ENGINE

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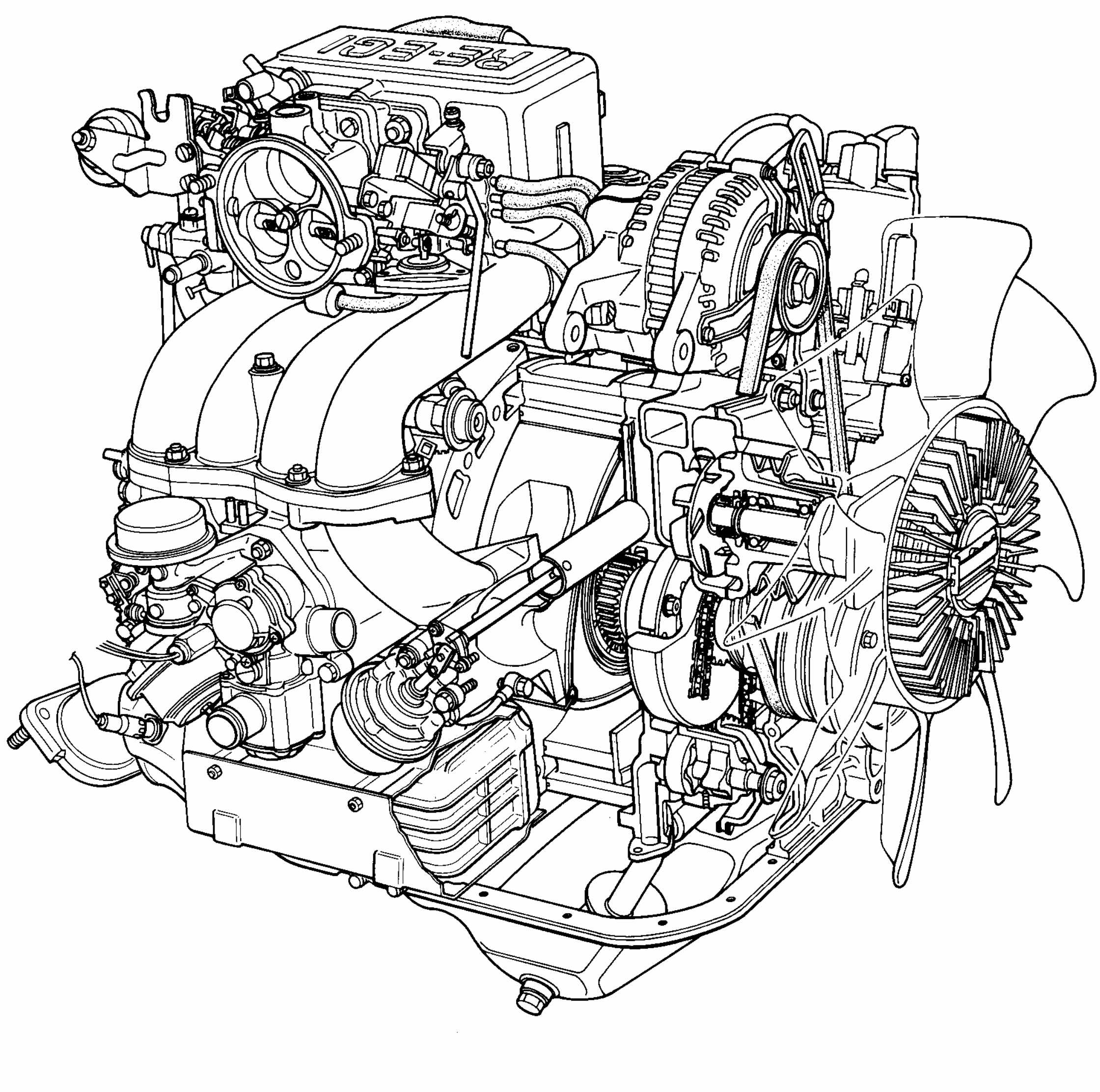
OUTLINE

OUTLINE OF CONSTRUCTION

- Two types of rotary engine have been equipped for the 1984 RX-7 models: the 13B and 12A engines.
- Ribs have been added to the rotor housing, and the plating of the rotor housing trochoid surface has been changed.
- The rotor has been coated with a special SM (soft material) seat.

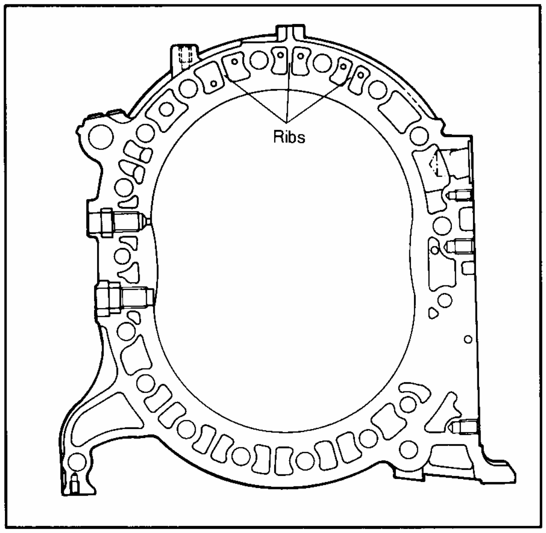
STRUCTURAL VIEW

13B engine



SPECIFICATIONS

<table>
<tr><td colspan="3">Engine model</td><td colspan="2">13B</td><td>12A</td></tr>
<tr><td colspan="3">Type</td><td colspan="3">Rotary engine</td></tr>
<tr><td colspan="3">Displacement cc (cu. in)</td><td colspan="2">654 x 2 (40.0 x 2)</td><td>573 x 2 (35.0 x 2)</td></tr>
<tr><td colspan="3">Number of cylinders and arrangement</td><td colspan="3">2 rotors, longitudinal</td></tr>
<tr><td colspan="3">Combustion chamber type</td><td colspan="3">Bath tub</td></tr>
<tr><td colspan="3">Compression ratio</td><td colspan="2">9.4 : 1</td><td>9.4 : 1</td></tr>
<tr><td colspan="3">Maximum power (HP/rpm)</td><td colspan="2">135/6,000</td><td>101/6,000</td></tr>
<tr><td colspan="3">Maximum torque (lb-ft/rpm)</td><td colspan="2">133/2,750</td><td>107/4,000</td></tr>
<tr><td rowspan="8">Port timing</td><td rowspan="6">Intake</td><td rowspan="3">Open ATDC</td><td>Primary</td><td>32°</td><td rowspan="2">32°</td></tr>
<tr><td>Secondary</td><td>32°</td></tr>
<tr><td>Auxiliary</td><td>45°</td><td>–</td></tr>
<tr><td rowspan="3">Close ABDC</td><td>Primary</td><td>40°</td><td rowspan="2">40°</td></tr>
<tr><td>Secondary</td><td>30°</td></tr>
<tr><td>Auxiliary</td><td>70°</td><td>–</td></tr>
<tr><td rowspan="2">Exhaust</td><td>Open BBDC</td><td colspan="2">71°</td><td>75°</td></tr>
<tr><td>Close ATDC</td><td colspan="2">48°</td><td>38°</td></tr>
<tr><td colspan="3">Fuel supply system</td><td colspan="2">EGI (Electronic gasoline injection)</td><td>Carburator</td></tr>
<tr><td colspan="2" rowspan="2">Ignition timing</td><td>Trailing</td><td colspan="2">20° ATDC (RED)</td><td>20° ATDC (RED)</td></tr>
<tr><td>Leading</td><td colspan="2">5° ATDC (YELLOW)</td><td>0° TDC (YELLOW)</td></tr>
<tr><td colspan="3">Idling rpm</td><td colspan="2">800</td><td>750</td></tr>
</table>

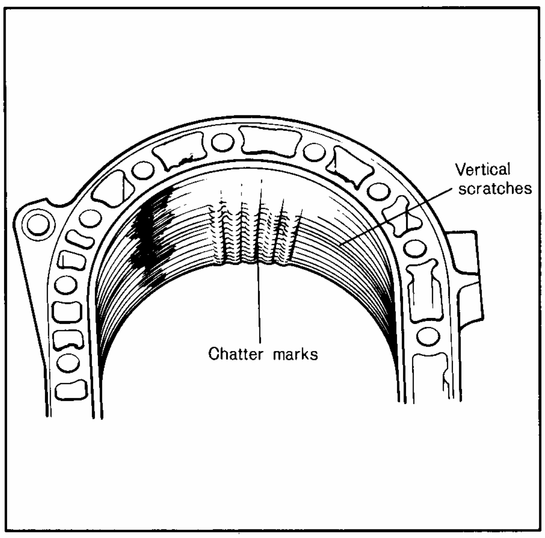


ROTOR HOUSING

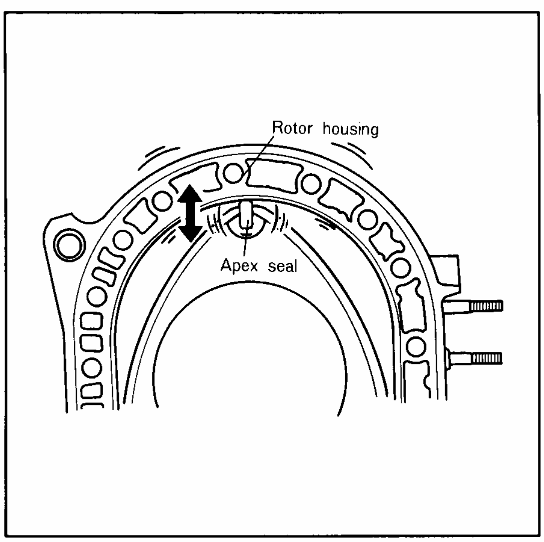
Addition of ribs (13B and 12A engines)

As shown in the figure at the left, ribs have been added at three places to the rotor housing.

The reason is to prevent vertical scratches and "chatter marks" on the rotor housing trochoid surface.



"Chatter marks" are the wavy, stepped wear which occurs on the rotor housing trochoid surface, and vertical scratches are, as their name indicates, scratches made by the apex seal in the rotor's direction of rotation.



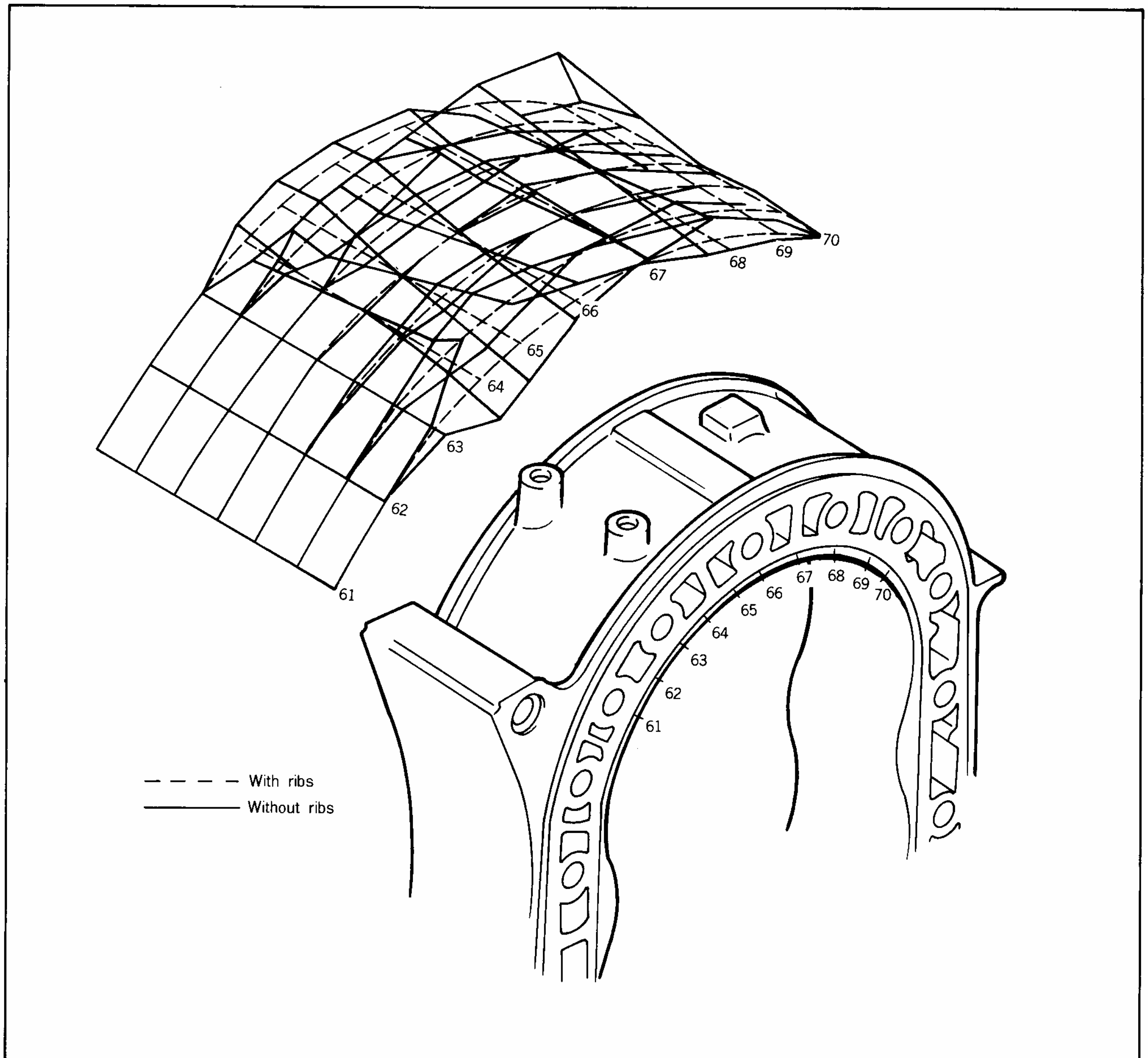
One of the primary causes of the chatter marks and vertical scratches, the sympathetic vibration (resonance) of the apex seal and rotor housing, was clarified by experiments.

This sympathetic vibration (resonance) is a result of the individual specific vibrations, which mutually amplify each other.

For the rotary engine, if there is resonance of the apex seal and the rotor housing, the apex seal beats against the rotor housing trochoid surface as it moves, with the result that such chatter marks and vertical scratches easily occur.

Structural analysis of the rotor housing

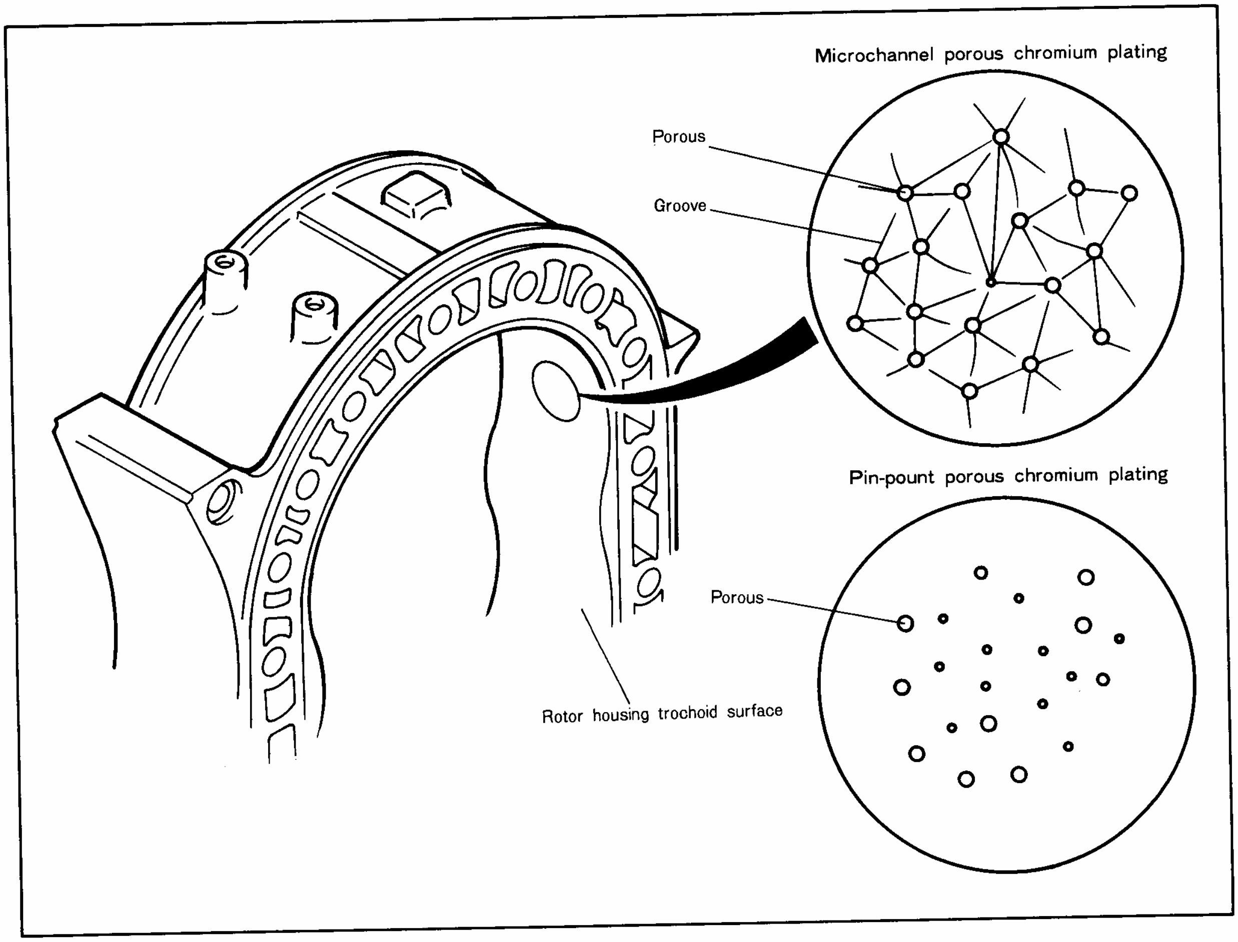
Thus, ribs have been added to the rotor housing and, by increasing the hardness, the specific vibration characteristic is changed, with the result that, during ordinary driving, resonance does not occur.
The figure below is an analysis of the construction of the rotor housing, with and without the ribs.
As can be clearly seen, there is little vibration for the rotor housing to which ribs have been added.



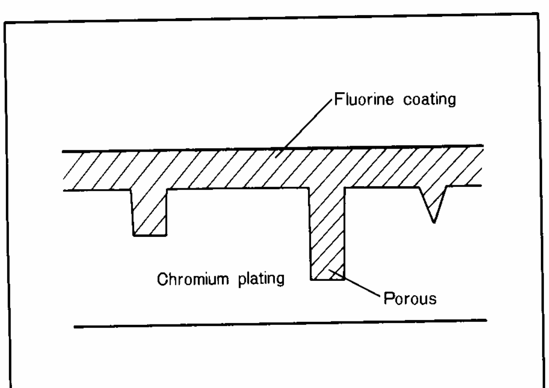
Plating changes of rotor housing trochoid surface (13B and 12A engines)

Microchannel porous chromium plating

The plating of the rotor housing trochoid surface has been changed from pin-point porous chromium plating to microchannel porous chromium plating.



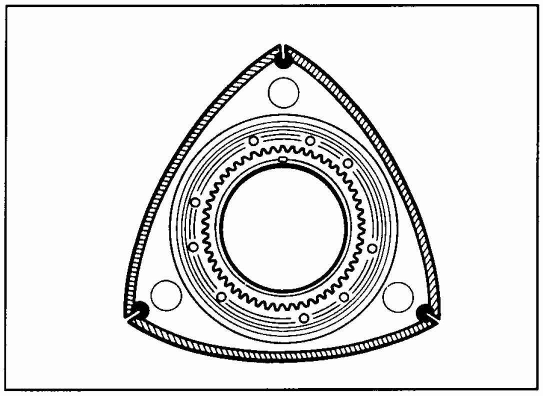
The objectives of microchannel porous chromium plating are to improve the oil retention of the rotor housing trochoid surface and to prevent chatter marks and vertical scratches caused by the apex seal. And, in addition, the plating hardness is increased by 20%, thus improving the durability of the rotor housing.



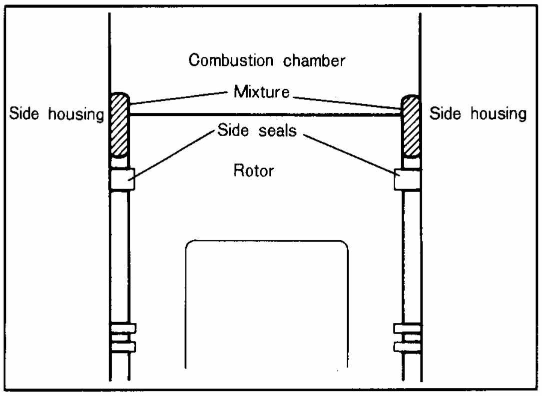
Fluorine coating (13B engine only)

For the 13B engine, a fluorine coating is applied to the rotor housing trochoid surface after the microchannel porous chromium plating process. This coating results in a great improvement in the initial seating between the apex seals and the rotor housing.

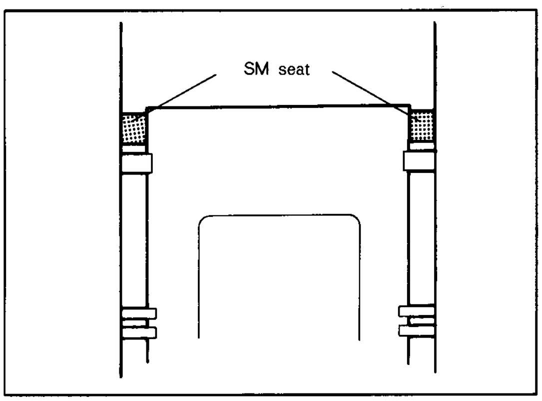
ROTOR



SM (soft material) seat (13B and 12A engines)
In order to reduce the amount of incombusted gases, a SM (soft material) seat is coated on the outer side of the rotor side seal (shown by the shaded area in the figure at the left). This SM (soft material) seat is made of a special resin, and is baked on at high temperature.



For the former rotor, the mixed gases (HC) in the shaded areas in the figure at the left were not completely burned, because of the low surrounding temperature, and were exhausted to the catalyst converter where they were oxidized.

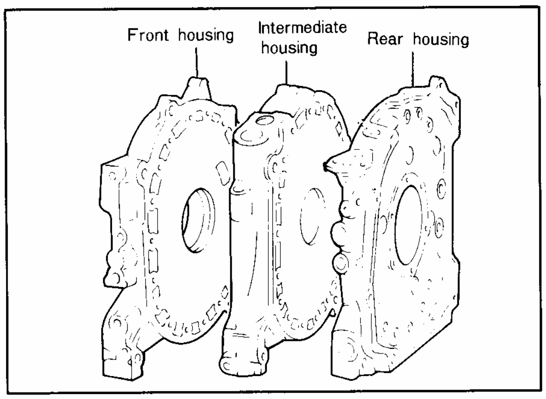


In order to even further improve the exhaust gas performance therefore, this SM (soft material) is coated, thus preventing mixture from reaching the zone where combustion is difficult, and thereby preventing the generation of incombusted gases.

Service point
Do not use a wire brush or similar tool for cleaning the SM (soft material) seat, because it will scrape off the coating.

ENGINE DEVELOPMENT

The RX-7 equipped with the 12A rotary engine was placed on sale in October of 1978. Its styling and driving safety, matched by its engine performance, soon won for it a high reputation, a reputation which is still just as high today.
To this model, the 13B EGI (Electronic Gasoline Injection) engine has been added for 1984.
We want to take this opportunity to briefly outline the development of the 12A rotary engine.
The following is the chronological order of that development.

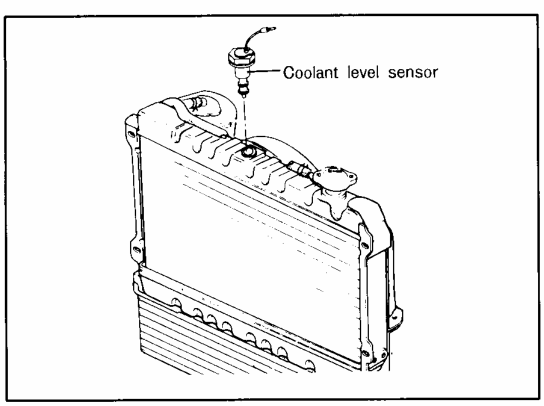


1979 MODELS

FRONT HOUSING, INTERMEDIATE HOUSING AND REAR HOUSING

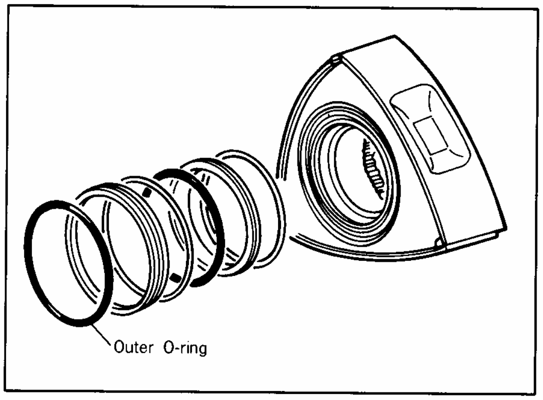
To prevent wear of the oil seal, corner seal and side seal, the REST (Rotary Engine Surface Treatment) process was used on the front housing, etc.

In the REST process, the surfaces of the front housing, etc., were subjected to nitrogen gas treatment in a special, high-temperature oven in order to harden these surfaces.



ENGINE COOLANT LEVEL SENSOR

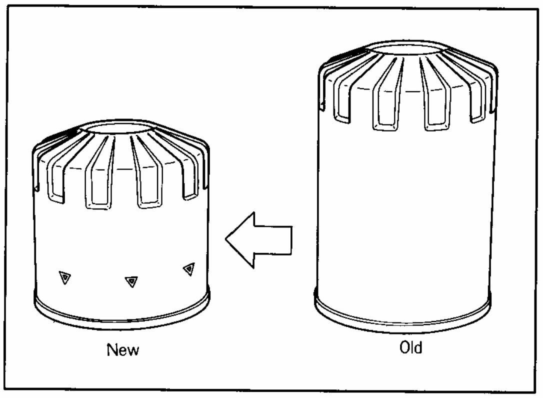
An engine coolant level sensor was equipped at the upper part of the radiator, and a warning light was installed in the instrument panel, in order to warn the driver of a drop in the amount of engine coolant and thus to prevent engine overheating.



1980 MODELS

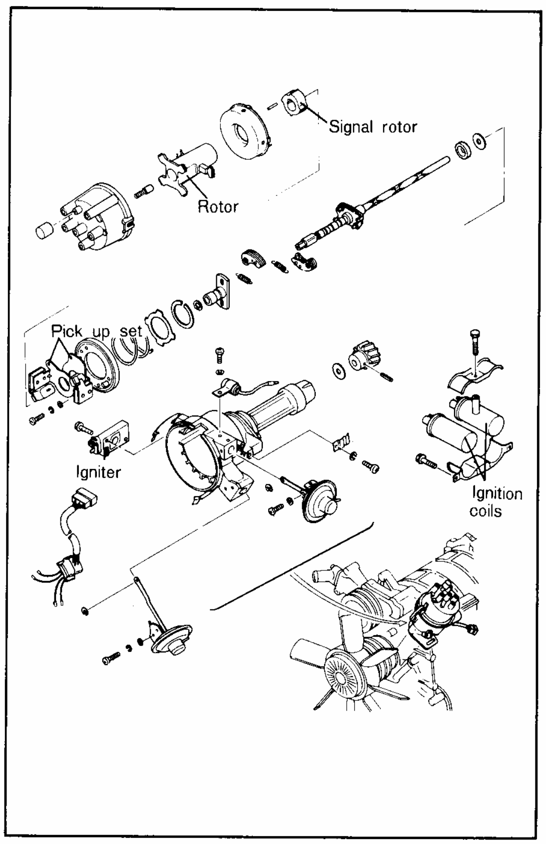
OUTER "O"-RING (rotor)

The material of the outer O-ring was changed from silicone rubber to a fluoric rubber with outstanding heat-resistance properties, thus improving the durability of the O-ring.



OIL FILTER CARTRIDGE

The length of the oil filter cartridge was changed from 120 mm to 80 mm, and the oil capacity was changed from 0.4 liters to 0.3 liters, thus reducing weight.



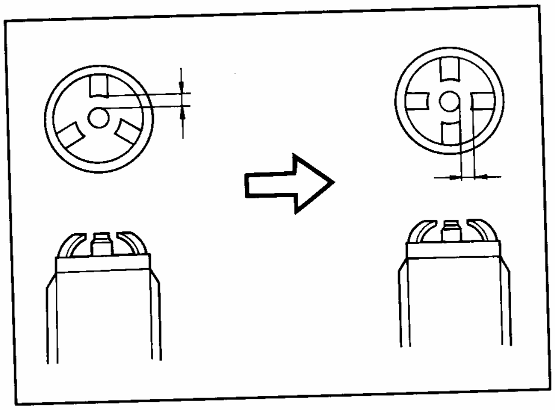
IGNITION SYSTEM

Distributor and Ignition Coil

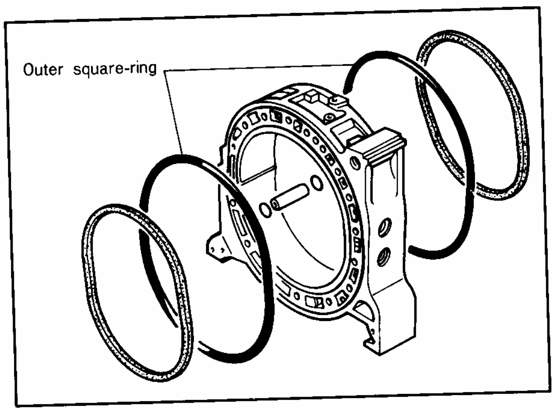
The high energy ignition system is adopted to:
increase the ignition ability.
improve fuel economy.
improve starting ability.
improve reliability.

Item \ Model		1981	1980
Breaker type		Pointless (igniter)	Point
Ignition coil	Primary resistance	1.15 Ω	1.4 Ω
	Secondary resistance	10.2 kΩ	9.3 kΩ
	Resistor resistance	–	1.6 Ω

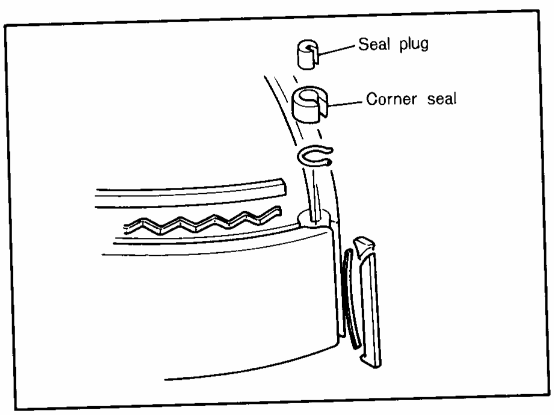
1981 MODELS



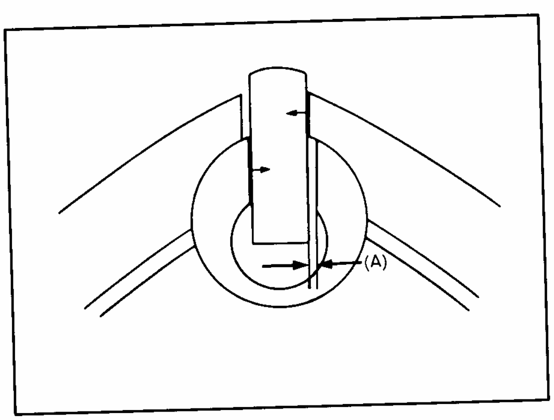
SPARK PLUGS
For easier sparking, the 4-pole ground electrode type of spark plugs were adopted, thereby reducing uncombusted gases and protecting the catalyst.



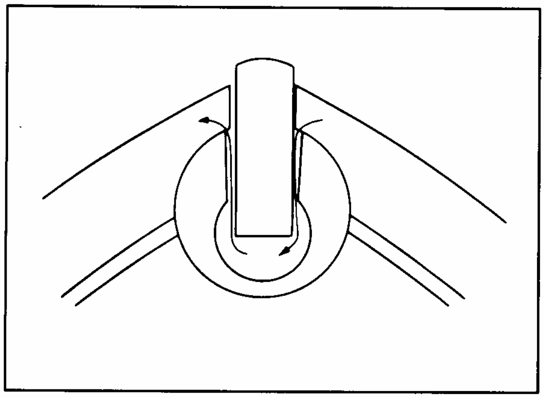
OUTER SQUARE RING (rotor housing)
The material of the outer square ring was changed from E619 to E680, thus improving the durability of the outer square ring.



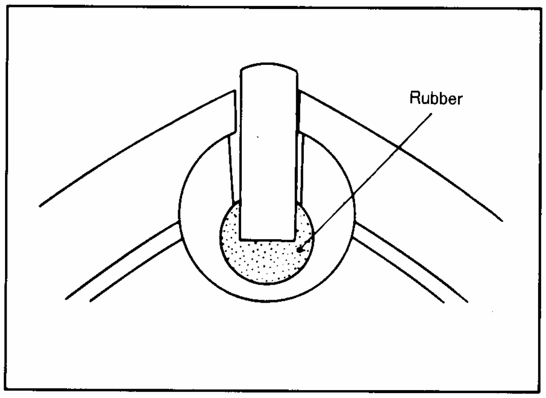
CORNER SEAL PLUG
1. A corner seal plug was added inside the corner seal, thus reducing the gas leakage from the gap between the apex seal and the corner seal.



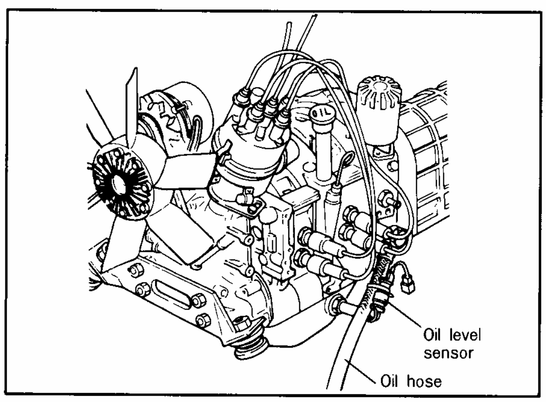
2. If the gap (A) between the apex seal and the corner seal is reduced to a certain value or less, the apex seal would be pressed on both the rotor groove and the corner seal, movement would be hindered, and the seal's performance would be reduced.



3. For that reason, it was necessary that the width of the groove of the apex seal used on the corner seal be greater than the groove in the rotor. But by doing so, a gap between the groove of the apex seal of the corner seal and the apex seal itself developed at both sides of the seal, and gases could easily escape from these gaps.

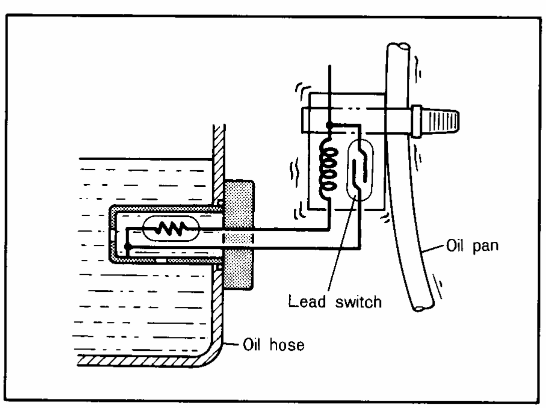


4. In order to prevent this, a rubber seal was added to the corner seal, as shown in the figure. This seal acted, without cramping the apex seal even if there was a slight manufacturing error of the groove width or the seal width, to maintain constant contact and to maintain airtightness. As a result, fluoric rubber, with outstanding resilience and excellent heat-resistance properties, is used.

