NEW FROM GALE! THE MIGHTY...

V SOVEREIGN

DELIVERS A NEW DIMENSION IN BIG-POWER SPEED AND SMOOTHNESS

Brawn and BALANCE in a perfect power package! Here's the thrust and zip of 60 hp...the power reserve of a deep-chested V-BLOCK engine. Here's smooth, flowing power to plane the heaviest cruisers, to pull a troop of skiers. Here's QUIETNESS. V SOVEREIGN purring power "floats" on rubber, sealed by a fiberglass cover. Rugged reliability, too! From thermostat-control to quiet anti-friction bearings, to trim, slim "TORPEDO" underwater unit, the new Gale V SOVEREIGN is engineered for maximum economy and carefree long life.

Take a look, skipper! See the new Sovereign and Buccaneer Motors—from 3 to 60 hp. Find your Gale dealer in the "Yellow Pages." Write for colorful brochure to: Gale Products, Dept. 316, Galesburg, Ill.

GET A GALE AND GO—ANYWHERE

Gale
OUTBOARD MOTORS

GALE PRODUCTS, GALESBURG, ILLINOIS • DIVISION OUTBOARD MARINE CORPORATION
Q. Why does Mickey Thompson, holder of the U.S. speed record, use Champion spark plugs?

A. Men whose careers depend on performance and power know they can rely on Champions! Your car will get a boost in performance—and save gasoline, too—with new Champions. Put in a set every 10,000 miles!

World's favorite spark plug—engineered for every car built by Ford Motor Company, General Motors, Chrysler, American Motors, Studebaker-Packard and every major foreign maker.
Three fourths of all night driving is now done with the low beam!

The low beam of G-E SUBURBAN Headlamps gives you a "spotlight" effect . . . lets you see better in spite of the other car's lights

OLD LOW BEAM
25 feet beyond those approaching headlamps there's a barrel in the road. It's not yet within the range of the low beam of any previous 2-headlamp cars.

NEW G-E LOW BEAM
There's the barrel—225 feet away! This is how the low beam of G-E SUBURBAN Headlamps (made only for 2-headlamp cars) helps you see in spite of oncoming lights.

When there wasn't a great deal of nighttime traffic, you used the upper beam most often because it lit up a lot more light farther down the road. So, headlamp manufacturers put the upper beam filament on focus for maximum beam control.

Since nighttime traffic has increased tremendously, motorists find they must use the low beam more and more. So, General Electric now puts the low beam filament on focus to give maximum beam control where it's needed most—to provide a "spotlight" effect which directs more light down the right side of the road. That's why the low beam of new General Electric SUBURBAN Headlamps lets you see past the oncoming car when you're 75 to 200 feet apart. Only General Electric SUBURBAN Headlamps have this feature for 2-headlamp cars. General Electric Company, Miniature Lamp Department M-905, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

ATTENTION ALL OWNERS OF 2-HEADLAMP CARS!
For approximately the same results as the four-headlamp systems in brand new cars (whose low beam filaments are also on focus) . . . have a pair of new G-E SUBURBAN Headlamps installed and aimed today. Tonight you'll see better in spite of the other car's lights.
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Next Month...

YOU MAY SAVE your property—or your life—by reading the lead story in the February issue. “What to Do Until the Firemen Come” takes you through those important moments between the alarm and the arrival of professional fire-fighting help. . . . February also brings a timely report on a unique ship, rigged like a submarine of the near future, to test-fire the new and deadly Polaris missile.
NEW PROTO TRUARC RETAINING RING PLIERS

Now you can remove and replace retaining rings simply and quickly, without damage to the rings. Proto Truarc Pliers handle the rings you find on shafts and linkages, in bores… on appliances, engines, parts and accessories, TV sets and radios.

HERE’S WHY PROTO TRUARC PLIERS ARE BEST:
• Precision ground tips, induction hardened at just the right angle, insure trouble free ring installation.
• Tips are permanent... can’t lose them, don’t have to set them.
• The right size plier prevents ring distortion, saves time. 12 Proto Truarc Pliers handle nearly all applications.
• External pliers for shafts up to 4” in diameter.
• Internal pliers for bores 3/16” to 7” in diameter.
• Universal pliers handle middle range of both.

You’ll find Proto Truarc displayed soon at your Proto Dealers, including Hardware, Auto Parts, and Builders Supply stores all over the country.
PONTIAC'S TEMPEST ENGINES ARE FULL-HOUSE

Pontiac for nineteen-sixty is a mighty full package for those with a highly trained sense of car appreciation.

Lovers of true road machinery have been having a field day admiring the great new Tempest power plants. Ranging from the economy 215 horsepower model to the full-house 318 horsepower version, they're the most respected V-8's ever tucked under a passenger car hood. Gear boxes to match. Axle ratios to suit.

And listen. The noise boys have dampered sound down to where you'll swear they've insulated the road. Suspension improvements have also helped in this department... as well as in ride and handling.

These are the kinds of advances you expect from the team that created Wide-Track Wheel Design—greatest cure for "car-sickness" in an American passenger car. 'Nuff said? Go see! You'll learn in a quarter mile why people who know cars best respect Pontiac most. PONTIAC MOTOR DIVISION - GENERAL MOTORS CORPORATION

PONTIAC THE ONLY CAR WITH WIDE-TRACK WHEELS

JANUARY 1960
More features for less money

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Accuracy for close-tolerance work.
Smooth, vibration-free operation for exceptionally fine finishes.
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10" swing, up to 34" between centers, for handling wide variety of small work.
48 longitudinal feeds, 48 cross feeds, 48 thread cutting feeds (Model A).
4 types — 94 models to choose from. Prices start at $388, f.o.b. factory.

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South Bend 22, Indiana
Building Better Tools Since 1906
Up to 24 months to pay

Over the Editor's Desk

Our family is still growing. Popular Mechanics takes great pleasure in welcoming two new members of its family of foreign language editions this month.

Holland becomes the home of our fifth European edition with the publication of "PM — het beste uit POPULAR MECHANICS" which, translated, means "PM—the best of POPULAR MECHANICS." Already we have long-established editions published in French and German, and two Scandinavian editions edited at Copenhagen, Denmark: one for Danish and Norwegian readers, another for Swedish.

Since May, 1947, a Latin-American and Spanish edition has been published at our Chicago office under the title MECANICA POPULAR. This month a new edition in the Portuguese language begins publication at Rio de Janeiro, Brazil, to serve the vast Portuguese-reading audience of that fast-growing land. To serve better the interests of both readers and advertisers the Spanish MECANICA POPULAR will be published in two separate editions, one aimed at the Mexico-Caribbean area and the South American countries of Peru, Ecuador, Colombia, and Venezuela; the Southern Hemisphere edition reaching Argentina, Chile, Uruguay, Paraguay and Bolivia.

Altogether, these eight foreign editions reach some 500,000 buyers each month in addition to the nearly 1,500,000 circulation of our own American edition.

To the Editor:

That detailed and interesting article: "The Squash Bug Searches for Pay Dirt" (Sept. PM) was of more than normal interest to me, because of the statement that "even blue Kimberlite clay" might be detected through the use of organic reagents as an indicator.

A prospector just recently showed me about 15 small diamonds that he recovered from his placer-gold sluicebox while working a remote creek bed situated in a rugged area of the Valhalla Mountains here in British Columbia. This prospector admits it could take him many years to trace up that creek and its tributaries for the Kimberlite formation those diamonds came from. Here is an instance where the appli-
Are You "STANDING STILL" on your job?

You can justify a real pay raise and a better position—by making one simple move—the move that opens the way to more earnings and promotions—practical training.

If YOU are "standing still" on your job—no promotions—only token increases in pay—then you had better do something about it. You know that if you are untrained, your chances of getting ahead are slim. NOW IS THE TIME TO PREPARE.

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The only answer, as you know, is that success does come to the man or woman who is really trained. LaSalle has provided the "key to success" for many thousands of ambitious people who have sought our training for more than fifty years.

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The coupon below is for your convenience. Simply mark the program in which you are most interested, and mail at once. We’ll send you, without obligation, free booklets describing that field together with the opportunities and what you must know to be a success.

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Please send me your booklet describing the program I have checked below:

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- Federal Income Tax
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- Cost Accounting
- Business Law
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- CPA Training
- Complete Accounting

BUSINESS LAW
- Law of Contracts
- Insurance Law
- Claim Adjusting Law
- Law for Trust Officers
- Business Law I
- Business Law II
- General Law
- Probation Law
- American Law and Procedure (LL.B. Degree)

TRAFFIC & TRANSPORTATION
- Organization & Management
- Transportation Agcy. & Services
- Transportation Law & Regulation
- Rate Making & Rate Cases
- Complete Traffic & Transportation

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- Forensis Training

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- Secretarial

MANAGEMENT
- Basic Management
- Production Management
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Name
Address
City, Zone, State

JANUARY 1960
I was determined to make good in my job...but determination, I found, was not enough!

Six months later... I.C.S. sent my boss regular reports of my progress. Then one morning...

Burt, I've just made you the assistant manager of your division...at $15 more a week. And the way you're going now, this is just the beginning.

Gosh! Thanks Mr. Taylor!

I got it, honey! I got the promotion! Our money worries are over! Today's our lucky day!

Why not make this your lucky day? Let I.C.S. put you on the road to more pay, rapid advancement, real job security. Here's the famous coupon. Mail it now!

I had plenty of experience...and the boss seemed to like me. I lacked just one thing—training!

Sorry, Burt! I know you've worked here longer, but Ted has the special training we need. Your chance will come...someday!
I WAS TIRED OF WAITING FOR "SOMEDAY." I MADE UP MY MIND TO ACT! I'D GET THE TRAINING I NEEDED...SOMEHOW! JANE HAD A SUGGESTION...

I CAN'T QUIT MY JOB AND GO BACK TO SCHOOL! AND I SURE DON'T WANT THAT NIGHT CLASS ROUTINE IN THE CITY!

WHY NOT STUDY AT HOME?...THE WAY DAD DID... WITH I.C.S.

JANE SHOWED ME AN I.C.S. ADVERTISEMENT IN POPULAR MECHANICS. THERE WAS THE FAMOUS COUPON. AND THERE WAS EXACTLY THE COURSE I WANTED...

SAY, THEY'LL SEND ME A CAREER KIT FREE... DAD SAYS HE NEVER WOULD HAVE BEEN MANAGER IF IT WEREN'T FOR I.C.S.

"HOW TO SUCCEED" 32-PAGE GOLD MINE CAREER CATALOG... OPPORTUNITIES IN YOUR FIELD. SAMPLE LESSON (MATH) SHOWS I.C.S. METHOD.

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- Architecture
- Architectural Drafting
- Building Contractor
- Business Management
- Carpenter
- Construction Estimator
- Construction Foreman
- Parcel Post
- Reading Architectural Drawings
- Auto Body Rebuilding
- Auto Technician

AVIATION
- Aircraft & Engine Maintenance
- Business Administration
- General Accounting
- Ad Sales
- Auto Repair
- Electrical Engineering
- Metalworking
- Electronics
- Graphic Arts
- Ink
- Paper
- Pulp and Paper Making

CIVIL ENGINEERING
- Civil Engineering
- Construction Engineering
- Highway Engineering
- Professional Engineer (Civil)
- Radio/Television Engineering
- Surveying and Mapping

DRAFTING
- Drafting
- Drafting & Design
- Drafting & Machine Design
- Drafting & Machine Design
- Drafting & Machine Design
- Structural Drafting

CHEMICAL ENGINEERING
- Chemical Engineering
- Chemical Engineering
- Chemical Engineering
- Chemical Engineering
- Chemical Engineering

ELECTRICAL ENGINEERING
- Electrical Engineering
- Electrical Engineering
- Electrical Engineering
- Electrical Engineering
- Electrical Engineering

HIGH SCHOOL
- High School Diploma
- High School Diploma
- High School Diploma
- High School Diploma
- High School Diploma

Name
Age
City
State
Canadian residents send coupon to International Correspondence Schools, Canadian, Ltd., Montreal, Canada... Special low monthly tuition rates to members of the U. S. Armed Forces.

JANUARY 1960
cation of surface soil testing with organic reagents could not only shorten his search to one season, but also lead to positive success.

More articles in similar vein will always be welcomed by many of us who are interested in discovering more of our natural resources.

L. C. de Koek,
Nelson, B. C.

To the Editor:

For many years there have been articles written about the first auto made in this country. I have never seen any item about the car or cars that Terry Stafford of Topeka, Kansas, built in his bicycle shop on east 5th street.

I recall being in about third grade in the Harrison school in Topeka and after school I'd go to Stafford's shop and watch him build this car—a high, solid-tired device, rod for a steering lever, like an engine in a buggy. This was at the time of the big political issue between Bryan and McKinley prior to the election of 1896 so it is possible that Stafford was working on his car in 1895 or 1896. It could be as early as 1894. By the time of the Spanish-American war of 1898 the car was running the streets, as an old-timer. This could be the first car that ran, made west of Detroit or Chicago. It is my guess that had Stafford made this car in the industrial east instead of so far west, he might have become a sort of Henry Ford.

Edwin Wolff,
Tooele, Utah

To the Editor:

I have read your magazine for many years and the car owner's reports really amuse me. Many owners complain of their cars being too low, too long, wide, hard to get in and out of, no legroom or headroom, too much glass, dislike gaudy styling, poor quality, etc. What I wonder is, why they bought the car? Didn't they road-test one, sit in one, or at least look at the car before buying? If they had, maybe we would have had sensible cars sooner.

Harold Olsen,
Albuquerque, N. Mex.

Foreign-Car Report

We received so many letters about the foreign-car report (August and September PM) that we can publish only a few typical excerpts:

(Continued from page 14)
Make More Money Soon Fixing Electric Appliances

Learn at Home in Spare Time

Earn more money. Enjoy doing important, interesting work. Learn Electrical Appliance Servicing. This is a field of increasing opportunity. Today every wired home has many electrical appliances and millions and millions of new appliances are made and sold each year. Find out more about this great, growing field. Find out how NRI can train you, at home and in spare time to be an Appliance Service Technician. See how you can start soon to make extra money servicing appliances.

Add to Your Income Soon After Enrollment Opportunities Increasing for Service Technicians

NRI Training is practical, thorough. You get easy-to-understand lessons, and NRI supplies parts to build professional type Multi-Use Tester. Use it to get practical experience. Soon, you can add to your income by servicing appliances. Build a profitable sideline for your spare time—qualify for a good job—develop a business and be your own boss. As an Appliance Service Technician, your opportunities are broad—your services wanted, gladly paid for, highly regarded in your community.

Appliances are necessary to comfortable, convenient living. Owners pay well to keep them in repair. The field is amazingly big. In addition to major appliances such as electric ranges, air conditioners, refrigerators, there are over 40,000,000 electric irons, 5,000,000 electric blankets, 15,000,000 coffee makers, plus more millions of vacuum cleaners, fans, toasters, mixers, etc.

Learn and Earn With Tester Diploma When You Finish

Locate appliance troubles easily with Portable Appliance Tester you build. You use it to learn and do actual electric appliance repair jobs. For only $3.00 with enrollment and $8 per month, get training including Tester—a small price to pay for increased earnings. Mail coupon for Sample Lesson and Book—your first step toward more interesting work, bigger earnings. NATIONAL RADIO INSTITUTE, Dept. AAO, Washington 16, D. C.

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Please send me Electric Appliance Servicing Lesson and Book FREE. (I understand no salesman will call.)

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Over 40 Years Experience Backs Up NRI Training

Find Out What Appliance Repair Offers You

JANUARY 1960
You Can Earn 5½% On Your Savings...By Mail

It's Safe...and so much easier...

Picture yourself in this profitable scene. You can save by mail from the comfort of your home and earn 5½% a year paid quarterly on your hard earned funds. First Western Savings, Nevada's largest Savings and Loan Association offers this attractive anticipated interest scheduled to begin January 1, 1960. This higher interest rate follows fourteen consecutive interest payments to First Western Savers of 5% per annum or more, paid quarterly. Quarterly payments allow you to easily withdraw funds without losing interest, or you can let the interest remain in the account for compound earnings, every three months.

Few savings institutions can offer such an attractive rate. First Western can do it because it is located in the fastest growing area in the country, where dollars are needed to finance expansion. The officers and directors of this $34,000,000.00 institution are all community and state leaders of long standing. And, First Western proudly boasts a long history of dependable performance and above-average earnings. Another important point; withdrawals by mail have always been paid instantly.

Saving by mail is the easiest and most profitable way to save—no traffic, no waiting in line, no wasted time. Determine now to join the First Western Savers from all 50 states and 51 foreign countries who save more and earn more by transacting their savings business by-mail...with First Western Savings, Nevada's largest Savings and Loan Association.

You can open a Save-By-Mail account, with as little as $1.00. The anticipated interest scheduled to begin January 1, 1960 is: 5½% a year on accounts over $5,000, and 5¾% a year on all others. Interest paid quarterly on all accounts. Funds received by the 15th of any month earn from the 1st.

Write or mail funds to:
FIRST WESTERN SAVINGS
AND LOAN ASSOCIATION, DEPT. T,
118 Las Vegas Blvd., South • Las Vegas, Nevada • A. G. Neumeyer, Pres.

12
You'll soon be happy in a great new job... earning BIG money...

...if you start training NOW for success in

AIR CONDITIONING AND REFRIGERATION

You could be earning top pay in months. It's mostly a matter of getting your training now. Your best bet is to be a mechanic in the air conditioning and refrigeration field. This industry is growing so fast that 20,000 newly trained mechanics are needed each year. Over 150 million units are in use; over 5 million new air conditioners, freezers and refrigerators are sold annually. Skilled men are desperately needed for installation and repair work. Be a mechanic! Mail coupon for free success booklets on CTI's amazing new Home Training Plan.

You can earn cash during your training

Because CTI training is so practical, you'll soon be making profitable service calls. Perhaps you'll work on your own. Or, you may prefer to get a part-time job with a local appliance dealer or air conditioning contractor. You can add to your present income this way. With extra cash, you can buy additional shop equipment, pay your tuition, even bank money.

You could go in business and be independent

Own a business—and enjoy independence! Thrill to the satisfaction of being the boss. Give orders—don't take them! The refrigeration field is ideal for getting started on your own. You can make friends as you make service calls. In time, you'll have a list of potential customers. You can also sign service contracts with food stores, taverns, restaurants, etc. Ever so many CTI graduates have their own successful shops. Most of them began with nothing more than their new training and pluck. You, too, can start small and grow big. Be a business man!

You could get into the profitable new auto air conditioning field

Hundreds of thousands of new cars are being equipped with air conditioners. Auto dealers are advertising for skilled refrigeration mechanics, offering premium pay, to set up service departments. Or, you can go in business for yourself, and contract with auto agencies to do this type of installation and repair. You can make big profits either way.

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JANUARY 1960

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DEPT. R-679

Send on your free opportunity booklet, Science in Air Conditioning & Refrigeration, and Lesson Sample. Both FREE.

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ONLY CTI SENDS PARTS AND TOOLS TO BUILD A CONDENSING UNIT!
"You'll probably be getting a good many letters about your article on which import is best for you. How about that gas mileage table? Was Dale Kelly driving with the emergency brake on? I drove a Fiat 600 for nine months and never got less than 43 miles per gallon."

Jack Shaw
Monterey Park, Calif.

"Why wasn't my car, the English Ford, compared with the others?"

Robert L. Dalton
Kansas City, Mo.

"Over-all your imported-car story was very good. I suspect that some of the owners who are unhappy with service have been having their cars serviced at 'back alley' garages and filling stations. I would suggest to them that most franchised dealers feel as I do that every DKW I put on the road brings in another customer. We service over 200 DKWs in this area and have yet to find an unhappy customer."

Walter A. Lee
Woodbridge, Conn.

"I read with interest the article on foreign cars. Generally I am in agreement with the article, but find a serious discrepancy between the gas mileage reported and mine. My figures for one year of operation on my 1958 Volvo show 583 gallons of gas used in 16,209 miles. This gives an average of 27.8 miles per gallon to one-decimal-place accuracy."

John P. Hoyt
Professor of Mathematics
Annapolis, Md.

"Kudos are in order for your article 'Which Foreign Car Is Best for You?' It is the best by far of many such articles on small cars recently. As the owner of a Dauphine I concur with most of your author's conclusions, but feel that some good points are a bit understated. My records show an average of 33.7 miles per gallon for in-town driving and up to 43.0 miles per gallon on extended travel on Florida highways. Also local dealer service is outstanding."

Mrs. J. B. Powell,
Coral Gables, Fla.

"I have just finished reading the September issue and, while my blood is still
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RADIO - ELECTRONICS

NOW! at a price you can afford.

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PEAR...Training that is proved and tested
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out of the material in our ONE
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show you how!

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spare time at home, for these unlimited
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thorough Practical training—YOU
LEARN BY DOING! We send you complete standard equipment of
professional quality for building various
experimental and test units. You
advance step by step, perform more than
100 experiments, and build a
complete TV set from the ground up,
that is yours to keep! A big, new TV
picture tube is included at no extra
charge.

EARN AS YOU LEARN. We'll show you
how to earn extra money right from
the start. Many of our students pay for
their course—and more—while
studying. So can you!

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Flash free TV-Radio "Opportunity" Book and sample
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School at Los Angeles, the world's TV capital,
their show is the TV-RADIO SHOW, the
biggest, most complete facilities offered by
any school. Expert, friendly instructors. Personal
attention. Graduate Employment Service. Help
in finding home near school... and part time
job while you learn. Check box in coupon for
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2. Friendly Instruction and Guidance
3. Job Placement Service
4. Unlimited Consultation
5. Dipломs—Recognized by Industry
EVERYTHING YOU NEED FOR
SUCCESS!

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COVERS ALL PHASES OF INDUSTRY
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Communications

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their show is the TV-RADIO SHOW, the
biggest, most complete facilities offered by
any school. Expert, friendly instructors. Personal
attention. Graduate Employment Service. Help
in finding home near school... and part time
job while you learn. Check box in coupon for
full information.

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2. Friendly Instruction and Guidance
3. Job Placement Service
4. Unlimited Consultation
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EVERYTHING YOU NEED FOR
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3. Electronics for Guided Missiles
4. Sound Recording and Hi-Fidelity
5. FCC License
6. Automation and Computers
7. Radar & Micro-Waves
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Communications

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School at Los Angeles, the world's TV capital,
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biggest, most complete facilities offered by
any school. Expert, friendly instructors. Personal
attention. Graduate Employment Service. Help
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biggest, most complete facilities offered by
any school. Expert, friendly instructors. Personal
attention. Graduate Employment Service. Help
in finding home near school... and part time
job while you learn. Check box in coupon for
full information.
Do You Know This Old Timer?

You think that "extras" are something new in the auto dealer's bag of tricks? You're wrong. Back when this car was in style, buyers had to pay $125 extra for a windshield and a speedometer, bringing the total price of the car to $1375. Even front doors cost extra. In this case, the owner had them installed two years after he bought the car. The car had a carbide gas tank for the headlights on the right running board and a kerosene taillight. Recognize it? The handsome canna bush in front doesn't help, does it? Turn to page 285 for the answer.

EARN GOOD MONEY in Excavating and Landscaping
Start Now with Your Own Low-Cost John Deere Unit

"My John Deere 71 Loader has the power to do really tough digging and loading. I like the high lift of the bucket and the time-saving tractor direction reverser."

P. A. Ashcraft
Landscaping Contractor
Waco, Texas

You, as an independent contractor or subcontractor, can be a "man in demand"—grading, digging basements, pipe trenches, septic tanks—building earth dams for farmers. You'll be equipped for a variety of jobs with just one low-cost John Deere Industrial unit.

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John Deere Industrial Division
Dept. 2335 - Moline, Illinois

POPULAR MECHANICS
These Men are Building Lifetime Businesses!

VIRGINIA
"My 8th year
and business
keeps growing.
Have made as
much as $855
in one day"

CALIFORNIA
"Made as much
as $347 on just
one job. You
can't miss with
Duraclean"
G. W. Morris, Sacramento.

SOUTH DAKOTA
"Earned $1,571 in a
single month.
Homeowners here
have great need
for our services"
L. Canaday, Rapid City.

ARKANSAS
"Every person thinks
of owning a
business. I know of
no other which can
offer a man
so much"
E. Bailey, Hot Springs.

ILLINOIS
"Have averaged
over $50,000
over past 3 years.
Wags' help make it possible"
M. Lyons, Chicago.

MINNESOTA
"Averaging
over $300 per
month
part-time. Nothing beats
being your own boss"
T. Mason, Winona.

NEW YORK
"National
advertising
is tops. Our lead
from Wags' got me 3 jobs
in 30 days"
T. Cook, Freeport.

6 WAYS TO MAKE MONEY
You get exclusive use of unique ab-
sorption process which cleans carpets
and upholstery without harmful scrub-
bag, soaking or shrinkage. It's ac-
claimed by housewives, mfs and backed
by McCalls and Parents' Seals. Five
other profitable services are soil re-
tarding, mothproofing, flame
proofing, spotting and carpet re-
paring. Thus, on most jobs you mul-
tiply profits. "Headquarters pay gross
$9.00 per hour. I gross up to $12.00.
Many dealers I know do even better,"
says Dan Chilcott of N. Platte, Neb.

IN YOUR TOWN, there's a real
opportunity right now for you to
meet the growing demand for cleaning
of costly carpets and upholstery
services for which homeowners
are ready to pay good money. Me-
canical methods have proved to
be harmful to fabrics, so the field is
wide open with our exclusive, safe,
scientific absorption method of cleaning. Have you investigated this
opportunity? Thousands like those
above have, and are now enjoying
the financial security of their own
business. Many have started part-
time and so can you!

This business is easy to learn, and
quickly established. There's no shop
needed...you operate from home
and provide all services in your
customer's homes.

IN YOUR TOWN, there's a real
opportunity right now for you to
meet the growing demand for cleaning
of costly carpets and upholstery
services for which homeowners
are ready to pay good money. Me-
canical methods have proved to
be harmful to fabrics, so the field is
wide open with our exclusive, safe,
scientific absorption method of cleaning. Have you investigated this
opportunity? Thousands like those
above have, and are now enjoying
the financial security of their own
business. Many have started part-
time and so can you!

This business is easy to learn, and
quickly established. There's no shop
needed...you operate from home
and provide all services in your
customer's homes.

SINCE 1934
We'll train you, show you the
proved methods for operating and
building your own business, and
then back you with 25 continuous
services.

By starting now, you will be getting
in on the GROUND FLOOR of a
$750 million a year industry!

WE HELP YOU GROW
Under our unique cooperative pro-
gram, you are fully trained through
a nearby dealer and at our 50-hour

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DURACLEAN CO., 0-161 Duraclean Bldg., Deerfield, Ill.
Great Pioneers in Science
Do You Know Them?

By James S. Thistle

SOME CALL HIM “the pioneer of the Atomic Age,” largely because his theory of relativity expressed the equation for converting matter into energy. It is said that his letter to President Franklin D. Roosevelt in 1939, suggesting the use of atomic energy as a war weapon, brought about the dropping of the A-Bomb in 1945.

Born in Germany, this mathematical wizard taught in the Universities of Zurich and Prague, and later became director of the Kaiser Wilhelm Institute in Berlin. He won the Nobel Prize in physics in 1921. After the Nazi government stripped him of his property, position and citizenship in 1933, he accepted an appointment for life at Princeton's Institute for Advanced Study.

In 1940 this scientist-mathematician became a citizen of the U. S. after refusing to accept an offer to be president of Israel.

These letters, unscrambled, spell the name of this month’s Great Pioneer in Science:

LAETRINNEBESTI
(First and Last Names)

Write the correct name here:

Now turn to page 293 for the answer.

POPULAR MECHANICS
6-5-4-3-2-1...
DON'T LET TIME RUN OUT ON YOUR BIG CHANCE

to Prepare At Home for a Profitable Job in
Electronics
Guided Missile Control - Radar - TV - Radio, etc.

NO ADVANCED EDUCATION NEEDED!
A breath-held hush! Dramatically the cold voice completes the count-down:
"...3...2...1..." And with a mighty roar, a missile rises from its
launching pad, picking up speed that quickly lifts it out of sight. Another
rocket thunders into space... a triumph of ELECTRONICS and ASTRONAUTICS.
You may have a future in this fascinating field—with DeVry Tech's help. You
—if you are 17-55—can train at home in your spare time. You, may be in that
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real money. You, as an electronic technician, can back the men who launch
the missiles!
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good job or your
own service shop
when you complete the program.

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Address:___________________________________________ _____________
City ___________________________________ Zone ______ State ______
__ Check here if you face military service.
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JANUARY 1960
boiling. I am writing to take you to task for a very glaring omission in the foreign-car article. If this was indeed a survey of ten representative cars, as your writer insists, then how can you possibly explain the failure to include the English Ford? And the German-made Opel?"

Donald Leight
Long Island City, N.Y.

"As a foreign-car owner (VW) I cannot agree with your mileage figures based on a single 50-mile test. I have read dozens of test reports on Volkswagen, some covering as much as 2000 miles. The figure for VW should be 30 to 40 miles per gallon with the average about 32."

George F. Moore
Joliet, Ill.

Actually, the mileage figures shown in the September article are conservative, but are, PM thinks, an accurate reflection of the actual miles per gallon these cars will average over a year's normal usage. This includes considerable short-run operation, winter driving with wasteful choke operation, and all the other things that make actual miles per gallon much lower than publicized test miles per gallon. We could not test all imports, so decided to select a variety of designs and nationalities. The engine designs range from three-cylinder, two-stroke, water-cooled, through four-cylinder, four-stroke, air-cooled—Ed.

"I am an owner of a Hillman Husky station wagon and am not in love with it or with the place where I bought it. Gas mileage is not 25 miles per gallon. I had to get a head gasket replaced. Cost was $39.27 less 10 percent. A Chevrolet man told me it would cost $19 on his car. You can see the difference in price. I hear the same stories about VWs and other cars of foreign make. I'll never be taken in by a foreign make again."

T. E. George, Jr.
Fairfax, Va.

"I believe if Ford had continued making the Model A and improved it and kept the price down, they would be selling more cars than any one of the Big Three."

C. L. McKee
Greeley, Colo.

See page 183.—Ed.

(Continued to page 22)
The STUDY of LAW
A “Must” for the ambitious man seeking Business Success!

...Can YOU answer these legal problems?

CASE #1 Jones wrote Smith making an offer. Smith wrote his acceptance and mailed it. Then he decided to call it off and telegraphed Jones to that effect. Jones got the telegram before he did the letter. May he hold Smith to the contract?

ANSWER: Yes. Both Smith and Jones became bound when the letter containing the acceptance was mailed.

CASE #2 Doe said to Crane, “I will sell you 100 shares of XY stock at $50.” Crane said, “I’ll give you $45.” Doe, knowing the market was unsettled, said nothing, but an hour later tendered 100 shares and a bill for $4,500. May he hold Crane?

ANSWER: No. Crane’s counter-offer was a rejection of Doe’s offer.

Law...A FASCINATING STUDY AND A LIBERAL EDUCATION

Law today is involved in practically everything we do—regardless of what our position or status in life may be. That’s why thousands of ambitious men and women who never intend to practice are studying Law with LaSalle in spare time—not for a legal career but as an aid to business advancement.

Whether your work is related to banking, insurance, advertising, credit or collections, transportation, accounting, claim adjusting, merchandising, store proprietorship, partnerships, brokerage, manufacturing—ANY FIELD—you need to understand and know Law.

The study of Law is a great help to men in every walk of life. Many physicians, clergymen, and other professional men are now studying Law with LaSalle as a matter of recreation, mental training, culture, as a necessary part of a liberal education.

Aside from the actual knowledge that you acquire, the reading of Law is conceded to be a superior developer of reasoning power. For all types of work, Law training develops keen, clear, quick, correct and decisive thinking. Reading a Law text is much more interesting to most people than a fiction story—you’ll be learning the underlying principles of man’s relation to society, his rights, privileges, and restrictions toward himself and his fellow man.

STUDY AT HOME—IN SPARE TIME

You can study American Law and Procedure right in your own home—advancing at your own pace. For over 50 years we have helped more than 1,400,000 ambitious men and women to greater success in the business world. You too can benefit, as have so many before you. Low cost—easy terms.

The training includes the 14-volume LaSalle Law Library—American Law and Procedure. This library has been compiled by leaders in the field of Law. It covers the whole basic field of Law in an orderly and easily understood manner that can be quickly learned. Collateral reading and printed lectures on legal problems supplement the text. Law instructors who are licensed attorneys personally supervise your program from the first assignment to the LL.B. Degree or Diploma.

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JANUARY 1960
"I was glad to read that people were not going all out, after all, for the space-age Chevrolet (the only space it reminds me of is the empty one in the stylist's head). It is a credit to the American car buyer's intelligence that he still rates the functional at least as high as the silly, the childish and the idiotic. I like the Volkswagen's motto: We change a car only to improve it, not to make last year's car look obsolete. (I don't like the Volkswagen, though.)

H. Landauer
Tampa, Fla.

"How does it happen that the electric cars that are being experimentally built today have nowhere near the performance of electric cars on the market from 1910 to 1920? My mother drove one during those years which performed much better than the claims now. Art Raiton’s Detroit Listening Post article on the electric car seems to be contrary to the statements I have read in numerous other publications on the subject. Some comment to support the inference that all commentators on this subject are out of the step except Mr. Raiton will be interesting."

R. W. Garlick
Honolulu, Hawaii

PM, obviously, is not responsible for what other publications write on any subject. In the case of the electric car (June PM), Mr. Raiton investigated the claims and came up with his own conclusion, which was far different from the claims of the electric-car promoters (and other magazines also). His analysis seems to have been more accurate. As yet, the Charles electric car (which he was discussing) has not been built and, at last report, will not be built.—Ed.

"You say not to hold your breath waiting for the electric car. Well, I am not waiting and I will tell you why. I have owned three Detroit Electrics. In 1917 we drove an electric car from Long Beach to San Diego and had to do it by stages. We spent the night at Oceanside, had the batteries recharged. We had them charged again at San Diego and again at Oceanside on our return. After reading your article on electric cars I know that you have the right dope."

Bert C. Mills
Burbank, Calif.

(Continued to page 26)
DON'T BE HALF-TRAINEP!  
Be A Master Technician

NOW... ONE  
modern master home training course  
IN ALL 3 PHASES

AIR CONDITIONING-REFRIGERATION  
ELECTRICAL APPLIANCES

ALL AT ONE  
LOW TUITION

only National Schools gives you this complete training at no extra cost

FUTURE BRIGHT FOR TRAINED  
MASTER TECHNICIANS

Over 30,000 new technicians must be trained annually. You are needed to help service and repair the 50 million air conditioners, refrigerators and electrical appliances that will need fixing this year alone. No wonder the Master Technician has steady work, even in bad years. The demand for his services is constant and growing. Armed with full course training, his earning power is unlimited.

THE MOST FOR LESS

We give you illustrated Shop-Tested Lessons and Manuals—many other schools just give you a Manual. This is an all-inclusive course. With your own personal instructor, you will learn the latest methods of repair and service. You will be able to maintain all household appliances. Your earning power is limited only by your ambition.

JOB TRAINING AT HOME

You get Professional Tools, Precision Instruments PLUS a Factory Mode APPLIANCE TESTER! A shop-full of PRACTICAL, professional equipment. We ship the entire course to your home... all you need is time and effort. You will be ready to earn money in five to six months. You can work on your own schedule, at your own pace.

EARN AS YOU LEARN

You can start NOW. You can work in your own home. You can work part-time... or full-time... or both. You can work in your own home. You can work part-time... or full-time... or both. You can work with a manufacturer, dealer, distributor or department store. Armed with all course training, your earning power is limited only by your ambition.

GET THE BENEFIT OF OUR OVER 50 YEARS EXPERIENCE

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TV—RADIO—ELECTRONICS  
and AUTO MECHANICS—DIESEL

If you wish to take your training in our Resident School at Los Angeles, start NOW in our big modern Shops and Labs. Here you work with latest equipment—professionally installed. By our Resident School, you have the chance to learn in a real shop... and at the same time, you can work... and earn... and learn... and earn... and learn...

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JANUARY 1960
The Dark Continents of Your Mind

DO YOU struggle for balance? Are you forever trying to maintain energy, enthusiasm, and the will to do? Do your personality and power of accomplishment ebb and flow—like a stream controlled by some unseen valve? Deep within you are minute organisms. From their function spring your emotions. They govern your creative ideas and moods—yes, even your enjoyment of life. Once they were thought to be the mysterious seat of the soul—and to be left unexplored. Now cast aside superstition and learn to direct intelligently these powers of self.

Accept this Free Book
Let the Rosicrucians, an age-old fraternity of thinking men and women (not a religion), point out how you may fashion life as you want it—by making the fullest use of these little-understood natural faculties which you possess. This is a challenge to make the most of your heritage as a human. Write for the Free Book, "The Mastery of Life." Address: Scribe M.L.C.

The ROSICRUCIANS
San Jose (AMORC) California

Sidelights from the PENTAGON

By William R. Kreh

The Navy now has a cheap and effective way to protect its men from overexposure to high-energy radar beams—all because Lt. Walter Johnson of its Medical Corps one day got a hot seat.

Lt. Johnson was using an elaborate detector to measure microwave radiation aboard the guided-missile cruiser Galveston when, all of a sudden, he felt something burning him aft. The seat of his trouble was caused by a couple of flash-bulb-size neon lamps he had stuck in his hip pocket. The doctor had stood in the path of radar waves which caused the lamps to glow.

Now, each crew member aboard the Galveston, and other ships equipped with similar electronic gear, wears a little neon lamp on his uniform: When it lights, the wearer knows he's in a radar beam. The bulbs light well before the danger point from radiation is reached.

Walking is nothing new in the Army, but one group of soldiers recently gave this old game a new twist—they walked nearly 300 miles, backwards!

Men of the 105th Transportation Terminal Service stationed at Thule, Greenland, were given the job of discharging 297.6 nautical miles of submarine telephone cable, which was necessary for communication between Thule and Cape Dyer, Baffin Island. It was laid by a British cable-laying vessel. But because the cable was stored in circular tanks, the Army men had to guide it into place by walking backward in a continuous circle for its entire length.

Largest anchor chain in the world will be used by nuclear aircraft carrier Enterprise. Each 360-pound link is 28 inches long, 17 inches wide and nearly five inches thick. The chain will have a breaking strength of more than 2½ million pounds.
6 REASONS WHY RCA TRAINING IN ELECTRONICS can be the smartest investment you'll make in your entire lifetime!

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4. You get prime quality equipment as a regular part of your Course...equipment that you keep and use on the job. You never have to take apart one piece to build another.

5. You get each study group on a pay-as-you-go basis. Should you wish to interrupt your training at any time, you will not owe RCA Institutes a penny more, unless and until you decide to resume the Course.

6. You get top recognition — worldwide. Graduates of RCA Institutes now work for leaders in the electronics field; many have their own businesses. This record is true tribute to the high quality of RCA Institutes training.

Send for this 64-page Home Study Catalog FREE!

RESIDENT SCHOOL Courses in New York City offer comprehensive training in Television and Electronics. Day and Evening classes start four times each year. Detailed information on request.

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Without obligation, send me FREE 64-page CATALOG on Home Study Courses. No salesman will call.

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To save time, paste coupon on postcard.

JANUARY 1960
“I have been reading your report on foreign cars. To be truthful it makes me sore to hear people talk like these things are superior to American cars. There is a good old American car in every class that will surpass anything our competitors can build. I may be lazy but I like a little bit of comfort and horsepower and the day I can’t afford a little bit of gasoline I will ride a kiddie car.”

Paul Bogart
Albuquerque, N. M.

“I found your articles on foreign cars in the August and September issues quite interesting, factual and impartial. The latter quality I particularly like, since many magazines definitely have an axe to grind when they discuss foreign cars. I have owned one foreign sedan for five years and also have an American sedan. Generally speaking, my foreign car seems better for local driving and short trips, but the American car is superior for long, high-speed superhighway trips.”

D. B. Robinson, Jr.
Madison, N. J.

“PM has gone to great length to help potential car buyers in choosing their next car. However, I would like to point out one fault. What has happened to the six-cylinder test reports on Ford, Chevrolet, Plymouth and Rambler? When you consider power, mileage, comfort and safety and the amount of car per dollar both in initial cost and cost of operation, only then can you make a true choice. Being a mechanic I have many views on this.”

Donald E. Walduker
Vienna, Va.

“For two issues in a row, PM has literally run down the small imported cars. I want you to know that as long as there are people who know how to drive small cars, the big gas burners and high-repairbill cars are going to lose out. That driver Kelly of yours better learn how to drive a car and Railton better get used to the fact that small cars are here to stay.”

Sgt. Wm. Aplin, RCAF
Canadian Forces in Europe

PM had no intention of running down the imports. It has tried to point out their good and bad features. Incidentally, PM’s Auto Editor Railton is already accustomed to the fact that small cars are here to stay. He’s owned a small, economy import since 1956, and just bought his wife an American compact car.—Ed.
Superior’s New Model 70 UTILITY TESTER®
FOR REPAIRING ALL ELECTRICAL APPLIANCES and AUTOMOBILE CIRCUITS

As an electrical trouble shooter the Model 70:
* Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc.
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INCLUDED FREE This 64-page book—practically a condensed course in electricity. Learn by doing.
Just read the following partial list of contents: What is electricity? • Simplified version of Ohm’s Law • What is wattage? • Simplified wattage charts • How to measure voltage, current, resistance and leakage • How to test all electrical appliances and motors using a simplified trouble-shooting technique • How to trace trouble in the electrical circuits and parts in automobiles and trucks.

Model 70 comes complete with 64 page book and test leads $15.85

RCA RADIATION COUNTER
MADE TO SELL FOR $150—OFFERED FOR ONLY $47.50
(Much less than cost of manufacture.)

