

**WITNESS: The Jet That Ditched in the Ocean**

# POPULAR MECHANICS

DEC. 1970  
50 CENTS

**40 Great Home and  
Shop Tips to Save  
You Work and  
Money** Page 156

**SKYLAB—Our Next Great  
Step in Space**

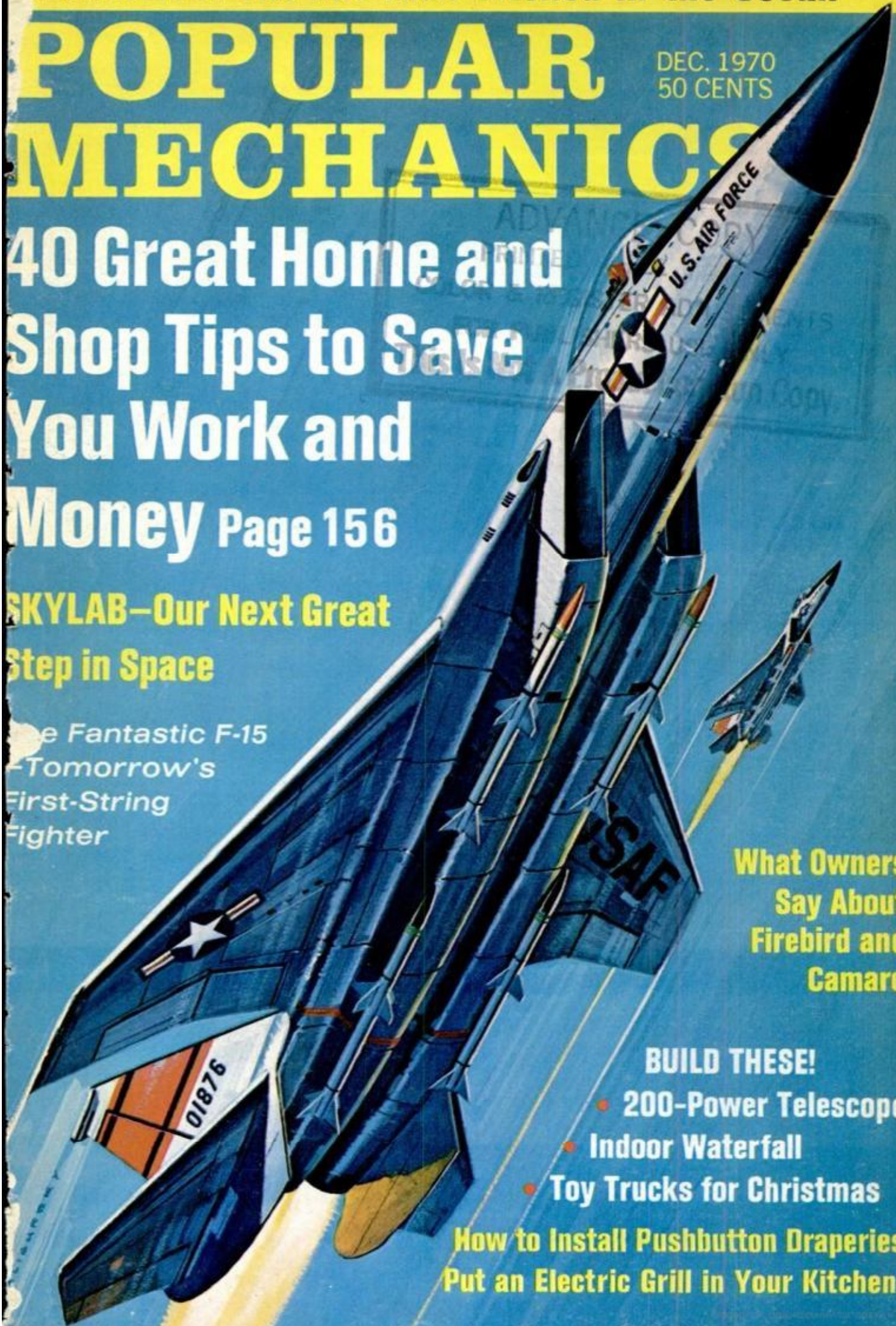
**The Fantastic F-15  
—Tomorrow's  
First-String  
Fighter**

**What Owners  
Say About  
Firebird and  
Camaro**

**BUILD THESE!**

- 200-Power Telescope
- Indoor Waterfall
- Toy Trucks for Christmas

**How to Install Pushbutton Draperies  
Put an Electric Grill in Your Kitchen!**





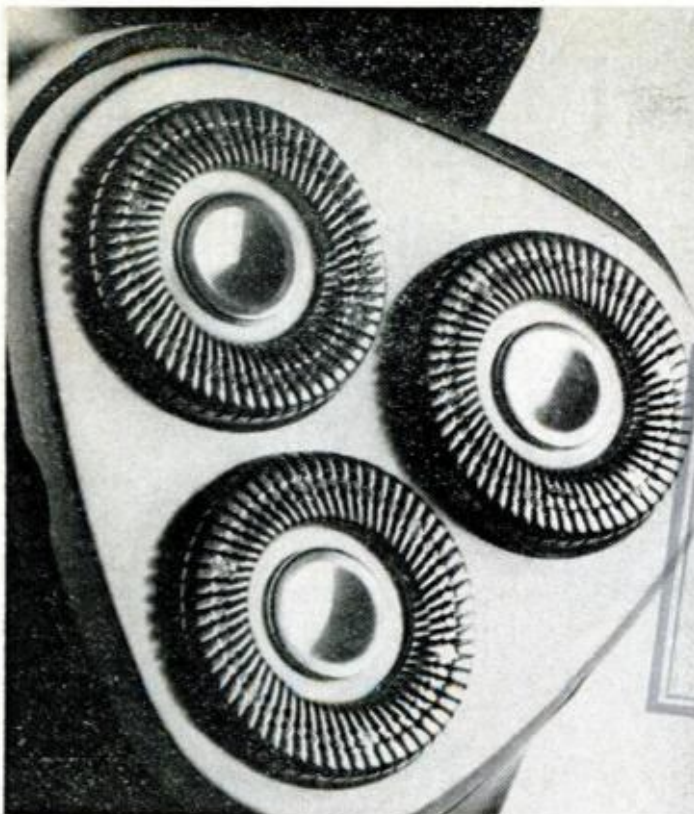


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## This is what we have against blades.

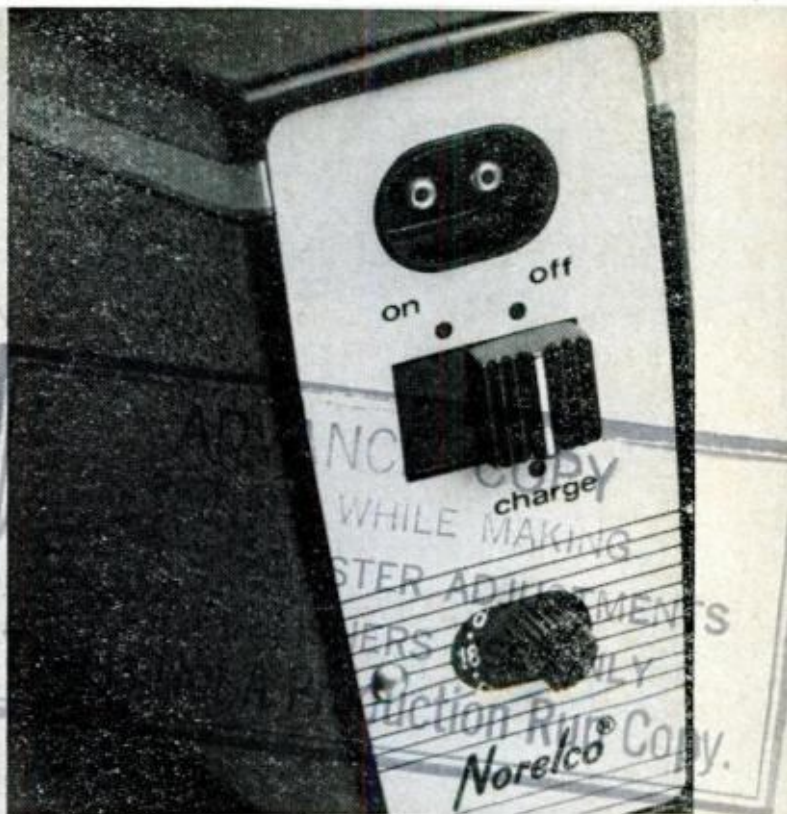
A shaver that shaves as close or closer than the new platinum and chromium blades.

99 men tested our Norelco Tripleheader 35T against these new blades. Each shaved one side of his face with a blade and the other with the Tripleheader. Our three floating heads followed the curves of their faces. And our eighteen rotary blades shaved in every direction at once (that's the way beards grow).

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What's more, the Tripleheader has a pop-out trimmer. So you can get your sideburns straight and even for a change.

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A rechargeable that gives up to *twice as many shaves per charge* as any other rechargeable.

Our Rechargeable Tripleheader 45CT has all the features of our regular Tripleheader. It has three Microgroove™ floating heads. And eighteen rotary blades that continuously sharpen themselves to cut down on bothersome blade replacement. And a hidden pop-up trimmer for neat sideburns and mustaches.

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DECEMBER 1970

1



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## NEXT MONTH IN POPULAR MECHANICS

**Special Tear-Out Section: Auto Racing Guide for 1971.** The cars (in color), the drivers, the tracks, the races and the records. This special section was prepared especially for PM's auto-racing fans by our automotive editors.

**Those TV Cartridge Tape Systems.** Which does what?

**Should Mechanics Have to Have a License?** Is it time to make them "professionals"?

**Wanted: Electronic Detectives.** The quarry: "bugs" planted by industrial spies.



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DECEMBER 1970

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This One



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Lights easy—  
takes its own good  
time about burning



## LETTERS TO THE EDITOR

### Right to fly

Congratulations for *Will You Lose Your Right to Fly?* (page 88, Oct. PM). I've gotten pretty disgusted with a lot of the rubbish that has appeared in the general press and TV coverage of this subject. I believe the writer of your article did a very good job interpreting this complicated subject for readers who may have little or no knowledge of the real situation. It's gratifying to see this, since so often this subject has been distorted by people who should know better.

As a private pilot and a foe of bureaucratic bungling and airline arrogance, I certainly hope I *don't* lose my right to fly, and I thank PM for helping report this important subject in its proper perspective. WICKENBURG, ARIZ. MARSHALL LINCOLN

### 'Just fantastic'

I thought you might be interested in seeing a picture of your *2-Way Season's Greeter* (page 136, Nov. '68 PM).



I really had a lot of fun and enjoyment making this project, and the comments and compliments from the people in my neighborhood were just fantastic.

Thanks for the nice project.

ANN ARBOR, MICH.

ROBERT L. BAIRD

*Looks great! And if other readers want to duplicate the display (there's not much time left), you can order Xerox copies of the article for 95 cents from Popular Mechanics, Dept. JL, 224 West 57th St., New York, N.Y. 10019.*

### Honey's not for the birds

In one of your September *Letters to the Editor* (page 6), a reader recommended

[\(Please turn to page 8\)](#)



# Are you still working for peanuts while others are making it big?



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**LETTERS**

*(Continued from page 6)*

putting honey in feeders for hummingbirds. We recently read an article warning against feeding a honey syrup to hummingbirds. The honey ferments in the sun and causes a fungus disease on their tongues. A syrup, made of one part sugar to four parts water and colored red with food coloring, is recommended.

CARLSBAD, CALIF. MR. & MRS. E. T. LANNIN

**'How soon indeed!'**

*How soon a three-wheel car? you ask in Detroit Listening Post (page 38, Oct.*



*PM*). How soon indeed! The enclosed ad was taken from a 1911 issue of the old *Life* magazine.

LAWRENCEVILLE, N.J. HARRY H. PRATT

*Well, as somebody once said, there's not much new under the sun. The Motor-ette above ("Highest development of the motorcycle. Not a cheapening of the automobile." Price: \$385) is indeed a three-wheeler, but you don't see many around these days. However, some new ones are on the way—you can read all about 'em in next month's PM under the title: Is There a Three-Wheeler in Your Future?*

**Not so easy**

*How to Talk to Vietnam—Free (page 108, Sept. PM) seemed like an answer to our prayers, but our son in Vietnam wrote that calling home isn't so easy. He says calls are placed only between 10:00 p.m. and 2:00 a.m. and that you can't always get through on the night you want. Radio hookup is to Barstow, Calif., where*

*(Please turn to page 10)*





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Check for facts on GI Bill  
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## LETTERS

(Continued from page 8)

it gets transferred to the telephone company, and we must pay person-to-person rates from there.

MILWAUKEE

C. R. EBERHARDT

Shortwave propagation from Vietnam is best between 4:00 p.m. and 3:00 a.m., but some strategic bases may restrict telephone-patches still further because of military considerations, reports our author. How long your son waits to put his call through depends on the weather (propagation conditions) and how many other soldiers want to call home at the time (holidays are hectic). Radio hookup is to whatever MARS station picks it up best—not just Barstow. (Phoenix picks up about 60,000 calls a month.) Our article mentioned the commercial telephone costs to you; the MARS service is free.

## No cylinders

In *Freon Engine for Datsun* (page 48C, Oct. PM), you say, "The gas drives the engine's six cylinders . . ." Not so. The inventor, Wallace Minto, found steam and fuel piston engines inefficient and unsuited for his fuel type drive. His engine uses two fluted rotors.

BROOKLYN, N.Y. F. WILLIAM BOETTCHER

## Joe dunnit

Unfortunately, we forgot to credit photographer Joe Munroe for his superb work in *Cruising the Cascades* (page 132, Nov. PM). In addition to being a top-flight still photographer, Joe recently completed a 53-minute movie, *To Dare the Wildest River*, about men who run the Colorado in dories. It'll be on TV (the date's not set), and if you look quick, you'll catch a glimpse of PM Editor Bob Crossley.

## Racing Guide

I enjoyed your 1970 *Racing Guide* (page S1, Jan. PM). The track layouts and the brief section on rules were worth the price of the magazine.

Being a dirt-track fan, I was disappointed that this exciting phase of the sport only came in for slight mention. Perhaps next year the sprint cars and the dirt-track championship cars will be awarded their rightful place in your informative racing booklet.

ARLINGTON, KANS.

T. D. BARCLAY

They will be. Look for the 1971 *Racing Guide* in your January issue of PM. ★★★

POPULAR MECHANICS



# If you're earning less than \$1,000 per week, we think that you're selling yourself short.

**T**HE very fact that you're reading this says something important about you: either you are now in business for yourself, or you plan to be in the near future. If so, here's something for you to consider. As a self-employed individual, your earning power should be in the neighborhood of \$1,000 per week, or about \$50,000 per year.

We didn't just pull this figure out of the air. It's based on our years of working with people who work for themselves. What's more, common-sense arithmetic bears us out.

Not too many years ago, a man was on his way to Success if he was earning \$10,000 per year by the time he was 30. But times have changed, and that \$10,000 figure has lost most of its glitter. Today, many kids straight out of school command starting salaries of \$12,000 to \$15,000. By the time they're 30, those same young men are being paid \$25,000 to \$35,000 per year—working for somebody else. Which brings us to our conclusion: if you can make, say, \$25,000 working for somebody else, you can make \$50,000 working for yourself. Because you'll work harder, and you'll work longer hours, and because you won't have to split your earnings with bosses.

If this kind of arithmetic makes sense to you, and if self-employment is indeed your near-future goal, American Unifax would very much like to hear from you, because our success is based upon attracting the interest and support of persons like you.

We're in the office products field. When we entered this field, we did so with two important principles fixed firmly in our mind.

The first of these principles was that we would offer for sale only those products which were demonstrably superior to any other products available from other companies, regardless of brand or price.

Our second principle was that we would make these products available to the

business community through Direct Distributors—men who had the drive and determination to earn \$50,000 or more per year.

We have never wavered from these two guiding principles, even though the kind of product we seek is rare, and the kind of man we seek is rarer still. As a result, we have enjoyed a steady, healthy growth, both in our merchandise line and in the team of Distributors which carries that line to the public.

It started with COPYFAX, our Space Age replacement for old-fashioned carbon paper. COPYFAX represents a totally new concept in multiple copying. Instead of the conventional combination of flimsy tissue and a carbon-grease-wax mixture, COPYFAX employs an incredibly strong film of DuPont MYLAR® only .001" thick, which, by means of a patented process, is treated with a liquid ink similar to that used by printers. One piece of ordinary carbon paper is good for about five rather smudgy copies before it's ready for the wastebasket. One sheet of COPYFAX gives as many as 200 crisp, clear, print-like copies—at about one-fifth the cost of carbon-paper copies.

Carbon paper is a \$203 million industry in America. Steadily and surely, COPYFAX is taking over the lion's share of that industry.

COPYFAX is just one of our products. We've introduced the American Unifax Typing Ribbon, which is based on the same patented process that makes COPYFAX possible. And American Unifax Correction Paper, a unique solvent-ink paper that makes correcting typing errors almost unbelievably easy. More new products are on the way.

In selecting our Distributors, we exercise the same care as in selecting our products. It seems to us that our kind of company—dynamic, flexible, and doing a very high sales volume—is better off with one man who demands \$1,000 per week than with five men who'll be

happy with \$200, or with ten who'll settle for \$100.

This is not to say that the bulk of our Distributors come from the ranks of the supersalesmen. Quite the contrary. One, for example, is a bank manager who makes over \$300 a week in his spare time, selling COPYFAX through the mail. Another is a printer who, with our help, has recruited over 100 sub-distributors who sell for him. A third, a housewife, had "never sold a thing in her life"—but who landed a \$785 order in less than five minutes.

Another thing about our company which might interest you—we don't charge franchise fees. We believe that your effort, interest, and loyalty are more valuable to us than any fee we could reasonably ask from you. Therefore we don't ask for any fee at all.

These are some of our principles and attitudes. We intend to stick by them, because they work. In two short years, American Unifax has grown into a company of major importance in the office products field. And we're growing faster all the time.

We'd like you to grow along with us. We won't guarantee that you'll make \$1,000 per week, but we promise you this: we'll give you all the tools you need to earn that much money. And if you're the kind of man we hope you are, you'll know how to use them.

**AMERICAN UNIFAX, INC. Dept. PM127  
95 Madison Avenue  
New York, New York 10016**

The American Unifax way of doing business makes sense to me—give me the tools to start making \$1,000 per week.

Rush complete information, FREE and without obligation.

I enclose \$9.00. Rush me 1 pack COPYFAX, 1 Typing Ribbon, and 1 pack Correction Paper (retail value \$12.40), plus complete information.

I enclose \$49.00. Rush me a special starter kit with profit potential of \$300 or more, and a balanced assortment of American Unifax products, plus complete information.

If you wish, specify make and model of typewriter.

NAME .....

ADDRESS .....

CITY..... STATE..... ZIP.....



The People  
Who Bring You  
Tomorrow's  
Office Products  
... Today

**AMERICAN UNIFAX  
95 MADISON AVE. N.Y., NY 10016**

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**Jeep guts will take you  
deep into the backwoods-  
comfortably.**



# The Jeep Wagoneer— the first 4-wheel drive family wagon. It's rugged, safe, comfortable.

Take your family off the beaten track. But don't leave their comfort behind. Jeep Wagoneer is for you. It's a 4-wheel drive station wagon that carries luxury anywhere.

We've been putting 4-wheel drive vehicles together longer than anyone else. So we've learned a few things.

Like how to build the Wagoneer with a higher ground clearance and lower center of gravity than any other 4-wheel drive family wagon. So you don't worry about holding the curve with a full load.

For added safety, the Wagoneer has independent hydraulic systems for both front and rear brakes. And these heavy-duty servo-type brakes are also self-adjusting. Your Wagoneer stops when it has to.

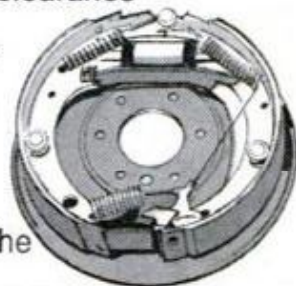
On the road and in town, too, the Wagoneer is at home. Roomy, comfortable, with custom interiors. Enough cargo space for a spinet piano. Or a little league baseball team. And your pick of options like a husky V-8, power brakes, power steering, automatic transmission, air conditioning.

The Wagoneer outsells all other 4-wheel drive family wagons combined. Test drive one at your Jeep dealer's today.

**The toughest  
4-letter word on wheels.**

# Jeep

**Products from American Motors**





ON-THE-GO

# CAMPING

BY WADE MITCHELL

**INTERIOR CRASH-PADDING** will begin to appear on 1971 coaches. Sharp corners and square table edges will be gradually removed. Potential hazards during highway collision must be considered, hence, interior crash-padding is inevitable. Several major coachmakers have scouted suitable materials and are presently studying the best methods for crash-padding a recreational vehicle. Heavily upholstered dining areas, window-restrainer bars in overcab sections, recessed appliance hardware and many more safety features will be designed into the coaches of the next generation. Look for activity to begin in this area during mid-'71.

**FEDERAL TRAILER-HITCH REGULATIONS COMING?** They might, if a new regulation by the Department of Transportation and National Highway Safety Bureau is adopted. In it, all trailers weighing under 6500 pounds would be covered. Manufacturers will be required to provide and distribute information as to safe towing limits and hitch types for various gross weights of trailers. The carmaker must further state to the buyer how much weight his vehicle can safely handle. Handling performance under various loads must also be provided the buyers. Carmakers already specify that certain hitches must be used to protect the warranty. If the customer fails to use the right hitch, he stands to lose his service policy.

**CAMPER TRUCKS GET BAD PUBLICITY IN NATIONAL TESTS**—but we're not much impressed with the published evidence. Blame a poor matching of truck and camper coach. The crew for the so-called "testing magazine" selected 11-foot camper coaches which were placed on 8-foot cargo boxes. Only a greenhorn would *deliberately overload* a pickup by failing to observe this simple rule: *Never exceed the GVW of a pickup with your camper coach!* If a coach weighs 3300 pounds (as some 11-footers do, a full water tank and a normal amount of family cargo will far exceed the 3500 pounds GVW of most 3.4-ton trucks, such as those used in the highly publicized "road tests." What they did could be compared to loading 12 passengers into a 6-passenger car, and then *complaining* because the car won't handle right nor stop quickly enough! It proved nothing but the ineptness of the testers, in my opinion.

**COLORADO MAY INITIATE CAMPER TAX!** Yes, according to rumors out of the Highway Revenue Committee, the State of Colorado is considering such a tax to cope with what has been termed "traffic jams" of recreational vehicles. State Sen. Wayne Denny of Cortez, Colo., has allegedly stated (about campers) ". . . now I think they have got to start paying their way." State Sen. George Jackson of Colorado Springs reportedly told newsmen that some means of deriving more revenue from the thousands of camper vehicles must be found. PM predicted two years ago that special "camper taxes" might be the wave of the future. Oregon has already taken such steps and may tax campers if the need arises.

**GOODYEAR RECALLS TRAILER TIRES.** If you bought a trailer during spring or summer, 1970, from any of the following companies check your tire serial numbers: Coachmen Industries, Boise Cascade Recreational Products, Holiday Rambler, Bee Line Travel Trailers, Henschler Industrial Corp. The numbers on the faulty tires begin with WT-5 and EU-5 (Goodyear tires only). The problem, according to Goodyear statements, is that 1523 of these trailer tires were produced with the wrong ply stock. Goodyear stores and dealers will replace the tires being recalled in line with the company's regular adjustment policy.

★★★



**START YOUR NEW CAREER NOW! WITHOUT OVERHEAD! ANY PLACE! ANY AGE!**

# UPHOLSTERING JUST ONE

**you don't even have to quit your present job!!!**

Start learning now. At home, or in the garage, in your spare time — no outside classes to attend. If you can tie a knot and drive a tack, you can learn this business, quickly, easily. You start learning the basics **right away** through the proven MUI Home Training Plan. And before you're barely into it, you can start doing the simple upholstery jobs that are all around you waiting to be done. Chairs, cushions, seats, footstools. Even before MUI students finish their training, people start bringing upholstery jobs to them, and remember—the world is full of furniture that needs fixing and re-upholstering and more is wearing out all the time!

**CHAIR can pay you as much as your present weekly paycheck!**

**"What started as a hobby, now pays me \$10 an hour"**  
 Yes, many MUI graduates make better than \$10 an hour turning old wornout furniture into bright new decorator pieces! **Stack it up against what you're doing now!** Are you making \$150 a week? \$200? \$250? Do you put in long hours of dull work, with small raises? Is that the way you want to spend the rest of your life? Just imagine, you can make \$150, \$200, \$250 upholstering just **one chair or sofa** these days! And if you're the kind of person who likes to work and earn, you can sometimes finish a job like this in a day. That's pay, ... and it beats what most college graduates make!

**AS YOU LEARN, YOU JUST SLIP INTO THE IMMENSE FLOW OF UPHOLSTERY WORK!**

Think of all there is! . . . Sofas, lounging chairs finished in beautiful fabrics, which MUI tells you how to get at the right price — even leather and all the new vinyls. And then you have built-ins and breakfast nooks, boats, trailers and all the millions of automobiles in America. Yes, you learn all this and more! When we finish teaching you, (in your own home in your spare time) and when you get our California state approved diploma, you **know** this business . . . as a **real professional!** You will then have one of the most fantastic moneymaking skills in America built into your head and hands! No one can ever take this skill away from you . . . and no one can ever fire you, because **you're the boss** of a business that you can take with you . . . You can make big money from then on . . . any time, anyplace you want to put out your shingle!

When you read the papers you see there's a strike here, a lockout there, Detroit lays off 150,000 men. A plant is shut down and moved out of state. A new automated machine eliminates 5,000 jobs. They talk about dislocated workers and try to do something about it. What pays the bills if you get caught up in one of these situations? When you know upholstery, life gets very simple and lots of fun. It's simple because where there are people, there are upholstery jobs and lots of them. It's fun because life is fun when the bills are paid and there's money in the bank, even enough to buy those things you've always wanted for yourself.

**MUI IS APPROVED BY THE CALIFORNIA SUPER-INTENDENT OF PUBLIC INSTRUCTION AND IS AUTHORIZED TO ISSUE A DIPLOMA IN UPHOLSTERY.**

**MODERN UPHOLSTERY INSTITUTE**  
 Box 899-DPV Orange, Calif. 92669

**YOU GET SIX BIG FURNITURE KITS FREE**



**YOU GET THIS AUTHORIZED DIPLOMA WHEN YOU GRADUATE**



Name \_\_\_\_\_ Age \_\_\_\_\_  
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**WORK THE HOURS YOU LIKE TO WORK!!**

If you favor a regular 35 hours a week, upholstery lets you do it and make a really fine living. On the other hand, if you're really ambitious and want to work 60 or 70 hours a week, **you are starting to talk about some big, big money!** The important thing is that the choice is yours, not somebody else's! (Not like when you're working for someone else.) Many students of retirement age just do a few pieces now and then just to keep things nice and comfortable.

**TO GET STARTED, JUST GET THE COUPON IN THE MAIL... TODAY!**

It costs you nothing to get the information and there's no obligation. No salesman is going to call you. This much and this much only, every successful MUI graduate must do for himself — **send the coupon today!**

**YOU'LL GET A BIG ILLUSTRATED 32 PAGE BOOK ON UPHOLSTERY**

and the upholstery business, and an actual free sample lesson showing how the fabulously successful MUI system is taught. For your sake and the sake of your future, do it now. Cut out the coupon, fill it out, put it in an envelope and mail it now. Air mail reaches MUI about two days sooner!

**ALL THE SPECIAL "TOOLS OF THE TRADE" ARE YOURS... FREE**

**THIS FREE UPHOLSTERY BOOK may be the most important information you ever read.**  
**MAIL COUPON NOW!**

**MODERN UPHOLSTERY INSTITUTE, Box 899-DPV Orange, Calif. 92669**

Please send the **FREE UPHOLSTERY CAREER BOOK**, the **FREE SAMPLE LESSON**. I understand I am under no obligation whatever and am just sending for the free facts on job and career opportunities in Upholstering and the MUI home training program. I understand that no salesman will call.



**APPROVED FOR VETERANS**



# YOU'RE BEING ROBBED!

Virtually every time that you spend money, whether at the supermarket, department store, drugstore, or gas station, you're being ROBBED! You're being duped, hoodwinked, and swindled out of the full value of your money by a combination of deceptive selling techniques that include Madison Avenue double-talk, mendacious salesmanship, and insidious labeling and packaging ploys. Senator Warren Magnuson, the most alert consumer watchdog in Congress, says that deceptive selling is today's "most serious form of theft, accounting for more dollars lost each year than robbery, larceny, auto thefts, embezzlement, and forgery combined." Sidney Margolius, the dean of American consumer writers, asserts that "Never in the 30 years I have been reporting on consumer problems has the public been as widely and steadily exploited as today." And Ralph Nader, the nation's most renowned champion of consumer rights, states that "Nowadays consumers are being manipulated and defrauded not just by marginal, fly-by-night hucksters, but by America's blue-chip business firms." In short, commercial flimflammy is rife throughout the nation and the American consumer is being victimized as never before. As a partial antidote to this widespread fraud and deception, an intrepid, authoritative, new publication has been launched. Its name is Moneysworth.

Moneysworth, as its name implies, aims to see that you get full value for the money you spend. It rates competitive products as to best buys (as among cameras, hi-fi's, automobiles, and the like); it offers tips on how to save money (they will astound you with their ingenuity); and it counsels you on the management of your personal finances (telling not only how to gain maximum return on your investments and savings, but also how to protect your money against the ravages of inflation). In short, Moneysworth is your own personal consumer crusader, trusted stockbroker, and chancellor of the exchequer—all in one.

Perhaps the best way to describe Moneysworth for you is to list the kinds of articles it prints:

- Earn 12% on Your Savings (Fully Insured)
- How to Buy A Car for \$125 Over Dealer's Cost
- Inaccurate Billing by the Phone Company
- The Advantages of a Swiss Banking Account
- The New U.S.-Made Minicars: An Evaluation
- 14 Recession-Wracked Cities Where Real Estate Is Selling for a Pittance
- "Consuming Fire"—Moneysworth takes aim at companies that are defrauding the public.
- Unsafe at Any Height—A comparison of the safety records of America's airlines.
- A Consumer's Guide to Marijuana
- Free Land and Free Money from Uncle Sam
- Stocks that Are on the Rebound
- Send Your Child to College Abroad
- The Moneysworth Co-operative—Details of a price-discount co-op (for purchasing typewriters, cameras, and the like) that Moneysworth subscribers automatically become members of.
- How Much Are You Worth?—An amazingly simple chart gives you the answer in 60 seconds.
- High-Priced Lemons—Mechanical failures on brand-new Imperials, Continentals, and Cadillacs.
- The Link Between Heart Attack and Coffee
- The Economics of Being Black
- Cashing In on Canada's New "Floating" Dollar
- Cyclamates: Did America Overreact?
- How to Buy Art Without Getting Framed
- Critics' Consensus—A regular feature of Moneysworth in which the opinions of leading book, record, and film critics are tabulated.

## Providing Your Teenager with Contraception

"Unit-Pricing"—The most revolutionary development in food stores since trading stamps.

## The Effect of Air Pollution on Potency

The Great Odometer Gyp—How rent-a-car companies take the American public for a \$10-million-a-year ride.

"No Load" Mutual Funds—A list of 45 funds that return the equivalent of an 8% profit at the very moment of investment.

12 Ways to Put the Touch on Friends—And 12 ways to demur.

## How to Buy Medical Insurance Without Trauma

The Encouragement of Reckless Driving by GM, Chrysler, and Ford—Verbatim quotes from their souped-up ads in hot-rod magazines.

Taking Stock of Your Stockbroker—Nine ways to probe his probity.

## Legal Ways to Beat Sales Taxes

### Co-ops and Condominiums Explained

"The Safest Car of 19..."—A new series of annual awards by the editors of Moneysworth.

### How to Break a Lease

Land Investment in Australia—At \$1.20 an acre, land down under rates high among speculators.

### How to Sue Without a Lawyer

The Impending Ban on Leaded Gasoline—How it should affect your next car purchase.

A Guide to Legal Abortion—Including the costs in different states.

And Now, Microwave Pollution—An exposé of the damage wrought to humans by radar, electronic ovens, and TV transmission.

### Social Security's Special Rules for Women

### How Metrecol Hurts Your Diet

Life Insurance: A Legalized Swindle—A Hartford actuary tells why he believes that "more than 90% of American policies are sold through misrepresentation, deceit, and fraud."

Teaching Your Child the Value of Money—Without having him overvalue it.

### How to Handle Computerized Dunning Letters

Taxproof Money—A collection of highly creative, little-known, perfectly legal gimmicks.

How to Distinguish Health from Hokum at the Health-Food Store

### Blindness Caused by Contact Lenses

Don't Buy U.S. Savings Bonds—Why they make a terrible investment, how they undermine sound government fiscal planning, and why one leading investment counsellor says, "They are palmed off mostly on rubes and financial boobies."

G.E.'s New Synthetic Diamonds: Will They Ruin the Value of Real Diamonds?

### The Truth about Cut-Rate Gasolines

### "No-Fault" Insurance Clarified

### Checking Up on Your Social Security Account

That's the Spirit—Big bargains in booze, beer, and brandy.

Stop Chewing the Fat—How to read the new labels on frankfurters.

Free Checks—A list of 200 banks that allow unlimited writing of personal checks.

### Bootleg Birth-Control Pills

When in Doubt, Deduct—The ten most common forms of income-tax overpayment.

### \$99 Fares to Europe

In sum, Moneysworth is a hip, trustworthy financial mentor. It reflects the quintessence of consumer sophistication.

In format, Moneysworth is a newsletter. It is designed for instantaneous communication and easy reference when you're shopping. It is published fortnightly. This ensures you that the information in Moneysworth will always be up-to-the-minute. Product ratings will appear precisely when you need them most (automobiles and sailboats will be rated in the spring, for

example, and Christmas gifts and ski equipment in the fall.)

In style, Moneysworth is concise, pragmatic, and above all, useful. It is also completely forthright. Moneysworth does not hesitate to name brand names (whether to laud or lambaste them), to identify big corporations when they gouge the public, and to quote the actual prices and discounts that you are entitled to and should be getting. Moneysworth can afford to be this candid because it carries no advertising whatsoever; it is beholden to no one but its readers.


The editors of Moneysworth are a team of hard-nosed, experienced journalists. The editor-in-chief is Ralph Ginzburg, creator of the flamboyant magazines Fact, Eros, and Avant-Garde. Mr. Ginzburg was the first editor to provide a platform for Ralph Nader to express himself on the subject of automobile safety. Moneysworth's publisher is Frank R. Brady, generally regarded as one of the publishing industry's shrewdest financiers. Herb Lubalin, the world's foremost graphic designer, is Moneysworth's art director. Together, these men will produce the first and only—consumer magazine with charisma.

Moneysworth is available by subscription only. Its price is \$10 a year. However, right now you may order a special introductory Charter Subscription for ONLY \$5! This is HALF PRICE!!

Moreover, we are so confident that Moneysworth will prove indispensable to you that we are prepared to make what is probably the most generous subscription offer in publishing history: We will absolutely and unconditionally guarantee that Moneysworth will increase the purchasing power of your income by at least 15%—or we'll refund your money IN FULL. In other words, if you now earn \$10,000 a year we'll guarantee that Moneysworth will increase the value of your income by at least \$1,500—or you get your money back. As you can see, a subscription to Moneysworth is an absolutely foolproof investment.

To enter your subscription, simply fill out the coupon below and mail it with \$5 to Moneysworth, 110 W. 40th St., New York, New York 10018.

We urge you to act at once. Stop being robbed and start getting your Moneysworth!



## MONEYSWORTH

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I enclose \$5 for a one-year subscription to Moneysworth, the authoritative new consumer newsletter. I understand that I am paying only HALF PRICE! Moreover, Moneysworth guarantees that it will increase the purchasing power of my income by at least 15% or I will get my money back IN FULL.

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**The risk of developing lung cancer has decreased for cigaret smokers who switched from the regular to the filter type 10 or more years ago.** That's one of the findings in a study of 350 lung cancer patients and 700 control subjects who were matched to the patients by age and sex. The lowered risk is probably due to the lower tar content in filter cigarets, say the researchers—physicians associated with New York's Memorial Hospital, the Sloan-Kettering Institute for Cancer Research and the American Health Foundation. The scientists also note that the risk declines after 4 years of complete cessation of smoking and appears to approach the level of nonsmokers after 13 years of abstinence.

**When Britain's Concorde SST recently clocked 1210 mph in a test run—its fastest speed to date—the sonic boom shook up people in Northern Ireland and Wales.** A curious complaint was voiced by some Welsh ladies: They felt as if they were being stripped of their clothing. Medical men explain that pressure waves against the abdomen cause a shrinking sensation that makes clothing feel loose.

**In a few years you'll be able to bring the noonday sun into your living room—in the form of a new molecular arc lamp under development by General Electric.** GE scientists say the lamp does a far better job of matching the sun's spectrum than any existing artificial light source, is compact and efficient. It is 16 times as bright as a standard 100-watt household incandescent. Light is generated by passing an electric arc through a vapor of tin chloride. The lamp seems ideally suited for commercial interiors like clothing stores, photography and TV studios and for outdoor lighting of sports events. It may be on the market in a couple of years.

**A contour map of the retina in a cat's eye was recently made by University of Michigan researchers who used lasers to produce a hologram, or 3-D picture, that permits measurements of height differences as small as a 50th of an inch.** The results are believed to be the first safe and successful use of holographic interferometry in studying a living retina. Further work may make a similar process possible for use with the human eye. If so, the method could become a valuable aid in vision studies and eye diagnoses.

**Apollo 15 is scheduled for launch July 25, 1971, according to NASA officials, and will try for a landing at the base of the Apennine Mountains, which rise over 8000 feet above the moon's surface.** It is thought that rock samples from this area will be even older than the 3.7 billion-year average age of Apollo 11 samples. The site is about 465 miles north of the lunar equator. In contrast, the sites where Apollo 11 and 12 landed, and the Fra Mauro site for Apollo 14—scheduled for launching Jan. 31, 1971—are all within 70 miles of the equator.

**A laser smaller than a grain of sand has been developed by Bell Laboratories scientists.** It's a semiconductor device, powered by ordinary dry-cell batteries, and converts electrical current directly into coherent light. It may someday speed the transmission of voice and other information signals in optical communications systems. (A photo of the laser appears in News Briefs, page 78.)

**The oceans are not a limitless food basket able to provide protein for the world's exploding population.** That's the opinion of Dr. John H. Ryther, a biologist at the Woods Hole (Mass.) Oceanographic Institution. He says that 90 percent of the oceans are so deep they're virtually lifeless and that the remaining 10 percent—the continental shelf areas—are being fished to "maximum efficiency".

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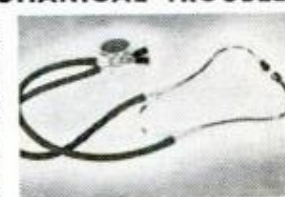
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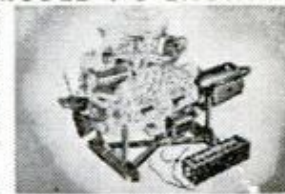
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DETROIT

# LISTENING POST

BY ROBERT LUND

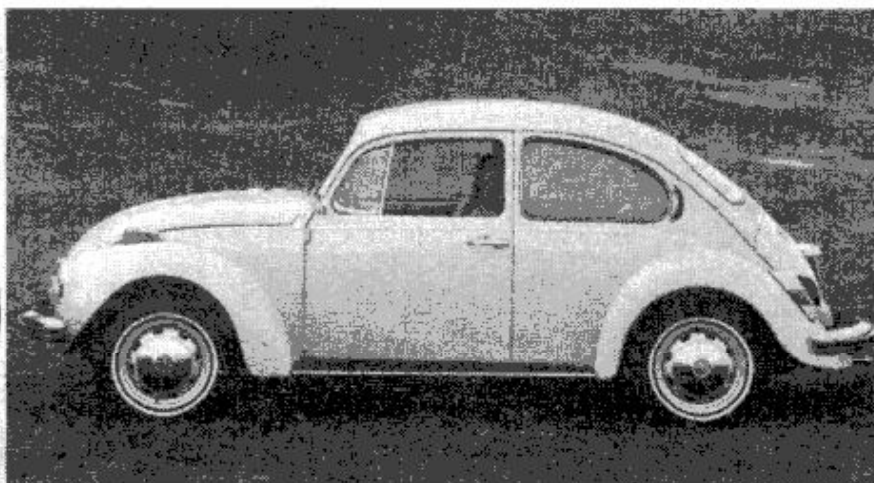
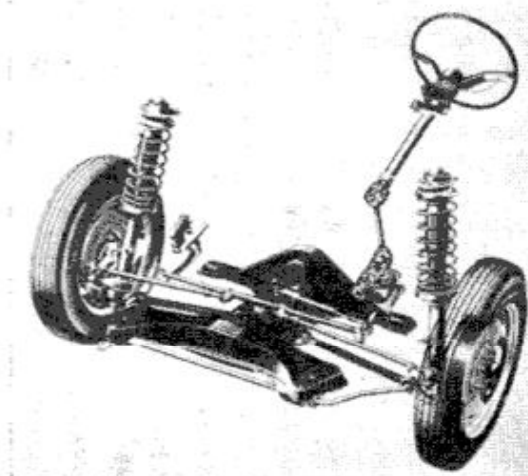
**WHEN FORD WAS DEVELOPING PINTO**, the yardstick it used in every area except styling was Volkswagen. Ford engineers disassembled a VW and worked toward a goal of equaling or improving on every nut and bolt that goes in a VW. Ford is now doing a piece-by-piece dissection of a Toyota Corolla. Why? For its own information, to find out how Corolla stacks up against Pinto? Or as preliminary to another new car—something below Pinto in size? If you'll settle for a free-style guess, we'd bet Ford's costing out a son-of-Pinto.

**MORE SMALL ENGINES** in the works: Sixes and Fours? It looks that way. A source at Chrysler who plots changes in engines so the petroleum industry can anticipate what the auto companies will be asking for in the future in the way of fuels and lubricants says he sees a decline in installations of V8s through 1972. Eights have been going into almost 89 percent of all cars; that is expected to drop to 75 percent within two years.

**THERE'S BEEN A LOT OF WHISPERING** between Detroit and Washington the past few months. An eavesdropper who's sat in on several of the conversations says much of the talk is meaningless sparring between the auto companies and government agencies or members of Congress. But Agent X says there could be something important brewing on a couple of fronts. He says the government has asked the auto firms what would be involved in salvaging oil drained off when cars receive an oil change and re-refining it so it could be used over again. The idea isn't aimed so much at conserving oil—the country has a plentiful reserve of petroleum—as it is at solving the problem of disposing of waste oil. In turn the auto firms have been asking around Washington what the chances are for a Federal law making it mandatory for car owners to maintain their automobile engines—antipollution equipment in particular. Car-builders argue it doesn't make sense to install antismog gear if there's no backup legislation requiring motorists to keep the equipment operative.

**IT'S A SUPER BEETLE!** Volkswagen's ubiquitous Beetle comes in two models for 1971—the Beetle and the Super Beetle. Though they're hard to tell apart from the outside—and they share the same 60-hp engine—there are more engineering changes in the Super Beetle than in any VW since the first "bugs" came to America 21 years ago. Among them: a 9-cu.-ft. front trunk (twice as large as the previous VWs); 3.2-inch greater

*(Please turn to page 26)*



**MACPHERSON-TYPE FRONT SUSPENSION** on Super Beetle uses progressive coil springs to smooth ride; two universal joints help limit movement of steering column in collision. Profile shows its more rounded hood

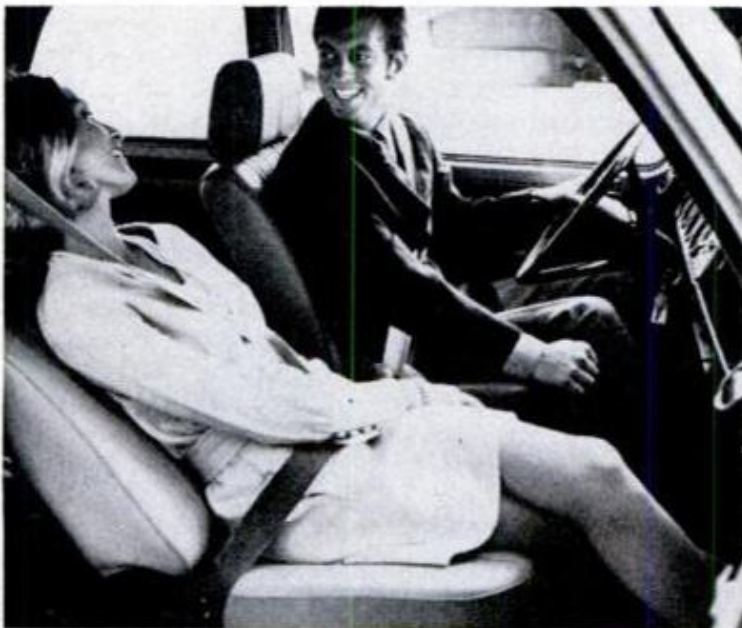




"Ride and handling. Huge cargo space. Excellent visibility. General sturdiness. Overall, we were impressed with the new Simca." *Sports Car Graphic*. "On the road the car is very stable, a general characteristic of front-wheel-drive, but the ride is excellent

too with little pitch." *Motor Trend*. Now add torsion-bar suspension, front disc brakes, a rear seat that folds to give you a 41 cubic foot cargo area and an engine that delivers 25 to 35 mpg. Is it any wonder *Motor Trend* calls it "a machine of many surprises"?\*

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"Much of the energy is concentrated on the seats, which are surely vinyl-covered down pillows in disguise."\* *Car and Driver*

The above quotes are in reference to the 1970 Simca. Minor detail improvements, but no mechanical changes, have been made for 1971.

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## DETROIT LISTENING POST

*(Continued from page 24)*

overall length than the Beetle (161.8 vs. 158.6); front track of 54.3 inches (2.7 inches wider than the Beetle); tighter turning circle (31.5 feet compared with 36), and a MacPherson-type coil-spring front suspension. East Coast prices: \$1780 for the Beetle, \$1899 for Super Beetle.

**THAT "CAMEL" BATTERY** from GM has to rate high on any list of winners out of Detroit this year. It never needs water or checking and supposedly won't corrode. It carries GM's standard guarantee on batteries—three years—but should top that by a year or more. But don't get too steamed up about it, because your chances of getting one on a '71 car are pretty slim. In the first place, the division (Delco-Remy) making the unit can't crank out more than a thousand a month. That's full-blast. Second, Pontiac and Oldsmobile are arguing over who has first claim on it. Pontiac apparently has first dibs (because it participated in the development program) and has made the battery standard on Grand Prix SJ. Pontiac says it will also offer the item as an option if you take the 455-cu.-in. engine. But Olds thinks if Pontiac is first to install the battery as standard equipment, Olds should have first crack at offering it as an option. On Toronado.

There's more than a hair-pulling contest between two GM divisions involved here. GM had a reputation for years of being Mr. First in the innovation department. But six or seven years ago, the other companies, led by Ford, began to be more daring as GM became more conservative. Most of the new ideas, new hardware, new body styles, new types of cars, came from the other automakers—the "Little Three." GM's out to change that. Mr. Big has pioneered a slew of first-time features the past few years—ideas rival car producers have imitated as fast as they could tool up or buy the pieces from GM. The no-water battery is another notice from GM that it's resuming command. Coming soon from GM's idea department: a sealed braking system guaranteed for a certain number of miles.

**YOU COULD SAVE** yourself two percent on the price of a new car by holding off a month and buying it in January. Maybe. The seven percent excise tax on cars is supposed to be reduced to five percent the first of the year. You'd be entitled to the difference. But don't spend it

*(Please turn to page 28)*



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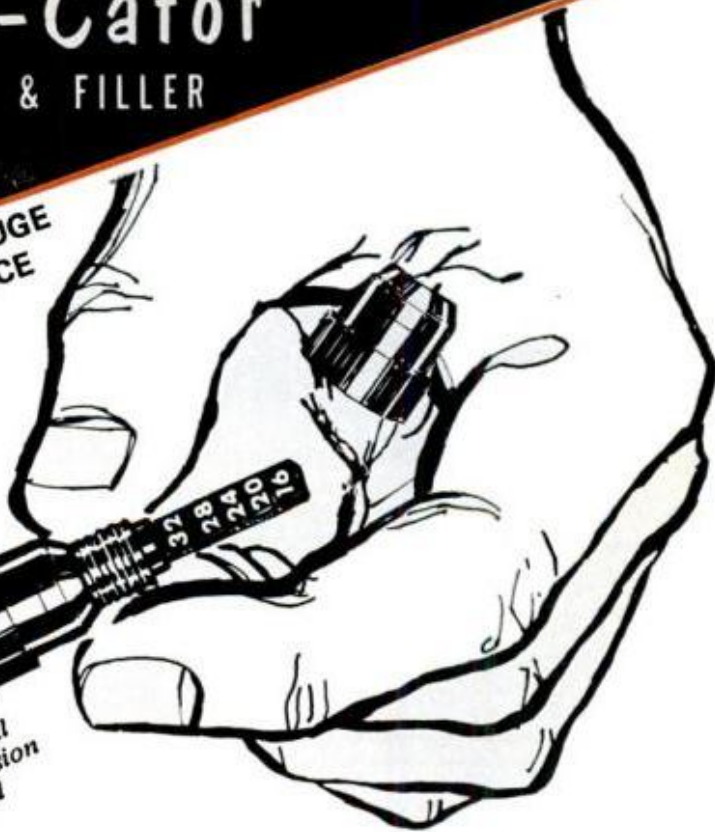
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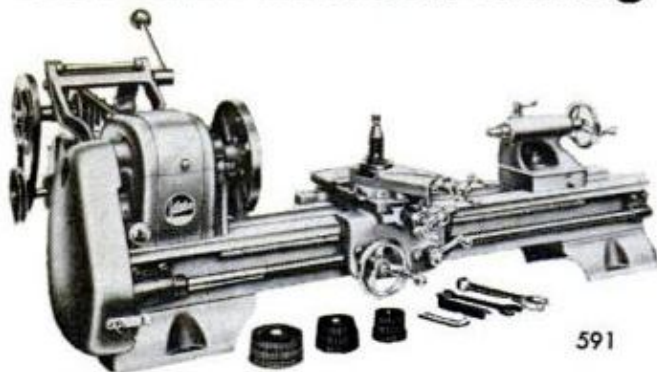
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## DETROIT LISTENING POST

(Continued from page 26)

before you get it. Congress may decide it needs the money and could push through legislation to keep the tariff at seven percent. But if you're not in a real bind to buy a car, it might be worth waiting to see if the excise eases.

**YOU CAN ALSO SAVE** yourself some money if you're keeping the old car by having it repaired now. Assuming it needs repairing. Most car owners tend to put off nonemergency repairs during winter, wait to have the work done in the spring. But you'll pay more for parts next spring than you'll pay now. Parts prices are going up. A guess: five to eight percent. Any increase the United Auto Workers Union wins for people on the assembly line automatically applies to workers in parts plants. Just as soon as the auto companies get the pieces sorted out on what the new labor contracts with the UAW add up to, prices of replacement parts will be marked up.

**MARKING UP PARTS** is just a sliver out of a forest of problems the auto companies have to deal with after settling with the UAW. Consider some of the stumpers facing GM:

How many GM customers have gone over to the competition, rather than wait for a GM car? How long will it take the company to catch up with demand and refill the pipelines, restock dealers. If Pontiac is still trying to catch up on back orders for its current cars come March, should it delay launching its small car until fall? With Vega in short supply, how long will it take GM to get a true reading on how Vega is registering with buyers vs. Ford's Pinto? Did GM miss the boat in pricing Vega almost \$200 over Pinto? If GM is still selling all the '71s it can turn out next July or August, should it halt production to change over to '72 models? GM wouldn't like the idea of extending the model run, because it would put GM divisions in the position of selling '71 cars at a time when Ford, Chrysler and American Motors would be selling '72s. GM rivals wouldn't like it either. They aren't anxious to beat GM to the showroom by a month or two. If Ford, Chrysler and AMC guess wrong—high, low, too much or too little—on prices, equipment, warranties, body styles, this or that, there'd be an embarrassing scramble to conform to GM's lead later on. In socking GM first, the UAW may have created a situation making for a real cat-and-mouse of a model year. ★★★





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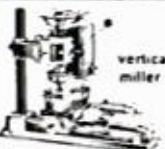
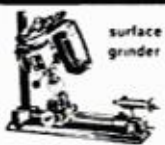
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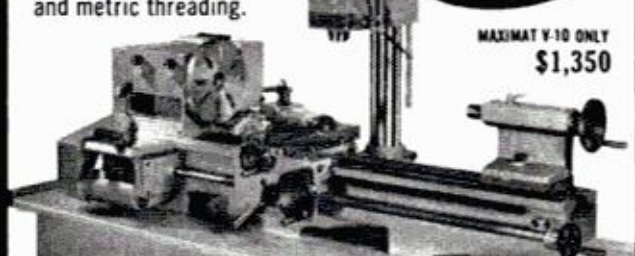


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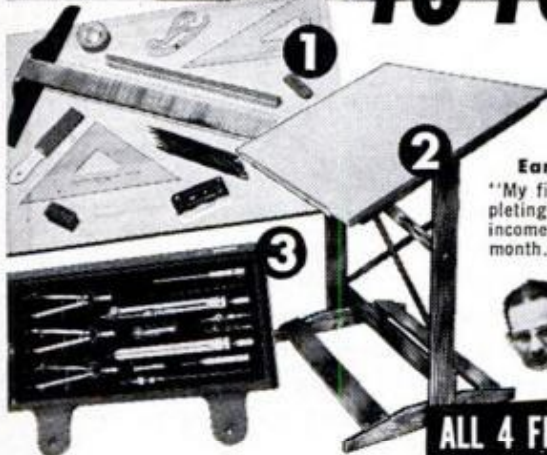
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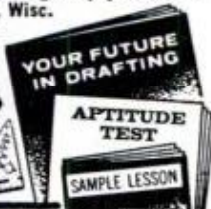
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# Drivin' with Dan

Which are faster, Indy or Can-Am cars? How did you pick cars you drove in various races? Will rotary engines be used soon in racing? What is octane? Dan Gurney answers these and other automotive questions

**Q.** Is it just my imagination or are Indy cars faster than Can-Am cars?—Mike Kelly, Tyndall Air Force Base, Fla.

**A.** I would guess they are, but on many road circuits they lap slower. I believe they'd be faster at Indy than Can-Am cars.

**Q.** What became of your Eagle V12 engine? It appeared about as strong as anything when you

were racing it in 1967-68?—Bruce Hughes, North Abington, Mass.

**A.** We still have a few, gathering dust. It was a great engine all right, and I feel it is safe to say it would not be obsolete today if we had continued to develop it. It progressed from 368 hp in the beginning to 420 hp at 10,200 rpm when we stopped. We were expecting to reach about 470 hp at its peak of development.

**Q.** How did you pick the cars you drove in various types of racing?—Randall McKinstry, Conyngham, Pa.

**A.** I used to look at the rules, the competition, the costs, the sponsorship conflicts if any, and then tried to pick the one with the most potential for winning. Durability, safety, power, handling, aerodynamics—all had to be considered.

**Q.** I have a 327-c.i.d. 1967 Camaro with air. I feel the brakes are inadequate. Do you think it would be wise for me to install front disc brakes, and would I have installation problems?—Guy House, Dayton, Ohio.

**A.** Chevrolet has some excellent brakes which it used on 1970 Camaro Trans-Am cars. I would look into the possibility of using them on your car. Better yet, if 1967 disc brakes are already offered for your model, then installation should be no problem if you stick with Chevy parts.

**Q.** Do you think rotary engines will be used in racing in the near future?—Richard Scott, Pikeville, Ky.

**A. No.** The sizzling Mercedes C111 was *(Please turn to page 34)*



**DAN IN DRIVING SUIT** about to hop into any type of car—Trans-Am, Can-Am, Championship, Stock, you name it—has been part of the auto-racing scene for the last 15 years. He'll still be building cars and driving them, but he's indicated that professional competition will be left to young lions the likes of Swede Savage, Dan's fast-learning protege



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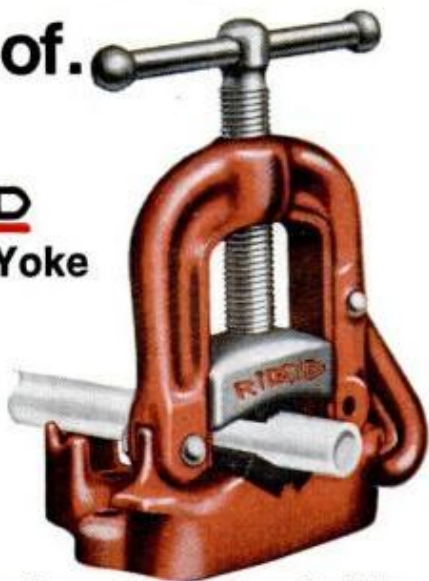
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## DRIVIN' WITH DAN

*(Continued from page 32)*

speculated as being a leading Wankel candidate for the circuits, but Mercedes-Benz denies it.

**Q.** Is it possible for me to double horsepower by using a turbocharger?—Elmer Dow, Sutton, Mass.

**A.** Certainly. However, you can expect to run into plenty of problems and expense. You don't get something for nothing.

**Q.** Could you explain what octane is?—Frank Federico, Medford, Mass.

**A.** The dictionary says that octane is an oily hydrocarbon occurring in petroleum. Octane number is a number representing the "antiknock" properties of a gasoline. The higher the number the greater the antiknock properties are. There are several different ways of manufacturing gasoline to achieve various octane ratings.

**Q.** Race cars must run at extremely high temperatures. What methods are employed to keep these from blowing their cool?—T/Sgt. H. A. Thompson, Novato, Calif.

**A.** The water temperature in a good racing car usually runs below 190° F., often below 180°. We usually use plain water and sometimes add some stop leak just before a race. Our filler-cap pressure-relief spring goes off at about 20 p.s.i.

**Q.** On a banked oval track, does the left front or right front tire take the worst beating?—Cruz Santiago, Bronx, N.Y.

**A.** As a rule, the right front tire gets it worst on a high-speed oval with cars running counterclockwise.

**Q.** Do you think a Jeep of World War II vintage would be safe or impractical for highway use?—Joe Michaels, Brooklyn.

**A.** It should be fine if it is in good shape and you drive carefully. However, it could be a slowpoke on high-speed throughways and turnpikes.

**Q.** I have used extra heavy-duty oil for some time since most of my driving has been long highway

*(Please turn to page 36)*



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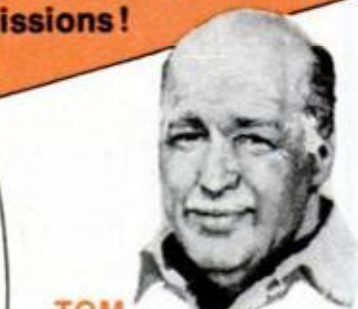
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## DRIVIN' WITH DAN

*(Continued from page 34)*

trips. Now I am about to do mostly city driving and wonder if you think I should use a lighter oil?—A. Langlois, Ottawa, Canada.

**A.** I'd stick with your heavy-duty oil.

**Q.** If a car's roll center is at its center of gravity, would the car lean anyway?—Cary Rabitz, Lexington, Ky.

**A.** Yes, mostly because of tire deflection. In theory it wouldn't. In fact, if the C.G. is below the roll center it should lean like a motorcycle, but this condition creates other problems so that this doesn't happen in practice.

**Q.** I have noticed that most racing drivers now wear astronaut-type helmets. Who makes these helmets and how much do they cost?—Doug Huffines, Doraville, Ga.

**A.** Several companies make them, but the leader in the industry, in my opinion, is Bell Helmet Co. of Bell, Calif. I think they cost \$59.95 retail. The one you refer to is named the Bell Star.

**Q.** As a former Le Mans winner, could you tell me about how much the total purse is and how much the winner makes?—Billy Womack, Nashville.

**A.** When I took the race with A. J. Foyt in 1967 for Ford Motor Co., I won approximately \$5800, including all driver contract fees and bonuses from Ford. I also received a wristwatch which stopped working after being worn for 10 days! And it was more than six months after the victory before I got the watch. I was disappointed and disillusioned.

**Q.** Of all tracks you've driven, which do you think is most dangerous?—Steve Moore, Denver.

**A.** Probably the Nurburgring in Germany, or Spa Francorchamps in Belgium. Most European tracks are very dangerous because they have a lot of blind turns, lots of rain and minimum fire and ambulance service and access in the event of an accident. ★★

*If you have questions on racing, high-performance and everyday driving techniques, send them to "Drivin' with Dan," c/o Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Questions cannot be answered by individual letters. Questions on maintenance and repair should be addressed to the Auto Clinic (see page 66).*



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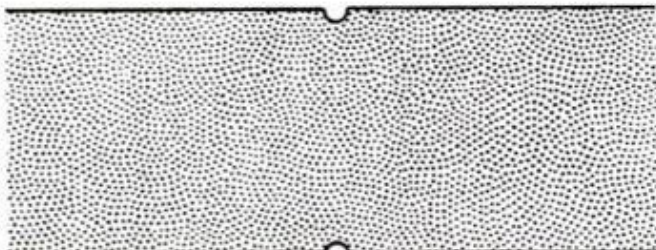
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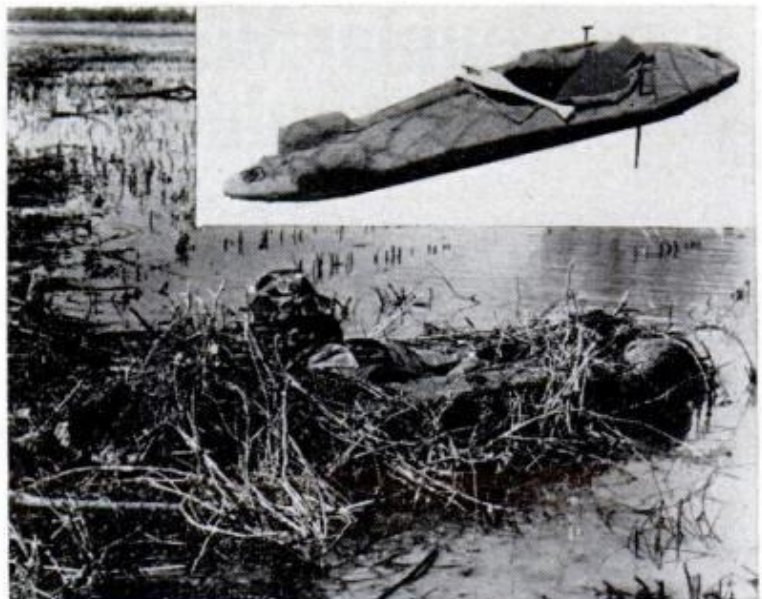


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BY ROB KINSON



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**ALLIGATOR** is a portable duck blind made of molded fiberglass and covered with heavy jute. Foam flotation makes the 60-lb. craft unsinkable and easily transported. In the field, you throw on sticks, leaves and stubble for camouflage. Stabilizer rods keep the blind in position; gun and shell racks in the deck keep your ammunition handy. Alligator's maneuverability lets you carry, skid or paddle it to new positions. With optional bracket it can be powered by small outboard or electric motor. Write Arrow Glass Boat & Manufacturing Corp., 1371 Farmville Rd., Memphis, Tenn. 38122.



**PORTABLE, TRANSPARENT CABIN** by Daybreak Dynamics for ice fishing, hunting and skating blocks out cold winds and soaks up sunshine. In summer Kabbanette becomes a beach cabana for sun lounging on chilly days. The tubular steel, polyethylene-covered frame is 9 ft. long, 4 ft. high and 3 ft. wide. It sets up in seconds and has shoulder-strap carry. Write Daybreak Dynamics, Dept. PM, 913 E. Elm St., Wheaton, Ill. 60187.

**ICE FISHING** is more fun if you can cut a hole through the ice fast. This new straightedge auger blade is faster and easier than the standard round-edge design, and you can resharpen your own blades. The two-piece, solid-steel handle, cadmium-plated for durability, has a threaded bracket that lets you lock the unassembled sections for easy carrying and storage. The 6 and 8-in. blades are interchangeable on the same handle and come complete with a blade guard and sharpening instructions. Complete, the 6-in. auger retails for \$13.75 and the 8-in. model for \$17.75. The blades are \$6.75 in the 6-in. size and \$11.75 for the 8-in. size. This unique Worth/Mustad straight-edge tool is made by Worth Co. For more information, write it at Stevens Point, Wis. 54481. ★★





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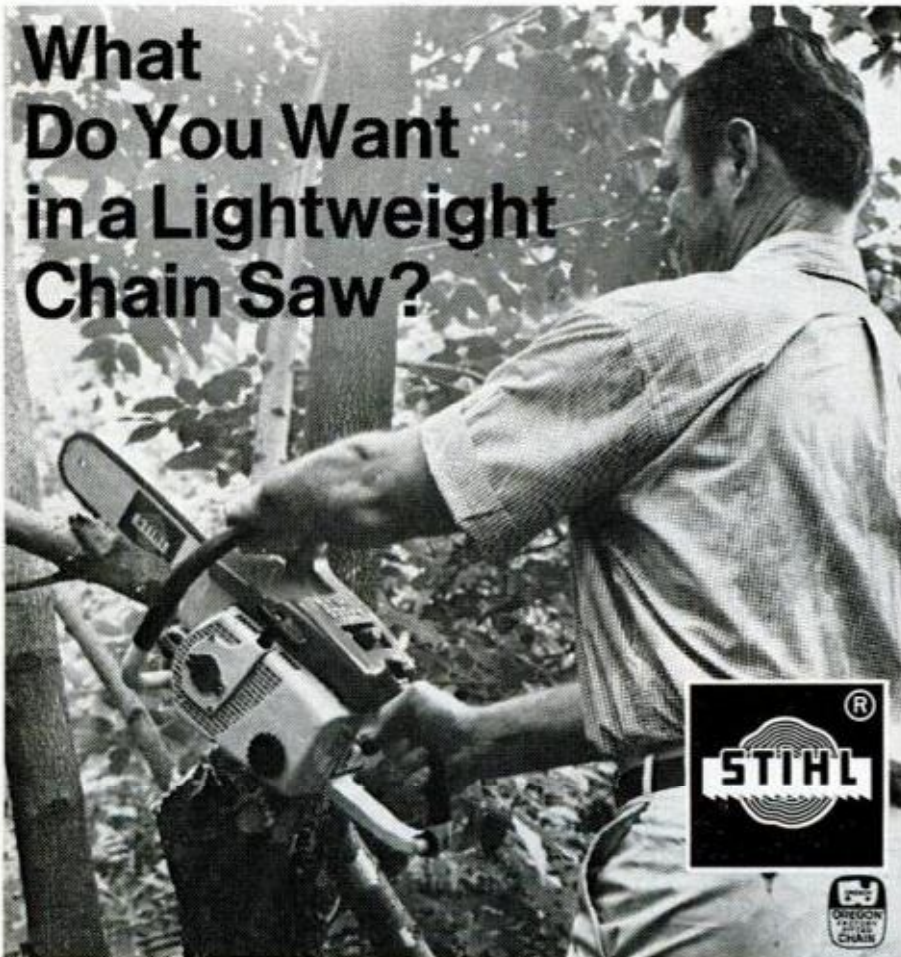


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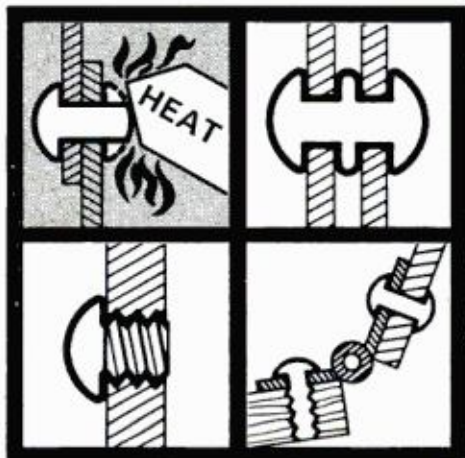
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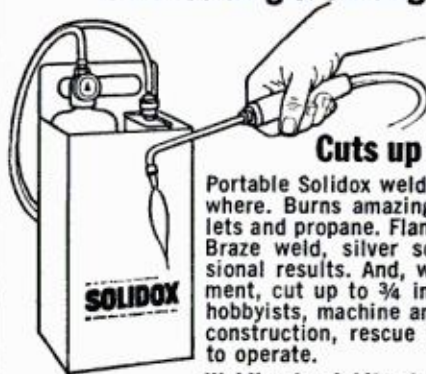
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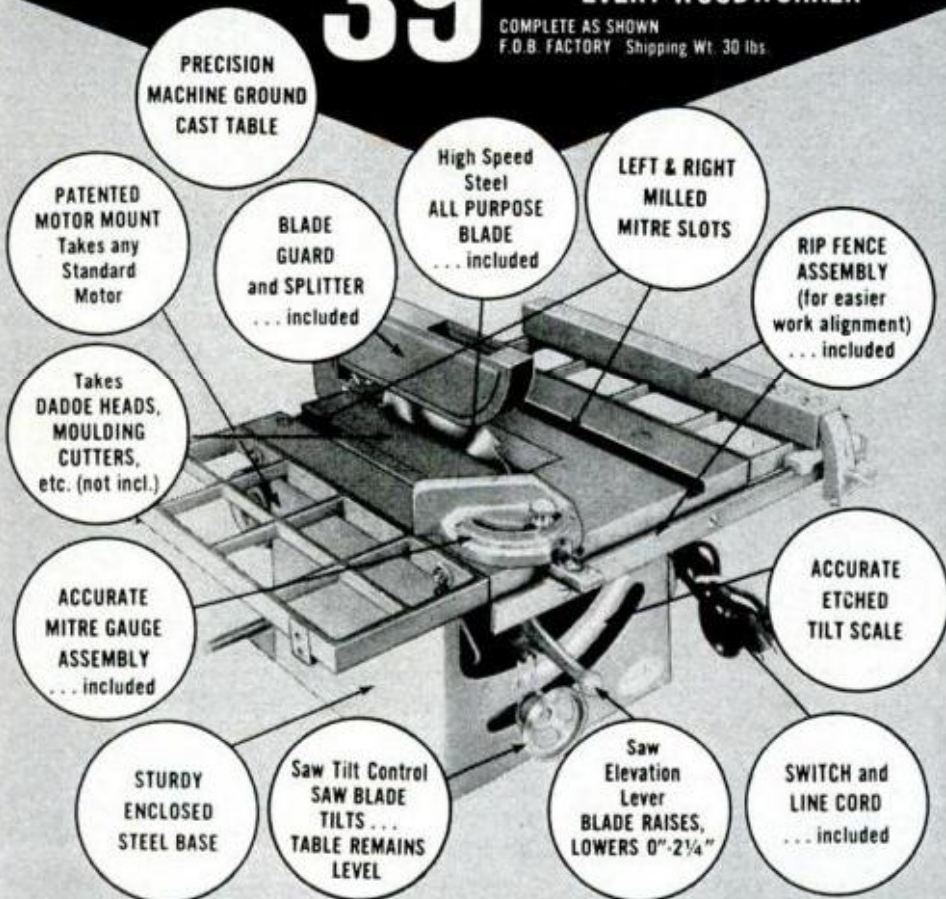
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The patented motor mount takes any standard 1/4 hp motor or larger; its special design keeps belt tight, assures perfect alignment at any angle, transmits full power.

