

**WIN A CAR AND 1,000 GALLONS OF GAS!
Play Spot-the-Cars
Game... SEE PAGE 86**

PS 3-6-5

JANUARY 1967 35 CENTS

Popular Science

MONTHLY

**Now! Instant Crime
Control in Your Town**
By J. EDGAR HOOVER

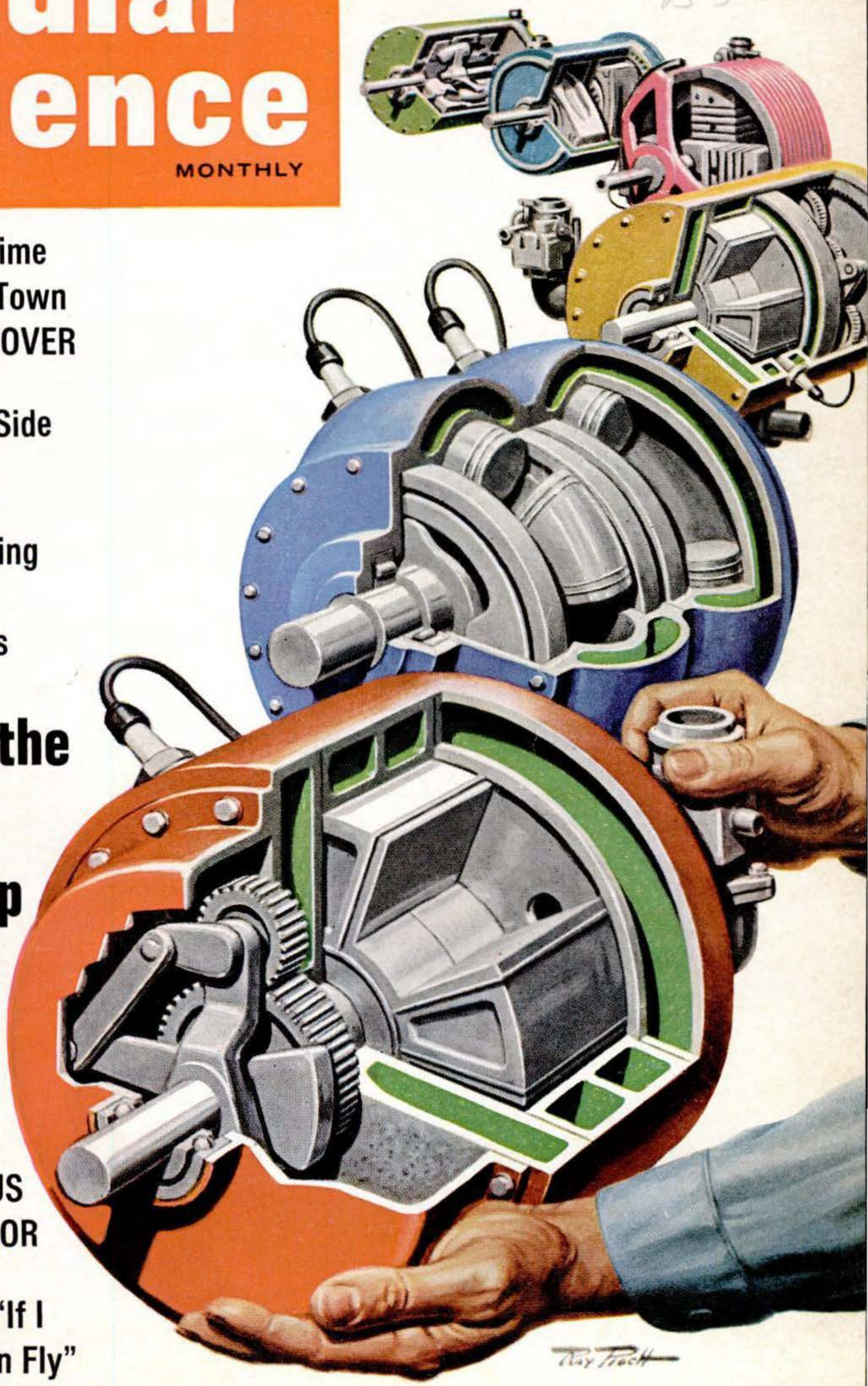
**SD: The Other Side
of the Story**

**Secrets for Getting
a "Piano" Finish
on Your Projects**

**Rivals to the
Wankel:
A Roundup
of Rotary
Engines** ➔

**Getting Started
in Boating...PLUS
31 Boats in COLOR**

**DANNY KAYE: "If I
Can Fly, You Can Fly"**



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The Champagne of Bottle Beer



Fifth frame favorite
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Always Sparkling... Flavorful... Distinctive!



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You supply the skill.

We'll supply the extension phone—and its installation.

Then, you can make calls right from your shop. And put the job aside, instead of putting it away.

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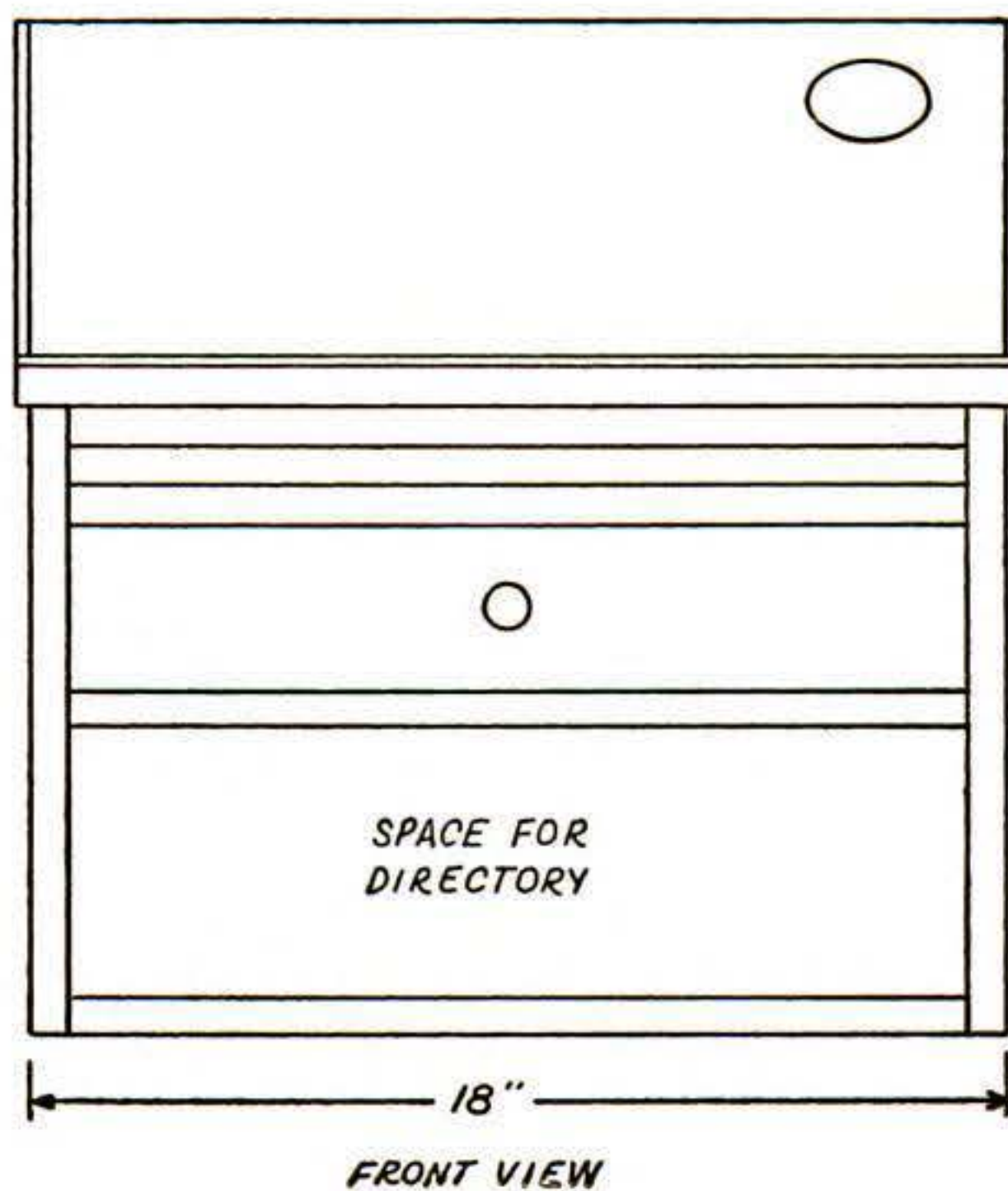
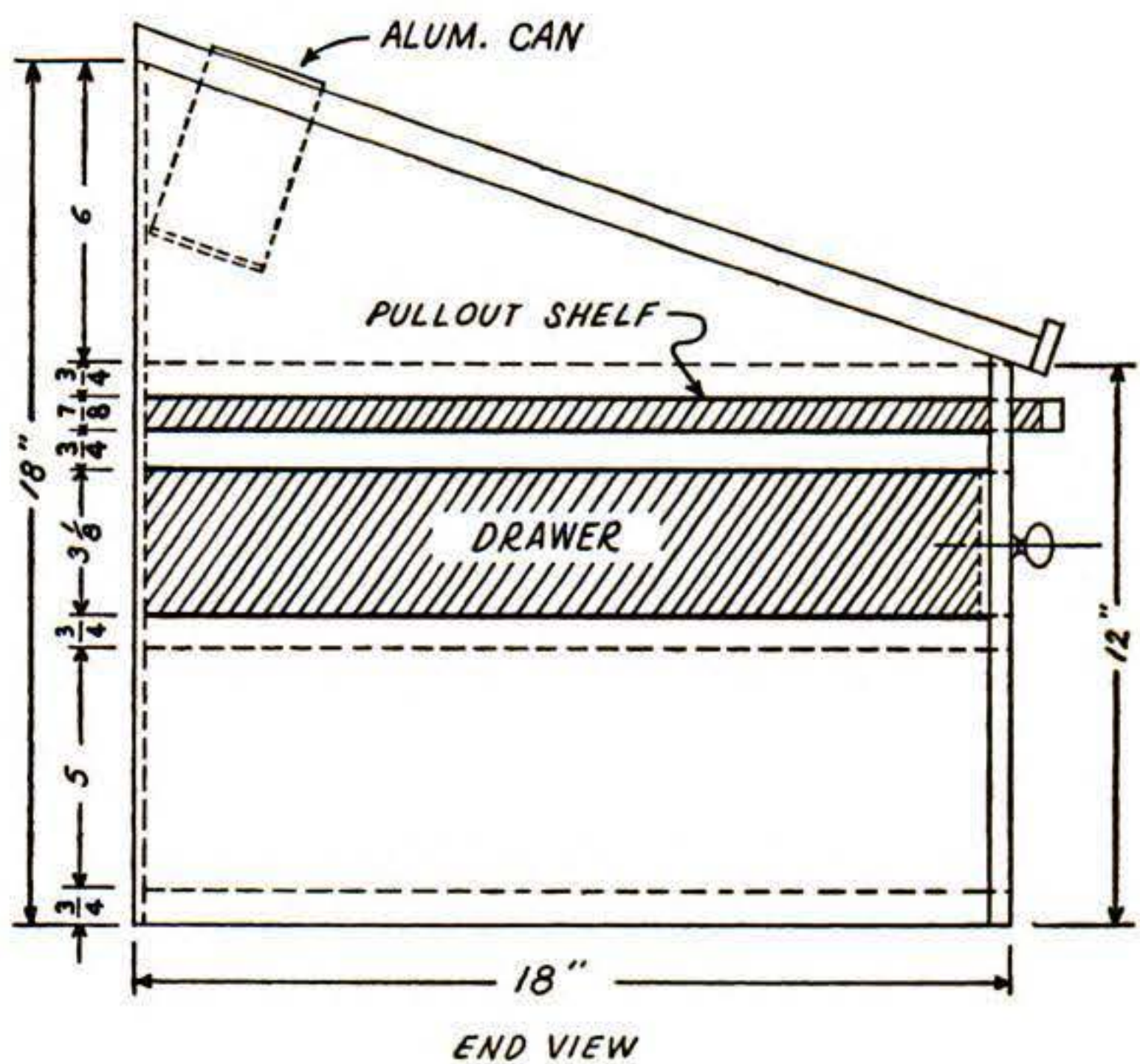
the whole family if you put your extension near your bench and near the laundry or game room.

But it adds only a fraction to your telephone bill.

For the handy extension phone, just call your Bell Telephone Business Office or ask your telephone man.



Phone shelf has a wide drawer, recess for phone directory, and pull-out panel for listing often-called numbers. Major pieces can be cut from one 4' x 8' sheet of $\frac{3}{4}$ " fir plywood. For drawer sides and back, use $\frac{1}{2}$ " plywood and for drawer bottom use $\frac{1}{4}$ " plywood. Ends of plywood finished with $\frac{3}{4}$ " x $\frac{1}{4}$ " white pine. Assemble with sixpenny nails and glue.



HIGHLIGHTS OF THIS ISSUE:

Now: Instant Crime Control BY J. EDGAR HOOVER PAGE 67

Here's how the FBI's new computer system will put the finger on criminals—instant information to police in your town for instant law enforcement.

The '67 Fleet's In! PAGE 70

Pictures of the new boats in full color . . . And don't miss: "Getting Started in Boating: A's to Your Q's" (page 114) . . . and "What's New in Boating" (page 118)

"If I Can Learn to Fly, You Can Learn to Fly" BY DANNY KAYE PAGE 76

"Would you believe," says TV's famous redhead, "that that's me up there, flying a jet?"

Rivals to the Wankel: A Roundup of Rotary Engines PAGE 80

Pipe dreams or power plants of tomorrow? Here's a look at the major rotary engines. They all work—and they all have problems.

A Classic "Piano" Finish Is Most Luxurious of All PAGE 148

The ultimate treatment for wood is the true rubbed finish. Here's how you put it on.

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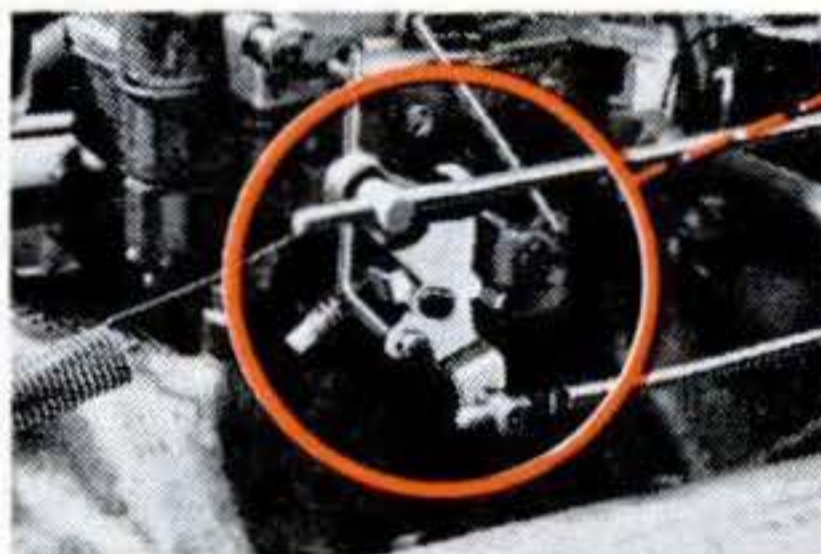
at leading
auto supply
stores



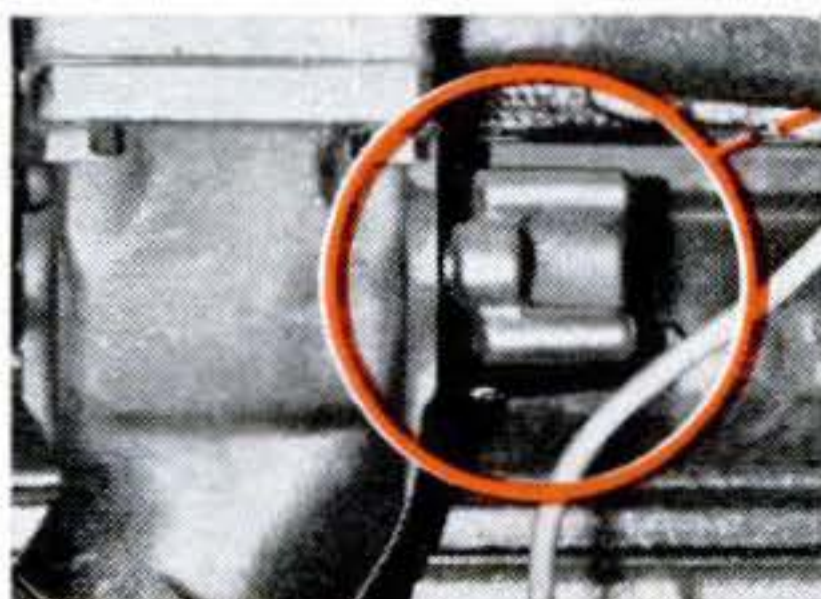
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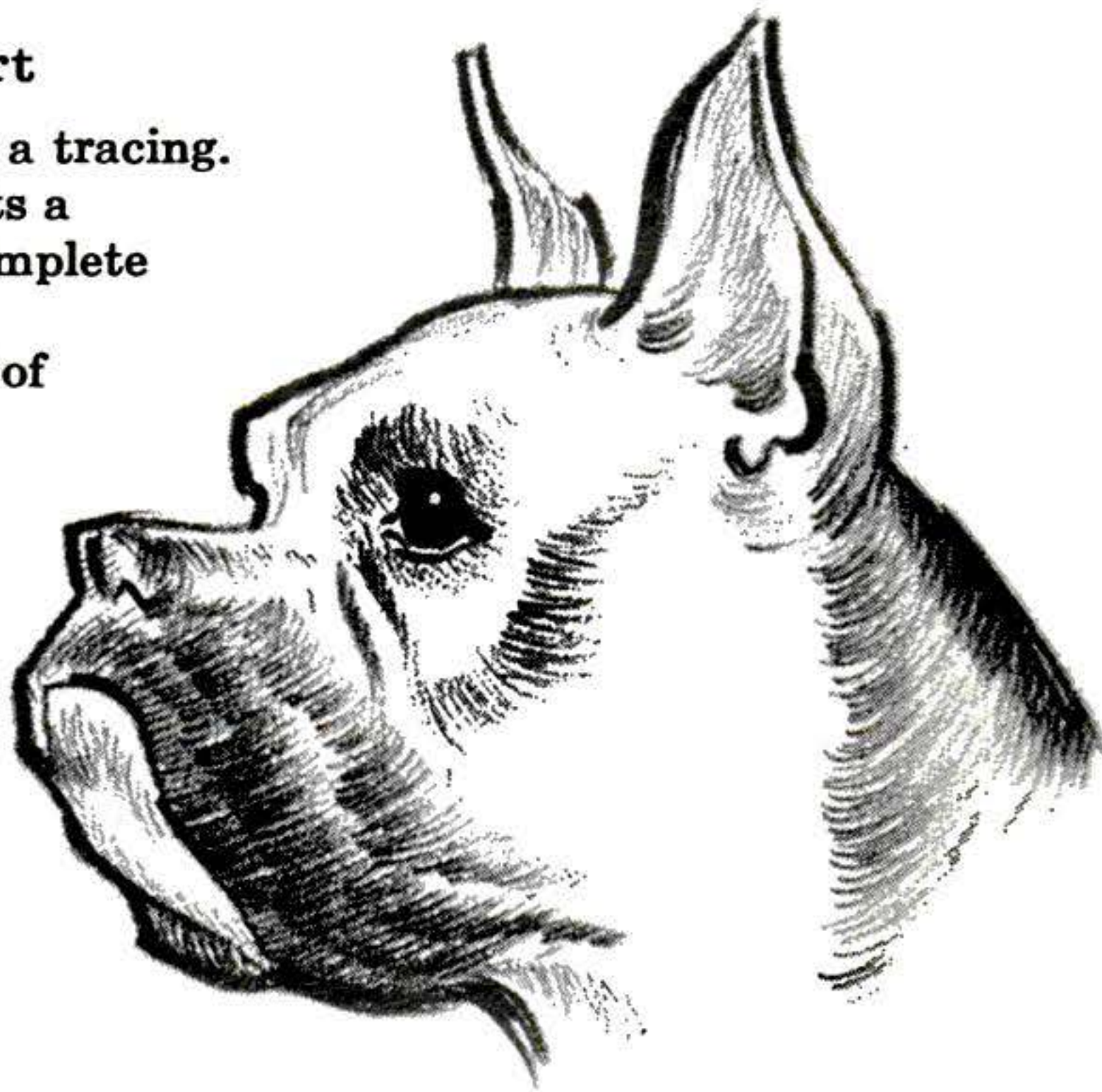
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Occupation _____ Age _____

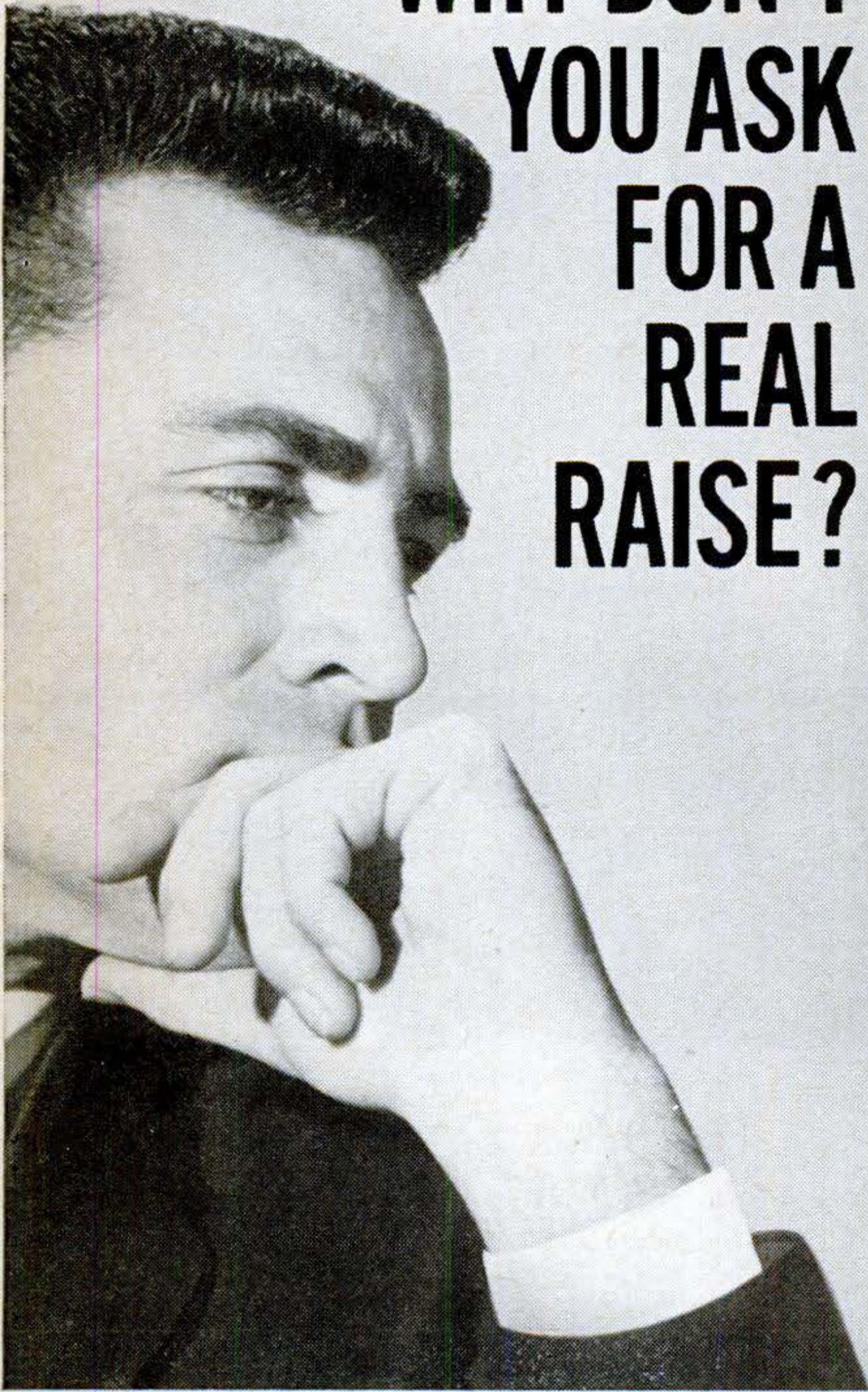
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WHY DON'T YOU ASK FOR A REAL RAISE?

Think you may be turned down? Here's how ambitious men get important promotions without even having to ask.

If it's been a long time since you've celebrated a raise in salary, ask yourself why. Are you really worth more money? If you're not sure, look again at men who have moved ahead...men so clearly marked for promotion that when it came it was just what everyone expected.

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**Talk
about
measurements**

200-185-155-120-90

What they stack up to are five of the sweetest white water makers since OMC started turning oarlocks into ornaments: the 1967 FASTBACK OMC Stern Drives. Say you want to add scamper to a stately cruiser, but you also want to keep her regal profile regal. Okay, you've got two choices—the sizzling FASTBACK 200 hp or a red-hot FASTBACK 185. Or maybe you want to add stateliness to a scampering runabout.

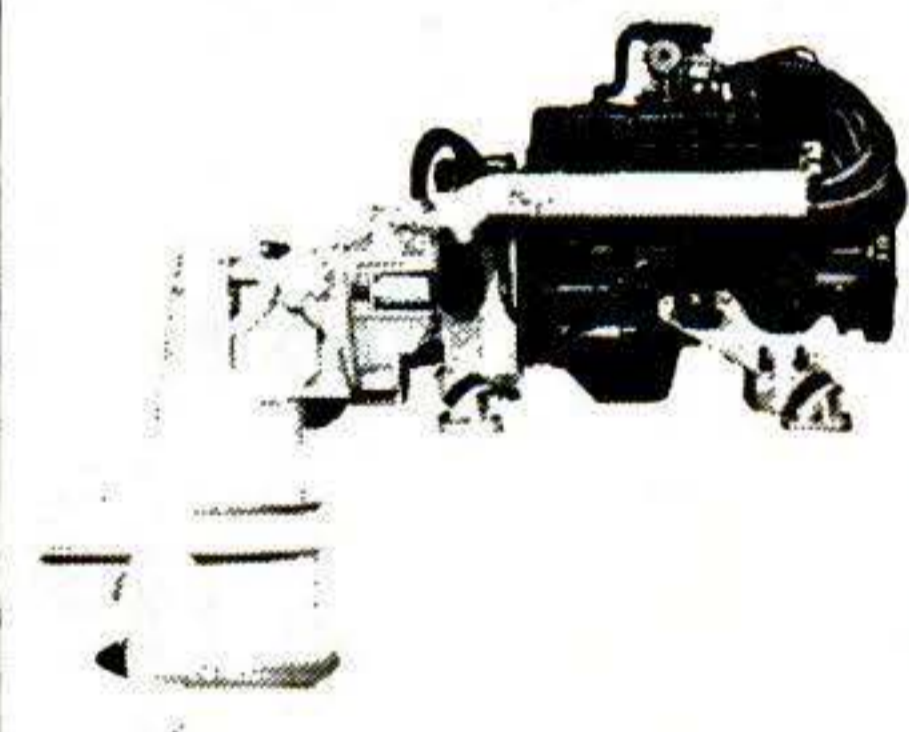
Then it's your pick between the FASTBACK 155, 120 or 90 hp.

And, speaking of measurements, try these on for size: 90°—75°—2. That's how sharp FASTBACK turns from port to starboard—how high she power-tilts . . . and how many years the famous OMC warranty* stands behind you. For the whole racy FASTBACK story, test drive one first chance you get. And get the FASTBACK Fact Book by writing: OMC Stern Drive, Galesburg, Ill.

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**For 24 months after purchase, OMC Stern Drive will replace to the original purchaser of an OMC Stern Drive any part of its manufacture, which upon inspection proves to have failed in normal use due to faulty material or workmanship.*

FASTBACK



OMC STERN DRIVE

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PS Readers Talk Back

Want to get something off your chest?
Write "Readers Talk Back," POPULAR SCIENCE,
355 Lexington Ave., New York, N.Y. 10017.

Camaro vs. Mustang

Your comparison between the Camaro and the Mustang was unreal and unfair ["The New Mustang," Nov.]. The Mustang's 390-cu.-in. engine has no business being compared to the Camaro's 350-cu.-in. engine. Why not give the Chevies a six-inch advantage and compare the 390 Mustang with a 396 Corvette?

HOYT FITZSIMMONS, Chattanooga, Tenn.

PS compared the competitive Camaro and Mustang with the maximum-displacement V-8 engines available for each model. To compare the Mustang with the Corvette would be illogical in view of the price difference.

... Andretti says the Mustang is heavier than the Camaro. Your October specs list the Camaro as 3,380 pounds—15 pounds heavier than the Mustang.

RICHARD VADASZY, Amityville, N.Y.

We goofed. Model for model, the Mustang is lighter than the Camaro.

Remembering a great driver and PS writer



How many people remember Wilbur Shaw's "Reports from the Driver's Seat" in POPULAR SCIENCE? Recently I reread his tests on the 1951 Plymouth in which he compared that year's model with the previous year's car. I got a kick out of it because I own a '50 Plymouth. All of Wilbur Shaw's reports were complete and unbiased. I think some tribute should be paid to him on the 12th anniversary of his death.

DAVE POLLOCK, Victoria, B.C.

World's longest radio antenna

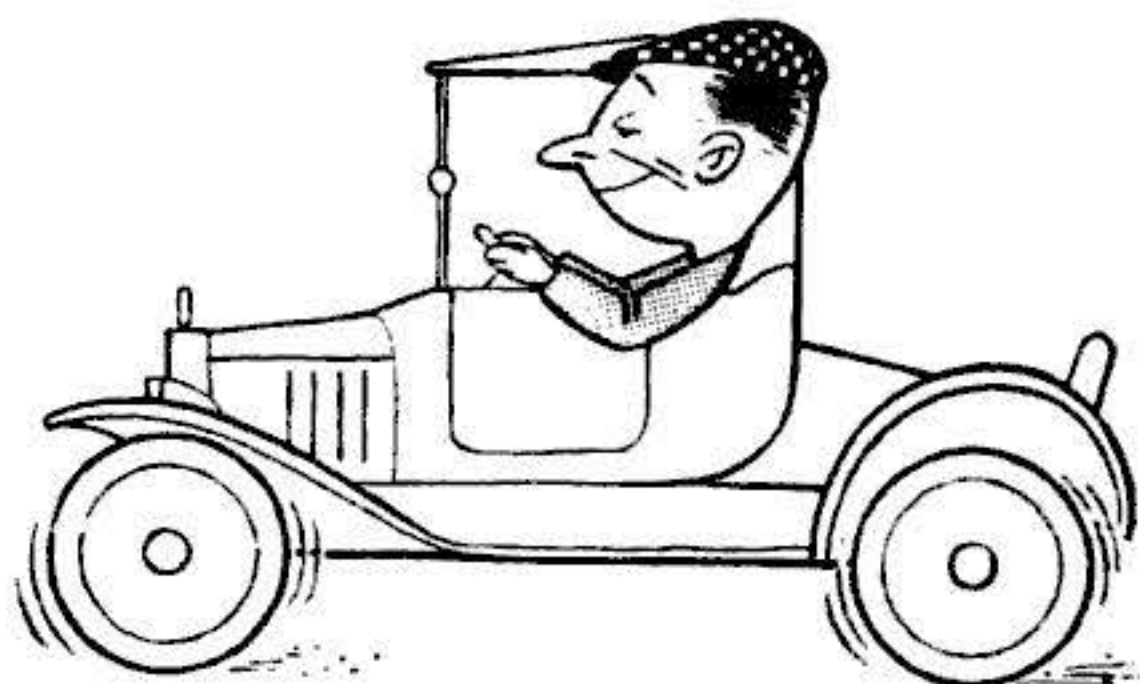
We at Byrd Station take exception to the description of the world's longest radio antenna (two miles) in "Science Newsfront" [July]. Two antennas here are considerably longer. One is a 21-mile dipole, the other is a 10-mile dipole oriented at right angles to the longer antenna. The antennas were placed on the snow surface approximately 8,000 feet above the earth's surface. This places them at an effective height of around 2,000 feet when the dielectric properties of the snow and ice are considered.

At present the installation is being used by the University of Washington and Stanford University for geophysical research.

RONALD L. SEFTON, Station Scientific Leader,
Byrd Station, Antarctica.

New idea from Oldsmobile?

The new climatic combustion-control system offered by Oldsmobile is more or less a device that sucks hot air from the manifold and channels it to the carburetor ["Engines Pack More Power Per Pound," Oct.]. My 1924 Model T



Ford has the same kind of setup. Looks like Ford had it a bit earlier.

BRUCE GLOVER, Elmont, N.Y.

Ski lift and limited-slip differentials

Your portable ski tow [Nov.], which runs off the power in a car's rear wheel, was very ingenious, but there is one thing you forgot. Do not run the ski tow from a car with a limited-slip differential. The wheel on the ground will spin instead of the wheel off the ground, because it is the wheel with the most traction. Another stand could be used to get the other wheel off the ground in such cars.

GEORGE SIMONS, Tucson, Ariz.

How good are our truck drivers?

It seems to me that George Elderstrom, who wrote that trucks are a highway hazard ["Readers Talk Back," Nov.] is a poor driver—not very well informed on highway-safety figures. The semi drivers are the safest and most courteous drivers on the highways. If car drivers were as careful and courteous, there would be fewer accidents on the highways.

BERNARD HOWARD, Dayton, Ky.

... Truck drivers are no doubt among the best drivers who make driving their profession, but unfortunately a number of them take the safety of us "amateur" drivers lightly by their performance on the highways.

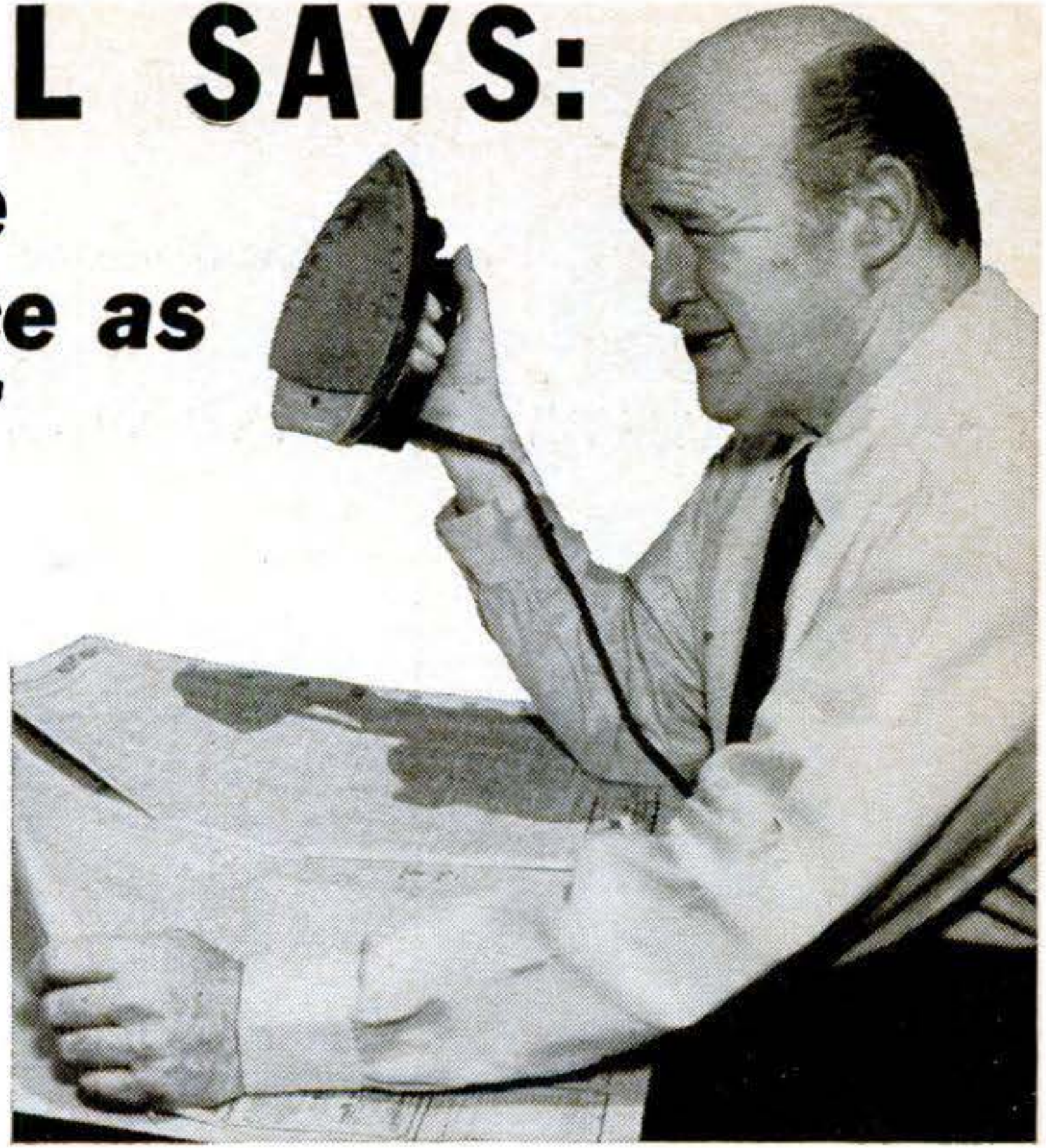
ALFRED R. CHAN, Los Angeles, Calif.

... I drive one of those "highway hazards," which is regulated on height, weight, width, length, and speed by federal and state laws. The unit I drive pays \$4,420 a year in road-use taxes, which helps to build new highways. The unit goes through a safety lane and is inspected for any defects before it leaves on a run. I must pass an Interstate Commerce Com-

Continued

TOM McCAHILL SAYS:

“Good Appliance Repairmen are Scarce as Edsel Dealers!”



I don't think anything disturbs me as much as trying to find an appliance repairman . . . and finding out I'll have to wait my turn because he has more business than he can handle.

With over 400 million Appliances now in use, and more coming every year, there just are not enough repairmen around to take care of every Mrs. Jones who wants a broken Appliance mended in a hurry! And that's why a smart guy could really clean up in the Appliance repair field.

Some years back, almost anyone could do a fast repair on an iron or toaster with a bit of fancy tinkering. But today's complicated Appliances call for a special brand of know-how the average Joe doesn't have without training. Appliances are loaded with thermostat controls, solenoids, and special devices. Unless a repairman has a working knowledge of these parts, he won't even get to first base.

That's why I want you to take a good look at the home study course offered by the Appliance Division of the National Radio Institute. They show you all about repairing home and commercial Appliances—even farm Appliances and small gasoline engines. If you're interested, they also include a special package covering air-conditioning and refrigeration repairs. The cost is surprisingly low, and even includes a special Appliance Tester.

NRI is one of the biggest and best schools in the field, and has been around since 1914. They have a staff of 150 people in Washington, D.C., who are

equipped to guide you through the easy course with expert and personal instruction.

Take it from Tom . . . this is one of the easiest and most rewarding fields a guy can enter today. You don't need a college education, you don't even need to know the first thing about Electrical Appliances when you begin your training.

There's nothing to lose . . . except the price of a stamp on your letter or postcard. Fill out the coupon below *now*, before you turn the page. Get the full rundown on the training that can increase your spare time income or provide you with a business of your own a lot sooner than you think. In just a few short months you could be ready to take the first profitable step towards a new and rewarding career. Do it!

Tom McCahill

TOM McCAHILL

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AVAILABLE UNDER NEW GI BILL.
If you served since January 31, 1955
or are in service, check GI line below.

601-017

OK—I want to see for myself. Send me the free book on Professional Appliance Servicing. No salesman will call.

Name _____ Age _____

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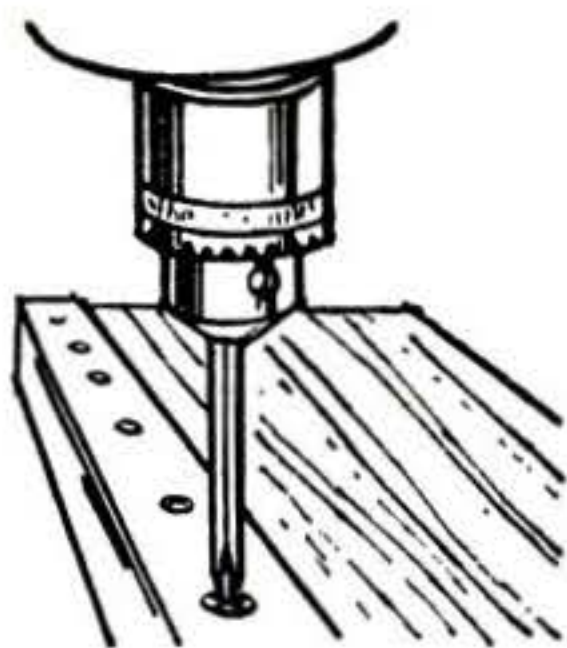
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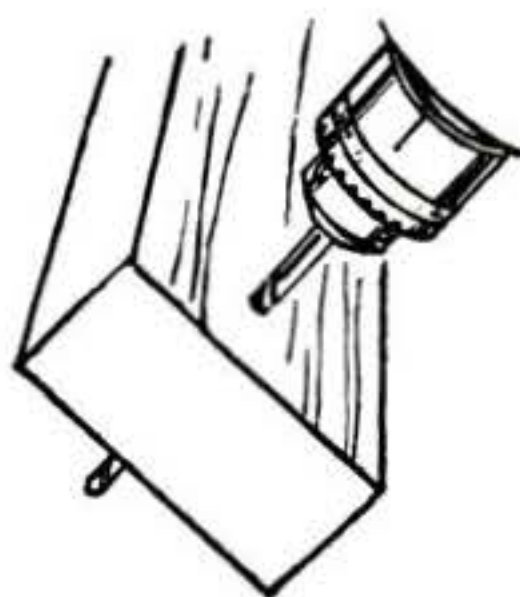
Check for facts on new GI Bill.



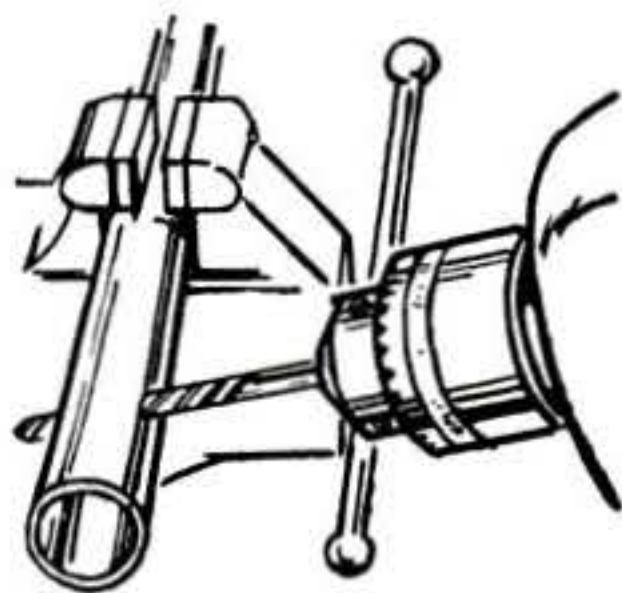
Controlled speed. You can use your Variable Speed Drill to mix paint in any size can and never slop or splash.



Great for screwdriving. Simply use slow speed to start screw. Speed up by squeezing harder until screw is tight.



Drill in wood as you do with any drill, using higher speeds. The same bits used for metal can be used for wood.



Drill in metal without center punching! You can start slow enough to drill into a rounded surface with ease.

New 1/4" Variable Speed B&D Drill gives you true workshop versatility.

Use a Black & Decker Variable Speed Drill for a new experience in workshop versatility. This 1/4" Deluxe double-insulated model lets you squeeze any speed from 0 to 2250 rpm. Mix paint without splashing, start a drill bit on rounded metal, drive screws—do jobs ordinary drills can't do. For a limited time, Black & Decker includes two screwdriving bits for the \$29.99 price of the drill alone: one for slotted, one for Phillips head screws. Save \$2.65. See the selection of Black & Decker drills at your nearby dealer's, or write Black & Decker, Dept. C-0177, Towson, Md. 21204.



PS Readers Talk Back [Continued]

mission physical check before I am allowed to drive on the road. And the hours I drive and time I am on duty are regulated by the I.C.C.
BILL BAILEY, E. St. Louis, Ill.

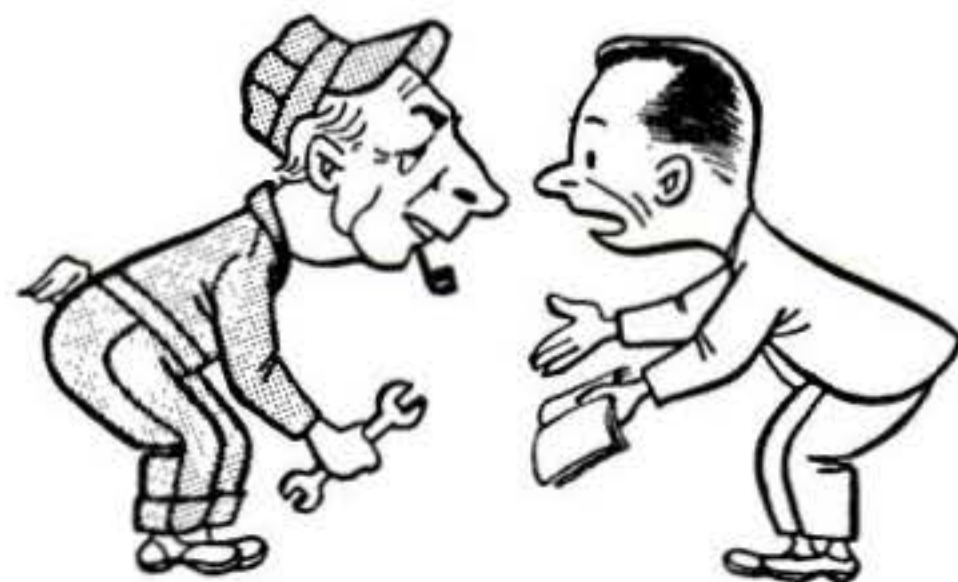
A letter from Vietnam

I was very impressed by "Home Murals from Your Favorite Photos" [Sept.]. Your magazine is highly enjoyed by the men in Vietnam.

W.O. WADE BISHOP JR.
APO 96490, San Francisco, Calif.

Gus gets a tip

In "The Engine That Wouldn't Stop" [Oct.],



why didn't Gus simply pop the hood and stick his hand over the air intake to stop the engine?
JOE CRUMPLER, Falmouth, Ky.

It probably would have taken Gus just as long; he would still be standing in that monoxide-laden atmosphere; and it sure wouldn't have done his hand any good.

Steve McQueen's motorcycles

I enjoyed "Motorcycles: What I Like in a Bike—and Why" by Steve McQueen [Nov.], and hope you have more articles of this type in the future. How about getting Steve McQueen to finish testing the other bikes?

R. MAUSSER, Kitchener, Ont.

Better care for your car battery

I think you pulled a boner in "Hints from the Model Garage" [Nov.] when you recommended hammering on the battery post to force the clamp down. There's no quicker way to ruin a battery than to hammer on the post. It's better to loosen the bolt and spread the clamp.

CARL M. WAGGONER, North Canton, Ohio.

Read the piece again. It advises what to do instead of hammering on the clamp.

Biomechanics for astronauts

The U. S. space program is costing billions and one result is that our spacemen are exhausted by only minor work efforts. "Astronauts Get a Tool Kit" by Dr. Wernher von Braun [Oct.] shows tools which are designed to make extra effort for the user, according to what you say in "How 'Human Engineering' is Making Better Tools for You." Perhaps

How to get into one of today's hottest money-making fields—servicing 2-way radios!

More than 5 million two-way transmitters have skyrocketed the demand for service men and field, system, and R&D engineers. Topnotch licensed experts can earn \$12,000 a year or more. You can be your own boss, build your own company. And you don't need a college education to break in.

HOW WOULD YOU LIKE to start collecting your share of the big money being made in electronics today? To start earning \$5 to \$7 an hour...\$200 to \$300 a week...\$10,000 to \$15,000 a year?

Your best bet today, especially if you don't have a college education, is probably in the field of two-way radio.

Two-way radio is booming. Today there are more than five million two-way transmitters for police cars, fire trucks, taxis, planes, etc. and Citizen's Band uses—and the number is growing at the rate of 80,000 new transmitters per month.

This wildfire boom presents a solid gold opportunity for trained two-way radio service experts. Most of them are earning \$5,000 to \$10,000 a year more than the average radio-TV repair man.

Why You'll Earn Top Pay

One reason is that the U.S. doesn't permit anyone to service two-way radio systems unless he is licensed by the Federal Communications Commission. And there simply aren't enough licensed electronics experts to go around.

Another reason two-way radio men earn so much more than radio-TV service men is that they are needed more often and more desperately. A home radio or TV set needs repair only occasionally, and there's no real emergency when it does. But a two-way radio user *must* keep those transmitters operating at all times, and *must* have them checked at regular intervals by licensed personnel to meet FCC requirements.

This means that the available licensed experts can "write their own ticket" when it comes to earnings. Some work by the hour and usually charge at least \$5.00 per hour, \$7.50 on evenings and Sundays, plus travel expenses. Others charge each customer a monthly retainer fee, such as \$20 a month for a base station and \$7.50 for each mobile station. A survey showed that one man can easily maintain at least 15 base stations and 85 mobiles. This would add up to at least \$12,000 a year.

Be Your Own Boss

There are other advantages too. You can become your own boss—work by yourself or gradually build your own fully staffed service company. Instead

of being chained to a workbench, machine or desk, you'll move around, see lots of action, rub shoulders with important police and fire officials and business executives who depend on two-way radio for their daily operations. You may even be tapped for a big job working for one of the two-way radio manufacturers in field service, factory quality control, or laboratory research and development.

How To Get Started

How do you break into the ranks of the big-money earners in two-way radio? This is probably the best way:

1. Without quitting your present job, learn enough about electronics fundamentals to pass the Government FCC Exam and get your Commercial FCC License.

2. Then get a job in a two-way radio service shop and "learn the ropes" of the business.

3. As soon as you've earned a reputation as an expert, there are several ways you can go. You can move out and start signing up and servicing your own customers. You might become a franchised service representative of a big manufacturer and then start getting into two-way radio sales, where one sales contract might net you \$5,000. Or you may be invited to move up into a high-prestige salaried job with one of the major manufacturers.

The first step—mastering the fundamentals of electronics in your spare

time and getting your FCC License—can be easier than you think.

Cleveland Institute of Electronics has been successfully teaching electronics by mail for over thirty years. Right at home, in your spare time, you learn electronics step by step. Our AUTO-PROGRAMMED™ lessons and coaching by expert instructors make everything clear and easy, even for men who thought they were "poor learners." You'll learn not only the fundamentals that apply to all electronics design and servicing, but also the specific procedures for installing, troubleshooting, and maintaining two-way mobile equipment.

Get Your FCC License... or Your Money Back!

By the time you've finished your CIE course, you'll be able to pass the FCC License Exam with ease. Better than nine out of ten CIE-trained men pass the FCC Exam the first time they try, even though two out of three non-CIE men fail. This startling record of achievement makes possible the CIE Warranty: you'll pass the FCC Exam upon completion of your course or your tuition will be refunded in full.

Before Ed Dulaney studied with CIE, he was a crop duster. Today he owns the Dulaney Communications Service, with seven people working for him repairing and manufacturing two-way equipment. Says Dulaney: "I found the CIE training thorough and the lessons easy to understand. No question about it—the CIE course was the best investment I ever made."

Find out more about how to get ahead in all fields of electronics, including two-way radio. Mail coupon for two FREE books, "How To Succeed In Electronics" and "How To Get A Commercial FCC License."

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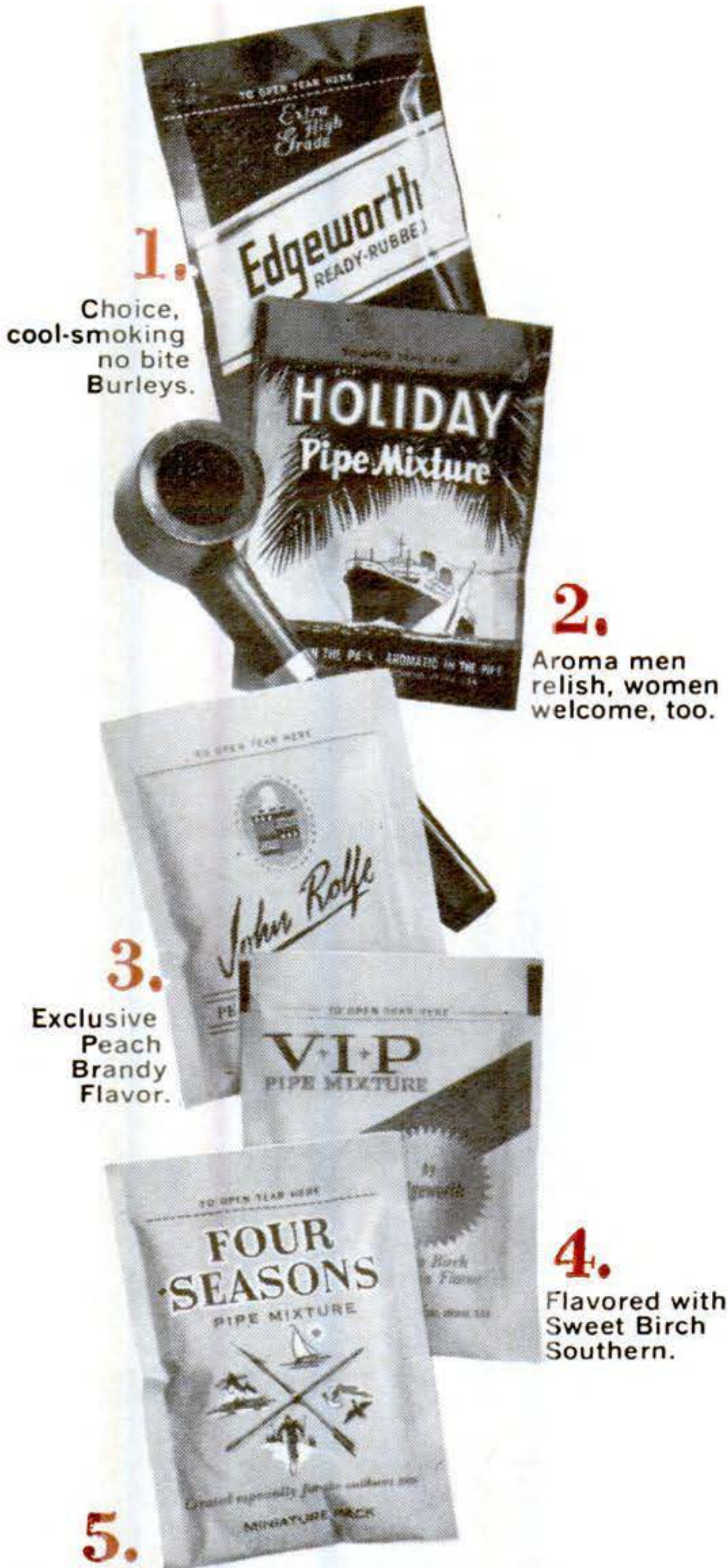
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PS Readers Talk Back [Continued]

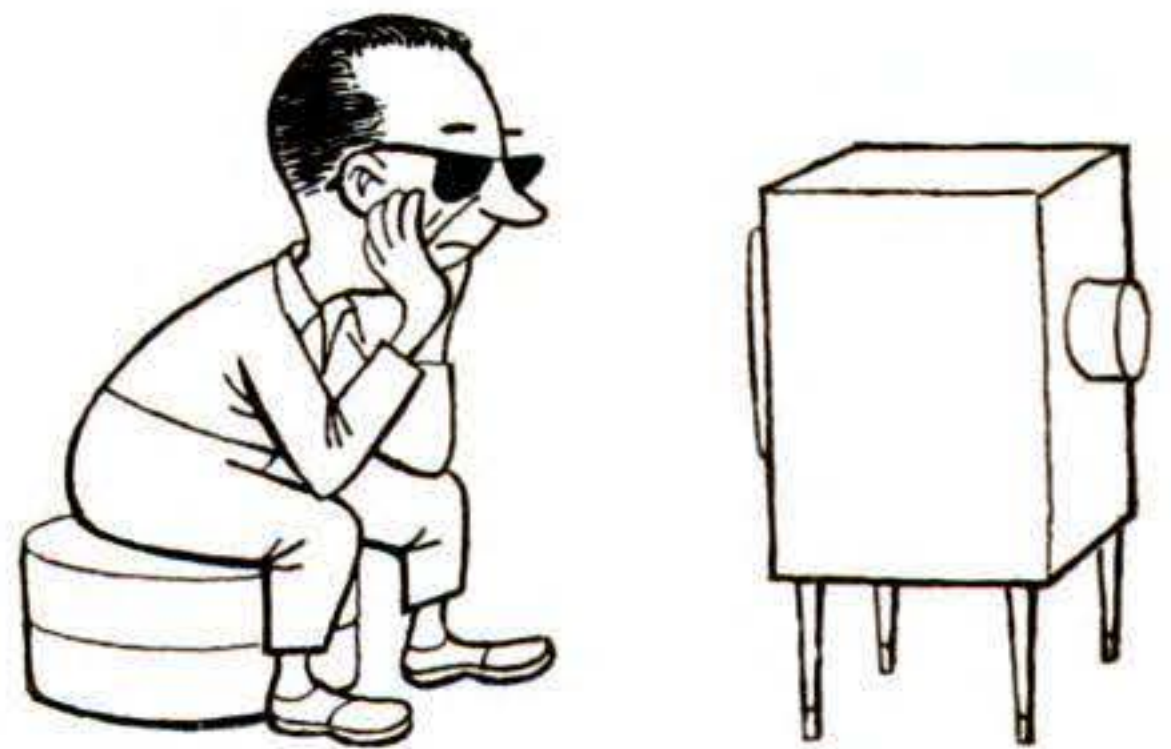
Black & Decker, Martin Co., and NASA should check Dr. Tichauer for some tips on relieving strain and burden in space-tool applications.

WALTER SCHICK, San Rafael, Calif.

The problems of human engineering are different in the weightless conditions of outer space than they are on earth. Many adjustments in biomechanics must be made to take into account the strange environment.

In the dark on fluorescents

In "23 Ways to Improve Your Home Lighting" [Sept.] you propose mounting four 48-inch, 40-watt fluorescent lamps in a space 10-inches wide to light a TV corner. These four lamps will produce the equivalent of 160



watts per square foot, which is ridiculous. The TV corner would burn up with light.

J. N. HELPBRINGER, Columbus, Ohio

The sketch for mounting these lamps shows only two lamps in a 10-inch area to produce 80 watts per square foot.

A vote for Powerglide

Every time PS does a report on any Chevrolet, you always cut down the Powerglide transmission. In "How Good is the New Camaro?" [Oct.] Mario Andretti asks "Why would they put that old box on this car?" Regardless of Andretti's opinion, I think it's a darn good transmission. I've got a '55 Chevy six with 'Glide and it just turned over 181,000 miles. The transmission has never had a wrench on it. And Powerglide is also the only automatic box that can be shifted into drive from reverse, without coming to a full stop, after backing out of your driveway.

TOM SPAIN, Brevard, N.C.

A detector-detector-detector?

"Science Newsfront" [Sept.] reports on a radar detector-detector. Next there will be a detector to detect the detector that detects the detector. Then a detector to detect the detector that detects the detector that detects the detector . . .

A. G. GLADMAN, NYC.



***"It's amazing the set up
you get in the accident
investigation field."***

GOOD PAY, NEW CAR, EXPENSE ACCOUNT

"I received a good starting salary, a new car, credit cards, expense account and insurance. It's amazing the set up you get in the Accident Investigation field."

Those are the words of a recent Universal Schools' graduate who went to work as a staff investigator for an insurance company. Before stepping into this remarkable field of opportunity, he worked in a factory. He had no experience in Accident Investigation, no college degree.

Yet, he made the jump from plant worker to professional man in a surprisingly short time with the training and help of Universal Schools. There are hundreds of such personal success stories in the files of Universal because ...

Men Are Urgently Needed

The Accident Investigation field is booming now—everywhere—and getting bigger every day. Here's why: Before this day ends, there will be more than 440,000 accidents and losses of all kinds in all parts of this country and Canada. And that happens every day! These accidents must be investigated, reported, settled by trained men. Is it any wonder that more and more men are needed now to handle this tremendous work load?

State Approved For Veterans' Training

FREE PLACEMENT SERVICE

Universal Schools provides prompt, effective job placement help in any part of the United States and Canada. More than 1,000 companies have requested and receive our monthly list of graduates. Universal trains and places more men in the Accident Investigation field than any other school. Or, if you would prefer to start your own full or part time business, we will show you exactly how to do it.

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Every year the accident rate goes higher as population increases. Just imagine what the daily accident and loss rate will be in 10 . . . 15 . . . 20 years when our population has increased by millions upon millions of people.

And that means security, solid security, for the man who trains now for Accident Investigation. He can look ahead to years of steady, exciting, growing opportunity with no fear of lay off, automation or recession. Good times or bad, accidents and losses will keep right on happening and trained men will be working to keep up with the demand.

3 Career Choices Open To Men Everywhere

1. Be Your Own Boss: Start your own independent Accident Investigation business in your own home at virtually no cost. Average earnings are \$6.44 an hour, plus expenses. Some Universal graduates in their own businesses earn to \$8.00 an hour and more.

2. Work Spare Time: Many Universal graduates keep their full time jobs and earn an extra paycheck every week by taking spare time assignments. Spare time earnings can easily range from \$50 to \$100 a week and more, plus expenses.

3. Company Staff Investigator: As a full time company employee, you typically receive good starting pay, a

new car, expenses paid and an insurance program. Pay and benefits are equal to approximately \$8,000 a year to start. Salary reviews and chances for advancement are frequent in this fast-moving business.

Free Book Tells How You Can Qualify

For many years Universal Schools has specialized in training inexperienced men of only average education to step into excellent positions in Accident Investigation. Successful graduates range in age from 20 to 55. Hundreds of Universal trained men are at work right now in all parts of the United States and Canada, enjoying fine incomes, security and prestige in Accident Investigation.

Free and without obligation of any kind, we will send you a book outlining your opportunities in this field. No salesman will call on you. We will show you what Universal has done for others; what we can do for you. We will show you how you can train in your own home, at your own pace, at amazingly low cost. No need to change or switch jobs. We will give you actual names and locations of successful Universal graduates in all sections of the United States and Canada. You read, you consider, you decide in privacy. You have nothing to lose.

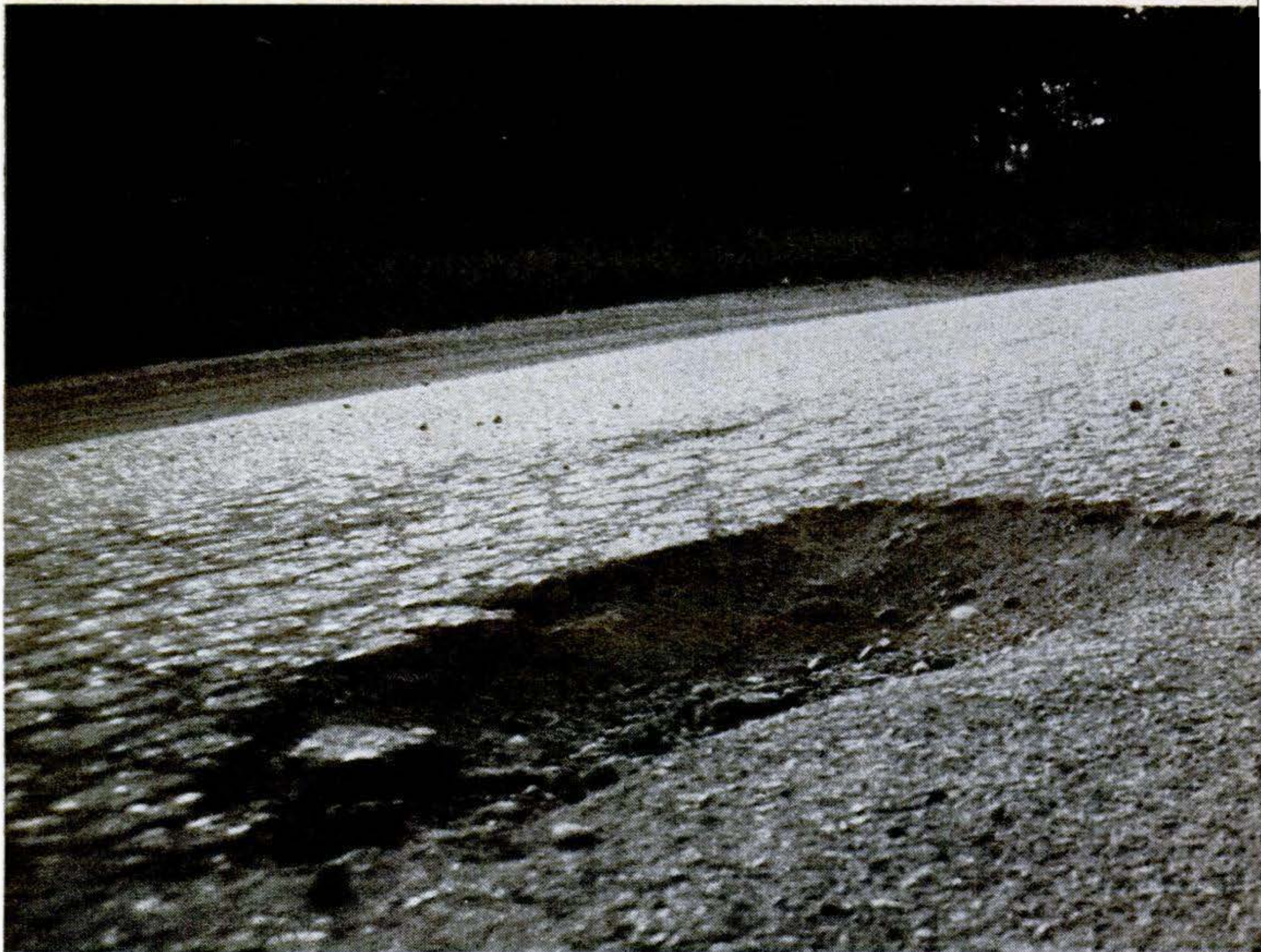
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What a difference a name makes

JANUARY 1967 | 15

"Say, Smokey—"

A clinic on cars by America's most famous mechanic

Each month in POPULAR SCIENCE Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Ask Smokey. You'll find the address at the end of the column. Please *print* your name and address.



.....

"My '65 Corvair Monza has a wet-type air filter. It's pretty dusty here, and the filter has to be changed every three or four thousand miles at a cost of a little less than \$9. Could a dry type be used without damage?"

C. H. ANDERSON, Saskatoon, Sask.

I'm for the dry filter 100 percent. I believe the paper type does a better job—if it can be kept dry. If you change over, be sure there are no leaks. Even a quarter-inch hole would ruin its usefulness.

"The valve in the heat riser of my '64 Olds 98 continually freezes up. What procedure and/or lubricant should be used to keep it open?"

LT. ASHLEY V. WILSON, Key West, Fla.

Your best bet would be to replace the heat-riser assembly with a new one. After they freeze up or stick for some time, usually they get rusty and galled and never work well again.

"The exhaust valves in my '65 Opel, with 12,700 miles on it, are burned and must be replaced. What's the reason?"

ANDREW J. KUCHINSKY, Concord, Mass.

Heat, of course, is the villain in all valve burning. Excess heat is generated by lugging, overloading, running too fast, using the wrong fuel, not having the right carburetor jets for your area, wrong timing, a poor exhaust system, and, last but not least, valve adjustment.

"I can feel engine vibration in the steering wheel of our 1966 Ford six, with the 240-inch engine and automatic transmission, while cruising around town at certain speeds, such as at 26 and 32 m.p.h. Is this normal for a high-compression six?"

CLARENCE FRANK, San Jose, Calif.

There could be many different reasons for this. One common cause of six-cylinder-engine vibration is that at certain speeds all the cylinders don't get exactly the right fuel mixture. If this is the cause, the engine will also vibrate at the same r.p.m. without load. The only cure is to try another intake manifold. The engine itself may be out of balance. Let me say that frequently drivers think their vibration originates in the engine when the transmission or drive line is out of alignment. There is even a chance that your wheels and tires may be out of balance.

"I have recently rebuilt the 3.4-liter, twin-overhead-cam engine of my '57 Jaguar roadster. Friends tell me that I should use only regular gas, since premium fuel probably would burn up the engine. I've also heard that an increase in octane might not increase performance."

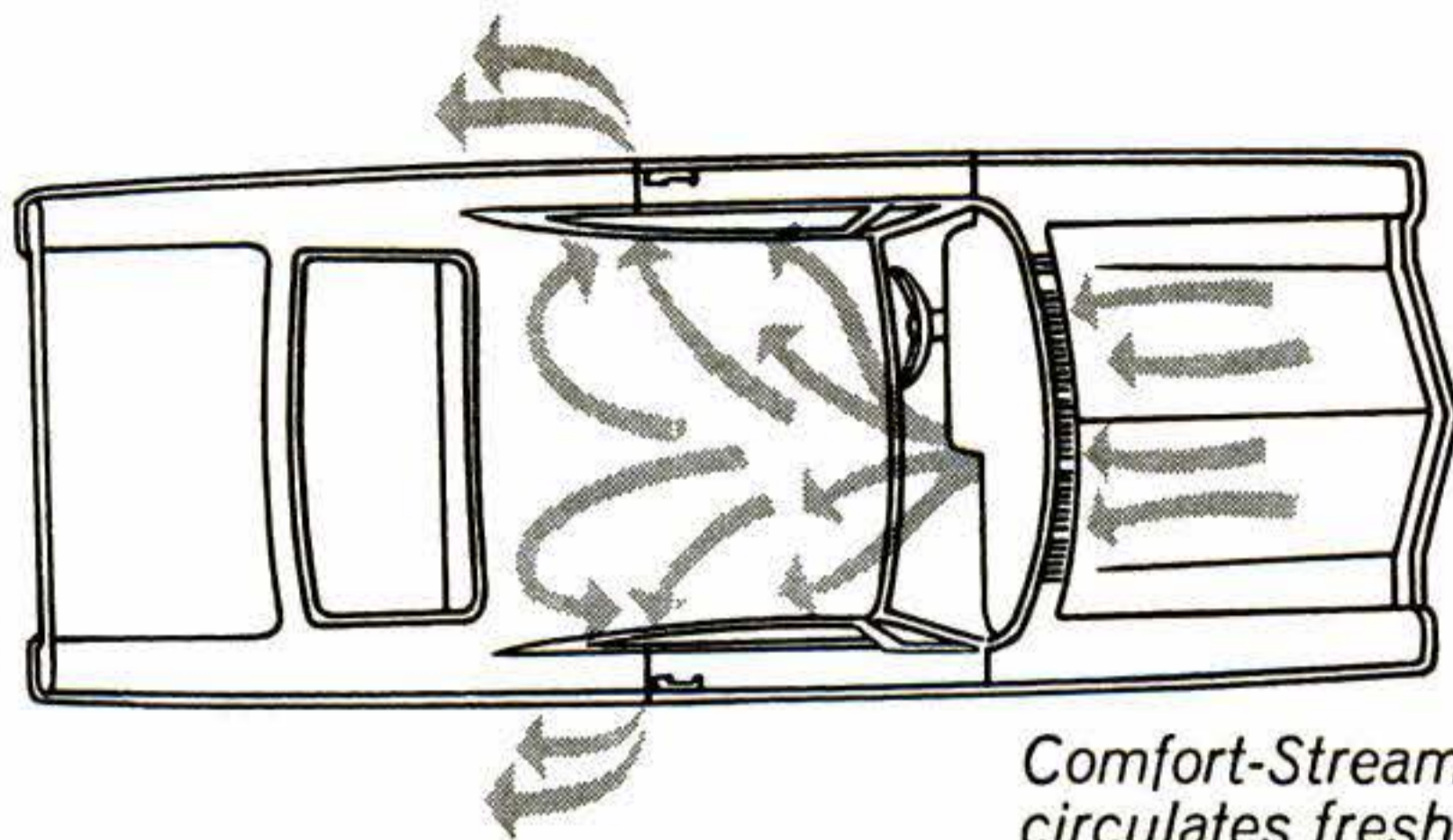
JOHN R. MUSACCHIO, Adelphi, Md.

Just call your Jaguar dealer and ask what fuel his book recommends for that cat. If you haven't altered the compression ratio, it should do fine on regular. I don't believe higher octane gas would damage the engine, but I doubt it would perform any better—assuming it was put back together with stock specs.

"I bought a new set of ultrapremium tires for my '62 Buick Electra and then drove carefully for a couple of days to be sure they were seated on the rims. Then I took the car to the Buick agency to have the wheels balanced. The mechanic there said that two of the three tires were too badly out-of-round to balance. Back at the tire company, they said the mechanic was wrong. They put the car on a lift, and spun the tires to prove that the variation was within tolerances, using a bubble balancer. It looked to me as though the variation between the spinning tire and a stationary object was between

Continued

New Engineering Magic:



Comfort-Stream Ventilation circulates fresh air without noise or drafts.

Better ideas make the '67s from Ford the easiest driving ever

Ford engineering goes all out with better ideas to provide total comfort for people who spend an important part of their lives in the driver's seat.

Twin-Comfort Lounge Seat is a new and better idea that's available on all LTD's. The two halves of what would normally be a bench-type seat are mounted on separate tracks so that they may be adjusted independently. When positioned together they form a single bench seat with ample room for three.



Other better ideas on the '67s from Ford: the handy, push-button release for the second seats in Ford and Fairlane wagons. Or the simple adjustment

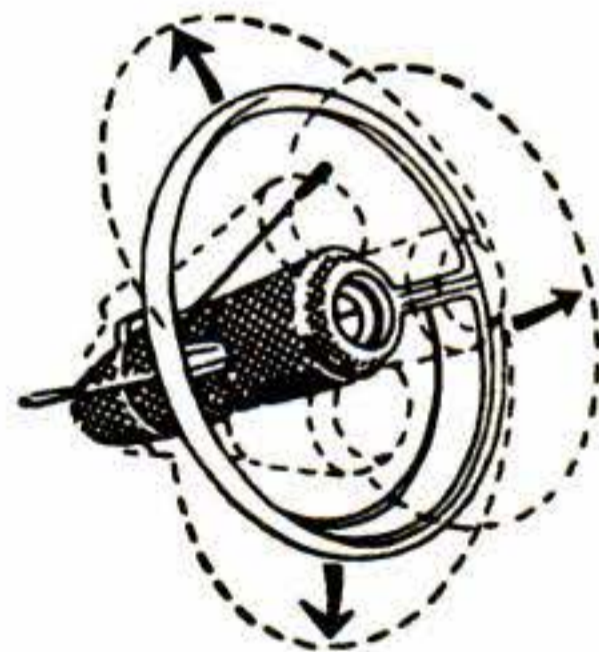
that lets you set the backs of all Ford bucket seats to their most comfortable angle.

Another better idea . . . Fingertip Speed Control (optional on Ford, Mustang and Thunderbird). Controls are located within easy reach. The driver's hands stay close to the wheel, and his eyes need never leave the road. The automatic control (a governor and vacuum bellows) keeps the car steady at any speed you set between 25 and 80 mph, yet disengages instantly at a touch of the brake or control button.

Comfort-Stream Ventilation (standard on Ford LTD and Thunderbird—optional on any other Ford) is a better idea that increases the comfort of every occupant of the car. Fresh air enters through the grille on the cowl, flows into the passenger compartment through control outlets on the instrument panel.

Incoming fresh air circulates through the entire car, then forces stale air out through special exhaust vents.

Take the new Tilt-Away steering wheel (standard on Thunderbird, optional on Mustang). It has a universal joint near the top of the steering column. This permits the driver to adjust the wheel through 9 different positions by simply touching a lever. The same universal joint allows the column to swing to the right automatically—to ease exit or entry.



For a closer look at all the many better ideas from Ford, drop in at your Ford Dealer's and see for yourself how easy driving can be in a '67 from Ford.

You're ahead in a Ford

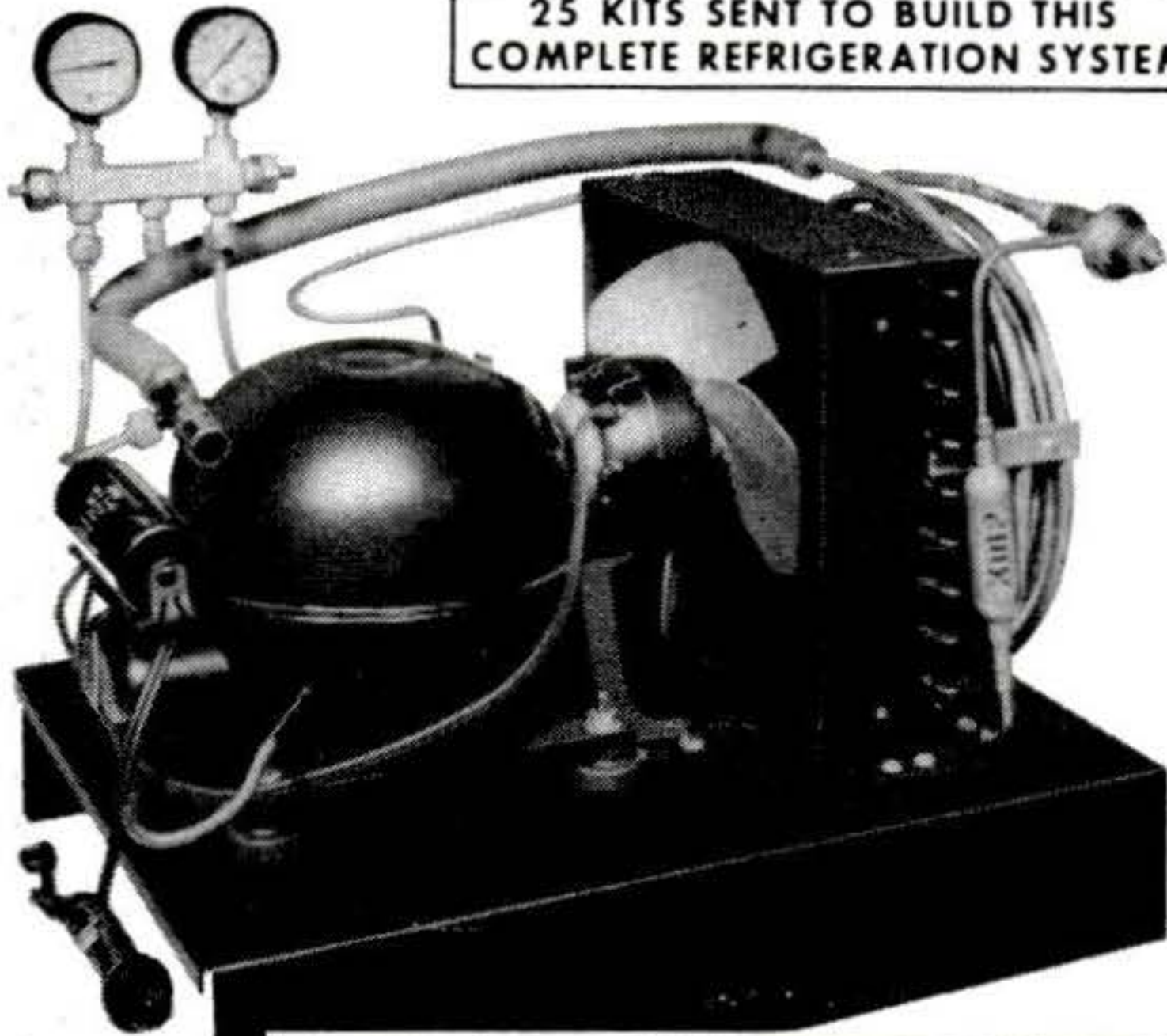
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"Say, Smokey—"
[Continued]

1/16 and 1/8 inch. What is the permissible tolerance? Under what circumstances should a tire be trued by cutting?"

R. H., Montclair, Calif.

This is a giant problem that the tire manufacturers tend to ignore, though some of it lies with the wheel manufacturers. You have a ready fix. Take the car to a shop with a Kem True tire-truing machine. After truing and balancing, you'll get a smooth ride until you have to demount the tires. Then the game starts again. Under no circumstances should a tire be trued by cutting.

"Our '64 Chevrolet station wagon, with 250-hp. engine and power steering, handles well around town. But on the freeway at speeds over 55, it drifts on curves and will not track. At high speeds it is actually difficult to drive. Help!"

R. L. CAIRNS, Sunnyvale, Calif.

Here is a group of possible causes: looseness in the suspension or steering and/or incorrect alignment, a rear-axle assembly that is not straight and in line with the chassis, and/or bad rear suspension bushings. Wheels should be straight and mounted with late-type, low-profile heavy-duty premium tires, at the recommended pressures. For additional insurance, install a set of heavy-duty shocks. Put on the heaviest sway bar that will fit your model.

"The heat-control valve in my 1965 Pontiac wants to rattle. In this mild climate I wired it open for a few days. Nothing felt different. What does this valve do?"

JOSEPH AVILLA, San Jose, Calif.

The valve is to give you a faster warm-up. It increases the intake-manifold temperature in the carburetor area. It won't hurt to leave it wired open in hot weather, but there is a better way. Get it adjusted, with the correct spring tension on it, and then you can be safe against sludge, varnish, and acids when you fire up a cold engine in cool weather.

"My '66 Dodge Dart developed a squeaky left-front brake at 6,000 miles when I rotated the tires. A friend says there must be grease on the brake lining and it will wear away soon."

BILL CHILD, Davis, Calif.

Brake squeals usually mean contaminated linings or poor fit. Get the drums pulled and the linings examined and cleaned off if necessary. Check the fit of the lining to drum, and drum to the hub. Be sure the drum finish is smooth.

"My 1956 Cadillac Eldorado keeps breaking heads. I have replaced three, and now it has

Continued

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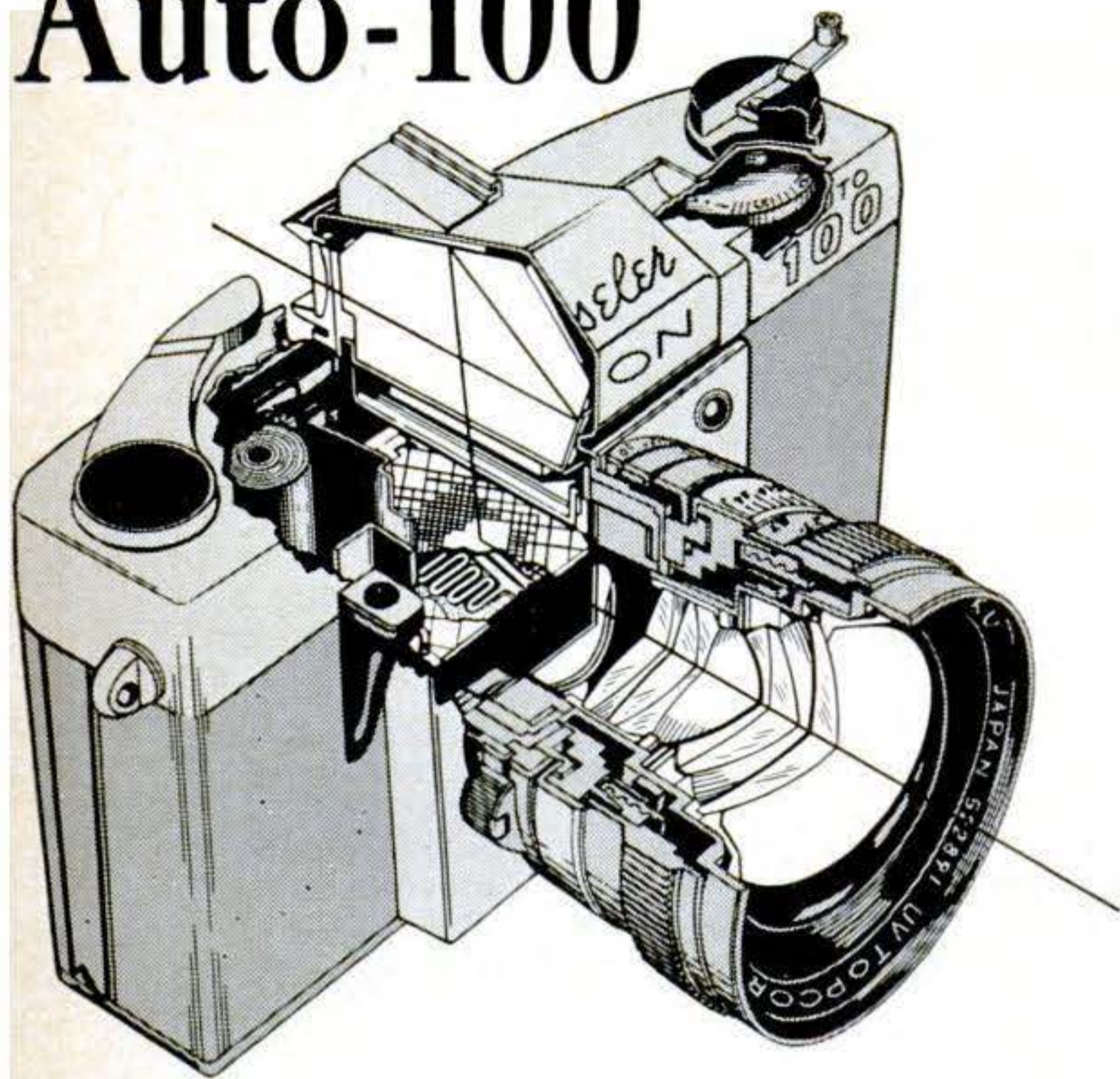
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"Say, Smokey—"

[Continued]

broken another. I have checked everything anyone has suggested. I know I'm using the right cylinder head for this model. Got any new checks?"

CARL T. MILLER, Tigard, Ore.

Are the heads running full of coolant? Everything has to be clean and offer an unobstructed flow to the coolant. Look for air pockets and check the gaskets, hoses, thermostat, radiator, and pressure cap. There are other causes of cracked heads, of course—running on too lean a carburetor, timing too advanced, and a restricted exhaust system.

"My '66 GTO with four-speed manual transmission chatters in third gear. The first trip back to the dealer resulted in a replaced bearing, the second in an adjustment of the linkage. He now passes off the continued chatter as the 'nature of the beast.'"

IDEN A. REDMOND, Daisy, Tenn.

It is not the "nature of the beast" to have a noise in that transmission. Don't rule out that it could be clutch trouble or faulty engine mounts. If they check out okay and the chatter continues in third gear, it is probably the third gear and its mating gear not meshing properly. The probable fix is to replace both gears.

"The trunk of my '65 Mercury two-door hard-top is always full of water from condensation. The dealer applied undercoating in the lid. It did not help. What now?"

PAUL SIROIS, Eastview, Ont.

First, check all the seals on the trunk, and make sure you have no leaks. Get in the trunk, close the lid—I'm serious—and have somebody thoroughly bathe the trunk with a garden hose above and below. If she's tight, figure out how to vent the trunk to either the inside of the car or the atmosphere—without making the vent hole a water intake.

"The timing chain and sprockets need frequent changing in my '61 Tempest Four. I understand I can buy heavy-duty replacements. Would you recommend the change?"

PAUL NIELSON, Little Neck, N.Y.

Yes. Be sure to get the latest replacement parts—you'll go a lot longer between changes.

Got a question on autos? Send it to:

"Say Smokey—" POPULAR SCIENCE

355 Lexington Ave., New York, N.Y. 10017.

Not every question may be used. Questions cannot be answered by individual letters.

Science Newsfront

Last-minute news and notes to keep you up-to-date

By W. STEVENSON BACON

What makes engine oil "good"?

Trace impurities—measurable only by using an atomic reactor to make them radioactive—are what make one engine oil better than another, say engineers at Pennsylvania State University. Trace impurities combine with additives to give oil desirable or undesirable characteristics, and appear to be even more important than the petroleum itself, according to Drs. William A. Jester and E. Erwin Klaus. Sulfur reduces the ability of mineral oils to withstand oxidation or evaporation, for example, while lubricity ("slipperiness") is related to bromine content.

Should you be overweight?

If you weigh too much, here's reassuring news: Some people are born to be plump, if not obese, and should stay that way. This revolutionary idea comes from Dr. C. Wesley Dupertuis and his wife and colleague, Helen S. Dupertuis, of Western Reserve University, who have for 30 years gathered data on body types in relation to fitness and disease. Reducing is good for people with basically slender, small-boned frames, but heavier types, known as endomorphs, require more food for their larger intestines and stomachs. The two scientists observe that many people attempt to attain a mythical ideal, though for some, obesity is natural. Reducing makes them nervous, tense.

Coal-dust explosions power pump

A pump that works like an internal-combustion engine except that it needs no piston and uses coal dust for fuel has been developed by the Bureau of Mines. The pump has three chambers: one in which coal dust is mixed with air, a second in which the mixture is ignited, and a third containing water. Each explosion generates gases that expand into the third chamber and displace the water, creating a pumping action. Valves open to permit more fuel to enter, while valves in the pump chamber release exhaust and let in more water.

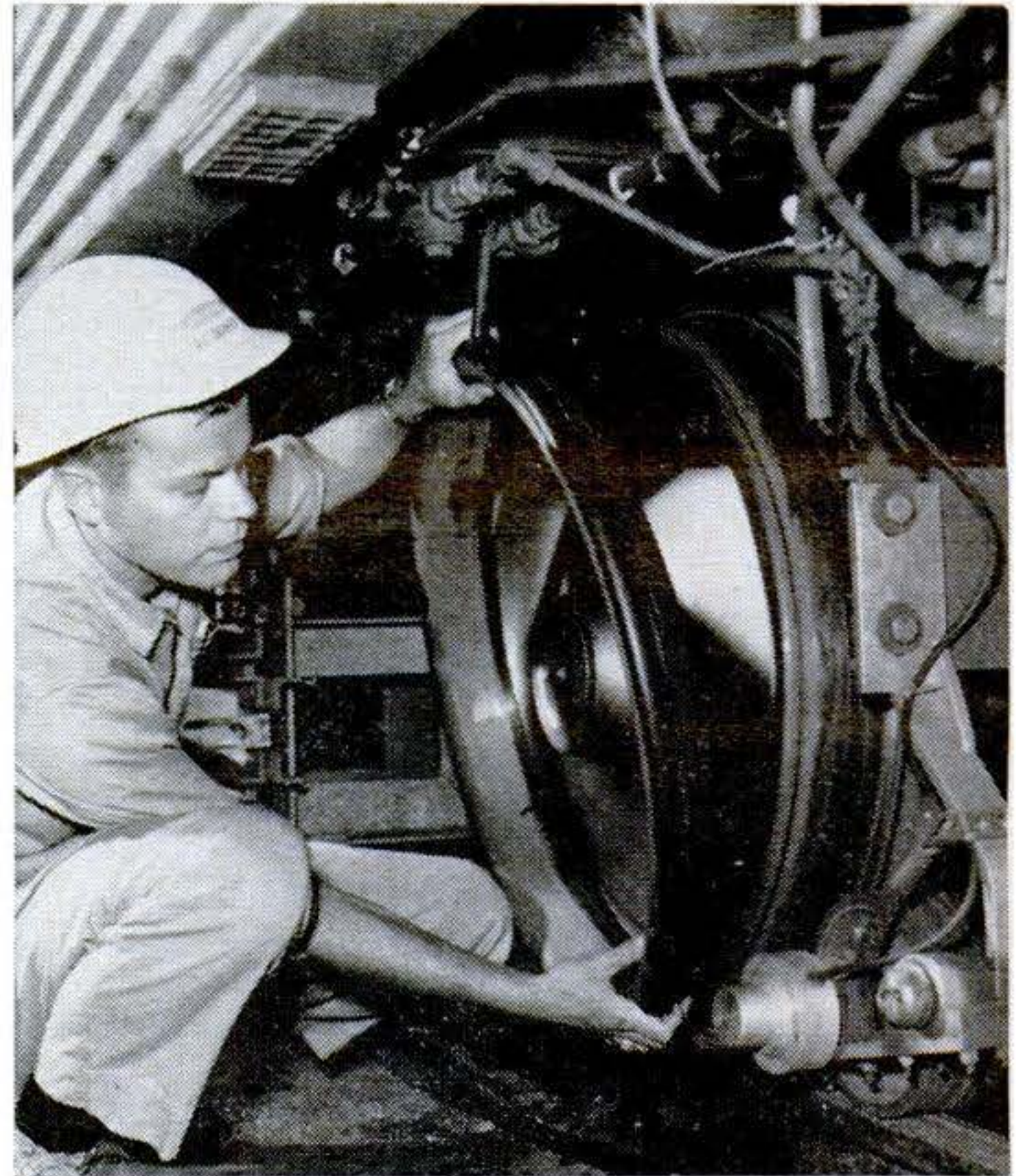
Gravity-free points may aid moon flights

There are five gravity-free "escape points" in outer space where a spaceship would be able to stop motionless with respect to the earth-moon system. Such stopping places, where the gravitational attraction of the moon exactly balances that of earth, could make it possible

for ships to land on any part of the moon, not just near its equator, as planned for Apollo. According to Dr. Leo Steg of General Electric, the gravity-free point between earth and moon provides Apollo teams with an alternate flight plan. The main spacecraft could stop at that gravity-free point, and the astronauts proceed the remaining 35,000 miles in their lunar lander. Subsequent takeoff from the moon and rendezvous with the Apollo would not be as critical as meeting it in orbit, Steg believes.

A promise of noiseless cars, homes

A unique new plastic that literally soaks up unwanted sounds may make cars, trains, planes, and your home as quiet as a sound studio. Called "Deadbeat," the material is technically a polymer-based elastomeric damping material developed by B. F. Goodrich. So effective is it, that a ring of Deadbeat bonded to



the wheel of a transit car (see photo) reduces noise inside and out, and is said to virtually eliminate the squeal of wheels on rail curves.

Radio waves may affect you

Does UHF radiation from TV and radar transmitters affect your nervous system? It's

Continued

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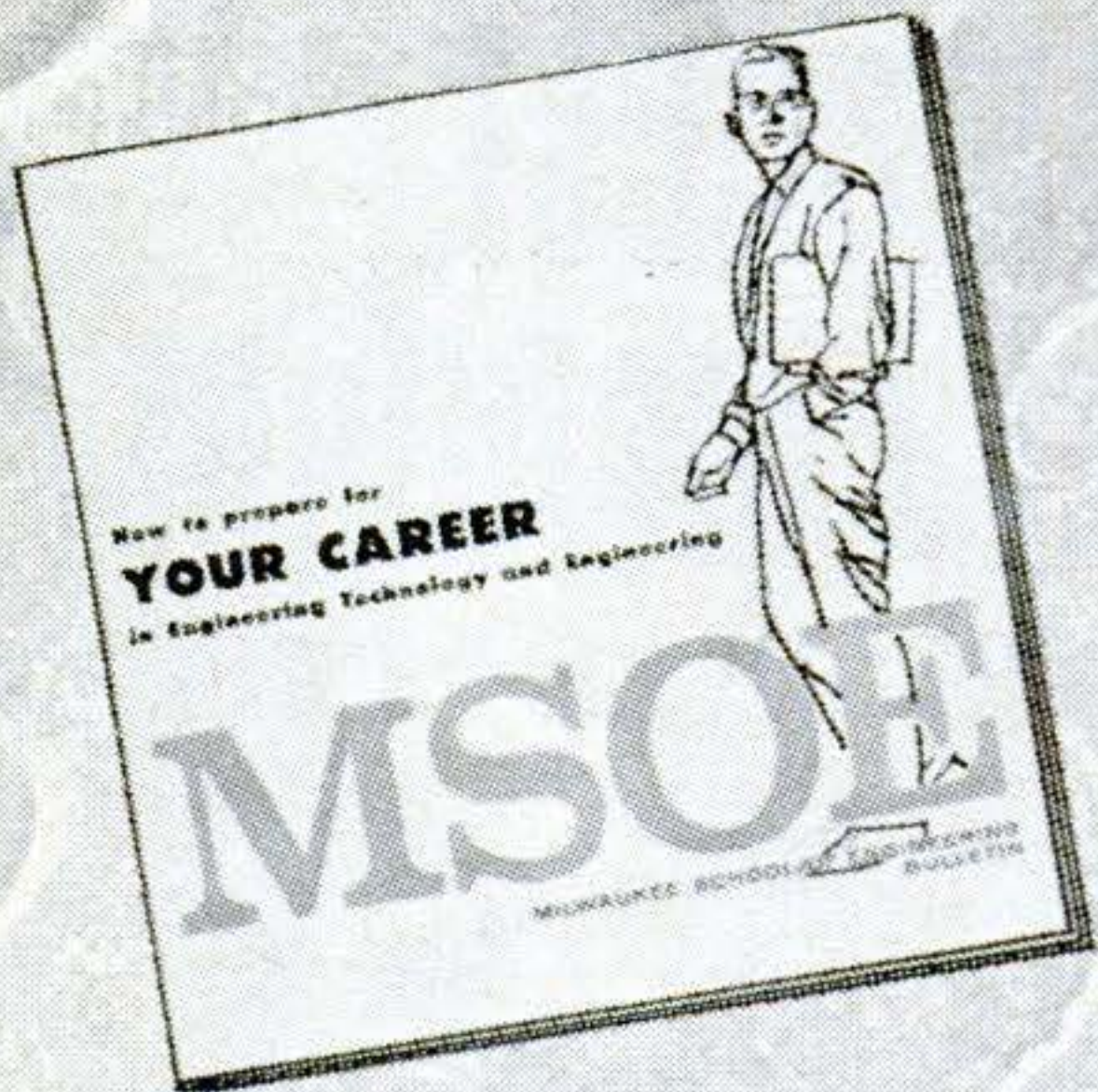
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Science Newsfront

[Continued]

possible, studies on the behavior of rats indicate. To test the theory, Dr. Susan Korbel of the University of Arkansas exposed rats to the low radiation levels a person might receive 10 or 20 miles from a transmitter at frequencies between 320 and 947 MHz for periods ranging from a few weeks to two months. Dr. Korbel reports that UHF-irradiated rats were overactive and showed more "emotionality" than control rats. The period of hyperactivity was followed by consistent long-term lethargic behavior.

Tail-light controversy continues

Long a subject for debate by automotive engineers, tail-light brightness and color again are being investigated. Among findings of Robert R. Stafford, research associate at Ohio State: Cars with amber tail lights and red stop lights confuse following drivers less than cars with conventional red-red lighting. Increasing the 5:1 legal minimum-luminance ratio (stop light five times brighter than tail light) does not improve driver performance, but reducing it does harm performance. Red lights always appear farther away than they are, blue appear closer, and green at actual distance—another argument against the current lighting system.

He feeds cows—by computer

With the use of computers growing by leaps and bounds, it seemed only natural to Tim Runner, 22-year-old data-processing and research consultant of Redlands, Calif., that he should use one to feed cows. Basically, the problem is determining for cattlemen what feeds give the most nutritious diet for the least cost. Renting time on a computer owned by Lockheed Propulsion, he gets together a nutritional breakdown of 50 feeds, checks their latest costs in the areas he services, and gets answers in minutes that would take years by ordinary methods. Runner is expanding his computer services to solve such problems as library-book usage, exchange matching of real-estate listings, matching job applicants to available jobs, and finding compatible dates for high-school students.

No fire hazard in outer space

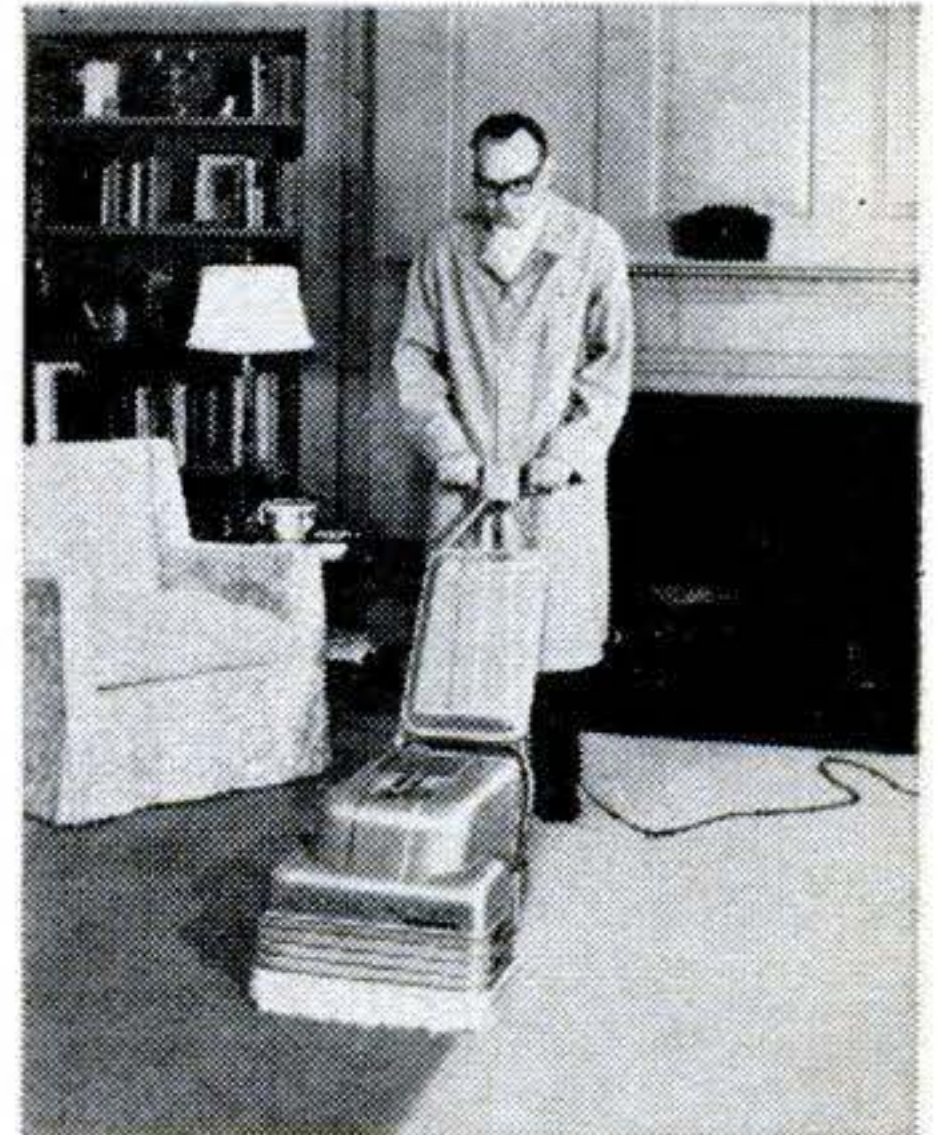
Space planners, long concerned with fire hazards in the pure-oxygen atmospheres of confined spacecraft cabins, have made a useful discovery. On earth, a fire keeps burning because the burned-up, lighter-than-air fuel rises, causing convection currents that circulate more oxygen to the flame. In the weightlessness of outer space, however, nothing is lighter than air, there are no convection currents to make more oxygen available, and the combustion products simply blanket the flame and suffo-

Continued

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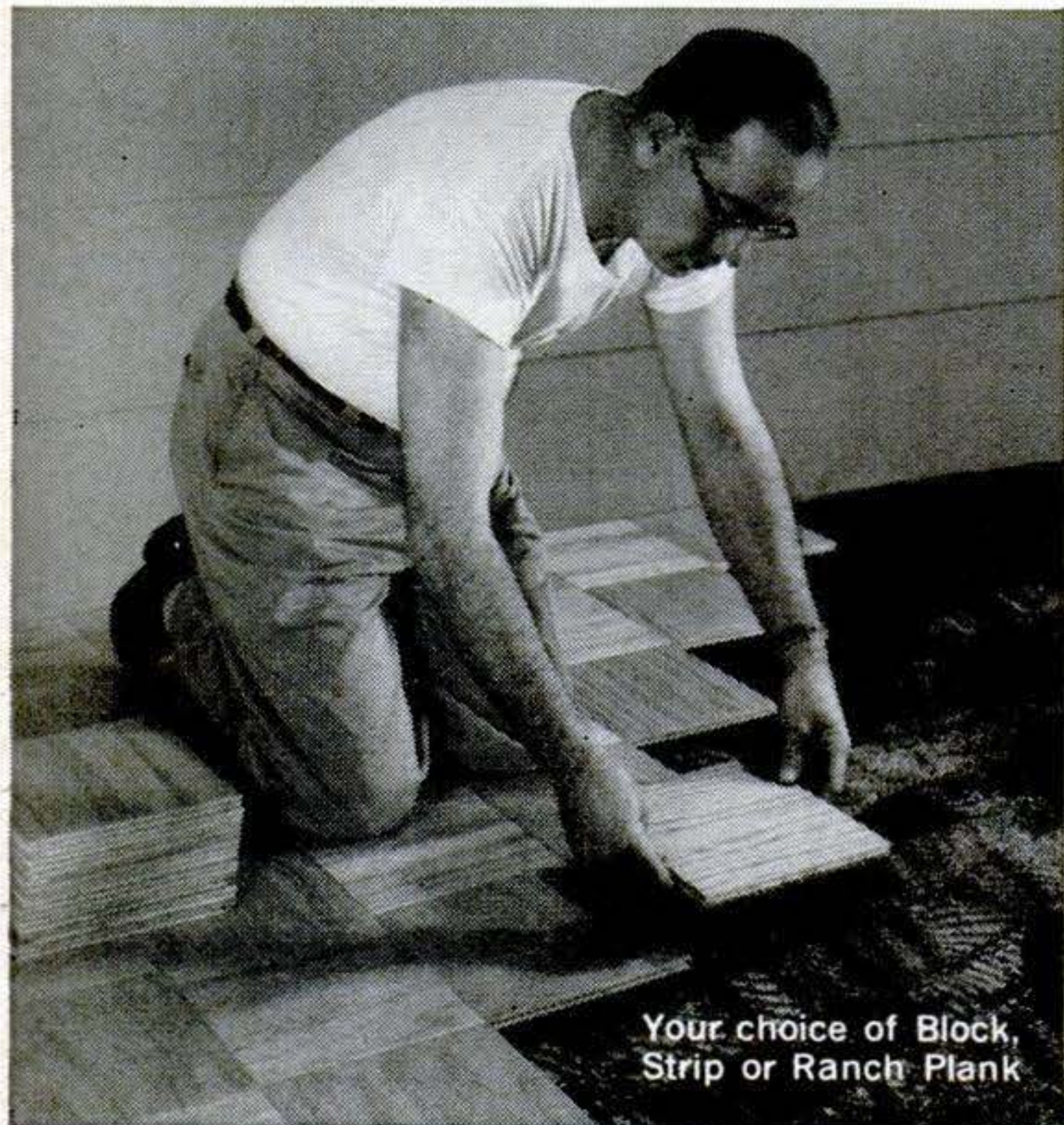
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Science Newsfront

[Continued]

cate it. A NASA team from the Houston Manned Spacecraft Center has been studying the effects of weightlessness on fire, and recommends more research into the effects of other air currents such as air movement caused by the astronauts themselves.

Air-cushion conveyor belt

A new conveyor belt floats heavy 180-pound sacks on a thin film of air at speeds of five feet or more per second using just a simple vacuum-cleaner motor for power. Industries of all types are expected to find uses for the new conveyor, which is made possible by a special air valve. Previous air conveyors have used a continuous air flow (wasting power) or have incorporated valves operated mechanically by the pressure of the goods being transported (creating friction and mechanical shock). The new valve, developed as part of the system by the Spencer division of Elliott-Automation, London, remains closed until a sack hovers over it; it then opens just long enough to let air escape and reinforce the air cushion under the load.

Army rifle targets shoot back

GIs in a research program at Aberdeen Proving Ground, Md., have a new threat to contend with: targets that shoot back at them with stinging BB pellets. The man-shaped targets incorporate gas-operated pellet guns that fire every half-second. Soldiers wear protective clothing and an instrumented hood containing electrodes to measure stress. Other equipment records target fire and the soldier's return fire. According to researchers, the greater the stress (that is, the greater the target fire), the poorer the rifleman's accuracy and rate of fire, and the longer it takes him to get off the first round. GIs may be unable to hide from the targets, but can let 'em have it—with M-14 rifles.

Booby traps used in safety study

A kitchen rigged with accident-causing booby traps provided investigators with new insights into home accidents. A project, recently conducted by Joan S. Guilford of the American Institutes of Research, Los Angeles, used a kitchen with such things as a rubber ball left on the floor, unplugged appliances set on "high," spilled coffee, protruding towel racks, scalding tap water, and items placed on shelves too high to reach. The kitchen was prearranged, Dr. Guilford reports, "to maximize accident potential as well as opportunity for accident-avoiding behavior." The 226 subjects of the experiment—who thought they were testing the kitchen layout—experienced 714 accidents (none serious). Most frequent were bumps and falls (264), followed by burns or scalds, and cuts and jabs. P 5



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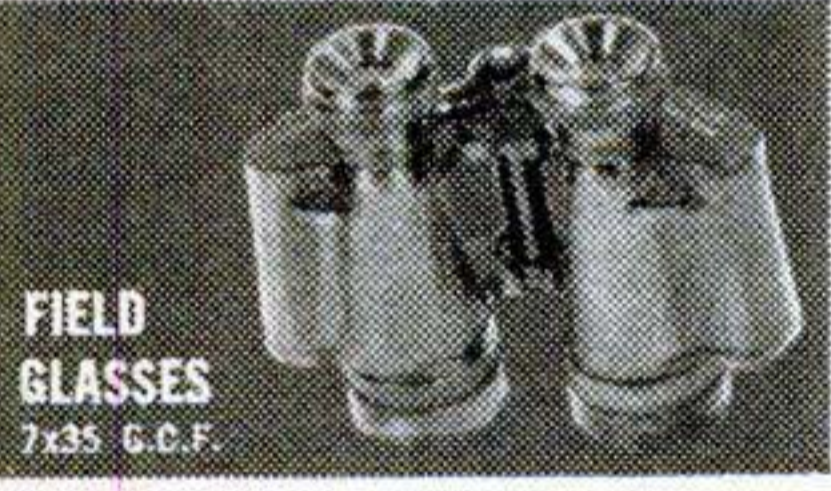
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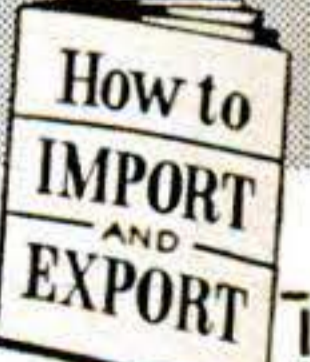
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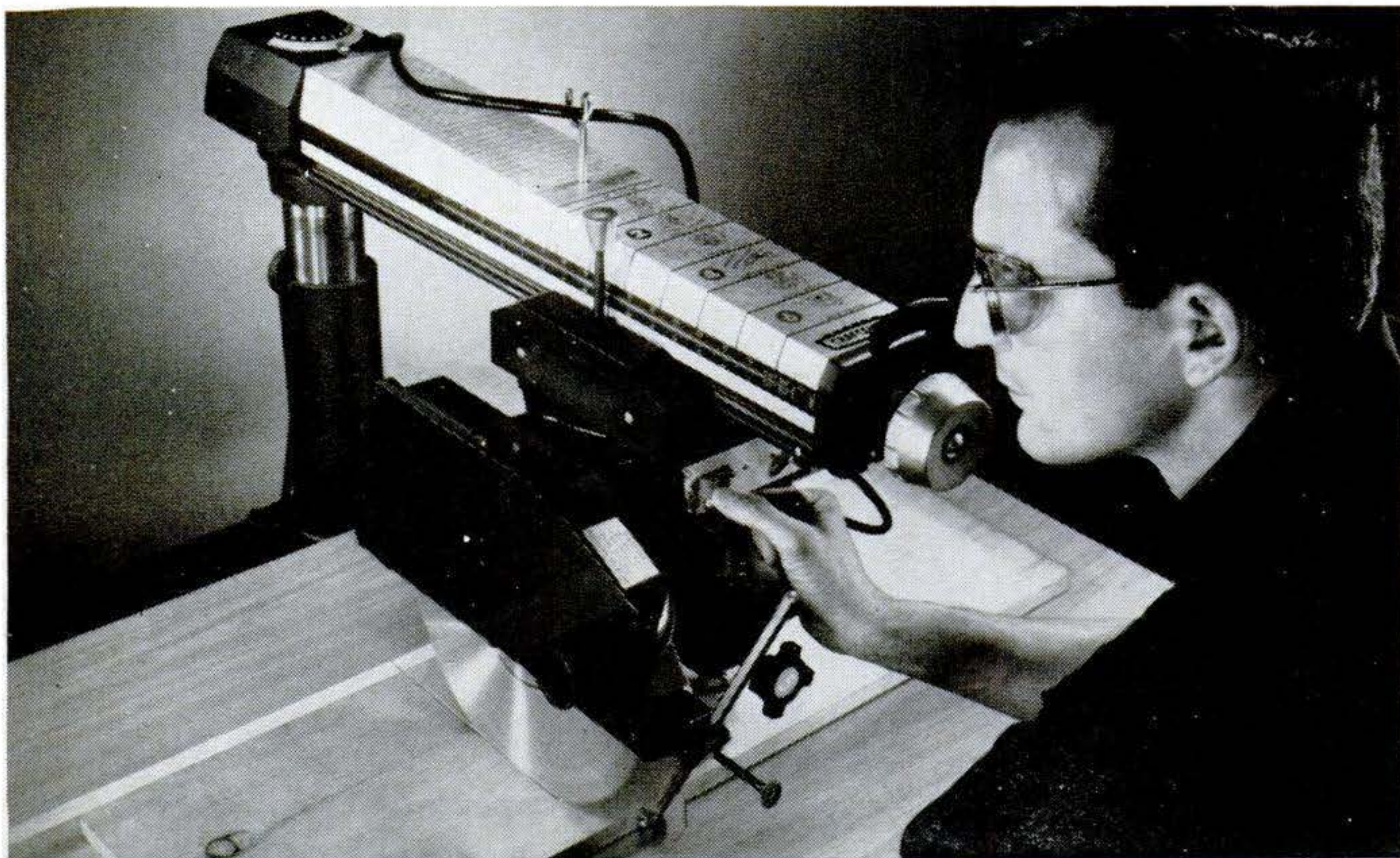
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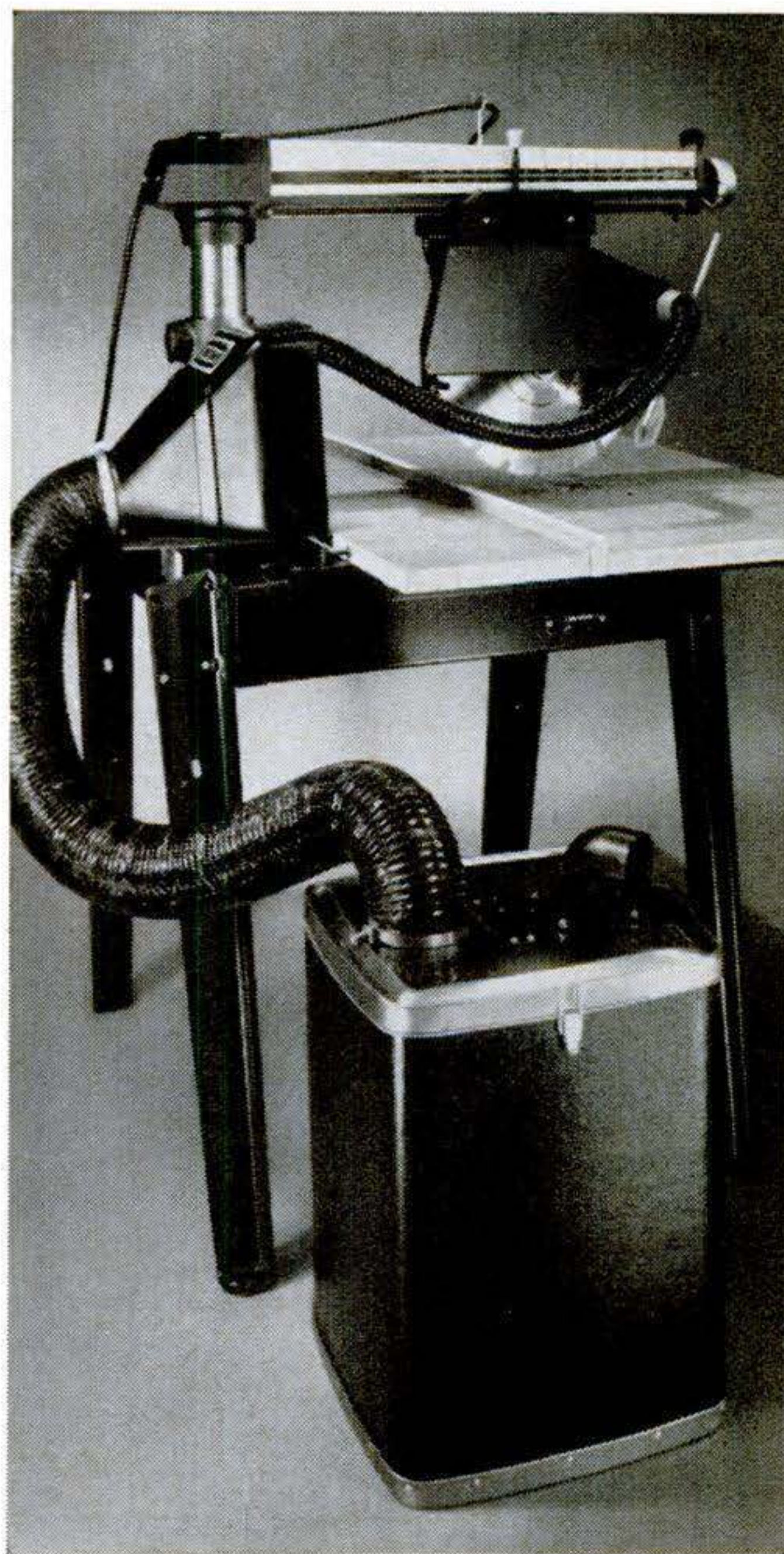
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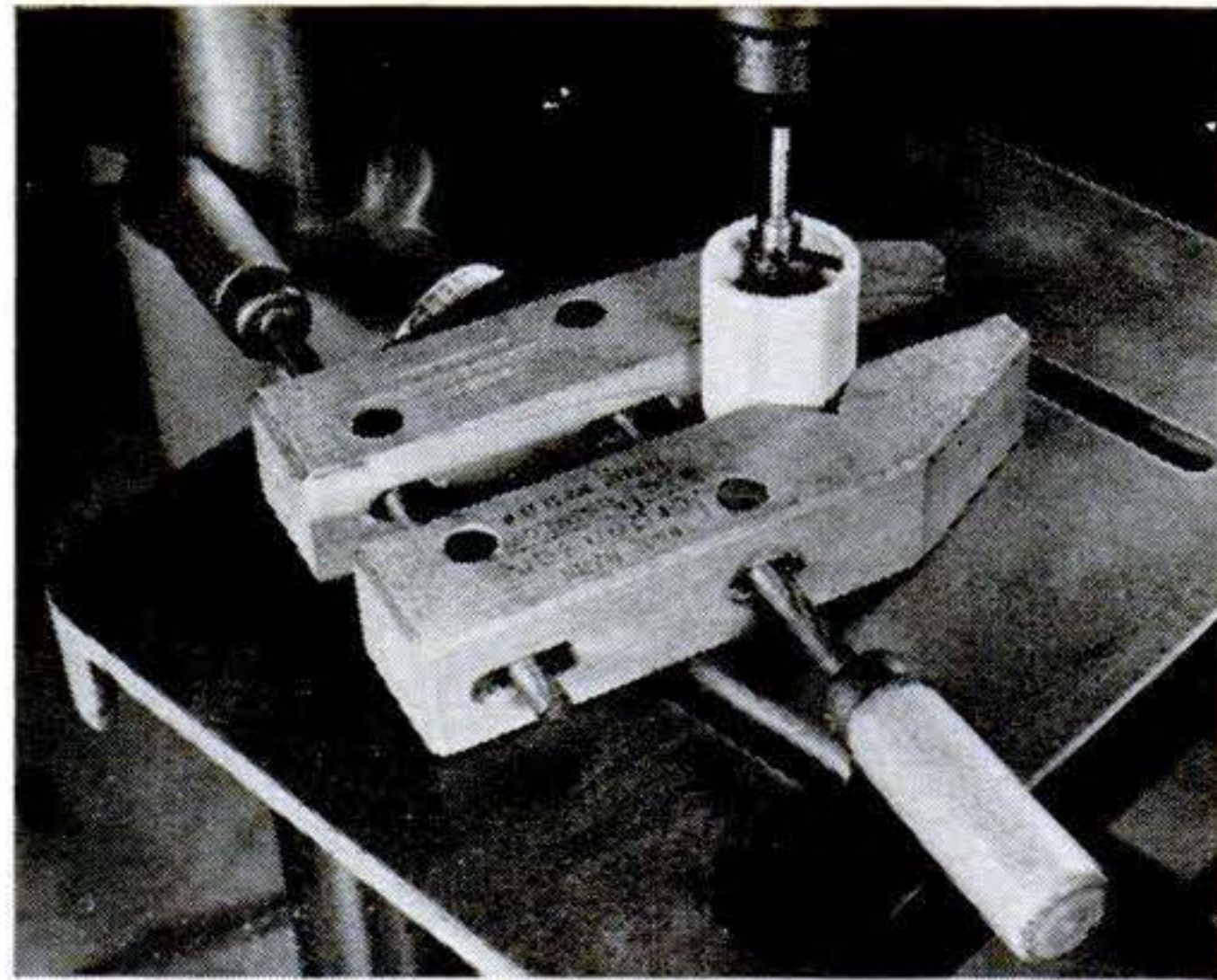
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SHORT CUTS AND TIPS

FROM PS READERS



Use a screw clamp as a V block

Cut matching vees in the inside face of the jaws on a screw clamp, as in the photo above, and you have a fine way to hold cylinders or dowels for concentric drilling. Set up as shown, one handle of the clamp can bear against the drill-press column to keep the work from twisting. You can hold the work in position with the other clamp handle.

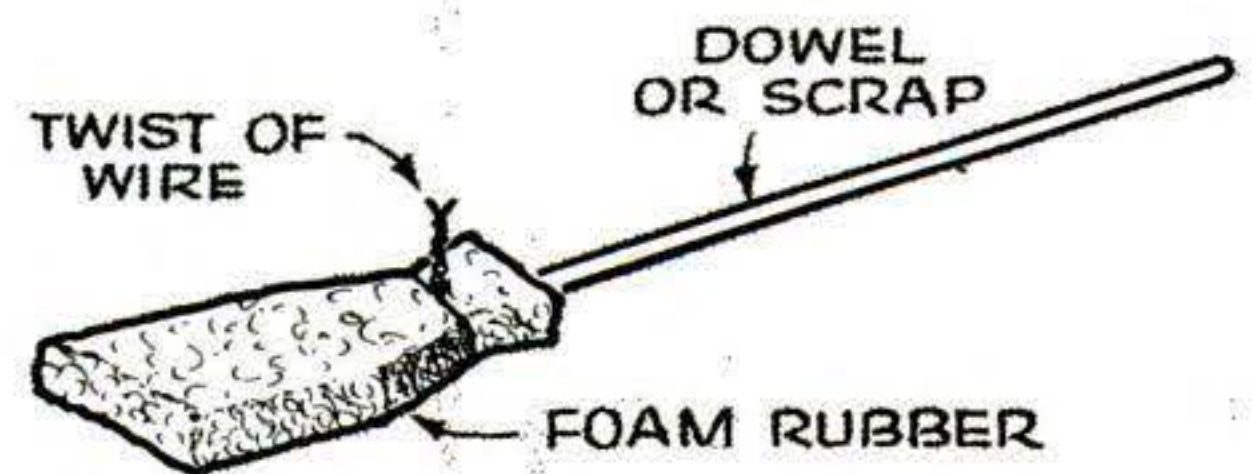
R. J. DeCRISTOFORO, Los Altos Hills, Calif.

Sealer protects lettering on rule

While I was working as a maintenance carpenter some time ago, my buddy remarked as I withdrew my rule from its pocket: "I see you have been issued a new rule."

On the contrary, my rule was as old or older than his. I had put a heavy coat of clear sealer on the areas that rub against the pocket. My ruler actually looked new. You could barely read his.

HENRY GEISEL, Leighton, Pa.



Throwaway touch-up paintbrush

You can make handy disposable brushes for touch-up painting from small pieces of foam rubber. Cut the pieces to a brush shape as shown in the drawing above. Tie the rubber to a dowel or any scrap stick of wood with a piece of wire.

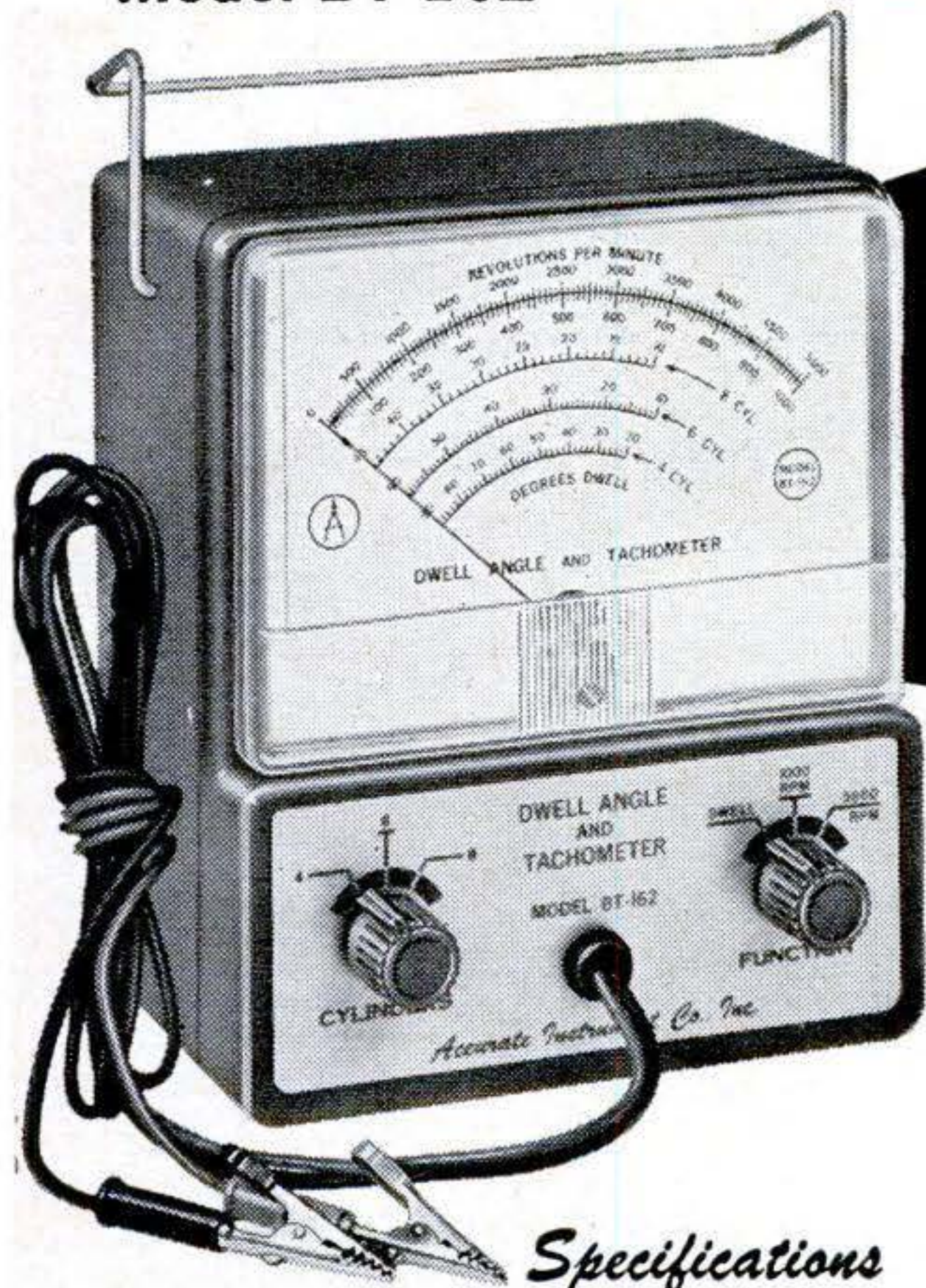
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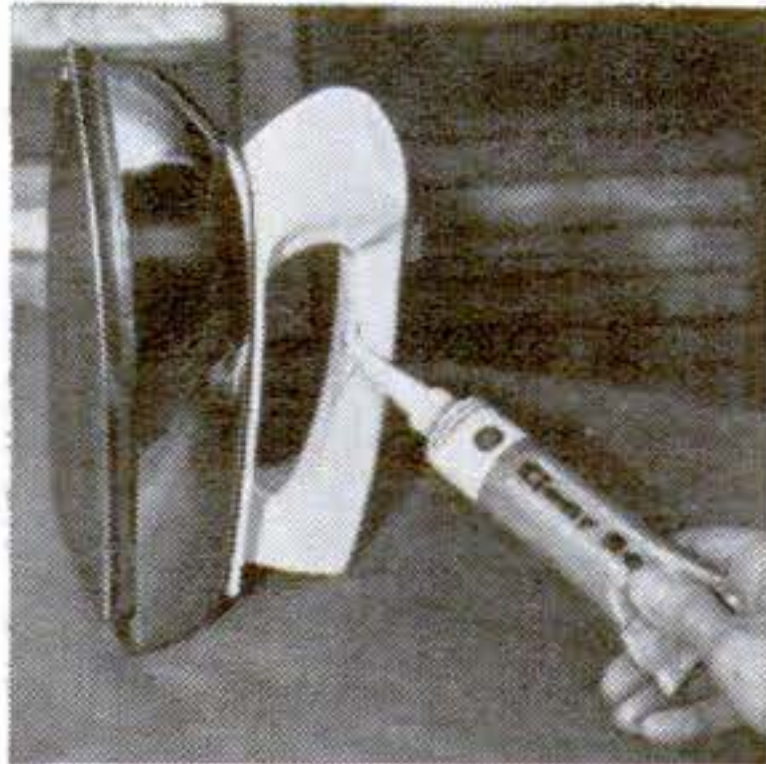


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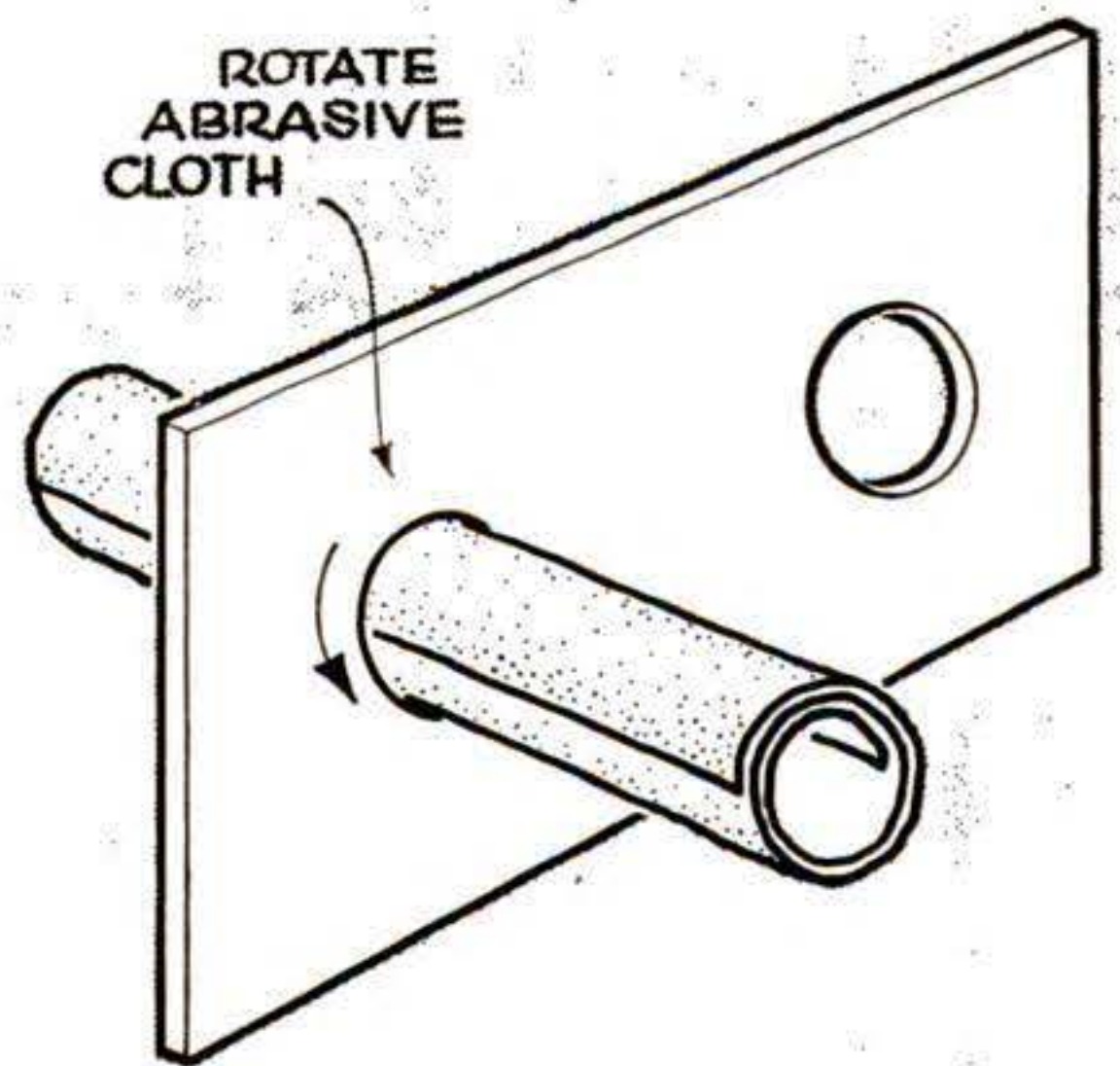
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HAROLD T. BODKIN, Wyandotte, Mich.