Enhanced experiments and discoveries in the new field of nuclear energy are made possible when you acquire this finely built and engineered device. The past, a rugged counter which was suitable for the prospecting of radioactive ores such as uranium, thorium and radium, was unsuitable for laboratory work due to the inability of combining accuracy with ruggedness. Conversely a laboratory counter, while being extremely sensitive, could not withstand use in the field where it would be subjected to abuse and abnormally hard knocks.

In the laboratory where determination of intensity (counts) of a reading are necessary, the W-10AWB provides sensitivity for surpassing many laboratory counters.

SPECIFICATIONS
* Employs the extra sensitive 1B85 Bismuth Type Geiger Counting Tube. Sensitivity is .01 microcuries per hour (1 MK/18=1,900 counts per minute).
* Three counting ranges: 0-100/1,000/10,000 counts per minute.
* Handy reset button. Ideal for survey work because the complete unit weighs only 5 lbs.
* Easy and sound indications by on-off flashes and headphone. When an indication is obtained you switch to meter reading for exact measurements.
* Denotation easy with damp cloth applied to the weather-proofed aluminum case.
* A radioactive specimen is included for instrument checking and experiments.
* Included in kit is extra charging card.
* U.S. Atomic Energy Commission booklet titled, “Prospecting with a Counter.”

R.C.A. Model W-10AWB comes complete with self-contained batteries which provide over 800 hours of intermittent operation.

Comes with complete set of batteries, carrying strap, headphones, radio-active specimen and A.E.C. booklet. Only $47.50

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NO MONEY WITH ORDER—NO C.O.D.

Try any of the above instruments for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. No Interest or Finance Charges Added! If not completely satisfied return unit to us, no explanation necessary.

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Dept. D-701 3849 Tenth Ave., New York 34, N.Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

Name
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City
State

January 1960

☐ Model 70 .........Total Price $15.85 $11.50 within 10 days. Balance $4.35 monthly for 3 months.

☐ RCA Counter ....Total Price $47.50
$11.50 within 10 days. Balance $6.00 monthly for 6 months.

All prices net. F.O.B. N.Y. C.
"In the October issue there was a picture of a 1910 Overland roadster. You are wrong. That was a 1914 Overland body, but the rest of the car was 1910 as you said."

William D. Johnson
Branchport, N. Y.

"In reading your survey on imported cars, it comes to my attention that some of your answers are not quite true. As we are dealers for several of the cars mentioned, I am in a position to check my figures and yours. The luggage-space figure on the Morris is not up to par. The Morris has considerable more room than the VW (we are distributors of both). Should I be wrong, I apologize, but I am simply going by the experience I have had with imports through our distributorship."

George Smith
Fort Worth, Tex.

Luggage-space measurement is a difficult task because there is no recognized standard. Do you measure all the volume? Or just the usable volume? Or just the volume that will take luggage? The American auto industry can't decide this point even among themselves. PM has for years used an arbitrary one-cubic-foot cardboard carton as a unit. Unfortunately, sometimes this particular shape does not make full use of the available luggage space in a car (as perhaps in the case of the Morris). But if we were to use any other shape, the same problem would arise. There is need for some standardized measurement here.—Ep.

"Enjoyed your impressions of the new compact cars. However, there is just one item I found to be inaccurate. You state, about the Falcon, that "the handshift gearbox is synchronized in second and third and the shift lever is mounted on the floor." I think you will find that the Falcon has a column-mounted lever which works very satisfactorily. Personally, I think there is only one really fine stick shift transmission made in America. It is the four-speed transmission made by Chevrolet."

John Reynolds, Jr.
Tallahassee, Fla.

He's right. The Falcon shift lever is on the steering column. This was one of those weird blunders that nobody can explain how it happened.—Ep.
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Please rush FREE SAMPLE LESSON and full information to tell me how I can learn watch repairing at home.

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JANUARY 1960
That is a chain of four formaldehyde molecules. Assembled in a line with no side branches, those molecules form what chemists call a linear polymer. If space on this page permitted us to show a chain of a thousand of those molecules, we'd have the chemical signature of "Delrin" acetal resin, du Pont's newest plastic discovery. Result of 10 years' work and $42 million worth of development, the tough, rigid thermoplastic may affect your life more than any plastic so far, since over 75 percent of its potential applications are in fields now dominated by die-cast metals; it will compete with steel, brass, aluminum and zinc in many areas.

Even at this early date, while the raw plastic costs 95 cents a pound—more than any of the metals it seeks to replace—it is so easily formed and finished that it is competing in some fields. Among its uses are automobile interior parts, moving parts in appliances, plumbing components, gears, bearings and bushings for almost any use, and consumer products ranging from fishing reels to aerosol containers. Zebco has already marketed a fishing reel, made almost entirely of Delrin, which is light, very strong, and noncorrosive in salt water.

Delrin can be fabricated by conventional plastics methods, and once formed can be sawed, drilled, nailed, machined, painted—even coated with metal. As an example of its strength, it is impossible to strip threads cut into the plastic by a self-tapping screw. The head of the screw will twist off before the plastic gives up. It's resistant to wear, too—a Delrin speedometer cable ran against a steel worm gear for the equivalent of 100,000 miles at 110 miles per hour with negligible wear. In other field tests, it has been used as the support fingers in dishwashers, as a shower head, as fuel pump and carburetor parts, and even in cleats for football shoes. Performance in bushing and bearing tests has been excellent. Delrin has a friction coefficient on steel of .08 which puts it in a class with powdered graphite.

Credit for the Delrin development goes to three DuPont men—A. E. Barkdoll, Jr., who started the basic research 10 years ago; Robert N. MacDonald, who followed up Barkdoll's work with polymers; and W. H. Linton, Jr., who headed the 66-man research and development team since 1955. Production will begin this year in a new Delrin plant in Parkersburg, W. Va.
IT'S INCOME TAX TIME—
Be Glad You’re a “Do-It-Yourselfer”

By Allen J. Parker of the New York Bar

WHY BUILD, fix or paint it yourself?
"I get a kick out of doing these things," you might answer. "Then, too, I know that the job will be done the way I want it done. And, further, I save money."

All of these are good reasons. But there is another that becomes especially important this time of year. Doing it yourself can save on income taxes.

And what is income? Well, the Supreme Court and Internal Service agree that income does not include the value of your own services rendered to yourself without recompense, even though you save money by doing a job yourself. For tax purposes, a penny saved is not a penny earned.

For example, Sam and Bill work on the same shift at a plant. Both their houses need painting. Sam figures that apart from the cost of the paint, he can have his house painted for $400. He decides to take a second job to earn this money.

Bill does the job himself and saves the $400. Are they even? Not when you take taxes into account. Even assuming the lowest income tax bracket of 20 percent, Sam has to earn $500 in order to have $400 left to pay the painter.

Suppose Sam helps Bill paint his house, and in return Bill does the same for Sam. In that case, they are, in effect, exchanging services and not simply doing work for themselves. However, so long as neither one of them could be said to be in the painting business, they will not have any income tax to pay as "do-it-yourselfers."

If Sam and Bill work without pay on their church, they’re really making a gift of their services. Same tax result: They’re not taxed on someone else’s saving money, although they can’t make a charitable deduction for the value of their time.

Let’s take it a step further. Suppose that Bill also builds an outdoor fireplace and patio, using fieldstone collected from the mountains. At an outlay of, say $25, he has actually increased the value of his home by $500. Is this $500 taxable income? Not at all—at least, not until he sells the house. Even then this added value will not be taxed if he uses the money received from the sale to buy another house that is equally expensive. This is a break the tax law gives to homeowners. Otherwise, people who sold houses in time of inflation would find themselves faced with a heavy tax—not so much because the house they sold was worth more, but because dollars were worth less. When they tried to buy a new house, they would face the same high prices, but with hundreds of dollars less money after the tax bite.

There are other tax savings around your home that you can pick up. The tax laws encourage home ownership by making mortgage interest and local property taxes deductible for federal tax purposes.

Almost equally important, although less obvious, is the tax savings represented by the money which you have invested in the purchase of your home. Suppose that your investment, represented by your down payment and payments of principal on your mortgage, now amounts to $4,000. Presumably, you could have invested this $4,000 in bonds, perhaps yielding five percent, or $200 per year. If you are in a 20 percent income tax bracket, this would leave you only $160 a year net after taxes for paying rent on an apartment. But when you invest $4,000 directly in your own house, in effect, this investment is tax free.

The tax laws also say that you can deduct the cost of any casualty loss. This means the uninsured portion of any loss by fire, ice, flood, or damage to shrubs and trees through a severe and unusual drought. Even damage caused by termites is considered to be a casualty if the invasion is fairly sudden. A really serious fire, such as that caused by a tornado, could wipe out your taxes not only for this year but could result in a refund of taxes paid for two previous years and even a forgiveness of your taxes for several years to come.

How can you make the most of your tax savings in your home?

First, by doing any work that you would otherwise have to pay someone else to do. Second, by keeping permanent records of all deductible items and permanent improvements that would increase the tax cost of your home. This includes the cost of little things, such as new shrubbery, flagstone walks or electric circuits that you buy and install as well as the cost of an entire wing or a finished attic.

These records will reduce income tax if you ever sell the house and don’t buy a new one. The few cancelled checks or receipts don’t take up much room. Keep them—they may prove valuable!
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Now you can get exciting Imports at trifling cost abroad and sell them by mail order, or to friends and stores. New Plan starts you in full or spare time without capital or previous experience. Just imagine the huge profit you could make on this 17-jewel watch you can get for only $2.87 in Europe—the 16-mm camera at just $2.80, the transistor radio or the hunting rifle. Mellinger globe-trotting couriers discover and show you how to get fast-selling imports just like these—show you how you can deduct your profit in advance, even before ordering merchandise.

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JANUARY 1960

33
Machine Duplicates Book In Few Minutes

Students and researchers can now have copies of rare, old or out-of-print books to mark up as they please. Eugene B. Power, a man who microfilmed 6,000,000 irreplaceable documents in England to protect their contents from the German blitz, has developed a machine, the Copyflo Xerox, that makes duplicates of books or magazines in a matter of minutes.

A book's pages are first copied on microfilm; a microfilm roll of the complete book is placed in the machine and a reproduction emerges (as shown above). Because of the order in which pages have to be microfilmed, each page of the facsimile is a double thickness of paper folded at the outside edge; the inside edges are glued to the book's spine.

The machine takes its name from a printing process, Xerography, and its ability to print successive pictures from microfilm in a continuously flowing process. In Xerography, a light is projected through a film negative — in this case of a book page — which casts a shadow on a metal plate positively charged with electricity and coated with selenium, a non-metallic element. Because selenium is sensitive to light, the entire surface of the plate — except for areas in shadow — becomes negatively charged. Shadow areas remain positive. A black powder is dusted over the plate and, carrying a negative charge, sticks to the shadowed areas. Paper, pressed against the plate, picks up the dust, becoming a duplicate of the original page. The Copyflo Xerox does all this automatically, then heats the page, fusing the powder into permanent print. Microfilm can be stored indefinitely, so the world's book treasures can now always be available.
There are many millions of electrical units, electrical appliances, electrical machinery and electrical equipment in daily use...in factories, in homes, in office buildings and on the farm. Skilled electrical technician with the proper "Know-How" are needed to keep all this electrical equipment in good running condition.

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often charged for making ordinary repairs. In the privacy of your own kitchen, basement or garage we show you how to repair refrigerators, motors, vacuum cleaners, washing machines, toasters, sewing machines, etc. How to do house wiring, farm wiring, etc.

If you are mechanically inclined, can hold and use tools, we can give you the training and time saving kits that will enable you to Command More Money at work...Get a Better Paying Job Elsewhere...Or own a profitable business of your own.

CHRISTY Training Manuals are written in simple, easy-to-understand language, check full of hundreds of detailed photographs and drawings that show step by step repairing procedures. Lesson manuals that are used daily by servicemen the country over.

We show you how to locate, quickly fix and what to charge customers. Many students report big earnings even before graduating.

"Due to your course I was able to learn paper which saved me $800.00. Going to quit my job to operate my own business." 

R. W., New Orleans, La.

"The training I received from your work shop and have saving made $800.00. Going to quit my job to operate my own business." 

J. S., St. Louis, Mo.

"I work at the ship yard. After taking I operate from my cellar and garage. Average $200.00 every day." 

H. Hanks, Brookline, Mass.

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Prefect Voice Institute, 210 S. Clinton St., Studio AP-2, Chicago 4, III.
I'd like to give this to my fellow men... while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my summer home, my Cadillacs, my Winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that will carry your destiny, which, taken at the crest, will carry you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things; of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is rubbish! And anyone who tries to tell you that you can think your way to riches without effort is a fool. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be earned! I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them reach the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man who would not sacrifice something to gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "log" up to the achievement of your goal. Frankly, I'm not going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you will do all you can to help the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The usual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one-man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing every year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And you need to let anyone else know you are "on your own". It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it could be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is purely automatic, you must be able to work with your hands, use tools, etc. And you must be willing to do some manual labor. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use tools, etc. And you must be willing to do some manual labor.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name and address. What I send will may convince you of the truth of this proverb. And what I send you will not cost you a penny, now or at any other time.

VICTOR B. MASON
1512 Jarvis Ave., Suite M-2-A
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JANUARY 1960
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finish, developed after years of experience,
can be sprayed on anything transforming
ordinary things into expensive masterpieces
of beauty. You must see it to believe it, so
mail coupon below and receive free samples.

JOIN THESE MEN AND WOMEN
who have already started. "Earning
$500.00 a year from spare time start"
Mr. H. S. Green, "Got $250 doing auto
trunks in four hours—earned $18 per
hour." J. O., Mo.; "Swamped with
orders already!" W. F. Cole, "Got $100
job first day!" C. H. E., Md.; "Quick
$140 order from store—5 other orders
in 4 hours." K. G. R., N.Y.

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"Here is Mr. J. F. K., with a few of
the items he has sprayed with Flok-
Kraft. He is now earning $25.00 per
hour ($400 for 16 hours work) just
showing companies how to spray new
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Make old (even broken) radio and
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Spray average size cabinet in 15
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Over 5,000 big profit uses. Spray lamps,
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anything! Flok-Kraft makes old, dam-
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saleable—makes new things worth more.
You can even spray cheap butcher pa-
per and make it look like velvet-suede,
and sell it for gift-wrapping paper.

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Recondition worn automobile inte-
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seats, etc.) with Flok-Kraft. Just
spray it on—works like magic!

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Amazing Flok-Kraft rayon and cotton
fibers are now available in over 24 brilli-
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Here's a rare opportunity to own your
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400% profit possible just spraying
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items with beautiful Flok-Kraft.
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to-understand instructions in addition
to materials that enable you to start at
once. All sent at our risk because we
want to start new Flok-Krafters in
every area.

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Imagine, there is a possible 20 Million
Dollars worth of Flok-Krafting to be
done. Get your share! Be first in your
area to fill urgent orders that come from
stores, offices, homes, neighbors,
gift shops, architects, car dealers, etc.
Learn how to get orders by mail order.

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January 1960
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Become Take-Apart Toys

Four of the improbable but world-famous
animals created by Dr. Seuss, author of
the best-selling books for children, have been
made into plastic toys. Made in snap-together,
interchangeable pieces (one animal has 29),
they offer endless combinations with a
mathematical possibility of 14 million variations.
The animals are, left to right, Gowdy, the Dowdy Grackle; Roscoe, the Many-Footed Lion; Norval, the Bashful
Blinket; and Tingo, the Noodle-Topped
Stroodle. The high-density polyethylene
plastic is unbreakable, non-toxic and light-weight.

POPULAR MECHANICS
Shrinks Hemorrhoids
New Way Without Surgery
Stops Itch—Relieves Pain

For the first time science has found a new healing substance with the astonishing ability to shrink hemorrhoids and to relieve pain—without surgery.

In case after case, while gently relieving pain, actual reduction (shrinking) took place. Most amazing of all—results were so thorough that sufferers made astonishing statements like “Piles have ceased to be a problem!”

The secret is a new healing substance (Bio-Dyne*)—discovery of a world-famous research institute.

This substance is now available in suppository or ointment form under the name Preparation H. Ask for it at all drug counters—money back guarantee.  *Rec. U.S. Pat. Off

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JANUARY 1960 41
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Cost Over $20.00 New; While They Last. $3.95

Generates 440 Volts. Use to power electricity, to ring bells, light up lights, to drive a medical battery, deliver electric shocks, to power many electrical experiments, classrooms, etc. Made by leading electrical companies. Each has powerful magnets—above wants more than total cost, generating amperage, wire leads, gear crank, ready for use. Most new (never used). Several models. Postpaid $3.95.


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Powerful continuous thrust for models: boats, cars, planes. No moving parts, easy to start, runs on regular gas. $1.49. Complete, only.

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The Post Office has divided 106 cities into postal delivery zones to speed mail delivery. Be sure to include zone number when writing to these cities; be sure to include your zone number in your return address after the city, before the state.

POPULAR MECHANICS
Flying TV Classroom Serves Six States

This fall, a DC-7 airplane will be an important aid in the teaching of grade-school, high-school and college students in six Midwestern states. Carrying two television transmitters, the DC-7 each school day will fly six hours in 10-mile circles centered some 50 miles northeast of Lafayette, Ind., and at a height of 22,000 feet. The transmitters will beam 24 half-hour lecture programs—some that have been recorded on video tape, some relayed from lectures being given below at Purdue University—over an area of 125,000 square miles. The courses can be tuned in by 13,000 schools.

"By using a plane, we'll be able to broadcast courses of instruction to many areas where they're not now available," says Dr. John E. Ivey, president of the Midwest Council on Airborne Television, the organization that will administer this bold experiment in educational TV from headquarters at Purdue. "If we are successful, we hope similar arrangements can be made all across the country. By pooling their resources in this manner, school districts and states can put into their classrooms a caliber of teaching none could afford alone."

The telecasts, which will cost slightly less than $7 million a year to produce, will be financed with gifts from industry and philanthropic institutions. To make sure the expensive shows go on, the Council will keep a second DC-7 at some other field in the six-state area. "If one plane is grounded by snow, for example, chances are the other one can get in the air," says Ivey. "We expect to have a telecasting aircraft operating at least 98 percent of the scheduled time."

Synthetic Penicillin Pill May Replace Shots

Synicillin, a synthetic penicillin in pill form, may not only obsolete penicillin injection, but may allow more people to use the antibiotic without getting dangerous allergic reactions that sometimes accompany "shots." The allergy-inducing enzyme, penicillinase, produced by micro-organisms, is not as active in destroying the experimental compound, explains Dr. Amel R. Menottie, scientific director of Bristol Laboratories, Syracuse, N. Y., where the drug was developed. Early tests also indicate Synicillin to be more potent than several injectable or other oral forms of penicillin. In test tube studies, for example, it destroyed staphylococcal strains that resist other penicillins.
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24 different makes—1953 thru
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"Quick-Check" charts—more
than 30,000 essential repair
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clear you can’t go wrong!

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this slant manual before he’s
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January 1960
Mechanical Quarter Horses
Speed Cattle Handling

Cow ponies took another step toward extinction in the San Antonio Union Stockyards when a fleet of electric scooters went into action in the handling pens. Horses are expensive to keep, and men on foot can’t keep up with the cattle, but the little electric scooters can sho a herd along at 11 miles an hour with near-equine maneuverability. Stockyard officials report that the new vehicles have increased the men’s herding capacity by 50 percent, while helping reduce shrinkage, bruising, and injuries to the cattle.

Brittle, Light Beryllium
May Carry Men Into Space

When man finally zooms into space, the ship he rides in may be made in part from the rare metal beryllium—if experiments carried on by Nonair Division of the Northrop Company, Los Angeles, continue to be successful. Until Nonair scientists struck on a way of extruding parts from beryllium, the metal—which is stiffer than steel and 33 percent lighter than aluminum—posed serious problems when considered for aircraft or space-ship use. It was stiff and brittle. Extrusion demands that metal be shaped by ramming it through a hot die, and beryllium would not stand up under such treatment. Nonair scientists have compensated for the brittleness by lubricating the dies with glass and making changes in the tooling apparatus. Beryllium is now heated to 2000 degrees F. and forced through dies at pressures up to 1700 tons. The desired length for spaceship parts is 20 feet. Nonair so far has produced parts 15 feet long and 1/4-inch thick.
2.3 HP Engine
$14.95 Postpaid

This brand new quality engine which cost our Government many times this price is offered you for use on go-carts, models, air-propelled boats, etc.

Features and specifications: 2.3 H.P. @ 3400 Rpm, 2 cycle, 2" bore, 1½" stroke, roller bearing crankshaft, 3-ring aluminum piston, bronze connecting rod. Tillotson variable speed carburetor. Mfgd. by or for Jacobsen of Racine, Wis. for the U.S. Army. Shipped postpaid as shown except carburetor and timer must be attached. Propeller for engine sold less hub for $8.00 additional. Instructions for assembly of timer and ign. included. Guaranteed or money refunded (less postage).

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JANUARY 1960
AMERICA'S NEED FOR 100,000 NEWLY-TRAINED MECHANICS

America's population has increased roughly 15 per cent in the past 10 years. When you compare this with the astonishing 43 per cent increase in car and truck registrations during the same time, you can easily see how America's need for 100,000 trained mechanics was brought about. This figure of 100,000 is based on an estimate of one of the country's most famous automotive vice presidents, a man who knows the automotive industry from his years of experience in the field.

But that's not the whole story. The fact is that today's cars and trucks are getting more and more complicated. Two or three highly-trained mechanics are needed to do the same repair job that one mechanic could do several years ago. Mechanics are becoming specialists in certain kinds of repair jobs, and more specialists are needed as the complexity of our vehicles increases.

To give you an idea just how big the auto industry is, look at the following facts:

- An average of 2,500,000 new drivers get licenses each year.
- Over 36,000,000 households in the U.S. own automobiles.
- There are 70,000,000 car, truck and bus drivers in America.
- The automotive replacement parts business accounted for $2,400,000,000 in sales in 1957 alone.
- 54% of all die castings made in the U.S. go into auto plants.
- The auto industry buys almost 20% of all the steel produced in this country.
- 24% of all retail sales are for automotive products.

(Continued to page 84)

COMMENTS FROM MEN WHO HAVE TAKEN TRAINING IN AUTO MECHANICS

"I am doing very well in the craft I learned through my correspondence course. During my training I made $175. Today I am working full time as a general repair man. I am sure of a good pay any time." — Samuel Dixon, Bronx, N.Y.

"I am now working as an auto mechanic, earning $4.50 an hour. That's doing very well, thanks to my training in mechanics." — Edward McNamara, Poughkeepsie, N.Y.

"I am a correspondence school graduate. Now I have a job as a service manager with five men under my direction. It was a grand feeling to get my diploma." — Bill Wermuth, Oshkosh, Wis.

"Because of what I learned through my training course in auto mechanics, I got a job taking care of a fleet of trucks. It's a steady job and I get a pay raise every three months." — Tex Lamprecht, Calgary, Canada.
LEARN MEAT CUTTING AT NATIONAL
Pay After Graduation

The steady dependable trade of Meat Cutting taught easily in a short weeks. YOU LEARN BY DOING under actual meat market conditions in big modern school at Toledo.


Buying, cutting, percentage, pricing, advertising, selling, etc. A complete retail meat education. National School established 77 years. Get national training NOW. Pay your tuition in easy weekly payments after you graduate. Send coupon for FREE school catalog — TODAY. G.I. approved.

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Send me your FREE school catalog on National Training at Toledo in Meat Cutting, Meat Merchandising and Self Service Meats. No obligation. No salesman will call.

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Obtain a Ph.D., M.D., or Ph.D. Be a Teacher, Lecturer or Accredited Practitioner. Teach others how to achieve Health, Happiness and Contentment. Overcome problems. Correspondence Course only. Write for FREE book telling how.

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LARGE & SMALL THEY DO IT ALL

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Without obligation send me FREE booklet about your big new rug shampoos. I want to know how I can start my own permanent, profitable business.

Name: ____________________________
Address: __________________________
City: __________________ Zone: ______ State: ______

Not everyone does as well, but T. N. COUD, who started a business of his own, reports...

For 12 months I've averaged $800 PER MONTH INCOME

—most of it clear profit for me!

Many men have discovered how to be independent, to be free of layoffs and bosses. C. G. Naples grossed more than $200 his first week. A father-son combination grossed $44,000 their second year. H. Lomon says, "I netted $133 in one 8-hour day."

How much you make depends largely on you. You need no special skill, no large investment. Start part time if you wish.

NO SHOP NECESSARY • Our Electric Deterger shampoo rugs, carpets right on floor—removes dirt and grime and helps to show their natural color and beauty. So efficient and safe it is used by largest railroads and hotels.

This is not a lease proposition. You own the machine, you work when and where you please and all the money you take in is your own. You take no risk. Machines fully guaranteed.

JANUARY 1960 49
### Been on the Scales Lately?

New tables of average weights for men and women, released by the Society of Actuaries after a three-year study of weight records of five million people, show that, on the average, women weigh less and men more than members of their sex did 30 years ago.

Here are the new average weights. Where do you stand?

#### MEN

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The FATE-ROOT.HEATH COMPANY, Dept. PM-1, Plymouth, Ohio

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QUALITY PLANS FOR $1.38

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SUIT 1570, 28 E. Jackson Blvd., Chicago 4, Ill.

JANUARY 1960
These Engineers Do Things by Halves

Building the new Freeway in Tacoma, Wash., created an unusual problem: The route passed above one of the city’s major water lines, causing engineers to wonder how they were going to fix any future break without drilling the road. They solved the problem by making two half-sections of 24-inch concrete pipe. They placed one section below the Freeway’s grade, laid in the water pipe and set on the other concrete section. The water pipe now can be jacked out to the side of the road for repairs.

Air Conditioners Keep Fliers Cool

Navy pilots—who feel perfectly comfortable in their warm pressure suits at the subzero temperatures of high altitudes, but too hot when moving through the 90-degree air often found on the ground or flight deck—are now being equipped with all kinds of cooling devices. Prefabricated air-conditioned buildings are being installed at fields where there are ready rooms. Where there are none, air-conditioned trailers are being moved onto the fields; they also have suit-ventilation facilities, showers, drying and storage rooms, lockers and bathroom. After the pilots are briefed, they will be transported to their planes in air-conditioned trucks containing suit-ventilation facilities. Abroad ships, the pilots will have battery-powered air-conditioning units to keep them cool while going from ready room to airplanes.
Sworn statement from Chas. Lemming reads:

"After starting my own business

I've averaged $100 A DAY
—most of it clear profit!"

Not everyone does as well... Mr. Lemming owns two machines

- In city of less than 50,000, Mr. Lemming started his own business after filling in coupon like one below. He averaged $100 a day during first year, some days $200. F. E. Doran grossed $1000 in single month. Geo. Held grossed $300 in one week.

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JANUARY 1960
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Intake of Jet Engine Protected by "Inner Tube"

Any size jet-engine intake can be protected on the ground with a lightweight expandable plastic plug now being manufactured by Boeing Airplane Company. The plug is equipped with an inner tube which may be inflated to fit any intake. The unit also covers the oil cooler and air compressor intakes which formerly required separate plugs. The new device replaces wood plugs which had to be shaped for each engine. In addition to lower cost, the plastic plugs weigh only five pounds compared to 50 pounds for the older type.

Jet-Flight Planning Speeded by Computer

Planning of jet flights is being speeded by a new computer that cuts the time required to work out flight details from an hour to about three minutes. Up to now the computing has been done manually. The computer, developed by Bendix Aviation Corporation for United Air Lines, is asked by paper tape to lay out a flight plan for each of several possible routes. The tape carries information on wind, temperature, gross weight and fuel requirements. The computer then checks flight information stored on magnetic tape, completes its calculations and supplies detailed flight plans to the pilot for his decision.
Electronic Artificial Larynx Restores Speech to Voiceless

Researchers at Bell Telephone Laboratories have developed a self-contained, transistorized artificial larynx which will enable many voiceless persons to speak intelligibly and with control over volume, pitch, and inflection never before possible. With a little practice, the user can even sing simple tunes. The electronic larynx gives users up to 97 percent sentence intelligibility. The entire mechanism is enclosed in a plastic cylinder, 1 3/4 inches in diameter by 3 3/4 inches long, and is powered by two small mercury batteries or can be plugged into a 110-volt electric outlet.

Scientist Says Algae Could Nourish World

If covered with growing algae, an area the size of Rhode Island could nourish the population of the world, according to Dr. C. M. Palmer, algologist of Cincinnati, Ohio. Algae, the little green plant that causes scum on ponds and lakes, is “ripe” for harvesting and can be put to good use—except that no one knows how to gather it inexpensively. It could supplement food and forage products and become a source of vitamins, animal feed, fertilizer and other organic products useful to man. Algae “gardens” now exist in many communities as a treatment for sewage.
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-A February feature, takes you down to the ocean floor aboard the U.S. Navy Bathyscaphe

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JANUARY 1960 77
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JANUARY 1960 79
Robot Radio Beacon on Island Guides Ships Through Fiord

Crew members of the Navy icebreaker USS ATKA recently erected an antenna on Crunccher Island to send a radio beacon automatically, guiding ships through a maze of islands and inlets into Soundrostrom Fiord, Greenland. Ships desiring to fix their position send out a coded signal. The beacon, a self-contained robot, responds by sending a signal for five minutes. The signal can be reactivated.

Stamp-Size Circuit Replaces Transistor

Advances in electronic products and rocketry are forecast with the development of stamp-size circuits by five Army scientists. The new circuit, in \( \frac{1}{200} \) of a cubic inch, replaces a one-cubic-inch transistor circuit. In stencil-like fashion, materials are “printed” photographically on a tiny plastic wafer, eliminating all wires and casings. The circuits are expected to save the Army \$200 million a year. They will permit missiles to carry lighter payloads with no loss in essential equipment and will permit pocket-size TV sets to be built at a fraction of present cost.

JANUARY 1960
Water Under Long Beach
Stops That Sinking Feeling

Throbbing day and night, eight huge batteries of pumps are piping millions of barrels of water into the sands below Long Beach Harbor as engineers make a desperate, and apparently successful, fight to keep parts of the city from slipping under the sea. A 20-square-mile section of Long Beach that lies above the second richest deposit of oil in the United States has been sinking since the late 1930s, when oil was first pumped from the field. Today the area resembles a crumbling funnel. The ground has sunk two to three feet at the edges and as much as 28 feet at the center, which is near the $170 million naval shipyard. As the ground gradually sank, parts of the shipyard were damaged and, in the city, sewer lines cracked, railroad tracks twisted. Bridges have been shortened and sections cut from wharves and buildings to keep stress from snapping them like kindling wood. If continued, the subsidence could knock out much of the oil field, which has returned the city $317 million in royalties during the past 20 years and where an estimated billion barrels of oil remain; it has, in fact, caused $25 million worth of damage to pipes and parts of the 2900 active oil wells.

The water-injection program, begun in 1953 after the city and industry spent $1,000,000 on geological and engineering studies, is designed to repressurize the field by filling with water the voids left when oil was pumped from between rocks. It seems to be working, for some piers and parts of the shipyard have stopped sinking. At present, water is pumped from 93 seaside wells, desanded and chemically treated to kill bacteria and prevent corrosion, and then forced by high pressure into sand lying from 2000 to 6000 feet under ground. Now 87 percent completed at a cost of $6,000,000, the system already is the world's largest repressurization project and, eventually, it will have 268 water wells and additional pumping stations to send one million barrels of water (44 million gallons) into the sands each day.

Ironically, the costly sinking has also brought about a benefit. The water used to repressurize the substrata will, as it moves through sand, push oil there to the wells, where it will be pumped to the surface. Geologists estimate that 400 million barrels of oil, which otherwise could not be recovered, may thus be produced because Long Beach was forced to devise its system of water injection.

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JANUARY 1960
America's Needs for Mechanics
(Continued from Page 48)

These are a few of the reasons America's auto industry is one of the greatest industries in the world, and these are the reasons you will want to consider the field of auto mechanics carefully before you select a career.

Despite the tremendous demand for trained mechanics, figures show that less than one-tenth the required number of men are getting any kind of an automotive education. This means that there are endless opportunities in this field—opportunities just waiting for alert men with an eye to the future.

One of the best features of this field of work is that the demand for auto-mechanics isn’t confined to big cities. Jobs are available in small towns from coast to coast. This means that, no matter where you live, jobs are waiting, and while you’re learning auto mechanics, you can get practical experience right in your own hometown.

The earning power of a qualified mechanic is comparable to that of a college graduate, and yet a qualified mechanic doesn’t need the years of formal schooling required in other professions. In Chicago, for example, mechanics are earning, on the average, $3.00 an hour. And this is just an average figure for a qualified mechanic—opportunities for more responsibility and greater specialization can lead to an income of as much as $15,000 a year.

Another advantage of this field of work is that mechanics are seldom, if ever, out of work. There is always a demand for a skilled man—he can choose where he wants to work, and if he desires, he can make a comfortable living with a repair business of his own.

How can you get started in this lucrative field? You can actually become an expert in a matter of months, not years, and one of the best ways to start is to take a correspondence or resident-training course in auto mechanics.

One top correspondence school offers a total of 86 lessons covering every phase of car repair and diesel - mechanical training. If you’re good with tools, if you like to know what makes things work, and if you take pride in workmanship, you probably have the natural ability to become a professional auto mechanic. You don’t need previous training to become successful—just the will to get ahead and the desire to work with tools.

It isn’t necessary to have a high school degree to take auto-mechanic training. This is a special field of practical knowl-
edge in which the will to learn is more important than previous formal schooling.

Correspondence training offers some advantages. You can set your own classroom hours and allow yourself plenty of time to complete your courses, although most students finish up within a year. Your lessons are graded and evaluated by qualified instructors and the correct answers are returned to you in the mail.

What about practical training? Many students find that after a few lessons they are able to make money with part-time repair work right in their own neighborhoods. If you own a car, you can put your correspondence training to practical use, but having a car isn't essential. When you learn the "how" and "why" of automotive maintenance, you'll find it easy to put your knowledge to practical use when the opportunity arises.

Resident training has the advantage of offering on-the-spot practical lab work to supplement lesson material. Many resident and correspondence schools offer special job-counseling services specifically designed to help you get the job you're looking for.

One highly-regarded school offers students a complete set of hand tools including a socket wrench set, pliers, screwdrivers, a ball peen hammer and a metal carrying case. Testing equipment is also offered—timing light, compression tester and vacuum gauge. In addition repair manuals are provided, and it's all included in the cost of tuition. Other schools offer similar equipment to help you get started in your repair jobs.

Training in auto mechanics might provide the pathway for a better job for you in one of America's leading industries. No question about it, the opportunities are almost unlimited, and if you're looking for a solid career opportunity, be sure to check this field.

For more information on school training opportunities, write Popular Mechanics, Skills for America, 200 E. Ontario St., Chicago 11, Illinois.

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JANUARY 1960

85
American families are better housed – thanks to Advertising!

Tubeless Aircraft Tire
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Tubeless tires, inflated like a football with a needle, are now being used on military and commercial aircraft. Designed by Goodyear Tire and Rubber Company, the tires eliminate wheel-weakening valve stems and holes that cause concentrated stress. The two-inch needle is kept in a spongy container filled with lubricant. Points of inflation are marked by blue dots on the sidewalls.

Detergents Find Way
Into Drinking Water

Detergents used in household cleaning are finding their way into drinking water, creating a serious public health problem, says Jesse M. Cohen, chemist at the Water Supply and Water Pollution Branch of the Robert A. Taft Research Center, Cincinnati, Ohio. He says filter and other water purification methods that remove soaps from sewage just don’t work on the synthetic cleaners. Some idea of how widespread the pollution can be is shown in these figures: In 1958, more than 3.8 billion pounds of detergents were used in the U.S. compared to 1.3 billion pounds of soap. More than 85 percent of the detergent went down household drains. Cohen says data must be gathered to find if long-term ingestion of detergents is harmful. In the meantime, he said there is a simple test for detecting detergents in drinking water: Water at the tap will foam if detergents or other pollutants are present.
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POPULAR MECHANICS
Insect Sprayer Treats Many Crops

Straddling wide rows of corn and rasping along on four long legs, a new insecticide sprayer looks like a monster version of another effective insect killer—the praying mantis. Now in use at an experimental station run by the University of California, the sprayer—because of its great flexibility of operation—is speeding tests of insecticides. Its virtues may make it adaptable for general farm use. The diesel-powered machine has these features: The operator can, at the touch of a button, adjust the 15-foot-wide, rear-mounted spray boom from ground level to a height of five feet. In one hour, two men can adjust the width between wheels to fit spacing of crop rows. Experimental batches of insecticide may be mixed right on the field, because the sprayer carries two tanks, one of which contains water to vary solutions, or to mix new batches.

“We can test insecticides on a tall crop, such as corn, one day, and on a low crop, such as beans, the next,” says Dr. Lauren D. Anderson, the University entomologist who designed the sprayer. He believes farmers could use the machine to good advantage, if it were stripped of extra tanks and fittings. A cotton grower, for example, could treat plants after they grew tall.
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POPULAR MECHANICS
Pellets Move Apart
To Ground Lightning

Special pellets in a new lightning arrester act like a valve when excess voltage—usually caused by lightning—occurs in a line. They separate for a few millions of a second to ground potentially dangerous surges, then close, returning the line to operating condition. The 120/240-volt arrester requires no maintenance and its aluminum hardware can be attached to the side of a house or hung from conduit adjacent to service lines. When service wires are stripped with pliers, the arrester may be attached and taped.

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NOTICE—It is the intention of this magazine to provide its readers with information regarding the latest developments in the mechanical arts. Except where otherwise indicated, this magazine has no informa-
tion of these developments reported herein. It is suggested that patent attorneys be consulted to avoid liability for patent infringement. It is not the purpose of this magazine to encourage patent infringement but, as indicated, it is the intention of this magazine to report on the latest developments in the mechanical arts.

Envelope Around Screen Serves as Storm Window

Suited for use in rented apartments or homes, an inexpensive substitute for storm windows is now available. It is a plastic envelope that fits three standard sizes of casement-window screens. No tacking is required for the envelopes slip snugly over the screens. They provide one dead-air space between the sheets of polyethylene plastic, and another when the unit is set in the window. They fit metal screens 16½ inches wide by 24, 36 and 48 inches long.
Flag Pops up When Mail Arrives

When the postman now opens the roadside mailbox door, a bright flag automatically springs up, easily visible from the house or the car. The attachment consists of a four-inch-long coil spring with a clamp that supports a red or yellow square metal flag. It is clamped to the top of the mailbox latch bracket. Each time you take the mail out, you connect the flag so that it will spring up when the door opens, saving unnecessary trips for mail.

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JANUARY 1960

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Why your 1960 car has four times more aluminum than your 1950 model

Rugged new engines deliver more horsepower per pound

Power for one of the new U.S. compact cars comes from an exciting new aluminum engine. Because aluminum weighs only one-third as much as iron or steel, this power plant delivers far more horsepower per pound of engine weight.

Now let's say you get 17.5 miles per gallon of gas. Based on operating tests, if you reduce car weight 400 lb. you'll boost that figure to 20 mpg. You'll get away from stop lights 10 per cent faster, too, because a big enemy of car performance is weight.

Airplane engines, toughest proving grounds for ruggedness and dependability, have been made of strong, tough aluminum since the time of the Wright brothers.

Experimental aluminum V-8 engine built by Alcoa engineers in 1917.

All U.S. cars have used aluminum pistons since 1955 (most earlier). Alcoa developed the special alloys and shapes which made these pistons possible. Racing car drivers have demanded aluminum heads since Barney Oldfield's day because they permit higher compression ratios. To nonracing car drivers, this means knock-free performance on regular gas.

By 1961 we predict you will see still more cars with aluminum engines. And with a lighter engine, they can use lighter chassis, brakes, steering mechanisms and axles. This weight saving suggests lighter transmission, drive shaft, differential, radiator and wheels. In other words, the weight-savings snowball. That's why auto makers are switching to aluminum as fast as they can tool up for it. And Alcoa is contributing the same intense research to this move as it has for the past 50 years.

Aluminum brakes reduce "fade" . . . save relining

Heat dissipation in aluminum brake drum (right) is measured in a heavily instrumented Alcoa test car. Special thermocouple pack fits over the wheel hub (left).

Two popular U.S. cars now have aluminum brake drums, a major advance in automotive safety. Because aluminum dissipates heat three times as fast as iron, aluminum drums stay many degrees cooler. After two or three "panic stops," or when braking down a steep grade, ordinary
brakes get hot and tend to "fade," so the lining loses its grip on the drum.

By contrast, aluminum brake drums have made 10 consecutive severe stops from 100 mph with no sign of brake fade. Iron brakes faded after 3 stops. In a controlled test under identical conditions, at 70 mph, an iron drum heated up to 630°F, while an aluminum drum only reached 420°F. Cool-running aluminum drums also increase the life of the brake lining. And they save weight, too—unsprung weight that lets wheels hug the road to give you a better ride.

**Aluminum grilles and trim**

stay showroom bright for years

You've probably noticed the big swing to aluminum for auto grilles and for trim, inside and out. Superb corrosion resistance is the reason. Aluminum that's anodized—a process perfected by Alcoa—has a surface of hard, brilliant aluminum oxide (the material from which sapphire is formed). This gleaming surface stays showroom bright till trade-in time and beyond.

Because it's not a coating, it can't chip or flake as paint does. Water is the only cleaner you'll need.

Versatility is another aluminum trim feature which gives the stylist a satin finish or brilliant polish, an exciting texture or beautiful, lasting color.

Everywhere on your car—upholstery, paint and trim—aluminum gives you gleaming beauty.

**COMING:**

lightweight, efficient aluminum radiators

This spring, one car will make its debut with an aluminum radiator. Weighing only about half as much as ordinary radiators, the new aluminum jobs will improve steering, cut front-end weight, reduce the load on shocks and springs.

