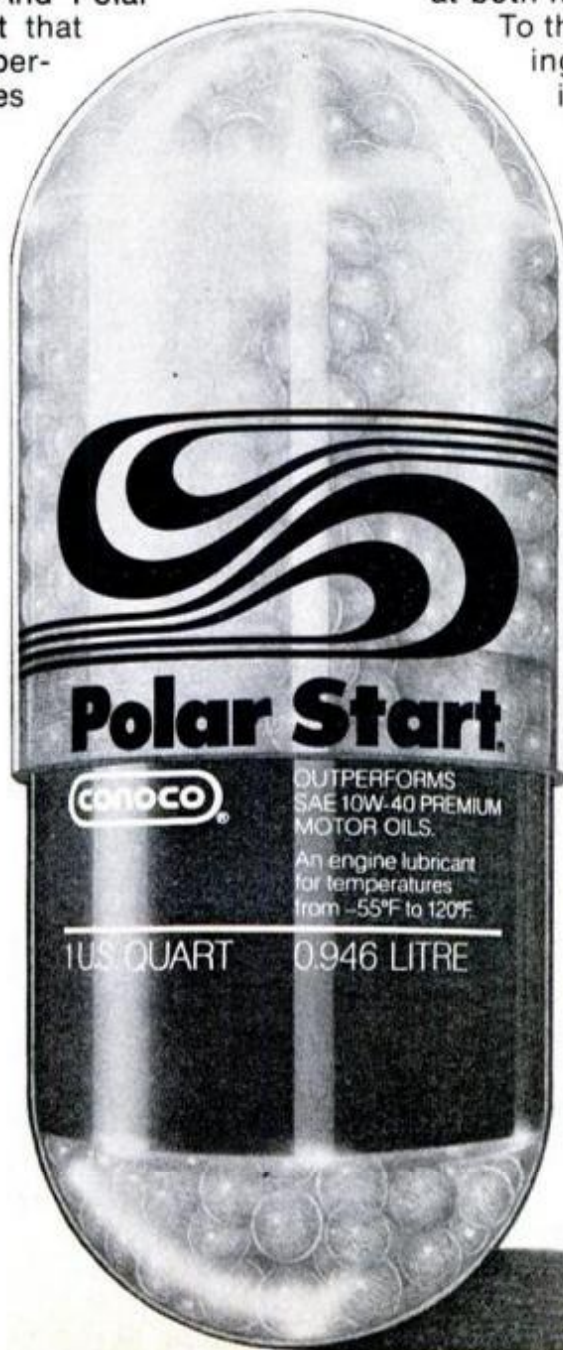
The Navy uses Polar Start in the Antarctic. And it was used in the machines that built the Alaska (Alyeska) Pipeline. And Polar Start is a 10W 30 lubricant that works equally well at temperatures as hot as 120 degrees above zero.

It's just one example of Conoco's leadership in the research and development of high performance motor oils. In 1922, Conoco was the first oil company to introduce additives to improve oiliness and increase film strength.

In 1941, we introduced

the first synthetic petro-chemical additives which permitted longer drain intervals, even at higher temperatures. In 1950, an improved additive system in Conoco's new Super Motor Oil resulted in a 50,000 mile test with no measurable wear. In 1962, our new ashless dispersant improved performance of Conoco Super Motor Oil at both higher and lower temperatures.

To this day, Conoco has been meeting the challenges of your changing driving habits and the improved cars you drive by continually changing and improving the Conoco oils you use...from Conoco Super to All Season to Polar Start. Polar Start is available at most Montgomery Ward retail stores and many other fine retailers.



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Only NRI supplies you with an Engine Component Kit designed for training. Hands-on experience comes quickly with the NRI Small Engine Repair Course. Along with the bite-size lessons fully illustrated, you receive all the components of a versatile 3½ HP Clinton Engine. Using NRI Power-On training principles, you assemble the complete engine, to use in your workshop or to install at a profit on one of your first jobs.

Where other courses give you inexpensive hand tools, NRI includes with its training an *inductive tachometer, professional volt ohm meter, torque wrench, valve spring compressors, ring compressors, and all the wrenches and specialized tools you need to start your own repair shop.*

Two courses available.

The 30-lesson Basic Repair Course covers the theory and practice of small engine operation and repair including lubrication, ignition, cooling, and starting systems. You specialize in professional lawn



mower and other lawn-and-garden equipment repairs. You learn in depth...with up to 10 times as much information provided as in competitive courses.

With NRI's 45-lesson Master Repair Course, you move into more advanced training. Lessons cover chain saws, minibikes, mopeds, outboard engines, snowmobiles, golf carts, all-terrain vehicles, welders, generator sets, and other industrial equipment...plus six lessons on motorcycle repairs.

You learn the specific engine requirements for power take-offs charging systems, electrical systems, etc. Practical working knowledge of clutches, torque converters, transmissions, and other drive train parts gives you the professional's edge.

You get more training and more equipment for your money with NRI.

NRI is the unquestioned leader in technical home training, with more than a million students in its over six decades of instructional service. The oldest and largest school of its kind in the country, NRI offers you expert help every step of the way. You'll move ahead at your own speed, earning as you learn, with small engine repairs for your family, friends, and neighbors.

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HOW TO MAINTAIN YOUR MOPED

(Continued from page 186)

top of the piston. Replace the head. Just remove the sparkplug, and the four head bolts. Install a new gasket when reinstalling the head. If the head has a compression release, slip the cable out of the unit so you can remove the head. The Motobecane motor, for example, uses a compression release, and this motor must be removed from the moped before the head can be removed.

When reinstalling the head, you should use a torque wrench and follow the shop manual torque specs in tightening head bolts. It's easy to strip the threads, either on the bolt, or worse, in the engine block internal threading. Typical head-bolt torque spec is 7 ft.-lb.—not much, so you see how easy thread stripping is.

Decoking the muffler

If you are lucky enough to have a moped with a muffler that can be taken apart and decoked, fine. Otherwise you will need a new muffler, say, every 3000 or 4000 miles.

Take-apart mufflers have one or two sheet-metal screws near the rear end of the muffler. Just remove the screws to pull out muffler innards.

Some makes have a rubber seal between the silencer section and the main muffler section. It should be replaced when reassembling the muffler after decoking. The decoking procedure is simple: Clean off deposits with a wire brush and/or burn them off with a propane torch.

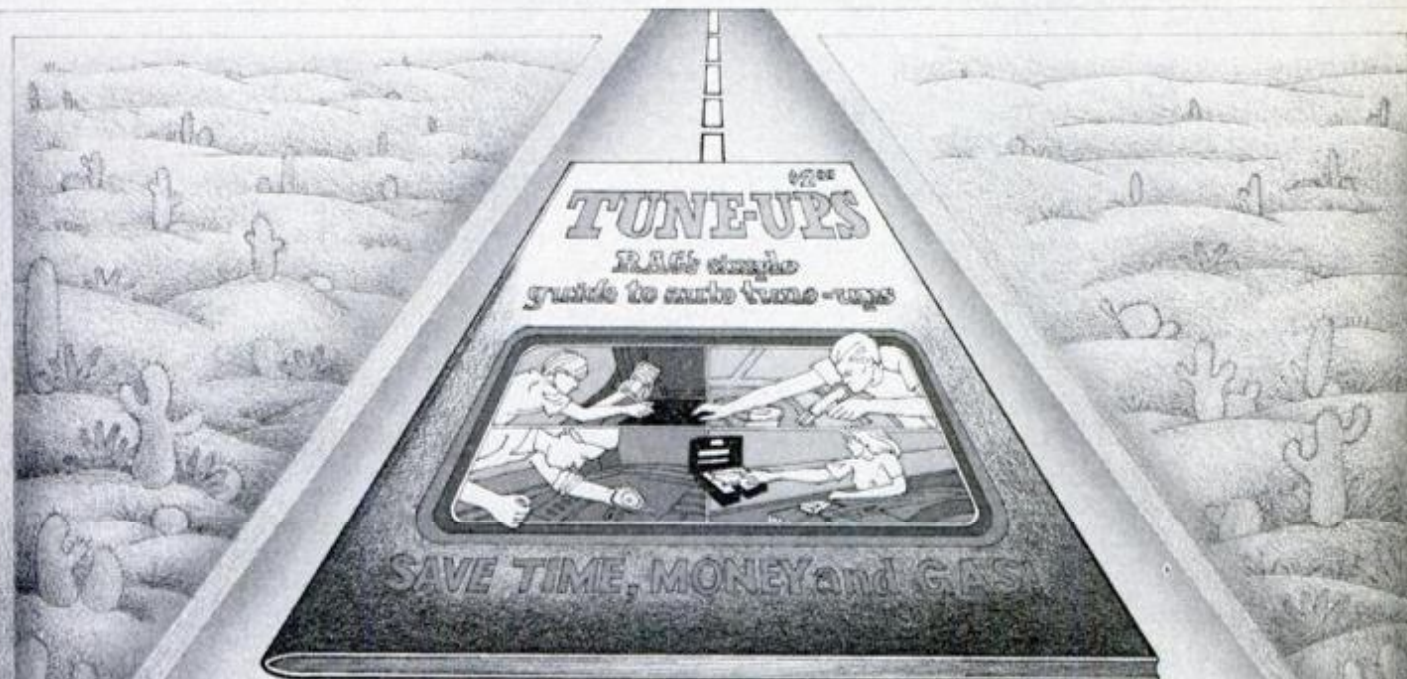
Brakes

As brake cables stretch and brake shoes wear, cable slackening must be taken up. Most mopeds have a simple barrel/hex nut arrangement at the brake lever which, when adjusted, will take up this slack. Adjust application with about a half-inch brake-lever squeeze. Cables should be lubricated every six months, more often if you ride in the rain a lot. If you need more adjustment than you can get on the lever barrel, take up the cable at the brake itself by pulling the cable slack through the fixing bolt and retightening the ferrule. Use pliers to pull the excess cable through, first readjusting the barrel at the brake lever to open position so you can fine-adjust the cable later on.

Check brake-shoe wear by looking in the inspection port or checking the brake-shoe-wear indicator labels. Better mopeds provide some means of inspecting brake-shoe wear without removing wheels. If shoes are at the wear point, replace them. ★ ★ ★

One for the road

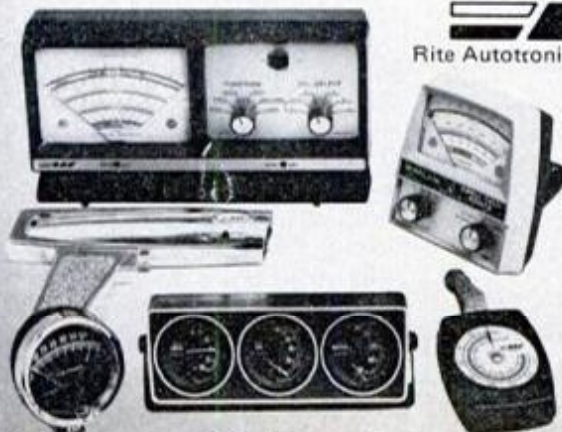
Another tune-up tip from the people who wrote the book.



Keeping your car running smoothly is an easy matter. You can tell for yourself when tune-up work is needed by observing its performance daily. Does it start as easily as it did before? Does it surge or miss? How is the idle — smooth or rough? Does it miss on acceleration? Are you getting the same gasoline mileage?

This tune-up tip from RAC demonstrates how easy and economical it is to care for your own car. You can tune your engine completely and keep it running smoothly by following the simple steps outlined in the original RAC "Tune-Ups" Book.