- Popular Science says: "no woodworker's fantasy ... it's for real ... Sound, imaginative engineering ... Saw deal a nifty."
- Workbench Magazine awarded us their coveted "Workshop Tested" seal.
- Saw in use 23 years. "I still use the 8" saw I bought from your company 23 years ago." A. Bordogna, Trafford, Pa.
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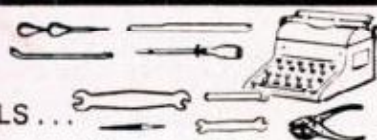
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PITTSBURGH, PA.—The Coal Research Center at the Bureau of Mines has turned ordinary garbage into a low-sulphur oil, providing a means of garbage disposal and a valuable resultant by-product. Scientists heat-treated wet, ground garbage with carbon monoxide and steam at about 700° F. in an airtight chamber, converting 90 percent of the organic material in the garbage into water and a petroleumlike substance that will dissolve in benzene, and leaving small amounts of gas, ash and unconverted material. With the same yield on a large scale, one ton of garbage would produce over one barrel of oil. The procedure is as yet too novel to assess accurately the cost and feasibility of large-scale production.

DAVIS, CALIF.—The California Department of Water Sciences and Engineering has constructed a working model of a natural water system, authentic down to bedding materials, water flow and living organisms known to be present. By introducing pollutant variables such as herbicides, salts, sewage and pesticides, the ministreams can be studied and compared to predict the future effect on our rivers, streams and lakes, and prevent irreparable damage before it occurs.

WASHINGTON, D.C.—The first diesel bus in this city equipped with an experimental modification for reducing smoke, odor, noise and emissions is in service in a joint project by the Department of Transportation and General Motors. The equipment, GM's "Environmental Improvement Program" (EIP), has reduced hydrocarbons up to 96 percent, carbon monoxide up to 64 percent, and nitrogen oxides up to 23 percent, according to before and after tests. Similar tests are reported to be underway in other cities.

BERKELEY, CALIF.—A professor at the University of California has developed a process of using common seawater to remove sulphur oxides, the most serious air pollutant, from smokestack gases. Prof. Leroy Bromley's method cools raw stack gases, runs them through a chamber where they are "scrubbed" clean by seawater, and reheats them before releasing them through the stack. The seawater, an inexpensive and readily available material, rapidly absorbs sulphur dioxide, and the salts it contains act as a catalyst in converting sulphur dioxide to harmless sulphate.

DO YOU KNOW about some action being taken to fight pollution that we don't know about? In your community? On the job? Tell us about it. Write Environment Editor, Popular Mechanics, 224 W. 57th St., New York, N.Y. 10019.



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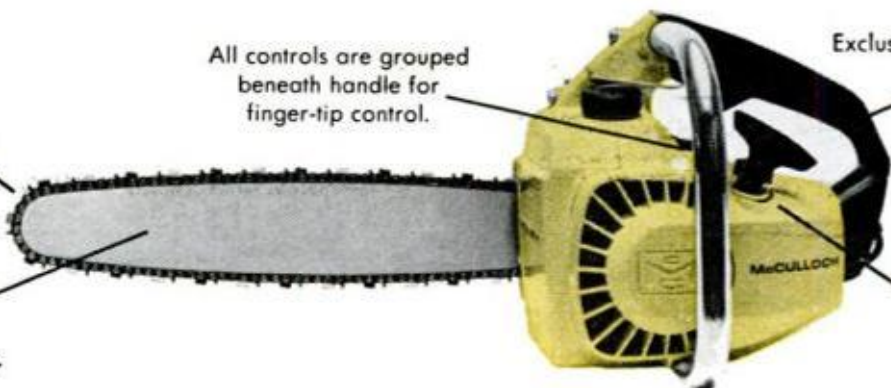
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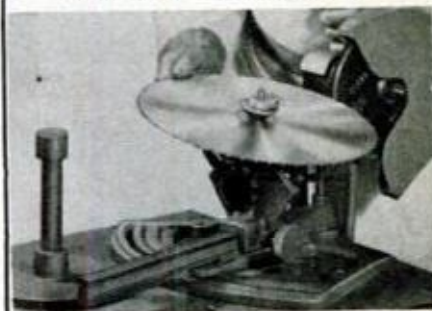


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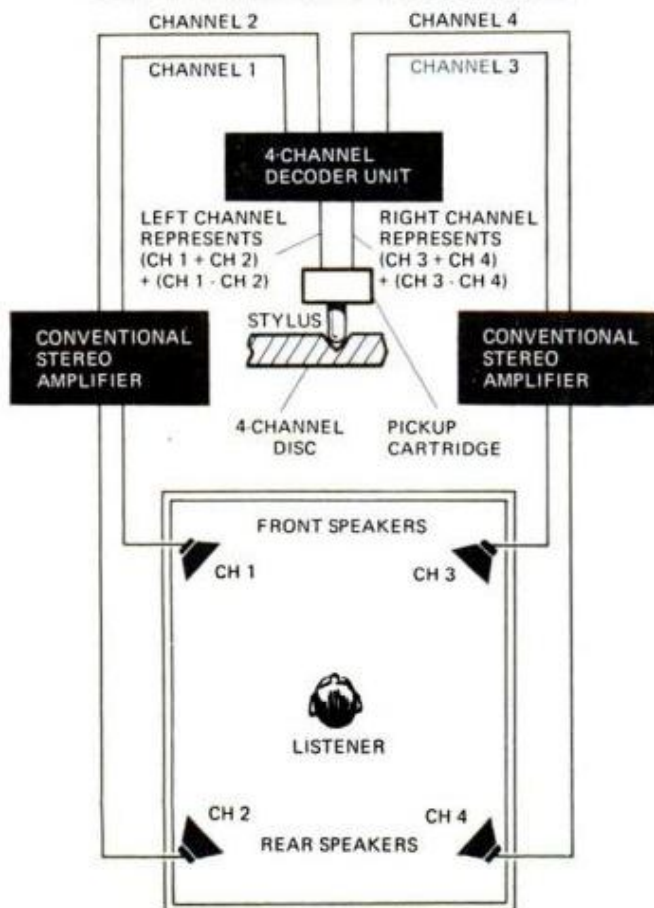
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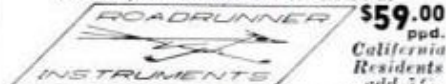
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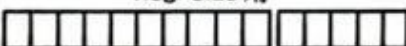
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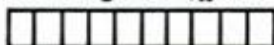
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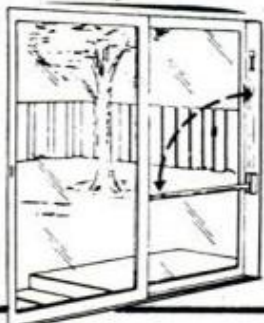
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(Continued on next page)



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(Continued from preceding page)

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(Continued from preceding page)

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## BUSINESS OPPORTUNITIES

(Continued from preceding page)

**HOW To Finance Your Own Business.** Get \$1,000 to \$2 million. Free details. Capital-17. Kerrville, Texas 78028.

**MAILORDER** Book publisher wants dealers. Wonderful "drop-ship" proposition. Sample imprint circulars free. Neil H. Tasker, Shamokin, Pennsylvania 17872.

**FREE REPORT!!** 609 Unusually successful businesses, indoor-outdoor, evenings!! Write: Associated, Box 238-B-12, Lafayette, California 94549.

**ESTABLISHED** 40-year house, formerly state based, seeks county representatives. Receive and forward mail orders. Stationers, Drawer 5350-C, San Antonio, Texas 78201.

**UNBELIEVABLE** Spare time profits! Repairing vacuum cleaners at home New, easy method. Free details. Baron, Box 863, Portales, New Mexico 88130.

**MAILORDER!** How anyone can prepare catalogs for \$8 per 1000. Free proof! Obie-MKL, Brooklyn, New York 11219.

**MY Income \$70,493.28** year mailorder. Helped beginners. Guaranteed method! Chapman, 1578-C12 58th, Brooklyn, New York 11219.

**PIANO Tuning Learned Quickly At Home!** Tremendous field! Musical knowledge unnecessary. GI approved. Information free. Empire School, Box 327, Miami, Florida 33145.

**OVER \$16.50** an hour. Spare time at home! Rubber Stamp industry needs small manufacturers. We furnish all equipment and know-how! Particulars free! Write: Roberts, 1512 Jarvis, Room CR-2-H, Chicago, Ill. 60626.

**BLACK Widow Spider Ranchers needed!** Big guaranteed market! Complete program \$1.00 (Refundable). NBWC, Box 260 CPM4, Brigham City, Utah 84302.

**VINYL REPAIRING** A golden opportunity. The world is knocking at your door. Free information. AMH Industries, P.O. Box 5386, Santa Ana, Calif. 92704.

**SPARE Time Cash—Sell Advertising Book Matches—every business a prospect—no investment—no experience needed—build steady, repeat business. Powerhouse selling kit with new complete catalog Free. Quick sales—big cash commissions. Dept. MX-1270, Superior Match, 7530 S. Greenwood, Chicago, 60619.**

**FREE FRANCHISE JOURNAL** magazine with over 100 franchise opportunities in every issue. Franchise Journal, Dept. G, Box 1790, Newport Beach, Calif. 92663.

**\$400.00 MONTHLY** Raising giant fishworms. Soilless method. Charlie Morgan, Bushnell, Florida 33513.

**EARN Money** raising fishworms for us! Write: Oakhaven-38, Cedar Hill, Texas 75104.

**400,000 BARGAINS** Below wholesale! Many free. Liquidations . . . closeouts . . . job lots . . . simple samples. Free details: Bargainhunters Opportunities, Box 730A, Holland, Michigan 49423.

**ADVERTISING BUSINESS—YOU** own it. \$350 First Week or Money Back. Electric Neon Action Ad Clock, 229 W. Illinois, Chicago 60610.

**WANT To make big money at home?** \$10.00 profit in an hour possible with invisible mending. Make tears, holes disappear from clothing, fabrics. Steady year-round demand from cleaners, laundries, homes. Details free. Fabricon, 1585 Howard, Chicago 60626.

**SELL Lifetime.** Metal, Social Security Plates. Big Profits! Sample and Sales Kit Free. Russell, Box 286-PM, Pulaski, Tennessee 38478.

**COPUBLISH** "Mail Sale Advertiser," leading mailorder paper. Copy and details 25¢; U.S.A. only. Vanroy Shirk, Lebanon, Pa. 17042.

**\$200.00 DAILY** In your mailbox! Your opportunity to do what mailorder experts do. Free details. Associates, Box 136-A, Holland, Michigan 49423.

**DRAFTSMEN!** Operate own DRAFTING SERVICE! Full, Part Time; Experience unnecessary; Details: Roberts Drafting, 1741 Circle Road, Baltimore, Maryland 21204.

**RAISE Rabbits** for us on \$500 month plan. Free details. White's Rabbitry, Mt. Vernon, Ohio 43050.

**MAIL ORDER** Sell books. Fascinating, profitable, details. Jobre, Box 27, Great Neck, N.Y. 11023.

**WORLD'S Largest** supply. Merchandise 25% to 40% under wholesale. Bankrupts. Closeouts 10¢ on dollar. Imports. Hongkong clothes. Automobile discounts. Free details. International Buyers, Box 16386-MM, Portland, Oregon 97233.

**HOLLYWOOD CEMENTCRAFT:** Offers Highly Profitable Home Business. Experience Unnecessary. Unlimited Unique Pottery Designs Easily Made Without Moulds. Bird-baths, Fountains, Wishing-Wellis, Waterfalls, etc. Chemical Coloring Formulas. Marble-glazing. FREE Illustrated Brochure. CONCRETE FACTS, 602 Athens Street, Altadena, California 91001.

**SELL Books** by mail. 400% profit. Royal, Box 450-X, Cleveland, Ohio 44127.

**FREE Catalogs.** Repair air conditioning refrigeration. Tools, supplies, full instructions. Doolin, 2016 Canton, Dallas, Texas 75201.

**VENDING Machines.** No selling. Routes earn amazing profits. Big catalogue Free. Parkway Corporation, 715PBM Ensor Street, Baltimore, Maryland 21202.

**ADDRESSERS** And mailers needed. Send stamp for information. Lindbloom, 3636 West Peterson, Chicago 60645.

**SELL Beautifully** colored Social Security Plates. Big Profits! Free Sample. Paul Wright, 1075 Ringwood Avenue, Pompton Lakes, N.J. 07442.

**CLIP Short** newspaper items. To \$10.00 each. Details free. Foster, 272-M12, Brooklyn 11235.

**BUILD Custom** Cases at home for profit. Get orders by mail. We supply materials, instruction—everything. Free home business details. Custom Case Supply Co., 6961 CPM Hayvenhurst Avenue, Van Nuys, California 91406.

**TAKE Catalog** orders. We drop-ship 1001 best selling specialty products. Guaranteed lowest below wholesale prices. Fantastic spare-full time home business. Free book shows you how. SMC, 6963 SPL, Hayvenhurst Avenue, Van Nuys, California 91406.

**VENDING Machine** big catalog. Rake, 523 A Spring Garden, Philadelphia, Pa. 19123.

**I MADE \$40,000.00** Year by Mailorder! Helped others make money! Start with \$10.00—Free Proof. Torrey, Box 318-Y, Ypsilanti, Michigan 48197.

**MAIL Baby** Catalogs Imprinted with your address to New Mothers for Big Profits! Details 25¢. Volz PM, Ypsilanti, Michigan 48197.

**MAILORDER** Records help get increased business! Complete 32 Page Record Book shows your inquiries, orders, advertising, expense, etc. Only \$1.00. C. A. Martin, Popular Mechanics, Dept. PM, 224 West 57 Street, New York, N.Y. 10019.

**MAILORDER!** Make big money working home. Free report reveals millionaire's trade secrets! Executive (1A12), 333 North Michigan, Chicago 60601.

**NEW Canadian** oil leases. \$1.00 acre. Free information. Northern, Box 70-FB, Montreal 206.

**MAKE \$10.00** Hourly Demonstrating portable sandblaster. Inka, Box 66573, Houston, Texas 77006.

**MAIL Order** Collection Agency can make you \$1000.00 monthly. Free Details. Continental, Box 2023-A, Des Moines, Iowa 50310.

**MAKE Money** from old tires. Operators clearing \$800, weekly. Equipment costs \$1500. Get facts. S & S Patents, Inc., 3752 N. Damen, Chicago 60618.

**BIG Money-making** new greaseless donuts in kitchen. Everything furnished. Sell stores. Free recipes. Montgomery Ray, Waseca, Minn. 56093.

**EARN \$60.00** Daily Manufacturing Concrete Fence Posts. Practically no investment. Send stamped, addressed envelope. American, Excelsior Springs, Mo. 64024.

**MAKE \$46** from square foot plywood; jigsaw or bandsaw necessary. Free details. Woodar, Bridgewater, Mass. 02324.

**MAKE Fortune** in Mailorder! Easy! Advances, Box 24, La Grange, Illinois 60525.

**FREE Information.** Don't be fooled. Mail order is profitable only when you know how. Hillcrest, Box 2445, N. Hollywood, California 91602.

**I MADE \$2,000.00** Monthly by mailorder—evenings only. You can too! Free Proof! Kingman, Box 723D, Montclair, New Jersey 07042.

**FABULOUS** Profits operating Vinyl upholstery repair service. Full, part time; experience unnecessary; details 25¢. Greg's, P.O. Box 921, Sanford, N.C. 27330.

**START A HOME** Business in Spare Time. Make extra money. Experience not essential. Literature free. Promotional Services, 1913-M2BR Eleventh Street, Altoona, Penna. 16601.

**DRAFTING SERVICE! \$\$\$** At Home! Your Own Boss! Full, Part Time; Experience Unnecessary; Details \$2.00. Coastal Consultants, 11312 Stillman Street, Lakewood, Calif. 90715.

**\$500-\$800** MONTHLY Raise small Laboratory-breeding stock for us. We supply equipment, breeders, and instructions. Illinois Research Farms, Dept. MPD-12, Barrington, Illinois 60010.

**BOOKKEEPERS** Earn \$500.00 week. Operate Bookkeeping Tax Service. Details free. Universal, Box 664-M, Springfield, Missouri 65801.

**\$70.00 WEEKLY**—home, spare time. Simplified mail bookkeeping. Immediate income easy. Auditax, 34741A, Los Angeles 90034.

**\$60.00 DAY.** Manufacturing concrete Posts. Blocks. Mold Equipment Catalog \$1.00 refundable. Carlayne, Route One Box 95, Rapid City, South Dakota 57701.

**MAKE Magnetic** car signs. Write Route 1, Box PM-49A, Bardstown, Ky. 40004.

**MAIL Baby** Or Gift Catalogs, Imprint. Big Profits! Details \$1.00. Krefski, 609-A Lee, Plymouth, Penna. 18651.

**TREMENDOUS** \$1,000.00 Profit From 1,000 Mailings! Exciting, New Products! Tested! Everything Furnished! Free Guidance, Proof! George, Box 2188-PM, Cypress, California 90630.

**FRANCHISING?** Amazing New Way to own your own business. Send for free copy. Modern Franchising Magazine—P, Des Plaines, Ill. 60016.

**MAKE RUBBER STAMPS!** Easy profitable hobby or full time business, low starting cost package, free details, Barco Type, 237 S. Evergreen, Bensenville, Ill. 60106.

**"LET MAILORDER** Put \$30,000.00 Annually In Your Mailbox—Details Free—Ventures, Box 832, Department PM-12, Kingsport, Tennessee 37662."

**UPHOLSTERY DIRTY?** Electro Sprinkle and never see dirt again. New easy method, no messy foam. Buy a kit for your home. Big money sales plan, sell for us. Become a distributor, let others sell for you. Rem-Ko Sales, 3637 S. Loomis Rd., R 4, Mt. Pleasant, Mich. 48858.

(Continued on next page)



## BUSINESS OPPORTUNITIES

(Continued from preceding page)

**CALIFORNIA MANUFACTURER NEEDS** man to assemble our product and be local agent, experience unnecessary. May start while presently employed. Five-figure income for responsible applicant. S.K.R.M. Manufacturers, 2347 West 238 Street, Torrance, California 90501.

**MAKE A year's income in 8 weeks camping.** No capital investment, no selling, no land ownership necessary. 9 different ways. Write EDU'S, Rt. 5, Box 5733, Gig Harbor, Washington 98335.

**OPERATE Your own business.** Manufacturing and selling rights to top quality big-time money maker can be yours! Millions of prospects. Start small, grow big fast. Learn how free. Write: Star Chemical Products Co., Dept. PM, 328 Penn. Ave., Washington, D. C. 20003.

**1000% PROFIT Bronzing Shoes.** Free Literature—N.B.C., Box 11069-PM, Kansas City 64119.

**MAKE MONEY.** Details 10¢. R. A. Allen, 2418 Lori, Santa Ana, Cal. 92706.

**FRANCHISES Available.** Drafting machine similar to \$128 unit from manufacturer for \$49. Refund guaranteed. Haro Industries, 6440 Val D'Anjou, Montreal 433, Canada.

**PROFIT With Popular Mechanics' subscription plan.** No investment, no experience needed. Earnings begin immediately when you obtain subscription for Popular Mechanics, Good Housekeeping and others. High commissions, bonus. No experience needed. Deal directly with the publisher. Write Popular Mechanics, Room 12B, 250 West 55th St., New York 19, N.Y.

**GIANT NEW MONEY MAKER,** Dealers Wanted U.S.A. And Canada. Beautiful Lifetime Remembrance Of Baby's Birth. No Stock To Carry. Tremendous Continuous Sales In Test Markets. Details 50¢ To: Mara-Can International Distributing, P.O. Box 1168, Chatham, Ontario, CANADA.

**CANADIAN Manufacturer needs home packagers in U.S.** No selling. Minimum income \$5200. Annually. Product sample, details, copy ten-year contract \$2.00. Rigsby, 1044-P2 Yellowstone, Xenia, Ohio 45385.

**MAILORDER Dealers Wanted.** Earn outstanding profits using tested promotions! Executive type business. Details 25¢. Rutward, Box 735-PP, Norwalk, Conn. 06852.

**MAILORDER-Home Business Guild.** Receive hundreds money-making, business building propositions. Year's membership only 25¢. Digest, Box 839-PML, Long Beach, New York 11561.

**NEW, Illustrated Encyclopedia of U.S. Government Benefits.** Lists thousands of benefits available to you. Details free. Fred Smith, Chestnut Grove-E, King, North Carolina 27021.

**HUGE Profits! Mail order importing.** Free information. ITIS, PM-12, Box 454, Hollywood, Calif. 90028.

**HOMEWORKER Magazines.** Directory 25¢. Arseneau, Box 21 Dalhousie, New Brunswick Canada.

**MAKE Magnetic Signs.** Free Information. 8208 Grail, Wichita, Kansas 67207.

**NEW: Canadian Timber Leases:** \$1.00 acre. Free information. Timberland, Box 70-FB, Montreal 206.

**JEWELRYCRAFT—It's easy! Big profits!** Catalog. 25¢. Modern Craft, Box 4796, Clearwater, Florida 33518.

**BOTTLES Are Valuable! Free Information—Bottle Treasures,** 7311 Van Nuys, Van Nuys, California 91405.

**\$128.00 IN SALES FROM \$12.00.** Material New—Different. Everything furnished. Details 25¢. Bauer Enterprises, Route #4 Box 445, Lehigh, Pa. 18235.

**START and successfully operate your own business.** Send quarter for details on practical book giving specific recommendations and know-how. Helm, Box 1731-M, Yakima, Wash. 98901.

**ESTABLISH Profitable Mailorder Business.** Everything furnished. Free details. Vikari's, Box 1312PM, Salt Lake City, Utah 84110.

**MAILORDER Business.** Free information. Stamp. Andrews, Box 485, New York, N.Y. 10013.

**BECOME Ordained Minister.** Free Information. Church, Box 191, Auburn, New York 13021.

**MAILORDER.** Sell Baby Products with your imprinted catalog. Sample, details. 25¢. Doorbar-PM, 3364 Northwest 35th St., Ft. Lauderdale, Florida 33309.

**BIG CASH ON THE SPOT PROFITS.** full or spare time. Sell and appoint sub-agents to sell our BEAUTIFUL THREE COLOR LIFETIME METAL SOCIAL SECURITY PLATES. Send your full name and social security number with \$1.00 (REFUNDABLE) for your personally engraved plate, and complete sales kit. GEE BEE Products, Dept. PM-12, Drawer B, Chambersburg, Pa. 17201.

**\$128.00 IN SALES FROM \$12.00 MATERIAL.** New and different. Everything furnished. FRIEDLAND ASSOCIATES, 10522 Fernglan Avenue, Tujunga, California 91042.

**COMPLETE PIANO TUNING COURSE!** With all tools, \$20.00. DSS-D, Box 633, Scarsdale, N.Y. 10583.

**SELL Books by Mail.** Complete Dealer Set-Up—20¢. Midwest Mail Sales, Box 44R2-PM, Shawano, Wisconsin 54166.

**\$48,000.00 YEAR!** No investment, free detail. Idrach, Box 10067, San Antonio, Texas 78210.

**DEALERS—Specialty ad salesmen "Bonanza".** Write: Garen's Historical Documents, Xenia, Ohio 45385.

**FABULOUS Profit!!! Growing Beansprouts.** Full, Sparetime. Write: Tso, Box 288-P12, Gladstone, Oregon 97027.

**INVESTORS read . . . World Resource Investment Digest,** Box 283-P, Birmingham, Michigan 48012.

**AMAZING Mailorder Book Business easiest way to mailorder's big money profits.** Free proof; write: B&W Enterprises, Box 824PM, Norman, Oklahoma 73069.

**MAKE MONEY addressing, mailing, etc.** Golden opportunity! Send stamp for money-making folder. Hicks Service, 37-215, Los Angeles 90037.

**MAIL Order Rules for Beginners.** \$1. Other titles. Details free. William A. Howes II, Dept. PM-1, 1256 State, Alton, Ill. 62002.

**START A home business in spare time.** MAKE extra money. Experience not essential. Send TODAY for FREE circular outlining several ways to make a FORTUNE. Telemarketing Systems, Dept. P366, 2038 Old Gulph Road, Villanova, Pa. 19085.

**MAIL Galore! Money-making offers!** Your name on national mailing lists, 25¢. Three months, 50¢. Sullins, Box 206-M, Forsyth, Georgia 31029.

**REPAIR Hydraulic Jacks.** Big Money. Write Hydraulic, Box 36, Richland, N.J. 08530.

**SELL Books By Mail.** Fascinating! Profitable! New, Illustrated Manual Reveals How. Details Free. Fred Smith, Chestnut Grove-E, King, North Carolina 27021.

**BE YOUR OWN BOSS.** Our instructional manuals show you how. Thousands of business opportunities. Free catalog. Informative Publications, Box 187, Painted Post, New York 14870.

**MOLDING Rubber Liquid Plastic.** Hobby Supplies. Details 10¢. Chaney's, 5415-L San Jose Blvd., Jacksonville, Fla. 32207.

**NEW!! "Ideas For Self Support".** Details. Eddie's, 4809-PD North Montclare, Chicago, Illinois 60656.

**FREE MAIL ORDER Catalogs Profitable HongKong products,** wearing apparels, watches, radios, cameras, oil paintings, carpets, wigs, ivory ware, jewelry, etc. drop-shipped from HongKong. Make big money! Airmail inquiries CHANSON INTERNATIONAL, P.O. Box K-1732, Kowloon, Hongkong.

**HOTTEST (STREAMLINED) Home Study Mail Order Course complete details free.** B. A. Sands, Route 3, Box 99, Port-Orchard, Washington 98366.

## MONEYMAKING OPPORTUNITIES

**8mm MOVIE Camera Owners: Earn up to \$100.00 week part time.** Start immediately. Complete Guide \$1.00. Adrian Richards Co., 710PM Division Street, Gloucester City, N.J. 08030.

**\$19.00 HOURLY Gross Profit, one serviceman . . . \$26.00, two . . . \$33.00 three.** Seven "on-location," nationally advertised services . . . homes, shops, motels, offices, institutions. Successful worldwide. No shop, no experience needed. We train . . . help finance . . . guide . . . back you. Gross \$30,000 yearly with First serviceman. Additional servicemen's machines furnished. Large profit Each serviceman. (Starting spare time, business profits increase job salary.) Little over \$1000 establishes Your successful, lifetime business. Interesting, exciting, gratifying career. Inquire Today while territory open. We'll mail information. Duraclean, CO-16DB, Deerfield, Illinois.

**NOVELTY IMPORTS Sell like mad: Make huge profits.** Nine samples and large wholesale catalog—\$1.00. Lakewood Imports, 6800 North Campbell, Chicago, Ill. 60645.

**\$625-\$900—MONTHLY Raising Rabbits, Chinchillas, other small animals.** We supply everything, equipment, instructions, breeders, buyers, big demand, big markets. Fox River Valley Research Farms, Dept. PMO-1, 2727 Justen, McHenry, Illinois 60050.

**EARN Up To \$700 A Month.** Learn tax preparation at home in your spare time with H&R Block, America's largest tax service. No previous experience necessary. Anyone may enroll. Low tuition. Job opportunities for qualified graduates. Write for free information. H & R Block Tax Training Institute, Suite 301-A, 4410 Main, Kansas City, Missouri 64111.

**PENNY STOCKS Have big profit potential.** Free information. Penny Stock Reporter, 608 N. Guadalupe, PM, Redondo Beach, Calif. 90277.

**CIGARETTES 12¢ a pack.** Improved roller makes 20 filtertip, plain, king or regular for 12¢. Facts free. Green River Tobacco, Box 953, Owensboro, Kentucky 42301.

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**MAKE Statuettes, novelties, imitation marble.** Sell to stores or start gift shop. Free details. Marbleizing, 41 Waverton, St. Louis, Mo. 63124.

**HOW To Make money writing short paragraphs.** Information free. Barrett, Dept. C-27-K1, 6216 N. Clark, Chicago 60626.

**FREE Copy of world's leading contest magazine!** Write Prizewinner, Box 11569, St. Petersburg, Fla. 33733.

**FREE. 206 Easy Ways to make money taking orders for exciting new products—spare time.** Send name, age for 5 months free subscription. Opportunity Magazine, 1460 Hancock Center, Dept. 17-MM, Chicago 60611.

**HOMEWORK. Mailing circulars.** Free details! Cam Company, Dept. 155-KP, Verona, N.J. 07044.

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## MONEYMAKING OPPORTUNITIES

(Continued from preceding page)

**SCIENTIFIC Messages:** Big Earnings uncrowded profession. Learn spare time at home. Diploma awarded. Free catalog. Write Anderson School, Dept. P-1C, Princeton, Illinois 61356.

**CLIP Newspaper items.** \$1.00-\$5.00 each. Details free. Walter, Box 1360-P, Erie, Pa. 16512.

**MAKE:** \$12.00 Profit each dozen assembling Belts. Details Free. (Stamp appreciated.) Redikut's-40, Richland Center, Wis. 53581.

**HOW TO GET RICH!!** Free "Money-making Brochure"! Success International, Box 2447-C, Livonia Mich. 48151.

**\$200.00 FROM Sheet 1/4" plywood (scrap).** Details 25¢. Novelties, 610 So. 24th, Elwood, Indiana 46036.

**VENDING Machines.** No selling. Routes earn amazing profits. Big catalogue Free. Parkway Corporation, 715PMM Ensor Street, Baltimore, Maryland 21202.

**LEARN** The secrets of repairing junk batteries "Fabulous Profits" at home. Battery Shop, Route 1-188 D, Blythe, Calif. 92225.

**HOW TO GET RICH!** Amazing plan revealed! \$2.00 Refundable. Seco, Box 144, Walkerton, Indiana 46574.

**\$2.40 HOURLY** Making simple wood novelties. Free details! Gene's, 55 Boxwood, Falmouth, Mass. 02540.

**\$500-\$800 MONTHLY** Raise small Laboratory-breeding stock for us. We supply equipment, breeders, and instructions. Illinois Research Farms, Dept. MP-12, Barrington, Illinois 60010.

**SELL Lifetime Metal.** Social Security Plates. Sample and Sales Kit Free. Lady McGuire, Box 3333-PM, Anderson, S.C. 29621.

**SKETCH Photos—(Home Goldmine!)** Free Information. Gem, 365-F Longhill, Shelton, Conn. 06484.

**NO Risk \$15.00 stock advanced.** Pay wholesale cost when sold. If not sold pay nothing. MASTER RESEARCH, 115 Garner Road, Lilburn, Georgia 30247.

**MAKE Money with hobby-business.** MONOGRAPH, Box 661, Cucamonga, California 91730.

**GAIN RICHES.** Learn Mystic success laws. Marvin Koehler, Thorndale, Texas 76577.

**GAIN Higher Income, Confidence, Power.** Success. 228 page book reveals how to anyone who wants to get ahead. \$2.00. B-CARROLL Stones, 115 Mardi Gras, Pittsburgh, Pa. 15239.

**YOUR Money Dreams Come True.** Distribute amazing patented product. No competition. Free details. Inette-P Box 1314, Tampa, Fla. 33601.

**LYRIC WRITERS** write songs with writers who write hits for top Nashville artists. Globe, 420 Broad, Dept. PM, Nashville, Tenn. 37203.

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**MAKE \$500.00 Weekly** reconditioning used cars. Instructions \$3.95. Reconditioners, 37 Limerick Road, Royersford, Pa. 19468.

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**AMAZING Information,** 315 magazines free. MacMillan, 133-R Holly Drive, Cleveland, Ohio 44135.

**BE A DISC JOCKEY!** 400 Page course \$20.00. Free information. DSS-A, Box 633, Scarsdale, N. Y. 10583.

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**MONEY made on Government surplus.** LEARN the ART of BUYING and SELLING by Mail for profit. This valuable booklet tells how and where to buy millions of dollars worth of Government surplus and the method of selling by mail order. Send only \$1.00. A. Amster Associates, 854 Peralta Street, Oakland, California 94607.

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**GREATER Stock Profits.** Free Details. Box 383, R.D. 4, Cortland, Ohio 44410.

**CLIP Newspaper Items.** \$1.00-\$20.00. Free Information. Send Stamp. Richard, 111-PM2, New Baltimore, Michigan 48047.

**MAKE 3 Times Your Cost.** Hundred of products. Giant catalog \$1.00. Refund first order. Details free. Roberts Perfumes, 432-A Fremont, Springfield, Ohio 45505.

**REPAIR Clocks.** Clock Engineer Helps. McEntire, 323 Tram Road, Columbia, South Carolina 29210.

**MAILERS WANTED.** Gross up to \$500.00 mailing 1000 circulars. Details 25¢. Smyre's, 953-PS, Newark, N.J. 07101.

## PROFITABLE OCCUPATIONS

**\$625-\$900—MONTHLY** Raising Rabbits, Chinchillas, other small animals. We supply everything, equipment, instructions, breeders, buyers, big demand, big markets. Fox River Valley Research Farms, Dept. PMP-1, 2727 Justen, McHenry, Illinois 60050.

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**MAKE \$300 CLEAR MONTH** few hours from 10 customers, representing us in your community. No individual selling. Repeats forever. Customers waiting. \$1 for sample, details. Our 40th year. Progressive, Box 1302, Springfield, Ill. 62705.

**HOW To Make Money** writing short Paragraphs. Information Free. Barrett, Dept. C-27-K2, 6216 N. Clark, Chicago 60626.

**BAKE New greaseless doughnuts** in kitchen. Sell stores. Free recipes. Michael Ray, Waseca, Minn. 56093.

**\$500-\$800 MONTHLY** Raise small Laboratory-breeding stock for us. We supply equipment, breeders, and instructions. Illinois Research Farms, Dept. MPA-12, Barrington, Illinois 60010.

**MONEY In Imports.** Start Business With Government Help. No Merchandise Investment! Booklet BMO-52-1 Only \$1.00. CHAMBERLAIN HOUSE, Chamberlain Road, Merrimack, New Hampshire 03054.

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**HOUSEHOLD Products Route.** Earn \$25.00 or more daily. Larger repeat orders. Man, woman. Full, part time. McNess, Freeport 26120, Illinois 61032.

**THERE'S Money** in selling office supplies and equipment, full or part time. Steady repeat commissions. Free selling outfit. Write. Oseco, 3505-PM North Elston, Chicago 60618.

**EARN Big money** calling on business-professional men. Send us their delinquent accounts for collection. General Finance, Dept. PM-11, Columbia Bank Bldg., Kansas City, Mo. 64106.

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**SELL Advertising Ball Pens, Calendars, Ad-Specialties—Build Own Repeat Business—Free Details—Fleming, Dept. A, 6535 Cottage Grove, Chicago 60637.**

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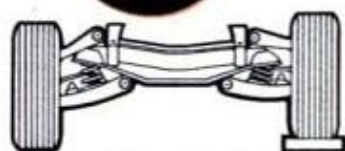
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# SOLUTIONS FOR MECHANICAL HEADACHES

# AUTOMOBILE CLINIC

BY MORT SCHULTZ

## Doesn't make it

*When the weather is damp and my 1968 Plymouth Fury II engine is cold, a short seems to develop that causes the windshield wipers, turn signals, radio and panel instruments to stop functioning. The trouble usually clears up after a few miles but occasionally these failures occur intermittently when I'm driving. What's a likely place to look for the cause?—Kenneth C. Ippolito, Avon, N.Y.*

Concentrate on the bulkhead connector where wires for electrical components come together in junction. It sounds as if wire terminals have built up corrosion. When corrosive materials get damp, a wire will ground out. Pull wires from the connector and check terminals. If there's greenish crud (corrosion), clean the terminals bright with an emery board. Reconnect the wires into the panel, making sure they are pushed in all the way. One more thing: your car might not be equipped with a watershield that protects the bulkhead connector (part No. 2983326). If not, have a dealer install one as instructed in service bulletins 69-8-12 (Chrysler and Plymouth) and 69-8-5 (Dodge).

## Vacuum gauge won't read

*I hooked a vacuum gauge to my 1966 Oldsmobile Cutlass, but got no reading. The engine was hard to start, so I overhauled the carburetor. Still no reading. What's wrong?—John Conant, Sparta, N.J.*

Could it be that you're not taking the reading correctly—that you're not taping the vacuum gauge line into the intake manifold as you should? If you are, better check the gauge.

## Vinyl top protection

*Do you know of a coating that can be applied to vinyl tops which will protect them from ugly white water streaks that result from rain and washings? How do you remove those streaks?—F. Osborne, Stewart, B.C., Canada.*

Visit your local auto parts supply store. You will find several brands of high-grade vinyl top dressing, as it's called. Get rid of stains by scrubbing them with a floor

brush, mild dishwashing soap or car-wash soap, and plenty of water.

## Generation gap

*I wonder if you could settle an argument I'm having with my son. We have disc brakes and instead of keeping my foot on the pedal at traffic lights I shift into Park. My son says it's better to keep your foot on the brake than to keep moving the selector. Which is worse—heating brakes by keeping your foot on the pedal or putting wear on the automatic transmission by using it so much?—Ben Rubin, Baltimore.*

This is carrying the generation gap too far. You wouldn't put enough heat on the brakes to singe a marshmallow. In case you don't know it, with disc brakes the pads are in constant contact with the discs when the car is being driven. If that doesn't generate enough heat to damage the brakes (it doesn't), then keeping your foot on the pedal when the car is motionless certainly won't. As for your son, he would probably wear out the upholstery before he can damage a transmission by shifting it from Drive to Park. Gentlemen, close the gap. Each of you can do your own thing safely.

## Lockup

*I have a 1964 Chevrolet Nova Six with the gearshift lever on the steering column. While shifting, the lever keeps locking so that I can't move it unless I go under the hood and release the locked parts. What's wrong?—S. A. Mintel, Rahway, N.J.*

A worn-out lower mast jacket bearing or shifter tube.

## Standing tall

*I have a 1968 GMC ¾-ton pickup and I have to stand on the pedal to get the brakes to hold. The linings were good, so I concluded the drums and shoes were crystallized. I had the drums reamed and new shoes put on. Now, 2000 miles later, the trouble's beginning again. What now?—Bill Meise, Plain, Wis.*

Better replace the drums. Sounds like  
*(Please turn to page 68)*



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## AUTOMOBILE CLINIC

(Continued from page 66)

they've got hot spots that go right through the metal. Cutting the drum won't eliminate the failure. And, Bill, take a long, hard look at how you're loading the truck. If you're lugging much over  $\frac{3}{4}$  of a ton you're overloading the brakes and causing the problem yourself.

### Lost reverse

*I have a 1965 Chrysler Newport. Lately, whenever I do highway driving at a fast speed and then stop I find that I don't have reverse. When I shift the automatic transmission into reverse, the car won't move. This clears up after the car sits for about half an hour. It doesn't happen when I do city driving. Any suggestions?*  
—Richard A. Goldberg, Flushing, N.Y.

Get the transmission heated up as it is after a highway drive and take pressure tests on the line at the rear servo apply and at the governor. I'm pretty sure there's a hairline crack somewhere inside that case which is opening up as a result of heat and pressure, causing a leakdown condition. When it cools (or remains cool), the crack closes. The transmission may have to be overhauled. The trouble could also be loose valve body bolts.

### Temperamental starting

*I have trouble starting my 1969 Ford with 390-cu.-in. V8 engine. Hot or cold, but more often when hot, at the turn of the key, the engine always turns over but immediately kicks out—that is, the starter disengages. It always starts eventually, but the starter will not crank the engine continuously.*—J. D. Watson, Dearborn, Mich.

This is a case of a slipping Bendix drive caused by wear of the one-way clutch. Ford has issued a stronger drive assembly. See your dealer.

### Getting a haircut

*The car is a 1970 Plymouth Sport Suburban wagon with 383-cu.-in. engine and automatic box. It has been back to the dealer five times in 3800 miles. The problem: when the transmission is supposed to shift from second to high, the engine*

*rages before it will finally shift. This can become quite "hairy" in city traffic. My dealer says he's "waiting for a service bulletin." Is one coming?*—H. R. Schneider, Webster, N.Y.

Not that I know. This sounds like a case of the throttle pressure being set incorrectly. The linkage rod at the carburetor should be readjusted. If this doesn't stop delayed up-shifting, transmission pressure checks should be made. The trouble could be incorrect line pressure or a damaged valve body.

### Gulp, gulp

*Have you ever heard of a gulp valve? What is it?*—S. W. Wimpfheimer, New York.

It's a valve in the exhaust emission control systems of 1968 and newer models that meters out fuel emissions to the combustion chambers for burning. The engine can only handle efficiently a particular amount of these emissions at a time. The gulp valve, then, holds emissions in reserve until the engine is ready for more.

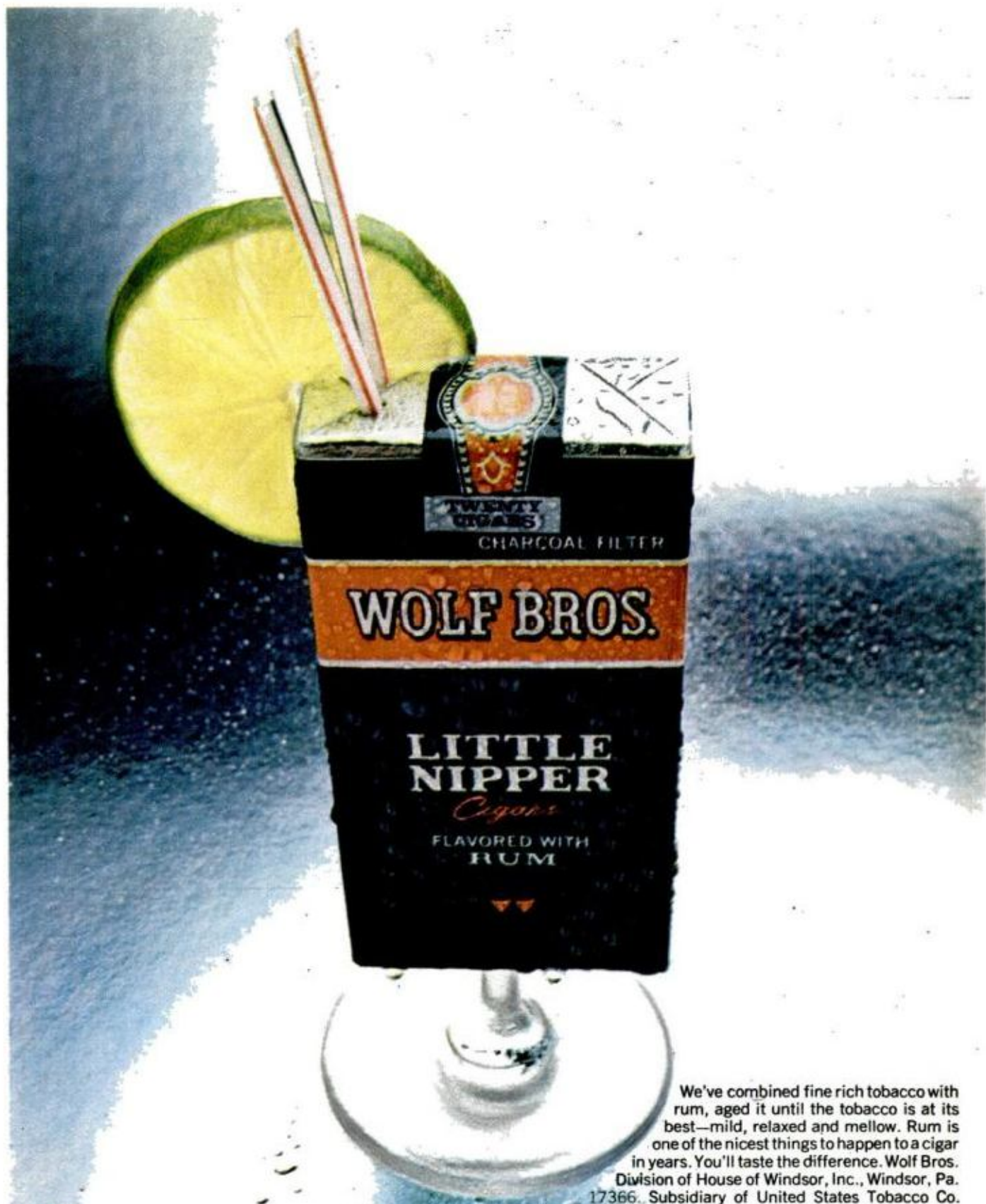
## Service Tips

- Chrysler Corp. warns you to be careful not to bend the choke diaphragm link in the wrong place when making the vacuum kick adjustment. The link must be bent at the U-shaped bend. If bent anywhere else, interference or misalignment can result that will lead to poor cold starting, improper fuel metering, or complete loss of choke action.
- Some 1970 Mercurys equipped with 2.75:1 and 3.07:1 ratio rear axles are experiencing driveline noises in the form of groans at 38-42 mph (2.75:1) or about 36 mph (3.07:1). The noise is a result of the front universal joint being at too great an angle. Service bulletin 38 (6.8.70) explains how to install shims at cross-member support brackets to reduce this angle.
- Rubber Manufacturers Assn. now recommends that passenger-car tires should be replaced when the tread wears to less than  $\frac{1}{16}$  inch in any two or more adjacent grooves, or if any part of the ply becomes exposed. The association's new pamphlet, *RMA Tire Inspection Guide*, is available free by writing RMA, 444 Madison Ave., New York 10022. ★★

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**GOT A PROBLEM WITH YOUR CAR?** Ask Mort about it. Send your question to Auto Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of general interest will be published in the column.





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# HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

## Cleaning a fireplace

*Is there some way to clean away the soot on the inside of a fireplace I no longer use so that it appears bright and clean, with a few birch logs on the grate just for "atmosphere?" Will some cleaner do the trick?—F.E., Ark.*

If your fireplace is lined with firebrick and not a metal unit, you can then make a rather effective mixture yourself. Shave a bar of yellow laundry soap—the old-fashioned kind—into a container and add  $\frac{3}{4}$  gal. or so of clean water. Boil this mix until the soap is melted, then cool it and add about one cup of ordinary household ammonia and a pound of pumice. Mix this goop well, brush it onto the sooty surfaces and let it stand a half hour or more. Then rub it off with a stiff-bristle scrubbing brush and lots of elbow grease. Follow with a warm-water rinse to clear away most of the muck, then finish with a medium to strong detergent and rinse again with warm water. This should do it, but if the fireplace interior is badly sooted, you may have to repeat the process.

I'm not so sure about the bright-and-clean appearance you specify, but you can be fairly certain the interior will appear unused. You can use this mixture at half strength to clean the exterior of fireplaces that smoke under certain conditions.

## Open porch floor covering

*My porch, open year-round and protected by a slant roof, gets wet in driving rains, sleet and snow. The rails are of matched flooring attached vertically and there are openings at the bottom, the space being about 3 in. all around. I'd like to cover this wood floor with a waterproof covering, but what?—C.S., Ky.*

How about indoor-outdoor carpeting, laid wall-to-rail in one piece? If the floor is reasonably level—the boards not cupped or slivered at the edges—this material may be the solution. Manufacturers say it's not water-absorbent, is nonfading, mildew and stain-resistant, as it's made entirely from synthetic materials. Before installing it, re-nail the floor boards to make a more solid base over which to lay the carpeting. Choose a color you can live with and lay any strips that may not

be wide enough to cover the whole floor in one piece across the boards rather than parallel to them. This will prevent the tendency of adjacent strips to break at the meeting edges. Your dealer will supply full instructions for the installation, also the proper cement to use. Follow these in detail. He may also advise you to apply a 3 or 4-in.-wide spread around all edges of the carpeting. The job, of course, should be done only in warm weather.

## Improvised 'mud room'

*We don't have a mud room in our house and our family of six has a problem with tracked-in dirt, snow and even wet mud. Continuous mopping keeps the floor near the doors fairly clean but mats of any kind are hopelessly soiled and dirty nearly all the time, and cleaning them would be a daily project. Isn't there some other effective way short of me enduring housemaid's knee?—M.L., Pa.*

There is, if you can endure mats made from newspapers. These are relatively cheap and when they're wet and soiled you merely toss 'em in the garbage can. Open several newspaper sheets full out, stack them neatly to about 8 to 10 layers and staple the edges to form an absorptive mat. Make several such mats so you have a supply on hand. Instruct the juniors to brush snow and mud from their footwear before coming inside and the improvised mats will last for days of inclement weather.

Any other paper, of course, can be used for this purpose. With a bit of imagination you might make up mats of plain paper with fanciful edges, such as a modified sunburst pattern or perhaps a huge shape in the form of a foot track, as a reminder.

## Uninsulating an attic

*Last winter, while sitting in my living room I seemed to feel cold drafts from above. There's about 2 in. of pour insulation between joists so I spread a heavy sheet of plastic over the area. This seemed to help, but early last spring I happened to notice the existing insulation was very damp and soggy in places. What's wrong?—D.G., Me.*

Take that sheet of plastic out and pour at least 4 more inches of insulating material over that already there, making 6 in. in all over the whole attic floor. Don't put the plastic over the insulation. Moisture rising from the room below passes through the ceiling and is stopped by the plastic sheet, thus creating the condition of dampness you describe. ★★★





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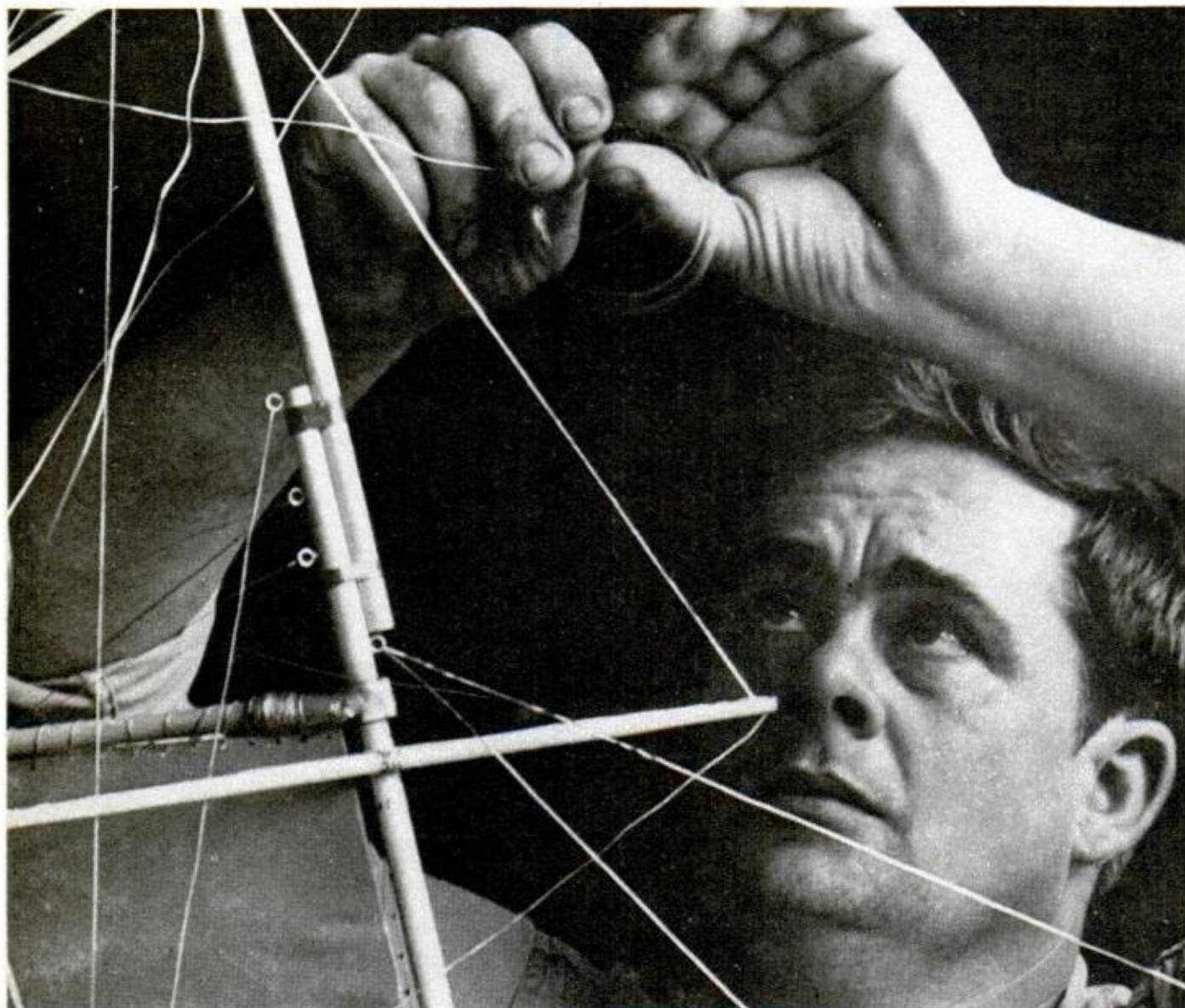
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**AVIATION**



# A FIGHTER PILOT'S FIGHTER PLANE

Though it can do many things, the Air Force's F-15 is a plane with a single purpose—to tangle with enemy fighters and destroy them.

By KEVIN BROWN

**I**N WORLD WAR II, American fighter pilots racked up a record of eight victories for every loss. In Korea, the kill ratio soared to 14-to-1. In Vietnam, with only sporadic activity by enemy aircraft, the ratio dropped to a near standoff 2-to-1.

What happened?

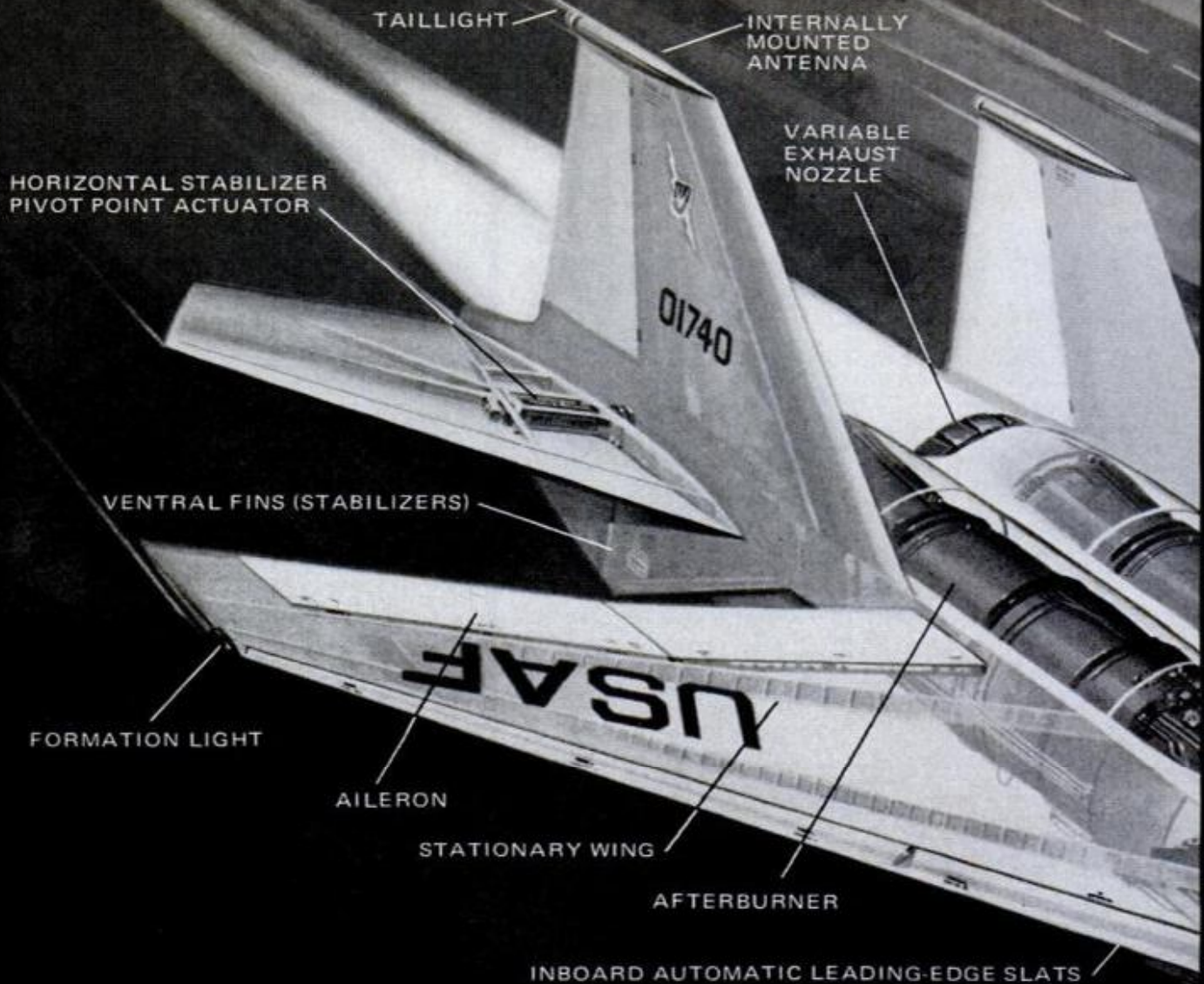
American fighter pilots are still as good as ever, perhaps the best in the world. And, in Vietnam, they were flying against second-rate pilots in not quite first-rate aircraft—hand-me-down Russian MiGs. Still they could do no better than score two victories for every loss. The men in the Pentagon who worry about such things decided it was not the pilots but the planes.

The best American fighter in Southeast Asia was the F-4 Phantom II. But its history goes back as far as 1954, and its improvements have reached a saturation point. Others used extensively in Vietnam, the F-100 Supersabre and F-105 Thunderchief, go back even farther.

Worse, the Russians weren't standing still in technological development. The MiGs they sent to the North Vietnamese, even though they just about held their own, were not the best in their inventory. At a recent Moscow air show, the Soviets showed no less than six new fighters, several of which had characteristics superior to anything we now have flying, specifically more maneuverability and better acceleration. And we have nothing new coming along to top them.

Until now. The Navy is working on a new fighter to guard its fleet called the F-14 (See *A Hot New Fighter for the Navy*, page 83, Jan. '70 PM.) And just recently the Air Force announced the awarding of contracts to build a new





fighter called the F-15 to clear the skies over land.

This is the story of the F-15, and, in an era when the cost-conscious people who make these decisions require every new aircraft to be all things to all men, it is something unique. The F-15 is the first fighter in 20 years to be designed for only one mission—fighting other fighters. Whatever other duties it may perform—reconnaissance, air-to-ground attack—will be entirely secondary, with no compromise in the hardware to fit it for these roles. The last fighter to be so privileged was the F-86 Sabrejet, which built up an unbelievable record in Korea. The decisionmakers were reminded of this when making their decision.

So, in Air Force language, the F-15 is meant to “find, identify, engage and destroy enemy aircraft.”

In layman’s language this means, “Go

get ‘em, make sure they’re the bad guys, then stick the gun up their tailpipe and pull the trigger!”

To perform this simple mission the F-15 needed a simple design. Advocates of using new technology to build airplanes bigger and more powerful to fly higher and faster are often surprised to learn that the recent history of aerial combat destroys this myth. Most dog-fights these days are done at subsonic speeds and at low altitudes. The highest engagement speed on record is Mach 1.3, and the normal combat altitude is around 10,000 feet, and below Mach 1. So high mach numbers and high-altitude capabilities are irrelevant in the heat of combat, which is the ultimate purpose of a fighter.

What is relevant is range enough to go where the enemy is, maximum maneuverability to outfly him when you get





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20MM CASELESS AMMUNITION FEEDING WINDOW

# U.S. Air Force F-15

PRIME CONTRACTOR: McDONNELL DOUGLAS CORP.

Illustration by Roy Grinnell and Fred Wolff



there, and sufficient firepower to destroy him when you do. So the F-15 does not have to be the biggest, fastest and highest-altitude aircraft ever to be built.

It is, in fact, relatively small, about 40,000 pounds (compared to the 46,000 pounds of the F-4 and the 55,000 pounds of the F-14); relatively simple, a fixed wing with no extra "garbage" on it for exotic flight maneuvers (nothing whatever on the leading edge); and relatively easy to fly, just one pilot does all the seeking, identifying, engaging and destroying.

It is, to use the cliché, a fighter pilot's fighter plane.

It got light by extensive use of new high-strength and lightweight metals. About 40 percent of its airframe is titanium and boron composites. The small size and light weight add miles to its range (still classified) and extra zip to its maneuverability.

The configuration adds more. The stubby delta wing gives sufficient lift with extremely low wing loading (weight to wing area), as well as minimum drag and maximum maneuverability.

The engine nacelles are flush against the fuselage, reducing the "wetted" areas of separated nacelles, the areas that are exposed to the airstream causing extra boundary-layer drag. The adjustable intakes (for high and low-speed airflow) are separated slightly, then the nacelles are mated to the fuselage with streamlined fairing. Toward the rear, the F-15's fuselage and engines are almost all one piece of hardware. The twin tails have twin vanes beneath them for greater stability and maneuverability on this lightweight fighter.

Inside, from front to back, the F-15 is relatively standard: Electronic equipment in the nose, for better acquisition and truer tracking, a single cockpit with standard ejection seat, a bubble canopy that is built for 360° visibility and not streamlined for speed, and a fuselage that is almost all fuel tank.

The usual "Gatling" gun is placed in the right wing, just outside the right engine, instead of in the fuselage. There it doesn't have to occupy any space that could be put to better use in the slim aircraft.

Air-to-air missiles are hung from stations on the engine nacelles, and pylons may be added to the wings to carry wing tanks or air-to-ground weaponry. The normal weaponry will include a mix of the following, some which will be used for the first time with the F-15.

The current Gatling gun used with most fighters is the venerable M-61 Vulcan, a 20-mm, six-barrel cannon capable of firing 6000 rounds per minute. It has disadvantages. Its ammunition is housed in cases that must be collected and stored inside the aircraft. If the cases were ejected, the aircraft could suffer considerable FOD (foreign object damage) at high speeds, the shells striking the fuselage or control surfaces. And 20-mm ammo is just not

**NEW, CASELESS AMMUNITION** developed for the F-15 eliminates need for storage of cases. Conventional 20-mm and 25-mm shells (left) are smaller, lighter when housed inside casings (right). Firing pin forces casing into breech; casing, which is all propellant, explodes, is completely destroyed





enough to insure penetration and destruction of newer, tougher enemy aircraft.

So the F-15 is going to 25 mm—and another problem. As the shell size goes up, so must the casing, and so must the mechanism and the storage area necessary to dispose of them after firing. The solution is “caseless” ammunition with the shell housed not on top of the casing, as in most ammunition, but *inside* it. The casing itself becomes the explosive propellant, destroying itself as it fires. When each of the six barrels moves into place, the firing pin explodes a small propellant, forcing the shell out of the casing and into the breech of the barrel. This in turn builds up the pressure inside the casing (which is all propellant), the casing explodes and the shell is on its way.

The F-15 will also carry an assortment of medium and short-range missiles. Its new short-range missile, now under development, will also be a first. It is meant for close-in head-and-head dogfighting, when each aircraft is making tight maneuvers and pulling high Gs. Today's missiles, even with homing devices, pretty much need so-called “on-bore” sighting when the pilot has the other aircraft lined up in his sights. The missile can be fired with “off-bore” sighting. The pilot makes his calculations, even in an extremely tight turn with the enemy aircraft far out in front of his sight, rigs the missile accordingly, then fires. The missile is built to withstand the pressures of high-G forces, turn inside the enemy aircraft, and catch up with it in a turn.

The F-15's avionics will have “look down, shoot down” capability, which only the Mach-3 supersecret F-12 has now. Today's radar, when looking down toward the ground, has trouble separating low-flying aircraft from the jumble of ground targets. The new avionics will give it this capability of separation, thus removing a vulnerable blind spot.

Beyond all these improvements the F-15 will be the first Air Force fighter

in history to have a thrust-to-weight ratio of more than 1-to-1. This means that the thrust from its engines, as measured in pounds, is more than its weight (29,000 pounds in each engine, or 58,000 pounds, to a gross weight of 40,000 pounds). By comparison, the F-4, the best combat fighter flying today, has a T/W ratio of .7-to-1. It weighs more than its power. The F-15 will have considerably more power than weight.

To put it in practical terms, the F-15, once it's in the air, could point its nose at the sky, pour on the power, and accelerate going straight up, even to supersonic speeds.

It could operate just like a missile or, to use the old cliché, it is a missile with a man in it. The F-15 has a combination

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**'Our biggest problem  
may very well be  
pilot selection . . .'**

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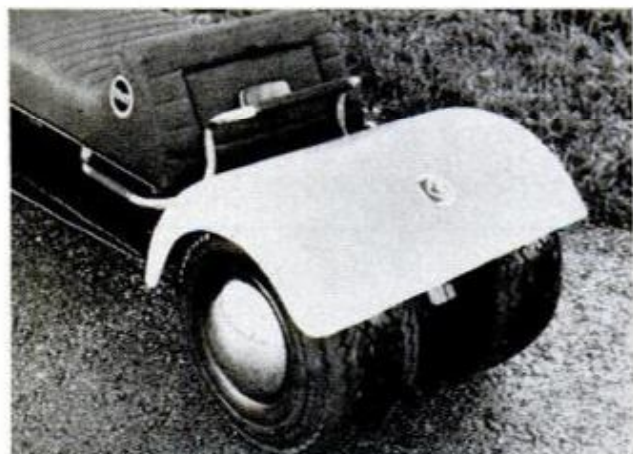
of things that no missile has, things that have Air Force pilots turning flips on the flight line in anticipation—long range, great acceleration, high maneuverability at combat speeds and extremely versatile firepower.

The F-15 may, in fact, reverse the current problem of our pilots being better than the planes. Brig. Gen. Benjamin Bellis, the man in charge of the F-15 program, told *PM*: “Our biggest problem may very well be pilot selection. It would be a great waste to build a plane with this potential if we couldn't find enough pilots to take full advantage of it.

