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Scientific American

★ 100th Anniversary Year ★

REPORTING THE PROGRESS OF SCIENCE AND INDUSTRY

America's Frontier — On Wheels . . . See page 65

The Story of HIGHWAY TRANSPORTATION

Anniversary Issue
No. 8

ROLLING ON borrowed time

BY ALL NORMAL STANDARDS, thousands of trucks now carrying war loads would logically have been consigned to the junkpile long ago.

For a nation dependent on motor transport, this would have been a major calamity. But thanks to the untiring effort of the men and women of the trucking industry, it wasn't allowed to happen.

The trucking industry is to be congratulated for the way it has kept over-age and overworked trucks serving America, in spite of limitations on manpower, equipment and gasoline quality.

Just as the war has dramatically spotlighted the importance of transportation, so too has it brought home the importance of the part gasoline plays in our national economy. We of Ethyl are glad to have been able to contribute to the improvement of engines and fuels in the past . . . and look forward to continuing both this research work and our cooperative efforts with truck operators and manufacturers in the future.

ETHYL CORPORATION, *Chrysler Building, New York 17, N. Y.*

Scientific American

Founded 1845

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Our Cover: A motorized caravan of flat-bed commercial trucks hauling trailers over the Pennsylvania Turnpike for delivery to war-production centers to relieve a housing shortage.

SCIENTIFIC AMERICAN, August, 1945. Vol. 173, No. 2. Owned and published by Munn & Co., Inc., Orson D. Munn, President; I. Sheldon Tilney, Vice-President; John P. Davis, Secretary-Treasurer; A. P. Peck, Assistant Secretary; all at 24 West 40th Street, New York 18, N. Y. Entered at the New York, New York, Post Office as second-class matter June 28, 1879, under act of March 3, 1879. Additional entry at Orange, Connecticut. Published monthly by Munn & Co., Inc., 24 West 40th Street, New York 18, N. Y.

Previews of the Industrial Horizon

By A. P. Peck

PATENT LICENSING

OUR DAILY correspondence shows plainly that there are a large number of patent holders who desire to grant licenses under their patents, but who either do not know how to go about finding the right manufacturers or lack the facilities for doing so. Such patent holders will be interested to know that there has been set up in the United States Patent Office a public register of patents available for licensing. No charge is made to the patent owner for recording on this register the fact that he is willing to grant such licenses on stated or reasonable terms.

In the words of Commissioner Conway P. Coe: "Inventors, patent owners, and others desiring information concerning this register should address their inquiries to the Commissioner of Patents. Commerce Building, Washington 25, D. C."

WAR-STYMIED PATENTS

CONSIDER the case of an inventor to whom a patent was issued just prior to Pearl Harbor. Under normal circumstances, his patent would have given him the right to exclude others from making, selling, or using his discovery for a period of 17 years from the date of issuance. However our hypothetical inventor had devised an article which required strategic materials in its manufacture and the Government issued a war-necessitated order which prohibited and still prohibits its production. That was some four years ago. As of the present, almost one quarter of the life of the patent has expired, during which time the inventor, through no fault of his own, has been unable to capitalize upon his ingenuity.

The case is not unique. There are a large number of patent holders whose rewards depend upon the strength of their patent rights and who must reap the harvest during the 17 years of patent protection, or not reap them at all. When the effective life of a patent is cut short by a national emergency, it is only just that relief be granted to the inventor in the form of a patent life extension equal to the period during which he was unable to exploit his invention.

It is gratifying to note that three bills have been introduced in Congress to afford such relief. In essence, any one of these bills, if it becomes law, would provide for the extension of patents whenever the use of them is prevented by war. Copies of this page are being sent to the House and Senate committees to which these bills have been reported, indicating our full approval of patent extension where patent rights have been curtailed because of the war.

The bills referred to are S. 840, H.R. 2043, and H.R. 3069. Readers who wish to obtain further details or to comment upon this legislation are urged to write or wire to Senator Claude Pepper, Chairman of the Senate Committee on Patents, and Representative Frank W. Boykin, Chairman of the House Committee on Patents.

THAT ALL MAY BENEFIT

ON THE industrial horizon looms the biggest composite job that ever faced this or any other nation from the beginnings of time: Conversion from war-production to manufacture for civilian needs and desires; employment for the millions of returning war veterans; maintenance of an economy that has come to be known as "the American way"; and, perhaps most important of all, application to industrial pursuits of the vast technological knowledge acquired during the war.

Appropriate to constructive thinking about these facets of the future are the following statements by outstanding figures in American industry:

"Our problem," says Dr. Gaston Du Bois, senior vice president of Monsanto Chemical Company, "is not merely one of reconversion but also, and quite as important, it consists in the creation of entirely new things, new demands, new activities, which alone can give jobs to an increased number of workers working shorter hours and at higher rates than before the war. . . Technologists realize that such developments require a certain incubation period which, if delayed, will delay the creation of new jobs. It should be possible for industry to pilot-plant these new developments now."

Emphasizing that in the post-war period the demands upon research of all kinds—industrial as well as pure science, social, and political—will be extremely heavy, P. R. Cassidy, executive assistant, The Babcock and Wilcox Company, says: "If we do not plan more intelligently for controlling this demand [for material things], than we did after the last war, we shall repeat the rapid inflation and the consequent cycling from inflation to depression. If we concentrate on material things, and pre-war ease and comfort when this war ends, we shall be 'lotus eaters'. . . The war has taught us that when all our citizens concentrate on a common objective and co-operate toward its accomplishment, wonders can be accomplished. If this can be done for the negative purpose of war, it can also be done for positive purposes dealing with the welfare of our people."

"We know that research and invention create new industries and new markets, which in turn generate new auxiliary industries and new jobs," says Dr. Cole Coolidge, assistant chemical director, E. I. du Pont de Nemours and Company. "In 1900 the horse and buggy business gave work to around a million persons. In a typical pre-war year the automobile industry furnished employment, directly and indirectly, to more than six million persons. . . Our high standards of living, and our hope for the future, lie in our *productivity*. That is the key word of our whole industrial mechanism. . . The thousands of people making cellophane, nylon, and neoprene, for example, hold jobs that at the end of the last war did not exist."

IMPROVING ON RESEARCH

WHEN General Electric undertook the job of designing a warmed oxygen mask to protect high-altitude aviators from the dangers of frozen moisture that might clog ports and valves, accepted testing procedure involved human guinea pigs who sat for hours, uncomfortably, in cold rooms. To eliminate this and, at the same time, to maintain better control over the tests, General Electric scientists designed a mechanical head that simulates the thermal properties of the human face and head and which breathes through the nose and mouth.

By such sensible means does technology advance, eliminating variable factors and putting its experiments and tests on ever more sound and reliable bases.

FOR FUTURE REFERENCE

AT Ohio State University is the A. F. Davis Welding Library, one of the most extensive collections on welding in the world; engineers doing original work in welding are invited to send their papers to the Library for use by industry; patent numbers of patents on welding are also desired to complete the file. . . Use of virtually pure oxygen for blast furnace operation may reduce steel mill fuel costs. . . A minor revolution in agriculture is predicted through the design of new plows and cultivators. . . Successful war-time experience with "suggestion boxes" in many industries indicates that this employee co-operation system will be carried over into peace-time and probably expanded.

These scientists are working for you

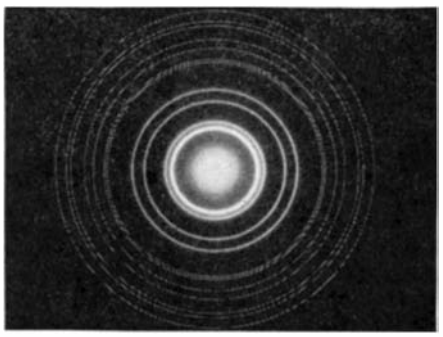
Worst weather in the world is found atop Mt. Washington, N.H., where ice feathers like these sometimes grow three feet in a single night, and where G-E scientists are conducting cold weather research for the Air Forces. General Electric devices are helping the Signal Corps, the Weather Bureau, and the Air Forces predict the weather all over the world. Accurate weather prediction aids troop movements, saves crops, protects you.

A G-E SCIENTIST, winner of the Nobel prize, studies oil films in a pan of water. And out of this research comes a clue to make glass invisible, to make metals stronger, to create a fog by machine.

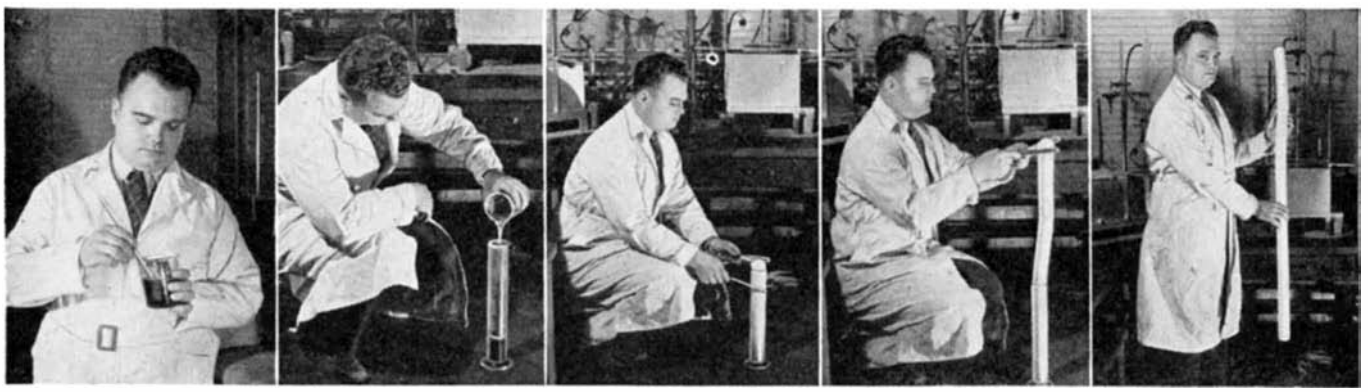
Engineers working with certain kinds of radio waves run a temperature. A G-E fever machine utilizes this principle, so doctors can treat patients with artificially created fevers.

This page of pictures isn't one-hundredth part of what is going on at General Electric. But you will see a few ways in which life can be made easier, healthier, and happier. And that's what we are trying to do. *General Electric Company, Schenectady, New York.*

Ever see pure vitamins? These three pinches of vitamin crystals in the hand of a G-E scientist are enough carotene, vitamin C, and thiamin to supply the average man for one day. Research at G-E Consumers Institute helps improve diet, make food taste better.



Electrons took this photo. This picture of gold, made by shooting electrons through a gold sheet less than *one-millionth* of an inch thick, was made in the G-E Research Laboratory, where scientists are studying metals to make new stronger combinations.



You can actually see it grow. New G-E foam plastic grows like magic at the rate of an inch a second from a liquid resembling molasses. When it stops growing, it's ready for use. Lighter for its size than a loaf of bread, it promises to have many uses after the war.

★

Hear the G-E radio programs: *The G-E All-girl Orchestra,* Sunday 10 p. m. EWT, NBC—*The World Today* news, Monday through Friday 6:45 p.m. EWT, CBS—*The G-E House Party,* Monday through Friday 4:00 p. m. EWT, CBS.

FOR VICTORY—BUY AND HOLD WAR BONDS

GENERAL ELECTRIC

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of August, 1895)

MOTOR CARRIAGES — "The carriages driven by petroleum now cost a cent or one and one-half cents an hour per horse power to drive them, so that even for a long journey the cost for fuel is not very great. The first cost of an automobile carriage is about $1,000, not much more than a good carriage. Hardly any one would care to run a machine carriage more than ten hours a day, the cost being 50 cents a day for fuel or $15 per month. Under favorable circumstances a good horse cannot be kept in a large city like New York or Chicago for less than about $30 to $35 per month."

ROADS — "The roads in France and England are almost perfection; but in this country a fairly good road is the exception, i. e., roads that are good the year round. Between the mud of the rainy season and the roughness when this mud is frozen, there are long periods of time when the petroleum carriage would have great difficulty in transporting passengers or freight."

AUTO MANUFACTURE — "In matters of transportation, no question is more generally agitating the public mind than that of horseless vehicles. . . Their construction has reached a stage when it may be well for the carriage and wagon manufacturer to give it consideration. Be made they will, and if carriage builders who are well equiped to produce them continue to antagonize their construction, stock companies, with ample capital, will be formed, and by securing the patents they will control the manufacture and prove formidable competitors."

ARTIFICIAL LIMBS — "The artificial limb manufacturer ranks, in a sense, with the reparative surgeon in the good he does to humanity. Especially at the present day his operations are of importance. . . The leg with restricted back and forward ankle motion was constructed by Mr. A. A. Marks. . . Experience of ten years showed that the ingenious and much praised ankle joint was too weak for hard service, and repairs were very frequently required. . . Now, except in very special cases, the ankle joint is definitely abandoned, and the India rubber foot, the result of a vast number of experiments, is employed."

TIRES — "With a rigid or semi-rigid tire the bicycle rider is obliged to exert sufficient force to lift himself over every obstruction encountered by the wheel; the descent from the obstruction gives back a portion of the power expended in surmounting it, but not all of it. In the case of the pneumatic tire, however, the small obstructions are not an opposing element of any consequence, as the tire yields, in lieu of the wheel being raised, and the result is the wheel travels as upon a smooth track."

REHEATING STEEL — "The Carnegie Steel Company at Homestead tested July 17 a new plan which Manager Schwab and Chief Electrician Kinkey have devised for reheating molten metal that has become chilled before it can be poured into the moulds. The new plan consists in using an electric current, by which an intense heat is generated. The molten steel was set to bubbling, and the light and heat were so intense that the workmen's eyes suffered seriously, but at the next test they will wear glasses."

METEOROLOGY — "Meteorological data will be a necessary to the engineers of flying machines, when practically perfected, as charts are to sailors. Ballooning can be then carried on with much less risk than at present, since it will be an easy matter to determine what currents of air are likely to be met at various heights, just as it is now a small task to find the Gulf Stream or the trade winds. A still greater service will be rendered by this information to scientists, who now believe that men will be able to soar like birds as soon as the upper air currents are definitely understood."

TELEGRAPHY — "By the connection of several different lines telegraphic communication was established between Derby and Cape York, Australia, a distance by the wires of 7,246 miles. This is believed to be the longest telegraph line in the world. The rate of transmission was eleven words per minute. There were fourteen repeating stations."

CABLE'S END — "A few days more will witness the ending of the cable system as a means of passenger transportation in Philadelphia. Within a week every remaining cable car on the Market Street main line, the last link in the cable system, will be displaced by trolleys."

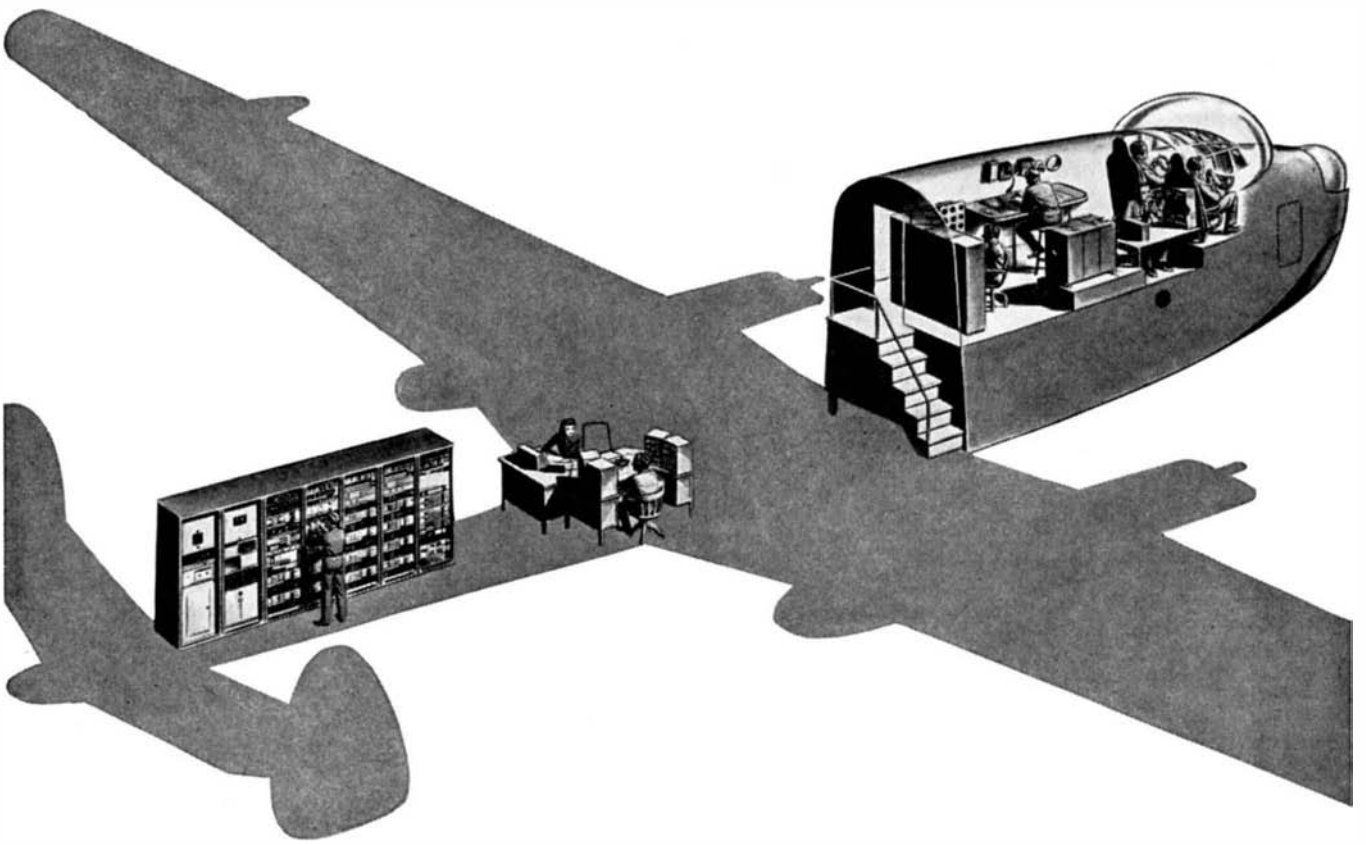
ELECTRIC LOCOMOTIVE — "With the view, principally, of escaping the nuisance of smoke and gases from a steam locomotive in drawing passenger trains through a long tunnel, the Baltimore & Ohio Railroad, with the co-operation of the General Electric Company, has brought into its service a powerful electric engine. . . The machine bears with its entire weight of 96 tons, or 192,000 pounds, on its eight driving wheels, which is considerably more than twice the weight on

the driving wheels of the heaviest steam locomotive. It has two trucks and eight driving wheels of a diameter of 62 inches each outside of the tires, the wheel base of each truck being 6 feet 10 inches; the length over all, 35 feet; and the height to top of cab, 14 feet 3 inches. . . There are four motors, two to each truck, or one to each axle. . . Each motor is rated at 360 horsepower and takes a normal current of 900 amperes at a pressure of 700 volts. The controlling devices and measuring instruments occupy the interior of the cab, the controller being of the series parallel type."

LEVEES — "Captain George McC. Derby has announced that the attempted feat of building a levee with the force pumps on the great dredge, the Ram, was successful. . . The Ram is very powerful; in practice it was found that she could deliver about 2,000 yards per working day of ten hours. The total cost per cubic yard of a levee built by the Ram to a height of 10 feet will be 3.91 cents per yard. Hitherto the price of levee work has ranged from 10 to 12½ cents on an average per cubic yard."

STREAMLINING — "A novel method of determining the curves of least resistance in water and air was recently employed at Newport News. The idea was to make the water and air themselves shape the model, and accordingly rectangular blocks of ice were towed in the water, and the alterations in their shape and in the pull necessary to keep them moving at a certain speed carefully noted. . . Wax was the material used for the models moving in air, and the air currents were heated sufficiently to gradually melt the wax."

THIS SEA-GULL LIVES ON THE GROUND



This is a "flight trainer"— an electronically operated replica of the PBM-3 flying boat. It was conceived by the Bureau of Aeronautics and developed by Bell Telephone Laboratories to train Navy bomber crews on the ground.

The new crew climb a few steps to get in and from then on it is like being in a big plane at night. Controls tug against the pilot's grasp and "engines" roar in response to the throttle. From his desk, the instructor creates every situation of real flight — even to iced-up wings, conked-out engines and sudden air-pockets. The novice pilot and his crew get the feel of danger without the hazard.

Once the control dials are set, the various effects are automatically organized and set in motion by concealed machinery which includes 200 vacuum tubes, 60 motors, loudspeakers and hundreds of associated parts. Twenty Laboratories engineers worked more than a year developing the project. Drawings covered an area equal to 15,000 square feet.

This is only one of the 1200 projects in which our experience has been able to help the Armed Forces. What we have learned in devising electronic circuits to train flyers will help build better telephones.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for the Armed Forces at war and for continued economies and improvements in telephone service.

POINTED RHYMES FOR TRYING TIMES

by
Berton Braley

Here is wisdom by the peck
Versified to save your neck!

DON'T BLOW IT

Oh, workman or scholar,
Hang on to your dollar
And do not spend it soon,
For every cent
Unwisely spent
Inflates the price balloon.

IT MAKES SCENTS

To market (black market) to spend lots of jack
Careless of how many ceilings you crack,
To market (black market) where prices are dear,
—Gosh, there's a terrible smell around here.

If you can keep your head and calmly ponder
How silly spending drives the prices high;
If you can save the cash you'd like to squander
And only buy the things you need to buy;
If you can do your part to fight inflation
By simply being thrifty with your pelf,
You'll do a vital service to the nation
And—furthermore—you'll benefit yourself.

Bonds you buy with payroll earnings,
Help fulfill your future yearnings.

NO GAMBLE

When the war is over, will the prices
rise or fall?
We do not know the answer, and
nobody does, at all.
But this much we *can* prophesy—
whichever way they go:
You will find it more convenient if
you've saved a little dough.

★ ★ ★

Money in your pocket,
Take it out and sock it
Into War Bonds, which
Help to make you rich.

DOUBLE AND NO QUITS

When you boost your paycheck quota and allot it
To another bond—it's pretty soft for you!
For, although you've spent your money—you
have got it,
And the Interest is interesting too.

WHO? ME?

There was a little dope with a fat
pay envelope
And she spent every cent that
was in it.
And she wondered, by-and-by,
why the prices rose so high,
But she didn't blame herself for
a minute.

★ ★ ★

INFLATIONARY MARY

Inflationary Mary spills
This silly kind of chatter:
"My little teeny-wee bills
And spendings do not matter.

"And if I cheat a little bit
On rationing and ceilings
The Nation's welfare isn't hit
By my small lawless dealings!"

Inflationary Mary's wrong.
For she'd be much to blame
If people in a mighty throng
Should say and do the same.

Small spendings, in the aggregate,
Reach sums extraordinary,
So let's not try to imitate
Inflationary Mary.

★ ★ ★

SNAKE IN THE GAS

There was a crooked man and he
lived in crooked style,
He dealt at crooked markets with a
smugly crooked smile.
He viewed himself as clever with
his crooked ration book,
But everybody knew him for a
crooked little crook.

★ ★ ★

THE GANG'S ALL HERE

You may ask, "Why should *my* spending
Cause inflationary trending
Though I squander every penny I have got?"
—If you're joined by sixty millions
Of civilians blowing billions,
You'll discover that it matters quite a lot!

YOU CAN LAY TO THAT

As the best egg for a nest-egg
Buy a War Bond—buy a batch.
But you gotta keep 'em settin'
Or they ain'ta gonta hatch!

Save your pay
Here's a way—
Bonds and savings and insurance
Give your future more endurance.
Mrs., Mister,
Brother, Sister,
Don't compete in buying things
That is whence inflation springs.

ONE PERSON CAN START IT!

You give inflation a boost

—when you buy anything you can do without
—when you buy above ceiling or without
giving up stamps (Black Market!)
—when you ask more money for your services
or the goods you sell.

SAVE YOUR MONEY. Buy and hold all the War Bonds you can afford—to pay for the war and protect your own future. Keep up your insurance.

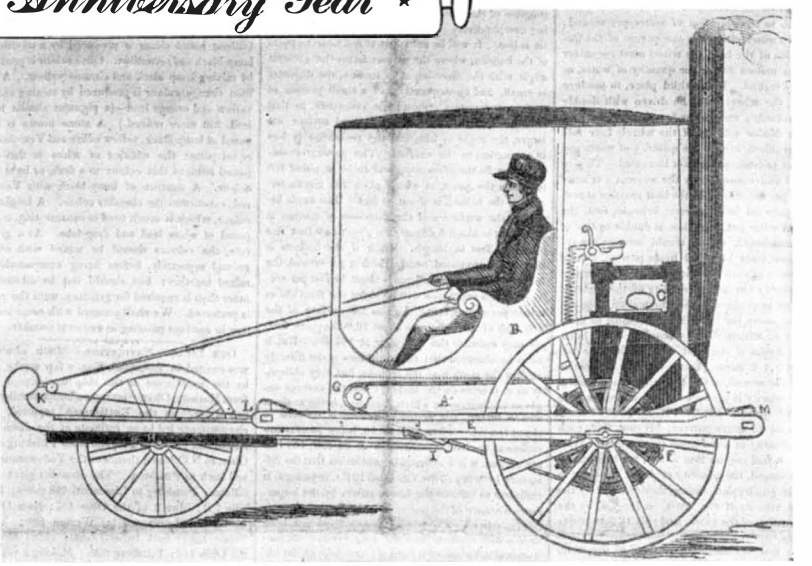
A United States War message prepared by the War Advertising Council; approved by the Office of War Information; and contributed by this magazine in cooperation with the Magazine Publishers of America.

Scientific American

AUGUST • 1945

* 100th Anniversary Year *

Virot's steam carriage (France, 1888)



Proposed steam carriages for common roads (United States, 1845)

Above: French steam tricycle and trailer (1888)

Right: Simonds' light steam road wagon (1894)

Illustrations above are from Scientific American. Dates indicate year of first publication

America On Wheels

By LESLIE PEAT

From Evans' Road Vehicle of 1789, Through the Famous Selden Patent of 1895 and the Rough-and-Tumble Days of the Early 1900's, to the Present Day, Automotive History in the United States Shows a Dominating Influence on the Growth of Other Industries. Co-Operative Engineering, Imperative to the War Effort, Will Benefit Many in the Future

SCORES of competent engineers are hard at work today trying to harness jet propulsion to highway transportation for tomorrow's tomorrow. Thus the pioneering spirit of mankind which from time untold has been seeking to eradicate distance and reduce time is still hard at work. But research these days is correlated, and with the aid of organized facilities, instead of the handicaps of unrelated experimentation which

TRENDS OF 1902

Of 23 cars, 18 had engines under the seat or in the rear, and only five had them under the hood.

Of 20 vehicles, 14 were battery-equipped; 14 had some form of planetary transmission, five had sliding pinion transmissions, and one had friction disks.

Sixteen out of 32 had two speeds forward and six boasted three, 17 had chain drive, five used bevel gears, and one had spur gear drive.

The average speed of a group of 26 vehicles was 20 miles an hour; average cost in the light-weight field was $896 and $1585 for the heavier vehicles. In the light-weight group the engines averaged six horsepower.

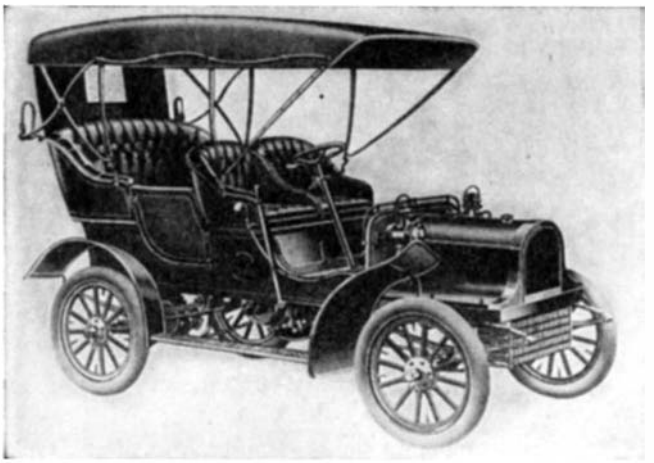
Most had tiller steering, and Packard advertised an ammonia gun to squirt at dogs with a penchant for running alongside and nipping at the tires.

marked automotive developments before the turn of the present century, the future of technological advance is a bright one.

While the chronology of automotive developments stems from hazy, almost legendary, writings, the real beginnings may be said to lie in a patent granted to Oliver Evans for a self-propelled road vehicle in 1789 and in Robert William Thompson's British patent on a pneumatic tire 100 years ago. Many steam, electric, treadle-operated, and other types of vehicles have appeared since. An engine using gunpowder for fuel was made to operate—but it was too dangerous to become popular. The track-layer, or Caterpillar type of tractor, made its bow 99 years ago.

No one person or single corporate group can be credited with the development of the automobile as it is known today. It has been a gradual process with many persons in different countries sharing in the research that was destined to bring about the epoch on wheels of the 20th Century. Although France led in initiating tests and experiments in the earlier days, America was from the first the leader in production.

The industry got a healthy start in this country about 1900 with production during that year of around 4000 cars, and with managerial and organization talent quickly gravitating to this new and promising enterprise from many long established industries. American automobile builders contributed many improvements, but the two most important aspects of the industry which developed here in the early part of the century were mass production, based on the assembly-line principle, and the standardization of parts.



David D. Buick's 1904 model, the first Buick to go on the market. It sold for $850, top and lights $125 extra. Buick formed a company with $75,000 capitalization in 1903 and had sold 750 cars by the end of the next year. In 1906 the company brought out a four-cylinder car with sliding gear transmission. General Motors Corporation bought the company in 1908

The period from 1900 to 1910 saw the industry out of the workshop stage—often in smithies—and into an important branch of American manufacturing, while the next five years witnessed the adaptation of its products to the middle-class market. During both of these eras there was a remarkable growth interrupted only by recessions corresponding roughly with changes in general business conditions.

Output in 1903 stood at 11,235 units; by 1910 it had jumped to 187,000, and five years later to 970,000. After 1917, the expansion was marked by five major factors: The self starter; the cord tire; low-priced cars; instalment sales; and closed cars.

A recent study of a representative group of 1940 passenger cars showed that the average retail price was about 23 cents a pound and $9.00 per horsepower, as compared with about 32 cents a pound and $16.70 per horsepower as of 1929. The price of the post-war car and truck will depend, of course, largely upon wage rates and materials costs, with the latter weighted heavily by the former.

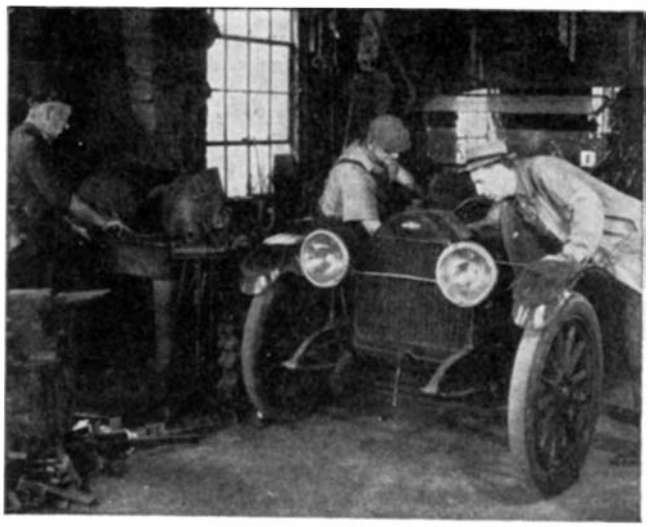
IMAGINATION — The development of the mechanics of modern highway transportation owes much to the older American manufacturing industries, and many of the manufacturing executives got their start in railroad shops, at tool makers' benches, in bicycle plants, and in other factories which were long established when the first wheezing motor car passed them on a dusty street and fired their imaginations with the possibilities of the coming horseless-carriage era.

Many interesting related factors reflect the influence of the internal-combustion engine on our way of life.

Mack's first bus, 1900, was bought by a sight-seeing company. Builders of many commercial vehicles, Mack also builds marine and automotive Diesels

It has opened up isolated country districts; motor vehicles stimulated to a remarkable degree the development of the country and its subsequent industrialization. America had no national or even state road policy at the beginning of the century. All the hard-surface roads in the country at that time would scarcely have formed a highway from New York to Boston if laid end to end. None of it could be called "good roads" today.

But, roads or no roads, the motor car was being developed in the United States at the turn of the century; when it was accepted by the public as a useful vehicle, motorists demanded better roads. The American Automobile Association held its first good roads convention



More than 100,000 automotive service establishments in the United States, doing a pre-war annual business of about a half-billion dollars, have replaced the village smithy as repair shops. Several automobile companies started from blacksmith and wagon shops

in 1907—meeting jointly with the National Grange—to discuss methods by which roads could be developed, but it was not until 1916 that Congress passed the Federal Aid Road Act.

BETTER ROADS — Thereafter the country began to build good roads with extraordinary speed. Federal expenditures for roads jumped from 63 million dollars in 1921 to 1171 million dollars in 1939. After the war the nation's roads will be modernized still further if Congress has its way. Tentative plans call for the expenditure of 1500 million dollars for a three year building and improvement program with the individual states and Federal Government matching the outlay dollar for dollar.

As the automobile revolutionized the living and thinking of people, it was an equally dominating force in the growth of other industries. When World War II broke out in Europe the motor industry was using a preponderant share of many raw materials: 51 percent of malleable iron, 75 percent of plate glass, 68 percent of upholstery leather, and 80 percent of rubber. In addition, the automobile took more than 18 percent of the steel output, approximately 10 percent of aluminum, some 13 percent of copper, and about 34 percent of lead.

The sturdiest link in the industrial entity built up by the motor vehicle is the oil industry. In its early days gasoline, representing only a fraction of petroleum, was considered undesirable and refiners were sometimes prosecuted for dumping the stuff into rivers and streams.