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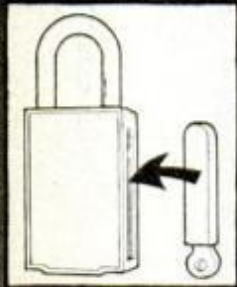
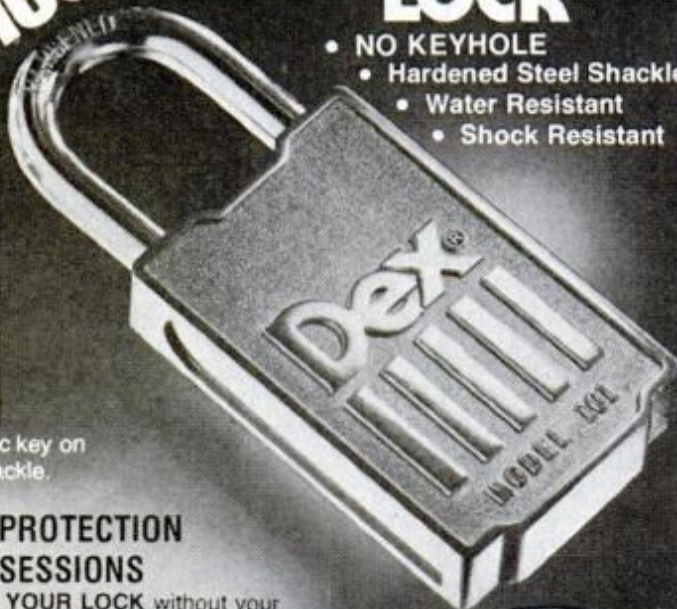
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CAR-BATTERY CHECKER

(Continued from page 70)

belt slips, reducing output and system voltage. Tighten the fan belt.

Frying your battery

If the meter stays near or above 15 during driving, the voltage regulator is set above the proper 14.6 volts. As you drive, the battery is being overcharged. Your dashboard light or original-equipment ammeter will not indicate there is a problem. They respond only to current, not voltage levels. The life of the battery is being shortened. Adjust or replace the regulator.

Poor regulation

The meter never getting above 13.8 volts is the opposite of frying your battery. The regulator is set too low. The battery never gets a full charge. Your light or ammeter won't tip you off to this one either. Another symptom is weak cranking.

Old battery

If, over several months, the meter falls farther when you turn on your lights than it did before, the battery is getting old and weak. Other symptoms include lazy cranking and, on generator cars, a noticeable dimming of the lights when the car engine is idling.

Leaky wiring

If, after several days without using the electrical system, battery voltage falls to 12 to 12.1 the car may have leaky wiring. Disconnect one battery cable when the car is not in use for a while. If the battery voltage still falls, it's a sure sign the trouble is in the battery. If that's not the case, try to track down a leak in the wiring.

By adding a switch and a 6-volt zener diode. (Radio Shack No. 276-561; 89 cents) you can tell when you are not getting proper cranking voltage to start your car. Switching the 6-volt zener into the circuit lowers the meter scale to read from 6 to 9.5 volts. The scale is expanded, reading 6 volts on the left and 9.5 volts on the right. When you switch in the 6 to 9.5 volt range, the 12-volt zener has no effect in the circuit. Check out your cranking voltage by reading low, fair or good on the replacement meter face we've provided. If it's low or only fair, better start trouble-shooting the auto electrical system again.

Zener diodes, plugs, switches, meters and other parts for the auto electrical system tester also are available from LAT Enterprises, 10 Idell Rd., Valley Stream, N.Y. 11580. ★★

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"Now that I'm a locksmith, I've increased my salary by at least \$175 a week. Even earned \$550 before completing the course! I think the Locksmithing Institute is the best!"



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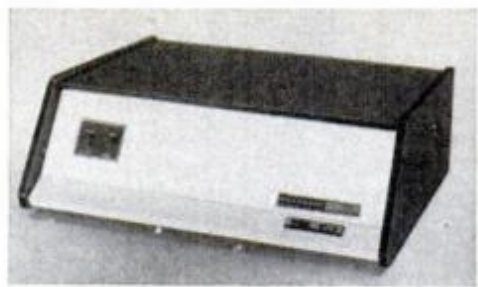
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EVERYMAN'S HOME COMPUTER IS HERE (Continued from page 93)



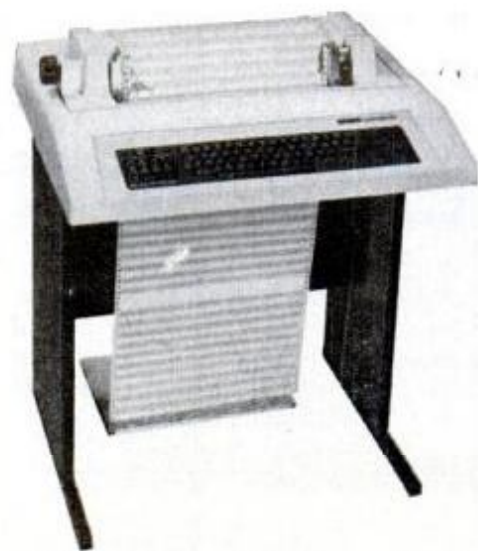
Heathkit top-of-the-line H11 computer reads words with twice as much information as most other home-computers.

stand words composed of eight bits of information. A few, like the top-of-the-line Heath H11, \$1295, take in twice as much information at a gulp with 16-bit words.

However many bits it contains, a word is properly known as a *byte*. Memories are sized according to the number of bytes they can hold, usually in multiples of 1000. The TRS-80 comes equipped with 4000 bytes of memory. You can order the computer with 8000 bytes of memory for about \$100 extra or 16,000 for \$290. Heath sells 4000 bytes of extra memory for \$275.



Model 43 from Teletype Corp., 5555 Touhy Ave., Skokie, Ill. 60076, gives hard-copy printout of what your computer says.



Similar to Teletype, this lets you talk to computer via keyboard on DEC Writer II from Heath. It prints replies on paper.

Metric prefixes are used in memory sizes. For instance, 1000 bytes are called one *kilobyte* or, simply, *1K*.

Computer memory doesn't need to be as long as an elephant's to do most chores you'll think up for your machine.

The 4K, standard on the TRS-80, will do all the things mentioned here, including playing a complicated blackjack game. The optional 16K will handle your advancing needs for years. But, for those who want to redesign the Taj Mahal via computer, Radio Shack hints at a micro-giant 64K black box in the near future. And a *floppy disk* for upward of 100K memory.

Memory can be slow and deep or fast and shallow. *Random access memory* or *RAM* can be searched very rapidly by a microprocessor, but it's expensive to buy very much of it.

Floppy disk, cassette-tape and other *bulk memories* are cheaper to buy and hold great gobs of data. But they require more time for a microprocessor to extract the data.



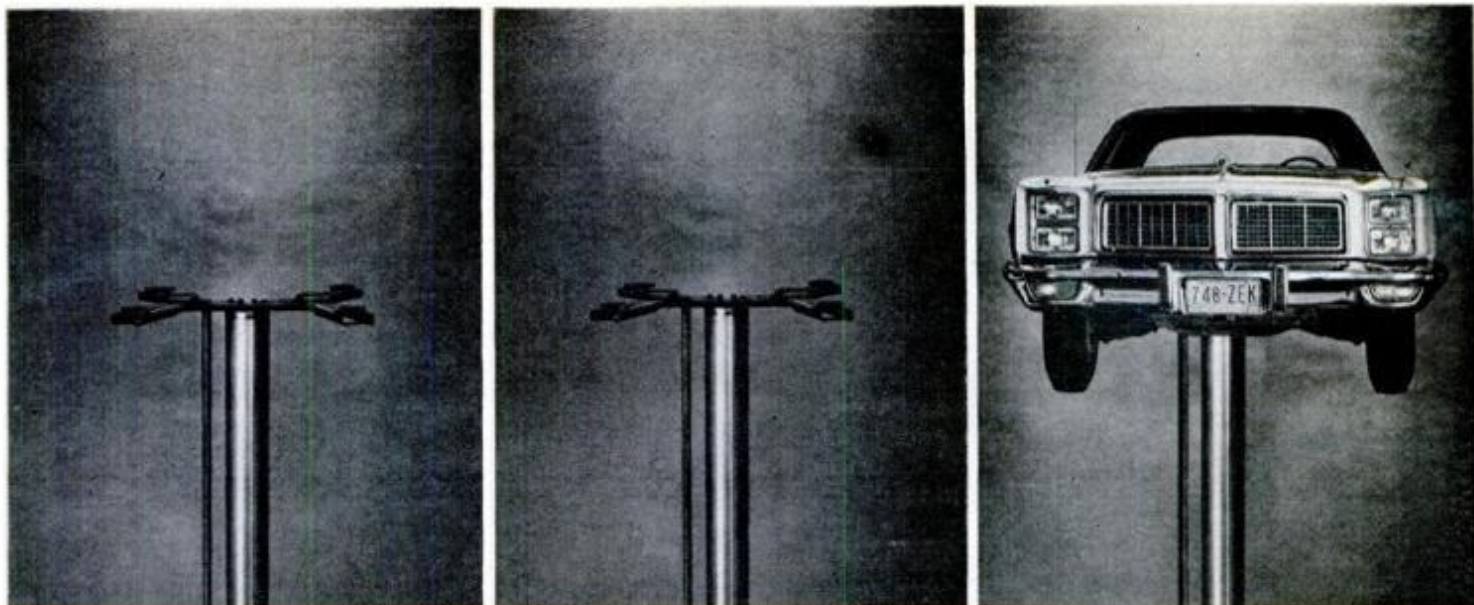
Microcomputers in small businesses keep payrolls, inventory, accounts, ledgers.

Your first bookshelf full of programs probably will be on simple audio cassette tapes.

Uses for home computers are limited only by the imaginations of the users. Family finances and games are most common, but everybody has his own idea. Computers can control your entire food preparation, dishwashing and clothes washing/drying operations, as shown by new Sears appliances with built-in microprocessors. Full-size railroad trains, or miniature models in your basement, can be routed by computer. CB beam antennas can be pointed by a computer even as it stores a directory of all the handles you have collected over the air.

Home heating and cooling, lighting and entertainment can all be overseen by a microprocessor to save you time and money.

Your micro can be used to index your personal library or analyze your automobile engine as you tune it up. ★★★



With Mobil 1 you can eliminate at least 2 oil changes a year.

Spend less time in the air.

Switching to Mobil 1 is a good way to keep your car where it belongs. On the ground.

If you've been changing your oil the way most people have (every 4 to 6,000 miles) Mobil 1 could take you much farther and eliminate at least 2 oil changes a year. You could rack up a total of 15,000 miles or go a full year, whatever comes first, before you have to put your car up on the rack for an oil change. (If your car is still under warranty, you should change your oil in accordance with warranty requirements.)

The oil that saves you gas.

Mobil 1 cuts friction so well it actually takes the average car up to 10 extra miles on a tankful of gas.

The oil that saves you oil.

Since Mobil 1 doesn't evaporate as rapidly as ordinary oil you should be using less oil. (Provided, of course, that your engine is in good mechanical condition.)

Better in hot and cold weather.

Mobil 1 is a synthesized engine lubri-

cant that outperforms premium motor oil all seasons of the year. Since Mobil 1 doesn't thicken up as much as ordinary oil in cold weather, you'll be getting easier cold weather starts. Mobil 1 can actually help your car get started in temperatures as low as 35 degrees below zero.

Mobil 1 doesn't thin out the way ordinary oil does in hot weather, either. It continues to spread a better protective film over the moving parts of your engine, even in the hottest days of summer.

Better engine protection.

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HOW MY WIFE AND I TEAMED UP TO BECOME MILLIONAIRES IN FIVE YEARS

WITH AN EIGHTH GRADE EDUCATION AND \$500.00 BORROWED MONEY, I RETIRED IN LESS THAN FIVE YEARS WITH A WEALTH OF OVER A MILLION DOLLARS.

In my system that I'll send you on certain good deals that you bring me. I'll be your partner, guide you and offer financial assistance. For instance, some of you may be short of capital to undertake that big deal. I'll come in with you. Yes, I'll use my own money and financial backing to help you handle that really good deal using my system, if the deal is right. We can then be assured of a profit. I intend to operate on a nationwide basis, so location will not be a problem. I'll be interested in considering real estate throughout the country.

