

JANUARY 1976 75 CENTS

Popular Mechanics

Create gems from stones with a \$50 homemade polisher

2 shops that pack a lot into a small space

DIESELS: PM drives the new ones—and Mercedes owners tell pros and cons

Mini subs now in quest for North Sea oil

9 budget speakers: Some sound great!

Make an old-time rolltop desk

New keep-warm outdoor gear

**WIND
DISASTER
PLANE CRASHES
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Country.

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or Longhorn 100's—
you get a lot to like.



This One



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Wind disaster—plane crashes shed new facts about invisible air turbulence. See page 49. *Illustration: Ed Valigursky*

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Popular Mechanics®

JANUARY 1976 • Vol. 145 No. 1

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SPECIAL FEATURES:

A special five-page DIESEL section including reports on VW's test diesel; an In-Use Report on Mercedes 240D; one man's drive conversion. Page 60.

A rolltop desk you can build. Detailed plans for constructing a turn-of-the-century piece of furniture that's a natural for any room decor. Page 80.

You'll get real bargains buying 'recycled' car parts if you have solid knowledge about shopping and saving at auto wreck yards. Page 70.

Have you ever thought about drilling for oil? Well, one couple did. Their frustrating and grueling story starts on page 84.

Unraveling the mysteries of cassette tape repair can be easy if you know that snarled and broken cassette tapes can be fixed. Page 95.

Two mini workshops for small spaces let you have a dreamed-about shop in a space-stingy apartment or small home. For unique plans, see page 98.



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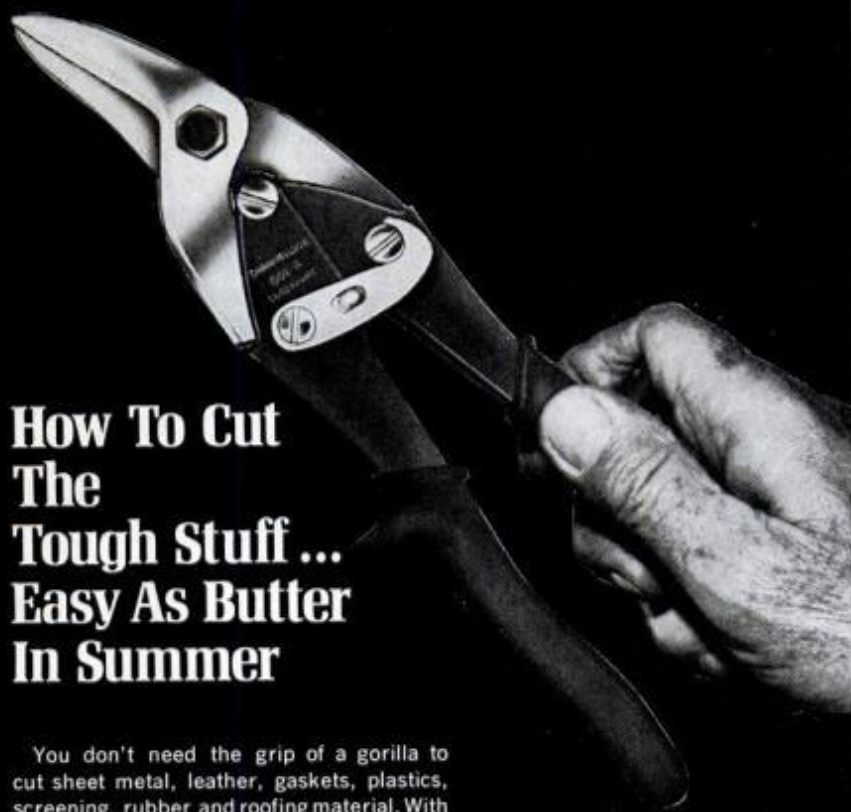
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However, first let me tell you what I have.

I've got a *copyrighted job changing system* that you can use to move up in your field, or out to another field, but at significantly higher earnings.

It took myself and five other professionals two years and \$250,000 to develop—but it works!

Furthermore, it doesn't require "genius" and it doesn't require "luck." All you have to do is put it into action.

The reason we developed it was because with 84 million employed, and 15 million circulating resumes each year, this area was ready for some revolutionary ideas.

We knew more people than ever owned prestige cars & yachts, summer homes and international retreats, as well as having securities, real estate holdings and lots of cash in the bank.

In short, many people in the U.S. are living good lives!

At the same time, however, the great majority have no excess cash, little job security, and are frequently restless, bored with their jobs, commuting long hours, and harrassed by inflation!

We asked ourselves how do people get to live the "good life"?

Well, we found that most successful people were there because they never wasted time in dead-end situations!

What these people did was to make crucial job changes, and *parlay* their higher earnings into small fortunes!

Take a look at the economics!

Do you realize that if you were to change jobs every 4 years, at an average annual increase of \$4,000, and then put the increases in the bank at 6%,—that in 20 years you'd accumulate an extra *half million dollars!*

Getting raises is one thing, but getting significant increases because of job changes is a very important source for wealth!

The next question then, is how can you easily change jobs? This is where the unique system we've developed fits in.

Our system can work for anyone from \$8,000 to \$80,000. Do it right and you'll gain higher earnings, lifelong job security, but most of all, *everlasting self confidence!*

This is because once you've used it, you'll know you can *always* get a new job,—quickly and predictably.

Perhaps you're wondering why our system works? Well, it works because it's a *completely different approach*, based on totally new concepts.

But, also because it's simple, practical, and self-tailoring. You could start next week—and do it *without strain, confusion or worry.*

But, there is one catch! You won't be a success if you use old methods for dealing with recruiters & agencies, for answering ads & sending out letters, for handling interviews & negotiating salary.

To make more money without a hassle, you'll have to be willing to change. You'll also have to follow our system, have an open mind & have faith in yourself.

However, do this and a better life will be yours!

With our system, whatever you seek—a better job, a new career, higher pay, more satisfaction,—*I believe nothing can stop your success!*

Not age, sex, education, or even low earnings or past working history.

Personnel Magazine said we have a "breakthrough."

Business Week devoted a full page article and called it "indispensable."

The National Public Accountant even said it was "capable of catapulting any average person into a position offering much greater rewards."

However, your best proof of our system is that we've already received thousands of letters from grateful customers.

Letters like one from a gentleman in California who wrote: "In 4 weeks I changed jobs and raised my salary 33%! I wish I had it 10 years ago!"

Another man from New York said "I used one of your letters, sent 24 out, and got 13 interviews and 3 job offers!"

Still another from California said "In just 11 days I received an offer of \$7,000 more!"

I know this sounds almost too easy and I can't promise that you will do as well. But, then again you may do better!

Even the largest business magazine in the U.S., **Nation's Business**, said our materials were "incredibly effective."

Now, if you're serious about wanting to move up, then I know that our system is something you've got to have!

In fact, I'm so convinced that you'll agree that it's worth *hundreds of times the cost*, that I'll make sure you have nothing to lose.

First of all, when your order arrives, we'll ship within 24 hours. No delays!

Secondly, you can examine our system for 10 days.

Third, if at the end of that time you are dissatisfied, return it, & I personally guarantee your 100% refund will be mailed in 3 working days—with no questions asked!

To let me prove everything I've said, and to take advantage of this nothing-to-lose offer, just fill in and mail me the coupon below.

Performance Dynamics Inc.
Attn: Mr. Robert Jameson, President
17 Grove Avenue
Verona, New Jersey 07044

Dear Mr. Jameson:

Your offer sounds great! Please rush me your Professional Job Changing System right away, but on one condition. I understand I may examine it for 10 days, & if at the end of that time I return it, you will mail my full refund within 3 working days, with no questions asked. On that basis, here's my \$12, plus .50 for postage and handling.

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Name _____

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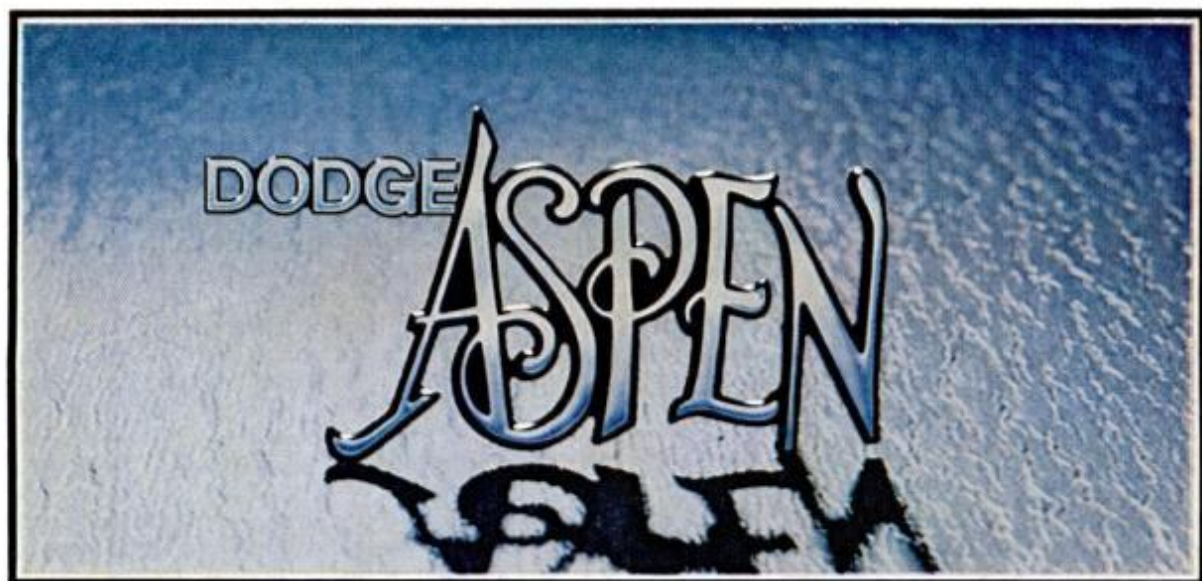
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PM

— New Jersey residents add sales tax —

Mr. Jameson's ideas have been the subject of more than five hundred articles, ranging from 600 words in *Business Week* to 3,000 words in *Chicago Today*. This material has also been nationally advertised in leading media including *The Wall Street Journal*, *Scientific American*, *Nation's Business*, *Signature*, *The New York Times*, *Newsweek International*, *The Los Angeles Times*, *American Scientist*, *Income Opportunities*, *Time*, *Specialty Salesman*, *Success Unlimited*, *Chemist*, *The Army Times*, *New York*, *The Chicago Tribune*, *True & others.* © 1975 Performance Dynamics, Inc.



We took the things you said and engineered them into

This new kind of car was developed for those people who wanted the economy and maneuverability of a small car, but did not want to sacrifice comfort and ride.

It is available in two versions: Dodge Aspen and Plymouth Volaré.

To give you a big-car ride, we invented a new suspension.

This new kind of small car called for a new suspension. So, our engineers invented an Isolated Transverse front suspension (Patent Pending). It's truly unique. Road shock is kept as far away from the driver and passengers as possible.

For greater quiet, we engineered two noise-reducing systems.

Most people take noise for granted in a small car. But not our engineers. They developed two special sound systems. A sealing system that minimizes wind noise and an insulation system that reduces road noise.

Dodge Aspen and Plymouth Volaré are roomier than many larger cars.

We reserved smallness for the outside. Our sedan models offer more total headroom and legroom than many bigger cars. The two-door coupes seat five passengers, comfortably. The four-door and the station wagon models seat six, comfortably.

There was no small-car scrimping on comfort.

Getting in and out of some small cars can be a problem. In these cars, our engineers developed wide door openings that make it easy. There's even an optional seat that gives the driver a greater amount of comfort adjustment than conventional seats, and also in two-door models a pull-strap seat-back release that lets you get in and out of the back seat using only one hand.

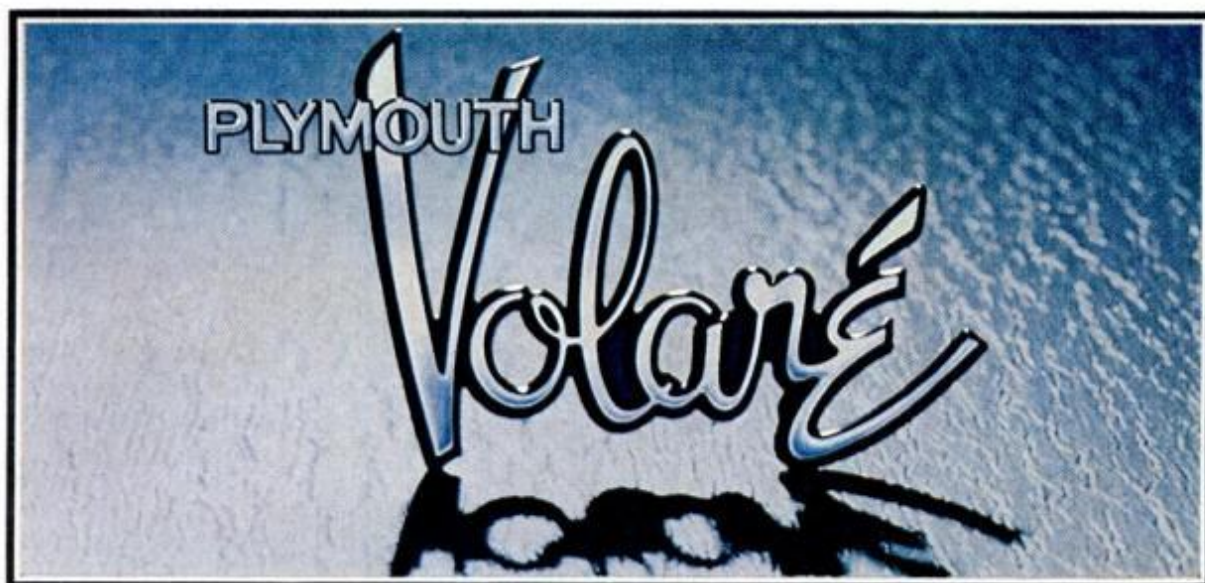
Plymouth Volaré and Dodge Aspen are designed to make it easier to see the road.

We evaluated the relationship between the driver, the steering wheel and the seat to put you in a comfortable position to see the road, and large windows and windshield make it even easier to see.

Aspen and Volaré achieved E.P.A. rated highway mileage of up to 30 m.p.g.

According to official E.P.A. estimated mileage results, Aspen and Volaré with Slant Six engines and manual transmissions got 30 on the highway and 18 in the city with their wagon models, and 27 on the highway and 18 in the city with their coupes and sedans.* We did this by designing the shape to reduce wind friction. Then we reduced weight to about a thousand pounds less than a full-size car. That all helps increase economy. Of course, your actual mileage may differ depending on your driving habits, the condition of your car and optional equipment.

*In California, see your dealer for E.P.A. mileage figures for California equipped cars.



were important in big cars a new kind of small car.

Plymouth Volaré and Dodge Aspen are covered by The Clincher.

This means that for the first 12 months of use, any Chrysler Motors Corporation dealer will fix, without charge for parts or labor, any part of your 1976 Dodge Aspen or Plymouth Volaré we supply (except tires) which proves defective in normal use, regardless of mileage. Of course, the owner is responsible for normal maintenance such as changing filters and wiper blades.

With three body styles, your choice is not restricted.

These new small cars are offered as a 2-door coupe, a 4-door sedan and a 4-door station wagon—in several versions. Our new-size wagon weighs up to 1,200 lbs. less than some bigger ones. That means you'll save gas and even though it's two feet shorter than a full-size wagon, you can carry 92% as much weight and up to 76% as much bulk. Compare what you can carry with competitive wagons.

SIZE	LENGTH OVER-ALL	TOTAL LOAD CAP.	CU.FT. CARGO SPACE	PAS-SENGGERS
FORD COUNTRY SQUIRE	18.8 ft.	1,200 lbs.	94.6	6
CHEVELLE WAGON	18.0 ft.	1,100 lbs.	85.1	6
OUR NEW WAGON	16.8 ft.	1,100 lbs.	71.9	6
PINTO WAGON	14.9 ft.	850 lbs.	57.2	4

They're even easy to service.

We included all of our electronic advances. That means you can forget about replacing points and condensers. And, under normal driving conditions, there is no recommended transmission maintenance.

We wanted you to be able to order the options you wanted.

Many small cars are limited in the number of convenience options you can add. Ours can take all the important ones. For example, air conditioning engineered to provide comfort levels comparable to larger cars, power seats, power windows, electric door locks, tilt steering wheel, 4-speaker stereo, sun roof, power steering, power disc brakes, 50,000-mile battery, Sure-Grip axle, 4-speed manual overdrive transmission.

The price may be the biggest surprise of all.

You will find it hard to believe that you can get so much car, so much value for such a low price.

We made two versions . . . with two names . . . Dodge Aspen and Plymouth Volaré.

Aspen at your Dodge dealer's. Volaré at your Chrysler-Plymouth dealer's. See them now.

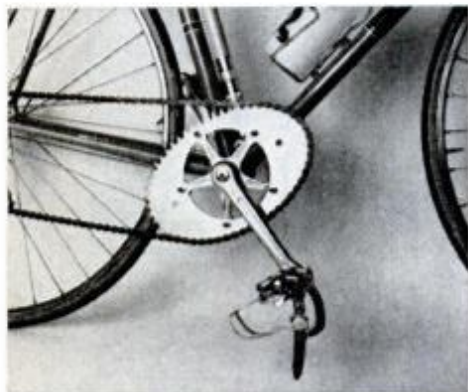




THE BICYCLE SHOP

GENE ANSWERS READERS THIS MONTH

Out of round



I have seen ads for an elliptical chainwheel. The idea seems attractive, but I hate to spend the money without advice. Any ideas?—Henry White, Manteno, Ill.

I have used an elliptical chainwheel and can report that it does indeed smooth out the pedal stroke. The elliptical sprocket flats out in speed at the top of the pedal position for more torque application. Racing and long-distance cyclists report faster rides and less fatigue and muscle soreness after long, hard rides. I found less tendency to stall on hills. You can order one for \$17.50 post-paid from the manufacturer, Durham Bicycles, 3944 Marathon St., Los Angeles, Calif. 90029. Be sure to give make and model of your current chainwheel set.

Avoiding dupe gears

I've noticed that whenever you talk about 15-speed bikes, you specifically recommend a freewheel with 14, 17, 22, 28 and 34 teeth. However, when it comes to chainwheels, you never give any specifics in terms of the number of teeth there. I'm planning to buy a triple-plateau chain set, preferably one with 30, 42 and 52 teeth. What do you think of this combina-

tion?—Restee Refuerzo, Baguio City, Philippines.

From the chart below, you will note I have indicated (with bold face type) several almost duplicate gears in the combination you mention. For example, the 14-42 gears give a gear number of 81, and the 17-52 pair a gear of 82.6. Since the 81 gear will, at 70-rpm pedal cadence, drive you at 16.87 mph and the 82.6 gear at 17.10 mph, this is almost a duplicated gear. Also, the 22-42 combination gives a gear of 51.5, and the 28-52 pair a gear of 50.1—same story. The chart shows an even worse situation with the 26 chainwheel, with 14-26 and 28-52 both giving the same 50.1 gear, and 17-26 and 34-52 both giving 41.3; so changing the 30 to a 26-tooth chainwheel obviously isn't the solution. You can have another too-close match if you go to a 54-tooth chainwheel. The answer is to use the 14, 17, 22, 28, 34-tooth freewheel with a 30, 42, 50-tooth chainwheel, avoiding really close duplications, as the chart shows.

For cold dogs

How do you beat cold feet in winter?—T. A'Hearn, Billings, Mont.

Up where you live, probably nothing will keep feet warm. In more moderate climates, as in the Midwest and New England, I recommend double-thick ski socks in one-size-large fleece-lined bike booties, the chukka style, available from bike stores that cater to racing cyclists. You could also use Polar Pals—plastic covers that strap to pedals. You can get them from your bike store or by mail from Eco-Cyclery, 8505 No. SR 48, Waynesville, Ohio 45068, for about \$2.50. Please note: If you use larger shoes, you may have to use a larger size toe-clip or shim out your clips with aluminum bar stock to maintain proper foot position on pedals. ★★★

If you have any questions about bicycling send them to The Bicycle Shop, 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.

REAR	FRONT*					
	26	30	42	50	52	54
14	50.1	57.9	81	96.4	100.3	102.2
17	41.3	47.6	66.7	79.4	82.6	85.8
22	31.9	36.8	51.5	61.4	63.8	66.3
28	25.1	28.9	40.5	48.2	50.1	52.1
34	20.6	23.8	33.4	39.7	41.3	42.9

*FOR 27-IN. WHEELS. GEAR NUMBER = $\frac{\text{FRONT}}{\text{REAR}} \times 27$
 EXAMPLE: $\frac{26}{14} \times 27 = 50.1$

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*U.S. Dept. of Labor Bulletin 1824

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LETTERS

TO THE EDITOR

Let Navy build GM cars

In *Detroit Listening Post* (page 50, Nov. '75) Robert Lund mentioned GM's "New Theory on Cause of Rust." Where has GM been?

When I was in the Navy in 1969, I took a training course in aviation mechanics. In it we learned about the reaction of dissimilar metals and called it "galvanic corrosion." It occurs when dissimilar metals are in contact and an external circuit is provided by the presence of moisture. Maybe GM should have the Navy build their cars.

STEPHEN J. PUGLISI
BROOKLYN, N.Y.

More on tabletop hockey

I am considering building the tabletop hockey game (*Build This Tabletop Hockey Game for Family Fun*, page 94, Nov. '75), but there is one detail that is not clear to me.

Author George Kaler mentions that he "selected a used Vent-a-Hood range exhaust fan with two 1/25-hp, 1550-rpm motors, each driving a 3 1/2 x 4 1/2-inch squirrel-cage blower." What is the C.F.M. rating on this arrangement?

B. MORGAN FULTON
ERLANGER, KY.

The blowers in the Vent-a-Hood range exhaust fan put out a total of 290 C.F.M., which enters the 2-inch plenum through a 4 3/8 x 7 1/4-inch opening.

Don't burn old oil

In *How to Set Up an Auto-Repair Cooperative* (page 30B, Nov. '75), you describe a possibly hazardous means of disposing of engine oil.

Burning engine drain oil in the home furnace may liberate quantities of metal particles into an already dismal atmosphere. The metal particles are from the engine that the now "dirty" oil lubricated.

Maybe the coop members have had no problems with their burners, but they are not helping us "breathers"!

PAUL G. KOUTNIK
DOWNERS GROVE, ILL.

Even though the man shown has been using old engine oil for something like 25 years, we doubt if we would do it. The metal particles are

more likely to settle at the bottom of the tank than go elsewhere, but there's always the chance of clogging the burner nozzles—or, as you point out, releasing metal particles into the air.

Tip for winter drivers

In reference to *10 Tips for the Road This Winter* (page 70, Nov. '75), this tip might help your readers.

Numerous times when I have gone to the trunk to get some sand for a helping hand, I found it frozen solid. I tried everything to keep it from freezing, but to no avail. I found something else that does a much better job.

I fill my old, dry antifreeze jugs or milk jugs with cat litter and keep them in the trunk or on the car floor. When I get stuck, I open the top and pour the cat litter where I want it. Since it's coarser than sand, it gives superb traction and never freezes.

KENNETH GOEBEN
PASADENA, MD.

Turn the chisel

Permit me to compliment you on your well-written article *Your Tools—One of the Best Investments You'll Ever Make* (page 104, Nov. '75). I agree with the wording, but the picture on page 107 killed the article entirely.

A craftsman never lays his chisels on the cutting edges. Chisels should always be laid flat with the bevel down (and planes should be on their sides). Reason for this is very obvious: You avoid nicking.

JAMES S. HICKEY
HOUSTON, TEX.

Yes, it's good practice to keep the cutting edge off the surface. We should have turned the chisel bevel side down.

About amateur auto painters

Having worked in a body shop for three years and having done a number of home car-painting jobs, I disagree with parts of your October '75 *Saturday Mechanic* (*How to Repaint Your Car Yourself*, page 58).

You stressed that one could come out dollars ahead by painting his car himself. Using prices in my area, my estimate for the materials you men-

tioned is \$75 to \$85. That takes into consideration the tools involved, which the ordinary person wouldn't have. Also, an inexperienced painter would get exactly what he paid for: runs, fisheyes and chicken tracks. More than likely, he'd end up chucking the whole deal, just to have someone else paint it and spend even more money.

The article was correct in its instructions, but every painter has to learn *how* to paint. It is a technique, not something that comes out great with the right ingredients.

GEORGE P. DICKERSON
GARY, IND.

But don't underestimate the skills of Popular Mechanics readers. With correct instructions at their disposal, they can do just about anything—and well.

How to keep firewood dry

Have you ever piled cordwood or split wood to dry outside? The photos in *How to Cut Firewood and Use a Fireplace* (page 60, Oct. '75) show split wood piled with the bark on the bottom. As a boy I learned to pile wood with the bark side on top because it then sheds water rather than absorbing it under the bark.

R. NORMAN LUNDBERG
POPLAR, WIS.

Gas mileage and big cars

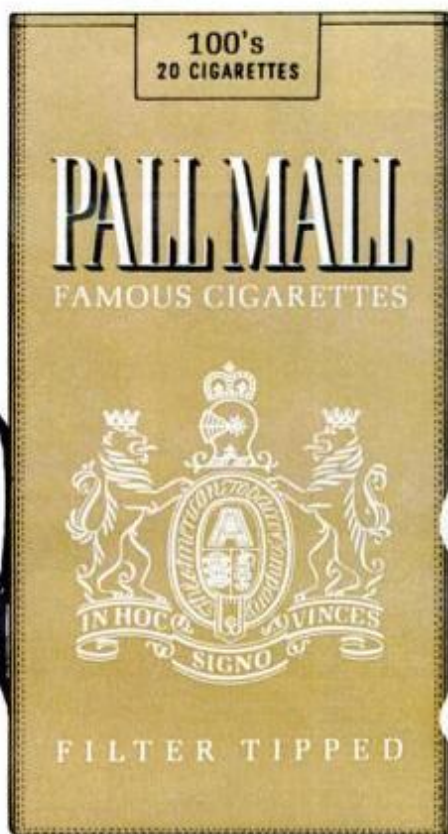
In 1956 and 1961 I bought full-size Dodge station wagons. Each was equipped with 318-c.i.d. engine and automatic transmission; neither had airconditioning. During that time Alaska had a 50-mph speed limit and each of those cars, carrying my family of six and camping gear, would consistently deliver 23 and 25 mpg. Some models in between and in later years had less attractive mileage.

Detroit can put out a full-size car with competitive mileage results compared to the smaller car class. Look what could be done on an intermediate size. I understand that the '75 models had most of the smog gear removed so mileage should be good. Why does Detroit refuse to give the public efficient engine operation that is available and proven?

PAUL W. ROHWER
ANCHORAGE, ALASKA

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ALL OUTDOORS

WITH BILL McKEOWN



Even the most avid outdoorsman spends some January days inside during bone-chilling weather. So now is a good time to look up or track down information on products and places you've been meaning to find out about and tricks and techniques you have wanted to try. Those special items of equipment you once admired are almost certain to be for sale somewhere. Here are sources for further research.

Mail-order catalogs listed in PM's display and classified ads are often free or may cost a dollar that's frequently refunded with your first order. From these you'll get a look at the latest in gear and usually good instruction on how to use it as well. The following are ones we have found useful.

For shooters

Try your local sporting goods or gun shop for useful recent digests, catalogs and directories like *Winchester-Western's Ball Powder Loading Data* guide for handloading of shotshells and rifle and pistol cartridges. The new *Handloader's Digest*, from Digest Books, covers both equipment and methods in well illustrated detail for \$7.95. The *Shooter's Bible Gun Trader's Guide*, \$3.95, gives a good basis for judging the value of your guns. Getting started in muzzle loading? Check *Lyman's Black Powder Handbook*. It's \$6.95 at gun shops or \$7.95 direct postpaid from Lyman, Middlefield, Conn. A pamphlet on *Federal Target Loads* is available free from Federal Cartridge dealers. Collectors can get the *Arco Gun Collector's Fact Book* in paperback for \$5.95, and contact Cherry's Sporting Goods, Geneseo, Ill., for antique and recent models.

For boatmen

Ever wonder what your used boat is worth, or how much a dealer is likely to allow on it? If you're willing to wonder \$30 worth, or can talk several boat club members into chipping in, you can order the *Used Boat Directory* from BCU International, Fort Lauderdale, Fla. In addition to covering 160,000 pleasure craft dating back as far as 1929, it also lists outboard motors from 1965.

New boating gadgets and gear?

Chris-Craft, Algonac, Mich., has a catalog that is a good source. For hardware and general fitting out and marine repair supplies, Defender Industries, New Rochelle, N.Y., provides a comprehensive catalog for \$1. Gifts and mementos of the sea may be selected from the catalog of Mystic Seaport, Mystic, Conn. And for an excellent reference afloat or ashore, covering everything from emergency procedures to regulations and seamanship, the \$4.95 *Boatman's Handbook* by Tom Bottomley is available from Motor Boating & Sailing Books, 224 West 57th St., New York, N.Y. 10019.

For RV owners

Tracking down trailer and camper equipment can be difficult; there are not yet many RV supply stores around and mail-order may be your best answer. Well-equipped outlets we can recommend include Fredson Trailer Supply, 815 North Harbor Blvd., Santa Ana, Calif.; Camping World, Beech Bend Road, Bowling Green, Ky.; Viking Camper Supply, 99 Glenwood Ave., Minneapolis, Minn.; and W & W Vacation Trailers, Highway 68, Haubstadt, Ind. All have catalogs for about \$1 and carry extensive stocks of those many accessories that seem so hard to find.

For fishermen

Anglers who don't have a chance to head south will find an admirable selection of new how-to-do-it books and pamphlets waiting for off-season study. What-to-use volumes include *Fishing With Natural Baits* by Vlad Evanoff, and *Bass Guide to Fishing Lures* for good coverage of how to choose and how to rig and use both live bait and artificials. For building your own, check through *Fiberglass Rod Making*, a Winchester Press book by Dale Clemens, with directions for designing, constructing and customizing your own. Then, once you've caught some trophy fish, consider the advantages of mounting your own. Don't wait to start with that trophy, though, advises W. E. Moore in his well-illustrated *Mount Your Own Fish Trophies*, from Doubleday. Instead, begin with some small species, follow the simple directions carefully, and your success

will show you what to do once you land that keeper lunger.

For assembling, or making, your own tackle and other sporting goods as well, invest \$1 for the extensive catalog from Herter's, Mitchell, S. Dak. Sports Liquidators, Sun Valley, Calif., and Cabela's, Sidney, Neb., are additional sources.

How to be the best fisherman around? Just become another A. J. McClane. His fishing encyclopedia is considered the standard in the field, and now we can find how he found out so much in an admirable collection of his writing edited by George Reiger, PM's former resident angling ace. The book, *Fishing with McClane*, covers 30 years and endless streams and ocean adventures. From Prentice-Hall, it's \$12.95, and after reading it all, if you could force yourself to part with it, the book would also make a handsome present for another fisherman.

Another gift possibility is a highly informative book from Bill Wisner, famed fisherman and fishing writer. Titled *How to Catch Salt-Water Fish*, this 584-page illustrated book gives you tips on tackle, baits, lures and techniques for catching 23 of the most popular Atlantic Coast sport fish from blues, blacks and flounder up through mackerel, pollack and striped bass and on to marlin, tuna and swordfish. Doubleday & Co. publishes the book which sells for \$8.95.

For campers and travelers

Outdoorsmen looking for general equipment catalogs and guides are in luck. We've found a wide assortment of good ones available. Pick almost any pastime or destination and there's likely to be companies offering what you need. The latest in clothing is carried by Recreational Equipment of Seattle; L.L. Bean in Freeport, Me.; Norm Thompson, Portland, Ore.; or Eddie Bauer in Seattle, Wash., just to name a few.

For finding new places to go, consult *Adventure Trip Guide*, \$4.50 postpaid from Adventure Guides, 36 East 57th St., New York, N.Y. 10022. *Hiking Trails in the Southern Mountains* and *Hiking Trails in the Midwest* give details for \$6.60 from Great Lakes Living Press, 435 North Michigan Ave., Chicago, Ill. 60611. ★★

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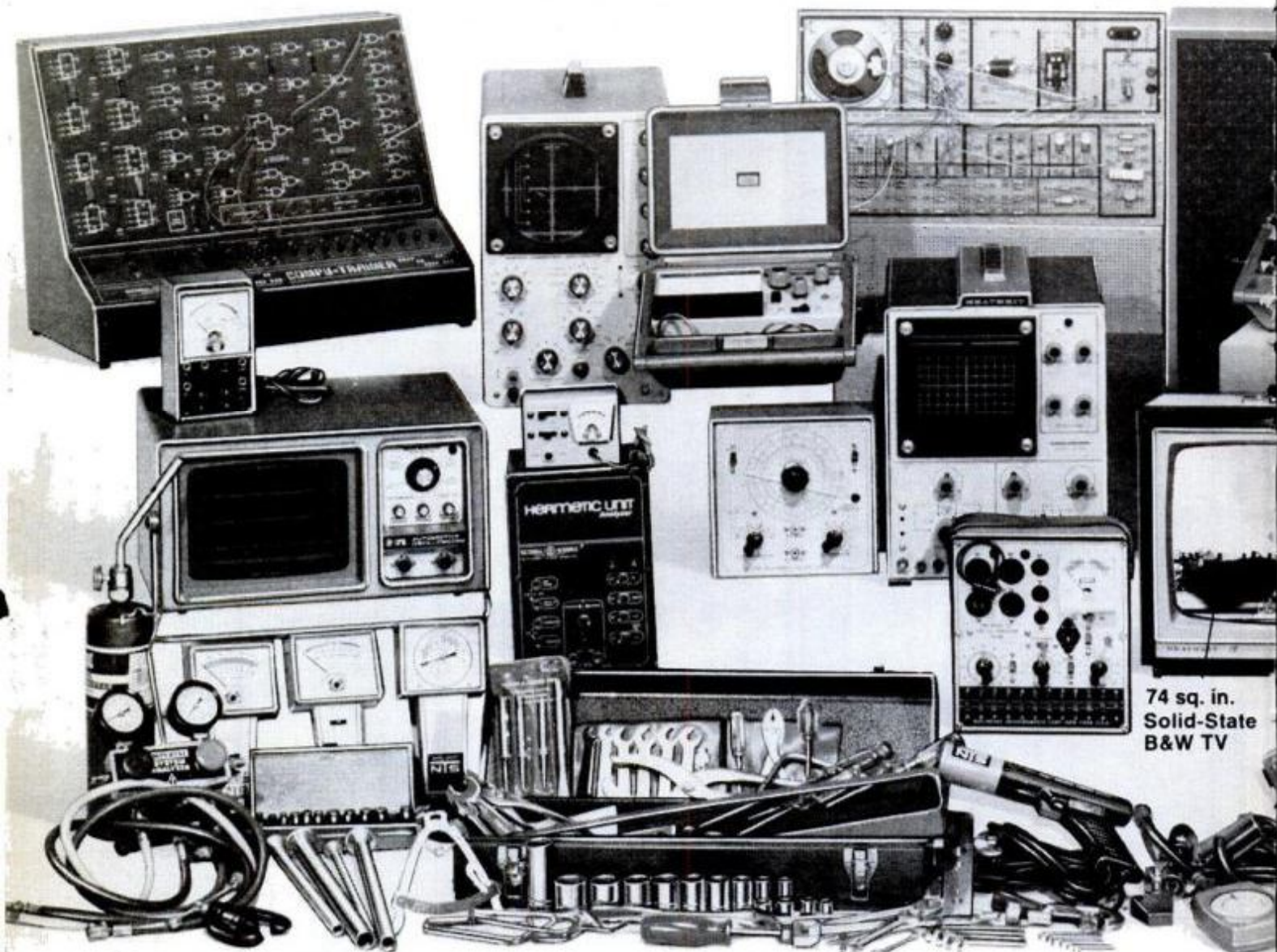
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CAR CLINIC

BY MORT SCHULTZ



Straight answers

Either I misunderstood the salesman or he gave me a bum steer, but I've been under the impression I must use nonleaded gasoline only in my 1974 Malibu Classic. Yet last time out I tried a tank of premium gas and determined that my highway mileage went from 13.8 miles per gallon to 14.5 miles per gallon. Disregarding the difference in cost, is it okay for me to use premium instead of nonleaded regular? Are there advantages?—J. Henry Burgess, Gloucester, Mass.

Yes, it's okay. But beginning with '75 cars, only nonleaded gasoline can be used. That's the law. However, I should warn you Chevy says leaded gas may shorten sparkplug life.

Tell me—what kind of sensitive fuel per mileage gauge did you use to make your test run, because only with such equipment is it possible to determine a difference of 7/10ths of a mile in test runs. But even if you are accurate, we'll say for argument's sake, a small difference can be accounted for by variations in road conditions and wind resistance between one test run and another.

Advantages in using premium in your car? I see none!

Me—man in the middle

I have a 1975 Chrysler New Yorker Brougham, driven about 5000 miles. Recently the car develops a clunk-type noise in both rear wheels whenever I go over bumps, up or down driveways, and when turning corners. I've taken the car to dealerships and finally lodged a complaint with the factory. In every instance I'm told that the condition is normal and nothing can be done. However, independent mechanics have told me that they feel the car is dangerous to drive, and that I should demand the dealership install a new rear axle. I feel Chrysler is stalling until my warranty runs out. I would appreciate your point of view.—Monte Kurtyka, Redford Township, Mo.

I do not think the condition is normal; neither do I think it is dangerous. I think Chrysler should remedy the condition, which may be caused by one of the following:

1. Loose spring shackles.

2. Bad shock absorbers—the dealer should install two new heavy-duty shocks in the rear.

3. If the car is equipped with a sure-grip differential, the noise could be caused by a damaged clutch assembly. A new one should be installed.

Never on time

I own a 1975 Plymouth Fury custom equipped with a 318-cu.-in. engine, which I bought new. I've had problems with ping from day one. It's been back to the dealer three times and to an independent mechanic once for a solution to the problem with no results. Timing has been checked and rechecked. Premium gasoline helps, but doesn't completely eliminate the ping. Any suggestions?—M.A. Roach, Lynchburg, Va.

I suspect the damper pulley has been stamped improperly with respect to timing marks. I've seen marks off by as much as 20°, so there's no way to get correct timing by setting ignition to specification.

I would therefore set the ignition in your car until the ping has been eliminated. Stamp in a chisel mark on the damper pulley in line with the index marker, and take this as your timing reference from now on.

Tanked up

I had to replace the fuel filter after driving my Ford Granada only 5000 miles because it clogged with dirt. The fuel tank was flushed. However, the filter plugged again at 8000 miles. Is it possible that my gas cap isn't sealing tight enough and dirt is being drawn in? My dealer says no.—Gene S. Bontrager, Kalona, Iowa.

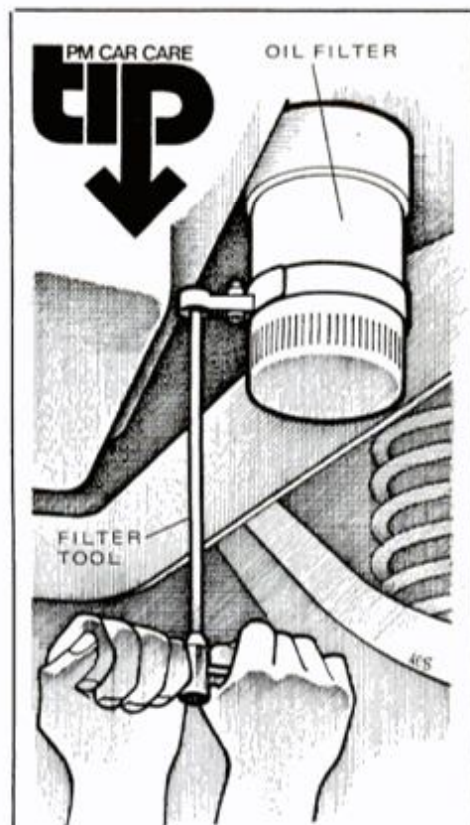
The dealer, I feel, is right. It's unlikely that the problem is being caused by an ill-fitting gas-tank cap. The solution, I feel, is to remove the fuel tank and blow out the fuel line all the way to the carburetor. When a fuel filter gets as badly clogged as you indicate yours is getting after relatively short mileage, flushing the gas tank is hardly likely to relieve the situation. Steam cleaning might do the job. If the dealer is willing to again drop the tank and replace it if steam cleaning doesn't work, let him. But I think that as long as the tank

has to be dropped to clean out the fuel line anyway, the tank might as well be replaced, so everyone can go away happy.

A better solution

Why does my 1974 Opel Manta 1900 with automatic transmission stall on acceleration after a stop or acceleration after coasting through a turn when the engine is warm and the weather is hot—never under "cold"?

(Please turn to page 24)



Hands only

Oil-filter tools are for loosening only—not tightening. When replacing your filter, strap the tool tightly around it and turn counterclockwise until the filter is free. Make sure the contact surface is clean of old gasket material and coat the gasket of the new filter with oil. Place the filter in position, taking care not to cross-thread, and *hand-tighten* the filter until the gasket meets the contact surface. Then, tighten the filter by *hand* only a half turn more. Tightening a filter with your wrench can result in distortion and an oil leak.



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CAR CLINIC

(Continued from page 22)

engine conditions? It doesn't stall at idle either. We've taken the air-conditioner out of the car, installed four new carburetors, and replaced the vacuum advance control. I'm ready to give up.—Dr. Russell S. Hill, Jr., Chesterfield, Mo.

Don't give up yet. Find a dealer who will use Opel Service bulletin 74-T-02, which explains how to set the carburetor correctly using a water-manometer and how to correctly set the accelerator pump linkage. I also think you should try a different brand of fuel. Some are more volatile than others and more apt to percolate.

Encountering resistance

What's the difference between resistor and nonresistor sparkplugs? What happens if you use resistor plugs in an engine calling for nonresistor plugs, or vice versa?—Gerald Cronin (address not given).

A resistor sparkplug has a resistor built into the center electrode near the firing tip that meters energy stored in the sparkplug. It was developed to eliminate static emissions caused by electric spark discharge. These emissions would cause radio, stereo and television frequency interference were it not for the presence of resistor elements.

An added advantage to resistor sparkplugs is the reduction of plug electrode erosion that the resistor provides. The AC Spark Plug Div. of General Motors tells us that resistor sparkplugs in an ignition system, "with or without other static suppression components, can increase electrode life 30 to 50 percent."

Practically all automobiles now in production use a form of resistance in the secondary circuit other than resistor sparkplugs. Other forms of resistance include a resistor in the rotor or distributor cap, or resistance-type sparkplug cables. Resistor sparkplugs are employed primarily in cars having two-way radios to provide the maximum in noise suppression. However, car owners who replace resistance-type sparkplug cables with metallic conductor cables for longer cable life frequently install resistor sparkplugs to obtain the necessary suppression.

You won't harm anything by installing resistor sparkplugs in an engine using another means of suppression, and you will get longer electrode life. However, you will pay about 40 cents more per plug. In a V8, then, you will pay approximately \$3.20 by switching from nonresistor to resistor sparkplugs.

Feeling the heat

Please indicate the temperature at which the cooling system of my 1970 Buick (350-cu.-in. engine) will boil over. No one knows.—Eugene P. Hagemann, Huntington, N.Y.

About 262° F.—assuming that everything is working properly.

You should be using a mixture of ethylene glycol in your radiator which protects the engine from freezing down to -20° F. (if more or less, change the numbers I'm about to give you accordingly). The boiling point of ethylene glycol (good quality) mixed thus is 224° F. However, the radiator pressure cap raises the boiling point of coolant 2.5° F. for every pound of pressure at which it's rated. Your car uses a 15-lb. cap. Therefore, the boiling point of coolant is raised by 38° F. Addition: 224° + 38° = 262° F.

Traffic 'jamitis'

I have a 1965 Chevrolet with a 283-cu.-in. V8 engine. Owners and service manuals tell me to use a 180° thermostat. I do a great deal of city driving in the summer and often get caught in traffic where coolant bubbles and boils away. The cooling system is clean and unobstructed. Should I switch to a 160° thermostat?—Charles W. Maynard, Carteret, N.J.

Switching to a 160° thermostat won't solve anything. The purpose of a thermostat is to let an engine warm to operational temperature as fast as possible by keeping coolant in the engine where it benefits from engine heat. Once this temperature is reached, the thermostat valve opens and coolant is free to flow through the radiator where it dissipates excess heat. Thus, engine temperature remains relatively constant unless an extraordinary operational condition, such as a city traffic jam, causes a temperature increase.

For those who drive often in heavy city traffic and have a problem, I suggest installing a coolant recovery system. This will cost about \$15, but it's worth the money. You'll make up the cost in coolant saved.

Rather than having coolant boil over and out through the overflow tube onto the pavement, it will flow into a plastic tank where it will be stored until the hot engine condition subsides. You can purchase a coolant recovery system from a dealer of automotive supplies and install it yourself. It's a simple job.

SERVICE TIPS

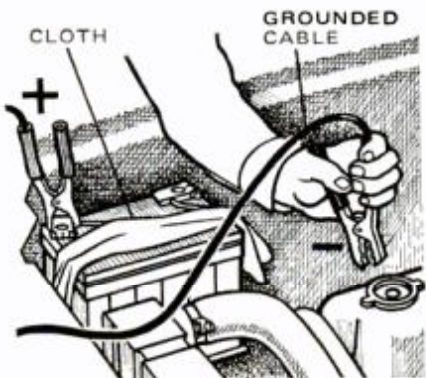
■ Ford Motor Co. has issued the following repair for '75 models that won't start in wet or high-humidity conditions: Wipe moisture and dirt from exposed areas of

the distributor cap and coil tower without disturbing wires. Replace damaged wires and attempt to start the engine. If the engine won't start, remove the distributor-to-coil high-tension cable and wipe out the coil tower and center tower of the distributor. Wipe off the cable. Now, apply Dow 4X or General Electric G-624 silicone grease to the outer surface of the coil tower and center tower of the distributor. Reinstall the cable firmly in both towers. If this doesn't work, replace the coil-to-distributor high-tension cable. The problem is being caused by the cable's boots not sealing tightly.

■ Is your 1974 or '75 Dodge Colt 2000-cc engine knocking slightly when started? The trouble may be caused by slack in the timing-chain tension damper, especially if the noise diminishes after a few seconds of engine operation. There's a new tension damper available—part No. MD-021227. Ask your dealer to consult service bulletin 09-10-75 for authorization. ★★

Jump right

Incorrect use of jumper cables and booster battery can damage the electrical system and cause personal injury. Now's a good time, at the start of real cold weather, to review the five-step proper procedure: 1. If boosting a battery in another car, make sure the two cars are not touching. 2. See that everything which runs on electricity is off, set parking brakes and place automobile transmissions in Park and manual transmissions in Neutral. 3. Remove vent caps from both batteries and cover vent holes with a cloth. 4. With engine off, connect one end of a jumper to the positive terminal of the weak battery, and then the other end of the same cable to the positive terminal of the booster battery. 5. Connect the other jumper to the negative terminal of the booster battery and then to a ground, such as the engine block, on the disabled car. Start the engine of the car possessing the booster battery and turn on the disabled car's ignition. When the disabled car starts, reverse procedure to disconnect jumpers. And no smoking or any other spark or flame!



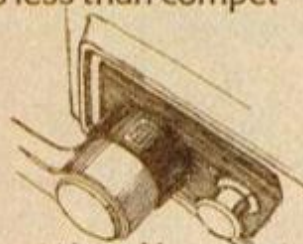
This is living.



This is Chrysler's 135: More power per pound!



Bring our 135 into your life and you can really live it up. With just about the most powerful outboard you could want. A hair-trigger performer with the action to accelerate with a competitive 150 (with comparable props) from a standing start, as shown in our 1975 test data. Yet it has the lightest weight per horsepower of any comparable 4-cylinder outboard—actually weighs less than competitive 115's. It comes with advanced features like high compression, race-style crankcase, specially calibrated carbs and exclusive fuel-saver throttle. You get Magnapower C-D ignition for instant starts, satin-smooth performance from idle to full throttle. And it's clean and uncluttered under the hood to make service and maintenance a cinch. Check the Yellow Pages for your Chrysler outboard dealer. And start living!



This is Chrysler's 75: More punch per piston!



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PHOTO HINTS

FROM READERS

Tobacco pouches for accessories



Organize those small, loose accessories that get lost at the bottom of your gadget bag: just slip them into tobacco pouches. But don't use old pouches. They're likely to be just too dirty.—*Kenn Oberrecht, Coos Bay, Ore.*

Pencil eraser marks slides



A pencil eraser makes a handy rubber stamp for imprinting position spots on color-slide mounts. Just press the eraser on an ink pad then on the appropriate corner of the slide. Worn erasers make smaller spots, new erasers make larger ones.—*Walter E. Burton, Akron, Ohio*

Memory aid for double exposures



If you're shooting deliberate double exposures with a 2 1/4 x 2 1/4 reflex, mark the layout of the first shot on a 2 1/4-inch square of transparent acetate—it will make composing the second shot easier.—*John Koncewicz, New Britain, Conn.*



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HOMEOWNERS' CLINIC



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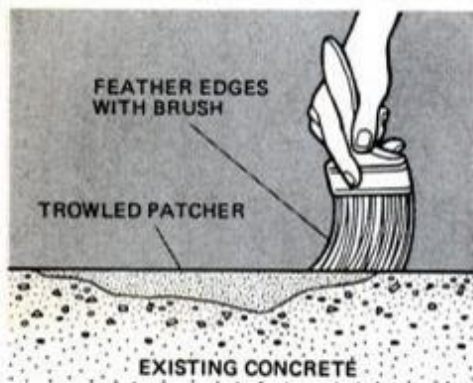
When my home was built, 4 in. of insulation was poured between the attic floor joists. I have access to Styrofoam sheets used as packing. Could I use these between joists, or would it be better to add blow-in insulation, and how much more?—Royce Watson, Bryan, Tex.

I would add, say, 3 in. of poured insulation for a total depth of about 7 in. In time, this should return its cost in fuel savings. Be leery about using the styrene foam sheets. Styrene insulation is used in home construction but the variety used for packing may not have the fire-retardant qualities or insulating rating that you need. Be sure you know what you have before you use it.

Feathering patcher

I've always had trouble troweling a concrete patcher when making a shallow patch. I can never get it quite flush, smooth and neat. How is this done?—J. Erickson, Moline, Ill.

Ordinarily, you don't trowel a patch when edges require shallow



filling. Instead, smooth and level these edges with a brush as indicated. Use an old paintbrush or the coarser-bristle kind for masonry paint. Cover such a patch with coarse fabric and keep it damp for several days while the patching cures.

Condensate on floor

The floor in my basement recreation room is tiled and walls are paneled. The poured-concrete foundation forms two walls of the room. The floor is drawing water along these walls. How do I stop this leak without taking up the tiles along the

baseboard?—Robert Ash, Cleveland.

"Drawing water" is an unfortunate term—it does not describe what is happening. Water you see along the baseboard is condensate that will form on any surface at a lower temperature than the room air. Usually, improved ventilation is the cheapest cure; screen the basement windows and open them on cool days to let cooler, dryer air circulate freely. If there are no windows, use an automatic dehumidifier to lower moisture level of the air.

Warped paneling

I've installed paneling over the poured-concrete foundation in my basement, gluing the furring strips to the walls without insulation as there was no seepage or dampness. Now the paneling is warped and furring has loosened in several places. Would small vents at the floor and ceiling correct the trouble?—Frank Larson, West Point, N.Y.

Warping and loosening seem too far advanced. The vents might be a temporary, emergency remedy, but ultimately you will have to replace both paneling and furring, installing foil-faced insulating blankets (with the foil facing out, not in) between the furring strips.

Changing laminate color

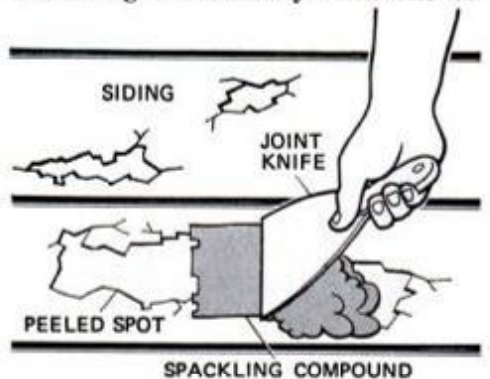
Is it possible or practical to change the color of plastic laminate to a lighter shade by painting? The present color is a gold which seems rather dark and unattractive.—Mrs. F. T. Bruce, Arcade, N.Y.

Paints do not bond readily to smooth, hard laminate surfaces, and no air-drying finish can match the durability of the laminate itself. You could try roughening the surface with a medium-coarse steel wool to provide a "tooth" for paint, but don't be surprised if the coating doesn't hold up well.

Filling blisters

Paint has blistered and peeled in several small areas on wide siding, leaving ugly spots that show shadow lines in sunlight. Is there any practical way to conceal these defects?—Edwin True, Detroit.

I have concealed such defects successfully with spackling compound. Brush away any dust, then force the compound into place with a wide putty knife or joint knife, smoothing and flattening it. Let this dry thoroughly and then sand it flush. Protect the filling immediately with one or



two coats of paint. I recommend this procedure only where there are relatively few defects. It is no substitute for a new paint job.

Below-grade tile

I plan to retila a 14x30-ft. basement room where there is humidity and foundation moisture. After old tile is removed and adhesive scraped away, should I wash the floor with a cleaner such as trisodium phosphate for better adhesion? The old tile is asbestos and I intend to replace it with vinyl.—Bud Haak, West St. Paul, Minn.

I favor asphalt tile for installation on concrete floors below grade. It wears well and is less subject to harm caused by the moisture conditions found in most basements. But I know of asbestos-tiled basement floors—including one that has been flooded twice—that are 25 years old and still in good condition. In any case, you'll need to clean the floor thoroughly to remove all cement residues, dust and dirt before laying new tile. It must also be dry before you lay tile. ★★

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, \$4.49 postpaid. Send orders to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.

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APPLIANCE CLINIC

BY PAUL MANN



For openers

My General Electric Deluxe Toast-R-Oven is burning my toast and me to a crisp. I have to sit, watch and manually operate the thing, because the door won't open automatically. What's wrong?—A. J. Borg, Elmira, N.Y.

A defective solenoid, a defective switch or a defective mechanical spring coil. The solenoid works like a thermostat. It monitors heat, shuts down at a preset point and allows the door to open. If the solenoid is bad, the door stays shut. The switch activates the solenoid, so if it's bad, the solenoid won't work. The spring coil actually opens the door; if it's binding or stuck, the door may not open.

Whatever the origin of the problem, you should be able to make the repair at home, but you will need a schematic, instructions and parts for your model—GE has been making Toast-R-Ovens for about 10 years, and models do differ. Get the catalog number of your unit from the bottom of the crumb tray and send it to Frank Frumento, Service Center Manager, GE, 7100 Airport Highway, Pennsauken, N.J. 08101, with a note reminding him of this discussion. Frank told me he would send you a schematic and step-by-step repair instructions. After troubleshooting, you can write him again to let him know which parts you need.

Steady problem

The blades of our electric knife won't hold steady. They come loose while carving. They don't come out of their socket, but they are sloppy.

Would new blades help?—Thomas W. Peery, Waverly, Ohio.

The answer to your question depends on where the sloppiness is occurring. Look in two places. First, at the tip of the blade. As shown in the illustration, one blade has a small metal rivet that locks into a slot in the other. This rivet can wear down and become oblong in shape, causing blades to exhibit sloppiness instead of holding firm when moving. If that rivet looks oblong, the problem can be solved by replacing the blades.

If the blade lock is okay, check the blade holder or rocker arm inside the case. This part is usually plastic and can wear; blades then will not lock positively or at all. The part is easily replaced—the problem in getting a new one depends on the age of your knife. Consult a dealer who represents the manufacturer, or check your local directory for a small-appliance parts dealer.

Scour skipper

I have a Whirlpool dishwasher that has the Super Scour cycle which heats water in the first wash and final rinse while circulating the water. Is there any way to adjust the machine so the pump motor won't run until the water reaches its maximum heat?—R. Pierce, DuBois, Pa.

You're putting me on—either that or you haven't read the instruction manual that came with the dishwasher. The Super Scour cycle has a definite purpose—it's for pots and pans that need strong scouring to get rid of heavy deposits; prolonged water circulation accomplishes this.

If you don't want the Super Scour

cycle, you don't have to use it. Simply use the Super Wash cycle—this achieves the same result you would get by doing what you asked, and with *much* less trouble.

Plugging away

I own a Hotpoint clothes washer about 9 years old. It works fine except that the transmission leaks fluid. The company serviceman told me that when all fluid is gone, so is the washer. Why can't a person drill a hole in the transmission case, refill the transmission with fluid, and plug the hole?—Harold E. Roberts, Sylmar, Calif.

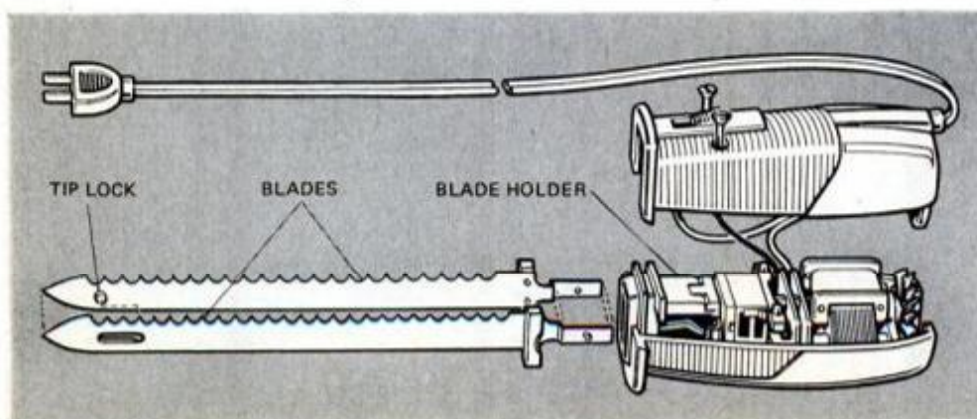
According to General Electric, there's a threaded plug in the top of the transmission case that can be unscrewed so the transmission can be refilled. But two difficulties arise: First, pulling the transmission from the machine so you can get to the threaded plug—this is a big job. Second, getting the fluid, which is a special 90-weight transmission oil—get in touch with the GE and Hotpoint Regional Parts Center in Burlingame, Calif., to find where to buy it in your area.

Sooner or later, you'll reach a point of no return with your washer. Leakage will get to the point where fluid is coming out as fast as you can pour it in, and you'll find that taking a couple of hours to pull the transmission for each refill isn't worth the effort. You then have two options: having the transmission overhauled and new seals installed for about \$150 (the figure I was quoted here on the East Coast), or buying a new washer.

Where's Waring?

Could you tell me the address of the maker of the Waring blender?—Charles G. Babian, Athens, Tenn.

Sure—Waring Products Div., Dynamics Corp. of America, New Hartford, Conn. 06057. ★★★



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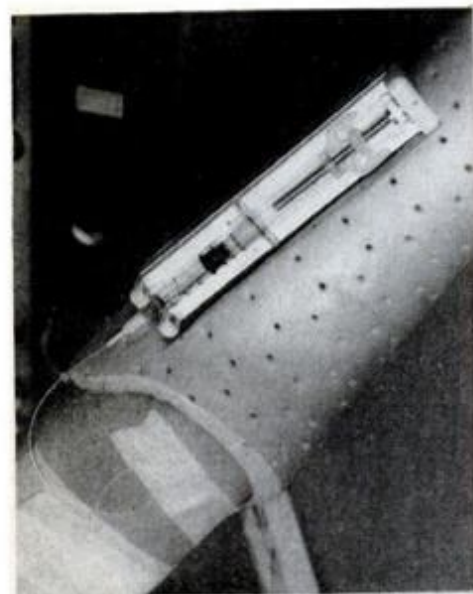
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SCIENCE WORLDWIDE



Motorized syringe

Certain medical conditions require large doses of drugs to be given intravenously. A mechanical pump or "drip" setup is used at bedside, causing the patient to remain immobile for long periods of time. Yet physicians think it's better for most patients to remain mobile.

Now British researchers claim to have solved the problem with the invention of a portable motor-driven syringe. A small battery-run motor is linked to a rod that pushes the syringe plunger. A timer controls the rate at which the syringe is emptied. Instead of the usual needle, pliable tubing connects the syringe with the patient's vein. The entire unit is strapped to the forearm so the patient can carry on normal activities while receiving the drug.

Land sinking in some states

Land subsidence—sinking of the land surface—occurring in parts of the nation could become more prevalent in the future, according to the U.S. Geological Survey. One USGS report, prepared with the California Department of Water Resources, notes that at least 4300 square miles of the San Joaquin Valley in California has subsided more than a foot since the 1920s.

Another report discloses that an area near Houston has subsided more than eight feet since 1920 and could

sink three more feet by 1980. Similar problems have developed in Louisiana, Arizona and Nevada. Most are caused by large withdrawals of ground water and petroleum, say USGS scientists. Though sunken land can never be raised to its former level, subsidence can be slowed and even stopped by recharging the ground with surface water.

Shock absorbers for skyscraper

The 60-story John Hancock Building in downtown Boston, due for completion in 1971, may finally welcome its first occupants this year. The delay was created by wind sway. In 1972 windows began to pop out; eventually all 10,344 were replaced. The framework was also beefed up with extra steel.

Now two huge shock absorbers, similar in principle to those on cars, are expected to dampen the effect when strong winds hit the building. Each will have a damper made up of a big steel box filled with lead that slides on a 30-foot steel plate. The damper will be connected to stiff springs anchored to structural columns on the 59th floor. Big hydraulic cylinders, also part of the system, will help to absorb motion. The two shock absorbers will cost about \$3 million.

Fats good for muscles

Fats create more weight for your muscles to move around, but some fats are vital to the health of muscles, says Dr. Charles D. Tweedle, a zoologist at Michigan State University. Normally, each fiber within a muscle—and there can be thousands of fibers in a large muscle—is connected to a single nerve cell. If that connection is broken because of injury or disease, the muscle fiber slowly withers and dies.

