ENGINE CONTROL SYSTEM

■ DESCRIPTION

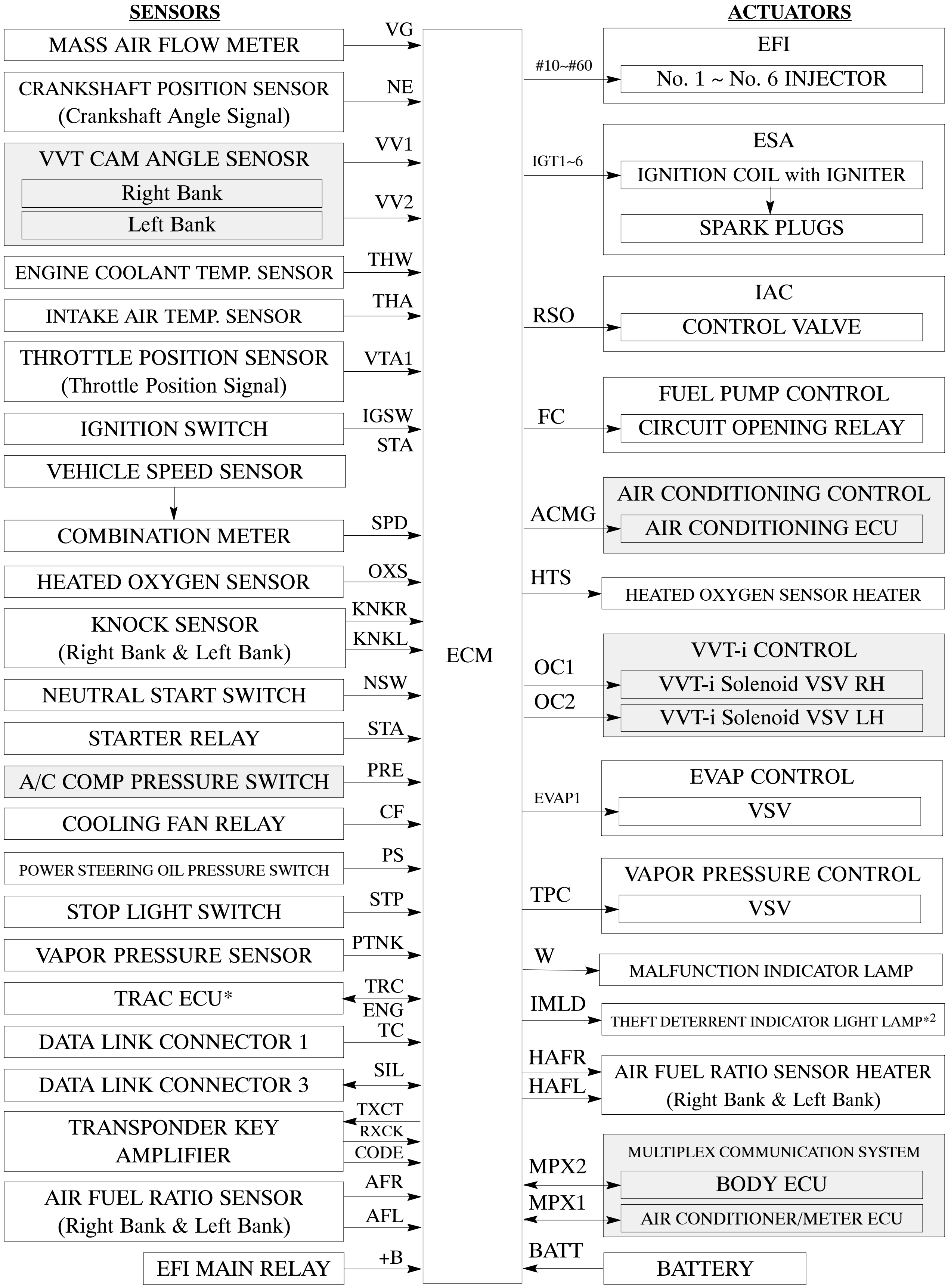
The construction and functions of the new 1MZ-FE engine includes the following modifications and additions in comparison with the 1MZ-FE engine installed on the '98 ES300 as the base:

System	Outline	RX300	'98 ES300
SFI (Sequential Multipot Fuel Injection)	The newly adopted L-type SFI system directly measures the intake air flow by means of the hot-wire type air flow meter.	○	○
	The newly adopted air assisted fuel injection system facilitates fuel atomization for the improvement of emission control performance and fuel economy.	○	○
ESA (Electronic Spark Advance)	Ignition timing is determined by the ECM based on signals from various sensors. Corrects ignition timing in response to engine knocking.	○	○
	The torque control correction during gear shifting has been used to minimized the shift shock.	○	○
	2 knock sensors are used to further improve knock detection.	○	○
IAC (Idle Air Control)	A rotary solenoid type IAC system controls the first idle and idle speeds.	○ (1-Coil Type)	○ (2-Coil Type)
VVT-i (Variable Valve Timing-intelligent)	Controls the intake camshaft to an optimal valve timing in accordance with the engine condition.	○	—
ACIS (Acoustic Control Induction System)	This system changes the intake manifold length over in three stages according to the engine rpm and throttle valve opening to improve the performance at all engine speeds.	○	—
Active Control Engine Mount	The damper characteristic of the front engine mount insulator is varied to reduce idling vibration.	○	—
A/F Sensor and Oxygen Sensor Heater Control	Maintain the temperature of the A/F sensor and oxygen sensors at an appropriate level to increase accuracy of detection of the oxygen concentration in the exhaust gas.	○	○
Air Fuel Ratio Feedback control	The precision air fuel ratio feedback control has been improved through the adoption of the air-fuel ratio sensor and oxygen sensor.	○	○*
Engine Immobilizer	Prohibits fuel delivery and ignition if an attempt is made to start the engine with an invalid ignition key.	○	○
Function to communicate with multiplex communication system	Communicates with the body ECM, A/C ECU, etc., on the body side, to input/output necessary signals.	○	—