HOW DID WE START - IT WAS EASY.

I am quite certain that with my education and background I am not smarter than you and yet it was so easy. In fact I couldn't believe how easy it was. Let me start at the beginning of our success story.

In 1967 at the age of 38 on two hundred dollars per week selling appliances. I was struggling to provide for a family of six. Just trying to pay the bills and surviving was a struggle. Needless to say I was heavily in debt.

WE DISCOVERED OUR METHOD

We found our key to success and security in the real estate business - a system that my wife Dianne and I perfected. After using this method for six months, Dianne, working alone, had earned more than \$68,000. It was then that I left my appliance sales job and joined Dianne. We worked fulltime to develop our new career in real estate. We knew that this newfound success would work time and time again.

WERE WE SUCCESSFUL - YES

After applying our method, in only five years time we were able to semi-retire. By 1972, we had a cash flow of over \$100,000 a year from our successful system. We bought a beautiful new home in a prestigious suburb of Houston that's close to our 345-acre ranch where we raise registered cattle and quarter-horses.

We also found that we could operate our business venture in our spare time, without a real estate license, and in our home.

TWO OF OUR DEALS

Here are two examples of how well our system worked for us:

In 1968, using the same method, we put up a \$1,000 deposit on a real estate investment. We had 120 days to finalize the transaction. In only 45 days, we sold it, earning a profit of \$98,000. We had made 98 times the \$1,000 we had initially invested in earnest money.

In 1972, using the same system, we put up a \$5,000 deposit on an investment opportunity. We sold our contract almost immediately for \$380,000 profit, with a capital gain. (We have the closing statements to back our figures.)

OUR METHOD IS SIMPLE

It can be used by anyone, anywhere, whether you are single or married. Our system is real, it is workable, and it will work for you. What is our system? It is a unique discovery of how to buy real estate properties below wholesale, income property, raw land, subdivisions, acreage, home sites, or that week-end retreat. Yes, I can show and direct you how to locate the type of real estate properties that you are interested in buying. Buy with as little as \$100 down, and at bargain prices so that you can immediately turn the purchase into ready cash. Sounds too good to be true. I guarantee that you or anyone following our system can make a financial success. Maybe you won't make a million dollars, but you can certainly improve your financial condition. Double or even triple it, in a matter of only a few short months.

NATIONWIDE SYSTEM

Our method is now nationwide. We are getting letters, telephone calls daily. A California man wrote, "Jim, I bought 15-16 different books on how to make money, as far as I am concerned the author is the only one that made money. Your method is great. It is simple. It is working for my wife and I. You may use our name in your ad if you so desire."

As our success grew from word of mouth to a front page editorial on the business section of the Houston Post, I was besieged by friends who wanted to know how they could duplicate my success.

I directed a doctor friend and his group on two sales using our system. Their gross profit was \$20,000 on the first transaction and over \$100,000 on the second. Their total money investment was under \$2,500.00 for both transactions!

YOU AND I BOTH WILL PROFIT

You are probably asking why I am willing to share my secret of success with you. It is physically impossible for any person to investigate and follow up on all of the land opportunities and investments which I describe in my book. These opportunities exist in every town, city, county and state in America. The fact is that I have found a method which assures success. You can become my partner by following this system. The end result: we both profit and make money.

REFERENCES

I am an active member of the Rosenberg-Richmond Chamber of Commerce, the Houston Chamber of Commerce, and a respected member of my business community.

If you prefer, send a check post-dated for 30 days, this will completely eliminate any risk on your part. I want you to consider my method and see how it will work for you.

JIM STEPHENSON

30 DAY FREE TRIAL

PM-10

204 SOUTH 3RD - RICHMOND, TEXAS 77469

Jim, I am sending you \$10.00 for your system with no risk on my part. If your system does not prove to be a moneymaker like you say, then I'll send it back to you within 30 days. There will be no obligation on my part, and you will give me a complete refund of \$10.00. (Allow approximately 2 to 3 weeks for delivery.) If you have any questions call me at 713/342-6928.

Name _____
Address _____
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DIANNE STEPHENSON, HOUSEWIFE AND MOTHER, MADE \$68,000.00 IN HER FIRST SIX MONTHS

YOUR FINANCIAL SECURITY

By using my method you will be surprised how easy it is to make money, and be financially secure.

Here are a few things that my system will tell you.

1. Buy income property at half price.
2. Buy land or acreage at fifty cents on the dollar.
3. Begin without cash.
4. How to sell your earnest money contract.
5. Be self employed and your own boss in six months or less.
6. Immediate capital gain.
7. I'll be your partner.

When you send a check for \$10.00 you will receive our entire system. I guarantee that you will be completely satisfied. If for any reason you should change your mind, let me know and I will send back your \$10.00. No questions, no hassle - just the refund.

As you use our system, your wealth and ability will grow. But you may want or need additional advice on some of your business deals and propositions.

Whenever you need me. Contact me by phone or by letter to find out more about this service.

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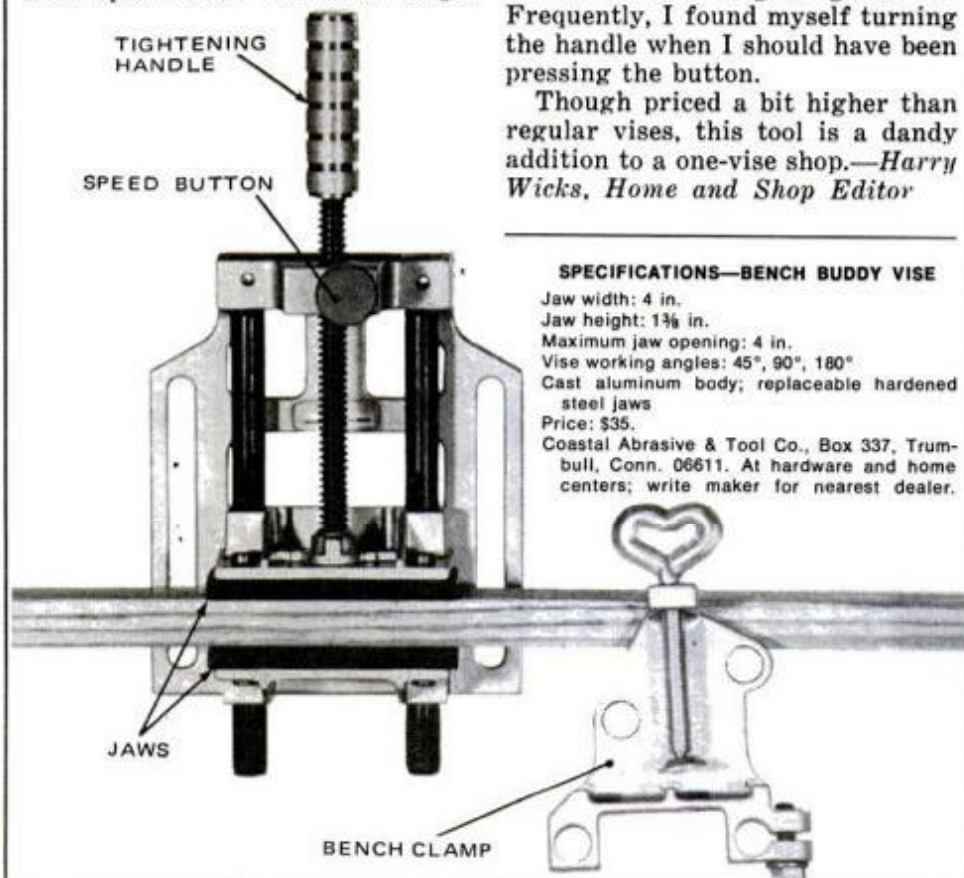
CUSTOMIZING CENTER 4401 Birch St., Dept. #8097 Newport Beach, CA 92663

PM TOOL TEST: Instant bench vise

Labeled Bench Buddy by its maker, the vise shown below has earned a permanent niche in my workshop. It is lightweight, easy to use and does not have to stay in one fixed spot on the workbench edge.

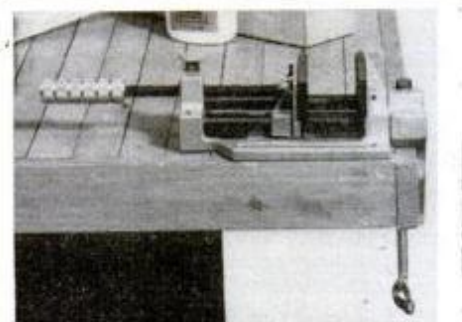
This tool's biggest plus is its versatility. The bench clamp is fitted on bench edge and then the vise can be affixed in one of three work positions—45°, 90° or 180°. The speed button takes some getting used to. Frequently, I found myself turning the handle when I should have been pressing the button.

Though priced a bit higher than regular vises, this tool is a dandy addition to a one-vise shop.—*Harry Wicks, Home and Shop Editor*

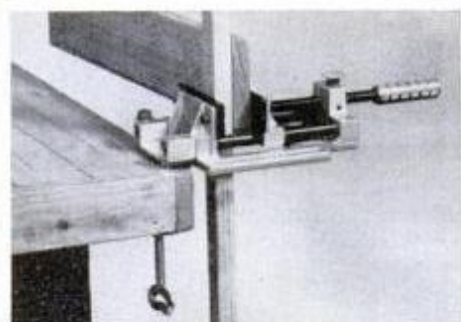


SPECIFICATIONS—BENCH BUDDY VISE

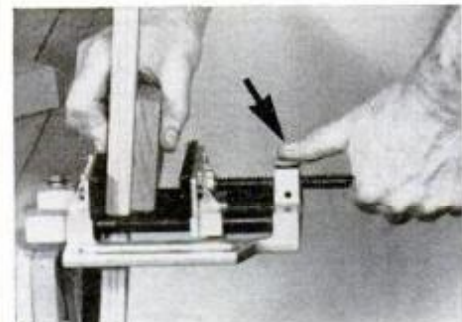
Jaw width: 4 in.
Jaw height: 1 3/8 in.
Maximum jaw opening: 4 in.
Vise working angles: 45°, 90°, 180°
Cast aluminum body; replaceable hardened steel jaws
Price: \$35.
Coastal Abrasive & Tool Co., Box 337, Trumbull, Conn. 06611. At hardware and home centers; write maker for nearest dealer.



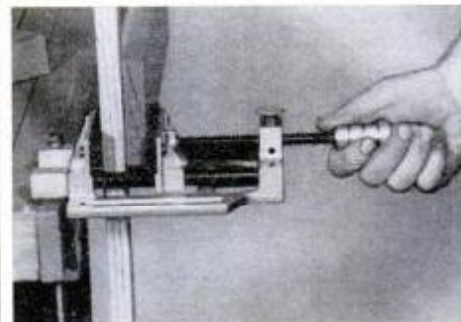
Versatile vise is used as above when maximum workpiece support is needed.



Bench clamp stays put; vise is repositioned 180° from position shown at left.