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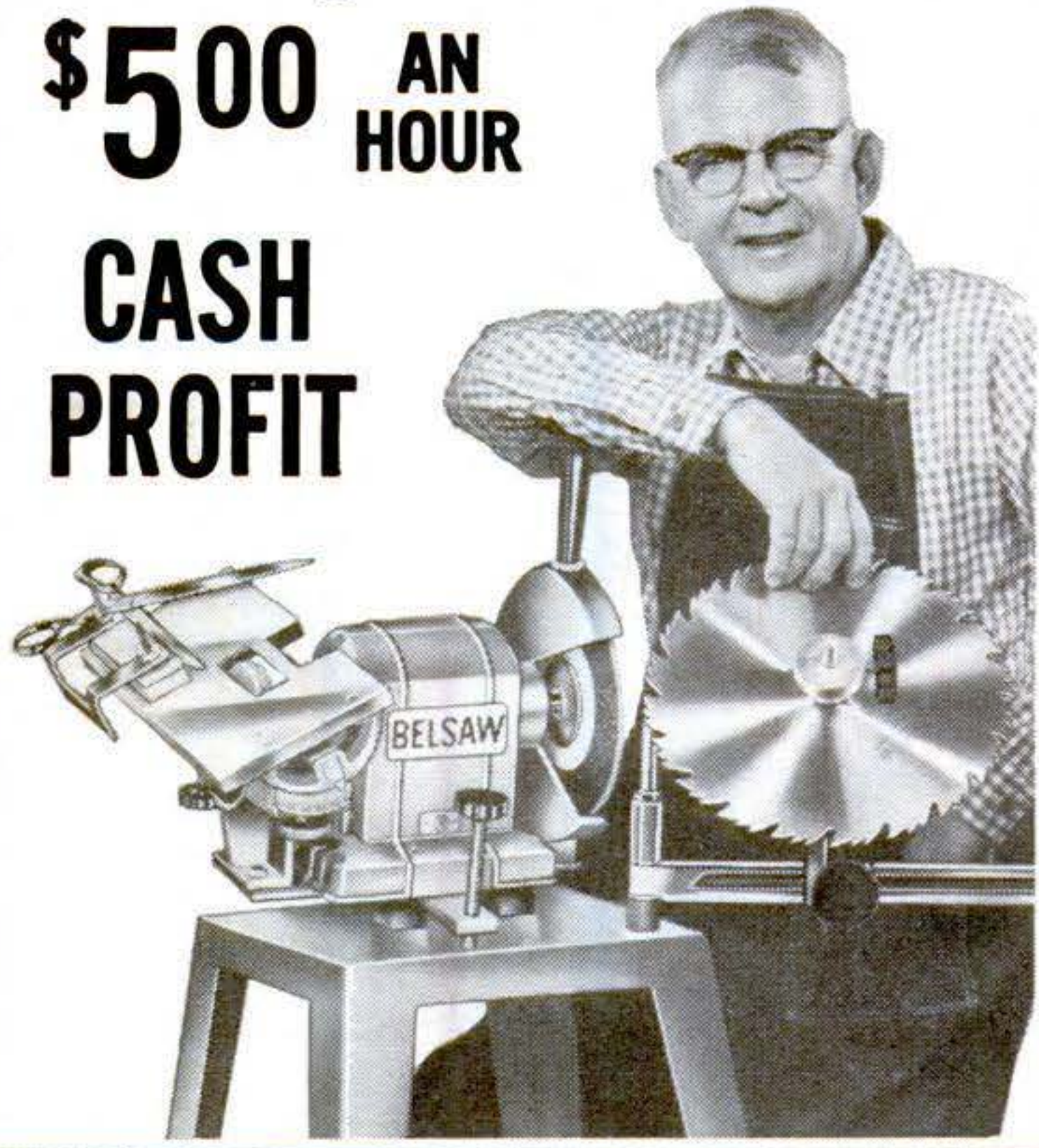
Holes in metal or other materials may be smoothed or enlarged with abrasive cloth as shown. Roll a short length of the cloth into a cylinder and insert it in the hole. Then rotate it in a direction opposite to that in which it is rolled, to make the layers of cloth expand and exert grinding pressure against the edges or walls of the hole. From time to time, move the cylinder lengthwise to bring fresh abrasive to the work.

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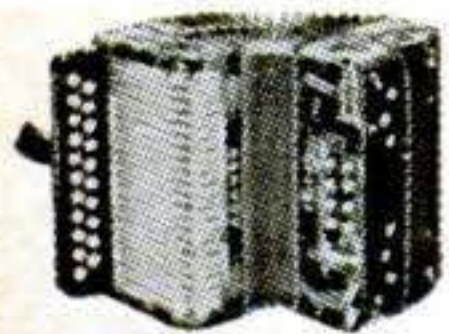
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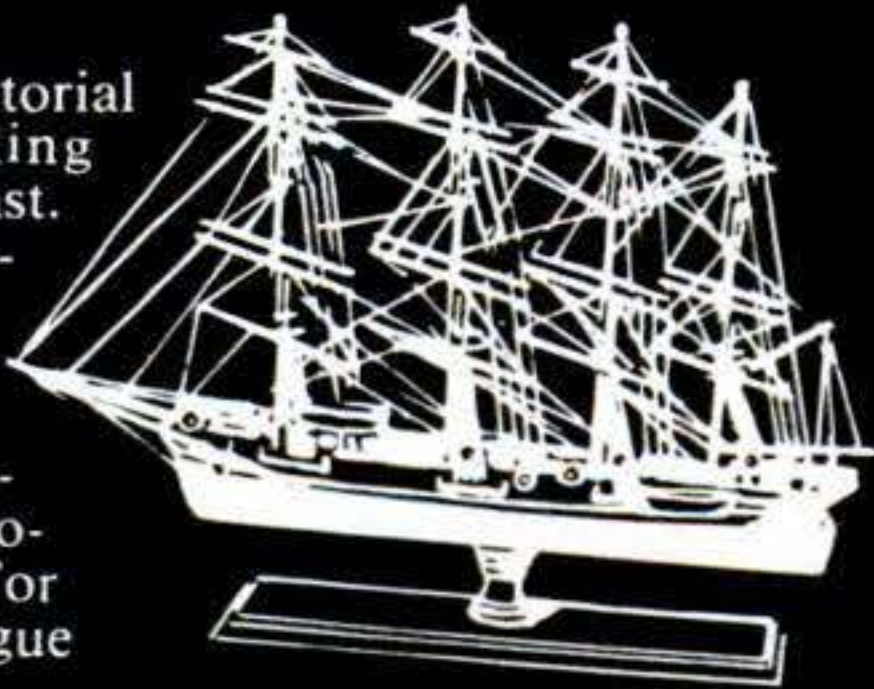
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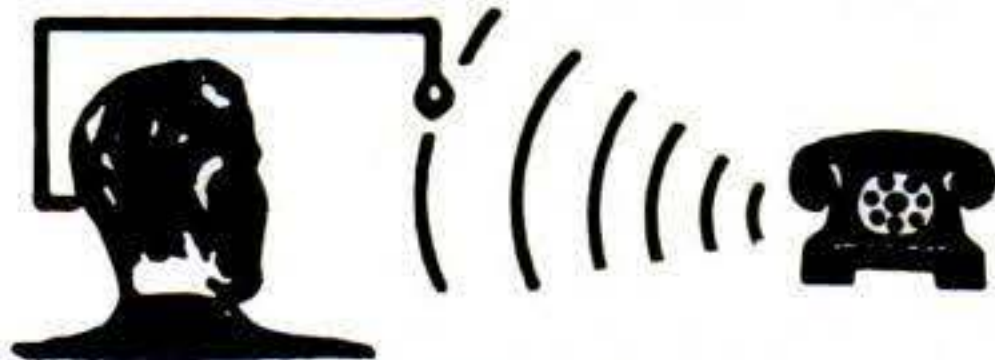


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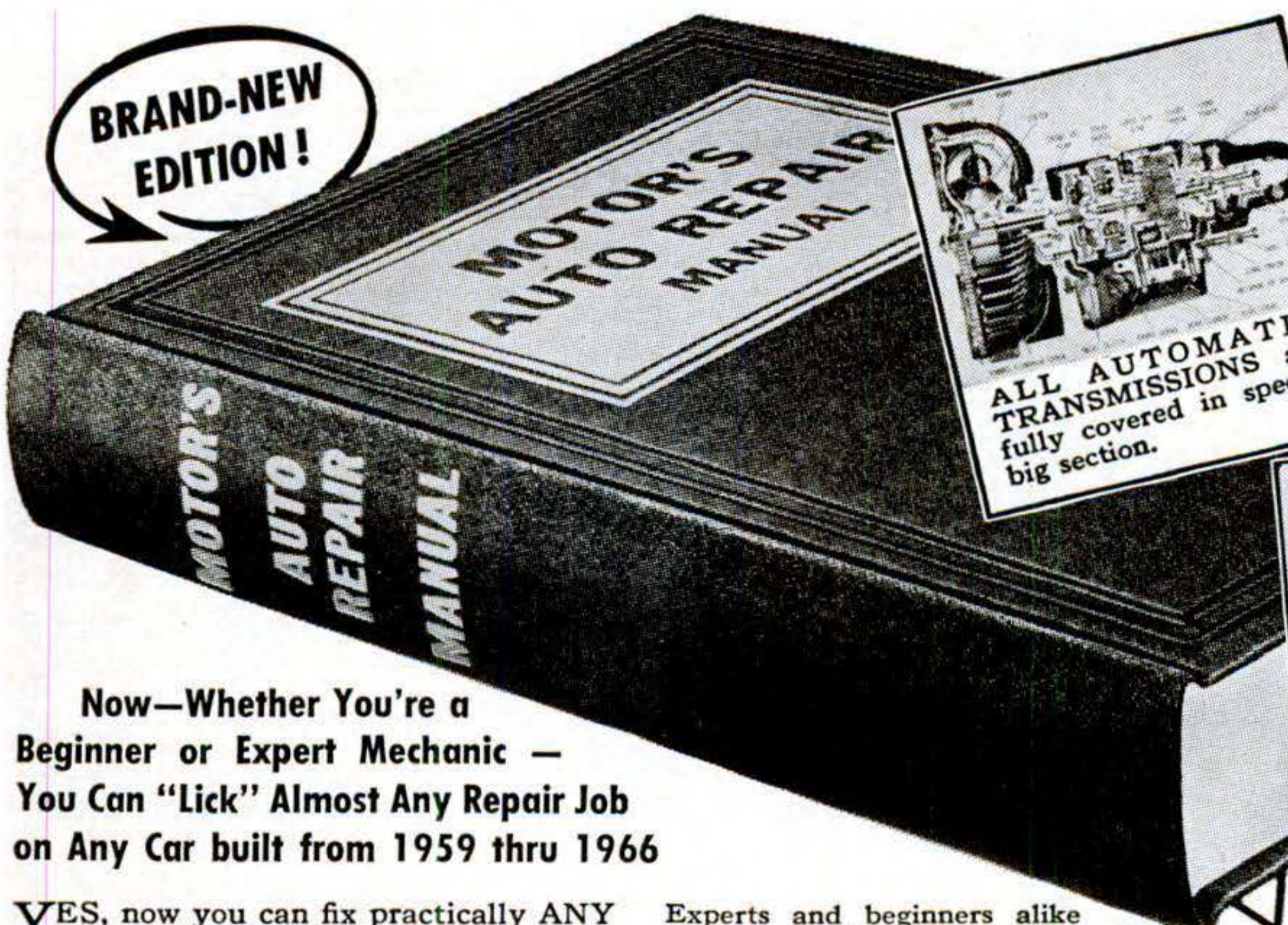
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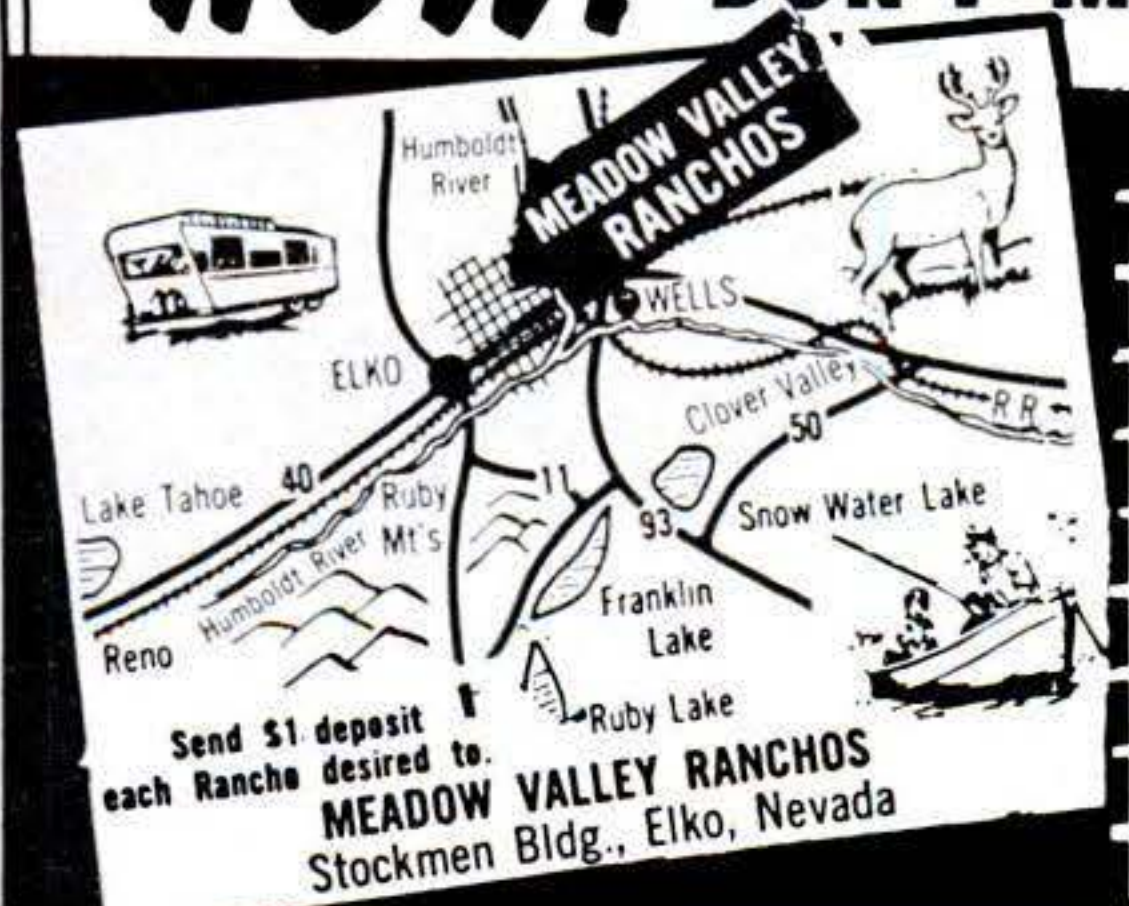
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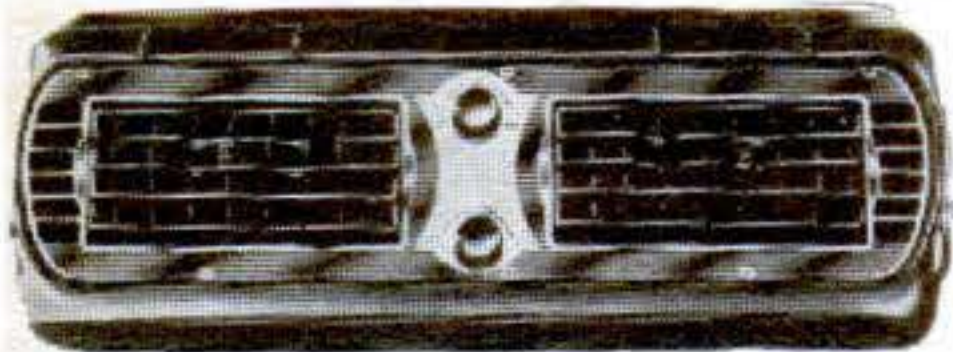
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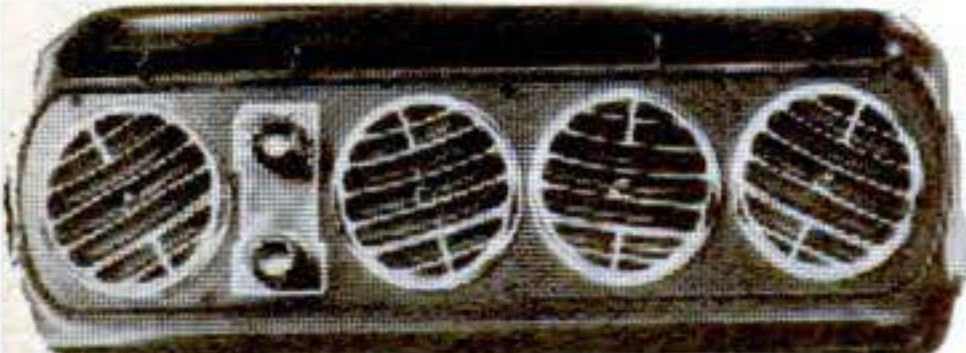
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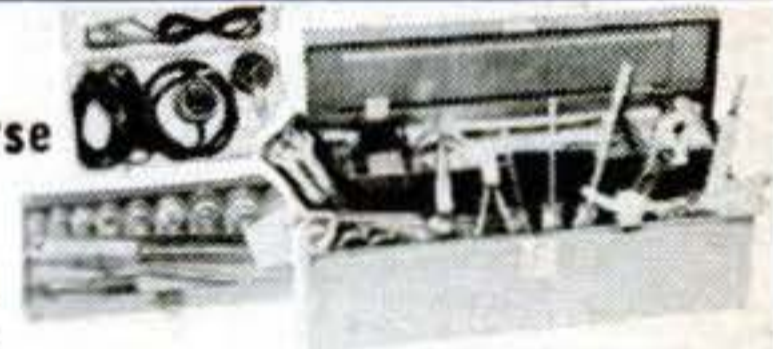
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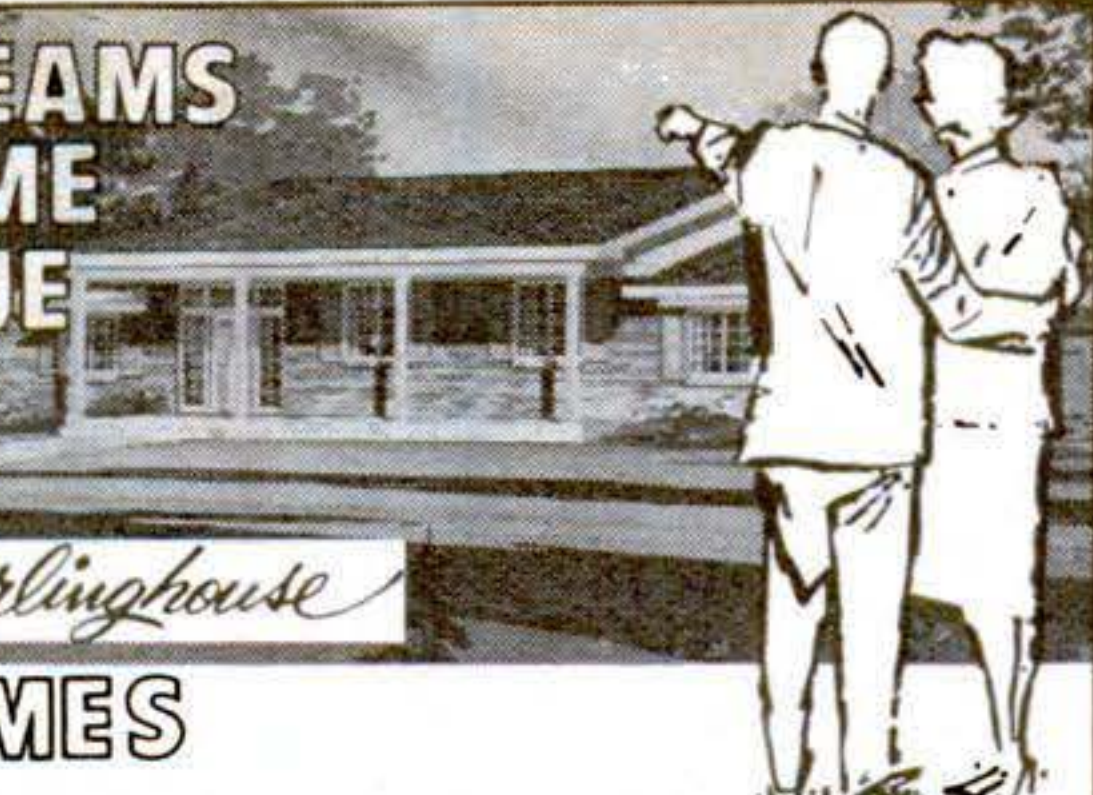
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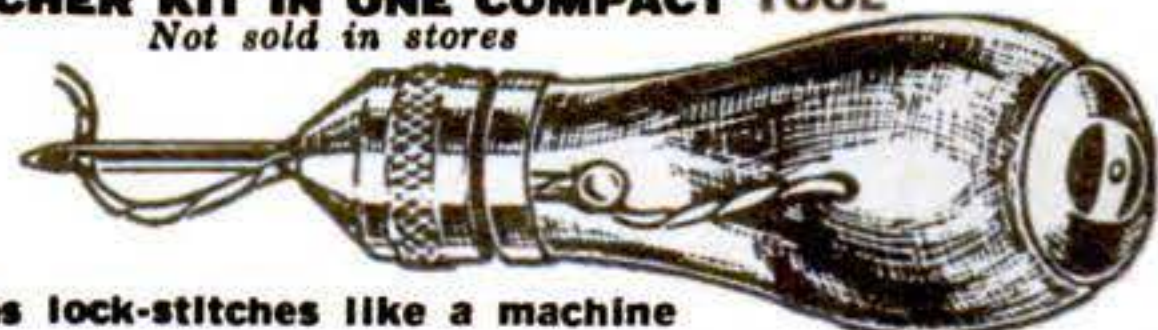
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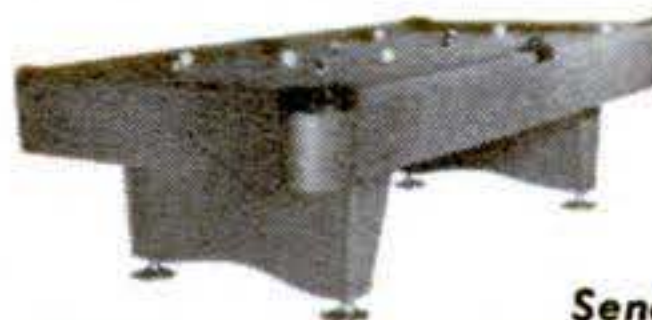
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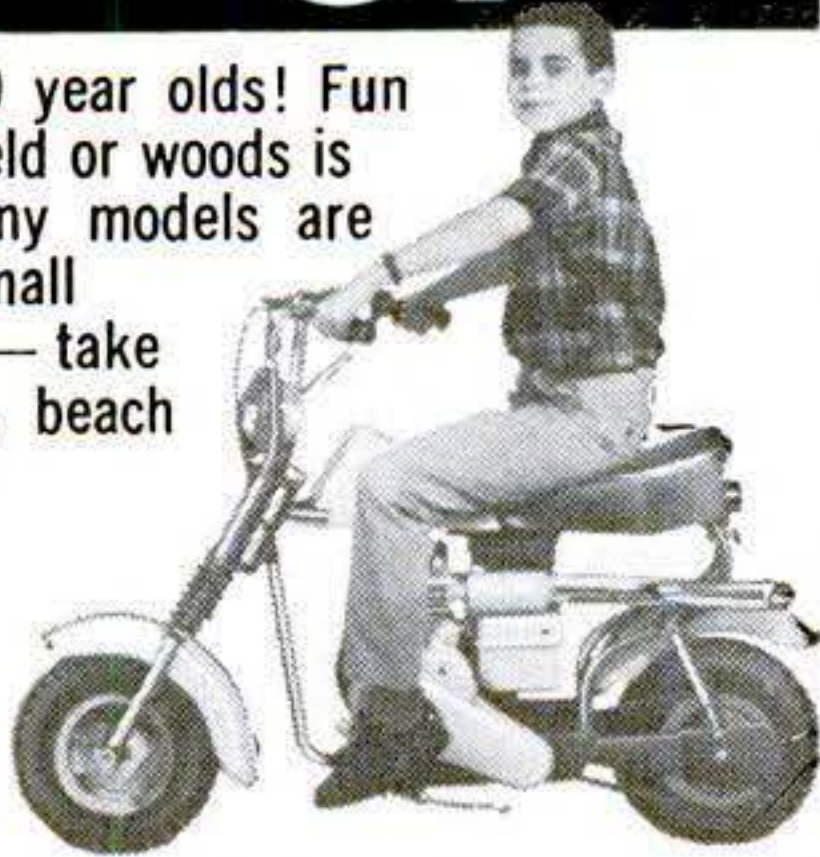
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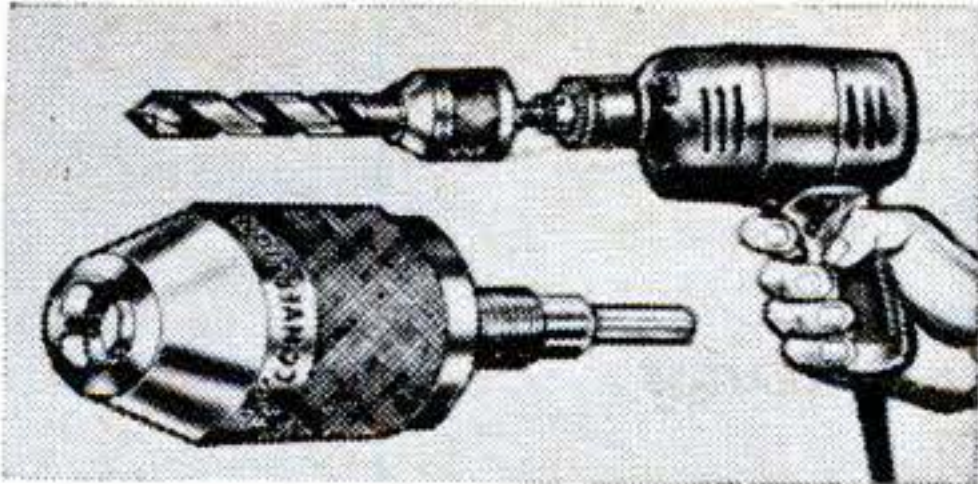
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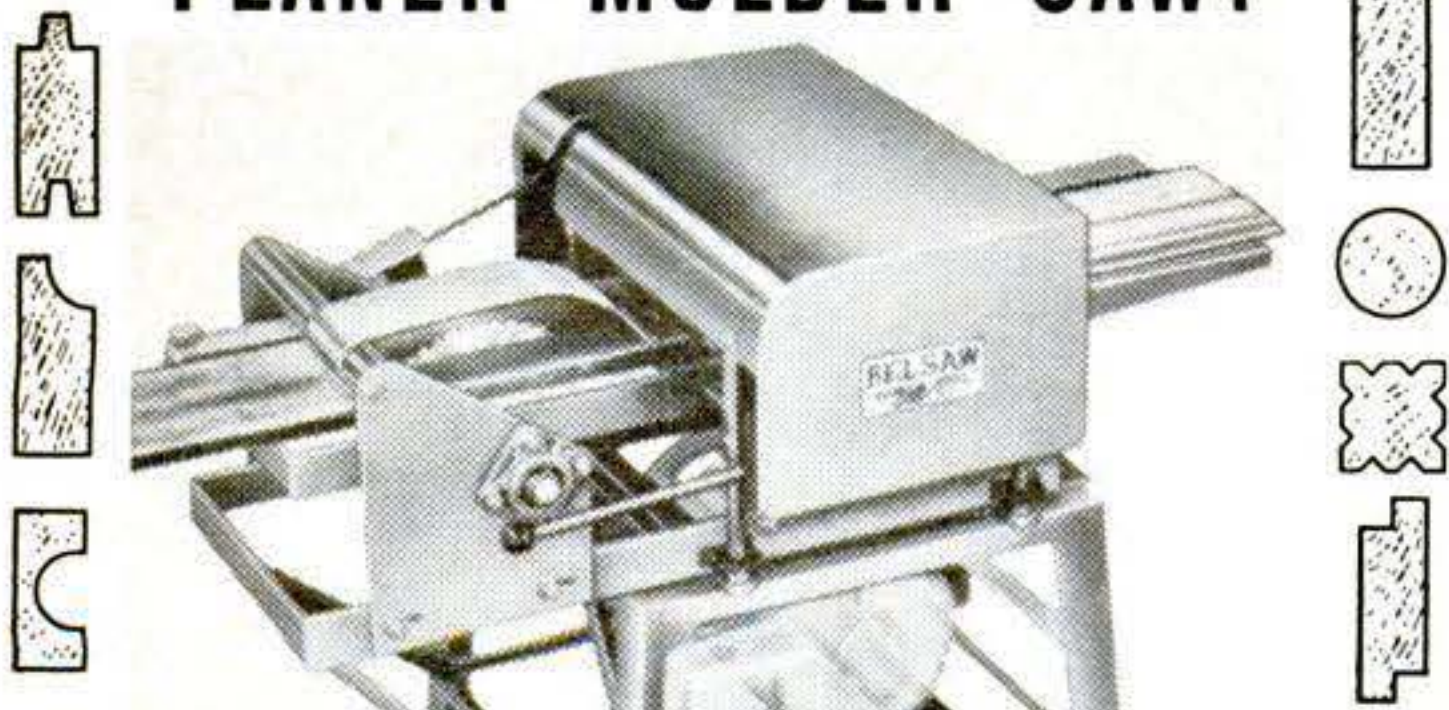


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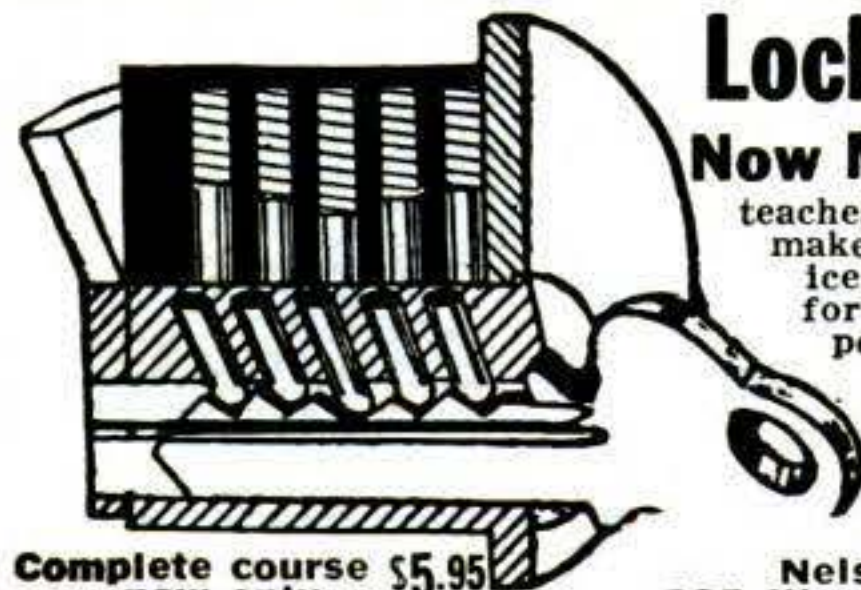
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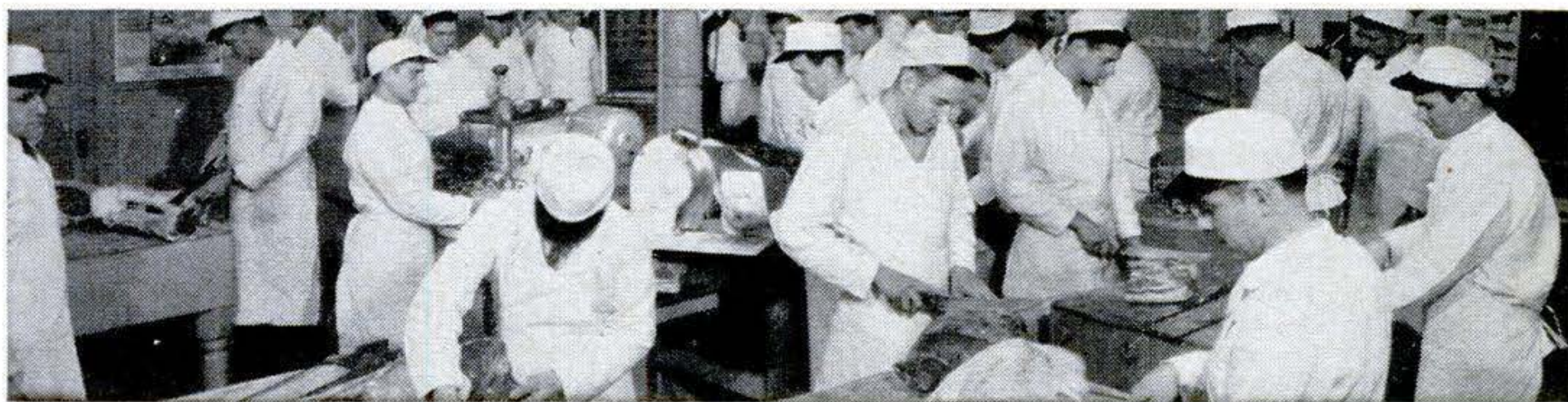


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Detroit Report . . .

FORD HAS FROZEN THE NEW '68 ENGINE DESIGNS. There will be a whole family of lightweight cast-iron V-8s to replace the Y-block 352-, 390-, 410-, 427-, 428-, and 462-cu.-in. power units. First, a 385 will replace the workhorse 390 in most Ford car lines, and a new 462 will replace Lincoln's present 462 V-8. Then, as production builds up, intermediate versions of the new engine will be offered on Thunderbird and Mercury. Special features in the new engines: better cooling, better breathing, and reduced exhaust emissions.

Pontiac's sporty Firebird, to come out late this month, bears an overwhelming resemblance to Chevrolet's Camaro. Main differences are in the power plants: Pontiac uses its OHC sixes and "small" V8s. Engine options are topped by a 400-cu.-in. V-8 that turns out 325 hp. Pontiac expects to sell 80,000 Firebirds in the first 12 months, while Mercury is shooting for 90,000 Cougars in the '67 model year.

Watch for an all-new Corvette next year. It will have a revolutionary power-train design. Like the expected 1968 Shelby Cobra, the next Corvette will have a midship-mounted engine. A special transaxle and rear suspension system are being developed for this car.

High-performance cars from American Motors can be expected now that Victor Raviolo has been brought in to head that company's automobile development. Raviolo was once chief engineer at Ford of England and is responsible for the Lotus Cortina, which has done so well in sedan racing. One of his mottoes is: "Hot cars are safer cars." He explains by saying that a car designed to perform well at ultra-high speed gives a big margin of safety when driven at slower speeds.

Chrysler Corp.'s Cleaner Air Package smog-control system may sweep the board. American Motors and Mercury switched from their complicated air-pump system in the middle of last year to the less-expensive Chrysler CAP, and Pontiac will change before the year is out. How important is this to the average car buyer? Very. All cars will have a smog-control package next year (1968 model). A price difference of \$30 in favor of CAP-equipped cars could be passed on to you.

Air conditioning keeps growing in popularity: Over 30 percent of new cars now have it, compared with two percent just 10 years ago. Experts say every other car will be built with A/C by 1970.

Plastic grilles now adorn nine of the '67 cars, and you can look for the use of plastics to grow in coming years. So far, plastic has been uncoated for the most part, but chrome-plated plastic will show up as soon as problems of deterioration can be licked.

Plastic gas tanks may be standard equipment on all Detroit cars within two years. Fiberglass gas tanks are coming next year on some GM cars, and government safety regulations may force all cars to go to improved materials for the 1969 models. Nonbursting tanks made of cellular plastic look like the answer right now.

Unit-body cars continue to lose favor in Detroit. Five cars—Lincoln, Fairlane, Comet, Falcon, and Chevy II—are in line for separate-frame-and-body construction within a year and a half. Lincoln is planning a major styling change next fall and at the same time will make the switch to a separate-frame chassis. Then Lincoln assembly lines will be able to run both T-birds and Lincolns, since T-bird switched to a separate frame for '67. Chevy II is getting a frame to make its assembly more compatible with Chevelle's. The frame will be virtually the same on both cars. And, since frames are planned for Fairlane and Comet, Ford decided to extend the design down to Falcon, making that car just as competitive as the '68 Chevy II.

Biggest breakthrough in safety could come in seats: seats that wrap around you, with solid connection to the floor, integral belts, and built-in whiplash pads. Problem here is fastening them to the floor strongly enough so they won't tear loose in an accident, while keeping them adjustable to the driver's height. Experts say a seat of this type would cushion riders on three sides, encourage belt fastening.



Detroit Editor



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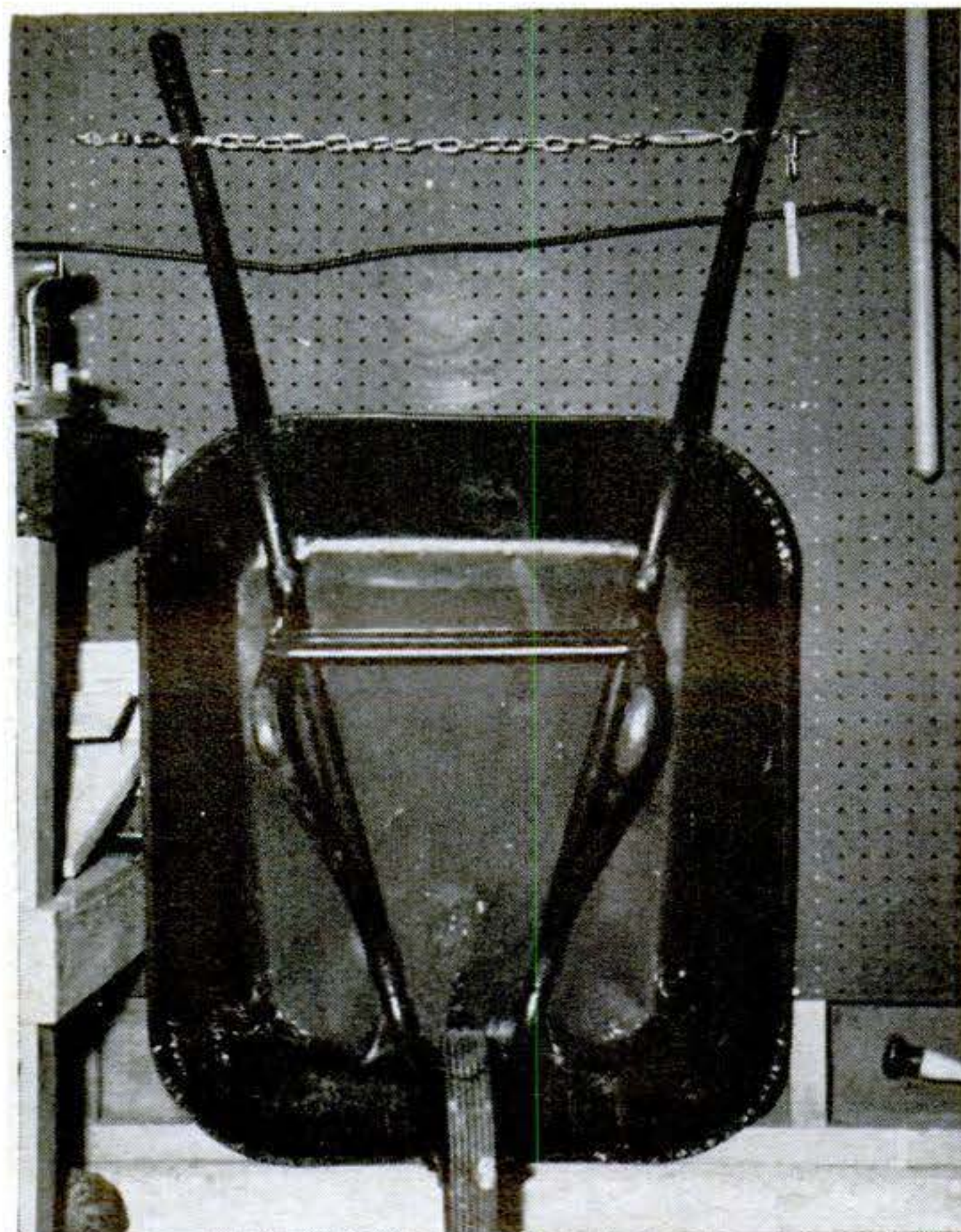
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JANUARY 1967 | 57

Sawdust collector keeps your shop clean

Many table saws lack a sawdust drawer. You can make your own out of sheet metal riveted at the corners, or $\frac{1}{4}$ " plywood. Put a shield over the motor to direct dust into the back of the drawer, and almost all sweeping will be eliminated. Add handles to the drawer and you can easily carry out the sawdust.

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Store a wheelbarrow in less space

A short length of chain is handy for holding a wheelbarrow against a garage wall so that it takes up small space. Place screw-eyes in studs so the chain will come just below the handle grips. Use a harness snap at one end of the chain so you can easily unhook the chain.

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Support for railroad-rail anvil

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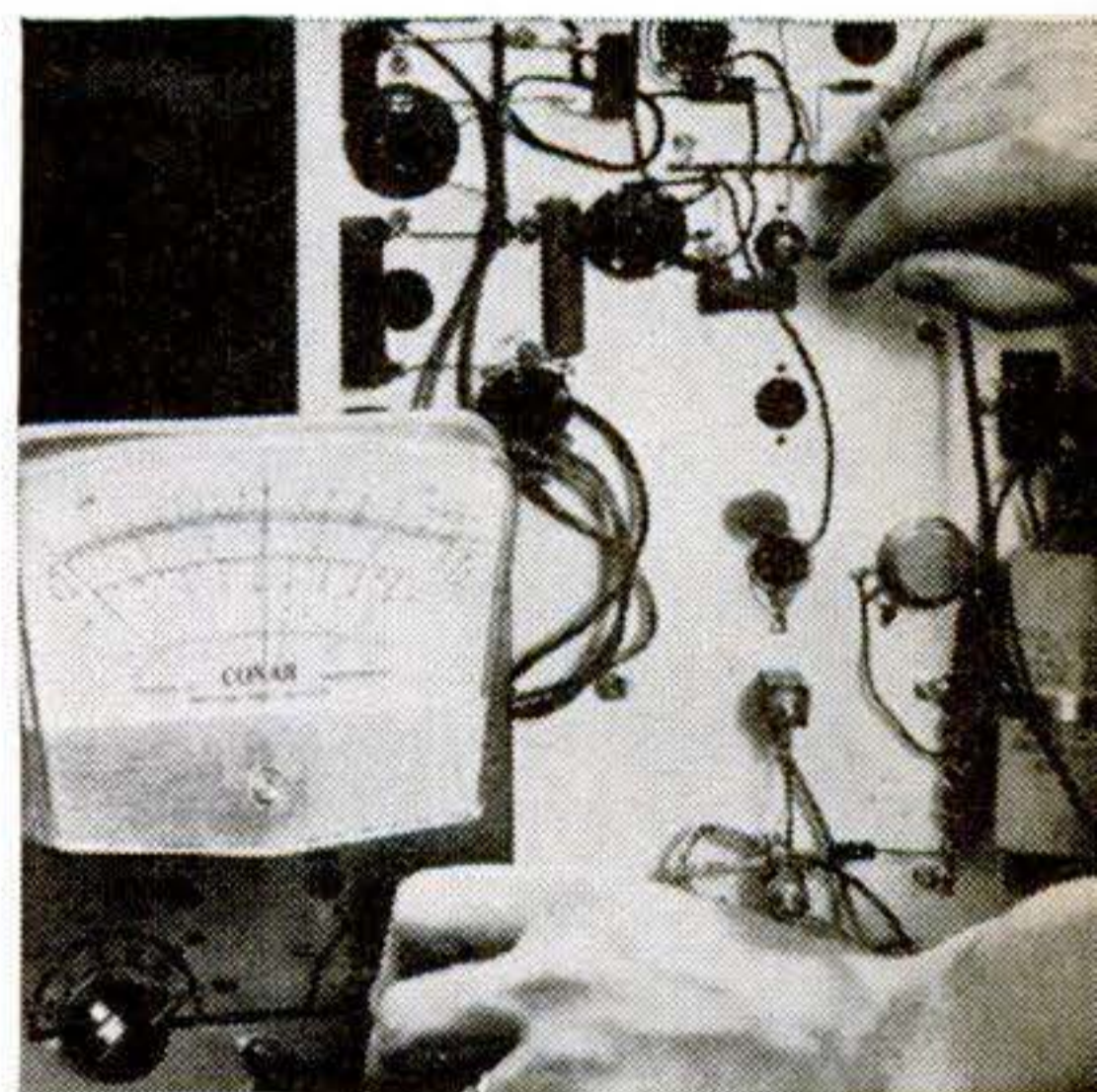
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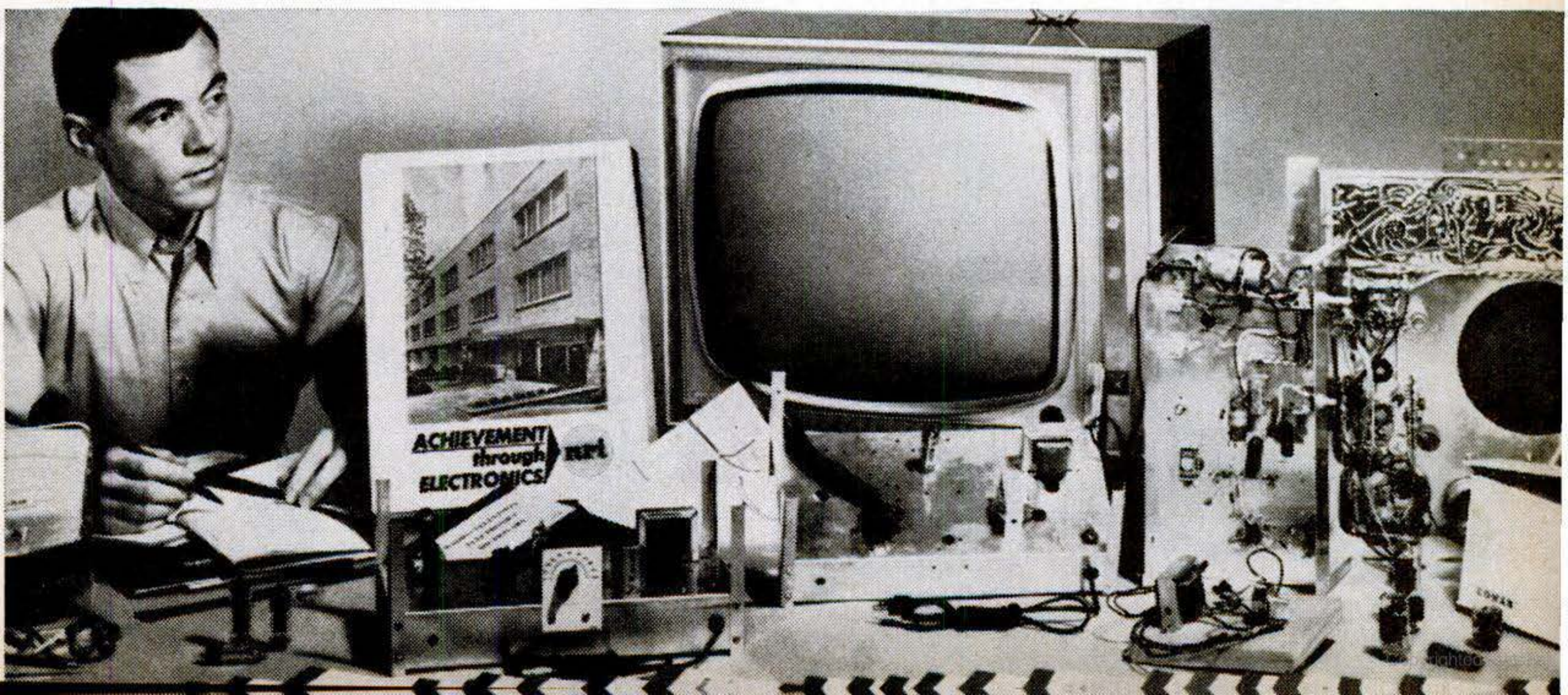
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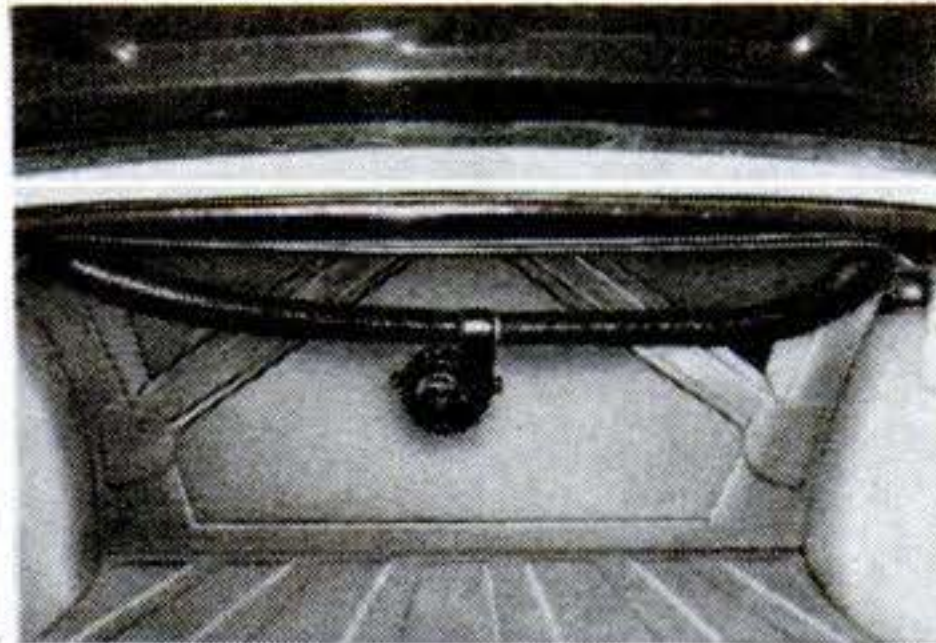
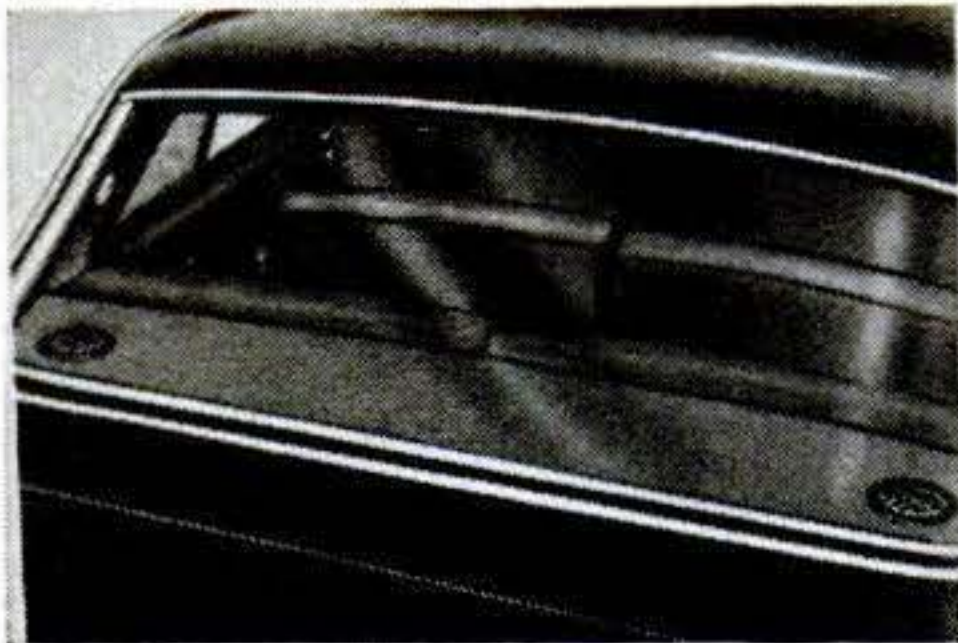
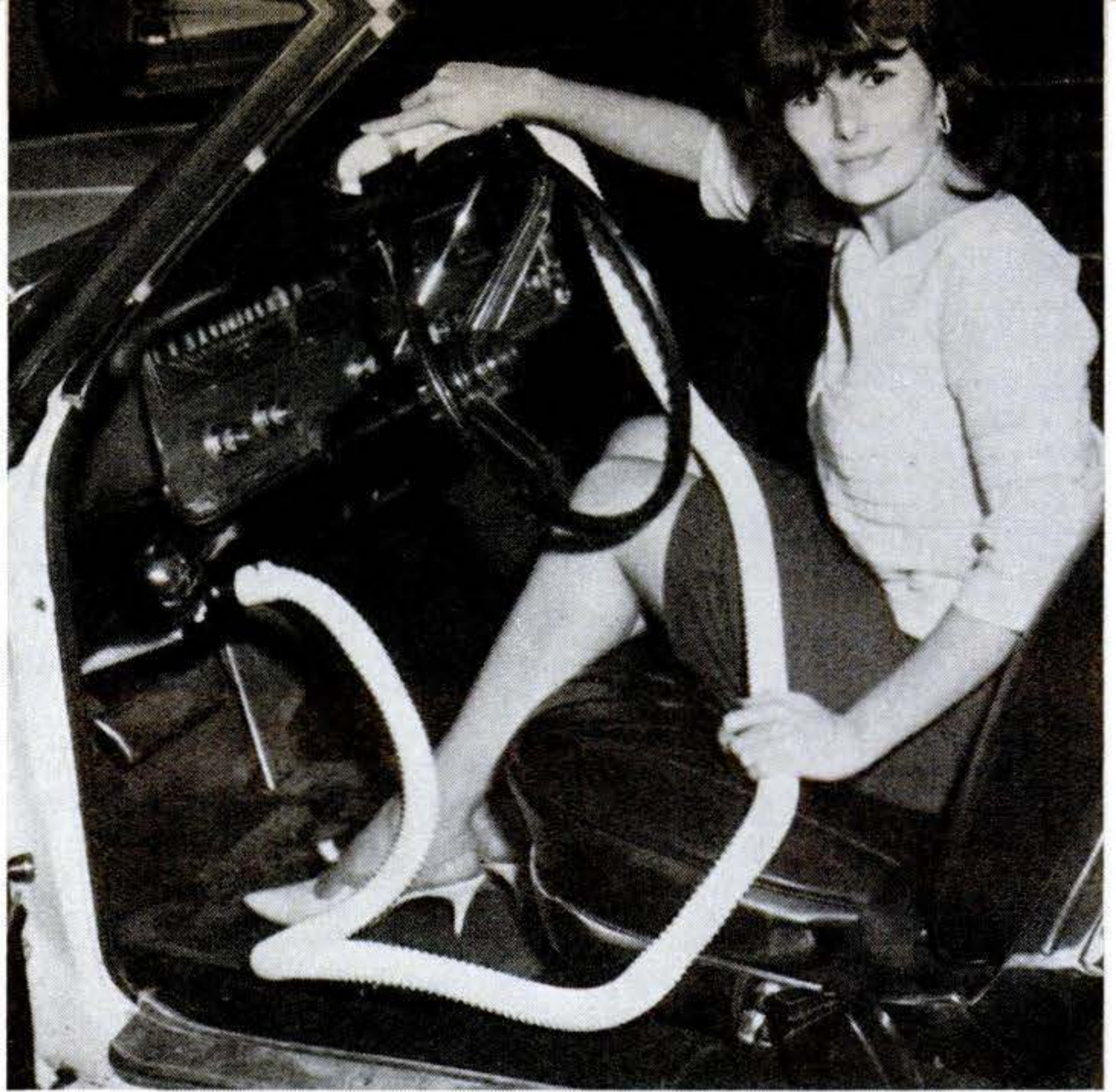


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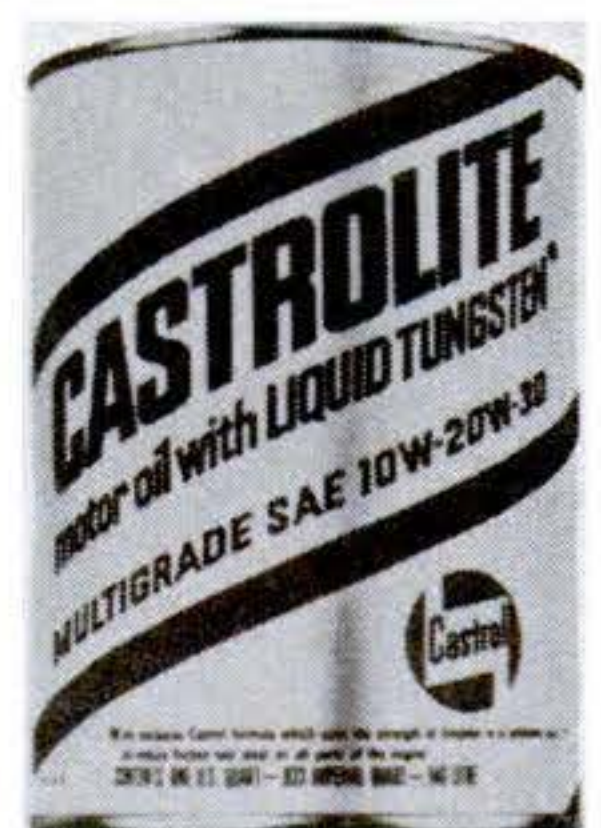
Cold-Chek antifreeze tester

This handy gadget will check the frost protection of your engine coolant accurately to 40 degrees below zero. And it's temperature-compensated for checking antifreeze whether the engine is hot or cold. It works on the principle of specific gravity, and five colored balls give an easy and simple reading. Thexton Mfg. Co., 611 Twelfth Ave., Hopkins, Minn. 55343.



Liquid tungsten makes oil tougher

Tungsten—one of the hardest metals known—is turning up in motor oil. Castrol Oils, Inc., of Newark, N.J., claims to have found a way to make it soluble in oil. Unlike most additives, they say, tungsten never separates from the oil or combines with metal surfaces. Tests indicate the liquid-tungsten oil (in four grades, seen below) has outstanding antifriction properties.





**This is a GM Original:
It helps in rain
or heavy snow.**

**This is a GM Replacement:
It's also a
foul-weather friend.**

GM Originals and GM Replacements are as identical as two parts can be.

That's reassuring when you have to replace something like the windshield wiper motor armature. A part that must be rugged enough to operate in snow, sleet, heavy rain—and in blistering heat and sub-zero cold.

Genuine GM Parts, in GM and United Delco packages, are available just about everywhere. Go where they use them. Good service goes with good parts.

GENUINE GENERAL MOTORS PARTS



CHEVROLET • PONTIAC • OLDSMOBILE
BUICK • OPEL • CADILLAC • GMC TRUCKS

United
Delco





THE CHRYSLER CREW COMES THROUGH FOR YOU

*Beautiful new Chrysler Hydro-Vee runabouts!
Spanking new, fun-engineered Chrysler outboards!
Greatest choice ever of Chrysler inboard and I/O power!*



Hydro-Vee interiors feature swiveling-reclining bucket seats; sport-car appointments.



New 35—improved version of the record holder!



New 45—quieter version of a favorite!



New 55—only 2-cylinder motor in this class!

**CHRYSLER OUTBOARDS
27 MODELS
FROM 3.5-105 HP.!**



When Chrysler know-how hits the water, things happen. Fun things. Look! . . .

All-new 14- to 23-foot Chrysler Hydro-Vee runabouts skim you over the surface like a hydroplane, slice through heavy water like a Deep-V. They're safe—with exclusive Foam-Pac fiberglass construction. They're roomy—with more cubic feet of capacity per foot of length. See them. See aluminum and fiberglass Chrysler boats from 12 to 24 feet. They're **more fun per foot!**

Fun-engineered Chrysler outboards bring you


new fun, too. Brand-new this year are the 35-, 45-, and 55-horsepower models. You can pick from 27 beautiful Chrysler outboard models—from a spunky 3.5 to a snarling 105. And **one** is just right for you!

Chrysler inboard-outdrive and inboard engines also give you top choice in 1967. Nine different I/O's—from the popular 80- to the 290-hp. model. Inboards start at 125—go all the way to 335 horsepower.

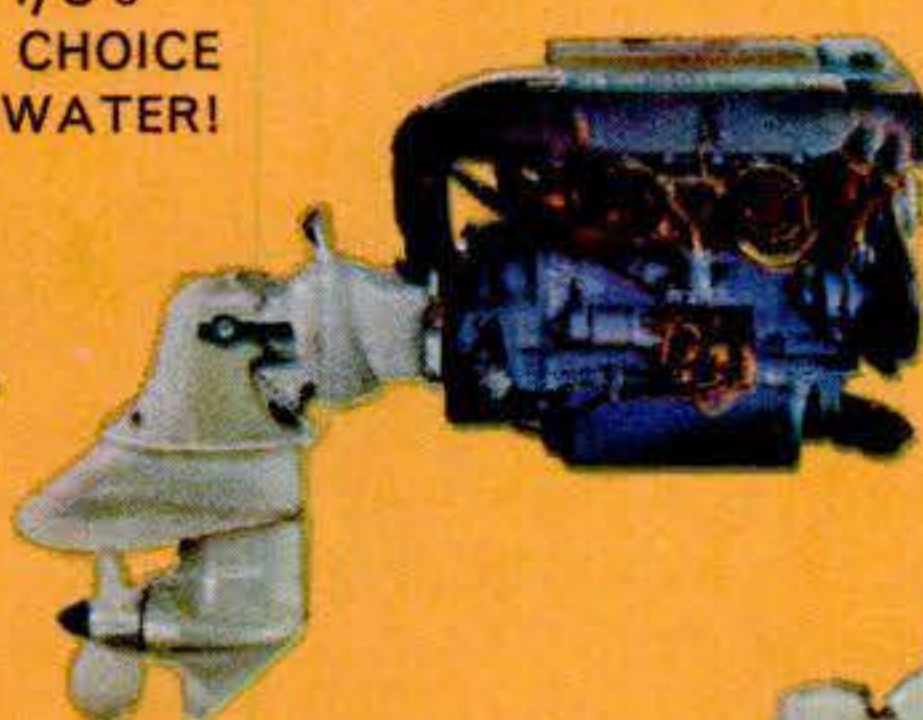
Get in on all of the fun. Why don't you let the Chrysler Crew—the dealers who offer Chrysler marine products—put **you** on the water this year!




27-foot Courier 229. The "229" indicates hull capacity—a full 229 cubic feet, according to official B.I.A. formula! More fun per foot.



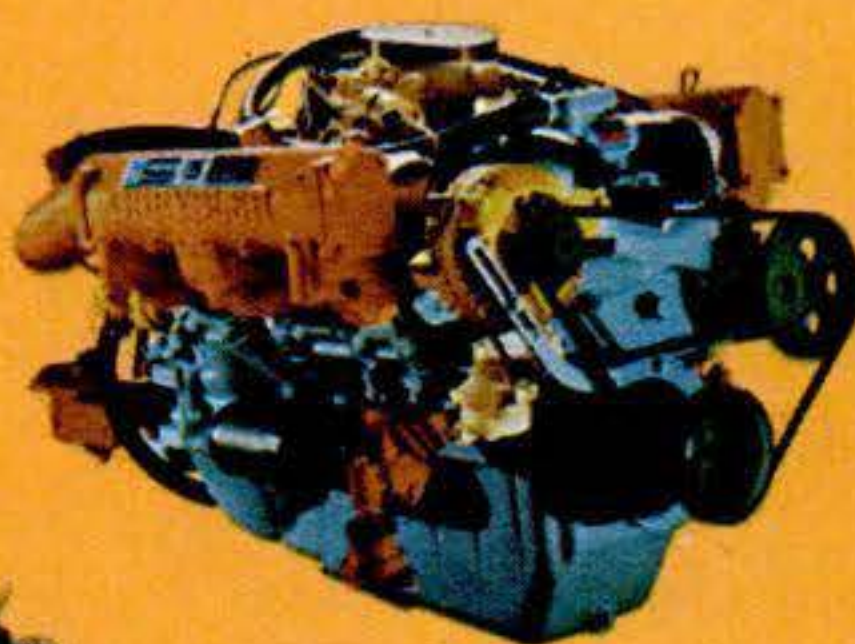
CHRYSLER INBOARDS AND I/O's WIDEST CHOICE ON THE WATER!



COMPACT 80
fits even 14-ft. runabouts!



NEW 175
a big one among boat builders!



CHRYSLER INBOARDS
broadest choice,
40 years of know-how!

Meet the world's toughest 2-door



**This brand new Chevy pickup looks so good you could call it a 2-door.
(You could also call it the toughest Chevy pickup ever built!)**

How's that for a nice looking truck?

We'll go so far as to say that it looks as good and rides as smooth as many cars. And is just about as comfortable inside.

That's a lot to say about a truck. But this is a brand new breed of Chevy pickup. It was built for hard work, certainly; but, beyond that, it provides more style, comfort and convenience than trucks have before.

For instance, the roomy interior is now color-keyed to match exterior paint. And there are many new safety features. You can even get

bucket seats—they're standard in the Custom Sport Truck (CST) model. You'll think you're in a car—till there's work to do. Then this new Chevy turns right around and becomes the toughest of trucks with more durable cab and sheet metal construction, sturdier pickup box and dependable Chevrolet truck power.

The result is a truck that does more for you. Works even harder and plays harder when the work is done. You can see this tough good-looking 2-door at your Chevrolet dealer's, right now. . . . Chevrolet Division of General Motors, Detroit, Michigan.



A BRAND NEW BREED FOR '67!

PS EXCLUSIVE

**Now:
Instant Crime Control
in Your Town**



**By
J. EDGAR
HOOVER**

The Director of the FBI here unveils a dramatic new development: a computer network against crime that instantly will flash from coast to coast information on wanted criminals

With crime in jet-age, mobile America steadily on the rise, many a criminal, able until now to evade local authorities, may soon find he can no longer outrun the law. The reason: rapid advances in transcontinental communication and electronic data processing. A nationwide computer network, which goes into operation this month, is going to work to help police everywhere intercept lawbreakers before they can strike again. This vast network against crime is the FBI's new computerized electronic data-exchange network, the National Crime Information Center, or NCIC. Brought from proposal to actuality in just over a year, the NCIC will complement electronic information systems being set up or already in use by metropolitan police departments or state law-enforcement agencies.

What will the Center mean to the average, law-abiding citizen? It will mean many things, all of them good. Most importantly, it will mean no intrusion whatsoever upon the right to privacy.

The NCIC will have no other purpose than to bring criminals to justice—persons who have violated federal statutes or against whom there is a felony warrant outstanding, and whom the state is willing to extradite. The NCIC will guarantee the security of information in its files against access or removal by unauthorized persons.

Importantly, nobody can misuse the NCIC data banks to embarrass you with some ancient traffic violation or tidbit of personal credit. No such information will be stored there.

What will it do for you? Equally important to the law-abiding citizen is the increased security of his person and property which the NCIC will provide. It will enable police officers to obtain from an information index, national in scope, the pertinent fact or facts they need to hold a suspect, *when they need them*. In police work, that means *right now*.

The great need for a *National Center* (or index) of Crime Information is obvious from the steadily rising incidence of crime *unconfined by considerations of geography*. Only a nationwide computerized communications web, such as we will now be operating, can wipe out this factor and bring crime prevention and control abreast of the criminal element's jet-age mobility.

It is indispensable to law and order that we do so, for mobility constitutes a subtle advantage for the lawbreaker. In it he can find a sanctuary which, too often, stands up even in court.

A Los Angeles hoodlum, for instance, can fly from California

Continued

“The great need for a National Center of Crime Information is obvious from the steadily rising incidence of crime unconfined by geography. It will enable police officers to obtain pertinent facts when they need them—now.”

to New York City, steal a car in New Jersey, pull a holdup in Philadelphia, and be on a plane back to the West Coast in a matter of hours. With careful planning, he might even be able to establish an alibi that he had never left Los Angeles.

Here is where the “instant information” available from the NCIC could make all the difference between solving the crime promptly, and expending disproportionate amounts of time, money, and manpower on investigation—or perhaps never solving it. But *if* the stolen car could be traced in minutes to its point of origin; *if* a gun recovered at the scene could be traced rapidly; *if* some significant aspect of the M.O. (method of operation) could be immediately identified as limited to certain criminals, law enforcement would have come into possession of a singular advantage counterbalancing the criminal’s advantage of high-speed mobility. We might even be able to meet him coming off the jet in L.A.

With the NCIC in operation, we will have that advantage at last. Such a system excites the imagination of the law-enforcement community because it will enable local officers, through coast-to-coast and border-to-border cooperation, to close ranks against crime and its practitioners. That means *all* local officers, whether they have their own departmental computers or not.

How can that be? Paralleling the development of the computer, new communication methods have been devised that permit a person several thousand miles away from a computerized file to interrogate that file by one of a number of typewriter or phone-like devices, and receive a response in seconds. This brings the benefits of a computerized information system within the

reach of even the smallest police departments which do not need their own computer installations.

Think what this will mean in your town!

● An alert teen-ager spots the number on a getaway car’s out-of-state tags as it speeds away from an armed robbery. Local police check the number with the NCIC by their telephone link to, say, the state police agency terminal, which has instant direct access to the NCIC’s data-storage banks in Washington. The NCIC computer does a lightning review that used to take hours or even days, shoots back word that the car is stolen, and furnishes an immediate lead to the source

● A local police raid on a “hot-rod” headquarters turns up several four-on-floor transmissions and high-powered engines. Obviously, strippers have been at work here. If a check of local or state-wide information systems is negative, can the stolen status of these items be ascertained in time to keep evidence from vanishing? A check by the NCIC of its serial-numbers index reveals the expensive parts are all stolen—and does it in minutes, while your police wait at the scene. Until now, such a checkout of serial numbers took days or weeks.

● It has been extremely difficult to trace business equipment



Data on known criminals is instantly available to police across the country through the FBI computer network put into operation this month. It also stores such data as auto license numbers and information on other kinds of stolen property.

if stolen outside the local area. Now, when police recover an electronic calculator, a check of the NCIC files can disclose where it was stolen.

● Or say a man is arrested for assault. Time was when he might be given a nominal fine and let go before a fingerprint check could be returned advising that he was wanted for murder in another state. Not any more. An NCIC scan would furnish this information in minutes, and the man would be held, possibly another murder prevented.

● There used to be no practical or simple way to trace a gun found at the scene of a crime, except locally. The NCIC data banks can disclose in minutes when and where it was stolen, throughout the nation.

The possibilities for eventual utilization of such a system are virtually unlimited. The obvious base file of such a digital system is the 16½ million individual criminal fingerprint-identification records now stored manually in FBI files. This information eventually will be immediately retrievable by electronic means. Another obvious application is the transmission of photographs of criminals or missing persons and fingerprint- and criminal-identification records at high speeds for immediate use.

No time off. Because crime does not confine itself to an eight-hour day, nor observe holidays other than by making itself known in increased volume, the twin IBM 360 Model 40 computers that go into operation this month at FBI Headquarters in Washington will be "on the air," from the start, 24 hours a day, seven days a week. We have this built-in capability for one purpose: To guarantee state and local law-enforcement agencies, nationwide, an uninterrupted electronic flow of up-to-the-minute crime data. If for any reason a computer or storage unit fails, a second piece of equipment will take over automatically. When not in use for this purpose, the duplex equipment is also going full-speed handling the administrative programs of the FBI.

Initially, during a pilot program or testing period, there will be 15 local and state law-enforcement agencies participating and directly tied in to the FBI computers. They, in turn, will service numerous other police agencies. We anticipate eventually having one terminal agency in each state, as well as a terminal agency in each of the 25 or more larger metropolitan areas. These terminal agencies will be state or local establishments. And all of the FBI's Field Divisions will be tied in to the NCIC computers, along with offices of other Federal investigative agencies.

Initially, the system will operate through a network designed for the FBI by the Institute for Telecommunication Sciences and Aeronomy of the Department of Commerce.

The funding of this network for a one-year pilot operation is being provided through a grant from the Office of Law Enforcement Assistance, an office created by statute to furnish financial assistance for innovations in law enforcement.

Agencies participating in the NCIC system will communicate with the computer through communications links at a relatively low speed—say 100 words per minute. Ultimately, as local and state computer facilities are developed, transmission rates will greatly increase, and high-speed links (3,000 words per minute) will be needed.

This will be particularly true when facsimile and video trans-

[\[Continued on page 196\]](#)

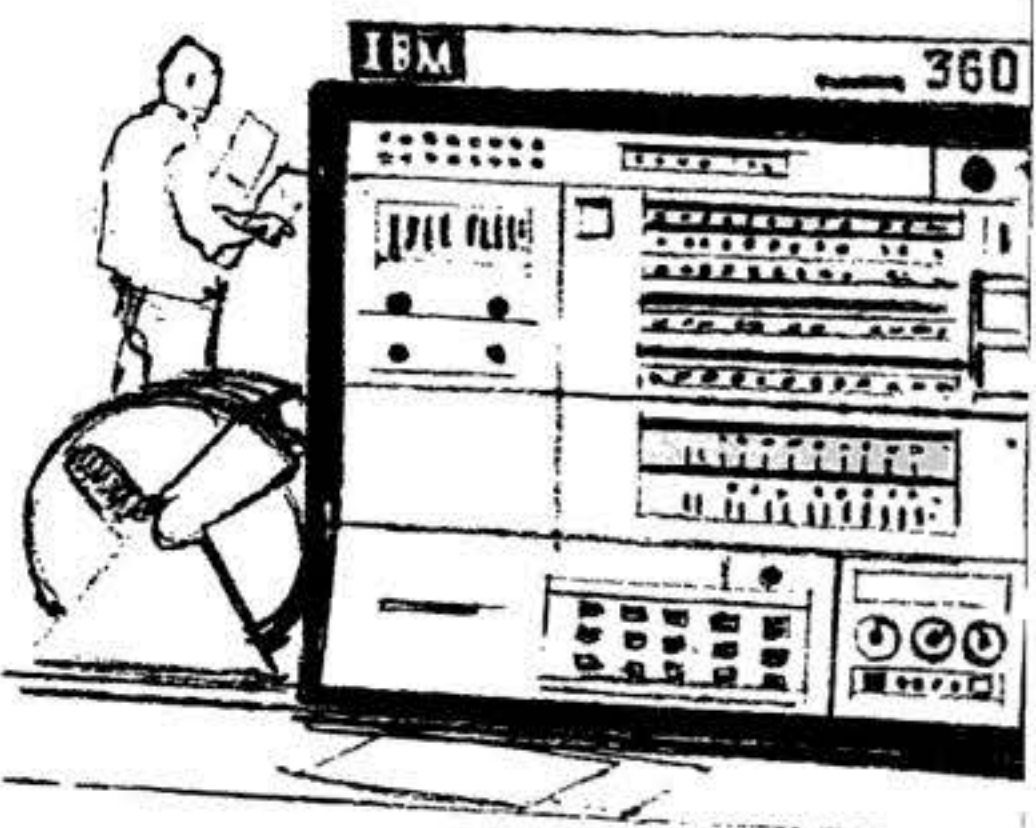
How stolen cars can be traced instantly



Cruising trooper, spotting an abandoned car, radios license number, 123 VA, to desk



Local police, using teletype, query the NCIC computer in Washington about the vehicle.



At NCIC headquarters, IBM 360 computer automatically searches memory for license number.



The answer received—in moments—shows car serial number, owner, and address.



Sleek Rebel is one of a fleet of fine sailing craft made by Ray Greene & Co., Toledo, Ohio. A 16-footer, the Rebel has a fiberglass hull and is sloop rigged.

Thunderbird has a stable-riding cathedral hull. Boat above is powered with MerCruiser 120-hp. stern drive. Models are available from 15 to 22 feet.



Crosby fiberglass runabout is a cool cat. She sports fancy leopard-skin-style, wraparound seat. Power: a 100-hp. Johnson.

Indomitable Boston Whaler serves as skindiving base. She's Johnson-outboard-powered. The Whaler is credited with being the first of the "multikeels."



Calling all sailors



By **JIM ROE** / *PS Boating Editor*

If you already have a boat, you know that there is no sweeter pleasure than shopping for a craft even better than your present pride and joy.

If you do not yet own a boat, we in the boating fraternity urge you to join us. We'd love to have you aboard. For present and prospective boating families, **POPULAR SCIENCE** has assembled a colorful showroom of samples of the great fleet for 1967. Worried about costs? Don't be. Boating isn't just for the well-heeled. You can buy a new boat for less than \$100

portsmen, fishermen — and landlubbers!

The '67 Fleet's In!

...and here's how it shapes up

and likely have as much fun with it as J. P. Morgan had with all his yachts. Boating takes the whole outdoors and gift-wraps it in a multipleasure package:

- The big thrill is in handling a sail or power boat. This is the basic fun — an exciting punctuation mark to humdrum or too-tense days on the job.

- The sun, the sky, the spray — and *really* fresh air.


- Water, water everywhere. And it's all yours: swimming, skindiving, water skiing. Or just watching the endless and ever-changing scene of lake or stream.

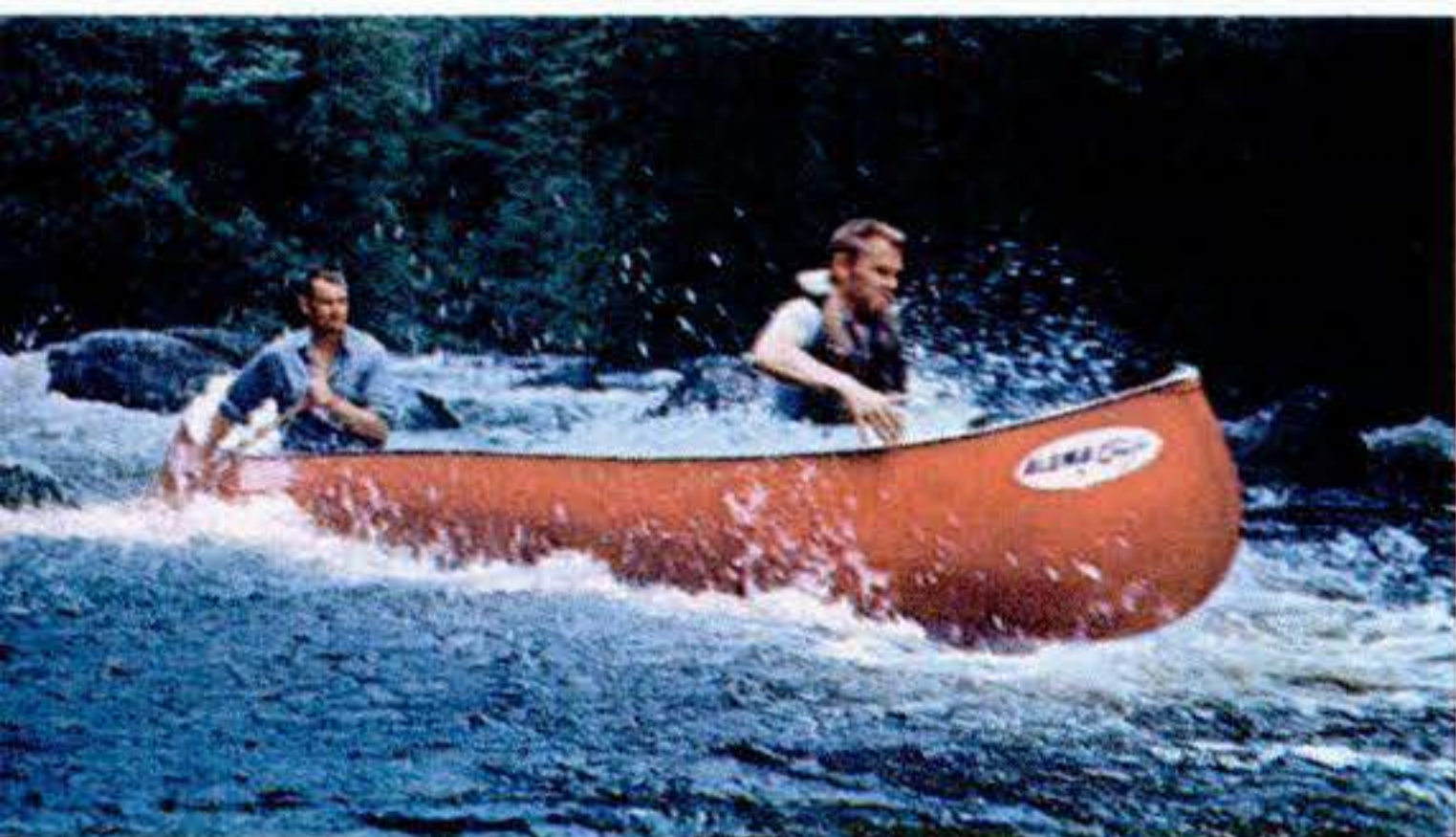
- Fishing. Alone, with your best friend, or with a whole group, as you choose. Far up the tiniest branch of the smallest river, or on the world's biggest oceans. Those fish can

decorate your frying pan or your family-room wall.

- A summer cottage that moves. Cruisers and houseboats are gaining steadily in popularity. They'll give you home-size electric refrigerators, stereo, hot and cold running water, showers, even electric blankets and electric shaving. If you feel like roughing it, you can eat your steak from a paper plate.

- Great for kids. Of all ages. Boating is a big thing for youngsters who like to learn how to coax the last bit of speed from a well-tuned sail, or who hunger for the feel of power at their fingertips. A thorough grounding in marine courtesy and rules of the road helps instill a sense of responsibility in pre-driving-age youngsters — makes them better, safer drivers.

For more boats in color, see the next four pages 



New Aluma Craft canoe rides the rapids like a happy duck. She's one of half-a-dozen models, in three lengths. Available with square stern for outboard.

Jet-drive Bar Harbor by Buehler Turbocraft is 24 feet long. Fold-up top adds ventilation. Hull is a deep V. Three-stage jet drive, 290 to 325 hp.



Glastron's V-234 is a husky, handsome 23-footer. Has two bunks in cozy cabin. A 36-gallon gas tank is standard. She handles 150 hp. to 315.

Traveler Saturn is a husky 17-foot multipurpose runabout. Power comes from OMC stern-drive unit. It handles up to 160 hp., has deep-V keel.





Johnson boat-family portrait includes from left to right: husky 19-foot Surfer, 16-foot Reveler, 15-foot

Caprice. All have Johnson trihedral hull design. Stern-drive powered with 200, 155, and 90 hp.



Formula 190 and Johnson outboard team up as top ski combination. Fiberglass 19-footer has tangent chine for stability at rest and moving.



MFG Beachcomber, with new Chrysler outboard power, has fiberglass Tri-Glide hull. Also: open bow deck, foamed-in-place flotation, anchor locker.



River Queen is a go-anywhere boat with strong steel construction, speeds above 30 m.p.h., all the comforts of home in well-planned interior.

Fast fiberglass runabouts: Gulf Stream and Sea Ray step out to the power of Mercury 1100 outboard, MerCruiser 160-hp. stern drive.



Four Chrysler outboard-equipped craft find a picturesque beach. Twin-engined boat with white hull is Thompson's seaworthy classic lapstrake.

Lund aluminum Fisherman has Johnson outboard on the stern, new Tempo-Troll electric trolling motor at the bow. Rheostat controls trolling speed.





Starcraft's 16-foot Upstart claims a new feature: the ability to right herself from a swamped position without help from crew or centerboard.

Charger and a 105-hp. outboard are headliners from Chrysler. Boat has Chrysler's new Hydro-Vee hull combining features of three-point hydro, deep V.



Twin Larsons above are 18-foot Model 186s. It comes in outboard or stern-drive versions like the MerCruiser boat in the foreground.

Crestliner's disposition is as sunny as her color. Powered by an OMC stern-drive unit, she's a fine base of operations for surface diving.



Evinrude-powered Glasspar Seafair Sedan is 17 feet long. Has twin bunks. Fiberglass, with modified-V hard-chine hull. Two 12-gallon gas tanks.

Evinrude Sportsman 155 likes divers, too. Fiberglass boat is 16 feet long. Low freeboard, handy to use with new Aquanaut floating air station.





Chris-Craft Capri is 26-foot fiberglass Sparkman-and-Stephens-designed sloop. Four berths, 301 square-foot sail, 4,800-pound displacement.



Chris-Craft Corsair Sport-V Transdrive. This 17½-foot fiberglass sport boat has 150-hp. V-6 engine speeds up to 41 m.p.h. It is also available as an



Queen of the '67 Chrysler fleet is this Courier 229. New Chrysler Hydro-Vee hull. Power: Chrysler in-board-outdrive. Also available for outboard.

Starcraft Islander is designed for offshore fishing, overnight cruising, other family activities. Concave-V hull design breaks up choppy water.



Grumman's new aluminum fishing boat teams up with McCulloch's outboard for a relaxing day of fishing. It's better than tranquilizer pills.

Big 47-foot Bertram goes anywhere, gives you all the comforts of home. Raised sun deck and control center, forward and stern cabins, deep-V hull.





outboard model. Chris-Craft Corsair fleet for 1967 includes nine models. There are four hull designs: Sport-V with smooth sides and longitudinal stabi-

lizers; Twin Sponson with three hulls in one; Sea-V with lapstrake sides, bottom stabilizers, and deep-V aft; and the Lancer deep-V design.



Tahiti Custom, powered by a Merc 650 outboard, will give you lots of wind in your face. A racing stripe adds dash for the young-at-heart.



Alplex runabout in fiberglass is a whole-family friend. It's powered by Evinrude's 100-S outboard, offers ample room, power for skiing or cruising.

Grady-White Catalina hardtop is 27 feet long. Of lapstrake design, wood construction. Has 220-hp. engine, or can be fitted with twin 157-hp. engines.

New Owens 27-foot fiberglass Express Cruiser carries a full range of live-aboard convenience for happy cruising with the whole family.





**DANNY KAYE'S
OWN STORY:**

TV's famous redhead, now piloting jet planes, tells how he learned—and how he took a test with a liverwurst sandwich in his pocket

"If I Can Learn to Fly, You Can Learn to Fly"

Once each week, lithe, redheaded Danny Kaye entertains millions on his CBS TV show. For many years he has been a movie star. But few of his fans know that Kaye is an accomplished pilot as well, licensed to fly multi-engine planes and holder of a coveted instrument rating that permits him to fly when the clouds close in.

Now he is in "transition" training, from propeller aircraft to jets.

Let Danny himself tell you the story of his affair with his second love, flying. His first love, of course, is show business. He talked to POPULAR SCIENCE's Devon Francis between sessions in transition ground school at the Lear Jet Corp., Wichita, Kan.

This goes back (began Danny). It was 1959. I had made a movie with a fellow named Michael Kidd. We used to drive to the studio together. Now, I wasn't altogether crazy about Mike's driving. No, let me put it another way. It got so I wouldn't even ride with him.

Some months after we finished the picture, I got back from a trip abroad, and somebody told me Mike had become a licensed pilot. Well, it was shattering. I couldn't believe that anyone as inept

Danny Kaye, in command pilot's seat of a 575-m.p.h. business plane on the opposite page, is a vice president of the Lear Jet Corp., Wichita, Kan. In photo at right he is in jet-transition ground school. He told PS, "Be sure to mention the fellows all over the country who work the airways traffic and approach controls and the towers. They do a great job handling air traffic under difficult conditions."

as Mike was in a car could ever have mastered the art of flying—and it is an art, as I was to find out later.

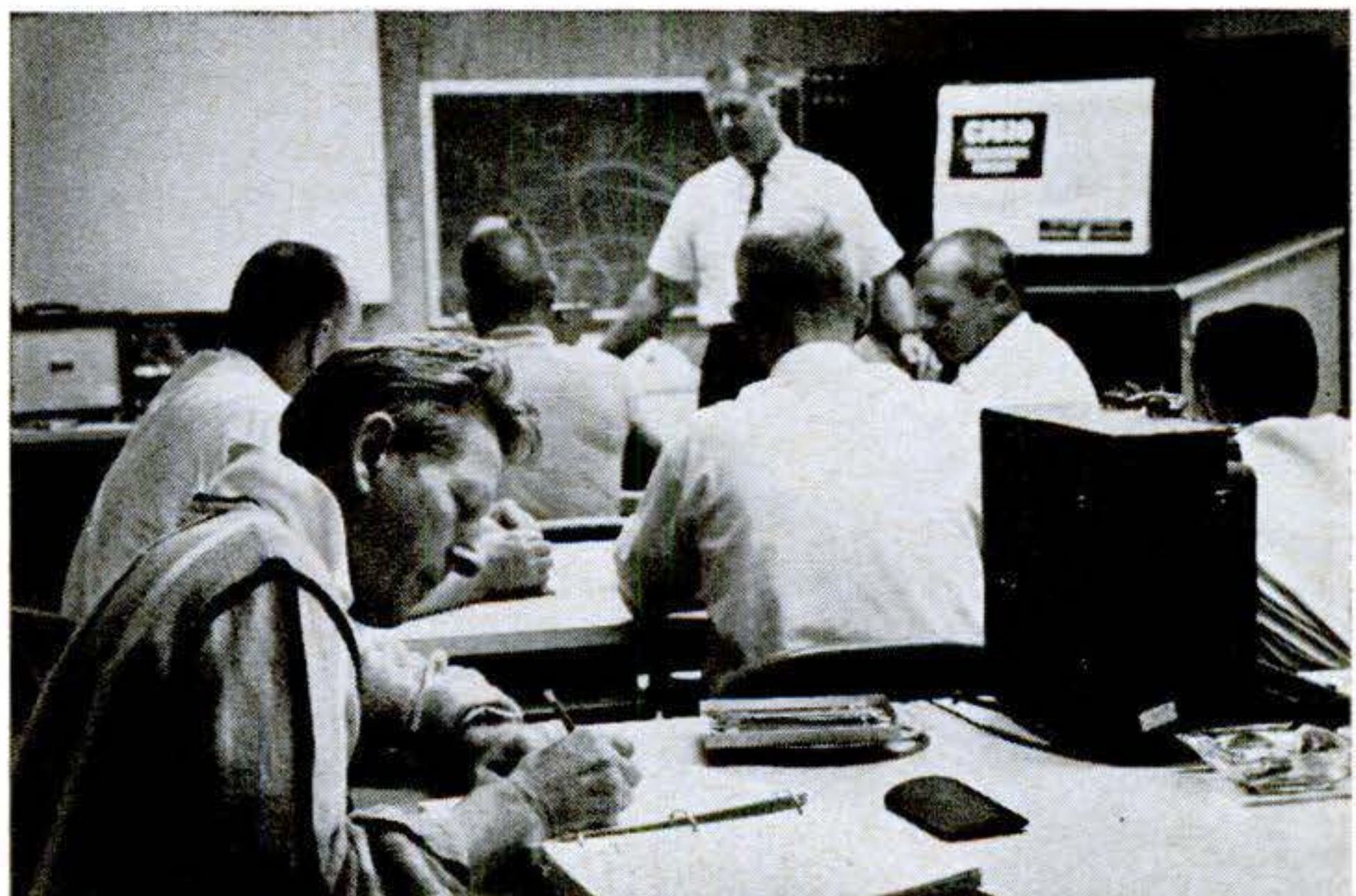
I called Mike on the phone and said, "What is this implausible nonsense about you being a pilot?"

He said yes, he had been learning to fly, and now he was a qualified pilot.

Curiosity gets the best of all of us sometimes. I had to find out about Mike's flying. Summoning up my courage, I remarked, "I'll go up with you." He picked me up and drove me to the Van Nuys (Calif.) airport. On the way I noticed there was an appreciable improvement in his driving. Could learning to fly have made such changes in his driving habits?

Now, I'd been flying as an airline passenger since 1933. My first trip was in a Ford trimotor. Somewhere in my uninformed mind I had the vague idea that if I ever flew an airplane I'd hop in and yell, "Hey, fellows, this is Danny and I'm going flying." I'd roar down the runway in helmet and goggles, with scarf streaming out behind,

Continued





Danny poses at the entrance to the Lear Jet Model 24, accommodating six passengers and two pilots. An identical plane circled the globe last year in 65 hours, 40 minutes, setting 18 world speed records.



"Would you believe," asks Danny, "that this plane climbs to 41,000 feet from sea level in 13 minutes?"



Kaye shows PS writer Francis one of two engines, each producing 2,850 pounds of takeoff thrust.

and be off into the wild blue yonder.

But oh, no! Mike spent a full half-hour on what he called preflight, checking the airplane. He got on the radio to ask permission to taxi and take off. He *understood* all that jargon coming out of the receiver from Ground Control.

Learning the lingo. This was the most beautiful combination of Greek, Japanese, and native Aleutian I'd ever heard in my life. It sounded like, "Roger, neeaw-whup-emup, altimeter razzmatazz, wind wheekipperedherring." I was impressed.

We flew. Mike was good. I was even more impressed.

Mike said, "Why don't you put your hands on the controls?" and I think that's when it hit me. There was a little bug, nondescript in color and not very large, that had evidently got into the cabin. It flew 'round and 'round, finally hit me in the back of the head, buried itself in my brain, and I had caught that marvelous disease spread by the "flying bug."

I said, "Hey, Mike, what do you have to do to learn how to fly?"

He said, "Danny, it takes coordination, and you seem to have that in abundance anyway, so it would probably be easy for you."

I said, "Mike, outside of that, what do you have to do to get a license?"

He casually said, "Oh, not very much, Danny. All you have to do is take some lessons and pass a simple little written exam."

I said, "I'm sunk."

Now, bear that point about the written exam in mind because I'm coming back to it.

I began taking lessons.

Dick Weaver, my instructor, was an ex-Navy pilot, a gruff but likable guy. He didn't care whether you were a movie actor or a mechanic or a politician. He growled at everybody in exactly the same way. But his pupils knew they had been taught well.

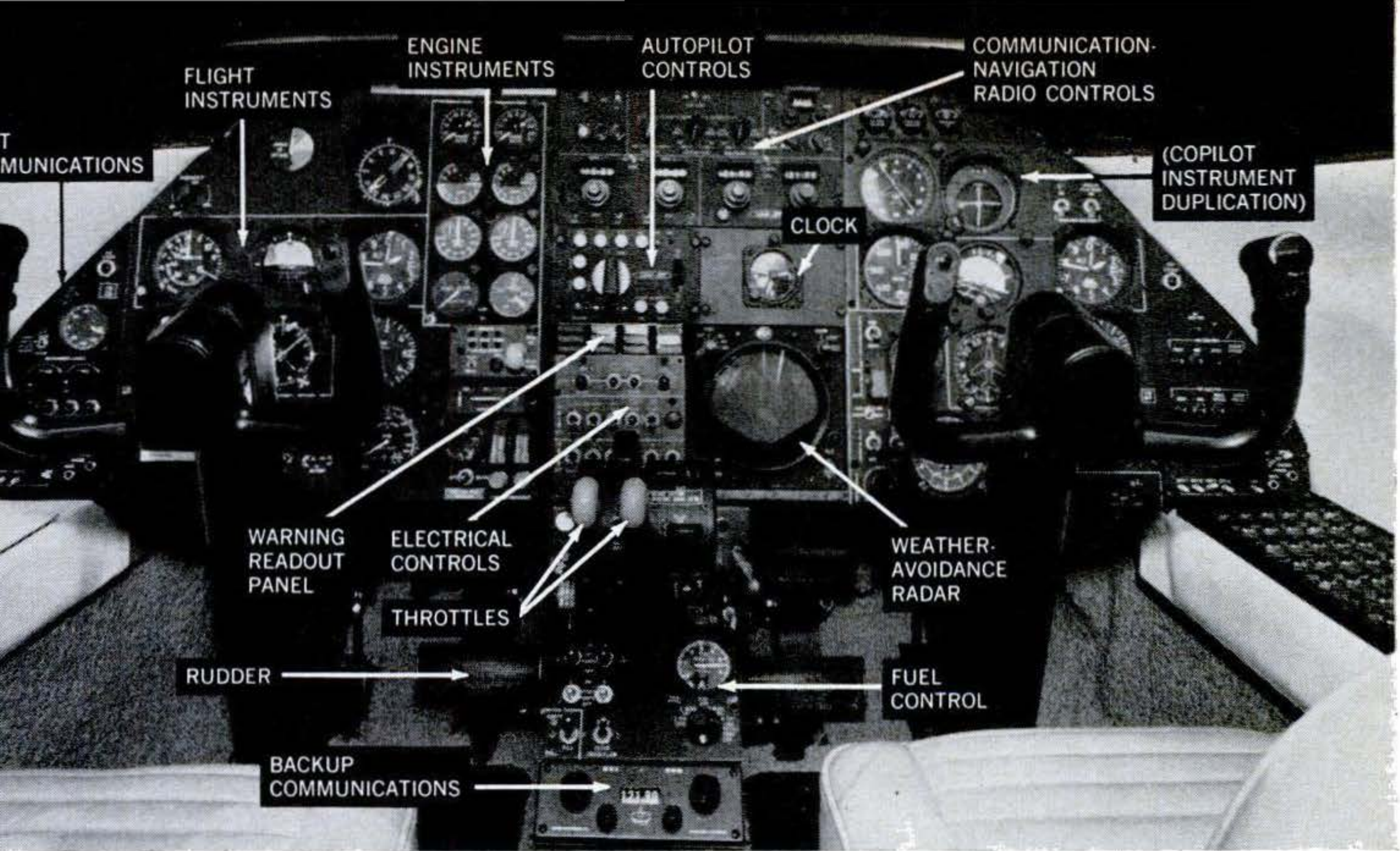
"What if it stops?" At one point on my first instruction flight I said to Dick, "Hey, what if that thing stops?"

He said, "What thing?"

I said, "That thing that's making fresh air out there."

He said, "Oh, if this thing stops?" Whereupon he switched off the engine.

He said very calmly, "Now there's no engine."



This is the instrument panel facing actor-pilot Kaye when he flies his jet. He says, "Once I've got the

plane to altitude, flying level, I fly it by simple finger movements. It's alive. It wants to fly."

I said, not quite so calmly, "I just happened to notice that. Don't you find it excessively quiet in here?"

He said, "Not for glider pilots."

The point he was trying to make was that even if you lose your engine, you can still glide gracefully down to a safe landing.

When we got down I was really excited. I started ground school. That's where the written exam would come in. Oh, boy!

Mathematics, yet. The subjects were meteorology, navigation, power plants, aerodynamics, and the Federal Air Regulations. Let me tell you why I had my wind up over the forthcoming exam. When I was a kid in school I just couldn't get mathematics. Here I am in the midst of a course that requires mathematics, and I can't even add.

If I've got four sets of figures to sum up, I begin at the top and add down. Then I add from the bottom up. Then I separate the figures, two and two, add them, and

take those sums and add *them* together, and if it comes out the same, I must be right.

If I'd been shot to the moon in a capsule I couldn't have been on more unfamiliar ground right then. But George Budde, my ground-school instructor, was a patient, kindly man who guided me beautifully through the whole course.

I spent weeks flying with Dick in the morning and studying with George in the afternoon. You learn to do eights-on-pylon, lazy eights, and chandelles. You learn to keep that black ball in the turn-and-bank indicator right in the center in turns. At first, I could hardly even keep it in the cockpit. You learn to bank without losing altitude.

That first solo! I'd had about 10 hours of instruction. One morning Dick Weaver remarked, "How about taking it around yourself?"

Whew! Here it was. I expected a long

[Continued on page 198]

Striking coast to coast, this is one of several hundred Lear Jets in business service. A larger version will soon be licensed, and soon the company will test-fly a 40-passenger airliner. Famous Lear Jet passengers include Lynda Bird Johnson, the Smothers Brothers, and Mia Farrow, Sinatra's bride.



Rivals to the Wankel: A

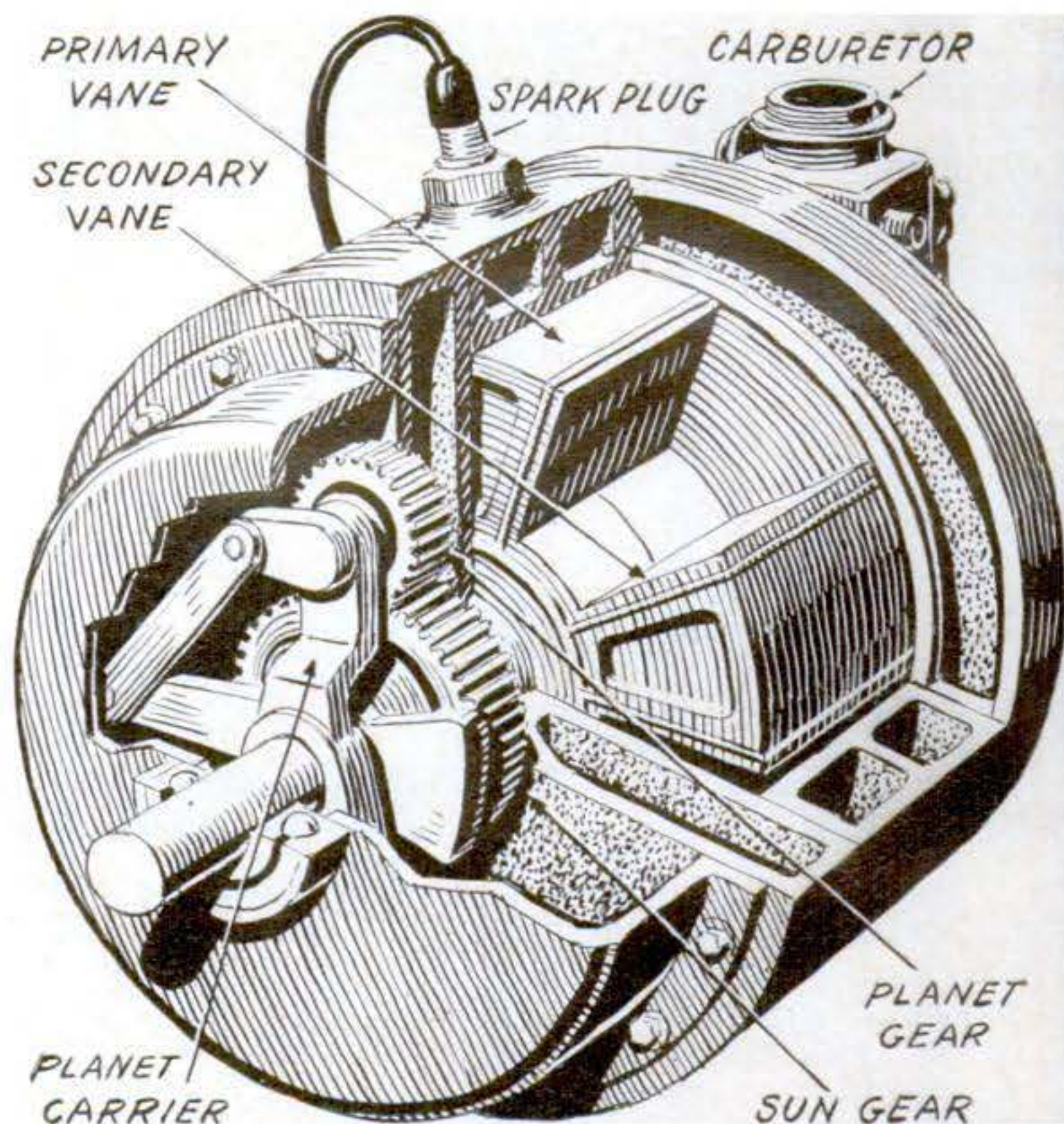
Pipe dreams or tomorrow's power plants? Many new types of these engines are striving for success

By JAN P. NORBYE / PS Automotive Editor
DRAWINGS BY RAY PIOCH

Auto engine of the future? That's what every inventor of a rotary engine hopes he's got. The conventional piston engine once seemed as much of a miracle as the gas turbine did to a later generation. Now, the Wankel rotating combustion engine has made it into production cars (NSU in Germany, Mazda in Japan; soon to be joined by Citroën in France). Detroit has intensive development programs on Wankel engines. But the Wankel has many rivals. Strange engines with rotating pistons, curved pistons, vane-type pistons, orbiting pistons, and scissor-action pistons. You name it, it has been invented, and it works.

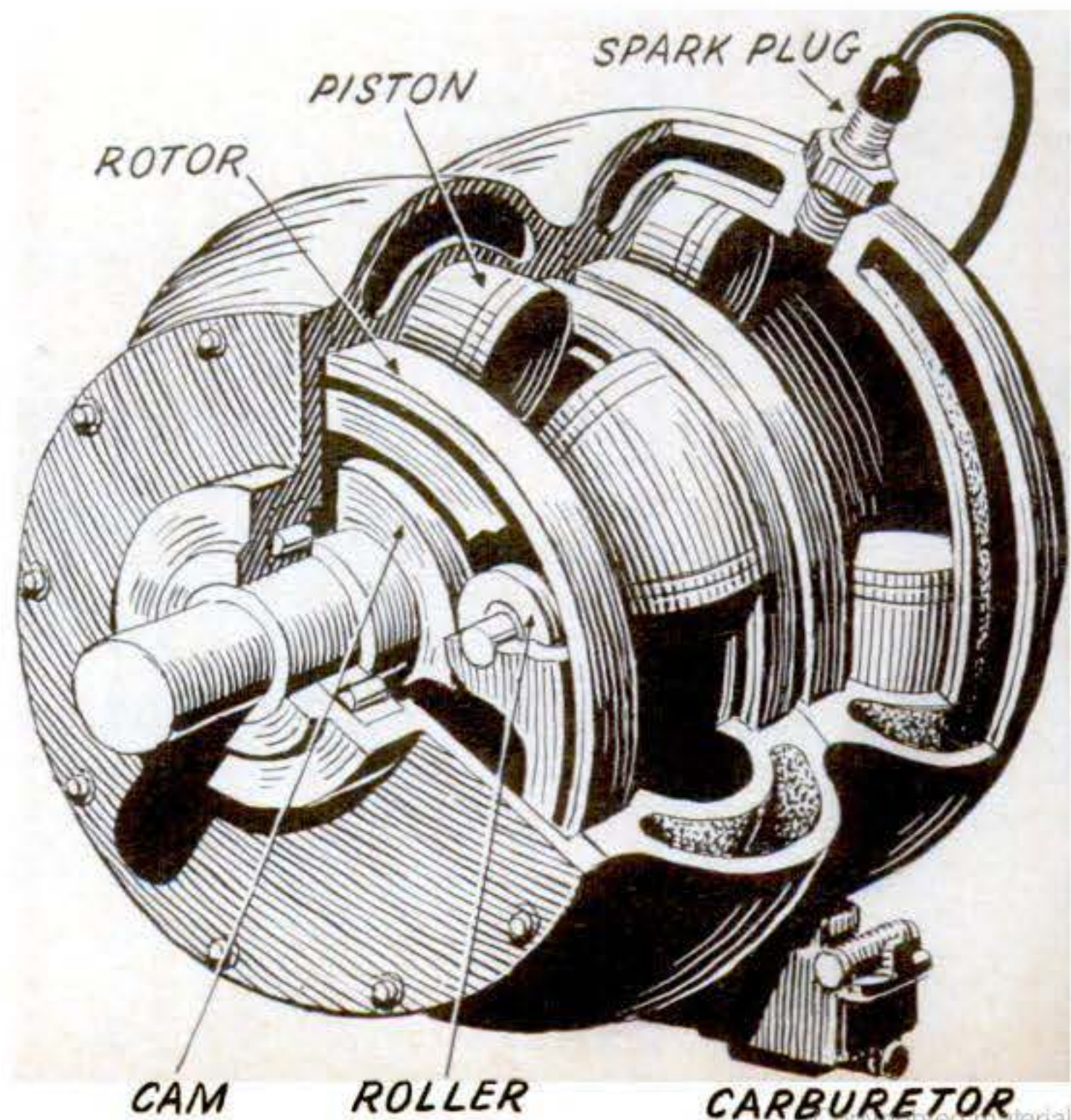
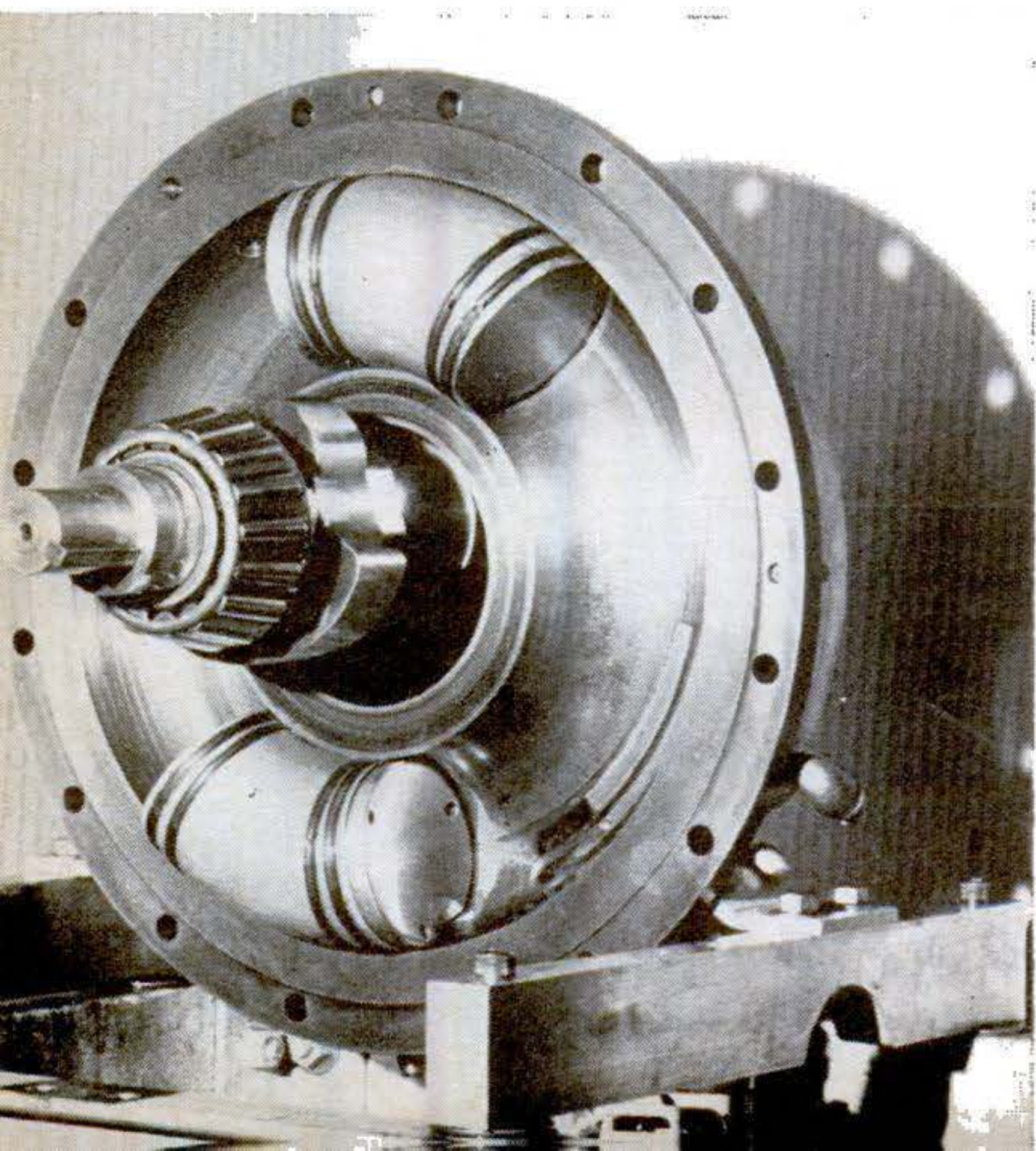
Here is a roundup of rotary engines that may challenge the Wankel—and, in turn, the conventional auto engine. Each one has some advantages, and some show considerable promise. Others may never be

Continued

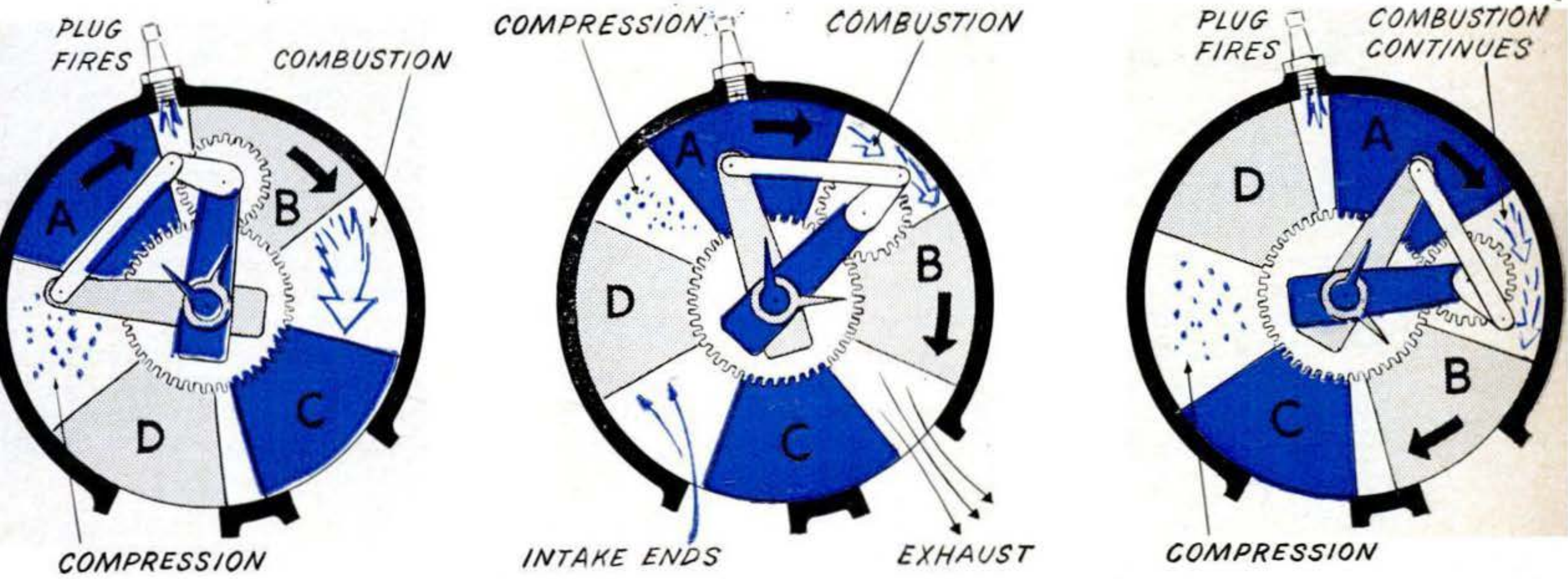


KAUERTZ engine has vane-type pistons in a circular-section working chamber. Two sets of vanes rotate on the same axis but continuously change position relative to each other. This speeding up and slowing down of one set of vanes changes the volume of gas between the two sets. Changes in gas volume produce the pumping action needed for intake, compression, combustion, and exhaust. Four effective combustion chambers assure four power phases per output-shaft

TSCHUDI engine has four curved pistons running a toroidal track. A pair of diametrically opposed pistons is



Roundup of Rotary Engines



revolution. Correct phasing of the vane motion is assured by a gear-and-crank system. The output shaft carries a coaxial but stationary sun gear and a planet-gear carrier that revolves with the shaft. A crank fixed to the planet-gear axis describes two complete revolutions for one turn of the planet carrier. The planet-gear crank is linked to a counterbalanced arm that both rotates and oscillates around the output-shaft axis. Both movements of this arm are produced by the crank and its linkage. The arm is rigidly fixed to the secondary set of vanes. These vanes alternately catch up with and fall behind the primary vanes, which are fixed to the output shaft and therefore drive the planet carrier. Both faces of all four vanes work full-time, going through all phases of the four-stroke cycle. Vane sealing is obtained by free-riding blades held against the housing by centrifugal force.

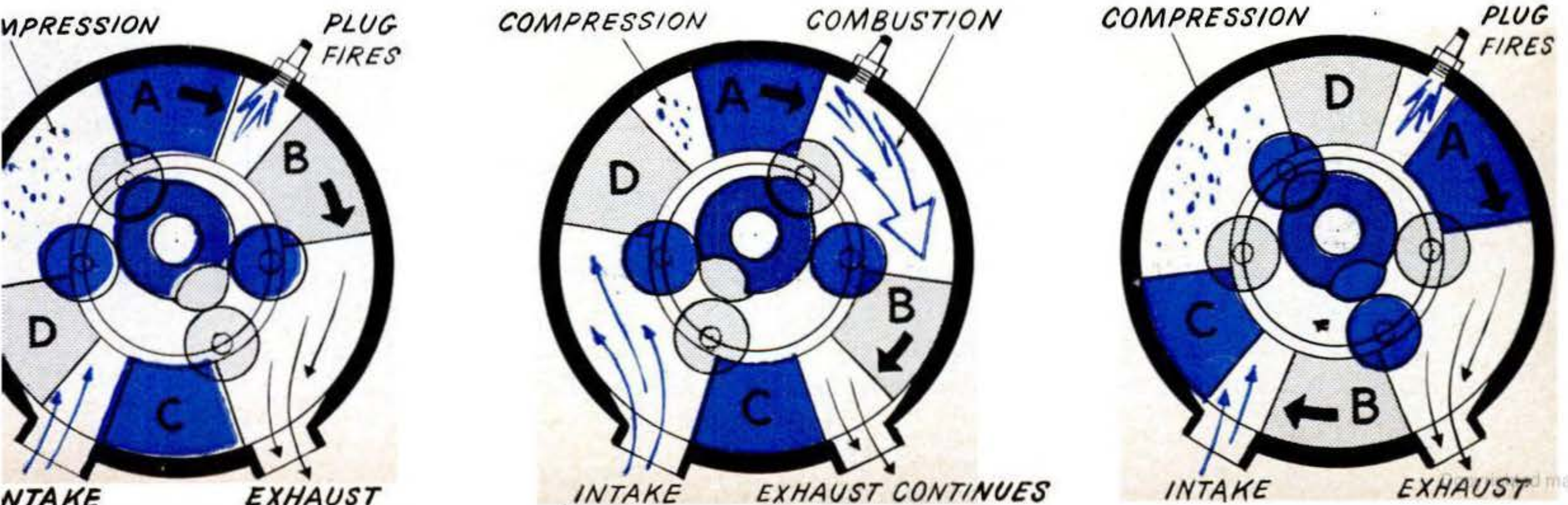
The Kauertz engine has no unbalanced inertial forces, and very high speeds are possible because there is no valve gear. The vanes themselves open and close the ports with accurate timing. The inventor (right) claims high volumetric efficiency at all speeds. A 61.7-cu.-in. version has been tested and found to give 213 hp. at 1000 r.p.m. It runs as smoothly as a V-8 piston engine.

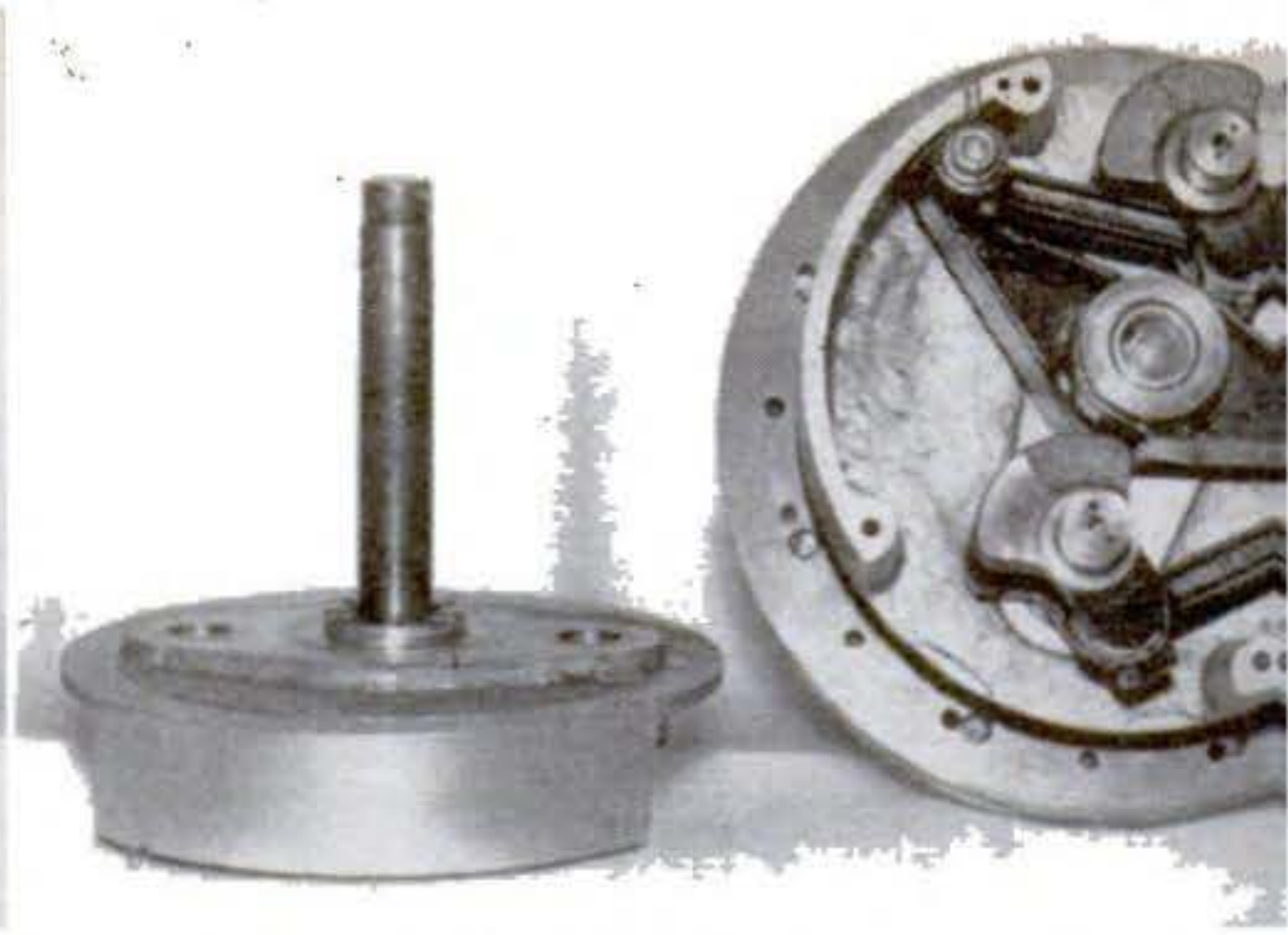
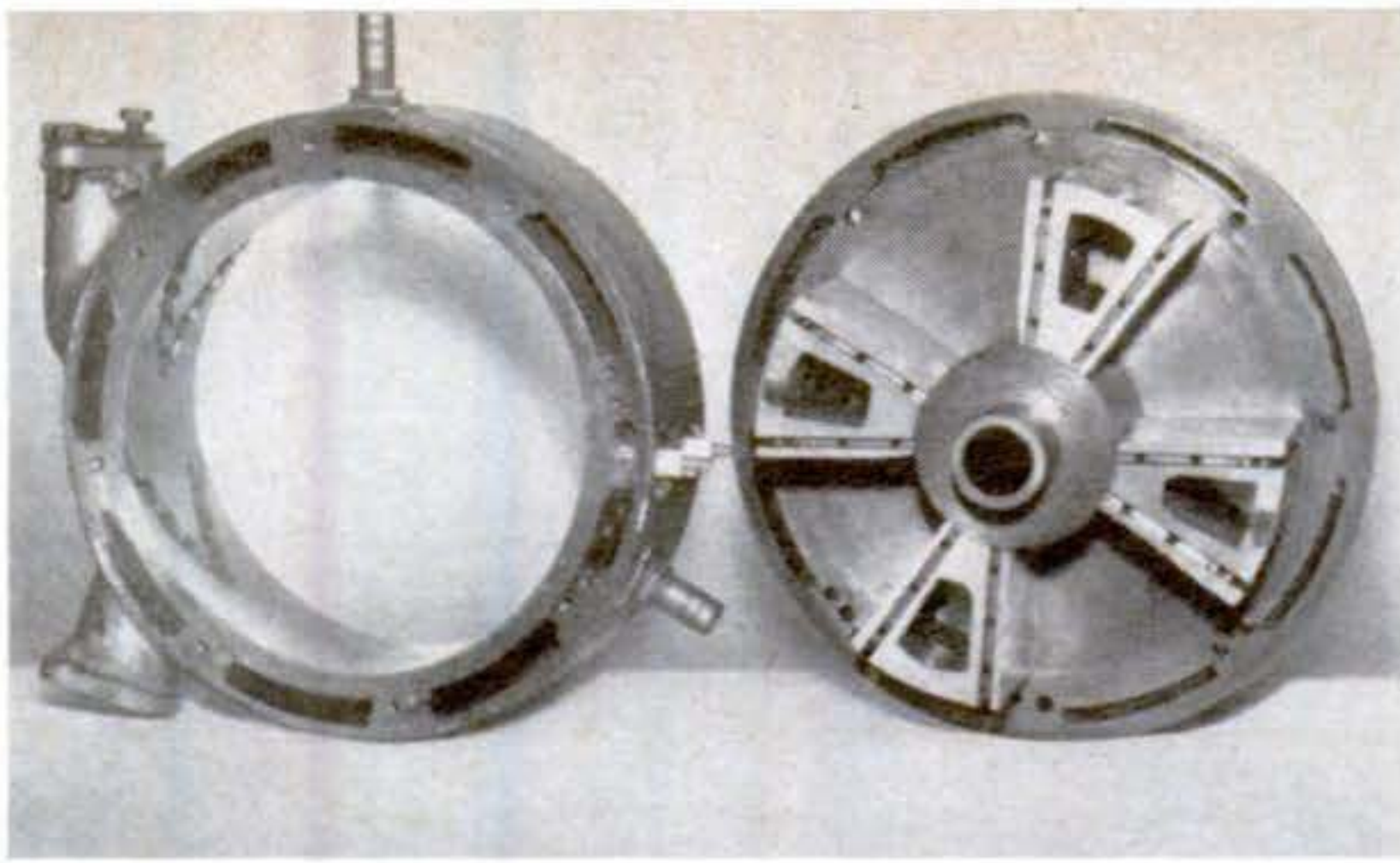


carried on each rotor. Each rotor also carries two rollers. These rollers bear against two identical cams fixed to the output shaft. The rollers rotate only because of friction against the cams. Power flow is achieved by having one roller push into a cam groove while the other assures positive cam location. The cam disengages from the rollers to allow one rotor to stop. When two pistons stop and restart, the engine obtains a change in the gas volume between the pistons. Piston travel, controlled by cam and

roller action, therefore directs intake, compression, combustion, and exhaust phasing. When one set of pistons stops, the other set continues to turn the output shaft. The shaft is eccentric in relation to the toroids and the rotors, and it makes 1.2 revolutions for each 360 degrees of piston travel.

Like the Kauertz, the Tschudi works on the four-stroke principle. Unlike the Kauertz, each toroid produces only two power impulses per output-shaft revolution. A practical Tschudi needs two toroids.





VIRMEL engine has two sets of vane-type pistons and a gear-and-crank system that controls piston phasing. It differs from the Kauertz in several respects, but works on a similar cycle. It produces four power impulses for each output-shaft revolution. The two vane sets are fixed to two concentric shafts, and there is a stationary sun gear. But in the Virmel engine, the sun gear has two satellites, each one with a crank linked to a lever splined to one of the two main shafts. Rotation of the satel-

lite gears and cranks directs piston acceleration and retardation. The satellites are always diametrically opposed on either side of the sun gear. Satellite rotational speed (and output-shaft speed) is steady, while one set of vanes is momentarily brought to a complete stop twice during each cycle.

In the Kauertz engine, the primary vanes run at steady speed—secondary vane speed varies. In the Virmel engine, both vane sets stop and restart.

Unlike the Kauertz, the Virmel has no through

heard of again, but none can be called worthless.

If you're interested in engines you'll realize that, in principle, any kind of a pump can be fitted with ports and a spark plug and be made to work as an engine. A piston-type pump would become a normal piston engine. A centrifugal pump would become a gas turbine. A vane-type pump could become any type of rotary engine.

Rotary engines come in four main groups:

1. Scissor-action types with pistons or vanes, such as Tschudi, Kauertz, and Virmel.
2. Eccentric-rotor types, such as Wankel, Jernaes, Sima, Rotom, and Isuzu.
3. Multirotor types, such as Walter, Schefel, and Walley.
4. Revolving-block types, such as Mercer, Selwood, and Porsche.

Most rotary engines claim to be smaller and lighter than reciprocating piston engines of comparable power. Rotary engines usually have fewer parts, particularly moving parts, and should be cheaper to produce. (For a rundown on the operating principles of the Wankel engine, see PS, April '66.)

The inner workings of the Kauertz and Tschudi engines are explained on the two previous pages. Swiss-born engineer Traugott Tschudi, now in New York, began to design his engine in 1927 and keeps improving it every year.

I went with Dr. Tschudi to the Blair Tool & Machine Corp. in Queens to see his engine. It seems to have inherent gas-sealing advantages over the Wankel, but a

drawback in the high stress loads on the cams and rollers.

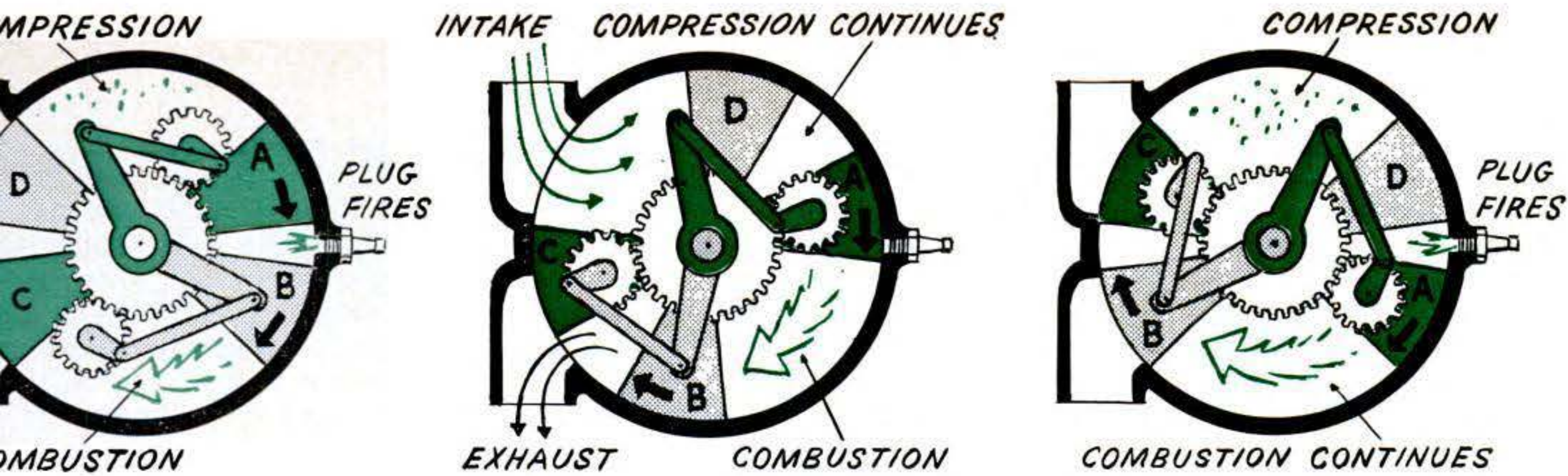
Eugen Kauertz lives in retirement in Huefingen in Southern Germany and spends his time inventing things. His engine may be put in production by the South African government. Hi-Pow'r Roto, which holds Kauertz rights for Canada, Japan, and Australia, is building a factory in Victoria.

The main drawback in the Kauertz engine seems to be the high inertial loads generated on the phasing vanes and transmitted to the frail-looking linkage. The same objection applies to the Virmel.

Melvin Rolfsmeyer's engine (Vir for his wife Virginia, Mel for himself) is the result of years of work with rotary engines. Displacement is 50 cu. in., and power output exceeds 300 hp. at 3,800 r.p.m. The Virmel is under development by the Lynx Corp. in Lincoln, Neb., for use in automobiles and motorboats. Rolfsmeyer also told me that an industrial concern in Toledo, Ohio, is interested in it.

Hans Maier of Stuttgart has built a similar engine in which the two coaxial main shafts drive a compound planetary gear train. Phasing the vanes is accomplished by eccentric pins fixed on the planet gears registering in radial slots in the two main-shaft ends. A closely related engine has been designed by Hans Fritz, an Austrian mechanic working in Judenburg.

J. C. Rayment of London has invented a similar engine with simplified gearing. It resembles the Virmel in that the sun gear is stationary and the planet gear drives the output shaft.



shaft. The two concentric main shafts do not continue beyond the sun gear and crank system. Power flow is taken via the satellite gears and crankshafts revolving at satellite speed to another planetary gear train. The satellites in both planetary gear trains simultaneously orbit and rotate. The final gear set reverses rotation in a 1:1 ratio to turn the output shaft in the same direction as the twisting force applied to the engine mass. This practically eliminates torque reaction, simplifies installation.