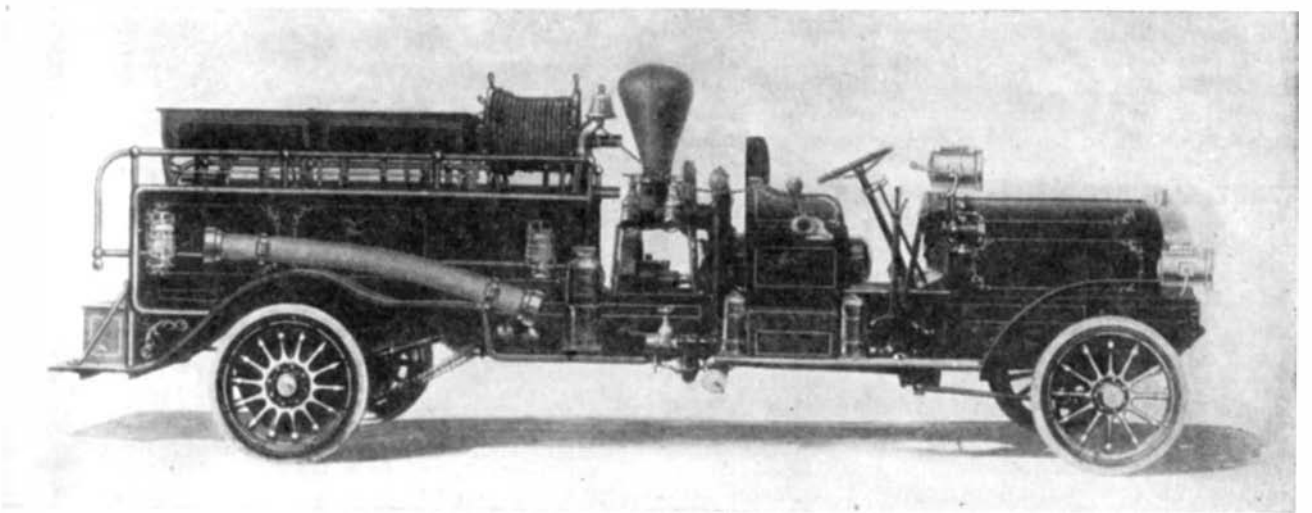
Statistically, the oil industry was born when the internal-combustion engine was mounted successfully on wheels. Production of crude oil soared from 63.6 million barrels in 1900 to 1500 million barrels two years ago.

Just as the motor vehicle industry grew from infancy prior to World War I to one of the nation's staunchest economic factors, it may be expected that the engineering, sales, and management programs of the automobile and truck business will accelerate to new levels as soon as the war manufacturing job is ended. Whatever the compromises between comfort and style on the one hand and economy on the other may be in respect to passenger cars, the factors of durability and economy of operation will determine the success or the failure of truck manufacturers.

DURABILITY — Improving durability has been a 20-year achievement of the truck and bus manufacturers, and their service experience with current military vehicles is a substantial asset in continuing this trend. Truck owners consider they are due about 50,000 miles of mechanical-trouble-free operation, whereas they individually accept the usual 4000-mile guarantee on their own passenger cars. This dependability of American trucks and buses is a complicated story of careful development of materials, manufacturing methods, and detail design over a period of a quarter of a century.

It is safe to say that the design and manufacture of heavy-duty trucks and large buses have contributed more to the progress of metallurgy during the past two decades than any other product. Many of the metallurgical and lubricant developments which have made for better passenger cars have stemmed from the work and experience on these vehicles, where performance requirements were more rigid.

Gear steels of greater strength and longer fatigue life; other new steels which have multiplied by many times the life of springs; alloy irons for castings, less subject to wear and abrasion; extremely hard materials for valve seats which, together with valve steel developments, increased valve life from a few thousand miles to virtually the life of the truck, are a few ex-



Starting the retirement of horse-drawn fire engines, Mack built the first motorized hook and ladder fire truck in 1910 and this pumper in 1911. Mack is expected to be an important factor in the fire-fighting equipment field post-war

Founder of the Autocar Company, Lewis S. Clark's vision led him to experiment with automotive vehicles in 1897. The tricycle with which he is shown here (but which never went into production) had a single-cylinder engine and weighed about the same as a front spring of a 1944 heavy-duty Autocar truck

amples of metallurgical developments traceable to the constant effort to increase the life of the motor truck.

Virtual abandonment of the four-cylinder engine for the six-cylinder power plant enabled operation at higher speeds with greatly reduced destructive vibration. With the six-cylinder engine came a larger number of bearings for crankshafts and force-feed lubrication, which permitted carrying heavier loads at higher speeds with a longer life than was possible with the previous four-cylinder designs.

To eliminate destructive "whip" in the longer crankshafts of the six-cylinder engines, engineers developed torsional dampers which, when mounted on the front end of the crankshaft, resulted in increasing crankshaft life from an average of 35,000 miles a few years ago, to a point where a crankshaft today lasts almost indefinitely.

Higher operating speeds of both trucks and engines and higher output of engines were, of course, reflected in increased operating temperature throughout the engine. Since engineers could not limit the expansion of metal under heat, they set to work to make the expansion uniform and thus prevent engine distortion.

START AND STOP — In the fields of transmission and brake development, many automotive engineers believe they have a long way to go, although the newer types of transmissions offered with late model cars, trucks, and buses just before the war were a step in this direction. Despite the lower efficiency of hydraulic couplings, torque converters, and mechanical automatic transmissions, engineers are agreed that improvements are demanded because of the ease of operating heavy vehicles with these aids. Hence many development projects are afoot in this area of automotive engineering.

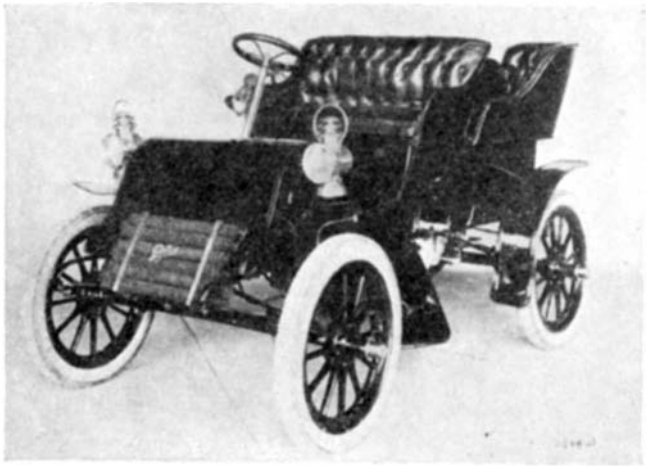
Brakes face radical improvements. Overloading is a common practice, and the necessity of carrying off the heat generated had become acute before the war. Many truck engineers are looking into aircraft brake systems for an answer, and a large number of projects on brake design and test work are underway throughout the industry. During the past two decades life between brake re-linings has been more than quadrupled, thanks largely to the developments of hydraulic and pneumatic systems and improvements in metallurgy and brake-lining materials.

FIRSTS — Probably in no industry has the "battle of the firsts" been waged with more words and engendered more bitter and frequent recriminations than in the automobile business. Most famous in the chronicle was the long-fought Selden patent case which stemmed from the experimental work of George B. Selden, a graduate of Sheffield Scientific School, Yale. In 1877 he started to work on a "road engine," and in 1879 filed a patent application on the basis of drawings and descriptions. A patent attorney, he succeeded in keeping his patent from being granted for 16 years. Thus in 1895 he received a patent (U. S. No. 549,160) for an invention of 1879, but had not yet built a motor car.

Then, in 1898, Selden assigned his patent to the Electric Vehicle Company. In 1900 the company sued the Winton Motor Carriage Company for infringement, notice having been served upon the infant industry that stormy litigation was ahead. The Winton company and 17 other manufacturers joined with the Electric Vehicle Company and formed the Association of Licensed Automobile Manufacturers which, by July 2, 1904, had 33 members. Names such as Olds, Autocar, Packard, International, Cadillac, Studebaker, and Buick were on the ALAM roster, as were important pioneering corporations which have ceased to exist or been merged with present manufacturers; Apperson, Knox, Locomobile, Hayes-Apperson, Peerless, Franklin, Thomas, and Pope, were among these.

Conspicuous by its absence was the Ford Motor Company, and for the eight years of the ALAM's existence Henry Ford fought—often alone—against the 1¼ percent royalty of the retail price which each member manufacturer paid the association. The American Motor Car Manufacturers Association was formed by those who, like Ford, did not agree with the famed decision of September, 1909, handed down by Federal Court Judge Hough upholding the Selden claims. By the end of 1910 Ford and Thomas B. Jeffery stood out alone.

Most venerable of today's automobile is the Oldsmobile, which made its bow in 1897 with this single-cylinder model. A contemporary advertisement claimed a speed of 20 miles an hour on a smooth road. General Motors acquired Oldsmobile in 1908



The Cadillac, which first appeared in 1902, was a product of Leland and Falconer, machinery builders. Powered by a single-cylinder engine with a five-inch bore and a five-inch stroke, this vehicle had ball-bearing axles and a planetary transmission. An important feature was a "novel sparkplug which could be removed for cleaning with the greatest of facility"

Although in 1907 the royalties were reduced to 4/5 percent, it has been estimated that the growing industry paid a total of $5,800,000 in royalties. The ALAM was disbanded after the Circuit Court of Appeals held that the Ford Motor Company had not infringed the Selden patent. The ALAM's membership formed the Automobile Board of Trade, which soon became known as the National Automobile Chamber of Commerce, now the Automobile Manufacturers Association, the trade association of the vehicle manufacturers.

In view of the circumstances just related, any resume of "firsts" in automotive inventions and developments must be done with a sketchiness which is necessitated by the cloudiness of the industry's history.

By the turn of the century, the horseless carriage had become a fact and the automobile began to take on the semblance of a utilitarian vehicle rather than the fad it had been. Eight thousand vehicles were in use. These companies, still in business, were in production: Autocar, International, White, and Mack (now trucks exclusively), Oldsmobile, and Packard. Scores of other famous names, since out of production, contributed to 1900's 4192 automobile production.

By the end of the next ten years, 522,497 cars and 70,228 trucks, with a wholesale value of 385½ million dollars, had been produced. Among the mechanical improvements were the introduction of steering wheels to replace the tiller in 1900, and automatic spark advance in 1901—both by Packard; steering knuckle by Elliott; shock absorber by E. V. Hartford; speedometer by J. W. Jones; Prest-O-Lite for headlamps by Eugene Bournonville; demountable rims; lamps included as standard equipment by Pope-Hartford in 1904; tubular horns by Miller Reese Hutchison; tire chains by Weed; power tire pumps; ignition locks; storage battery as standard equipment introduced by Buick; front bumpers; nickel-plated trim by Oldsmobile; Buick's sliding gear transmission in 1907; vanadium steel introduced by Harold Wills of Ford; sleeve valve engines; left-hand steering; silent timing-gear chains; electric horns; baked enamel finish; helical gears; Hupmobile's transmission and clutch integral with the engine; multiple disk clutches; one-man tops; overdrive transmission on Gramm trucks; and Buick's six in 1910. More than 125,000 automotive inventions had been patented by the end of 1910, and nearly 200 passenger car and truck manufacturers were in the business at the end of that decade.

Automotive standardization was begun in earnest in 1910 when the six-year-old Society of Automotive Engineers named Major Henry Strouther as chairman of its Standards Committee, and 13 divisions and their subcommittees went into action on scores of projects.

NAMES — Motor vehicle licensing legislation, installment selling of cars and trucks, an attempt to regulate used car prices, and cross-country races were some of the highlights of that historical era during which Ford became one of the industry's most important names and hundreds of companies ventured into the vehicle manufacturing arena. These were rough-and-tumble days, in corporate financing and in vehicle sales schemes, as well as in engineering. The decade from 1900 to 1910 saw the beginnings of names now famous the world over, such as Buick, Hudson, Cadillac, FWD, Studebaker (first with an electric and then in 1904 with a

When Thomas H. White started to manufacture sewing machines some 86 years ago, he laid the foundations for one of the most successful automotive vehicle businesses. The famous White Steamer stemmed from the invention, by his son Rollin, of the automobile flash boiler in 1899. Above is the White steam car and at left the steam truck, of 1900. In 1909 the company turned to gasoline engines exclusively

Packard's 1902 "Old Pacific," with the late Tom Fetch at the wheel, made a transcontinental trip in 1903 and blazed the trail for the Lincoln Highway. This feat—and track racing—was the era's most dramatic sales promotion for the horseless carriage. Formed in 1900 by an electrical equipment manufacturer of Warren, Ohio, Packard Motor Car Company was credited with many "firsts" during the initial decade of the present century. First Packard that was offered for sale was purchased by Wm. Rockefeller

gasoline vehicle), Mack's first bus, Graham, Overland —and, in 1908, the Willys-Overland—Reo, International Harvester Company, Diamond T, Packard's first truck, Pontiac, Oakland, Autocar trucks, Hupp, Chevrolet, Lincoln, American-LaFrance, and Federal. More than 350 other names, lost by merger or because of withdrawal from business, were on the roster of "those present" during that period. Altogether, there have been more than 1500 makes of cars and trucks on the market, all built in the United States.

The pattern of mass production was beginning. Always dependent upon the products of supplier companies, the growth of vehicle demand nurtured many metal-working companies and established new ones as production figures soared and as new mechanisms were developed. Despite advanced engineering of European manufacturers, American mass production methods started a trickle of United States cars and trucks overseas until, in 1943, total United States automotive exports reached nearly 368 million dollars. These often sold despite a substantial disadvantage because of heavy import duties abroad.

Many American cities tried to legislate the automobile off their streets in the early days. Due to the vigilance of the motorist, most of these regulatory attempts were blocked. It is recorded that the city fathers of Glencoe, Illinois, used tax-payers' money to build humps across the streets to discourage driving. Speeds were held down. Sale of gasoline for vehicles was forbidden in some places, although explosive cleaning fluids were under no ban. Several states passed laws requiring a licensed steam engineer to drive a steam car, and a number of statutes were proposed to make the same requirement for operators of gasoline vehicles.

TRENDS — Automotive mechanical development can best be viewed in four periods: From 1900 to the beginning of World War I; World War I itself; from the Armistice to the beginning of World War II, and during the emergency engineering achievements of World War II to date. Here are four reference points from which to consider design trends of the car and truck of the future.

In the period of the first 14 years of this century, most of the lasting achievements were made by in-

An International tractor-truck hauls logs out of the big woods in the state of Washington

THIS FAMOUS TOWN* WAS ONLY A PRAIRIE until trucks came along!

Everything the citizens of Franklin Square eat, use or wear is hauled to them by truck!

FRANKLIN SQUARE, Long Island, is the living symbol of over 50 thousand thriving American towns that *already exist today.* And of thousands more that *can* be built if trucks and highways are wisely put to work.

For here's a town that depends on trucks—and trucks alone. *There's no railroad!* Everything that rolls—in or out—of Franklin Square rolls *by truck.*

Result? Homes, goods, jobs for a prosperous and thriving community of 10 thousand people!

Today—thanks to trucks—America can put to use whole areas that are "off the rail line"—areas that might otherwise be wasted. New frontiers are opened up—new towns, new industries, new opportunities for our homecoming servicemen.

Yes! All over America—through peacetime and war—trucking is a dynamic economic force. Reawakening tired old communities—creating new ones. Stimulating jobs, industries, opportunities!

50 thousand towns like Franklin Square are proof of this fact: With good roads—and the freedom to use them—*trucking can do the job!*

THE AMERICAN TRUCKING INDUSTRY

AMERICAN TRUCKING ASSOCIATIONS, WASHINGTON, D. C.

TRUCKS CREATE NEW INDUSTRIES—NEW JOBS—NEW WEALTH!

dividual inventors. Often working alone, few were ever adequately rewarded for their labors. Yet the pattern of things to come was beginning to be clear, because some of the earlier failures were again taken up and made to succeed.

The second period saw the beginning of coördinated engineering effort demanded by the national emergency of World War I. The Liberty airplane engine was an example. On May 27, 1917, the Government asked a group of outstanding automotive engineers to develop an airplane engine. Through co-operative effort, the first production engine was delivered to McCook Field, Dayton, on Thanksgiving Day of that year. The Washington office of the Society of Automotive Engineers had participated in working out many of the details and in calling upon companies to assign men to the task. Although the war ended before many of the Liberties got overseas, it was a good engine by the standards of those days.

The third period saw the organization of great engineering and research staffs, and the building of huge laboratory and experimental facilities. General Motors, Studebaker, Ford, and a late-comer, Chrysler (with its almost legendary Zeder-Skelton-Breer technical triumvirate in 1924) led the way. Every major car and truck producer developed engineering and research organizations, as did the more progressive parts and components manufacturers. A few new companies came into the automotive picture, and many faded. By 1923, five years after the Armistice, the millionth Buick had come off the production lines, and Ford had produced 2,000,000 vehicles. Duco was first used as the Oakland's standard finish, ethyl gasoline was on the market, and four-wheel brakes had been introduced.

The production peak of cars and trucks was reached in 1929 with 5,358,420 units. Motorists had available all-steel bodies, hypoid gears, rubber engine mountings, adjustable front seats, hydraulic brakes, synchro-mesh transmissions, safety glass, and graceful styling.

The fourth period (during the present war emergency) has been marked by a vigorous coördination of the great research and engineering organizations of the automotive industry, in the interest of winning the war more quickly. Never has the nation seen anything like this pooling of technologies. Under the general supervision of the Army and Navy engineering staffs, new processes and designs, test data, and even experimental information have flowed freely between automotive companies. Management of the automotive companies has assigned more than 3500 of their best engineers to more than 1400 war engineering projects conducted by the Society of Automotive Engineers alone. The basic engineering work done will always be available to American industry, except for those studies which may remain under the cloak of Government censorship.

Actually a fifth period has already begun, because with cutbacks in weapon manufacturing programs many engineers have now been released for post-war projects. A total of 86 million motor vehicles had been produced by the American industry up to the discontinuance of civilian production, but never has the market been so hungry for vehicles as it is now.

To the galaxy of development engineers—both in and out of the automotive industry—will be added thousands of men and women who have had an introduction to new developments through military service and other war work. The ingenuity of this segment of the American population has been fired by making and using the motorized weapons which have helped in the achievements of the United Nations all over the world. These people will demand that tomorrow must give them something better than today's superlatives. They want progress and they will get it by being part of it.

Modern roads relieve traffic congestion by such devices as the Kew Gardens Loop on Long Island

Machine Tool Magic

Machines That Make Other Machines Have Progressed Rapidly During the War, Yet the Immediate Future Will Demand Continuing Supplies of New Tools. What Improved Machine Tools Mean to Industry and What May be Expected of Them in the Light of New Knowledge

HOUSEHOLD refrigerators will run so quietly that nobody will know when their motors turn on and off. They will have deep-freeze sections as standard equipment, too. Printing will be sharper, clearer, on more beautiful paper, filled with color, yet so inexpensive that every business house will be able to afford better work than the pre-war best. Automobiles will be lighter, faster, more durable, more economical, and much less troublesome in such small details as filling up the gas tank and keeping the brakes adjusted. Railroad trains will be faster, more comfortable, safer. Television sets will come in much sooner than anyone expects.

These and a thousand other post-war promises can be kept because just one industry—the machine-tool industry—can back them up. And right there is a story of what the automotive industry has done for the United States and perhaps for the whole world.

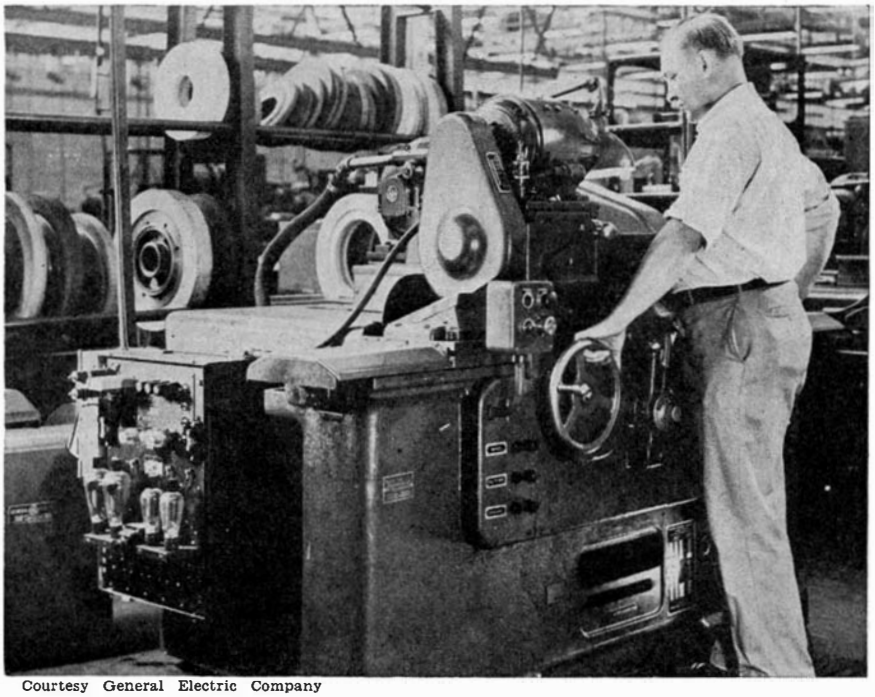
It was away back in the dim 1906 days of the automotive industry that dreaming executives began to see the real values of machine tools—machines that make other machines.

The slogans which the early automobile makers used show what they were thinking. Historians disagree as to who said what, whether any one idea was first expressed by Olds, Ford, Leland, Dodge, Willys, or any of the others who were equally great. But all of these men were saying "automobiles will be manufactured by men and power, and a machine tool is a means of submitting more power to the control of a man," and "no automobile ever will be as good as the machine tools that make it, therefore for better cars we must have better tools," and "as soon as we get the machine tools we want we can make good cars at any prices the public is willing to pay."

Ideas like this made the automobile industry the target of every machine-tool designer and maker who had brains. Cars got better and better right along with the machines that made them. And contrary to popular snap judgement the improved machine tools did not decrease either the amount or the wages of labor. Rather, in every case where direct comparisons could be made, it was found that the better the machine tools and the better the car the more the man hours of labor on it, even though the retail price went down.

Automobile makers ran dozens of small factories as well as their huge ones, and proved that superior machine tools work the same wonders in a small plant as in a large one. But from the viewpoint of the machine-tool builders, the trouble was that only a handful of industries (vacuum cleaner, refrigerator, radio, and the like) followed the automobile example. As late as 1939 more than 80 percent of the machine tools in use in the United States were over 10 years old and a big percentage were more than 20 years old. And with its products lasting that long and being allowed to get out of date that way, it was a good year when the machine tool industry had $350,000,000 in gross volume to whack up among the 200 or so machine-tool builders.

The war changed all this. Beginning with 1942 the entire metal-working industry of our nation became like one big automobile industry. Nobody cared what a machine tool cost, but many cared



Courtesy General Electric Company

Electronic control has made machine tools more versatile, more reliable

about what it would do. The object was to get out the most production, of the highest quality, and in the shortest time. All sorts of factories —tobacco companies, tire builders, railway shops, gas stove makers— got large quantities of machine tools and started producing shells, tanks, precision instruments, mechanical products of the most exacting accuracies. After learning the amazing things that machine tools can do, many an industrial executive made up his mind to have the full benefits of them in the oncoming peace-time.

BIG SALES—One of the first to feel this demand was the machine-tool industry itself. Its sales skyrocketed from $200,000,000 in 1939 to $1,322,000,000 in 1942. Another billion dollar year was 1943, and 1944 followed along with $500,000,000 dollars worth of output. Half of this may have been special machines useful only for war contracts. But right now our nation has a full ten-years' normal output of machine tools of models less than four years old.

Strange to say, this surplus does not mean that the machine-tool industry will suffer from lack of normal business volume, excepting for the reconversion hiatus which may affect all industry. The progress of the machine-tool users who follow the course laid down by the automobile industry will be to find new and better ways to do many things, requiring continual supplies of new and better machine tools or at least drastic rebuilding of old ones.

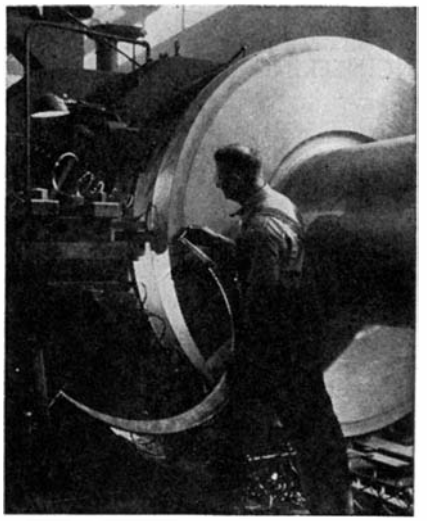
A large manufacturer of pumps is an example of what is happening. In the pre-war years this plant stuck to many a machine tool that was over 30 years old. Production lots of any one item were small, the line of products was highly diverse, and the management felt that it would do best with "old faithfuls" which its highly skilled mechanics knew exactly how to run.

The war changed all that. New machine tools came in and were installed right beside the old ones. And the better the mechanic the more advantage he took of rapid power traverses, pre-selectors of cutting speeds so the mechanic can set the speed for one operation while he is performing another and have that new speed come on automatically when he changes operations, one-shot lubrication so the whole machine is oiled or greased at a single push of a plunger, better lighting, more micrometric adjustments with magnifying glasses over their scales so they will be quick and easy to read, and other features.

It became certain that the company could make still more products and make them better, at lower prices, if it kept the new machines and discarded the old ones. But there always was the question of which new machines to keep.

CHECK LISTS—To settle this, the methods engineers worked out check lists of exactly what features any lathe, shaper, miller, or other machine tool should have to be ideal for the making of any one line of pumps in any department. These check lists showed the management a surprising fact.

There are few or no war-born machine tools which are ideal for peace-time use. The check lists showed blank space after blank space where no machine tools having all the desired abilities could be found.



Courtesy Westinghouse

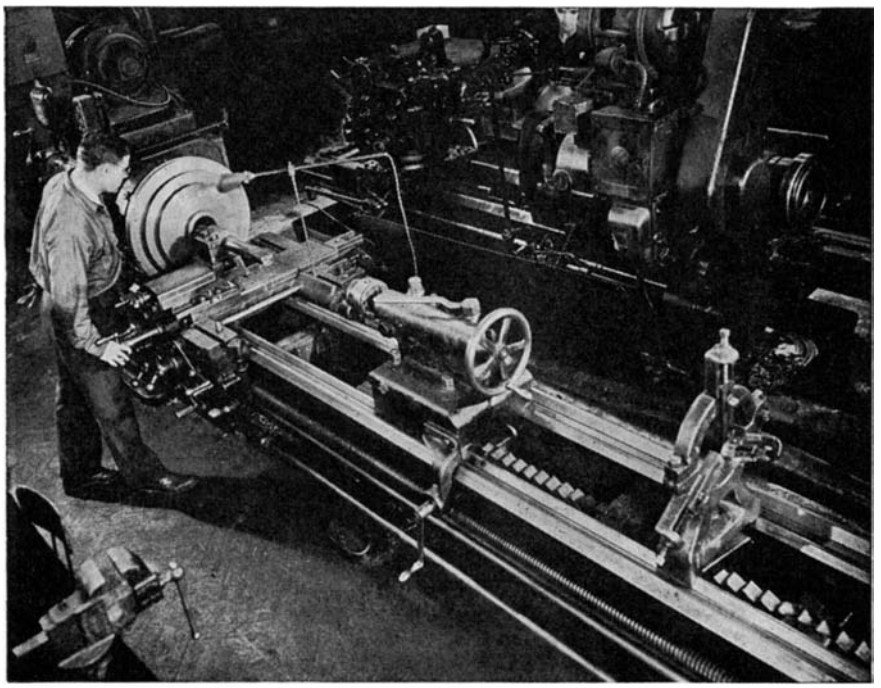
With this micrometer the 25-ton shaft of a vertical water-wheel generator is measured to .0005 inch precision

This manufacturer will use its war tools, or such of them as the government allows it to buy (many of the best machines will be taken over by the navy yards and the air forces) to earn money with which to buy new ones. But from the first minute of reconversion it will be looking for machine tools which can fill in the gaps in those check lists, challenging the design engineers of the machine-tool makers to work out new and better machines.

The schools in which mechanics and foremen are trained will change also. For years the fact that these schools were equipped with machine tools of ancient vintage has been a national problem. As far back as 1937, when the depression was still with us, the machine-shop managers of the nation were getting together and trying to find ways to modernize the schools so the skilled labor shortage could be relieved by a constant stream of modernly trained men.

Now those schools are to be equipped with government owned modern machine tools. They will not be turning out men who know how to work on ancient models. Their graduates will be trained to run the latest machines and to be quick about learning how to run still later ones. There will be skilled labor aplenty for shops which have late model machine tools but very little for those which stick to old methods.

MODERNIZATION—The railroads will modernize their shops too. It was the railroad repair shops which trained such automobile men as



Courtesy Western Electric Company

A lathe that can accommodate work up to 24 inches in diameter by 10 feet long

a nation-wide search for scientists of tomorrow

A MAJOR NEED of America today is the discovery and development of scientific ability among boys and girls now in high school. Real ability for creative research and engineering is rare. Many who do not now have the opportunity to develop their scientific talents will be discovered and made available for America's future progress through the Science Talent Search, conducted by Science Clubs of America and sponsored by the Westinghouse Educational Foundation.

WHY THE SCIENCE TALENT SEARCH WAS STARTED

The objectives of this unique search are threefold: to discover high school seniors of exceptional scientific aptitude – to focus their attention on the need for developing scientific knowledge and skill in research – and to make the American public aware of the importance of science in their daily lives.

HOW ENTRANTS ARE TESTED

Examination of entrants in Science Talent Searches is based largely upon rigorous science aptitude tests – to determine their research ability, reasoning powers and breadth of scientific knowledge. These tests are prepared by Dr. Harold E. Edgerton and Dr. Steuart H. Britt, prominent educators and psychologists.

HOW THE SEARCH IS CONDUCTED

Each year, high school seniors all over America compete for Westinghouse Science Scholarships, of a total value of $11,000, by taking these aptitude tests and submitting original science essays. Selection of the 40 finalists in the Annual Science Talent Search is based upon their records in aptitude tests, scholastic standing, recommendation of teachers, and science essays, in the order given.

WHAT IT HAS ACCOMPLISHED

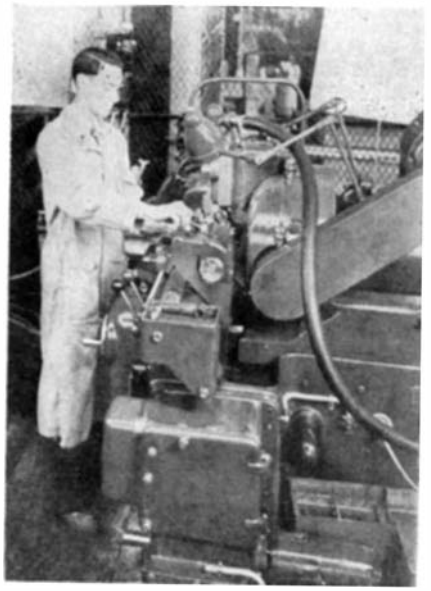
To date, 160 brilliant youngsters—winners of Science Talent Searches – have been awarded $41,500 in Westinghouse Science Scholarships. In addition, 429 winners of Honorable Mentions in the *first two* Science Talent Searches have received scholarships, valued at $132,450, from other sources. Of perhaps greater importance, a continuing study of one of the early Searches has disclosed that more *than 75% of those who entered this competition have actually gone to college – against a national average of only 35% for high school students!*

SEND FOR SCIENCE TALENT SEARCH LEAFLET

If you are the parent of a scientifically-gifted boy or girl who will be a high school senior this fall . . . or if you know of such talented youngsters . . . send for Science Talent Search Leaflet SA-85 which gives full information about these competitive awards. Write: Westinghouse Electric Corporation, Box 1017, Pittsburgh 30, Pa.

Westinghouse
PLANTS IN 25 CITIES OFFICES EVERYWHERE

Tune in: JOHN CHARLES THOMAS—Sunday, 2:30 pm, EWT, NBC • TED MALONE—Monday through Friday, 11:45 am, EWT, Blue Network



Precision in machine tools, such as this thread grinder at the Jones and Lamson Machine Company, insures precision in the final assembled product

Walter P. Chrysler and gave them their first modern methods mindedness. But later on a large part of those shops went into the doldrums. They had no money with which to modernize, and their old machine tools were adequate, with a few additions here and there, for the kinds of rolling stock the roads owned.

Now the railroads are modernizing their rolling stock. And the new equipment is made up of Diesel engines, turbo-electric engines, electromotive equipment, ball-bearing journals on cars—refrigerating and air conditioning equipment in cars—the kinds of mechanisms which can be built and repaired only by the use of the most modern, high accuracy machine tools.

The steamship lines are a similar case. Gone are the days when the chief engineer could repair his engines by using a Stillson wrench, a drill, a file, a torch, and a suitable assortment of other small tools. He has Diesels now, and highly complex electromotive drives, and turbines and other equipment which needs the very finest machine tools for overhaul and repair.

Everything, then, from the tiniest pump to the largest steamship engine, will require the most modern machine tools to build and to maintain it. And the benefits to everybody will be plentiful.

ACCURACY—Silence in all kinds of moving machine parts will be had from higher accuracies in their production and from the better balancing which is part of accuracy. Accuracy of operation is built right into modern machine tools; the skill of the operator is in the ways in which he directs that accuracy and not in the ways he obtains it.

Versatility with high speeds and accuracy is another advantage. Modern machine tools can be set up more quickly and for wider ranges of operations. This removes limitations from product designers—they can work out their consumer or industrial product ideas without worrying very much about whether or not the machine tools to make the resultant products can be had. It is the versatility of modern machines which will bring in television and the family airplane so quickly.

Complete dependability is another point. Thousands of mechanisms containing gears, bearings, and automatic control mechanisms will be completely sealed in the future, never to be opened for lubricating or other servicing until they have lived out long and trouble-free lives. Mechanisms can be sealed this way because the machine tools on which they are made are so completely dependable in the qualities and accuracies of the parts which are made on them.

Back of all the progress is a brand new factor in the machine-tool field itself.

Machine-tool makers have had decades of experience compressed into five short years. Where they used to make 100 or so of a new model and learn how to impove it by seeing it at work in a few automobile plants, they have made thousands during the war and seen them at work in hundreds of plants. Thus they have learned, years ahead of the normal time, what is good and bad in the new machine-tool ideas as well as some of the old ones, and how to make improvements.

WATER LUBRICANT

Can be Used
Where Bearings Permit

MAKING stern tube bearings for ships out of materials which can use water as a lubricant is an old trick. Yankees used lignum vitae for this purpose decades ago, and the later rubber and the phenolic resin impregnated canvas bearings of today are proving their values everywhere.