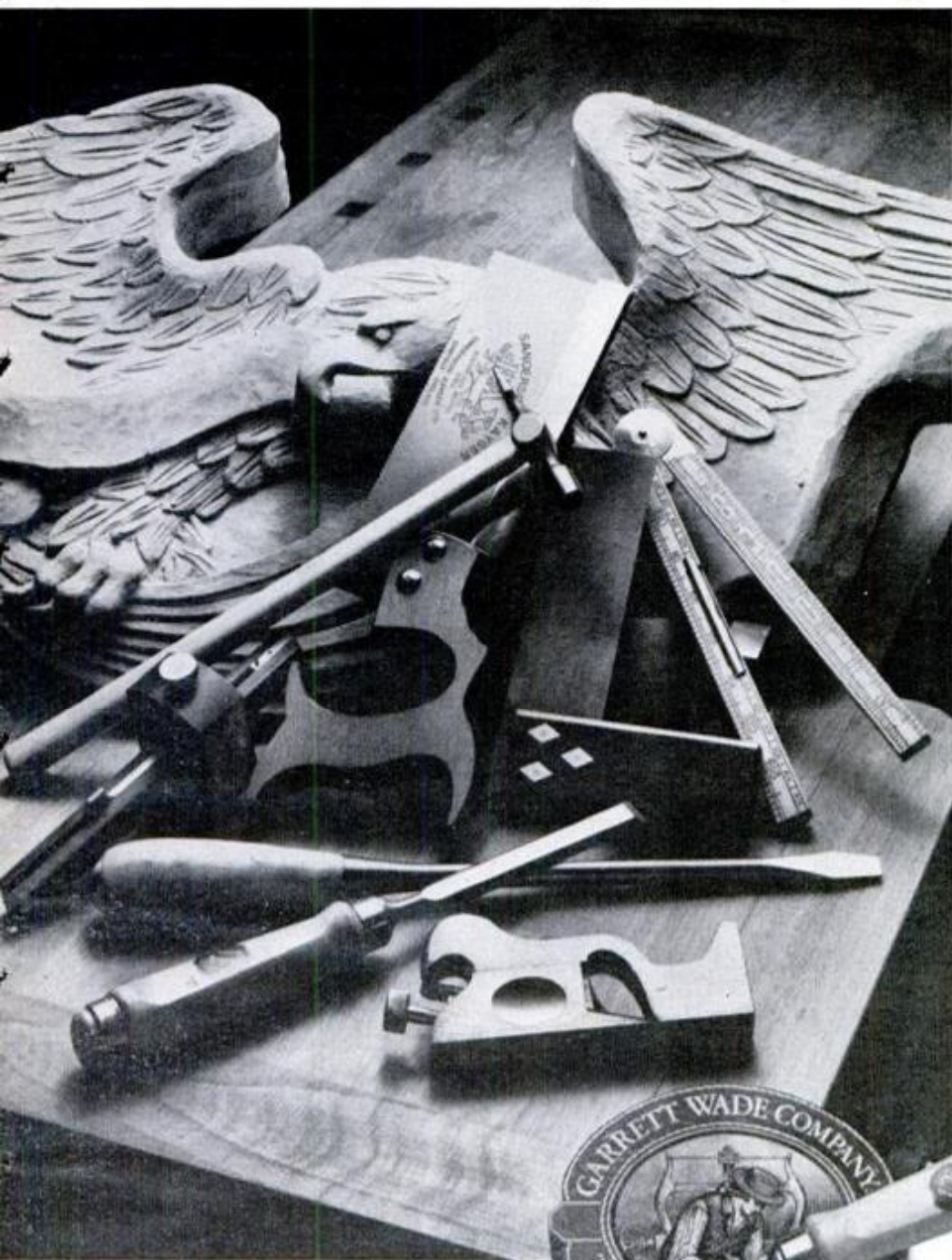


Button permits a fast change of setup, eliminates excessive cranking of jaws.



Final tightening to hold workpiece secure is done by turning the handle.

If you want to be as good as you can get, your tools should be as good as they can get.



You're only as good as your tools. With the right ones, an ordinary ability can become an enjoyable talent. You'll be able to tackle projects you never dreamed possible before.

It's all a matter of pride, really. For you, it's in the accomplishment of making something with your own hands. For us, it's in being able to provide you with the finest line of woodworking tools available anywhere.

We've searched the world for these fine tools so you can be as good as they are. For example, take a look at the brass-backed dovetail saw (\$26.00) shown in the photo; it's made in England. And the 26mm double-hooped chisel (\$9.10) which comes from West Germany. Beautiful, aren't they, even in black and white.

Imagine using some of the others: a 3½ oz. Warrington hammer (\$7.80) for the cabinetmaker in you; a Stanley No. 92 rabbet plane (\$28.40) for accuracy when you need it; and a 6" heavy duty screwdriver (\$5.20) that'll take all the abuse you can give it. (We haven't overlooked the best from the U.S. either.)

We also offer other precise tools to help make you proud of your finished project. A folding 36" Boxwood rule (\$13.90), mortise/marking gauge (\$10.20), and a basic 6" try-square (\$8.80).

Why we even offer classic Old World workbenches from 3 different countries. They're so beautiful some people use them as furniture.

Just reading our catalog could make you a better craftsman. That's because it's a 108-page work of art unto itself. Not only does it show and describe all our tools, but it's crammed with helpful information as well. There are diagrams, "how-to" sections and specific pointers for getting the most out of your tools. Just reading it could help you become a better woodworker.

Like all good things, our catalog costs money (\$1 to break even) but we think you'll find that's a small price to pay for our unique presentation of tools. In fact, you'll be very pleased to learn exceptional tools such as ours are still available in this day and age.

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Gentlemen:

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HINTS FROM READERS

Removing glue from your hands



I've found that water-soluble glues wash off quicker if you apply talcum powder, then wash with brisk rubbing motion.—*Elizabeth Daniel*

Stop eyeglasses slipping



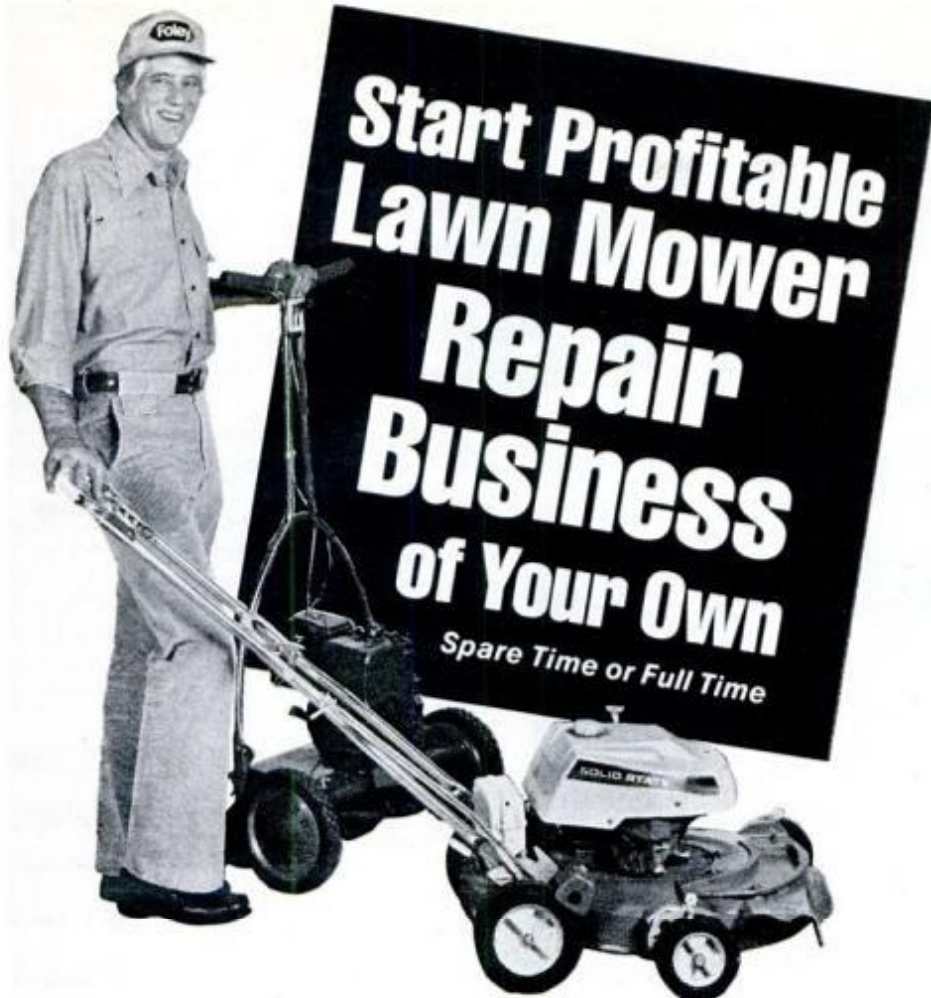
Eyeglass bows can be tightened by tying rubber bands around hinges as shown. Cut off the excess so that remaining rubber band acts as a hinge stop.—*George Logan*

Recycle candy containers



Store nails, brads, screws and other small shop items in candy mint containers. Remove the lid to fill, then secure the lid with vinyl tape.—*Robert Caplan*

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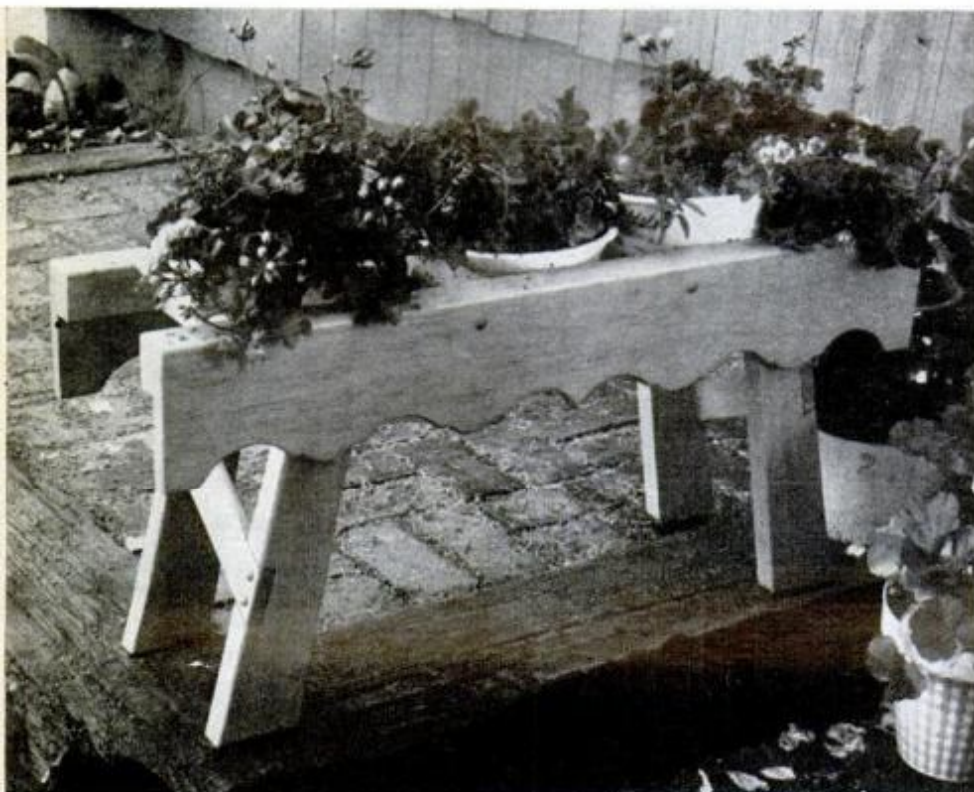
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2 planters you can use indoors or out



Planter designs by Harry Wicks

Here are two handsome pieces for showing off your prized potted plants. Both are total do-it-yourself projects that were created in the PM workshop. The contemporary bench-type stand features scalloped skirts which hint of early Americana. It's built entirely of pine. The hanging cubed planter is of redwood, and ordinary window sash chain is used to hang it.

Both of these plant containers can be used on the patio during the summer and simply moved indoors when cool weather arrives.

Use only hot-dipped galvanized or aluminum nails and screws for fastening. Ordinary steel fasteners will quickly rust and produce unsightly stains. The best adhesive choice because of exposure to weather is resorcinol glue. This is a two-part glue which is easily applied (after mixing) with a clean brush or wooden spatula. Caution: Read manufacturer's instructions for mixing and use, and mix the glue in batches that will be used in your work session—leftovers cannot be saved.

The bench was finished with an exterior stain and two coats of Man O'War spar varnish. The hanging planter was left natural, because it is of redwood, and treated with clear wood preservative.

