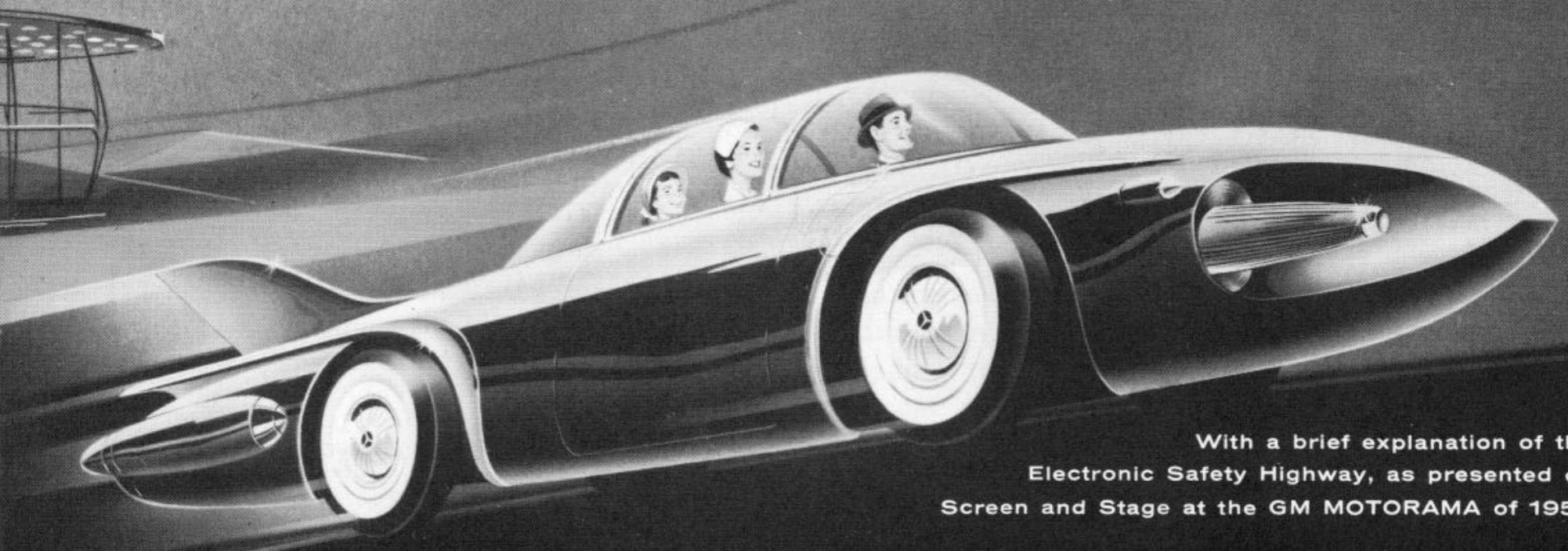
THE STORY OF

FIREBIRD II

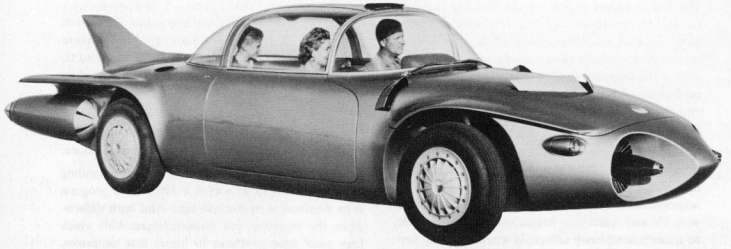
"THREE-ZERO-FOUR"

The Gas Turbine Family Car

General Motors latest "LABORATORY ON WHEELS"



With a brief explanation of the
Electronic Safety Highway, as presented on
Screen and Stage at the GM MOTORAMA of 1956.



The story of Firebird II—"Three-Zero-Four"—is really two stories

The first—a report to you on the amazing progress General Motors designers, research men and engineers have made in the development of the gas turbine engine. And – what's more – in the creation of a car with a transmission system, suspension, brakes, air conditioning, and over-all design capable of making effective, comfortable use of gas turbine power for family transportation.