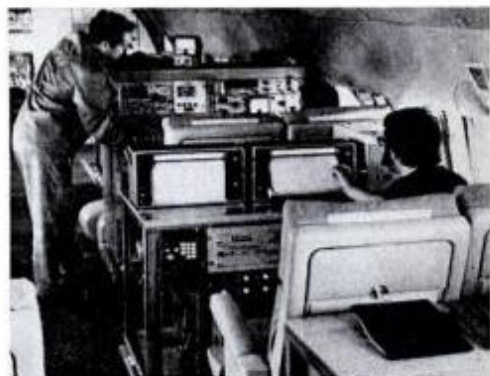
The connection can be reestablished, however, by a fatty compound discovered by Dr. Tweedle. The compound is released by nerveless muscle fibers and acts as a distress signal, which in turn is answered by nerve cells connected to undamaged, adjacent muscle fibers. "The nerve cells sprout threadlike branches, which eventually connect to the muscle fiber

sending the message," explains Dr. Tweedle. Once the new nerve connection is made, the muscle fiber works again, returning the muscle to almost normal strength.

Sniffing for gas with radar

Airborne radar that's already been used to discover valuable resources outside the United States is now at work searching for hidden pockets of natural gas in Virginia, West Virginia, Ohio and Kentucky. Carried aboard a jet at 40,000 feet, the side-looking radar cuts through clouds and weather as it "views" terrain from an angle. Electronically processed, the return signals are used to form a maplike image (see below) far superior to a conventional photo in revealing faults and other earth formations.

The other photo shows radar gear aboard the jet used by Litton Industries' Aero Service Div., which is making the four-state survey. De-



veloped by the Goodyear Aerospace Corp., the radar system has been used to map huge areas in South America. One set of maps led geologists to the discovery of a major iron-ore deposit in Venezuela. ★★★

YOU DON'T HAVE TO WIND UP AN EVINRUDE 200 TO MAKE IT GO.

Some people were surprised when we announced a new 200 horsepower V-6 instead of some lesser horsepower number. Until they found out why.

The why is simply that we saw the need for an outboard big enough and strong enough to deliver a high level of performance at economical cruise throttle; avoiding the penalty of sustained full throttle operation.

When the Evinrude 200 is run at cruising speed (a few mph below top speed), it uses up to 45% less fuel than when being run wide open. When throttled all the way down to the equivalent of 135 hp, it compares in fuel economy to a 135 running full out. And you still have 200 horsepower performance in reserve.



At cruise throttle the engine is running easy, even though it may be running stronger than any outboard has ever run before. It runs smoother and quieter, and lasts longer.

With 2.4 liters of displacement (149.4 cu. in.), the 200 can be broad-tuned for the full operating range. There's no need to go for broke at the top end.

The Evinrude 200 develops high torque in the critical planing range where offshore boats running in offshore seas need all the throttle response they can get.

It cruises efficiently faster than most motors can run.

You don't have to wind it up to make it go.



EVINRUDE
DIVISION OF OUTBOARD MARINE CORP.
first in outboards

If you can use any of these tools...

You can gain exciting new skills as an electronics troubleshooter in Bell & Howell Schools' fascinating learn-at-home program that includes building and experimenting with the new generation color TV.

Simulated TV test pattern



You may already have some of the skills you need.

Most of us at one time or another have put a screwdriver, a pair of pliers or some other basic tool to work. Fixing a bicycle wheel, tightening a window latch, putting up a bookshelf, or what have you.

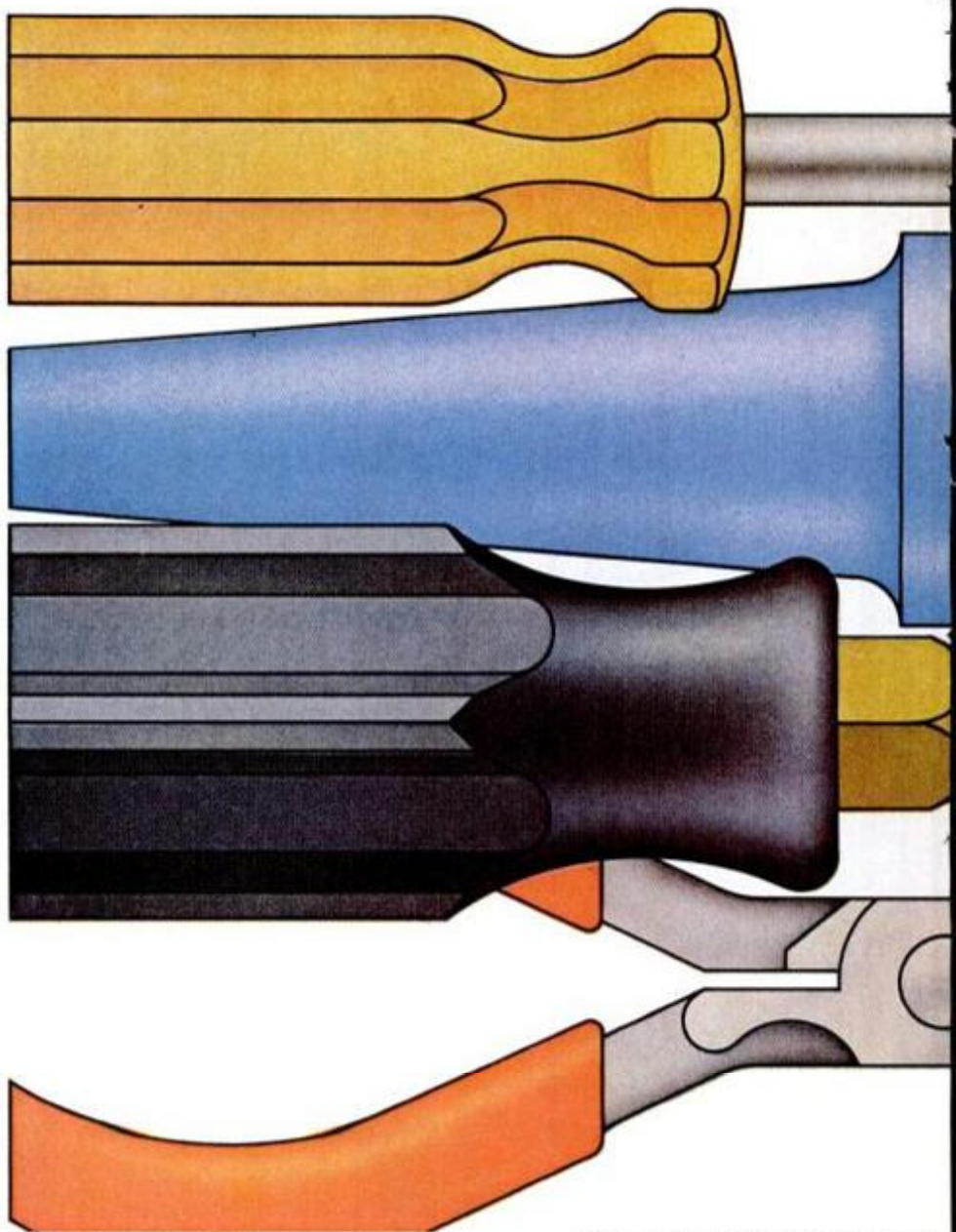
But here's a thought.

Using these same simple tools as a starting point, you can develop the ability to put them to work for you in far more ways than you ever dreamed of. And Bell & Howell Schools' fascinating home learning adventure in electronics will show you how.

These days when it seems like there's an "electronic everything," it makes good sense to have occupational skills in the servicing and repair of such products as TV's and other home electronic equipment. Bell & Howell Schools is ready to help you develop the specialized abilities you need to become an electronics troubleshooter. While no assurance of income or employment can be offered, we try to assure you that no better-at-home training in electronics is available anywhere.

We have an exciting way for you to pick up these specialized skills in your spare time.

Don't think for a moment that we want you to spend your off-hours just reading a bunch of "how-to" books. That would bore anyone after awhile. What we at Bell & Howell Schools offer is the modern way to learn... a very different approach from the way you've been used to.



First of all, we believe that when you're exploring a field as fascinating as electronics, reading about it is just not enough. That's why throughout this learning adventure you'll get lots of "hands on" experience with some of the latest electronic training tools available today. You'll test and experiment with them and gain exciting new skills all along the way.

While no assurance of income opportunity can be offered, once you've completed this program a number of directions are open to you.

1. Use your training to seek out a job in the electronics industry.
2. Use your training to upgrade your current job.
3. Use your training as a foundation for advanced programs in electronics.

No electronics background necessary.

That's one of the many attractions of this program. We start you off with the basics and help you work your way up one step at a time. As a matter of fact, with your very first lesson you receive a special Lab Starter Kit to give you immediate working experience on equipment as you are picking up the fundamentals.

It makes the learning process faster and certainly a lot more interesting.

You'll build and perform exciting experiments with Bell & Howell's Electro-Lab® electronics training system.

You build this Electro-Lab® system step-by-step, too. First, the design console. After you assemble it, you'll be able to set up and examine circuits without having to solder them in place.

Next, you'll enjoy building a digital multimeter. This important instrument measures voltage, current and resistance and displays its findings in big, clear numbers like on a digital clock. Far easier to read than "needle pointer" meters.

Then comes the solid-state "triggered sweep" oscilloscope which is similar in principle to the kind used in hospital operating rooms to monitor heartbeats. You'll use it to analyze tiny integrated circuits. The "triggered sweep" feature locks in signals for easier observation.

You'll actually build and work with Bell & Howell's new generation color TV... investigating features you've probably never seen before!

This 25" diagonal color TV has digital features that are likely to appear on all TV's of the future. Features made possible by the applications of digital electronics

to home entertainment.

You'll probe into the technology behind all-electronic tuning and into the digital circuitry of channel numbers that appear big and clear, right on the screen!

You'll also build-in a remarkable on-the-screen digital clock, that will flash the time in hours, minutes and seconds. Your new skills will also enable you to program a special automatic channel selector to skip over "dead," channels and go directly to preselected channels.

You'll also gain a better understanding of the exceptional color clarity of the Black Matrix picture tube, as well as a working knowledge of "state-of-the-art" integrated circuitry and the 100% solid-state chassis.

Having actually built and experimented with this TV, you'll come away equipped with the kinds of skills that could put you ahead of the field in electronics know-how.

We try to give more personal attention than other learn-at-home programs.

1. Toll-free phone-in assistance. The program is designed so that you can proceed through it smoothly, step-by-step. However, should you ever run into a rough spot, we'll be there to help. Many schools make you mail in all your questions. We have a toll-free line you can call when you have a question that can't wait.
2. In-person "help sessions." These are held in 50 major cities at various times throughout the year where you can talk shop with your instructors and fellow students.

Why wait?

Find out more on how you can pick up new skills in electronics troubleshooting as you work with Bell & Howell's new generation color TV. You've got the tools to do it!

Mail the postage-paid card today for full details!

Taken for vocational purposes, this program is approved by the state approval agency for Veterans' Benefits.

If card has been removed, please write to:

An Electronics Home Study School
DeVRY INSTITUTE OF TECHNOLOGY

ONE OF THE
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4141 Belmont, Chicago, Illinois 60641

698R4



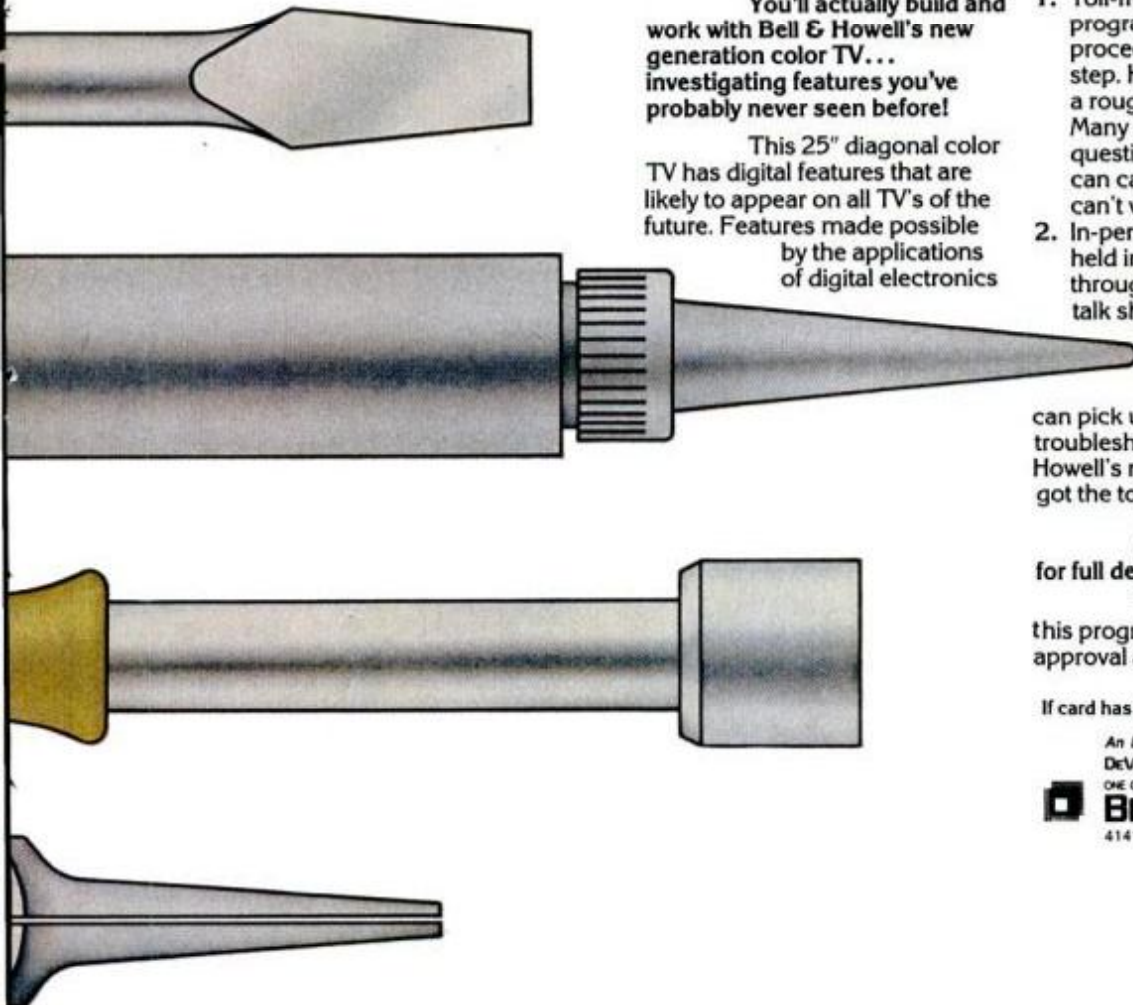
Channel numbers that flash on the screen



On-screen digital clock



Automatic pre-set channel selector



Your menthol
letting you down?

Come up to the consistently
smooth taste of extra coolness.
The taste that only KOOL has.

Come up to KOOL.



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

DETROIT LISTENING POST



GM to divvy up sub-Chevette

GM sources now say four GM divisions will get a crack at the smaller-than-Chevette car coming in 1979. Chevette is still favored to get a one-year jump on the other divisions in selling the car. But Buick, Olds and Pontiac will have copies no later than the second year, if that long.

Although the car will be smaller than Chevette by at least six inches (Chevette has a wheelbase of 94 inches), it may not be GM's lowest-price car. Chevette may retain that claim, because even though the new car will be smaller, it will be a more luxurious package. But trying to peg the price of the car this far in advance is just plain guessing. Nobody really knows what the new cars will be selling for three or four years from now.

Chrysler tags mini a '78

Chrysler dealers who chide company execs for not having a subcompact to sell against competing cars are told they will have a small car in 1978. But Chrysler doesn't specify whether that's the '78 calendar year or the model year beginning in fall of 1977. The company would like to make it by the earlier date, but doesn't want to commit itself and then not be able to deliver.

GM, VW, Ford hot on diesel

GM has now confirmed it is working on a light-duty diesel for a passenger car, as PM reported in October. It will be a 280-cu.-in. Eight. (For a complete report on diesels, see page 60.) GM says the engine in its present state of development can't meet pollution-control standards for 1978. Even so, the company has bids out for tooling to produce the engine. Oldsmobile has the assignment to do the development work and is expected to turn out job one—engine No. 1, not a car you will be able to buy—by late 1977.

GM is contemplating a fairly expensive car, say around \$10,000 to \$12,000, that will give it an opportunity to build up experience with the diesel. Experience in producing it and experience with diesels in the hands of owners. Along with the

Eight, GM is testing four and six-cylinder diesels.

GM isn't the only automaker with high hopes for the diesel. Volkswagen discloses it is working on a dieselized version of its 1.6-liter Four. In trial runs at the Environmental Protection Agency lab at Ann Arbor, Mich., the VW diesel scored 50 miles to the gallon!

Ford is also cranking up a diesel development program. It's doing the work in Europe.

Tracking the turbine

While GM was confirming production of a diesel, Chrysler nailed down an item in last month's DLP on the turbine. We said the turbine is a good bet for 1980-81. George Huebner Jr., former director of research for Chrysler, says the engine possibly may be ready in three to four years. Huebner, who retired from Chrysler a few months ago, is the father of the turbine in this country. He has worked on the engine for 30 years.

The turbine that Chrysler has now, Huebner says, will have the fuel economy of a Six combined with the power and performance of an Eight. When Huebner says Chrysler will have a turbine in three to four years, he's talking experimental cars. I still think it will be in the 1980s before the company offers a turbine you can drive home.

No fat boy label for Ford

Ford has put itself on a crash program to remove as much weight as possible from its full-size cars in 1977 without benefit of new bodies or any appreciable change in overall size. It's not just coincidence that's the year GM will bring out a new line of full-size cars. The GM products will be 500 to 700 pounds lighter than comparable '76s. Ford says it isn't going to be caught napping if there's a fat boy contest.

Meanwhile, GM has asked Pontiac to work up a Phoenix II car. Phoenix, a two-door Ventura, is GM's lab-on-wheels for reducing weight. On the first version of the car, Pontiac trimmed off 700 pounds through use of lighter materials. Pontiac doesn't expect to equal that on Phoenix II,

but it could lop off another 300 to 400 pounds.

Speaking of GM's full-size cars, a company staff man who has seen the '77 products says they have virtually no grille. The hood slopes down to a narrow opening, giving the cars a very light look in front.

GM automatic a winner

Chevette is getting all the attention, but it's not the only winner GM has come up with this year. The company has another hit on its hands in the three-speed automatic transmission that's offered as an option on Chevette.

Dubbed the Turbo Hydramatic 200, it's the most compact, lightest unit GM has ever offered. Every GM car division except Cadillac is asking for dibs on the 200. Buick and Olds are even interested to the extent that they want to try the unit in their big cars. American Motors would also like to buy the 200 for use in its small cars.

Radial-tire claims punctured

Carmakers are having some second thoughts about radial tires, but not from a durability standpoint. Radials outlast bias-belted and bias-ply tires by 25 percent—40,000 miles with a set of radials versus 25,000 to 30,000 with bias tires. But that's not such a bargain when you figure radials cost 35 to 40 percent more than regular tires. The car companies are disappointed with radials because they have turned out to be not as puncture proof as the tire companies led Detroit to believe.

One tire engineer I talked with at Ford told me it has been his experience that the steel cord used in the radials acts to channel objects into the tire, instead of diverting objects away and preventing punctures. He said that radials are neither worse nor better than the bias-ply, bias-belted tires in this respect. "If you're going to get a flat, you're just as likely to get it with a radial as with a nonradial. The radial is still the best tire for most cars, but it's far from being the supertire it's supposed to be." ★★

If you can use a screwdriver you can create a classic family heirloom to enrich your home

HENTSCHEL Grandfather Clocks brings you its famous quality and craftsmanship in this unique **Pre-Cut Kit**.

Step-by-simple-step, you build your own beautiful, enduring Grandfather Clock designed to last for generations.

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No wonder families cherish these enduring timepieces from generation to generation. Fine homes everywhere echo their deep, mellow chimes. Collectors prize them more and more with the years.

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You may find it hard to believe that you can create such an heirloom yourself. But now it's made possible—easy—by the finest clock kit you can buy: the **HENTSCHEL Grandfather Clock Kit**.

This unique Kit took us years to develop. It had to have the same quality and craftsmanship **HENTSCHEL** has been perfecting since 1890. With no production shortcuts... no compromises in material. Yet it had to be quickly and easily assembled by almost anybody. A tall order; but our new Kit fills it.

The Finest Material—from Solid 3/4" Walnut to Polished Brass.

You'll find only one kind of hardwood in your **HENTSCHEL Kit**: kiln-dried, 3/4" solid walnut.

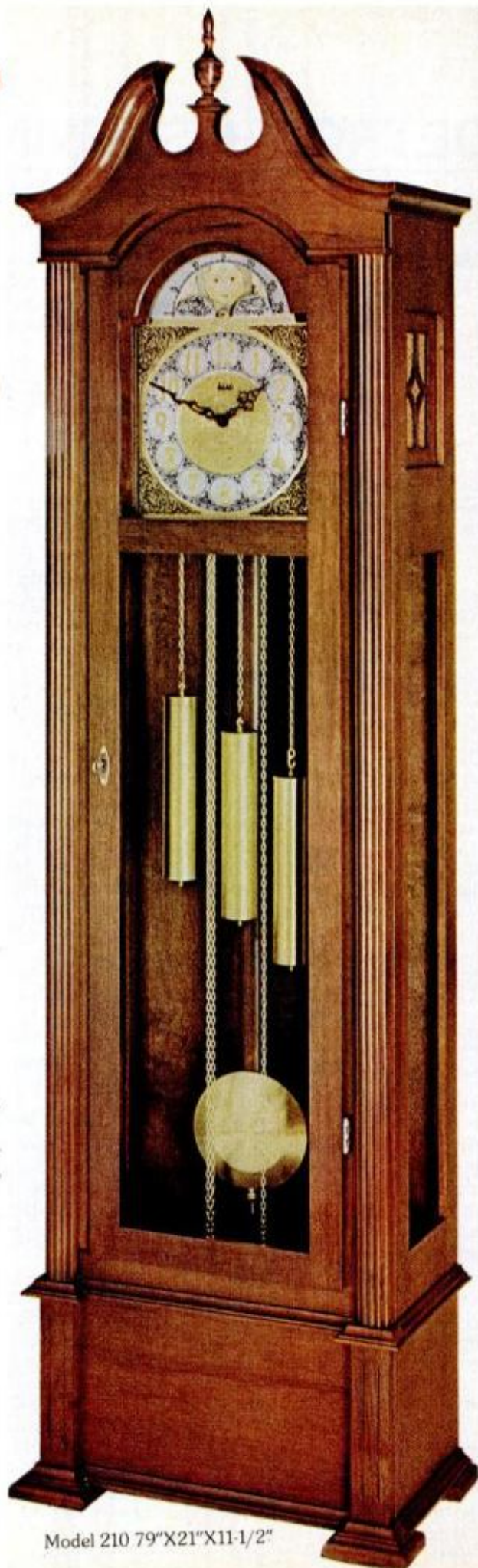
No plastics, no veneers.

The movements (which you order fully assembled) come from the hands of world-famed Black Forest craftsmen whose mastery goes back three generations.

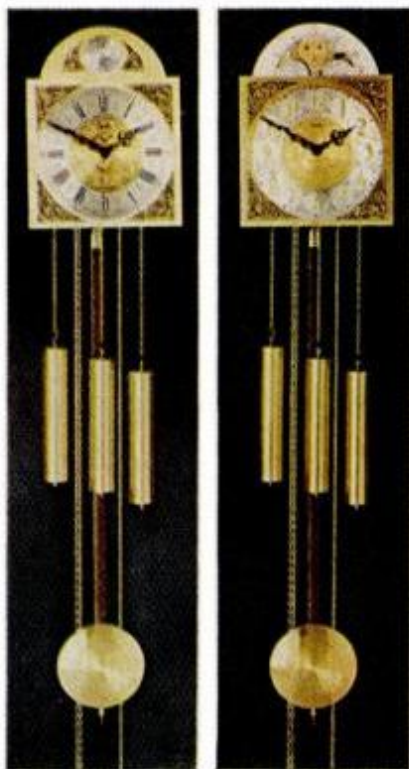
Solid, polished brass; precision-cut, hardened steel. The estimated life of these movements is 100 years.

Every piece of wood in a **HENTSCHEL** Clock Kit is precision pre-cut. All miters are pre-drilled. And dowelled for extra strength. Corner blocks and other parts are pre-drilled and counter-sunk. And every piece of wood is sanded on **both** sides, visible or not.

Exactly the way custom clocks are made.



Model 210 79"X21"X11-1/2"



1000-W

1000-T

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HENTSCHEL Movements are made in West Germany by craftsmen whose tradition of excellence and pride of craftsmanship goes back three generations. These precision movements are 8 day—weight driven—polished brass shells and bob—solid brass plates with hardened steel pinions.

1000-W Westminster Chime-Tempus Fugit Dial Chimes the 1/4 hour, 1/2 hour, 3/4 hour, and hour, with a Big Ben strike on the hour. Solid brass deeply engraved dial with "Tempus Fugit"—"Time Flies" overpiece... \$139.50.

1000-T Triple Chime-Moving Moon Dial Chimes three famous traditional melodies: Westminster, Whittington, and St. Michael. The solid brass polished dial, shows the changing phases of the moon... \$169.50.

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30-Day Guarantee If you are not completely satisfied with your **HENTSCHEL CLOCK KIT WITHIN 30 days**, simply return it in the original shipping carton for a complete refund. In fact, so confident are we of **HENTSCHEL** quality, we will even pay return shipping charges!

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Unique Step-by-Step, Picture-by-Picture Instructions. If you own a screwdriver, you're ready to tackle a **HENTSCHEL Kit**. Step-by-step instructions take you every inch of the way. Exploded views show you how each part fits, and where. Photographs show you exactly how the finished product looks. You'll feel as if one of our master clockmakers is looking over your shoulder.

Mail Your Order Today. Enjoy the beauty, the elegance, the long-lived craftsmanship built into a **HENTSCHEL Grandfather Clock** soon. Begin with the pleasure of working with fine walnut. Then savor the interest and admiration of everyone who sees this handsome heirloom timepiece in your home. Enjoy the unique satisfaction of explaining that it's the product of your own hands. Mail the coupon today!



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	HENTSCHEL	OTHERS
1. A true 6' 7" tall Grandfather Clock case for less than \$150.	Yes	No
2. Lumber sanded on All sides.	Yes	No
3. All parts including miters precision pre-cut.	Yes	No
4. Miters pre-drilled and dowells provided for maximum strength.	Yes	No
5. Corner blocks and other parts pre-drilled and counter-sunk.	Yes	No
6. All Hardware Plus all screws included.	Yes	No
7. Some sub-assemblies stapled for production short-cuts.	No.	Yes
8. Possibility of costly errors in cutting miters.	No.	Yes
9. Complete glass kit (including bevelled front door) available for only \$19.95.	Yes	No
10. Free, solid brass personalized nameplate included, a \$3.95 Value.	Yes	No

\$139⁵⁰

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YES, please send me _____ Grandfather Clock Case Kit(s),
 Model No. 210, at each \$139.50 _____

Please send me the checked movement for my clock at price indicated.

Model 1000-W Westminster Movement and Tempus Fugit Dial at \$139.50 _____

Model 100-T Triple Chime Movement and Moving Moon Dial at \$169.50 _____

Complete Glass Kit (including lower beveled door panel) each \$ 19.95 _____

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Send illustrated 4-color brochure

Enclosed is my Check or Money Order Total _____

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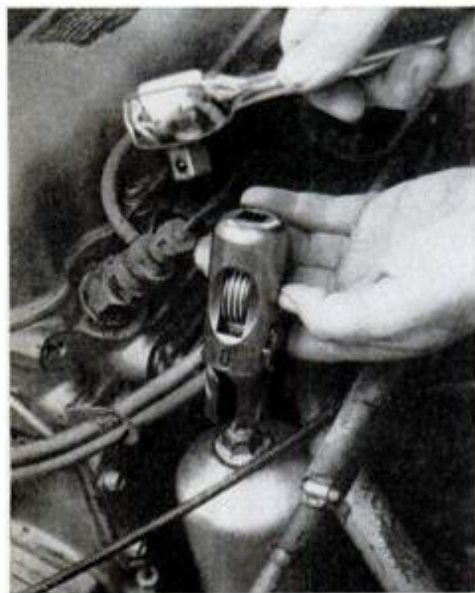
Address _____

City _____ State _____ Zip _____

I understand that if not fully satisfied I may return the kit(s). I have ordered within 30 days for a full refund—including return shipping charges.

H-002

THE PM GARAGE



Dial-a-bolt

I have the perfect engine problem for the Gripall solution. I have a diesel in which all engine bolts are metric and all the bolts on accessories are English. The correct-wrench problem is obvious when changing the fan belt. I have to break loose two metric bolts on the engine and two English bolts of the American-made alternator. The Gripall Dial-A-Socket is a hefty steel socket (or impact) wrench attachment that's adjustable to fit any bolt from $\frac{1}{8}$ in. to $1\frac{1}{8}$ in. and metric equivalents in size. The two-point head of the Gripall permits good purchase on bolt heads and nuts. I was quite impressed with the sturdy unit that works with any $\frac{1}{2}$ -in. drive (or you can get from any hardware store a $\frac{1}{2}$ -in. adapter to fit your $\frac{3}{8}$ -in. drive). The one problem I noticed is that the unit requires clear access to all bolts. The Gripall is a little more than four inches long. So don't throw away your open-end or narrow socket wrenches. But for \$24.95 you can add a useful and well designed tool to your kit, especially as we go metric. Schlesinger's For Tools, Ltd., 1257-61 Utica Ave., Brooklyn, N.Y. 11203.—D.F.

Redecorate with spray

If you're tired of your car's upholstery color, by all means change it. It's super-simple with the vinyl spray paints now on the market.

I sprayed the interior of my Ca-

maro convertible in 1969, changing it from black to avocado. Everything has stood up amazingly well these past seven years; no regrets. I have, though, had to touch up worn areas on the seats and armrests twice.

The trick to spraying auto upholstery is to get everything absolutely clean. I use Formula 409 and scrub with a fingernail brush first, then hose that off and go over all surfaces with rubbing alcohol.

More recently I sprayed the front bench of my wife's Dodge wagon with Tony Nancy's Vinyl Spray. Again, the job turned out fine. For the single bench, it took three cans of paint, costing \$10.41 (\$3.47 per can). Tony Nancy Vinyl Spray is available at most car parts stores or from Sperex Corp., 16131 South Maple Ave., Gardena, Calif. 90248.—M.L.

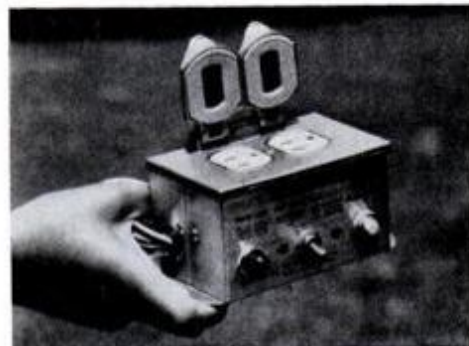


Voltage booster

If you need household current outside your house, Tote-A-Volt can convert your car's 12-volt alternator to 110 direct current. You can run most electric tools on it, plus kitchen and bathroom appliances.

Tote-A-Volt offers several different models ranging from about \$15 to \$88. I chose the mid-priced Model 250-A (\$26.95) and found it easy to install and simple to use. Installation takes about half an hour and requires only common hand tools.

Being 110-volt d.c. (not alternating current), there are some electrical items that Tote-A-Volt won't power. It won't operate motors without brushes: pumps, refrigerators, washing machines and the like. Nor will it run appliances that use transformer power supply: TV sets, radios and conventional battery chargers. Also, since Tote-A-Volt's output varies with car engine speed,



110-volt record players and tape recorders give an extreme wow-wow effect. You have to hold the throttle at a steady 2200 rpm (about 50 mph equivalent) to generate 110 volts. Tote-A-Volts are available at most car parts stores or from the manufacturer: Cliff Granberry Corp., Box 9505, Dallas, Tex. 75214.—M.L.

Glove-box bible

I've always carried a loose-leaf book in the glove box, and I've faithfully recorded all gas purchases and scribbled in oil changes and other maintenance or repairs. The looseleaf approach is better than keeping no record at all, but there's an even better way: Kay's 100,000 Mile Auto Maintenance Record. I would have been reluctant to recommend a \$2.95 (plus 40 cents for postage and handling) book just to keep track of your car's



health and appetite, but I came close to scoring my rear brake discs simply because my loose-leaf method doesn't remind me to check everything. The Kay book does. It has a maintenance section, mileage section and more. Kay Publications, 3103 North Monticello Avenue, Chicago, Ill. 60618.—B.H. ★★★

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Two bed sizes. Datsun gives you two tough choices. You can get our Li'l Hustler with a 6-ft. bed. Or our Li'l Hustler Stretch with a longer 7-ft. bed.

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Strong backing. To keep your Datsun trucking, there are nearly 4,000 factory-trained service technicians coast-to-coast. Plus a vast computerized parts network. That's how we plan to **stay** number one.

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Datsun Saves



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Tobacco. It's as proud a part of the American tradition as the Statue of Liberty. At Liggett & Myers, we've made tobacco into a cigarette worthy of that tradition. The rich, mellow, distinctively smooth L&M. Smoke it proudly.

For color poster of New York Harbor without commercial identification, send 2 L&M pack bottoms and 75¢ to P.O. Box 60-1904, Minneapolis, MN 55460. Offer void to persons under 21 years of age. Good in U.S. only, except where prohibited, licensed, taxed or restricted by law. Offer expires December 31, 1976. Allow four to six weeks for delivery.

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Материал, содержащий информацию о табаке

Weather demons in the sky



Charred hulk is all that remains of Flight 66, an Eastern 727 that crashed and burned at Kennedy last June, killing 114. Cause is believed to be wind shear, producing sudden loss of lift during landing attempt.

Recent plane crashes are triggering new research into a pilot's nightmare—invisible air turbulence.

by Mort Schultz

Until recently, the term "wind shear" was little known outside aviation circles. Then, last June, came the tragic crash of an Eastern Airlines 727 jet, Flight 66, which plunged to a fiery end while attempting a landing in heavy turbulence at New York's Kennedy International Airport. The crash—the worst single-plane disaster in U. S. history—took the lives of

114. It was blamed on a strange phenomenon called wind shear.

Actually, wind shear is the greatest meteorological menace facing people who fly. It's known to have caused at least three other accidents since 1973 and perhaps one other in which 38 people died.

Even among aviation experts wind shear is a relatively new phenomenon.

"We began defining wind shear and identifying it as hazardous only in the past decade," says Charles Miller of the Flight Safety Foundation.

The Federal Aviation Administration's *Aviation Weather* manual defines wind shear as "a change in wind speed and/or wind direction in a short distance, resulting in a 'tearing' or 'shearing' effect.

"A narrow zone of wind shear, with its accompanying turbulence, is often encountered when an aircraft climbs or descends through a temperature inversion," the manual states. "It is a potential hazard to aircraft immediately after takeoff or on the final approach for landing . . . an aircraft may encounter a large loss of airspeed . . . this situation can be dangerous since the zone is only a few hundred feet above the ground."

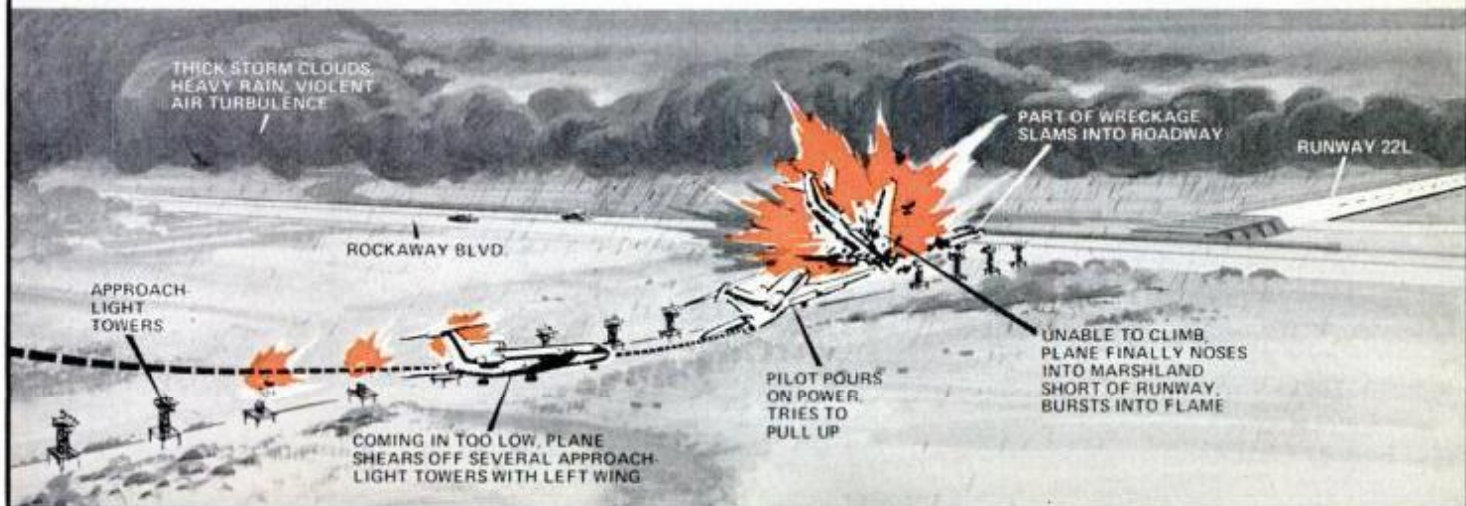
Suddenly you're out of control

Blind to the presence of wind shear, or even if he knows it's around, a pilot who encounters the phenomenon may be unable to control his aircraft. He may have his plane flawlessly stabilized on an approach, with thrust

THE FIERY END OF FLIGHT 66

The sky was black, lightning flashed ominously and heavy rain lashed the field as Eastern Airlines Flight 66 turned on its final approach to New York's Kennedy International Airport. It was June 24, 1975—a day long to be remembered for a massive tragedy that touched off outrage, controversy and renewed efforts to establish the causes of mysterious air crashes. As the big 727 jet neared its assigned runway, 22L, it was caught in a sudden, violent downdraft—that invisible menace "wind shear"—and

dipped far below its normal glide slope. Hopelessly low, it sheared off several approach-light towers as its pilot fought vainly to pull up, then nosed into marshland short of the runway and burst into flames. Of the 124 on board, 114 perished. The time was 4:06 p.m.—lucky for some—for part of the wreckage skidded out onto Rockaway Blvd., a busy roadway skirting the airport. If the crash had occurred an hour later, the wreckage would have slammed into heavy rush-hour traffic, undoubtedly killing even more.



setting, airspeed, flaps and rate of descent all coordinated.

Then the plane will hit a tremendous vertical gust, or a gust from the rear. A head wind becomes a tail wind, or vice versa, and the aircraft gets caught in a violent downdraft, with its rate of descent suddenly accelerated.

The effects of wind shear are more hazardous during a landing than during a takeoff. On approach, a plane's power is substantially reduced. During takeoff, full thrust is being applied, which is usually sufficient to overcome the violent pull down.

According to reports, wind shear velocities in which the ill-fated Flight 66 found itself were in the order of 90 mph. Winds of 75 mph constitute a hurricane.

Two pilots who flew through the same zone several minutes before Flight 66 also found themselves in deep trouble.

Capt. C. L. Nickerson was landing his Eastern Airlines L-1011 jumbo jet, but had his airspeed upped 20 knots above the norm in anticipation of "hazardous air currents." He wanted the cushion so his aircraft would have enough momentum to overcome any sudden downdraft, allowing him to "go around."

Still, Nickerson's airspeed dropped from 150 to 118 knots in just two seconds and stayed at this low level for a dangerous period of time.

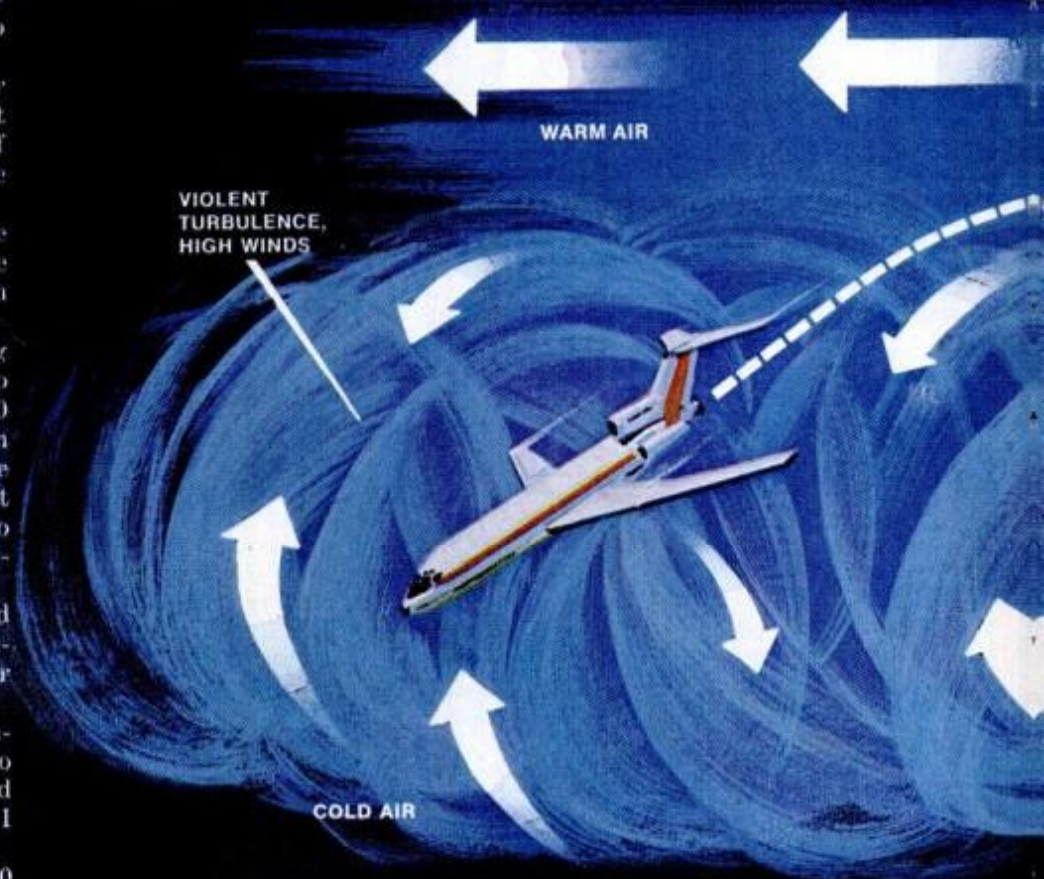
"A change in airspeed is not uncommon," Nickerson explains, "but to have it stay there and not move, and not be able to move it, is something I hope never to experience again."

Perhaps because of the extra 20 knots he had tacked on during his descent, Nickerson was able to overcome the pull-down effect. He pulled

Major types of

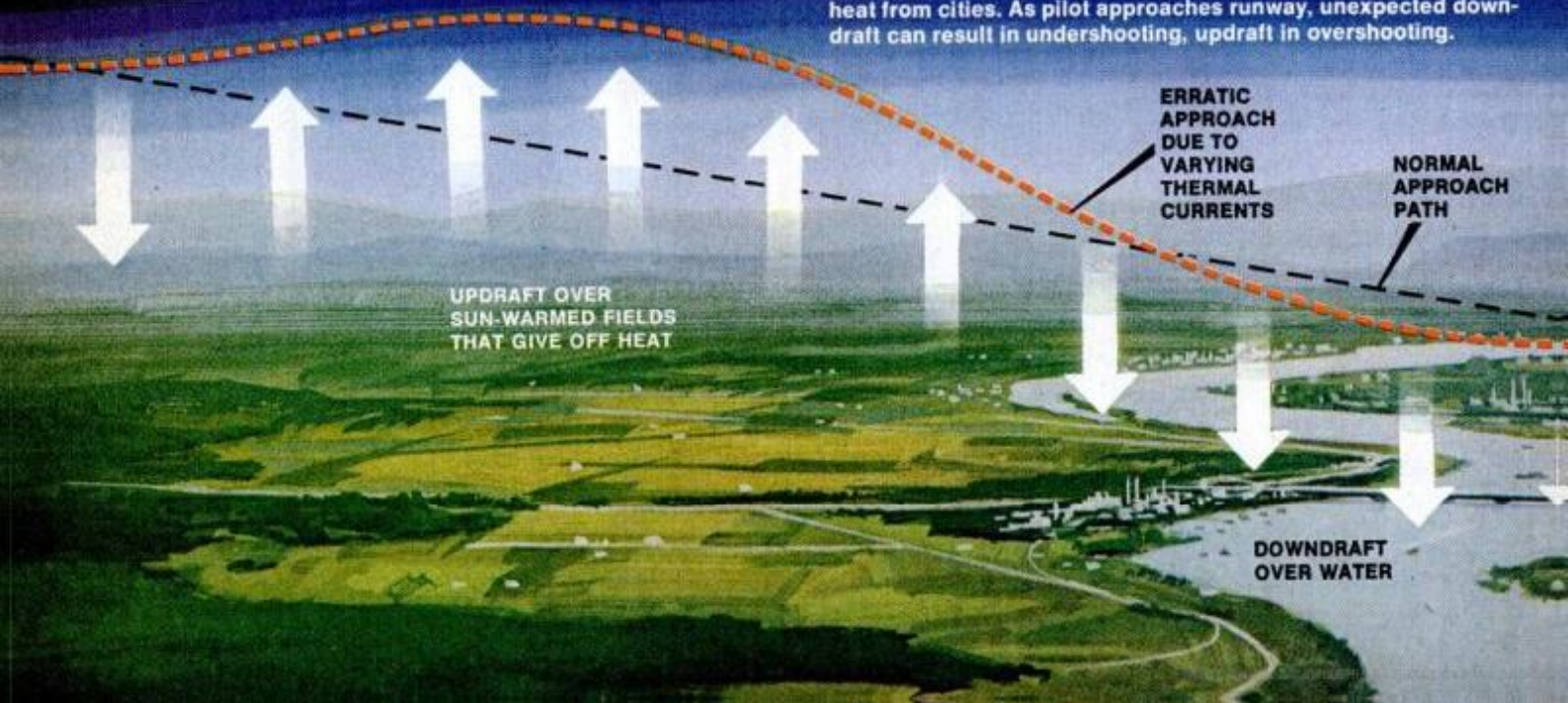
WIND SHEAR

Violent turbulence occurs in a narrow zone between two air masses moving in different directions, often in a temperature inversion situation where warm upper air moves across a stationary layer of colder air below it. Resulting wind velocities can reach or exceed hurricane force, causing extreme buffeting and loss of lift. If close to ground, as in making a landing approach, aircraft may lose too much altitude and airspeed to regain control and avoid a crash, as apparently happened to Flight 66.



CONVECTION TURBULENCE

Sudden changes in air currents can be caused by temperature differentials of land features, such as cool bodies of water, rising heat from cities. As pilot approaches runway, unexpected downdraft can result in undershooting, updraft in overshooting.



air turbulence

VORTEX TURBULENCE

Planes create turbulence themselves, especially today's giant jumbo jets. Spiraling wake, much like waves from a boat, sets up powerful counter-rotating air currents trailing hundreds of feet behind. A smaller, lighter plane following too close can be caught in this swirling "vortex" and violently buffeted, even flipped upside down.

TURBULENT WAKE FROM JUMBO JET

SMALL PLANE CAUGHT IN VORTEX EFFECT CAN BE FLIPPED UPSIDE DOWN

MOUNTAIN DOWNDRAFT

Cold air spilling down over the lee side of a mountain range can create a severe downdraft and loss of lift. A pilot attempting to clear the peaks or land on the ground below may lose sufficient altitude and airspeed to go out of control and crash.

COLD DESCENDING AIR CREATES STRONG DOWNDRAFT

UPDRAFT OVER CITY

AIRPORT RUNWAY

Art: Ed Valigursky



In Denver crash of Continental 727 last August, jet was pushed into ground on takeoff by strong downdraft thought to be the effect of wind shear. Fuselage broke into three sections, causing some injuries but fortunately no fatalities.

his giant jet up and headed for Newark Airport, 30 miles away.

Several passengers on Nickerson's flight complained about "poor service" resulting from the diversion. They were lucky. Those on Flight 66 never got a chance to complain.

Maybe they would have if warnings by Capt. Jack Bliss had been heeded. Bliss landed his Flying Tiger DC-8 cargo jet about eight minutes before Flight 66 started its approach.

Sounds warning

He admits to a seat-of-the-pants landing, diving his aircraft at a 20° bank so one main gear hit the runway first, then the other.

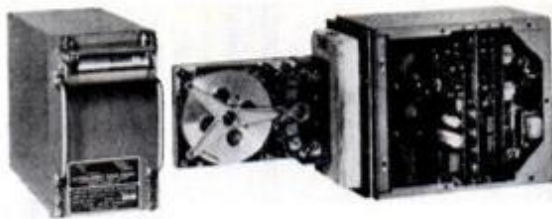
"If I had flown by the book, I would have been in real trouble," Bliss claims. "If I had slowed to 'bug' speed, I would have been in serious trouble."

Bringing his aircraft safely to taxi speed, Bliss warned the tower of a "tremendous wind shear."

Secrets a flight recorder can tell

Inside every commercial airliner are two small but vital "black boxes." These are the flight recorders that help investigators determine the cause of an accident and what to do to keep it from happening again. One type is called the flight data recorder.

Newest versions, like the Lockheed model shown partly disassembled above, can record on magnetic tape up to 64 separate functions continuously throughout an entire flight right up to the final second of impact. Some of these functions include altitude, speed, acceleration, engine operation, flight control movements, heading, time and temperature—important clues to what might have gone wrong. The second type is a voice recorder that tapes cockpit conversations for later playback and analysis of crew reactions during an emergency. Tremendously rugged, flight recorders can withstand an impact force of 1000 Gs and temperatures of 2000° F.—conditions seldom encountered in even the severest crashes. Where are these little boxes located? In the tail, because that's the part of a plane least likely to be damaged in a crash. The secrets they reveal can save many lives on safer future flights.



As it descended toward runway 22L, Eastern Airlines' Flight 66 dropped to "bug" speed—for a Boeing 727 about 130 knots.

"Bug" speed is the setting on the airspeed indicator signifying to a pilot the minimum speed he is to maintain on his landing approach.

Flight 66, from New Orleans, carried 116 passengers and a crew of eight. The time was 4:06 p.m. The blackness, broken only by bolts of lightning flashing from cumulonimbus clouds reaching 40,000 feet into the air, necessitated an instrument landing approach.

As the plane got closer to touchdown, Flight Attendant Mary E. Mooney was belted in her seat when

suddenly, she recalls, "The plane rolled to the left and full thrust power was applied. We lifted up, then we leveled out and hit."

Flight 66 had struck three towers supporting approach lights 2300 feet from the outer marker. The plane rose as Capt. Jack Kleven apparently applied full power in a vain attempt to save his aircraft. The jet cleared three other towers, plunged into four more and then to the ground. The burning wreckage was strewn over five acres of Long Island marshland.

Questions but few answers

Many questions have been raised. Who, if anyone, was to blame? Who

(Please turn to page 111)

What they're doing about turbulence to make flying safer

Barrel-like devices, shown below installed at New York's Kennedy Airport, were originally designed to detect and measure vortex turbulence, are now being modified to monitor wind shear effects as well. Tilted at various angles, they contain highly sensitive microphones that pick up acoustic impulses produced by turbulent air. Type and intensity of impulses indicate height and severity of turbulence. This information is then fed to a computer, giving an instantaneous readout that can be radioed to an incoming pilot to warn him to expect turbulence at a particular point in his landing approach or to advise him to abort landing attempt entirely. Dramatic evidence of vortex turbulence is shown in photos at right of NASA test. At top, smoke generator in tower spews stream across runway as plane lands below it. Seconds later, smoke is swirled into violent eddies (lower photo), indicating strong turbulence produced by plane's wake. Results of such research have led to possibility of installing deflector plates on wingtips to help break up turbulence before it gets dangerous.



IT'S NEW NOW



It's an oddball, but it goes

This rolling ball is one of 51 winners out of a surprising 4935 entries in Honda's annual employee design contest in Japan. Workers have use of company facilities, are encouraged to come up with new ideas—however far out—that might lead to practical improvements in vehicular engineering. The motor-driven ball, operating on the principle that a sphere can roll in any direction, can be steered forward, backward or sideways merely by turning wheel at the top.



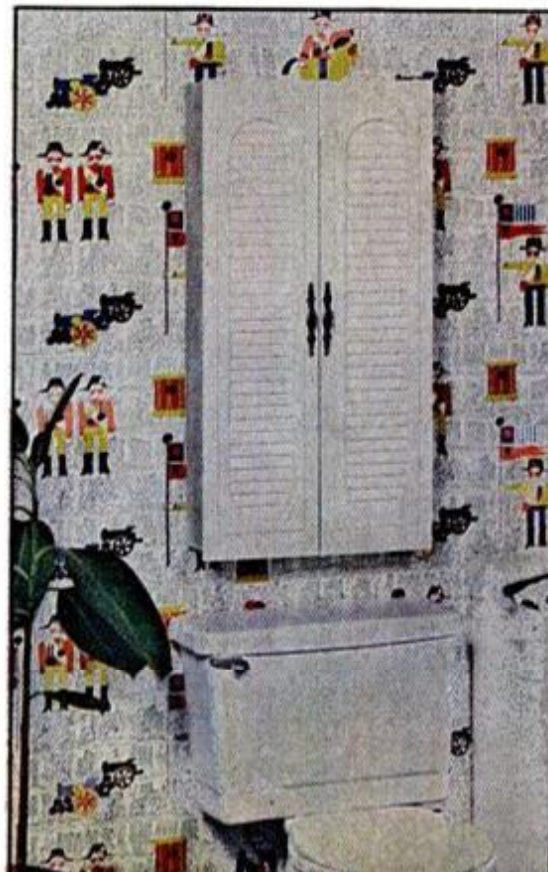
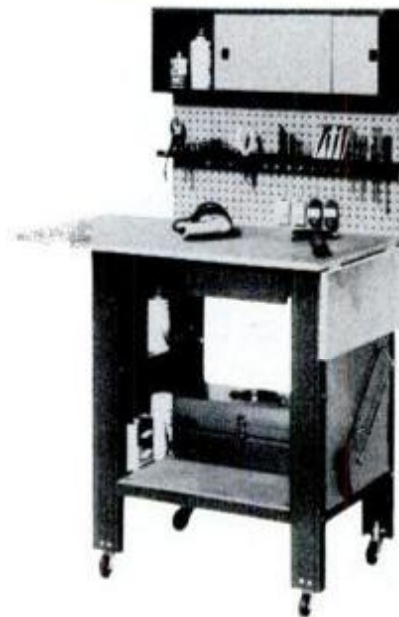
Handy carryall for drill and accessories

This take-anywhere toter keeps your electric drill and accessories neatly organized and ready to carry to the job. Plastic tray holds $\frac{1}{4}$ or $\frac{3}{8}$ -inch drills, has 25-hole rack for bits from $\frac{1}{16}$ to $\frac{1}{2}$ inch. Other compartments take tools and attachments, while two drawers store screws and small parts. Drill-Mate is \$7.25 postpaid from Popular Mechanics Master Workshop Organizers, Box 1014, Radio City, N.Y. 10019.



Wall-hung work center

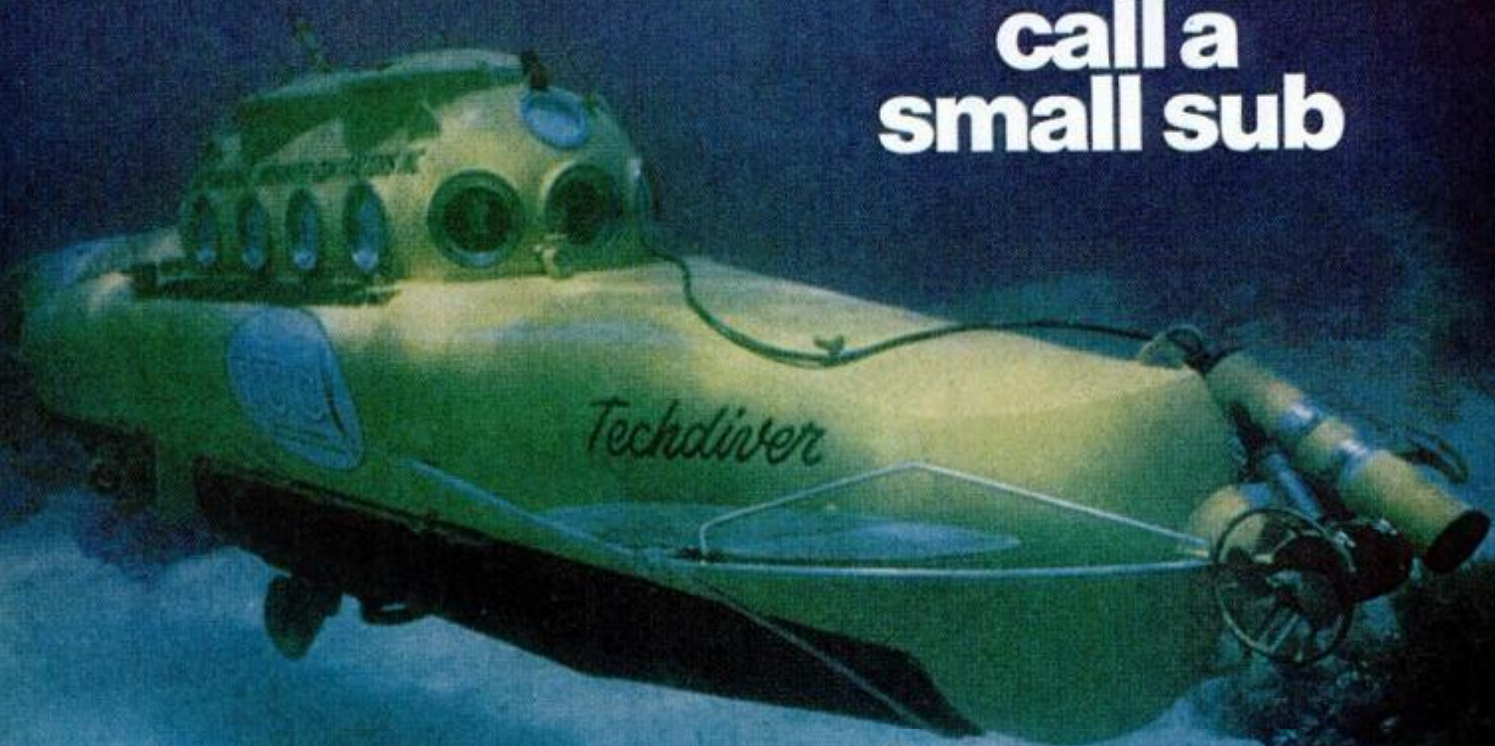
Virtually any size and shape of work center can be put together from these modular wall-mount bench and storage units. Three sizes include a 24-inch width for \$34.95, 48-inch width for \$59.95 and 24 by 24-inch corner section for \$17.95. Units feature perforated toolboards, overhead cabinets, undercounter drawers. Electrical knockouts in wall supports permit installing power outlets. Wall-mount design provides clear floor space for free movement, easy cleanup. Where wall mounting isn't desired, alternate base units are available. Also available is 20 by 30-inch mobile work center (left) with locking casters. Hirsh Co., 8051 Central Park Ave., Skokie, Ill. 60076.



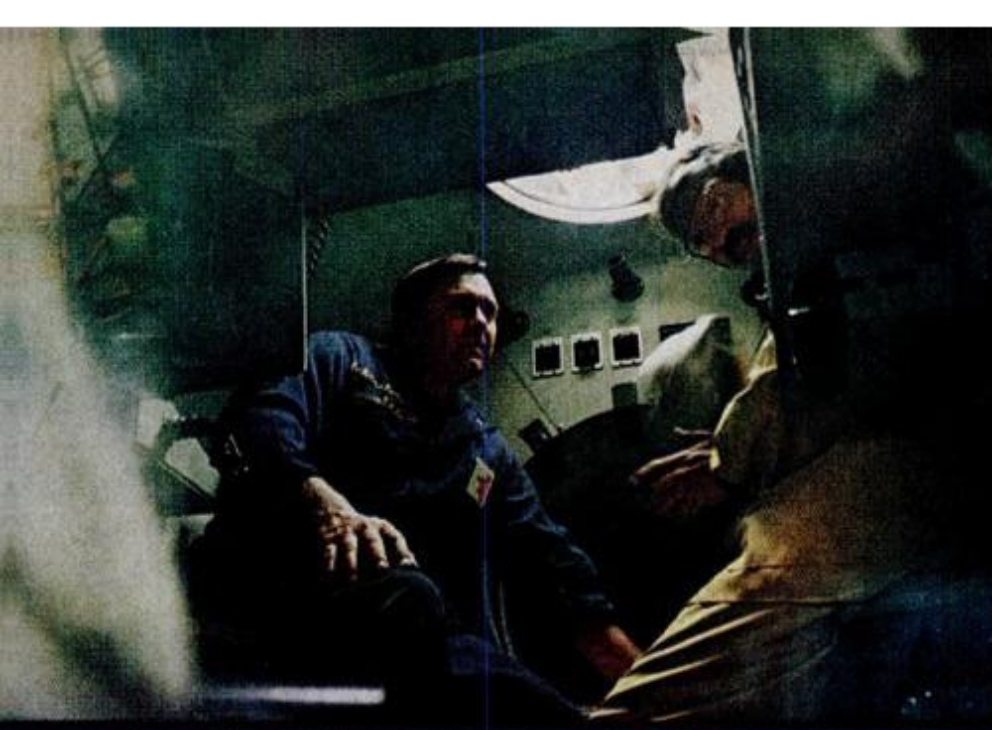
Bath cabinet for narrow wall space

Waste space in a bathroom can be put to use with this tall, slim wall cabinet designed especially for mounting above a toilet. The storage unit measures 36 inches high, 18 inches wide and $5\frac{1}{4}$ inches deep. Four shelves provide $2\frac{1}{2}$ square feet of space for concealing towels, toiletries and other bath items. The Wall-Ette comes in three styles: colonial (shown here), Mediterranean and French Provincial. Price is \$64. Matching vanities in choice of sink colors are also available in the same three styles. Universal-Run-dle Co., 217 North Mill St., New Castle, Pa. 16103.