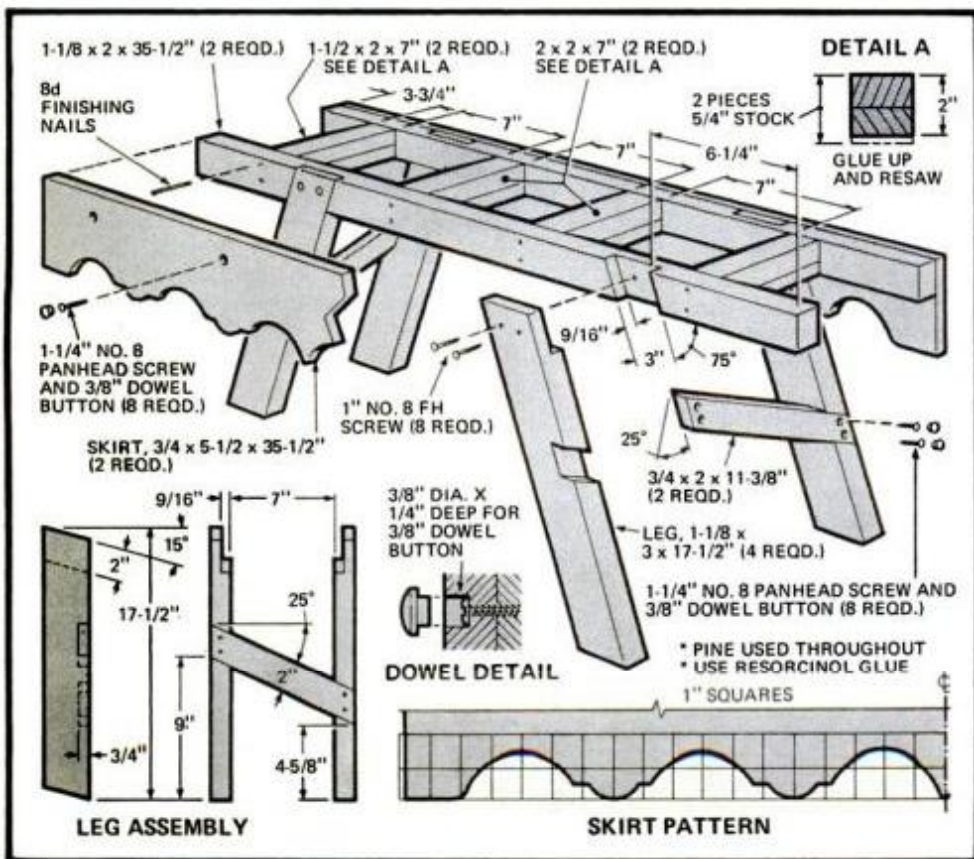
Bench-type planter

To save cutting problems through and around knots, use clear pine for the skirts. Other parts can be of No. 1 or 2 common pine.

Start by cutting parts to size. To make notches in the legs, use either a handsaw and chisel, table saw or radial-arm saw. Note that the cross-pieces are created by gluing up two thicknesses of 5/4-in. stock and then resawing them to desired size. When all parts are cut, test-assemble using 4d finishing nails only. When satisfied, permanently assemble with glue and fasteners.

Hanging planter

A quickie project that actually is fun to make, this hanging plant con-



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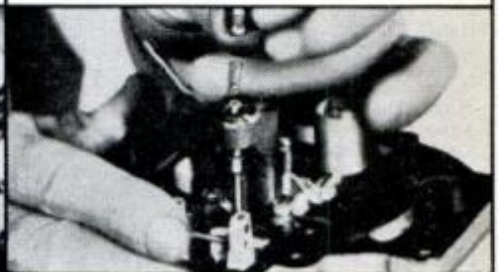
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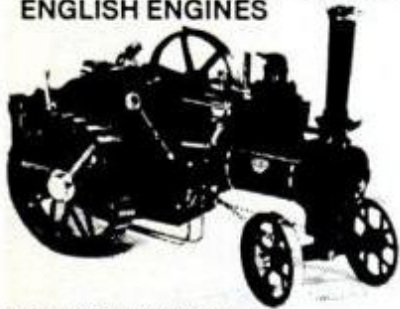
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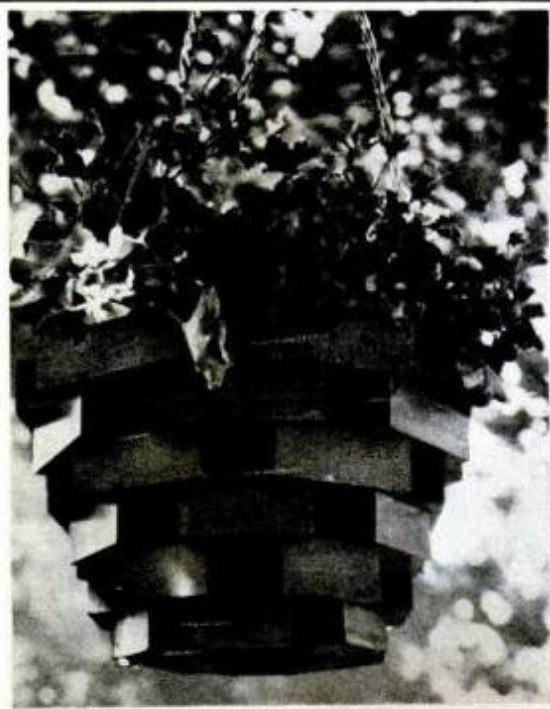
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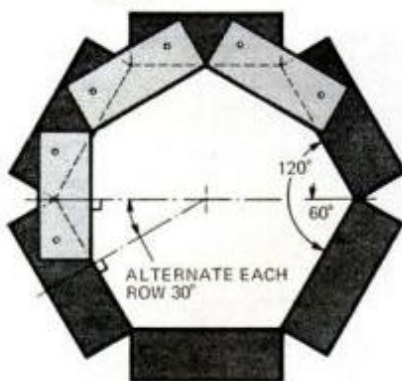
tainer is sized to suit a good-size flowerpot. The design can be used for smaller flowerpots, but the blocks must then be reduced in length and width.

Cut the required number of blocks on a table saw or radial saw. Sand and dust off all parts. Assemble the

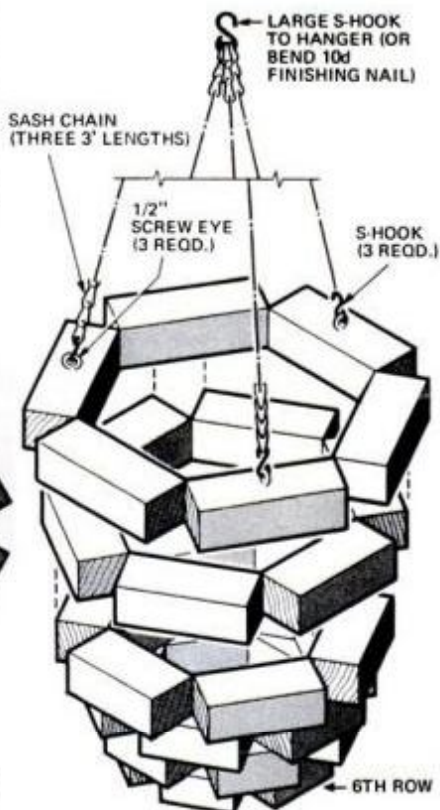
planter upside down using glue and nails. Note: Lay out each course on the preceding layer, arrange blocks until satisfied, mark their positions, and permanently fasten them with glue. Insert screw eyes, attach sash chain and suspend planter from a stout S-hook. Install flowerpot. ★ ★ ★



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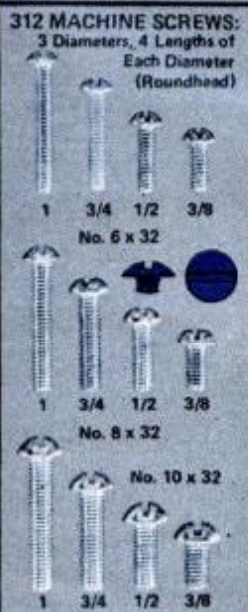
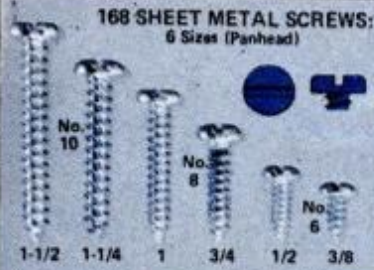
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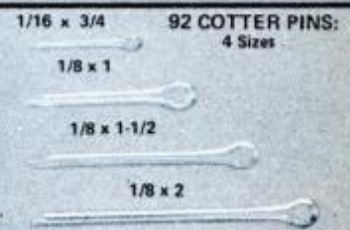
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TOOL TEST: Impact wrench



Wrench is comfortable in your hand. It can even be used with a portable drill.

Claimed to be a totally new concept in impact wrenches, the tool shown here converts a reversible power drill into an impact wrench capable of delivering more than 150 ft.-lb. of torque in five seconds.

Called U-Impact-It, the device can be used in any 1/4 or 3/8-in. power drill within the speed range of 1000 to 1750 rpm. It is designed for use with 1/2-in. square drive sockets; the maker recommends using 6-point impact grade sockets which will take the pounding better than standard sockets. I tried



the latter and was able to dull the points quickly.

The tool will be welcomed by those whose chief do-it-yourself activities are in automotive repairs. It is important to note that since the impact force is not transmitted, there is no undue strain on the power tool driving the unit. For safety, read and follow manufacturer's instructions for use.—*Harry Wicks, Home and Shop Editor*

SPECIFICATIONS—U-IMPACT-IT

Maximum torque: 150 ft.-lb. (used at 1200 rpm)
 Use: with 1/4 and 3/8-in. power drills
 Minimum speed: 1000 rpm
 Maximum speed: 2000 rpm
 Price: \$34.95
 Manufacturer: Technical Research Corp., Box 687, Jackson, Mich. 49204, available at auto supply stores, industrial supply houses and tool distributors; write manufacturer for the nearest source.

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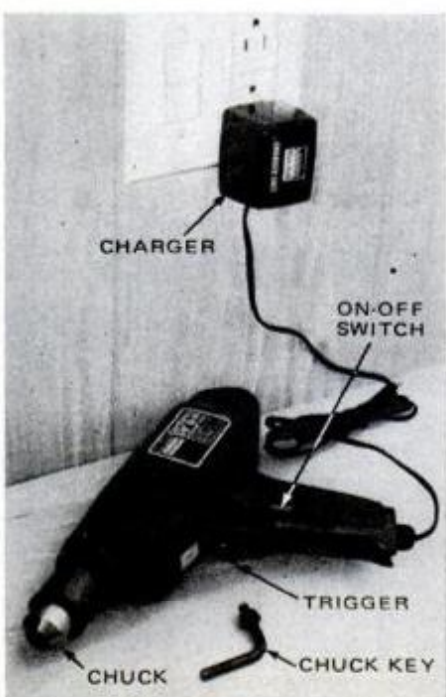
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Box 1014, New York, N. Y. 10019

PM TOOL TEST Cordless drill and screwdriver

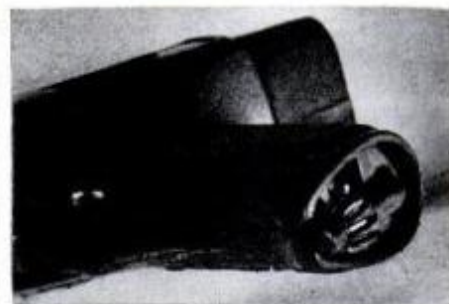
It is not exactly earth-shaking news to say that most cordless power tools simply do not have the power that their 110-volt cousins do. Thus to be fair when evaluating one of these, I make it a point to use the tool on light chores as well as heavy ones. On the latter—boring a lot of dowel holes in a planter—the tool slowed down production. But on the former—drilling pilot holes for traverse-rod hardware, and in house siding for an electrical fixture—the tool was a joy because there is no trailing and tangled line cord in the way. Used to drive screws the tool excelled.—*Harry Wicks, Home and Shop Editor*

MANUFACTURER'S SPECIFICATIONS Model TSZ-9221A 3/8" cordless drill

Capacity: 3/8" dia. (steel), 1/2" dia. (wood)
Maximum speed: 300 rpm
Features: safety trigger lock, reversing switch
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Price: about \$38
Montgomery Ward & Co., 1 Montgomery Ward
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Drill comes with a charging unit which gives tool full charge in about 14 hours.



