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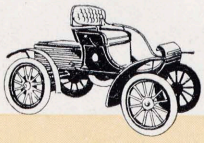
★ RESEARCH ★

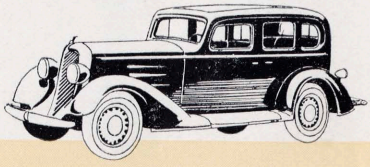
AT

A Century of Progress

WHEN the pioneers began to put together horseless carriages 40 years ago, little did they realize that chemistry would one day contribute rubber tires, Duco, and Ethyl gasoline; electricity, the self-starter, ignition and lighting systems; metallurgy, precise heat treatment and alloy steels; and mathematics, smaller and stronger gears, more comfortable vehicles and engine balancers that wipe out vibration.

Today's automobile—the product of 40 years of scientific progress, is more complicated but infinitely more reliable, larger but more easily operated, more quickly built but more durable than those pioneer carriages. General Motors offers, at A Century of Progress, an exhibit of some of the tools Science has placed in the hands of Research—Research that offers assurance that General Motors is sincere in its efforts always to build better automobiles.





From

GENERAL MOTORS BUILDING

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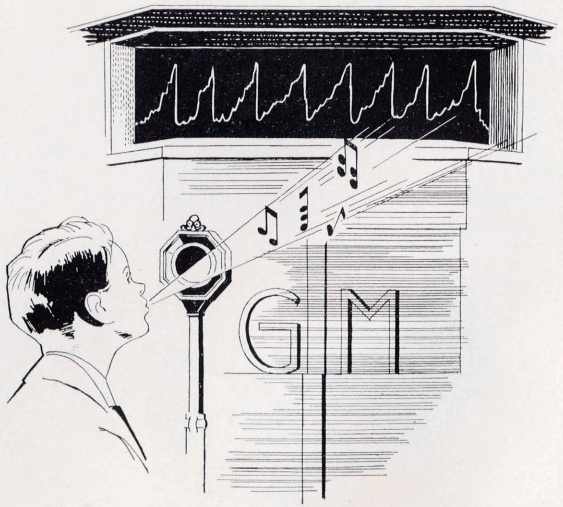
SOUND

SOUND may mean music—music that lulls or increases the pulse beat. It may mean a voice over the air or the roar of traffic through the open window. But to the men who strive to improve automobiles it means gear whine, engine roar, or body reverberation. To rid the car of these things is the problem, but to do that they must be measured, classified and compared.

To show how this is done, the Research engineers have built for exhibition an enormous oscillograph or sound recording device. It will faithfully portray on a screen 4 feet long any sound, from the boom of a kettle-drum to the shrill note of the piccolo. A spot of light moving across the screen at the rate of an inch in a thousandth of a second registers the slightest sound vibration.

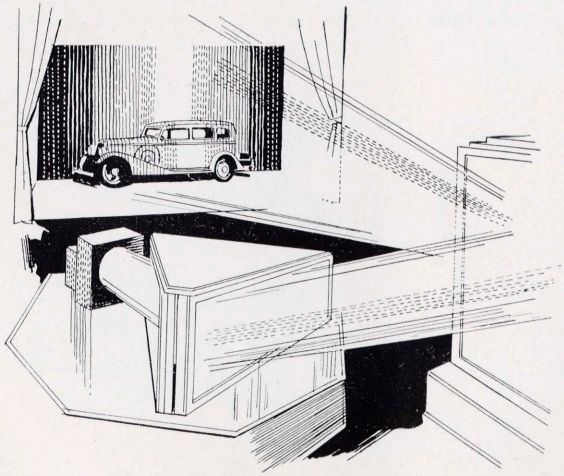
At the Exhibit you may actually see your voice, but in the Laboratories the engineer photographs the car noise as evidence to be used in improving the automobiles of today.



COLOR

THE RAINBOW is color—color made in Mother Nature's laboratory with sunlight and raindrops. But for a Century of Progress, General Motors' engineers wanted to produce a super-rainbow or spectrum. So they used, instead of tiny raindrops, a huge prism and an intense electric light beam. A vivid band of colors—a symphony of purest tones—was the result.