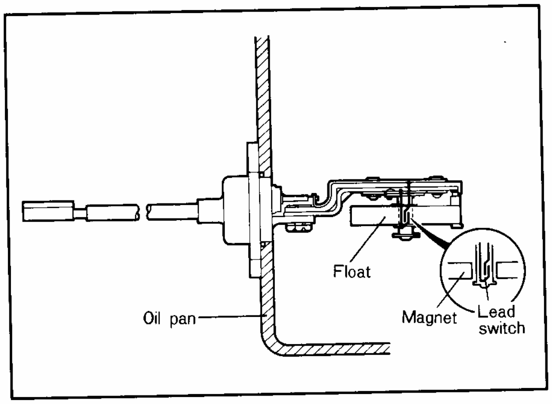


OIL LEVEL SENSOR

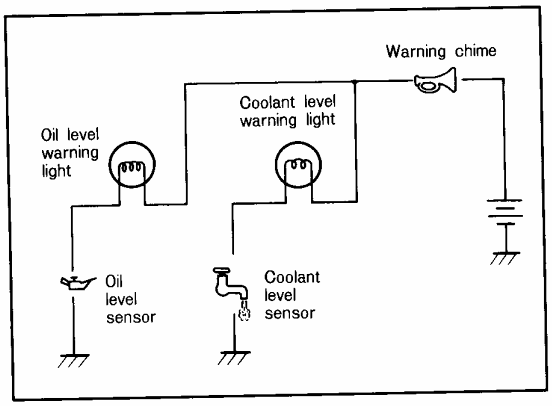
1. The oil level sensor was changed from the thermistor type to the float type, thus improving performance.



2. The lead switch of the thermistor type was clamped to the oil hose, with the result that engine vibrations were transmitted through the lead wiring to the lead switch, causing incorrect operation.



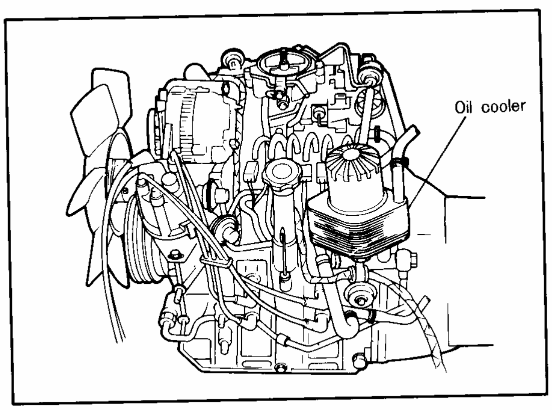
3. The float type has a magnet inside the lead switch, thus improving performance resulting from engine vibration.



1982 MODELS

ENGINE COOLANT LEVEL AND ENGINE OIL LEVEL WARNING CHIME

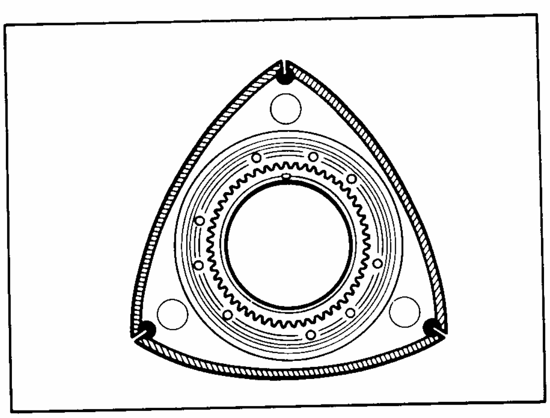
Formerly, a warning light was used, but a warning chime was added in order to increase the warning effect and capability.



1983 MODELS

OIL COOLER

A water-cooled oil cooler was adopted to reduce weight.



ROTOR

In order to reduce the amount of incombusted gases, a SM (soft material) seat is coated on the outer side of the rotor side seal (shown by the shaded area in the figure at the left). This SM (soft material) seat is made of a special resin, and is baked on at high temperature.

LUBLICATING SYSTEM

OUTLINE 2–2
OUTLINE OF CONSTRUCTION 2–2
OIL FLOWCHART 2–2
SPECIFICATIONS 2–3
METERING OIL PUMP 2–4
OIL PRESSURE VALVE SPRING 2–8

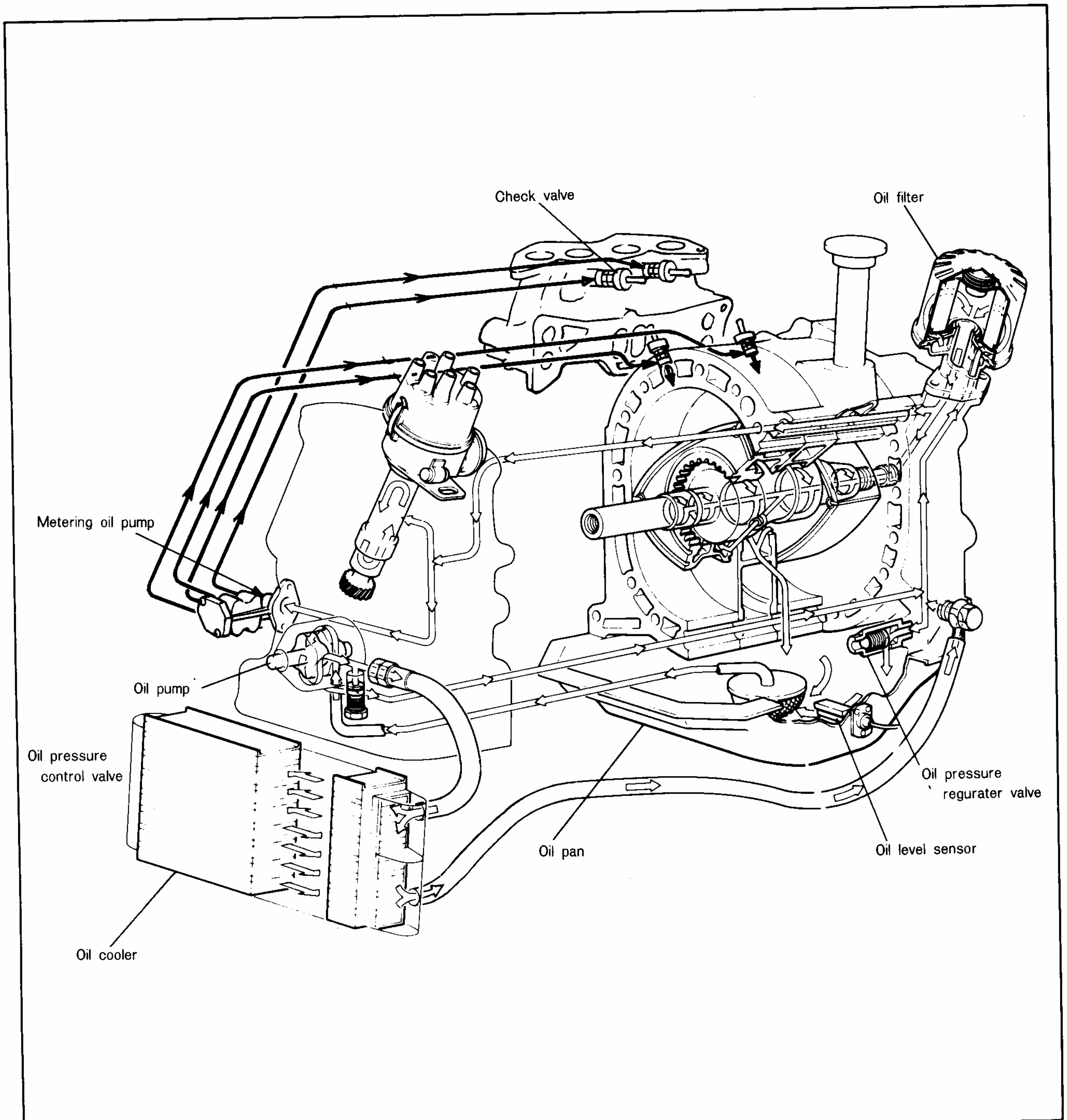
OUTLINE

OUTLINE OF CONSTRUCTION

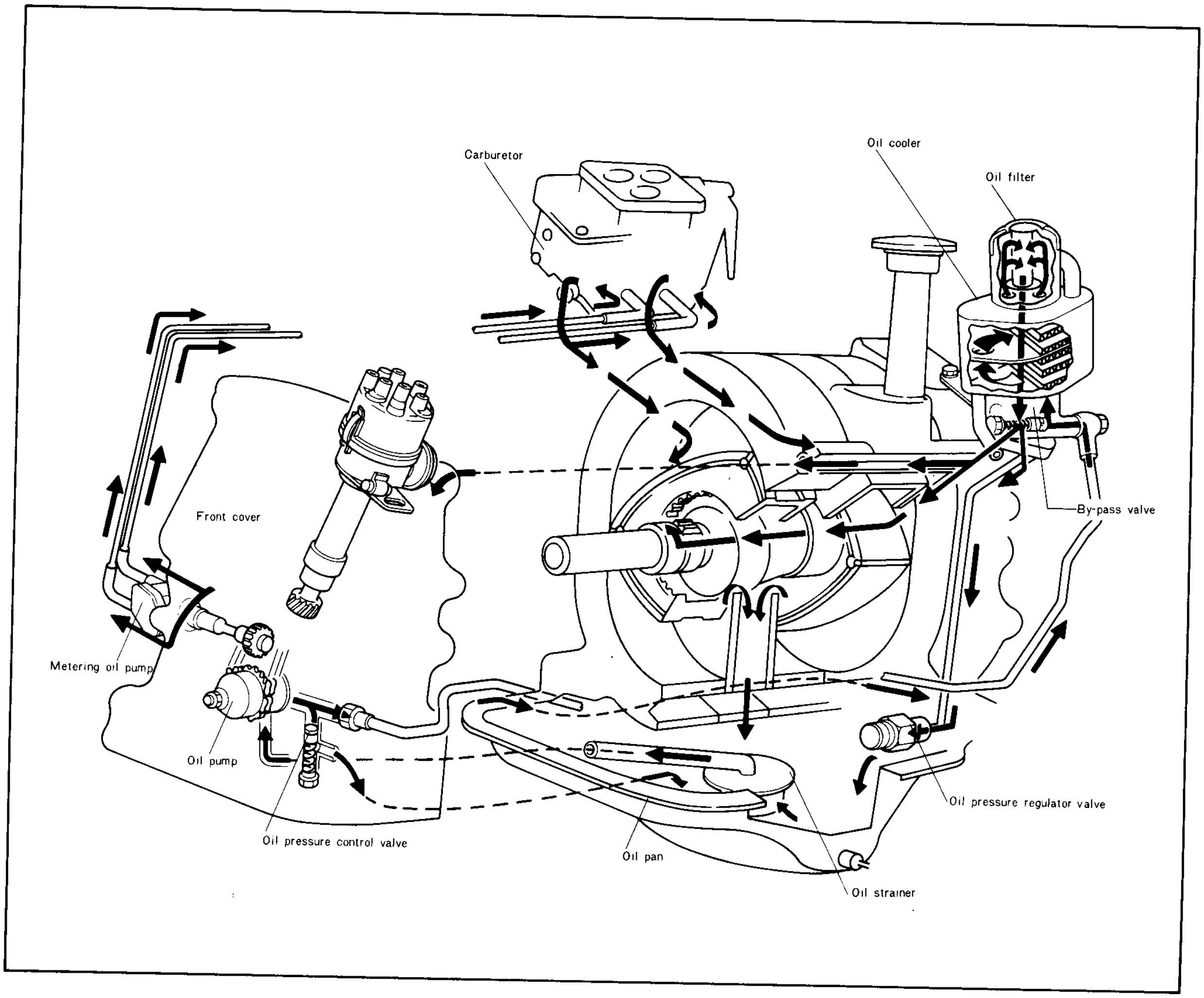
- The oil-cooling system employed for the 13B engine is the air-cooled system, and, for the 12A engine, is the water-cooled system. As a result, the oil flow is different for each engine type.
- For lubrication in the 13B engine, the metering oil pump sends oil to the intake manifold (2 places) and to the combustion chamber (2 places), for a total of 4 places.
- The oil pressure control valve is different for the 13B engine and the 12A engine.

OIL FLOWCHART

13B engine



12A engine



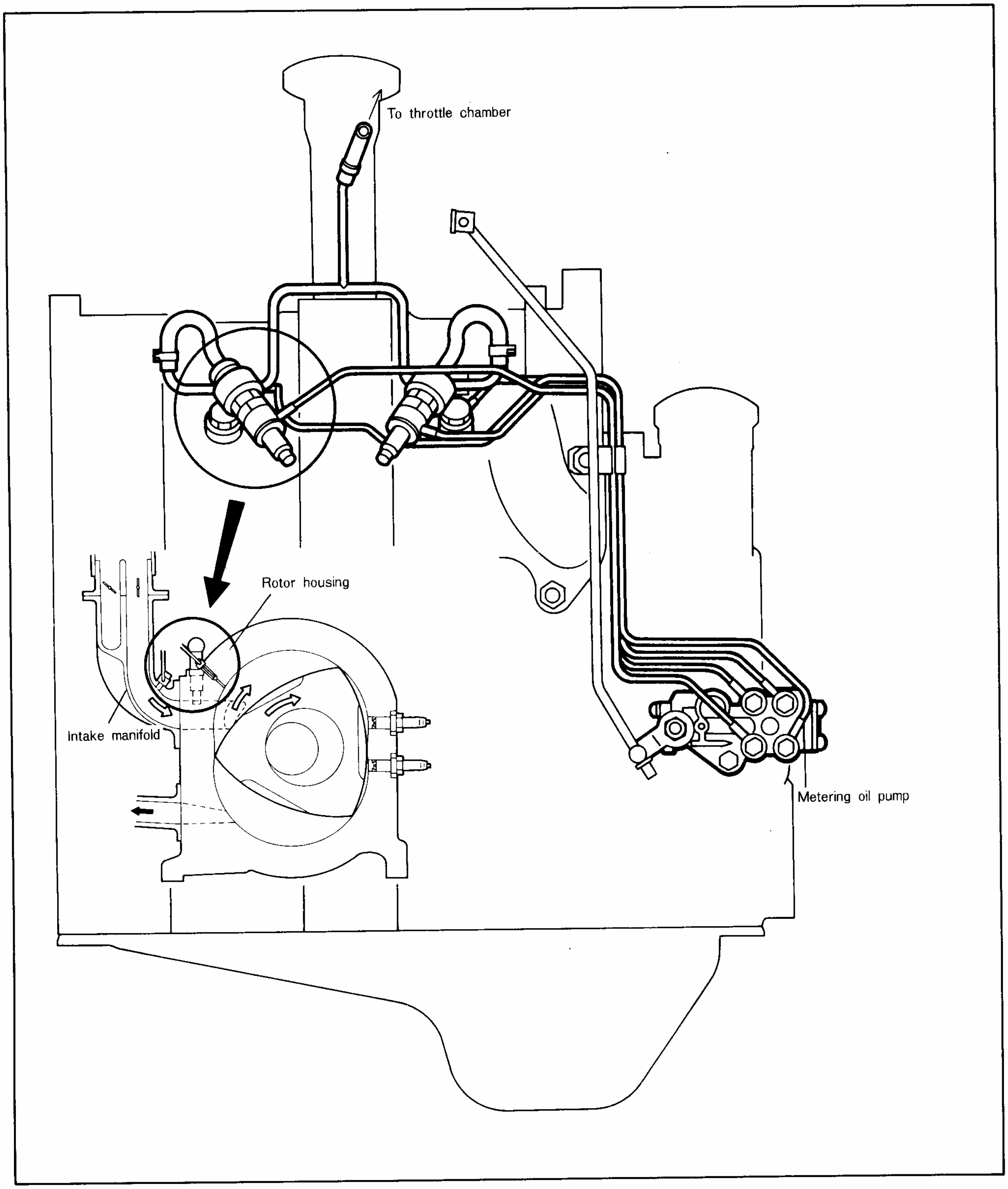
SPECIFICATIONS

Engine model			12A	13B
Lubricating system			Forced-fed type	
Oil pump	Type		Trochoid type	
	Pressure-control valve opening pressure		900 kPa (128 psi)	
Oil filter	Type		Full-flow type, paper filter	
	Relief-valve opening pressure		100 kPa (14 psi)	
Oil capacity	Total	13B engine	5.6 liters (5.8 U.S. qts., 5.1 Imp. qts.)	
		12A engine	4.6 liters (4.9 U.S. qts., 4.0 Imp. qts.)	
	Oil pan		4.2 liters (4.4 U.S. qts., 3.7 Imp. qts.)	
	Oil filter		0.3 liters (0.32 U.S. qts., 0.26 Imp. qts.)	
Engine oil			API service SD, SE or SF	

METERING OIL PUMP

For the 13B engine, a parallel system is used by which the engine oil sent from the metering oil pump is sent to the intake manifold and also directly to the rotor housing trochoid surface and the apex seal, where lubrication conditions are most severe. As a result, durability is improved.

Location of components related to 13B engine metering oil pump

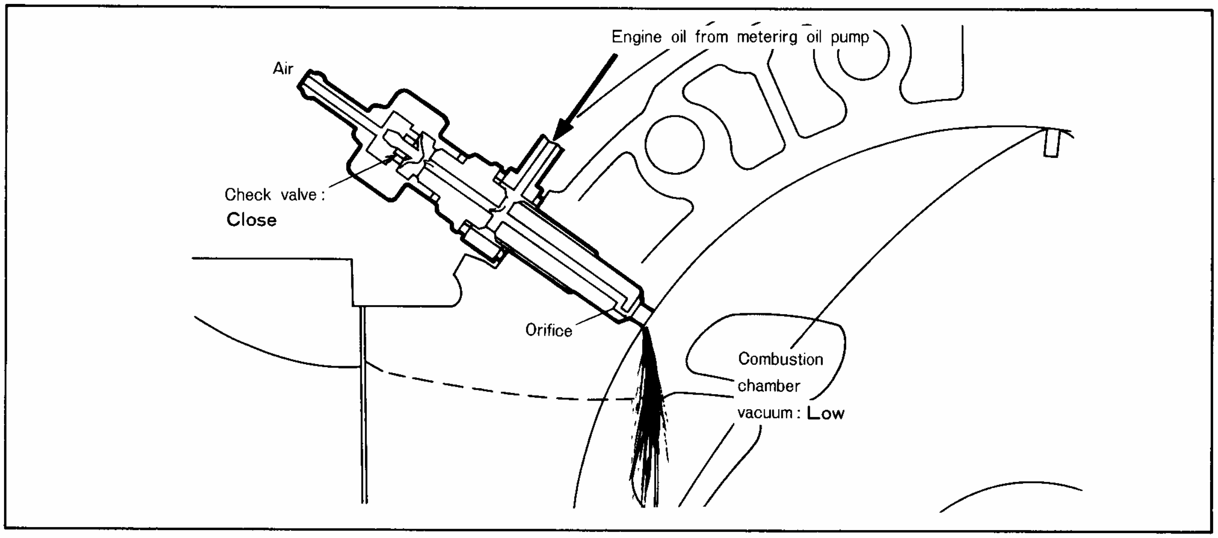


Check valve

A check valve is installed at the oil discharge port.
The purpose of the check valve is to prevent a reverse flow of the engine oil in the air passages during high-load, low-rpm conditions of the engine, in other words when the vacuum of the intake manifold and combustion chamber becomes low.
To test the check valve, check to be sure that there is:

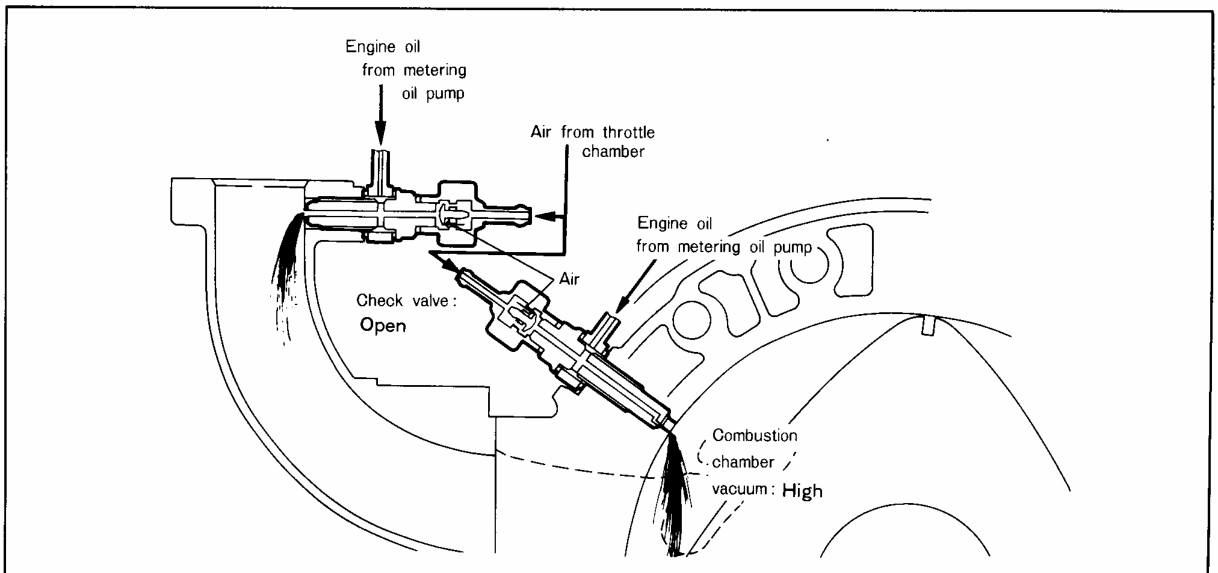
- continuity when it is blown
- no continuity when it is inhaled

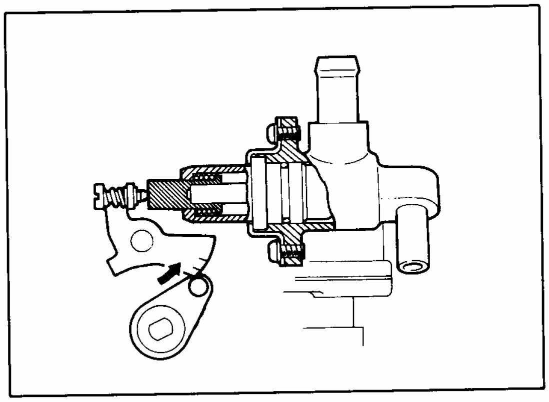
Replace the valve if necessary.



Throttle chamber air

Air is led from the throttle chamber to the check valve.
The reason for this is to prevent the suction of a large quantity of oil by the vacuum when the vacuum of the intake manifold and combustion chamber becomes high during rapid deceleration, etc.
Consequently, the amount of engine oil measured by the metering oil pump is supplied, regardless of the vacuum caused by the check valve.



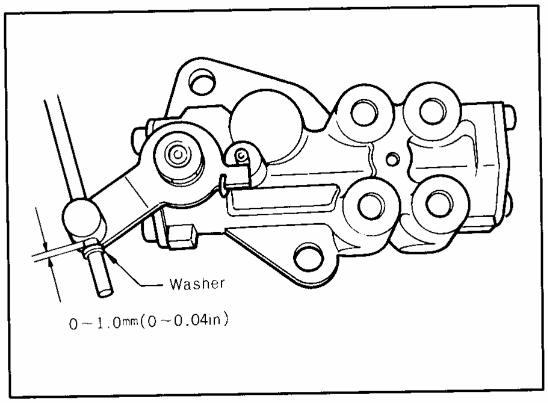


Adjustment of the metering oil pump (13B engine)

Because, for the 13B engine, the discharge amount test conducted for the 12A engine cannot be used, the discharge amount can be judged by visually checking the play of the oil pump rod.

The adjustment procedure is as described below.

1. Press the fast-idle cam in the direction of the arrow, by using a flat-tip screwdriver, to forcefully release the cam.



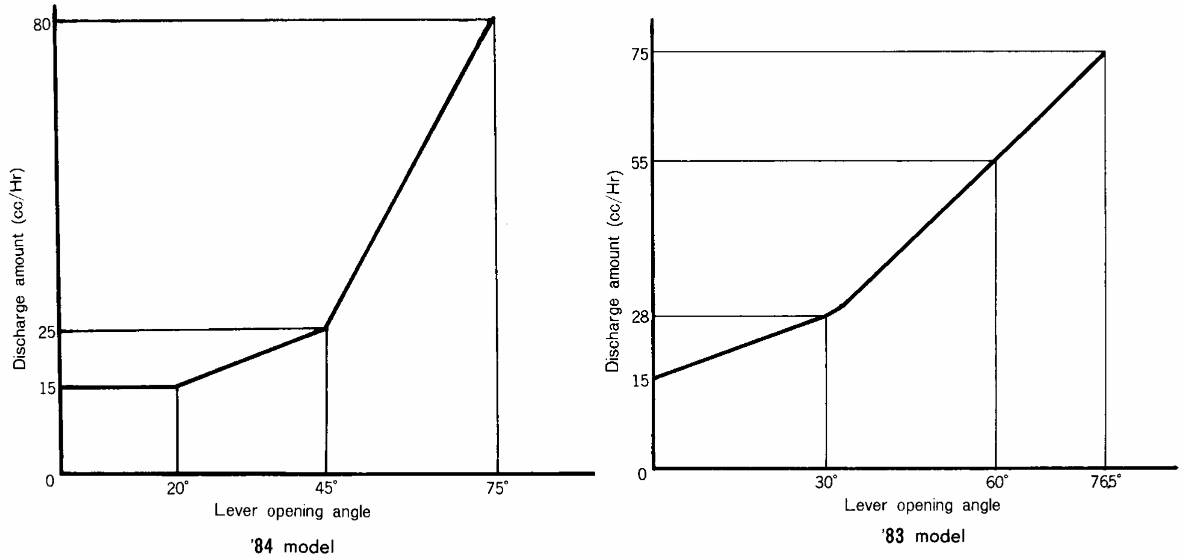
2. Then adjust rod and lever clearance.

Standard clearance: 0 ~ 1.0 mm (0 ~ 0.01 in)

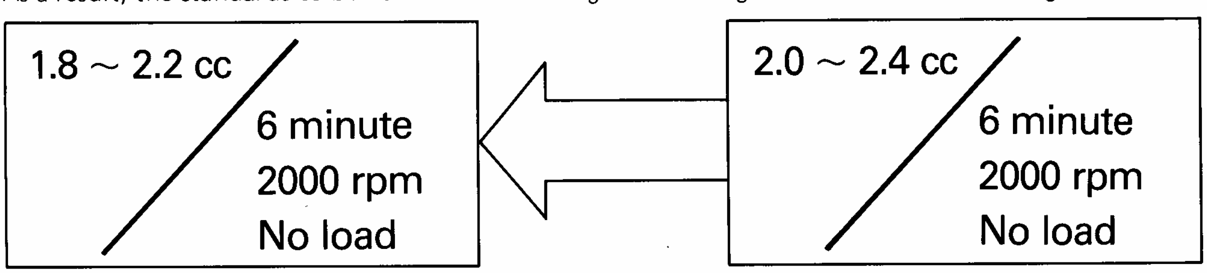
12A engine metering oil pump discharge characteristics

The 12A engine metering oil pump discharge characteristics have been changed so as to optimize the discharge amount. As a result, oil consumption has also been improved.
The discharge characteristics are as shown in the figure.

Note
The graphs show the discharge amount of a discharge nozzle at 1,500 rpm on the worm shaft.

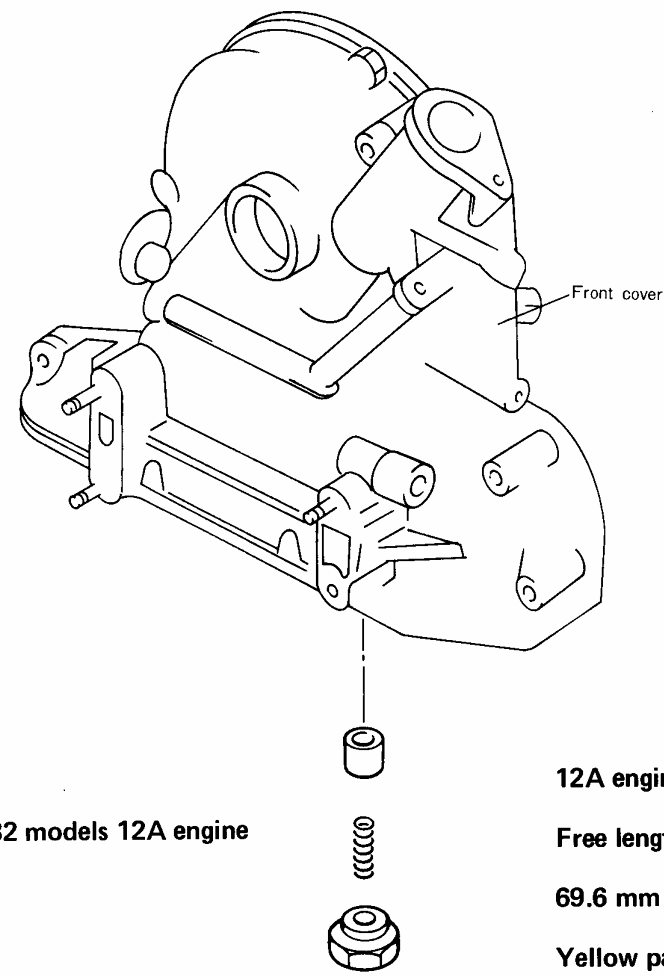


As a result, the standards to be used when checking the discharge amount have been changed.



OIL PRESSURE VALVE SPRING

The oil pressure control valve spring located in the front cover is different between the 13B engine and the 12A engine.
To avoid oil leakage from the oil cooler mating surface, the free length oil pressure control valve spring of the 12A engine is the shorter than that of the 13B engine, and lowers the oil pressure.
For indication, the oil pressure control valve spring of the 12A engine is painted yellow.



13B engine & before '82 models 12A engine

Free length

73 mm (2.87 in)

12A engine ('83, '84 models)

Free length

69.6 mm (2.74 in)

Yellow painted

COOLING SYSTEM

OUTLINE 3–2
OUTLINE OF CONSTRUCTION 3–2
SPECIFICATION 3–2
COOLING FAN 3–3
WATER PUMP 3–4

OUTLINE

OUTLINE OF CONSTRUCTION

- The shape of the cooling fan has been changed in order to reduce fan noise.
- The water pump bearing has been changed from the ball bearing type to a shaft bearing.

SPECIFICATIONS

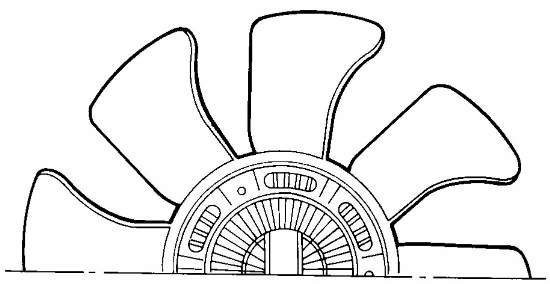
System		Water-cooled, forced circulation
Coolant quantity		9.5 liters (10.0 U.S. quarts, 8.4 Imp. quarts)
Thermostat	Type	Wax type
	Initial opening temperature	80.5 ~ 83.5°C (197 ~ 183°F)
	Full-open temperature	95°C (203°F)
	Full-open lift	8 mm (0.315 in) or more
Water pump	Type	Centrifugal
Radiator	Type	Corrugated-fin type
	Cap valve pressure	75 ~ 105 kPa (11 ~ 15 lb/in^2)
Cooling fan	Outer diameter x quantity	390 mm (15.4 in) x 8
Fan drive	Type	Thermo-modulated

COOLING FAN

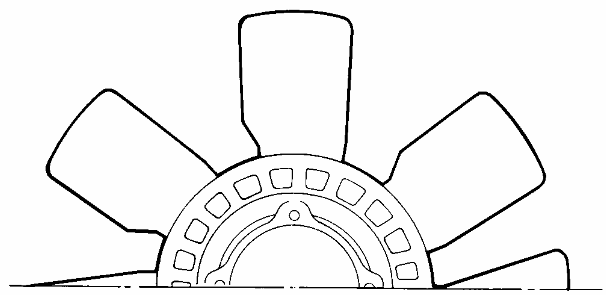
In order to reduce noise caused by the cooling fan, the shape, diameter and number of blades have been changed.

	1984 models	1983 models
Diameter	390 mm (15.4 in)	410 mm (16.1 in)
Blades	8	7

For 1984 models, the blade shape has been redesigned for smoother "stirring" of the air.

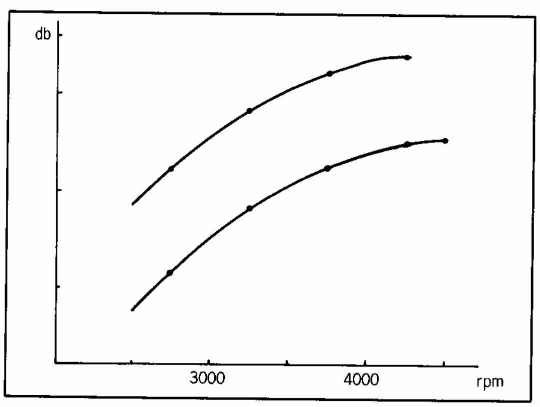


1984 model



1983 model

As a result of these changes, fan noise has been greatly reduced.