“What we'll need are men who are physically fit to be able to take the high-G maneuvers, who can make proper weapon selection under great stress, men who can think and act, not just ride through the maneuvers, but do something while they're in them.”

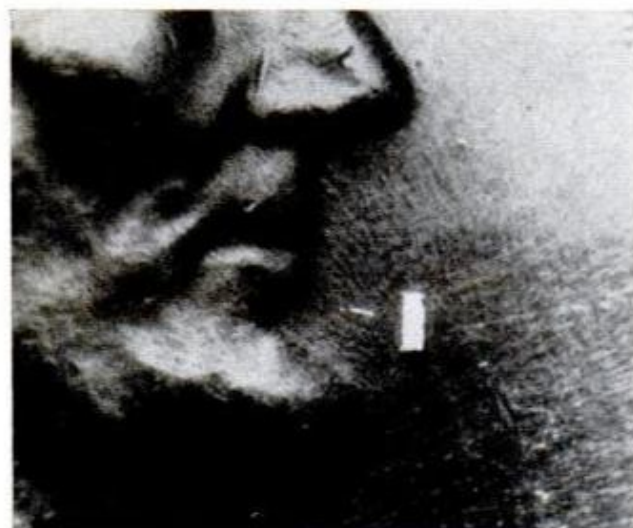
The F-15 is expected to be operational in 1975. Young men with the sky in their eyes have five years to get ready for it. ★★ ★





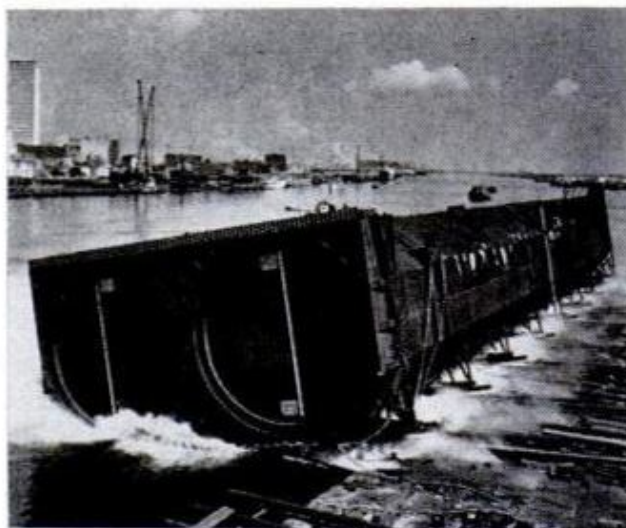
## Wheels for snowmobiles

Snowmobilers can convert their machines to year-round vehicles with a new wheel kit offered by Kiekhaefer Aeromarine. The kit includes coil-spring suspension, automotive-type shock absorbers and disc brakes (front and rear). The wheel kits, which fit most popular snowmobiles, can be installed with basic tools; no drilling, welding or fabrication is required. The converted vehicle can be used for trail riding, hill climbing and on dunes and beaches. The complete kit is priced at \$499.50.



## Tiny laser

A new semiconductor laser developed by Bell scientists measures 15/1000 of an inch long by 3/1000 of an inch wide. (It's shown here on a penny.) Powered by ordinary dry cell batteries, it will emit a beam of near-visible infrared light.



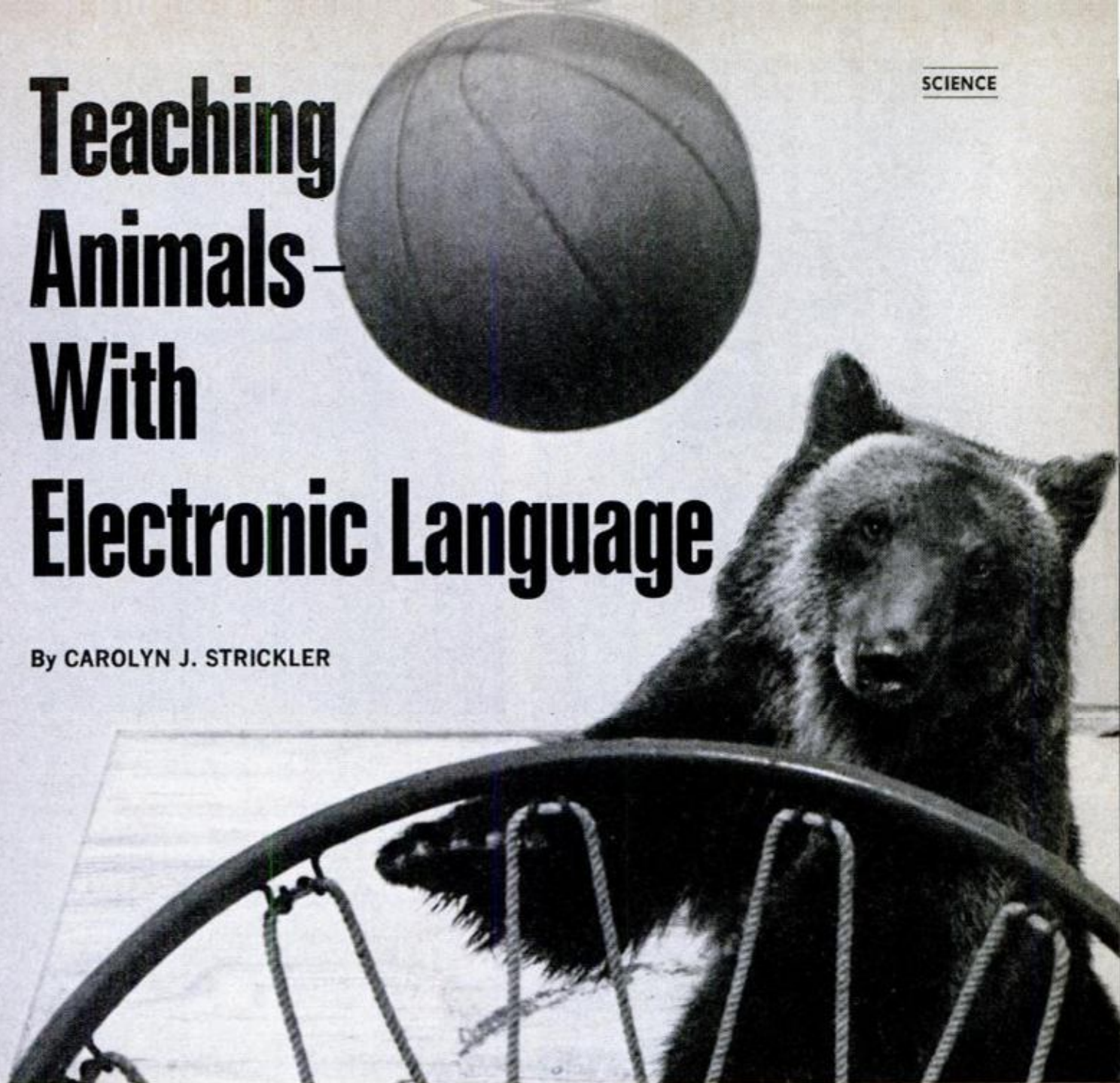
## Highway-tunnel launching

The steel shell for a four-lane highway tunnel under the Mobile River is launched by Alabama Dry Dock and Shipbuilding Co. The shell, made of three million pounds of Armco steel, is the first of seven tunnel sections. It was floated to the site, then sunk.



# Teaching Animals— With Electronic Language

By CAROLYN J. STRICKLER



**A new, automatic method of training animals may lead to the use of monkeys, baboons and owls to pick crops and serve as watchmen and sentries.**

**H**OW WOULD YOU go about teaching a wild bear to play basketball all by himself, or teach him to walk a high wire 20 feet in the air? How would you teach a fish to retrieve a ball or play poker with a human opponent—and *win* two times out of three?

Such things are being taught with the aid of an exciting new technology that is fast revolutionizing the field of animal training.

The originator of this new method,

called Behavioral Engineering Techniques, is a 34-year-old psychologist-animal trainer named Don Leon Smith of Anaheim, Calif.

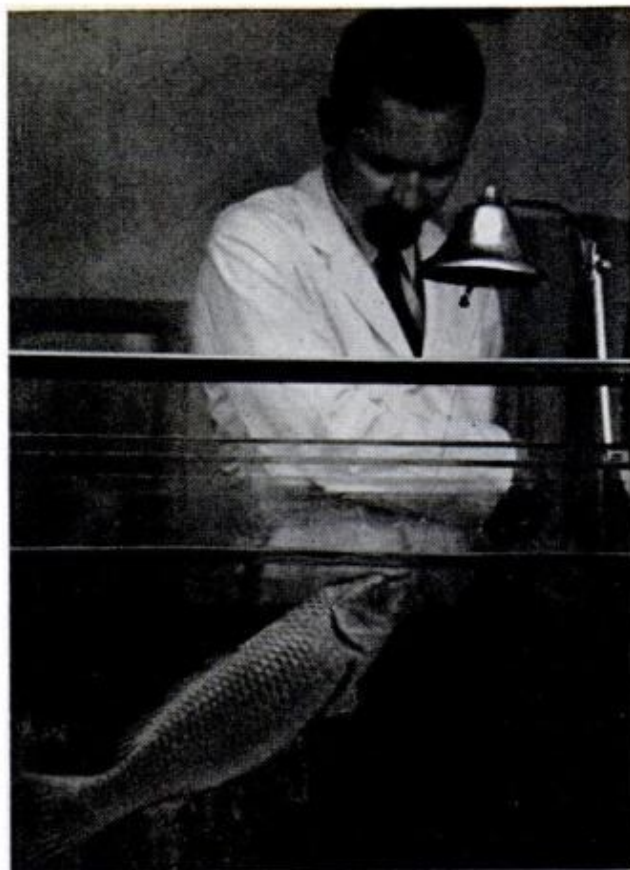
So effective are these techniques, or BET as Smith refers to them, that he claims it is now possible to teach "virtually *any* species of mammal, bird or fish to do almost anything it is physically capable of."

Smith's methods incorporate highly-complex, reward-based psychological

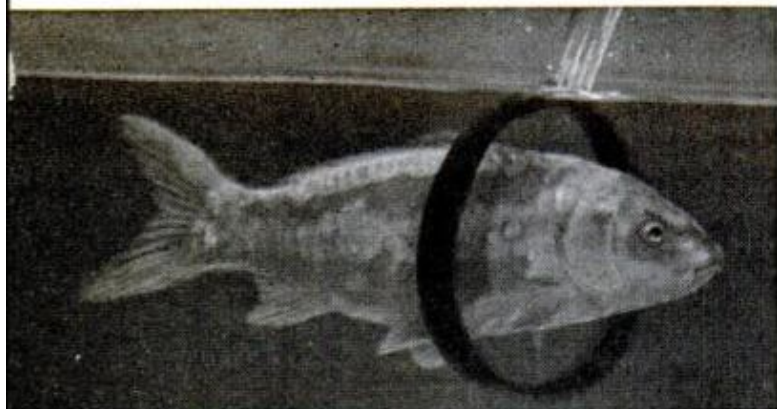




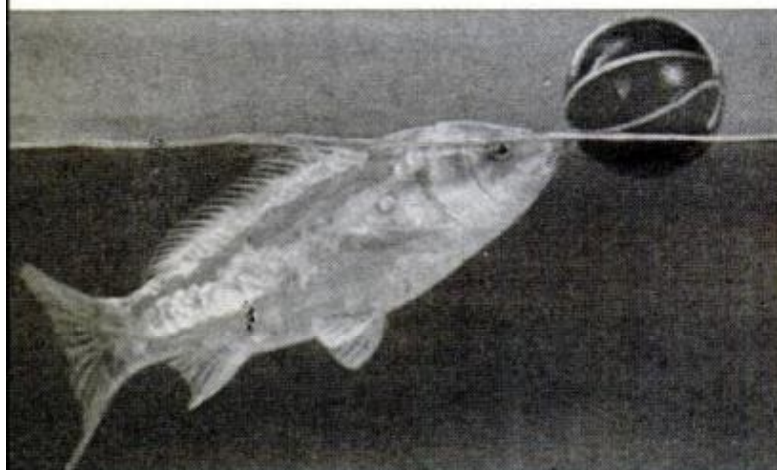
**WILD ANIMALS** like this bear can be trained, without taming, from electronic console outside cage



**RINGING THE BELL** for Don Smith is Old Gold, a 40-year-old carp who can do it 200 times a day



**JAPANESE CARP**, 16 years old, swims through hoop, one of several routines fish has taught himself



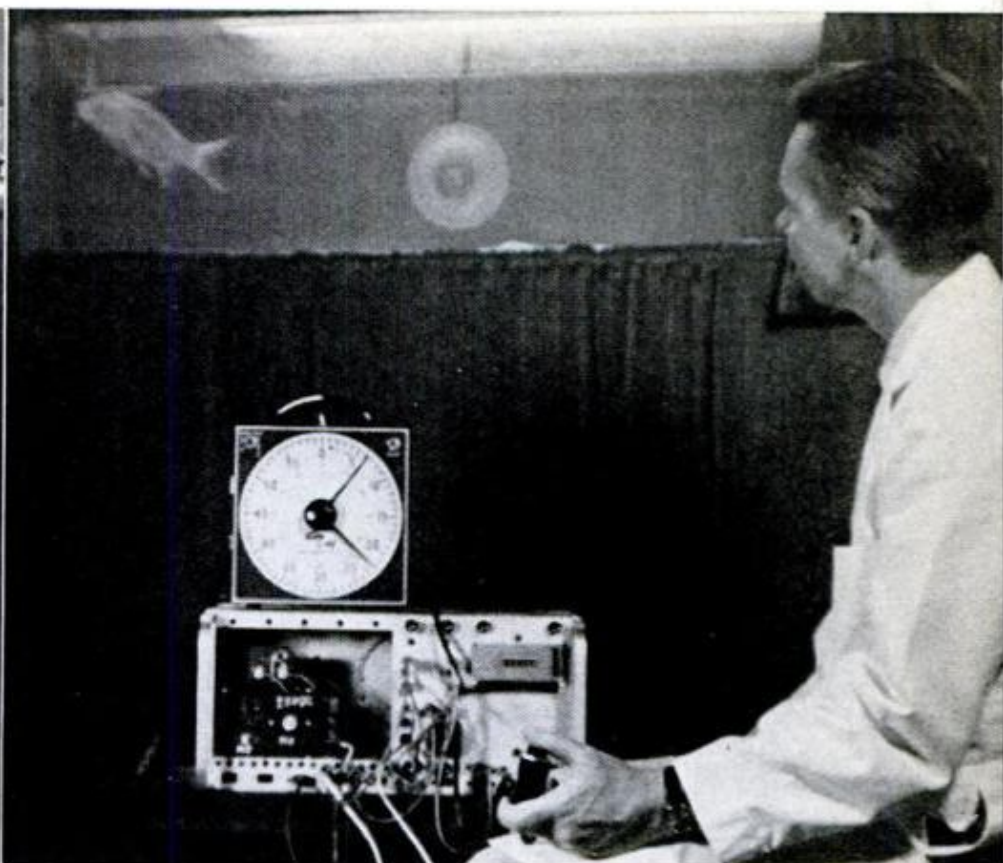
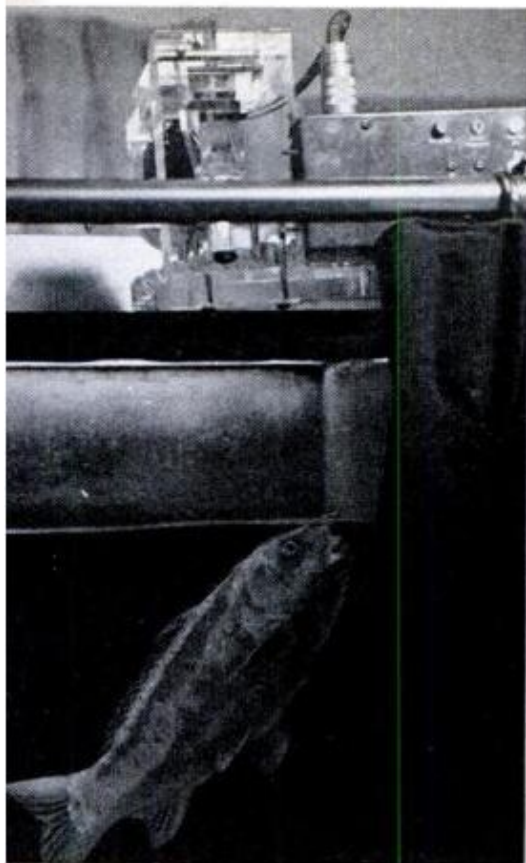
**RETRIEVING BALL**, carp pushes it to opposite end of the tank for her reward and a pat on the head

conditioning techniques, which are communicated to animal "trainees" by electronic signals and cues. These are implemented by a wide assortment of electromechanical devices, which are vital to the training process. Some of them can be bought off the shelf of any commercial electronics supply house and include simple doorbell buzzers, auto calls, amplifiers, sound generators, microswitches, proximity switches, heat sensing switches and photoelectric relay systems.

Smith himself designed some of the electronic equipment, acquiring his expertise while serving in the U.S. Air Force as an electronics technician in SAC, and at the University of Texas.

It was during his first year of graduate study as a Ph.D. candidate in the university's school of psychology, that concepts for BET began to take shape when he became fascinated by the classical or *respondent conditioning* techniques of the Russian scientist Ivan P. Pavlov (who taught dogs to salivate by ringing a bell) and the *operant conditioning* techniques of the controversial





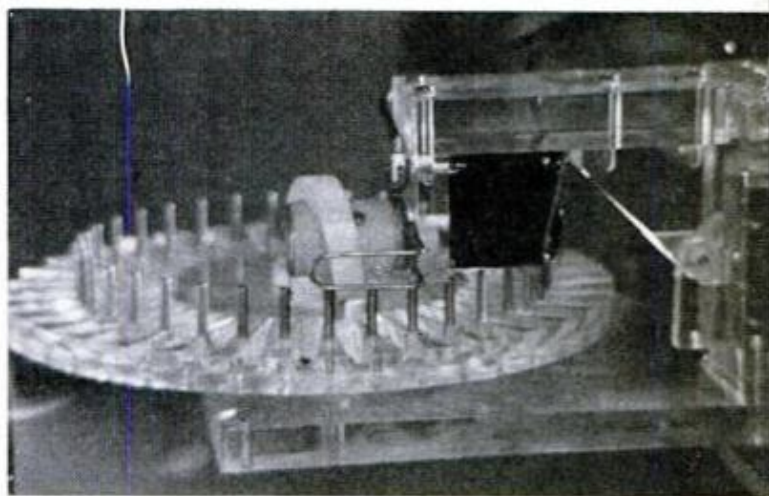
**FISH BEING TAUGHT** to press lever that will release food is helped by underwater conditioning tone actuated by Smith's hand switch. Electronic equipment includes feeder, counter, timer and preamp unit

behavioral scientist, Prof. B. F. Skinner of Harvard (who invented teaching machines).

Classical conditioning is well known and widely used in studies of behavior in psychology labs. It begins after the animal has been adapted to the training environment, and involves the pairing of a signal (either sound or lights or both) with the presentation of a reward such as food.

Says Smith: "This must be done in four-tenths of a second after the signal is initiated. Whether it's a chimp or a chicken, the animal quickly grasps the idea that whenever he hears or sees this signal, he knows he will be treated immediately to a food reward. His whole body chemistry changes with the food he knows is coming." This step, Smith adds, can be done within one day or less if training is carried out correctly.

Operant conditioning is the next step of training and is also widely used by researchers in studies of behavior. In brief, it involves the rewarding of an animal with a signal, which has pre-

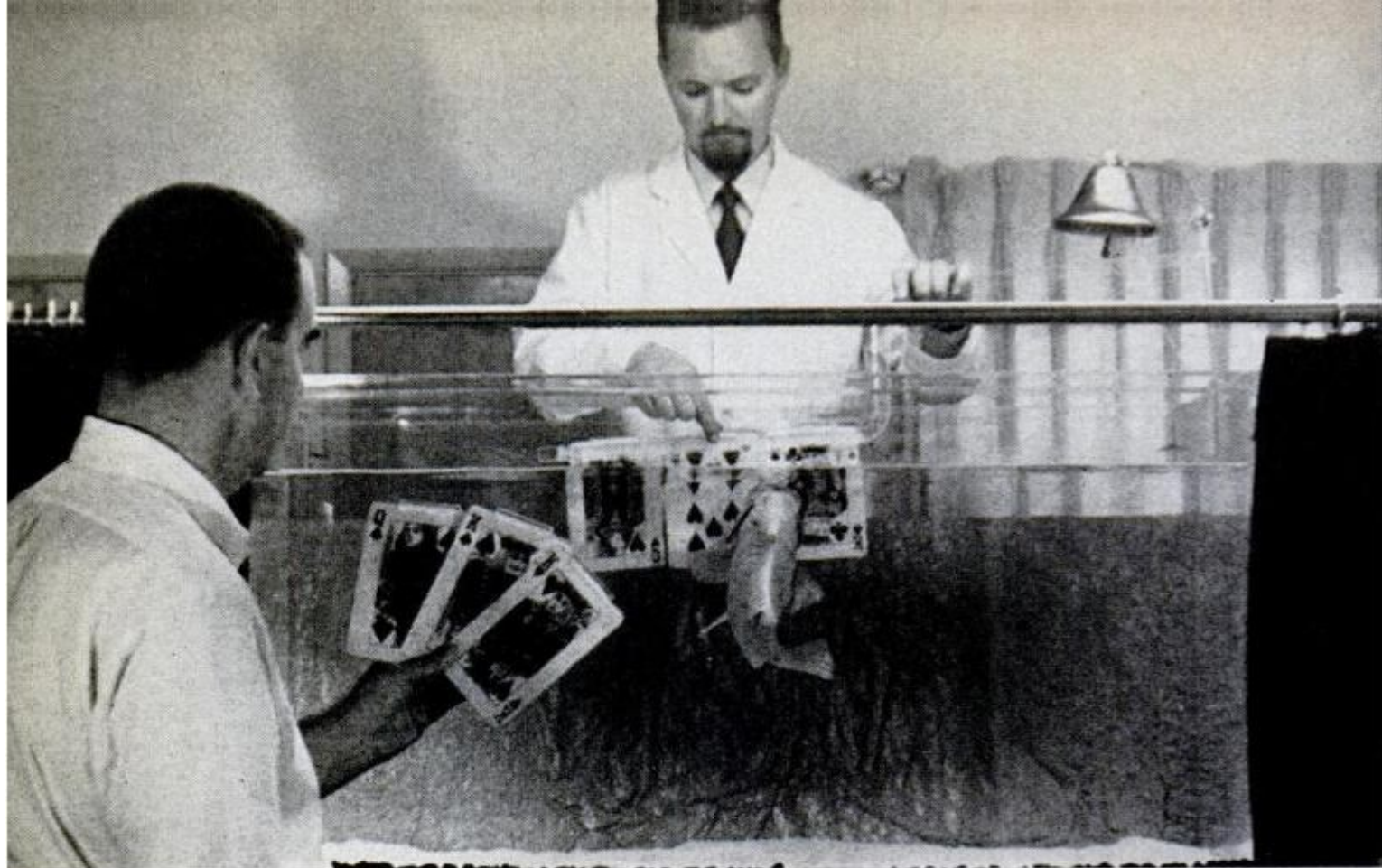


**AUTOMATIC FEEDER** releases food pellets from rotating disc in from 1/15th to 1/30th of a second

viously been paired with food, for performing a correct behavior and not rewarding him when he performs incorrectly. The basic premise of operant conditioning, says Smith, is that *rewarded* behavior will repeat itself with a higher probability than behavior which is not rewarded.

As in the preliminary stages of training, operant conditioning is done via electronic signals and cues (either sound or light), and, as in classical con-





**CARD-PLAYING CARP** has been taught to discriminate between cards and almost always selects a winning poker hand for herself. Trainer Don Smith (right) accomplished this with reward-based conditioning

conditioning, the signal indicating that a reward is coming must follow in four-tenths of a second in order for learning to be most effective.

Not long after Smith first learned of these techniques, he decided to test them for himself and set up a crude experimental lab in his home.

"I didn't have any of the sophisticated electronic equipment I was used to working with at the university," he recalls, "so I started conditioning raccoons, rabbits and baby chicks with nothing but a cardboard box for a 'training chamber' and a little dime-store clicker for a 'conditioning signal.'

"Conditioning can be done without electronics," says Smith. "In fact, you can even use hand claps or make sounds with your mouth for a conditioning tone. But you are severely limited as to speed, as to the complexity of the behaviors and as to what kind of animal you can work with. You can't work with a killer bear, for instance, and a cardboard box."

Despite the lack of electronic equip-

ment, Smith was "astounded with the results." He saw that it would be possible to completely alter present methods of animal training—for the better—and in the process, revolutionize the field of animal training. (He believed it was possible to train animals in literally thousands of heretofore undreamed of applications for the entertainment business, and eventually for industry, defense and even agriculture.

In 1964 he launched a profession he would eventually call behavioral engineering. Adding his electronic communication system to the core techniques, in just six years Don Smith has successfully conditioned more than 200 animals for movies, television, outdoor parks and oceanariums.

They represent over 41 species, including wolves, chimps, house cats, dogs, raccoons, lions, monkeys, macaws, coyotes, pigs (including Arnold on the *Green Acres* TV series), chickens, bears, dolphins, rabbits and sea lions.

He has trained raccoons, chickens

*(Please turn to page 188)*



A Nationwide Survey Based on  
1,441,000 Owner-Driven Miles

**PM OWNERS REPORT**  
**CHEVY CAMARO/PONTIAC FIREBIRD**

# ***SUBTLE DIFFERENCES LOOM LARGE FOR CAMARO AND FIREBIRD OWNERS***

By MICHAEL LAMM, West Coast Auto Editor/Photos by the Author

**L**ITTLE THINGS mean a lot—to the owners of 1970 Camaros and Firebirds. Said one Camaro owner: "I bought mine because I don't like the front and rear styling of the Firebird; also the Camaro was priced lower." Replied a Firebird owner: "Pontiac options make the difference—suspension, three-speed automatic; it's a heavier automobile." [Editor's note: The 350-cu.-in. Firebird weighs 256 pounds more than the 350-cu.-in. Camaro.]

Other owners' reasons for buying one over the other included: "The Camaro doesn't ride as well." "I don't like the Camaro's grille." "I am a Chevy man, plus the price was about \$500 less than for the same quality Firebird." "Camaro dealer had my car in stock. I would have had to wait for a Firebird, and with a truck strike, I wasn't taking any chances." "I think my Firebird has more pizzaz than the Camaro."

Overall, both Firebird and Camaro owners were well-pleased with their cars. We want to emphasize that, because the volume and range of complaints might make one lose sight of most owners' satisfaction. To repeat, the vast majority of both Camaro and Firebird owners *were* pleased.

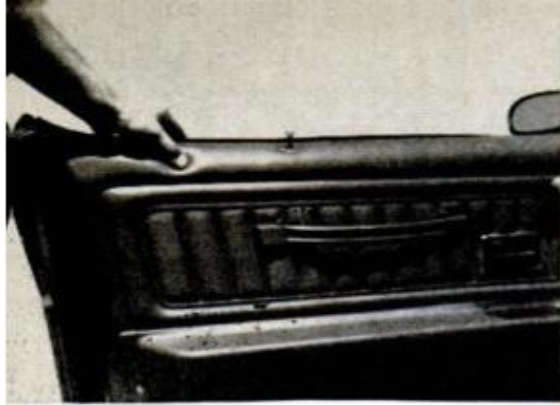
Predictably, styling led as the main reason for buying. Many who answered our questionnaires called their cars "sports cars," and a number compared both nameplates with Corvettes, mentioning that they'd owned 'vettes previously.

Most owners were either single or childless—young, style-conscious, and not especially bothered by their cars' impracticalities.

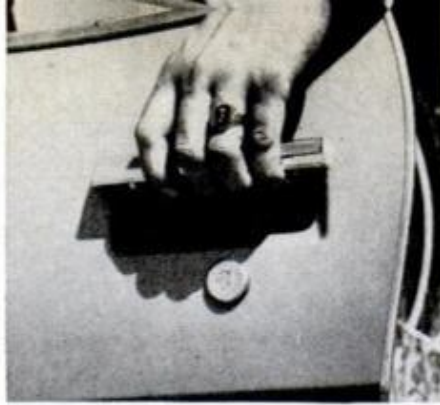
Small trunks and cramped rear quarters were cited with fair regularity, but as one Firebird Esprit owner explained: "I like the car as it is. I didn't buy it to be functional, so to complain about a small trunk or cramped rear







**FIREBIRDS** have door bins, Camaros don't. Neither car has ventipanes



**RECESSED** door handles on both cars make one-finger opening easy



**FIBERGLASS** hood on Formula 400 fits poorly, has fake scoops



**JACK HEAD** fits in slot in Firebird's rear bumper, with similar slot up front. These help steady jack



**FIREBIRD** engineers talked Fisher Body out of three-passenger rear seat, used space for suspension travel



**DARN TIGHT TRUNK** with no-Space Saver spare. It's one cubic foot smaller than last year's Firebird

seat would be silly, though I'm sure many people will."

Of course, that's not all they complained about. Quite a number of Firebird and Camaro owners griped because they had no rain gutters above the side windows. This caused wet laps getting into or out of the car in the rain. Drip rails or rain gutters are standard only on the Esprit and Rally Sport series—optional at extra cost on all others. (Actually the Camaro's stands so near the roof that it can't catch rain, and it's listed as "bright window molding.")

It does seem rather chintzy to omit drip rails, but other items were left off too, like front ventipanes and rear quarter windows. One auto exec remarked recently that by eliminating two ventipanes and two rear quarter windows per car, GM had saved a cool million in manufacturing costs during the 1970 Camaro/Firebird run.

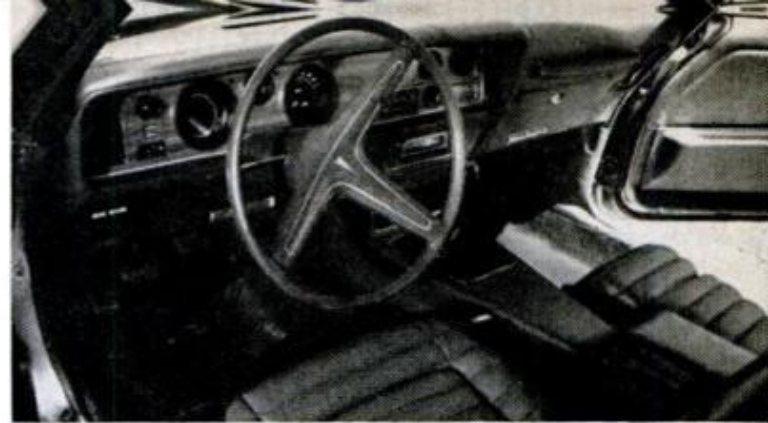
Both cars' big side windows came in for a number of frowns. Several owners said they'd had the glass replaced because it had gotten scratched just from being rolled up and down. A few mentioned it didn't seal properly at the top (although not nearly so many as with the Challenger/Barracuda coupe). A number also felt the doors were too long and heavy to handle comfortably. They're five inches longer than last year and heavier because of the side-impact bars inside. Women, especially, complained of this extra weight.

A few owners of each car said they were unhappy with the paint job. "Too





**CAMARO'S** Rally Sport dash combines simulated wood and flat black dial backgrounds in padded plastic



**SIMILAR** but different Firebird dash uses same basics. Big doors are heavy but easy to get through

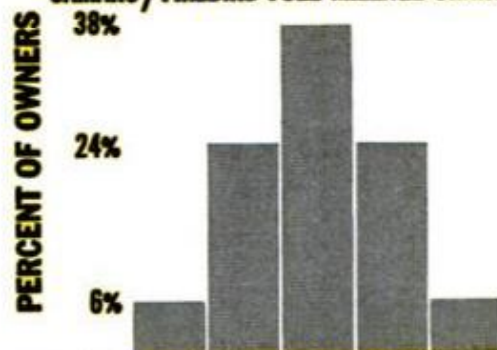
thin—too easy to scratch, often ripply.” As for the rubber bumpers, one Camaro owner said, “Endura bumper does not hold paint as well as body; it gets absorbed into the plastic and has to be repainted.” Echoed a Firebird driver, “The paint on the front rubber bumper must be put on differently. It bubbled up and then peeled off. It also changed colors.”

Camaro drivers would like the front ashtray relocated so they don't bark their knuckles when shifting into park (or reverse and low and third with the manual four-speed). Anytime the ashtray is open, it always ends up with a fist in it. Also, Camaro rear-seat passengers miss having ashtrays of their own—another little cost-cutting oversight.

The difference in base price between the 1970 Camaro and the 1970 Firebird was \$126 f. o. b. last year, which isn't nearly so much as most owners thought. Prices of major accessories likewise

stand within a few dollars of each other. Yet many Camaro owners proudly pointed to their thrift by going Chevy instead of Pontiac. And buyers of both makes complained about the rising costs of new automobiles. Said a Camaro devotee: “Best \$2000 car I ever owned for \$4751.” And a Fire-

**CAMARO/FIREBIRD FUEL MILEAGE CHART**



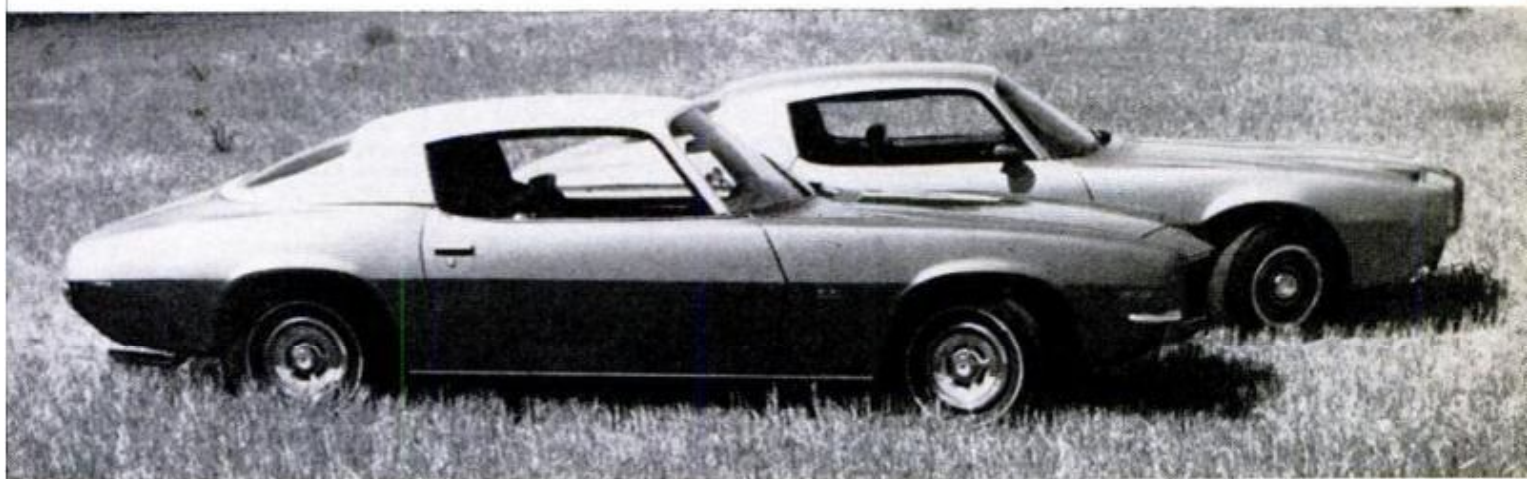
**CAMARO 350 V8**

Local	7.3	10.0	12.7	15.4	18.1
Trips	10.7	13.3	15.9	18.5	21.1

**FIREBIRD 350 V8**

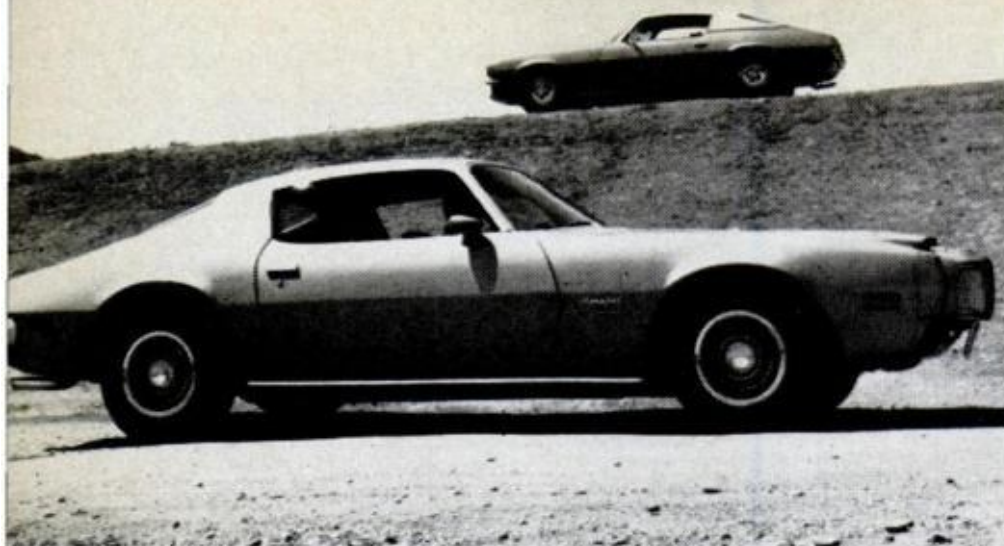
Local	8.0	10.3	12.6	14.9	17.2
Trips	10.2	13.0	15.8	18.6	21.4

**MPG**



**VENTIPANES** and rear quarter windows, absent from both cars, save money for manufacturers but cause owner gripes. Glass gets scratched by rollers, sometimes doesn't seal well. All owners praise clean styling





**ENDURA BUMPERS**, available now on both cars, don't always match body color. Rubber bumper surface apparently tends to bubble. Bodies have been moved forward 3 in. on wheelbase over last year's models

birder: "All I'd like is for it to be built like it should for \$4300."

More than anything, owners of both makes felt they'd been short-changed on workmanship. Among specific dislikes, 20.3 percent of Firebird owners cited sloppy workmanship. That's among the highest such percentages we've gotten in our 1970 Owners Report series. Cougar and Challenger owners also put down workmanship as their No. 1 specific dislike, but only

12.4 percent and 18.5 percent mentioned it, respectively. Barracuda owners listed workmanship as their No. 2 dislike at 16.1 percent, and Mustang owners put it No. 5 at 7.4 percent. So, you fellows on the Camaro and Firebird assembly lines—Ooooo, are you gonna get yelled at!

According to our survey, Camaro drivers come off a bit more performance-conscious than Firebirders. While 23.6 percent of all Camaros were

### Summary of 1970 Camaro Owners Reports\*

Total miles driven ..... 751,581

**Average miles per gallon:**

250-cu.-in. 6, local driving . . . 16.7  
 long trips . . . 20.1  
 307-cu.-in. V8, local driving . . . 14.6  
 long trips . . . 18.5  
 350-cu.-in. V8, local driving . . . 12.7  
 long trips . . . 15.9  
 396/400-cu.-in. V8,  
 local driving . . . n.a.  
 long trips . . . n.a.

**Engines:**

250-cu.-in. 6 ..... 11.3%  
 307-cu.-in. V8 ..... 31.2  
 350-cu.-in. V8 ..... 51.8  
 396/400-cu.-in. V8 ..... 5.7

**Transmissions:**

3-speed manual ..... 13.9%  
 4-speed manual ..... 23.6  
 Automatic ..... 62.5

**Why did you choose this car?**

Style ..... 76.6%  
 Size ..... 11.7  
 Handling ..... 11.0  
 Performance ..... 11.0

**Specific likes:**

Handling ..... 71.7%  
 Style ..... 60.1  
 Performance ..... 18.1  
 Comfort ..... 15.2  
 Economy ..... 12.3

Power ..... 11.6  
 Ride ..... 10.9

**Specific dislikes:**

Workmanship ..... 20.3%  
 Trunk space ..... 19.6  
 Rattles ..... 9.4  
 Gas mileage ..... 9.4  
 Finish ..... 8.0

**What changes would you like?**

Bigger trunk ..... 13.2%  
 Better vision ..... 10.1  
 Ashtray location ..... 8.5  
 More quality ..... 7.8  
 Better styling ..... 7.8

**Had any mechanical trouble?**

Yes ..... 43.4%  
 No ..... 56.6

**What kind of trouble?**

Transmission ..... 21.0%  
 Fuel system ..... 14.5  
 Power steering ..... 6.5

**Did you repair it yourself?**

No ..... 94.8%  
 Yes ..... 5.2

**Dealer repairs satisfactory?**

Yes ..... 71.2%  
 No ..... 28.8

**Is this your only car?**

Yes ..... 46.9%  
 No ..... 53.1

**Other cars owned:**

Chevrolet ..... 41.9%  
 Pontiac ..... 17.6  
 Volkswagen ..... 13.5  
 Buick ..... 12.2  
 Oldsmobile ..... 8.1

**Accessories/power options:**

Automatic transmission ..... 62.5%  
 Power steering/brakes ..... 55.7  
 Radio ..... 49.2  
 Airconditioning ..... 31.3  
 Tinted glass ..... 27.6  
 Console ..... 19.4  
 Vinyl roof ..... 16.4  
 Locked differential ..... 14.2  
 No accessories ..... 12.1

**What accessories/options would you order next time?**

The same ..... 43.8%  
 Airconditioning ..... 30.7  
 Stereo tape ..... 5.1  
 Power steering ..... 11.7  
 Rear defroster ..... 7.3  
 FM radio ..... 5.8

**Age distribution of owners:**

15-29 years ..... 66.6%  
 30-49 years ..... 25.4  
 50-plus ..... 7.9

**Would you buy another Camaro?**

Yes ..... 67.7%  
 No ..... 32.3

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









# What's All the Noise About

**What's in a name? Swingers, Cherry Bombs, Golden Rams and the like offer music with the muffling. What else can you expect?**

By MICHAEL LAMM, West Coast Auto Editor

**E**VER WONDER what your car would sound like with straight-through mufflers? Louder, right? But how much louder? Mellow, too. Well, maybe mellow and maybe not. Could be too much like an air hammer—too “blatty.”

If you've wondered about louder pipes, here are some of the pros and cons. There's more to them than just hanging on a pair.

What does a straight-through muffler really do? Most people buy them for the *sound alone*—nothing more. But is there more to them than just that?

Ads for these mufflers stress four benefits: 1) more performance, 2) better gas mileage through decreased back pressure, 3) longer muffler life and 4) that “. . . deep, rich, throaty wake that follows you wherever you drive.”

How much truth is there in these claims? To find out, let's first take a look at stock mufflers.

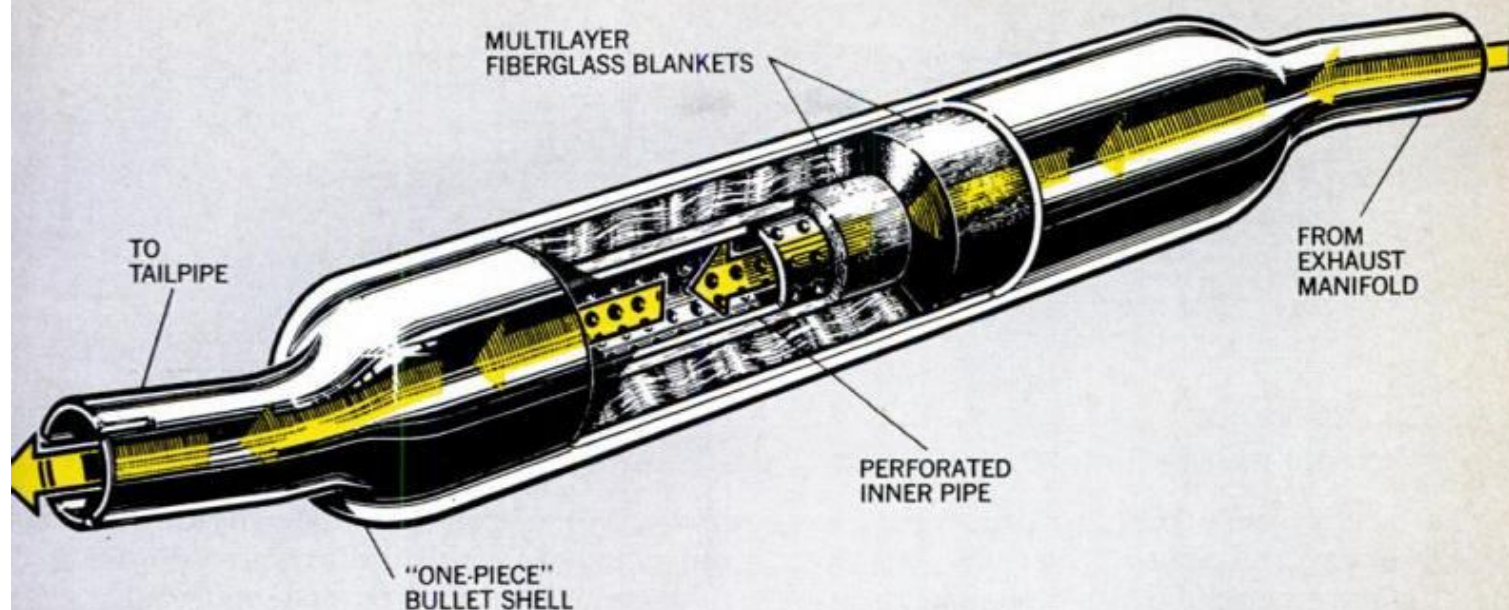
Most new cars come with single-exhaust systems. These funnel all exhaust gases through one muffler. From Detroit's viewpoint, one muffler per car makes sense. It's the simplest, cheapest, quietest possible exhaust system.

At low engine speeds, a single exhaust system works as well as any. In fact, in one way it works better, because the fewer cylinders you run through a muffler, the noisier the exhaust. In other words, if you use one muffler for each *bank* of cylinders in a V8, the total volume of sound coming out both tailpipes will be louder than if you run all eight cylinders through one muffler.

This means that, even with dual muf-



## Typical Straight-Through Muffler



# Straight-Through Mufflers?

flers in a stock system, each muffler has to have so much extra baffling that you lose a lot of the benefit of a dual system.

Let's run that by again—it's important. Say you take a V8 engine and stick a single exhaust system on it. You use a stock muffler with normal interior baffling. The result: acceptable silence. Now you take that same V8 engine, separate each bank, give it its own exhaust system, put the same muffler on *each* pipe that you used for the single system. Result: more noise than with the single exhaust and single muffler. Why? Because of greater sound-wave "gaps" between individual valve-opening periods—gaps that are twice as large for each four-cylinder bank than for the total of eight cylinders.

So to keep most factory twin-pipe systems reasonably quiet, the muffler engineers add more baffles. And this cancels out much of the benefit of twin pipes. As a compromise, you often find the big-inch V8s with not just one muf-

fler on each individual bank, but two. This gives a total of four mufflers—very expensive. The rearmost two, though, are usually called resonators, not full-fledged mufflers. (Some systems use only three—the third accepting exhaust gases from both forward mufflers.)

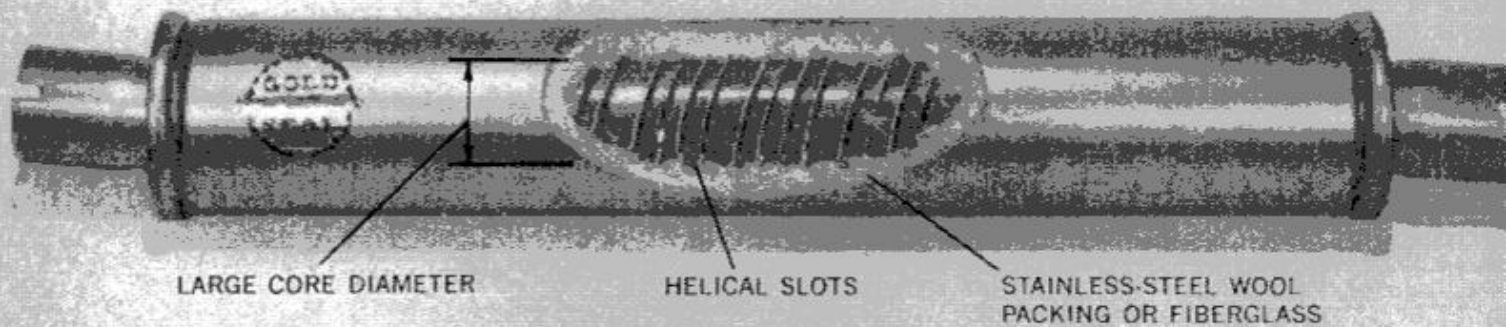
We mentioned before that, at low rpm, a single stock muffler does all right. As engine rpm goes up, though, more and more exhaust gas has to pass through the muffler's baffling. Since the muffler can only accept so much gas at a time, back pressure builds up in the exhaust pipe. This means that not all the burnt gases can get out of the cylinder. Which means you lose power at high rpm.

What to do? The obvious answer for maximum engine efficiency would seem to be to take off the exhaust manifold. That way there'd be no back pressure at all. It might be loud (it *would* be loud), but at least it'd be efficient.

Well, no. Actually, a stock engine



## CUTAWAY—HELICAL PERFORATIONS



**STRAIGHT-THROUGH MUFFLERS**, bullet-shaped or conventional, use a center pipe variously perforated

needs some back pressure for maximum efficiency. Detroit engineers figure normal back pressure into the way they grind their cams, calibrate timing, carburetion, and so forth. In other words, with too little back pressure, a stock V8 won't run well either. That's because the intake and exhaust valves in any engine stay open at the same time for an instant. This is called overlap. With too little back pressure, inrushing cold fuel/air mixture would follow hot, spent gases right out the exhaust valve. The cold temperature would warp the hot valves, and at the same time you'd be wasting gasoline.

Obviously, then, unless you're contemplating a radical hop-up job, with altered camming, carburetion and such, about all you want is an exhaust system that breathes well. That means, in all likelihood, twin pipes and straight-through mufflers.

The people who sell straight-through mufflers will never tell you exactly how much more horsepower, miles-per-gallon, or whatever you'll gain with their systems. And really, they can't. It again depends on how far you go with modifications and what you've started with.

Some will try to tell you how much their mufflers reduce back pressure. Be careful, though—these claims can be misleading. Douglass, for example, says its straight-through mufflers cut back pressure to "near zero." That

might be true for the muffler by itself, but when you take the exhaust manifolds, plumbing, curves, diameters, and so in into account, you're bound to end up with quite a bit of back pressure. Similarly, AP's Golden Ram claims "48.5 percent less back pressure," and with the Merit's Dragon you get "49 percent less." What do these figures mean—less than what? So be wary of claims that mention absolutes. There aren't any in this game.

If you have a stock single-exhaust system—say in a Mustang, Camaro, Buick Special—you've got pretty kinky plumbing plus the muffler set crosswise near the rear axle. This is a tortuous and restricted system. You'll benefit from twin straights, and you'll probably be able to feel a difference in performance. It won't be a tremendous difference—perceptible, that's all. You probably won't notice a difference in fuel consumption, though.

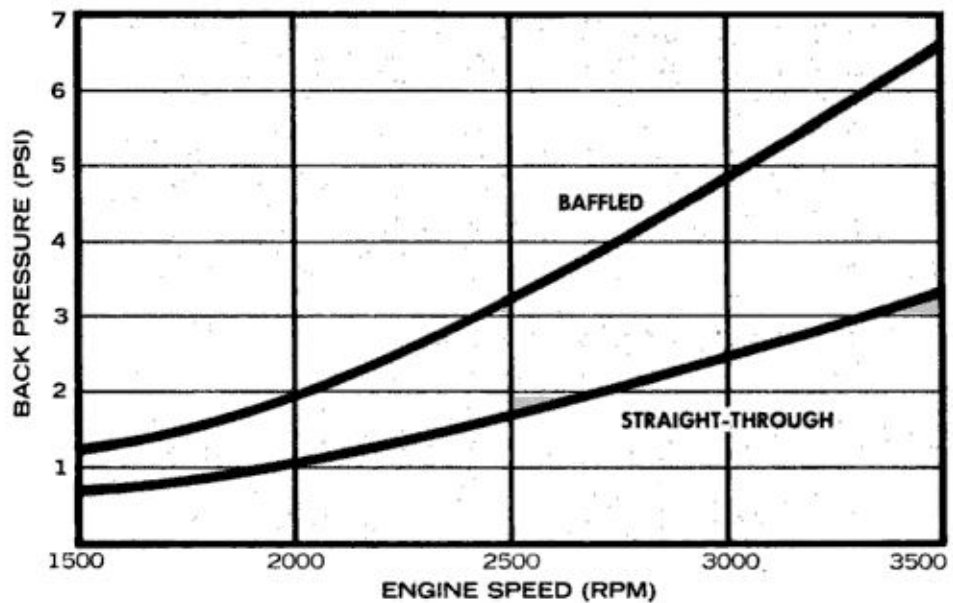
If your car's exhaust system is already dual, perhaps with four mufflers (e.g. 1960 Cadillac, 1966 Thunderbird), you won't notice any difference except in sound. In factory three-muffler setups, like stock Chevy duals, 1963-65 Buick and Firebird, you again probably won't notice a perceptible increase in performance. Perhaps the added sound will make you *think* you're getting more power, but chances are you're not.

Next question: How much is all this



## BACK PRESSURE VS. ENGINE SPEED

**TOTAL ELIMINATION** of back pressure is not desirable in engine design. Straight-throughs are designed to maintain some back pressure, yet less than baffled mufflers, especially in the high-rpm range where loss of power is greatest



going to cost? Again, it depends. If your old muffler has about had it—and that's when most car owners begin to think seriously about switching to the more tuneful types—you won't necessarily spend more for a replacement straight-through glasspack than for a conventional muffler. Nor will replacing your existing exhaust pipe, tail pipe, clamps, hangers, or labor cost more.

In some instances—if you have to replace not only the main stock muffler but a resonator as well—you might actually pay less for a glasspack, because that way you probably need no resonator.

But these conversions sometimes get out of hand. Too often you'll be tempted to go from a single to twin pipes, then to headers, then collectors, and so on. If you switch from singles to duals, you automatically pay double. With headers and the rest, the tab can easily run into hundreds of dollars.

The lowest-priced glasspacks list for about \$4 each, minus installation. More realistically, expect to pay \$10-\$15 per muffler and another \$7 or so each for installation. This doesn't take into account crossover pipes, equalizers, or the possibility of replacing rusted pipes. Chances are that if you have a rusted-out muffler you'll also have a leaky pipe.

You can get all sorts of dual systems—not just noisy ones but high-perfor-

mance quiet ones too (Douglass sells its Duotone systems either way). Most auto-supply catalogs offer do-it-yourself kits for what seem to be bargain prices. Average cost runs about \$35 for everything. But if you figure on installing a set yourself at home, you're in for a big surprise. Revamping your car's undersides, especially without a lift and proper tools, can be real bullet-sweating work.

And while we're talking about costs, don't forget those indirect, hidden ones. Loud mufflers seem to be open invitations for traffic tickets, not only "excessive noise" citations but all other kinds as well.

Another consideration: Is your car still under factory warranty? If so, think twice before you install straights. If you do and then come back with, say burnt valves (or any other engine malady that could possibly be blamed on the exhaust system), your dealer may politely tell you you've voided your warranty.

Most straight-through mufflers are the tube-within-a-tube type. The inner pipe might be perforated with many tiny holes, fewer bigger holes, slots, or might even have what looks like a big coil spring. Between this inner core and the outer case, there's usually fiberglass packing. Some straights use stainless-steel wool packing instead of fiberglass. A few use sheet-metal baffling,

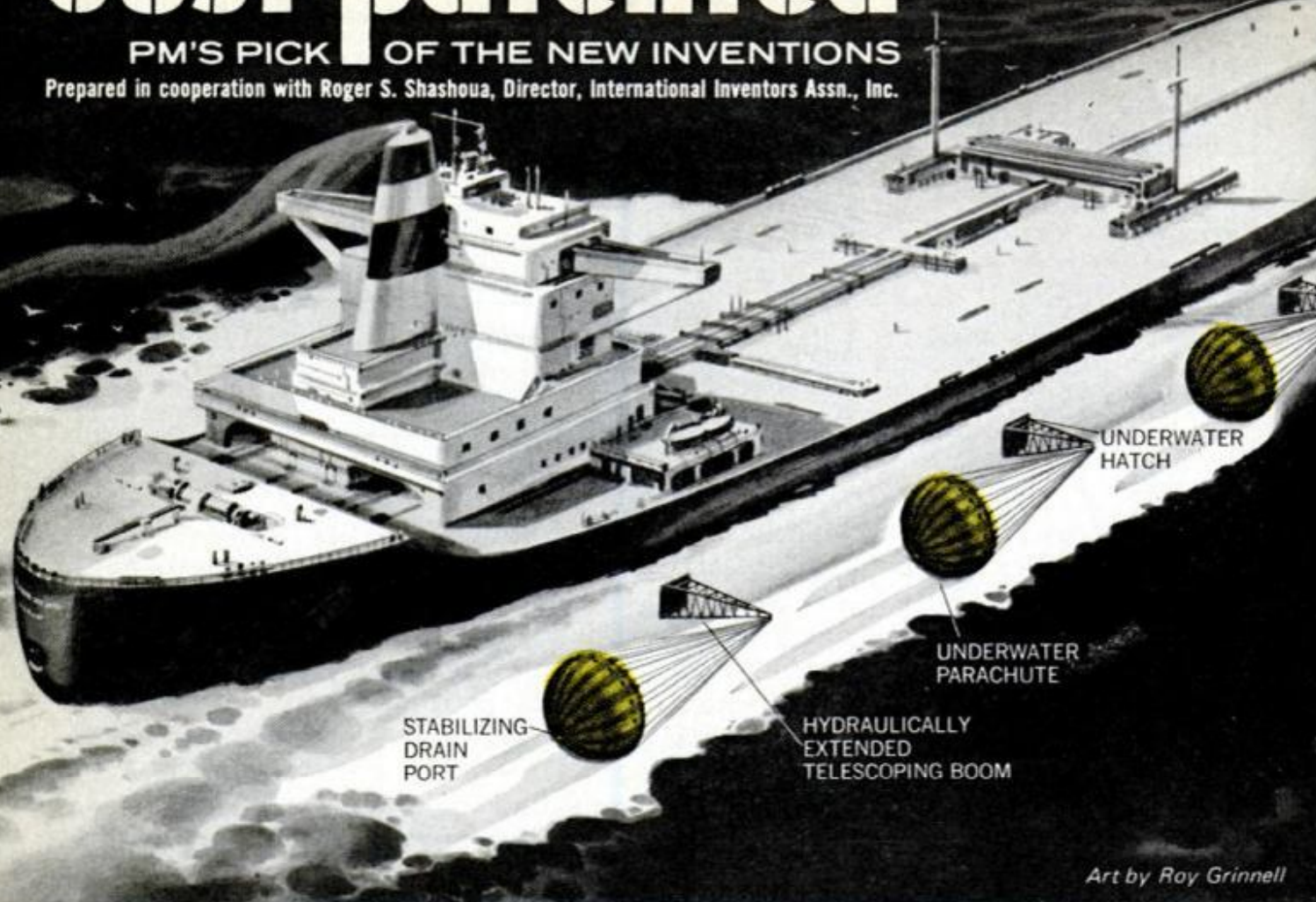
*(Please turn to page 184)*



# Just patented

PM'S PICK OF THE NEW INVENTIONS

Prepared in cooperation with Roger S. Shashoua, Director, International Inventors Assn., Inc.



Art by Roy Grinnell

**1. UNDERWATER PARACHUTES** serve as "brakes" for big ships, helping to stop them faster and make them more maneuverable in congested waters. Designed for use on supertankers and heavy cargo vessels, the chutes can be extended all at once or one at a time, depending on the amount of drag desired. By

deploying only those on one side, they can also be used to help steer a ship in the same way a tank or bulldozer is turned by braking one track. The chutes are said to be much safer than an emergency reversal of engines because, in the latter case, the bow frequently swings dangerously out of control

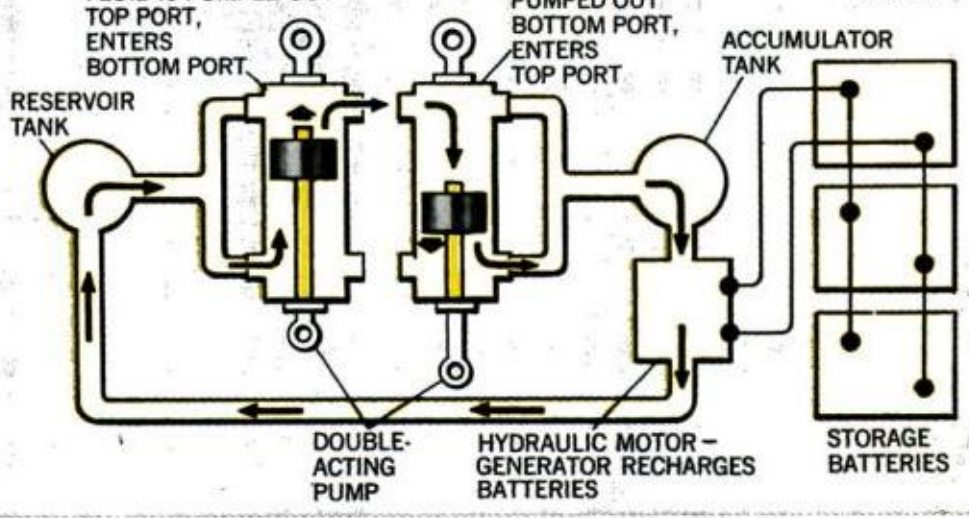
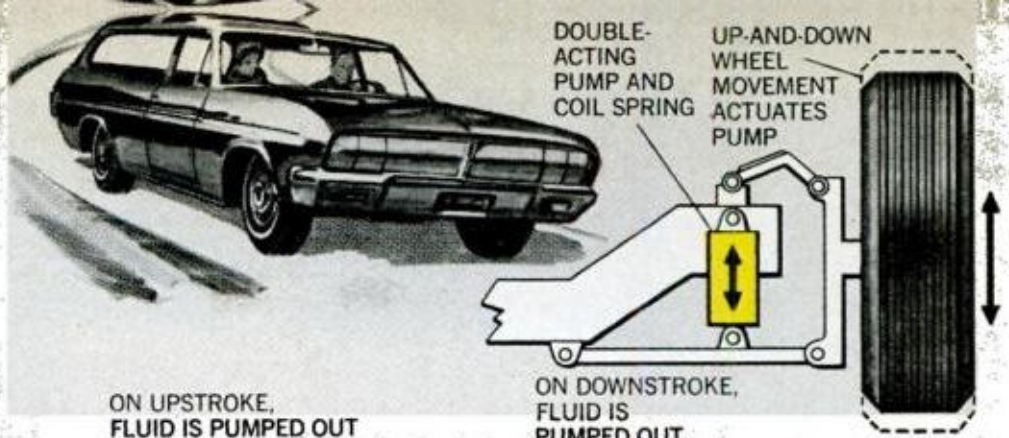
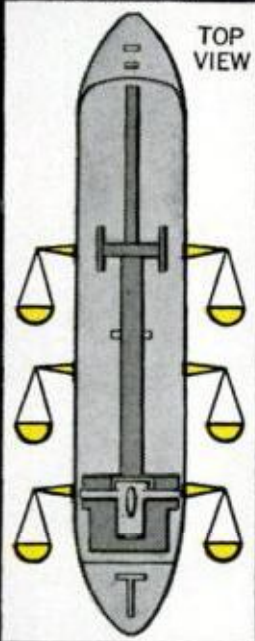


**2. PAPER CLIPS POP OUT** of this novel dispenser by themselves, ready for easy removal without your fumbling around for them. The secret is a ring magnet around the rim. As clips are pulled out, others are drawn up in their place by the magnet. The dispenser can also hold pins, tacks and small nails





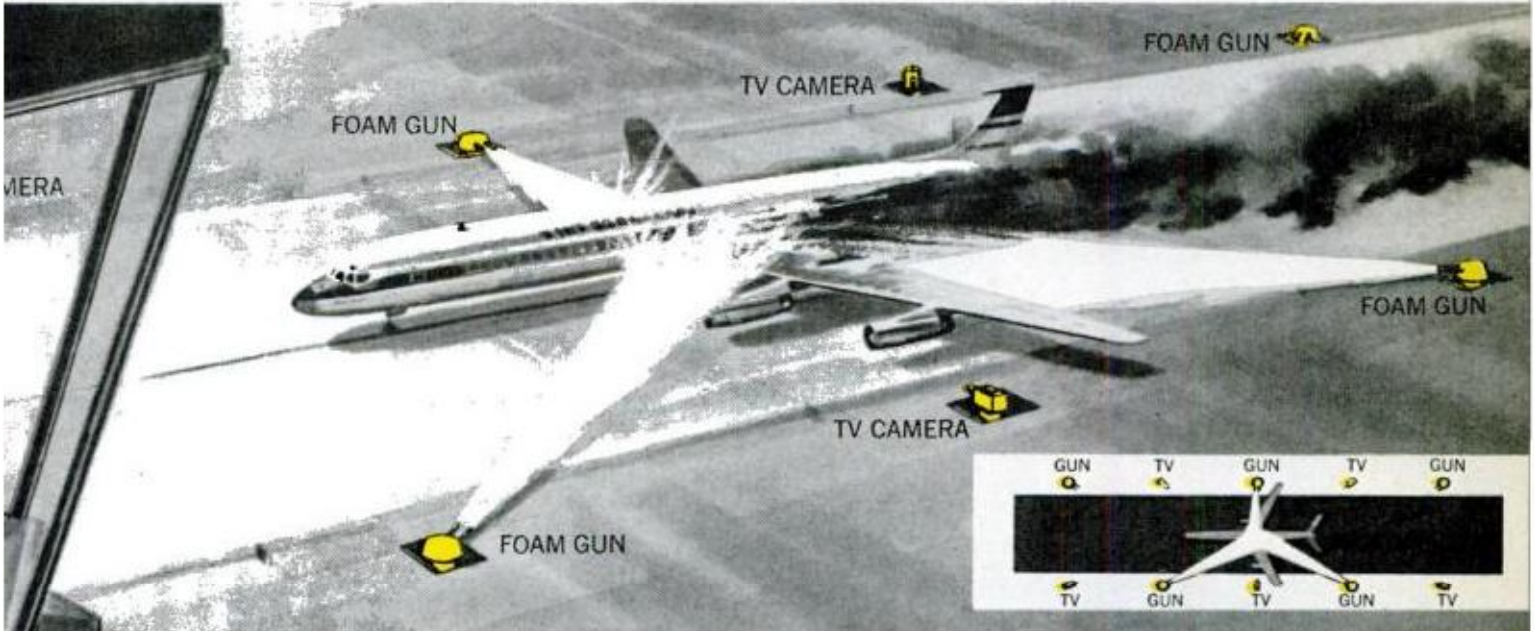
3 PARACHUTES ON EACH SIDE OF SHIP



**3. SELF-GENERATING ELECTRIC CAR** uses the motion of its own wheels to add supplementary power in the ingenious system shown above. Double-acting pumps installed in the place of shock absorbers drive a fluid-powered generator to help keep the batteries charged as the car moves along. The system is not designed to supply total power, but to permit longer runs between recharging stops

**4. FOAM-SPEWING GUNS** literally shoot out airport fires in the emergency system shown below. Installed at intervals along the runway, they follow a flaming airliner as it lands, spraying it with foam and putting out the fire before the craft even comes to a stop. TV cameras also follow the plane,

showing its position on monitor screens in a master control console. From these, the console's operator can tell where the plane is on the runway and which foam guns to activate. The system can also be used to spread foam quickly on a runway if a disabled liner is about to make a wheels-up belly landing



Inventors of the items shown on these pages are as follows: 1. Mitsubishi Heavy Industries, Ltd., Marunouchi, Chiyoda-ku, Tokyo, Japan; 2. Mailalot, Ltd., 119 Red Lion Rd., Tolworth, Surrey, England; 3. Landon H. Howard

and Benjamin T. Howland, 2841 Monogram St., Long Beach, Calif.; 4. Karl-Heinz Engel, Priessnitzstr. 7, 6277 Camberg/Taunus, West Germany. International Inventors Assn. is located at 680 Fifth Ave., New York, N.Y. 10019.