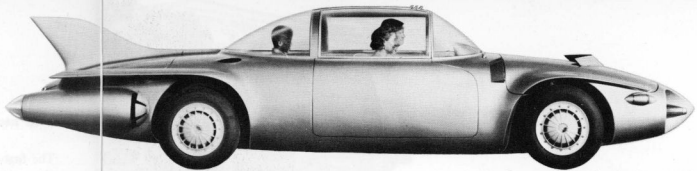
The second – an attempt – the most complete ever worked out – to show you how – by incorporating into both car and highway design such present-day accomplishments as two-way radio communication with TV and "electronic brains" – it may be possible to create a completely safe rapid transit highway system in the future.

The first, then, shows the way our designers, research men and engineers think, plan and work on projects which may well find their way into actual production cars within the foreseeable future. For though there will never be a production car precisely like Firebird II, there may well be GM cars containing elements of its engineering and design.

The second illustrates how these same designers, research men and engineers keep themselves on their toes by constantly probing the more distant future.

Both, we believe, demonstrate their understanding of the problems to be solved if automotive progress is to continue at its historic rate. And both demonstrate the ingenuity and resourcefulness with which they meet these problems to insure that tomorrow, as today, your key to greater value is the key to a GM car.

"PROGRESS REPORT"—The Gas Turbine Family Car



For many years it has been General Motors practice to take design and engineering ideas beyond the blueprint and laboratory stage and build them into actual running cars—"experimental laboratories on wheels."

Firebird II is the latest in a distinguished line of "blueprints come true," successor to the famous "Y-Job," XP-300, Le Sabre and the first Firebird which was road-tested in 1953 and presented at the 1954 Motorama.

The first Firebird was the end-result of long years of intensive research in gas turbine design. For our GM engineers, who pioneered high-compression engines after World War II, were determined to discover what, if any, future benefits to the motoring public would come from gas turbine development and whether the gas turbine engine could eventually find a place in passenger car production.

Firebird XP-21—which was, of course, the first gas turbine passenger car built and tested in America—was a "one-seater," of radical aviation-type design—practicable only for test-track use. And—though its performance was highly satisfactory—it left many problems such as engine noise and exhaust heat still unsolved.

Now—with the Firebird II—General Motors presents a four-seater—a comfortable family car—powered by an engine in which noise and exhaust heat have been impressively lowered. As GM President Harlow H. Curtice has stated, "We have come a long way. The last two years have been highly encouraging."

This progress reflects an impressive, yet typical, example of General Motors teamwork.

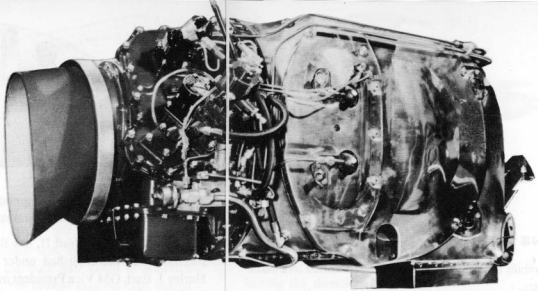
The styling of the Firebird II, like that of the original Firebird, was accomplished under the direction of Harley J. Earl, GM Vice President in charge of Styling Staff.

The Firebird II gas turbine engine, chassis and other engineering features were developed by the GM Research Staff headed by Vice President Dr. Lawrence Hafstad.

Among the General Motors divisions which contributed to the development and success of various engineering features of the Firebird II are the Engineering Staff, which developed its special transmission and fabricated many of the special parts; the Delco Products Division, which developed the car's Delco-Matic Air-Oil Suspension System; the Delco-Remy Division, responsible for many of the electrical components.

The Moraine Products Division was responsible for the car's new all-metal Turbo-X brakes. The Saginaw Steering Gear Division perfected the Firebird's hydraulic steering system and electrical actuators. Harrison Radiator Division provided the car's elaborate air conditioning unit.

AC Spark Plug Division contributed to the new ignition system; Diesel Equipment Division designed new type fuel nozzles; Fabricast Division fabricated the turbine buckets; Hyatt Bearings and New Departure Divisions provided new type bearings; Packard Electric Division supplied cables and Inland Manufacturing Division provided suspension bearings.



BEATING THE HEAT—Whirlfire GT-304

One of the most exciting features of Firebird II is the way GM Research Staff experts have tackled the problems inherent with all gas turbine engines—high fuel consumption, high heat loss and engine noise.