Excellent heat conductivity and high corrosion resistance make aluminum a natural for radiators. Small wonder that more aluminum radiators are on the way.

**TOMORROW:**

high-strength bumpers with lifetime gleam

Within a few years most auto bumpers will probably be made of aluminum. Trucks and buses have been using them for years. Aluminum bumpers have great shock-absorbing capacity. They have no plating to chip off. They'll trim anywhere from 20 to 40 lb from front-end weight and give you better steering.

**How to heat and cool your 196X car**

This special Alcoa sheet has tubing formed right into it during manufacture. Someday it may be used for auto floor, roof and side panels. In winter, hot water might flow through the tubes; in summer, cold gas from the auto air conditioner. (The tubes can also act as structural members...part of the auto frame.)

**Body panels with built-in trim**

Today's auto trim is fastened onto the sheet body—a costly process. Tomorrow's cars may have body panels stamped from aluminum sheet, with raised sections left unpainted to form highly polished trim.

**ALCOA ALUMINUM**

Gives every car more Gleam and Go!

JANUARY 1960
Only Perfect Circle gives you

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POPULAR MECHANICS
Masters of Explosives

"The cheapest way to 'bust up' anything is with explosives." That's the motto of the powder peddlers, trouble-shooting engineer-salesmen for the explosives manufacturers . . .

By
Ted Dutton

JANUARY 1960
IN THE SPRING of 1954, on the construction site of the colossal new highway bridge spanning the rough, cold Straits of Mackinac in Upper Michigan, a tense drama brewed.

At Alpena, steel fabricating crews had built the lower sections of two huge, circular caissons, 116 feet across, with 15-foot watertight tanks between inner and outer steel walls. Tugs had towed the brutes to the center of the Straits and spotted them between temporary anchor piers. Concrete, flowing into the tanks, slowly sank the monsters while ironworkers raced time and vicious spring gales to complete the inside sections.

Finally, 200 feet down, the caissons touched bottom. But now came the tricky part. Explosives lowered through wells were supposed to rip circular trenches in the lake bed, settling the wedge-bottomed caissons exactly eight feet into solid granite, without tilting or dislocating them a fraction of an inch.

The day came. The charges went down, and divers plunged into the icy, murky water, checking placement. Electrical connections were made and the area cleared. Down went the firing key, "Blooie!" Geyser of white water shot into the air. Spectators gasped as the great caissons lurched. But they sank obediently into the calculated position, to become the foundations of Big Mack's soaring main suspension towers.

Winning the sensational gamble caused no one any real surprise; near-miraculous feats are routine stuff to modern blasting experts. Old time blasters used to be self taught, but America's current crop of 20-odd troubleshooting "powder peddlers" for such big explosives makers as DuPont, Atlas and Hercules are university-trained geologists or mining engineers, and are wizards at constructive destruction. Of course, nothing about blasting is ever really cut and dried; blasting engineers often draw assignments that tax even their remarkable ingenuity.

Today's blasting specialists wouldn't perform much magic were it not for modern high explosives. A Tyrolean named Kaspar Weindl fired the first industrial "shot" nearly 300 years ago to mine coal in Hungary. But primitive black powder was the only practical commercial explosive until the Swedish inventor, Alfred Nobel, exercised his inventive genius in the late 19th century.

In 1846, Ascanio Sobrero, a chemistry professor at the University of Turin, Italy, had discovered the explosive properties of nitroglycerin. But for years it was more an oddity than a practical explosive because it was too sensitive to handle, ship or detonate safely. Its only practical use, oddly, was in medicine, as a heart stimulant.

In 1867, Nobel absorbed savagely powerful but dangerously sensitive nitroglycerin in a sandy earth called kieselguhr. The safe, stable new compound—dynamite—won immediate acceptance in mines and quarries everywhere. Shortly, in California, Hercules and Giant powders appeared. These were "active dope" dynamites—nitro absorbed not in sand but in other granular explosives. In 1875, Nobel dissolved colloid cotton in nitro, producing history's first blasting gelatin.
Zero plus .8 second. The larger burst at the right is from North Rock; the smaller eruption from charges in South Rock, which were fired a few milliseconds later. The Ripple Rock blast was the largest intentional non-atomic explosion in the history of the blasting business.

High explosives today are still basically the same but have become more powerful, less sensitive, and far more versatile. About 200 types and grades exist, including all possible combinations of strength, density, water resistance and flammability.

There are straight, gelatin and "free-running" pellet dynamites. A bevy of low-power "permissibles" have been cleared by the government for use in dusty, gaseous coal mines.

To this wide assortment have recently been added small "singles" and "duels" for small-scale mining and "batteries" of half a dozen or more "chambers" for large operations. There are guncotton and a new explosive named Nitramex, which is a mixture of guncotton and cottonwood fibers. If it is to be used in mines or other hazardous situations, it must be made in the right proportion to ensure stability and safety.

Cross section of Ripple Rock shows the plan for removing the massive underwater peaks. Over 2500 feet of seven-foot tunnels lead from nearby Maud Island (right) under the channel and up into the peaks. From there, dozens of "coyote tunnels" honeycombed the peaks to hold the explosives. Varying loads in each tunnel insured a uniform blast despite the irregularity of the rock contours. Mining engineer Victor Dalmage devised the plan to get "Slipstick" Bickel's Nitramex into position for the enormous blast.

Zero plus 4.7 seconds. Great chunks of rock appear in the 1000-foot geyser of water and smoke as Ripple Rock blows its top. Photo on page 97 shows the explosion at its peak, 8.4 seconds after the moment the shot was detonated.
been added new high-velocity blasting agents—ammonium nitrate compounds containing no nitro but combining vicious wallop with reassuring insensitivity. These agents can be burned, crushed, drilled, chopped, shot at or dropped great distances without detonating, but suitable primer charges, set off by Primacord fuse and electric blasting caps, will do the job every time.

Armed with such tools, today's blasting masters can crush, crack, puncture, fracture or obliterate just about anything. Routinely, they dig ditches, post holes, wells, canals, foundations, tunnels and quarries. They break up subsoil for tree planting, shatter boulders, extract stumps. They demolish sunken ships, knock down walls, break up log and ice jams, cut timber, prospect for oil, tap blast furnaces, and perforate oil-well casings. You name it; they'll shoot it—safely and efficiently, for time has proved the blaster's maxim that "the cheapest way to bust up anything is with explosives."

Yet there are problems, which come in many shapes.

One is the terrific financial risk involved in really king-sized shots. Normally, in quarrying or open-pit mining, you drill rows of vertical holes, load them, connect your fuse network, and blow a modest portion of the face into the pit. But sometimes rock structures force you to dig "coyote" tunnels horizontally into a hill. Large coyote shots are amazingly efficient, for all the explosive force is expended in useful work. But there is risk of misfire. If only a portion of the blast goes off, the contractors can lose millions on mop-up work.

Perhaps the riskiest coyote shot ever fired was at barren Promontory Point, Utah, in June of 1957. The monster causeway to replace the Southern Pacific Railroad's old timber trestle crossing Great Salt Lake needed millions of tons of fill rock—enough to bury 25 city blocks 30 feet deep. To get it, engineers planned to break up a whole mountainside in a series of enormous blasts.

In the largest of these, Atlas Powder Company technical advisers were called in and dug a 5000-foot labyrinth of main and crosscut tunnels, loading them with 1,432,000 pounds of a high velocity nitrocarbonate blasting agent called Amocil and 385,000 pounds of 60-percent dynamite in 50-pound "sticks," this last to promote com-
As soon as the rubble stopped falling, two big shovels and dozens of men went to work pitching tons of pulverized granite over the side into the canyon. As they worked, track-laying crews followed at their heels installing the temporary tracks. Within one hour the eastbound California Zephyr, above, passed safely over the spot where only a freshly scarred rock outcrop marked the location of the old Gore Canyon tunnel.

plete detonation. They hooked up a heavy-duty explosive fuse network and pushed the plunger. The ground shook miles away as the great cliff erupted into a maelstrom of black smoke and heaving, sliding rock. When the haze cleared, the cliff was gone. Three million tons of rock had been pulverized in seconds, and the largest non-atomic explosion fired to that date in the U.S. had been a smashing success.

But sheer firepower doesn’t impress blasting engineers much. They’re more intrigued by precise sharpshooting jobs like toppling 200-foot brick smokestacks down narrow alleys between buildings. You draw some chalklines, do some lipstick work, and drape gelatin necklaces around the stack, then stand back and hit the switch. Bingo! The carefully calculated charge drops her down the line, much as a lumberjack’s V-cut “places” a big Douglas fir.

If that sounds tricky, it’s no more so than shooting indoors in the middle of crowded business sections, and that’s commonplace. Excavators fire dozens of dynamite shots in New York City subways each year, with trains whizzing past and with pedestrians going calmly about their business 20 feet above. Construction workers often blast inside occupied office buildings—for instance, to cut out foundations for new equipment. Once a demolition gang blew three 30-ton steel vaults into scrap in the basement of a downtown Des Moines bank. They snaked gelatin along the seams, covered the work with a canvas muffler and let it rip. Customers and tellers upstairs felt a faint tremor, but they never heard a sound. Actually, sound is an inverse indicator of efficiency—the more racket and debris whistling around, the more energy is being wasted on thin air.

Back in 1944, after 18 months’ incessant sharpshooting in Colorado, blasters met in the middle of the 13-mile Big Thompson Diversion Project water tunnel. So accurate had the trigonometry and blasting been that engineers measured only a 7/8-inch error where the shafts joined. Blasting experts shrugged off such routine feats. However, tunnel blasting does have special hazards, including ventilation, vibration and concussion. Unpredictable rock faults can sidetrack a shot in the wrong direction. Hidden springs, opened by a blast, can flood a tunnel in seconds. The new Fort Pitt auto tunnel near Pittsburgh posed a ticklish problem. Worked-out mine shafts honeycombed the hill to be driven. If a cave-in started, homeowners atop the hill.
might have found themselves dropping down in the world. To prevent it, blasters laid their shots in rows, firing them in sequence a fraction of a second apart with ingenious new delay detonators. To the ear, such stuttering blasts sound like one "pow." But it's a mild noise, and produces little vibration.

**Sam Russell's Classic**

Normally, surface blasting is far less tricky than tunneling. It wasn't so with the classic—still to be duplicated—shot set off by Sam Russell, one of history's greatest blasters, in July, 1930.

As a phase of the Alcoa Power Company's Saguenay River project at Chute-A-Caron, Quebec, contractors had built a generating station and partially finished a power dam to serve it. Now a coffer dam must be built to force the river through a diversion channel so the main job could be completed.

Plans went awry. Heavy rains swelled the river, hamstringing efforts to place sheet piling and fill dirt. A call went out for Russell, then working for DuPont, who came up with a fantastic idea. He built an 11,000-ton concrete block, standing on end at the river end of the pier. The block, 90 feet high and 45 feet wide, was shaped on the river side to match the contour of the stream bed. Russell said he could drop it into the stream, damming the wild waters. "You'll miss the mark," skeptics insisted, "or the block will break up during the fall."

Undaunted, Russell laid 1000 pounds of dynamite in carefully plotted holes drilled in the pier under the block. The time came. Nervously, Russell backed off and pressed the firing key. The concussion reverberated

**Tacanite, a type of quartz, is one of the hardest rocks on this continent, but also a good iron ore. To break it up for handling with power shovels, holes are sunk with a "jet piercer," which uses oxygen and kerosene to create a 4300-degree flame which melts a 40-foot hole in two hours. Ammonium nitrate is then poured into the hole and detonated. This agent is so insensitive that a newer method allows filling the holes automatically from a hopper mounted on an ordinary truck**
Entire Utah mountainside turns into pulverized fill rock in a split second as the Promontory Point shot is fired through a complicated heavy-duty explosive fuse network. The relatively small amount of smoke and fly rock attests to the expert placement of the explosives, since noise and flying debris mean the explosive force is being wasted on thin air. This was the last of a series of shots supervised by Atlas technical advisors, and until the Ripple Rock shot was the largest non-atomic blast ever intentionally fired off the canyon walls, as the huge block tumbled and landed with a terrific splash. Wild cheers went up, and Russell opened his eyes. His prefabricated dam lay—intact and functioning—just one inch from the calculated spot.

The Biggest Shot of All

The great grandaddy of precision blasting jobs in more recent history came last spring in Seymour Narrows, 100 miles north of Vancouver. That spectacular blow-out can be attributed to the genius of another Du Pont powder peddler—F. D. “Slipstick” Bickel, generally conceded until his retirement last year to be unrivalled in skill by anyone in his profession.

The target was Ripple Rock, a lethal reef lying astride the busy inside ship passage to Alaska. Ripple’s twin peaks, lying nine feet below the surface at low tide, created a deadly whirlpool. In 1875, it sucked two U.S. gunboats against the rocks, sinking them. Since then, it scammed 125 ships, with frightful loss of life and property. A few years ago, the Canadian government tried to place demolition charges from barges anchored over the peaks. But the rip tide snapped their cables and the barges went down, drowning nine men.

In 1955, Bickel and a mining engineer,
Victor Dolmage took up the challenge. Abandoning the direct approach as too dangerous, that great team drove seven-foot tunnels 570 feet down from nearby Maud Island, thence 2150 feet laterally under the sea bed, and finally up 300 feet inside Ripple Rock. They honeycombed the peaks with coyote tunnels and loaded the tunnels with Nitramex blasting agents. The work cost $3 million and needed three years to prepare.

Finally, in April of 1958, the Coast Guard halted shipping. Hard-hatted engineers crouched tensely in dugouts ashore; movie and sequence cameras began grinding; rockets went up to leave shock-recording smoke trails. Bickel, in the crowning act of his great career, slammed home the plunger. At first nothing happened. Then a great mound of water bulged skyward. Through its center shot a 1000-foot geyser of debris, water and smoke. Pressure waves raced across the Narrows; fly rock beat a tattoo on the bunker tops. When the pall cleared, there was nothing to be seen on the unruffled waters— the fearsome whirlpool had vanished. Sounding craft went out to investigate and reported their findings. The great blast—the largest non-atomic explosion intentionally fired anywhere—had moved 370,000 tons of rock. It had trimmed 38 feet from the tops of the peaks, leaving ships a 47-foot clearance.

Once again, modern explosives and explosives engineering know-how had performed their accustomed vital service to mankind, and Ripple Rock had been “busted up”—cheaply—with explosives.
AN EYE ON SPACE

By Dr. Dan Q. Posin

PROFESSOR OF PHYSICS, DE PAUL UNIVERSITY
SCIENTIFIC CONSULTANT AND ADVISOR, COLUMBIA BROADCASTING SYSTEM

SATELLITES have been gathering scientific information as they go sailing around Earth. But what other uses will develop as the satellite game is played more fully? Here is a list of possible developments:

1. Research. Satellites will carry more equipment to study radiation, the flight of tiny dust particles, stray atoms, solar light. Satellites will discover new radiation zones.

2. Weather control. Satellites will report on cloud formations. The motion of great cloud bodies can thereby be anticipated for weeks. This constitutes weather forecast. Weather control will come later. Satellites may release great quantities of chemicals which will break up advancing clouds.

3. TV, radio, and telephone relay systems. Plans already are under way to utilize satellites as relay links in several ways. In one system, three satellites spaced 120 degrees apart circle Earth, receiving signals from the ground and beaming them to each other for eventual down-shooting to Earth. A more advanced scheme is that in which three satellites are launched in an equatorial orbit up to 22,300 miles above Earth, each traveling at about 7000 miles per hour around Earth. In such a situation, the satellites turn with the Earth, each one remaining always above the same point on the ground. This situation is exactly equivalent to having three TV, radio or telephone towers 22,300 miles tall, but results in the saving of some lumber and steel. The system can also be used as a "post office without a building." On the ground, standard forms are filled out in the writing of a letter. These are scanned and turned into electrical signals which are then sent to the satellite overhead, which thereupon transmits the messages to the next satellite; and this one sends the radio signals to the ground, where they are converted back into words. The effect is that of a satellite messenger boy who has no legs and requires no tip.

4. Solar cells. Satellites can be used merely to orbit in space and collect solar energy, converting it into electrical power, later to be transmitted to a demanding point. This is strictly for the future.

5. Beacons for space ships. Satellites will certainly be out there, flashing lights and sending radio messages or signals, acting in general as beacons for space ships plying the vacuum ocean.

6. Satellites as Earth navigation aids. If a satellite's position at any moment is known over the surface of the Earth, then the satellite can serve as a star for the taking of bearings, regardless of the fact that it is moving.

7. Rescue beacons. Satellites can receive messages beamed by ships, airplanes or lost parties on the ground.

8. Space steps. Satellites will be streaming on various orbits. Thus, possibly 20 different elliptical orbits will surround Earth at desired distances, and the space ship will contact each as it goes onward to its destination.

9. Satellites around the moon. Satellites in orbit around the moon will keep constant watch, relay messages around the moon, as they will be doing also around the Earth. The moon explorers thus will know what their friends are doing on the other side of the moon.

10. Satellites around the planets. A series of satellites will certainly swing around Mars, Venus and some of the other planets.
Remote Handler for "Hot" Cobalt

Radiographic inspection of big steel parts like this 36-inch wheel is a simple thing; photographic film is wrapped around the outside, then a "pill" of the isotope cobalt 60 is placed in the hub. Patterns formed on the film by particles passing through the steel reveal inner flaws. It's simple—except that the pellet of cobalt is dangerously radioactive; this examining area is walled with 18 inches of concrete and the pill is kept in a lead safe. To protect personnel, yet allow fast, easy inspection, the National Supply Company of Pittsburgh, Pa., uses this mobile carrier. Hand-operated from outside the enclosure, it moves the pellet out of its lead jacket and into place through a flexible tube, then returns it when the exposure is finished. Control lights on the outside unit follow the pill, and the geiger counter monitors radiation outside.

Hot Seat Keeps Battery Strong

Sub-zero temperatures won't bother your car battery if it sits atop a hot plate that keeps it at 60 degrees regardless of temperature conditions. The plate, which can be left under the battery all year round, is heated by 110-volt current from any household outlet. The heating coil is Nichrome wire molded into a heat-resisting plastic. Zinc-plated steel sheets protect the element, top and bottom, from acid damage. Batteries, when warm, have more than twice as much cranking power as they have when cold, so by maintaining a warm battery you are assured of quicker starts in winter.
Troops guide Lacrosse missile with tracker and range finder. Tracker, right, leads missile to the target.

**Soldiers Get Guided Missile**

Ground troops, using a mobile guidance system, can fire the Army Lacrosse missile and hit an enemy target with deadly accuracy. Quickly moved by Jeep or foot, the system guides the missile toward its target under any weather conditions. Conventional direction methods first locate the target. When the missile is fired, a tracker locks onto it and a computer guides the missile to its mark.

After initial blastoff, a Lacrosse missile (lower left) streaks to its target. Soldier at front line uses a portable range and direction finder (lower right) to measure accurately the exact distance to the target.
BEFORE THE FIRST Mercury Astronaut can be strapped in his contour couch and blasted off into space—either for a ballistics ride or an attempt at orbiting the Earth—there are a number of nagging problems still to be solved.

Robert R. Gilruth, head of the Space Task Group which directs Project Mercury, says: "We don't need any new scientific break-throughs to achieve this task. We do, however, have a formidable engineering job, and we expect many difficulties and surprises."

The seven Astronauts discussed some of these difficulties with me during the week I spent with them at Langley Field in Virginia. Each Astronaut has been assigned a particular specialty in which he works with engineers and scientists and then reports back to his fellow pilots. Here are some of the difficulties with which they are presently grappling:

**Yaw controls.** The peculiarities of space travel require a single hand-control easily accessible to the weightless Astronaut. This control presently combines the three attitude corrections which the pilot will have to make—pitch, roll and yaw. A forward-and-back motion opens jets which
Diagram shows sequence of events as capsule is blasted into orbit, slowed, parachuted to earth and recovered.

correct pitch, a sideways motion corrects roll, and a twisting motion controls yaw. This arrangement plus the design of the cockpit was one of the first things firmed up by the Astronaut-engineering team. However, experience on simulators has shown that the pilot sometimes gets yaw movement when he doesn't call for it. As a result, some of the Astronauts—particularly Wally Schirra—want to experiment with the yaw controls in a rudder pedal that can be foot-operated. Opponents say that sufficient foot movement will not be possible. However, experiments will undoubtedly be made in this direction.

Tracking stations. When the capsule has attained orbit, it will be followed by 14 tracking stations located at strategic spots throughout the free world. The Astronauts will also be able to communicate with these stations. Although the ideal locations have been selected, the sites haven't yet been cleared with the countries involved. There is also a shortage of funds for building the equipment needed for each of the tracking stations.

Land recovery. The Mercury capsule will drop by parachute at the rate of 30 feet per second—with a landing equivalent to jumping off a 15-foot wall. (When I

Though Astronauts took skin-diving instruction as a group, they are left on their own to keep in top shape.

POPULAR MECHANICS
Model of the capsule is positioned in wind tunnel as part of the laboratory and free-flight testing program.

asked the Astronauts how this compared with a normal parachute jump, they all got out slide rules and came up with several different answers, finally deciding that a normal chute landing would be 21 feet per second or equivalent to jumping off a seven-foot wall.) Striking water at this rate, the Astronaut inside the capsule would not be hurt—and of course the plans are to recover the capsule in water. But even a tiny error in the time of re-entry could change the recovery point by many miles (an error of one second causes an error of five miles in landing position). Thus there is always a possibility the cap-

Although the Astronauts have strong feelings that the “first man in space” theme is being overstressed, the Popular Mechanics editorial team which visited Langley Field couldn’t help speculating on the question. They came back with some definite ideas on the subject, and accordingly have deposited in a sealed envelope their predictions on the order in which the Astronauts will be sent up into space. This refers to the Redstone ballistic flights—not the orbital flights that will come along some months later. The envelope will be opened after public announcement of the first manned ballistic flight.

No plush quarters for the Astronauts. The men share this cramped office where they study technical reports.

JANUARY 1960
Instrument panel for the capsule has gone through many changes, mostly at the insistence of Astronauts who will have to use it.

Astronaut climbs into F-102, assigned to Astronauts, for few minutes of relaxation.

The capsule will come down on land—with no certain knowledge the occupant would be uninjured. A shock-absorbent material is being used beneath the pilot's couch, but land descents will have to be tested with animals before any exact knowledge is possible.

Point of recovery. For many reasons—shifting winds, failure of automatic equipment, errors in timing—the accuracy of the capsule impact point is difficult to predict, but recovery is set up for a point in the Atlantic Ocean off the Bahama Islands. The capsule will be hoisted aboard a recovery ship—probably a destroyer—in a

(Continued to page 252)

Each of the Astronauts has a foam-plastic acceleration couch moulded to his body. Here the fit of Shepard's couch is carefully checked by a flight surgeon.
Hillman Minx
Goes Automatic

Hillman offers a three-speed automatic transmission using two magnetic-powder clutches, one for low and intermediate gears and one for top gear. Metallic powder is "solidified" by current from the generator, engaging the coupling. As engine speed drops, the current is interrupted and the "solid" powder returns to its original "liquid" state, disengaging the clutch. Gear shifts are controlled by an electric "brain" sensitive to road speed and to accelerator position. No clutch pedal is needed and the selector lever is on the steering post.

Restyled Anglia
Has New Engine

Ford of England’s new Anglia features a reverse-slant rear window, a brand new, overhead-valve engine and four-speed transmission. The new four-cylinder engine of oversquare design has 41 horsepower. Anglia's unique rear window eliminates snow accumulation and also offers protection from the sun.

Submarine Viewer
Helps Fishermen

Next best thing to a glass-bottomed boat, an underwater viewing tube lets boaters peer through up to 30 feet of water to locate reefs, shoals, weed beds and other fish hangouts, or find lost gear or motors on the bottom. Basically a length of six-inch aluminum tubing with a plate-glass window in one end, its available in two, four and six-foot lengths for use from any size boat.
Mine-Planting Aids Developed by Army

Two new machine-driven diggers now speed planting of land mines by Army Engineers. Upper left, a two-man, jeep-mounted earth auger drills 100 holes an hour. It's a regular commercial earth auger with an eight horsepower engine. At upper right and left center is an American adaptation of a British method: A cup-shaped scoop is mounted on a bulldozer blade, and can dig 11 holes a minute on a straight run with about 18 feet between holes. The scoop assembly can be fabricated in field shops and installed on any bulldozer.

Vertical Chessboard Helps Kibitzers

Chess games attract knots of kibitzers wherever the game is played, but an ordinary table and chessboard has room for only a few spectators. The employees of a Berlin electronics firm, who play chess during their lunch period, installed a king-size vertical chessboard in the garden where they eat. With pegged chessmen fitted into holes drilled in the squares, the board allows an unlimited number of spectators to watch a single game. A roof over the board insures that none of the games will be called off account of rain.

(Russia is said to have developed a new glass that is harder than steel yet lighter than aluminum.

POPULAR MECHANICS
Who Shot That Arrow?

Certainly not that Indian—he's a TV extra from Van Nuys who never drew a bow before this picture. But the gentleman standing behind him is "Senator" George Bahr, ace crossbowman, who has just fired the arrow (gently) into a thick block of wood strapped on the actor's back (see below). The old method, with the arrow placed beforehand, is much less convincing.

Right, the William Tell trick the easy way. Bahr shoots an arrow, apple and all, into the wall, the actor steps under it, and the camera does the rest. But he can do it for real, too, if the script calls for it.

JANUARY 1960
5000-MILE GAME OF CATCH

Tracking and recovering a 15,000-mile-per-hour "fastball" from Canaveral takes a lot of teamwork and electronics skill

By Richard F. Dempewolf

Under glaring floodlights, men swarm across a launching pad at Cape Canaveral, Florida. In the center of the milling army of foil-garbed specialists, a nine-story rocket juts skyward, spilling out liquid oxygen frost and vapor.

"T minus 20 minutes and counting!" The terse countdown call blares from loudspeakers around the pad. It booms through the blockhouse. It croaks from headsets clamped to the ears of scores of technicians seated at a nightmare of in-

Air Force Missile Test Center
5000-Mile Atlantic Missile Range

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POPULAR MECHANICS
struments all over the missile “complex.” It races out over the airwaves from powerful transmitters to island tracking stations in the Atlantic far off the coast of South America.

And, across 3500 miles of tossing, night-shrouded ocean, it crackles from radios in the darkened bridges and communications rooms on board six far-flung weird little ships. On these vessels, the men who hear it already are at their stations, monitoring banks of telemetry gear in “the hole” below decks, plotting precise positions in the navigation shack, and scanning the tropical sky through powerful glasses.

High on each ship’s superstructure, under a pair of huge white domes known to the crews as “the Mae Wests,” corkscrew-shaped radio antennas clank and rumble as they peer this way and that across a precise sector of sky, like a pair of rolling electronic eyeballs.

The moment for which these hardy mariners may spend up to 45 miserable storm-tossed days on their heaving splinters of steel, is imminent. In 20 minutes, if all goes well, the missile will lift off its pad at Canaveral on a 5000-mile ballistic ride through space at 15,000 miles per hour. One by one, each station or ship will track it from horizon to horizon as it passes overhead. The crew on the last vessel, picketed at the end of the line beyond Ascension Island will—if the navigation was good and the weather is right—actually see the burning nose cone streak like a giant meteor toward the sea. If the mission involves recovery, their job will be to find that speck in the black ocean, lift it aboard ship without damage and bring it home.

**Special Fleet**

The special fleet that does this work is made up of half a dozen odd little radome-
As the falling re-entry vehicle reaches 20,000 feet, a heat cover ejects, exposing the parachute compartments.

Next in the sequence, a parachute whips out and slows the vehicle from hypersonic to subsonic speed.

studded ships, each faintly resembling a miniature destroyer with a severe growth of lumps on its topside. Some have peculiar names like Rose Knot, Sampan Hitch and Coastal Ansader. A slightly smaller class has no names at all. Each is informally referred to by its crew members as “that bucket,” but officially answers to a num-

Jubilant recovery crew surrounds the advanced ICBM re-entry vehicle taken from the Atlantic in April, 1959.

U.S. Air Force photos
Fully deployed, the parachute further slows the descending vehicle to its terminal velocity.

Inner part of recovery assembly separates, location aids and shark repellent are ejected.

When inflated, balloon is tethered to float above the parachute.

As the vehicle nears the water, it is falling at a rate of 60 to 100 miles per hour.

Kytoon aerial helps spot high missile under adverse conditions.

Balloon provides buoyancy in water, radio and light beacon operate and dye disperses.

JANUARY 1960
Signals from the missile and Canaveral are received and taped in “the hole”—the ORV’s telemetry room.

In poor weather, infrared equipment picks up the scorching missile cone as it streaks in from space.

Technicians, at left, locate with great precision the spot on the range map where the ORV will have to sit before a shoot. At right, another technician inspects a spiraling antenna inside the picket ship’s radome.

12 feet, boasting an overall length of only 176 feet with a slim 34-foot beam, they could ghost in and out of shallow harbors unnoticed at night.

Today, this trim little fleet, painted a gleaming white, reports to the Air Force and is operated under contract out of Port Canaveral by Pan American World Airways. On board each one, a highly skilled group of six or seven RCA technicians and engineers operates the complex maze of RCA-designed electronic wizardry that makes the fleet a vital link in the giant missile range chain.

It’s one thing to send a mammoth chunk of fire-spitting steel out of this world, but quite another to keep track of where it goes and what it “sees” and “feels” enroute. Today, virtually all big missiles carry an instrument package designed to count cosmic rays, take temperatures, test magnetic fields, look at the sights through camera eyes and perform a host of other chores. All this data is radioed back to earth. To pick up these broadcasts from space, and track the big bird with pinpoint accuracy to its watery grave, telemetry stations are spotted along the earth under the missile’s flight path. On the Atlantic range, stretching halfway across the ocean from Cape Canaveral, 10 such stations are strung through the chain of islands north of South America’s coast. The last is in mid-ocean on Ascension Island. With all the handy islands, this still leaves unmonitored watery gaps totaling 3500 miles in

(Continued to page 264)
"Replacement for Man" Does Dangerous Jobs

Mobot Mark I, the first mobile remote-controlled handling machine for use in radiation labs too dangerous for man, flexed his steel arms recently and showed how he can move into "hot" areas to perform intricate tasks. Remotely controlled by operators who watch through closed-circuit TV eyes, Mobot, built by Hughes Aircraft Company, can lift 150 pounds with either arm, take apart a metal case with electronic hand tools and even remove a printed circuit.

Huge Radio Telescope Stretches Across Desert

Thousand-pound lead weights keep two miles of transmission lines of a huge radio telescope taut in the Anza-Borrego Desert, California. Radio signals from remote celestial objects are picked up by a grid of eight parallel rows of north-south dipole elements, spaced 1443 feet apart along the east-west length of the transmission line. What the radio telescope "sees" is recorded as a wave pattern on paper.
Oil-Spraying Rocket Calms Waves for Rescue Operations

Latest development by the German Rocket Society is a one-man, hand-fired oil-spraying rocket to be used in coastal rescue operations. Fired like a crossbow bolt, the rocket flies out 500 feet and explodes in mid-air. The tailfins are inclined to cause the rocket to spin on its longitudinal axis, and the combination of spin and explosion sprays its quart of oil over nearly 90,000 square feet of water. Even that thin film will help calm rough water, and allows launching of rescue boats. The operator is protected from the exhaust gases by a shield on the launcher.

Twin-Deck Rail Cars Carry Foreign Autos

One atop the other, new automobiles are being transported in double-deck freight cars across Europe. The special freight cars are used by the German Federal Railway between Germany and Switzerland.

Paper Test Helps Doctor Choose Effective Antibiotic

Chemically treated filter paper is helping doctors decide what antibiotic to give for an infection. The paper is divided into several divisions, and small quantities of individual antibiotics are placed in each division. Infectious material taken from the patient is swabbed onto the paper, which is then sealed in a plastic bag and heated. If an antibiotic halts the growth of the bacteria causing the infection, the paper remains white. But if an antibiotic does not work, the bacteria grow and the paper turns red. The doctor administers the one that keeps the paper white.

POPULAR MECHANICS
Collapsible Dam Solves Water-Diversion Problem

Faced with the problem of diverting water from the Los Angeles River with a structure that would not be torn out in a flood, the Los Angeles Department of Power and Water installed a collapsible dam. It's a neoprene and nylon tube, 150 feet long and 30 feet around. Bolted to the river bottom, the tube automatically inflates with water when the river is low and deflates when it floods.

Up-the-Stair Switchboards Handle 6000 Calls Daily

Twenty desklike switchboards, arranged on shallow steps of a winding stairwell, permit British Automobile Association operators to handle 6000 calls a day. Developed from a time-motion study, the layout allows operators to give breakdown help and motoring information without leaving their seats. All are linked by phone to a control room at the top of the stairs, which contacts patrol cars.
Vacuum Degassing Method Produces Better Steel

Cleaner, tougher steel results from a vacuum degassing process developed by A. Finkel & Sons Company. After the electric furnace is tapped, the 3000-degree nickel alloy steel is degassed in a high-vacuum chamber where hydrogen, oxygen and nitrogen gases boil out. A helium gas injection increases circulation and allows more steel to be exposed to the surface. The degassed steel then goes into an ingot mold. At left is steel immediately after degassing.

40-Foot Array Antenna Tracks Space Vehicles

Departing from the “dish” type conventional antenna design is this array assembly developed by GB Electronics for tracking space vehicles. The National Aeronautics and Space Administration has purchased one of the new units for installation at the Wallops Island, Va., test site this spring. The antenna, combined with other equipment, can track vehicles in space with an assembly that has only a fraction of the weight and area of a conventional dish-type paraboloidal antenna. The new array antenna is 40 feet across, compared with the 60-foot dish paraboloid. It will cost less than $250,000—or approximately half the cost of the tracking antennas now in use—and can be installed and maintained by fewer men.

POPULAR MECHANICS
Penny-a-Year Safety Light for Stairs and Hallways

Lasting nearly 10 times as long as an ordinary bulb, a flat "light bulb" provides a green safety light for stairways and hallways. The light has two prongs to be inserted into any outlet. According to Westinghouse, the lamp burns all year, day and night, for less than a penny.

Sight-Seers Elevator

Patrons of the Saxony Hotel in Miami Beach, Fla., ride a glass-enclosed elevator that travels on the outside of the building, permitting a panoramic view of surroundings below. At night, lights in the elevator switch off so the guests have a view of the illuminated streets.
Strange Shapes On the Campus

Set among trees at Lake Erie College is inviting Lincoln Commons, where 480 students dine and center their social life. The $760,000 free-form structure was designed specifically with "feminine character"

By Sheldon A. Mix

FOCAL POINT of the Lake Erie College campus in Painesville, Ohio, is a new, multifaceted student commons building with "lily pad" patios. In designing a combined dining hall and social center for the woman's college, architect Victor Christ-Janer produced a building of feminine character while at the same time harmonizing it with the surrounding wooded terrain.

Only a few trees were removed in constructing the building. As a result, the college's 480 students, who take their meals on the building's third level, "dine in the tree tops" behind a glass-curtain wall. Circles and curves are dominant Roundness is the Commons' dominant form. Also, note walls of reading lounge and hallway: They do not reach the ceiling
designs in the free-form building. On the ground level, terraces under trees outside the structure are linked to the interior by circular brick floor patterns. Rooms on the ground level are shaped by curved walls that stop about a foot short of the ceiling. Even the exhaust fans outside the building are located within a fenced circle. Steel structure supports open, interior stairwells.

The building is mainly a glass and steel frame encased in concrete. No brick is used above the outside walls of the ground level. Flared atop the structure is a 60-ton, exposed-concrete roof. On the ground level are a hi-fi room, a reading room and a lounge called "The Cave," which has a 12-sided fireplace with downward smoke exhaust. The second floor holds a snack bar and an expansive lounge area for study, television viewing and bridge. Deliveries are made on the ground floor and lifted by dumbwaiters to the third-floor snack bar and kitchen.
SIGHT-SEEERS visiting the Tokyo Tower, the world's highest, view the Japanese capital from a two-story platform, halfway up the 1092-foot structure. The tower, which houses several local radio and television stations, tops the Eiffel Tower of Paris in height by 118.25 feet. Three elevators carry visitors to the platform. Weighing about 4000 tons, the tower's foundation can withstand a load of about 16,000 tons. The tower is fireproof and earthquake-proof. It is reported that the central platform is as rigid as the floor of a home and that visitors feel no vibrations. Constructed at a cost of about $75 million, the tower is the highest commercial television tower in the world. At the very top are television antennas for six stations. Just below these antennas is the television and radio relay platform, 738 feet above the ground. Below the relay platform and just above the observation platform is a section of the tower containing FM broadcasting antennas and antennas for communications with mobile radio receivers.
Car Sinks Into Flower-Garden Garage

Colonel W. Wright's flower garden in front of his Hampstead, London, home looks like any other until he decides to park his car in the garage. His garage consists of a hydraulic ramp that lifts right out of the ground among the flowers and then lowers his car completely out of sight. After driving his car onto the ramp, the colonel presses an electric button inside his house and a three-kilowatt motor lowers the ramp, putting the car to bed. This unique garage is exclusively Wright's too, since London laws do not allow such lifts to be installed anymore.
Electronic Guide Steers Canal Builders

Rear view of machine shows the smooth bed it creates. The machine crawls on caterpillar treads. Its forward and lateral motions are controlled by an electronic regulator with metal fingers that "feel" wire
Man on platform controls filling of tubes with concrete splashing from mixer to hopper to conveyor.

EARTHMOVING equipment has made easy the job of roughing out irrigation canals, but until recently, smoothing the bed to grade was a time-consuming chore. The task was mechanized during building of a canal near San Jacinto, Calif. A huge machine smoothed and graded, then spread concrete. The monster was guided by electronics.

Metal fingers, right, grip wire, set machine’s path. Traveling bridge, below, carries cement finishers.
"Boxcar" Antenna
For Warning Net

Air invaders hundreds of miles away can be detected by a rotating 50-ton radar antenna which will soon join the nation's SAGE defense network. The unique antenna array represents a considerable advance in the state of radar antenna art. Its immense size—the housing is 104 feet long—is required to perform its distant-warning task. The antenna will be mounted on a three-story transmitter-receiver tower housing the 262 separate units that make up the system. The SAGE defense system gathers and computes early warning data and decides the best retaliatory tactics against targets.

Kit Tells When to Change Oil

When to change engine oil? A kit that measures the solids and acids in oil helps you decide. An oil drop is placed on the test paper; if solids are present they will show up. A test liquid in a tube turns yellow if acid is present.

"Hot Foot" for Back-Seat Riders

If a new electric heating pad is slipped under the floor mat, back-seat riders should have no complaints about cold feet. Operated by the auto's ignition system, it will warm up to 160 degrees F., using standard 12-volt current.
Huge Sundial
Also Provides Heat

RESIDENTS OF the growing colony of artists and writers at Carefree, Ariz., 26 miles north of Phoenix, can set their watches by one of the nation's biggest sundials. It also is unique in that the 66-foot long, 30-foot high structure was designed by a solar-energy expert to provide warm water for a solar heating plant. Water from a pool is heated by the sun, then pumped into a nearby real-estate office and shopping center, first commercial buildings in the community.

JANUARY 1960
WHAT'S NEW FOR Your Home

BABY STROLLER becomes a walker or sleeper with a few quickly-made adjustments. It converts to a walker when the canopy and footrest are removed, a sleeper when footrest is raised and backrest lowered. Fashioned from chromium-plated tubular steel, the multipurpose stroller has a shopping basket behind the seat, a built-in seat belt, and a white enameled steel snap-out tray. Upholstery is washable.

Hamilton Cosco, Inc., 2500 State St., Columbus Ind.

HOME CANNER and freezer packer uses no lead or solder and allows cans to be reused up to three times. Capable of handling four sizes of cans, the unit's sealing head crimps on the lid in factory style. The operator puts the filled can of fruit, vegetables, meat or game on the base plate, swings the head into place. Pressing a lever with her left hand, she turns a crank to crimp the lid.

How Plastics and Die Casting Co., 2640 N. Southport St., Chicago 14, Ill.

DOOR CHAIN can be unfastened with a key from the outside. The parts are installed in the usual way (right) but the plate on the door is a lock; its cylinder extends outside (center). When unlocked (right), chain catch rotates and chain drops from slot. No key is needed to unfasten chain on inside.

WASTEBASKET HOLDER fits on a slide behind a kitchen cabinet door and can be pushed from view. It has a lid, and holds 11 x 15 x 20-inch basket.

Magnetic Door Stop prevents a sudden breeze from slamming the door shut and holds it open for ventilation. The contact plate (wall mounted at left) has a spring to cushion impact. Unit may also be used on hinged windows.

Garbage Can takes a beating without losing its lid. A ¾-inch steel ring encircles top of can. Metal fingers under lid hold firmly under ring. The lid can be removed only when the handles on the cover are squeezed together.

Adjustable Bed automatically lifts a sleeper to awakening position. Designed to give support for reading, TV watching or to be used as a foot, head or backrest, the mattress-box spring combination performs the wake-up chore when plugged into a clock radio. It comes in twin size, and is available with either manual or electrical adjusting controls.

Darnel Metal Products Co., Union City, N.J.

PENG, 1040 E. Tucumcari, Phoenix, Ariz.

January 1960
Push-Button Coal Processing

Five men, pushing 600 buttons at a new 10-story coal preparation plant in Clinchfield, Va., control the automated processing of 15,000 tons of coal each two-shift day. All told, only 16 men are needed for each shift at the plant, which is roughly the size of a football field. Because huge machines such as one capable of lifting and unloading 22 to 24 railroad cars of mined coal an hour, are linked by a variety of conveyor belts, the five button pushers—without leaving their control centers—guide coal through screens, wash boxes, centrifuges, heat dryers, load 18 railroad cars an hour, and dump refuse into a valley a half-mile away.

