

CHEVROLET

PONTIAC

OLDSMOBILE

BUICK

CADILLAC

CHEVROLET and GMC TRUCKS

FRIGIDAIRE HOME APPLIANCES

ALLISON

GM DIESELS

GENERAL MOTORS

Detroit, Michigan

"More and Better Things for More People"

HOW

GENERAL MOTORS

ENGINEERING AND

RESEARCH WORK

FOR YOU

*General Motors New Multimillion
Dollar Technical Center, near Detroit*

*A thumbnail review of
the Technical Exhibits at the
GM Motorama of 1953*

**QUICK
VIEW OF A
POINT OF
VIEW**

Thousands of people stood in lines several blocks long outside the Waldorf-Astoria Hotel for a chance to see the GM Motorama of 1953 in its New York showing. The same interest was evident when this fascinating show went on the road—to Miami and other cities.

This booklet provides a condensed “tour” of the research and engineering exhibits and end-product displays. They serve to explain, in their necessarily limited way, what General Motors engineering does for you. And why GM engineering makes the key to a General Motors car *your key to greater value.*

Take the Research Exhibit. Here are four examples of the persistent effort of GM research engineers to

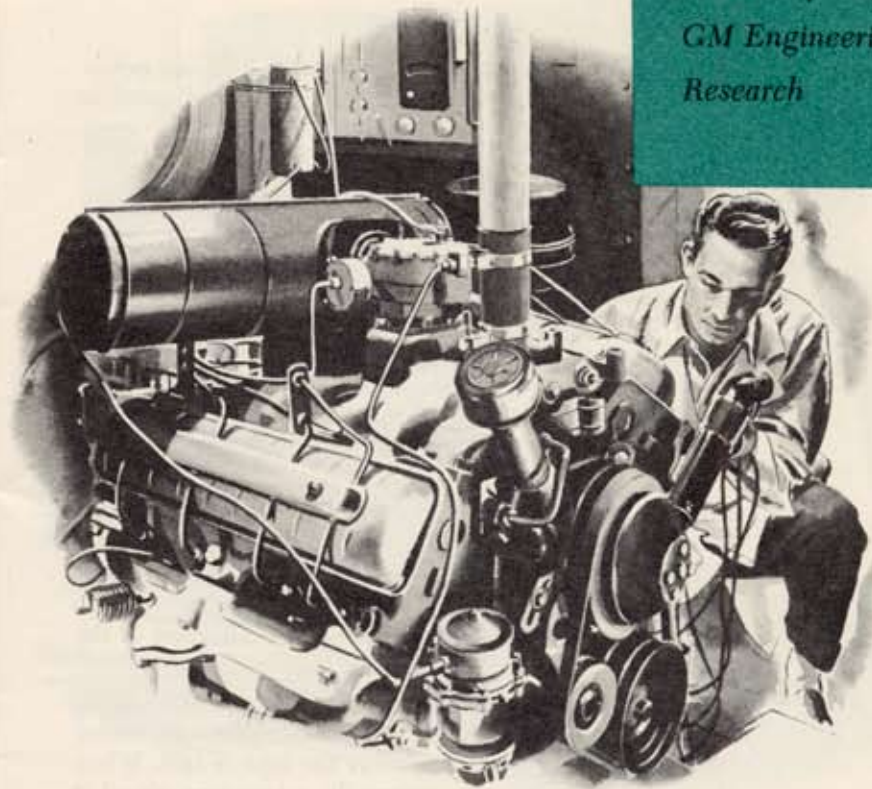


*Engineering Building,
GM Technical Center near Detroit*

probe beyond known facts for new findings in such widely varied fields as fuel chemistry, light radiation, metallurgy, and electronics. And all to the practical purpose of developing more efficient, economical, longer-lasting automotive products for you.

Or take the Engineering Exhibit. Here are scale model demonstrations of the scientific devices our GM engineers use to test new ideas in motorcar design and construction. True, they give you but a glimpse of the type of activity which goes on at GM's huge multi-million dollar Technical Center near Detroit and among all the Divisional engineering groups. Yet this glimpse suggests the lengths our engineers go — to give your GM car the ultimate in alert, smooth flowing power, in easy handling, in safer, more comfortable riding.

Yes—all of these exhibits represent not only the wealth of GM engineering resources—but the wealth of GM engineering resourcefulness: the point of view which refuses to let anything stand in the way of sure and solid progress, of building more and better things for more people.