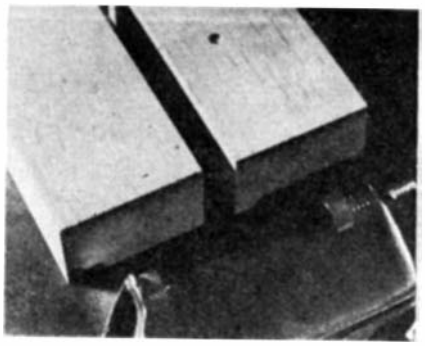
Industrial plants also use many such bearings on laundry equipment, chemicals process machines in which bearings must operate under water, food processing machines which must be washed so often that lubricant is rinsed out of ordinary bearings, and pumps which are exposed to the weather but seldom serviced.

New uses are being found on machine tools. Here the age-old problem is whether to use water soluble cutting oils which do not do very good jobs as lubricants of machine bearings, or good lubricants which will take care of the bearings but will not reduce cutting heat as thoroughly as the water soluble oils, or to shield the bearings so lubricant can be used in the "bearings end" of the machine tool and soluble oil in the "cutting end." The bearings which can use water as a lubricant are another solution of this problem, if they are not damaged by oil. And plastics bearings can stand either water or oil.

WOOD HARDNESS

Can Be Tested Easily
By a Simple Clamp

THE HARDNESS of wood can be tested by Brinell or by Rockwell instruments, provided the wood section is small enough to be brought to the instrument and the wood is not already fastened into a structure so that it cannot be moved. But when the wood is too large or is inaccessible to the instrument, another means of testing must be found.



Penetration measures hardness

One simple testing means uses merely a C clamp. The clamp is placed on the wood and tightened with an predetermined force, the amount of penetration into the wood being an easily measurable index of the wood's hardness.

A more accurate amplification of this method employs a coiled spring which operates a moveable ball-pointed thrust rod at one end of the clamp. The pressure of this spring always will be a constant for any given amount of tightening of the clamp screw which opposes it, and therefore the penetration at a given spring pressure is known.

By measuring the indentation at the time it is made and then waiting 24 hours and measuring it again, the "spring back" of the wood can be determined.

Automotive Plastics

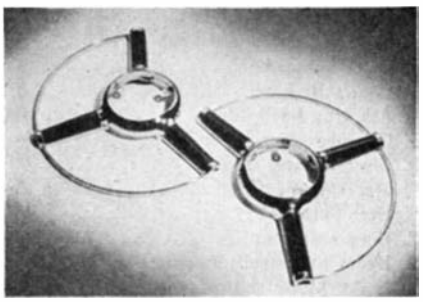
Will "The Car of Tomorrow" have a Plastics Body? Probably Not, Until Many Technical Problems are Solved. However, Even Pre-War Cars Used Many Plastics Parts, Pointing the Way Toward Vast Increases in the Use of these Materials for Decorative and Functional Purposes

TWO HUNDRED thousand new passenger cars by the end of 1945. Four hundred thousand more in the first quarter of 1946. Such are the latest predictions. Of course, since every one of these machines will go to war workers, government services, doctors, and other essential users, the average car owner realizes that he has little chance of obtaining one of these models. But the fact that new cars are going into production gives him a different attitude toward the machine that has seen him through the past few years. He suddenly is conscious of its shabby appearance, its eccentricities, its deficiencies. Suddenly he needs a new car. And what will this new car be like?

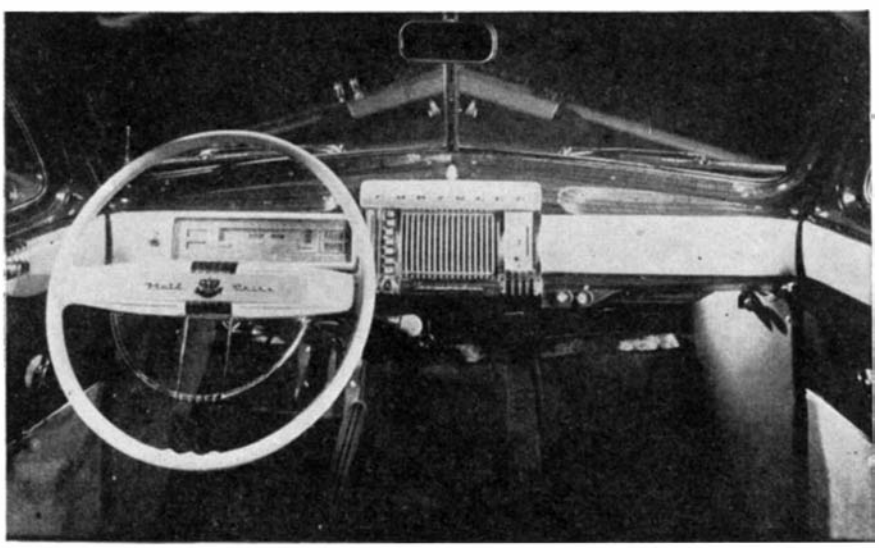
As the date for resumption of all-out automobile production draws near there is less and less talk in the trade of the revolutionary new car. Some companies are at pains to explain how similar the first cars off the production line will be to the prewar models. Slight changes will be made, but nothing drastic. Thus, it is only necessary to subtract age from the cars now in use to find the first cars of tomorrow.

On this basis, the cars of 1945 and 1946 will be equipped with a surprising number of plastics parts. Car owners have probably forgotten how sharp was the increase in the use of plastics in the 1942 model as compared to the machine put out the previous year. It was then, with metal beginning to be a problem, that automobile manufacturers gave increasing consideration to the color possibilities of plastics materials, to the wide range of applications in which they could be used, and to the low cost at which they could be formed.

During this period the automobile industry undertook exhaustive studies of all types, kinds, and classes of plastics. This research, combined with performance records of innumerable new applications, gave rise to more or less formal specifications. It is to be expected that these specifications will be expanded and modified as a result of the war-time experience of automobile manufacturers—changes which should work to the benefit of plastics materials in view of the record they have chalked up in airplane construction.



An attractive and structurally sound plastics and metal horn ring unit



A pre-war instrument panel, made of injection-molded plastics with metal inlays

UNDER THE HOOD—Thermoseting plastics materials, both molded and laminated, have a long record of achievement in the automobile industry. The reason lies in their excellent electrical, mechanical, and chemical properties. For the most part these materials, the phenolics in particular, are used in conjunction with cam shafts, in distributor heads and other electrical assemblies, timing gears, washers, and insulation. They have, in addition, given outstanding service in brake linings. But while these applications are as essential to the successful operation of a car as the wheels or the engine itself, the public gives them scant attention. It is by the exterior of a car and the interior appointments that the majority of motorists pick their next car.

INSIDE AND OUT—It was in the exterior and interior appointments that plastics made their greatest gains in the automobile industry immediately before the war shut down production. When nine companies were interviewed just before the introduction of their 1942 models, all reported increased use of plastics in decorative applications. The cellulose acetates, cellulose acetate butyrate, and the acrylic resins in particular enjoyed a sharp rise

PLASTICS IN 1942 OLDSMOBILE MODELS

1. Dome lamp lens	U
2. Dome lamp switch cover and button	A
3. Regulator knobs	A
4. Regulator escutcheons	A
5. Regulator handles	A
6. Remote control handles	A
7. Rear quarter window adjustment knobs	A
8. Cowl ventilator control knob	A
9. Ash tray lid knobs—rear comp.	A
10. Window garnish rail medallion insert	A
11. Window garnish rail medallion insert	M
12. Windshield wiper control knob	A
13. Hood latch control knob	A
14. Light switch control knob	A
15. Cigar lighter knob	A
16. Gear shift knob	A
17. Ash tray knob—dash	A
18. Glove box door	M
19. Cluster lens	M
20. Steering wheel	A
21. Horn button	M
22. Horn ornament	M
23. Hydra-Matic shifter control box cover	A
24. Hydra-Matic shifter control box cover lens	A
25. Hydra-Matic shifter control box cover screen	A
26. Gear shifter knob—Hydra-Matic	A
27. Heater switch control knob	A
28. Defroster switch control knob	A
29. Fog light switch control knob	A
30. Radio tuning knobs	A
31. Radio selector knobs	A
32. Aerial escutcheon	B

A — acetate; U — urea; M — methacrylate; B — butyrate

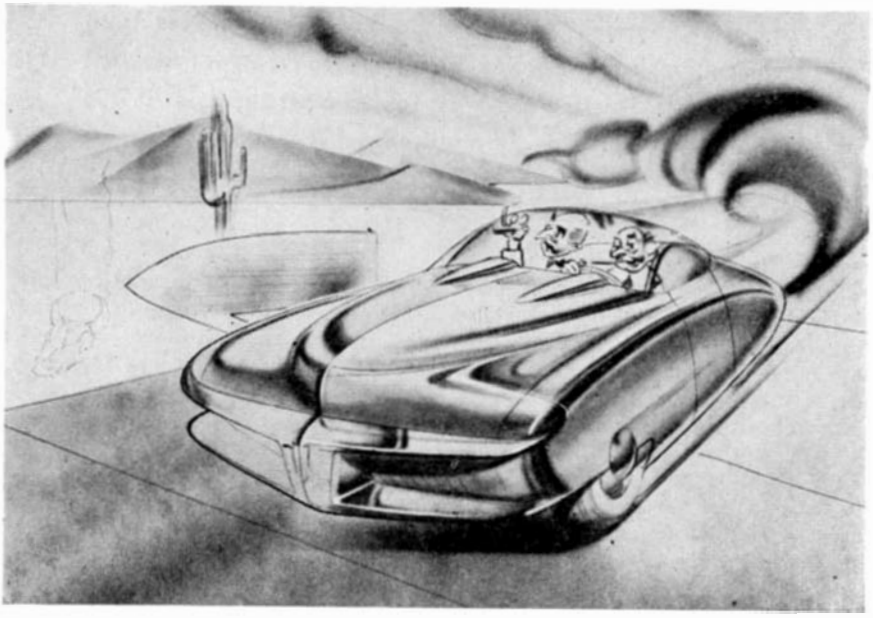
in popularity. As a matter of fact, applications of the acrylics in 1942 models were almost double those found in previous models—jumping from 39 in the 1941 models to 70 in the 1942 cars.

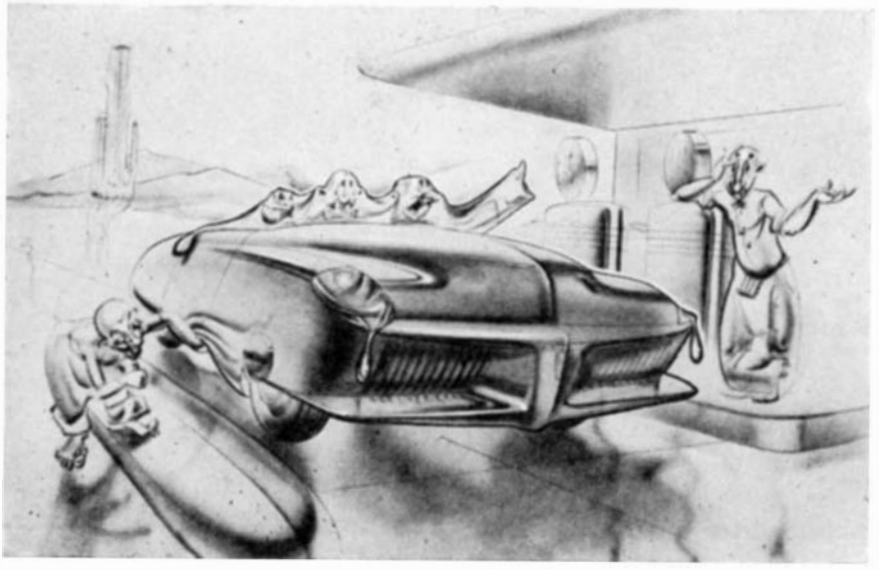
The uses to which the acrylics were put in these cars apply to the other plastics materials as well. Among these parts were radiator ornaments, parking lamp lenses, horn buttons, speedometer panels and dials, instrument cluster panels, clock panels and dials, medallions, radio lenses, indicator dials, horn rings, name plates of various types, and ornaments. Probably the best known plastics application is the steering wheel. In fact, many cannot remember when this part was made of any other material.

The accompanying table presents 32 decorative applications for plastics which were incorporated in the 1942 Oldsmobile and the material from which they were made. Outstanding in this list are the acetate window regulator handles and remote control (interior door handles) —instances where plastics were used to replace die-cast metals.

Plastics should hold their gains in these applications and they should step in and take a firm hold on another part of the interior—the upholstery. Fabrics woven from extruded plastics monofilaments are today giving good performances in many public conveyances. Not only do they wear well but they are easy to clean, a consideration which should make them popular in the cars of families with small children. They have the added advantage of color fastness and resistance to dampness. In fact, everything seems to their advantage as car upholstery material.

The automobile industry has been somewhat cautious in undertaking the use of plastics for exterior applications. The transparent cellulosics, by virtue of their clarity, were from the beginning interesting materials. They were used very early in sheet form for side curtains in the popular touring car. In





These two cartoons, used by Carl Sundberg, of Sundberg-Ferar, to serve as a warning against spreading misconceptions of what plastics can and cannot do for the automobile industry at present, tell the following tongue-in-cheek story: Above: Two post-war prophets start out in their all-plastics automobile for a road test across Death Valley. Note the smooth, flowing lines of the perfectly shaped body, possible only because it is injection-molded, in one piece, of transparent material. This handsome thing is painted from the under side and features name-plates, trim, and so on in bas-relief. In reality, the body is but a coat of paint protected by a covering of transparent plastics. Below: Note the smooth, flowing lines of the post-war Plasticar as it pulls into Death Valley Louie's a half-hour later. The prophets have a car with a top that now fits not only the body but their heads and shoulders as well. Oh, well, it's just the first rough model and there are still a few bugs to be worked out. Anyway, look at small fry gathering up the side panel for a look at the chassis. This gives the boys an idea: Now they can go to work on a body that needs only to be peeled back for a look at the motor, for minor repairs, or for changing a tire!

DUREZ

PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- OIL SOLUBLE RESINS

MOLDING COMPOUNDS

SWEET MUSIC FOR THE DESIGN ENGINEER

Just as this Durez phenolic plastic clarinet plays sweet music, so do thousands of other products molded of Durez. Only in these latter cases the sweet music is referred to in the figurative sense, for we're talking about the versatility of the Durez phenolics used . . . versatility that covers a wide range of highly desirable properties . . . versatility that is truly sweet music to the imaginative design engineer. Such characteristics as excellent dimensional stability at temperature extremes, lustrous finish, excellent moldability, dielectric and impact strength, and resistance to moisture, chemicals, and heat—to mention a few—are inherent in all of the more than 300 Durez molding compounds . . . are responsible for the use of Durez on a scope that is practically all-embracing throughout industry.

INDUSTRIAL RESINS

THE DIE IS CAST FOR CASTING RESINS

There's a bright future in store for users of the new Durez casting resins—for these remarkable resins substantially reduce production time and costs when used for such items as hydropress and stretch-press dies, jigs, assembly and holding fixtures, foundry patterns, and masking shields for plating.

OIL SOLUBLE RESINS

PROLONGING THE LIFE OF A SPAN

The durability and corrosion resistance which Durez resins impart to bridge paints make them real life prolongers . . . keep repair and maintenance bills at a minimum. The remarkable properties—such as acid, alkali, and water resistance—which Durez resins impart to paint, varnish and lacquer—have resulted in their extensive use throughout the protective coatings field.

● If you're looking for a versatile plastic material, the place to start is with the phenolics, for these are the most versatile of all plastics . . . and when you look to the phenolics, look to Durez—specialists in this field for the past quarter century. When you add the versatility of the more than 300 Durez phenolic molding compounds to the multi-propertied Durez industrial resins and the unusual protective values of Durez oil soluble resins, you can understand why manufacturers everywhere come to Durez for plastics or resins to fit their jobs. The background of Durez technicians includes successful product development experience throughout practically all fields of industry . . . product development experience that has resulted in the continuing leadership of Durez phenolic plastics and resins. The benefits which this wealth of experience and a large accumulation of proved data can provide are available to you, your designers, and engineers at all times. Durez Plastics & Chemicals, Inc., 528 Walck Road, North Tonawanda, N. Y.

PLASTICS THAT FIT THE JOB

molded form they were only just coming into their own when civilian automobile production was halted. Examples are cellulose acetate light lenses, fender lights, and rear deck directional signals; acrylic directional lamps; and radiator ornaments.

THE FUTURE—It is possible that some day entire automobile bodies will be made of some plastics material, but the accomplishment of this is so remote to be deserving of only "possibility" thinking. There has been the suggestion that bodies be produced by low-pressure molding of plastics-impregnated fibrous material of various kinds. However, putting technical consideration aside, the optimum molding cycle is, at present, far too slow to keep pace with automobile production.

When Carl W. Sundberg of the firm of Sundberg-Ferar, industrial designers, used the two accompanying cartoons of the Plasticar to illustrate an address before the Detroit Society of Plastics Engineers, his purpose was not to ridicule the concepts of progressive designers nor to deprecate the properties of plastics materials. Mr. Sundberg wanted, as he explained, to point out "the harm that is done by the representation to the public of unproved ideas in the name of promises for the immediate future." The industrial designer who wants to promote the increased use of plastics in the automobile or any other field can best serve both the industry and the consumer by recommending the right material for the right job.

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SUN-LAMP

Portable Type Designed For Traveler's Luggage

THE DAY is fast approaching when an ultra-violet ray lamp will be a standard part of many travelers' baggage. The Sun-Kraft, Inc. has completed production plans for just such a unit which will be housed in a two-piece case molded of colored urea-formaldehyde.

This portable lamp will be equipped with adjustable plastics arms so designed that they fold away inside the top of the case when the lamp is not in use, yet can support the cover and the reflector housed therein at any desired angle when the machine is in operation. The over-all outside dimensions of the lamp will be but 10⅛ inches long, 5½ inches wide, and 5½ inches high. The high frequency oscillator circuit will be positioned in the lower half of the case; the reflector, adjustable arms, and part of the timer in the upper half.

RADIO MASTS

Made of Plywood Tubes Are Light in Weight

BECAUSE extra ounces of weight can be a serious hindrance to our soldiers, many of the radio antenna masts used by the United States Army Signal Corps are being made of plywood sections which can be dismantled and nested in a compact box. These masts, some of which are 50 feet in height when set up, are formed by Plymold Cor-

Plastics radio mast packed in chest

poration of thin layers of wood veneer impregnated with urea-formaldehyde resin by a special process.

After impregnation the layers are wrapped spirally on a mandrel in such a way that some of the veneers are parallel to the axis of the tube, some are at right angles, and some are at 45 degrees to the axis. This three-phase construction is said to give to the Plytube a strength approximately the ultimate strength of wood. Even when packed with auxiliary equipment in two fitting chests, the 50-foot mast is considerably lighter than the equipment previously in use.

POCKET COMPASS

Light, Precision Made, Popular with Air Corps

ONE OF the most popular items with the Army Air Corps is a pocket-size, dial type, liquid compass, attached to a case which holds small water-proof matches. Together with case it weighs less than two ounces and resembles a flashlight battery. It is three inches high and one inch in diameter. Military specifications for this pocket compass call for the same rigid tests as those given to standard compasses on B-29's and other fighting aircraft. Such a fine degree of accuracy is required that a variance of .0005 inch would result in rejection. This is necessary because the all-purpose pocket compass must be able to stand up under all sorts of service conditions.

The compass, which containes 16 separate parts, is injection molded of Tenite II at a slow cycle to keep maximum dimensional control. The units are produced at the rate of 2000 daily by DuPage Plastics Company. The sighting window on the compass is Lumarith.

TRANSPARENT PLASTICS

Protects Workers From Flying Chips

AS A protection to machine workers, the Dilley Manufacturing Company has introduced a magnetic grip shield consisting of a thick sheet of Plexiglas anchored to a horseshoe permanent magnet. The magnet holds the transparent plastics shield in position between the worker and his machine. In this way flying fragments of steel, wood, and so on, are deflected while at the same time the operator of the machine has an unobstructed view of his work.

PRE-HEAT

Controlled Electronically at Plastics Molding Press

ELECTRONIC heating equipment has been successfully used for several years in pre-heating plastics molding briquettes just before they are placed in the molding press. At first, relatively high-power equipment was needed because the blocks of plastics material took more and more power as they swelled and changed in electrical characteristics during the heating process.

Now, however, electronic control equipment recognizes each change in the plastics material during heating and automatically tunes the electronic generator for maximum operating efficiency so that peak power is utilized throughout the entire cycle. Several experimental installations have already been made in the Boonton Molding Company plant with excellent results.

With this arrangement, bulky electronic generators can be located outside the crowded molding shop, away from dust and steam, and the radio-frequency power can be fed through transmission lines to small and simple heating heads located alongside each press. Heating heads can be interlocked so that only one is used at a time but all receive power in sequence for maximum utilization of a single generator.

Petroleum Pavements

Asphalt in Varied Consistencies, Distilled From Petroleum, Surfaces Many Thousands of Miles of America's Highways. Quickly and Economically Laid in the Molten State, it Forms a Resilient and Flexible Road-Bed Whose Cushioning Surface Wears Long Under Constant Use

THESE days everyone seems to have a preferred label for the contemporary world. Some call it the age of steel and some the age of electricity. Coal men insist that it is the age of coal while fliers assert that it is the epoch of aviation. But whatever other title may be given the present-day world, there is no doubt that it is the age of the internal-combustion engine. In America millions of automobiles roll along thousands of miles of hard-surfaced roads. Petroleum furnishes the motive power and, in the form of asphalt, it furnishes a large part of the wear-resistant road surfaces.

Asphalt's most valuable attribute as a paving material is its flexibility and resiliency. These qualities enable it to remain in contact, under severe stresses, with the supporting earth beneath it. A rigid material would be forced to bridge every shrinkage of the road's foundation or break under the strain.

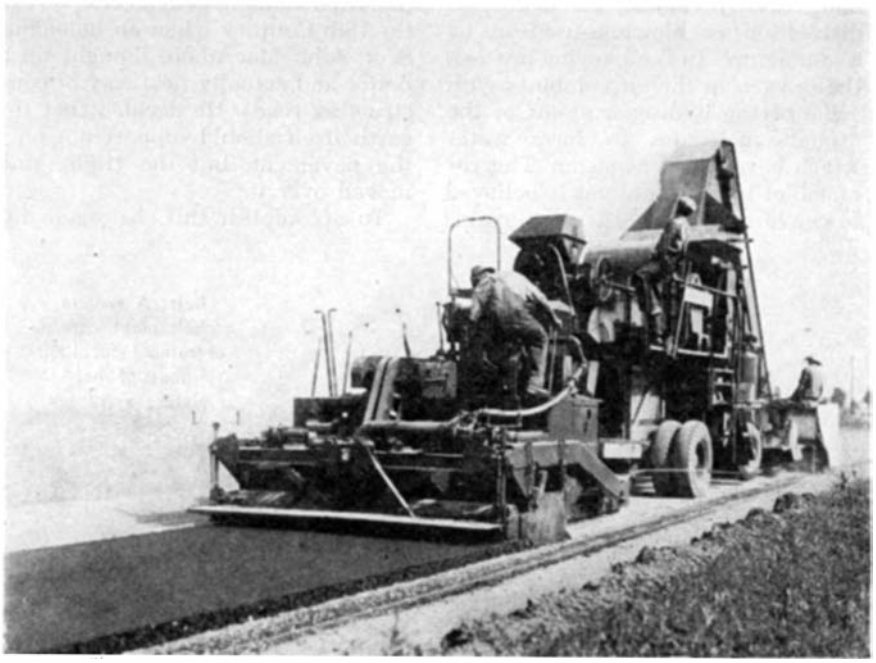
There are approximately 647,000 miles of road in the United States whose surfaces are better than ordinary gravel. Bituminous products are used on 524,000 miles of these roads, and approximately 87 percent of these bituminous road-surfacing materials are derived from petroleum. Asphalt covers two thirds of the improved mileage of state highway systems, and nine tenths of county and town roads. The streets of America's busy cities are covered mainly with asphalt—four fifths of them, in fact.

Manufacturing and distributing the vast quantities of asphalt used for these purposes is an important part of America's great petroleum industry.

It is believed by many that most of the asphalt used for paving our streets and roads comes from the "pitch lakes" of Trinidad, Venezuela, and California where it is found in the natural state. As a matter of fact, these lakes ceased to be important sources of asphalt many years ago. By 1940, according to figures of the United States Bureau of Mines, 93.5 percent of the asphalt processed in the United States was derived from petroleum through refining methods while the balance came from natural deposits.

After the refining of petroleum became a major industry, asphalt remained for a long time a much disliked and relatively useless sticky substance that had to be grubbed laboriously out of the bottoms of stills after the distillation of crude. Today asphalt is one of the most widely used of petroleum products. Asphalt in the natural state, obtained from asphalt lakes, was originally formed by crude petroleum seeping through cracks and crevices in the earth's strata and collecting in pools exposed to the sun. The lighter fractions were distilled away by the sun's heat. The natural asphalt remained as a residue. To be useful, it must be mixed or "fluxed" with a heavy oil or a soft asphalt from the petroleum industry.

FROM CRUDE—Asphalts produced by the petroleum industry in the process of refining crude are composed of the highest boiling petroleum hydrocarbons. In the laboratory these can be separated into three groups known as "oily constituents," "resins," and "asphaltenes." The smaller the content of oily constituents, the harder the asphalt and the higher its softening point. Asphalts vary in consistency from a semi-fluid to a brittle solid. They do not react with acids or alkalis. Their ability to repel water is one of their most important properties and their



This modern road-building machine scoops up the materials laid out before it, mixes them with asphalt in the desired proportion, and spreads the finished product

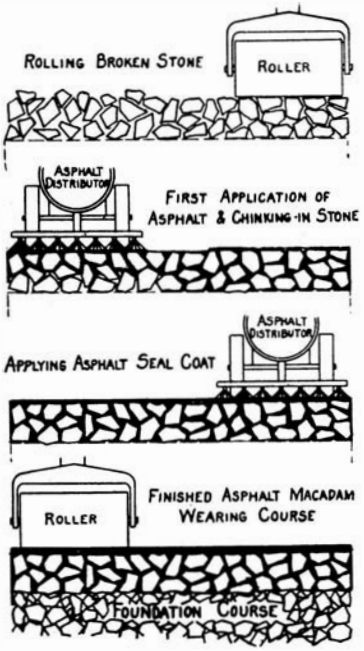
high adhesive qualities serve to bind together the aggregates used in road construction.

The starting point in the manufacture of asphalt from crude is the residue, known as reduced crude, left after the distillation of crude petroleum in a bubble tower. This residue is usually a heavy liquid. It is further processed by additional distillation or by blowing with air while in a heated condition. The blowing operation is conducted when the residue is heated to a temperature between 400 and 500 degrees, Fahrenheit. At that temperature the air reacts chemically with the material to produce an asphalt with a higher softening point than would have been produced by straight distillation. As the softening point is increased, the asphalt becomes harder as indicated by penetration tests. Asphalts obtained in this way are known in the industry as blown asphalts.

An alternative distillation process is carried out in a pipe still. In this operation reduced crude is pumped through a coil of pipe heated in a furnace so that its outlet temperature is about 700 degrees, Fahrenheit. As the reduced crude emerges from the coil it is sprayed into a large tank known as the flash tower where an instantaneous separation takes place between the asphalt and the heavy distillate oils in which it was dissolved. The recovered asphalt falls to the bottom of the tank and is drawn off to storage. Its hardness is controlled by the maximum temperature to which the reduced crude is heated in the pipe still.

The characteristics of a finished asphalt product can be altered markedly by varying the degree of distillation or blowing used in its manufacture. In the blowing process, the oxygen in the air combines with some of the hydrogen atoms of the asphalt molecules to form water which is removed as steam. The removal of hydrogen atoms is believed to convert oily constituents to resins and resins to asphaltenes. In this way the softening point is increased by increasing the proportion of resins and asphaltenes in the asphalt and not by stripping out oily constituents as in the case of straight distillation.

MACADAM'S IDEA — Until the emergence of the automobile age, the greatest road builders known in history were the ancient Romans who traveled far, and for their times, extremely fast, and realized the value of straight, solid roads. The celebrated Appian Way was a causeway made up of rigid layers of stone three feet thick. The Roman idea that roads had to be thick and heavy persisted among engineers up to the 18th Century when an ingenious Scot, John MacAdam, thought up a better and actually new way of constructing roads. He decided that the earth itself should support not only the pavement, but the traffic that moved over it.



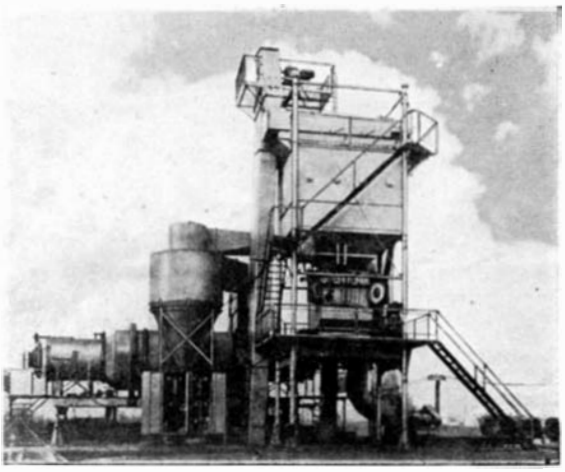
Steps in paving with asphalt macadam

To accomplish this, he made his road surface a light stone shell in place of the massive Roman construction. The big thing in MacAdam's road was to see that the earth remained dry and firm underneath the surface. He found that by breaking the stone into fragments, their angular faces could be forced together to join in an interlocking crust and that rock dust, when wetted, would form a cement to fill the voids and thus provide a relatively thin, impervious crust sufficient to sustain traffic while it rested on the dry, firm earth underneath.

As the friction of iron shod-wheels and hooves wore away the rock, it provided new dust to cement the surface. The coming of fast-moving, rubber-tired autos to the macadam highways raised a problem. They whirled the rock dust high and far, and the soft rubber wheels did not abrade the surface enough to produce a new supply. Asphalt came to the rescue and entered upon the era of its greatest usefulness to humanity. Melting it in small pots, engineers poured it over the crushed stones of macadam roads to bind them securely, yet elastically together, forming a cushioning, tough, and water-repellent surface.

At first the asphalt was heated and poured laboriously and tediously by hand. Improvement and mechanization of the work was rapid, however, and today a modern distributor with a crew of six can apply 70,000 square yards of material in an eight-hour day. Working with old-fashioned hand pouring pots, the same number of workers could treat about 1750 square yards.

Meanwhile, research workers were busy improving asphalt for paving uses. Road builders had complained that heating and softening asphalt


Left: A modern asphalt plant capable of turning out 1000 tons of hot mixture every day


Right: Sheet asphalt looks well, and serves long, on this wide suburban street

to get it to the desired consistency was expensive and slow. The technicians sought an easier way to achieve the same ends, and found it in solvents. They added gasoline to asphalt and called the product "cut-back." The new material could be laid cold since the gasoline would evaporate and leave the asphalt binder in place. This discovery vastly widened the uses of asphalt for road building.

The technologists then observed that the *rate* of evaporation or setting was important. With an excess of small gravel and dust, the gasoline evaporated too quickly, and so they added kerosene as an additional solvent. Finally they classified all cut-backs into groups—the slow-curing, the medium-curing, and the rapid-curing. In 1942, before war needs had seriously reduced both the amount of petroleum available for road surfacing and the number of workers engaged in that activity, more than 2,200,000 tons of cut-back were used for paving in the United States. Total consumption of all types of paving asphalt amounted to almost 5,600,000 tons.

PAVING PLANTS—A great deal of the asphalt laid on country highways and city streets is prepared in paving plants. These may be described as factories for turning out paving mixtures in accordance with the requirements of road engineers. Today they operate on Diesel or electric power and the stone and sand is fed into mixers by automatic feeders. The dryers are heated by oil-burning furnaces. The stone is separated by vibrating screens; precise weighing machines, sometimes controlled photo-electrically, accurately proportion the materials and mixing cycles. A modern asphalt plant with a capacity of 100 tons an hour can be operated by five men.

In many coastal regions, such as Cape Cod and the eastern Carolinas, stone is absent or scarce, and sand, though abundant, is not of standard grading. Road engineers and asphalt technologists found ways to deal with this problem. Methods were devised to obtain firm, dustless surfaces from mixtures of local sand and bituminous materials. A similar problem was found in the sand hills of Kansas and Nebraska, where fine blow sand was all that could be had for road building. Here, too, a method was developed to blend asphalt with the sand to provide thin, firm mats for high-speed roads. Along the Mississippi River, great dykes or bluffs of a fine wind-blown dust known as loess seemed to have little practical use. Then engineers found it made an admirable filler for pavements and its use has cut road costs in Mississippi.

In addition to its big job of surfacing roads, asphalt has other uses in the field of automotive transportation. It goes into battery boxes and brake linings, enamels and paints, as well as panels and accessories. In the manufacture of synthetic rubber tires, it is used as a contributing material under the popular label of "mineral rubber." Asphalt thus is made to roll on asphalt.

The post-war prospect for asphalt seems to be one of expanding use and consequently greatly augmented production. The manufacturers of petroleum asphalt, according to the Asphalt Institute, are getting ready to supply a demand, once hostilities in the Pacific cease, greater than any that existed before the war. The civilian airports of the future will consume vast quantities of asphalt for runways and taxiways. The country's highways, after the neglect caused by the urgency of devoting materials and labor to the needs of war, will need widespread repairs and resurfacing. Above all, a new America on wheels will require thousands of miles of new roads. Asphalt and the asphalt makers will be busy as beavers doing a better job than ever.

AIRCRAFT LUBRICATING

From Central Source
Cuts Operating Costs

ADAPTATION of centralized lubrication to aircraft makes it possible to lubricate many bearings from a single source. Many points formerly lubricated only when the aircraft was on the ground can now be lubricated during flight. The system delivers a predetermined amount of lubricant to each bearing.

Replacement of worn bearings and parts, due to faulty or neglected lubrication, has been a major expense in aircraft operation and upkeep, according to Alemite engineers who have worked with aircraft manufacturers in developing the new method of lubrication. This expense has been due to inaccessibility of lubrication points which encouraged neglect, use of improper lubricants, and over-lubrication, with resultant safety hazards.