Fine coal is settled out in these pools (foreground) and water is filtered and re-used. Note hill conveyor

One man can control 90 percent of operations from 80-foot-long panel in 10-story coal-processing plant
Army and Navy Join Forces to Test Ship-to-Ship Loading

Joined stern to stern with the Navy transport Comet, the Army's new shallow-draft lighter Page takes on cargo. Designed to relieve beachhead bottlenecks, the Page unloads on the beach through a bow ramp, then pushes off with a hydraulic ram and goes back for another load. The 338-foot craft is designed to draw only four feet of water at the bow. It can handle the biggest trucks, tanks, and mobile equipment.

Heating Mat Keeps Concrete Warm

Steam lines in concrete walks, driveways or floors are ideal for melting snow or heating barn floors, but few homes or small buildings have steam systems. A new electric heating mat, embedded in concrete, does the same job. The basic mat is 10 feet long and 18 inches wide. It uses 230-volt current to produce 42 watts per square foot and can be bent around odd shapes or to fit under stairs.

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Arkansas
Farmers
Harvest
Rice and
Fish

New Arkansas farm crop includes husky, albino catfish. Ben Nelson, above, developed the highly edible, meatier strain of sunstroke victims though. They're commonplace remarks among a group of farmers who are carrying on a unique form of agriculture—fish farming.

Today, dotted throughout the fertile farmland of central Arkansas are more than 300,000 acres of flooded pasture. Placidly swimming in the hip-deep waters bordered by earthen dikes are hundreds of thousands of catfish, buffalo, bass and crappie. They're being grown to maturity by farmers-turned-fishermen, who sell their wriggling crops to fish markets and groceries at profits exceeding those from any rooted crop they ever planted.

Fish farming—now in its twelfth year—has become big business in this prairie-flat region. The nation's only fresh-water-fish cooperative processing plant, located at Dumas, Ark., was set up in 1958 by the Fish Farmers' Cooperative Association. It now does a weekly volume of over $3000, selling mostly to supermarkets in Arkansas and Mississippi.
The world's largest minnow hatchery, at Lonoke, yearly sells millions of finger-sized minnows to the farmers as "feed." More than 200 farmers are licensed by the state Game and Fish Commission to raise and market fish at present and more are applying all the time.

The industry originated in 1947 on the property of Ewell Nixon, a Lonoke rice farmer, who today is the dean of the land-locked fish growers.

Nixon had decided to reap two rewards from one act when he flooded one of his fields and stocked it with bass and buffalo. Agricultural experts had told him that a stocked pond would increase the fertility of his rice field — and provide some excellent off-hours angling.

Later, after he drained the field and planted it to rice, the harvest he got per acre was twice that of the previous, record yield. Meantime, however, he had sold his fish harvest at a good profit, and found there was market for all he could raise.

That proved to be the opening step. Soon Nixon's neighbors around Lonoke were bulldozing up dikes and turning water into their fields. Rice suddenly became a secondary crop in the area, taking a back seat to fish.

It didn't take long for the area citizens to become expert in fish husbandry. Now it's routine for rice and fish to rotate as tenants of the same field.
Here's how the system works. The ideal fish-rice rotation begins in the fall after rice harvest. Dikes are built and fields are flooded, from wells, to a depth of three to four feet. Two pounds of minnows are thrown in per acre, to forage on rice stubble and multiply as future fish food. In the following spring, 300 catfish fingerlings are added per acre to feed on the minnows. By that time, the minnow population has grown so large that the catfish can dine voraciously without making a noticeable dent in their numbers. By fall, the farmers must seine out a portion of the minnows to be sold or used for stocking new ponds.

After a year in the water, the catfish weigh from one to two pounds, and are ready for sale. Using hinged drain pipes which extend through the dikes, the farmers drain their fields, trapping the fish in specially dug low spots. The fish are easily seined out and dumped in tubs for trucking.

Most of the state's "field-bred" fish are marketed through the cooperative at Dumas. The cooperative is a modern fish-processing plant, owned by the farmers themselves who put up $45,000 at $10 a share to supply the original capital. Today, the 12 to 20 workers at the plant clean and dress some 15,000 pounds of fish per week, most of which are sold to 120 supermarkets through the state.

When the production of the ponds is too great for the cooperative to handle quickly, the fish are stored in special freezer rooms. There they are frozen hard as flatirons in temperatures down to minus 40 degrees, until they can be processed or shipped.

In operation less than a year, the plant has handled 375,000 pounds of fish, about 85 percent being buffalo. The record yield brought to the co-op thus far was chalked up by Eric Schenebech, a nephew of innovator Ewell Nixon, who harvested 21 tons of catfish, buffalo and bass from an 80-acre pond—averaging out to 525 pounds an acre. He expects to better his mark. "I didn't follow all the recommended techniques," he admits. "I should be able to do better next year."

A program of selective processing on the part of co-op officials has paid off in the market place. The average price for their buffalo has been 17 cents a pound, some seven cents higher than the average wholesale price.

**Must Increase Production**

Markets are still growing, and Malcolm Johnson, a co-op president, says, "Our major problem in the future will be one of supply. We need more reservoirs. That, plus more efficient management of fish farms, could increase production by as much as 200 per cent."

To support this burgeoning business, a 5000-acre minnow nursery prospers on Rt. 70, near Lonoke. It's made up of scores of ponds, ranging from 50 to 150 acres in size. They are tended by four brothers, and, collectively, constitute the Anderson Minnow Hatchery. The hatchery was originally started to supply minnows for sport fishermen, but with the fish-farming boom, it grew enormously, and now most of its production goes into nearby farm fields.
**New “Golden” Catfish**

The hatchery has also developed a new strain of fish that promises to do its bit toward improving the farmers’ profits. Gleaming pinkish-gold in color, it looks like a rich cousin of the normal mud-gray catfish, but has more edible meat per pound. The new strain is an albino catfish developed by Ben Nelson, a technician at the Anderson Hatchery. He spawned nearly a million of the new breed last year, selling most to the fish farmers. 

“They should help farmers’ business a lot,” he says. “Not only do...

(Continued to page 286)
Navy's "Big Dish" to Probe Universe

With a diameter equal to the length of two football fields, the Navy's 600-foot radio telescope being erected in Sugar Grove, W. Va., will catch signals from astral bodies as far as 38 billion light years out in space—19 times the distance probed by the optical telescope at Mount Palomar, Calif. The 20,000-ton unit will be completed in 1962.

Fixture Supplies Heat and Light

Combining electric radiant heating with built-in lighting, a recessed ceiling unit supplies 1000 watts of heat and 200 watts of light. The unit, designed for both commercial and home use, is available in 120, 208 and 240-volt models, with either polished chrome or baked white-enamel finish.
Mockup Battle Trains Tankers

Marine Corps tank crews can be tested for combat readiness indoors with a battle conditions simulator designed for the Navy by engineers of the Jam Handy Organization. Working in a real tank turret stripped of armor, the crew can perform 23 operations and use 10 of their instruments under conditions realistically simulated on a half-dome screen, complete with sound effects. Computers record “rounds” fired from the real 90-mm. rifle, hits on target tanks, and efficiency in tracking and hitting the targets. Instructors can gauge the crew’s efficiency better than in field maneuvers.

Whirlybird Trainer Floats, Won’t Fly

Captive, yet free, the German Bolkow BO 102 Heli-Trainer gives realistic preflight training without the expense of electromechanical flight simulators and at one-fourth the cost of a real helicopter. It is linked to the ground by a pivot mount in early stages, then mounted on pontoons so the student can move it around a pool but can’t take off. The preflight grad can solo after about two hours of dual instruction.

JANUARY 1960
NOTHING MAN has invented has had the impact of the automobile. Nothing has added such convenience, yet nothing has created so many problems for society.

No single product has so rearranged our lives and our geography. As a result, no place in America (and soon none in the world) is the same. The cocoonish, isolated village is doomed, for better or for worse.

Because it is so much a part of our lives, the automobile has made more money for more people than any other product in history. It has created a handful of billionaires, hundreds of millionaires, uncounted thousands of rich individuals and kept millions more employed.

To pay tribute to this business, the biggest business of all, PM presents a pictorial history of the still-surviving companies. These are the most durable of about 1500 American companies that have built cars since 1900. They have proved their durability by their existence and their flexibility by the new, smaller cars introduced this year.

PM wishes to acknowledge the help of the library staff of the Automobile Manufacturers Association as well as the assistance of the Goodheart-Willcox Company, publishers. Detailed chassis and engine drawings were done by George W. Blow, PM staff artist.

Research by Robert L. Hull, Jr.  Art work by Phil Austin

READY-TO-FRAME FULL-COLOR REPRINTS AVAILABLE
Reprints of these two charts, printed on one side only and on one continuous sheet, are available as long as the supply lasts. Send 25 cents in coin to the Bureau of Information, Popular Mechanics, 200 E. Ontario, Chicago 11, Ill.
<table>
<thead>
<tr>
<th>Year</th>
<th>Carburetor</th>
<th>Air Cleaner</th>
<th>Radiator</th>
<th>Shock Absorbers</th>
<th>Brakes</th>
<th>Engine</th>
<th>Exterior</th>
<th>Safety</th>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>1922</td>
<td>1st Ethyl gas</td>
<td>Balloon tires</td>
<td>Standard</td>
<td>1st hydraulic shock absorbers</td>
<td>Hot-water car heaters</td>
<td>Safety glass</td>
<td>Air silencer, straight-through muffler</td>
<td>Downdraft carburetor, auto radios</td>
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<tr>
<td>1923</td>
<td>Millenium</td>
<td>Buick</td>
<td>Built</td>
<td>Millenium</td>
<td>Buick</td>
<td>1st Lincoln</td>
<td>1st In isolette</td>
<td>Marequette light 6</td>
<td></td>
</tr>
<tr>
<td>1924</td>
<td>Oakland 1st to use Duco spray finish</td>
<td>1st with chrome plating</td>
<td>Cadillac 1st crankcase ventilation</td>
<td>2 millinths</td>
<td>Buick</td>
<td>1st Pontiac</td>
<td>Overhead-valve 6</td>
<td></td>
<td></td>
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<tr>
<td>1925</td>
<td>Thermostatic control for cooling system</td>
<td>Over 2 million</td>
<td>Model T built this year</td>
<td>&quot;The Good Maxwell&quot; born</td>
<td>Chrysler Corp. formed</td>
<td>1st Chrysler high compression engine, 7-bearing crankshaft, oil filter separate</td>
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<tr>
<td>1926</td>
<td>9109 Model T's built Nov. 25, world's record</td>
<td>Over 2 million</td>
<td>Model A born</td>
<td>1st Whippet</td>
<td>Studebaker takes over Pierce-Arrow</td>
<td>Fuel pumps introduced, free wheeling</td>
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<tr>
<td>1927</td>
<td>Safety glass, windshield standard</td>
<td>Ford sells 456,416, passed by Chevrolet</td>
<td>Chrysler buys Dodge</td>
<td>Packard 1st with hypoid gearing, low-priced Ajax</td>
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<tr>
<td>1928</td>
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<tr>
<td>1929</td>
<td>OLDSMOBILE</td>
<td>CADILLAC</td>
<td>BUICK</td>
<td>PONTIAC</td>
<td>CHEVROLET</td>
<td>CORVAIR</td>
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<tr>
<td>1930</td>
<td>FORD</td>
<td>LINCOLN</td>
<td>MERCURY</td>
<td>CONTINENTAL</td>
<td>THUNDERBIRD</td>
<td>EDSEL</td>
<td>FALCON</td>
<td></td>
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<tr>
<td>1931</td>
<td>DODGE</td>
<td>CHRYSLER</td>
<td>PLYMOUTH</td>
<td>DE SOTO</td>
<td>IMPERIAL</td>
<td>VALIANT</td>
<td></td>
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<tr>
<td>1932</td>
<td>PACKARD</td>
<td>NASH</td>
<td>WILLYS</td>
<td>STUDEBAKER</td>
<td>HUDSON</td>
<td>KAISER-FRAZER</td>
<td>RAMBLER</td>
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</tbody>
</table>
1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet
1. Follow instructions on the other side

Back

Inverted Back

1. Follow instructions on the other side
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>1910</td>
<td>1st Indianapolis 500 race</td>
</tr>
<tr>
<td>1911</td>
<td>Cadillac 1st with electric self-starter</td>
</tr>
<tr>
<td>1912</td>
<td>Cadillac</td>
</tr>
<tr>
<td>1913</td>
<td>Cleveland has 1st electric traffic lights</td>
</tr>
<tr>
<td>1914</td>
<td>Selden patent useless, ruled valid but not infringed</td>
</tr>
<tr>
<td>1915</td>
<td>Hand-operated windshield wipers, step lights standard on some cars</td>
</tr>
<tr>
<td>1916</td>
<td>Vacuum-tank fuel feed</td>
</tr>
<tr>
<td>1917</td>
<td>Cord tires</td>
</tr>
<tr>
<td>1918</td>
<td>Battery under hood</td>
</tr>
<tr>
<td>1919</td>
<td>Detroit has 1st three-color traffic lights</td>
</tr>
<tr>
<td>1920</td>
<td>Duesenberg 1st U.S. car with straight eight</td>
</tr>
<tr>
<td>1921</td>
<td>Duesenberg 1st with 4-wheel brakes</td>
</tr>
</tbody>
</table>

**Typical Engine**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1911</td>
<td>Valve-in-head, torque-tube drive</td>
</tr>
<tr>
<td>1912</td>
<td>Durant, Chevrolet founder, GM president</td>
</tr>
<tr>
<td>1913</td>
<td>GM buys Chevrolet</td>
</tr>
<tr>
<td>1914</td>
<td>1st ship across the Atlantic</td>
</tr>
<tr>
<td>1915</td>
<td>Lincoln Motor Co.</td>
</tr>
<tr>
<td>1916</td>
<td>1st moving assembly line</td>
</tr>
<tr>
<td>1917</td>
<td>Titantic sunk, 1517 killed</td>
</tr>
<tr>
<td>1918</td>
<td>Lincoln Motor Co.</td>
</tr>
<tr>
<td>1919</td>
<td>Ford bought from H. Ford Co.</td>
</tr>
<tr>
<td>1920</td>
<td>U.S. enters World War I Armistice</td>
</tr>
<tr>
<td>1921</td>
<td>Maxwell-Chalmers</td>
</tr>
</tbody>
</table>

**Other Events**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1910</td>
<td>U.S. Motor Car Co. fails</td>
</tr>
<tr>
<td>1911</td>
<td>Dodge Brothers Motor Car Co.</td>
</tr>
<tr>
<td>1912</td>
<td>1st Dodge, 1st with all-steel body</td>
</tr>
<tr>
<td>1913</td>
<td>Spiral-bevel rear axle</td>
</tr>
<tr>
<td>1914</td>
<td>Willys-Knight car with sleeve-valve engine</td>
</tr>
<tr>
<td>1915</td>
<td>Packard 1st with twin 6, aluminum pistons</td>
</tr>
<tr>
<td>1916</td>
<td>Nash Motor Co.</td>
</tr>
<tr>
<td>1917</td>
<td>Maxwell 1st with adjustable front seat</td>
</tr>
<tr>
<td>1918</td>
<td>1st Nash with internal hot-spot manifold</td>
</tr>
<tr>
<td>1919</td>
<td>Essex Motors division formed</td>
</tr>
<tr>
<td>1920</td>
<td>1st light Essex 4</td>
</tr>
<tr>
<td>1921</td>
<td>Lafayette Motor Car Co. acquired; Nash rubber-mounted carriage</td>
</tr>
</tbody>
</table>

**Other Information**

- Cadillac 1st with electric self-starter
- Oakland
- Peary
- Titanic sunk, 1517 killed
- Lusitania sunk
- U.S. Motor Car Co. fails
- Dodge Brothers Motor Car Co.
- 1st Dodge, 1st with all-steel body
- Spiral-bevel rear axle
- Willys-Knight car with sleeve-valve engine
- Packard 1st with twin 6, aluminum pistons
- Nash Motor Co.
- Maxwell 1st with adjustable front seat
- 1st Nash with internal hot-spot manifold
- Essex Motors division formed
- 1st light Essex 4
- Lafayette Motor Car Co. acquired; Nash rubber-mounted carriage
- Essex coach 1st low-priced coach
**POPULAR MECHANICS**

THE AMERICAN AUTOMOBILE

A pictorial history of the nation’s surviving automobile manufacturers.

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**HISTORICAL TIMELINE 1893 to 1900**

- **1892** Duryea 1st car built in U.S.A.
- **1895** Selden patent
- **1899** Winton 1st U.S. car sold

**GENERAL MOTORS**

- **1899** Olds Motor Works
- **1899** Detroit Automobile Co.

**FORD**

- **1896** 1st Ford gasoline car
- **1899** Columbus and Electric Vehicle Co.

**CHRYSLER**

- **1898** 1st Columbia

**OTHER MAKES**

- **1899** 1st Packard Motor Car Co.
- **1901** Studebaker electric

**AUTOMOTIVE FAMILY HISTORY**

- **1899-1900** 30,000 die as eruption destroys St. Pierre, Martinique
- **1901** 1st round-world cruise of U.S. fleet

**HISTORICAL EVENTS**

- **1901** Winton 1st car to cross U.S.
- **1902** Ignition locks
- **1903** Curved-dash Olds, 1st U.S. mass-produced car
- **1904** 1st service station in U.S.
- **1905** Peerless patent H-slot gearshift
- **1906** 1st Glidden Tour
- **1907** Front bumpers appear
- **1908** GM buys Olds
- **1909** Cadillac Auto. Co., 1st Cadillac
- **1910** Buick Motor Co., 1st Buick
- **1911** Cadillac Motor Car Co.

**Typical Chassis Of The Decade**

- **1901** Peerless patent H-slot gearshift
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- **1903** Ignition locks
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**Typical Engine**

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<td>Price cuts</td>
<td>Automatic transmissions take over</td>
<td>Small car bid fails</td>
<td>Tubeless tires standard on all cars</td>
<td>V8 era begins</td>
<td>Introduction of tailfins</td>
<td>12-volt batteries</td>
<td>Directional signals</td>
<td>License plate size standardized</td>
<td>Headlight era starts</td>
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- **Automatic headlight dimmer**
- **Wrap-around windshield on 1954 models**
- **3rd place in industry sales**
- **Plastic-body Corvette**
- **Fuel injection offered**
- **Retractable hardtop**
- **Retractable rear window**
- **Two-seat T-Bird reborn as Mark II**
- **Continental now Lincoln series, Mark II dropped**
- **Four-seat T-Bird Edsel introduced, vertical grille**
- **Ford's small car Falcon**
- **Chrysler 300 A**
- **Sputnik I**
- **Front torsion bars throughout corporation**
- **1st Imperial now separate from Chrysler**
- **Bombay light, side windows**
- **Explorer introduced**
- **Valiant introduced**
- **Studebaker-Packard Corp. American Motors Corp. Kaiser-Willys Corp. Sales decline begins**
- **Henry J dropped**
- **Kaiser discontinued**
- **Rambler American**
- **Nash discontinued**
- **Push-button drive and electric doors**
- **Built on shell of Studebaker Packard discontinued**
- **Jeeps discontinued**
- **Willys drops car, makes only Jeeps**
- **Jet dropped**

**Brands:**
- **Oldsmobile**
- **Cadillac**
- **Buick**
- **Pontiac**
- **Chevrolet**
- **Corvair**
- **Ford**
- **Lincoln**
- **Mercury**
- **Continental**
- **Thunderbird**
- **Falcon**
- **Dodge**
- **Chrysler**
- **Plymouth**
- **De Soto**
- **Imperial**
- **Valiant**

**Sponsors:**
- **Studebaker-Packard Corp. American Motors Corp. Willys Motors**
2. Follow instructions on the other side

Back

Inverted Back

1. Follow instructions on the other side
1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet
Proud, that's what the industry is—proud of itself. And with reason. It proved its vitality, its flexibility. It proved that it responds to public demand, after all.

Sure, there was a period of delay, a period which gave critics a chance to shriek. But the delay wasn't due to mental ossification, but to that old mass-production bogeyman, lead time.

All the while the highly articulate critics were tearing around in their chariots screaming about Detroit's failure to act, the industry was acting—at full speed. Never before have three all-new cars, with all-new engines, been brought out with such speed, with such rightness. As one engineer said, "It sang right from the start."

These designs are good. These new cars are good—not perfect yet, but good. Better than they were expected to be. Anybody who has driven them knows this. PM's test report on page 168 also shows it. They make sense and that is what the public said it wanted.

Detroit executives must have had to do considerable lip-biting and fist-clenching to keep from shouting back last year as so many critics, private and governmental, accused them of stupidity, of failure to respond to the public's wishes. But they did hold their tongues and now the new cars speak for them—loudly and clearly. Where are the critics now?

Yet the industry is not real certain how many of you do want the smaller, more economical cars. Things looked clearer in 1958. Then, the party was draggin', sales were laggin', and the switch began—a switch to smaller cars. But then along came 1959 and big cars started to sell again (to be sure, compact cars like Rambler and Studebaker sold even better). Apparently, it really was the recession that had cut sales in 1958 and not the size of the cars. By this time next year, the industry will feel better about its gamble—or worse, depending on your reaction.

Total industry production in 1959 was up about 32 percent over 1958 (see chart on page 158). Some companies have more than doubled production. A few are down, but these are De Soto, the late Edsel and Lincoln, three cars that certainly can't be considered bellwethers.

Biggest news, of course, is the tremendous upsurge at American Motors (even more spectacular was its skyrocketry on the stock exchange). Many 1959 buyers, anxious to show more sense, turned to Rambler.

As a result of its sudden prosperity, American Motors, instead of being a tiny, seen-but-not-heard member of the minority (as it was content to be a few years back) has become an outspoken, bold challenger that now builds more than half as many cars as Chrysler Corporation.

So bold is it that it claims, just as Da Vinci "invented" Mona Lisa, so it "invented" the compact car, preferring to forget that not too long ago all cars were compact (if size is the only criterion).

Actually, the three new compact cars are exciting more for their weight than for their over-all length or wheelbase. The Falcon and Corvair weigh about 2300 pounds (Valiant weighs 2635, much of its extra weight being due to the bigger-than-necessary engine which was not specially designed for a compact car, but for Plymouth).

By comparison, the 1960 Rambler six weighs 2948 pounds. Even the American with only 100-inch wheelbase weighs 2500 pounds. These all-new compacts, despite the AM ads, are not just copies of Ramblers, but are all-new, bold engineering achievements in their own right with modern design to reduce unnecessary bulk.

And the interesting thing is that they are so different from each other that the buyer's choice is wide.

The year 1959 will be remembered (Continued to page 284)
VALIANT

Valiant, Chrysler's compact car, features a six-cylinder engine inclined 30 degrees to the right. Its aluminum intake manifold has six curved tubes that feed directly to each cylinder. An alternator charges while the engine idles. Unit constructed, the car has torsion bars in front, leaf springs at rear and offers a wagon with rear-facing third seat.

LARK

Studebaker's Lark, introducing a convertible and four-door wagon (rear-facing third seat extra), has an improved 90-hp L-head six and a virtually unchanged 180-hp V8. Sporty Hawk retains its styling but drops its six, adds a bigger 210-hp V8.

CORVAIR

Corvair long will be remembered as the most revolutionary car to hit the American automotive scene in three decades. The GM compact entry sports an air-cooled, flat six made mostly of aluminum and mounted in the rear. Unit-built, it has fully independent coil suspension. The floor hump is gone, due to a transaxle combining the transmission, engine and differential. Corvair, now a four-door sedan, plans a two-door coupe in January.
FALCON

Simply styled on the outside, Ford's Falcon is the most luxurious compact inside. Available in two and four-door sedans, Falcon has a unit body and lots of luggage space. There are high coil springs in front. It is powered by an inline six with a short, very rigid, block that results in the industry's shortest stroke.

AMERICAN

After a successful revival—American accounted for 25 percent of AMC's 1959 model run—the small Rambler sticks with a winner but adds a four-door sedan. One of two remaining L-head sixes, American's changes include more glass area, doors that open wider. Power steering, outside tire mount are extra. Other models: two-door sedan, wagon.

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<tr>
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<th>VALIANT* V-100</th>
<th>LARK*</th>
<th>CORVAIR* 500</th>
<th>FALCON* Ford</th>
<th>AMERICAN* Deluxe</th>
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*All specifications for lowest-price 6-cylinder four-door models except as noted.

JANUARY 1960

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CHEVROLET

Joining the swing to economy, Chevrolet has an economy V8 with a low-lift camshaft and is designed to run on regular gas. There’s also an overhead-valve six, plus optional 283 and 348-cubic-inch V8s. Fuel injection, still offered on Corvette, has been dropped by Chevy. Corvette styling is unchanged. There’s easier trunk access on the big Chevrolet, too.

FORD

Ford’s dartlike styling highlights the body-length fender lines and provides a sleek, low appearance. The wraparound windshield is gone, but there’s 17 percent more windshield glass area. Under the new sheet metal, Ford offers four engines, a 223-cubic-inch six and three V8s developing up to 300 horsepower. Loading space in the wagons is a foot longer.

PLYMOUTH

Plymouth has two new engines, one for economy and one for power. The all-new six, tilted 30 degrees to the right, permits a low hoodline, lowers the center of gravity. Then there’s the 330-hp. V8 with ram induction, which provides extra power in the 20-to-60 m.p.h. range. Retaining its fins, Plymouth now is unit built. Options include door locks that lock automatically when the engine is started.
DODGE DART


RAMBLER

All-new, Rambler retains the same styling concept, but now offers rear-facing third-seat wagon. Wagon tailgate is replaced by a side-hinged door. Horsepower on the Rebel V8 is cut to 200, while OHV six stays at 127. Grille, front and rear bumpers are in two sections to reduce repair costs. Unit body. Suspension by coils front and rear.

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<th>CHEVROLET* Biscayne</th>
<th>FORD* Fairlane</th>
<th>PLYMOUTH* Savoy</th>
<th>DART* Seneca</th>
<th>RAMBLER* Super</th>
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*All specifications for lowest-price V8 four-door models, except as noted.

JANUARY 1960  155
PONTIAC

Pontiac offers an improved 389-cubic-inch V8, including an economy version, along with the new Ventura two and four-door hardtops. V8 options range from 215 to 348 hp. Variations in power are due entirely to different carburation and compression. Also optional are aluminum wheels with integral hub and brake drum.

AMBASSADOR

Ambassador, the big Rambler, is nearly two inches lower and shorter. Among its many styling changes is a compound windshield that has 24 percent more glass area. Unit-built, Ambassador is powered by a two-barrel carburetor, 250-hp. V8 engine that runs on regular gas.

DODGE

Completely new, with a unit body, Dodge keeps its same personality, adds emphasis to its fins. There are two Dodge series, Matador and Polara, instead of three. Each has three engine options: A 361-cubic-inch V8; a 383-cubic-inch V8; plus the 383 V8 with ram induction. All have 10.0 to 1 compressions. Chrysler Corporation's torsion bar suspension is up front, leaf springs in back.

POPULAR MECHANICS

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BUICK
In addition to a restyling to give it a heavier look, Buick features a huge extra-quiet muffler placed cross-wise behind the rear axle instead of usual multiple-muffler system. A mirrored instrument panel adjusts to suit each driver. Engines: Economy V8; standard 250-hp. V8; and 401-cubic-inch V8 for Invictas, Electras only.

EDSEL (Deceased)
You'll have trouble finding one, but there are some 1960 Edsels on the road (only 2820 were built). Never before has a car so carefully planned, failed so completely. Most of the planning, however, was by merchandisers who couldn't tell a camshaft from a crankshaft. In three years, 110,749 Edsels were built—the most costly 110,600 cars in history.

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<th>PONTIAC*</th>
<th>AMBASSADOR*</th>
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*Lowest-price V8 four-door models, except as noted.
†Usable luggage space, not total trunk volume.

JANUARY 1960
OLDSMOBILE

Oldsmobile puts its economy engine, the 371-cubic-inch V8, in the 98. This engine operates on regular gas. A 394-cubic-inch V8 is standard on the Super 88 and the 98 series. The tailfins are gone and bodies are one to two inches shorter over-all. Super 88 and 88 series have rear-facing third-seat wagons, the 98 has no wagon.

DESOTO

De Soto hopes for a sales comeback with all-new styling and unit body. Only four-door sedans, two and four-door hardtops are available in Fireflite, Adventurer series. Engines: 361-cubic-inch V8 standard on Fireflite; 383-cubic-inch V8 for Adventurer with ram induction extra.

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<td>2</td>
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<td>382,865</td>
<td>Up 29.1%</td>
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<tr>
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<td>8</td>
<td>DOOR</td>
<td>151,851</td>
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<tr>
<td>9</td>
<td>MERCURY</td>
<td>150,000</td>
<td>Up 12.5%</td>
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<tr>
<td>10</td>
<td>CADILLAC</td>
<td>142,272</td>
<td>Up 16.8%</td>
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<td>STUDEBAKER</td>
<td>131,377</td>
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<td>12</td>
<td>AMERICAN</td>
<td>91,491</td>
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<td>13</td>
<td>THUNDERBIRD</td>
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<tr>
<td>14</td>
<td>CHRYSLER</td>
<td>64,244</td>
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<tr>
<td>15</td>
<td>DE SOTO</td>
<td>45,307</td>
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<tr>
<td>16</td>
<td>EDSEL</td>
<td>44,891</td>
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<tr>
<td>17</td>
<td>LINCOLN</td>
<td>26,906</td>
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<tr>
<td>18</td>
<td>AMBASSADOR</td>
<td>23,769</td>
<td>Up 63.1%</td>
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<tr>
<td>19</td>
<td>IMPERIAL</td>
<td>17,262</td>
<td>Up 7.2%</td>
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</table>

TOTAL FOR INDUSTRY—5,566,527 passenger cars—Up 31.8% from 1958

PERCENTAGE OF INDUSTRY PRODUCTION

Ford Motor Company 30.25% Up 1.50% from 1958
General Motors 48.00% Down 2.34% from 1958
Chrysler Corporation 12.64% Down 3.16% from 1958
Studebaker-Packard 2.26% Up 1.12% from 1958
American Motors 6.72% Up 2.88% from 1958

Chart shows how many 1959 models of each make were produced and how this compares with 1958. Period covered is approximately a year, beginning August 1958.

POPULAR MECHANICS
CHRYSLER

Chrysler's "300"-inspired styling is molded around a unit body, providing more legroom, higher seats. Windsor, Saratoga models are powered by 383-cubic-inch V8, New Yorker by 413-cubic-inch 350-hp. V8. New 300F is due later, will feature four bucket seats.

MERCURY

Conservatively styled, Mercury is stressing soft ride and quietness of operation. Two V8s operate on regular gas (a larger V8 on premium). No four-barrel carburetors are available, all engines having two-barrels for better economy. Montclair and Park Lane models have 430-cubic-inch V8, with 310 horsepower, hydraulic valve lifters.

<table>
<thead>
<tr>
<th></th>
<th>OLDSMOBILE® Dynamic 88</th>
<th>DE SOTO® Fireflite</th>
<th>CHRYSLER® Windsor</th>
<th>MERCURY® Monterey</th>
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<td>34.6</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>rear</td>
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<td>44.1</td>
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<td>Hiproom, front</td>
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<td>65.2</td>
<td>62.4</td>
<td>62.8</td>
</tr>
<tr>
<td></td>
<td>rear</td>
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<tr>
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<td>18.3†</td>
<td>18.3†</td>
<td>18.3†</td>
<td>18.3†</td>
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</table>

†Usable luggage space, not total trunk volume.

*Lowest-price V8 four-door sedans, except as noted.
LINCOLN

Most important change in this year's Lincoln and Lincoln Continental is the switch to leaf springs, replacing coils in the rear. Gone are the trailing arms. Lincoln retains its 430-cubic-inch V8, but has cut horsepower by 35 to 315 and has added a new carburetor. Unit-built, both cars have had grille and rear styling changes. Roof and rear window are new.

IMPERIAL

Restyled, but retaining such characteristics as gunsight taillights, Imperial is powered by a 413-cubic-inch V8 developing 350 horsepower. Unusual features are high-backed driver's seat, electroluminescent non-glare panel lights and elliptical steering wheel. New back window gives LeBaron a town-car look. It is only frame-plus-body car at Chrysler.
**CADILLAC**

Improved Cadillac brakes have finned, extended rear drums that keep brake temperature 30 percent lower under hard usage. Automatic parking brake releases when car is put in gear with engine running. Engines: Two 390-cubic-inch V8s, 325 and 345 hp. Air suspension on Brougham, Biarritz, Seville; optional on others.

**THUNDERBIRD**

Thunderbird, fast becoming the second best-selling Ford Motor Company car, is introducing the first sliding sunroof on an American car as optional equipment. Also new is an automatic top that folds into the trunk of the convertible. T-Bird engines: 300-hp. 352-cubic-inch V8 and 350-hp. 430-cubic-inch V8.

<table>
<thead>
<tr>
<th></th>
<th>LINCOLN*</th>
<th>IMPERIAL*</th>
<th>CADILLAC*</th>
<th>THUNDERBIRD*</th>
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<td></td>
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<tr>
<td>headroom, rear</td>
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<td>33.3</td>
</tr>
<tr>
<td>Legroom, front</td>
<td>44.0</td>
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<td>46.1</td>
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</tr>
<tr>
<td>legroom, rear</td>
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<td>42.9</td>
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<td>59.6</td>
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<td>hiproom, rear</td>
<td>65.2</td>
<td>60.2</td>
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<td>48.7</td>
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<tr>
<td>Knee room, rear</td>
<td>35.7</td>
<td>31.8</td>
<td>31.4</td>
<td>20.4†</td>
</tr>
<tr>
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<td>31.8</td>
<td>16.4†</td>
<td>20.5†</td>
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<td>413</td>
<td>390</td>
<td>352</td>
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<td>31.5</td>
<td>350</td>
<td>325</td>
<td>300</td>
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</table>

*Lowest-price V8 four-door models except Thunderbird.
†Usable luggage space, not total trunk volume.
FOREIGN CARS-1960

IMPORTS HAVE PROSPERED. Will they continue to, now that Detroit offers "compacts?" Nobody can be certain, but it seems unlikely that cars as big as the Corvair, Falcon and Valiant will compete with VW, Renault and Simca. Sensible, quiet and comfortable as they are, the new compacts don't drive the same, don't "feel" the same, as the more nimble, alert, small imports. They are still worlds apart—smaller worlds perhaps, but worlds nonetheless.

Certainly after a spectacularly prosperous 1959, no import plans to surrender sales without a struggle. Dealers are stronger than ever and will fight it out with these newcomers, the American compacts. The outcome, as always, is in your wallets, dear public.

FIAT

Square lines give the Fiat 1200 an elegant look. Luxurious interiors have reclining front-seat backrests and an optional folding rear seat. Suspension: coils up front and leaf springs in the rear. Top speed is 87 m.p.h. Fiat's 18 models range in price from $1098 to $3498.

MERCEDES BENZ

Featuring a wider, lower grille, the Mercedes-Benz 220 has four headlights, fins and more luggage space. Valve-gear and camshaft changes provide 124 hp. Suspension: coils. Other models unchanged.

HILLMAN

One of two small imports offering automatic transmission, Hillman uses a magnetic powder to work the clutch. Styling changes include a wider windshield and rear fins. Unit body has coils in front, rear leaf springs. Horsepower is upped to 57.

*Port-of-entry price at New York City

<table>
<thead>
<tr>
<th></th>
<th>Price*</th>
<th>Engine Type</th>
<th>Displacement</th>
<th>Horsepower</th>
<th>Weight</th>
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<td>MERCEDES 220S</td>
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<td>2940</td>
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<td>HILLMAN Minx</td>
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<td>2172</td>
<td>162.0</td>
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<td>36.0</td>
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</table>
TRIUMPH

Triumph's new Herald Saloon combines style with such features as independent four-wheel suspension, large luggage capacity and greasing only every 12,000 miles. Suspension: coils in front, leaf springs in rear.

ENGLISH FORD

England's Ford Anglia is an exciting styling change with sloping hood and reverse-slit rear window. New engine has large bore, bigger valves and drives through a four-speed transmission. Unit body with front coils, rear leaf springs.

METROPOLITAN

Although styling is unchanged, Metropolitan now has outside trunk access and side window vents. Continued are the same Austin A-55 engine and the unit body. Front suspension uses coils and the rear has leaf springs.

LANCIA

Powerful, luxurious and expensive, the Lancia Flaminia coupe seats four to five persons. With a top speed of 105 m.p.h., it is the only make powered by a V6. Suspension: coils in front, leaf springs in the rear.

*Port-of-entry price at New York City

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Engine Type</th>
<th>Displacement</th>
<th>Horsepower</th>
<th>Weight</th>
<th>Overall Length</th>
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</tbody>
</table>

JANUARY 1960 163
VOLKSWAGEN

Soundproofing and engine refinements make the 1960 Volkswagen the quietest ever. While styling is the same, additions include a front sway bar, horn ring, recessed steering post and push-button door handles. Suspension is fully independent by torsion bars.

DAF

Only small economy car to offer an automatic transmission as standard equipment is the Dutch Daf. Daf has no clutch pedal. It's belt-driven. Never needs greasing either. Suspension: coils in front, leaf springs in rear.

SAAB

Hoping to expand its U.S. market, Swedish Saab will offer a two-door station wagon this spring. Major sedan change is that the door is no longer hinged at rear. Saab keeps its front-wheel drive, coil suspension, unit body.

ALFA ROMEO

Alfa Romeo, in its 2000 line, offers luxury and comfort (at a price) plus a small engine with lots of power. A 118.5-cubic-inch engine develops 120 horsepower and 105 m.p.h. speeds. Suspension is with coil springs.

<table>
<thead>
<tr>
<th>Price</th>
<th>Engine Type</th>
<th>Displacement</th>
<th>Horsepower</th>
<th>Weight</th>
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<th>Overall Width</th>
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<td>$3028</td>
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*Port-of-entry price at New York City  †Figures for sedan, not wagon shown here

POPULAR MECHANICS
VAUXHALL

Vauxhall wagon increases loading ease with a counterbalanced tail door and spare tire flush against the right side. Grille and side panels are new while the inline-four engine is unchanged. Suspension: front coils; rear leaf. Unit body.

NSU PRINZ

Sporting minor styling and engineering changes are the NSU Prinz sedan and coupe. Sedan (photo) has reclining front seats. Able to seat four in a real pinch, coupe has a top speed of 85 m.p.h. Both use coils and have unit bodies.

BORGWARD

Only prototypes of the new Borgward (photo) have been built, but this latest entry shows the American influence. Luxurious and big, it has a six-cylinder engine. The four-cylinder Isabella is unchanged. Both use coil suspension.

GOGGOMOBIL

Goggomobil’s new Isar series comes with a four-seat two-door sedan and two-door wagon. Spare tire rests under the hood atop air-cooled engine and there are extra-big brakes. Front suspension: coils; rear, leaf springs.

*Port-of-entry price at New York City  †Data for Isabella, not model shown here

<table>
<thead>
<tr>
<th></th>
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JANUARY 1960
**LLOYD**

Slated to compete against VW, the flat-four German Lloyd Arabella has ample interior, trunk room, clean styling. There's a wrap-around rear window, optional sunroof. Suspension: fully independent by coils. Other Lloyds are unchanged.

**SIMCA**

Cheaper version of the Simca Elysee is this new Etoile, five-passenger sedan. Heater, automatic choke standard. Three new Simca models are on sale in U.S. Other models virtually unchanged. Coils in front; leaf springs, rear.

**ROLLS-ROYCE**

Rolls-Royce offers its first V8, and it's aluminum, no heavier than the old six. Hydraulic tappets help make engine very quiet. Silver Cloud styling is unchanged. New limousine model is Phantom V. Coils in front; leaf springs, rear.

**RENAULT**

Renault promises greater riding comfort with auxiliary springs in addition to its fully independent coils. Also new are stops to hold doors open. Styling changes are minor. Caravelle, 4CV round out the line.

---

<table>
<thead>
<tr>
<th></th>
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<th>Engine Type</th>
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*Port-of-entry price at New York City*
AUTO UNION

Auto Union 1000 models are unchanged except for a wrap-around windshield on all but four-door saloons and wagons. New is the tiny Junior, two-door with 34 hp, a lively car. It has torsion bars; 1000, leaf springs.

BMW 700

BMW's newest entry into the small car field is the 700 with a two-door coupe and sedan. Unit body makes the car real solid and rear engine powers it to speeds of 75 m.p.h. Luggage space, spare are up front. Suspension is by coils.

JAGUAR

In the new 3.8, Jaguar has a compact luxury car for the American market. The five-passenger sports sedan features four-wheel disk brakes, power steering and automatic transmission. Other Jaguars are unchanged.

CITROEN

Continuing its advanced engineering which includes a central hydraulic system, Citroen is unchanged. So is the 2CV. But British Citroen plants are building plastic-body 2CV's, portending future changes.

*Port-of-entry price at New York City
†Data for sedan, not wagon shown here

<table>
<thead>
<tr>
<th>Make</th>
<th>Price</th>
<th>Engine Type</th>
<th>Displacement</th>
<th>Horsepower</th>
<th>Weight</th>
<th>Overall Length</th>
<th>Overall Width</th>
<th>Turn Circle</th>
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<tbody>
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<td>Inline 3, two-cycle, front-drive</td>
<td>36.8</td>
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<td>Flat 2, OHV, air-cooled, rear</td>
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<td>139.4</td>
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<td>JAGUAR 3.8</td>
<td>$4740</td>
<td>Inline 6, front, twin overhead cam</td>
<td>230.6</td>
<td>220</td>
<td>2136</td>
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<td>2475</td>
<td>189.0</td>
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How Good Are the

**ECONOMY**

<table>
<thead>
<tr>
<th></th>
<th>CITY</th>
<th>ACCELERATION</th>
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<tbody>
<tr>
<td></td>
<td>20.1</td>
<td>0 to 30</td>
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<tr>
<td></td>
<td>miles per gallon</td>
<td>5.0 seconds</td>
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<tr>
<td>COUNTRY</td>
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</tr>
<tr>
<td></td>
<td>miles per gallon</td>
<td>16.5 seconds</td>
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<td></td>
<td></td>
<td>40 to 60</td>
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<tr>
<td></td>
<td></td>
<td>9.3 seconds</td>
</tr>
</tbody>
</table>

City test was 50 miles at average of 18 m.p.h., never over 30 m.p.h. Corvair did best on this.