In the Firebird II, GM engineers have added a regenerator to conserve both fuel and heat. This regenerator is a metal mesh drum which rotates first through the hot exhaust gas and then through the relatively cool compressor discharge air, carrying the heat from the exhaust to the incoming air.

So efficient is this unit that it recovers over 80 per cent of the heat in the exhaust gas—heat that otherwise would be blown out and wasted. The engine can be operated on a wide variety of fuels, including gasoline, kerosene and fuel oils.

For this reason most of the heating of incoming air is done by the regenerator, and only enough fuel must be burned to bring hot air the rest of the way up to its operating temperature of 1650 degrees at the turbine inlet. This gives GT-304 fuel economy approaching that of present piston engines.

Another advantage in using this regenerator is that exhaust temperature is lowered as much as 1000 degrees. Unlike the hot blast from a jet engine, the exhaust from Firebird II is pleasantly warm. In fact, you can hold your hand over an exhaust port.

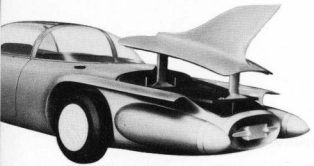
A silencer built into the nose of Firebird II muffles engine noise so successfully that the car is as quiet as most automobiles of today.

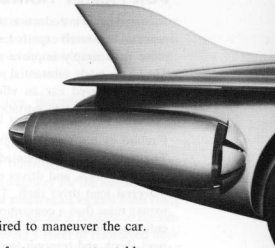
As for its general design, the Firebird's engine—Whirlfire GT-304—follows pretty much the pattern of its predecessors. It consists of two mechanically independent parts—the gasifier section—and the power section.

The gasifier section is essentially a small jet engine which produces a fast-moving stream of hot gas. It is simply a shaft with an air compressor at one end and a turbine on the other. Air is sucked into the compressor, heated in the regenerator and burner, and the resulting rush of hot gas spins the turbine which in turn spins the compressor and brings in more air.

The gasifier spins at a rated full power speed of 35,000 r.p.m. and idles at 15,000 r.p.m. The compressor operates at a pressure rate of 3.5 to 1.

The power section is essentially a "windmill" that is spun by the impinging stream of hot gas. Its turbine, or "windmill," is connected to the drive shaft through reduction gears. The shaft transmits power to the car's automatic transmission between the rear wheels.





TAILORING CAR DESIGN TO FIT GAS TURBINE POWER

There's more to building a gas turbine passenger car than designing a practicable engine. There's the problem of the actual car design itself—plus all the kindred problems of transmission, suspension and the like.

Perhaps the outstanding feature of Firebird II design is another GM "first," the material the body is made of – that lightweight metal of tremendous strength, here used for the first time in motorcar construction—the wonder metal, titanium.

One of the most corrosive-resistant of all metals, titanium requires no paint, is brush-finished to a satin lustre.

Body design is airplane-type, with a transparent canopy over the passenger compartment. This canopy swings up at either side to admit passengers when a magnetic key is inserted in a slot in the body side panel. Although a half-foot lower than most of today's production cars, inside headroom is virtually the same.

Engine exhaust gases rise vertically from ports atop the rear fenders. Fuel tanks are side-mounted behind the rear wheels. On each side of the nose is an engine air scoop. Head lamps are retracted when not in use, leaving the directional signals exposed.

Unique tail lamp ensemble transmits stop and back-up signals through a parabolic reflector. Directional Signals are travelling blinker lights, left and right.

Luggage compartment deck and floor lift automatically, elevate to waist height.

Inside the car is a new concept of steering control, with a pair of steering control handles replacing the conventional steering wheel. Firebird II's Power Steering is so responsive that only small movements of these handles are required to maneuver the car.

Other unique interior features are retractable seat belts which are out of the way and out of sight when not in use; airplane-type reclining seats with ventilated seat cushions and adjustable head rests, electrically operated; beverage cooler; adjustable pedals and toe board and indirect lighting. A specially designed air conditioning system is built into this car of the future. Passengers may adjust air conditioning to individual comfort through controls in front of each seat.