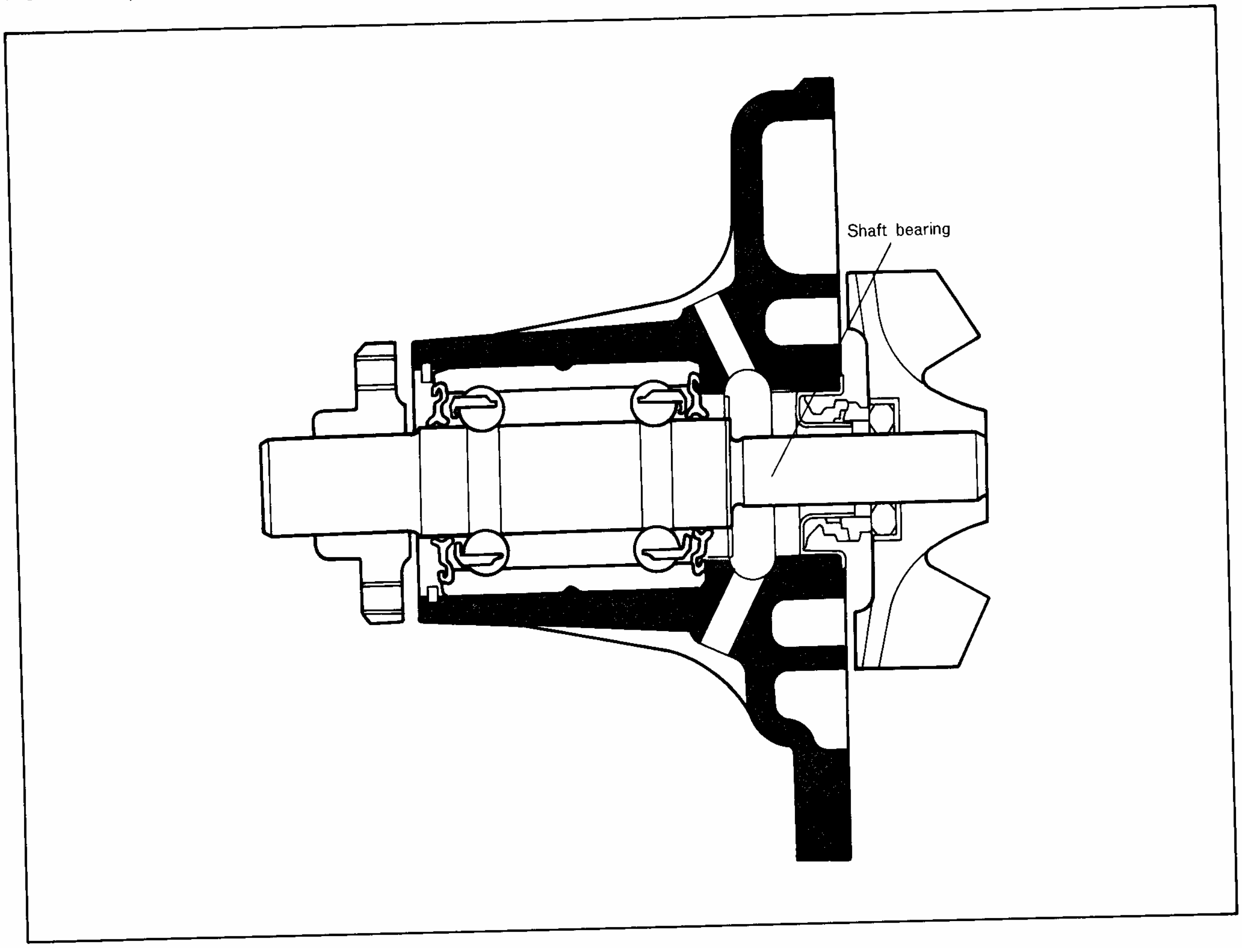


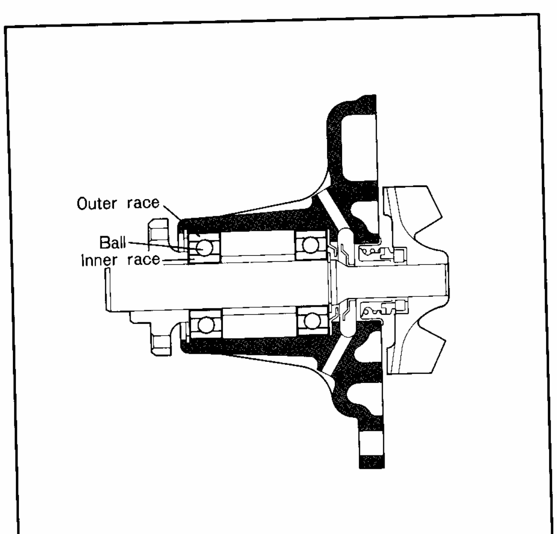
Fan noise has been reduced by the following amounts in the 1984 models as compared to the 1983 models:

4.5 dB at 3,000 rpm
5.0 dB at 4,000 rpm

WATER PUMP

The water pump bearing has been changed from the ball bearing type to the shaft bearing type. As a result, overall bearing durability has been improved.





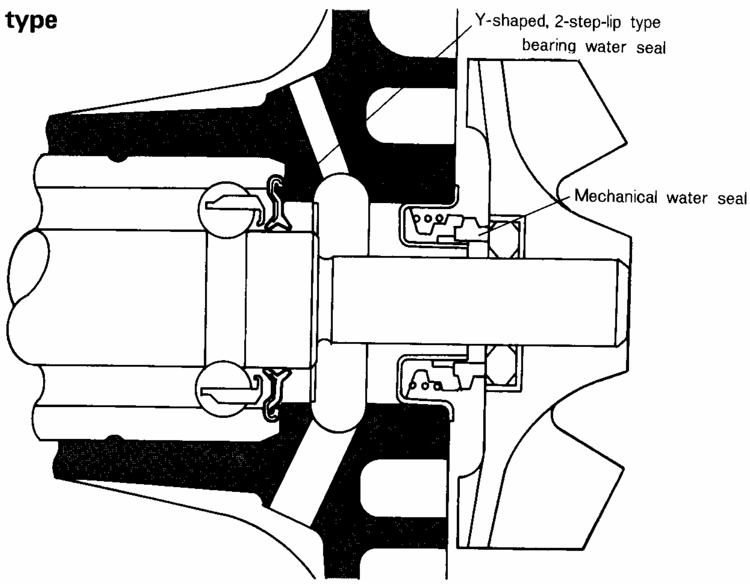
One advantage of the shaft bearing is that there is no mutual positional deviation of the ball and outer and inner race when the bearing is pressed into the water pump cover, with the result that there is less chance of bearing play.

Bearing water seal

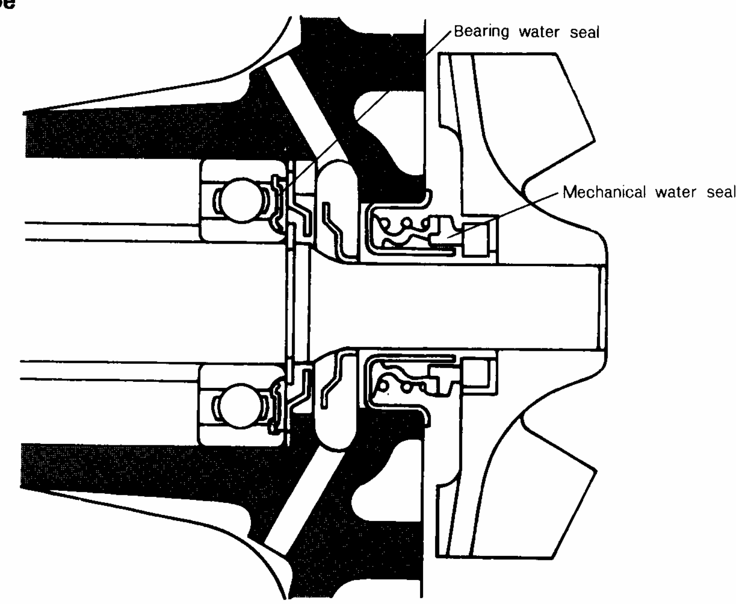
In addition, the water seal of the bearing has been changed to the Y-shaped, 2-step-lip type so that it is more difficult for water to penetrate in to the bearing.

Normally, lubrication of the mechanical water seal is performed by the coolant during rotation. Coolant leaked from the water seal is discharged externally through the water drain hole, but water droplets which were not discharged and steam penetrated through to the bearing through its water seal, with the resulting problems of rust and bearing play. In order to solve this problem therefore, the Y-shaped, 2-step-lip type of bearing water seal has been adopted, thus improving the seal's performance and improving the durability of the bearing.

Shaft bearing type



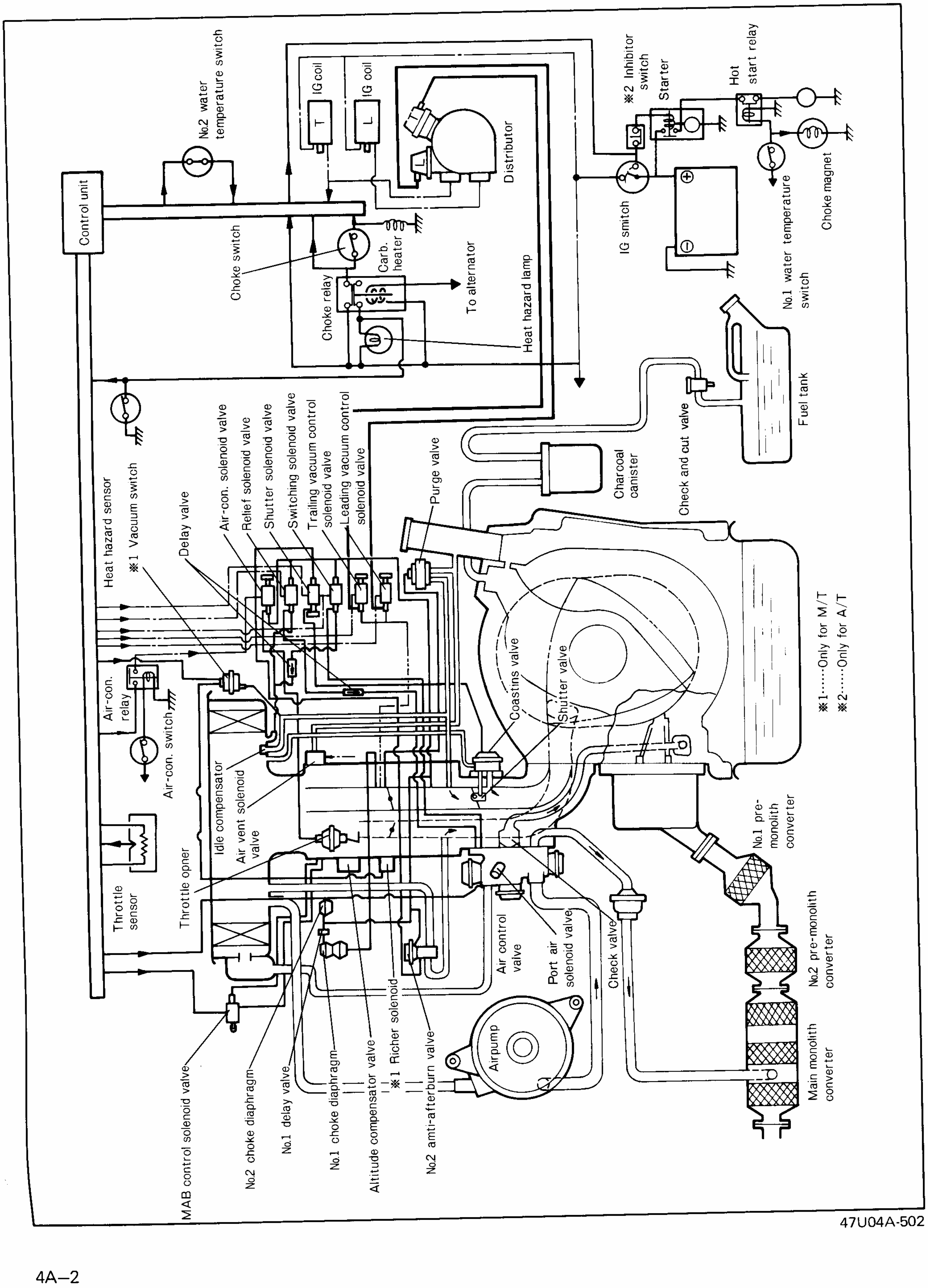
Ball bearing type



FUEL, INTAKE, EXHAUST AND EMISSION CONTROL SYSTEM (12A ENGINE)

SYSTEM DIAGRAM 4A– 2
EMISSION CONTROL SCHEMATIC DIAGRAM 4A– 3
COMPONENT DESCRIPTIONS 4A– 5
OUTLINE OF CONSTRUCTION 4A– 9
EMISSION CHECKING PROCEDURE 4A–15
VACUUM HOSE ROUTING DIAGRAM 4A–21
SPECIFICATIONS 4A–22

SYSTEM DIAGRAM



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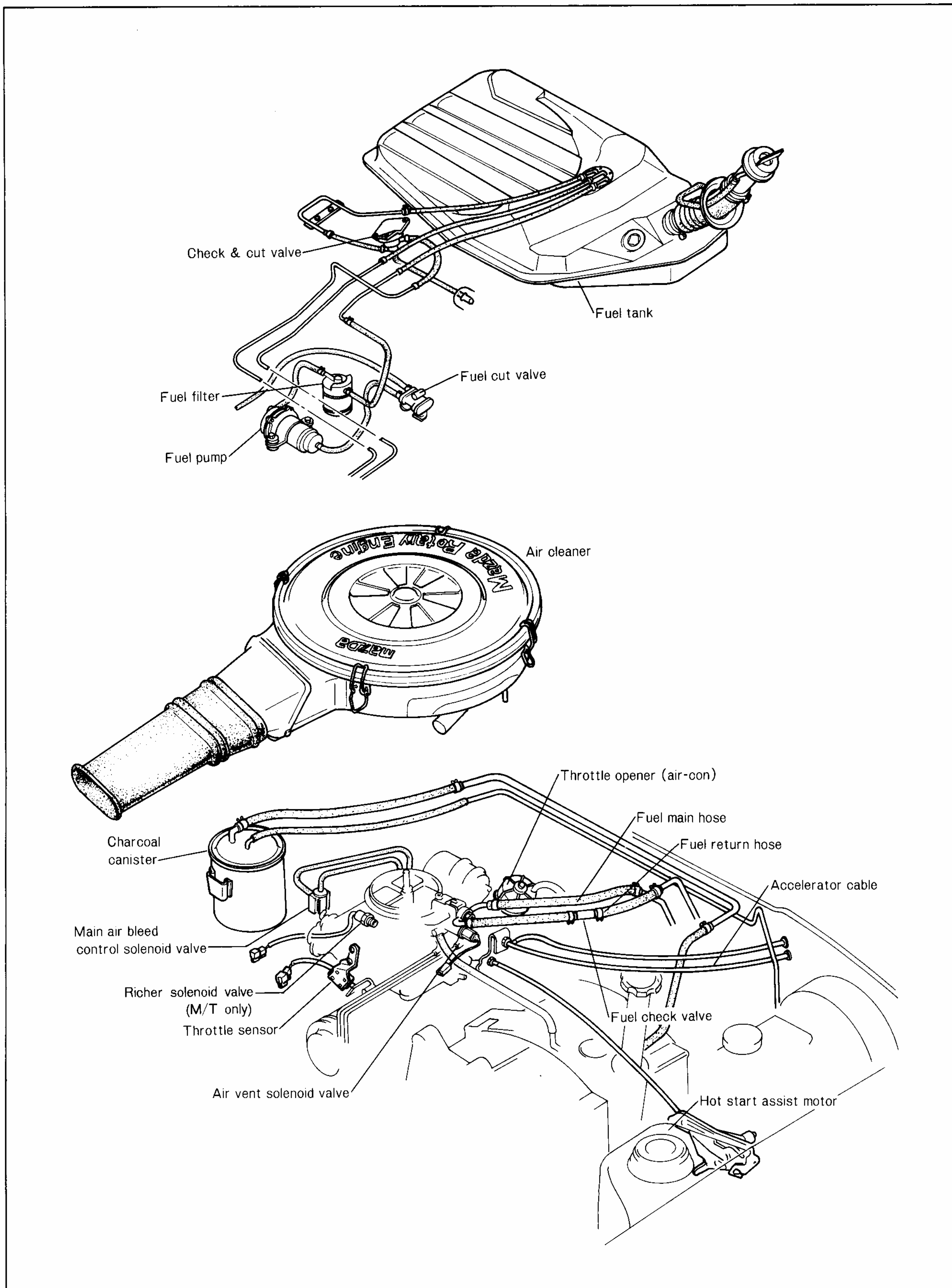
EMISSION CONTROL SCHEMATIC DIAGRAM



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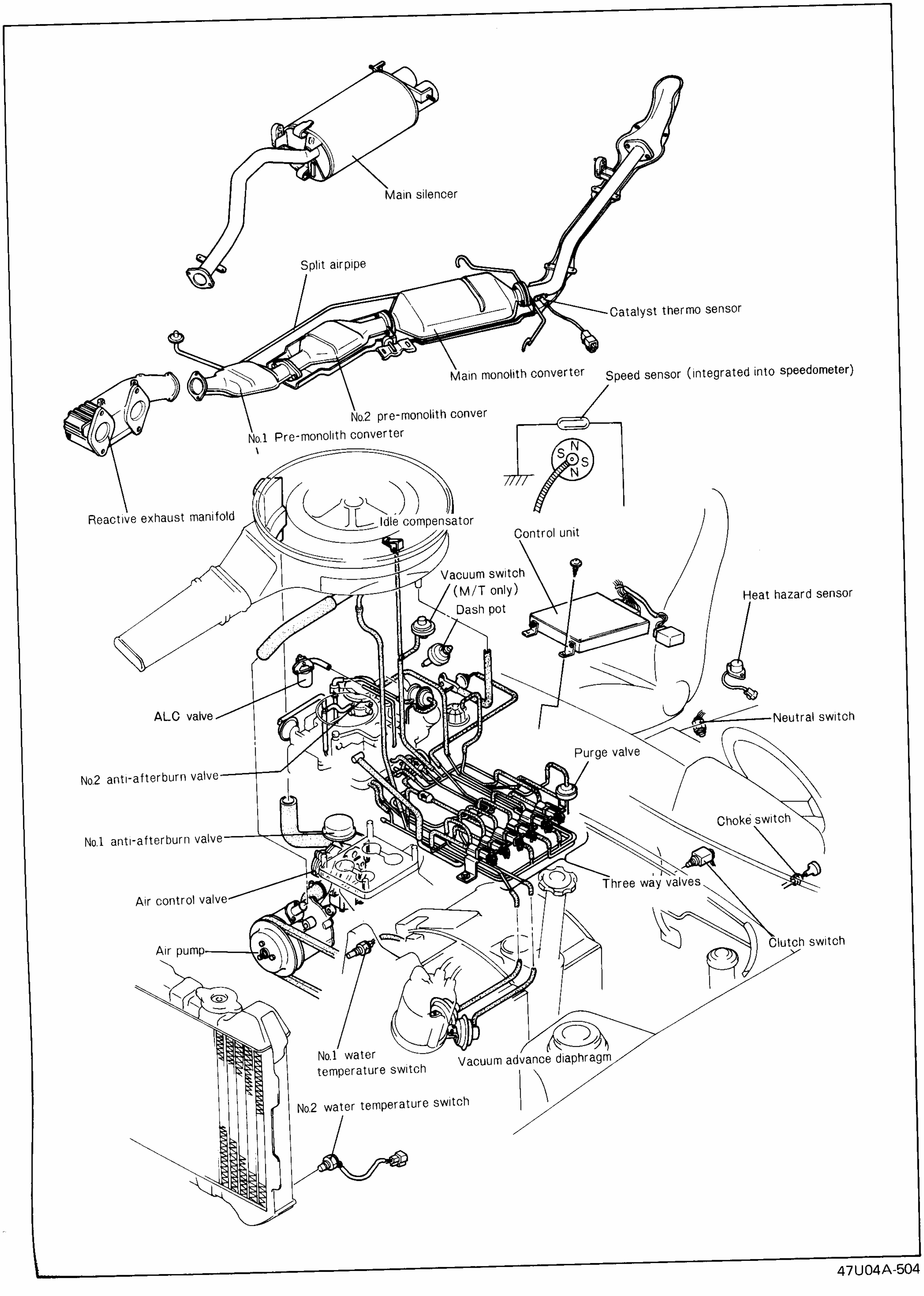
EMISSION CONTROL SCHEMATIC DIAGRAM



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COMPONENT DESCRIPTIONS

Component	Function	Remarks
1. Anti-Afterburn Valve (No. 1)	Supplies fresh air into the front primary port during deceleration	Included in air control valve; vacuum operated
2. Anti-Afterburn Valve (No. 2)	Supplies fresh air into the rear secondary port during deceleration	Vacuum operated
3. A/C Solenoid Valve	Applies vacuum to the throttle opener when A/C switch is turned on	White
4. Air Cleaner	Filters air into carburetor	
5. Air Control Valve (ACV)	Directs air to one of three locations: Exhaust port, 3-bed catalyst or back to the air cleaner	Consists of 3 valves: Air relief valve Air switching valve No. 1 AAV
6. Air Pump	Supplies secondary air to ACV	
7. Air Vent Solenoid Valve	Vents float chamber to the canister while the engine stops	When the engine is started, the fumes are drawn into the intake manifold through purge valve
8. ALC Valve	Leans the mixture at high atitude	Adds air to carburetor air bleeds
9. Canister	Stores gas tank and carburetor fumes when engine stops	Vented to atmosphere through charcoal and filter
10. Catalyst Thermo Sensor	Detects exhaust gas temperature; sends signal to control unit	Rear exhaust pipe of rear catalyst opens when: 770°C (1418°F) . . . M/T 740°C (1364°F) . . . A/T
11. Check and Cut Valve	Releases excessive pressure or vacuum in the fuel tank to atmosphere Prevents fuel loss if the vehicle is over-turned	

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COMPONENT DESCRIPTIONS

Component	Function	Remarks
12. Choke Bimetal Heater	Gradually opens the choke valve after engine is started	ON: after engine is started with choke OFF: when choke returns to off position
13. Choke Diaphragm (No. 1)	Pulls choke valve partially open after delay valve opens or when accelerating (ported vacuum)	2 diaphragms, connected to choke bimetal
14. Choke Diaphragm (No. 2)	Forces the choke valve to open a little after engine is started	1 diaphragm connected to choke valve
15. Choke Switch	Applies power to choke heater, controls secondary air injection and distributor vacuum advance through control unit	Pull knob out above 10 mm (0.4 in): closed
16. Clutch Switch and Neutral Switch (only for MT/)	Detect in-gear condition	Closes when clutch pedal is depressed; opens when clutch pedal is released Closes in neutral; opens in all other ranges
17. Coasting valve	Supplies fresh air into the rear primary port when decelerating to prevent excessive vacuum	
18. Control Unit	Detects the following: 1 Engine speed 2 Radiator coolant temperature 3 Throttle opening 4 Choke condition 5 Floor temperature 6 Air conditioner ON/OFF condition 7 Exhaust gas temperature 8 Vehicle speed Controls operation of the following: 1 Vacuum control solenoid valve (T) 2 Vacuum control solenoid valve (L) 3 Switching solenoid valve 4 Shutter solenoid valve 5 Relief solenoid valve 6 Air con. solenoid valve 7 Port air solenoid valve 8 Main air bleed control solenoid valve 9 Richer solenoid valve 10 Fuel pump cut relay	1 Ignition coil – terminal 2 No. 2 water temperature switch 3 Throttle sensor 4 Choke switch 5 Heat hazard sensor 6 Air con. switch 7 Thermo sensor 8 Speed sensor

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Component	Function	Remarks
19. Dash Pot	Gradually closes throttle during deceleration	Contacts at 3,800 ~ 4,200 rpm (in neutral)
20. Delay Valve	Delays switching valve operation from port air to split air	Delay time: 0.8 ~ 1.5 sec.
21. Delay Valve	Delays relief valve operation from relief air to injection air	Delay time: 0.8 ~ 1.5 sec.
22. Heat Hazard Sensor	Detects floor temperature and sends signal to control unit	Closes above 130°C (266°F) When heat-hazard sensor is closed; relieves secondary air
23. Idle Compensator	Keeps idle constant with temperature change	Operation temperature: 65°C (149°F)
24. Main Air Bleed Control Solenoid Valve	Opens air passage and leans the mixture during acceleration at a certain speed	Adds air to primary main air bleed Opens air passage when; Engine speed: 3,000 ~ 4,000 rpm Vehicle speed: above 50 MPH
25. No. 1 Pre-monolith Converter	Reduces HC and CO	Oxidizing catalyst
26. No. 2 Pre-monolith Converter	Reduces HC, CO and NO x	3 Way catalyst
27. Port Air Solenoid Valve	Closes port air by-pass passage during acceleration at a certain speed	Closes port air by-pass passage when; Engine speed: 3,000 ~ 4,000 rpm Vehicle speed: above 50 MPH
28. Purge Valve	Carries evaporative fumes from gas tank and canister to intake manifold	During open throttle
29. Relief Solenoid Valve	Relieves secondary air to air cleaner when unnecessary	Blue
30. Richer Solenoid Valve (only for M/T)	Opens primary fuel passage after decelerating	Operates for 30 seconds when the engine speed becomes 1,100 rpm or less

Component	Function	Remarks
31. Shutter Solenoid Valve	Operates coasting valve during deceleration above 1,100 rpm Operates shutter valve at the same time	Yellow
32. Shutter Valve	Shuts off the rear primary port during deceleration	
33. Speed Sensor	Detects vehicle speed	Reed switch; integrated into speedometer
34. Split Air Injection Pipe	Secondary air injected into main converter between center monolith and rear monolith Above 1,100 rpm with open throttle and choke off	
35. Switching Solenoid Valve	Switches the secondary air to exhaust port or rear catalyst	Gray
36. Throttle Opener	Pulls the throttle valve partially open when A/C switch is turned on	Compensates for load of compressor During air-con. operation; 1,200 rpm (neutral)
37. Throttle Sensor	Detacts the throttle opening angle	
38. Vacuum Advance Diaphragm	Controlled by solenoid valve	
39. Vacuum Control Solenoid Valve	Cut vacuum to distributor during deceleration, etc.	Leading: Brown Trailing: Green
40. Vacuum Switch (only for M/T)	Defects intake manifold vacuum	Opens at intake manifold vacuum of 0 ~ 120 mmHg (0 ~ 4.7 inHg)
41. Water Temperature Switch (No. 1)	Holds choke on below 70°C Operates hot start motor above 70°C	On the water pump body Below 70°C (158°F): closed
42. Water Temperature Switch (No. 2)	Detects radiator coolant temperature; sends signal to control unit	Above 15°C (59°F): closed
43. 3-bed Monolith Converter	Further reduces HC, CO and NO x	3 Way catalyst (Main converter)

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OUTLINE OF CONSTRUCTION

The system modified from the 1983 model is explained below.

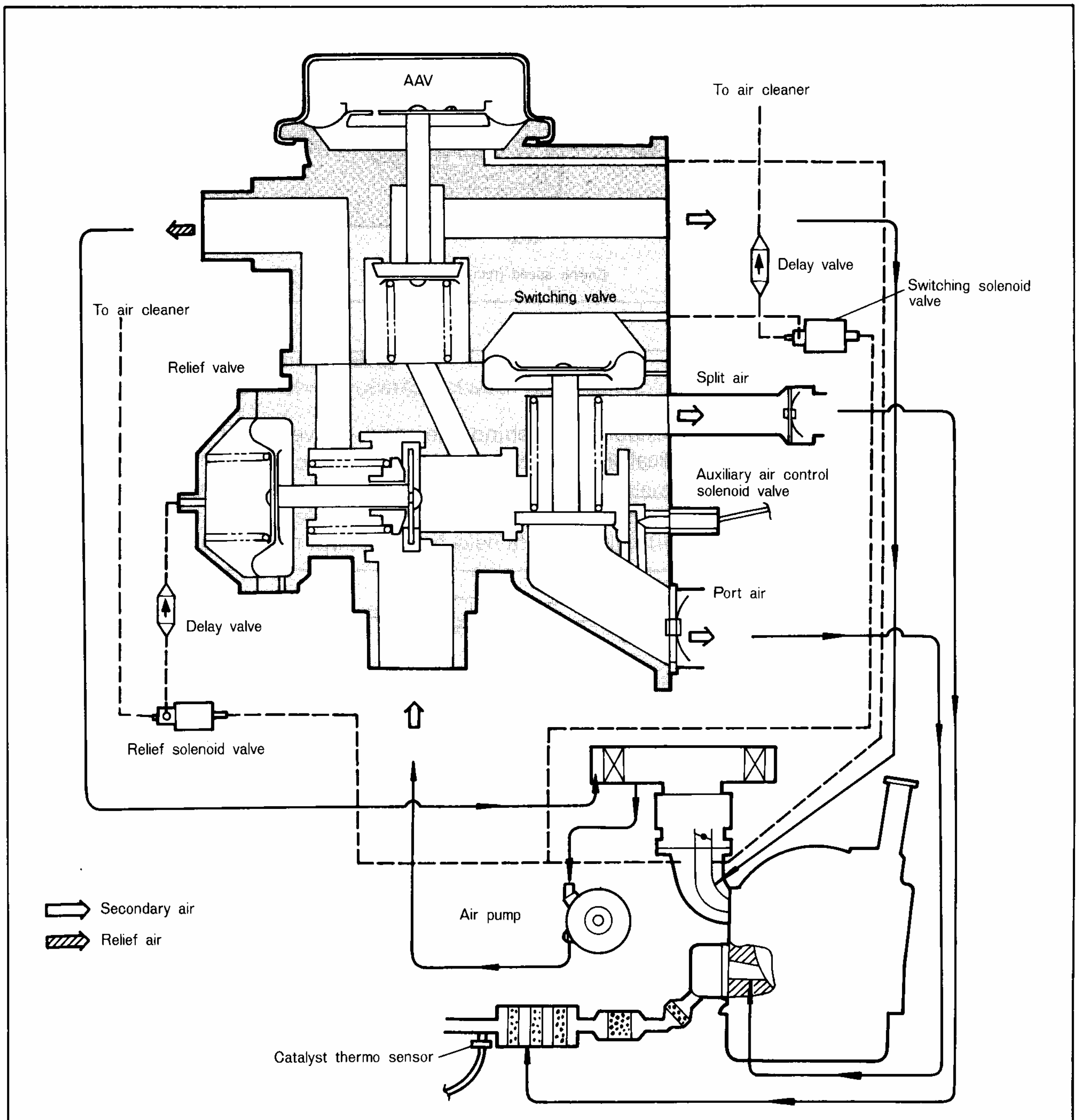
1. SECONDARY AIR CONTROL SYSTEM

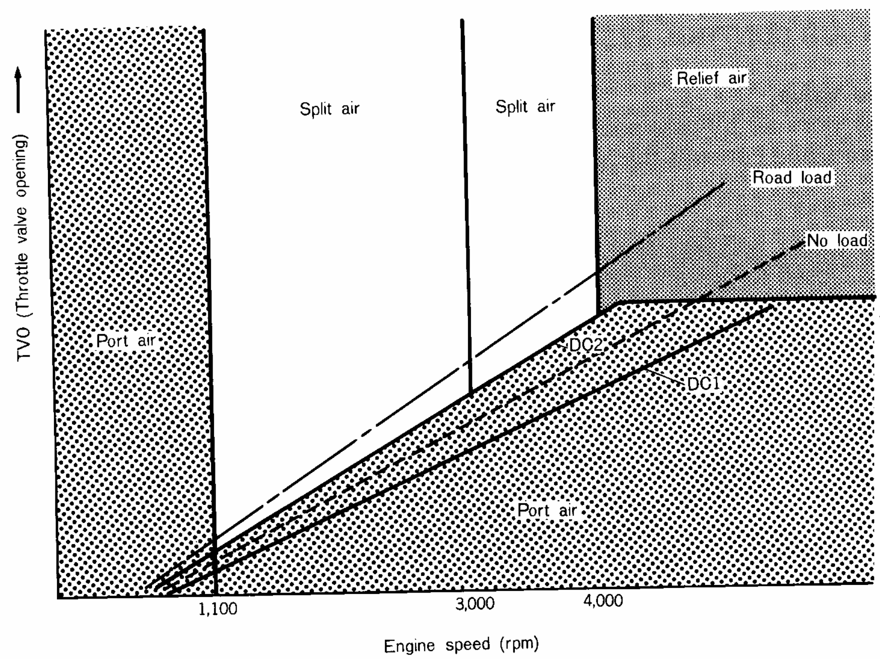
Port Air Solenoid Valve

The newly-added port air by-pass passage is opened and closed in accordance with the engine speed or the vehicle speed, and controls the amount of by-pass air at the split air.

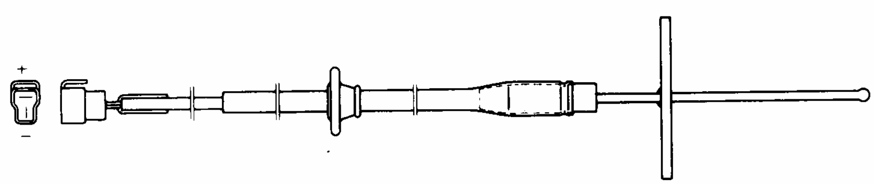
Operation:

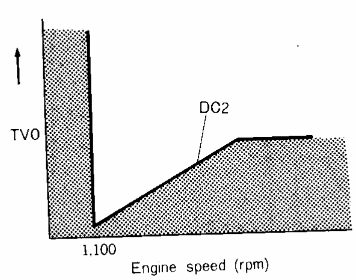
When the engine speed is 3,000 ~ 4,000 rpm or the vehicle speed is above 50 MPH, the port air by-pass passage is closed to prevent the overheat of catalyst converter.





Catalyst Thermo Sensor
The catalyst thermo sensor is newly established behind the main converter. It detects the exhaust gas temperature and transmit the electrical signal to the control unit.



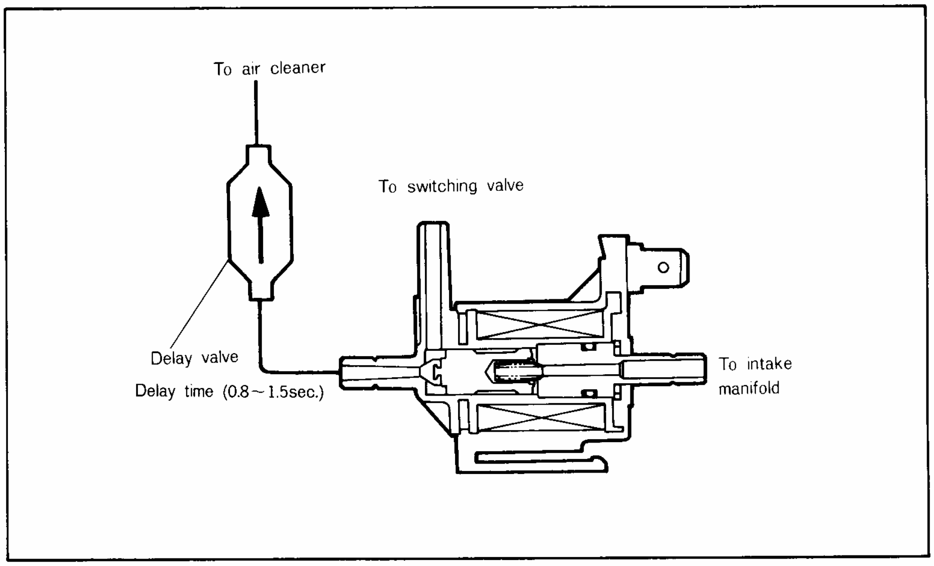


Operation:
When the exhaust gas temperature exceeds a certain temperature, receiving the signal, the control unit makes the relief solenoid valve operate when the engine speed is above 1,100 rpm and decreases the catalyst temperature.