Bill Johnson





CARIB QUEEN

935

# The Last Flight of the CARIB QUEEN

By W. STEVENSON BACON

Art concept by Bill Johnson

The plane ran out of fuel over the Caribbean, turning a pleasant flight into a nightmare. Twenty-three people lost their lives when the 115-passenger airliner became the first commercial jet to ditch at sea. The exclusive report that follows is based on eyewitness accounts



**S**MILES CAME EASILY that morning of May 2, 1970, as stewardess Margaret Abraham greeted passengers boarding ALM flight 980 bound for the Caribbean. The DC-9 was due to take off from New York's Kennedy International Airport at 11:00 a.m. Its destination: St. Maarten, one of the Leeward Islands in the West Indies.

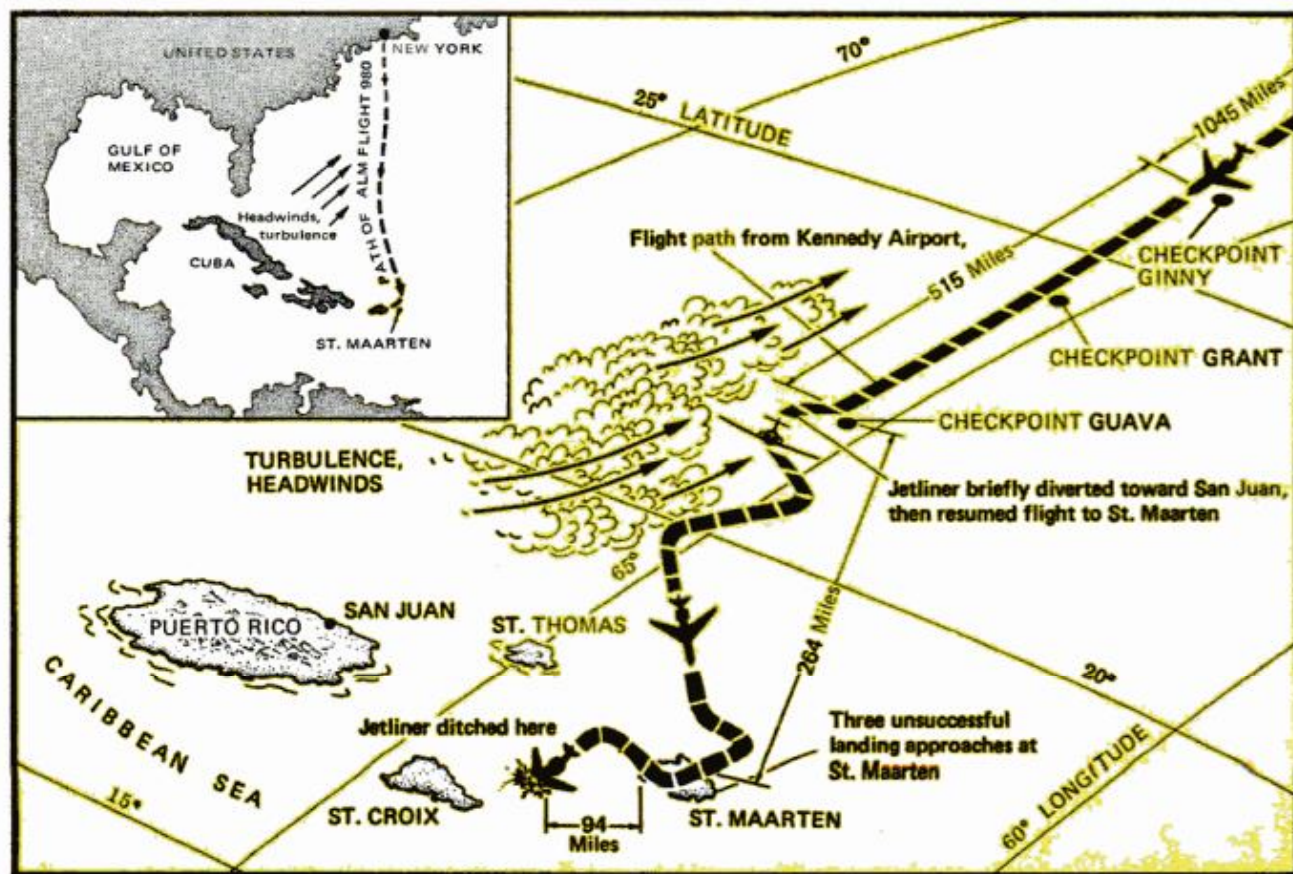
Four hours and 49 minutes later the engines of the *Carib Queen* would flame out and she would be the first commercial jet ever to be ditched at sea. Twenty-three people, including two children and Miss Abraham, would die. Many would be injured. Equipment designed for reliability would fail, emergency procedures would backfire and some theories of aviation safety would come into question. Even after seven months some mysteries connected with the accident remain unsolved.

Preparations for the flight were routine. Shortly before 9:00 Capt. Balsey DeWitt arrived at the operations desk of Overseas National Airways (ONA) and met with navigator Hugh Hart and copilot Harry Evan to plan the flight. Under a special agreement, ONA furnished the plane and cockpit crew for the ALM flight. (ALM stands

for Dutch Antillian Airlines, a subsidiary of KLM, Royal Dutch Airlines.)

The over-ocean flight to St. Maarten, a speck of land 170 miles east of Puerto Rico, was long for the DC-9-33CF—a stretched DC-9 “convertible freighter.” Careful planning was necessary because it was operating at the limits of its range. Given reasonably favorable winds and weather, the DC-9 could make the flight nonstop as scheduled. If there were delays in taking off or if bad weather were encountered, a refueling stop at Bermuda was a possibility.

DeWitt and Hart huddled over fuel consumption charts, one for a speed of .78 Mach (Mach 1 is the speed of sound) and one for long-range cruise, and came up with an average figure of 19,000 pounds of jet fuel. Since the





big engines gulped about 4 percent more than the specs indicated, an additional 10 percent was added, totaling 21,000 pounds for the "burnoff"—the fuel the plane would actually consume.

As with all such flights, ALM 980 would also cram into its tanks fuel to fly to the farthest alternate runway and for a 30-minute "hold." Added to that would be a 10 percent reserve for deviations in the flight plan over water. Choosing St. Thomas, V. I., as the farthest practical alternate, DeWitt added the reserve and holding requirements: a total of 6500 pounds.

A last-minute ONA bulletin added the final word. Planes flying to St. Maarten had been arriving with inadequate fuel reserves, and, as of May 2, crews were to plan to arrive with 7000 pounds of fuel left over. DeWitt added another 500 pounds to the 6500 for a total of 7000. This was added to the original 21,000 to make 28,000 pounds of fuel.

"We're liable to have less than 28 by takeoff," DeWitt said. "If that happens, I'll refile for Bermuda the minute we're in contact with the New York Center."

Still busy with pencil and paper, Hart calculated that air time en route would be 3 hours and 26 minutes. Minimum time to fuel exhaustion would be 4 hours and 34 minutes. Although he had not considered all reserve allowances, his last figure, in what has been described as a million-to-one shot was to prove tragically accurate.

**T**HE TIME was now close to the 11:00 a.m. departure. The last of the 57 passengers, including Jennifer and Kristin Caldwell, two youngsters accompanied by their parents, boarded the ship and were assisted to seats by the ALM cabin crew. There were couples, some elderly, a businessman or two and a few residents of St. Maarten, including Miss Jacinth Bryan, a hotel owner.

In addition to stewardess Margaret Abraham, the ALM cabin crew includ-



**Somehow, the enormous raft began inflating, filling the tiny galley area . . .**

ed purser Wilfred Spencer and steward Tobias Cordeiro. Miss Abraham, a pretty brunette from Curacao, looked forward to the trip as much as any of the passengers. She was heading home to her fiance. They were to be married on June 15.

Although small in comparison to planes usually flown on long-duration, over-water flights, the 115-seat DC-9 offered the 57 passengers plenty of room. With the last person on board, the cabin door was closed and the engines started. The plane taxied to runway 13. There was no waiting for takeoff that sunny Saturday. DeWitt fed fuel to the engines, lifting off at 11:14. The estimated time of arrival was 2:40 p.m., Eastern Daylight Saving Time, at the small Juliana Airport on St. Maarten. Checking the totalizer—the main fuel gauge which adds quantities in the DC-9's four tanks—DeWitt noted that 28,450 pounds of fuel remained. The men in the cockpit relaxed, glad that even more than the projected 28,000 pounds of fuel had been crammed into the tanks.

Visibility was unlimited and the





**On the left wing,  
DeWitt struggled to get  
the exits open . . .**

DC-9 rapidly climbed to its assigned altitude of 29,000 feet. Just 23 minutes after takeoff, ALM 980 reached its first mandatory checkpoint—"Tuna." Her arrival at this geographical spot, which is marked only by latitude and longitude, was reported to Air Traffic Control. Keeping track of the plane's progress by Loran (LONG RANGE Navigation by radio), Hart signaled checkpoint Roy at 12:03 EDST and Landry at 12:43.

Things were also going smoothly in the passenger area. The European-style cabin service included champagne and mixed drinks. About an hour into the flight, dinner was served with wine.

**N**EW YORK'S good weather vanished as ALM 980 bored southward. About five miles north of Landry, Capt. DeWitt encountered turbulence and eased the speed down from .78 Mach to .76. The weather wasn't as

predicted. DeWitt and Hart theorized that the low-pressure system which they were supposed to be flying through—and which they had counted on to provide a helping tailwind of at least 10 knots—had either moved more rapidly than weather forecasters had predicted or had changed in intensity.

At checkpoint Ginny the turbulence was worse. Using radar to pick out severe weather activity, Capt. DeWitt maneuvered among the cumulonimbus and cirrus shelf clouds that indicated thunderstorms. Clear-air turbulence took hold on the other side, and he requested clearance to 27,000. He'd go underneath the "shelves," DeWitt decided, because the cloud formations indicated that turbulence might be worse higher up. Then there was the fuel he would have to burn up trying to climb out of the weather.

South of Ginny near Grant checkpoint the crew encountered the same weather conditions at 27,000. They went down to 25,000 and cut back the airspeed to Mach .72. Still, buffeting turbulence and headwinds of 20 to 25 knots caused the ship's ground speed to fall sharply.

ALM 980 was behind schedule when it reported in at Grant Intersection at 2:02 p.m. The time the plane could remain in the air was slowly ticking away, but the deviations made so far were routine. They were made to insure a comfortable flight, and they went unnoticed by the passengers.

Guava was the next checkpoint and ALM 980 called in at 2:24, still at 25,000 feet and with about 8600 pounds of fuel. Here the plane would leave the safety of established routes and fly farther out into the Atlantic to St. Maarten. Quickly calculating, DeWitt estimated they would land at Juliana with 6000 pounds of fuel remaining—less than the 7000 they were aiming for, but well within safe limits. Cross-checking Hart's Loran positioning at Guava with the Automatic Direction Finder (ADF) beacons at San Juan and on the island of St. Thomas, DeWitt



congratulated him: "It's the first time I've been down here with one of you navigators who got me on Guava exactly!"

Food trays, glasses and coffee cups in the cabin were stowed in preparation for arrival at St. Maarten. The purser announced to the passengers that the plane would arrive about 3:00 p.m., some 20 minutes late because of weather. The seat-belt signs went on, say witnesses, about 2:30.

Although no one had given it much thought, there had been no welcome and progress reports from the captain to the passengers. The reason was that the public address system from the cockpit wasn't working. Though inconvenient, the situation didn't seem crucial.

By now the flight was proceeding according to routine. The plane got clearance from San Juan to fly direct to St. Maarten and descend to 10,000 feet.

**H**unched over the radarscope, Hart strained to pick out St. Maarten. But the signals were confused by echoes from thunderstorms in the area. Then, just 15 minutes from Juliana, a series of radio exchanges began that, when all the evidence is considered, might be said to have sealed the fate of ALM 980.

As he started his descent from 25,000 to 10,000, DeWitt was surprised to hear his radio crackle. It was San Juan, and the message was that St. Maarten was below minimums for landing. Visibility had to be at least two miles and the ceiling 600 feet, and tiny Juliana tower was reporting rain showers. The plane would have to land at San Juan. DeWitt requested clearance at 21,000, the altitude he was then passing. Clearance granted, he began the right turn to San Juan, certain at least that a well-equipped airfield awaited him.

On the way to San Juan, the radio came alive again. Juliana tower wanted to talk to ALM 980 on 118.7 mega-



**Coast Guard 'copters hauled up 11 passengers, while 26 were recovered by a Navy 'copter.**

cycles. When he called, DeWitt relates, he received a weather report giving him a ceiling of 1000 feet, broken, 5000 feet overcast, a visibility of three miles and rain showers.

"Why do you give me this message?" DeWitt asked. "I'm on diversion for San Juan because of below minimums at St. Maarten."

The reply from Juliana was a repeat of the improved weather—possible landing weather, if it held.

After another exchange with Juliana, DeWitt decided to again head for St. Maarten. He got clearance from San Juan, calculating that they could make



St. Maarten, hold, and even get to an alternate, if need be. ALM 980 now had 5800 pounds of fuel. "On the blocks" at St. Maarten she should have 4400 left. Making the left-hand turn for St. Maarten, now 90 miles southeast, DeWitt descended to 10,000 and homed on the Juliana beacon.

The time was now 2:57. ALM 980 took a compass heading of 090° so that

**At about 100 feet over the runway the third landing attempt was aborted.**

she would miss any inbound traffic to St. Maarten while descending to 6000 feet. Flying through heavy rain while monitoring the radar and ADF, the DC-9 arrived over the beacon at Juliana at 3:13 p.m., 33 minutes later than originally scheduled. If the time—20 minutes due to weather and 13 minutes to divert to San Juan—was insignificant, the fuel used was not. Approximately 3300 pounds had been burned.

Following the procedures for St. Maarten, DeWitt, still high in the overcast flew over the beacon on an outbound track, went into a turn, let down to 600 feet, then told the copilot and navigator to yell when they spotted something.

Switching from the radar, Hugh Hart peered out of the windows—often seeing nothing but sheets of rain—as did Harry Evan. They were searching for the shoreline of St. Maarten, the VASI (Visual Approach Slope Indicator) lights or the runway itself. The rain was heavy on the unusual dog-leg ADF approach path, which required good visibility to execute. Finally, as they descended, they could see the angry ocean below.

The runway loomed up slightly off to the north. Since he was too far off the runway center line, DeWitt decided to go around again.

"We have you in sight," the tower

broke in. "You're clear to make any turns you wish."

Evan continued to monitor the tower for weather, and was still being given a ceiling of 1000 feet and two-to-three-mile visibility, information that the crew and at least one observer on the ground later held to be highly optimistic. Unquestionably the weather was bad for landing. Hugh Hart calls it atrocious. "I'd have rather tried landing in their bay than on their runway," he says.

Nevertheless, another circling approach was made. This time the DC-9 overshot and couldn't get into the "VASI profile"—the glide path that would lead the plane down to the proper touchdown point. ALM 980 circled the beacon, made a turn and came back for a third try. Deciding that there was a lot more tailwind than Juliana tower was aware of, DeWitt went to full flaps and an air-speed of 128 knots.

For a moment things looked good. The plane was right over the runway center line and in the VASI glide path. But the plane didn't sink fast enough. At about 100 feet over the runway the third landing attempt was aborted.

"If I had reduced power to cut my speed I would have unspooled the engines," Capt. DeWitt explained later. In other words, power would have been reduced to the point where it would have taken at least five seconds to get the engines back to full thrust.

DeWitt had read 3800 pounds of fuel left after the second approach, and decided to go for an alternate. Between rain and a strong tailwind a safe landing at St. Maarten was impossible. But his 3800 pounds of fuel was to prove an illusion.

Circling back to the ADF beacon a final time to use it as a reference point to navigate to St. Thomas, DeWitt advised Juliana of the change.

**T**HE TIME was 3:26. In the passenger cabin a vague uneasiness was manifesting itself. Arthur Johnson,



a former pilot sitting with his wife in row 13, looked out of the window and recognized St. Maarten. No announcement was made, he later testified, though it was obvious conditions were "not minimum" and the tower should have advised ALM 980 not to attempt a landing.

Miss Jacinth Bryan also knew the plane was leaving St. Maarten. "I was wondering what was going to happen," she testified, "because I realized it would be difficult to land."

Now the signs of a crisis began to reveal themselves. As the DC-9 climbed to 4000 feet, leaving the St. Maarten ADF beacon far behind, Hugh Hart glanced down at the totalizer. He gasped. The instrument was reading very low, a mere 850 pounds, too little to reach even the closest alternate. As Hart called the reading to the captain's attention, the instrument began to spin like, in Hart's words, "a slot machine on which the handle has just been released." The stakes were terribly high—the lives of 63 people.

The crewmen watched, horrified. The digital figures went up and down, first too fast to read, then pausing momentarily at 850, 1350, 1850. Then the readout swung down again. The trouble was probably due to the angle of the climb plus the turbulence, DeWitt reassured Hart. The gauge should stabilize when they reached altitude and leveled out.

In the meantime Hart chose the middle totalizer reading of 1350 pounds and quickly suggested St. Croix as the nearest possible alternate landing field. At 100 pounds a minute, the flight would have another 14 minutes of life, enough to reach St. Croix with five minutes to spare. At 3:36, ALM 980 requested the distance and was cleared for St. Croix.

Now the fuel gauges had stabilized—not at 1350 pounds—but at 850!

Unable to believe his eyes and mindful of similar experiences with faulty gauges, the captain told Hart that in his judgment there was no way that

there could be less than 2000 pounds on board. Where could the fuel have gone?

And on the final approach to the beacon at St. Maarten, the totalizer had read 3800 pounds. To get from there to the point where the totalizer read 850 could not possibly have taken more than 1500 pounds. The reading should have been 2300, yet the gauge stubbornly refused to budge.

The clock was slowly, relentlessly, ticking out the final minutes of the flight of ALM 980, and in an amazing coincidence it would end exactly at the moment of fuel exhaustion predicted on takeoff from Kennedy.

**D**EWITT radioed San Juan that he appeared to be low on fuel and was cleared to 12,000 feet. Slowly he nursed the ship upward, still refusing to credit the erratic gauge, but conserving whatever fuel remained. Could he believe the totalizer? He debated the possibilities until at 7000 feet it read between 400 and 500 pounds. Now DeWitt decided he had no choice but to believe the totalizer. Even though he wasn't expecting a flame-out he

***The crewmen watched, horrified. The digital figures went up and down . . .***

would get down to the water and prepare for a ditching.

If a spur to action was needed, it was provided shortly after the plane left 7000. A red fuel pressure light went on in the cockpit, providing an indication independent of the totalizer that ALM 980 might, indeed, be running out of fuel. It was now 3:40 p.m., and DeWitt radioed San Juan Center that "there is a possibility that I might have to ditch this aircraft. I am now descending to the water."

From this point the record is confused and contradictory. Yet it is pos-

*(Please turn to page 180)*





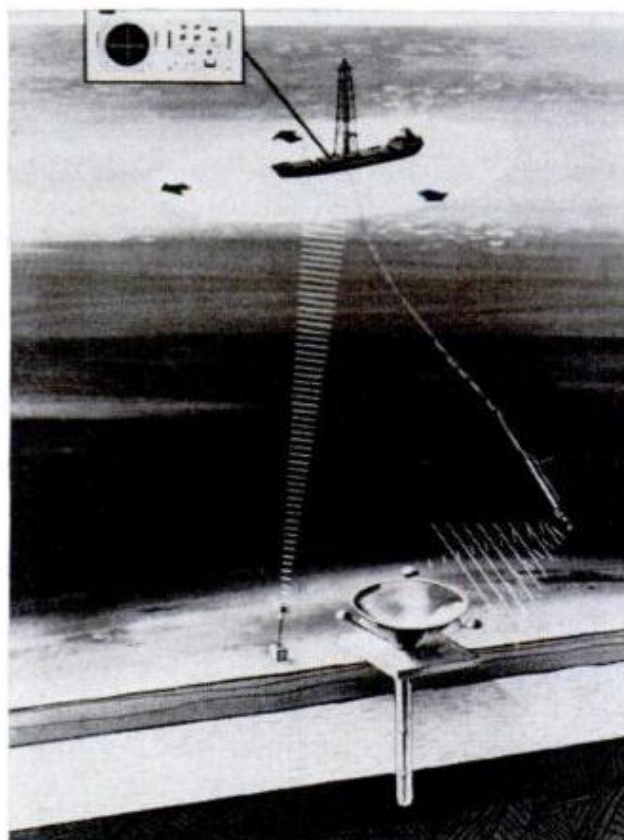
## Okay, now who's going to scramble all the eggs?

What Henry Ford is to cars, Peter Porter of South Africa probably will become to toast. Porter has invented a giant toaster that can turn out a slice every five seconds. The machine toasts by infrared heater bars, and is designed to be used in hotels, airports, passenger ships and the like. Porter showed his machine at a recent inventors show and plans to produce it commercially in the near future.



## Rotterdam's temporary look

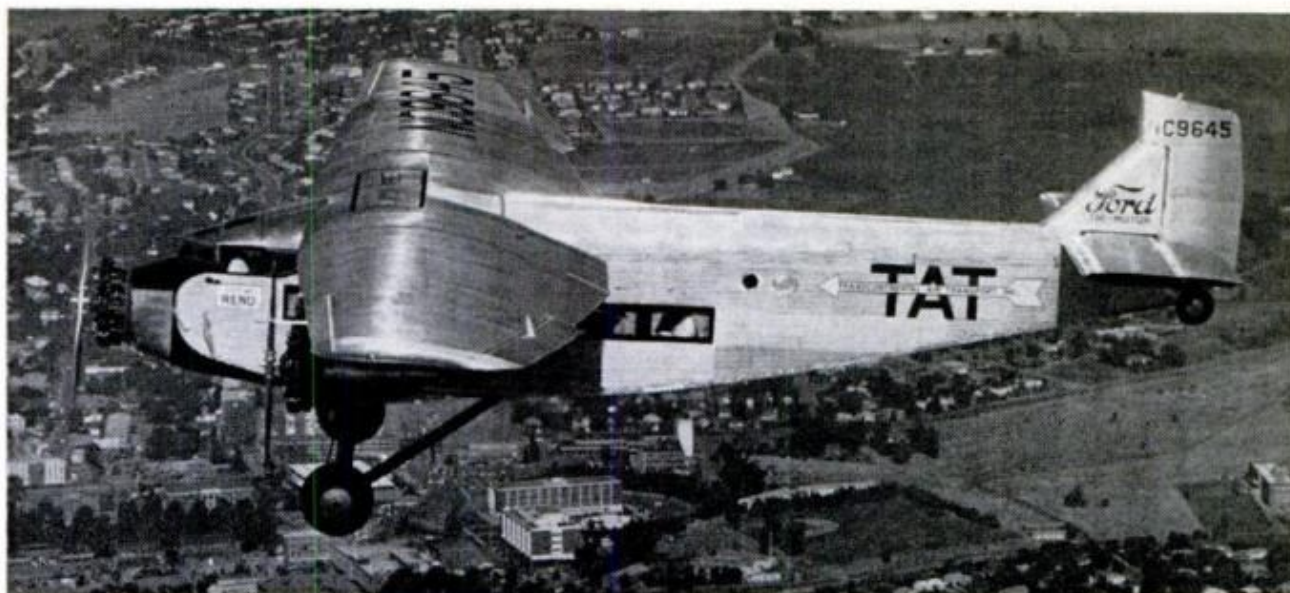
Rotterdam had a changed face this year when steel power-transmission towers (top) and cable cars suddenly appeared in the ancient city. However, they were there only during the Communications 1970 exhibition.



## Re-entry cone on ocean floor

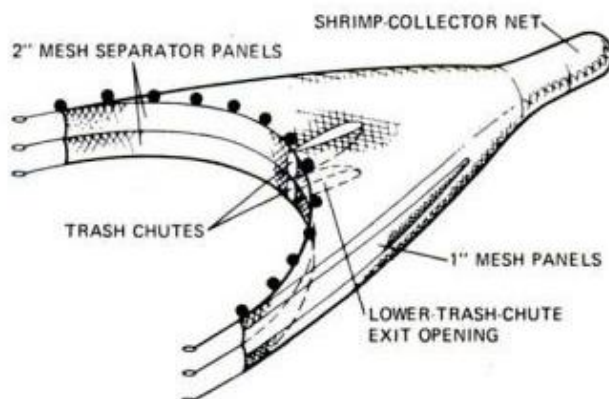
A new device may help oceanographers and oil drillers get through hard rock that previously dulled bits so much that drilling had to be abandoned. Now a sharp bit (right) can be guided back to the core hole by the use of sonar devices on the re-entry cone above the core hole, which send back readings to a panel (upper left) on the ship. The ability to re-enter the same hole makes penetration through hard rock possible.





## 'Tin Goose' is just as good as it was in 1928

Restored to its original factory condition by the staff of Harrah's Automobile Collection, Reno, Nev., this 42-year-old Ford Trimotor is currently touring the country making appearances at auto and aviation shows. The Ford Model 5-AT-B (serial No. 8), originally built in December 1928, is one of seven Trimotors still in existence out of 198 built by Ford from 1926 to 1933. The airline models carried 13 passengers and a crew of three.



## Coastal explorer

The *Kaiyo II*, a new Japanese underwater research vessel, is exploring the coastal waters of Japan to a depth of 90 feet. Marine scientists are lowered below the surface in a steel cylinder (bottom photo) suspended from a gantry aboard the vessel.

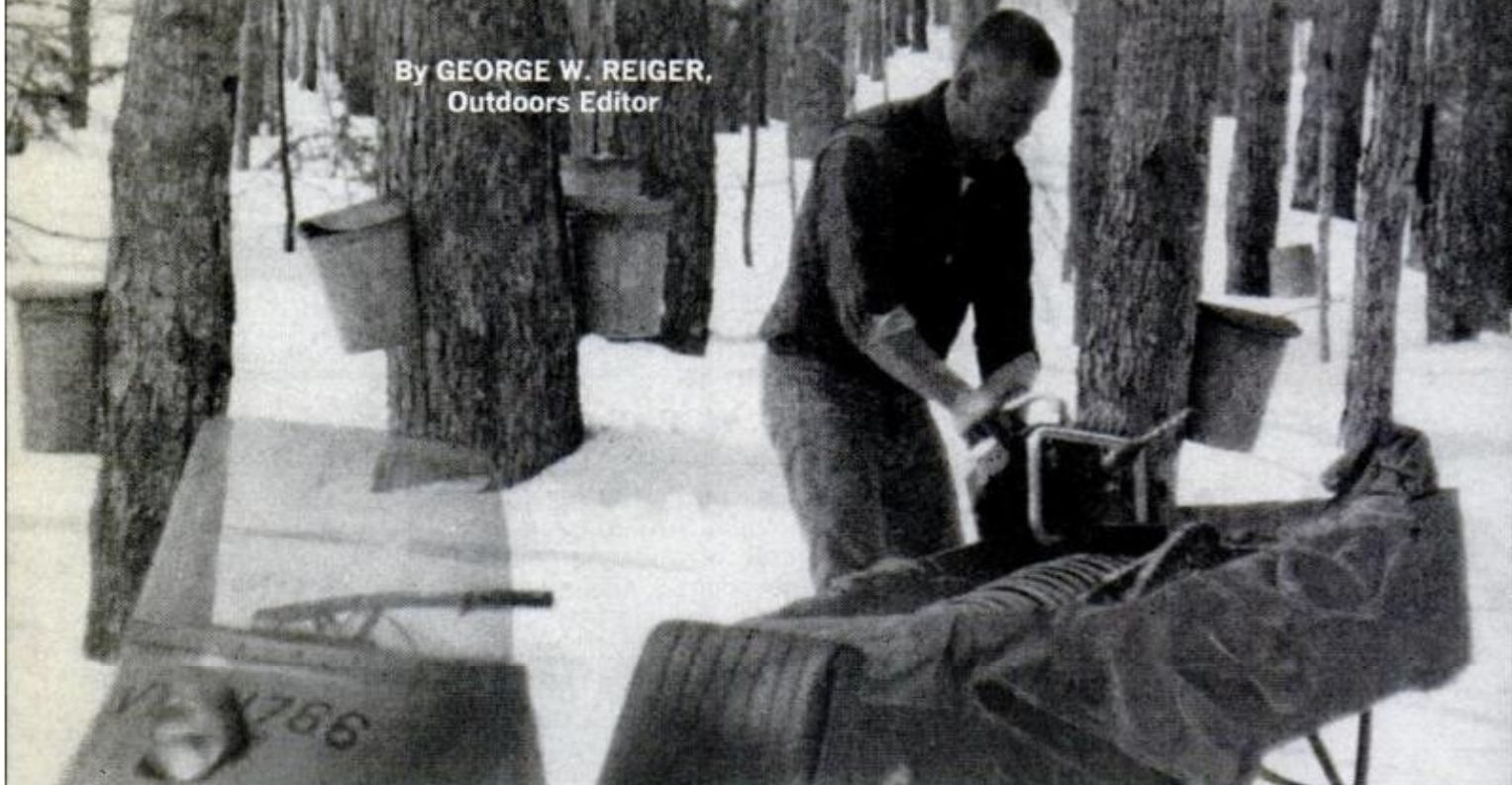
## Trawl keeps the good ones

Self-sorting shrimp nets are increasing shrimp catches by sorting out trash and scrap fish in large mesh panels that allow the shrimp to pass through into a small-mesh collection net. The trawl was devised by the Bureau of Commercial Fisheries, Seattle.



# SAP 'N SNOWMOBILES

By GEORGE W. REIGER,  
Outdoors Editor



Photos by Ernie Gay

**Hold it! We're talking about cargo, not drivers. Replacing Dobbin on the maple-sugar circuit is just one job Vermonters have created for the versatile mushers**

**L**AST WINTER a group of friends and I rented a farmhouse in Vermont. Waitsfield is an hour or less from some of the best slopes in New England—Sugarbush, Mad River, Glen Ellen, Killington, Stowe—and our intention was to use the farm as a base from which to ski, ski, ski! But in four months of weekend visits, I never even got on a pair of slats. With spacious hillside meadows at our doorstep, and state and national forests nearby, we spent the winter on snowmobiles.

Even the *schuss-boomers* in our group, skeptical and sometimes critical of the fun of such noisy machines, finally took rides—and came away more open-minded, if not always converted, to the uses of snowmobiling.

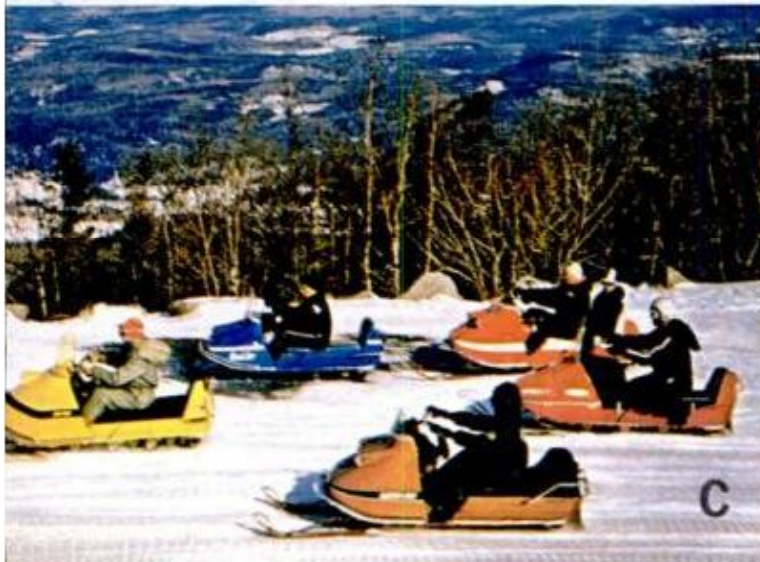
The sport has long been known to

New Englanders. In fact, people in Maine, Vermont and New Hampshire were among the first Americans to catch on to snowmobiling as it drifted across the border from Canada. And, perhaps, because snowmobiling is not particularly new to New England, or because folks up that way are a little more serious-minded than the rest of us, Vermonters seem to use their machines as much for work as for play.

While people elsewhere look on the

- A. **TWO VERMONTERS** plan sugaring expedition in setting that has changed little in the past 50 years
- B. **NO MORE TRUDGING** over trapline in snowshoes. Take a pair—but only as backup for a snowmobile
- C. **SNOWMOBILE CLUB MEMBERSHIP** makes for fellowship and fine outings such as this one at Ascutney
- D. **MAINTENANCE MEN** at ski lift on Mount Snow find that snowmobiles make their job a lot easier







snowmobile as one way to recapture the flavor of a Sunday drive with the family (lost on hectic highways), Vermonters also regard these machines as the best way to reach maple stands for sugar or the pines to cut firewood, or even the far hills to check trap lines. Snowmobiles tending ski lifts at Stratton or bringing down wounded skiers from Mount Snow hardly get a second glance—except from out-of-staters.

But you don't have to be a woodcutter or a trapper to enjoy snowmobiling Vermont-style. With more than 40 snowmobile clubs and some 31 state-organized trail areas, Vermont welcomes the visiting snowmobiler. You can rent machines at many ski resorts, and enterprising dealers have even set up trails for demonstration, instruction and rental activities behind their shops. If you pack your own snowmobile, check for latest registration information with the Vermont Department of Forests and Parks, Montpelier, Vt. 05602 or Forest Supervisor, Green Mountain National Forest, Box 519, Rutland, Vt. 05701. Describe your proposed trip, and they'll give you maps, addresses of local service facilities and anything else you may need. Happy riding! ★★★



**SUGAR DRILLING** or wood cutting with a snowmobile makes light work of sometimes toilsome tasks

**SNOWMOBILE-SKIING?** Call it what you will, this combination of two different winter activities is fun

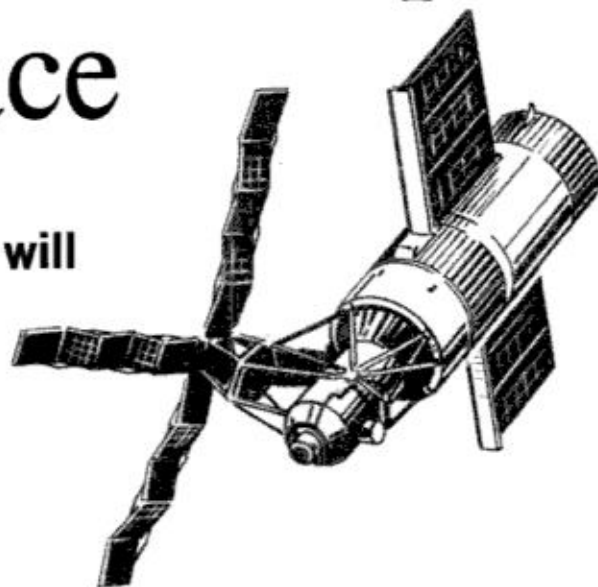




# SKYLAB: Our Next Giant Step In Space

Late in '72 a mighty Saturn rocket will blast a three-man workshop and lab into Earth orbit—a mission that could prove a springboard to Mars

By JOHN F. PEARSON, Science Editor



**A**BOUT A DAY APART, late in 1972, two towering Saturn rockets are scheduled to rumble skyward from Kennedy Space Center. A Saturn 5, with only its first two stages loaded with propellants and its empty third stage equipped as a workshop, will orbit the hardware for Skylab, America's first space habitat. A three-man crew will follow in a Saturn 1-B. Riding with them will be a big question: Can man live and work in a weightless environment for extended periods?

Apollo moon missions can't provide the answer. They're like a quick test drive around the block when you're wondering if your car will take you cross-country. The longest U.S. space mission to date was Gemini 7, in 1965. It lasted 14 days. Recently, Russian cosmonauts spent 18 days in orbit. But the question remains.

Skylab is the most extensive and elaborate mission yet dreamed up by NASA planners. The blueprint calls for three three-man crews to live successively aboard Skylab and carry out some 50 scientific experiments. They'll

aim telescopes at the sun, test themselves in various ways, try out new space devices, and use spectrometers and scanners to develop new information about the Earth. The first crew will remain in orbit up to 28 days, and the two other crews will each attempt to stay as long as 56 days. The mission will take about eight months to complete.

If Skylab goes well, it will be a giant step toward space voyages lasting months or even years. Some top NASA scientists think we'll be sending manned flights to Mars as early as the 1980s.

Skylab will orbit the Earth at a height of 270 miles. It will not be a single spacecraft but will be made up of a cluster of components: orbital workshop (OWS), airlock module (AM), multiple docking adapter (MDA), and Apollo telescope mount (ATM). The cluster will be 83 feet long, weigh 130,000 pounds and, with solar panels extended, look like a huge flying windmill.

After the Saturn 5 has boosted the

*(Text continues on page 110;  
Skylab painting on page 108)*



# SKYLAB: America's First Space Habitat

Artist's concept shows Skylab's three-man crew in orbital workshop (right) and engaged in extravehicular activity—replacing film in the Apollo telescope mount. Only two astronauts are needed to make the film exchange—one on top of the telescope mount and a second just outside the airlock hatch. In painting, the second man is hidden by arm of ATM's solar array.

TELESCOPES

FILM MAGAZINE

SOLAR PANELS

UMBILICAL

APOLLO TELESCOPE MOUNT (ATM)

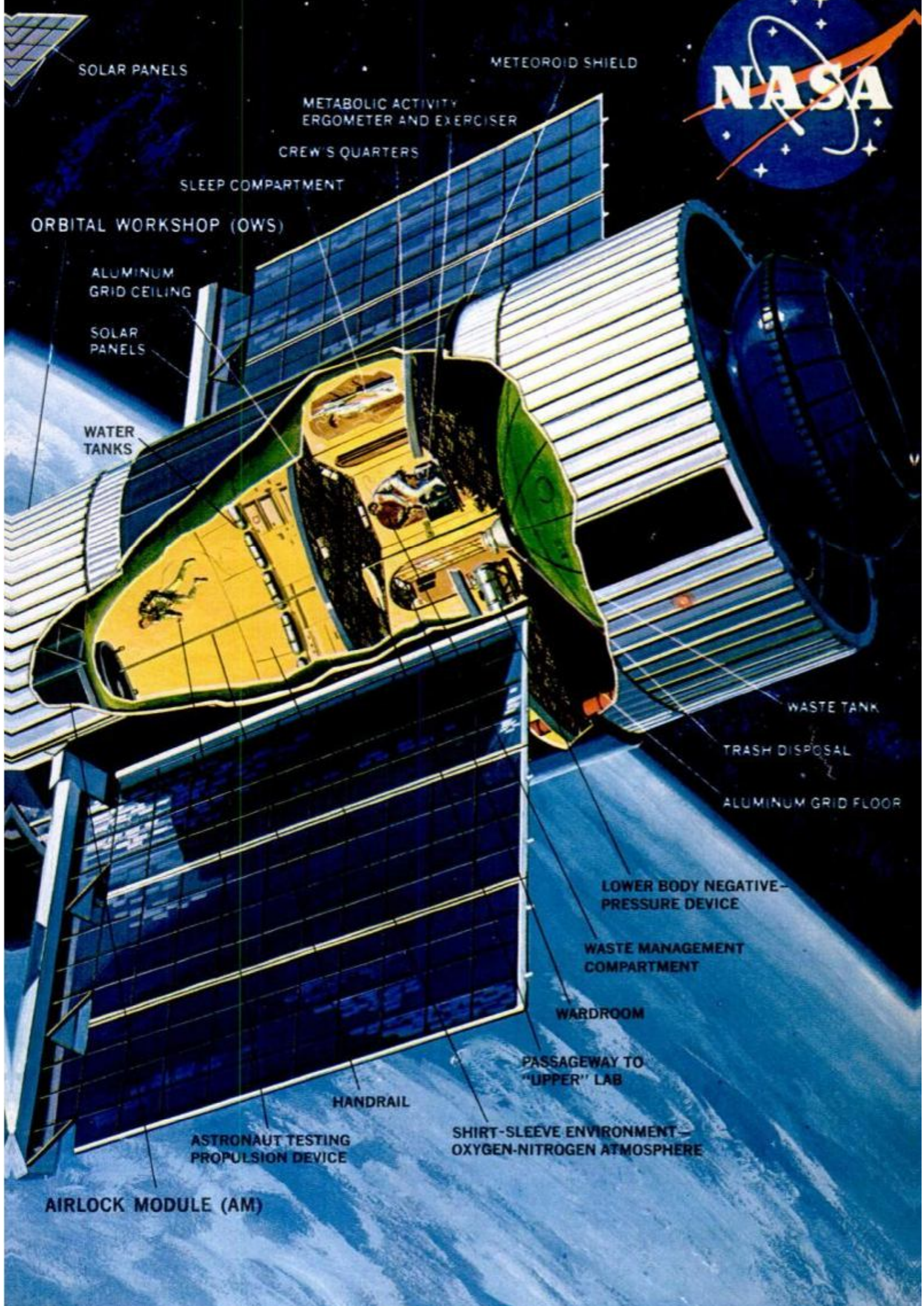
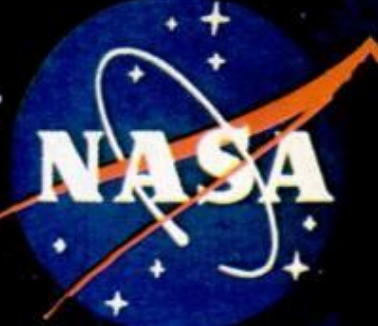
MULTIPLE DOCKING ADAPTER (MDA)

APOLLO COMMAND AND SERVICE MODULE (CSM)

VALIGURSKY

Painting by Aerospace Artist Ed Valigursky





SOLAR PANELS

METEOROID SHIELD

METABOLIC ACTIVITY  
ERGOMETER AND EXERCISER

CREW'S QUARTERS

SLEEP COMPARTMENT

ORBITAL WORKSHOP (OWS)

ALUMINUM  
GRID CEILING

SOLAR  
PANELS

WATER  
TANKS

WASTE TANK

TRASH DISPOSAL

ALUMINUM GRID FLOOR

LOWER BODY NEGATIVE-  
PRESSURE DEVICE

WASTE MANAGEMENT  
COMPARTMENT

WARDROOM

PASSAGEWAY TO  
"UPPER" LAB

HANDRAIL

SHIRT-SLEEVE ENVIRONMENT—  
OXYGEN-NITROGEN ATMOSPHERE

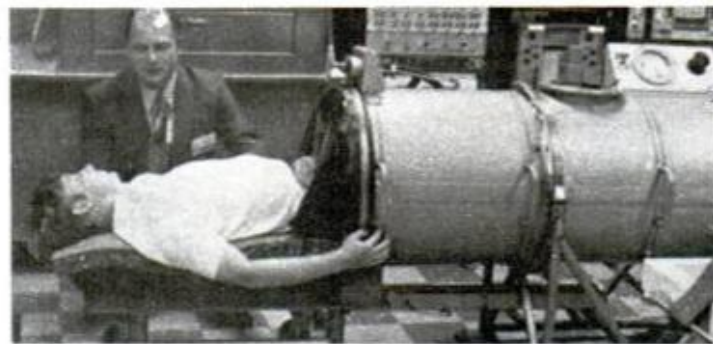
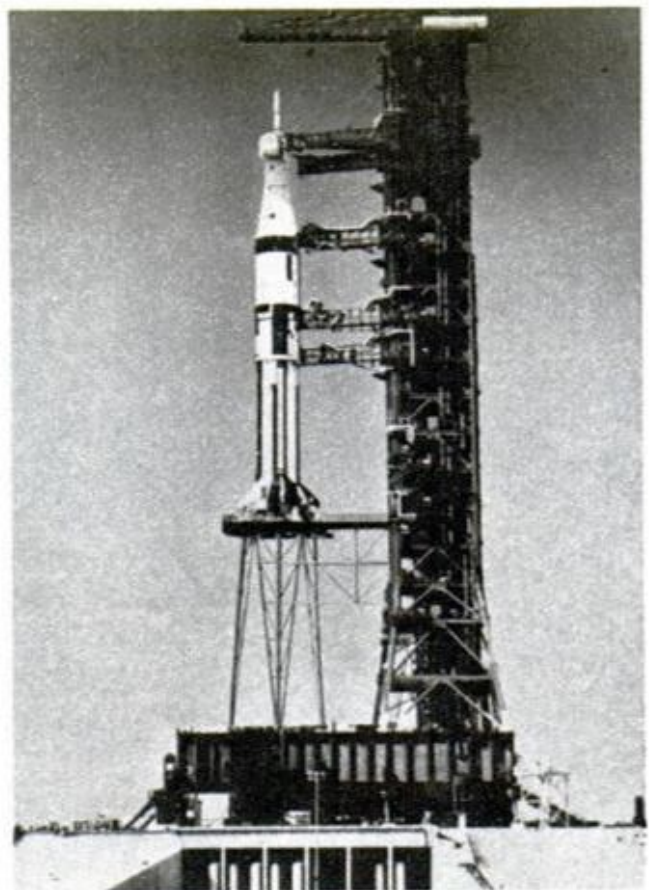
ASTRONAUT TESTING  
PROPULSION DEVICE

AIRLOCK MODULE (AM)

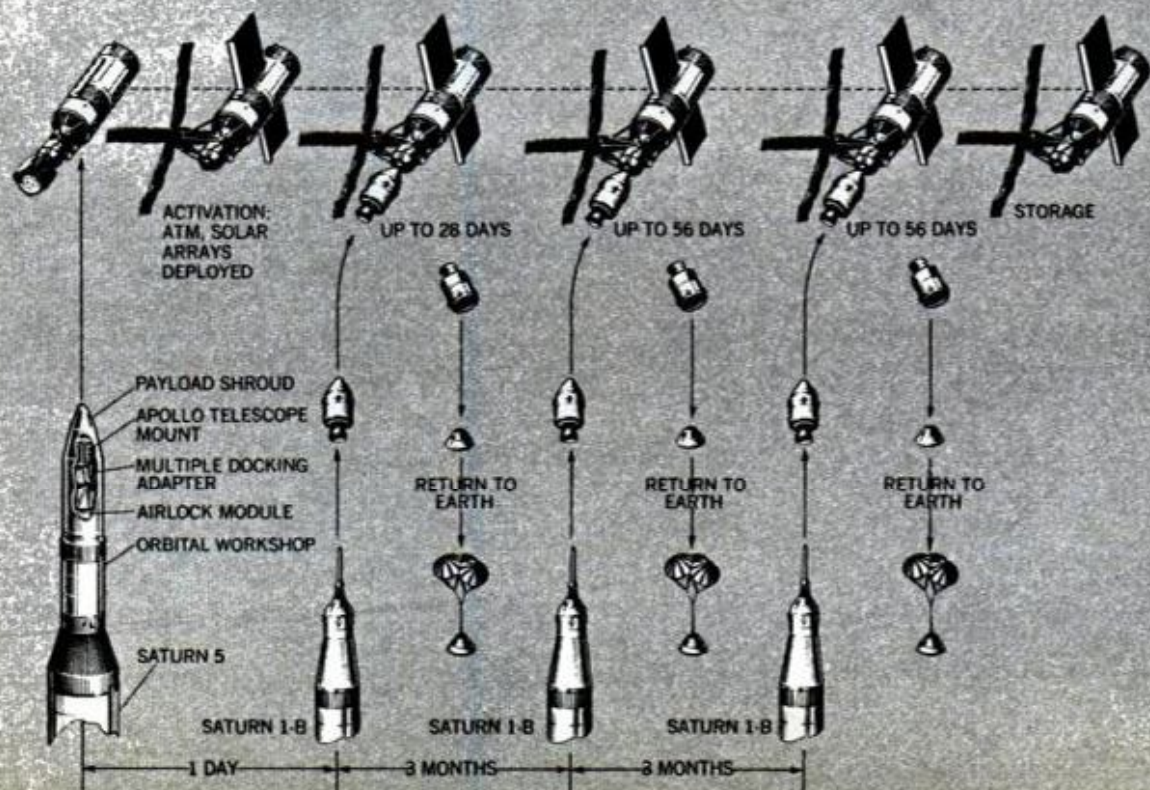


workshop—the modified S-4B third stage—and the other components into orbit, the cluster's telescope mount and its solar arrays will deploy. Then the crew will be orbited by a Saturn 1-B, the two-stage rocket used in the early Apollo Earth-orbit missions. After five orbits to permit maneuvering, the astronauts will guide their Apollo command and service module to a rendezvous with the workshop cluster. They'll dock the CSM at a port at the end of the multiple docking adapter and enter the cluster, moving through the airlock module into the workshop.

Compared with the cramped quarters of the Apollo command module, Skylab is a "mansion" of 13,000 cubic feet, which makes it larger than the average three-bedroom house. The biggest unit is the orbital workshop—a 48-foot-long cylinder with an interior diameter of almost 22 feet. Though there is no "up" or "down" under zero-G conditions, the workshop is divided into a two-story configuration. Open aluminum grids are used for floors and ceilings. The "lower" (aft) story has a seven-foot ceiling and contains the crew's quarters, including sleep compartment (70 square feet), ward-room (100 square feet) and waste man-



### Profile of Skylab Mission





agement compartment (30 square feet). The largest space on this level is devoted to the work area (180 square feet), which contains the hardware for several important medical experiments.

Solid doors make it possible to completely close off the wardroom and the waste management compartment so that odors and loose particles can be contained. In a weightless environment, floating droplets of water or crumbs of food can be a nuisance.

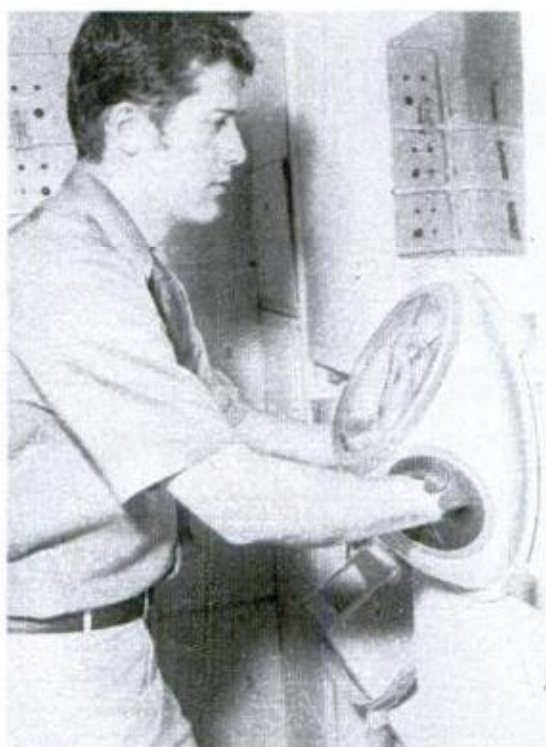
Thermal control and a ventilation system will give the astronauts a "shirt-sleeve" environment with temperatures ranging from 60° to 90° F.

The grid ceiling permits an easy flow of air in the workshop. This will be the first U.S. spacecraft with a two-gas—oxygen and nitrogen—atmosphere. Pressurized at only five pounds per square inch—about one-third of atmospheric pressure on Earth—it will be extra rich in oxygen.

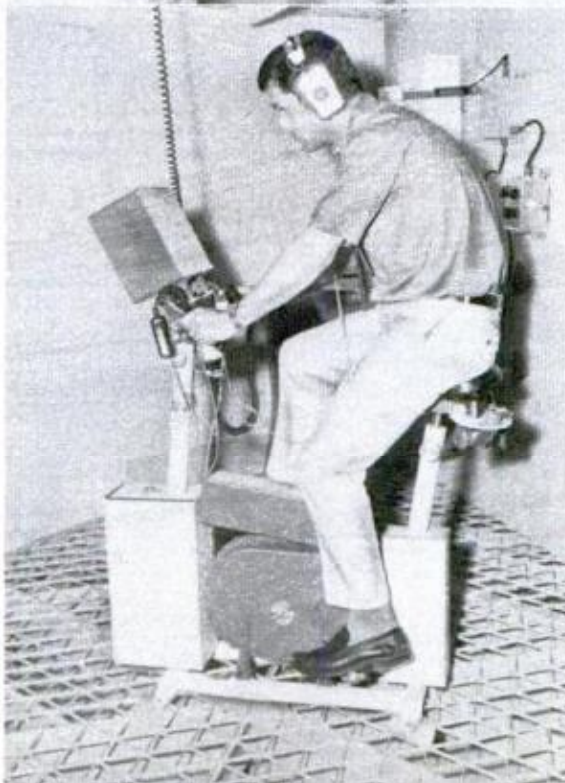
In the center of the ceiling there's an opening several feet across, large enough to permit the astronauts to float "up" to the second floor. This chamber, for lab activities and water storage, is some 20 feet high. Roominess of this lab will permit testing several per-

*(Please turn to page 178)*

**SKYLAB CREWS** will blast off atop Saturn 1-Bs, as is shown in composite picture (left, top). The 1-B needs a 128-foot pedestal so that normal servicing configuration of mobile launcher can be used. The launcher normally is used for the Saturn 5, a much taller rocket. Lower photo at left shows demonstration of "lower body negative pressure device," a piece of experimental hardware that will be installed in crew's quarters



**LIVING IN SPACE** for long periods calls for elaborate support systems and unusual devices. Photos (right) were made in mock-up at the Marshall Space Flight Center in Alabama. Top left: Engineer shows how to use hand-washing fixture in waste management compartment. Rubber cuffs keep droplets from floating away. Top right: Meals in canisters will be heated in overhead oven. Lower left: Engineer pedals metabolic activity ergometer, used for calibrated exercises that measure energy output, help keep crewmen fit. Lower right: Zippered restraint rig, anchored at floor and ceiling, prevents crewman from "floating" in sleep. Because of weightless environment, astronauts don't have to sleep in "horizontal" beds. Shut-eye taken while "upright" is perfectly comfortable in space







AUTOMOTIVE

# SEVENTY YEARS OF





**I**N THE EARLIEST DAYS of automobiling, carmakers borrowed wheel know-how from two main sources—wagons (wooden wheels) and bicycles (wire).

Evolution of the wheel waited patiently for the tire to grow up. In the good old days, tires went flat at the slightest provocation, even “when spoken to sharply.” The best wheel, then, allowed pneumatic tires to be changed the most quickly and easily.

At first, wheel rims were simply dished circular bands of steel. The air-filled monotube tire bolted to it directly. Next, with the invention of the inner tube, the tire casing could be made open at the inner circumference, and clincher rims became popular. Clinchers held the tire on by air pressure with holding action equal at all points, unlike the bolted tube which held only at the bolt locations. And clinchers made tire-changing faster.

Then in the 1920s, the drop-center rim was invented, although it didn't become widespread until the 1930s. The drop-center would eventually permit wider tire profiles and lower pressures, thus a softer ride, better wear and wider contact with the road.

During the teens and '20s, wooden spokes were used on the less expensive cars while wire wheels graced the more luxurious and sporty. Wooden wheels (sometimes called “artillery”) were often oak, usually made up of separate

spokes radiating from the hub, joined at the center. These had a steel outer rim, which was sometimes the clincher section itself. The wheel stayed on the car more or less permanently (didn't unbolt), and if you had to change a tire, you did it by removing the tire from the wheel as it stood on the car. Later, the demountable rim came about. This was a cincher section that slipped onto or off the wheel. The wheel, though, again stayed on the car. And as a final refinement, demountable clinchers got a split-ring arrangement so they could be collapsed slightly. This made it easier to get the tire off.

Two problems plagued wooden wheels. Hit from the side, they often snapped. Also, in the wet they swelled, and in dry weather they shrank. When the spokes became loose, they squeaked.

Wire wheels, meanwhile, were often offered optionally on cars with wooden ones. They used the same tires as their wooden friends but were usually supplied in sets of five, so instead of having to fix a flat on the spot, you could change wheels and repair the tire later. This was because wire wheels were easier to get onto and off the splined axles or hubs. Wire wheels were also stronger and usually lighter.

During the 1920s, the steel disc came onto the scene. If you're old enough, you may remember seeing these on Chevrolets of the late '20s and early '30s. The disc normally bolted semipermanently

## **WHEELS!**

**The only thing still the same is that they're round. Otherwise, car wheels have passed through several revolutions**

**A—1899 DeDion Bouton**

**B—1903 Curved Dash Olds**

**C—1909 Stanley Steamer**

**D—1912 Stutz Bearcat**

**E—Houk on 1922 Ford**

**F—1930 Gardner**

**G—1931 Ford Model A**

**H—1929 Auburn Speedster**

**I—1931 Bugatti Royale**

**J—1932 Auburn Speedster**

**K—1933 Duesenberg**

**L—1934 Packard**

**M—1936 Willys 77**

**N—1955 Ferrari**

**O—1946 Kurtis Indy car**

**P—1963 Chrysler turbine**

*All photos taken at Harrah's Automobile Collection, Reno, Nev.*



## WHEEL RIM EVOLUTION



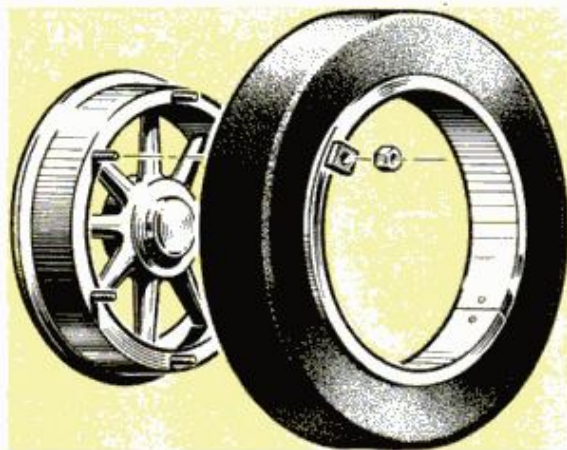
Bolt-on rim



Clincher rim



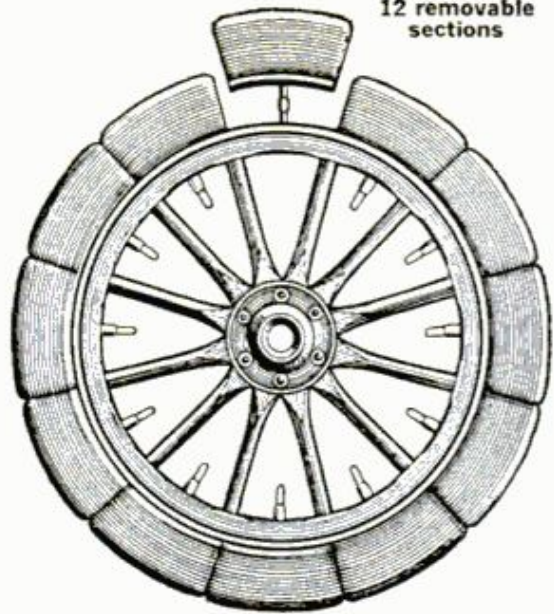
Drop-center rim



Demountable clincher on artillery wheel

**WHEEL EVOLUTION** is tied directly to development of tires. At top, monotube tire used bolts through rubber plus dished rim to hold tires on. Later, with inner tube, tires opened up at top so air pressure clinched them on. Today we use drop-center rims without a tube—the wheel and tire join to hold common air supply. Next? Perhaps a permanent bond

12 removable sections



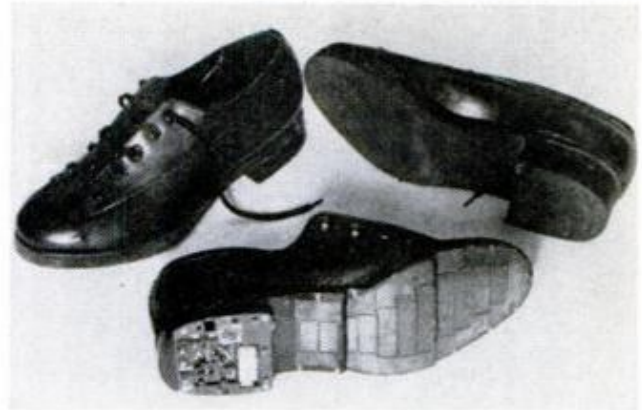
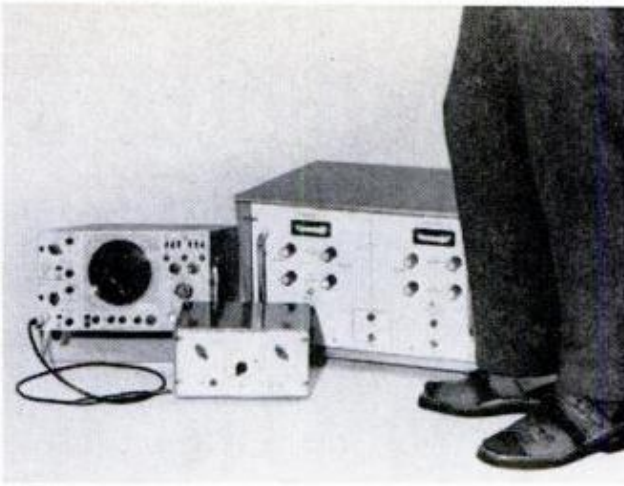
SECTIONAL TIRE

to each axle, with demountable rims carrying the tires. Steel disc wheels cost about midway between wires and wood, yet they were easier to clean than wires, just as strong, and less noisy and stronger than wood.

About 1930, people felt that wire wheels looked sportier than either wooden ones or discs, so a new type of less expensive wire wheel was invented. This, instead of having wire spokes laced from a central hub to the rim (bicycle fashion), had the spokes electrically welded in place. By the time these became popular, most cars had four-wheel brakes, so the hub could be large enough to bolt to the brake drum. Also, drop-center rims had replaced clinchers by then, and automatic welding made these "fake wires" cheap to produce. Model A Ford wheels are examples of welded-spoke wires, but even high-priced lines like Cadillac, Pierce and Packard had them.

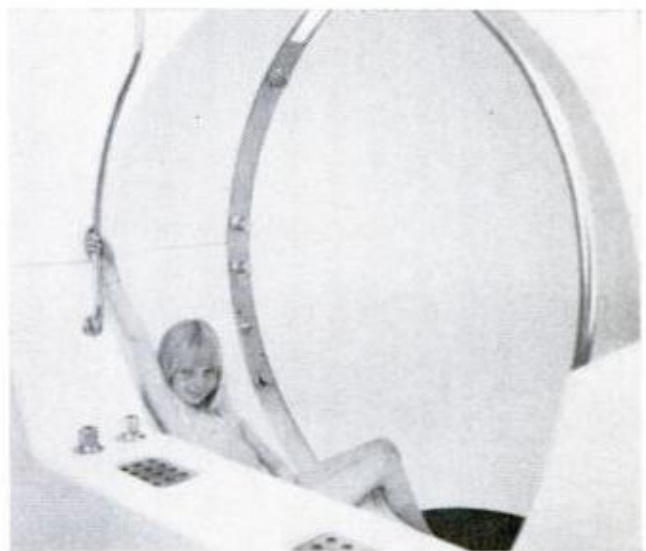
Then in the mid-1930s, many auto-makers began switching to pressed-steel wheels. These were essentially the same as we use today except that the center sections were scalloped to imitate thick spokes (see color photo M). Here, the center consisted of one section of pressed steel, and the drop-center rim was either riveted or welded on. Today, the most common car wheel is a derivative of this last type. ★★





**'Bugged' shoes help doctors measure success of surgery**

Shoes that send signals to recording equipment now enable doctors to measure improvements they've made with hip-joint surgery. While the patient walks, pressure readings along the soles of the shoes are transmitted via electronic equipment in the heels. The signals are picked up and recorded by the equipment shown in the left-hand photo.



**Inflatable vase**

A vinyl container, the Inflat-A-Tainer, can be stored flat (center, above), then inflated to hold ice cubes (left) or flowers. Colors are black, white or clear.

**It's a bathtub!**

The Italian designer of this futuristic bathtub calls it "the perfect washing machine for people." It appeared in a recent exhibit.



**Ready for a moon ride**

Astronauts test a full-scale mock-up of a lunar roving vehicle that's scheduled to be used on the moon during 1971.

**Gas-turbine train**

A gas-turbine-powered train, capable of reaching 114 mph, recently went into service on the Paris-Cherbourg line.



# How to Keep Your Shooter's Eye Sharp the Year Round

The farmer you help in the spring and summer by ridding his barns of a noxious pest may ask you back next fall to hunt his posted lands for deer or pheasant

By GEORGE REIGER, Outdoors Editor

**T**HE PRESSURE WAS ON. I had convinced the farmer I knew what I was doing. Two pigeons sat on the edge of the barn roof and watched me coming. I had to shoot them both without damaging the barn or upsetting the livestock — and I had to do it in front of a pair of skeptical onlookers: the farmer and his foreman.

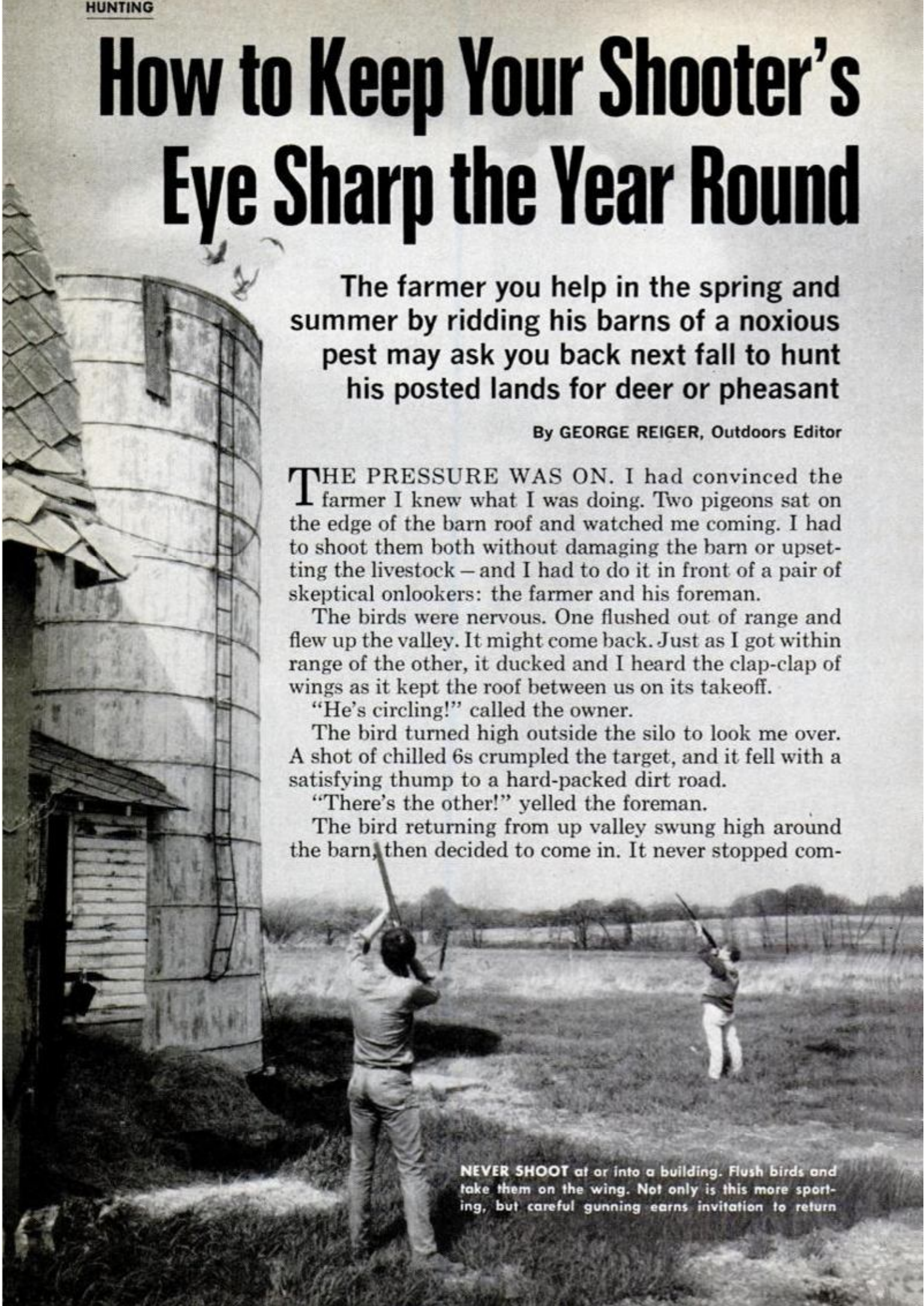
The birds were nervous. One flushed out of range and flew up the valley. It might come back. Just as I got within range of the other, it ducked and I heard the clap-clap of wings as it kept the roof between us on its takeoff.

“He’s circling!” called the owner.

The bird turned high outside the silo to look me over. A shot of chilled 6s crumpled the target, and it fell with a satisfying thump to a hard-packed dirt road.

“There’s the other!” yelled the foreman.