MAKING THE MOST EFFECTIVE USE OF GAS TURBINE POWER FOR FAMILY TRANSPORTATION

As stated in the introduction of this booklet, GM engineers and research experts have, in Firebird II, done more than simply improve the gas turbine engine. They have made substantial progress in making a gas turbine powered car an effective and comfortable means of family transportation.

Firebird II has new concepts of wheel suspension. The transmission is mounted on the frame between the rear wheels, and drives each wheel by a double universal joint drive shaft. This system has less unsprung mass than a conventional rear axle and differential combination, and thus is able to absorb more road shock and transmit less shock and bumping to frame and passengers. Front wheels have double wishbone suspension combined with new wheel and brake design to provide easier steering.

At each wheel, individual Delco-Matic Air-Oil Suspension Units replace the usual shock absorber and spring combination. The Air-Oil Unit uses a cushion of air to provide soft spring action and a hydraulic leveling feature to compensate for light or heavy loads and to keep the car level under all conditions. Firebird II is the first American car to provide leveling both front and rear. When the car is in motion, the leveling circuit is shut off and the car rides smoothly on cushions of air.

Another Firebird II feature is the new Moraine Products Division's Turbo-X brake. This all-metal brake gives the car a smooth-positive, straight-ahead stopping ability.

Heart of the new brake is a cast iron disk that rotates with the car's wheel. When hydraulic pressure is applied, this disk is squeezed between movable pads of metal lining material on the inboard side and fixed pads on the outboard side. Actual stopping power is directly proportional to the applied hydraulic pressure. This directly proportional stopping power assures straight-ahead stops, inasmuch as each of the four brakes on the car does the same amount of work. Balanced braking at each wheel eliminates the possibility that the car will swerve or pull to one side.

Extra power for "light touch" stopping is supplied to brake lines by a specially designed power booster. Designed by Saginaw Steering Gear Division, it is powered by high-pressure oil from Firebird's central hydraulic system.

To increase the brake's stopping capacity, a unique turbo-cooling system is built into the disk. The system is so efficient that it completely eliminates "fade" or gradual loss of braking ability as the brake becomes distorted from excessive heat.

An electric gear selector is another important feature of Firebird II. When the driver sets the selector in "drive" position, one part of a two-step solenoid is energized and the plunger moves in part way. When "reverse" is selected, the plunger moves in the rest of the way.

Electric gear selecting is only one feature of the entirely new kind of electrical system built into Firebird II. A new alternating current generator for the charging system has better over-all voltage-speed characteristics and can deliver nearly its rated output of 100 amperes at idle speed. This high output is obtained from a unit much smaller than its conventional direct current counterpart.

Another advantage of this alternating current system is that the generator has no commutator requiring maintenance or replacement. A rectifier produces direct current for the battery. Generator output is controlled by a completely new transistor voltage regulator.

Special oval section tires, mounted on magnesium wheels, were designed to reduce over-all height and keep unsprung weight to a minimum.

Another Firebird II innovation—a special floor designed to provide passageway for the numerous oil, fuel and electrical lines which must extend from front to rear of car. Square steel tubing is bonded to bottom panel; on top of this tubing a sheet of reinforced fiber glass is applied and the void between tubes is filled with foam plastic.

Finally, Firebird II has a new central hydraulic system, utilizing a special pump which supplies oil under high pressure to all units requiring hydraulic pressure —power steering, power brakes, the new Air-Oil Suspension System and windshield wipers. Two accumulators store oil under pressure at all times in the same way a battery stores electrical energy, so it is possible to use the hydraulic system before the car is started.

"PROGRESS POSSIBILITY"

The Electronically Controlled Car on the Safety Autoway of Tomorrow

For several years General Motors has played an important role in the continuing campaign to bring our highways up to date.

At the same time, our designers and engineers have continuously planned and worked to make the motorcar an ever safer form of transportation.

Now the Styling Section of General Motors–under the leadership of Harley J. Earl, GM Vice President in charge of Styling–has created for the Motorama of 1956 a dramatic and daring concept of a Highway of Tomorrow.

Shown on VistaVision film in Technicolor, and on the Motorama stage, this amazing concept places control of the motorcar in the hands of an "electronic brain" –actually releasing the driver from the wheel.