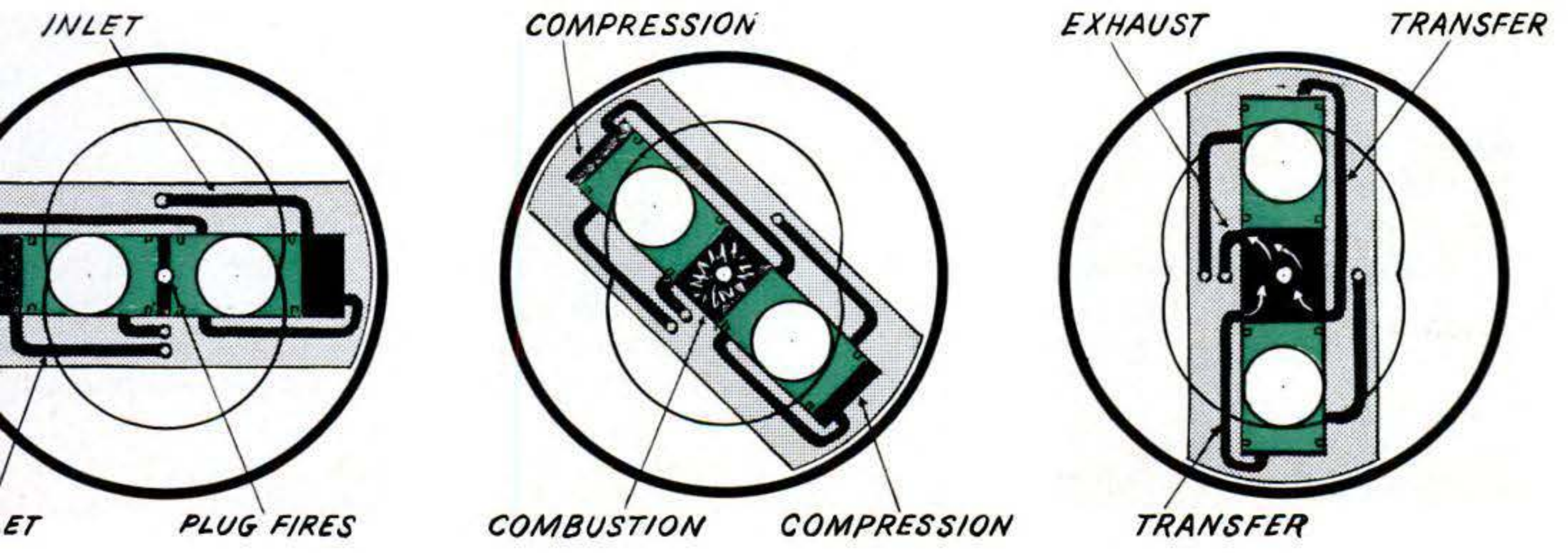
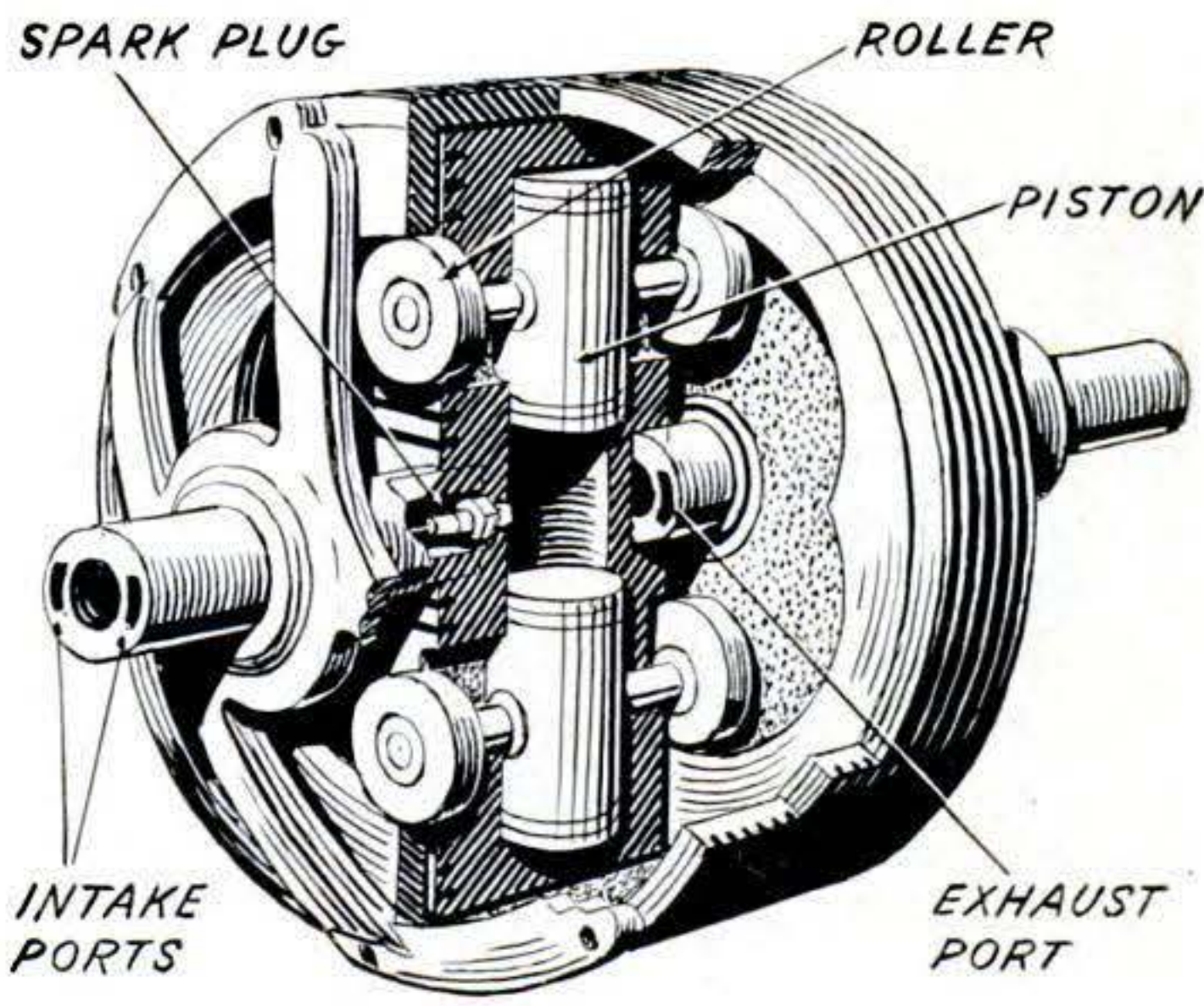
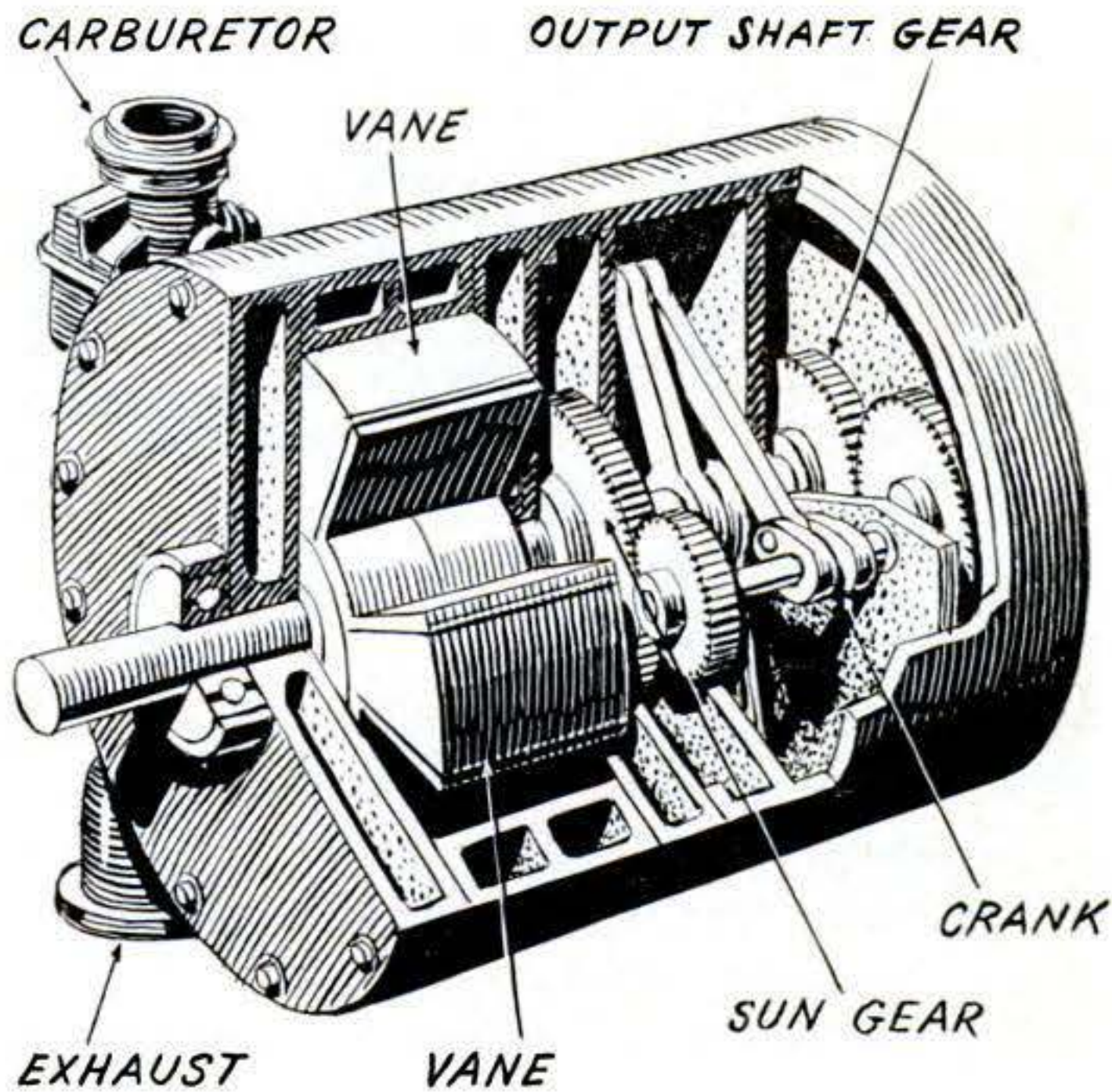
Who was first? The first eccentric rotary machine we know of is a water pump used by Agostino Ramelli in Italy in 1588 (see drawing).

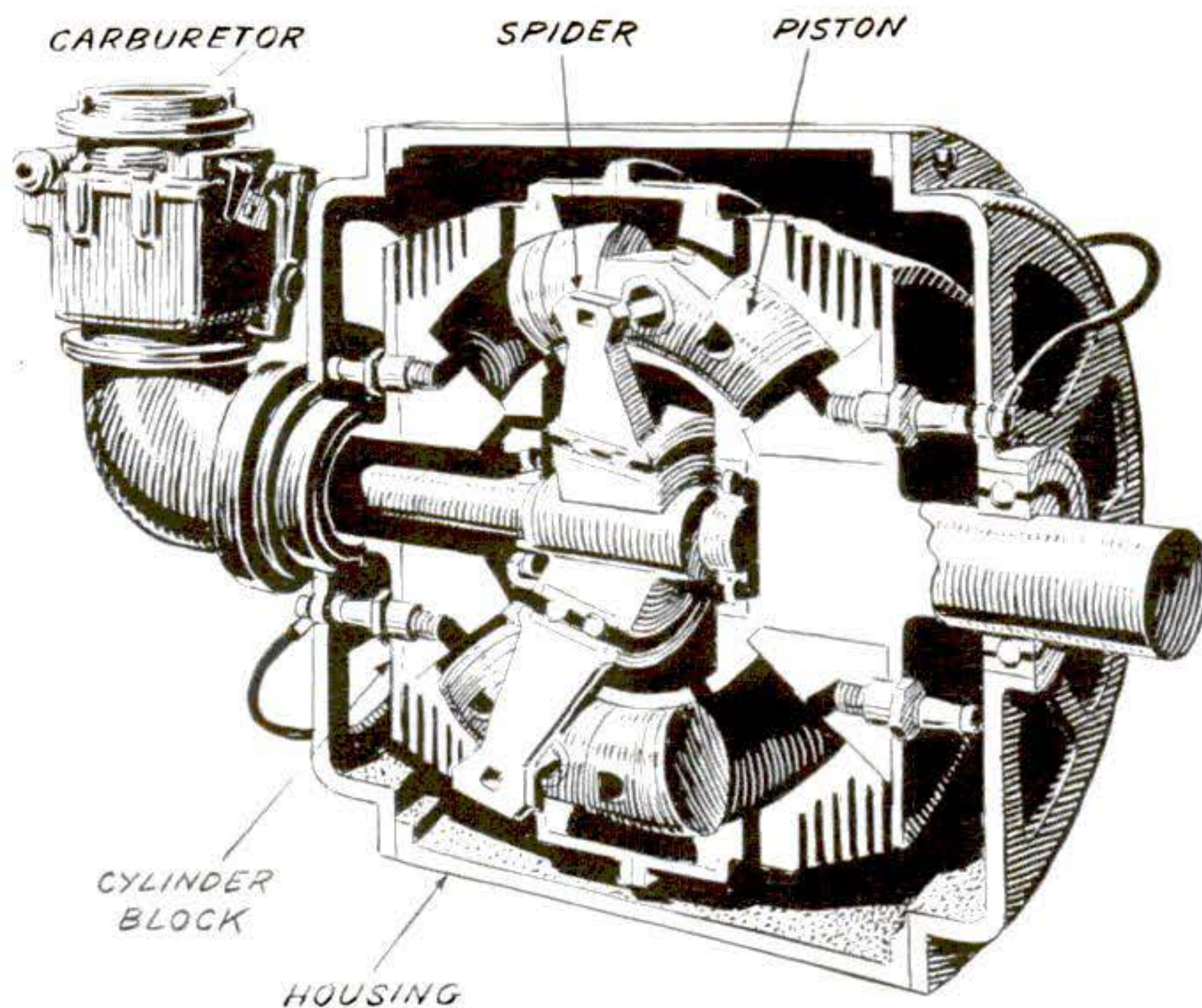
Next was James Watt, the Scottish steam-power pioneer. He proposed a rotary steam engine as early as 1759.

The Sima engine, a Dutch invention, is

Continued

MERCER engine consists of two opposed pistons in a single cylinder. Each piston pin works as the axis for two rollers. The rollers run on a track that looks trochoidal but is merely the peripheral track of two intersecting circles. Combustion in the center forces the pistons—and rollers—apart. The rollers can move outward only if the cylinder block turns. The output shaft revolves with the block. The only reciprocating parts are the pistons, and since they move in and out in unison, the engine is inherently balanced. The output shaft does not continue on the other side of the block. A hollow shaft at the other end carries the spark plug, feeds a gas mixture from the carburetor, and delivers lubricating oil. The exhaust ports are in the output shaft. The pistons open and close the ports.





SELWOOD engine is rotary in the sense that the cylinder block revolves, driving an output shaft, while the main shaft, which supports the spider and the pistons, is stationary. As the spider is fixed at a 15-degree angle, it works like a swash plate. The pistons run back and forth in toroidal tracks. Piston travel is possible only by letting the block turn. But the piston doesn't really reciprocate; it orbits around the main shaft and goes through 30 degrees of track travel in half an orbit. The next half-orbit, the piston moves 30 degrees back again. Like the Mercer, the Selwood works on the two-stroke principle.

When one side of a piston begins a power stroke, the other side starts a compression phase. The prototype has six pistons and works as a V-12.

based on the Ramelli pump. The eccentric circular rotor has three radial vanes, giving three combustion chambers. The Swiss machine tool company, Oerlikon, was working on a similar engine as early as 1911, using a turbocharger for larger intake-gas volume.

The Rotom engine is a related development. It was invented by F. E. Heydrich, a German engineer now in Australia. A circular rotor with two-piece vanes runs in an elliptical housing. It's a very small unit with 7.3-cu.-in. displacement, developing 17.5 hp. at 7,000 r.p.m.

The Gilbert engine, invented by H. S. Gilbert of Hove, England, has a circular rotor with two vanes, two rotary seals phased to open when the vanes pass, non-return valves in the intake ports, open exhaust ports, and two spark plugs. Main drawback is low thermal efficiency.

An engine now under development by Isuzu (see drawing) in Japan is based on John F. Cooley's patent of 1903. It comes very close to some of Wankel's early designs. Isuzu uses a two-lobe eccentric rotor in a housing whose cross section looks like an overhead view of a three-leaf clover. Renault in France has designed a four-lobe eccentric rotor engine, and American Motors has an agreement with Renault for its development.

Finn Jernaes, a Norwegian inventor, has taken the rotor and trochoid from Wankel but has come up with a novel type of gearing (see drawing).

Departures from the basic principle include such designs as the Geiger (see drawing), engines made by Emile Bousereau and by Marcel Fillols (both in France), and the Franke (see drawing).

Why multiple rotors? The idea behind multiple rotors is getting positive displacement of the gases by the interaction of rotors in permanent contact inside a close-clearance housing. The same principle is used in the Roots compressor.

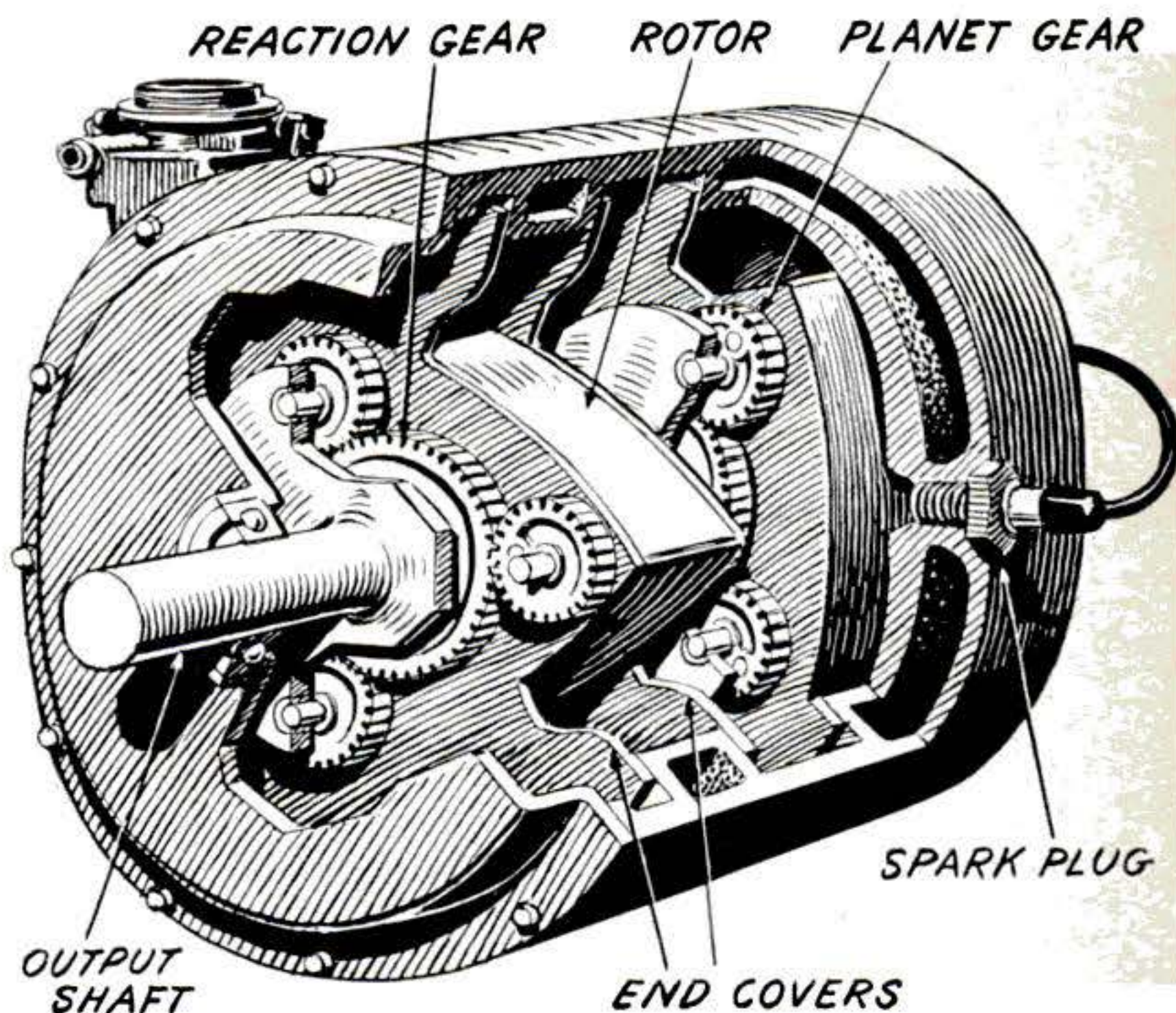
Instead of the two equal-size rotors of the Roots blower, the Walter engine uses oval-section rotors, one small and one large, inside a keyhole-shaped housing. It was designed in 1957 by Helmuth Walter, inventor of the Walter rocket motor. Walter now lives in the U.S.

C. E. Walley of Chester, England, runs his engine on the same principle but uses four oval-section rotors.

Walter Scheffel of Weissenburg, Germany, has an engine with no less than nine rotors. The rotor shafts double as intake and exhaust manifolds. There are four combustion areas. Apart from overcomplication, this design would suffer from torsional vibrations and cooling problems.

The revolving block. First engine with this feature was built in 1898 by F. O. Farwell. His design was used in the 1905 Adams-Farwell automobile. Its principles reappeared in the French Gnome-Rhone aircraft engine during World War I, and are now used for Mercer, Selwood, and Porsche rotary engines.

JERNAES engine is built up around a central output shaft with an integral circular disk. This disk works as the rotor hub. Unlike the Wankel rotor, the rotor has no internal gearing. Instead, the disk supports three planet gears running on eccentric shafts. These gears mesh with a stationary reaction gear mounted concentrically with the output shaft and the disk. Each planet gear has the same eccentricity, and they are spaced 120 degrees apart. As the rotor turns, it carries the planet gears along. They are phased to let the output shaft turn at rotor speed (instead of three times rotor speed as in the Wankel). Finn Jernaes claims that his gear mechanism makes for a big increase in torque at relatively low r.p.m. In other words, a four-stroke, single-rotor Jernaes engine produces the same number of power impulses per output-shaft revolution as a six-cylinder piston engine. Rotor side-sealing is ingenious: The end covers revolve with the rotors and are sealed with two simple rings on each side. Intake and exhaust ports in the casing are opened by holes in the end covers.



Austin Mercer of Bradford, England, continues to develop his engine [PS, Feb. 1964]. Now he has a completely redesigned unit (see drawing). It is lighter, smaller, and simpler. The cruciform cylinder block has been replaced by one cylinder, and the supercharger has been discarded.

Thinking along Mercer lines, Harry Leath designed a square-section block with four cylinders and placed a roller in each corner.

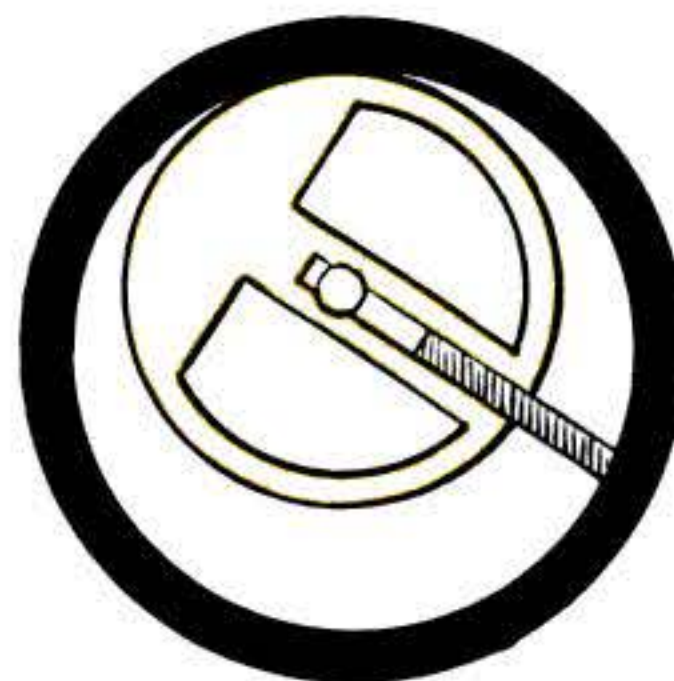
Porsche (sports-car makers in Stuttgart) patented a crankless engine in 1963. The four-cylinder cruciform block revolves in a cage, but, unlike Mercer and Leath, the Porsche gets its power on inward strokes. Each piston has a roller connected by belt-like links to the other rollers. All rollers are in permanent contact with a large two-lobe cam on the central shaft.

William R. Selwood of Southampton, England, decided to sponsor development of an engine (see drawing) invented by Cecil Hughes in 1952. Progress was slow, and now Selwood has sold the engine to a new company, Orbital Engineering, in Bristol. Hughes is still working on its development.

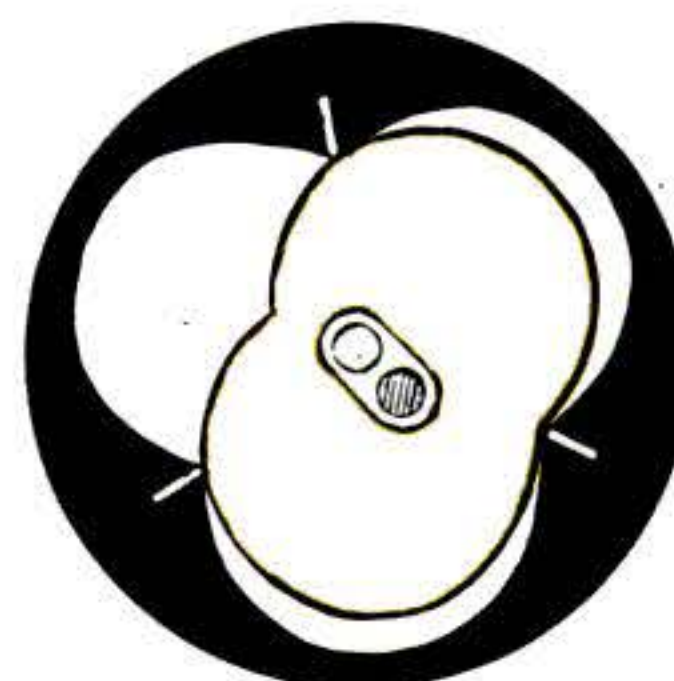
Development. That's the key word from now on. Inventing a rotary engine is the easy part. The difficulty lies in making it a *good* rotary engine.

Most of the engines in this survey claim to have solved the basic problems of sealing and cooling. But much remains. Their inventors and developers still know rela-

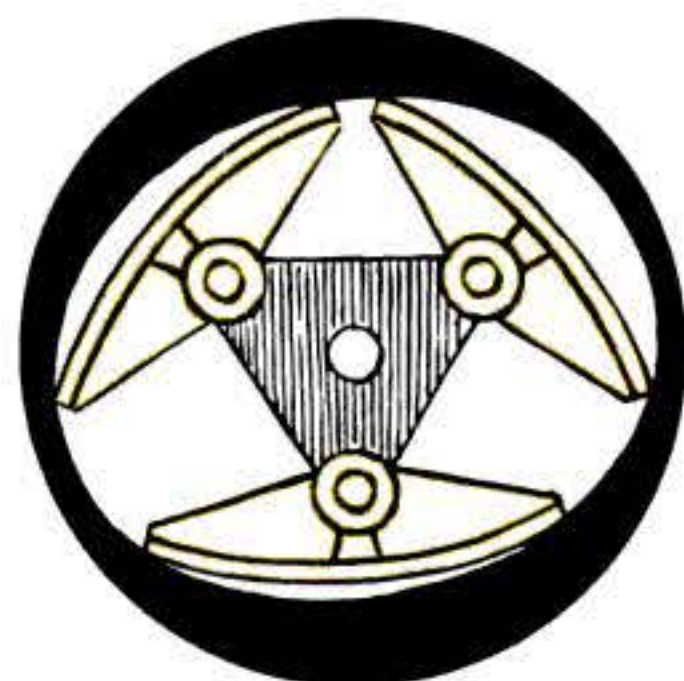
tively little about the effect of changes in porting, shape of combustion area, or spark-plug location and ignition timing. They have no clear idea of production costs, durability, and ease of maintenance. But there's no reason why the Wankel should be the *only* winner from the rich ranks of rotary engines. **PS**



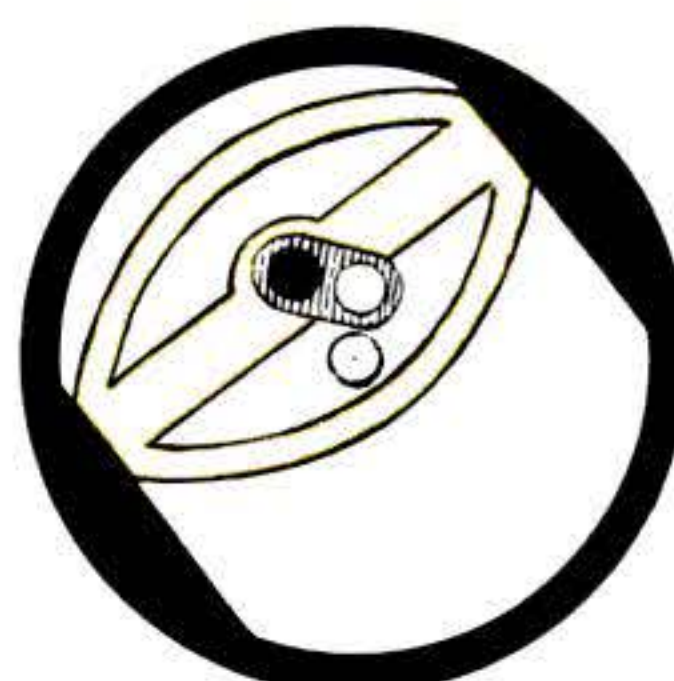
Ramelli's 400-year-old pump is the basis for Sima rotary engine—and today's exhaust-emission control pumps.



Isuzu in Japan is testing a 30-cu.-in. rotary engine with a trochoidal rotor running in a three-lobe track.



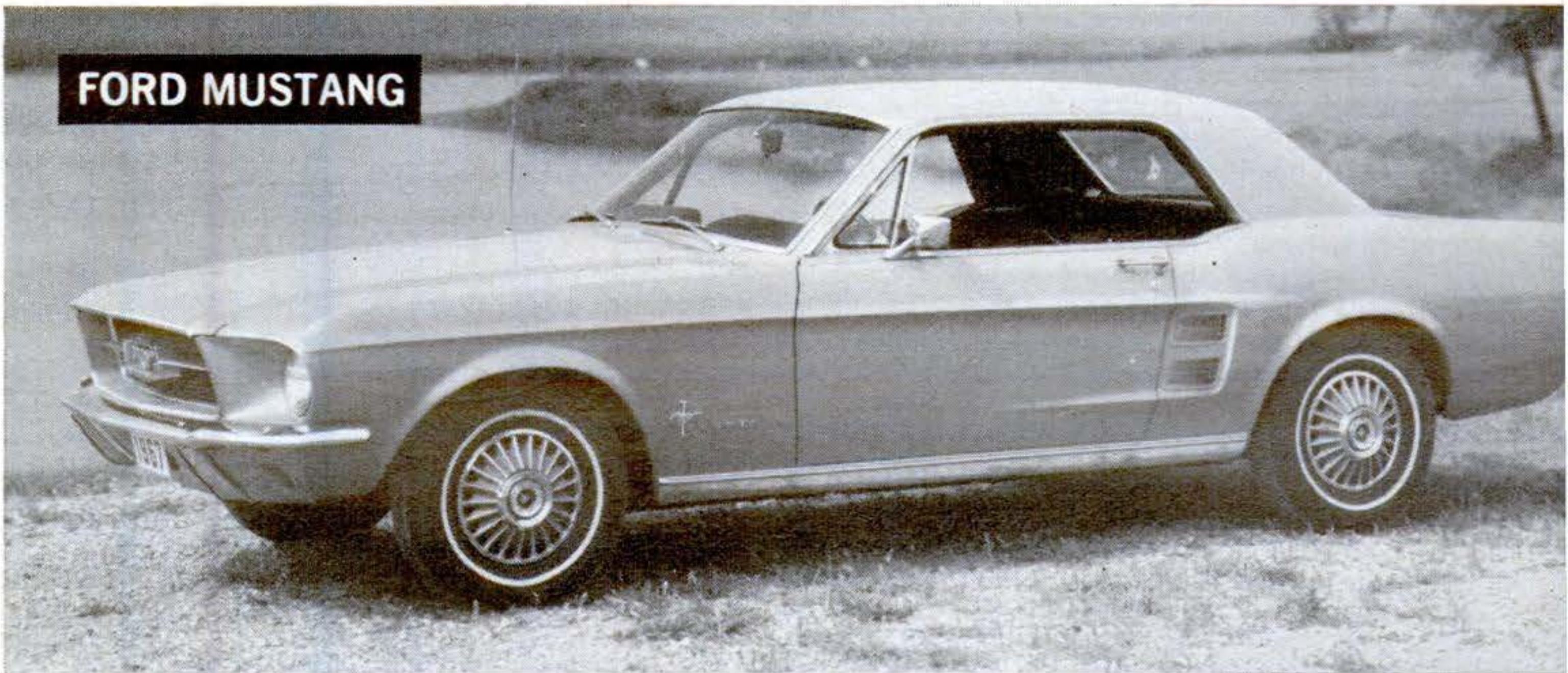
Geiger engine (1960) uses shoe-type pistons running in an oval-section reciprocation track. They pivot on a triangular rotor.



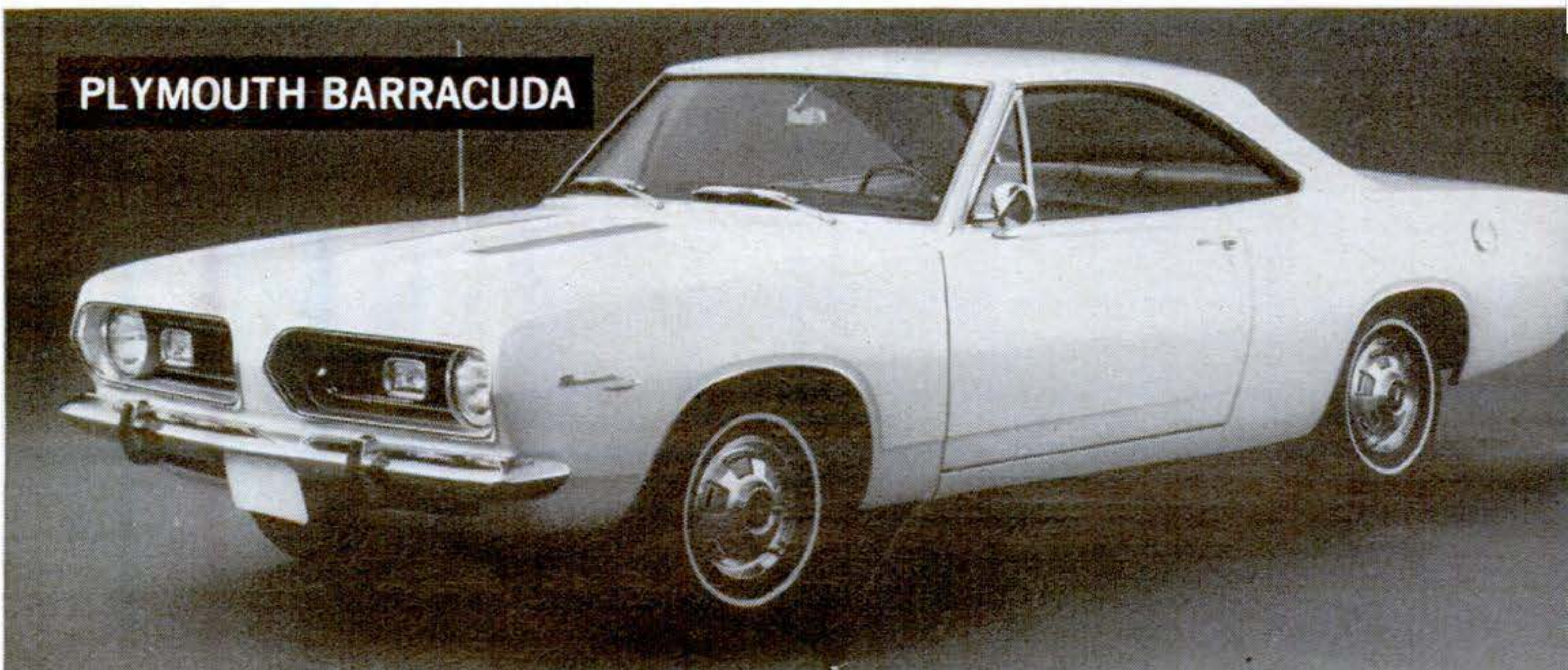
Franke engine (1963) is not truly rotary—it has an oval-section reciprocating piston. Pivot arm and crank turn the shaft.

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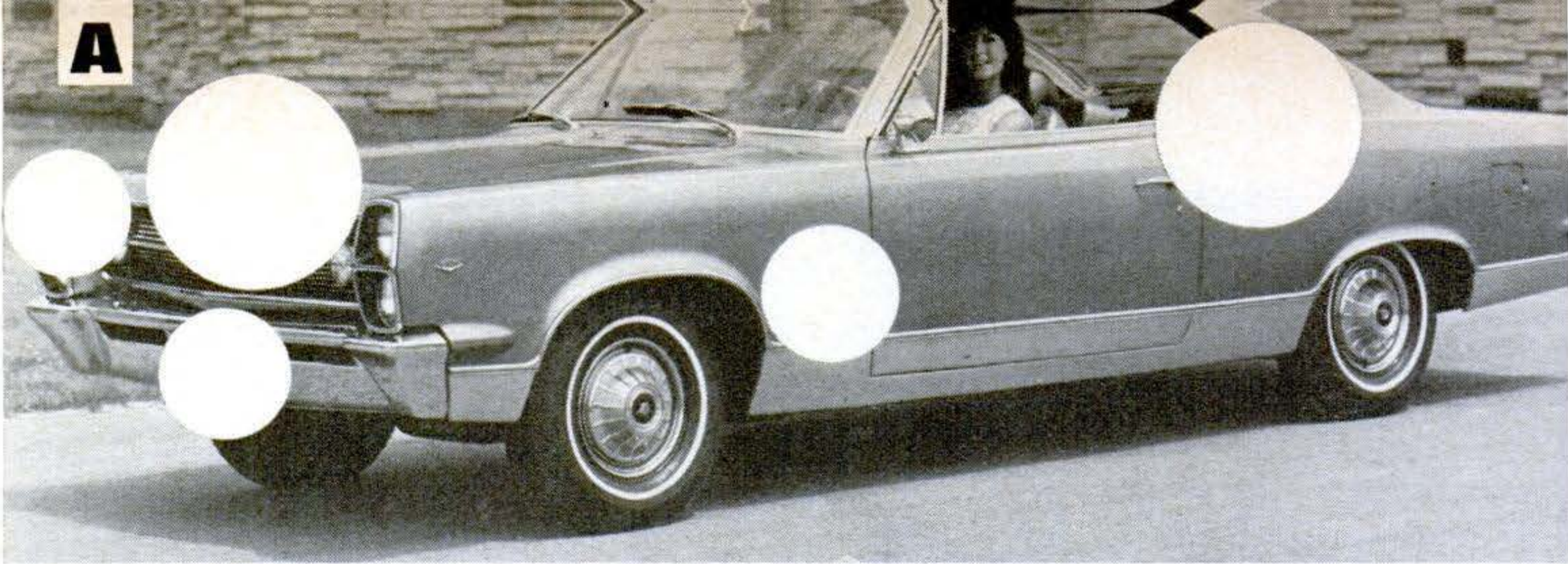


Rambler Rebel SST—and gasoline (1,000 gallons) to run it

How expert a car spotter are you?

Pictured on the following pages, partially hidden by Mystery Spots, are six 1967 popular-make cars you see in your town and on the highways every day. Identify four of the six shown—and you may be the winner of a brand-new car and 1,000 gallons of gasoline, or one of the other exciting prizes. For helpful tips, check the clue list on the next page, or visit your local car dealers for a close-up look at the actual cars





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OFFICIAL RULES for the PS Spot-the-Cars Game:

1. On the official entry blank—or on plain paper—identify four of the six cars you see pictured above; then print your name and address. No purchase is required. The issue of POPULAR SCIENCE may be consulted in libraries and reading rooms. Additional entry blanks can be obtained by mailing a request to Box 321, Collingswood, N. J. 08108.

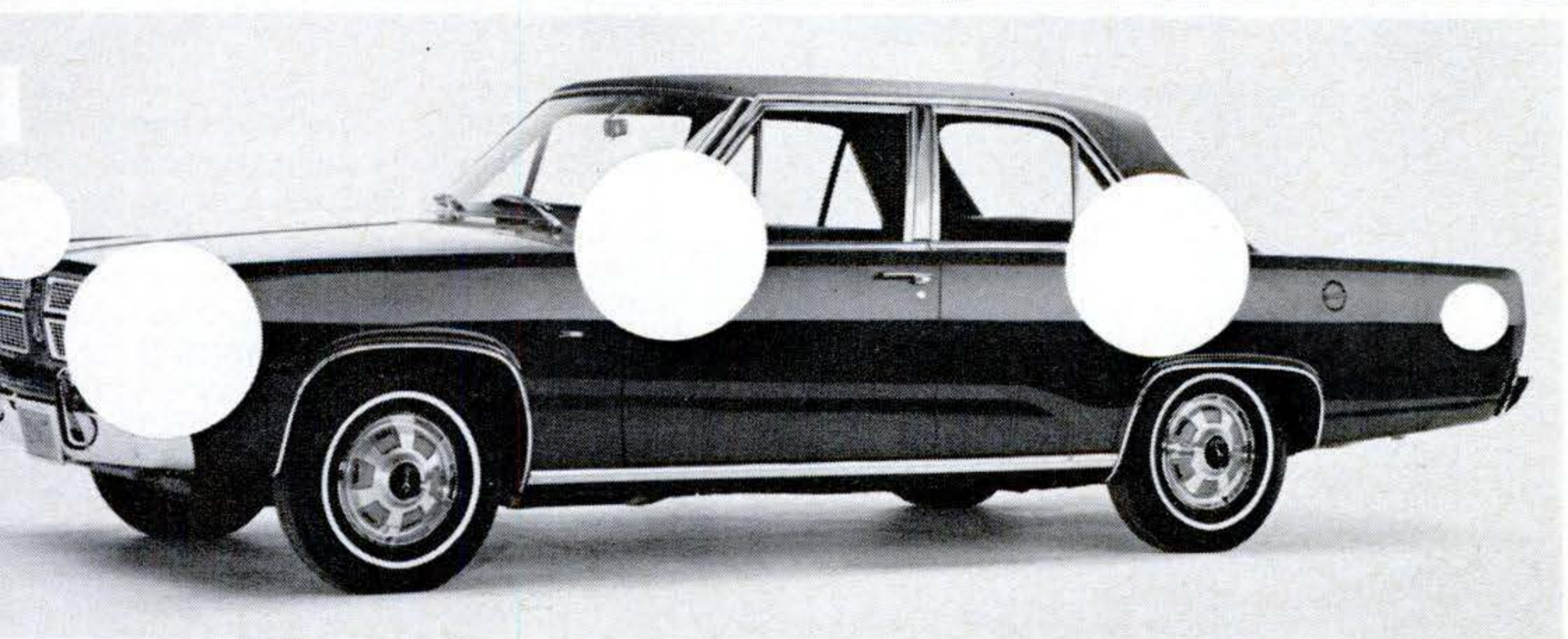
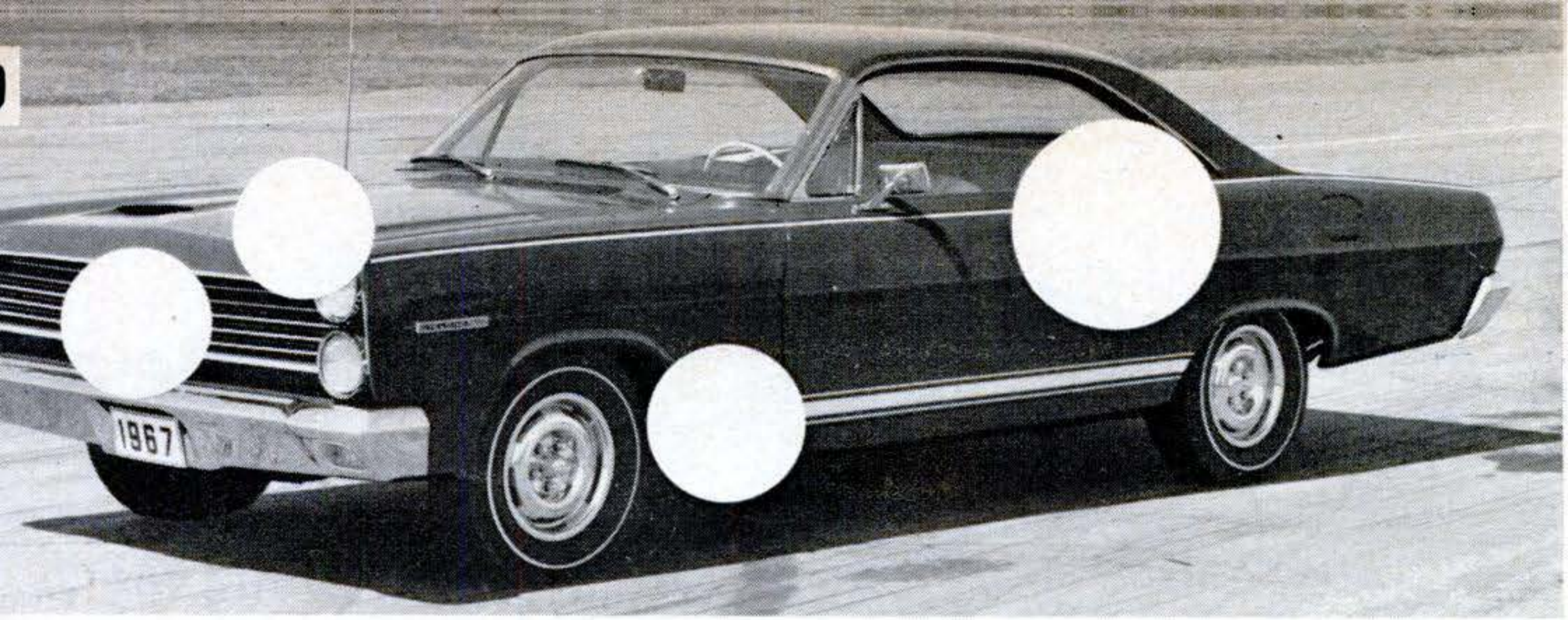
2. You may enter as often as you wish; each entry must be mailed in a separate envelope.

3. Mail your entry to Spot-the-Cars, Box 298, Collingswood, N. J., 08108. Entries must be post-marked no later than February 15, 1967, and re-

ceived no later than midnight February 25, 1967.

4. Winners will be selected in a random drawing from among all correct entries by Reiter-Ross Premium & Contest Division, Inc., an independent judging firm whose decision will be final. Only one prize to a family. Winners will be notified by mail within 30 days after the close of the contest.

5. All U.S. residents may enter the Spot-the-Cars Game, except employes (and their families) of POPULAR SCIENCE, Reiter-Ross and/or its advertising agency, or where prohibited by state or local laws or regulations. Taxes on prizes are responsibility of winners. No substitutions for prizes will be allowed.



NO PURCHASE REQUIRED TO ENTER

The correct names of the mystery cars are in this list:

- Chrysler 300
- Ambassador
- Mercury Marquis
- Buick Wildcat
- Oldsmobile 98
- Pontiac Bonneville
- Rambler Classic
- Dodge Dart
- Dodge Monaco
- Mercury Cyclone GT
- Chevrolet Corvette
- Plymouth Valiant

Spot-the-Cars Game, Box 298, Collingswood, N.J. 08108

The cars are:

(Please Print)

(A) _____

(D) _____

(B) _____

(E) _____

(C) _____

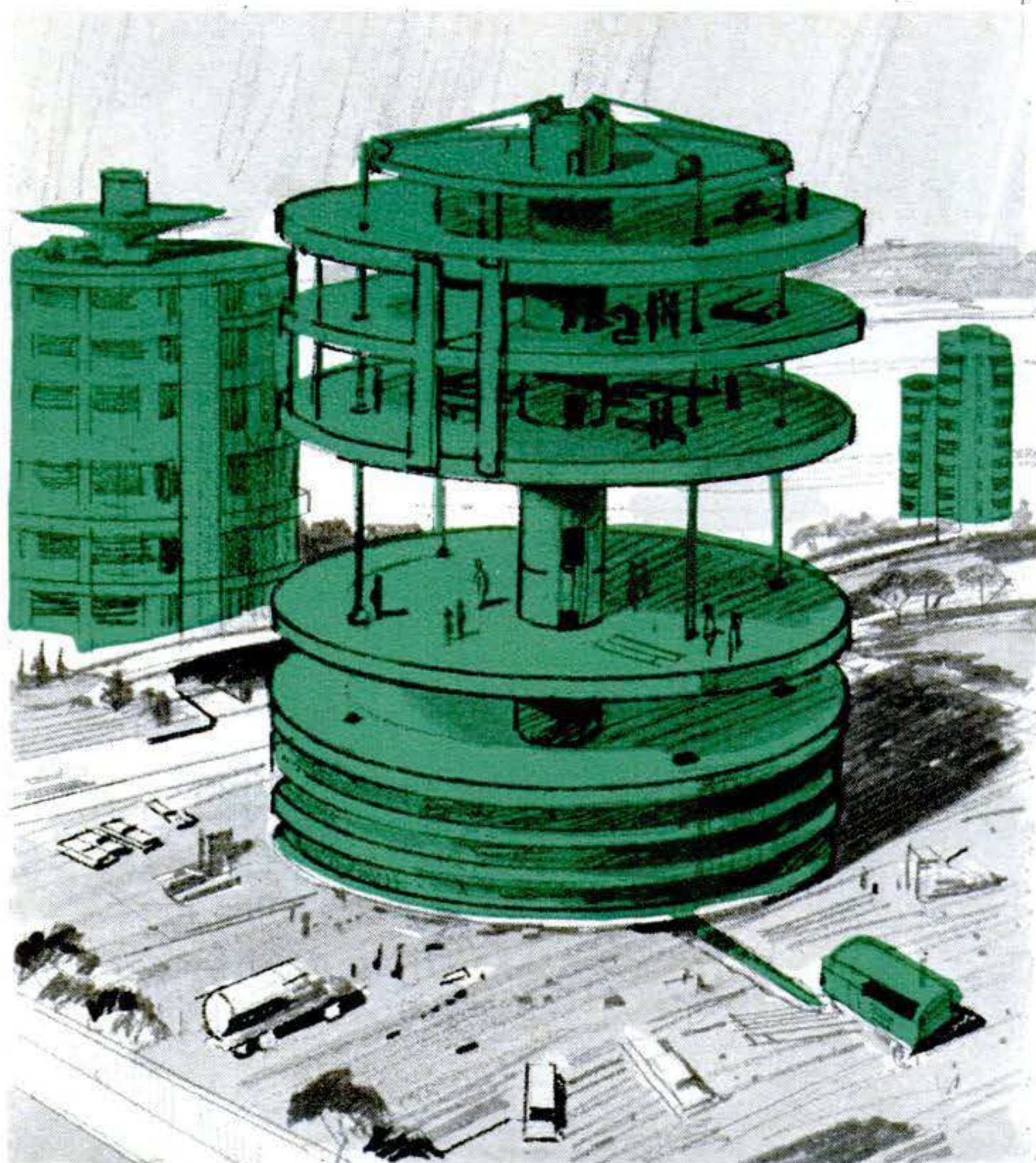
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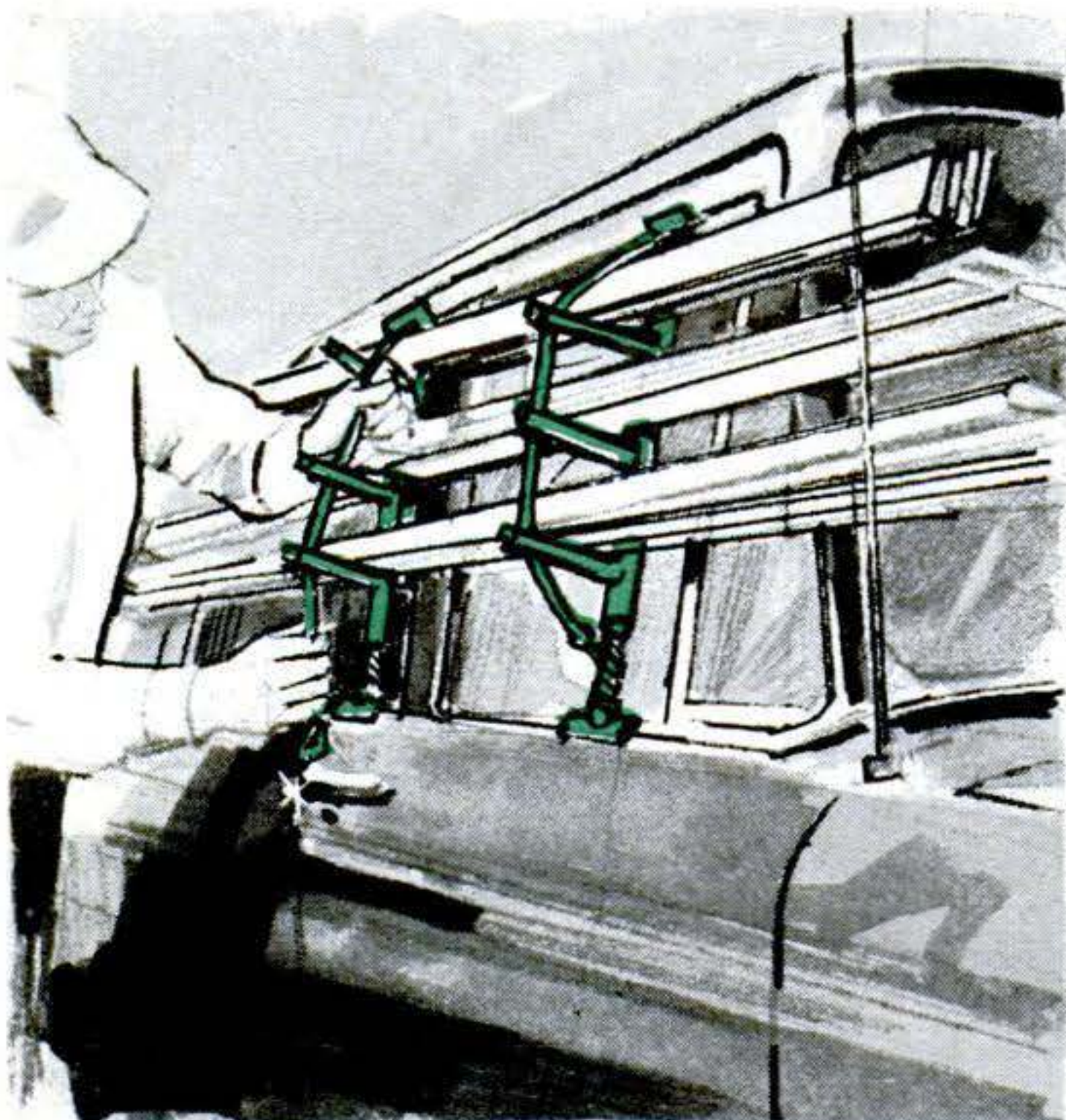
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Coming Next Month—More Opportunities to Win Prizes

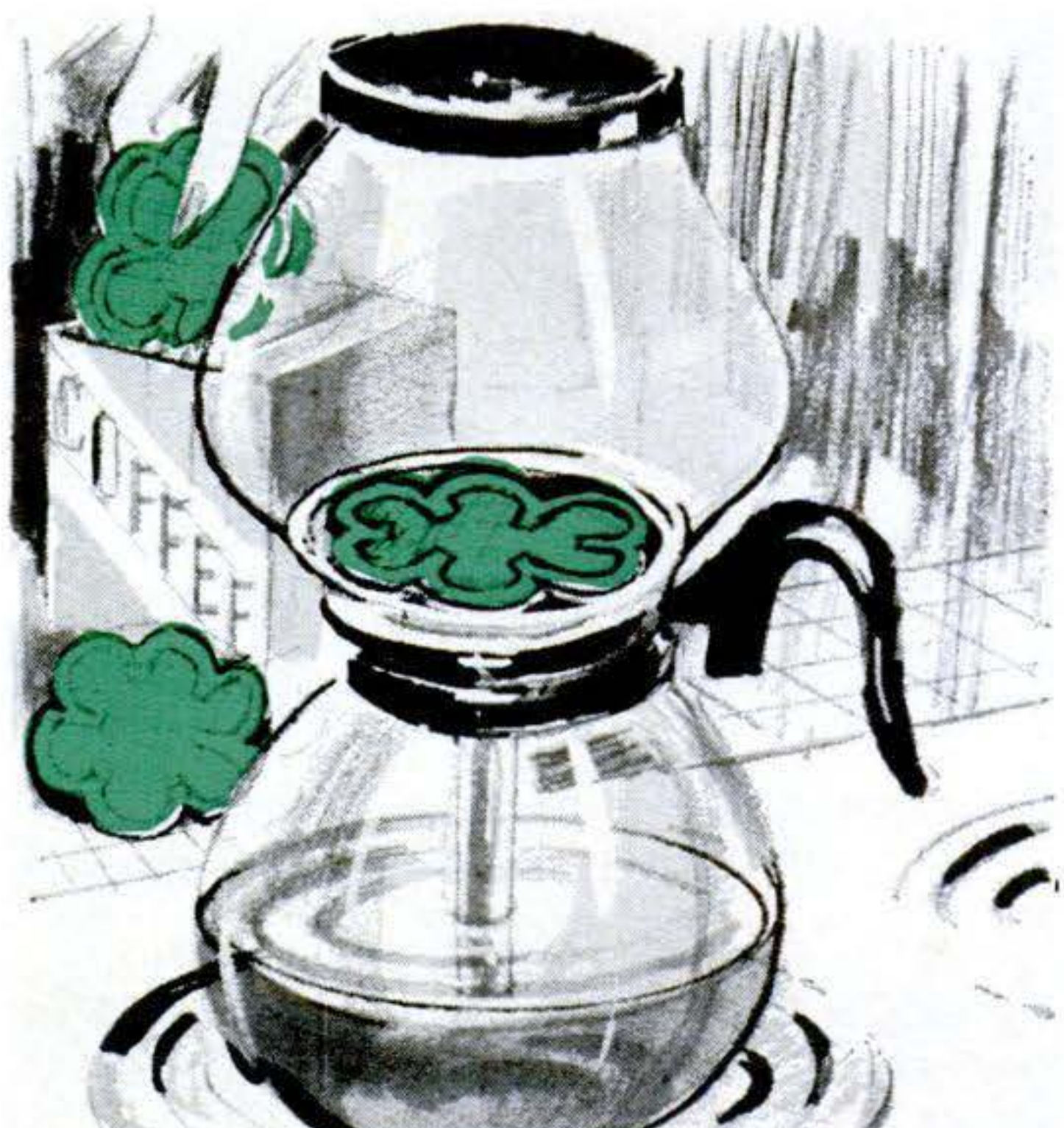


New Ideas from the Inventors

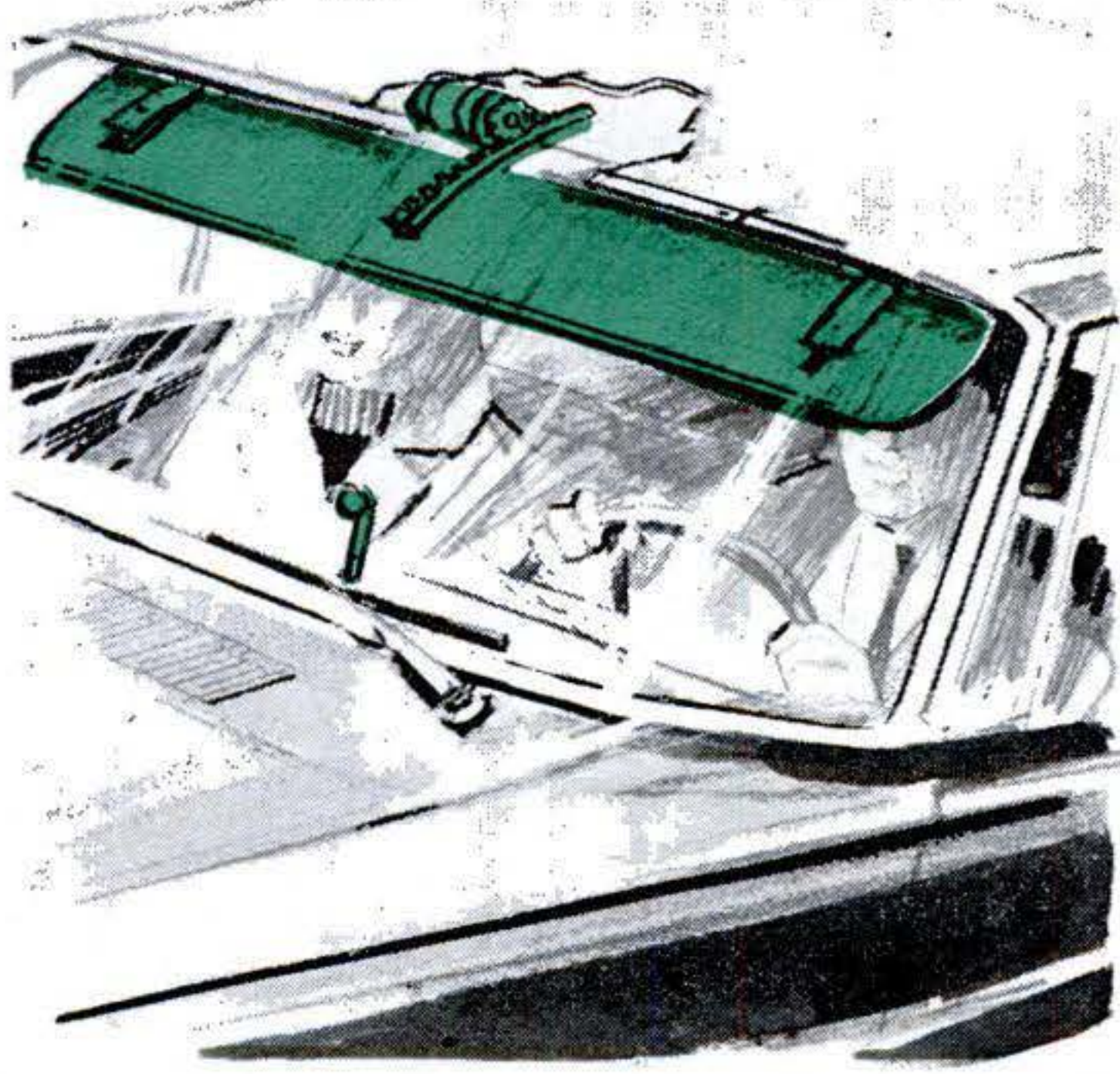
Building core raises floors. Tall buildings might be erected faster and at lower cost, according to this recent patent, if upper floors were formed at ground level around a central service core and then winched up, in order, into place, using the core as a support. Constructing floors on the ground would save money by eliminating booms and by using repetitive systems—the same forms could be used over and over, say, for concrete.



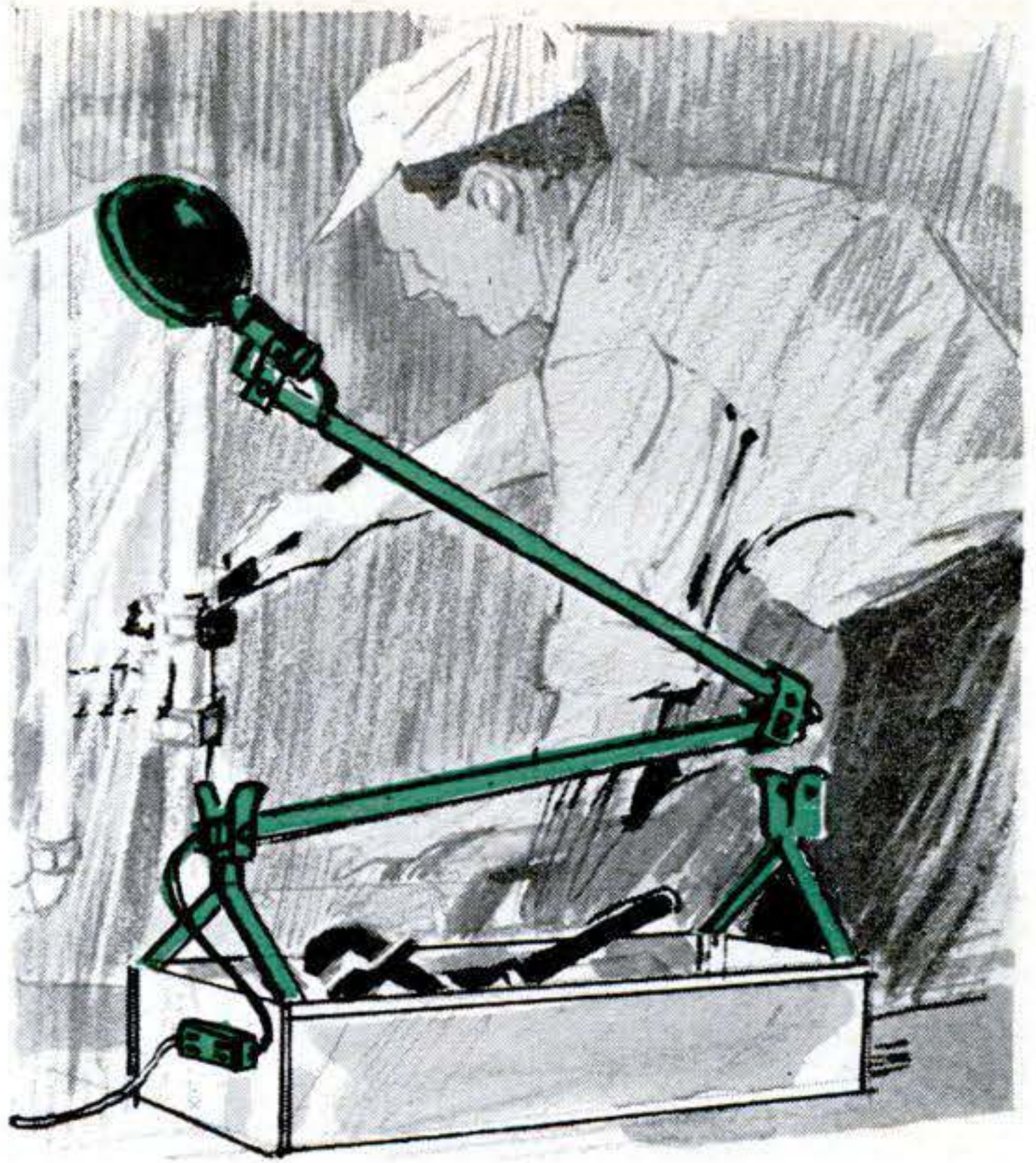
Window clips hold long loads. Adjustable racks that could be tightened inside the window frames of a car or station wagon would let you carry oversize lumber, pipe, or camping gear. Pegs projecting from the uprights would support the cargo, and a clip-on strap would snug it down. Padded plates at top and bottom would grip the window sills, and a locking screw adjustment would extend the rack to fit the opening.



Filter bag premeasures coffee. Uniform amounts of ground coffee packed flat in filter cloth or paper would fit into a standard vacuum pot to simplify both brewing and clean-up. Bags could be made in various sizes, or two or more could be used to brew larger quantities. Scalloped edges could let coffee flow down around the bags rather than through it, and thus, says the inventor, make the coffee taste less bitter.



Light adjusts powered visor. On signal from a light-detecting photocell mounted behind the windshield, an electric motor would slide this visor forward or back (or tilt a standard hinged type). According to this GM patent, the visor could be controlled by the same light amplifier used for an automatic headlight dimmer. A manual switch would override the photocell.



Tool tray lights your work. Metal rods that form the handle of this tool carrier would double as the hinged supports for a light that could be extended or angled to illuminate your work. Friction washers on the flattened ends of the rods would hold the light in any set position. The light connection would also provide extension outlets for plugging in power tools.



Copter spray fights fires. Forest fires are often spread by flaming treetops, so ground-level sprays and water drops can't fight them effectively. These floating tanks would have built-in noz-

zles to spray high branches. Several could be carried empty by a copter. The extras would fill themselves at a lake or pond while filled ones were being emptied while flown over a blaze.

The following patents have been issued on these inventions: **Stacked-floor building**—No. 3,260,028 to R. L. Fraser, Memphis, Tenn.; **Car-window rack**—No. 3,007,582 to A. E. Lindstrom, Silver Bay, Minn.; **Coffee bag**—No. 3,208,854 to A. A. Hediger and V. K. Michel, Wilmette, Ill.; **Powered visor**—No. 3,226,151 to A. H. Reuther, Dayton, Ohio; **Tool-tray light**—No. 3,231,730

to C. M. Wagner, Steeleville, Ill.; **Fire spray**—No. 3,220,482 to K. A. Eveleth, Clarksville, Ohio.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 50 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.



Wheelie-Bar attachment is made of steel tubing and skate wheels.

Drag bike rides high on Wheelie-Bars

Bikes are pointing their noses in the air nowadays with the help of a new gadget called the Wheelie-Bar. By attaching the device to the rear of your cycle, you can tilt back on the hind wheel; wooden skate rollers at the end of the bar let you ride high, the way stock-car dragsters do. The new bike bar costs about \$12 and is made by the Wham-O Co., which introduced the contraption recently at a Los Angeles track where races were held over a 50-yard course. Times set by the participants, seven to 16 years old, ranged from 4.8 seconds to 6.4 seconds for the distance. Wham-O plans to stage contests around the country for bikes equipped with their Wheelie-Bars.

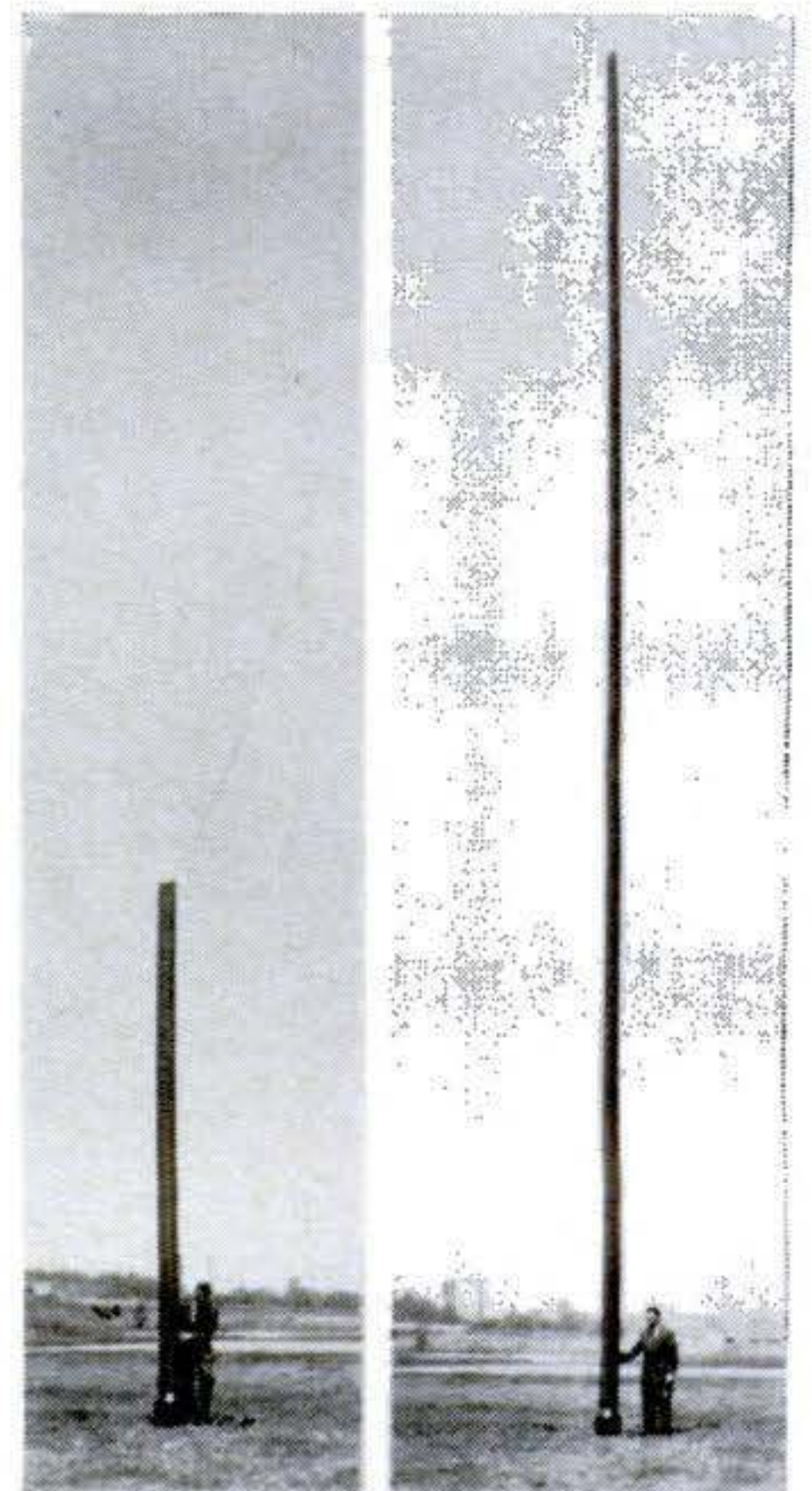


Drag-bike racers get off to a good start at a track in California.

Giant antenna collapses into a knapsack



Technician unhooks a knapsack that holds inflatable antenna.



Antenna mast is partly raised at left, at full height at right.

A 60-foot collapsible antenna is now being used by U.S. troops fighting in Vietnam. The plastic antenna fits in a backpack and can be quickly foot-pumped up for long-distance communications in jungle areas with tall obstacles. The antenna gives radios a 25-mile range compared with a maximum of one-fifth mile for radios with whip antennas when foliage blocks signals. The device is manufactured by the Goodyear Aerospace Corp.

Called more dangerous than narcotics by many, LSD—when properly used—may be a potentially valuable drug in the fight against illness

Twenty-three years ago, a Swiss chemist swallowed by accident a tiny speck of a newly concocted drug that made him see bizarre visions. Today that drug, LSD, has become the most controversial of any ever developed.

Known as the “acid,” the “cube,” the “trip-maker,” it is so much the “in” drug among thrill-seekers, so widely abused, that it has given rise to national hysteria, complete with sensational press coverage, beatniks, college students, Congressional investigations—and with scientists worried that a valuable tool is going to be cast into limbo, lost to serious scientific use.

Stories—true ones—of people taking LSD for kicks, for dazzling, mystical inner journeys, only to end up in abject terror, even in insanity, abound. New York’s Bellevue Hospital has been getting two a week. In Los Angeles, the University of California’s medical center had 70 in seven months.

Medical authorities have warned that, indiscriminately used, LSD is “the most dangerous drug on the illicit market—more dangerous than heroin because a single dose may cause permanent derangement.”

States have rushed to make its sale a felony.

But researchers, working with LSD, have reported that it appears to be valuable in many ways—in the treatment of alcoholism, of neurotic illnesses, of severely disturbed children; in easing the suffering of patients with incurable cancer and of others with intolerable pain. They credit it with providing a new insight into schizophrenia and revolutionizing the whole approach to this most important of all mental-health problems, the one that fills 25 percent of all hospital beds in the country.

Says Dr. Sidney Cohen, associate professor of medicine at UCLA: “Just as hypnosis was lost to us for 50 years—while it was used on the vaudeville stage and in the parlor—the same is going to be true of LSD.”

What’s the real story behind LSD? If it is an extremely dangerous drug, how can it also be a potentially very useful one? What will we lose if research with it collapses? What’s the whole score on why science needs it despite its abuse—in fact, all the more urgently because of that abuse?

A millionth of an ounce—that’s all it takes for LSD to produce its weird effects.

LSD

The other side of the story

By LAWRENCE GALTON

Continued

JANUARY 1967 | 93

To some, LSD means hope—a drug that

Even now, after more than 20 years of research, investigators aren't certain exactly how the drug works. One thing they know: It alters the brain's chemical make-up. According to one theory, it acts on serotonin, a body chemical. Serotonin is involved in the regulation of nervous activity, and LSD sets off nervous changes.

A Swiss chemist, Dr. Albert Hofmann, discovered it while working with ergot, a dark purple fungus that blights cereal grains. Ergot contains lysergic acid. Hofmann, adding a few chemicals, created the powerful LSD, which stands for lysergic acid diethylamide.

Recalling his personal experience with it, Hofmann says: "I lost all control of time; space and time became more and more disorganized. I felt as being outside of my body. I thought I had died. My 'ego' was suspended somewhere in space and I saw my body lying dead on the sofa."

A clue to schizophrenia?

Schizophrenia is one of the most devastating and widespread of all illnesses. One of every 100 people in the world has, has had, or will have the disease, which removes people from reality; makes them see, hear, feel, smell illusions; gives some delusions of being persecuted, others of being all-powerful, and makes some withdraw into a stupor.

Mostly, schizophrenia has been regarded as a psychological disturbance—a result of something wrong in childhood, something that warped personality. A few investigators thought it just might have an organic basis. Then came LSD, which could produce in some people symptoms much like those of schizophrenia. Investigators didn't think LSD was the cause of schizophrenia. But if a chemical in such tiny amounts—no more than one 70-millionth of a man's body weight—could have such distorting effects, then it seemed likely that some other chemical produced in the body could cause schizophrenia.

LSD soon was coming in for other study. Investigators began to note that volunteers, taking carefully controlled doses of the drug, could with skilled questioning be made to recall long-forgotten events.

Could LSD help compulsive drinkers by getting at the source of their compulsion?

In one Canadian study at Union Hospital, Moose Jaw, Sask., 29 men and four women alcoholics were treated with LSD. The drug seemed to work two ways. It gave the patients insight; it also deepened their relationship with psychiatrists. Six men and one woman, in follow-up periods of up to 88 weeks, completely abstained from drinking; nine other men and one woman cut down markedly.

This past summer, at a University of California conference on LSD, another Canadian researcher, Dr. Abram Hoffer of the University of Saskatchewan College of Medicine, reported that where, ordinarily, only 10 percent of severe alcoholics treated by the usual means are expected to be helped, in his experience about 50 percent of 700 cases given LSD since 1953 have controlled their drinking, some of them remaining continually sober.

Of all the mentally ill, perhaps the most pathetic are children with autistic schizophrenia—so severely disturbed they can't speak, can't relate to people, keep making meaningless continuous rhythmic movements such as flapping their arms.

LSD has shown promise in helping these children. At UCLA's Neuropsychiatric Institute, Dr. James Q. Simmons reports that the drug reduces their bizarre movements. It also makes them more approachable and receptive to treatment.

LSD and psychotherapy

There have been studies of LSD as an aid to psychotherapy for patients with emotional problems. Cary Grant, who took LSD under the supervision of a psychiatrist, has written in his autobiography:

"The chemical releases the subconscious so that it becomes apparent to yourself. So that you can see what transpires in the depths of your mind . . . and learn which misconceptions, guilts and fears, with their resultant repressions, inhibitions and insecurities have formed the pattern of your past behavior . . . I learned a great deal—and the result of it all was rebirth . . . an immeasurably beneficial cleansing of so many needless fears and guilts, and a release of the tensions that had been the result of them."

Last August, a report in *Diseases of the Nervous System* detailed dramatic benefits.

may help cure crippling mental diseases

One case involved a 24-year-old woman who, during pregnancy, went into a state of agitated depression. When she tried suicide, electroshock was used. That helped, but two days after giving birth to her baby, she went into depression again and nothing would bring her out of it.

As a last resort before committal to a mental institution, three LSD treatments were tried. She began to talk and for the first time reveal the basis for her depression. She had been raped at the age of 11, had never told her family. Not long afterward, her five-year-old brother had died in a hospital. She had become convinced "his death must be a punishment for what I had done." Ten days after the LSD treatment, she could be discharged.

LSD also appears to have value as an analgesic for patients in intolerable pain—and for mollifying the emotional and mental suffering of the gravely ill.

In a first preliminary report three years ago, Dr. Eric C. Kast of the Chicago Medical School told of a study with 50 patients in extreme pain from cancer, gangrene, or severe burns. Large doses of powerful narcotics gave them relief for two hours. With LSD, they were free of pain for 32 hours. But only one-fourth wanted another dose. Apparently, most had difficulty handling the upsurge of subconscious activity from the drug. What was needed, it seemed, was a way of making the LSD experience more acceptable.

A few months ago, Dr. Kast made a promising second report. He had given LSD to 80 patients with incurable cancer. Again, excellent pain relief. Then, six to 10 hours after LSD administration, another drug, chlorpromazine, was given to counter the hallucinatory effects. Now only 10 percent of patients didn't want to repeat LSD. All the rest benefited, and not only from pain relief; they had greater insight, greater lucidity of mind. The drug increased communication between patient and doctor, and between patients and relatives.

Will LSD research continue?

There is a rising feeling among physicians that LSD may have great promise, but much work remains to be done before the drug's value can be fully evaluated. As things stand now, they fear LSD research

work has been put into limbo by the current furore.

Illicit use of LSD on a widespread scale has been attributed to the publicity given the experiments conducted at Harvard by psychologists Timothy Leary and Richard Alpert, who were dismissed from the faculty in 1963. Their students who took the drugs described ecstatic experiences. After leaving Harvard, Leary and Alpert founded the International Foundation for Internal Freedom, dedicated to promoting use of hallucinogens. Many amateur experimenters interested in mysticism tried LSD.

A few months ago, Leary, who sees in hallucinogens such as LSD opportunities for unplugging the human mind, getting rid of inhibitions, and transforming "our concepts of human nature, of human potentialities, of existence," established a new religion, the "League for Spiritual Discovery," which is to guide initiates in achieving "chemically induced dialogue with the inner person." For an hour a day at a home shrine, each member will meditate and then once a week take a full-fledged trip.

Leary, as the high priest of the free use of hallucinogens, has been lashed at by Dr. James L. Goddard, head of the Food and Drug Administration. The Learys of this world, Goddard says, are "wrong in science, wrong in ethics, and wrong in social responsibility." LSD, he points out, is "erratic" and "unpredictable." Those who use it outside of strict medical controls are engaging in "chemical Russian roulette."

The black market in LSD

For medical research, the legal makers, Sandoz Pharmaceuticals, Hanover, N.J., packaged LSD in tablets, powders, ampoules. But LSD on the black market is sold as a drop of liquid on a cube of sugar—at \$5.

It's a growing, profitable racket. Despite stories that any college or even high-school student with a bit of knowledge of chemistry can concoct LSD, it takes a good organic chemist to do the job. Most black-market LSD, with the same hardened criminal element that pushed narcotics now pushing the cubes, is smuggled into the country, believes Lewis P. Lasher of the FDA's new Bureau of Drug Abuse Control. Lasher figures that a company making

[Continued on page 200]

Prestige cars for the budget-conscious: Pontiac Catalina, Mercury

We have felt for some time that car tests should include more information of real value to the car buyer. As the traffic picture and the use of automobiles change, test reports must change, too. We have added several new and exclusive test procedures. We drive the cars under a variety of conditions. We check interior equipment, accessories, and all aspects of comfort and convenience. We believe you will find our Norbye/Dunne Report the most comprehensive new-car evaluation ever offered to American auto buyers.

By JAN P. NORBYE / PS Automotive Editor PHOTOS BY BILL MORRIS

Pontiac now enters its fourth consecutive year as Number Three (behind Chevrolet and Ford) in the production race, and we decided to test the lowest-priced full-size Pontiac together with cars of similar price, size, and performance from Ford Motor Co. and Chrysler Corp. Although the big Pontiac outsells Mercury three to one and Dodge four to one, the Monterey and the Polara are, from a product viewpoint, the Catalina's closest rivals.

One thing has been obvious since the '67s were announced [PS, Oct.]: Engineering philosophy is quite unconventional at Pontiac. One important example: gearing. The Catalina has a 2.29:1 axle ratio, which means that the car does over 27 m.p.h. per 1,000 engine revolutions. The Mercury is geared for 22.5 and the Dodge for about

24 m.p.h. at the same engine speed. The chart on the facing page shows the radical shift points chosen by Pontiac. Under full-throttle acceleration, it stays in intermediate up to an astonishing 98 m.p.h.

In acceleration from standstill, the Catalina has a slight edge on the competition. The 25-70-m.p.h. tests also showed Pontiac best: 9.7 seconds against the Mercury's 10.1 and Dodge's 10.5.

All our tests are tests of the complete vehicle, not just one of its systems. Our stopping test is more than a test of the brake system. Weight transfer, suspension geometry and spring rates, and tire size and design all affect a car's stopping ability and its stability under braking. We measure stopping distance in a 12-foot-wide lane from 60 m.p.h. after warm-up, and

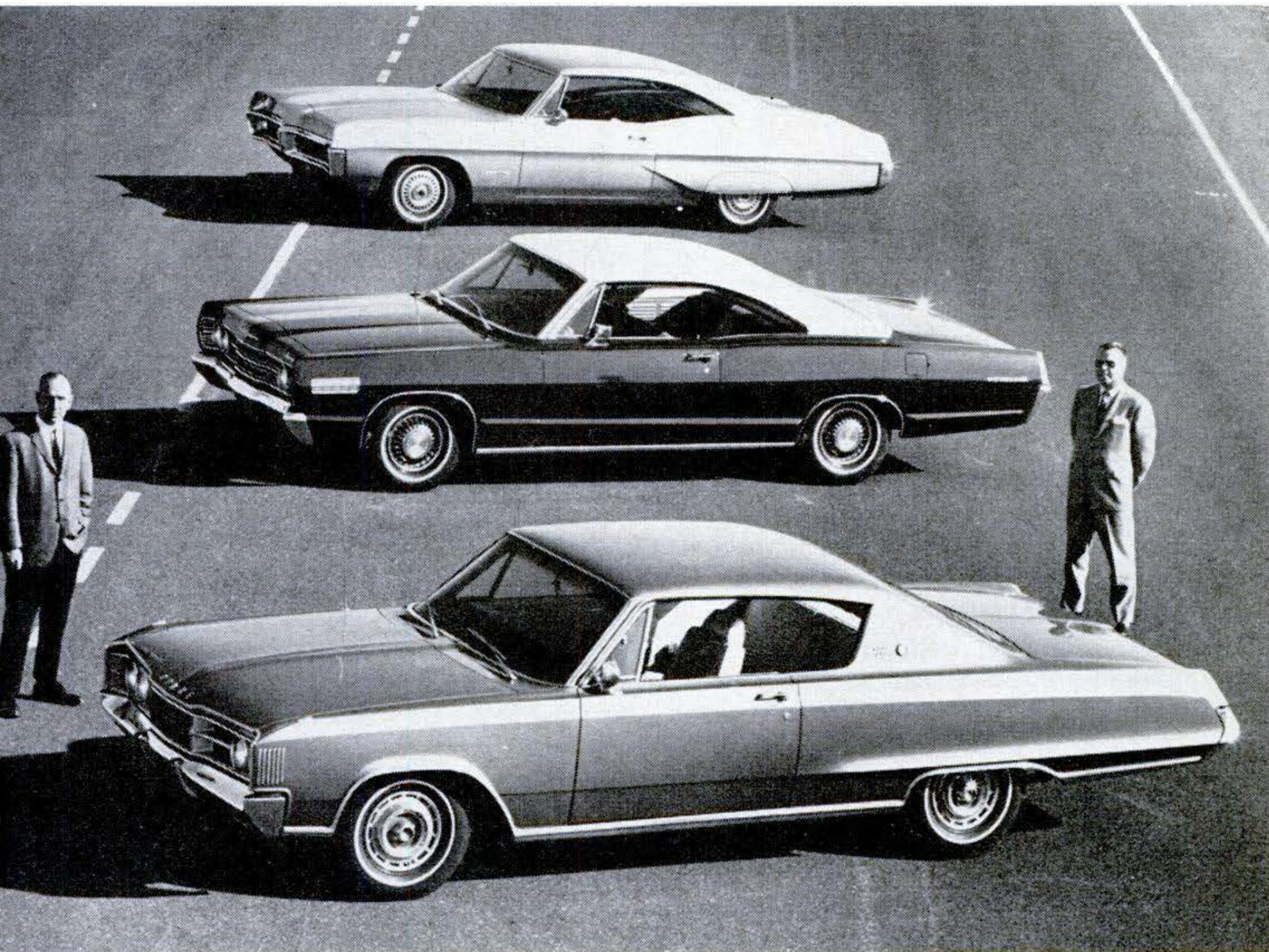
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Pontiac's tail began to drift out when side force reached 0.84 g on a 255-foot-radius turn.

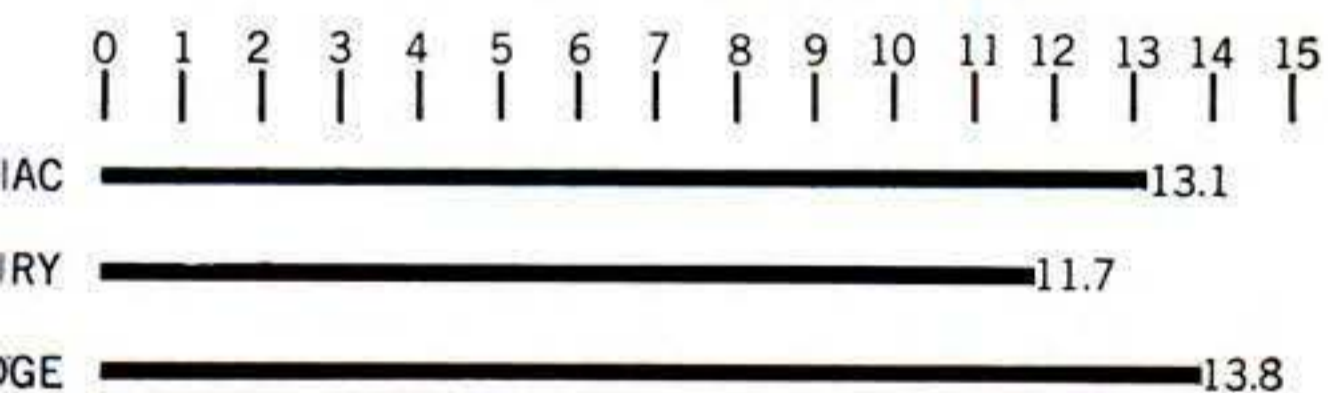
Mercury's understeer built up steadily on same turn. The maximum side force was 0.77 g.

Monterey, and Dodge Polara

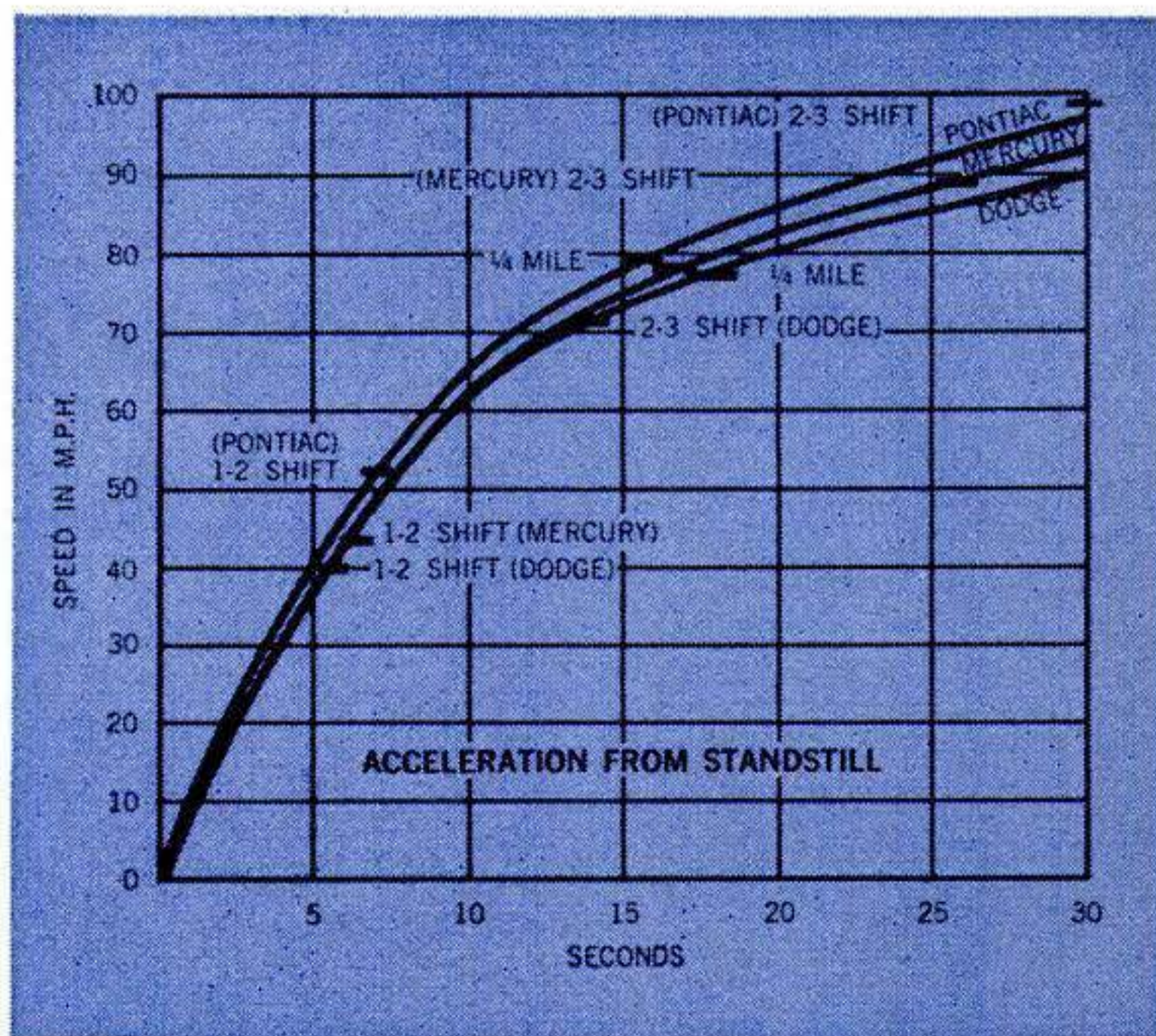


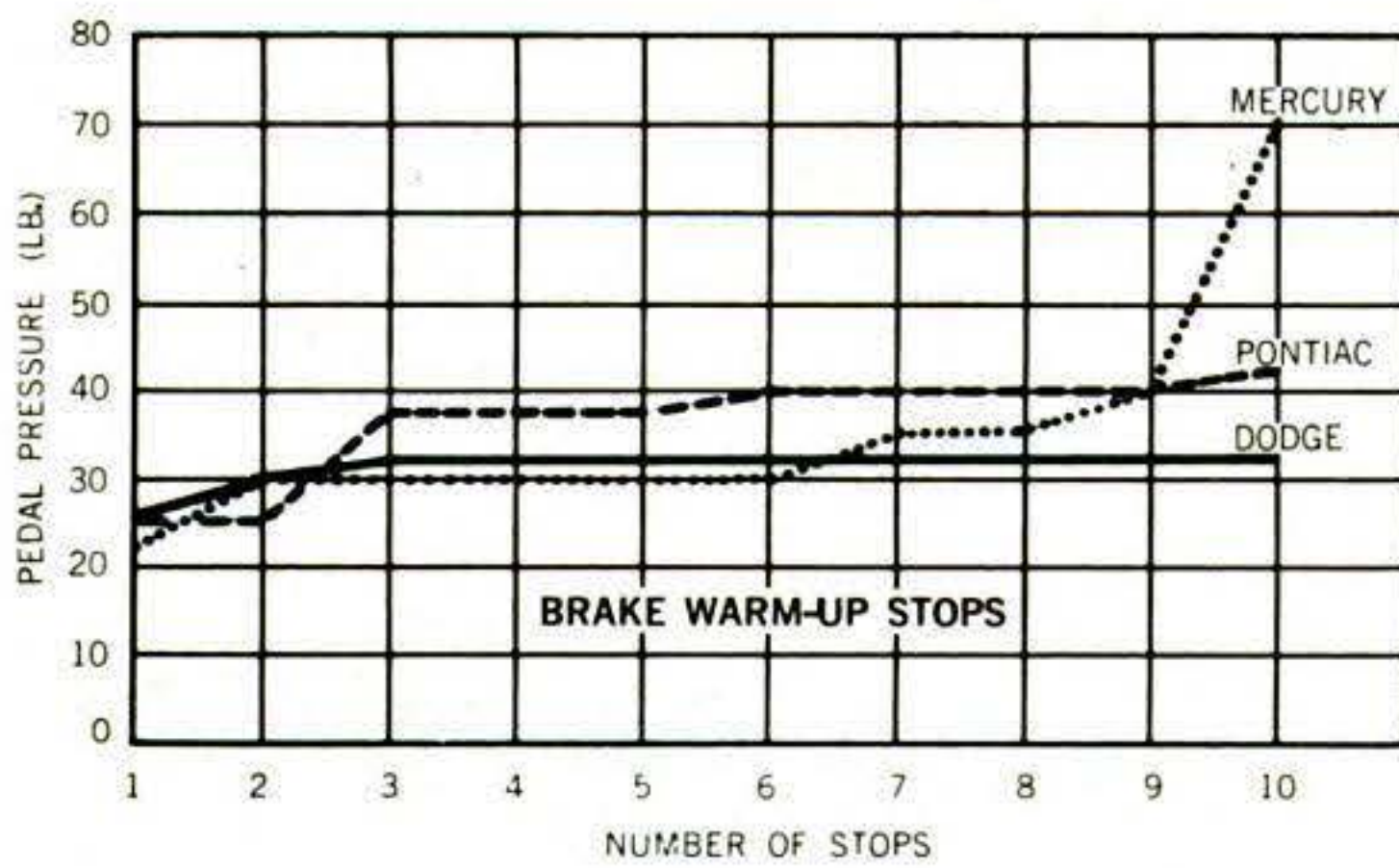
Pontiac (top) is GM style leader. Mercury (middle) has Lincoln look. Dodge shares Chrysler body.

AVERAGE FUEL CONSUMPTION (M.P.G.)



Dodge threatened early tail-end drift but the car maintained stability up to 0.82-g side force.





record pedal pressure and maximum retardation.

The tests. We have three different tests for handling. A car that does well in one does not necessarily come out best in the others. That's because all engineers aim for the best compromise but come up with different answers.

The constant-radius fast U turn (entry speed 55 m.p.h.) simulates the situation you're faced with when you see a sharp turn ahead too late. This can happen on country roads or on expressway exit ramps. It's an emergency. The best car here is the one that remains balanced and controllable under the highest side force.

A side force of 1.0 g means that a load equal to the weight of the car itself is trying to push it sideways off the road. In normal driving, you rarely exceed 0.65 g. All three cars indicated an ample margin beyond that figure.

The wiggle-wobble test and the slalom are explained in the captions for the dia-

PONTIAC	179 FT. 40 LBS. 76g MAX.
MERCURY	198 FT. 65 LBS. 71g MAX.
DODGE	153½ FT. 28 LBS. 84g MAX.



Pontiac: Its drum brakes stood up well.



Mercury: Fair stopping despite fade.



Dodge: Excellent disk-brake system.

Maximum stop is made from 60 m.p.h. without locking wheels, after 10 warm-up stops of 0.5-g retardation from 60 at half-minute intervals. Graph shows how pedal pressure went up as the brakes got hotter.

grams and photos. One important fact that emphasizes the validity of these tests is that the limit of controllability was set by different causes in each car.

It's fair to point out in connection with handling tests that tires have a lot to do with a car's success or failure. Tire brands and dimensions are listed in the data box.



Comfort and

By JIM DUNNE / PS Detroit E

Access to rear seat in two-door Pontiac is restricted by the locking mechanism that keeps seat backs in place. A good safety feature, unique to GM cars, the button could certainly be placed in a more convenient spot than low down on the backrest. Here Jim Dunne tries to bend the driver's seat forward and put his small son in the back seat.



Pontiac slalomed at 25 m.p.h.



Pontiac: Best—with some tail-wagging.



Mercury's limit was 22 m.p.h.



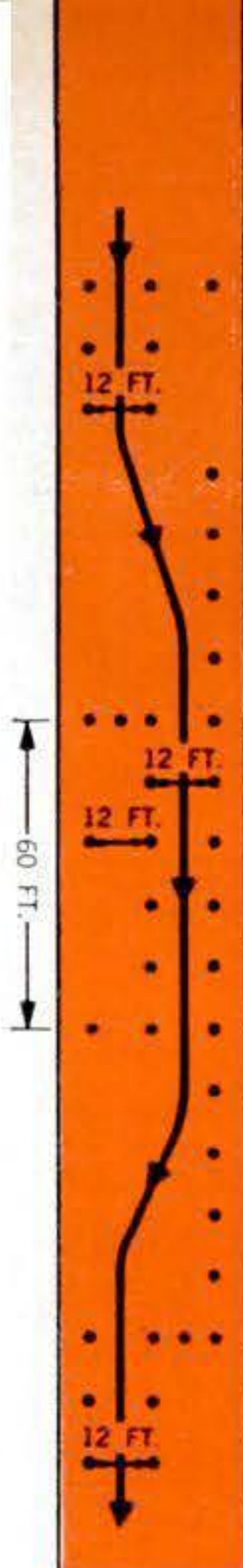
Mercury: Too much body movement.



Dodge was okay up to 24 m.p.h.



Dodge: Pump catch slowed steering.



Slalom test indicates ability of a car to cope with tight city traffic, cabs and buses stopping and starting, trucks double-parking, pedestrians running. The test also simulates narrow mountain road.

Wiggle-woggle simulates a high-speed lane change with no space to spare. The Pontiac was in complete control at 60 m.p.h., did one clean run at 65. Maximum for Dodge and Mercury was 55 m.p.h.

In addition, I think it's useful to note that tread width was a full six inches on the Dodge, 5½ inches on the Pontiac, and only five inches on the Mercury. Naturally, tires also play a big part in acceleration and braking. You might think that the added rolling resistance of more rubber on the road would increase fuel consumption, but

we have no indication of that. The Dodge, with the biggest tires, also showed the best gas mileage.

Summing up: A look at the results of my tests shows that Pontiac's imaginative engineering pays off. No wonder its customers keep Pontiac sales ahead of production capacity.

Safety; Flaws and Serendipity

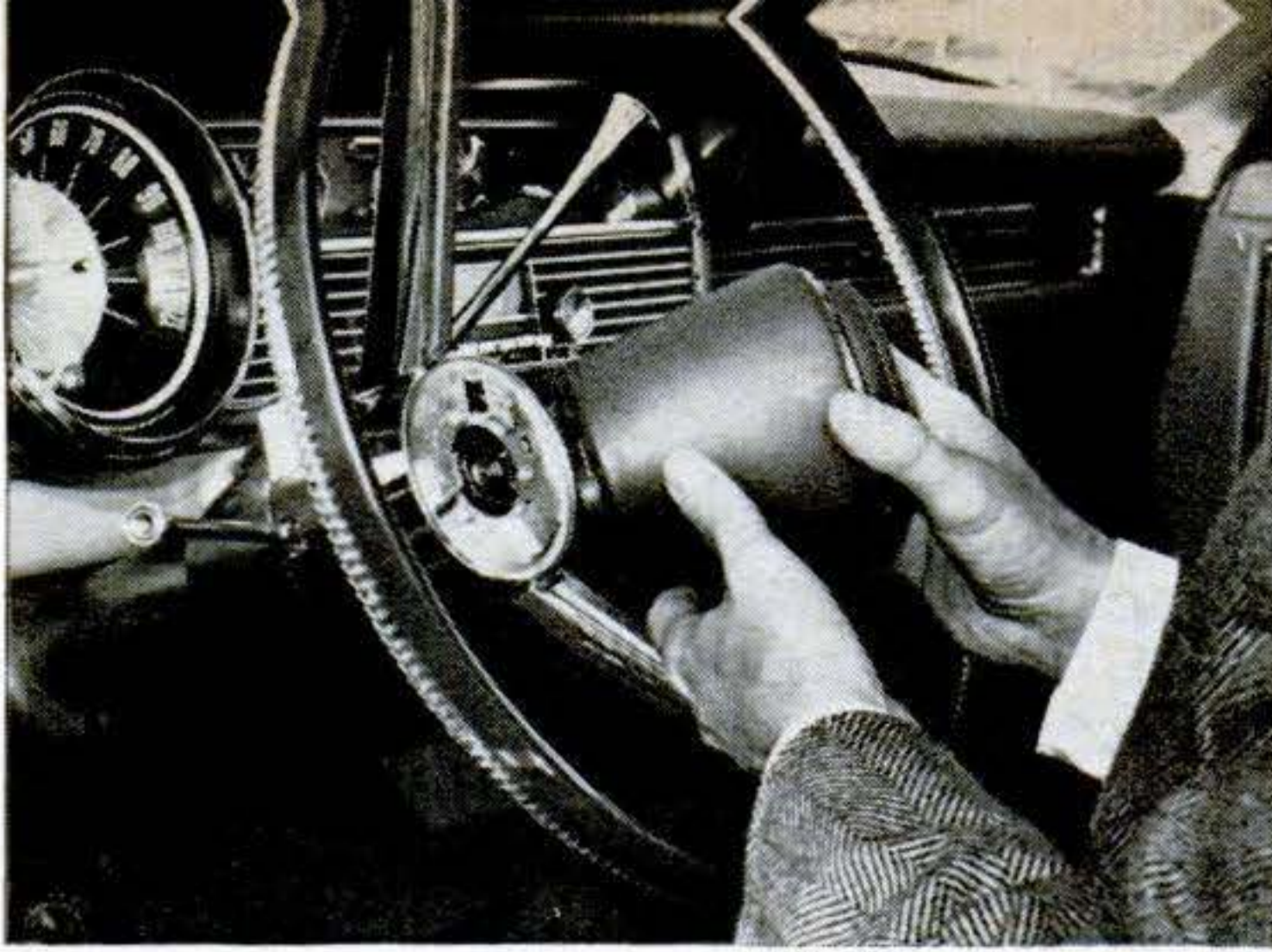
These three cars are definitely a cut above the Ford, Chevy, and Plymouth we tested last month. They have room aplenty, richer materials in the finish, and adequate power for their weight. But each one has its flaws, some in design, some in quality. And each car has some advantages over the others.

- Dodge gives a better view from the driver's seat than Pontiac and Mercury.
- Mercury's interior is easier to keep clean, and its trunk offers easier loading.
- Pontiac has a clear lead on elimination and insulation of engine noise.

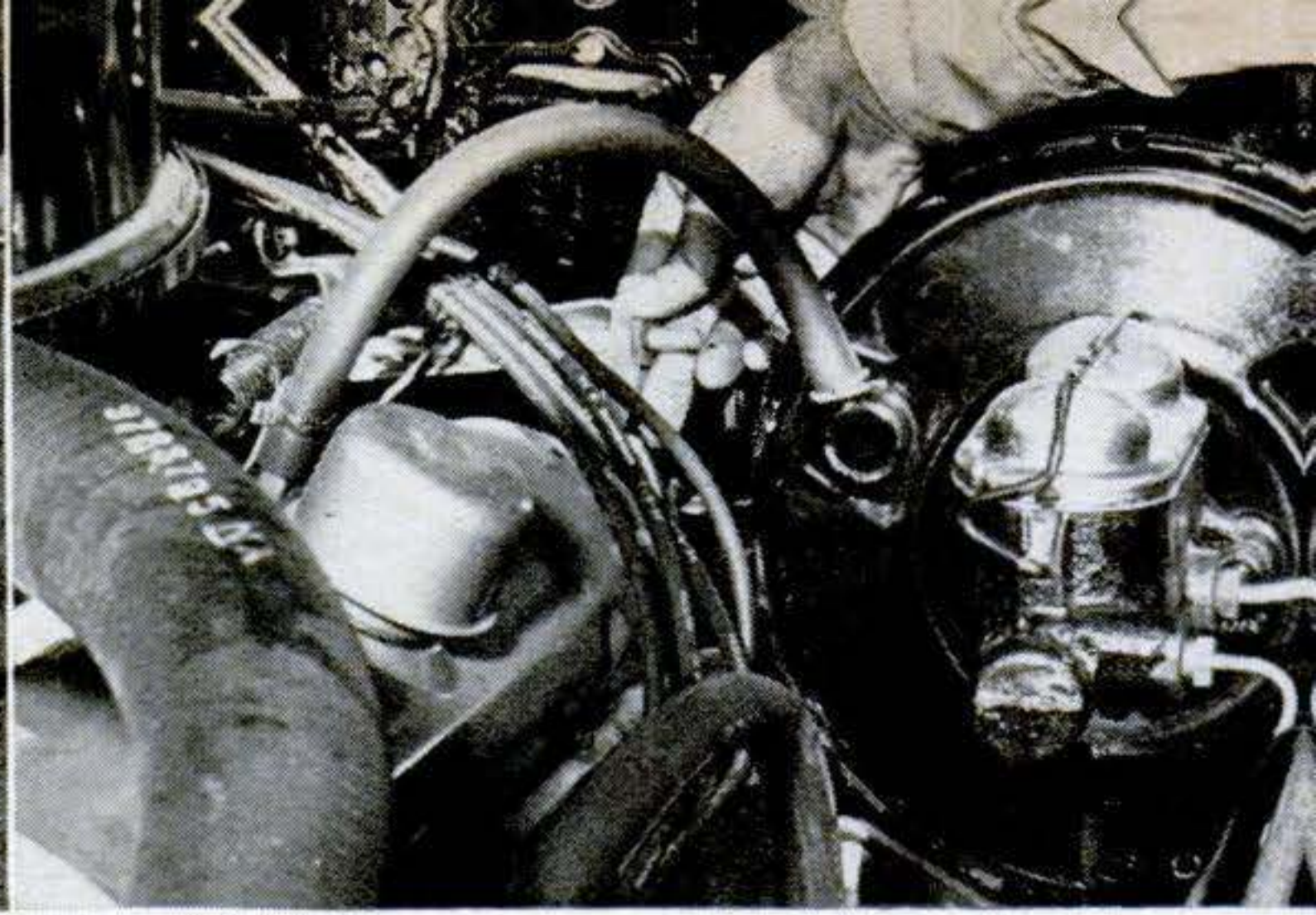
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Power-brake pedal with little travel on the Mercury was inconveniently high (five inches) off the floor.



Cushioned steering-wheel hub on the Mercury came off with a mere twist of the hand. Not so good.



Pivot shaft in the throttle linkage on the Pontiac repeatedly fell out of the bracket that holds it.

Flow-through ventilation is standard on the Polara, optional on the Monterey, and not available on the Catalina. It is a good system to have in your car, and a comfort plus not to be lightly dismissed. I found the flow-through especially welcome during freeway driving when the wind noise from an open window can be eliminated. It makes for a restful long-distance drive.

Dodge's toggle-switch-studded instrument panel not only presents some safety problems, but the toggles actually cover the names of the switches. You have to flip the switch up to the ON position before you find out what the switch does.

All three cars have unlighted control identifications, making it near impossible to read them by the dome light alone at night. And the control knobs in each are similar in shape and size, precluding identification by touch. If you are not familiar with the placing of the small controls, you're in trouble during night driving.

Mercury not only has padded windshield posts (Pontiac still chrome-plates these

parts), but the roof rails on the two-door hardtop are also padded. The other two cars have no padding here. Mercury's door-panel armrests are crushable, too—another exclusive among the three cars. Dodge has the well-designed Chrysler Corp. door handles that continue to be a step ahead of anything the other companies offer. Pontiac has the only seat-back lock of the three cars, a significant safety item but a pain in the neck to release.

No-package package shelves. Safety experts tell us that the so-called package shelf beneath the rear window must not be used for storage. Sudden stops cause packages stowed on the shelf to fly through the interior of the car. Because of the roof lines, these cars have an enormous expanse of shelf area. Mercury's is the biggest, Pontiac's two inches shorter. Dodge's package tray is "only" 19 inches long. Why don't car designers lower the shelf six inches or so and put a cover on top?

While these cars were in our hands, several small things went wrong (see pho-



Enormous rear shelf on the Mercury is two feet long and nearly five feet wide—but it's useless space.



Soft-padded molding surrounded the roof girders on the Mercury—a small but good safety item.



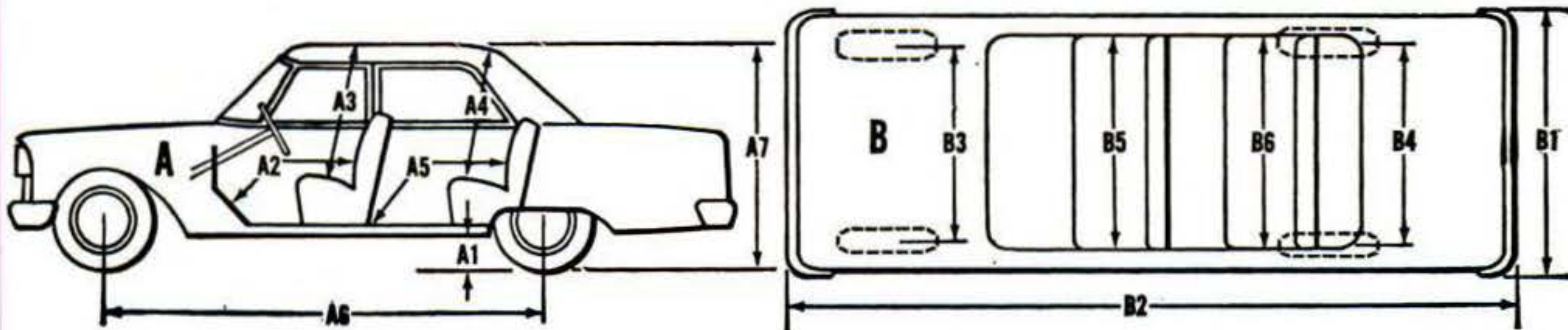
Parking-brake release handle on the Dodge failed to retract. The fresh-air vent was stuck open.



Floor-mounted sheath for seat belt on the Dodge was loose. Irritating—and it slowed buckling-up.

tos and captions). In addition, the Mercury sprang a leak in a heater hose and lost most of its coolant. Mercury also had wind-noise problems, and the Pontiac developed some annoying rattles.

Detroit is talking a lot about improving quality control these days, but if these cars can be taken as fair samples, buyers of 1967 cars can still expect to be trotting back to dealers with minor complaints. **PS**



	PONTIAC Catalina	MERCURY Monterey	DODGE Polara
DIMENSIONS (inches)			
A1 Ground clearance	5.7	5.9	6.0
A2 Front leg room (max.)	42.7	41.9	42.0
A3 Front head room	38.4	37.9	37.5
A4 Rear head room	37.7	37.4	37.3
A5 Rear leg room (min.)	38.1	33.3	34.3
A6 Wheelbase	121.0	123.0	122.0
A7 Overall height	55.3	55.1	54.6
B1 Overall width	79.7	77.9	80.0
B2 Overall length	215.6	218.5	219.6
B3 Front track	63.0	62.0	62.0
B4 Rear track	64.0	62.0	60.7
B5 Front hip room	63.7	62.6	63.3
B6 Rear hip room	62.4	61.7	63.6
SPECIFICATIONS			
Engine type	OHV V-8	OHV V-8	OHV V-8
Bore & stroke	4.12 x 3.75 in.	4.05 x 3.78	4.25 x 3.38
Displacement	400 cu. in.	390 cu. in.	383 cu. in.
Compression ratio	10.5:1	9.5:1	9.2:1
Carburetion	Single 2-bbl.	Single 2-bbl.	Single 2-bbl.
Power @ r.p.m.	290 @ 4,600	270 @ 4,400	270 @ 4,400
Torque @ r.p.m.	428 @ 2,400	403 @ 2,600	390 @ 2,800
Transmission	Turbo-HydraMatic 3-speed	Merc-O-Matic 3-speed	TorqueFlite 3-speed
Axle ratio	2.29:1	3:1	2.76:1
Tires	Uniroyal	B.F. Goodrich	Goodyear
Tire size	8.55 x 14	8.15 x 15	8.45 x 15
Steering ratio	21.7:1	21.9:1	19.12:1
Turns (lock to lock)	4.2	3.67	3.5
Turning diameter	42.8 ft.	44.5 ft.	43.5 ft.
Brakes	All drum	All drum	Disk/drum
Brake-swept area	326.9 sq. in.	330.2 sq. in.	437.1 sq. in.
Curb weight	4,000 lb.	4,013 lb.	4,055 lb.
Basic price	\$2,951	\$2,985	\$2,958
Price as tested	\$3,514	\$3,818	\$3,448



FORD CORTINA Wider and roomier, the new Cortina from English Ford is a mite shorter than the four-year-old record seller it replaces. Bigger engine options include a rugged five-bearing, oversquare 83.5-hp. four.

NEW EUROPEAN CARS boast bigger engines, roomier interiors, more window area, racier styling, and more fastbacks



TRIUMPH GT 6

This is a combination of Spitfire chassis, new fastback body, and a beefed-up six-cylinder engine from the Triumph 2000. Top speed is 107 m.p.h. Strictly a two-seater, it has good luggage space.



JENSEN INTERCEPTOR

Italian-styled fastback on a Chrysler-powered British chassis, it has disk brakes on all four wheels and TorqueFlite automatic transmission. Shock absorbers are adjustable from the driver's seat.

VOLVO 144

Sweden's Volvo adds a new high-quality car to its range—it does not replace the 122-S. The 144 has many unique safety features, including a dual brake system with three-wheel action on each circuit. Hp.—85 or 115.



SUNBEAM ARROW

This newcomer in the Chrysler-controlled Rootes stable replaces the Hillman Super Minx. Its 105-cu.-in. engine develops 80 horsepower, for 0-60 take-off in 14 seconds. Automatic box is an option. Brakes—disks and drums.



VAUXHALL VIVA

GM's British baby is both longer and wider for '67. Engine is bored out to 70.7 cu. in., and power options reach 70 horsepower. New Viva rides on coil springs all around (the old model had rear leaf springs).



OPEL REKORD

Striking fastback coupe is pacesetter for GM's German division. It's available with overhead-cam four- or six-cylinder engines. Suspension system uses coil springs all around. Range includes sedan and wagon.



PEUGEOT 204

A sporty fastback coupe (and a convertible) are added to Peugeot's 204 range (sedan and wagon). The 204s are tough, high-quality front-drive cars with an overhead-camshaft four-cylinder, 58-hp. engine of aluminum.



PS EXCLUSIVE

This first installment of a two-part story tells how a courageous sailor built and tested his amazing boat

I Crossed the Atlantic in a 12-Foot Sloop

Part One: The Preparations

By WILLIAM E. VERITY

Boats are bred in the bones of Bill Verity—his family has been building them on Long Island in New York State since 1644. Bill Verity is 42 years old, a stocky five feet 6½ inches, and round-faced, with bright blue eyes. He was a turret gunner in a Navy torpedo plane during World War II, seeing action from the Solomons to the Pelew Islands. Today he holds a private pilot's license.

For three years, he operated a charter boat out of the Bahamas, taking out sportsmen for giant tuna and marlin. In 1955, a boat he designed and built set a motorboat speed record that still stands. In this first of two installments, Verity tells why he embarked on his record-breaking ocean crossing and of his preparations for it. He describes how he designed the Nonoalca and the testing of the boat—and himself—in a round-trip voyage of 3,510 nautical miles from Florida to Yucatan, across the Gulf of Mexico.



Bill Verity stands

The first day is the worst. As you cast off, it hits you like a sock in the guts that you are leaving all you hold precious—family, friends, security, perhaps life itself—to trust yourself to the uncertain sea. Given a preview of some of the experiences I was going to have, maybe I'd have turned back right then.

My imagination was sneaking in enough scares of its own. What if I got appendicitis, or an abscessed tooth, while alone in midocean? Suppose I began to hallucinate, as other loners have on long crossings? Or fell overboard, helplessly to

watch my boat sail away from me? (It was just as well I couldn't foresee the times I'd be in the icy Atlantic, clinging to the mast, itself flat in the water and the boat on its beam ends.)

About the boat I had no doubts, having built every inch of her myself. I knew there would be no structural failure—no danger of the rudder falling off or a big sea crushing the hull. Yet recalling things that did happen—the tanker that almost plowed me under, the Russian roulette of sailing in pea-soup fog—still makes the hair bristle on the back of my neck.



Match of Nonoalca as it lies anchored in Tralee Bay at Fenit, Ireland, at end of his voyage.

But, that first day, I fretted about my own fitness: Was I in shape, physically and mentally, to survive the voyage I had planned so long? Or had it been a crazy idea from the beginning?

The prod. A Chinese proverb says the longest journey begins with a single step. Mine started with a film of the Mayan structures of Central America, seen in high school. It struck me forcibly that these magnificent buildings could not have been erected by ignorant savages. Their builders surely were mathematicians, engineers. Had the Mayas learned from outsiders?

Thor Heyerdahl's book, *Kon Tiki*, with its theory of mass migrations from the Americas to Polynesia, fascinated me (I've read it 12 times). Even more did the many legends, encountered from Mexico to Peru, of black-bearded, white-skinned strangers who came from the east and taught the native peoples stone sculpture, agriculture, astronomy, among other things.

These legends long antedate Cortes and Pizarro. It was because the tales foretold the return of white-skinned gods that the Spaniards, taken to be those gods, so easily

Continued

conquered the awed Incas and the Aztecs.

Giving substance to the legends are many artifacts depicting big-nosed, heavily bearded men with European features. Such artifacts have been found in Mexico, Peru, Central America, and northwest Florida. In none of these areas did the natives grow such luxuriant beards.

Saintly navigator. Then I read of St. Brendan, an Irish monk ordained in 512 A.D., who is believed to have made long westward voyages. His legendary voyages coincide in time with New World tales of bearded men, in robes bearing white crosses, who came out of the east in boats of skin.

Written records of Brendan the Navigator are overlaid with myth. Yet the Norse, who probably reached the New World about the year 1000, left hints that Irishmen had preceded them. Could Brendan and fellow monks have reached America 500 years before the Vikings? Had he landed in Florida, perhaps crossed the Gulf of Mexico to Yucatan? The riddle roused my Irish blood.

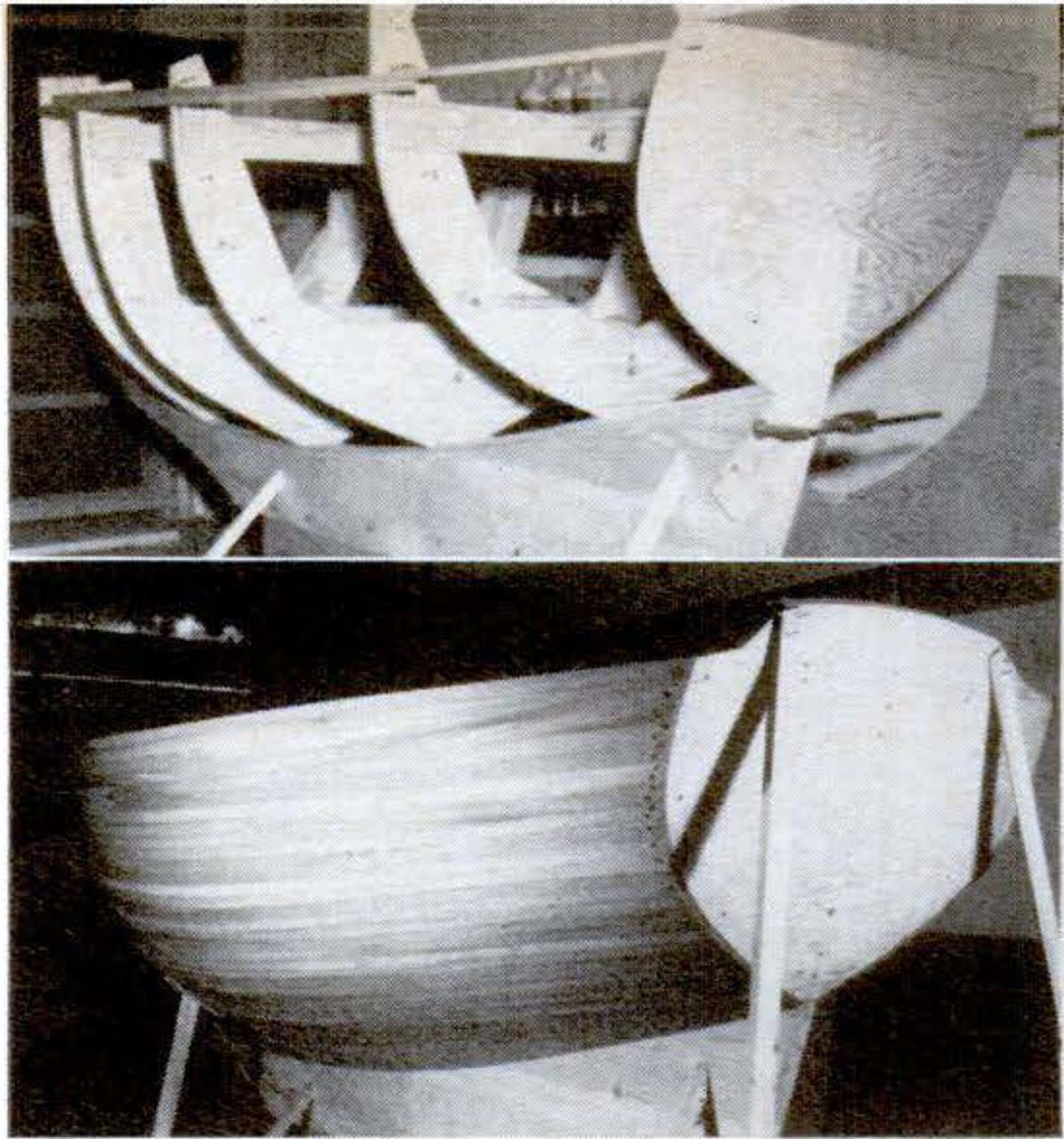
I knew the odds against such a journey. Scholars have found no proof that Brendan ever made it. But might I not be able to show that he *could* have? As a first step, I could cross the Gulf both ways in a small boat, then attempt the long Atlantic passage from Florida to Ireland.

Once I drove a 13½-foot outboard from Key West to Havana, round trip, with a friend. But we were snarling at each other almost constantly. That trip convinced me that sailing long distances with a companion tends to bring out the worst in both persons. I was determined to go alone.

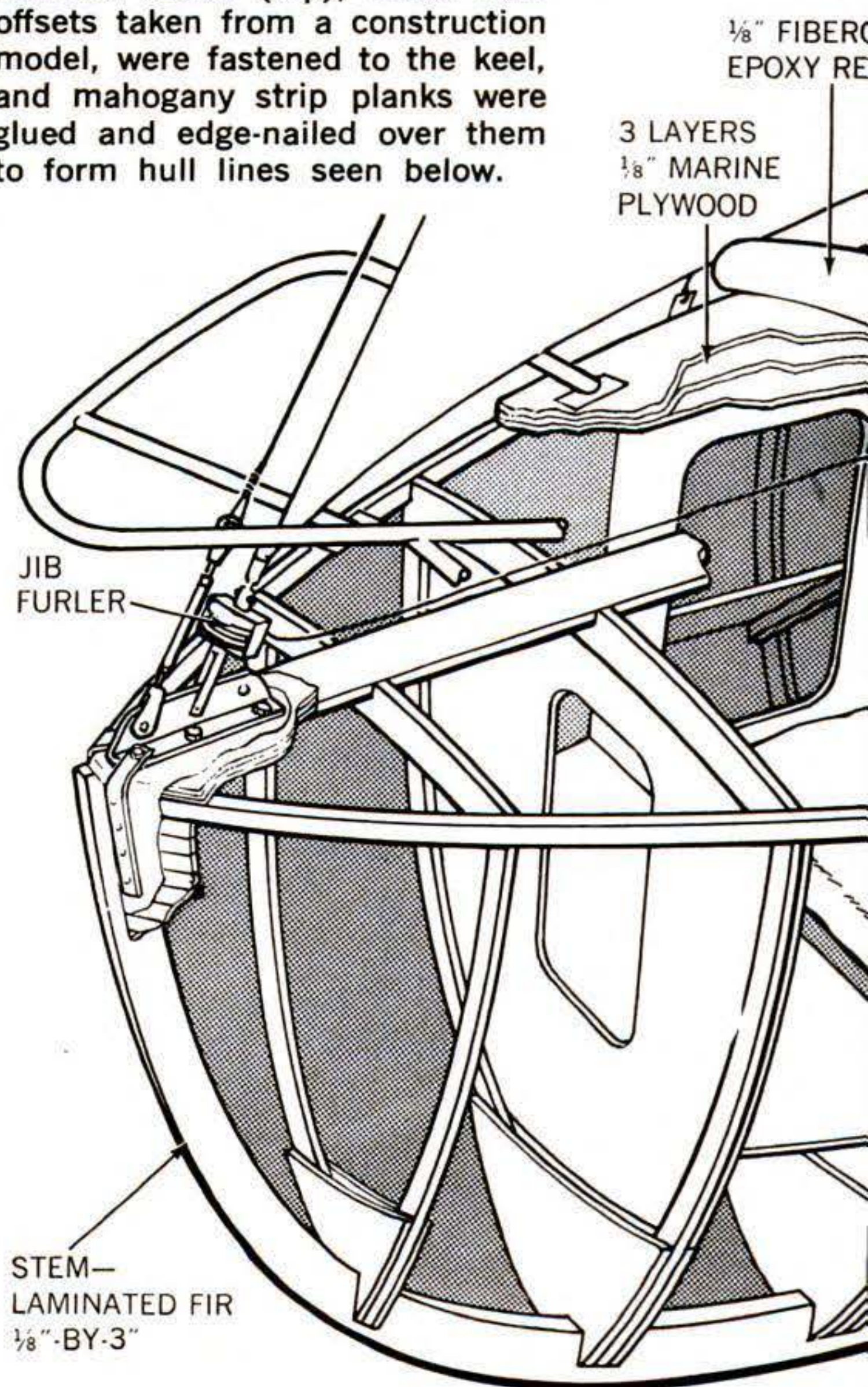
One-man boat. My boat, I decided, should be as small, seaworthy, and comfortable as possible. Comfort is important to combat two of the three things most likely to attack the lone voyager—fatigue and exposure. (The third is malnutrition.)

I decided on a length of 12 feet, a five-foot beam, and the largest displacement possible in that size hull. After drawing plans, I made a construction model. From this I took the offsets, making a few changes, and built full-size molds.

The molds were fastened to the keel. Mahogany strip planks, a half-inch thick and 1¼ inches wide, with one edge grooved and the other rounded to fit into the groove of the next, were glued and



Full-size molds (top), made from offsets taken from a construction model, were fastened to the keel, and mahogany strip planks were glued and edge-nailed over them to form hull lines seen below.

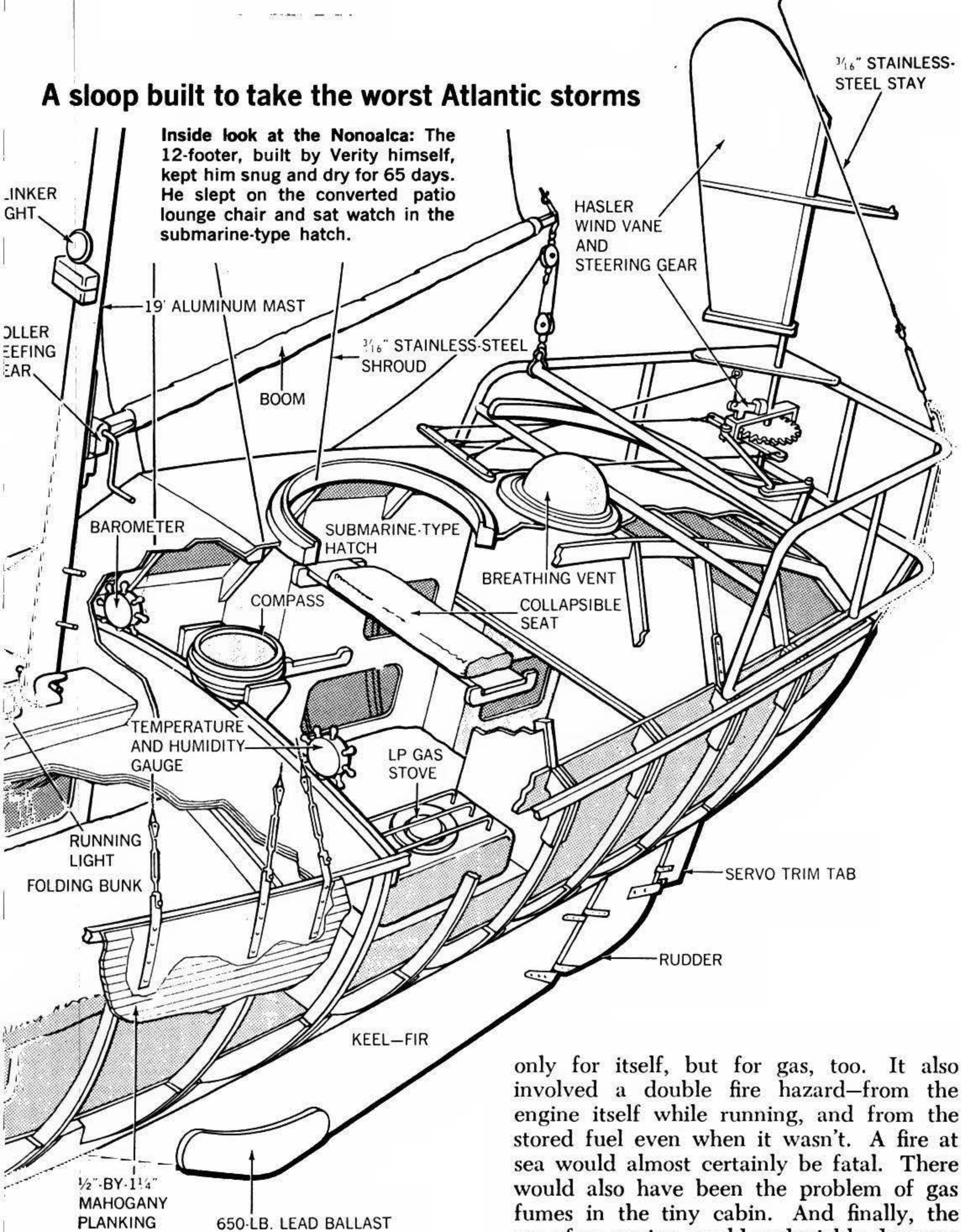


edge-nailed over the molds to form the curved hull lines.