The bird returning from up valley swung high around the barn, then decided to come in. It never stopped com-



**NEVER SHOOT** at or into a building. Flush birds and take them on the wing. Not only is this more sporting, but careful gunning earns invitation to return





ing—and landed with a thump echoing the fall of its companion.

“Great shooting!” called the owner, “You’ll find more tucked in the hayloft. I’ll get my boy to flush them. Shoot ’em without peppering the barn, and you’re welcome here anytime.”

That was 15 years ago. I went back mainly to hunt new infestations of feral pigeons, but often, too, during regular season to hunt the farmer’s posted fields. His son and I walked them together; the pheasant shooting was fabulous.

The European Rock Dove (*Columba livia*), alias common pigeon, probably came over on the *Mayflower*. Early colonists raised them for eggs and squab. Most you see today live in cities with vertical heights reminiscent of cliffs they bred in centuries ago.

Urban populations are often vermin and disease-ridden. For example, streptococcus meningitis, transmitted by pigeons, kills an average of three people annually in New York City. In the country, the birds roost in high lofts and silos, are not easy targets. They’ll flush at the sound of a shell being chambered once they’ve been shot at. The gunner who bats .400 is doing well. Use express 6s or 7½s.

Pigeon practice on summer weekends will make winter waterfowling duck soup. And speaking of soup, country pigeons, fed on seeds and grain, aren’t bad eating. Tough, and best in a stew, but not bad. Happy hunting! ★★★

**DON'T BE SATISFIED** with results at one barn. Try another. You'll have continual action and learn the area  
DECEMBER 1970

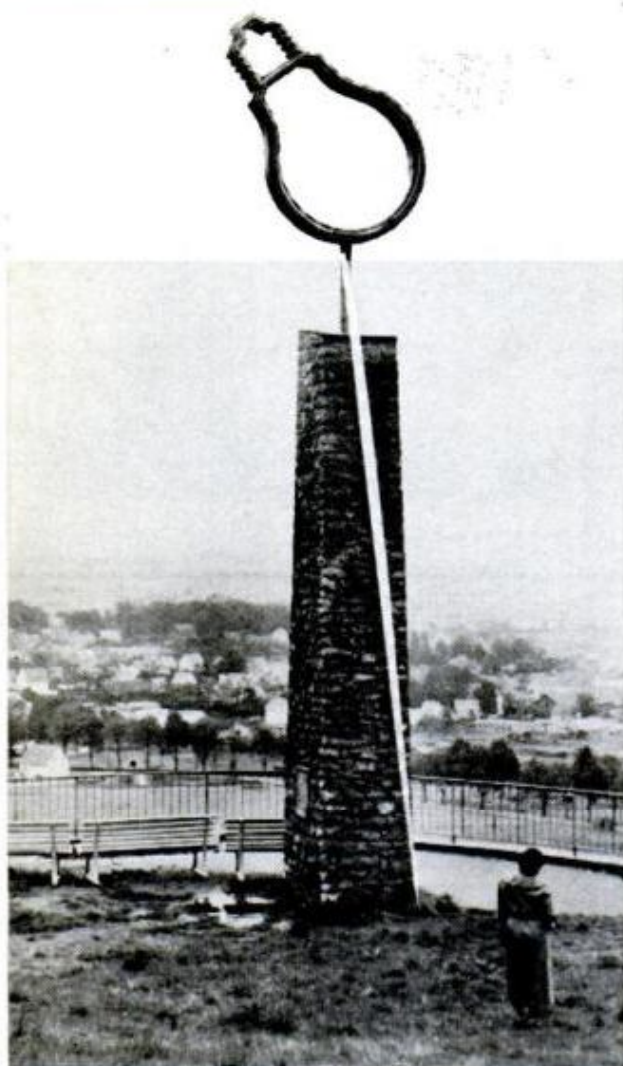
**MOST STATES** have no closed season on pigeons, starlings and blackbirds, but check local laws



**UNARMED HUNTER** in barn flushes birds to partner outside. Three shots, and men change places







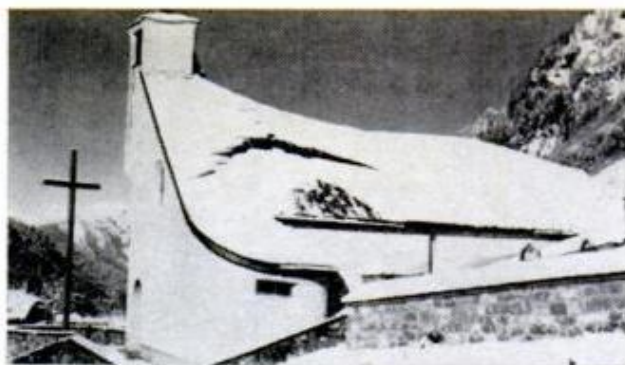
### **They claim first light bulb**

Citizens of Springe, West Germany, have erected this monument to support their contention that the first electric light bulb was invented there by Heinrich Goebel in 1854—25 years ahead of Edison.



### **Discotheque for the deaf helps them speak**

Deaf children are learning to speak at an English school with the help of a discotheque-inspired machine that flashes colored lights in response to certain sounds. The youngsters try to light up the same lights as the teacher does—thus matching the sound.



### **Avalanche-proof church**

Because avalanches sometimes sweep down the Alps in their area, the residents of Langen am Arlberg, West Germany, built their church in a wedge shape. The shape allows a snowslide to sweep over the building without damaging it or trapping people inside.



### **Quiet concrete-breaker**

With its hammer driven hydraulically rather than by compressed air, the Hydroville, a French-built concrete-breaker, is 10 times quieter than a conventional air hammer. A damper cuts hammer noise by 80 percent.







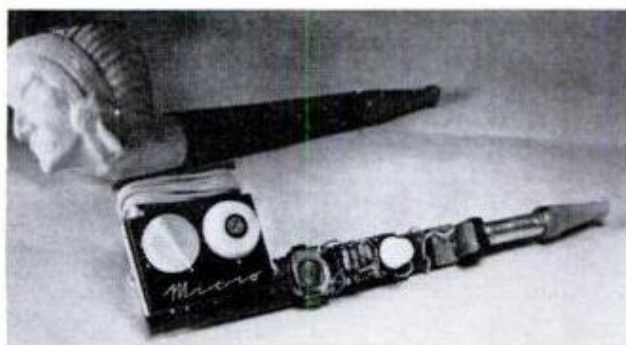
## With attached garage

An old schoolbus has been converted into a mobile home—with attached garage—by Stan Starr Sr., Nashville, Tenn. A ramp at the rear enables Starr to load his racing Camaro in the bus to take it on the stock-car racing circuit. Two bunks, a table and stove inside provide comfortable living for the crew. The rig is shown at the Citrus 250.



## Plastic igloos

Eight to ten people can live in one of these polyurethane "igloos" that are being built in Germany for use in Turkey to replace earthquake-destroyed homes.



## Piped-in music

A tiny radio receiver built into the bowl of this pipe can be heard only by the "smoker." The bowl transmits sound down the stem, where it's picked up by the user's teeth and conveyed to his auditory organs.



## Steam wagons are old-timers

Built during World War I and still in use at the Brown Baylay Steel works in Sheffield, England, are seven steam wagons. The wagons, which are operated daily, are powered by coke.



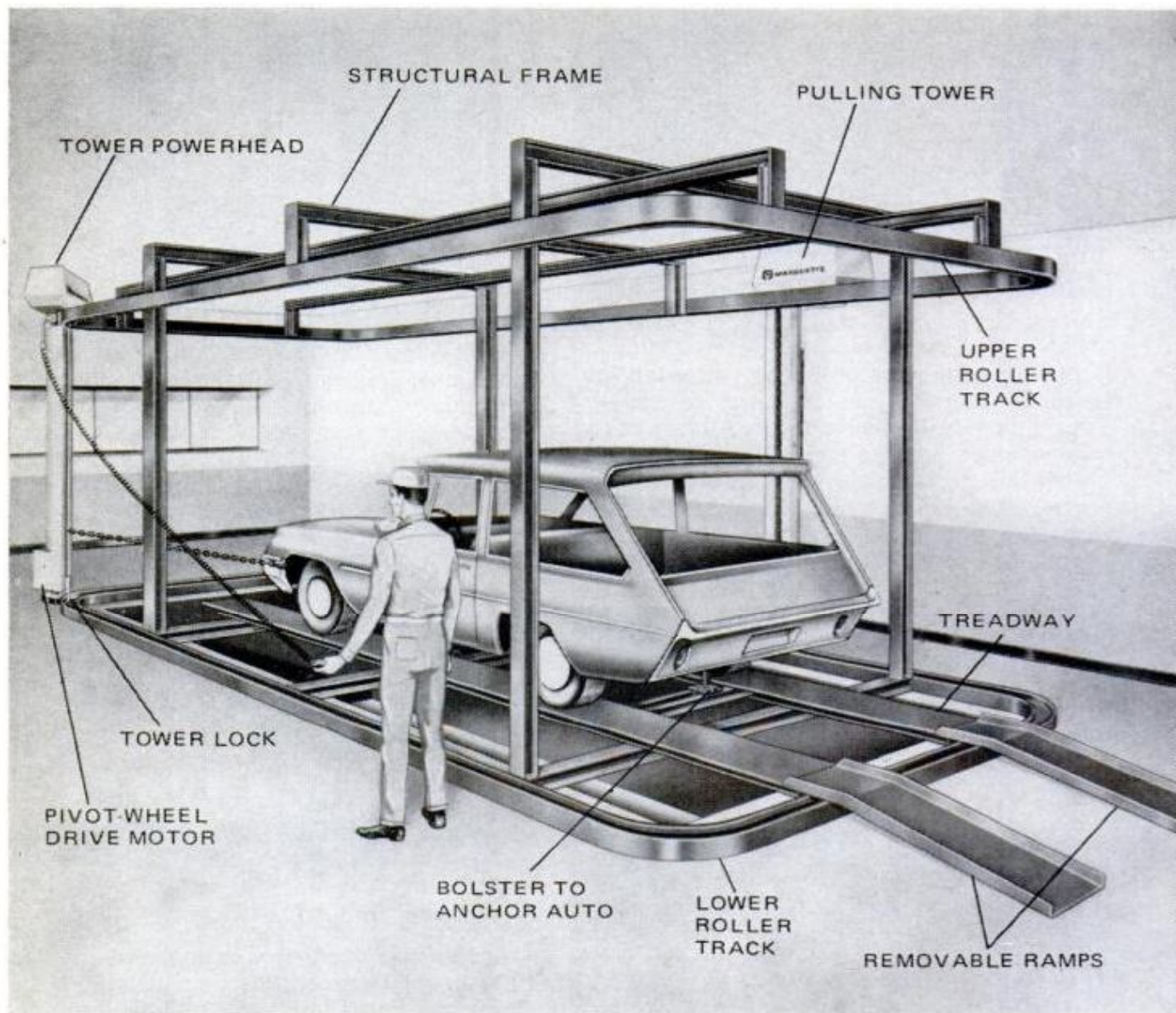
## Vintage 1924

Advertising gimmickry is not new—as this 1924 Daimler proves. The car was built in the shape of a bottle, and was used by Worthington breweries in England until 1953. The vehicle, now at the Montague Motor Museum, appeared at a display of unusual vehicles.





# One-Man Auto



**BODY AND FRAME ALIGNMENT SYSTEM** with its two mobile electric pulling towers allows full power pulls from all directions 360° around the car. The Marquette Corp. manufactures this extraordinary machine

**T**HE COLLISION SQUASHED the 1967 Ford's rear like a paper cup. Trunk and quarter panels were pushed in 20 inches, both rear doors were jammed, the bumper resembled corrugated sheet metal and there was a buckle in the frame. Making it roadworthy again would require new parts, some 20 hours of labor by a group of professional body repairmen and about \$400 of the insurance company's money. And could the frame be straightened?

The frame was straightened and the whole job done by *one* man—with the help of an extraordinary body unbend-

ing machine. The heavy steel girder framework of the device is about the size of a living room—11 feet high by 26 long by 15 wide. Taut, heavy chains slung around the undercarriage and hooked to steel beams secure the car.

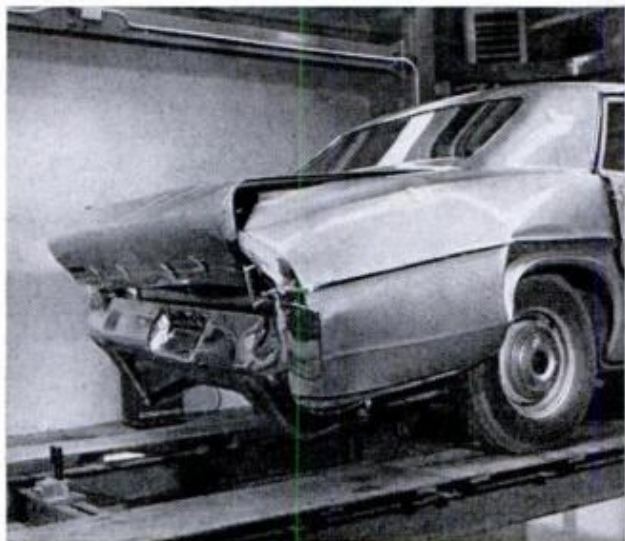
The operator now rolls two towers around the framework to face the crumpled body. He extends heavy chains from each and anchors their giant hooks to the damaged area. When he operates a hand-held control, the chains pull tight and continue pulling.

With the electric motors that deliver power through a 1200: 1 torque multi-

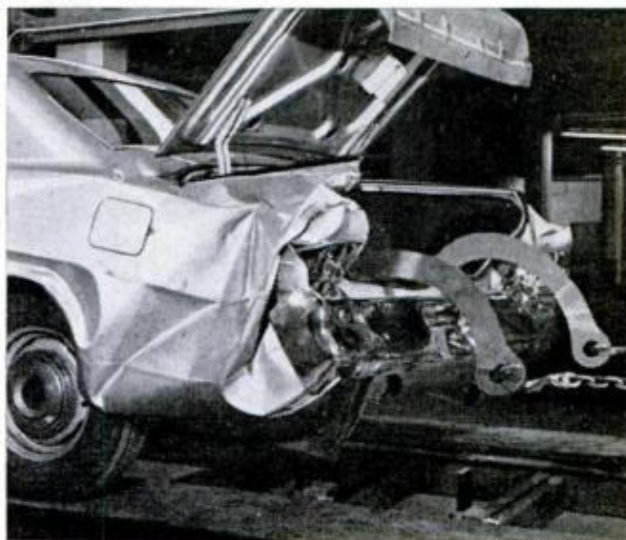


# Body Shop

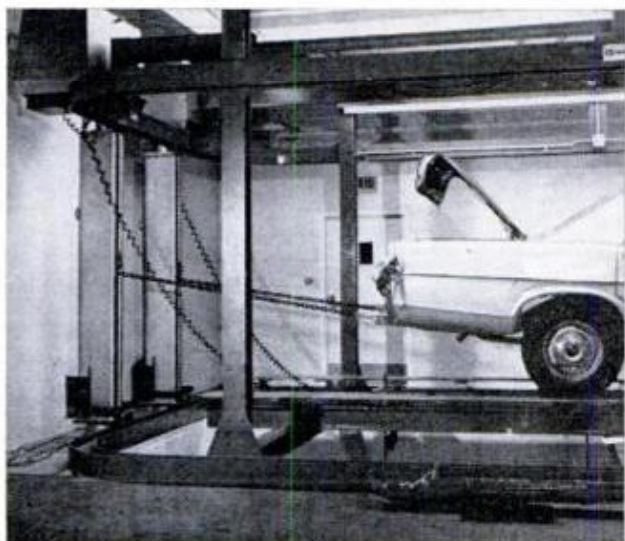
By MORT SCHULTZ



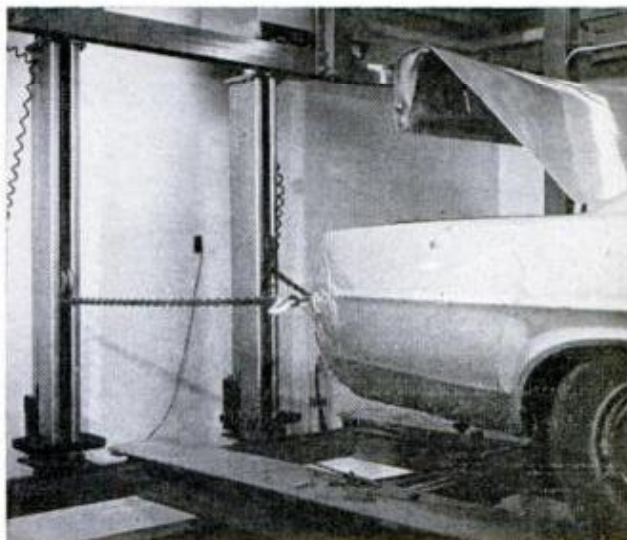
**DAMAGED CAR** is wheeled into place on treadmill of body and frame system and anchored to structure



**GIANT HOOKS** are set in place and an initial pull applied to restore bumper and trunk to original shape



**BOTH PULLING TOWERS** provide pull to straighten frame and align body. Rear door can now be closed



**TAILLIGHT SECTION** is restored in final pull. So far the elapsed time is 30 minutes, no mallets used

plier, up to 25 tons of pulling power can be applied. Pulls of a fraction of an inch to eight feet are possible.

Once body and frame are straightened, badly torn metal molding strips and broken glass are replaced. Often, a quarter panel, fender or some other body part is so badly battered it can't be salvaged. But usually, tears can be filled prior to sanding and painting.

What's the trend in the auto-body repair business? The answer would be "One-man operations" if you asked the Marquette Corp., maker of the new machine. ★ ★ ★

DECEMBER 1970



**FINISHED JOB** after sanding, painting and new molding looks like new. Whole job was done by one man

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### On-the-road back scrub

There have been several systems invented for keeping the rear window of a car clean—but perhaps this is the simplest. The mini-car, with its passenger operating a long-handled scrub brush, was spotted in London.



### Shipshape restaurant

Diners at Bernstein's Fish Grotto in San Francisco enter the restaurant through the bow of a replica of a Spanish galleon. The "vessel" is even equipped with port and starboard lights.



### Smoky surprise for a thief

A thief who grabs the Benwell Security Case from a courier's hand and tries to make off with it soon finds that he has dense clouds of orange smoke to contend with—to say nothing of orange-stained money to try to negotiate if he gets away with the case. Money goes in the case (upper left) next to a smoke cartridge. The firing lanyard attaches to the bearer's wrist (above) so that the cartridge is set off when the case is torn from his hands (left).



# How to S-T-R-E-T-C-H Your Camera Lenses



By BURT MURPHY

**Low-cost extenders can double—even triple—the power of your present 35-mm lenses. But they do have some limitations. Here's what you should know about choosing and using one**

**I**MAGINE GETTING TWO LENSES for the price of one—well, almost. An inexpensive extender can turn a regular 35-mm lens into the equivalent of two lenses by doubling or tripling its original focal length. A normal 50-mm lens becomes a 100 or 150-mm telephoto. A 150-mm telephoto becomes a 300 or 450-mm cannon. A single extender can thus give you two lenses for every one you already own.

Extenders are low-cost accessory lenses that mount between your camera and regular lens. You can buy them to fit nearly all makes of 35-mm, interchangeable-lens cameras. Among the most common are those sold by Prinz, Soligor, Spiratone and Vivitar. Prices run from \$16 to about \$50.

The secret of an extender is that it incorporates what is known as a negative lens. Instead of causing light rays to converge, as in a conventional lens, it spreads them out. Mounted behind the regular lens, it intercepts the converging rays, spreads them out and forces them to travel a longer path before reaching a focal point. This has the effect of increasing

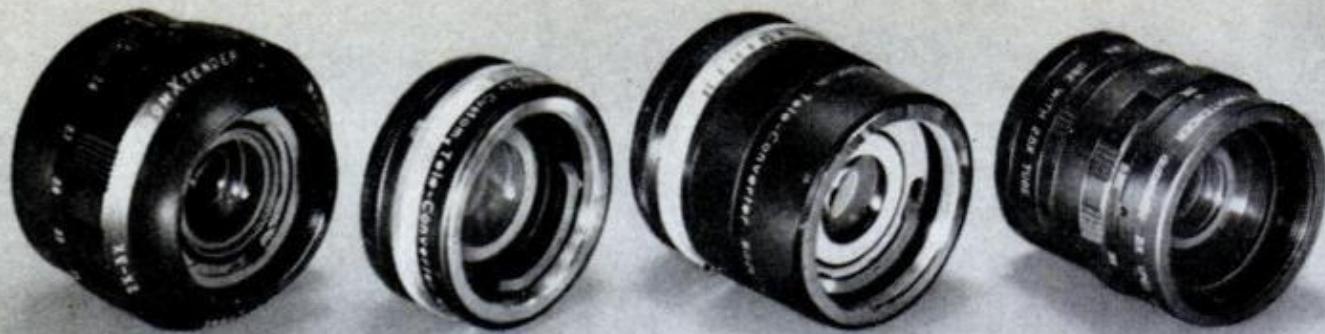
the lens's original focal length so you get a greatly magnified image on the film.

A 2X extender doubles a lens's focal length, and a 3X extender triples it. Thus a normal 50-mm lens combined with a 2X extender becomes a 100-mm moderate telephoto. With a 3X extender, it becomes a fairly hefty 150-mm telephoto. (Extenders are not recommended for short-focus wide-angle lenses because increased focal length destroys the wide-angle effect.)

Both manual and automatic extenders are available. The latter, when used with an automatic lens, will preserve the automatic stop-down function when you trip the shutter release. This feature generally adds about \$10 to the price.

In addition to fixed-power 2X and 3X extenders, there are also two special models offered by Spiratone. One is a 2X to 3X automatic zoom extender that varies magnification smoothly from two to three times in the same way a regular zoom lens offers continuously variable focal lengths. You just twist a ring to get the magnification you want. Called the ZoomExtender,





SPIRATONE  
2X-3X ZOOM

VIVITAR  
2X

VIVITAR  
3X

SPIRATONE  
2X-3X VARIABLE

**ARRAY OF EXTENDERS** shown here and on the opposite page represents most of those commonly available today. Principal brand names are Prinz, Soligor, Spiratone and Vivitar. Basic 2X type doubles a lens's original power and sells for \$16 to \$32, depending on make of camera it fits and whether model is manual

### How Extenders Can Increase Your Lens Power



**TWO EXTENDERS  
STACKED TOGETHER**



**ONE 2X EXTENDER  
WITH 135-MM TELEPHOTO**

**SOME TYPICAL COMBINATIONS** of lenses and extenders are shown in this chart. Note how two lenses and two extenders can give you a progression of focal lengths all the way from normal 50 mm to a whopping 405-mm telephoto. A single zoom extender can do the same. While two extenders can theoretically be stacked together for even greater magnifications, as shown above, severe light loss makes this impractical in most situations



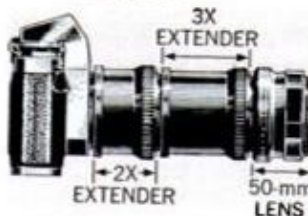
**100-mm  
LENS**



**150-mm  
LENS**



**270-mm  
LENS**



**300-mm  
LENS**



**405-mm  
LENS**





PRINZ  
2X

PRINZ  
3X

SOLIGOR  
3X

SPIRATONE  
3X

or automatic. The 3X type triples lens power and ranges from about \$23 to \$40. Spiratone's 2X-3X zoom model offers continuously variable magnification from two to three times for about \$50. The 2X-3X variable for about \$20 adjusts power in three steps, but you must add or remove spacer rings to make the change



**DISTANT STREET SCENE** photographed with normal 50-mm lens from about 75 yards away looks like this



**ADDING 2X CONVERTER** turns normal 50-mm lens into equivalent of 100-mm, giving this magnified view



**3X CONVERTER** triples lens to 150 mm, bringing store front close enough to read signs in window



**COMBINING 135-MM LENS** with 3X converter gives 405-mm power, zeroing in on small portion of scene

it costs \$49.95, but is handy because it provides a wide choice of focal lengths in a single accessory. Used with a 135-mm lens, for instance, it gives you a zoom telephoto from 270 to 405 mm.

The other Spiratone accessory is called the VarXtender, a variable extender that

changes focal length in three steps—2X, 2.5X and 3X. It costs only about \$20, but is less convenient to use because you must add or remove screw-on spacer rings depending on magnification wanted.

Lens stretchers, no substitute for true telephotos, are an economical way to ex-



## BUYING GUIDE FOR LENS EXTENDERS

MAKER	AVAILABLE MODELS	APPROXIMATE PRICE RANGE	SOURCE
PRINZ	2X	\$19.95	Bass Camera Co., 179 W. Madison, Chicago, Ill. 60602
	3X	24.95	
SOLIGOR	2X	16 to 25	Allied Impex Corp., 168 Glen Cove Rd., Carle Place, N.Y. 11514
	3X	23 to 30	
SPIRATONE	2X	30 to 33	Spiratone, Inc., 135-06 Northern Blvd., Flushing, N.Y. 11354
	3X	35 to 44	
	2X-3X variable step	19.95	
	2X-3X zoom	49.95	
VIVITAR	2X	19 to 32	Ponder & Best, P.O. Box 64733, Los Angeles, Calif. 90064
	3X	28 to 38	

tend your present lens range. One extender will give you four lenses from two, six lenses from three, eight lenses from four and so on. If, for instance, you own a normal 50-mm lens and a 135-mm telephoto, a 2X extender will give you a 100-mm lens from the 50-mm and a 270-mm lens from the 135-mm. Your available focal lengths will now run 50, 100, 135 and 270 mm—four lenses for the price of two and an extender. If you add a 3X extender, you'll get a 150-mm lens from the 50-mm and a 405-mm lens from the 135-mm. Your lens collection will now range all the way from the 50-mm normal to a whopping

405-mm telephoto in six conveniently spaced steps. Cost for the two extenders (or one zoom model): only about \$50.

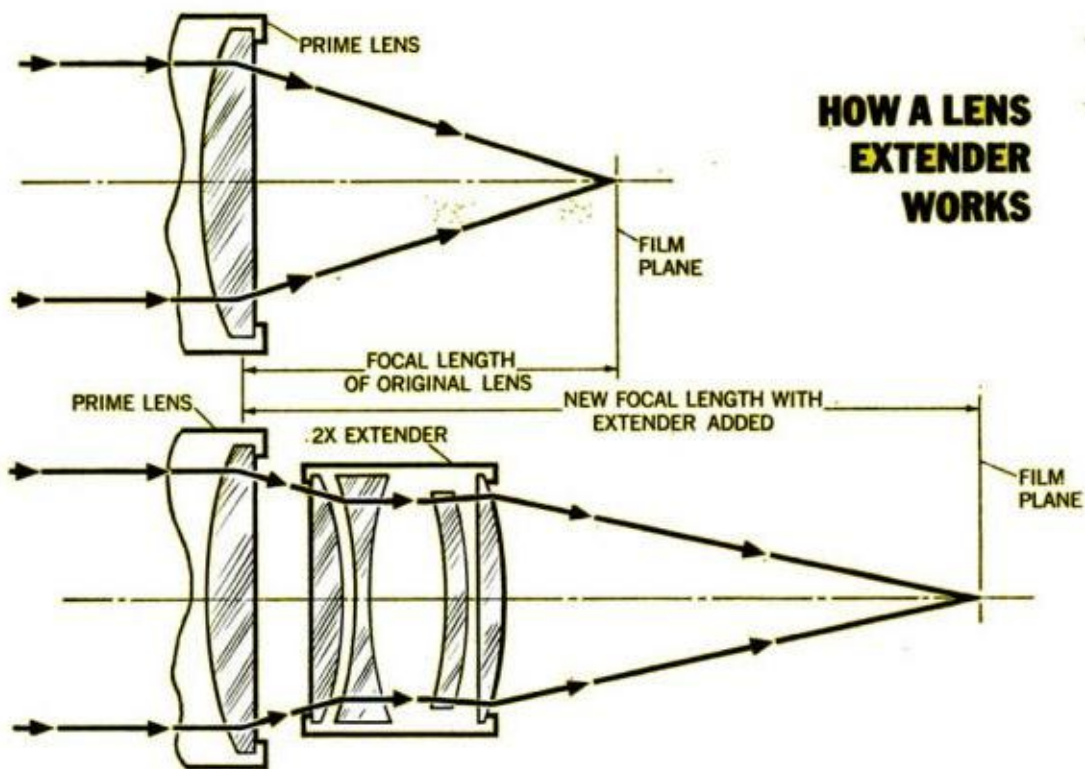
Extenders do have their limitations, however, and it's important to bear these in mind. Because of the extra optics they interpose in the system, they absorb considerable light and have the effect of slowing down your regular lenses. A 2X extender requires an exposure increase of two stops; a 3X extender three stops. If normal exposure is, say, 1/250th of a second at f/8, you'd have to open the lens two stops to f/4 with a 2X extender or slow your shutter speed two stops to 1/60th of

**TURNING A RING** on Spiratone's 2X-3X zoom extender varies image size smoothly just like a true zoom lens, making the accessory handy and versatile

**STEP-TYPE EXTENDER**, also by Spiratone, is made up of three rings. It's cheaper than zoom but awkward because you must change rings to vary power







## HOW A LENS EXTENDER WORKS

A LENS'S FOCAL LENGTH is determined by point where converging light rays come together. The farther behind the lens this point falls, the longer the focal length. An extender, inserted between the original prime lens and camera, intercepts the converging rays and lengthens their path so they converge at a point farther away, as shown in the simplified diagram above. Since this increases the effective focal length, the image you get is magnified

a second. A 3X extender would require a lens opening of  $f/2.8$  or a shutter speed of  $1/30$ th of a second—neither one an ideal setting for clear, sharp, action-stopping pictures.

Another problem is that extenders give sharp results only if the regular lens is closed down at least two full stops from wide open and, in some cases, three stops where long focal lengths are involved. This means an  $f/2$  lens must be stopped down to  $f/4$ . Slower telephoto lenses would be closed even more. In poor light, the only way you can maintain such lens openings is to cut back on your shutter speeds. This, in turn, makes it difficult to freeze motion in action shots and you may get streaky blurs.

Such limitations put some necessary restrictions on the practical use of extenders. For best results, you need bright sun and a film speed of at least 400 ASA or better. This may rule out the use of slower color films, especially with long focal-length lenses. Your subjects should be as free from motion as possible, and it's wise to use a tripod whenever you can to minimize camera shake.

Determining the correct exposures with an extender is easy if your camera comes with a built-in meter as it will automatically com-  
(Please turn to page 192)

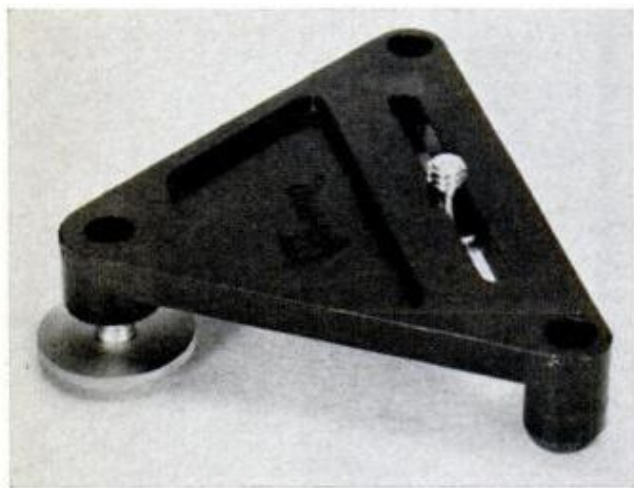


**CAN YOU TELL THE DIFFERENCE?** Close-up above was made with 105-mm true telephoto lens, while one below is product of normal 50-mm lens and 2X extender to give similar focal length. Both are almost equally sharp, proving that extenders can give good results





# NEW IN Photography



▲ **HANDY LEVELING STAND** lets you set up a camera on a table, fence, tree stump or other flat surface for steady shooting—especially helpful on time exposures. The novel three-legged stand, called the Tri-Pad, has nonslip rubber feet and a leveling screw that permits a 10° tilt adjustment. \$3.95, Leaf Engineering, 18748-3 Bryant St., Northridge, Calif.

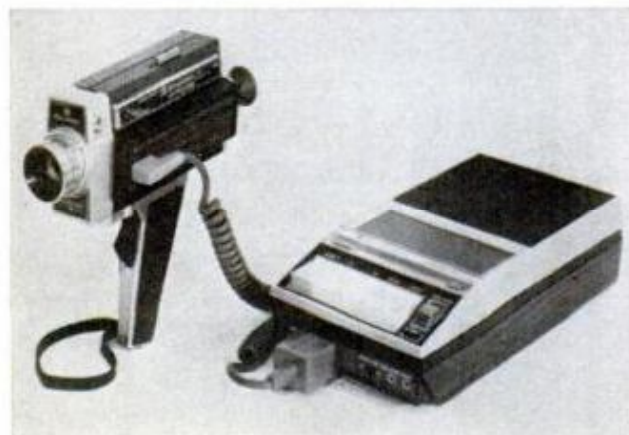
**NEW SUPER-8 MOVIE CAMERAS** from Bell & Howell (below) include five models ranging in price from less than \$50 to about \$200. The cameras are basically similar except that advanced models offer such added features as power zoom and a built-in self-focusing arrangement. Model 376S (bottom photo) is equipped for use with B&H's recently introduced Filmosound system for making sound movies with a synchronized cassette recorder. Its price is \$119.95. Another model, the 376, with power zoom and self-focusing but no synchronized sound, is \$109.95.



▲ **ALMOST TWICE AS MANY SLIDES** fit in this new Kodak Carousel projector as in earlier models. The rotary tray on top holds 140, compared to 80 in the past, greatly extending your viewing time. The Model 760 has automatic focusing and remote control for forward and reverse. \$149.50 with 5-inch, f/3.5 lens.



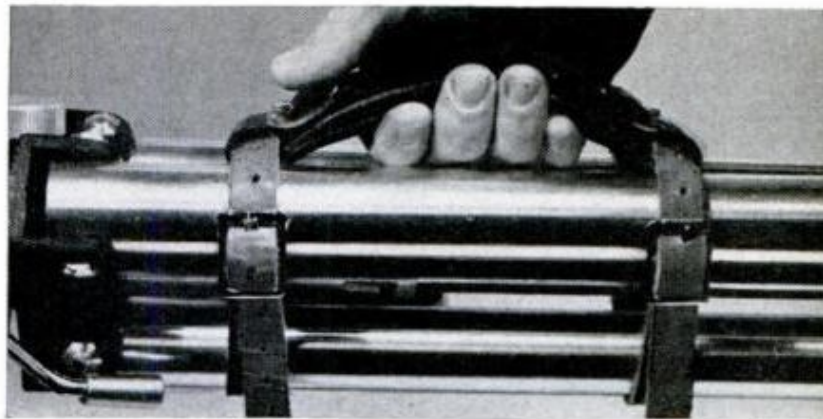
▼ **MINI SLIDE PROJECTOR**, only six inches long when closed, is designed for easy portability. You can run it on house current or take it along in a car, boat or camper and operate from batteries by switching the projection lamp to a 6 or 12-volt bulb. About \$30, Travel Things, 447 Cambridge Ave., Palo Alto, Calif.



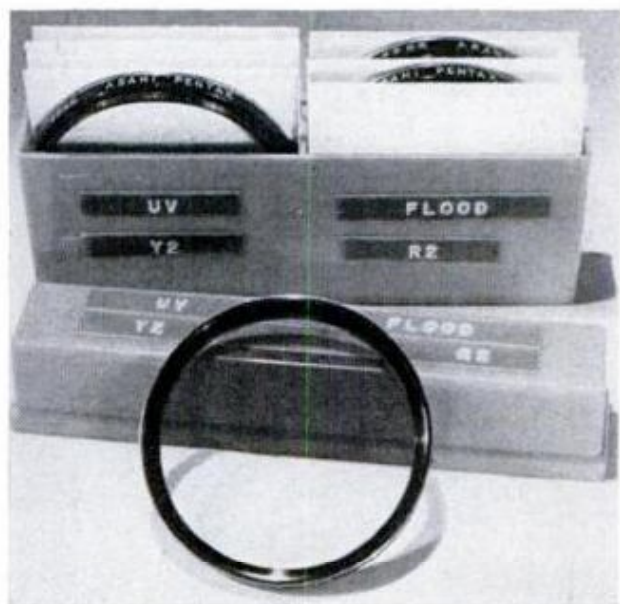


# PHOTO HINTS

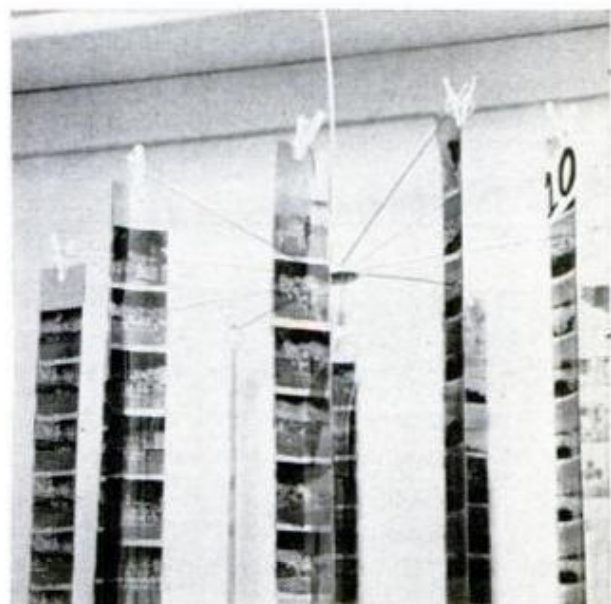
**CARRYING A TRIPOD** is always awkward because you can't grab it by one leg without the others swinging open. You can solve the problem by making a carrier from a strap-on luggage handle. It will bind the legs together and give you a balanced handgrip for holding the tripod. The same arrangement can be used to bundle light stands together for easy carrying.—*C. Boyd Pfeiffer*



**FOR CLEANER NEGATIVES AND PRINTS**, it's best to filter your developer, fixer and other solutions *before* you use them. You can do the filtering at the same time you pour chemicals into your trays with the simple rack at left, above, made to hold two funnels stuffed with absorbent cotton. A ring stand can also be used to hold a funnel as at right.—*Robert Hertzberg*



**PLASTIC SLIDE BOXES** are perfect for storing filters safely. Their compartments are just right for holding Series VI accessories and the 49-mm size used on some cameras. Cut dividers from cardboard.—*Michael Burn*



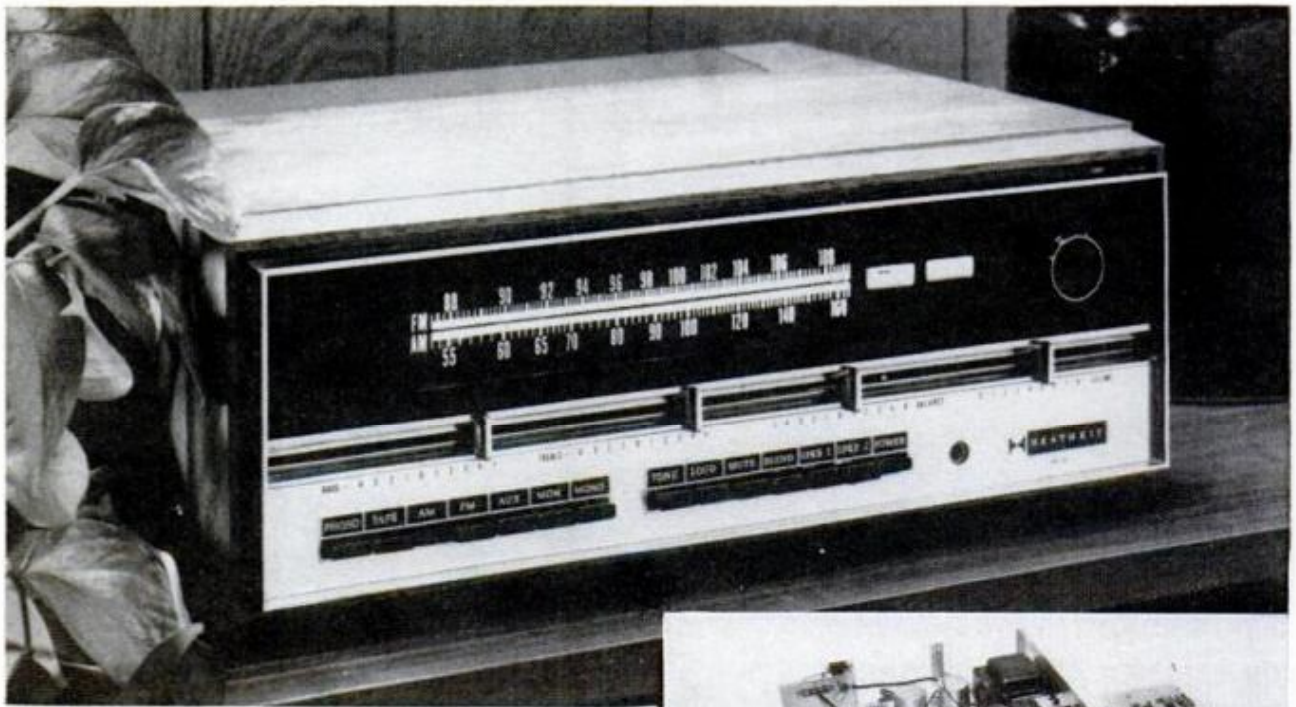
**A HANDY DRYING RACK** for roll film can be made from a lady's hosiery hanger. The hanger, costing about \$1 at department-store notion counters, has pivoted arms that fold out of the way when not in use.—*J. R. Chenoweth*



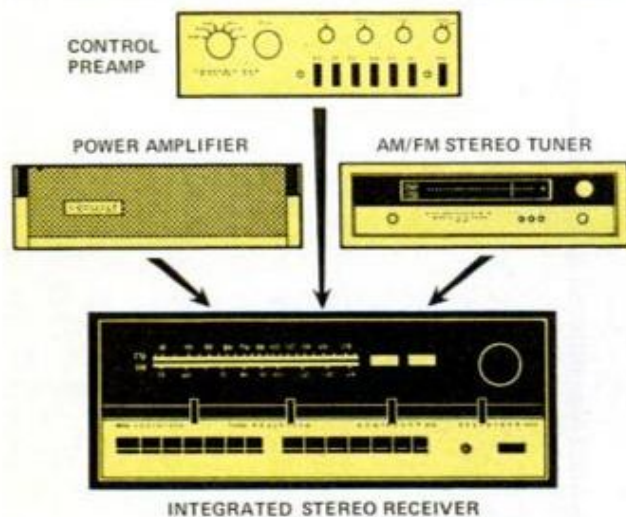
# All-in-One Music Centers:

First it was components. Now it's single-unit receivers. Is there still a case for separates? Here is what you should know about this popular new trend in space-saving stereo

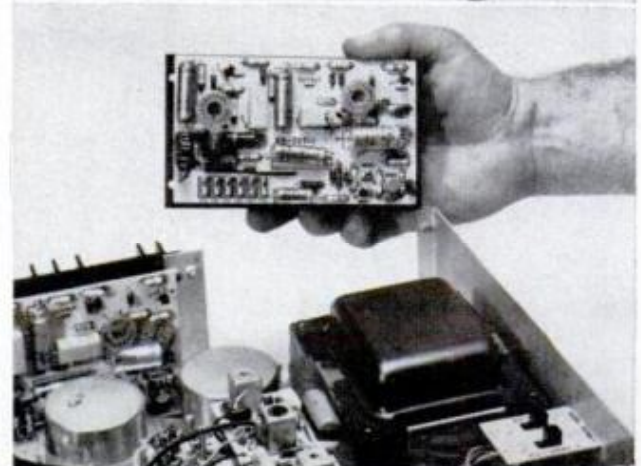
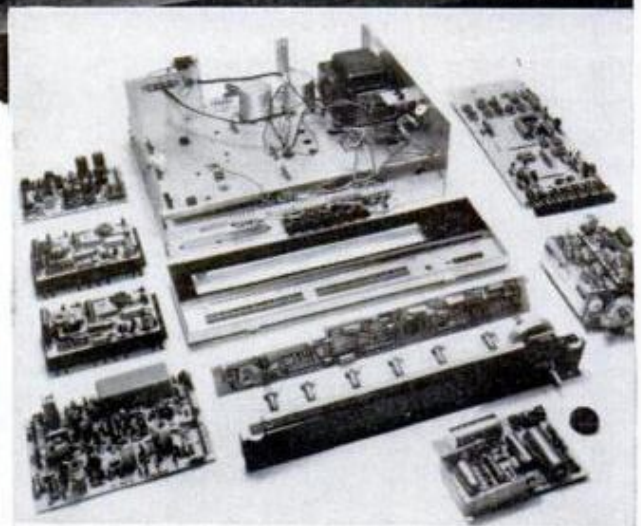
By HANS FANTEL



## All These Go Into an Integrated Receiver



AT LEAST THREE MAJOR COMPONENTS go into modern stereo receivers like the new AM/FM Heathkit AR-29 shown above and at right. Tiny circuit boards and cool-running transistors make it possible to pack a whole array of separate functions into a single, compact cabinet. Typical of today's many fine all-in-one receivers, the AR-29 uses self-contained, plug-in modules that make assembly and servicing a breeze. Priced at \$285 as a kit, it offers a generous 50 watts per channel and sleek pushbutton controls





# Your Best Bet in Hi-Fi?

**B**ACK IN THE PIONEER DAYS of hi-fi, you happily stacked your shelves with a mass of separate components and tangled cords in the quest for good sound. Today, most hi-fi systems are built around a single, central unit—the integrated receiver or stereo compact. Like a multiple vitamin pill, these all-in-one music centers pack a lot of different functions into one box—AM tuner, FM tuner, preamplifier, power amplifier and, in the case of compacts, a record changer piggybacked neatly on top. Many models even incorporate a cassette tape player as well.

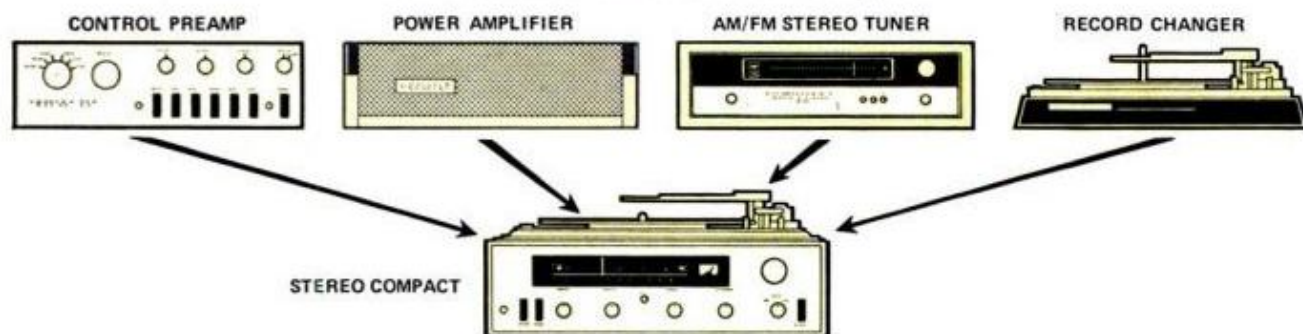
It's easy to see why such packaged systems are so popular. You can't beat them for compactness, simplicity of installation and ease of operation. They take little space. There's no rat's nest of interconnecting cables. All controls are grouped

conveniently on one panel. In cost, they may represent half the investment of a component system.

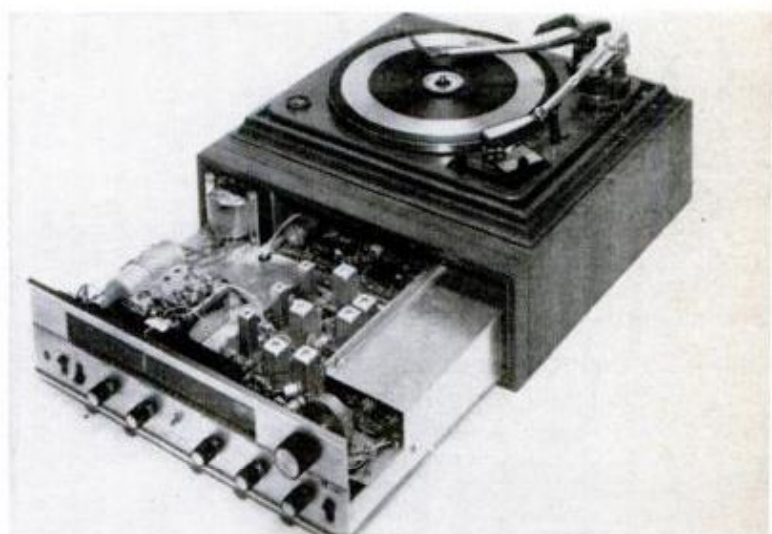
In performance, well-designed receivers and compacts come pretty close to providing the quality you get with components. Even inexpensive models sound remarkably good and can represent an excellent bargain if you're interested in an economical system for general entertainment. The development of solid-state electronics, tiny printed-circuit boards and ultra-miniaturization techniques have made it possible to shoehorn a lot of separate hi-fi functions into a small space without sacrificing performance too much.

Back in the old tube days, tuners and amplifiers needed plenty of room to spread out in to keep their parts from cooking to death in the intense heat. They also re-

## All These Go Into a Stereo Compact



**PERCHED NEATLY ON TOP**, a handy record changer makes this Allied Knight-Kit compact a complete entertainment center small enough to sit on a bookshelf. The changer's motor hangs down into a recess



in the chassis below, as shown at right, fitting as snugly as a hand in a glove to save space. Many models also offer a built-in cassette tape player. Prices for compacts range from under \$100 to \$500





**STEREO COMPACTS** sport built-in record changers and some even include tape players. At top is RCA's VS-6025 offering a stereo cartridge player for \$399.95. At center, Altec Lansing has two models, one with a cassette player for \$650 and one without for \$499. At bottom, medium-priced Panasonic features novel two-level design for \$229.95

quired massive output transformers to feed the speakers. One maker who tried to build an all-in-one tube receiver says, "After we got it put together, we found we couldn't lift it."

Transistors don't require output transformers, and they run much cooler than tubes. The result is a space-saving ratio of more than 8 to 1 compared to tube sets—you can cram eight times as much solid-state electronics into the same size box!

Does this mean separate components are dead? Not at all. It depends on what you want and what you're willing to pay for. Components offer a flexibility not possible with integrated sets. Suppose you live in a deep-fringe area and want a sensitive FM tuner to bring in distant stations but are willing to settle for a medium-power amplifier. Perhaps you want AM without FM or FM stereo only. Or maybe you don't care so much about radio reception but want a top-grade amplifier for listening to records and tapes.

You can't have these kinds of choices in a packaged deal. You must take what the manufacturer has decided to include in his particular mix. In most cases, this is likely to represent a compromise.

Components let you tailor your system to your specific needs. You can combine one make of tuner with another make of amplifier if each offers certain features you want. You can buy the preamplifier separate from the amplifier if you're going to insert special sound effects devices such as echo chambers for making home recordings. You can add or change components without making your whole system obsolete. And you can build your collection a piece at a time, putting more into each one than you might want to invest if you had to buy them all at once.

There's another case for separates, too. Integrated receivers can match components in quality on most points—with one important exception. In separates, each component has its own power supply. In an all-in-one receiver, a single power supply serves tuner, amplifier and preamplifier simultaneously. This can cause problems, especially in modestly powered economy models. Power to a tuner or amplifier is like food to an army. Like an army, audio equipment "marches on its stomach." It can't function properly unless all circuits are fed their full ration of electricity.

The demand for power varies according to the signal. Deep bass sounds pack a lot of energy and call for sudden bursts of power. Without adequate reserve power at these critical moments, voltages get wobbly and distortion sets in. Bass notes become dull and mushy instead of crisp and sharp, and the sound is blurred. To avoid this in marginally powered receivers, some makers deliberately limit the bass response so it won't put so much



strain on the power supply. Thus, without knowing it, you're being robbed of some of the music's depth and richness. You may not hear actual distortion, but you also aren't getting all the sound you should.

Separate components generally avoid this problem because they have individual power supplies and also because they're more likely to be designed for quality rather than economy. There are fewer limitations on space and cost. You expect to pay as much for a separate tuner or amplifier as for an all-in-one compact. Maybe more. Therein lies the answer—separates can afford to be better.

Still, this is true only if you're interested in the ultimate in sound quality. For average hi-fi needs, single-unit receivers and compacts offer a tremendous bargain in economy as well as everything-in-one-place convenience. The important thing is to choose a model with enough power to handle all of its functions adequately. A rating of 20 watts per channel is generally considered minimum power for good room-filling sound. Be sure, too, that the rating method follows one of the reliable, industry-accepted standards—either IHF music power or rms continuous power. Some ratings are given for a 4-ohm output. Since most speakers require 8 ohms, the actual available power is half the advertised amount. The term "peak power" used by some makers is also an inflated figure—again usually double the true output. (For a more detailed discussion of power requirements and rating methods, see *What's Watt in Choosing a Hi-Fi?*, page 143, Oct. PM.)

Today's receivers fall mainly into three price groups—rock-bottom, medium and deluxe. The magic number is \$199.95. This is about the lowest price of admission for a receiver with enough power and quality to satisfy critical listeners. Among the entries at this price level are Panasonic's Montvale RE-7800, Harman-Kardon's Nocturne 330, Scott's 341, Sansui's 350, Allied Radio's 369, Lafayette's LR-775, Sony's STR-6040, Kenwood's KR-70 and the Electro-Voice EV-1181.

You probably get the most sound for your dollar in the medium-price range from \$250 to \$350. Virtually every hi-fi maker has one or more entries in this bracket, so the choice is plentiful. At this level, you can expect fairly hefty power ratings of around 40 watts per channel,

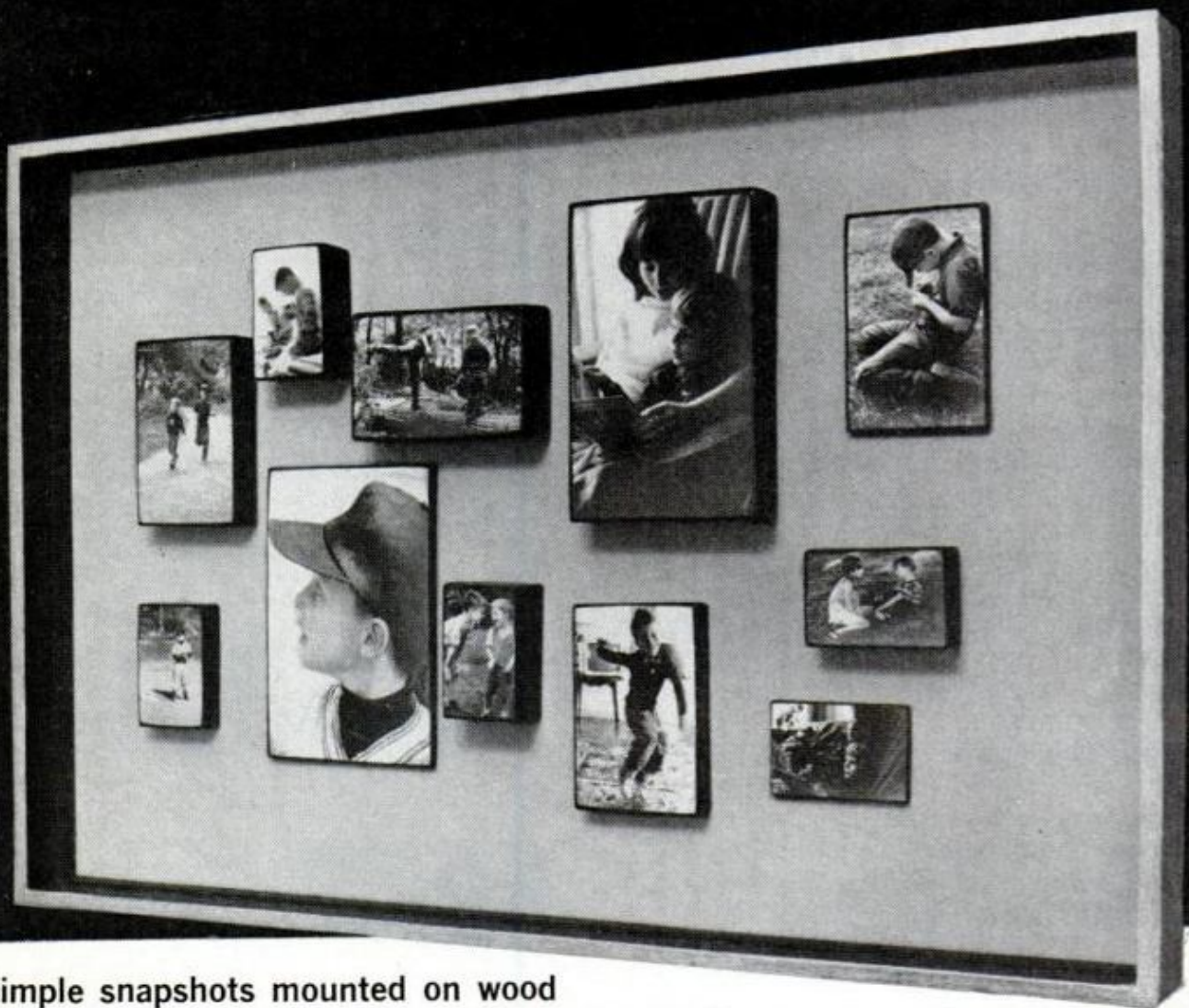


**STEREO RECEIVERS** range widely in price and power. Typical models above are (from top): Kenwood KR-7070 with 150 watts per channel and remote control for \$549.95; Ampex ASR-100, 38 watts per channel, \$250; Harman-Kardon 230, 20 watts per channel, \$159.95; Panasonic RE-7070, 9 watts per channel, \$249.95 and Scott 387, 63 watts per channel, \$449.95

with some going considerably higher. Lafayette's LR-1500T, with 85 watts per channel, is an excellent buy at \$299.95. For kit builders, Heath offers two fine choices in its widely acclaimed AR-15, with 75 watts per channel for \$340, and the newer AR-29, a somewhat more moderately powered model putting out 50 watts per channel for \$285. Allied, Eico, Scott and Harman-Kardon also offer receivers in kit form. ★★★

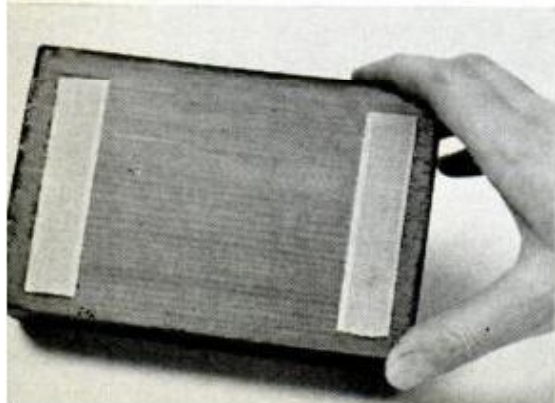


# ADD 3-D TO YOUR PHOTO DISPLAY



Simple snapshots mounted on wood blocks create an unusual wall decoration that's easy to make

**SMALL STRIPS** of Velcro tape on back of each block make it easy to arrange pictures on display panel covered with matching Velcro. Blocks stick firmly where pressed on panel, and can be quickly removed and rearranged whenever you want to display new photos





**O**RINARY SNAPSHOTS take on a dramatic appearance when you mount them on blocks of wood, producing a three-dimensional relief effect. By varying the size and thickness of the blocks, you can create an unusual random-pattern wall display of pictures that otherwise get stored away unseen in a bureau drawer or photo album.

The blocks are standard wood thicknesses— $\frac{1}{4}$ -inch,  $\frac{3}{4}$ -inch (1-inch nominal) and  $1\frac{5}{8}$  inch (2-inch nominal). Three basic sizes accommodate 8x10, 5x7 and 4x5 prints. You can, of course, make the blocks any other sizes you wish depending on how you want to crop your shots. Trim off the borders and mount the prints on the blocks with a white wood glue (don't use rubber cement as this will bleed through, staining the prints).

The blocks are painted flat black to give a sense of depth and contrast. After the prints are cemented on, trim their edges flush with a sharp knife or razor blade and sand them smooth with fine abrasive paper. Then touch up the paper edges with a black felt-tip marking pen so they blend in with the blocks and become invisible. Arrange the blocks on a backing panel of  $\frac{1}{4}$ -inch plywood or hardboard. This can be edged with picture-frame molding or 1x2 strips to create a shadow-box effect to enhance the 3-D look of the photos.

The display panel shown here incorporates an added feature that makes the blocks easy to mount and rearrange. It's

**MATERIALS FOR PHOTO DISPLAY** include  $\frac{1}{4}$ -inch backing panel, wood blocks of assorted sizes, self-adhering Velcro material, special Velcro adhesive, trimming knife and a small brush for spreading glue

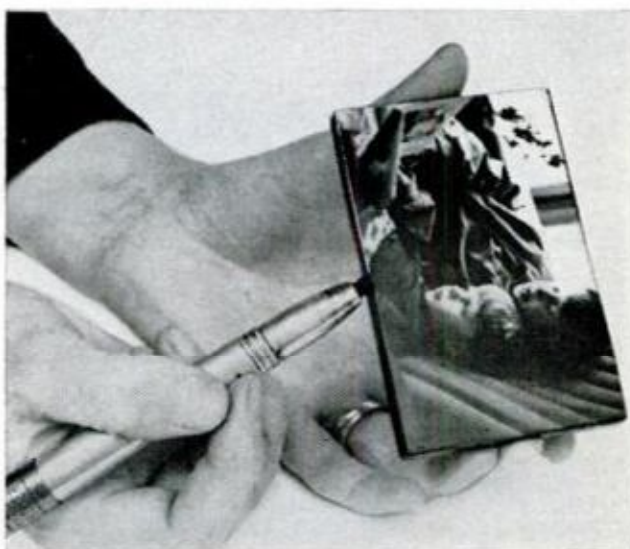
based on the use of Velcro—the two-part, self-adhering material sold as a substitute for zippers and buttons on clothing. One part consists of thousands of tiny nylon loops and the other part has hook-shaped fibers that catch in the loops. When pressed together, the two stick firmly to each other, yet can easily be pulled apart.

The looped Velcro is cemented to the display panel and strips of the matching hooked material are fastened to the backs of the blocks. All you do is press the blocks onto the Velcro-covered panel and they stay by themselves. You can move them around to change the arrangement or add new blocks whenever you like.

Velcro comes in black, white, gray and various colors. The looped material is 48 inches wide and sells for about \$12 a yard. Cut in half, one yard will cover two 2x3-foot panels—a handy size for wall display. The matching hooked material comes as a tape  $\frac{3}{4}$  inch wide for about \$1 a yard. Special cements for mounting both types are also available. Velcro supplies are sold at many department stores, sewing centers and fabric shops. They are distributed by Maharam Fabric Corp., 130 W. 46th St., New York, N. Y. 10036 or 1113 S. Los Angeles St., Los Angeles, Calif. 90015.

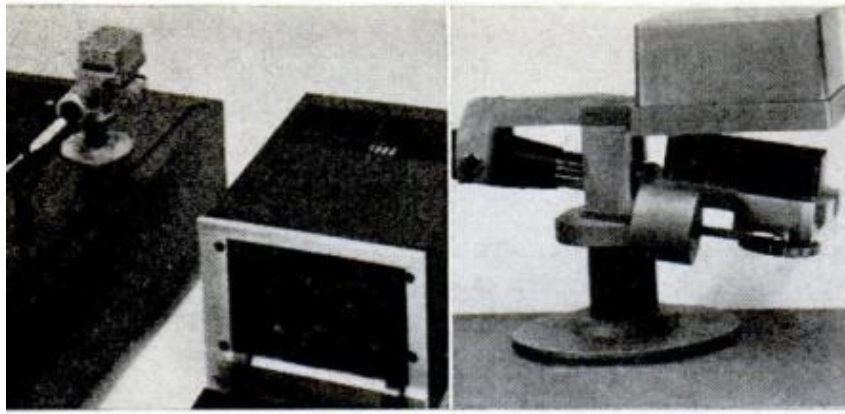
If you don't wish to use the Velcro, you can attach the blocks with either screws from the rear or glue. In this case, lay out the blocks on the display panel in a flat position and make sure you have a pleasing arrangement before permanently mounting them in place. ★★★

**BLACK MARKING PEN** is used to touch up edges of prints so they blend in with black-painted blocks. Run tip along the corners, slanting pen backward so that it can't slip and mar the faces of the prints





# NEW IN



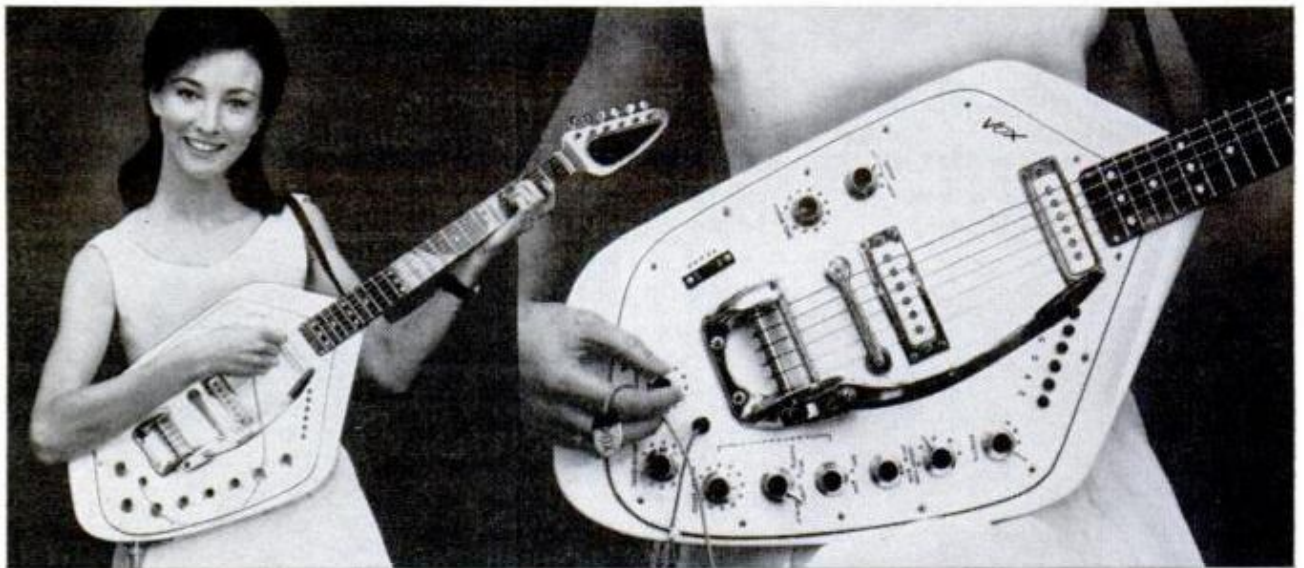
**SELF-CORRECTING TONE ARM** electronically cancels out unwanted vibrations that cause distortion and mistracking. Vibrations produce signals that move arm electromagnetically to damp them out. Said to be faster-acting than oil-damped arms, this ingenious Panasonic device is expected on the market soon.



**SLIDE SYNCHRONIZER** works with any monaural recorder, enabling you to put slide-show commentary on an inexpensive cassette machine. It records inaudible cueing signals on same track as commentary. Cues trigger projector to change slides automatically where desired. Two models, \$50 to \$80. Saunders Associates, 297 Danbury Rd., Wilton, Conn.



**ACCESSORY SPEAKER** is designed especially for use with small tape recorders, transistor radios and battery TV sets to improve their sound quality. It incorporates an 8-ohm, 4x6-inch oval speaker and has a miniature phone plug to fit the tiny speaker or earphone jacks typically used on such portable equipment. \$14.95, Ampex Corp., Elk Grove Village, Ill.