Operating temperature:
above 770°C (1418°F) . . . M/T
above 740°C (1364°F) . . . A/T

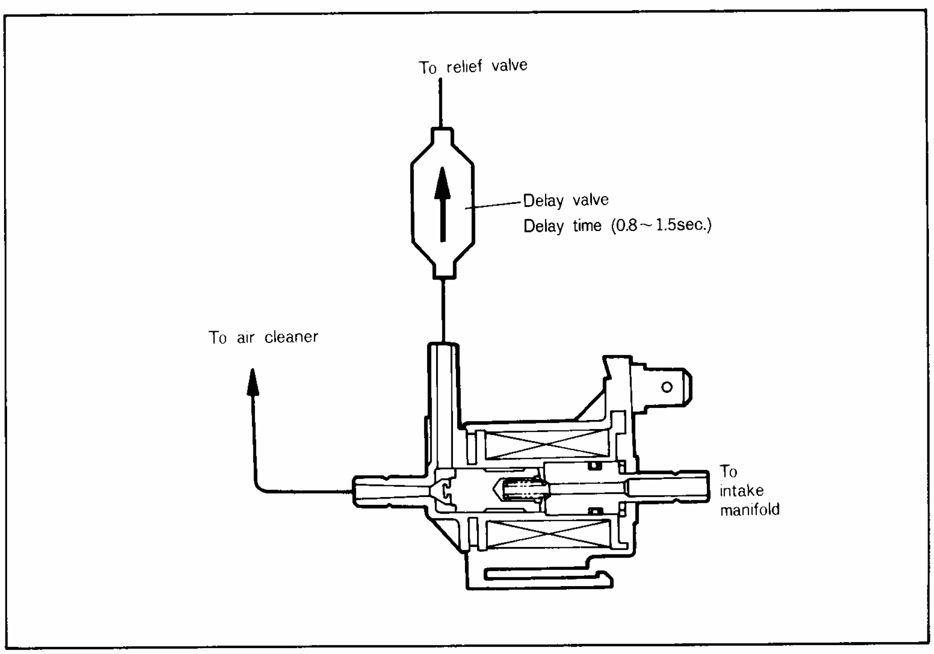
Delay Valve (for switching valve)
The vacuum delay valve is newly located at the atmosphere passage of switching solenoid valve.

Operation:
Switching into split air from port air is delayed by 0.8 to 1.5 sec. by the operation of delay valve.
In the driving condition, such as repeatitious accelerating and decelerating, port air is maintained to promote oxidization of CO and HC which tend to be emitted in this condition.



Delay Valve (for relief solenoid valve)
The vacuum delay valve is newly located between relief solenoid valve and relief valve.

Operation:
Switching from relief air into injection air is delayed by 0.8 to 1.5 sec. by the operation of delay valve. When driving the vehicle by repeating accelerating and decelerating above 4,000 rpm, the temperature of catalyst converter increases to prevent the increase in temperature of catalyst converter and after-burn, the relief air condition is maintained even after decelerating from above 4,000 rpm.



2. MIXTURE CONTROL SYSTEM

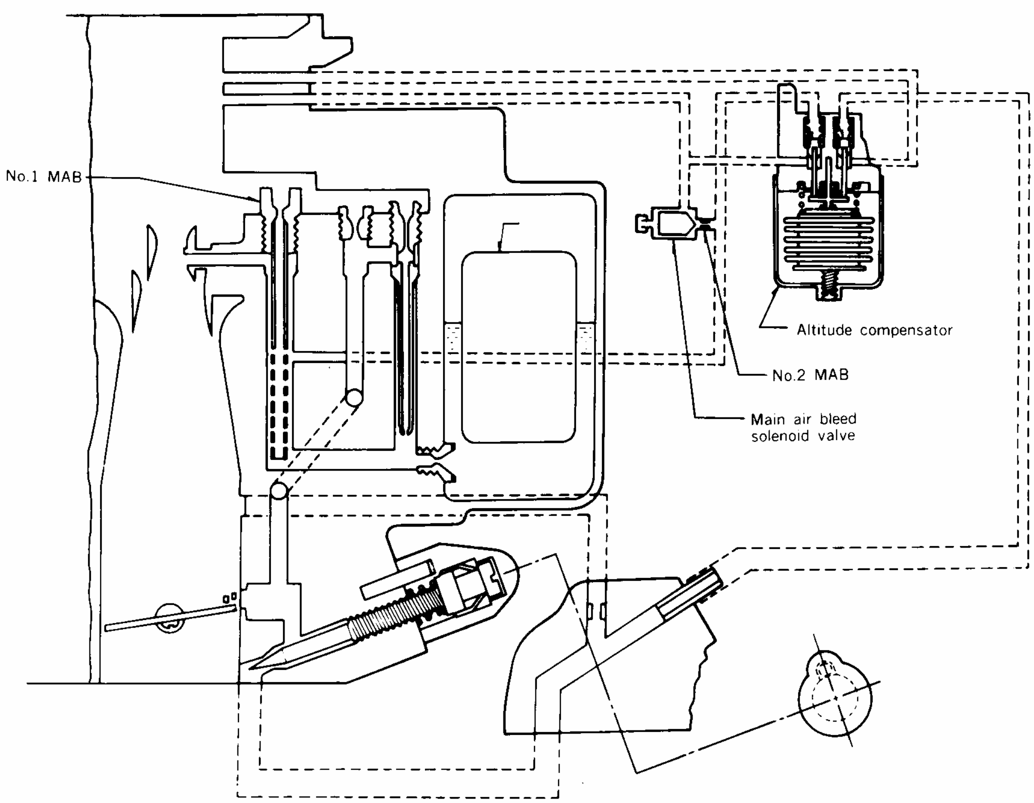
Main Air Bleed Control Solenoid Valve

The carburetor is equipped with No. 2 primary main air bleed passage.
The passage is opened and closed by the solenoid valve in accordance with the engine speed or the vehicle speed.

Operation:

When the engine speed is 3,000 ~ 4,000 rpm or the vehicle speed is above 50 MPH, No. 2 primary main air bleed passage is opened to make the A/F ratio lean. Thus, the overheating of catalyst converter is prevented.

Note
The main air bleed control solenoid valve operates at the same time as the port air solenoid valve.



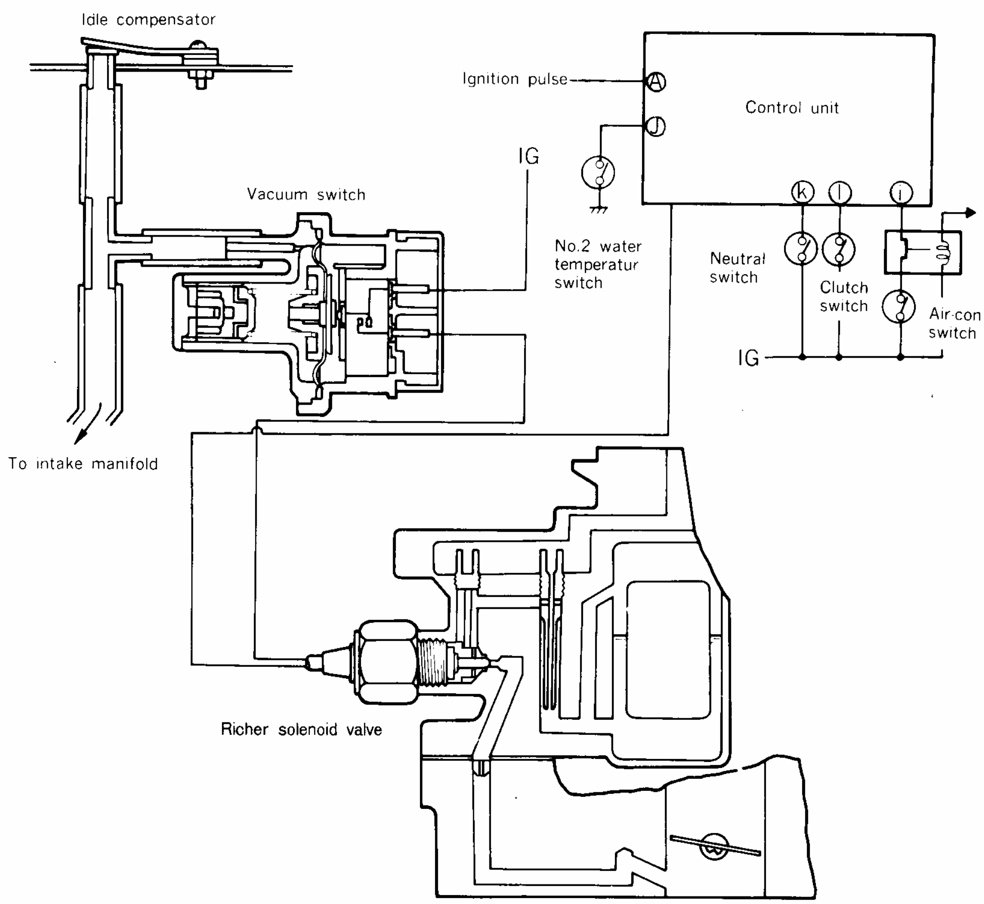
Idle Richer Solenoid Valve (only for M/T)

The idle richer solenoid valve is established to stabilize the emission level below 1,100 rpm at decelerating.

Operation:

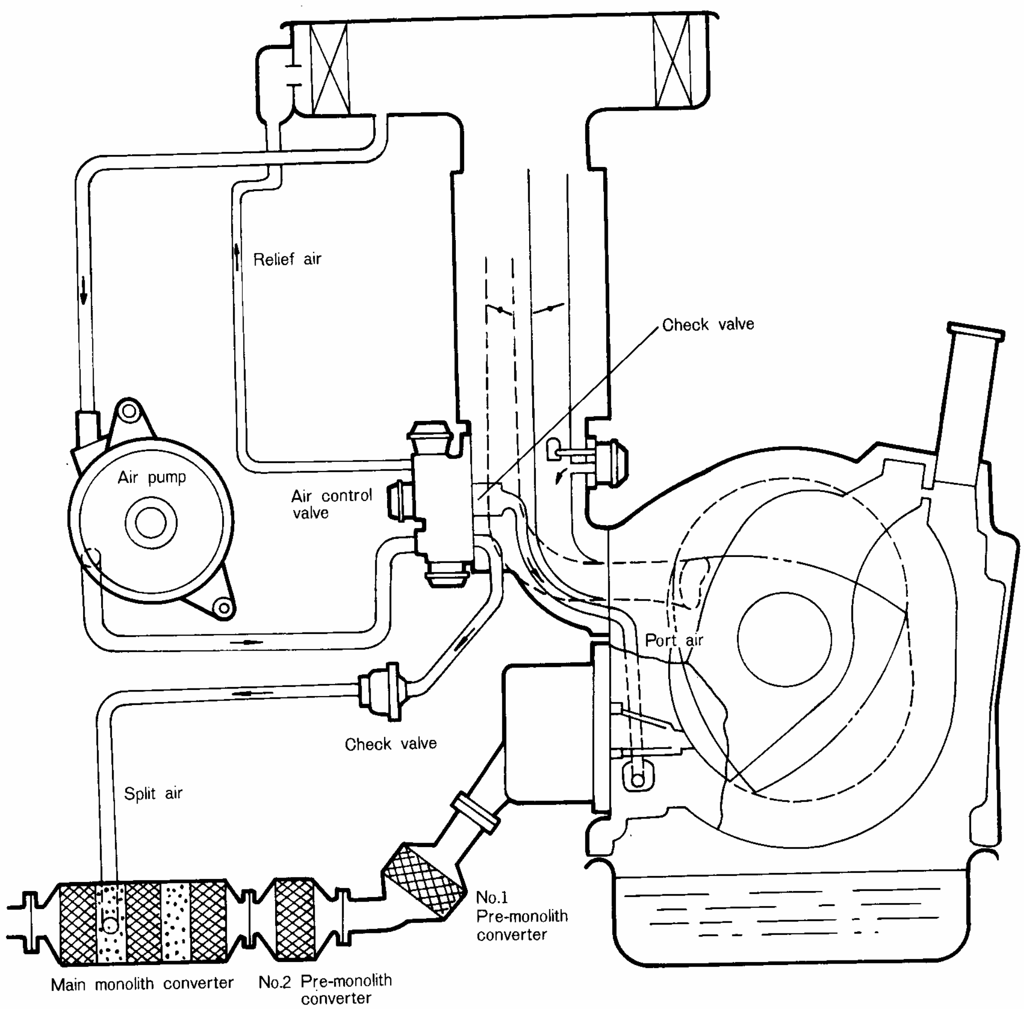
The idle richer solenoid valve operated for 30 seconds from the moment when the engine speed decreases to 1,100 rpm or less to make the A/F ratio rich.
Under the following conditions, it does not operate.

Choke switch	Closed
Vacuum switch	Open
No. 2 temperature switch	Open
Air-con. switch	Closed
Neutral switch Clutch switch	Open



3. CATALYST CONVERTERS

Part Name	1983 Model (12A)	1984 Model (12A & 13B)
No. 1 Pre-monolith	Not Equipped	Equipped
No. 2 Pre-monolith	Equipped	Equipped
3 Bed Monolith (Main)	Not Equipped	Equipped
2 Bed Pellet (Main)	Equipped	Not Equipped
REM	Equipped	Equipped



FUEL, INTAKE, EXHAUST AND EMISSION CONTROL SYSTEM (13B ENGINE)

SYSTEM DIAGRAM 4B– 2
EMISSION CONTROL SCHEMATIC DIAGRAM 4B– 3
COMPONENT DESCRIPTIONS 4B– 5
OUTLINE OF CONSTRUCTION 4B– 9
AIR INDUCTION SYSTEM 4B– 9
BY-PASS AIR CONTROL (BAC) SYSTEM 4B–13
EMISSION CONTROL SYSTEM 4B–16
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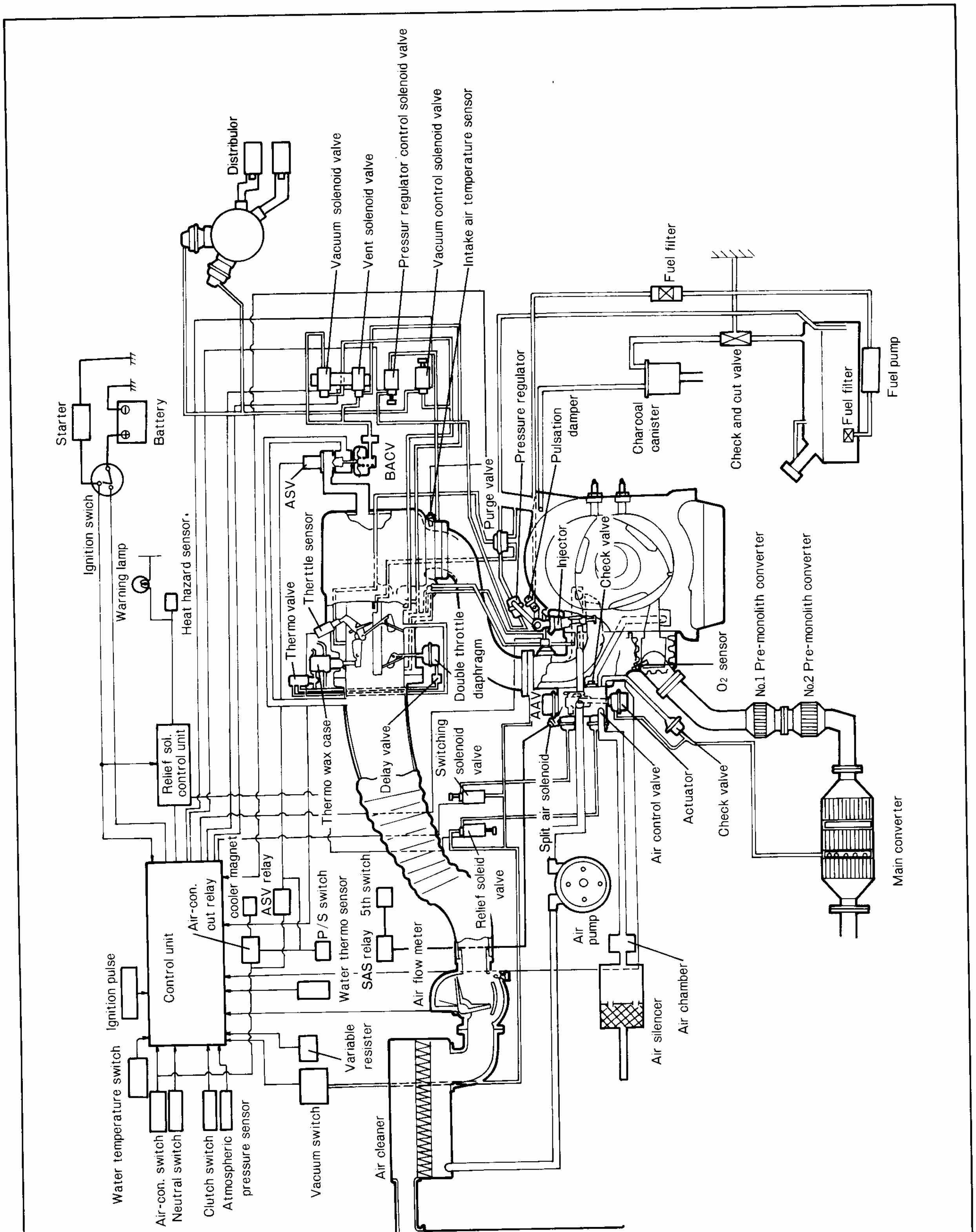
SYSTEM DIAGRAM



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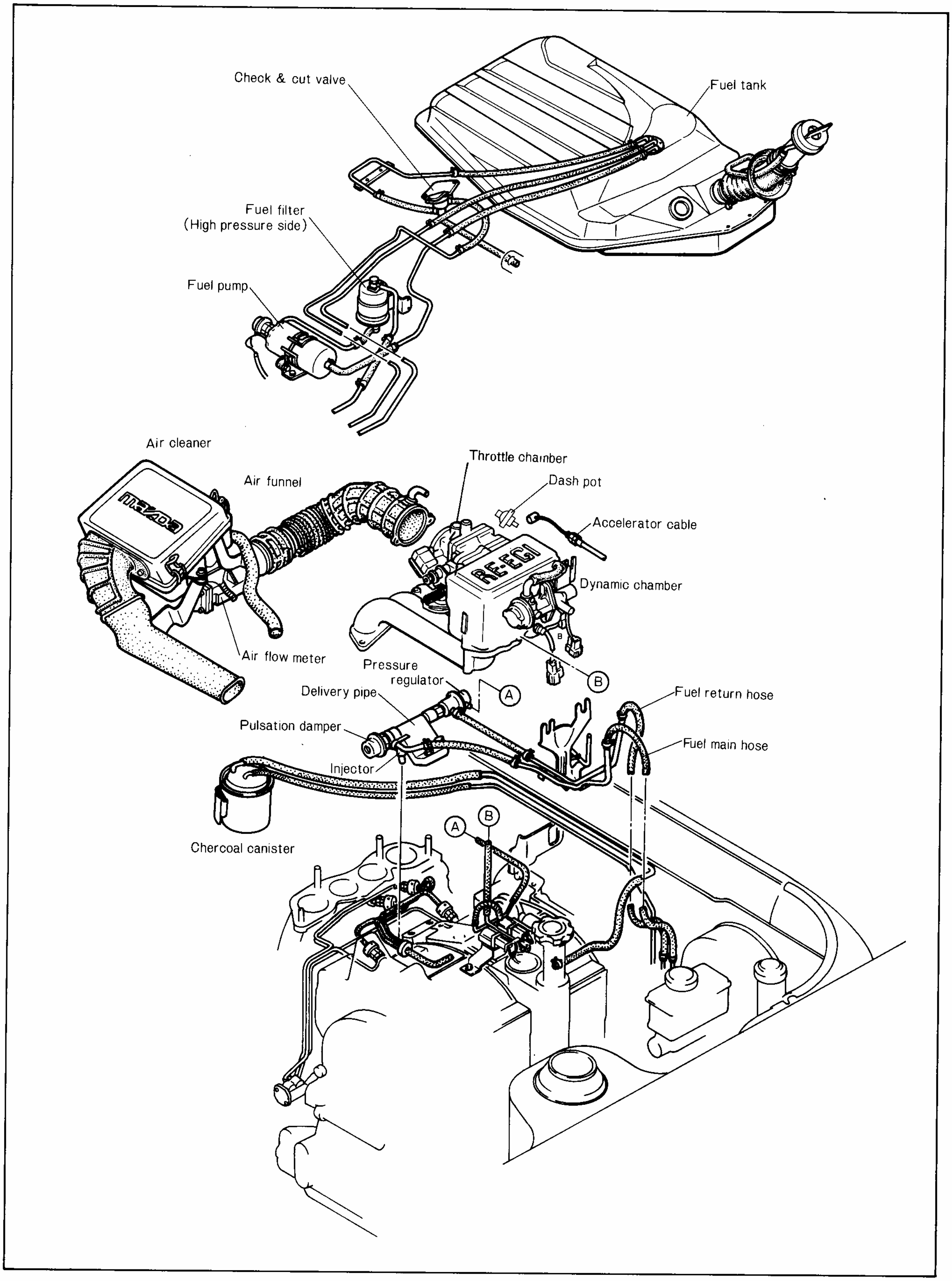
EMISSION CONTROL SCHEMATIC DIAGRAM



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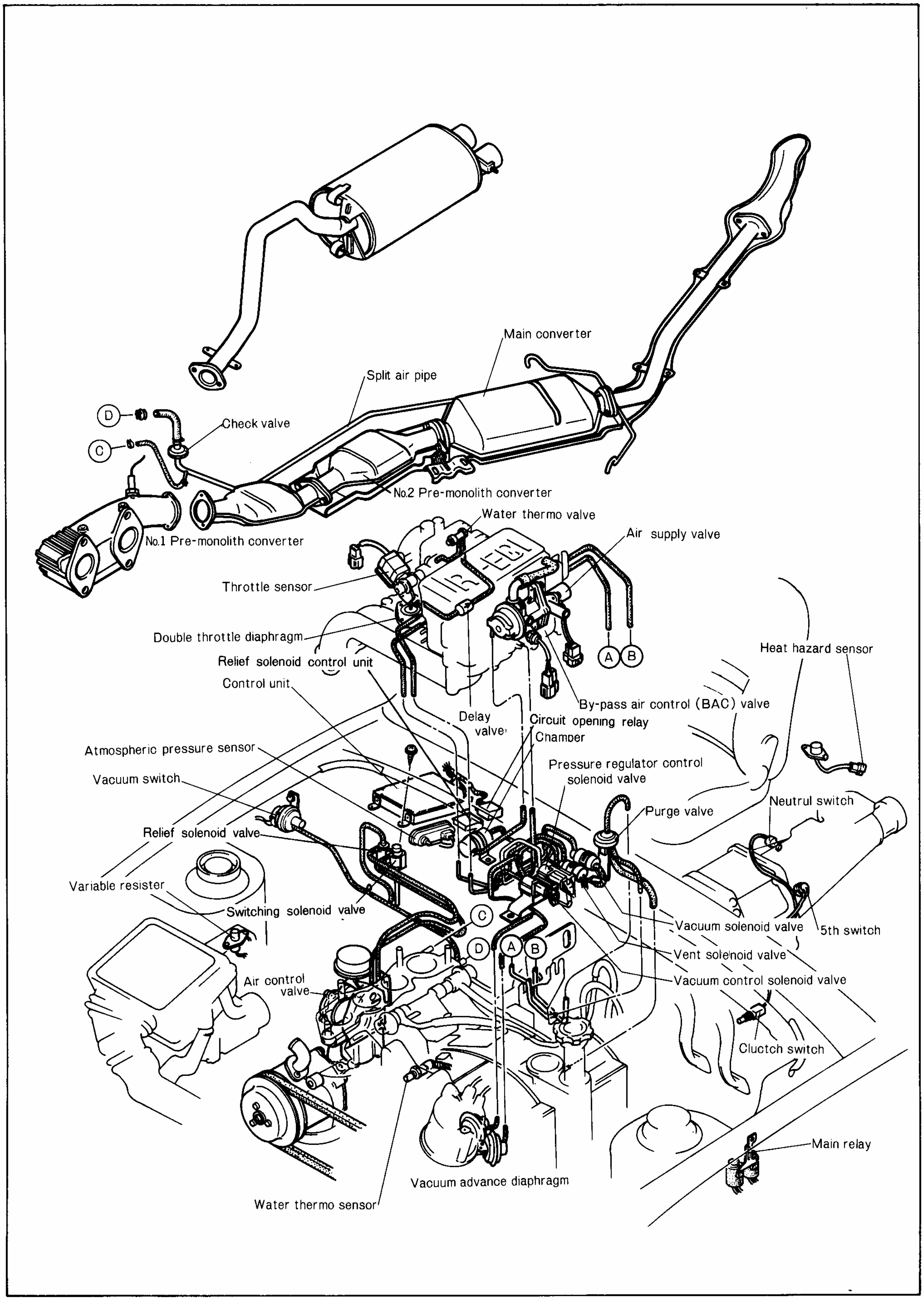

Main converter
Split air pipe
D
C
Check valve
No.2 Pre-monolith converter
Water thermo valve
No.1 Pre-monolith converter
Air supply valve
Throttle sensor
Double throttle diaphragm
Relief solenoid control unit
Control unit
A
B
Heat hazard sensor
By-pass air control (BAC) valve
Delay valve
Circuit opening relay
Chamber
Atmospheric pressure sensor
Vacuum switch
Pressure regulator control solenoid valve
Purge valve
Neutrul switch
Relief solenoid valve
Variable resister
Switching solenoid valve
Vacuum solenoid valve
5th switch
Vent solenoid valve
Vacuum control solenoid valve
Air control valve
Cluctch switch
Main relay
Vacuum advance diaphragm
Water thermo sensor

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COMPONENT DESCRIPTIONS

Component	Function	Remarks
1. Air Cleaner	Filters air into throttle chamber	
2. Air Control Valve (ACV)	Directs air to one of three locations; exhaust port, 3-bed catalyst or back to the relief air silencer	Consists of 3 valves: Air Relief Valve Air Switching Valve Anti-afterburn Valve
3. Air Flow Meter	Detects amount of intake air; sends signal to control unit	
4. Air Pump	Supplies secondary air to ACV	
5. Air Supply Valve	Supplies by-pass air into dynamic chamber	During air-con. operation During P/S operation
6. Anti-Afterburn Valve	Supplies fresh air into rear port during deceleration	Included in ACV; vacuum operated
7. Atmospheric Pressure Sensor	Detects atmospheric pressure; sends to control unit	
8. By-pass Air Control (BAC) Valve	Controls amount of by-pass air to maintain idling speed, etc.	Controlled by vent solenoid valve and vacuum solenoid valve
9. Canister	Stores gas tank fumes when engine stops	Vented to atmosphere through charcoal and filter
10. Check and Cut Valve	Releases excessive pressure or vacuum in fuel tank to atmosphere Prevents fuel loss if vehicle overturns	

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Component	Function	Remarks
11. Clutch Switch and Neutral Switch	Detect in-gear condition; sends signal to control unit	Closes when clutch pedal is depressed; opens when clutch pedal is released Closes in neutral; opens in all other ranges
12. Control Unit	Detects the following: 1. Engine speed 2. Radiator coolant temperature 3. Engine coolant temperature 4. Throttle opening 5. Intake manifold vacuum 6. O_2 concentration 7. In-gear condition 8. Idle mixture 9. Floor temperature 10. Intake air temperature 11. Cranking signal 12. Atmospheric pressure 13. Air conditioner ON/OFF condition 14. Amount of intake air Controls operation of the following: 1. Vacuum control solenoid valve 2. Switching solenoid valve 3. Relief solenoid valve 4. BAC valve (vent solenoid valve and vacuum solenoid valve) 5. Pressure regulator control solenoid valve 6. Fuel injection system	1. Ignition coil − terminal 2. Water temperature switch 3. Water thermo sensor 4. Throttle sensor 5. Vacuum switch 6. O_2 sensor 7. Clutch switch and neutral switch 8. Variable resistor 9. Heat hazard sensor 10. Intake air temperature sensor 11. Starter switch 12. Atmospheric pressure sensor 13. Air con. switch 14. Air flow meter
13. Dash Pot	Gradually closes throttle during deceleration	Contacts at 2,350 ~ 2,650 rpm (in neutral)
14. Heat Hazard Sensor	Detects floor temperature; sends signal to relief solenoid valve control unit	Closes above 130°C (266°F) when heat hazard sensor is closed; relieves secondary air

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Component	Function	Remarks
15. Intake Air Temperature Sensor	Detects intake air temperature; controls pressure control valve and BAC valve through control unit	Thermistor
16. No. 1 Pre-Monolith Converter	Reduce HC, CO	Oxidizing catalyst
17. No. 2 Pre-Monolith Converter	Reduce HC, CO and NOx	3 way catalyst
18. Over Drive Switch	Controls ACV solenoid	5th gear: open Others: closed
19. O_2 Sensor	Detects exhaust manifold O_2 concentration; sends signal to control unit	
20. Pressure Regulator Control Solenoid Valve	Shuts vacuum passage between dynamic chamber and pressure regulator (to prevent engine stopping)	Operates when: Intake air temperature is above 50°C (122°F) During cranking After cranking
21. Purge Valve	Carries evaporative fumes from gas tank and canister to intake manifold	During open throttle
22. Relief Solenoid Valve	Relieves secondary air to air cleaner when unnecessary	Blue
23. Split Air Solenoid Valve	Controls amount of split air; increase split air when ACV solenoid operates	Operates when overdrive switch is open

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Component	Function	Remarks
24. Split Air Injection Pipe	Secondary air injected between center monolith and rear monolith (main converter) above 1,100 rpm with open throttle	
25. Switching Solenoid Valve	Switches secondary air to exhaust port or rear catalyst	Gray
26. Throttle Sensor	Detects throttle opening angle	
27. Vacuum Advance Diaphragm	Controlled by solenoid valve	
28. Vacuum Control Solenoid Valve	Cut vacuum to distributor during deceleration, etc.	Green
29. Vacuum Switch	Detects intake manifold vacuum; sends signal to control unit	Opens when intake manifold vacuum is 0 ~ 100 mmHg
30. Vent Solenoid Valve and Vacuum Solenoid Valve	Controls BAC valve	Controlled by control unit
31. Water Temperature Switch	Detects radiator coolant temperature; sends signal to control unit	Above 15°C (59°F): ON
32. Water Thermo Sensor	Detects engine coolant temperature; sends signal to control unit	Thermistor
33. 3-bed Monolith Converter	Further reduces HC, CO and NOx	3 way catalyst (Main converter)

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OUTLINE OF CONSTRUCTION

AIR INDUCTION SYSTEM

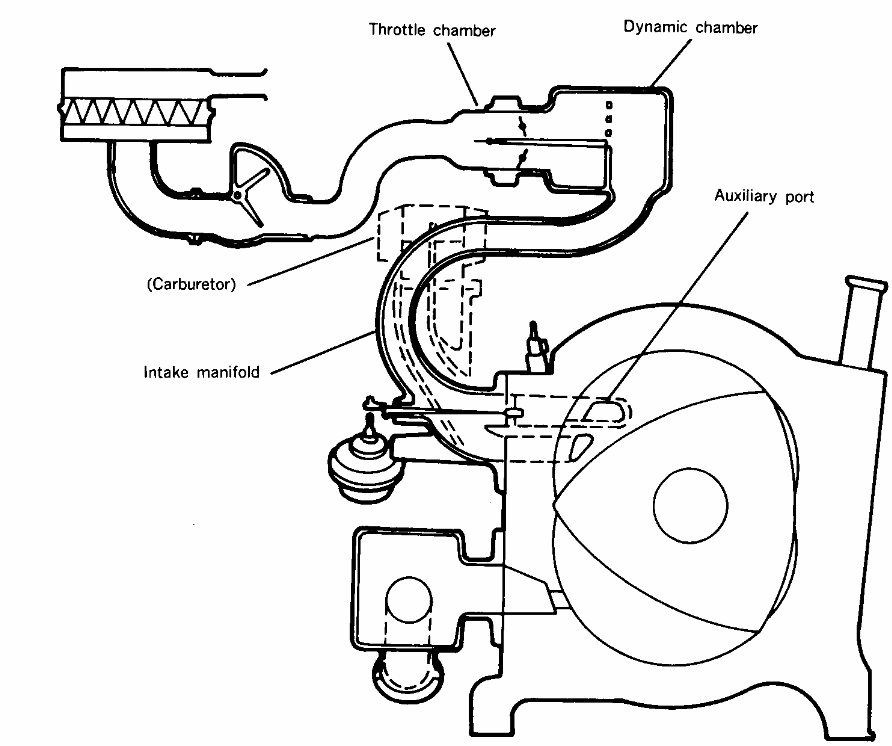
1. DYNAMIC SUPERCHARGE SYSTEM

The dynamic chamber is completely separated in to primary and secondary chambers. Each chamber is connected to the intake ports for each rotor by two intake manifolds, totalling four in the twin-rotor engine.

The dynamic chamber inlet is provided with a two-stage throttle valve. An electronic gasoline injection (EGI) system is used, which makes possible the use of the long intake manifolds.

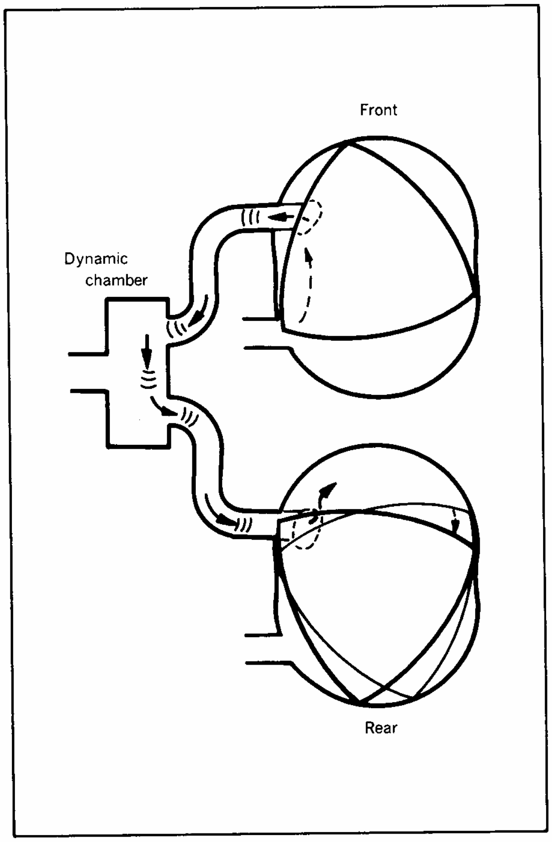
(1) Objective

To take advantage of pressure changes in the intake path in order to improve intake air efficiency.



Reference notes:

- When the EGI is used, the air and fuel can be thought of as individual components. Consequently, there is much more freedom regarding the shape, diameter and length of the intake manifold than when a carburetor is used.
- When a carburetor is used, a triple venturi arrangement is used in order to improve vaporization of the gasoline. But, because the inner diameter of the intake manifold is correspondingly smaller, charging efficiency is poor in the high-speed range, and there is a sharp loss of power.
- The dynamic supercharge system is designed for high intake air efficiency from low speed to high speed by using the multiplication effect of the 6-port induction (6PI) system.