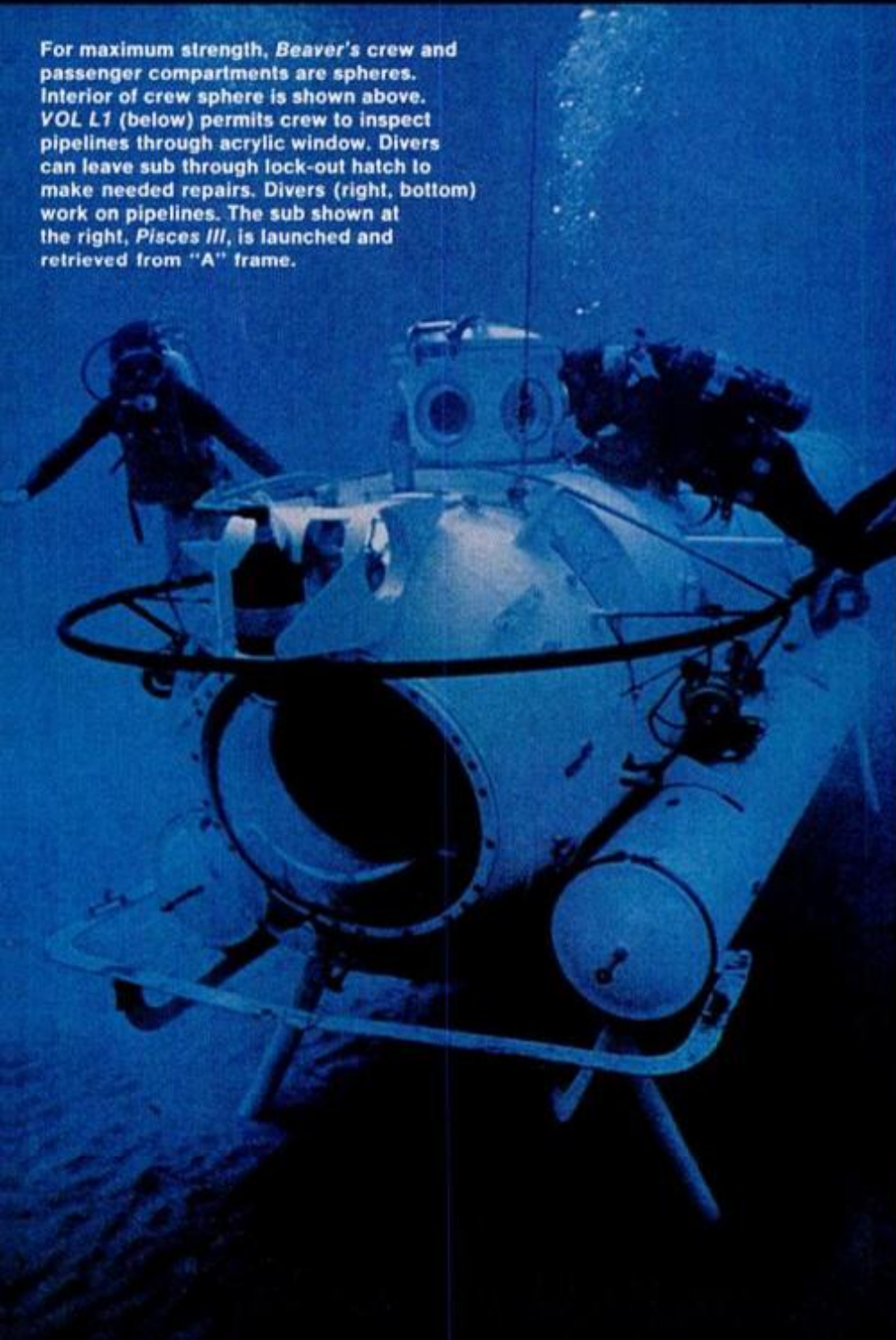
**For big jobs
in deep water—
call a
small sub**



The sleek *Techdiver* (top photo) is a 22-foot, two-man sub operated by International Underwater Contractors. Equipped with a closed-circuit TV system, the sub has been used to inspect pipelines in many parts of the world. It joined in the search for the H-bomb lost off the coast of Spain in 1966. *Beaver Mark IV* (above and right) has a working depth of 2700 feet, carries a crew of two plus three passengers or divers and has a 2½-knot cruising speed.



For maximum strength, *Beaver's* crew and passenger compartments are spheres. Interior of crew sphere is shown above. VOL L1 (below) permits crew to inspect pipelines through acrylic window. Divers can leave sub through lock-out hatch to make needed repairs. Divers (right, bottom) work on pipelines. The sub shown at the right, *Pisces III*, is launched and retrieved from "A" frame.



by Dan Hall

Tiny *Pisces III*—a 20-foot-long vessel with barely enough room for a crew of two—is part of a growing fleet of submersibles that have invaded parts of the Atlantic and the North Sea. Unlike most other undersea craft that have appeared in these waters, notably the silent marauders of the German navy during World War II, these pocket-sized subs work for a living.

On Aug. 29, 1973, *Pisces III*, operated by Vickers Oceanics of England, was engaged in burying a section of newly laid transatlantic telephone cable. The site was some 150 miles southwest of Cork, Ireland, and *Pisces III* was working at a depth of about half a mile. A nozzle held in the sub's manipulator arms ejected a powerful jet of water that cut a trench in the seabed. As the trench was formed, the cable sank into it. In time, current action would cover the cable with seabed material.

It was a routine job. After eight hours, the two pilots aboard *Pisces III* brought the craft to the surface, where a diver connected a towline to it from the support ship, the *Vickers Voyager*. Soon after the *Voyager* began winching in the sub, *(Please turn to page 124)*



Improvements in this year's snowmobiles are the result of growing pains—developmental aches probably felt more severely in the snowmobile business than in any other industry. People have loved—or hated—them so much that builders have entered crash programs to make them better.

The results are impressive. Models are quieter and well below the 78-dB sound level required for '76, easier to ride—even faster if you buy the biggest engines. New trends include liquid-cooled engines claimed to make less noise, hold more uniform temperature and provide better performance with lower fuel consumption. Suspension is divided between slide-rail for flatter trails and race tracks or bogie wheels when the going gets uneven.

Manufacturers are down to less than a dozen that seem to want to stay—not long ago there were over 100. New well-groomed trails help drivers head away from private property, and new insulated clothes make long runs less cold, more fun. The new snowmobiles are probably safer than many drivers who run them.

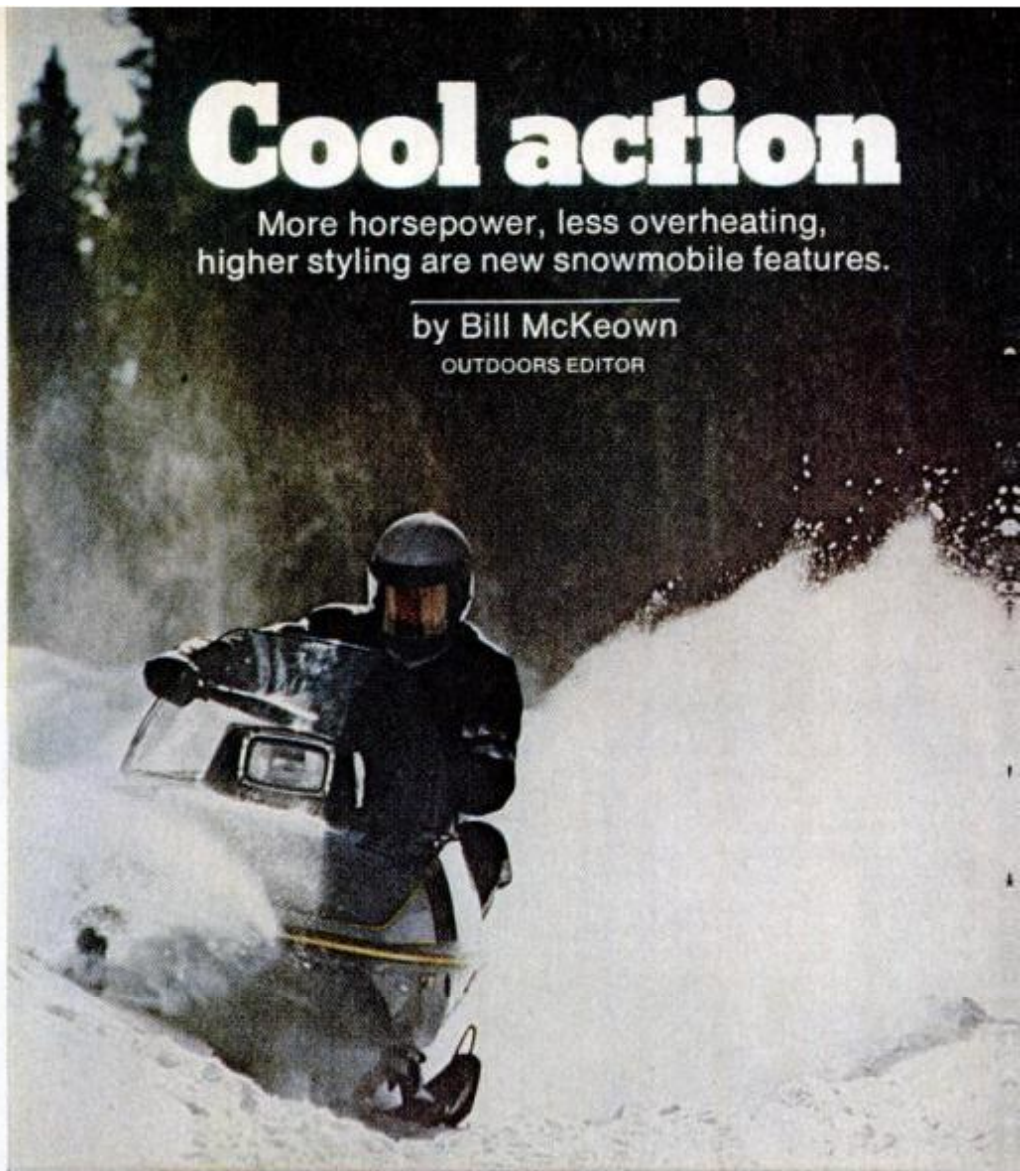
Racing helped start the sport, and now a number of builders are making models for competition. John Deere's new 340/S (right) is one example. Other new performers include Merc Trail-Twister (below); Ski-Doo Elan, Olympique and T-N-T (lower right), Massey-Ferguson entries (bottom).

Cool action

More horsepower, less overheating, higher styling are new snowmobile features.

by Bill McKeown

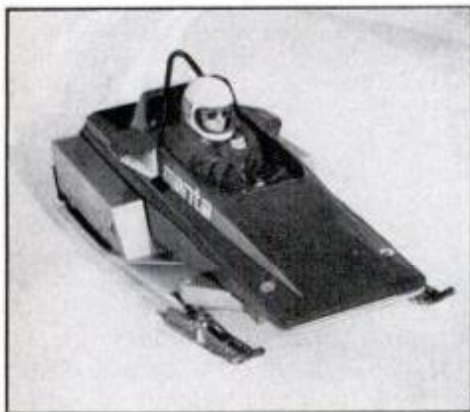
OUTDOORS EDITOR



HOT PERFORMERS



Future look is forecast by prototypes like Brooks Stevens design for Evinrude (above). Enclosed cockpit and rear stabilizer are features. Manta (below) also has twin tracks, and adds rear engine, roll bar, plus wide stance for front steering skis. Single-seaters appear to be trend for competition models. Windshields are minimal.



Race classes are being organized so that lower-power machines also have suitable classes, like Polaris (above), while professional drivers and factory teams can compete with free-air high-performance machines like Scorpion's special Odd Job (below). Several makers are fielding factory teams for the first time in '75-'76.



Warm gear

Try light clothing layers for air-space insulation that keeps out the cold.

by Jack Galub

Want to keep comfortable outdoors this winter as the mercury starts falling, or any other time when a chill wind blows? Then line your body with layers of warm air.

That's the message coming out of the Natick Development Center in Massachusetts. Natick is headquarters for the Army Clothing, Equipment and Materials Engineering Laboratory, the units responsible for the development of Arctic weather clothing used by GIs.

Although the center's work is combat-oriented, there is considerable similarity between the conditions faced by field soldier and civilian outdoorsman.

"All you do is hurry up and wait," is the centuries-old gripe of the chilled infantryman trying to keep warm. Similarly, you may find yourself sitting in the cold for hours watching for deer or waiting for fish below the ice. Or you may be frozen by wind blast while snowmobiling, or sitting in the stands during a football game. Research in the physiology of the body and impact of cold on it at Natick has reinforced some of the folk knowledge accumulated by Eskimos over the ages, and added some new hard medical facts to build on as well.

Where your heat goes

Body warmth is generated in the torso as a product of metabolic action and is carried by the bloodstream to the arms, legs and head. When heat loss begins to build up at these points, the blood vessels constrict, cutting down the flow of blood to protect the torso. The next thing you know, your feet and fingers become uncomfortably cold, your nose turns blue, your ears start hurting. Shivering sets in as an instinctive reaction that steps up your heart's pumping action and the flow of blood. Goose bumps dot your body surface and your body hair starts standing up, trying to build up pockets of warmer air. This is a waste of energy since we swapped our body fur for clothing eons ago.

What to do

Natick's field and laboratory experiments with various types of cold

weather clothing have resulted in the formulation of three basic principles followed by the Army when outfitting troops for winter combat. They are water-repellent shell, layer insulation and ventilation, says Ted Bailey, chief of the Natick Clothing and Equipment Div.

■ **An outer shell**, tightly-woven and water-repellent, protects layered insulation from rain and wind.

■ **Insulation** reduces heat loss; by adjusting the amount of insulation worn you can regulate heat retained against the body or allowed to escape to adjust to temperature changes. Layering is the most efficient form of insulation. Several layers of medium-weight, loosely fitting clothing are more effective than one heavy garment as thick or thicker than the combined layers.

■ **Ventilation** helps keep body temperature level, lets perspiration evaporate. Trapped perspiration fills your



Air warming mask from 3M, formerly white, now comes in tan so wearer no longer can be mistaken for a white-tailed deer.

clothing with moisture, reducing its insulation effectiveness. The easiest way to cool an overheated area is to open cuffs or collars, or take off a layer of clothing.

What to wear

If you are going to be exposed to the severe weather of mountain altitudes or northern snow-belt states for any extended period, your first layer of clothing should be cotton underwear worn under long johns. Quilted dacron is excellent for deep north country, double-layered cottons for more temperate areas. Wool-



Head warmth, essential for chill protection, is easier with convertible pull-down cap like Scottish balaclava, under \$5 in various colors by Recreational Equipment.

blend shirt and pants, and over them a water-repellent hunting jacket or parka with a removable insulating layer will protect your body and arms. Down or fiber-filled parkas and pants are particularly useful for maximum warmth and lightness. Note that most ski clothing is designed for active sport and may not offer the insulation needed for other activities.

WIND CHILL INDEX

TEMPERATURE	WIND SPEED M.P.H.		
	10	20	30
40	28	18	13
30	16	4	-2
20	4	-10	-18
10	-9	-25	-33
0	-21	-39	-48
-10	-33	-53	-63
-20	-46	-67	-79
-30	-58	-82	-94
-40	-70	-96	-109

DEGREES IN FAHRENHEIT

It's colder than thermometer shows when air or outdoorsman is moving. Wind-chill factor brings rapid frostbite to unprotected skin that's exposed to cold plus breezes.

The Army uses one pair of padded wool-blend socks, instead of the two tighter-fitting pairs advocated by some outfitters. These are worn under vapor-barrier insulated boots for Arctic conditions. The Army did not solve the problem of foot frostbite during the Korean war until it developed the vapor-barrier boot, Ted Bailey says. Until the old leather combat boots were replaced, troop

commanders expected half of their fighting strength to be lost through frostbite instead of enemy action.

Keeping hands warm remains a continuing research headache, the Army has found. Mittens are better than conventional fingered gloves. But in the search for lighter, warmer hand covering, the Army now is working on the use of heat-reflective materials or electric heat in mittens.

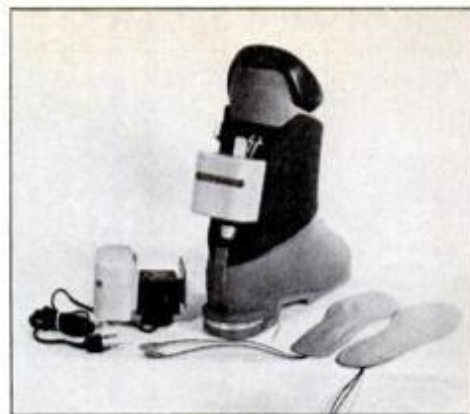
Face and head coverings

For face protection, the cold-weather face masks used on the Alaska pipeline project along with the synthetic fur-lined hoods do a good job. But if you plan only to sit and ice-fish, ride a snowmobile or watch a football game, an air-warming mask may be all you need. Especially if you have respiratory problems, the mask protects nose, cheekbones and mouth, and its use raises the temperature of inhaled air to an average of 60°F. and 95 percent humidity when the temperature outside the mask is -20° and the humidity 10 percent. It can make breathing comfortable instead of sometimes agonizingly painful.

Proper head covering during cold weather is a must, especially the kind that can be pulled down over the ears. A state-trooper-type hat, knitted ski hat or Navy watch hat will do the job under many conditions.

One hazard of cold, dry weather is wind chill, something TV weathermen like to talk about. Strong winds make low temperatures seem even colder, increasing the need for body insulation. When it's a comfortably cold 10° outside, even a moderate 10 mph breeze, for instance, drops the effective temperature down to -9° so far as the body is concerned. Increase that wind to 20 mph and the wind chill equals a bitter -25°. With the wind-chill index chart shown you can easily calculate what the effective cold can be when you are skiing or snowmobiling rapidly, or a strong wind is blowing.

The most effective protection against wind, other than a wall or armor plate, is the tightly woven outer shell of a well-made jacket or



Electrically warmed insoles for shoes and boots plus gloves with space-suit features are being developed by Comfort Products, Aspen, Colo., to use rechargeable packs.

parka. Usually these shells are also water repellent. If yours has drawstrings or bottom buttons, use them to keep the wind from seeping through or blowing up inside.

Dressing for cold weather

How can you tell if you are dressed correctly for a cold-weather outing—before you start sweating? A basic rule of thumb calls for feeling cool when you get out in the open. Then, when you start moving, your body heat will warm the air pockets trapped inside your insulating layers of clothing.

The Army recommends, however, that you put on your full complement of clothing insulation layers at the start. Then when you get warmed up, you can peel off some of the layers before you work up a sweat.

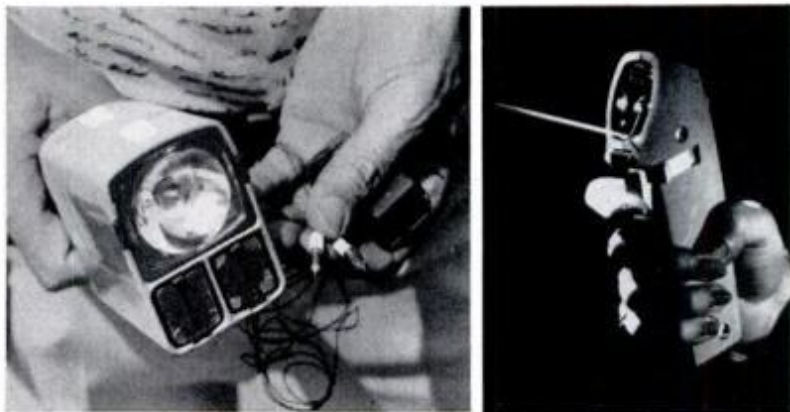
Fortunately, the same kinds of clothing used by the Army can be bought locally at sporting goods stores or from mail-order outfitters.

Recently, cold-weather camping and extended high-altitude hikes and mountain climbing have become a challenge, and for these activities special study is necessary. Extended exposure to cold lowers the body core temperature, and as this occurs, judgment can be impaired and additional danger incurred. Hypothalnia is the technical term for this gradual cooling off, and the hiker needs to learn the symptoms so that he can watch his companions and himself and prevent the onset of this lethal chill. With care, however, and proper equipment, the cold weather need no longer stop the sportsman. Eskimos had the answer. ★ ★ ★



GumShoe, latest adaptation of famous Maine hunting boot by L.L. Bean, has waterproof bottom, laced low leather top.

IT'S NEW **NOW**



Bang—you're zapped

They look like harmless flashlights, but they can give an assailant a stunning surprise. Both offer nonlethal protection from muggers and other criminals. Taser device (left) fires tiny electrically charged "harpoons" that stun an attacker with 50,000 volts. Guardian (right) shoots a stream of chemical repellent. Both incorporate flashlight beams to aid aiming at night, work up to 15 feet. Taser is \$200 at department and specialty stores. Guardian is \$8.95 ppd. from Stanley's, Box 14030, West Omaha Station, Omaha, Neb. 68114. (Such devices may be illegal in some areas; check with local authorities before use.)

Wedge-shape stereo has eye, ear appeal

The wedge-shaped cabinet of Zenith's new Allegro Series III makes its controls easy to see and use from many angles. And it makes room for more controls: In addition to its FM-stereo and AM (with tuning meter), 8-track stereo tape cartridge recorder and phonograph, it has a high filter, FM muting and AFC switches, and a matrix for simulated four-channel sound, plus sliding bass, treble, loudness and balance controls. From Zenith, Chicago, Ill.



Computer catches forgeries

Nobody can sign your name as you do—not even the best forger. Time and pressure variations form a pattern as unique as your fingerprints. Using this principle, a British firm has developed an electronic system for verifying signatures at banks. You sign on a pad that records your "print" and stores it in a computer for future comparison when you sign again. Verisign NPL, Teddington, England.

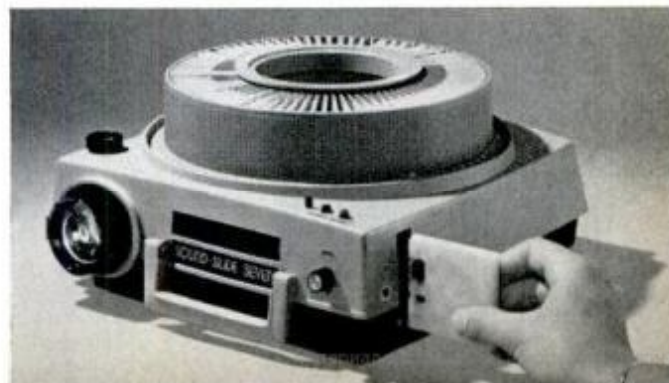


Battery pack for Kodak sound cameras

The batteries powering this camera won't go dead till it has shot between 40 and 60 50-foot film rolls. Super-batteries? No—just a big pack of ordinary nickel-cadmium cells clipped to the photographer's belt. The pack is designed to power Kodak's Supermatic 200 (shown) and Ektasound sound movie cameras, can be recharged at least 500 times, and costs \$50 including charger.

Sound slides into this projector, too

That's no slide being inserted into the side of this slide projector. It's a continuous-loop sound cartridge for a sound-synchronizer small enough to fit in a standard Kodak projector. IAV Standard sells the sound system and projector together—\$300 for the Sound-Slide Six playback-only version, and \$330 for Sound-Slide Seven that lets you record your own narration and effects together with the slide-synchronizing pulses. The maker is at 3070 Lake Terrace, Glenview, Ill. 60025.



Here come the diesels

Special five-page diesel section

- **The new ones:** Now you can get a diesel-powered International Scout, and it looks as if GM and VW may soon offer diesels.
- **One man** who couldn't wait converted his pickup to diesel.
- **Owners** tell what it's like to live with the Mercedes 240 diesel sedan.

by Michael Lamm WEST COAST EDITOR

Forty years a stepchild, the diesel automobile finally appears to be coming of age. Mercedes, Peugeot, and International are currently marketing diesel cars in this country, and Volkswagen and General Motors stand on the verge.

There's a brisk demand for diesel automobiles. Mercedes and Peugeot can hardly keep them in stock. This demand was heightened by the gasoline crisis of December, 1973. Diesel fuel now is up to 25 percent cheaper than gasoline, so for people who put lots of miles on a car, fuel savings can make up for even the high initial cost of an expensive automobile like the Mercedes diesel (see Owners Report, page 62).

Whether diesel fuel will continue relatively inexpensive remains to be seen. If enough owners want it, demand and taxes could push up the price to that of gasoline. So for fuel economy, the attraction of diesel cars might be short-lived.

Diesel engines have certain inherent quirks, too, that make them hard to live with. Powerplants have to be

Volkswagen's Rabbit (left) has been fitted with a diesel and is being tested. International Scout (below) is now available with a diesel option.



VW Rabbit diesel engine is, like the gasoline engine, mounted transversely.

International Scout diesel engine is a six-cylinder in-line, displacing 198 cu. in.



HERE'S ONE DRIVER WHO DIESELED HIS OWN

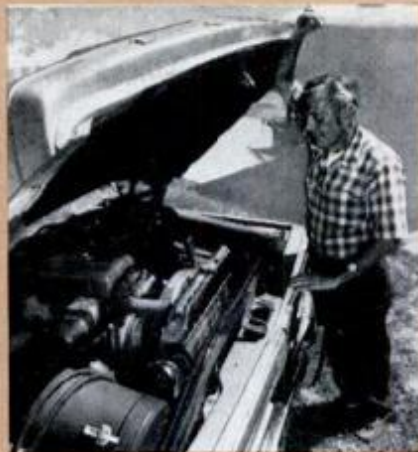
heavier than their gasoline counterparts—thus more expensive—because compression ratios of 20:1 aren't uncommon so that reciprocating parts get more strain. To counter rough running, the diesel's flywheel has to be large and heavy also, as do the head and block. A 200-bhp gasoline engine weighs about 600 pounds, while a diesel of the same power rating weighs three times as much.

It's no secret that diesels are noisy and smelly, but still the average automotive diesel fulfills current U.S. smog requirements without such hang-ons as catalytic converters, pumps, electronic ignition, EGR, and the like. Still, diesels put out 3.8 times as much sulphur dioxide as gas engines and 7.8 times as many particulates (soot and lead). So if the government ever decides to restrict smell and soot, the diesel's pollution advantages might go up in smoke.

Another diesel handicap is relatively sluggish performance. Now, though, diesel cars like the Mercedes and Peugeot will keep up with normal American traffic. And while drivers have to compensate for slower acceleration, they soon learn to adjust and drive accordingly.

But none of the drawbacks of

(Please turn to page 126)



Marvin Haynie inspects the three-cylinder GMC diesel in his 1971 pickup.

This past summer, Marvin Haynie of Stockton, Calif., yanked the V8 from his 1971 Ford ¾-ton pickup and slipped in a three-cylinder GMC diesel.

Haynie is one of a growing number of engine swappers who are going for diesels to help beat the rising cost of gasoline. Several garages and shops around the country now specialize in diesel swaps. The average conversion can take up to 100 hours of work at normal shop rates, with the cost of the engine additional.

Owners of motorhomes and one-ton trucks are the more anxious customers for diesel swaps, but car and truck drivers are also among those switching to diesels.

Haynie, who's a shade-tree mechanic par excellence, has worked on diesels for 40-odd years. He did all his own conversion work in this instance, so he saved considerable money. Even so and despite the fact that he puts 45,000 miles a year on his pickup, it'll take him several years to recover costs.

\$3050 investment

His total investment, excluding labor, stands at about \$3050. This breaks down to \$1000 for the engine itself, which he bought used and immediately overhauled to the tune of \$600; \$300 for the turbocharger; \$150 for the Chrysler TorqueFlite automatic and \$1000 for incidentals.

The engine is a Series 3-53 GMC diesel (the "3" in the designation means three cylinders, the "53" denotes displacement per cylinder, for a total of 159 c.i.d.). It's a two-stroke unit that originally powered a railroad track-bed tamping car. In that form it was unturbocharged and rated at 78 bhp. Haynie concluded that 78 bhp wouldn't give his pickup enough oomph, especially since he wanted to keep its original power steering, power brakes and airconditioning. So he decided to hop the engine up a bit.

Tricky turbocharger

After the overhaul, he replaced the stock 40-mm fuel-injector nozzles with 55-mm and added the turbo. This last came via quite a bit of cut-and-try. It ended up being half from a Cessna 220

and half D-6 Caterpillar. Both halves are Airesearch, but the cold end came out of the Cessna and the hot end from the Cat.

Haynie machined his own engine-to-transmission adapter to mate the GMC diesel to the TorqueFlite. The reason he chose Chrysler's automatic is that it doesn't depend on vacuum to signal shift points. Ford's and GM's automatics do use vacuum. And while diesels produce vacuum via a vacuum pump, it's of a different order than that of gasoline engines and makes for rough shifting. The TorqueFlite uses governors and shifts smoothly with a diesel.

Accessories bolted on engine

Haynie figures, too, that since the diesel will outlast his Ford pickup, he wants to be able to transplant it in a newer vehicle in the future. Toward that goal, he's bolted all accessories directly to the engine—the turbo, all filters, plus the power units for air, steering and brakes. This way he can remove the entire powertrain as a unit and re-install it in a new pickup when necessary.

Meanwhile he was careful not to make any frame or sheet-metal changes to the '71 Ford pickup, and any time he wants to reinstall the original V8, he can.

Haynie's two biggest headaches in this conversion were routing the exhaust for a free gas flow, and discovering and compensating for the fact that Ford engineers had originally offset the V8 1½ inches to the right. Had he known that before he started, Haynie could have saved himself the trouble of remaking new engine mounts twice.

Driving impressions

The engine fires with a roar and settles down to a remarkably smooth, yet noisy, idle. Drop the selector into "Drive," and the pickup moves out with the sound of a big rig. There's a combination of diesel rap, turbo whine and throaty exhaust roar. It's louder than any normal passenger vehicle, but the sounds aren't annoying, and at 55 mph, wind noises cancel out the engine noise.

Acceleration feels more than ample. Chassis dynamometer checks show 100 to 105 bhp at the rear wheels—about the same as the 351-c.i.d. V8 used to deliver. At 60 mph, the turbo is putting out 6 to 8 p.s.i., so the diesel gives good passing acceleration.

The three-cylinder GMC engine weighs 230 pounds more than the Ford V8, so there's a little more front heaviness, but you'd never notice it in normal cornering. If you hot-dog it through turns, you feel a little more understeer than usual, but nothing drastic.

There's relatively little engine braking with a diesel, and that's something that takes getting used to. Another odd feature is that the engine doesn't die when you switch off the key. You have to hit a separate kill button.

All in all, it's a pleasure to drive this pickup, and even more so when you realize you're saving about \$3 on every tankful of fuel.—Michael Lamm





The 240D is Mercedes' least expensive model, just under \$10,000 for '76. Owners like clean lines, ample interior space. The 240D shares basic body with other 200 series sedans, so only way to tell it from 230, 300D and 280 models is by the "240D" on trunk lid.

A nationwide survey based on 4,449,779 owner-driven miles.

PM OWNERS REPORT: MERCEDES 240D DIESEL

The pleasure and pain of owning a diesel

by Michael Lamm WEST COAST EDITOR

Mercedes introduced its first diesel-powered passenger car in 1936—the 260D. This, in fact, became the first mass-produced diesel car in the world.

Owners of diesel automobiles have always been a breed apart. Surveys show they're generally more knowledgeable about cars. They drive longer-than-average distances (some of our correspondents put as many as 95,000 miles a year on their cars), so they're more interested in long engine life and fuel costs.

On the other hand, they're willing to put up with or ignore such diesel traits as low horsepower, noise, high initial cost and searches for diesel-fuel stations.

Most people don't regard Mercedes as an economy car. The 240D currently retails for \$9930 East Coast port of entry, and that's with four-speed transmission and minus transportation, taxes, license and any accessories. Equipped with automatic and air, a new 240D rolls out the showroom for over \$11,000.

An expensive car like the Mercedes can be economical if you drive it far enough. The diesel's low maintenance and depreciation help make it so over the years.

Yet in our survey, 72.2 percent of 240D owners put down **economy** as their primary reason for buying. And no fewer than 64.7 percent listed **economy** as the one thing they like most about their Mercedes diesels.

How do owners rationalize economy with so expensive a car?

"I used to own a large car that gave five miles per gallon when gas was short. This 240D gets 28 out on the highway," says a New York merchant.

A retired colonel in Florida sees it this way: "I'm 76 years old and don't expect to buy another car. This one is good for 15 years, is economical, well built and meets pollution requirements years ahead."

And a self-employed Texan: "Fuel economy and low depreciation are why I keep buying Mercedes. This is my third. I've driven each one five years and then sold it for about what I paid new."

An Illinois machinery salesman: "I bought



Photos by the author

To start cold engine, driver must wait for glow-plug to light—a minute or so in really cold weather. Some owners want the windshield wiper/washer controls changed.

my car for the long life of the diesel engine, no tune-ups, minimal maintenance, good mileage, inexpensive fuel and prestige."

Economy is, of course, a relative thing, but if the diesel owner drives his car long enough, he surely can realize a saving in fuel. Take this example. Compare the 240D with a full-sized American car, both driven 20,000 miles a year. Say the Mercedes averages 28 mpg on diesel fuel costing 45 cents a gallon. The U.S. car averages 14 mpg on gasoline costing 60 cents a gallon. The diesel owner, then, spends \$535.50 less annually for fuel. Over five years, that's \$2677.50.

Five-year-old Mercedes diesels still bring nearly \$4000 on the used-car market. Used full-sized American sedans, on the average, are worth perhaps \$1500 at age 5. So you can see that the combination of high resale value and good fuel economy can, indeed, turn the expensive Mercedes into an economy car.

A retail salesman from Bay Harbor, Fla., observes: "No matter what the price, America

One 240D owner said that like Hudsons and Studebaker enthusiasts, diesel owners are a breed apart.

Lack of a carburetor and ignition system eliminates conventional tune-ups.

Expensive parts, long waits for service, and steep periodic maintenance irk a number of Mercedes owners.

cannot produce a car that approaches the quality, safety, engineering, road stability and dependability of a Mercedes-Benz. The diesel is phenomenal at highway speeds, and I feel safer in my 240D at 90 mph than at 40 mph in any American car. And the Mercedes can run forever at 90!"

Such boundless enthusiasm seems to be typical. Comments a semiretired Arizonan: "I can't praise this car highly enough. It's my first Mercedes—wish I'd found out about it 20 years ago. My 240D rides like a stiff Cadillac, so I can drive 500 to 600 miles a day and not be tired (I'm 63 years old). The diesel is almost foolproof—I've seen some with 500,000 miles and still running fine."

And a Virginia communications manager: Excellent workmanship—absolutely zero flaws in the car when it was delivered. Nothing needed fixing. I'd ordered my car shipped directly from Germany, too. The arrangements were handled by the North American distributor, but my local dealer handles warranty items agreeably. I'm especially impressed with the durability of the diesel engine, low fuel costs, excellent handling and roadability, and low depreciation."

It can't all be roses, though, and it's only fair to consider owners' complaints as well. Here are representative samples:

"Poor passing capability, noisy when idling, smoky and a short disc-brake-pad life," says an Illinois business owner.

An Iowa sales engineer: "Sluggish performance in the mountains make this car nearly impossible to drive in those regions. I'd also like to see other sources of service besides the dealers."

"Brake pads don't last more than about 12,000 to 14,000 miles," says a Chicago commodity broker, and he's echoed by nearly 10 percent of our correspondents.

A Wisconsin furniture contractor: "Noise level is a bit high when talking back to front during highway cruising. I also consider the cost of parts too steep for both mechanical and body items."

We should point out that a full 25 percent of our owners said they had no complaints at all with their cars. That's an extremely high percentage in this day and age. But moving

Summary of Mercedes-Benz 240D Owners Reports* (Owners surveyed bought their 240Ds in January 1974)

Total miles driven 4,449,779	Workmanship 12.0	Good to excellent 98.0%	Loose fanbelts 14.3
Average miles per gallon	Specific dislikes:	Average to poor 2.0	Brakes 9.5
Manual transmission	Lack of power 22.2%	Rear seat	Transmission 8.3
Local driving 26.5	Poor or expensive service 12.5	Good to excellent 88.0%	Electrical 8.3
Long trips 30.0	Brake wear 9.7	Average to poor 12.0	
Automatic transmission	Rattles 6.9	Number of vehicles owned:	
Local driving 24.2		Mercedes only 23.1%	
Long trips 27.8		Two cars 57.1	
Transmissions	What changes would you like?	Three cars 14.7	
Automatic 57.1%	Increased power 19.0%	Four or more cars 5.1	
Manual 42.9	Better tires 7.0	Makes of other cars owned:	
Why did you choose the M-B diesel?	Better materials 5.6	Mercedes-Benz 22.5%	
Economy 72.2%	Is buying diesel fuel inconvenient?	Volkswagen 17.5	
Performance 17.2	Yes 10.4%	Chevrolet 14.2	
Quality 9.9	No 89.6	Ford 10.0	
Past experience 7.9	Dealer sales policy:	Buick 7.5	
Comfort 7.9	Good to excellent 75.1%	Had any mechanical trouble?	
Specific likes:	Average to poor 24.8	Yes 53.8%	
Economy 64.7%	Workmanship opinion:	No 46.2	
Handling 42.0	Good to excellent 97.4%	What type of trouble?	
Comfort 40.7	Average to poor 2.5	Airconditioner 19.0%	
Performance 18.7	Comfort opinion:		
	Front seat		

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



Front buckets rate tops in comfort, and most praise rear seat as well. Some say vent wings would improve air circulation.

This four-cylinder diesel gives long, trouble-free life, say owners, and many plan to keep driving well past 300,000 miles.

along to something very different, let's hear comments about general comfort.

From a professional chauffeur in Tempe, Ariz.: "For six months I was employed as a chauffeur for a Phoenix businessman. He had occasion to ride in my 240D when his Cadillac limousine was being repaired. He's 6-2, with long legs, yet he commented several times how comfortable the car is. Even I like the back seat when others drive!"

"The back seat is more comfortable than the front," observes an Iowa sales consultant, and several other owners agree. Yet a Michigan cattleman counters: "We have a Cad Coupe de Ville. The Mercedes rides better, but the rear seat is a little tight for big passengers (it's fine for the grandchildren)."

And a North Carolina textile engineer: "This car is like an orthopedic mattress. It's hard, but after 500 miles behind the wheel, I can get out and walk away with ease."

In the area of dealer service, nearly two-thirds of the owners we surveyed gave it a mark of *good to excellent*. That's on a par with responses we received from owners of, for instance, the AMC Pacer, the Chrysler Cordoba and GM's Nova and Ventura.

Here are some comments about the Mercedes dealers' service departments:

"My dealer makes you make an appointment," says a self-employed Miamian, "and some parts aren't on hand. My dealer had to replace my engine mounts due to a drivetrain vibration. The vibration is still there, but the factory rep is going to re-examine the car next week."

A Louisiana chain-store owner: "My dealer was 20 miles distant until he lost the M-B franchise. Now there's only one mechanic left in this area, with the nearest dealer 55 miles away. Yet I rate service satisfactory."

A Tennessee sales engineer: "Service is generally good here. I do think, though, that they are too anxious to replace rather than adjust something."

An Oregon petroleum jobber: "A small Mickey Mouse cap on the back of the fuel injector disintegrated, allowing diesel fuel to run down into the clutch. Ever since, I haven't been able to start out smoothly. Even though the car was on warranty, the factory man refused to put a new clutch plate in. The dealer took the clutch apart and charged me \$38. The mechanic forgot to tighten the rear engine

mounts, so by the time I got home, I could hardly move the car. If any other manufacturer made a comparable diesel, I would buy it over the Mercedes merely because of M-B's attitude concerning the clutch."

A Virginia accountant says of Mercedes' service: "Expensive—but good."

Relatively few owners maintain their Mercedes themselves, but those who do complain that the oil filter is very hard to get at—and messy once it finally drops. Another persistent complaint—the one about the soft front disc-brake pads—irked a majority of maintain-it-yourselfers. A minister from Oregon wrote: "They put in these soft brake pads so they won't squeak, but they definitely wear too rapidly."

"More power," urges an Illinois administrator, "because at 5000 feet in the Rockies the car will hardly go." Fully 19 percent of our correspondents concur.

A Virginia attorney: "A larger fuel tank—20 to 25 gallons—would give the car a great range at no sacrifice of trunk space." The present tank holds 17.2 gallons plus a 2.4-gallon reserve.

A North Carolina Navy chaplain: "Reposition controls. Starter very inconvenient. Glow-plug light can't be seen."

A Michigan pharmacist: "I'd like to see a turbocharger offered, at least optionally, and especially in the higher altitudes."

A Minnesota diesel mechanic: "Put vent windows back in the front doors. Wind noise is excessive when front windows are rolled down any amount at all. I'd also suggest turbocharging the engine."

"Better tires," says a retired Oregon doctor, "because I had to replace my original set at 22,000 miles. The rears, especially, wear erratically under varying loads with the independent rear suspension."

And what do owners think of the 240D's general workmanship?

A retired nurse from Virginia muses: "We thought about this question for a long time and couldn't come up with a single complaint. It's a marvelous automobile. We're proud to own a Mercedes and thank the Germans for their impeccable design and engineering."

A Virginia dentist "Excellent quality—car is really tight."

A Florida elevator serviceman: "Excellent;

(Please turn to page 127)

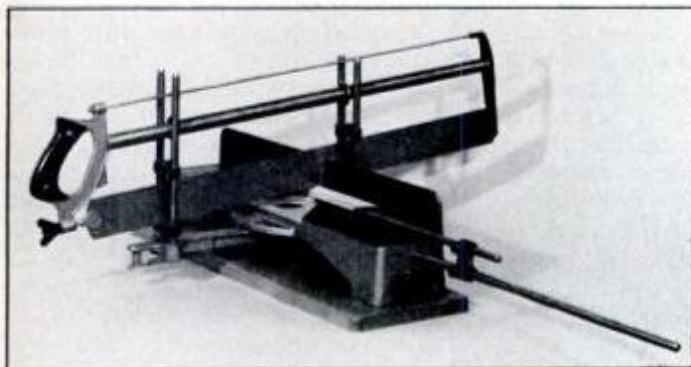
Owners who change their own oil would prefer a spin-on filter, and those who take their cars in for service say that oil changes can sometimes take four hours.

Fuel-tank capacity on the 240D and 300D is greater for '76—up to 20.6 gallons.

One owner says, "I'd like quality steel-belted radials as original equipment instead of the lousy rayon radials." Several others echoed this sentiment.

It's hard to find good mechanics in smaller communities.

IT'S NEW NOW



Miterbox with unique blade has great capacity

Depth of cut with this miterbox is not limited to saw-blade width. Instead, a hacksaw-like frame holds a thin, flexible blade under adjustable tension. The relatively narrow blade produces fine cuts and less friction when buried in a cut, and is fully supported by guides front and rear. These have rubber bumpers to eliminate shock at the end of a stroke and a device to hold the blade up so stock can slide under freely. Saw frame rides in practically frictionless Micarta bearings. Accurate locking is provided at 45°, 60° and 67½° right or left and 90°. Beechwood box has adjustable stop rods, comes in 17½ and 24½-in. lengths; \$103 and \$141 postpaid from Woodcraft Supply Corp., 313 Montvale Ave. Woburn, Mass. 01801.

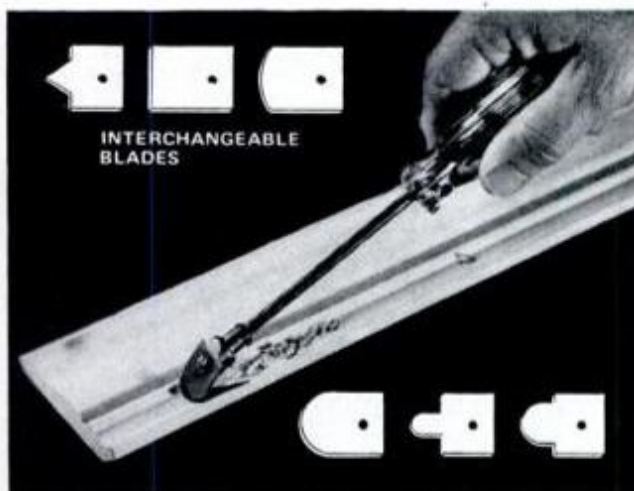


Compact food and beverage center

You can keep just about anything in this smartly styled compact refrigerator from Frigidaire. It has space above for glassware, utensils or a cheese board. The unit provides 4.3 cu. ft. of refrigerated space, including a freezer compartment with ice tray, has a spreads compartment, condiment shelf, egg nests and three interior shelves. Its handy serving surface can even double as a desk. "The Male Box" is suggested for den, family room, patio, college dorm or office, and sells for about \$270.

Scraper goes where sandpaper can't

To get at tight spots on furniture or window frames for refinishing or repainting, Shape-Skrape has six quickly interchangeable blades to fit virtually any surface contour. Handle and long shank assure positive control; blades are hard-tool steel and reversible. Shape-Skrape sells for about \$3 retail or \$3.99 postpaid from Connecticut Valley Mfg. Co., 265 Newington Ave., New Britain, Conn. 06051.



Graphite lubricating 'paint' for home, yard

Suitable for a variety of household lubrication tasks, Slip-Plate is a dry graphite paintlike coating that cuts friction without attracting dirt, is unaffected by temperature, impervious to corrosion and works equally well on wood, plastic or metal. Won't come off on hands or rub off in use; a 14-oz. aerosol can is about \$3 retail or \$3.99 postpaid from Superior Graphite Co., 20 North Wacker Dr., Chicago, Ill. 60606.



Thermostats update steam heat

For fuel economy and comfort, new individual thermostatic valves control steam radiators to maintain desired room temperature. The thermostats require no wiring, can be installed with their control dials separately mounted and can be used with hot-water and two-pipe steam systems as well as on radiators. In angle and straight-through styles for ½ or ¾-in. pipes, Honeywell, Inc., Minneapolis, Minn. 55408.

PM tests budget speakers:

If you've been going without lunches to save up for a stereo system, here's a bunch of speakers that may put you on a regular diet again. PM checked out nine models that offer respectable sound at price tags under \$80 and found that the best of them are very good indeed. As a group, these speakers give the pleasures of good audio for the lowest prices.

As the actual voice of your sound system, speakers—more than any other component—determine what

you hear. And if you are short on cash, the choice is all the more important for speakers are often the biggest item in your audio budget. With this in mind, we've tried to pinpoint the best buys among current low-cost speakers.

All speakers in this group are two-way systems, with woofers for the lower frequencies and separate tweeters for the highs. All are compact, some

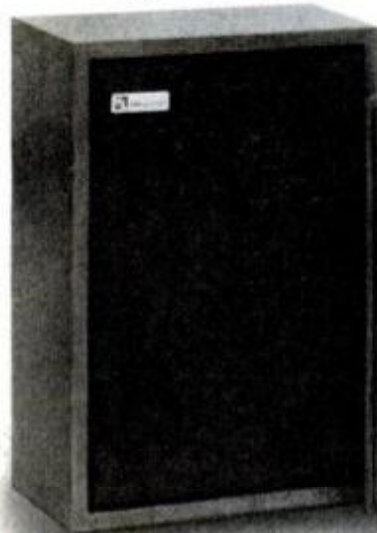
hardly bigger than a shoebox. Smallness is one reason for their low price; it takes less material to make them. Also, the woofers in these units range in diameter only from 6 to 8 inches—about 4 to 6 inches smaller than in full-size speakers; that, too, is an economy. As for the tweeters, most of them are cone-shaped rather than dome-shaped, which reduces cost, though it also reduces the angle of treble dispersion slightly.

We found considerable difference between the various models tested. But on the whole, most of them produced pleasing and musically acceptable sound. Only one was clearly below par. And two were clear stand-outs in terms of naturalness and clarity of sound and outperformed some of the larger systems selling at twice the price.

Granted, the lowest reaches of the orchestra, the thump of the bass fiddle and the deep pedal notes of the organ, don't come through with the same solid thrust as in larger systems. Nor does the limited power-handling capacity of these speakers let you shake the walls with hard rock or Wagnerian thunder. But the best of the group had a very natural tonal balance, an adequate bass, sweet highs and enough treble dis-



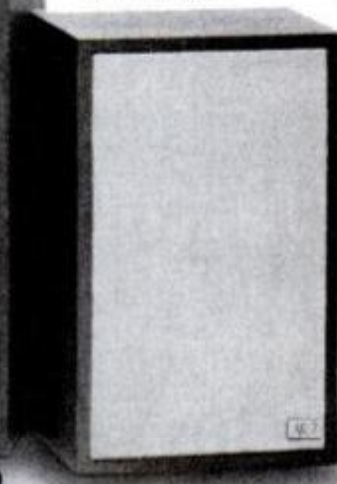
Hegeman H-80, \$72



Advent 2, \$74



Acoustic Research AR-7, \$75



Dynaco A-10, \$60



Avid 60, \$60



Some give rich sound

by Hans Fantel

persion to give the sound a spacious and open feeling.

Test methods

The performance of a speaker can't be accurately pinned down by purely technical measurements. Frequency response and other specifications—even when correctly measured and honestly reported—don't really tell what a speaker sounds like. So the judgment is necessarily personal. But to gain a measure of objectivity, I didn't rely on my ears alone but asked two other experienced and knowledgeable audio fans to rate the speakers independently. As it turned out, all three of us noticed the same variations in tonal color.

In our test setup, all speakers were hooked to a switching device permitting instant A-B comparison of any two pairs of speakers. We drove the speakers with a high-quality Yamaha amplifier rated at a moderate power output of 15 watts per channel. We deliberately picked such a low-powered amplifier because budget speakers are most often used in low-cost installations where available power is limited.

We set up all of the speakers in a room larger than the typical living room to toughen the test conditions. In our case, the room measured 18 by 25 feet. If a speaker could fill a room this size with ample sound, we figured that it would have no trouble in most homes. Nearly all speakers in the group put out more than adequate sound levels under these

conditions—even in heavy orchestration—without budging into distortion.

Equalizing loudness

In comparing speakers, all speakers under test must be heard at exactly the same loudness. Otherwise, a slightly louder speaker will always sound better rather than louder, regardless of its true merit. We therefore equalized the loudness of all speakers through a special set of controls on the switching comparator. To obtain the most accurate possible loudness match, we made these adjustments with a "white noise" test signal, which contains all audible frequencies in a random mix. ("White noise" is the kind of sound you hear on FM sets between stations.) On speakers having a separate tweeter level control, we set these controls in the position providing "flat" response—neither stressing nor softening the highs.

We checked out all speakers with different types of music: a heavily orchestrated symphony, a concerto for guitar and orchestra with a very transparent sound texture, vocal music, jazz and rock. The object was to see how each speaker handled these different types of sound.

Test results

The two standouts in the group were the Advent 2 and Hegeman H-80. All types of music sounded lifelike and convincing. Even the big orchestral climaxes stayed clear and

undistorted, the rock bass had a sharp punch and real presence, and the highs were remarkably natural and spread nicely all around the room. It was the kind of sound that lets you forget the speakers' low cost.

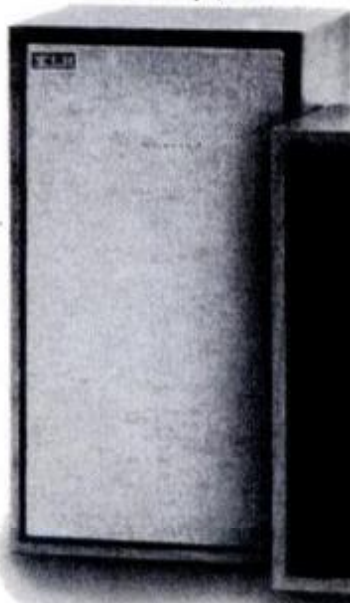
The Electro-Voice E-V 13B just about equaled these high standards, especially in its clean, natural bass. The only negative comment was that the treble sounded just a trace hollow when an operatic soprano cut loose with some high notes. (And it wasn't just the timbre of her voice—we checked that against the other speakers.)

The Acoustic Research AR-7 and Dynaco A-10 speakers sounded quite similar to each other, nicely balanced, with an unobtrusive but ample bass and clear highs. Because of their rather softly rounded highs, both these speakers produced a very smooth impression of orchestral strings, but they lacked just a bit of punch for jazz and rock. They would appeal mainly to classical listeners.

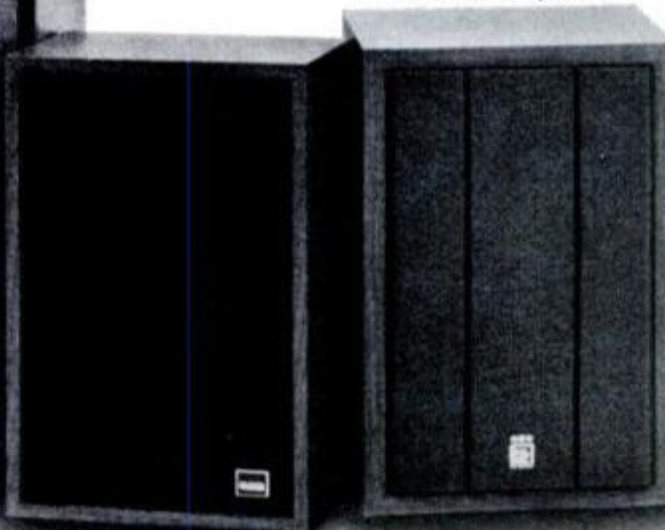
The BIC-Venturi Formula 1 had a nice, punchy bass and crisp highs, while the Sylvania AS 3708 sounded a little tubby in the lows—but its highs were clear.

The KLH 32 had a "big" sound. This may appeal to some listeners, but to us it seemed boomy—like a jukebox. An effort to make the speaker sound more

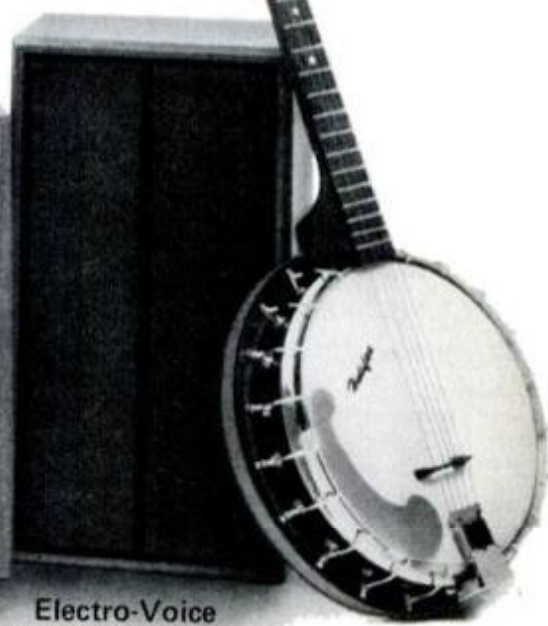
KLH 32, \$63



BIC-Venturi
Formula 1, \$75



Sylvania AS 3708, \$65



Electro-Voice
E-V 13B, \$80



Our test equipment included this Advent speaker switcher, which let us compare all of the speakers at the same sound level, and this Yamaha amplifier.

full-bodied apparently resulted in too much bass resonance.

The only seriously flawed speaker tested was the Avid 60, with a honky resonance in the midrange, rather weak bass and muddy highs.

Efficiency ratings

Because speakers in this price range are mostly used with low-powered amplifiers in inexpensive systems, we also measured their efficiency. Keep in mind that efficiency has nothing to do with a speaker's sound quality; it merely tells how much sound is put out for a given amplifier wattage. In fact, the most efficient model tested was the Avid, which flunked out on all other counts. Our ratings in the table below show how many decibels softer than the Avid each speaker would be when fed the same amount of amplifier power. Since 3 decibels (dB) is the smallest readily perceptible sound change, differences of less than 3 dB are insignificant.

Next to the Avid, the BIC-Venturi and the Hegeman were most efficient and would probably produce plenty of sound with amplifiers rated as low as 8 watts per channel. The Advent, AR and Dynaco were the

least efficient, but even they put out plenty of sound when fed by 15 watts per channel, and would probably work well on 12 watts. The rest had medium efficiency and would need about 10 watts per channel for satisfactory use in a large room. Maximum amplifier power these speakers can handle safely is probably around 25 watts per channel. All are rated at an impedance of 8 ohms, except Advent (4 ohms). But this makes no practical difference.

Design details

Some models offer interesting design. The BIC-Venturi differs from the rest by using a horn tweeter rather than a cone tweeter. It also features a modified bass-reflex enclosure (the "Venturi" design) to maximize bass output. Both factors contribute to its high efficiency. The Hegeman uses an aluminum tweeter cone to gain crisper transient response, sharpening the impact of drum-beats and the plucking of strings; an aluminum insert in the woofer cone smooths and extends the high end of the woofer's response.

Tweeter-level controls on some of these speakers help match their tweeter outputs to the acoustic properties of the listening room by adding or subtracting treble. But the amplifier's treble control does about the same thing, so the absence of a tweeter-level control is no handicap.

Speaker placement

Unavoidable limitations of small speakers at the low end can be partially overcome by placement tricks and in setting amplifier controls. Putting speakers on the floor and in corners will greatly increase bass output and efficiency. These small speakers can also use help from the amplifier to project more bass. Therefore, it's often wise to set the bass control on the amplifier for a slight boost, but not so much as to make the sound boomy. These simple items of audio know-how will help you make the most of these excellent speaker bargains. ★★★

A KIT SPEAKER



I BUILT IT: Speakerlab's instructions are simple, fun and thorough. They make assembly easier than changing a light bulb—and with less chance of getting burned. Wiring is preassembled, speaker openings pre-cut, and the only tools you need are a scout knife and sandpaper (though a stapling gun can cut assembly time from 90 minutes to 60).

But if you still have any problems—directions that seem confusing or parts that seem to be missing—Speakerlab offers the ultimate in kit convenience (and courage): a free long-distance number you can call for advice.

Once your speakers are ready to hook up Speakerlab is ready too with an eight-page operating manual (*Technical Compendium & Hot News Gazette*) that gives everything from a tongue-in-cheek graph of power requirements vs. your age (20 watts if you're 50 or over, 200 watts if you're a 20-year-old rock fan) to frequency-response graphs that help you pick the best speaker locations.

Dimensions of the \$59 Speakerlab S1's are 9½ x 11¼ x 18¼ inches; it's a two way system (woofer and tweeter) with a tweeter level control. My only regret was that with an engineer waiting to give me free advice over the phone, the instructions were so complete that I had no excuse to call him.—*Bill McKeown*

I HEARD IT: Unfortunately, the S1 came too late for our full-dress test. But in comparison with one of our top-ranked speakers, I found the S1 has a fine open treble, and medium efficiency. Its only failing is a slight bass resonance which made the lows fairly impressive at first hearing, but might sound muddy on extended hearing; but it's not enough to be annoying, and does add a bit of punch to rock.—*Hans Fantel*

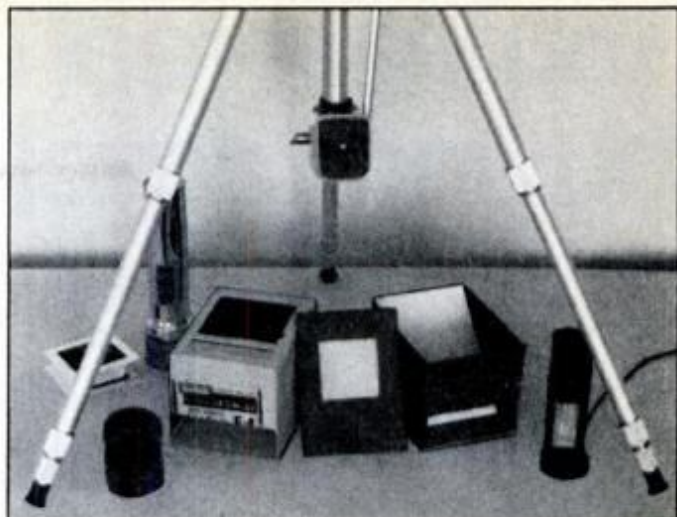
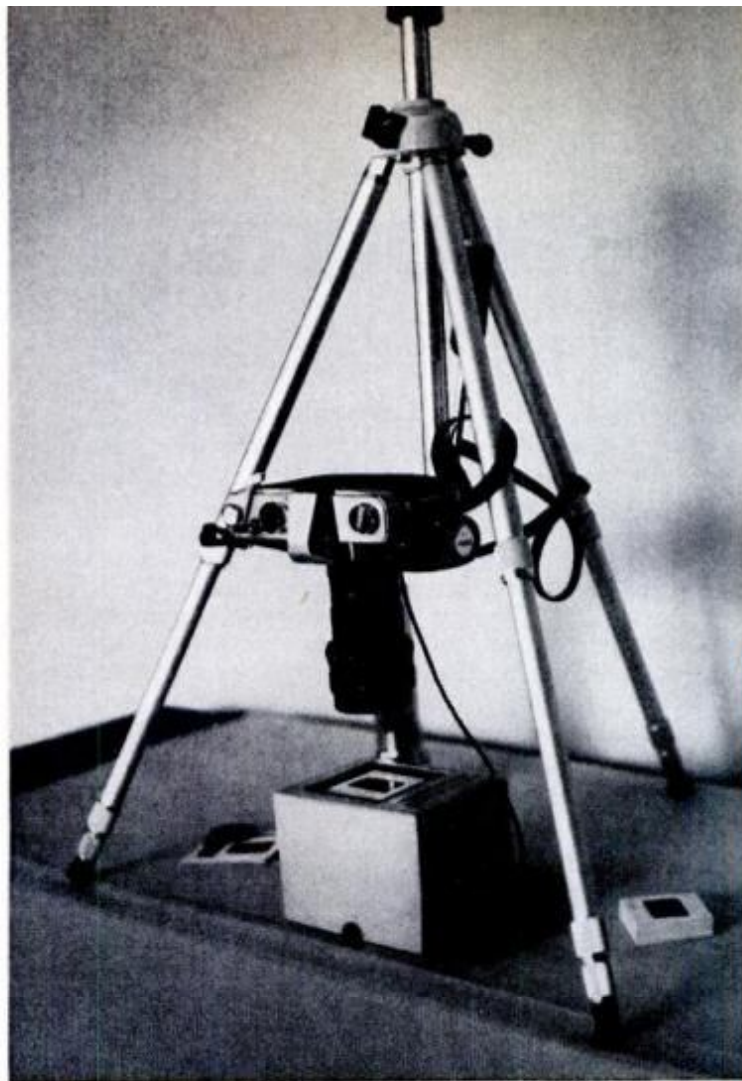
Who makes it: Speakerlab, 5500 35th N.E., Seattle, Wash. 98105.