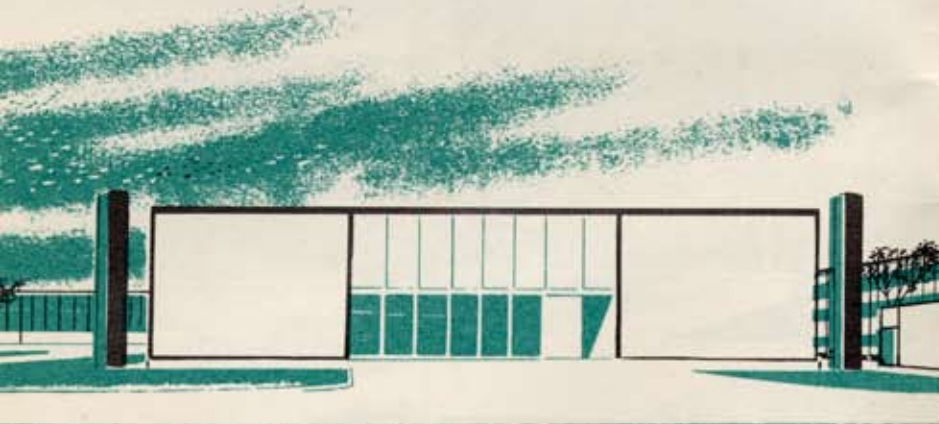
MODERN FUELS FOR MODERN ENGINES

Engines run on fuel. So our GM engineers have to know just as much about fuels as they do about engines.

And fuel studies have for many years been among the most important of their research projects.

Much of the research work in this field has been a cooperative effort with leaders in the petroleum industry.

Over-all result, to date, of this inter-industry teamwork is that two gallons of gasoline now do the work it took three gallons to do twenty-five years ago. You, as a car



driver, get more mileage for less money. And our petroleum resources are saved 249 million barrels of gasoline a year.

Much of this progress—as well as hope for further progress—lies in the continuous development of more efficient engines, which means engines with a higher compression ratio.

In the past 20 years, compression ratios have risen from 5 to 1 to more than 8 to 1. To raise them still higher, engine parts must be able to take steeply increased stresses. Fuels must be developed to meet the demands of higher compression without engine knock. For the higher the compression ratio the greater the tendency for knock.

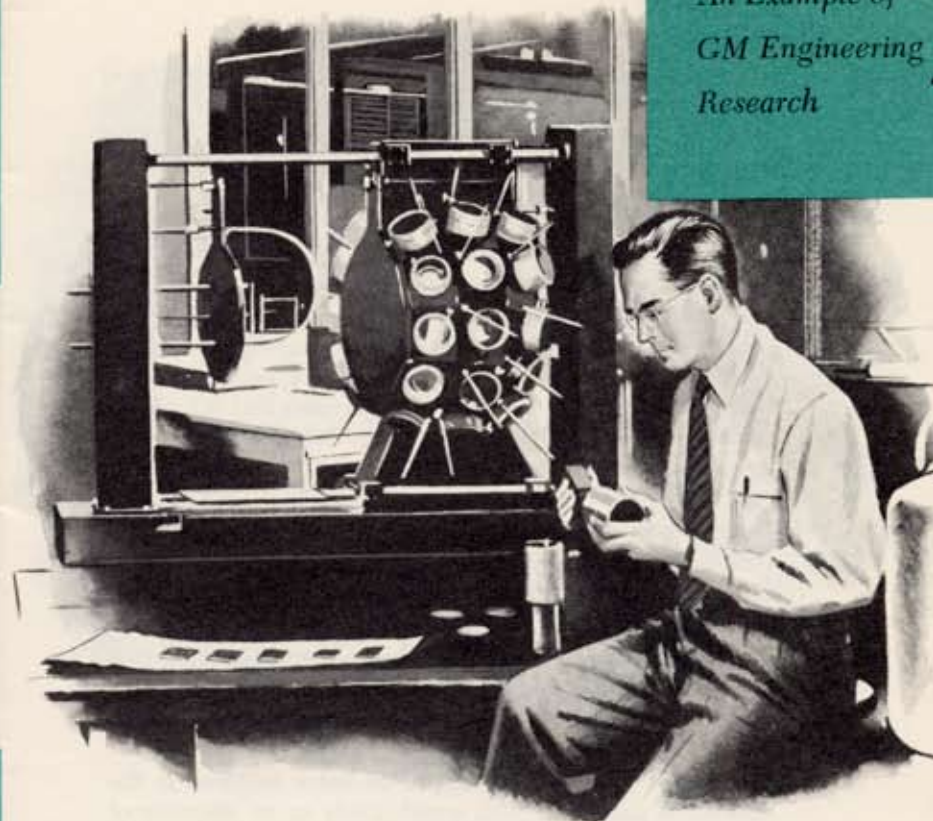
GM fuel research engineers are among the vanguard in industry's attempt to solve this combined problem and attain the additional 30 per cent improvement in engine efficiency its solution would accomplish.