This construction isn't new; we've used it for about 50 years. With marine glue and serrated Monel nails, it made a hull I was willing to bet my life on. It was reinforced with ⅛ inch of glass cloth and epoxy resin on the outside, making a total thickness of ⅝ inch. Then the molds were

A sloop built to take the worst Atlantic storms

Inside look at the *Nonoalca*: The 12-footer, built by Verity himself, kept him snug and dry for 65 days. He slept on the converted patio lounge chair and sat watch in the submarine-type hatch.



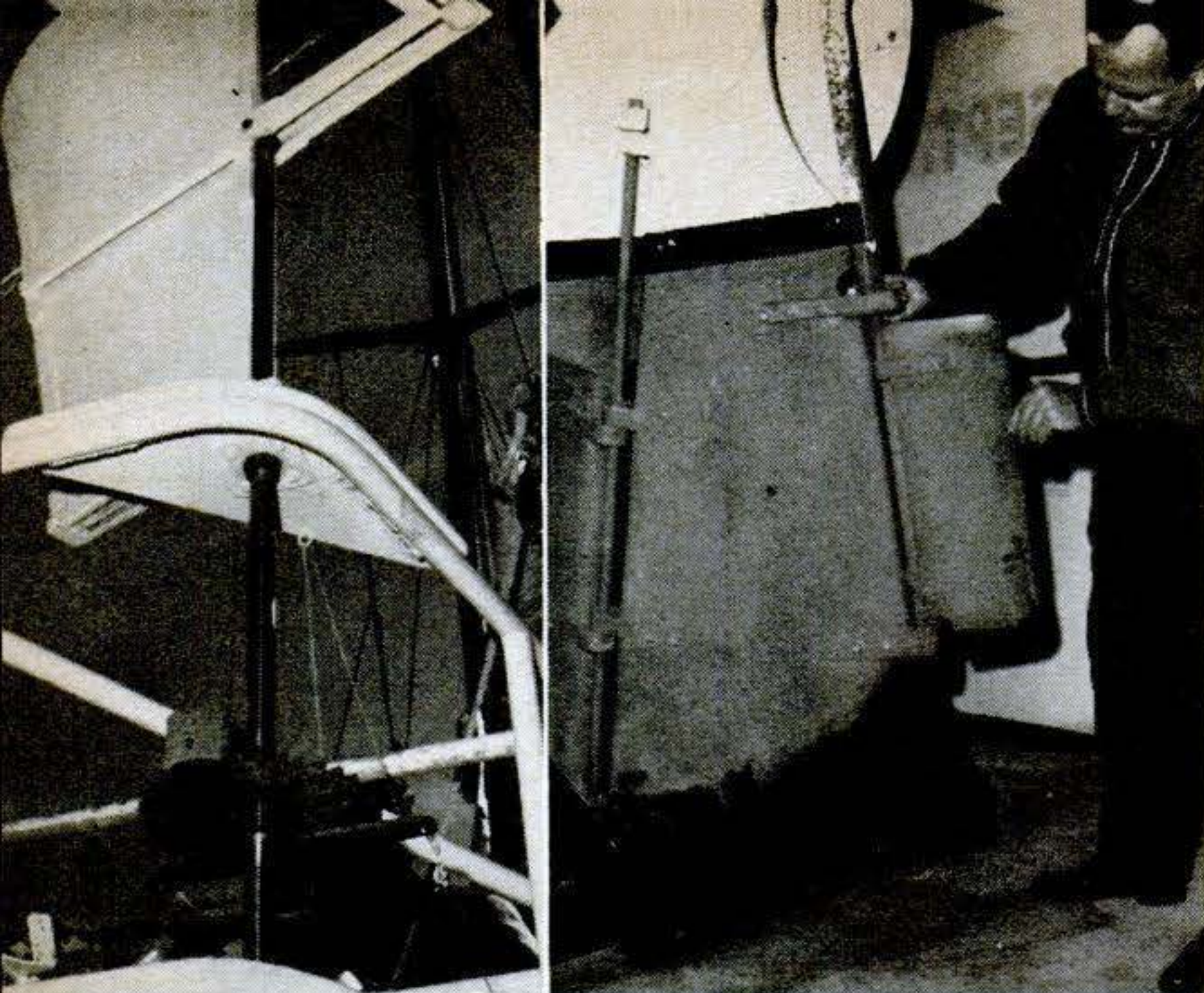
removed. No resin was applied inside, for this would have kept the wood from breathing and led to condensation between layers.

Despite the chances of being becalmed (as I was for long periods) I decided not to take a motor. There's hardly enough room in a 12-footer for water and provisions. A motor would take up space not

only for itself, but for gas, too. It also involved a double fire hazard—from the engine itself while running, and from the stored fuel even when it wasn't. A fire at sea would almost certainly be fatal. There would also have been the problem of gas fumes in the tiny cabin. And finally, the use of an engine would undeniably decrease the value of my trip as evidence that Sixth Century man could have made a like one.

Everything in reach. Three layers of 3/8-inch marine plywood form the deck; and two of 1/4-inch plywood, the cabin. A submarine-type hatch can be tightly sealed. When it's open, I can reach all the sheets and halyards by standing up. For ventilation in bad weather with the hatch shut,

Continued



Part of automatic steering system, wind vane (left) and servo trim tab on rudder (right) relieved skipper of need for standing constant watch. To establish neutral position for normal sailing, Verity (beardless, here) let the vane orient itself with the wind when the boat was trimmed and on course, then dropped connecting linkage into gear.

I added a cabin vent covered with a plastic tank-turret blister to keep out spray.

With a 650-pound lead-ballast keel, the hull draws three feet, displacing 1,750 pounds. The boat is sloop-rigged. A 19-foot aluminum mast is braced with stainless-steel stays. Roller reefing for the main, and a jib furler, are used to reduce the 100 square feet of sail. The rudder is deep enough for good response even when the boat is heeled over.

For a sea anchor, I fastened the pilot chute from an ordinary parachute to a 150-foot line. Had I known what hurricane Alma was to do to this rig, I'd have reinforced its shrouds. But at the time I had no inkling that I would ever battle such a blow.

To avoid having to stand constant watch at the helm while under way, I installed a Hasler wind-vane steering gear. This ingenious mechanism, perfected by Blondie Hasler, has been used in ocean racing by him and others since 1960.

It has a vane that swings with the wind, a small servo trim tab on the rudder, and connecting linkage that can be set at various positions. With the boat on course and trimmed up, you let the vane orient itself with the wind, then drop the linkage into gear. This establishes a neutral position for normal sailing.

Any time the boat veers or the wind

shifts, the movement of the wind vane moves the trim tab opposite to the way the helm should go. Water action on the tab then swings the rudder the right way to bring the boat back on course, returning the vane to its neutral position. Except for a tendency to oversteer when running before heavy weather, it worked well. It let me relax while the boat sailed herself.

A dab of comfort. Fatigue attacks physically and mentally. When tired, I've caught myself making mistakes in simple addition and subtraction—unforgivable in navigation. At sea, it is important not to drive yourself beyond your recovery limit. Once you do, it's a long pull back to normal energy level. So I gave much thought to resting in my limited quarters.

As a result, I modified a three-section aluminum lawn chair, cutting it short enough on one end to fold over without hitting the deck beams. A ratchet permits locking the back at various angles five degrees apart. A quadrant can be adjusted to compensate for the list angle when the boat is heeled over, as it usually is when sailing. This combination bunk and contour chair served me well.

A Coleman tank-gas stove does for cooking and cabin heating, a Coleman gas lamp for light. The head is a camp toilet.

Atop the mast I mounted a 10-square-meter radar reflector to ensure being seen on ships' scopes. A small wooden sailboat unequipped hardly registers, and I wanted to be "visible" to shipping. But despite the reflector, I was headed for one of the worst scares of my life.

Then I named my boat—for the white-skinned, bearded strangers of the Vera Cruz legend—Nonoalca. Translated, this means "the mute ones," or, more commonly, "those who do not speak our language."

So I was ready. Now all I needed was a trial run, to make sure my boat and gear would stand up to the rigors of an Atlantic crossing.

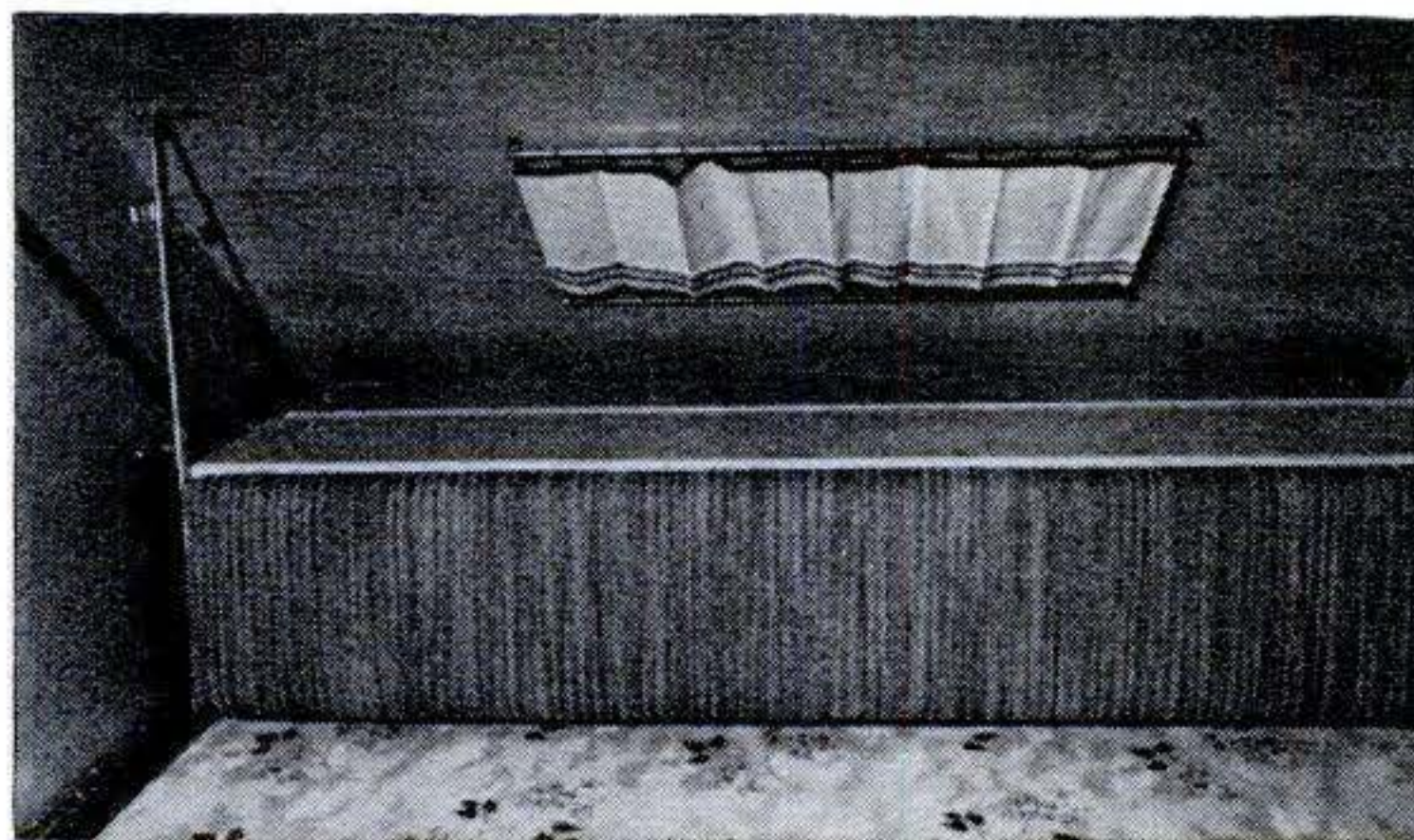
In the Gulf. After trying out the boat in local waters, I sailed to Dry Tortugas. From there, I departed on April 3 for Vera Cruz, Mexico, a distance of 870 nautical miles. I took only a crude sextant, a compass, and a taffrail log as navigation aids. Having no watch or radio, I could use the sextant

[Continued on page 202]

NEXT MONTH: Bill Verity's own story of his record-breaking crossing



Camper's back pops out when you're stopped and increases the interior living area by about a third.



Fold-away sofa is kept made up when camper is on the move. It folds out to sleep two.



Ready to roll: Photo shows the Interstater with back retracted flat for highway use.

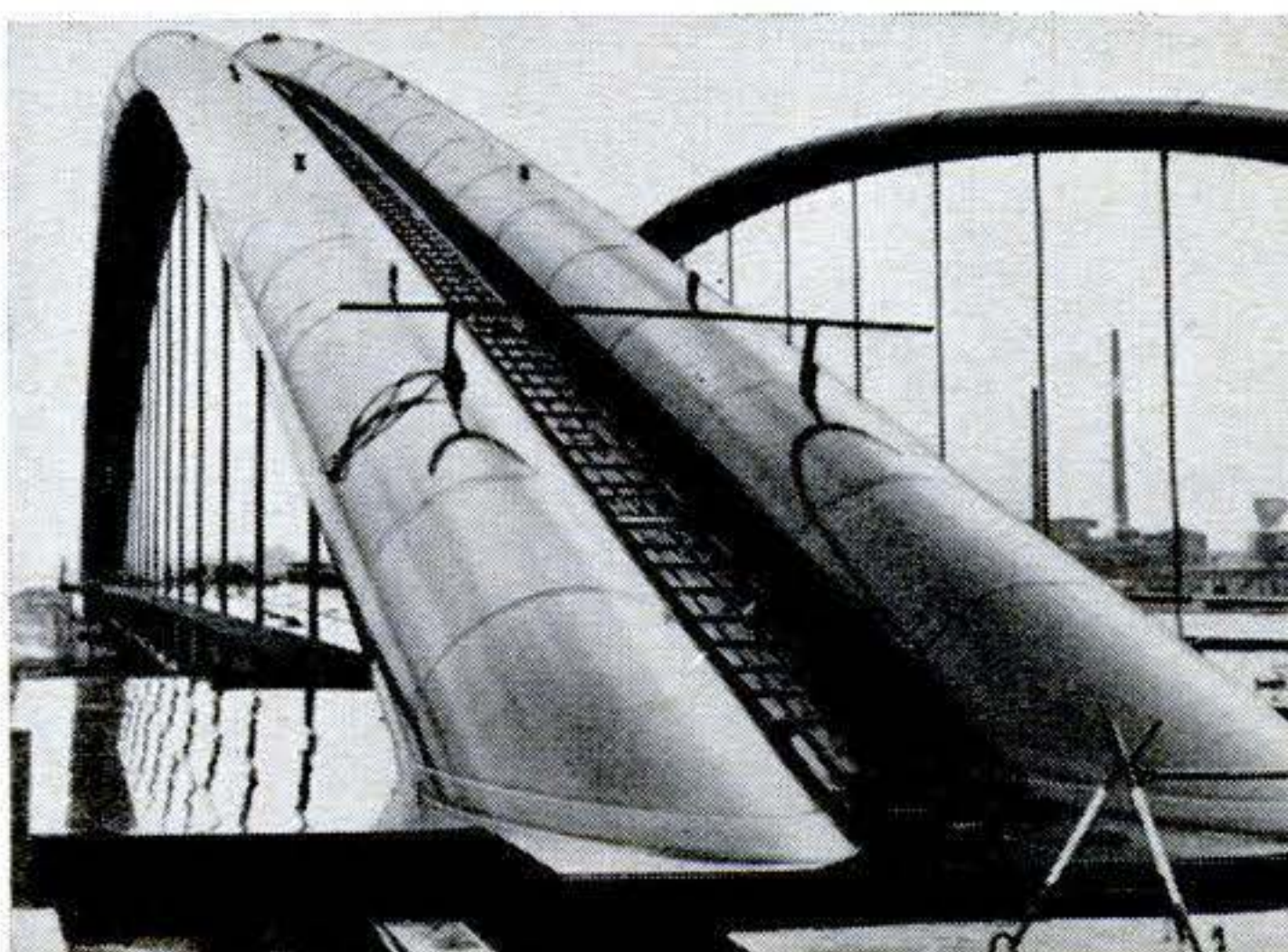
Expandable camper folds up when you're on the go

This new camper has a fold-up bed that expands when you stop to bed down. The "hump" on the Travelhome Interstater increases living area by a third and allows six persons to sleep comfortably. The pickup camper has a thermostatically controlled heater, a refrigerator, 15-gal-

lon water system, and a chemical toilet. It has a maintenance-free molded-fiberglass roof with urethane-foam insulation that keeps the inside at comfortable temperatures while shutting out noise. The camper is made by Travelhome, Inc., 733 Main St., Grinnell, Iowa 50112.

Pipes form arch of German bridge

Two pairs of welded steel pipes carry the 675-foot roadway of a bridge across the Main River between Frankfurt and Offenbach. They are lighter and have a greater load capacity than arches of other design, may also be used for distributing gas when the bridge is finished.





Revised suspension system on the '67 Toronado gets a rugged workout as Norbye takes it through the PS wobble-wobble handling test at Bridgehampton Raceway.



A stop on 2

Is Front-Wheel Drive for You? Round Two

The Toronado has earned the enthusiasm of thousands—and taken lumps from some critics—since our 10,000-mile test drive last year. There are big changes for '67. Here's a 2,000-mile-drive and track-test report

By HUBERT P. LUCKETT

Thousands of happy Toronado owners have said "yes" to front-wheel drive since we reported on our 10,000-mile test drive last January. It was and is the most adventurous design concept to come out of Detroit in decades—unique in engineering design and in styling. It is aimed squarely at the customer who wants the unconventional, who is fed up with the "me, too" cars.

Along with widespread enthusiasm for the extra room and comfort afforded by flat floors, superb handling, and excellent high-speed stability, there have been some criticisms: The ride was too stiff for a few, and some professional car testers found that the rear brakes were apt to lock up in a panic stop with the car lightly loaded.

Oldsmobile engineers have attempted to answer these criticisms in the '67 models.

To find out how well they succeeded—and if anything good was lost in the process—I drove one of the first '67 Toronados for a month, around town and cross-country, on a 2,000-mile practical-use test. Jan Norbye, our auto editor, put it through the rigorous PS test-track routine.

When I first heard that Olds was going to "soften" the ride in '67, I was dismayed.

I'll admit I was prejudiced when I slid behind the wheel for my first drive. I was fearful lest this beautiful-handling car would go the way of the other plush jobs out of Detroit—too many compromises aimed at a soft boulevard ride to be an able, safe-handling, high-speed highway cruiser.

The first few miles over cobblestone streets and well-worn city pavement strengthened my misgivings. How much handling and stability had been sacrificed?

But open highways and back-country roads proved my doubts completely unjustified. After 2,000 miles on all kinds of roads, I won't take back any of the good things I said about the '66 after my 10,000-mile drive last year. I still think the Toronado is the safest-handling and most stable car at high speeds of any you're apt to find in your local showrooms.

The braking system. There's significant improvement here. A rear-brake balance valve—a pressure-reduction device that prevents rear wheel lock-up in a panic stop at high speeds—has been added as standard. Our test car was also equipped with optional front disk brakes.

On our road test, the brakes performed well in city traffic, high-speed stops, mountain driving, in drenching rain, mud, and



Our test drive was Steamtown, U.S.A., the outdoor steam-train museum near Bellows Falls, Vt.

slush. There was no squeal, shudder, or chatter from the front disks. Braking was smooth, without pull or swerve.

The track test. The car stopped in 185 feet from 60 m.p.h. immediately following 10 warm-up stops of $\frac{1}{2}$ g deceleration. Brake-pedal pressure rose from 25 pounds on the first stop to over 200 on the tenth. The rate of fade rose rapidly after the sixth stop. (This is an unusually severe test, but some disks we've tested recently showed only a 10-pound rise in pedal pressure during the 10 stops.) The brakes did not become erratic, however, and recovered quickly.

The most remarkable thing about our track test of the Torino was the ease and aplomb with which it breezed through

our handling tests. Top speed through the wiggle-wobble course (simulating an urgent lane change) was 65 m.p.h.; the slalom (simulating a winding country road), 27 m.p.h. No car we've tested so far bettered these marks. More important, the runs were made without the heroics that usually accompany the shepherding of a rear-drive car through these tests—no tail wagging or rear-end breakaway. Beyond these speeds, the car simply understeered too much to get around turns any faster.

In our turning test, the maximum side force obtained was .85 g, among the best we've gotten with any car.

We'd say the Torino is a success. The next question: "When will we see a similar concept in a popular-price car?"

SPECIFICATIONS

Engine type	OHV V-8
Bore & stroke	4.125 x 3.975 in.
Displacement	425 cu. in.
Compression ratio	10.5:1
Carburetor	single 4-bbl.
Power @ r.p.m.	385 @ 4,800
Torque @ r.p.m.	480 @ 3,200
Transmission	3-speed Turbo-Hydramatic
Axle ratio	3.21:1
Tire size	8.85 x 15
Steering ratio (overall)	17.8:1
Turns, lock to lock	3.4

Turning diameter	43 ft.
Brakes	disks front, drums rear
Swept area	360 sq. in.
Curb weight	4,624 lb.
Price	base \$4,869; as tested \$6,673.91

PERFORMANCE

0-60 m.p.h.	9.0 sec.
0-80 m.p.h.	16.3 sec.
25-70 m.p.h.	8.6 sec.
SS $\frac{1}{4}$ mile	17.7 sec.
Speedometer error, indicated 60=true	57 m.p.h.

Sea-and-Air Armada



Dr. von Braun, left, outlines to PS Editor-in-Chief Ernest V. Heyn the plan for the voyage to the moon that will climax the coming series, succeeding Gemini, of three-man Apollo space flights.

An armada of ships and planes, deployed around the globe, will relay commands and flight data at critical moments of our Apollo astronauts' flight to the moon.

The sea and air stations will complete a new communications network being set up for our three-man Apollo space flights—which now succeed our completed one-man Mercury and two-man Gemini series.

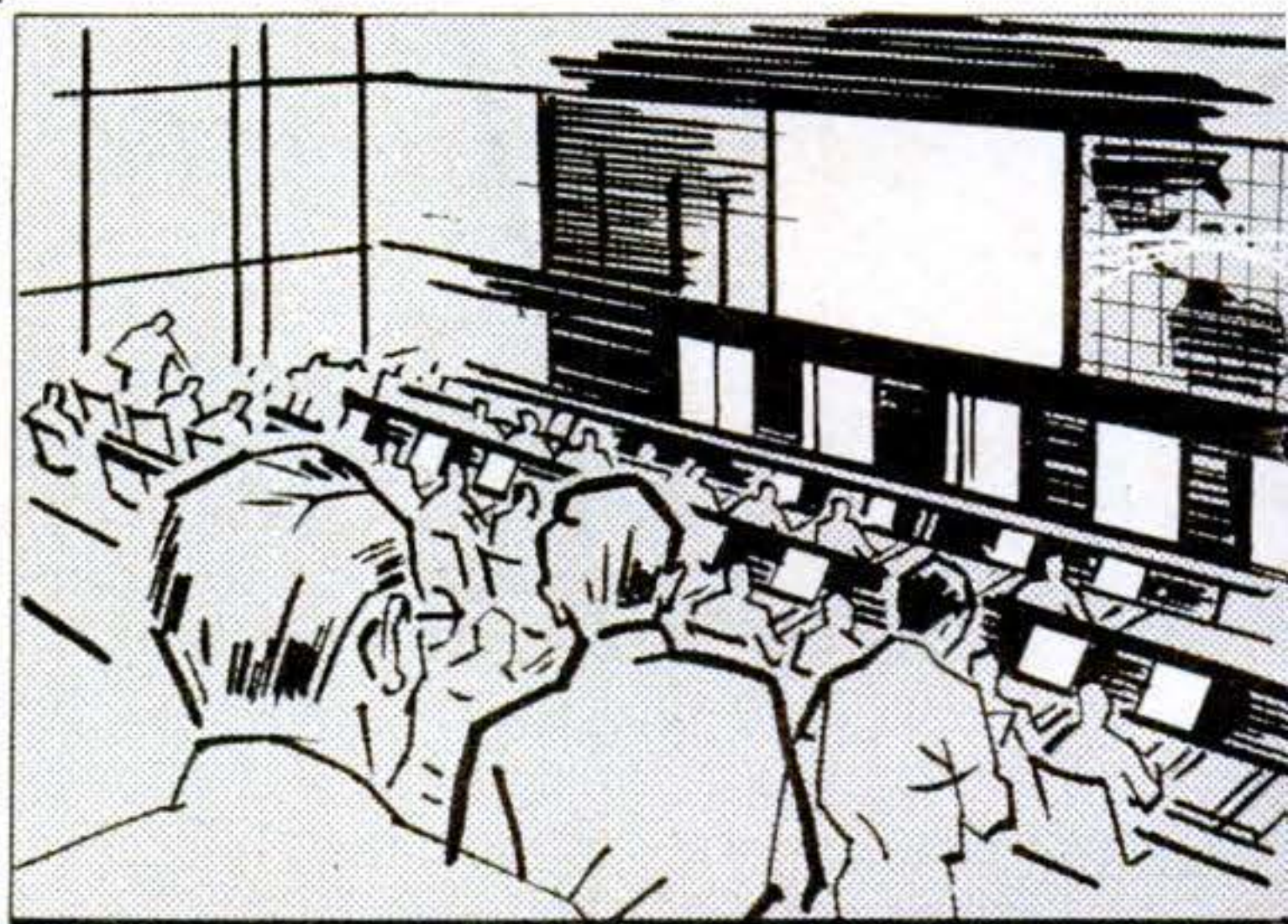
Manned space flights demand reliable radio links with earth to track the spacecraft's path, receive telemetered scientific and operational data, and provide voice communication, for reports and commands, between the astronauts and the Mission Control Center at Houston, Tex. So long as a spacecraft is within line of sight of one of our land stations, scattered over the earth, they fill this need. But since water covers $\frac{7}{10}$ of the globe, our Gemini program had to have three electronic support ships. Apollo flights will ultimately call for even more elaborate support.

Ships for Apollo. The coming network will employ five newly converted tracking-and-communications vessels—the Vanguard, Redstone, Mercury, Watertown, and Huntsville. Two of these will support the first,

Electronic ships and planes will link astronauts with earth at critical moments of lunar voyage

By DR. WERNHER VON BRAUN

Director of NASA's George C. Marshall Space Flight Center, Huntsville, Ala.



earth-orbiting manned Apollo flight; all five, the lunar mission.

Each ship is the floating equivalent of a full-fledged land station. It provides tracking, telemetry, and voice communication with the astronauts. It will have two independent links to land—by a high-frequency voice circuit, and via Comsat satellite.

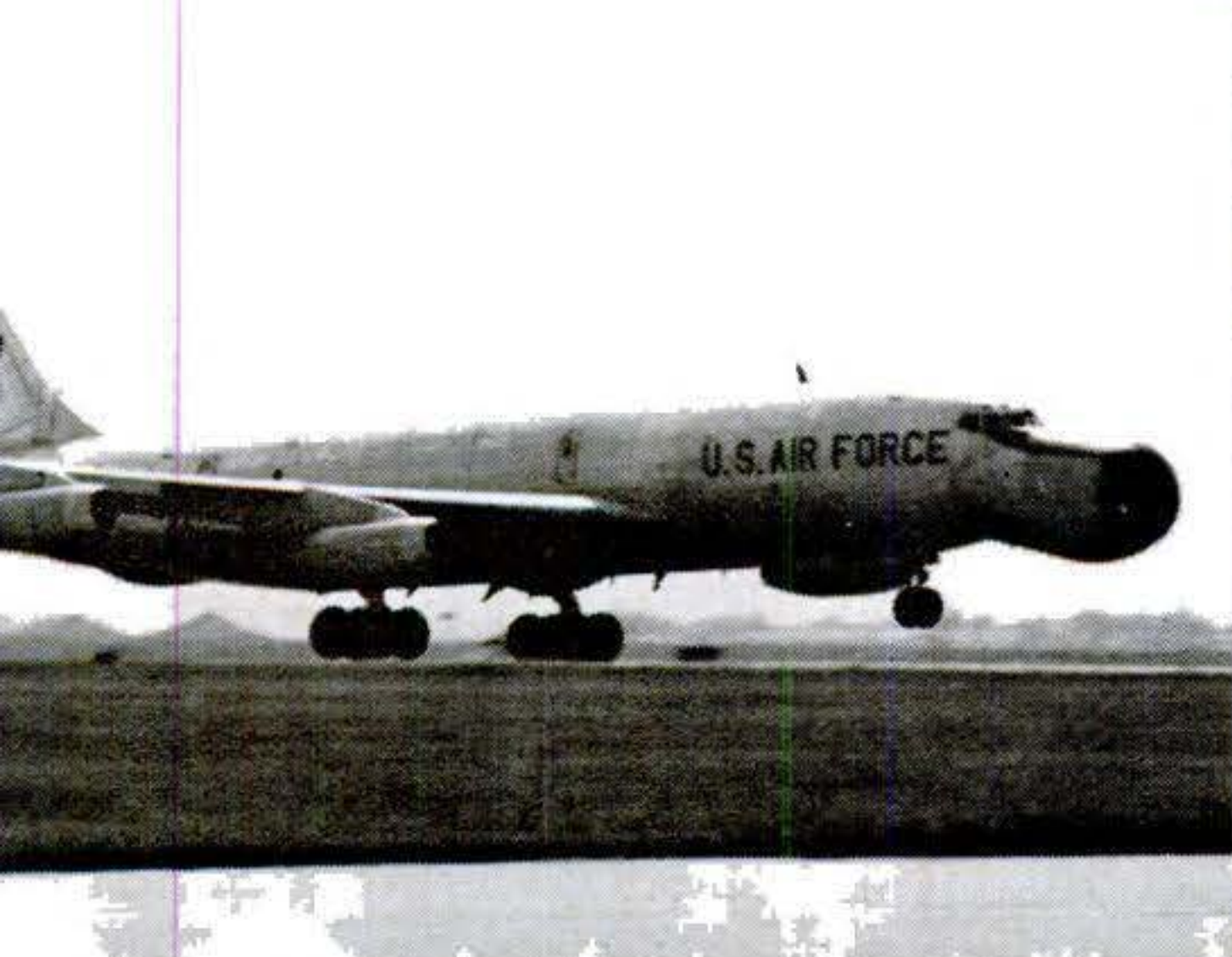
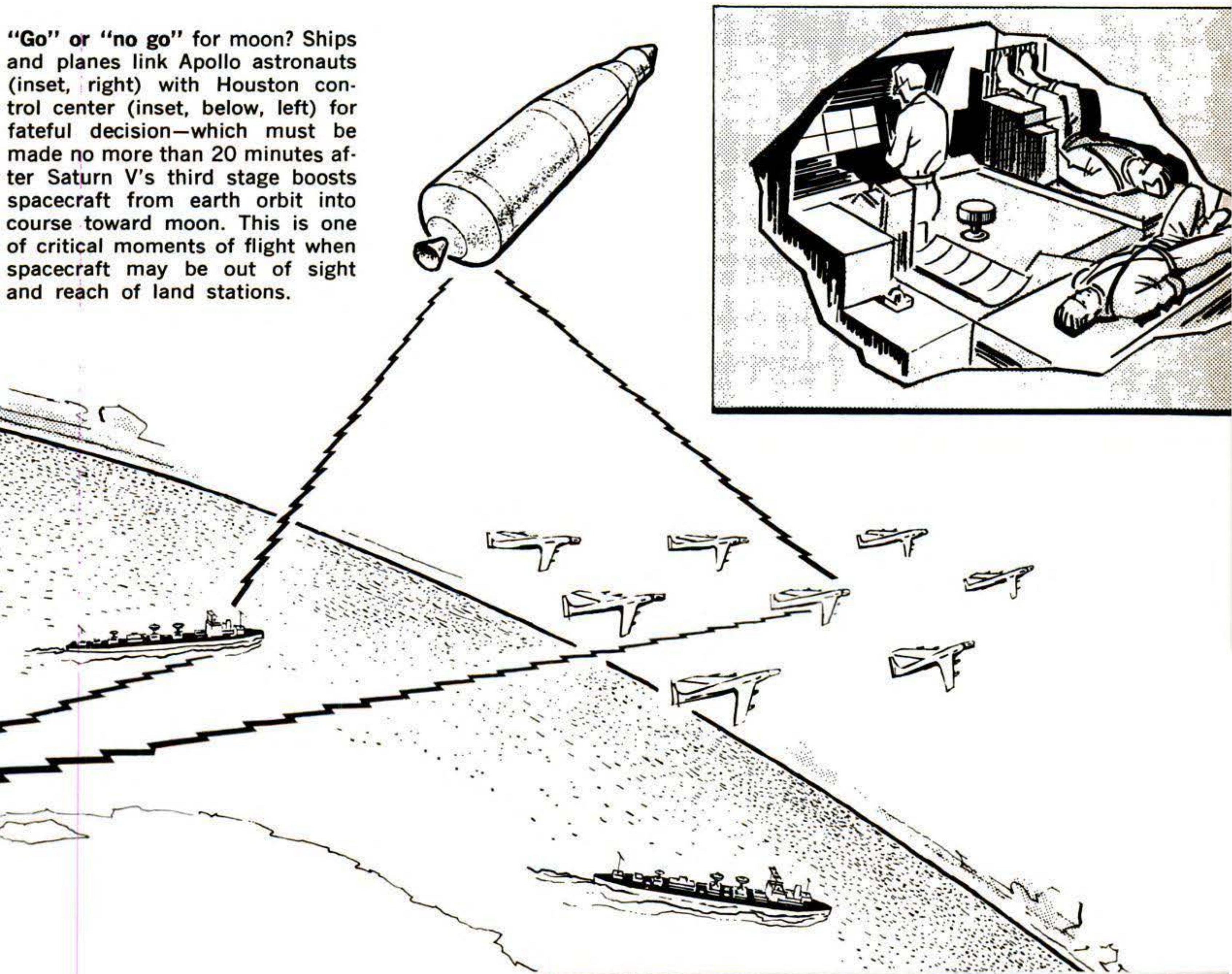
For the flight to the moon, one ship will be placed in the Atlantic, east of the Florida launch site, to cover the tail end of the first phase—putting the Apollo spacecraft into a “parking orbit” around the earth. Safe insertion in orbit, and the needed orbital data, will thus be reported to Houston.

Two ships, one in the Indian Ocean and

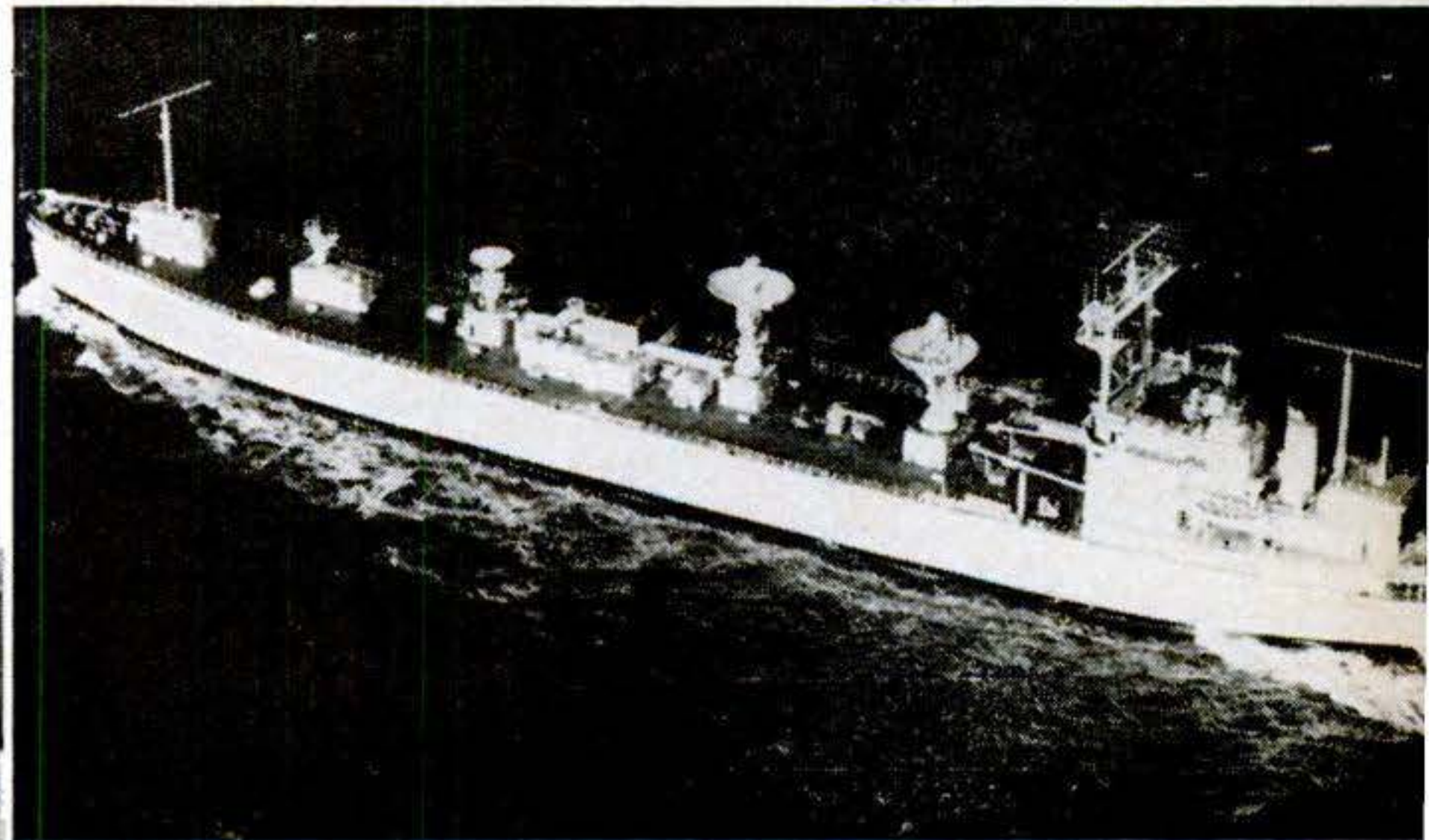
[\[Continued on page 204\]](#)

to Aid Flight to Moon

"Go" or "no go" for moon? Ships and planes link Apollo astronauts (inset, right) with Houston control center (inset, below, left) for fateful decision—which must be made no more than 20 minutes after Saturn V's third stage boosts spacecraft from earth orbit into course toward moon. This is one of critical moments of flight when spacecraft may be out of sight and reach of land stations.



Apollo communications plane, one of eight, undergoes tests at Edwards Air Force Base, Calif. Bulbous protuberance at nose contains sky-scanning antenna for voice and telemetry link with spacecraft.



Communications ship Vanguard, converted from T-2 tanker, begins sea trials. Two of these antenna-studded ships will support early Apollo flights orbiting the earth; five, the flight to the moon.



POWER OR SAIL? OUTBOARD OR STERN DRIVE

Getting Started in

By **JIM ROE** / *PS Boating Editor*

So you've decided you want a boat. You have seen the other fellow trailer his runabout or cruiser along the highway toward inviting waters, watched him in envy from shore or riverbank, perhaps even had a taste of boating life on a friend's craft. Anyway, you've been lured by the sport, you're eager to get in.

Buying the right boat, maintaining it, getting docking and storage, accumulating all the accessories you need, and acquiring boating skills takes time, effort, and money. But you'll find it's not as difficult or as expensive as you thought. These answers to your questions will steer you on the right course to getting the most fun and satisfaction out of boating.

Q How much does it cost to get into boating? I have heard boating is only for the well-heeled.

A This is false. You can get into boating for \$50 or less. This is the cost of a good secondhand canoe—one of the most useful, romantic, and pleasurable craft in the world. A used rowboat can likely be found in the same price range. Maybe even a motor goes along with it. My first outboard motor cost just \$25. It worked fine, and still does. Or you can pick up low-cost secondhand small boats of several other common types, such as a sailing dinghy or sailboard.

Q How about a typical family runabout in the 15-to-20-foot range?

A Let's take new outfits first, then secondhand. You can buy a good 15-foot boat, with a good 30-40-hp. motor, and a trailer, for \$1,500 or less. A good day sailer of about 15 feet will cost under \$2,000. If you want to go to a 20- or 22-foot outboard cruiser, with enough horses to handle it, you'll be talking \$3,000 to \$5,000. This is a deluxe way to go to sea, and it still costs no more than an ordinary car. In general, for about \$5,000 you can get a really fancy runabout in the 18-22-foot class—with inboard, twin-outboard, or stern-drive power. When you get this, you're driving quite a boat. For \$8,000-\$10,000, you can graduate into sizeable boats: a 25-30-foot cruiser, say, or a serious sailboat of about the same length.

Q How about secondhand?

A Deduct about a third to a half from these prices and you can buy a good, sound boat. There are thousands of them for sale.

Q Am I just buying someone else's trouble if I buy a secondhand boat?

A Hardly ever. Boats aren't like cars, which are usually not traded off until they are rusting out or something mechan-



FRIBREGLASS, WOOD, OR ALUMINUM? WHAT SHAPE HULL?

Boating: A's to Your Q's

ical is wrong with them. Boats are traded off because a boatman is having so much fun he wants a larger boat. While he lovingly polishes the boat he has, his eyes are straying across the harbor to a boat three feet longer. The results are predictable: He sells his present true love and buys a bigger one.

Q What's the best—power or sail?

A No one but you can answer that. A boat is for pleasure; you will have no difficulty knowing what looks like fun to you. In general, some of these factors will figure in your decision: If you want to engage in competitive racing, you probably will be interested in sail. If you want to get from here to there in a hurry, you obviously will want an adequately powered power boat. If you like to camp when you're boating, you'll want a beamy run-about roomy enough to carry camping equipment, and with the power and speed to get you to remote camping sites in a hurry. If you aim to cruise and live aboard, you'll want some sort of cabin. If you like to cruise in silence with only the sound of wind and wave, you'll want a sailboat.

Q What do you recommend—outboard or stern drive?

A I like them both. In the lower horsepower range, for fishing, the small out-

boards are unsurpassed. If you want a really high power rating, choose either a big stern drive or an inboard. But there's a big area from around 60-80 hp. up to 200 in which you can be happy with either outboard or stern-drive power. Stern drives offer advantages of the outboard and the inboard at the same time. And they come all installed in the boat in one package so you have a minimum of rigging to do when you buy the boat. But they haven't been selling like hotcakes at the expense of the outboards. It's just that more people are entering boating. A single- or twin-engined outboard installation gives you maximum power flexibility. Also, it's easy to shift these engines from boat to boat if you change hulls. I've driven hundreds of outboards and stern drives. I like them both. When you buy your boat, test-ride several at least. You'll know the one you really want the moment you put her through her paces.

Q I've heard the waterways and the harbors are crowded. Will I be able to find a place to moor my boat?

A Sure. If you get an easily trailerable boat, it is likely you'll want to moor it in your garage. This will give you maximum opportunity to trail it all directions to interesting waters. You'll have little difficulty finding handy and available launching ramps. Slips and mooring buoys are in short supply in some areas. But boat deal-

ers and municipalities are increasing facilities rapidly. Sometimes it takes a shoehorn, but there is 'most always a place for one more boat. Also, with the new dry marinas, hundreds of boats can be stored safe and sound inside a shoreside building and be in the water ready to go in minutes.

Q Big outboards and most stern-drive boats are pretty heavy. Can I handle them on a trailer on the highway, and are they difficult to launch and recover?

A They get easier to handle all the time. Trailer engineers have already made the trailer a magic carpet for boatmen. Just be sure to buy a recognized brand that has stood the test of time, and buy from a reputable dealer. Make sure it is designed for more weight than you now plan to carry. You'll add equipment to your boat, and be piling all sorts of fishing, diving, and picnic gear in it. One tip: Be sure to bolt a power winch on the winch stand of your trailer if your boat is heavy. This little marvel takes all the back work out of handling a heavy craft.

Q What's the best kind of "first boat"?

A Here's a tried-and-proven formula: Buy the most popular small boat in your particular area. There are good reasons for doing so: First, that boat has undoubtedly proven seaworthy and capable in the local waters. Second, obviously it is the boat that does what most boatmen in the area wish—fishing, picnicking, skiing, etc. Third, there will be good buys available both in new and used craft, and dealers will be used to servicing and repairing them. To top it all off, you'll have lots of friends available who can help you learn the skills of handling and enjoying that particular boat.

Q What's best—fiberglass, wood, aluminum, or steel for the hull?

A If you want one of the new-style hulls with complicated curvatures and multiple keels, such as the cathedral style, go to fiberglass. Glass enables a boat builder to get any angle and curvature he wishes. Fiberglass is increasingly popular for runabouts of any hull design because of their

easy maintenance. They need not be painted to protect the hull. Don't assume, though, that this means they never need to be painted at all. Some day you doubtless will want to paint yours to enhance the luster and renew its appearance. But fiberglass is tough stuff, and will forgive you many a bump at the dock or on rocks.

Aluminum has strong appeal as a fishing boat and car-topper. It's light in weight, doesn't need painting either, and also has the advantage of standing up to tough punishment. One disadvantage: It is sometimes noisy in rough water at good speed. Make certain either a fiberglass or aluminum boat has built-in flotation.

Wood is the old standby, and is still preferred by many purists. Large cruisers are built of heavy oak frames, cedar, and mahogany planking. Most smaller boats are now built of marine-grade plywood. This is extremely strong for its weight and if properly cared for will give years of dependable service. Modern caulking compounds have virtually eliminated leaking between the seams of wooden boats. Wood makes for a dry, quiet boat, and for one with a "boaty" look. It also offers some degree of flotation ability, though if you have engines of any great weight you'd better be certain there is extra flotation built into your boat. Everybody knows wood's disadvantage: the painting or varnishing.

Steel is generally found only in cruisers of 30' or larger. Here it offers a fine building material indeed. It holds a coat of paint for a long time, obviously has no seams to leak, and is strong. But you won't find small runabouts built of it.

Q What shape hull? I understand there are lots of new ones.

A Right. Time was, when we had flat-bottom boats and round-bottom boats. Now we also have deep-Vs, multikeel cathedral types, and endless variations and combinations of these two. The reasons for these hull shapes fill many volumes on naval architecture. Capsule summary: A flat bottom is generally confined to small fishing-type boats. It propels easily, but will pound badly in rough water. A classic round-bottom hull is exceedingly seaworthy. It won't plane quite as easily as a hull with a flatter planing surface or with the new lifting strakes.

The deep-V hull was designed for high speed in rough water. It knifes through a chop without pounding. Most deep-V keels have longitudinal lifting strakes attached to help give them better planing ability and to stabilize them somewhat while at rest. One disadvantage of the deep-V is this comparative instability while at rest and a tendency to tilt when weight is concentrated off center.

The cathedral or multikeel style of boat is the newest to gain in popularity. These keels use the catamaran principle to give a boat great stability. A lot of new hulls have been designed in the past five years. A good many of these are combinations of the deep-V and the multikeel cathedral. And they are mighty good.

Q Do boats take a lot of upkeep?

A Not necessarily. The typical family-style runabout need cost you only pocket money for upkeep. Particularly if you enjoy doing a bit of tinkering on her yourself. Engines are dependable, and tend to keep going year after year with a minimum amount of attention from a mechanic. Fiberglass boats need loving attention with the washing and polishing cloth. A wood boat probably will need painting every year.

Q Are houseboats becoming more popular?

A Yes. And for good reason. They offer a maximum of square feet of usable living space for the money. And they are mighty seaworthy. I have run the rugged River Queen in rough Lake Michigan waters, in great comfort.

Q Will I have to buy a lot of equipment?

A You won't *have* to. But part of the fun of boating is equipping it with all sorts of useful and handy items. You *will* need the legally required things—life jackets, anchor and line, signaling device, fire extinguisher, etc. But you'll want many other things, too—radio direction finder, radio telephone, speedometer. Any boatman likes to push levers, turn knobs, and read dials. This equipment doesn't need to be purchased all at once; it is often more fun to assemble it piece by piece.

[\[Continued on page 208\]](#)

How Big A Boat Should I Buy?

Don't worry about it. Buy what you can afford right now. *Whatever* size boat you buy, next year you'll want one three feet longer. As the sequence below shows, we began with a canoe, advanced to a 36-footer. Now if that Pacemaker were only six feet longer . . .



Roeboat the first. We still have it. Note the home-built car-top carrier for convertible.



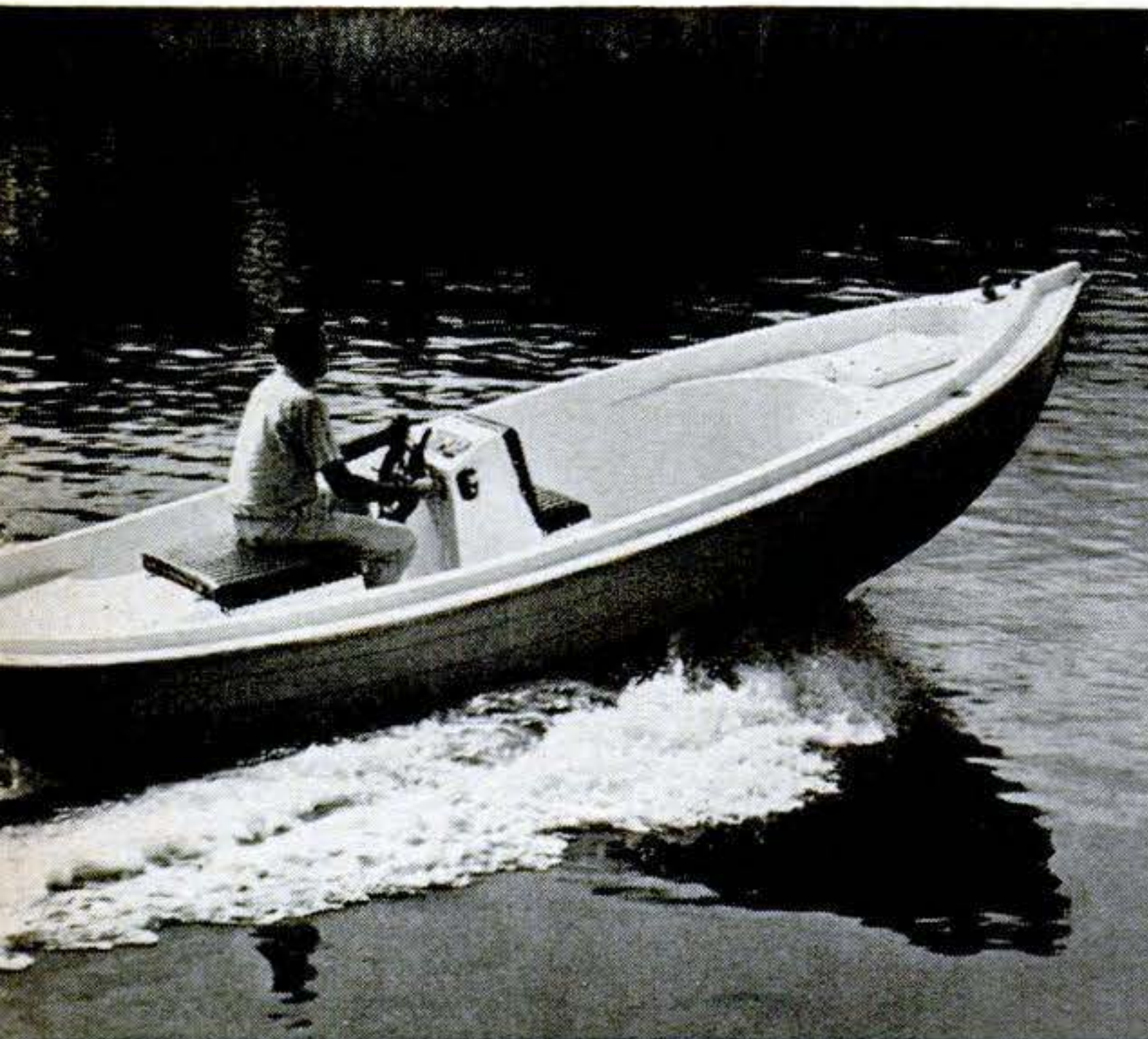
Moving up! This 19-foot cruiser with twin outboards was big enough to take a crowd aboard.



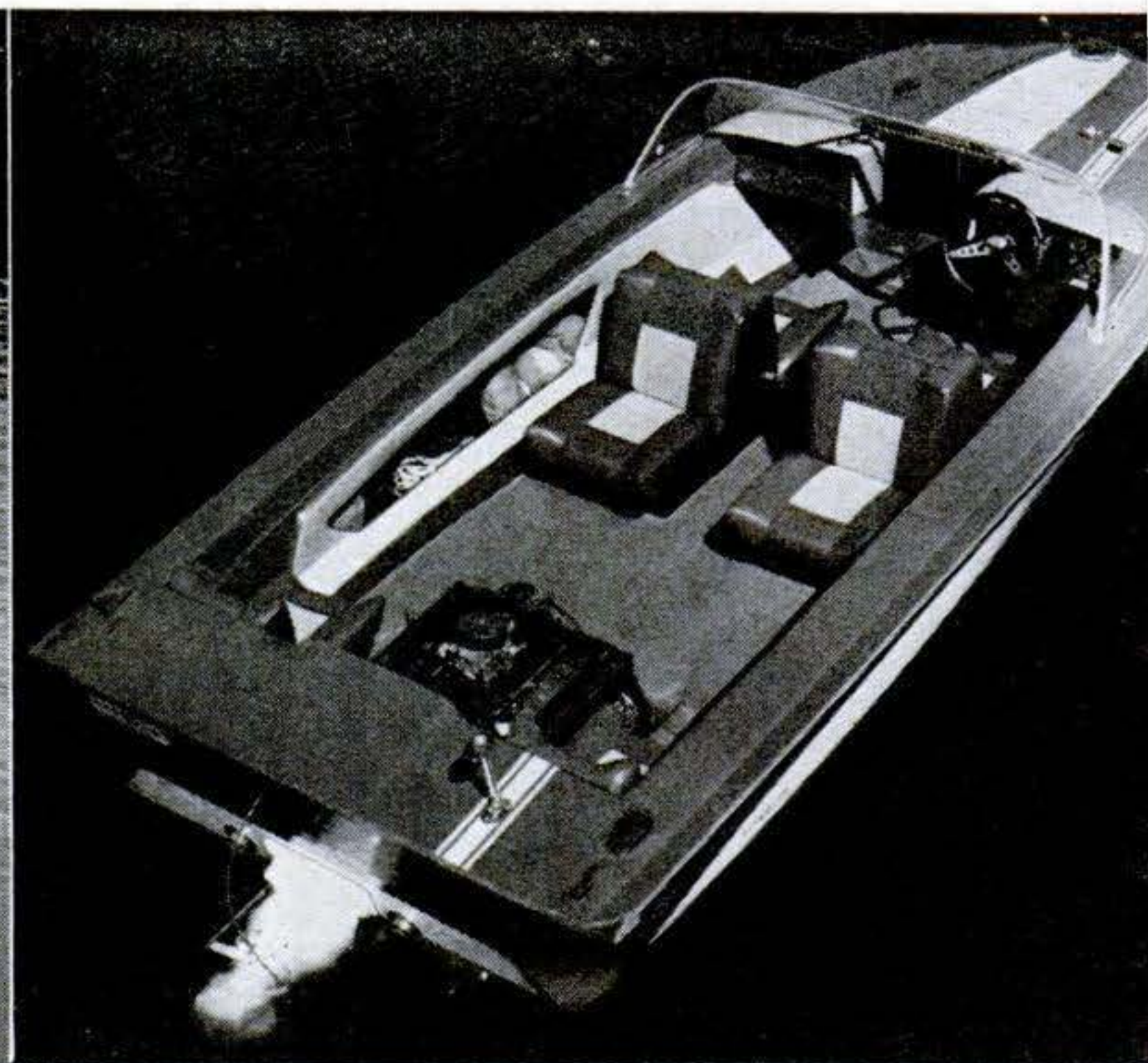
Three more feet: Our 22-foot Thompson had twin 75-hp. Johnsons—and a trailer.

Today's Roeboat: 36-foot Pacemaker fly-bridge sedan. Do we eye larger boats? You bet!

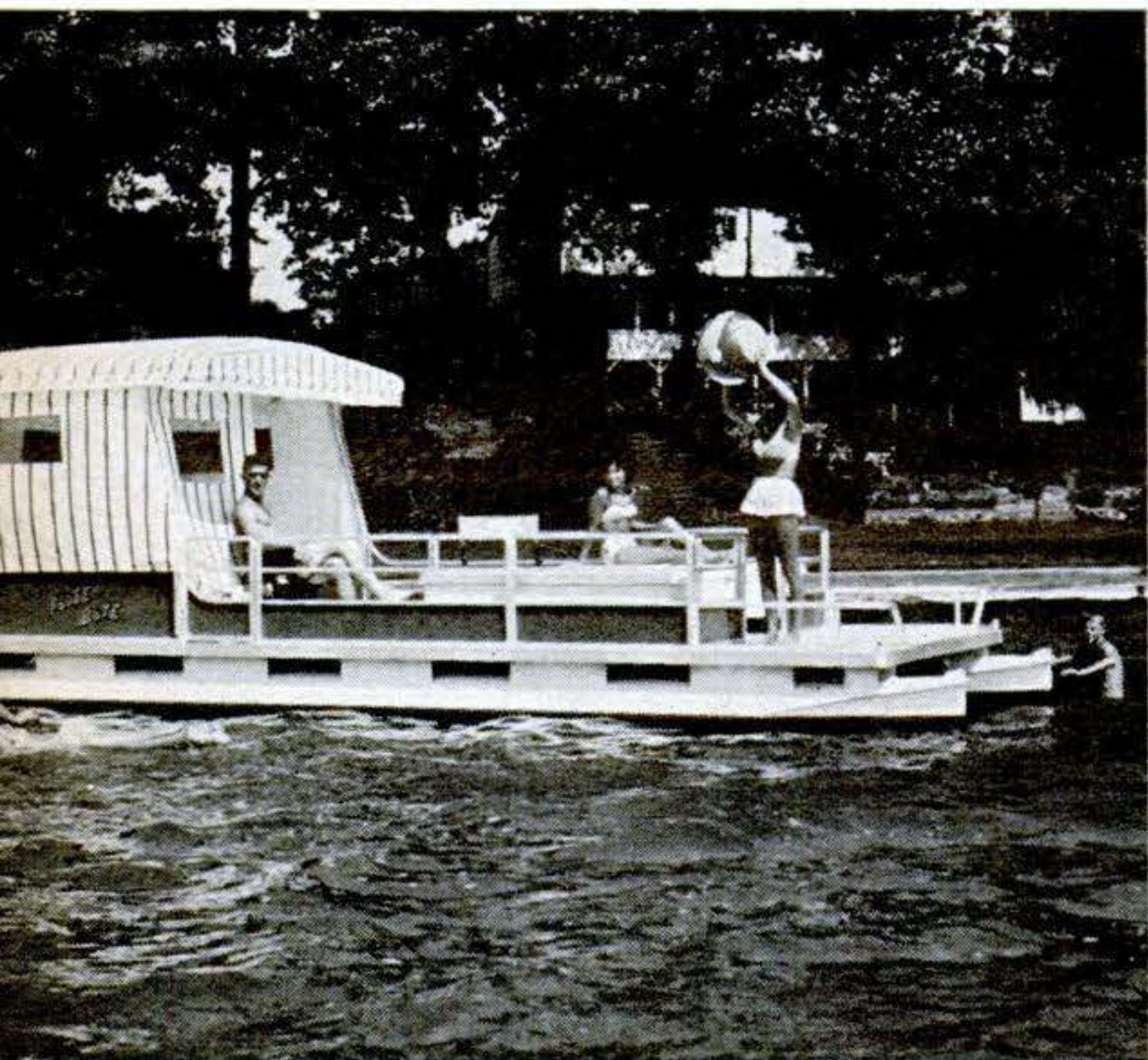




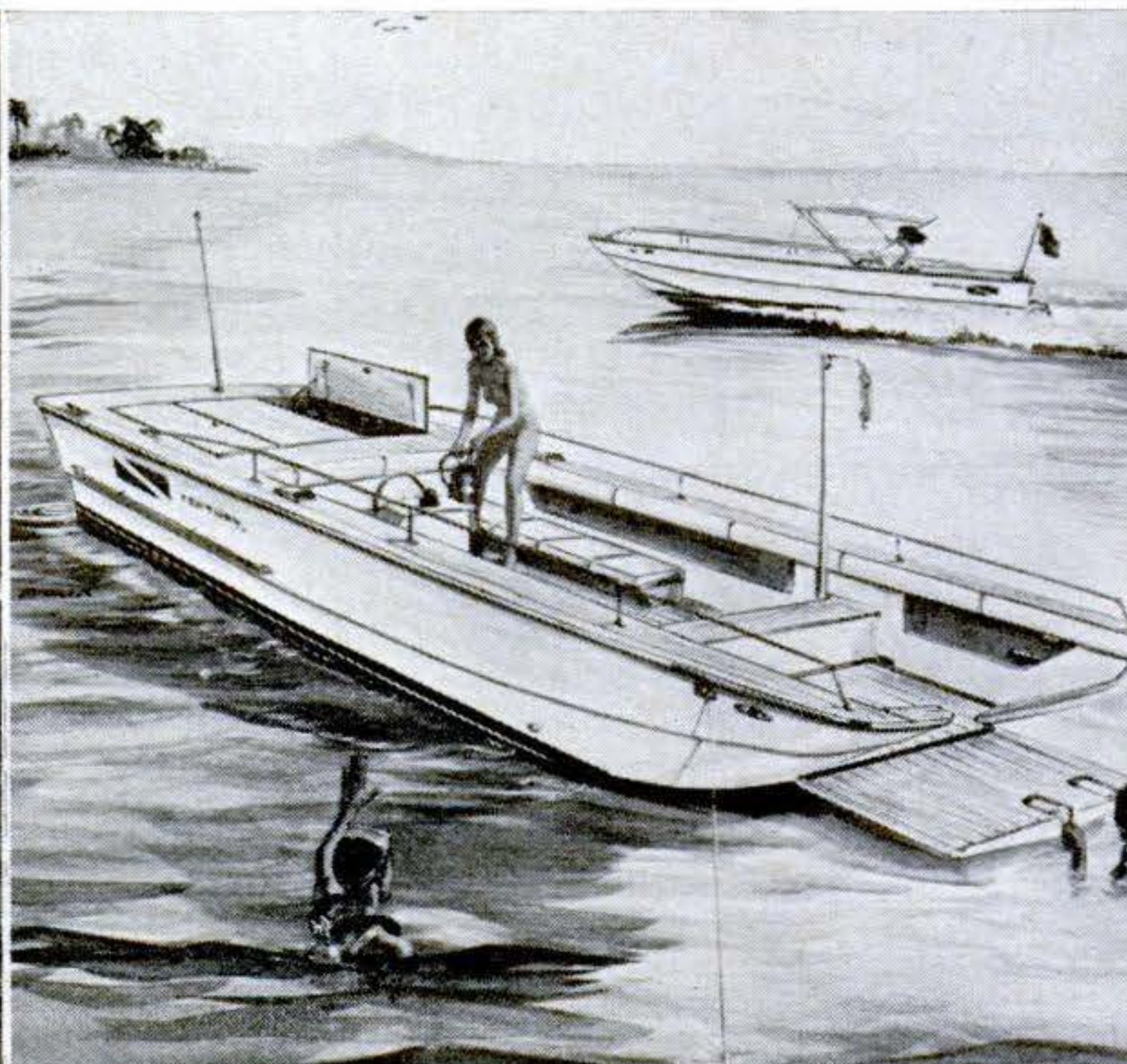
Canoe-sterned, the new Fjordling is an all-fiberglass, deep-V, high-speed, lapstrake seagoing dory. At slow speeds, the upper body is stable. When more power is applied, the hull lifts on its deep-V underbody and becomes a high-speed runabout. Length is 18 feet. With a 110-hp. stern drive it is said to do better than 30 m.p.h. Lauderdale Marina, 1900 S.E. 15 Street, Fort Lauderdale, Fla. 33316.



Complete jet drive in one handy package is the Pack-a-Jet. It includes everything but the boat: a Berkeley Model 12JA jet drive, marine engine, transom adapter, through-hull adapter, adjustable engine mounts, drive coupling, cooling hoses and fasteners, instrument panel, wire loom, steering assembly, throttle and shift controls. Berkeley Pump Co., 829 Bancroft Way, Berkeley, Calif., is the maker.



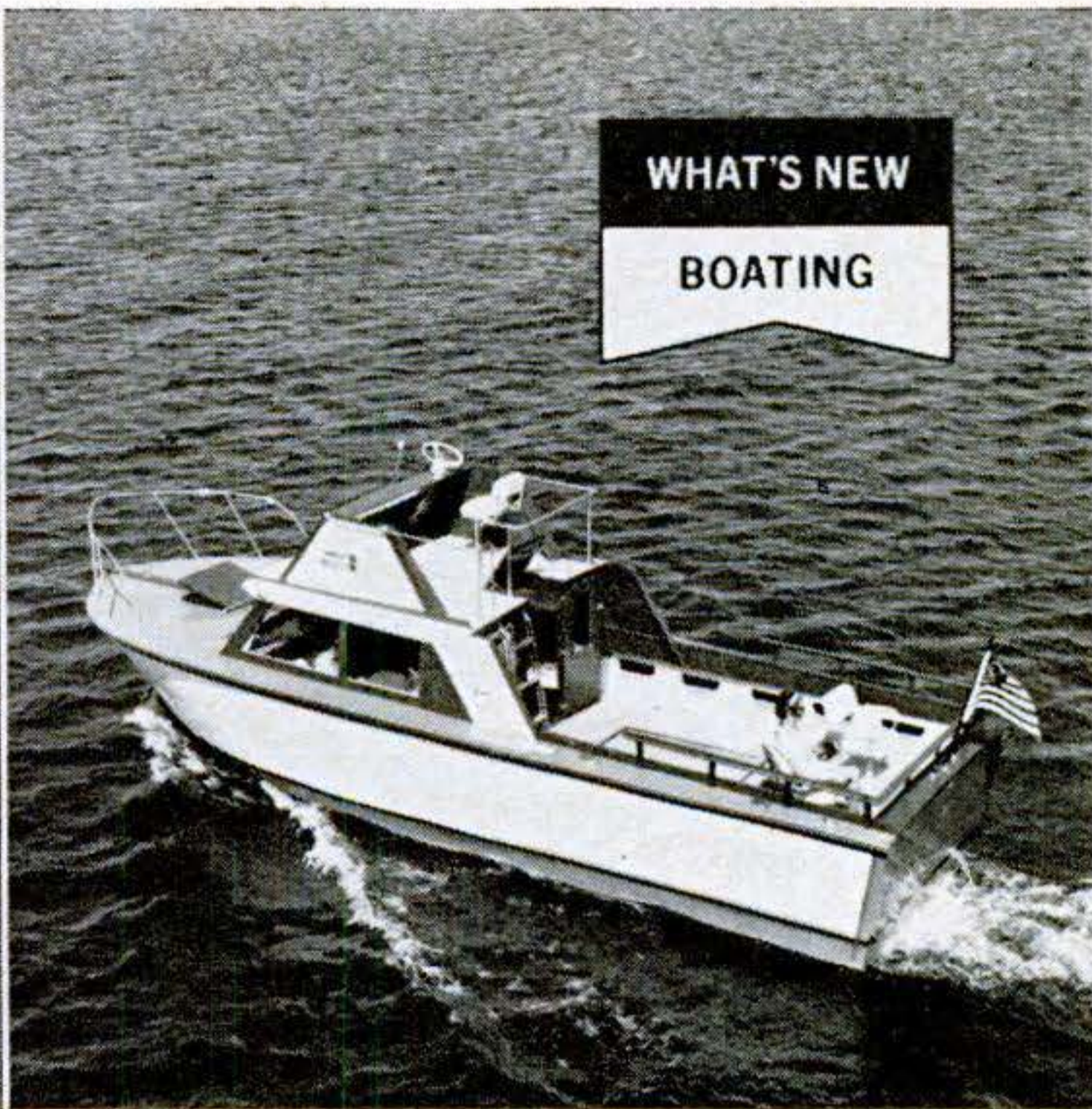
Pontoon-style Flote-Botes can be equipped with a Dacron "cabin" enclosure. They are available in six models, from 20 to 28 feet, and with steel or aluminum pontoon construction. The boats are easily transported on their own special trailers. The cabin plan is single-level. Aft visibility is said to be excellent, through big windows in the after bulkheads. Harris Mfg. Corp., 2801 W. State St., Fort Wayne, Ind.



Ideas for skin divers are designed into the new Trident. This 20-foot catamaran is packed with features for divers. Among them: hinged bow section which lowers for easy access from the water, designed storage areas for air tanks and equipment. It has an eight-foot beam, can be powered by twin stern drives of 60 to 110 hp. or outboards of 40 to 100 hp. Century Boat Co., 1860 Broadway, NYC 10023.



This new houseboat sleeps eight. It is 37 feet, seven inches long, has a 22-by-10-foot cabin with seven-foot headroom throughout. The sundeck, 260 feet square, is easily reached by ladder from the bow deck. The Playliner 220 comes complete with all furnishings, pressure water system, equipped galley. The fiberglass hull is foam-filled for secondary flotation. Cargile, Inc., 999 Polk Ave., Nashville, Tenn.



You can be your own boatbuilder with the Luger 32-foot Capri Sport Fisherman. It sells as a kit. The deep-V hull comes in five molded fiberglass sections. A factory-molded deck is supplied in two sections. All the fiberglass parts are ready for putting together, with no finishing or fitting required, according to the manufacturer. Luger Industries, Inc., 9200 Bloomington Freeway, Minneapolis 55431.



One-design sloop, Chrysler's LS-16, has a sail area of 160 square feet. The sailboat is 16 feet long, with a 73-inch beam. Maximum draft is two feet, 10 inches. Weighing 450 pounds it has a load capacity of 900 pounds. Chrysler Boat Corp., Plano, Tex.

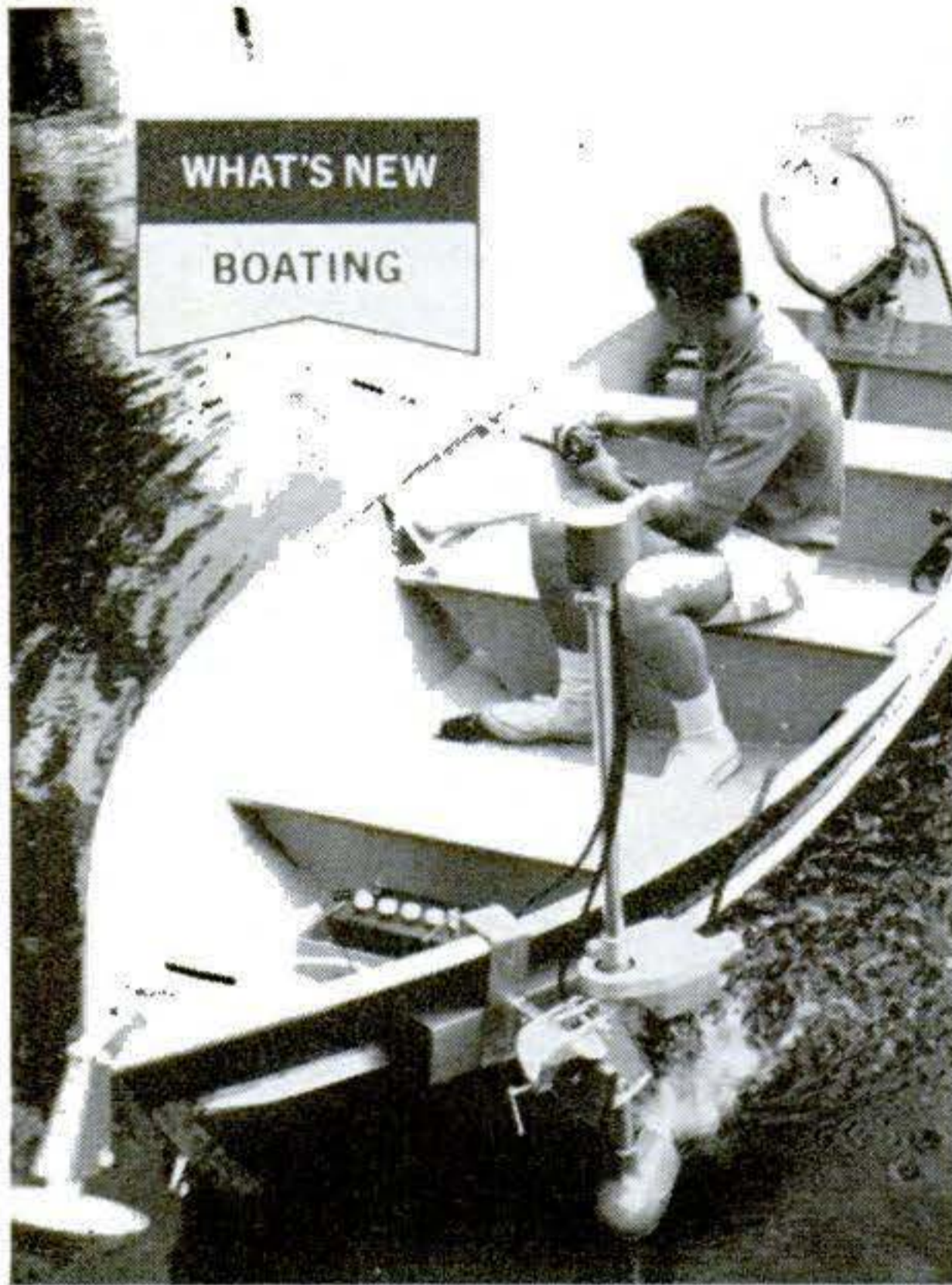


This sailboard can be rigged and running minutes after it's off your cartop. Lateen-rigged, Glastron's 15-foot Alpha sports 98 square feet of sail, tilt-up rudder for beaching. Cockpit of the 600-pound-capacity craft is self-draining. Glastron Boat Co., Austin, Tex.

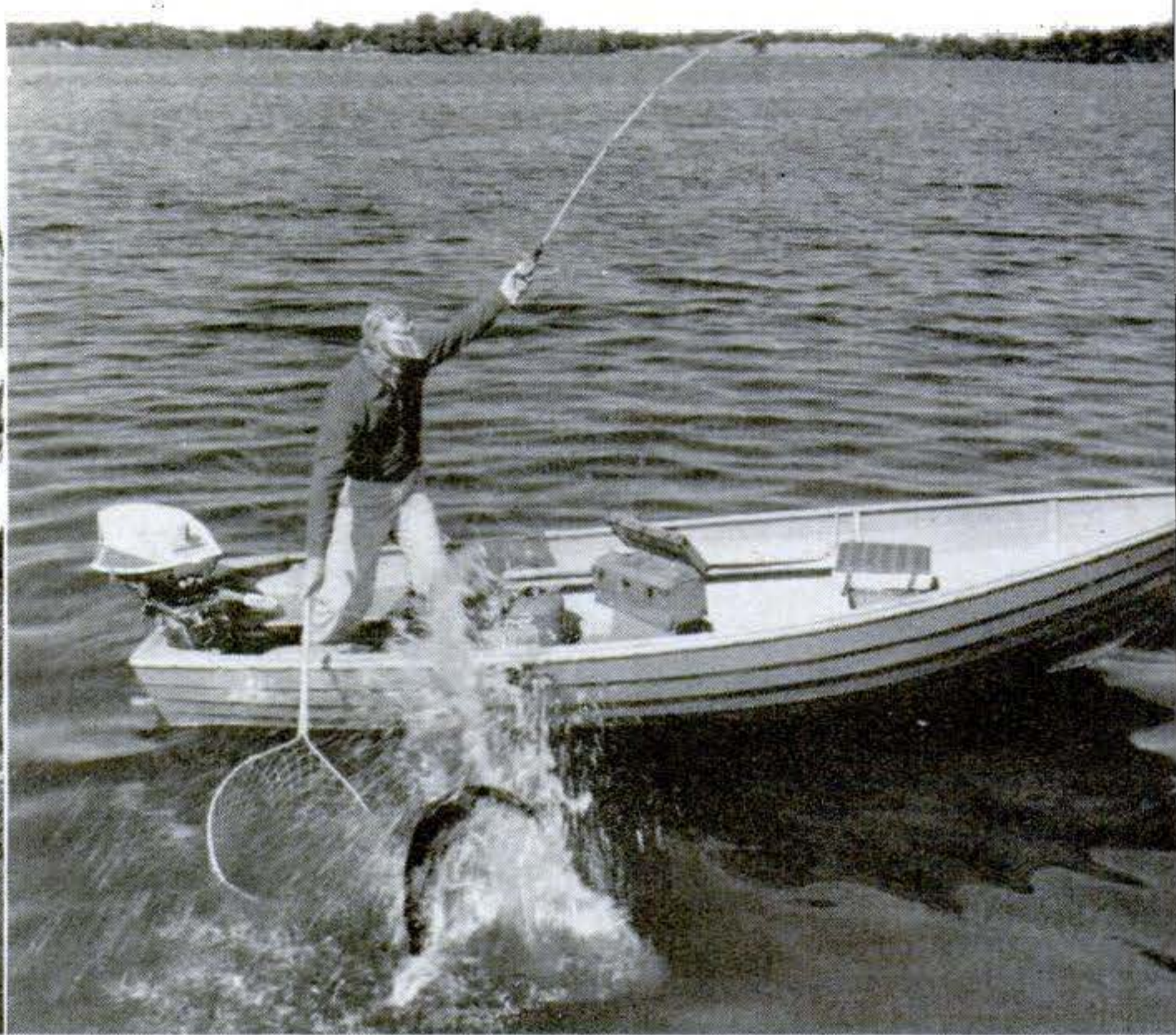


A versatile fiberglass 18-footer, Baronet is designed for outboard power up to 110 hp. She'll carry 1,200 pounds. Quadralift hull has parallel step planes to provide lift as boat speeds up. Winner Boats, Box 231, Dickson, Tenn. 37055.

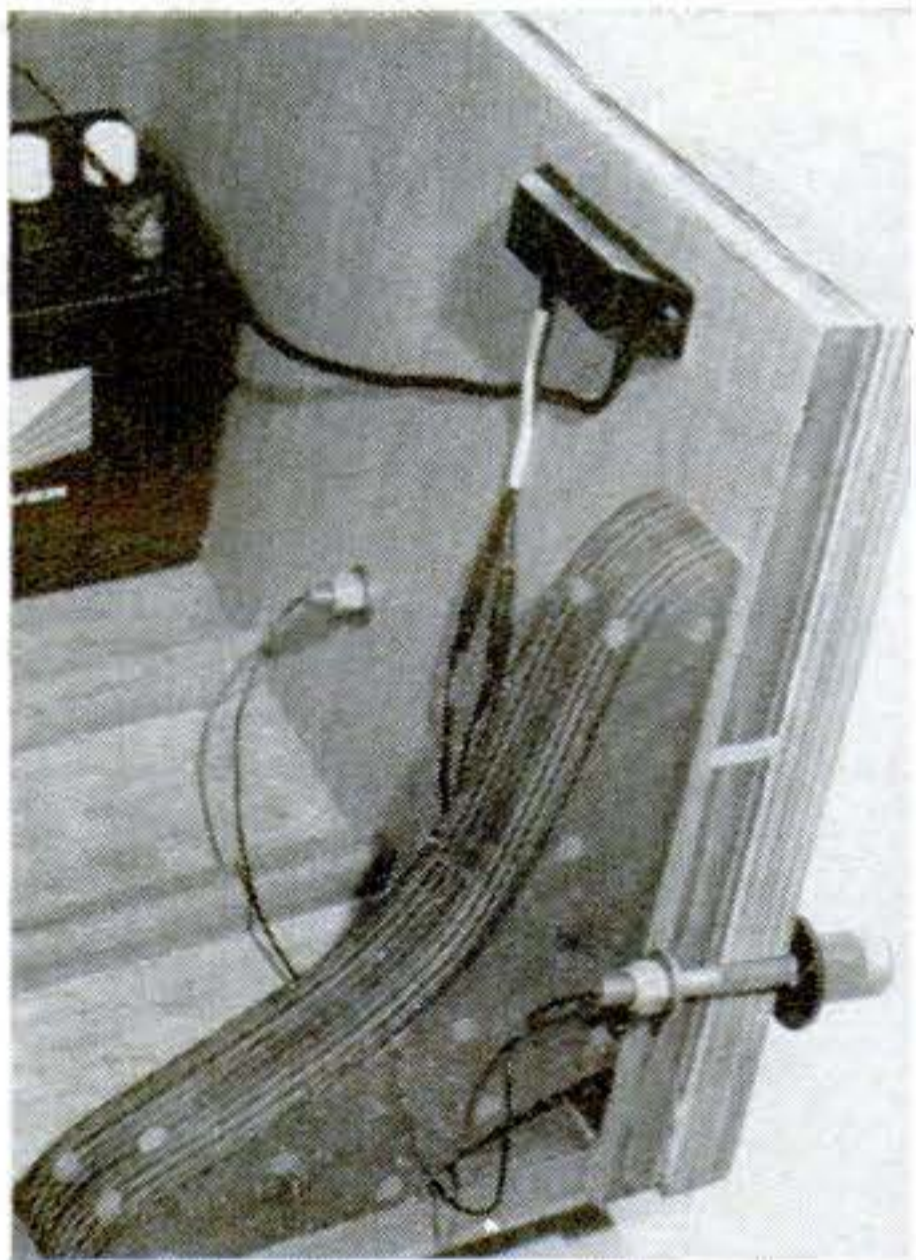
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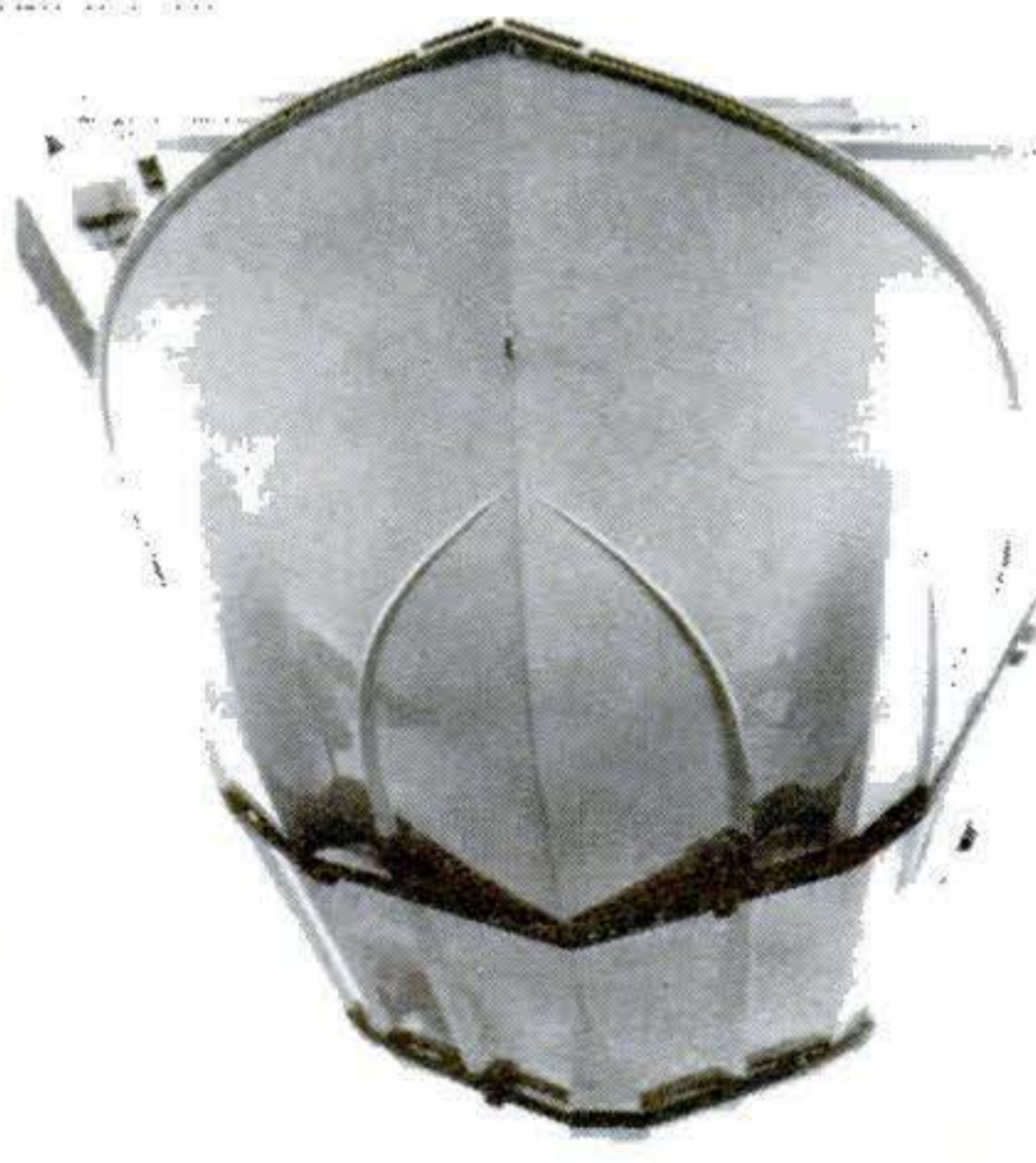
You can stop, start, steer, or reverse this electric trolling motor with your foot. Remote-control pedal allows you to sit anywhere and use the Lazi-trols. They operate on six-, 12-, or 18-volt storage batteries. Standard 12-volt unit draws approximately seven amps at 370 r.p.m., eight amps at 500 r.p.m., nine amps at 730 r.p.m. Standard model powers 10- to 14-foot boats; heavy-duty model, boats 14 to 18 feet. Byrd Industries, Inc., Ripley, Tenn.



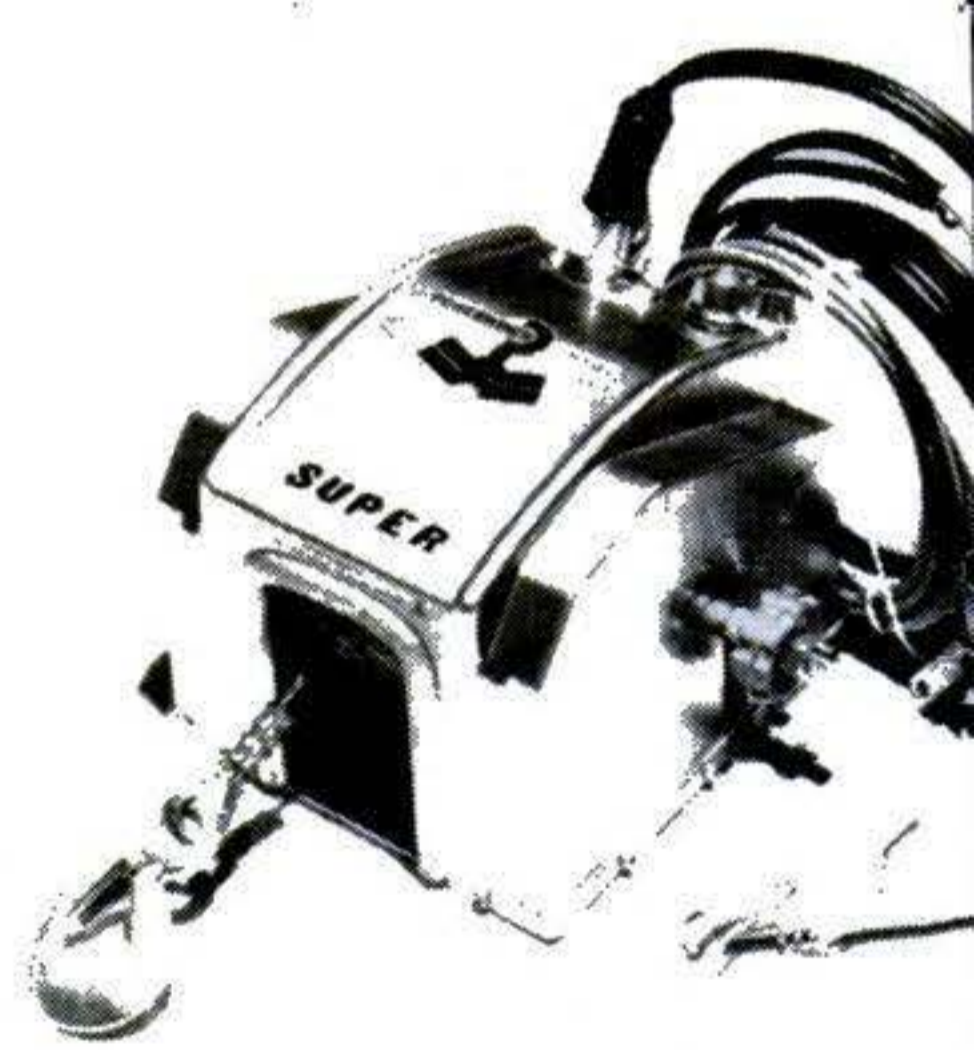
Rugged, new skiffs from Old Town have seaworthy design, lapstrake construction. They come in seven models from 10 to 16 feet. Smaller ones, designated as rowing skiffs, are equipped with two pairs of oarlocks and a horseshoe stern seat. They can handle motors up to 7½ hp. The larger outboard skiffs perform best with 10- to 20-hp. power plants. Bottom and sides are red cedar; frames, knees, and gunwales are oak or ash. Old Town Canoe Co., Old Town, Me. 04468.



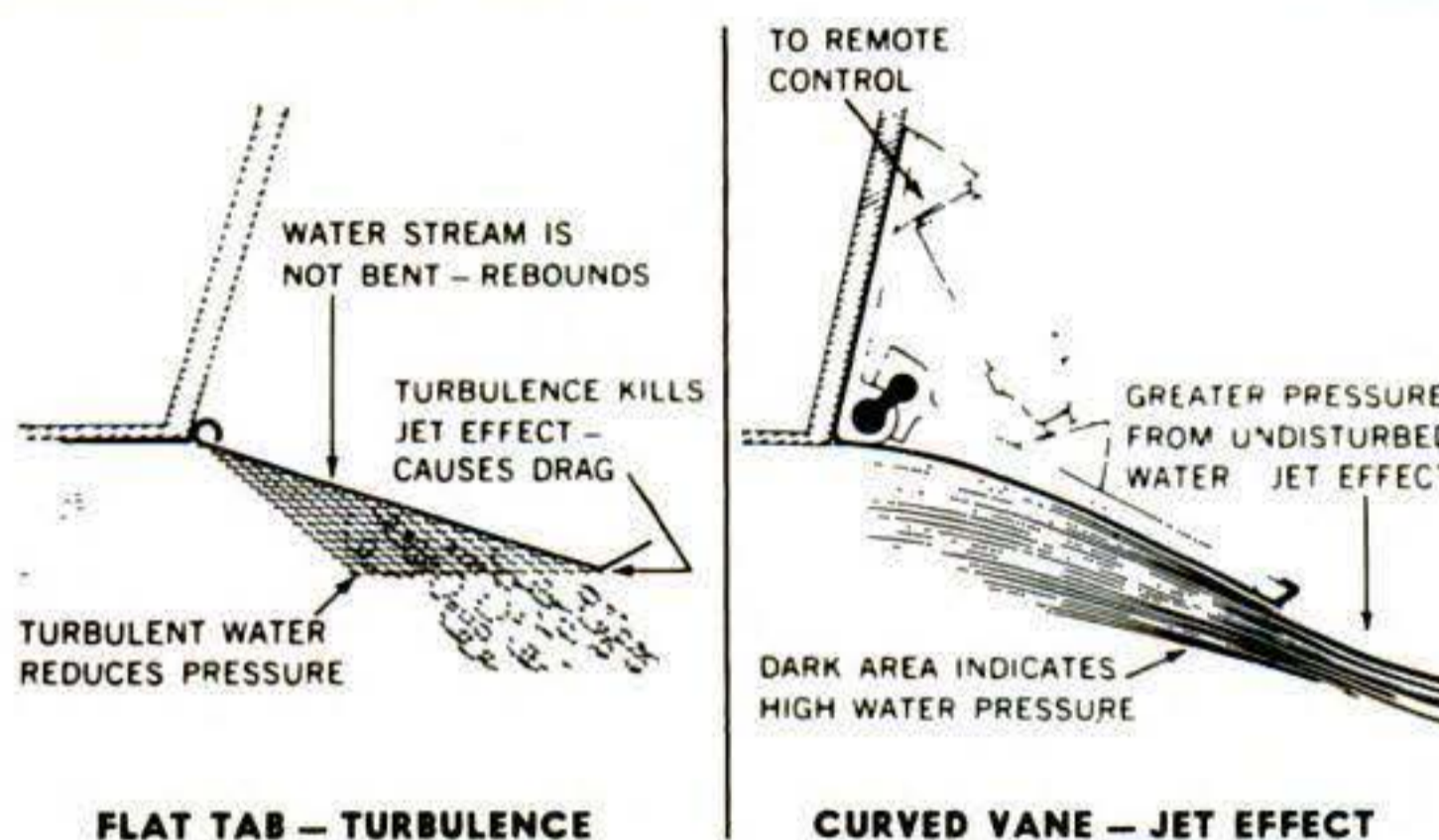
MerCathode, a new accessory for stern drives and outboards, fights salt-water corrosion. It has two electrodes, and a small box with solid-state components that mounts inside the transom. Electrodes, installed through the transom just below the waterline, operate from boat battery. Kiekhaefer, Fond du Lac, Wis.



A brand-new hull from Chrysler, is the Hydro-Vee. Available in 14-, 16-, 17-, and 23-foot lengths, it combines features of a three-point hydro and a deep-V to give stability, speed, and a soft ride. There are step sponsons, two longitudinal lifting strakes, and a delta keel. Made by the Chrysler Boat Corp., Plano, Tex.

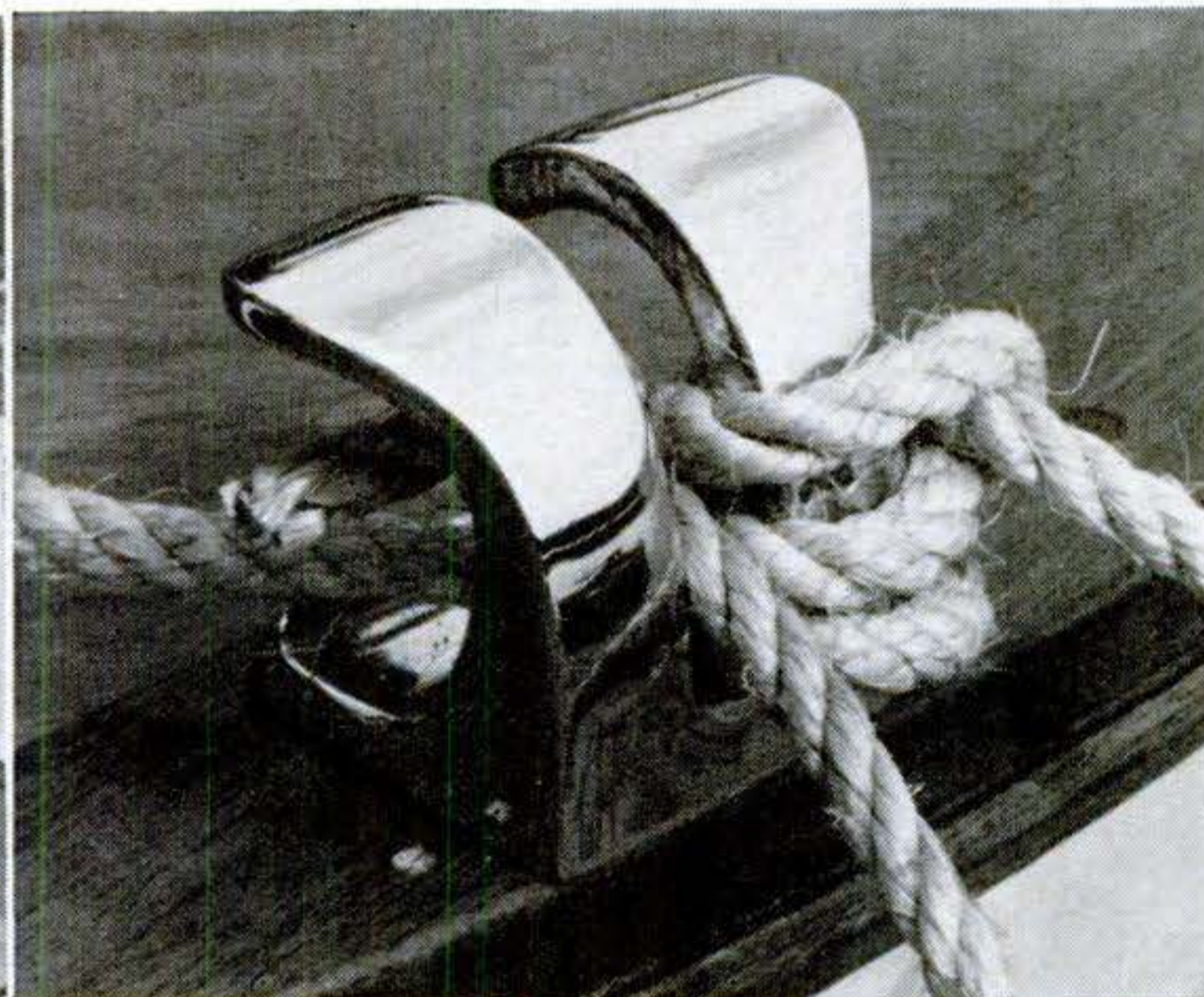


A new, more powerful boat-trailer winch handles boats weighing up to 6,000 pounds. The Powerwinch Super comes with 50 feet of cable and a wiring kit for bringing current from car battery back to the trunk for plug-in. Powerwinch Corp., 51 Garden St., Bridgeport, Conn.



Fiberglass cathedral hull is feature of this 15-foot model 1514 Sportsman, one of a new family by Cruisers, Inc. There is also an 18-footer. Both are designed to give a soft, air-cushioned ride. They're great, too, for high-speed turns and easy handling in rough water. The boat shown offers a bait box, bow rail, center steering console, cushioned swivel pilot seat, and full-width stern seat as standard equipment. Made by Cruisers, Inc., Oconto, Wis. 54153.

New trim tabs produce a "jet effect." Drawing at left, according to Tempo engineers, shows turbulence created by flat-surfaced tabs. Drawing at right shows new curved-surface trim tabs. Water in the jet stream from curved trim tabs is said to provide greater lift. In photo at top, dark areas of nonturbulent water show up immediately behind tabs. Tabs are adjustable, hydraulically controlled. Tempo Products Co., 6200 Cochran Rd., Cleveland 44139.



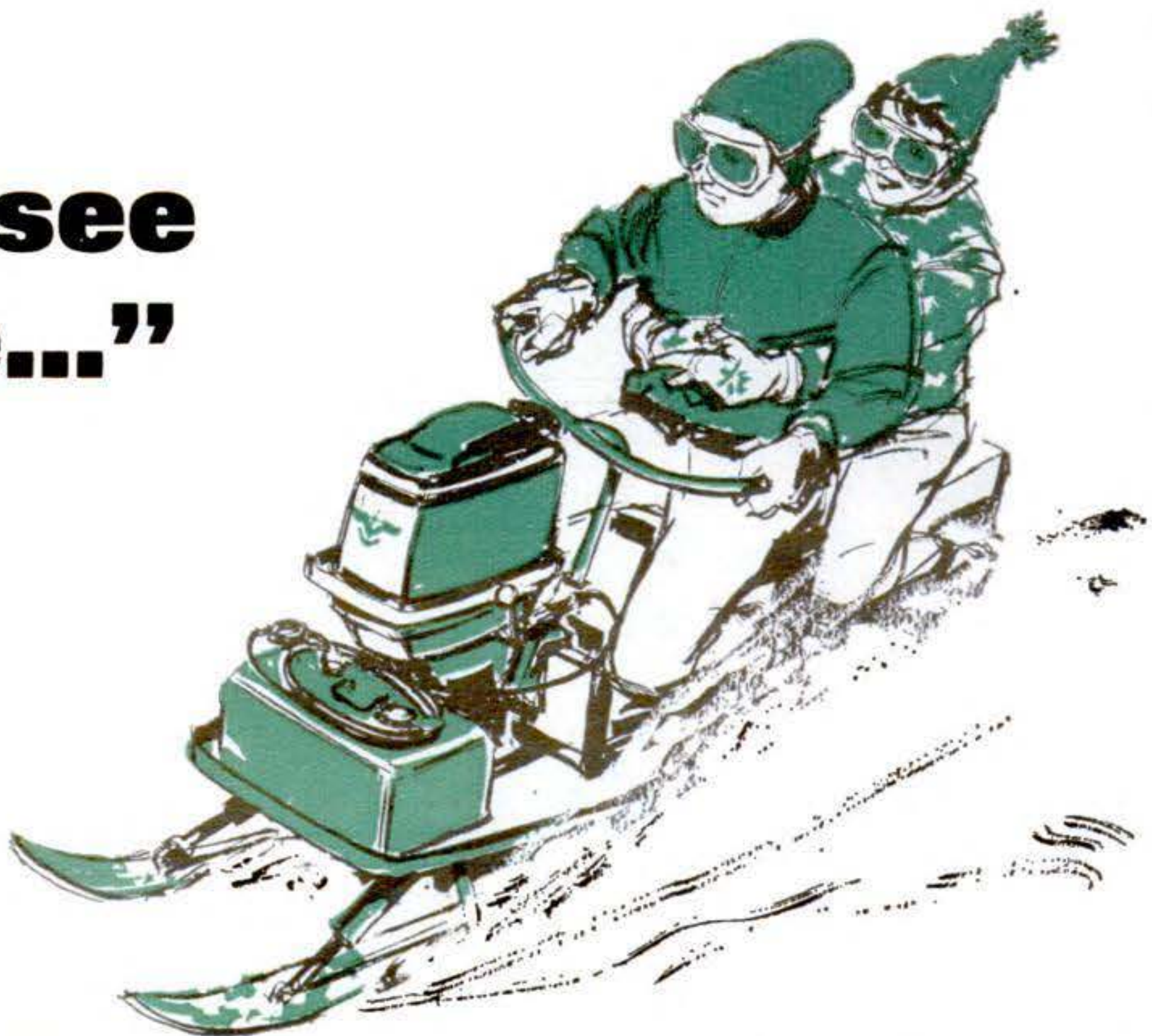
This sports vest inflates into a life preserver. Pulling two tabs opens tiny compressed CO₂ cylinders and instantly inflates two air chambers in the preserver. It also has an oral inflation valve. Tests are said to show that the vest will float an unconscious adult in an upright, face-up position for hours. Made of neoprene-coated nylon, the vest comes in both men's and women's models. Rubber Fabricators, Inc., Grantsville, W. Va., makes the life-saving garment.

A new idea in cleats is the Chock-Cleat shown above, said to eliminate the knotty problem of rope chafing. It mounts on the gunwale, freeing the deck of obstructions. Same standard ties are used as on a normal cleat, or a simple knot in line can be used. The new family of cleats includes a style for bows, multiple-slot units for spring and stern lines or for mounting on docks. Seal Basin Marine Co., Box 227, Barrington, Ill. 60010. PS

"I'd like to see them make..."

DRAWINGS BY DANA RASMUSSEN

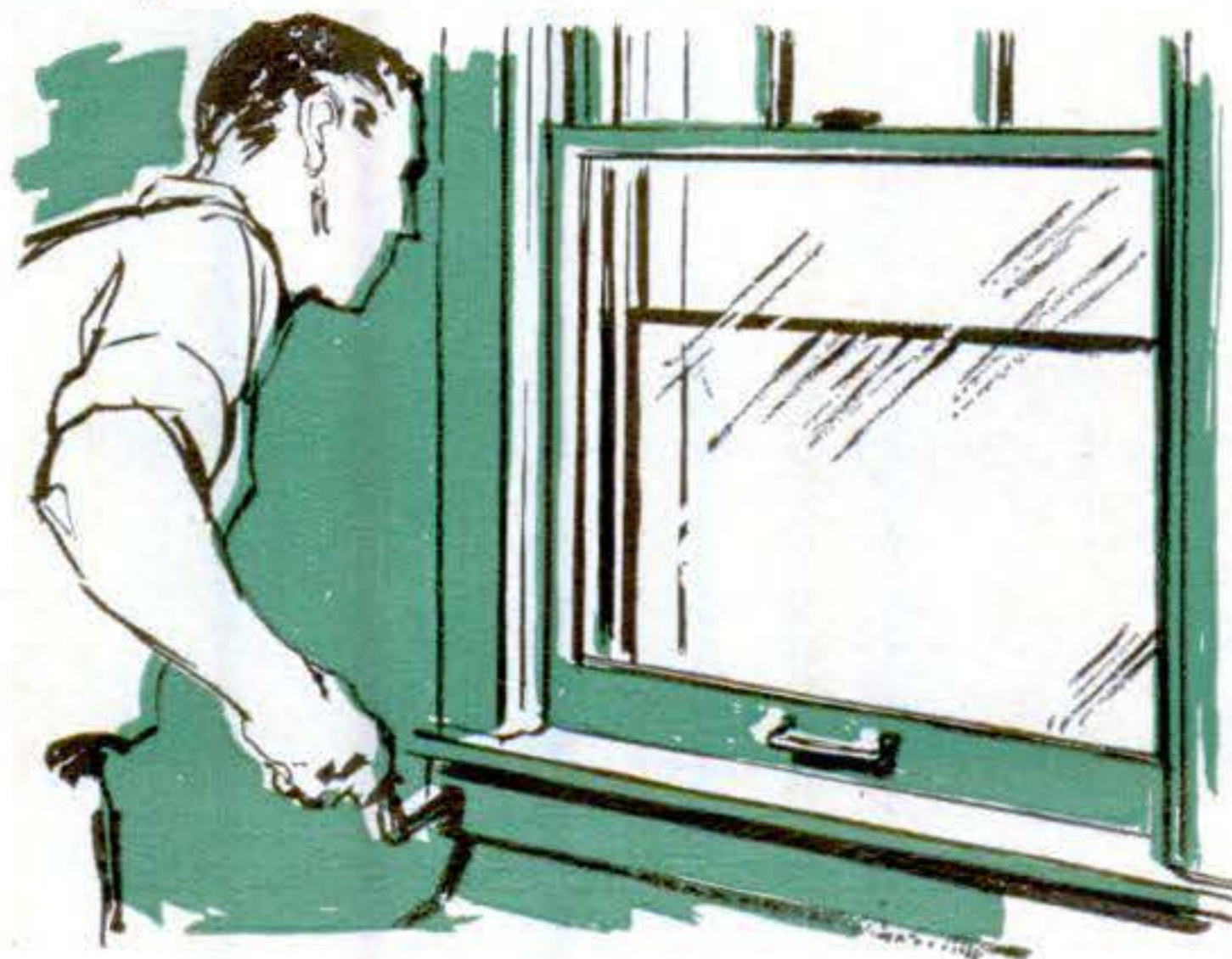
Outboard motors designed to power ski-scooters, too. You'd just remove the prop and slip a chain over the back wheel or track.—*James Ferrero, Tulsa, Okla.*



Hollow windshield wipers with water spouts built in instead of at the base of the windshield. Less fluid loss and a quicker, cleaner wash.—*Dick McIntyre, Great Falls, Mont.*



Alarm clocks that light up when the alarm is set. Then you'd know at a glance, even in the dark, whether you had forgotten this often automatic chore.—*John B. Ligon, Ames, Iowa.*



Disappearing storm windows you could lower between house walls, freeing the window of multiple panes in summer. A crank handle could be detachable.—*Gary G. Gillie, Nekoma, N.D.*



A lazy-Susan triangular board for draftsmen. To draw angular lines, you'd simply rotate it so you could place the T-square head against one of the three edges.—*Fred Lettino, NYC.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay \$5 for each one published. Please use Government postcards

only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 10017. Write your name and address clearly. Contributions cannot be acknowledged or returned.

Simple kits let you build 12 electronic gadgets

Want a fire alarm? Or a room-to-room intercom? Or maybe just a gadget that blinks a row of neon lamps in random order, but doesn't really do anything practical? These three devices are included in the new Eico-craft electronic module kit series made by the Eico Co.

Kits consist of an easy-to-wire printed circuit board plus electronic components and hardware. Total construction time: less than an hour for any one.

Also available are an audio amplifier, a burglar alarm, an electronic metronome, a tremolo circuit for electric guitars, a signal-light flasher, a photocell relay, an electronic siren, a code-practice oscillator, and a six-volt DC power supply.

The photo shows how you combine the intercom module with the power supply and two external loudspeakers to make an intercom system.

Prices range from \$4 (for the code oscillator) to \$9 (for the tremolo circuit).

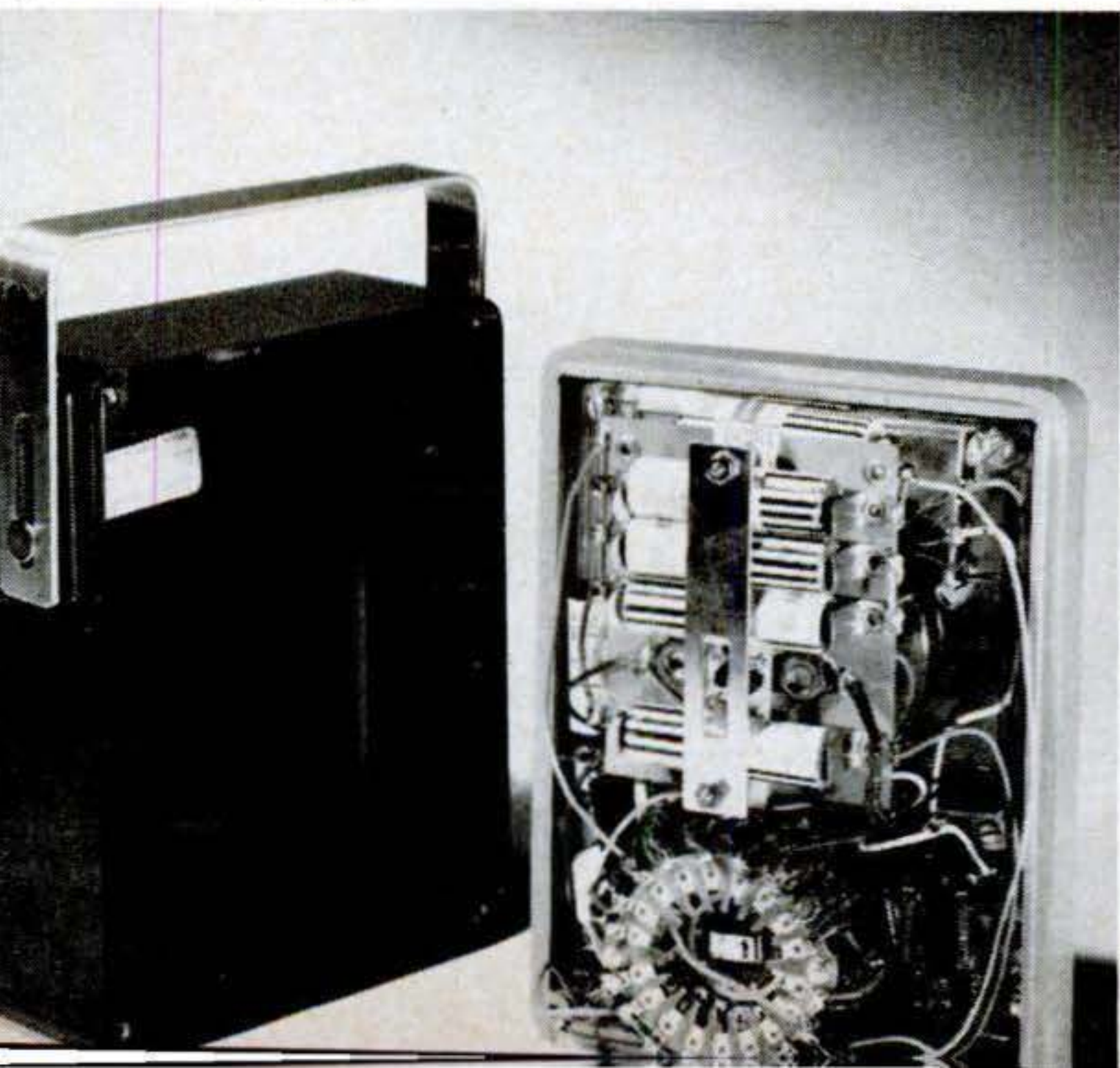


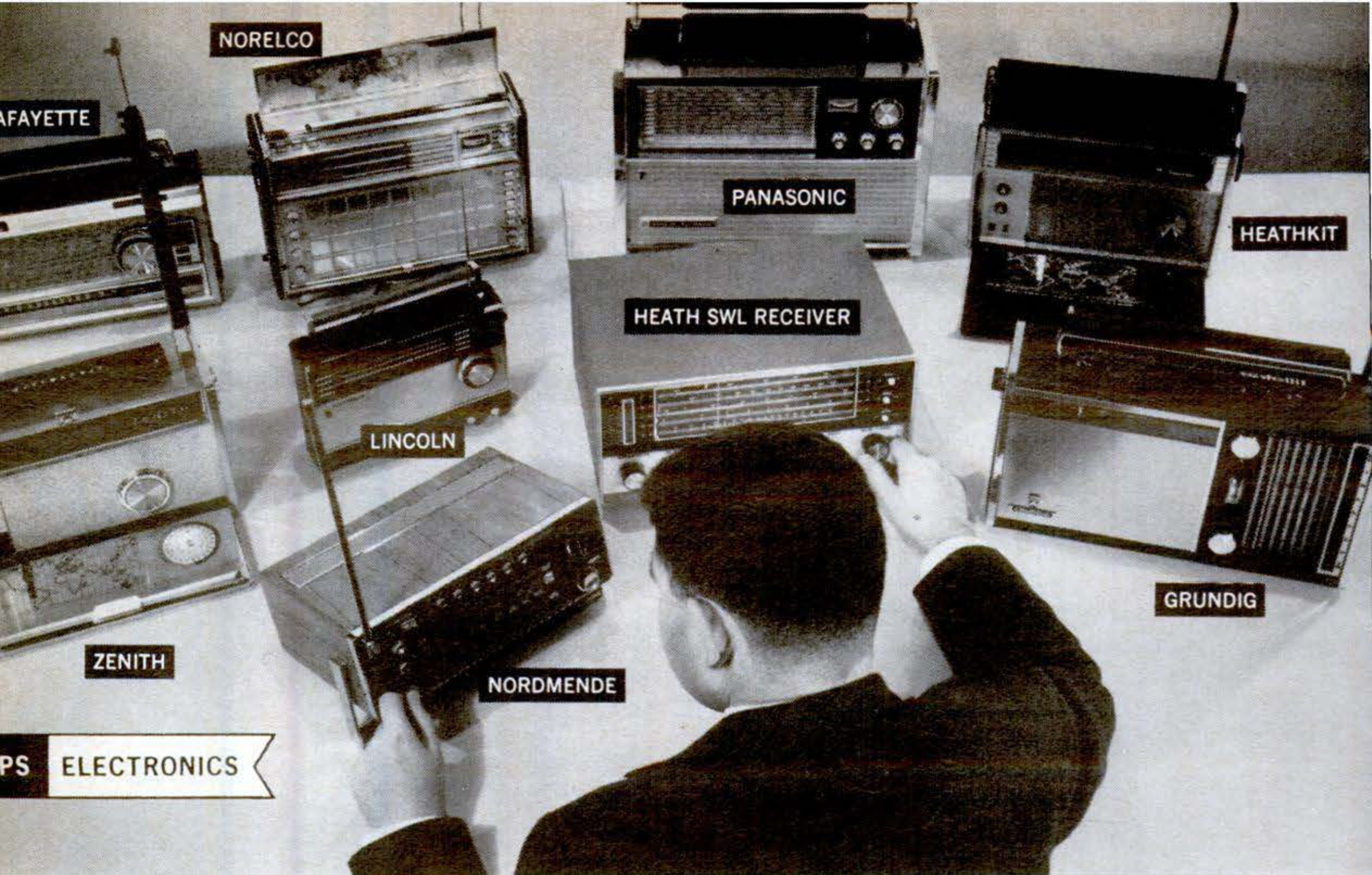
Low-cost electronic test meter has professional-type taut-band meter movement

An accurate multirange volt-ohm-milliammeter is the one test instrument that every electronics hobbyist should own. Here's a VOM that sports a rugged, easy-to-read, taut-band mirrored-scale panel meter. The meter's moving parts are suspended by a thin, tightly stretched, metal ribbon, rather than by jeweled pivots and a coil spring, as in conventional movements.

This lowers movement friction, makes the meter more precise. The mirrored scale eliminates parallax errors in reading.

The Knight KG-640 has 57 different voltage, current, and resistance measuring ranges, and has built-in overload protection for the meter. It's available in kit form for \$40, or factory-wired for \$60. Allied Radio Co., Chicago.





We compared the portables with a shortwave listener's receiver to test their sensitivity.

PS BUYER'S GUIDE:

Portable Radios That

If it's on the air, these super-transistor radios will pick it up. Here's the lowdown

BY RONALD M. BENREY
PS Electronics Editor

Phileas Fogg needed 80 days, but you can visit around the world in the time it takes you to twirl the tuning knob on one of these amazing multiband, transistor portables. Take your pick from thousands of broadcast and special-service radio stations in the U.S. and overseas that transmit all or part of their program schedule in English. Here's my reception log of a typical evening of listening to an all-wave receiver:

- 6:00 p.m.—the latest world news, as

the foreign press sees it, from London.

- 7:00—the Moscow Symphony Orchestra direct from the USSR on Radio Moscow.

- 7:30—a parade of French-Canadian folk songs from Montreal.

- 8:00—the latest pop music, broadcast from Beirut, Lebanon.

- 8:30—the superaccurate time-signal transmission from the National Bureau of Standards.

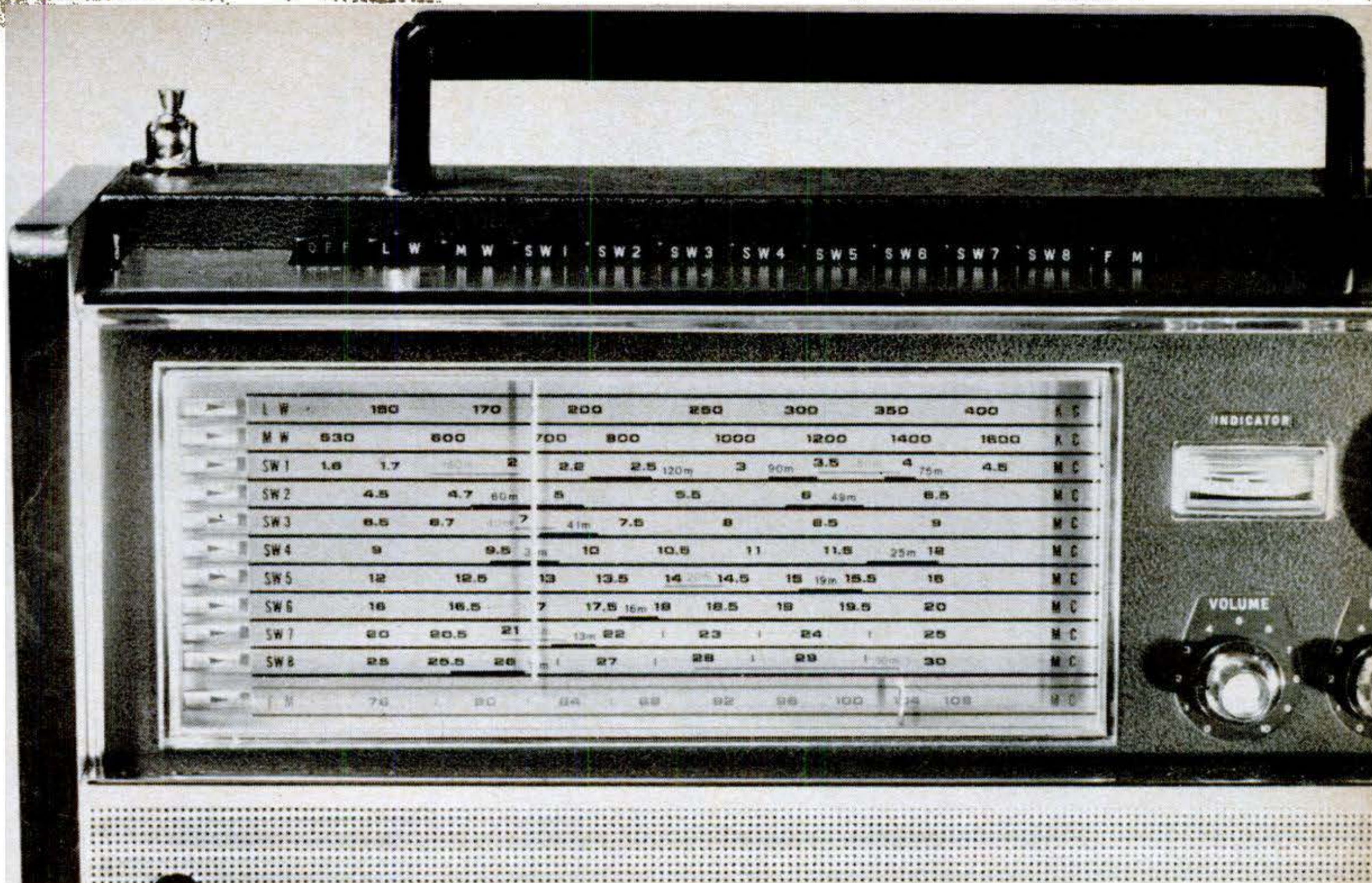
- 8:35—the latest weather forecast, courtesy of the Federal Aviation Agency, from the transmitter at my local airport.

- 8:45—two amateur radio operators chatting back and forth across the country.

- 9:00—local AM and FM stations for the rest of the evening.

As I see it, that's an impressive performance from a battery-powered carry-around radio the size of a desk dictionary, operating without an outdoor antenna.

To help you find the all-waver ideal for



Huge Panasonic RF-5000 tunes across the complete long, medium, and shortwave spectrum.

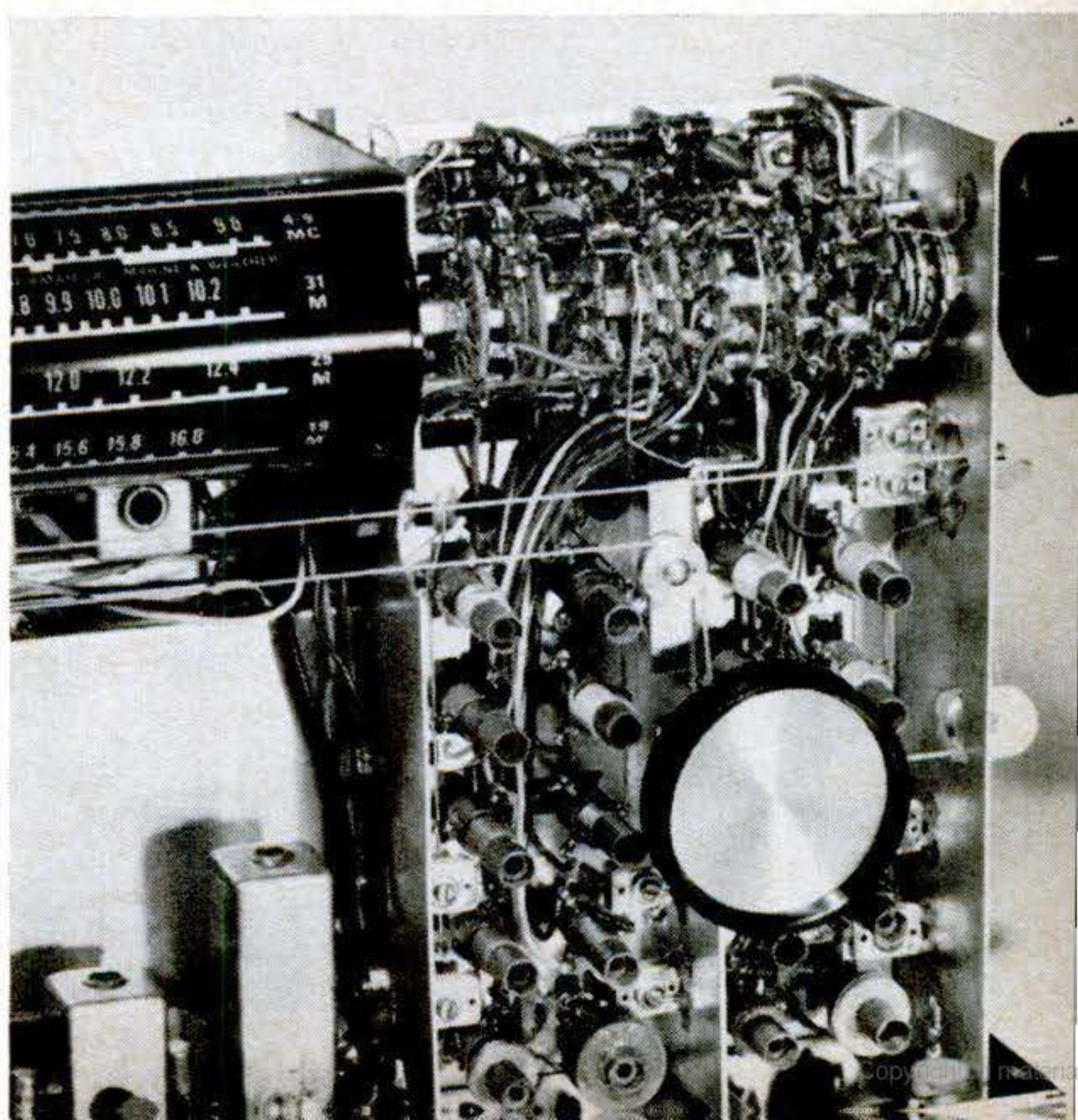
Tune In the World

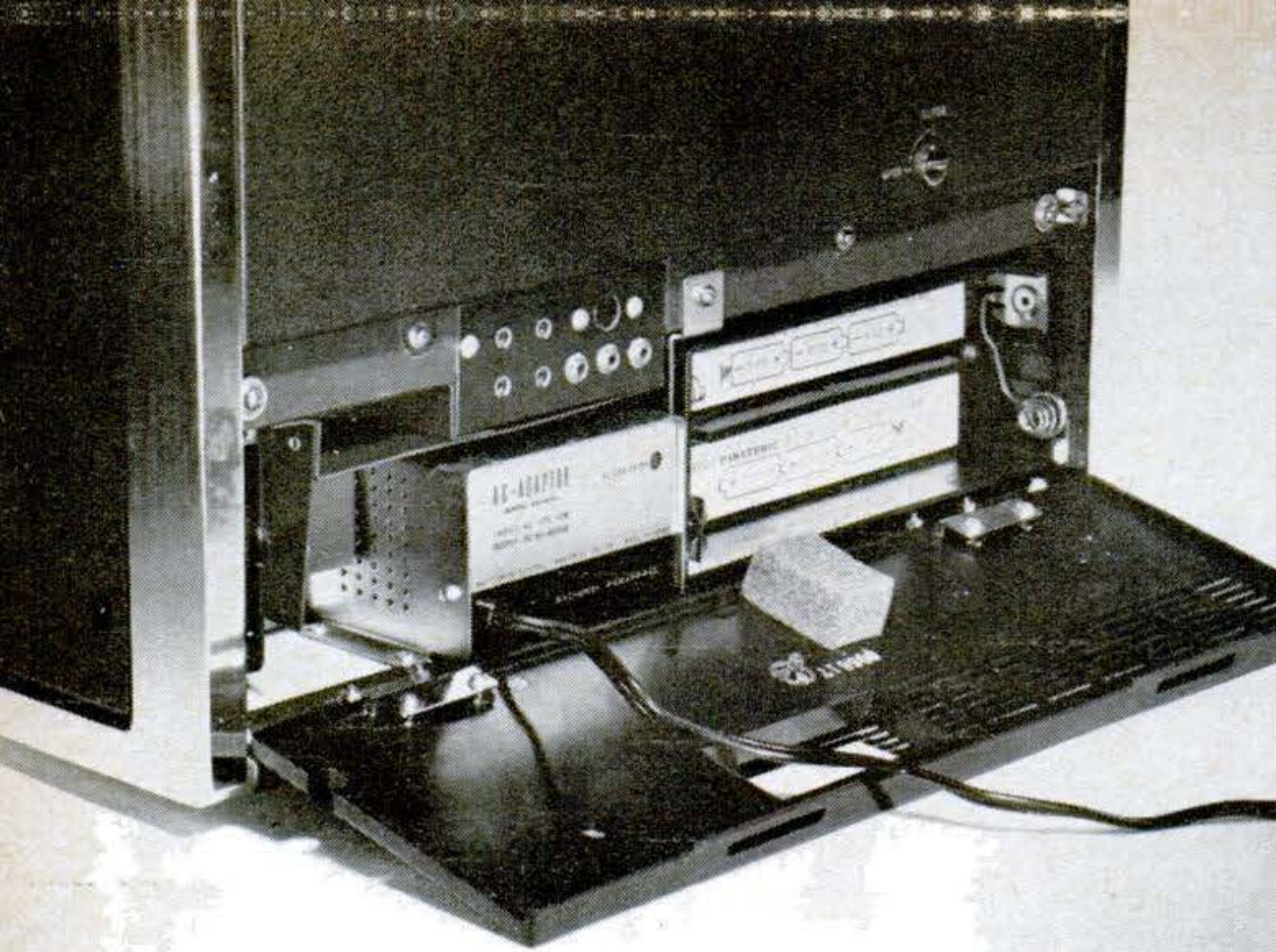
you, I recently lived with eight of the most popular multiband receivers for several weeks. The models I chose (above, at left) could all tune in the standard AM and FM broadcast bands; the long-wave band (F.A.A. weather reports and navigation beacons); the medium-wave (marine) band; and one or more shortwave bands (foreign broadcast, amateur radio, time signals, and Citizens band radio).

In my tests I first compared the eight portables with each other. Then, I judged each radio's short-, medium-, and long-wave performance against the reception of a good quality vacuum-tube multiband receiver: the Heathkit GR-54A. This \$85 (in kit form) radio is a shortwave listener's receiver. It's specially designed for people who make a hobby of tuning in faraway radio stations. Finally, I compared each portable's FM performance against a Dyna FM-3 FM tuner.

Continued

A multiband receiver's front end is a veritable rat's nest of tuning coils, transistors, fixed and variable capacitors, and switch contacts. The circuitry below belongs to the kit-built Heathkit GR-43.





Panasonic RF-5000 has a built-in automatic AC adapter. When you connect line cord to 117-volt AC, a relay closes and disconnects battery of D cells. If power fails, set switches back to cell power.

In all my tests I used both the built-in antennas supplied with each radio and my own external shortwave and FM antennas.

Before I report the differences that my tests revealed, let me tell you about the features I found in all eight receivers.

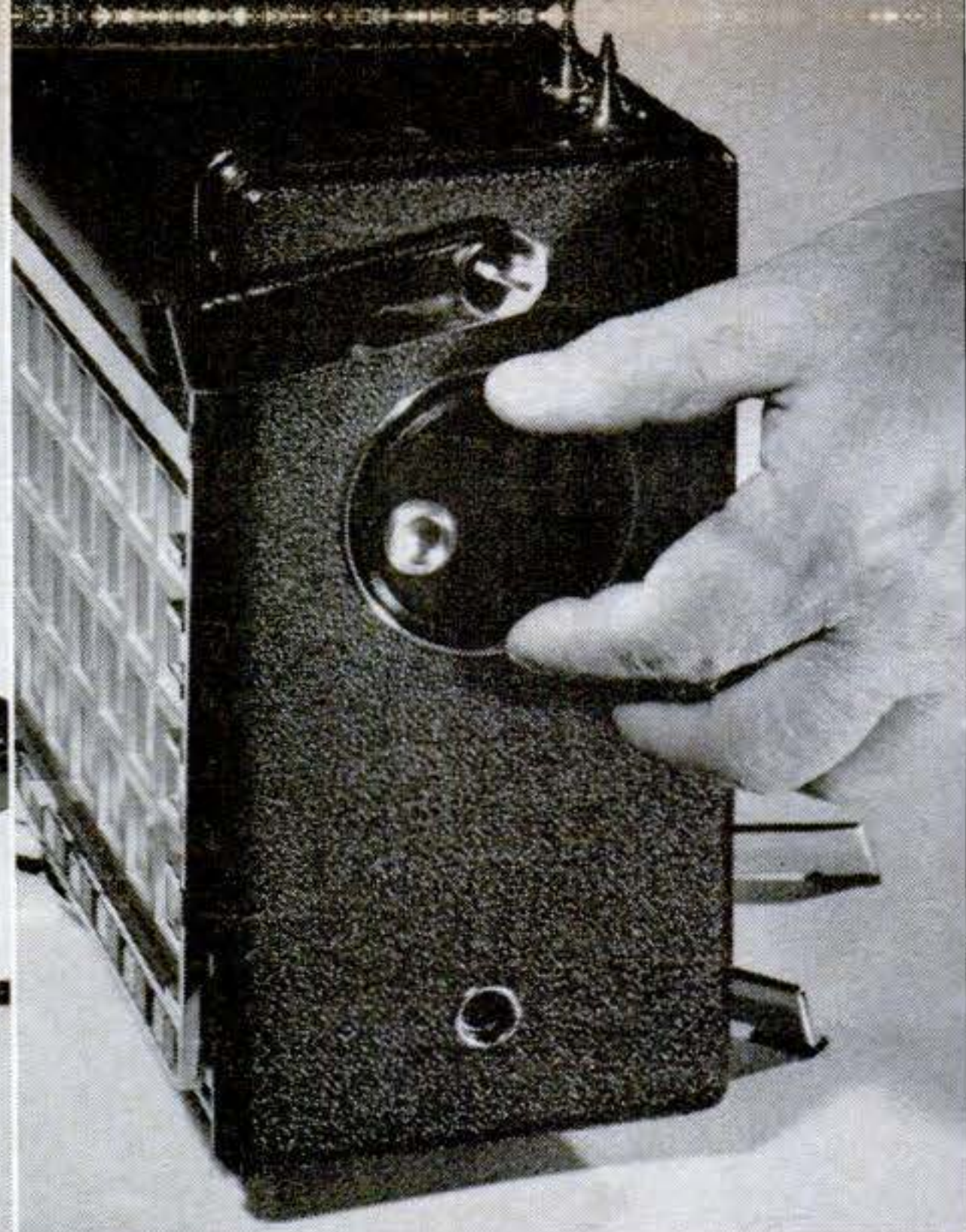
Fantastic front end. Look inside any multiband receiver and you'll find its heart: a complex front-end circuit filled with dozens of tuned circuits, arranged in groups of three, that are tied together by an elaborate band-switch assembly. Each trio of tuned circuits equips the radio to tune in one segment—or band—of the total radio-frequency spectrum.