BUDGET SPEAKERS COMPARED

Make and Model	Price* Per Speaker	Dimensions	Efficiency (see text)	Tweeter Level Control
Acoustic Research AR-7	\$75.00	6¼ x 8¼ x 15¾"	-10 dB	Yes
Advent 2	74.00	7½ x 11 x 19½"	-9 dB	No
Avid 60	60.00	8¼ x 8¼ x 28"	-0 dB	No
			(Reference)	
BIC Venturi Formula 1	75.00	10 x 11 x 17"	-7 dB	Yes
Dynaco A-10	59.50†	8 x 8½ x 15¼"	-12 dB	No
Electro Voice E-V 13B	80.00	8¼ x 10 x 19¼"	-7.5 dB	Yes
Hegeman H-80	72.00	8 x 11 x 17½"	-8 dB	No
KLH 32	62.50†	7 x 11 x 19½"	-12.5 dB	No
Sylvania AS 3708	64.50	6¼ x 10¼ x 16½"	-13.5 dB	No

*List price (often discounted by local dealers)

†Sold only in pairs



Slide-copy illuminator for less than \$1

by James L. Abbott

Photos by the author

Call this box a "slide converter" because it lets me shoot with slide film all the time. Then I can convert the results into any other type of film: black-and-white, color negative or duplicate slides. I can also make 35-mm copies of 126 (Instamatic) or $2\frac{1}{4} \times 2\frac{1}{4}$ (120) slides, and sandwich negatives or positives for unusual effects. But the best of all is the box's cost: less than a dollar.

The box originally held $3\frac{1}{2} \times 5$ -inch photographic printing paper. If you don't use it in sufficient quantity so you have a box this size, you can get one from your local film processor, usually for nothing. But any box of similar size and construction will do—you could even make your own in a pinch. The $3\frac{1}{2} \times 5$ -inch card that goes just below the lid and the 45° matte-white reflector both can be cut from scraps of poster card stock. A

piece of diffusion plastic is available from plastic dealers, among others, for a few cents. You may be able to do without the plastic entirely; but if you try it, make test shots to be sure the opening is evenly illuminated without dark corners. Just a few minutes spent cutting and assembling the components will quickly produce a valuable and versatile accessory for your single-lens reflex.

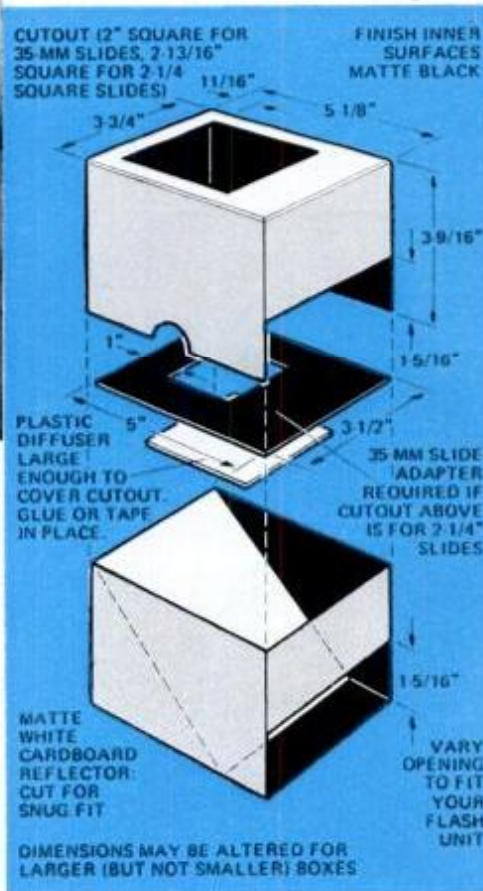
Cardboard box is sturdy

You can make the box from more substantial materials, but it's hardly necessary. The cardboard version should have many hours of use, and another can be made in short order.

To use the box, slip your flashgun into the slot, mount your camera

above the box with extension tubes or bellows to let you get close enough, and drop the slide you want to copy into one of the holes on top of the box. The 2×2 -inch lower opening will block off part of a $2\frac{1}{4}$ -square slide—but not as much as you think: just $\frac{1}{16}$ inch from each edge of the visible image area. If you use only $2\frac{1}{4}$ -squares, you can do without the inner adapter plate. (If you don't make $2\frac{1}{4}$ -square slides, then you simply can cut a 2×2 -inch hole in the box top, and do without the inner adapter.)

One last tip: Since the flashgun illuminates only the slide as you shoot, keep a flashlight handy to light up the slide as you focus and frame your camera. ★★★



All you need to copy slides is a camera having close-up gear, an electronic flash and this box—which you build for about \$1. The disassembled view (above) shows simplicity of construction: just a photo paper box, a white cardboard reflector, a cardboard mask and a piece of plastic diffuser. The flashlight is used to illuminate the slide for focusing. The dimensions shown at left aren't critical, but smaller box might not fit your flash.

You'll get real bargains buying 'recycled' car parts

Solid tips on shopping and saving at auto wrecking yards

by Michael Lamm
WEST COAST EDITOR

An auto part bought at a wrecking yard costs you a third to half what you'd pay for it new through a franchised dealer. For older cars, the dismantler's price comes down as low as 10 percent.

Even so, some people wouldn't stoop to shop for car parts at a wrecking yard. Too tacky, they'll tell you; also too risky and too messy. Besides, you get no guarantee, and

you usually end up with the wrong part anyway. On top of that, they'll argue, wrecking-yard owners love to haggle, and they're unfriendly because they won't let you go "out back."

The purpose of this article is to dispel some of these myths and to tell you the ways auto dismantlers really work—how you can save money and time by using wrecking yards, which types are least expensive, how you can help them help you and what sort of service to expect.

Since so many people have never been to a wrecking yard and haven't even considered going, this primer might break some ice.

First, the dismantling business has come a long way since the old greasy sneaker days. "We're now a lot like any uptown store," one owner told me. His clean, well inventoried, medium-sized yard gives a 30-day exchange warranty on all parts and has three "hot lines" to help find items he himself doesn't stock.

He and others in the business pre-

Photos: Irv Dolin



It's a sea of car doors, but a good parts dismantler will have all the doors marked and will have the locations of doors for specific makes and models indexed in his office. Good

sheet metal and window glass bring relatively high prices, although nowhere near what you'd pay for the parts new. Check the new-part price before visiting a dismantler.



A dismantler's hot line will locate a part that he doesn't have in stock. This saves running around, but hot-line parts cost more than in-yard parts. The hot-line setup shown here is at Mid-Island Auto Parts in Deer Park, N.Y. Dave Marro helps a customer to find parts he needs for his Datsun 510.

fer the term *dismantler* but accept *auto wrecker*, although they say, "You wreck, we dismantle." They don't accept the term "junkyard," and dismantlers aren't scrap or metal salvage dealers.

The more progressive yards around the country currently use concrete aisles, space-saving pigeon-hole stacking in wire racks, forklifts for retrieval, pneumatic tools for removal and computerized inventory systems. Today there's a general atmosphere of a department store about them.

The Association of Auto and Truck Recyclers (AATR), based in Washington, D.C., estimates that there are 10,000 dismantlers in the country. The average parts yard covers five acres, employs three to seven people, stocks 300 cars and grosses \$500,000 a year.

Dismantlers are of several types. Some sell late-model parts only; others specialize in imports, older cars and even in single makes of cars. Some, of course, don't specialize in anything and carry a smorgasbord.

The dismantling business has been booming of late. Economic hard times mean good times for wrecking yards because people who hang onto their cars in tight-money times would rather fix than switch.

How to get the best prices

For the best prices and service from a dismantler, remember these three rules:

- Phone around to find the part you need;
- Get price quotes before you see the part;

- Bring in your old part to be sure the new one matches.

Let's say you need a decklid for your 1970 Torino sedan—your present decklid's been bent out of shape by some minor rear-ender.

Begin by phoning your local Ford dealer's parts department to get an idea of what the decklid costs new. Then, using your local directory call half a dozen wrecking yards to see if they have the part or can get it via their "hot lines."

Ideally, you want to find the yard that has the part in stock and at the lowest price. Hot-line prices are



higher than in-stock prices. I'll explain why in a moment. While you're phoning, comparison-shop by getting quotes before you leave your home. It often helps, too, to locate several decklids, because the first one might not pan out for some reason. And you might stumble onto one that's your color, so you might save re-painting it.

An important point is to establish

Small parts that you may need, like side-view mirror above or gas-cap door spring at left, may be hard to buy separately because the dismantler wants to keep the door or panel intact so he can sell it as a unit.





Good deals on engines removed from low-mileage wrecks can be had, but be careful and be sure that you obtain a written warranty.



For some parts, such as axles, alternators and so on, bring in your old part for comparison.

price early—before you drive to the yard—because once the counterman hands you the part, if you *then* ask him for its price, it will likely be more expensive than if you had asked beforehand.

How hot lines work

All larger yards have so-called “hot lines”—radiotelephone hookups to other yards. Hot lines operate like the old country party line or like a huge intercom system. The intercom is always open, and everyone on the line listens in continuously. By pressing a button, any yard in the system can talk to all the rest.

Currently some 120 hot lines are crisscrossing the nation, linking approximately 4000 yards. Most larger dismantlers have three hot lines: a local one that covers 20 to 30 other wreckers within, say, a 15-mile radius, plus two regional lines that span much larger territories. Regional lines often overlap but link up two different sets of yards. In other words, Regional Line A might tie together 80 dismantlers in upstate New York, and Regional Line B might cover another 80 yards, also in upstate New York, but these last 80 will be a different set. In any given town, perhaps four yards will belong to Line A and another four to Line B.

Local lines usually cost the dismantler \$15 to \$30 a month; regional ones \$125 to \$200, depending on the number of terminals and the size of the territory.

There are statewide and nationwide hot-line hookups. Rarely,

though, will a part be shipped farther than 200 miles because freight charges become prohibitive. National hot lines are viewed as something of a luxury.

If the yard you're phoning doesn't have your Torino decklid in stock, a good counterman will say, “Let me put out a call on my hot line.” He'll ask you for your name and phone number and will call you back within the hour.

Keep in mind, though, that hot-line parts are about 25 percent more expensive than parts in stock. That's because of shipping, overhead, time spent in locating and the local yard's commission. So, avoid hot-line parts if you can. Sometimes, of course, it's

the only way to find something, especially in a hurry.

The price of parts

Prices vary from area to area. Big-city parts are more expensive than ones in rural wrecking yards. A \$25 part in Stockton, Calif., brings \$40 in Los Angeles. Why? Because land costs more in bigger cities. So does labor. Also, there's simply more demand for used parts in population centers like Los Angeles—more people trying to keep older cars on the road. Too, big cities have more wrecking yards bidding on insurance salvage.

To give you an idea how prices vary, here are the results of a 16-yard survey taken across the country by the AATR last May.

Part	High	Low	Average
1971 Chevrolet 350 V8	\$375	\$250	\$310
1970 Chrysler TorqueFlite trans	150	75	110
1969 VW Bug transaxle	125	75	90
1971 Pinto rear axle assembly	75	45	65
1969 Cadillac driveshaft	85	45	65
1971 GMC 15-inch wheel	10	7	9

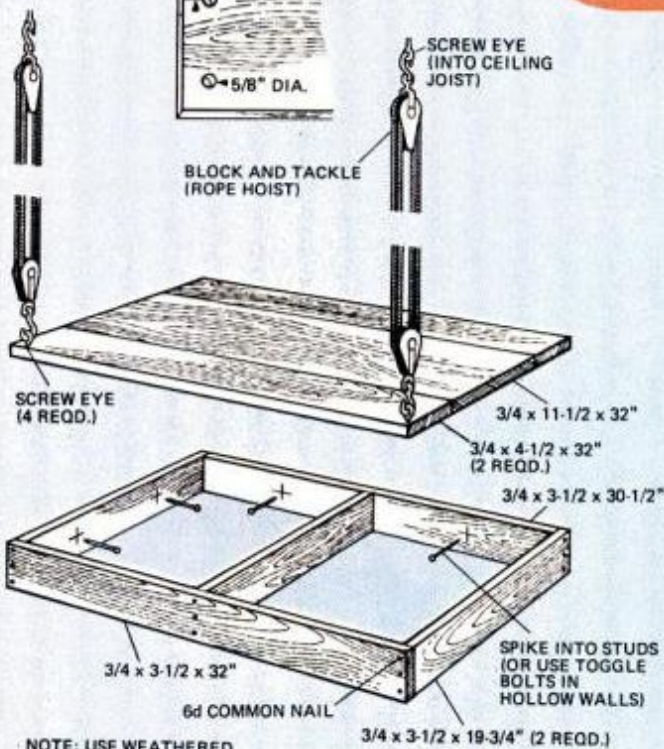
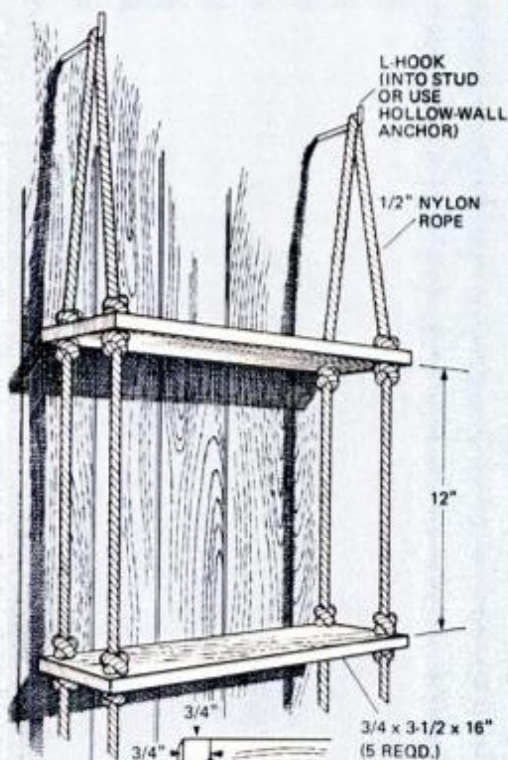
Prices vary locally, too, but not to so great an extent. The size of the yard makes little difference, because the hot line represents a great educator. Every yard on a line knows what every other yard is charging, so if the counterman at a small yard overhears what a large yard is getting for a part, why should he charge less?

Generally speaking, the later model the part, the more it will cost. That's
(Please turn to page 156)

Used wheels from a dismantler are a good buy, even if they are the cast-alloy type.



A room with nautical flavor



NOTE: USE WEATHERED BOARDS IF POSSIBLE. OR, USE COMMON PINE, THEN FINISH TO SIMULATE BARN SIDING.

Sheltered haven for youngster or dad gets its mood from weathered paneling and the hanging desk and shelf we show you how to build.

Interior designers know that a home decorating scheme stands a far better chance of being successful when a basic theme is adhered to—and if elements within the room are kept relatively simple. Because both rules were followed here, this room with seagoing theme is both appealing and functional. Two panelings from the Masonite Corp. help to create the mood: Chapel White Stone applied to one end wall, and Driftwood (from the Forrester series) on the remaining three walls and ceiling. Hefty, but false, rafters overhead complete the feeling of seashore and ships.

The clever room accessories, for which we've drawn plans, are at once charming and practical. To build them, you can use low-cost common pine which can quickly be made to look like driftwood. After cutting parts to size, distress the lumber by beating with a chain. Next, sand the parts smooth and apply a latex stain. Finally, brush on two coats of semigloss varnish. Assemble and hang the pieces as shown, using nylon rope and hoists which are available from Sears stores and catalog outlets. *Caution:* Make certain hooks are well anchored in wall and ceiling.—Harry Wicks

New gadgets turn your pocket cameras into photo systems

by Ivan Berger
PHOTOGRAPHY EDITOR



Pocket camera lenses (from rear): Tiffen HCE telephoto, Burleigh Brooks Computer tele, Kodak 608 with built-in tele, Sedic wide-angle.

What if cameras that took the new, tiny 110-size film were as versatile as their bigger, heavier 35-mm cousins? Camera buffs have been asking that question ever since they first learned how good 110-film photos (especially slides) could be.

Since such cameras aren't in production yet (though they could be very close), accessory manufacturers—and at least one camera company—are doing what they can to make pocket cameras more versatile. Already you can get skylight filters, adapter rings for other filters, close-up lenses, copy stands, electronic flashguns, rubber eyecups, wide-angle and telephoto lens attachments—even motor drives—to fit various 110-camera models.

How many of these attachments you can use depends on which 110 camera you own: Since Kodak's Pocket Instamatic line seems to be the best-selling 110 series, more accessories are made for various Kodak models than for any other makes. (But not by Kodak—which makes only a Magicube extender



for its older models, and an electronic flash and an off-camera flash extender for its new Trimlite series.) But the cameras with the widest range of accessories are the new Sedic 110 cameras—because Sedic designed its cameras for them. About the only attachment that you can be sure to find for any 110 model is electronic flash—there are almost as many 110-flash units around as there are 110 cameras to fit them to. (As we went to press, Vivitar announced one to fit Trimlite and other cameras using the new FlipFlash bars.)



Two dream accessories

Telephoto and wide-angle lenses are the dream accessories, the ones that convert cameras from mere snapshotters' delights to versatile, system cameras. That's probably why Kodak seems to be concentrating its current efforts around the Tele-Instamatic 608, a \$35 camera that switches from normal to a mild telephoto lens with 1.7X magnification—about equivalent to an 85-mm lens on a 35-mm camera—at the flick of the lever just in front of its chrome-plated shutter-release button.

For simpler Pocket Instamatics and Trimlites, Willoughby-Peerless sells Tiffen's HCE telephoto (\$10), a big-lens attachment that gives a moderate 1.6X magnification (equivalent to a 35-mm camera's 80-mm lens). Burleigh Brooks's Computar kit (\$40) fits Kodak's fancier Pocket

Instamatic 60 with a wide-angle and a telephoto lens; the wide-angle is moderate (its 0.85X magnification equates to a 41-mm lens on a 35 reflex), but the telephoto's 1.85X magnification is equivalent to a satisfactory 92-mm telephoto on a 35. And for \$25 each, Sedic offers an 0.7X wide-angle (like a 35's 35-mm lens) and a 1.5X telephoto (equivalent to a 75-mm).



Instamatic 60 with a wide-angle and a telephoto lens; the wide-angle is moderate (its 0.85X magnification equates to a 41-mm lens on a 35 reflex), but the telephoto's 1.85X magnification is equivalent to a satisfactory 92-mm telephoto on a 35. And for \$25 each, Sedic offers an 0.7X wide-angle (like a 35's 35-mm lens) and a 1.5X telephoto (equivalent to a 75-mm).

(Please turn to page 116)

Safety and style: You'll be getting both!

by Michael Lamm
WEST COAST EDITOR

PEDESTRIAN BAR RAISES TO TRAP VICTIM ON SOFT "HOOD" SURFACE. NOTE CLEAR PLASTIC CENTER SECTION ALLOWING DRIVER FORWARD VISIBILITY WHEN BAR IS ACTIVATED. SOFT TRAMPOLINE "HOOD" IS STRETCHED OVER LARGE CAVITY. THIS IS PART OF PEDESTRIAN SAFETY SYSTEM.

CAR-WIDE REAR-VIEW MIRROR GIVES PANORAMIC VIEW. ADJUSTS FROM DASHBOARD.

FRONT WINDSHIELD HINGES UP TO ALLOW ACCESS TO COWL WIRING, HARNESS, DASHBOARD AIR-BAG MECHANISM, WIPERS, ETC.

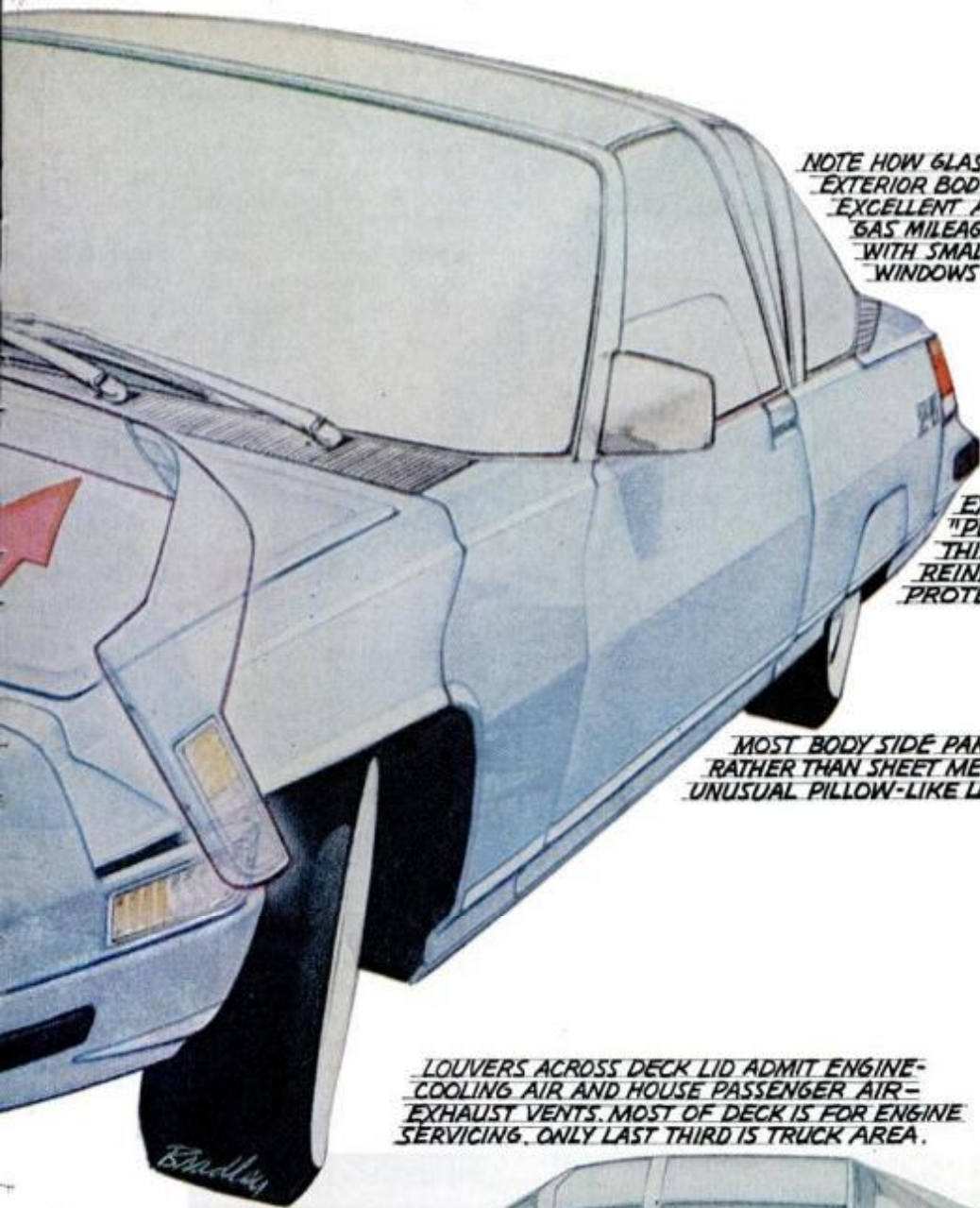
ALL SEATS HAVE SEE-THROUGH HEADRESTS AND AIRCONDITIONING OUTLETS THAT DIRECT AIR UPWARD FOR BETTER BACK-SEAT CIRCULATION.

SEAT CUSHIONS ARE VERY THIN (3 INCHES). STUDIES SHOW THAT THICK PADDING ADDS TO FATIGUE FACTOR AND HAS CONFINING QUALITY. EXCELLENT NEW SYNTHETICS WILL PROVIDE HIGH DEGREE OF COMFORT.

Passengers might have walked away from 70-mph rollovers, 50-mph head-ons and 30-mph side impacts, but the fact remains that America's first generation of ESVs (experimental safety vehicles) weighed too much, cost too much and guzzled too much.

Those early ESVs of the 1950s and '60s by AMF, Liberty Mutual, Ford, GM and the like tried to protect their occupants by sheer weight and bulk. They were heavy, unwieldy, expensive, thirsty and never very practical for actual production.

Now a second generation of ESVs is taking an entirely different approach. These lightweight, compact, stingy, fairly inexpensive research-and-idea cars try to be genuinely practical for production. They are aimed toward the mid to late 1980s and they achieve safety through innovation rather than by bulk. A number of



NOTE HOW GLASS IS NEARLY FLUSH WITH EXTERIOR BODY ELEMENTS. THIS PROVIDES EXCELLENT AERODYNAMICS AND INCREASED GAS MILEAGE. ALL WINDOWS ARE FIXED WITH SMALL, HAND-OPERATED ACCESS WINDOWS ON DRIVER AND PASSENGER SIDES.

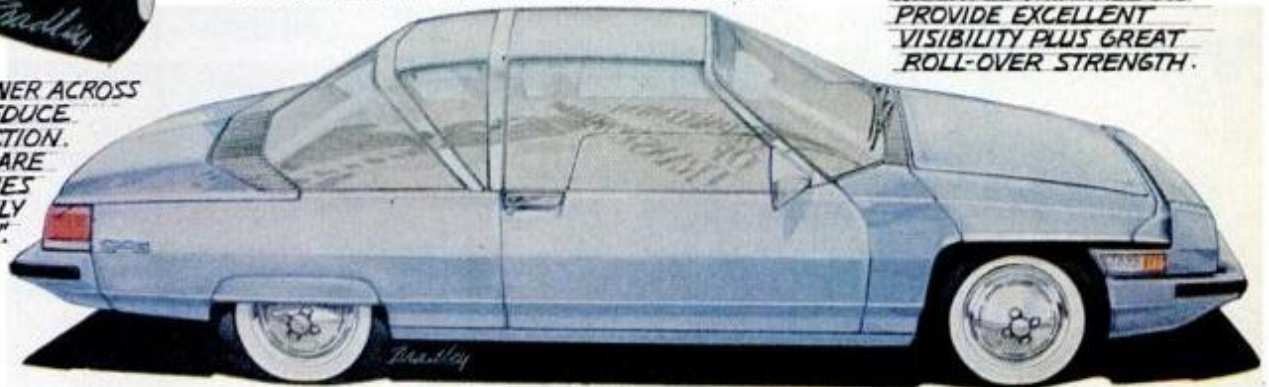
EXTERIOR IS SLAB-SIDED WITH NO "PULL UNDER" AT ROCKER PANELS. THIS PERMITS EXTENSIVE SIDE REINFORCING AND IMPACT PROTECTION.

MOST BODY SIDE PANELS ARE VINYL SKINS RATHER THAN SHEET METAL. THIS GIVES AN UNUSUAL PILLOW-LIKE LOOK.

LOUVERS ACROSS DECK LID ADMIT ENGINE-COOLING AIR AND HOUSE PASSENGER AIR-EXHAUST VENTS. MOST OF DECK IS FOR ENGINE SERVICING. ONLY LAST THIRD IS TRUCK AREA.

EXTENSIVE GLASS AND MULTIPLE THIN PILLARS PROVIDE EXCELLENT VISIBILITY PLUS GREAT ROLL-OVER STRENGTH.

TIRES ARE THINNER ACROSS TREAD TO REDUCE ROLLING FRICTION. THERE'S NO SPARE WHEEL AS TIRES ARE VIRTUALLY "FLATPROOF".



Art: Harry Bradley

these innovations are noted in the drawings on these pages.

Though the first-generation ESVs proved impractical, some design features did, in fact, filter down and now appear in today's cars. Slant-nose front-ends, big bumpers and decisions to eliminate hardtop models came from the first ESVs. So regardless of the second ESV's destiny, some of the research ideas you see here will actually find their way to Detroit's production lines within the next decade.

Designing the second generation ESVs has aroused international interest. Companies in Japan and Europe are getting involved voluntarily, including Austin, Audi and Volkswagen. Their ideas will be presented to our government along with ideas from a number of our own companies.

Last July 20, the federal government com-

LOWER BODY IS SELF-SKINNING, COLOR-IMPREGNATED FOAM OVER LIGHT-GAUGE METAL. THIS IS DENT-RESISTANT AND PROVIDES GOOD SIDE-IMPACT PROTECTION.

THE 1980s LOOK STYLED FROM 2ND GENERATION SAFETY CAR. NOTE CONVENTIONAL RATHER THAN GULL-WING DOORS.



missioned two independent contractors to plan and build the "mules" (working prototypes) of this second generation of safety cars: Mini-Car of Goleta, Calif., and Calspan of Buffalo, N.Y. Calspan is associated with Cornell Aeronautical Labs in Ithaca, N.Y.

The main thought behind these multimillion-dollar contracts: Build a true safety car that can really be mass-produced at a reasonable price. Calspan is working with Chrysler Corp. and is essentially modifying the Simca 1307/1308, making that car sophisticated and producible.

Mules are just starting to take shape, and most of my information comes from unofficial sources regarding Mini-Car's work. Mini-Car will supply 25 test-vehicle structures. Some will be styling mockups, others ride/handling protos, braking cars, configuration studies and crash structures.

Basically, Mini-Car is proposing a

relatively high sills, something like a big bathtub made of .018-inch sheet metal and foam-filled around the periphery. Fenders are solid foam except for wheel wells. It's a so-called "self-skinning" foam, which means its surface forms a natural glaze—smooth or grained—in any color injected into it. The surface is soft to the touch, and the foam's crush rate can be varied by changing density. This, along with the crushable sheet-metal "tub," lets passengers walk away from 50-mph barrier crashes.

The "pedestrian catcher" includes a soft, giving "trampoline" where the hood ought to be. Tests in England have shown pedestrians normally get hit below thigh level and are tossed up onto the hood. As the driver panic-brakes in reaction, the victim slides violently forward again onto the road where he usually cracks his skull or gets run over by the car that hit him or one passing by. So the pedestrian catcher uses

tempered glass. Fixed windows eliminate the weight and complexity of roll-up mechanisms. There's only one small openable window so the driver can reach out to pay tolls. Ventilation is by forced air.

To ward off side impacts, door inners are filled with lightweight, honeycombed sheet metal. Inside the proto, small airbags protect front riders, and all four passengers wear three-point harnesses. In the Mini-Car, seats are of thin section, with a clear polycarbon head restraint that suspends the seatback from the car roof. Seats have flexible nylon spines and are upholstered conventionally. To allow entry to the rear compartment, the seat roof suspensions detach, and the entire buckets flip forward. In other cars, no roof suspension is planned. Pedal-operated front seats slide forward.

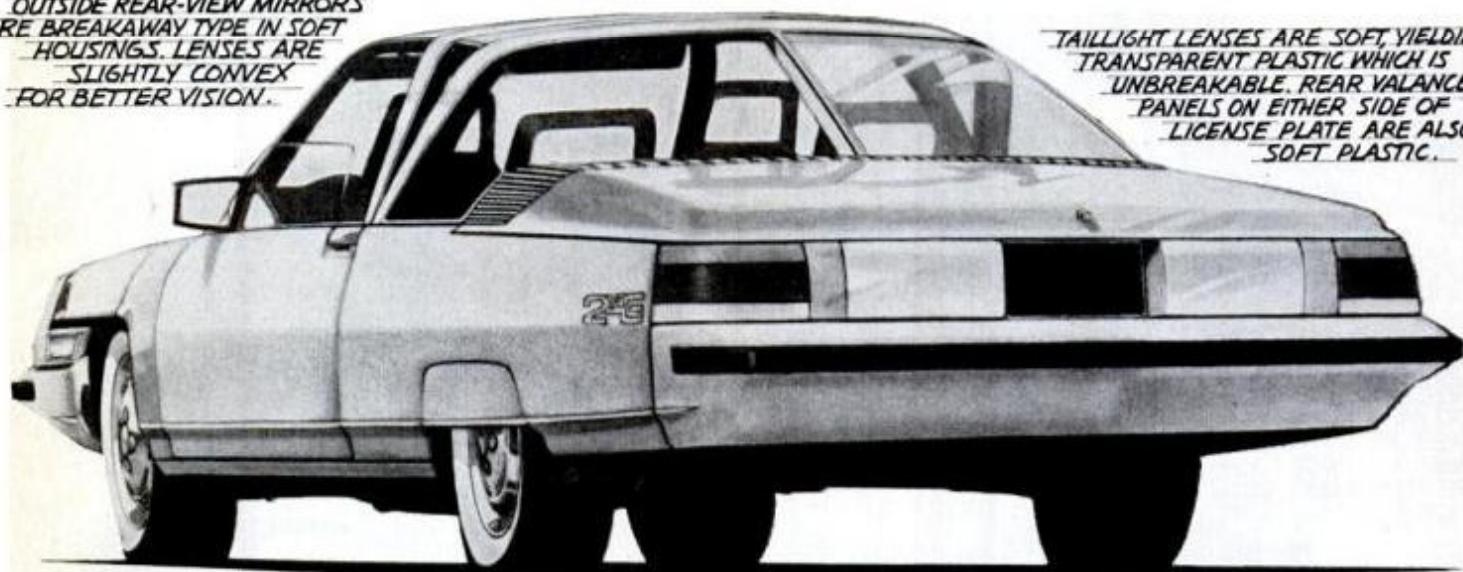
Relatively thin roll bars—three hoops—are mounted over the windshield and at the B and C pillars,

PILLARS ARE INTEGRATED INTO OVERALL STYLING SO THEY DON'T LOOK LIKE THEY WERE TACKED ON.

FRONT SEAT HAS NO MOVABLE BACK. PEDALS MAKE UNIT MOVABLE FOR BACK-SEAT ACCESS. STEERING WHEEL IS ADJUSTABLE.

OUTSIDE REAR-VIEW MIRRORS ARE BREAKAWAY TYPE IN SOFT HOUSINGS. LENSES ARE SLIGHTLY CONVEX FOR BETTER VISION.

TAILLIGHT LENSES ARE SOFT, YIELDING, TRANSPARENT PLASTIC WHICH IS UNBREAKABLE. REAR VALANCE PANELS ON EITHER SIDE OF LICENSE PLATE ARE ALSO SOFT PLASTIC.



ONE-PIECE WHEEL WITH EXPOSED FOUR-LUG BOLT PATTERN. WHEEL-COVER STYLING IS BUILT INTO WHEEL DESIGN.

NO BRIGHT TRIM OR EMBLEMS ON BODY SIDES TO REDUCE WEIGHT. TAILLIGHTS ARE ALSO WITHOUT BRIGHT MOLDINGS.

1900-pound four-seater with foam-filled steel construction. It is a little larger than today's Pinto, with a 104-inch wheelbase, 175 inches overall, and 55 inches tall.

Mini-Car's revolutionary car will have a pedestrian catcher in front, self-skinning crushable foam for the body, radar-coupled four-wheel antiskid disc brakes, all-independent suspension, gull-wing doors, transverse midship engine, front airbags, thin-section fixed glass and three integral roll bars.

The main supporting structure has

the trampoline to soften slamming onto the car hood, then moves a "gate" that comes up to keep the victim from flying back out into traffic.

Below the trampoline is a small trunk compartment with a foot-thick foam floor that's part of the front crash/crush structure. In a 60-mph head-on, the entire front end collapses at a predetermined rate. Bumpers—also foam—are part of the system.

To help keep weight down, all glass is of a new thin section about half as thick but just as strong, as today's

with a center brace running down the rear glass.

Suspension in the Mini-Car mule is Fiat X-1/9, and the antiskid brakes are basically Porsche as modified by Tevis. Engine is a reworked Honda CVCC with the Honda five-speed overdrive gearbox.

Cost analysis studies show that the Mini-Car concept shouldn't be any more expensive to build or buy than conventional production compacts. Finished, running cars are supposed to be ready for evaluation by the government by May, 1978. ★★★

Easy home color prints from slides

by Ivan Berger

PHOTOGRAPHY EDITOR

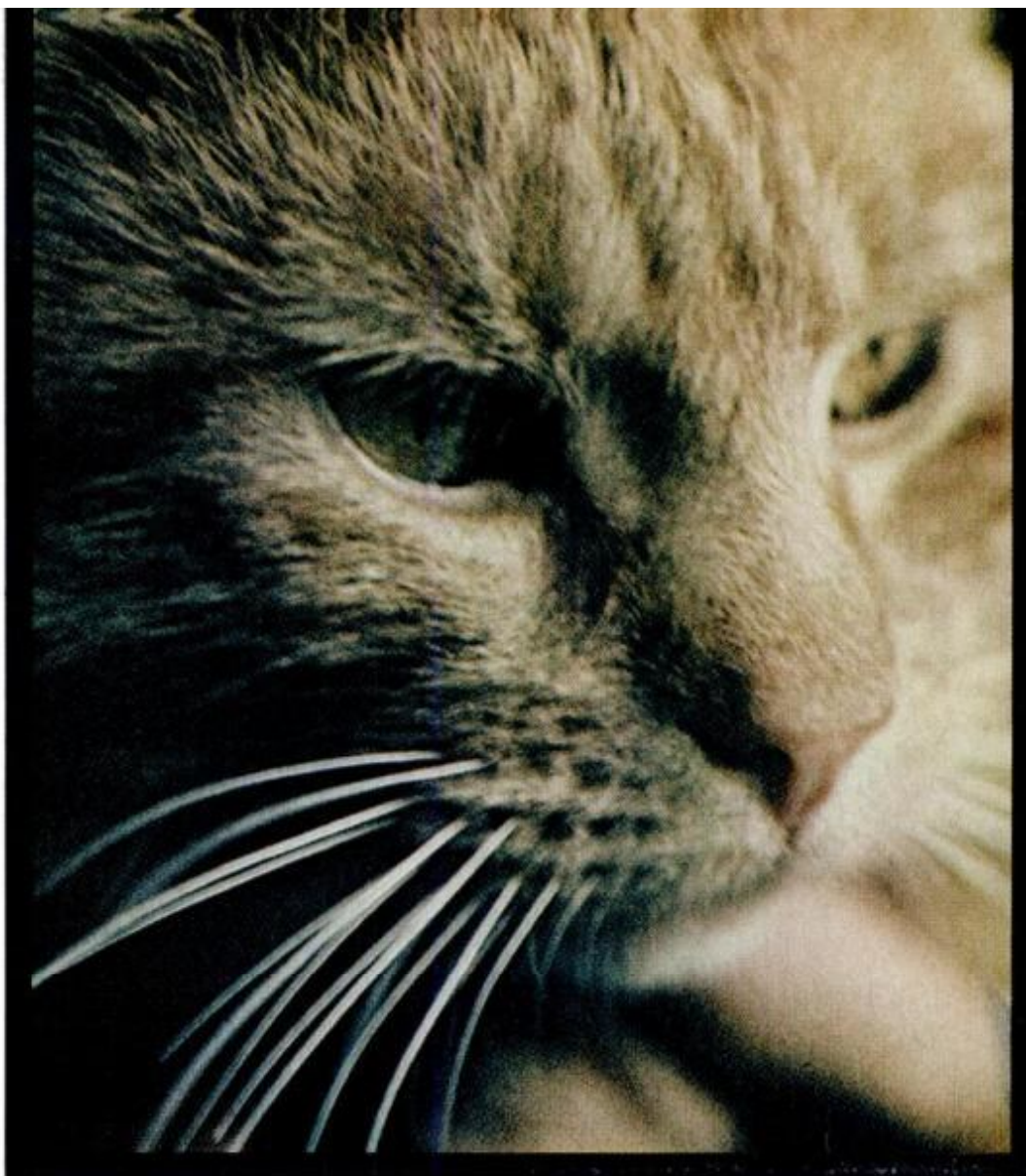
Color photo and print by the author

Making my own color prints from slides didn't exactly scare me, you understand, but I must admit I let a lot of months go by between the time I got my first sample pack of Cibachrome and the time I took it out of my freezer to use it. Now I'm kicking myself for not starting sooner. It took me only one night to begin to get the hang of Cibachrome, and one more to start turning out good prints like this.

Actually, a reproduction on a printed page can't show you quite how good a Cibachrome print is. Unlike most color papers, Cibachrome has its dyes already in the emulsion, rather than forming them chemically during processing. That gives it really rich and luscious colors and—because the dyes act as filters to minimize light scattering—increased sharpness. Combine that with the rich colors and grainless sharpness you can get from slides, and the results are well worth 12 minutes of your time and \$2 of your money (for an 8x10)—especially when you consider that Cibachrome's dye chemistry makes it more fade-resistant than ordinary color-print materials, too.

You get custom results

Then there's the quality advantage that comes from doing it yourself: Only *you* know precisely the tones you want in your final print. And only you know when you want to print the whole slide; when you want to fill the 8x10 frame with just a portion of the slide, as I did in the color shot here (compare the full-slide version partially shown at right), and when you want to frame your picture in some other proportion than 8x10 as in my Eiffel Tower shot, also shown at right.



Color prints like this are easy with new Cibachrome. Useful accessories for this or any color process (right): Brantronics Temp-Set bath (top) for temperature control, Falcon Air-Evac bottles (in bath), Chromega drum and agitator printing base, Unicolor Jingle Bell programmable timer. Prints show custom cropping (see text).

If you're an experienced darkroom worker, you can add still further custom touches, such as "dodging" some areas by partially blocking the light to darken them, or "burning in" other areas with extra exposure to make them lighter. You can even alter color balances of selected areas by waving gelatine filters above them during exposure.

Since you're working from slides, you can see just what colors you're trying to reproduce or change, and check the print against its original. It's easier to judge framing and cropping with slides than with negatives, too.

It's easy

And Cibachrome itself is easy. Processing takes just nine minutes until you can see what you've done,



Photo: Benn Mitchell

just 12 until the print is ready to hang up to dry (its triacetate base won't curl as paper would). You need just three chemicals (developer, bleach and fix), plus a water wash. The recommended temperature of 75° F. (24° C.) is easy to maintain, especially with a 3° leeway up and down, and the steps are each short

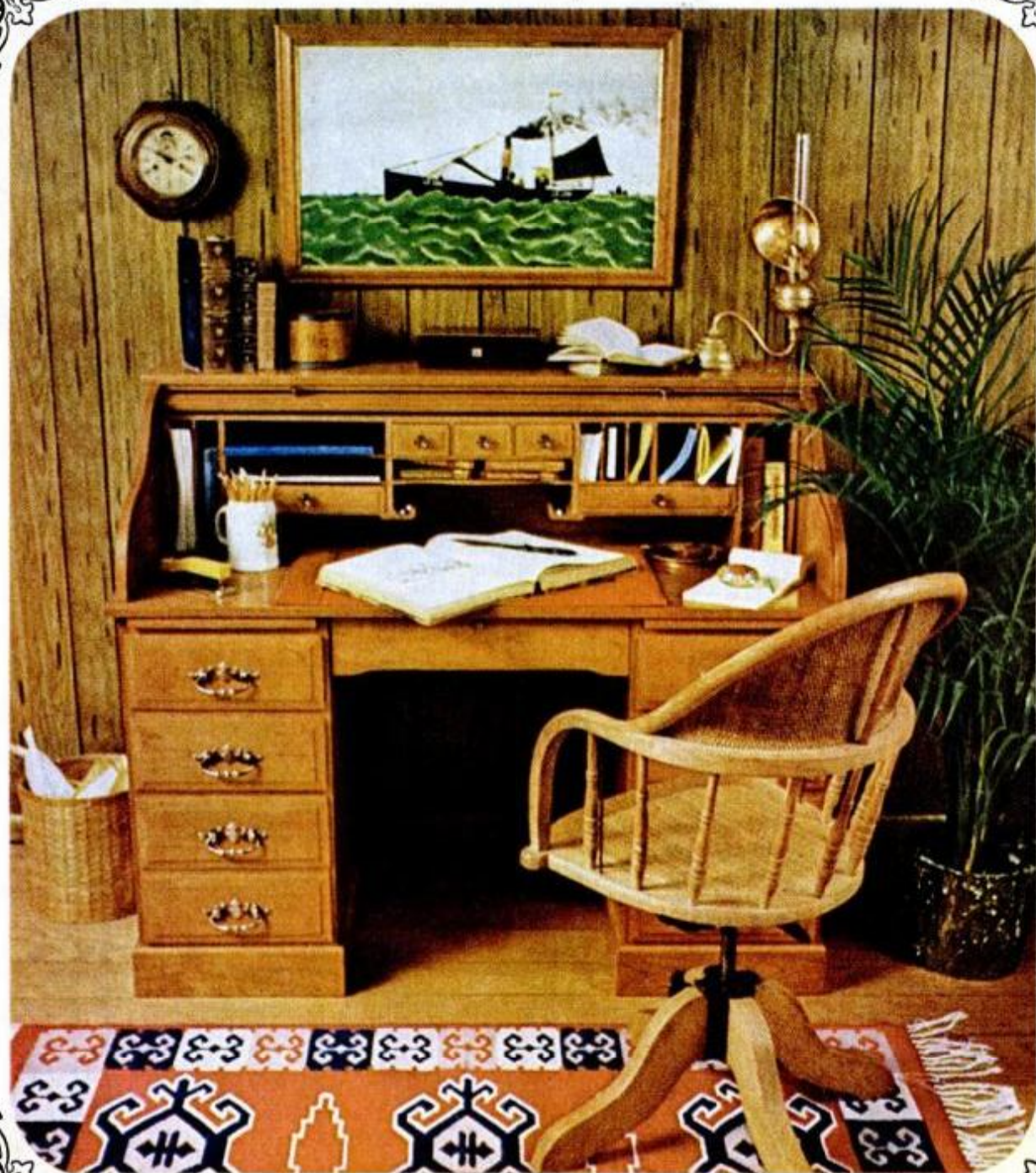
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For nostalgia buffs... a rolltop desk you can build

Turn-of-the-century charm
makes this piece a natural for any room decor

by Rosario Capotosto



Back in the era of the trolley car and Model-T, the rolltop desk was popular in both home and office. Today, it's a cherished antique and you can pay as much as \$1300 and more for a store-bought reproduction. Build it yourself in fine cherry and you can own the charming heirloom you see here for a material cost of about \$380. You build it as two separate units, a base and a rolltop. Here's how:

Step-by-step construction

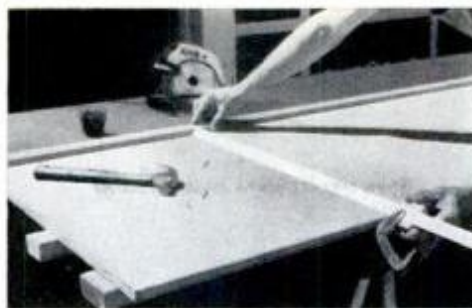
1. Rip the strips for all the frames: upper, lower and center. Use cherry where visible, poplar otherwise.

2. Cut tongues in ends of frame side members (use table saw with spacer between two outer blades of dado set to form two parallel cuts in same time). Tenonner or homemade jig should be used.

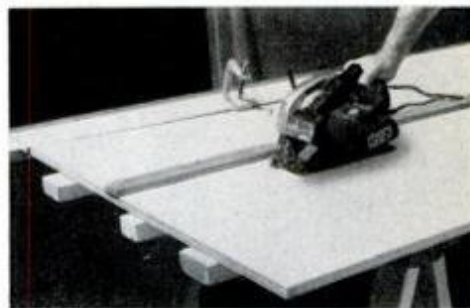
3. Cut 1/4-in. grooves in all side and end frame members, 1/4 in. deep. Cut dust covers from 1/4-in. gum plywood. Make a bit scant to allow space for glue.

4. Cut the pedestal side panels to size from veneer plywood.

5. Use straightedge guide to cut veneer panels to exact size. Since pieces are too large to handle on the average table saw, a portable circular saw is the best. Use great care in setting up the guide and use a smooth-cutting blade. Cuts must be



Block clamped to rule assures accurate straightedge placement to saw plywood.



Good side of panel is placed down and panel is supported by 2x3s on sawhorses.



Identical dado cuts are made before moving jig. Outboard work support is *must*.



Tenon jig and pair of same-size blades with spacer are used to cut frame tongues.

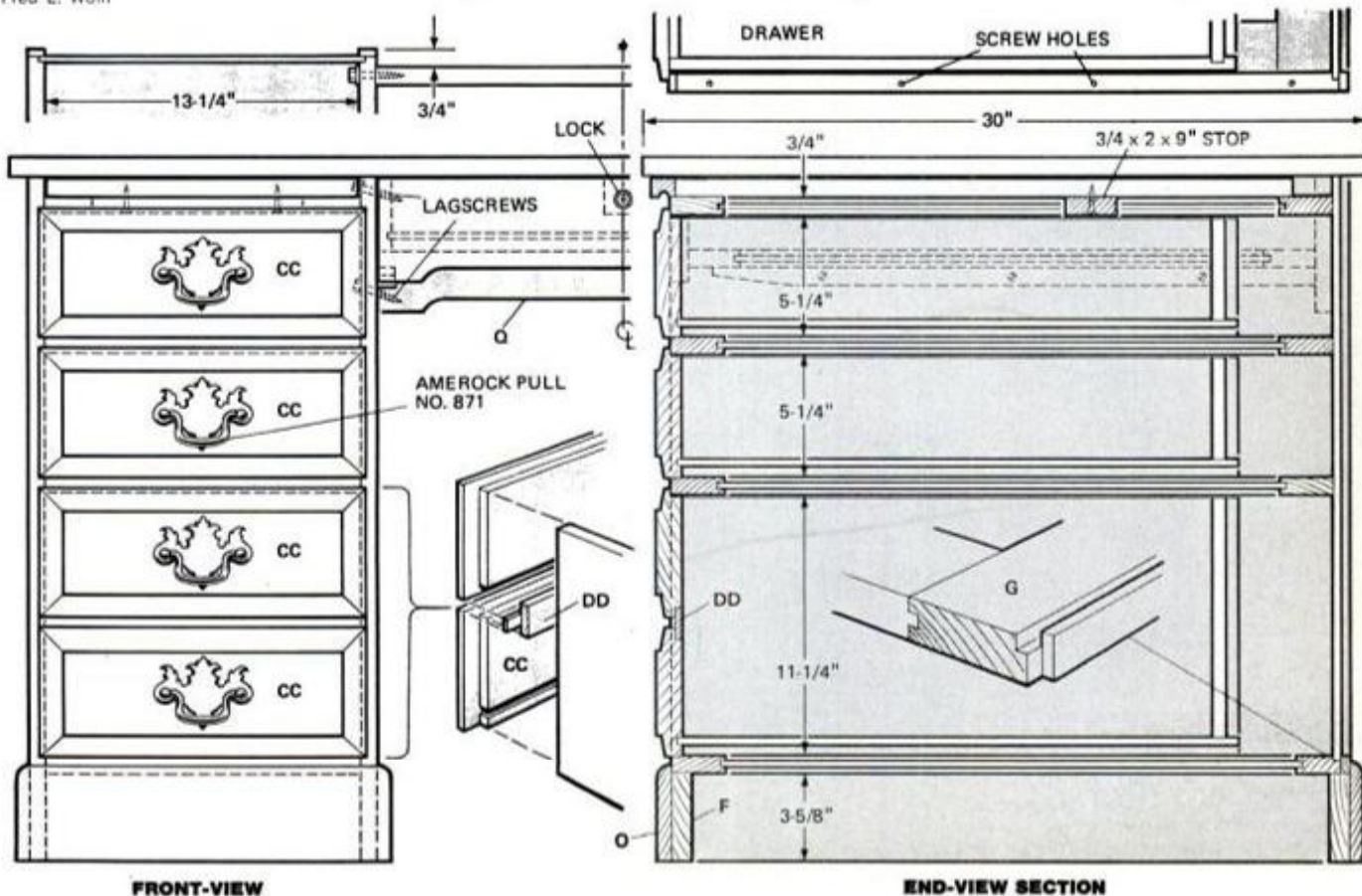


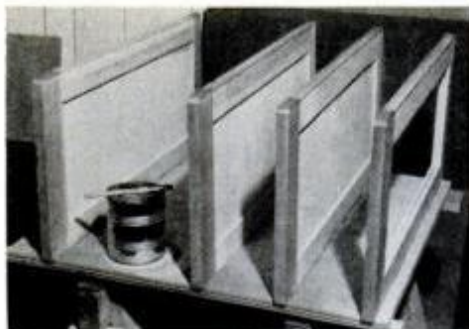
Grooved end members are added to sidepieces after latter are on dust panel.



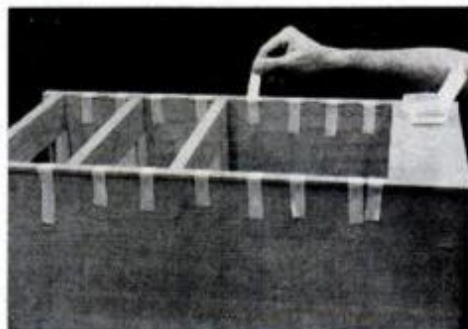
Corner notches are formed by gluing short 1/4-in.-thick strips to the front edges.

Styling: Gabe Herrick
Art: Fred L. Wolff





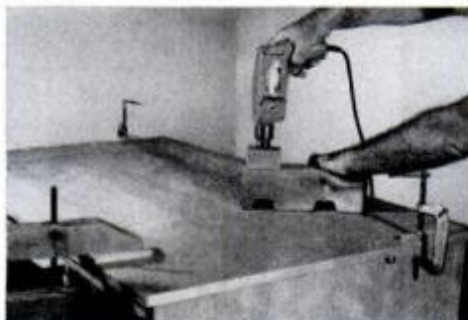
Use a slow-setting resin glue rather than white to allow ample assembly time.



Toothpick standoffs keep tape away from glue line on inside pedestal surfaces.



Center frame is set in place without glue, then drilled for screw pilot holes.



Counterbored holes for wood plugs are drilled at right depth with homemade jig.

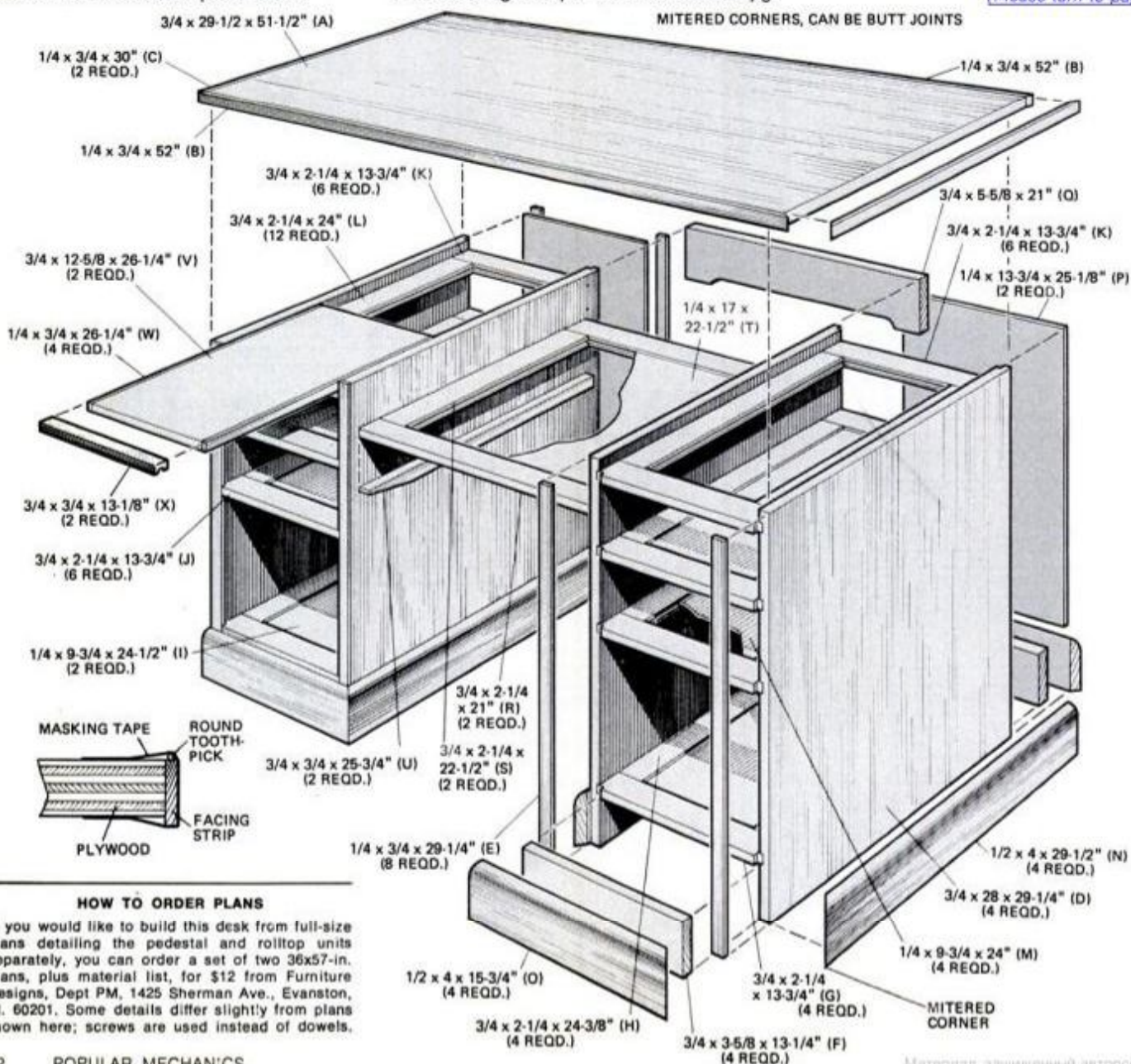
finish cuts. Note: Tack nails are okay for saw guide because all cutting must be done from the back surface of panel in order to obtain clean, sharp edges on the face of the panel with a portable saw.

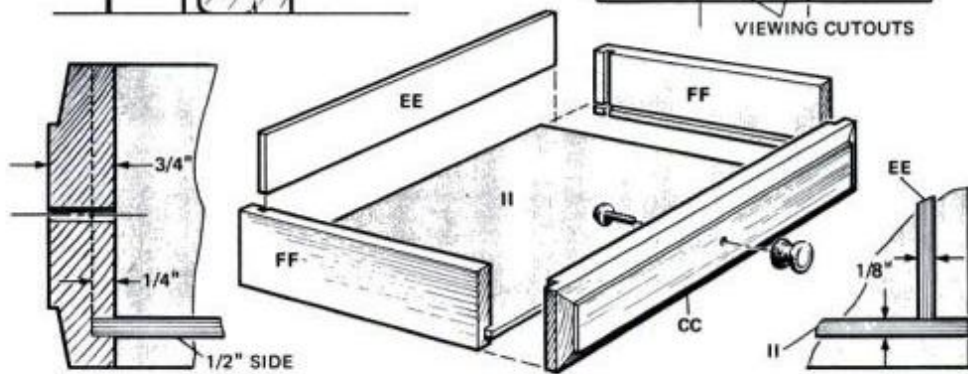
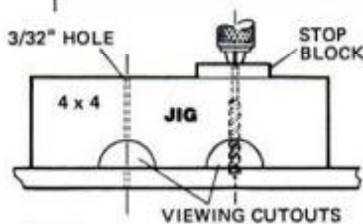
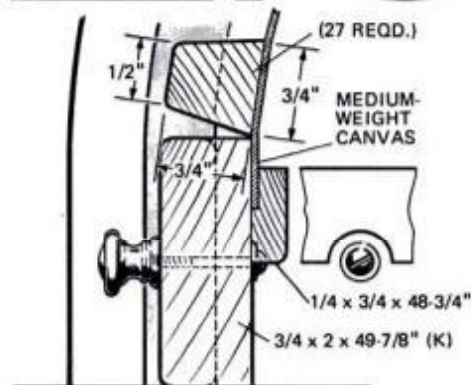
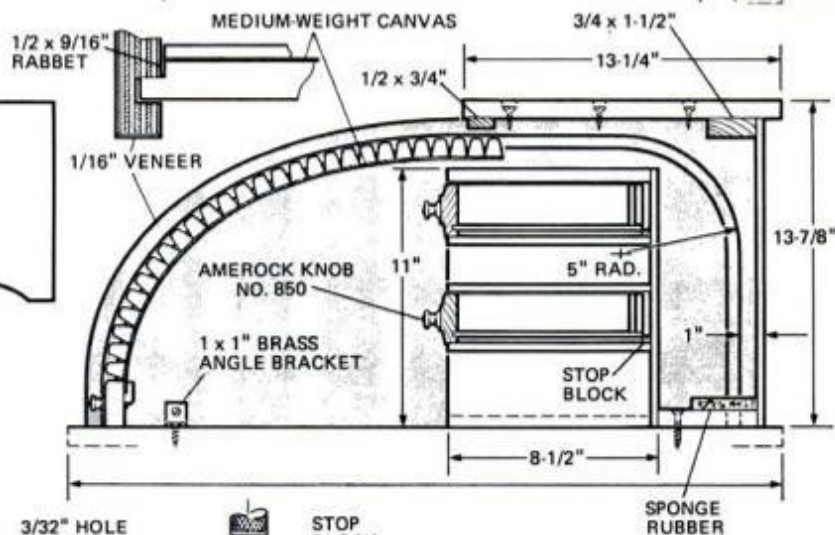
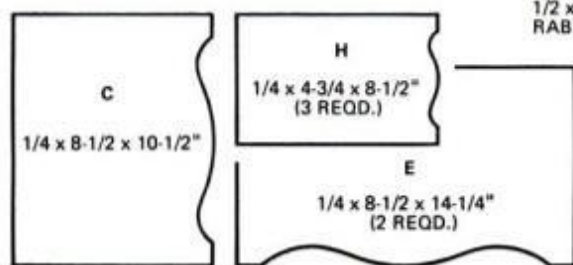
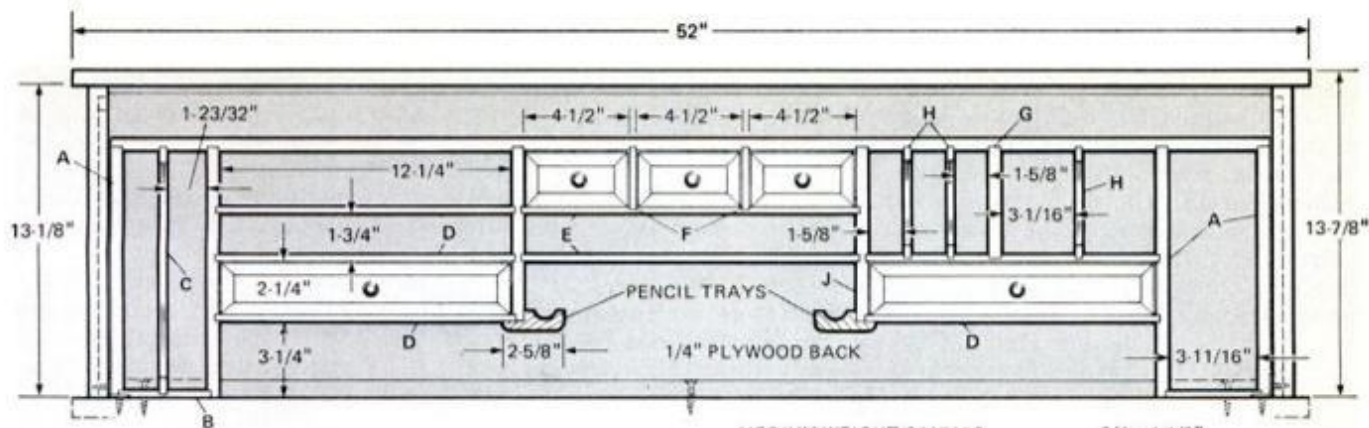
6. Method of notching corners of front frame members to allow the installation of facing strips on the veneer side panels is optional: It can be done with dado cutter or by adding $\frac{1}{4} \times \frac{3}{4}$ -in. strips to the fronts of the frames. The strips are cut short at both ends and must be glued perfectly centered.