*: Calfornia only

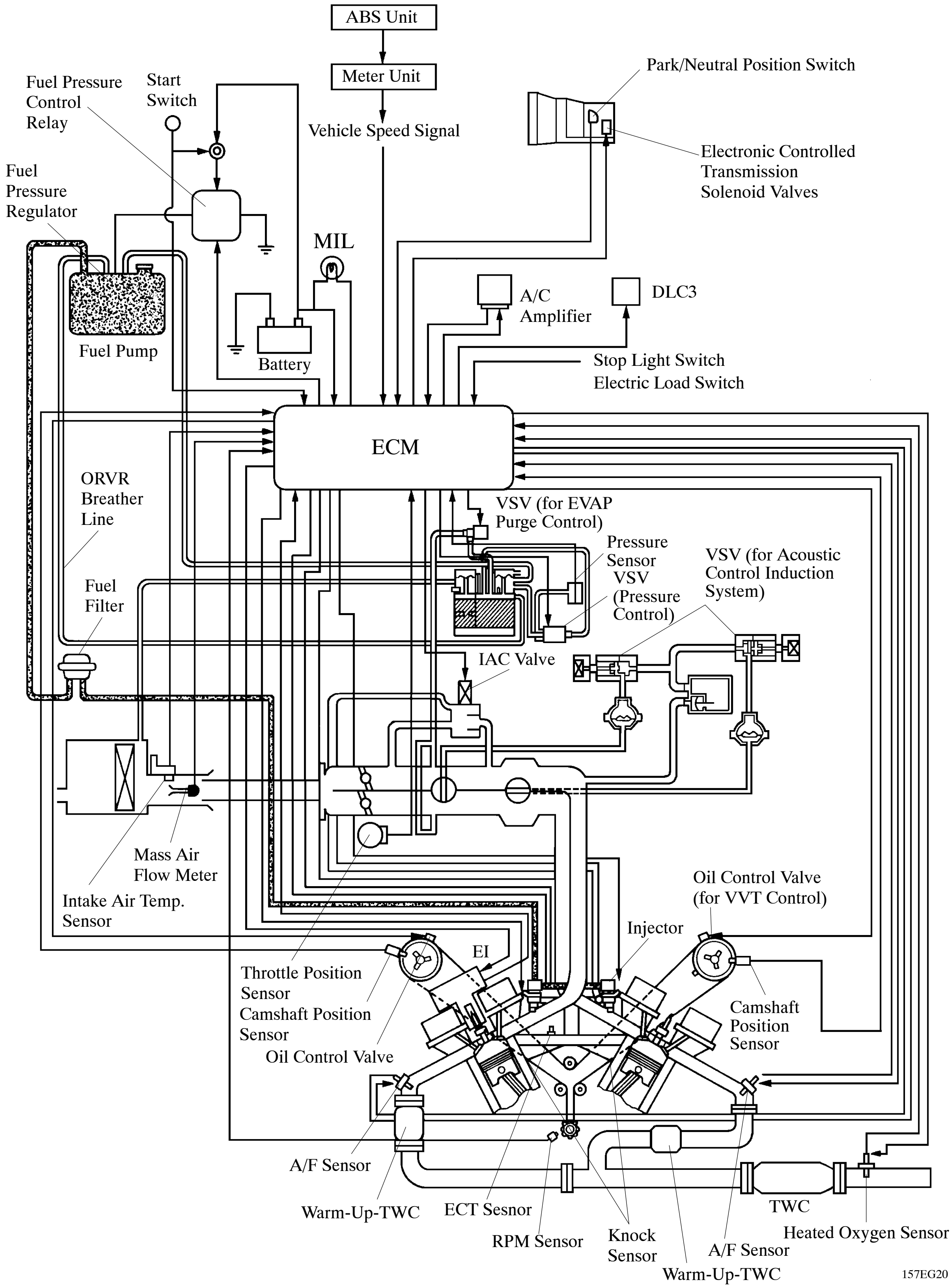
■ CONSTRUCTION

The configuration of the engine control system in the new 1MZ-FE engine for RX300 is as shown in the following chart. Shaded portions [ ] differ from the 1MZ-FE engine for '98 ES300.