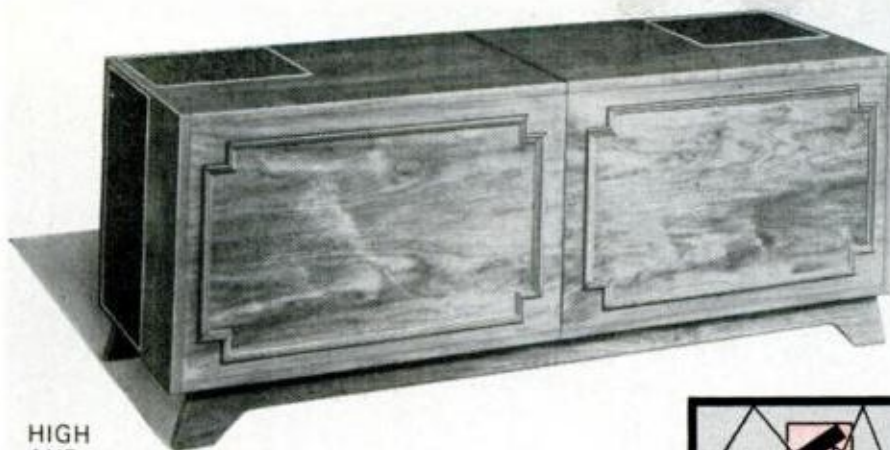


**THIS WEIRD-LOOKING INSTRUMENT** resembles an electric guitar but sounds more like an organ. Built-in electronic tone generator, controlled by a mass of knobs and switches, converts normal guitar sounds into various organ voices. You can also vary the tempo

electronically, create the effect of banjo strumming, or add accompanying drumlike percussion beats. Developed by Jennings Musical Instruments in Dartford, England, the Phantom Guitar Organ sells for about \$480. It can be played like a conventional guitar.



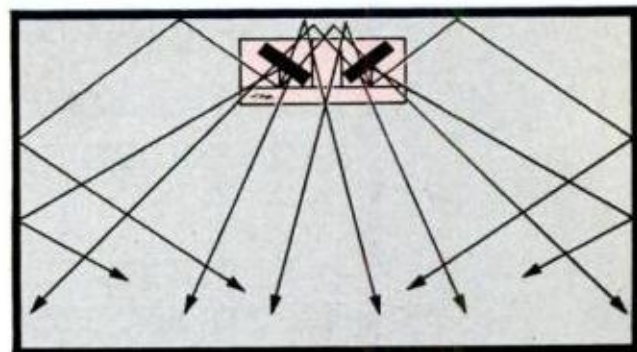
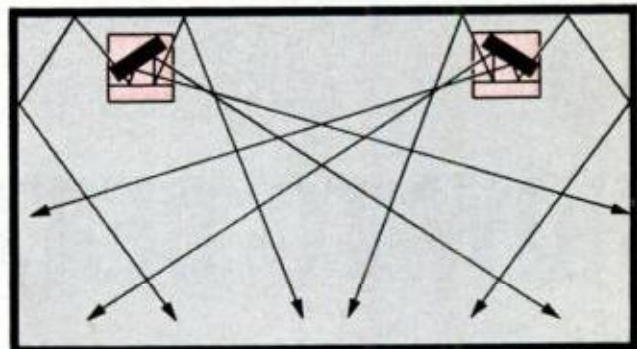
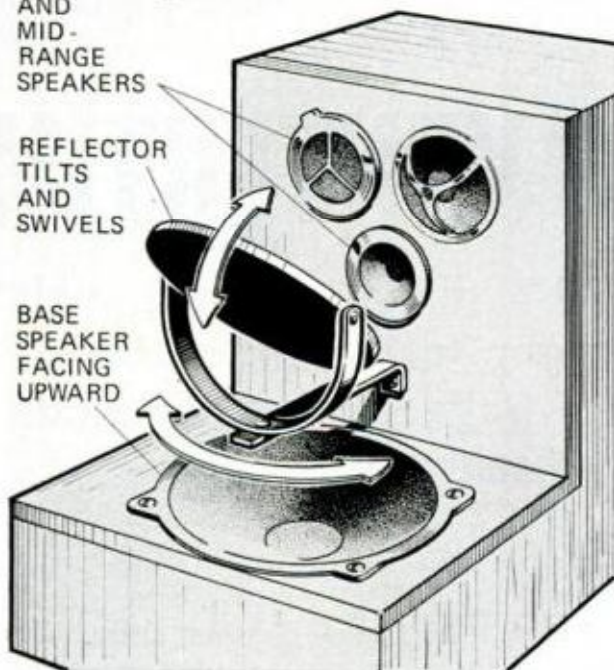
# ELECTRONICS



HIGH AND MID-RANGE SPEAKERS

REFLECTOR TILTS AND SWIVELS

BASE SPEAKER FACING UPWARD



**SOUND WAVES ARE "STEERED"** where you want them in these unusual Wharfedale Vari-flex stereo speakers. Each incorporates an upward-facing woofer and three vertical high and mid-range speakers. Between them is a pivoted disc you can turn and tilt to any angle. The disc acts as a reflector, directing sound

waves anywhere in the room. By adjusting the reflectors, you can tailor the speakers to your individual room acoustics and overcome problems in speaker placement. You can stack two speakers on special base, get good stereo separation despite closeness. Price: \$317.60 each. British Industries, Westbury, N.Y.

**YOU CAN LISTEN IN** on emergency broadcasts with this Hallicrafters FM monitor receiver. It tunes in local fire, police and civil defense transmissions and also covers marine, weather and mobile broadcasts. You can take your choice of two models, one designed to cover the low band from 30 to 50 MHz and the other the high band from 144 to 174 MHz. Both are transistorized and have automatic noise limiters. Called Civil Patrol, the monitor is \$59.95 for either model. Hallicrafters Co., 600 Hicks Rd., Rolling Meadows, Ill.





**BATTERY FAILURE** is the biggest single cause of wintertime no-start problems. Because of great loss of power in battery at low temperatures, always keep it fully charged. One end of a special wire brush tool cleans terminals; other end cleans posts



# HOW TO BEAT 3 WINTERTIME

Last winter the AAA made approximately 34 million emergency calls to motorists stranded because of battery, starting circuit and ignition system breakdowns!

By **MORT SCHULTZ**

**W**AIT AND FREEZE, or walk and freeze. Neither alternative is particularly inviting on a snowy or rainy winter day when your car's engine refuses to start. You can save yourself bone-chilling discomfort this winter, as well as time and money, by preparing now to handle the "big three" wintertime emergencies.

A weak battery is by far the most common problem. Even a new battery can fail if the temperature is low enough.

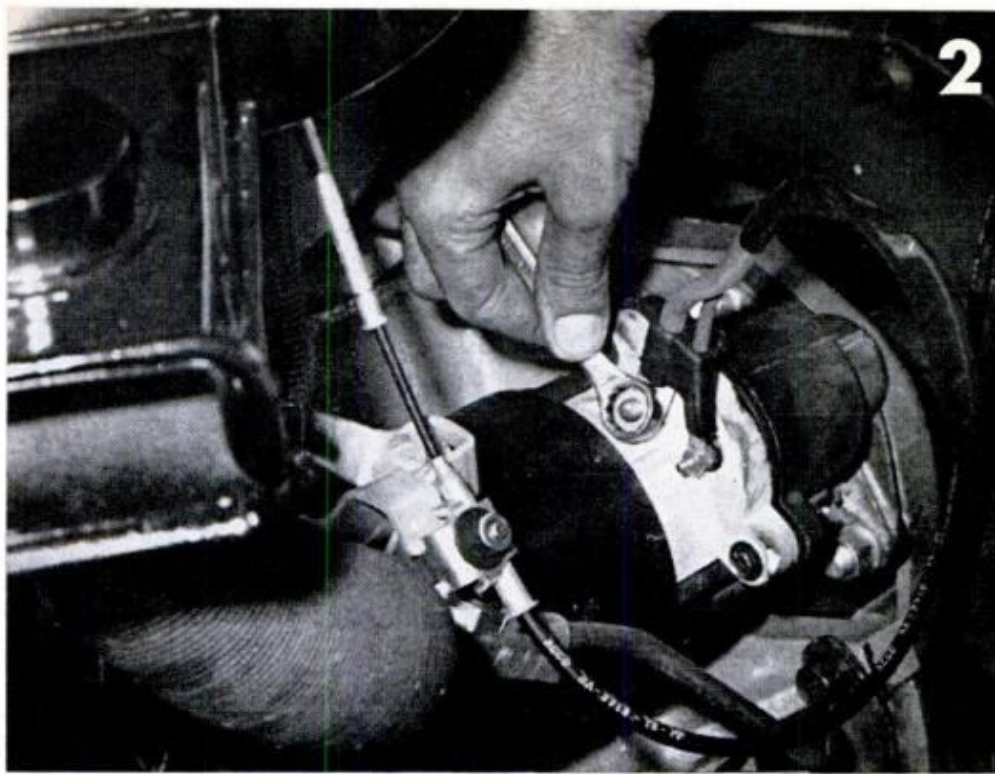
At 0° F., a fully charged battery operates at only 50 percent of its full-charge strength. If a battery is less than fully charged to begin with, it's only a matter of time until it will leave you stranded. Charge it, or get a new battery that will take a full charge. If you do become stranded, a set of jumper cables wisely placed in the trunk at the start of winter will be a lifesaver.

If your car has a manual transmission, the battery failure is easily overcome with a push. Line up the bumpers of the two cars, place the transmission into second gear, and depress the clutch. Make sure that the ignition switch is turned on.

As your car starts to roll, keep an eye on the speedometer. When it reaches about 10 mph, let out the clutch. If the problem is a weak battery, the engine will start.

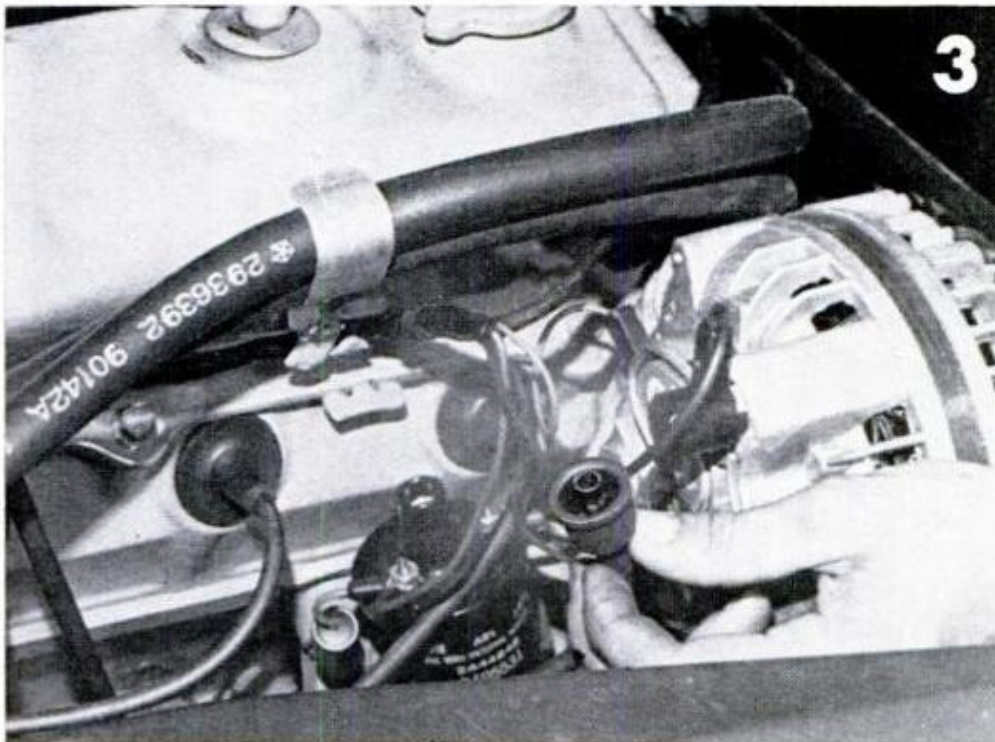
It's more difficult to push-start a car equipped with an automatic transmission. Some cars with an automatic box can't be started by





**SELF-STARTER** found in most cars is not usually as accessible as this. Remove connections, clean terminals and connectors with sandpaper and retighten securely. Before working with the starter cable, disconnect battery to open circuit

# STARTING PROBLEMS



**IGNITION SYSTEM** is under an additional strain in cold weather. Weak coil can cause hard starting. To check possibility that coil is drowning out, remove center cable, dry off cable terminal and interior of the center tower. Be sure connection is tight

pushing. They lack a rear pump that allows the engine to be driven through the transmission.

Since your chance of push-starting an automatic transmission-equipped car depends on the type of transmission, now is a good time to find out what you have if you don't know.

DECEMBER 1970

Every transmission has a model number somewhere on the pan or case. You may have to clean off caked dirt to find it, but it's there. Take this number to the parts department of a dealer who sells your make of car. He will tell you what type of transmission you have.

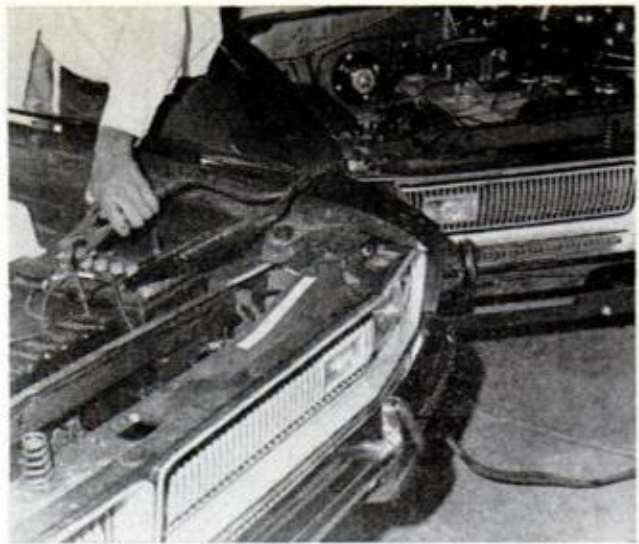
If pushing doesn't start the car, the

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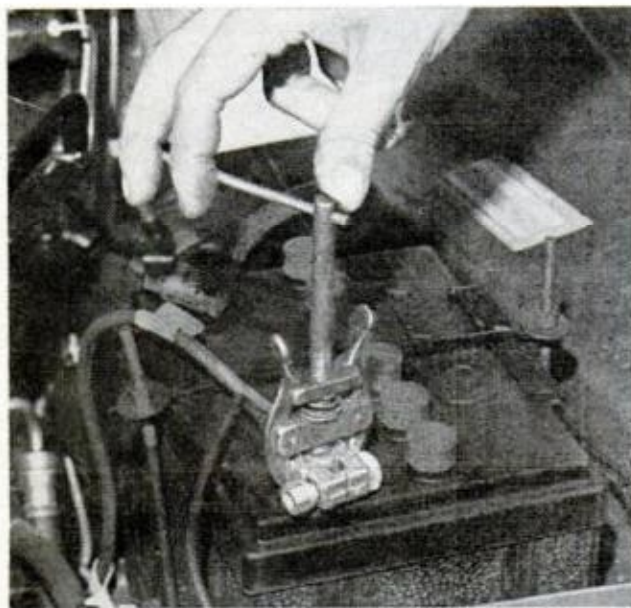




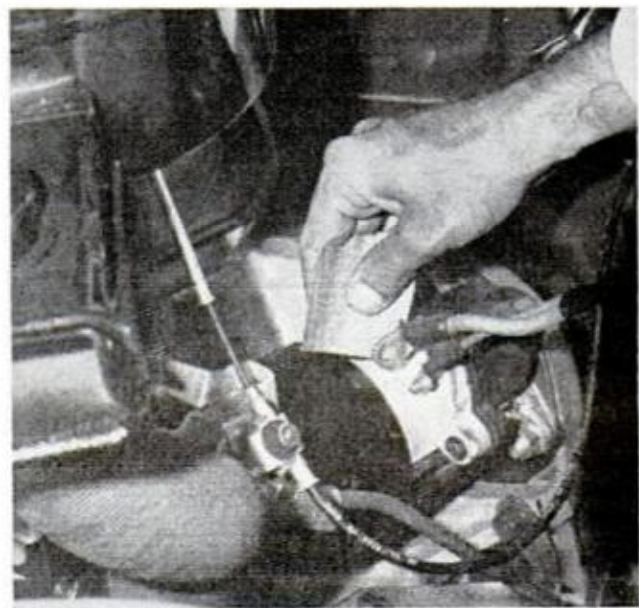
**TRANSMISSION MODEL NUMBER**, found on casing, may be necessary to tell if car can be push started



**JUMPER CABLES** put another battery into circuit. Connect positive to positive, negative to negative



**TERMINAL PULLER** makes removing battery cables a breeze, prevents damage, but costs several dollars



**BATTERY-TO-STARTER** cable end and terminal point will decrease flow of starting current if corroded

battery is probably stone dead. A car equipped with an a.c. generator (alternator) will not start if the battery is completely drained, since there will be no residual magnetism in the rotor.

The only other roadside way to get going when a battery fails is by using the power of another battery. It can be a battery in the car of a good guy who has stopped to help, or it can be a spare battery that you carry in the trunk for such emergencies. In any case, you need a pair of jumper cables, which you can buy at an auto parts store.

In connecting your battery to the booster, be certain that the hookup is correct *the first time*. This is especially true if your car has an alternator. A reverse

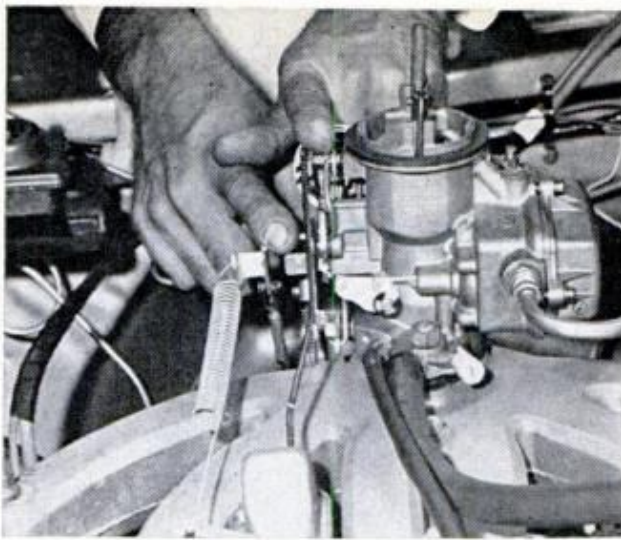
connection will cause the diodes in the alternator to burn out.

Connect the two batteries in parallel—positive post to positive post, and negative post to negative post. The jumper cables are also positive (red), and negative (a color other than red) and should be connected correctly—that is, positive to positive and negative to negative.

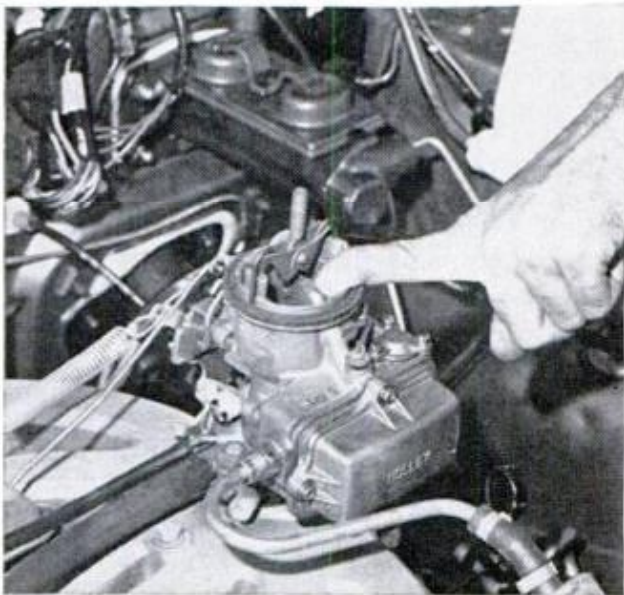
With the hookup made, start the engine in the normal manner, but don't keep cranking if it doesn't catch. If an engine won't start within 10 seconds, the problem is something other than a run-down battery. Continued cranking will only drain the good battery.

Trouble in the starting circuit is another reason for engines failing to start





**AUTOMATIC CHOKE** may be opened by hand to stop flooding by releasing choke arm from fast idle cam



**CHOKE PLATE** should be closed when starting cold engine. If not, close it manually, check mechanism

in cold weather. Corrosion prevents the maximum delivery of current needed for starting. This is particularly true when this corrosion is present in cold, wet weather.

The most common areas of corrosion buildup are the battery-cable terminals and the terminal where the "hot" battery cable connects to the starter. Other areas to look at are the battery-cable ground connection and the point where the "hot" cable connects to the starter relay. All of these points can be found by tracing the cables from the battery.

Clean the cable terminal and battery posts. Use sandpaper or a special wire-brush tool. Clean the starter connection. Before you touch that cable at the starter

(or starter relay), which is hot, be sure that you disconnect one of the cables at the battery to break the circuit. Otherwise you'll get zapped.

If the engine cranks smartly but doesn't start, you stand a good chance of ignition connections being wet or loose. The first emergency step is to give each connection a firm push at the coil tower, distributor cap and each sparkplug cable.

If the engine still refuses to start, carefully work connections from place for drying. Concentrate first on the coil tower. Dry off the cable terminal and the inside of the tower. Reconnect the two tightly and try to start the engine.

If you have no success, carefully pull off and dry each of the sparkplug cables and sparkplugs if they aren't recessed, and then each cable connection at the distributor cap.

Aside from the "big three," there are other reasons for a no-start problem in wintertime. Flooding is one, and it's caused by the driver or an automatic choke.

Too many drivers think pumping the gas pedal in cold weather will assure better starting. Not true! In fact, this will prevent a car from starting.

The right way to start a cold engine in any weather, but especially in winter, is to depress the accelerator pedal to the floor one time only, hold it one-third to halfway down, and crank the engine. If you should flood it, shove the accelerator pedal right to the floor and keep it there as you crank. However, if the engine doesn't catch within 15 seconds or so, stop cranking. You don't want to add a drained battery to your other headaches.

If the engine is cold and floods, and this procedure doesn't help, chances are likely that the automatic choke is closed tight. The choke has to be opened before a flooding condition can be relieved. To open the choke, pull back on the fast idle cam and release the choke arm.

There is another choke-related reason for a cold engine not starting. The choke might be binding because of dirt and not closing, which will starve an engine of the fuel it needs for starting. Check the plate. If it's open, wipe the dirt from around it and force the plate closed by hand.

Down to your last resort, why not try an engine-starting fluid—it may save the AAA a trip. ★★★



EXCITING  
**NEW PRODUCTS**  
 BY CATHERINE BILSKI

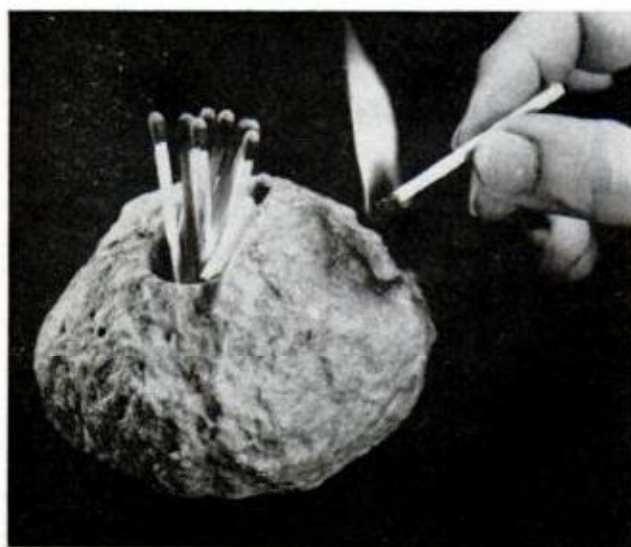


**DON'T WORRY** about your hot and cold-water lines freezing this winter; be prepared with Pipe-De-Icer (pat. pend.) which clears ice from frozen lines without chemicals or electricity. It attaches to a faucet in seconds without tools to clear an ice blockage in five minutes and it's reusable as often as your frozen water-line problem occurs. The four models shown (above, right) are priced from \$10 to \$15; Liquid Systems, Inc., Box 145, Congers, N.Y. 10920.



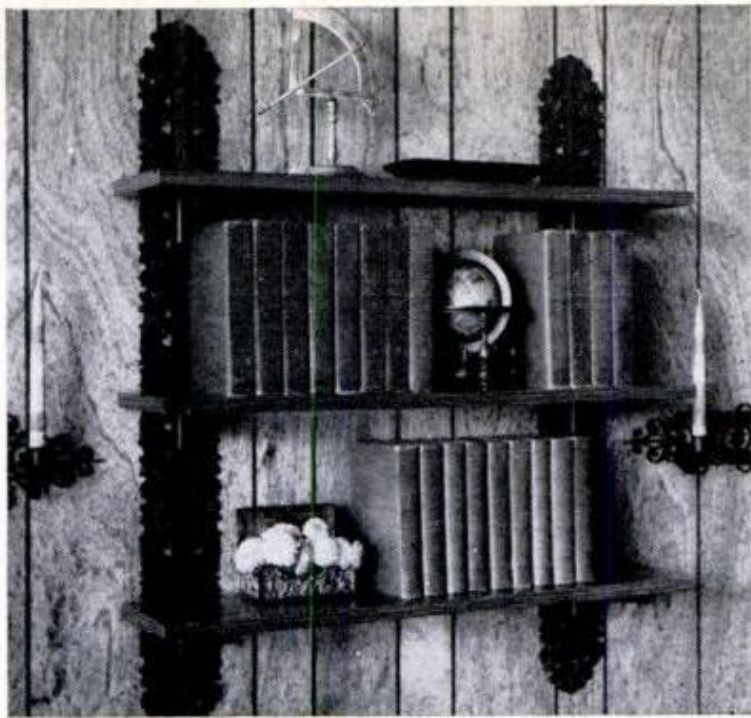
**A MODEL MASTERPIECE** to delight all model enthusiasts is the *Golden Hind* (left), flagship of Sir Francis Drake. The kit has everything you need to make this historically authentic ship. \$22.45 postpaid from Scientific Models, Inc., 113-M Monroe St., Newark, N.J.

**A SCIENCE SET** that rockhounds will enjoy is the RIC-920 Rock Identification Computer (below), which lets you analyze and identify over 125 kinds of rocks. It's fascinating and sells for under \$20. Skil-Craft Corp., 325 W. Huron St., Chicago, Ill. 60610, makes it.



**A FUN GIFT** to give or receive is the Sticks and Stone goofproof lighter (left). Made of natural rock, it has a recessed area to hold the sticks—old-fashioned, wooden kitchen matches. Retail for \$5. Pocoh Industries, Inc., 8943 Wilshire Blvd., Beverly Hills, Calif.





**GO MEDITERRANEAN** and add a touch of elegance to any room with pilaster shelving. These shelves come in a kit that includes three Spanish Oak shelves, two anodized aluminum standards, six anodized aluminum brackets, four endpieces and two centerpieces. Priced at \$34.95 and made by the Dorfile Manufacturing Co., 3800 S.E. Naef Road, Portland, Ore. 97222.

**REDUCE EYESTRAIN** when doing intricate work, viewing small objects or reading fine print with the 3-D Sight Booster (below). It can be worn over your own glasses and has a flip-up movement. Made of lightweight unbreakable plastic with an adjustable headband, it sells for \$5.95 (4-power loupe, \$2 extra). Better Vision Co., 23-26 143rd St., Whitestone, N.Y. 11357.

**SHOVELING SNOW** no longer has to be a bending, stooping and backbreaking chore, thanks to the Back Saver snow shovel. Its S-curved handle allows you to stand up straight while you're shoveling and a silicone vinyl finish helps sticky snow slide off the blade easily. It's made by the Rugg Manufacturing Co., 105 Newton St., Greenfield, Mass. 01301 and it sells for \$6.40 postpaid.



**SPEED, STRENGTH AND VERSATILITY** are what make Vigor Aron Alpha Adhesive unique for use on almost any kind of material needing extra high-strength bonding. Simply apply a drop (below) and press parts together firmly to close air gaps. \$2 postpaid from Vigor Co., 53 W. 23rd St., New York, N.Y.





**Colored lights flash on and off wildly in this simulated electronic display. Based on ordinary Christmas-tree blinker bulbs, it can be built in a few hours for fun during the holiday season and throughout the year.**

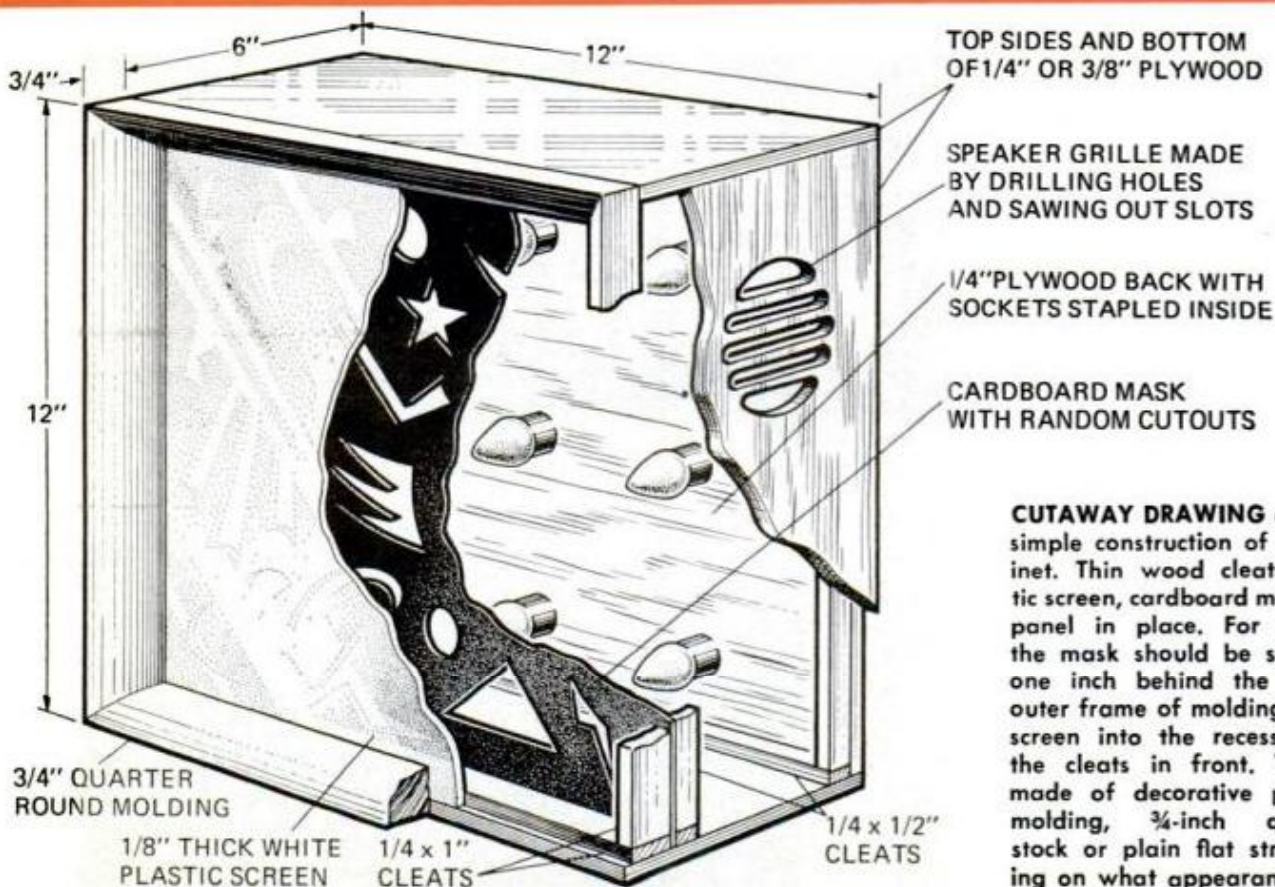
By **DON RIMMER** and  
**RUDOLF F. GRAF**

**YOU WON'T QUITE BELIEVE IT** when you see it, but these flashing colored lights appear to dance in time with music just like expensive electronic lighting displays. Actually, there's no electronics involved at all. The lights are merely blinker-type Christmas-tree bulbs that flash on and off at random. The curious thing is that when you play a radio or record at the same time, the bulbs seem to wink in time with the music's beat no matter how fast or slow the tempo is.

You'll find it fascinating to watch the constantly changing patterns of colors and shapes that flash on the screen. To heighten the effect you can build a small speaker into the display box and connect it to the speaker terminals on your hi-fi set so the sound appears to come right from the screen. Or you can place the box near one of your regular hi-fi speakers.

The display is fun to build because it's simple and involves practically no expense. It's just a plywood box with a string of blinker bulbs stapled to the back and thin white plastic for a screen in front. In between is a cardboard mask with random-shaped cutouts—stars, circles, triangles and other geometric figures. Light shining through the mask from the bulbs projects images of the cutouts on the

## Build Your Own



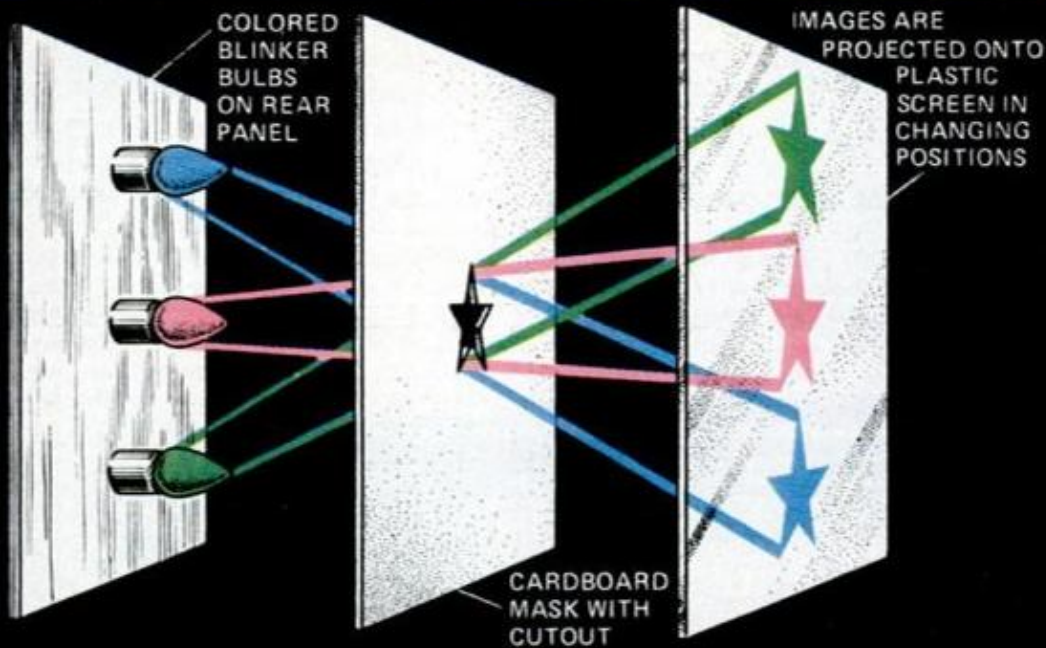
**CUTAWAY DRAWING** at left shows simple construction of display cabinet. Thin wood cleats hold plastic screen, cardboard mask and back panel in place. For best results, the mask should be spaced about one inch behind the screen. The outer frame of molding strips holds screen into the recess formed by the cleats in front. This can be made of decorative picture-frame molding,  $\frac{3}{4}$ -inch quarter-round stock or plain flat strips, depending on what appearance you want

POPULAR MECHANICS

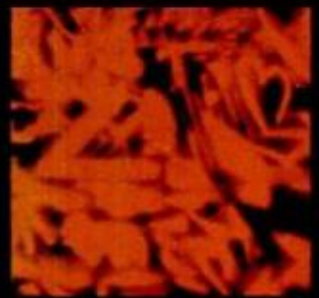




# Dancing Light Display



**PRINCIPLE BEHIND DANCING EFFECT** is shown in drawing above. The mask is placed slightly behind the screen so light shining through a cutout hits the screen at changing angles. Each bulb projects an image of the cutout in a different position on the screen because its light passes through the cutout at a different angle. Each cutout thus creates identical images in different colors. Since the lights flash rapidly on and off, the images appear to dance wildly. The three small color insets at right show how screen looks when each of the three colors—green, red and blue—is turned on separately without the others.







**OPTIONAL SPEAKER** can be mounted inside cabinet so sound appears to come from behind screen. Use a small 8-ohm, 4-inch type and cut slots in the box's side to form a grille. You can omit the built-in speaker if display is placed near external speaker

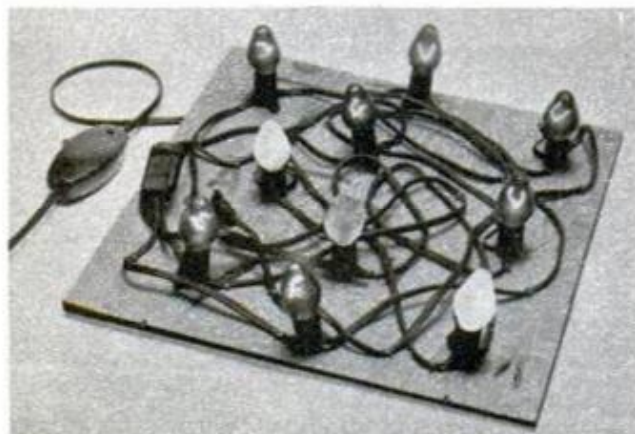


screen. The images dance around wildly, changing position and color as different bulbs flash on and off.

You can make the display any size you want. The one shown here is 12 inches square by 6 inches deep—a handy size to fit on a shelf. Dimensions aren't critical except for the spacing between the mask and screen. For the best effect, they should be about one inch apart. If the mask is farther back, the images get too fuzzy; if closer, the images are sharp but their apparent motion is reduced. Paint the interior of the box and the mask flat black to kill stray reflections.

A dozen bulbs are about right in this size

**STRING OF BLINKER BULBS** is simply stapled to back panel in a random arrangement, making it easy to mount the lights. Stapling the wire on either side of each socket will hold bulbs in an upright position. Also staple excess loops in place, being careful not to run fasteners into the wire itself



display, but you can vary the number. Blinker bulbs are available where Christmas-tree supplies are sold. You can also use regular bulbs and wire them into plug-in Christmas-tree flashers, as shown below. This will produce a similar flashing effect, but the blinker bulbs are brighter and create more dramatic results. The 1/8-inch plastic for the screen is available from plastics suppliers as listed in your classified telephone directory. Opal glass, sold by glaziers, could also be used. Experiment with different patterns of cutouts before permanently mounting the mask. You may find that some shapes produce better displays than others. ★★★

**ALTERNATE ARRANGEMENT** using plug-in flashers instead of blinker bulbs is shown below. In this case, use regular nonblinking bulbs and divide them into three groups of three or four each. Plug each group into a separate flasher. Row of three flashers can be plugged into strip outlet for a neat wiring job

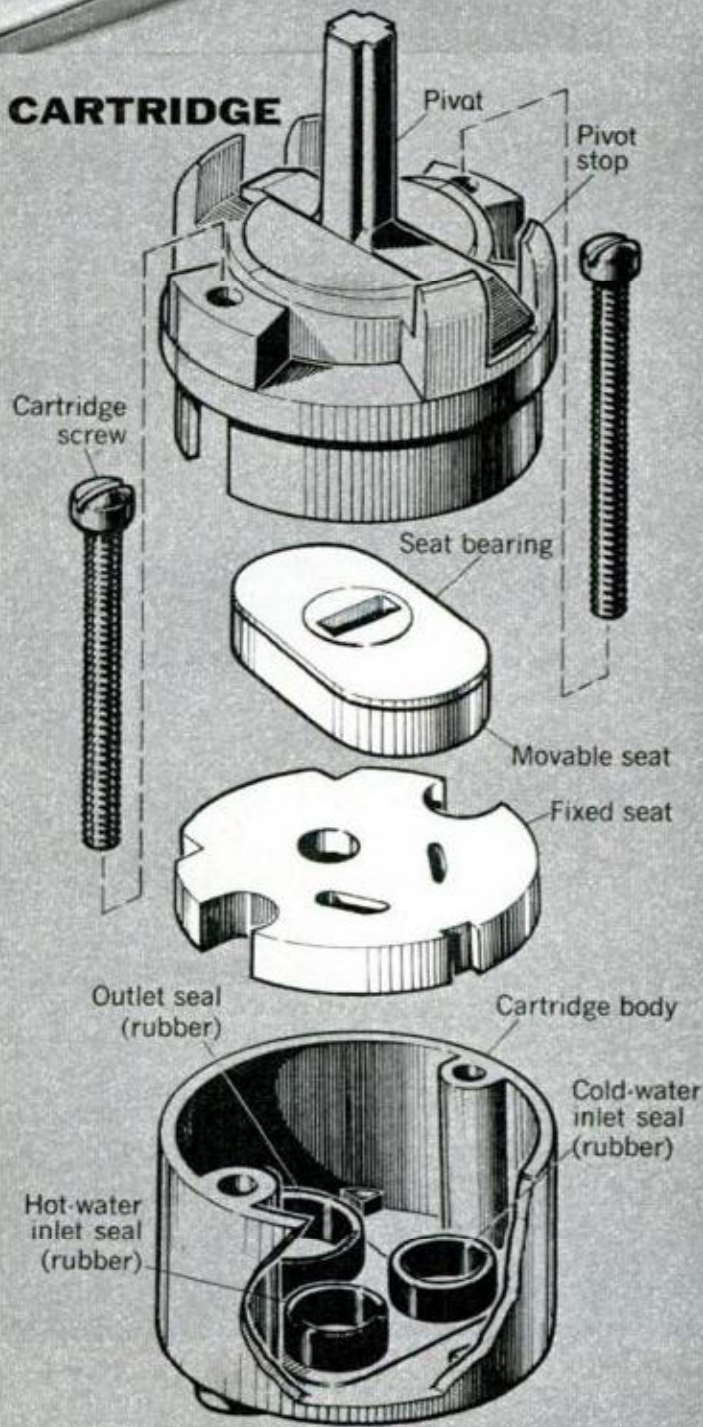




# Now...An Indestructible Water Valve



## CARTRIDGE



**I**T DOESN'T SEEM POSSIBLE that a kitchen, lavatory or bathtub water spout won't ever drip, but that's the promise made for a ceramic-disc cartridge in a new line of one-handle faucets.

Until now, faucets employed either neoprene seats or O-rings that wear and are affected by contaminants in water. Thus, they have to be replaced periodically.

The new type shown uses noncorroding materials for all parts that come in contact with water. For example, the cartridge case is glass-reinforced plastic and the valve inside the case is a tough ceramic called alumina. (In the laboratory it showed little wear after being subjected to the equivalent of 25 years of use.)

The alumina valve consists of two discs that have machined cold-water, hot-water and outlet ports. The position of the ports in the top disc and those in the lower disc allow cold or hot water or a mixture to be delivered. The top disc moves as you activate the faucet handle; the bottom disc remains stationary at all times. The discs are held together by a vacuum force created as the two rub together.

Three rubber seals are fitted into the cold-water, hot-water outlet ports of the bottom disc. Although these won't wear out because they don't move, they can deteriorate in areas where water has a high mineral content. If a seal fails, it is easily replaced.

The faucet shown is the Aquarian by American-Standard, 40 W 40th St., New York, N.Y. The kitchen type sells for \$28, the bathroom version for about \$24.50.

—Steven J. Howard



# Put Life in Any Room With A Rock-Garden Waterfall

It's easy to build with plywood and bluestone slabs—a small pump circulates the water

By ROSARIO CAPOTOSTO

**M**ILLIONS OF AMERICANS spend their leisure summer hours on a back-yard patio that is made more pleasant by the presence of a rock-garden pool and waterfall. And, if you are among those who share that pleasure, you know that during these cold months it would be enjoyable to hear that splashing water as it spills over the rocks.

Wanting that enjoyment year-round is what prompted me to undertake the project you see here. And once the project was sketched out on paper, it was obvious that it would not be a difficult one. Once you have pretty much decided on your design (it can be altered during construction), select the floor space where it will be located. The floor plan in our home gave us a perfect spot—a little used corner located opposite the front entrance.

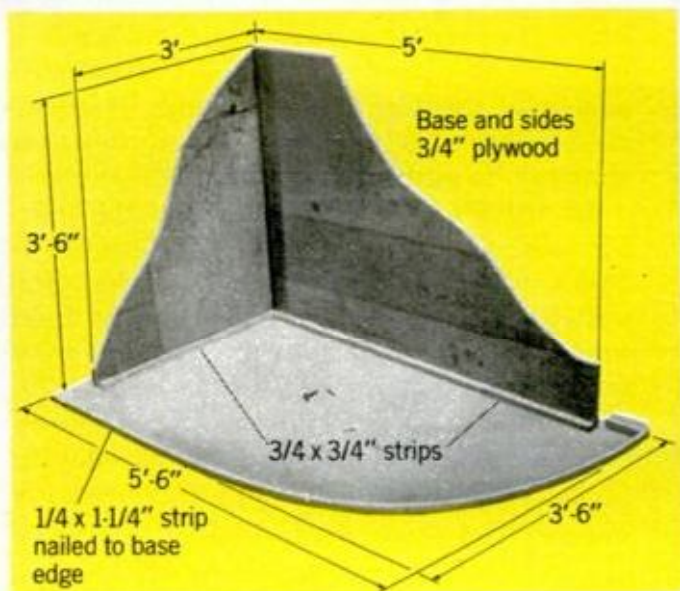
*How to build it.* The project begins with a base and a two-sided,  $\frac{3}{4}$ -in.-plywood frame. The overall dimensions, 36x42x60 in., were determined, of course, by space limitations. These can be altered to suit any space. A three-course-base wall of bluestone slabs represents the only formal arrangement of this otherwise informal rock formation. The bluestone slabs can be purchased at a local mason supply house along with the mortar cement. If you want to work with minimum fuss, you can use a ready-mix mortar. If you want to mix your own, use one part mortar cement to two parts sand, and just enough water to obtain a dryish mix.

The rocks I used were gathered in nearby fields. But they can be purchased. You'll find that prices range from a few cents per pound to about 20 cents per pound for the more unusual-shape rocks. Select bluestone about 4 in. wide in lengths you can form

**MOVING WATER** is always an attraction, and this indoor waterfall is no exception. You'll enjoy its murmuring sounds and the admiring comments of your guests





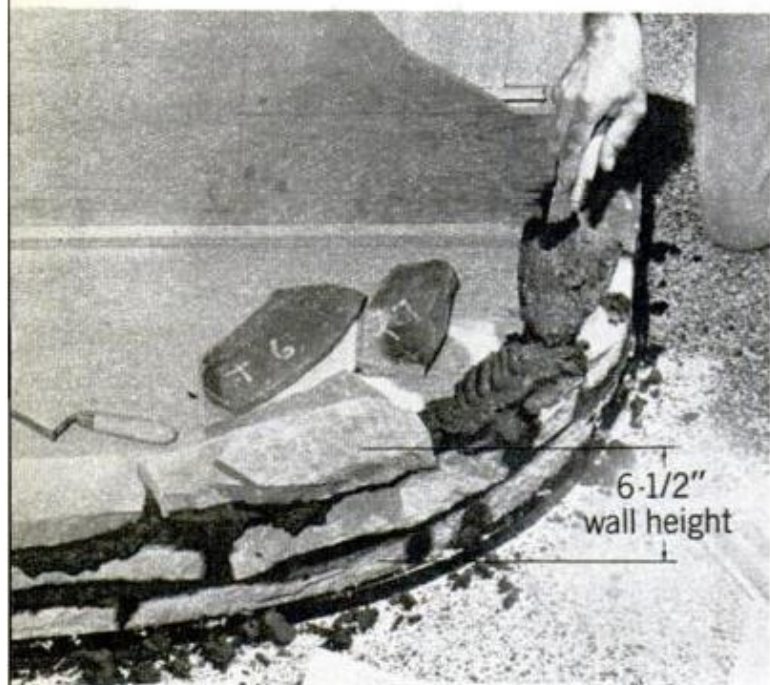


**BLUESTONE** can be cut with chisel, but buy a few extra pieces. Chalk-number pieces as they are fitted





**PANEL ADHESIVE** holds first course of stone to the wood. For convenience, prepaint base edge first



**MORTAR CEMENT** is troweled in furrows as is done with bricks. Remove all "ooze-out" before it sets



into a radius with a minimum of cutting.

You can work outdoors with the frame to do the initial cutting and fitting of the bluestone, which is a bit messy. But don't begin the actual assembly until you are set up in the final location; the assembled mass would be too heavy to move. Use a hammer and cold chisel to trim or cut the stone to size (for safety wear goggles), chalk-numbering the pieces as you go. Then it is a simple matter to position them in the same order for cementing. Since the first course rests on the wood base, I used globs of Marlite panel adhesive which insured good adhesion between stone and wood.

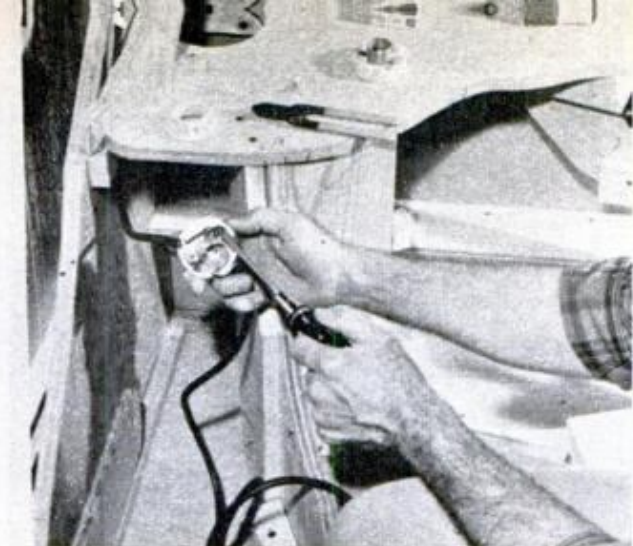
A large plastic pan (a 16x32-in. baby bathtub, 7 in. high, was used here) is set in the bottom to form the pool which stores and collects the recirculating water. Using only your imagination and scraps of wood, build up a series of shelves or ledges to form the basic contour of your "mountain." Since we used a free-form, hit-and-miss arrangement, specific dimensions were purposely avoided. Actually, you'd have much difficulty in trying to duplicate it exactly. Since no two rocks are precisely alike, use our framework only as a guide. But, as you lay out your rocks, keep in mind that water not only runs downhill but will, on occasion, creep along the bottom of a rock dripping water where you may not want it. For this reason be sure that you arrange the basic opening for the pool so it is centered over the pan.

Two "caves" are built into this formation, a little one near the top and the main one leading to the pool. The upper one allows illumination from within to light up the water dripping over its opening. The main cave allows access to the pump while also emitting light from the inside. Bore holes through the frame where necessary to allow the hose from the pump to have access to the top of the mound. Then install porcelain lamp-sockets in locations that can be easily reached.

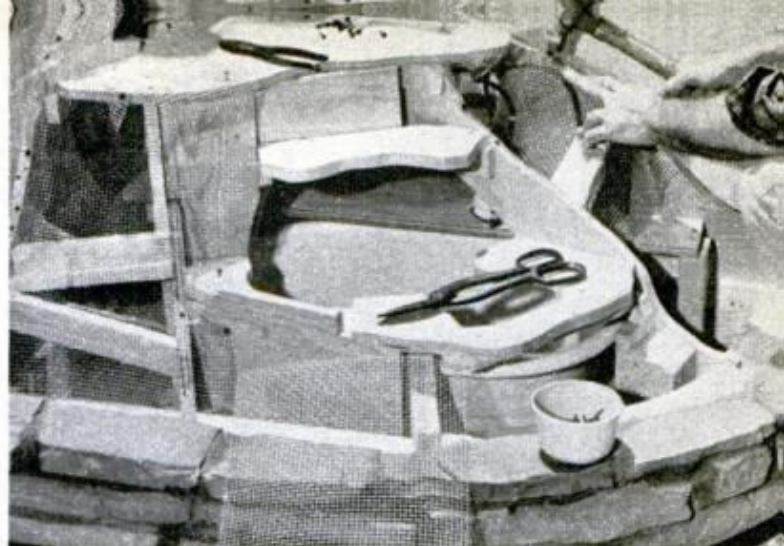
In order to provide a base for the mortar over the irregular form, a network of 1/4-in. wire mesh is nailed over the completed framework. Use overlapping small pieces of the mesh, rather than try to form large sections. Assemble your rocks and prepare the mortar for the most fascinating phase of the project: guessing an

**SHELVES** placed at random will support rocks. For strength, fasten the wood members with screws





**LAMP SOCKETS** should be located where they will be within easy reach but remain out of direct view



**DRAPE WIRE MESH** over woodwork and open spaces to prepare a surface that the mortar can key into

arrangement that will direct water exactly where you want it to go. Use flat rocks to spill water over a ledge and angled combinations to form gullies to direct streams. Mistakes can be corrected by adding more cement and rocks.

Work with a relatively dry-mix mortar and, to slow down drying time, dampen each rock before placement. Compact joints with a small trowel to render them watertight. When all the cement work is completed, gather up all loose particles of grit from the mound and pool before filling with water and installing the pump.

The pump, a Little Giant model No. 1 WFL, will circulate more than enough water for a waterfall this size. This pump, a submersible type, is mounted in the water and operates noiselessly. A hose restricter is supplied to permit control of the flow. Position the hose at the top of the mound and conceal it with rock. Addition of realistic plastic plants and a tree complete the project. Insert some green and blue light bulbs and a layer of crinkled aluminum foil in the bottom of the pool to reflect light, then turn on the current to enjoy the fruits of your labor.

Actual working drawings for a remodeling project of this nature are purposely omitted. They can serve no purpose since individual space allotments and room shapes differ so widely. Dimensions provided on the photos will serve to guide you in formulating your own proportions.

Have fun with your remodeling; it'll increase the esthetic and dollar value of your home. ★★★

**WATER PUMP** is compact unit mounted in the water. Only a screwdriver is needed to connect the hose



**USE STIFF MIX** but dampen rocks to insure a good bond. Compact the mortar so it will be watertight





# NOW: COOKOUT



**ELECTRIC GRILL** is an exciting approach to indoor cooking. Built-in surface ventilation (right side of grill) eliminates hood



# FUN INDOORS, ANYTIME!

This countertop grill for family and party cookouts duplicates the flavor of patio charbroiling electrically

By WAYNE C. LECKEY, Home and Shop Editor

**W**ITH THIS COUNTERTOP GRILL you are ready for instant "cookout" fun indoors 365 days of the year.

It's Jenn-Air's new electric single-grill Savory Center which provides an exciting new adventure in cooking. With it you can charbroil steaks, hot dogs, hamburgers, fish and fowl faster than on an outdoor grill—and without the fuss. Some 2800 watts of clean radiant heat vaporize droplets of meat juices as they strike the grill rock below. The smoke and vapors created bathe meat with true charbroiled flavor. The surface vent quietly whisks these fumes outdoors before they can escape into the room.

The grill's exclusive surface venting eliminates an overhead hood. And because the exhaust system is built-in under the surface rather than at ear level, it's whisper quiet. What's more, because ventilation is within the grill, greasy vapors are kept below flame-up temperatures. Excess grease is automatically collected in an attached, removable jar.

Due to its compact size and efficient fume removal, the grill's a natural for controlled environment of a mobile home or apart-

ment. Venting is simple, and the no-smoke, no-odor feature is especially desirable.

If you are now eager to install this amazing grill, the critical requirements are: overhead cabinets should be at least 18 in. above the grill and you should have 240 or 208-v. current in your home.

Fitting the grill in a counter is simple enough, but the spot you pick is determined to some extent by the convenience it offers in ducting the grill outdoors. Obviously, a good spot is in a counter along an outside wall where ducting can go directly at 90° angle to the outdoors. Not only does it require less work, but less pipe. In an island installation the duct must go through holes in both the cabinet and the floor and then at right angles to a hole in an outside wall. By using 3¼ x 10-in. flat vent pipe instead of 5-in. round pipe, the ductwork can run across the floor to the outside in the free toe space under the cabinet. This is feasible in peninsula and similar-type cabinets.

When the grill is installed in a cabinet along an inside wall and it is not practical to exhaust it to an outside wall, flat duct pipe again can be used to vent the grill

## ACCESSORIES TO MAKE YOUR GRILL A MOST VERSATILE APPLIANCE



OPTIONAL ACCESSORIES will convert your grill to a rotisserie, shish kebab or french fryer in seconds. Griddle, which comes with grill, has tough, nonstick surface coating that can't be damaged by metal spatula

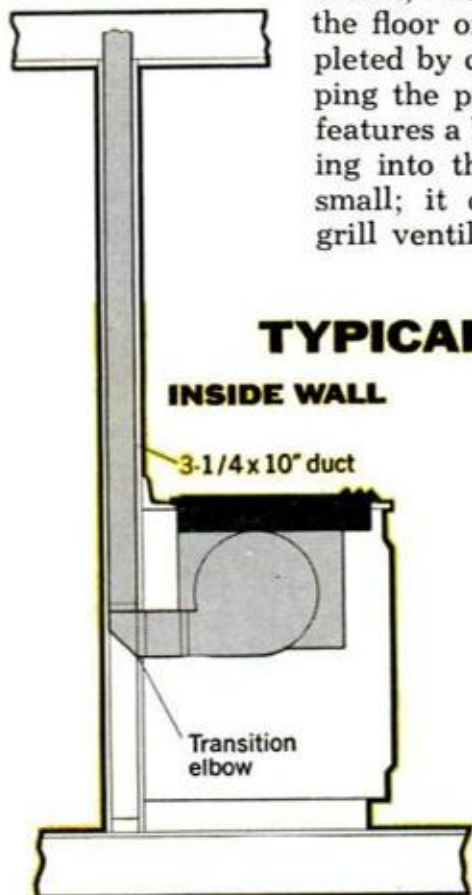




**1. USING TEMPLATE** that comes with grill, place it in position on counter and pencil-mark four corners



**2. AFTER DRAWING LINES** from corner marks, bore holes and carefully saw along lines with a sabre saw



UP INSIDE WALL TO ROOF

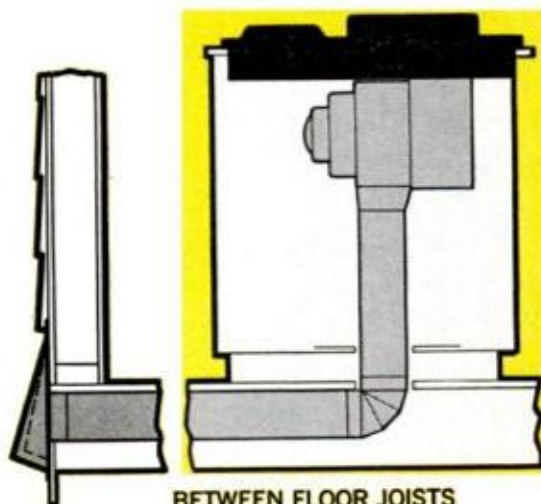
through the wall and out the roof. The fan housing can be swiveled 90° to direct it either out through the wall or down through the floor to suit the particular installation.

The grill requires a counter cutout  $16\frac{7}{8} \times 20\frac{1}{4}$  in., and a sabre saw makes quick work of cutting through the countertop. A template you get with the grill not only is used to mark the cutout, but also to locate the duct holes when ducts go through the floor or out the back of the cabinet. The ductwork is completed by cutting a  $5\frac{1}{4}$  in. hole in the side of the house and capping the pipe with a 5-in. aluminum wall cap. This special cap features a back-draft damper which prevents breezes from blowing into the house. A 3 or 4-in. laundry-type wall cap is too small; it creates back pressure that lowers efficiency of the grill ventilation system and can back up smoke into the kitch-

## TYPICAL DUCT ARRANGEMENTS

**INSIDE WALL**

**PENINSULA OR ISLAND**



BETWEEN FLOOR JOISTS





**3. REPOSITION TEMPLATE** over cutout and use it to locate vent-pipe hole. Here pipe runs through floor



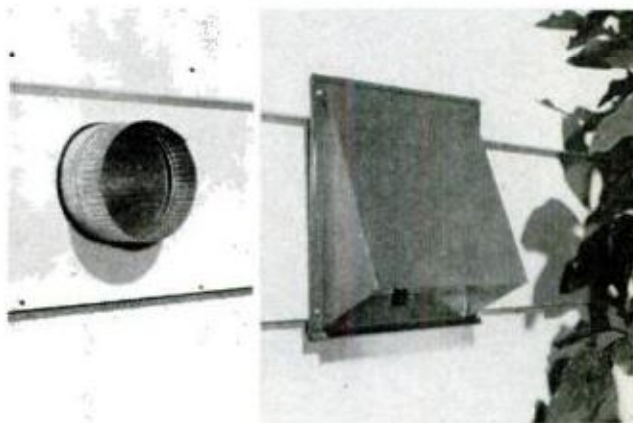
**4. WITH DUCTWORK IN PLACE**, lower grill in cutout and connect to pipe. Then screw in glass grease jar

*Installation photos by Robert Borst*

en. Maximum duct length is 22 ft. with 5-in. pipe (less 4 ft. for each 90° elbow) or 30 ft. with 3 1/4 x 10 or 6-in. pipe (less 5 ft. for each 90° elbow).

The deluxe grill features a lighted fan switch and pilot light, a built-in timer and a handy convenience outlet with circuit breaker. The suggested retail price of \$235 includes the griddle accessory. The economy model in the color photo sells for \$185 less griddle. For more information, write Jenn-Air Corp., 3035 Shadeland Ave., Indianapolis, Ind. 46226, for a free brochure.