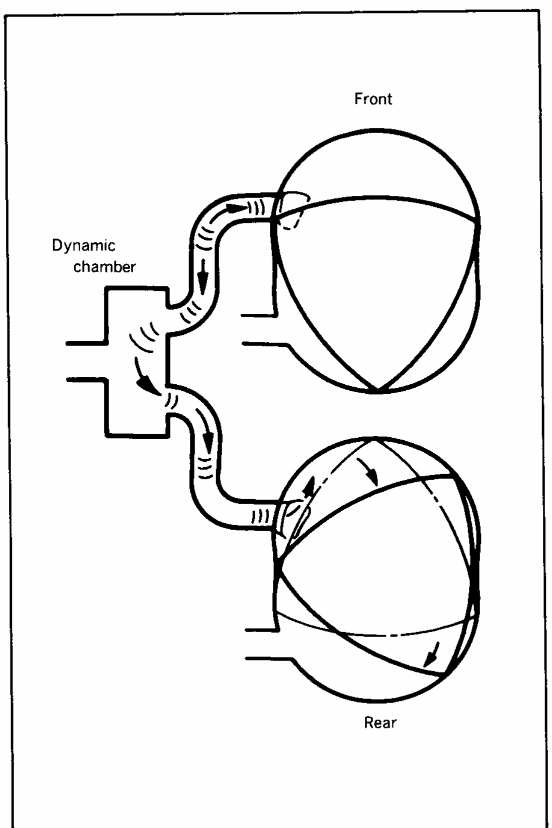


(2) Effects of the dynamic supercharge system

Intake air efficiency is improved by the combination of the following two effects.

Exhaust obstruction effect

When the front intake port begins to open, because there is an overlap, there is pressure in the dynamic chamber caused by exhaust pressure within the cylinder. At that time, the rear rotor enters the compression cycle, the cylinder pressure begins to become higher than the pressure of the intake manifold, but, because of the effect of the pressure return from the front, supercharging of the air is possible until immediately before the rear intake port closes.

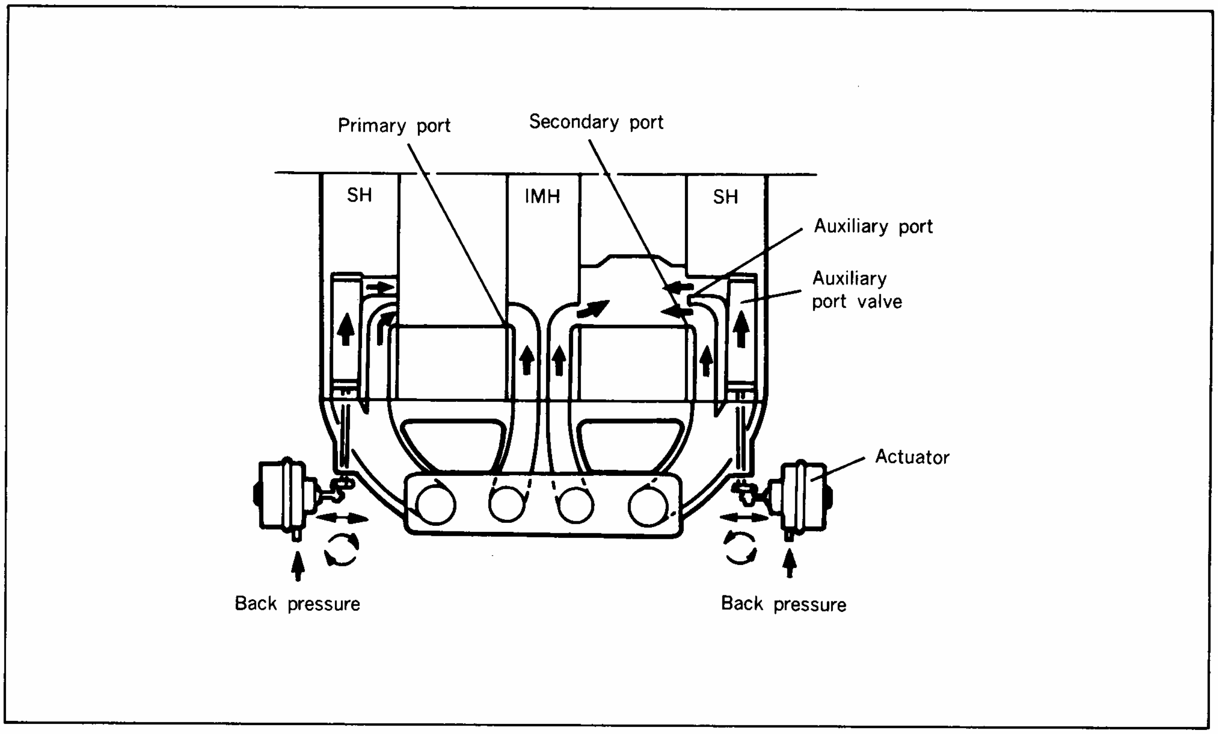


Intake inertia effect

Intake inertia is caused by the closing of the front intake port. A compression wave occurs, and the pressure within the manifold is changed from negative pressure to positive pressure.
This compression wave passes through the dynamic chamber and accelerates (supercharges) the intake of the rear cylinder.

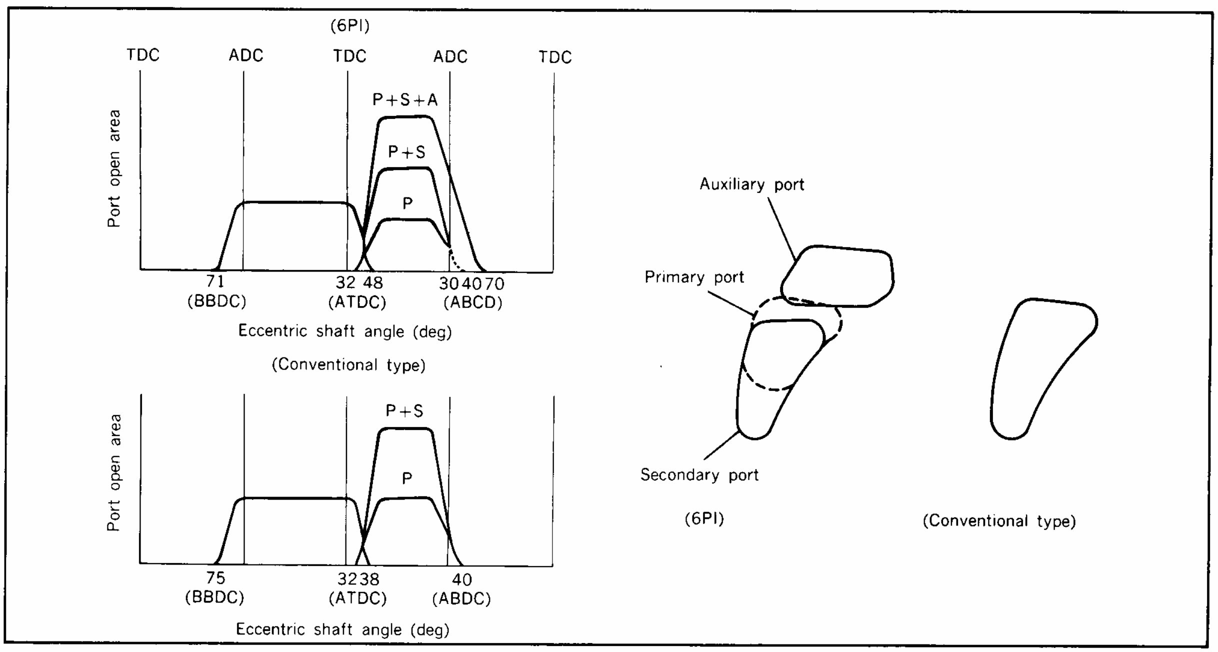
2. 6PI (6-PORT INDUCTION) SYSTEM

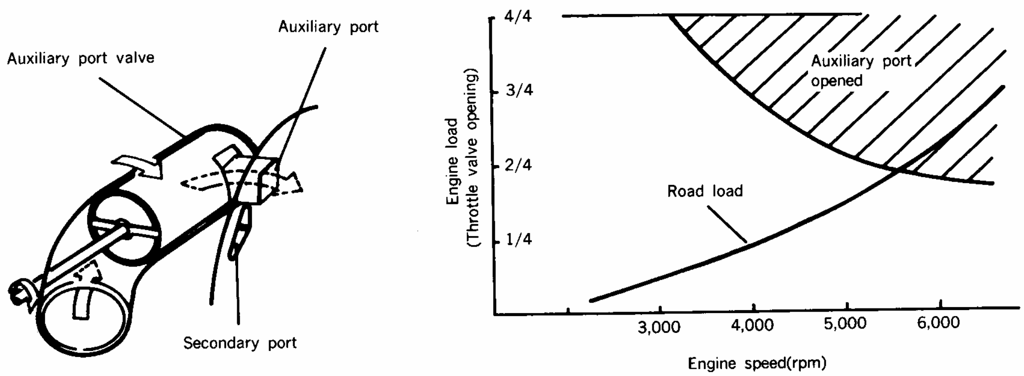
The 6PI system is composed of three intake ports per rotor: a primary, a secondary, and a secondary-auxiliary port. There is a total of six ports in a twin-rotor engine.



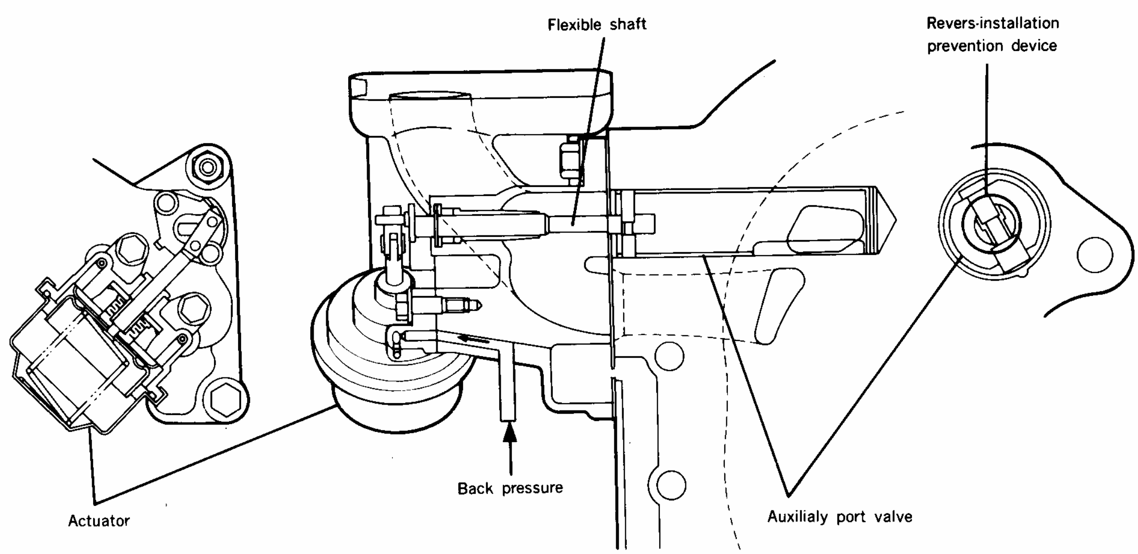
To prevent mixture blowback into the intake manifold at low speeds, the IC (intake port close) timing of the primary and secondary main ports are relatively advanced to suit the low-speed requirement. IC timing of the auxiliary port is optimized for high-speed performance. The auxiliary port is equipped with a rotating valve (auxiliary port valve), controlled by exhaust pressure which is virtually proportional to the power.

This rotating valve closes at low speeds, and opens or closes at high speeds depending on demand.



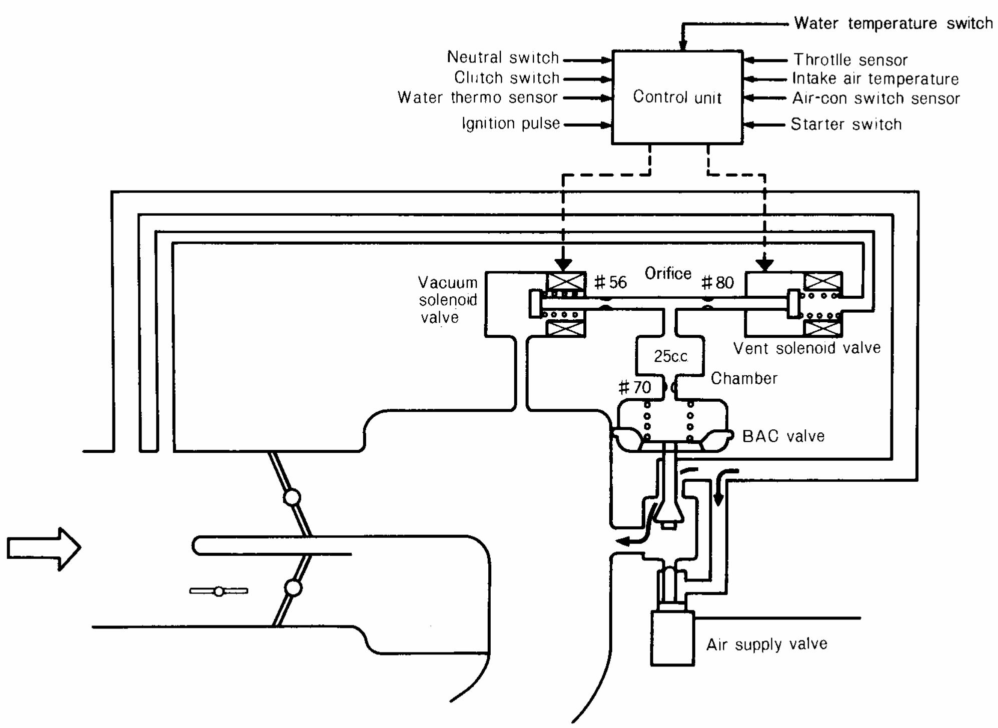


The auxiliary port valve and actuator are two separate parts. In addition, a flexible shaft is provided at the middle of the driveshaft in order to absorb dimensional variations, and a reverse-installation prevention device is fitted at the valve coupling.



BAC (BY-PASS AIR CONTROL) SYSTEM

This system consists of the BAC valve, chamber, vent solenoid, vacuum solenoid, ASV (Air Supply Valve) and control unit.
Except during AWS (accelerated warming-up system) operation and warming-up (when the fast-idle mechanism operates and the primary throttle valve is forced open), the BAC valve operates, by commands from the control unit, to maintain 800 rpm during idling.



OPERATION

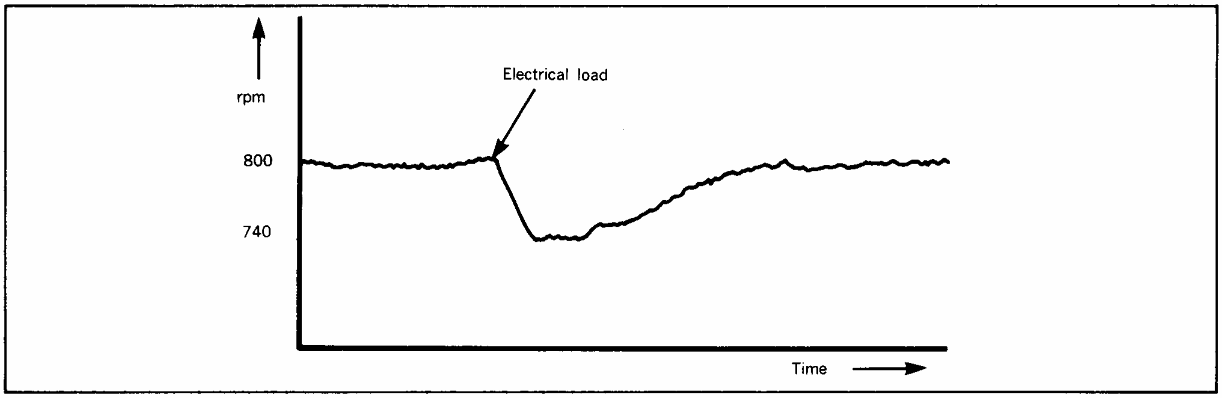
1 Operation under ordinary conditions

(1) The vacuum and vent solenoids operate little by little as on off duty signals are received from the control unit, making a pressure adjustment of the amount of vacuum applied to the diaphragm chamber of the BAC valve.
(2) The vacuum is led once to a chamber (25 cc), where pressure pulsations are alleviated (surge prevention).
(3) Depending upon the volume of vacuum applied to the diaphragm chamber, the valve moves up and down, thereby controlling the amount of by-pass air.
(4) When the amount of by-pass air is increased and the engine speed (idling) increases, rpm signals are sent to the control unit, so the control unit once again emits commands to each solenoid to maintain the engine speed at 800 rpm, the vacuum applied to the diaphragm chamber becomes large, and the amount of by-pass air decreases.
(5) If engine speed decreases too much, operation is the same as described above: the vacuum applied to the diaphragm becomes small, and the amount of by-pass air increases.

2 Electrical load

When, during idling, a small load (electrical load) is applied, such as for example when the headlights are turned on, the engine speed drops to 730 ~ 740 rpm.

It takes a little time (a few seconds), because of the effect of the vacuum tube diameter, and the capacity of the diaphragm chamber, the air chamber and the orifice, for the idling speed to return to 800 rpm by the correction made by the BAC valve.



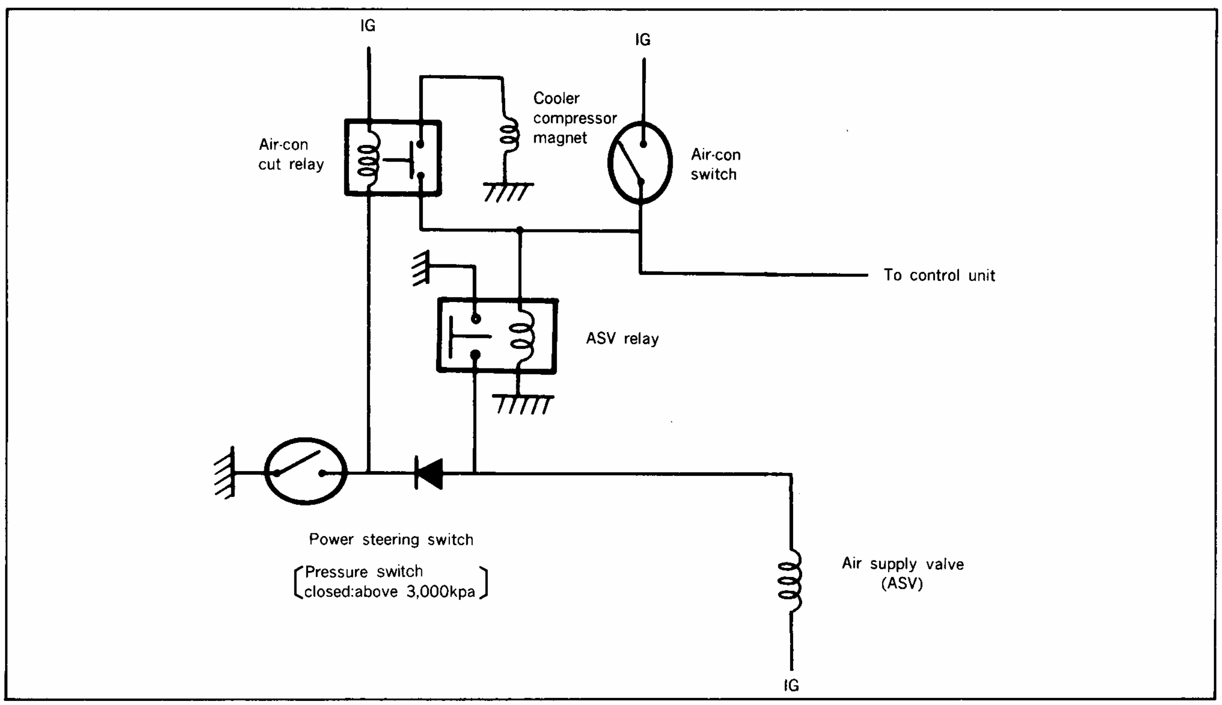
3 Air-conditioning and power steering load

If, during idling, the air-conditioner or the power steering is switched on:

Note

The power-steering is switched on when the steering wheel is turned all the way in either direction.

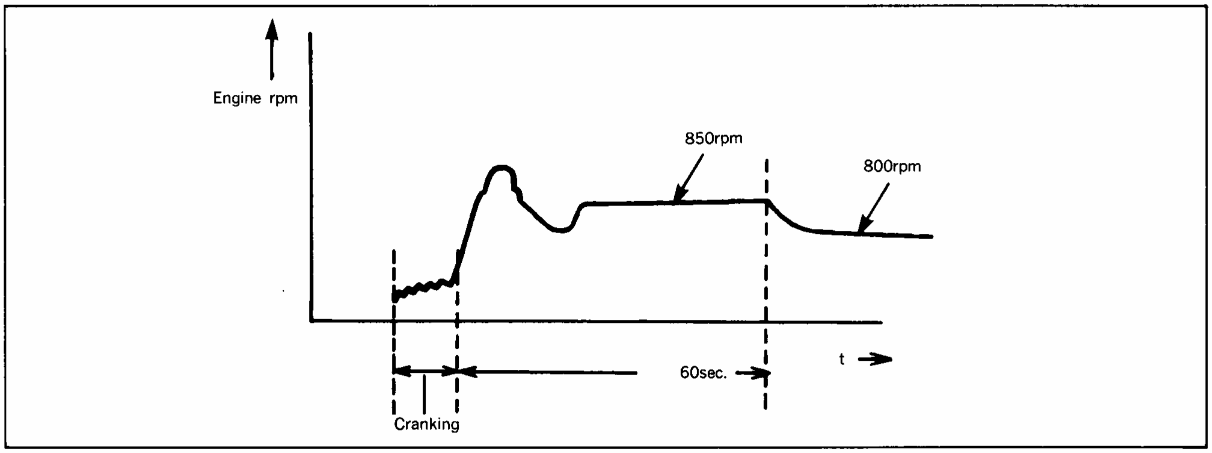
- When the air-conditioner load or power steering load is applied, in order to maintain a steady idling speed, the ASV (air supply valve) supplies a certain amount of by-pass air, and then the BAC valve functions to correct the idling speed to 800 rpm.
- If the power steering is switched on while the air-conditioner is operating, power to the air-conditioner magnetic clutch is switched off, stopping the compressor operation without stopping the blower motor.



4 Restarting the engine while hot

In order to improve engine idling stability when the engine is restarted while hot (when the intake air temperature is 50°C or higher), the BAC valve is regulated for 60 seconds after starting so that the idling speed is maintained at 850 rpm.

- Fuel pressure control (the pressure regulator control solenoid valve in the fuel system) is synchronized. See page 4B–28.

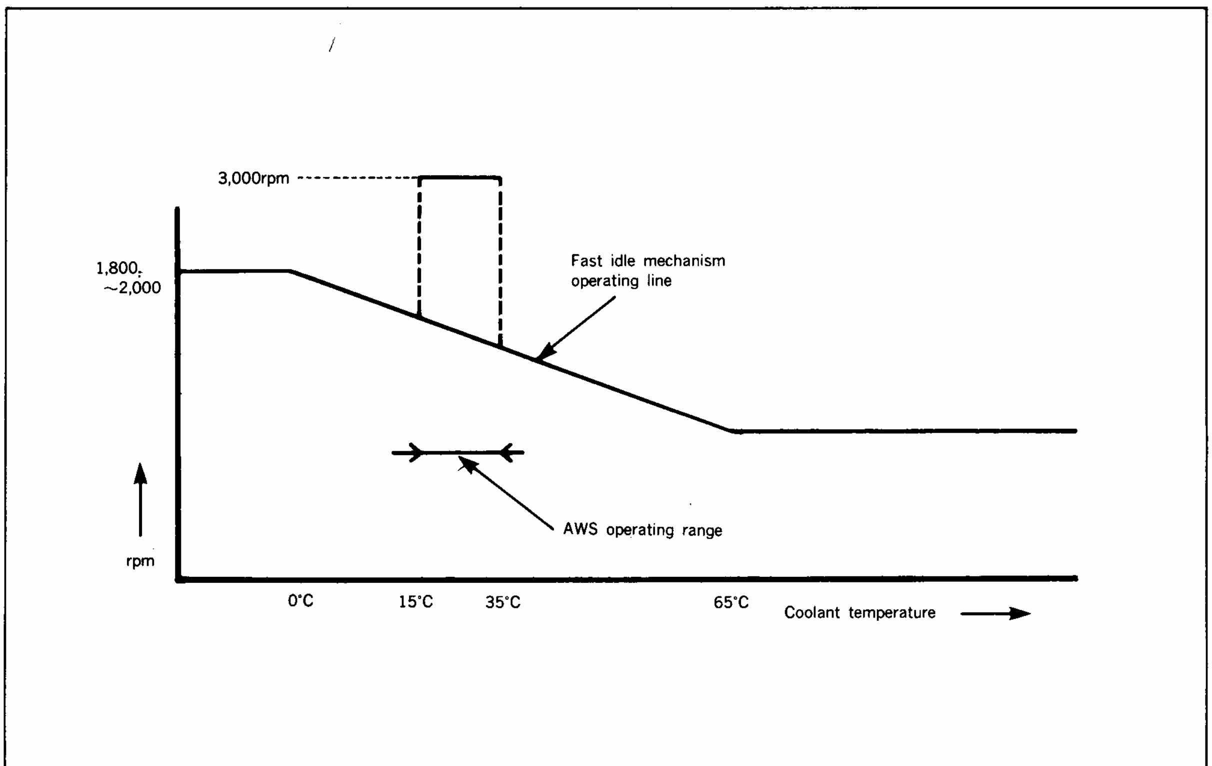


5 During operation of accelerated warming-up system (AWS)

When all of the conditions below are satisfied, the engine speed is held at about 3,000 rpm for 13 seconds after the engine is started.

(1) Engine coolant temperature 15 ~ 35°C (59 ~ 95° F) . . . water thermo sensor
(2) Clutch pedal is depressed . . . clutch switch
(3) Transmission in neutral . . . neutral switch
(4) Starter signal switches from on to off . . . starter switch

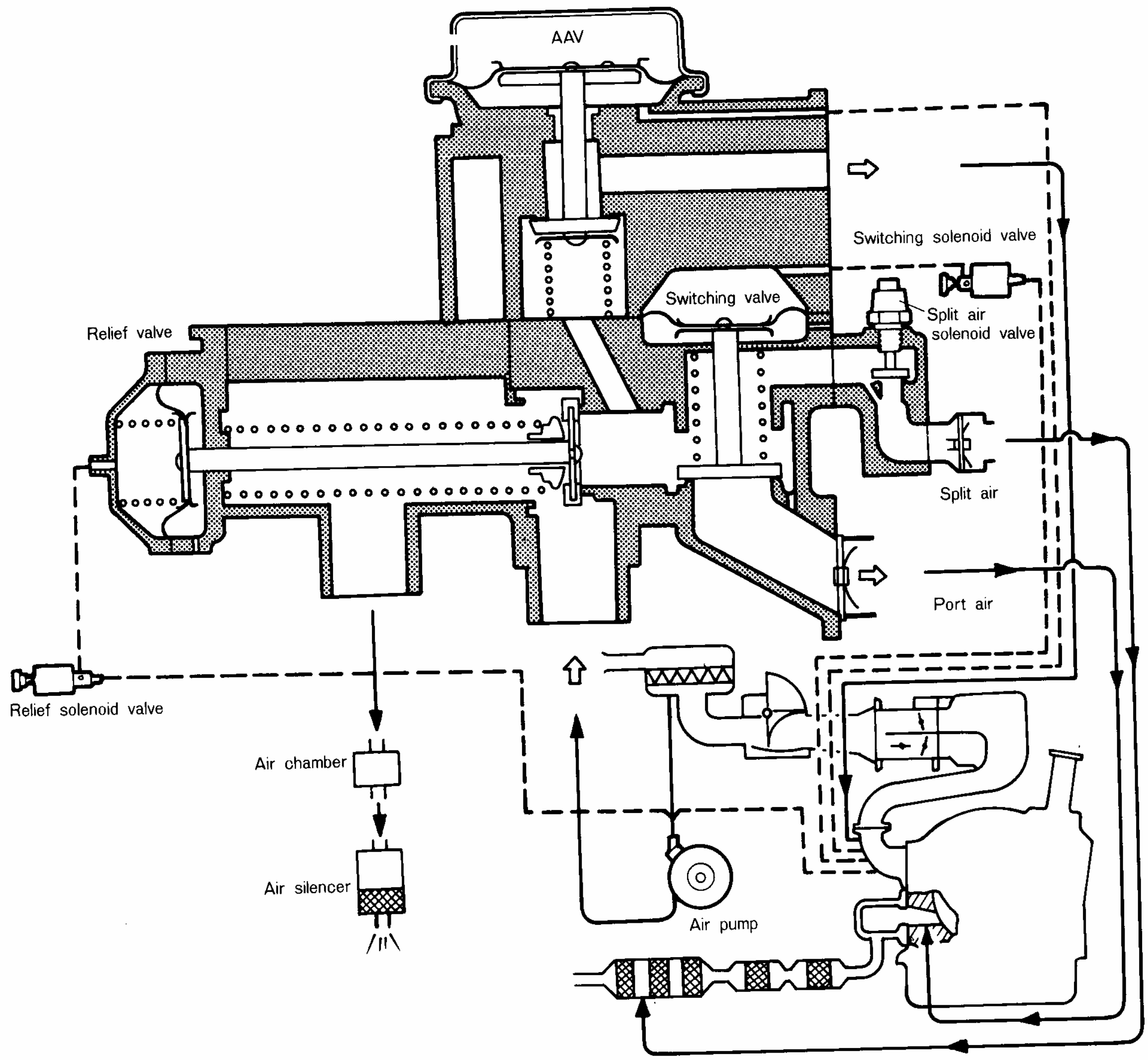
- AWS when all conditions are satisfied.



EMISSION CONTROL SYSTEM

1. SECONDARY AIR CONTROL SYSTEM

The switching valve and relief valve operate by commands from the control unit, depending upon the engine coolant temperature, the engine speed, the throttle opening, the vacuum switch, the timer, the speed sensor and the radiator coolant temperature, thus expediting the purification of the CO, HC and NOx within the catalyst converter and preventing overheating of the converter.

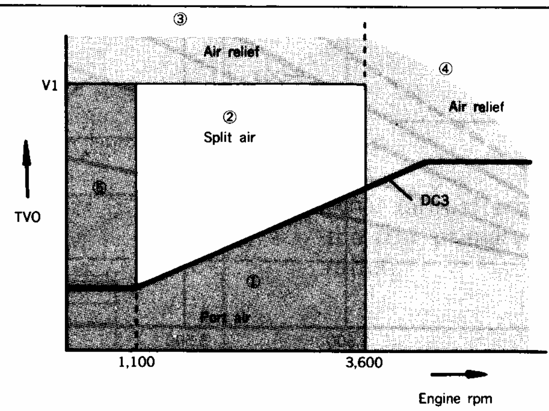


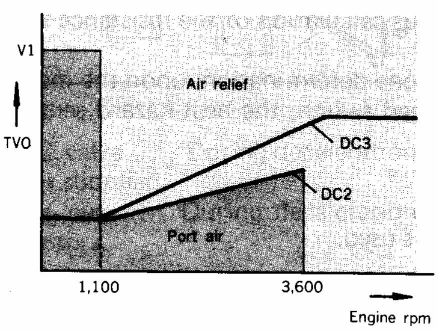
Operation after engine warm-up

(1) During idling and during deceleration, port air is supplied, and CO and HC are oxidized.
(2) During normal conditions of 1100 ~ 3600 rpm and during acceleration (at or above the DC3 line, described on page 4B—18), split air is supplied, NOx is reduced, and CO and HC are oxidized.
- Note that 120 seconds after the switchover from port air to split air, secondary air will be relieved.

(3) When engine speed is 3600 rpm or less, there is air relief (V1 vacuum switch OFF) if the intake manifold vacuum becomes −100 mmHg or less.
(4) Secondary air will be relieved at 3600 rpm or higher.
(5) When the throttle opening is large at 1100 rpm or less, port air changes to split air 8 seconds later.

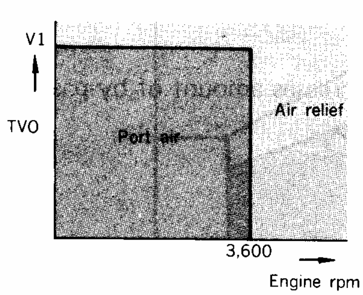
Note
Secondary air will be relieved when the heat-hazard sensor (floor sensor) is ON.





When radiator coolant temperature is 15°C or lower

- The operation will be as shown in the illustration at the left.
  Note that operation will occur with the DC2 line as the border.
  There is no relationship to engine coolant temperature.



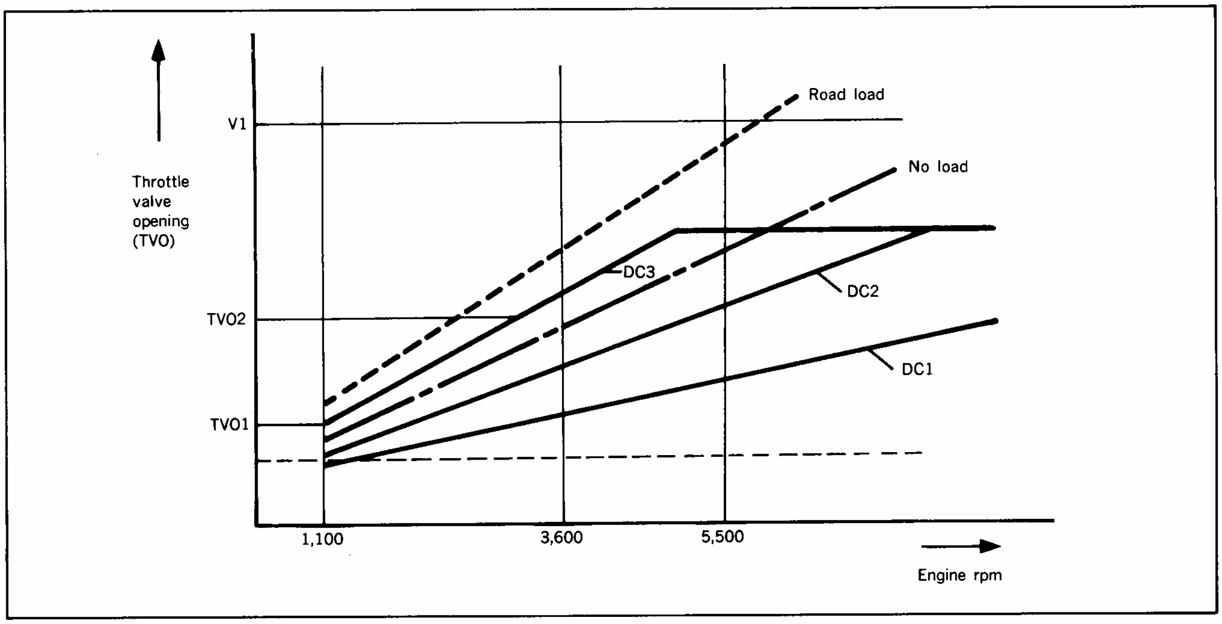
When radiator coolant temperature is 15°C or higher and engine coolant temperature is 50°C or lower

- Port air is supplied until 3600 rpm. At that time, fuel volume is increased (warm-up volume increase), and the catalyst temperature is quickly increased.

REFERENCE NOTE

About the DC lines

The relationship between the load of the engine and rpm is shown in the illustration below.
The DC lines are memorized lines. The relationship between the resistance value of the throttle sensor and engine rpm changes is constantly being input to the microcomputer within the control unit.



Whether actual running conditions (acceleration, cruising, deceleration) are at a position above the DC line or are at a position below it is determined by instantaneous calculation of the resistance value of the throttle sensor and the engine rpm (input signals).
The activation of each device also depends, in addition to the zone determination, upon the individual conditions of the coolant temperature switch, the vehicle speed switch, the heat-hazard sensor, the clutch switch, the neutral switch, etc.