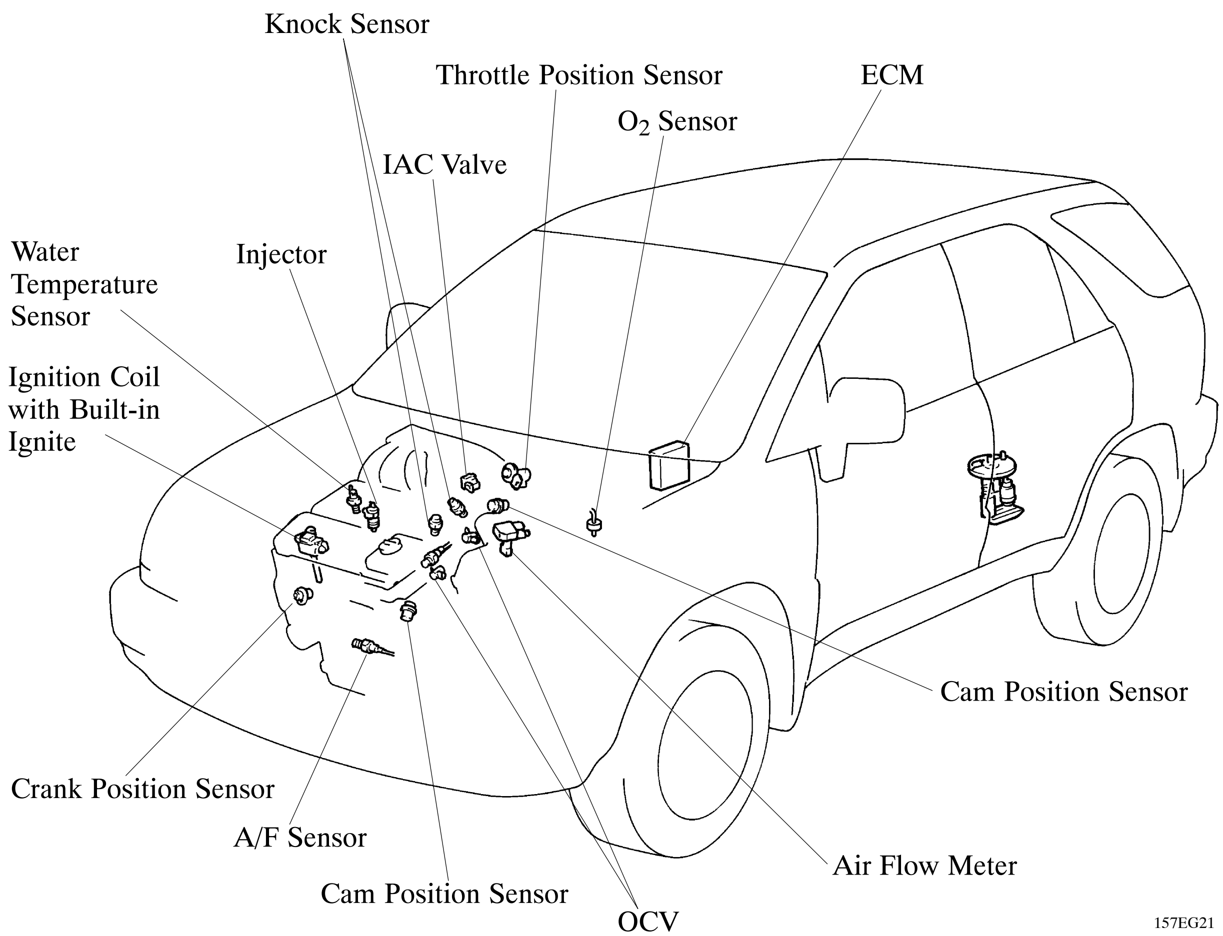


*: Applicable only to vehicles equipped with the TRAC System.

■ENGINE CONTROL SYSTEM DIAGRAM



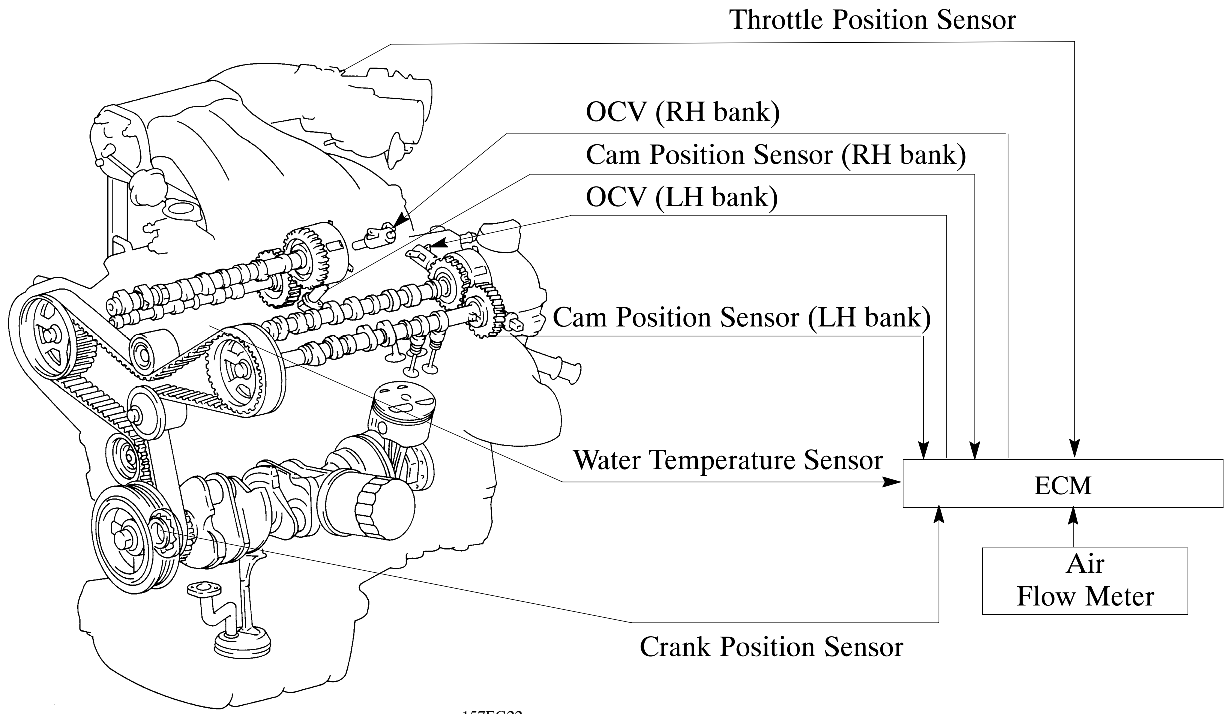
■ LAYOUT OF COMPONENTS



■ VVT-i CONTROL SYSTEM

General

- This system controls the intake camshaft valve timing so as to obtain balance between the engine output, fuel consumption and emission control performance. The actual intake side valve timing is fed back by means of the cam position sensor for constant control to the target valve timing.