Graphic demonstration of the problem is afforded in the Motorama "Engine-Fuel" Exhibit.

Using a single-cylinder engine of the type employed in high-compression research, the operator can vary either the compression ratio of engine or the type of fuel. When he ups compression ratio materially, a knocking sound is heard, which means a higher quality of fuel is needed. He can eliminate knock either by decreasing compression ratio or improving grade of fuel.

On one side of the engine demonstration is a panel visualizing the octane scale, measure of antiknock quality of gasoline. Octane rating of a fuel is determined by comparing its knocking performance to that of a mixture of two fuels, taken as standards: normal heptane and iso-octane. Percentage of iso-octane in this mixture, whose knocking performance corresponds to the fuel being rated, gives octane number of that fuel. The higher the octane number, the greater the antiknock quality.

On the other side of the engine demonstration is a panel showing two major ways a fuel can be improved: (a) by adding tetraethyl lead, (b) by changing the molecular structure of the fuel.



SEARCHING THE SUN'S SPECTRUM

FOR PAINT ENEMIES

Moisture and oxygen are enemies of paint. So—for years—our GM research engineers have been studying ways to make the paint on your General Motors car less susceptible to their attacks.

They've also had a strong suspicion that among the rainbow of hues which compose the white light we call "sunshine" are certain colors which contribute most to paint deterioration.

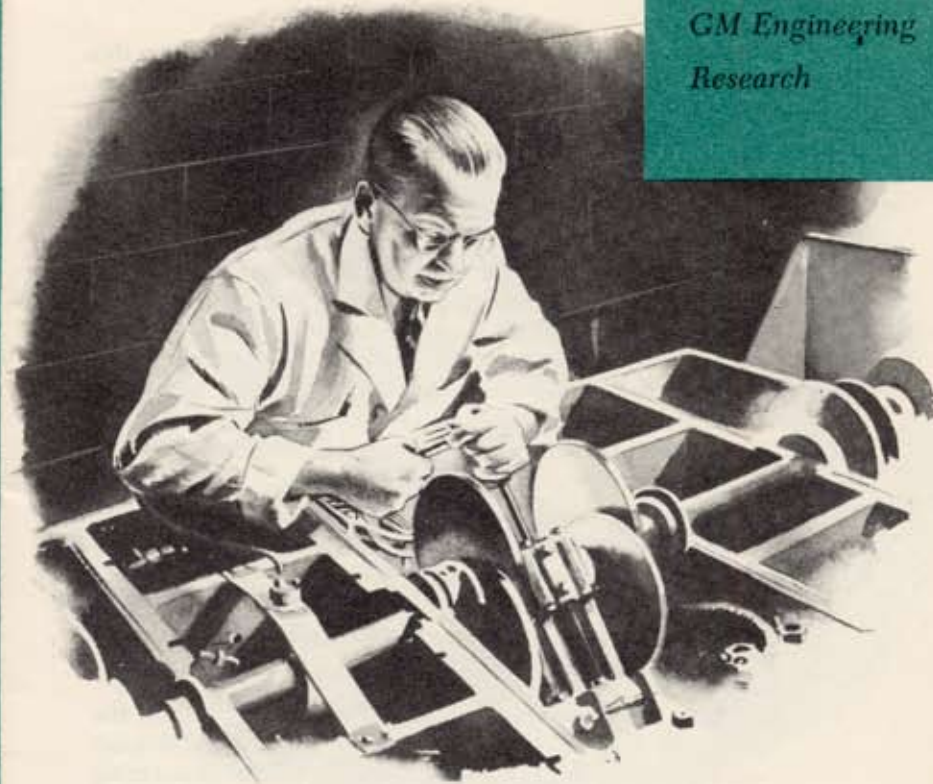
So, typical of their relentless pursuit of facts which will make for a better, longer-lasting product, they have been carrying on extensive studies of the effects of the sun's spectrum on paints. In Florida—this research is carried on in actual sunlight. In GM Research—it is carried on with the aid of the weird looking contrivance pictured here and exhibited in the Research Section of the Motorama.