1 DC1 line

This is a line that effects fuel cut; the zone below the DC1 line is used.

- Zone below DC1 line:
  Throttle opening . . . very small
  Engine rpm . . . high
  (Conditions similar to full deceleration by engine braking)

2 DC2 line

At or above the DC2 line . . .

- Vacuum advance of distributor is activated.

At or above DC1 line and at or below DC2 line . . .

- One-side fuel cut (front cut) and operation of BAC valve. (Increases amount of by-pass air during deceleration.)

3 DC3 line

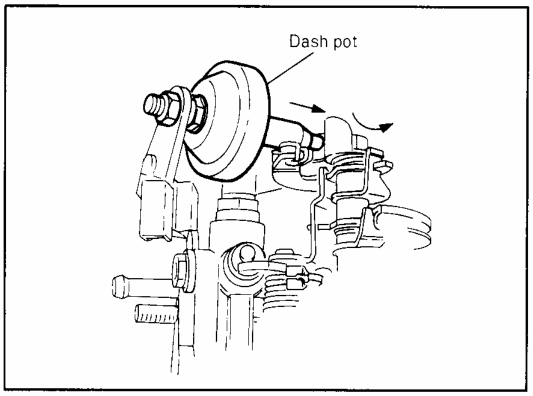
At or above DC3 line . . .

- Switching valve is activated: port air → split air

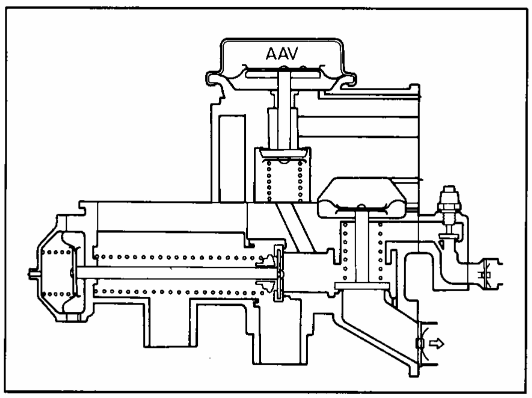
Because it is at a position above the no-load line, the area at and above the DC3 line is the no-load area, and can't be reached even if the engine speed is increased. Note, however, that it can be reached momentarily when there is a change from idling to rapid acceleration, but a test of the operation of the device cannot be made.

2. DECELERATION SYSTEM

When there is a change from acceleration to deceleration, the air/fuel mixture deteriorates sharply (becomes rich), and, because misfiring occurs, CO and HC increase. These problems are resolved by the systems described below.



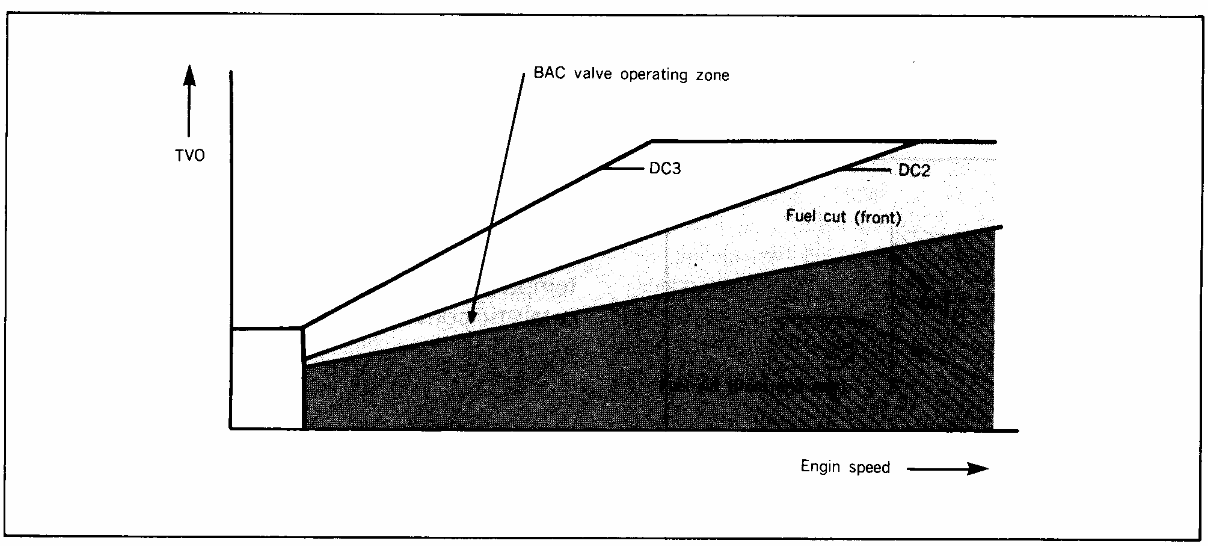
(1) Dash pot . . . During deceleration, the throttle valve is gradually closed, thus preventing a sharp deterioration of the air/fuel mixture.



(2) AAV (anti-afterburn valve) . . . Air is supplied to the rear primary port immediately after deceleration.

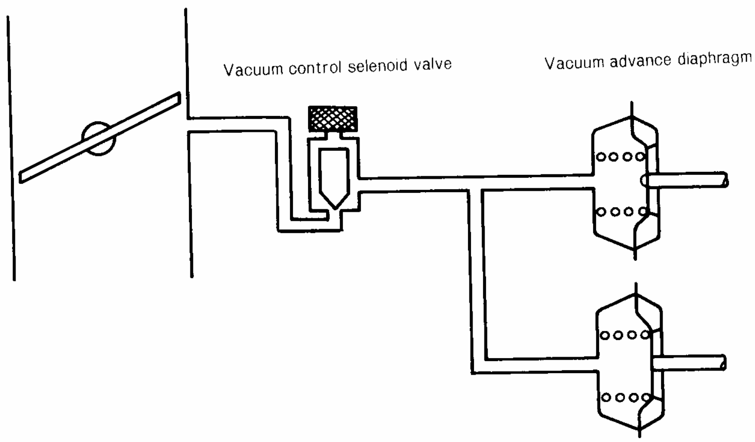
(3) BAC valve . . . During deceleration (semi-reduction of speed), the BAC valve operates, and by-pass air is supplied.

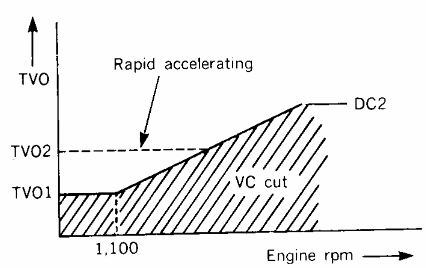
(4) Fuel cut . . . During deceleration above a certain engine speed, fuel is not supplied from the injectors.



3. IGNITION CONTROL SYSTEM

The leading and trailing vacuum advance is controlled by commands from the control unit.

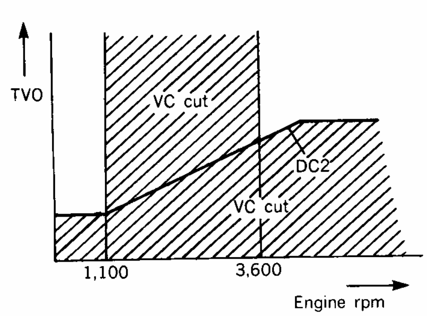




Operation after engine warm-up

- VC at and above DC2 line
- VC cut at and below DC2 line
- When there is sudden acceleration from a position at or above TV02 (broken line), VC is cut for 3 seconds (to prevent ''knocking'').
  *TVO change rate 20% or more/0.13 sec.

Reference
VC. . . .Vacuum from intake manifold to vacuum advance diaphragm.



When radiator coolant temperature is 15°C or higher and engine coolant temperature is 50°C or lower.

- During 1100 ~ 3600 rpm for 120 seconds after engine is started, VC is cut, and exhaust gas temperature becomes high to warm up the catalytic converter quickly.

EGI (ELECTRONIC GASOLINE INJECTION) SYSTEM

This system consists of various types of sensors, which detect engine conditions, and a control unit which controls the injection amount based upon the detected signals. It is designed to always maintain the most suitable air/fuel ratio depending upon driving conditions.

FEATURES OF THE EGI SYSTEM

The EGI system has the following advantages over the carburetor system.

1. A good driving "feeling"
   (1) Because there is no venturi restriction such as there is with a carburetor, there is little intake resistance, so engine output is large.
   (2) Because the amount of fuel injected near the combustion chamber corresponds with changes of the amount of intake air, engine response in relation to axle operation is good during acceleration.
   (3) Because the air/fuel ratio can be automatically corrected to the optimum value by the computer, the "feeling" is excellent from cold starting to high-speed driving.
   (4) Because a fuel reduction is possible during deceleration, the "feeling" of deceleration is good and fuel consumption is improved.
2. Exhaust gas countermeasures can be more easily made.
   (1) Because the amount of fuel injection can be set most appropriately and the air/fuel ratio of each combustion chamber can be made uniform, there is little variation of CO and HC and, moreover, because the absolute volume can be reduced, exhaust gas countermeasures can be more easily taken.

OUTLINE OF THE EGI SYSTEM

The EGI system can be roughly divided into the following 3 parts:

1. Intake Air System

The necessary amount of air for combustion is supplied.

2. Fuel System

The necessary amount of fuel (gasoline) for combustion is supplied at a fixed pressure to the injector. The injector measures and injects the fuel within the intermediate housing air-intake port according to injection signals from the control unit.

3. Control System

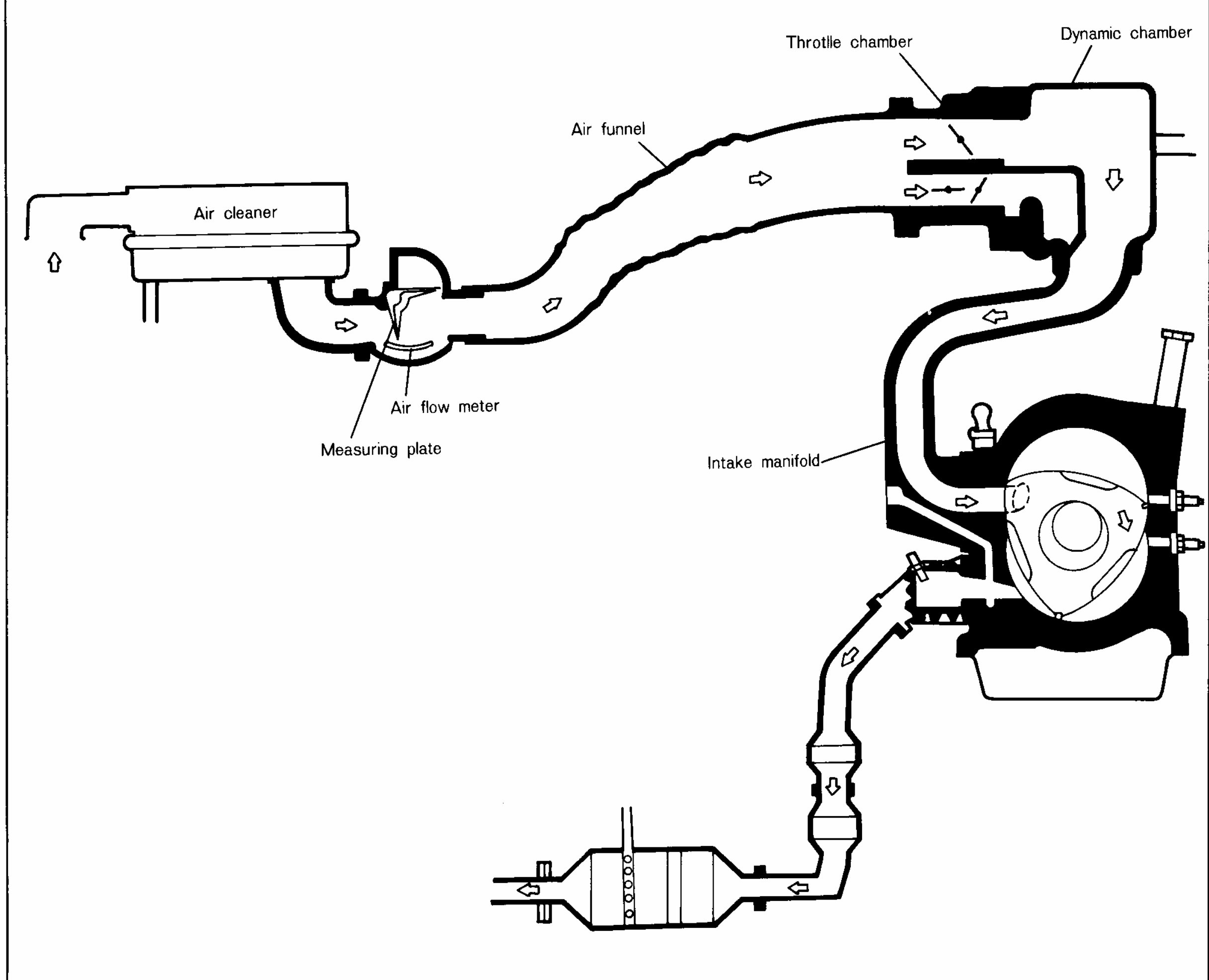
The various sensors detect conditions such as the amount of intake air, engine speed, coolant temperature, intake air temperature, acceleration or deceleration conditions, oxygen concentration in the exhaust pipe, atmospheric pressure, etc. Then the injection time is determined by the control unit based on these signals. There are two types of injection control: injection control of injection signals sent to the injector, and fuel pump control of the on/off operation of the fuel pump.

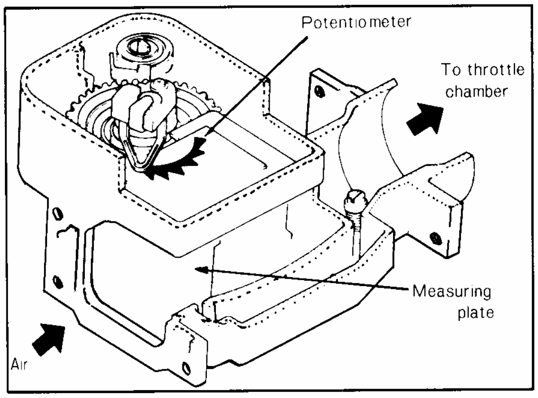
1. INTAKE AIR SYSTEM

The intake air system is the system which supplies the amount of air necessary for the mixture, and also measures the quantity of air flow.

Operation

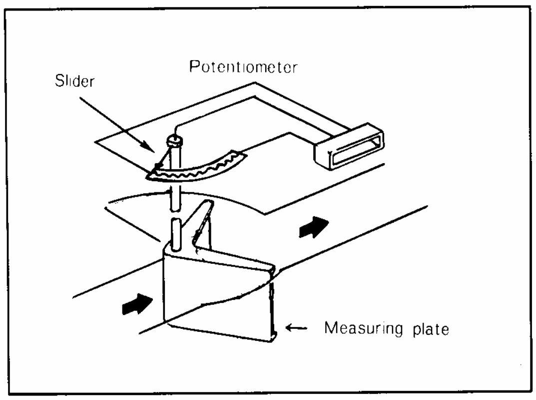
The amount of intake air flow, changed by the throttle opening and engine speed, is measured by the opening angle of the measuring plate in the air-flow meter, and electric signals are sent to the control unit.
Meanwhile, the amount of fuel is controlled to the most appropriate amount, according to the amount of intake air, by the control unit, and is injected by the injector.



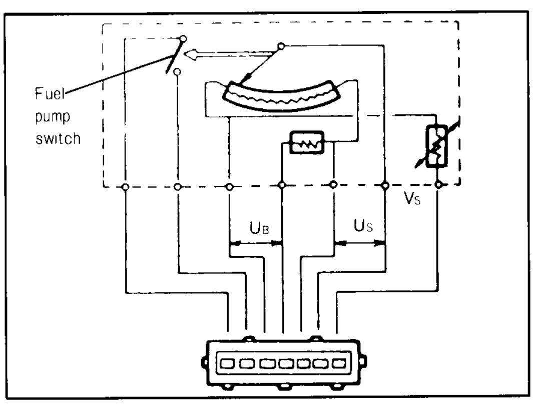


Air-flow Meter

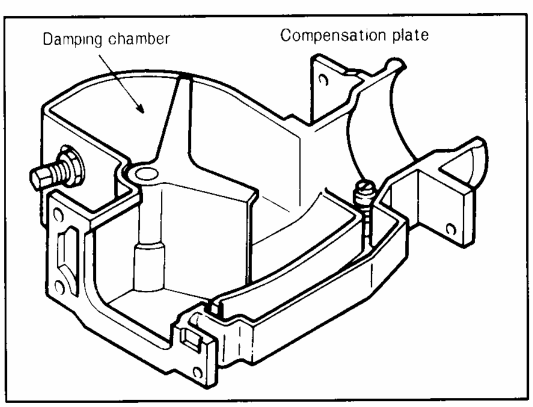
- The air-flow meter detects the amount of intake air as voltage changes of the potentiometer, and the control unit determines the basic fuel injection amount according to these signals.



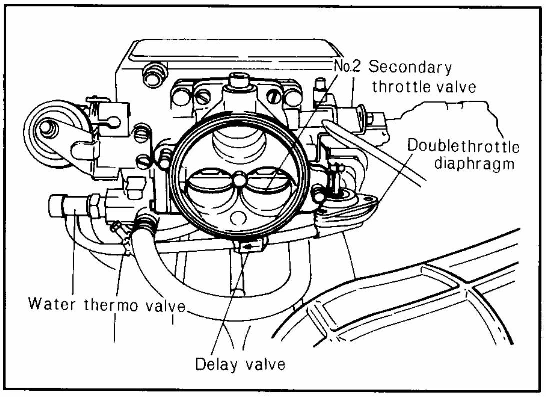
- When the air from the air cleaner passes through the air-flow meter, the measuring plate opens the return spring to the balance angle as a result of the force created by air flow. At this time, the amount of intake air is detected as a voltage ratio by the potentiometer, which is connected to the same shaft as the measuring plate. The resulting signal is sent to the control unit.



- The voltage which detects the changes of the measuring plate opening is called **Vs** voltage; this voltage becomes higher as the plate opening becomes larger, and becomes lower as the plate opening becomes smaller.
  The potentiometer detects the amounts of intake air as voltage ratios **Us** and **UB**.



- The damping chamber applies reverse torque to the compensation plate when there is a sudden reduction in the amount of intake air (when the throttle valve is suddenly closed) in order to prevent over-response of the air-flow meter, and also absorbs pulsations within the intake air pipe so that the amount of intake air is stably measured.



Throttle Chamber

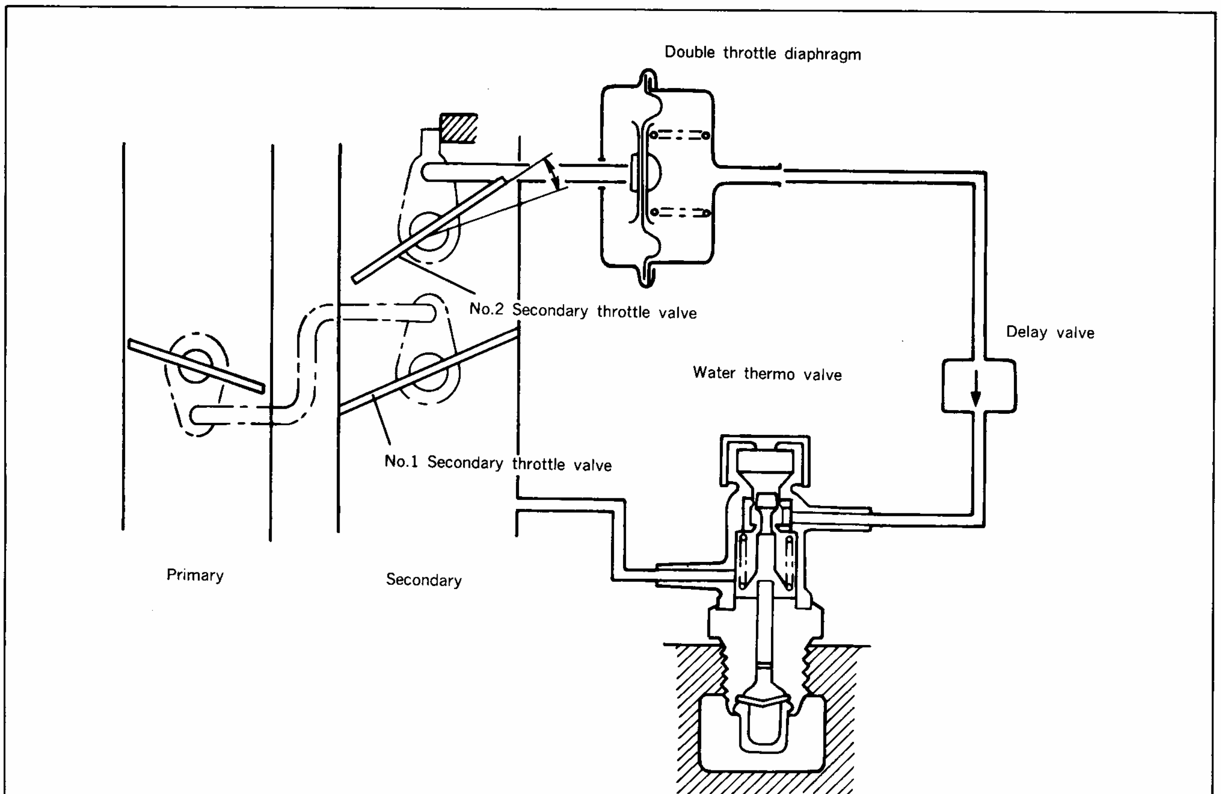
- A 2-stage, 3-barrel type throttle chamber is used.
- It is composed of a throttle valve to control the amount of intake air, a by-pass system used during idling, a fast-idle mechanism and throttle sensor to detect the throttle valve opening, and a dash pot.
- The primary valve and secondary valve are connected by a link arrangement, and, when the degree of opening of the primary valve becomes 15 degrees or more, the interlocked secondary valve begins to open.

Double-throttle System

The double-throttle system is composed of the No. 2 secondary throttle valve, a double-throttle diaphragm, a delay valve, and a thermo valve. It functions to prevent full throttle operation when the engine is cold.

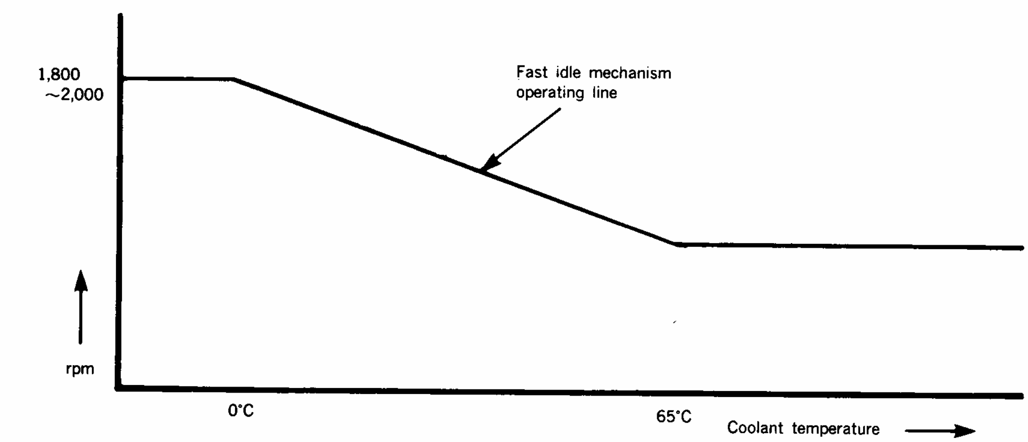
Operation

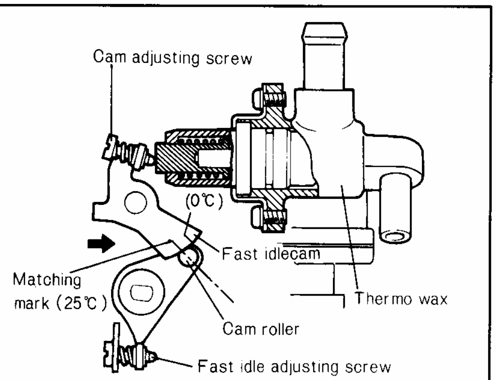
When the engine is cold (60°C (140°F) or less), the vacuum passage of the thermo valve opens, and the No. 2 secondary throttle valve is closed by the double-throttle diaphragm.
When the throttle valve is fully open, the intake manifold vacuum becomes nearly equivalent to atmospheric pressure, but, because the vacuum in the diaphragm chamber is gradually reduced by the action of the delay valve, the No. 2 secondary throttle valve does not open quickly.
When the temperature of the coolant exceeds 60°C (140°F), the vacuum passage of the thermo valve is closed, and, because the atmospheric air passage opens, the No. 2 secondary throttle valve becomes fully open.

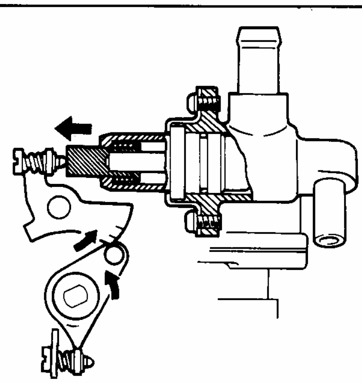


Fast-idle Mechanism

With a function equivalent to the choke of a carburetor, it performs this function by the degree of opening, by thermo wax, of the throttle valve, and by the amount of fuel increase. The thermo wax case is located on the throttle chamber.
Engine coolant is led into the wax case, the wax rod extends as the coolant temperature becomes higher, this turns the fast-idle cam, and the throttle valve is thus gradually closed.







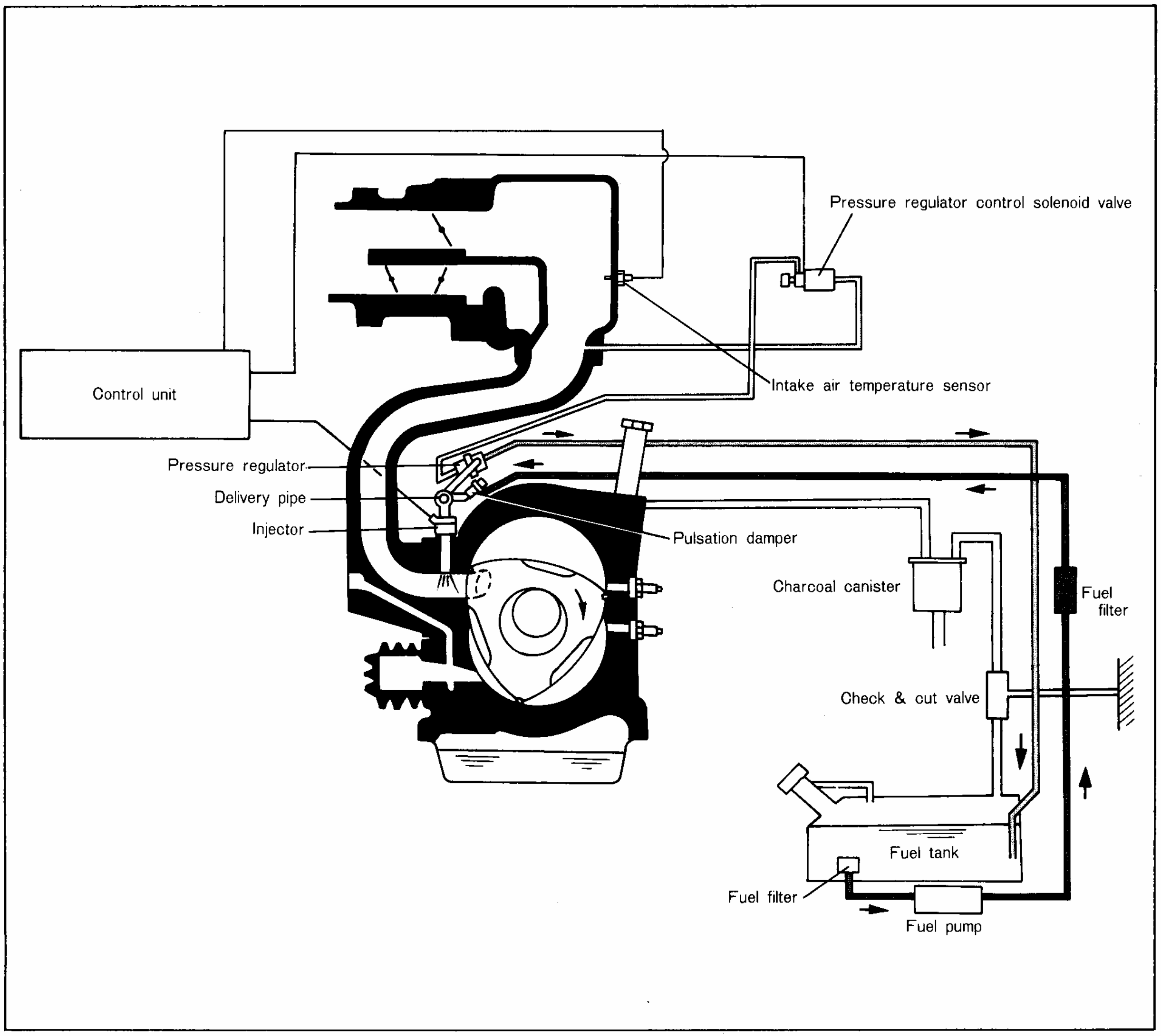
Operation of the throttle valve

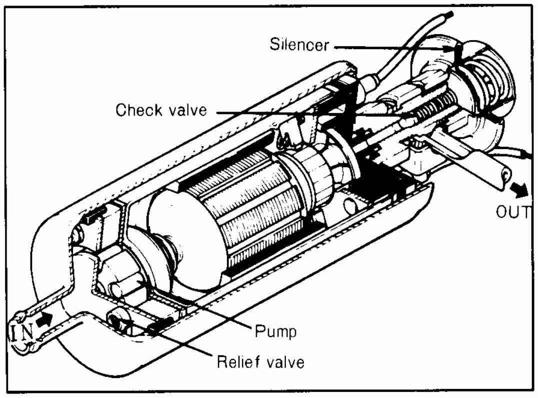
(1) Before starting, the accelerator pedal is first depressed once, bringing the fast-idle cam over the roller.
(2) After starting, the degree of opening is maintained according to the coolant temperature at that time by the fast-idle cam.
(3) As warm-up progresses, the thermo wax rod extends, the fast-idle cam turns, and the throttle valve begins to close.
(4) When the engine is completely warmed up, the fast-idle cam moves away from the roller, and the throttle valve opening changes to the prescribed (usual) idle opening.

2. FUEL SYSTEM

The fuel system sends the fuel necessary for combustion at a fixed pressure to the injectors, and then measures and injects the fuel according to injection signals from the control unit.

- The fuel pump sends the fuel in the fuel tank under pressure to each injector via the fuel filter (low-pressure side), the pressure line (high-pressure side), the fuel filter (high-pressure side), and the delivery pipe.
- Each injector opens the solenoid valve within the injector according to the injection signal from the control unit, and fuel is injected to the intermediate housing intake port.
- The pressure regulator adjusts the fuel pressure applied to the injectors. Extra fuel is returned to the fuel tank through the return pipe.



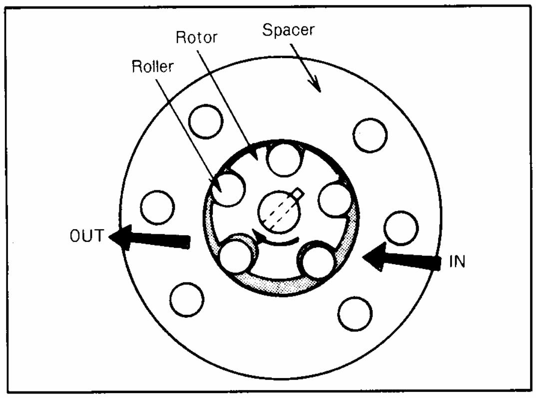


Fuel Pump

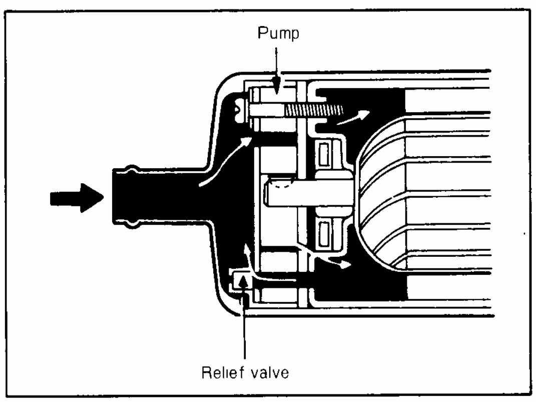
The fuel pump used is the motor type. In addition to the main body, the pump includes a silencer, a check valve to maintain residual pressure, and a relief valve.

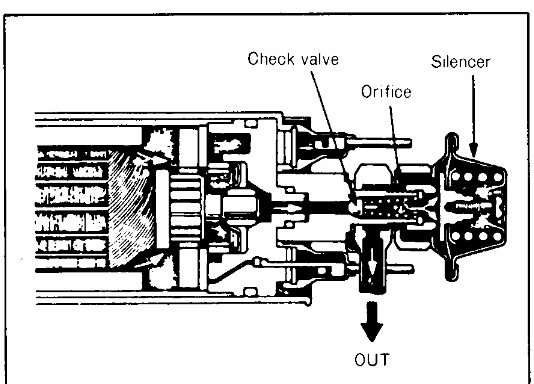
Specifications

Discharge (discharge pressure: 200 kPa) Voltage 12V, current 5.0A or less	100 ℓ/h or more
Outlet pressure	350 ~ 500 kPa ($49.8 \sim 71.1$ lb/in^2)



- The main body of the pump itself consists of a pump spacer which is the outer circumference of the motor-driven rotor pump, and a roller which functions as the seal between the rotor and pump spacer.
  When the rotor turns, the roller is pressed against the inner wall of the pump spacer by centrifugal force, and it then turns together with the rotor, acting as a seal as it turns. The volume of the chamber enclosed by these three parts changes as the rotor turns, fuel is sucked in at the intake side, and pressure is applied to the fuel at the discharge side.
- If, because of some abnormality at the discharge side, fuel could not be discharged, the fuel pressure would become high. When the pressure reaches 350 ~ 500 kPa, the relief valve opens, and the fuel at the high- and low-pressure sides in the pump circulates, thus preventing the pressure from exceeding the specified pressure.





Silencer

The pump discharges fuel five times for each turn of the rotor. The pressure within the fuel pipe changes each time fuel is discharged, resulting in pulsations. The silencer functions to absorb these pulsations of the fuel pressure, absorbing them by movements of the diaphragm and the orifice.

Check Valve

After the pump stops, the check valve is closed by spring force, thus maintaining the residual pressure within the fuel pipe. This residual pressure not only prevents vapor locking when the temperature is high, but also functions to make engine starting easy.