Actually, few multiband transistor portables are true all-wave receivers—only the most expensive models will pick up the complete spectrum of long-, medium-, and short-wave frequencies ranging from 150,000 Hz (150 kHz) to 30,000,000 Hz (30 MHz). The others tune in only the segments where you are likely to find broadcast or useful special-service stations.

Incidentally, the terms “long wave,” “medium wave,” and “shortwave” are arbitrary designations of the approximate wavelength of a radio signal. Low-frequency signals—from 150 kHz to 450 kHz—have long wavelengths; medium-frequency signals—from 450-kHz to three-mHz—have medium wavelengths; high-frequency signals—from three mHz to 30 mHz—have short wavelengths.

Here are some important features you should know about:

- **RF amplifier.** It boosts the strength



Fine-tuning control, like one on this Norelco receiver, lets you zero in on weak shortwave transmissions. It's useless on the long- and medium-wave bands. Other receivers feature similar controls.

of the tiny radio-frequency signals captured by the receiver's antenna. The result: a significant increase in sensitivity and selectivity over a conventional transistor portable not equipped with an RF stage.

- **External antenna connectors.** Every set I tested has one: Although the radio's built-in set of antennas works well, an external antenna provides optimum shortwave and FM reception.

- **Provision for dual power supplies.** Every multibander is powered by a set (usually six or eight) of inexpensive, easy-to-get C or D flashlight cells. Typical battery life is about 150 playing hours. Also, all the sets can be powered—through an adapter—by 117-volt AC house current. The Panasonic and Grundig radios have built-in adapters; the others use external accessory adapters that plug into cabinet-mounted power jacks.

- **Dial light.** A nice touch, and a useful item when you tune an all-waver in the dark. On every set it's controlled by a spring-loaded pushbutton switch: Running a pilot lamp continuously on a battery-powered set would be excessively wasteful.

- **Hefty case and chassis.** They are called “portables,” and they have handles, but every set, except the low-priced Lincoln, tops the scales at over 10 pounds—the big Panasonic weighs 20, with batteries installed—so don't plan to carry them around all day.

The weight is mainly due to their complement of heavy batteries, and their heavy-



Lafayette Globepacer uses an outboard AC adapter that plugs into a side-mounted power jack. The adapter's output plug is a special shape so that it won't fit into an earphone jack by mistake.



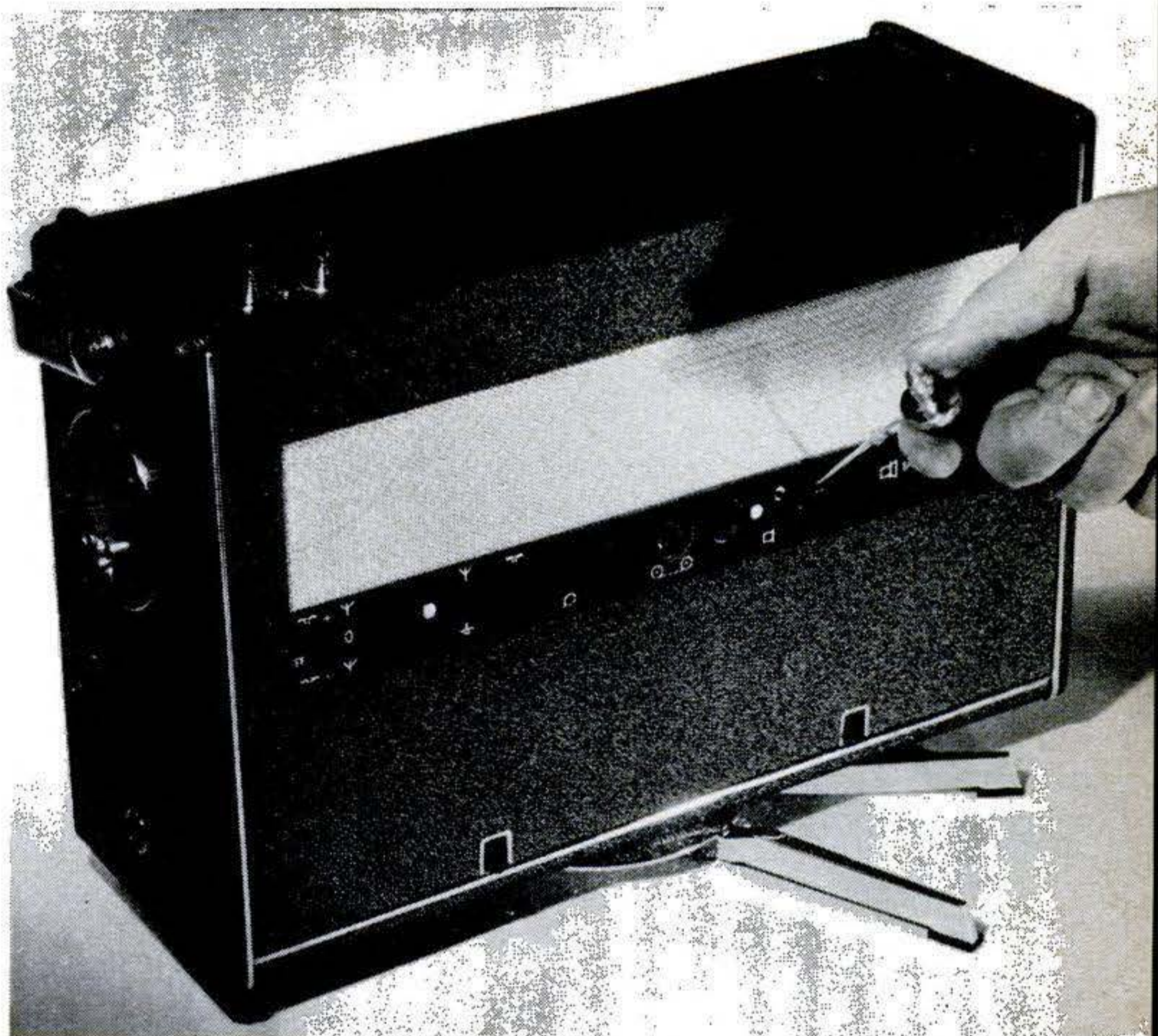
Nordmende Globetrotter sets the record with 15 separate bands. Eleven of them are very small short-wave segments that encompass a frequency band heavily used by international broadcasters.

gauge metal chassis and rugged metal or laminated wood (often leather or leatherette covered) cabinets. Remember, these receivers are built to take rough carry-around treatment.

In my tests, I looked for several things: First I calculated each receiver's overall coverage—the percentage of the total long-, medium-, and short-wave spectrum that the receiver can tune in. Then I estimated the effective coverage—the percentage of the frequencies that I feel you are likely to want to listen to and that the receiver can tune in.

Next, I gauged each receiver's band-spread ability in the important international broadcast bands. In other words—is the tuning scale long enough so you can easily select between several stations crowded together in a narrow frequency band?

A rating of E (for excellent) for this test, and the tests that follow, means the receiver does as well (or better) than our test-standard shortwave listener's receiver. G (for good) means the receiver rates as acceptable. P (for poor) means the receiver rates below average.



Two features that make the Norelco receiver a gadgeteer's joy: a pop-in/pop-out built-in earphone, and a lazy-Susan base that lets you use the radio as a marine direction finder in your boat.

Next came two overall performance tests: I evaluated the overall sensitivity and selectivity of each receiver on both its AM (long-, medium-, and short-wave) and FM bands. (NOTE: FM tests were made with automatic frequency control—AFC—off.)

Then I judged overall operating ease:

[Continued on page 206]

Add 1-2-3 Turn Signals to Your Car

This attention-riveting light system means greater safety when you turn or brake. Here's how you build it

By RUDOLF F. GRAF

For about \$20 worth of electronic components, you can add one of the newest safety features to your car: an eye-catching, triple-lamp, sequential turn-and-brake light system. The cost will be even less if your car already has a pair of readily accessible three-lamp tail-light clusters (like those on many recent Chevrolets). If it hasn't, you can mount two additional out-board clusters, like the set pictured here.

Unlike conventional three-light clusters that flash all three lamps simultaneously, the lights in this 1-2-3 system come on in an attention-getting sequence: First, the innermost light glows, then the middle light, and finally the outermost light. Then all three lights go out, and the sequence starts again and repeats until the turn-signal lever returns to its neutral position.

An unusual additional feature of the system is that the three lamps go through one 1-2-3 sequence and then remain on steadily whenever you apply the brakes.

How it works. The system consists of a handful of electronic parts mounted on a 3"-by-2" piece of perforated phenolic chassis board. You must build two identical boards—one each for your car's left and right cluster of lights.

On the schematic diagram farther on, the three lamps in one cluster are labeled A, B, and C (A flashes on first, followed by B and C). Because A is connected directly between the flasher/brake-light control line

and ground, it comes on as soon as the flasher contacts close (when you flip the turn-signal lever) or you step on the brake pedal.

In almost all recent U.S. cars, the same rear light bulbs (or the same filaments in multifilament bulbs) are used as both turn signals and brake lights. In your trunk you will find a single wire leading to the turn-light/brake-light lamp or cluster on each side of the car's rear deck. Both of these wires come from the car's flasher control board, which is usually incorporated as part of the turn-signal switch. This control center routes either continuous or pulsing electric current to the appropriate lights when you signal a turn or step on the brakes. (The wires mentioned above are not connected to those leading to the tail lights that come on with the headlights. Thus you can install the 1-2-3 system without disturbing your running lights.)

After lamp A goes on, a simple time-delay circuit, composed of resistor R1 and capacitor C1, goes into action. C1 charges slowly until the voltage across it reaches the trigger level of the trigger diode, D1. Then D1 conducts a pulse of current into Q1's gate, turning it on. Q1 is a silicon-controlled rectifier (SCR). Normally this component acts like an open switch—it has a very high electrical resistance. However, when a current pulse is fed into its gate, it becomes, almost instantaneously, a closed switch—it



has a very low electrical resistance. Thus, bulb B lights.

Because Q1 is turned on, capacitor C2 can now begin to charge. After a short delay its voltage reaches D2's trigger level, and the second SCR, Q2, turns on, lighting up bulb C.

What happens next? If you are signaling a turn, the car's flasher momentarily interrupts the current, and both SCRs turn off. When the flasher turns on again, the sequence begins from scratch. If you are applying the brakes, your car's brake-light switch keeps the current steady until you let up on the pedal. Then the three lamps and the two SCRs are all turned off. If you reapply the brakes, the lamps go through

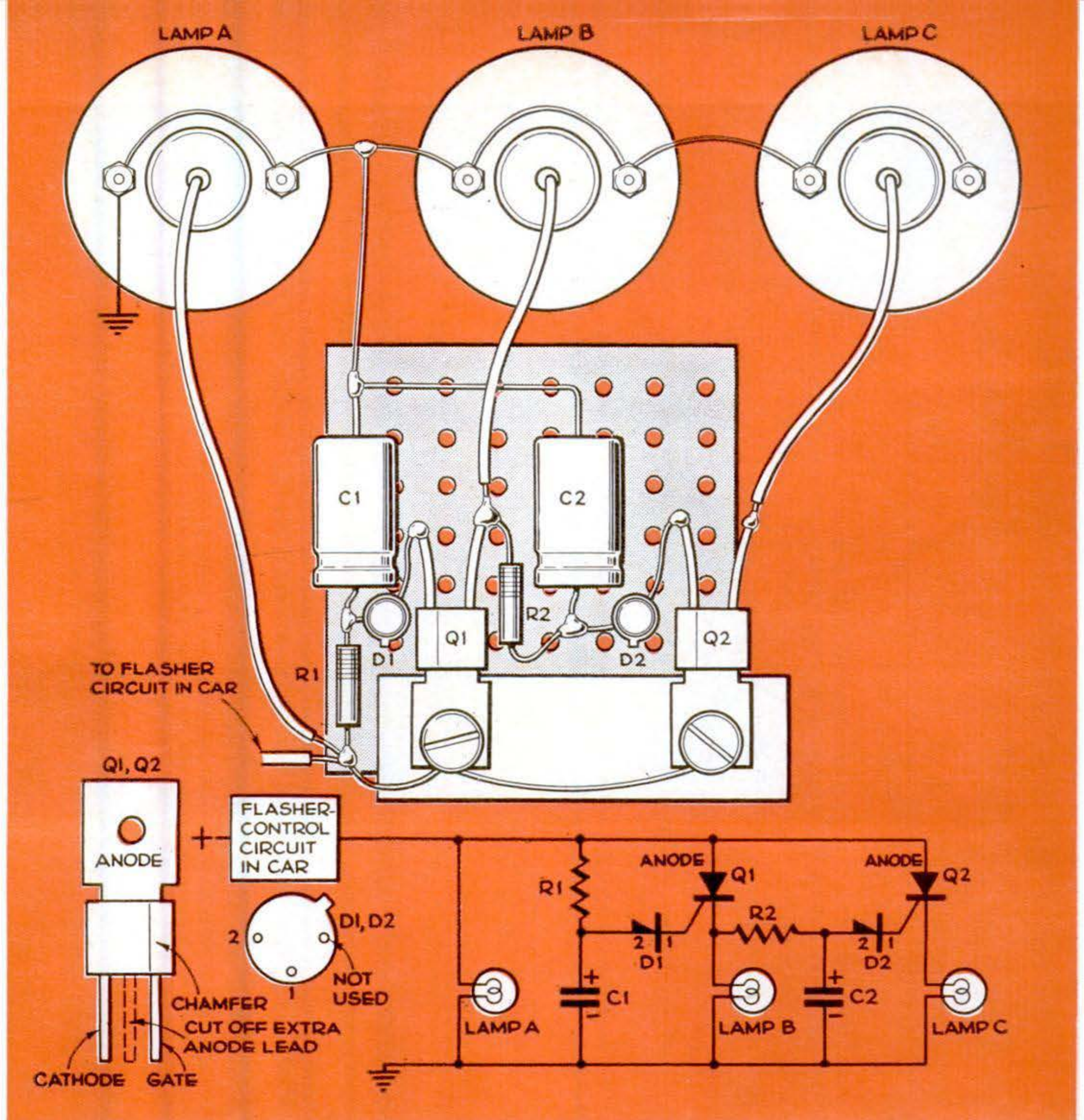
one sequence and then remain on continuously as before.

Building it. You can wire each of the two circuit boards individually, or mount both circuits on a single large perforated phenolic board. Use push-in terminals (flea clips) as soldering points.

Bolt the anode tabs of Q1 and Q2 to a ½"-by-2" mending plate (or any similar piece of scrap metal). This serves as a heat sink. Cut off the unused extra anode lead of both SCRs close to the body, before soldering the other leads in place.

Mount the wired circuit boards (or board) in an aluminum minibox. Since the device will be installed inside your car's trunk, it

Continued



PARTS LIST

R1, R2—10,000-ohm, ½-watt carbon resistor
 C1, C2—15-mfd., 25-volt electrolytic capacitor
 D1, D2—General Electric D13D1 silicon unilateral switch (used as trigger diode; see text)

Q1, Q2—General Electric C106B1 silicon-controlled rectifier
 Note: Semiconductor components D1, D2, Q1, Q2 are available from the Allied Radio Co., P.O. Box No. 4398, Chi-

cago 60680, though not listed in their standard catalogue. When ordering by mail, list component number instead of a stock number
 Misc.—perforated phenolic board (Vectorbord),

push-in terminals, aluminum miniboxes to fit perforated chassis, hardware, wire, etc.
CAUTION: This device can be used only on cars with 12-volt, negative-ground electrical systems.

need not be waterproofed or sealed tight.

Using it. You must make the five connections shown in the diagram to hook up each of the circuit boards: three to the lamp cluster, one to the flasher/brake-lamp wire from the flasher control center, and one to ground.

If you must mount an outboard three-lamp cluster on your car, you can use almost any accessory light fixture sold for automotive use. We used three Yankee 975

tail-light assemblies for our 1-2-3 system.

Note: When you hook up the completed circuit you may find that your car's standard flasher unit (and the flasher unit in the four-way emergency warning flasher, if your car has one) operates too quickly: It flashes off before lamps B and C can operate. If this occurs, replace the standard flasher with a unit designed for triple tail-light service. Any flasher rated for three rear lamps will work.

Laser TV is here. Are picture tubes obsolete?

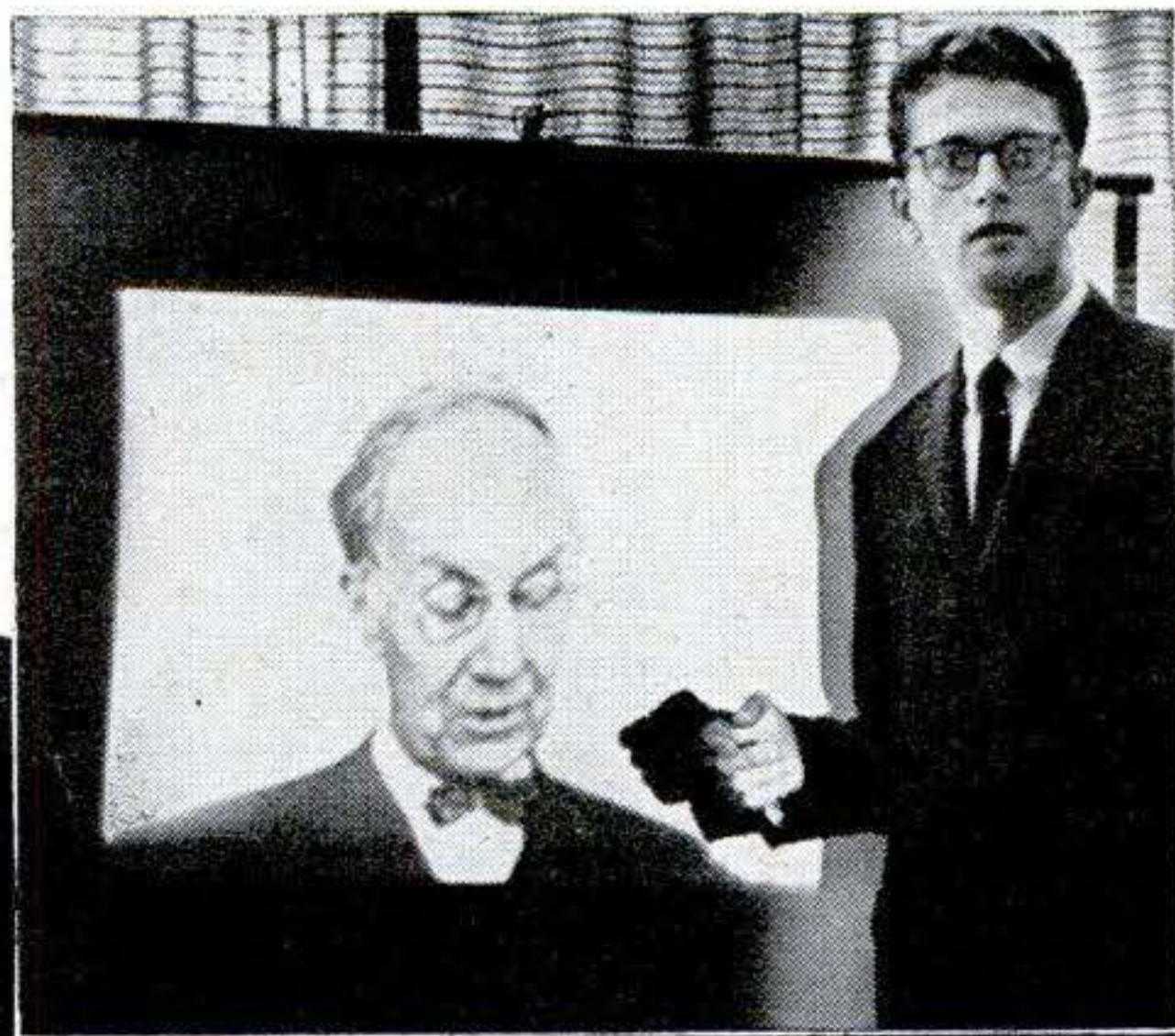
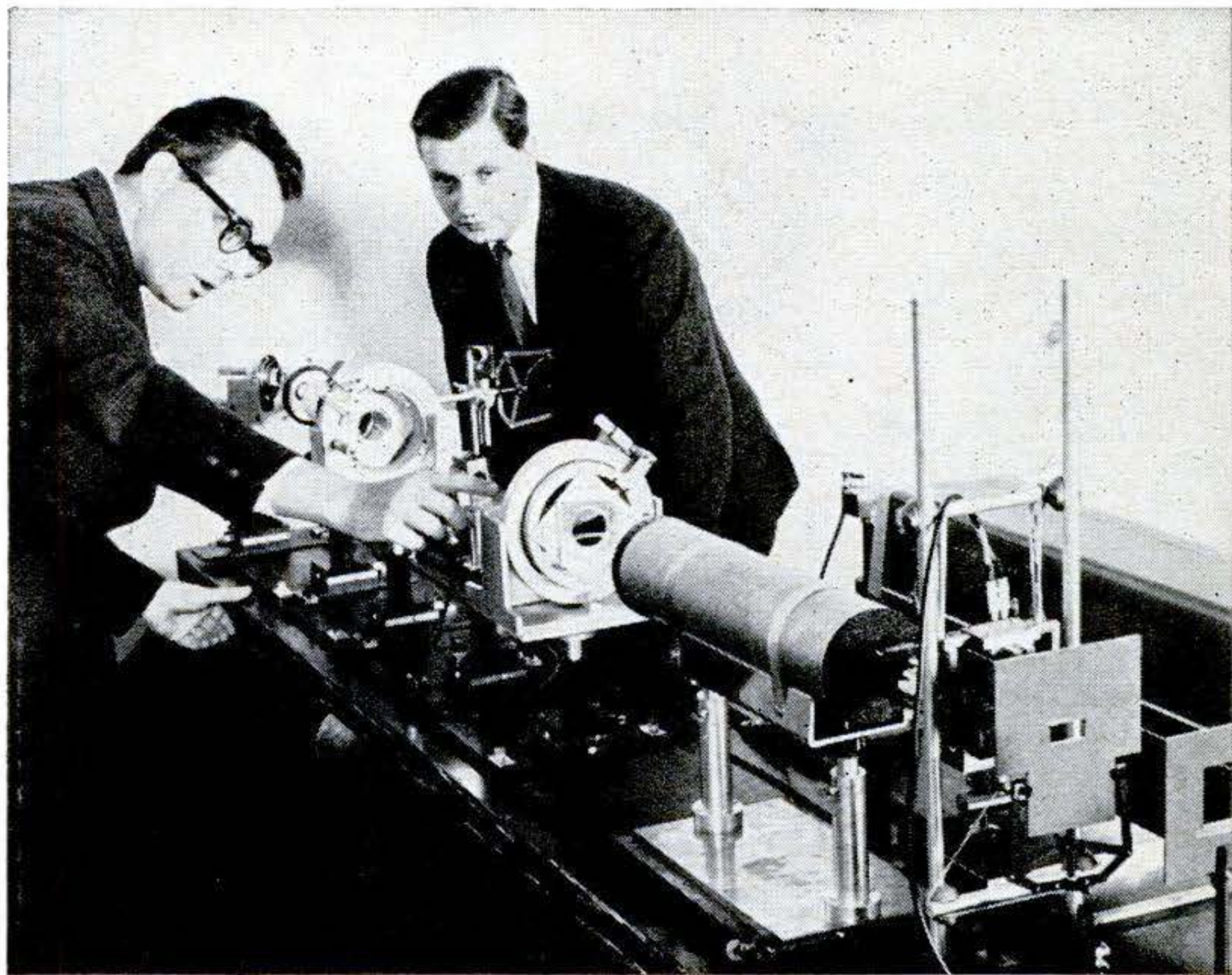
This experimental TV system, developed by Zenith, uses the pencil-thin ruby-red light beam emitted by a helium-neon gas laser to project a large TV image on a wall-mounted screen.

Two deflection cells scan the beam horizontally and vertically at high speed across the screen. The moving beam's brightness is varied by an intensity-modulation cell to form a TV image.

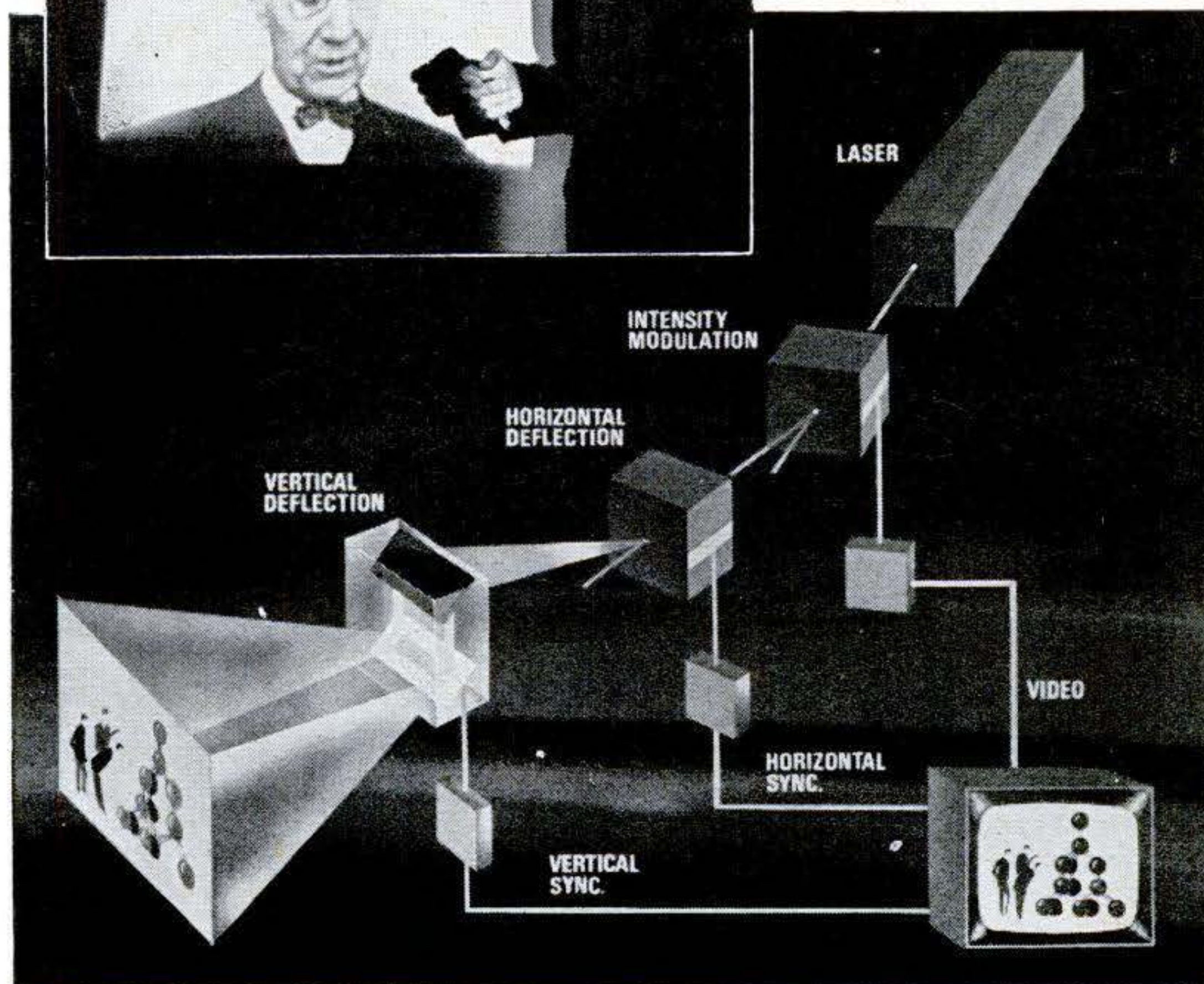
A horizontal-deflection cell—a small brass tank, with windows at either end, filled with highly purified water—is a brand-new ultrasonic device. Ultrasonic sound waves, directed into the cell by a bank of transducers on its wall, interact with the laser beam and deflect it back and forth horizontally.

The intensity modulator acts like an electronic venetian blind. The stronger the ultrasonic sounds directed into it, the more laser light the cell transmits.

The vertical deflector is a simple vibrating mirror that reflects the beam up and down.



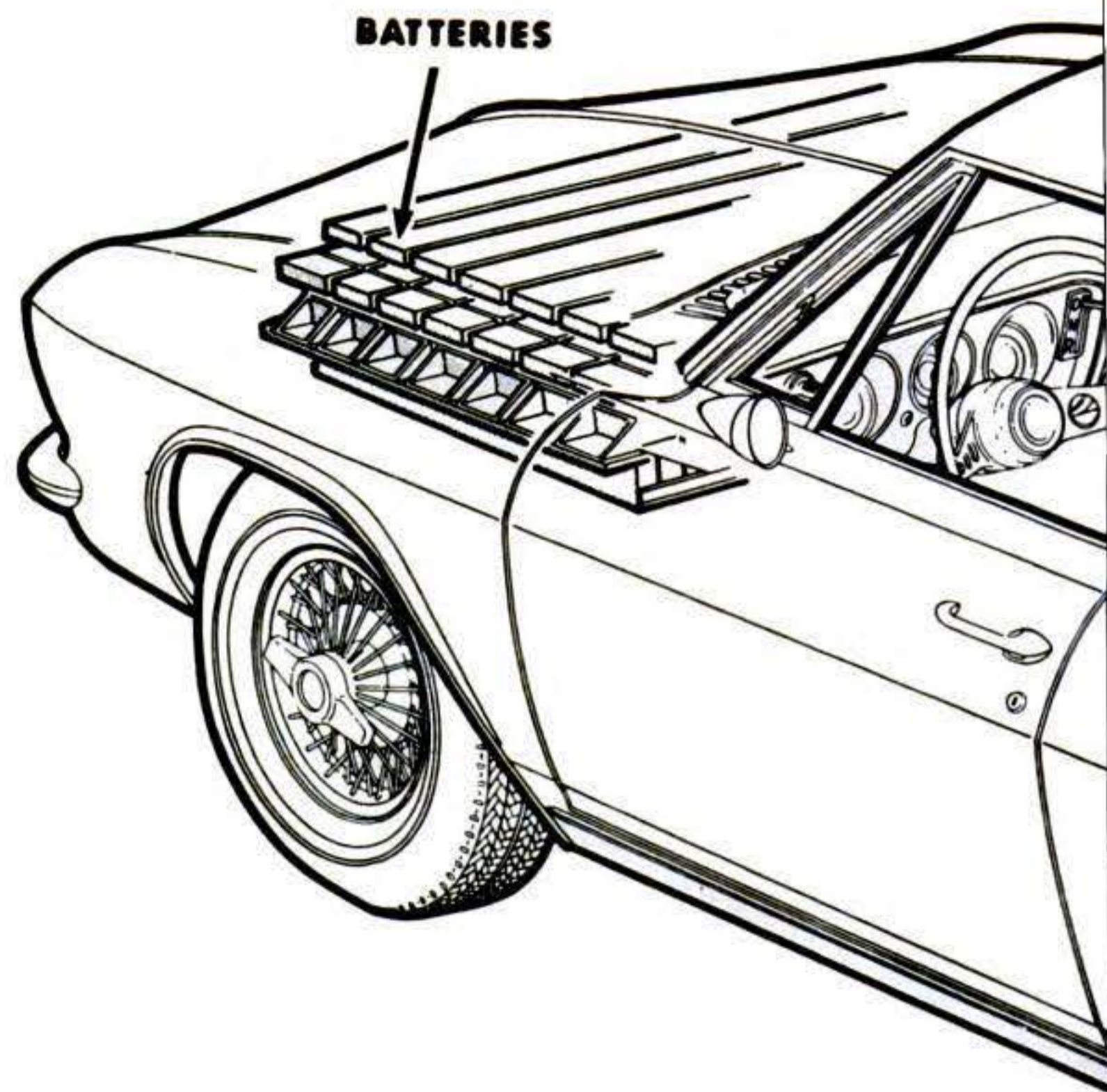
Complete laser TV system (above) includes conventional optical components that focus and shape the beam. On the screen, the TV image at left appeared in black and red because of the laser beam's color. However, other color beams also can be used.



A conventional television chassis provides the electronic signals that control the paired deflection cells and the beam-intensity modulator cell.



PS Detroit Editor Dunne looks over car's forward batteries. Tires are oversize to carry added weight.



GM makes an electric Corvair

Recently the Ford Motor Co. announced the development of a sodium-sulfur battery that could power a production-line electric car, perhaps within five years [PS, Dec. '66]. Now General Motors has gone Ford one better—it has exhibited an experimental electric driven by a silver-zinc battery.

Jim Dunne, PS Detroit editor, is the only person apart from GM personnel to have driven it. Here are his comments:

"You flip the ignition switch to ON. No sound. A needle on the battery voltage dial swings up. That's your power indication. A blower for an oil cooler whirs—oil is used to keep down the temperature of the motor and controls. The high currents involved produce a lot of heat.

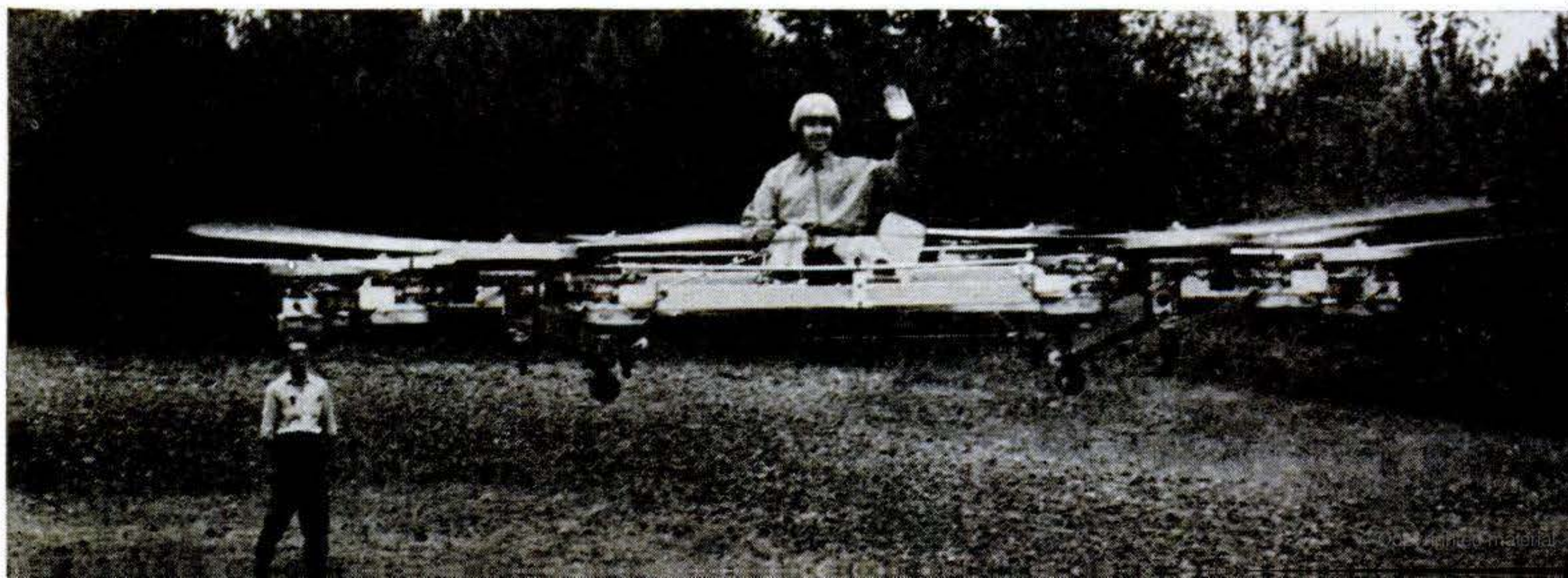
"You shift a lever to D-for-drive to put the car in gear. There's no gearshifting, of course. You press the accelerator. Not all the way, a GM engineer beside you warns—just enough to get rolling. Initial acceleration is

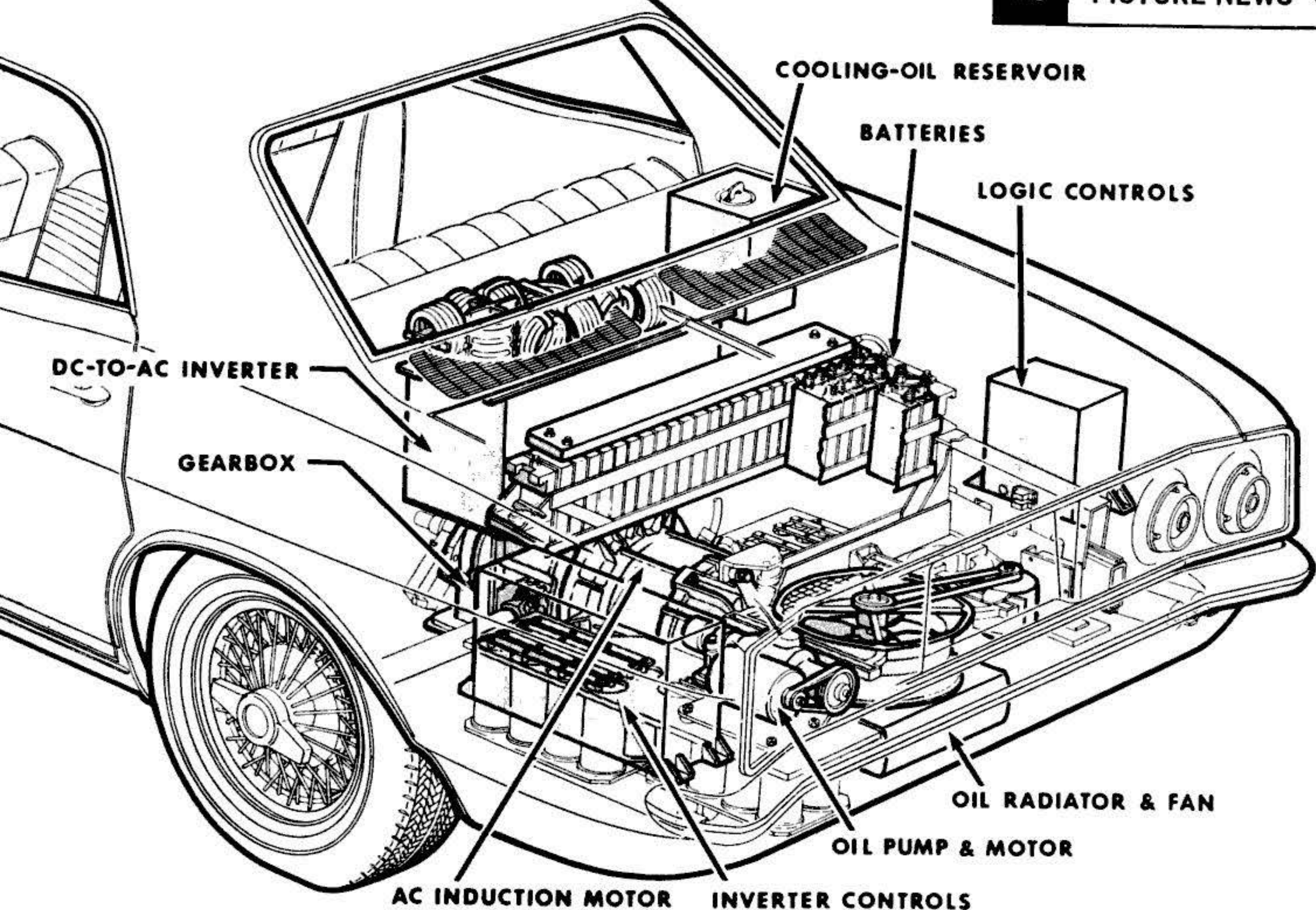
slow. Once you're going five m.p.h., you can floor it.

"Zero to 60 takes 16 seconds in this vehicle, built on a Corvair chassis and named the Electrovair II. The only sound besides the blower is a buzz, pitched low, then high as you gain speed. The handling is imprecise. Heavier than a standard Corvair by 800 pounds, the car wallows.

"The performance is smooth, though. Top speed is 80 with the motor at 15,000 r.p.m. That's just for spurts. Motor speed for normal driving is redlined at 13,000 or 60 m.p.h."

The Electrovair II has other debits, and on the basis of Ford's projections for its car, GM will have to hump to compete. GM's batteries alone cost \$15,000, controls \$5,000, chassis \$1,000. That's now. If the car ever got into production, costs might toboggan. Both the front and rear compartments are loaded with batteries and machinery weighing 1,230 pounds.





Electrovaair II is driven by a three-phase AC induction motor. It weighs only 1.3 pounds per horsepower. Switching equipment changes batteries' direct current to alternating current. It varies both the voltage and frequency of the power. This unit requires 18 silicon-controlled rectifiers to handle the high currents in the short switching time available at 13,000 r.p.m. Since switches can be turned on but not off by a small power pulse, car requires

a set of capacitors, which are alternately charged and discharged to blow the switches out. Second block of capacitors is needed to smooth out power flow to motor. A "logic box" translates driver's control from ignition switch, gear lever, and accelerator into signals to develop more power, less power, or motor reversal. It also contains a series of safety circuits. Ordinary lead-acid battery, driven by motor, supplies current for lights, heater, and horn.

The complete stopper at present is that the batteries wear out after 100 recharges. Ford says its batteries should be good for the life of the vehicle.

There are credits. The Electrovaair II, like the proposed Ford electric, emits no gases to

foul the air. The batteries recharge in six hours on ordinary house current. With a full charge, the car will go 40 to 80 miles, depending on the speed at which it's driven.

GM figures a production electric car is at least 10 years away.

Zany helicopter looks like a flying bedspring, but cruises like a Magic Carpet

An experimental helicopter made by the Bensen Aircraft Corp. is something out of Jules Verne—in fact the master science-fiction writer predicted something like the Magic Carpet nearly 100 years ago. The helicopter has 10 McCulloch two-cycle engines that drive 10 two-blade rotors seven feet in diameter. The machine will stay aloft with any one of the engines or rotors out of operation. It has hit an "altitude" of 20 feet, made 45 m.p.h.

The experimental craft was designed to be used as an airborne tractor for farms. It could lift 350 pounds of pesticides, liquid fertilizer—even a calf or a pig.

Each of the chopper's engines has its own starter, choke, ignition, throttle, and fuel system, entirely independent of the others. This eliminates the possibility of the pilot running out of power all at once. The FAA has issued an experimental airworthiness certificate.

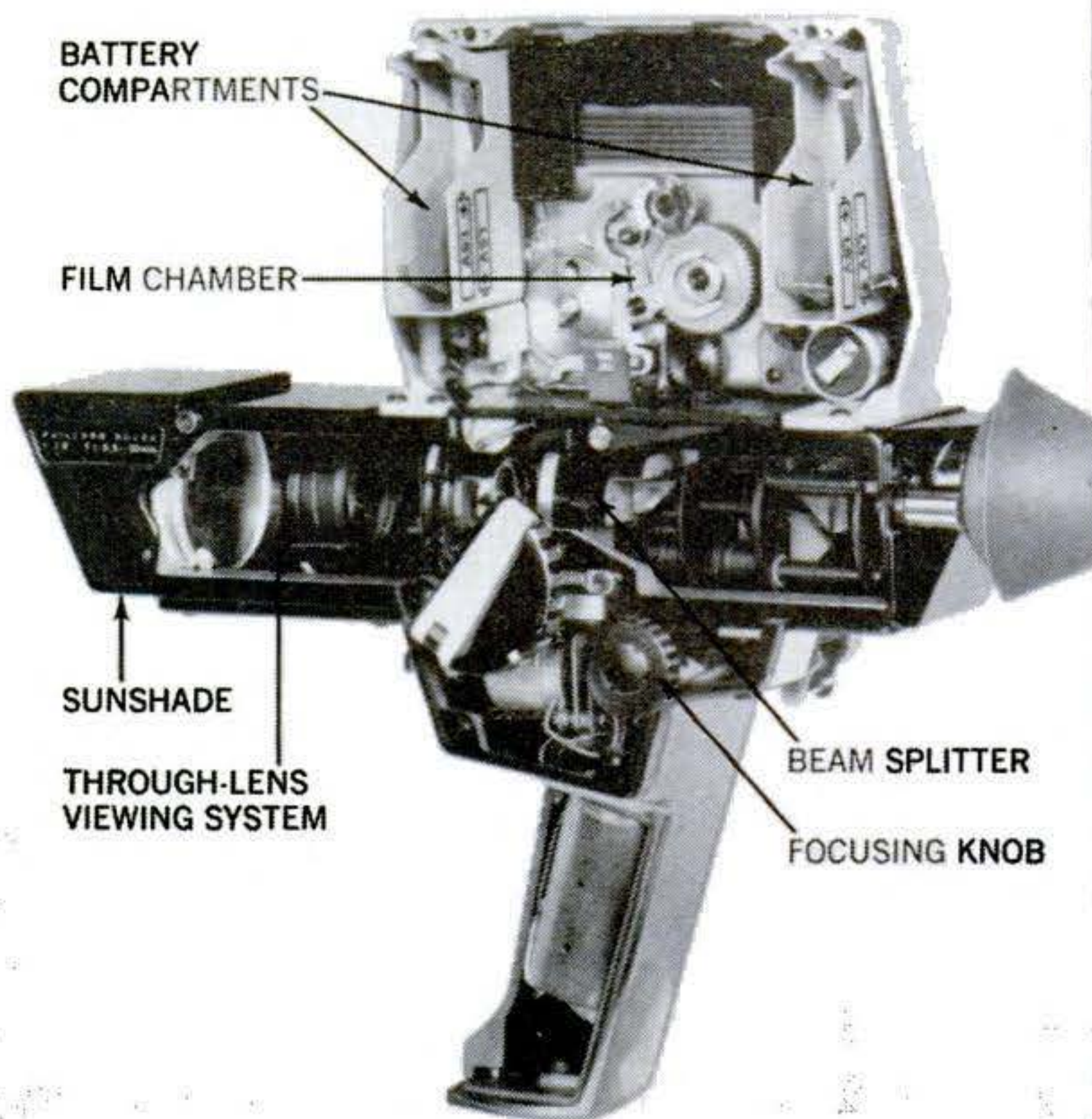
INSIDE PHOTOKINA: **Way-Out**

By **ARTHUR GOLDSMITH**
Head of Instruction,
Famous Photographers School

What new cameras, lenses, projectors, films, and photographic accessories will be coming your way during the months ahead? What shiny gadgets and gleaming hardware will you soon see in photo dealers' windows? What equipment will be debated, pro and con, by amateurs and professionals during 1967?

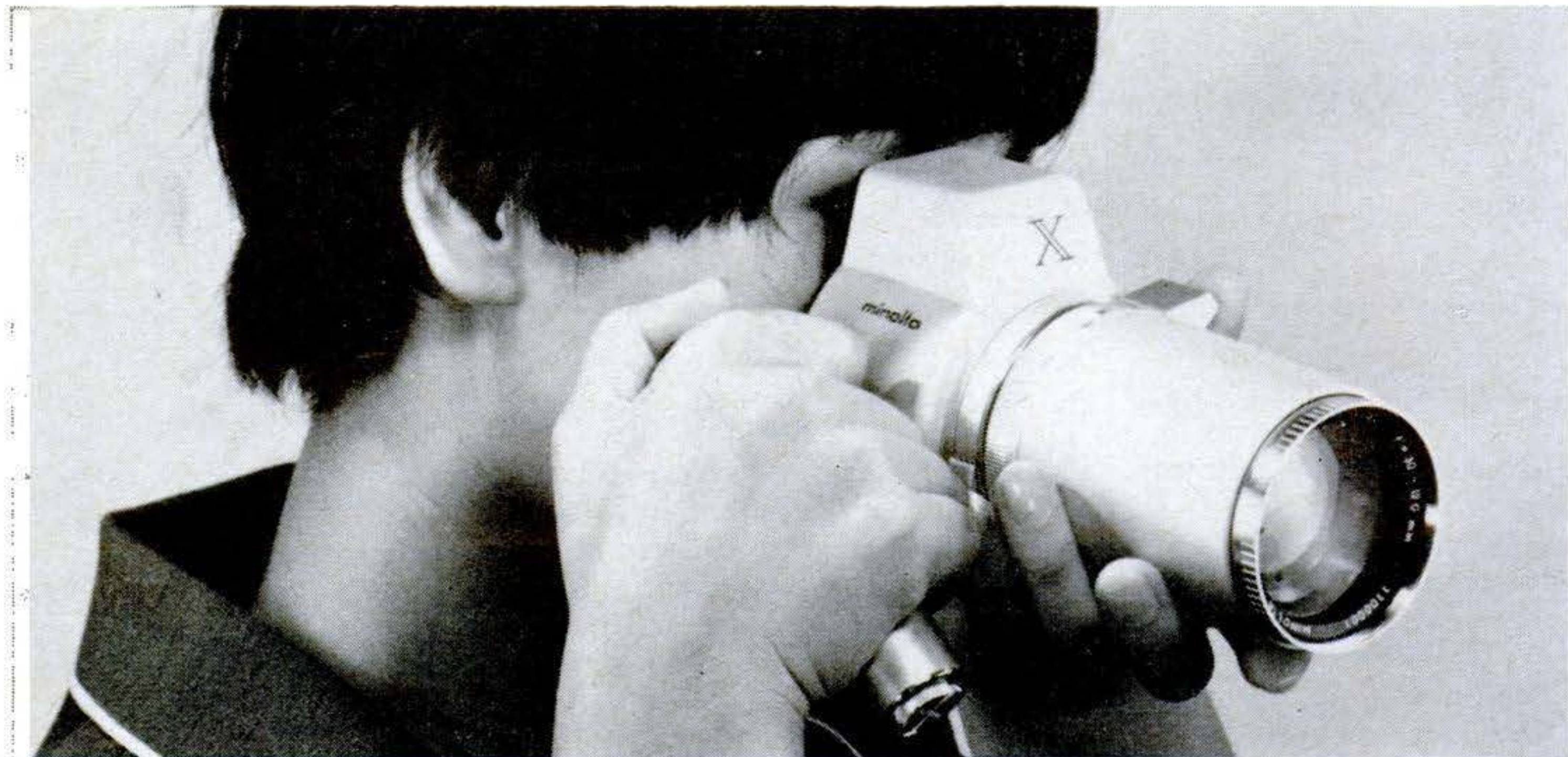
I recently had a preview of things to come in Cologne, West Germany, at Photokina 1966—the most colossal photographic trade show ever held, with more than 600 exhibitors from 23 countries filling 10 giant, double-tiered halls with a staggering array of new products.

Camera of the future? The most way-out camera at Photokina was a prototype model of Minolta's Electro Zoom-X. A single-lens reflex with a microprism focusing spot, the Zoom-X is designed to use instant-



Bolex 150 Super puts Instamatic cartridge in top of camera along with batteries. Motor is in the handgrip.

loading Minolta cartridges giving Super 16 (12-by-17mm) format negatives—40 percent more area than with conventional 16mm. It has a zoom lens, electronic focal-plane shutter, and CdS through-the-



Minolta Electro Zoom-X is designed for 16mm cartridge. It has a zoom lens with range from 30mm to

120mm. The CdS through-the-lens exposure system is powered by batteries housed in the side handle.

Cameras Make News



Ingenious sunshade folds to protect lens. Opened or closed slowly, it makes fade-ins, fade-outs. Viewing

and exposure control are both through-the-lens. Diaphragm lock turns exposure meter into a spot meter.

lens exposure control. Don't expect to see this futuristic model on the market soon.

Automation—especially the sophisticated application of electronics—keynoted the fair. The mechanics of picture-taking are

becoming increasingly simplified, not only on amateur cameras but on top-quality professional equipment.

Zeiss Ikon, for example, introduced the Contarex Electronic—the world's first single-lens reflex camera with a fully electronic system, including its focal-plane shutter, automatic exposure control, self-timer, and remote control. Accessories include a remote release on a 33-foot cable that can be triggered by radio, light, or sound, and an electric motor drive for manual or remote-control sequence photography.

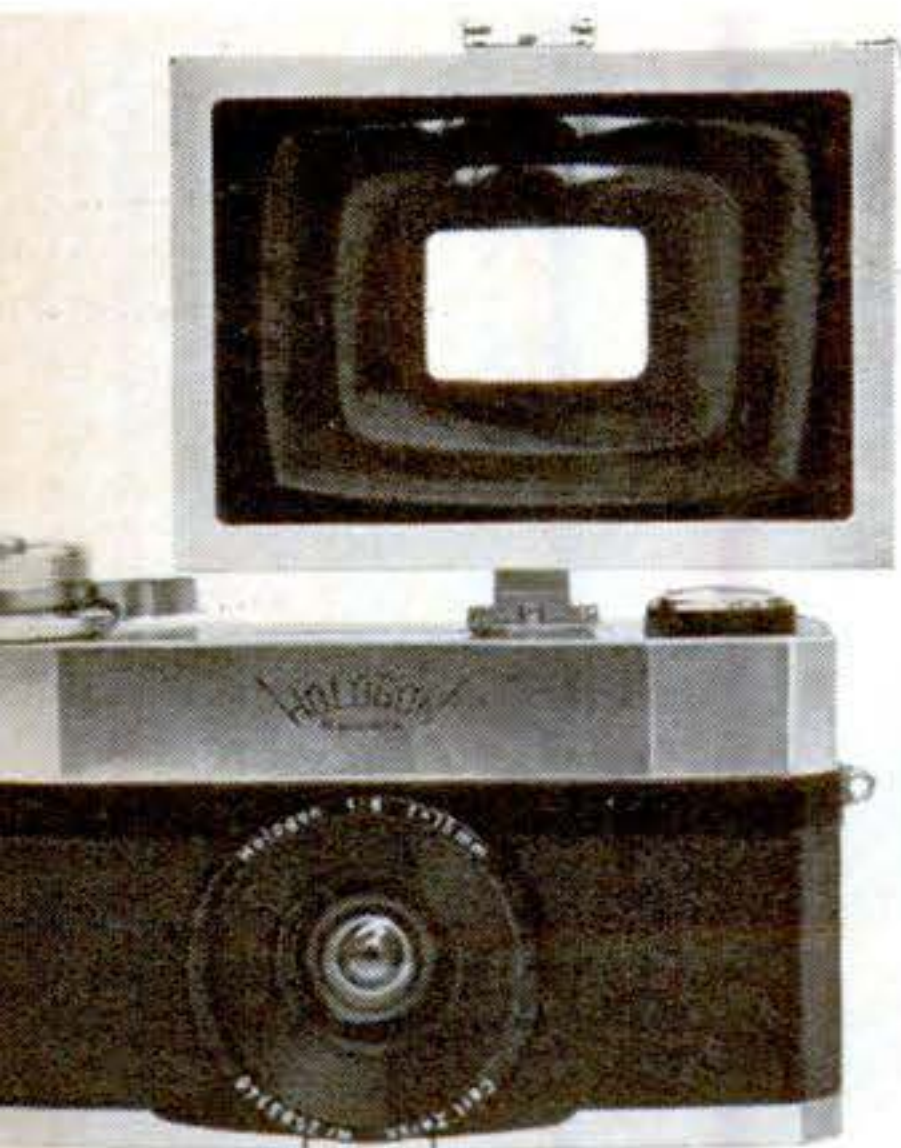
Electronics also was a feature of the Voigtlander Vitessa 500 AE, a medium-priced 35mm camera with a Prontor Electronic 500 between-the-lens shutter coupled to a CdS meter system. The automatically selected shutter speed (from 1/500 to 10 full seconds) shows in the viewfinder before you take the picture, along with the manually controlled lens setting. By adjusting the lens setting, you can achieve faster or slower shutter speeds as you wish.

Electronic light meter. I also was in-

Continued



Pentax 220 looks like a jumbo-size version of standard 35mm Pentax. It takes 2 $\frac{1}{4}$ -by-2 $\frac{3}{4}$ pictures.



Rollogon is a camera built around a fantastic 15mm wide-angle lens with fixed $f/8$ opening. Giant viewfinder fits in accessory shoe.



Contarex is the first SLR with all elements controlled by electronics: shutter, automatic exposure, self-timer, remote control.



Icarex 126 is an SLR designed for amateurs. It uses Kodapak cartridges, but offers focal-plane shutter, lens interchangeability.

New trends in photography: a move to 120-size

trigued by another application of electronics—in the Zeiss Ikon Ikophot T exposure meter—which has no internal moving parts but uses only transistorized circuitry. When you point the meter and press a button, one of two pilot lamps lights up. An arrow on the lamp indicates the direction in which you are to rotate a dial marked with f /stops and shutter speeds. When you reach the correct position, the first lamp goes out and the dial itself lights up, giving you your reading directly in f /stops and shutter speeds.

Another important trend at Photokina was the growth of 120 roll-film single-lens-reflex equipment. The camera that caused the most excitement was Rollei's SL66 [see "At Last: Rollei Has an SLR," PS, Nov. '66]. Personally, I found the SL66 a bit cumbersome to handle, and its focal-plane shutter, synching to electronic flash at 1/30 second, may not appeal to some of the professionals for whom it is designed.

Adding to the roll-film SLR news, Asahi showed a prototype model of the Pentax 220. This new camera puts 10 or 20 "ideal format" ($2\frac{1}{4}$ -by- $2\frac{1}{4}$) negatives onto 120 or 220 film, respectively. The ideal format is nearly identical in proportion to an 8-by-10 sheet of paper, and has a number of enthusiastic supporters among professionals. The Pentax 220 also features an electronically controlled focal-plane shutter with speeds continuously variable from one to 1,000 seconds. When can you have one? The manufacturer won't say, but this camera deserves watching.

Another interesting camera was the Zeiss Ikon Icarex 126—the first interchangeable-lens SLR designed for 126 Kodapaks. It has CdS exposure control, a focal-plane shutter with speeds from 1/30 to 1/500 second, and is available with five bayonet-mount lenses from a wide-angle 32mm $f/2.8$ Distagon to a 135mm $f/4$ Tele-Tessar. A far cry from the first humble Kodak Instamatic!

The most spectacular example of miniaturization was the Rollei 35 [PS, Nov. '66], an inventive attempt to give full-frame 35mm quality in a subminiature package. It's the smallest 35 ever built—only slightly larger than a king-size pack of cigarettes—and weighing less than $14\frac{1}{2}$ ounces. The Rollei people had difficulty in producing a model for me to try. "We had a lot of them, but they keep disappearing," a company official told me. "I think," he said wryly, "it may be a little too pocketable."

The new movie cameras. Window-shopping among the motion-picture equipment almost made me dizzy—there were some 69 new movie cameras alone! The emphasis was on Super 8 which, like advanced electronic automation, also firmly established itself at Photokina '66.

Bolex officially introduced its first Super 8 model—another way-out camera. An unusually designed camera with a pistol grip, it has the film cartridge located above the lens at a 90-degree angle from the lens axis. A mirror provides direct, through-the-lens viewing; exposure is fully automatic and controlled by a through-the-lens CdS cell, and the $f/1.9$ lens zooms from 8.5mm to 35mm. An imaginative feature is the col-

meras, increasing use of electronics, wild lenses

lapsible lens shade. You can fold it down to protect the lens during storage and carrying, or use it as a device for making fade-ins and fade-outs.

A number of motion-picture projectors were shown, including "straight" Super 8 and dual-purpose (regular 8 and Super 8) models. The availability of many good-quality dual-purpose projectors in a wide price range should help ease the dilemma that many movie makers found themselves in last year: "If I go to Super 8, what about all my regular 8mm films?"

The new lenses. Fascinating new lenses were shown at Photokina, too. Zeiss Ikon alone introduced 40 new designs. Among the Zeiss offerings was a spectacular super-wide-angle, the Hologon. This 15mm three-element glass bubble with a fixed aperture of $f/8$ is mounted in a 35mm camera body. The huge viewfinder—almost as large as the camera—is mounted on an accessory shoe.

Depth of field sweeps all the way from $1\frac{1}{2}$ feet to infinity so that focusing is unnecessary. The unusual, almost spherical design of the lens reduces the distortion that is the bane of super-wide-angle photography. The Hologon's field of view is so wide you have to be careful in gripping the camera or you get your knuckles in the picture—as I discovered while shooting views of Cologne and Photokina with it.

Less obviously spectacular, but representing a remarkable breakthrough in lens design and manufacture, was the Leitz $f/1.2$ 50mm Noctilux—the world's first true "aspheric" lens for picture-taking. An aspheric lens is one containing curved surfaces that are not sections of a sphere or circle. In the Noctilux, Leitz claims a high-speed lens remarkably free from spherical aberration and field distortion, and with improved contrast and reduction of flare. In practice, this means the Noctilux should produce an image quality "wide open" that a normal high-speed lens only produces when stopped down to its optimum aperture (usually around $f/4$ or $f/5.6$).

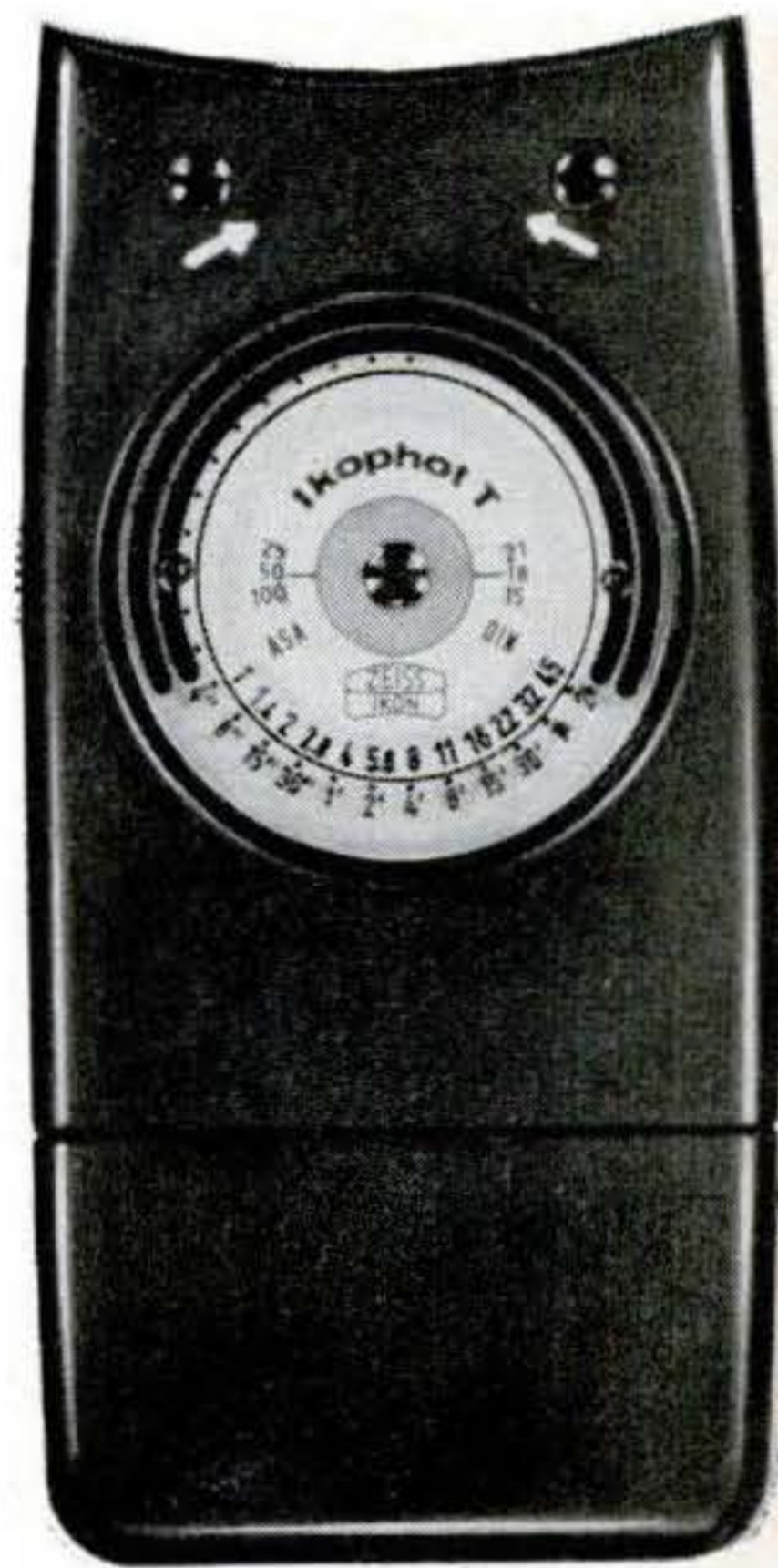
The Leitz lens, which will cost several hundred dollars, may open the door to a whole new generation of aspheric lenses with performances exceeding anything we have today. In the long run, the Noctilux may well be one of the most significant items introduced at Photokina '66.

Schneider showed a novel new lens—the Pa-Curtagon, a 35mm $f/4$ perspective-control lens for 35mm single-lens reflex cameras. It shifts both vertically and laterally, giving 35mm SLR photographers a measure of distortion control for architectural and still-life subjects. Zoom lenses for still cameras were much in evidence, including a Konica lens with a remarkable 58-to-400mm range.

Faster films. Agfa-Gevaert announced improvements in its line of black-and-white films, and upped the speed of Isopan Ultra a full stop to 400 ASA, based on the new standardized rating procedure. Ilford came out with an improved version of its high-speed HP4. With a recommended exposure range of 400-650 ASA, the new HP4 is claimed to be an unusually "forgiving" fast film, with considerable exposure latitude and good shadow detail.



About the author: Arthur Goldsmith has been taking pictures since his high-school days, and writing magazine articles since he earned his master's degree at Northwestern's famed Medill School of Journalism. Formerly Executive Editor of *Popular Photography* and Picture Editor of *This Week*, he is now Head of Instruction at the Famous Photographers School, Westport, Conn.



Ikophot T light meter has no moving parts. Light-up buttons near top tell which way to turn dial. Face lights when dial is right.

PS



PHOTOS BY
ROBERT D. BORST

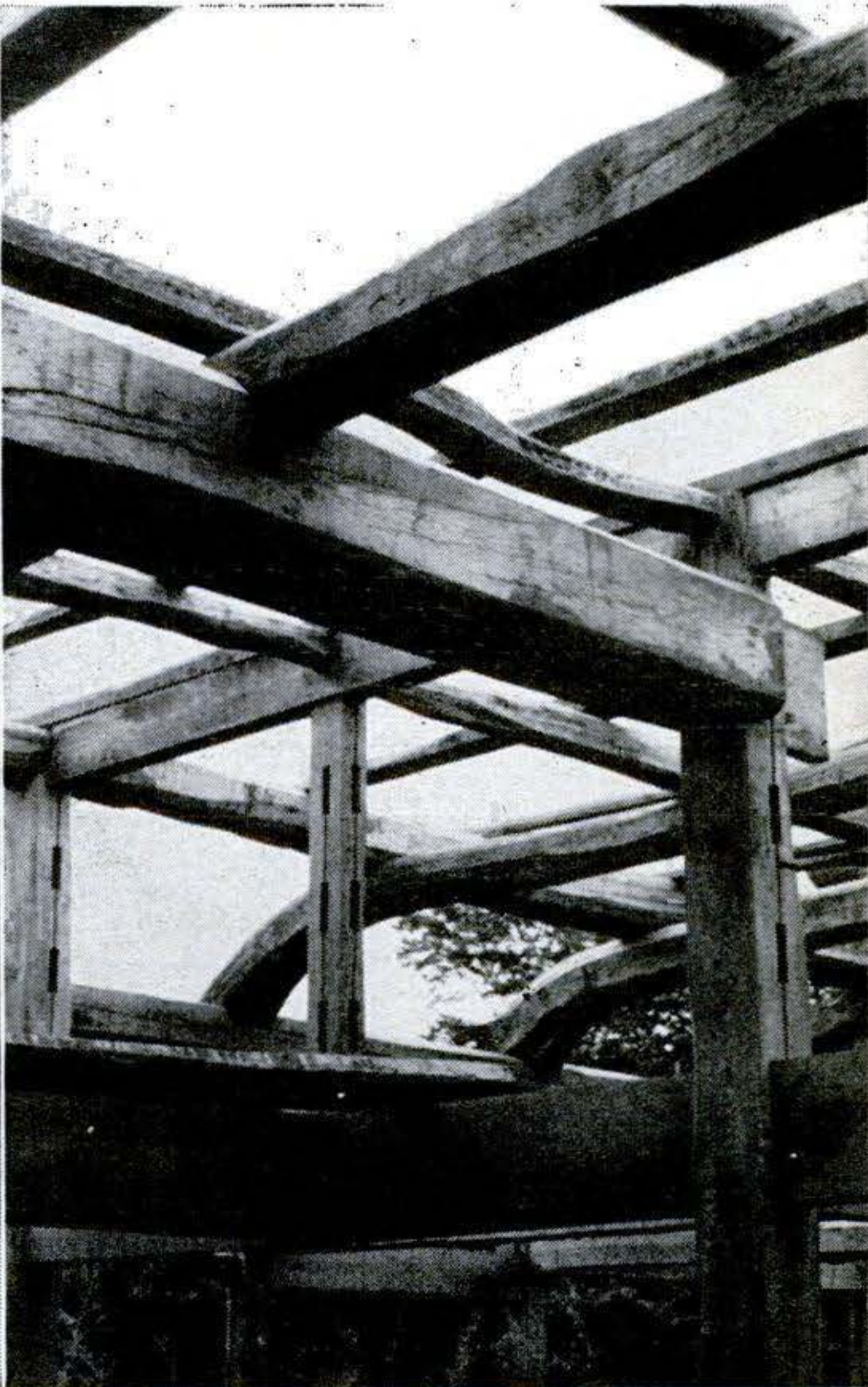
Seventh-generation master carpenter Shoji Koeke displays the ancient tools he uses in working Japanese style. He's shown holding a **nokogiri**—a two-edged saw that cuts on the backward stroke. On the left in foreground are a collection of **nami**—chisels, some of which have been passed on in Shoji's family for generations—and pry bars. Next to the chisels are several **kannas**—planes. The **kannas** cut as they are pulled toward the user. The gadget that looks like a Dutch shoe is a marking device that puts on an inked cutting line on a piece of wood. Shoji carved the marker himself. Also at right foreground, a carpenter's square and a long-handled chisel.

The Strange Tools and Exotic Secrets of Japanese Carpentry

The old razor-sharp hand tools and ancient carpentry techniques seemed out of place in New York City, but it was just what Rocky Aoki wanted for his authentic new restaurant: Benihana of Tokyo East.

For a real Japanese look, he imported timber from a dismantled 150-year-old farmhouse near Osaka. The carpenters came from Japan, too, along with their

strange, exotic tools. Heading the crew was Shoji Koeke, a seventh-generation carpenter whose family specialized in building Shinto temples. Shoji brought his own tools, some of which have been in his family for 200 years. Shoji and his crew used almost no nails. The pieces hang together with tongue-and-groove joints. Gravity supplies the adhesive.



Clad in traditional "happy" coat and wearing zoris (sandals), Shoji Koeke forms a tongue on the end of a beam with two-edged nokogiri. He can cut with either set of teeth, switch over if one set becomes dull. The long-handled saw permits him to use both hands and work in a semi-erect position. It cuts on the pull stroke. Shoji prefabricates parts before assembly; he may spend days tongue-and-grooving members, then put them all up at once.

Section of 150-year-old country house above shows typical nail-less construction. Slots in verticals permit boards to pass through or hold tongue end of beams. Weight of the beams gives structural rigidity. The house, near Osaka, was dismantled to supply wood used in building new restaurant in New York. (In New York, building codes required use of some nails, particularly in attaching plywood interior walls. Code also required fireproofing beams. *Continued*

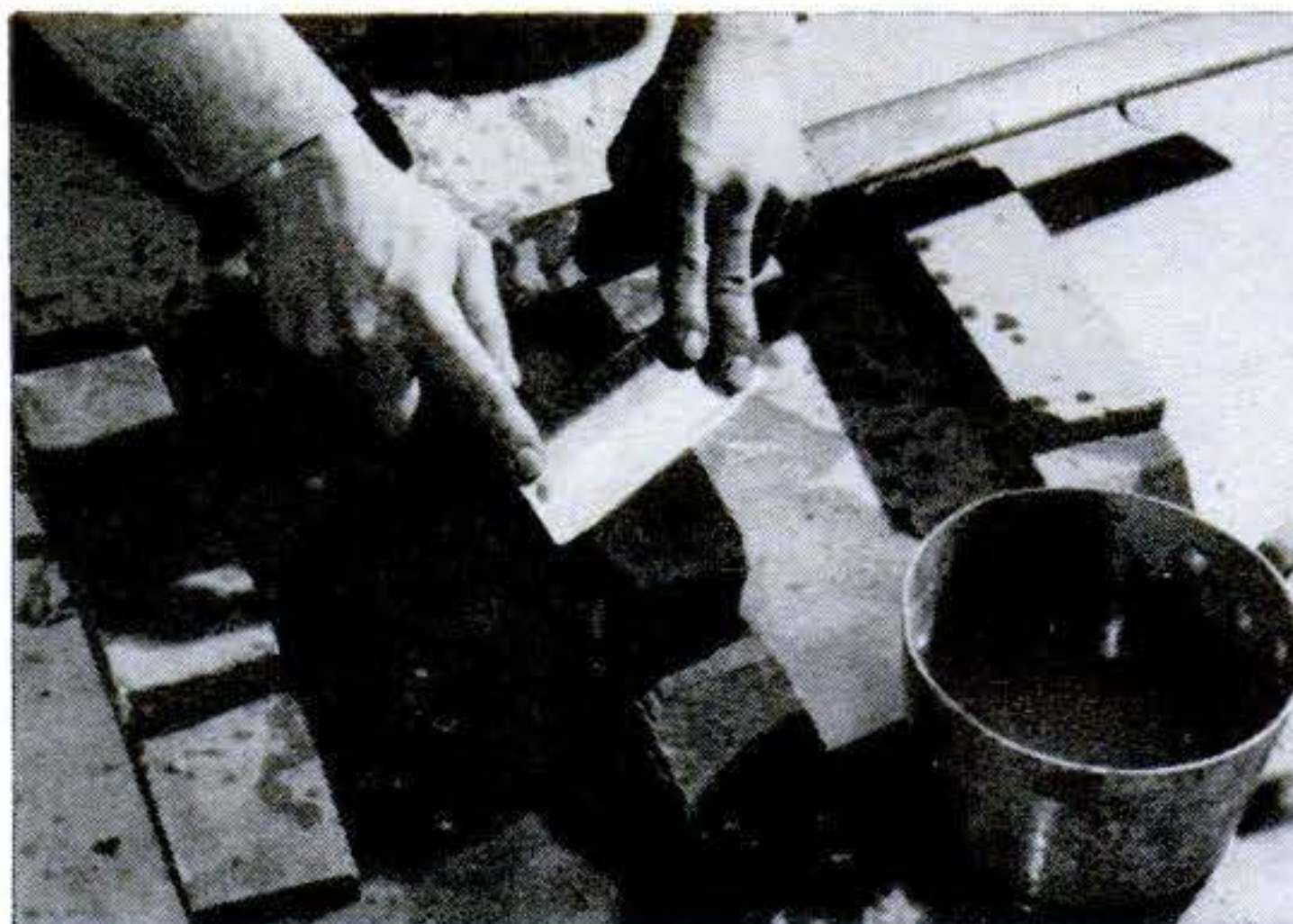
Nail-less construction holds things together by their own weight



Using curved-handled adze, Shoji fashions a beam out of a rough piece of timber. The rough marks of the adze on the surface are not smoothed out but are left there to make an interesting textural pattern. Japanese name for this tool is chona.



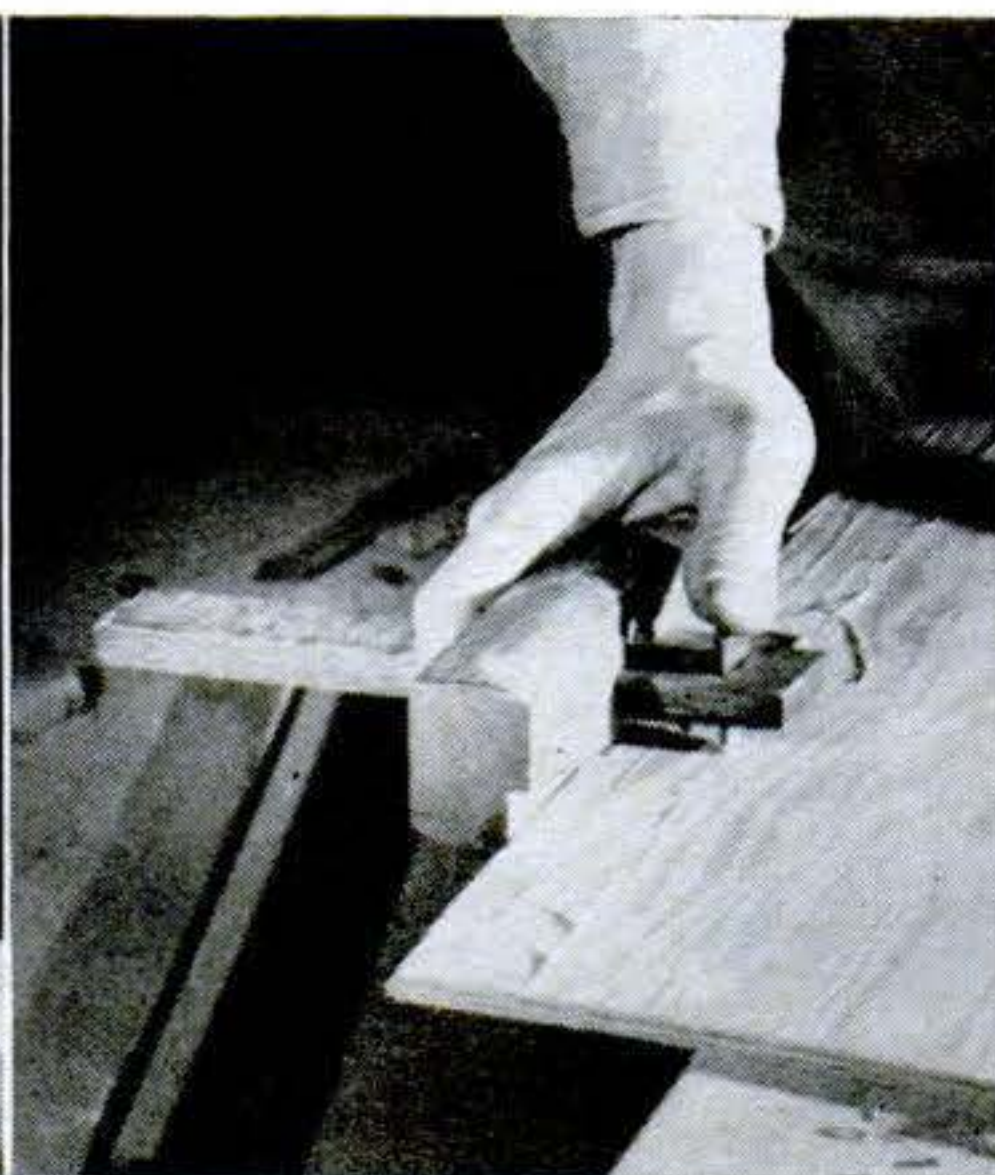
Ingenious hand-carved marker is used on large surfaces, too big for convenient use of a straightedge. It's similar to our markers, but the string, instead of being chalked, is inked from a pad in well.



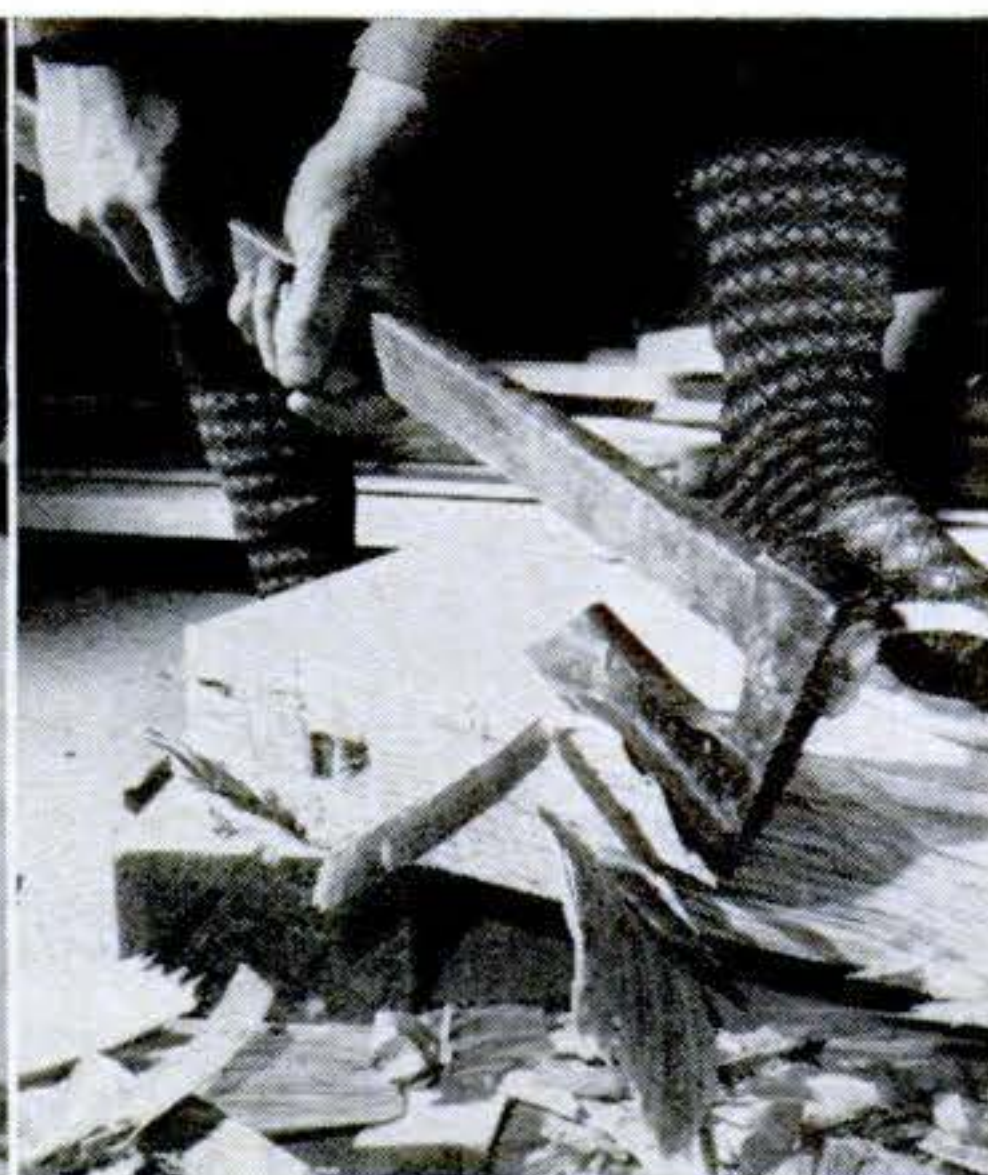
Keeping tools sharp is a constant chore with Shoji, as with good workmen in any part of the world. In picture above, he is sharpening his masakari (axe) on a toishi (sharpening stone). Photo directly below shows Shoji at work with the masakari.



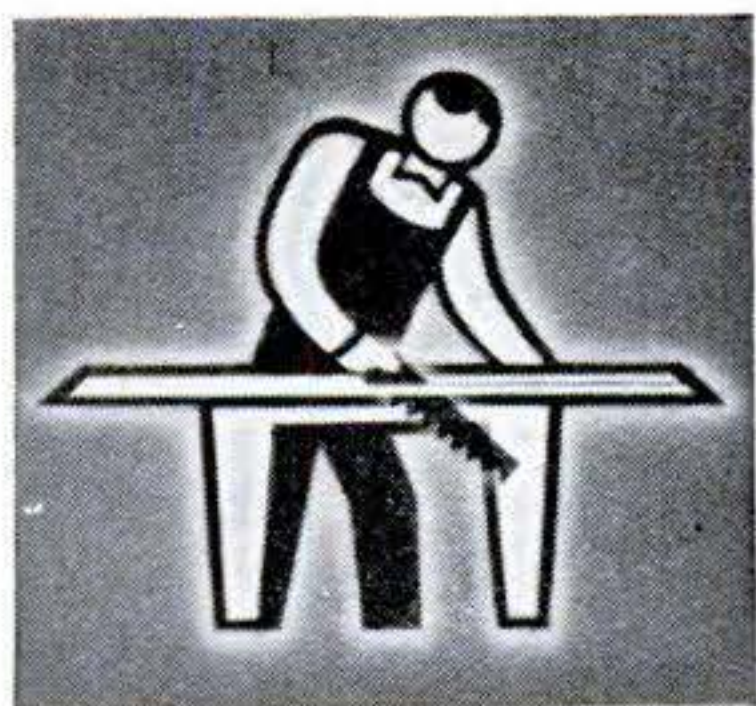
Shoji's plane, called a kanna, works on same principle as Western planes; but Japanese reverse it in use so it cuts on the pull stroke instead of the push stroke. Shoji keeps his planes razor-sharp.



Edge cutter, called a kehiki, is used for thin woods and veneers. It works like a U.S. marking gauge, but instead of merely scribing, it neatly slices off a strip of wood.



U-shaped axe is used by Shoji here to groove out a timber corner. A matching tongue will fit it perfectly, without need for nails or screws. Shape of axe makes it light, easy to wield. **PS**

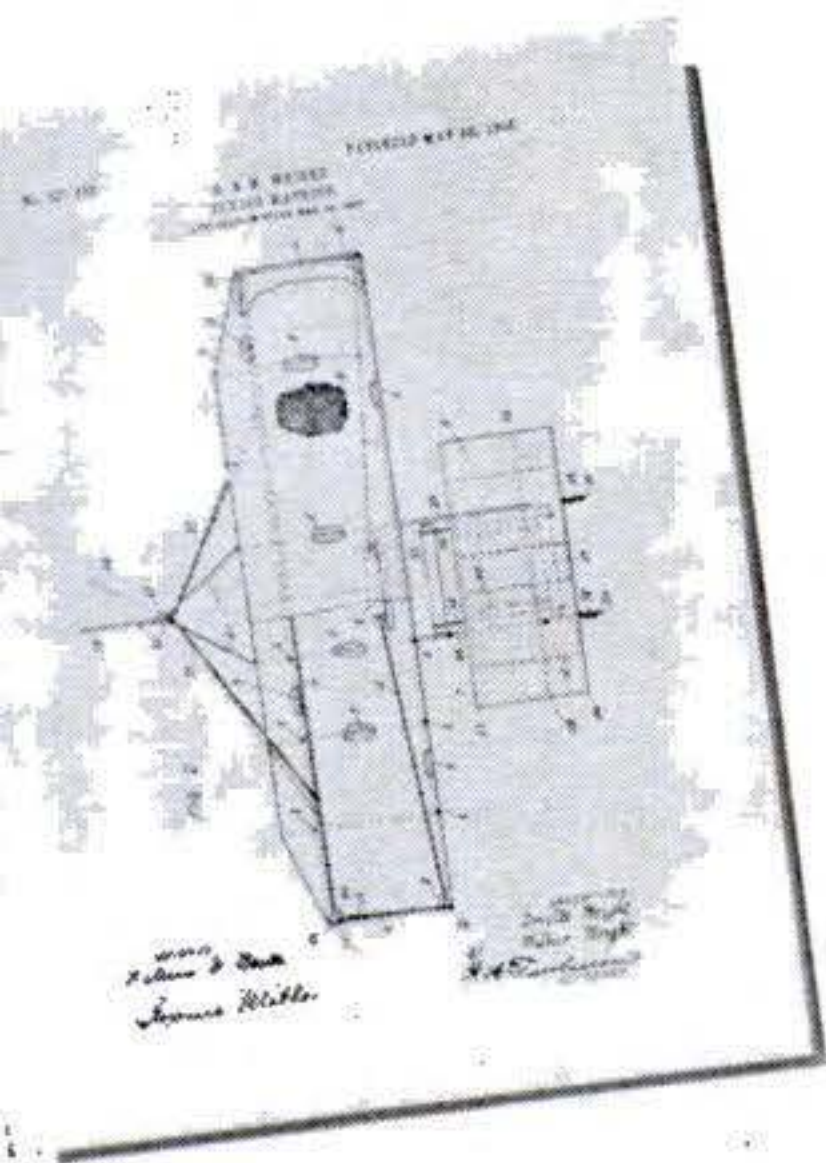


Shop Talk

By ROBERT P. STEVENSON

Now you can buy pine "boards" up to 30" wide

Kiln-dried knotty pine is now being edge-glued into panels up to 30" wide and 16' long at Georgia-Pacific's sawmill in Pilot Rock, Ore. The panels, designed for industrial and home-shop use, come in widths from 14" to 30", lengths from 6' to 16'. Boards extend full length of the panels. Selected one-by-six, one-by-eight, and one-by-ten boards are used. Two sides are smooth-sanded to $\frac{3}{4}$ " thickness. New electronic bonding equipment was developed to handle the extra-wide panels.



Decorate your shop or den with original patent drawings

How about framing a copy of the original patent sketch for the Wright Brothers' flying machine (at left) for your wall? Or Whitney's cotton gin, Howe's sewing machine, Bell's telephone, Edison's phonograph or electric lamp? You can get all of these, each reproduced on 8½"-by-11" parchment-finished paper, for \$5 a set. Write Cambridge Archives, 639 Mass. Ave., Cambridge, Mass. 02139.

Warning: Silver solder containing cadmium can kill you

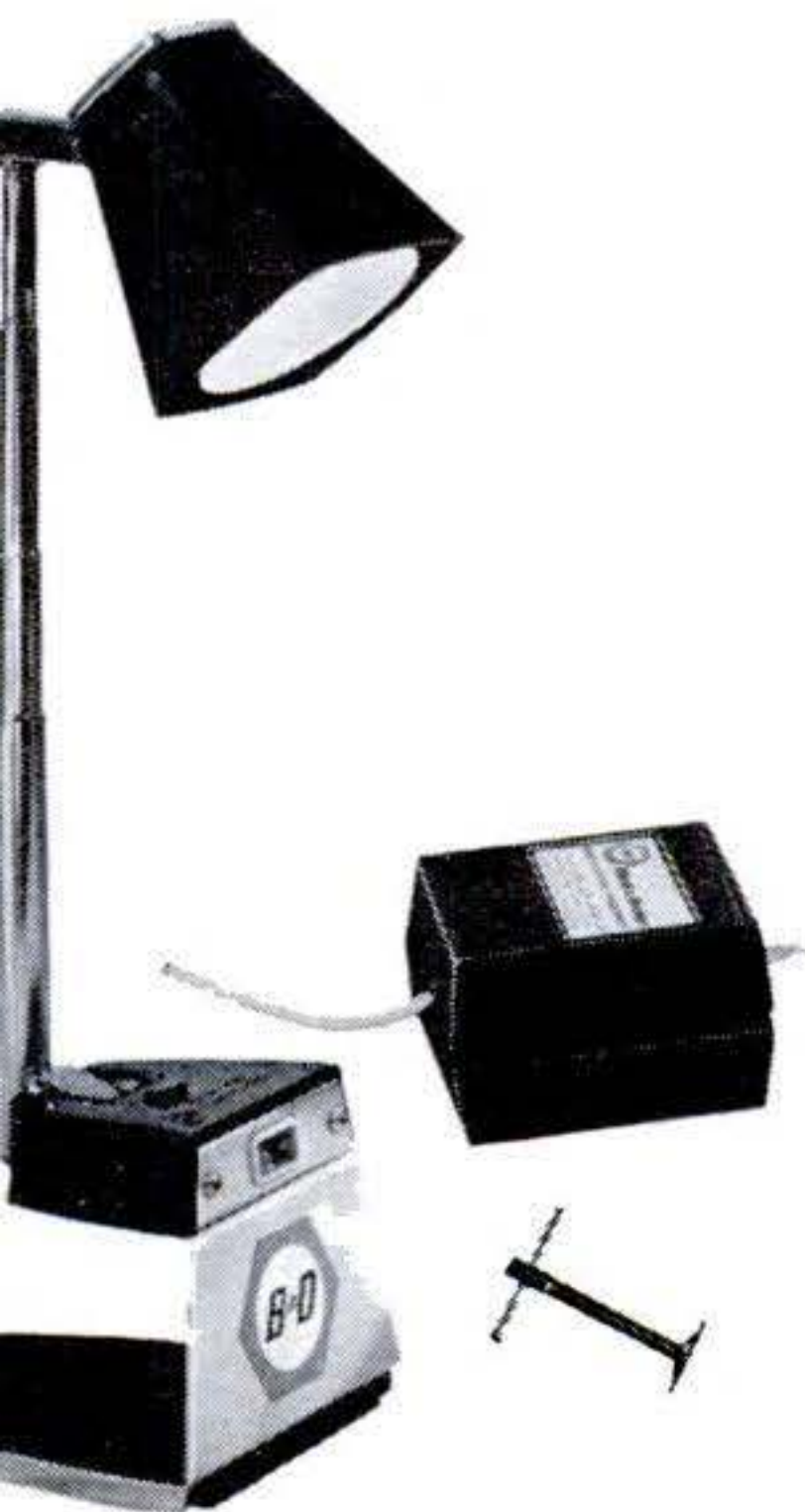
The U.S. Public Health Service has issued a warning concerning home-workshop use of silver solder containing cadmium. When heated, cadmium produces an oxide that can cause death four to eight hours after inhalation of only a small amount of the vapor. Tin-based solders present no hazard. But if you suspect that a silver solder is cadmium-based, use it only where you can get rid of the solder fumes.

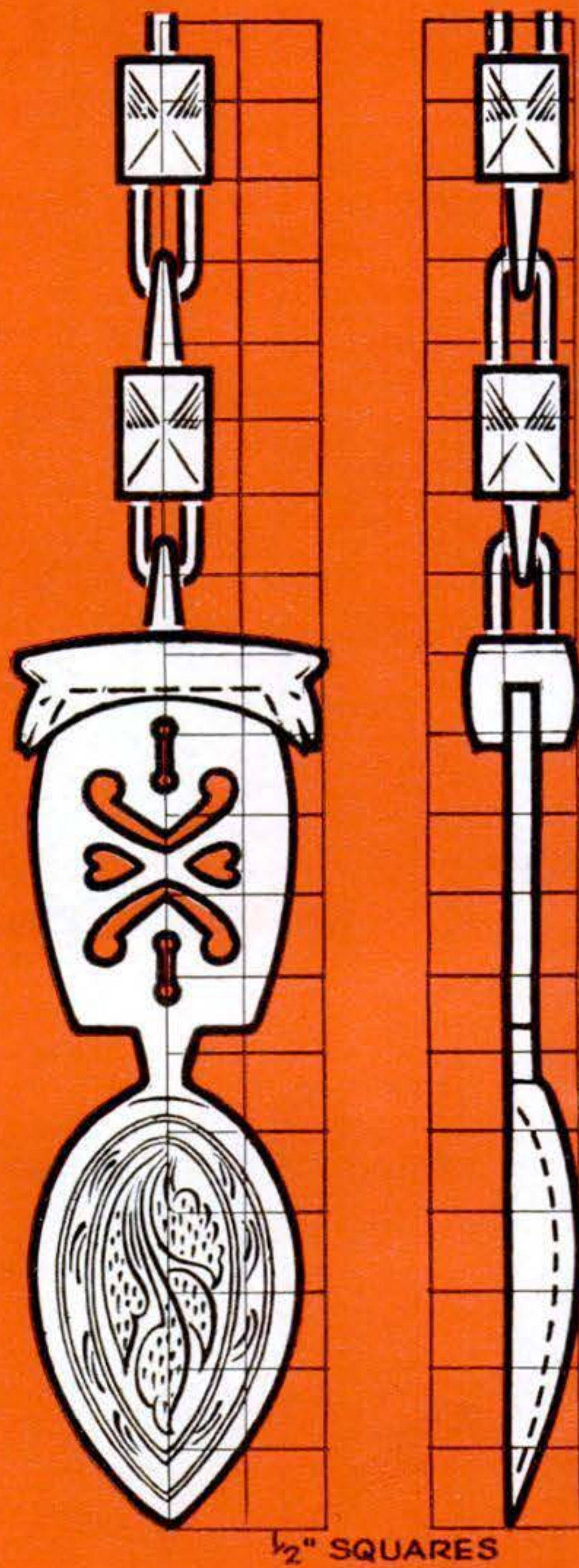
Good reading that you can get for the cost of a stamp

Two pocket-size guidebooks, "How to Use Screwdrivers" and "Helping Hand for Electrical Wiring," are available free from Vaco Products Co., 317 E. Ontario St., Chicago 60611 . . . If you face a major household move, and want to do it economically with a rented truck or trailer, you can get a free guide for estimating the cost. Write U-Haul, Box 14000, Portland, Ore. You get a free tape measure, too, to measure your chattels in making the cost estimate.

Products to look for in your local hardware store

You can now buy hinges by the inch. They're the continuous, or piano, type, made of plastic in white, aluminum, or black colors by Atlas Minerals & Chemicals Div. of Electric Storage Battery Co. You cut Polyhinge strips to length with scissors or knife. A four-foot roll costs about \$1.98 . . . Black & Decker has introduced a high-intensity lamp especially for home-shop use (see photo). It has a three-way base—flat for desk use, a magnet for metal surfaces, and a clamp for a shelf. It sells for \$16.99 . . . To cut through metal with minimum burr, try a hacksaw blade (No. 614A) made by Wiremold, Hartford, Conn. It has very fine teeth, 40 per inch compared with the usual 14 or 18 . . . Millers Falls has three new heavy-duty portable circular saws—6½", 7¼", and 8¼"—with double insulation for electrical shock protection . . . Channellock has introduced a new lather's shearing plier that's said to cut channel iron much faster.





1. WEDDING SPOONS

Many generations ago, newlyweds in Norway ate with wooden spoons joined by a chain to symbolize that they were joined for life. A few of these spoons still exist today in private collections and museums. The pattern shown is an authentic copy of one of these rare sets.

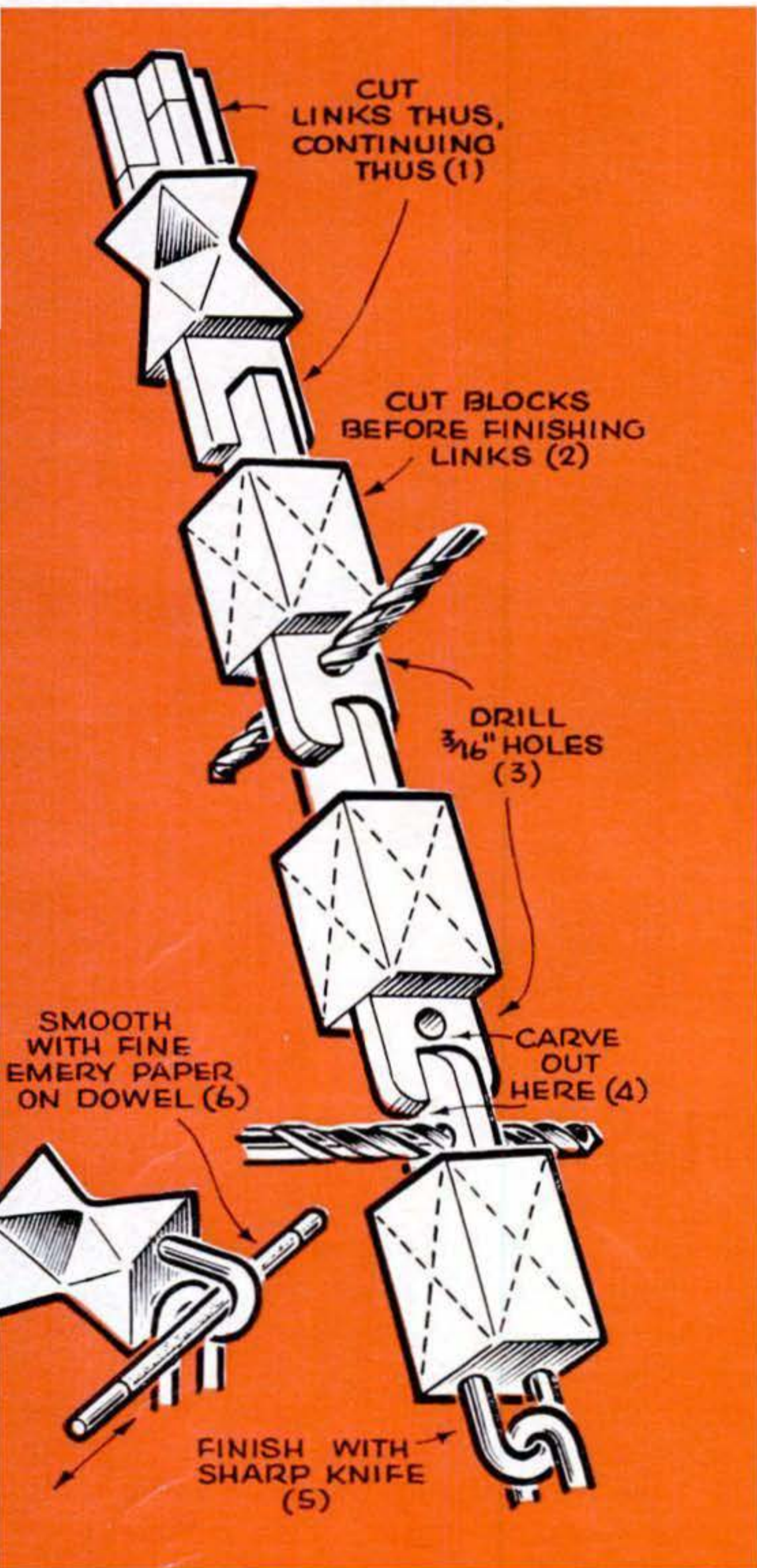
You can make a duplicate if you're handy with wood-carving tools. The finished spoons

are a unique and appropriate wedding gift.

Carve the spoons separately from the chain. Clear pine is easy to work. Gouge out the bowls before rounding the bottoms. Then drill and cut the handle decorations. Use needle files and sandpaper wrapped around small sticks and dowels to smooth the perforations. Etch the decorations in the bowls with a pointed knife. Sand smooth.

The chain and end blocks are carved out of one piece of pine 26" long. First groove the end blocks to fit the handles of the

Workshop Projects



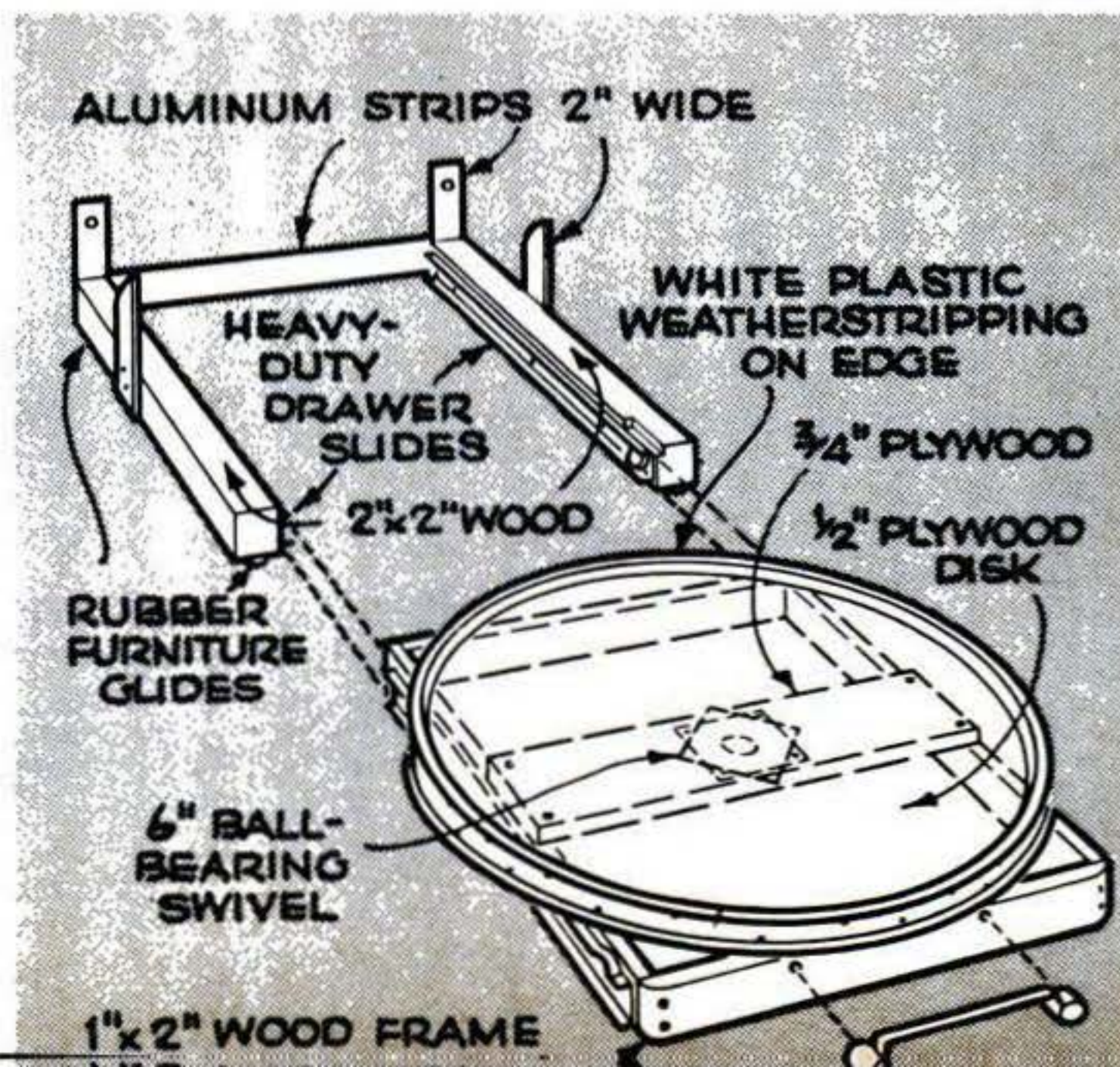
2. REFRIGERATOR SHELF

Food at the back of the bottom shelf of a refrigerator is hard to reach. The solution? A rotating shelf that slides out.

Make a base of two-by-twos to fit the refrigerator. Mount aluminum flanges at the rear and connect them to the refrigerator shelf supports to keep the tray from tipping down when you slide it out.

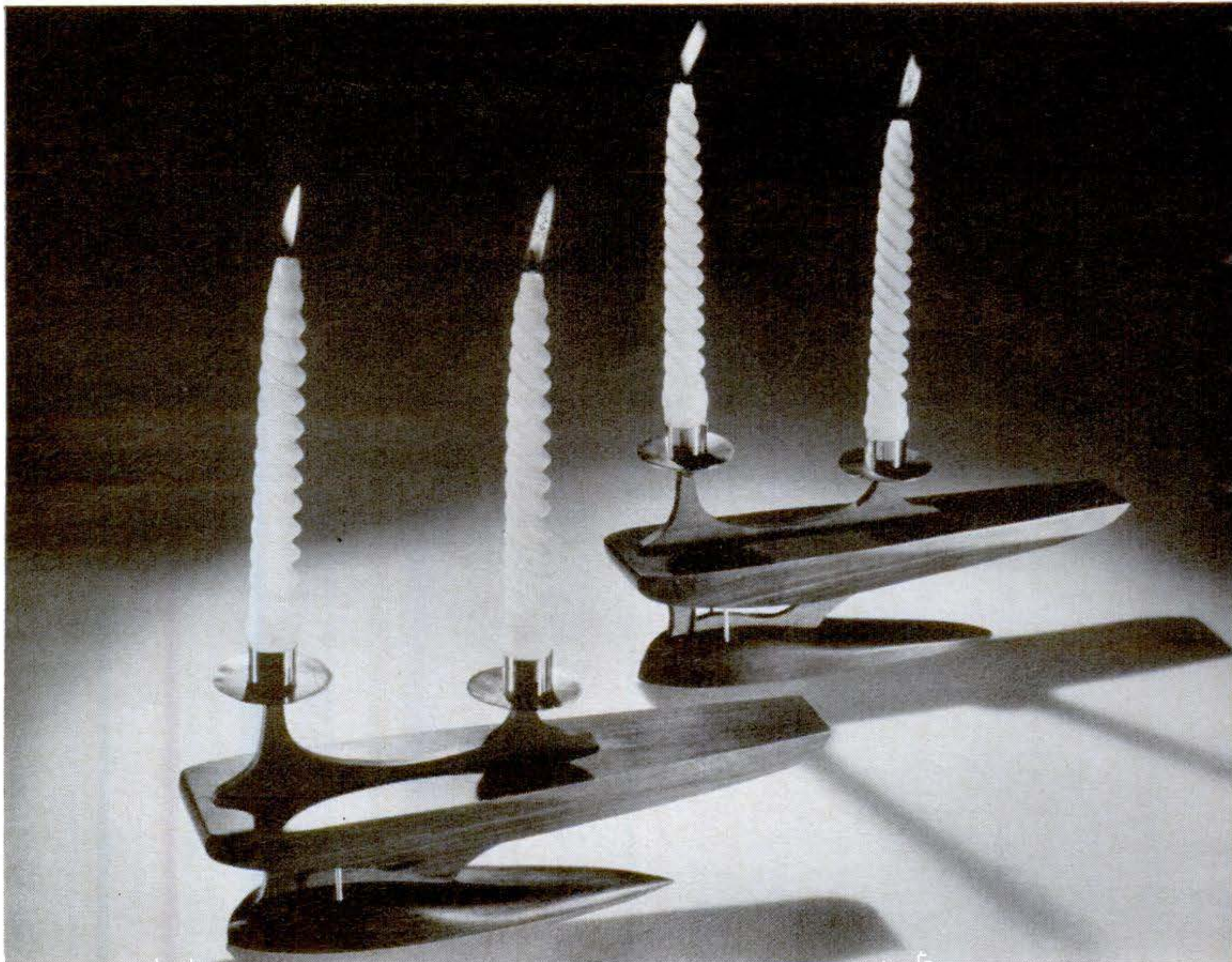
Cut the circular shelf from $\frac{1}{2}$ " waterproof plywood. Cover with white Formica and circle it with white plastic weatherstripping, lapped $\frac{1}{4}$ " above the top to keep items from sliding off. Paint all wooden parts with white enamel.—W. B. Sill.

Continued



spoons. Then carve the faces. Check drawing for details of the end blocks.

Cut the V notches in the blocks between the chain links first. Then drill as shown in a drawing to start the links. Finish with a sharp knife. Don't work too fast or you may split the wood or cut too deep. Smooth the links with files and sandpaper the same way you smoothed the piercing in the handles. Glue the blocks to the spoons, and soak with linseed oil or apply a clear penetrating finish.—Hi Sibley.



3. DANISH SCHOONER CANDLESTICKS

The flowing grace of a sailing ship is captured in these modern Danish candlesticks. They're simple in design but a challenge to any woodworker, and a functional project you'll be proud to display on your mantle or table.

The hull. Start with a block of straight-grained walnut $1\frac{1}{2}$ " thick, 3" wide, and 1' long. To make the bevels on the sides of the hull, tilt the jointer fence to 75 degrees and make three cuts on each edge of the block. Then tilt the fence to 60 degrees and make two more cuts on each edge.

The tapers in the width of the hull and underside of bow and stern may be cut by two methods. The safest way is to draw the lines on the hull, cut them on a bandsaw, and smooth them on a belt sander. You can also cut the tapers on a jointer the same way you'd taper table legs, but this method is dangerous if you're not skilled in operating a jointer. A belt sander is a

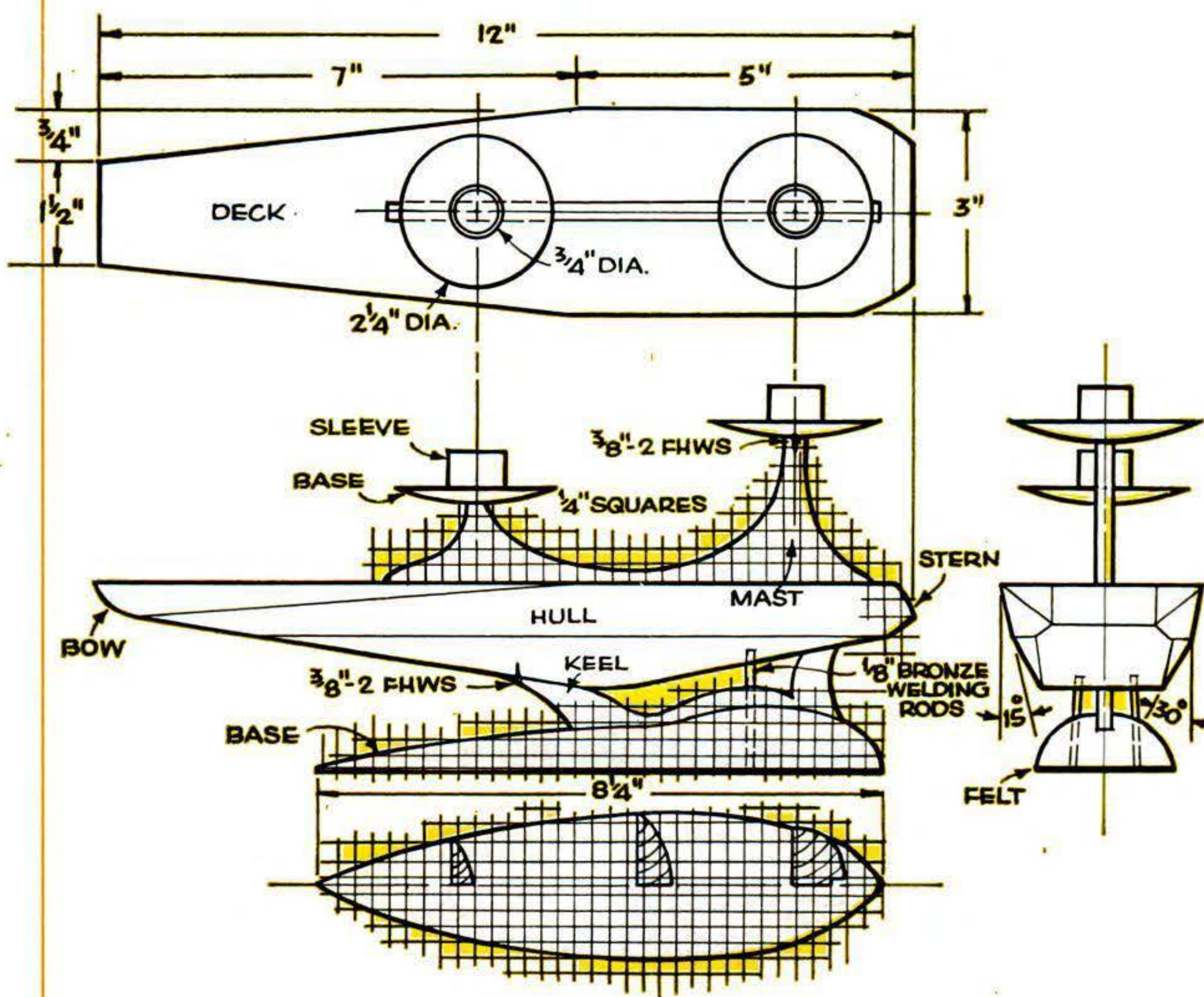
good way to finish the bow and stern curves although you can also do it by hand.

Outline the shape of the base on a walnut block 1" thick, $2\frac{1}{8}$ " wide, and $8\frac{1}{2}$ " long. Rip a $\frac{1}{4}$ "-by- $\frac{1}{4}$ " groove down the center to accept the keel, and then shape the base with a bandsaw and carving tools.

The keel and masts. Jigsaw these from $\frac{1}{4}$ "-thick walnut. Drill and countersink a $\frac{3}{32}$ " hole up through the keel, $\frac{1}{2}$ " from the front, to take a $\frac{3}{8}$ " #2 flathead brass wood-screw. Sand all walnut parts to a smooth finish, first with 3/0 paper, then with 7/0.

Apply glue to the parts of the keel that contact the hull, and fasten it to the hull with a $\frac{3}{8}$ " brass screw. Glue the keel into the groove in the base and clamp the parts firmly with hand screws.

After the glue dries, locate the two holes for the $\frac{1}{8}$ " brazing rods. Drill the holes through the base and into the hull, slanted in at a 75-degree angle. Slip the brazing



rods into the holes, and fasten the mast piece to the top of the hull with glue and wire brads. Finish the wood with penetrating finish or walnut paste filler. Brush the filler across the grain, let dry, and wipe off the excess with a soft cloth.

The candle holders. The sleeves are $\frac{3}{4}$ " brass pipe drilled out to $\frac{7}{8}$ ". The bases are sheet brass, drilled with a $\frac{3}{32}$ " hole at center. To dome the bases, place them over a 2" hole in a scrap of wood and rub the metal with the round end of a ball-peen hammer.

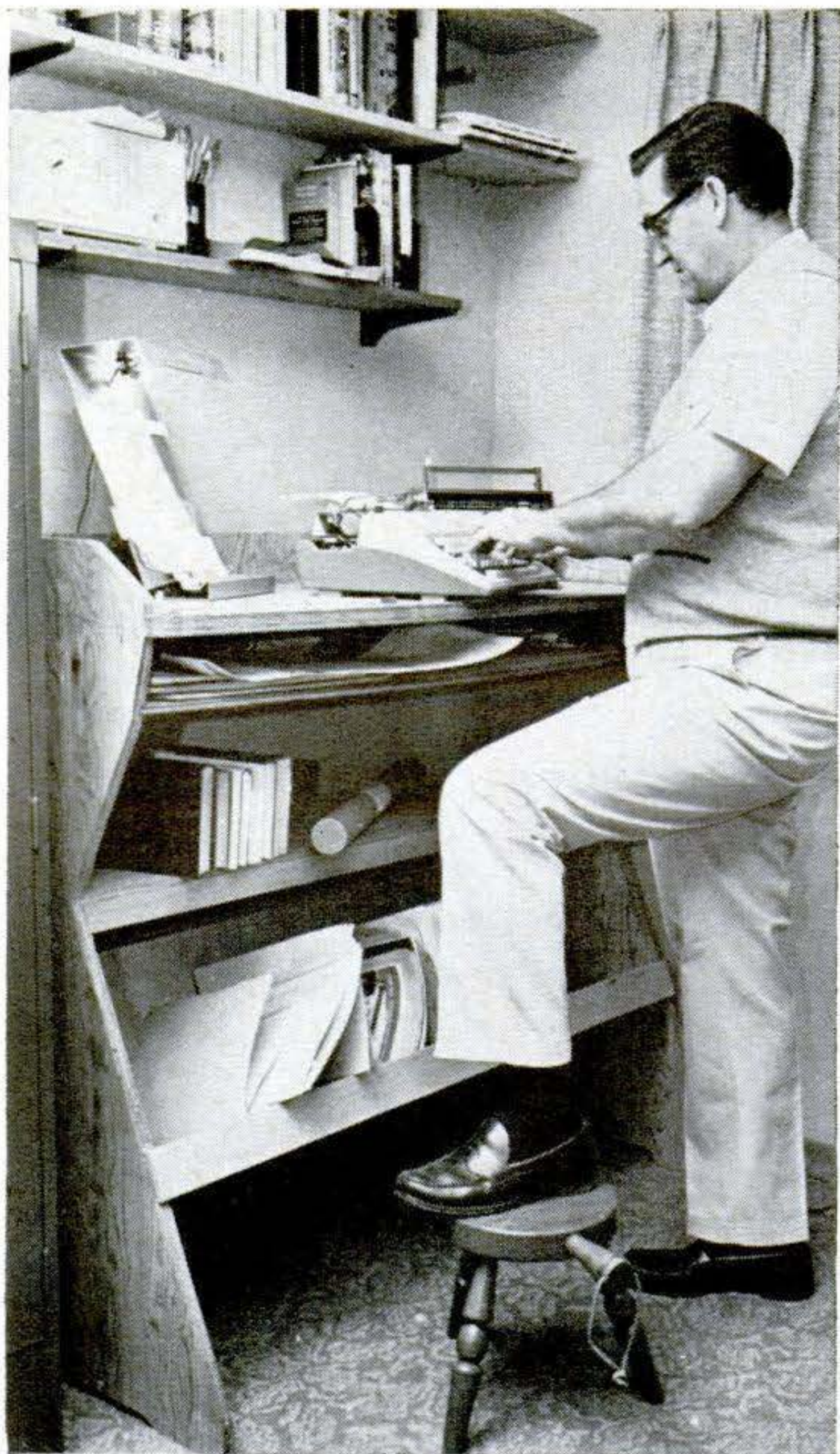
Clean the parts with steel wool. Brush flux on the sleeves and set one on each base. Place a few small bits of solder inside the sleeves close to the edge. (Don't use too much solder or you'll get a messy joint.) Heat with a propane torch from below till the solder runs all around the joint. Polish with fine steel wool, lacquer to prevent tarnishing, and fasten to the mast piece with a $\frac{1}{4}$ " #2 flathead screw.

As a finishing touch, glue a piece of felt to the bottom of the base.—*John E. Reppert.*

Continued



Clamp stop block to table to keep jointer from throwing the hull block back at you. Hold block as shown, lowering it on cutter and pushing with push stick. (Note: Jointer guard should be in place.)



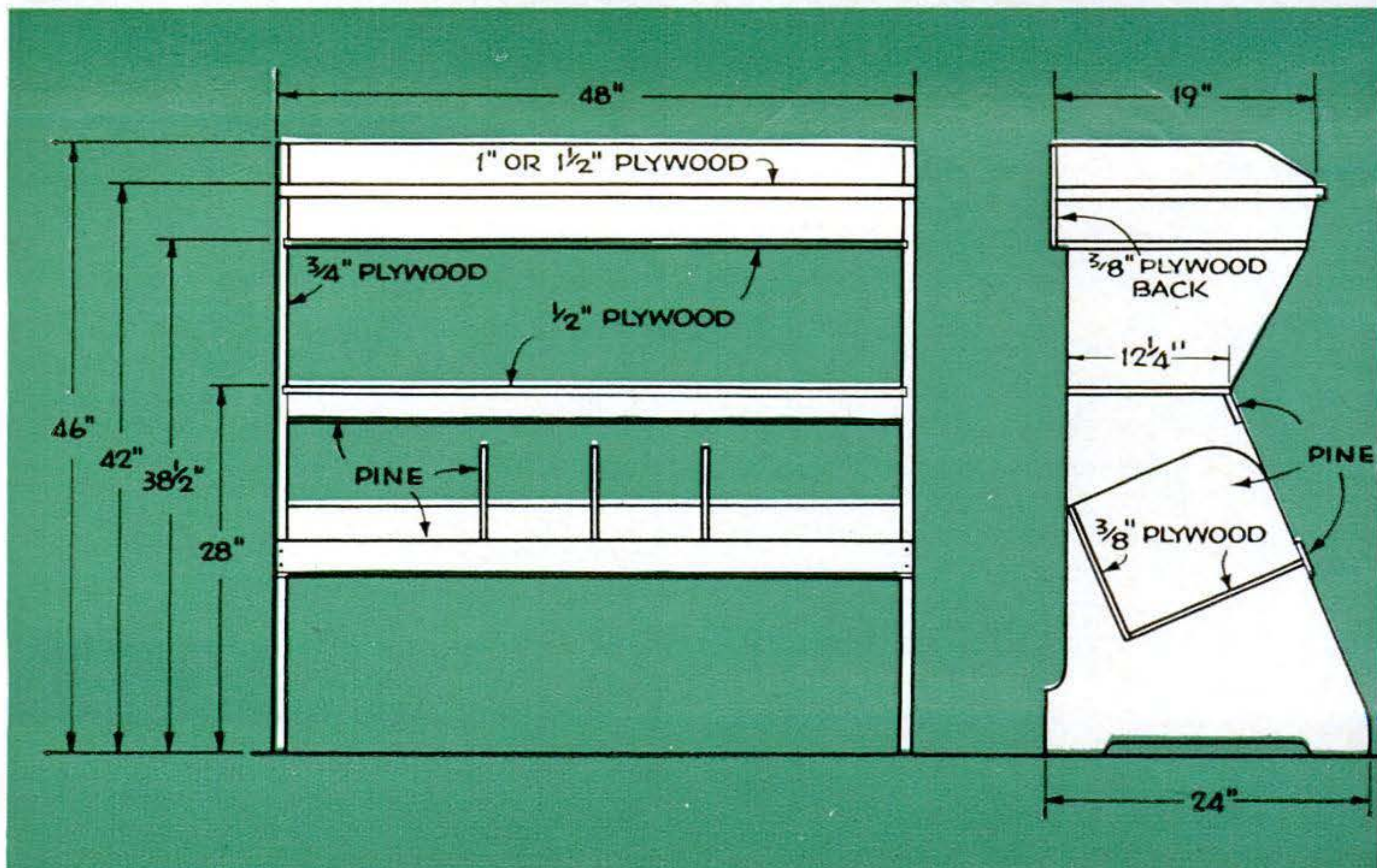
4. STAND-UP DESK

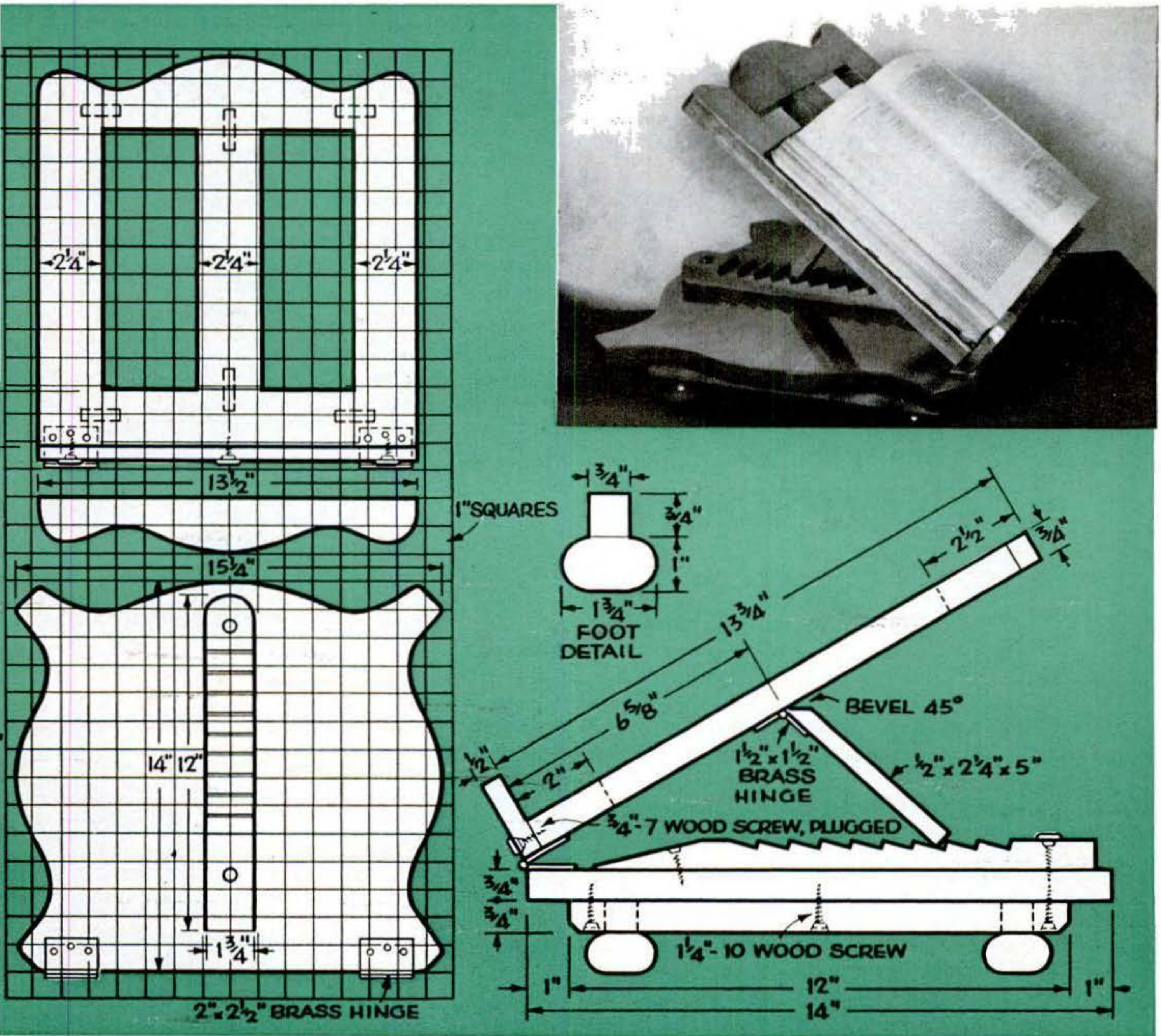
Like most people who work sitting down all day, I relax best by moving around or standing up. But frequently I have to bring work home, or spend leisure time on family accounts and correspondence. After some thought the solution suggested itself: Why not a stand-up desk?

There's nothing new or original about a stand-up desk. It's been used by such men as Benjamin Franklin, Thomas Jefferson, and Ernest Hemingway. Finding one, however, was another problem. The only commercial model I could find cost in the neighborhood of \$800. But you can make one of plywood, as I did, for less than \$20. Cut the two sides from $\frac{3}{4}$ " material by clamping two sheets together, drawing the pattern on the top one, and cutting both at the same time.

In cutting the shelves and other parts, be careful to saw them without splintering the edges. Cut the $\frac{1}{2}$ " grooves for the shelves with a router, and assemble the parts with finishing nails and glue.

Prime with plywood sealer and putty the nailheads before sanding. Finish the desk with enamel or varnish.—Don Holm.





5. ADJUSTABLE BOOKSTAND

Here's a bookstand you can use to display a dictionary or Bible, or to hold large reference books while you study or take notes. It's designed to let you adjust the angle of the book from almost flat to almost vertical for easy reading.

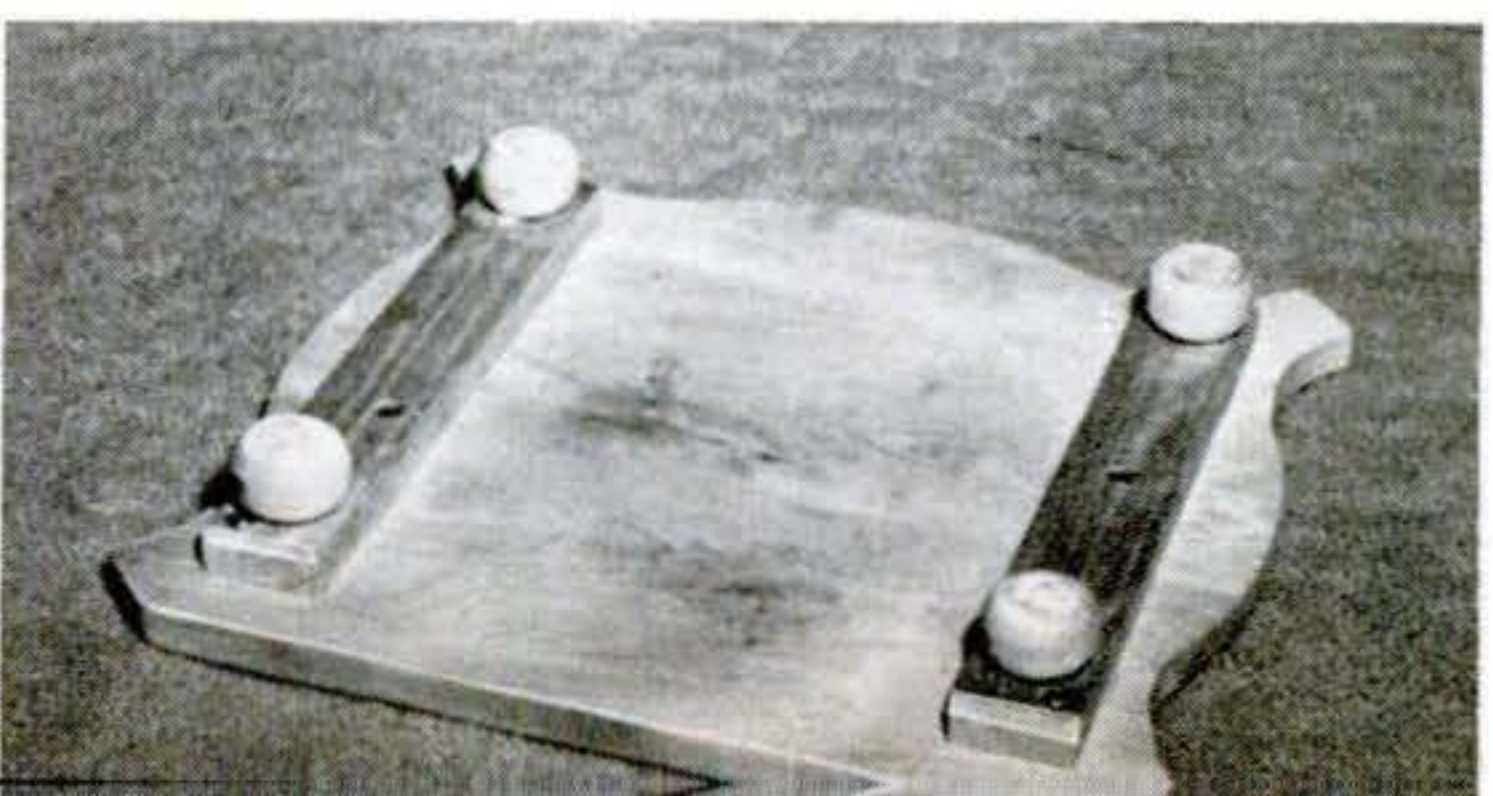
Make it from any wood you like. Mahogany or walnut will give it a rich, luxurious look; stained pine will look antique.