It is called a polychromatic radiator. Its elements include a high-pressure mercury vapor lamp and precision filters. The lamp gives out light very similar to sunlight. And the filters break this up into individual colors, each filter permitting just this one color to pass through and fall on the paint panel to be tested. As you can see, there are thirty apertures through which the light travels to the filters and then to the paint samples.

By taking a particular paint and placing it on separate panels, each subjected to a particular color of light, it is possible to observe the effects of the different colors on the paint.

This research project—like all such penetrations of a new field of study—will require a long period of intensive work before it supplies the precise answers our GM researchers demand.

The model of the polychromatic radiator featured in the Motorama display is well worth study as an example of extent to which fundamental GM research goes to build more and more value into your GM car.



BUILDING BETTER BEARINGS

The better the bearings the better the engine.

So bearing development has naturally been one of the important fields of GM Engineering Research.

Back in the twenties, connecting rod bearings were manufactured by casting babbitt directly into the rod and finished by boring out the excess. For it was then thought a relatively thick bearing would stand the gaff longest.

Research, however, showed that within limits, the thinner the babbitt the better it stood up under heavy loads. So,

first, a more accurate boring procedure was used to thin down the babbitt. Later, when this failed to satisfy them, our engineers figured out the precision-insert bearing. Early bearings of this type employed two semicircular pieces of steel with the bearing material cast on their inner surfaces. After precision finishing, the two semicircles were inserted into the connecting rod.

But thinning down the babbitt was only one direction pursued by research. Equal ingenuity on the part of GM metallurgists resulted in a continuous improvement in the actual bearing material. Such material developments include the replacement of tin-base babbitt with lead-base babbitt which both conserves scarce tin and makes for a stronger, more durable bearing with better fatigue characteristics.

Also GM engineers have succeeded in developing several different types of bearings to meet different requirements. Among these are the Durex 100, a bearing used in passenger cars, the Moraine 400 bearing used in Diesel engine trucks and tanks; and several types of silver bearings used in aircraft engines.

All this is demonstrated in the "Bearing Exhibit" in the Research Section of the Motorama. The center display contains two single-cylinder engines whose connecting rods contain two different size bearings, one weighing .08 pounds with 4 square inches of bearing surface area; the other weighing 7.8 pounds with 71 square inches of bearing area. If there had been no progress in bearings in the last thirty years, the larger bearing would be needed to bear the loads now carried by the smaller one.

At the left of this display are pictures of the various machines used by GM research engineers in their bearing development work. First, the machine used to study fundamentals of friction. Second, the centrifugal machine for dynamic testing. Third, the hydraulic test machine for fatigue studies. Fourth, lubricant test machine and other simulated engine tests for bearings.

At the right of the display are specimens of the bearing types mentioned above: Durex, Moraine 400, Silver, and Gridded Silver.



HOW ROUGH IS SMOOTH?

With America's production lines busy at the twin jobs of supplying civilian needs and defense requirements, any aid to the precision with which these quantities of goods are produced becomes of national importance.

Such an aid is this little instrument developed by General Motors Research Laboratories—the Surfagage.

For the Surfagage, now made available to all American industry, supplies a quick, precise means of determining

the surface roughness of manufactured parts and comparing with known standards before final assembly. And with machine components being produced in plants scattered all over the country, the ability to determine quickly whether or not a finish conforms to specifications means a tremendous stride forward in quality control and production speed.

How precise that quality control is when the Surfagage is used is quickly explained by the fact that this little instrument can measure surface defects as small as 1/1,000,000th of an inch. A diamond pickup stylus detects the tiny scratches on a surface and passes the information to an electronic amplifier which transforms the signal from the pickup into dial readings on the front of the Surfagage box. By slowly running the stylus over the surface of, say, a piston, crankshaft, clutch facing, cylinder lining, valve, piston ring or bearing, the Surfagage operator can immediately read the measure of roughness of the specimen.

The Surfagage Exhibit in the Research Section of the Motorama contains a model of the instrument and test specimens with which the visitor may himself discover unseen surface roughness.