7. Use dado head to cut the four dado grooves in the four pedestal panels. Mark all panels for advantageous grain orientation and make each cut on each panel before repositioning rip fence.

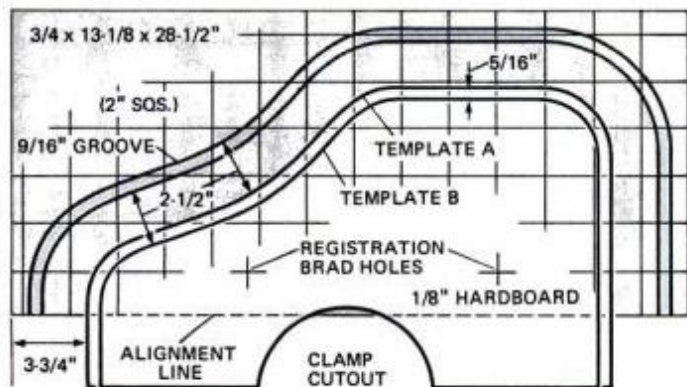
8. Don't use white glue or aliphatics; both set too fast for assembling the pedestals. Plastic resin is okay because it allows about 25 minutes assembly time at 70° F. Scrape off all glue run-off with a

(Please turn to page 144)

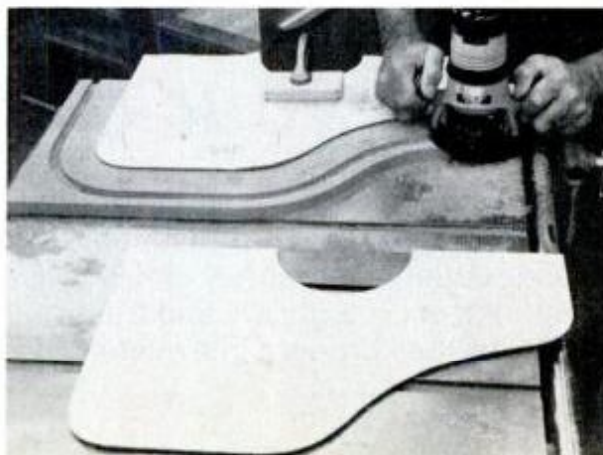




Drawer faces are beveled with saw blade set at 8° angle. Keep hands safe distance.



Two templates guide router to form 9/16-in. groove with 1/4-in. straight bit. Remaining 1/16 in. between 1/4-in. grooves is removed by guiding router freehand.



You've seen it in the movies: They've been drilling for oil for ages. They're broke, ready to quit. Then all of a sudden the well comes in a gusher, pouring down on them like black rain. Their troubles are over; they're rich. Delirious with joy, they splash and roll in the oily muck. Cut.

With slight changes in the script, this could be the true-life story of the Douglas Mitchell family living near Bartlesville, Okla. When Doug, a forestry expert turned amateur prospector, recently struck oil in his back yard, the Mitchells didn't romp in the muck, nor did they become rich overnight. Though the well was pumping a healthy 76 barrels of oil a day at \$11 a barrel, it would be a long time before the Mitchells could begin to enjoy their good fortune—they'd be paying off mounting bills and loans.

While more people are finding oil in odd places, not everyone can expect to. It helps, of course, if your back yard happens to be in Oklahoma, a state known to contain oil deposits. The first oil discovered there was at Bartlesville, the Mitchells' home town. That's why Doug's father, a long-time oilman with Phillips Petroleum, acquired the mineral rights to the property when he bought the land. His foresight paid off.

Long, tough road ahead

But it wasn't easy. Before Doug went into prospecting, he had been holding down two jobs and his wife, Linda, taught school to make ends meet. When he decided to take the gamble, he had to give up his jobs and the family of six had only Linda's teaching for support. They grew as much food as possible and tried raising cattle, but crop and cattle losses added to their troubles. Doug worked 16-hour days while other family members helped with farm chores. Linda, whenever she

wasn't teaching, was out back with Doug slinging well pipe around like a toughened, seasoned oilman. They sweat night and day for a year. Doug borrowed on his life insurance and took out every bank loan he could wangle. He scrounged second-hand equipment, much of it old and outmoded. He had bet his last buck on a hole in the ground.

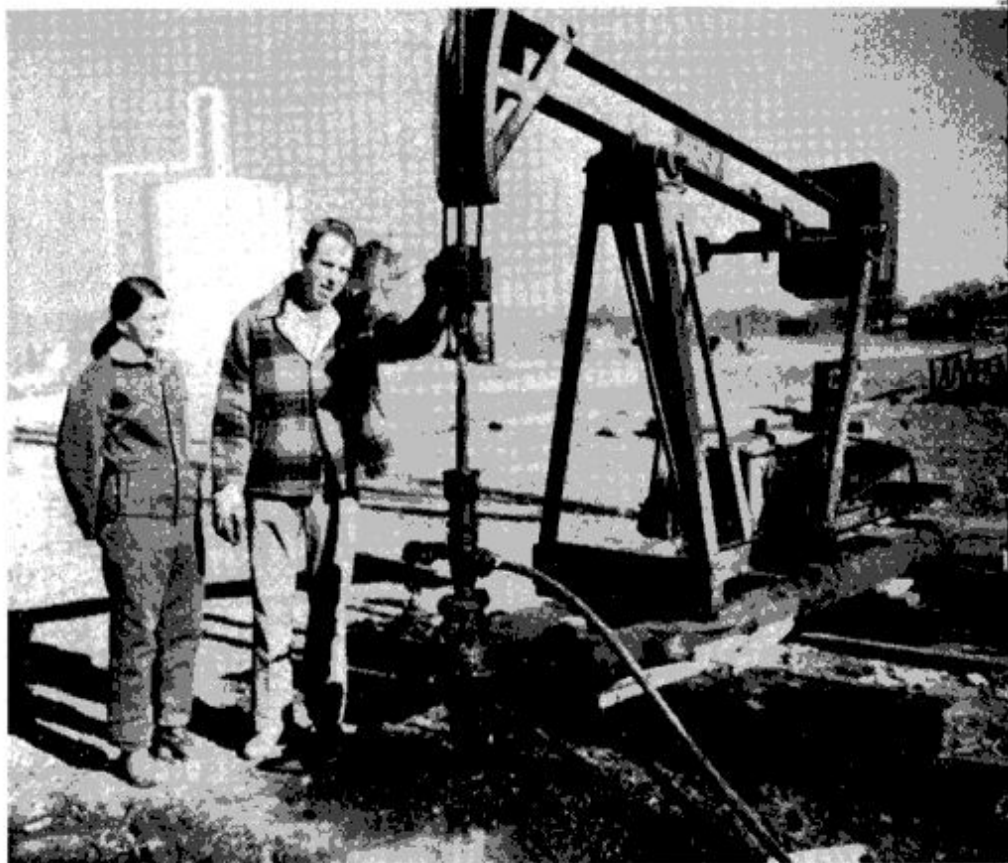
The first step was installing a K-type Star spudder—an antiquated cable-tool drilling rig used in the earlier days of prospecting. It cost \$500, kept falling apart and spent almost as much time in the repair shop as on the job. The crown sheave, a heavy pulley wheel, fell off one day,

nearly killing Doug. Cable-tool equipment has now largely been replaced by modern rotary drilling rigs. But rotary drills are expensive.

Slow going

A cable-tool rig consists of a heavy steel mast with a pulley at the top. The drill stem and bit are suspended on the end of a steel cable that runs over the pulley and is spooled around a motor-driven drum at the base of the mast. The drill is raised by power and drops by gravity, continually rising and falling in the well casing as the bit chisels away the rock.

Doug doggedly drilled away for two months in the bitter cold of mid-



Old rocker-arm pump pours out a steady flow of oil from Mitchell ranch near Bartlesville, Okla. Well is now paying off after much time, sweat and money.

Striking it rich— oil in your own back yard

They laughed when a young couple decided to try for oil on their small ranch in Oklahoma. Their equipment was antiquated, their money almost gone. Then finally, after months of grueling toil and frustrating moments of near failure, they brought in a gusher. Nobody's laughing now.

by James M. Liston

winter as the bit inched slowly down. Son Jim, 13, became a helper on the "crew." A drill crew on such a rig usually consists of the driller who operates the equipment and a "tool dresser" who sharpens bits and washes sand samples. The wind blowing across the Oklahoma prairie in January can be vicious, but says Doug: "No man ever had a better crew. Linda and Jim kept me going."

He kept going until he had reached 1287 feet by the end of February. Now came the crunch. He needed more pipe and pumping equipment. He was out of money and there was nothing left to borrow on. If he didn't complete the well, they'd be

hopelessly in debt and would lose the ranch. It began to look as if he had dug a hole he couldn't get out of.

Help comes running

But word got around among friends and neighbors, even people they had never heard of: The Mitchells had problems. Suddenly things started happening. One stranger offered the use of a winch truck. Others contributed tools, tubing, rods, a pump and two 100-barrel storage tanks.

"With help like that, we felt we just had to succeed," says Doug.

The well looked promising. Minute traces of oil were beginning to show

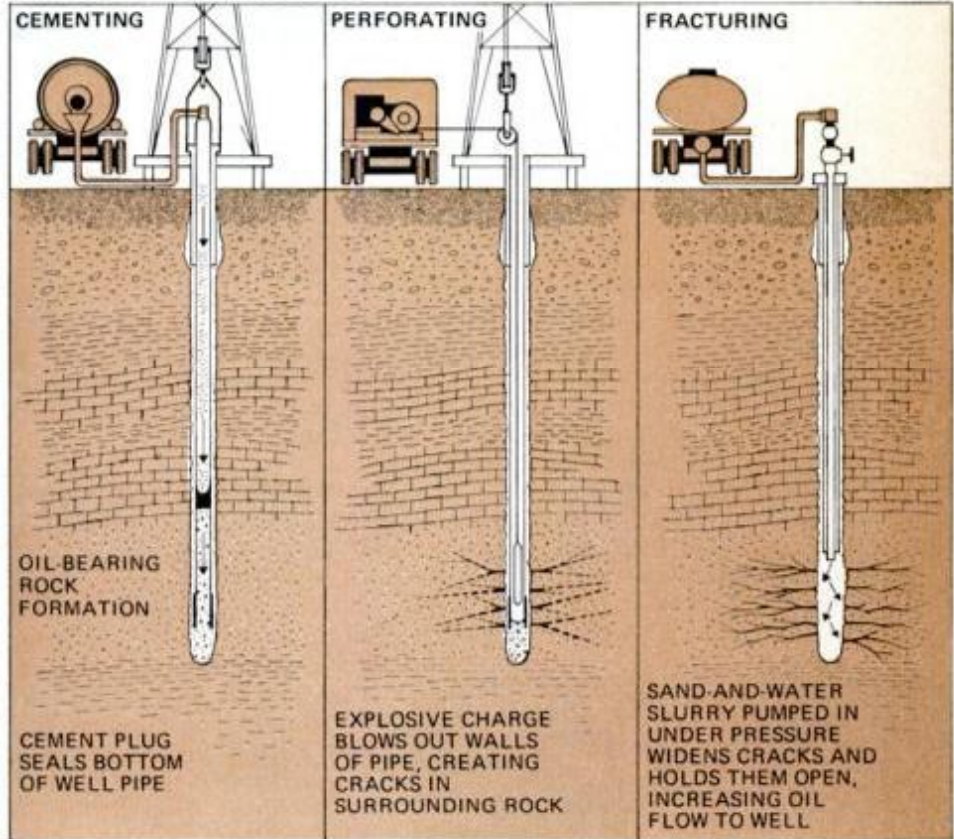
up on the drilling tools and in bottom samples. Some oilmen rub a pinch of sand between their fingers while holding it up to an ear and claim they can "hear" oil—a difference in the grittiness of the sand. Watching for oil traces on the tools is called "catching teardrops." The Mitchells were definitely catching tears.

It was time to call in a contractor to "treat" the well—prepare it for production. The 4-inch steel casing first has to be cemented in place at the bottom. Then a probe is lowered that produces a radioactive log of the well. This gives a cross-sectional "map" of the various formations, helping to determine the best depth

(Please turn to page 151)

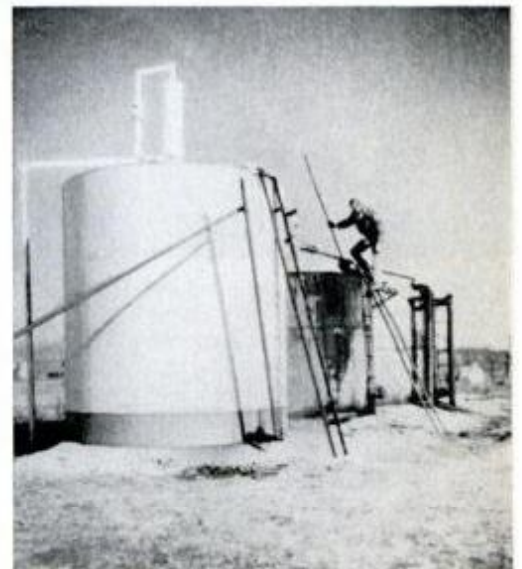


THREE STEPS TO MAKING A WELL PAY OFF



Dulled drill bits must be constantly hammered back to shape with a sledge, then resharpened—called tool dressing—as shown in upper photo. In lower photo, Mitchell family poses in front of ancient cable-type drill rig that brought in the well. Drawings show steps in opening well bottom so oil flows in.

Linda Mitchell guides section of well pipe into place as husband Doug lowers it (near right). Two worked together as team during long drilling ordeal. At far right, Doug climbs ladder to check oil level in storage tank with a simple "dipstick"—a long pole. Instrumentation isn't fancy.



How to replace

Your biggest problem with disc brakes is worn pads. Inspecting and replacing pads isn't difficult when you know tricks the pros use, and follow an orderly procedure.

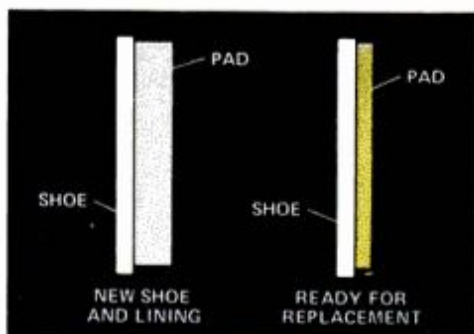
Frequent brake-pad inspection pays dividends. If you do it every time you're supposed to rotate tires, you should never have to resurface or replace rotors (discs).

A brake-pad replacement kit, which generally consists of four pads—two for each of the two front wheels—and other necessary parts, costs \$8 to \$13, depending on the car. But remember that the main cause of rotor failure is the wearing down of pads, leaving metal scraping against metal.

Pistons and pads

Disc brakes have one, two or four hydraulically driven pistons that force pads against revolving rotors. Except for some trucks, two-piston units are passé. They were used on 1963-66 Studebakers, first in the United States to offer discs.

Except for 1970 AMC models, 1970-72 Dodge Darts and Plymouth Valiants, and Corvettes and Camaros with disc brakes at all four wheels, all cars with discs since 1970 use



Check the thickness of the disc-brake pads periodically so you don't score discs.

trate on Delco-Moraine and Kelsey-Hayes one-piston units, used in nearly 98 percent of all cars with disc brakes built in the '70s. Only Pinto, Mustang II, Maverick and Comet use the Bendix one-piston unit. If your car's disc-brake unit is other than the two discussed here, you should have little trouble changing its worn pads if you follow these procedures, with slight variation.

Delco-Moraine one-piston units

Cars using this system are:

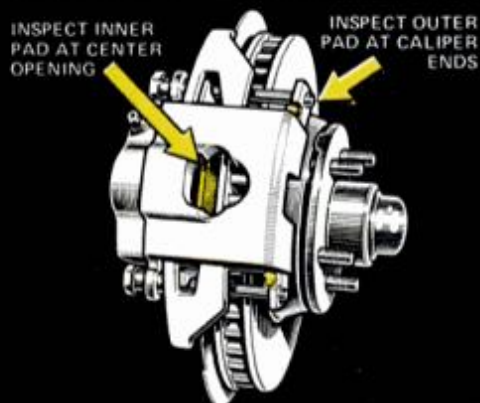
- Buick intermediate and compact models, 1969-76, and Buick full-size models, 1970-76.

- All model Chevrolets (except those noted), Cadillacs, Oldsmobiles and Pontiacs, 1969-76.

Inspect the outer pad: Look in each end of the caliper, where wear is usually greatest. Check inner pad by looking through the inspection hole in the top of the caliper.

If either pad is worn to about the same thickness as the metal shoe to which it's riveted, replace both pads and those on the disc unit of the other wheel. All-around replacement assures braking equalization.

Seat piston in bore using C-clamp (Delco-Moraine single piston, Step 4).

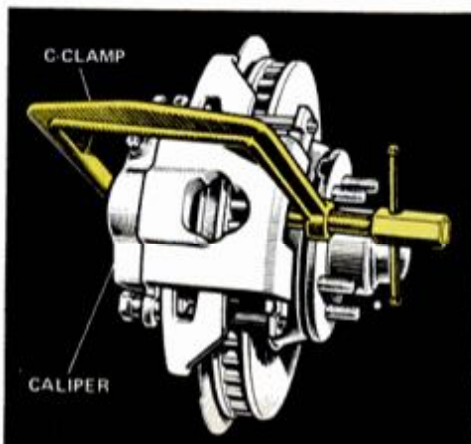


Pad inspection can be done without having to remove calipers on Delco-Moraine assemblies and on some Kelsey-Hayes units.

either Delco-Moraine, Kelsey-Hayes or Bendix one-piston units. Discs with four pistons were mostly used before 1970 and on the above exceptions.

Disc brake types

We don't have space to discuss repadding all types, so let's concen-



Steps in replacing the pads of a Delco-Moraine single-piston setup:

1 With a clean spoon, dip brake fluid from the master cylinder reservoir so it remains about one-third full. Discard fluid. Make sure you're not taking fluid from the wrong reservoir by tracing brake lines to see which feeds front discs and which feeds rear drum brakes.

Don't unscrew the brake line to draw off fluid, and don't empty the master-cylinder reservoir of all its fluid. Doing so will make it necessary to bleed air from the hydraulic system when you're done, and who wants to get involved with that!

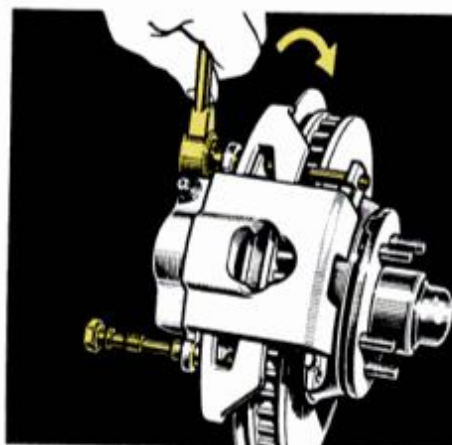
2 Jack up the front of the car, making sure everything is secure. Remove the front wheel assemblies.

3 Put a seven-inch C-clamp on the caliper so the solid side of the clamp rests against the back of the caliper and the screw end rests against the metal side of the outer shoe.

4 Tighten the C-clamp as much as you can to move the caliper out away from the car and push the piston to the bottom of the bore.

5 With the caliper moved out and the piston bottomed, remove the C-clamp.

6 Unscrew the two mounting bolts which attach the caliper to the support bracket. Note that bolt heads

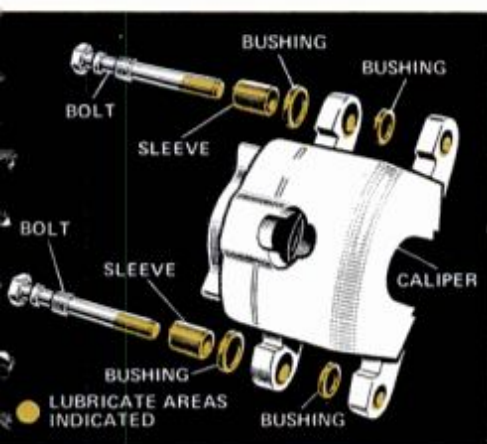


Release the calipers from the support brackets by unscrewing the bolts.

are behind the caliper. Use a socket and ratchet, if you have them, but you can also work an open or box-end wrench into position.

7 Lift the caliper off the disc. You needn't disconnect the brake

disc brake pads by Mort Schultz



Lubricate the parts of the caliper assembly as indicated in color above.

hose, but be sure that you don't put stress on the hose.

8 You can now remove inner and outer pads. If either is stuck, pry it off carefully with a screwdriver, but watch out that the tool doesn't slip and damage the caliper.

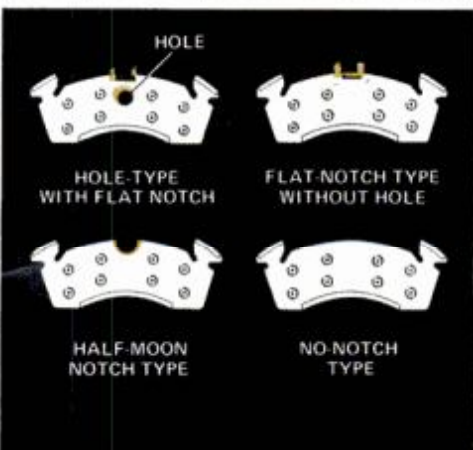
9 Remove antirattle (shoe support) spring—it will be lying either in the piston cavity or on the inner shoe. Place this spring with the new pads. It will be reused.

10 Turn to the two inner ears of the caliper. Push out and discard the sleeve from each. Remove and discard the rubber bushings in the grooves of the *four* caliper ears.

You should have four new bushings and two new sleeves in the pad replacement kit you've purchased. Make sure they are the right pads for your Delco-Moraine unit.

11 Clean holes and bushing grooves in the caliper ears with a rag and wipe dirt from mounting bolts. Do not use an abrasive cleaner. It will rub away the plating.

Four disc-brake-pad types that vary depending on configuration of the calipers.



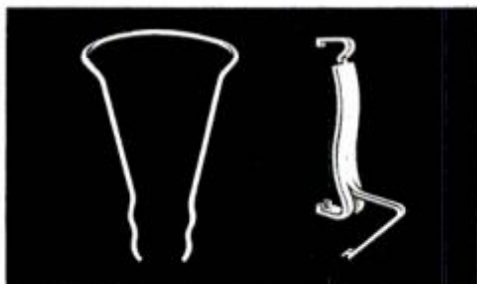
If bolts are corroded or bent, replace them. Clean inside of the caliper.

12 If fluid is apparent on the piston dust boot, the caliper should be overhauled. Otherwise, wipe the boot clean with a rag.

13 Use good-quality silicone lubricant to lubricate entire surface of new sleeves, new rubber bushings, bushing grooves and tips of mounting bolts. Install rubber bushings in caliper ears by hand.

14 By hand, install sleeves, positioning them so the ends that face the pad assemblies—the inner ends, that is—are flush with the machined surfaces of the ears.

15 Four variations of inboard pad assemblies are made for Delco-Moraine units: no-notch, half-



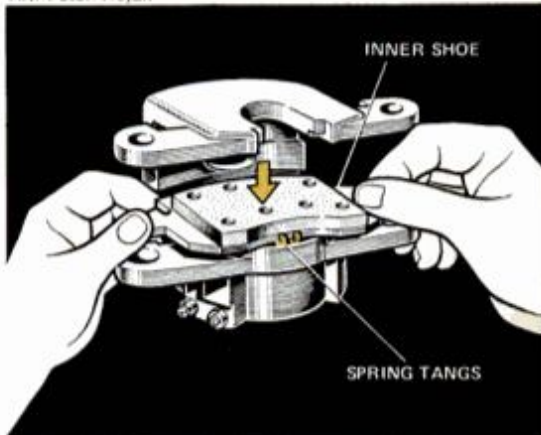
Springs that hold disc-brake pads: At left is the spring-wire, antirattle spring; the clip type is shown at right.

moon notch; flat notch without hole, and flat notch with hole. Your variation depends on the caliper your car uses. Examine the setup to identify that and proceed with installation. Be sure to note that no-notch and half-moon notch pads have a spring-wire antirattle spring and the other variations use a spring-wire antirattle spring or clip-type spring.

16 If your unit has a spring-wire antirattle spring, place it in the center of the piston so the spring's two tangs point up and toward the front of the caliper. Put the new inner-pad assembly in the caliper so the bottom edge of the shoe rests against the spring's tangs. Shift spring, if necessary, so its tangs will fall in the center of the shoe.

Press down on the ears of the shoe to get it to lie flat against the piston. With the assembly properly seated, the spring's tangs won't extend more than 0.100 inch above the base of the shoe.

Art: Peter Trojan



Inner pad is installed with the help of the spring-wire, antirattle spring.

17 If your units use a clip-type spring, place its top tang over the notch in the center of the inner shoe or into the hole from the rear of the shoe and press the spring on. It should fit the shoe securely at top and bottom.

Place the pad assembly on the caliper and press down on both ends until the shoe falls into a flat position, resting on the piston.

18 With inner-pad assembly in place, put the outer-pad assembly in the caliper so ears of the shoe line up with caliper ears.

19 Lift the caliper and rest bottom edge of the outer-pad assembly on outer edge of the disc. See that *no* clearance exists between tab of the outer shoe and caliper.

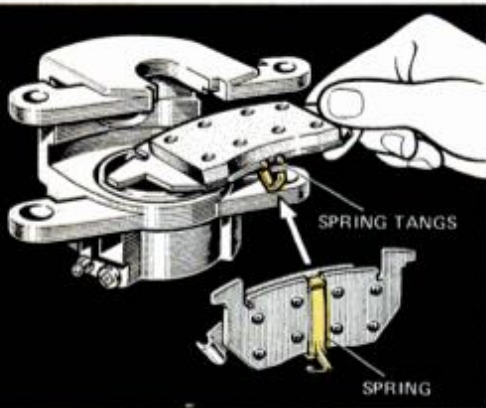
20 You should have a clean piece of $\frac{1}{4} \times 1 \times 2\frac{1}{2}$ -inch metal stock handy for use as a bridge across the cutout in the caliper. Bridge the cutout and reattach the C-clamp, making sure it's clean to keep from transferring dirt to the pad.

Do not tighten the C-clamp too much—just enough to hold the bridge securely and press the *outer*-pad assembly against the caliper with moderate pressure.

21 With Vise-Grip or Channel-lock pliers, clinch both ears of the outer shoe. Hold pliers $\frac{1}{8}$ to $\frac{1}{4}$ inch away from the outer edges of the ears.

Ears must be clinched flat against the caliper housing so no clearance exists. If there is clearance, do the clinching again.

22 Remove C-clamp and place caliper over the rotor, lining



After spring is fitted securely, the inner pad can be fitted to the caliper.

up holes in caliper ears with holes in the support bracket. Be sure the brake hose is straight.

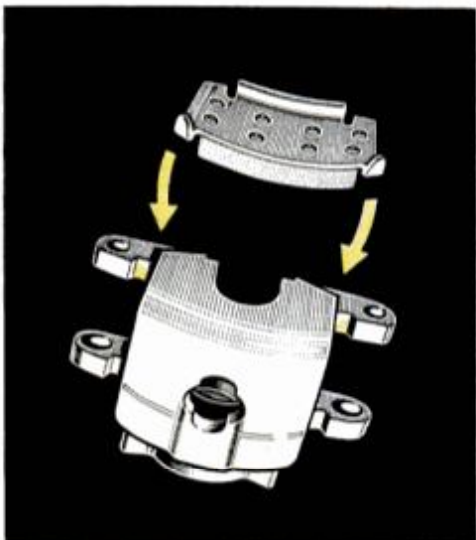
23 Insert mounting bolts through sleeves in the inboard caliper ears and push bolts through to engage bushings in the outboard ears, starting bolt threads into the support bracket carefully. Don't cross-thread. Tighten bolts with a torque wrench to 30-35 ft.-lb.

24 After installing new pads on both wheels, put on wheel and tire assemblies and fill the master cylinder with brake fluid meeting heavy-duty standard SAE J1703. Pump the brake pedal a few times and recheck fluid level. Add fluid if necessary to bring level within 1/16 inch of the reservoir top.

Kelsey-Hayes single piston unit

Cars using this system are:

- All AMC models, 1971-76.
- Plymouth Fury, Belvedere, Satellite and Barracuda; Dodge Monaco, Polara, Charger, Coronet and Challenger; Chrysler (except the 1969 Imperial), 1969-76.



Outer pad assembly is fitted and attached to the caliper as shown here.

■ Ford; Mercury; Mark III and IV; Thunderbird, 1968-76.

■ Lincoln, 1970-76.

■ Cougar and Mustang (except Mustang II), 1968-76; Montego and Torino, 1968-76; Fairlane and Falcon, 1968-70; Comet, 1968-69.

Let's start with the Kelsey-Hayes unit on Chrysler and AMC models. Inspection of pads is the same as for the Delco-Moraine brake. So are preliminary steps of removing brake fluid and raising the car. Now proceed:

1 With a socket, remove the caliper guide pins and positioners to separate caliper and adapter.

2 Slowly move caliper out and away from the rotor.

3 Fashion a hook from a wire coathanger. Hook one of the ends through caliper, the other around a suspension member so caliper hangs without straining brake hose.

4 Remove the inner and outer pad assemblies, and the antirattle spring. Save the spring.

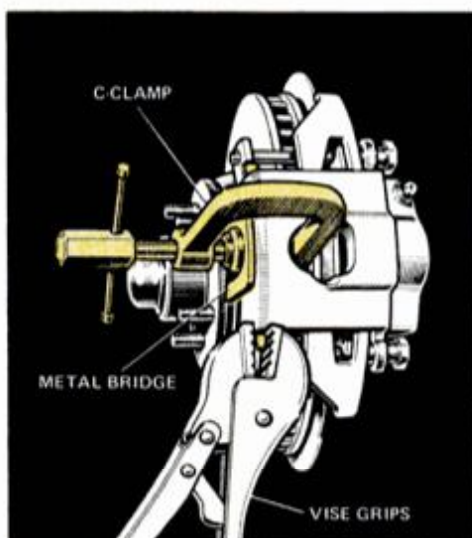
5 Use a drift to remove and discard outer bushings from caliper holes.

6 Slide inner bushings off guide pins; remove positioners.

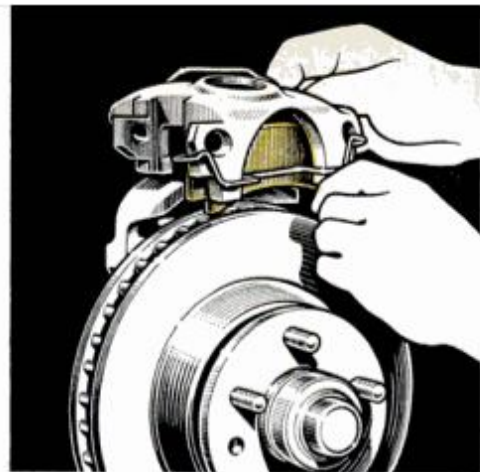
7 Be sure there is no fluid leak. Use a clean hand to push piston back in place if you can. If not, use a clean C-clamp.

8 Install two new inner guide-pin bushings from your pad replacement kit in the caliper with the flanged end of the bushing on inner side of the caliper.

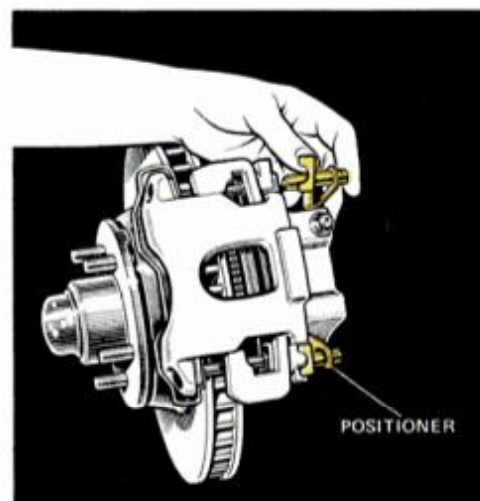
9 Compress flanges of the two outer bushings and work them into their respective holes in the outer holes of the caliper. Press in place, if necessary, with the flat side of a screwdriver tip.



For installation of the outer shoe (Step 21, page 87), "vise-grip" pliers are used.



Caliper is replaced on disc by aligning guide pin holes. (This is the Kelsey-Hayes single-piston unit).



Guide pins are installed, as you make sure that the positioners are in place.

10 Slide new inner-pad assembly into adapter. Metal shoe must be seated fully in adapter recess.

11 Slide the new outer-pad assembly into caliper so the antirattle spring slides over outer part of the caliper. Be sure metal shoe is seated fully in caliper recess.

12 Hold inner-pad assembly in place and carefully slide the caliper in position on adapter and over rotor. Align guide-pin holes.

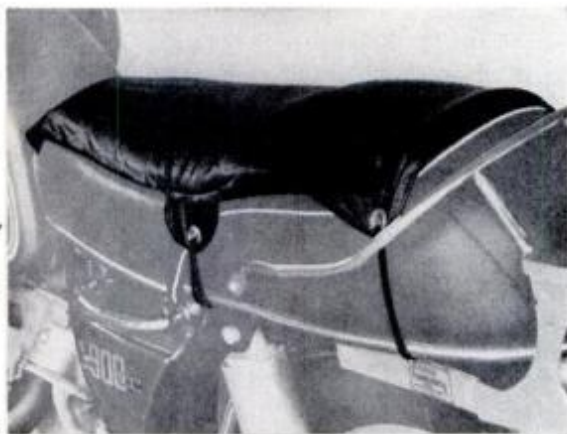
13 Install new positioners on guide pins with the stamped arrows on the positioners pointing upward. Working from the inboard side, install positioners and guide pins through the bushings and holes.

14 Press on ends of guide pins and thread them in place. Take care not to cross-thread. Tighten guide pins to 30-35 ft. lbs.

15 Refill master cylinder with brake fluid meeting Department of Transportation standard 3. Mopar brake fluid is recommended. Press brake pedal a few times and recheck master-cylinder fluid level.

The Kelsey-Hayes single-piston disc-brake system used on Ford Motor Co. cars is repadded similarly. The major difference is that two antirattle clips are used. ★★★

IT'S NEW **NOW**



Hydraulic shock absorber for cyclists

If you've got a waterbed at home and yearn for the same kind of comfort on your motorcycle, you can install a Travel Ease Water Cushion on its seat. For winter riding, fill it with hot water—but add rubbing alcohol for antifreeze. Rider and passenger cushions are individually adjustable. \$24.95 ppd. JML Products, Box 3708-A, Milwaukee, Wis. 53217. Specify make, model, year of bike.

Bolt-on bike engine is self-starting

This mini gas engine for bicycles needs no starting rope to get it going—it starts itself as you roll along. Basically the same engine as AquaBug's outboard motor, it hits up to 18 mph, gets over 200 miles to the gallon. \$174.95. AquaBug International, 100 Merrick Rd., Rockville Centre, N.Y. 11570.



New generators for stand-by power

Power insurance for the home is given by Onan's new series of portable generating sets that produce 120/240-v. power. Used with Onan's transfer switch, they can meet a house's electrical needs during a short or extended outage (see *Your Own Electric Power—Whenever You Need It*, page 102, July '74). P-series sets have tubular carrying frame or hood and dolly shown, with wattages from 2000 to 5500. Prices: \$616 to \$1280. Onan Corp., 1400 73rd Ave. N.E., Minneapolis, Minn. 55432.



Multipurpose drive kit

Easy-driver toolkit has reversible ratchet in Lexan ball that gives large grip for lots of torque, includes heavy-duty blade, drive-shaft, screwdriver bits, 1/4 and 3/8-in. drive socket adapters; \$11.95. Creative Tools, 309 County St., Bennington, Vt. 05201.



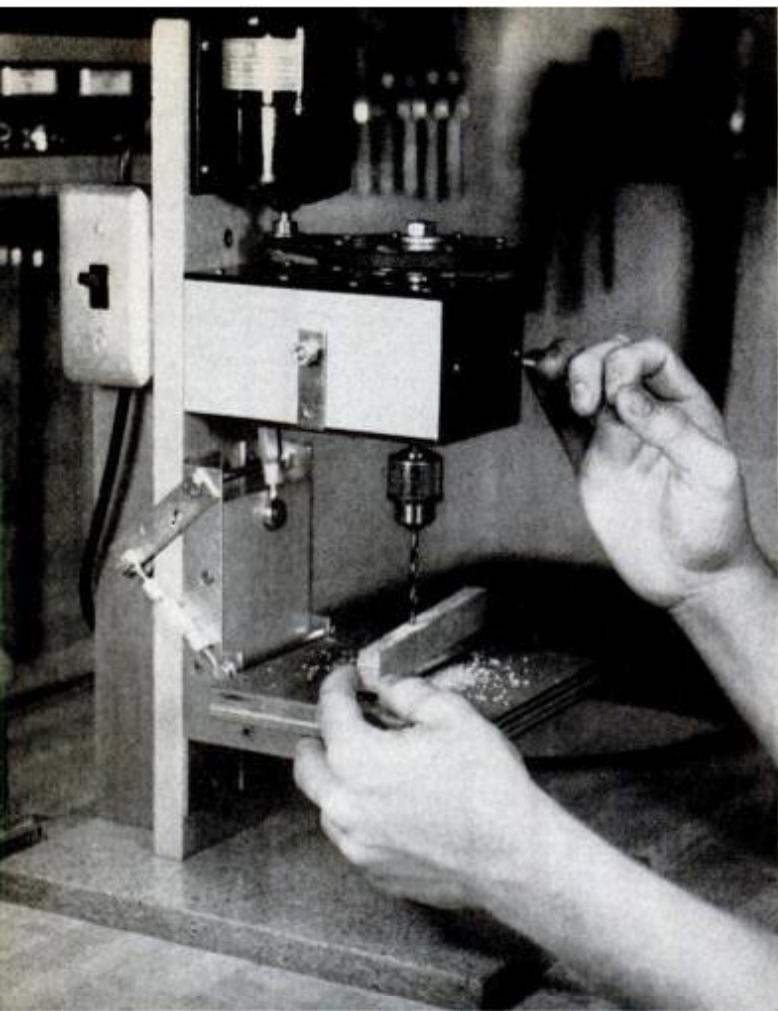
Fast oil finish

Tru-Oil gives hand-rubbed finish without rubbing. Works on stained or unstained, old or new wood. Needs no separate filler, dries in 60 to 90 minutes; 8-oz. can \$3.50, spray can \$2.19, plus \$1 postage and handling, from Birchwood Casey, 7900 Fuller Rd., Eden Prairie, Minn. 55343.

Pipe wrenches for the do-it-yourselfer

Four pipe wrenches designed especially for homeowners feature full-floating hook jaw, forged hardened steel jaws and I-beam handles with comfortable grips. The tools are patterned after the Ridgid line of heavy-duty professional pipe wrenches. Sizes available are 8, 10, 14 and 18 inches. Suggested retail prices range from \$3.99 to \$11.49. The 14-inch model shown here is \$7.99 suggested retail. Ritco Hardware Div., Ridge Tool, 321 Summer St., Elyria, Ohio 44035.





TWO SHOP TOOLS YOU CAN BUILD

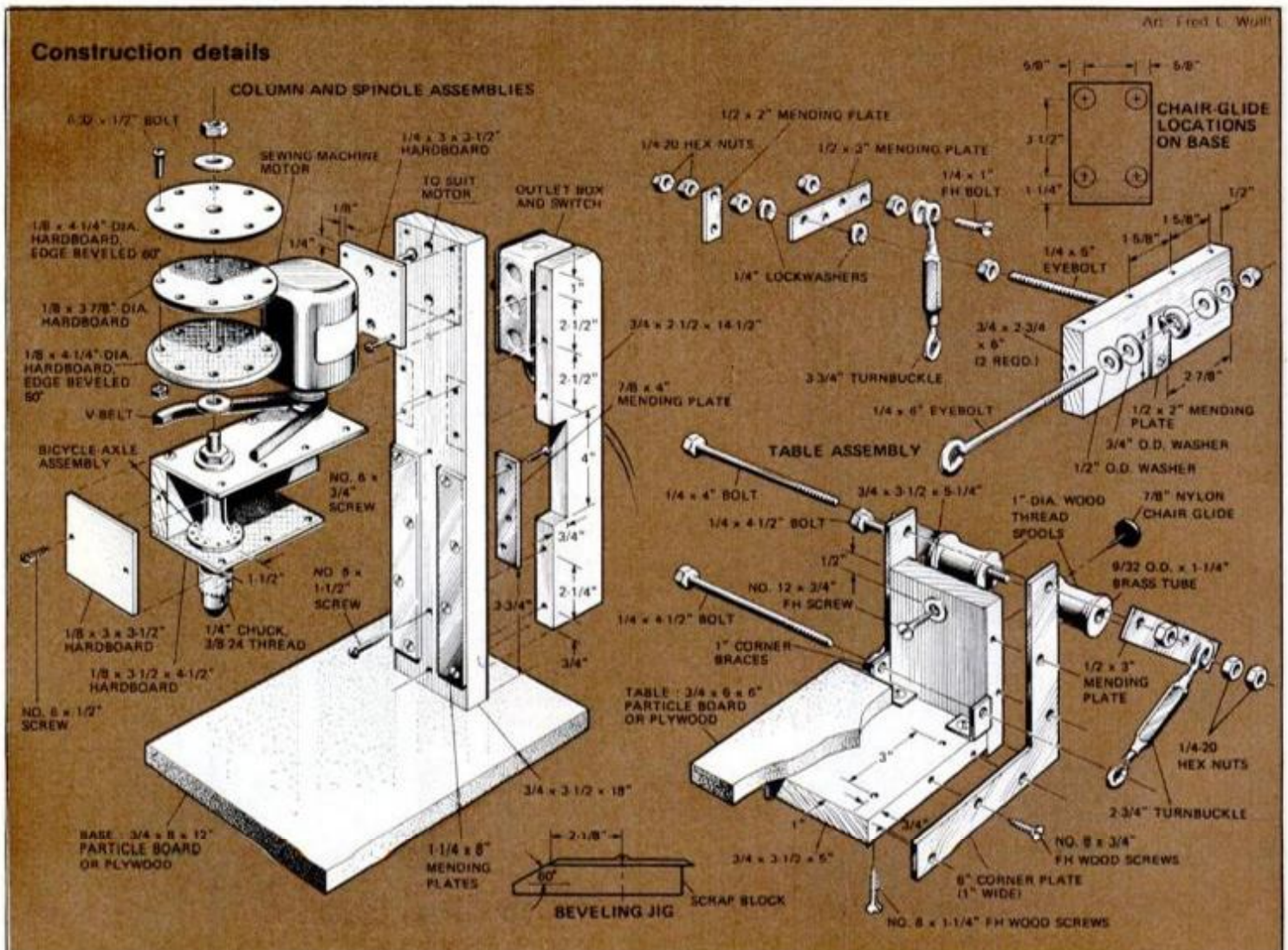
Beginner's drill

This simple drill press, designed for the person who needs an inexpensive machine for small projects, can be built with common hand tools.

If you have an old sewing-machine motor and a 1/4-in. drill chuck, you can build the drill press for about \$15. Despite low cost and simple construction, it will drill 1/4-in. holes in hardwood or light metal without overloading, and work with enough precision for the delicate drilling many hobbyists require.

The ball-bearing spindle for the drill press is a bicycle axle, hub and bearing assembly made by Union and sold by Schwinn dealers for about \$5. Axle threads fit 3/8-24 thread commonly found on 1/4-in. chucks. Spindle and motor are fixed in place and the table moves to feed the work to the drill bit. Table height is adjustable by means of a turnbuckle, which is also a depth stop. The metal plates are standard items and already have the holes required, although some of these may have to be enlarged. Ends of wood parts must be square, as final alignment will depend upon them. Use a miterbox or allow extra material for truing with coarse sandpaper.

Start building with the spindle assembly. Assemble parts with the hub in place and mark locations for six 6-32 bolts to hold the hub. Disassemble, drill 9/64-in. holes for bolts, reassemble with eyebolts and other hard-



press by Richard F. Cutler

ware in place. Holes in the bike hub may require slight enlarging to accept bolts.

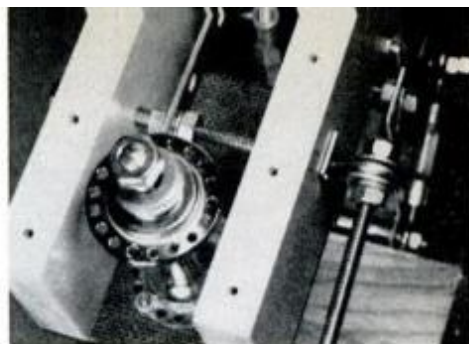
Make the column assembly next, then begin the table assembly by attaching nylon chair glides to the backboard. Glides must not be more than 3/16 in. thick; I used Hancock-Gross type 1336C. Attach corner plates to the backboard and subtable; since some screws must be placed near board edges, clamp boards near the screw holes to keep the wood from splitting as screws are driven. Attach corner braces, turnbuckle and table. Turnbuckle size is measured between centers of eyes in fully closed position.

Epoxy brass tubing (from a hobby shop) into spools with 1-in. dia. rims (Coats & Clark and Star are best). The table assembly may now be attached to the column. Adjust turnbuckles so the table moves freely, without excess binding or play. Fast-

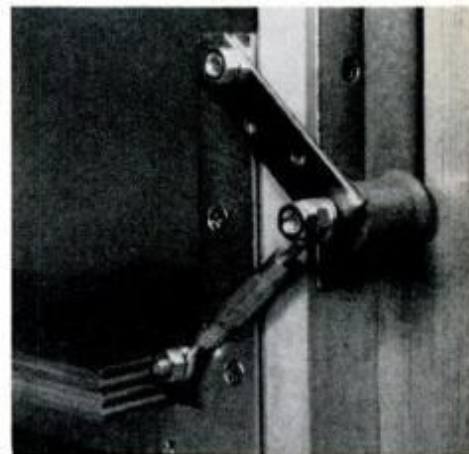
en the spindle assembly to the column and hook up the table-lifting hardware; adjust if necessary.

Build up the pulley, and drill eight equally spaced 9/64-in. holes around the edge. Coat inside surfaces with epoxy, bolt together. Coat V-groove with epoxy and place in warm (150° F.) oven until cured; repeat coating until groove looks glossy. Drill centerhole to 3/8 in., attach pulley to axle with hardware supplied with hub.

Most motors used with a standard Singer belt (part No. 198651) will require a 1/4-in. spacer (two pieces of 1/8-in. hardboard). Spacer thickness should make the belt snug but not tight. Most sewing-machine motors are rated at 1/15 hp at 5000 rpm; this gives a bit speed of about 1000 rpm. Install the outlet box and switch after the motor is mounted. After adjustments are made, the drill press may be taken apart for sanding and finishing. ★ ★ ★



Spindle assembly contains a bicycle-hub bearing and table-lifting linkage.



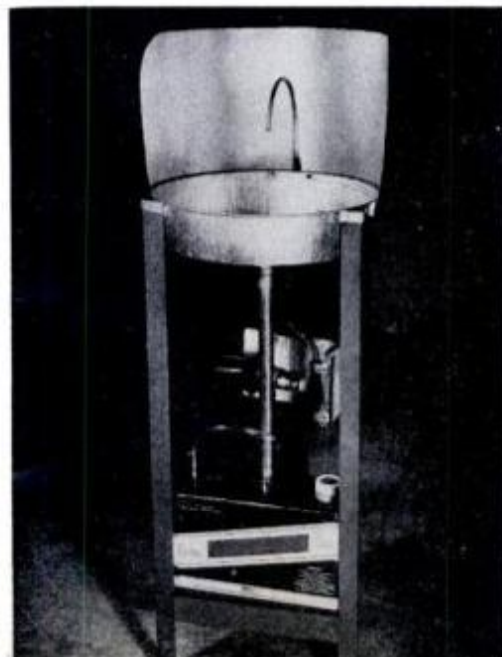
Thread spools serve as rollers for table movement; turnbuckles permit adjustment.

Parts cleaner

After working on a car or lawnmower, you want something better than a pan of kerosene to clean parts in. I built a parts degreaser like those used in garages, holding costs down by using a portable electric drill and an inexpensive drill pump. The basin is a radiator drain pan, supported by three angle-iron legs attached with aluminum straps Pop-Riveted in place.

Three angle-iron braces bolted or welded to the legs form a shelf for the kerosene tank, a 2 1/2-gal. gas can held in place by the 1-in. drain tube. (Handle and fill vent on the can are removed. A 1-in. tub drain goes at the center of the pan, with a matching threaded fitting soldered to the drain tube—which is soldered to the tank when the rest of the assembly is complete. Drill mounts on the

platform with a U-bolt of 1/4-in. steel rod threaded at the ends (or threaded rod). Clamps shaped from 1/8 x 3/4 in. aluminum bar stock hold the pump. The discharge tube is 1/4-in. copper tubing, the splash shield is galvanized sheet metal Pop-Riveted to the pan (with standoff brackets for a lipped pan). Suction and discharge lines to the pump are vinyl tubing.—Douglas Blodgett



Degreaser circulates kerosene from tank to basin and back for cleaning grime-laden parts—and an old toothbrush is a good scrubbing tool. Unit is powered by 1/4-in. portable electric drill driving a small pump. Platform of 3/4-in. plywood allows removal of drill or pump for other use, separately or together.

"Call me from that phone over there," said Gerald Kruse, equipment supervisor at a large San Francisco telephone exchange. I did, and his phone began to ring even as I pulsed out the last digit on the push-button phone I was using.

"That's electronic switching at work," Kruse started to explain; but before he could finish, I heard a short beep tone on the line. "This is a call coming in for you," he said.

I pushed down my switch hook, then released it. Kruse was on hold, and I heard another voice: "We're ready for the next demonstration," it told me.

I hit the switch hook again to put that call on hold and bring back Kruse. Then we all hung up to try a new trick: three-way calling. I phoned Kruse and put him on hold by hitting the switch hook. I heard a pulse interruption, then a new dial tone. Pulsing a second number brought back my other caller, a maintenance man elsewhere in the Pacific Telephone building. After I touched the switch hook again, Kruse was on the line with us.

"You can go on doing this almost indefinitely," he explained, "as long as each new line you bring into the circuit is equipped with the three-way calling feature.

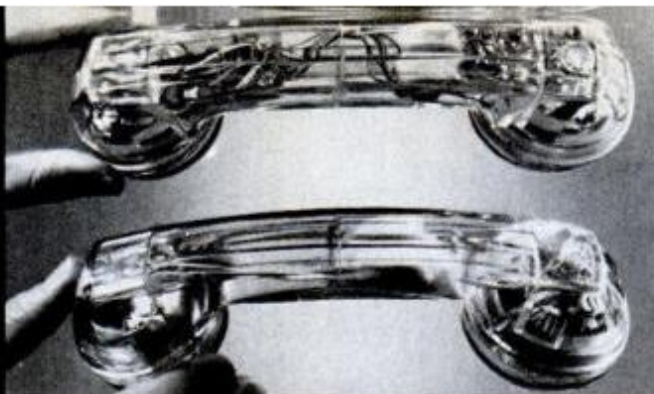
Our conference call over, I hung up and punched out a special code. Then Kruse and I went to another part of the building, knowing that any calls we got would follow us there.

Not futuristic—they're here

There was nothing futuristic about the telephone services I'd just been using. They—and other features like Speed Calling and International Direct Distance Dialing—are already available to millions of U.S. telephone subscribers as part of improved switching systems. After 1978, even mobile telephone users should have some of these custom calling services.

Yet these improvements will all take place behind the scenes, as part of a new revolution in telephone central-office design called the Electronic Switching System, or ESS for short.

Few of us realize that the tele-



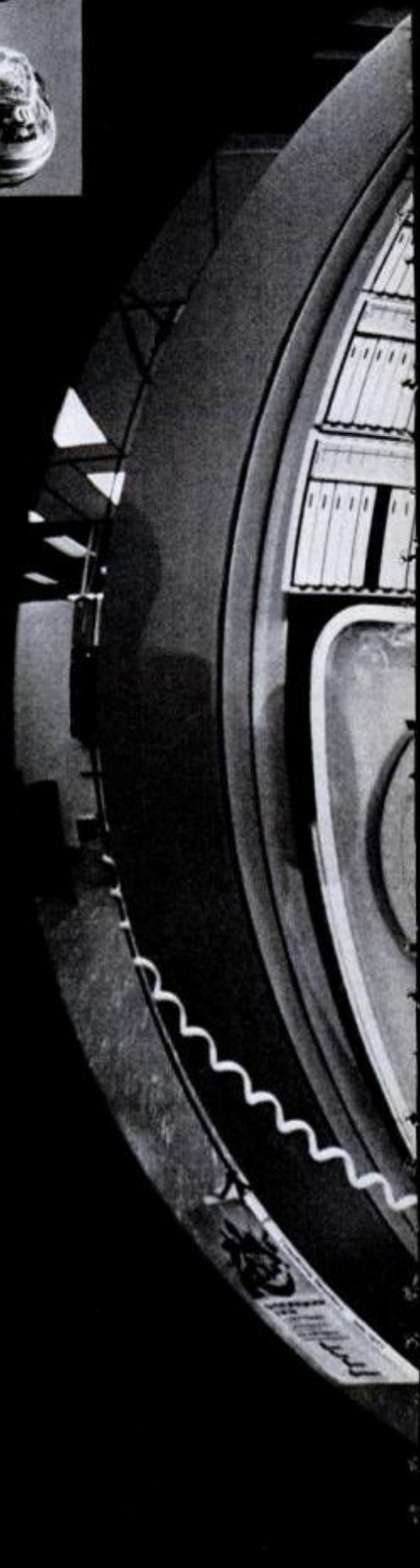
Amplified handset (top; note extra circuitry compared to standard model below it) will bring clearer reception to rural customers.

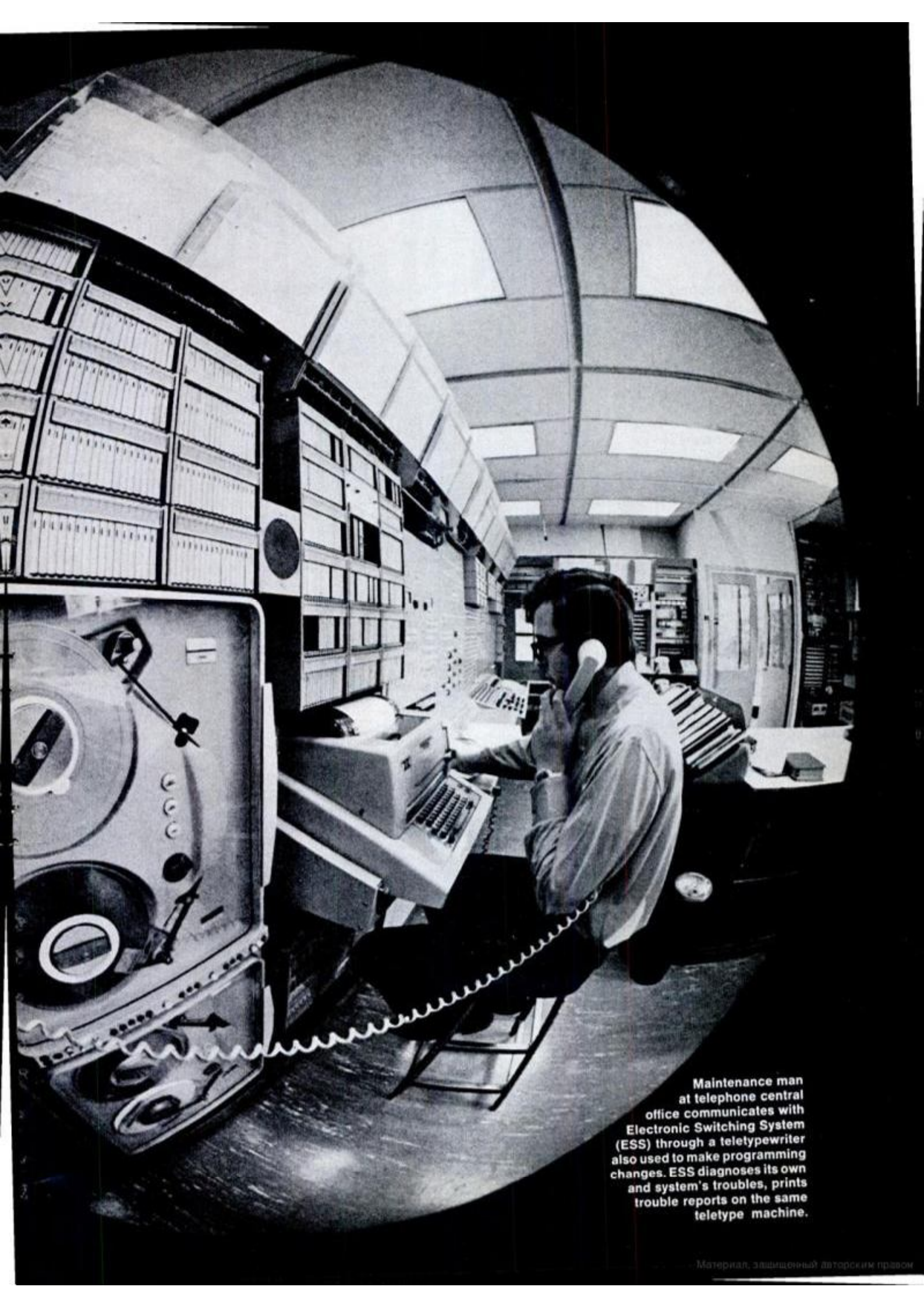
Invisible revolution inside your phone

by Joseph Zmuda

phone sitting on our desk or hanging on the wall is merely the first link to a vast, invisible switching network that provides communication to all parts of the world. While the telephone instruments in our homes change little over the years, modern technology is making big changes in the rest of the network. For example, the invention of the transistor at Bell Laboratories 28 years ago has led down a long road of research and development to ESS.

ESS takes the place of conventional switching systems that rely primarily on electromechanical call processing. In ESS, call switching is still performed by mechanical (though ultramodern) relays. But its control and memory sections use solid-state components—122,700 transistors in the metropolitan-type No. 1 ESS I was visiting—all mounted, together with other circuit compo-





Maintenance man at telephone central office communicates with Electronic Switching System (ESS) through a teletypewriter also used to make programming changes. ESS diagnoses its own and system's troubles, prints trouble reports on the same teletype machine.

nents, on plug-in modules that are easily replaced in event of failure.

Along with the reliability and the rapid action of near-total automation, ESS also saves money through more efficient maintenance procedures. It's more compact, too: this particular ESS machine, capable of handling up to 110,000 calls per hour, occupies just half of one floor of the building. The neat and aesthetically pleasing banks of modern equipment give the office room the feel of a data processing center.

Touch-Tone and beyond

There is one revealing sign in our homes and businesses of the change in telephone technology, the push-button Touch-Tone phone. While all switching systems can be adapted to Touch-Tone calling, ESS features it as part of its program design. But even in the way it handles Touch-Tone calls, ESS is different, because it responds *instantly* to Touch-Tones and dial



Information operator uses computer-controlled microfilm for instant access to as many as 15 million listings.

pulses. That's how my call to Kruse got through so quickly—operating more than 2 million separate operations in the time it takes to complete a call.

A switchboard you 'talk' with

ESS has still another virtue: easy programmability. Conventional exchanges must be rewired in order to change your phone number or the type of service you require. With ESS, the phone company can alter the programming of any line through teletypewriters located in the central office and plant service center. This means quicker service changes, since phone company clerks can now program ESS directly, rather than having to wait for maintenance personnel to make needed wiring changes.