All three cars had handshift transmissions. Times are the average of 8 runs, 4 each way.

<table>
<thead>
<tr>
<th></th>
<th>CITY</th>
<th>ACCELERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19.7</td>
<td>0 to 30</td>
</tr>
<tr>
<td></td>
<td>miles per gallon</td>
<td>5.9 seconds</td>
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<tr>
<td>COUNTRY</td>
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<td></td>
<td>miles per gallon</td>
<td>21.1 seconds</td>
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<td>40 to 60</td>
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<tr>
<td></td>
<td></td>
<td>14.5 seconds</td>
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</table>

Country test was 50 miles on rural roads at speeds from 40 to 70. Falcon did best on this.

Falcon's 3.10-to-1 rear axle (the others have 3.55 axles) makes it slowest by a wide margin.

<table>
<thead>
<tr>
<th></th>
<th>CITY</th>
<th>ACCELERATION</th>
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<tbody>
<tr>
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<tr>
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<td>miles per gallon</td>
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<td>COUNTRY</td>
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<td>miles per gallon</td>
<td>14.5 seconds</td>
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<td></td>
<td>40 to 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.0 seconds</td>
</tr>
</tbody>
</table>

Valiant's extra weight, bigger engine give it about 9 percent less economy than other two.

Valiant is best here, but Corvair comes close. Both show up well in 40-to-60 passing range.

POPULAR MECHANICS
COMPACT Cars?

BOULEVARD
Excellent. Engine noisy at high speed.
ROUGH ROADS
Excellent. Quiet, no harshness or wheel fight.
SEATING
Very low. Good back support. No center hump, front or rear.

FRONT
Low roof, low seat mean you must get down to enter, climb up to leave.
REAR
Somewhat easier, although you still have to climb out.
DOOR OPENING
Inside handles tiny. Rear doors hard to close from inside.

Seats may be too low for some. Car has safe, secure feeling on corners, over rough roads.

Vertical stick is exactly as long as floor-to-door-header distance on Corvair—38.5 inches.

BOULEVARD
Excellent. Engine extremely quiet.
ROUGH ROADS
Poor. Considerable harshness and wheel fight. Noisy.
SEATING
Excellent height. Good support. Rear seat center bottoms on tunnel easily.

FALCON
Silky as a royal coach on smooth roads, on a rough stretch it turns into a bumpy pumpkin.

Same stick in Falcon door opening shows there is about two inches more clearance, arrow.

BOULEVARD
Excellent. Engine fairly quiet.
ROUGH ROADS
Excellent. Quiet, tight, no harshness. Some wheel fight.
SEATING
Excellent height. Front seat tilts back too much. Good padding atop hump.

FRONT
High roof, high seat make getting in and out easy.
REAR
No four-door sedan was available at time of test.
DOOR OPENING
Large, easy-to-use inside handles. Outside good. No rear doors tested.

Easily best over-all ride of three, although rear end tends to break loose on chuckholes.

Again the same stick, this time on Valiant, and there's even more open space, arrow.

JANUARY 1960
TRUNK SPACE

Grocery bags stand upright in Corvair's front trunk, but for long trips luggage space is small, irregular.

Wagon is 18.5 feet behind rear bumper, clearly visible to Corvair driver as he backs up. Huge rear window gives wider view than camera can cover. Front visibility is excellent. Wipers leave no unclear center in windshield.

FALCON

Groceries must be laid flat in Falcon's trunk, but it has lots of room for long trips, even enough for golf clubs.

Car and wagon in same places. Falcon driver easily sees wagon as he backs up. Window is more vertical, shows more distance, less width than Corvair's. Front visibility is excellent. No unwiped center in windshield there either.

VALIANT

Groceries won't stand up in Valiant, but spare tire under floor makes trunk biggest, most usable of three.

Car and wagon same, but Valiant driver can just see the top of wagon. Backing up could be nerve-wracking in a child-infested suburban driveway. Front visibility is excellent except wipers do leave center area untouched.

SUMMARY

Which is best? That's for you to decide. Each of us has his own favorite features. Some want a nimble car, others a heavy car. Some want luggage room, others just an around-town car. Some want economy, others want performance too.

One thing is certain: Drive each of these cars before making up your mind. And don't forget those other two cars in this category: Rambler and Lark, both good automobiles.

Here's a quick summary:

CORVAIR

Spirited, that's the Corvair. It has a lot of joy built into it. Air-cooled, rear engined, it should require little attention, summer or winter. Traction is excellent on snow or ice.

Surprising performer for 80 horsepower, being just behind the 101-horsepower Valiant. Economy is good although its gas heater will reduce that somewhat in cold weather.

Of the three cars, this is certainly the most fun, but you can't drive it with the trunk so full that the lid won't close.

POPULAR MECHANICS
**HANDLING**

With lightest front end, Corvair is easiest to park. Nimblest in traffic, most fun around corners. Shifting is smooth, but long reach to 2nd. Holds the road well, no wandering.

**CORVAIR**

Low, no-grille Corvair easy to wash. New scissors jack simplifies tire changing. Dimmer switch too high. No rear ashtray. Dash has only speedo, gas gauge.

**FALCON**

Big steering wheel, slow ratio make Falcon easy to park, but eliminate nimble, sporty feeling. Gearshift on steering post is stiff, clumsy. Front end gets light at high speeds.


**VALIANT**

Heavy engine, fast ratio make parking the Valiant hard work. Power steering desirable. Gearshift a delight, best ever built in the U.S.A. Not nimble, but best over-the-road car.

Valiant's bulges hard to wash. Park brake takes strong leg. Vertical scales on dash hard to glance-read. Speedo not easily read at night. Wipers noisy.

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**FALCON**

Sensible, easy to get in and out of, high seated, good visibility. Suspension is great on minor irregularities, but leaves much to be desired on chuckholes and washboard.

Best long-trip economy, but its 3.10 rear axle penalizes it in city as more downshifts are required. There is a 3.56-axle option that would give better performance, but somewhat less economy.

Except for stiff shift, this is best around-town "hacking" car. Docile, tame and gentle.

**VALIANT**

Solid and substantial, with good seat heights, lots of luggage space and surprising quietness and comfort. Best ride over-all.

There's none of the small-car feel that many want and many more don't. It has a lot of power, plenty of speed and gives a secure feeling.

It has more style, with its lunging nose, semi-fast back and fake spare-tire cover.

Of the three, this is the most sturdy, most versatile, all-purpose car.

**JANUARY 1990**

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Those New

By Roger Huntington

YOU'VE BEEN able to buy domestic compact cars for a long time. Even before today's Ramblers and Larks, there were the Willys Aero, the Hudson Jet, the Henry J.

All these cars had one thing in common: They all used long-stroke high-friction engines that were originally designed about 20 years ago and not specifically designed for lightweight economy cars.

Thus the three new compact-car engines are the first truly modern engines tailored to fit the new concept in American autos. There are no excuses for compromise now. That's why it's so interesting to see such a wide variety among the three engines—from an air-cooled pancake to a tilted inline six. Twenty years of engineering apparently haven't brought agreement on even the most elementary principles.

From the very beginning, GM used an entirely different design and merchandising philosophy from Ford and Chrysler in the compact-car field.

The two smaller companies felt a scaled-down version of a conventional Detroit sedan would fill the bill. But GM figured it would take something different, something new, to sell in this market. And, it figured, that the type of buyer most interested in this car would be the kind to appreciate advanced engineering features.

The answer was an air-cooled, rear-engine car with four-wheel independent suspension.

The rear-engine layout required cylinders opposed in pancake fashion to keep down over-all length. And it had to be made with lots of aluminum to prevent excessive rear-end weight.

In the case of the Valiant, the Chrysler people planned to use this basic engine in a wide variety of car sizes and styles and in a wide range of bore and stroke sizes. (Actually, this engine had been in the works before the Valiant program was started—it was the engine destined to replace the flathead Plymouth six.) It was logical to tilt the whole thing 30 degrees to one side to reduce over-all height and allow lower hood lines, especially with the long-stroke versions. By tilting, it was also possible to move the water pump to the side which also cut over-all length. The fact that the tilt left room on one side for an advanced free-flow manifold design was a bonus feature.

Otherwise the Falcon and Valiant en-
Compact-Car Engines

Engines are quite conventional inline sixes with rocker-operated inline overhead valves in wedge-shaped combustion chambers, four-main-bearing crankshafts, over-square stroke-bore ratio and single-throat carburetors.

Ford, through advanced foundry techniques, was able to hold the weight of the cast-iron Falcon engine to 345 pounds, only 35 pounds more than the aluminum Corvair engine.

Also of interest is the fact that the Corvair crankshaft gets by without any counterweights. With adjacent throws in each of three pairs spaced 180 degrees apart, one throw balances centrifugal forces on its mate. Without weights, the whole crank weighs only 25 pounds. And as long as we have to buy steel by the pound, every little bit saved helps.

As for fuel economy, Ford and Chrysler had little trouble designing miserliness into the engines. They were working with tried-and-true features that they knew so well. Chevrolet, on the other hand, was breaking new ground with its flat six. And it had a real rough time getting MPG.

For one thing, the cylinders on an air-cooled engine run hotter than on a water-cooled job, so you can’t use as much compression with regular gas. Corvair has only an 8.0 to 1 compression ratio, compared with 8.7 on the Falcon, 8.5 on the Valiant. This means a little less energy bled out of each drop of gas. Then, too, Corvair had to use a separate carburetor for each bank of cylinders because of the long distance between ports. This caused additional problems. The uneven suction impulses with three cylinders on each manifold caused lopsided mixture distribution between cylinders and the very low air flow through each carb made low-speed flexibility a problem.

Corvair’s final solution was a masterpiece. Special carburetors were used with weird spoked nozzles that cause turbulence in the air flow and meter fuel smoothly at very low speeds. These carbs were offset toward one end of the manifolds. The offset prevented the flooding of the center cylinder (which occurred when they were located centrally). For some reason that Chevy engineers don’t yet understand the far cylinder is not starved.

Then there is no exhaust heat on the Corvair intake manifolds. These are cast integral with the aluminum heads and sections are made very thick. The manifolds thus pick up heat from the cylinders and

January 1960
store it, giving an even warmth to help vaporize the liquid gasoline without the usual hot spot that robs power. Finally, a single automatic choke valve is located in the air-filter inlet, serving both carburetors, preventing the rough running you'd get if one choke shut off before the other.

Result of all this: The dual carburetors on the Corvair can be leaned down to give as good mileage as the Falcon and Valiant and still allow the pancake engine to run dead smooth. This was quite an engineering accomplishment, believe me.

On paper and in fact, the Valiant is the hottest engine of the bunch. It has about 30 more cubic inches and fair-size ports and valves. Its horsepower output is greater.

Contributing to its surprising power is the free-flow intake manifold. Instead of the usual “log” type manifold common to inline sixes, we have six separate pipes sweeping from a central carburetor chamber to six separate intake ports in the head. There are no sharp corners.

This not only reduces breathing restrictions, but fuel-air mixture distribution among cylinders is better than with a simple log manifold.

Add to this the open combustion chamber, where the walls are not squeezed in around the valves to give a flat quench area over the piston and you can see the reason why the Valiant has excellent breathing. Evidence of this is the very flat peak at the top of the horsepower curve between 4000 and 5000 revolutions per minute.

Whether the market will demand that these engines be boosted substantially in performance is still uncertain. If it does, the potential is apparently there.

All the camshafts are very “cool” now and could be readily hopped up. Corvair already has a hot-cam option. Rumors are that the option includes solid lifters and that it will put out over 90 horsepower at 6000.

We understand that the Falcon engine has been wound up to 5600 revolutions per minute in second gear by Ford engineers without any protest from the valve gear.

Valves and ports could be enlarged, compression ratios raised for premium gas, bores and strokes increased.

But engineers worry about other things than performance and economy. There is durability, too. These new engines have achieved some great advances here.

The Falcon engine is the smoothest, quietest power plant ever put out by Ford engineers. They found that the long studs usually used to hold the rocker cover on top literally made a sounding board out of the stamped cover. It broadcast engine vibrations like a loudspeaker. Engine noise

(Continued to page 288)
GAUGES ARE NOT JUST ORNAMENTS

By Dale Kelly

WHAT'S THE most useful gauge on the dash? Probably the speedometer. From it, you learn how well your engine is performing, how legal is your speed. From the related odometer, you compute miles per gallon, tire and brake-lining life.

Yet do you know how accurate your speedometer is? Or your odometer? Generally, they are somewhat "rigged" to exaggerate speed and distance so you are favorably impressed with performance and economy. It is simple to calibrate the instruments.

To check out your speedometer, drive your car at a constant speed (being careful to keep it constant) for a measured mile, available on any toll road,* clocking the number of seconds it takes. Compute the true speed by dividing the number of seconds into 3600. The table below saves you the trouble for three speeds. It's wise to check your speedometer at the various speeds posted as limits—speeds like 30, 50, 70. If you know how accurate your gauge is, you'll be less likely to run afoul of the radar cops.

To calibrate the odometer, slow down at the first milepost and record the odometer reading exactly to the tenth. Then drive 50 miles or so and compare your odometer mileage with the true mileage. Divide the indicated distance by the actual distance, point off two decimal places and you'll get the number of miles indicated per 100 true miles.

*If you don't have access to a measured mile turn to page 280 for an explanation of how to lay out one.

SPEED-TIME TABLE FOR MEASURED MILE

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<tr>
<th>SPEEDOMETER MILEAGE</th>
<th>30 MPH</th>
<th>50 MPH</th>
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<tbody>
<tr>
<td>TIME (SECONDS)</td>
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<td>118</td>
<td>120</td>
</tr>
<tr>
<td>TRUE SPEED (MPH)</td>
<td>31.9</td>
<td>29.5</td>
<td>28.0</td>
</tr>
</tbody>
</table>

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AMMETER

The ammeter shows if your battery is being charged or discharged and how rapidly. Charging action of the generator moves the pointer toward "C" (charge); battery discharge by use of lights or radio moves the pointer toward "D" (discharge). When the generator is charging at the same time current is being drawn by lights and ignition, the ammeter shows the net charge or the difference between what's going in and what's coming out of the battery.

With the engine running faster than idle, the ammeter normally shows a charge. With the engine stopped and current being used, the ammeter should show a discharge. With the engine stopped and everything off, the reading should be zero.

If, under this condition, the ammeter shows a slight discharge the stoplight switch may be stuck. If it reads charge, it is defective or incorrectly connected. After installing a new battery you check for proper polarity by turning on the lights. If the battery is hooked up backwards, the ammeter will read charge, not discharge.

A violent deflection to extreme discharge usually indicates a short circuit. If this can't be cleared at once, remove one battery cable to avoid wiring damage. An abnormally high reading on the charge side could mean that the regulator is not working. In this case, you can use the car without risk of burning out the generator by temporarily disconnecting the wire that runs between the "F" (field) terminals of the generator and the regulator.

Each time the engine is started, the generator charges at a high rate for as long as is necessary to replace the energy used during cranking.

Rate of charge or discharge (the actual number of amperes) is worth knowing because with it you can figure how long it will take to charge or discharge the battery fully. Suppose, for example, that you want to leave the headlights burning on a parked car. If the lights show a 10-ampere discharge on the ammeter and you have a nearly new 60-ampere-hour battery, it should carry the load for six hours. Unfortunately most ammeters have no numerals.

OIL PRESSURE GAUGE

The oil pressure gauge measures the pressure at which oil is being delivered to the engine. It cannot tell you how much oil is flowing, because it is connected to the dead end of a branch line from the pump.

As long as the oil level in the crankcase is high enough to reach the oil-pump intake, the gauge will show the proper pressure. Any change in the amount of oil above the level of the intake will not affect the reading. When the oil drops below this level, the gauge will register zero pressure.

If you think you are running low on oil, but the gauge pointer is steady at its usual reading, the oil level is not yet too low. However, you may not have enough oil to last another five miles, so keep your eye on the needle. As soon as it wavers, you know you should add oil at once.

A gradual decrease in oil pressure as a car ages is usually an indication of bearing wear. Proper repairs should restore the pressure substantially to the reading obtained when the car was new. Unless the engine is badly worn, an appreciable decrease in pressure as the engine warms up indicates that the oil is losing viscosity (becoming thin or light) and you can use the gauge to compare one brand of oil with another in this respect.

WHAT ABOUT WARNING LIGHTS?

Warning lights are used instead of ammeters and oil pressure gauges on many cars. These do not provide the same data.

An oil pressure light that goes on when pressure drops below 8 pounds can't distinguish between 9 pounds and 40 pounds. Yet the difference can be very important.

A generator warning light does not warn when the charging is too low or too high, only when the generator is not charging at all. You may be taking more electricity from the battery than the generator is putting back in, but the light won't tell you this and eventually you'll end up with a dead battery. Nor will the light warn of a discharge when there should be none as, for example, when the headlights are left on.

Unless you remember to check the lights after turning on the ignition and before starting the engine, the bulbs may be burned out just when you need them.
TEMPERATURE GAUGE

Engine temperature indicators show the water temperature in the cooling system. Most carry only relative markings such as “cold,” “hot.” A scale with numerals to indicate degrees is, of course, best.

Cooling water normally runs at the temperature at which the thermostat opens. It may, however, exceed this temperature in very hot weather, particularly if the engine is working hard or the cooling system is clogged with rust or dirt. It may not reach this temperature in very cold weather, particularly if speed and engine load are low as in traffic.

The graph at left shows a cold engine wears out faster than a warm one. Life of cylinder walls is cut in half if the cooling system temperature is reduced from 160 to 110 degrees and is again cut in half if it drops to 100 degrees. Overheating, of course, can do great damage in a short time.

Higher temperatures than normal are usually due to one or more of the following: Insufficient water, slipping fan belt, obstructed air flow through radiator, obstructed water flow through radiator or engine, or failure of thermostat to open. Abnormally low temperature is usually due to failure of thermostat to close.

PERFORMANCE METER

There are two types of performance meter, quite different in appearance but working the same. One is essentially a case enclosing a pendulum, free to swing forward and backward in response to car motion and to move a pointer over a scale. One commercial type is shown at left.

The other has a steel ball or a liquid in a transparent tube. This type can rather easily be homemade, see drawing at left.

Installation involves nothing more than attaching the meter to any stationary object in the car and leveling it so that the liquid column or pointer rests at zero when the car is stopped on a level surface. No other connections need be made.

If the car is driven at a constant speed on a level road, the meter will read zero, indicating that rear-wheel horsepower is neither more nor less than the amount needed to overcome wind resistance, tire resistance, braking friction, etc. If the throttle is suddenly opened wide, the pendulum or liquid will swing to the rear at an angle proportional to the acceleration. This, in turn, is proportional to the amount by which the full-throttle horsepower exceeds that needed for constant speed.

(Continued to page 292)
### How Do They Measure Up?

#### Headroom (A)

<table>
<thead>
<tr>
<th>Front</th>
<th>Rear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chevrolet</td>
<td>Studebaker Lark</td>
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<tr>
<td>Studebaker Lark</td>
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<tr>
<td>Studebaker Hawk</td>
<td></td>
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<tr>
<td>American Rambler</td>
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<tr>
<td>Ambassador</td>
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<tr>
<td>Lincoln</td>
<td></td>
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<tr>
<td>Plymouth</td>
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<tr>
<td>Pontiac Cat. Str. Chf.</td>
<td></td>
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<tr>
<td>Buick Electric</td>
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</tr>
<tr>
<td>Oldsmobile 88, Sup. 88</td>
<td></td>
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<tr>
<td>Oldsmobile 88</td>
<td></td>
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<tr>
<td>Imperial</td>
<td></td>
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<tr>
<td>Thunderbird</td>
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<tr>
<td>Buick Electra</td>
<td></td>
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<tr>
<td>Oldsmobile 98</td>
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<tr>
<td>Oldsmobile Super 88</td>
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<tr>
<td>Falcon</td>
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<tr>
<td>Mercury Park Lane</td>
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<tr>
<td>Pontiac Vent., Bonn</td>
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<tr>
<td>Cadillac 62</td>
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*All specs except Thunderbird for 4-door models.*

#### Legroom (B)

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<tr>
<td>Buick LeSabre</td>
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#### Seat Height (C)

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#### Hiproom (D)

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#### Rear KneeRoom (E)

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#### Trunk Volume (Cubic Feet)

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*Useful luggage space is not available.*
AUTOMOBILES speak a universal language. Men everywhere crowd around a shiny new car, sharing its excitement. Ideologies vanish, language barriers evaporate before this common denominator, the automobile.

It is man's greatest servant, yet his fondest dream. It's practical, yet it's visionary. It's down-to-earth, yet it's pie-in-the-sky.

That's why men pilgrimage to auto shows all over the world. Biggest and most spectacular is held in Frankfort, Germany, every other year. Here is the story of that show.

Unveiled at Frankfort was the bigger, fancier Borgward six.
American cars were there, but only 1959 models. The 1960s were first shown at the Paris show a week later. Here, at the GM stand, a Pontiac attracts the attention of Europeans who still marvel at the tremendous bulk of the American automobile.

There are a million square feet of displays, of which a fourth is out of doors like this display of trucks. The outdoor exhibits add a "state fair" atmosphere as the customers stroll among them.

Cutaways of bodies and engines fascinate all, but especially the European who seems more interested in the mechanism of the car than in its appearance.

Surprise hit of the show was the BMW 700 two-door sedan that, the company hopes, will snare sales from Volkswagen. It has a modern flat roof, lots of glass. Its two-cylinder air-cooled engine is rear-mounted, of course.
You can take a 10-minute-long free ride in any car. You pick up a ticket at the car's exhibit area and present it at the demonstrator-car park where there are 242 brand-new cars of all makes, each with a chauffeur just for this purpose. Many who don't want to ride, stand around to watch the new cars in action.

Camping trailers are also on exhibit. There were 60 of them at the show. Sizes range from this big one down to lightweights for cars like VW. The German couple, like fairgoers everywhere, enjoy a chocolate-coated ice-cream bar (more ice than cream, however).

World's largest truck, the French Berliet 700, was shown in one of the several truck buildings. Altogether, there are 23 separate halls of exhibits. The 10-day show (it is not open nights) had 900,000 paid attendance with 144,000 of them on a single day.
Some companies take over an entire building and remodel it. One of these is the Mercedes-Benz hall, always a beautiful display. These are real cars, not models, on that platform.

Spare parts and accessories are displayed by 551 companies. This is a typical brightwork exhibit. Altogether, there are 726 companies from 13 nations in the show, with 42 makes of cars from outside Germany being exhibited.

Volkswagen, Germany's top producer, built a realistic copy of a freighter at one end of its exhibit hall to represent its worldwide export business. These are full-size cars, lined up and tied down as in actual shipment.
In 1930, this $440 Deluxe Phaeton made you the biggest sport in town

"Not Since the Model A . . ."

It's an exciting year for the auto industry. Not since the Model A Ford has there been so much speculation, so much excitement. This is due, of course, to the new small cars—the Corvair, the Falcon and the Valiant. Just as exciting, just as eagerly awaited, back in December 1927, was the Model A. Imagine! It really did have a gearshift lever! No more tiptoeing among the three pedals.

For PM readers too young to have known the Model A and for older readers who enjoy a backward glance, here is the car that made hearts flutter back in the late Twenties.

Engine, left, and chassis, right, were simple, but the "A" was as flashy as a racer.

Photos courtesy owner, Edward Hickman

JANUARY 1960
PERIODIC engine tune-up and general inspection and adjustment of the fuel and electrical-system components are the best possible insurance against hard winter starting when the thermometer dives to zero and below. A car that started easily during warm summer and cool fall months may balk the first really cold morning when congealed lubricants, cold gasoline and contracted metal parts gang up to make starting tough. At this time, trouble-shooting knowledge is handy.

If the engine turns over but will not start, most likely the fuel system is at fault. Fig. 8 shows the main components. First check the automatic choke. Remove the cover from the mechanism, Fig. 1, and check for binding in the spring, shaft and other sensitive parts. If this is not the cause of the trouble, have someone press the accelerator down and feel the choke valve with your finger, Fig. 2 and upper arrow of Fig. 3. It should move under light pressure. A bit of gasoline will loosen a frozen or stuck choke valve.

With the choke set correctly, the engine may run a few seconds and die. In this case the gas in the carburetor float bowl, lower arrow Fig. 3, is used up. This indicates a freeze-up in the fuel line or in the filter bottle, Fig. 4. Freezing usually occurs in the lowest parts of the line, near the tank or the pump. Accessible lines may be thawed out by wrapping them in cloth and pouring hot water over them. It is a good idea to drain the tank and
then use an additive in the fuel. Also keep an eye on the starting motor. Water and mud may freeze at the point circled in Fig. 11 and make the starter inoperative.

The electrical system can cause hard starting too. An electric clock, incorrectly adjusted generator regulator and heavy use of lights and horn, Fig. 7, in winter traffic all tend to put a greater strain on the battery. When you consider that a fully charged battery is only 65 percent efficient at 32 deg. F., and only 40 percent efficient at zero, it is evident that a battery must be kept in top condition if it is to handle the load on a cold winter morning. Take a look at Fig. 12 and note...
the comparative current draw. Be sure that the generator and its regulator are working at maximum efficiency.

No doubt you are familiar with the practice of using a booster battery to get a car started. The most common procedure is to wire the two batteries in parallel. However, if you are really in a jam because both batteries are low, and they have the same voltage rating, try wiring them in series. To do this, connect the negative post of the booster battery to the positive post of the car battery, and the booster’s positive post to the car’s starting motor, as indicated in Fig. 12. This doubles the voltage so be sure to turn off all unnecessary switches to avoid damaging your instruments. Do not operate the starting motor and ignition switch for more than a few seconds at a time with this hookup. Also, when adding water to your battery, Fig. 6, be sure to run the car a while to mix the water with the electrolyte, or it may freeze and crack the battery casing.

If the fuel system and the battery are in good order and problems persist, the ignition system is next in line for a check. Fig. 5 shows how a mechanic locates trouble in faulty ignition parts with an oscilloscope by noting the response of the instrument to the various components. You, of course, do not have this instrument, but you can look for the obvious signs of trouble in the same parts—the coil, distributor, points and condenser. Burned-away high tension distributor-cap sockets, Fig. 9, will keep your car from starting on a wet, snowy morning. Worn or poorly aligned points are a detriment in any weather but more so in winter. Good contact of the points is impossible if they are worn or pitted or misaligned as in Fig. 10. Timing should be checked against a drop in temperature and perhaps retarded a bit to ease cold starting. Accurate timing is best achieved with the use of a stroboscope as in Fig. 13.

Intermittent short circuits can cause trouble by slowly running down the battery. Or there may be a slow leak that will not show up on the ammeter even when the motor is shut off. Finding this type of short is a job for a mechanic with the necessary instruments.

At the end a trip back home, get into the habit of speeding up the motor before turning it off. Then, as the engine slows to a stop, pump the accelerator a few times. This will provide the engine with a charge of fuel ready to be fired as soon as the engine turns over. Starting an engine should be followed by at least a half-hour’s driving to help replace the energy used by the battery while cranking the engine.

POPULAR MECHANICS
Core of Tire Valve
Removed With Cotter Pin

In an emergency, you might try using a cotter pin to remove the core of a tire valve. Cut the jaws of the cotter pin to equal length with a pair of cutter pliers, and spread them just enough to fit snugly over the core. You may find it necessary to file the ends of the pin square. A slight twist should be enough to remove the core. If necessary, a pair of pliers can be used to turn the pin in the case of an unusually tight core.

Daniel Bousha, Jackson, Mich.

Extended Fuse Circuit
Helps Trace Short Circuits

An intermittent short that drains the battery can be traced with this simple tester. Extend the regular fuse from your car with a pair of leads connected to the fuse lugs. Mount the fuse in a cigar box with a pilot light and a toggle switch as illustrated. With the circuit of the car in use, the light will come on when the fuse blows and the switch is in the closed position. When the circuit is not in use, and the switch is open, it will light, being in series with a load across the fuse terminal lugs.

Information on Car Engine
Kept on Feeler Gauge

Important information on your car engine, such as spark-plug gap, ignition-point setting, firing order of the plugs, and valve clearance will always be at hand for instant reference if kept on the handle of the feeler gauge. Type or write the information on a paper label and glue it to the gauge, or use a piece of white tape. To protect the lettering, cover the label with cellulose tape.

Richard Hanscom, Elmhurst, Ill.

Small Drain Hole
Prolongs Muffler Life

Your muffler’s greatest enemy is the condensation which collects in it after the car is left parked and the muffler is allowed to cool. The condensation is apt to be greatest in winter, especially after frequent short runs. The life of a new muffler can be prolonged, however, if you drill a small hole in the lowest portion in order to allow the condensation to drain out. Contrary to what many believe, this will not materially affect the safety qualities of the muffler.
Trouble Shooting
THE TOUGH ONES

By Ben L. Davis

TUNING AN AUTO ENGINE is not just a matter of hooking up the cables from a "magic box" and reading a few dials, especially when a job is encountered that seems to defy all attempts at setting it right. Such was the case when a 1955 Mercury came into the shop.

This driver was convinced that his car couldn't be tuned, because the engine idled roughly despite several visits to as many garages. Since the motor was fairly cold the opportunity of listening to it warming-up suggested that the condition was somewhere in the carburetor. Irregular idling became more apparent as the automatic choke opened and the speed dropped. Adjusting the air-bleed screws had little effect.

On a hunch, the carburetor was pulled off. I expected to find either clogged passages or a poor gasket. This presumption also proved false. Turning even closer attention to the carburetor gave the tip off. The secondary throttle valves on this four-barrel job were not in line with each other. Therefore, one of them couldn't have been seating at idle speed, photo at left, which accounted for the unevenness. Aligning the valves correctly and readjusting the engine took care of this tough one.

188 POPULAR MECHANICS
Unusual Locations Where Trouble May Occur

Low Brake Pedal

Inability to get a high pedal on the 1955 British Ford is most likely due to a brake adjustment failure. A pin which joins the adjustment bolt head to the eccentric cam inside the wheel may break free from the cam. More often than not, the trouble begins when someone rotates the adjustment bolt in the wrong direction. This will bring the straight edge of the cam in contact with a brake-shoe pin. Pressure at this point will break the cam loose. Remember, the proper direction in which to turn the adjustment bolt is the direction away from the cylinder.

Speedometer Sticks

Most automobile manufacturers calibrate the speedometers on new cars so that they register a higher speed than is actually being driven. This is done for safety reasons. The speedometer on the 1958 Chevrolet, however, does just the opposite. The needle sticks at zero and will spring back to its proper position only after the car is driven several blocks. The trouble is due to the design of the dial which causes the needle to hug the dial face. It is necessary to remove the speedometer and bend the needle away.

Safety Switches

In their efforts to eliminate automobile troubles, manufacturers have added gadgets which sometimes work at cross-purposes. The 1957 Dodge, for instance, has two automatic safety switches between the ignition and the starter motor. The vacuum starting switch, circled, makes use of the engine vacuum to avoid accidental cranking while the motor is running. The switch is sometimes so effective that the motor cannot be cranked at all. You may then find it necessary to join the two wires leading to it in order to start your car.

Sprung Doors

Hardtops are beautiful automobiles, but be careful that you don't allow yours to be placed on a frame-contact hydraulic lift. This kind of lift will cause the car to rest with its weight on the frame and the hardtop will come under a "hogging" stress. This means that the points of support are brought closer together than they are when the car is resting on its wheels. The result—the weight of the body will be thrown outward and the doors will be sprung.
Flashlight Becomes Flare
For Night Auto Repair

Roadside repairs can be dangerous, especially at night. There is always the danger that drivers of oncoming cars will not see you in time to stop. You can prepare for such an emergency by carrying a homemade flare in your car. The flare consists of a flashlight covered by a red plastic container like the ones in which food, beverages and ice cream are bought. A wire stand can be devised to hold the flashlight upright in the road, or you can place it in a larger container stuffed with rags or paper. Placed a few feet up the road, the flare will provide a light strong enough to be visible at a considerable distance.
Arthur R. Tanner, Jr., Poughkeepsie, N. Y.

Wrong Spark-Plug Gap
Causes Engine to Overheat

An automobile engine may at times be sluggish in performance and may even overheat due to no apparent cause. If the cooling system is not at fault, check your spark plugs. Poor spark-plug point adjustment can affect engine performance and reduce gasoline mileage. Be sure that the spark plugs are set to the gap specified for the make and model of your car. A gap of less than .025 in. may not cause the engine to misfire but is bound to give you less than peak performance.
Glen F. Stillwell, Manhattan Beach, Calif.

Replaced Breaker Points
Call for Timing Check

Tune-up mechanics should never neglect to check the timing after installing a new set of points. Wear on the cam-follower arm, and a tilting of the breaker support plate, will change dwell angle more than two or three degrees. Keep in mind that the plug fires only when the points are open. Thus, the earlier the points open, the greater the spark advance. Notice in the illustration that the breaker points open four degrees earlier when the dwell angle is changed from 45 to 37 degrees.

Small-Car Parking Woes

Small cars with short wheel bases may be popular for their fuel economy and handling ease, but they take a beating in diagonal parking spaces where they are constantly being bumped by larger cars. Not being able to spot a small car hidden by its larger neighbors, the driver of a large car may pull in and actually hit the small job. With an increase in the number of complaints from the owners of both kinds of cars, many police departments have endorsed the idea and encouraged the drivers of small cars to allow the rears of their cars to stand in line with those of the cars parked on either side. In this way, an approaching motorist can easily see that the space is occupied.
John Yolton, Hayward, Calif.
WHAT TO DO about a closure for that problem clothes closet, that storage wall, that hall doorway opposite the bathroom—where there's no room to swing a conventional single door? The answer to that one is, use bifold doors. Decor wisely they add an attractive detail to any room, swing in half the space, open and close at a touch, and are easy to hang with the new bifold door hardware.

Although you can use any one of several conventional single doors, or make them yourself, the louver or shutter-type doors pictured are recommended. They are light and easy to handle and can be finished in the natural wood or to match any color scheme. Have the hardware and doors at hand, but before you begin work, note these figures: To calculate the widths to which the individual doors must be cut to fit in a four-door installation when the hardware is surface-mounted, divide the width of the opening by 4 and deduct \( \frac{\frac{3}{16}}{\frac{1}{4}} \) in. If only two doors are used divide by 2 and deduct \( \frac{1}{4} \) in. If the bottom jamb pivot, Fig. 7, detail A, is mortised into the jamb as in Fig. 1, add \( \frac{1}{2} \) in. to the total of the door widths. The door height for mortised hardware must equal that of the finished opening less \( 1\frac{3}{4} \) in.

These dimensions apply when measuring from floor to header. Allow for rugs and carpeting.

Now note Figs. 2, 3, 6 and 7 which show the location of the butt hinges on the pairs of doors and how the top door pivot, the suspended guide and the bottom door socket are mortised into the top and bottom edges of the doors. The track socket, top pivot, bottom socket and jamb pivot are shown in their relative positions in the left-hand photo on the following page. The suspended
Guides are attached to the inside pair of doors. The track is attached to the header as in Figs. 2 and 3. The track and the jamb pivot can be centered on the header and jamb as in Fig. 1, or can be attached flush with one edge. Only one section of track is used for a two-door job. Two sections are required for four doors. Place the pairs of doors in position as in Fig. 7, detail B. Note that the track socket and jamb pivot are adjustable for plumbing the doors after placement, Fig. 7, details A and C. Finish the job by installing the aligners as in the photo above.
Discarded Implement Wheel Makes Fine Fence Turnstile

Sagging gates and run-away livestock are made a thing of the past with this fence turnstile. It is made by cutting away the rim and all but four of the spokes from a discarded implement wheel. A pipe axle is driven into the ground in the center of the fence opening. The hub and spokes are then mounted on the axle. The turnstile turns easily, permitting easy passage for adults and children, but providing an effective barrier for the livestock.

G. E. Hendrickson, Argyle, Wis.

Modified Pin Prevents Injury

There is no need to risk injuring your hands and fingers every time you work the hitch on your tractor. Two safety hitch pins, like the ones illustrated, will hold the drawbar without sideplay. A 1½-in. washer is welded to the top of a 3/4 x 7½-in. rod. About 2½ in. below this, weld on a block about ½ x 2 x 2 in. The block will leave enough pin length below itself to hold the drawbar. The space between the block and the washer provides a "handle" which you can grasp without fear.

A. M. Wettach, Mt. Pleasant, Iowa

Toolbox Lid Is Handy Blackboard

Job estimates, time records, dimensions and the like, have a way of getting lost, smudged and torn if kept on paper or in a small notebook. This problem is done away with if you use a portable blackboard. Simply paint an area on the inside lid of your tool box with blackboard paint. All you need to carry now is a piece of chalk which can be kept in the tool box itself. The data will be safe, handy, private and readable at all times. Rubbed with a damp cloth, the board is ready to be used again.—G. E. Hendrickson, Argyle, Wis.

Use Cellophane Tape to Mask Trim

Don't risk ruining a fine piece of craftsmanship in the last stages by running a piece of sandpaper or steelwool over a cross-grain edge or trim strip. You can make a simple mask to avoid this by placing a piece of cellophane tape over the cross grain. This will allow you to do the waxing or sanding right up to the edge of the cross grain without leaving an unfinished area between the two pieces of wood. The trim strip itself can be finished in the same way without ruining the previous sanding or waxing job by masking the area around it with the same kind of tape.

R. Hanscom, Elmhurst, Ill.
Photographer's Timer Alarm Quieted With Adhesive Tape

In a small, quiet darkroom, the sudden, loud ringing of a timer alarm can be quite disconcerting, especially if you happen to be engrossed in other work at the time. The alarm of a timer, such as the one in the photograph, can be quieted down in the following manner. Remove the cover from the timer and apply several layers of heavy surgical, adhesive tape to the bell at the point where it is struck by the clapper. The tape will serve to effectively reduce the loudness of the ringing to a bearable level and you will still be able to hear it at a considerable distance from the darkroom if you must leave a timed project in process.—Kenneth Murray, Colon, Mich.

Drums Turned on Wooden Platform

When heavy, steel drums are to be loaded into a railway car or truck, it is often necessary to roll them into position on the loading platform and then turn them at right angles to roll them onto the loading ramp. Since the steel drums are made with straight sides, considerable effort must be used to twist them into the proper position. To solve this problem, a four-way ramp, like the one illustrated, can be made easily. Lap a piece of 2 x 4 in. stock about 3 ft. long into another piece of the same length. The pieces should be cut so that both ends slope from the center. Secure the two pieces with heavy nails and you will be able to roll, twist and turn steel drums with less than half the effort it once required. If it is secured permanently between the loading dock and the ramp, the device will ease both the loading and unloading of the barrels.—G. E. Hendrickson, Argyle, Wis.

Painted Arrows Tell Direction In Which to Move Spirit Level

If you have ever tried to level or to plumb work with a spirit level, you may have found yourself becoming confused trying to decide which way to move the level and the work to bring the bubble to center. The next time you try this, you will eliminate all guess work if you paint an arrow at each end of the bubble tubes. The arrow at the end of the tube where the bubble stops will automatically indicate the direction in which the level must be moved in order to bring the work into proper position and the bubble to center. The direction in which to move the level will be determined at a glance. Arrows may be cut from reflective tape for working in poorly lighted areas.—R. Hanscom, Elmhurst, Ill.
Inexpensive Stools From Discarded Items

AROUND MOST HOMES and farms there are discarded items lying about that can be converted into useful and attractive additions for the home, shop, or recreation room. Utility stools, for example, can be made at practically no cost. The one shown was made from the seat of an old cultivator and makes a comfortable shop or bench stool. If you want something different, make several and use them as counter stools. The legs are ½-in. steel rods welded to a ¾ x 5 x 5-in. steel plate. The leg assembly is then secured to the seat with a ½-in. carriage bolt. The height of the seat may, of course, vary to suit individual needs and tastes. A similar stool may also be made from an old kitchen chair. The legs are removed and replaced with either wooden or metal legs of the desired length. An old fashioned dining-room chair with arm rests used in this manner makes a fine "captain's" chair. If you are a boat owner, here is something else you can try; saw the legs off an old kitchen chair and secure the back and seat with screws or C-clamps to a boat seat. Add cushions and you will have provided yourself with a comfortable back rest. Folding or card table chairs may also be used in this manner. They have the added advantage of folding out of the way when not in use or when additional deck space is needed. You will find the uses for discarded items are almost limitless.
1. SEWING-MACHINE THREAD can be kept from unwinding too fast if a rubber washer is fitted snugly over the tip of the spool spindle. Cut the washer from a piece of inner-tube rubber just large enough to cover the head of your largest spool of thread.

2. A HANGING VASE for ivy, Chinese evergreen or other water-grown plants can be made from a small Chianti bottle. Stripped of its straw base, it can be hung from a trellis or near a window where the light will shine brightly through the clear, green glass.

3. PAPER BAGS won't be scattered all over the kitchen if they are kept in this handy container. It is made of cotton or plastic material hem-stitched to two wire hangers and can be hung in any convenient corner. It also makes a fine carrier for wild or garden flowers.

4. STIPPIED PATTERNS for walls, panels and novelties are painted with flat synthetic sponges. Cut the sponges into oval, or diamond shaped patterns and your work will have that "different" look. Sponges can be cleaned and stored for future use.