The exhibit also includes a mock-up of a piston pin production line, showing how the Surfagage could be used to "pass" or "reject" pins. Surface profiles of four automotive parts, magnified 16,000 times, reveal the microworld of surface roughness which Surfagage so quickly and precisely reveals.



FOR SAFER STEERING

GM ENGINEERS ROLL THEIR OWN

When a car goes around a curve it always tends to lean away from the direction of the turn—due to centrifugal force.

This leaning away is called "roll."

And, naturally, too much roll makes a car unsafe. Too little roll, on the other hand, makes it too stiff for comfort.

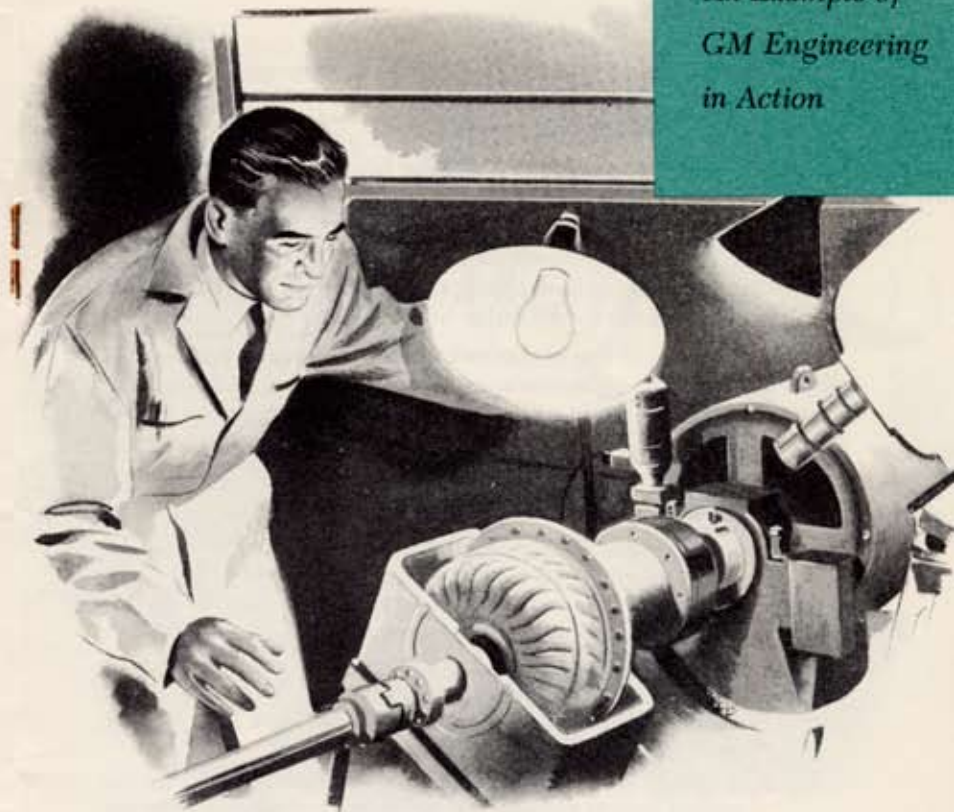
To be sure that your GM car handles the way it should on turns, our GM engineers make many tests of a car's roll characteristics, including those made on a special test area at the Technical Center in Detroit.

The test car is run onto a fifty-four-ton slotted cast-iron bed plate equipped with four large platform scales capable of weighing up to 6,500 pounds each.

A long, weighted lever fastened to the frame of the car, forces it to roll just as it does on a high-speed curve. By slowly adding more and more weight, it is possible to reproduce the effect of driving faster and faster on the turn.

Result: "roll" reactions which would take place in only a split second on the road can be spread over long enough time for accurate and complete measurement and recording. And our engineers are able to know how well the particular test car's design and construction meet GM requirements of safer, easier steering.

This is demonstrated in the GM Engineering in Action Exhibit at the Motorama on a test model with a one-quarter scale chassis.



TWIN-TURBINE DRIVE IS

OUT OF THIS WHIRL

For years General Motors has led in the development of automatic drives.

Among the latest accomplishments of our GM transmission engineers is the twin-turbine torque converter, available this year as the Buick Twin-Turbine Dynaflo.

And here, and in the working model in the Engineering in Action Exhibit at the Motorama, you see one of the many

research studies which marked the long series of scientific tests leading to its production.