It also gives the customer some in-



Manual switching, as shown in this 1879 engraving, contrasts starkly with the speed, efficiency, accuracy and low manpower needs of today's ESS exchanges.

stant programming capability, using his pushbutton (or dial) phone instead of a teletype. Phone in an activation code and a phone number, and your calls are automatically transferred to that number till you dial the deactivation code.

With this Call Forwarding feature, you don't have to risk missing important calls, whether you're going next door or even out of town. When calls are forwarded, the calling party is billed the normal rate to your phone while you pick up the additional message units—or toll charges—to the forwarded location.

Speed Calling, too

Speed Calling, another ESS service, allows an individual to reduce the number of digits needed to dial frequently called numbers. Depending on which service you order, you can store up to eight or up to 30 commonly called numbers in the ESS memory system, and then dial them (even long distance numbers) by entering only three or four digits instead of the usual seven or ten. Aside from its speed, this service cuts down on misdialing.

Inside ESS

But the advantage of ESS may be less in the extra services it can provide than in the efficient way that it performs them. Mechanical switch-

ing machines delegate pieces of common equipment to customers for the duration of each call. But ESS cuts down equipment needed by constantly scanning every line it handles and switching only when it senses it can perform a useful function. The semiconductor logic circuitry of ESS's Central Control (CC) interrogates each line five times a second, sensing when a customer has picked up his phone, needs a dial tone, or has begun to dial, then moves on to see what everyone else's phone is doing before coming back to the first customer—200 milliseconds later.

Information about calls in progress and about the condition of equipment is continuously updated in a temporary memory called the Call Store. CC even checks itself; and data about troubles there or elsewhere in the ESS system is immediately printed out on the same teletype that the ESS personnel use in communicating their instructions to the machine. In addition, should a major trouble occur in Central Control, a duplicate CC is ready to take over until repairs are completed.

How CC will operate in any given situation is determined by information stored in a semipermanent memory, the Program Store. Thousands of thin, aluminum memory cards, each containing thousands of mag-

(Please turn to page 129)

Optical fibers (shown here being made by a new Bell Labs process) carry modulated beams of light instead of electricity. They may replace wires in underground telephone cables of the not-too-distant future.





Too's for cassette repair include: Audio Accessories kit (far left) with spare shell, splicer, and splicing tabs; 3M kit (top left) shown in more detail below; Editall splicing block (left) with splicing tabs, special tape-marking crayon, and razor blade. 3M kit (photos below) includes strips that fish broken tape ends out of cassette shell, splicing block to repair broken ends, winder to take up slack in tape after completion of repairs.

Snarled and broken cassette tapes can be fixed

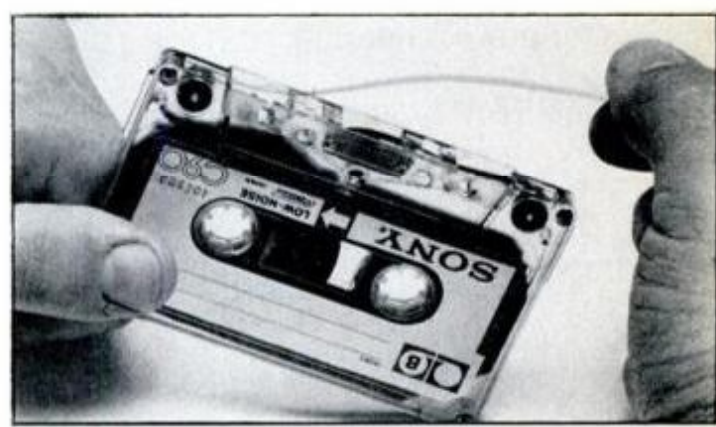
by Robert Charolais and Ivan Berger

Cassette tapes don't break or snarl as often as they used to—improvements in cassette construction have seen to that. But the cheaper cassettes still are often troublesome, and even the better ones cause occasional problems—invariably on recordings that simply can't be duplicated.

Those problems may seem baffling—curlicues of tape snarled in your recorder's works, broken tape ends hiding shyly inside the cassette's plastic shell, even seemingly intact ones whose tape refuses to budge—but they can be cured. All it takes is a little knowledge, a steady hand, and the right tools.

The most common cassette problem is the jammed cassette whose tape won't move. The cause usually is friction inside the cassette, and an uneven "pack" of tape

(Please turn to page 128)



Build this raft boat for under \$450 —with power

Art: Fred L. Wolff

It took only a week of evenings and \$385.65 to build this simple and handsome pontoon deck boat. That price includes two electric outboard motors for power, steering.

by Michael McDougall

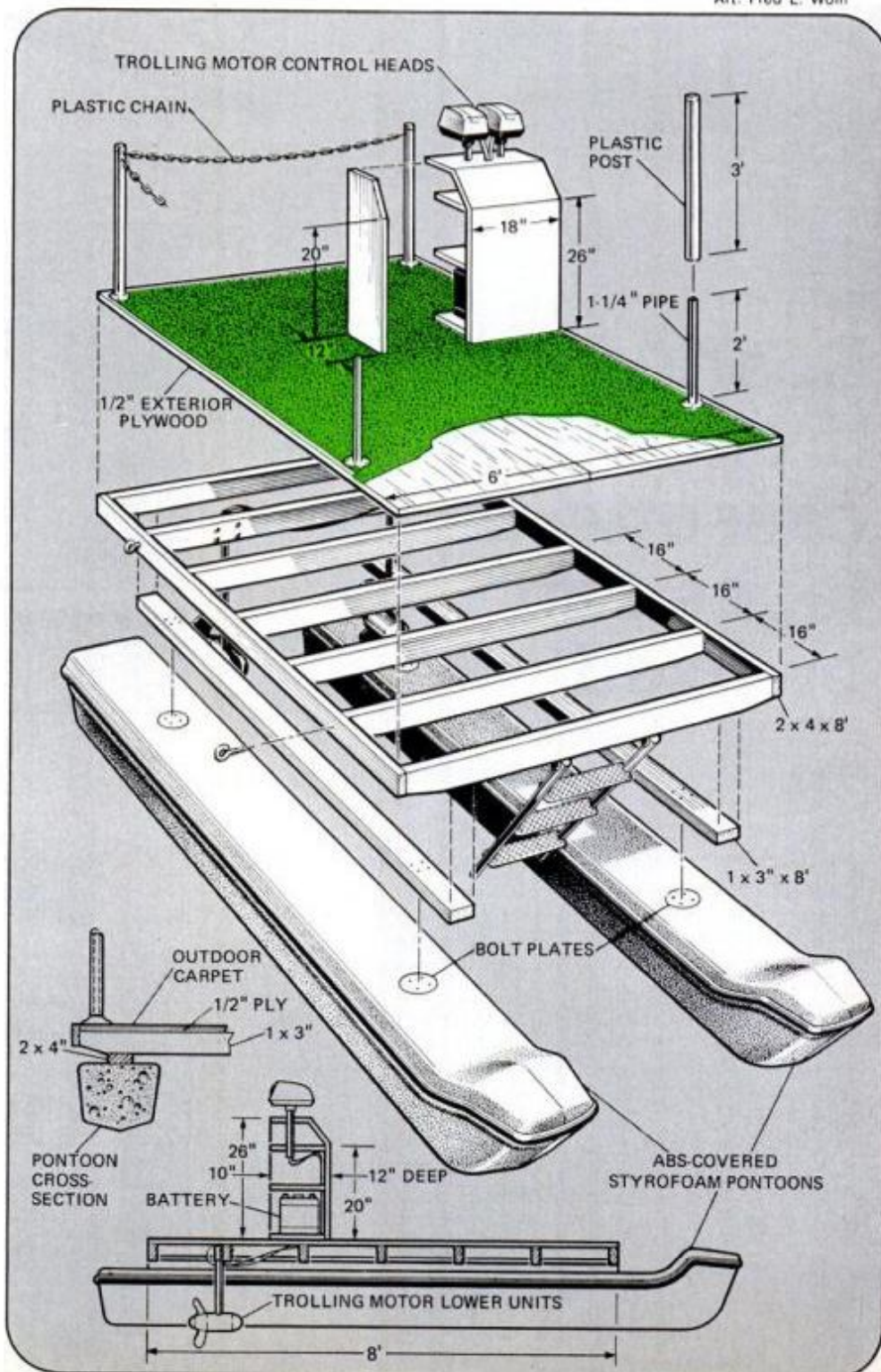
In several evenings' work you'll be ready to launch, once you start building this attractive pontoon boat. It is simple to construct, performs well, and the price is right. My cost was \$385.65, and though prices have gone up, you can still build yours for under \$450, including twin-screw electric power.

One key to the low cost is the availability of plastic-covered foam pontoons originally designed for a catamaran sailboat. I ordered each of them for \$65 plus \$5 handling f.o.b. from the Formex Corp., Box 812, 505 Belvedere Rd., Elkhart, Ind. 46514. They are now \$85 plus \$5 handling apiece, and worth it. The ABS covering of the Styrofoam gives the pontoons a handsome look, and fittings recessed fore and aft into each make them easy to attach. With a simple 6 by 8-foot plywood platform, reinforced by a supporting frame of 2x4s, the strong but lightweight pontoons will support a whole family or two couples.

Use two electric motors

I chose two trolling electric outboard motors to provide a comfortable 2 to 3-knot speed and a method of steering without a rudder. Mounted on the platform as far apart as possible, the motors will turn the boat in one direction or the other; you simply switch off the motor on the inside of the turn. To turn in one boat length, you reverse one motor.

You can't pull a water skier with





this arrangement, but you can keep up with some sailboats. A rudder and tiller can be purchased from the pontoon manufacturer.

Construction is simplified by the aluminum castings molded into the top of the Formex pontoons. They contain four $\frac{3}{8}$ -inch tapped holes to which the platform can be bolted. The 6 by 8-foot platform, reinforced by the 2x4s on 16-inch centers, provides a good compromise between weight and strength. One and a half sheets of $\frac{1}{2}$ -inch exterior plywood are used for the deck, and the remainder can be used for the control console. Coat everything liberally with wood preservative and marine paint.

Mounting the motors

To mount each motor, saw in half the tube connecting the control box and the lower unit. Splice No. 14 or heavier wire to the wires coming from the lower unit. Bring them through a hole drilled in a crutch tip that fits the motor shaft and seal with silicone adhesive. Run wiring from motors along the bottom of the platform and up through the console.

The console contains the battery and controls. Drop-front doors can enclose the shelves. Drill holes in the door enclosing the battery compartment to provide ventilation while charging. A lock on one compartment and a cutoff switch inside can pre-

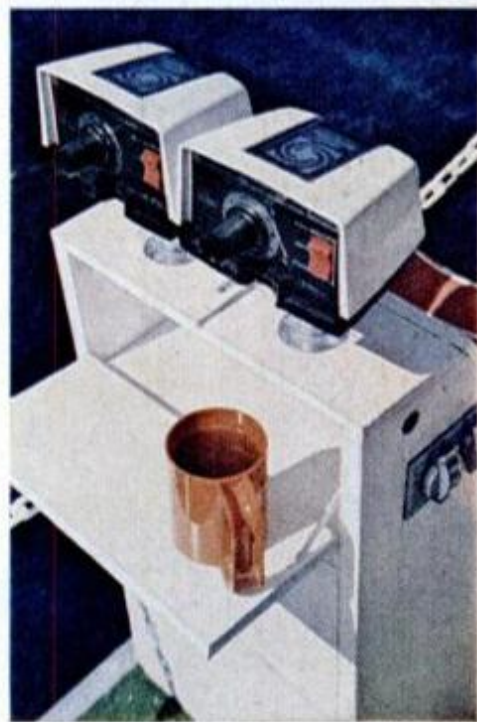
vent unauthorized operation. I included a waterproof plug on the outside of the console to make hooking up a battery charger easy.

Construction is simplified by the aluminum castings molded into the top of the Formex pontoons. They contain four $\frac{3}{8}$ -inch tapped holes to which the platform can be bolted. The 6 by 8-foot platform, reinforced by the 2x4s on 16-inch centers, provides a good compromise between weight and strength. One and a half sheets of $\frac{1}{2}$ -inch exterior plywood are used for the deck, and the remainder can be used for the control console. Coat everything liberally with wood preservative and marine paint.

Finishing off

Cover the platform with indoor-outdoor carpeting and trim the edges with aluminum carpeting threshold. The safety stanchions are $1\frac{1}{2}$ -inch pipe screwed into pipe flanges. I covered them with plastic posts from a garden supply store and added plastic chain. Swimming steps are mounted forward and fold back under the deck. Install more rugged railings for fishing, or gas outboards for added speed. And get ready for questions and compliments. ★★★

Simplified steering requires only turning power knobs on control console (right). A drop-leaf door becomes a shelf for drinks.



RAFT BOAT PARTS LIST

Lumber		4 $1\frac{1}{2}$ " pipe flanges	4.76
7 pcs. 2x4—8'	\$ 6.16	22' plastic chain	4.14
2 pcs. 2x4—8'	2.00	Miscellaneous	
2 pcs. 1x3—8'	3.68	2 electric trolling motors	80.00
2 4x8' pcs. $\frac{1}{2}$ " exterior-grade plywood	11.00	2 ABS-covered Styrofoam Formex pontoons, \$65 each plus \$5 handling (f.o.b); now \$85 plus \$5	140.00
Accessories		Heavy-duty 12-volt battery	41.25
Carpeting (felt polypropylene)	34.00	Wood preservative and paint	20.00
Double-stick tape (attach carpet)	2.50	Hardware	16.00
4 8' sections aluminum threshold	12.00		
4 pcs. $1\frac{1}{4}$ " x 2' threaded pipe	8.16		
		Total cost	\$385.85



Photo: Stephen Fay

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Two mini workshops for small spaces

Here and on the following pages are two ways you can get more shop than you ever thought possible into an apartment or small house.

1 We asked designer Tom Fung to give us a bench that would be really practical for a serious hobbyist but wouldn't spoil the looks of an attractively decorated room. His solution is a roomy workbench-cabinet that looks good enough to keep in the living room.

It's not for large-scale woodworking, of course, but the range of hobbies it can accommodate is impressive—try modelmaking, electronics, tabletop photography, movie or slide editing, microscopy, bookbinding and jewelry-making for a start. It's great for just about any kind of kit-building. Say you've got one of those Pocher 'd Italia car kits with 2199 parts—definitely not a one-evening project. With our mini-shop, you can leave parts set out as you like them on the rear section of the work counter, close up the drop leaf when you're done for the evening, and know those parts will still be there, undisturbed, when you come back.

Enough room for everything

We told Tom the bench must provide enough storage room so that all tools and materials for a hobby or

(Please turn to page 106)

It's a place (left) to keep everything for your hobby, with a well-lighted work area—but when it's closed (inset) our mini-workbench is beautiful furniture.

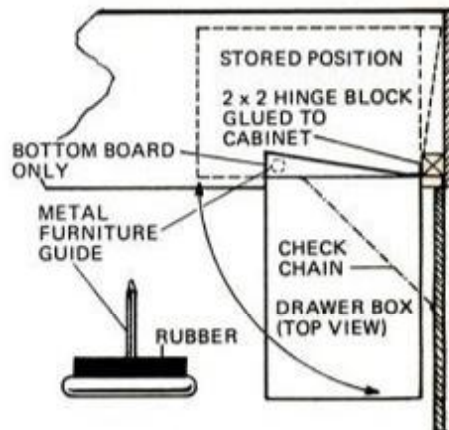
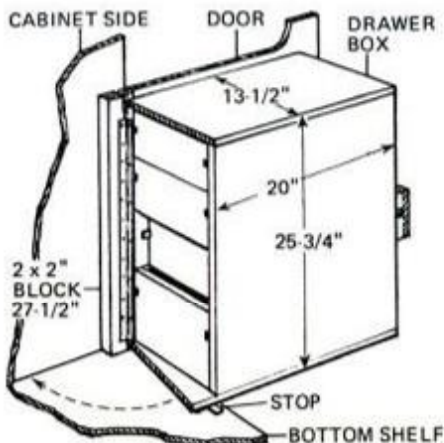
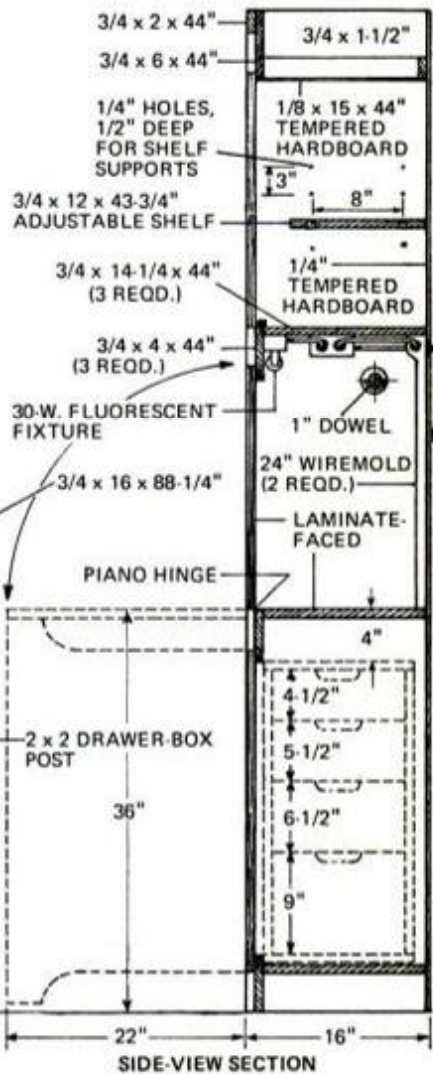
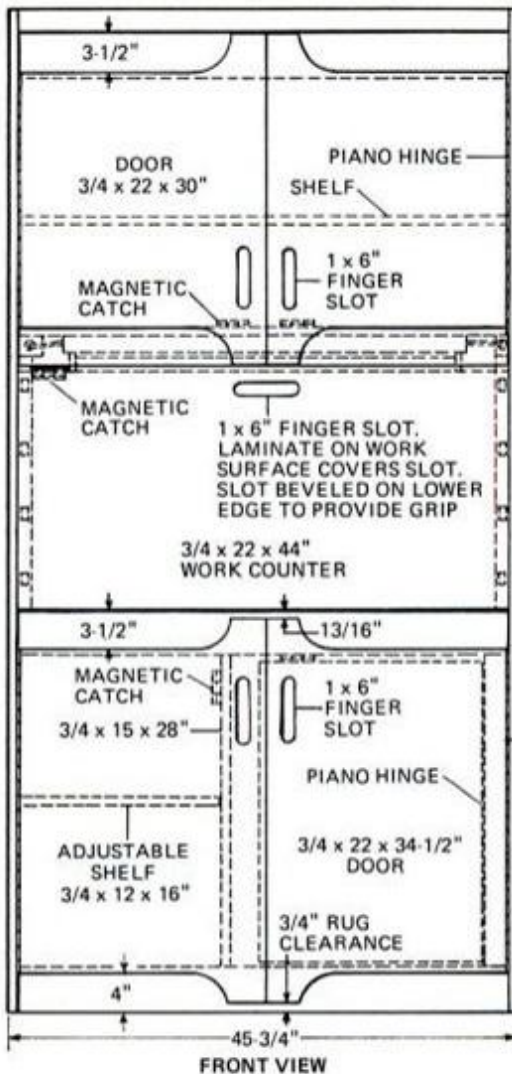
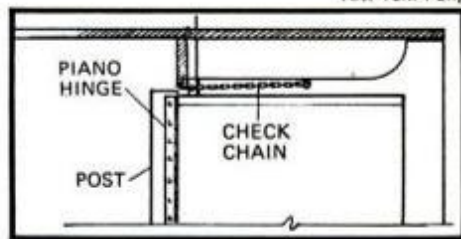
Construction: Rosario Capotosto
 PanaVise: Colbert Industries
 Stool, chair: Laverne Enterprises Ltd.
 Rug: Regal
 Model trains, tools: Roundhouse II, New York
 Styling: Shari Green



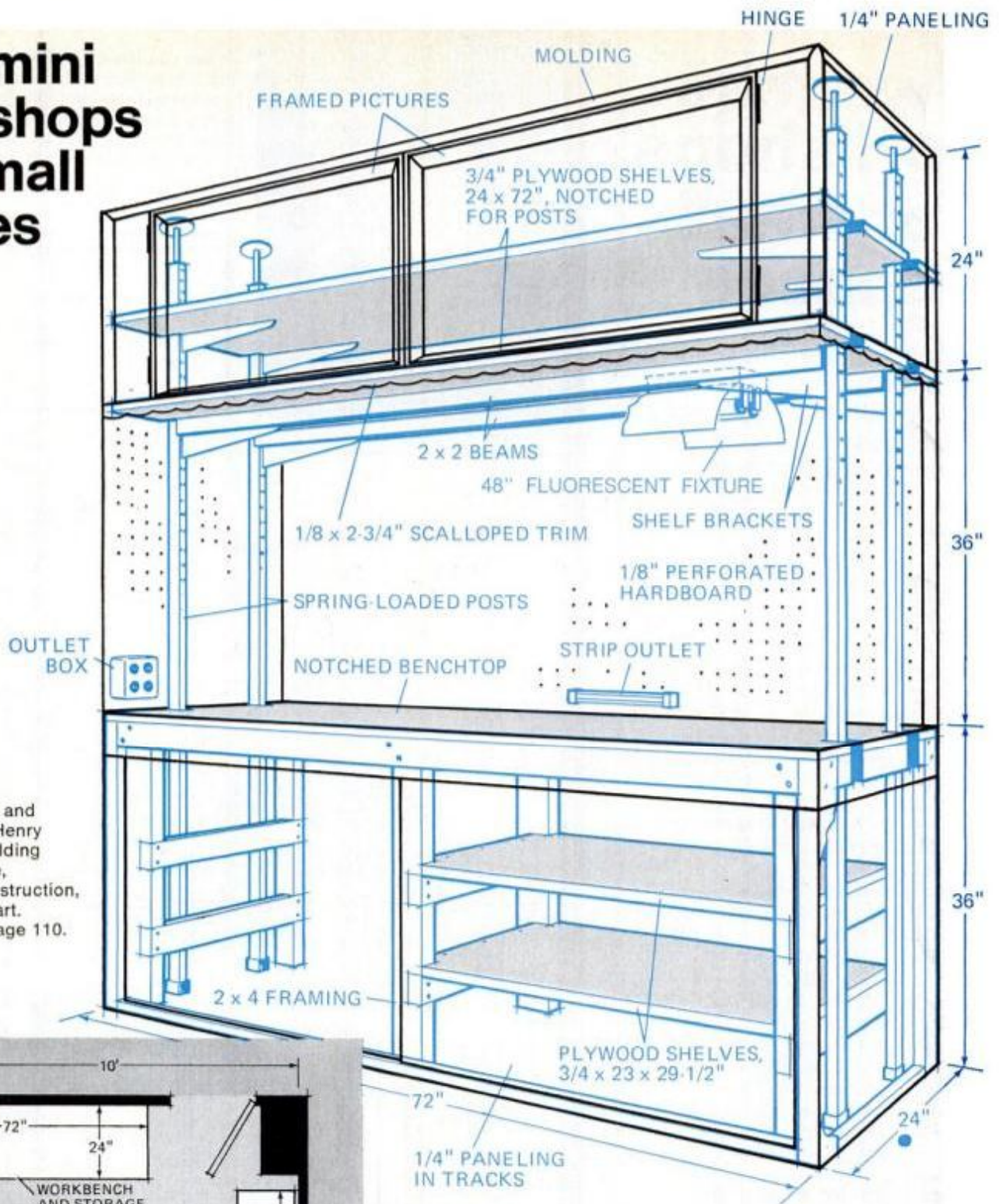
When you finish a project, you can snap its picture right at the workbench—seamless paper for tabletop photography unrolls from dowel rod near top of work area. Clamp-on photographic lights with "barn doors" are from Spiratone.

Car model: Anthony J. Arons

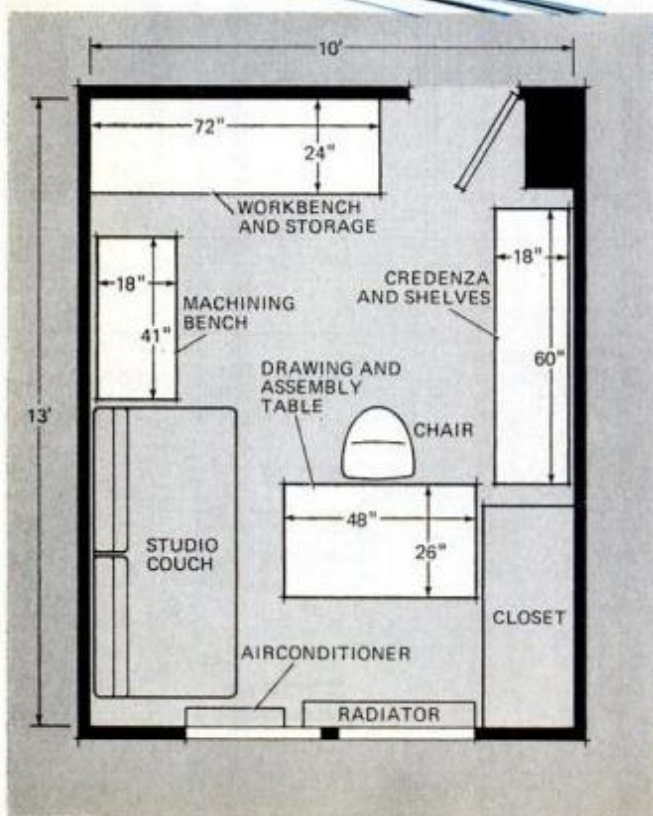
Art: Tom Fung



Two mini workshops for small spaces



Main workbench and storage area in Henry Iken's model-building shop is of simple, freestanding construction, can be taken apart. See details on page 110.



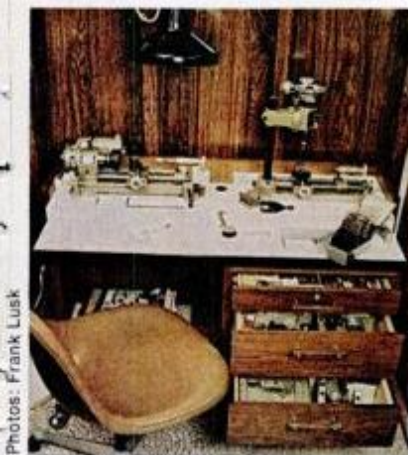
2

When Henry Iken's oldest daughter married, he acquired something he had wanted for a long time—a room in his family's three-bedroom apartment he could turn into a small shop. After years of building detailed ship models on the kitchen table—and having to clear the table for meals—he now began, after first paneling a wall and laying a new vinyl floor, to set up a really versatile shop for small-scale projects.

His use of the available space was clever, especially considering that the family insisted that the room remain usable as a guest room. All parts of the shop are freestanding or supported by spring-loaded poles, with no permanent installations to which the landlord might object. The main workbench was scratch-built, but the other units are ready-made office furniture, attractive and durable, with tough laminate tops. The



Compact shop includes everything Iken needs for modelmaking, as well as for furniture repairs, other light maintenance chores. Here he shapes a ship-model hull with a Surform tool.



Machining bench has two Unimat lathes, full set of accessories.



Swivel vise handles large workpieces near the support post.



When reversed, wall picture is screen (above) for slide projector on shelf above credenza (right).



machining bench is a typewriter table—"just the right height," Iken says—with three-drawer pedestal on casters; the drawing and assembly table is a simple desk, and the credenza provides both an auxiliary work surface and additional drawers for storage of small tools and supplies. All are in the Departure Series from Designcraft Corp., 111 Kero Rd., Carlstadt, N.J. 07072. Cost when Iken bought them was about \$750.

Shelves within the main bench provide storage space for materials, kits, paints and glues—with enough room left for a Shop-Vac and attachments. Shelves above the credenza hold a large file of slides of prototype ship details and a projector. Iken can conveniently sit at the drawing table to sketch details of a model projected on the reversible picture screen on the opposite wall. Lighting supplied by the bench-mounted fluorescent fixture is supplemented by a combination incandescent-fluorescent Luxo floor lamp; its usual position is beside the machining bench.

Iken's full-time work is as a technical illustrator and partner in the firm of Walken Graphics. The drawings opposite and on page 110 are his.—*Stephen Walton, Assistant Home and Shop Editor*

(Please turn to page 110 for construction details)

Speedy gem polisher you can build

by R. S. Hedin



You're off to a fast start in lapidary with a home-built vibrating polisher that works four times faster than anything you can buy for the money.

By polishing the rocks you collect with progressively finer grades of abrasive, you can turn them into glowing gemstones. Inexpensive tumblers do the job well enough, but slowly—requiring at least one month per load. Vibrating rock polishers do it in one-quarter the time.

Commercial versions cost \$200 and up, but you can build this one for about \$50. It is basically a shaker table, with a platform, which holds the rock bowl, suspended on four coil springs and vibrated by eccentric weights on a rotating shaft attached to its underside. The base supports springs and drive motor.

The rock bowl is made from two Melmac mixing bowls (No. 118 by Texas Ware) fastened mouth-to-mouth. The bottom of the upper one is removed. Grinding is the best method—use eye, nose and mouth protection. Pencil a cutting line on the outside of the bowl and grind with the corner of the wheel. Silicone-rubber caulking is used to cement the bowls together (sand the glaze off the rims) and to line the lower one. The rubber needn't be smooth, but pockets that could trap grit should be filled. The lining should be about 1/16-in. thick.

Springs specified in the hardware list are just about right to support the load and isolate the base from vibration. If they're too stiff, the base will tend to walk; if too light, they may buckle under the load.

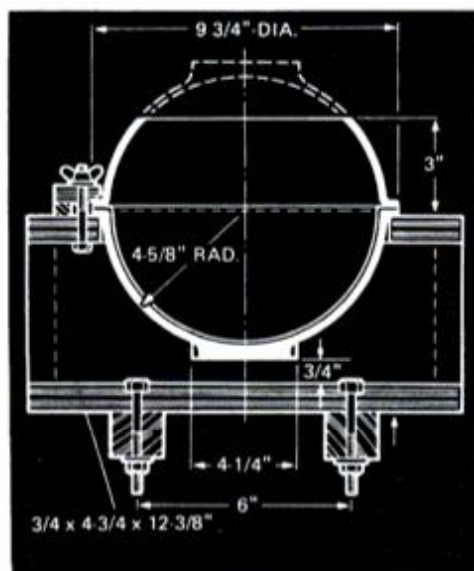
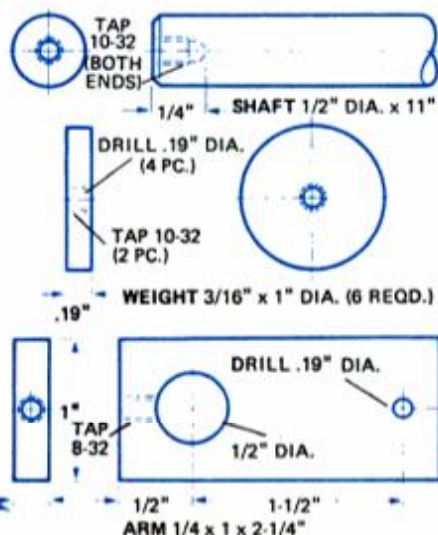
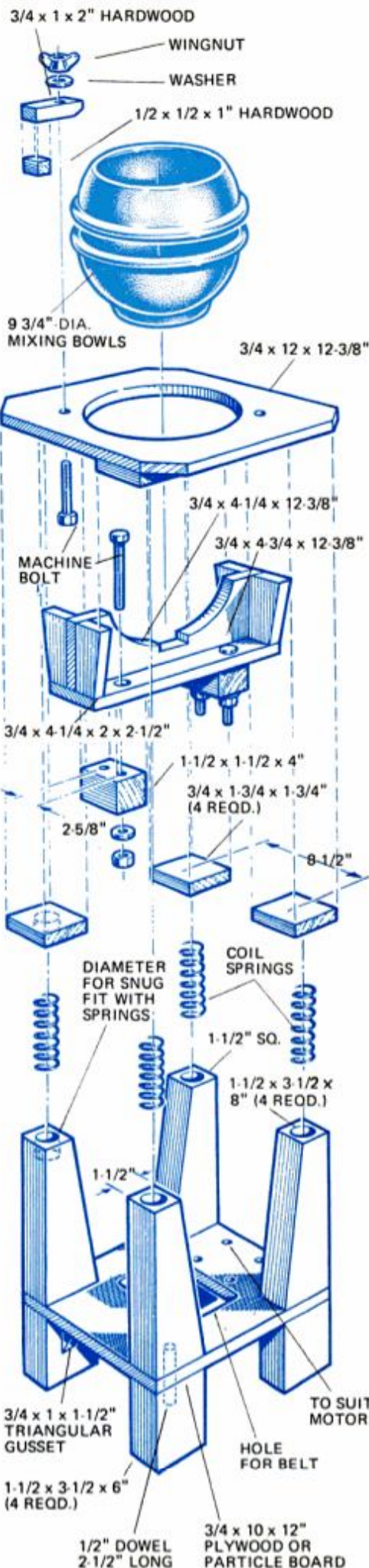
The pillow blocks for the shaft include ball bearings and can be bought most conveniently from a bearing supply house or well-stocked hardware store. Weight arms are held to the shaft with setscrews. Tapped holes in the shaft ends are for screws and washers that act as safety stops in case the arms loosen.

Defer buying pulleys and belt until the polisher has been assembled, then measure the distance between shafts—from this and pulley size you can determine belt length. *Without* the bowl and rocks in place, it should be necessary to compress the springs about 1/4 in. to install the belt.

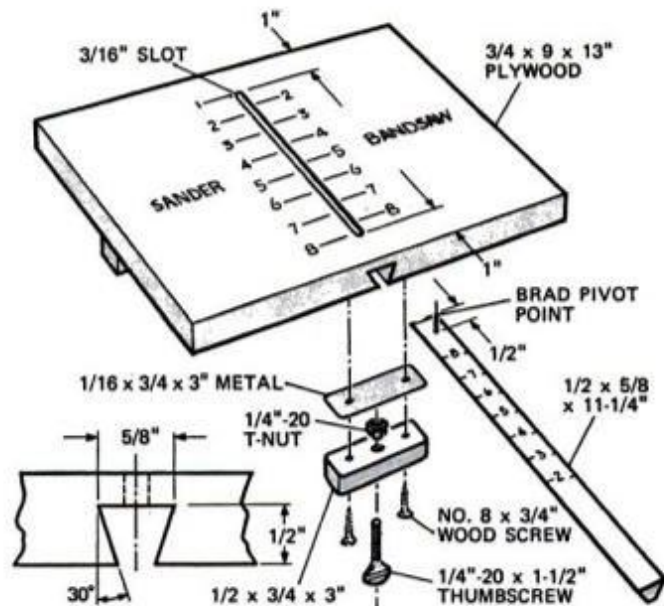
Setting up the first run

For a first run, set the weight arms 90° apart, two weights on each. Fill the lower bowl with 10 lbs. of rocks (to assure correct motion and circulation), a cup of water and a few tablespoons of detergent, and, if starting with rough stones, 1/4 cup of 120 or 220-grit abrasive. Get the abrasive from your local rock store or hobby shop, which can provide more information on technique than can be presented here. To begin in lapidary, you can use this basic guide: Rough grind—120 to 220 grit for one to 1 1/2 days; fine grind—400 to 600 grit for two to three days; prepolish—levigated alumina for one to two days; mirror polish—tin oxide for two to three days.

Don't use too much water; it will
(Please turn to page 118)



Perfect circles every time



If you have need to cut a number of wood discs accurately and quickly, it will pay you to make this workshop fixture which will handle discs up to 16 in. in diameter. It's designed for use first on the bandsaw and then on the disc sander—first to saw the disc, then to sand it to the exact size. In each case the fixture is positioned by the miter-gauge table groove.

In use, you set a brad point for the

desired radius, lock it and impale the work on the point. Then you place the fixture in the saw-table groove, move it inward until the work touches the blade, clamp it in position with a C-clamp, turn on the saw and slowly rotate the blank. If a number of discs of the same size are to be cut, leave the pivot point undisturbed. If different sizes are needed, simply reset the pivot point for each change of size.

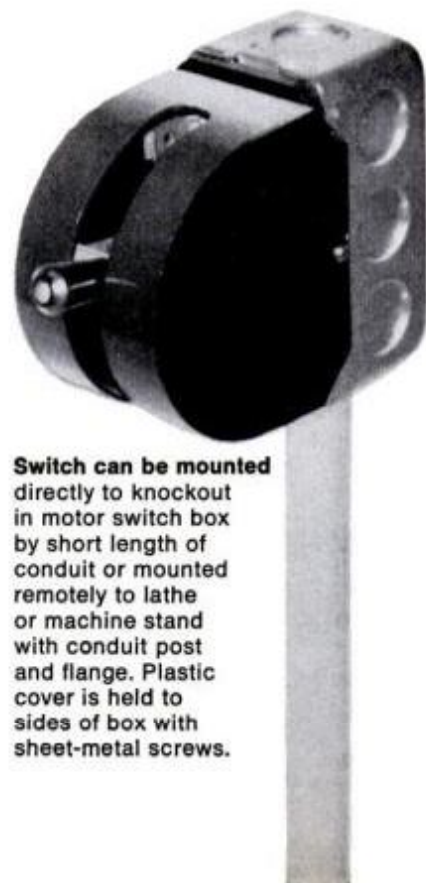
The setup is repeated in switching from bandsaw to sander, except that the brad point is set to the sander calibrations on the fixture. The disc is replaced on the brad, the sander turned on and the fixture moved inward in the groove until the wood disc contacts the spinning abrasive. Here, as before, you clamp the fixture and rotate the disc slowly to produce a perfect circle.—Paul D. Fiebich

Motor-reversing switch you can make

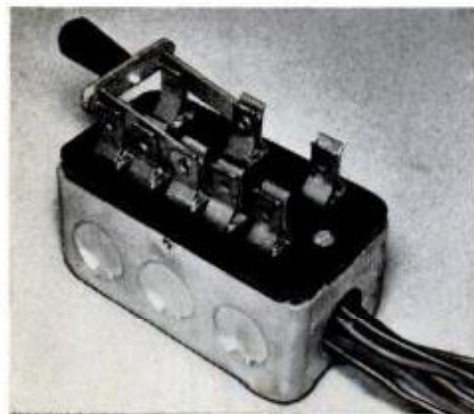
You can make a simple motor-reversing switch from a double-pole, double-throw knife switch which will operate most single-phase reversible motors up to 1 hp. Two extra contacts are added to one side of the switch. All are mounted on a plastic base (discard the porcelain one) cut to fit a standard utility box.

Make a safety cover of 1/8-in. plastic by cutting a half-circle wood

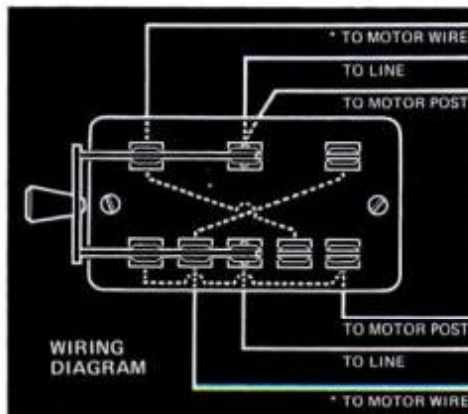
block the width of the utility box. Then heat a 2-in.-wide strip of plastic over an electric hotplate until it softens. Bend it over the wood form and hold until it cools. Add plastic sides to the curved piece so they lap box, cement with plastic solvent and trim flush. Cut a slot to accommodate the switch handle and attach cover to sides of box with sheet-metal screws. —William Waggoner



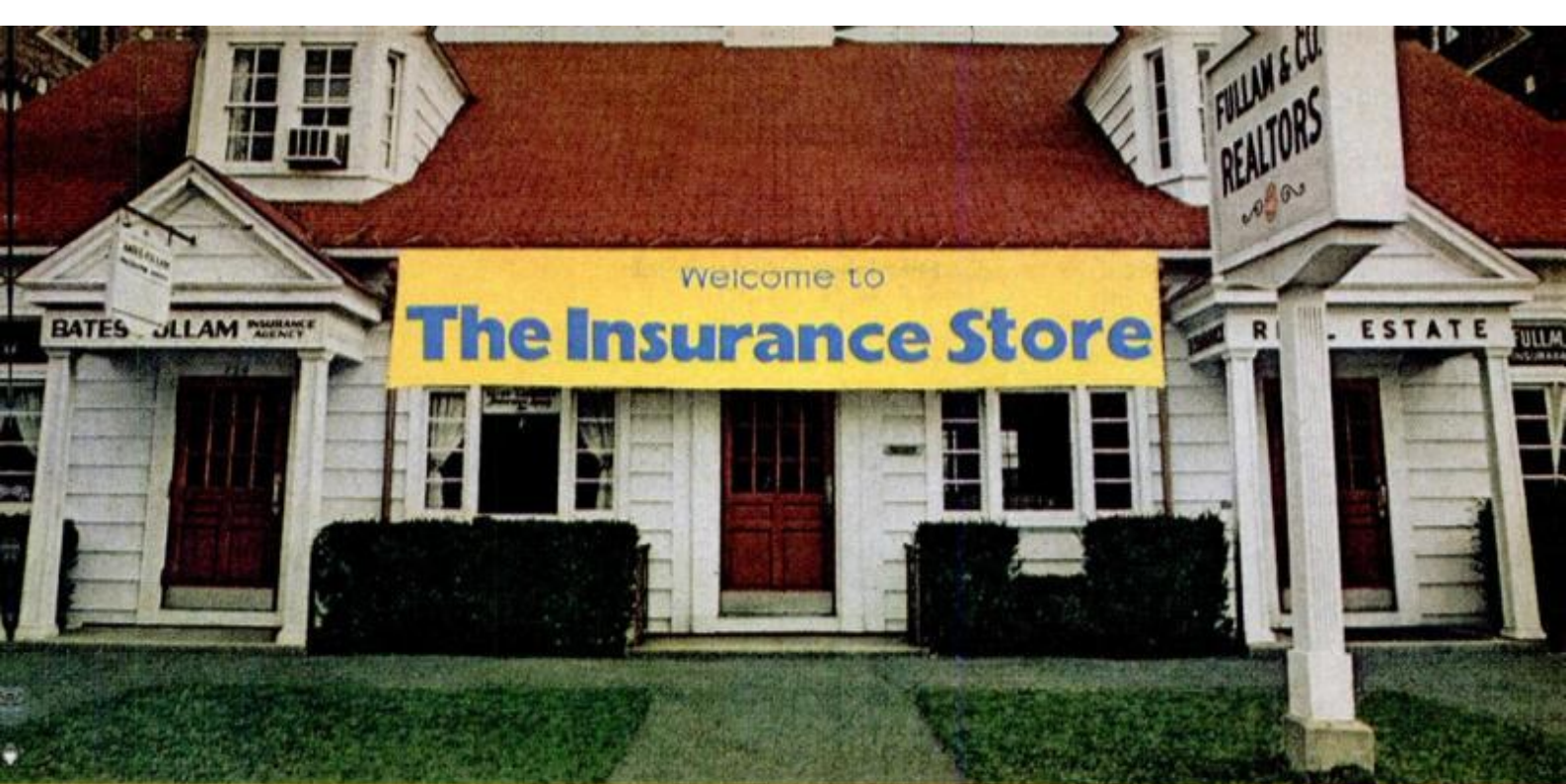
Switch can be mounted directly to knockout in motor switch box by short length of conduit or mounted remotely to lathe or machine stand with conduit post and flange. Plastic cover is held to sides of box with sheet-metal screws.



Switch's porcelain base is replaced with plastic one cut to the same size as box.



Follow diagram in wiring the switch to line cord and motor. Note two extra contacts.



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craft could be kept together. His design not only does this, but it also lets you store frequently used tools for ready access in upper drawers of the swing-out drawer box. Lighting and electrical outlets are integral.

The bench couldn't have met the requirements we set if it weren't fairly large, so you should plan ahead in construction—if a tight corner or stairway is a possible obstacle, do the final assembly in the room where you'll use the bench. Accurate cutting is vital. If you have (or have access to) radial-arm and table saws, this will go quickly; if you are limited to portable tools, it will take longer, but you can still do a good job. Essentials

use a smooth-cutting blade and face the back of the panel up. Follow with rabbets along the inside back of both side members, using a router or a dado head on a table saw. Dados for shelves can be cut with a radial-arm saw, router or portable saw. They cannot be cut accurately or safely with a table saw.

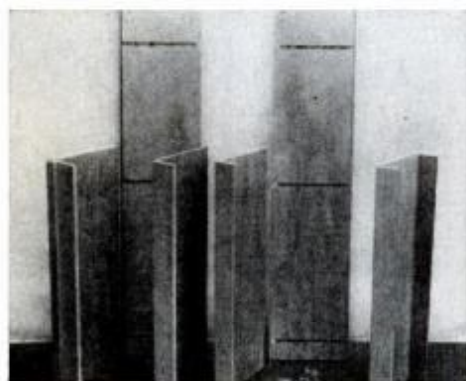
Facing strips are applied to cross members, and flexible wood trim to exposed edges, before main assembly is done. Overhang from the trim, which is available in 1-in. by 8-ft. rolls, is removed with a block plane or sharp knife.

If joints are made well, you can assemble the cabinet with 2-in. fin-

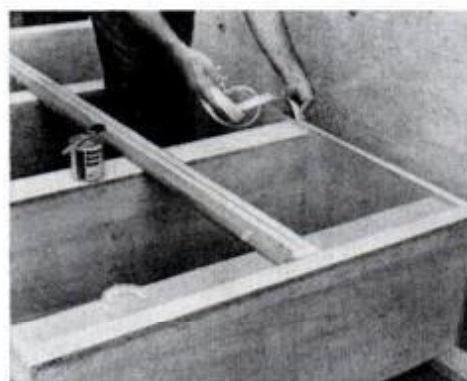
panel to just under exact inside dimensions of the cabinet, then mark as in the photo. Curved cuts on doors can be made with a bandsaw or sabre saw. Install door hinges, using the method illustrated for alignment. It's all right if doors touch at the center; later you can trim them for 1/8-in. clearance.

To make finger slots, cut out waste between 7/8-in. holes with a fine blade in a sabre saw (cut from the back), using a tacknailed guide strip.

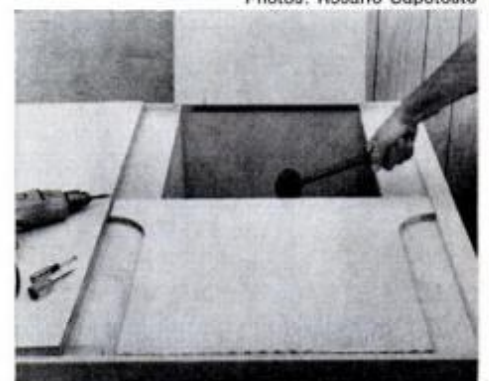
Since the thickness of the laminate and hinge sections are the same—1/16 in.—the drop-leaf hinge need not be set into the wood. Attach it to the fixed cabinet surface first, setting



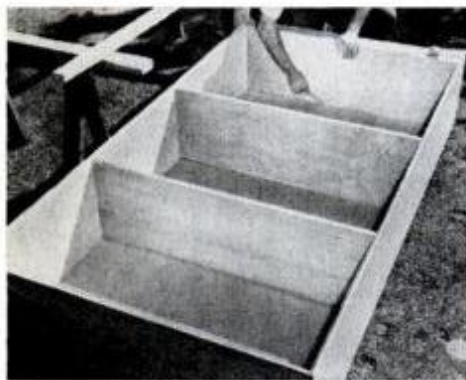
1. Major components ready for assembly—blind dados are made easily by gluing softwood inserts into the voids.



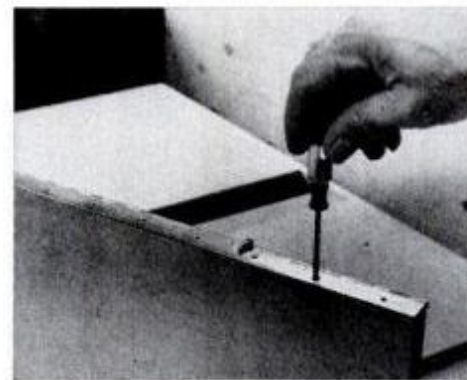
3. Surface long front edges carefully. If wood trim strip veers off, cut it short, butt-join a new piece and continue on.



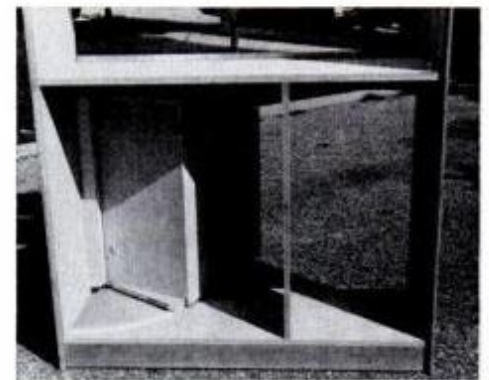
5. With hinge attached, lay door in place and tap with mallet. Screwheads will make indentations showing the correct location.



2. Panel for doors, drop leaf is accurately marked for cutting when inserted into front of the frame, back surface down.



4. For perfect hinge alignment, attach a doubled-up hinge to the door and turn in roundhead screws near each end to hold it.



6. Rear view shows how bottom extension helps support weight of drawer box. Glide rides smoothly on track cut from laminate.

are a circular saw, sabre saw, router and drill—and a really straight strip of wood to guide the saw and router.

Wood chosen for our prototype was lumber-core birch. You could economize by using ordinary fir plywood and a painted finish, but select panels carefully if you do.

■ **Begin the project** by cutting the side panels; use a portable saw, since 4x8-ft. panels on a table saw are extremely awkward. Tack-nail a straightedged wood strip for a guide (allowing for the offset of the base),

ishing nails and glue; otherwise, screws will be necessary, with counter-bored holes and wood plugs. Test fit before applying glue; recheck squareness during assembly. When glue has set, cut the 1/2-in.-plywood back to fit rabbets and attach it temporarily with 1 1/2-in. wood screws into cross members. It will be glued in later, with nails around the perimeter.

■ **Doors and drop leaf** are cut from one panel in their relative positions for best grain appearance. Cut the

the pivot axis in from the edge so the panel will close flush with the cabinet front. Make a stiff paper or cardboard pattern for the inner piece of laminate, cutting it about 1/16 in. undersize so it won't have to be forced against the walls. Allow a rear overhang of about 1/4 in. to trim later. Use wrapping-paper slip sheets to help position the laminate before bonding it into place. Apply 1-in. strips of laminate to the drop leaf's shorter edges, then its longer ones,

(Please turn to page 108)

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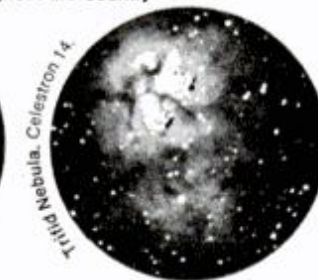
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see page 46



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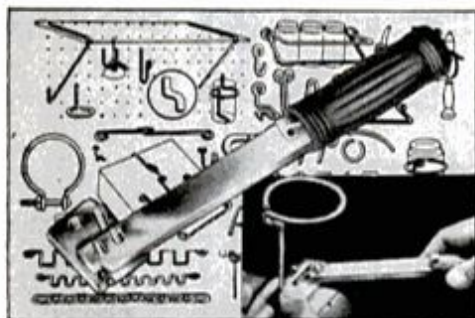
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MINI WORKSHOP (NO. 1)

(Continued from page 106)

and trim flush. Laminate the work surface only after the hinge position is certain.

■ **The swinging drawer box** is assembled with butt joints, except for the rear, which is rabbeted for a 3/8-in. plywood back—attach it only after drawer runners are installed. The metal glide and laminate track should be in place before you locate the hinge.

■ **Installation of the lamp and outlet wiring** is easier if done before the back panel is installed permanently, although it must be in place when outlet strips are added. The Plug-mold strip is sold in 6-ft. lengths; cut one length down to obtain two 24-in. pieces.

Connect all wires together in a surface-mount box located on the bottom of the shelf above the work area. Pass the power cord through a hole in the back panel. A perforated-hard-board tool board can be mounted between the outlet strips, with stand-out cleats for clearance.

■ **To finish the prototype**, a coat of white Firzite was applied to the fir plywood back, then the entire inside was painted white. Exterior wood was given a wash coat of Constantine's sanding sealer which had been diluted 1:1 with lacquer thinner and applied with a cloth.

After light sanding, Beverlee's Provincial stain was applied with a cloth, one section at a time, and wiped with a clean cloth. This was followed by two coats of Constantine's Wood-Glo satin finish, with light sanding with 220-grit paper between coats.

Floor must be level

Three important things should be noted: First, the cabinet may tend to rack or twist if placed on an uneven floor. Check it with a level at the installation point, and shim if necessary, before final trimming of the doors.

Second, expect some degree of warping of the drop leaf, since it is a freestanding panel laminated on one side without the customary backing sheet. Visually, the warp is not serious, and in our prototype two heavy-duty magnetic catches eliminate it when the leaf is up in the closed position.

Third, the unit must be secured to the wall because it will tend to tip forward when all hinged parts are in the open, full-forward position. Two screw eyes at the top rear can be used to receive washered screws, or screws can be driven into studs through the back panel in the upper compartment. ★★

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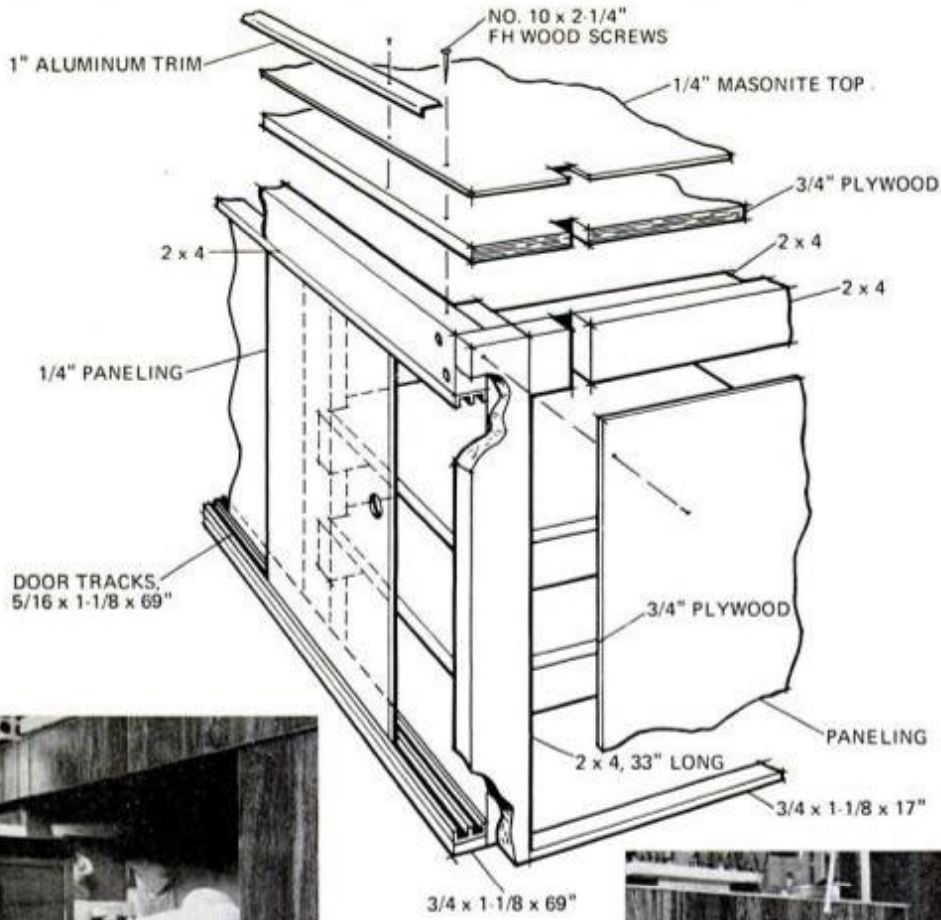
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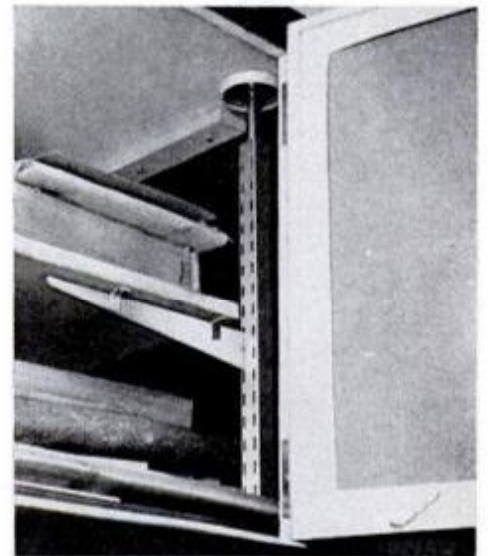
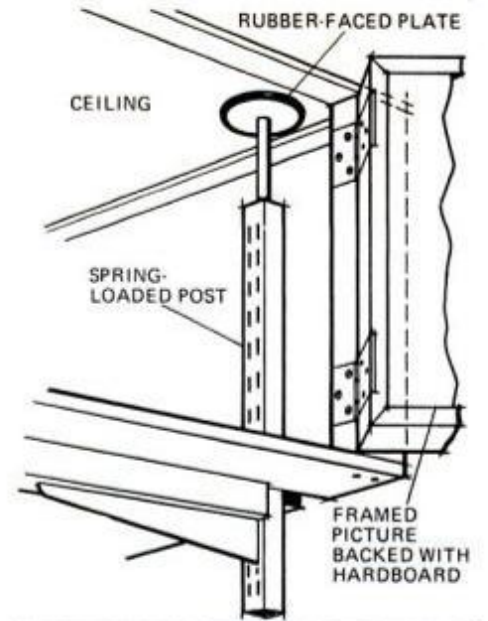
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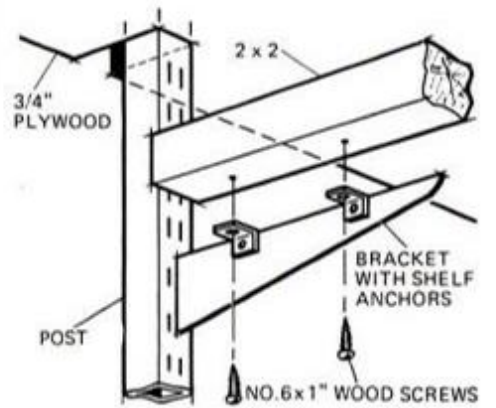
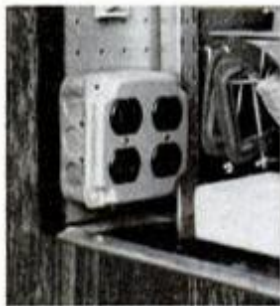
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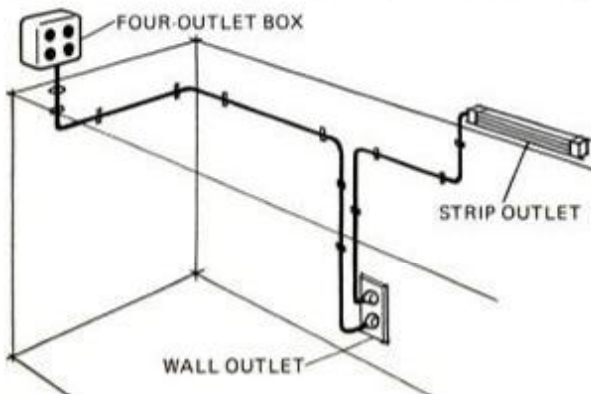
Under-bench area offers plenty of storage space for Shop-Vac and full set of attachments (left), model-building supplies (right). Sliding doors are 1/4-in. paneling running in commercial door tracks.



Poles anchor structure firmly to ceiling, so that no wall attachment is needed.



More storage above working area. Drawing shows attachment of beams to poles.



Wiring setup uses existing wall outlet behind bench to provide accessible power for tools through four-outlet, surface-mount box and continuous-outlet strip at other end of bench.

WEATHER DEMONS IN THE SKY
 (Continued from page 52)

is in a better position to judge wind shear effect—pilots or ground controllers? Why wasn't runway closed after Capt. Bliss's warning? A \$4.6 billion damagesuit has been filed—the largest ever as the result of a plane crash. Ironically, as recently as the destructiveness of wind was hardly recognized. More attention was paid its twin brother—turbulence (CAT).

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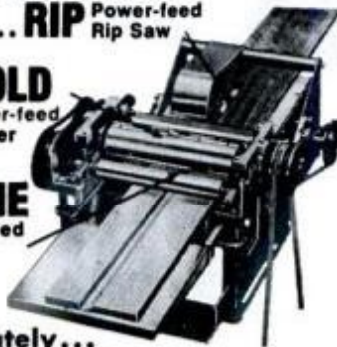
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WEATHER DEMONS IN THE SKY (Continued from page 111)

dent investigation report declares.

On Dec. 17, 1973, an Iberian Airlines DC-10 on an ILS approach dipped below its glide slope, struck the approach-light piers 500 feet short of runway 33L at Logan International Airport in Boston and skidded to a stop 3000 feet beyond the runway threshold. There, 167 people evacuated a craft virtually split in two. The increased rate of descent was "induced by an encounter with a low altitude wind shear at a critical point in the landing approach," the NTSB concluded.

The next accident known to have been caused by wind shear was that of the ill-fated Flight 66, and several weeks after that, on Aug. 7, 1975, wind shear brought down a plane that had just taken off in Denver. The Continental Air Lines 727 had raised its gear when suddenly it fell back to earth on its belly from an altitude of about 200 feet. The fuselage split in two places and one passenger sustained serious injuries.

The unofficial explanation is that the plane lost power in one engine, and the reduced thrust could not overcome a severe wind shear.

Comes and goes

Wind shear is elusive—overcoming its dangers will be one of the most baffling problems the airlines have ever faced. It can exist one minute, disappear the next and reappear two minutes later.

This was vividly demonstrated when Flight 66 died. Between the time Capt. Nickerson struggled to bring his L-1011 back into the sky and the time Flight 66 didn't make it, several other aircraft landed without encountering any wind shear.