In the Laboratories a small duplicate of the prism is used with a number of lenses in an instrument called the spectroscope. Scientists for many years have trained these instruments on the heavenly bodies—they know the elements on the sun, for each element on that incandescent body leaves its fingerprint or trace on the spectrum produced by the sun here on the earth. But the Research engineers have turned the spectroscope from the distant stars to the fiery maw of the furnace from whence comes the steel from which automobiles are made. Here the instrument that told the story of the stars tells the story of steel—the amount of chromium, nickel or molybdenum, those minute quantities that exert such a profound influence on the performance and endurance of the car of today.

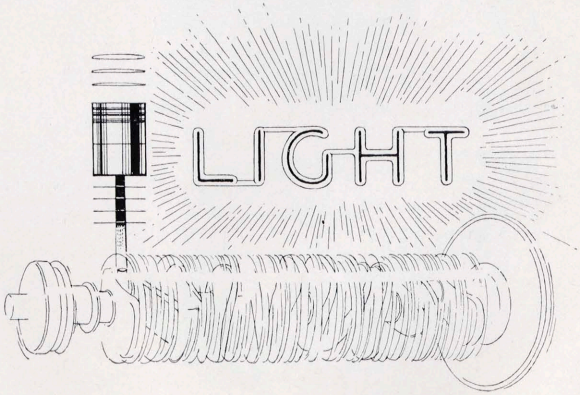


LIGHT

LIGHT is a versatile thing—particularly light produced by a neon tube. It has the peculiar property of rapid cut-off—in other words, it can be extinguished and relit with extreme rapidity. That property has enabled the Laboratories' engineers to see the moving parts of the automobile while in rapid action.

For instance, take the Pontiac engine on exhibit. Assume that the engineer wants to see what the valve spring is doing when the car is traveling at the rate of a mile a minute. That valve spring is compressed and released in approximately one one-hundredth of a second—too fast for the eye to follow. But not too fast for the neon light. The stroboscope is a controlled neon light—controlled so that it will flash or wink very rapidly, even 100 times in a second. The result is that when illuminated by that light the spring is apparently stationary. But if the light flashes only 99 times a second the valve will appear to move slowly and its action may be readily observed.

As a tool of Research the stroboscope is invaluable—it makes it possible to see moving pistons, rotating gears and the path of the oil being whipped around in the crankcase. It has extended the engineer's vision and at the same time his knowledge of the automobile.



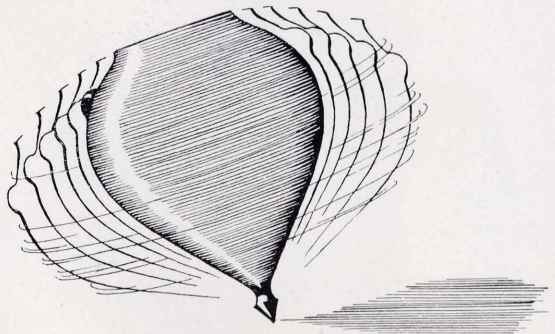
VIBRATION

SINCE the very early days automobile owners have been afflicted with two things that accompanied car operation—noise and vibration. Both of these have been gradually reduced until today they contribute amazingly little to the discomfort of the driver and passengers.

There will be found elsewhere in this pamphlet a description of the Research engineer's method of attacking the noise problem. Let us consider Vibration. Two things must be considered, the chief cause and the cure.

At a Century of Progress Exhibit the Research Laboratories show two crankshafts, one balanced and the other unbalanced 1 ounce. Light beams reflected to screens from mirrors attached to these shafts indicate the slightest vibration of the shafts. It is quite evident that 1 ounce is sufficient to cause the crankshaft to vibrate violently. Engine vibration then is caused to a large extent by the crankshaft, the engine's backbone, being slightly unbalanced.

The cure is also shown adjacent to this demonstration. It is a machine developed by the General Motors Research Laboratories that balances crankshafts so accurately and rapidly that every crankshaft that goes into a Cadillac, La Salle, Buick, Oldsmobile, Pontiac or Chevrolet is balanced by this method. Each of these Divisions of General Motors has a battery of these machines constantly operating to eliminate this form of vibration at its source.