5. A DOOR STOP, which will mar neither the floor nor the door finish, is made from a piece of garden hose. A section of the hose is cut out leaving two larger end pieces. Slipped under the door, it lets you adjust the door opening without removing the stop.

6. CHILDREN'S MITTENS will be kept dry and comfortable through a day of hard snow playing if a small plastic food bag is first slipped over each mitten. They are fastened with a stout rubber band over the opening at the child's wrist. The plastic will prove durable and inexpensive to replace when torn.

7. SLIPCOVERS are adjusted easily on your overstuffed furniture, using a rubber plate scraper to tuck the fabric into the spaces between the cushions. The scraper does the job without tearing the fabric.

8. WORK-TOP SPACE in your kitchen can be increased with a cover fitted over the sink. Made of ¼-in. plywood and covered in colors to suit, the cover slides on and off the sink on rubber-headed tacks.

9. RECORD ALBUMS are displayed like pictures on the wall and become part of the room decoration with this modern album holder. The holder can be cut and assembled in one evening. Its length and depth are determined by individual taste and storage needs.

10. PAPER CUPS used to hold hot liquids will neither scald your hands nor allow the liquid to cool rapidly if the cup is placed inside another cup which has been covered inside and out with aluminum foil.

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Removable Foot Rest Eases Painting Pains

Standing for long hours on the narrow rungs of a ladder will tire your feet and increase your general fatigue. This removable foot rest will remedy the situation. The step is cut from 1 3/8 x 5 x 11-in. stock. The sides are 2 1/2 x 4 1/2-in. plywood, slotted as indicated in the illustration. The top slot forms a hook which fits over the top rung of the ladder. It is important for safety's sake to allow a 1 3/4-in. overlap so that the rest cannot slide off. The bottom of the rest does not really touch the rung. A clearance of 1/2 in. is allowed between the rung and the top of the slot. Thus, your full weight will be centered on the top portion of the rest. Make the rest narrow enough to slide between the sides of the ladder. It will be a simple matter to lift the rest out and raise it up the ladder to suit your needs. The pieces are held together with 1 1/2-in. wood screws and should support your weight in comfort and safety.

—Robert L. Sarginson, Berwyn, Ill.

Tape Holds Hinges in Place

Screwing hinges into a standing door or holding them to a precise place in their rabbets can be an annoying job as the hinges have a way of sliding out of place. This bit of nuisance can be eliminated with a piece of cellophane tape. The tape, placed over the hinge, will hold it in place while the screws are being driven. The tape is then stripped off. Since the tape leaves no residue of adhesive, there is nothing further to remove or clean before applying a coat of finish—H. Hanscom, Elmhurst, Ill.

Cigarette-Paper Dispenser

Rolling your own can be exasperating when a stiff wind threatens to take away your "makings." However, a dispenser can be made in a few minutes. Cut a 3/8 x 1 3/8-in. slot in the back of the paper book your cigarette paper comes wrapped in. Fold the papers end to end and interlace them so that the top fold of each sheet covers the bottom fold of the sheet above. Insert the first sheet through the slot in the cover and the papers will pop out one at a time as you need them.—B. D. Hill, Meridian, Miss.
Collapsible Wooden Sawhorse Folds Away When Not in Use

If yours is a small home workshop with limited working space, you will prize this strong and sturdy, yet completely collapsible sawhorse. Though collapsible, the sawhorse is designed so that there is no sacrifice in utility or in strength. The cross bar of the horse is a piece of 2 x 4-in. stock on each side of which are centered and mounted two pieces measuring \( \frac{3}{4} \times 4 \times 20 \) in. On the ends are mounted four pieces \( \frac{3}{4} \times 4 \times 4 \). This leaves a space four inches from each end which fits into the top of the leg assembly. Each set of legs is constructed of a pair of 2 x 4-in. pieces 30 in. long. Each piece, beginning 4 in. from the top, tapers to \( \frac{1}{2} \) in. Two sets of \( \frac{3}{4} \times 5 \)-in. braces serve to secure the leg assemblies at the top, and a piece measuring \( \frac{3}{4} \times 3 \) on the outsides near the bottom finishes the job of construction. The sawhorse is put together by sliding the cross bar into place. The spaces left in the bar at the ends are sanded smooth on the inside edges so that the bar fits easily into the openings at the top of each leg assembly. All pieces are secured with \( \frac{3}{4} \)-in. wood screws.

Ted M. Fenn, Skokie, Ill.

Common Items Help to Solve Tough Household Problems

Items common to every home often can help solve a tough problem. For instance, glycerine will remove a stopper stuck in a bottle. Pour a little around the neck of the bottle and allow it to stand for a few hours. The stopper will then come off with little trouble. Glycerine can also be used as a lubricant for kitchen appliances. The use of petroleum-based oils would spoil your food. It is a good lubricant for mixers, beaters, blenders and the like, and is at the same time odorless and tasteless. Even such a common thing as bread can be put to surprising uses. Since the slightest amount of dampness in a verticle copper tubing installation will make soldering impossible, something is needed which will absorb the moisture and yet not clog the pipe. A piece of bread inserted a few inches up the pipe will absorb the moisture and help to sweat the joint. When the soldering job is finished, the water can then be turned on and will wash the bread away.

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BUILDING THE 24-FT. PM HOUSEBOAT

IN THE EVENT you have not actually started construction of this trim little houseboat, presented last month, a clarification in dimensions of the bottom frame members should be noted. Bottom members of frames 1, 2, and 8 are 4½ in. wide, whereas bottom members of frames 3, 4, 5, 6, and 7 are 5¼ in. wide. While this ¾-in. variation tends to “level” out the floor at the bow and transom, it is of no great consequence if you have gone ahead and made all the bottom members 4½ in. wide. It merely means that the floor will have a somewhat greater upward sweep as it follows the contour of the hull bottom at the bow and transom. Also, any question as to how the joints are staggered in planking the bottom of the hull is clarified in Fig. 11. The two panels identified with color are applied first and at the specific frames indicated. You can’t miss in applying the rest of the panels.

Resuming construction, your next step is to saw off the projecting waste ends of the side frame members. Since the deck has a 2-in. camber (crown), these members should be cut off at a 4-deg. angle rather than at right angles. A T-bevel held against the side planking is a handy tool to use for marking each member for sawing. A handsaw will have to be used for this and you should try to saw as squarely as possible. The projecting ends of the stiffeners at the bow and transom also are cut off at this time but these are cut flush.

POPULAR MECHANICS
with the faired edge of the planking. In both cases, the waste ends are cut off at the very edge of plywood planking.

The nine floor battens including the main one at the center are added next. These are placed on top of the bottom frame members, from bow to transom, directly above the planking battens and keel and against the side frame members. A single brass screw (2½"-No. 10) is used at each frame to fasten the battens, whereas two screws are used to fasten the center batten in place directly above the keel. Fig. 10 shows how the floor and bottom planking battens, as well as the keel, are boxed-in with ¼-in. plywood gussets to give additional rigidity to the hull at points where the skegs are attached. The gussets are cut to fit between the frames and flush with the tops of the floor supporting members. Openings are made in the gussets at points opposite the skeg bolts so there is provision for future tightening of the nuts. Gussets are added only to the members to which the skegs are bolted. They are not applied to the other battens. Since the supporting floor members rest on top of the frames, fill-in strips are used to bridge the gap between the longitudinal members. These are nailed and glued to the top edges of the frames as shown in Fig. 10. You'll have better footing when working inside the hull if it is floored now. However, since bilge access openings must later be cut in the floor, as well as openings for members which support the forward berths, the ½-in. floor panels should only be fastened temporarily in place at this time. Floor the entire area between the frame side members, from bow to frame 8.

Your next step is to cut five deck beams. These are laid out on 1½-in. fir stair-tread material, following Fig. 12. Cut to fit between and butt against the sheer members, the three beams for the fore deck are notched at the ends for cover boards and also for a king plank and two deck battens. Two of the beams are fastened to the for-
ward faces of frames 1 and 2 with glue and a single brass carriage bolt as shown in Fig. 15. The third fore-deck beam rests in two plywood saddles which are cut as shown in Fig. 14 and glued and screwed to the sheer members midway between the bow frame and frame 1. Glue the beam in the saddles and drive long brass screws into the ends through the planking and sheer members. The fourth deck beam, which is bolted to frame 8, differs from the others in that no notches are required. Dadoes, however, are first cut ½ in. deep across the aft face of the beam to house the members which frame the aft hatch opening. Locate the dadoes so they center at points marked 23¾ in. each way from the center line of the hull.

Members called the inner sheer clamps are added next to both port and starboard sides. These butt against deck beams at frames 2 and 8 and are glued and screwed to each side frame member as in Fig. 16. Next in order are the cover boards which are applied along the sheer and across the bow and transom. Due to the overall length
required, chances are the boards will have to be pieced along the sheer. Note that they butt against the bow and transom cover boards. In studying Fig. 13, you will notice that portions of the cover boards, both fore and aft, are rabbeted to allow the deck planking to fit flush. If a portable router is at hand, the rabbeting can be done after the cover boards are in place, otherwise the rabbeting should be done beforehand. Most of it can be worked with a circular saw and later squared up with a chisel. Being only \( \frac{3}{4} \) in. thick and 8 ft. long, you'll have no trouble in springing-in the bow and transom cover boards to assume the 2-in. deck crown. After the cover boards are installed you can complete the framing of the fore deck by adding the king plank and battens. Notches in the bow cover board house the forward ends of these members. A single panel of \( \frac{3}{4} \)-in. plywood is used to plank the fore deck. This fits flush in the cover-board rabbets. At frame 2 the deck planking is brought even with the after face of the deck beam.

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The 18 x 47-in. hatch opening in the aft deck is framed with four headers installed as shown in Fig. 17. Here a sectional drawing at the centerline shows how three 1/4 x 2 1/2-in. members are housed in the dadoes previously made in the deck beam and in dadoes cut in the top transom member. The hatch opening is made 18 in. wide by fitting crowned headers between the others, one being 3 1/2 in. wide and the other 3 3/8 in. wide. You will note that the latter is positioned flush with the rabbeted edge of the transom cover board. The after-deck planking is a single plywood panel too, cut out over the hatch and trimmed to fit neatly in the rabbeted edges. While the hatch cover actually rests on 3/4-in. sq. cleats in the opening, the cover planking overhangs the after edge 3/4 in. to fill the cover-board rabbet. It also has a flat brass, overhanging trim binding applied all around the top. The binding is left off, however, until after the decks and cabin roof have been covered with glass fiber. Like the planking on the fore deck, the after-deck planking is kept flush with the forward face of the deck beam. As a final step before starting the cabin, a 5-in. coaming member is added to the faces of the sheer clamps and the deck beams. Projecting 1 1/2 in. above the cover boards and fore and aft decks, you will note in Fig. 16 that the coaming has a 5-deg. bevel 1 1/4 in. wide along the outer top edge at the sheer. The coaming across the aft deck has an 11-deg. bevel but the coaming across the fore deck has no bevel at all. Instead, a 1 1/4-in.-wide filler strip,
Below, 3/4-in. members called stiffeners, are installed at both door openings. Placed on each side 1 1/2 in. in from the edges of the door cutouts, the stiffeners are notched to fit over roof beam and coaming beveled 15 deg., is bowed to the deck curvature and glued and screwed to the forward face of the coaming. See Fig. 21. In each case, the degree of bevel corresponds with the inward slant of the cabin members.

Figs. 19, 23 and 24 give the patterns for the plywood sides and ends of the cabin. Since the ends lap the sides, cut and install the sides first. Here two panels will have to be butt together to obtain the overall length required, which is taken directly from the job by measuring the distance from the beveled filler strip to the beveled coaming aft. Window cutouts are identical in both side panels of the cabin and these are best cut and shaped with portable electric tools. After the lower edges of the side units are beveled to fit against the cover boards, they can be glued and screwed to the beveled edges of the coaming. Temporary blocks backing up the butted joints in the panels, plus braces placed from side to side, will hold the assembly until the cabin ends can be installed. The cabin ends are cut from 3/4-in. plywood, following Figs. 23 and 24. Again, overall sizes are taken from the job and the pieces fitted directly. The front cabin door measures 25 in. wide. Where the lower edges of the panels are cut to match the

(Continued to page 274)
SOLDERING TIPS

RUBBER GROMMET cemented on "spotlight" bulb of a soldering gun prevents the bulb from becoming broken when it is carried in a toolbox with other tools. The grommet hole is centered on the built-in lens of the bulb so as not to obstruct the light beam.

SANDPAPER cemented on the lid of a soldering-paste can provides a handy abrasive for cleaning the soldering-iron tip and brightening parts to be soldered. Used as a worktable when soldering small parts, the rough-surfaced sandpaper tends to hold them in place.

EYE-GLASS CASE has strong grip and enough weight to hold wires and small parts in position while soldering them together. The space inside is a good place to carry spare soldering tips, wire solder and other small items needed for a job away from the shop.

CERAMIC INSULATOR on pencil-type soldering iron kept in a toolbox can be protected from breakage by clipping a paper clamp on it as indicated in the photo below right. Then, when tools are dropped in the box there is no danger of hitting the insulator.

EXTRA TIPS for a soldering iron are inserted in holes drilled in a wooden disk that is bolted to the soldering-paste can. The holder permits quick selection of tips and reduces the risk of losing them.
Place a piece of heavy paper, cut to the shape desired, on a piece of leather known as seven-ounce thickness. With the paper as a guide, cut the leather to the appropriate shape with a sharp swivel knife.

You may want to experiment with several possible patterns for the tooling. When you have decided on a design, make a detailed drawing of it on a piece of tracing paper also cut to the appropriate shape.

Fasten the tracing-paper drawing onto the cut-out leather with small pins or paper clips. Press your modeling tool over all the main lines of the design so that an impression is made visible on the leather.

It may take talent and years of intensive training to make an expert leather craftsman, but almost anyone can work in leather and produce articles that are decorative and highly useful. All you need are a few inexpensive tools, a piece of leather, imagination and a bit of patience. Articles such as wallets, ladies' purses, or holsters, like the one shown on the next page, can be worked in leather and carried with the pride that comes from having conceived and done the work yourself. Leather goods are not only handsome but durable as well.

Tooling is something you will find easy to learn. The tools, especially made for this work, will seem to work almost automatically once you get the knack and feel of them. Stitching, though a bit more complicated, can be learned by anyone able to tie Boy-Scout knots or sew a simple hem-stitch. The variety of articles you can make is limited only by your own ingenuity. Once you have started into leathercraft, you are in for many evenings full of accomplishment and surprise.

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Having moistened the leather with a damp cloth, you are ready to begin working directly in the leather, above right. With a swivel knife, the one with the saddle-shaped handle, cut along the lines previously impressed with the modeling tool. Remember, never cut deeper than one third the leather's thickness.

Now draw the blunt end of the modeling tool along the cut lines, right. The proper use of the tool will turn the slits into smooth, sculptured contours, containing and forming the design. This is the first step toward giving leather the depth which is the distinctive mark of a finely-tooled piece of work.

Special marker wheels, below, come in various sizes. They are used principally to mark indentations in the leather which serve as guides for punching or stitching. The same indentations may also be used as a part of the general design along borders, or where a line of equally spaced dots is desired.

A special split knife, below right, will allow you to smooth the rough edges of your work, and is useful where beveled edges are desired. In making wallets, holsters, or any type of case where a fine lacing or stitching is desired, this tool will allow for tight, close, neat-looking seams on your work.
Graphite Subs for Carbon Paper
When Making Large Tracing

When making a tracing of drawings or plans covering an area that is too large to use carbon paper, try rubbing powdered graphite on the back of the pattern to provide a tracing medium as shown. If more than one copy is desired, it may be necessary to apply a touch-up coat of graphite. This tracing method is especially useful when reproducing outlines for paintings and artwork, where lines produced by carbon paper tend to “bleed” through the paint. Graphite lines erase easily without leaving a smudge.

R. Hanscom, Elmhurst, Ill.

One or two wide strips of adhesive tape applied lengthwise to each shoe sole helps to give firm footing on icy pavement.

Handsawing a Butt Joint

Here is an easy way of obtaining a tight-fitting butt joint on long pieces of plywood to be glued together, when a jointer is not available to true the meeting edges. First rough cut the plywood panels to be joined together, if this has not been done. Then arrange three lengths of thin stock on a pair of sawhorses so that when the panels are butted together on them, they are supported at the outer sides and along the joint as shown in the drawing. Then tack the panels lightly in position on the center strip and saw along the joint line with a handsaw, cutting the support member as well. The saw kerf will remove material from each of the facing edges of the joint to provide a perfect fit, unless of course, a wide gap has been left by poor rough cutting.

Daniel Bousha, Jackson, Mich.

Display Collection in Egg Carton

Egg cartons make practical, inexpensive display trays for small sea shells, mineral specimens, insects and other small items. The pockets are numbered, and a typed legend identifying each specimen according to number, is stapled to the lid of each carton as shown in the photo. Cartons may be reused after disposing of the previous collection, simply by typing new legends to describe the new specimens. The soft material of which such cartons usually are made, helps to protect delicate specimens from damage. When carrying cartons of specimens to an exhibition, cotton is laid on top of the pockets to prevent intermixing. Cotton batten, 1-in. thick, is best for this purpose.—E. V. Reyner, Salinas, Calif.
Trailer for Moving Sows With Litters

Sows with litters are hauled safely in this trailer from farrowing house to pasture on one large Midwest hog farm. The safety feature is in the loading and unloading of the animals. A side door forms a ramp when lowered and two gates carried in a rack at the back of the trailer are hooked in position on the trailer, one on each side of the ramp as shown in the photo above. This chute arrangement combined with an axle-level trailer bed, minimizes the risk of injury to sows or piglets when loading or unloading them.

A. M. Wettach, Mt. Pleasant, Iowa.

Rubber-Tired Planter Wheels Do Better Job of Packing Soil

Inner tubes stretched around the rims on packer wheels of a corn planter as shown at right, do a better job of firming loose soil, according to one farmer. Another advantage of this arrangement is that old cornstalks are prevented from catching in the open parts of the wheels which are covered by the inner tubes. Each wheel requires one tube, which is severed at the valve and then cut along the center of its inside circumference. After stretching the opened tube around the wheel rim, the overhanging portions are folded inward toward the center and the edges are then "stapled" together with hog rings.

A. W. Ranniger, Carroll, Iowa.

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"WETTER WATER"

Makes Chores Easier

Add just a small amount of wetting agent to cleaning water, photo-negative rinse, liquid insecticide, or most any other water-base solution used around the home and you will get much-improved results with less effort. Available at most chemical and photo-supply stores, commercial wetting agents work their wonderful magic by lowering the surface tension of water. This in turn, promotes more rapid penetration of surfaces being cleaned, or treated and permits other chemicals in the solution to which it is added to attain a more perfect distribution. The latter characteristic also saves on material. Mild household detergents have a similar effect on water, but they cannot be used for most non-cleaning applications because other chemicals present would be harmful.

The amount of wetting agent required for a job depends upon the type of application. When mixed in a solution for cleaning windows, moistening gummed tape, or for removing postage stamps, 1/2 tsp. per qt. of water is sufficient. Solutions used for removing insects spattered on a car, and for other difficult cleaning jobs, require a greater concentration of wetting agent, 1 tsp. per pt. of water. To the latter, 1/2 pt. of isopropyl alcohol is added, making the solution even more effective as a cleaning agent. Some of the more common applications of "wetter water" are illustrated below and on the next page.

Philatelists will find it easier to remove stamps from envelopes when back of paper on which stamps are affixed is wetted with water containing several drops of wetting agent.

"Wetter water" makes easy job of cleaning walls and waxed floors. Good solution to use for this purpose consists of wetting agent, 1/2 tsp., water, 1 qt. Apply with sponge and wipe dry with cloth. Fine too, for removing bugs stuck on bumper and hood of car.
To avoid streaked results when washing windows, mix 1 tsp. of wetting agent with the wash water. Water spots won't appear on photo negatives and prints, if they are given final ½-min. rinse in solution consisting of wetting agent, 1/10 oz., water, 1 gal.

Garden spray does a better job of covering leaves of shrubbery and plants when 2 tsp. of wetting agent are mixed with each gal. of insecticide solution. Several drops of wetting agent stirred in water used for moistening gummed tape makes it adhere better.

"Wetter water" sprinkled on unpaved roads and drives located next to farm buildings helps to keep dust down for longer periods of time than when plain water is used. An effective solution is wetting agent, 1 oz., water, 10 gal.
Improvised Snow Plow Cleans Sidewalks

Instead of shoveling snow from your sidewalks this winter, why not use a simple plow like the one shown. It will handle snow up to two or three inches deep, and will save lifting. The plow consists of a sheet-metal blade screwed to fairly long handles of hardwood. The lower edge of the blade is faced with a heavy steel strip bolted to the blade to produce a long-lasting edge, which is beveled to provide a scraping action. The handles are braced horizontally and with an X-brace.

W. D. Terrill, Oak Park, Ill.

Garage Location Is Winter Asset

Make your new garage serve another purpose by placing it where it will serve as a windbreak in the winter. If summers in your area are the more severe, place it where it will serve as a sun shield.

Hasp Used to Lock Sill Cock

Small children consider it great fun to turn on a sill cock and let the water run. The running water will ruin flower beds and even cause serious leaks in house foundations. To prevent this, attach a hasp to the side of the house so that the slot aligns with the opening in the sill-cock handle. A padlock passed through the hasp and the handle will prevent the latter from being turned.—Daniel Bousha, Jackson, Mich.

Acid Drip Caught in Rubber Ball

If you have ever used a bottle of acid you have no doubt had spots of corrosion left on your workbench and floor by the acid that dripped down the side of the bottle. To prevent this, cut a rubber ball in half and cut a hole in the bottom of one of the resulting rubber cups. Slipped over the top of the bottle, the cup will catch the drippings and can be washed after each time it is used.

HOLE FOR BOTTLE NECK
Record Browser Gives Living Area a Luxurious Touch

THOSE LP RECORDS hidden away in a closed cabinet are hard to get at, difficult to select, and add nothing to the appearance of your living room. Their colorful jackets standing in this modernistic browser will make your record collection the focal point of your decor. The browser is made of 1/2-in. plywood, with sides measuring 14 1/2 in. long and 8 in. high. The front is 14 in. wide. The backboard against which the records lean, measures 13 x 13 in., and, like the other parts, is secured with countersunk wire brads. The one illustrated was tilted two inches in from the back at the bottom. When assembly is completed, sand all parts and fill all cracks and holes with filler. Now screw the legs on. Wrought-iron legs, like those illustrated, may be purchased at little cost. Set all screws 1 in. in from the bottom edge. The height of the legs may depend on the height of your phonograph for easy access to the records. Two strips of aluminum molding on the front add a distinctive touch. Stain and finish as desired.

Al Toffler, Falls Church, Va.

JANUARY 1960
**Early American Clock Has**

By E. R. Haan

NOW THAT YOU have made the pillar-and-scroll clock case and the front and back plates of the 30-hr. wooden movement as described in Part I last month, you are ready to make and install the gear trains. There are two trains, the time train, Fig. 31, and the strike train, Fig. 45. These trains are shown in their relative positions in Fig. 29, which pictures the movement with the front plate and count wheel removed. Note that the strike train, Fig. 45, includes, in addition to the wheels and pinions, detents S-6, S-7 and the striker S-8. Detents S-6 and S-7 are detailed in Fig. 35 and the striker in Fig. 36.

Except for the escapement wheel, which is made from hard brass, all gear wheels are made from quarter-sawn black cherry. The wheels are turned and toothed separately and are then mounted on the spindles, of which the pinions are an integral part. All wheels except T-1, T-4, T-5 and

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### Wheel Details

<table>
<thead>
<tr>
<th>Wheel Number</th>
<th>Number of Teeth</th>
<th>Radius of Circle &quot;A&quot;</th>
<th>Radius of Circle &quot;B&quot;</th>
<th>D</th>
<th>G</th>
<th>W</th>
<th>Number of Teeth</th>
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<tbody>
<tr>
<td>T-1</td>
<td>36</td>
<td>1/2</td>
<td>3/8</td>
<td>7/8</td>
<td>3/4</td>
<td>11/16</td>
<td>11/16</td>
<td>8</td>
<td>3/4</td>
</tr>
<tr>
<td>T-2</td>
<td>48</td>
<td>1/2</td>
<td>3/4</td>
<td>3</td>
<td>3/4</td>
<td>11/16</td>
<td>11/16</td>
<td>8</td>
<td>3/4</td>
</tr>
<tr>
<td>T-5</td>
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<td>1/2</td>
<td>3/4</td>
<td>1</td>
<td>3/4</td>
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<tr>
<td>T-7</td>
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<td>1</td>
<td>3/4</td>
<td>11/16</td>
<td>11/16</td>
<td>1</td>
<td>3/4</td>
</tr>
<tr>
<td>T-8</td>
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<td>3/4</td>
<td>11/16</td>
<td>11/16</td>
<td>1</td>
<td>3/4</td>
</tr>
</tbody>
</table>

**All Parts Same as T-1 But Reversed**

<table>
<thead>
<tr>
<th>S-1</th>
<th>ALL PARTS SAME AS T-1 BUT REVERSED</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-2</td>
<td>36</td>
</tr>
<tr>
<td>S-3</td>
<td>36</td>
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<td>S-4</td>
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</tr>
<tr>
<td>S-5</td>
<td>36</td>
</tr>
<tr>
<td>S-6</td>
<td>36</td>
</tr>
</tbody>
</table>

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POPULAR MECHANICS
S-1 are glued and bradded in place. The four wheels just referred to must be free to turn on the spindles. Although the original spindles usually were turned from laurelwood, you can use hard maple, boxwood or lemonwood. The 3/16 in. pins in the ends of the spindles are cut from drill rod. The driving gears, or great wheels, Figs. 33 and 34, turn free on the winding drums, Fig. 34. Both wheels, T-1 and S-1 in Figs. 30 and 33, are identical in size and number of teeth, except that they are made right and left as are the ratchets, Figs. 33 and 34. The winding drums are turned from hard-
wood and are center-drilled for a light drive fit on the drill-rod spindles. On each drum the great wheel is mounted on a projection of the drum, in which position it is adjacent to the ratchet. The spring-loaded pawls, also made from hardwood, engage the ratchets as in Fig. 33. The great wheels are held in place by pins and pressure plates of thin sheet metal and assembled as in the lower right-hand details, Fig. 34.

The table, Fig. 30, gives the data needed to make the wheels and pinions in both gear trains. Here it will be noted that each wheel is identified by the letters T and S (time and strike) and a number for convenience. The tangential lines A and B, Fig. 30, locate the tooth faces from circles A and B. Note also that the lines A and B appear on the drawings detailing the gears. One other point to take special note of before making the pinions: In Fig. 30 the pinion is shown in the rough-filed shape, or profile. Although the gears will mesh with the pinions and operate when the latter are filed to the rough shape, friction in the trains can be greatly reduced by finishing the pinion teeth, or leaves, to a bulbous, or pear-shaped, profile. This can be done with a few light touches of a fine round file after rough-filing to the profile.

The rough thickness of the teeth should be slightly over the finish dimension T in Fig. 30 to allow for filing to final shape.

Faces, or slopes, of all gear-wheel teeth are flat. It is quite important that the faces of the teeth be laid out and cut at the angles indicated. Teeth on all the larger gear wheels are easily and quickly roughed out on the bandsaw as in Fig. 32. Use a narrow blade, 1/8 in., and be careful to keep the
cuts in the waste. It's best to rough-cut teeth of the smaller gear wheels on a jigsaw, using a fine fretwork blade.

Several details of the assembly should be clearly in mind before turning the spindles and mounting the wheels. The minute wheel, T-4 in Fig. 44, and the wheel T-5 in Fig. 43, turn freely on the spindles and are held in place with triangular pressure plates made and fitted as in the lower details, Fig. 44. The hour wheel, T-6, Fig. 43, is mounted on a hollow spindle that slips over the hand-post assembly, T-4 in Fig. 44. This arrangement allows the hour and minute wheels to rotate at different speeds. The wire trip on the T-4 pinion, Fig. 44, frees the detents that control striking sequence and is the only connection between the time and strike trains.

The escapement wheel, Fig. 42, and the count wheel, Fig. 37, call for special care both in layout and toothing operations. The count wheel is shown actual size in Fig. 37. Note especially the contour of the wheel in the sectional view and the position of the notches in the raised rim. When the strike train is assembled and is in locked position the flattened projection of detent B, part S-7, Fig. 35, engages one of the notches. When the strike train is fully released by the trip wire on part T-4, Fig. 44, the detent B, part S-7, Fig. 35, is lifted clear of the notch in the count wheel. This clears the strike train and permits it to operate. The distance between the notches in the raised rim of the count wheel determines the number of times the mechanism will strike. The count wheel is driven by the end pinion of the assembly.
S-2, Fig. 46. The spaced pins on the gear wheel S-2 engage the hammer tail of the striker S-8, Fig. 36 when the parts of the strike train are in operating position. Make the count wheel from a piece of specially selected cherry and be careful to file the notches to a uniform depth and width. Notice also that the layout lines for the tooth slopes, or faces, are tangent to a single concentric circle.

Filing the teeth of the escapement wheel, part T-8, Fig. 42, begins with a painstaking layout of the tooth slopes. The teeth must be spaced with precision as otherwise the pallets of the verge assembly, Fig. 38, will not engage and release properly. Scribe the lines A and B with a sharp-pointed scriber so that they are easily seen. Scribe a circle to indicate the depth of the teeth. A needle file (handled type) of the knife shape usually will be found best for filing the teeth to the required shape. All teeth must be filed to a sharp point and to a uniform height. When mounted, the wheel is wedged tightly against the shoulder of the spindle by three pins, the ends of which enter holes drilled equidistantly in the spindle hub. The pins also fit into indentations made in the wheel with a small cold chisel so that they prevent the wheel from turning on the spindle.

The verge, Fig. 38, consists of the pallet, or rocker, the anchor, or yoke, and the crutch wire. The unit is available ready-made or possibly may be salvaged from an old spring movement. In either case it may be necessary to fit a new crutch wire of the correct length. If you make the
Holes for Fastening Door Pulls Located With Calipers

When installing a cabinet door pull of the type shown at left, the locations of the holes for the fastenings can be transferred quickly to the door with a pair of calipers. This method is also more accurate than using a ruler to measure the distance between fastener holes. Calipers of the type shown can be adjusted so that the points coincide with the centers of the holes in the handle. Then, when transferring bolt locations to the door for drilling, there is no possibility of making an error.

G. E. Hendrickson, Argyle, Wis.

Umbrella and Overshoe Stand

This combination rain-gear stand not only provides convenient storage for over- shoes and umbrellas but leaves more space in the guest closet for other things. Designed by Masonite Corp., the stand is made of ¼-in. tempered hardboard, except for the legs and framing members which are cut from 1 x 1-in. stock. The base is 24 in. square, the front 18 in. of which has a 1-in.-wide border of hardboard glued to it to retain water from wet overshoes. The rear 6 in. of the base forms the bottom of the 18-in. high umbrella holder. The legs are 6 in. high. Front legs are braced with wooden angles glued in place as shown, rear ones are extensions of framing members. The stand is painted to match surrounding decor.

Loosen Rust-Seized Hinge Pins With Notched Steel Pry

Door hinge pins that are rusted tight usually can be loosened with the aid of the pry shown. The latter is a ½ x 1-in. length of flat steel in one end of which a semicircular notch is filed as in the detail. One side of the notch is beveled so that it can be forced between the hinge and shoulder of the pin more easily. To avoid bending the pry, it is best to tap it with a hammer rather than pressing down on the handle.

Robert L. Sargisson, Berwyn, Ill.

Repair for Snowshoe Binding

Here is a quick repair for a broken snowshoe binding when afield. Before setting out, cut 2 bands 1½-in. wide from an inner tube and slip one over each ankle. Then, when a sandal strap breaks, stretch the band over the toe piece and hook it under the boot toe.—D. Duffey, Clintonville, Wis.
Extension Plank Easily Set Up With These Hooks

Raising a heavy work plank or extension plank to a high working position on ladder jacks is not an easy job for one man, unless a pair of hooks are used like the ones shown. Each of the hooks is shaped from a length of $\frac{3}{8} \times 1$-in. flat steel so that one end can be hooked over the edge of a plank and the other end hooked on an extension-ladder rung as indicated in the drawing at right. Note that the overall length of the hooks is approximately 2 in. less than the distance between a first and third rung.

In use, a pair of hooks are slipped on a plank and spaced to line up with ladder locations. Then each end of the plank is hung on the highest rung that can be reached from ground level, after which it is raised to the desired height one end at a time as illustrated. A hand rail, each end of which is clamped to a ladder rail as shown in detail A, serves as a safety accessory. Attached at waist height, it also provides a convenient place to hang paint buckets.

Robert L. Sargisson, Berwyn, Ill.

Shock Guards for Test Light

Fuller balls slipped on the probes of a neon circuit-testing light as shown in the photo, prevent the fingers from slipping accidentally and touching the uninsulated probes.—H. Hanscom, Elmhurst, Ill.

Prevent Water Stains on Rugs

Rug stains resulting from spilled water that has been allowed to soak through to the backing can be avoided, if the water is blotted up before it soaks in, according to the National Institute of Rug Cleaning. Pure water alone, can produce such stains which usually are brown or yellow in color. Recommended blotting procedure is to first use white unstarched terry cloth, white absorbent tissues, or white paper towels. Then place fresh blotting material on the wetted area and weight it down. As the remaining moisture rises to the ends of the tufts it will continue into the blotting material, carrying the impurities with it instead of leaving them at the surface of the rug pile. Often the best means of concealing a stain is to cover it with furniture or scatter rug.

JANUARY 1960
DUPLICATING machining operations on small parts having curved and irregular finished shapes by manipulating the lathe carriage by hand is a time-consuming procedure and the accuracy of the work is never entirely reliable. Parts having stepped shoulders, radii at one or both ends, concavities, beads, tapers, and other surface features that cannot be machined completely when chuckered or mounted between centers, usually can be worked speedily with form-turning tools. These generally are carried in special mounting fixtures on the cross slide to permit machining and cutting off with fast, in-and-out movements of the cross slide alone, the carriage remaining in a fixed position, or requiring only short longitudinal movements between stops.

Forming tools can be ground to combine several cuts in one operation and can be designed for turning curved and irregular parts to a uniform shape. In some setups this can be done without moving the lathe carriage. Tools ground as in Figs. 1 and 2 can produce any number of duplicate pieces with speed, accuracy and uniformity.

When only a few duplicate parts are to be made certain types of jobs can best be turned by single-point tools, as in Fig. 3, saving time over grinding an intricate forming cutter. With a little practice the tool can be accurately controlled, operating by hand both the lathe's longitudinal and cross feeds simultaneously. Use of a template, as the work progresses, will insure accurate results.

Many jobs, such as rounding the ends of rods, can be readily accomplished with ordinary tool bits ground as in Fig. 4. The single tool bit can also be ground for turning a concave, a short taper, or various other shapes on the ends of work pieces. Where individual parts are to be formed from plastics, or the softer metals, the work can be done with special hand chisels ground from ordinary flat files as in Figs. 5, 6 and 7. The surface near the end of the file is ground smooth and perfectly flat, the tip brought to the desired shape and beveled at approximately 30 deg. to form a cutting edge. Be careful not to overheat files when grinding.

These tools can be used by hand on a small lathe in a manner similar to wood-turning chisels. A bar of flat steel held in the toolpost and projecting from one side to act as an improvised toolrest will allow many odd shaped jobs to be accurately formed, as in Figs. 6 and 7.

Hand-forged tools of various shapes, Fig. 8, are convenient for turning inside and outside V-cuts, convex and concave shapes and for rounding right-hand and left-hand corners simultaneously. Tools of this type are milled or filed to shape before harden-
Parts made from soft metals and plastic can be turned with tools made by grinding discarded files to the contour required as in Figs. 4 to 7 inclusive below. Of course, care must be used when grinding to avoid overheating and drawing the temper of the file. After grinding, fit the file with a suitable handle.
ing. They are then ground and honed perfectly flat on top to produce a sharp edge and are given the same clearance angle of ordinary lathe toolbits. Cutters for forming irregular curved shapes also can be ground from flat tool steel and fastened to a suitable shank for mounting in the toolpost or in a turret-type tool block. Both the work and the wide cutters of this type must be mounted rigidly and the lathe run at slow speed to avoid chatter marks.

Forged cutters, of the type shown in Fig. 9, can be ground to form one diameter and two radii. In this setup the cutoff tool is mounted on the rear of the cross slide for cutting off the completed workpiece. Forged cutters are generally mounted directly in the toolpost or in the turret tool holder and are the simplest of all types of forming cutters.

In addition to the forged forming cutters there are two other types, the dovetail or straight forming cutters and circular forming cutters. The straight forming cutters detail A, Fig. 10, are mounted on a cross slide in tool holders, similar to those in Fig. 10, details B and C. They are held in a dovetail slot and are locked at the desired height by a clamp screw. The short holder generally is set up on the front of the cross slide, detail D, where a typical job is being formed, while the taller holder is used with an inverted tool on the rear of the cross slide. On some types of work the position of the tools is reversed as in detail E, Fig. 10. Forming cutters of the straight, or
dovetail type, detail A, Fig. 10, have the contour ground the full length of the tool and are set in the holder at an angle to provide front clearance. With the cutting edge of the tool ground flat and square across one end it can be resharpened repeatedly and still accurately retain its original shape. Each tool holder should have rocker or swivel in the base for adjusting any slight inaccuracy in the setting of the cutter or holder. The dovetailed forming cutter, while difficult to shape, is easily set up, the exact form is retained throughout its life and the tool is rigid and can be operated under moderately heavy lathe feeds.

Circular forming cutters, with their contours properly shaped, can be used for a wide variety of operations. The contour running entirely around the circumference gives the tool exceptionally long life. As the cutting edge is dulled by use the top surface can be reground repeatedly and the resharpened cutter, when ground radially, will always retain its original shape.

Circular forming cutters detail D, Fig. 13, are usually mounted in a holder of the type shown in details A, B and C. Often the regular cross slide is removed and another of the type shown in detail E, Fig. 11, is substituted. A typical setup is shown in details A and E where the circular cutter is mounted in the holder at the front of the cross slide and the cutoff tool set up to make its cut from the back. For extreme accuracy the cutting edge is set at lathe center height as in Fig. 12, where the cutter face is in a horizontal plane running through the center of the work. On roughing cuts, Fig. 13, the cutting face can be given a top rake of 5 to 10 deg. This will speed the work but will slightly change the shape of the cut. To give the cut its
proper shape, the finishing tool, with its cutting edge ground radially and set as in Fig. 12, must follow the roughing operation if the work is to match the contour of the cutting tool.

The ability to take smooth finishing cuts with forming tools will depend largely on the rigidity of both the lathe and the tool holder. The tool holder must support the forming cutter rigidly to make moderately heavy feeds possible. The work should be gripped firmly and any overhang supported by the tailstock center or, when necessary, by the steady rest. Overhang of the cutting tool must be held to a minimum for smooth cuts under average to heavy feeds to avoid any possibility of tool chatter.

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**Speed Chart Gives Belt and Gear Settings at a Glance**

All lathes, even the smallest machines, have charts giving spindle speeds and other data for settings of the change gears. But here's an added convenience in the form of a typed chart attached to the hinged headstock guard where the various combinations are easily seen. Arrows indicate belt positions on the motor and headstock pulleys. Gear combinations also can be indicated if desired. The values can be typed or hand lettered on good quality paper and then the sheet is sprayed with a clear lacquer to prevent smudging. Attach the sheet to the headstock guard with glue or tape.—H. Hanscom, Elmhurst, Ill.

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**Lathe Chuck Increases Range of Work on Milling Machine**

A three-jaw chuck makes a handy workholding device on a milling machine, greatly increasing its range of work on small parts which are difficult to mount in a vise. Cuts can be made direct off the machine spindle or by means of the overarm on any parts that are within the chuck's capacity. The chuck can be mounted on the machine table in various ways but one of the simplest is that pictured. Here the chuck is screwed to a flat steel plate, milled on both faces and bolted to the machine table. The chuck is centered on the plate and is held in place with the three screws with which it is normally attached to a backing plate.

**POPULAR MECHANICS**
**Jointer Operation Made Safe and Sure**

First among the ABC-s of safe jointer operation is the rule of always planing with the grain of the wood, detail A. Next, if you must joint the edge of a piece of stock warped along the length as in the lefthand detail, B, take the concave edge first. Then turn the piece over and plane the convex edge, being careful to prevent the stock from rocking. Use the same procedure when facing stock that is cupped, or dished, due to warping. Take light cuts and check the direction of the grain before planing. When planing a taper on square stock or when squaring up wide stock as in the photo, lower the front table of the machine a distance equal to the taper, detail C. Then place the forward end of the stock on the rear slowly. Jointer knives must be sharp.

**Trammel For Large Diameters**

Fit a yardstick or a length of lattice stock with two sheet-metal clips, drill the projections of the clips for a brad and pencil point and you have a handy trammel for striking large arcs or complete circles. The clips should fit tightly so they will hold securely at any desired point.