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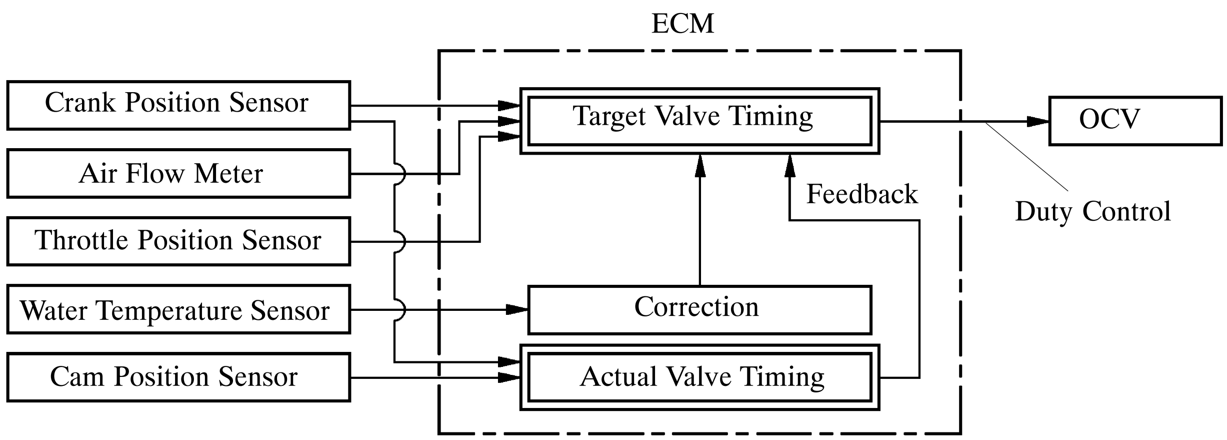

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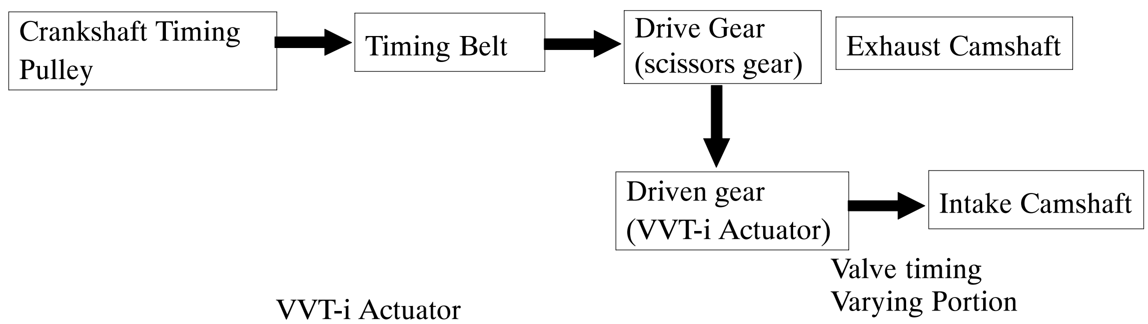
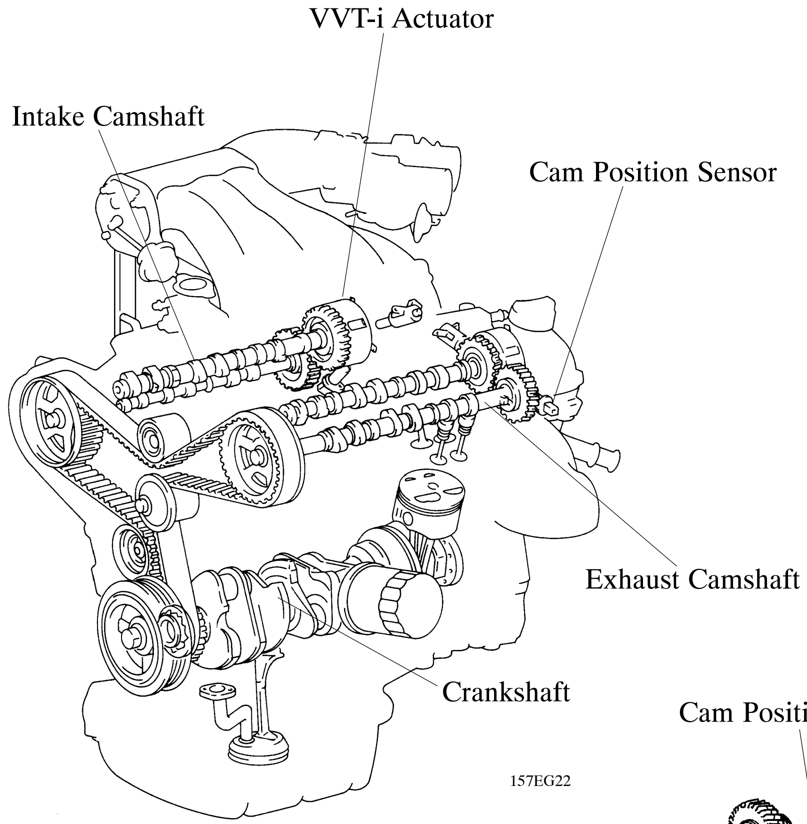
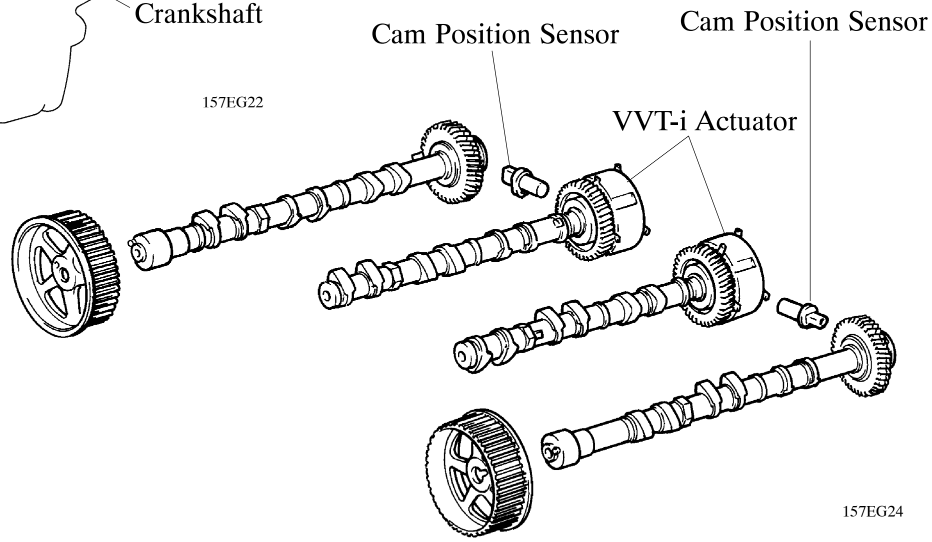
■ CONSTRUCTION AND FUNCTIONS