Inside this transparent model, oil is pumped at high speed against various types of turbine blades or vanes. A high-speed camera takes motion pictures of the action at the rate of 7,000 frames a second. These pictures are later projected on a screen in slow motion at the rate of 16 frames per second, enabling engineers to make an accurate analysis of each particular blade action.

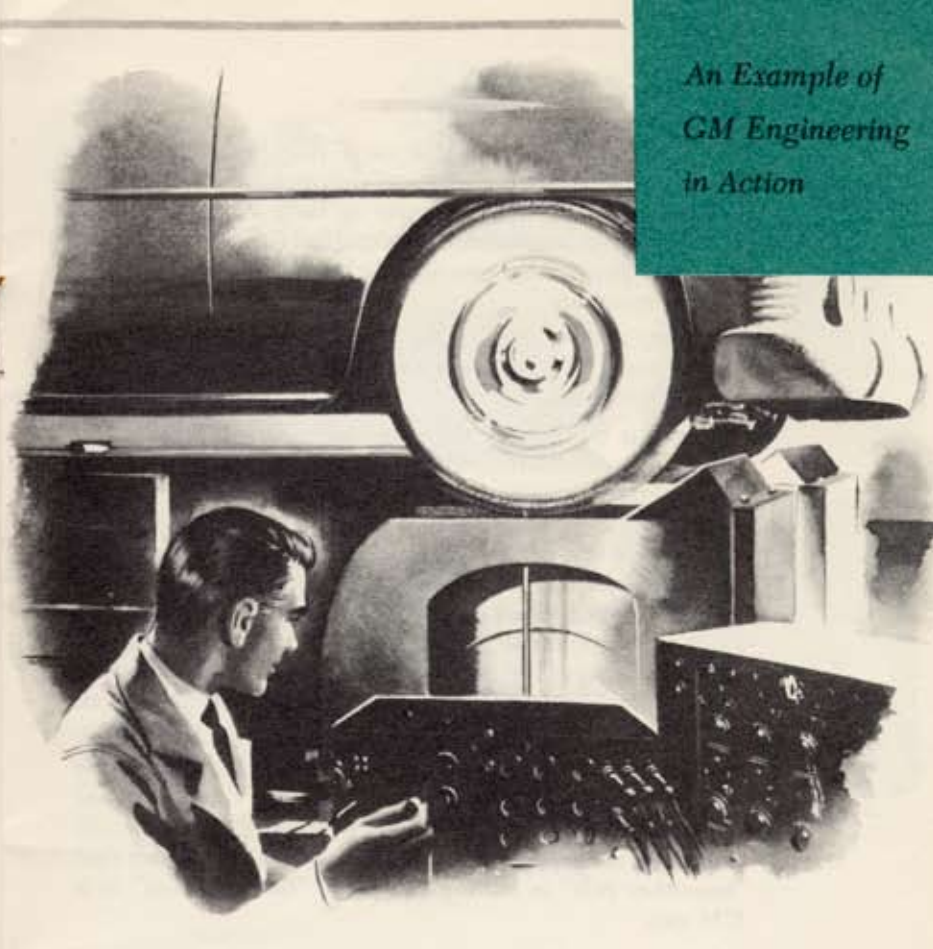
The model at the Motorama is set up—not for this precise study—but to give the spectator an opportunity to see how the twin-turbine torque converter works through the four major phases of its operation. To assist the viewer, thousands of small synthetic rubies have been placed in the oil.

These four phases are:

1. *High Torque Drive*, where the first turbine delivers all the drive by itself and through its own gear set, giving high-starting torque and rapid acceleration for the car. This is the up-to-8½-miles-per-hour range.
2. *First Turbine Drive*, where both turbines contribute to the drive but most of the drive comes from the first turbine, giving continued fast acceleration and good hill-climbing ability. This is the 8½- to 30-mph range.
3. *Second Turbine Drive*, where the torque delivered by the second turbine exceeds that of the first turbine, since the car is reaching cruising speed and torque demand is relatively light. This is the 30- to 53-mph range.
4. *Coupling Drive*, where the first turbine free wheels, contributing nothing to the drive, while the second turbine and oil pump operate as a fluid coupling giving speed and high economy. This is the over 53-mph range.

Another highly developed torque converter type automatic transmission is the famous Chevrolet Powerglide which through continuous research also has been even further refined for improved performance and economy.