**Lifter For Glue-Bottle Cap**

Glue bottle caps that snap onto the flanged spout in a friction fit are often difficult to remove. To prevent splitting the cap, drop a small metal washer over the end of the spout before you press the cap in place. The washer provides a means of lifting the cap with a straight pull.
HACKSAWING CAN BE EASY

WHEN SAWING METALS the trick in producing uniformly good work is in knowing how to handle the hacksaw, what blade to use, and how to position the work in a vise. Common hacksaw frames are shown in Fig. 1, the standard frame being the most widely used. Insert the blade in the frame and tighten to the correct tension as in Fig. 2. Lock channels, angles and I-shapes in the vise as in Fig. 4. These positions allow you to cut at an angle through the thin sections. If the parts are relatively small you'll do better work using a blade having 18 teeth per inch. Solid rounds and rectangular shapes Fig. 5, details A and B, can be cut with a blade having 14 teeth per inch. Tubing and thin sheet metal should be placed in the vise between blocks of softwood and cut with a blade having not less than 24 teeth per inch. Note Fig. 5, details C and D and you'll see why, in cutting thin sections, two teeth must always be in contact. Otherwise, you've got trouble. The hole saw, Fig. 3, also is a hacksaw of a type. Use it in your drill press to cut clean holes in sheet metal and large-diameter tubing.
Drill Press Attachment
Cuts Circles in Steel

With this device, a drill press or a portable electric drill can be used to cut disks in light sheet metal. The circle cutter consists of a twist drill holder turned from 2 1/2 x 3/4-in. steel stock. One insert end is shouldered to 1 in. in length and 1/4 in. in diameter. The opposite end is drilled to receive a 1/4-in. twist drill and also is drilled and tapped for set screws. Cross drill another hole through the center of the guide. Its diameter will depend on the size of the shaft and cutters you plan to use. Slip an 8-in. shaft into the holder and on each end mount a cutting wheel taken from a pipe cutter. Fit shaft collars on each side of the wheels to hold them in position. They will permit adjustment for circles up to 8 in. in diameter.

Edwin B. Davenport, Fairfax, Calif.

Butt Hinge Serves as Brake For Bending Sheet Metal

It is possible to make a sharp, right-angle bend in light sheet metal without scratching or marring the surface. A square butt hinge of average length makes a good brake for such bends. Close the hinge on the metal along the line on which the bend is to be made. Grip the hinge with a pair of pressure or slip-joint pliers and bend upward. Larger bending operations can be done by placing the work between two blocks of hardwood or heavier gauge metal. The work, placed between these and locked in a bench vise, can be bent with hand pressure and a rubber mallet.

R. Hanscom, Elmhurst, Ill.

Extra Swiveling Table Bracket Supports Spindle Extension

An extra table bracket, available from the manufacturer of your drill press, can be utilized to carry a bearing for a spindle extension used for milling and high-speed routing. A pipe nipple and tee serve as a bearing for the drill-spindle extension. The pipe nipple is screwed into a floor plate attached to the milled face of the table bracket. The tee is bushed with babbitt to provide a bearing for the spindle extension. The same setup can be used with a router bit for wood working at high speeds or to drive a cup-type abrasive wheel in high-speed grinding operations.

Hugh Botta, New York, N. Y.
Mount Disk Harrow On Auto Wheels

The problem of moving a disk harrow from place to place without causing damage to the blades can be solved by simply adding wheels. If two rubber-tired auto wheels are fastened to the frame of the harrow, they will provide a means of transport that is always ready and available for use. For transporting from one field to another, the harrow is turned over backward onto the wheels. This allows it to be pulled more easily and at higher speeds. This also prevents dulling of the disk blades when they must be taken over gravel or asphalt roads.

A. W. Ranniger, Carroll, Iowa

Ink stains in rugs can be removed if a few simple rules are observed, according to the National Institute of Rug Cleaning, Inc. Ink dries rapidly and should be blotted at once. Use paper towels, tissues, or white cloth. Remember to blot—not rub. Do not use milk, as it may set the stain. Now apply a dry cleaning fluid. Work it in and blot the excess. Then apply a solution of detergent and warm water. Rinse the spot and if it persists, add ammonia to the detergent solution. Regular ink removers are risky as they may remove the dyes as well as ink. Paper towels or cloth, folded to an inch in thickness, are now placed on the spot and weighted down.

Mobile Field-Service Station

This mobile service unit saves trips and time when field work is under way. It is assembled on a four-wheeled trailer to which is bolted a light box. A 100 gal. gasoline barrel is secured by steel hoops. Part of an old tank truck holds oil cans, tools, funnels, a pressure-grease outfit and other needed items. The rig is left in the field and is refueled by the tank truck.

Richard Hatch, Donnellson, Iowa

Use Wooden Ramps To Unload Grain

Where facilities are limited, this ingenious set of ramps takes the place of a mechanical dump to unload grain from trailer to elevator hopper. Each wedge-shaped ramp is set on two 6-ft. runners made of 2x6-in. stock. A 20x10-in. plank extends from one end of the runners up to the top of a 2x10-in. post, 2 ft. high. The ramp is placed under the trailer which is backed up and tilted. The grain is then allowed to pour out into the elevator hopper.

Loren R. Reif, Danville, Iowa
Holes in Line

By C. W. Woodson

When it's necessary to drill rows of holes in line or on a radius as in roughing out a die, a jig gives you a degree of accuracy not ordinarily attainable in any other way. When you know the diameter of the holes to be drilled, make a simple jig as in the sectional view A, and cut two pins from drill rod of the same diameter as the holes. Place the jig and drill the first hole. Insert a pin and drill the next hole. Insert the second pin and drill the third hole as in detail B. The pins serve as locators as is shown in detail C, the jig being inverted to show how the pins keep the row of holes in line. Rows of holes also can be drilled at right angles as in detail D, or on almost any radius by using two pins as in detail E, which shows a jig in use.
SHOPPING FOR TOOLS

1. ELECTRIC SHARPENER uses removable abrasive belts in place of the usual grinding wheel. Wide selection of belts for polishing wood or other soft materials as well as grinding metals. Powered by ¼-HP. motor, grinder is ideal for home as well as shop.

Branick Mfg. Co., Fairbanks, N. D.

2. HEAVY-DUTY GRINDER available in ¼ and ½ hp., features two wheels and tool rest adjustable for height, angle and distance from wheel. Extended frame permits grinding large, odd-shaped parts. Sealed ball-bearings are lubricated for normal life.

The Stanley Works, New Britain, Conn.

3. ZONE CONTROL UNIT for single-pipe heating system is mounted on radiators. Automatic water valve and low-voltage thermostat feed heat from zone to zone. Valve blends water temperatures, eliminating water hammer and heat expansion noise.

White-Rodgers Co., St. Louis, Mo.

4. TINY TAPPING ATTACHMENT weighs ten ounces, has steel tapping capacity from #00 to #6. Lead error eliminated by free floating action and planetary ball reversing mechanism. Spring loaded ball clutch stops tap instantly on hard spots and holes.

Tagmatic Corporation, Costa Mesa, Calif.

5. MIDGET SPEED-LETTERING TEMPLATE allows anyone to do expert lettering. Skeletonized letters made through five cut-outs can be finished free hand without guide or space lines. Cantilevered construction eliminates smearing of inked letters or pencil lines.

Timely Products Co., Baltimore Ohio.
6. PRECISION INSTRUMENT SCALE permits setting of instruments to three decimal places without need for gauge blocks. Has direct reading scale and dial calibrated in .001 increments. Knob moves a helical scriber line on the barrel to give two fixed points for settings in tool and die, and design work where accuracy counts.

Tico Machine Products Corp., Cleveland, Ohio

7. HEAVY-DUTY PORTABLE SAW features a safety switch which cuts off all current in case of overload. Push-button rotor eases blade changes. Balance and comfort are provided by a two-position guide knob. A telescoping rip fence gives 30 percent greater ripping capacity and makes for easy storage. Saw has a 2 hp. motor.

Sears Roebuck and Co., Chicago

8. ROTATING PARTS BIN has four trays that revolve at a touch of the finger. Each tray is divided into five sections, giving easy access to screws, nuts, bolts, nails. Of heavy steel construction, it eliminates the need for shelves and saves bench space. Valuable addition for the shop or hobby enthusiast, also for salvage shops.

Walker Manufacturing Co., Cleveland, Ohio

9. SPECIAL MICROMETER designed with three-point contact, detects out-of-round settings on centerless grinders. Also measures three-fluted cutting tools, taps, milling cutters, and reamers. Used like a conventional outside micrometer, "mx" has carbide facings to eliminate wear under abrasive conditions that can cause inaccuracies.

L. S. Starrett Company, Athol, Mass.

10. ADJUSTABLE STOP GAUGE used on radial and bench saws assures accurate cutting of wood stock. A scale graduated in 1/16 in. is easily set to exact measurement. Locks in place allowing craftsman quick, precise work. Gauge is made of aluminum and fits on either side of the saw. Eliminates need for "C" clamps on saw table.


JANUARY 1960
11. UNIVERSAL SCREW ANCHOR is adaptable to almost any size screw, screw eye, screw hook, etc. Short size makes it ideal for use in modern thin-wall construction. Anchoring ability comes from spring clamps within the square tube. Spring clamps open and hold the screw and spring pressure operates each shoulder independently. Square construction, though fitted into round, drilled holes, has a digging-in quality which assures a permanent fit.

Fitsall Distributors Inc., Hempstead, N.Y.

12. ROLLER-BEARING TAIL CENTER for metal lathes has tapered roller bearings, a replaceable center point and a special bearing adjustment. The roller bearings allow the center to absorb extreme thrust and radial loads with minimum wear. A special built-in adjustment for preload and a take-up for bearing wear prolong the center's life. Center points are of heat-treated chromium steel. Any design may be used depending on the material being machined.

Trio Machine and Manufacturing Co., Cleveland, Ohio

13. RADIAL-ARM SAW has many special features. Out-front controls allow instant, simple, one-hand operation and a selective drive gives a range of seven speeds with the correct RPM for any job. Fence changing is eliminated with a sliding, one-piece table and the coil cord is hidden so it can't be damaged. The arbor can be used at either end, permitting use of the blades on the left or the right sides. This allows full table capacity for all miter cuts.

Tuba Construcitied Industries Inc., San Francisco, Calif.

14. COMBINATION CLUTCH-BRAKE comes as a complete unit with bearings, shaft and stand. Both clutch and brake are magnetically set, including a neutral position. They can be furnished with a common armature, splined to the driving shaft, or given a common hub with separate armatures to key the hub to the shaft with zero backlash. Torque ranges from 25 in. oz. to 175 in. lbs. Both clutch and brake can be wound for voltages up to 90 volts DC.

Stevens Electric Corporation, Milwaukee, Wis.

15. A BIT of novel design makes it possible to drill holes up to 2.9/16-in. in diameter with a ¼ or ½-in. drill. Tool steel blades mounted on extensions allow holes to be drilled to any depth. Plumbing and wiring can be installed without disturbing existing plaster walls. Planing action of the drill cuts only .020 in. per revolution, requiring less torque than other bits of similar size. Extensions are threaded so that ordinary pipe may be used for extension.

Time Saver Tools, Inc., Skokie, Ill.
Miter Gauge and Saw
Turn Perfect Tenon

A dowel hole bored by hand in the end of round stock will probably not be perfectly concentric, or in exact alignment with the axis. Avoid such inaccuracy by sawing a round tenon on the end of the stock. Clamp a miter gauge to the table of a circular saw so that the work extends over the center and at right angles to the blade. Adjust the saw or table for minimum depth cutting. Using the fence as a stop, rotate the stock against the direction of blade rotation and remove a layer of wood the length of the tenon. Readjust the cutting depth until the desired diameter is reached being careful not to cut too deeply.

Sandpaper Slides Into Place
With Aid of Metal Plate

When fitting sandpaper into a floor sander, it is necessary to get the ends of the paper well down into the slot of the drum. This is difficult to do with the open-coat abrasive because the rough surfaces contact one another and prevent the ends from sliding easily. If a small metal plate—long enough to cover the entire width of the paper—is slipped between the sandpaper faces, it will prevent them from contacting one another and will permit them to slide freely into place. The metal is removed before clamping the paper.

Large Spring Clip
Keeps Sandpaper Handy

Loose and scattered sheets of sandpaper can often lead to a case of short temper and frayed nerves—especially when you can’t find the particular grade of paper you’re looking for. A large spring clip makes a convenient sandpaper holder, and since the clip can be hung on a wall the paper remains flat and isn’t apt to get creased and crumpled as it would in a drawer. The desired grade can be selected quickly by leafing through the sheets and can be removed from the clip without removing the rest of the paper.
Selecting and building the components of your personalized stereo-fidelity system takes some work and a more-than-superficial insight into the problems of sound reproduction. But the results are worth the effort. In this article, after some initial thoughts on hi-fi buying, we'll describe the construction of an equipment cabinet. Subsequent articles will deal with the selection and construction of speaker systems and electronic component kits which meet your individual needs from a standpoint of both quality and cost.
For the quality you want, at a price you can afford
CUSTOM BUILD YOUR STereo Hi-Fi SYSTEM

PART I
By Lothar Stern

LET'S TALK HIGH FIDELITY. Let's dispense with the glowing adjectives of the advertising-copy writer and discuss it in the more subjective terms of what, why and how. The object—to help answer some of the questions that will come up when you go to buy your hi-fi music system, and to help you select units which fill your immediate needs without becoming obsolete in the wake of future developments.

What is fidelity? Webster calls it "exactness—as in copy," and no one will quarrel with this definition. It's when we add the word HIGH that we run into conflicting opinions. The manufacturer of a low-priced unit may well justify the hi-fi label on his instrument by comparing its performance with that of a table-model radio or portable phonograph, and the difference is often demonstrable. But the connoisseurs, those who love and KNOW music, have different values. They rate a system not in terms of how much better is it than an inferior one, but how much worse is it than the ultimate—the orchestra itself. And by those standards the difference between a true high-fidelity system and some others bearing the hi-fi label can be as dramatic as the difference between today's motion pictures and the "flickers" of yesteryear.

Balancing this performance difference is the difference in cost. Perfection, or near-perfection, in anything is expensive, and hi-fi is no exception. The person who buys a low-priced unit on the strength of the hi-fi label alone is likely to be seriously disillusioned after a more intimate contact with true high fidelity.

On the other hand, let's be practical. The high cost of hi-fi is hardly justified for the casual listener. If you like music only as a background—to bridge the lull in a conversation or to stimulate the appetite—if the boom of the bass drum gives you a headache or conditions prevent you from playing your music system just barely above a whisper you may as well stick to one of the lower-priced music systems which can satisfy your musical tastes at a relatively low cost. If, however, you enjoy listening to music for an hour or two to the exclusion of other activities, if you want to hear music as it was intended to be heard, an investment in anything less than true high fidelity would be a poor one indeed.

Two Ways to Buy Hi-Fi

There are two ways of buying your hi-fi system. The first—and that's the easiest way—is to visit a large music store, pick out two or three sets within your budget, listen to them and buy the one that sounds best. The whole procedure shouldn't take more than an evening or two and chances are that your purchase will be quite satisfactory—at least for a while.

The second method is far more involved, but in the long run it offers a number of advantages. It consists of buying the separate components which make up a complete system and interconnecting them yourself.

About Furniture Consoles. What's wrong with complete, cabinet-installed hi-fi systems? From a standpoint of actual performance—nothing. Today it is possible to buy cabinet consoles which perform as well as some of the best custom-built systems. But you can't buy these in tabletop designs or at bargain prices. Good lumber is expensive and cabinet makers don't work for nothing. While a mass-produced cabinet costs less than a custom-built
Small but representative sampling of kit-built hi-fi components includes preamps, radio tuner, power amplifier, tape recorder and record player. Critical selection assures top quality at lowest cost.

One, you'll still pay considerably more for a cabinet model than for individual components capable of equivalent performance.

But even if you're willing to pay extra to have everything neatly consolidated in an attractive piece of furniture, the cabinet models still have a number of drawbacks. No. 1—lack of self-expression.

When you buy a cabinet model you buy the components which the manufacturer thinks are best in a given price range. But his ears aren't necessarily the same as yours and his opinion of what's best may differ quite radically from your own. Then, too, your choice is likely to be governed as much by cabinet styling as it is by actual sound quality. This sounds better, but that one looks better; and so you buy for style rather than quality.

Versatility must be considered too. Few phono consoles have provisions for the eventual addition of a radio tuner. If you buy a radio-phono combination, you'll run into the same problem should you try to add a tape recorder at a later date. And, in the event of major changes in the hi-fi field, such as the recent advent of stereo, a cabinet model may become virtually obsolete.

What About Separate Components? Most of the limitations of cabinet models are obviated by the purchase of individual components. You can choose from literally dozens of record players, tuners, amplifiers and speaker systems in almost any price range. You don't get a cabinet, unless you buy one at a premium price, but then you're no longer tempted to sacrifice sound quality for furniture appearance. You choose the components that sound best to your ears; you buy with an eye towards possible expansion, and in the event of future changes you replace only the part that is obsolete.

But don't expect to save money on components-built hi-fi systems. In fact, the reverse is often true. By the time you're through comparing components in various price ranges, you'll realize that there is a difference. Flaws, compromises and inconveniences often overlooked in cabinet models are actually accentuated in a components-comparison and, initially, you'll probably spend as much for a components system than you would for a furniture model. But you'll have better sound, more lasting satisfaction and a new interest in good-musical listening which makes the selection of hi-fi components a highly rewarding project.

Building Your Own

There's one way, however, of obtaining the ultimate in fidelity while still going easy on the family budget. That's by building the components yourself.

Now hold on a minute! Before you turn to the next article because you even had trouble assembling Junior's bicycle, read just a little further. You can build your own hi-fi system! Regardless of your previous electronic experience—even if you don’t know the difference between a resistor and a vacuum tube—you can put together a number of component kits which perform as well as the best commercially assembled jobs at a savings of up to 50 percent. All you need is a little patience, willingness to follow instructions and the ability to use a soldering iron and other simple hand tools.
But it does take some effort, and the actual assembly of the components is likely to be the easiest part of the over-all job. **The Specifications Story.** When you buy a cabinet model, or even factory-assembled components, your ultimate selection will probably be based on a listening test. Most cities, and many of the smaller towns, have demonstration rooms where hi-fi components can be compared. Test records and tapes are available to help you in your selection (these will be discussed more extensively in a future article) and you need only a superficial acquaintance with the principles of high fidelity.

Not so with kits! These are normally purchased by mail directly from the manufacturer and there are few, if any, places where kits of various concerns can be compared. When buying kits, therefore, you are dependent almost entirely on the manufacturers specifications and your ability to correlate these to your requirements.

Are the specifications accurate? In most cases—yes! This opinion was arrived at after the construction and test of a good number of kits by different manufacturers, and by carefully studying independent laboratories' reports on others. Variations do exist but, in most cases, kit manufacturers are scrupulously honest in their ratings and a number of kits tested actually exceeded some of the specifications claims.

Entirely aside from the money-saving aspect, building your own hi-fi system offers some very worthwhile fringe benefits. Kit building is fun—providing you enjoy that type of activity as a hobby—and there's real satisfaction in saying "I built it myself" when others admire the performance of a particular unit. But more than that, the knowledge gained contributes to the more efficient use of the equipment and can substantially reduce maintenance and repair costs. Summarily, a kit-built system represents the most for your money—both in performance and satisfaction.

**The Equipment Cabinet**

Hi-fi components are attractive. They are as much at home on end tables and open shelves as they are in custom-designed cabinets. But they must be interconnected with cables, and the "interior decorator" is likely to balk at a maze of wires marring the decor of her livingroom. A cabinet, therefore, is an essential part of most high-fidelity systems.

Describing the construction of an equipment cabinet before discussing the equipment itself may seem a little like placing the cart before the horse—but it isn't. While many aspects of hi-fi are subject to personal opinion and preference, one thing is certain: the hi-fi enthusiast eventually will want a complete system—record player, radio and tape recorder. Though the budget may limit the initial purchase, the relatively low cost of electronic kits permits rapid expansion. The cabinet must be able to handle your total needs and the unit described here meets this condition.
BUILDING AN EQUIPMENT CABINET

Designed with the do-it-yourselfer in mind, this cabinet includes all the features required for a complete, functional stereo-fidelity system. It's small enough (only 16¼ in. deep) to fit into most living-rooms and its contemporary styling blends in with virtually any type of furniture. Simple enough to be built by anyone familiar with the use of a power saw, it depends mainly on the matched grain of the wood itself for its distinctive appearance.

There's no dustcatching trim and no fancy fittings. Press-to-open touch latches eliminate the need for handles and its very simplicity is your assurance that, if you like it now, you won't tire of it in the years to come.

But let's take a closer look at the design. Horizontally, the cabinet is divided into two sections. The upper section has three compartments—the lower one, two. The upper right-hand compartment is designated for a record changer, concealed by a hinged top, while the identical left compartment can house a tape recorder.

The center section of the top is permanently fastened down so that it can be used as a resting place for a decorative center piece. Access to the center compartment is gained through a drop-leaf front panel so that there will be a minimum of stooping when manipulating the controls of the components (the preamplifier and radio tuner) mounted in this section.

Record storage is provided in the lower right-hand section which, alternatively, could be employed as a speaker enclosure. There's ample space in the lower left-hand compartment for a power amplifier or any other components or accessories which may be desired to round out the system.

A word of warning here. While all compartments are large enough to house a representative number of components, it would be impossible to design a single cabinet to fit every possible combination.

### TABLE 1 — LIST OF MATERIALS

<table>
<thead>
<tr>
<th>SHEET VENEER PLYWOOD, ⅛&quot; x 48&quot; x 96&quot;, (Veneer two sides, matched one side)</th>
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<tr>
<th>SHEET ⅛&quot; FIR PLYWOOD</th>
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Weldwood flexible wood trim (veneer tape), 9 rolls, or 1" x 8'; Weldwood plastic resin glue—mix as directed—for all glued joints; Weldwood contact cement for flexible wood trim; 1" x 2" (open) butt hinges (10); 1 pr. cabinet hinges (IR & IL) for center drop door; friction lid supports (1 for each lid, 1 for center drop door); Stanley reversible lid supports, (2 for each lower door); brass legs (6") with mounting plates; rubber tack bumpers (4).
without a considerable increase in size. If you already have a set of components, check the dimensions to make sure that everything will fit properly. It’s a relatively simple matter, in the initial layout, to allow for an extra few inches in any direction.

Almost anyone handy with tools can put together some sort of cabinet. It’s the choice of lumber and the attention paid to construction details which spells the difference between a professional job and one which looks like the homemade variety. We’ll try to point out some of the pitfalls but the main thing is—work slowly, carefully, accurately. It’s faster to measure twice and be sure you’re right than to waste a piece of material and start over in the event of an error.

**Choice of Lumber.** Before you can order your materials you’ll have to decide what type of lumber you want. This cabinet was made of ¾-in. walnut-veneered plywood which takes an excellent finish. To match the other furniture, you may prefer some other veneer. They’re available in a great many types and patterns. A visit to your lumber or plywood dealer is recommended so that you can personally select your exact requirements. Matching the grain pattern of the exposed pieces is important. Take a close look at the front-view photograph of the completed cabinet. It isn’t by accident that the “flames” of the upper panels coincide with those of the lower ones. It was planned that way.

The patterns of some veneers may be confusing and it is sometimes difficult to pick just the right combination. One good method is to cut out full scale tissue paper templates of the necessary veneered pieces (see Table 1) and to move these around on the matched veneer surface until the best possible solution has been worked out.

Employ the factory-cut edges of the plywood sheet as one edge of as many pieces as possible. This gives you a straight edge to use as a guide on your bench saw. If you’re careful, you should be able to cut all the face pieces from a single 4 x 8-ft. sheet of veneered ply, but some of the more difficult patterns may require a second sheet.

Now trace the templates on the wood surface with chalk or a soft pencil, being careful not to score the surface. Since the face veneer is only ½-in. thick, it is easily damaged beyond satisfactory repair. Label each piece with the code number coinciding with that in Table 1 and in the “exploded view” drawing.

You’ll need a sharp handsaw, or a portable power saw, to rough-cut the individual pieces from the large plywood sheet. Be careful here—the underside of the thin veneer chips easily when cutting across the grain. Unless there’s plenty of space between the pieces it’s a good idea to “score” the underside of the wood deeply with a sharp knife near the “finish” line. Any chipping will then end at the scored line.

Finishing cuts on the individual pieces should be made on a bench saw, but even here care must be taken to avoid chipping. The use of a planer (hollow ground) blade helps, but doesn’t eliminate it altogether. The best way is to accurately set the rip fence of the saw for the final cut and score the underside of the piece by running it through the saw with the blade clearing the table by a mere ⅛th in. Then, when you finally cut off the waste, with a second pass, you’ll have a clean edge which requires no sanding.

Before you touch a blade to the wood,
carefully study the construction details of the exploded view and the side and rear views. Since complete, step-by-step instructions can't be given here, it will pay you to become thoroughly familiar with the various parts of the cabinet and with the assembly details. We can, however, point out a few details which will help clarify the construction.

**General Construction.** Tongue-and-groove construction, with rabbets for the lid-hinge support piece (P) and bottom piece (K), is used throughout. This provides a sturdy cabinet while eliminating the need for unsightly and hard-to-install cleats. All joints are made with a good wood glue (see list of materials) which, when dry, makes a stronger and neater union than either nails or screws. All exposed plywood edges are covered with Weldwood flexible wood trim (to match the surface veneer) to give the completed cabinet the appearance of being made from solid lumber.

Careful inspection of the drawings reveals that, wherever a tongue-and-groove joint is used, the tongues are \( \frac{3}{4} \) in. less than the total length or width of the panel and the grooves are correspondingly "stopped." This adds gluing surface, thereby increasing the strength of the joint. The rabbets in bottom piece (K) and the corresponding rabbets in side pieces (I) and (J) are similarly treated.

Special attention should be paid to compartment separators (M) and (N). Detail 3 shows the cutting details for these pieces. Note that the \( \frac{3}{4} \times 6\frac{1}{2} \) in. notch in the rear permits flushmounting of lid-hinge-support (P) with the back edges of the side pieces. A \( \frac{3}{8} \) in. step in the top edge of both (M) and (N) raises the permanently fastened lid (B) slightly above the two outside lids. This small difference is compensated for in the front by rubber bumpers fastened to the top edges of (D) and (F). In the rear, the outside lids are leveled by careful recessing of the hinges.

The \( \frac{3}{8} \) in. steps in the front edges of (M) and (N) provide the slight amount of clearance needed for proper operation of the touch-latch used in conjunction with drop-door (E).

Looking at the rear view, the holes and cutouts in lid-support (P) and back (Q) are for ventilating purposes. Electronic components get hot during operation and require adequate air circulation. The number of holes and the pattern isn't important. Remember, however, that each compartment housing a heat-producing component must be furnished with a cool-air intake at the bottom and a hot-air outlet at the top. The more material cut away, without weakening the panel, the better.

After all parts have been cut to size, dry-fit all joints—that is, assemble all unhinged parts. This is the time to check for accuracy of fit and to correct any discrepancies—not after glue has been applied. You'll probably need some help for this, unless you have enough bar clamps to hold the cabinet together. Always protect the stock from damage by clamps with wood blocks. Check everything carefully. After glue has been applied, it may be too late.

Satisfied with the fit, you can start the final assembly. Try to have everything you need in readiness beforehand—glue, a damp rag with which to
wipe off the excess, sufficient bar clamps, and a try square to check for squareness of the assembled parts. Use plenty of glue between the joined pieces—enough so that it oozes out all along the edges as the joint is brought under pressure. The excess, however, should be wiped off, before it has had a chance to harden.

Best starting procedure is to lay the end pieces (I) and (J) on edge and join them to bottom piece (K). Wood screws may be used, through the bottom piece, to hold these parts together. They won’t add much to the strength of the union, but they will eliminate the need for an unwieldy set of clamps. If screws are to be used, be sure to predrill pilot holes (after checking for squareness) before glue is applied.

Horizontal divider (E) is next, followed by front panels (D) and (F). Again, make sure that all parts match perfectly.

The rest is easy. Like the bottom piece, hinge support (P) may be fastened to the sides with screws since these won’t show from the front. Dividers (M), (N) and (O) are next, followed by lid (B). The latter may need to be trimmed so that it just bridges the stepped-up edges of (M) and (N).

Now it’s time to tape all exposed edges. Contact cement is recommended for this job, but this takes special care. You only get one chance, since the cement makes an immediate bond. Make sure that the tape lines up evenly with the entire surface before making contact. Otherwise you’ll ruin a lot of tape. Trim the excess tape with sharp knife or razor blade and finish with fine garnet paper.

Hinges for lids (A) and (C) are recessed in the top edges of (P) and underneath the lids. Properly installed, they will raise the back of these pieces ¹⁄₄ in., to be flush with the back of center lid (B). The outside lids are leveled at the front with rubber bumps installed on the top edges of (D) and (F). The bottom doors (G) and (H) are then hinged in a similar manner.

Knife hinges are used for the drop-door (E). Remember, however, that all doors and lids must be taped before being installed. A bit of jockeying, even some edge trimming, may be required to obtain a close fit between these and the adjacent stationary panels.

Installation of the ¼-in. plywood back (Q) and the various items of hardware completes the construction project. The hardware consists of three friction lid supports (one for each of the hinged lids and one for the center drop door), four reversible lid supports (two for each of the bottom doors), three touch latches and a set of brass legs with mounting plates. The instructions supplied with the touch latches should be followed carefully to assure proper operation of the three doors.

A word about “finishing.” The appearance of even the best cabinet can be utterly ruined by a poor job of finishing. The way you finish your cabinet depends, of course, on the rest of your furniture. You may wish to stain or just varnish the outside, or you may decide to paint the whole works. We won’t try to second-guess your requirements by furnishing instructions here. Anyway, there’s plenty of available literature on the subject and we suggest you visit your library unless you’ve had plenty of previous experience in this line of work.

Looking Ahead

For all practical purposes, the cabinet is finished. There still remain a few odds and ends, but these will have to wait until you have selected your equipment. For example, you’ll have to provide corner posts or some sort of frame to which the mounting boards of the record player and tape recorder can be fastened (see “exploded view”) and you’ll have to drill holes in various separator panels through which (Continued to page 282)

POPULAR MECHANICS
Fastest moving Sea-Horse ever launched

JOHNSON V-75

... combines new speed, power and dependability in 1960’s “dream” motor!

The 1950’s were exciting years in outboading! Ten years ago who could have imagined the progress that has been made in outboard power, speed and dependability?

An all-new motor for a new decade
But what lies ahead for the 1960’s? Johnson engineers have come up with their answer—the all-new Sea-Horse V-75, a “dream” of a motor. For the first time in outboard history you can get the best of speed, power, quietness and dependability in a single power plant.

A new high in “V” power
Johnson’s famed, balanced-firing V-engine design now develops a full 75 hp, O.E.C. certified at an easy running 4500 r.p.m. Displacement is 89.5 cu. in. This fast-thrusting power makes heavy cruisers feel frisky as runabouts!

New speeds of over 40 m.p.h.
Actual on-the-water tests have verified that this is the fastest moving Sea-Horse ever launched. One reason: the V-75 has a remarkably compact, yet complete, lower unit gearcase. The lower unit is blade-thin, cutting the water with far less drag than any lower unit ever before—an engineering masterpiece when you consider that it still allows full gearshift. You also get a choice of 3 propellers, at no extra cost, to get maximum performance whatever your boat or load.

New ideas in dependability
Over two million Sea-Horses already built (more than any other make) have earned the reputation of being the most dependable outboards afloat. But Johnson engineers were not satisfied. For 1960 the V-75 has outboading’s first automatic choke for faster starting in any weather. They have added new hydraulic shock absorbers to absorb the shock of the motor when it flips up and comes down, should you hit an underwater obstacle at high speed.

New Sea-Horse V-75...$895 with electric starting

See this exciting V-75 and six other new Sea-Horses, 3 to 40 hp, now at your Johnson dealer’s. He’s listed in the Yellow Pages under “Outboard Motors.”
New Dexall Brush Cleaner

- Cleans paint hardened brushes easily.
- Cleans all types of bristles.
- Nonflammable — re-usable.

Snaps paint-hardened brushes back to life!

DESHLER PRODUCTS, INC.
Deshler, Ohio

Modernize old-style wood finishes

New Dexall Wood Bleach

- Effective, fast-acting on woodwork, furniture, floors.
- Will not harm wood or natural grain.
- Nonflammable. Eliminates hours of sanding!

At paint and hardware stores everywhere.

Clinic for Homemakers

As a service to our readers in solving the hundreds of problems pertaining to a home-inside or out—the editors of Popular Mechanics invite you to present your problems to The Clinic Editor for help and advice. Address your questions to The Clinic Editor, Popular Mechanics Magazine, 200 East Ontario Street, Chicago 11, Ill.

Salvaging Old Workbench

Q—I have just purchased an old cabinet workbench in used (very much used) condition. The top is very rough, chipped, or hacked away on the front edge near through the thickness of 3 in. One drawer front is split across its width and the whole cabinet shows the marks of long and hard usage. But the bench is all hard wood and heavy and I'd like to put it back in usable condition. Any suggestions? J. L., Pa.

A—We'd begin with the top. Wire brush the chipped or hacked area to clean off dust and grit, metal chips and whatever else may be present. Then cut away the damaged wood with a sharp chisel, cutting in from the edge and down from the top on a scribed line so that you finish with a side mortise large enough to remove all the damaged wood. Then fit a piece of matching wood into the opening, taking care to cut the piece to a close fit. Glue and clamp the filler piece in place. Take the damaged drawer next. Remove the side drawer by tapping the parts lightly with a hammer or better, a wooden mallet. Open the split, apply glue and draw up tightly with clamps. If the split is not too old, you should get a reasonably good joint. If the drawer bottom is damaged in any way or is coated with dirt or soiled with oil, now is the time to replace it. The same is true of the sides. Separate the parts carefully and then make a duplicate part or parts, as a replacement. Plane the top first across the width and then lengthwise to expose new wood. Plane the patch flush at the edge. Any unwanted holes that may have been drilled in the top can be plugged with short lengths of hardwood dowel.

Closed Louvers

Q—During the winter months my low attic seems to be very cold, in fact, the temperature is very nearly equal to that outside on a cold day. It has seemed to me that it would be best to close the louvers during the winter months. Do you agree? N. M., Minn.

A—No. If you close the louvers tightly, you are inviting trouble from moisture condensation. Leave them open all winter long for that is when they do their best and most important job, that of ventilating the attic, equalizing the temperature with that outside and preventing frost formation.

(Continued to page 259)
YOUR ROCHESTER-GM CARBURETOR SPECIALIST OFFERS THESE FACTORY-RECOMMENDED WAYS TO NEW CAR POWER!

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in the attic space on exposed nails and rafters. You do not mention undue consumption of fuel, or any shortage of heat and this is an indication that your home is well insulated and provided with a vapor barrier and that the louvers are of the correct size to adequately ventilate the attic.

Paint Peels From Casing
Q—Every year the paint peels from my window casings. I’ve tried everything I could think of to prevent this, have used different kinds of paint, removed the paint to the bare wood and primed with shellac, aluminum paint, and a prepared primer. Still it peels from the outside surface. What causes this and what can I do to prevent it?

Y.S., New York

A—Using different kinds and types of paint will not prevent the trouble. You must have old type window frames with weight wells at each side of the frame. Moisture from the air in the rooms passes into the wells around the trim which is never tight. It then forms its way through the casing to a point under the outside paint film. Here it breaks the bond of the paint and causes it to peel from the wood. Sometimes this can be prevented by removing the the trim pieces, cleaning the exposed face of the casing with asphaltum varnish or a prepared primer and a finish coat of oil-base outside paint. Or, fill the space within the weight well with an insulating material, cover it with a vapor barrier such as aluminum foil or any of the various coated materials available for this purpose. Then hang the sash on spring balances.

Fireplace Wood
Q—I have a large natural fireplace that I like to make use of during the fall and winter months, but the cost of such woods as I’ve been using are prohibitive. Just what is the longest-lasting wood for a fireplace? We seem to burn a lot of wood but don’t require much heat in return.

T.D., Ky.

A—Perhaps the kind of wood is not so much at fault as are the methods of laying and maintaining a fire. We note your mention of a large fireplace. If, for example, you build and maintain a relatively “clean” small fire in a large fireplace you will use a lot of fuel and get very little heat from it. If you lay and maintain the fire on a low bed of ash, or no ash at all, you will get the same result. If you keep the damper wide open the fire will burn brightly until the fuel is consumed and most of the heat will go up the flue, more especially if the latter is long and straight and the draft is strong. The trick in keeping fuel consumption at the minimum and at the same time obtaining maximum heat from an open fire is largely in the methods of laying and maintaining the fire and of adapting the methods to the conditions. The best procedure in a large fireplace begins with use of a backlog of the correct size. This should be cut to extend only 2/3 the length of the fireplace and should be at least 6 in. or better, in diameter. Green wood is best, but if the backlogs are seasoned leaves them, so that they are always damp. Keep the fire burning against the backlog with smaller sized pieces of fuel.
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I Lived With the Astronauts
(Continued from page 112)

cargo net. However, because of the many variables involved, a complicated network of communications—directed from Cape Canaveral—is being established and tested on practice shots to insure that trajectory information can be dispatched to the recovery force as quickly and efficiently as possible.

Reactor nozzles. Astronaut Gus Grissom told me: “We’re having some difficulty with the reactor nozzles that control the attitude of the capsule. There’s too long a delay from the time the pilot activates the control until the reaction takes place.” There has also been some difficulty with the automatic pilot picking up stray signals which confuse the mechanism. Both of these problems have been referred back to the manufacturers of the equipment and are under study there.

Reliability of the Atlas booster. Deke Slayton, whose specialty is the Atlas, says: “There’s no question about the ability of the Atlas to put us in orbit; our only problem here is reliability which so far hasn’t been good enough. But we know we’ll have that licked by the time we’re ready to use it.”

Pressure suits. One of the most vexing problems facing the Astronauts is proper protection of the pilot against the heat of re-entry. When the capsule plunges into denser atmosphere as it comes out of orbit, air friction will heat it to 1600 degrees F, on the downward end, the interior temperature of the capsule walls will rise to about 300 degrees F., and the air temperature to over 100 degrees. A suitably ventilated pressure suit to protect the Astronaut against this heat has not yet been perfected. Thus far, in simulated flights, the Astronauts have been wearing Navy Mark IV suits. They now have on order 20 suits in which the air will flow through a waist connection, circulate through the suit and be exhausted through a pipe in the helmet. They hope these suits will solve the ventilating problem.

Minor Difficulties Will Arise

The foregoing will give some idea of the specific sort of problems with which the Astronauts are wrestling. The major breakthroughs are behind them, but minor difficulties will probably continue to arise right up to flight time.

What is flight time? Although it is impossible to pinpoint dates, there is a definite progression that will have to be fulfilled before one of the Astronauts is (Continued to page 254)

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actually put into orbit. Here is the sequence of events that will take place before the first manned orbital flight:

1. **Firing of empty ballistic capsule.** On Sept. 9, 1959, a model of the Mercury capsule—called “Big Joe”—was fired for the first time, and the capsule recovered in the South Atlantic. Failure of the Atlas stages to separate properly caused the firing to be reported as unsuccessful. But the primary objective for Project Mercury—to discover how the heat shield of the capsule would stand up under the heat and shock of re-entry—was successfully fulfilled. Although the Atlas' failure caused the capsule to fall some 200 miles off the scheduled impact spot, the tracking system operated well, and the capsule was recovered speedily. The automatic parachutes opened as they should and cushioned the descent of the capsule. The heat shield also passed its test with top marks. I examined the recovered capsule—still packed with seaweed—in the NASA laboratories, and it appeared in excellent shape. There is little doubt that, had a man been aboard, he would have survived the flight.

The firing was the first of a series of such shots to be made with the empty capsule. No one knows how many will be necessary to prove out the equipment, but an educated guess might be a half dozen, with the last one or two employing the actual Mercury capsule with full instrumentation.

2. **Firing ballistic capsule with an animal aboard.** Once the equipment is found satisfactory, animals will be strapped in the Astronaut's couch in actual Mercury capsules and fired on the ballistic range—using Redstone rockets which are cheaper than the Atlas. The animals will probably be monkeys or chimpanzees. The scientists would like to use a gorilla or a bear because their size and weight more closely approximate those of a man, but these animals are extremely difficult to handle and can't be put under sedation without confusing the medical data needed. A compromise possibility is a pig, which is easy to handle and has tissues comparable to man. There will probably be another half-dozen ballistic shots with animals aboard.

**First American in Space**

3. **Firing ballistic capsule with a man aboard.** If we are to deal seriously with “firsts,” the first American in space will actually be the first Astronaut to ride in a Redstone ballistic shot. The Redstone will carry the capsule about 100 miles into the air and some 130 miles out over the Atlantic from Cape Canaveral. At the

(Continued to page 256)
top of its trajectory, the Astronaut inside the capsule will have about five minutes of weightlessness in which to find out how he will react to the longer orbital flight to come. The entire Redstone flight will take about 15 minutes, and everything will be automatic. Stresses on the pilot will not be as great as the orbital shot, weightlessness will be shorter, acceleration less, and heating on re-entry not as severe. But the five minutes will be invaluable in preparing the pilots for the orbital shot. Probably three or four—possibly more—of the Astronauts will take this ride, with about a month required between firings to get ready for the next one. Project Mercury officials hope to send the first Astronaut on a ballistic missile ride sometime in 1960.

4. Orbital flight and recovery of the empty capsule. This step may be eliminated if the preceding steps have been satisfactory and the Atlas has proven its reliability in other tests. The Atlas is expensive, and if Mercury officials feel that no new data can be turned up by firing an empty capsule into orbit, they may pass this step completely. It’s impossible at this point to predict, but the chances are that this shot won’t be deemed necessary.

Animals First

5. Orbital flight with animals. This is an absolute prerequisite of manned space flight. The animals which prove out best in the Redstone firings will again be introduced to the Astronaut’s couch and sent this time into orbit. These flights will provide all the remaining necessary data for putting a man in orbit. Physiological reactions of the animals will be carefully observed, all of the automatic controls will be checked in actual operation, and re-entry and recovery techniques tested.