Construction

The camshaft on the exhaust side is driven by the timing belt from the crankshaft pulley, and the camshaft on the intake side is driven by the gear train from the exhaust side.
The camshaft drive gear (exhaust side) is combined with a scissors gear to reduce the gear noise due to torque variation. The camshaft driven gear (intake side) is integrated with the VVT-i actuator to vary the intake camshaft valve timing.



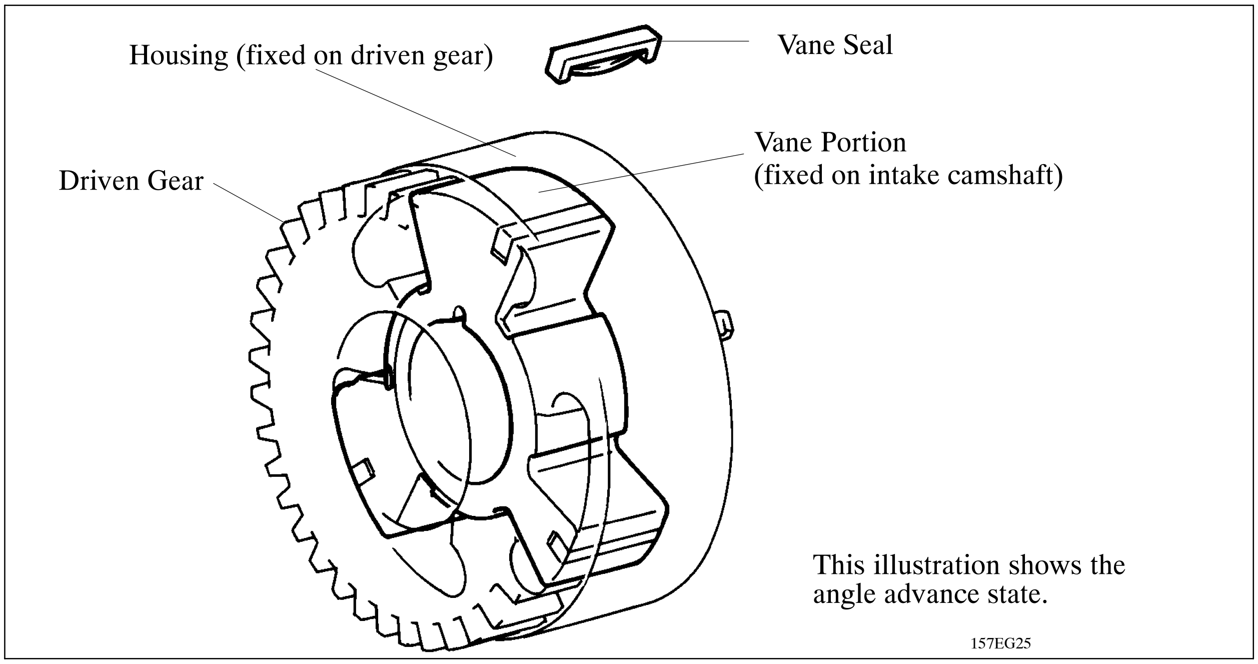




The ECM distributes the pressure generated by the oil pump into the advance side and retard side by means of the OCV (oil control valve) installed on the side wall of the cylinder head for adjusting the pressures before and after the VVT-i controller vane to control the intake camshaft phase.