An Example of
GM Engineering
in Action



TOUGH TESTING MAKES

EASY RIDING

Riding qualities of a car depend on the functioning of many elements such as springs, shock absorbers, engine and body mountings.

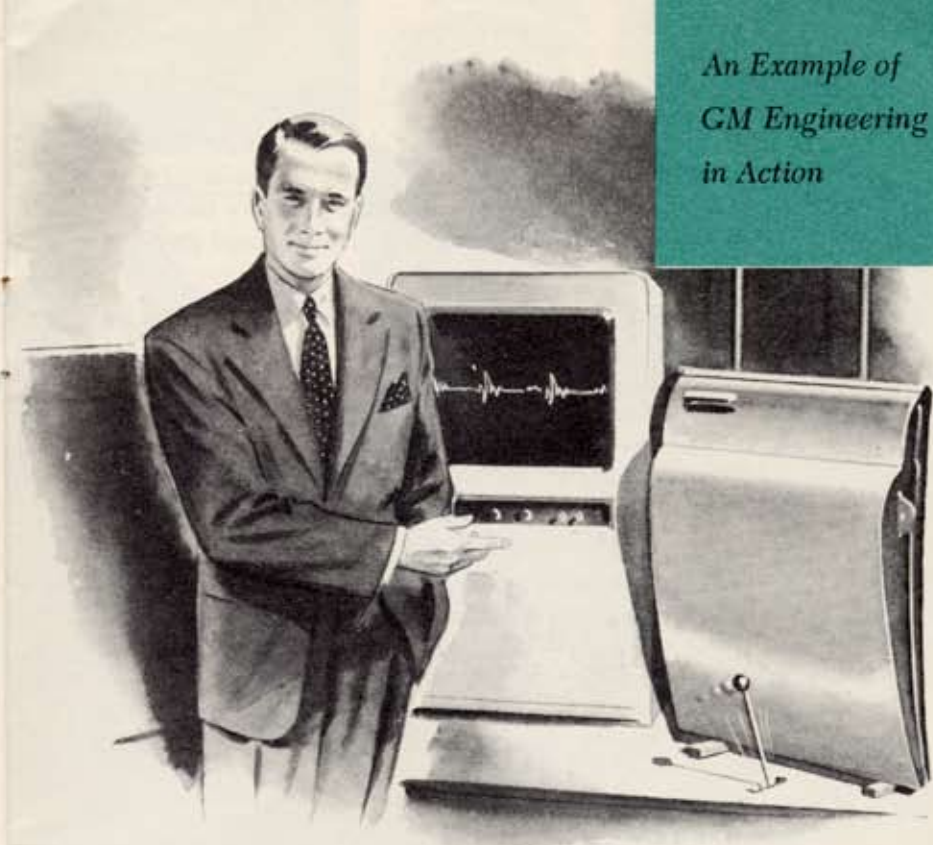
And our GM engineers do a tremendous amount of road work on the GM Proving Ground to test how well they do their job of delivering a smooth, comfortable ride.

But it's not always possible on a road test to discover precisely what part of the car's suspension is guilty of excessive vibration. So, typical of their resourcefulness, our suspension engineers have designed a means of putting a car's suspension under scientific laboratory scrutiny with the car in action.

And here it is—the new Ride Test Room at the GM Technical Center, a miniature model of which is on display at the Motorama.

Using this equipment GM engineers can duplicate any road surface condition which a car could encounter—and worse. For various types of cams capable of producing any desired type of bump are bolted to huge revolving drums. And while the car rides these simulated “washboards,” complex electronic instruments give precise information as to the vibration effect on the parts being studied. Further, since the equipment is designed to allow the floor to be lowered, leaving the car practically suspended in mid-air—engineers, using stroboscopic (slow-motion) lights can inspect the underpinning while the car is taking the bumps.

Tests made with this equipment plus the multiple types of actual road tests give GM engineers the wealth of technical information they need to develop continuously improved suspension systems. And, of course, insure that “smoother ride” is among the many “better values” in a GM car.



*An Example of
GM Engineering
in Action*

GIVING YOUR CAR THE SILENT TREATMENT

The reason your GM car is so well insulated against outside noises like hail and rain on the roof, not to mention engine and road noises, is again a tribute to the persistent testing efforts of General Motors engineers.

And so is the fact that your car doors don't bang when you slam them.