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Not-so-crazy hinge

Every so often a product comes along that looks like it isn't for real. That's exactly what I thought of the wild-looking hinge below when I first saw it. Humorously labeled Kra-z-ee hinge, the plastic hardware-in-a-roll has proved virtually indispensable since I first brought it to my workshop.

I've used it to hinge lids to built-for-job-abuse toolboxes, hang flap-

type awning windows on sheds, connect flexible freestanding dividers—and as a temporary hinge when checking the fit of cabinet parts.

Aside from ease of installation, the low-cost hinge is ideal when money-saving is a concern; it provides the same quality of hinging action that a continuous metal hinge does but for a lot less money.

For light-duty jobs, it can be



Hinge gives a slightly-greater-than-90° swing as pictured above and below.

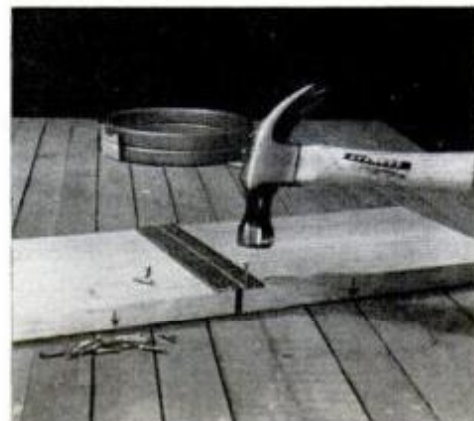


fastened with appropriate-length annular nails as at left. Where weight is a concern, the hinge can be attached to wood or metal using either roundhead screws or nuts and bolts.

—Jake O'Boyle



Plastic material can be cut using large shears or a razor-blade utility knife.



On test piece, author used short ringed nails to fasten the Kra-z-ee hinge to wood.

KRA-Z-EE HINGE

Plastic hinge without nails: 3-ft. sample roll, \$2.95; 12-ft. roll, \$11.95; 100-ft. roll, \$55. All prices include postage. Manufacturer: Provost Displays, Inc., 618 West 28th St., New York, N.Y. 10001.



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FRAMPTON (RECORD)
- TAVARES 24180
LOVE STORM (RECORD)
- BOBBY VINTON 34259
THE NAME IS LOVE (RECORD)
- Tchaikovsky 14350
THE NUTCRACKER (RECORD)
- HERB ALPERT & THE T.J.B. 23678
GREATEST HITS VOL. II (RECORD)
- THE OUTLAWS 33275
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- HENRY MANCINI 14012
MANCINI'S ANGELS (RECORD)
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- Neil Sedaka: Gr. Hits ... 24171
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- Best Of Best Haggard ... 33505
- Best Of BTO ... 43597
- Hair ... 03292
- Brecker Bros.: Stop ... 34365
- J. Denver: Gr. Hits V. 2 ... 33461
- Sweet: Off Record ... 24228
- C. Rich: Gr. Hits ... 04631
- Kiss: Destroyer ... 24001
- Helen Reddy: Gr. Hits ... 32302
- Frampton: Wind Change ... 14505
- J. Strauss: Gr. Hits ... 10143
- ZZ Top: Tejas ... 32110
- Paul Anka: 21 Hits ... 00120
- Bay City Rollers ... 24258
- Van Cliburn's Faves ... 13500
- Dr. Hook: Little Bit ... 34041
- Best Of Dolly Parton ... 33508
- Cat Stevens: Gr. Hits ... 20015
- Dickey Betts/Gt. South ... 14304
- Bob Seger: Night Moves ... 43584
- Joan Baez: Diamonds ... 40313
- Nazareth: Hair Of Dog ... 33747
- Roy Clark: Gr. Hits ... 23644
- 3 Dog Night: Gr. Hits ... 24056
- Waylen Jennings: Live ... 32142
- Jeff. Star.: Octopus ... 23896
- Steppenwolf: 16 Hits ... 13453
- Rod Stewart: Sing It ... 14392
- Segovia: Span. Encores ... 04486
- Best Of Guess Who ... 04306
- Platters: Gold ... 01129
- Moody Blues: Future ... 20084
- Gold Rock V. 1 ... 13711
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- Natalie Cole: Unpred. ... 23787
- ZZ Top: Fandango ... 13864
- Best Of Sam Cooke ... 00243
- Shalamar: Uptown ... 24244
- Best Of Statler Bros. ... 13572
- J. Travolta: Let Go ... 33771
- Best Of Freddy Fender ... 14013
- Ohio Players: Gold ... 30281
- Natalie Cole ... 33409
- Chuck Berry Gold ... 13728
- G. Campbell: Gr. Hits ... 24107
- BTO: 4-Wheel Drive ... 14360
- Heifetz: Tchaikovsky ... 22851
- Best of Uriah Heep ... 23296
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- ZZ Top: Tres Hombres ... 23596
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- Nazareth: Close R'n'R ... 34094
- D. Bowie: Americans ... 04609
- Grand Funk: Hits ... 33939
- Best Of Jim Reeves ... 00257
- Monkees: Gr. Hits ... 13564
- Sylvers: Special ... 14460
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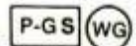
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New Sinclair Cambridge Programmable.

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How pocket calculators grew up
A couple of years ago, calculators took a step forward. Programmability transformed the old slide-rule calculator into an advanced scientific machine.

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Now the all-new Sinclair Cambridge Programmable puts programmability where it belongs: in the palm of your hand, for less than \$30.

Key features of the Sinclair Cambridge Programmable

The Cambridge Programmable is genuinely pocketable. A mere 4½" x 2", it weighs about 2oz.

Yet there is absolutely no compromise in the package of functions it offers.

Because the Cambridge Programmable is both a scientific calculator with memory, algebraic logic and brackets (which means you enter a calculation exactly as you write it), and a programmable calculator which offers a simple, flexible through-the-keyboard program entry and operation.

The Cambridge Programmable has a 6-step program memory, and features conditional and unconditional branch instructions (go to and go if negative).

There is also a step facility, which allows you to step through the program to check that it has been entered correctly. If there is any programming error, the learn key allows you to correct single steps without destroying any of the remainder of the program.

To achieve this, each program key-stroke has an identifying code, or 'check symbol'. The symbols for the digit keys are the digits themselves, while the symbols for the operator keys are letters printed beside the keys.)

The check symbol for \square , for example, is F. So if, as you step through the program, the display shows

it means that \square is programmed as step 26. If step 26 should have been \square , all you have to do is press



puts machine into 'learn' mode.

It's as simple as that!

Use the 294-program library to tailor the machine to your own speciality

Like a full-size computer – and unlike far more expensive specialist calculators – the Sinclair Cambridge Programmable can be programmed to handle calculations concerned with any speciality.

It can even be given to an operator who doesn't understand the program!

To save you time, and to help inexperienced programmers, Sinclair have produced a library of 294 programs ready to be entered straight into the calculator.

Using these standard programs, the Cambridge Programmable solves problems from quadratic equations (where the program gives both real and imaginary roots) to twin-T filter design, and from linear regression to bond yields.

(The calculator is supplied with 12 sample programs, and full instructions for entering your own program. The four books in the program library are available at \$4 each, or \$10 for the complete set.)

A home computer – great education, and great fun!

The Programmable is a true computer in miniature.

An hour or two spent with it gives more insight than any plodding text book into the way computers work.

Great for children – and children find it easy to understand. What's more, the library shows you how to have fun with your computer. There's a 'matchstick' game (where you can win) and a real lunar landing program to run. (Right decisions – soft landing. Wrong decisions – disaster!)

The approach is so simple, and so immediate, that writing your own programs becomes an absorbing addiction. (New programs written by owners reach us all the time – send us yours, and we'll publish them.)

Why the Cambridge Programmable costs so little

The Sinclair Cambridge Programmable uses the Sinclair talent for miniaturisation to the full – as you'd expect from the company that pioneered the truly pocketable pocket calculator, and recently introduced the world's first pocket TV.

Chip and circuitry design are unique to Sinclair, and the Cambridge Programmable is assembled by Sinclair's own staff at their headquarters plant.

The result is a pocket programmable calculator of advanced design, sold by the manufacturer with the manufacturer's own 1-year comprehensive guarantee, at a price unmatched by any comparable calculator.

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There's a lot more to this remarkable calculator than a brief written description can cover.

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Physics and Engineering
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_____ (qty) Program Library Book 4 at \$4
Electronics (networks, circuits, filters, electro-dynamics, radiation and propagation) \$ _____

_____ (qty) complete set(s) of 4 books at \$10 per set \$ _____

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Atlas 350-XL transmits 350 watts of power across six shortwave ham-radio bands.

Tiny new ham radios span the globe

With thousands of channels, hundreds of watts of power, these mini-stations can reach the remotest corners of the world.

by Anthony R. Curtis, K3RXK
RADIO EDITOR

The reason for stepping up to ham radio from CB is the thrill of chatting with amateur operators around the globe. Now you can do that with a ham station no bigger than a shoebox. Wherever you are—in your home ham shack, boat, RV, car, plane or van—you can plug these radios into your 12-volt system and reach the farthest corners of the world. Each radio has sensitive receiver circuitry so you can hear the faintest signals. The built-in transmitters run hundreds of watts of power.

Precision frequency counters

The new ham sets display, in large light-emitting diodes (LEDs), the exact spot on the radio dial where you are transmitting and receiving. Along with the legal need and technical desire to know your exact fre-

quency, LED readouts make tuning considerably more convenient and a lot easier than using the old-fashioned rotary-drum or slide-rule dials.

The best of these new ham radios are made in America and Japan. All are about equal in power frequency range and sensitivity. They include:

FT-301 D, Yaesu Electronics Corp., Box 498, Paramount, Calif. 90723.

350-XL, Atlas Radio Inc., 417 Via Del Monte, Oceanside, Calif. 92054.

Triton IV, Ten-Tec, Inc., Sevierville, Tenn. 37862.

TS-820S, Trio-Kenwood Communications Corp., 116 East Alondra Blvd., Gardena, Calif. 90248.

Pro 80-10, Stoner, Inc., John Hancock Building, Mercer Island, Wash. 98040.

3750, Hy-Gain Electronics Corp.,
(Please turn to page 214)

These solid-state, shoebox-size two-way ham radios run 200 watts transmitter power, have ultrasensitive receivers and digital frequency displays for precision tuning. Yes! FT-301D (far upper left) has voice-operated switch to turn on transmitter when you speak. Astro 200 (near upper left) has switches replacing tuning knob. Ten-Tec (far lower left) changes transmit to receive so fast you hear signals coming in even as you transmit. Kenwood (near lower left) has power supplies built in for operation on house current or directly from car or boat battery. All are used for voice code, radioteletype and television.

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If you're looking for a chance to make yourself some MONEY—this could be it! If you want to get in on the ground floor of something BIG—you may be our man! If you're fed up with daydreams and broken promises ... if you're ready because what you read

for some hard, cold FACTS—read on, could turn your life around!

FACT #1: If you're ever going to do anything with your life, you have to get where the real action is.

FACT #2: In this country today, the action is in the Automotive Field—America runs on wheels!

FACT #3: The cost of owning and operating any vehicle—car, bus, truck, you name it—has gone straight through the ceiling! The cost of gasoline and oil? UP! The payments demanded by skilled (and not-so-skilled) mechanics? UP! The pricetags on new cars and trucks? UP! It's positively sickening—and it's going to get worse before it gets any better!

CAN ANYTHING BE DONE ABOUT IT?