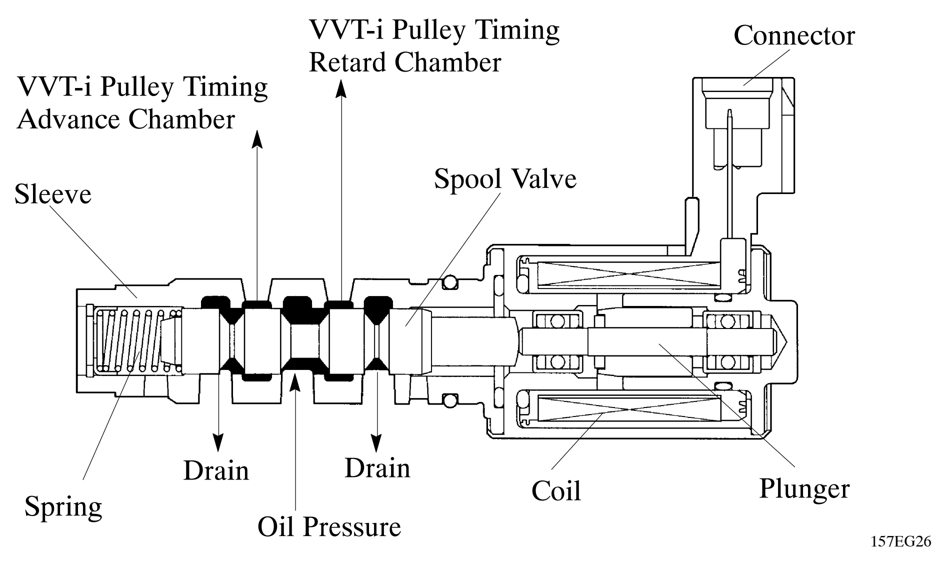
VVT-i Controller

This controller consists of the housing driven from the exhaust camshaft and the vane coupled with the intake camshaft.
The oil pressure sent from the advance or retard side path at the intake camshaft causes rotation in the VVT-i controller vane circumferential direction to vary the intake valve timing continuously.



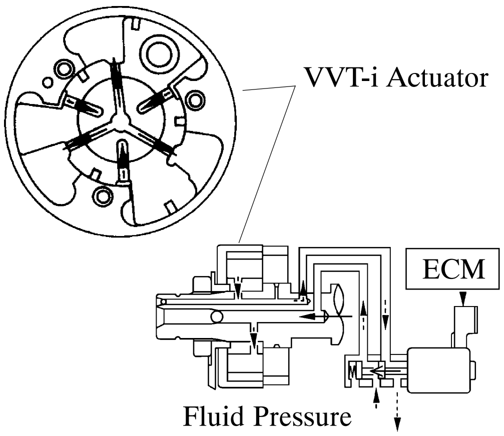
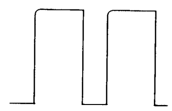
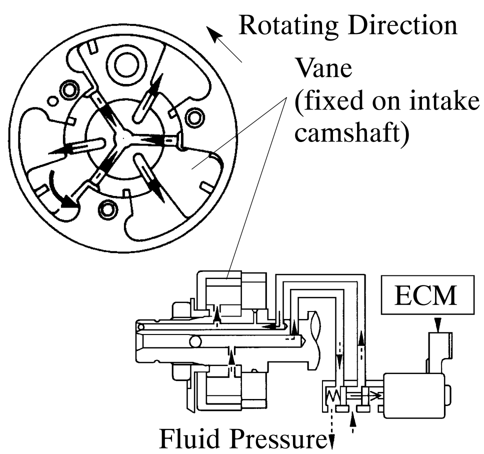
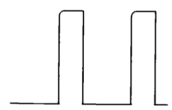
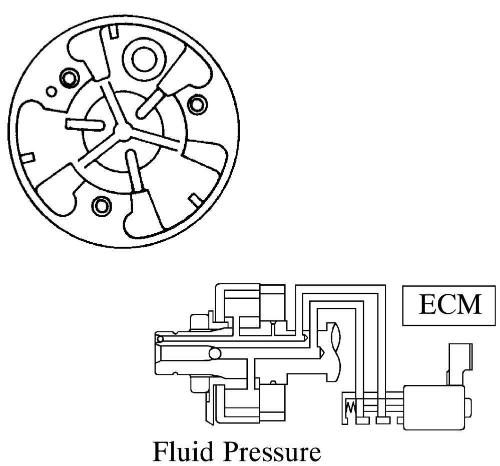
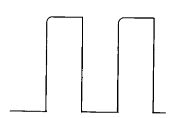
OCV (Oil Control Valve)

The oil control valve spool position is varied to constantly obtain the optimum valve timing according to the duty signal sent from the ECM.
The latest timing position is set by the spring force while the engine is stopped.



Operation (Hydraulic System)