One example of time-saving as a result of the new system involves the engine cowl flap rings of a two-motored aircraft. Each cowl ring has 24 plain bearings and one actuating gear box, or 25 points of lubrication. Time required for a mechanic to lubricate the twenty-five points has been reduced from 45 minutes to one minute. Added weight caused by installation of the Alemite centralized system is said to be negligible, especially when viewed in the light of time savings and efficiency. In the case of the engine cowl rings, only 2.5 pounds per ring or 1.6 ounces per bearing were added.

OIL EXPORTS

Expected to End After War
To Conserve Resources

THE UNITED STATES will virtually cease to supply Europe with oil after the war, was the conclusion reached after a recent survey of European post-war petroleum problems. War-born producing and refining facilities in the Middle East and in South America probably will absorb a substantial part of these peace-time markets, the survey revealed, according to *Ethyl News*.

"Conservation of proved oil reserves in the United States, it is believed, will be the order of the day in the post-war period," the publication points out. "There will be no exportable oil, except specialty products, and the country must be prepared to fuel another war if that ever becomes necessary.

"This condition, translated into pre-Pearl Harbor days, means that the United States stands to lose an export business in oil products approximating more than 200 million barrels, excluding such by-products as grease, wax, petroleum, coke, blending agents, and asphalt."

CASH REGISTER TEST

Helps Oil Refiners
In Post-War Planning

IN MODERNIZING and revising equipment to meet post-war competition, oil refiners must be sure that their plans are both technically and economically sound. To help them in this task, the M. W. Kellogg Company, petroleum and chemical engineers, have a yields and economic division, whose function is to put "the cash register test" to the recommendations of the process engineers.

The workings of this department are shown in a recent typical economic study of refining operations. Consulted by a refiner-client as to what steps that company should take to improve its process position, Kellogg engineer-economists developed three alternate new operations increasing the firm's net operating credit by $3,295,000, $3,913,000, and $3,908,000 respectively.

Electronics On The Road

Two-Way Vehicle Radio Units, the Walkie-Talkie, the Handie-Talkie, Electronic Ignition Systems, and Safety Devices are Some of the Developments that May Well be Expected to Make Commercial Vehicles More Versatile, Motor Cars More Efficient, and the Highways Safer

By JOHN MARKUS
Associate Editor, *Electronics*

IF JUST one electronic unit gets onto the mass-production dream car of tomorrow, there is every prospect that another market approaching the magnitude of entertainment radio will unfold for the fast-expanding field of electronics. The possibilities of radar must be discarded at present for automobiles. The equipment is too costly and its abilities at present do not lend themselves to any sort of detection, safety, or control function at mile-a-minute speeds on highways. Probable future advances in highway transportation lie in two things—radiophone communcation from one vehicle to another or between vehicles and the telephone system of the nation, and electronic devices for making motoring safer.

The Bell Telephone Company of Pennsylvania intends to offer radiotelephone service for trucks, buses, other commercial vehicles, and private automobiles on a fixed-fee basis similar to existing business telephone service charges. Company officials hope to have the service available by the end of 1945.

Initially, master high-frequency transmitting and receiving stations will be installed in Philadelphia and Pittsburgh, with switchboards linking these stations to existing telephone lines. Each vehicle participating in this mobile radiotelephone service will carry its own compact high-frequency transmitter and receiver, with a whip antenna and dashboard telephone handset much like those used on police cars today.

Present plans call for service covering only vehicles traveling within a radius of about 15 miles of a central station. Through the central switchboard, a person at practically any telephone in the United States will be able to talk to the driver of any radiotelephone-equipped car within the service areas of the master stations. Later it is planned to establish relay stations or additional master stations in other areas to extend the service.

In Cleveland, the Yellow Cab Company is now successfully using Motorola frequency-modulation two-way radiotelephone units for dispatching cabs with a minimum of dead cruising for customers. Talk-back from driver to dispatcher is clear and distinct over the entire Cleveland area even though both the mobile and fixed transmitters have power outputs of only 15 watts. Reception is free from both natural and man-made static interference, indicating a promising future for frequency-modulation radio units cruising on streets and highways.

The FCC plans to assign channels for this type of service on an experimental basis pending final determination of the best method of operation—12 channels for development on a common carrier basis, four for trucks, and four for buses. In all, 40 channels will be available for general highway mobile use, the other 20 being in the band from 30 to 40 megacycles which can be picked up on the average home all-wave radio set. Unless speech-scrambling equipment or other electronic message-secrecy devices are employed at these lower frequencies, private word or number

Right: Dashboard installation of a radiophone handset in a Cleveland cab. Left: Two-way radiophone equipment in the luggage compartment of a cab, showing the compactness of the 15-watt Motorola transceiver which has its own dynamotor (in foreground) for supplying the high voltages required by the radio tubes

codes may well become the vogue for highway radio service.

Other commercial applications for highway radio include physicians' automobiles, ambulances, express and other delivery services, and expansion of the already widespread use of radio by repair trucks and patrol cars of street railway systems and other public utilities.

Even in the present stages of development, the entire equipment for radio service in a private automobile takes up less than half the space in the luggage compartment at the rear. The equipment operates directly from the storage battery in the car, and has its own dynamotor for generating the higher direct-current voltages required by radio tubes. When mass production of two-way car radios gets under way, it is highly probable that the equipment will be made still more compact.

NATION-WIDE — American Telephone and Telegraph Company has worked out elaborate plans for a network of automatic radio relay stations all over the country, spaced about 18 miles apart, so that motorists equipped with two-way radio can telephone from their moving cars anywhere in the country to regular telephone subscribers.

To make a call from his car, the driver would signal the operator at one of the control stations into which the relay stations in a given region feed. The operator would then put the call over the regular land line to whatever telephone subscriber is desired, with long-distance calls being made just as easily as from your own home. This means that, when world-wide radiotelephone service is resumed after the war, a person driving along some charming country road in, say, Minnesota could chat with a friend in Java without even stopping the car, assuming, of course, that his credit was good with the telephone company.

CITIZEN'S RADIO—Personal two-way radiophone communication between civilians, recently provided for in frequency allocations of the FCC, permits a nontechnical person to operate his own radiotelephone transmitter.

Licensing requirements are simple: the station license requires only that the owner be a citizen of the United States and the operator's license merely involves passing a written examination in radio laws, much like an auto driver's examination.

The present military version of the citizen's radio is built like a French phone, is called a handie-talkie, and resembles in some ways the small personal radio receivers that came on the market just prior to the war. The citizen's radio will have its own batteries and antenna, along with a built-in telephone transmitter and earphone. Although the reliable range of present models is necessarily small, about one mile under average conditions, such sets allow mobility that no other radio equipment permits, as the Army has discovered.

Emergency truck of the Toronto Transportation Commission, equipped for two-way frequency-modulation communication. In this installation the radio apparatus is on the roof of the cab and the antenna is alongside the driver

Possible uses for these tiny radiophones are almost unlimited. Already they have been used by newspapers to transmit spot news directly to the copy desk from the scene of action, to replace regular telephone lines in an aircraft plant pending repairs after a fire, and to direct the operator of an overhead crane in a big factory from any point on the floor.

Storekeepers could use the sets for routing deliveries and pickups, to eliminate the time wasted by drivers in going to telephones or returning to headquarters for further orders. Clerks could get in touch with floorwalkers and section heads by radio, eliminating the oftentimes long delays of call systems and repeated telephone calls for roving personnel. Constructions crews on bridges and buildings likewise could profitably use walking radiotelephones for intercommunication and for contact with foremen and supervisors.

The cost of a civilian handie-talkie can be computed roughly in terms of the popular pre-war personal receivers, which sold at an average price of $20. Technical differences in construction and circuit design indicate that prices starting at $50 post-war for a two-way self-contained midget radiophone are feasible.

The Army walkie-talkie also commands high civilian interest, because of its much greater range. This set must be carried in a pack on the operator's back because it is larger and contains heavy-duty batteries. Farmers and ranchers having employees who are miles apart during working hours can use two-way radio profitably, as can fire department officers directing operations of their men inside burning buildings, and tug-boat crews bringing ocean vessels to and from their berths.

INTERFERENCE—If the two-way low-power sets meet widespread acceptance after the war, it will then be necessary to make some technical provisions for taking care of such inter-station interference in heavily populated areas. Perhaps common courtesy will provide a solution; if voices are heard on a particular frequency, other users will desist from using their radiophones until the first user has completed his conversation. There is greater hope in technical improvements, however, as amateur radio experience in crowded bands indicates that human nature is what it is, and there will always be people who just can't wait their turn.

Ignition interference from automobiles is an important factor in radiophone communication in the high-frequency channels. The effective communication range can be increased considerably if all cars have efficient noise-suppression devices. Meetings of a noise-suppression committee formed of both automobile and radio representatives

have been held, with the goal of setting standards in interference suppression to be followed by all auto manufacturers after the war and incorporated in all new cars. This program will eventually assure police and other radio services of comparative freedom from ignition and generator noise.

IGNITION SYSTEMS—The application of electronics to automotive and aircraft ignition systems already promises solutions to the problems of cross-firing, maintaining spark intensity at high speeds, and reducing sensitivity to loading of the high-tension system by dust and grease deposits on the spark plugs. Many electronic ignition system patents have been granted, and technically electronics can produce today an ignition system that will work perfectly at speeds as high as anyone cares to drive, but economic aspects are definitely against the electronic version as yet. You will still find in your new post-war car the time-honored breaker points, ignition coil, distributor, and spark plugs, collectively serving to step up the storage battery six-volt output to some 10,000 to 15,000 volts and to apply this in correct sequence and timing to individual plugs.

Although superior performance over present ignition systems can be demonstrated, designers of these electronic ignition systems are limited by the fact that the primary power source available is only six volts in the average automobile and rarely more than 24 volts even in aircraft, whereas electron tubes require voltages of the order of hundreds of volts in order to operate with any degree of efficiency. Either rotary- or vibrator-type power packs are needed to provide these high voltages, and instantly the cost goes up. Only when sufficient superior performance can be demonstrated with not more than a moderate increase in price can you expect to lift up the hood of your new car and see one or more electron tubes mounted on the distributor or thereabouts.

SAFETY—In the hands of many people the automobile is a weapon of self-destruction regardless of intent. Witness the 40,000-odd deaths on the highways each year, with no small proportion of them at railroad crossings despite crossing gates, swinging signals, and alarm bells. Consider also the hundreds of thousands who are maimed for life each year because drivers disregard mechanical or electrical warning signals or drive faster than road conditions warrant. These figures approach the casualty figures of war.

Here is where electronics can do a real service to humanity. Here, if people will demand it to the extent of offering to pay a few dollars more for their new cars and for taxes to make highways safer, human lives can be saved.

First, considering only the role of electronics in this accident situation, is control of driving speed. Laws are ineffective because road conditions vary from day to day; a little girl on a sleigh was killed this year because the driver was going 15 miles per hour on slick ice and lost control of his car, yet legally that driver was in the clear. Somebody outside of the driver's seat must determine the safe driving speed at each period of the day for each locality and, with the aid of electronics, force all vehicles to keep within this speed. Technically this is feasible today; it means putting governors on every car, with their adjustments controlled by radio from police radio stations spotted at strategic intervals over the country. But manufacturers in an era of competition will not voluntarily boost their costs by installing such equipment until the people demand it. Each advance in radio has been a result of popular demand, and people likewise have in themselves the power to make highways safer.

Years ago mechanical devices to prevent grade crossing accidents were patented and perfected, and today electronic control could make them doubly safe with the aid of light beams and ever-watchful photoelectric eyes to replace the eyes of neglectful motorists. At least one of these devices raises a barrier in the road that no car can cross—but such devices cost money and the railroads cannot be expected to foot the entire bill It is up to us, while still living, to make our highways safe for future generations, using electronics whenever and wherever it can do the job better than simple mechanical or electrical devices.

PISTON RINGS

Gaged for Size by Photoelectric Set-Up

To eliminate the human element in production checking of the accuracy of piston rings, a new electronic instrument made by the Sheffield Corporation automatically inspects the trueness of periphery and the width of gap of a specific size of piston ring. Inspection is much faster than present handchecking methods and the production rate is determined by the speed at which the rings are presented to the gage. The inspection cycle per piece is less than five seconds.

Quick gaging of piston rings

The piston ring to be checked is inserted inside a master ring of correct dimensional quality which is rotated by a power-driven roller. The gaging functions are performed by scanning beams of light directed onto phototubes which energize electronic circuits to illuminate three signal lights.

As the ring revolves, one beam of light is projected on the periphery of the piston ring. A clearance between it and the master ring will result from any out-of-round condition of the piston ring, permitting part of the light beam to fall on the phototube. This actuates a red rejection signal should an excessive amount of light indicate that the piston ring is out-of-round beyond an acceptable point.

A green signal flashes on at the end of one complete revolution if the width of gap is also within tolerance. Another beam of light actuates a yellow signal should the gap be undersize. A third beam of light energizes another circuit to illuminate the red rejection signal should the width of gap be oversize.

SILVERED CRYSTALS

Produced Quickly With Simple Equipment

Quartz crystal manufacturers can now produce a thin conductive silver coating on quartz crystals by simply dipping the crystals into a series of solutions. The work is easy to do and can be accomplished by inexperienced operators. The only equipment required is a few photographer's trays, and clips to hold the crystals. Several hundred crystals may be coated simultaneously, according to Metaplast Company.

Highways Of The Air

Feeder Lines, Serving the Trunk Airlines But Also Providing Short-Haul Aerial Transportation, Have Great Possibilities If Costs are Reduced to Meet Competition of Other Forms of Transportation and if Adequate Facilities are Made Available for Handling Traffic

Is it possible that feeder lines, area airlines, or local airlines, as they have been variously termed, will become the highways of the air, and carry more passengers than the great transcontinental airways? There is much discussion of the question and many people seem to think that feeder lines have great possibilities, provided the right equipment, operational methods, and landing field facilities are forthcoming.

Mr. Neil B. Berboth, summarizing a survey undertaken by Dean C. Smith of Fairchild Engine and Airplane Corporation, calls the term "feeder line" a misnomer. It conveys the idea of small aircraft feeding passengers between trunk airline terminals and smaller off-line cities. A newer and probably sounder conception is one of a nation-wide system serving the trunk lines, but also providing a local interurban air service.

The huge potential markets of the feeder airlines can become an actuality only if cost can be reduced to two cents per passenger mile. In the hearings before the Civil Aeronautics Board the fare rate base is generally given as about five cents a mile; with taxi service and short trips of 50 to 75 miles, this works out to about 6.3 to 7.0 cents a mile! Such a cost would be prohibitive. The chances of success are slim unless over-all travel cost can be reduced to less than 3.5 cents per passenger mile, including airport-to-city transportation.

Here are some of the design factors recommended for lowering the costs of feeder line operation: Convertible cargo and passenger capacity through the use of a movable bulkhead; provision of convenient baggage stowage so that passengers can handle their own luggage, except when this is excessively heavy and cumbersome; provision of roomy cabins set close to the ground, thus eliminating cumbersome loading equipment; use of wide tread landing gear with a steerable nose wheel and powerful brakes to increase maneuverability on the ground; high controllability to reduce air maneuvering time; separate loading doors for cargo compartment and passenger cabin; and provision for quick attachment of fuel hose nozzle underneath the wing, plus rapid gages for measuring the amount of fuel introduced into the tanks.

COST COMPARISON—Granted a passenger load factor of 50 percent and full efficiency of operation, here is what may be expected in comparison with other methods of transportation over a 75-mile stretch:

City-to-City	Air	Rail	Bus
elapsed time (including time to airport)	1:15	2:05	2:13
Passenger fare	$1.75	$1.15	$0.95

If this simple table is not over-optimistic, then these figures are quite encouraging. But, of course, besides saving in time and cost because of the design of the airplane, every other opportunity of economizing must be grasped. If care is exercised in all these matters, and airplanes are built which would specifically meet the requirements of local traffic—carry something like eight passengers, baggage, and 1000 pounds of cargo—or, alternatively, twelve passengers and 200 pounds of cargo—then very shortly after the war some 30,000 miles of feeder lines may be expected to be profitably at work, and several hundreds of short-haul aircraft purchased annually from the plane manufacturers.

An experienced motor bus operator, Manfred Burleigh of Great Lakes Greyhound Lines, in an editorial in "Aero Digest," makes a very strong case for the coördination of bus and air equipment in local transportation. He writes: "Local air-bus service, which surface transportation companies propose to inaugurate, would carry passengers, mail, and express, operating on frequent schedules between bus stations in the downtown sections of cities and towns. The air-bus system would be integrated with motor-bus

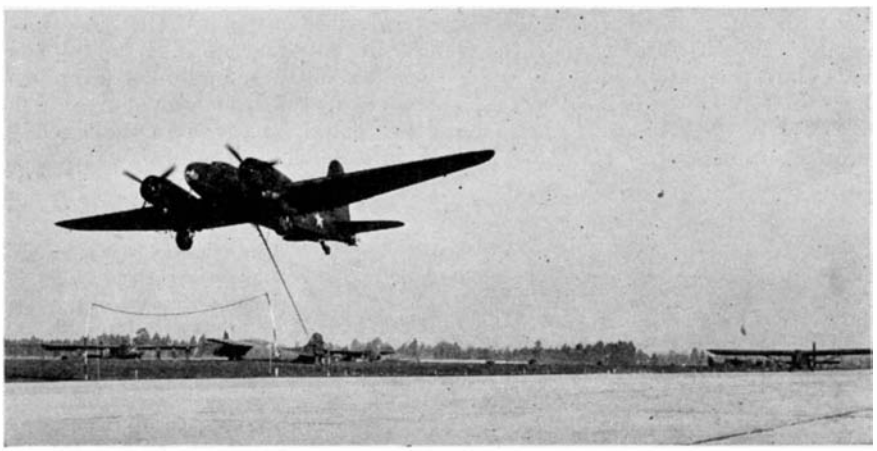
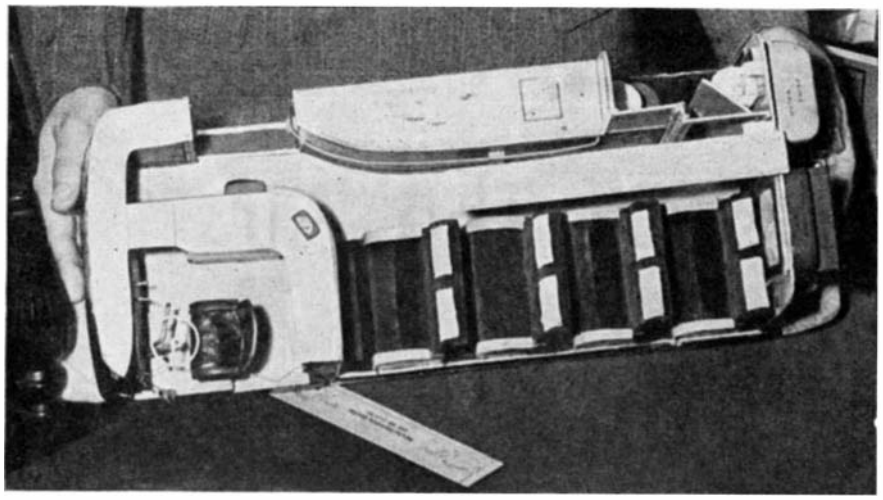


Photo by U. S. Army Air Forces

A B-23 "picks up" a glider (right) at an Army Air Force training center



A model of the Parks mobile airport station

transportation to bring maximum convenience and economy for the traveling public. Every air-bus terminal or station, whether in small towns or large cities, would be located close-in to the central business district."

HELICOPTERS—All this sounds very reasonable. Perhaps as a surface transportation man, Mr. Burleigh does not give quite enough consideration to the difficulties attendant on the flying of an airplane right into the heart of a city. But probably he meant that helicopters would be the appropriate aerial vehicle, for he goes on to say: "Helicopters, where used, would maintain a minimum scheduled speed of 90 miles per hour, with stops at intervals of 25 to 75 miles depending upon the distribution of population. Direct helicopter connections would be made available to thousands of small communities not financially able to build and maintain the large airports required for fixed wing aircraft. By coördination of motor-bus and air-bus schedules, the residents of small towns and rural areas in between helicopter stops would have air service conveniently accessible to them."

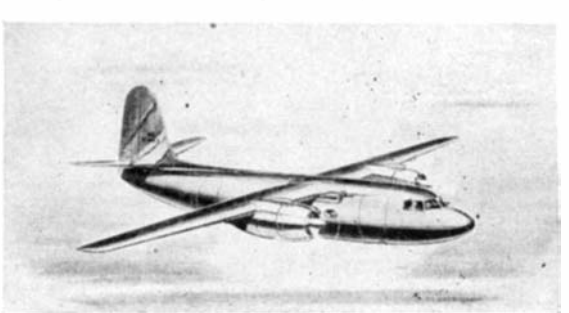
There are many technical difficulties to be overcome, before the helicopter can safely enter such service, but there is a great deal of logic in Mr. Burleigh's remarks.

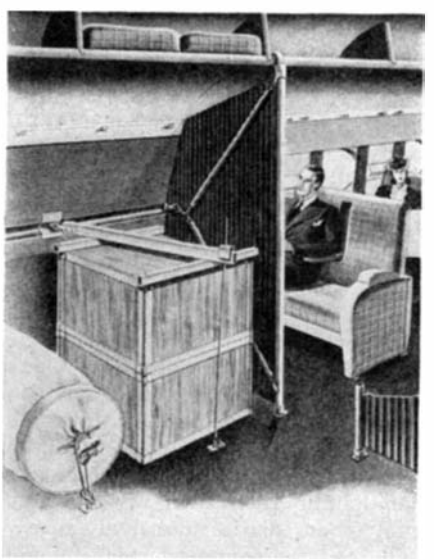
But if the helicopter is not to be brought into service right away, and if the airplane is still to be the mainstay of even local airlines, what can be done to decrease landing time losses in airline operation, losses which more than compensate for the greater speed of the airplane once it is in the air when short-haul operations are involved?

James G. Ray, vice president of Southwest Airways Company, and himself a pilot of long experience, answers this question. Speeding up the airplane alone is not sufficient because indefinite increase in speed also means prohibitive increase in cost. The answer lies in the intensive study of causes of delay at landing stops. If passenger doors actuated a small folding step, attached to the airplane, passengers could easily climb in and out without the necessity of a loading platform. In refueling a plane, it would be more logical to have a smaller container holding about the amount of gasoline that needs to be serviced into the airplane and mounted on a vehicle similar to a jeep that could be handled much faster than the present tank trucks. It is not unusual to see the engine turn over for quite a few seconds before it starts. At refueling stops it may still be necessary to stop the engine because of fire hazards, but a method should be devised to keep the engine running at all other stops. By taking advantage of these and other improvements, as much as four or five minutes could be saved in the loading and unloading of aircraft.

Dealing with improvements in airport facilities, Mr. Ray has this to say: "Airports as they exist today have become cumbersome and unwieldy in the endeavour to accommodate larger, faster aircraft. The inevitable result of increased landing and take-off speeds has been the expansion of airports in every direction, to the point where they have become so expensive as to be prohibitive for the average small city to establish and maintain. For this problem, too, the area airlines have an efficient and economical solution—flight strips. If possible, these should be laid out parallel to the course of the area line and sufficiently long—at least 2000 feet—to permit landings from either direction without the necessary time-wasting circling, except in the case of strong head winds. The perfect flight strip would be 4000 feet long, enabling planes to land, discharge their passengers or cargo at a point midway down the strip, and then continue their take-off in a continuous directional operation without taxiing delays."

There will also be other developments for the improvement of ground facilities. Here is an idea of a totally different kind, though still related to the same objective, recently presented to the Civil Aeronautics Board by Oliver L. Parks, of Parks Air College. It involves a mobile airport station that looks like a trolley bus and performs like a station wagon. It is designed to drive right up alongside an airplane where it stops, deliver and take off passengers, mail, and cargo —in short, to serve all the requirements of an airport terminal building and more. This would be an excellent device to coördinate with the flight strip, and certainly of interest to the feeder-line operator. Built-in features will include everything from a ticket-sales counter to toilet





Left: Martin's high-wing 30 passenger plane. Right: Interior accommodations of a transport plane with movable partitions by means of which cargo space in the forward compartment can be expanded or contracted. Note provisions for securing odd-shaped packages

facilities. All will be housed in a vehicle 8 feet wide, some 22 or more feet in length, and 9 to 10 feet in height.

PLANES—Engineers of the Glenn L. Martin Company have designed a 30-passenger plane for short-haul operation. The plane can be either low or high wing. There is so much discussion regarding the position of the wing, and there are so many good arguments on either side, that Martin is quite right in providing alternatives. The high wing furnishes better passenger vision, greater ease of loading and unloading, and reduced ground time. On the other hand, the low-wing design provides a shorter landing gear and reduced empty weight. In both cases a tricycle landing gear is provided for convenience in loading and unloading and to keep the floor level at all times. Either Wright or Pratt and Whitney engines can be employed.

The models are designed to operate over a 500 mile range, at a cruising speed of 250 miles an hour, or nearly 50 percent greater than that of present-day airliners.

There are included in the Martin design two large hatches—one forward and one aft—at lower than truck height, which is significant. There will also be available a moveable bulkhead or wall to separate cargo and passenger compartments. Thus the size of each compartment can be varied according to the number of passengers and amount of cargo demanded for each trip and, with standard cargo tie-down fittings, a complete conversion will be made in 20 minutes or less. As an added convenience for passengers, a compartment for hand luggage is included just inside the entrance so that air travelers can bring their own bags aboard and have them available throughout the flight.

The proposed Douglas "Skybus" probably comes closer to the requirements of the local airline than does the excellent Martin proposal. This design involves a high-wing, twin-engine, all metal monoplane with tricycle landing gear. High pay load will be provided with a maximum of 24 passengers; extreme maneuverability in the air and on the ground, ability to land and take off in small airports, and low landing speed are among important features. Further, two wide, truck-bed-level doors, an adjustable bulkhead in the cabin, large baggage racks, and many other new features assure quick and easy loading. The engines are of 700 horsepower each.

Any discussion of feeder airlines must at least mention the system of air pick-up used so successfully by All American Aviation for mail and cargo, and now adapted to glider and human pick-up. This system of pick-up has peculiar significance for the small community, and greatly increases the chances of even the smallest communities securing the maximum in air service. Further, there is not the slightest doubt that, should it be found practicable to employ gliders in air cargo transportation, the pick-up system will be completely ready for service.

If the new highways of the air—the feeder lines—can be made successful through inventiveness or the application of mechanical ingenuity, their operators can certainly be confident of receiving such help.

FASTEST FLIGHT

Achieved by New Jet-Propelled Plane

THE SHOOTING STAR, newest American jet-propelled fighting plane, produced with the aid of the Army Technical Service Command at Wright Field, General Electric Company, Lockheed, and the British RAF, has aroused considerable interest.

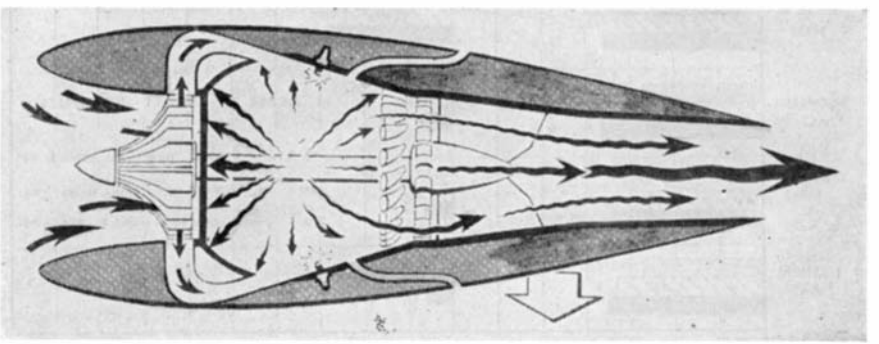
Streamlined ducts in the leading edge of the wing lead air to the engine where a high-speed fan forces the air into it at high compression. From the compressor, the air passes into the combustion chamber where it is mixed with fuel injected at high pressure. A continuous explosion occurs in this combustion chamber, heating the gases to an extremely high temperature and causing them to expand violently. The exploded mixture under great pressure can move only in one direction—toward the back of the airplane.

Once the engine is started, no ignition system is necessary. A small metal plug protruding into the combustion chamber heats red hot in the first few seconds of operation, and thereafter serves to ignite the mixture of air and fuel as it is introduced. For the initial starting, spark plugs are used.

From the combustion chamber, the hot gases pass rearward through a gas turbine. The turbine, connected by a shaft to the compressor fan, supplies the power necessary for the intake and compression of air.

The basic simplicity of jet engines may lead to rapid production for military purposes now that workable engines have been developed. Many of the problems of reciprocating engines—cooling, complex electrical systems, gear drives, and the like—are all eliminated. For fuel, the General Electric's engine uses kerosene, which is preferable to gasoline because it provides somewhat more Btu's per pound and per gallon. Thus the dangers of handling high octane gas are eliminated. While no definite design or performance information is given, the Air Force permits it to be known that these planes are faster than anything that Japan or Germany have flown, including the tailless Messerschmidt 163 Rocket Interceptor. Production is well under way.

Armament of the Shooting Star is located in the nose for most effective concentration of firepower. The fuselage is lacquered to a high polish of indefinite color and, with a minimum of air resistance, slips through the skies like an apparition of death. The wing is refined and is a brand-new type, with a knife-like leading edge, to avoid the problems generally encountered at or near the speed of sound. Streamlined air-intake ducts nestle on each side of the fuselage just forward of the leading edge of the wing. Rate of climb and angle of climb at high speeds are said to be superlative. The cabin is pressurized.



Courtesy Lockheed Aircraft Corporation

A major misconception concerning jet propulsion is that the expanding gases push against the outside air to furnish forward motion. However, this simplified diagram of the distribution of forces in a jet-propulsion engine shows that it does not depend on the air for its forward thrust but entirely upon reaction against the engine

Automotive Rubber

Forgetting for the Moment Today's Pressing Question of Tires, Consideration is Given to the Place of Synthetic Rubber in Mechanical Parts for Post-War Vehicles. Temperatures Encountered in Operation, Stresses Imposed, and Other Factors Must Be Known if the Designer is to Take Full Advantage of the Mechanical Qualities of the Synthetics

SYNTHETIC rubber is here to stay for mechanical parts on automobiles, trucks, tractors, and airplanes—not as a rubber substitute but as an essential engineering material. Natural rubber will never again be used for hundreds of different mechanical parts, in which synthetic rubbers are already outperforming it. The development of synthetic rubber is in its infancy and we can look forward in the immediate post-war years to further improvement in compounding technique and to the development of new synthetic elastomers.

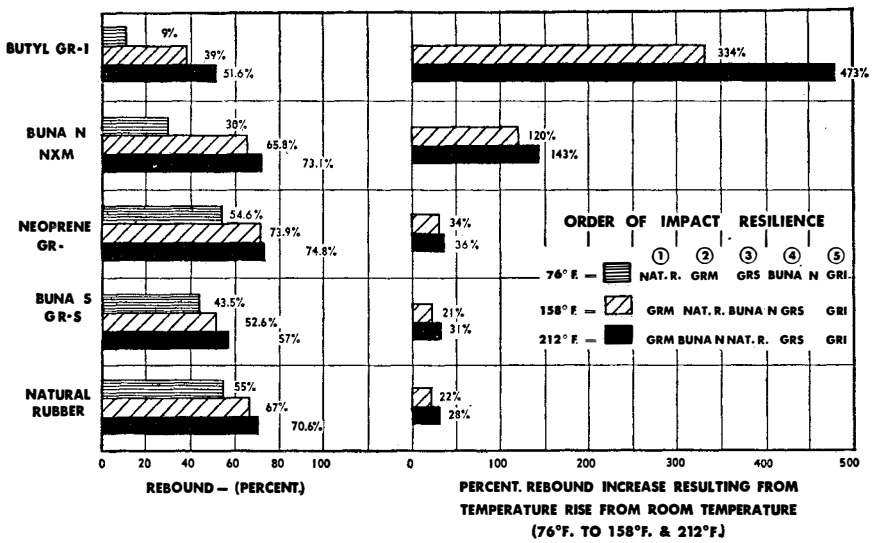
All synthetic rubbers (that is, synthetic elastomers) are tailor-made, long chain molecular arrangements, high polymers with molecular weights ranging as high as several hundred thousand. They are products of polymerization phenomena, and the wonders of this mechanism have just begun to be realized. While no one of the tailor-made elastomers possesses all of the properties wanted today, several of them have already made natural rubber take a back seat in certain specific applications. With the rapid development in this field, entirely new synthetic elastomers will undoubtedly possess properties greatly superior to those now in production. The rubber industry should then be able to give vehicle manufacturers materials with tailored-to-order physical properties for specific applications.

PROPERTIES—The synthetics possess amazing properties. They provide wonderful resistance to oils, gasolines, solvents, chemicals, gases, ozone, sunlight, flame, heat, cold, and flexing, that enable us to build mechanical parts which are giving unbelievable performance in planes, tanks, amphibian units, and sea-operating craft. In fact, synthetics permit the use of rubber-like materials where natural rubber could never be considered.

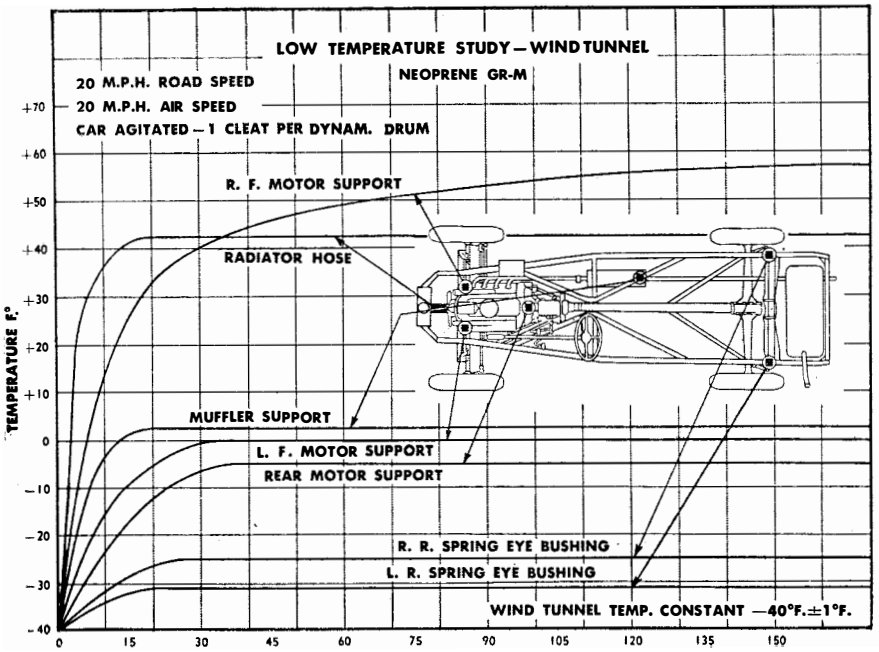
Information generally available on synthetic rubbers has been limited to room temperature, conventional physical properties, and static studies such as ultimate tensile strength, elongation at rupture, and compression set. But highly functional synthetic rubber parts demand of designing engineers full knowledge of the synthetic elastomer compounds they plan to use at operating temperatures which seldom are room temperature. A few of these men have been thoroughly disappointed with some synthetic rubber compounds which give inferior performance in designs based on knowledge of the properties of natural rubber. Any changeover is not so simple as just specifying the use of synthetic instead of natural rubber; the properties of synthetic rubbers are vastly different from natural rubber over a range of conditions. Often alterations of design and certainly of dimensions are necessary for success with synthetic.