Though the realization of such a "dream highway" belongs in the far, far future–it utilizes present-day knowledge and experience gained through electronic control and computation, radar and television – all now in operation.

To present this spectacular vision on film – General Motors built a replica of such a highway on the Arizona desert–as well as a more complete miniature highway on a Hollywood stage for filming purposes. What's more, they incorporated, in the Firebird II, elements helpful in demonstrating such an electronically controlled operation.

These include a Dashboard View screen which has two panels. The left panel is for "internal communication" between car and driver (information he would normally receive from visible instruments as to fuel supply, engine operation and temperature). It also reveals a radar pattern when he guides the car onto the electronic control-strip for automatic steering.

"External communication" from the control tower in his Autoway Zone also appears on this panel.

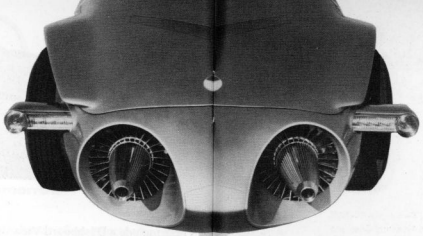
The right-hand panel supplies normal television reception, and two-way television communication with motels, other cars, etc.

Rearview mirror is replaced by a small circular view screen on the left side of the dashboard which projects images picked up by a TV camera at the rear of the car.

The steering control handles are designed to slide forward out of the way when car is on automatic control.

Extending from the two engine air scoops on each side of the nose of the car are probes or antennas which pick up wave impulses from the conductor strip in the center of the control lane.

None of these features is operative in the Firebird II. They serve merely to complete the demonstration of how an electronically controlled car should be equipped to function on the electronic Safety Autoway.



THE SAFETY AUTOWAY—How It Might Work for You

When you enter the Safety Autoway you are under manual control, traveling in the slow lane at the right.

Entering into radio and television communication with a nearby Control Tower, you indicate that you wish to switch to automatic.

The Tower directs you to move into the middle lane, where your car straddles a metallic conductor which emits electronic signals to your car.

These signals, of different wave lengths, are picked up by probes at the front of your car and fed into motors which control steering, speed and braking.

When you are "tuned in" with the system, you relinquish control and your car is automatically channeled into the high-speed lane – still riding over a signal-emitting control band.

From here on, your car is "driven" by an electronic brain which has been fed all pertinent information, including your destination. All cars in the high-speed lane travel at a constant speed, at the proper distance from each other and without passing. In the case of any emergency all cars are automatically braked and slowed down. In extreme cases, cars can be automatically directed to slower speed lanes.

Not only do you relax and enjoy your journey, but you are as safe as modern science can make you. For, while human beings can err in judgment, the electronic brain is completely foolproof.