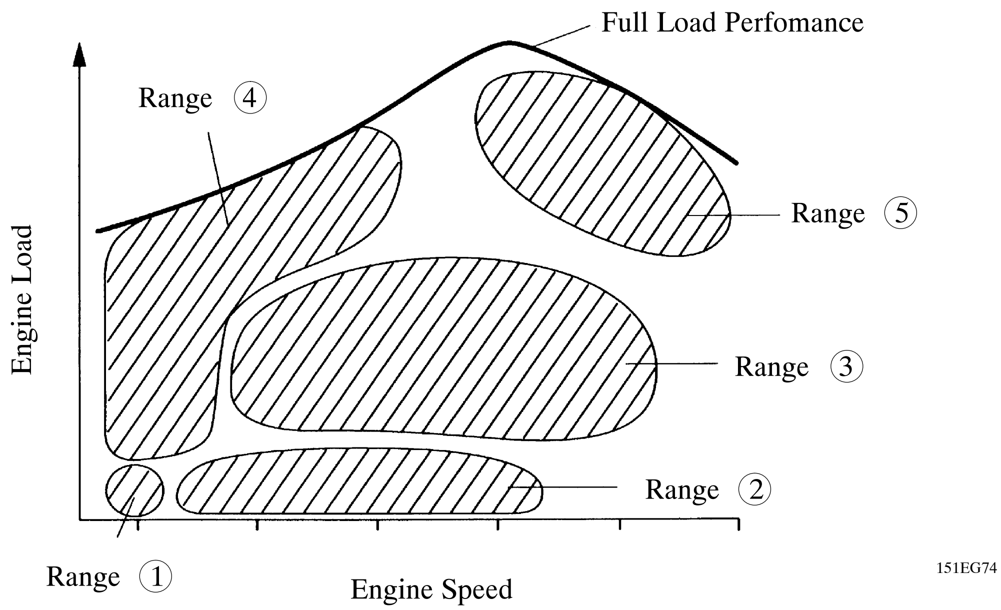
The OCV selects the path to the VVT-i actuator according to the advance, retard or hold signal from the ECM. The VVT-i actuator rotates the camshaft in the timing advance or retard position or holds it according to the position where the fluid pressure is applied.

	Operation	OCV drive signal	Description
Advance	 157EG27 157EG28	Advance Signal  Duty Ratio 157EG35	When the OCV is positioned as illustrated at left by the advance signal from the ECM, the resultant fluid pressure is applied to the timing advance side vane chamber to rotate the camshaft in the timing advance direction.
Delay	 157EG29 157EG30	Retard Signal  Duty Ratio 157EG36	When the OCV is positioned as illustrated at left by the retard signal from the ECM, the resultant fluid pressure is applied to the timing retard side vane chamber to rotate the camshaft in the timing retard direction.
Hold	 157EG31 157EG32	Hold Signal  Duty Ratio 157EG37	The ECM calculates the target timing angle according to the traveling state to perform control as described above. After setting at the target timing, the valve timing is held by keeping the OCV in the neutral position unless the traveling state changes. This adjusts the valve timing at the desired target position and prevents the engine oil from running out when it is unnecessary.

ECM

In proportion to the engine speed, intake air volume, throttle position and coolant temperature, the ECM searches an optimal valve timing under each driving condition and control the camshaft timing oil control valve. In addition, ECM uses signal from the VVT sensors and the crankshaft position sensor to detect the actual valve timing, thus performing feedback control to achieve the target valve timing.

▶ Operation During Various Driving Condition ◀



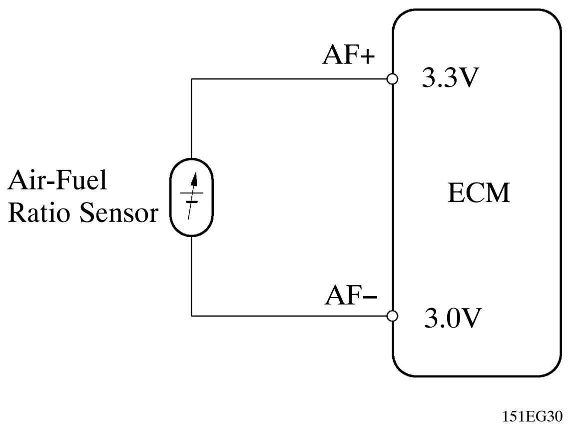
Operation state	Range	Valve timing	Objective	Effect
During idling	①	IN EX Latest timing	Eliminating overlap to reduce blow back to the intake side	Stabilized idling rpm Better fuel economy
At light load	②	→IN EX To retard side	Decreasing overlap to eliminate blow back to the intake side	Ensured engine stability
At medium load	③	← IN EX To advance side	Increasing overlap to increase internal EGR for pumping loss elimination	Better fuel economy Improved emission control
In low to medium speed range with heavy load	④	IN← EX To advance side	Advancing the intake valve close timing for volumetric efficiency improvement	Improved torque in low to medium speed range
In high speed range with heavy load	⑤	IN → EX To retard side	Retarding the intake valve close timing for volumetric efficiency improvement	Improved output
At low temperatures	—	IN EX Latest timing	Eliminating overlap to prevent blow back to the intake side for reduction of fuel increase at low temperatures, and stabilizing the idling rpm for decreasing fast idle rotation	Stabilized fast idle rpm Better fuel economy
Upon starting/ stopping the engine	—	IN EX Latest timing	Eliminating overlap to eliminate blow back to the intake side	Improved startability

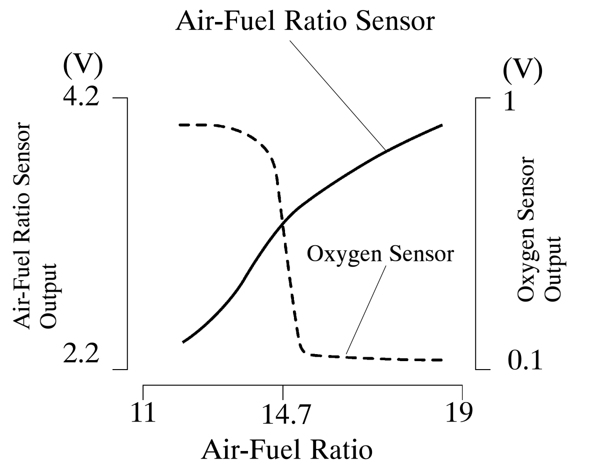
■SFI (Sequential Multipot Fuel Injection) SYSTEM

- The L-type SFI system is adopted to adjust fuel injection volume by directly measuring the intake air flow with a hot-wire type air flow meter.
- An air assist type fuel injection system is adopted to improve emission control and fuel economy be facilitating fuel atomization.