Some of the synthetic rubber compounds are superior to natural rubber compounds for mechanical rubber goods parts. A goodly number of the properties of any synthetic rubber stock depend on the compounding ingredients and the compounding technique. Lack of success may not be the fault of a particular basic synthetic elastomer. Much can be accomplished by correct compounding. As an illustration, a GR-S compound showed flexing fatigue failure after 9000 cycles; however, the same elastomer with an entirely different compounding technique gave a flexing life up to 99,000 cycles, an improvement of 1000 percent. Synthetic elastomers are much more sensitive

Based on abstracts from a paper by Ellwood F. Riesing, Chief Automotive Engineer, Firestone Industrial Products Company, presented at the War Engineering-Annual Meeting of the Society of Automotive Engineers. Final original paper copyright 1945 by Firestone Industrial Products Company.



Results of resiliency tests of five general-utility rubber stocks



Temperature rise of synthetic-rubber car parts, starting from low temperature

to differences in compounding than is natural rubber.

In pre-war years, we were not too concerned with the effect of temperature on the properties of natural rubber. Temperature greatly changes properties of both natural and synthetic rubber compounds but the influence which temperature has on the properties of the synthetic rubbers available today is much more pronounced than on those of natural rubber; therefore the designing engineer must not only consider the temperature range in which his designs are to function, but must know at what temperatures the maximum and minimum stress occurs in the synthetic rubber parts under consideration.

The conventional method of specifying properties for mechanical rubber goods compounds today is the same as it was 30 years ago. Tensile values are still expressed in pounds per square inch at rupture, tested at room temperature. Elongations also are still expressed at rupture at room temperature.

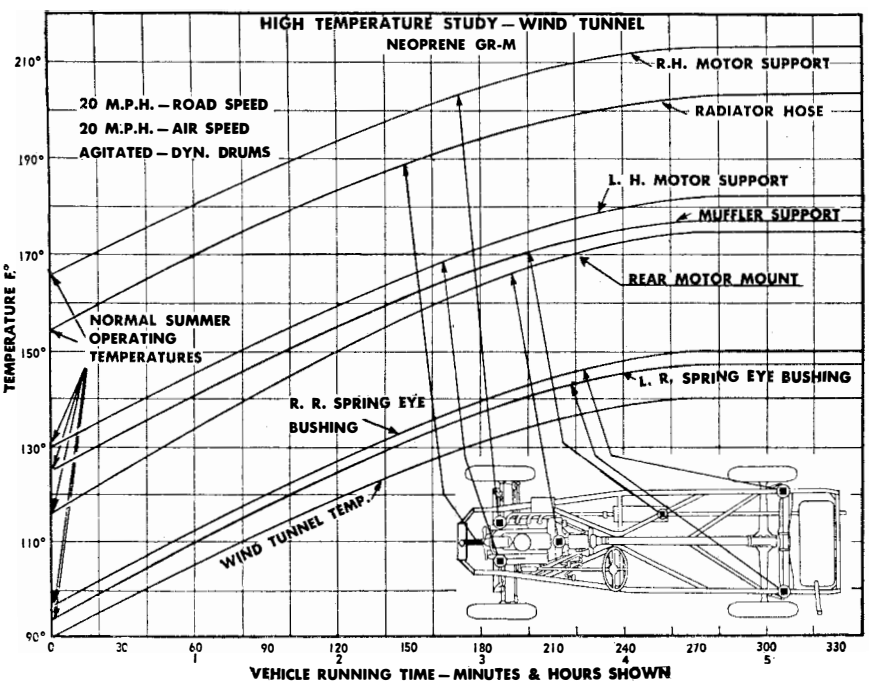
Actually, not one of the highly functional rubber parts of automobiles, trucks, tractors, or airplanes operates at room temperature only. Consider, for example, the operating temperatures of motor supports, fan belts, muffler insulators, water pump seals, radiator hose, engine throttle insulators, and other parts. Hence the conventional room-temperature property studies alone do not permit complete evaluation of the synthetic elastomers commercially available today. Careful measurements of the operating temperatures of various highly functional automotive mechanical rubber parts recently revealed some astounding data. Automobile motor mountings, as an illustration, on vehicles operating in hot southern states build up temperatures of 150 to 180 degrees, Fahrenheit. On desert runs temperatures may rise as high as 214 degrees, Fahrenheit.

STRENGTH—Tensile pulls and their respective elongation, as has been noted, are expressed at rupture at room temperature. However, all highly functional resilient insulator parts have their movements limited mechanically, and it is therefore not logical to study only ultimate tensile values. None of the vibration isolation or insulator devices employed today on vehicles allows movement much beyond 100 percent elongation at operating temperatures. Most of them function at 15 to 30 percent elongation, so why study tensile values at rupture at room temperature where elongations may run to 800 percent or more? Tension curves for synthetic and natural rubber compounds are not linear and therefore show amazingly different tension modulus values in the lower elongation ranges encountered under actual working conditions.

Conventional tensile determinations at rupture would condemn some of the synthetic elastomers that are today actually giving amazing performance. Some of these are definitely giving better performance than natural rubber compounds.

Pre-war natural rubber (50 durometer stock) has the same tension modulus at 150 percent elongation as does neoprene (GR-M) and Buna S (GR-S); however, a raise in temperature to 158 and to 212 degrees, Fahrenheit, stiffens the modulus of the natural rubber and the Buna S (GR-S) in this low-strain actual operating range, but does not noticeably change the tension modulus of the neoprene (GR-M) compound. The stability of this neoprene compound is therefore better suited and more ideal for motor mountings or other parts operating under these indicated temperature conditions. Tension modulus studies at low temperatures (0, −25, and −40 degrees, Fahrenheit) bring out the low-temperature sensitivity of the general-utility synthetic elastomers.

BOUNCE—Resilience values of compounds at specified temperatures



Temperature rise of synthetic-rubber car parts, starting from high temperature

are essential in any design of impact-absorbing devices, such as rubber springs, spring stabilizer insulators, frame insulators, axle bumpers, shock absorber insulators, engine stabilizers, instrument mountings, and aircraft landing gear parts.

Resilience can be determined by the rebound of a steel ball, permitting comparisons between synthetic elastomers and natural rubber compounds. "Impact resilience" is expressed by dividing the first rebound height by the distance of the free fall.

Butyl rubber behaves remarkably in this test. At room temperature it has a rebound of only 9 percent, but after the compound has been heated to 212 degrees, Fahrenheit, has a value of 51.6 percent. This rebound at the boiling point of water is greater than Buna-S rebound at room temperature. The neoprene compound is approximately equal to the natural rubber at room temperature and exceeds the rebound of the natural rubber when both are heated to 158 degrees, Fahrenheit. The rebound of neoprene compound also exceeds that of the natural rubber compound when both are heated to 212 degrees, Fahrenheit.

The Buna N (Butaprene-NXM), a butadiene acrylonitrile co-polymer, likewise shows greater rebound than natural rubber at 212 degrees, Fahrenheit. The butadiene acrylonitrile copolymers have a high resilience at elevated temperatures, but comparatively poor resilient properties at low temperatures. Butyl (GR-I) shows the greatest increase in rebound resilience of all the elastomers resulting from the temperature rise from room temperature to 212 degrees, Fahrenheit —that of 473 percent, compared to 28 percent for natural rubber. Certainly there should be applications where this property of Butyl can be utilized to its fullest extent.

At extremely low temperatures where rubber-like materials must be used, one or more of the present-day synthetic elastomers will not only out-perform natural rubber, but will also have the desirable feature of not becoming brittle at temperatures substantially below the brittle point of natural rubber. Some of the oil-resistant synthetics have lower brittle points than natural rubber. Emulsion polymerized polybutadiene compounds not only will excel natural rubber in having an extremely low brittle-point temperature (—100 degrees, Fahrenheit), but will also out-perform natural rubber by being flexible at low temperatures. The comparatively new technique of compounding synthetic rubbers with low-temperature depressing plasticizers for extremely low-temperature operating conditions is becoming increasingly important to the design engineer, especially for the aircraft industries. Natural rubber does not lend itself, as do synthetic elastomers, to compounding with large amounts of low-temperature depressing plasticizers and modifiers, which cause too serious a decrease in mechanical properties.

For resistance to ultra-violet rays, ozone, acid, and gas diffusion, one or more of the synthetic rubbers show up vastly superior to natural rubber. Under conditions of direct sunlight, ultra-violet radiation, and ozone as generated by corona electrical discharge and by other means, natural rubber deteriorates very rapidly. Some of the synthetic elastomers are better than natural rubber by several thousand percent in life under these conditions. Resistance to ozone and corona are all-important for ignition distributor gaskets, distributor harness boots, ignition wire covering, sun-exposed windshield wiper blades, and sun-exposed windshield and window seals.

In intimate contact with oils, natural rubber is an inferior material and can not possibly give satisfactory performance, whereas several of the synthetic elastomers have been giving outstanding performances over long time intervals.

The future possibilities of synthetic rubber-like elastomers as engineering materials are practically unlimited. Some special compounds of emulsion-polymerized polybutadiene, not on the market today, may prove to be the long-awaited material for use in special refrigeration equipment. In such applications natural rubber could never be used as it becomes as brittle as glass at temperatures below —68 degrees, Fahrenheit.

NEW SYNTHETICS—Butyl is the newest of the present-day commercially available synthetics, and has real possibilities. The tremendous improvement in resilience of Butyl compounds resulting from rise in temperature from room temperature to 212 degrees, Fahrenheit, should make this synthetic the answer to numerous application problems where this property is desired.

Greater improvements in Buna-S copolymers can be expected because of the large number of variations possible in butadiene and styrene ratios. This is true also of the Buna-N group where startling results can be anticipated from multi-polymerization of the butadiene with various other materials, plus blending with various plastics which would withstand temperature variations from —40 to +350 degrees, Fahrenheit, without charring or violatilizing and without shrinking or becoming brittle and having the least tendency to absorb water. Silicone rubber has all of these properties and should prove to be the engineering material for dozens of special-purpose applications.

Dichlorostyrene-butadiene copolymers likewise recently have been announced. They should also prove very desirable engineering materials because of their compounded physical properties being a combination of those normally associated with natural rubber.

One or more of the present-day synthetics are superior to natural rubber in a vast amount of different physical properties. With further developments in synthetics, new materials for engineering applications may be expected to give performance not even approached by any other engineering materials used in the past or available at present.

❁ ❁ ❁

ALCOHOL FROM FARMS

Made More Economical by Use of Mobile Units

IMPROVED economies in the output of alcohol from farm products and wastes are expected in the post-war period by the production of alcohol on a train of five railroad cars fitted out as a mobile plant. High freight charges on raw material and the need for large quantities for continuous operation will be obviated by taking the mobile plant to the raw material source. The process used employs many recent improvements which speed up the operation and allow a plant of economical capacity to be mounted on freight cars.

Although economies in manufacturing costs can be effected by the new mobile plant, the quantity of alcohol producible from a bushel of corn is unchanged and limits the possibility of converting farm products economically into motor fuel, when the farmer is paid a reasonable price for his product. The new mobile unit is expected to cheapen farm-produced alcohol by reducing production expenses as well as by obtaining its raw material at the most advantageous price directly at the farm.

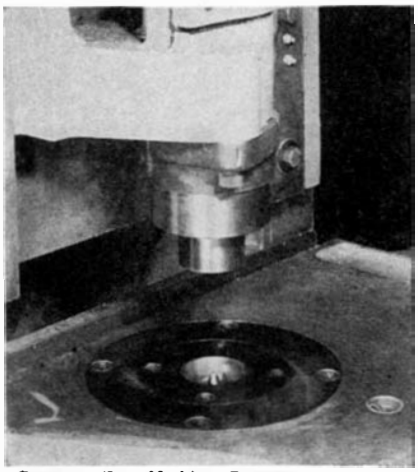
Miracle Or Mirage?

Powder Metallurgy, an Older Art than Many Realize, Can Thank the Automotive Industries for Much of its Recent Expansion. Will this Growth Continue or Will the "Modern Miracle" Prove to be a Mirage?

ONE of the largest question-marks facing industry today is the future of powder metallurgy, that simultaneously ultra-modern and old-as-the-hills metal-working process that can circumvent both metal-melting and machining to produce precision parts at mass-production rates. Large companies and small are either actively engaged in or interested in the use of metal powders, with scores of others wondering if they too, shouldn't be!

The automotive industries share with the manufacturers of electrical products the credit for most of the outstanding powder metallurgy developments in recent years. Their example has been followed by other industries, and out of this has emerged a well-integrated "powder metallurgy" industry.

In view of this expansion, widespread applicability, and growing prominence of powder metallurgy, many manufacturers are today asking themselves: "Is this something I should be using? Is there a place for powder metallurgy parts in my products, or, indeed, should I even enter into the production of powder or powder-parts, either for our own use or for sale outside?" The answers to these questions must be based in any case on a clear understanding of what powder metallurgy is and what it can do.



Courtesy Kux Machine Company

Punch and die on a mechanical press that molds powder metallurgy parts

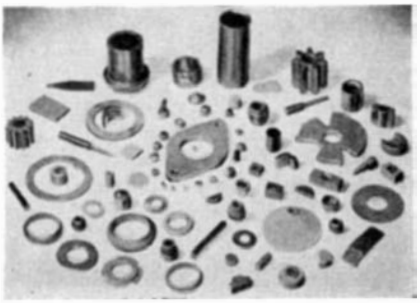
WHAT IT IS—The term "powder metallurgy" most accurately covers the whole field of the production and use of metal powders, but here emphasis shall be placed on that phase represented by the manufacture of parts and solid products by pressing metal powders to shape in a die or mold, heating or "sintering" the pressed part (called a "briquette") to strengthen and consolidate it, and then (in many cases) subjecting it to a final coining or sizing operation to obtain closest dimensional accuracy.

For each type of product to be pressed and sintered, the powders must be carefully chosen for purity, size, size distribution, flow characteristics, "apparent density," and pressing characteristics. Powders that are not clean with respect to individual particle surfaces may not consolidate properly; too hard a powder may be expensive to press; incorrect particle size distribution may result in poor packing, "bridging," inability to achieve the exact density or porosity desired in the finished part, and so forth. The "apparent density" of a powder (the weight in grams of one cubic centimeter of the powder) is a vital factor since it affects the amount of powder required to produce a briquette of a given size, the blendability of the powders when they are mixed, and so on.

POWDER COSTS—Metal powders are quite expensive, as raw materials go. A standard grade of copper powder costs about 20 cents a pound, while iron powder, on which any future expansion of powder metallurgy as a competitive parts-fabricating method clearly depends, is priced between 10 cents and nearly one dollar a pound for various grades. But an ear to the ground can occasionally detect rumblings that indicate a possible early lowering of price and an increase in the amount of inexpensive iron powder available.

After selection and grading, powders are sent to a mixing or blending machine, if more than one metal or more than one particle size distribution are involved, and the blended powders are placed in a mold and pressed in a mechanical or hydraulic press.

Courtesy Kux Machine Company



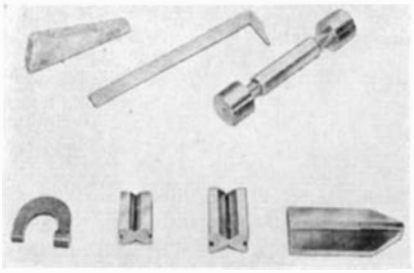
Some typical powder metal parts

In recent years press sizes and pressures have increased considerably, with a consequent increase in either the maximum cross-section area of parts that can be pressed or in the density and mechanical properties of the pressed products. Thus two of the chief classic limitations of powder metallurgy parts—their characteristically small size and their relatively low strength—are being successfully attacked and may in time be much less important than formerly.

The "green" (pressed but not sintered) briquettes are next consolidated and strengthened by heating to a suitable temperature, usually in an inert or reducing atmosphere and occasionally in a vacuum. The temperatures employed are approximately two thirds of the melting point of the metal or alloy being

sintered, although some sintering temperatures approach the melting point itself.

The sintering operation, while necessary to obtain product strengths comparable to those of conventionally cast or wrought metals, introduces problems of its own, especially through the dimensional changes (usually shrinkage) that occur in the process. Thus it is often desirable to control final size very accurately or to improve surface finish by repressing or coining the part in a final sizing operation. This practice is now widely used, especially for parts whose dimensional tolerances must be held to 0.001 inch or closer.



Through the powder-metallurgy process, these precision gages and die parts are made from iron powders by Chrysler Corporation's Amplex Division

Another auxiliary operation of considerable importance is the impregnation of porous parts or materials with a pore-filling constituent, the best examples of this being the impregnation of porous bronze or iron bearings with oil to make them "self-lubricating" and the absorption of molten copper into porous tungsten to produce tungsten-copper electrical contacts.

SPECIAL EFFECTS — From this necessarily brief description of the powder metallurgy process it is evident that it can achieve certain special effects or structures that would be difficult or impossible to obtain otherwise. It can produce materials or parts of controlled porosity, as in the porous or self-lubricating bearing and filters or screens. It can produce solid metals whose melting points are prohibitively high for the usual melting and casting practice, such as, for example, tungsten or tantalum products.

In addition, mixtures of non-alloyable or immiscible-by-melting metal combinations like copper and lead for copper-lead bearings, or tungsten carbide and cobalt for carbide tools, can be manufactured by powder metallurgy. It permits the production of parts and materials in which the ingredients retain their separate characteristics; the heat conductivity of copper, the running properties of lead, and the friction-producing characteristics of emery in the sintered copper-lead-emery clutch facing is a good example of this.

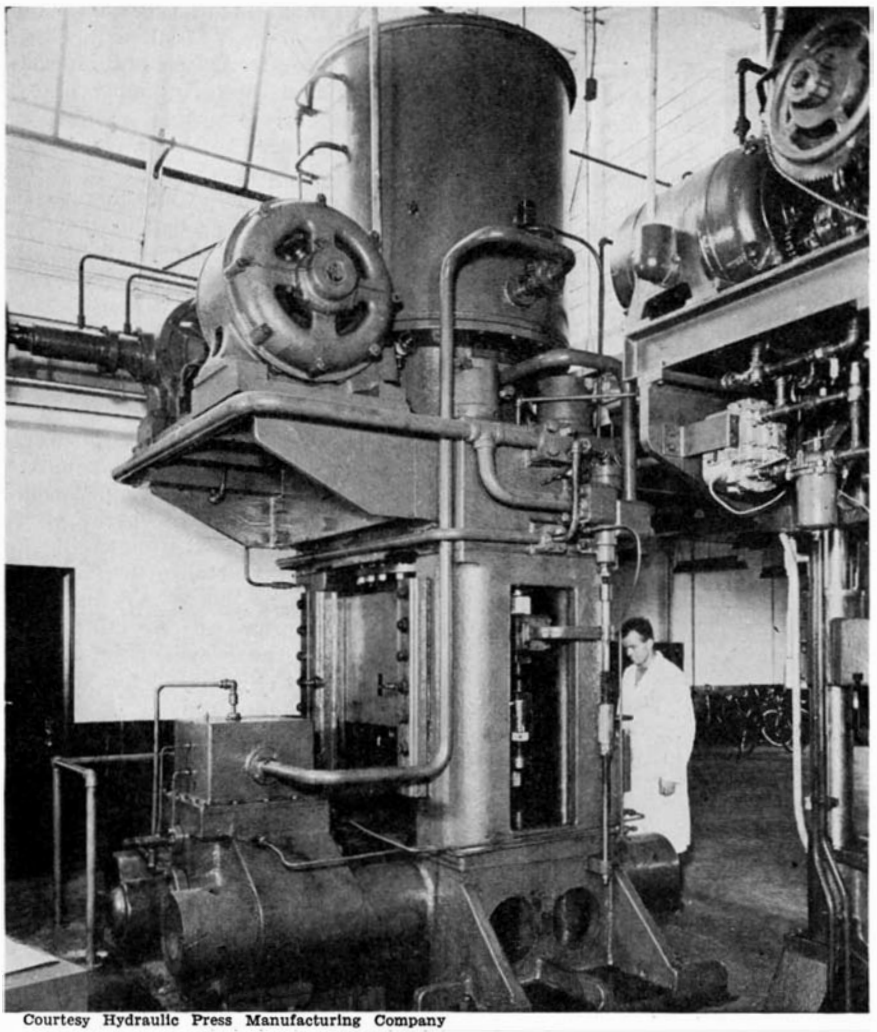
Where ultra-high purity of the material is vital, as in refractory metal products for electronic tube service, magnetic cores for radio and telephone use, and so on, powder metallurgy avoids the possibility of contamination that is usually present in melting and casting operations. Again, powder metallurgy is especially useful for materials like Alnico magnets that are virtually impossible to machine to final dimensions.

COMPETITIVE FEATURES — All these are the "specialty" advantages of powder metallurgy which have led to its use for literally millions of parts that could not be made commercially by other methods. But what of the "competitive" features of powder metallurgy that permit it to replace machining or forging or stamping or casting for certain mechanical parts, with evident cost or production advantages, and what of its disadvantages and limitations in these respects? These features are important, for on them may depend the answers to the question about powder metallurgy's future.

In the first place, powder metallurgy is fast; production rates up to 1600 pieces per hour are common and much higher rates (even up to 500 per minute) have occasionally been reported. There is virtually no material waste in the process because of the absence of machining, casting sprues, forging flash, and the like. In many cases overall economy may be considerable through the automatic, high-production, low labor-cost nature of the process and the elimination of many operations often required to make the parts by machining.

Close dimensional tolerances (about ±0.001 inch on parts up to two inches long or wide) can be held, with 0.0005 inch available at extra cost, for special work on small parts. Larger parts can be held to ±0.002 inch tolerances.

The chief competitive disadvantages of powder metallurgy are the high cost of the powders in comparison with the raw material for other metal-working methods, and moderately high cost of dies, and the relatively low mechanical strengths



Courtesy Hydraulic Press Manufacturing Company

A hydraulic press for briquetting tungsten bars

of powder metallurgy products. A rather imposing set of design limitations (avoidance of sharp corners, abrupt changes in section thickness, undercuts and re-entrant angles, parts that are too long for their cross-section, and so on) not only restrict the complexity and variety of products, but also require the use of part and die designers with considerable experience in this field.

Part sizes, too, are definitely limited by press capacities. And, finally, powder metallurgy is economically best suited to mass-production requirements, although a few cases are on record of economical production of parts in lots of less than 500.

The competitive advantages of powder metallurgy have outweighed its disadvantages in comparison with other methods for scores of machinery and ordnance parts, made chiefly from iron, brass, or bronze powders. A familiar example is a small spur gear for automobile oil pumps, formerly made by machining cast-iron blanks. When pressed from powdered iron, enough material (normally wasted in machining out the teeth) was saved to more than offset the higher raw-material cost of the powder; indeed, the final cost of the powder metallurgy gear was only 40 percent of that of the cast-and-machined gear, and the surface properties of the sintered gear were superior.

Gears, cams, ratchets, door-locks, levers, splined parts, zipper die molds, trigger components, and dozens of other parts made from metal powders have justified the economy of their manufacture and proved the applicability of powder metallurgy during the war. But it is still far from a panacea for the cure of all production problems.

LOOKING FORWARD—Actually the best thinking in the industry runs something like this: Powder metallurgy's basic importance and major applications still rest largely on "specialty" uses — self-lubricating bearings, electrical contacts, cemented carbides, filters, friction materials, refractory metals, motor brushes, and so on, that can be made only by this method.

The use of powder metallurgy for making machinery parts will gradually increase and the rate of increase will be accelerated if and as a lower cost, good-pressing iron powder becomes available in large quantities, much larger presses than those now in use are built, and the mechanical properties of pressed and sintered parts are considerably improved. But it will be at least a few years before the expansion in this phase reaches "boom" proportions, and it will *never* reach the stage where powder metallurgy will be a menace to the forging, casting, or machine tool industries.

For those curious about the place of powder metallurgy in their lives the best answer therefore seems to be — investigate powder metallurgy and powder metal parts for your products wherever possible, especially with the help of an experienced powder fabricator. Such parts may save you time, money, or materials. But unless you have a distinct economic or raw material or technical advantage, don't enter the field of powder or parts manufacture in competition with the established and experienced producers, for it is one field that is fast approaching saturation.

DEEP DRAWING

Now Accomplished With ½-Inch Magnesium Sheets

Most of the deep drawing and forming work on magnesium alloys has been done with light and medium-gage sheet—0.125-inch gage and lighter—and they have usually been formed through only one or two press operations. The Worcester Pressed Steel Company, however, has developed a technique of deep drawing magnesium domes 10 inches wide and 11 inches deep from magnesium alloy sheet ½-inch thick.

The process involves hot drawing at about 600 degrees, Fahrenheit, in a double-action draw press, "ironing" the sidewall to reduce its thickness, and hot forming (piercing, indenting, upsetting, and sizing) the dome to final size and shape. The material and method replace cold-drawn aluminum previously used for this part.

METAL POWDERS

Pose Problems for Post-War Use

With all the interest in powder metallurgy and its post-war possibilities as a method for fabricating machine parts, it is well to remember that the metal powders now in largest production are used for an entirely different purpose. The amount of aluminum and magnesium powder used in bombs and flares represents far and away the largest metal-powder application in the war; actually, the annual tonnage production of aluminum powder alone (mostly for pyrotechnic use) is now greater than the corresponding pre-war figure for aluminum metal in all forms.

This suggests a tremendously expanded post-war use of aluminum paints and printing inks, thermit welding, aerated concrete, and other established peace-time applications of aluminum powder. But who knows how we will use our great magnesium-powder production capacity when the war is over?

MAGNETIC ALLOY

Exhibits Powerful Permanent Magnetism

A comparatively new permanent magnet alloy called Alnico No. 5, has been found to have about double the residual magnetism of any Alnico previously made.

This alloy has had many applications for ordnance equipment. Its composition is approximately 8 percent aluminum, 14 percent nickel, 24 percent cobalt, 3 percent copper, and 51 percent iron. To bring out the maximum magnetic properties, a special heat treatment is required which consists in heating to 2420 degrees, Fahrenheit, and cooling in a magnetic field.

VACUUM CASTING

Introduces New Metal-Working Technique

The growing use of vacuum and low pressures in metal-working processes is interestingly exemplified in the technique developed by Machlett Laboratories, X-ray tube manufacturers, for casting copper anodes for X-ray tubes.

The anodes are from three to five inches long and up to 2⅝ inches in diameter, with a tungsten insert cast on for the target. Graphite molds, machined to size and shape, are used, the mold serving as a graphite crucible with the copper ingot so positioned that when molten it will run down into the mold.

Melting is accomplished by induction heating. The furnace itself is made of glass and consists of a quartz cylinder inside a glass cylinder with cooling water circulating between them. The graphite mold with its copper ingot ready is suspended inside the furnace; the latter is evacuated by means of oil diffusion pumps to 0.00001mm of mercury. The vacuum is maintained during the melting and cooling of the copper casting.

A series of eight furnaces is employed to give semi-continuous production—one casting every 25 minutes. The technique, which provides clean, oxide-free, gas-free, highly pure castings, can be applied to most metals.

The 'Jeep' Post-War

Improvements and Changes in the Famous Military Vehicle Have Already Made it More Useful for Heavy Work in Civilian Life. Retaining the Famous Four-Wheel Drive, the New Jeep has a Transmission Adapted to Many Uses and a Re-Designed Combustion Chamber

OFTEN asked is the question: "What about the 'Jeep' in the post-war period?" And now the answer can be definitely given: "There already is a post-war Jeep."

The post-war Jeep is modestly described by Willys-Overland officials as "the first vehicle in history to combine successfully the basic functions of the light truck, tractor, mobile power unit, and passenger conveyance."

Although it resembles the standard military Jeep, and embodies the same automotive concept which made this car the most versatile weapon in the allied arsenal, the post-war Jeep presents to the public special values of its own for the farm, factory, railroad yards, mines,

Jeep can deliver a crate of eggs or a load of baled hay with equal ease

oil fields, lumber camps, and other peace-time operations.

The concept represented by the military Jeep—a balance of power, weight, size, four-wheel drive, dependability, and ruggedness—has been adapted for peace-time service to mankind around the clock, around the year, and around the world.

POWER TAKE-OFF—Most important differences between the military Jeep and the post-war Jeep are the special power take-off which can be used with a spline shaft for direct power or with a belt pulley, thus making it possible to delegate up to 30 horsepower to anything from a buzz saw to a thresher; and the changed gear ratios in the transmission, transfer case, and axles. This latter revision results in maximum efficiency while operating at a necessary farm pace of three to seven and a half miles an hour. A gear ratio is provided to give a road speed of 60 miles per hour. These developments assure long life for the post-war Jeep.

The power take-off, as far as the Jeep is concerned, is something brand new. The post-war Jeep is engineered and designed to take advantage of mobile Jeep power to carry it over difficult terrain to the job; to adapt it to a long list of stationary tasks; to pull heavy equipment over the highways at a rapid rate; and to perform tractor-type jobs on and off the highways with speed and efficiency.

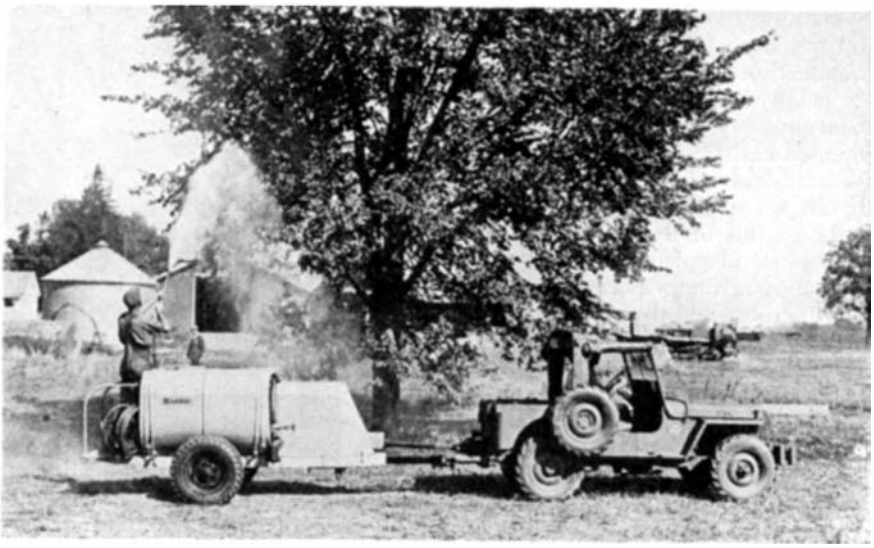
In the Jeep's new transmission, there are wider gears of more suitable ratios, better lubrication, and larger bearings, which means an unusual combination of power and speed. There is a higher oil level in the engine and greater oil capacity.

IMPROVEMENTS—Other differences between the military Jeep and the post-war Jeep are:

1. A new combustion chamber in which altered dimensions in the cylinder head and combustion chamber, perfected in the light of the newest engineering knowledge, increase the power of the post-war Jeep.

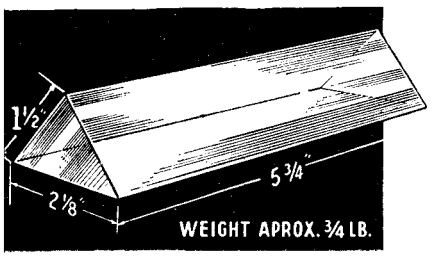
2. A radiator shroud provides more effective cooling for continued low-gear driving on the farm and in other highly-demanding work.

3. A larger clutch permits easy starting with increased loads. Once engaged, the capacity of the clutch to transfer the full torque of the engine makes only a nominal difference, but in the act of starting, additional stress is necessarily put upon it, and the change obviates any



Tree spraying, using a Jeep to pull tank and provide pressure

TERRIFIC BARGAINS IN WAR SURPLUS LENSES AND PRISMS



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MISCELLANEOUS ITEMS

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3016-S	Pentagon Prism	.75 each
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1004-S	2 reducing Lenses	1.20
3001-S	Lens Surface Prism	2.00 each
503-S	No. 1 Sable Hair Lettering Brush	1.00 dozen
3021-S	Amici Roof Prism (3rd Grade)	.25 each
4009-S	Heat Absorbing Glass 4" x 5"..	.35 each
4010-S	Heat Absorbing Glass 2" x 2"..	.10 each
2020-S	40 mm. Neg. Lens, Cross Lines..	.25 each
3020-S	Right Angle Prism 48 mm. wide (3rd grade)	.35 each
523-S	Six Threaded Metal Reticle Cells	.25
26-S	First Surface Aluminized Mirror, Diam. 1¼"	.25 each
1027-S	Perfect Plano-Convex Lens, Diam. 12.5 mms. F.L. 20 mms.	.30 each
624-S	Neutral Ray Filter size 4¾" x 2½"	.25
3022-S	Round Wedge 65 mm. Diam. ...	5.00 each
3036-S	Roof Prism — 80 degree . . . face 1⅝" wide	4.00 each
22-S	Inclinometer — Aircraft type ..	.25 each
704-S	Lens Cleaning Tissue, one ream (480 sheets) size 7½" x 11"..	1.50
6002-S	Educational Set. 1 blank and 1 finished Perro Prism (3rd grade)	.25 set
1003-S	50 Power Microscope Lens Set ..	.70
1028-S	8 Power Mounted Magnifier ...	.35 each

(Minimum order — $1.00)

POLAROID — Suitable for Experimentation. Consis 2 discs — 2½" diam. Some imperfections in glass

Stock #622-S ..... $1.00 Postpai

12-POWER COLOR CORRECTED MAGNIFIER SET – Consists of two 15 mm. diam. magnesium fluride lov reflection coated Achromatic Lenses and section of meta tubing for mount.