FURTHER FACTS ABOUT FIREBIRD II FOR THE MOTORCAR EXPERT

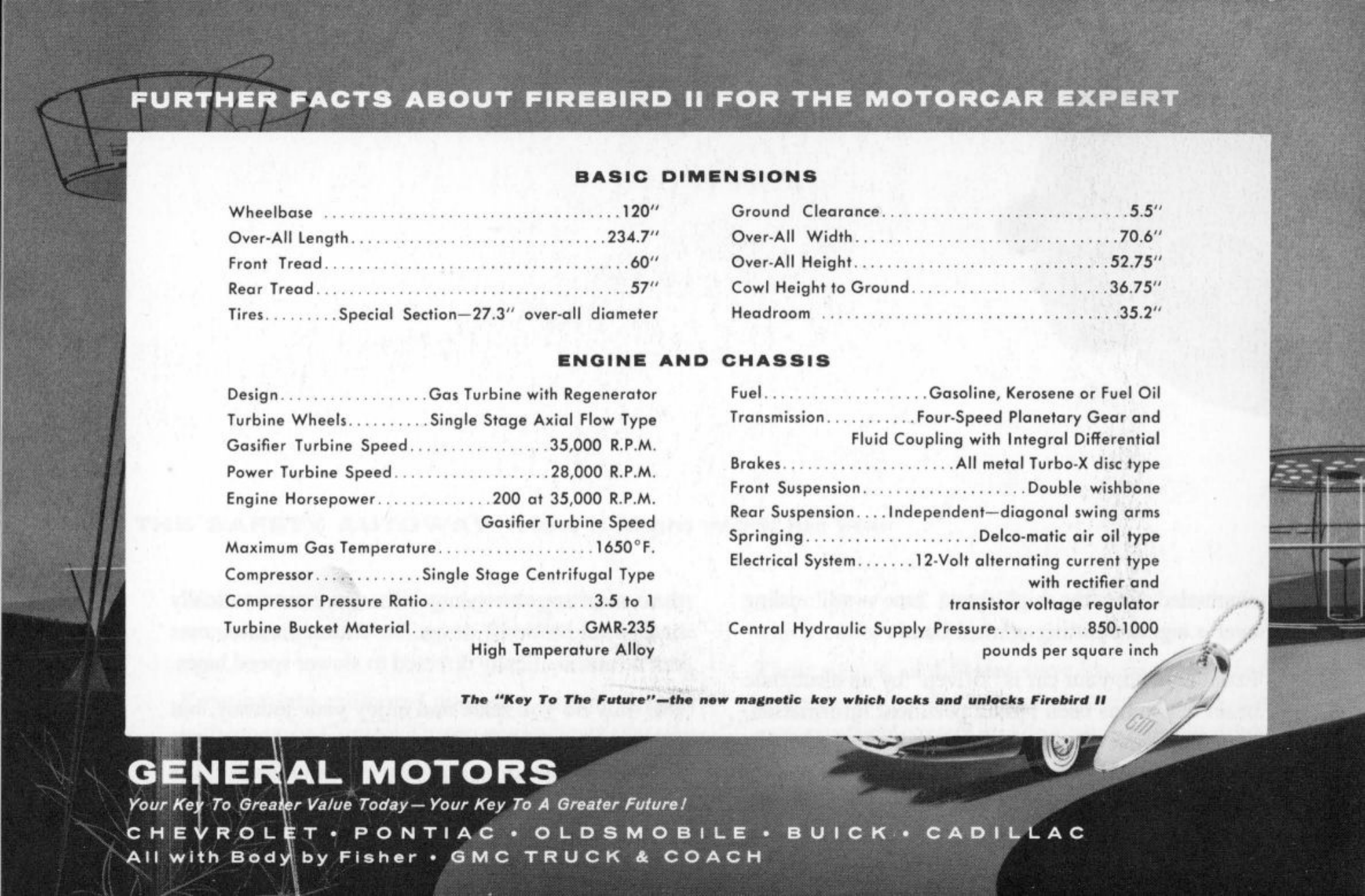
BASIC DIMENSIONS

Wheelbase	120"
Over-All Length	234.7"
Front Tread	60"
Rear Tread	57"
Tires	Special Section—27.3" over-all diameter
Ground Clearance	5.5"
Over-All Width	70.6"
Over-All Height	52.75"
Cowl Height to Ground	36.75"
Headroom	35.2"

ENGINE AND CHASSIS

Design	Gas Turbine with Regenerator
Turbine Wheels	Single Stage Axial Flow Type
Gasifier Turbine Speed	35,000 R.P.M.
Power Turbine Speed	28,000 R.P.M.
Engine Horsepower	200 at 35,000 R.P.M. Gasifier Turbine Speed
Maximum Gas Temperature	1650°F.
Compressor	Single Stage Centrifugal Type
Compressor Pressure Ratio	3.5 to 1
Turbine Bucket Material	GMR-235 High Temperature Alloy
Fuel	Gasoline, Kerosene or Fuel Oil
Transmission	Four-Speed Planetary Gear and Fluid Coupling with Integral Differential
Brakes	All metal Turbo-X disc type
Front Suspension	Double wishbone
Rear Suspension	Independent—diagonal swing arms
Springing	Delco-matic air oil type
Electrical System	12-Volt alternating current type with rectifier and transistor voltage regulator
Central Hydraulic Supply Pressure	850-1000 pounds per square inch

The "Key To The Future"—the new magnetic key which locks and unlocks Firebird II



GENERAL MOTORS

Your Key To Greater Value Today—Your Key To A Greater Future!

CHEVROLET • PONTIAC • OLDSMOBILE • BUICK • CADILLAC

All with Body by Fisher • GMC TRUCK & COACH