You can't close airports when wind shear is likely to be present—it's around as often as not. Closing airports indiscriminately would literally shut down commercial aviation.

The only tangible scheme seems to be developing equipment that warns of the presence of wind shear before an aircraft begins its approach—before control passes from the pilot to the gods who watch descents.

One piece of equipment that looks promising, oddly enough, was developed to measure another serious turbulent condition called wake vortex.

Wake vortex turbulence is generated by large jet aircraft, especially jumbo jets, operating at low speeds during approaches and departures. Invisible eddies created behind the jets resemble tornadoes in form and severity—especially violent to following aircraft coming in for a landing.

Wake turbulence normally creates

severe disturbances in the runway area for a minute or two after an aircraft passes—more than five minutes in a calm and stable atmosphere.

From 1964 to 1972, 112 accidents in which 44 fatalities occurred were blamed on wake vortex turbulence. One such crash occurred on July 15, 1969, at Kennedy International Airport in New York. A Boeing 707 took off from runway 31L. About two minutes later, New York Airways Flight 905 was cleared for landing on this runway. As the aircraft came to within 50 to 100 feet of the ground, its left wing suddenly lowered violently, the entire plane turned sharply and crashed.

The violence of the tornado-like wake vortex that destroyed the aircraft and killed three of its occupants was demonstrated by the fact that the plane came to rest 160° from its original direction of landing.

Detecting turbulence

To prevent wake vortex turbulence accidents, increased separation between aircraft taking off and landing has been imposed. This varies from three to seven minutes, depending on atmospheric conditions.

Increased spacings, however, have caused air-traffic delays. In an effort to overcome them, equipment to detect and track vortices has been developed that's been undergoing tests for over a year.

The setup I saw was in position at the threshold to runway 31R at Kennedy. Developed by Avco Corp., it consists of a series of wind-speed measuring devices called anemometers and an acoustic-pulse sensing system which tracks vortices up to about 2000 feet.

An operator monitoring the computer readout can communicate with the control tower, advising of the severity of vortices and recommending shorter or longer landing times.

According to Paul G. Malone, Avco's on-site project engineer, the wake vortex detection system was modified after the Flight 66 crash.

"We've been successful in measuring the presence and severity of wind shear," Malone claims, but indicates more tests will be needed before the Federal Aviation Administration decides if the system has merit.

If it is adopted, every runway at every airport in the country would have to have the system installed to make aviation as wind-shearproof as possible. This would mean an investment of many millions of dollars.

This, then, is where the wind shear problem stands. Nothing offers aviation more of a challenge. ★ ★ ★



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IMPORTS AND MOTORSPORTS

More mpg for Mazda



Mazda hasn't just been spinning its rotors. It has raised mpg of the '76 models 40 percent over last year's EPA certification figures, and has just introduced a new, top-of-the-line model EPA-rated at 29 mpg highway.

The last two years have seen the need for increased fuel economy from internal-combustion auto engines.



The challenge has been greatest for rotary-engine advocates—apparently too great for GM: Unable to boost mpg, it dropped plans for rotary models and is sitting on an investment of millions.

The new Mazda Cosmo, shown above, uses the Mazda two-rotor powerplant (110 hp at 6000 rpm) that has been made more fuel-efficient by a number of modifications. Among them are improved apex seals, leaner mixtures from a new carburetor, more precise timing and scavenging, less back pressure and an added heat exchanger. What it adds up to is good economy with the same old great performance (see RX-4 test and *PM Owners Report*, page 96, July '74). The \$6000 Cosmo wouldn't be a Mazda without its whacky styling elements, but, still, it's an interesting car.

Toyota keeps on truckin'

Among the changes and additions in the '76 Toyota lineup is this long-bed version of the SR-5 Sport Truck. The 87.8-inch cargo body is on a wheel-

base of 110 inches. Toyota now has four pickup models: the basic half-ton and the Sport Truck, both in short and long-bed versions. The short beds are 72 inches long and have 12.2-gallon fuel tanks, while the long beds have a fuel capacity of 16.1 gallons. Pickup prices start at \$3578.



Bikecentennial!

It's heartening to see that assimilation of Harley-Davidson motorcycles into the respectable conglomerate of AMF Inc. has taken no meanness out of the machines. They still flaunt their nonconformity, and the 1976 models carry it to new heights. If Paul Revere could have gotten his hands on a bike for his midnight ride, surely it would have been a metallic black Liberty Edition FX/FXE-1200. You can almost feel that steely-eyed eagle's talons cutting into your leathers. The Liberty Edition graphics (below) are just what's needed for a bikers' bicentennial. The mural-like decal is applied over a metallic black paint finish in which aluminum chips are suspended in clear acrylic.

Paint isn't the only new H-D story.



Two lightweight bikes are added to the street-machine line. The SS-175 and SS-125 (above) are two-stroke singles with oil injection and five-speed transmissions. The SS machines have a lot of nice features, but unique to the 125 is an automatic spring-loaded chain tensioner.

Shaft drive for Yamaha



Not too long ago, BMW and Moto Guzzi were the only motorcycles with the very desirable feature of shaft drive. Smooth and maintenance-free, shaft drive is catching on. Honda introduced it on the Gold Wing last year, and now Yamaha has it on its new XS 750C.

The four-stroke, three-cylinder bike is an eye-catcher for other reasons, too: The cast aluminum wheels of six-spoke design replace the standard spoke type, and the front and rear brakes are hydraulically operated disc brakes. The XS 750C also features automatically canceling turn signals and a positive crankcase ventilation (PCV) system.

More and more people are moving up to large displacement bikes like the XS 750C and the Harley heavyweights. Their performance and touring comfort are the reasons, but they are heavier bikes than most people are used to. And they are unique in other ways. In a feature next month we'll be discussing what to consider before you move up to a big bike. ★★★

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For close-ups, Sedic cameras take two accessories: Copy stand (above, left) shoots at 10 cm (4 inches); stand doubles as focus and framing check in other close-up uses (above, right). Close-up attachment (top right) has focus chain, shoots at 20 inches.

TURN POCKET CAMERAS INTO PHOTO SYSTEMS *(Continued from page 75)*

and a 1.5X telephoto (equivalent to a 75-mm).

What the angles mean

The pictures on page 75, shot at about the same distance, should give you a fair idea of what those angles mean.

After testing all of these except the Sedic telephoto, I was reasonably happy with the way each of them performed optically. Their convenience, however, varied.

The Computar set was convenient to mount: Both lenses screwed easily into a mounting frame that you can leave on the camera. But figuring out just what each lens sees is a problem. For the wide-angle, you have to overlook the bright frame in the finder and think of the entire finder area. That isn't too difficult—but it isn't too accurate, either: The lens actually takes in quite a bit more than that. For the Computar telephoto, you have to mentally restrict your image to an area whose limits can be derived from the lines of the finder, a process just about as difficult as it sounds.

The Computar set requires re-focusing, too: to shoot a subject 10 feet away, you set the focus scale at 15 feet when using the wide-angle, and about 3 feet when shooting with a telephoto, according to a scale on the bracket.

Built in telephoto easiest

Kodak's Tele-Instamatic 608 is the easiest of all: With the telephoto built in, there's nothing to carry, mount or lose; the lever that switches

in the telephoto lens simultaneously switches in a viewfinder mask to show the new field of view.

Sedic accessory lenses are quite easy to use, too: Each screws right into the lens mount, and each comes with a bulky but clear viewfinder.

The Sedic's threaded lens mount takes more than just accessory lenses: Sedic also makes a close-up lens and a copy/close-up lens and stand (see photographs above), and you can also fit filters. For \$10, the close-up lens brings the Sedic's minimum focus distance down to 50 cm—about 20 inches; a dangling chain helps you set the distance accurately, and a prism attached to the lens corrects the viewfinder for parallax. The other attachment takes you down to 10 cm (4 inches) with a frame attached that shows you exactly what's in view and in focus. It also doubles as a copy stand for shooting down onto small objects.

Not all Sedic accessories fit the front element, either: For rapid sequence shooting, you can fit the more expensive Sedic models with a compact, spring-wound motor drive, the first in 110-film photography (and, at \$30, the world's least expensive motor drive).

For 110 cameras whose lenses aren't threaded like the Sedic's, Hoya makes a \$4/slip-on skylight filter to reduce the blue-tint in distant scenery. And Andrew Jacobsen, 5618 East Edgemont, Scottsdale, Ariz. 85257, makes a \$25 custom adapter that holds Series VIII filters in front of both your camera's lens and its electric eye (if any). ★★★

EASY COLOR PRINTS FROM SLIDES

Continued from page 79

enough to minimize the problem of keeping solutions within the recommended temperature limits.

Filtration's easy, too

Finding what filters give you the right color balance is the hardest part of color printing, but Ciba makes that easy, too. Each package of papers is stamped with basic filter recommendations for use with Kodachrome slides (though the data sheet and Cibachrome's \$5 instruction book don't tell you that). Once you've adjusted that filter pack to match your tastes and your equipment, you can easily calculate the changes you'll need to print from Ektachrome, Agfachrome, GAF or Fujichrome slides (the book tells you how; data sheet gets you figure it out indirectly).

When you switch to a new batch of paper, you just modify your standard filter packs by the difference between the filter recommendations for the two batches. If the second batch calls for 10 units more magenta, just add 10M to all previous filter packs.

What you'll need—and want

If you want to do your Cibachromes as cheaply as possible, all you'll need is a pack of 20 sheets of Cibachrome 8x10 paper for \$25 (or 10 11x14 sheets for \$24.25), a \$15 chemical kit (enough for either pack of paper), three trays and a set of filters for your enlarger's filter drawer (\$27.50 from Ciba, though available from other sources, too). But you'll be well advised to buy a drum (Ciba's is \$17.50, but other drums will do), so you can process your prints with the light on, instead of spending nine minutes in the dark.

As you can see from the photo on page 79, I added a few extras to this basic setup: A Chromega motorized agitator base (\$70) and a \$23 Chromega drum (because it fits the agitator better than the Ciba drum does), an \$80 Brantronics Temp-Set bath to keep my chemicals at precisely 75°, and a Chromega color head for my enlarger (\$233 with stabilized power supply) so I could just dial in my filter changes instead of having to shuffle filters physically.

Two other additions in the picture are so cheap it would be folly to skimp on them. Falcon's Air-Evac bottles extend the life of the expensive color chemicals by collapsing like accordions to expel air and bring the bottle cap right down to the level of the chemicals. And Unicolor's Jingle Bells timer (\$17 from Spiratone) ingeniously signals when each step of processing should end, too. ★ ★ ★

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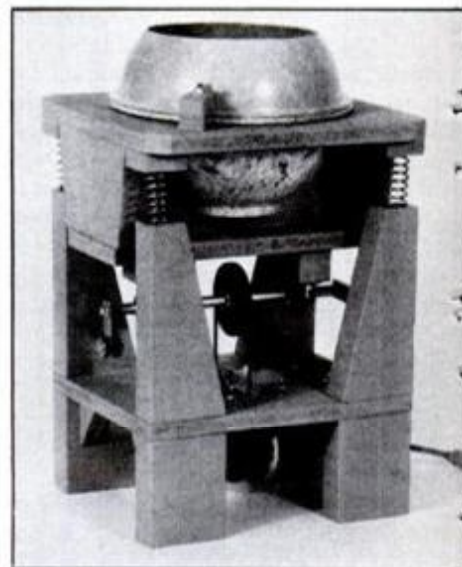
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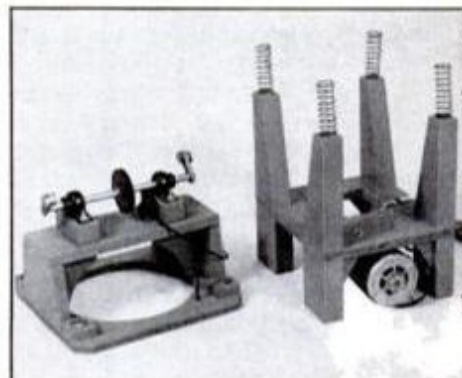
SPEEDY GEM POLISHER

(Continued from page 103)

only splash out. Always start with full load of rocks to get proper action. The rocks should circulate, rising to the top of the center of the bowl, traveling to the edge and then going under again. The pattern of the motion can be varied by changing the angular relationship of the weight arms, while the speed of rock motion can be varied by adding or removing weights. Although the polisher is not very noisy, it can be made quieter by covering the bowl with an old bath towel doubled up. ★ ★



Complete polisher with bowl in place (the second hold-down clamp is hidden)



Major assemblies, platform inverted to show pillow blocks, shaft, arms, pulley.

HARDWARE REQUIRED

- 2 10-32 x 1" RH machine screws
- 2 1/4 x 2 1/2" machine bolts
- 4 1/4 x 3" machine bolts with nuts
- 4 1/4 x 1 1/2" machine bolts with nuts
- 2 1/4" wingnuts
- 2 pillow blocks, Fafnir PB 1/2
- 2 3/16" or 1/4" V-belt pulleys; 3" dia., 1/2" bore
- 3/16" or 1/4" V-belt, 22" long or to suit
- 1/4-hp split-phase motor, 1725 rpm
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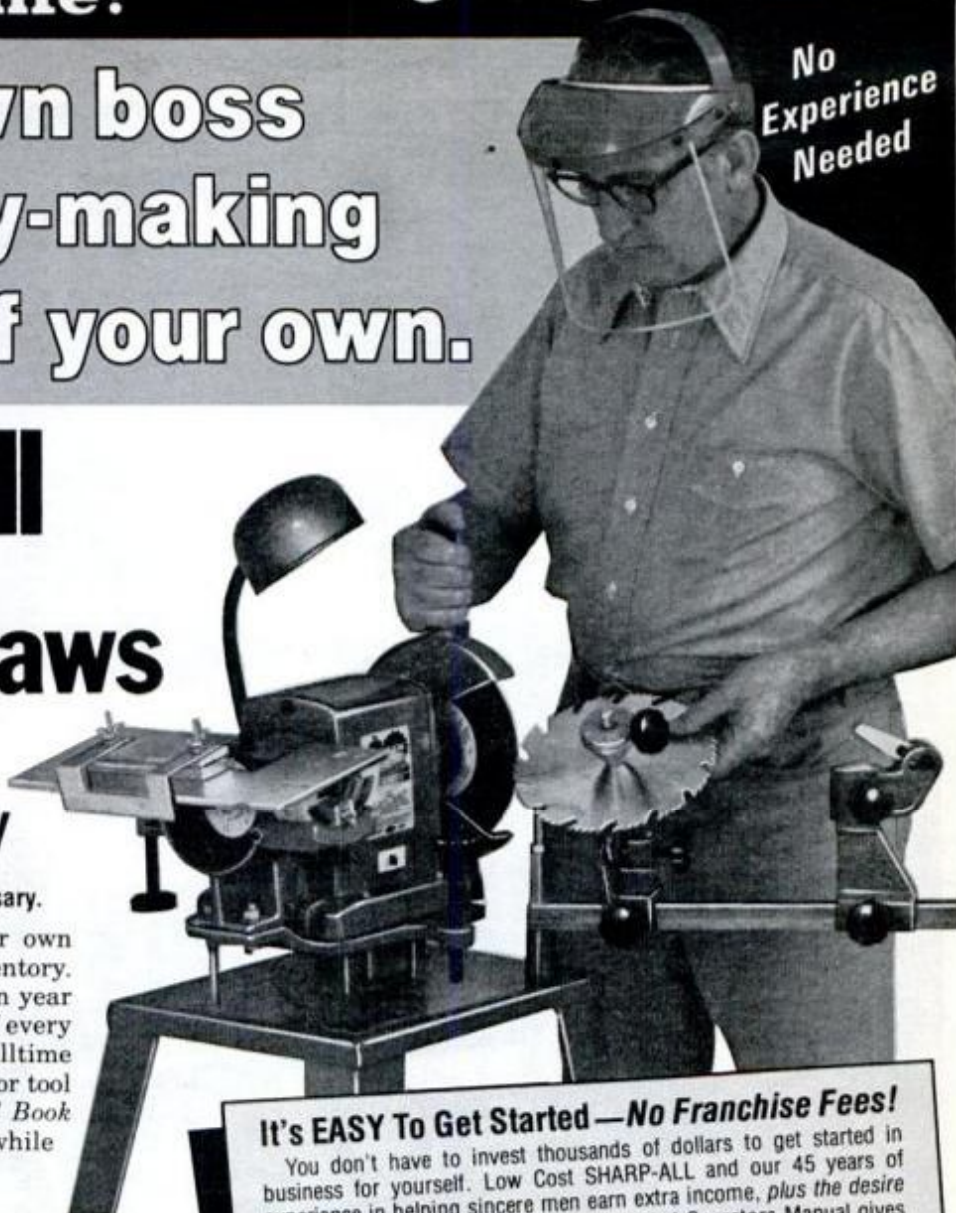
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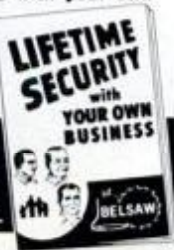
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FOR DEEP-WATER JOBS, CALL A SMALL SUB (Continued from page 55)

waves flipped the momentarily slack towline around the hatch lock on the sub's rear buoyancy sphere. The hatch cover was pulled off, and more than a ton of water poured into the sphere. The increased weight snapped the towline as *Pisces III* plunged into the depths. At 1575 feet, she hit bottom.

Seventy-six hours later, with the air supply almost exhausted, the sub and its two crewmen were rescued. The operation involved two other manned submersibles, including Vicker's *Pisces II*; an unmanned, surface-controlled recovery vehicle, *CURV III*, made available by the U.S. Navy, and two support ships.

The rescue dramatically demonstrated the submersible's value in deep-water work. *Pisces II* and *CURV III* were sent down to the disabled sub, carrying toggles—devices with two arms that open and close like an umbrella. Using manipulator arms, the rescue vehicles inserted two toggles through the open hatch of *Pisces III*'s flooded compartment. Then the toggles' arms were snapped open and locked in position. Lines from the toggles to a support ship were used to winch *Pisces III* to the surface.

Big in North Sea

Though this dramatic occurrence isn't typical of day-to-day operations, it shows the potential dangers facing the commercial subs as they work in rough ocean waters.

The accelerated search for oil and gas deposits in offshore waters has created a big demand for submersibles, especially in the North Sea,

where 14 subs are operating now, with another six under construction for duty there. Subs are also being used in offshore-oil work in the Mediterranean, Caribbean and the Gulf of Mexico.

This increased need has meant brisk business for the two major builders of these subs: Perry Oceanographics, Inc., Riviera Beach, Fla., and International Hydrodynamics Co., Ltd. (HYCO), Vancouver, B.C., maker of the *Pisces* subs.

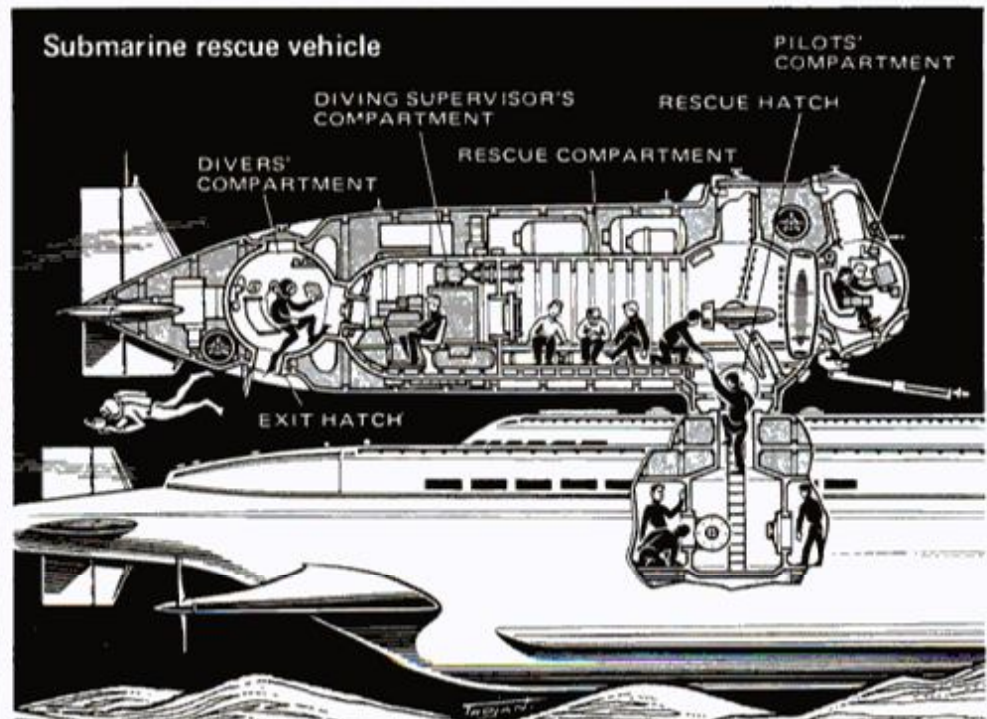
The world's largest fleet of commercial submersibles is operated by Vickers Oceanics, a British company that has nine subs and five support ships. On this side of the Atlantic the leaders are International Underwater Contractors, Inc., City Island, N.Y. (three subs) and HYCO of Canada.

The subs carry out various assignments in the oil fields. They make seabed surveys for new pipelines and siting of underwater structures; inspect and maintain rig structures, pipelines and wellheads; locate and recover lost equipment; make videotape and photo records of inspections.

Some subs are equipped with manipulators, mechanical arms that can be fitted with a variety of tools for such tasks as gripping, cutting, sawing, drilling and pumping. They can be switched under water.

A big advantage of the sub over the human diver is that the vessel can go a lot deeper. At present, the maximum working depth for a diver is about 1000 feet. Some subs, on the other hand, have a depth limit of better than 6000 feet.

Bruce C. Gilman, executive vice-



president of Perry Oceanographics, points out that at any depth the manned submersible has obvious advantages: "It can perform heavier tasks and deliver greater loads than can the diver. It can work in stronger currents and for longer periods. It can carry to a work site 70-mm cameras, video equipment, lights and water-sampling gear, which, if divers were used, would at least require many dives."

However, there are jobs at levels down to around 1000 feet that call for a diver's greater dexterity and ability to work in confined spaces. To fill this need, subs such as Vickers' VOL LI have lock-in, lock-out systems that enable divers to exit from and re-enter a pressure sphere separate from the compartment containing the operating crew. While the pressure of the divers' sphere equals that of their working depth, the pilots' sphere is at a pressure approximating that at surface level, providing them and any passenger-observer with a "shirt sleeve" environment.

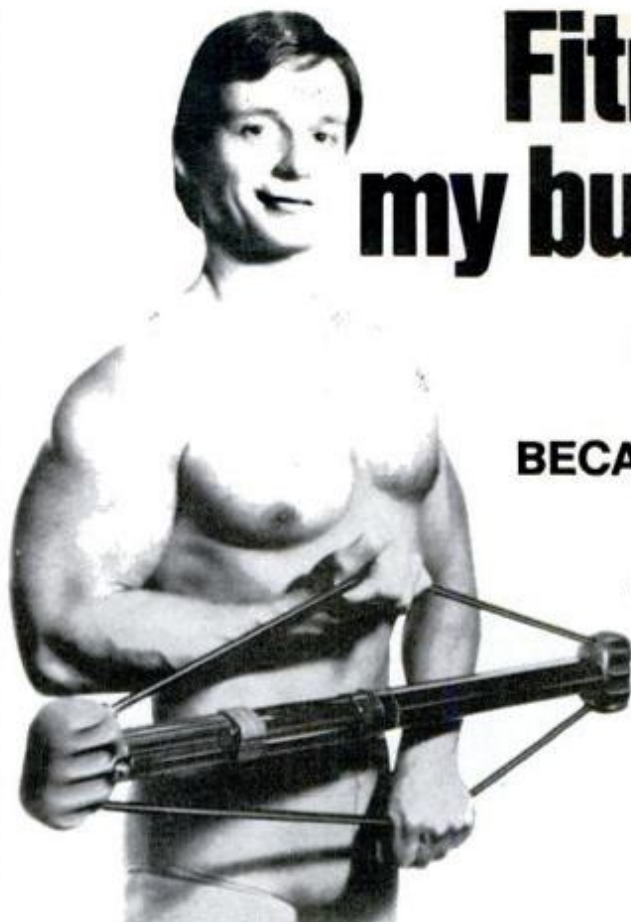
No need for speed

When compared with even a small atomic submarine displacing about 3000 tons, the commercial sub of 10 or 15-ton displacement is a real mid-get. The typical submersible has underwater speeds of 3 to 5 knots. Higher speeds are not needed and would waste energy. Power for propulsion and operating onboard equipment comes from batteries, usually the lead-acid type. Oxygen is fed into compartments at controlled rates, and carbon dioxide is removed from the atmosphere by scrubbers.

Dive duration for many subs ranges from about 5 to 10 hours. In the event of an accident, emergency life-support systems can sustain a crew for several days.

Despite the success of current submersibles, there is room for improvement. There's a need for increased power—and fuel cells and nuclear energy are mentioned as possible sources. The launch and recovery of subs in rough seas could be made surer and safer. A possible solution developed by a Swedish company utilizes a 1600-ton submarine-support vessel as the mother ship for a 50-ton submersible, which is launched and recovered in calm, below-surface depths. The drawing on page 124 shows the military version of this system, in which the submersible is used as a rescue vehicle.

The need for commercial subs should even increase, experts say, as the search for oil and gas sources expands into deeper waters and as the mining of minerals from the ocean floor becomes established. ★ ★ ★



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HERE COME THE DIESELS

(Continued from page 61)

diesels can take away a very strong enthusiasm for them among many people, or detract from the very clear advantages of this long-lived type of automotive powerplant. There's no ignition system to go wrong, and there isn't even a carburetor to fiddle with since diesels use a fuel-injection system. Easy maintenance is a bonus to the owner on top of the excellent fuel efficiency.

Let's take a look now at what's available in diesel cars and what's coming down the road.

General Motors diesels

Sources at Oldsmobile presently admit they've been developing a diesel V8 based on the 350-c.i.d. Olds block. Plans call for selling it to Chevrolet (by Olds Div.) to drop into 1977 Chevy vans, pickups and some passenger cars. Whether the Olds diesel V8 will then appear in Oldsmobiles is moot.

An Olds insider told us recently the decision to experiment with the division's V8 was due to that engine's very strong bottom end. The 350's bearings and crank can take the added strains of high compression

with little (if any) modification.

General Motors, too, is toying with at least one other diesel-powered car—the Vega. This subcompact, shown to the press, carries a 2100-cc, 60-bhp German Opel diesel engine instead of the regular ohc Four.

Volkswagen diesel

Also experimental but a natural for production quite soon is the Volkswagen diesel. Two VW Rabbits with diesel powerplants based on the standard VW gasoline four-cylinder engine have been tested by the EPA. The diesel got 51 mpg on the highway and 40 mpg in the city. Possibly—this is *really* speculating—since AMC is buying VW (Audi) engines you'll see a VW diesel in something like the AMC Pacer or Gremlin before 1980.

We found out what it's like to drive the 1.5-liter, 50-hp diesel Rabbit from a New Jersey Dasher owner. He told us how he was invited to drive the experimental diesel-powered Rabbit at the Volkswagen of America offices in Englewood Cliffs, N.J. The marketing department there is doing a study on customer reaction to diesels. The Dasher owner, who displayed a good knowledge of cars, was impressed. The diesel ran up to

60 mph in about 18 seconds, emitted practically no smoke after a short warmup and retained the Rabbit's handling (after suspension modifications to handle the greater weight of the engine).

Driving was a bit noisy, however, but not bad considering no special sound-deadening had been added—as it would be if the car goes into production. And, yes, he would willingly pay \$200 more for a diesel, answering a question from the marketing people about the diesel versus the gasoline Rabbit.

New International diesel

International Harvester now makes diesel engines available in its Scout II, Traveler wagon and Terra pickups. After testing and comparing several diesels, I-H settled on the Nissan CN6-35 unit, an in-line Six of 198 c.i.d. Nissan builds Datsun cars and trucks in Japan. This engine develops 92 bhp at 4000 rpm with a compression ratio of 22:1. The powerplant itself weighs 662 pounds.

Fuel mileage for the Nissan diesel is said to be 50 to 60 percent above that of gasoline engines in the same vehicles. Prices of diesel-engined Scouts, Travelers and Terras are quite a bit more than their gasoline

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Peugeot diesel

Peugeot began offering diesels in Europe in the early '60s, but didn't bring them into this country until 1974. The latest Model 504 Peugeot diesel car has a four-cylinder push-rod engine delivering 65 bhp at 4500 rpm. Torque is fairly weak (88 ft.-lb. at 2500 rpm), so no automatic transmission is available.

We drove a Peugeot 504 diesel and found it pleasant and amazingly quiet for a diesel—but lazy. Driving it takes patience. Cold-morning starting does, too—it demands switching on a glow-plug with the ignition key before spinning the engine. Most automotive diesels have similar systems. You usually wait less than a minute for the glow-plug to heat, though. A dashboard light comes on to tell you when the engine's ready to crank. Once the engine is warm, the car starts without waiting for the glow-plug.

Mercedes diesel

Mercedes surprised many Americans with a five-cylinder, in-line automotive diesel for 1975. Actually, odd-cylinder diesels are fairly common. John Deere, Detroit Diesel

(GM), Ford, Deutz, Onan and Hercules all make three-cylinder diesels; some are two-strokes.

Mercedes sells two series of passenger-car diesels: the four-cylinder 240D and five-cylinder 300D. Internally, they're practically alike. The 300D simply has one more cylinder and one extra main bearing.

Externally, these cars are again very similar—same wheelbase, overall length and interior dimensions. The 300D comes with an automatic transmission as standard; in the 240D it's optional.

The 240D puts out 62 bhp at 4000 rpm; the 300D develops 77. Compression ratio on both engines is 21:1.

In normal driving, the five-cylinder 300D feels almost—but not quite—like a six-cylinder gasoline engine. It's noticeably smoother than the four-cylinder 240D, which in itself isn't annoyingly rough or noisy. You know you're driving a diesel, though, and again, there's the typical diesel laziness, especially in the 240D.

We're sure to see more automotive diesels in the near future. Within a few years, many corner filling stations likely will be adding one more pump. The day of the passenger-car diesel is definitely dawning. ★★★

PM OWNERS REPORT—MERCEDES

(Continued from page 64)

everything on the car works, and that's saying quite a lot nowadays."

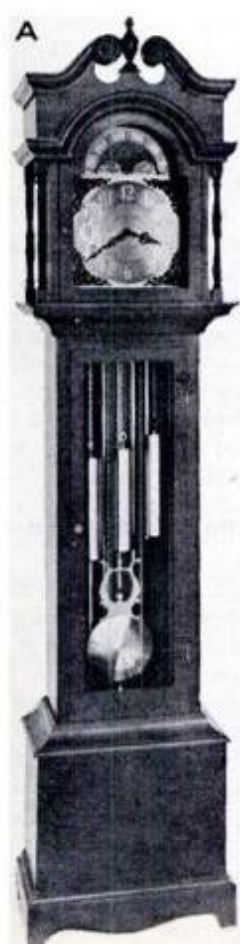
A Florida administrator: "The Mercedes is put together in fine detail instead of the assembly-line theory."

"American workers can't duplicate Mercedes quality because we no longer give a damn," states the Michigan cattleman.

All in all, then, owners of diesel-engined Mercedes appear well pleased and satisfied. We'll let some random, noncategorizable comments serve to ring down the curtain.

A lady in Washington, D.C.: "I like everything about the car. It handles well and, being small, is much easier to park than our big Oldsmobile. Furthermore, it doesn't create air pollution and is much cheaper to operate."

The president of an Indiana ad agency: "I'm essentially a salesman and need a car that will travel 300,000 miles with great economy and comfort. This 240D is better than any other car I've ever owned. Diesels are obviously the engines of the future—they make gasoline engines obsolete." ★★★



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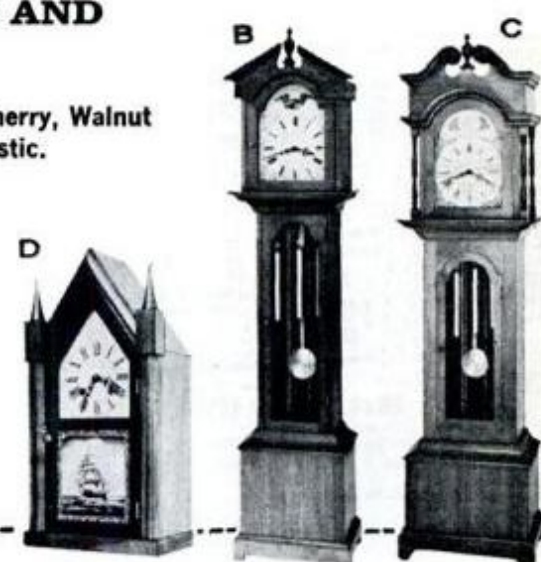
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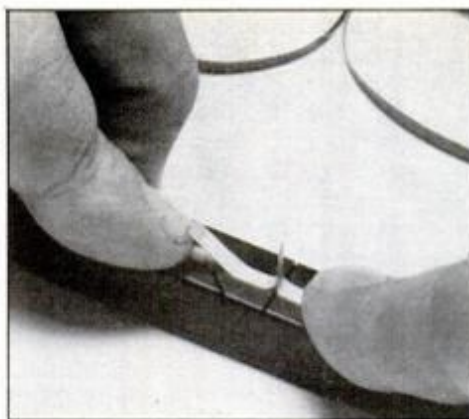
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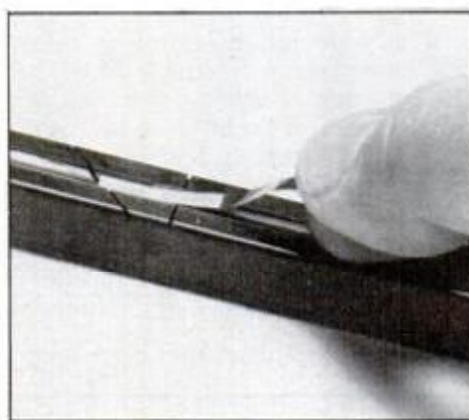
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SNARLED AND BROKEN CASSETTE TAPES

(Continued from page 95)



Splicing tabs to make repairs are easier to apply than splicing the damaged tape on rolls. Splicing tabs need less trimming, pick up less finger oils.



Splicing block holds tape in precision channel while you cut and trim with your razor blade. With this type of splicing block it's easy to flick out tape.

around the cassette's internal hubs. But the cure is usually simple: Hold the cassette three or four feet above a hard surface (such as a desktop or an uncarpeted floor), and drop the cassette so that it lands flat. Do this several times, including at least once on each side. It won't damage the cassette, and will frequently cure the jam-up.

If it doesn't, you'll have to open the cassette. If it's held together with screws (usually five small Phillips-head ones), you're in luck. Place the cassette flat and screw-side up on a table with plenty of clear working space. Carefully remove the screws, the top shell and the plastic slip-sheet inside. If your luck still holds, and the tape hasn't broken or stretched, you can simply smooth it out and wind it back in place. Check to make sure the tape can then move freely and in its correct path from one hub to the other, then reassemble.

Welded cassettes

There seems to be no good way to

open welded cassettes; the best way found is to stand the cassette up on its broad edge (the one through which the tape shows), rest a screwdriver on the seam in one corner between the tab pushout and the rear edge), hammer the screwdriver until the seam opens, then force the screwdriver down the edge to break the rest of the seam. Repeat this on the other side and, if need be, along the back seam. Then lay the cassette flat and gently pull the shells apart so that the parts all stay in place on the lower shell.

Tool No 1: the spare-parts kit

If you've just had to blast open a welded cassette, or if parts of a cassette are broken or missing, and the problem is due to such carelessness as using fixed plastic guides instead of tiny rollers to guide the tape, you'll need a spare-parts kit like the Maloney Audio Accessory kit shown, or the similar ones sold by Robins and Certron.

These kits are actually spare-parts kits with everything but tape. There are two shells, plastic hubs, the slip-sheets which prevent friction and static electricity from building up inside the cassette, tiny teflon rollers and stainless-steel pins to hold them in place, pressure pad assemblies, and metal shields, plus, usually, a cassette splicer to splice tape.

As needed, you can replace missing or defective parts from one of the kits, or lift the entire tape pack out of the old shell to fit into a new one. If that's the case, then wind the tape carefully around the rollers inside the plastic tape guides and in front of the pressure pad behind the tape window at the cassette's edge. This isn't as easy as it sounds—cassette tapes are thin and wispy, and it helps if you hold your breath to prevent the tape from being blown away as it can be done.

Tool No. 2: the 3M repair kit

If the only problem is a broken tape, you don't have to open the cassette up—not since 3M brought out its handy Cassette Editing and Repair Kit. The kit includes plastic repair wands with sticky ends which you can fish down into the cassette shell to pick up the tape—usually after several tries—bring it out for splicing (more often than you'd like to admit). Once the repair is complete, you fit one end of the kit's repair wand into one of the tape hubs to wind the slack tape you've pulled out and splice.

Tool No 3: the splicing block

Splicing any tape requires a device to cut broken tape ends neatly and to hold those ends in alignment while the splicing tape is applied and trimmed. There are lots of splicers around for cassette tape (regular-tape splicers can't be used—cassette tape's too narrow), some with two arms that hold the tape while a third arm comes down to trim the tape ends or the splicing tape, others are simple blocks with channels that hold the tape while you cut and trim with razor blades. Most professional tape editors use blocks like the Editall, and I found it the easiest to use of the three splicers shown on page 95. The Editall's weight keeps it steady (you can also screw it down), its slot is deeply undercut to hold the tape securely, its aluminum construction keeps razor blades from widening the cutting slits and its splicing tape tabs are very easy to apply.

The 3M kit's splicing block, molded into the kit case, held the tape as securely, but didn't sit as steadily or resist cutting like the Editall. Its splicing tabs were almost as easy to use. The small splicing block that came with the Maloney kit was adequate, but nothing more; the splices with it appeared to be Editabs.

Splicing

When splicing, always be sure the tape's shiniest side is up, and that neither end is twisted. Then overlap the ends by half an inch or so, make a diagonal cut with a razor blade (or your cutter's built-in splicer, if it has one), remove the loose ends, butt the clean-cut ends together, and attach the tape. Trim away any bits of splicing tape which overlap the edges of the tape; overhead-arm splicers do this for you, but with blocks, you have to run your razor blade along the undercut lip of the tape-holding slot to do it. ★★★

INVISIBLE REVOLUTION INSIDE YOUR PHONE

(continued from page 94)

netic data bits, form a data bank to which CC refers 180,000 times per second for instruction on what to do with the calls it senses.

Smart? Actually CC is, like all computers, an idiot that can do only one thing at a time. But since it does them at electronic speeds, CC processes calls hundreds of times as fast as older switching systems.

ESS isn't everything

ESS isn't the only new development to improve your phone service. For example, some phone offices are now using microfilm and minicomputers

for high-speed directory assistance.

Instead of having operators leaf through stacks of telephone books, directory pages are recorded on microfilm, 1440 directory pages to a strip, with up to 60 strips—15 million listings—controlled by one mini-computer. To locate a particular listing, the DAS/M information operator presses a key corresponding to a particular directory, then the first four letters of the last name. The computer locates the page and flashes it onto a TV-type screen. And systems already exist to have computers "print" directories on microfilm to enable quick updating of new subscribers and number changes.

Bell Laboratories is constantly



Lighted pushbuttons using solid-state Light-Emitting Diodes (LEDs) instead of incandescent bulbs will use less power and burn out less often. Several phone companies are now using them.

dreaming up new ideas—like Picture-phones—that someday may be available to everyone. Solid-state amplifiers are now being built into handsets used by rural customers to boost the volume of telephone conversations that have gone through long, rural lines. The Bell System is already using a new round storage battery, good for 30 years' service, and one whose principles may someday be applied to automotive use.

Finally, a touch of the awesome future is provided in the design of pocket-size cordless telephones: women might wear them around the neck, and men could have one in a billfold format. Even interconnection between phones and telephone exchanges may involve fiber optics—hair-thin glass fibers carrying light instead of electricity. Impossible to believe? Some still say that about ESS. ★★★

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Driving the Renault 5

by Bill Hartford
and Michael Lamm

There are already a million Renault 5s on the road—in Europe. Here, they go on sale next month. In Europe, the 5 has proven itself and is highly acclaimed. Here, the 5 is an underdog in a field of small, economical sedans priced from \$3000 to \$4500. The Renault 5 is joining the Chevy Chevette, VW Rabbit, Honda Civic and still more high-mpg models from Japan.

It may be that the 5 has the edge on all these competitors for one very big reason: its big-car ride. Drivers used to big Detroit sedans are bound to be impressed by the 5. It's only 141.5 inches long, but its wheelbase is a full 95 inches. Actually, it's 94.6 inches on the right side and 95.8 inches on the left—because rear wheels are independently suspended with transverse torsion bars. Since they're transverse they must be offset one ahead of the other.

The 1300-cc in-line Four is up front, driving the front wheels. It's not transverse like the Rabbit or Civic, though. It runs the long way, yet behind the transaxle for better weight distribution. The engine actually sticks back into the passenger compartment a bit, but Renault designers cleverly disguised this fact with what looks like an upright console. The console houses the optional radio which also stands upright.

Sound insulation is so good you hardly hear the engine, and all around it's a rather quiet car. The unitized body sits on a stamped plat-

(Please turn to page 136)



Renault 5GTL feels like much bigger car.

Part of big-car ride is a result of the tremendous wheelbase for car of its length, as evident above. At right is indication of high degree of body roll which can prove annoying. The front-wheel-drive French import is fitted with steel-belted radials.



RENAULT 5 SPECIFICATIONS

Vehicle type: front-engined, front-wheel-drive, 3-door, 4-passenger hatchback

Price: 5TL—\$3250 (est.) p.o.e. East Coast
5GTL—\$3500.

East Coast availability, Feb. '76;
West Coast, Apr. '76.

ENGINE

Type: In-line Four, ohv, water-cooled, cast-iron block, aluminum head, wet and removable sleeves, longitudinally mounted behind drivetrain

Bore and stroke: 2.9 x 3.0 in. (73 x 77 mm)

Displacement: 78.66 cu. in. (1289 cc)

Compression ratio: 8.5:1

Max. bhp @ rpm (SAE net): 58 @ 6000

Max. torque @ rpm (SAE net): 70 @ 3500

Carburetion: Weber 2-bbl.

DRIVETRAIN

Transmission: 4-speed transaxle, all synchro

Ratios: 1st, 3.667:1 3rd, 1.456:1

2nd, 2.235:1 4th, 1.026:1

Reverse, 3.545:1

Clutch: Single dry plate, woven asbestos lining, 7.125-in. diameter

Final drive ratio: 3.625:1

DIMENSIONS (inches)

Wheelbase: 95.8 (L), 94.6 (R)

Overall length: 141.5

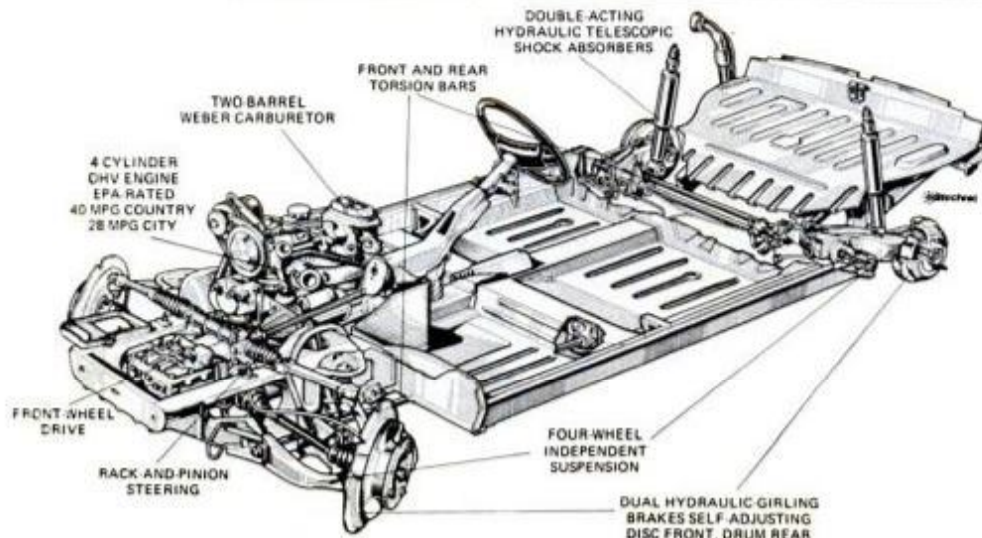
Overall width: 60.0

Overall height: 55.0

Track, front and rear: 50.7/49.0

Turning circle diameter (between curbs): 32 ft.

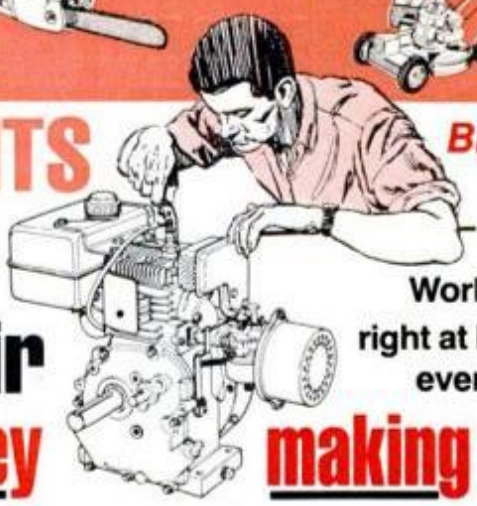
Curb weight: 1819 lbs.



Fold-back, canvas sunroof is also a lunroof. Rear wiper is standard on 5GTL.



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DRIVING THE RENAULT 5

(Continued from page 134)

form chassis, with independent torsion-bar suspension all around. Front is by unequal-length control arms; rear by trailing arms. The front torsion bars are longitudinal and, as mentioned, the rears are transverse, all helping to maximize interior space by running no leaves, axles or coils up under the body.

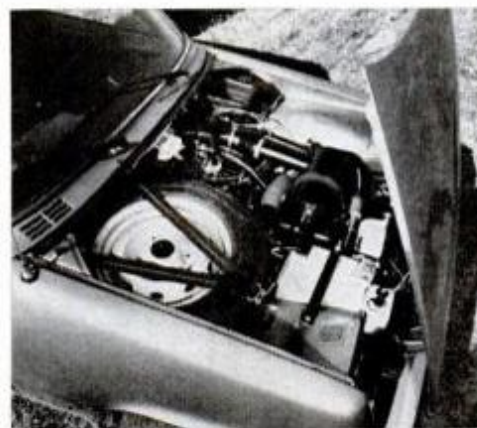
Steering comes by rack and pinion, feels precise and quick. Gearshifting is precise, too, despite the tricky linkage required to go forward around the engine. Front disc brakes are standard.

The rear seatback folds flat, and with the rear hatch you've got the equivalent of a small station wagon. Even with the seat back up, there's a big square cave hidden beneath the fold-up parcel shelf.

The 5 comes in two levels of luxury: the plain Jane 5GTL and the plainer Jane TL (if you know a non-sexist equivalent for "plain Jane," let us know.) Both share the same mechanicals, the difference coming in carpeting, vinyl appointments, garnish and a rear-window wiper/washer standard on the GTL.

Options include a sunroof, various radios, airconditioning, roof and ski racks, custom wheels, trailer hitch and so on.

The Americanization of the front and rear ends with smart-looking soft bumpers is well done. And, by



In-line, four-cylinder engine of 1300-cc displacement is well hidden by spare tire.

the way, don't think the front end is a copy of the AMC Pacer. If anything, the Pacer is a copy of the 5, since the 5 was introduced in Europe in 1972.

We had the opportunity to drive the first 5s to arrive in the United States and here are our reactions to the car.

Lamm: If you look beyond the appearance and take a test drive, you'll discover that the Renault 5 rides like



Interior of 5GTL is plain, but shows thoughtful use of carpeting and vinyl.



Hatchback up and rear seat folded opens up 31.5 cubic feet of cargo space.

no other minicar. The R5 on pavement feels like a duck landing on Lake Chelan. It's that smooth—and amazingly silent.

The R5 handles and maneuvers fine, but leans a lot. It's got the cornering poise of a 1949 Nash. Yet the R5 goes where you point it, and front-wheel drive lets you whip through sharp, fast benders in complete control. Standard Michelin radials help, both on cornering and braking.

Acceleration comes as another surprise. For a car that can squeeze 40 miles from a gallon of gas, this one moves out. It's willing and strong. Long grades don't leave it puffing. And for fast passing on two-lane highways, you plug in third, nudge the gas, and around you go. The R5 has that rare combination of zip plus sip.

Workmanship impressed me, as did seating up front. Front buckets recline in the GTL, which helps you find a comfortable position. The rear seat, though, feels a trifle tight for adults.

It's a pleasant, well-thought-out, well-built car that might put Renault back among the important importers.

Hartford: Put a flaky, 1950s canvas sunroof over a big, yawning hole in the roof, and put it in a little car

(Please turn to page 137)

DRIVING THE RENAULT 5

(Continued from page 136)

that's so modern in every other way and what do you have? A Renault 5, of course. The front-wheel-drive 5 is big in economy, ride, performance, roominess... but it's biggest in... personality. For me that's the clincher. The Chevette may be cheaper, the Civic more chic, the Rabbit a model of lean, Teutonic efficiency, but only the sunroofed 5 would give me what I'd want in a small, economy sedan: some fun getting where I'm going. I'll go out of my way, or pay extra, because *how* I get somewhere counts. With the 5, the inconvenience would be that the Renault dealer nearest me is some miles away. It would be the same for most people because of the still-small dealer network.

I put enough miles—and fast miles they were—through the hilly roads, and on freeway stretches, in Northern California to have complete con-



Styling of Renault 5 is obviously French, as evident, for example, in treatment of the taillights and vent slots positioned at the rear corners of the car.

fidence in the car—in its handling, stability and braking. That's a more significant statement when you know my two kids were in the car with me on those roads. The car maintained a tenacious hold on the road through lots of fast S-turns despite the annoyingly high degree of body roll.

Amusingly, the most terrifying (for the kids) part of a dirt-road ride near Muir Woods was turning the car around on a road hardly wider than the length of the car. On one side the road dropped off into a deep valley and they thought that that's where we'd all wind up. Needless to say, an 11.8-foot-long car is incredibly maneuverable.

I don't particularly like the cheap treatment of the dash, and I don't find the instrument layout aesthetically pleasing, but I do like being able to get into a comfortable driving position because of the neat seats and good relationship of all the controls. I don't like the spare tire mounted in the engine compartment, but, ah, that sunroof! The biggest, bloomin' sunroof in the business—and happily, there's a solid car under it. ★★

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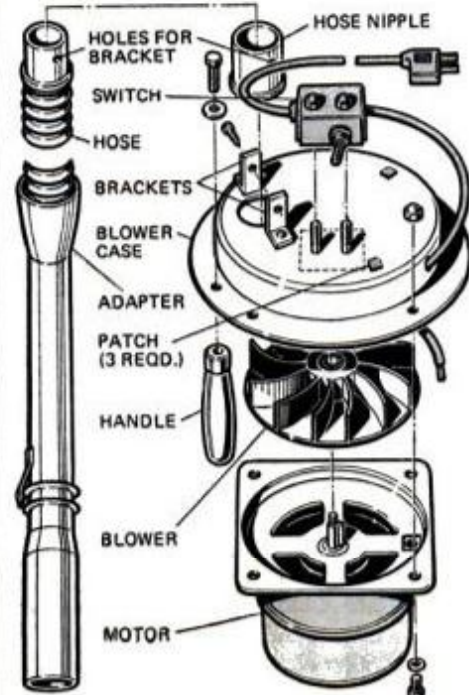
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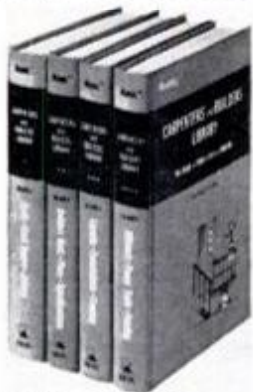
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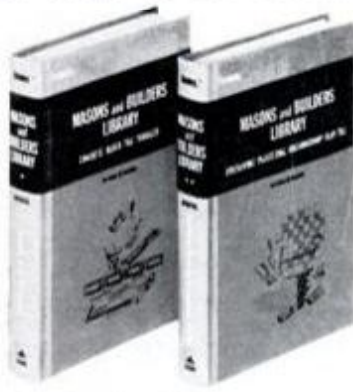
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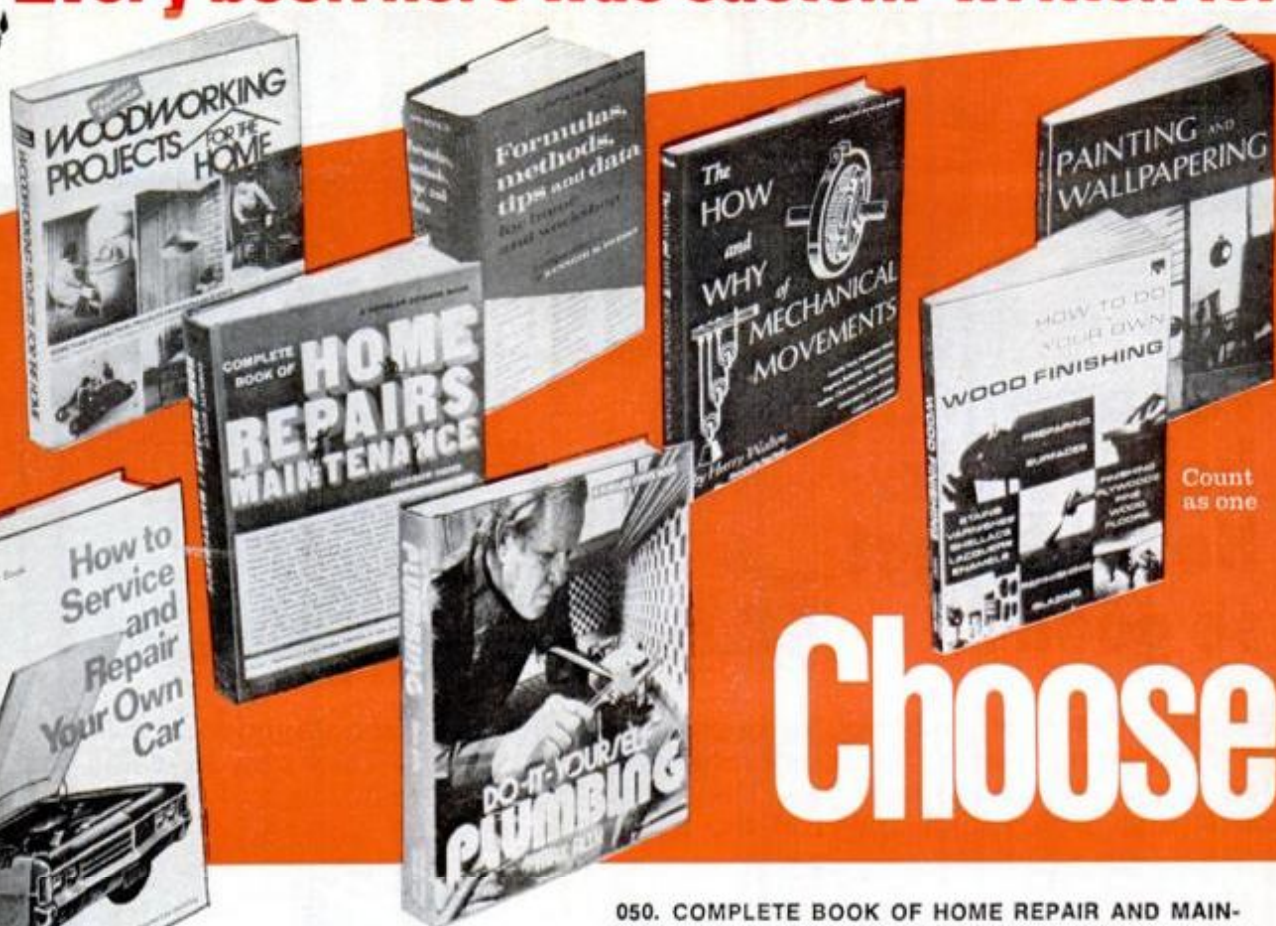
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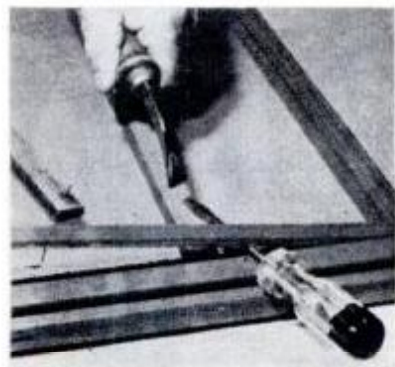
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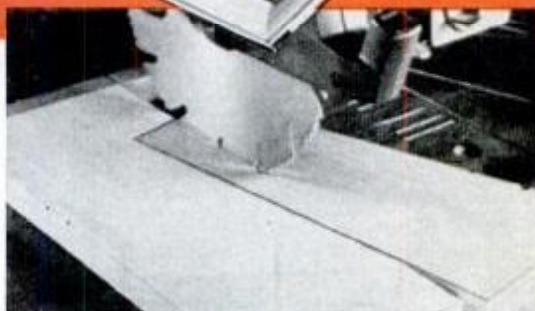
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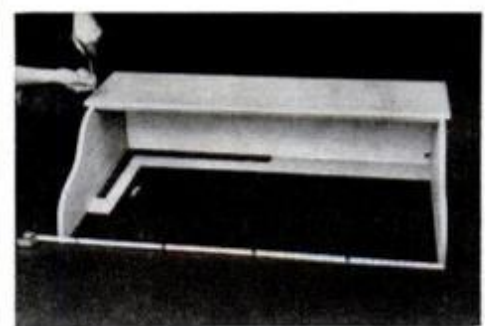
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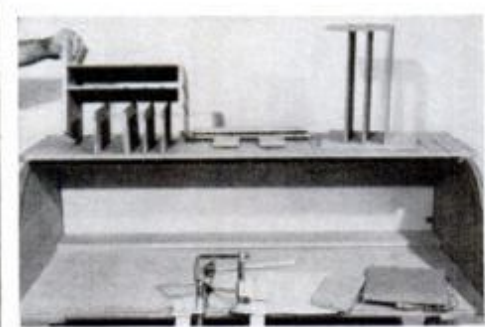
(Continued from page 82)



After parts are test-fitted, screws are driven in counterbored holes and capped.



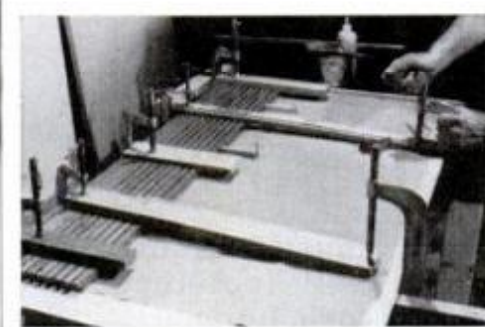
Pencil trays are made by passing stock at 75° angle across 10-in. blade.



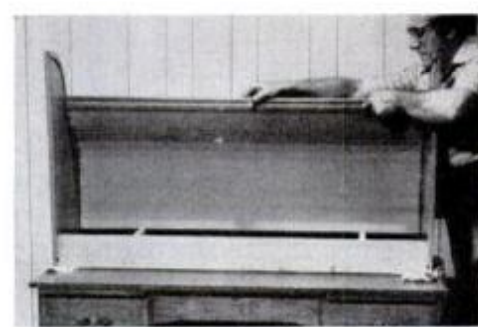
Preassemble right and left section of cubbyhole unit first, then glue rest.



Beveled slats for tambour lid are ripped with sharp blade at 10° angle.



Slats are glued to cloth back 8 to 10 at a time, apply glue to cloth only.



Slat ends are waxed, then inserted into track. Complete by screwing top to base.

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sharp chisel; use damp cloth to remove traces that remain (finish won't take over glue).

9. Glue edge strip to each bottom back frame to form groove for the back panel.

10. Use brads and glue to install pedestal back panels. Add solid cherry strips to raw plywood edges at back.

11. Cut pedestal base pieces to rough overall size, then miter corners carefully for perfect fit.

12. Attach long trim pieces to sides of pedestal first. If you prefer to avoid mitered corners, use butt joints at the corners and lap the side members with the fronts.

13. Cut front and rear base pieces to size, miter or butt the ends, and glue in place.

14. Nails driven from rear with only the points protruding will keep the base pieces in place during clamping—a very important step.

15. Fit the back apron "Q" so it sets in 1/4 in. closer to the front

than is indicated in the full-size plans. This is to allow clearance for direct drilling of lagscrew pilot holes from within the pedestal. This is an easier and more effective way to secure (rather than to use blind dowels as shown in plan). Use 1/4 x 1 1/2-in. hex-head lags and drive with socket wrench.

16. Screw and glue center frame supports into place.

17. Install center frame and drill holes for screws (instead of dowels) from within the base. Countersink the heads.

18. Use smooth-cutting blade to cut desktop panel. Add 1/4 x 3/4-in. solid-wood strips to ends first, then front and rear strips to conceal plywood edges.

19. If sufficient number of long clamps are not available to clamp the strips, you can do a good job with masking tape. Apply plenty of strips to insure good contact.

20. Important note when using

(Please turn to page 146)

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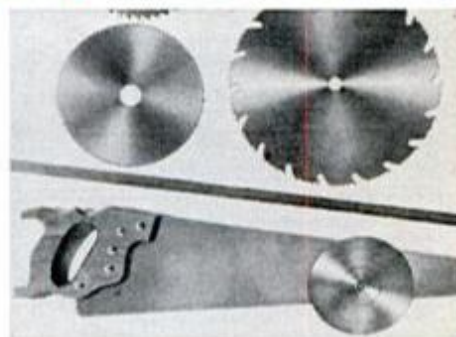
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(Continued from page 144)

tape to apply the vertical strips to the front edges of the pedestals: Elsewhere the strips are cut a bit oversize so they overhang and later are planed flush. But here the strips must be fitted flush at the start along the inner sides of the pedestals because they would be difficult to trim flush. In this case, it is advisable to use round toothpick standoffs to keep the tape away from the glue line. Otherwise, a gummy residue will result that's hard to remove. See sketch, page 82.