For at the Noise and Vibration Laboratory at the General Motors Proving Ground, GM engineers use the latest electronic measuring devices to discover precisely the materials which most effectively damp vibration, and give you a quiet car to ride in.

This they do by applying such a damping material as asphalt-saturated paper felt to a steel plate, supported on a stand. The plate is then vibrated magnetically. A microphone picks up the sound generated by the vibration. When the plate is vibrating at resonance, the power is cut off. And the rate at which the vibrations die off, as measured in decibels, gives an accurate measure of the damping qualities of the insulating material on the plate.

The model shown in the Engineering in Action Exhibit at the Motorama represents this test. It is, however, modified for purposes of demonstration by using a pendulum impact type of vibration rather than the continuous magnetic drive.



**TYPICAL END PRODUCTS
OF GENERAL MOTORS
RESEARCH AND
ENGINEERING**



1. CARBURETORS

*Rochester Products Division
of General Motors*



GM carburetor engineering has but a single object. And that's to develop carburetors which give your car engine the utmost in performance at the least cost in fuel.

Among the latest examples is the Cadillac-Oldsmobile 4-Jet Carburetor exhibited in cutaway transparent model form at the Motorama. Here you can see, with the aid of a speedometer and a special gauge registering horsepower output, how the added cruising and power jets cut in as the speed of the cutaway engine increases through various ranges from idling, through cruising, into higher speeds.

2. POWER STEERING

*Saginaw Steering Gear Division
of General Motors*



Among the most important recent developments of General Motors engineering is GM Power Steering.

For Power Steering supplies the car driver with an automatic helping hand which allows you to swing the wheel more easily, to get away from a curb—back into a parking space—make a turn. And gives you safer control of the car

when a chuckhole, bump or blowout gives a sudden yank on the wheel.

Simply stated — Power Steering saves four fifths of the effort of ordinary steering.

Yet — with GM Power Steering you always keep the feel of the wheel. Always keep command. For the hydraulic Power Steering mechanism cuts in only when three pounds or more of pressure are needed to swing the wheel.

The Saginaw Exhibit at the Motorama allows you to determine for yourself the amazing difference in effort needed to turn a wheel with and without a Power Steering hookup.



3. DUAL-RANGE HYDRA-MATIC TRANSMISSION

*Detroit Transmission Division
of General Motors*

Typical of the continuous contributions GM Engineering makes in the field of automatic transmissions is the Dual-Range Hydra-Matic used on Pontiac, Oldsmobile and Cadillac cars and GMC trucks.

This new transmission has two driving ranges instead of one — a range for the open road and a range for mountainous driving and for congested city traffic. The quadrant selector dial provides for five positions of the lever: Neutral, two Drive positions, Low and Reverse.

The first driving position provides four forward gear ratios, with fourth gear giving exceptionally low engine speed compared to car speed for increased economy: smoother, quieter operation, lower oil consumption, less wear on engine parts.

The second driving position locks out the fourth gear up

to 75 miles an hour, resulting in better acceleration in traffic and faster "step-down" acceleration.

Control lever can be moved at will between these two positions.

Detroit Transmission Exhibit at the Motorama shows a cutaway Hydra-Matic, demonstrating how it works as a car travels different types of roads from city streets, to main highways, to mountain climbs.



4. TURBO-JET ENGINES

*Allison Division of
General Motors*

General Motors engineers have produced more gas turbine aircraft engines than any other manufacturer. Combat-proved Allison Turbo-Jets deliver the highest thrust per pound of weight and are built at the lowest cost. Allison Turbo-Props promise revolutionary new standards in both military and commercial transport operation.

Allison Exhibits in the Motorama include a cutaway model of an Allison J35 Turbo-Jet, similar to those powering Northrop Scorpions and Republic Thunderjets in Korea. Also displayed are models of the Torqmatic Converter and Torqmatic Transmission, drive systems such as those used in huge off-the-highway vehicles and other large units.

Aeroproducts Division is represented by a plastic plane model demonstrating with lights the location and function of hydraulic actuators built by GM engineers for military use.

Again we would like to remind you that these are just a few among myriad examples of how GM engineering and research work for you to produce ever more and better things—and to make the key to a General Motors car your key to greater value.

GM ENGINEERING
.. PERFECTS TODAY'S PROGRESS
.. PATTERNS TOMORROW'S
PROMISE



NOTES

GENERAL MOTORS



*Your Key to Greater Value—
the Key to a General Motors Car*