Hot Start Assist System

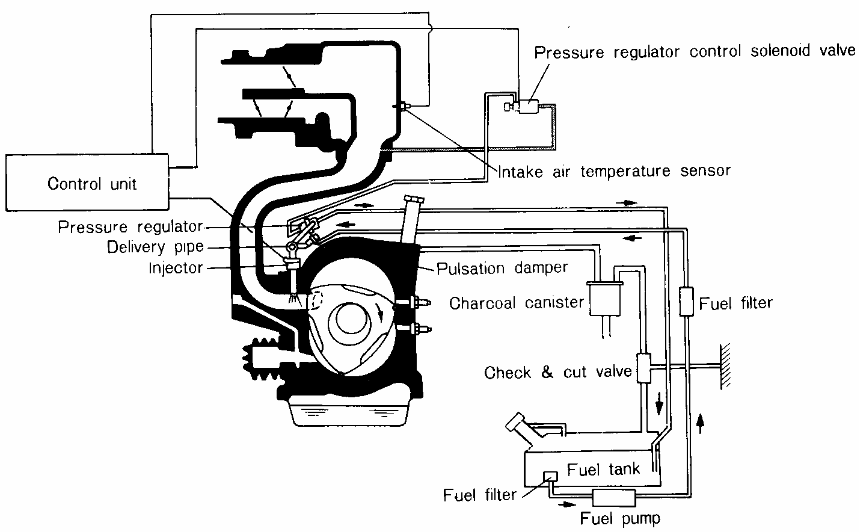
This system is composed of a pressure-regulator-control solenoid valve, pressure regulator, control unit and intake air temperature sensor attached to the dynamic chamber.

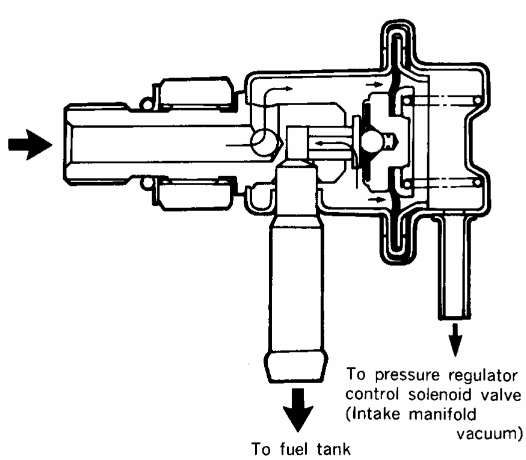
The hot start assist system has been developed for easier starting during hot under-hood conditions, and to maintain the proper idling speed once the vehicle has been started.

Operation

When the temperature within the engine compartment becomes 50°C (122°F) or more, the resistance of the intake air temperature sensor is measured. The control unit activates the pressure-control valve, and, for 60 seconds after the engine is started, the vacuum passage between the dynamic chamber and the pressure regulator is closed.

As a result of this, the diaphragm chamber of the pressure regulator maintains atmospheric pressure as it is, and fuel is injected from the injector at a pressure of 260 kPa (37.0 psi). In order to synchronize with the BAC system during this time the idling speed becomes approximately 850 rpm. When the 60 seconds have passed, the fuel pressure during idling becomes about 200 kPa (28.4 psi) because the vacuum is led to the diaphragm chamber of the pressure regulator.

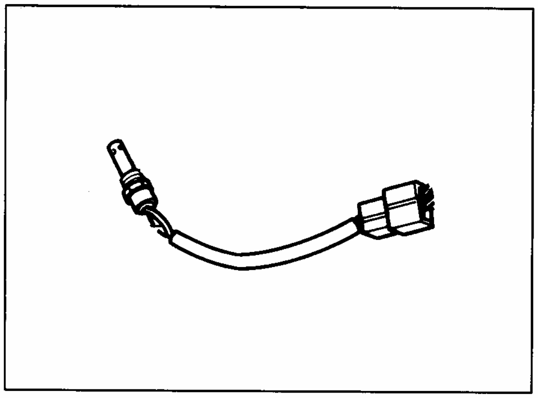




Pressure Regulator

The pressure regulator adjusts the fuel pressure applied to the injector.

Because the amount of fuel injected is regulated by the time the injector is activated, it is necessary that the fuel pressure applied to the injector always be constant. If, however, the fuel pressure is kept constant, the amount of fuel injected will change slightly when the intake manifold vacuum changes, even if the activation times (operation times) to the injectors are the same. Thus, the manifold vacuum is led to the spring chamber of the pressure regulator, and the fuel pressure is always maintained at a high pressure of 260 kPa (37.0 psi) relative to the manifold vacuum, thereby making possible fine adjustments of the fuel injection amount. When the fuel pressure becomes 260 kPa (37.0 psi) or higher relative to the intake manifold vacuum, the diaphragm is pressed, the valve opens, and the excess fuel is returned to the fuel tank through the return pipe.

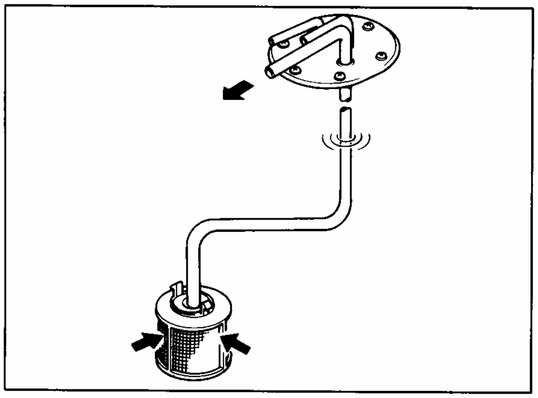


Intake Air Temperature Sensor

This is a sensor to detect the temperature of the intake air.

The intake air temperature sensor is a thermistor; its resistance value changes according to changes of the temperature of the intake air.

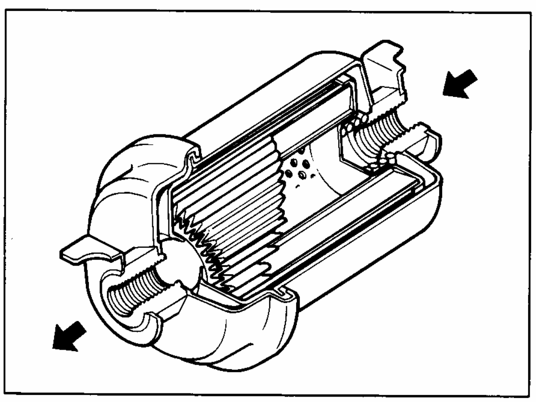
These changes are replaced by voltage so that signals are sent to the control unit.



Fuel Filter (low-pressure side)

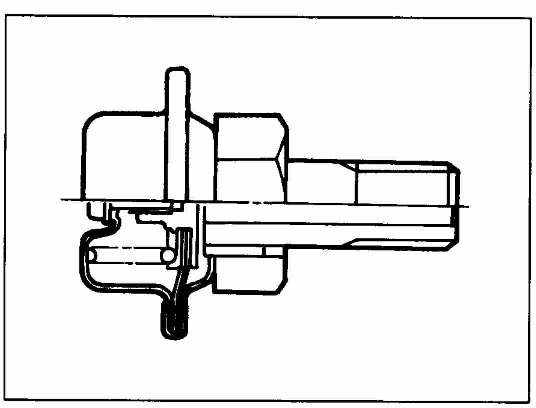
This fuel filter removes dirt and other foreign materials from the fuel brought up from the fuel tank.

This filter is built into the fuel tank.



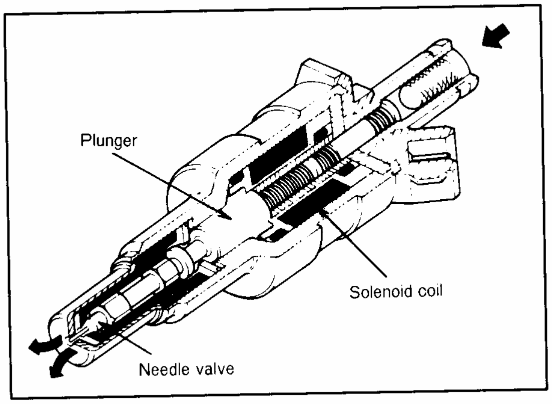
Fuel Filter (high-pressure side)

This fuel filter removes dirt and other foreign materials from fuel passing through the fuel pump.



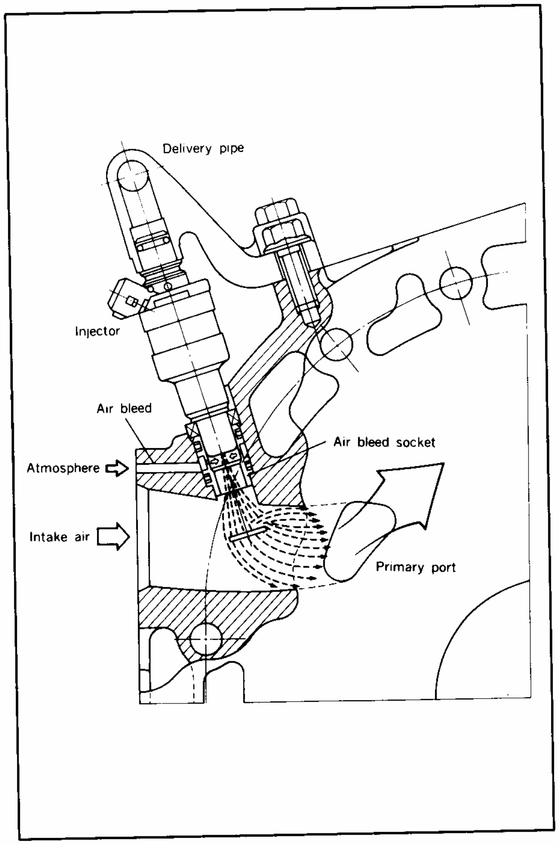
Pulsation Damper

This pulsation damper absorbs pulsation sounds caused by operation of the injectors and sounds of the operation of the injectors themselves.



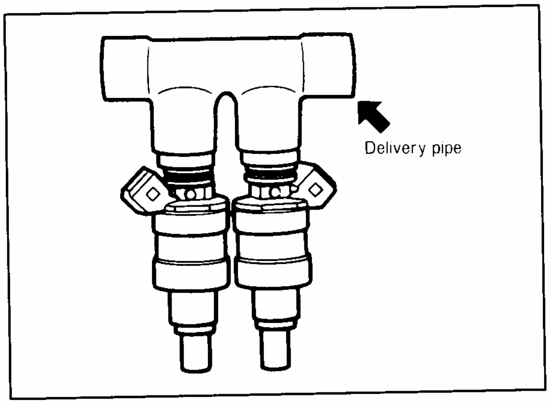
Injector

The injector injects the fuel based upon the injection signals calculated by the control unit. When these injection signals are applied to the solenoid coil, the plunger is attracted to the coil. Because the needle valve is unified with the plunger, the valve is pulled toward the inner side and fuel is injected. Because the stroke of the needle valve is constant, the amount of the injection is regulated by the time the needle valve is open, or, in other words, by the activation time of the solenoid coil.



Semi-direct Injection Mechanism

One injector is located at the front and at the rear of the intake air port of the intermediate housing.
There is, on the nozzle, an air bleed which functions to vaporize the fuel during idling, when the flow of air is slow, and when the load is light.
In addition, in order to improve the mixture of fuel and air, there is an air bleed socket which prevents mis-flow of the fuel and also further heightens the fuel injection performance.



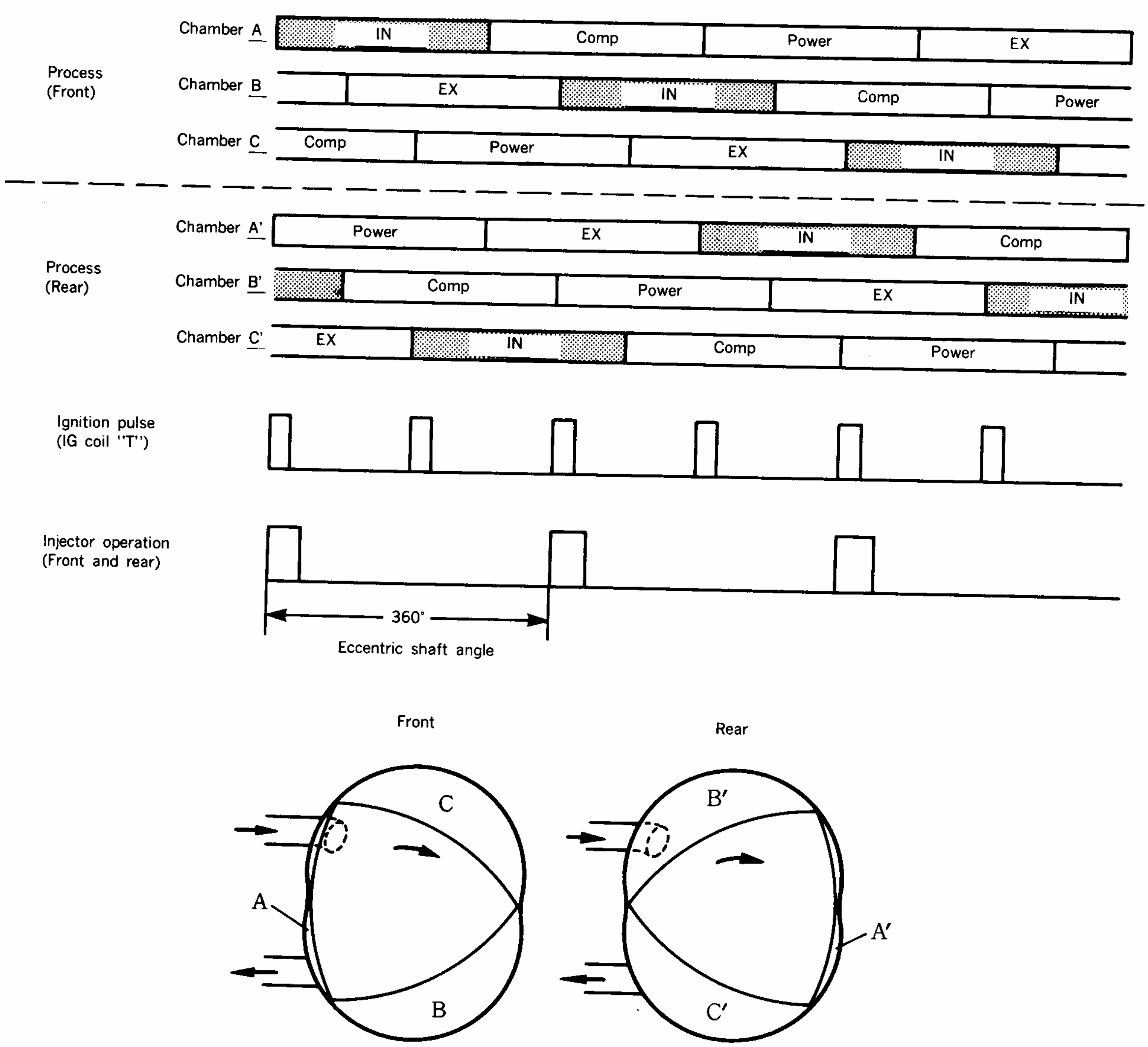
Delivery Pipe

The delivery pipe functions to distribute the high-pressure fuel to each injector.

3. CONTROL SYSTEM

The basic amount of fuel injection is calculated by multiplying the ratio (Q/N) of the intake air amount (Q) and engine rpm (N) by a constant coefficient. There is one injection during the intake process.

1. Number of Injections and Injection Timing

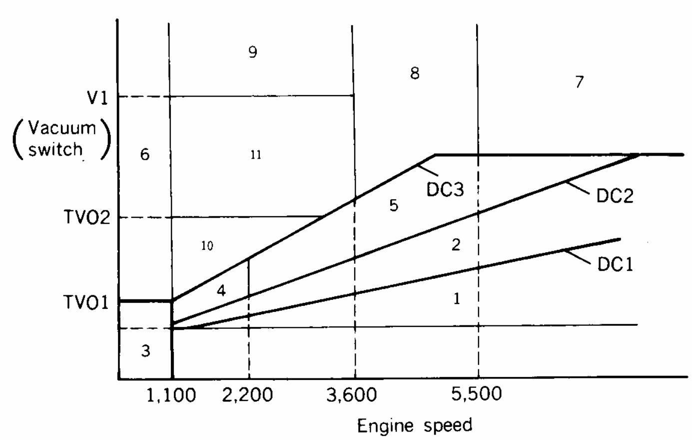


2. Correction of Basic Injection Amount

The correction of the basic injection amount is made by changing the time the solenoid coil of the injector is energized.

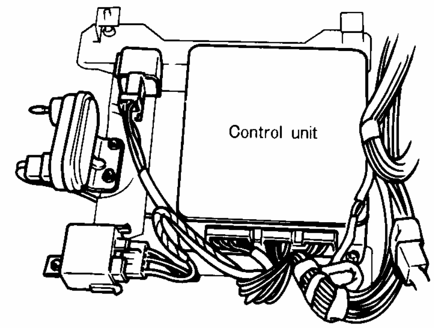
Correction of air/fuel ratio

Correction	Input sensor	Reason
Air concentration correction	Intake-air temperature sensor (with built-in air-flow meter)	To correct any deviation of the air/fuel mixture caused by changes of the air concentration
Battery voltage correction	Battery voltage	To prevent fluctuations of needle valve-open time
Feedback correction	O_2 sensor	To cope with exhaust gas
Volume increase immediately after starting	Coolant temperature sensor Key switch	To prevent stalling immediately after starting
Warm-up volume increase	Water thermo sensor	To improve driveability during cold
Deceleration volume decrease	Throttle sensor Ignition pulse	To improve fuel consumption To improve driveability during deceleration
Output volume increase	Vacuum switch Ignition pulse	To improve driveability under heavy load
Acceleration volume increase	Throttle sensor Ignition pulse	To improve response during acceleration
High speed volume increase	Throttle sensor Ignition pulse	To reduce exhaust gas temperature
Air/fuel ratio volume increase	Throttle sensor Ignition pulse Variable resistor	To improve idling stability
Light load volume increase	Throttle sensor Ignition pulse	To improve driveability
High-altitude correction	Atmospheric pressure sensor	To reduce fuel consumption at high altitude



Air/fuel ratio correction range (after warm-up)

1. Deceleration decrease (both sides cut)
2. Deceleration decrease (front side cut)
3. Idling increase. . . . manual adjustment of air/fuel ratio
4. Light load, low speed increase . . .30%
5. Light load, high speed increase. . .20%
6. Low speed increase 25%
7. High speed increase 26%
8. High speed increase 20%
9. Output increase. 15%
10. Feedback correction
11. Feedback correction



Control Unit (EGI)

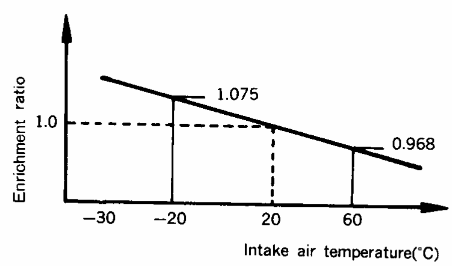
The control unit calculates the intake air signal from the air-flow meter and the basic injection signal from the engine speed, then adds to this corrections made according to signals from each sensor, and then determines the final injection time (fuel injection amount). In addition, it also calculates the injection timing from the engine speed, and the injector is controlled by the injection signals determined by this timing.

$$\text{Injection Time}(T) = K \frac{\text{Air Flow Rate}(Q)}{\text{Engin Speed}(N)}$$

K ; a coefficient

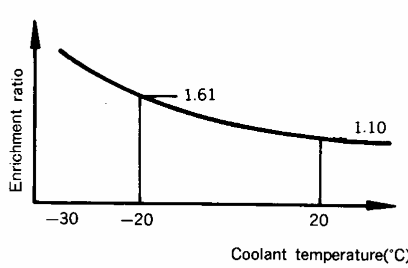
Basic Injection Characteristics

The most fundamental injection characteristics are those calculated from the intake air amount, detected by the air-flow meter, and the engine speed, detected from the ignition pulse.
The relationship between the injection amount and the amount of intake air and engine speed is shown in the figure at the right.



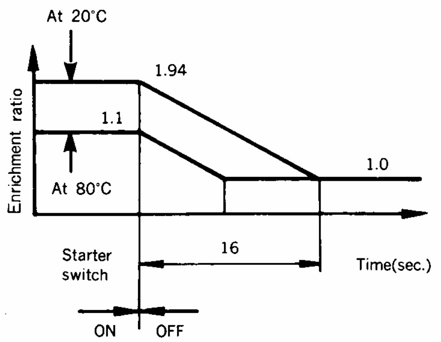
Intake Air Temperature Correction Characteristics

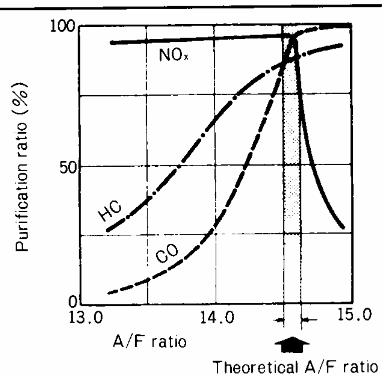
This is a correction made in order to prevent deviations of the air/fuel ratio as a result of differences of intake air concentration caused by differences of intake air temperature.
Intake air temperature is sensed by the intake-air temperature sensor in the air-flow meter. With an intake air temperature of 20°C (68°F) as the standard, there is an injection increase at any temperature below the standard, and a decrease at any temperature above the standard.

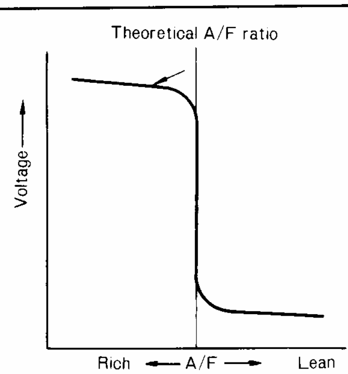


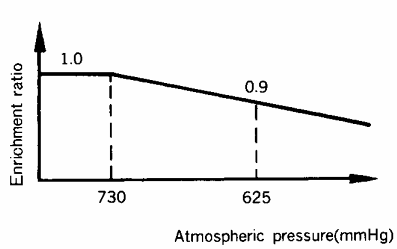
Warm-up Injection-increase Characteristics

In order to maintain good driveability during cold weather, the injection amount is increased as a result of signals from the water thermo sensor when the coolant temperature is low.
With a coolant temperature of 80°C (176°F) as the standard, there is an injection increase when the temperature is below that standard; at 80°C (176°G) or higher, there is a return to the basic injection amount.









Starting Injection-increase Characteristic

Starting performance is improved by an injection increase for a fixed time period after the engine is started (after the starter is disengaged), and also by an injection increase during engine starting (while starter is engaged). The ratio of increase is maximum during starting, thereafter decreasing as time passes after the engine is started. The increase ratio and the length of time the increase continues vary depending upon the coolant temperature.

Air/fuel Ratio Correction Characteristic (feedback correction characteristic)

Increases and decreases of the fuel injection amount repeatedly occur as a result of signals from the O_2 sensor. The air/fuel ratio is regulated within a narrow range near the high theoretical air/fuel ratio (of the purification performance of the 3-way catalyst).

In order to maintain good starting and driving performance, there is no feedback control under the following conditions:

- During starting (when the starter is operated)
- When coolant temperature is 50°C (122°F) or lower
- When there is an increased amount of injection (idling, light load, output, acceleration)
- When the fuel amount is cut (deceleration)

When, as a result of the characteristics mentioned above, the air/fuel ratio is richer than the theoretical air/fuel ratio, the O_2 sensor sends a high electromotive force signal to the control unit, and, when the air/fuel ratio is leaner than the theoretical ratio, it sends a low signal to the control unit.

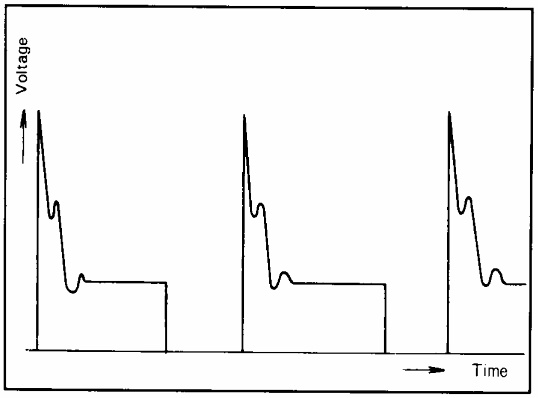
The control unit compares this signal to a certain fixed standard voltage, and, if it is higher than the standard voltage, the control unit judges that the air/fuel ratio is richer than the theoretical air/fuel ratio, and so reduces the amount of fuel; if, on the contrary, the signal is lower than the standard voltage, it judges that the actual air/fuel ratio is leaner than the theoretical ratio, and so increases the amount of fuel. In this way, the purification performance of the 3-way catalyst is regulated so as to be near the high theoretical air/fuel ratio.

High-altitude Correction Characteristics

Because air density is low at high altitude, the usual amount of injection would result in an air/fuel ratio which is too rich, which would impair driving performance.

In order to compensate for this, the amount of fuel injection is reduced by signals from the atmospheric pressure sensor.

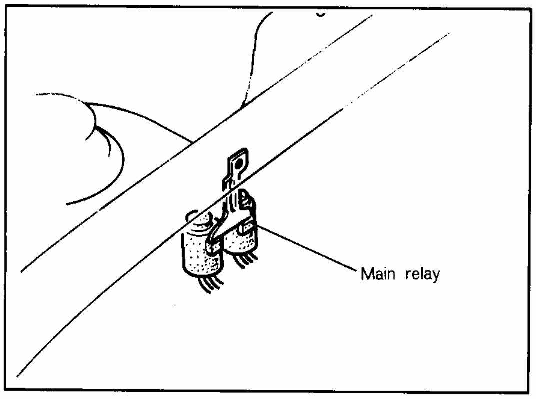
With an atmospheric pressure of 730 mmHg (28.7 inHg) as the standard, there is a reduction of the fuel injection amount at any atmospheric pressure below that standard.



Ignition Pulse

This signal detects the engine speed from the counter electromotive force (300V ~ 400V) which occurs when the primary current of the ignition coil is switched ON/OFF.

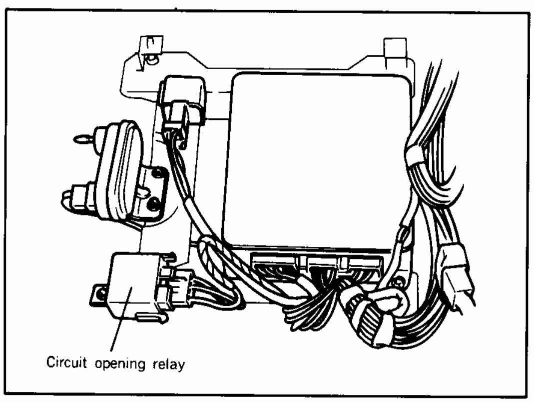
The engine speed signals become, together with the potentiometer signals of intake amount, the fundamental signals for determination of the length of time of the injection.



Main Relay

There are 2-contact relays which switch the power supply which regulates the injector and the control unit.

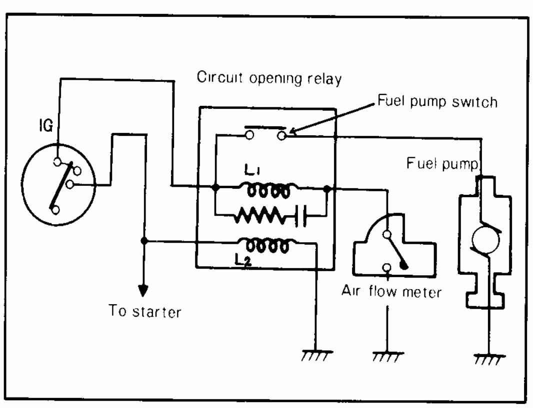
They are located in front of the clutch master cylinder.



Circuit Opening Relay

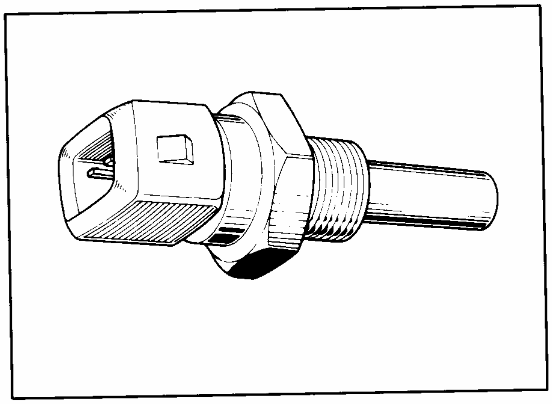
This relay regulates signals to the fuel pump.

It cuts off the power supply so that the fuel pump won't operate if the engine is not running, even though the ignition switch may be ON.



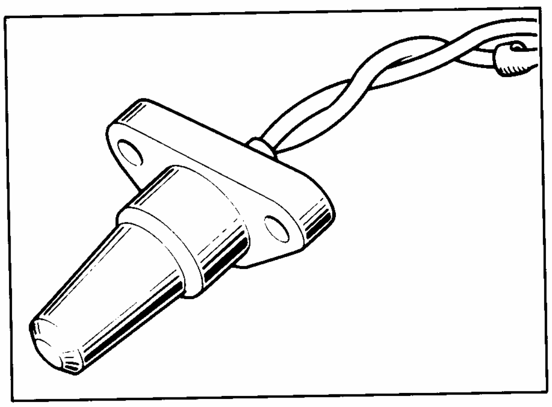
Operation

1. When the starter is turned, current flows to the coil (L2), the points close, and current flows to the fuel pump.
2. When the engine starts, current no longer flows to the coil (L2).
3. The fuel pump switch built into the air-flow meter is switched ON.
4. Current flows to the coil (L1).
5. When the engine is stopped, the fuel pump switch is switched OFF.
   (The pump stops even if the ignition switch is ON.)



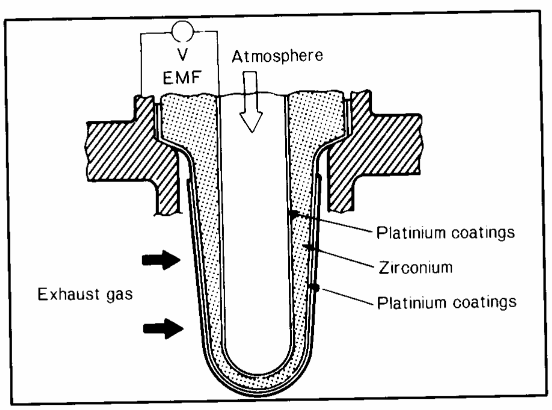
Water Thermo Sensor

This is a sensor which detects the coolant temperature, and has a built-in thermistor which changes according to changes in the temperature. The change in the temperature of the coolant is detected as a change in the resistance value of the thermistor, this is converted to voltage. This signal is sent to the control unit. Acting on this signal, the control unit increases the amount of fuel in accordance with the temperature of the coolant, thus improving driving performance when the engine is cold.



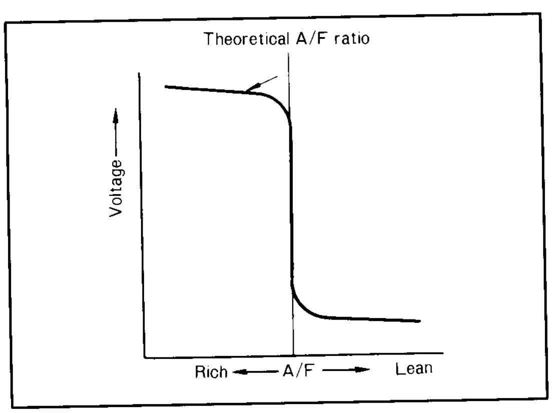
Intake Air Temperature Sensor

This sensor detects the temperature of the intake air, and is located within the air-flow meter.
Changes in the temperature of the intake air are detected as a change in the resistance value of the thermistor inside the intake-air temperature sensor. This is converted to voltage, and a signal is sent to the control unit. The control unit increases or decreases the amount of fuel injection according to the rise and fall (resistance high or low) of the temperature of the intake air.



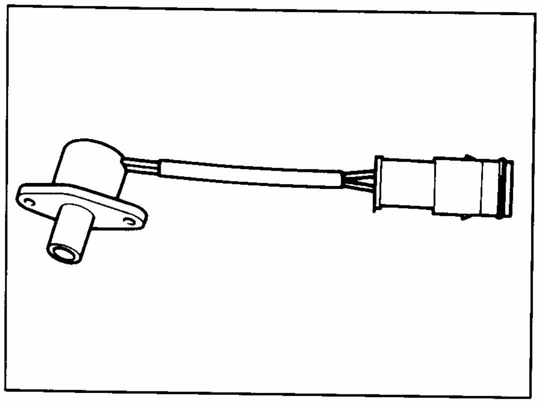
O_2 Sensor

This is a sensor which detects the oxygen concentration (air/fuel ratio) of the exhaust gas. Acting on its signal, the control unit decides upon fuel increases or decreases.
The O_2 sensor is located within the exhaust pipe. Exhaust gas is directed to its external surface and outside air to its internal surface. When the concentration of oxygen is different for the two surfaces, the zirconia element generates an electromotive force. When the temperature becomes high, the electromotive force (EMF) is suddenly changed to the boundary of the theoretical air/fuel ratio as a result of the catalytic action of the platinum coated on the surface.

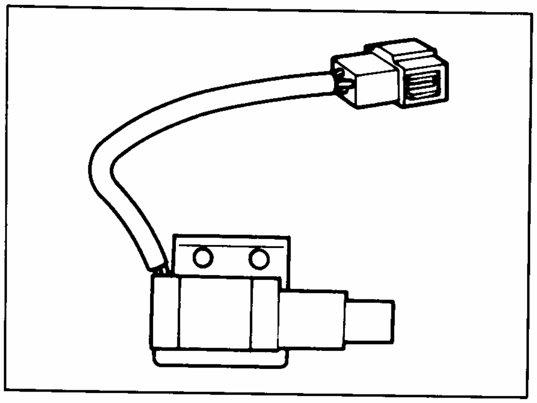


O_2 sensor characteristics

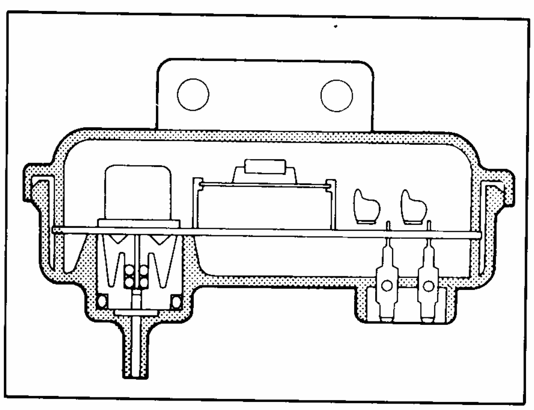
Actual air/fuel ratio < theoretical ratio (rich)	Large EMF
Actual air/fuel ratio > theoretical ratio (lean)	Small EMF



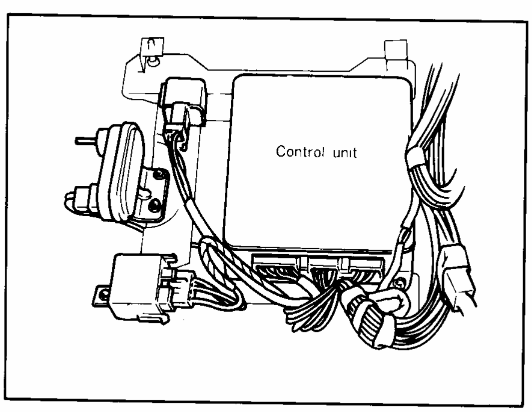
Variable Resistor
The variable resistor is used to adjust the air/fuel ratio at the factory only (tamper-proof).