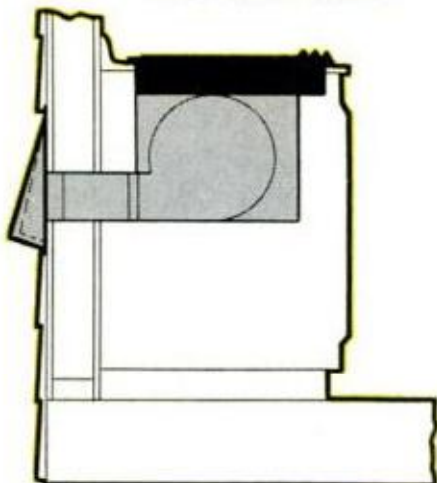
★★★



**5. FINALLY INSTALL WALL CAP.** It fits 5-in. round pipe and is fastened to siding with four wood screws

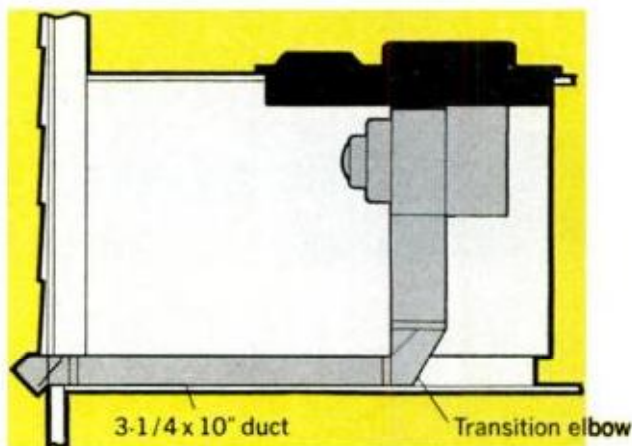
*Technical Art by John Lind*

**OUTSIDE WALL**



**DIRECTLY TO OUTSIDE**

**PENINSULA**



**THROUGH CABINET TOE SPACE**

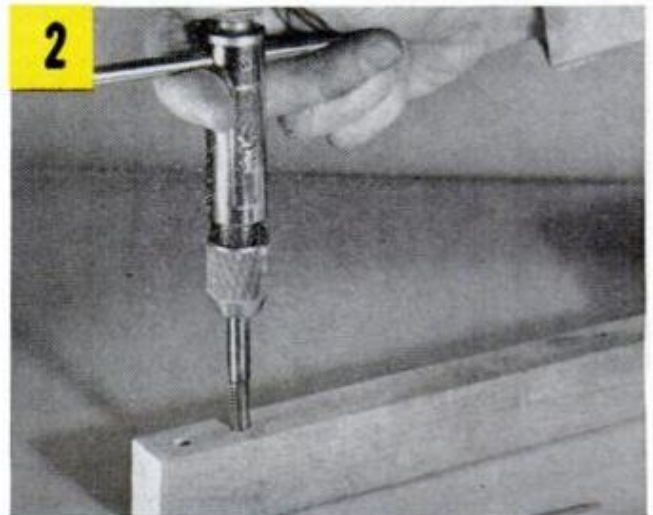


# 40 GREAT HINTS FOR YOUR HOME AND SHOP

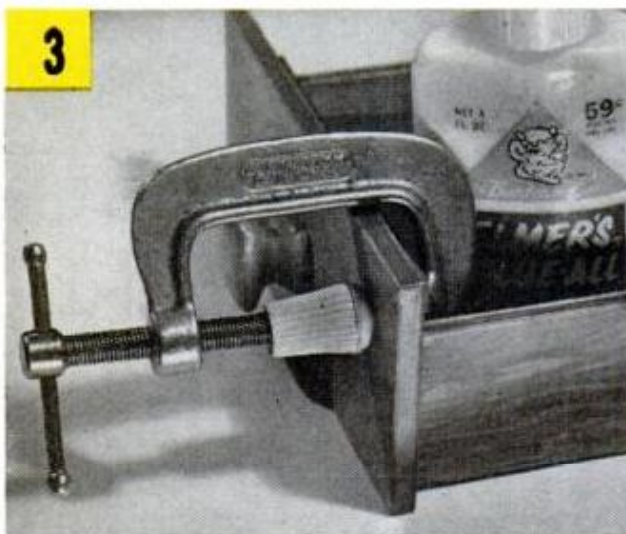
Photos by Walter E. Burton



**MAGAZINE PLANS** will be kept conveniently in full view for quick, continual reference if you hold the pages open with a trouser hanger. With PM's new glue binding, two-page spread will stay perfectly flat



**A BETTER GLUE-DOWEL JOINT** is assured if you run a machine tap into the hole that will receive the dowel. As the dowel is pushed in, excess glue is forced into threads to give a strong, permanent bond



**AVOID CLAMP SCRATCHES** when regluing a piece of finished furniture by placing a rubber crutch-tip over the clamp's pad. Various sizes are available at well-stocked drugstores and hospital supply houses

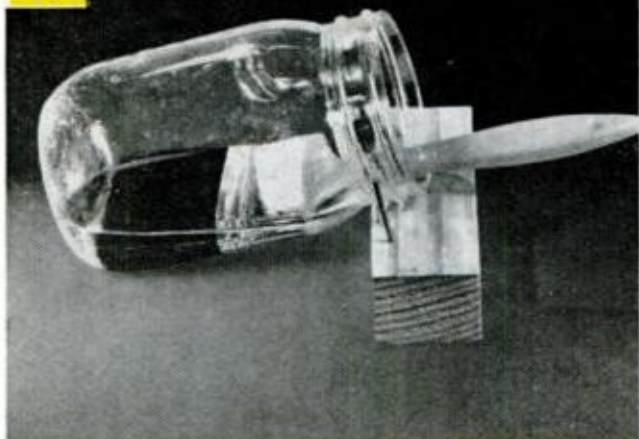


**A WIDE BAND** cut from an inner tube, and wrapped snugly around your oilstone, will keep the oil where it's needed when the stone is in use. If a tube's too big, try using a wide-type rubber band instead

POPULAR MECHANICS

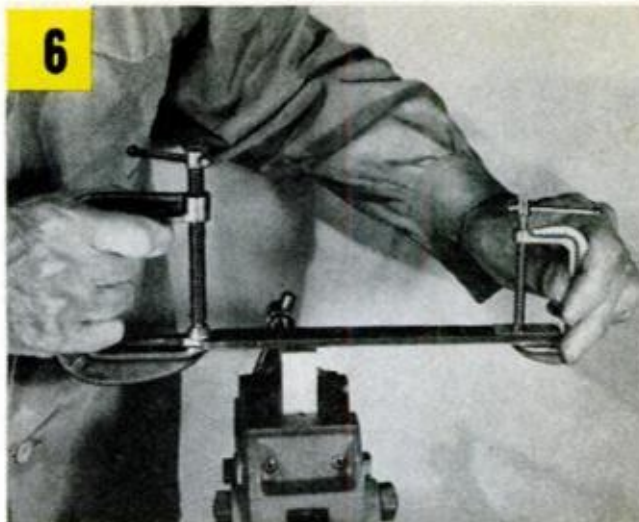


5



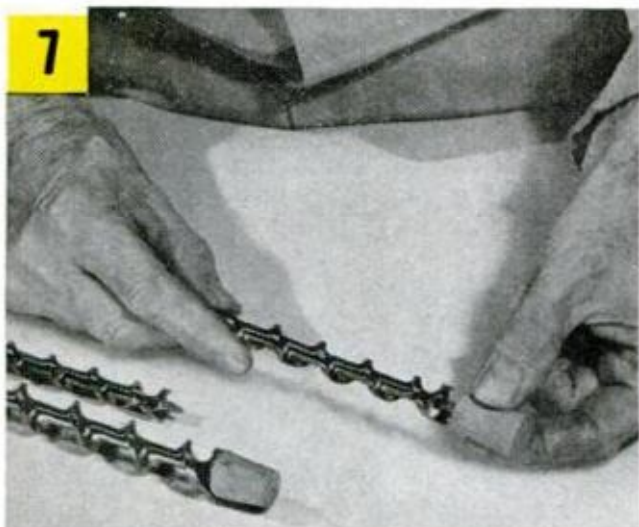
**YOU'LL USE LESS TURPENTINE** the next time that you have a paintbrush to clean if you tilt the jar as shown. Place the dirty brush in the container, then pour in just enough turps to cover the bristles

6



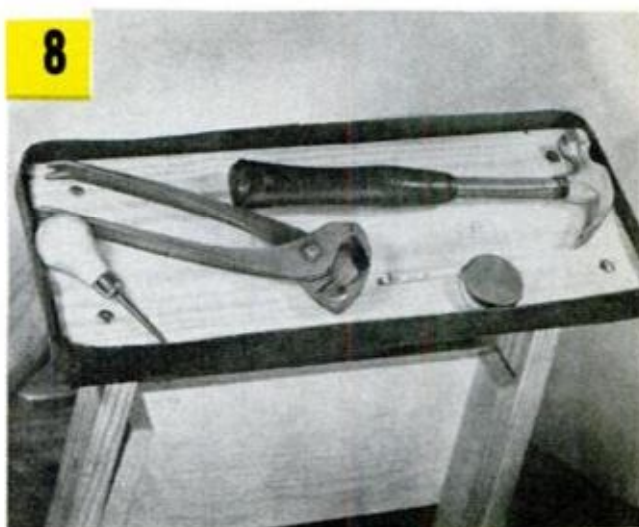
**YOU CAN IMPROVISE FILE HANDLES** by clamping both ends of a file securely with a pair of C-clamps. This way, your hands will be protected from accidental bumps against vise and puncture from tang

7



**AUGER-BIT SCREW POINTS** will stay sharper longer if they are protected before being parked in drawer or toolbox. A rubber bumper or bottle cork slips on and off quickly, yet absorbs the bangs and bumps

8



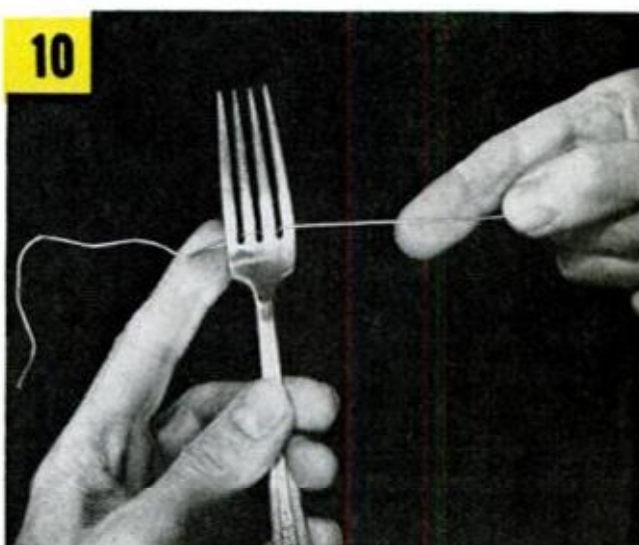
**HEFTY STRIP OF INNER TUBE** tacked around the perimeter of a stepladder's top step will keep small tools and round objects fenced in. Then, when you move the ladder, it's not necessary to unload tools

9



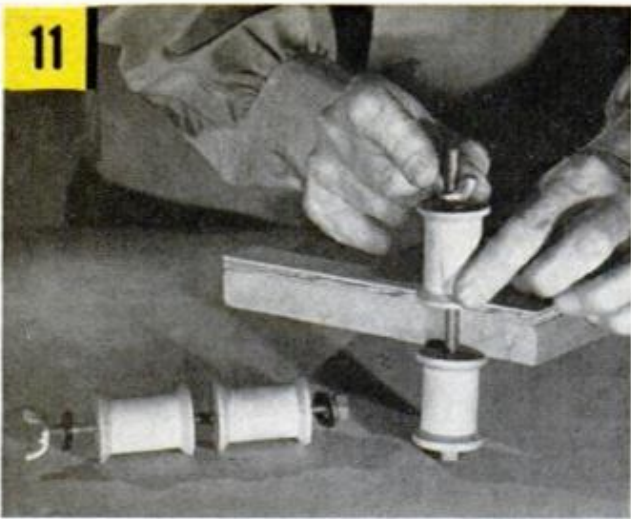
**USED FLASHCUBES** can add gaiety to your next Christmas tree at no cost. Once they have been flashed, the cubes will effectively reflect the array of colors hanging near them. Use ribbon to tie bulbs to limb

10

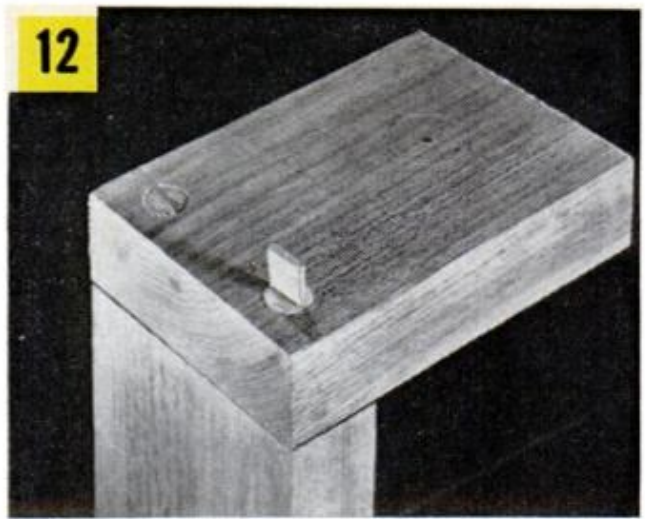


**STRAIGHTENING KINKED WIRE** is a snap if it is passed through the tines of a discarded fork as indicated. After positioning one end of the wire, draw the entire length through, using a firm and even pressure





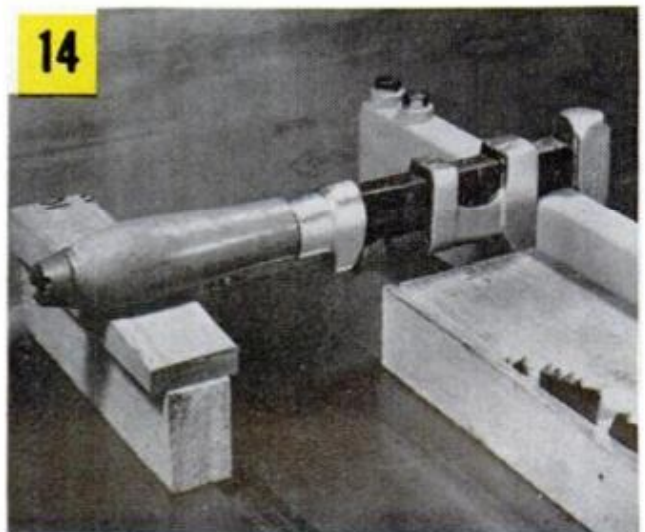
**11** **TWO EMPTY THREAD SPOOLS** and a stovebolt of suitable length can be teamed up to serve as a useful clamp when the depth-of-reach is small. Though a nut can be used to tighten, a wingnut will be better



**12** **DOWELS WILL FIT TIGHTER** in their mating holes if the exposed ends are split with a small chisel and thin hardwood wedges are driven between the segments. The joints are snug, even without using glue



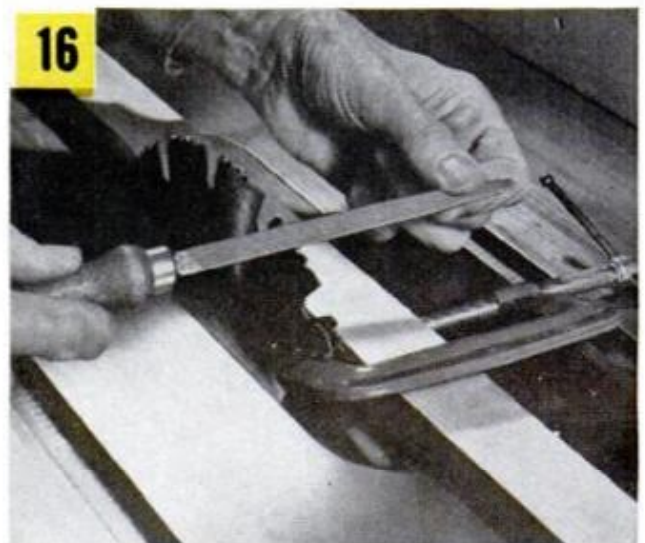
**13** **SPRING-SUPPORTING BED SLATS** will be prevented from falling out if you drive eyescrews into the ledger strips along the bed rails as shown. Then, simply fasten a hook to the ends of each slat to secure



**14** **A MONKEY WRENCH** can be quickly and easily set up to serve as an effective stop by clamping it at the desired spot on the saw fence. To prevent the handle from sagging, support it with small blocks of wood



**15** **KEEP PAINT-CAN RIM** free of paint slop that occurs whenever a brush is wiped across the rim by filling it with a bead of weatherstrip. When the strip is removed, the cover will again seat as it should



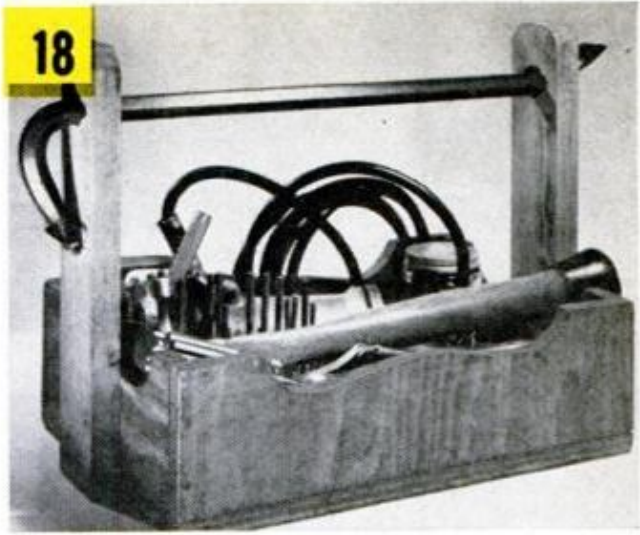
**16** **TABLE-SAW BLADE** can be given a fast touch-up (while still on the arbor) if you use a C-clamp and a strip of wood to hold it fast. To prevent an accident, make certain tool is disconnected from power

**POPULAR MECHANICS**

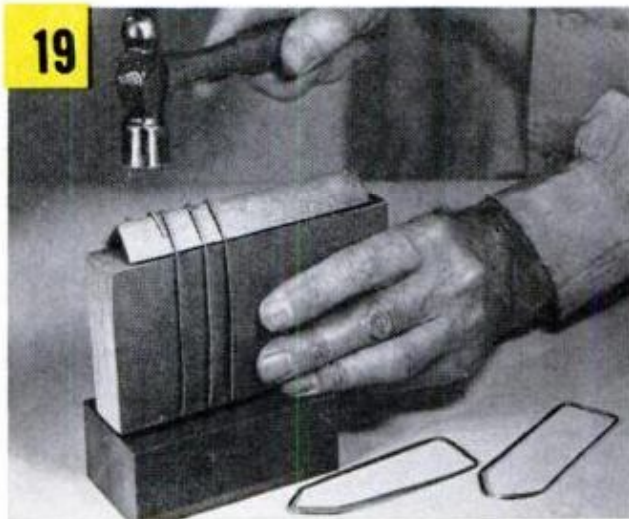




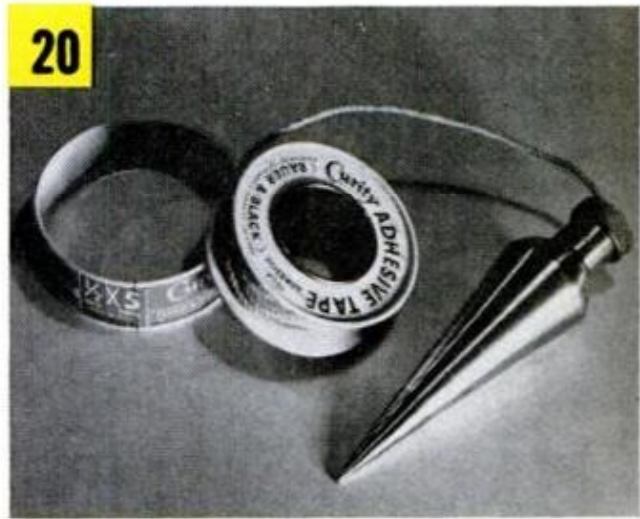
**17** **EGG CARTONS** make excellent storage containers for Christmas tree bulbs. For breakage-free packing, simply punch an undersized hole in each well, then push the male end of the bulb in for a force-fit



**18** **A WRECKING BAR** can be used as the handle on your toolbox if you drill appropriate-size holes in the uprights to receive it. Then the tool is conveniently at hand without using valuable toolbox space



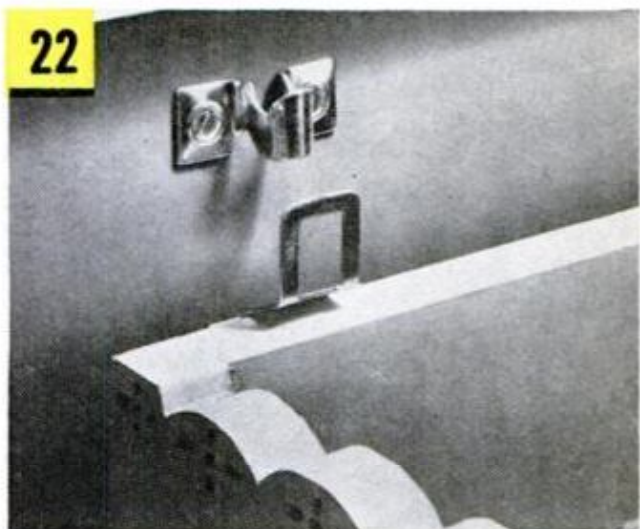
**19** **SHORT LENGTHS** of tie-wire can be quickly cut to a uniform length by placing a piece of angle iron atop a block of wood (that produces desired length). A sharp rap with a hammer does the actual "cutting"



**20** **AN ADHESIVE-TAPE SPOOL**, along with its cover, makes an ideal "case" for carrying a plumb bob. Permanently tie the free end of the cord to the spool, wind up the remainder and snap cover closed



**21** **A SANDPAPER "WASHER,"** if cut and installed on the knob-holding screw as shown, can be used to hold the loosest wood knob securely in place. When knob is tightened, abrasive grabs and holds it fast



**22** **ORDINARY STORM-SASH HANGERS** provide a quick, yet sturdy, method for hanging a window box. The box is then easily removable for painting and, if the hardware is galvanized, you'll have no rust stains





23

**EMPTY THREAD SPOOLS**, glued end to end, can be put to use as a comfortable-to-hold file handle. Use enough of them to insure full protection from the file point, then push on for a snug and slip-free fit



24

**COUPLED EXTENSION CORDS** can be annoying because when you pull on the line they have a tendency to separate. To prevent this, just tie a knot as shown. Then it, not the connection, takes off strain



25

**A WHITE RING** caused by a sweating beverage glass can be removed from furniture by rubbing spot lightly with a mixture of cigaret ash and a little water. Finish by buffing with furniture polish



26

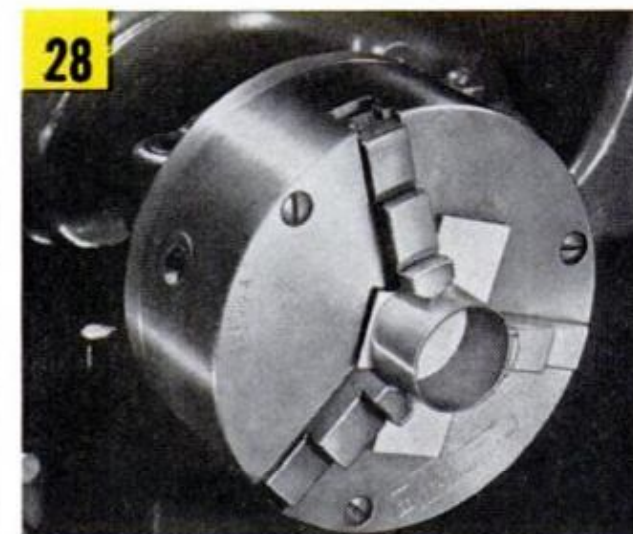
**LARGE BALL OF TWINE** that unravels from the center frequently becomes a tangled mess. You can avoid this by slipping a band of inner tube around the ball. At top, punch a hole for the twine



27

**WORKING** with tools on a ladder always presents the possibility of dropping tools on someone below. Prevent accidents by fastening a strip of leather to one rail forming pockets to hold tools you use

160



28

**SOFT WORKPIECES** that cannot be firmly gripped in the lathe chuck can be prevented from slipping into the chuck when pressure is applied. Insert a wood stop as shown and the problem is licked

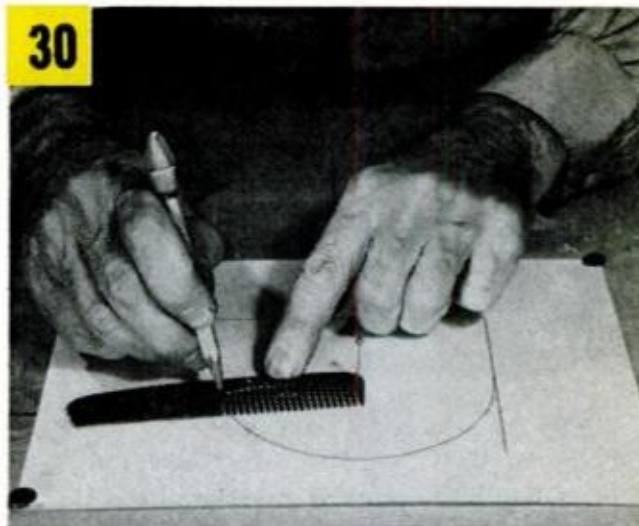
POPULAR MECHANICS





29

**SANDING A ROUNDED SURFACE?** After cutting a length of garden hose to suit the work, slit the piece its entire length. Then cut a piece of sandpaper to fit inside and apply shellac to "glue" it in place



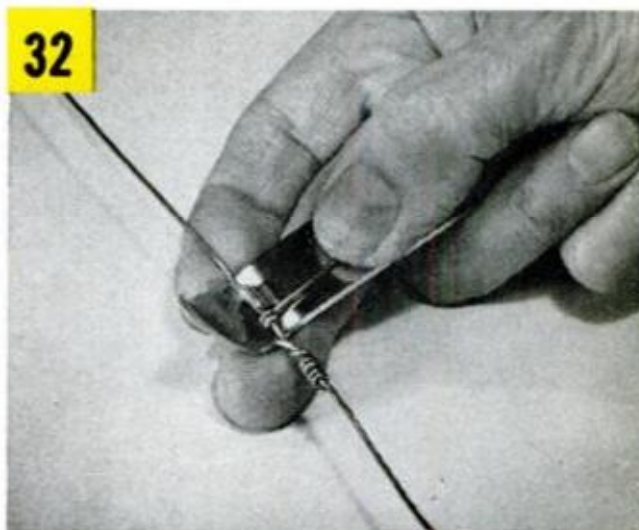
30

**AN EMERGENCY COMPASS** can be made by drilling a hole through the spine at one end of a pocket comb. Insert pin or thumbtack to act as a pivot and place pencil between two teeth to draw the circle



31

**THE STUBBORNEST JAR LID** will yield quickly if you wrap a length of ordinary garden hose around it to serve as a hand grip. Make certain that you cut the hose long enough to provide an ample hand hold



32

**A PUNCH-TYPE CAN OPENER** can be used to make neat, tight turns when you have to splice two or more lengths of wire. Make two or three turns by hand, then finish by using the opener's hook end



33

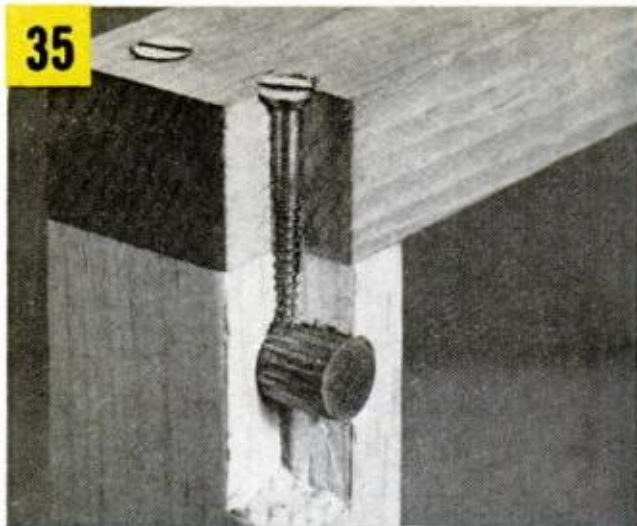


34

**TO GET THE LAST DROP** of solvent or other liquid from a can of type shown (far left), punch a pouring hole in one corner as near to the edge as possible. If can is to be reused, close hole with a drop of liquid solder

**KEEP THUMB TACKS** handy when working on a stepladder by pushing a dozen or so into the side of a roll of friction tape (left). The roll itself stays where it's put because of the fairly sticky surface on the other side





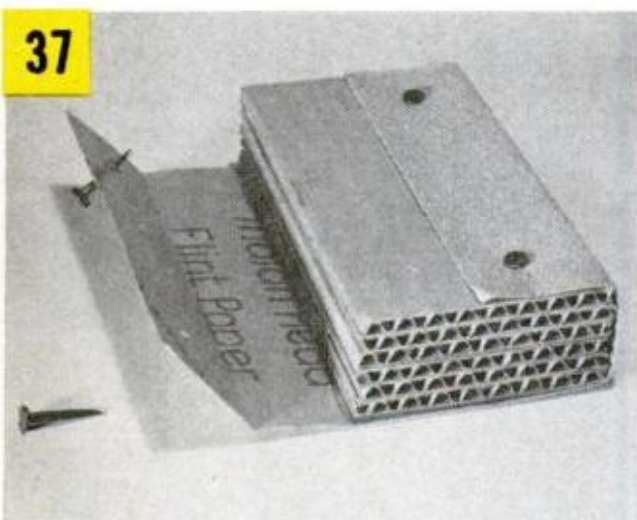
35

**A SCREW** driven into the end grain of one member of a joint will hold far better if a dowel is installed—perpendicular to the screw—for the latter to bite into. Then it won't be able to work loose



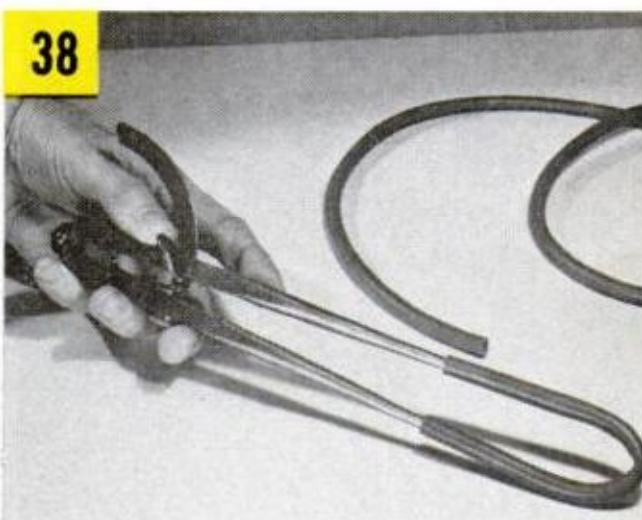
36

**YOU CAN PROTECT WOOD SURFACES** from wrecking-bar mars by covering the rocker end with a short length of garden hose. When not needed, simply slide the rubber up the shank and out of the way



37

**SANDING A CONTOURED SURFACE** is easier if the sanding block is resilient enough to conform to the irregular surface. Several layers of glued-up corrugated cardboard is one way to solve this problem



38

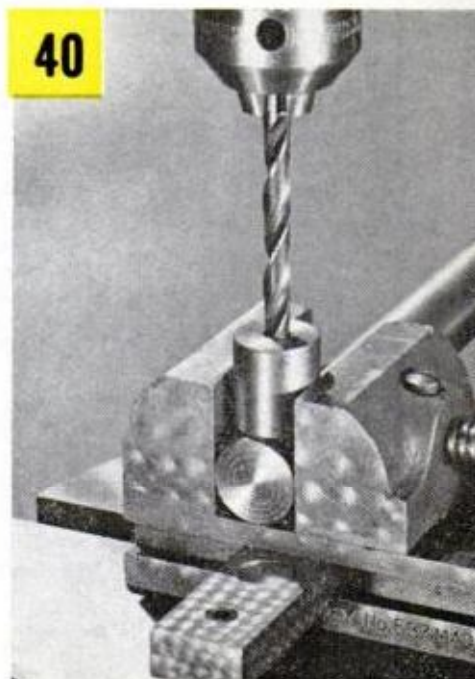
**DIVIDER POINTS** (on compasses and the like) can be prevented from becoming blunted in the toolbox if you will slip short lengths of rubber tubing over the ends. Tubing is available at most hobby shops

**SLIP A PAPER CUP** over your drill bit (right) the next time you have overhead drilling to do, and shavings and plaster dust will fall into it rather than on your face or down your sleeves. Hold cup in place with tape

**DRILLING** a centered hole transversely through a rod or pipe is easy if you use a metal sleeve of the same diameter (far right). Make hole in guide-sleeve the same size as bit used and clamp both pieces in the vise



39



40





How to Install:

# Pushbutton Draperies

By WAYNE C. LECKEY, Home and Shop Editor  
*Technical Art by Peter Trojan*

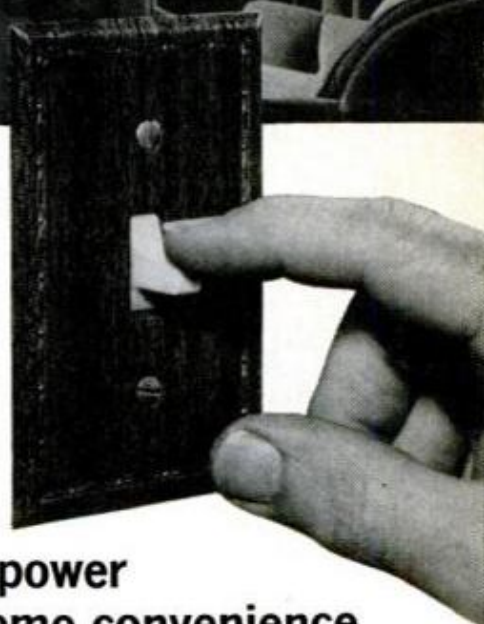
**Traverse rods that run by electromagnetic power plug in like an appliance to offer a new home convenience**

**I**F YOU ARE OPENING and closing the draperies on your windows with pull cords, you're doing it the hard way. What's more, in this electronic pushbutton world you're doing it the old-fashioned way. Now, with Kirsch's unique Electrac, you can open and close draperies electrically by simply pressing a button located anywhere in the room.

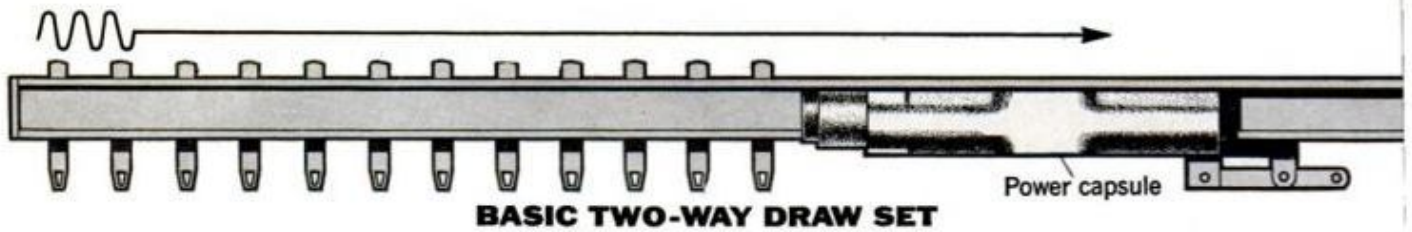
Far from being just a conversation piece, these motorized rods offer convenience

plus. Any homeowner who has tugged to open wide, extra-heavy draperies or struggled to reach them will appreciate being able to do it at the touch of a switch.

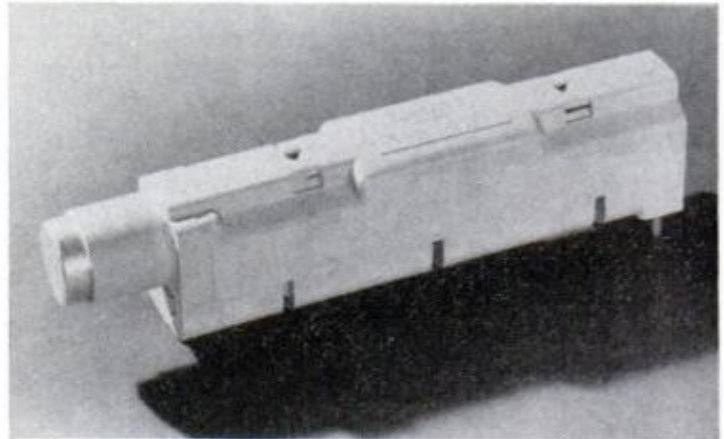
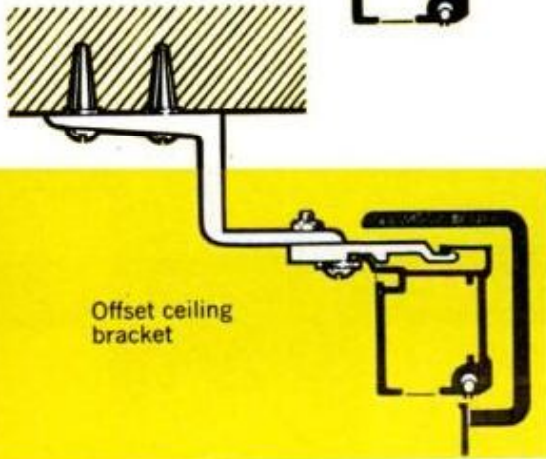
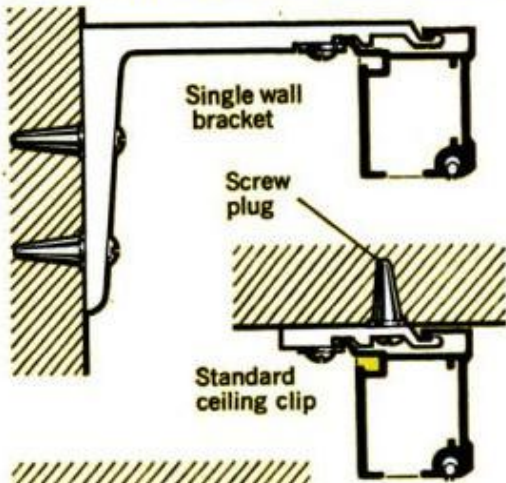
With the same ease, you can lie awake mornings, press a bedside button to open draperies and check the weather. On coming into a dark room at night, you have instant privacy by operating a doorside switch that closes the open draperies be-







### TYPES OF HANGING BRACKETS



**THE SAME ELECTROMAGNETIC FORCE** that makes a conventional motor spin will cause the power capsule to slide

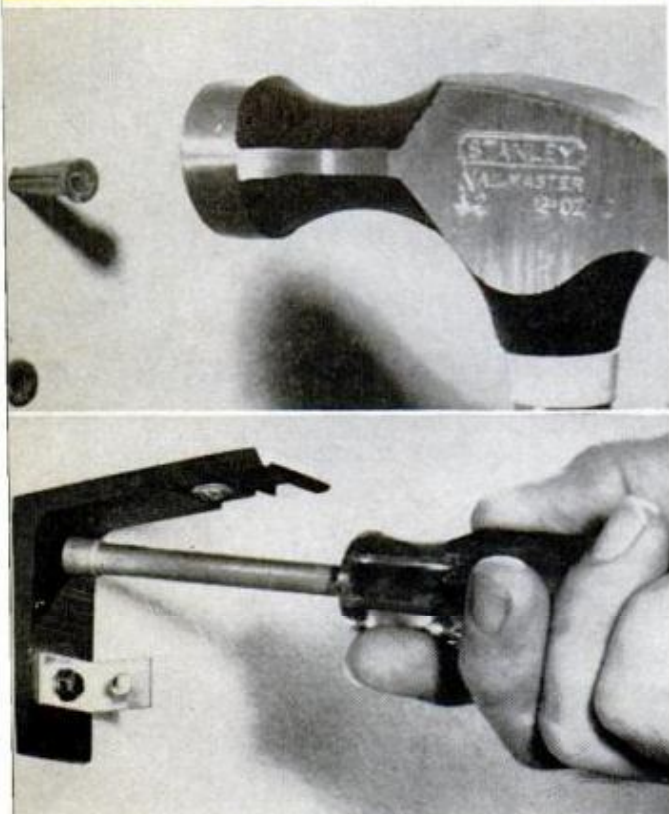
fore lights are turned on. And, because the power capsule is free-sliding, a guest who overlooks the control switch cannot damage the rod by hand-pulling the draperies, for the motor returns automatically to synchronization the next time the switch is activated.

*How it works.* The drapery rod employs a linear motor (basically a conventional rotary motor laid flat) that silently and automatically opens and closes draperies without use of cords or pulleys. This linear motor, composed of two parts—a small, hidden-from-sight power capsule and a specially designed track—operates by ordinary 110-v. household current. When the switch is pressed, the current is transmitted to conductor rails inside the track. This, in turn, creates a magnetic field inside the power capsule that causes it to move along the track, pulling the drapery panels open or closed.

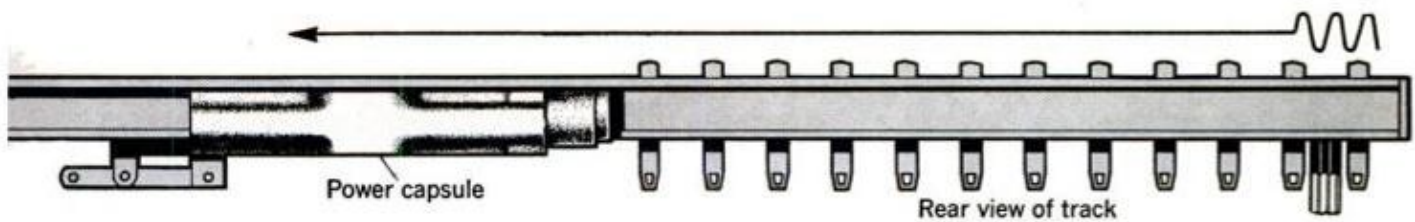
Because of their flexibility, the rods can be utilized at windows of almost any width—wide or narrow—collectively or individually. Draperies can be one-way-draw, two-way-draw or multiple-draw type, while the rods can be either wall or ceiling mounted.

Using one motor, single-draw draperies can be planned to close either from the right or left. With two motors, double-draw draperies up to 32 ft. wide can be controlled from a single switch. For lengths from 32 to 64 ft., additional motors are required. (A maximum of four mo-

**PLASTIC SCREW ANCHORS** (left) are used when mounting track-supporting brackets on plaster or drywall surfaces. There are three types of mounting brackets: wall, ceiling and offset-ceiling. The wall type is being attached here







**SURFACE-MOUNT SWITCH** (right) comes with all rod sets. For a built-in installation in a remote location you will need a special type of switch and a special receptacle (far right)

tors can be controlled from a single switch.)

Rod sets are ordered as completely assembled, ready-to-install systems, with full instructions for mounting.

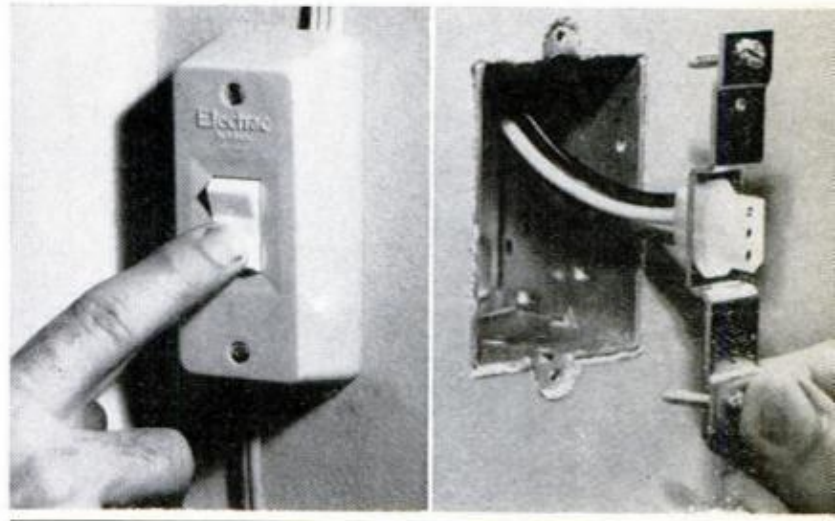
All electric rod sets are equipped with standard surface-mount switch, power cord and plug. If a built-in installation is desired, a special switch, receptacle and plug are required. Here the receptacle is mounted flush in the wall near the end of the rod set and then connected by wiring inside the wall to the operating switch and the 110-v. current. Switches are connected by three terminal wires to each receptacle.

The track is completely safe and shockproof, conductor rails are enclosed *inside* the front channel. A thermal breaker makes burn-outs or overheating impossible.

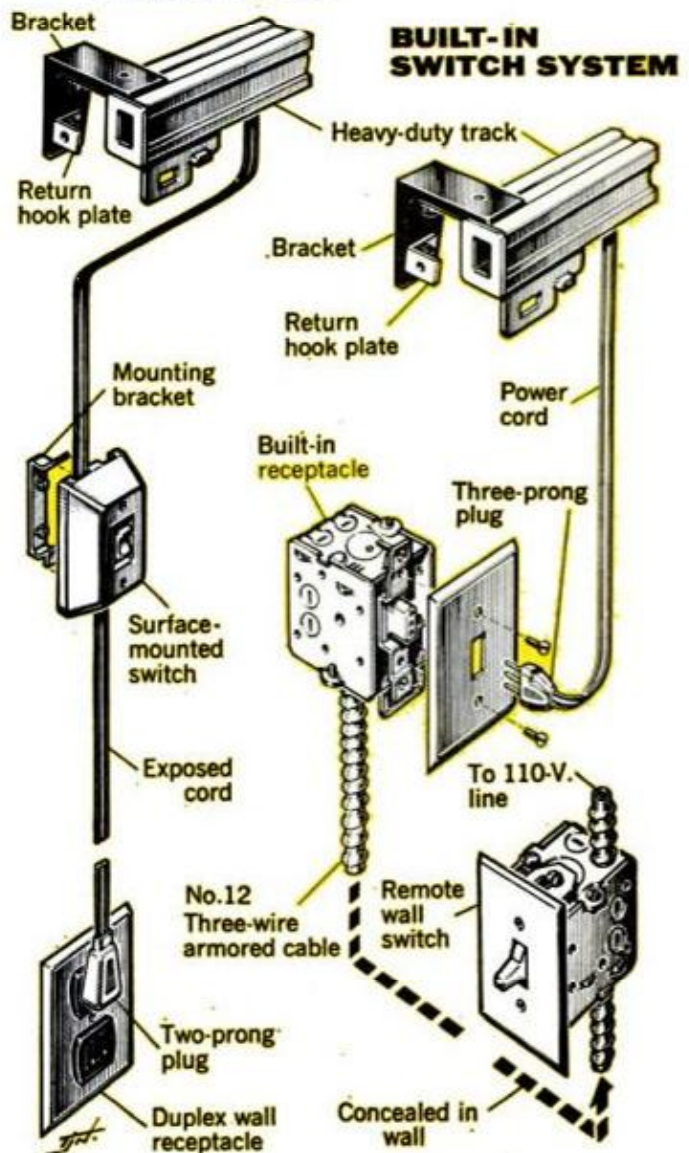
For best appearance and to provide maximum glass exposure when the draperies are open, the rod set should extend beyond the window casing on each side. Mount the brackets so that the rod is a minimum 4 in. above the glass line so the heading and hooks will not show from the outside. Based on rod length, you get the required number of brackets when the rod is ordered; a 12-ft. rod, for example, comes with four brackets. A good way to assure accurate alignment of the intermediate brackets is to stretch a string between the two end brackets. This way there will be no dip in the rod, which is important. Two return hook plates are included with each set. These are held by the bottom screw which anchors each end bracket.

For more information and prices write the Kirsch Co., 309 Prospect St., Sturgis, Mich. 49091. ★★★

DECEMBER 1970



### SURFACE-MOUNTED WALL SWITCH





# The Sky's the Limit With

## PART 1



**MIRROR-MAKING KIT** consists of two glass discs, a diagonal mirror, two eyepiece lenses, seven grades (called grits) of grinding compound, rouge and pitch



**FINISHED 'SCOPE** (above) is capable of serious astronomical work with power ranging from 50 to 200X, depending upon the eyepiece used. The "work-bench" (right) consists of a barrel that's weighted with 12 bricks, plus a piece of plywood with a hole cut in it to receive handle of the tool or the mirror



# This 200-Power Telescope

You can make it for less than \$50. This first part gets you grinding and polishing the mirror. Next month, you'll build the barrel and tripod legs.

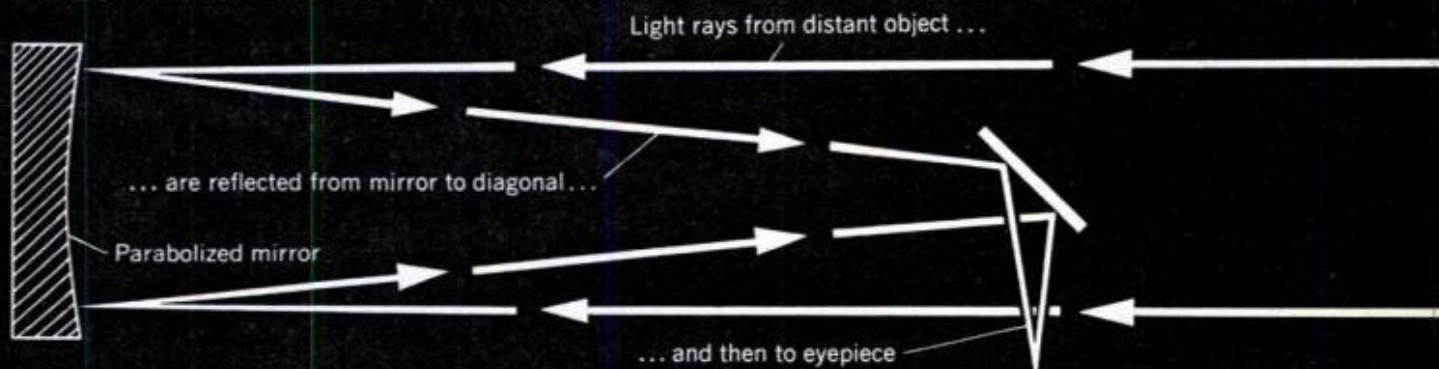
By ROBERT BRIGHTMAN  
Technical Art by Peter Trojan

**T**HOUGH SURPRISINGLY EASIER to build than a quick glance might imply, make no mistake about it: PM's version of a 200-power telescope is not a toy. With it, serious students of astronomy will be able to study craters on the moon, Saturn's rings, the polar caps on Mars, the satellites of Jupiter and giant nebulae. And just for the fun of it, you'll win the wager if you claim that you can read the time on a pocket watch or a newspaper headline a mile away.

The heart of the telescope is a 6-in. mirror. It's fashioned from a mirror kit and costs about \$4. It's available by mail order from Edmund Scientific Co., 380 Edscorp Building, Barrington, N.J. 08007. Additionally, you'll need a length of aluminum tube (7 in. o.d. x 60 in. long); this costs approximately \$15. You will also have to lay out about \$30 for miscellaneous hardware and wood for the tripod. Totaled up, your \$50 cash outlay will let you turn out a finished 'scope that is easily the equal of those selling for \$250 and up.

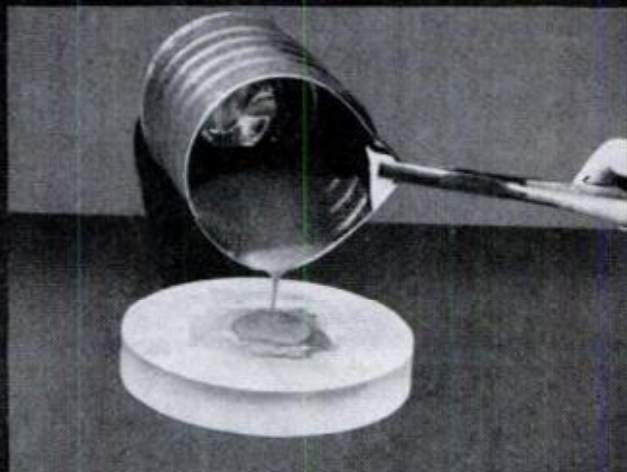
For comfort, cut the barrel workbench so that the work surface is 33 in. from the floor. The reason a barrel is best is that grinding and polishing necessitates walking around the workpiece.

Cement a handle to the back of each glass disc. The wooden cores used in wrapping paper rolls are ideal for this purpose. Melt some pitch in a can, swab



**TO CEMENT HANDLE TO MIRROR DISC**, melt some pitch in a can, then pour a little on the middle of the disc and quickly center the wood wrapping-paper core

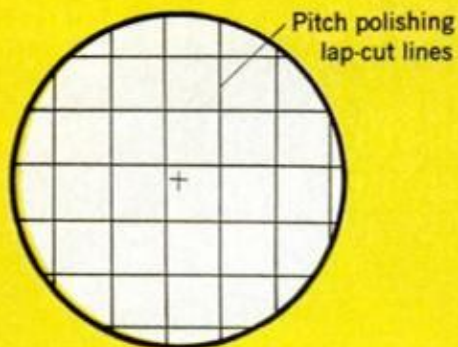
**POSITION CLEAN CLOTH** over the barrel and insert tool with handle into the hole. With mirror held as shown, the initial back-and-forth stroke is 2 1/2 in.



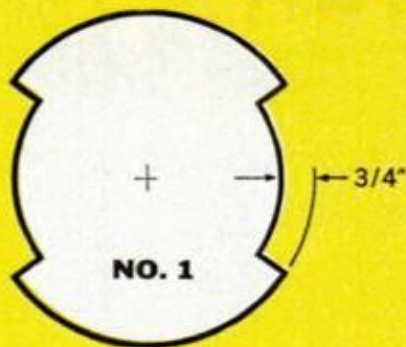


# PM's Back-Yard Telescope

## EYEPIECE MASKS



**POLISHING LAP.** Cross marks the center of the lap. Note that no channels intersect at center and no facet is in exact center

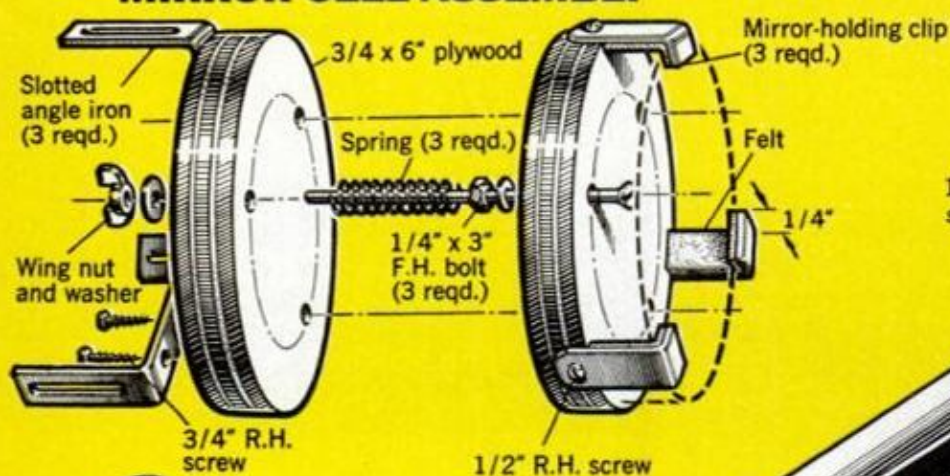


**MASK NO. 1** is used to test the outer zone of the mirror. Cut it out of stiff cardboard and tape it to the mirror edge



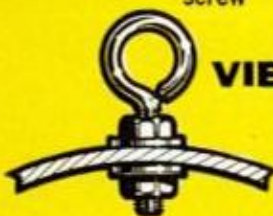
**MASK NO. 2** tests inner zone of the mirror. As indicated in text, there should be a difference of 1/10 in. between zones

## MIRROR CELL ASSEMBLY



Aluminum tube, 7" O.D., 60" long  
1/16 x 1-1/2 x 5" steel plate

## VIEWFINDER



1/4" eyebolt, nuts and washers

Mirror

1" thick

Scoop out for maximum elevation

Blacken inside with flock, paint, or black suede cloth

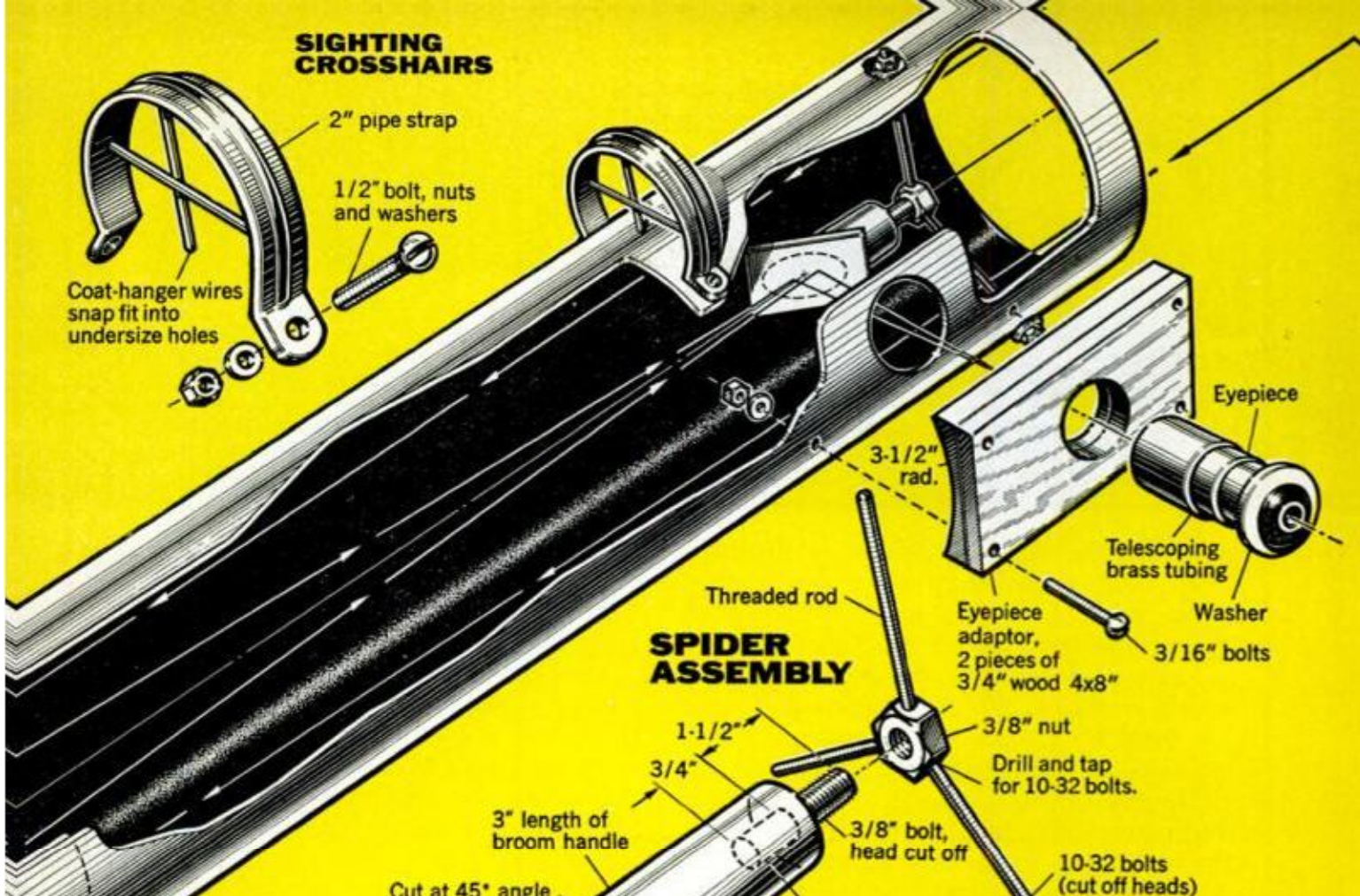
Mirror cell assembly

**MIRROR CELL** consists of two 3/4-in. plywood discs, each 6 in. in diameter. Sandwich the discs together and drill holes to pass the 1/4-in. bolts. Enlarge the holes in the lower disc for adequate clearance

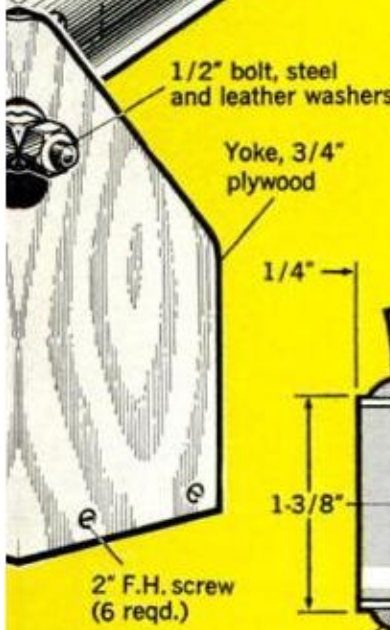
Technical Art by Peter Trojan



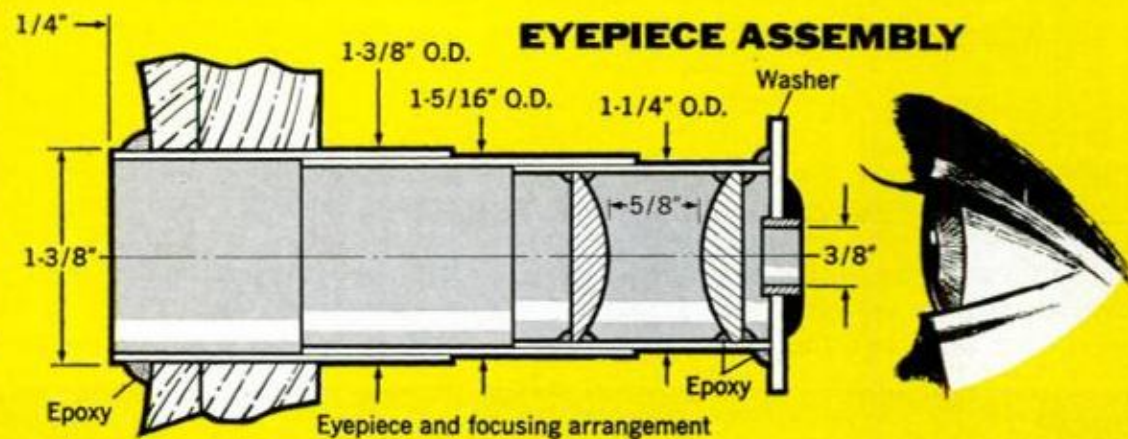
### SIGHTING CROSSHAIRS



### SPIDER ASSEMBLY



### EYEPIECE ASSEMBLY



the surface of each disc with a little turpentine and pour some of the melted pitch over the glass. Then, quickly center the wooden cores in the middle of each disc. The 1-in.-thick disc will now be referred to as the mirror and the thinner disc as the tool. Next, cut a hole in the barrel top large enough to accept the handles.

Supply yourself with a jar of clean water and an eyedropper forced through

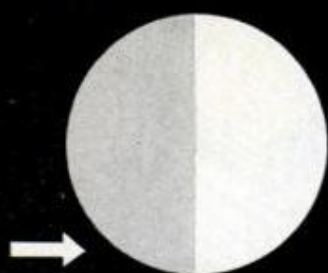
a cardboard cover to keep out any dust. The grinding abrasives are packed in shaker-top containers labeled 80, 120, 220, 320, 400, 600 and emery. Cut several cardboard collars to fit over the handle of the mirror and use a fresh one every time you change grit size. Cover the barrel top as shown and insert the tool. (Here, too, replace the rag with each grit change.)

Sprinkle a quarter teaspoon of No. 80



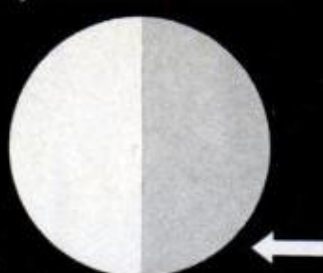
## KNIFE-EDGE TEST

Before radius of curvature



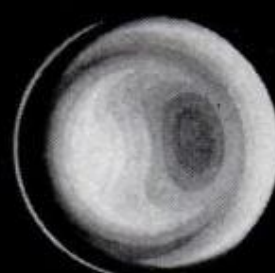
WHEN KNIFE EDGE is before radius of curvature, shadow moves from left to right as the knife edge is moved to the right

Beyond radius of curvature



SHADOW MOVES from right to left as you move knife toward lamp if the knife edge is beyond the radius of curvature

Parabolized mirror



A ROUGH IDEA of how a parabolized mirror shadow will appear when knife edge is midway between the inner and outer zones

grit over the mirror, add a few drops of water and grasp the mirror as shown. Using short back-and-forth strokes, rub it over the tool. There are three mirror-maker's motions. First, the grinding stroke, which is about  $2\frac{1}{2}$  in. forward and back—a total of 5 in. with the mirror overlapping the tool not more than  $2\frac{1}{2}$  in. at the end of each stroke. Second, rotate the mirror  $\frac{1}{8}$ th turn every three or four strokes. Last, every few minutes take a step around the barrel.

When the grit ceases to cut (the loud rasping noise diminishes to a swishing sound), add more grit and, if necessary, water. Repeat this step for about two hours. Remove the cardboard collar and wash the mirror. It should have a coarse, ground-glass appearance. Apply a straightedge and check the concave surface.

The amount of curvature to which our mirror is ground is governed by the focal length (48 in.) of the telescope I constructed. In photographer's language it is an f8 mirror (focal length of the mirror is eight times the dia. of the mirror and 48 in. divided by 6 in. equals 8, or f8). But it is an optical law that the radius of curva-

ture of a mirror is equal to twice the focal length. This means that our mirror will have to have a radius of curvature of 96 in. in order to have a focal length of 48 in.

Though you can use a cardboard template to determine this curve, it is so slight that it's possible to be over or under as much as 12 in. and still have the template touching the mirror. After a curve has become apparent and proved with the straightedge, you can determine focal length by the candle method. Wash the mirror and rinse it with water. Move a lighted candle slowly from left to right until you can see the reflection in the wet surface of the mirror. Then, as you move back, the candle flame will grow larger but it will continue to move in the same direction that you move the candle.

At a certain point, when you have moved back far enough, the candle image in the mirror will be upside down and move in the opposite direction from that which you are moving the candle. This means that you have passed the radius of curvature. Walk back to the mirror so that no apparent motion, left or right, is visible when the candle is moved. The mirror at this particular point will appear



TO GRIND CONCAVE SURFACE, apply an eyedropper-full of water to the top of the tool, sprinkle the top with No. 80 grinding compound and start the back-and-forth strokes. Rotate the mirror  $\frac{1}{8}$ th of a turn every so often and take a step around the barrel every minute or two. It takes about two hours to grind a radius of curvature of 100 in. (plus or minus an inch). Apply a straightedge from A to B to check this





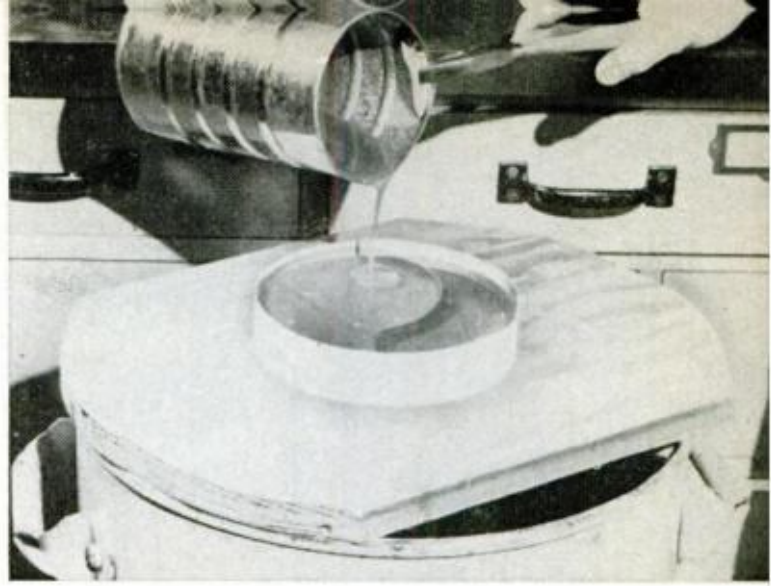
**TO CHECK CURVE DEPTH**, wash off grit and, while mirror's still wet, hold candle in front. At certain point reflection fills mirror, then looks upside down

as a blob of light. It's entirely possible that you may have to move back 20 ft. before this happens. This means you should grind the curve deeper. Continue grinding until the candle test shows that you have reached a curvature of roughly 120 in. At this point the mirror shows an obvious curve when the straightedge is applied. Clean away all traces of the No. 80 grit and wash the mirror, tool and barrel top thoroughly.

Next, repeat the procedure with No. 120 abrasive, shortening your stroke to 2 in. Use the same grinding technique to deepen the curve. Continue grinding until the mirror has a smoother surface and a clearer candle reflection. Stay with the second grit until the radius of curvature is about 100 in.

When you reach the desired radius, move up to the next higher grit. Grind with No. 220 and all succeeding grits, mak-

**FACETS IN PITCH LAP** are cut with wet hacksaw blade. Make certain that the two channels do not cross and that no facet is in exact center of the lap



**PITCH POLISHING LAP** is made by wrapping stiff paper around tool, then pouring heated pitch through several layers of cheesecloth. Finally, strip paper

ing certain to clean thoroughly between changes. A very smooth, fine-ground finish, which will hasten polishing immeasurably, can be obtained by following up the last grade of grit (No. 600) with emery for an hour.

**Polishing.** Take the pitch and break it into chunks. Place several pieces in a tin can and, since pitch is flammable, use an electric hot plate rather than an open gas flame as a heat source. Heat the pitch to the melting point without boiling. Carefully clean the tool under running warm water and, when dry, replace it on the barrel. Next, make a cardboard collar for the tool that extends about  $\frac{1}{4}$  in. above the top of the tool. Make it long enough so the ends overlap about 2 in. and hold it fast with tape. Moisten a rag with turpentine and swab the top of the tool.

When the pitch is melted, strain it through four thicknesses of cheesecloth

**POLISHING LAP** is made with compound of rouge mixed with water. Long stroke is used only when parabolizing the mirror. This step takes four hours







**HANDLE IS REMOVED** by sharp rap with screwdriver handle as you hold the mirror firmly. Pitch remaining can be cleaned off with razor blade and turps

and pour it over the tool. Start at the outside and work toward the center. When the pitch is level with the top of the cardboard dam, stop pouring.

After the pitch cools and hardens, strip away the cardboard. Then sluice the mirror surface with a sudsy solution of soap and water. Carefully lower the mirror over the pitch lap while moving it about the pitch lap in various directions (about an inch each way). This serves to conform the pitch lap to the spherical curve of the mirror. Keep doing this for about 30 minutes, or at least until the pitch starts to spread and form a ridge around the tool. When pitch lap and mirror are well separated by the soap solution, set the mirror and tool aside overnight.

The next day you will find it impossible to budge the mirror. The reason is that the outer edge of the mirror is sunk into the pitch lap. Trim away this excess pitch with a knife moistened in water. With a little pressure in various directions, you will then be able to move the mirror. Carefully slide it off and put it aside.

The next step is to cut the 1¼-in. squares (facets) in the pitch lap with a hacksaw. The pitch will probably splinter a bit leaving the lines ragged. This will not affect the polishing operation. *A word of caution:* The facets must be cut as shown in the drawing at top of page 168. The nearest facet to the center of the tool should be offset about ⅜ in. This is necessary to prevent the mirror from possibly



**USE A RAZOR BLADE** mounted on a block of wood and a 25-w. lamp inside a container to test curve of the mirror. Pierce tinfoil for a pinpoint light source

polishing in rings. Moisten the mirror with the soap solution and place it down over the pitch lap. Let it stay this way overnight. This step should make the pitch lap reconform to the curve of the mirror. Fill a quart milk bottle about one-third full of warm water and dump the package of rouge into the bottle. Cap the bottle and shake thoroughly.

Next you'll need a pound-size jar with a screw lid. After cutting a hole in the lid, force the rubber tip of an eyedropper through it. Over the open jar, place three thicknesses of clean cheesecloth. Shake the rouge solution, pour about half through the cheesecloth and discard the cloth. Stir the rouge solution a bit, and use the eyedropper as an applicator.

Squirt a dropperful of the rouge solution over the mirror and use the same stroke that you used in grinding, 2 in. forward and 2 in. back. You may have to add some of the rouge solution after five or ten minutes of polishing, especially if the mirror starts to stick. You can often eliminate sticking by sliding the mirror off the lap and then bringing it down again. If the mirror persists in sticking, try an application of soap solution, which acts as a lubricant, add some rouge and polish for 30 minutes. Then wash the rouge off the mirror, stand it on end and allow to dry.

Continue polishing until the final pit has disappeared from the edge of the mirror. However, if curious as to how your polish-



ing is coming along, check your work with a Foucault knife-edge (shadow) test. To do it, you need a razor blade and a pinpoint source of light.

The light source (see photo, page 172), consists of a small candelabra-base lamp mounted on a block of wood. Over this, place a cardboard tube or can with a 1/2-in. hole punched opposite the filament. On the inner side of the hole, paste a bit of wax paper to diffuse the light. On the outside, place a piece of tinfoil and perforate the tinfoil (only) with a needle.

Place the polished mirror on a firm support and position the razor blade (mounted on a block of wood) and the lamp about 8 ft. from the mirror and at the same height from the floor—about 30 in. The 8-ft. distance between mirror and test apparatus is equal to twice the focal length or the radius of curvature.

What you are doing is picking up the reflected pinpoint of light. But, inasmuch as this is quite hard, take off the lamp sleeve and explore the area with the larger source of light. Put your eye close to the lamp and move it back and forth and up and down until you see the reflected image of the lamp which appears to be suspended in air. Shim up the mirror, or twist it from side to side slightly, to bring the reflected light to a convenient point for viewing. The reflected image should come back so that it is an inch or two away from the lamp and at the left of the lamp. After the lamp image has been picked up, cover the lamp with the sleeve so that the pinhole faces the mirror. This may disturb the setting somewhat and again you will have to explore the immediate area until the pinpoint of light is picked up.

Since you might repeat this procedure during the stages of polishing, it is best to make a reference mark on the table where the mirror is standing in order to be able to bring it back to the same spot. As a further check, note where the image of the lamp is reflected to the opposite wall with the cover off the lamp stand. This way you can place the mirror so that the image always falls in the same spot. Then replace the lamp cover and you will be reasonably certain that the reflected pinhole of light is about where it should be.