Stock #1029-S ..... $1.50 Postpai

RETICLE SET . . . Five assorted, finely engrave Reticles from U. S. Gunsights. An unusual group . . just like those assisting our gunners to train sights o Tokyo. Worth several dollars each.

Stock #2035-S ..... $1.00 Postpai

PORRO PRISM SET FROM ARMY'S 6 POWER BINOCULAR . . . Consists of 2 Porro Prisms to make a erecting system for a Telescope.

Stock #3010-S ..... $2.00 Postpai

MAGNIFIER SET . . . 5 Magnifying Lenses . . Powers from 1 to 10. Various diam. for many uses

Free Booklet on Home-made magnifiers included.

Stock #1026-S ..... $2.00 Postpai

COLOR FILTERS

1 Red and 1 Yellow Filter in following Diam.

20	mm. (seconds)	40c	45.5	mm. (seconds)	90
32.5	mm. (seconds)	70c	31	mm. (seconds)	70
37	mm. (seconds)	70c			

(Minimum Order on Above—$1.00)

NEW 50 PAGE IDEA BOOK "FUN WITH CHIPPED EDGE LENSES"

ontains wide variety of projects and fully covers the scinating uses of all Lenses in sets listed above. . . only $1.00 Postpaid.

AW OPTICAL GLASS . . . An exceptional opportunity secure a large variety of Optical Pieces both Crown id Flint glass (seconds) in varying stages of process-g. Many prism blanks.

ock #703-S 8 lbs. (minimum weight) $5.00 Postpaid

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ELLNER EYE PIECE LENS . . . Focal Length 1¼ ches. Diameter of eye lens 16 mm. Diameter of field ns 25 mm. Eye achromat already cemented.

ock #6108-S ..... $1.00 Postpaid

ERFECT ACHROMATIC TELESCOPE OBJECTIVE ENS . . . Diam. 1¾ inches, F.L. 20 inches. **ock #6091-S ..... $5.00 Postpaid**

LEANING BRUSH SET . . . For Lenses, Optical struments, etc. Perfect quality — 12 inch lexible Plastic handle, hollow circular const. ange from stiff to very soft. 4 Brushes to set.

ock #504-S (Reg. 6.00 value) . . . Price $1.00

ENS FOR KODACHROME EYE-VIEWER . . . olor corrected cemented lens 41 mm. diam., 66 m. F.L.

tock # 6116-S..... $1.00 Postpaid

WAR SURPLUS ACHROMATIC LENSES

Stock No.	Dia. in mms.	F.L. in mms.	Comments	Price
6019-S	15	41	Cemented	60c
6111-S	16	36	Cemented	75c
6094-S	16	75	Cemented	$1.00
6115-S	46	108	Cemented	$1.00

USES:—Use these Lenses for making Projecting Lenses, Low Power Microscope Objectives, corrected Magnifiers, substitute enlarging Lenses, Eye Piece Lenses, Macrophotography gadgets, optical instruments, etc.

TANK PERISCOPE

Complete Set Mounted Components

Rugged, strong, originally constructed for U. S Tank Corps. Consists of 2 fine Periscope Mirror mounted in metal and plastic. Only plywood bod frame is required to finish this exceptional Peri scope. First surface mirror is well protected b glass windows. Set weighs 2¾ lbs. Overall lengt of mount 6⅛", width 2⅛". Would normally re tail at $40 to $50.

Stock #700-S .... $3.00 Complete Set Postpai

TWO SETS (4 UNITS)..SPECIAL $5.50 Postpai

ORDER BY SET OR STOCK NO. ❖ SATISFACTION GUARANTEED

EDMUND SALVAGE COMPANY • P. O. AUDUBON, NEW JERSEY

difficulties in getting under way.

4. Steering linkage has been redesigned to provide ease of handling and free rolling, and to make it possible to negotiate sharp turns more safely.

5. Greater rigidity is built into the chassis frame. At front and rear, and all along the frame, reinforcements have been added to aid in the attachment of implements, and to absorb the loads of heavy draw-bar work.

6. Rear shock absorbers are mounted at an angle to provide a level floor. New and more comfortable seats have been installed.

7. The gear shift lever is located on the steering column.

Additional features have been provided in the new Jeep, either as standard equipment or as accessories. Among these are seven-inch headlights which meet all legal requirements, a tail gate which enables the vehicle to function effectively as a pick-up truck, an automatic windshield wiper, a large tool box, and front and rear tops.

Owners of the vehicle will be able to purchase a list of special accessories which widen the range of the Jeep's usefulness, including snow plow and grader attachments, spray painting equipment, and others. A belt-driven governor is available and can be installed wherever constant engine speed is required regardless of load. Controlled from the instrument panel, the governor permits regulated engine speeds from 1000 to 2600 R.P.M. in steps of 200 R.P.M.

By no means new, but increasingly effective for post-war use, is the four-wheel drive, never before available to civilians in a vehicle of the Jeep's size and weight. This feature, which helped build a world-wide reputation for the military Jeep, promises to play an equally important part in hundreds of peace-time assignments. By spreading the Jeep's drive over four wheels, tremendous tractive power is achieved and the vehicle becomes a glutton for tough terrain. It is particularly effective on uneven or loose soil, where vehicles driven from only one axle frequently push their front wheels into the ground and stall. On the Jeep, the front wheels do not push, they pull.

Builds fences in a jiffy. Jeep can carry posts, operate hole-drilling augur, and stretch wire afterwards

JOBS—The list of jobs which the post-war Jeep will do runs into the hundreds. Many of these already have been studied and tested; others will receive attention soon. Some of the farm jobs include: Operating a combine or binder; threshing wheat; baling straw; elevating grain; planting and cultivating; plowing; disking; dragging; hauling grain, hay, and livestock; mowing and raking hay; operating a post-hole augur; sawing wood; filling a silo.

In addition, the Jeep can successfully: Operate an electric light plant; maintain utility lines; serve in mines; act as police patrol; deliver mail; move airplanes on field; skid logs; herd cattle; move yard freight; pump water; stretch fence wire; plow snow; service oil fields.

The Jeep has successfully served as a mobile power unit for a movable air compressor and for effective pavement breaking and street repair.

GAS CONSUMPTION—There has been much discussion about the Jeep's gas consumption record. Extensive field tests have proved the post-war vehicle's economy compared with other forms of tractive power. On the highway, it will deliver up to 18 miles per gallon. It is also economical in belt pulley operation. It is well to remember that gasoline consumption is a matter of how efficient the engine is, how heavy the load may be, the quality of gasoline used, whether time saved is more to be valued than gasoline consumed, and whether the vehicle being tested is moving over hard-surfaced roads or through mud, sand, or loamy soil.

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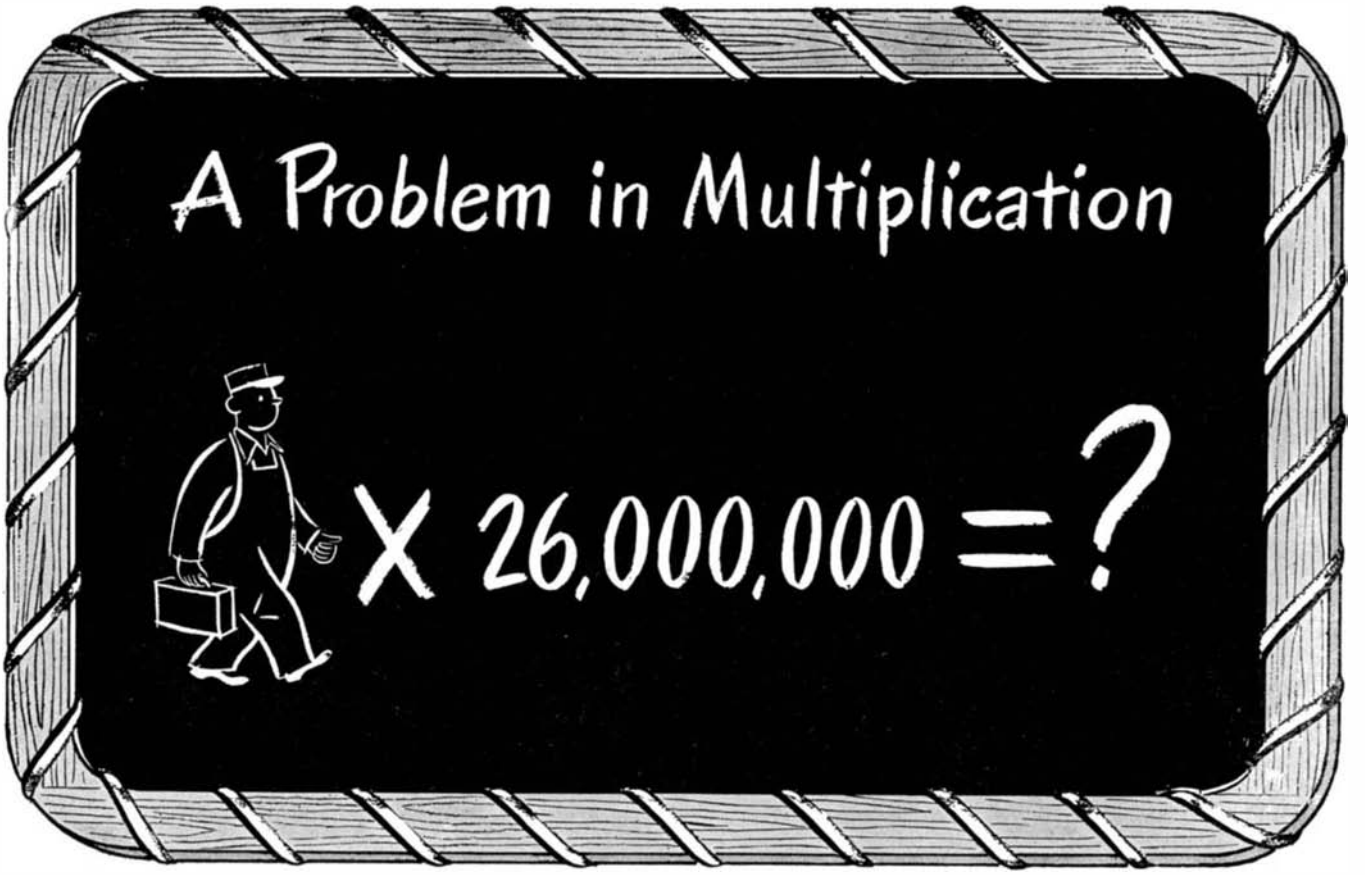
BUSINESS FLIGHTS

In Private Planes
Save Executives' Time

How appreciable savings in time and money can be achieved through travel in privately operated aircraft has been shown by the Civil Aeronautics Administration in connection with its contract termination program. On that assignment, more than $4500 in fares, subsistence, and salary time was saved by use of a Government-owned airplane. The

Versatile Jeep tows the corn husking machine to crib and is then put to work operating the long power belt

Taking the saw mill to the tree instead of the tree to the saw mill. The saw mounting folds into back of car



Take the case of John Smith, average American:

For over three years now, he's been buying War Bonds through the Payroll Savings Plan. He's been putting away a good chunk of his earnings regularly—week in, week out. Forgetting about it.

He's accumulating money—maybe for the first time in his life. He's building up a reserve. He's taking advantage of higher wages to put himself in a solid financial position.

Now suppose *everybody* in the Payroll Plan—everybody who's earning more than he or she needs to live on—does what John Smith is doing. In other words, suppose you multiply John Smith by 26 million.

What do you get?

Why—you get a whole country that's just like John Smith! A solid, strong, healthy, prosperous America where everybody can work and earn and live in peace and comfort when this war is done.

For a country *can't help* being, as a whole, just what its people are individually!

If enough John Smiths are sound—their country's *got* to be!

The kind of future that America will have—that you and your family will have—is in your hands.

Right now, you have a grip on a *wonderful* future. Don't let loose of it for a second.

Hang onto your War Bonds!

BUY ALL THE BONDS YOU CAN...
KEEP ALL THE BONDS YOU BUY

Scientific American

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council

value of an aircraft to business executives was further demonstrated by the 83 percent time saving. Actual time spent traveling was less than 103 hours by air against more than 609 that would have been required by rail.

The trip was made by a CAA Contract Termination Board of four members, one of whom served as pilot. They made 63 stops in 108 days. Best possible time by rail would have been 146 days, assuming trains would be scheduled exactly as needed. Time saved by the Board was probably greater than would be the case in many business trips, however, because much of its business was conducted at airports. It was also true that the trip was made during favorable flying weather—only twice in 108 days was the plane grounded because of weather.

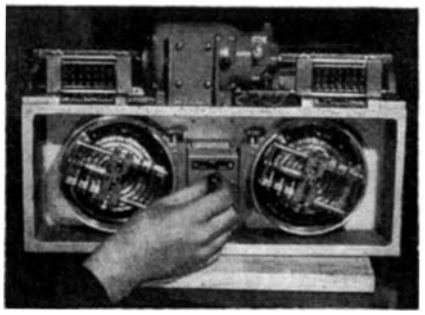
The cost of operating the plane, including depreciation, was $886.47 less than train fares would have been. The time saving of 152 man days represented $3626.72 in cash, on the basis of $17.86 average daily salary plus $6.00 per diem subsistence allowance.

EIGHT CHANNELS

Now Used on One Radio Transmitter

THE SUCCESSFUL use of an eight-channel system for transmission over a single radiotelegraph transmitter is announced by RCA Communications, Inc. The new system has been placed in operation between New York and London with extension channels to San Francisco.

Specially designed equipment operating on "time division multiplex telegraph" principles, permits handling of 488 words per minute inward and outward simultaneously, corresponding to eight channels each way with an individual channel speed of 61 words per minute. Four or two channels instead of eight can be used if desired. All eight channels may be utilized for two-way communication with one distant station. Alternatively, they may be set up in such a way that four channels with a total capacity of 244 words per minute can be operated in both directions simultaneously between two different stations.



Multiplex distributor for eight-channel system, showing channel switch

The printing mechanism accomplishes the feat of making the circuit virtually error proof, despite its high speed. A warning bell rings when a mutilated character is transmitted and a Maltese cross marks the exact spot of the error, facilitating correction. In other words, no error can get through directly to the message blank. The printer, known as the RCA Seven Unit Printer, is completely automatic. Each incoming letter is comprised of three marking (signal) impulses, plus four spacing (no signal) impulses. The name—seven unit—stems from this fact.

Although the new multiplex equipment is specifically designed to utilize the RCA Seven-Unit Printer System, it is also able to handle other telegraphic signalling codes. In fact, a different signalling code can be used if desired on each of the four pairs of channels forming the eight channel total.

In spite of its speedy performance the appearance of the transmitting and receiving equipment used is but slightly different from the conventional radiotelegraphy apparatus. One of the valuable features of the new system is the use of bells for signalling, each channel using two of them. One rings only when an incorrect group of signal elements reaches the receiving printer; the other, of different pitch, is operated by means of a switch similar to a telephone dial, and with it the receiving operator can pass a number of stock phrases for service instruction to the other end of the circuit, thus saving channel time.

Making an adjustment on one of the control panels of the new multiplex radio sending and receiving system

Punching tape for message transmission over eight-channel radio system

BETTER EYESIGHT

Will be Sought by American Workers

WAR PRODUCTION efficiency studies have disclosed that approximately one out of every three American workers has an uncorrected visual handicap, and as a result of these disclosures wide interest is developing in industrial visual problems, according to M. J. Julian, president of the Better Vision Institute.

"War production has spotlighted the problems of inadequate seeing conditions in many factories, the neglect by workers of their visual shortcomings, and the adverse effects of visual fatigue upon productive efficiency," says Mr. Julian. "The problem of better seeing for economic efficiency is being attacked in four general directions:

"First, professional ophthalmic men are studying visual needs of workers and are assisting in the formulation

of occupational eye care programs. Seeing requirements of various jobs are being analyzed so that workers may tune up their eyes for the most effective vision on their own particular jobs.

"Second, many industries are carrying on extensive educational programs to bring about higher standards of occupational eye care. Experience gained during the war has demonstrated to employers that half-seeing workers are an economic liability to the productive process.

"Third, the public generally is accepting higher visual standards as prerequisite to higher living standards. As a result workers in increasing numbers are taking steps on their own initiative to keep their eyes tuned to high efficiency.

"Fourth, many industrial plants are making surveys of working conditions to improve 'seeability.' Lighting of factories is being improved to provide greater comfort to the eyes of workers. Machines are being painted to facilitate seeing by pleasing contrasts of color. Efforts are being made to coördinate seeing skills of workers with jobs best suited to their particular visual qualifications."

MAGNETOCHEMISTRY

Is Revealing Many Unsuspected Facts

MAGNETIC studies, one tool of the chemist, are discovering new facts about catalysts, the vitally important "marrying parsons" in many chemical reactions, Dr. P. W. Selwood, associate professor of chemistry at Northwestern University, said in a recent address delivered before the American Chemical Society.

"Catalysts bring about or speed up chemical reactions without being affected themselves, but not much is known yet about the fundamental way in which they operate," Dr. Selwood said.

"Magnetic studies are just beginning to reveal certain hitherto unsuspected facts such as the nature of the activation process in catalyst preparations, the effect of diffusion, and the physical and chemical state of the various elements present in commercial and laboratory types of catalysts."

"From the nature and degree of magnetic attraction or repulsion," he explained, "it is possible to draw conclusions as to the structure of chemical compounds, the electrons in the molecules, the presence of impurities, and the mechanism of certain chemical and physical changes.

"The magnetic method is especially powerful in detecting minute traces of impurities, such as iron. As little as one part of iron in 1,000,000,000 parts of copper is easily detected. This method is convenient in testing and controlling the purity of raw materials and products, such as glass sands, activated alumina, rare earth preparations, and many other types of highly useful chemical substances."

"The magnetic measurements," he continued, "are also useful in studying organic free radicals, and studies of this kind may lead to a better understanding of the way in which plastics are formed.

"Similarly, the chemical structure of hemoglobin and of other complex compounds has been greatly extended by magnetic measurements. Some substances found in the animal body contain minute traces of iron which is, nevertheless, indispensable for life. Magnetic studies have shown how the iron is combined in these substances and, in some cases, have led to improved methods for studying blood chemistry.

"Magnetic measurements are also useful in powder metallurgy. Powder metallurgy is the art of making metal objects, such as gears, bearings, et cetera, by compressing and heating finely powdered metals or mixtures of metals. Recent studies have shown how the magnetic properties change

during this process, and how they may be used to follow the rate at which the powder grains of one metal diffuse into those of another."

GAS-DIESEL

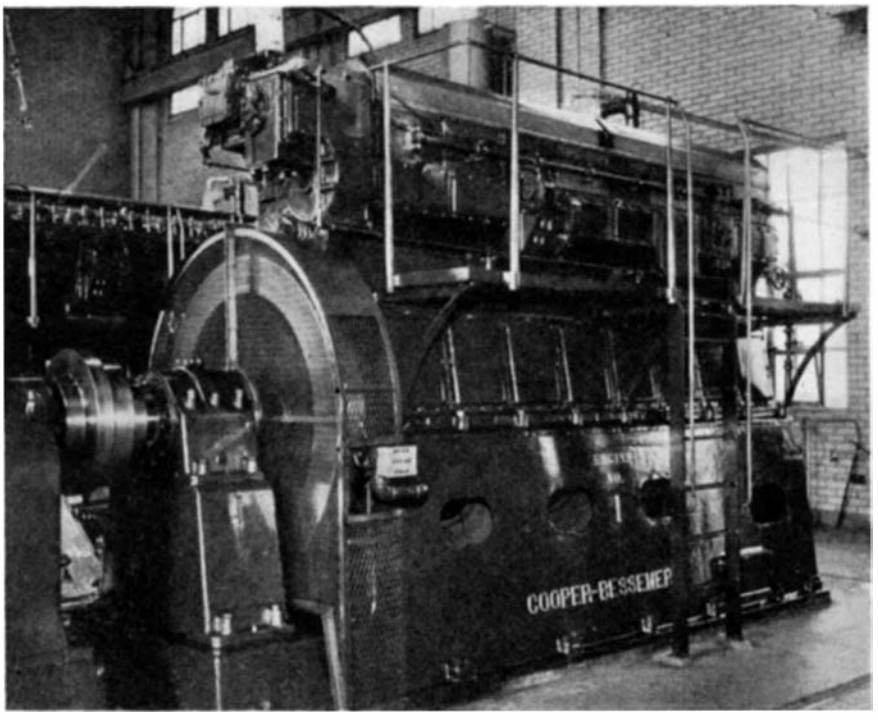
Can Show Great Savings In Sewage Plant

GAS DIESEL engines could save at least $33,000 a year in the operation of Cleveland's Southerly Sewage Treatment plant, a study of that plant's operation has just revealed and this serves as an indication that many additional thousands of dollars could be saved in similar plants throughout the nation by the application of the new engineering principle, according to Ralph L. Boyer, Cooper-Bessemer chief engineer.

The new gas-Diesel engine could save money by providing power facilities for utilizing the maximum sewage gas output instead of the minimum as now set up for units capable of using only gas for fuel, Mr. Boyer says. The new gas-Diesel development could also be used as a means of generating electricity for plant motor units on a self-sustaining basis.

Sewage plants now equipped with ordinary gas engines must necessarily provide for seasonal fluctuations of their sewage gas supply and, therefore, their engine installations operate on the basis of the minimum of gas production. When the gas supply exceeds these minimums, the surplus is frequently burned in the atmosphere.

By using the new gas-Diesel engine, the horsepower could be based on the plant's maximum capacity, with a standby fuel-oil supply available for use during seasonal declines in the gas supply. With the new gas-Diesel principle, it is possible to run on any percentage of gas available by adding fuel oil to supply any additional requirement. Thus, an engine now can run on 80 percent gas and 20 percent oil, or any other similar combination of fuels.



Gas-Diesel engines, used in sewage disposal plants, can be run on maximum sewage gas supply, using fuel oil for standby operation when gas supply is low

RUBBER TRACKS

Seen as Having Agricultural Advantages

A POST-WAR "back to the farm movement" for rubber tracks of the type used on tanks, Weasels, half-tracks, and other bouncing land battle-wagons is predicted by The B. F. Goodrich Company.

Originally designed for industrial and agricultural use—the first continuous-band rubber track was applied to a farm tractor in 1931—rubber tracks have "made rapid strides," figuratively and literally, during the war. The application of these new high-performance tracks to civilian vehicles is said to be a logical next step after the conflict ends.

The "sprinter" self-track-laying vehicles of this war are a far cry from the lumbering, thundering, vibrating tank treads of World War I. They move at high speed without excessive vibration and travel over macadam or concrete roads without undue punishment either to themselves or the paving and have several advantages over wheels for vehicles in "off-highway" use. They

A post-war track-laying farm tractor

have a drawbar pull nearly twice as great as that of wheels and provide better and more uniform traction. They make a broader area of ground contact than do wheels, and thus have a greatly reduced shearing force per unit of ground contact. Over "washboard surfaces"—for example, at a right angle to old corn rows—they provide a smoother ride, causing less fatigue to the operator. Their substantially lighter pressure per unit of ground contact reduces soil packing.

TENT CLOTH

Production-Treated With Synthetic Resins

CONTINUOUS production of water-, fire-, and mildew-proof duck for Army tent cloth is made possible through the use of synthetic resins which were developed to meet war-created shortages of imported materials. These resins have made possible a duck that actually wears longer, demonstrates increased strength over a period of years, and resists weathering and fungi better than pre-war tent materials.

In the early stages of the war, mildew destroyed one fifth of all goods shipped to the South Pacific. The wide range of weather and service conditions existing in the various theaters of war necessitated a material that would remain flexible at sub-zero temperatures, be completely water- and weather-proof, and exhibit proper coloration and lasting color retention. In addition, a replacement had to be found for one of the basic materials normally used to treat tent cloth.

Already familiar with synthetic resins from earlier experience in making book cloth and artificial leather, the L. E. Carpenter Company, with the co-operation of the Resinous Products and Chemical Company, devised a tent cloth coating compound which met the exacting specifications of the Military Planning Division.

The coating compound serves two principal functions. First, by sealing the relatively open weave of the tent cloth it renders it water-proof,

and, second, by acting as a binder and carrier for the flame-proofing and fungus-resisting agents, it protects the duck against fire and deterioration.

The manufacture of tent cloth coating consists in mixing the dry ingredients in a paddle mixer, followed by the addition of various liquid components and the plasticizer. The mix, which at this point has a thick, viscous consistency, is then ground in a large roller mill to insure complete pigment dispersion and a homogeneous mix. From the roller mill, the mixture is passed to the blend tanks where solvent is added and finally pumped to the coating troughs. The canvas cloth is passed through these coating tanks and a series of squeeze rollers at from 45

After impregnation and drying, new tent cloth passes through steam rollers (at top) and is ready for use

to 60 yards a minute. After the impregnating process, the cloth speeds through a drying tunnel some 60 feet in length which, incidentally, collects the vaporized solvent and returns it for further use. On the off-end of the machines, a series of steam cans removes the last trace of solvent and flows out the resinous coating in order to maintain a maximum sealing action.

GAS-TURBINE LOCOMOTIVE

Declared Now Ready For Practical Use

GAS-TURBINE locomotives now show sufficient merit to warrant serious consideration by forward-looking railroad engineers, Paul R. Sidler, resident engineer of Brown, Boveri and Company, Ltd., declared recently in an address before the American Society of Mechanical Engineers. He described operating tests for a period of a year on the Swiss Federal Railways, which constitute the basis of development of the locomotive type that is now offered to American railroads.

"This year of regular service confirmed the results of the earlier trial runs in regard to guaranteed performance," he declared. "All requirements have been fully met; no major disturbances of any kind have occurred. Minor adjustments could always be completed during scheduled waiting periods. Therefore, the availability record is excellent. The operating crews appreciate the simplicity of operation and the flexibility of the power plant."

This type of railroad power, the speaker explained, is designed primarily for long, high-speed runs with few stops, making possible comparison with the large Diesel-electric locomotives used by many carriers. The gas-turbine locomotive developed for American roads consists of a basic unit of 2500 horsepower which can be used singly or may be coupled in units of 5000 to 7500 horsepower.

Coupled to form a 7500 horsepower giant capable of speeds up to 75 miles an hour, the gas-turbine locomotive and tender are 198 feet long and weigh slightly over 1,000,000 pounds. Fuel consumption at full load is 800 gallons of bunker C fuel oil an hour. Starting is achieved by a Diesel-generator group, the entire process taking only about five minutes.

New Products and Processes

SPLINED NUT

Useful for Attaching Accessories

A SPLINED type Rivnut suitable for use in wood, plastics, leather, hard rubber, or other material where it is necessary to anchor a nut firmly for attaching accessories is announced by The B. F. Goodrich Company. This type is an addition to the regular line of Rivnuts now being adapted for use in many fields, including aircraft, automotive, refrigeration, and electrical equipment.

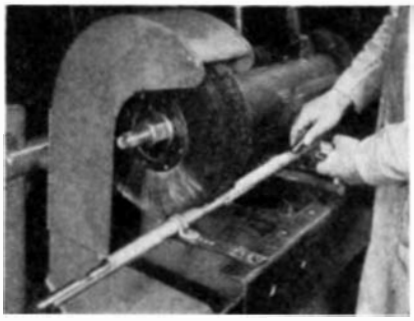
In the new type, splines beneath the countersunk head supply resistance to torque, while the bulge or "upset" which forms below the end of the splines furnishes the tension resistance. The splined Rivnut is thus locked into place two ways. Internal threads left intact within the shank take an attachment screw for installation of accessories.

FAST FINISHING

Of Metal Parts by Use of Special Fixtures

Two shop-made holding fixtures that provide power brushing with a new and effective means for fast output of properly cleaned and deburred metal parts, were recently reported to The Osborn Manufacturing Company.

One is a hand-made pair of forceps for holding tiny splines against a brushing wheel for removal of burrs and other surface irregularities. The use of



Two simple fixtures for power brushing. Above: A pipe holds threaded studs. Right: Forceps grip small parts

different sized holding heads makes this idea applicable to various sizes and shapes of parts to be brushed.

The other shop-born idea is for stepping up production in power-brushing threaded studs. This holding fixture employs a pipe placed at a level which enables it to employ gravity as an aid in the feeding. Opposing the gravity is a small side brush which extends through the pipe opposite the brushing wheel. When the threaded stud reaches this opening and comes in contact with the power brush, it also engages the small side brush. Since the power brush rotates the threaded part, it follows the course of the threads from one end to the other and controls the time the part is in contact with the brushing surface.

If the part being brushed is made of soft material, the pipe could be of plastics or other composition. This would avoid damage to the external threads as they pass through.

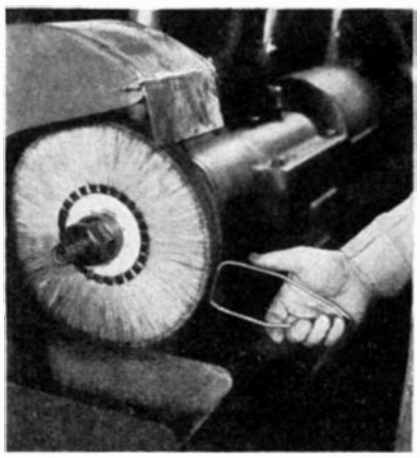
RECTIFIERS

Made of Selenium, Have Many Advantages

PROGRESS in the development of selenium power rectifiers for converting alternating to direct current on large aircraft is reported by A. L. Embry, design engineer of tungar and metallic rectifiers for General Electric.

Many of the large planes of the future will have auxiliary power generated as A.C. but considerable amounts of D.C. power will still be required, Embry says. The selenium rectifier will, therefore, have a wide field of application, he states. It has several advantages as a means of conversion: It does not have the high voltage drop of an electronic tube nor the moving parts and brushes of a rotating machine; it is simple, reliable, and easy to maintain; for three-phase power input it can be designed for 85 percent efficiency; weight of a complete unit, including transformer and voltage regulating equipment, compares favorably with that of a motor-generator set of the same rating.

According to Embry, selenium rectifiers can be used with transformers to obtain any desired output voltage. Input may be single phase or polyphase. The widest present application is for 28.5-volt D.C. units with three-phase

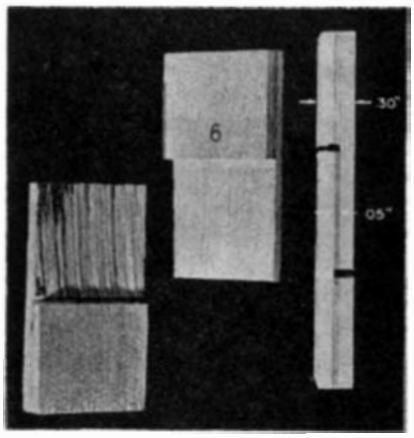


input. He says that for some applications where the D.C. load is substantially constant it may be practical to use selenium rectifiers without voltage regulation. Such rectifiers may be designed to operate directly from the A.C. line or with a suitable transformer to provide any desired direct voltage.

RESIN ADHESIVE

Made Craze-Resistant For Wood Assemblies

A CRAZE-RESISTANT urea-formaldehyde resin adhesive that offers improved bonding for intricate wooden parts where the application of high pressure to secure a uniformly thin, durable glue



A plywood shear specimen, with Urac glue line .05 inch, before and after. Note high percentage of wood failure

line has heretofore been extremely difficult, has improved features for low-pressure wood assembly work in the aircraft, furniture, automobile, marine, woodworking (including lumber lamination for wooden structures and buildings), sporting goods, and musical instrument industries. It greatly reduces the problem of crazing or fine cracking of the glue which causes deterioration of the glue lines.

Other advantages of the new adhesive, named Urac 183, over present craze-resistant adhesives, are stated by the American Cynamid Company to be: (1) greater storage stability; (2) elimination of amylaceous fillers; (3) control of glue-line pH to values acceptable under U. S. and R. C. A. F. specifications; (4) lower cost; and (5) provision of Hardener system for summer temperature use.

With Urac 183 in low-pressure bonding, glue line thickness up to .020 inches may be tolerated. This is of particular value in low-pressure assembly gluing where complex shapes prohibit perfect joining and high pressures are not applicable to insure uniformly thin glue lines.

SENSITIZED PLYWOOD

Makes Possible Highly Accurate Templates

PHOTOGRAPHICALLY sensitized plywood has been put to work in the design and tooling rooms of a leading aircraft manufacturer. Both interior and exte-

rior (water-proof) types of plywoods from one eighth of an inch to two inches in thickness are used for wiring boards, templates, form blocks, instruction boards, display photographs, and a multitude of other uses.

Douglas fir and maple plywoods are used most commonly and these are sensitized with a liquid-type photographic emulsion directly on either the unpainted or painted surfaces of the wood. A preliminary coat of white paint improves the contrast and makes reading easier. Plywood templates are particularly advantageous in the production of new experimental models as they give accurate information and quickly are converted into assembly jigs by attaching maple blocks and fixtures which are used to locate and hold the parts. The process is described by an engineer of the Boeing Aircraft Company as follows:

Liquid photo emulsion is applied to the surface of the plywood by using a paint spray gun, the interior of which has been chrome or silver-plated to prevent contamination from the brass parts in the gun. Actual spraying is carried on in a standard spray booth which is located in a ruby-lighted room.

Plywood templates are reproduced with a huge photo template camera by projecting glass plate negatives, previously made by photographing master layout drawings. The master layouts are hand-drawn on large lacquered steel sheets. When a draftsman has completed a layout it is photographed by the precision template camera at one-fifth the scale of the original drawing. A glass negative is used so that there will be no shrinkage or distortion.

After exposure, the glass negative is processed, dried, and placed back in the camera. A projection light is moved into place and the image is projected on a sensitized sheet of plywood to the exact scale of the original drawing.

SUPERCHARGING

Now Used On Gas Engines

SUPERCHARGING of gas engines and instantaneous conversion from the use of either oil or gas fuel is a new development announced by The Cooper-Bessemer Corporation. The new development is said to accomplish the following improvements:

1. In the oil field, it will make possible use of supercharged engine of the gas-Diesel principle in the drilling of deeper wells which predominate today. For example, at the beginning of a drilling project the operator could use oil as fuel in the absence of a ready supply of gas. The engine could be converted instantly to gas while under full load.