Glue up $\frac{3}{4}$ " wood into a piece large

enough for the base. Make a squared pattern from the drawing above, transfer it to the wood, and cut it out with a bandsaw or portable saber saw. A drum sander is handy for smoothing the edges. Cut two strips for the bottom of this piece. The rack members are glued and doweled. The sawtooth strip for propping up the rack can be cut with a dado on a circular saw tilted to proper angle.—*Joseph Olivari.* **PS**

Book rack can be held at any desired position by adjusting hinged prop on the sawtooth base strip.

Four wood feet, turned as shown in a drawing at top, are glued into $\frac{3}{4}$ " holes in two strips under base.



BEST FINISHES FOR WOOD

A Classic “Piano” Finish: Most Luxurious of All

The finest thing you can do to wood is give it a rubbed finish. Here's how to do it

By JACKSON HAND

The true rubbed finish is the ultimate in wood finishes—from the standpoints of both beauty and durability. It is absolutely level, without blemishes, perfectly clear. It can have the exact degree of luster you personally like best. Elegant and luxurious, the rubbed finish is known with affection and awe among good craftsmen as “the piano finish.”

And anyone can do it.

All it takes is a good glossy varnish or a good clear lacquer, a little willingness and patience, and a three-step procedure:

- Wood preparation. The wood must be clean—smooth—in good condition. The piano finish is not intended for rough, distressed, or beat-up surfaces, although it is appropriate on any species of wood. Sand with 6/0 or finer paper. Dampen to raise the grain. Sand again. If the grain is coarse (oak, pecan, Philippine mahogany) seal and fill. If the grain is medium (walnut or mahogany) filling is optional. If the grain is fine (maple or birch) don't fill.



- Finish application. Brush or spray on varnish or a high-build lacquer such as Fabulon. Sand between coats. Apply enough finish so that it can be rubbed to a perfectly plane surface without cutting through.

- Polish. With rubbing compound (optional) and wax, establish the high polish—without gloss—that is characteristic of the finish.

Key to the operation is rubbing. The objective is to make the surface both smooth and flat. Ordinary between-coats sanding on routine work is intended only to knock off the dust pinnacles and scarify the previous coat so that adhesion will be good. When you rub, you do more. You grind down areas that are above level. In a succession of coats, you keep grinding down the highs and building up the lows with more finish.

The rubbing materials may be ordinary sandpaper for the first coat or two. Then you start using pumice or waterproof sand-



paper. With either, the applicator is a block big enough to plane over the surface without dipping into depressions. For pumice, you use a felt block or a wooden block covered with felt. For wet sandpaper, use a rubber or wooden block with inner-tube rubber contact-cemented to it.

Waterproof sandpaper. Rubbing, as it was done a generation ago and is still done in many finishing shops, means pumice and oil. Today it is faster and less messy to use water, instead of oil, and very fine silicon-carbide paper. This material, with grit cemented by waterproof adhesives to high-wet-strength backing, comes in 400 grade and finer. It cuts faster than pumice and oil. It works as smoothly. Used in water, the grit doesn't fill, and a sheet lasts so long you finally just throw it away.

Since your supplier may not handle waterproof paper as fine as 400 or finer, you may want to use pumice for the final rubbing. For the highest luster, you must switch to pumice, then to rottenstone.

You must not use water and waterproof paper on the finish until you are sure that your coating of varnish or lacquer is entire; if there are voids, you'll soak the wood with water. The same goes for pumice and oil; if the finish isn't entire, oil soaks the wood.

The 12 steps to a perfect finish. These are what distinguish the work of a pro:

1. Clean the wood and smooth it.
2. Stain. Any method is okay—pigmented wiping, nongrain-raising, or water. If you use water, be sure to pre-raise the grain before final sanding.
3. Seal and fill if required.
4. Thin the first coat of varnish or lacquer so that you get maximum penetration from the varnish and maximum wetting from the lacquer. (If you sealed and filled—step 3—this step is not necessary.)
5. Let the first coat dry. Varnish needs 24 hours under the best conditions—such as a heated room in winter. If conditions aren't good, give varnish another 12 hours.

Continued



Water and waterproof sandpaper used with a rubber block is the fastest, smoothest way to a rubbed finish. Use 400-grit paper or finer. Keep a few pieces soaking as you work so the backing is soft before you use it.

Don't count on lacquer's vaunted quick-dry. It dries—but it is not dry enough for rubbing and recoating in less than about eight hours in good drying conditions. If you pile uncured coat on top of uncured coat, it will alligator or show other failure.

6. Use 6/0 or finer sandpaper to smooth the first coat. Try not to cut through, but if the surface shows a lot of raised whiskers, make it a thorough job—much as though you were using the first coat as a sanding sealer.

7. Apply the second coat. With this and all subsequent coats, put it on full enough for good leveling. Do not, however, put the finish on overthick, hoping to achieve the required build in fewer, thicker coats. The durability of the finish depends in large part on a succession of normally thin, well-dried, well-adhering coats.

8. Working with waterproof paper and water, or with pumice and oil, rub carefully. Now and then wipe the surface dry and examine it. It will be dull, with occasional spots that still retain the varnish gloss. These are low spots; they would disappear if you continued rubbing. But that would be inefficient. Instead, use medium steel wool to scarify these bright spots slightly for adhesion.

9. Put on another coat. Let it dry hard. Rub. This time, the little glossy spots

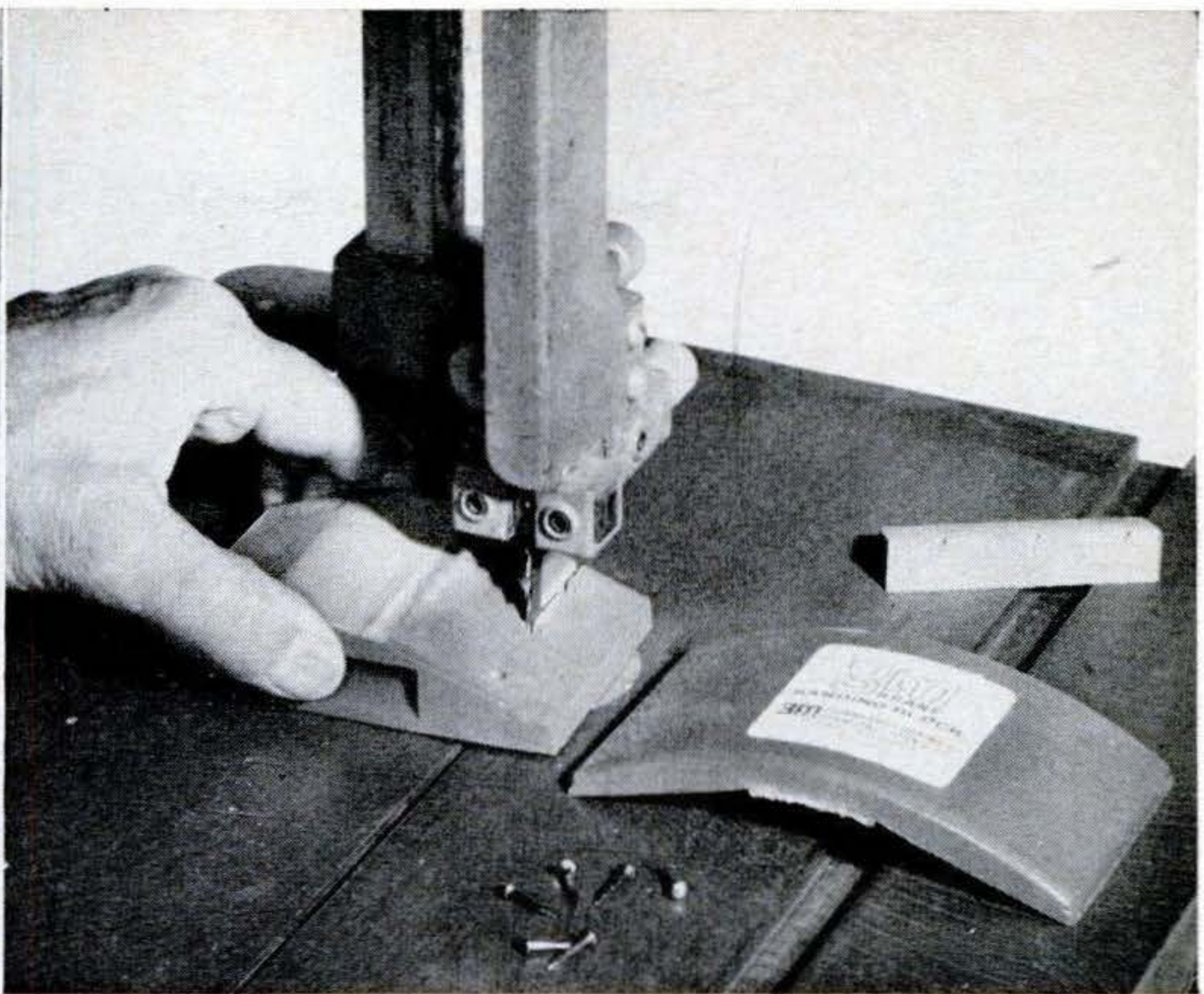
should be fewer, smaller. Perhaps they will all but disappear. (This may be your stopping point, for a Grade A finish. If the shiny spots are few and small, hit them with fine steel wool, apply two coats of wax, and you'll draw compliments. For a Grade AA finish, keep going.)

10. Brush on another coat and let it dry. Rub until there are no shiny spots. Then you know you are absolutely smooth and plane. (For a Grade AA finish, stop here and wax. Grade AAA takes a little more work.)

11. Switch to rottenstone and oil. Use sweet oil, crude oil, or 3-in-1. Or switch to crocus cloth and oil. Crocus cloth is the finest backed material you can buy; you may have to shop a little to find it. Work systematically with either of these materials, because the improvements in the surface are getting pretty subtle at this point. Smearing of the oil and the muddying effect of the rottenstone help tell you how well you are working over the surface.

12. Use turpentine or paint thinner to remove all oil. What is left is Grade AAA. You can wax it if you want to, but the luster is just about perfect without wax, and the degree of protection is unbeatable.

Carvings and moldings. The technique described is intended for flat surfaces—where the high-rubbed finish is at its best. Few



A sprinkler from the family laundry is a help in keeping wood wet for wet sanding. For efficient rubbing, cut down the rubber sanding block that

many paint stores sell. Reduce it to about 2 1/4" by 3 1/4" using a bandsaw, handsaw, or knife. Save the trimmed pieces for use on carvings or curved areas.

pieces of furniture, however, are all flat. Moldings, carvings, turnings, etc., cannot be glossy while the rest is a mellow luster.

It is neither possible nor necessary to work nonflat surfaces as smoothly as you work on the level. If you rub them too zealously, you'll surely cut through high spots. There are tricks, however, to make it easy for you to match irregular areas to surfaces that are carefully rubbed.

Where a regular rubber or felt block won't work—as on moldings, turnings, straight tapers, and other surfaces that permit a degree of rubbing, use a piece of smooth-pile carpeting to back up paper or abrasive. If you work with waterproof pa-

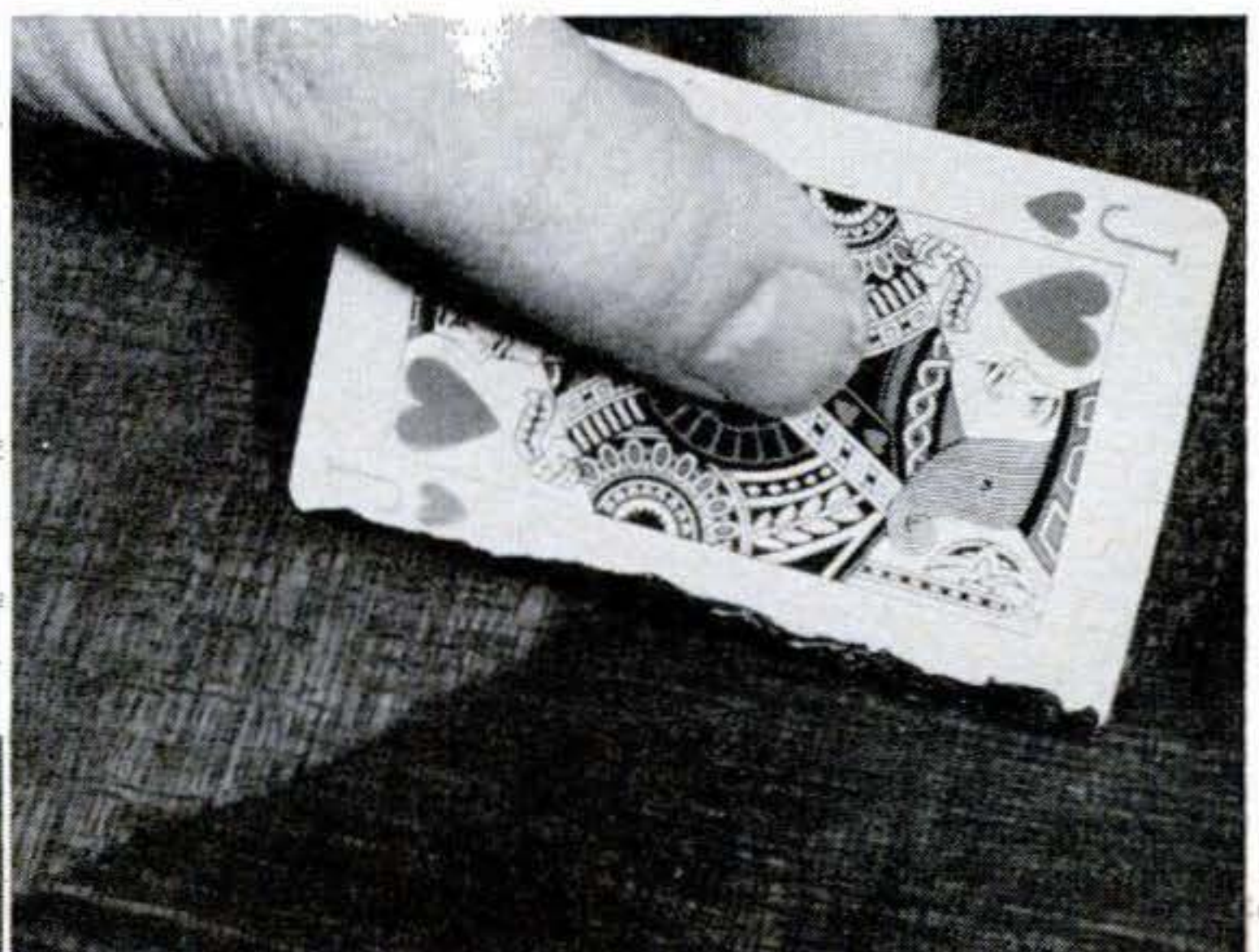
per, a piece of thick but flexible rubber replaces the rubber block.

On intricate carvings, use pumice and oil, and rub by means of a circular scrubbing motion with a vegetable brush, toothbrush, or other brush that will follow contours, reach into crevices, and respect turnings, without cutting through the finish.

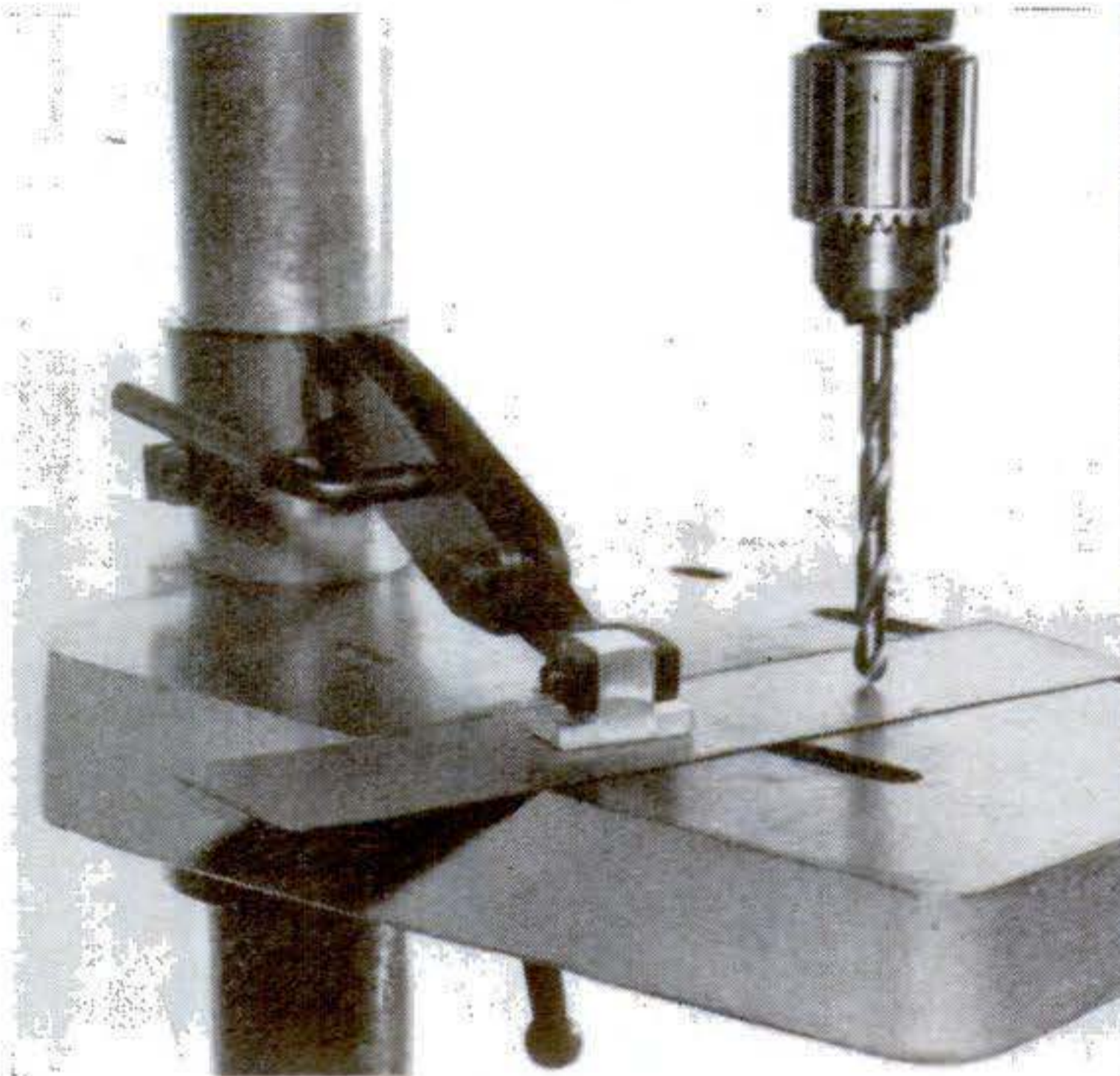
Don't overwork nonlevel areas. Just rub enough to take off the gloss, since absolutely smooth finish is not critical. Any careful wood finisher would be pardoned for using semiflat varnish on the most difficult carvings. Some of the new urethane varnishes come in a flat that passes quite well where the finish isn't critical. **PS**

Ingredients for pumice-and-oil rubbing are pumice, oil, and rottenstone. A spout oiler is handy for the oil, a saltshaker for the powdered abrasive. You must

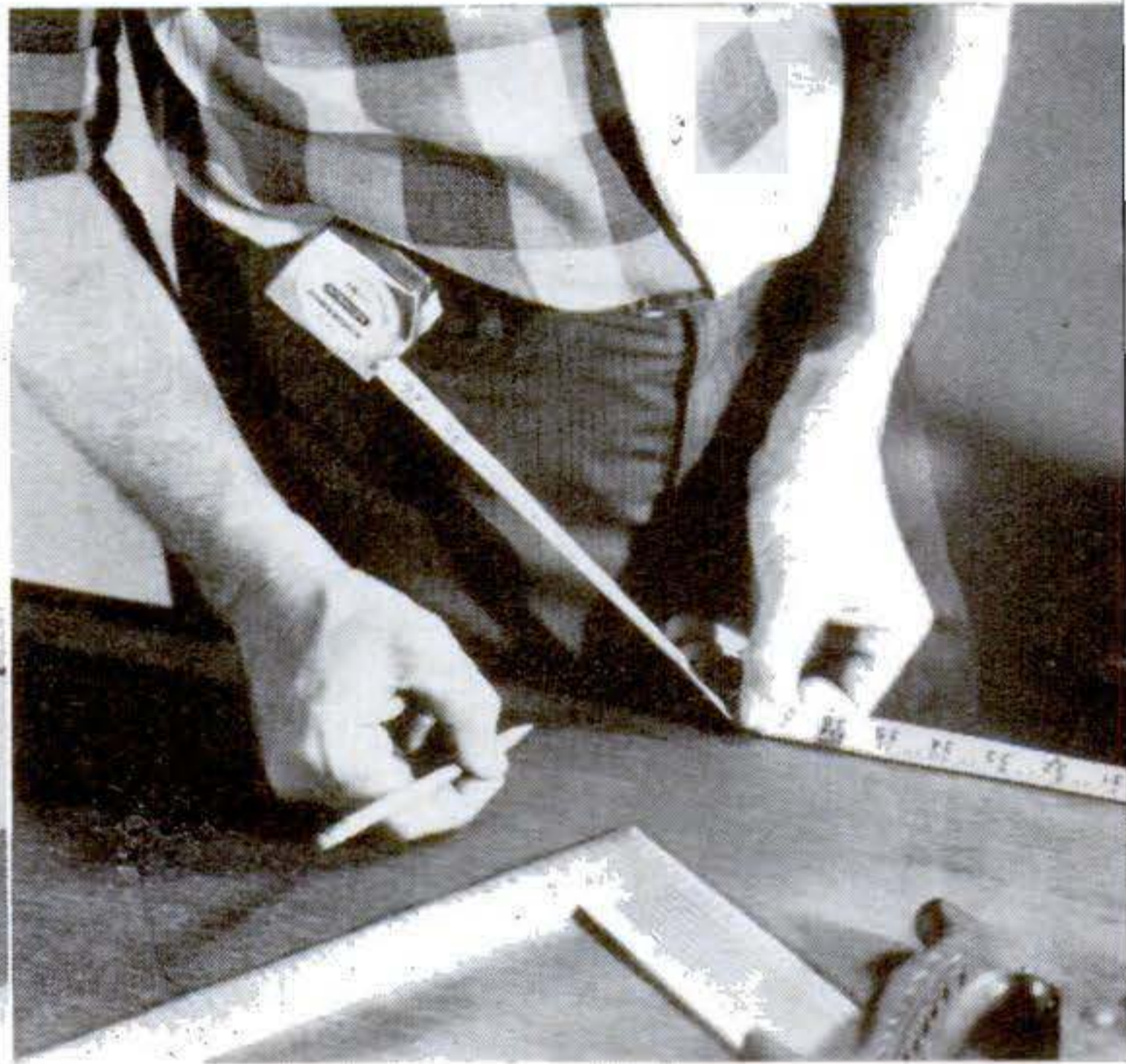
fill pores of coarse-grained woods because the finish won't. To force filler into cracks and make it level, scrape off excess with old playing card.



Roundup of New Tools



Work won't budge if it's held on the drill-press table with a clamp like this. Flipping a lever gives 400 pounds of holding force. The Cam-Lock clamp locks on the drill-press column, clamping the work in a single motion. It adjusts to three different lengths, at any height, and swings away when not in use. Welch Drill Bushing Co., 1630 Flower St., Glendale, Calif.



A longer steel-tape rule with thumb-slide lock has been added to Stanley's Powerlock line. Its 16' length speeds up big-job measurements. A handy belt clip lets you use the rule while it's attached to your belt as in the photo. The bright yellow blade's easy-to-read markings should last longer because the blade is clad in protective polyester film. Price: \$4.75.

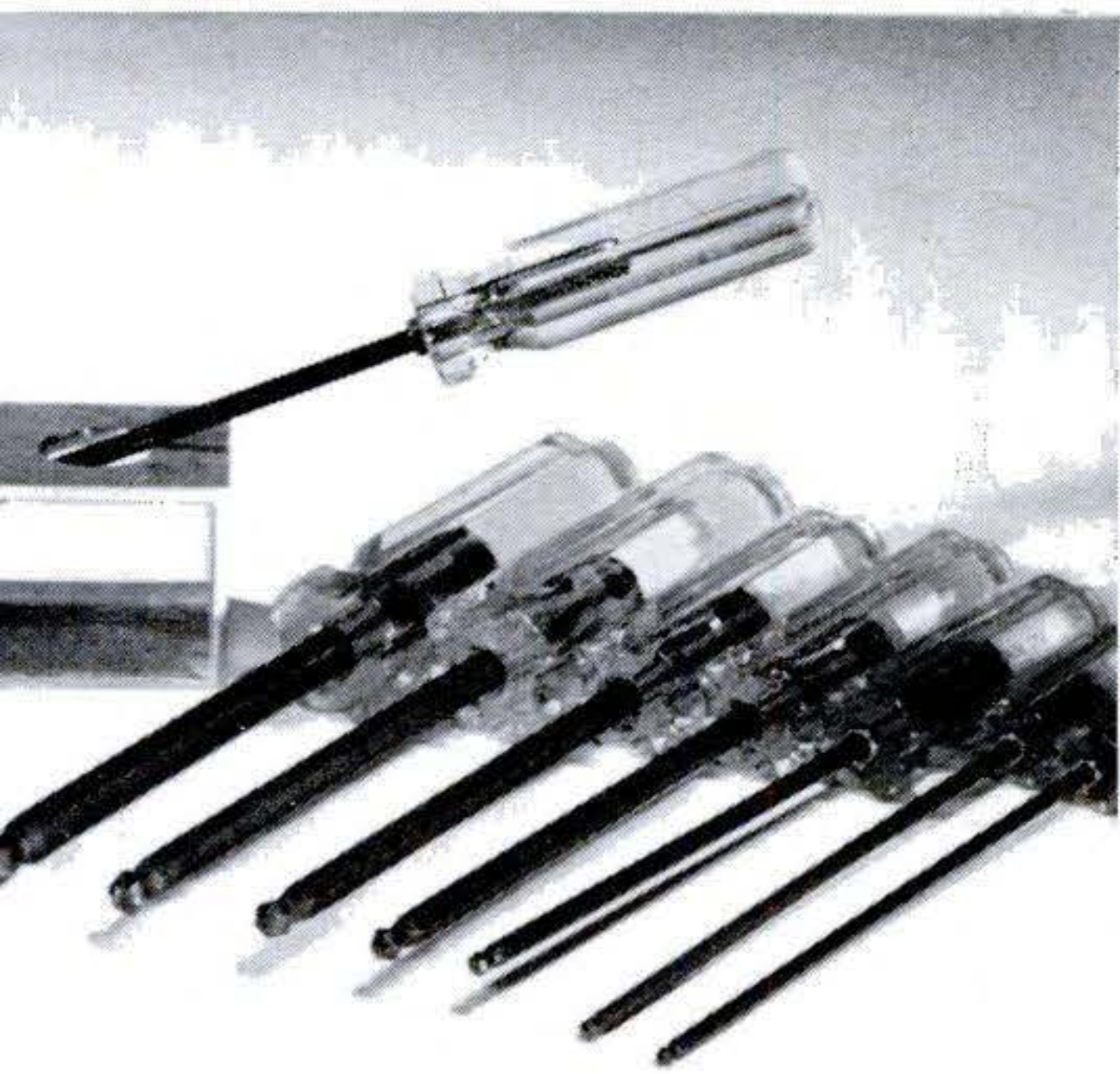


Nine new power drills rated heavy-duty, deluxe, standard, and variable-speed added to the Wen line of power tools should make it easy to put your drill finger on just the right tool for your work. There are four with $\frac{1}{4}$ " capacity, four with $\frac{3}{8}$ ", and one with $\frac{1}{2}$ " capacity. All have high-amp motors, needle and ball thrust bearings, a new machine-gun-grip auxiliary handle directly forward of the motor housing, welded burnout-proof armatures, and die-cast aluminum housings. Shown above is the Model 821 Deluxe $\frac{3}{8}$ " drill with a trigger speed control that regulates the r.p.m. from 0 to 1,100. This drill sells for \$29.95. Wen Products, Inc., 5810 Northwest Hwy., Chicago 60631, is the maker.

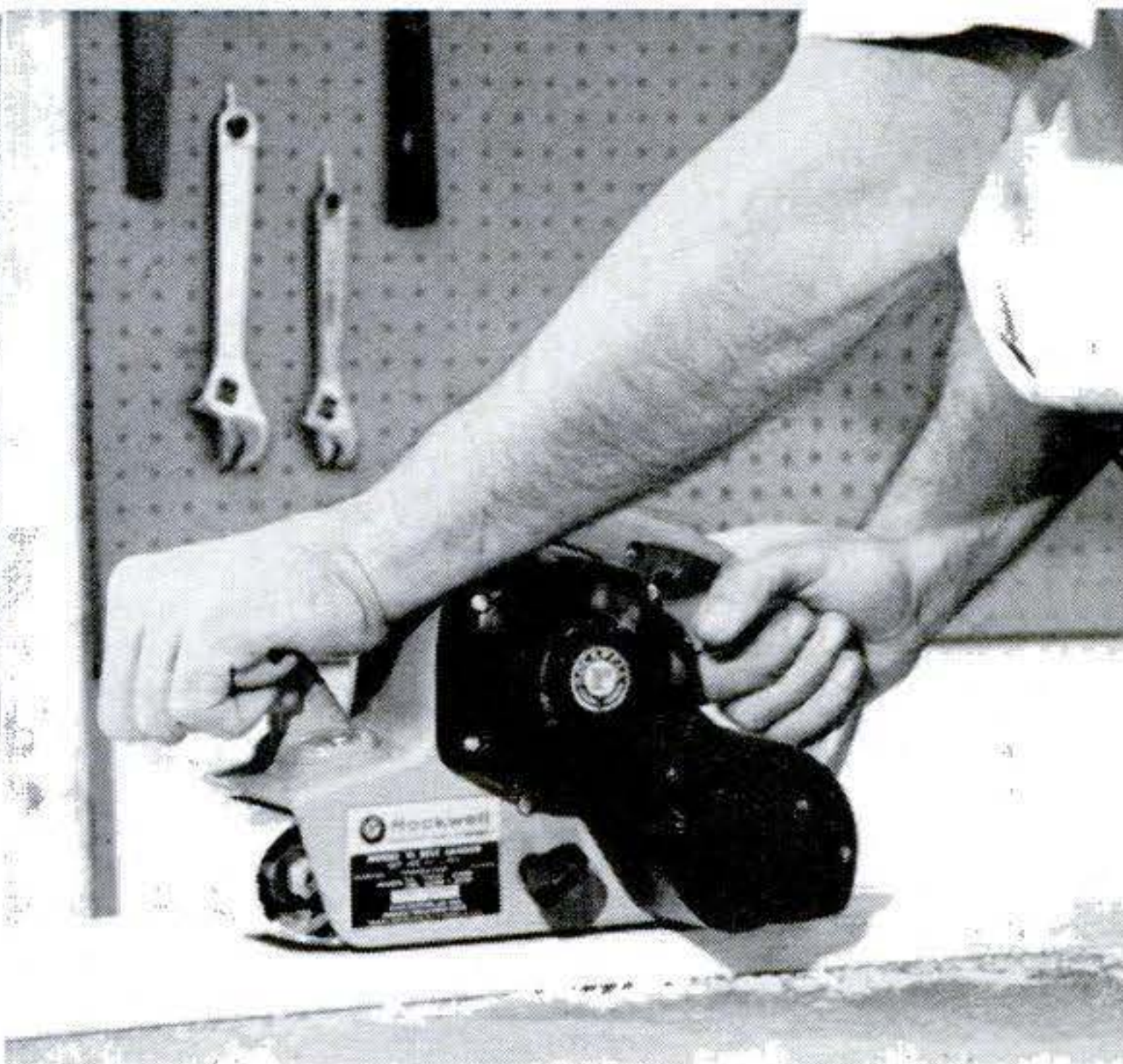


Tips change easily from plastic to steel, copper, lead, aluminum, or brass—even steel ball peen—on the new Safe-T-Grip hammer. This makes it useful for a variety of jobs. The handle and head are molded in one piece from a tough plastic that won't crack or chip. The tool is $8\frac{3}{4}$ " long, weighs six ounces. The form-fitting handle is designed for grip comfort. Industrial Specialties Corp., Box 3250, Fort Worth, Tex., makes the tool.

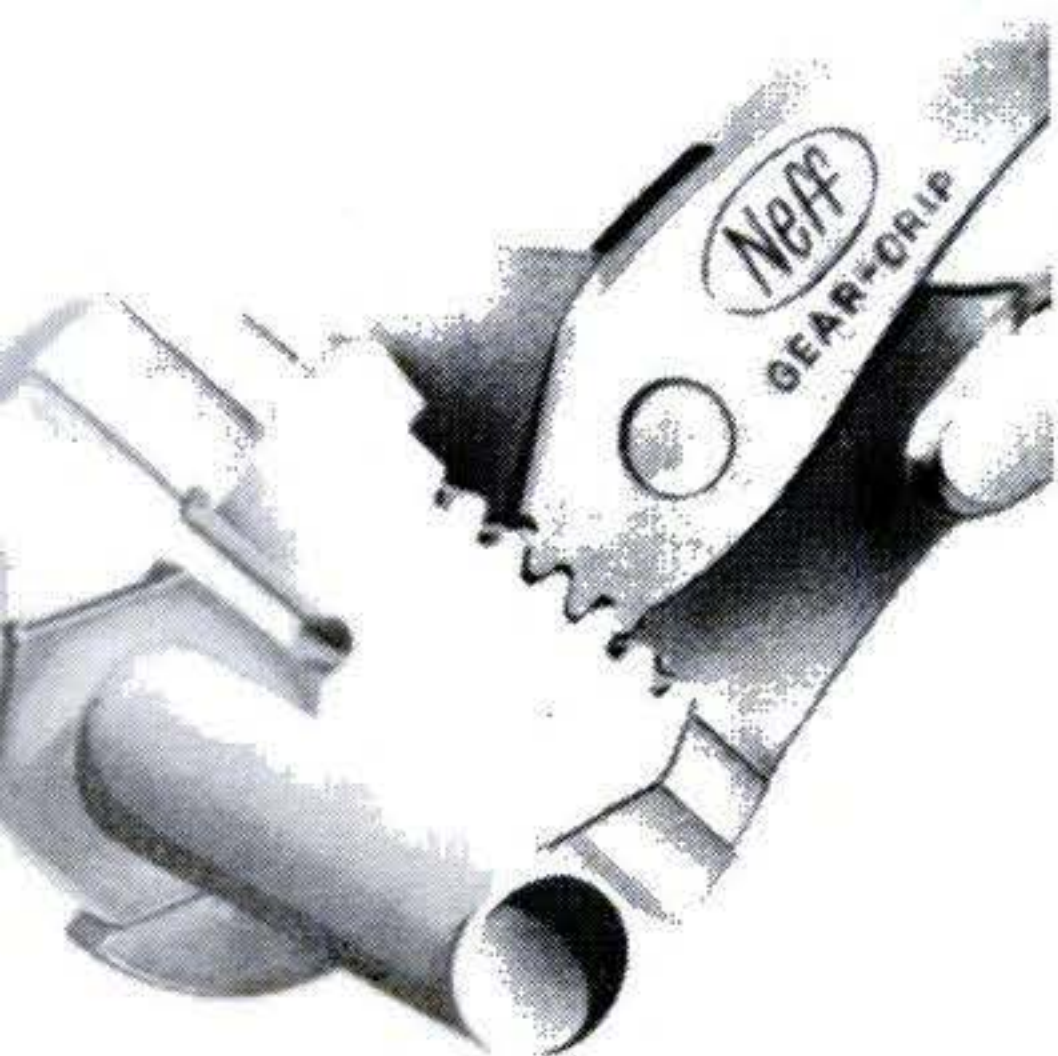
For Home and Workshop



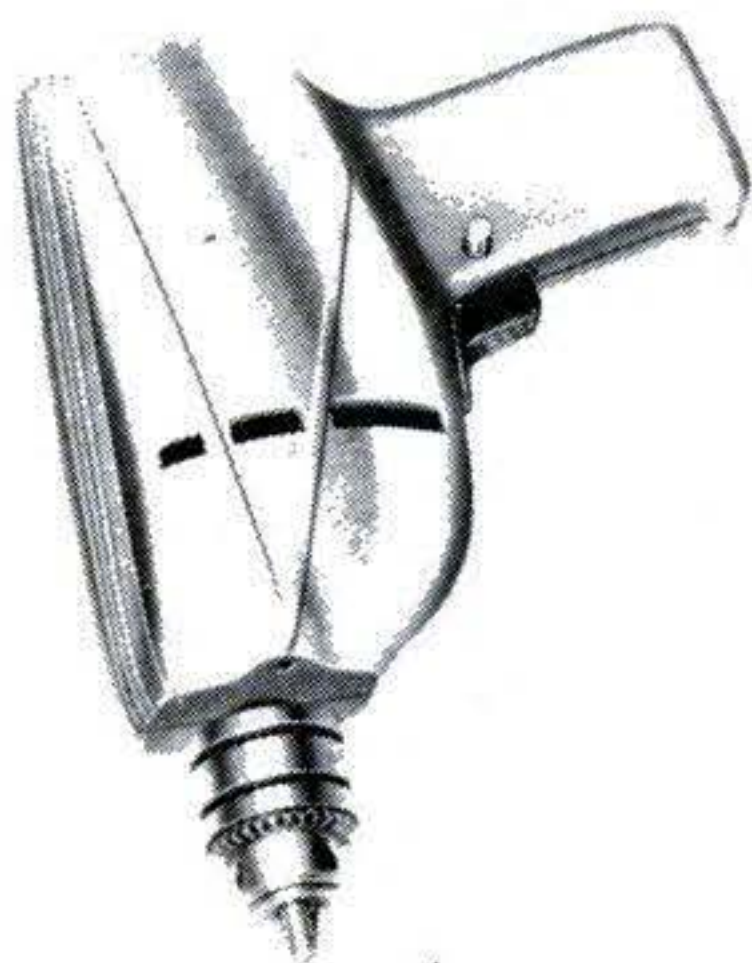
New ball-point screwdriver reaches into tight spots to drive socket-head screws with ease. A six-sided ball on the end of a screwdriver handle fits Allen screw sockets and lets you turn screws with the blade offset as much as 30 degrees. Bondhus Tool Co., Monticello, Minn. 55362, makes them. A set of eight to fit sockets from $\frac{7}{64}$ " to $\frac{5}{16}$ " sells for \$12.



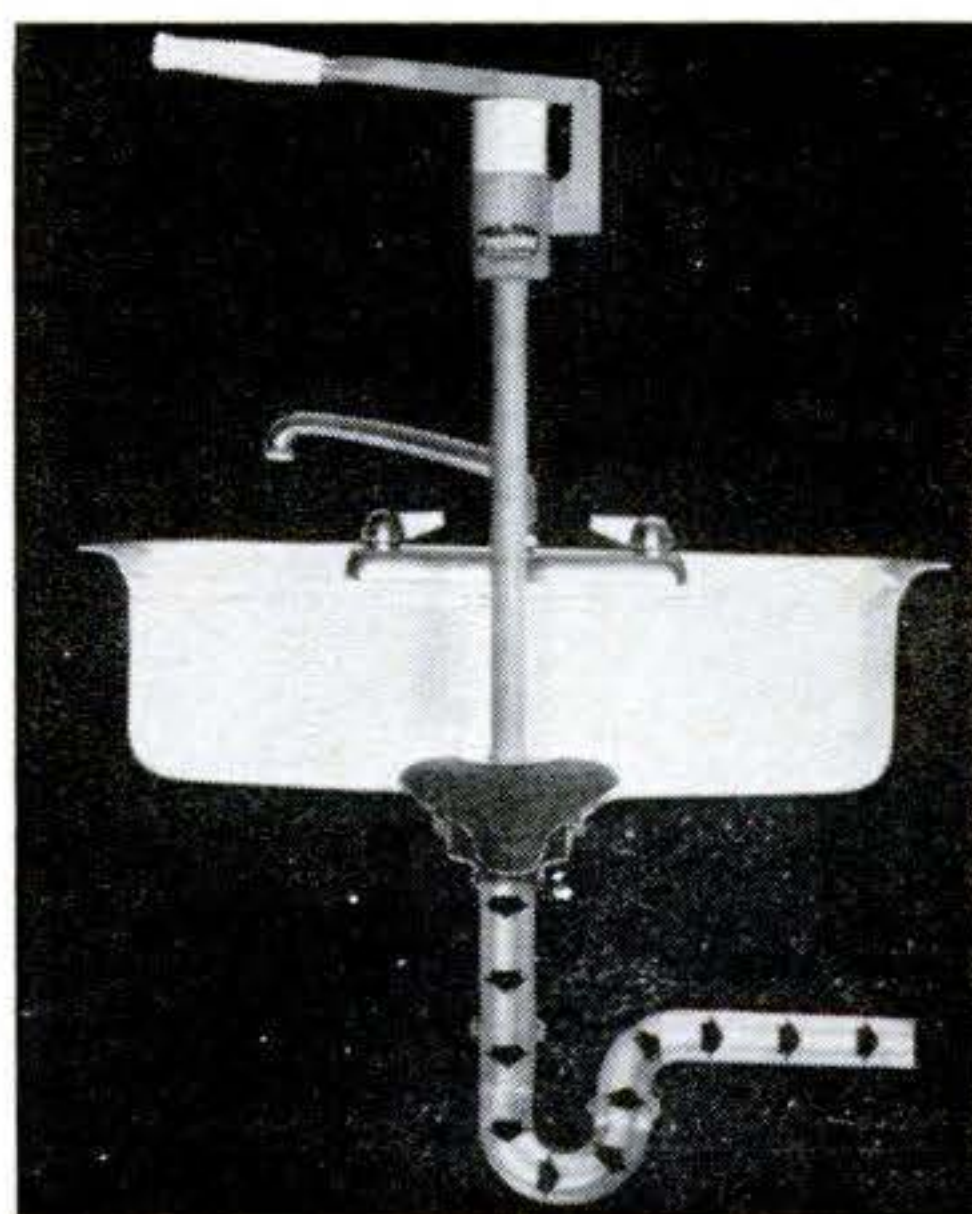
Lightweight portable belt sander priced for the home craftsman is new to Rockwell's Green Line of double-insulated, plastic-housed power tools, which use a standard two-prong plug. Weight: only 10 pounds. It has a six-amp., one-hp. motor, and a belt speed of 900 s.f.p.m. The standard unit, Model 91, is \$44.97; Model 90, with a vacuum dust collector, \$49.97.



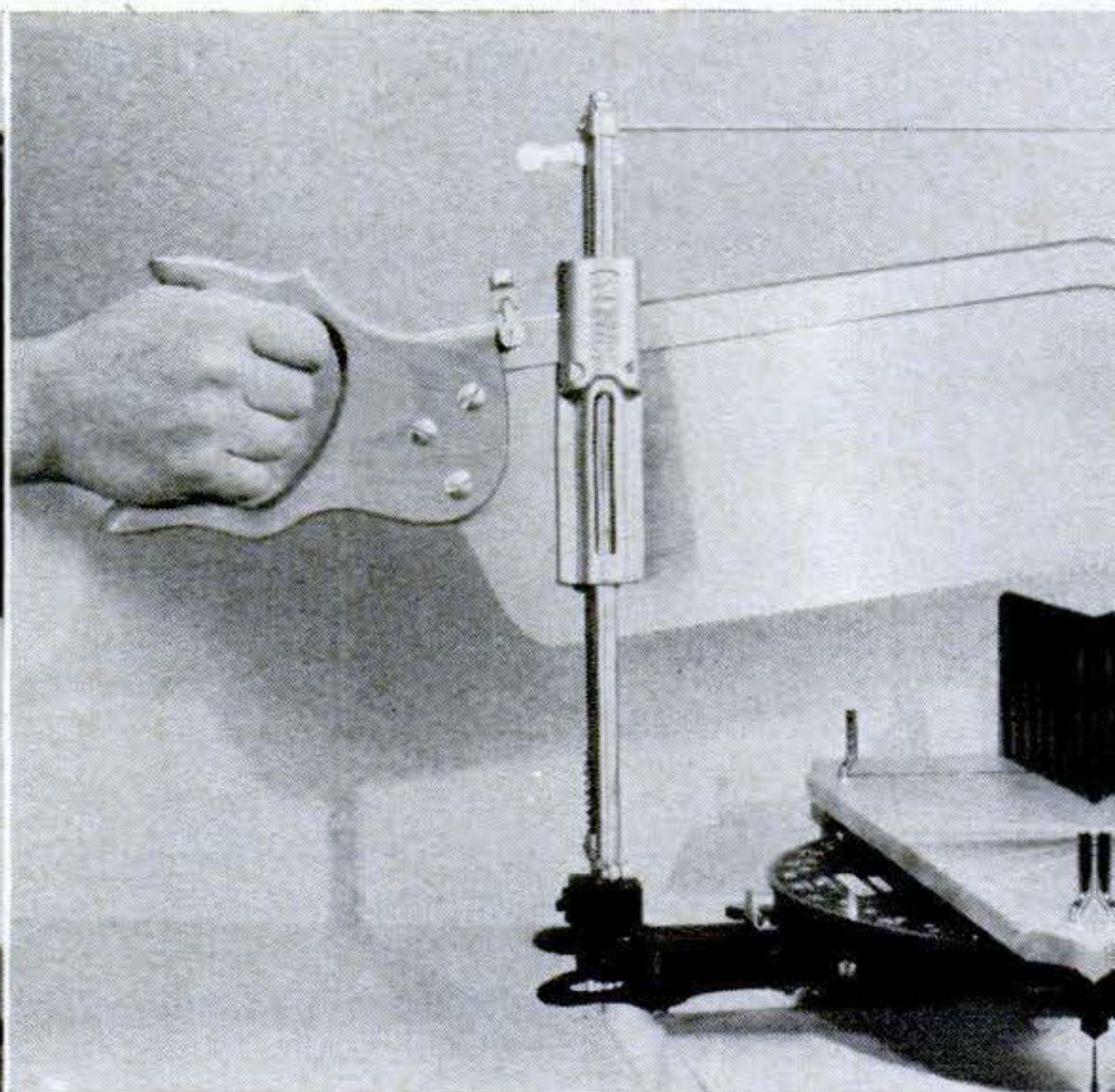
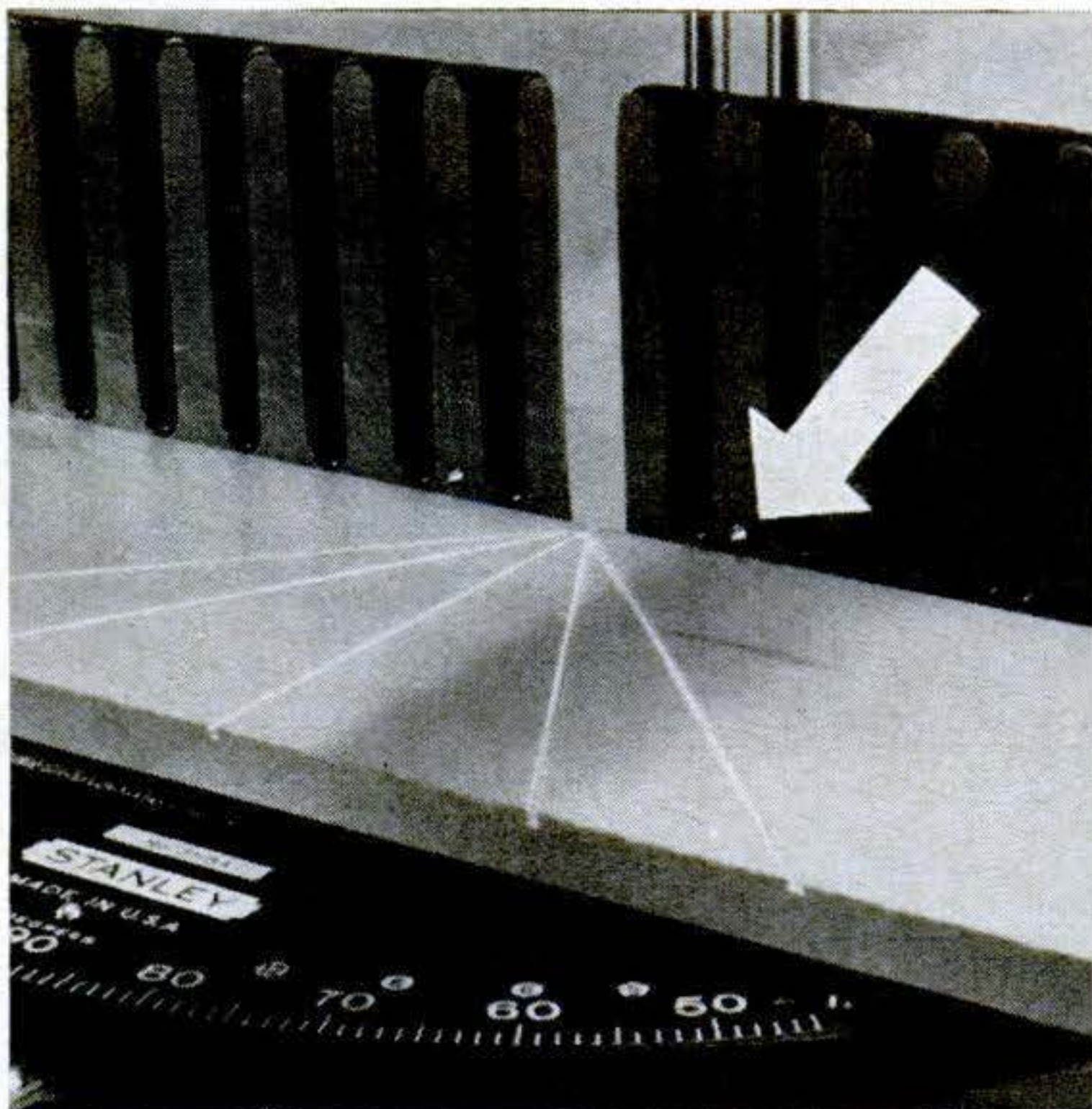
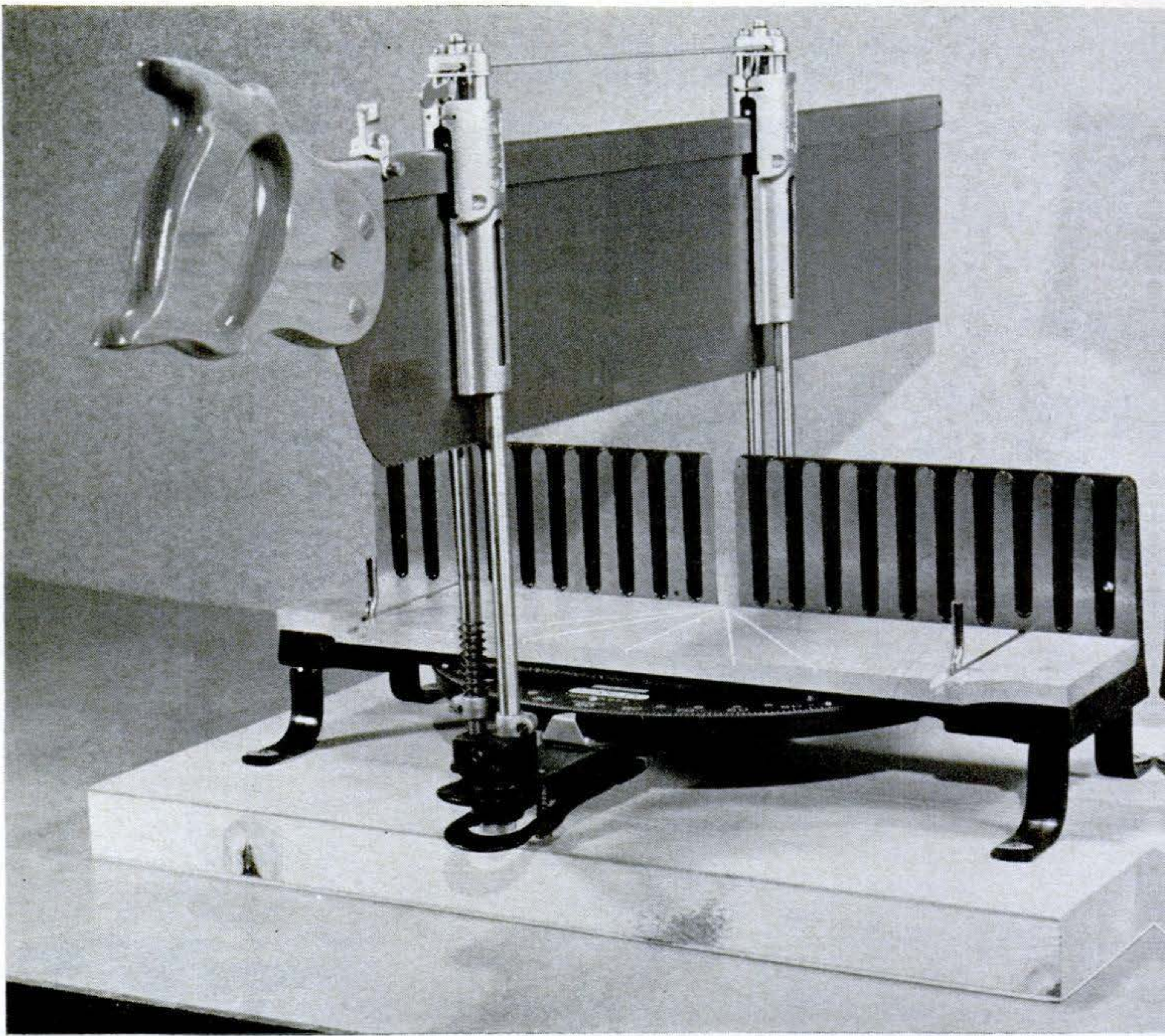
Two kinds of adjustable wrench grip like a pair of pliers, yet has parallel jaw action. Its gear arrangement gives you an 8:1 gripping ratio. Relaxing your grip adjusts the jaws to the work. The wrench is made with three types of jaws: V, straight, and V with be teeth. Available in an 8" size only, it's \$4.95, from Neff Enterprises, 1575 W. Rialto Ave., San Bernardino, Calif. 92410.



Four new drills with trigger-controlled variable speed (combined, in two, with double reduction gearing) have joined Thor's 900 Line of home-workshop-priced power tools. Besides the $\frac{1}{4}$ " model shown above, there are $\frac{3}{8}$ " and $\frac{1}{2}$ " models. All have ball bearings, speed control from 0 to full-rated r.p.m. They're made by Thor Power Tool Co., 175 N. State St., Aurora, Ill.



Stopped-up drains come clean with a swirling blast of air when you use a Cyclone drain cleaner—it's powered by replaceable aerosol cartridges. It's easy to use and you don't have to keep poisonous chemicals around the house. Bahl Products International, Mansfield, Ohio, sells the tool for \$9.95 with two aerosol cans. Additional refills cost 89 cents each.



Backsaw is part of this miter box—automatic catches hold it up out of way as you position work. Adjustable spurs (arrow) on each side of cutting

line hold work fast. Trip on the spine lets 5"-by-28" saw drop as you move it forward. Stops keep saw from going deeper than 1/16" into wooden bed.

The Case for Buying a Good Miter Box

You become master of all angle cuts and get a strong assist, too, in making all kinds of joints

By R. J. De CRISTOFORO

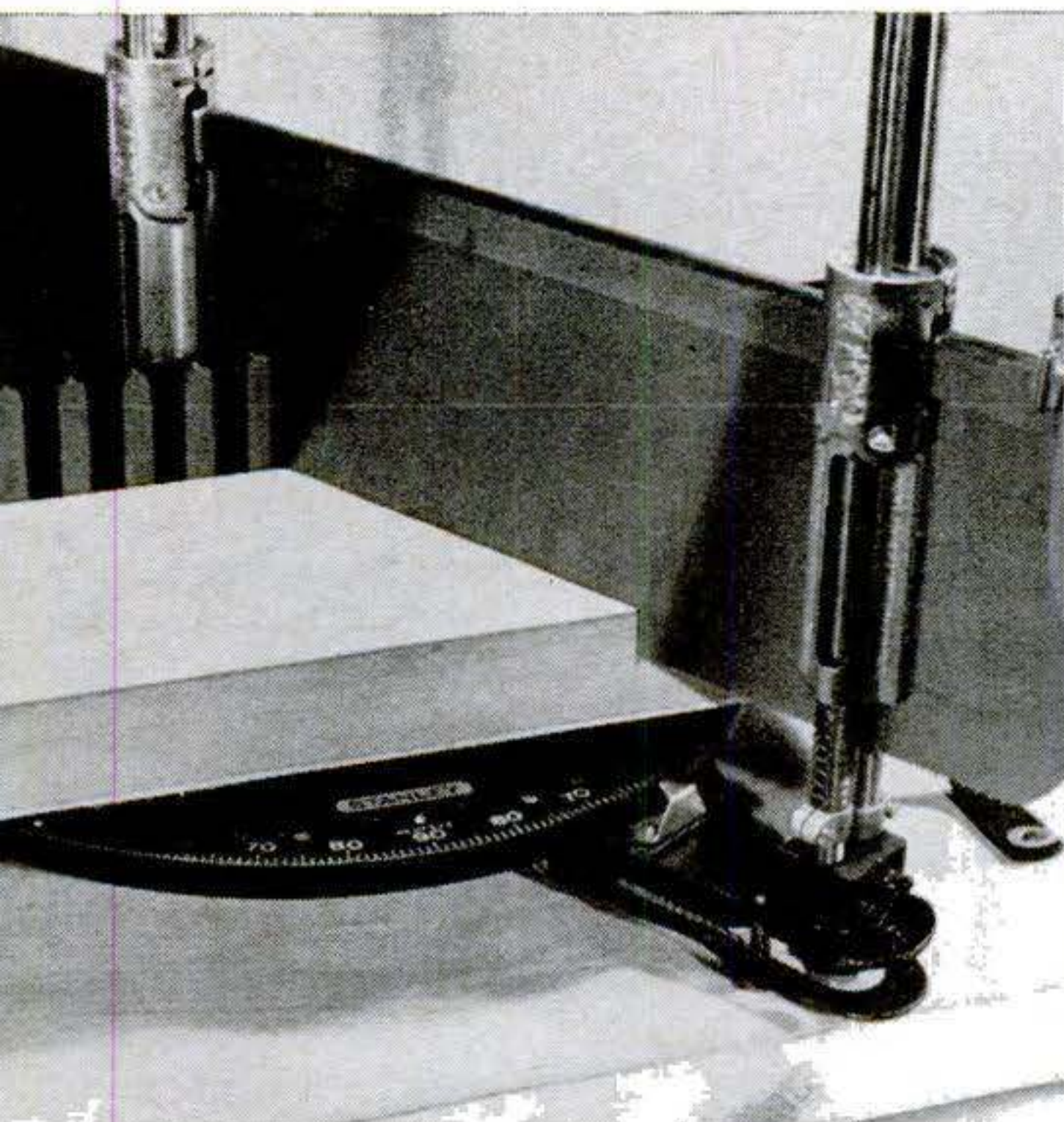
When you already have a good table saw or radial-arm saw, does it make sense to buy a miter box? Couldn't you get along just as well with an accurately made homemade box? After reviewing the pros and cons, I'd say that the ayes in favor of adding a commercial box to your shop equipment definitely have it.

Lining up advantages. With a good miter box, accuracy on angular cuts becomes completely mechanical. I'd be the last to suggest that a good table saw or radial-arm saw may not be accurate. But they require

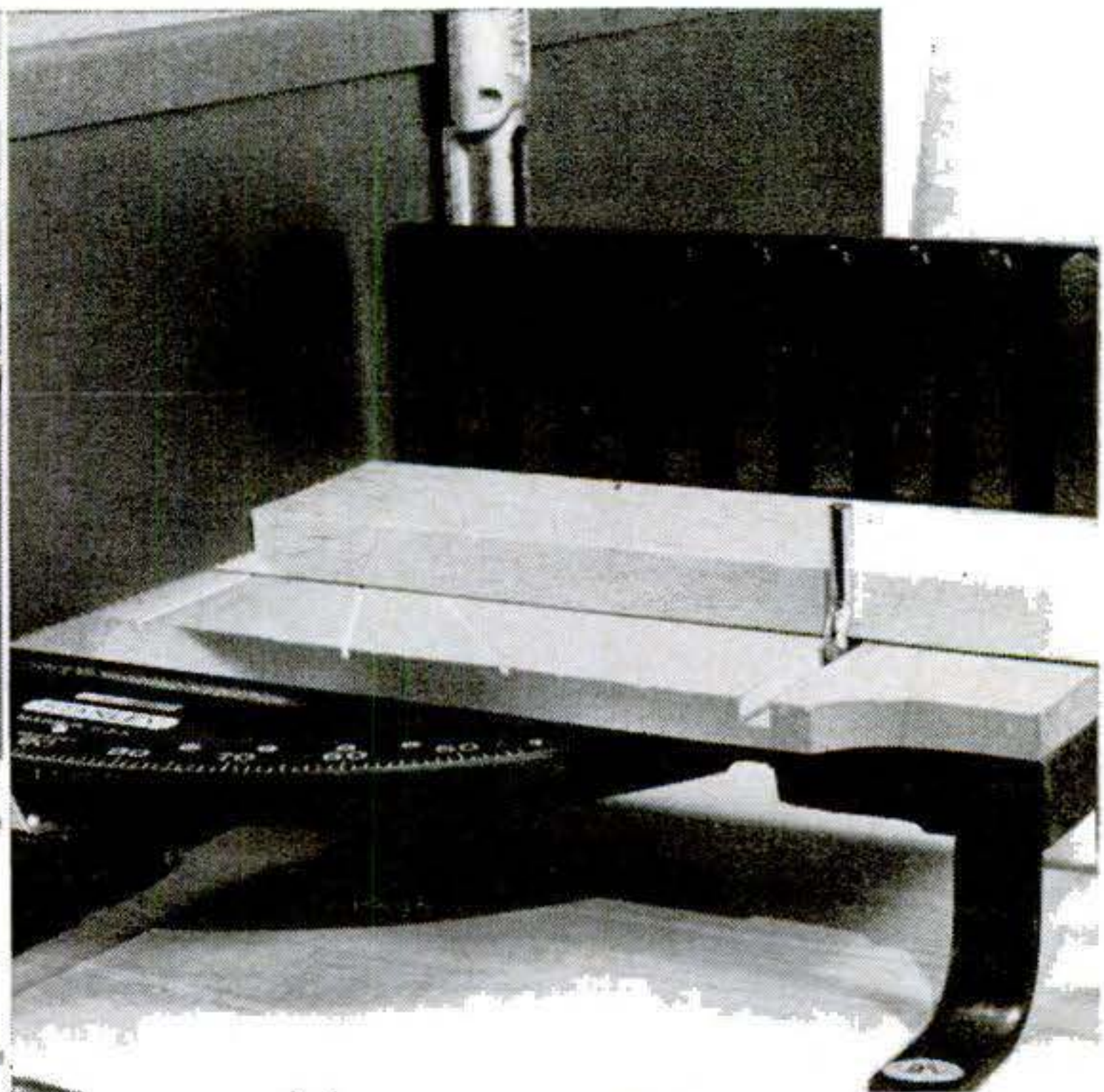
frequent checking of adjustments and extreme care by the operator for precision. Let the settings go off as much as a good part of one degree, and it will show up as a big gap when, for example, eight miter cuts are joined to form a frame.

A miter box doesn't have the "creep" factor which, even on a precisely adjusted power saw, can result in errors that are measurable in degrees. True, on a radial-arm, you hold the work firm and cut with the saw as you do with a miter box, but you do have to swing the arm and adjust

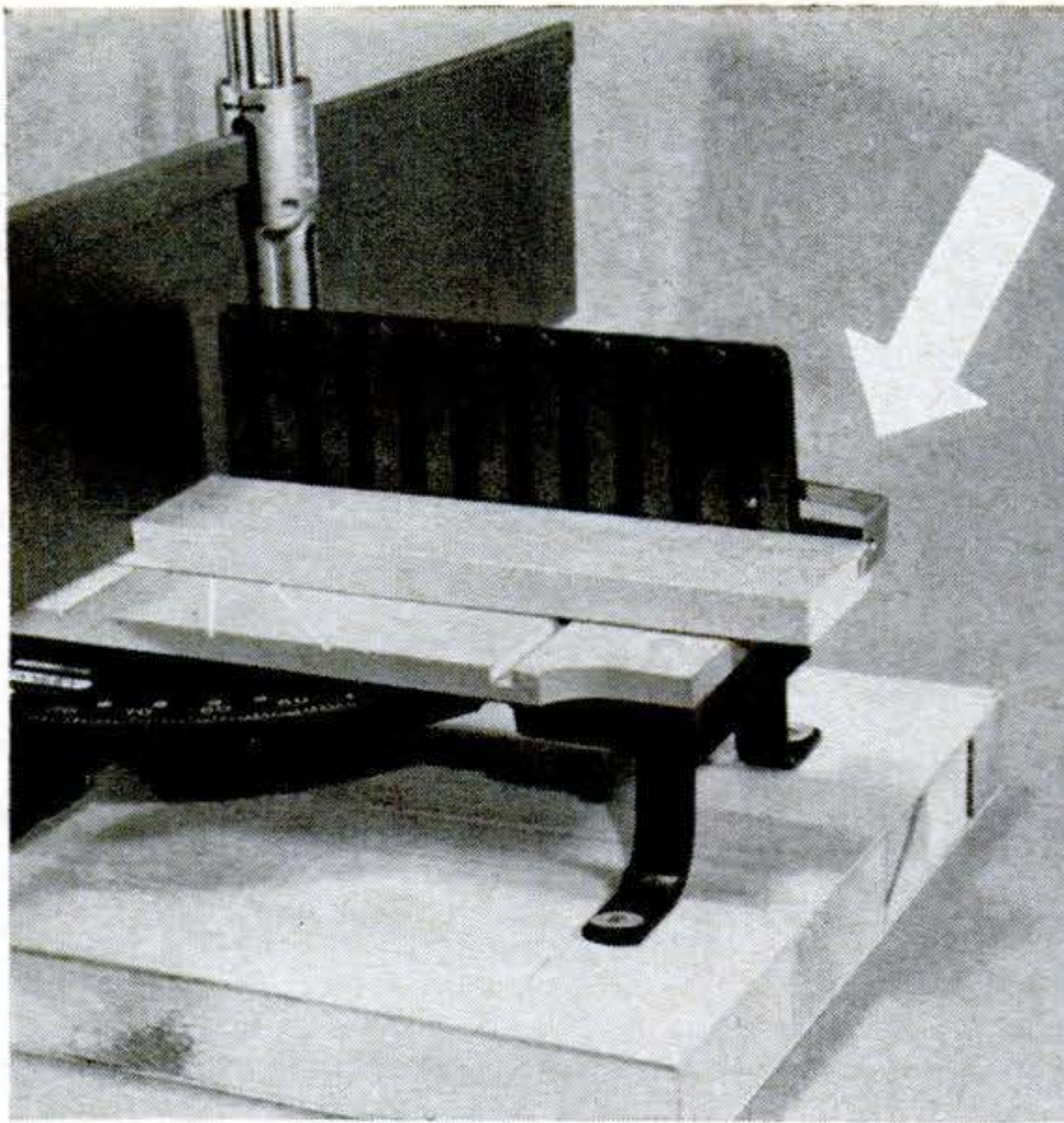
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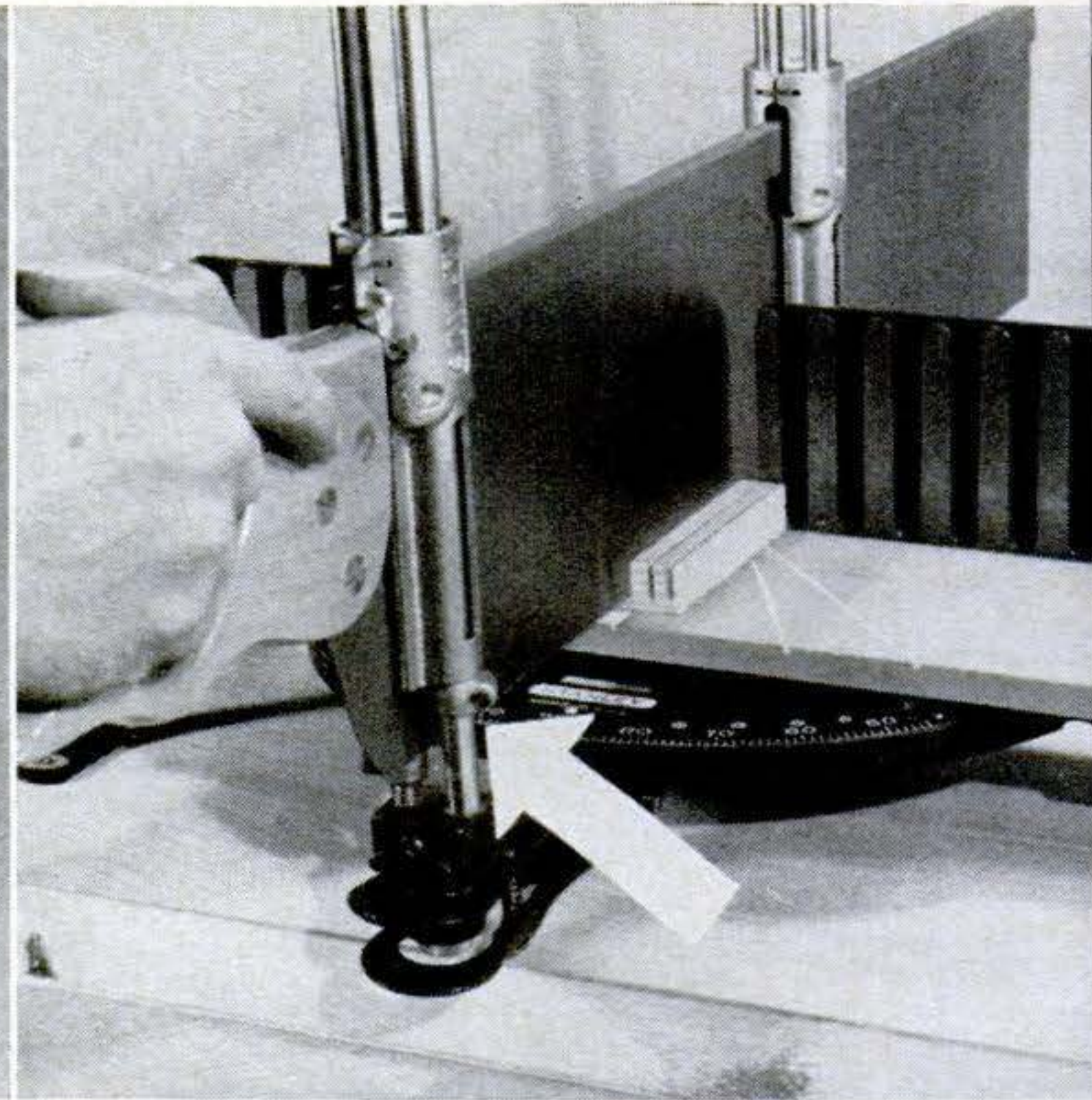
Fairly heavy stock can be handled on box like this. Width of cut at 90 degrees is 9½", at 45 degrees 6½", at 30 degrees 4¾". Depth of cut is about 5".



Stock guides (hold-ins) can be used in place of clamped guide strips to help support odd shapes. Guides are secured by thumbscrews behind fence.



Adjustable gauge lets you cut pieces to same length. For short pieces, gauge is reversed and mounted on front of fence. Gauge also controls length of work.



Adjustable stops (arrow) on front and rear blade guides can be set to limit cut depth—especially handy when making saw cuts for rabbets and dados.

it for accuracy. If you are off the slightest, you've got trouble.

Miter-box settings are accurate to begin with. They stay accurate because there is no vibration to upset them.

I don't have to impress anyone with how difficult it is to cut compound miters on a power saw with the precision needed to make two joined pieces form a square corner. You need exact blade tilts and miter-gauge settings. There is no allowable tolerance. The cuts must be right—or you must keep a can of wood dough handy.

On a miter box you can keep the work firmly set at the correct work angle and the job is reduced to a miter cut. You can work in a similar manner on power equipment but, again, you have to make some special provision to provide work support.

The same holds true for cutting coved moldings.

With a miter box you don't have to change the blade to get the kind of cut-finish you want for mitering and there is no break-off at the end of the cut—a problem with other machines that causes damage to expensive moldings.

Another point in favor of a box: It's portable; you can take it right to the job, wherever that happens to be.

In addition to making you king of the miters, a good miter box and a set of sharp

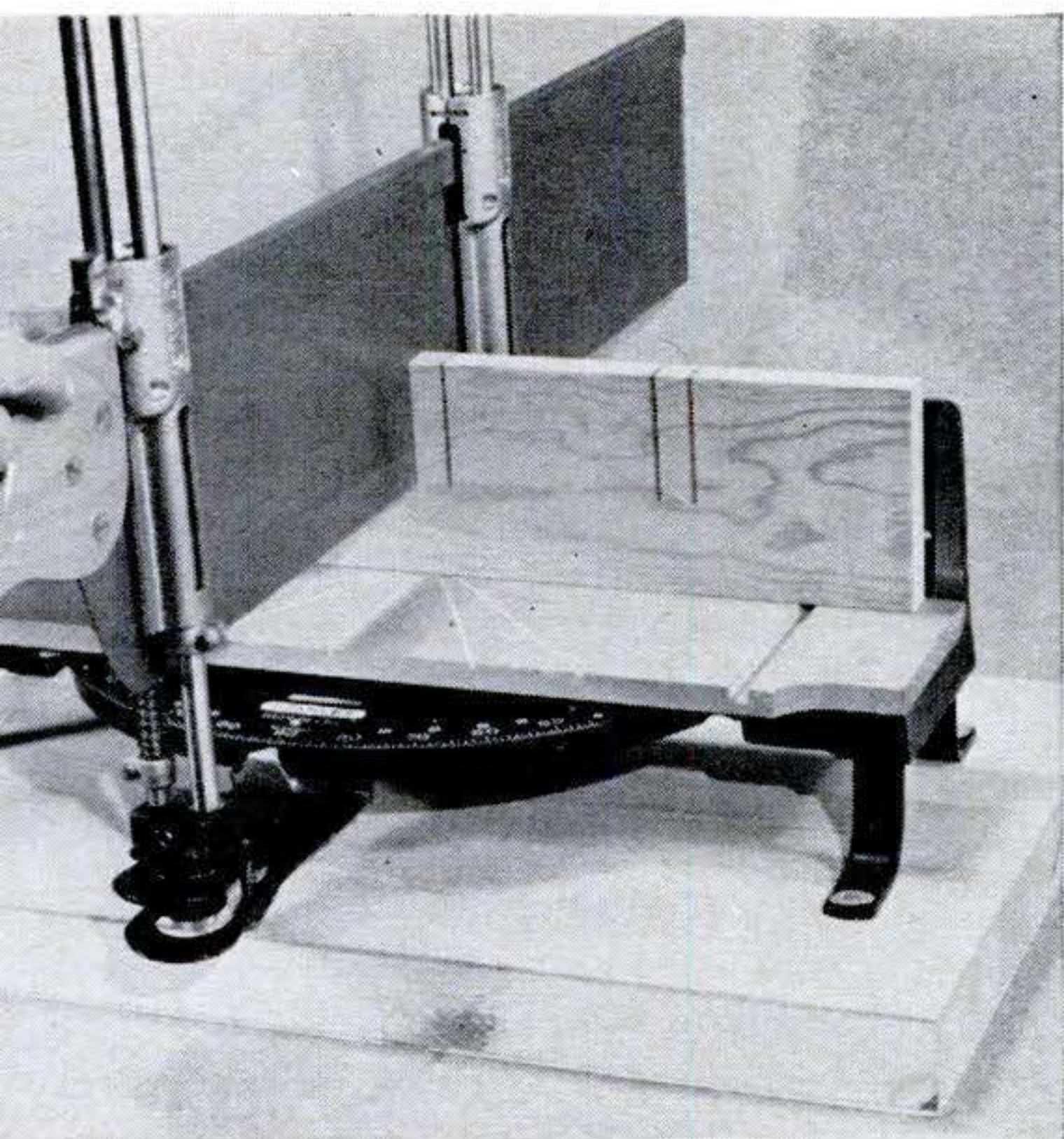
chisels can set you up to accomplish with superb accuracy a nice variety of practical, everyday joints.

Boxes—simple or elaborate. The most primitive box (and one still being made) is simply a U-shaped assembly of three pieces of wood with a left and a right 45-degree cut and a 90-degree cut between, made across the legs of the U. The work is held firmly in the channel as the cut is made with a backsaw. Such a setup is practical if made accurately but still pretty limited.

The \$89.30 miter box shown in the photographs will cut any angle between 30 and 90 degrees, either left or right, and do it with gratifying exactness. This is great on shaped pieces where it is necessary to swing from left to right, a procedure that can be frustrating even on the best table saws.

The index plate is graduated in degrees and is numbered so that you automatically have the right positions for sawing five-, six-, eight-, and 12-sided figures. The self-clamping swivel has a tapered pin that locks into holes to set the saw at the angles most commonly used, but the clamp will work at any position between holes.

The saw, a first-quality backsaw, rides on bearings and is held in vertical alignment by guides that permit a smooth sawing action but prevent any lateral motion. Per-



Outline cuts for notches are formed above with stops controlling depth. For egg-crate partitions, you gang boards, make all cuts at the same time.

manent stops keep the saw from cutting too deeply into the wooden bed. Adjustable stops are set to control depth of cut when you're rabbeting or forming notches.

Other good miter boxes are available at less cost.

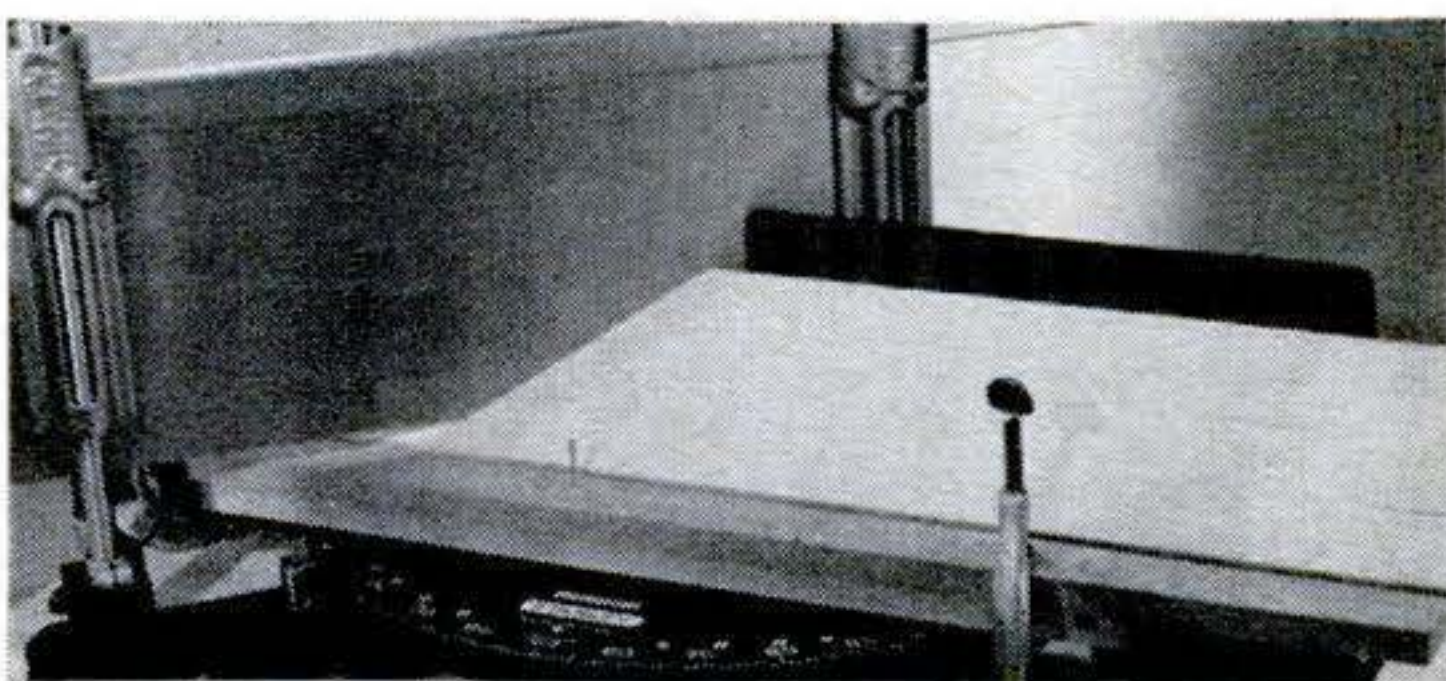
General hints. Anchor the box solidly to a strong base. You can do this with a heavy board (we used a cutout from a solid-core door) so the tool can still be moved around. You can also bolt it directly to a bench top. The point is to prevent any movement of the box while you're using it.

Chances are, the box will be accurate when you get it. But it doesn't hurt to check the factory settings on scrap wood. Adjustments are provided should they ever be needed.

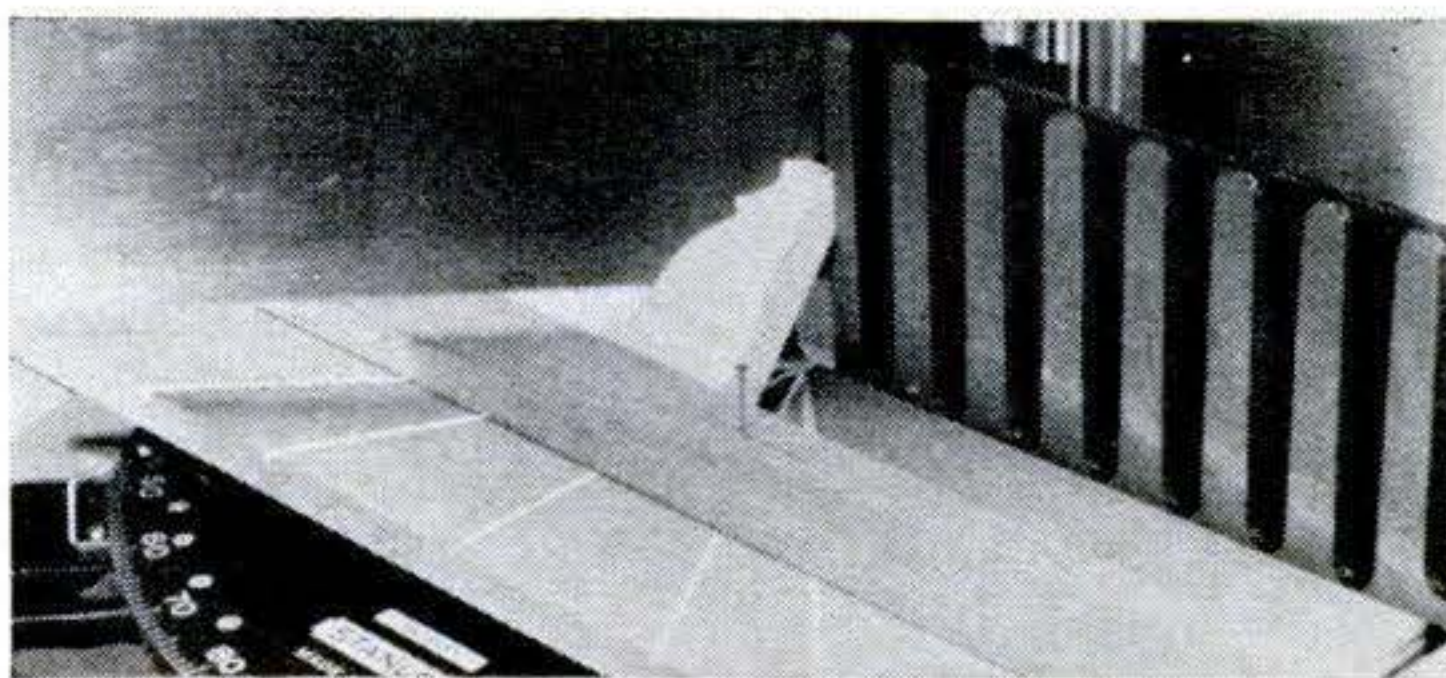
Take good care of the saw. Apply a coat of paste wax and rub this to a polish—do it right off and then renew the application frequently.

Let the saw down gently on the work. Start the cut with a back stroke. Take advantage of the support provided by the spring at the base of the front guide to help you cut easily. The blade is sharp and will tend to dig in if you apply pressure to speed the cut. Let the weight of the saw provide the feed pressure. This is accomplished best by keeping the saw level or by tilting it downward just a fraction at the front. **PS**

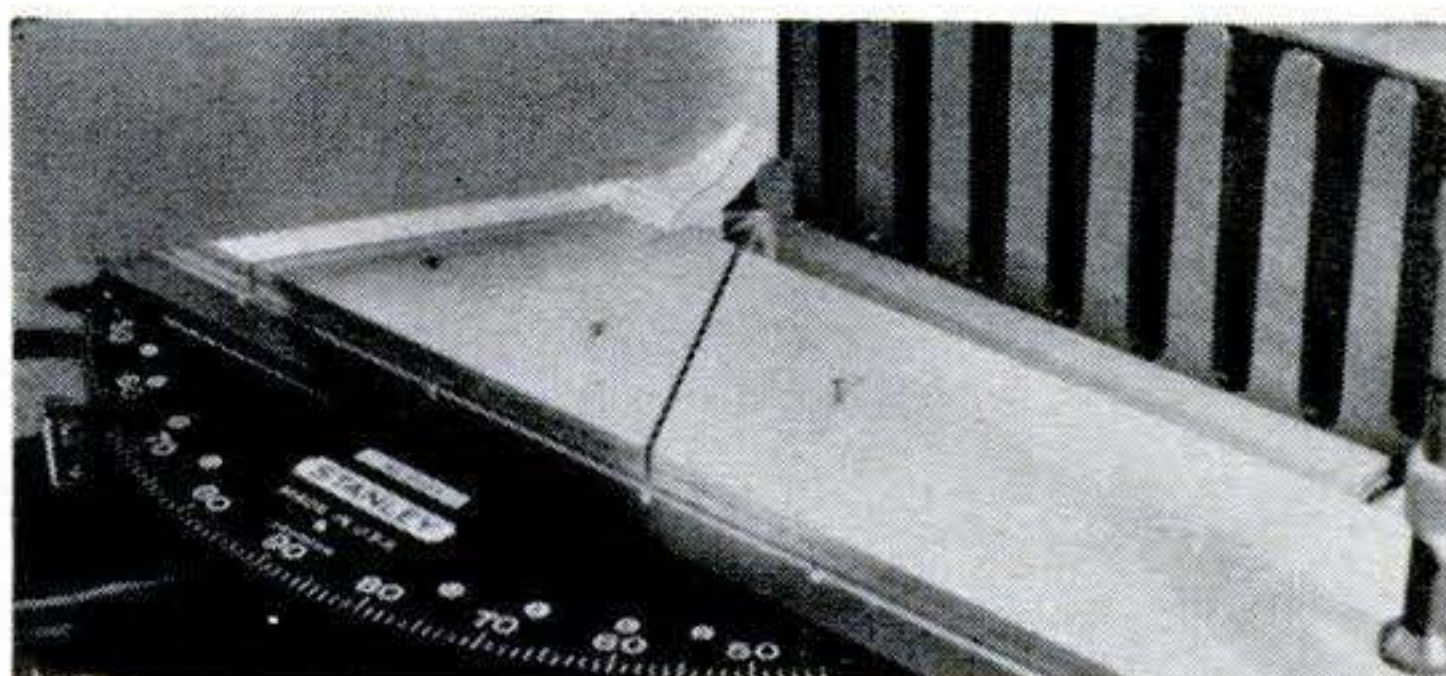
Good tricks for making the best use of a miter box



Compound angles can be cut with a clamped guide strip holding work at desired angle while blade cuts at 45 degrees. Use brads on each side of cut line.



Cove moldings can be hand-held, but work is easier, especially when you have several to cut, if you support stocks with clamped guide strip as shown.

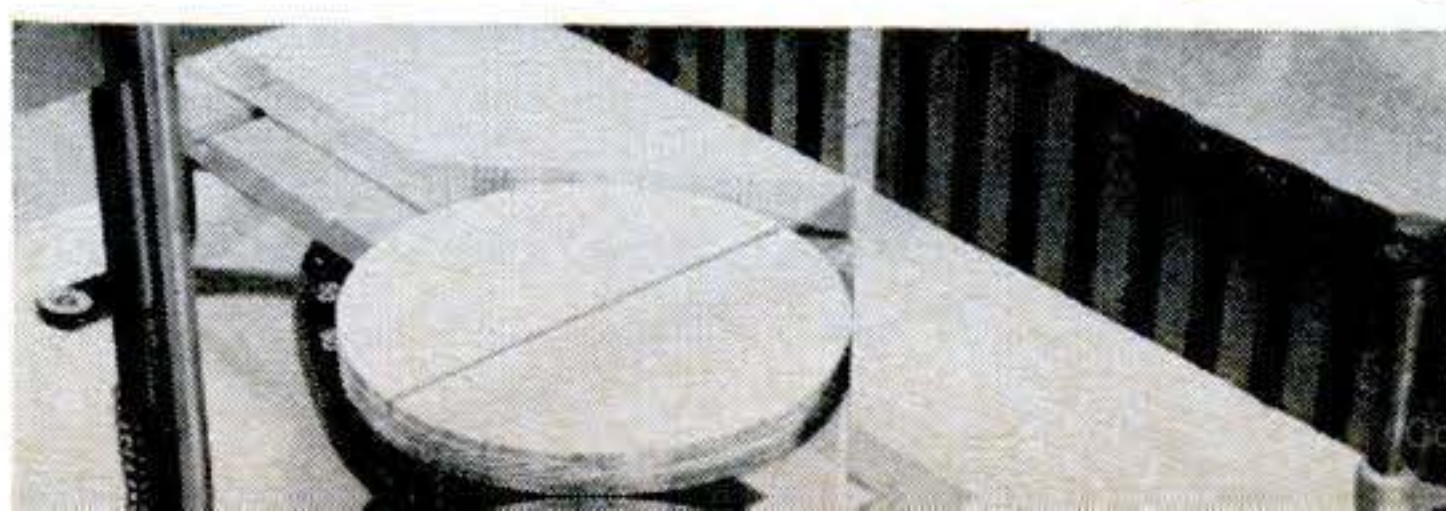


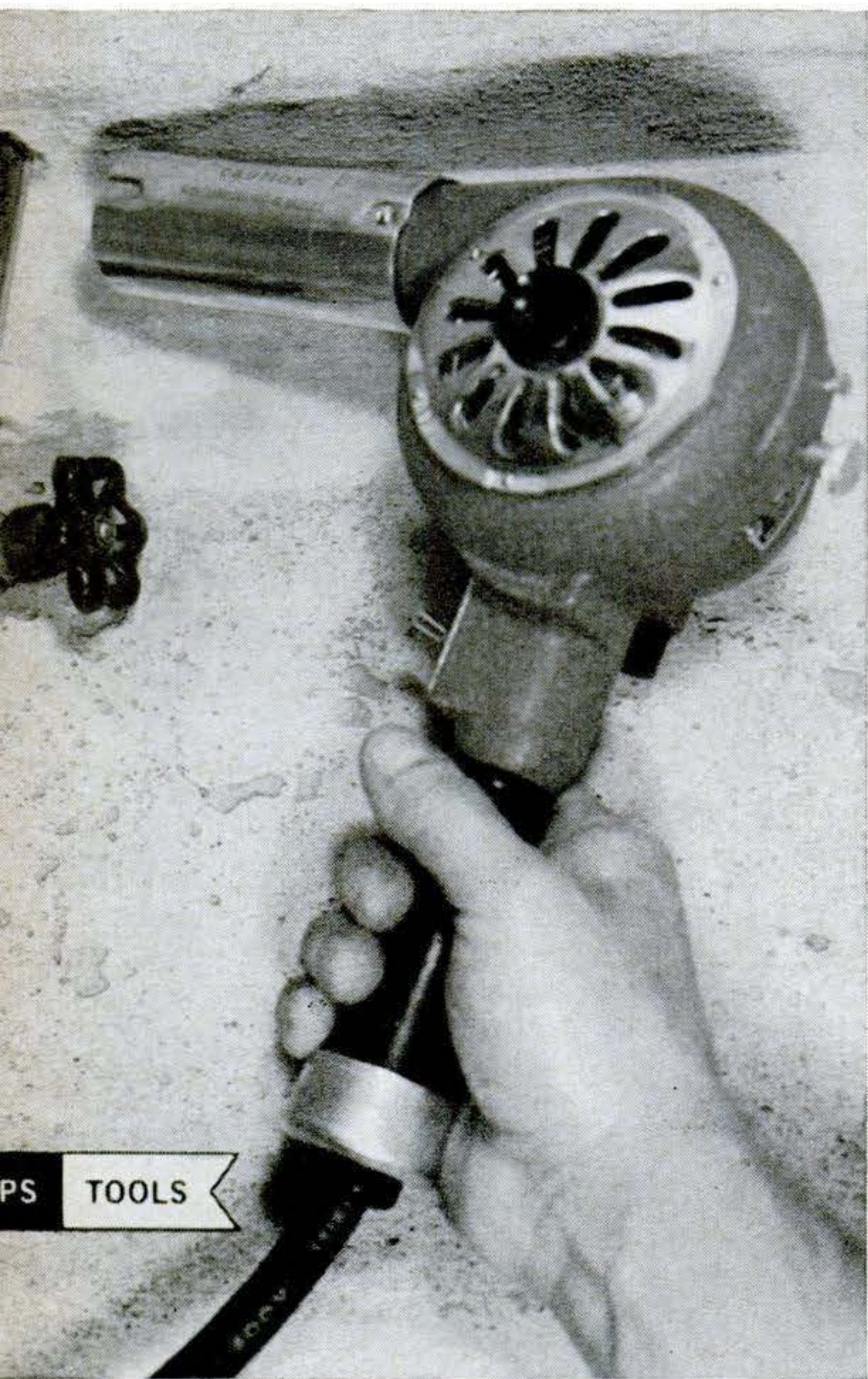
Picture moldings that already have a glass rabbet can be supported by guide strip that fits rabbet cut. Brads keep guide in place after cuts have been made.



Decorative surface cuts like this diamond pattern are feasible in unlimited variations by changing saw angle, attitude of work, and depth of cut.

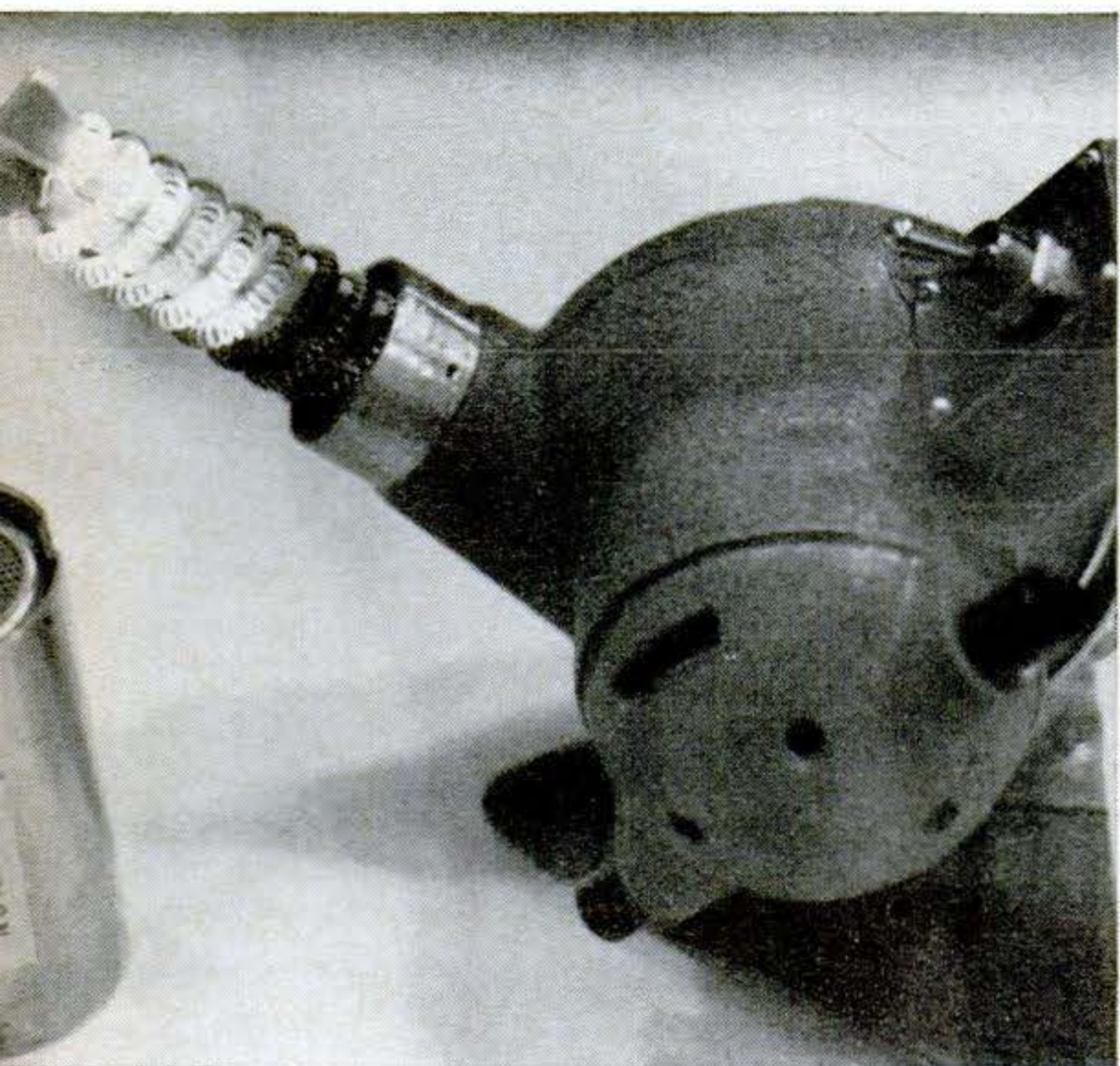
A V-block setup is good for cutting disks into segments. (To position "V," let saw rest on bed of miter box and butt point of each side against it.)





PS TOOLS

Frozen water pipes thaw quickly but safely under the intense flameless heat put out by the gun.



Fan blows air over this heating coil and out the nozzle. Heat-element housing is shown at left.

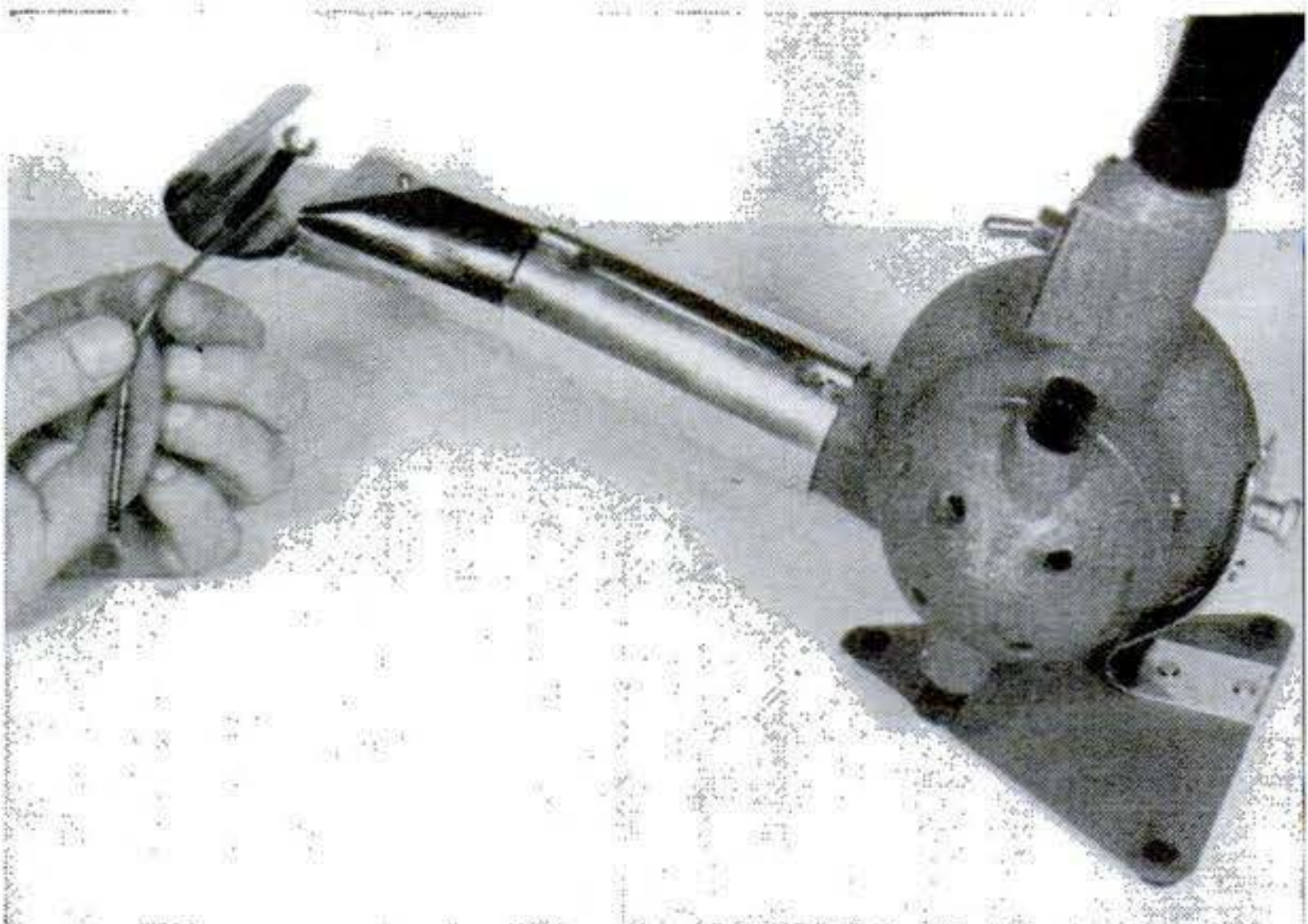
A Heat Gun for

By PHIL McCAFFERTY

Flip the switch and this gun shoots 500- to 750-degree heat that's safe for almost any heating job because it's flameless. The heat gun looks and works something like an old-fashioned hair dryer, but it's far more rugged. It has a heavy die-cast aluminum housing and a cord as big as a small garden hose.

What do you do with 500-plus-degree heat? I found most heating jobs are safer, easier, and more pleasant than with an open-flame torch. Here are a few of the jobs I tried with the heat gun:

- Forming plastics. Smoothing dents in plastic. Softening floor tile and plastic wall tile for bending around corners and edges.
- Removing floor and ceramic tile, pressure-sensitive tapes and labels; also removing jar lids and frozen nuts and bolts.
- Softening paint for stripping without scorching. Making age-brittled insulation, rubber, plastics, and stiff grease pliable.
- Drying negatives and prints. Evaporating moisture from water-cleaned steel parts before rust sets in. Safe drying of inflammable solvent-cleaned mechanisms. Selective drying of wet boots, camp and fish gear, wet upholstered furniture.
- Curing or speeding setup of epoxy



A stand comes with the gun for bench use. Nozzle adapter is good for heat-shrinking insulation.

Home Use

plastics, silicone sealers. Accelerating the setting of glue, or of contact and rubber cements.

- Thawing frozen pipes, pumps, radiators and refrigeration coils. Defrosting freezers and foods. Unplugging snowblowers, starting small engines in winter.

- Melting paraffin, waxes, ice—and low-melting-point metals, solders.

- Heating paint for faster drying, smoother, more glossy coat. Expanding housings so snug bearings can be easily slipped into place. Providing temporary shop or garage heat, and for warming cold batteries.

Nice features of this durable tool include a man-size handle and a stand to hold the gun at convenient angles on the bench. Heating elements, which are bound to fail in time, are relatively easy to replace. The motor is a husky universal type with exposed brush holders.

The heat gun's strong feature—great heat—is perhaps its only drawback. It does get hot. Caution must be used to prevent damage to the item you are heating.

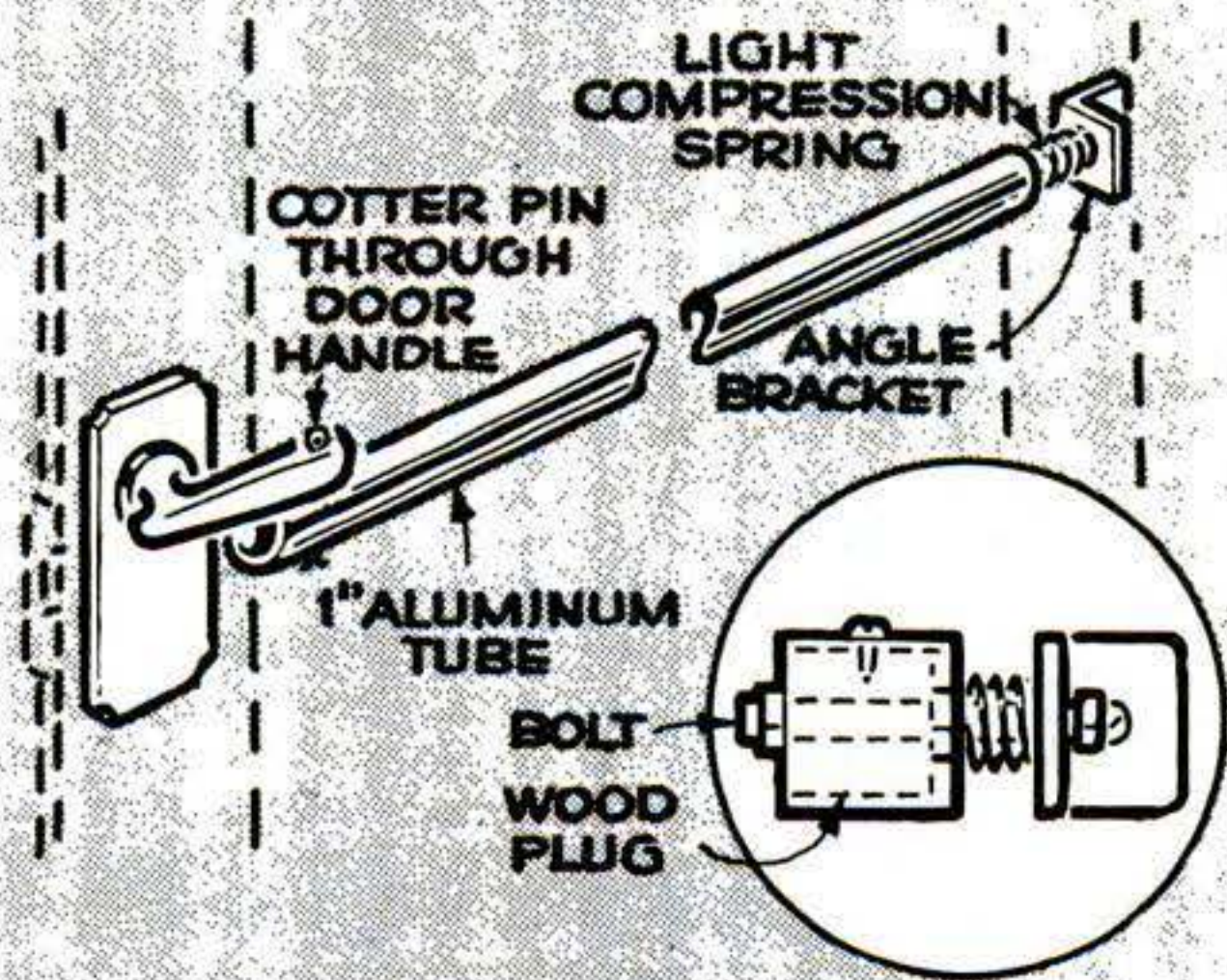
The pictured Model HG-501 Master heat gun is a 500-750-degree, 115-volt, 14-amp unit, which sells for \$45.35, including stand. Other models, both 115- and 230-volt, in capacities from 200 to 1,000 degrees, cost from \$40.25 to \$67.85 from Master Appliance Corp., Box 545, Racine, Wis. 53403.



Gun readily heats plastics for forming and repairing. Most plastics soften at around 325 degrees.

SHORT CUTS AND TIPS

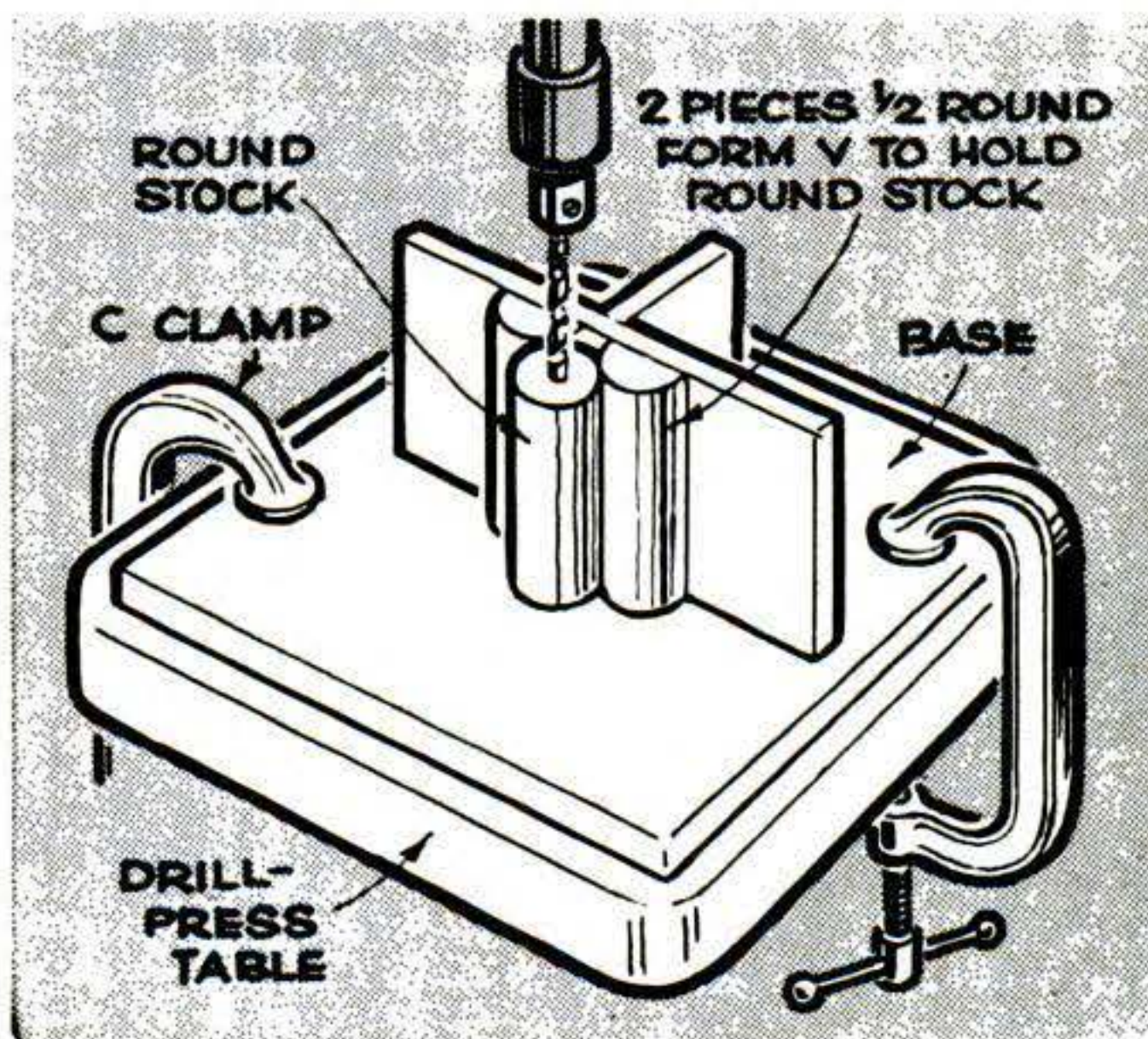
FROM PS READERS



Push bar makes unlatching door easy

A light bump on this bar lets you open a latch-handle door with both your hands full. Other types of latches require different connections to the handle, but even a pushbutton release can be actuated by using a U-shaped bracket to hold the bar in position against the button.

FLOYD E. FREEMAN, Binghamton, N.Y.

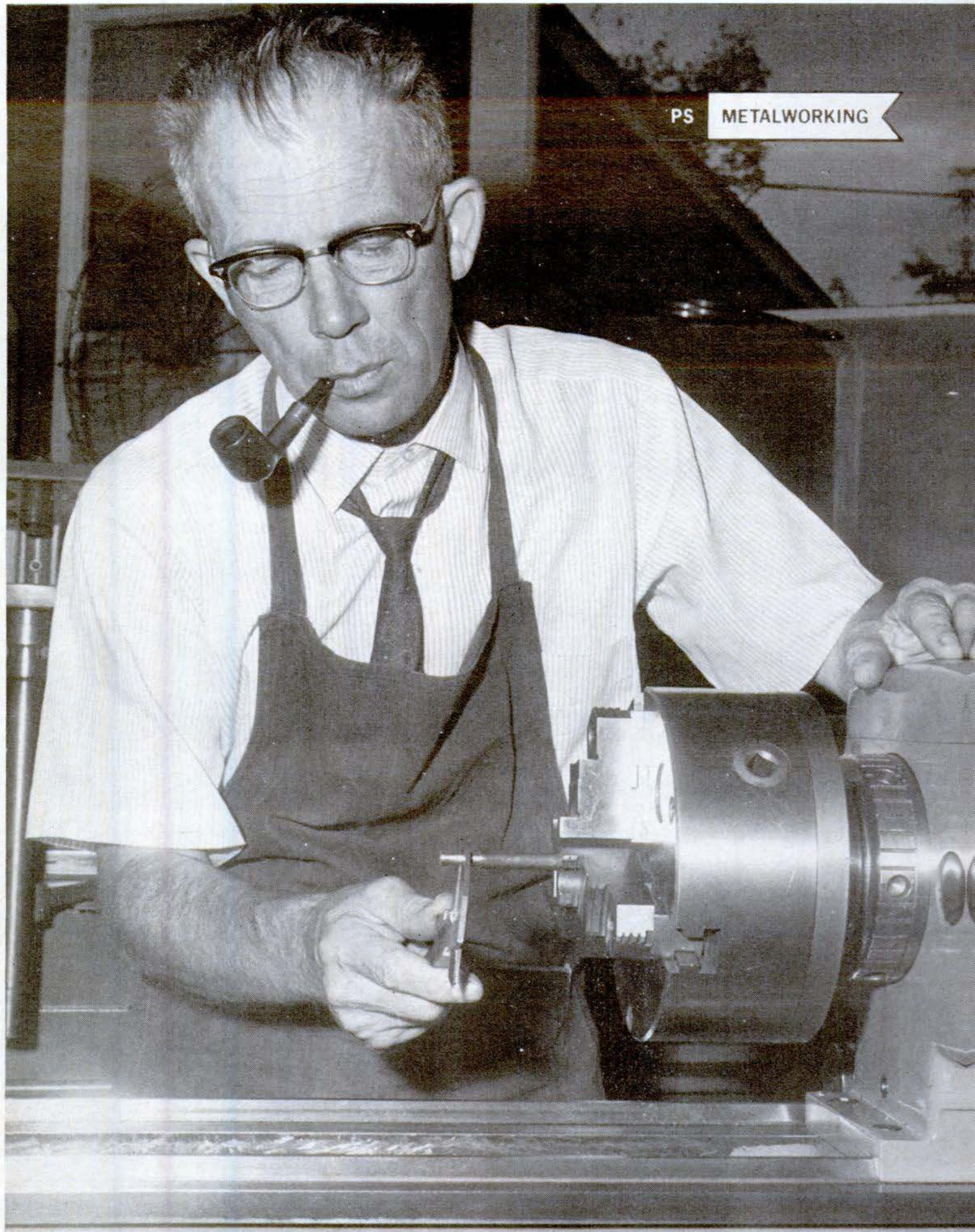


Jig simplifies end-drilling rounds

This simple jig lets you end-drill holes in the center of many pieces of round stock without having to mark the center of each piece. Glue and nail the jig together out of 1-inch lumber and 1-inch half-round. Clamp it loosely to the drill-press table and center the first piece of stock to be drilled. After tightening the clamps on the base, drilling the rest of the rounds is simple.

ROGER ISETTS, Kenosha, Wis.

FAMILY SECRETS FROM AN



PS METALWORKING

Gunsmith Gerald Hunter, shown above at his lathe, is the last of many generations of the Hunter family to build firearms. In this story he reveals some of the family's favorite shop techniques.

OLD-TIME MACHINE SHOP

A centuries-old gunsmithing family reveals tricks of the trade handed down from generation to generation

By GERALD R. HUNTER

Gunsmiths, of all craftsmen, are probably the most closemouthed about their pet systems, designs, and formulas. But I'd like to make an exception to this custom and share some shop short cuts used by the Hunter family since they supervised the royal hunts and built guns in Huntersdon, England, six centuries ago.

Most of these "gadgets" (something between a gimmick and a gadget), however, are no older than the 1880s. That's when Hunter Arms Co., makers of the fine original L. C. Smith, Comstock, Fulton, and Hunter Special set up shop in America. Nowadays, at our Thomasville, Ga., plant, we design and build gunsmithing equipment rather than make production guns.

Some of the tricks we've learned will help anyone doing metalwork. Here are a few of our time- and money-saving tech-

niques you can use in your own home shop.

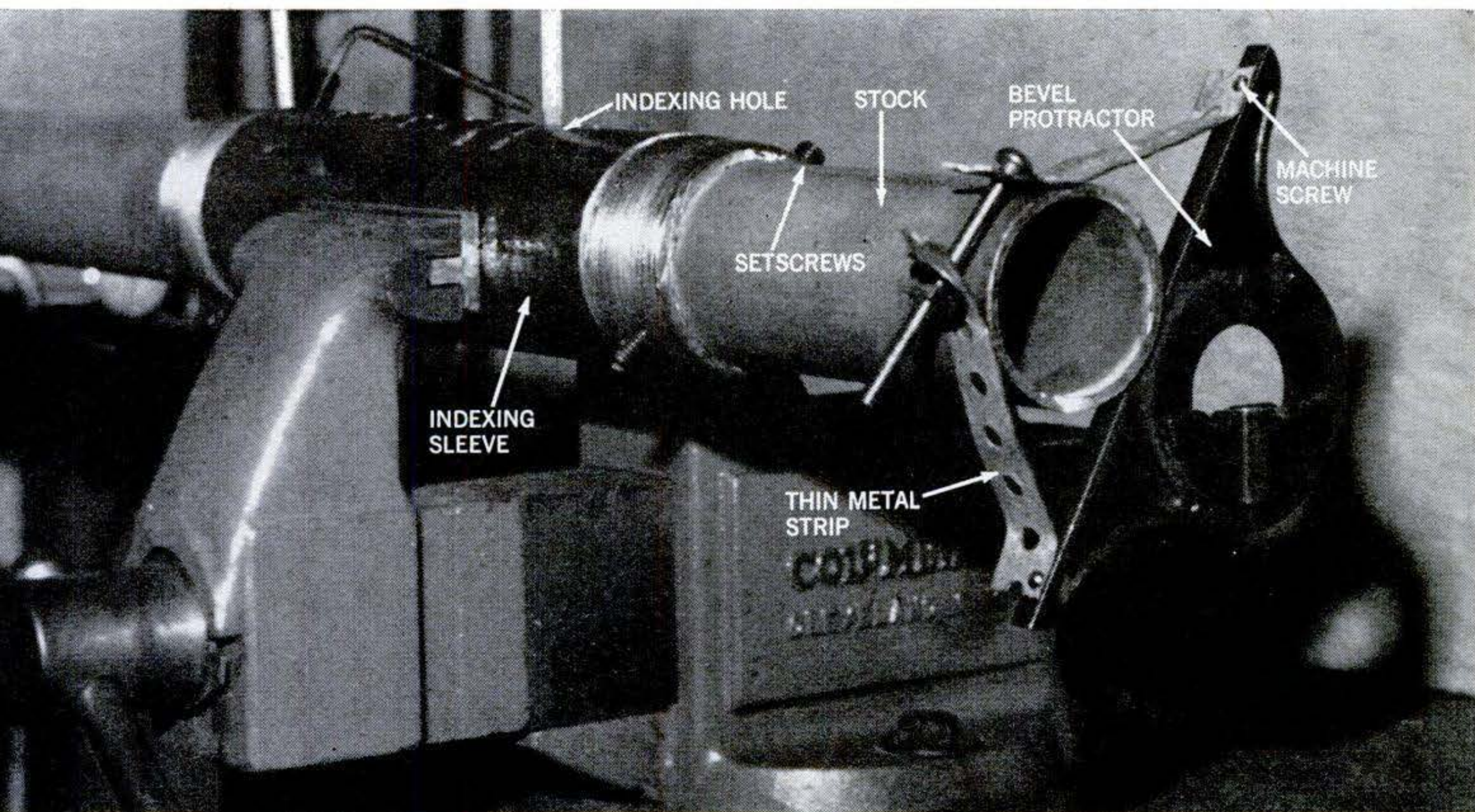
Simple way to index round stock. An often baffling problem to woodworkers and metalworkers is indexing stock away from the ends. Even more perplexing is the job of indexing stock at irregular spacings. Even the best of lathe headstocks are graduated only in multiples of even degrees.

Whatever degree markings you need you can make with accuracy using the protractor of a machinist's combination rule.

Fasten the protractor head to the stock and mount the stock in a close-fitting sleeve as shown in the photo below.

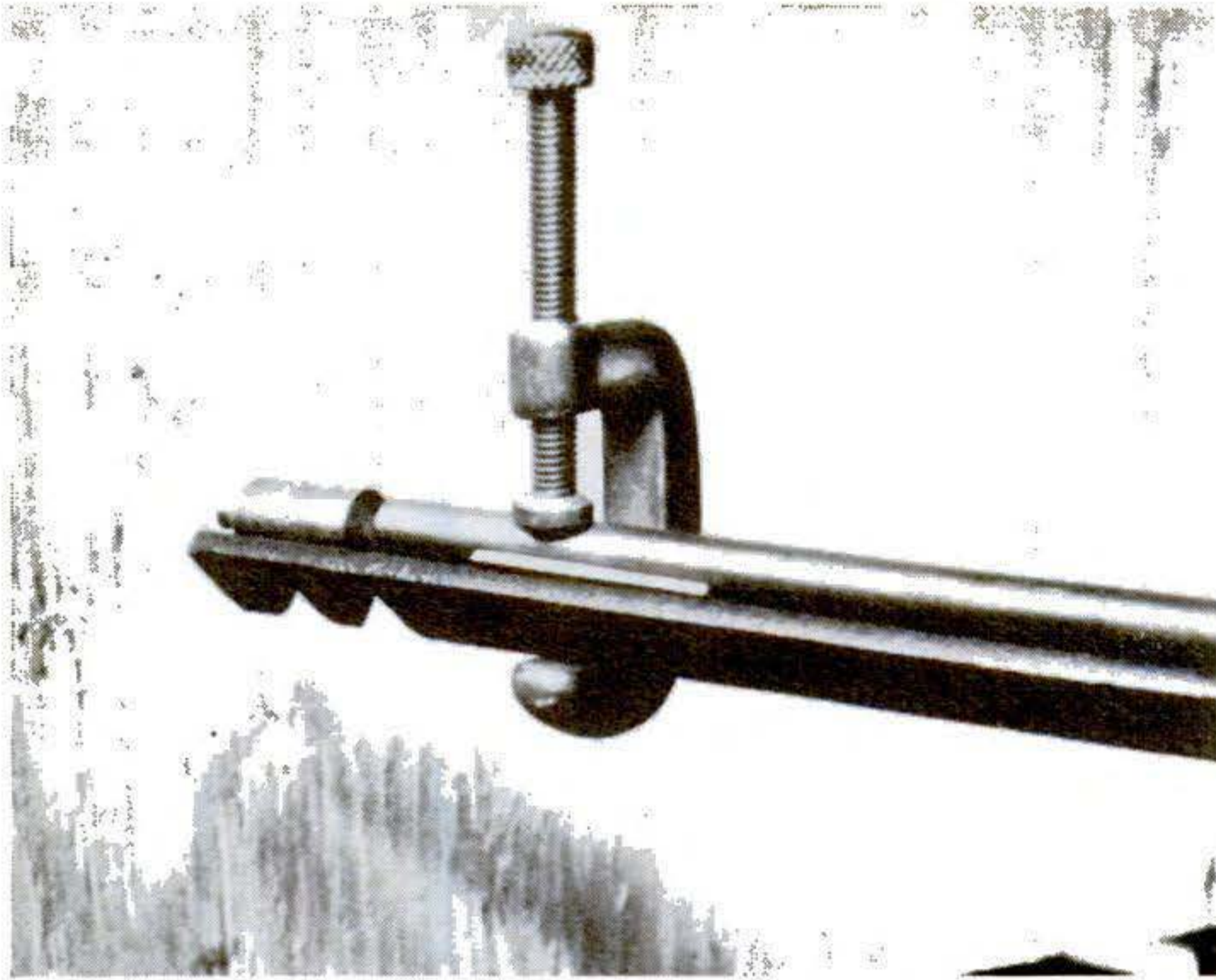
The hollow sleeve has a small indexing hole through which to make a punch mark. And it has setscrews to hold the stock firmly. The sleeve is held tightly in a vise, center hole on top.

To use it, set the protractor at zero and
Continued

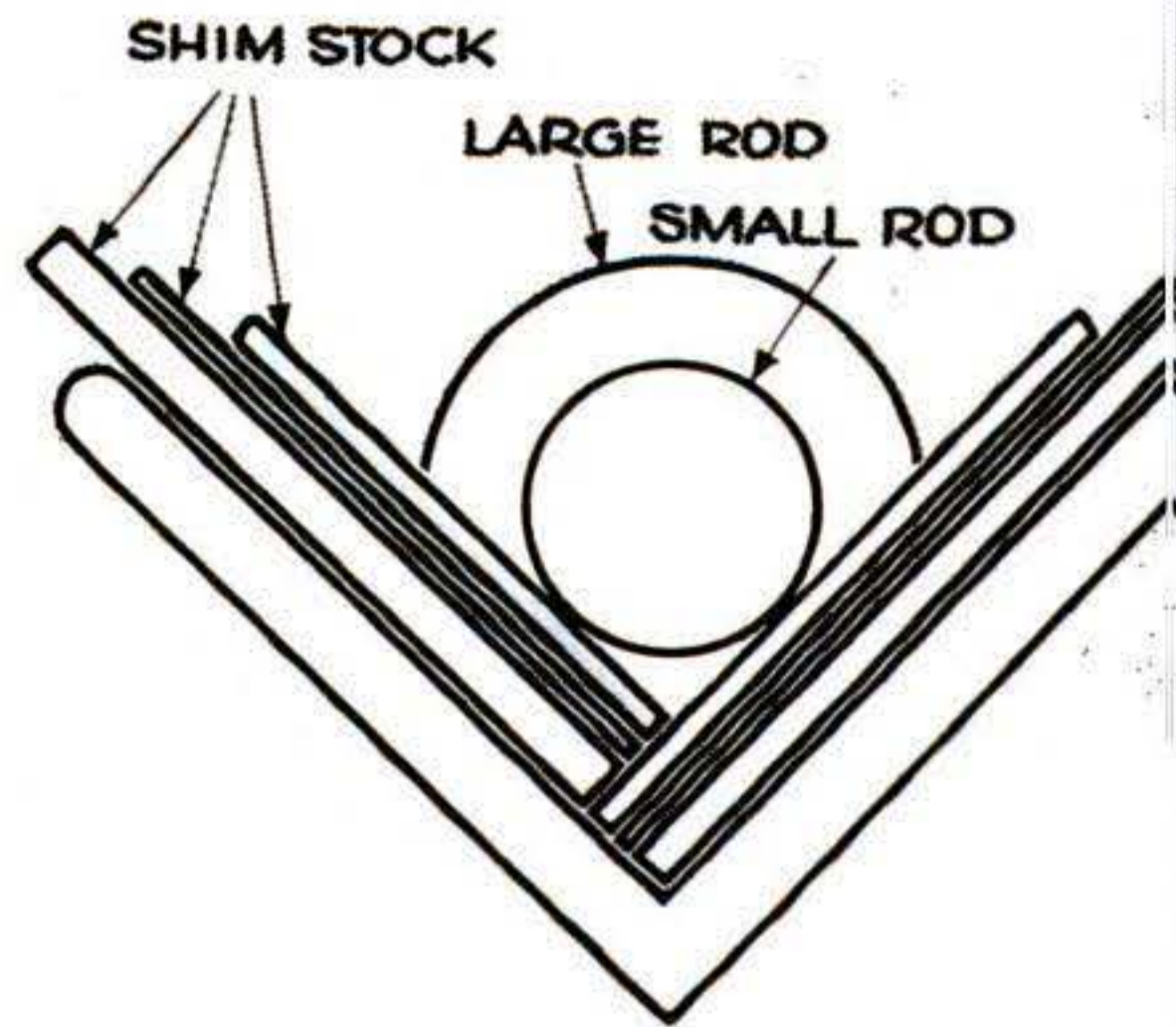


Indexing round stock to any degree is a simple job if you build the jig above. A protractor from a machinist's rule and a sleeve that the stock fits into

are assembled as shown. To index stock, simply center the level bubble, turn the protractor the required number of degrees, and level the bubble again.



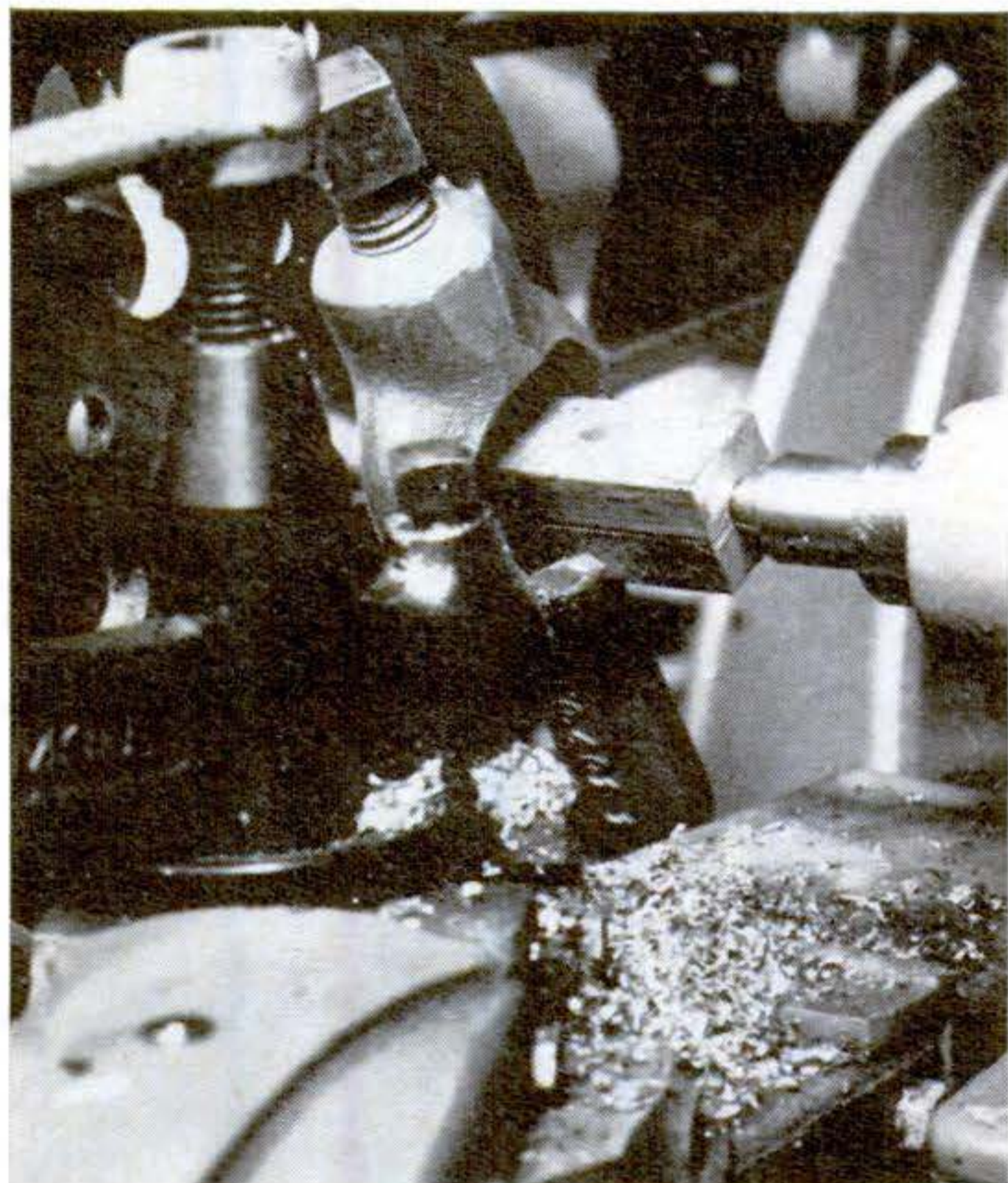
Concentric matching of rods of different diameters can be done with this simple jig. You just place the rods in an angle iron as shown and shim up the



smaller one on each side by half the difference in the rod thicknesses. Notches cut in the angle iron let you tack-weld both sides of the rod.

rotate the work within the sleeve until the bubble is centered. Punch the first mark through the indexing hole. Advance the protractor the required number of degrees for the first index mark. Again rotate the work stock to center the bubble. Punch

again. Repeat the process for each mark. This may sound inaccurate, but it isn't, as experience proves. Accuracy is increased considerably by using a very small indexing hole, and a punch hardened and trued to its point. It should fit the hole snugly.