*The test.* As the pinpoint of light enters the eye, the mirror will appear to be lumi-

nous. Now, carefully slide the knife edge (razor blade mounted on its stand) toward the lamp. Do this slowly, and a vertical shadow will appear to cross the face of the mirror. This shadow will move from left to right, the same way you are moving the knife edge, *if the knife edge is before the radius of curvature.* If you move the knife edge back an inch or two, the shadow will then appear to move right to left when you move the knife edge left to right. When it does so, it is beyond the radius of curvature. Move the knife edge back and forth until at a certain point the mirror darkens evenly all over as the knife edge is moved in toward the lamp. Also, there is no apparent movement of the shadow either way. *This is the shadowgraph of a spherical concave surface.*

The rays of light going from the pinhole

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**. . . to parabolize the sphere  
the surface must be deepened  
a few millionths of an inch.**

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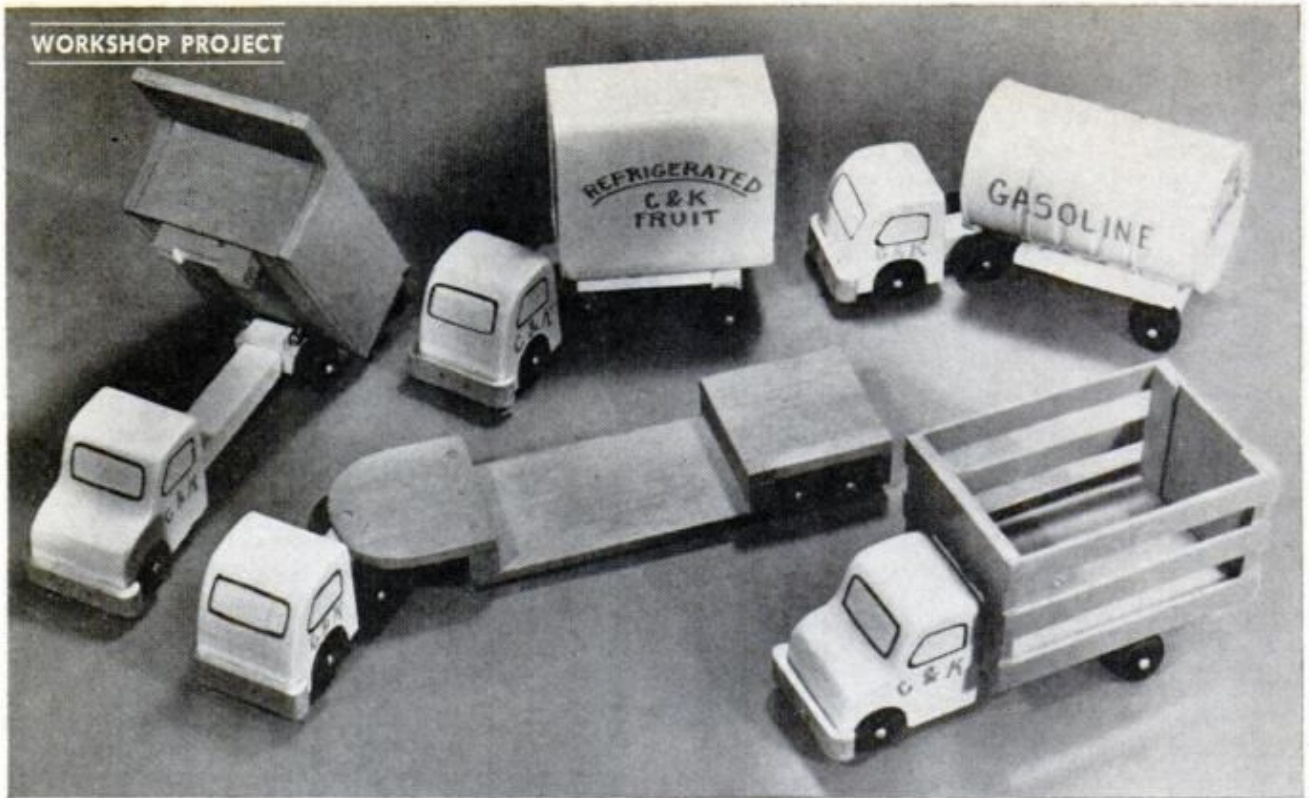
and coming back from the mirror can be considered as a giant radii. It is axiomatic that all parts of a sphere are equally distant from the center. Therefore, half the light rays are cut off at the center; hence the sphere seems to darken evenly all over. At this point you can use the mirror in your telescope. But if you want perfection, the spherical mirror should be turned into a paraboloid.

To parabolize the sphere the surface must be deepened a few millionths of an inch. To do it, cut two cardboard masks as shown on page 168. With mask No. 1 determine the exact focal point (half the radius of curvature) of the outer portion of the mirror. Mask No. 2 lets you determine the focal point of the central part of the mirror. For a true paraboloid, you want a difference of 1/10th of an inch between each area. To achieve this, increase polishing strokes to about 3 in. Use this stroke for no more than three minutes and repeat the test.

Place mask No. 1 over the mirror and note carefully at just what point the outer portion of the mirror (as seen through the cutouts) darkens evenly. Then use mask No. 2 and do the same thing for the central area of the mirror. You will find that

*(Please turn to page 184)*





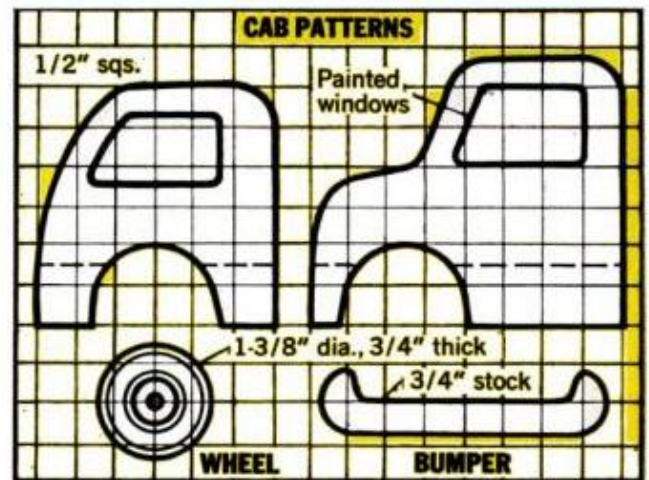
# Mini-Truck Fleet

By **ELMA** and **WILLARD WALTNER**

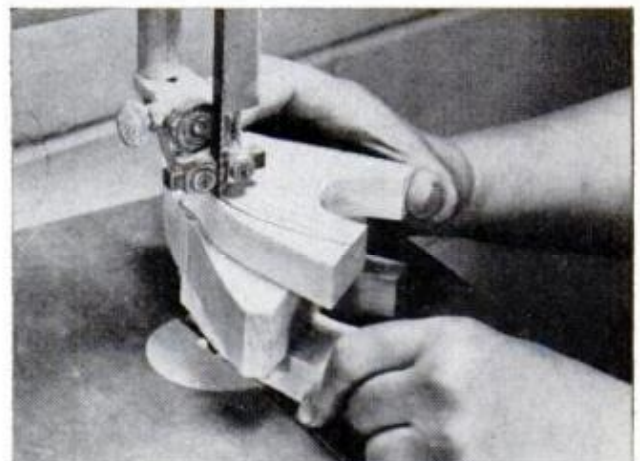
Technical Art by Peter Trojan and Jim Wright

**B**Y SPENDING a couple of hours in the workshop, you can make your youngster the proudest truck-fleet owner on the block on Christmas morning. The trucks' design is simplicity itself, intended to stir youthful imagination. Though no tricky woodworking techniques are involved in building the fleet, a bandsaw or jigsaw does make the project go faster. Since the models are of soft pine, however, they can also be cut with a coping saw—it just takes a little more effort.

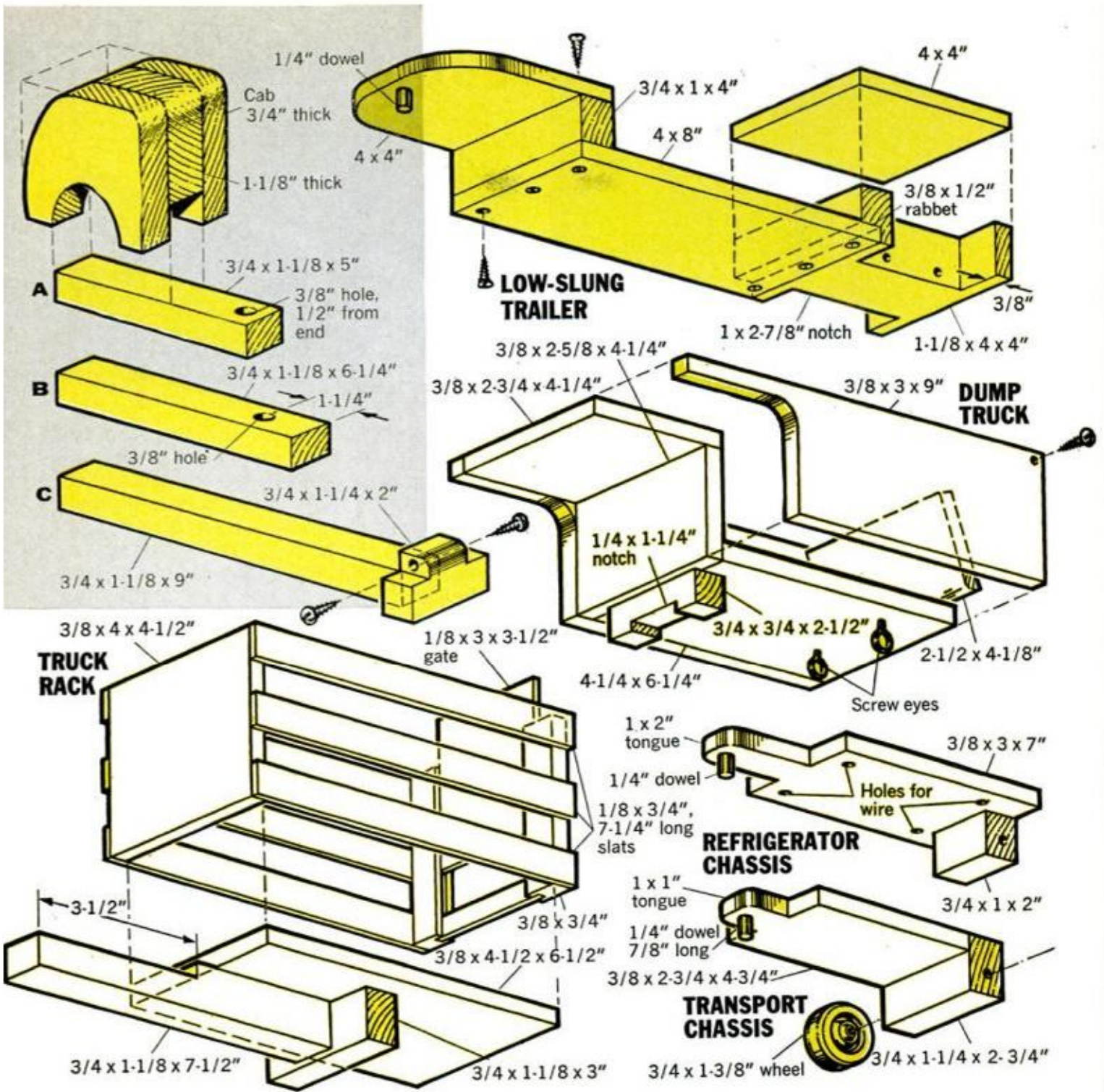
The gasoline-tanker body is a thoroughly cleaned-out, 46-oz. fruit-juice can. Punch two small holes in one end to drain the contents and leave both ends intact. The body of the refrigerator truck is a container used by a chocolate-drink mix. Pinch all around its circular opening with a pair of pliers to flatten the inside of the rim. Colors to paint the various trucks are a personal preference, but bright colors are best. The wheels are black and the bumpers aluminum. When bumpers are dry, attach them with brass escutcheon pins. ★★★



**CABS ARE CUT** to rough shape on bandsaw, then contours can be sanded with a Sand-O-Flex wheel

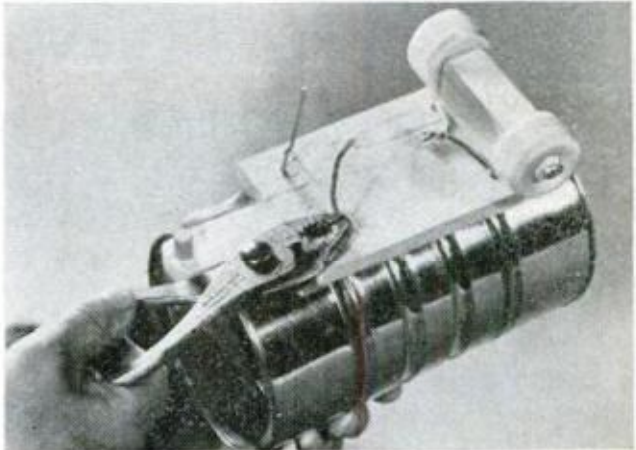
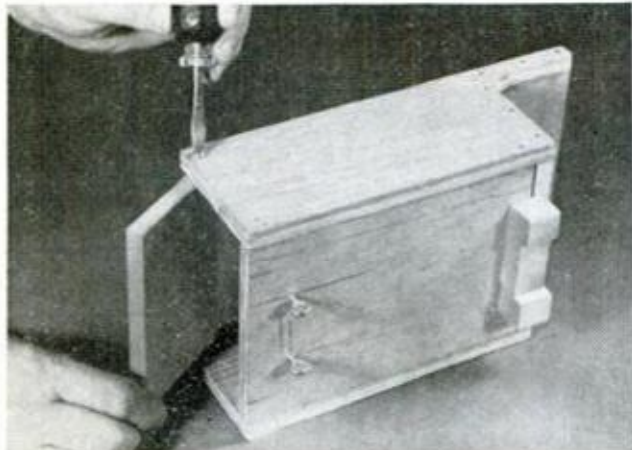






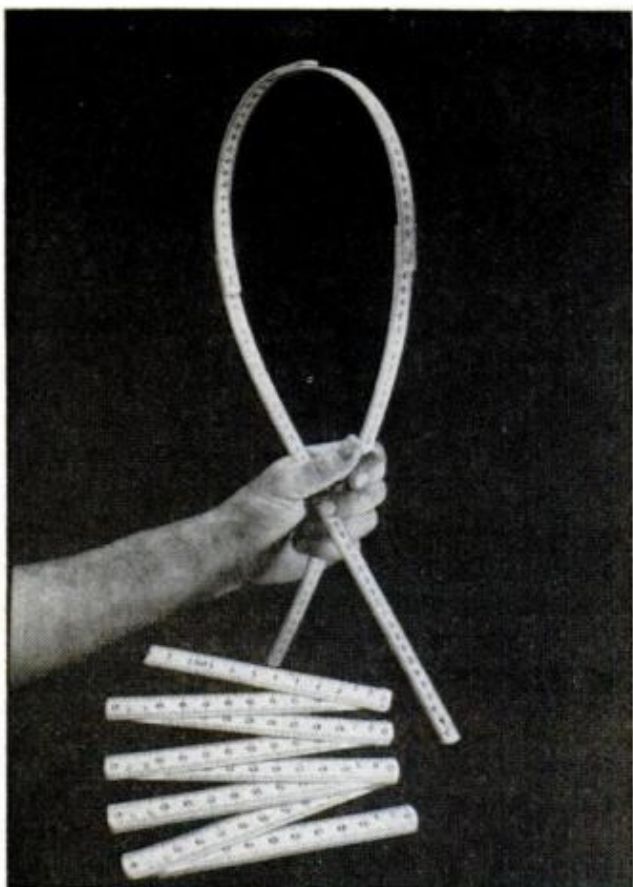
**SWINGING TAILGATE** is fastened to dump-truck sides with screws that pass through holes into gate

**TANKER BODY** is fruit-juice can mounted to base with 2-ga. wire. Hammer ends flat against bottom

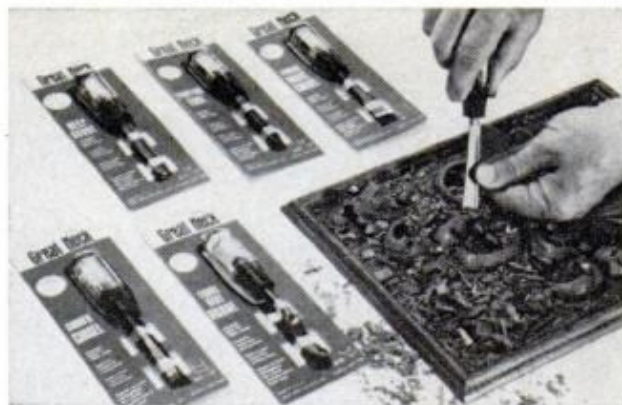




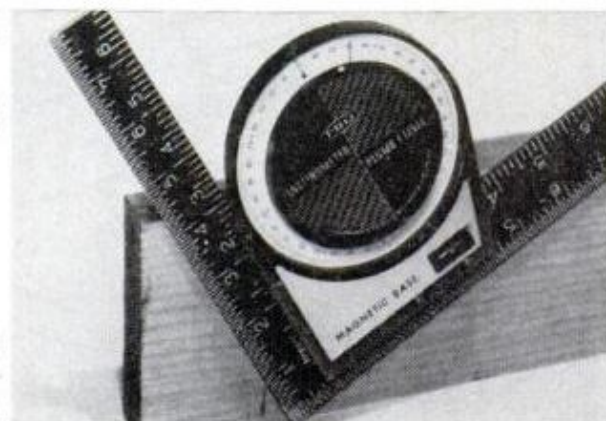
# Tools You'll Wish



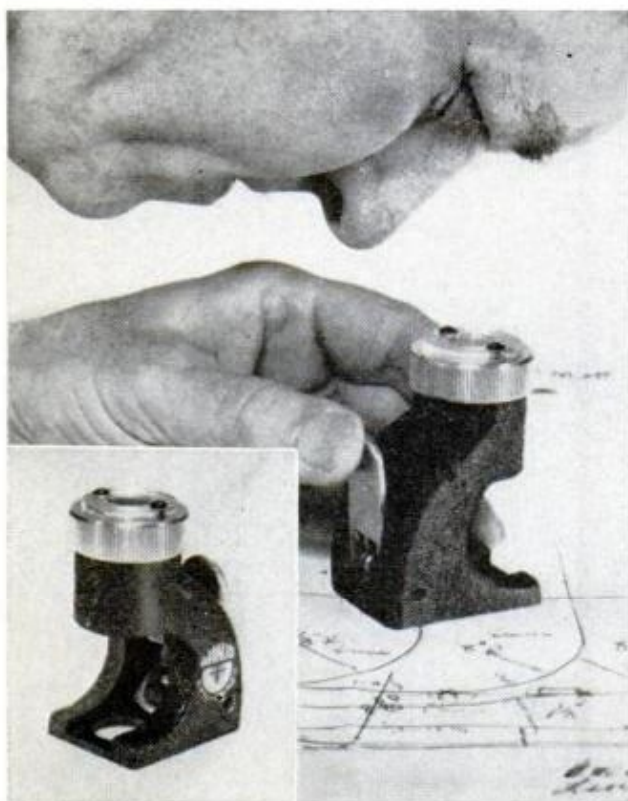
**NEW CONCEPT IN FOLDING RULERS** is this plastic version which is claimed to be unbreakable and can actually be used to measure circles. Called PAV-Pro-Magnirule, it's available now with metric measurements heat-embossed into the ruler. A version with 1/16-in. graduations will be on the market late next year. Priced at \$2.39 for a 6-footer, \$2.89 for 8 ft. Schlesinger for Tools Ltd., 1020 E. 54th St., Brooklyn, N.Y. 11234.



**WOOD-CARVING CHISELS** boasting handles made of high-impact, unbreakable Tenite are offered by Great Neck Saw Manufacturers, Mineola, N.Y. 11502. Hand-forged, ground, sharpened and tempered, the six chisel shapes available are firmer-basic, corner, straight-gouge, deep-gouge, front-bent gouge and parting tool. Sold through hardware stores, the chisels are priced at \$2.65 each or \$16 for the complete set.



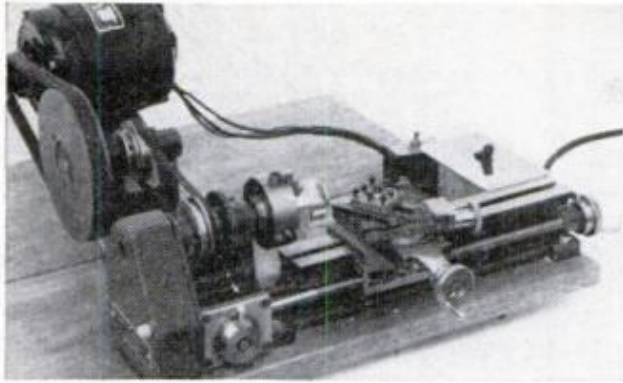
**MULTIPURPOSE PROTRACTOR** features a magnetic base for attachment to a carpenter's square to eliminate guesswork and time-consuming computation of angles. Tool gives instant dial readings from 0 to 90°, is claimed to be accurate within half a degree. Model 700-V Inclinometer (above) also includes a vial for checking level. At hardware stores, \$10. Pro Products Co. Inc., 812 22nd St., Rockford, Ill. 61108 is the maker.



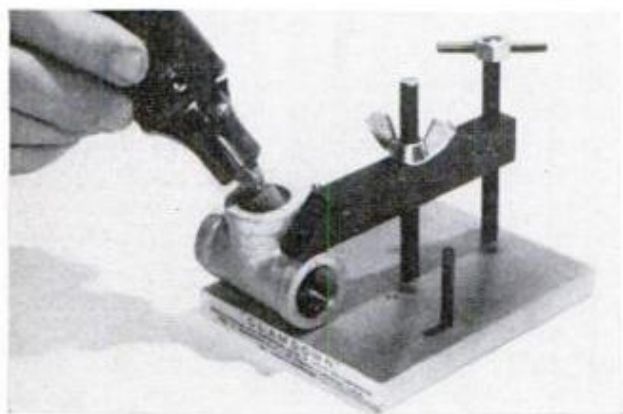
**SNAP-ACTION CENTER PUNCH** provides a reticle pattern that's a virtual image created by a transparent mirror which, when sighted through, appears to be resting on, and gives a six-power magnification of, the work area. The standard tip is hardened and can be re-sharpened or easily replaced. Opti-Punch has an introductory price of \$39.95 (carbide tip also available for an additional \$2). Wanjo. Inc., Gilmanton, N.H. 03237.



# Santa Would Bring



**PRECISION SCREWCUTTING LATHE** for modelmakers swings 3½ in. over bed, holds 9 in. between centers, features massive box-section bed with ground ways. The lead screw has a totally enclosed clutch mechanism, is back-g geared for slow turning. Four-jaw chuck, faceplate and four-way toolpost are standard equipment. Weighs 30 lbs. Without motor, \$300 f.o.b. Caldwell Industries, Box 170/C, Luling, Tex. 78648.

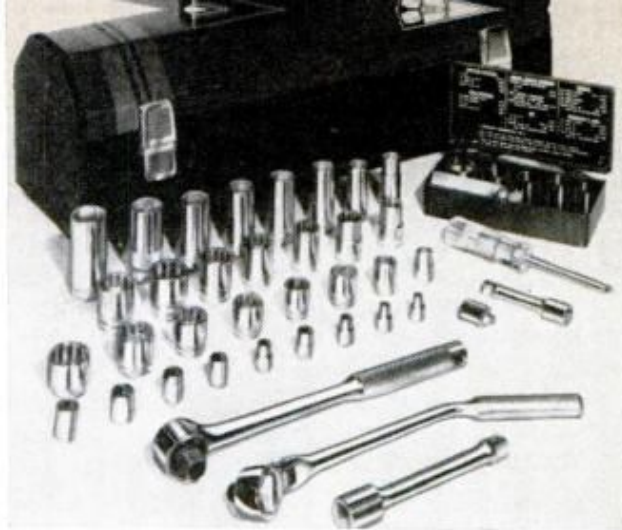


**PORTABLE, HORIZONTAL VISE** can clamp down workpiece with a feather's touch or a bulldog bite according to job requirements. The base is constructed of alloy aluminum; all other parts are of high-grade steel. Dubbed Clamdown, vise comes with three removable alignment pegs and 2¼-in. jaw opening. Sold with guarantee, \$7.98 plus 50 cents postage. B. R. Ditto Enterprises, 527 N. Alexandria Ave., Los Angeles, Calif. 90004.

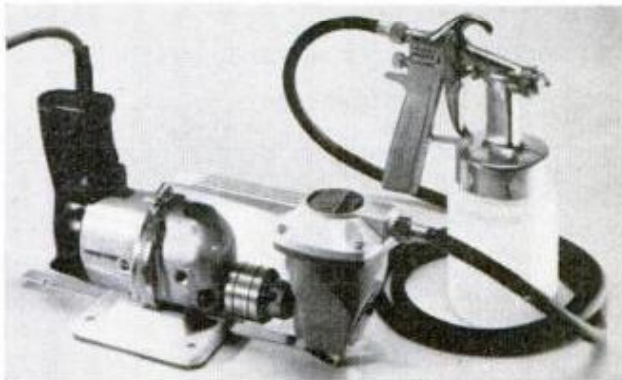
**FOR SAWING PROBLEM MATERIALS** such as plastic laminates and plexiglass, Model 314 Trim Saw is powered by a 4.5-amp. motor. The 4½-in. blade turns at 3800 rpm and will cut stock up to 1½ in. thick at 90° and 1½ in. at 45°. Wraparound base measures 50 sq. in., features single lock-knob for easy rip guide mounting. The saw is priced at \$90. Rockwell Manufacturing Co., 400 N. Lexington Ave., Pittsburgh, Pa. 15208.

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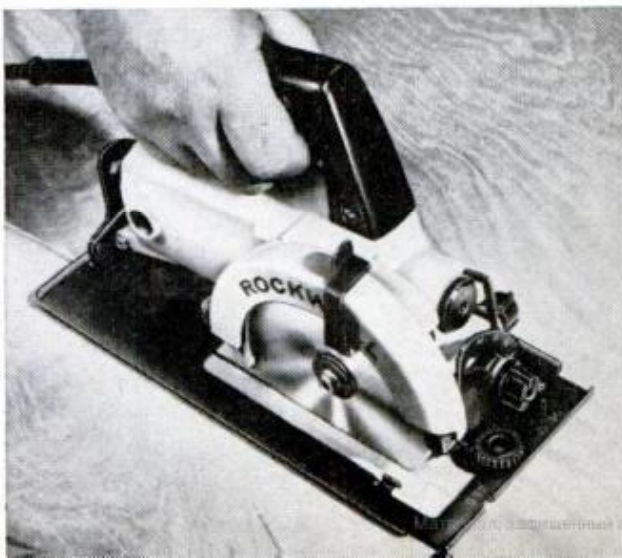
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**RALLY TOOL SET** includes the tools most frequently needed for pre-race preparation and pit-stop servicing. The 46-tool assortment includes ½ and ⅜-in.-drive reversible ratchets, a ¼-in. spinner handle, 31 sockets, two extensions and a ⅜ to ¼-in. reducer. Big plus in package is seven-piece Snap-Gap point-setting set for gapping ignition contacts. No. 7552, \$69. New Britain Machine Co., Box 1320, New Britain, Conn. 06050.



**GENERAL-PURPOSE AIR COMPRESSOR** and spray-gun outfit can be used for touch-up jobs, garden insecticides and other household spray chores. The Little Pro, which fits any ¼-in. drill for its power source, features a cast aluminum housing, flexible adjustable strap, adjustable mounting bar and base, rubber hose and a standard spray gun with a one-pt. cup. \$25. Thomas Industries, Inc., 207 E. Broadway, Louisville, Ky. 40202.





*(Continued from page 111)*

sonal propulsion devices that may in the future be used for extravehicular activities (EVAs). One unit is ridden like a bicycle and has foot-pedal controls for its small propulsion jets, an arrangement that permits an astronaut to use both hands in handling tools and cameras.

After the workshop is orbited, a thin aluminum shield will pop out to surround it like a second skin. Held against the stage's cylindrical outer wall during launch, the shield is deployed by swinglinks and torsion bars and held in place five inches from the workshop wall. Its purpose: to protect the workshop against punctures by meteoroids.

Connected to the forward end of the workshop is the second major element of the cluster: the airlock module. It is Skylab's nerve center, providing control of atmospheric gases, inside environment temperatures and electrical power distri-

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### **Significant studies of the sun are among 50 experiments planned for Skylab.**

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bution for the cluster. It also contains various kinds of instrumentation and a communications setup that links a ground network with the cluster command system.

The AM has a load-bearing truss framework on the outside, surrounding a compartmented, five-foot-in-diameter tunnel that provides a pressurized passageway between the workshop and the multiple docking adapter (MDA). In all, the AM is 16 feet long. It has a special hatch (developed in the Gemini program) that permits two astronauts access to the outside for EVA chores without requiring a depressurization of the entire Skylab.

The MDA—17 feet long and 10 in diameter—is primarily a docking facility. The command module will ordinarily dock at the rear port. But the MDA also has a side port at which a second command module could dock, making it possible for a CSM, orbited from Earth, to join the cluster on a rescue mission.

A second important MDA function is as a control station for the Apollo telescope mount and as a film storage area. Handling the telescope controls has been described by astronaut Walt Cunningham as "one of the most complex operations man has ever been called upon to do in space." (Cunningham has been associated with the Skylab program since 1968 and is

likely to command one of the crews.)

The module has two windows 180° apart; one to observe telescope operations, the other for Earth observations.

The last major unit—and the most distinctive—is the Apollo telescope mount, positioned "above" the MDA. At launch, the ATM is stowed at the very top of the hardware stack in the Saturn 5. In orbit, after the Skylab cluster has been rotated to face the sun, the ATM swings 90° into operating position. Then its solar arrays, which give it a "wingspan" of 102 feet, are extended. These arrays plus two others sticking out from the workshop's sides provide 2400 square feet of receptors to sop up solar energy. Together, they provide all of Skylab's power, some 22,000 watts.

It's essential for Skylab to face the sun—for power production and so that various solar experiments can be conducted. Three large gyros in the ATM provide attitude control and stability for the entire cluster. Sun sensors activate the gyros.

A battery of telescopes is set into the seven-foot-diameter dish that faces the sun. Each 'scope is rigged to a camera, which must be loaded and unloaded from the face of the dish, a task that will have to be done six times during the three phases of the mission.

It's a difficult and critical EVA. The astronauts will exit through the airlock hatch. One will move to the telescope dish atop the ATM, tether himself, and remove a film magazine. His buddy, positioned just outside the airlock hatch, will activate a STEM (storable tubular extendible member) mechanism that operates something like a steel carpenter's tape. Thin steel strips reel out from a housing to form a stable, 27-foot-long "pole" about 2 inches in diameter.

The astronaut at the dish hangs the magazine of exposed film on the end of the pole and the man at the hatch "reels" it in. Then he attaches a container of fresh film and sends it out to the astronaut at the dish.

Sound simple? It isn't, say NASA experts. The two astronauts will be required to do about 150 separate operations to retrieve and replace six film magazines. In all, the EVA will take two hours.

A number of significant studies of the sun are among the 50 experiments planned for Skylab. The orbiting 'scopes will see "more" of the sun than is possible from Earth, where atmosphere blocks certain types of solar radiation. By studying the sun in ultraviolet and X-ray spectrums, scientists hope to learn much about how energy is transported in this prominent, little known inhabitant of our universe.

The advantage of having a manned



ATM in orbit is that the astronauts, monitoring TV displays that show what the telescopes see, can quickly zero in on dramatic events such as solar flares.

Other experiments are in the fields of space medicine, earth resources, physics, materials technology and spacecraft habitability. Here are some brief descriptions:

● The astronauts will be kept on a programmed mineral diet for a specific time before and during the mission. Mineral balance will be determined from carefully controlled intake and output measurements of calcium and nitrogen, body weight and rate and amount of material lost by the body under space-flight conditions. Daily urine samples will be frozen and fecal matter baked to reduce its volume. They'll be stored for return to Earth and lab analysis.

● Cardiovascular changes will be studied. Heart rates, blood pressures and electrocardiogram data for the astronauts will be recorded during flight. The astronauts also will be tested in a piece of hardware called the "lower body negative pressure device." This is a cylindrical device of sufficient length to enclose a man's lower body. After it's sealed, pressure in it is dropped, causing blood to flow to the legs. The resulting cardiovascular stress and the body's reaction to it are measured. These tests will be run in conjunction with vigorous inflight exercises to keep the astronauts' circulatory systems fit.

● Earth resources will be studied by a variety of instruments, including radiometers and multispectral scanners. Pointed at the Earth, six precision cameras will provide surface coverage approximately 90 miles square with a resolution of 100 feet at 270 miles altitude. The object is to identify water resources, crops, soil and minerals, and to produce photos that can be used for mapping. According to Walt Cunningham, "one space photo can be equivalent to about 3200 aerial photos." The Earth resources studies influenced the choice of orbit. As a result, Skylab will pass over North America during the day.

● The advantages of casting metals in a zero-G environment will be studied to evaluate the possibilities of manufacturing in space. It's thought, for example, that perfect ball bearings can easily be made. A special chamber in the multiple docking adapter will be used for these tests.

● The physical and chemical characteristics of cosmic radiation that falls on the Earth's atmosphere will be investigated. A special nuclear package in the MDA will be exposed to radiation for later study.

Life aboard Skylab will be routinized as much as possible and will be structured according to Cape Kennedy or Houston

time. The three astronauts will sleep simultaneously and get up at 6 or 7 in the morning, explains Walt Cunningham. They will spend mornings and afternoons at work and will try to eat at regularly scheduled times. After the evening meal they'll take care of "personal hygiene problems," do some planning and perhaps even relax a bit.

"You like to have a period where you can sit and collect your thoughts, plan the next day's activities and maybe line up some of the experimental equipment," explains Cunningham. "There are thousands of cubic feet in which to stow equipment. It could be a real puzzle locating pieces of an experiment that has to be operated the next day. An awful lot of flight planning is going to be involved."

A recreation equipment package is being planned. It may include games, taped music and a video tape player.

Skylab will carry enough dehydrated and frozen food to last 140 days and enough breathing gases and water for

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eight months. There will be hot meals from an electronic oven. The crew will eat in the wardroom, which, incidentally, has an 18-inch-diameter window for observing the Earth. It would appear that NASA planners think there's nothing like a dining room with a pleasant view.

If all goes well, the first team will spend 28 days on Skylab. They will then button down the cluster, crawl into the Apollo command and service module, undock and head for a splashdown in the Atlantic. About two months later, after Skylab has been reactivated by ground control, the second team will blast off aboard a Saturn 1-B rocket. Three months later, after team No. 2 has completed its 56-day mission, the third team will head for Skylab to spend up to 56 days in orbit. When it leaves, the spacecraft will be buttoned down, perhaps never to be reactivated.

Skylab is not a space station, say NASA officials, because it can't be resupplied in space. More water and breathing gases, for example, can't be piped in from another vehicle. Even though much of its hardware comes right from the Apollo program, Skylab is a sophisticated spacecraft and the forerunner of true space stations. At this writing, NASA plans to launch a 12-man space station between 1976 and 1978. ★ ★ ★



## THE LAST FLIGHT

(Continued from page 101)

sible to piece together approximately what happened.

Summoning purser Wilfred Spencer, Capt. DeWitt told him that the plane was low on fuel and they might have to ditch. Navigator Hart, Spencer testified, was holding a plastic bag containing a life vest.

"Shall I inform the passengers?" Spencer asked.

"Go ahead," DeWitt replied.

Spencer immediately went to the back of the cabin, called Cordeiro, and told both him and Miss Abraham of the possible emergency. Using the intercom at the rear of the cabin, he told the passengers to don life vests as a precautionary measure, for the plane might have to make an emergency landing.

There is disagreement as to exactly how long before the ditching the announcement was made. Estimates range between

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**. . . without power, the plane flew at 90 knots and an angle of 6° into the water.**

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5 and 10 minutes. In addition, some survivors say that there was no urgency in the announcement. One can guess that Spencer probably wanted to alert the passengers without causing panic, but there is another explanation: The emergency ditching was at this point a *possible* event, not an inescapable one.

Sitting up front near the galley, Emerson Ussery in seat 1C turned to Vivian Rosato in 1E and said that he didn't like the looks of things.

"I turned white," Miss Rosato recalls. "There was still no word from the pilot on the public address system."

Unable to get the life vest out from under the seat, Miss Rosato asked Ussery for help. Then, seeing people standing in the aisle, she asked him, "Shouldn't these people be sitting down?"

Ussery turned to Margaret Abraham, then at the front of the cabin, and said, "Please get those people down in their seats!"

Down the aisle in seat 13E, Arthur Johnson reached under his seat but couldn't find a life vest. He undid his seat belt, got down on the floor, looked underneath the seats and pulled out two jackets. He helped his wife into one, put on the other and returned to his seat. Noticing that the seat in front of his wife

was tipped back, he got up again and pushed it forward. When he got up the last time, he saw people standing in the aisles, and one man with a camera, taking pictures.

Miss Jacinth Bryan, also in the center of the plane, put on a life vest and then found another one for a passenger who couldn't get his open. Then, recognizing an old acquaintance, she left her seat to sit with him. She fastened her seat belt and urged the man to do the same, but he refused. He didn't think they were going down, he told her; it was just one of those things.

Miss Bryan could see the water coming up very fast and put her head down on her knees in a bracing position. Out of the corner of her eye she saw sudden movement on impact. It appeared that the man's seat came up from the floor and that he plunged forward.

In those last minutes DeWitt connected the tanks together and turned on all booster pumps to squeeze the last bit of fuel from them. Hart, who had been ordered back to the cabin to help with ditching preparations, asked the steward, "Are they ready for the water?" On receiving a positive answer, he returned to the cockpit and he and Evan tried to help DeWitt determine wind direction when they spotted the ocean at 1200.

Unfortunately it was white water with waves six to eight feet high, and swells seemed to be coming from all directions.

As the DC-9 reached 500 feet and continued to descend, Harry Evan went through the emergency ditching procedures from memory, Seat-belt and no-smoking signs were switched on along with the cabin emergency light. Airconditioning was turned off and the cabin depressurized to prevent an outward explosion of air on impact. The emergency inverter was switched on to provide power for the plane's controls.

The plane now was down to about 20 feet above the surface of the water. The flaps were at 15° and the airspeed was about 145 to 150 knots when all of the fuel-pressure lights came on, then went off completely. Quickly, DeWitt went to full flaps, and shortly after that the engines, with fuel exhausted, flamed out.

Now without power, the DC-9 flew at 90 knots and an angle of 6° into the water. The time was 3:49; the place, a stretch of open water 30 miles east of St. Croix.

**P**LUNGING down into the waves with enormous force, the plane submerged completely, water leaking in through cracks and openings in the fuselage, then popped to the surface. The passengers



were caught in various stages of preparedness when the impact came. There was no final warning to brace and, according to some accounts, a few people were still on their feet while others had neglected to fasten their seat belts. The crew members—Hart, Spencer and Cordeiro—were working in the galley and were almost caught on their feet. Margaret Abraham, unaware of how close they were to disaster, was up in the aisle, last observed helping two elderly passengers get into life vests.

Passengers give widely varying accounts, but some tell of seats breaking loose and bodies hurtling up toward the front of the plane. "I had to step over bodies to get to the galley door," says Vivian Rosato. "The stewardess was underneath them and all the debris." Margaret Abraham, never to be seen again, had done her duty to the end.

Another survivor tells of her husband helping with her seat belt, only to be himself thrown forward and covered with the bodies of unconscious victims. "Bodies piled up on top of my husband," the woman later stated. "I pushed them off—they appeared dead. There was a man in front of me and he had his head split."

Tragically, the two young Caldwell girls, Jennifer and Kristin, were among the victims. So was their father. The children had been strapped to their parents' laps when the impact came.

Time was now short for everybody to get out of the rapidly submerging DC-9.

**W**HY HAD there been no warning that ditching was imminent? Capt. DeWitt testified that he had blinked the seat belt and no-smoking signs and rung the steward's bell. The public address system was inoperative from the cockpit, but the question is whether he would have had time to make an announcement if it had been working.

Restrained by his shoulder harness, he had hung onto the controls, fighting to keep the plane's nose up after it hit the water. He wanted to make the plunge as shallow as possible. The impact seemed to be one long decelerative force, and there was a moment of severe vibration when the panel instruments seemed to dance in front of DeWitt as the ship submerged before surfacing again.

As a result of a misunderstanding, all of the cabin crew and navigator Hart were on their feet up to the moment of impact. This may have misled some of the passengers, who were also standing. Anticipating that the plane would break up when it hit the water, Hart, with Spencer's help, had dragged a 25-man

lifteraft out of the forward coat closet and into the galley area. They were attempting to locate the inflation lanyard when Cordeiro joined them to detach the bar that held an inflatable emergency slide to the inside of the passenger door.

Hart called into the cockpit to ask the altitude. The reply was "two," and he assumed the plane was still at 2000 feet. Suddenly, out of the corner of his eye, he saw waves beyond the window, and screamed, "Sit down! Sit down!"

Leaping back into the rearward-facing galley seats, he and Spencer survived the impact with minor bruises. Cordeiro was similarly fortunate, sitting down on the liferaft and bracing between the galley cabinets.

But now another accident occurred to compound the tragedy of ALM 980.

After the impact, Cordeiro picked himself up and tried to open the galley service door opposite the main passenger entrance. The handle wouldn't move until he kicked it. When the door opened, at least one

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**'I had to step over bodies  
... the stewardess was  
underneath them ...'**

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passenger, Vivian Rosato, managed to escape through it. Ussery, who had been seated beside her, however, had been thrown forward at impact, slamming his head against the galley door. He lay stunned in the galley area.

Working desperately, with waves washing into the plane and out again, Hart and Spencer attempted to push the liferaft out through the service door. But it became wedged amid galley bins that fell when the plane hit the water. Harry Evan came out of the cockpit, and the three tried to clear the debris and launch the raft. Then, somehow, the enormous raft began inflating, filling the tiny galley area and pinning Ussery and Evan.

Efforts to puncture the huge raft were to no avail and the airplane, still filled with passengers, became a partially sealed tomb with only the wing exits remaining for escape. Hart was able to exit through the door. DeWitt, trapped in the cockpit, opened a window and swam back to the left wing exits, successfully opening them from the outside. Miraculously, Ussery and then Evan escaped.

When the raft inflated, "it felt as though somebody had put a clamp around my left foot," Evan later testified. "I was instantly pinned. I don't recall too much

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## THE LAST FLIGHT

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after that. The water level reached pretty close to my neck."

Evan later found himself in the sea. To this day he has no knowledge of how he got out of the aircraft.

With the crew cut off from the cabin by the inflated raft, the passengers were left on their own. Sitting next to the rear right-wing exit, Arthur Johnson pulled it open, although he does not remember doing so, and stepped out onto the wing. His wife was still in her seat looking for her pocketbook. He called to her "Honey, forget that—and let's get out of here."

In contrast to Johnson's calm manner, other survivors recall panic and terror inside the cabin with women screaming and people struggling to get out. Another male passenger strode over to the right-wing exit, pushed his wife and four other women through before following. A total

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**. . . many passengers survived without seat belts and suffered only minor bruises.**

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of 27 passengers followed Johnson out onto the right wing.

On the left wing, DeWitt struggled to get the exits open, found the front one blocked and opened the rear. He succeeded in getting one passenger out of it, then unblocked the forward exit and pulled a woman passenger through.

The DC-9 was sinking rapidly, and although it remained afloat for perhaps 10 minutes, the cabin rapidly filled with water. At last only the tail protruded from the water.

Of a total of 57 passengers and six crew members, 43 persons had escaped. What happened to the missing passengers? A later search revealed no trace, so it can only be concluded that 19 stunned or otherwise injured individuals and stewardess Margaret Abraham went to their deaths when the plane sank in 5000 feet of water. The explanation is inadequate, however, because many passengers who survived did so without seat belts and suffered only minor bruises. Could the others have been so incapacitated that they could not even exit the airplane?

Once in the water, Hugh Hart had a stroke of good luck, perhaps one of the few during the entire episode. Copilot Evan had appeared in the water without a life vest, and Hart was swimming rearward on the right side of the plane to look

for something for Evan to hold on to when he bumped into a large, plastic-wrapped package. He pushed it away, and then remembered something: The package contained the emergency slide that had worked its way loose from the galley service door. It was inflatable—not designed as a liferaft, but certainly the next best thing.

Not having enough leverage by himself to pull the bar which inflated the slide, Hart asked a woman to take one end and swim away from him. When she had gone as far as she could, he yanked hard and was rewarded as the big slide, fed by its built-in CO<sub>2</sub> cartridges, rapidly inflated.

Now there was flotation for the passengers, and they gathered around the improvised raft, hanging onto the sides, while Hart and DeWitt gathered in the stragglers. A few minutes later Vivian Rosato, who had found her own flotation in the form of a tire from the airplane and had been joined around it by Ussery and Mr. and Mrs. Johnson, joined the group, lashing the tire to the raft.

Although San Juan and St. Croix knew where the plane had ditched, "in the water you're wondering if they're going to pick you up, are they going to find you," Hart relates. "I reassured the passengers, but I had my own doubts, and I was deathly afraid of sharks."

Hart's concern about sharks was well founded. The area where ALM 980 ditched is known as "shark gulch" among local residents, many of whom come to the vicinity for sport shark fishing. The group around the raft examined themselves for bleeding, intending to put any bloody survivors up on the raft.

**T**HE FIRST aircraft to arrive on the scene was Pan Am Flight 454 which circled so a radar fix could be made. Shortly after, a flying boat appeared, circled, and to the intense disappointment of those in the water, did not land or drop more rafts. Harry Evan, up on the slide because he had no life vest, reassured passengers more help would be coming.

At last it appeared in the form of a small cargo plane, which released two rafts. DeWitt and Hart, well aware that they had only a slight chance of getting to them and then maneuvering them back to the passengers, started off.

"I've either got to go for it or be eaten by the sharks," Hart thought. There were other considerations: The injured were beginning to weaken, and an early twilight was falling over the storm-tossed water. With poor visibility, there was the chance they would have to spend the night in the water, and the injured would



never make it to the raft, sharks or no.

Although Hart and DeWitt got to the rafts, rescue helicopters appeared before they could return. Arriving at 6:27 p.m. EDT, two Coast Guard helicopters from San Juan hauled up 11 passengers, while 26 were recovered by a Navy helicopter from Roosevelt Roads. Three more persons were rescued by a Marine chopper from the aircraft carrier *Guadalcanal*.

Two of the 43 who exited the plane had died in the water, one the apparent victim of a head injury and the other of a probable heart attack. A third was declared dead on arrival at St. Croix, also appearing to be a heart-attack victim.

**I**T IS MUCH too easy in the tragedy of ALM 980 to point an accusing finger at human or mechanical failure and conclude it was responsible for the deaths of 23 people. It is very easy to forget that the accident was almost unprecedented in aviation history. Two investigations have been conducted, one by the Federal Aviation Agency and the other by the National Transportation Safety Board. Despite volumes of testimony collected, the answers are unsatisfying.

Capt. DeWitt, copilot Evan and navigator Hart were released by Overseas National Airways following the May 2 ditching, because of "poor judgment." Yet, as one source put it, 40 people are alive today because the crew did their jobs to the best of their abilities—both before and after the accident. Hart and Evan were injured in the impact (Hart was to wear a cast for five weeks), yet they ignored their own injuries in their efforts to aid passengers.

A veteran pilot with 17 years' experience, Capt. DeWitt, 37, served with the Military Air Transport Service for nine years. In commercial aviation he has worked as a flight instructor, assistant chief pilot and chief pilot. Like other crew members of the ill-fated ALM 980, his plans are indefinite, his future in aviation a question mark.

Navigator Hart, 35, joined ONA in 1966. Although flying is his first love, he will probably now return to the career in management that he left in 1966. Evan, 25, employed by ONA since 1969, also wonders about his future.

One questions the justice of their suspensions for, in the final analysis, the crew of ALM 980 were the victims of mechanical failures, questionable judgment on the ground at St. Maarten, and faulty government regulations. Before judgment is passed on DeWitt, Hart and Evan, we are entitled to answers to questions like these:

● *Should medium-range aircraft with only two engines be used on extended overwater routes?* The use of the DC-9-33CF between New York and St. Maarten was unusual in that it was the first time a two-engine jet had flown commercial long-range, overwater flights. Similar doubts had apparently occurred to others, for an ONA bulletin dated Jan. 12, 1970, reads in part: "Until such time as the rear aux fuel tank is installed (on or before 1 April 1970) giving the aircraft nonstop capability, fuel stops at Nassau are planned for both segments." As of May, 1970, the auxiliary tanks, which would have prevented the tragedy of ALM 980, had not been installed, nor were fueling stops being made. In this connection it is worth noting that the ALM flights to St. Maarten are now by Northeast Airlines using longer-range 727s.

● *Are the totalizer fuel gauges on the DC-9 inaccurate under certain conditions?* At least one experienced pilot reports

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### **Hart and Evan . . . ignored their own injuries in their efforts to aid passengers.**

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spinning much like that encountered on ALM 980.

● *Should airports like that at St. Maarten be permitted to handle jetliners?* Lacking adequate instrument landing facilities and other sophisticated devices for navigation and weather observation, the Juliana tower was manned by a single controller, a Dutch government employee and "two young fellows, fresh from school" (these are the words of the controller) when ALM 980 attempted to land there. The airport didn't even have a tape recorder to record conversations between tower and aircraft; records were kept in a handwritten log.

● *Is it realistic to expect that life vests and rafts can be deployed in the few minutes that may be available when a passenger jet is ditched?* None of the rafts aboard ALM 980 was utilized, and many passengers complained of difficulty with the vests. Better design could place both in more accessible locations.

If the ditching of ALM 980 was the first involving a passenger jet, it may not be the last, for over-ocean air travel expands each year. The jumbo jets present a frightening prospect when it comes to a forced landing at sea. The questions posed by ALM 980 require answers, a rewriting of the rule books

*(Please turn to page 184)*



## THE LAST FLIGHT

*(Continued from page 183)*

and even a redesign of emergency and cockpit equipment. Perhaps the contributions of the crew of ALM 980 in the sea off St. Croix and in government hearing rooms will one day save the lives of hundreds more passengers in another ditching. ★★★

## STRAIGHT-THROUGH MUFFLERS

*(Continued from page 91)*

and there's a rarer type that has nothing inside—it's just hollow. These, though, are too noisy for street use.

Conventional stock mufflers are made of galvanized sheet metal with the seams crimped, riveted, and/or welded. Many straights use this same construction, but the latest trend is toward one-piece "bullet" mufflers. These have no seam, or if they do it's been welded shut and filed smooth. They claim this type lasts longer, because it can't rust at the seams and the outer walls are usually thicker. Straight-through mufflers ordinarily do last longer than conventional ones because, with simpler construction, they trap less moisture.

There's no end to places that sell "competition" mufflers: your local speed shop, auto-supply house, muffler shop, service center, even your neighborhood filling station. But look around. Don't buy on the basis of price alone. You'll run into plenty of cheap, poorly built mufflers. Best is to stick with nationally advertised, reputable brands. A leaky exhaust is as deadly

with loud mufflers as with quiet ones.

You'll do well, too, to buy from a shop that can install your new muffler. That way the person who hangs it on can let you hear what the system will sound like before he tightens up all clamps. If you don't like the roar of one, try another. Resonators can quiet a too-loud system.

Boiling it all down—people buy straight-through mufflers for emotional, not rational, reasons. If you're looking for big increases in acceleration and gas mileage, you'll be disappointed. But if the sound pleases you, you'll be happy. ★★★

## 200-POWER TELESCOPE

*(Continued from page 173)*

you have to push the knife edge nearer the mirror in order to cause the central area to darken uniformly. Use a sharp pencil to measure the difference in radius of curvature of the two zones.

Next, the mirror should be aluminized (commercially) or silvered (which is not as tough as the former). Carefully clean the front surface of the mirror with distilled water and alcohol. Dissolve ¼ oz. of pure silver nitrate in 6 oz. of distilled water and add chemically pure ammonia, drop by drop, until the solution clears. In another vessel pour a teaspoonful of formaldehyde in 2 oz. of water. Add this to the silver solution and immerse the mirror in it until a good coat is formed. Stand the mirror up to dry.

The mirror part of the project is now complete. Next month's installment will detail barrel and tripod construction.★★★

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**TOOLS AND THE TRICKS THE PROS USE WITH COPPER TUBING.** This most informative piece shows you how to use the tools designed to cut, bend and swage copper tubing. Profusely illustrated, this January how-to story also puts you wise to the tricks of the trade when doing your own plumbing repairs.

**INTERNAL CARVING: A LITTLE KNOWN ART.** Though acrylic plastic (plexiglass) has been around for about 25 years, the art of internal carving—working from the back instead of the front—remains undeservedly out "in left field." *PM* readers will find this fascinating hobby in the January issue.





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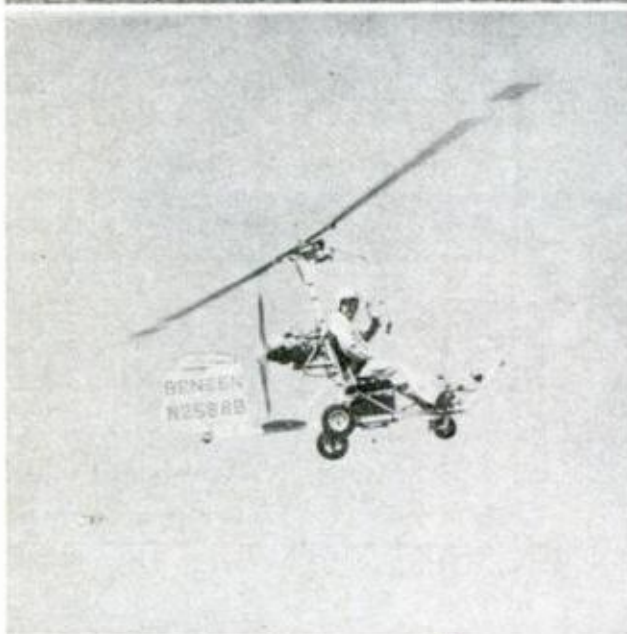
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## TEACHING ANIMALS

(Continued from page 82)

and wild bears to play basketball (not on the same team); a house cat to play a toy piano and to open her own can of cat food using a standard electric can opener; a macaw to answer the telephone and play poker, and a cockatoo to roller skate and pull a miniature chariot driven by a "speed-crazy" parrot.

Smith's Behavioral Engineering Techniques are taught by remote control, "thus eliminating the need for verbal commands, hand signals or physical contact (unless, of course, it is called for in a particular routine)." The trainer "communicates" outside the training chamber, operating an electronic gun or simple hand switch that transmits light and sound signals to the animal. In most complex training situations, the trainer may sit inside a control booth equipped with one-way glass and operate a console sporting a whole array of switches, which enables him to control

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### **Wild animals can be trained without having to be tamed first . . .**

---

all the operations required for that particular behavior.

Smith has found that, without the presence of a trainer to distract them, animals have nothing to do but concentrate on their tasks and props. Wild animals can be trained without having to be tamed first—like the ferocious Hokkaido bears at the Japanese Village in Buena Park, Calif., who are not tame and "never will be."

Since there is no physical contact with the animals, Smith is often asked: "How do you show the animals what you want them to do?"

"First of all," Smith explains, "you don't show them how to do anything. You let them figure out what they're supposed to do, all by themselves; only then is it readily recalled. Animals are like human beings. You can show them all day long how you want them to do something, but they have to learn how by doing it themselves."

There are five or six ways to initiate the action desired, such as waiting for an animal to make a natural movement, then instantly rewarding him for it. In training a bear to play basketball, for example, the first time the bear goes near the area where the ball has been placed on the floor, the trainer rewards him immediately with a signal. This is done by press-

ing a switch or button that simultaneously fires a conditioning tone, dispenses from an automatic feeder highly-nutritious food pellets, and activates a counter (similar to the type found inside vending machines and turnstiles), which keeps track of the food consumed and the number of times the animal performs correctly.

When the bear so much as touches the basketball—mainly out of curiosity at first, he is instantly rewarded. He does it again and is rewarded immediately, and so on for every correctly performed behavior at each step. When the bear performs correctly, he knows instantly he will be rewarded for it.

"You can actually see the bear thinking and learning," says Smith, "which is an astounding thing. You can almost see wheels in his brain turning as he progresses through each step required for the behavior, trying one thing, then another and every so often looking over at the feeder as if to say: 'Just what did I do right that made food come out of that contraption?'"

Finally, after the bear has learned all the steps of the behavior, the reward is delayed to the final stages when he makes a basket.

Actually, says Smith, what looks like one thing may require many separate steps. Even the simplest of behaviors "must be broken down to the smallest, irreducible steps and eventually these are 'chained' together to form a molecule of behavior."

The basketball routine, for example, calls for more than 11 separate steps chained in sequence. Among them are: (1) going to the feeder; (2) bending over; (3 and 4) touching the ball—first with one paw, then with both paws; (5) picking up the ball; (6) holding the ball above his head; (7) tossing the ball with both paws and (8) making the basket, first at fairly low heights then at increasing heights.

"Before going any farther," Smith said, "I would like to stress that no animal I train—whether it's a bear, a wolf (he recently acquired two cubs for research), a cat, a raccoon or any other species for that matter, is ever prodded, coaxed, punished or starved to get it to perform.

"Every animal is fed an excellent 'maintenance' diet after the training session. If the animal wants the special rewards or 'treats,' then he must work for them. If he chooses not to work, which happens occasionally in the early stages of the conditioning process, he is simply returned to his cage.

"The emphasis of BET is all on reward with the result that animals are highly

*(Please turn to page 190)*



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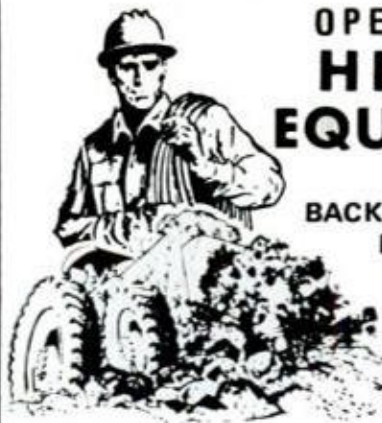
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## TEACHING ANIMALS

*(Continued from page 188)*

motivated to work or to perform. In fact, they eventually arrive at the stage where food reward becomes secondary to the excitement and stimulation derived from the work or the performance itself. And stimulation as reward or reinforcement is probably as powerful a reward as exists."

The speed with which animals can be trained is one more extremely important element of BET. "A trainer," says Smith, "can condition an animal in from 5 to 10 percent of the time required by the best 'traditional' trainers. And with the new behavior methods I employ, it may take only 30 minutes to teach a new behavior. Moreover, once the animal learns, he never forgets—even the most complex behaviors which might include 3 separate steps. And the performances will be as reliable as a fine piece of machinery."

A chimp, for example, can be taught to roller skate in one hour, whereas with traditional methods it might take months. In four weeks Smith conditioned a 31-year-old macaw (a South American bird) that had never been trained before, to assemble a ballpoint pen. This involved the use of two tools and required 14 separate steps, each of which had to be done in sequence.

It took Smith five days to train a cockatoo to ride a bike, three weeks to train a cat to use a standard electric can opener to open her own can of cat food, and three weeks to teach a 40-year-old Japanese carp to play poker—correctly 95 percent of the time.

"Once an animal has learned a behavior, automatic apparatus take over many of the duties of the trainer. Indeed," says Smith, "with a little electronic automation, the animals can perform or practice by themselves."

Far-reaching potentials of automatically trained animals have led Don Smith to pioneer a brand-new field he calls Automatic Conditioning Technology. This would be used where there would be a need for large numbers of animals to learn the same conditioned behaviors at low cost. With ATC for instance, it would be possible to condition 10,000 baboons for sentry duty at a cost of \$200 each; if a technician were present, the training would cost \$5000 for each baboon.

Smith foresees the time when he and a whole new breed of animal trainers, or "behavioral technicians" (as he prefers to call them) under his tutelage will be programming computers to train all kinds of creatures—from baboons, monkeys and raccoons to great horned owls—for hun-

dreds of tasks in agriculture, industry and defense; as crop pickers, inspectors, watchmen and sentries.

"Not only will it be economically feasible to train animals for these and many other tasks," says Smith, "but it will be necessary; both semiskilled as well as skilled nonhuman workers will be needed badly in that pleasure and leisure-oriented society beyond the 1970s."

He also predicts that "computers" will be training seeing-eye dogs at a fraction of the present cost of traditional methods, and he foresees local training centers equipped with computers that will train ordinary dogs in simple good manners as well as in complex behavior. Cats, birds and fish, too.

Smith concedes that the idea of computer-trained pets, animal laborers and performers sounds like so much science fiction. He believes, nevertheless, that they will be taken for granted in the world of 1984. When you consider what Don Leon Smith is doing with animals, it's easier to believe him than not. ★★★

## CAMARO AND FIREBIRD

*(Continued from page 87)*

sometimes when stiffer springs come as part of a performance package. These owners complained of rear-end harshness and wheel hop. Both the 1970 Firebird and Camaro have gotten two inches of additional rear suspension travel, and no one mentioned bottoming, so that's apparently not a problem. The harshness might also have been due to belted tires.

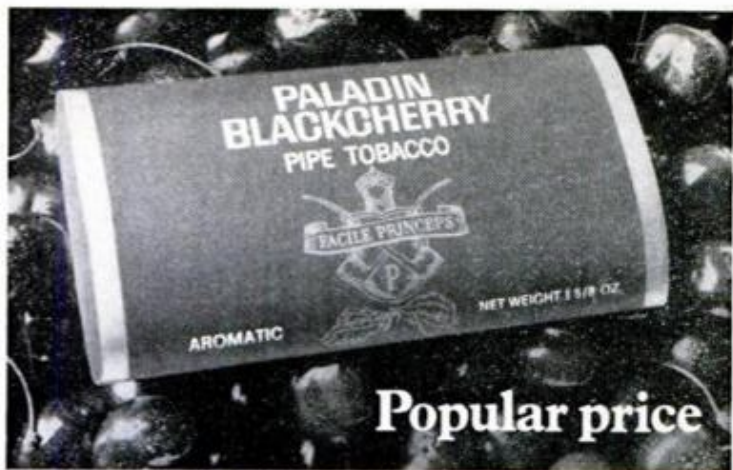
No one said much about the standard front disc brakes both these cars carry for 1970. Only one owner mentioned brakes, saying, "I'd like to see them make discs standard on all four wheels." Apparently all the owners we surveyed took front discs for granted—at least the brakes seemed to be doing their job, because no one complained about stopping ability, and with most other cars there are at least a few such complaints.

Briefly, from the *I'd Like To See* department: "More rearward vision." "A Firebird convertible." "Since it's almost impossible to drive with the windows open (too much noise and wind), why not make airconditioning standard?" "A different arrangement for storing spare in trunk to give more room; also the remote trunk-latch mechanism takes up valuable space." "Better workmanship."

The parting shot comes from a Firebird owner's wife who says, "He bought it to celebrate his second childhood." ★★★



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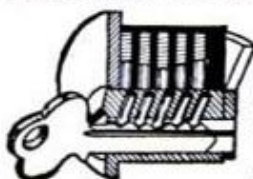
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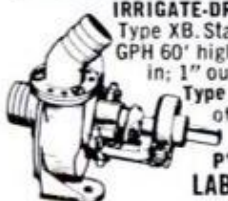
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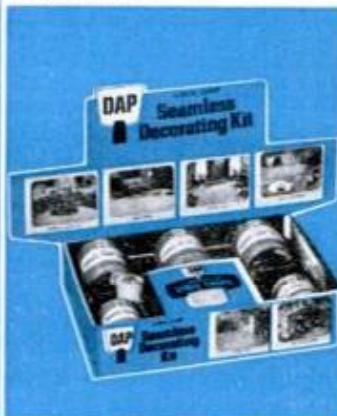
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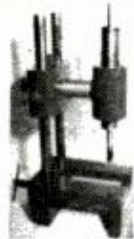
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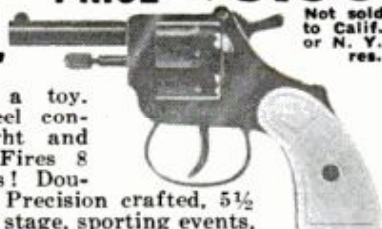
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## STRETCH YOUR LENSES

(Continued from page 127)

compensate for light lost through the added optics and give you fairly reliable readings. If your camera has a lens-coupled external meter, you can buy an extender with provision for meter coupling so you can retain this feature. In this case, the easiest way is to set the necessary exposure increase into the meter at the time you adjust it for the film speed you're using. This way, all subsequent meter readings will be correct without your having to convert them mentally. For a 2X extender, divide the ASA film speed by four; for a 3X extender, divide by eight. For example, a film speed of 400 ASA would be 100 with a 2X extender and 50 with a 3X model. You can also use this same system with a separate hand-held meter.

If you're working without a meter, remember that the exposure must be increased by the amount of the extender's power—two stops for a 2X and three stops for a 3X. In addition, most extenders have a handy scale on the barrel that does the exposure converting for you. You turn a ring to the indicated normal lens opening and the correct, adjusted opening appears in a small window next to it.

While two or more extenders can theoretically be stacked together to give added magnification, this tends to compound the exposure problem drastically. Combining a 2X with a 3X will turn a 50-mm lens into a seemingly giant 300-mm telephoto, but it will introduce a staggering light loss calling for an exposure increase of five stops—the amount of the two individual increases added together. It will also result in deterioration of image quality because of the extreme magnification. If you want a 300-mm lens, you're better off combining a 150-mm telephoto with a single 2X extender.

Because of their characteristics, extenders are best used as supplementary lenses rather than your main shooting equipment. They're ideal for the occasional times when you want a certain focal length but don't need it often enough to warrant buying a true lens of equivalent power. They're handy for doing portrait work or moderate telephoto shooting with a normal lens, or for adding extra reach to a long lens when you want to grab some really distant shot. But don't expect miracles. An extender used within reasonable limits can be a valuable addition to your photo equipment. When ordering one, be sure to specify the make and model of your camera as the accessory must be fitted with adapter rings to match your particular lens mount. ★★★



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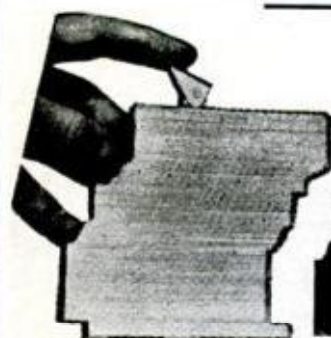
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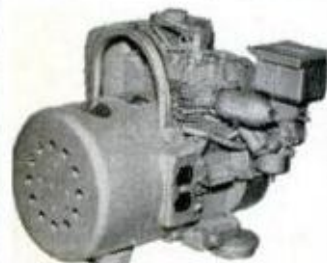


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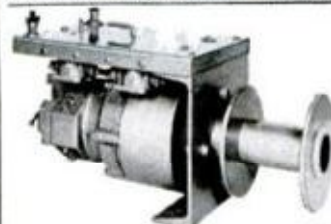
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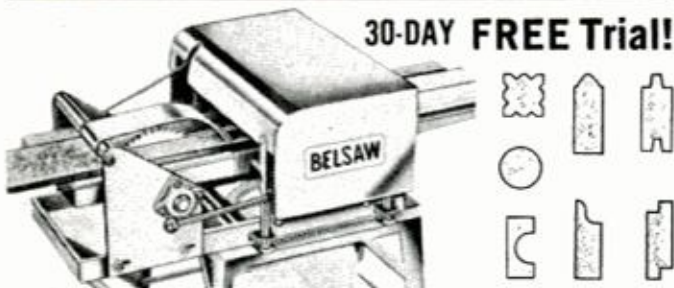
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## Prime crew of Apollo 14

Members of the prime crew of the Apollo 14 lunar landing mission pose with a mock-up of a lunar module at Kennedy Space Center. From foreground: Astronauts Alan B. Shepard Jr., commander; Stuart A. Roosa, command module pilot, and Edgar D. Mitchell, lunar module pilot. The Apollo 14 mission is scheduled to be launched Jan. 31.



## Giant birch-bark canoe

This 39-foot birch-bark canoe, a replica of the "Montreal" canoe used by French-Canadian voyageurs, was built by Bill Hafeman (left) for the Minnesota State Historical Society to display at the state fair.





## Steel hull for world cruise

Shown being launched is the steel-hulled yacht, *British Steel*, in which Chay Blyth hopes to sail solo around the world. The voyage is being sponsored by the state-owned British Steel Corp.



## Paris firemen's weapon

Shown in a recent demonstration staged by firemen of Paris, France, was a new television-guided "water gun."

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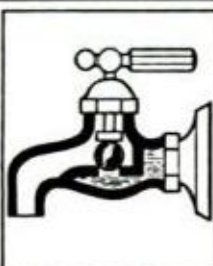
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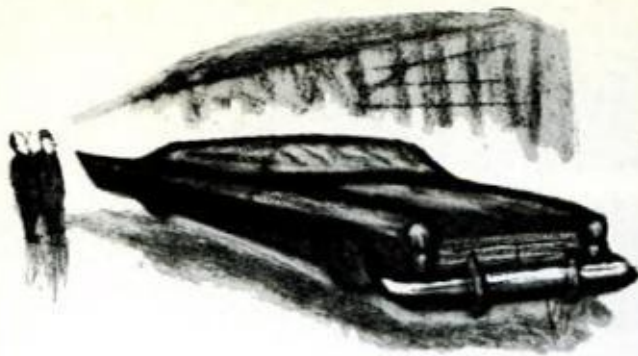
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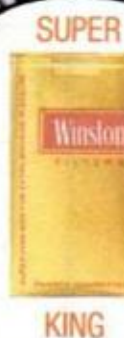


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