Air-Fuel Ratio and Feedback Control

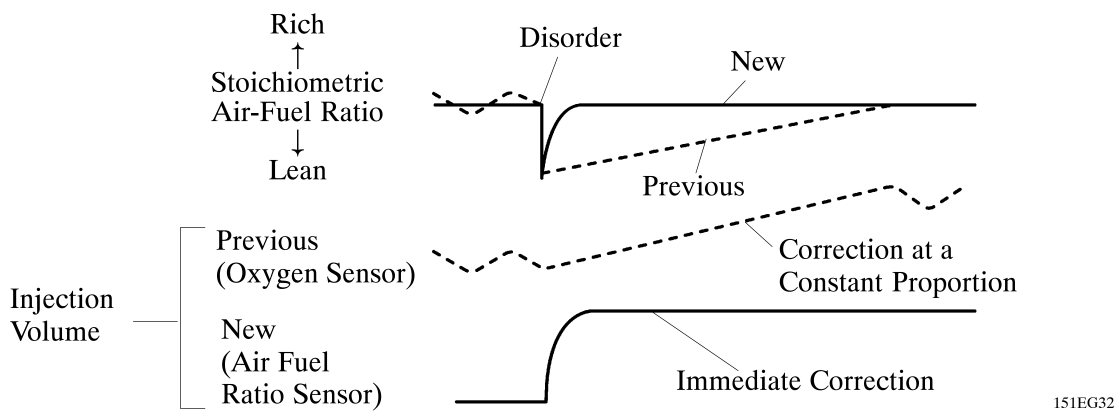
As illustrated below, the conventional oxygen sensor is characterized by a sudden change in its output voltage at the threshold of the stoichiometric air-fuel ratio (14.7 to 1). In contrast, the air-fuel ratio sensor output a voltage that is approximately proportionate to the existing air-fuel ratio by converting the oxygen density to the voltage. As a result, the detection precision of the air-fuel ratio has been improved.





Output Characteristics

The precision of the air-fuel feedback control has been improved through the adoption of the air-fuel ratio sensor. As illustrated below, if the existing air-fuel ratio diverts from the stoichiometric air-fuel ratio, the conventional oxygen sensor used to correct the air-fuel ratio at a constant proportion. However, with the air-fuel ratio sensor, the ECM can determine the extent of diversion from the stoichiometric air-fuel ratio and execute an immediate correction.



■ ACIS (ACOUSTIC CONTROL INDUCTION SYSTEM) CONTROL

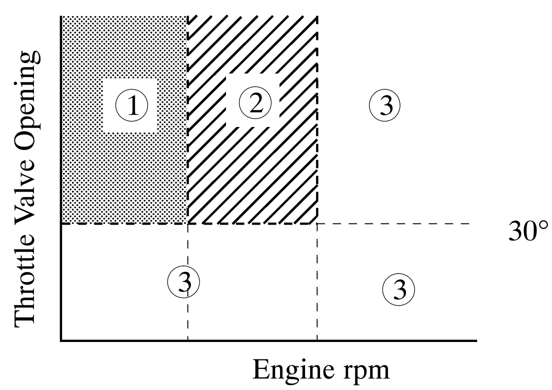
General

The ECM intake control valve is opened/closed according to the engine rpm and throttle valve opening to vary the intake manifold length in three stages for improving the torque under heavy load in the medium speed range.

Operation

Relationships between engine rpm and throttle valve opening

1 Engine speed below 2,700 rpm and throttle valve opening at 30 degrees or more (Low speed range with heavy load)
2 Engine speed between 2,700 and 3,700 rpm and throttle valve opening at 30 degrees or more (Medium speed range with heavy load)
3 Engine speed up to 3,700 rpm with throttle valve opening at 30 degrees or less, and full range with engine speed above 3,700 rpm (Idling range, light load range and high speed range)



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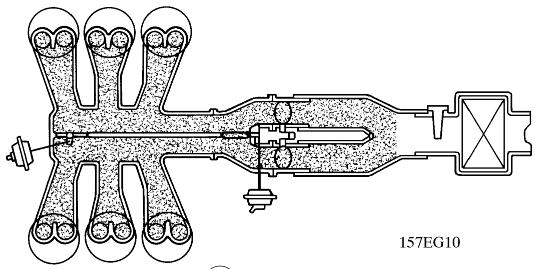

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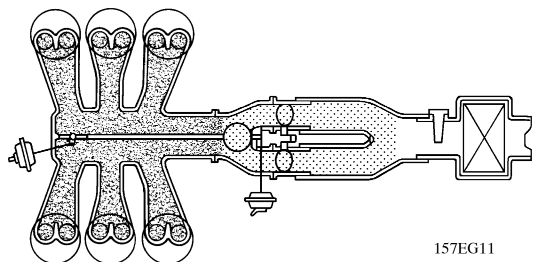
① Low speed range with heavy load



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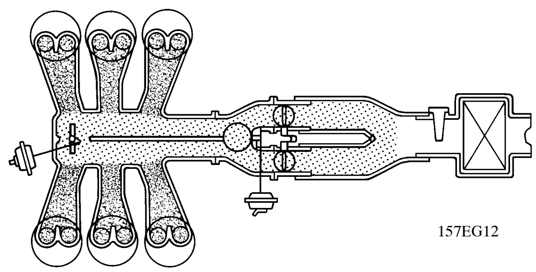
② Medium speed range with heavy load



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③ Idling range, light load range and high speed range