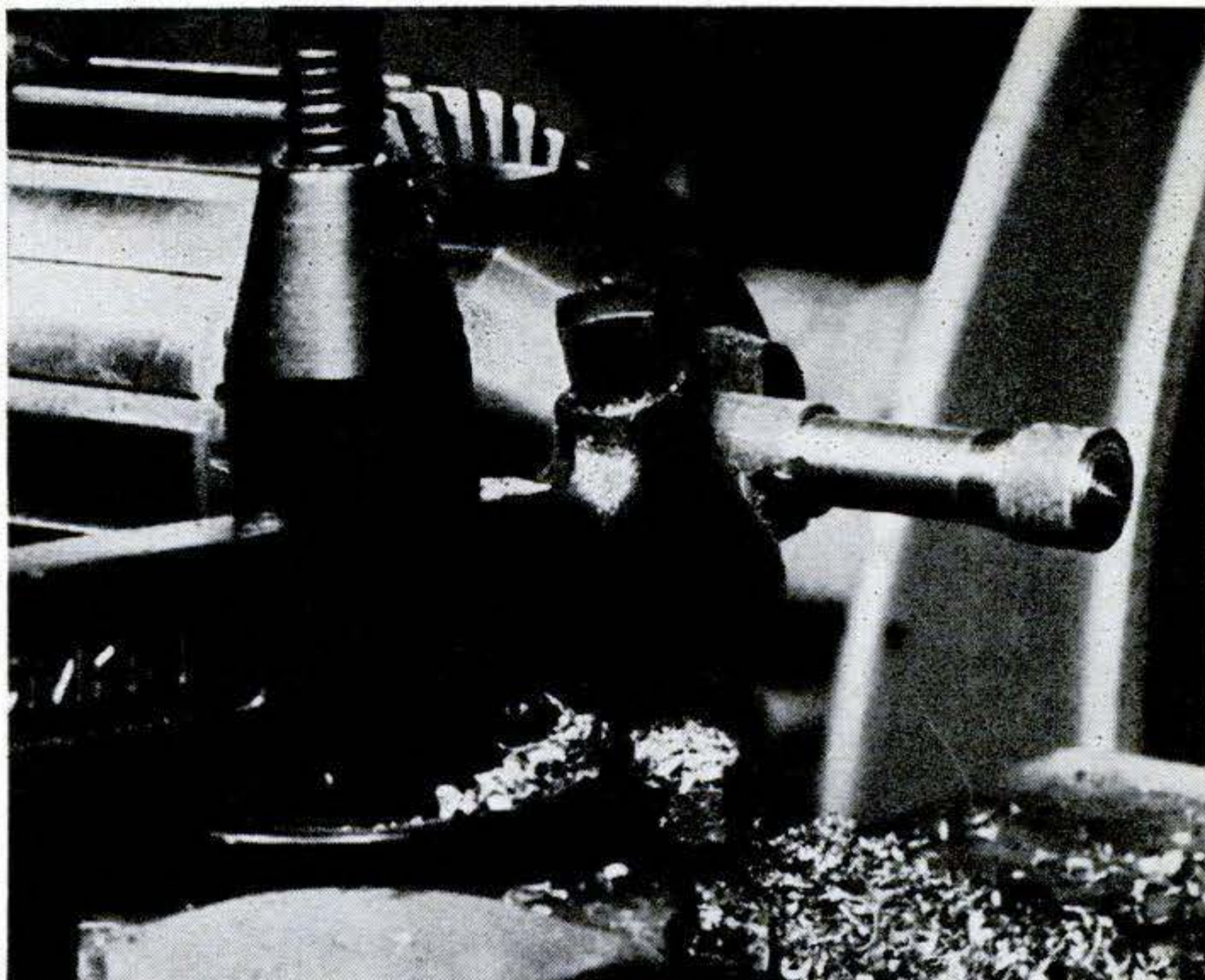
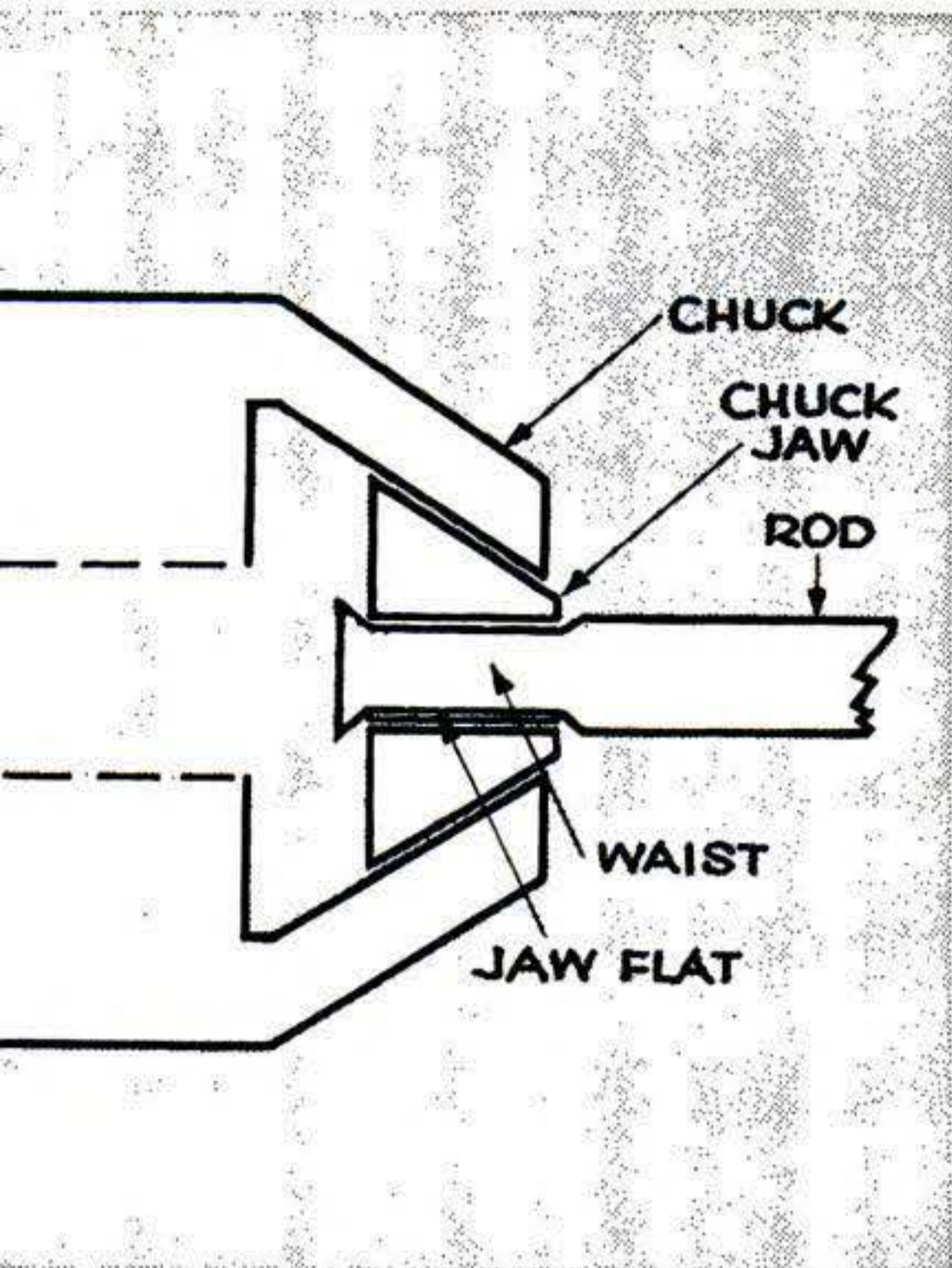
Matching half-round pairs can be machined if you first rivet together two flat bars which, when assembled, give you sufficient diameter. Center-drill the ends of the assembly and turn between lathe centers. Turn a true diameter on each end.

Joining mismatched rods. Our family has a knack for using at-hand materials to do a job. This talent helped solve a long-time problem around the shop—end-mating of rods or tubing of different diameters so that they are concentric.

You do it with angle iron and shims. First, measure the diameter of each rod. Clamp the larger rod in the angle iron. Butt the smaller rod against it but shim the smaller rod away from each face of the angle iron. Shim thickness is one-half the difference of the rod sizes. For example: To mate a $\frac{1}{4}$ " rod to a $\frac{3}{4}$ " rod, you need two shims, each $\frac{1}{4}$ " thick.

An old trick we use is to build up the exact thickness with paper shims. Here are some rules-of-thumb: Scotch tape and brown paper tape are .003" thick. Wheat-straw cigarette paper is .002", while rice-straw paper is .001". Jackets of the wheat-straw papers are .011" and rice-paper jackets are .013".

Clamp the rods lightly in place and tack-weld the ends together. Release the clamps, turn the rods 180 degrees, and tack-weld again. Remove the clamps and complete



Here's how to lock reamers and other tools in a lathe chuck so they won't wrench free if the tool sticks in the work. You turn a shallow waist at the chuck

end of the tool as shown above. With the chuck clamped around the waist, the tool cannot slip out. Put flats on the waist for more turning resistance.

the weld while rotating the rods. Cutouts in the angle iron let the torch reach most of the joint to prevent warping.

Machining half-round pairs. This little stinker of a job of machining a half-round part, like the most important invention in our company history, was licked by luck. One of our gunsmiths, Alexander Brown, "invented" the never-improved-upon L. C. Smith rotary locking bolt while trying to make a mechanical drawing "close out."

Similarly, I solved the nightmare job of making matching half-round pairs by accident. I was turning a rusty old piece in the lathe. When I took it out, the piece fell apart in my hand. I then realized that I was cutting two pieces rusted together. We now use this principle to make our unique jig to align shotgun or combination barrels without a lot of contortions.

You don't have to let the stock rust together; here's the easy way to do it. Begin with two flat bars which, when layered, give enough working diameter. Clamp the bars together and drill and pin them with push-fit common nails. Snip off the ends of the nails and lightly peen over the tips. Center-punch each end and drill the lathe center holes.

When turning, use hand feed and make light cuts with a bullnose tool to prevent excessive bumping. Before removing the work, turn a true diameter at each end of

the piece long enough to let you chuck the piece for drilling, internal boring, or cutting off.

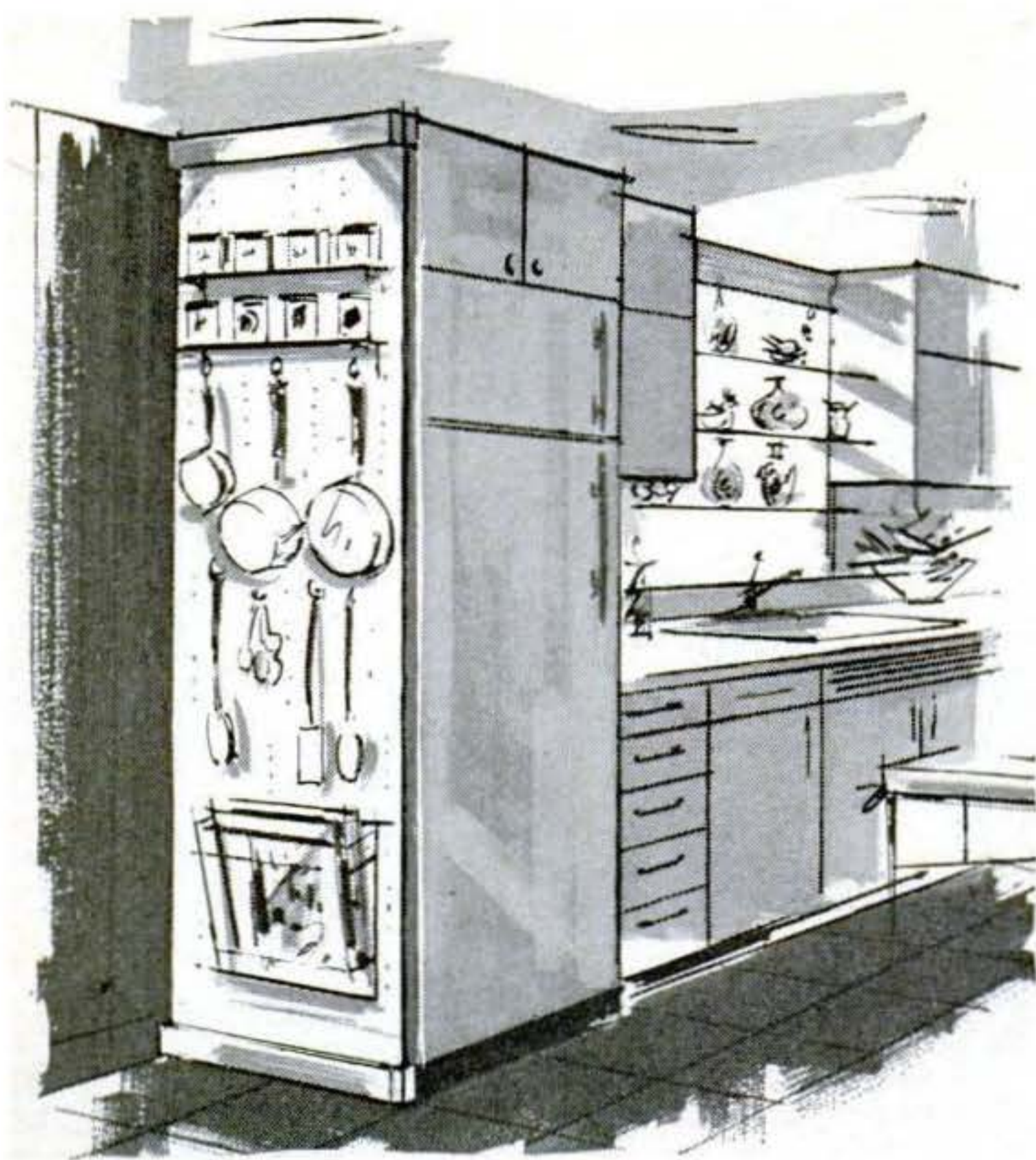
Cryproof chuck lock. The only time I ever saw a machinist sit down and cry was when a reamer extension came free of the chuck and stuck halfway through a very expensive piece of work. There was no way to unstick things without ruining both the work and the reamer.

Our remedy is quick and foolproof. You'll find you can use it on drills, taps, boring bits, and other tools, too.

Turn a shallow waist at the chuck end of the reamer. Make it as long as the chuck jaws. You can even do this on thin-walled tubing since you need only a slight depth.

With the chuck clamped on the waist, the tool cannot slip out. Shallow-tapered waist ends are best. They wedge the rod and keep it from spinning. Grind or file flats on the waist for greater resistance against turning.

Easy way to temper springs. After shaping the spring, heat it to an even, bright-cherry red and quench it in SAE 30 motor oil. Put the hardened spring into a shallow metal saucer, and barely cover the spring with the oil. Light the oil with a torch, and let the oil burn out. Let the spring cool naturally and it will be properly tempered. Don't let the torch blast hit the spring while lighting the oil. P S

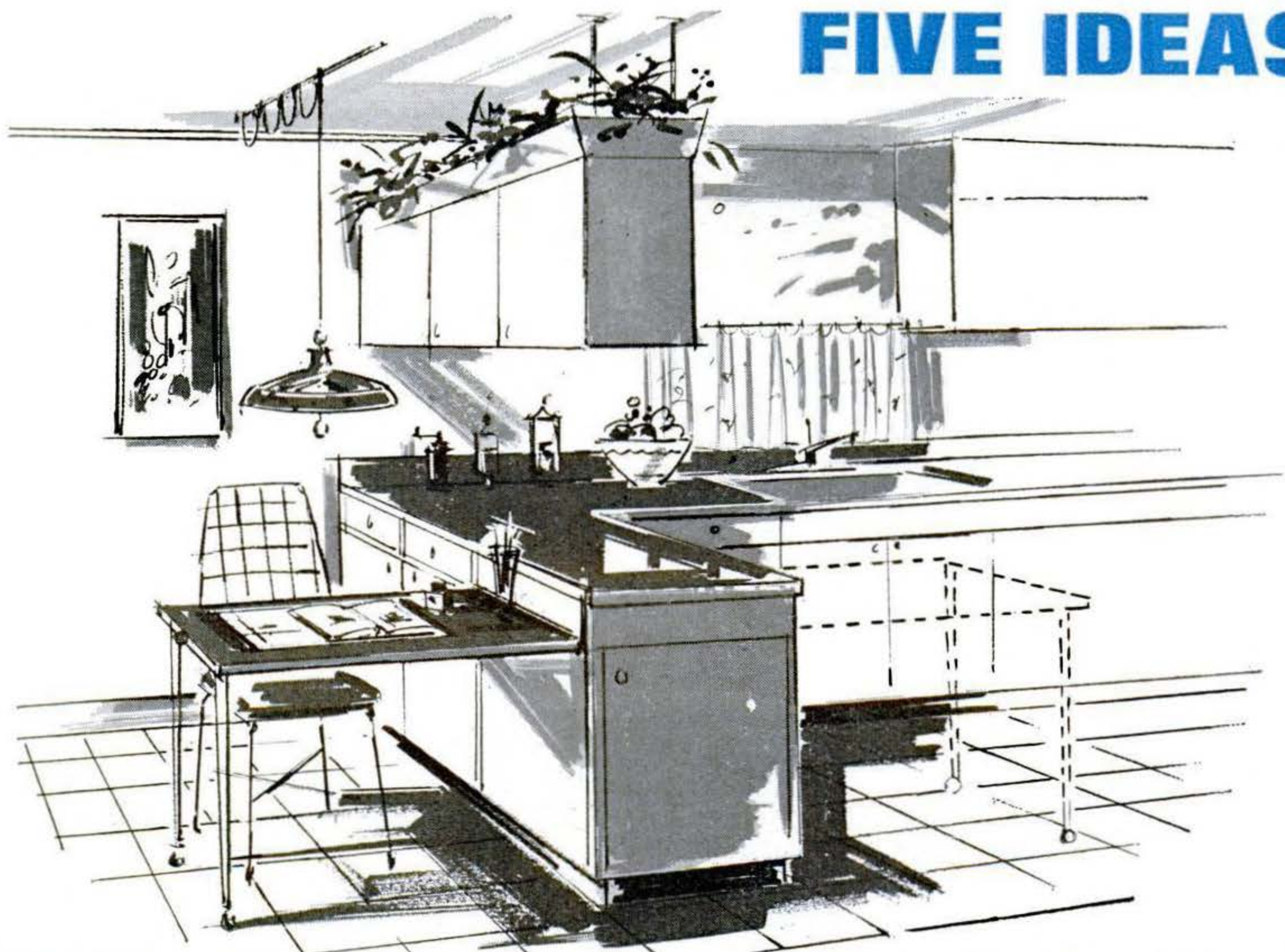


An extra storage wall can be placed next to a refrigerator. Make it from a floor-to-ceiling-length panel of perforated hardboard on a one-by-two frame. Use it to hang pots, pans, and other utensils.



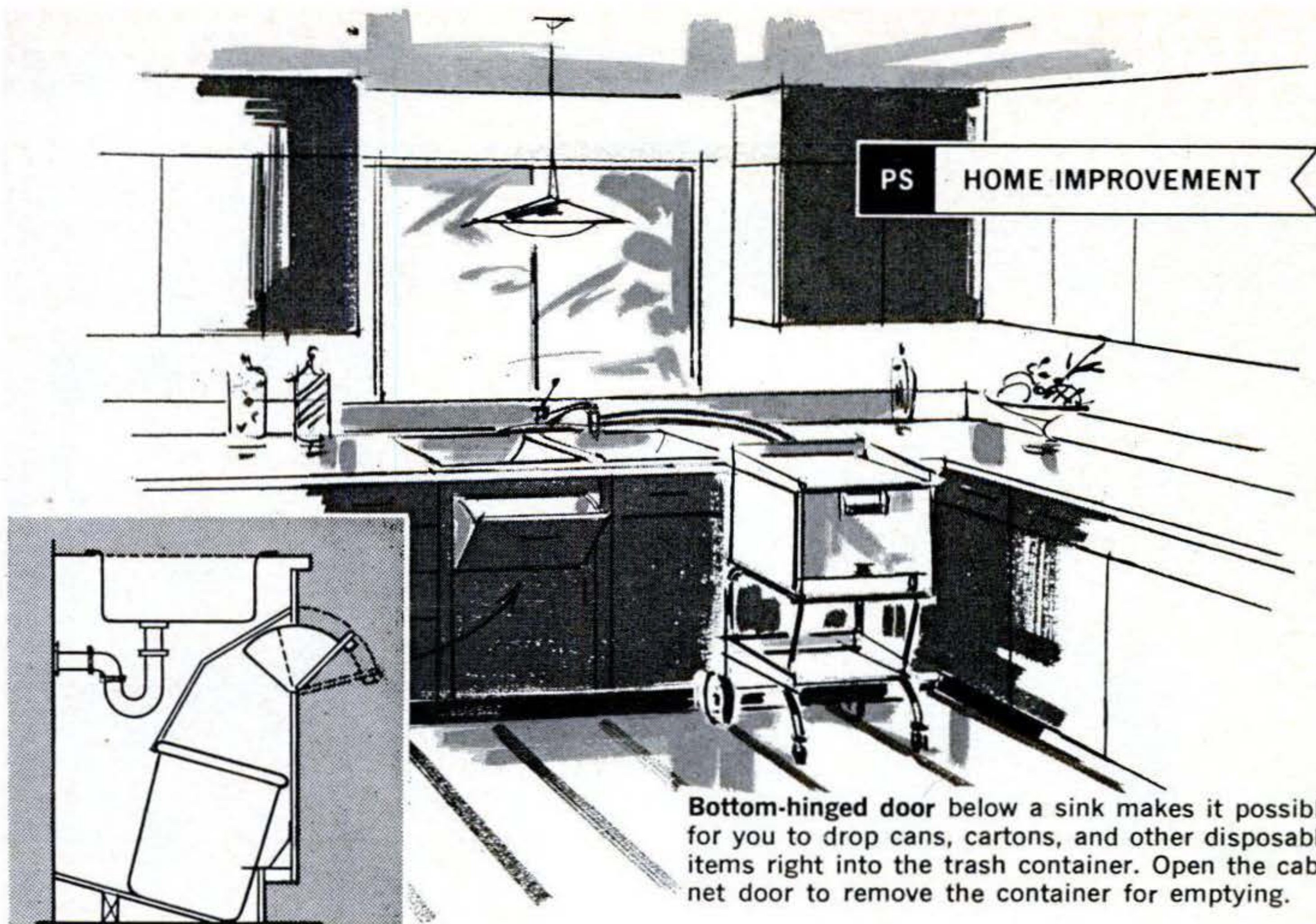
Folding breakfast table opens to make a table for eating or preparing meals while seated. It's a table-height counter with hinged top. Supported by pull-outs when open, it steals no space when closed.

FIVE IDEAS



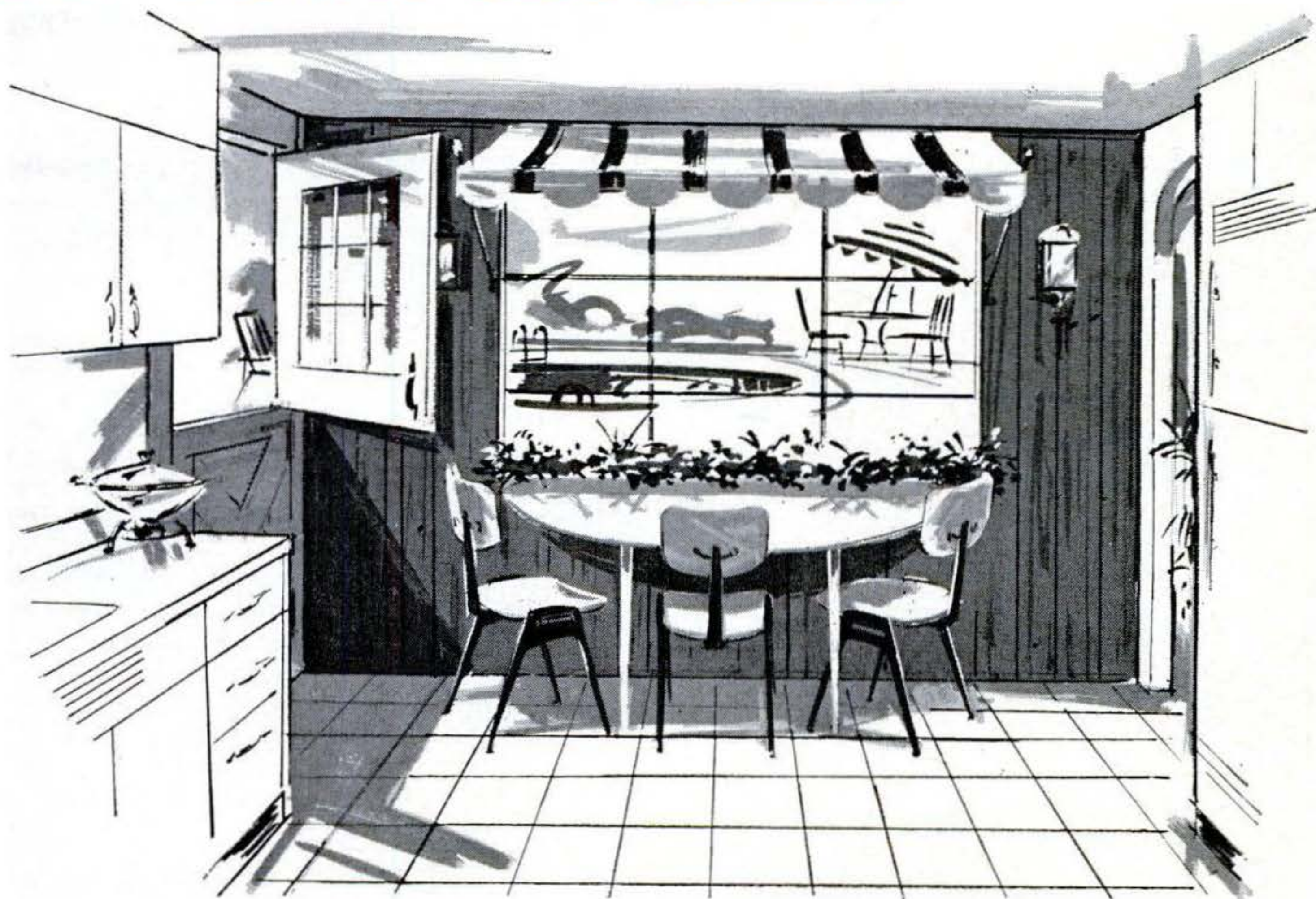
Sliding table fits through a slot in the cabinets. Pull it out on the kitchen side of the counter for prepar-

ing food or to hold dirty dishes. Pull it out on the dinette side of the counter for eating or writing.



Bottom-hinged door below a sink makes it possible for you to drop cans, cartons, and other disposable items right into the trash container. Open the cabinet door to remove the container for emptying.

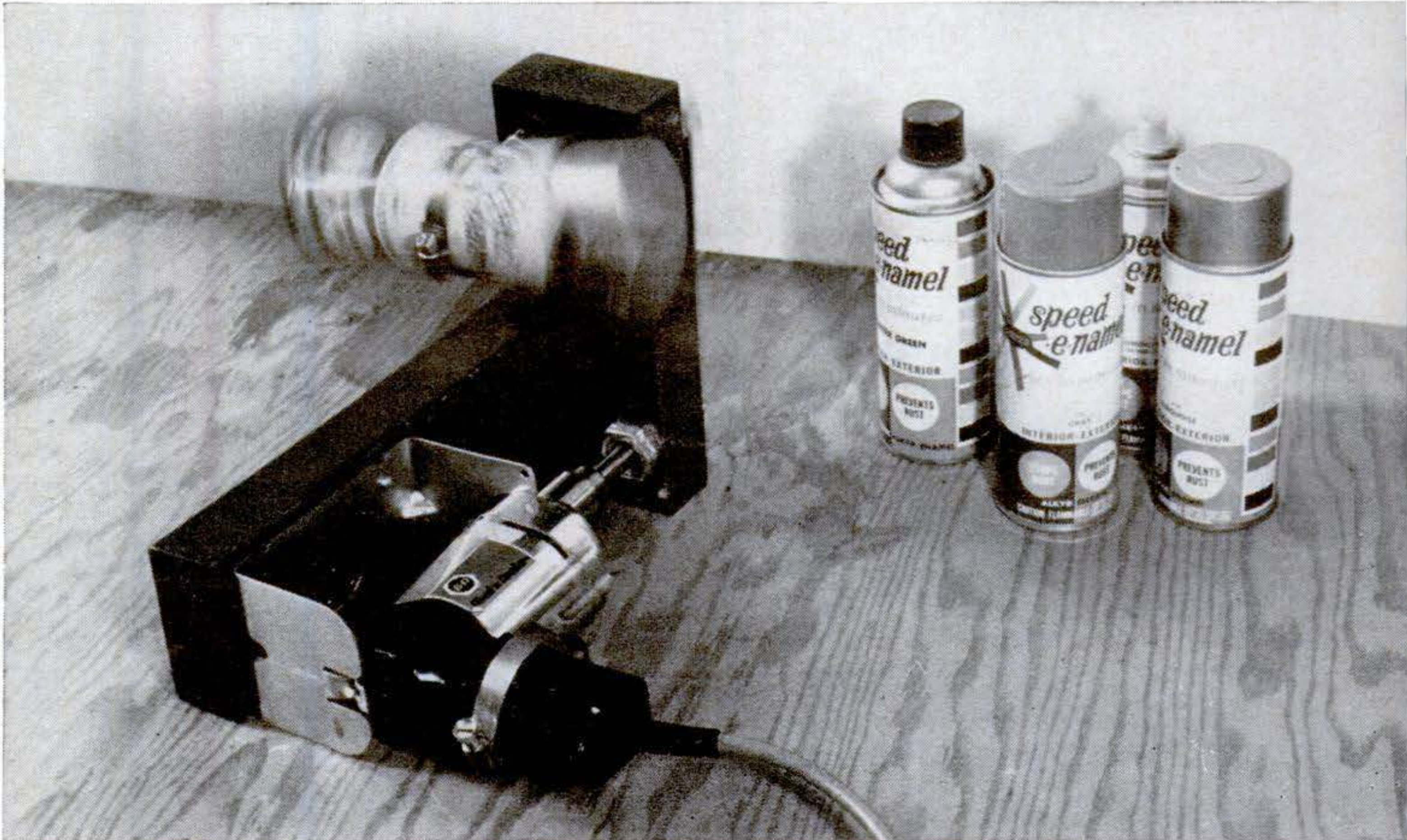
FOR YOUR KITCHEN



Semicircular table in front of a window lets you enjoy both food and scenery at the same time. Cut

it from a sheet of $\frac{3}{4}$ -inch plywood and hinge the table to fold against the wall when not in use.

Your Drill Can Power



Shaker does fast and thorough job of mixing spray-can paints. A hose clamp adjusts and holds

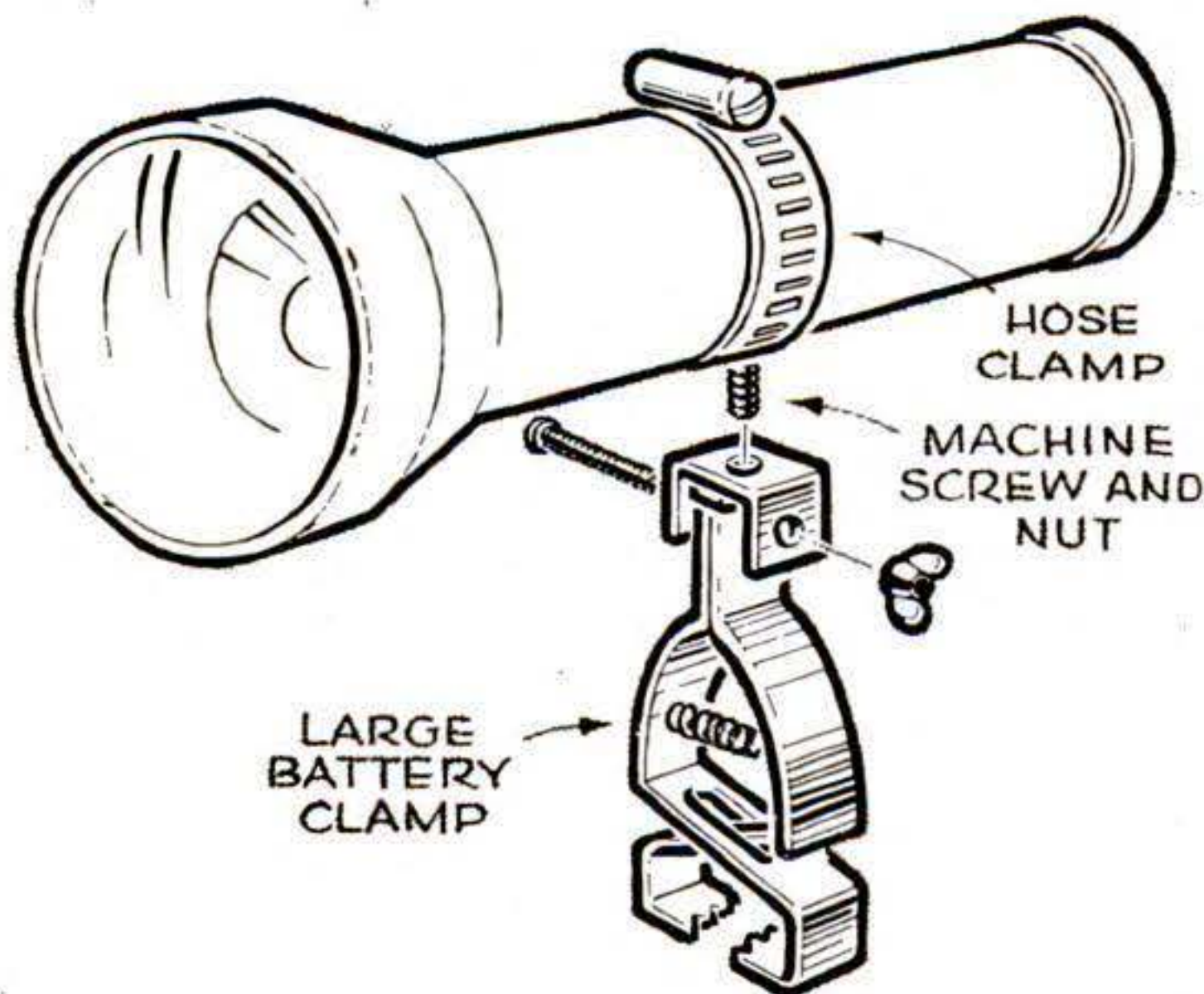
variable-speed trigger. Drill stand holds drill in place on two-by-four base. Second clamp holds can.

I put my new trigger-control variable-speed drill to the offbeat use of powering the paint shaker shown above. I use it with spray-can paints and enamels that carry instructions to "shake can vigorously for several minutes before spraying."

The rig does a better job than I could do by hand, and will handle the mixing while

I go about other work. A hose clamp around the handle and trigger adjusts to give just the right shaking speed.

For accurate positioning of the hole for the drive shaft at the bottom of the two-by-four stand, chuck a small twist drill in the drill mounted on the stand, slide it against the upright, and drill a pilot hole. Then



Quick-grip flashlight holder

You can make a clip-on flashlight holder from a battery clamp and a hose clamp. First make a metal U bracket with three holes in it, as shown in the sketch. Attach a thumbscrew-type hose clamp to it with a short flat-head machine screw and nut. Then fasten a large battery clamp in the bracket with a bolt and a wingnut.

PETER LEGON, Malden, Mass.

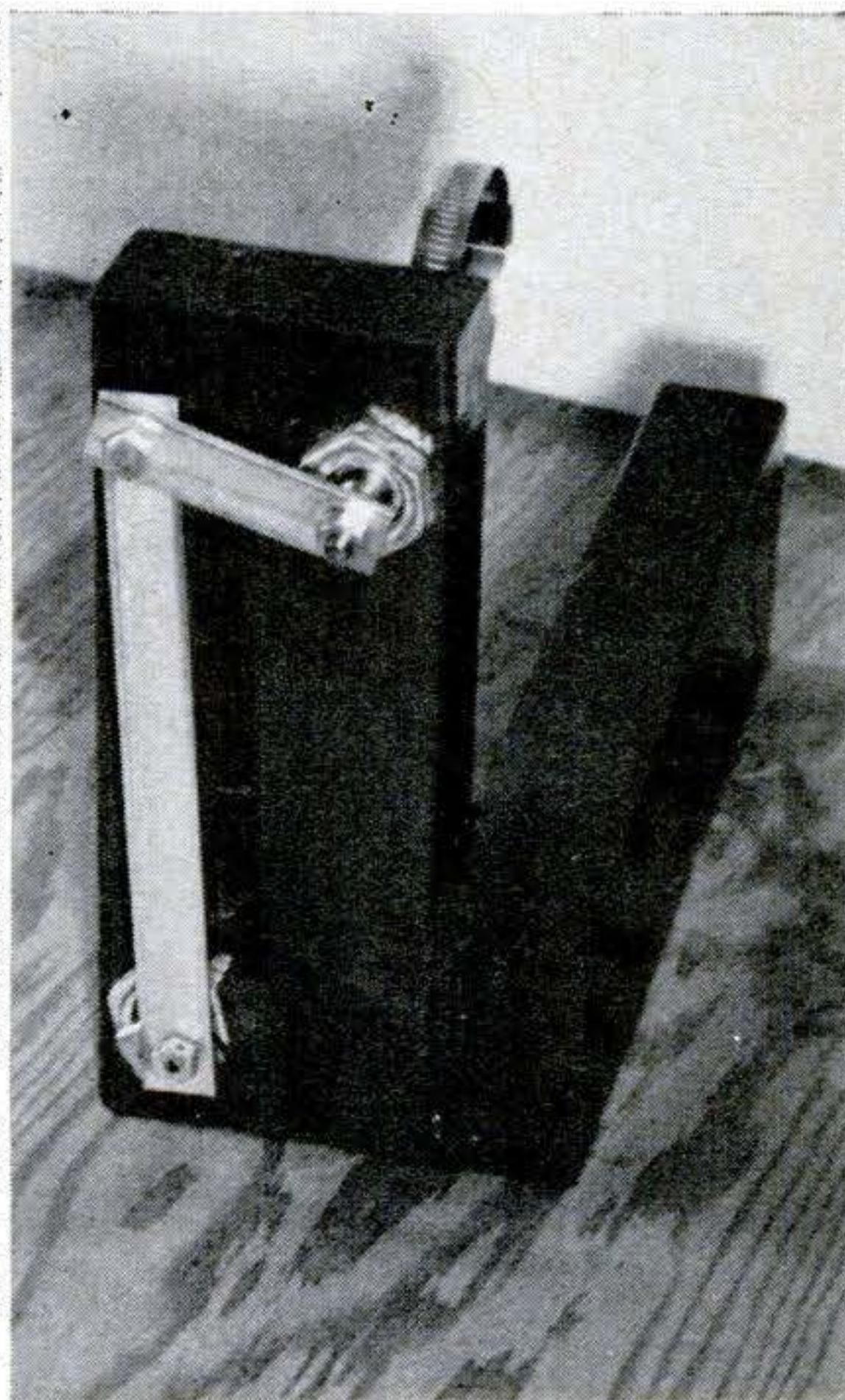
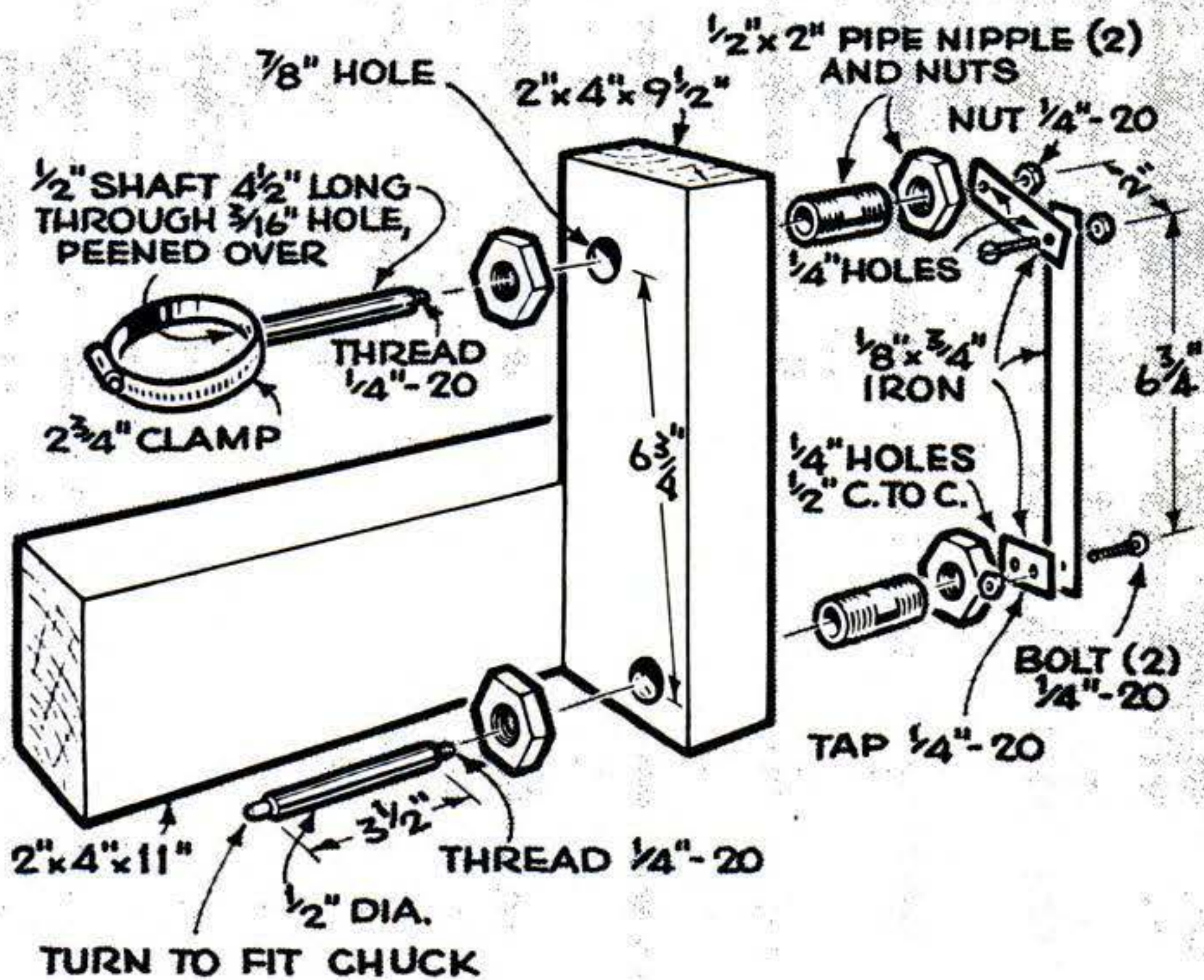
Padlock makes a temporary chain link

A padlock can be used as a link to fix a broken chain, to connect two chains, or to join the ends of a chain to form a circle.

KARNEL KEGRIS, Liverpool, Pa.

a Paint Shaker

By WILLIAM G. WAGGONER



Simple, inexpensive parts go together as shown in the drawing. Photo of back shows the simple

mechanical setup. Short crank at bottom moves longer lever up and down in quick 1" strokes.

drill the hole out to 7/8". Locate the upper hole 6 3/4" from the first, in the opposite corner of the two-by-four.

Press a short section of 1/2" bushing into each end of the two pipe nipples. You'll have to ream the nipples slightly with a 3/8" drill to get a good fit.

To fasten the hose clamp to its shaft,

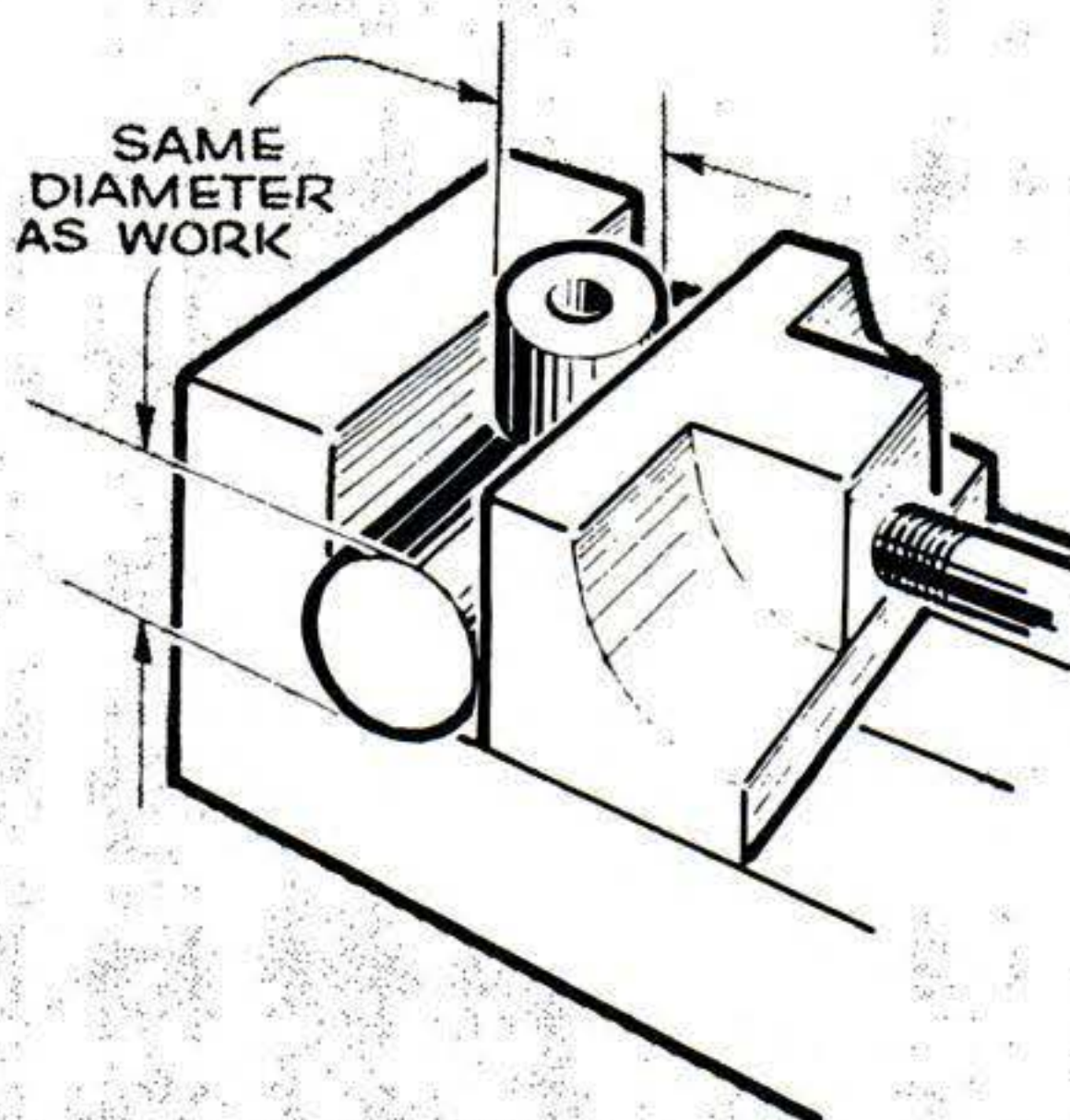
drill a 3/16" hole in the center of the clamp. Turn the end of the shaft down to fit through the hole, and spread it with a ball-peen hammer.

Make sure the drive arms are tight on the shafts so they won't slip, but leave the joints at both ends of the long arm loose enough to allow free movement.

Rod stock makes its own drill bushing

A handy jig for drilling holes in the circumference of rod stock can be made by using a piece of the same size stock as a drill bushing. Center the rod in a lathe and drill a hole into the end, 1/64" under the size you want in the finished work. Then ream the hole with the same drill that you will use to drill the transverse holes, and cut off the bushing to about 1/2" length. When using the jig, clamp the rod to be drilled in your drill-press vise with the bushing perpendicular to it. The drill-press vise will hold both of the pieces securely while you drill through the bushing and into the rod.

CHAS. B. KRAMER SR., Kissimmee, Fla.



Servicing the New DISK

Within limits, these rugged, efficient units can be serviced by the do-it-yourself mechanic. Here's what you need to know

By **WALTER ALLEY** and **RICHARD DAY**

Disk brakes are standard equipment on the front wheels of three 1967 U. S. cars and on all four wheels of one brand. No less than 10 American car brands offer disks as options. By 1968, some experts predict, seven out of every 10 U. S. cars will have disks either as standard equipment or options.

Disks are even more popular with foreign car manufacturers. The Volkswagen model 1600, for instance, has disks in front as standard equipment.

With the spreading use of disks, the question being asked by the do-it-yourself

mechanic is: Can I service them myself?

The answer is yes—within limits. On these pages we show you how linings are replaced. That, happily enough, constitutes the bulk of the service disks require. Disks are pretty rugged.

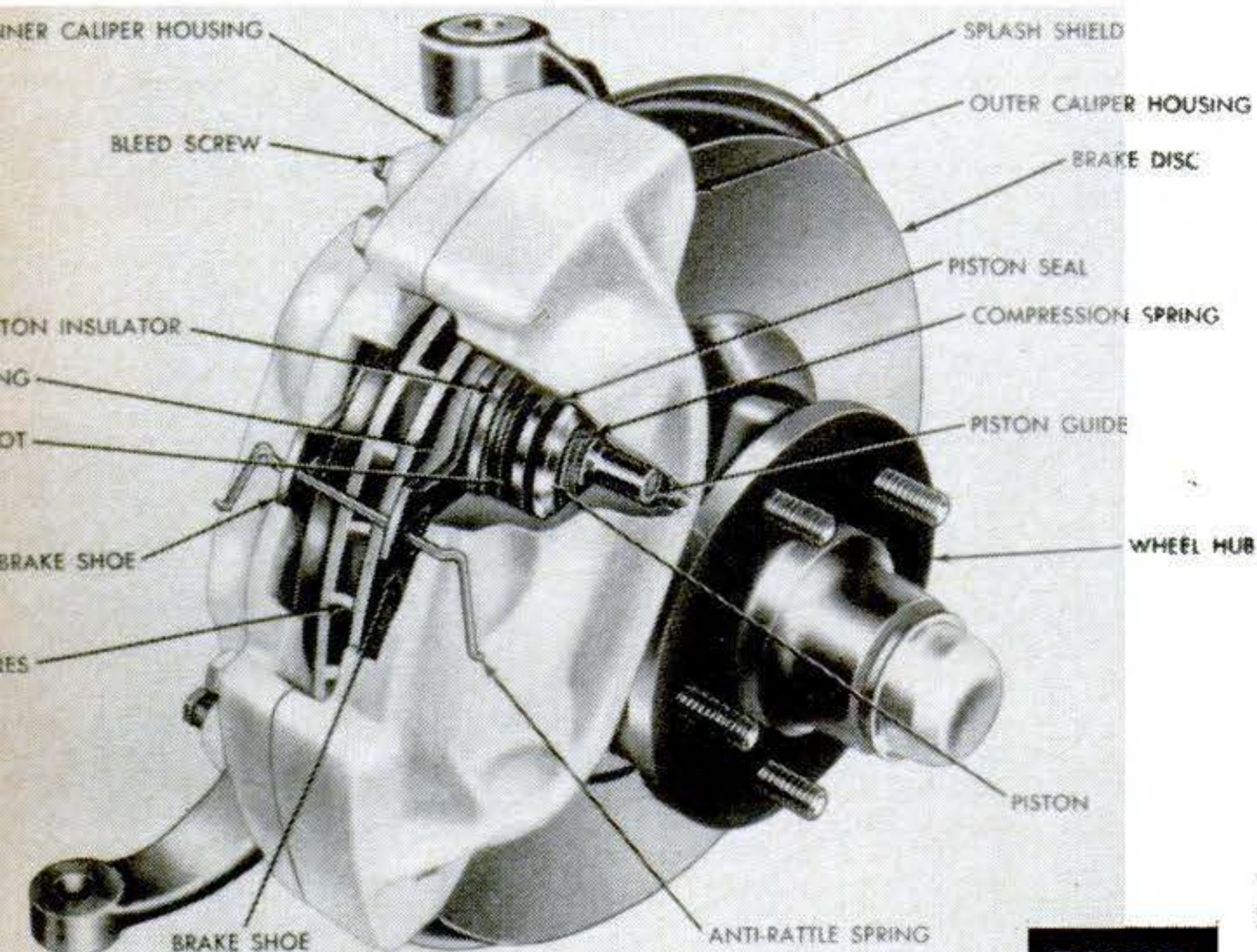
As a matter of terminology in the disk-brake business, if two pistons operate one brake shoe, it is called a shoe. A lining operated by one piston is a pad.

The hydraulic system of a disk-equipped car works like a drum system except that it usually is power-assisted. This often is necessary because of the high pressures needed for brake application.

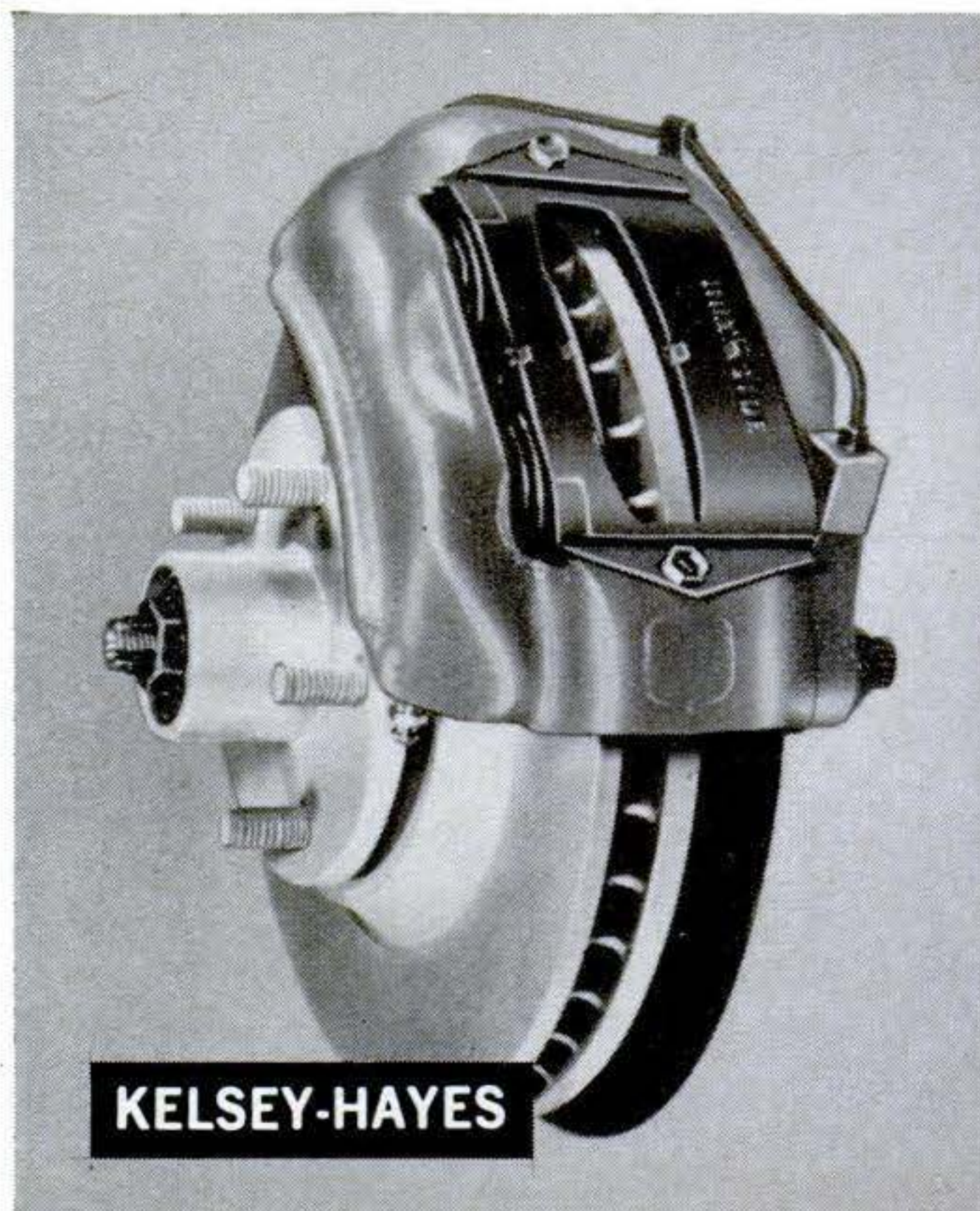
This brings up another difference between ordinary drum and drum-plus-disk systems. Conventional drums on the rear would lock up with the pressures needed to operate a set of front disks. Therefore, a proportioning valve is incorporated in the system that extends to the rear servos. It feeds less hydraulic pressure to the rear wheels.

All disk brakes used on U. S. cars are made by only four manufacturers and have

Four manufacturers turn out all the disks used on U. S. cars.



BUDD



KELSEY-HAYES

BRAKES

the same basic parts and principle of operation. Servicing (again, within limits unless you are an expert) is as simple as the three R's: replace, resurface, recondition. You can do the first and last easily. Resurfacing the disk itself should be farmed out to a professional shop.

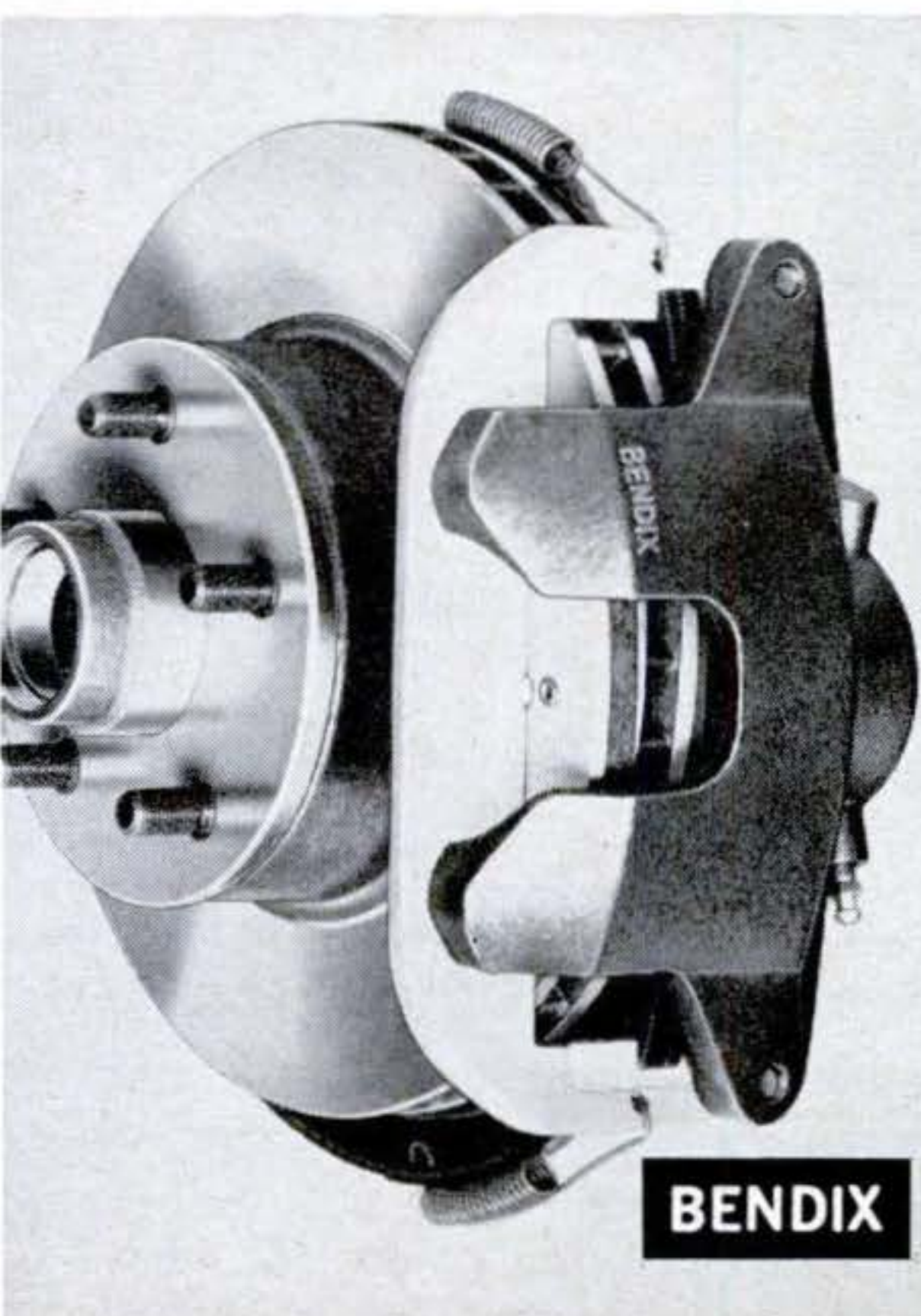
One service that disks do *not* need is adjustment. That's automatic. As the linings wear, hydraulic pressure in brake application plus, in some designs, a spring behind the piston, keep the lining in light contact with the disk at all times. This "free-running" contact is enough to keep the disk warm and prevent splashed water from freezing on it in cold weather.

Continued

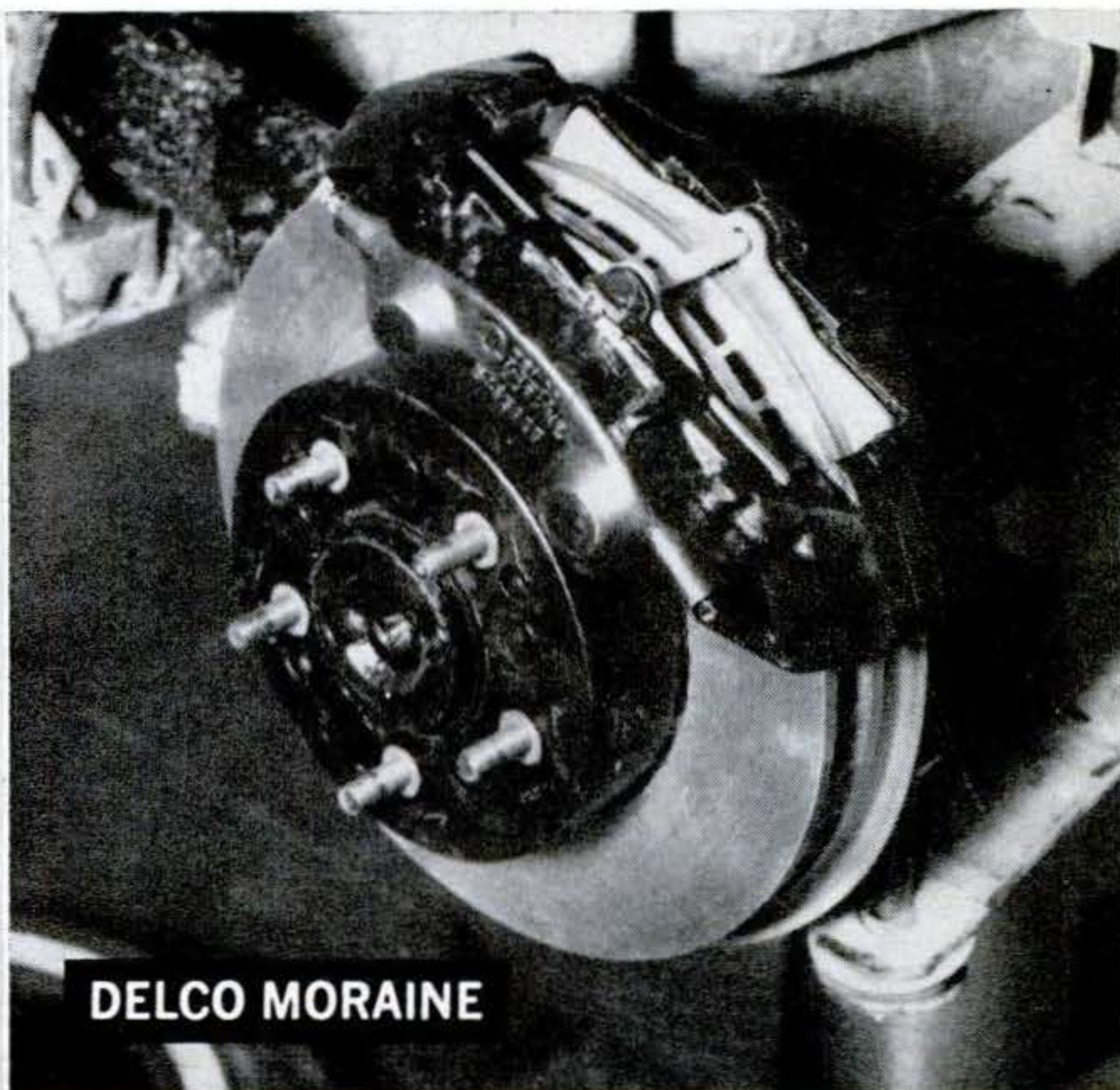


Disk-brake calipers act like a pair of powerful fingers squeezing the disk from both sides to stop it—and the car—when pedal pressure is applied.

There are minor differences, but all work on the same principle

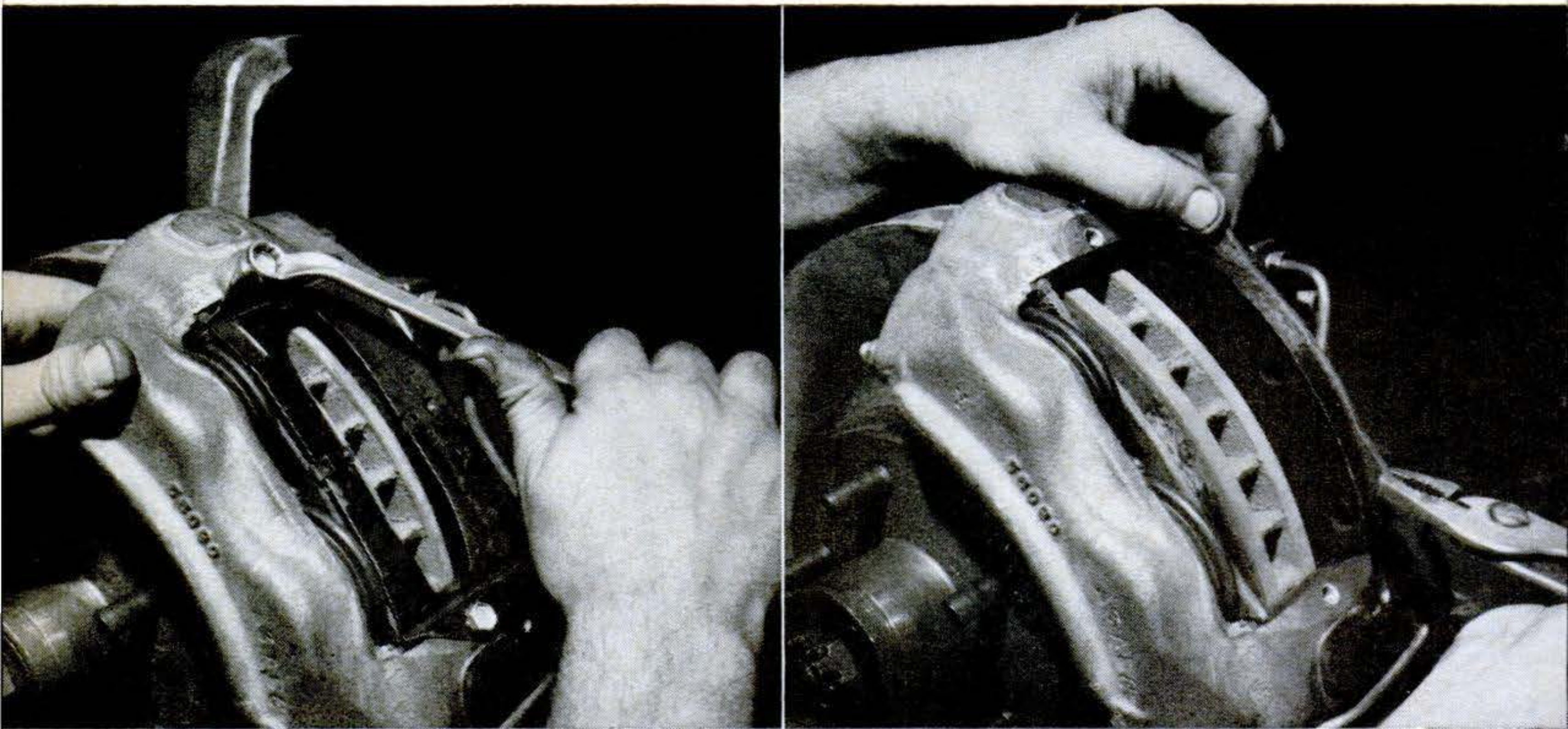


BENDIX



DELCO MORaine

Relining disks is a fairly simple job for the weekend mechanic



General procedure on relining is applicable to all brands of disk brakes. Each has a "holding device." That in Kelsey-Hayes unit, above left, for example, is the cover. Lining removal in this unit is illustrated in photo at right. Instructions on relining that follow apply to Budd brake (see cutaway photo on the opening page). Budd calipers (like Bendix's) must be removed to reline them. Remove lining holding device and brake-shoe antirattle spring. Remove bolts attaching caliper assembly to steering knuckle and steering-knuckle arm. Remove caliper from disk by sliding caliper assembly up and away from disk. Remove brake-shoe-and-lining assemblies one at a time through top opening. Insert a tool between piston insulator pads and use it to see that pistons are fully bottomed. Check for moisture and ruptures of piston

boot. If there is moisture, it will be necessary to disassemble caliper and install new piston seals and boots. Wipe cavity clean between inner and outer caliper housings. Check piston boot for proper seating in groove and under coiled retainer in caliper groove. To install new brake-disk shoe and lining, slide brake-shoe-and-lining assemblies into position in caliper assembly one at a time. Position shoes. Put tool between shoes, adjusting so it holds shoes apart but exerts just enough force against lining surface to keep it from slipping easily on disk. Slide caliper assembly from over brake disk and align mounting holes. As caliper lowers, disk will force tool out of caliper. Install caliper mounting bolts. With a torque wrench tighten to 70 to 80 pounds. Road-test the car, making hard 40-m.p.h. stops to seat units.

Under severe stop-and-go driving, disk linings will last as long as two sets of drum linings. The linings should be visually checked for wear at 10,000 miles.

The master-cylinder fluid level should be checked at least every 4,000 miles or three months, whichever comes first. The level should reach within a half-inch of the reservoir top. Use only the new high-temperature fluid designed for disks.

The manufacturers clue you in to the need for relining. Kelsey-Hayes has tabs, small protrusions on the shoe backing plate that make a scraping sound when it's time to reline. Budd's should be relined before the thickness wears to .03 inches. Replace Bendix linings when the pad is down to 0.125 inch. Delco Moraines call for new pads at about .062 inch; when the lining wears to this point a groove made in the

center of the shoes is no longer visible.

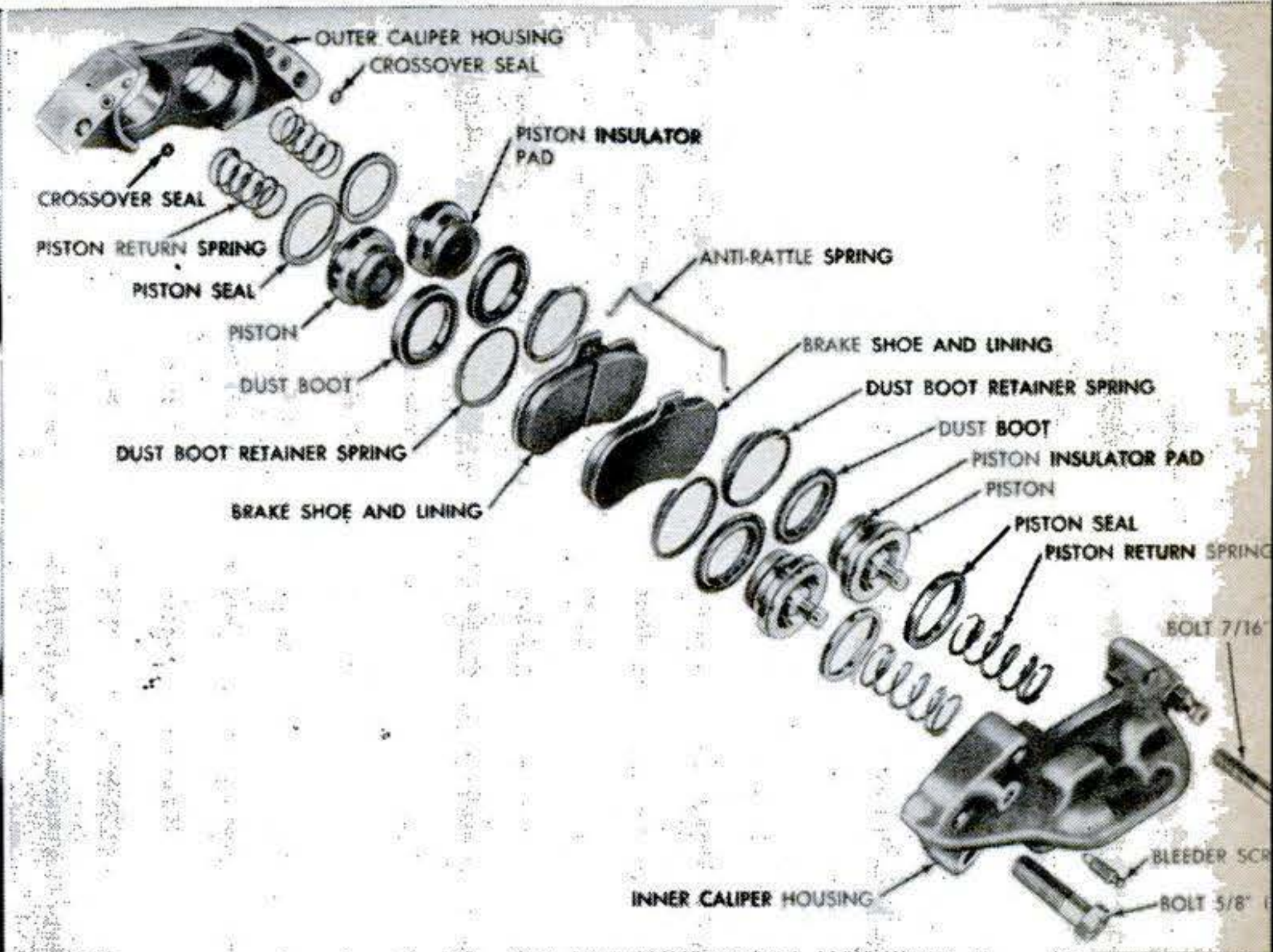
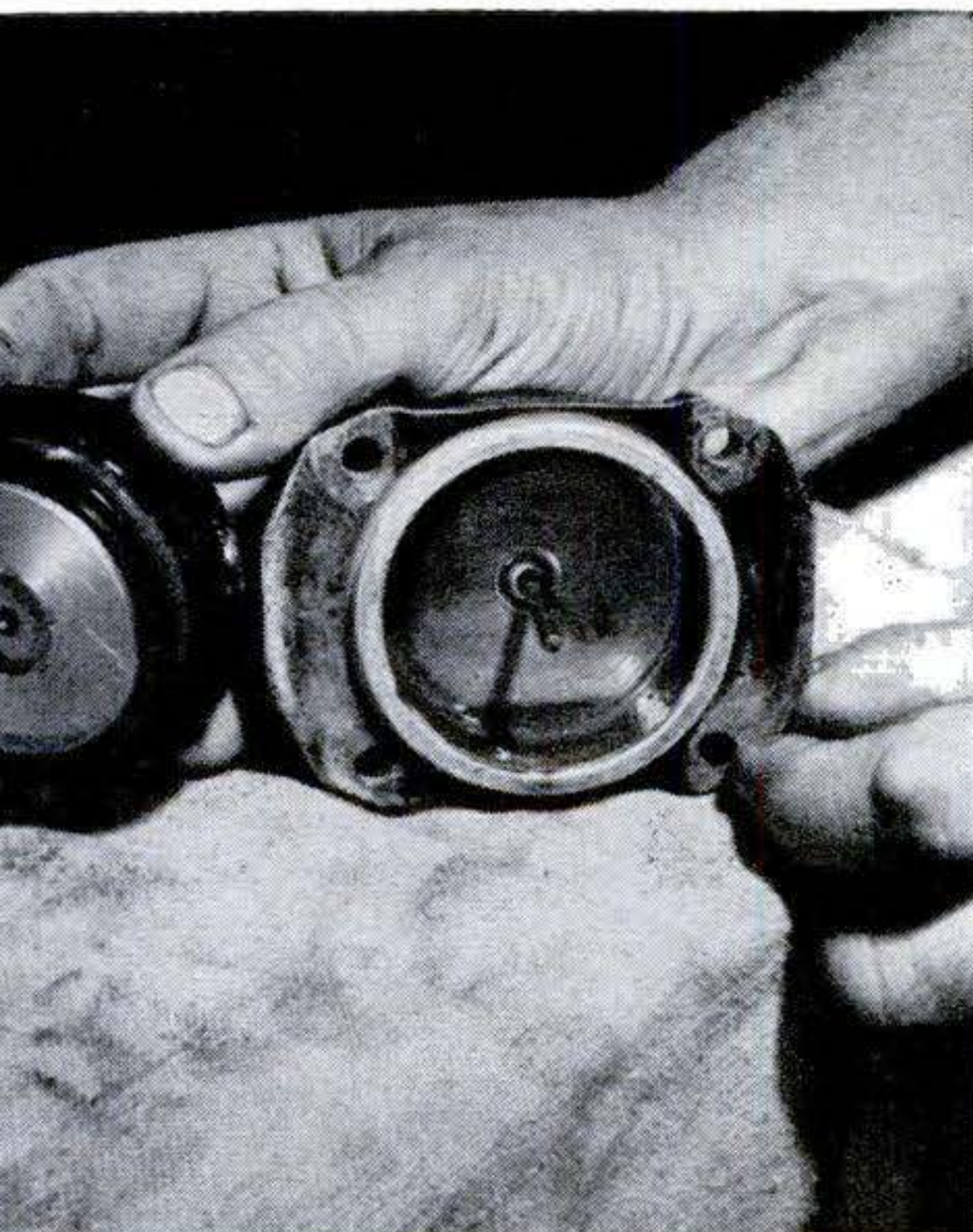
New linings are either riveted or bonded to the metal backing plate. Linings and plate come as a unit.

Inspect both faces of the disk for scoring. Also see if there are any ridges near the center and edge of the disk. If the disk is not worn, you may proceed with relining. If there is wear, take your car to a good brake shop for testing and service.

One wheel at a time. Both Kelsey-Hayes and Delco Moraine disks can be relined on the car. Budd and Bendix calipers must be removed. Work on one wheel at a time. If you try relining two wheels at once, you run the risk of popping the pistons out of a lining-less wheel opposite the one you're working on.

Before you start a relining job, obtain the disk-brake service manual for your car.

Assembling calipers and servicing them takes more ambition



To service caliper, again using a Budd unit (see exploded illustration above, right), start by draining it. Put in vise. Remove piston and four bolts holding caliper halves together. Remove crossover seals. Pry out dust-boot retainer spring with screwdriver and uncoil from its groove to release dust boot. Work boot out of groove, holding piston compressed. Remove piston, its seal, and return spring. Roll seal from groove. Remove remaining pistons. Remove bleeder screw from inner caliper housing. Clean parts in alcohol, wipe dry. Blow out drilled passages and bores with air hose. Check dust boots for punctures or tears. Inspect piston bores for scoring or pitting. Crocus cloth will clean corrosion or light scratches. Deep scratches require honing. Bore diameter must not be increased more than .002 in. (picture above,

left). Black stains on bore walls are harmless. After honing, flush caliper with alcohol, wipe clean. Clamp caliper housing in vise and coat cylinder bores with silicone grease. Install piston-return spring. Coat outside and inside of piston seal with silicone and push land into groove with fingers. Install dust boot on piston. Install piston assembly over return spring. Press until piston bottoms. Work boot lip into groove. Start coil-retainer spring into its groove by inserting end over boot. Be sure boot is locked in. Install other pistons the same way, testing for operation by depressing with fingers. Install crossover-passage seals. Mate caliper halves and bolt. Tighten to 55 pounds for 7/16 bolts, 150 for 5/8. As with relining, road-test car with several hard 40-m.p.h. stops to wear off foreign material and seat units.

Okay, now: Empty the master cylinder of fluid. Discard the fluid. A rubber diaphragm under the master-cylinder cover will form a hydraulic lock if the fluid reaches it, and the piston won't bottom.

Raise the car on a hoist or jack stands. Remove the wheel. Now follow the instructions in the caption on the facing page.

Procedures differ slightly with different brake brands. The Delco Moraine holding device, for example, is a pin.

On Kelsey-Hayes brakes you have to remove the caliper splash shield and anti-rattle springs. Then you pull the linings out by their tabs with two pairs of pliers.

Budd and Bendix calipers are removed by slipping them out from the disk side of the caliper. Whatever the brand, with the linings out, try pushing each piston back into the caliper with a screwdriver. If any of

the pistons are sticky, the caliper needs service.

Road-testing. When the wheels are relined, refill the master cylinder and bleed the system, as with drums. Road-test the car. Apply the brakes lightly at first, watching for any pulsations. These would indicate the need for service to the disk. So would pulling to one side or excessive squeaking. That would call for professional shop service.

It is important to reline rear-wheel drums at the same time as front disks to maintain braking balance.

Most disk makers recommend leaving caliper service—beyond relining—to the service shop. However, service literature of Dodge Dart and some other cars outline caliper reconditioning beautifully. If you

[\[Continued on page 193\]](#)

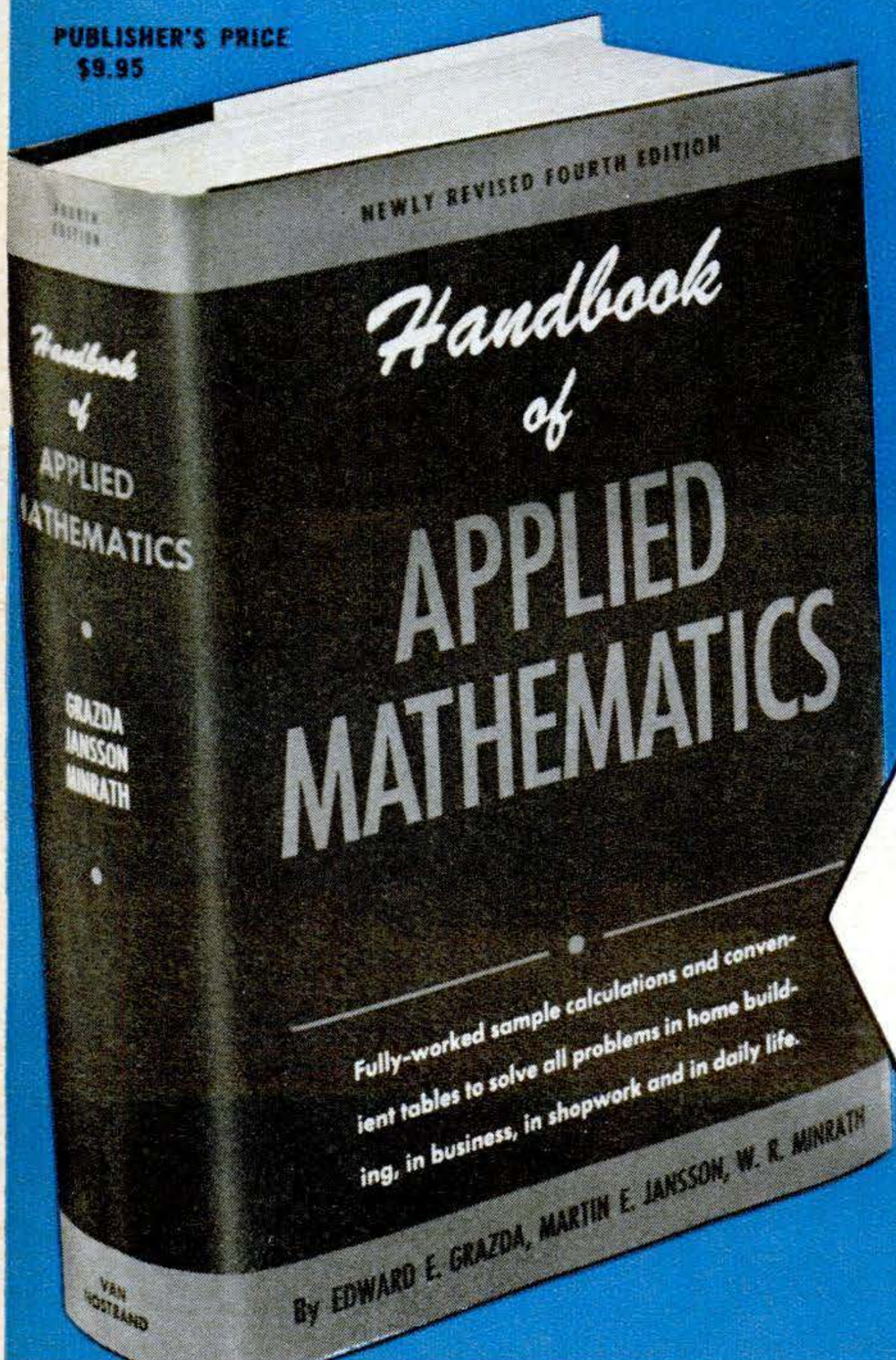
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CARD TODAY!



Gus Makes a Guest

When the school auto instructor is out sick, Gus takes over — and reveals one of his most valuable troubleshooting secrets

By **MARTIN BUNN**
ILLUSTRATION BY RAY QUIGLEY

Gus Wilson ducked from under a car hood and grabbed the ringing phone at the Model Garage. The persuasive voice of Matt Edwards, director of the new Vocational-Technical school, came through the receiver.

"Gus, I've got a problem, and I hope you can help me out."

Edwards seldom called just to chat. Operating on a shoestring budget, he had become adept at persuading local technical experts—including Gus—to serve as his advisory board.

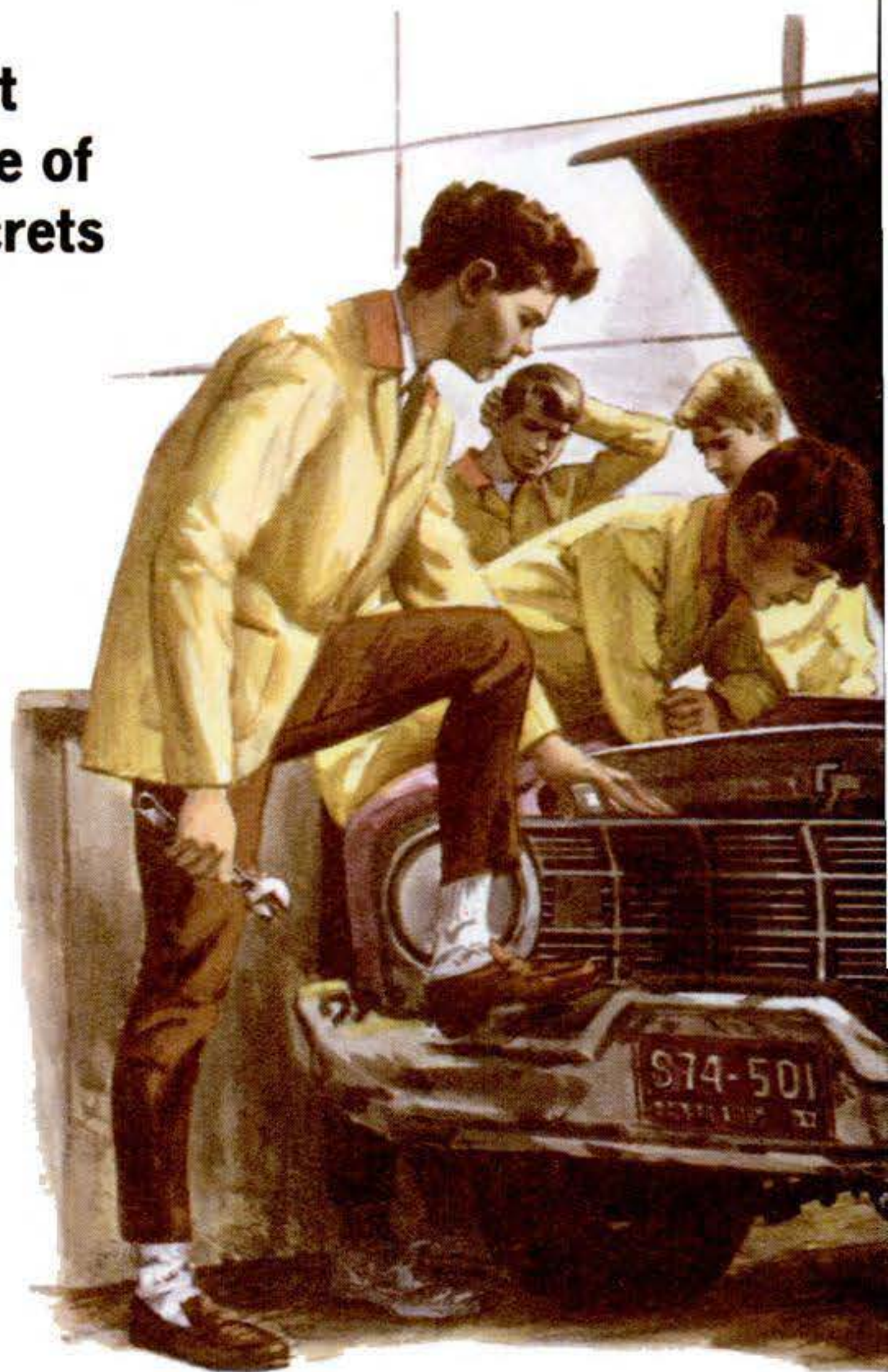
"Fire away, Matt." Gus knew how badly the area needed youngsters with sound post-high-school auto-mechanics training, and was a staunch supporter of the school.

"Your monthly lecture is Thursday, Gus. But I wonder if you'd come over this morning? Our auto teacher is out sick today." Edwards paused. "I've been trying to keep his class busy, but the truth is, I'm not enough of a mechanic to fix an ailing Falcon. What they need is a Gus Wilson lesson in troubleshooting."

"The car belongs to one of the boys," Edwards went on, "and the group is counting pretty heavily on taking it to Centerville this afternoon. They're competing with the Voc-Tech school over there in a mechanical-proficiency exercise. Incidentally, I hear young Bill Harvey is in trouble with the police about faulty equipment on the Falcon, too. See what I mean about needing your help, Gus?"

Gus sighed, put on his jacket, and started out of the office. He met his assistant, Stan Hicks, on the drive.

"Take over awhile, Stan. I've got to go take care of an investment."



"I think the biggest problem is that Gus Wilson is afraid to dirty his hands!" Gus wheeled to see Matt Edwards grinning delightedly.

"I didn't even know he owned stocks," Stan muttered to himself, as he watched Gus climb into the service truck.

Entering the old factory building Edwards had converted into a school, Gus quickly made his way toward the section devoted to the mechanical trades.

About six pairs of assorted jeans showed beneath identical shop-coated figures crowded around a faded but glistening Falcon. One of the boys was talking.

"If we don't get smart quick, we'll not only be walking to Centerville — we'll lose the contest sure, for being so dumb."

The boy, Bill Harvey, broke into a broad grin as he looked up and saw Gus. Sweeping

Appearance



back a shock of red hair, he extended a hand. "Mr. Edwards is flying around here like a mother hen today. Said we could expect you over. And man, have we got problems for you!"

Gus knew that the boys were allowed to work on their own cars in class if they bought the parts. On the used Falcon he'd just bought, young Harvey told Gus, the class had completely restored the ignition and fuel system using almost all new parts.

"Needs more than parts," Sam Archie said, looking up from the engine compartment.

"He's right, Mr. Wilson," Bill Harvey said sadly. "It runs great in here, but on the street it hasn't the power to pull the hat off your head."

"How about your trouble with the law?" Gus asked.

"Oh, gosh, yes. Two faulty-equipment tickets in two days. Officer Corcoran says if I don't get the stoplights on this thing working today, he'll make me go to a garage and get it fixed."

"The crazy thing is, they work fine in here." Lanky Sam Archie's Adam's apple quivered. "We found blown fuses, and a sluggish pressure switch. We went over every connection and grommet, and checked everything with a circuit tester. Nobody home. This morning Bill blew another fuse, got picked up, and still doesn't have any power."

"Will you have a look at it?" Bill urged.

Continued

"It's your problem," answered Gus. "I'm here only as an adviser; you guys are the mechanics. I'll offer a couple of thoughts, though. First off, I hope you don't expect that little engine to win drag races. Secondly, fuses don't blow without good cause, and a sticky stoplight switch is seldom a cause."

"I think the biggest problem is that Gus Wilson is afraid to dirty his hands!"

Gus wheeled to see white-haired Matt Edwards grinning delightedly.

"Sometimes a mechanic can earn his keep by listening and thinking," Gus said.

"Seriously, Gus, think you can help us? With the instructor off, and me tied up this afternoon, we'll have to make some

"I'll bet you don't think we even have a problem," Bill said glumly.

"I think we should assume that the two problems are not related," Gus said. "Let's go back to the shop."

Pulling up to the school building, Bill applied the parking brake and ran up the ramp to open the overhead shop door.

Inside, Gus directed the students to block the wheels, put on the brakes, rev the engine, and try to stall it in high gear.

With Bill at the controls, the little car strained at the blocks, labored bravely, and finally stalled. "What does that prove, Mr. Wilson?" he asked, cutting the ignition.

"Well, I'd say it proves what we found in test-driving it. It doesn't lack power."

"So either we're nutty, or . . ." Bill hesitated. "I bet I know—the air cleaner!"

"Right." Gus said, grinning.

"We've been running it around here and on the test drive without an air cleaner."

"Can't be," Sam Archie argued. "I cleaned it, and it wouldn't make any difference, on or off."

"Put it on and see," Gus said.

"I'll do it," Sam offered. "I'm the air-cleaner expert here." In no time he was calling "okay."

Bill hit the starter. The boys watched closely. As the engine started to rev, it starved, faltered, and starved again.

Sam's face turned red. "How stupid can a guy get?" he moaned.

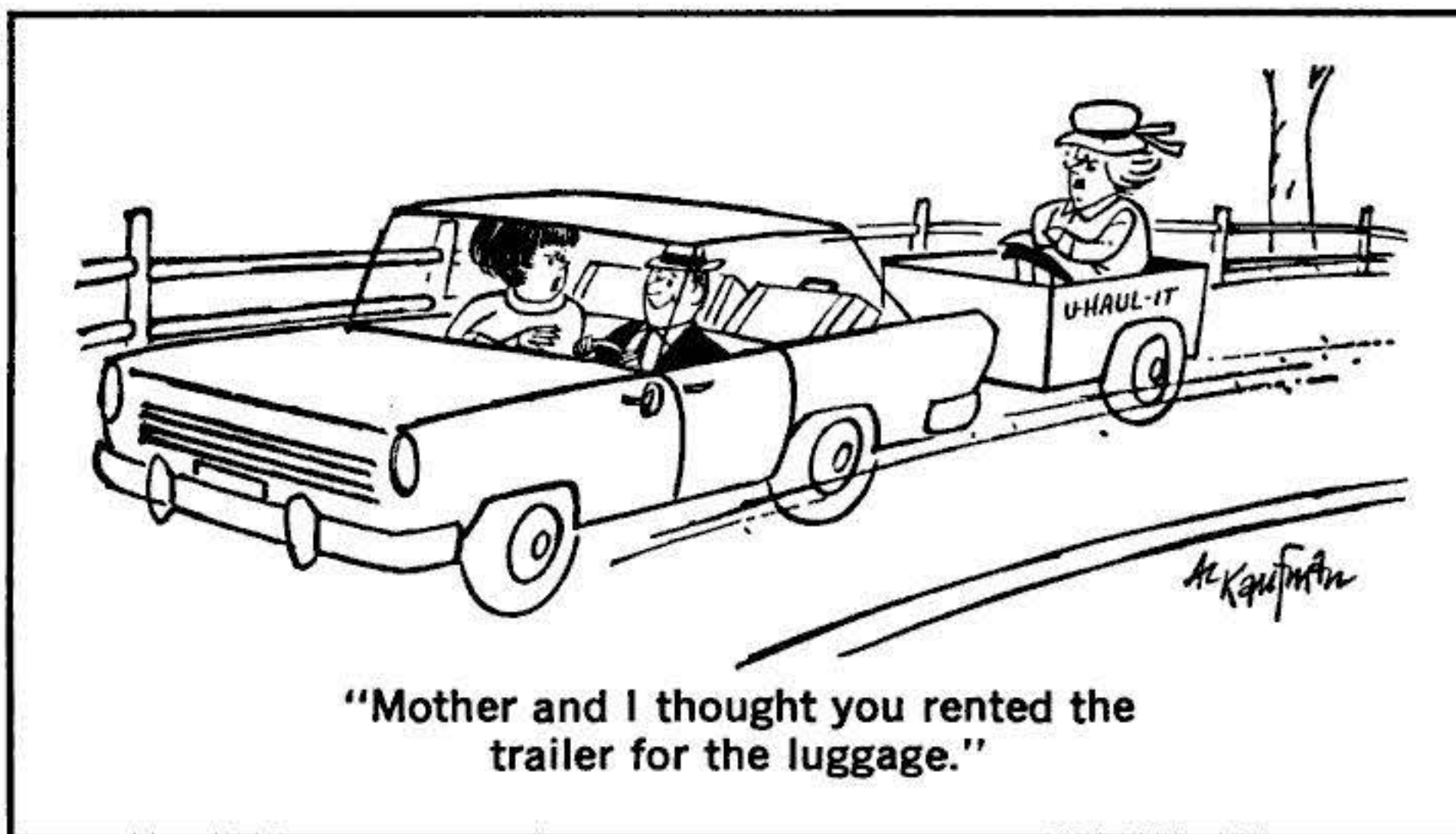
"That's your trouble, all right," Gus said. "Want to explain it to the class, Sam?"

"I guess I've been putting the air cleaner on wrong," Sam said shamefacedly. "The rush of air on acceleration was sucking the antifreeze tag over the intake horn. I guess I must have put it on wrong each time I replaced it."

"Don't feel too bad," Gus said. "When things go according to the book, a mechanic's job is easy. In troubleshooting a job like this, you may have to duplicate every condition that existed when the problem occurred."

"Does that hold true for the fuse and stoplight problem, too?" Bill asked.

Continued



"Mother and I thought you rented the trailer for the luggage."

other arrangement to get the boys to Centerville if they can't get the car fixed."

"Well," Gus said, "these boys are sharp, and it sounds as if they've taken every normal action. But I think it's about time to guide them in some logical thinking that will isolate the troubles."

"That's what they need," Matt said. "Nothing would make me happier than to see these boys whip Centerville this afternoon. They'll have some tough mechanical bugs to dope out, and they'll have to do it faster than the Centerville Voc-Tech youngsters."

With Bill at the wheel, Gus rode along as they took the Falcon for a test run. The engine performed perfectly.

"Let's take it on some rough streets and try the brakes a few times," Gus suggested.

They stopped on a quiet street, and Gus watched from behind as Bill repeatedly applied the brakes. The stoplights glowed.



Only in Ford's Bronco: 200 V-8 horses ahead of you, and a 24/24 plus 5/50 warranty behind you.

Ford Motor Company warrants to Ford Bronco owners that Ford dealers, using genuine new Ford or Ford Authorized Reconditioned parts, will repair or replace, free of charge including related labor, the following parts which are found, in normal use and within the following time and mileage limits (whichever comes first), to be defective in either workmanship or materials: (a) any part within 24 months or 24,000 miles, and (b) Power Train parts within 5 years or 50,000 miles. Power Train parts include: engine block, head and internal parts, water pump, intake manifold, transmission and transfer cases and internal parts, drive shafts, universal joints, differentials, and driving axles and their wheel bearings. Related items such as ignition, electrical, cooling, fuel and brake systems, engine or transmission controls or linkages, and clutch assembly are excluded. The owner is required to obtain certain maintenance services* and, every 12 months, a written certification from a Ford dealer that he has presented evidence that such services have been performed. The warranty does not apply to tires or tubes (adjustments are provided by tire companies), or to normal maintenance services or normal replacement of service parts such as filters, spark plugs, ignition points, wiper blades or brake or clutch linings, or to normal deterioration of soft trim and appearance items. The warranty applies to vehicles normally operated in the U.S.A. and Canada *Every 6 months or 6,000 miles: change oil and oil filter; clean air cleaner, air filter and oil filter cap; check axle lube and transmission oil levels. Every 12 months or 12,000 miles: replace air filter on closed crankcase ventilation systems; clean emission system and carburetor spacer; replace emission control valve and thermactor air filter. Every 24 months or 24,000 miles: change engine coolant and check radiator hoses. Every 36 months or 36,000 miles: replace air filter on open crankcase ventilation systems.

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FORD BRONCO
4 WHEEL
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"Could be. You fellows have established the result: blown fuses. You know it's in the stoplight circuit, and you've done the diagnosis work. What do you think?"

"Beats me," said Bill. "You checked when we made the test runs. Stoplights worked fine. It only happens when I drive it to school."

"Well, what are you doing differently?" asked Gus.

"Gee, I don't know. I back it out of the garage, close the door, and come to school, that's all."

Gus glanced at his watch. They'd have to do something pretty quick if the boys were to make it to the afternoon contest.

"Take it for a spin again and see what happens," he said.

Bill backed out of the stall. Gus noted that the brake lights did not go on as Bill braked to wait for the door to open.

"Brake lights don't work!" Gus shouted.

"But they worked when we checked."

"Somehow," Gus said, "we've duplicated the conditions. You say you have to stop, then close the door at home."

"What difference does that make? I stop, put on the parking brake, close the door, and go. Besides," Bill added, "the parking brake isn't electrical."

"Granted." Gus stoked his pipe. "But if I remember correctly, the parking brake is pretty close to a lot of wiring under the dash of a Falcon. You don't suppose. . ."

"I'm not supposing. I'm looking. Pull the brake for me, Sam." Bill was on his back under the dash.

"Well I'll be darned!" Bill came up. "There's a loose wire across the parking-brake housing. It gets hooked by a screw that guides the parking-brake lever shaft in the slotted housing tube. It pulls the wire taut when the brake is applied, and it cut through the insulation."

Sam spoke up. "So nothing happens until you apply the foot brake with the parking brake on. Then you get a dead short, and the fuse blows. Right, Mr. Wilson?"

"That's the way it looks. Probably didn't find it on trial runs before because you guys are so helpful that Bill didn't have to stop and close the door."

"Speaking about being helpful," Bill said, eyes narrowed, "which one of you fatheads put that new tag on when we changed antifreeze yesterday?"

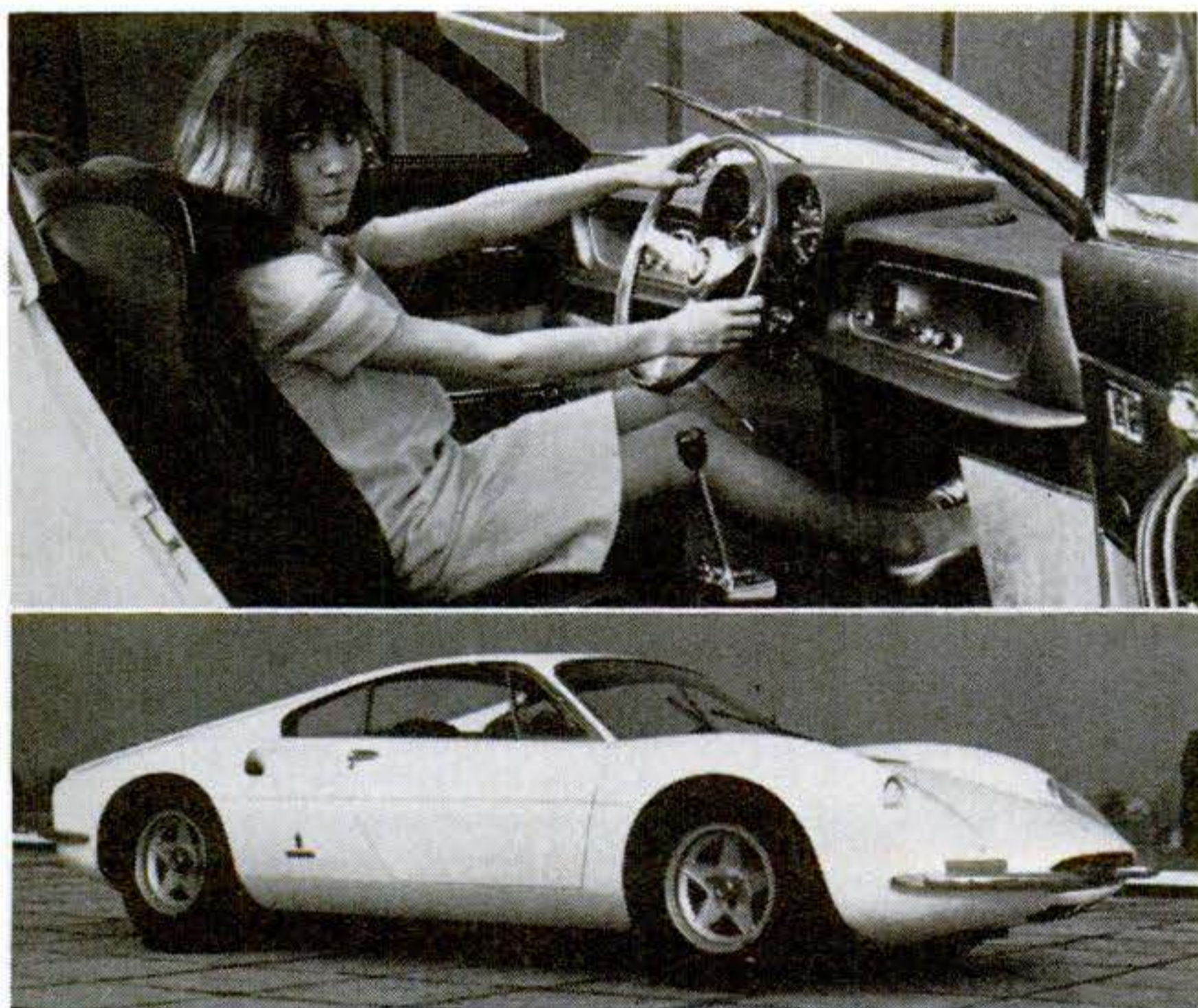
"Hold on," Gus said. "Let's nail down just how we went at these problems. It may help you this afternoon."

Gus was at his desk poring over the day's bookwork when the phone rang. Matt Edward's voice came on. "Wanted to thank you for substitute-teaching today, Gus. And get this. Our boys won the contest. Just by a hair, you understand, but they're learning. Also, about that lecture of yours next Thursday—"

"Next Thursday?" Gus murmured weakly. "But I thought—"

"Thought what, Professor? You know you have a lecture the first Thursday of every month!"

PS



New Ferrari three-seater has steering wheel in center

Ferrari's new 365 P Special Berlinetta, designed by Pininfarina, puts the driver in the middle with a novel centrally located steering wheel. The driver's seat is three inches forward of the passenger seats, which flank him. The dashboard controls are also located in the center of the instrument panel for the driver's convenience. The Berlinetta has a V-12 rear-mounted engine with 4,400cc. displacement. The classic Ferrari grille and low-slung body give the car a race-bred look.



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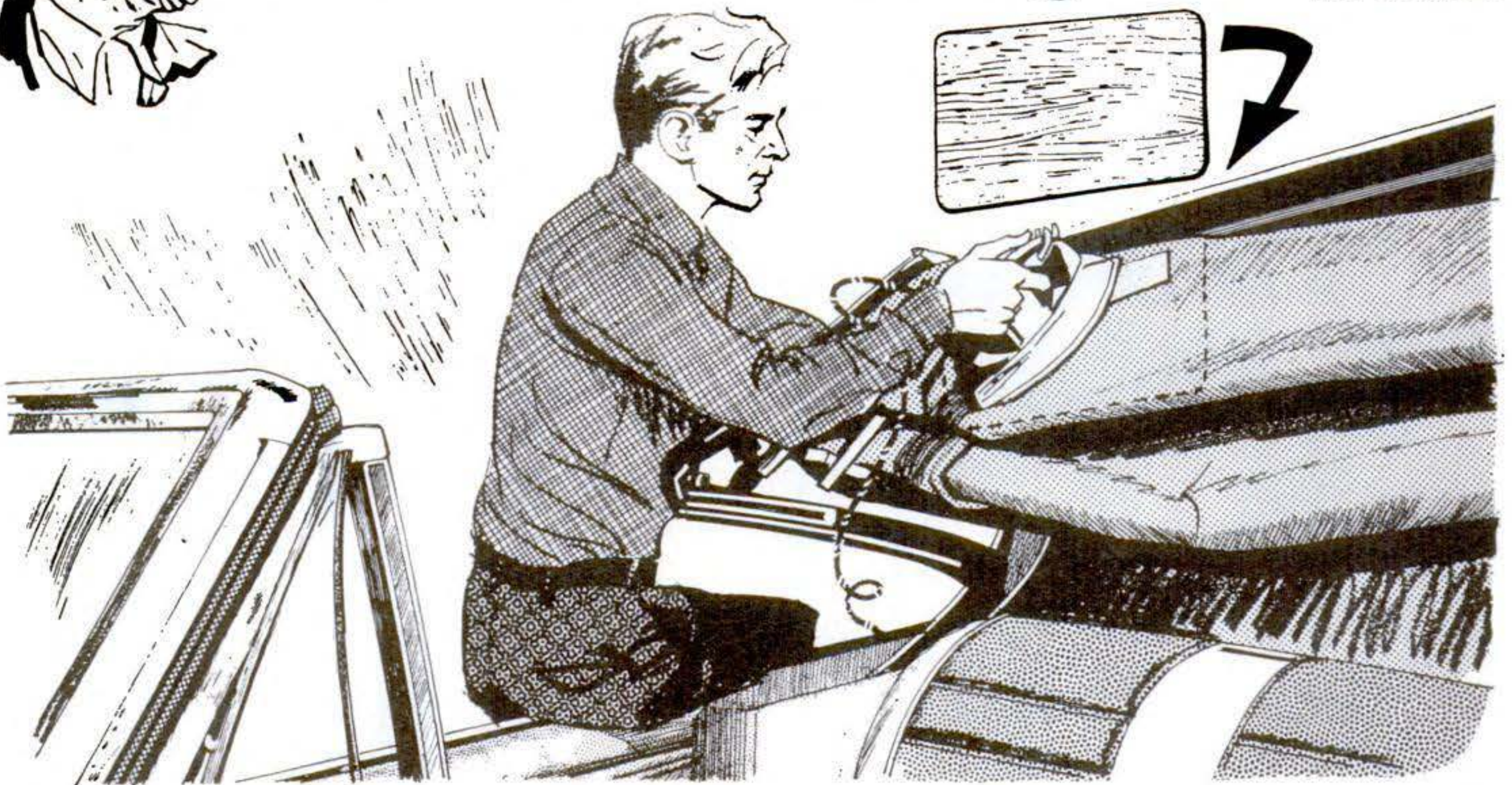


**Impala Sport Coupe shown with optional Turbo-Fire 327 V8, Powerglide, power steering, power brakes, radio, wheel covers, floor mats.*



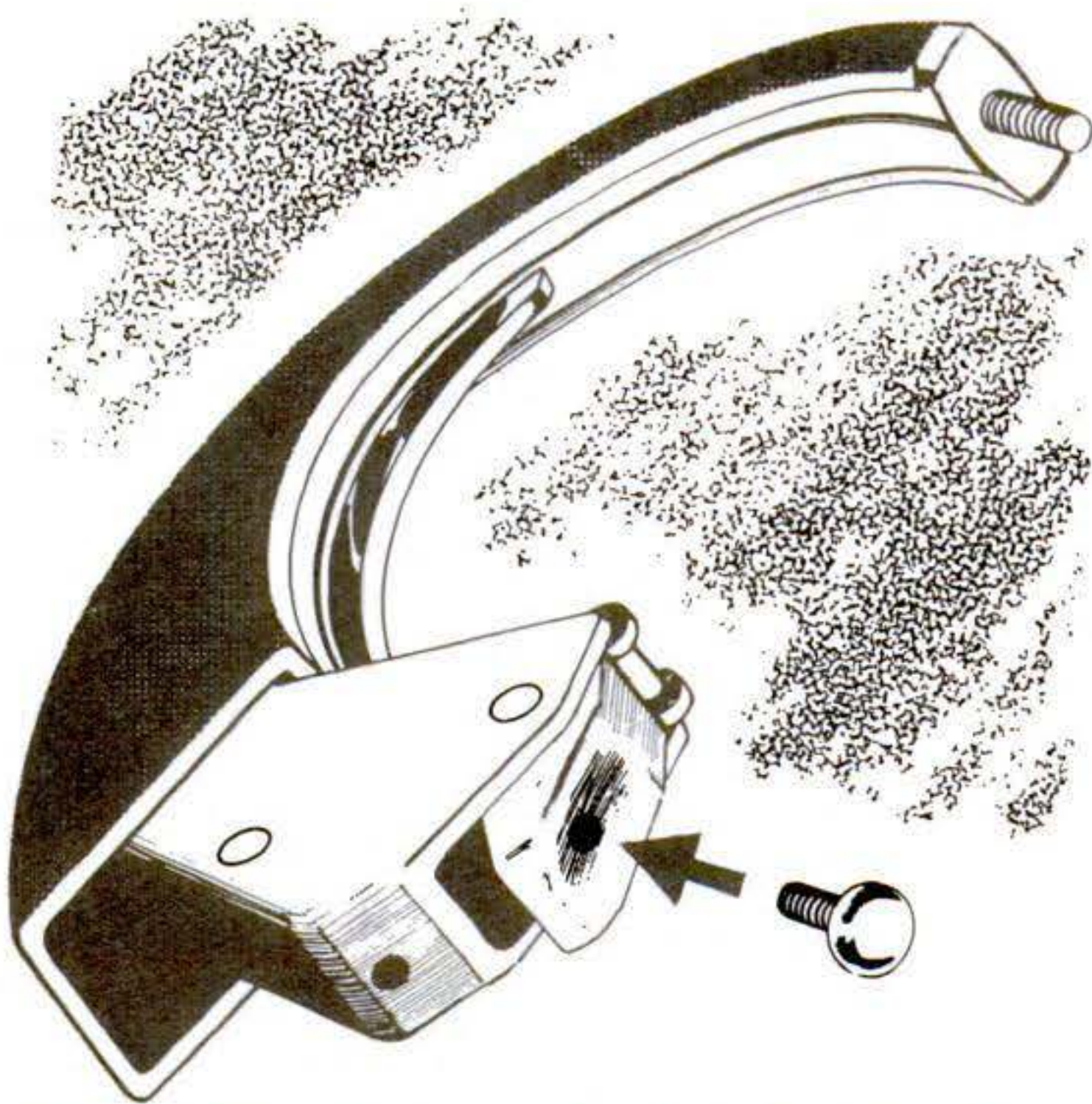
Hints from the Model Garage

DRAWINGS BY RAY QUIQLEY

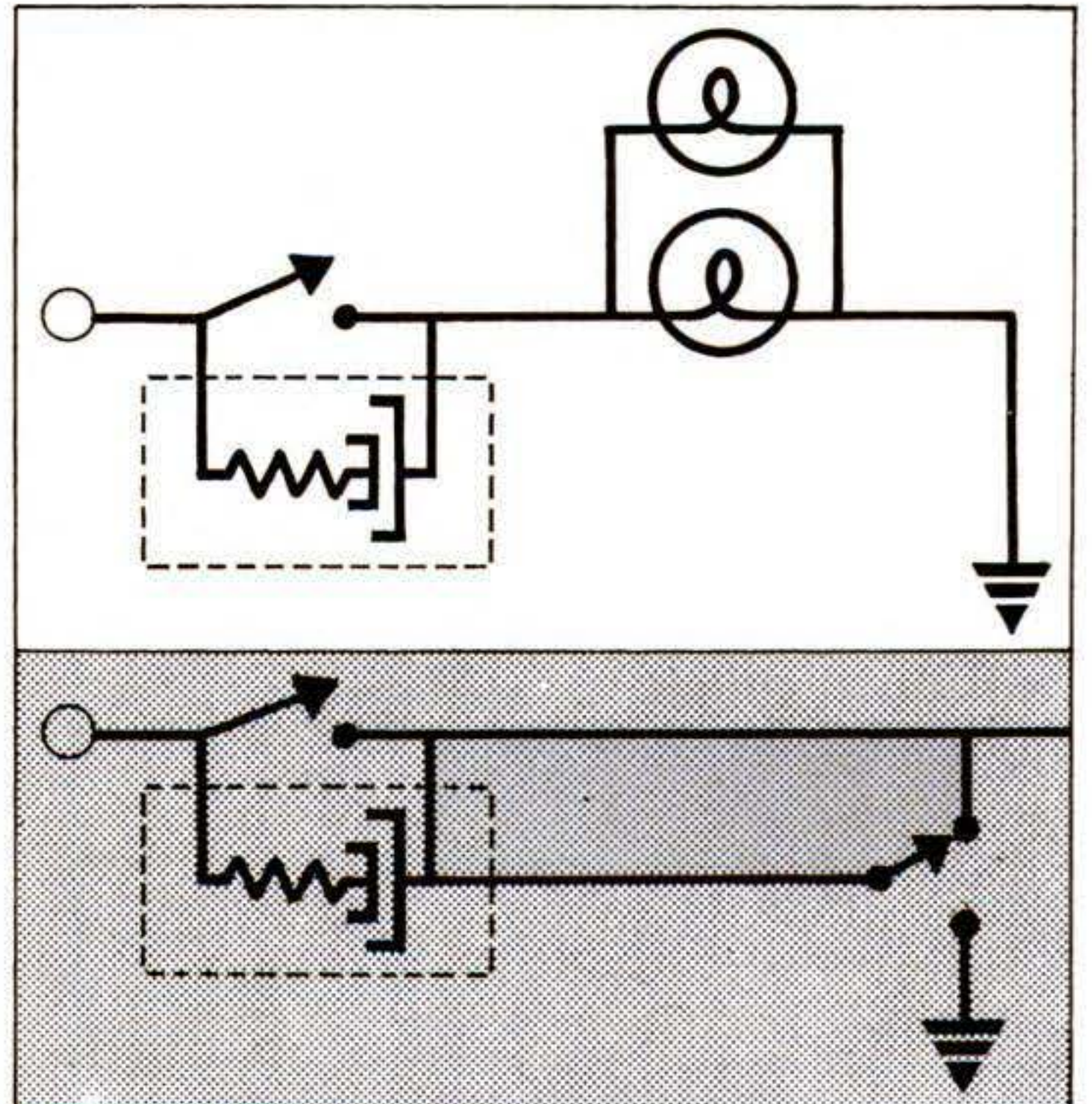


Repairing slits in soft tops is easy with heavy-duty iron-on rug tape. Heat settings may vary on different irons—use the minimum heat that will bind the tape. Lower the top to a halfway position and keep the material loosely folded so that when you put the tape on, any sag in the vinyl

caused by the slit will be taken up. Iron the tape to the inside of the top, using a piece of smooth plywood underneath as an ironing board. The adhesive used for iron-on tapes is waterproof, so when you're done ironing, the top is ready for use—rain won't leak through.



Worn latch-release mechanisms in door handles finally cease to open doors at all. Fix them by drilling a hole in the worn spot on the trip, inserting either a sheet-metal screw or a round-head bolt to make a higher wearing point. The repair will last for years.



For an ideal time-delay switch, wire your cigarette lighter in series across the headlight switch. Depress the lighter when you leave the car, and unlock your garage or house door aided by your headlights. When the element warms up, the circuit is broken and the lights turn off.

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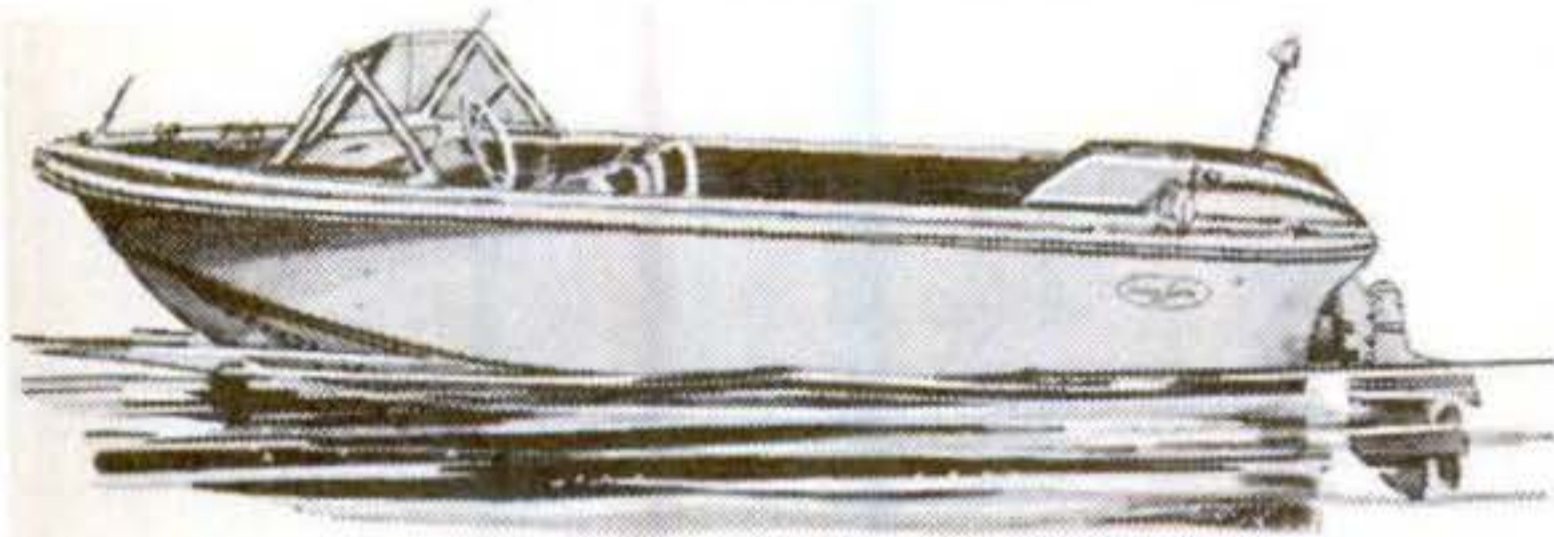
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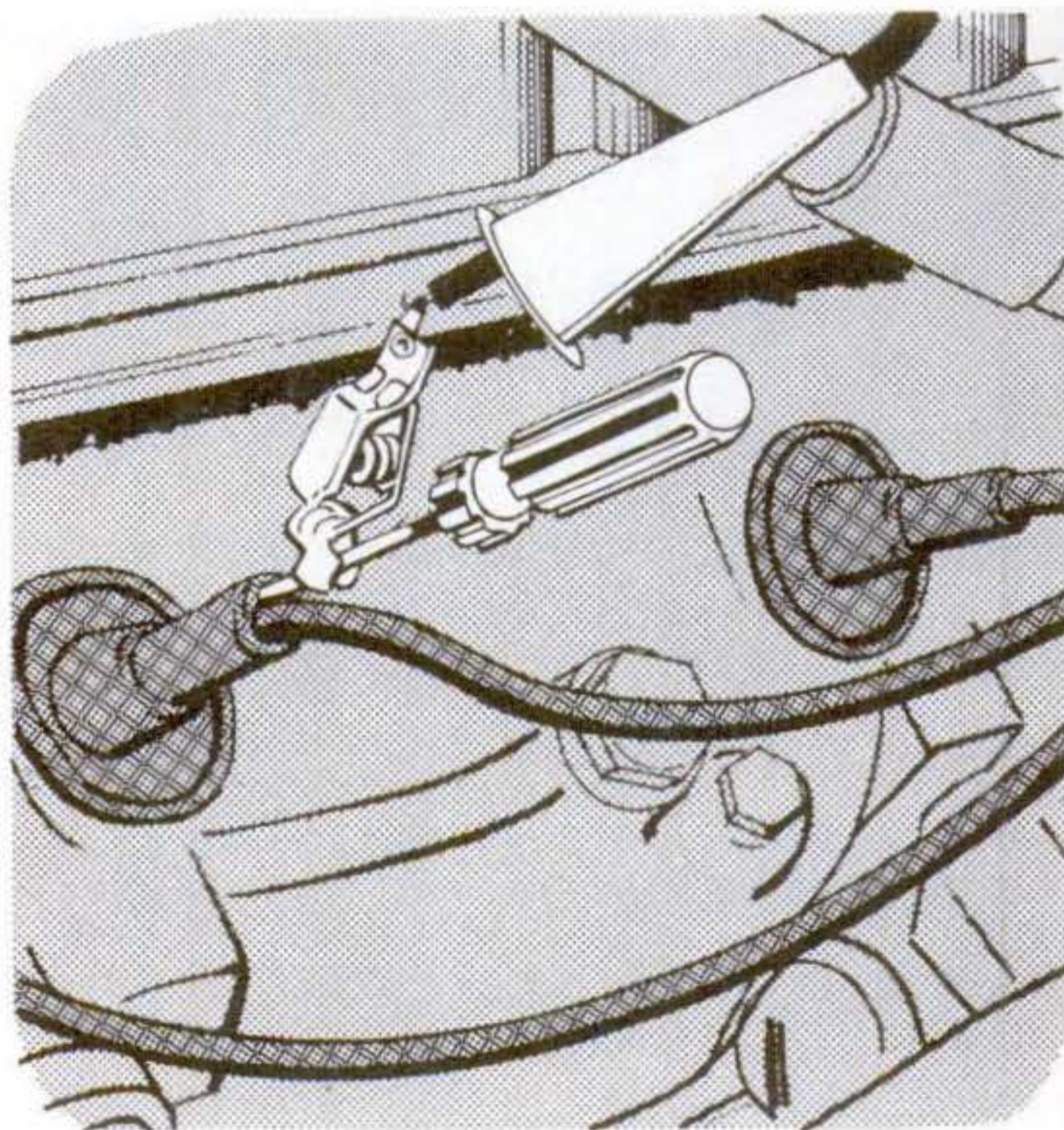


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More Hints from the Model Garage



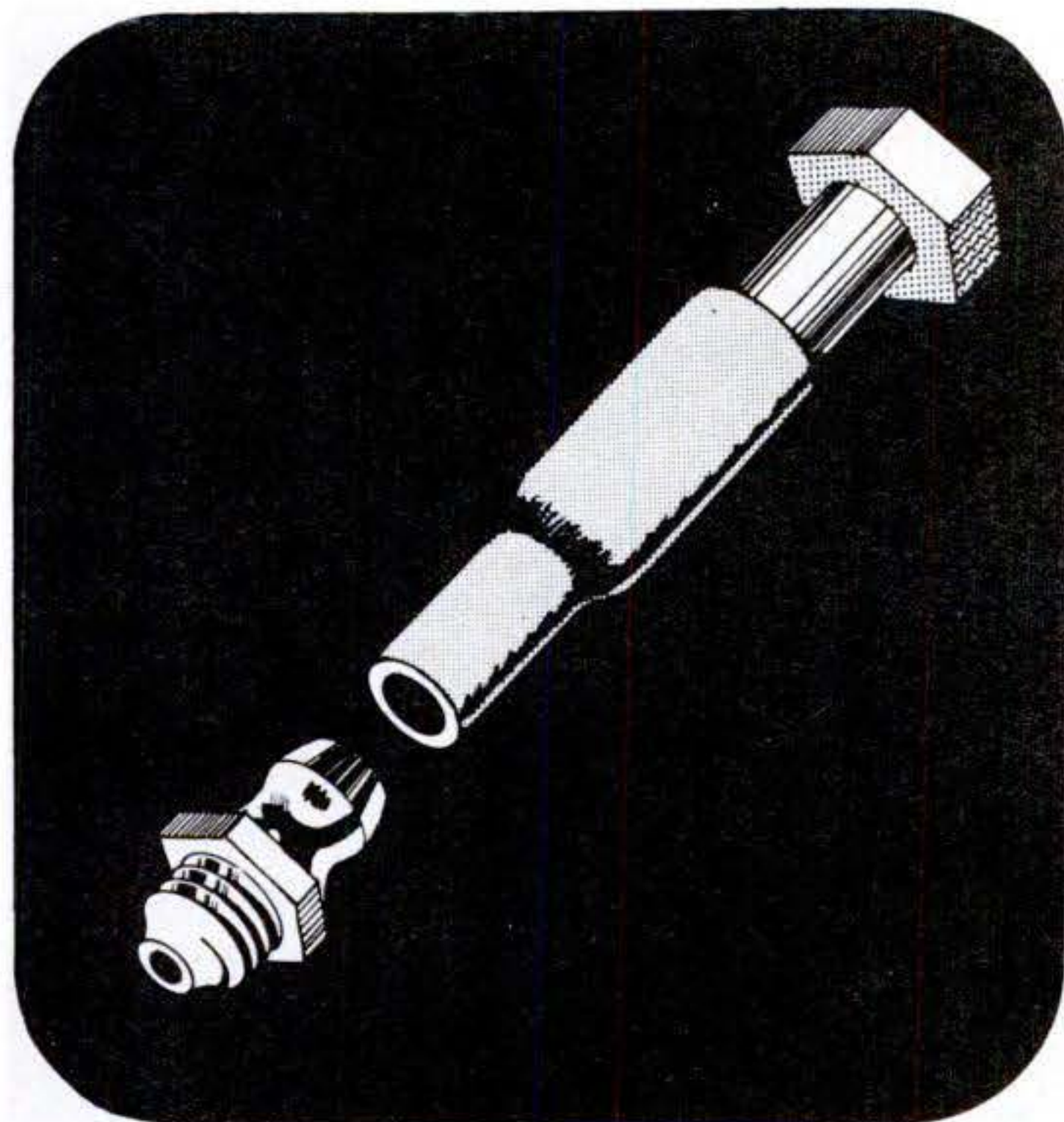
When removing undercoating from inside a fender to reach a nut or bolt, play a heat lamp against the outside. This will warm up the undercoating until it becomes soft and can be removed easily with a putty knife. Do not use a torch, as the hot flame may damage paintwork.



For timing engines, a small plastic-handled screwdriver is a big help. Just force it down alongside the wire and then clip the timing light to the blade of the screwdriver. This simple short cut can save hunting around for a suitable hook-up connection for the light.



Repairing punctures in tubeless tires in cold weather is hard: The plugs are stiff and difficult to fit. Try this: Bend some wire around the plug and dunk it in hot water for half a minute. This will make the plug more flexible and easier to fit without risk of damage.



Installing grease fittings in ball joints, steering gear, and universal joints can be made easier if you press the nipple head into one end of a two-inch-long windshield-wiper hose and put a hex-head bolt in the other. Screw the fitting in, pull the hose off, tighten with a wrench.

Kodak
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The KODAK CAROUSEL Projector has a round tray that sits on top—the best set-up for problem-free slide shows.