6. Manned orbital flight. Finally, after all the special problems have been solved and all the previous steps performed with success and reliability, the first Astronaut will be sent into orbit. He will probably be told several days, at least, in advance of the firing; there will be no last minute histrionics. (The Astronauts have a wonderful cartoon posted on their bulletin board which shows seven men doing push-ups in the morning haze at Cape Canaveral, with the project director looking on trying to make a choice.) Selection probably will not be willy-nilly, nor by lot; by the time this step is ready to be taken, chances are that special conditions will dictate the selection of the Astronaut to go first. If a reasonable choice is available—and the Astronauts think there will be—the selection will be made that way, probably by the project director.

All of the Astronauts will have an important part in the orbital flight. Four will probably be at Cape Canaveral, one in the capsule, the others working in control and communications centers. Two of the remaining Astronauts will be spotted at strategic tracking stations around the globe, while one will work with the recovery team. An Astronaut—who fully understands what is going on in the capsule—will be on hand at every control point where a vital decision may have to be made. And the Astronaut in the capsule will be able to communicate with one of his fellow Astronauts whenever he feels the need.

The Astronaut making the flight will be fed a low-refuse diet for several days before the shot. There will be no provision for refuse disposal or food in the early flights; urine will be taken care of in a tube.

When the Atlas is ready for firing, the Astronaut will mount the gantry and crawl into the couch secured to the bottom of the capsule. He will be strapped in at about seven stress points along his body. When all the equipment has been carefully checked, there will be a countdown, then a blastoff. This is probably the most dangerous point of the entire operation. If the Atlas doesn’t fire properly, then an instant decision has to be made in either the capsule or the central control to abort the Mercury mission. There won’t be much time to think it over. Once the decision has been made, the press of a button will activate a set of emergency rockets which will separate the capsule from the Atlas, and blast it 2500 feet into the air. There an emergency parachute will open and lower the capsule and its occupant into the water.

Capsule Will Go Into Low Orbit

If the shot is successful, the Atlas booster will be left behind at a height of about 50 miles. The missile itself will continue to about 100 miles, going into a low orbit. At this point in the flight the capsule will be separated from the top of the Atlas rocket, and the Astronaut will orbit by himself, weightless and free of the earth’s atmosphere.

First, he will turn the capsule over, with the fat end forward—the position in which his re-entry will start. Then, watching the periscope in front of him, he will be able to see about 1500 miles of the earth’s surface scudding below. He can track himself and check the altitude of the capsule by visual reference to the horizon and geographical check points. He will have voice communication with various tracking sta-

(Continued to page 258)
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Stainless steel oil rings deliver superior oil control—and for easily understood reasons. First, stainless steel resists the corroding and pitting effects of the gases of internal combustion engines. This means the oil ring surface stays clean. There is nothing for sludge or carbon to cling to. Thus the return oil vents stay open and you get the long lasting oil control you expect.

Second, stainless steel has no significant tension loss at engine operating temperature. This is unlike carbon steel oil rings. No tension loss assures proper tension of the side rails of the oil ring against the cylinder walls—even in tapered and out-of-round bores. Again, this proper tension is exerted for the entire life of the ring which means better oil control longer.

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tions as he passes over them; if voice fails, he will be able to communicate through telemetry.

All of the control adjustments necessary to orbit the capsule, correct its altitude, and eventually guide its re-entry will be automatic. If the automatic controls work properly, it won’t be necessary for the pilot to do anything more than observe. But no one—least of all the Astronauts—expects this to happen.

“We’ll take advantage of every opportunity to operate the equipment,” said Al Shepard. “Everything automatic can also be done manually. We’re up there to bring back data; certainly we’ll play with the controls.”

After about 4½ hours—during which the capsule has orbited the earth about three times—retro-rockets will automatically turn the capsule downward almost vertically and push it once again into the Earth’s atmosphere. If the automatic retro-rockets don’t operate properly, the Astronaut can fire them manually from the capsule or they can be fired from the ground. Here the friction of the capsule pushing air out of its way as it returns Earthward will produce intense heat, both inside and outside the capsule. The atmosphere will also slow the descent of the capsule until it reaches 65,000 feet; a drag chute will open to steady the capsule and further reduce its speed.

At about 20,000 feet, the main parachute will be thrown out to cushion the final descent. Throughout the descent, ground communications stations will track the capsule and plot the spot it will land. If all has gone properly, it will drop into the ocean. The Astronaut’s couch will protect him against the impact, and the capsule will float until the rescue team arrives to draw it out of the sea—brought to the exact spot by lights, radio signals and dye markers all spread automatically from the capsule. Thus will end the first extended junket by an American into space.

Years of Effort

Behind this trip will lie many years of dedicated effort from thousands of hardworking and talented people to whom success means a great deal. One of the NASA scientists told me, with very real feeling: “What if we kill the first man? That’s what worries me. It’s a life that we can’t spare, certainly. But it’s much more than that. It might ruin the whole project—make us all look like a bunch of half-baked dreamers. We all know this thing is right and that it will work, but there’s always a chance of failure the first time out. That’s

(Continued to page 280)
198 lbs.

(why Volkswagen's aluminum engine is still years ahead of its time)

Dead weight in an engine is the enemy of efficiency. That's why airplane engines are made of aluminum. Why Volkswagen's engine is ingeniously cast of aluminum and magnesium alloys (even lighter than aluminum).

Volkswagen reduces dead weight in still other ways. The engine is air-cooled—no bulky radiator. (No water to freeze in winter, or boil over in summer.) And placing the engine in the back gets rid of the conventional heavy driveshaft while giving direct power to the wheels. (In mud, sand, ice, snow, where other cars skid, you go.)

As a result, the Volkswagen engine weighs only 198 lbs. and every pound works. You get an honest 32 miles to the gallon (regular gas, regular driving) and will probably never need oil between changes. And the engine is so efficient, top and cruising speeds are the same. You can go 70 mph without strain, all day long.

These are some of the reasons a used VW is worth almost as much as a new one. Your VW dealer will show you the others.
the worst thing that could happen. The next worst is that an initial failure would torpedo the whole project. Yet it's a calculated risk that goes along with every pioneering exploration that's ever taken place. All our energies are directed toward preventing this; yet, it could happen."

But a week of talking with the people involved in Project Mercury left me with a strong feeling of confidence in their ability to bring it off. Optimism is infectious around Langley; no one is anticipating failure—least of all the Astronauts. The place feels and smells of success. But one thing is certain: the effort won't be made until virtually everyone involved is convinced of the overwhelming probability of a successful flight.

In this atmosphere of prevailing optimism, the Astronauts don't always agree on everything by any means—but their differences are technical and not personal. There is no individual among them that they thrust forth as their leader. All of these men are rugged individualists, and they feel no need for seeking leadership. They respect and trust one another completely, but this doesn't prevent them from disagreeing when the occasion warrants. None of them is aggressive; they feel no need to be. Glenn and Cooper are perhaps the most easygoing, Grissom the quietest, Shepard the most outspoken, Carpenter the most scholarly, Schirra the most straightforward, and Slayton the prototype of the dashing military pilot. When a question is asked the group, they invariably defer to the individual whose specialty is most closely allied to the answer sought. None of the Astronauts were close friends before Project Mercury; several of them had met in passing. Now they are more than close friends: they're a team in every sense of the word.

**Beyond Mercury**

What happens after the first Mercury shot has been successfully launched and returned? Project directors aren't planning this far ahead yet. But without question, the other Astronauts will have their turns at longer and longer orbital shots, leading first to an orbit of the moon and return, then to an orbit of other planets in our solar system. Mercury is just a bare beginning; the Astronauts will form the nucleus of a growing corps of space travelers to come along in the years ahead.

Right now it seems presumptuous for man to think of exploring the far reaches of our universe—and reaching out to new and undiscovered universes. Yet, this is certain to happen once the first long step into space has been taken. The solar sys-
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the system we now hope to explore is tiny in relation to the limitless universe about us—and there are many dedicated and adventurous men who are chasing for the opportunity literally to reach out of this world into the new dimensions that lie beyond. The seven young men at Langley Field who will take our first manned vehicles into space are at the vortex of this movement into space, and they deserve to be there. They are outstanding representatives of the very best that this nation and this civilization can offer in reaching out a hand to the mysteries that lie beyond the atmosphere of the earth.

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JANUARY 1960
5000-Mile Game of Catch

(Continued from page 120)

the big ICBM shooting gallery. And it is these holes that the tiny ships of the telemetering fleet must plug.

"Usually half of the ships are scheduled for duty," explains Captain Siegurd Hilseth, rugged tow-headed skipper of ORV E-42-1896. "The rest are in port, perhaps Trinidad or Recife, for resupply, repair, and to give the men a needed rest from weeks of being cooped up at sea." An average tour for a down-range picket ship, according to Hilseth, is about 21 days, though some have been out for as long as seven weeks due to lengthy countdown "holds" and severe tropical storms.

Shoot Set Up at Canaveral

A picket ship's tour of duty begins when a big shoot is set up by "Range Scheduling" at Canaveral. Captain and Technical Leader generally learn about it when a cryptic radio message in code crackles in from Patrick Air Force Base. "TEST # AM 11C XXX PROCEED LAT 14° 20' LONG 2° 43' XXX ON STATION TIME 06 1500 T-TIME 07 1700 RTN TRL." In English, this means that Atlas Missile 11C will blast off at 5 p.m. Greenwich time on the 7th, but that at 3 p.m. of the 6th, this particular picket ship must be on station at a pinpoint on the map beyond Ascension Island, returning to Trinidad after the bird has flown.

Crewmen, routed from tropical beach resorts, hotels and homes are all aboard 24 hours before departure. "We will be on station by F (safety day) minus one," announces the skipper. "You are on voice control with Cape Canaveral central control until the shoot is terminated or scrubbed. We go!"

Steaming out across the Atlantic in a tiny ship crowded with electronic gear and people can be grim duty. Hilseth's crew numbers 24, in addition to five technicians who report to RCA's instrumentation leader, Grady Cole—"Which leaves no mattress space to spare on this transistorized canoe," according to one crewman.

En route to rendezvous with the missile, life on board the ORV simmers down to a monotony of chores and wallowing through heaving seas.

"Our object is to get out on station and sit," says Hilseth. "But what hurts is when we lie out there pitching, rolling and gyrating to the four compass points for weeks during delayed shoots. For 10 days we rode out one hurricane so bad everyone was thrown from his bunk. Big ships went down in that storm, but no ORVs.

(Continued to page 266)
"That's when a crew comes apart. We had one technician so seasick he couldn't eat a crumb for 15 days. Took in his belt one inch a day until he looked like death. We've had men fake seasickness to get out of the service—stealing sandwiches from the galley at night when they thought no one could see them—but this fellow couldn't help himself; he even got sick when we tied up at dockside."

During long drifting periods, the men play cards, read, look at antique movies and grumble. Good days are spent rigging nets to scoop up flying fish attracted by lights the men hang on the fantail at night. This provides bait for dolphin, dogged in on headlines next day. "We've caught five footers," boasts the skipper, "and then we celebrate. Small things out there become huge events—like the whole day we spent watching the antics of a baby whale playing around the ship."

But the real fun begins on "F-Day." Up on the bridge, Hilseth and his navigator have been busy for days checking their navigation to within a hair's breadth of the predicted impact point of the missile. "The human and electronic brains at Canaveral can calculate with remarkable accuracy where that bird will drop," explains the skipper. "Nose cone pick-ups have been made in as little as 20 minutes. While the antennas clank around over our heads, we figure our precise current and wind, and correct our position with engines. We want to be not too close, but not too far from where that white-hot steel will plunge from space into the sea. The RCA boys watch that missile from the side, bow-on, and swing with it as it arcs across the sky. If I have to swing the ship, the antenna man down below goes crazy keeping his helicals pin-pointed on that radar blip screaming across the sky."

**Technicians at Stations**

Long before the shoot, all the technicians are lined up at their stations, where they've been running simulated countdowns, feeding data into their maze of electronic gear on one dummy "shoot" after another.

The telemetry room was not dubbed "the hole" for nothing. It is approached from the forward deck by ladder, opening into a vast steel-walled cavern below decks. "It was converted from a cargo hold," Grady Cole explains, "and there's 12 inches of concrete in the roof—not for protection against wild missiles, but for ballast. Without it the ship would ride like a cork." Actually, the comparison isn't too far-fetched anyway. Stout oak (Continued to page 268)
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bars lace the aisles between equipment racks—"so we can remain standing at a 45-degree angle," Cole points out.

Under that concrete sit the 24-foot-long banks of dials, switches, recording reels and electronic tubes—"everything from transistors to power tubes 15 inches high and eight inches across," says Cole. "It takes nine tons of sea-water-cooled air conditioning to keep this place at 70 degrees when everything is running."

Everything begins really running, in a bustle of activity, when countdown at Canaveral—replayed through the Pan Am communications man on board—closes in on "T-Time." Along the electronic corridors, earphone-clad technicians monitor their stations. One man stands by the remote controls that turn the antennas this way and that inside their white domes topside. "At a certain calculated time and place in the sky we expect to start picking up signals from the missile," says Cole, "so the two independently controlled tracking antennas in the Mae Wests are homed in at a predetermined look angle. If the signal doesn't come in when it should, we can send our own signal through the circuits and check them out almost instantaneously—so we know right away the missile has wandered, not us. Then we go nuts replotting flight curves from data pouring in from other range stations via Canaveral."

**Continuous Record**

Once the bird is picked up on the scopes, everyone aboard works to keep it there, and the ship's tape-recorder memory, in charge of two busy RCA experts, locks up a continuous record of all events occurring aboard the soaring missile, on the ship, plus data from other range vessels and stations. Superimposed on this high-frequency and UHF-coded jumble are continuous time signals squealing in from WWV. "A single shoot uses up 28,000 feet of tape," Cole reveals. "If played off at the usual record speed in your home, you'd have about two and a half days of continuous 'music.'"

At the tuning station, another man functions at high speed and precision. "He's got to know the precise instant of lift-off and exactly where the missile is at any instant after launch," says Cole. "He works to a tolerance of 50 milli-seconds, which means that at any fifty-thousandths of a second, he must be able to pinpoint the missile in flight—and don't forget it's traveling at 15,000 to 18,000 feet per second!"

In spite of all the hazards and pitching seas, no ORV has ever caused a countdown "hold" due to malfunctions, though Grady Cole winces at some near calamities. "Once, our only ballast tube blew just two hours before T minus zero," he recalls. "A young electronic genius in our crew sat down and, without any 'specs' to help him, actually fixed it out a combination of home-made resistors that pinch-hit for the missing link and gave us the whole shot. Another time, at T minus 30 minutes, a timing component went out. We just ran the shot without any time. Luckily, it was a faultless one."

As minutes tick by and the bird nears its target, a lookout man from ship's personnel stands in the bow peering up at the black sky. Close to the prescribed instant, if all goes well, and near a predicted place in the firmament, he'll spot blazing streaks of light arching toward the sea—usually two or three—like spectacular shooting stars. These will be the rocket's final stage, the nose cone and the separated instrument capsule, plummeting into the atmosphere at 15,000 miles an hour. "There she is!" he bellows, and everyone goes limp. "That yell," says Cole, "is the pay-off for all our trouble."

Though Hilseth's ship hadn't been involved in a nose-cone recovery up to last summer, several other ORV and search ships have. For them, the real chills come after the shot terminates.

**Search for Nose Cone**

Usually, three ships, arranged in a triangular group around the predicted impact point, lie in wait for the plunging payload. Often Navy ships do this job. Aircraft, on hand to help spot the cone in the tossing ocean, sweep the area in grid patterns. As the whirling, white-hot pieces of metal burn down through the atmosphere, the picket ships start their hunt, sailing a system of circles and squares over the sea. All units tune radios to a special frequency, ready to pick up signals being transmitted from the recovery package.

The rig that is used to bring a recovery package safely back from space involves an ingenious arrangement of parachutes and flotation gear. As the glowing nose cone hits the outer atmosphere, a switch, triggered by the sudden slack in speed, actuates a timer that starts a recovery sequence in the cone. At 20,000 feet, the rear cover of the re-entry vehicle pops off. A small ribbon parachute whips out and slows the plunging hardware from hypersonic to subsonic speed. Then a second, larger drag chute is released, and brings the space vehicle to earth at an impact velocity of 60 to 100 miles per hour—slow enough for a safe water landing.

(Continued to page 270)
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At some point in the last plunging mile, a big balloon is also ejected from the cone and automatically inflates itself. This ball is sectionalized—like the segments of an orange—so that if the impact bursts the skin at any point, remaining segments will keep it afloat. The instrument package, hatched to the balloon by 50 feet of nylon line, dangles deep under the sea's surface where it won't be battered by waves. The balloon, bobbing atop the waves, carries a transmitter that starts broadcasting a homing signal as soon as it hits the water. It also Blink's a white light off the tip of its antenna, and automatically spreads a fluorescent dye marker around itself for easier visual sighting by the planes.

Aboard any of the ORVs closing in on that package will be a few extra passengers, including skin divers and, if there happens to be a living cargo in the capsule, a medical scientist or two. First search vessel to spot the balloon (planes usually pick up the radio signal first and vector the ships in) rings it in the glare of spotlights. Over the side go the divers on a raft. One will swim down to hook a retrieving line to the dangling instrument package. Others stand by to help if needed. Some nose cones are huge things weighing half a ton or more. There are other problems, too.

**Shark's Gave Trouble**

Early in the recovery business, two divers heading down for the first Jupiter C nose cone found themselves in a mass of frenzied sharks that beat the water to a froth as they struck at the underside of the balloon and slashed at chutes and shrouds. It was too late to do anything about it, so the divers went on with their job while men in the raft beat at the monsters with oars and clubs. Men with high powered rifles aboard ship didn't dare shoot for fear of hitting the swimmers. So many sharks thrashed the area no one could get an accurate count. Later, investigation proved that the water in that area was alive with huge whites, tigers and makos, wildly attracted to missile recovery packages for reasons known only to themselves. To make recovery safe for divers, current recovery capsules spread a copper-acetate shark repellant around themselves.

Despite the remarkable efficiency of recovery packages, heartbreaking things happen. The capsule carrying Old Reliable, first monkey to soar through space last year, was spotted by the blinking light on its balloon marker. Then, as the ships steamed toward it, the light went out and

(Continued to page 272)
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radio signals quit. No trace of the recovery package ever was found. Though the last telemetered data proved that Old Reliable had survived his flight, the entire assembly obviously sank—in 5000 fathoms. Whether the balloon broke up on impact or was destroyed by sharks no one will ever know.

Since then, nose cones and capsules have been built with integral flotation. Lt. (jg) Edward Fay, who dove for the famous capsule containing Able and Baker, had a heartrending jolt when, at the end of the line beneath the balloon, he found only frayed nylon. “No nose cone!” he shouted when he surfaced. But as searchlights swept the water, the big Jupiter cone was spotted, heaving peacefully atop the waves nearby. Its own flotation cells had saved the two famous monkeys when the landing impact snapped the line. Everyone knows the rest of that story.

There will be bigger and more exciting recovery stories to tell as the space-flight program progresses. And you can be sure that in every one, the doughy little Ocean Range Vessels, tossing on a desolate black sea, will be out there making the catch.

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PM Houseboat

(Continued from page 206)

2-in. camber of the deck, the upper edges
are cut to give the cabin roof a 3-in.
camber, or crown. The cabin is backed up on
the inside at the corners with 1½ x 3-in.
stiffeners, Fig. 28, which fit between the
coaming and shelf members which are in-
stalled next. These members tend to stiffen
the cabin sides at the roof line and also
tie together the roof and sides. Since
the outer clamp members and the shelf
members are held integrally, as shown in
Fig. 26, you'll do best to apply the outer-
clamp members first, letting them extend
10 in. at the front to support the roof over-
hanging as in Fig. 20. The shelf members are
located 2½ in. down from the top of the
cabin sides and are glued and bolted in
place with brass carriage bolts passing
through holes drilled in both shelf and
clamp members.

Fifteen beams are needed for the cabin
roof and these are laid out on 1½-in. fir
stair-tread stock as in Fig. 25. Note that
the ends are angle cut 5 deg. to conform
with the slanting cabin sides and to let the
beams rest flat on their supporting shelves.
You can leave the lower edges of the
beams straight or bandsaw them to con-
form to the 3-in. crown. In either case,
one beam is cut narrower than the others
as indicated by the dotted line. This is nec-
essary to provide clearance for hinging
the forward cabin door. Since one beam
must be located to provide a gluing sur-
face for the forward bulkhead of the head,
start placing them so that one falls directly
above the side members of frame 6. From
here the beams are spaced approximately
12 in. center to center and glued and
screwed in place as you go. Before the
cabin can be decked over, a hatch must be
framed in the roof over the companionway
aft. This is located aft of the roof beam at
frame 6 and made to measure 22 in. wide
as shown in Fig. 22. Actually, the headers
which frame the opening should align with
the door stiffeners by half-lapping the ends
so that the two are flush. It takes four
4 x 8-ft. panels of ¾-in. plywood to cover
the roof. These are placed lengthwise and
shifted so that abutting joints center on the
roof batten and a beam. After the roof is
cut out over the hatch, the opening is lined
on three sides with a ½-in. mahogany
coaming. Since the hatch cover should be
level in relation to the roof crown, the ma-
hogany coaming on the port side of the
hatch will project higher above the roof
than the coaming on the starboard side of
the opening. Study the sectional view
Fig. 27.

(Continued to page 276)

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At this stage the cabin roof is waterproofed with glass-fiber cloth laid in a wet coat of polyester resin and then topped with another. The cloth is turned down about 1 in. all around the roof and turned up at the hatch coaming. While the resin is still tacky the raw edges of the glass-fiber cloth on the coaming are covered with ½-in.-thick doubler strips. The raw edges of the cloth at the roof line are concealed with 1-in. half-round molding. The glass-fiber covering is eventually painted.

The cover for the hatch is designed to slide forward to open which means that the wide member aft must be a little less in length than the width of the door cutout. Cross cleats on the underside of the hatch cover ride on the hatch coaming. Fig. 27 details the cover. Like the cabin roof, it, too, is covered with glass-fiber cloth and trimmed with half-round molding. Hooks may be used to lock the hatch cover from the inside. Knee braces applied to the inside will strengthen the rear member of the cover. This member, incidentally, should be wide enough to align with the lower edge of the outer clamp member when the hatch cover is in the closed position.

(Continued next month)
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277
Early American Clock
(Continued from page 221)

rocker use tool steel, file to the shape indicated, finish the pallets with a fine oilstone and then harden. Oilstone the pallets again after hardening to make sure that the surfaces which contact the escape wheel are glass-smooth.

The pendulum rod, Fig. 39, the pendulum weight (which consists of the lead weight and the brass facing assembled), and the bob wire, Fig. 40, are available readymade. The original weight is $\frac{1}{2}$ in. in diameter and if it is purchased its weight and diameter should be specified. The pendulum hanger, upper left-hand detail in Fig. 39, you make yourself from brass. It is fitted into a mortise cut in the front plate, the location of the hanger being shown on the movement-plate template in Part I.

Suitable hour and minute hands similar to those detailed in Fig. 41 also are available readymade. They may require individual fitting to the hand post.

The strike detents, parts S-6 and S-7 in Fig. 35, and the striker, part S-8 in Fig. 36, are quite easy to make. Use the same hardwood for the turned spindles that you used for the gear spindles of the time and strike trains. The final parts to be made are the fly fan, part S-5, Fig. 46, and the cam segments which are fitted on one face of the gear wheel, S-3 in Fig. 46, and are glued and bradded in place as indicated. The fly fan is made from softwood, such as basswood, and is held in place on its spindle by a short length of spring wire which engages a groove cut in the spindle at the time it is turned. Note that the fly-fan spindle carries a pinion which, in assembly, is driven by the gear S-4, Fig. 46. The purpose of the fly fan is to control the speed of the strike train.

The pin on one face of the gear wheel S-4, Fig. 46, engages detent C of the part S-7, Fig. 33, when the strike train is inoperative. After a striking sequence has been completed and the detent B, part S-7, Fig. 35, drops into a notch on the count wheel, the detent C drops into a position in line with the sweep of the pin on the rotating wheel S-4. In this position detent C engages the pin and stops the strike train.

When assembling the movement, mount the gears of both trains on the back plate as in Fig. 29, including the detents S-6 and S-7 and the striker S-8. In assembling the detents, the lever of S-6 is placed under lever A of the part S-7. When placing the striker, S-8, the rebound spring is pulled down to contact the flat on the striker spindle. See Fig. 36 and the note in Fig. 45.

(Continued to page 280)
Shoot "Sodium Cloud" Rockets
From Suspension Launchers

Current "sodium cloud" rocket firings being conducted by the National Aeronautics and Space Administration at Wallops Island, Va., mark the first use of zero-length suspension-type launchers with ASPAN (ASP with NIKE booster) rockets. Only the NIKE booster — suspended beneath the launching rail — is supported by the launcher while the solid-propellant second-stage rocket is held atop it with a coupling. The launcher operates like a crane, speeding and simplifying the handling of rockets. Purpose of the firings is to determine wind direction and velocity over the rocket's range and to measure the rate at which matter disperses in the upper atmosphere. A spectacular yellow-orange sodium vapor cloud released during the first firing of the series began at an altitude of 50 miles and stretched upward 145 miles.

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Then place the front plate over the posts at the top and work the spindles into the bushings. Small hardwood pins passing through holes in the shouldered ends of the posts hold the plate in position. Mount the movement in the case and fit dial, pendulum and hands and attach the cords from the winding drums to the weights. Finish all exposed parts of the mahogany case in the natural color of the wood with filler, sealer and two coats of flat varnish.

Electricity Made by Sunlight
May Power Spaceman’s Radio

Two engineers have proposed that a three-pound thermoelectric generator be used as an auxiliary source of power for spacemen on missions taking months or years to complete. Niles F. Schuh and Ralph Tallent say the generator is capable of converting energy from the sun into 2.5 watts of power—enough to operate a radio broadcasting a strong signal back to earth. The Westinghouse generator has a 20 by 50-inch aluminum sheet mounted in a semicylindrical shape to collect sunlight and concentrate its heat on thermoelectric material—in this case, two different metals which generate electricity in a closed circuit so long as the junctions of the metals are maintained at different temperatures. A mechanical problem connected with using the generator in space, and one they believe can be solved, is that the collector must have a large surface plate which can be collapsed during the ascent through dense air, and extended in space.
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WHAT TO DO UNTIL THE FIREMEN COME

Read this special article in the FEBRUARY issue and make your home safe

JANUARY 1960
Building an Equipment Cabinet
(Continued from page 246)
the cables of the various interconnected components can be passed. Finally, you may want to “panel mount” the tuner and amplifier in the center compartment, though these components could be installed merely by setting one on top of the other.

But there are instances where the equipment cabinet becomes more than a mere housing for the electronic components. In cases where a loudspeaker is to be mounted in the main cabinet, the design of the speaker compartment can have as great an influence on the quality of the overall sound as that of any other component.

Normally, the installation of the speaker in the same cabinet with other electronic components is frowned upon by the confirmed audiophile. Small speakers in limited-size enclosures, it is argued, can not reproduce the lowest bass tones with the same efficiency as their larger counterparts. Further, vibrations set up within a speaker enclosure could adversely affect the performance of the record player and other components mounted in a common cabinet. But these arguments are only partly valid.

Today it is possible to buy speakers especially designed for small enclosures, and some of the so-called “bookshelf” systems are among the most highly rated units in the field. The problems of interaction between speaker and other parts usually can be resolved by careful isolation. While a separate speaker enclosure is definitely preferable, where space is a factor a built-in speaker can give excellent results.

The storage compartment of the cabinet, behind one of the lower drop doors, has ample volume for adequate housing of 8”, 10” or 12” speakers. The installation of a complete monophonic speaker system will, of course change the appearance of the cabinet to some extent. Since such speakers must radiate outward into the living room, the speakers are front-mounted on the panel which, in turn, must be covered with grille cloth to protect the speaker cone. Though the adjacent storage compartment is not altered, it is probably best, from an appearance standpoint, to carry the grille-cloth pattern to the adjacent door as well, framing the edges with a suitable molding or trim.

For stereo it is possible to use a system whereby only the low frequencies are produced by the speaker in the cabinet. The high frequencies, together with the stereo information, can be reproduced by two
small, wall-mounted speakers, one on either side of the main cabinet. In such cases it is possible to mount the low-frequency speaker in the bottom of the compartment, facing the floor, so that the appearance of the cabinet need not be altered. Speaker systems, including construction data, will be discussed more thoroughly in next month's issue.

Smaller-Than-Hair Tubing
Strains Helium From Gas

Fused quartz microtubing so small in diameter that six lengths fit into an ordinary hypodermic needle (compared above with a pinhead) is playing a big role in a new process for obtaining rare helium gas. The general method of separating helium from natural gas requires huge plants to liquefy the gases. Using the tiny tubing, the new process can take place in a chamber about three feet long and 1½ inches in diameter. The capillary process strains helium out through the tubes.

JANUARY 1960
Parade of Cars
(Continued from page 151)

for the continued jump in sales of imported cars (double the 1958 total), with Volkswagen and Renault selling about a third of the total, the other 50 makes sharing the other two-thirds.

Will these import sales hold up in the face of the compacts? To this writer, at least, it seems that they will. These new American cars are not so competitive with the high-volume imports as many think. They are nowhere near as economical, or as nimble, or as fun-to-drive. Those buyers who insist on these attributes will still buy foreign.

The smaller the average American car becomes (and the compacts have shortened the average American car from 209.1 inches over-all in 1959 to 207.5 inches in 1960), the more acceptable, the less "foreign," the imports become. Next year's additional compacts (such as the Comet to be sold by Mercury dealers this spring) will reduce average American-car length even more.

Engineering achievements of the year (and it has been a great year for the slide-rule boys) include the rear-engine, air-cooled Corvair, the slanted inline six of the Valiant, the sudden emergence of unit bodies in every company except Studebaker-Packard, the start of the era of aluminum engines (and wheels, too), and the continuing trend toward lower horsepower, increased economy. Engines will continue to get smaller—the days of the mammoth V8 are numbered. Smaller, more efficient V8s are on the way.

Styling advances include the none-too-soon demise of the wraparound windshield with its aggravating dogleg that bangs knees of the non-profitive. Every one of the new body shells introduced for 1960 is wrapless. A couple of years ago, the wrap was the badge of modernity. Now it's gone where the old clay models go.

Virtually dead also are such former must-haves as dual exhausts, continental spare tires, four-barrel carburetors and those other affectations of the must-be-first-away crowd.

Useful innovations survive. Such items as windshield washers are obviously here to stay. It is to the credit of the good sense of the public that those expensive and useless extra-cost items, ballyhooed as the latest and greatest, have vanished like the hula hoop. Even two-toning is becoming rare as the public moves toward more sobriety.

Time continues to take its toll. This year, the Edsel was laid to rest after two years of feeble struggle. It never did learn to walk, spending its brief life at a crawl.

In the first year (1958 model), it sold 63,110 cars. Ford Motor Company's product planners had predicted it would sell at least 200,000. Second-year sales dropped to 44,819. Before the struggle ended on November 17, 1959, the 1960-model run had added up to 2809 Edsels.

Millions of dollars were lost in this venture, evidence of the fallibility of the product planners and motivators. It is likely that more man hours went into selecting the car's name, into choosing the precise shade of green for the dealers' signs, into setting up the introductory publicity, than into engineering of the car itself. Here was the real tragedy.

But to turn to happier things. There are several lively births to report. The three new compacts, Corvair, Falcon and Valiant, plus the pseudo-new Dodge Dart (really a Plymouth in Dodge clothing), bring the total number of makes to 24 (of which all but the Corvette and the Studebaker Hawk are shown in the Parade of Cars).

Next year a few more new names will be added, but probably a few will be removed as public taste takes its toll.

Worthy of note also is the continued success of the Thunderbird, a success that far exceeds the dreams of its creators. So successful is it that you can expect to see competitors put out by other companies within a year or two.

Ford Motor Company has put all its car production under Ford Division, including production of Mercury and Lincoln cars. However, Lincoln-Mercury engineering and sales are still separate.

Chrysler has all car production under a single leadership (as well as all engineering) and the separate divisions are more sales organizations than anything else.

General Motors alone retains the sharp divisional setup and, being biggest and richest, perhaps alone can afford it. But its Fisher Body division, which builds all GM bodies, gives a similar advantage.

What will more centralization mean? It means that cars in the future may tend to become more and more alike mechanically with the various car names denoting differences in body style and function rather than differences in social level or luxury.

Thus, for instance, Mercury might sell all Ford Motor Company's station wagons and nothing else. De Soto might sell all Chrysler Corporation's convertibles, Buick might sell all GM's highway cruisers.

All this, of course, is speculation, but there is more fluidity, less certainty in the industry today than ever in its history and from these shifting sands many changes will certainly result.
Finally, any roundup of the year wouldn't be complete without a mention of the extended steel strike which forced all producers to curtail production and, in some cases, to shut down entirely. What effect this will have on the relative sales of the various makes is unknown right now. What this will do to the course of the industry is a big question because the pattern of sales in this, the test year of the compact cars, may determine the future course of the industry for many years to come.

If nothing else, the steel strike will reintroduce a sales technique that hasn't been used since shortly after World War II—"we've got immediate delivery."

Cars that are available will sell, those that aren't, obviously won't. Let's hope the one you plan to buy is.

---

**Deodorants for Airports?**

How do you keep airports smelling anything like a rose when jet planes blast the odor of kerosene all over the place? That's one problem of the jet-age, says Thomas M. Sullivan, deputy director of aviation for the New York Port Authority, operator of New York International (Idlewild) Airport. There also are problems of noise, destructive blasts at takeoffs and storing huge quantities of fuel. Until someone finds a better solution, Sullivan says the odor must be dissipated by extensive air-conditioning and ventilating systems in terminals and hangars. Idlewild has tried to contain noise since it began handling jets in October, 1958. Half the takeoffs are routed over water, for example. But shrieks still slash the area. Sullivan suggests that more efficient engine design, use of suppressors, and accelerated takeoffs that get planes quickly upstairs can minimize the problem.

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**Do You Know This Old-Timer?**

(answer to quiz, page 16)

1909 EMF

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JANUARY 1960
they look more appetizing than regular channel cat, but they skin out easier and have less throw-away.'"

In future years, "Anderson Golden Catfish" should become well known to anglers throughout the U. S.; fingerlings have been shipped to nurseries in all parts of the country. The first, and probably the largest crops, however, will be harvested from Arkansas fields.

Fish farming, like most new industries, has its problems. One is the "swimming weeds"—commercially useless green sunfish, that gobble up minnows intended for fattening fish. When they get mixed in a tub of minnows, they must be removed before they devour the whole shipment. With no selective "weedkiller" known, these pests have to be removed by hand, the oldest known method of weed control.

At least one would-be fish farmer has gone back to dirt farming. He was a gentleman farmer from Little Rock, who decided he'd get a chunk of the fish-farming profits, even though he'd never seen a catfish. He and his wife parked themselves on the end of a pier, determined to hook a specimen for study. When his wife landed a big one and plopped it beside him, he got a quick look at the spiny-faced fish, recoiled in fright, and fell off the end of the pier.

Other than this disturbance, the pond-pockets of Arkansas are calmly giving the state economy a big boost—and their owners a growing profit.

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Arkansas Farmers
Harvest Rice and Fish
(Continued from page 141)
World's Ugliest Car Gets a Beauty Treatment
(for British Only)

Without doubt the world's ugliest (and yet the most likable) automobile is France's Citroën 2CV. The French love it so much they wait two years for delivery. But not the British. The car's angular lines with flat sheet metal that looks homemade just doesn't appeal to them. So the British subsidiary of Citroën has brought out a plastic two-door hardtop body to replace the ugly duckling. Suspension, engine and drive are unchanged. The new model is called the Bijou.

JANUARY 1960
Compact-Car Engines
(Continued from page 174)

was reduced by fastening the cover around its edges.

Ford’s new foundry core technique permits the block to be cast with an integral side plate. The usual bolt-on side plate is also a noisy vibration broadcaster.

Chevy engineers have virtually eliminated blower whine on the Corvair by careful duct design. This has always been a problem with air-cooled engines.

Perhaps the most important advantage of the new engines (at least as far as the owner is concerned) is the great reduction in required engine maintenance. Except for plugs, points and oil changes, I think you can just about forget the new Corvair engine for the first 60,000 miles. There’s no water or antifreeze to worry about, there’s no manifold heat valve to get stuck and require oiling. The full-flow oil filter will keep the lower end clean (if you change elements periodically). With the crankcase sealed together in right and left halves, there is a full 360-degree bulkhead support around main bearings, so bearings should last and last. The short stroke reduces piston travel and chromed rings on cast-iron walls assure long bore wear.

The soft aluminum cylinder head requires separate hard inserts for the valve seats, but these can be made tougher than the usual cast-iron heads so valves should go farther between grind jobs. It will all add up to less and less transportation cost per mile.

The Falcon and Valiant engines show excellent durability, too. They both have very rigid lower ends with lots of bearing area per cubic inch of displacement. They both have full-flow oil filters, high-alloy valves, chromed rings. Ford engineers got rid of the exhaust hot-spot valve broadcasting their intake manifold integral with the head so it absorbs and holds heat. They put a small exhaust-heated chamber below the center of the manifold and then piped heater hot water through an aluminum chamber between the carburetor and manifold to prevent icing on cold, wet mornings.

Finally, what is it like to drive one of these new engines? First thing is their good lugging ability. All pull away from low speed in high without bucking. All feature very short duration cams. Throttle response is excellent at the low end. Yet there’s no roughness due to over-carburetion and wild cam timing. Still they provide very decent acceleration on the highway for passing.

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JANUARY 1960
Here's How to Lay Out Your Own Course

By Dale Kelly

For those who don't have ready access to a measured mile (see page 175), it may be more convenient to lay out their own test course. Measuring a mile with a 100-foot tape is a chore, but there is a much easier way.

First, you measure the circumference of the right front tire of your car. You do this by marking the tire and pavement with the help of a box (see photo above).

Carefully move the car forward until the tire has rolled exactly one turn. Make a second mark on the pavement opposite the mark on the tire. Measure the distance between the two marks. This is the effective circumference of the tire.

Second, decide how long you want the test course to be in inches. A mile is 63,360 inches, but a shorter course of only 17,600 inches can be laid out in less time and makes for easier arithmetic because the constant for the course is an even 1000 (the time would be 25 seconds at a true speed of 40, 20 seconds at 50, 15 seconds at 67, etc.).

Third, mark the right front tire with a rag or large piece of tape so it can be seen by your helper from the front seat as the car is moving. Mark the beginning of the course with a stake at the roadside or a blob of paint on the roadway. Divide the number of inches of the tire circumference into the inches in your course length. With your helper leaning out the window counting the wheel revolutions, drive slowly over the course until the wheel has made the correct number of turns. Mark the end of the course.

Fourth, to check your speedometer you run over the course at a constant speed and time your run in seconds. If you use the short 17,600-inch course, you divide the number of seconds into 1000. If you are using a full mile course (63,360 inches) you divide into 3600 (the number of seconds in an hour). The result in either case is the true speed in miles per hour.
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JANUARY 1960

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Dept. PM
Performance Meter
(Continued from page 177)

When the car coasts in neutral, the meter, because of frictional resistances just mentioned, will read slightly on the other side of zero. The amount of this will show up any abnormal drag due to soft tires, misaligned wheels or dragging brakes.

When the brakes are applied, the meter will read over on the drag side and the reading will equal the total braking force expressed as a percent of car weight.

None of these tests has to be made on a level road. If the road is level, the meter will read acceleration or deceleration in "G" units (a G equals 22 miles per hour per second). If the speed is constant, the meter will read the grade in percent.

Regardless of grade or change in speed, the meter will indicate the acceleration that could have been obtained on the level and the grade that could be climbed at a constant speed.

VACUUM GAUGE

After you have had a little experience interpreting its readings, a vacuum gauge connected to the inlet manifold will give you a wealth of information on the condition of your engine. It also will give a fairly accurate indication of gas mileage.

With the engine idling or with the car running at any given speed and load, a high vacuum indicates a healthy, economical engine. Almost any condition that cuts down on efficiency or increases load will automatically require more throttle opening for a given performance.

This will admit more atmospheric pressure to the manifold and the increase in pressure will be reflected on the gauge as a decrease in vacuum. With a given throttle opening, an engine in good condition will idle at a relatively high speed and this will cause a high vacuum.

If, by using a light foot on the accelerator pedal while driving, you keep the vacuum above seven inches, you will avoid the uneconomical or over-rich mixture provided at full power by most carburetors. This will save quite a bit of gasoline at some sacrifice in acceleration.

A careful reading of the gauge over a long period will show up any changes in load such as might be caused by soft tires, misaligned wheels, dragging brakes, tight or dry bearings.

You can buy an ordinary vacuum gauge at a plumbing supply house or a hardware store for about $3. Or, if you prefer, for several times the price you can buy a special automobile vacuum gauge with a com-
plicated and often misleading scale which claims to read directly in miles per gallon. However, it indicates better mileage in second than in high and worse mileage when an overdrive is in use than when it is not.

In a car with vacuum windshield wipers you simply connect a "tee" at the point where the wiper line enters the intake manifold. The hose to the gauge connects to the "tee." If your car has a vacuum booster pump, don't connect between the pump and the wiper. In cars with electric wipers, you may be able to remove a plug in the manifold to get vacuum. In a few cases you may have to drill and tap the manifold.

If you buy an ordinary vacuum gauge and install it yourself use rubber wind-
shield wiper hose. It is stiff enough so it won't collapse under vacuum. To prevent vibration of the gauge pointer you will probably need a restriction in line, preferably at the end nearest the manifold. You can get this by cutting the head off an inch-long machine screw whose thread diameter is a snug fit in the rubber hose. Then push the threaded portion into the tubing end it smooths out the needle vibration by its restrictive effect. ***

This Month's "Great Pioneer in Science"

(Page 18)

Albert Einstein (1879-1955)

January 1960
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