2. In oil and gas pipelines, in addition to affording greater economy in operation, either gas or oil could be used for engine operation, depending upon availability of the supply and relative costs.

3. In oil field central pumping plants, it should be an important factor in increasing the economy and movability of these plants which are moved from one point to another as they complete their operations.

4. Stationary power plants will profit from the new development through concentrating the greater horsepower of the supercharged engines into less space than was necessary heretofore. This materially reduces building and foundation costs.

INTERFERENCE

Reduced for Airplane and Automobile Radio Receivers

ENGINE ignition static, the foremost interference in aircraft and automobile radios, can now be completely eliminated without reducing engine operating efficiency, it is claimed, by means of a new-type ignition system invented by Victor Welge, an electronics expert for Consolidated Vultee Aircraft Corporation.

Previously, there was no satisfactory method of cutting out engine noises in aircraft radio sets and, consequently, aircraft radio communications were often difficult to understand. Suppressors made automobile radios function with considerable clarity, but these units could not be used in airplanes because they reduced ignition efficiency.

Welge's ignition system is simply a new method of wiring and shielding. Its purpose is to confine radio-frequency disturbances to an engine by providing an isolated return path for

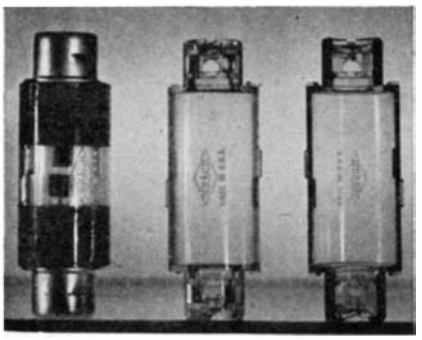
the sparking current which ignites gasoline in the engine cylinders. Engineers report that, besides eliminating the engine noises in aircraft radios, Welge's ignition system operates with unprecedented sparking efficiency.

LIGHTNING ARRESTER

Has Strong and Transparent Plastics Cover

RARE GAS lightning arresters for fire alarm and telephone and telegraph circuits are now protected by housings of transparent Tenite plastics. Molded in two halves, the housing fits around the cartridge and fastens by means of interlocking lugs produced in the mold. The two metal ends of the cartridge are slipped on over the Tenite housing.

In the presence of lightning or high-voltage circuits, the glow which indicates proper functioning of the arrester is clearly visible through the plastics. The electrodes are sealed inside and kept free from atmospheric conditions, dirt, insects, and other maintenance problems.



Transparent lightning arresters

BIGGEST TIRES

Now Constructed from Synthetic Rubber

CONSTRUCTION from synthetic rubber of the world's largest tires, each with 140 times as much rubber as the average passenger car tire, was accomplished recently. Weighing more than most automobiles, the giant tires are used on earth-moving equipment needed in the construction of military airports and highways. Because the tires must support the equivalent of up to 24 large truckloads of earth and often must operate in rocky areas, they must be particularly resistant to cutting, impacts, heat, and separation of plies. These are the four worst enemies of synthetic rubber tires.

The Firestone Company solved the impact problem by a special cord construction; the cutting problem by mixing new strengthening materials into the synthetic rubber; the heat problem by using rayon cord and an improved synthetic rubber compound; and the adhesion problem by using a hair-thin layer of natural rubber between the plies or layers of the tires.

The great size of these tires is necessary so that they will not sink into mud when weighted down with their heavy loads. The largest earth-moving tire is 9½ feet high.

This giant, cured in the world's largest tire curing equipment, is more than three feet wide. The area of it in contact with the ground at any one time is 1303 square inches—as large as a dining room table. One of these tires contains three miles of piano wire, and its tread is more than five inches thick. The tire has 34 plies, in contrast to the four plies used in most automobile tires, and can carry a load of more than 50,000 pounds.

LIQUID INSULATION

Guards Electric Circuits Against Corrosion

CREATED to provide lasting protection against moisture, weather, battery acids, and corrosion, a new liquid insulation can be easily applied with a brush or spray to any piece of electrical equipment. Known as PiB, the insulation, when applied to a wet or drowned-out ignition system, will enable the motor to start instantly, it is said.

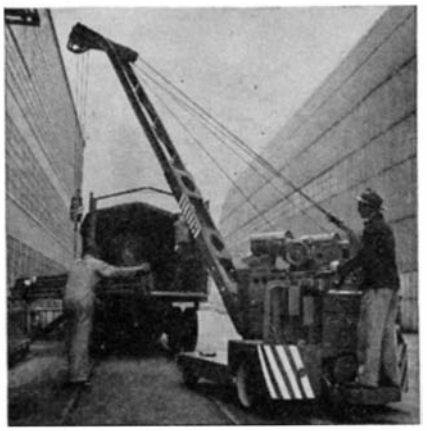
When applied to the cable, posts, and top surface of a battery, PiB will stop the formation of corrosion and eliminate short circuits across the top of the battery. It is also effective in waterproofing motors and transformers, generators, or other electric circuits subject to corrosion or condensation.

VISIBILITY

Of Mobile Equipment Increased with Stripes

CAMOUFLAGE to conceal fighters and their equipment in battle zones has been raised to a science, but in factories the opposite of camouflage—visibility—is the much-desired goal and safety engineers are studying ways of protecting men and machines by revealing their presence and movements.

The illustrations show a simple but effective method which safety engineers use for increasing visibility of mobile equipment by applying contrasting color combinations of stripes or bars. In one, an Elwell-Parker fork truck is shown tiering bundles and boxes of carton paper in a Michigan plant; in the other, an Elwell-Parker crane is lifting a heavy load of steel bars in an Ohio aircraft factory. Although a standard color for such equipment is a bright yellow, engineers in these plants have applied the stripes and bars to their fleets of these trucks as an additional safety measure. Luminous paint has been suggested and applied in some instances to trucks used in dim light and hazy atmospheres.



Stripes increase visibility

Safety-striped fork truck

GLASS HANGARS

Shelter Warplanes At Advanced Bases

GLASS cloth, woven of glass fiber yarns and coated with synthetic rubber or resin, has been selected by the United States Army Corps of Engineers for curtains, side walls, and ends in newly developed airplane hangars installed at advance Army Air Forces bases. Structural steel frame work and coated glass cloth are shipped to advance bases where the hangars are assembled for the A.A.F. Use of coated glass fabric for sections of hangars saves a great amount of shipping weight and speeds assembly of the hangars.

Glass cloth, made by the Owens-Corning Fiberglas Corporation, was selected because of its resistance to the effects of mold and fungus, high strength in proportion to its light weight, and ease of handling to fit around plane fuselages. Canvas duck, previously used, was subject to rot from tropical dampness and would not withstand fungus attack. In Arctic regions, canvas would become semi-rigid due to the extreme cold. Glass cloth has good weathering properties and is not affected by tropical heat or Arctic cold. Coatings used on the glass cloth include neoprene and vinyl compounds.

PAINT ON ALUMINUM

Made More Lasting by New Preparatory Method

ALUMINUM and its alloys can now be quickly and economically prepared for painting and lacquering with excellent adhesion and corrosion resistance qualities. The application of this surface preparation can be done either in the shop as a hot immersion process, or, when in the field, by cold-spray, brush, or immersion. The hot-immersion method consists of dipping the work for from three to 30 minutes in

a hot chemical solution, then rinsing and drying, after which it is ready for painting or lacquering.

The cold-spray, brush, or immersion method consists of applying a chemical solution (at room temperature), allowing from 15 seconds to one minute for setting, then rinsing the surfaces free of the applied solution. The work is then dried and is ready for painting or lacquering.

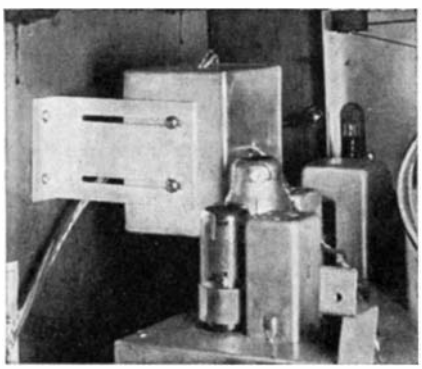
Both methods are reported to be excellent for paint and lacquer adhesion, and in many cases may replace the sand-blasting or anodizing of aluminum surfaces.

FM CONVERTERS

Will Enable Older FM Sets To Tune In On New Bands

Two CONVERTERS developed by the Hallicrafters Company will permit the reception of FM stations in the proposed new band between 84 and 102 megacycles on pre-war FM receivers built for the old band of 42 to 50 megacycles. These converters were designed and built at the request of the Federal Communications Commission after a Hallicrafters' representative had testified before the Commission that such devices could be used to prevent obsolescence of pre-war sets in the event of a change of FM frequencies.

The single tube converter is designed for use in primary service areas where signal strength is high and the principal considerations are appearance and convenience. It is small enough to go



One-tube FM converter installed in a typical pre-war console radio set

inside the cabinet of practically any FM receiver and will not interfere in any way with normal operation. A switch on the front panel of the receiver permits the converter to be connected or disconnected and selects the two frequency ranges, 84-92 and 93-102 megacycles. All tuning is done with the regular receiver dial. During the period when FM stations are being changed over to the new frequencies, a receiver provided with this converter will be able to listen to stations in both the new and old bands by merely switching the converter in or out.

The three tube converter, which includes its own power supply, is intended for use where signal strength is low and high performance is the prime necessity. This converter is equivalent to the first two tubes of a normal broadcast receiver designed for these frequencies, and will give comparable performance. It is provided with its own tuning dial. When connected to a pre-war FM receiver, the receiver must be tuned to 42 megacycles and the stations in the new band tuned in on the converter.

PHOTOMETER

Analyzes Metals by "Reading" Spectrograms

An ELECTRIC device that analyzes the composition of metals by "reading" a photographic plate of the metals' spectra, thus indicating the strength or resilience of alloys, is reported by General Electric. Such analysis is of great value to engineers for telling them the maximum endurance of metals used in various kinds of equipment, and the process is considered an important step in the manufacture of a great deal of war material.

Analysis of metals is made by the new device—called the transmission photometer—in combination with a spectrograph. In the process the spectrograph takes a picture of the spectrum of the metal, the resulting image showing the wavelengths of the components arranged as a series of lines. Measuring the densities of these lines to determine the concentration of materials in the metal is where the transmission photometer makes its contribution.

One of the newest and most important application of the transmission photometer is in analyzing the cemented tungsten carbide core of a recently developed armor-piercing projectile. Function of the photometer in this process is to make certain the cemented tungsten carbide, considered the hardest metal made by man, contains the proper proportion of components.

Since the areas involved in reading a spectrograph are extremely small and the variations in density very minute, even the most careful and experienced operators are unable to read the plate density directly, as the transmission photometer does. The photom-

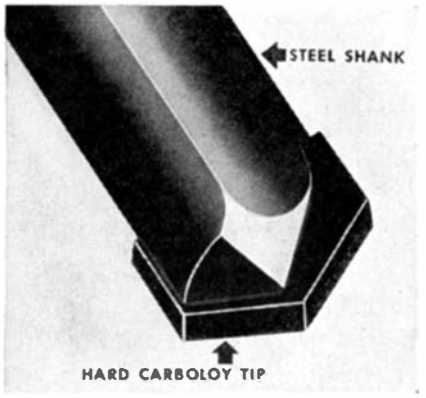
eter reads the spectrographic plate by measuring the intensity of the light transmitted through the plate. In this way it determines the concentration of materials in an alloy with great accuracy and much more quickly than was previously possible.

CONCRETE DRILLING

Speeded by Use of Cemented Carbides

THE THOUSANDS of conduit holes required in concrete ships such as "floating ice-boxes" are now being drilled ten times faster than was previously possible. This is made possible by a new type of masonry drill tipped with Carboloy cemented carbide. Each concrete ship requires some 4000 holes from 1 inch to 2½ inches deep for electrical installations alone. Total number of holes drilled per ship is much higher. Ordinary star drills were employed at the start of the contract, but, in an effort to speed drilling and save maintenance time, Carboloy drills proved so successful that they were adopted as standard.

Secret of the new masonry drill's ability to cut holes through concrete faster than any other available tool lies in the blade inserted in the drill's tip. This blade is made of Carboloy cemented carbide, which is so hard (approaching the diamond in hardness) that it easily cuts through concrete, making possible the drilling of holes and doing away with the prolonged hammering customary with regulation star drills.

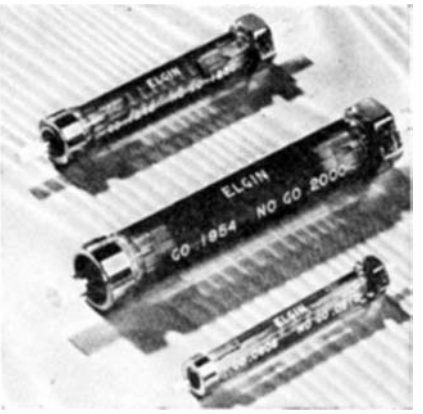


Inserted tip drills concrete fast

PLUG GAGES

Are Fitted with Plastics Handles

HANDLES of sapphire plug gages are now made from hexagonal Tenite rod stock produced by continuous extrusion. Exceptionally light in weight, Tenite makes for a sensitive touch and fine gaging. The plastics is low in thermal conduetivity and does not readily transmit heat from the operator's hand to distort the accuracy of the gage. Since both the Tenite and sapphire parts are non-magnetic, the gage may be used without interference near magnetic chucks and steel gaging members.



Tenite, a cellulose acetate butyrate plastics, forms plug gage handles

Sapphire plug gage handles are manufactured by cutting the hexagonal Tenite rod to the proper length, drilling, threading, and slotting the ends to receive the sapphire gaging members. It is possible, because of the resilience and toughness of Tenite, to secure the sapphire parts to the handle by means of a split threaded bushing with locking nut. Lettering and gage specifications are engraved on the handle.

SUNLAMP

Tans Quickly, Fits Ordinary Socket

A SUNLAMP manufactured by Westinghouse can be screwed into any regular light socket operating on standard alternating current.

Engineers claim that only five minutes' exposure is required to mildly redden the untanned skin of a person of average complexion who basks 24 inches from the lamp. To get an equivalent coloring one would have to sit under a July sun for 15 minutes.

Resembling the reflector floodlamp used for show window lighting, the streamline sunlamp emits both invisible ultra-violet radiations of the type known as erythemal energy and infra-red rays, likewise invisible, which provide cozy warmth. A special glass bulb is employed to transmit the ultra-violet and infra-red rays as well as a flood of visible light rays. The ultra-violet is generated by an electrical discharge through mercury vapor. The infra-red is supplied by a tungsten filament inside the bulb—operating at incandescence—which doubles as a "ballast," eliminating the need for the transformer.

Borrowing a principle from the sealed beam automobile headlamp, the rear half of the bulb interior is coated with vaporized aluminum to provide a reflecting surface which insures a high ultra-violet output for the 275-watt lamp's average life of 400 sunbaths.

NEW PEN

Has Ball-Bearing Point, Uses Viscous Ink

USING a miniature ball bearing as its writing contact and viscous ink, a new writing instrument which rolls the ink onto the surface dry, instead of inscribing it wet with a pen point, has just been announced.

The new pen operates on the principle of capillary attraction. It writes with greater ease than the smoothest lead pencil; writes on cloth or paper submerged in water or in an airplane at the ceiling of stratospheric air travel without leaking; writes on glossy paper, soft paper, blotting paper, or cloth without spreading. The ink, being rolled onto the paper or other material, dries as soon as it meets the surface.

Its miniature ball bearing writing contact will write in hair-line or in bold and heavy strokes. It is claimed that the pen cannot leak or drip and that ink cannot be shaken out of it.

The ink cartridge of the pen can be made large enough to contain at least a year's supply—enough for 257 continuous writing hours—and can be replaced with another cartridge in 20 seconds without staining the fingers.

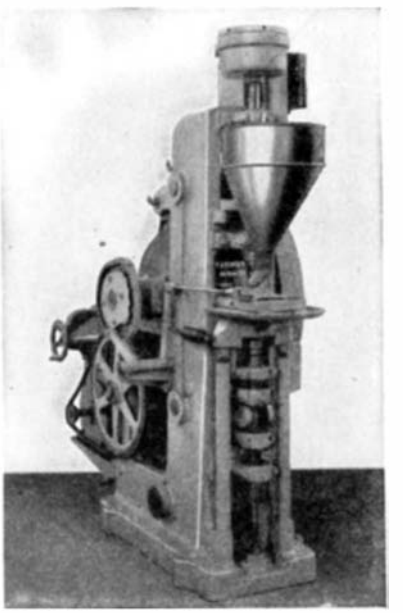
POWDER-METALS PRESS

Quickly Forms Wide Range Of Small Parts

FOR high-speed production, up to 45 strokes per minute in automatic operation on the usual run of work, and to operate also as a start-stop press in making parts with inserts, a new powder-metals press is of 12 tons capacity and of design similar to a model which has been in wide use for many years.

This press is recommended for making small machine parts such as gears, internally or externally splined bushings and ordnance components, carbide tool bits and drawing dies, carbon brushes, brushes with pig-tails and iron cores with threaded shafts molded in place, and many other similar parts.

As a start-stop press the operator simply places the insert in position and pushes a button; the press measures the charge in the usual manner, compresses the material around the insert, and ejects the finished piece, leaving the punch in the "up" position for the next cycle.



High speed powder-metals press

The machine is cam operated, with independent cam control of both upper and lower punch movements. The die table is braced to take the full rated tonnage of the machine, and pressures applied through the punches may be simultaneous or non-simultaneous. An independent secondary lower punch applies pressure up to 2½ tons and may be used as a fixed core rod. The upper punch will stay out of the way during nearly a third of the cycle, to facilitate feeding, and is timed to first descend rapidly and then slowly compress the material with controlled motion. A built-in hydraulic equalizer assures uniform pressure and more uniform density of each piece.

This press, which has a maximum die fill of four inches, is made by F. J. Stokes Machine Company.

HAND TRUCK

Upends Heavy Barrels With Ease and Safety

A BARREL upending truck manufactured by the Colson Corporation makes the handling of heavy barrels safe and

One step in upending a barrel

relatively effortless. In operation, the truck places two hinged lifting arms under the barrel so that when the operator places his foot on a step and pulls back on the handle, the hinged arms contact the barrel side in three successive steps while a fulcrum point slips under the load. The barrel is thus lifted in easy stages until it is upright. A slight forward push then sets the barrel safely on end.

ELECTRIC METERS

Sealed to Withstand Temperature Extremes

BY BUILDING the mechanism of electrical indicating instruments into a protective cup-like frame, and then sealing the glass cover to the metal rim, positive hermetic sealing has been effected with a minimum number of seals. There are no rubber gaskets or cement seals. Tests have proved the effectiveness of the new type of sealing under severe tropical and freezing conditions. The instruments, made by the Marion Electrical Instrument Company, can be immersed in boiling brine solution for weeks, or frozen to minus 40°, Fahrenheit, without deterioration of the seals. This sealing process was developed and perfected in co-operation with the engineers of the Corning Glass Company.

The glass covers employed are of double thickness tempered glass, processed for solder sealing, and are highly resistant to shock. Completely dehydrated, the instruments are filled with dry air at sea-level pressure. A newly designed crowned crystal permits greater scale length, reduces shadows, and makes for better visibility. Magnetic shielding makes possible interchangeability on any type of panel without affecting calibration.

CONVEYOR

Offers Extreme Flexibility of Operation

THE DEVELOPMENT of an entirely new type of conveyor, designed to handle bulk materials in a horizontal run-around path, within minimum headroom, is announced by Link-Belt Company. This "Sidekar-Karrier" provides conveyor storage for materials that are to be discharged simultaneously in varying quantities at a number of points.

The conveyor is self-feeding from any one of many feed spouts which may be located above its horizontal run-around path of travel, and self-discharging to any number of points, thus permitting continuous automatic operation. Any surplus material that is still left in the conveyor buckets after they have served the several discharge

Bucket conveyor for bulk materials

points will remain in the buckets, to be recirculated.

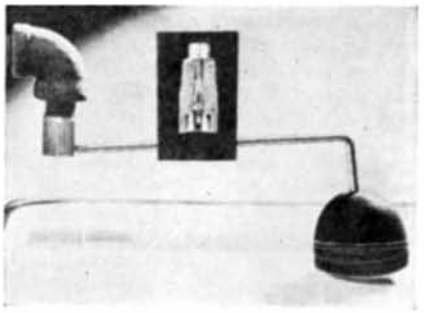
The design is such that two or more materials can be separately fed to the conveyor with the assurance that the admixture will not be disturbed in transit, and that it will be delivered to any predetermined discharge point in exactly the same mixed proportions as prevailed at the feed points. The conveyor spouts are self-cleaning.

FLOAT VALVE

Utilizes Mechanism of Tire Valve Core

FOR USES where a constant supply of fresh water must be maintained in pans or tanks, the new Simplex automatic water float valve fills a need for low cost, positive control of water level. It is designed for use by poultry men, stock men, pet fanciers, scientists, and experimenters, and for many household applications.

The valve body is turned from dural stock, anodized to prevent corrosion



Inset: Tire valve for water control

under all conditions. The valve mechanism itself is an automobile inner tube valve core. Since these are stocked at all gas stations, cores can be readily replaced when necessary. The intake vent of the valve body is located above the settling line to prevent clogging. In addition, when the valve is opened, the end of the valve core needle extends slightly above the intake vent to dislodge scale or sediment.

FIRE-REPELLENT PAINT

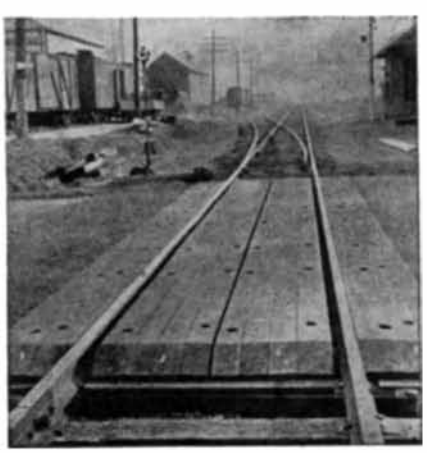
Reduces Hazard to Combustible Surfaces

A PAINT which protects wood and other materials against fire hazard, announced by the General Detroit Corporation, is endorsed by Underwriters' Laboratories and other leading testing bureaus for protection of interior combustible surfaces. Known as Fi-Repel, the new paint is made for use in factories, warehouses, hangars, garages, schools, hospitals, hotels, homes, and wherever else fire protection is necessary. It is shipped as a concentrated paste. After dilution it can be applied with a brush or spray gun to the surface to be protected. One concentrated gallon, at standard dilution, will cover as much as 185 square feet with two coats. Standard color is bone-white, but tints may be easily added.

GRADE CROSSINGS

Of Creosoted Wood Assembled in Factory

FACTORY-ASSEMBLED grade crossings of pressure-creosoted wood, ready for quick installation, are a new prefabricated product for the railroads. Com-



Complete crossing, factory assembled

plete crossings are constructed of select hardwood in panels about 2 by 8 feet and 5⅛ inches thick. The timbers are machined to proper shape, pressure-treated with creosote against decay, and tightly assembled into rigid panels with spiral dowels which grip along their entire length. This construction is said by its designers, the Koppers Company, not to be affected by vibration, swelling, or shrinking of the wood and to distribute highway wheel loads over the panel.

Individual panels are light enough to be installed by hand. They can be removed during track repairs and relayed without being damaged. For rails up to 110 pounds the panels are attached directly to existing ties. For rails 112 pounds or heavier, shims are attached between the crossing panels and the ties. Panels are attached to ties with lag screws.

PORTABLE LUBRICATION

Unit Speeds Servicing of Industrial Machinery

DESIGNED to provide a complete, compact, portable lubrication department for industrial plants, that can transport and dispense a variety of grades or types of lubricants, a new Lubrikart has just been announced by the Alemite division of the Stewart-Warner Corporation.

The new unit, mounted on five-inch ball-bearing casters, is only 21 inches

Complete, portable lubrication unit

wide. It is 31 inches long and 37½ inches high. Pushed like a perambulator, it is intended for one-man operation and is able to travel between rows of machines or elsewhere in a plant where space is limited.

The Lubrikart comes in two models, one of which carries two seven-gallon tanks equipped with low-pressure pumps and five and a half foot hose and non-drip nozzles for filling oil reservoirs on machines or hydraulic systems, and for filling gear housings; one seven-gallon tank with high-pressure pump for loading handguns; two one and three-quarter gallon tanks with oil transfer pumps for filling oil cans; six spout-type oil cans; and four lever-type handguns. There is also space for waste, replacement fittings, small tools or other material.

The second model has, in addition to the foregoing equipment, a high-pressure, hand-operated grease pump which holds 30 pounds of lubricant and has a five and a half foot lubricant hose fitted with a hydraulic coupler. This pump develops up to 7000 pounds of pressure per square inch, and can be lifted clear of the cart and carried to point of use, if desired. All pumps, loaders and transfers are manually operated.

HIGH SPEED PRESS

Molds Rubber Parts With Reduced Curing Time

RUBBER is now molded on a small high speed press by a new method utilizing an electronic heating device. The method, which is said to effect a substantial reduction in curing time compared with conventional equipment, is an offspring of the Baldwin Locomotive Works "Hyspeed" plunger molding press for plastics, announced some time ago.

The additional adaptation of the press for rubber provides economy of operation and maintenance, according to its designers. The press operates with a smaller number of cavities than are used in the conventional rubber molding presses. Yet, due to its high speed, it can produce the same number of products as larger conventional presses. Thus there is a savings in molds and maintenance, plus conservation of dies.

The new method is capable of molding all kinds of mechanical rubber goods, plumbers' supplies, and other items where cavity-molding is needed.

While this new method can be used without preheating the material, a still further increase in production may be obtained by using electronic radio frequency heating where possible. These radio frequency generators were developed by Westinghouse for use in conjunction with Baldwin's new press.

FERTILIZER

Made from Waste Of Plastics Plant

CONSTRUCTION of a non-profit ammonium sulfate plant to transform industrial acid waste into much needed fertilizer and designed to help reduce pollution of the Delaware River has recently been announced by the Rohm and Haas Company.

The waste materials came from the manufacture of Plexiglas, a transparent plastics. It was foreseen by research

chemists that Plexiglas would play an important war role, particularly in the aircraft field. Realizing that the acid residue from this manufacture might become a factor in river pollution, a research program was instituted on the utilization of the residue, resulting in the recovery plant now in operation.

A 300-acre farm which adjoins the plant property was the testing ground for the fertilizer, and hundreds of tons of this material are now being shipped to fertilize other farms in Pennsylvania, Delaware, Maryland, and Virginia.

Ammonia is the principal ingredient needed to convert this waste into fertilizer.

PYROMETER

Is Encased in Plastics For Better Illumination

EQUIPPED with a re-designed plastics case, the new Cambridge surface pyrometer is much easier to keep clean than the earlier metal-encased model and is corrosion free. The plastics case also simplifies electrical insulation problems and makes possible mechanical improvement.

In the new model an unbreakable Lucite window replaces the usual glass pane and extends over the top of the instrument, enabling the scale to be better illuminated and permitting more accurate temperature reading. These pyrometers are widely used to measure the temperatures of moving, still, flat, or curved surfaces in the rubber, plastics, paper, and metal working industries.

RUBBER STENCIL

Used in Stone Carving By Sandblast Method

THE WORK of inscribing names on headstones has been made easier by the development of a rubber sandblast stencil sheet. Until a few years ago the only way to do the job was for a skilled workman to cut the inscription with hammer and chisel. Then came the thought of stencils to make the work quicker and easier, but the difficulty was in finding a material tough enough to remain firm and whole under the high-pressure blast of the sand. After much experimentation, rubber was found to be the best material.

Such a stencil was developed by The B. F. Goodrich Company. It had to have many special properties. Not only did it have to be tough enough to withstand the blast of the sand, but it had to cut easily so that the stenciled lettering and designs would have smooth, sharp edges. It also had to have an adhesive surface on one side to adhere to the stone. Such adhesion had to be strong enough to hold tight and at the same time adhere lightly enough to strip cleanly away from the stone after the work was finished.

Before the war these stencil sheets were made of natural rubber. Now they are made of synthetic that is supplied in rolls of 50 yards, .051 inches thick. The stencils are being adapted to many other types of work.

Sandblast stone carving is made simple by use of a removable rubber stencil

MEGATHERM

Has Detachable Oven Equipped with Window

PORTABLE and of compact design, a new Megatherm for high-frequency heating of a wide range of dielectric materials has been developed by the Federal Telephone and Radio Corporation. Contained in a modern streamlined reinforced steel cabinet, standing 42 inches high, this one kilowatt model occupies a floor space only 20 by 24 inches, and is mounted on smooth-running casters furnished with a special lock-down feature which secures the unit at any selected location. The detachable work oven is situated at the top of the cabinet, and is equipped with an inside light and window to permit the operator to view the work during the entire heating cycle.

Dielectric heater has oven on top

A foot-pedal switch opens the oven door, leaving the operator's hands free to insert the work in the oven. Application of power to the work is controlled by a simple single or double push-button located on either side of the cabinet. Duration of the heating cycle is controlled by a fool-proof automatic timer, permitting operation by unskilled and non-technical personnel.

The new Megatherm is suited for

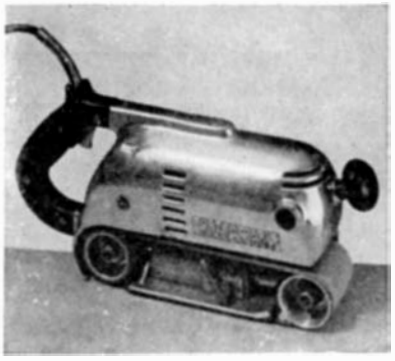
the preheating of plastics preforms, as a basic unit for incorporation into molding presses or into special production set-ups.

SURFACER

Increases Production by High Belt Speed

EASY to handle and light in weight, a new "streamlined" surfacing machine is designed for durability; its high speed provides faster surfacing.

The uses for these portable surfacers are almost unlimited. They are at work in metal and woodworking plants, pattern shops, maintenance departments, assembly lines, schools, boat building industries, and are being used for removing paint and refinishing numerous items, saving hand labor and with a



Light in weight for portability

speed that eliminates the use of many hands.

A three quarter horsepower motor drives the belt at a speed of 1600 surface feet a minute. Special features include: aluminum die cast frame; plastics handle; trigger switch in handle; and silent chain drive.

ROUGHNESS GAGE

Aids in Uniform Surface Control

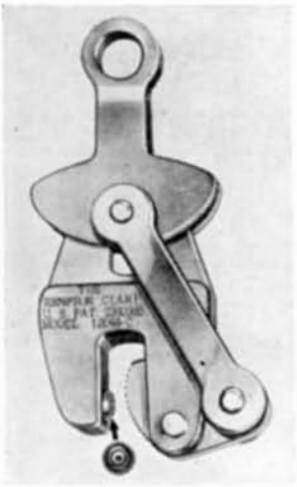
TO MAKE industrial surface control easier, a kit of roughness standards has been prepared with 20 replicas of machined surfaces bound in a 65-page educational text. The samples of machined surfaces were prepared by turning, grinding, milling, honing, lapping and polishing. They vary in roughness from 500 to 5 micro-inches. Made under the trade name Surf-Chek, the replicas are molded into a 5 by 7 inch plastics plate through the use of precise die inserts.

This new method of determining surface roughness eliminates guess interpretation, conveys the engineer's specific instructions to the machinist, and permits the making of rapid and efficient roughness comparisons without the need of special instruments.

CLAMP

For Lifting Steel Plate Has Safety Feature

AN ENTIRELY new clamp for lifting steel plate is now marketed under the name of Renfroe, by the Paul Henry Company. The use of a cable sliding through rings or guides to actuate the gripping cam is eliminated, which saves time required for inspection of cable. Through the action of the gripping cam shackle, the work is gripped



Cam shackle insures firm grip

instantly and firmly the moment tension is applied to the lift by the crane, even though the body of the clamp is in a horizontal position. The operator, therefore, does not have to hold tension by means of a cable, and stand in a dangerous position until the clamp starts to lift the work. In conjunction with the gripping cam, a swivel jaw is said to provide a deeper and more secure bite on the plate. Swivel jaw and gripping cam, and all other working or stationary parts of the clamp are readily replaced.

RESISTANCE WELDING

Reduces Air Drag On Planes in Flight

AN IMPROVEMENT in the method of fastening the skin of an airplane to its frame has greatly lessened the drag of air-flow over and around the plane. Instead of rivets, resistance welding is employed as the connecting medium, thus eliminating rivet heads. The sur-

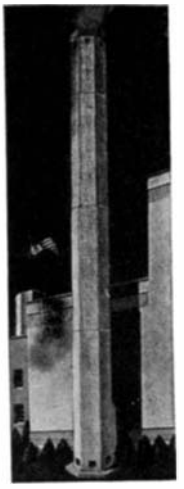
Welding airplane skin to frame

face is left perfectly smooth, allowing unobstructed flow of air over the outside surface of the craft. Other important advantages accruing from the newer method are reported. For example, fittings can be made smaller and lighter, because of the closer pitch permitted in spot welds.

STEEL SMOKE STACK

Has Insulated Lining To Improve Draft

OFFERING many advantages, a new "Durabilt" smoke stack consists of a hexagonal steel structure, adequately braced throughout its length to resist high wind load. shock, lightning, and earthquakes. Horizontal and vertical members are attached to the steel structure and these support anchor and tile-retaining castings. Each tile forming the inner wall is individually retained. The outer tile is supported by means of channels at definite spacings. Any section of tile may be independently removed without affecting the other.



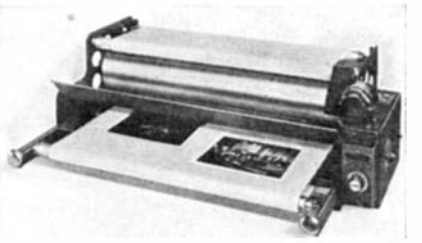
High efficiency insulated smoke stack

Insulation fits snugly and securely between the tile and retainer castings, providing low radiation loss and helping to keep temperatures within the stack uniform, thereby increasing efficiency by improving draft. The outer casing of the stack can be of tile, sheet steel, Transite, or water-proof material. Air space is provided between the insulation and outer tile throughout the stack. Vents are located at bottom and top. The Chicago Fire Brick Company is the manufacturer.