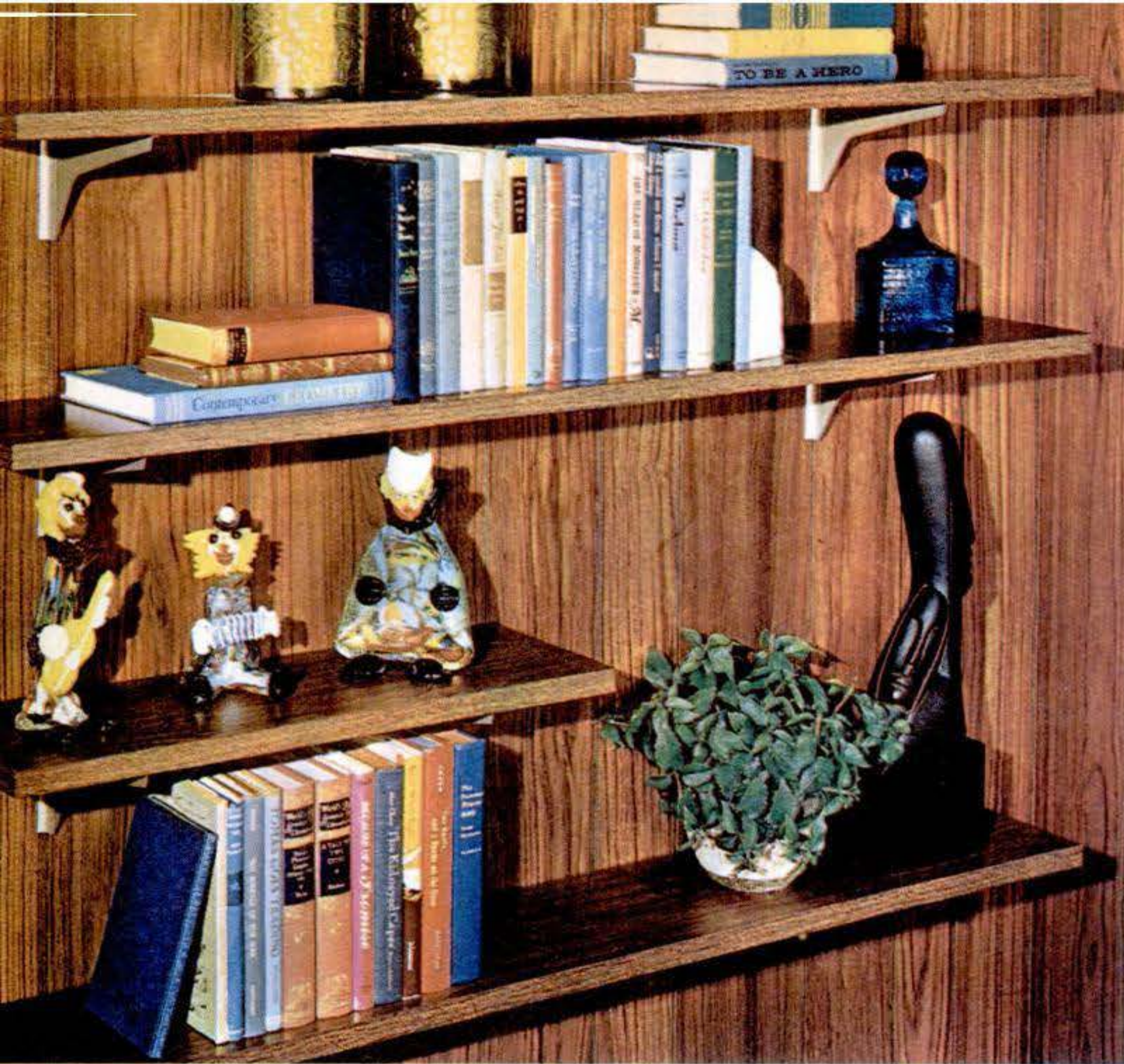
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Kodak Carousel Projectors





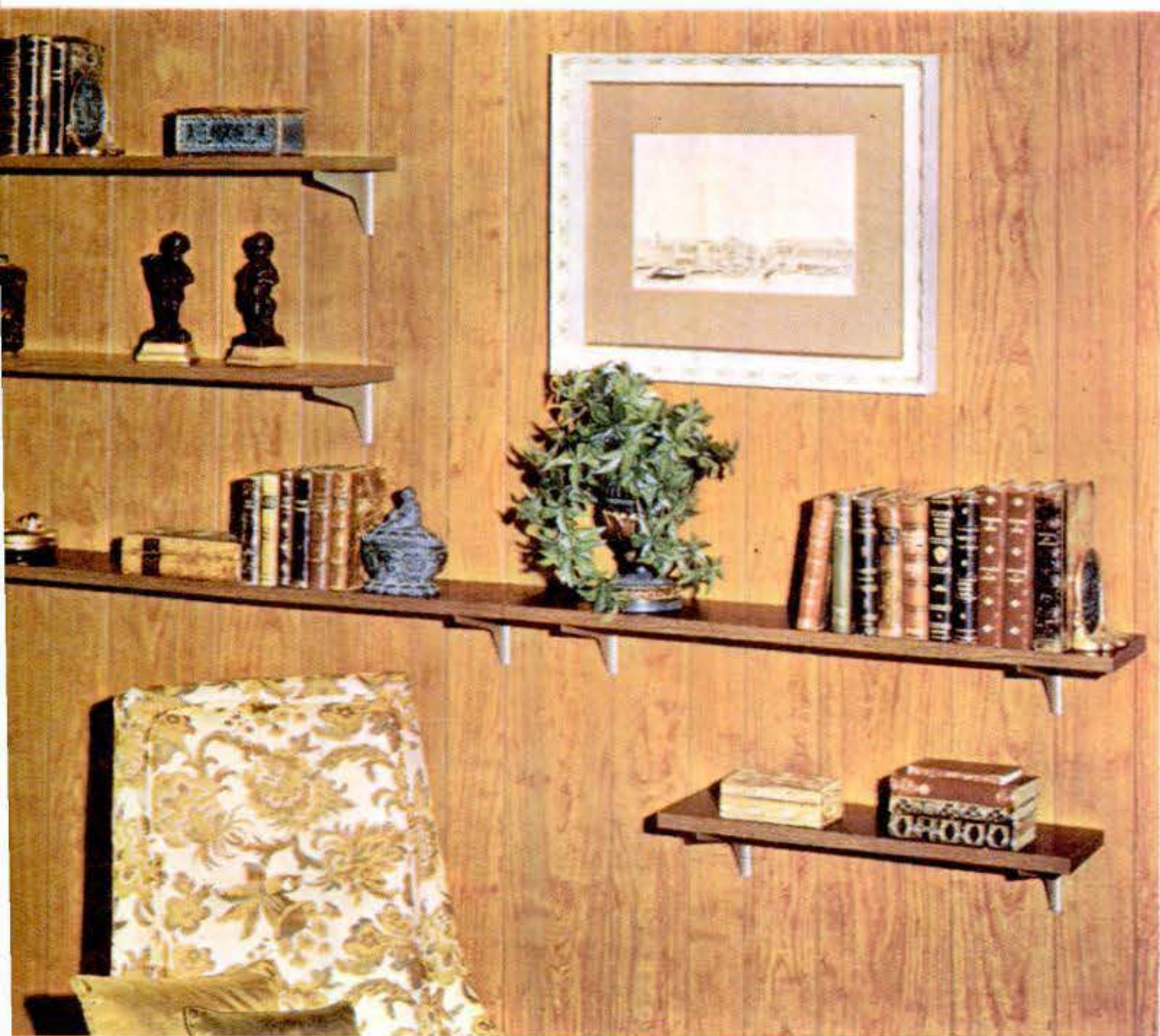
New Wall Paneling Has Built-In Shelf Supports

A new wall-shelf system does away with metal standards. Inconspicuous slots in the grooves of random-width paneling from Masonite accept shelf brackets and picture hooks. You can change shelf arrangements easily — and as often as you wish.

The 4'-by-8' slotted hardboard panels come in three Royalcote wood grains — sable walnut, honeytone cherry, and teak. All of these tones have been marketed for some time. Thus, you can panel an entire room in one wood grain, using slotted panels only where you want them.

Offered along with the new panels are gold-tone metal shelf brackets, picture hooks, and new walnut-grained shelves. The shelves come in five sizes — 8" wide and 24", 36", 48" long; and 10" wide, 36" and 48" long. The shelves are hollow — $\frac{1}{8}$ " hardboard over $\frac{3}{8}$ "-by- $\frac{3}{4}$ " wood-framing.

The shelves can also be used with metal standards, available in 24", 36", and 48" lengths.



Slotted hardboard paneling comes in three wood tones — teak, cherry, and sable walnut shown from top to bottom of page. Bottom photo shows a gold-tone bracket about to go into the slots in panel grooves.



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Super-Spy Lets You 'See Through' Walls, Fences and Locked Doors!

Secret of Private Detectives and Industrial Spies Revealed!

A remarkable optical device about half the size of a cigarette now makes it possible for you to see—without being seen. Your children, for example, can play in the "privacy" of an adjoining room—unaware that you can see everything they do!

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Super-Spy's uses are unlimited. With Super-Spy, you can keep an eye on the kids while they take their naps, even if the door to their room is closed!

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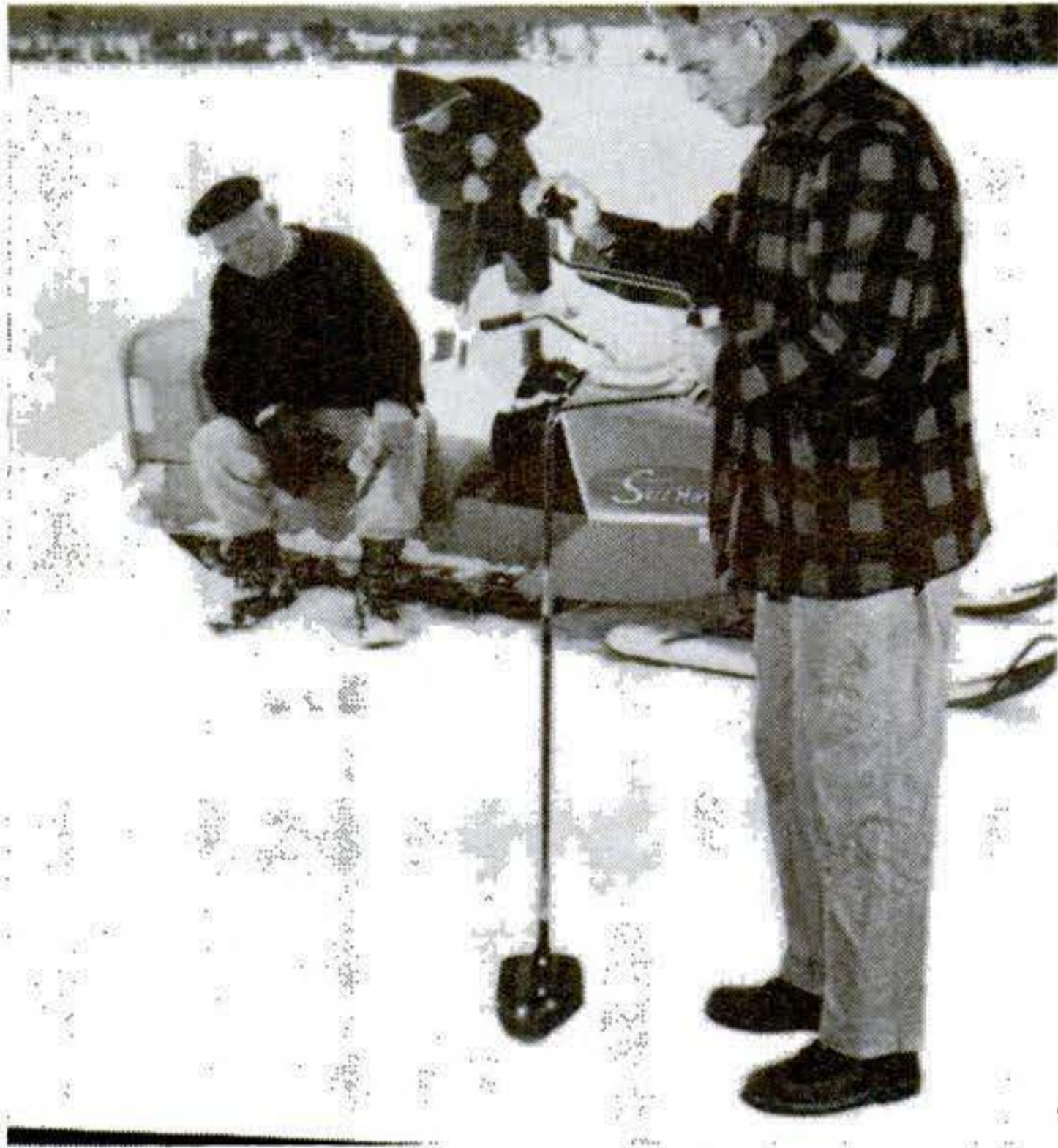
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WHAT'S NEW FOR OUTDOORS



Straightedge auger cuts ice fast

You'll have a hole through the ice ready for fishing in no time at all if you use an auger available from the Worth Company, Stevens Point, Wis. Its straightedge blade cuts through ice fast and it's easy to sharpen. Instructions for sharpening the four cutting edges are supplied with the augers, which come with 6" (\$12.20) or 8" (\$17) blades for the same handle.

BB gas pistol gives 20 shots for a penny

Combining the looks of a fine target pistol with trouble-free performance, the new Daisy CO₂200 semiautomatic is fine for both indoor and outdoor shooting. Because of low operating cost (about 20 shots a penny for both gas and ammo) some sections of the Armed Forces are using it for pistol training. It doesn't have the usual troublesome O ring.



It's time now to tie flies—with a kit

When winter keeps you away from trout streams you can always spend leisure time tying flies. Everything you need for several dozen flies comes in a \$4.95 kit from Waukegan Outdoor Products, 4419 Grand Ave., Gurnee, Ill. It contains a vise like that the pros use, a selection of fancy feathers, cement, hooks, silk floss, wool yarn, wax, tinsel, and easy-to-follow instructions.

New bolt-action, repeating, BB air rifle can be used as a scatter-gun, too



A high-compression, multiple-shot BB air rifle introduced by Crosman Arms Co. has a pump action that gives you a choice of muzzle velocity—up to over 500 feet per second. The magazine holds 180 BBs. A magnetized bolt transfers a single BB into the firing chamber. You can also shoot a single .177-caliber Super Pell by loading it through a port. Or hold the gun muzzle below horizontal and repeat the bolt feed until six or so BBs are in the chamber. Give the gun eight to 12 pumps—and you've got a scatter-gun. PowerMaster 760 costs about \$20.

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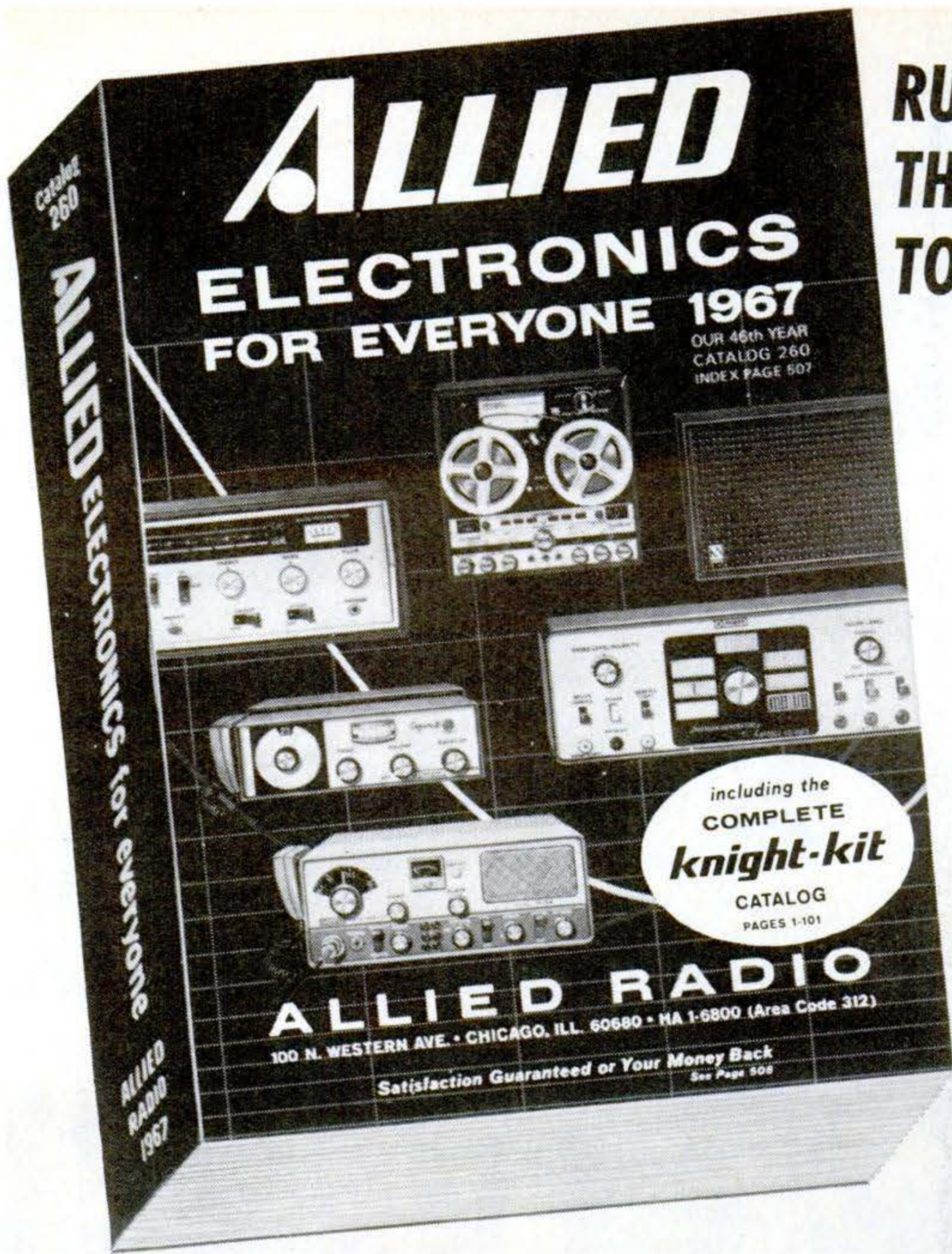
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Servicing the New Disk Brakes

[Continued from page 171]

want to tackle the job, get the instructions for your car. In many ways caliper reconditioning is similar to rebuilding a wheel cylinder on drum brakes.

The picture caption on a previous page covers the essential procedures.

Groans and rattles. Disk-brake troubles are rare. But a few pointers may save you a trip to the repair shop and tell you when to consult an expert. Disks sometimes creep and groan. This occurs when the car is moving at one m.p.h. or less. It results from the difference between the static and dynamic friction of the lining. There's no cure. A rattle or clanking in the caliper may show up on rough roads. The cure: Squeeze a little Permatex No. 2, nonhardening type, on the piston or insulating disk that contacts the shoe lining.

Squeal is the commonest disk-brake complaint. Check the caliper mounting bolts for tightness. If a special adapter bracket is used to mount the caliper, check its bolts for tightness. That failing, replace the linings and have the disk resurfaced. If none of this proves to be a cure, have a mechanic insert thin metal shims between the pistons and linings to alter the pressure pattern. Runout (wobble) is like eccentricity in a drum brake. Only resurfacing the disk will cure this.

Dishing or distortion on disks is like a bell-mouthed drum. It can be created when the lining is worn so thin that piston travel is restricted on one side. The opposite piston deflects the disk against the stuck piston. Resurface.

Disk-brake components that you should not try to service yourself are the power-assist unit, the proportioning valve, and the residual check and metering valves.

Easy on the pedal. One caution on the use of disks is in order. While they act like drum brakes, except for their higher efficiency, it is important not to ride the brake pedal. Disks are more affected than drums by even the slightest pedal pressure. On drums it takes a pound or so of force on the pedal to overcome the pull of the shoe-return springs. Disks do not have shoe-return springs. Thus, any force on the pedal will cause some brake drag. Continuous, if slight, pedal pressure will wear linings quickly, waste gas, and can heat the brake fluid enough to make it boil. P S

No wonder soldering is easiest with a

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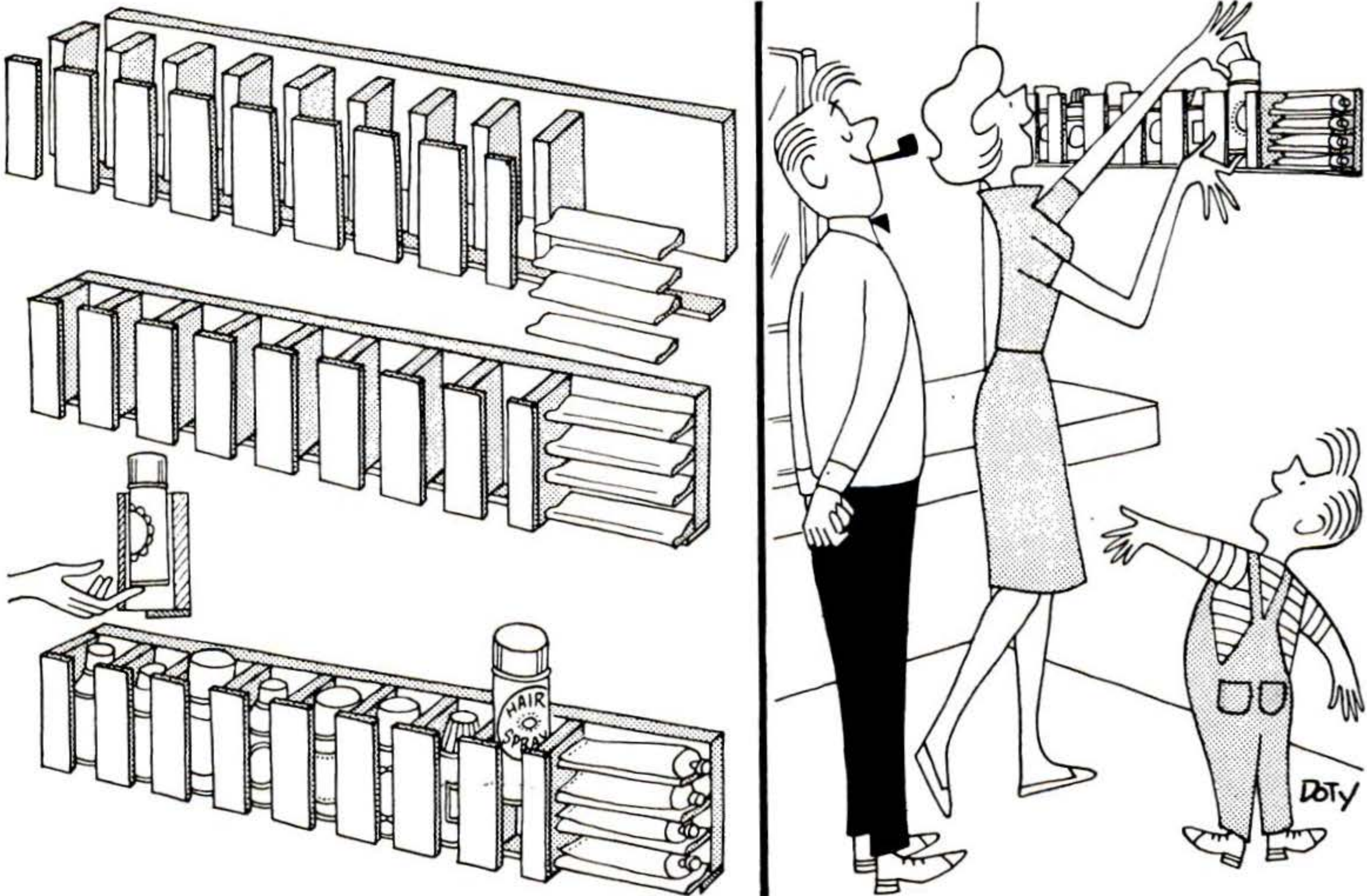
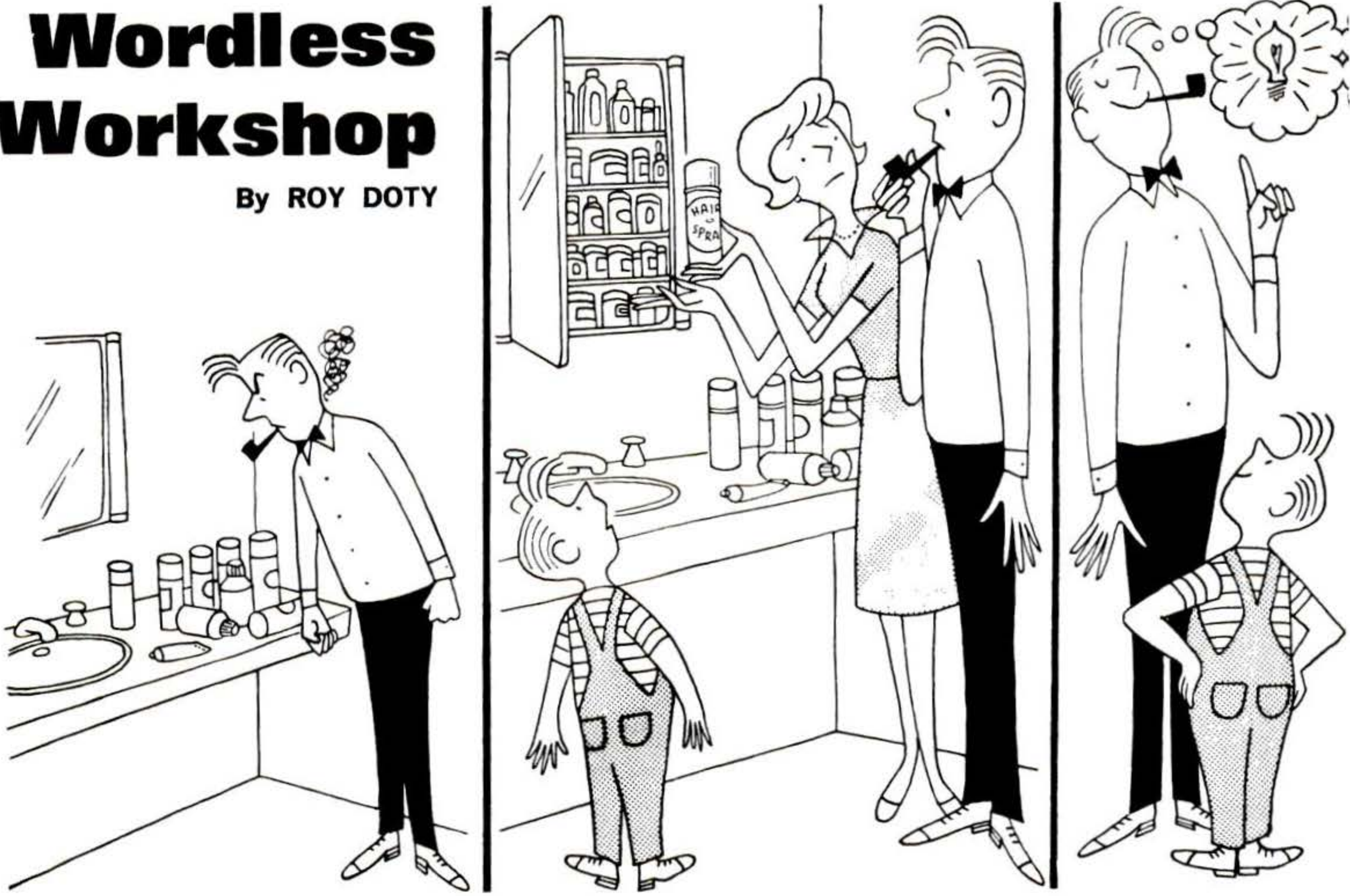
Weller Dual Heat Soldering Guns and Kits come in wattages from 100 to 325 —are priced from \$6.95 to \$12.95 list. See these precision guns at your electronic parts distributor or hardware dealer.

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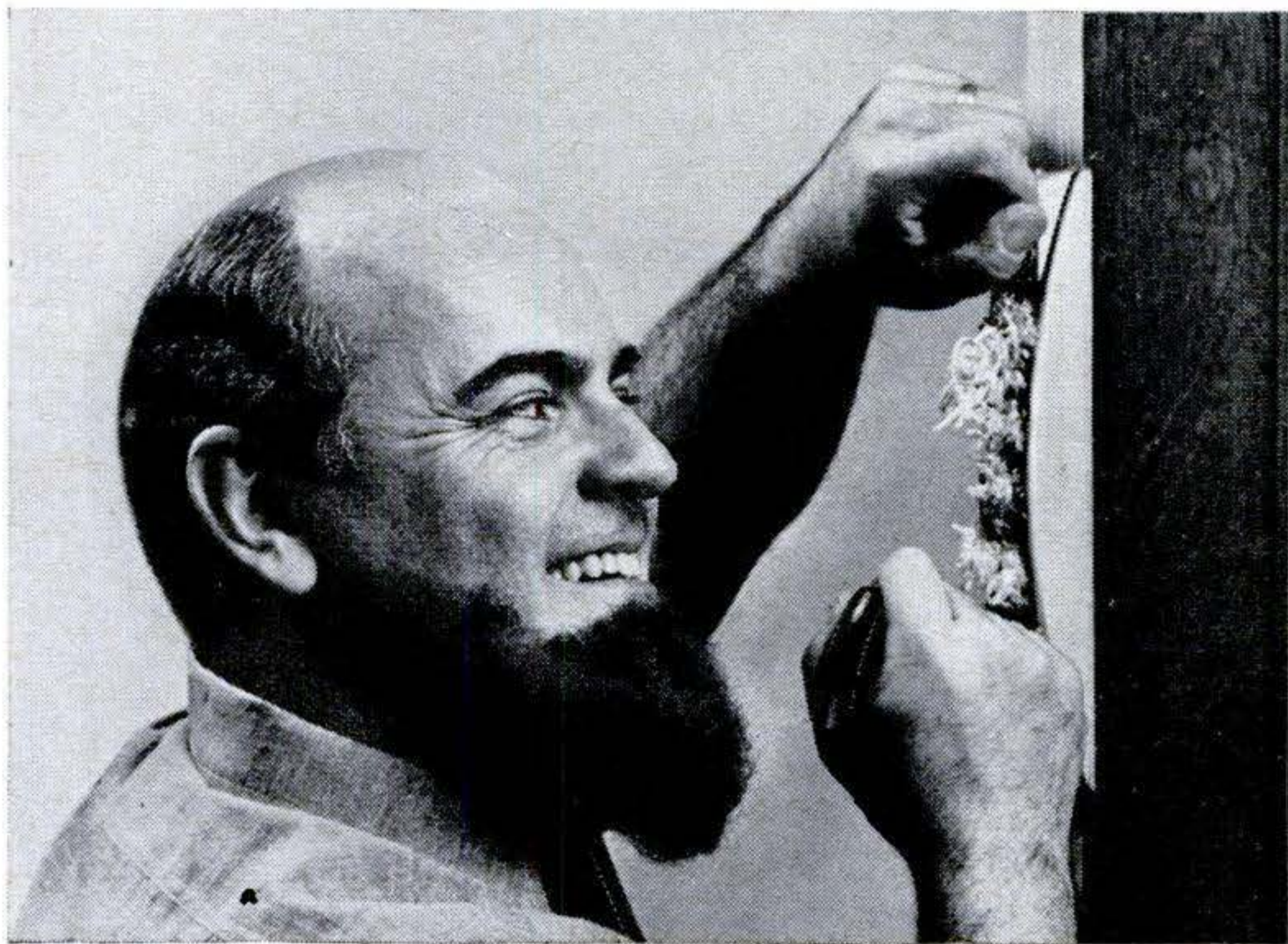
JANUARY 1967 | 193

Wordless Workshop

By ROY DOTY



The Stanley Surform[®] shaves everything but your beard.



This could be the most useful tool in your house. It shaves, shapes and smooths practically any surface.

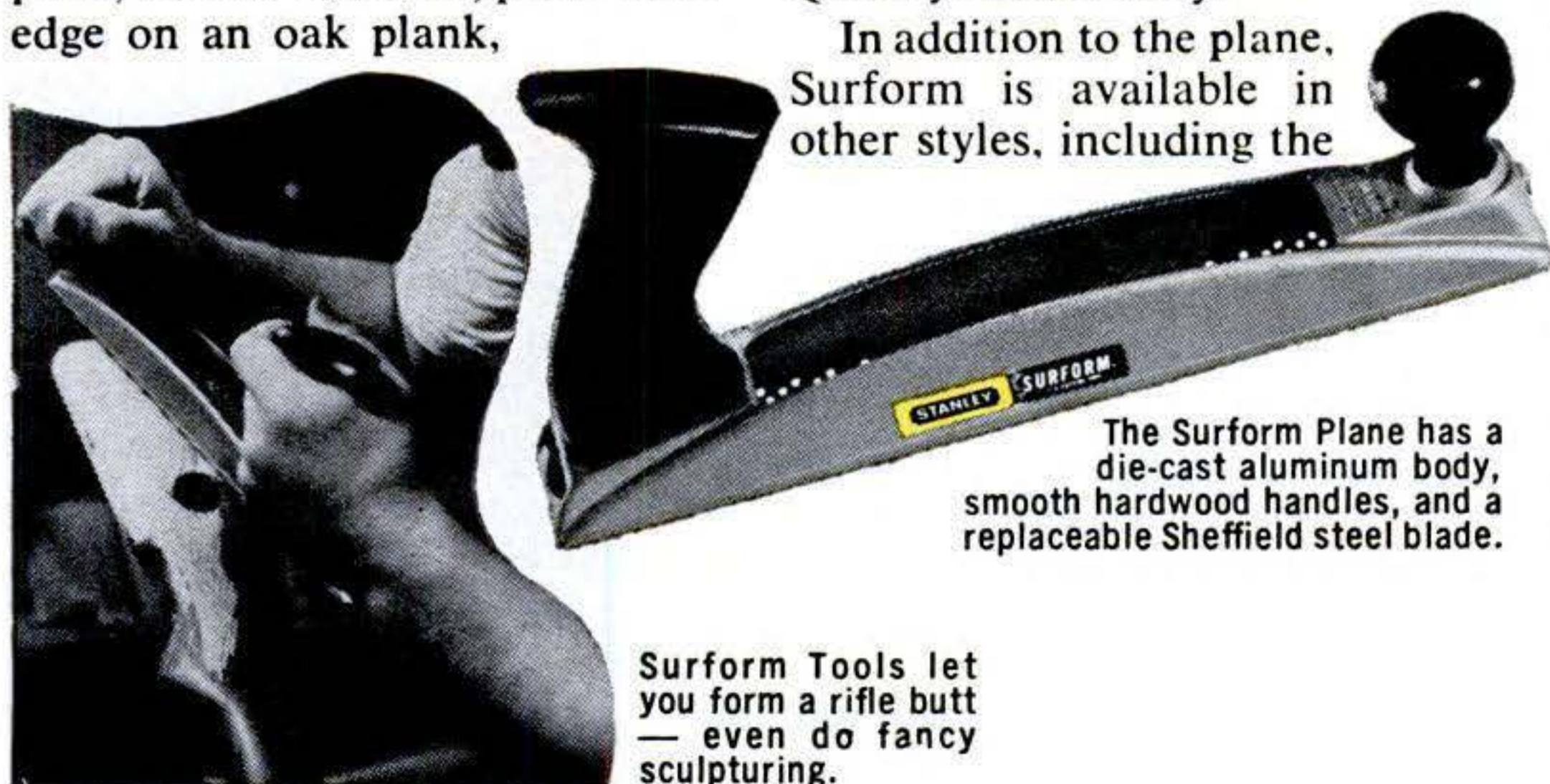
You can trim a door down to size (without removing it from the frame). You can put a good clean edge on a plastic counter-top, fix a sticky drawer, make an aluminum storm window fit tight. You can take the bark right off a log, square up the edge of a brass plate, form a rifle butt, put a bevel edge on an oak plank,

even do a little fancy sculpturing.

You can fit a board to an uneven wall, take the barb out of a copper pipe, make an asphalt tile snug, even remove excess filler on auto body jobs. And you can clean up a lot of those other little bothersome household jobs you've been putting off.

In short, Surform tools let you smooth things down, straighten things out, and round things off. Quickly. Effortlessly.

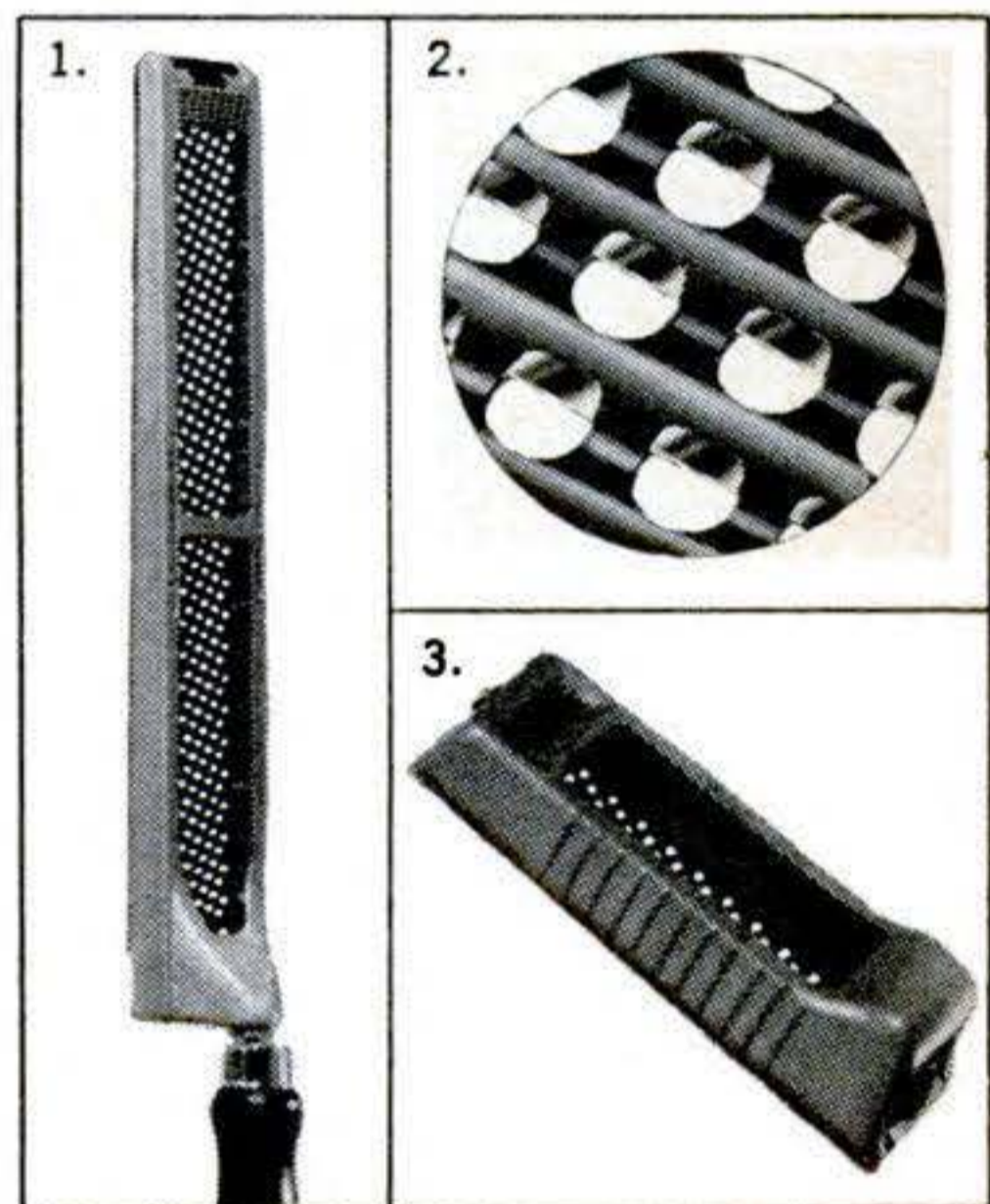
In addition to the plane, Surform is available in other styles, including the



Surform Tools let you form a rifle butt — even do fancy sculpturing.

The Surform Plane has a die-cast aluminum body, smooth hardwood handles, and a replaceable Sheffield steel blade.

file and the handy pocket size. They have replaceable Sheffield steel blades with 450 razor-sharp teeth. And every tooth has its own opening to prevent clogging — the shavings pass right through.



1. The Surform File works faster on wood than a rasp and has a wood handle, an aluminum body, and a 10" blade. 2. Enlarged section of Sheffield steel cutting blade. 3. This pocket-size Surform is only 5½ inches long — couldn't be handier.

Test the Stanley Surform for ten days. If you don't think it's the most versatile tool you've ever used, we'll refund your purchase price. Pick one up this week-end at your local hardware store or lumber yard. Stanley Tools, Division of The Stanley Works, New Britain, Connecticut.

STANLEY
helps you do things right

Now: Instant Crime Control in Your Town

[Continued from page 69]

mission become common. The law-enforcement network of tomorrow may even include a series of law-enforcement satellites in orbit for this specific purpose. The Institute for Telecommunication Sciences and Aeronomy is under contract to the FBI to explore these and many similar applications for the needs of the 1970s and beyond.

Terminal agencies preparing to begin utilization of the NCIC system in January, 1967, will in some instances use computers as terminals; in others, a simple teletypewriter or similar device. The FBI has made certain that its computers are able to interface, or be compatible, with any make equipment produced by major manufacturers. There is in this way no interference with the decision of local police agencies in selecting the equipment they desire.

Computer talk. One basic challenge was determining how the many types of computers were to "talk" to one another. We met that challenge by accepting responsibility for standardizing message formats and with the assistance of the Committee on Uniform Crime Records of the International Association of Chiefs of Police, formed a working group of line and staff police officers representing departments in all segments of the country. This group established uniform record formats, codes, and operating procedures.

As an example of the prescribed NCIC formats, each stolen-car entry will list license number, state of issue, year of license expiration, type of plate (dealer, truck, etc.), vehicle identification number, year, make, model, and so on, in precise order, so the NCIC computer can place each identifier in an appropriate index. To conserve storage space and transmission time, standard codes or abbreviations have been adopted for each item in the record.

The NCIC computer is given instructions as to what action to take concerning an incoming message, by means of an alphabetic "message key" which precedes each message. This "key" may instruct the computer to search its indices, add a new record to the files, or cancel an existing one.

In the area of fingerprint classification by electronic means, the FBI is furnishing financial assistance to research efforts in the field. The objective is the development of a scanning device that will read and ac-

curately classify inked finger impressions, and translate such classifications for computer storage. A rapid positive means of fingerprint classification, and the translation of such classification into computer language, will be invaluable to NCIC.

Looking ahead. The cost of wide-band transmission is rapidly being reduced, and technological improvements are making possible the use of video-band benefits for service other than television. With this in mind, it may be possible in the future to include as part of NCIC information, pertinent photographs, mug shots, and actual fingerprints. This information transmitted wide-band could be available in seconds.

Further to help the NCIC and local computerized law-enforcement information systems get needed data to police officers as fast as possible, in the not-too-distant future teleprinters to type out the computer's response to an inquiry will be mounted on the dashboard of a patrol car. Similarly, a facsimile printer, a cathode-ray tube, may be mounted in a car to display a mug shot or other graphic information.

The idea of the National Crime Information Center is to serve, not as a total information depot, but as a national information index which, by high-speed random-access search techniques and instantaneous electronic telecommunications, will eliminate the loss of time that having people try to do the same job inevitably involves. We will now be in a position to get pertinent information to the police officer on the scene at the moment he needs it: *right now*.

The Center constitutes a new and potent weapon for law enforcement, born of scientific achievement—a weapon, moreover, which, far from eroding the traditional concept of local and state autonomy in the control of crime, powerfully augments it. Furthermore, the utilization of such technology will have far-reaching effects on improving information handling by demanding a higher degree of accuracy which is essential to law enforcement's fulfillment of its obligation to protect and safeguard the rights of all law-abiding citizens.

The FBI and the law-enforcement agencies that are implementing this system are conscious that many problems will occur and must be overcome before a smoothly operating system is fully developed. ■

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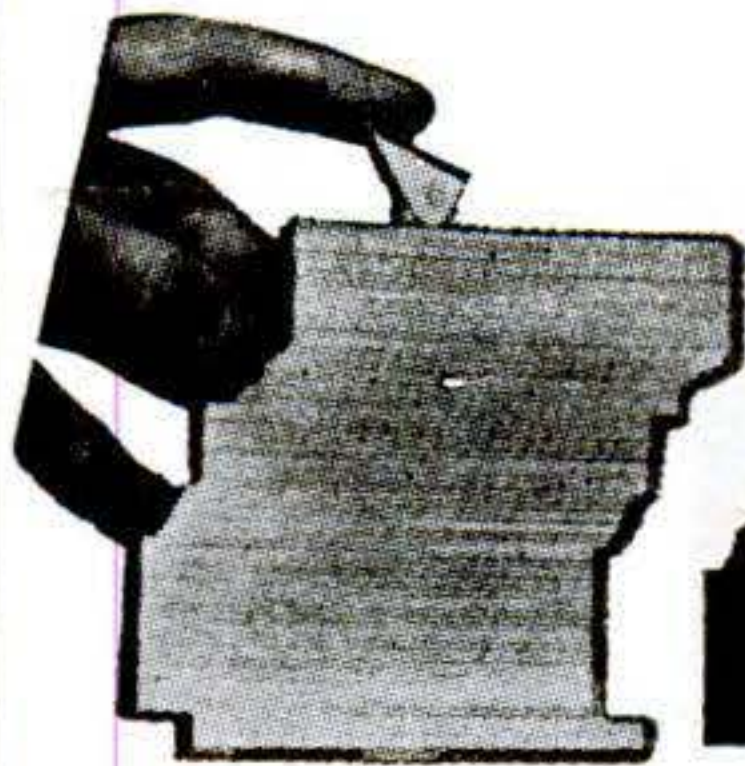
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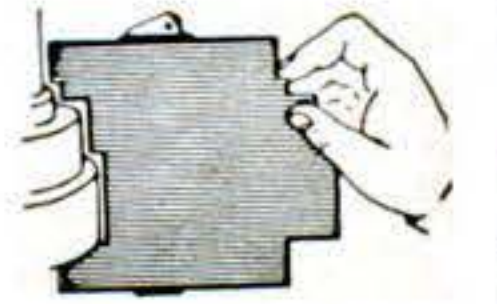


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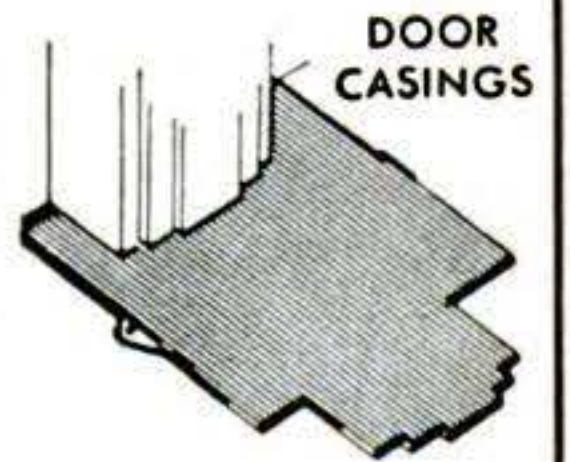


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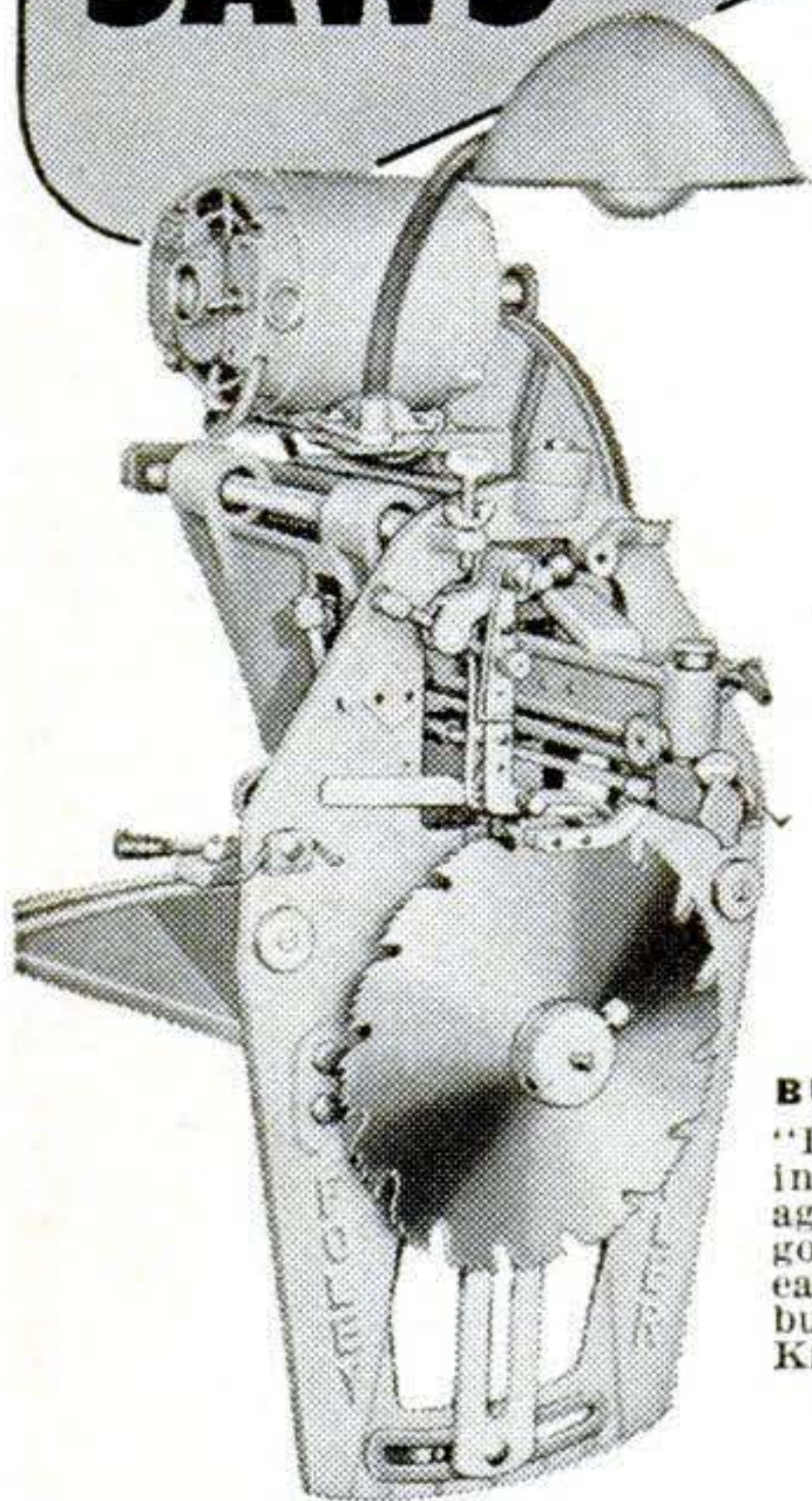
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Work comes from
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"I have filed about 500 saws
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good investment because it
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FOLEY FILED SAWS BRING NEW CUSTOMERS

Here is a steady repeat CASH business that pays from \$3 to \$8 an hour, and you can start in your own basement or garage in your spare time. Every saw you sharpen with the machine accuracy of the Foley Saw Filer is an ad that brings more customers. J. C. Delbert wrote us: "Since I got my Foley Filer five years ago, I have averaged 4 1/4 saws each day over all this time." Howard Kuhns says: "We operate 2 Foley Filers and our business averages about 500 saws per month. The count last year was 5,798 saws."

The new model 200 Foley Saw Filer (shown above) is the first and only machine that automatically sharpens combination (rip and cross cut) circular saws—also all hand saws, band saws and crosscut circular saws. The adjustments are simple—there is no eyestrain—and you can start right away to turn out perfect cutting saws. Exclusive jointing action evens up irregular teeth—old saws cut like new!

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Danny Kaye: "If I Can Fly, You Can Fly"

[Continued from page 79]

speech of do-this and do-that, and don't-do-this and don't-do-that. You know what he said? All he said was, as he folded the belts on the seat he had just vacated, "Hey, Redhead, don't kill yourself!"

And let me tell you something else—the first time that I soloed an airplane, John Glenn was nothing!

But that wasn't all there was to getting a ticket. Oh, no! The day came when I had to take that written exam.

The exam. Here I am with a liverwurst sandwich in my pocket because I know this is going to be a terror, going on for hours, and I sit down to a desk with all these questions in front of me. Here's something strange. I can step out in front of 20,000 people to do a show, and not be nervous at all. Yet when I went to take my examination, I was as nervous as a cat.

But I had something going for me. Mike Kidd had remarked to a friend of mine, "I don't think Danny will have the patience to do everything it takes to get a ticket." That did it! I'd get my ticket, or else.

I got through the exam. Don't ask me how. I left the Federal Aviation Agency office thinking, "Well, if I failed, I can study some more and take the exam over again. And after all, I just might have made it. Seventy's a passing grade."

Well, the grades came through. I got 90. My first reaction was that they had made a mistake. No, it was right. Ninety. I felt as if I was ready to run for Congress.

I still didn't have my ticket, though. I had practiced with Dick Weaver in a twin-engine plane, and after I passed the exam, I bought a Piper Aztec. There was much more to learn on that than there was on a single-engine airplane. How could I remember all the extra things?

But I did get my ticket, and not in a single-engine airplane. This may interest you—one of my friends told me later that I was one of only 14 people in the whole country—at that time—who had obtained a private license and a multi-engine rating at the same time.

I've done everything in my flying career backward. Most people get a private license, then a commercial ticket, then a multi-engine rating, and finally an instrument rating. Not me! Oh, no!

Six years after I got my private license

Danny Kaye: "If I Can Fly, You Can Fly"

—in a twin-engine airplane—I qualified for single-engine.

Flying "under the hood." A couple of years ago I thought to myself, well, why not an instrument rating? I practiced flying "under the hood" with Bob Dorn, and went up for my check ride and passed the flight test. I thought that this time the written exam would be easier. But oh, no! By some miracle, I got 90 again.

I decided to go for a commercial license. Here was that written exam again.

A few days later I'm at the home of Gusie Busch (August Busch, president of the brewing company and owner of the St. Louis Cardinals) in St. Louis, and every four hours I'm on the telephone to California to see how I came out on the exam. I made 91. I could hardly believe it.

The jet that "wants to fly." But let me do a commercial on the jet made by our company. This is such an incredible airplane—the Lear Jet. You hear all this stuff about frightening acceleration when you push forward on the throttles. Forget it. This airplane exceeds everything that you hear or expect. It's alive. It wants to fly.

You go to level out, and you're still climbing. The airplane is that "clean." Do you know how I fly this airplane once I've got it to 41,000 feet and flying straight and level? I pull my knees up and rest my hands on them, and just use finger movements. It's that easy. Of course, you can put it on autopilot and do crossword puzzles if you want to.

A jet flies mostly like any airplane, except that everything happens faster. In my transition training, I've discovered that you're never "ahead" of your plane at the start. There's so much to do. But you learn. You catch on to anticipating. You "lead" your airplane, just as you drive ahead of your automobile, anticipating turns and traffic, if you're a really good driver.

I'm using jets now to get to distant points, meet with business associates, and still get home for dinner on the same day. I could never do this before.

To finish the commercial, the executive jet is one of the most effective business tools ever invented. It literally creates time.

And what's that pitch the girl makes for sewing patterns? "If I can learn to sew, you can learn to sew." Let me paraphrase it. "If Danny Kaye can learn to fly, you can learn to fly." PS

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This glue sticks to everything except its own bottle cap.

Does it take you longer to unstick the cap than to use the glue? Then switch to U. S. Plywood's White Glue with the new twist cap. It doesn't stick, keeps glue at instant readiness. For wood, paper, leather, fabric, all porous materials, it's easy and safe—even for children.



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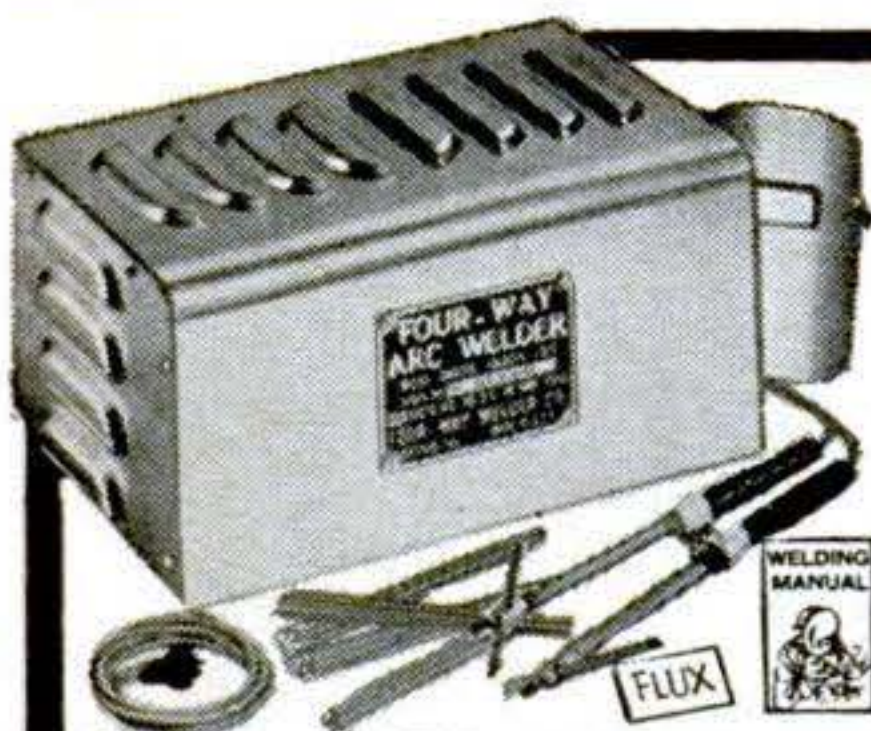


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LSD: The Other Side of the Story

[Continued from page 95]

LSD, say in Italy, can sell a kilogram—2.2 pounds—to a black-market distributor here for \$10,000. This will produce a million doses. At \$5 a cube, the distributor would gross \$5 million.

Estimates of the amount of illicit use of LSD vary widely. Senator Robert Kennedy, from reports of 50 universities, figures one percent of their students are on LSD. According to an FDA official, a study at Stanford University has shown at least 40 percent of students there taking LSD.

Off-campus, assorted addicts, beatniks, and others looking for kicks are lapping up the cubes. To a Senate investigating committee, Capt. Alfred Trembly, commander of the narcotics division of the Los Angeles police, reported that last year his force had one arrest for delinquent behavior from LSD use. "In the last six months, we have had 111 such arrests—the vast majority under 21 years."

Other reports—from police, hospitals, individual physicians, investigating medical committees—have been piling up, indicating widespread abuse and serious, often tragic, consequences. Some examples:

- In New York, a 30-year-old former medical student with a record as an LSD user has been charged with murdering his mother-in-law.

- In California, a young man, a suicide, was found floating in the Pacific Ocean after he went out to experience an LSD trip at the beach; another walked out on Los Angeles' Wilshire Boulevard, believing he could stop traffic, was run down and killed; a woman who was given the drug in her coffee without her knowledge went home and committed suicide, probably believing she was losing her mind.

- In New York, a County Medical Society committee, checking on 52 cases at Bellevue Hospital, found half had taken LSD only once; all had experienced abject terror; nine had "uncontrolled violent urges, including homicide attempts by two."

Close-out. With the LSD furore boiling up, Sandoz, the one licensed maker, decided to stop making it last spring. It had spent millions on research, supplying the drug without charge to investigators. It got out of the picture, some observers believe, because it could see only trouble ahead.

LSD: The Other Side of the Story

That left the illicit traffic still going on—but many research projects suspended.

It left a supply of LSD—turned over by Sandoz—with the National Institute of Mental Health which is to make it available for research. But it left many scientists worried.

They worry that NIMH will dole out its limited supplies only to projects having federal or state support, severely restricting research. Says one distinguished university researcher: "To take the drug out of the hands of all but a few favored investigators would be preposterous."

Both the American Medical Association and the American Psychiatric Association have issued strong position statements urging continued research. The AMA has called for legal manufacture and distribution of the drug for research use.

Illicit traffic in LSD certainly has to be stopped. It's not going to be easy. It will take more than laws and enforcement officers to stop it. Public education will be necessary. Perhaps the best means of education will be reports coming from scientists actually engaged in research with LSD, finding out more about its dangers and more about just whom it can help, under what circumstances, and with what safeguards.

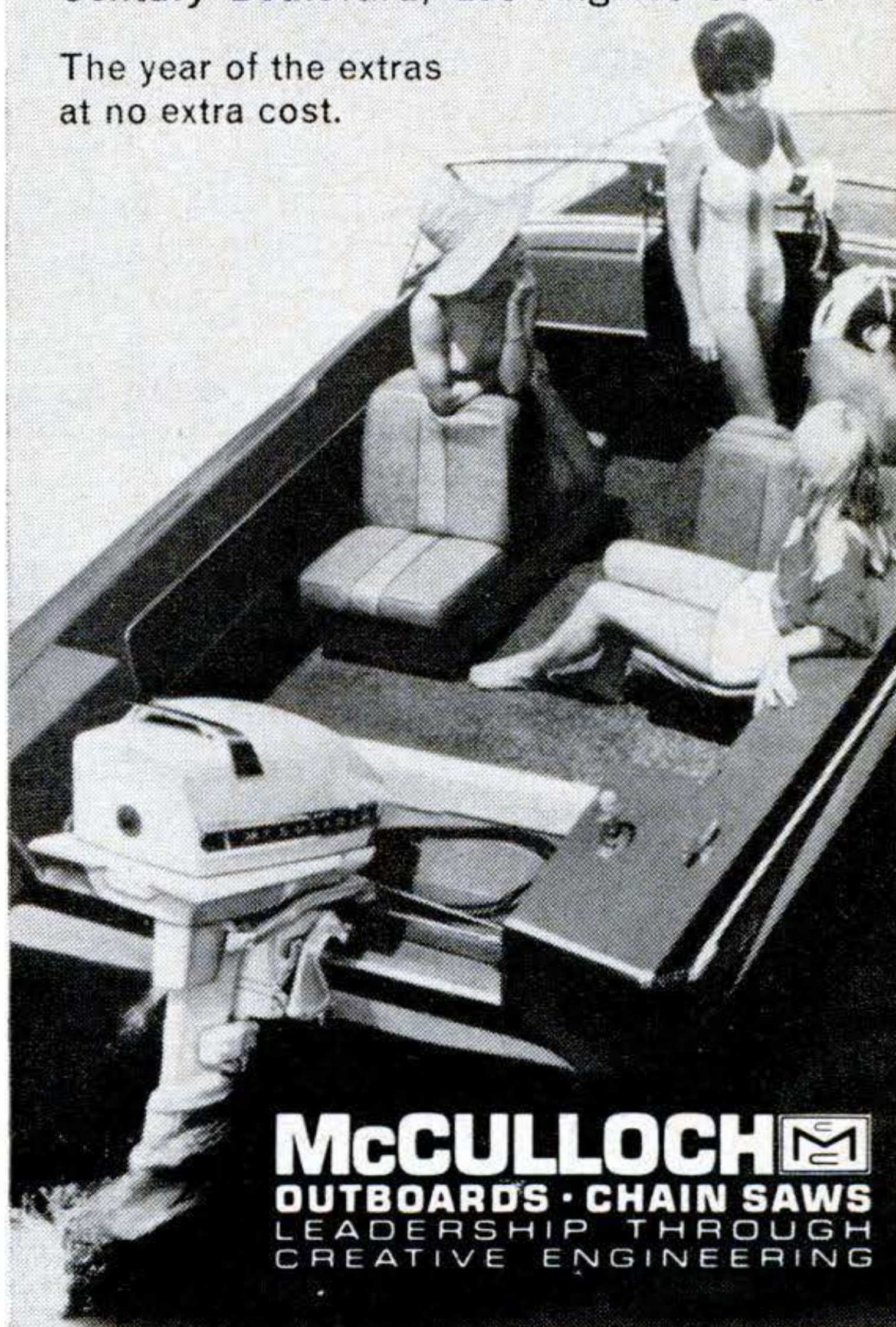
More to come? LSD is likely to be the forerunner of a flood of other mind-affecting drugs. Last spring, Dr. Stanley F. Yolles, director of the National Institute of Mental Health, told a Congressional committee: "In the next five to 10 years we will have a 100-fold increase in drugs that affect the mind." And only a few weeks later, at a University of California conference, a Chilean psychiatrist was reporting two such: yage, a drug used by South American Indians; and ibogaine, derived from a plant growing in the Belgian Congo. Both act like LSD. And ibogaine in trials to date seems to be even more effective than LSD in treating psychiatric patients.

We need to know about such drugs. We need to get our scientists back in the laboratories working on LSD and others. Out of such research could come a lot of good—ways to combat some of our serious existing health problems and maybe even a drug that could, with safety, satisfy the ambitions of those who would like to see a chemical expansion of the powers of the human mind. PS

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I Crossed the Atlantic in a 12-Foot Sloop

[Continued from page 108]

only to take sights of Polaris for latitude. I estimated longitude from the motion and color of the water, flotsam, land odors, and bird flights.

On April 14, I sailed over a big muddy area showing bottom grass. Water color, a light green, indicated a depth of 20 to 30 feet. A latitude check that night put me over the Sacramento Shoal, and I learned later that seismographs had registered an earth shock in the area shortly before. I had sailed over an underwater landslide.

I reached Vera Cruz in 13 sailing days, averaging 67 nautical miles per day. Ten days after leaving Mexico, I ran into several 50-m.p.h. squalls, got little sleep, and had to fight wind and seas constantly to keep on my northeasterly heading. Flocks of geese and ducks flew over, heading north for the summer. On the 24th something hungry took my taffrail spinner. From then on I had to estimate speed.

Fish were constant companions, including some I would have been glad to do without. One was a 40-foot pilot whale that sounded and blew 32 times under and about the boat.

Sardines and crab broth. Water was carried in one-gallon plastic bottles and used as inside ballast. As I used up fresh water, I refilled the bottles with sea water to maintain the ballast.

I had taken only a moderate amount of food. Small crabs picked off the sargasso weed made an acceptable broth to eke out my supplies. One day, a Norwegian freighter I encountered gave me some sardines, as well as a position report.

When down to four days' rations, I improvised some fish hooks out of wire, and two fish spears. The best spear was made from a stainless-steel table fork and a shaft of aluminum tubing. To make a hole for fastening the shaft, I heated the fork white hot and punched an awl through it. With this, I took dolphin, jack, and yellowtail.

But the best way to catch fish, I found, was with a fish trap made of two wire hoops of slightly different sizes. Gill net fastened around these and across the bottom one made a sort of collapsible bucket. I'd punch holes in a tin of sardines and set it in the bottom of the trap to chum the fish. When they swam in to investigate, I had only to lift the trap out of the water,

usually with two or three hand-size yellowtails in it. Such a simple fish trap ought to be standard in survival kits.

In one 24-hour period, off Port St. Joe, a town that has more thunderstorms than any other spot in the U.S.A., I logged 11 lightning squalls. I'm leery of lightning; to be the only thing sticking up for miles around when bolts are crashing about overhead isn't comfortable. The chain plates, backstay from the boom, and a wire from the jib furler are trailing in the water at all times, and the radar reflector and mast are similarly "grounded," but you get the uneasy feeling that a direct hit could incinerate a small boat.

When I got back to Ft. Lauderdale, having touched at Mobile Bay on the way, I had covered 3,510 nautical miles in 90 days at sea, ridden out 95 squalls (eight over 50 m.p.h. and one recorded by a Mobile-bound ship at 75), and been becalmed, in all, 432 hours, or 18 days. I was driven ashore on Englewood Beach at three a.m. of a stormy night when my anchor couldn't hold bottom.

In port—satisfied. Besides setting the small-boat record for Gulf crossings, I had proved some things to my own satisfaction: Early mariners could easily have caught rainwater for drinking, and fish for food, in the Gulf. Its natural sailing routes are indicated by winds and currents. Bird flights offer clues to the direction of land. If Sixth Century men did reach Florida, they could have sailed across the Gulf to Mexico and Yucatan. But could they have sailed from Ireland to Florida, a distance of 4,500 miles, and back?

The Nonoalca had proved herself. I planned to apply antifouling paint to the bottom. I would also add a timepiece and a combination radio direction finder, replace the spinner of the taffrail log—not for long, as it turned out—and install a flashing light to make my craft more visible at night.

Then I would make my try for Ireland. It would be a rough voyage—the Atlantic offers no refuge from storms, forgives no errors in judgment or navigation. Some who had set out on such a journey had never reached port—and my boat would be the smallest ever to attempt a nonstop Atlantic crossing. **PS**

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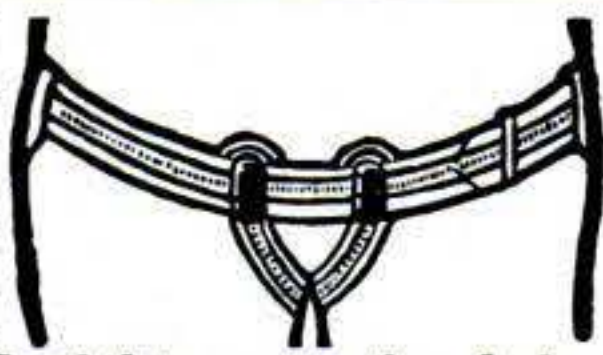
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Sea-and-Air Armada to Aid Moon Flight

[Continued from page 112]

one in the Pacific, will supplement land stations for tracking and other data at the critical time of the spacecraft's injection into its unpowered trajectory to the moon.

The other two ships, probably in the Pacific, will provide tracking and communication during the spacecraft's reentry into the earth's atmosphere. They may also be called in to retrieve the spacecraft and its crew upon splashdown in the sea—just west of Hawaii, according to present plans.

Planes to join net. Eight communications aircraft, too, will aid the lunar flight. Converted from Air Force jet transports, they will be equipped, not for tracking, but for telemetry and voice communication. Thus the astronauts can talk with the crew of the plane or, by way of it, with the Houston control center. The planes have a top speed of 600 m.p.h. and, with a full fuel load, can stay aloft about 12 hours. A huge bulb at the nose, added for Apollo use, houses a seven-foot dish-shaped, sky-scanning antenna that locks onto the spacecraft for communications.

So elaborate a communications net is required for the lunar flight, not because of the 238,000-mile distance of the moon, but because of the moon's movement around the earth. If a space flight's objective is simply to orbit the earth, we can take off whenever the launch crew is ready. But when we are to rendezvous with a target in space—whether it is an Agena or the moon—we have to time our launch in accordance with its position in orbit.

Thus, Gemini 11's successful rendezvous with an Agena in its first orbit required split-second timing of the Gemini's takeoff from the Cape Kennedy launch pad.

The moon-flight plan, instead, will allow a daily "launch window" several hours long—and have the Saturn V's third stage stop over in a parking orbit, where the space vehicle will get a final check before continuing the lunar voyage. The split-second timing is thus removed from the Cape launch pad and imposed on the instant of re-igniting the Saturn V's third stage, which will boost the spacecraft from earth orbit toward the moon.

The desired parking orbit is fixed in space. The earth rotates beneath it. So, as minor technical delays cause the moment of launch from the Cape to slip, the

Sea-and-Air Armada to Aid Moon Flight

launch azimuth of the Saturn V rocket must change continuously—say, from northeast to southeast, between the beginning and end of a three-hour launch window. For the southeast heading, precision tracking by the land station at Antigua Island may be possible. But a northeast one may put the point of insertion into orbit less than 10 degrees above Antigua's horizon, too low for reliable data. Thus an "insertion" tracking ship is needed to protect the earlier launch option.

At injection into lunar trajectory, the spacecraft's position must always be in the vicinity of the "lunar antipode"—the point on the earth's surface where the extension of a rod connecting the moon with the center of the earth would come out on the other side. Due to the earth's rotation and the moon's own movement, this point can range far and wide over the globe. On any given day its exact location varies—depending on whether the Cape takeoff has been early or late in the launch window, and on whether injection comes during the first, second, or third earth orbit. The location also will change with the launching date.

Planes can keep up. The Apollo planes will be mobile enough to chase the shifting point of injection, and assure unbroken communication at this critical phase—the entire "burn" of the re-ignited third stage and the next 20 minutes of flight, in which must come the command decision to "go" for the moon or abort the mission.

For the reentry over the Pacific, the Apollo sea-air net will be further augmented. If this maneuver cannot be conducted precisely as planned, the spacecraft may bounce back out of the atmosphere, before coming down once more at the end of a ballistic trajectory. In such an emergency case, the astronauts possibly could miss their intended splashdown point by hundreds of miles. Precise tracking will be imperative to assure their prompt and safe recovery, particularly if they come down in a bad-weather area. Hence a widespread fleet of 48 planes with advanced tracking gear will stand by to supplement the usual force of recovery aircraft.

Thus, although only a small part of it will be used at first, the sea-and-air armada required for the full Apollo program is already taking shape. **PS**



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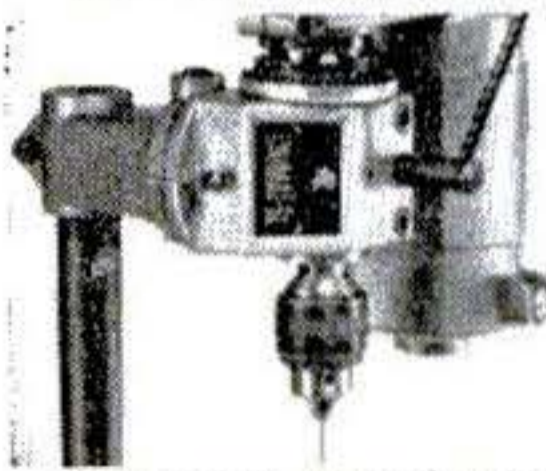
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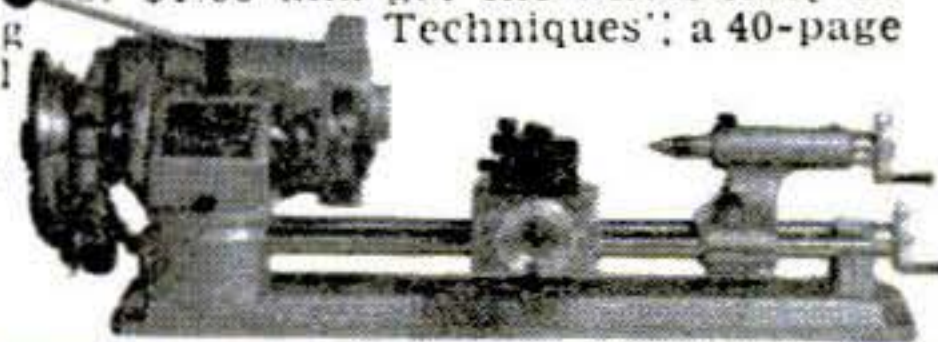


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Portable Radios That Tune In the World

[Continued from page 127]

Are the controls well placed, and their functions easy to understand? Is the set unnecessarily complicated to operate? Is the tuning dial easy to read? Are there too many controls? I peeked inside to see quality of construction. Are top-quality components used? Is the degree of finish representative of its price?

Here's how the eight receivers compared:

Grundig TR-5000. This German-made receiver is almost two multiband radios in one: It has six long-, medium-, and short-wave bands—locked to six vertical tuning scales on the front panel—that cover the complete 150-kHz to 30-mHz spectrum, plus six more narrow-segment bands—controlled by a horizontal drum-type tuning dial. Each of these completely covers an important international broadcast band.

Overall coverage100 percent
Effective coverage100 percent
SensitivityAM: G FM: E
SelectivityAM: G FM: G
Band spreadE
Operating easeP
Construction qualityE
Price\$220

Heathkit GR-43. This receiver is available only in ready-to-wire kit form. In my tests, FM reception was a standout feature.

Overall coverage70 percent
Effective coverage85 percent
SensitivityAM: G FM: E
SelectivityAM: G FM: E
Band spreadG
Operating easeE
Construction qualityX
Kit price\$160

Lafayette Globepacer. Here's a lot of receiver for a very low price. I rate this one as the *best buy*.

Overall coverage70 percent
Effective coverage85 percent
SensitivityAM: G FM: G
SelectivityAM: G FM: G
Band spreadG
Operating easeE
Construction qualityG
Price\$100

Lincoln 4-Band. This is a compact AM-FM portable with two short-wave bands.

Overall coverage40 percent
Effective coverage50 percent
SensitivityAM: G FM: P
SelectivityAM: G FM: G

Portable Radios That Tune In the World

Band spread	P
Operating ease	E
Construction quality	G
Price	\$50

Nordmende Globetrotter. This receiver, another German-made unit, was my favorite in the group because of its versatility. It can be used both as a carry-around radio—at just over 10 pounds it's a relative light-weight—and as a car radio. An optional (\$30) bracket lets you mount it under the dash. Shortwave performance and sound quality are excellent.

Overall coverage	80 percent
Effective coverage	90 percent
Sensitivity	AM: E FM: G
Selectivity	AM: E FM: G
Band spread	E
Operating ease	P
Construction quality	E
Price	\$170

Norelco L6X38T. This Dutch radio is chock full of gadgets that make it great fun to play with as well as listen to.

Overall coverage	70 percent
Effective coverage	85 percent
Sensitivity	AM: E FM: G
Selectivity	AM: G FM: G
Band spread	G
Operating ease	P
Construction quality	E
Price	\$230

Panasonic RF-5000. Without a doubt, this is the biggest and heaviest portable radio on sale today. It is also the easiest-to-operate all-waver in the bunch.

Overall coverage	100 percent
Effective coverage	100 percent
Sensitivity	AM: E FM: E
Selectivity	AM: E FM: E
Band spread	G
Operating ease	E
Construction quality	E
Price	\$300

Zenith Royal 3000. Here's the latest offspring of the granddaddy of all-wave portables. It is also the most rugged—the one I'd choose as a camping companion.

Overall coverage	70 percent
Effective coverage	85 percent
Sensitivity	AM: E FM: G
Selectivity	AM: G FM: G
Band spread	G
Operating ease	G
Construction quality	E
Price	\$200

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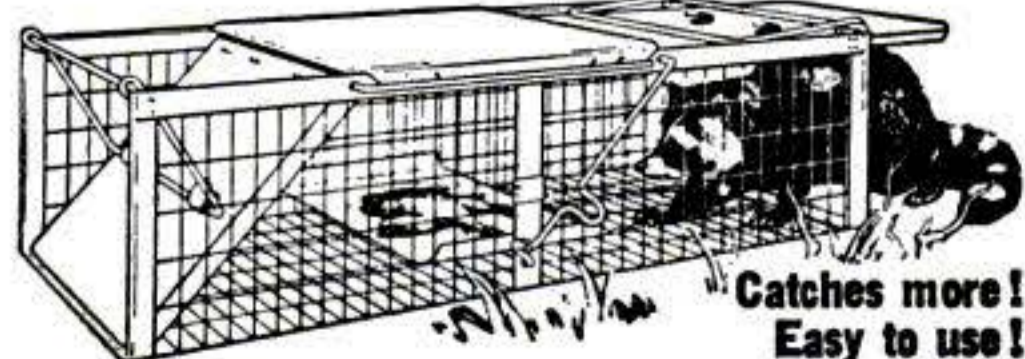
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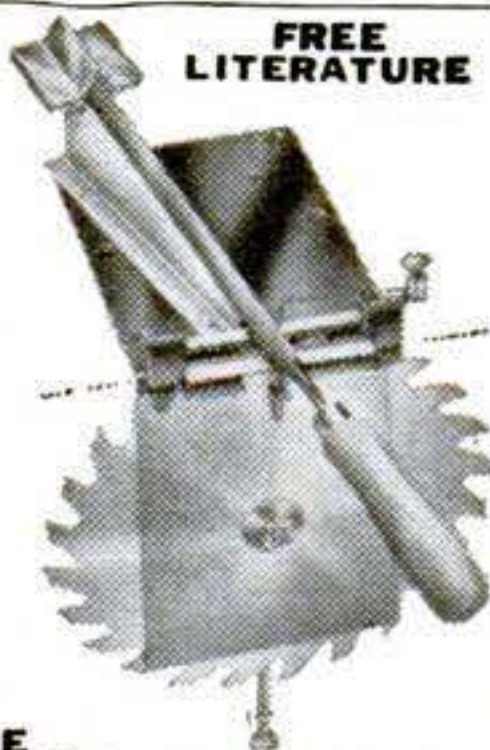
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A's to Your Q's on Boating

[Continued from page 117]

Q Can I finance my boat as I do my car?

A Yes, and you can buy a boat with a smaller down payment than for a car, but the interest rates may be slightly higher. Most banks and lending companies want a down payment of 20 to 30 percent of the price of the boat. The interest and time of repayment varies, so check around for the best deal.

Q Do I need insurance on my boat?

A Yes. Just as with your car, you should include insurance in the boat's overall cost. It needs the same kind of protection. But boat insurance is figured differently than car insurance. You usually pay only for the specific time the boat is in use.

Also, most policies are limited to operating the boat within a restricted area. If you cruise outside the limits, you must notify your insurance broker and temporarily extend your coverage.

Most boat insurance includes liability protection against damage and injury on the owner's boat as well as on any boat it collides with.

If you have a small outboard or dinghy sailer, you can often get protection under the comprehensive liability insurance you carry to protect you and your home. A separate indorsement is often needed.

Typical annual rates for your boat and motor run about five percent of their value.

Q How can I get instruction in boating?

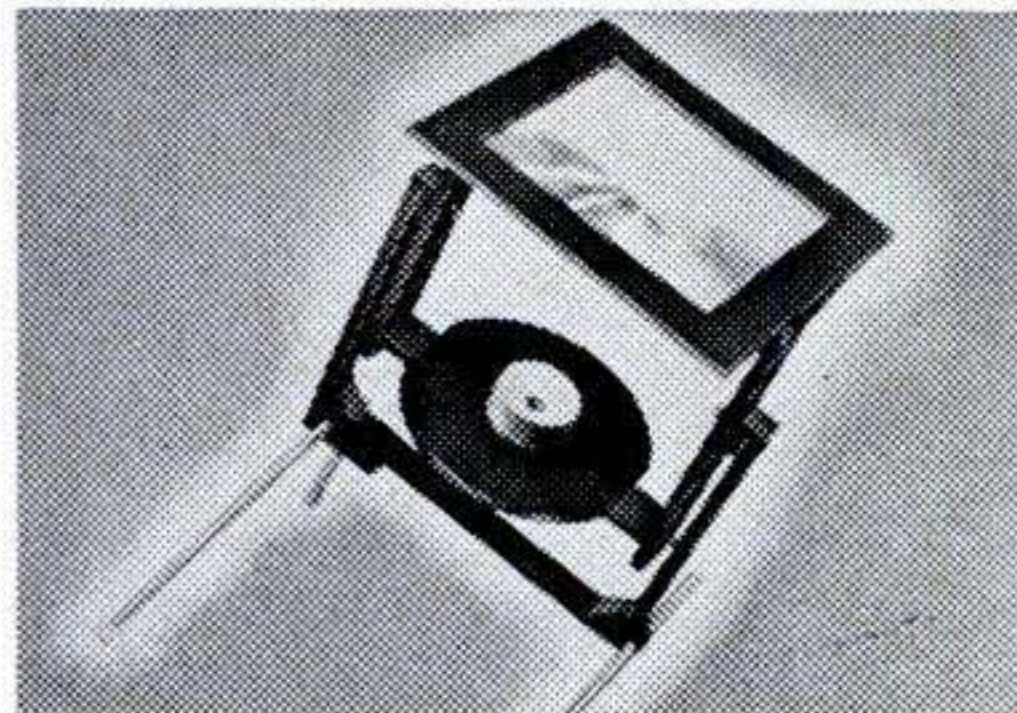
A In many ways. One is to take a free course offered by your local Power Squadron. Marine dealers can tell you how to get in touch with them. There are several professional sailing schools like the Ardell Sailing School out at Newport Beach, Calif. And many municipalities will help. For instance, Captain John Trinka's Special Services Division of the Chicago Park District offers a fine beginner's program within the sheltered areas of Chicago's lake-front harbors. Your dealer can put you in touch with such training sources, too. If your boat is powered, join your local Power Squadron for the ideas and know-how of your fellow members.

PS

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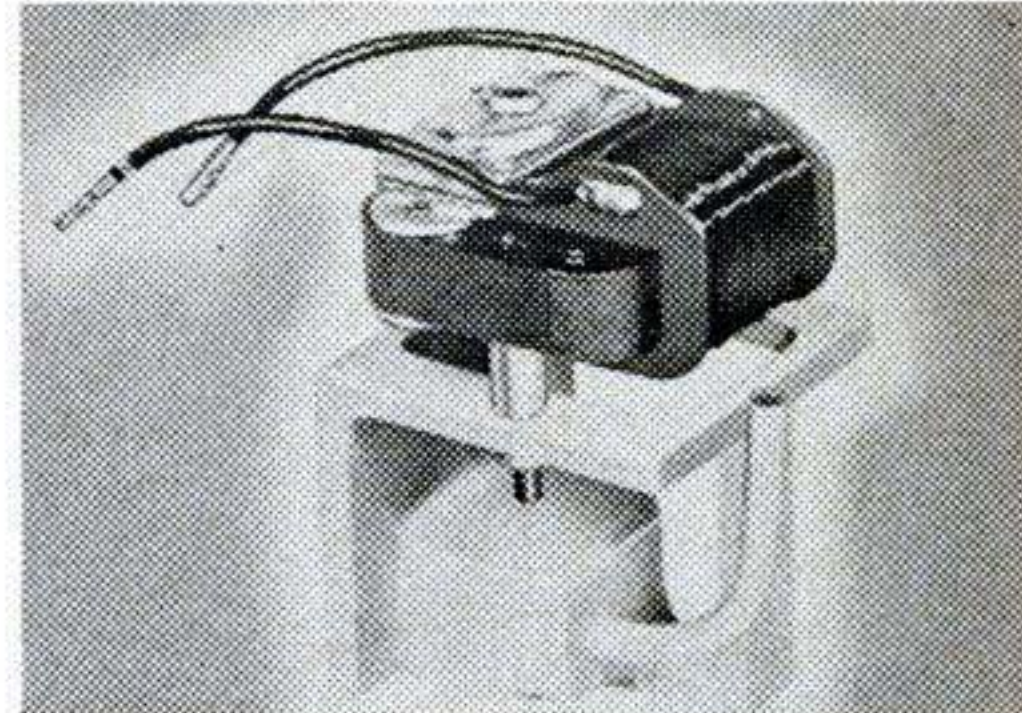
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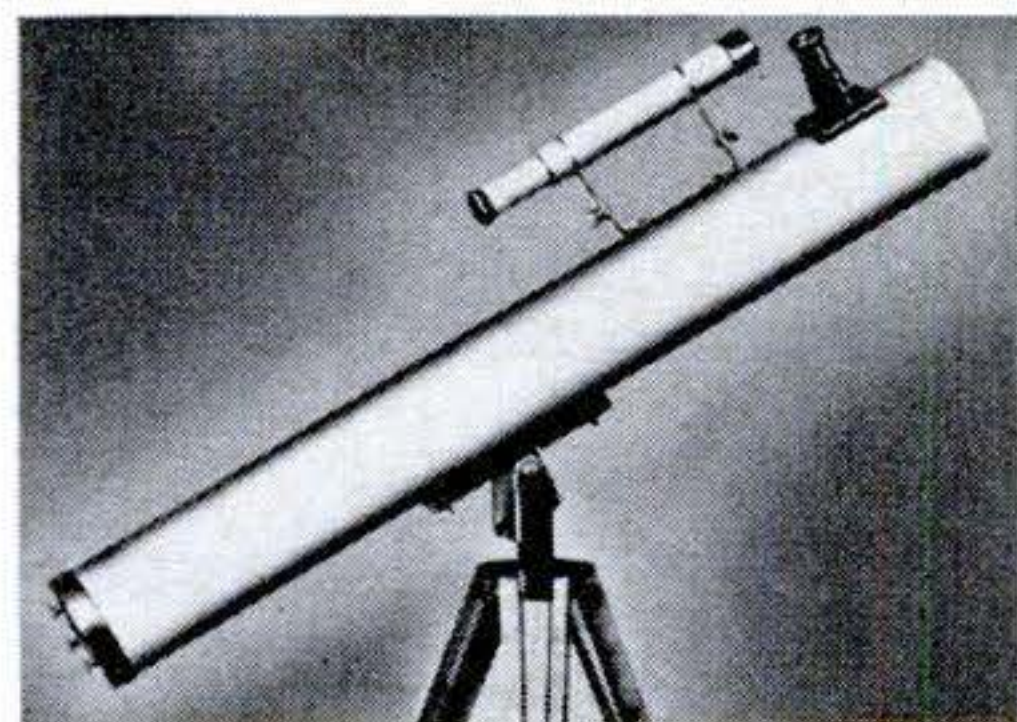
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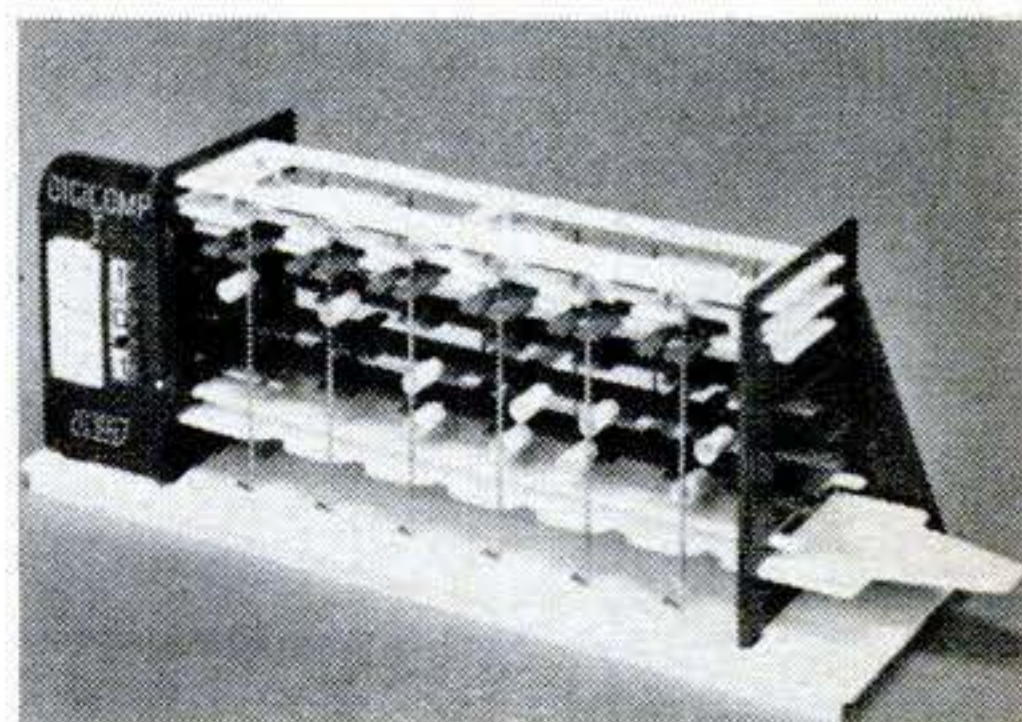
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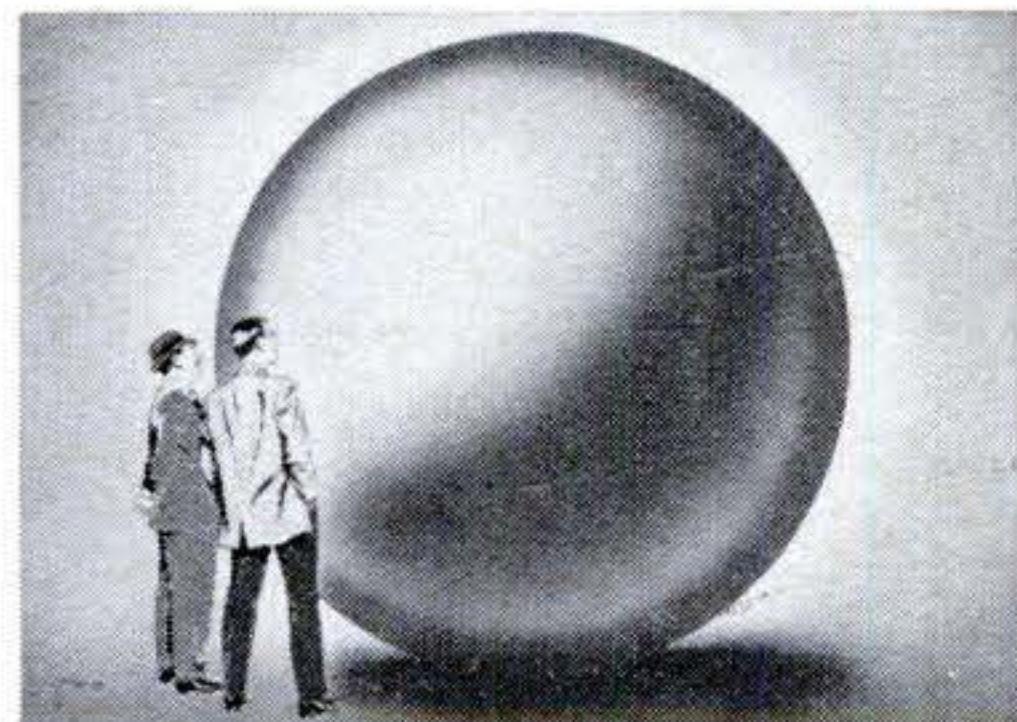
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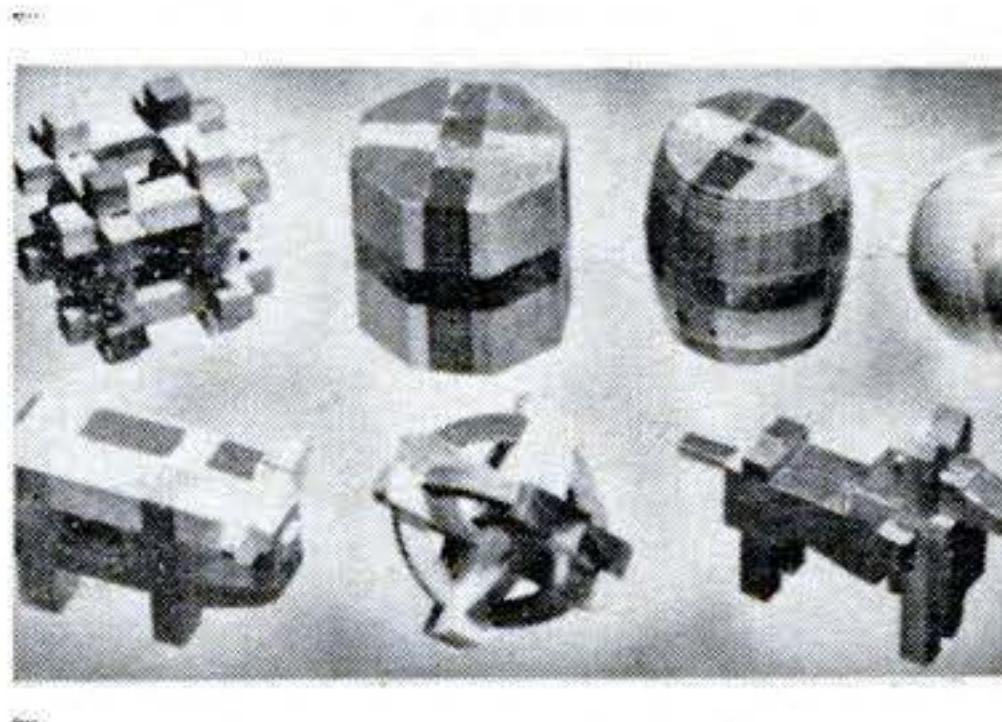
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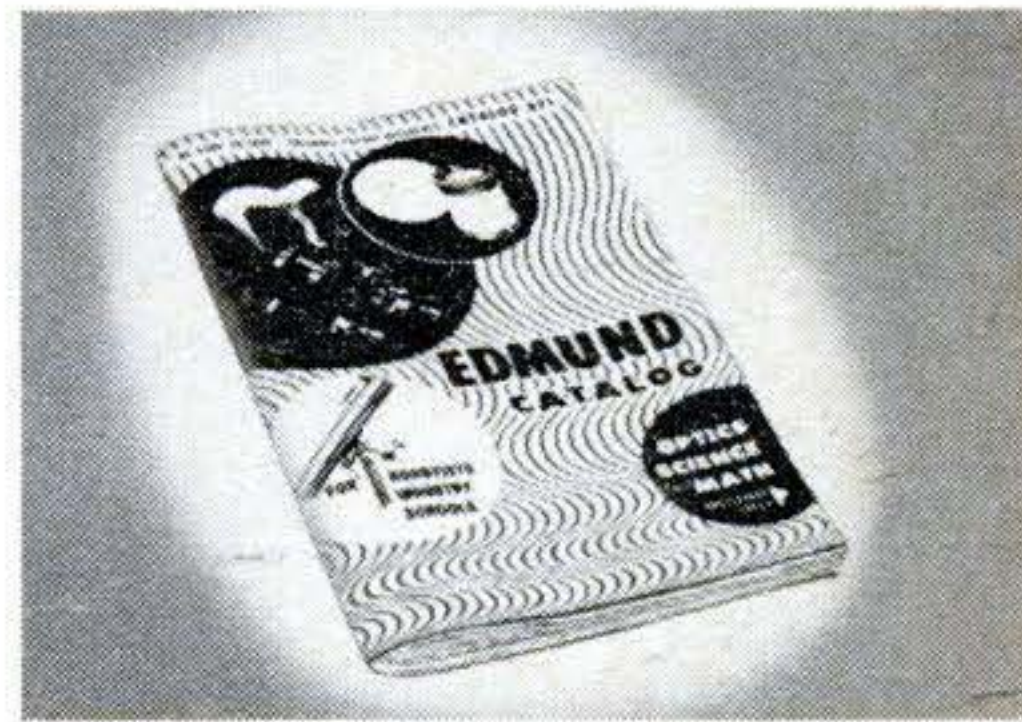
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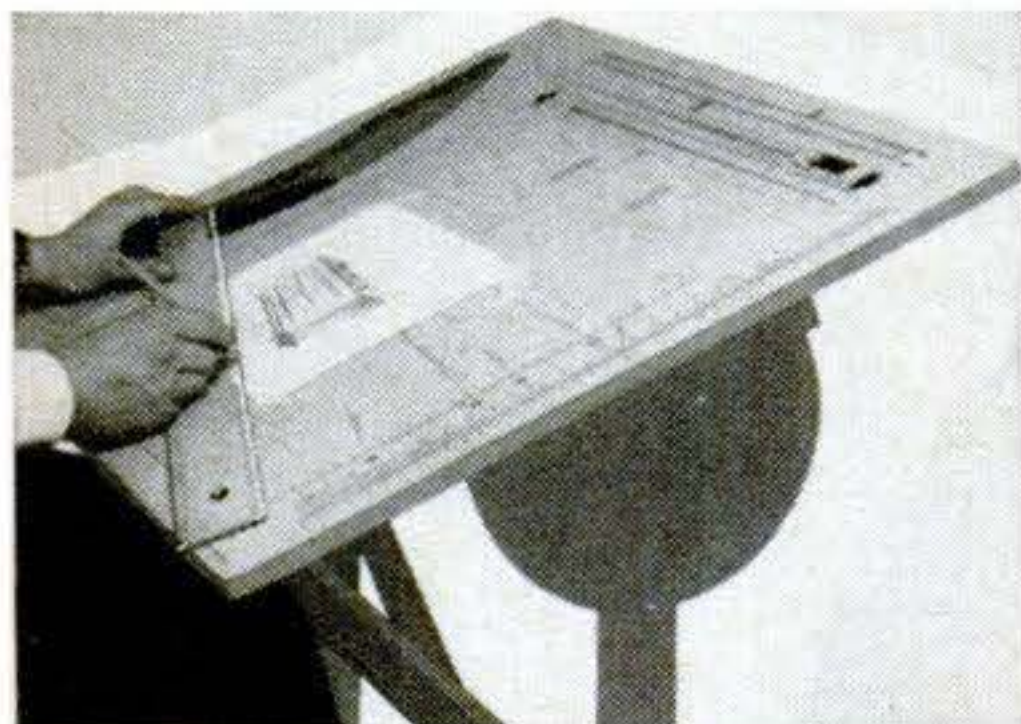
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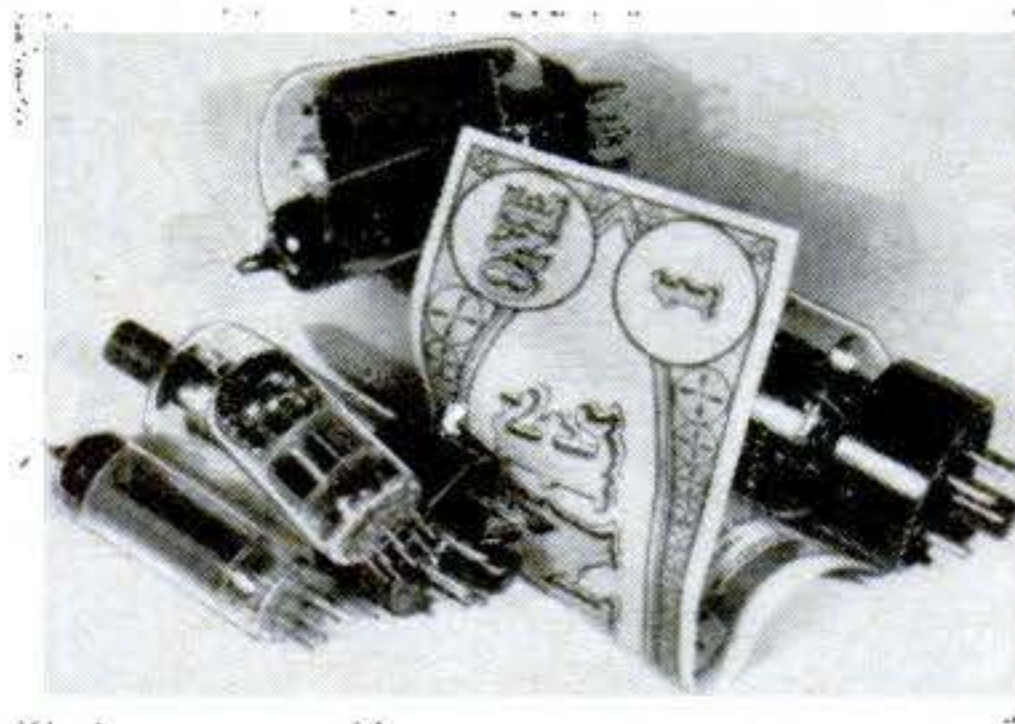
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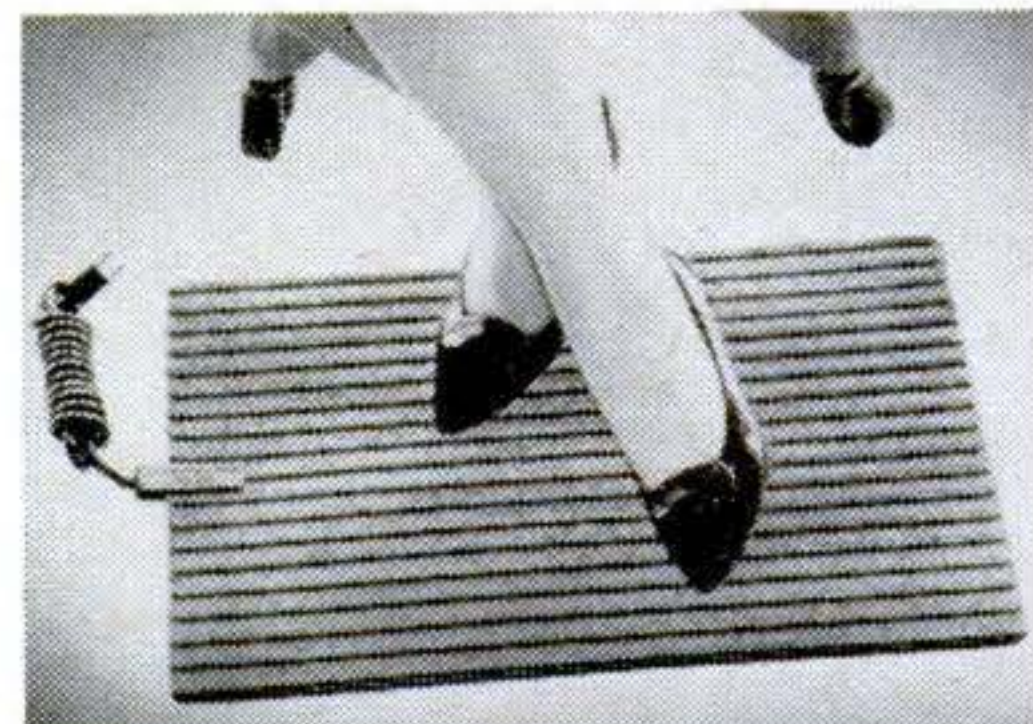
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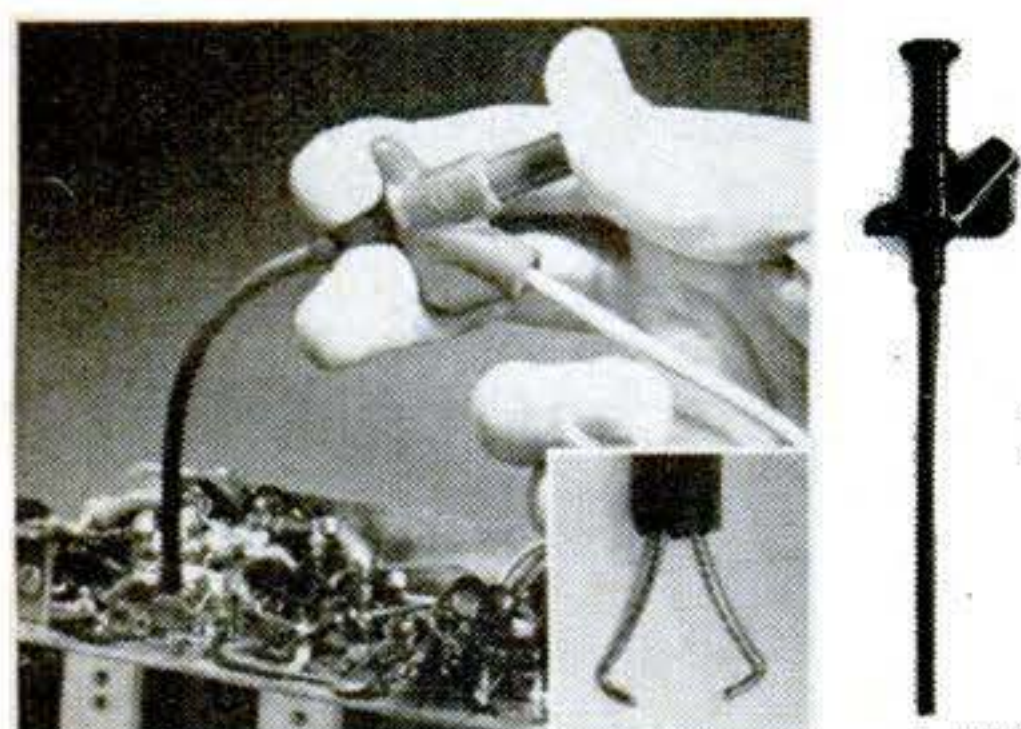
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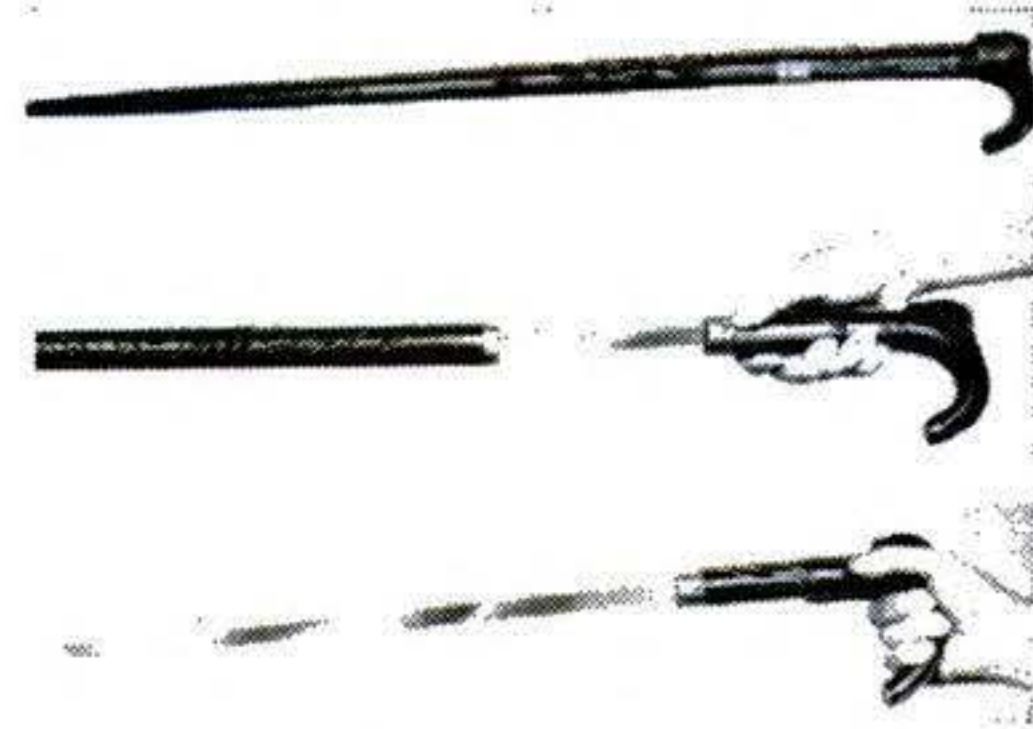
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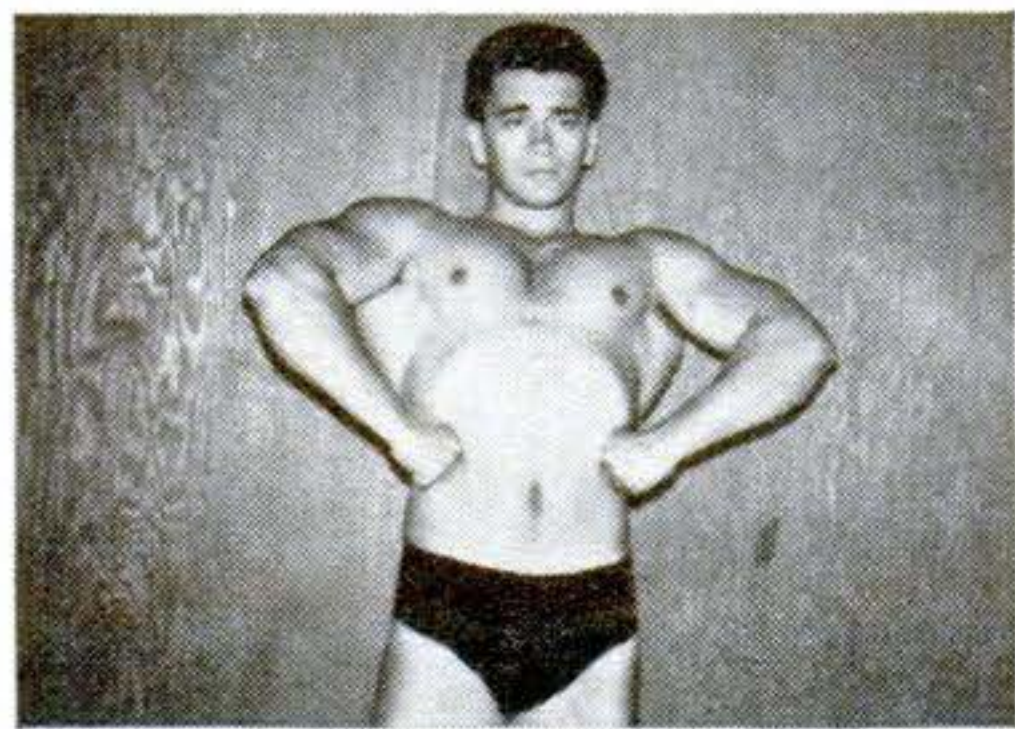
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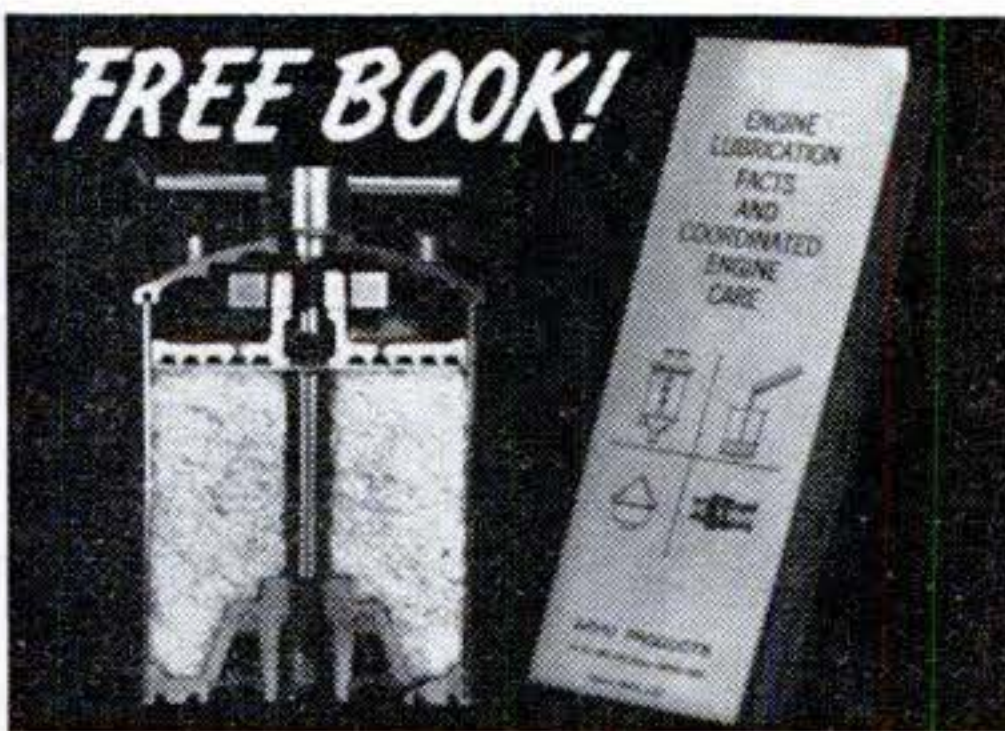
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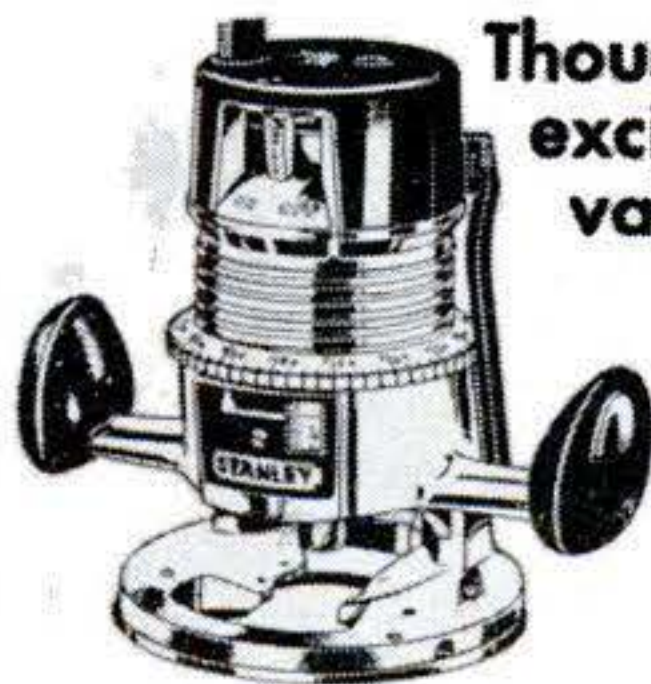
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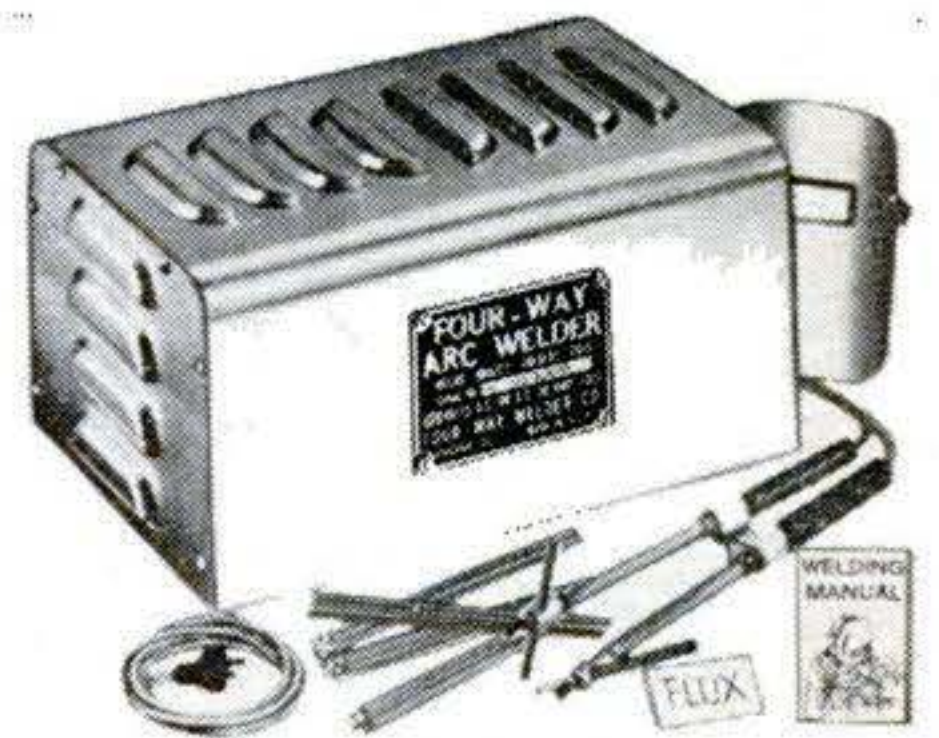
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LOANS by Airmail \$100-\$1000. Anywhere. Confidential. Write Union Finance, Dept. PS, 222 W. Osborn, Box 7457, Phoenix, Arizona.

OVERSEAS Jobs—Europe, South America, Far East, etc. 2,000 openings in all trades. Construction, Office Work, Sales, Engineers, etc. \$400 to \$2,500 month. Expense paid. Free information, write Overseas Jobs, International Airport, Box 536-P, Miami, Florida 33148.

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RUPTURED. Relief and Comfort. No Understraps, Elastic or Steel. Write Hand Lock Products, Preston 2, Ontario, Canada.

INVESTIGATORS, free brochure, latest subminiature electronic surveillance equipment. Ace Electronics, 11500-F, NW 7th Ave., Miami, Florida 33168.

CONFIDENTIAL counseling—\$.2. for personal answer. J. Chescher, Chester, Okla. 73838.

CHRISTIAN Tracts, Mimeograph & Give At Each House, Free Samples. 3905 Victoria, Hampton, Va.

MEXICAN Law General Practice, 1203 Arizona Ave., El Paso, Texas 79902.

BILL Problems? Poor credit no trouble. Not a loan company. Send for free application. Automatic Acceptance, 318PS Broadway Blvd., Reno, Nevada or 307PS Pocasset Ave., Providence, R.I.

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LEG Sore Sufferers—Send for Free Book on proven Viscose for relief of pain and aches of leg ulcers, swelling, itch, rash, due to deep vein congestion. Works as you walk. Viscose Co., 100-PS West Chicago Avenue, Chicago, Illinois 60610.

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INTELLIGENCE Test! with answers. \$1.00. (Free details.) Zorbas, Box 2224-S, Cleveland, Ohio 44109.

SUPER memory overnight! Success guaranteed! Bijou, Box 1727-V, Hollywood 28, Calif.

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Please send me the units checked. Payment in full enclosed \$..... or \$3 deposit each item enclosed, balance C.O.D. I MUST BE FULLY SATISFIED OR WILL RETURN UNIT WITHIN 10 DAYS FOR FULL REFUND. No questions asked.

- | | |
|--|--|
| <input type="checkbox"/> 8" Power Saw at \$14.95 | <input type="checkbox"/> Jointer-Planer at \$19.95 |
| <input type="checkbox"/> Standard Rip Fence #354 at \$3.50 | <input type="checkbox"/> Lathe at \$9.85 |
| <input type="checkbox"/> Long Rip Fence #354C at \$4.50 | <input type="checkbox"/> Set of 3 High Speed Turning Chisels at \$4.95 |
| <input type="checkbox"/> Belt Sander at \$14.95 | <input type="checkbox"/> Drill Press at \$29.95 |
| <input type="checkbox"/> Mitre gage for Sander at \$1.95 | <input type="checkbox"/> Disc Sander at \$7.95† |
| ½ hp GE Motor { | <input type="checkbox"/> \$14.80 (purchased with other item) |
| | <input type="checkbox"/> \$18.95 (if purchased separately) |

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SAVE AS MUCH AS... 80% WITH QUALITY POWER TOOLS

DIRECT FACTORY OFFER AND REVOLUTIONARY PATENTS decrease costs, increase efficiency. Full scale power tools of heavy duty 100% cast iron and steel. Streamlined design reduces weight, cuts material and production costs. Special patents provide added efficiency, accuracy, savings. Parts made, assembled, tested, packed right in our own factories shipped direct... save store profits.

UNCONDITIONAL 10-DAY MONEY BACK GUARANTEE
You must be fully satisfied. If not, return in 10 days, freight collect. Money promptly refunded in full.

ENDORSED BY AMERICA'S TOP MAGAZINES... Here is what the editors say: "A good bit of sound—imaginative—engineering." *Popular Science*; "(saw) boasts many features of bigger brothers." *Popular Mechanics*; "Amazingly versatile." *Workbench*; "Highly substantial construction, sturdy enough for production line use." *Industrial Woodworking*. And *Workbench* awarded these tools their coveted "Work Tested" Seal.

OVER A MILLION USERS confirm their precision, versatility and rugged performance.

* **10-YEAR FULL SERVICE GUARANTEE**... Any part or parts of any AMCO power tool (except motor) which may become inoperative for any reason within ten years after the purchase date will be repaired or replaced by the factory without cost to the purchaser. Your only cost: for postage.



8" TILT ARBOR POWER SAW

DOES WORK OF \$75 BENCH SAW as is. Converts easily to equal any \$300 floor model cabinet units! Crosscuts, rips, mitres, cuts compound angles, dados, makes coves and mouldings.

\$1495 f.o.b. factory. Wt. 25 lbs. Includes completely assembled cast iron and steel 8" saw with ground cast iron table... less blade. **RIP FENCE**, if desired, for easier work alignment, \$3.50 add'l.

SAW BLADE TILTS... TABLE STAYS LEVEL

Locks securely at any angle up to 50°, raises, lowers 0"-2¼". Patented tilt mechanism, accurate etched scale. Patented motor mount takes std. ¼ h.p. or larger motor, keeps belt tight, assures perfect alignment at any angle, transmits full power. Takes std. blade, saw insert removes to take dadoe heads, cutters, etc. (not incl.). Accurate mitre gauge assembly. Ground spindle. Enclosed steel base. "Compo" bearings. Accessories available at factory prices. **RIP FENCE**, if desired for easier work alignment: Std. size (for bench saw) \$3.50; larger fence (for cabinet base, as ill'd.) \$4.50.

FREE CABINET BASE PLANS Use as portable bench saw as received (inset photo)... or transform easily and inexpensively into floor model (as shown) guar. to do work of floor models costing \$300. **FREE plans**... all you'll need are a sheet of ¾" plywood and 3-4 hours. Use your AMCO saw for cutting. Plans provide 27" x 24" work surface, 33" height, tool storage compartment.

10-YEAR FULL SERVICE GUARANTEE*

6" SWING 3-FOOT LATHE



Optional faceplate for turning bowls, trays, lamp bases, rosettes, etc. \$2.50.

\$985 f.o.b. factory Wt. 14 lbs.

Set of 3 high speed turning chisels, \$4.95 add'l.

DOES THE WORK OF \$40 UNITS... with same precision and speed. Turns wood, plastic. Sturdy cast iron with tubular steel bed. Ball thrust cup center, spur center, T-rest assembly, lever action tail stock, 2-speed pulley. Fits any motor.

10-YEAR FULL SERVICE GUARANTEE*

PRECISION 4" x 36" BELT SANDER

f.o.b. factory. Wt. 15 lbs.

\$1495 †Disc Sander attachment incl. disc bracket, ground cast table (tilts 0-45°): \$7.95 add'l.

DOES WORK OF \$50 SANDERS... The world's most talented belt sander. Heavy cast sander incl. 4" x 36" sanding belt, V-pulley drive, multi-purpose drive spindle. Changes from horizontal to vertical sanding in secs. Uses ½ hp or larger motor.

10-YEAR FULL SERVICE GUARANTEE*



Mitre gage: \$1.95 add'l.

FULL 22" LONG, 4 1/8" JOINTER-PLANER

\$1995

f.o.b. factory. Wt.: 19 lbs. Complete as shown.



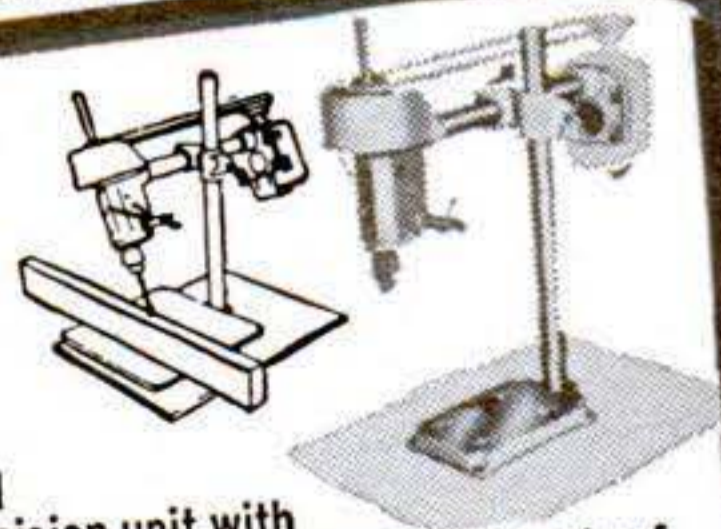
100% precision ground cast iron and steel.

DOES THE WORK OF \$60 UNITS... Professional power planing at a hand tool price. Make faster, more accurate joints, rabbetts, bevells for windows, doors, drawers, square tapered legs—Adjustable precision ground cast iron tables. Patent-pending design holds knife to table clearances at any depth. Rabbett depth 3/8". Fence adjustable 0°-50°. Hardened, ground hi-speed steel knives. Dual cutter guards. Balanced cutter head.

10-YEAR FULL SERVICE GUARANTEE*

32" RADIAL DRILL PRESS

All cast iron and steel f.o.b. factory Wt. 30 lbs. ½" cap. Jacob's chuck incl. **\$2995**



DOES WORK OF \$90 UNITS... and much more. Industrial quality precision unit with all standard features, many extras. Head raises, lowers. Depth of throat up to 16". Pre-set to any angle for on-or-off table drilling, even horizontal drilling. **10-YEAR FULL SERVICE GUARANTEE.***

BRAND NEW  ½ H.P. MOTOR... \$14.80 F.O.B. FACTORY / FOR ANY OF ABOVE MACHINES. WT. 17 LBS. PURCHASED SEPARATELY, \$18.95

INSIDE

What makes the new Merc 1100SS the world's most powerful, most advanced outboard?

⚡ NEW ALL-ELECTRONIC THUNDERBOLT PROVED IGNITION WITHOUT BREAKER POINTS. First on Mercury in 1966, finest by far in 1967—fires with lightning speed and power, eliminates pre-ignition. Polar-Gap spark plugs last seasons, not days. Engine efficiency and reliability are dramatically increased! No need for periodic adjustments to plugs and points—timing never needs resetting!

⚡ QUIET! Comes from Mercury's unique System of Silence: acoustically lined wraparound cowling, rubber-mounted engine support frame, neoprene-sealed fittings, "Wall of Water" exhaust jacket, Jet-Prop exhaust and Dyna-Float suspension. Add internal reed valves, Power-Dome combustion chambers, closer tolerances.

⚡ SMALL-BORE, SHORT-STROKE, IN-LINE DESIGN minimizes the major sources of engine wear, results in more horsepower per cubic inch, greater economy, longer engine life.

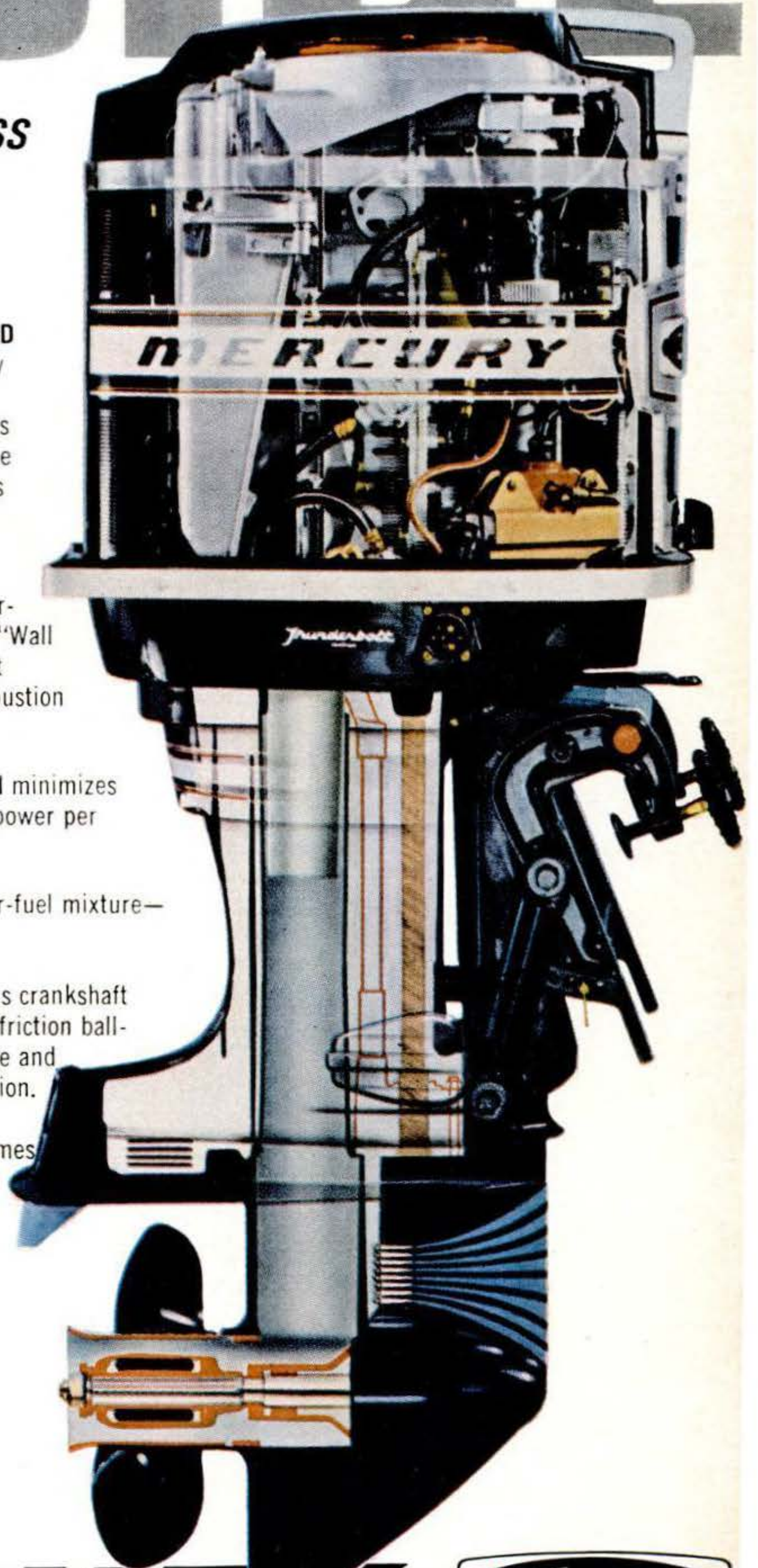
⚡ FIXED-JET CARBURETORS maintain a perfect air-fuel mixture—the engine can't run too rich or too lean.

⚡ ENDURANCE-PROVED CONSTRUCTION. Mercury's crankshaft and connecting rods are made of forged-alloy steel. Anti-friction ball-and-roller bearings are used throughout. Shearproof drive and hydraulic shock absorbers provide rugged impact protection.

⚡ JET-PROP EXHAUST fires exhaust sound and fumes through the propeller hub into the prop slipstream. Vacuum-caused drag is reduced, engine breathing improved.

See the 110-HP Merc 1100SS—plus 8 other new Mercs for '67—engineered to stay ahead: 3.9, 6, 9.8, 20, 35, 50, 65, 95HP—at your Mercury dealer—or write for '67 catalog to Dept. PS-1, Kiekhaefer Corp., Fond du Lac, Wisconsin.

Kiekhaefer Corporation, Fond du Lac, Wisconsin, Kiekhaefer Mercury of Canada, Ltd. Kiekhaefer Mercury of Australia Pty. Ltd. Subsidiary of Brunswick Corp.



MERCURY



WORLD LEADER IN MARINE PROPULSION

ANOTHER MERCURY FIRST: THUNDERBOLT IGNITION—Now without breaker points and available on 4 new Mercs—50 to 110 HP

No motor in its power class will go as far on 6 gallons of regular gas and one pint of oil



This is the 100 hp Evinrude motor that holds the world's outboard speed record (130.9 mph)!

How come it also beats all other big outboards in fuel economy?

There are two reasons:

First, it has a unique fueling and ignition system.

Each cylinder has its own fixed-jet car-

buretor... its own straight-in manifold... its own individually sealed compression chamber, with internal exhaust tuning. The combustion climate is thermostatically controlled. And ignition is all-electronic—with no mechanical contacts. It all adds up to faster firing, cleaner combustion, more power out of each fuel charge.

Second, the low-friction, low-profile V-4 design is inherently balanced. It

runs smoother. Its short, rigid crankshaft has less "torsional whip" than tall in-line designs.

The high-torque, short-stroke V-4 design delivers higher thrust over a wider speed range. Propelling is less critical. Its versatile power is more efficient under varying load and speed conditions.

If you enjoy passing gas docks, you'll enjoy it oftener with a Starlite 100-S.

See your Evinrude dealer, listed in the Yellow Pages.
Catalog free. Write Evinrude Motors,
4051 N. 27th St., Milwaukee, Wisconsin 53216

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