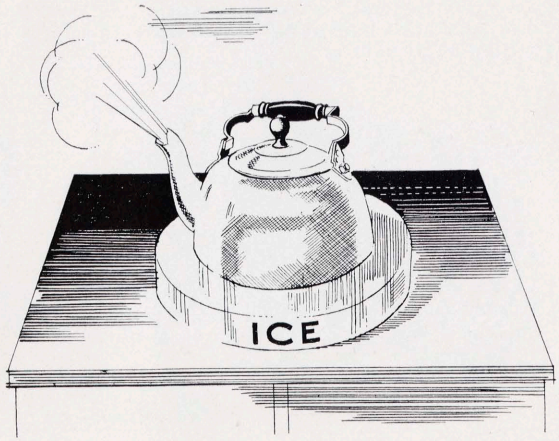
HEAT

SINCE the early days of the automobile, metals have been subjected to the closest scrutiny, and changes made in materials and methods until it can truly be said that we would not have the alloys and heat-treating processes of today were it not for the automobile.

But, like everything else which depends upon exact and careful control for its quality, experimental metallurgy depends upon special instruments for its success.

In making experimental alloys the temperature must be closely controlled and the molten metal must be free from surrounding impurities. Because it answers these requirements the Induction Furnace is used.

Essentially the apparatus is a magnetic stove. A current of electricity sent through a coil of wire produces a magnetic field above the coil. But the current changes its direction 100,000 times every minute. Consequently, when a metallic object such as a piece of iron, a teakettle or an ordinary silver ring is held just above the coil, the rapidly changing, invisible magnetic field causes heat to be produced in the object. Materials that are not easily magnetized are not influenced by the field. It is this phenomenon that makes it possible to boil water in a teakettle placed on a block of ice.



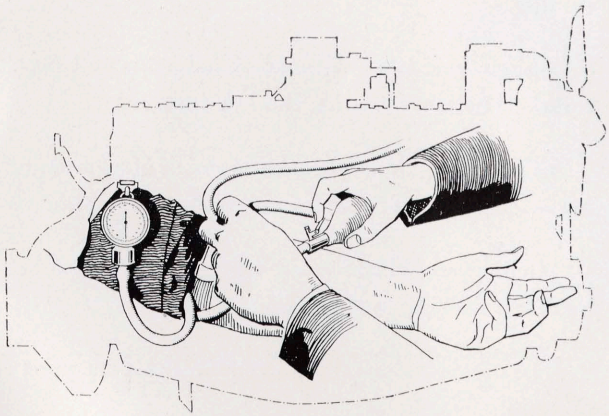
PRESSURE

THE automobile engine is almost human. It has a stomach, a place where it can digest its food—gasoline. The result of improper food and faulty digestion, in the case of the human being, is indigestion. Indigestion in the human being—knock, overheating and loss of power in the automobile.

So, like good doctors, the engineers sought means to help them diagnose the case in order to prescribe a remedy. That search led to the development of the Carbon Stack Indicator or telemeter, a device that will accurately record the slightest pressure—even the pressure of a finger on a railroad rail.

They have found that strange things occur in the engine's iron stomach during the process of digestion. When the mixture of gasoline and air is being burnt the temperatures reach 4500 degrees Fahrenheit and the pressures mount to 400 pounds per square inch. Imagine our stomachs under conditions like that.

Science has shed the same light over all professions. The doctor has his stethoscopes and sphygmometers—the Research engineer his stroboscopes and telemeters. Both working toward the same end—knowledge to cure.



Epigrams *of the* ENGINEER

- In science, opinions are tolerated only when facts are lacking.

- A problem thoroughly understood is always fairly simple.

- Good enough is an enemy of the best.

- There is no substitute for truth.

- A man must have a certain amount of intelligent ignorance to get anywhere with progressive things.

- Engineering is a combination of brains and material. The more brains, the less material.

- Engineering must partake as much of economic horse sense as it does of scientific principles.

- No one would have crossed the ocean if he could have left the ship in the storm.

- The most obvious thing in the world is the most obscure.

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