Something has been done about it—and it's called TMT. This Space Age discovery is the answer to the prayers of every vehicle owner, from private motorists to operators of nationwide truck fleets. TMT slashes sky-high fuel expenses ... slashes outrageous repair bills ... slashes prohibitive replacement costs of cars, trucks, buses, boats, campers, motorcycles—in fact, of any vehicle powered by an internal-combustion engine!

WHAT IS TMT?

TMT is a superconcentrated liquid formulation incorporating Du Pont TEFLON[®], the same chemical compound that went to the Moon in the lunar vehicle engines. When TMT is added to an engine crankcase, this key ingredient instantly goes to work against the No. One Cause of poor gas mileage, sluggish performance, high operating temperatures, and mechanical breakdown: *frictional drag*.

But unless you're a chemical engineer, right now you're more interested in *what* TMT does than how it does it. So here it is, in a nutshell:

TMT IS FAST! There's nothing complicated about using TMT—a 12-year-old kid could do it in less than 60 seconds ... and not even get his hands dirty!

TMT IS PERMANENT! It's an engine treatment, not an oil treatment. Just one single application is all it takes to permanently protect your engine, for as long as you own your car!

TMT IS SAFE! We've put our money where our mouth is on this ... with a \$1,000,000 Product Liability Policy issued by a nationally famous insurance company!

TMT IS EFFECTIVE! Effective for any car, truck, or other vehicle—whether it's this year's model or one that's 15 years old! Protects and preserves new engines ... "tightens up" and rejuvenates old ones!

TMT IS GUARANTEED! Every TMT Treatment sold carries with it the strongest, most iron-clad Guarantee we could think of!

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- **GUARANTEED:** Smoother engine performance ... less stalling and rough idling ... or money back in full!

- **GUARANTEED:** Increased horsepower and higher compression ... more zip and acceleration ... or money back in full!
- **GUARANTEED:** Longer engine life ... fewer repair bills (especially for costly ring and piston jobs) ... or money back in full!
- **GUARANTEED:** All these important, money-saving benefits no matter how long you own your vehicle ... or money back in full!

JUST IMAGINE THE SIZE AND SCOPE OF THE POTENTIAL TMT MARKET!

How many private motorists are there in your area—many with more than one car? How many truck owners? How many taxi fleets and bus companies? Factory and construction vehicles? Owners of boats, motorcycles, recreational vehicles? Police and fire departments and other government agencies? *The list is endless.*

In view of the many possible savings and benefits cited above, what do you suppose any vehicle owner or operator would gladly pay for a one-time, permanent treatment of TMT? \$50.00? \$100.00? MORE?

Well, listen to this: The established retail price of TMT is only \$14.95! That's right, only \$14.95—a tiny investment that could possibly pay itself back dozens of times over, in savings on gas, oil, and repair bills. *Fantastic.*

WHERE DO YOU FIT INTO THE TMT PICTURE?

If you're the man we're looking for, by now you should be asking: "What's in this for ME?" The answer: The Opportunity to become an Authorized TMT Distributor in your area ... the Opportunity to buy this powerhouse product at low, low wholesale cost and to earn as much as \$8.00 AND MORE on every unit you sell at retail ... and the Opportunity to get started with NO big investment, and without risking or gambling one penny of your own!

In order to get TMT to its vast potential market as quickly as possible, we're cutting out the middlemen and bypassing so-called "normal distribution channels"! Instead, we're going directly to ambitious, wide-awake men who know a good thing when they see one! And yes, WE'LL take all the gamble out of getting you rolling! If TMT is all we think it is YOU'RE the winner! If we're wrong, you're NOT the loser!

NO CURIOSITY SEEKERS, PLEASE!

Naturally, you want to learn more about TMT before you make any decisions. So we've prepared a big, information-packed Marketing Kit with complete technical data, market analysis, sample sales and advertising aids, and much, much more. The token cost is just one dollar—which we ask to protect ourselves against idle curiosity seekers and sample collectors. (If, after reading the Marketing Kit, you're NOT convinced that this deal is for you, just let us know and we'll rush you a check for TWO dollars—double your money back!)

Or perhaps you'd like to try TMT yourself, right in your own car. If so, we'll rush you a full-sized \$14.95 unit for just \$9.95, fully prepaid. (To protect our existing Distributors, we must limit this offer to one unit only at this special price.) If in your judgment TMT isn't everything we say it is, simply return the empty container to us within 30 days, and we'll rush you a full \$9.95 refund ... no questions asked!

ACT WITHOUT DELAY

So whichever way you choose to go, there's no way you can lose. But you can lose if you don't act NOW! A product like TMT doesn't come along very often ... so, to protect your own interests, mail the No-Risk Coupon right now—TODAY!

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SPERRY-OWENS COMPANY Dept. 109, 307 Fifth Avenue, New York, N.Y. 10016

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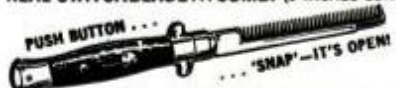
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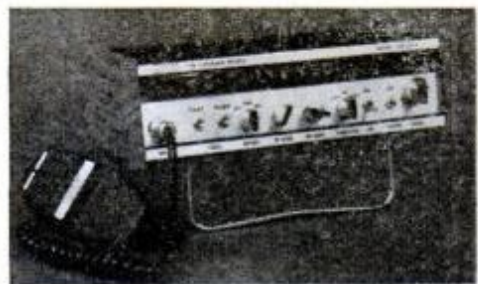
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TINY NEW HAM RADIO

(Continued from page 212)



Stoner Pro 80-10 is only 3 in. tall, 12 wide and 10 deep; runs 200 watts.

8601 Northeast Highway Six, Lincoln, Neb. 68505.

Astro 200, CIR Industries, Inc., 1648 North Magnolia Ave., El Cajon, Calif. 92020.

All run 200 watts transmitter power except the Atlas which has a whopping 350 watts.

They can be used for chatting with



Yaesu FT-101E has power supplies built-in for use at home or in car, boat or plane.

other hams via single sideband (SSB) voice transmissions, International Morse Code (CW), radioteletype (RTTY) and slow-scan television (SSTV).

Atlas, Yaesu, Kenwood and Hy-Gain each give you 3500 channels (a total of 3.5 MHz of spectrum space) in six ham shortwave bands from 1.8-

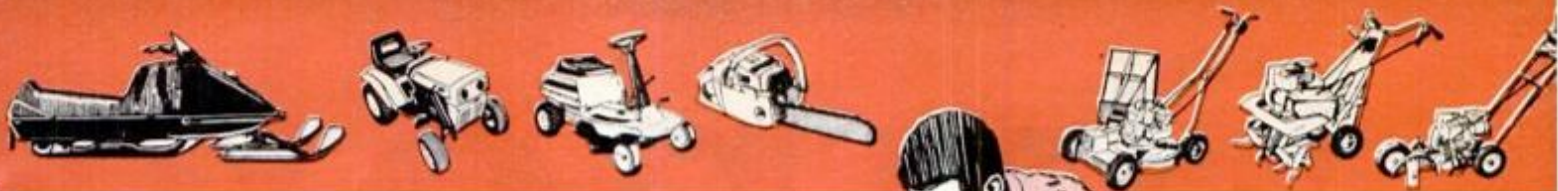


Hy-Gain 3750, 200-w. six-band transceiver, is packaged for classy home base station.

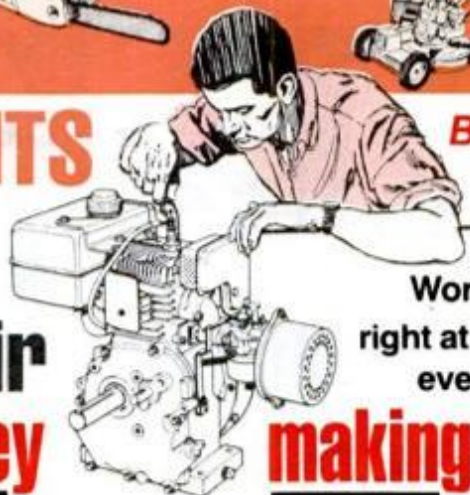
29.7 MHz. Ten-Tec, Astro 200 and Stoner cover 3300 channels in five bands, 3.5-29.7 MHz.

Priced from \$500 to \$1800, the new sets are powered by 12 volts d.c. for use in car, boat or plane. Extra-cost accessory power supplies permit operation from 120-volt a.c. house current. Kenwood and Hy-Gain have a.c. supplies built in. ★ ★ ★

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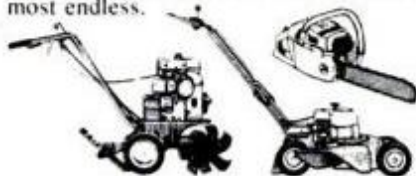
In just a short time, you can be ready to join one of the fastest growing industries in America...an industry where qualified men are making from \$10.00 to \$15.00 per hour...and that's just for labor. Parts, engines and accessories add even more to the profits.



Because the small engine industry has grown so quickly, an acute shortage of qualified Small Engine Professionals exists throughout the country. In fact, it's not unusual for a good small engine man to be three to four weeks behind in the summer and at least a week behind in the winter. When you see how many small engines are in use today, it's easy to understand why qualified men command such high prices—as much as \$17.50 for a simple tune-up that takes less than an hour!

46-million small engines are in service today!

That's right—there are over forty-six million 2-cycle and 4-cycle small engines in service across the U.S.A. That's the official count from the Engine Service Assn., and new engines are being built at a rate of one-million per month! With fully accredited and approved Belsaw training, you can soon have the skill and knowledge to make top money servicing these engines. Homeowners and businessmen will seek you out and pay you well to service and repair their lawnmowers, tillers, edgers, power rakes, garden tractors, chain saws, mini-bikes, go-carts, snowmobiles, generators, snowblowers, paint sprayers...the list is almost endless.



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 J. Johnson

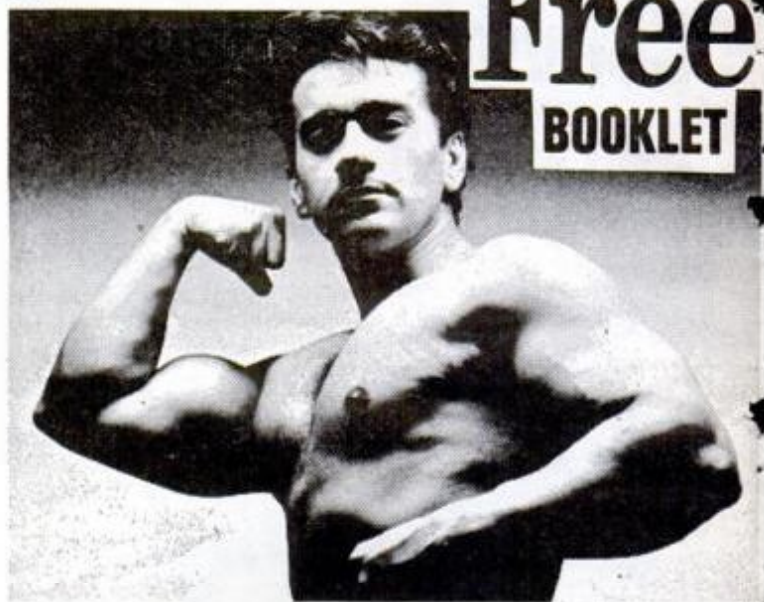
"In just 3 weeks I have gained 1½" on my arms and 4" on my chest. I have also lost 4" off my waist. Your course is just great!"
 D. Roberts

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 B. Abbott

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 P. Williams

"I have gained 20 pounds in just 30 days and I have gained over 6 inches on my chest. I find that my power has doubled. In sports I am a winner in everything I do."
 B. Daniels

"I have gained 5" on my arms and 12" on my chest, while losing 3" off my waist. I have tripled my power and speed. Thanks for what you have done for me!"
 M. Robinson

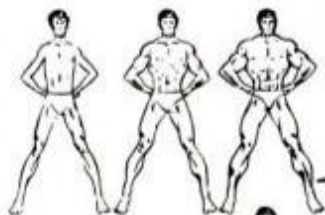


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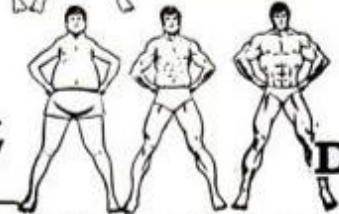
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The brainchild of Ed Almquist, internationally famous automotive engineer and the "Thomas Edison of high-performance accessories"... The Ram-Jet took over 20 years to develop and perfect. And now — only after proving itself beyond a shadow of a doubt — at Pocono and other stock car races, as well as in a national test of thousands of ordinary cars in normal driving situations... NOW, AT LAST, THE RAM-JET IS READY FOR YOU! READY TO TURN POLLUTION INTO FREE POWER!