21. When using masking tape, it is important to get a good-quality brand such as Scotch.

22. To drill holes for screws in desktop, set the top onto pedestals, then draw pencil lines on bottom of the top panel to outline the location of the pedestals.

23. Drill a 3/32-in. pilot hole for each screw location. Do this from the back face using the pencil outline as a guide. Since the panel cannot be handled on the drill press, all drilling must be done by hand. Therefore a drilling jig is a must for accuracy. See sketch, page 83.

24. When preliminary pilot holes have been drilled through the top, position the top onto the pedestals and drill through the top to transfer the pilot holes into the top edges of the pedestals.

25. Use a spur bit (which has a brad point) to counterbore 3/8-in. holes 1/8 in. deep into the top for matching wood plugs. This bit is recommended because it will do a clean job. Use the drilling jig for controlling depth and to assure perpendicularity.

26. Now proceed to drill the larger screw clearance holes into the top. Note that if the larger screw clearance holes were bored first, the spur bit would wobble around and tear up the work.

Steps for assembling

27. Glue and screw center frame and apron between pedestals. Apply glue to top edges and to the top and secure with screws. Be sure piece is level on floor or table.

28. Cut plugs from solid stock with a plug cutter—orient the grain direction and glue into place. Go easy with the glue.

29. Drawer fronts. Set the saw arbor to 8° bevel and slice ends first, then the sides; otherwise, chipping may occur. Pieces can be held firmly against rip fence by hand for this operation.

30. Rolltop. Plans call for 9/16-in.-wide groove in the ends for the tambour top. The contoured groove is best cut with a router using a straight bit.

MATERIALS LIST

PEDESTAL BASE

- | Pcs. | Size (letter key to drawings), description |
|------|--|
| 1 | 3/4 x 29 1/2 x 51 1/2" (A) Top* |
| 2 | 1/4 x 3/4 x 52" (B) Top edge strips, long |
| 2 | 1/4 x 3/4 x 30" (C) Top edge strips, short |
| 4 | 3/4 x 28 x 29 1/4" (D) Pedestal sides* |
| 8 | 1/4 x 3/4 x 29 1/4" (E) Pedestal facing strips |
| 4 | 3/4 x 3 3/8 x 13 1/4" (F) Bottom rails front and back* |
| 4 | 3/4 x 2 1/4 x 13 3/4" (G) Bottom frames front and back |
| 4 | 3/4 x 2 1/4 x 24 3/8" (H) Bottom frames, sides* |
| 2 | 1/4 x 9 3/4 x 24 1/2" (I) Dust panels*** |
| 6 | 3/4 x 2 1/4 x 13 3/4" (J) Upper frames, fronts |
| 6 | 3/4 x 2 1/4 x 13 3/4" (K) Upper frames, backs* |
| 12 | 3/4 x 2 1/4 x 24" (L) Upper frames, sides* |
| 4 | 1/4 x 9 3/4 x 24" (M) Dust panels*** |
| 4 | 1/2 x 4 x 29 1/2" (N) Pedestal base, long |
| 4 | 1/2 x 4 x 15 3/4" (O) Pedestal base, short |
| 2 | 1/4 x 13 3/4 x 25 1/2" (P) Pedestal backs*** |
| 1 | 3/4 x 5 1/2 x 21" (Q) Back apron |
| 2 | 3/4 x 2 1/4 x 21" (R) Center frame, front and back* |
| 2 | 3/4 x 2 1/4 x 22 1/2" (S) Center frame, sides* |
| 1 | 1/4 x 17 x 22 1/2" (T) Dust panel*** |
| 2 | 3/4 x 3/4 x 25 3/4" (U) Center frame supports* |
| 2 | 3/4 x 12 1/4 x 26 1/4" (V) Drawboards** |
| 4 | 1/4 x 3/4 x 26 1/4" (W) Drawboard edge strips |
| 2 | 3/4 x 3/4 x 13 1/4" (X) Drawboard nosings |
| 1 | 3/4 x 4 7/16 x 20 7/8" (Y) Center drawer, front |
| 1 | 1/2 x 2 7/16 x 20 3/4" (Z) Center drawer, back* |
| 2 | 1/2 x 3 3/16 x 23 1/2" (AA) Center drawer, sides* |
| 1 | 1/4 x 20 3/8 x 23 3/8" (BB) Center drawer, bottom*** |
| 8 | 3/4 x 5 1/2 x 13 3/4" (CC) Drawer fronts |
| 2 | 1/2 x 1 1/4 x 13 3/4" (DD) File-drawer front joiners |
| 4 | 1/2 x 4 7/16 x 12 3/8" (EE) Drawer backs* |
| 8 | 1/2 x 5 3/16 x 23 3/4" (FF) Drawer sides* |
| 2 | 1/2 x 10 3/8 x 12 3/8" (GG) File drawer, backs* |
| 4 | 1/2 x 11 3/16 x 23 3/4" (HH) File drawer, sides* |
| 6 | 1/4 x 12 3/8 x 23 3/8" (II) Drawer bottoms*** |
| 2 | 3/4 x 2 x 9" (JJ) Drawer board stops* |
| 8 | Drawer pulls, Amerock No. 152 |

PEDESTAL BASE

- | Pcs. | Size (letter key to drawings), description |
|--------------------|--|
| 1 | Lock, Corbin No. K02066 |
| Tambour top | |
| 1 | 3/4 x 13 1/4 x 52" Top |
| 1 | 3/4 x 1 1/8 x 49" Top back rail* |
| 1 | 1/2 x 3/4 x 49" Top front strip |
| 1 | 3/4 x 4 1/8 x 49" Bottom rail* |
| 2 | 3/4 x 13 1/4 x 28 1/2" Ends** |
| 1 | 1/4 x 13 1/4 x 49 3/4" Back*** |
| 1 | 3/4 x 2 x 49 3/4" Bottom slat (K) |
| 27 | 3/4 x 3/4 x 49 3/4" Tambour strips |
| 1 | 1/4 x 3/4 x 48 3/4" Canvas cover strip |

Interior of tambour top

- | | |
|---|--|
| 1 | 1/2 x 8 1/2 x 48 7/8" |
| 4 | 1/2 x 8 1/2 x 10 3/8" (A) Panels |
| 2 | 1/4 x 3 1/16 x 8 1/2" (B) Bottoms |
| 1 | 1/4 x 8 1/2 x 10 1/2" (C) Scrolled divider |
| 5 | 1/4 x 8 1/2 x 12 1/2" (D) Panels |
| 2 | 1/4 x 8 1/2 x 14 1/4" (E) Panels |
| 2 | 1/4 x 2 3/4 x 8 1/2" (F) Partitions |
| 1 | 1/2 x 4 3/8 x 8 1/2" (G) Partition |
| 3 | 1/4 x 4 3/8 x 8 1/2" (H) Scrolled dividers |
| 2 | 1/2 x 7 3/8 x 8 1/2" (J) Partitions |
| 2 | 3/4 x 2 3/8 x 8 1/2" Pencil troughs |
| 1 | 1/4 x 11 x 48 7/8" Back*** |
| 3 | 1/2 x 2 7/16 x 4 7/16" Drawer fronts |
| 3 | 1/4 x 2 7/16 x 4 7/16" Drawer backs |
| 6 | 1/4 x 2 7/16 x 8 7/16" Drawer sides |
| 3 | 1/4 x 4 7/16 x 8 7/16" Drawer bottoms |
| 2 | 1/2 x 2 7/16 x 12 1/2" Drawer fronts |
| 2 | 1/4 x 1 1 3/16 x 11 7/8" Drawer backs |
| 4 | 1/4 x 2 7/16 x 8 7/16" Drawer sides |
| 2 | 1/4 x 1 1/8 x 8 7/16" Drawer bottoms |
| 7 | 1/4 x 1/2 x 1" Drawer stops |
| 7 | Amerock knobs No. 850 |
| 1 | 21 x 48 3/4" Medium-weight canvas |

* Poplar wood
** Veneer plywood (cherry)
*** Plywood (gum)

31. After gluing up solid stock to get 13 $\frac{1}{8}$ -in. width, bandsaw the contours, then prepare to cut the grooves.

32. A router bit which will cut a 9/16-in.-wide groove in one pass is nonexistent (so far as I know); therefore, a $\frac{1}{4}$ -in. bit is used—a common size.

33. A "twin" or two-part template cut from standard tempered hardboard (Masonite) is used to cut the grooves. The radii vary between the two parts of the template so great care must be exercised to make the templates.

34. Templates. Draw the pattern full size onto paper, including the dotted base lines. Rubber-cement the drawings onto hardboard and bandsaw them carefully. Note that the difference between both forms is 5/16 in. and parallel. Tape both forms together with base lines lined up and with smaller form centered side to side over larger form; drill a couple registration pilot holes for nails through both sections.

35. Center one of the templates onto the end panel with the base line even with the bottom edge of the stock. Drive in a pair of snug-fitting brads to hold in alignment. Clamp to work table and make the first pass with the router. Take off only a little at a time to avoid burning the tool and wood.

36. When depth is reached, remove the first template and install the other using the same nail pilot holes to assure exact lineup which is important.

37. The two cuts made with the router will result in two $\frac{1}{4}$ -in. grooves with a space of 1/16 in. from outside to outside; thus a narrow strip of waste will remain in the center of the groove. This is cleaned out by making a freehand pass with the router.

38. Use a carbide-tip tool for cutting the tambour grooves and make each pass about $\frac{1}{8}$ in. or even less until $\frac{3}{8}$ -in. depth is reached.

39. After the grooves are cut and the inner faces of the end panels sanded, the top and back are assembled. Counterbored screws are used to make glue contact of top to sides. Plug the holes.

40. Cubbyhole unit. Make the required dado cuts, then assemble the left and right sections (as shown in photo on page 144). This will simplify assembly considerably. If an attempt is made to put it all together in one operation, proper clamping would be impossible. Half-inch lumber for this is not usually

stocked so you'll have to have it surface-planed at a lumberyard.

41. Prestain and finish the face of the back panel, then put it aside and proceed to stain the compartments. The job is tough because your hands won't fit in some of the compartments. Work from both sides (thus the reason for leaving off the back). See finishing steps later.

42. Tambour lid. Cut some boards to the required length for the slats, then run a dado cutter over the ends to form the notch.

43. Use a smooth-cutting blade to cut the strips. Set the arbor for a 10° tilt, then run each piece through twice to obtain the required bevel on both sides. Use two push sticks for safety and accuracy.

44. Sand and apply the finish to each piece before assembly. Don't get stain on the bottom surface; otherwise glue will not adhere properly. Use a flat board for a work surface. Lay sheets of kitchen wax paper down to prevent accidental sticking to table. Tape the canvas to the table to keep it flat, then brush a coat of glue on canvas (not the wood). Work about 8 to 10 slats at a time. Most wood warps when cut into thin sections so it is practically impossible to control all the slats in one step. Use sufficient number of clamps to get ample pressure throughout. The use of a thin guide strip nailed to the table at one end will insure accurate alignment.

45. When tambour is dry, wax the ends, then insert into the grooves. Wax in the grooves will help. Screw the unit to the desktop.

46. Finishing. Presand all components before assembly, then finish-sand by hand before applying finish. Use tack cloth to remove all sanding dust.

47. Apply a coat of American Lacquer thinned one to one with thinners to seal the wood and to permit better stain spread. Don't brush this on; use a pad of cheesecloth instead. Sand lightly after 10 minutes with fine paper (6 0); wipe with tack cloth.

48. Mix 1 part Sapolin Antique Walnut No. 300 and 1 part Sapolin Concord Cherry No. 305 stain. Apply with brush or cloth. Wipe off excess within 10 minutes.

49. When stain has dried (24 hours), apply a coat of Satinlac Low Gloss (or Constantine's Wood Glo). Sand first coat with 6/0 paper, then apply a second, final coat. Now stand back and admire your heirloom. ★★★

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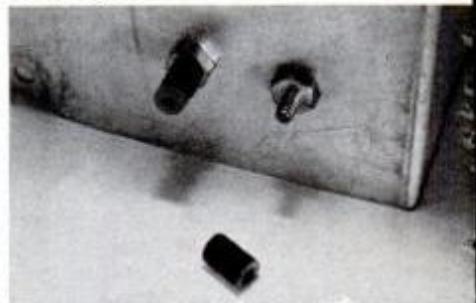
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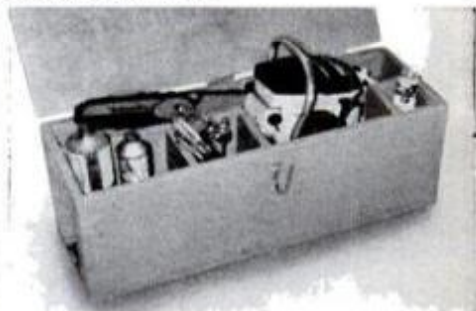
FROM READERS

Bolt caps



A protruding bolt end can be hazardous, but can easily be capped with a piece of rubber or plastic tubing with an inside diameter that assures a tight fit. Length should be slightly greater than that of bolt's projection. —Burt Web, Skokie, Ill.

Chain saw case



Whether you use your chain saw a little or a lot, it will last longer if you keep it clean and protected in a storage box made from scrap lumber. Spare parts and tools won't be left behind if they're stored in compartments alongside the blade. —Tom McCanna, Woodstock, N.Y.

Hammer as anvil



For hammer-shaping a sheet-metal part over a rounded surface, a ball-peen hammer clamped in a machinist's vise acts as anvil. Note padding to prevent marring of hammer poll. —Walter E. Burton, Akron, Ohio

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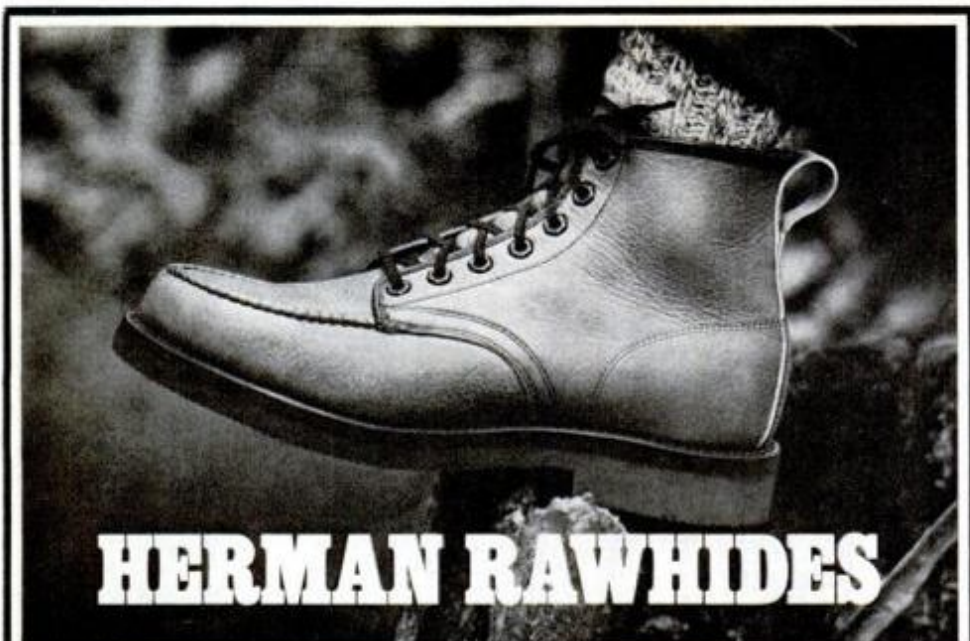
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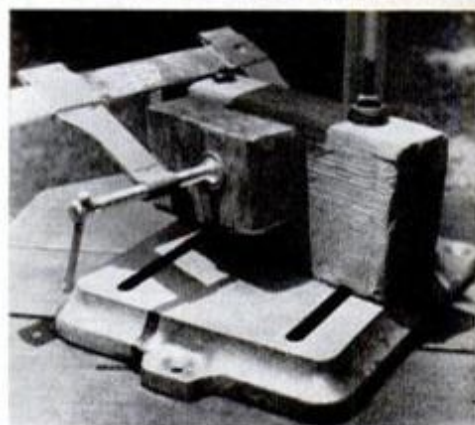
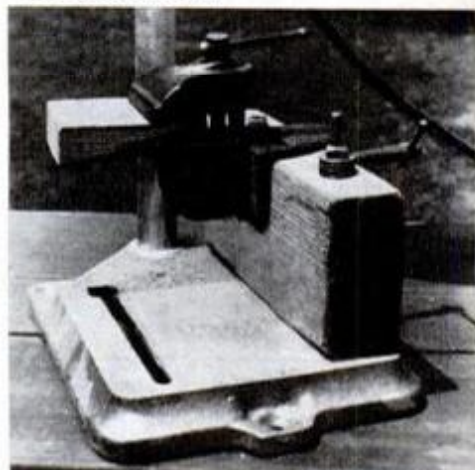
Handy soldering sponge



The tip of a soldering gun or iron should be kept clean and bright, and I've found that it's convenient to clean it with a small pad of steel wool held in a spring-type paper clip. The clip can be mounted permanently on the workbench with a screw.

—Ken Patterson, Regina, Sask.

Vise substitutes



The drill-press vises I've seen on the market are either too expensive or lacking in jaw capacity and tilts. I've had good success with substitutes that use a scrap of 2x4 bolted to the drill-press table as an anchor. Large workpieces are held to it with bar clamps, smaller ones are held in a clamp-on vise.—Gary Cosand, San Bernardino, Calif.

STRIKING IT RICH

(Continued from page 85)

for "perforation." A perforating gun is lowered and a charge set off that pierces the well casing with many fine holes at the ideal depth—in the Mitchell well, between 1006 and 1016 feet. Hopefully, through these tiny holes oil will flow into the well.

Not that simple

But there's still more to come before a well is a well. The next step is called fracturing—"fracing" for short—done by pumping acid into the formation to eat out passages through which oil can flow to the well or by forcing in a sand-water slurry under high pressure. The latter method, called "hydraulic fracing," was used on the Mitchell well. Sand is driven into cracks in the oil-bearing formation and remains to hold them open as the water seeps away.

A "pay" formation is rock—limestone, sandstone or dolomites—that holds oil like a sponge. When passages are cut into it, radiating in all directions from the well, the oil flow is greatly increased. In the Mitchell well, about 10,000 pounds of sand and 300 barrels of water were used in the fracing process.

Doug had now poured \$2675 down

the hole in the cementing, perfing and fracing operations, and the job still wasn't done. Connecting the pump required inserting tubing into the well casing, a section at a time, then slipping rods down the tubing. The pump was screwed onto the last section of tubing at the top of the well.

It was mid-April and the day had finally come for the crucial test. Linda went off to school scarcely able to keep her mind on her teaching. Doug nervously started the pump, knowing he had everything they owned down a hole that might yield nothing more than saltwater.

A gusher at last

There were a few tense moments. "All of a sudden," says Doug, "the pipe running from the pump to the storage tank started vibrating and broke the baling wire that held it down. This was due to gas pressure." Soon oil, water and gas were all being blasted up the well by the pressure below rather than the pump. The well was "flowing" by itself—with an unexpected violence. Doug had to chain down the pipe to keep it from blowing out of the tank.

During the first three days, the Linda K, as Doug decided to name it, produced a phenomenal 100 barrels of crude a day. Later it tapered off to

76 barrels and finally settled down to a steady eight. That's still exceptional—a well considered good in that part of the country produces five or six barrels a day.

The Mitchells could hardly believe their success, yet they refused to break into wild celebration. They knew that any minute the bubble could burst—a piece of equipment could break or the well run dry. Still, they had started something good and their willingness to stick it out through hardship was paying off. Doug immediately moved the old Star spudder to a new site and, together with Linda and son Jim, is working on the Linda K No. 2.


Many small producers needed

The *Tulsa Daily World* saw in the Mitchells' success new incentive for small independent producers, 10,000 of whom have left the industry in the last 18 years. Said the *World*: "Repeated thousands of times across the nation, Mitchell's tactics could result in badly needed oil production for conversion to gasoline and other petroleum products."

If there's a lesson learned here, it's that all oil producers aren't big or rich. Some are just plain hard-working do-it-yourselfers who know how to get a tough job done. ★★

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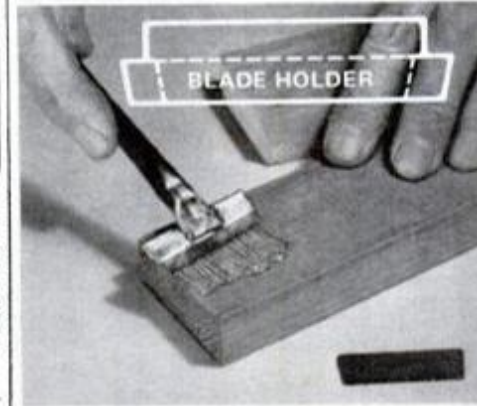
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Carving with impact



A lightweight air-impact hammer can replace the usual mallet to drive a woodcarver's chisel. At 3000 blows per minute, cutting is extremely smooth. Hammer works on as low pressure as 35 pounds per square inch from tank-type compressor. Right-angle guide brazed to chisel gives good control.—*Morton E. Milliken, Huachuca City, Ariz.*

Glue spreader



A spreader made from a 1½-in. length of worn hacksaw blade distributes paste-type glue in fine ridges over the joint area, also works with thinner adhesives. Holder (shaped as shown) and handle (5/16-in.-dia. x 6 in.) are soldered tin-can stock. Grinding blade section to a keystone shape lets holder grip it firmly. *Caution:* Don't try to break hacksaw blade—sharp fragments will fly when it snaps. Cutting and shaping can be done on a grinder.—*Walter E. Burton, Akron, Ohio*

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Now a lot of nice people are going to hate my guts for telling you this—including many ministers, school principals, Boy Scout leaders, and old fashioned conservative tycoons who made it the hard way. But my dear mother taught me to always tell the truth, and that's the way it's going to be. I got where I am today not by practicing the Puritan Work Ethic, but by avoiding it. In short, I actually bummed my way into the big money.

The fact is: the only difference between me and most other lazy drifters is that I developed a certain "Game Plan" that can make anyone who'll listen an awful lot of money. It's also a great way for the woman who wants to make money at home. With my Book (either with or without any travelling) she can do it without even taking the curlers out of her hair.

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\$\$ Then move on to another city if you

like, and I guarantee: You can do the very same things all over again. It's simply a matter of where you want to be at the time.

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Allan R. Holleschau

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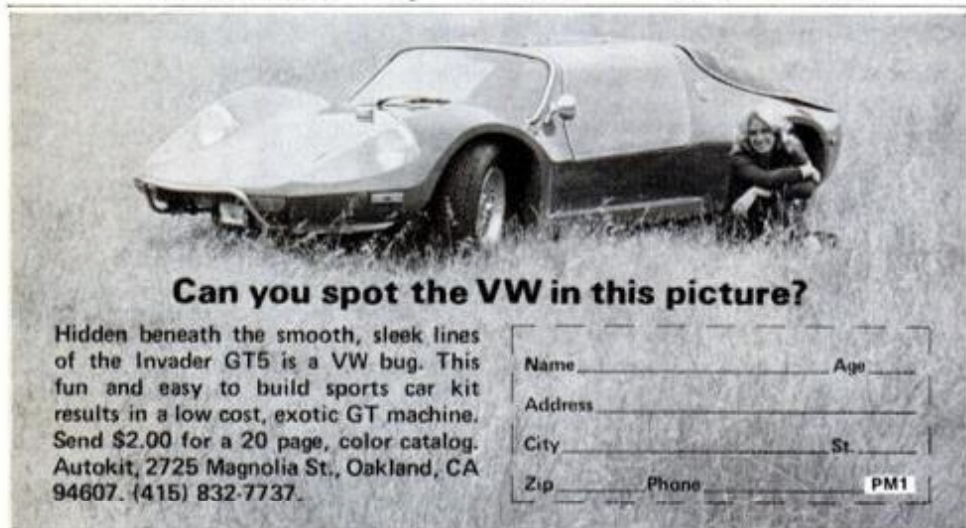


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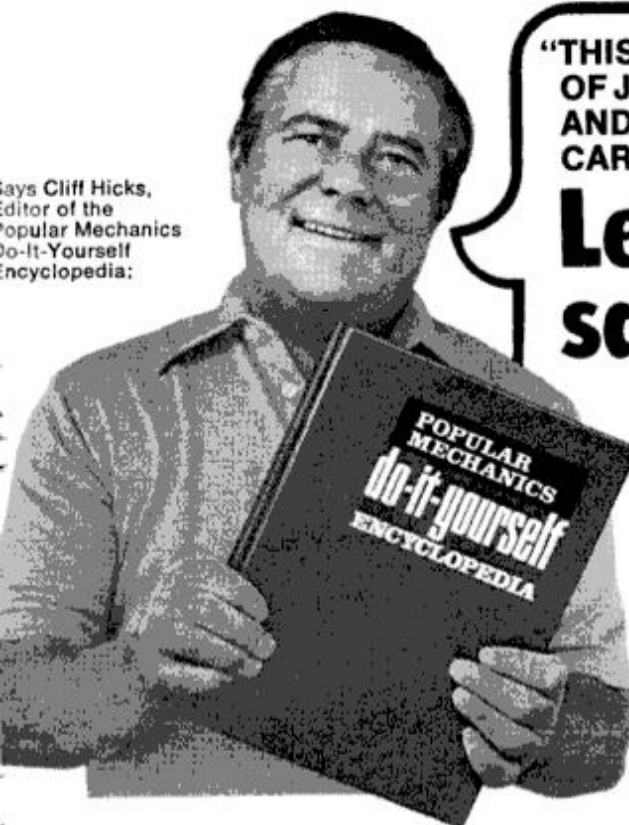
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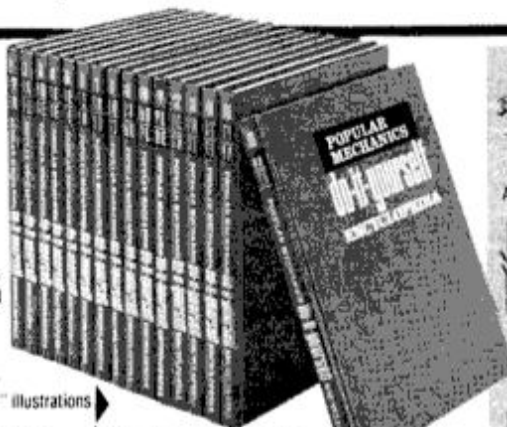
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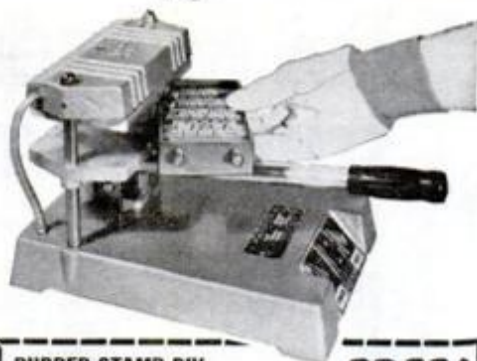
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BUYING 'RECYCLED' CAR PARTS
(Continued from page 72)

because newer cars cost the wrecking yard more.

Generally speaking, too, yards that specialize charge more than the that don't. For instance, a dismantler who stocks only imported cars higher than one who carries both domestics and imports. Likewise, yards that specialize in trucks, obsolete parts, orphan makes or single makes of cars.

That's because a specialized yard bids higher to assure itself of a full well-rounded stock; also, in some instances, to corner the local market. By patronizing the specialized dismantler, though, you'll probably save time searching, and you often come out ahead financially by sidestepping the hot line. So I'm not saying you ought to avoid yards that specialize.

What about haggling? Should you haggle over price once you see the part? It can't hurt, but it usually doesn't do much good. Some of the more progressive yards don't. Play it by ear.

Warranties

Nearly all dismantlers give a warranty of some sort. Some will post signs stating time limits and conditions. The most common warranty runs 30 days on parts, but excludes any labor you expend.

Even if there's no sign or written warranty, many wrecking yards will replace any defective parts you've bought from them. Such unwritten warranties have no set time limit.

To prove you're not returning your own worn-out part, wrecking yards almost always die-stamp larger assemblies like heads, blocks and transmissions. Smaller items like master cylinders are marked with yellow paint.

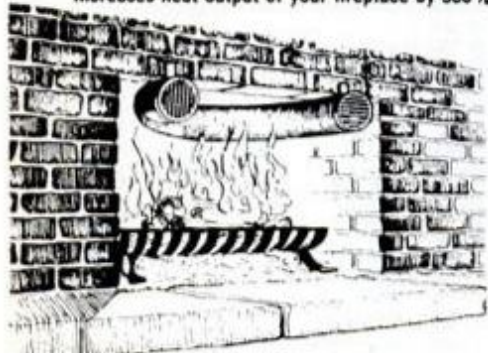
What about roaming out back?

When you get to the wrecking yard, you should not expect to be allowed out back, fun as that might be. Most dismantlers have strict rules against "roamers" or "tourists" for two reasons: 1. Their insurance doesn't cover nonemployees; 2. roamers tend to help themselves to small parts, so pilferage becomes a problem. "It's not that we mind people stealing little things like gas caps and rotors," explains one yard owner, "but if we sell an engine, say, and the rotor is missing, it means we have to rummage around for a new one. The time we waste searching might cost us the sale."

Despite tight no-roam policies, the yard owner knows you, either a

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friend or as a regular customer, he might sometimes take a chance on you. And a few yards actually encourage customers to roam and familiarize themselves with the merchandise. These, however, are rare.

In terms of money, you might save up to 15 percent on the price of the part if you remove it yourself, because otherwise the wrecker's man would have to do it.

Where a dismantler gets cars

Most cars in wrecking yards are insurance salvage—so-called "totals." After a wrecked car is declared a total loss (the cost of repairs equals or even exceeds the wholesale value of the car), the insurance company pays off the owner and in turn becomes the wrecked car's new owner. The insurer then puts the car up for bid. Wrecking yards are the most frequent bidders on such cars.

The average dismantler figures he needs to at least double his money on any car he buys. A yard that's doing good business in late-model cars will rotate its inventory 2½ times a year on popular makes (Fords, Chevys, VWs and the like) and twice a year on the so-called "heavies" (Cads and Lincolns, for example).

About 35 percent of the cars in wrecking yards are sold to dismantlers by private owners, especially in cases where something major is wrong with the car: a transmission out, terminal body cancer and so forth. In California, where the highway patrol cites polluters, cars that can't pass smog tests usually end up at the wrecker's.

Many types of buyers

Despite what you'd think, only about half of all wrecking-yard parts are sold to private car owners. Ironically, insurance companies buy back (indirectly) a considerable portion of the parts they previously sold to dismantlers. When you bash in a door, for example, and your insurance company (or someone else's) agrees to pay for repairs, the adjuster often specifies that the body shop use LKQ parts—of Like Kind and quality. Which means *used*. After all, your bashed door was used.

The component rebuilding industry also buys lots of parts from wrecking yards. So do new and used-car dealers, repair garages, service stations, trucking companies and taxicab owners. And why not? Components from wrecked cars, if they're usable, come assembled as built-up

(Please turn to page 158)

HENRY MORGAN SAYS: "Even if you don't know which end of a screwdriver you hold, you can learn to make money fixing appliances."



If you've seen this well-aged comic on television, you know I'm not in the business of fixing appliances. So what am I doing in an ad for an appliance repair course? It's simple: I got tired of laying out a sockfull of money every time something went wrong around the house. Then I came across an NRI ad and I thought, "Why not? I've spent a fortune on repairs . . . if I'm too stupid to fix a toaster, this is the way to find out."

So I took the course and now I can fix my own appliances and I can even make money out of it if I want to. As a matter of fact, there's enough money in fixing these things, I'm tempted to quit show business and go straight.

Think I'm kidding about the money? Just check out the receipts on your last repair bills. And then ask anybody if they know a good reliable repairman. You'll find they're scarcer than doctors who make house calls. If there ever was a field crying for good men, this is it. Opportunity is knocking louder than my car's engine, and it could be knocking for you.

If you've ever toyed with the idea of making it on your own, with your own repair business . . . NRI has a low-cost, home study plan that really makes sense. You can hang in there with your present job while you're learning, and you'll find NRI's course is quick, easy, and cheap.

Let's say you have trouble just plugging in your electric shaver. You'd better start with the basics . . . and the NRI course starts right there. First they tell you what electricity is, and you can't get any more basic than that. They take you by the hand, step by step, as fast or as slow as you want to go. If you get an attack of the stupids, there's always an NRI expert waiting to give you a hand. They do everything but turn the pages for you.

Like I say, I took the course and it turned out to be even better than they

said it would be. Sure they pay me for writing this ad, but it ain't much, believe me. I could make more in a month by fixing things for the neighbors . . . and I'm not kidding. It's just that I believe in seeing guys make it on their own. If you follow the simple texts and the big pictures, you can be a technician in no time. They even send you a professional appliance tester with the course.

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The more for the money shoe.

BUYING 'RECYCLED' CAR PARTS

(Continued from page 157)

units (you buy an entire engine, for instance, instead of a short block and the prices are definitely right).

You have to realize that the dismantling business is much more complicated today than it was even 20 years ago. Used to be, if you needed an axle for a 1947 Mercury, the wrecking-yard owner knew that an Ford or Mercury axle from 193 through 1948 would work. Today, though it's not that simple.

With eight different nameplates under the Chevrolet umbrella and seven of Ford parentage, you—the customer—have to be pretty specific when you ask for a part. You can simply say, "I need a heater blower for my 1971 Chevy," because the counterman won't know whether it's for a Vega, Nova, Camaro, Chevelle, Monte Carlo, Chevrolet, Corvette or Blazer. You'll have to give him year, make, model, engine size and option (blowers are different with different airconditioners).

Interchange manuals may help

It's true, though, that parts still interchange between certain makes and models. Two books no auto wrecker can be without are the Hollander Interchange Manual and the Mitchell Domestic Interchange Service Manual. These are published yearly and tell which parts interchange with which others, not just among makes but also between years.

When you phone a dismantler, and if he says he doesn't have the part you need, sometimes suggesting a quick search through an interchange manual can turn it up in another make or model of car.

Bring old part as a sample

When you arrive at the wrecking yard to pick up a part, be sure to bring along your old part as a sample. I mentioned this earlier, and it's very important. If it's that Torino decklid you need, show the parts man your old one. There might be differences in model trim or emblems. Likewise, if you need an axle, bring in your broken one. With so many variations among cars and suppliers, it's just good insurance.

You're ready now to shop for used parts with some confidence. Dismantlers have come to the point of meriting your confidence. Most are good, solid, reputable businesses; most of the people in the business are interested in cars and have tremendous car knowledge; often they'll help you with specific questions or problems; and their prices make shopping there very worthwhile. ★★

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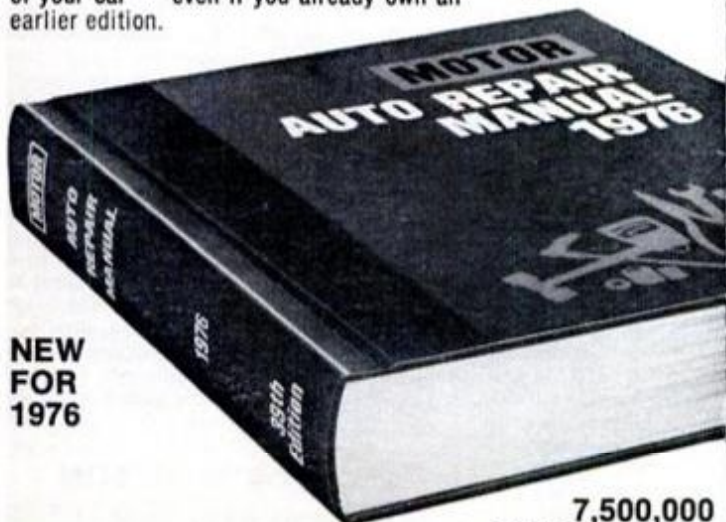
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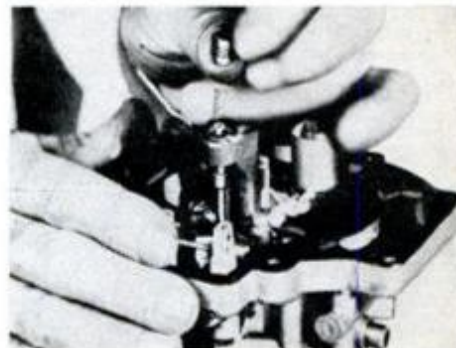
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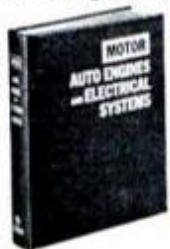
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I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my

summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to

gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and

ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest \$15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

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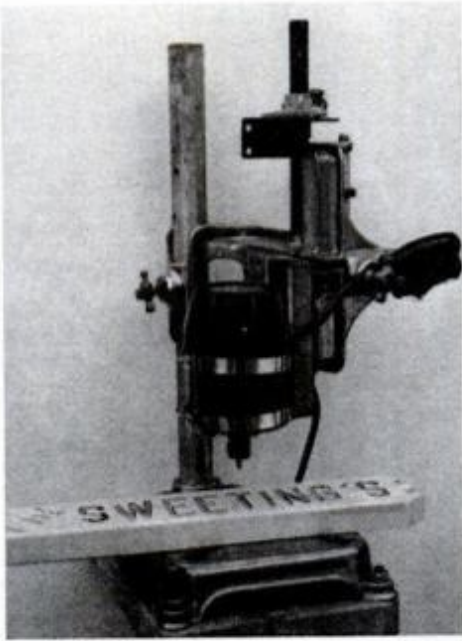
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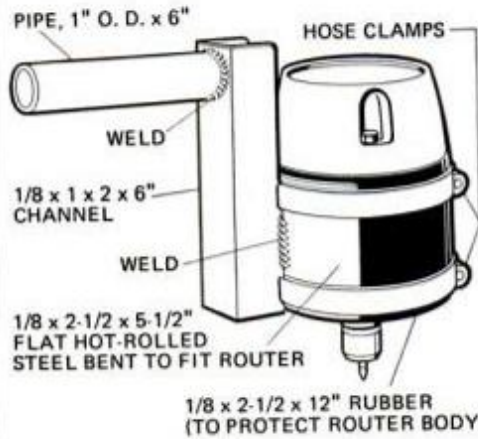
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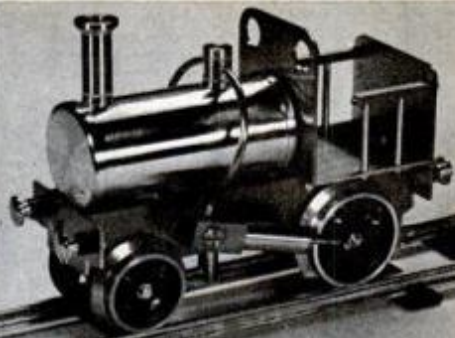
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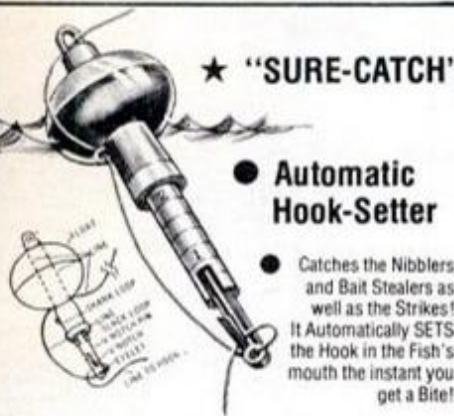


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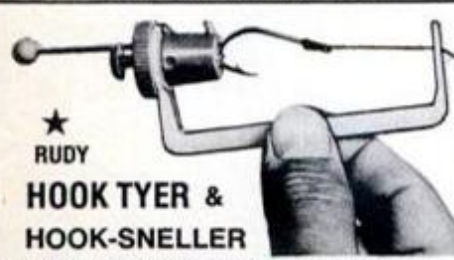
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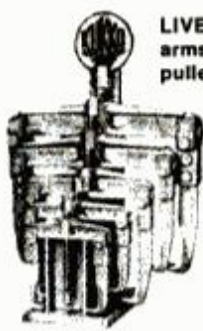
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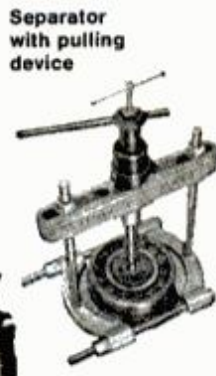
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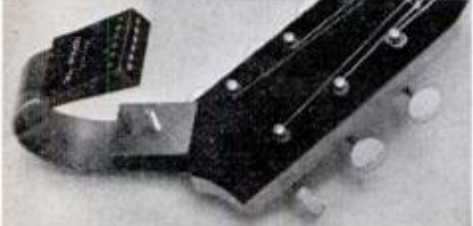
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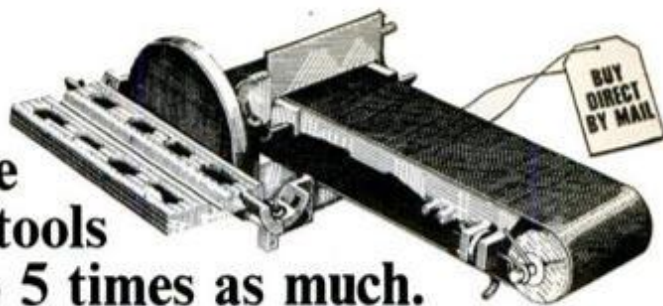
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LET Me show you how you can have your own Rubber Stamp business Free! Write: Roberts, Room RC-2-FC, 1512 Jarvis, Chicago, Ill. 60626.

PIANO Tuning Learned Quickly at Home! Musical knowledge unnecessary. Free information. Empire School. Box 450327, Miami, Florida 33145.

ADDRESSERS-MAILERS-HOMEWORKERS NEEDED! 50 firms listed. Information: Rush 25¢, Stamped, Addressed Envelope, South Plains Enterprises, Box 1086, Lubbock, Texas 79408.

BARGAIN MAILORDER LIBRARY. Professional secrets revealed, free details (Moneyback Guarantee), Suski, pmaa, 4318 Palmetto Avenue, Philadelphia, Pa. 19124.

MAILORDER—Nationally known **MILLIONAIRE** will teach you personally. Write for informative book, gift catalog, and complete details. **EVERYTHING FREE!** No Obligation. Mail Order Associates, Dept. 21, Montvale, NJ 07645.

EARN At Home! Rush 25¢ and SASE for offer. Details. J. Rohm, 65 N. Tenth St., Lemoyne, Pa. 17043.

COLLECT Names earn \$300 per thousand. **50 FREE** Dealerships available. Send 25¢ and stamped addressed envelope. Rick Dorrell, 5400 West 103rd Place, Overland Park, Kansas 66207.

\$250-\$500/THOUSAND. STUFFING ENVELOPES. COMPLETE ASSISTANCE. Rush stamped addressed envelope, Mailer Enterprises, Box 7538, Ft. Lauderdale, Florida 33304.

PROFITABLE Lifetime Business Opportunity. Free Information. Business Research & Development Co., Box C1002, Skokie, Ill. 60076.

MAKE BIG MONEY With our fantastic methods. Free Details. Ace Enterprises, Box 1025-PM, Williston, N. Dak. 58801.

YOUR Own Steady Repeat Business, Mail Color Brochure of Plastic Nameplates, Holders to Banks, Offices. Details \$2.00. Plastico, 1025 Green Valley, Waukesha, Wisconsin 53186.

\$300-\$700 MONTHLY. Raise Rabbits, Laboratory Animals for us. We supply Equipment, Breeders, Instructions. Details 25¢. MP11 Rabbits Of Michigan, Countyline Road, Pentwater, Michigan 49449.

MILLIONAIRE'S SECRET FORMULAS Free details. Learn how Millionaires make money fast. Write: Hall, 6111 Gulf Freeway, Box 26553, Houston, Texas 77207.

BECOME Our Mail Order dealer with \$35 investment. Details: Burnes, Box 499, Glen Ellyn, Illinois 60137.

MAILORDER SUCCESS. Tested procedures, instructions. West Bay, Route 1, Box 159-B1M, White Stone, Virginia 22578.

IMPORT-MAILORDER OPPORTUNITY. One year risk free trial basis. Earn \$15,000+ Annually or owe nothing. Details, Northeast Imports, Box 121M, Fremont, NH 03044.

\$500 MONTHLY Clipping items from your newspaper. Experience unnecessary. Free details. Send stamped envelope. Bill Derry Enterprises, P.O.B. 238, Kew Gardens, N.Y. 11415.

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\$100,000 YEARLY Possible! Your Own Business. Free information. CDC/10-016A, POB 11066, Tucson, Arizona 85734.

\$100 WEEKLY Possible! Clipping newspaper items. Stuff/address envelopes. Information—send stamped envelope. Income Opportunities, Box 721-A, Lynbrook, N.Y. 11563.

\$200—300+ DAILY. No gimmicks. Money back if not satisfied. Details \$2.00. Ideas International, PO Box 665 PM, Riverdale, Md. 20840.

HOME Business. Make Plastic Signs. Big Profits. Universal, Lenora, Kansas 67455.

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NEW Copyrighted Home Business Addressing Envelopes. Fantastic Profits. Send Self Addressed Stamped Envelope. Mantor House, Dept 8PM, Minoa, N.Y. 13116.

(Continued on next page)

BUSINESS OPPORTUNITIES

(Continued from preceding page)

ESTABLISH Successful Mailorder Business. Immediate, Continuous Income! Mears, C5363 Essex, Alexandria, Virginia 22311.

BECOME Our Mail Order Distributor with \$150 investment. Free Brochure. Audit Controls, 40 Brookside Ave., Fair Lawn, New Jersey 07410.

TAKE Catalog Orders. We drop-ship 1001 best-selling specialty products. Lowest below-wholesale prices. Immediate delivery. Spectacular home business opportunity. Free Book. SMC, 6061 De Soto Ave., Dept. 20-37, Woodland Hills, CA 91365.

\$200.00 SPARE Time earnings with your Tablesaw. Write: Workshop Five, 3800 Harney, Vancouver, Washington 98660.

VENDING Machines. No selling. Routes earn amazing profits. Big catalog Free. Parkway Machine Corporation, 1930PMB Greenspring Drive, Timonium, Maryland 21093.

\$1.00 LISTS You year sent to 1000 Importers, Jobbers, Mailers, our mailing year. Dixie, King, North Carolina 27021.

BECOME "Mortgage Broker." Lucrative! Capital Sources. Box 640099, Uleta, Florida 33164.

FREE COLLECTION AGENCY Details! \$1000.00 Monthly Possible. Master-PM, Dawsonville, Georgia 30534.

HOW TO RAISE \$100.00 to \$1,000,000.00! Write: Capital-PM, Dawsonville, Georgia 30534.

I MADE \$40,000.00 Year by Mailorder! Helped others make money! Free Proof! Torrey, Box 3189Y, Ypsilanti, Michigan 48197.

MAIL Baby Catalogs to New Mothers for Big Profits! Details 25¢. Volz-PM, Ypsilanti, Michigan 48197.

NEW, Compact fire extinguisher. Fantastic profits. Exclusive territories. Norwich Chemical, Norwich, Connecticut 06397.

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\$200 WEEKLY! Make, Sell Bricks! Free information! Xcfto Bricks, 5715 N. Mozart, Chicago, Ill. 60659.

FREE WEALTH BOOK: "2100 Unique Ways to Make Money!" Worlds Biggest Collection of Home Businesses! Success-M, 26903 West Eight Mile, Detroit, Michigan 48240.

WORLD'S Largest Supply. 25% to 40% under wholesale. Closeouts. HONG KONG Clothes, Automobiles, Electronics. Free Details. International Buyers, Box 16386MM, Portland, Oregon. 97233.

REPAIR Hydraulic Jacks—Details Free. Write: Hydraulic Parts Supply, Box 4157, Brownsville, Texas 78520.

YOUR Own Mailorder Catalog Business. No Merchandise Investment, Details Free. A.M. Sales, 31-14 94 St., East Elmhurst, NY 11369.

FREE MAILORDER Report! Plan Guarantees Beginners \$50.00 per order - to \$750 Weekly! Professionals, Box 21093-E, Seattle, WA. 98111.

EARN \$60.00 Daily manufacturing Concrete Fence Posts. Practically no investment. Send stamped-addressed envelope. American, Excelsior Springs, Mo. 64024.

\$178.00 WEEKLY. Work one hour daily. Guaranteed, FAS, Box 13703-J, San Antonio, Texas, 78213.

MAILORDER Millionaire helps beginners make \$500 weekly. Free report reveals secret plan! Executive (IA), 333 North Michigan, Chicago 60601.

\$70 TO \$200 WEEKLY—Home, Spare Time Simplified Mail Bookkeeping. Immediate Income. Easy. Auditax, Box 34741A, Los Angeles, Calif. 90034.

\$400.00 MONTHLY Raising giant fishworms. Soilless method. Charlie Morgan, Bushnell, Florida 33513.

MAILORDER DEALERS. Merchandise Dropshipped, Free Catalog. Details. Dunes, 310 1A Southeast Parkway, Richmond, Indiana 47374.

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FANTASTIC Profits! Super mailorder business! \$42.45 possible each order. Free details. J&S Sales, A1, 1488 Trentwood, Wyoming, Mich. 49509.

\$250-\$500/THOUSAND, STUFFING ENVELOPES, COMPLETE ASSISTANCE. Send Stamped addressed envelope, Cedar Enterprises, Box 46, Nashua, Iowa 50658.

\$250-\$500/THOUSAND, STUFFING ENVELOPES, complete assistance, rush stamped addressed envelope, Triple H Enterprises, P.O. Box 123, Fishersville, Va. 22939.

\$165.00 WEEKLY Working one hour a day, guaranteed, stamped envelope brings brochure, Horizon Enterprise, 8050 South Main, Houston, TX 77025.

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SELL Information by Mail! 2,400% Profit!!! Exciting Details Free! Sax, Dept. C-2901, Milan, Ohio 44846.

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"STARTING Your Own Business?" Step by Step instructions. Money-back Guarantee, \$3.95. Haendiges, 1313 Railroad, Bellingham, Washington 98225.

AMAZING Mail-order profits selling books and information! Free details. Valsaco, Box 268L, Eckert, Colorado 81418.

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SECRETS! Mail Order Success. Internationally famous expert reveals how to make home business fortunes. Beginners: Get free report "Make Money By Mail." Discloses free advertising, profitable products. Mailco, Dept. CC701, Woodland Hills, California 91364.

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(Continued on next page)

BUSINESS OPPORTUNITIES

(Continued from preceding page)

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\$175.00 WEEKLY Correcting Pupils' Lessons! Samples, \$1.00! Castle's, 507-LP Fifth, NYC 10017.

LEARN The secrets of repairing junk batteries. "Fabulous Profits" at home. Apex Engineering, 3100 Ramona, Atascadero, California 93422.

GET World's Biggest Wholesale Import Catalog. Write: World, Medina, Washington 98039.

FREE WEALTH BOOK: "2100 Unique Ways To Make Money!" World's Biggest Collection of Home Businesses! Success-M, 26903 West Eight Mile, Detroit, Michigan 48240.

\$1,000 MONTHLY! Stuffing Envelopes and Clipping Newspapers: Send Stamped Addressed Envelope . . . JOY, Box 936-C, Hyattsville, Maryland 20783.

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This 40-page, fully illustrated catalog is packed with high quality optics including binoculars, riflescopes, telescopes, camera lenses, sunglasses, and more. Plus tips on selecting the right equipment for your purposes. Free.

455. Chain Saw Guide

This definitive 25-page booklet from Sabre gives all the tips and techniques you'll need to keep your chain saw working at peak performance plus a variety of interesting projects to build. Free

456. Easy Styling With Tiles . . .

Is offered by EasySet modular ceramic tiles for swift, simple, do-it-yourself decorating. A free 8-page booklet from American Olean gives details, colors, and instructions.

457. Angling For A Better Rod?

Here's an 8-page brochure from Fenwick, "How To Build Your Own Fishing Rod", providing step-by-step instructions that will let you create your hand-crafted custom rod. Only 25¢.

458. Get A Head Start On Spring Gardening!

Find the right Wheel Horse tractor for your gardening needs in this free, 36-page, color catalog. These sturdy, dependable lawn and garden tractors also accept many accessories—including snow removal attachments for winter use.

459. Electronic Organ Kits

Combine the pride of craftsmanship and the joy of music! Schober Organ Co. offers a package of information on their electronic organ kits and optional accessories that includes 24-page catalog in full color, demonstration record, price list, Organ News, and more. Free.

460. Woodworking Versatility . . .

with DeWalt Powershop radial arm saws. These rugged saws give precise, accurate performance for all types of cuts and DeWalt accessories let you handle any woodworking task. Free 12-page brochure.

461. Selling Your Invention

If you've been wondering about how to start marketing your invention, here's a detailed 16-page booklet that can help answer your questions. It's free from Kessler Sales Corporation.

463. Pella Window & Door Ideas

Full-color, 16-page booklet on how windows fit into contemporary and traditional architecture. Energy-conserving double-glazing systems, low-maintenance exterior, easy-washing features and other benefits illustrated. Patio and wood folding doors are covered. Free.

464. Protect Your Tools!

Here are sixteen full color pages of tool boxes, chests, and roller cabinets to safeguard your valuable tools. They're all made of high quality steel for maximum protection and there's sure to be one to fit your needs. Only 25¢ from Kennedy Mfg. Co.

465. A Custom Touch . . .

For your car's interior. Envair Corp.'s handsome floor mats are custom tailored for all imports and domestics. These rugged mats are made of sturdy natural coco fibre with moisture-absorbing capacity to help deter body rust. Free full color brochure.

466. Garage Door Openers

ElectroLift offers free data sheets on their dependable "install-it-yourself" openers. They feature: solid state controls, vacation security switch, automatic safety reverse, and more. UL Listed, full FCC compliance.

467. Is Canoeing For You?

Here are two free booklets from Grumman Boats. The "Learn To Canoe Directory" is a guide to places nationwide offering canoeing training; while the "Grumman Book Rack For Canoeists" lists books of special interest to canoeists and would-be canoeists.

468. Learn To Weld

A 320-page book, "New Lessons In Arc Welding", covers techniques, electrode characteristics, and related subjects. Practice material and exercises are suggested for each lesson. \$2.00 from the Lincoln Electric Co.

470. Wood Staining Guide

Here's how to use stains to enhance the natural beauty of wood. This 16-page pamphlet from Samuel Cabot treats interior, exterior, and furniture staining and gives tips for getting the best results. Only 25¢.

471. Heirloom Quality Floor Clocks

You'll take lasting pride and satisfaction in the meticulously crafted clocks you can assemble from Viking Clock Co.'s quality kits. Or order your clock fully assembled. Free full color brochure.

472. Have A Better Looking Car!

This 12-page booklet from Krylon is teeming with tips to keep your car looking and running great. It includes body maintenance, under the hood maintenance, and sophisticated—but easy—spray painting techniques. Only 25¢.

473. Looking For Unusual Tools?

National Camera offers their new Winter 1976 NC Flasher catalog. It's 80 fully illustrated pages of tools and technical supplies and lists over 2,000 items—including many unique tools not available from other sources. Free.

474. For A Beautiful New Surface . . .

that's easy to care for, try Nevamar plastic laminate from Exxon. Free 12-page illustrated flyer gives detailed step-by-step instructions that make application a cinch.

Popular Mechanics 176
Box 1718, Sandusky, Ohio 44870

This Coupon Expires March 31, 1976

Please see that I receive the items checked below. I have enclosed 35¢ for the overall service charge, plus remittance for any priced items.

<input type="checkbox"/> 453	<input type="checkbox"/> 456	<input type="checkbox"/> 459	<input type="checkbox"/> 463	<input type="checkbox"/> 466	<input type="checkbox"/> 470 (25¢)	<input type="checkbox"/> 473
<input type="checkbox"/> 454	<input type="checkbox"/> 457 (25¢)	<input type="checkbox"/> 460	<input type="checkbox"/> 464 (25¢)	<input type="checkbox"/> 467	<input type="checkbox"/> 471	<input type="checkbox"/> 474
<input type="checkbox"/> 455	<input type="checkbox"/> 458	<input type="checkbox"/> 461	<input type="checkbox"/> 465	<input type="checkbox"/> 468 (\$2.00)	<input type="checkbox"/> 472 (25¢)	

Total items requested _____ Total money enclosed (including 35¢ service charge) _____

Name (Please Print) _____

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(Please send cash, check or money order made out to POPULAR MECHANICS. No stamps, please.)

Note: Popular Mechanics processes your requests for the above information and forwards these inquiries to the organization making the offer. Each company mails the material directly. Please allow 4-6 weeks for delivery.

You can forget about Delco's new Freedom Battery.

A revolutionary new battery designed to take care of itself for as long as you're likely to own your car.

It's the maintenance-free, worry-free, power-full Delco Freedom Battery from AC-Delco. Once it's installed you can virtually ignore it. That's why we named it "Freedom."

Features include sealed construction so you never have to add water, and Delco - Remy - pioneered changes in cell material and design to promote continuing reliable power.

The results are dramatic, even when compared to our

An advanced new technology for starting cars.



best conventional battery: superior ability to hold a charge, resistance to damage from overcharging, superior ability to withstand today's



No need to water it. You shouldn't have to clean it or check it. Shut the hood on battery worries.

higher under-the-hood temperatures and virtually no servicing required for the entire life of the battery.

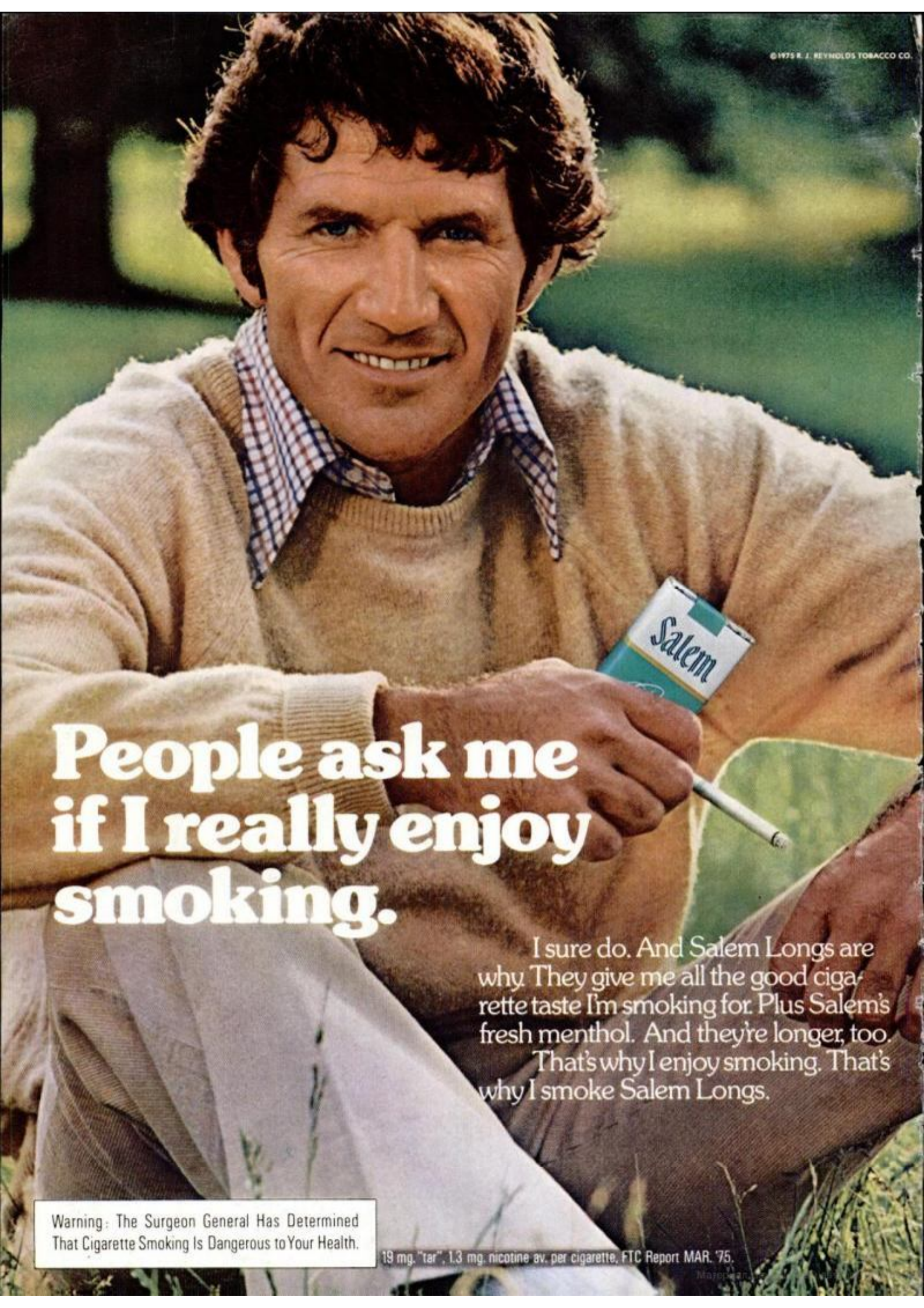
Important new technology has made the Delco Freedom Battery a better way to start your mornings for a long time to come. And Freedom is just one more good reason to go with the names you know, AC-Delco.

Go with the names you know.

AC-DELCO DIVISION OF GENERAL MOTORS CORPORATION



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A man with dark, curly hair and a slight smile is shown from the chest up. He is wearing a light-colored, textured sweater over a blue and white checkered collared shirt. He is holding a pack of Salem cigarettes in his left hand and a lit cigarette in his right hand. The background is a soft-focus green field.

**People ask me
if I really enjoy
smoking.**

I sure do. And Salem Longs are why. They give me all the good cigarette taste I'm smoking for. Plus Salem's fresh menthol. And they're longer, too. That's why I enjoy smoking. That's why I smoke Salem Longs.

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