PHOTO DRYER

Designed to Process Prints Speedily

NOW available is a photo dryer which operates with additional electrical heating elements that assure maintenance of even heat. It quickly dries matte or semi-matte prints or glossy prints as well as blue or black-and-white prints. Thermostatic control may be had and variable speed drive motors and controllers permit instantaneous speed changes over a range of 6 inches to 3½ feet a minute.



Electrically heated photo print dryer

A chromium plated copper drum that finishes photos with high glossy surface is included. Steel-clad, refractory insulated, nichrome heaters, nickel contacts, and asbestos insulated nickel wire are used, forming a long-lived heating and control unit. The dryer, made by Peck and Harvey, comes in 26 inch and 44 inch widths.

NEW PLASTICS

Combined with Fabrics Make Strong Materials

A NEW family of liquid plastics has been developed by United States Rubber Company. Known as Vibron resins, the new materials, when combined with spun glass or other fabrics, have a great strength. Stronger building materials for prefabricated housing, stronger and lighter luggage, and lighter furniture impervious to dampness will, it is claimed, be possible by the use of these plastics. They will also permit reduced fabrication costs of numerous products because they do not require expensive and cumbersome equipment for their manufacture.

These resins may be combined with fabrics to make an improved type of artificial leather; with wood veneer to form decorative structural panels; and with paper for packaging materials. Decorative textiles may be treated to make slipcovers or other upholstery fabrics.

ELECTRIC SHEAR

Cuts Sheet Metal Accurately and Easily

LIGHT in weight and easy to operate, the Stanley No. 214 portable electric shear cuts 14 gage hot rolled steel and other sheet materials in proportion. First introduced for use in aircraft production, it has also proved its usefulness in many manufacturing plants and metalworking shops where sheet steel, aluminum, and galvanized iron are fabricated.

The shear has a simple blade motion that feeds in the work so that little

For quickly cutting sheet metal

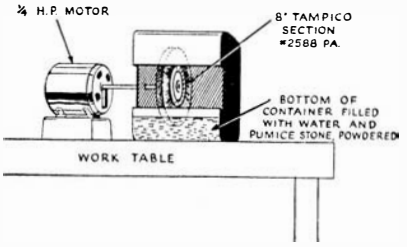
effort is required by the operator to cut straight lines, curves, angles, and notches accurately and without distortion of material. Blades can be removed easily for re-sharpening and replaced quickly. The duplex handle permits the operator to grip at a position most convenient for use.

POWER BRUSHES

Remove Excess Silver From Plated Watch Dials

Power brushing as a means of removing silver from watch dials following plating is enabling manufacturers to complete this operation in one sixth the time formerly required. Reports received from a Los Angeles watch dial manufacturer indicate that the use of power brushing in this operation is enabling watchmakers to accomplish more quickly the task of removing the excess silver from the dial without defacing or removing metal from raised numbers or other design figures.

Sand blasting, wire buff, or emery



Excess silver on plated watch dials is removed with a power-brush set-up

paper previously used occupied approximately three minutes per dial, it is reported. The operation is now completed in one half minute with power brushing.

The brush used, a product of the Osborn Manufacturing Company, is eight inches in diameter with an inside diameter of 3¼ inches and Tampico fibre sections approximately 17/32-inch in thickness. The dials are applied to the brush which is bench-mounted and operated by a one fourth horsepower motor. The buff revolves through a mixture of pumice and water.

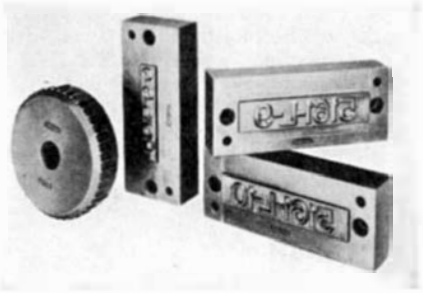
STAMPING DIES

Made with New Bevel For High Strength

Made from selected alloy tool steel, machined in such a manner as to utilize the "heart" of the steel where great strength is needed, and engraved with a new high-strength bevel, following the grain or flow of the steel, new stamping dies and roll dies are giving good results in hard service applications.

The roll die shown is for use in graduating scale bars used in the operating mechanism of a precision machine. By gearing with the slide carrying the scale bar as it is marked, the graduation markings are directed to the precision position required. The Acro-bevel die is so engraved as to withstand this gearing control.

The stamping dies shown are used in



Roll die and stamping dies

a press for full-depth sinking of the markings. Points of weakness in ordinary engraving are reported to be overcome by the technical advancement offered by Acro-bevel. In the case of a closed character or an unsupported part of an open character, for example, the new technique increases strength at that point to match the stress, thereby precluding premature breakage or wear.

CONDUCTIVE RUBBER

Tested With Simple Equipment

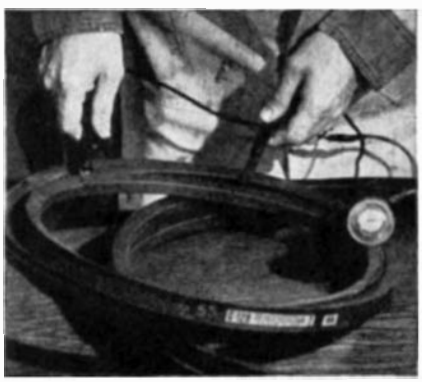
An easy method of determining whether any rubber V-belt, flat belt, hose, or other product is static conductive has been developed by technicians of The B. F. Goodrich Company, which recommends that all static conductive rubber belts be tested for conductivity at regular intervals of at least once monthly.

Static conductive rubber belts have proved valuable in many phases of war work, particularly in operations where a static spark might set off a fire or explosion. They also will have many other peace-time uses, including those on washing machines and other household appliances.

A simple assembly, using a five or six foot length of lamp cord with standard rubber socket plug, a two-watt neon bulb, two ordinary clamps or metal prongs, and two insulated handles can be readily constructed for the tests.

One of the wires of the cord is cut, the neon bulb connected in the circuit, the insulated handles installed near the end of each wire, and the prongs or clamps attached to the wires.

To make the test, part of the belt or other rubber product is moistened with water, leaving a dry section eight to twelve inches long between the moistened surfaces, the testing assembly is plugged into any 110-volt alternating



Testing conductive rubber belts

current line, and the clamps or prongs applied to the moistened surfaces, with the dry section in the middle. If the bulb glows, the rubber product is a static conductor.

The belt or other article under test must be suspended in the air between the clamping points, or rest on a non-conducting table or other surface.

RIVET GUN

Operates With One Hand to Install Blind Rivets

COMPACT and light in weight, a new rivet gun, the G-35, is designed for installing Cherry Blind Rivets in hard-to-get-at spots. It is operated with one hand—installs the rivet from one side of the job, with a pulling force—and eliminates the necessity of a man on the other side of the rivet.

The G-35 has already proved its ease

One-hand rivet gun

and flexibility of use in such industries as aircraft, sheet metal, radio, marine, railroad, automotive, and furniture. It installs blind rivets in sheet metal, plywood, rubber, plastics, and almost any soft or brittle material.

The gun is small, compact, flexible, measures only 11½ inches in length, weighs approximately 1½ pounds, is well-balanced for easy one-hand operation. The pulling head is notched so that it snaps onto or off the gun quickly and easily, allowing greater gun flexibility and quicker head interchange for holding any standard Cherry Blind Rivet—aluminum, copper, or steel.

PRESSURE SWITCH

Cuts Electrical Circuits In Case of Fire

AN ACCESSORY device recently designed for use with built-in carbon dioxide fire extinguishing systems assists in isolating the fire by automatically cutting off electrical circuits in fans, blowers, or other electrical equipment when the extinguishing system operates. It is a self-contained, mercury contact-type switch suitable for applications which employ gas or air pressure.

The Kidde pressure switch is connected by a bleed pipe from the main distribution line and is operated by the carbon dioxide in passing through this distributing piping to the discharge nozzles. The gas pressure actuates a plunger which trips the breaker arm of the switch, opening or closing the circuits desired. The device is available for control of two, three, or four circuits, each of which may be wired for normally open or normally closed operation. The pressure switch is provided with a manual reset to restore circuits to their original position after operation due to fire.

Current Bulletin Briefs

Conducted by K. M. CANAVAN

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

THE INFLUENCE OF MODERN GLUES ON THE UTILIZATION OF WOOD is a 17-page booklet based on an address by W. F. Leicester, President, Casein Company of America, which covers the technique of gluing of wood, plywood, lamination, modern glues, various resins, plywood tubes, using wood with other materials, and so on. Request Bulletin SAA. *Casein Company of America, 350 Madison Avenue, New York 17, New York.—Gratis.*

THE DI-ACRO SYSTEM OF DIE-LESS DUPLICATING is a 40-page booklet based on the latest models of precision machines for this work, including the use of Torrington roller bearings in all sizes of Di-Acro benders for increased capacity and ease of operation. The universality of this system will allow the machines to be readily converted from war- to peace-time production. *O'Neil-Irwin Manufacturing Company, Minneapolis 15, Minnesota.—Gratis.*

WHAT MAKES A GREASE is a 12-page pamphlet which deals in general terms with the qualities that should be inherent in an industrial grease, as well as those factors to be considered in selecting grease for a specific application. *Sun Oil Company, Industrial Products Department, Philadelphia, Pennsylvania.—Gratis.*

HIGH-VOLTAGE TEST EQUIPMENT, BULLETIN F, is based on information about several forms of high-voltage test equipment; also resistors which are available separately for use with suitable meters to permit measurements of potentials up to 200 kilovolts. *Shallcross Manufacturing Company, Collingdale, Pennsylvania.—Gratis.*

HYSTER LIFT TRUCKS is a series of four catalogs based on the applications and mechanical specifications of a complete line of pneumatic-tire lift trucks, gasoline powered. *Hyster Company, Portland 8, Oregon.—Gratis.*

Z-METAL is a four-page folder giving interesting and practical information on Z-metal chain belts and their applications. One of the characteristics claimed is its remarkable resistance to corrosion. Request Bulletin Number 460. *Chain Belt Company, Milwaukee 4, Wisconsin.—Gratis.*

SAFE PRACTICES AROUND CIRCULAR SAWS, SERIES B, is a set of six charts, each one containing an illustrated "Do" and "Don't" to avoid injury from circular saws. These charts are useful for employee training, educational programs, mounting on bulletin boards, and reproduction in safety training manuals. This is one in a series of 12 sets of Industrial Safety Charts. *Superintendent of Documents, Government Printing Offices, Washington 25, D. C.—Five cents.*

WHEELCO ELECTRONIC CONTROLS is a 12-page catalog describing an electronic principle by which control is effected without contact between measuring and control units of an instrument. Many items supplied by the company are included in a convenient, condensed listing. *Wheelco Instrument Company, Harrison and Peoria Streets, Chicago, Illinois.—Gratis.*

OIL REFINING is a 32-page technical and economic study of the development of oil refining from an elementary physical operation a generation ago to its present scientific status as one of the major chemical industries. The importance of petroleum as a raw material is emphasized. Fluid-catalytic cracking, thermal cracking, suspensoid cracking, and other basic processes are described. *The M. W. Kellogg Company, 225 Broadway, New York 7, New York.—Gratis.*

KLEM KLEANERS is an eight-page folder based on a step-by-step procedure to acquaint personnel with cleaning, derusting, phosphotizing, soldering, and maintenance processes. A layout chart of the concentrations of the cleaners for specific work and conditions is given. *Klem Chemical Works, 1500-18 East Woodbridge Street, Detroit 7, Michigan.—Gratis.*

THE STORY OF MUSIC-AT-WORK is a 16-page brochure tracing the story of music at work from earliest times to the modern planned programs being used today. The findings of government and college research into the results of planned music in factories and plants are given. *Director of Sales Promotion, Executone, Inc., 415 Lexington Avenue, 17, New York.—Gratis.*

WIRE RECORDING is a booklet, written in question and answer style, which deals with the many possible uses for this economical way of recording sound. *Lear, Inc., Home Radio Sales Division, 230 East Ohio Street, Chicago 11, Illinois.—Gratis.*

THE RADIAL ARM SAW WITH THE VERSATILE ELBOW is a descriptive circular announcing a saw which permits cutting a greater number of miters per hour than is possible with other saws and an attachment that affords three drill speeds, including 10,000 R.P.M. *Red Star Products Inc., 3455 Vega Avenue, Cleveland 13, Ohio.—Gratis.*

TEMPERATURE CONTROL CABINETS, Catalog 325, is a 48-page bulletin containing descriptions and photographs of various Freas constant temperature control cabinets and general information pertaining to mechanical and gravity convection heat transfer. *Precision Scientific Company, 1750 North Springfield Avenue, Chicago 47, Illinois.—Gratis.*

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the cooperation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want, and you will be furnished with the names of available books, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for. Books listed in these columns may be ordered from our Book Department. Add 25 cents per book for mailing outside U. S. All remittances are to be made in U. S. funds. Prices given are subject to change without notice.

TO MAKE CERTAIN that books ordered by or for men in the Army, located in the United States, or men in the Navy, Marines, or Coast Guard, located anywhere, will be delivered, insurance fees should be sent with orders, as follows: To $5 in value, 3¢ additional; from $5 to $25, 10¢; from $25 to $50, 15¢.

THE COMING AGE OF ROCKET POWER

By G. Edward Pendray

ONE of the early pioneers in rocketry, Mr. Pendray is also a member of that devoted group—the American Rocket Society—which has done so much to increase our knowledge of the subject. These experimenters have carried on with small funds, at considerable personal danger, and with exposure to the ridicule that so often attends the efforts of experimenters in a new field. The author of this book, an experienced and graphic writer, has given a splendidly accurate but non-technical account of the fundamental principles of rocketry. He deals with its many applications in ordnance, in gliders, in meteorological sounding, and in rocket-launching ships which are an indispensable part of our Pacific operations. Looking into the future, he visualizes rockets for carrying trans-oceanic mail and, perhaps, voyages to the moon. The facts are imaginatively yet carefully considered. Rocket propulsion undoubtedly has a great future, in both war and peace, and the present book can be recommended as one which answers many of the pertinent questions so constantly asked today. (244 pages, 5½ by 9 inches, a number of drawings and a group of photographs.)—$3.60 postpaid. —*A.K.*

SHALL WE SCRAP OUR MERCHANT MARINE?

By A. D. Rathbone, IV

IN AN easy, readable style, this author discusses the rise and fall of the great maritime powers of history. Beginning with the ancient Phoenicians, he carries us down through the ages, showing that these great nations held their supremacy in trade and wealth only so long as they maintained an adequate fighting navy to complement their merchant marine. He also points out that a victorious navy is dependent upon an adequate merchant marine to back it up. Citing examples in our own history to prove his thesis, he outlines the efforts of both the French and the British, especially the latter, to snuff out our merchant marine. This is a timely book, an invaluable book. Every library should have a copy for all to read. To every thinking American business man or industrialists it is a "must." (397 pages, 5½ by 8½ inches, unillustrated.)—$3.10 postpaid.—*W.D.A.*

SPLICING WIRE AND FIBER ROPE

By Raoul Graumont and John Hensel

HITHERTO an esoteric art known chiefly by experienced riggers, the splicing of wire rope can now be learned with relative ease by studying this excellent book. The growing use of wire rope in factories, oil fields, and shipyards, as well as in the haulage industries, makes a knowledge of wire splicing a valuable asset to men earning their living in these fields. The book describes and illustrates the entire range of wire and rope splicing and it contains many types of splices that have never before appeared in print. It would be a valuable asset to any industrial or technical library. (128 pages, 7½ by 10 inches, lavishly illustrated, indexed.)—$2.10 postpaid.

SCIENCE IN PROGRESS FOURTH SERIES

Edited by George A. Baitsell

MADE by the investigators themselves, here is a series of fascinating and informative reports on the latest developments in the nation's laboratories. The best scientific brains of the nation, many of whom are engaged in war work or on tap for consultation by the government, have contributed chapters, describing their work in pure science and how it is linked up both to the advances in daily living and the business of winning wars. Three sections of the book are the records of war research. These are "Psychological Aspects of Aviation," by Walter R. Miles, "The Physical Structure and Biological Action of Nerve Cells," by Detlev W. Bronk, and "Blood and

Blood Derivatives" by E. J. Cohn. This book is a must for the serious student of science. (331 pages, 6 by 9 inches, many illustrations, index.)—$3.10 postpaid.—*J.C.*

AVIATION RADIO

By Henry W. Roberts

IN AN introduction written by Dr. Lee de Forest, that grand old man of the vacuum tube, the statement is made that the author "goes into details of absorbing interest, items which his long personal experience has especially fitted him to outline and discuss." Covering the entire field of aviation radio, by which the airplane has been given eyes, ears, and voice, the text is divided into five parts: Understanding Aviation Radio; Primary Radio Facilities; Advanced Radio Facilities; Radio Navigation; and Aviation Radio Apparatus. Fundamental principles are dealth with clearly and concisely, furnishing adequate background for detailed study of equipment. The coming of peace will bring tremendous expansion in aviation radio, and this book will serve as a text for those who want to make it their life's work. (637 pages, 6 by 9 inches, over 465 illustrations, five appendices.)—$5.10 postpaid—*A.P.P.*

EBULLIOMETRIC MEASUREMENTS

By W. Swietoslawski

DESIGNED to make available to physico-chemical researchers, teachers, and students a comprehensive description of the ebulliometric method for measuring the boiling and the condensation temperatures of liquids and solutions, this book ably achieves its purpose. These measurements have found large application in ascertaining the degree of purity of liquid substances, in examining the azeotropy of binary and ternary mixtures, in molecular weight work, and many other laboratory tasks. (228 pages, 6 by 9½ inches, charts, diagrams, and index.)—$4.10 postpaid.—*J.C.*

PLASTIC MOLDING AND PLANT MANAGEMENT

By D. A. Dearle

TECHNIQUES of compression and injection molding, including full discussion of die design, costs, and suitability of material and methods, are here given full attention in simple clear language. In addition, the author presents practical solutions to a number of product and managerial problems in the plastics industry. (196 pages, 6 by 9 inches, a number of illustrations.)—$3.60 postpaid.—*A.P.P.*

THE OFFICIAL GUIDE TO THE ARMY AIR FORCES

DESCRIBED on the title page as "a directory, an almanac, and a chronicle of achievement" of the Army Air Forces, this rich and handsome book, studded with scores of striking full

page photographs, is in fact a history and an encyclopedia of American military aviation. All that anybody could want to know about the United States Air Forces is here. It would make an excellent gift for a boy obsessed, as so many boys are these days, with airplanes. That does not mean, of course, that older persons will not find it fascinating reading. They will. (380 pages, 6 by 8½ inches, lavishly illustrated.)—$2.60 postpaid.—*J.C.*

THE STANDARDIZATION OF VOLUMETRIC SOLUTIONS

By R. B. Bradstreet

ANALYSTS, research, and other laboratory men can save much time and labor in making up solutions by reference to the pages of this book where the author has gathered together a concise description of methods which have stood the test of laboratory experience. As the foreword points out: "This book is not for the beginner, since it presupposes a general knowledge and practice of analytical chemistry. It is a handy reference work for the man who must hurry to get his results. The discussions of the methods and their good and bad points are short and very useful, and the text is replete with helpful hints, equations, tables of important data, expressions for calculating normalities, and so on." (151 pages, 5½ by 9 inches, a few diagrams.)—$3.85 postpaid.—*A.P.P.*

HOUSEHOLD MECHANICS

By Earl L. Bedell and Ernest G. Gardner

REVISED and enlarged, this textbook for shop courses in household mechanics makes an instructive "how to do it" manual that every householder will find useful. With a lucidly written text and clear illustrations, it covers all the jobs that are likely to arise around the house, including woodworking, metalworking, painting, care of electrical appliances, maintenance of the water supply, and waste disposal systems. (240 pages, 8½ by 11 inches, illustrations and index.)—$2.10 postpaid.—*J.C.*

HOW TO DEVELOP PROFITABLE IDEAS

By Otto F. Reiss

THAT average people can have ideas which will pay off copiously in dollars and cents is the profitable idea (for the author, we hope) behind this readable and cleverly illustrated book. It is his belief that money-making notions do not bang one on the head like a piece of plaster falling from the ceiling, but that they often grow out of a person's normal environment and occupational interests. To prove his point, he cites as one of his examples the case of O'Sullivan, the man who surely will go down in history as the inventor of the rubber heel. O'Sullivan was an electrical worker who stood on an insulating rubber mat. One day he conceived the idea of attaching the mat to his shoes and the rubber heel came into being. There's a technique to developing profitable ideas, the author says, and he describes the technique in this interesting and well-written book. (202 pages, 6 by 9 inches, index.)—$3.10 postpaid.—*J.C.*

PLANNING TO BUILD

By Thomas H. Creighton

ANSWERS are given in this book to some of the many questions which will confront layman and specialist alike when they plan to build. Problems in planning, design, and construction are carefully considered by the author, competent architect and builder of the world's largest post office, who leaves no architectural stone unturned. New materials, heating, lighting, types of architecture, prefabrication, these and many more subjects are treated by Mr. Creighton in his lively and engrossing little book. (228 pages, 8 by 5½ inches, numerous sketches.)—$2.60 postpaid.—*A.T.*

BUILDING INSULATION

By Paul D. Close

WAR-TIME urgency of using less fuel has caused a heightening of interest, as a result of press and radio exhortations, of the importance of correct building insulation from the viewpoints of comfort and saving of money. It is an interest that will grow in the public consciousness after the war ends and Americans turn to the great job of building comfortable homes for everyone. It is these considerations that make the second edition of this book, originally published in 1941, so useful. The text gives a meaty treatise on the subject of heat and sound insulation and anyone who wants to inform himself thoroughly on these matters or have in his hands a reference to consult for the solutions of specific insulating problems, will want to have this book available. (328 pages, 5½ by 8½ inches, index, copious illustrations, diagrams, and tables.)—$3.60 postpaid.—*J.C.*

AN INVITATION TO CHESS

By Irving Chernev and Kenneth Harkness

NOTHING short of a miracle is this book about chess that the reader can enjoy and learn from without being a chess wizard to begin with. Through a pictorial presentation of the moves and their meanings, it imparts to the beginner at this fascinating and, contrary to popular belief, fundamentally simple game, a solid foundation and approach. The book is designed to bring the student to the point where he can sit down and enjoy a game with a full realization of the immense complications and fascinating mental warfare that can grow out of its basic simplicity. Those who do not know chess, but are bored by the news, tired of the radio, and fed up with cards will find this book an introduction to a stimulating and diverting pastime. (5½ by 8½ inches, richly illustrated.)—$2.10 postpaid.—*J.C.*

Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

Editor of the Scientific American books "Amateur Telescope Making" and "Amateur Telescope Making—Advanced"

THE large size of a 10.5 x 75mm richest-field binocular made, except the optics, by Henry Paul, 119 N. Broad St., Norwich, N. Y., is shown by comparison with the purchased 8 x 35mm binocular included in Figure 1. The big binocular has 3″ objectives and weighs 7 pounds. While it magnifies only 10½ diameters it has great capacity in revealing dim celestial objects.

Although this binocular has proved ideal for terrestrial use it was built mainly for astronomical observation. It is true, optical treatises point out that for astronomical use the added expense and labor represented by making and accurately mounting together two identical erecting telescopes, one for each eye, is not justified, and that the gains thus made are mainly psychological. For example, Bell, in "The Telescope," page 151, describes experiments which demonstrated that an increase of only 5 percent in magnification, if given to a monocular, was alone quite enough to bring its seeing power up to full parity with a binocular. Jacobs, in "Fundamentals of Optical Engineering," debates binoculars vs. monoculars, to the advantage of the monocular, where time and cost are prime factors. Paul concedes this for astronomical research but adds that "for the amateur it has been my experience that the ease of observation and the pleasure of viewing the skies are markedly increased by the addition of the second telescope."

Hardy and Perrin, in "The Principles of Optics," page 525, point out that binocular microscopes of the non-stereoscopic type also are growing in popularity because they give increased comfort. In any case, even a scientist (Paul is a nutrition chemist), when off the lot, sometimes finds it irksome to be too scientific, especially when equipped with a fully appointed shop (as he is) and possessed of the uncured itch to make fine things (Paul has made complete telescopes, all mechanically high-grade, Schmidt cameras including the optics, and acceptable roof prisms). "Although the optics of this binocular were purchased," he writes, "the mechanics of design, cementing and the rest, presented interesting shop problems.

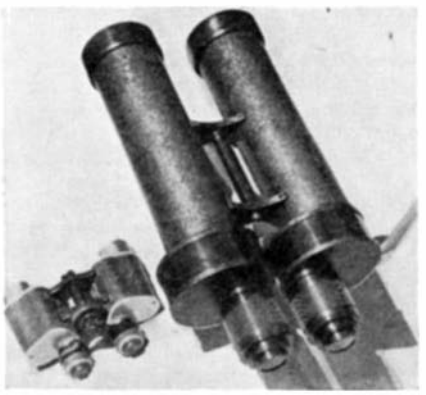


Figure 1: Binocomparison

"The 3″ objective lenses," he continues, "are 15″ in focal length. The eyepieces, of 1⅜″ focal length, came in focusing mounts. Their field lenses are 1¼″ and their eye lenses 1″ in diameter. Four regular 1¼″ right-angled prisms were cemented in a suitable holder to form Porro's second system of erecting prisms (Figure 2), not the more familiar first Porro system used in the majority of binoculars. In this second system the faces of the four prisms are all cemented, excepting the two faces from which the light enters and emerges. This compact system has been used by Alvan Clark and by Zeiss in the familiar circular drum-shaped boxes between telescope and eyepiece. For a binocular, two of these prism units are required. One of them *must be reversed,* the mirror image of the other.

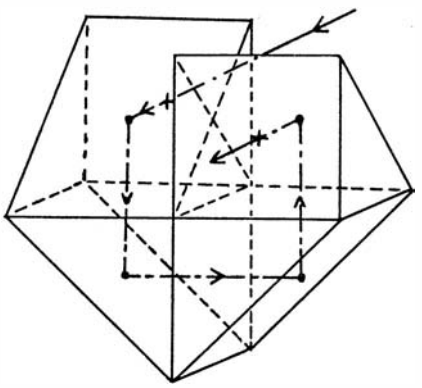


Figure 2: Porro's No. 2

"The light absorption of the 4 to 5 inches of modern prism glass in these erectors is not serious. An ordinary binocular usually has ten air-glass surfaces, two on the objective, four on the prisms, and four on the eyepiece lenses, with total loss of about 40 percent of the light. For astronomical use on nebulae this is a serious loss, not to mention other troubles caused by the reflected stray light. The use of Porro's second system cuts the 10 air-glass surfaces to 8. In the instrument described here all these surfaces except the one facing the eye are coated with non-reflecting films, which were on them at purchase and which were painstakingly maintained. Thus light loss is cut to a negligible quantity and the binocular becomes a highly practicable and pleasing richest-field instrument, free from stray light and ideal for faint nebulae.

"Adjustment of prisms and lenses in binoculars must be made with great care, else double images will result. Were the prospective maker not fully informed of this in advance he might well agree with those who claim that binoculars are not worth the effort.

"Scrap magnesium, aluminum, and duralumin were used throughout, helping to reduce the weight to 7 pounds. A similar commercial instrument weighs 18 pounds. The glass of the large lenses and prisms contributes a large percentage to the 7 pounds, and its weight cannot be reduced.

"Materials cost less than one tenth the price of a similar commercial model.

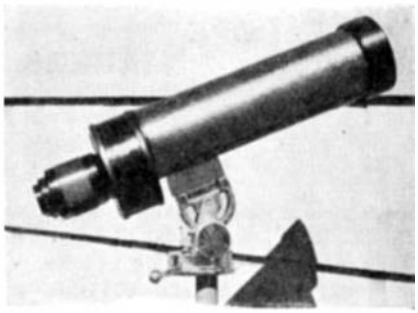


Figure 3: Mounted on stand

"It was my good luck that the *f*/5.3 objectives coupled just right with with the 1⅜″ eyepieces to give an instrument with greatest useful exit pupil of 7mm (1/3″) as is required in the RFT. Also, *f*/5 is about as high an aperture-ratio as can be used on a 3″ lens without too much color error. Both objective and eyepiece were probably designed for dim light, with these limitations in mind, although not necessarily for each other. The large clear eye-distance is convenient for wearers of spectacles, who can see the entire 50° apparent field (4.8° actual) without inconvenience.

"It may easily be overlooked that, in prism binoculars of this or of the conventional type, ordinary crown glass should not be used for the prisms. These should be of light flint glass. The high aperture-ratio of the objectives results in a steep cone of rays that exceeds the critical angle of ordinary low-index crown glass. (Of course, the hypotenuse of a crown glass prism could be silvered, but then it would no longer be totally reflecting, as theory and experiment demonstrate, though it would have the index of reflectivity of silver, about 95 percent.) Prisms may be checked closely enough for this purpose with a ten-cent protractor and a straight stick, by viewing a bright area such as the sky through the optical axis of the prism and noting how many degrees the eye may be moved away from the axis in the direction of the other prism face before the critical angle is reached. This is plainly indicated by a line of coloration. This angle is reached at 5° or 6° for ordinary crown, while light flint gives a reading up in the 10° range.

"A stand (Figure 3) was a great convenience with this binocular because of the weight and because it is

difficult to hold steady any binocular magnifying more than about eight times —especially in astronomical use.

"Camera users will recognize in the geared head of the stand the 'Gear Master.' This is very handy since one can sweep various areas of the sky without duplication, and study terrestrial panoramas conveniently.

"This big binocular has added more to my pleasure of 'star gazing' than any visual instrument I have constructed."

TO THE amateur telescope maker glass is the normal material for grinding tools, while the use of metal for such tools seems abnormal. To the professional the reverse is the case. The key to this apparent anomaly is that, when

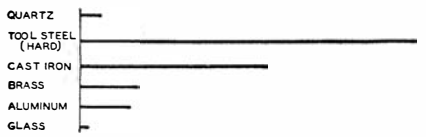


Figure 4: Relative resistance

only one job is to be done, it doesn't pay to make a metal tool even though the metal tool would be worn away less — for the wear on the glass tool will not greatly matter. An incidental dividend is the fact that the glass tool won't be so likely to scratch as a metal tool, into which abrasive particles tend to become imbedded and fixed.

Just how much less metal tools wear away than glass, also crystal quartz (note: not fused quartz) is the subject of quantitative researches made at the Bell Telephone Laboratories by W. L. Bond, a physicist, and described in the *Bell Laboratories Record,* Volume 22.

Figure 4 summarizes the findings quantitatively; it shows the relative resistance to abrasion of the six materials tested, when used against a cast iron tool. The author says: "It will be seen that the four metals have much greater resistance to abrasion than the quartz or glass, and that the resistance is of the same order as the hardness. The very soft aluminum, however, wore 2½ times as well as quartz, and yet on the Moh scale (of hardness) aluminum ranks 2 while quartz ranks 7. This is explained by the toughness of aluminum and the brittleness of quartz. The abrasive particles bury themselves deeply in the aluminum without removing pieces of the surface, while the brittleness of quartz enables the abrasive particles to break off small pieces, and thus the wearing away is faster. Glass, which is softer than quartz, and even more brittle, wears away still faster."

TWO Seattle, Washington, amateurs, Leonard Hughes, 810 E. 60th St., and R. V. Tomlinson, 8807 Roosevelt Way, made the 8" reflector shown in Figure 5. They write:

"The whole contraption was completed in less than four months of intermittent spare-time work (or should we say play?). The *f*/10 mirror is of Pyrex and the customary amount of grief was encountered in its manufacture. The tube consists of nine pieces of ¼" galvanized water pipe thrust through eight cast aluminum rings of 9" inside and 11" outside diameter. The thickness varies from ½" to ¾".

"The declination axis consists of two aluminum castings 5" in diameter with two machined faces held together by a double roller bearing and bolt and in such a manner that *a bearing surface the full diameter of the axis* is obtained [italics by the editor].

"The polar axis consists of a cast aluminum cone revolving in a cast aluminum cone receiver. The cone is held in contact by the axis, which is thrust into a small Timken bearing at the lower portion of the polar assembly.

"The castings were made by the general directions in 'A.T.M.A.'. The melting was done in an ordinary coal furnace with plenty of draft and coal.

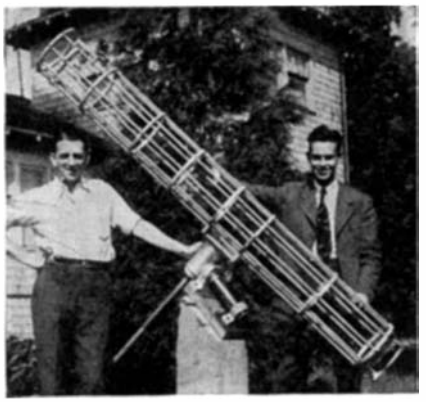


Figure 5: Tomlinson, Hughes

Best results were secured with a 20 percent mixture of foundry clay in fine sand. Trouble resulted if the molds were not dry; and it often resulted anyway.

"There is a total of 16 major castings in the mounting and tube. All casts were made in open mold, which greatly simplified matters.

"We plan to add setting circles, motor drive, and precision focusing mount.

"The whole telescope cost only $60 plus barrels of sweat.

"After the war we plan a 20" reflector of *f*/7 for photographic use. also a 4" photographic apochromat and a camera to match for a patrol of novae."

RELATIVELY few telescope descriptions have been coming in of late, yet "A.T.M." and "A.T.M.A." have increased in popularity each year throughout the war. These apparent contradictions seem to say that amateur telescope makers have been busy in war work, also have been unable to obtain materials; but that they are doing a lot of reading and planning for a revival of activity post-war.

WE DISCOVER that the names of two producing members of the amateur Roof Prism Gang were omitted from the summary in last November's number. C. S. Walton, 5975 W. 44th Ave., Wheatridge, Colo., and Anton Bohm, 6815 W. 29th Ave., Denver, Colo., made 488 roof prisms.

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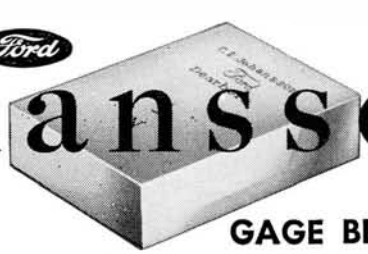

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