How does it work?

Just as a jet engine requires a certain supply of air to operate... so does the gasoline combustion engine in your car. And it's the carburetor that mixes this air with fuel to fire the cylinders and make your car go. The problem is that carburetors were invented over 50 years ago when gas was plentiful and cheap and air pollution wasn't even talked about. The carburetor hasn't changed much since then: It's still a big compromise! It only works perfectly on those rare occasions when all driving conditions are perfect. (Which averages only a couple of minutes at the most out every driving hour). Your carburetor just can't efficiently adjust itself to your stop-and-go driving, sudden bursts of speed; or to put it in technical terms... those many occasions when your engine is operating under 0-10" high-load conditions. When this crucial mixture of air and gas is not right on the money, the result is a loss of power with a lot more gas being burned than is really necessary!

JOIN THIS NATIONWIDE ENERGY-SAVING RESEARCH PROGRAM. Do your part to help America beat the energy crisis... simply by sending us a brief report of the kind of gas savings and increased power you enjoy once you add the RAM-JET Supercharger to your car. Many thousands of participants are needed for this most worthwhile research. The results of which will be tabulated and released to the engineering departments of major American universities, automotive companies, the U.S. Government and the general public.

*All performance claims are based on actual user reports (which may not be typical). Your results may be more or less, depending on vehicle make, age, condition, optional equipment; and when, where and how the vehicle is driven.

Turn Your Car Into A Money-Making-Machine. Enquire About Unique Ram-Jet Agent Program.

NOW WITH GOVERNMENT INSISTENCE ON POLLUTION CONTROL DEVICES, THE WASTE IN POWER AND GASOLINE IS EVEN GREATER THAN EVER. BECAUSE THE BLOW-BY POLLUTION THAT USED TO BE RELEASED INTO THE AIR IS NOW FED BACK INTO YOUR ENGINE.

If you've ever wondered why the newer cars seem to have even less power than the older ones, well now you know. Today, you can pay as much as \$10,000 or \$20,000 (or even more) for a new car and still find it lacks real oomph when you need it, hesitating and even stalling out on you frequently.

Now, at last, the Ram-Jet to the rescue! It solves both problems at once.

It brings your 50-year-old-carburetor design into the Jet Age.

1) It works like a "mini-computer" to automatically adjust the air/gas mixture to your every driving need. It thus steps up gas molecularization... reducing the over-rich mixture before it becomes wasteful. Just as a jet engine sucks air into it...

WHAT DO PEOPLE SAY ABOUT THE RAM-JET SUPERCHARGER? WE GET LETTERS LIKE THESE EVERY DAY.

An airline pilot writes: "Suddenly my little six cylinder engine seems to have the power of an eight. Yet it saves gas like it was a four. That little Ram-Jet is amazing!" — Phillip Shade, Plymouth, Connecticut

"I have a Ram-Jet. And so do many of my parishioners. We found out that we average from 2 to 6 more miles per gallon with much more engine pep and acceleration." — The Rev. P. Mick Harvey, Illinois

the Ram-Jet automatically and safely jets air into the gas mixture the very split second your driving conditions require it.

2) It captures the polluted air that would ordinarily be fed back into your engine... and re-energizes it into a "Jet Stream" that is once again ignited into useful clean power instead of clogging up your engine and making it hesitate and stall and waste gasoline and power.

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- 1) Ram-Jet air intake vent.
- 2) Waste gas from pollution control line enters here.
- 3) "Mini Computer" valve inside improves gas/air mixture for more clean power, and better economy.
- 4) "Jet Stream" of super vaporized mix improves carburetion — actually results in FREE power!! Adds as much as 15% more clean power (And it does so with absolute 100% safety).

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Please rush me the miraculous patented RAM-JET Supercharger that turns pollution into FREE Power! And as a free gift I will also receive the DOUBLE YOUR GAS MILEAGE report and Miles-Per-Gallon calculator to prove how much gas I save.

I understand that anytime during the next 100,000 miles I may return the RAM-JET for a full money-back refund. No questions asked. (And I may keep the report and the calculator as free gifts).

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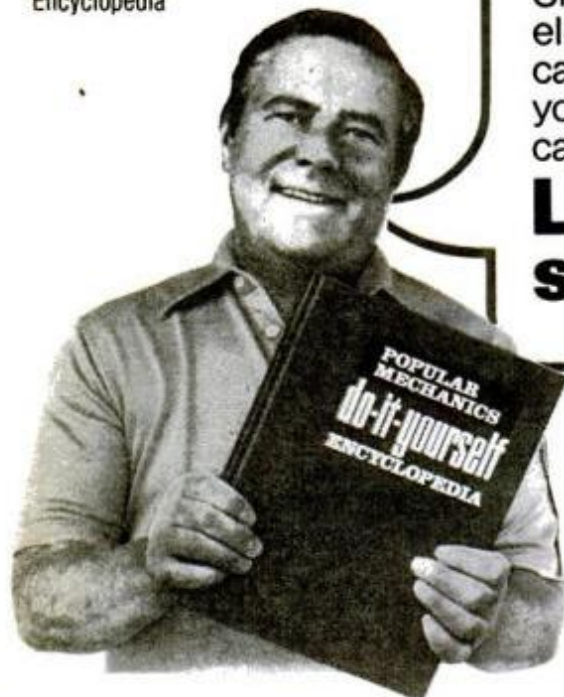
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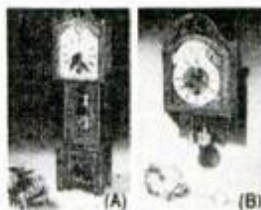


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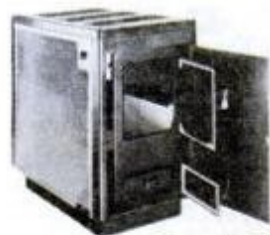
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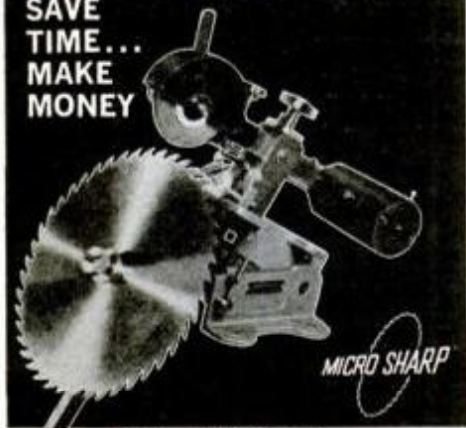
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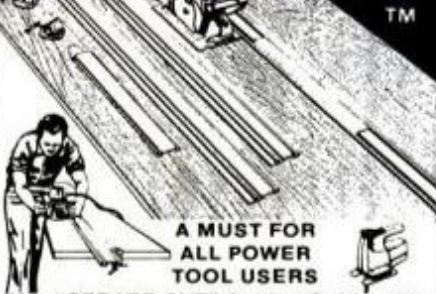
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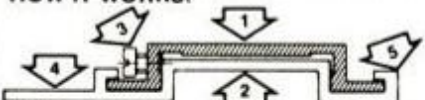
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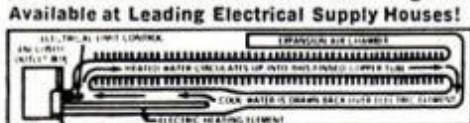
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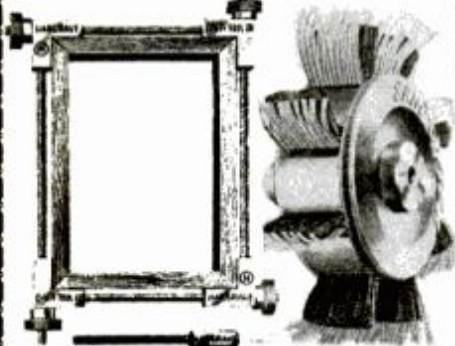
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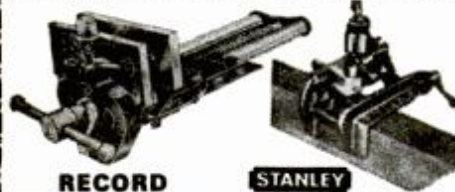
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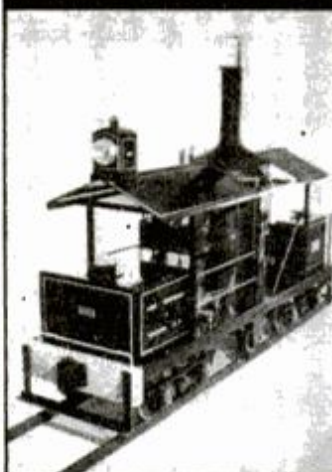


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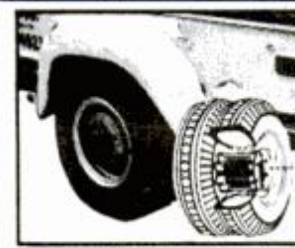
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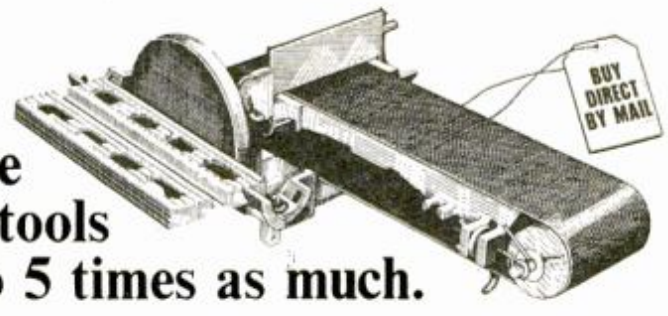
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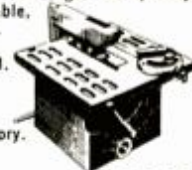
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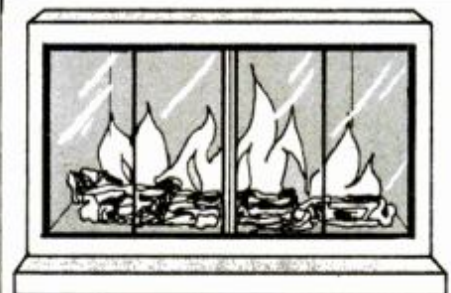
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(Continued on next page)

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(Continued from preceding page)

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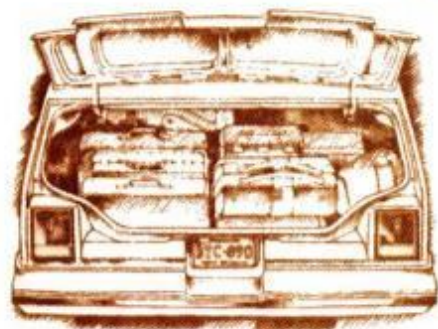
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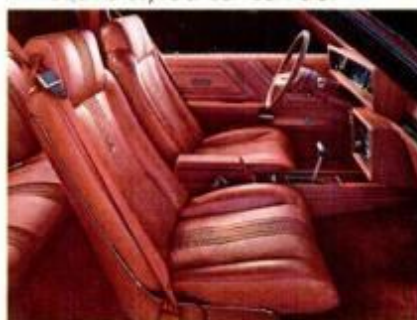
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