Throttle Sensor
The throttle sensor detects the degree of throttle valve opening, by detecting the output voltage resulting from the change of the resistance value caused by the change of the degree of throttle opening.



Atmospheric Pressure Sensor
The atmospheric pressure sensor detects the pressure of the atmosphere and converts this to electric signals. These output signals are used in order to make compensation adjustments for high altitude.



EMISSION CONTROL UNIT

Various conditions such as engine temperature, load, rpm, vehicle driving conditions, etc. are input to the emissions control unit as input signals.
These input signals are electrically processed within the emissions control unit. Then output signals which match input conditions are output to the various devices, and, together with controlling emissions, control signals (fuel-increase signals and fuel-cut signals) which match the engine operating range are sent to the injector.

ENGINE ELECTRICAL SYSTEM

FEATURES 5–2
SPECIFICATIONS 5–2
STRUCTURAL VIEW 5–3
COMPACT ALTERNATOR 5–4

FEATURES

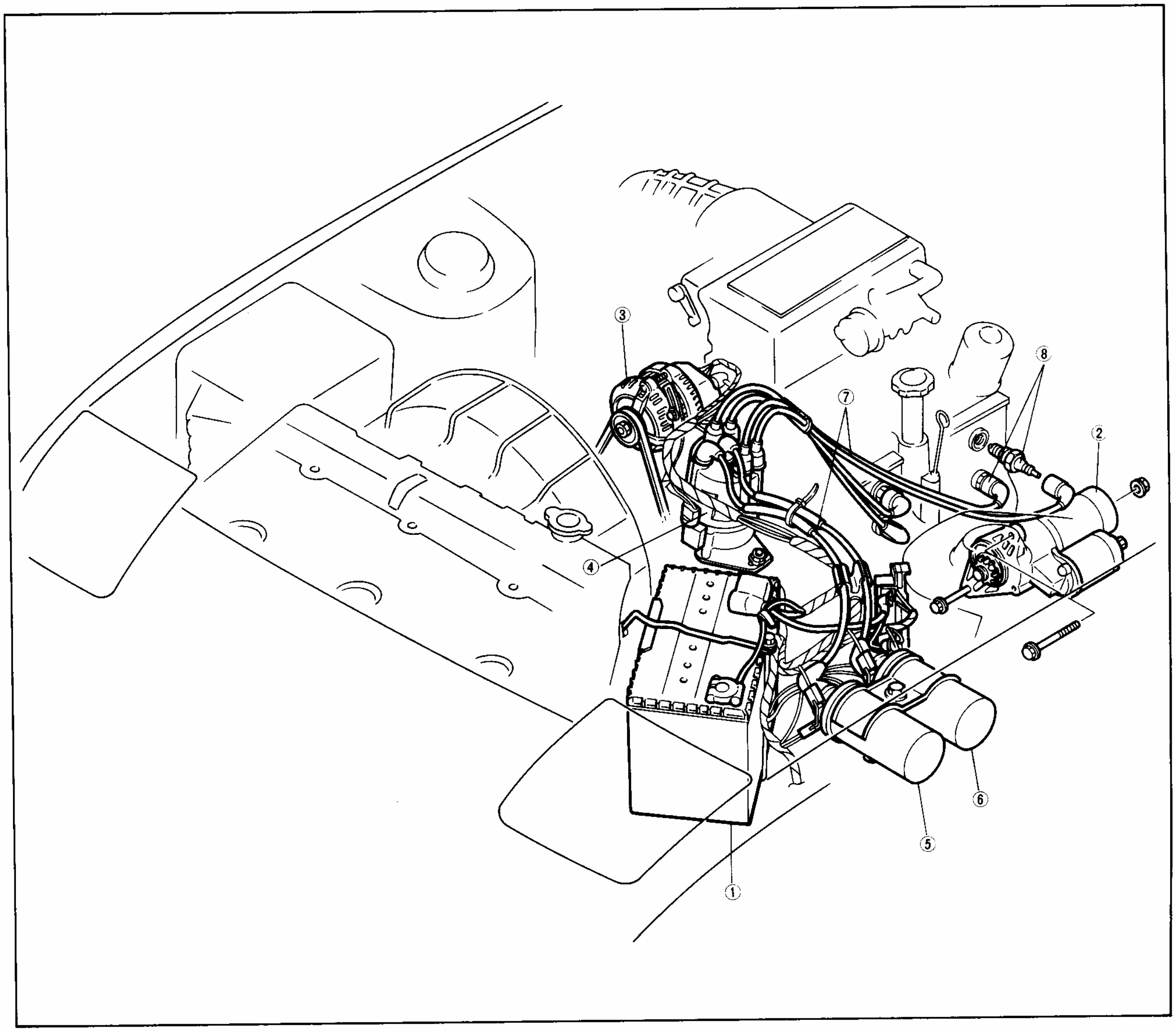
1. A compact alternator with built-in cooling fan has been adopted.
2. The spark-advance has been changed.

SPECIFICATIONS

			12A engine	13B engine
Battery type and capacity			50D20L: 50AH; 65D23L: 55AH	
Alternator	Voltage — Capacity		12V — 55A	12V — 60A
	Regulated voltage		14.2 ~ 15.2V	←
	Output test (at hot)	Voltage	13.5V	←
		Current	More than 51A	More than 53A
		Speed	2,500 rpm	←
	Brush length	Standard	16.5 mm (0.65 in)	←
		Wear limit	8 mm (0.31 in)	←
Ignition	Spark timing		T: 20° ATDC L: 0° TDC	T: 20° ATDC L: 5° ATDC
	Breaker type		Contactless (igniter)	
	Spark-advance control	Centrifugal spark-advance rpm: distributor rpm	T & L: 0°/500 rpm 12.5°/2,063 rpm	T & L: 0°/500 rpm 4.5°/750 rpm 13.75°/2,000 rpm
		Vacuum spark-advance	T: 0°/100 mmHg 15°/400 mmHg L: 1°/100 mmHg 4.5°/190 mmHg	T: 0°/100 mmHg 12.5°/350 mmHg L: 0°/100 mmHg 5°/250 mmHg
	Spark plugs	Type	BR7EQ14, BR8EQ14, BR9EQ14 . . . NGK W22EDR14, W25EDR14, W27EDR14 . . . N-D	
		Gap	1.4 ± 0.05 mm (0.055 ± 0.002 in)	

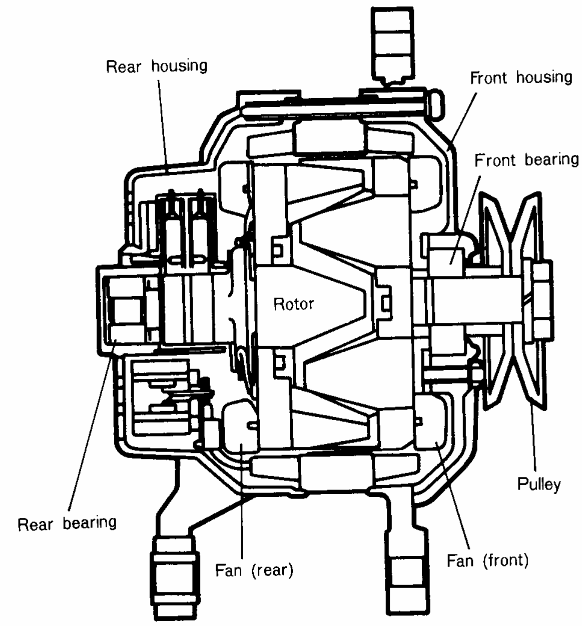
Starter motor	Output		1.2 kW	2.0 kW
	Applicable		M/T vehicles	A/T vehicles
	Free-running test	Voltage	11.5V	←
		Current	Less than 60A	Less than 100A
		Speed	6,500 rpm	3,500 rpm

STRUCTURAL VIEW



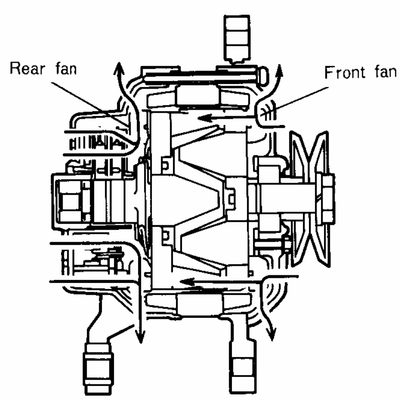
1 Battery
2 Starter motor
3 Alternator
4 Distributor
5 Ignition coil (T)
6 Ignition coil (L)
7 Hightension cord
8 Spark plugs

As noted elsewhere, the use of this alternator both improves cooling efficiency and is compact, with a weight which is reduced about 11% and a size which is reduced about 16% compared to the type formerly used.

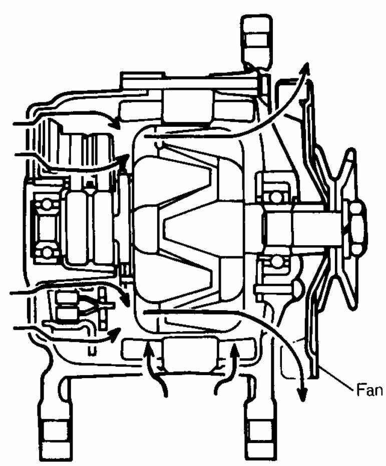


The flow of coolant air is shown below.

NEW TYPE



OLD TYPE

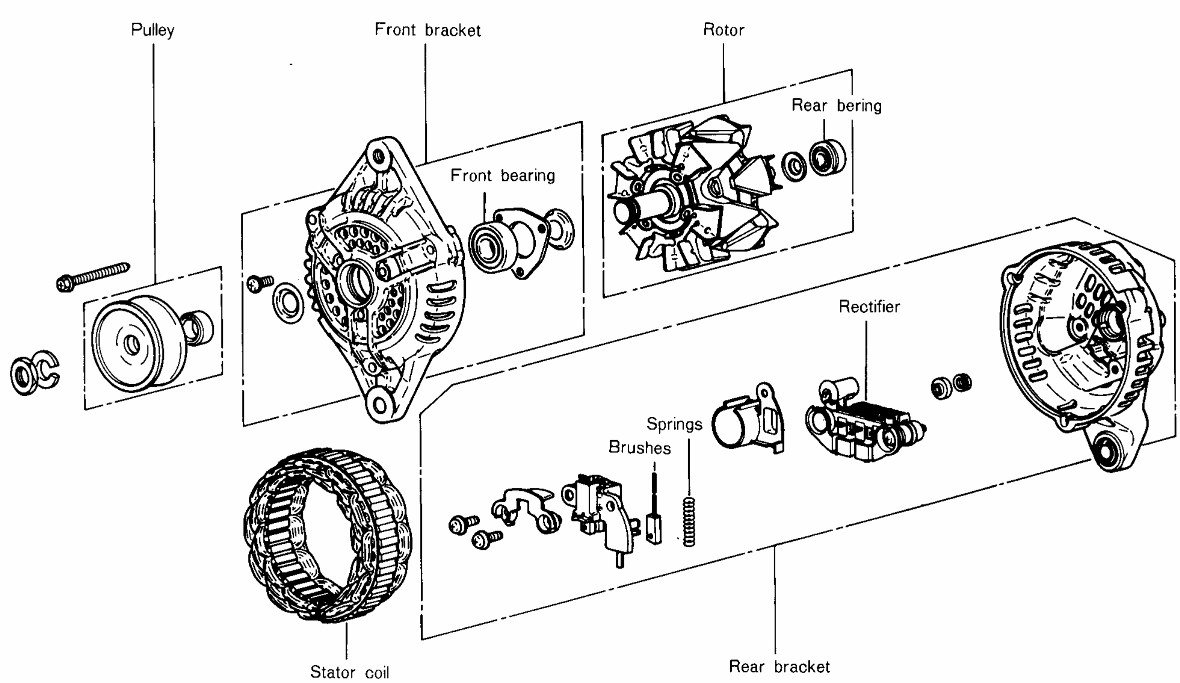


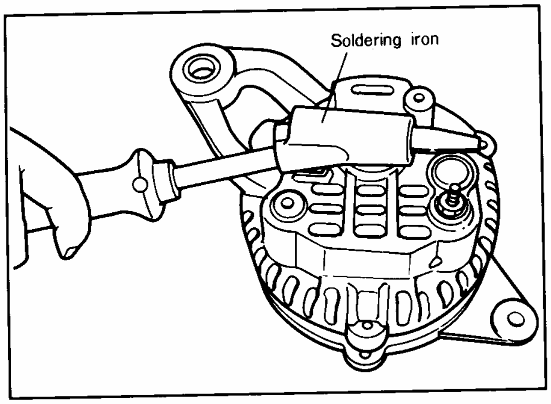
COMPACT ALTERNATOR

In order to increase cooling efficiency, the construction has been fundamentally changed from the former type.
The fundamental construction of the compact alternator has been changed as follows. The external diameter of the stator coil has been reduced by 7 mm, and the cooling system has been changed from one outer fan to two inner fans.
The other main points of changed parts are as described below.

- Rear fan (new)
  A cooling fan has been installed at the rear of the rotor. This fan is newly provided in order to reduce temperature increases of the coil, by "stirring" the air around the stator coil and thereby cooling the coil evenly.
- Front fan
  The front fan is built in, and is located at the front of the rotor. This fan makes possible a reduction of the external diameter, increases the maximum rotation speed, reduces air flow noise, etc.
- Slip rings
  The external diameter has been changed from 33 to 22. The objective is to reduce the slip ring revolution speed, and thus increase the maximum rotation speed.
  In addition, the material has been changed from stainless steel to copper in order to improve quality.
- Brushes
  In conjunction with the reduction of the size of the alternator, the brush length has been shortened. In addition, the material has been changed.

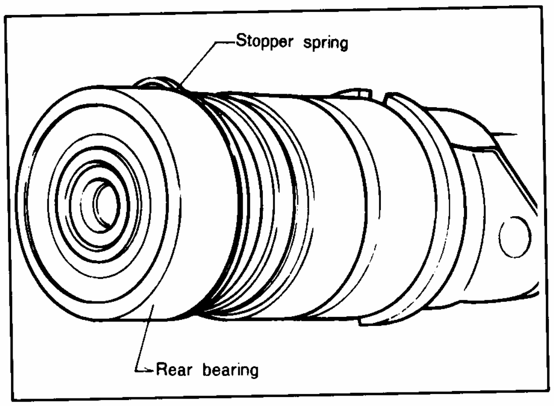
STRUCTURAL VIEW





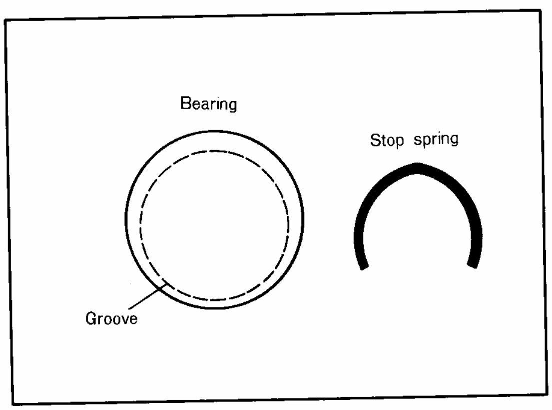
Disassembly/assembly notes

1. When the front bracket and the rear bracket are to be disassembled, it will be necessary, because the rear bracket and the rear bearing are tightly fit together, to heat the bearing box part of the rear housing for 3 or 4 minutes by using a soldering iron (200 W class). (Heat to about 50 to 60°C to expand the bearing box.)

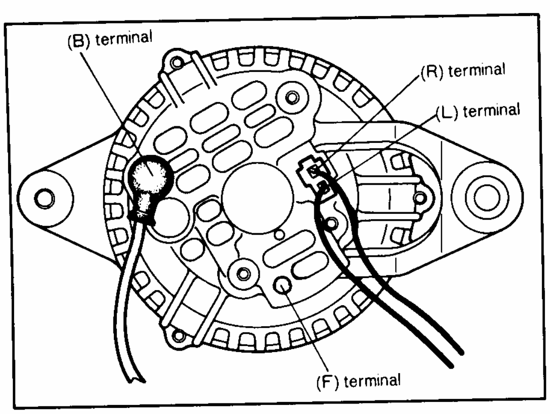


2. During assembly, particular care should be given to the position of the stop spring used at the rear bearing circumference. There is an eccentric groove in the circumference of the rear bearing, and the stop spring is to fit into it. When attaching this stop spring, care should be taken to be sure that the part of the stop spring which projects the farthest should be placed at the deepest part of the groove.
   In order to easily recognize this deepest part of the groove, the edge of the groove has been beveled. The reason for this is not only to make the assembly of the rear bearing and rear housing easier, but also to stop the bearing (outer) after the assembly is completed.

   Caution
   If this is not done, the rear housing may be damaged.



3. Terminal layout
   The terminal layout is as shown in the figure.



AUTOMATIC TRANSMISSION

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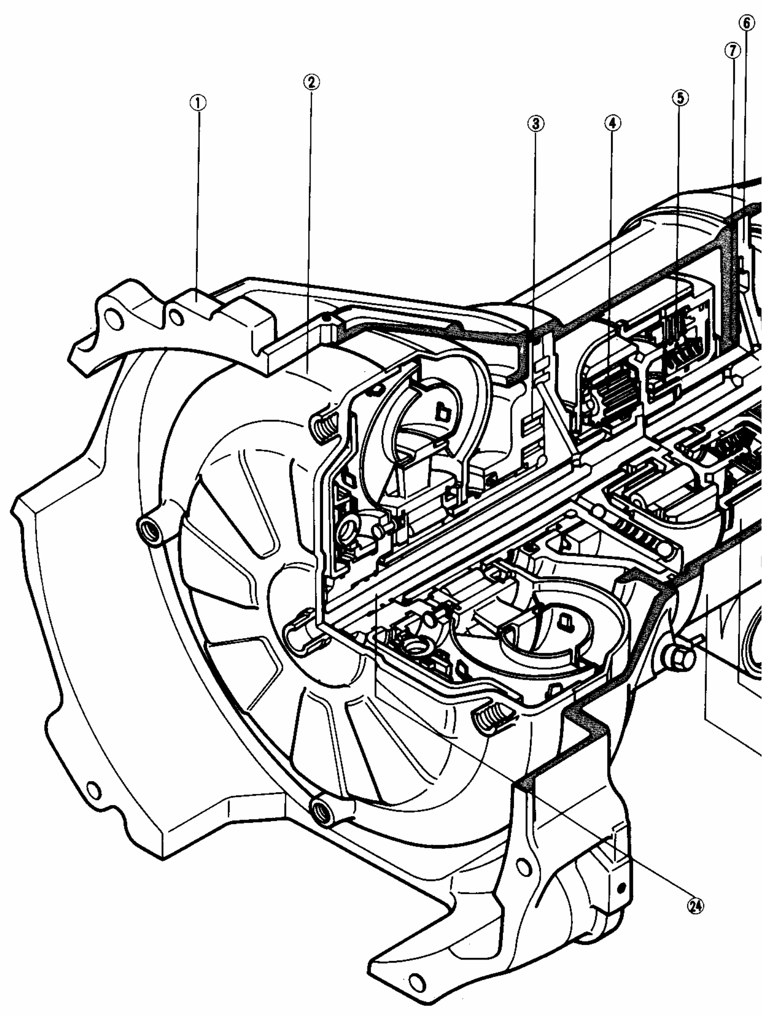
OUTLINE

OUTLINE OF CONSTRUCTION

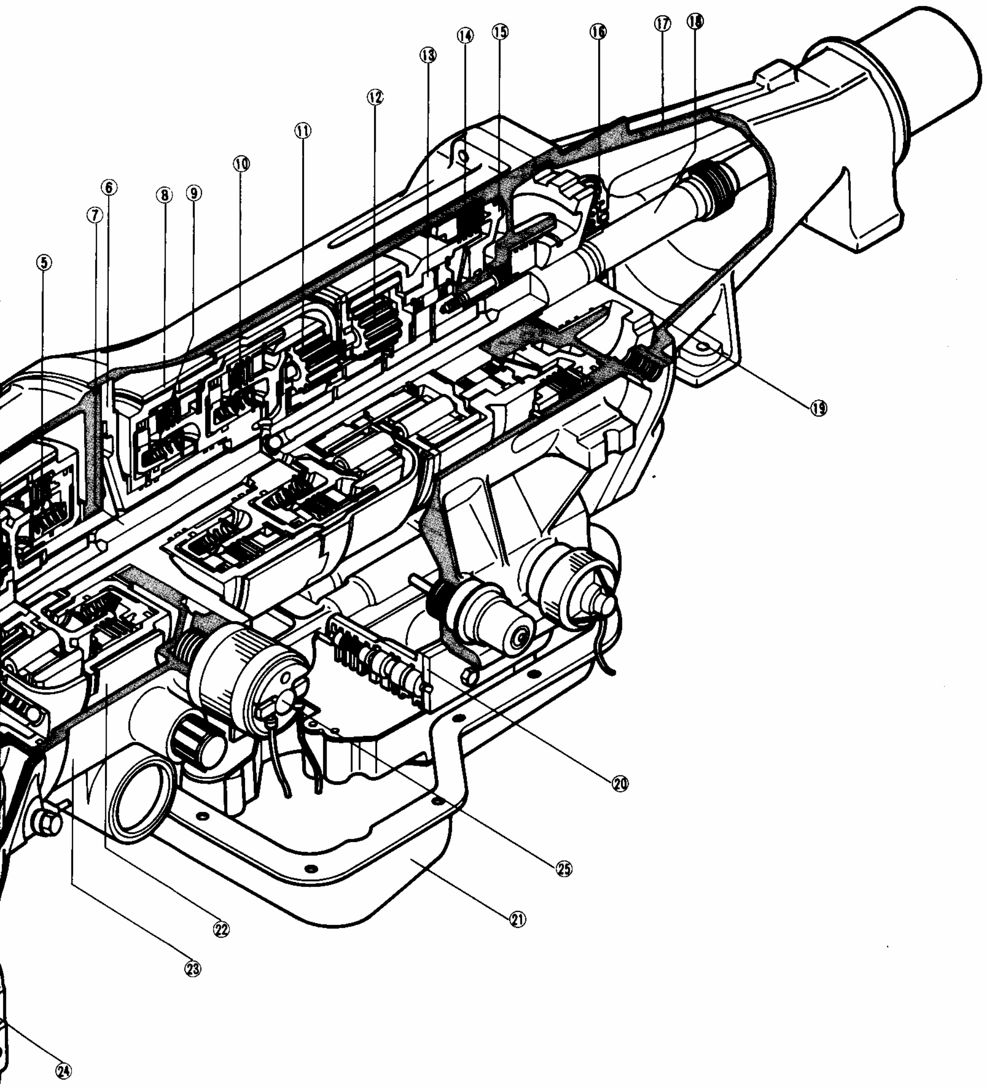
- The construction of the L4N71B transmission is fundamentally that of the 3N71B transmission, with the new addition of the overdrive system (hereafter OD system) and the lock-up system (hereafter LU system).
- The combination of the OD (4th) system and the LU system has made possible excellent characteristics of silence and low fuel consumption.
- The LU system is a system in which there is a direct connection within the torque converter in order to eliminate noise and losses resulting from slippage of the torque converter fluid, while continuing to apply engine power without change to the transmission.

OPERATION OUTLINE

- Operation in the P, R, N, D_1, D_2, D_3, 2, 1_1, and 1_2 ranges is the same as in the 3N71B transmission.
- The OD system operates under the following combination of conditions. When it is operating, the OD ON indication in the indicator panel is displayed.
  (1) OD control switch is ON
  (2) Shift to the D range
  (3) Accelerator opening 6/8 or less (except: 7/8 or less at 100 km/h or higher)
  (4) In the OD zone shown on page 7B–8
- The LU system operates under the following combination of conditions.
  (1) In the OD range
  (2) Vehicle speed is 70 km/h or higher
  Thus, it is possible for the LU system not to operate even though the OD system is operating.



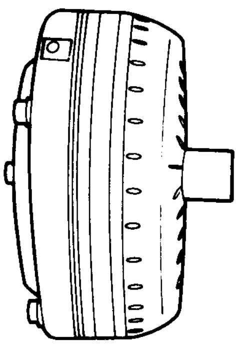
1. Torque converter housing
2. Torque converter
3. Oil pump
4. OD planetary gear
5. Direct clutch
6. Drum support
7. Intermediate shaft
8. 2nd brake band
9. Front clutch
10. Rear clutch
11. Front planetary gear
12. Rear planetary gear
13. One-way clutch
14. Low-reverse brake
15. Transmission case
16. Governor
17. Extension housing
18. Output shaft
19. Oil distributor
20. Control valve assembly
21. Oil pan
22. OD brake band
23. OD case
24. Input shaft
25. OD cancel solenoid



SPECIFICATIONS

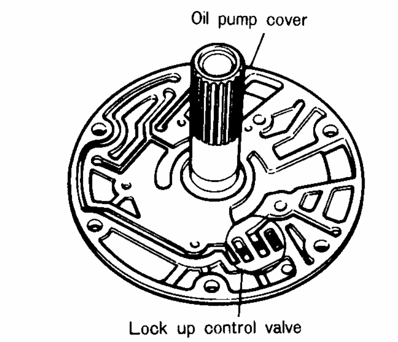
Model		L4N71B	3N71B
Transmission gear ratio	1st	2.458	2.458
	2nd	1.458	1.458
	3rd	1.000	1.000
	OD (4th)	0.685	–
	Rev.	2.181	2.181
Torque converter stall torque ratio		1.950	1.900
Number of plates	Direct clutch	2	–
	Front clutch	3	3
	Rear clutch	4	4
	Low rev. brake	4	4
Servo diameter (Piston outer dia./ retainer inner dia.)	OD band servo	60/40 mm (2.36/1.57 in.)	–
	2nd band servo	60/36 mm (2.36/1.42 in.)	60/40 mm (2.36/1.57 in.)
Oil	Type	A.T.F. type F (M2C33–F)	A.T.F. type F (M2C33–F)
	Amount	7.5 liters (7.9 U.S. quarts, 6.6 Imp. quarts)	6.2 liters (6.6 U.S. quarts, 5.5 Imp. quarts)

MAIN COMPONENT CHANGES

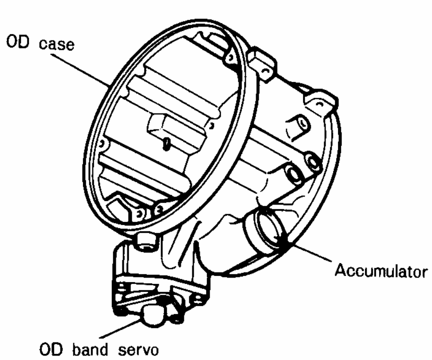


The main component changes in the L4N71B transmission, compared to the 3N71B transmission, are as follows.

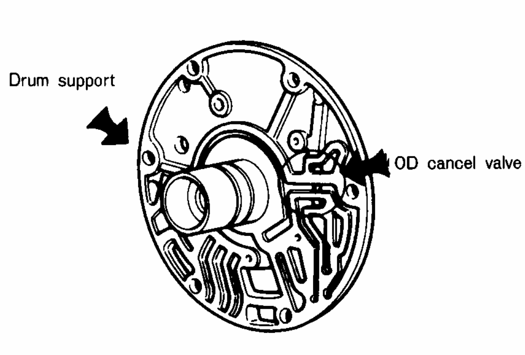
Torque converter
The lock-up (LU) system has been added within the torque converter.
For more information regarding the lock-up system, refer to page 7B—23.



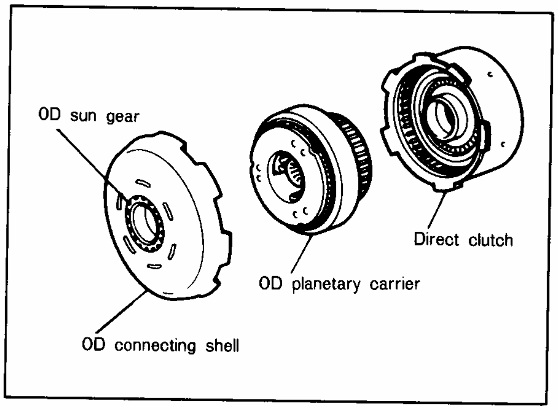
Oil pump
The configuration of the oil pump cover side as well as the internal hydraulic circuitry has been partially modified, and a lock-up control valve has been newly added.
Refer to page 7B—25 for information regarding the operation of the lock-up control valve.



OD case
This case encloses the newly added planetary gear set, direct clutch, etc. for the OD mechanism, and is installed between the converter housing and the transmission case. Furthermore, the OD cancel solenoid, OD band servo, accumulator, etc. are installed on the perimeter of this casing.



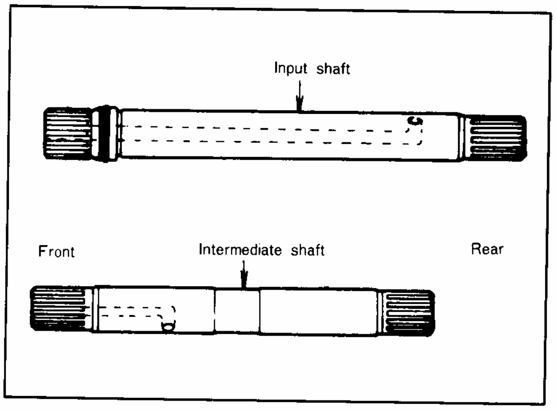
Drum support
The drum support is installed between the OD case and the transmission case in order to support the front, rear and direct clutch drums.
Furthermore, a hydraulic circuitry is located on the front side for the installation of the OD cancel valve.



OD geartrain

The OD geartrain is comprised of an OD planetary gear, direct clutch, OD sun gear, and OD connecting shell.

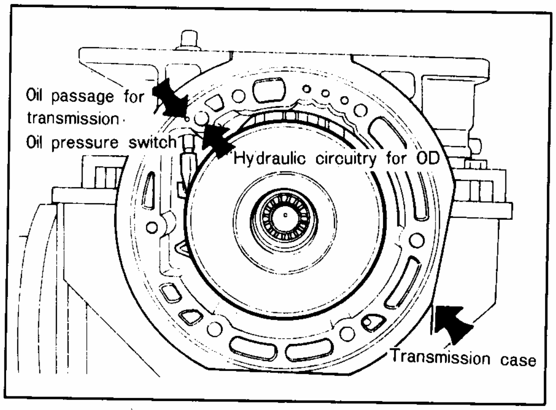
Refer to page 7B–10 for information regarding the operation of the OD geartrain.



Input shaft & intermediate shaft

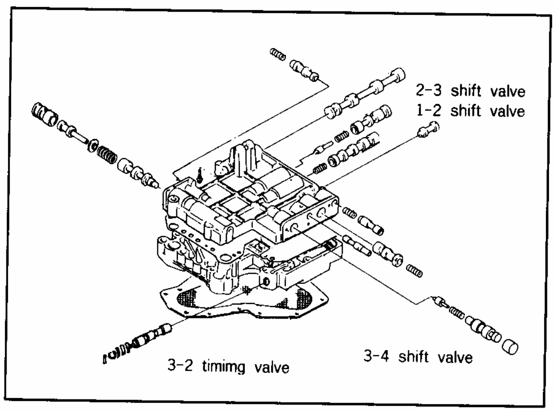
An oil passage for the lock-up circuit has been added to the input shaft.

The intermediate shaft has been newly added in order to couple the direct clutch hub and the rear clutch drum.



Transmission case

The Transmission Case has been modified with the addition of hydraulic circuitry for the OD and an oil passage for the OD indicator switch.



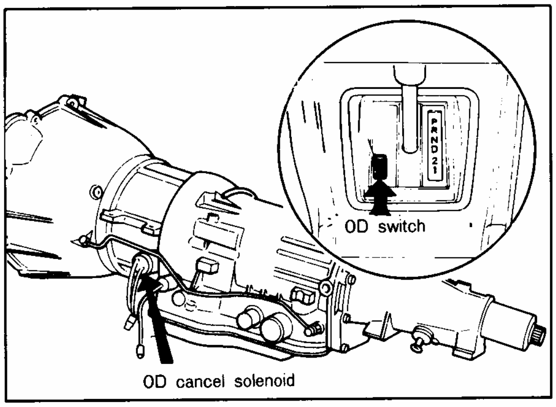
Control valve

The hydraulic circuitries for the upper and lower bodies as well as for the separation plate have been modified in accordance with the addition of the 3-4 shift valve.

Furthermore, the 1-2 shift valve and the 2-3 shift valve positions have been reversed for the same reason.

In addition, a 3-2 timing valve has been added to the control valve (lower).

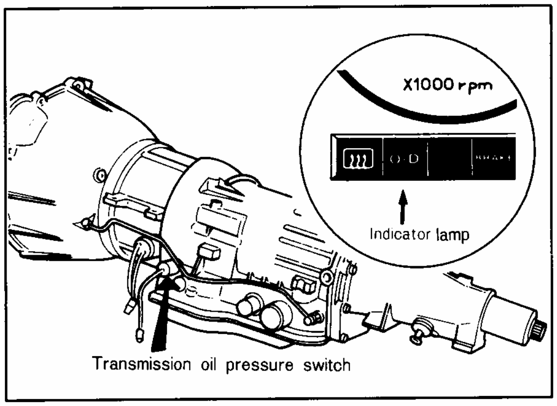
For more information regarding the operation of the 3-4 shift valve and the operation of the 3-2 timing valve, refer to pages 7B–12 and 7B–21 respectively.



OD control switch & OD cancel solenoid

This mechanism is provided to activate and de-activate the OD. The OD control switch is installed on the rear of the transmission selector lever, and the OD cancel solenoid is located on the left of the OD casing.

For information regarding the operation of the OD cancel solenoid and the OD control switch, refer to pages 7B–9 and 16.

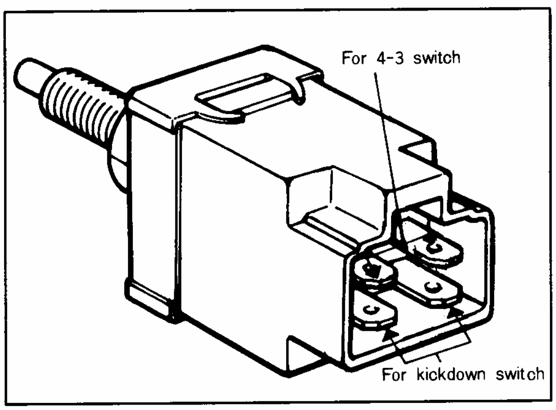


Transmission oil pressure switch & lamp

This mechanism is provided to indicate the OD activation to the driver.

The switch is located on the left side of the transmission casing and is actuated with the deactivation of the OD band servo's open side pressure.

The OD indicator lamps are installed within the combination meter for illumination during OD operation.



4-3 switch and kickdown switch

The 4-3 switch and kickdown switch are, as shown in the figure at the left, unified, and are located at the upper part of the accelerator pedal.

The 4-3 switch senses an accelerator opening of 6/8 or more, and the kickdown switch senses an accelerator opening of 7/8 or more.

The 4-3 Switch is provided to shift the gears from OD to 3rd gear.

The Kickdown Switch is provided to rapidly shift the gears down from 3rd to 2nd, and from 2nd to 1st gear.

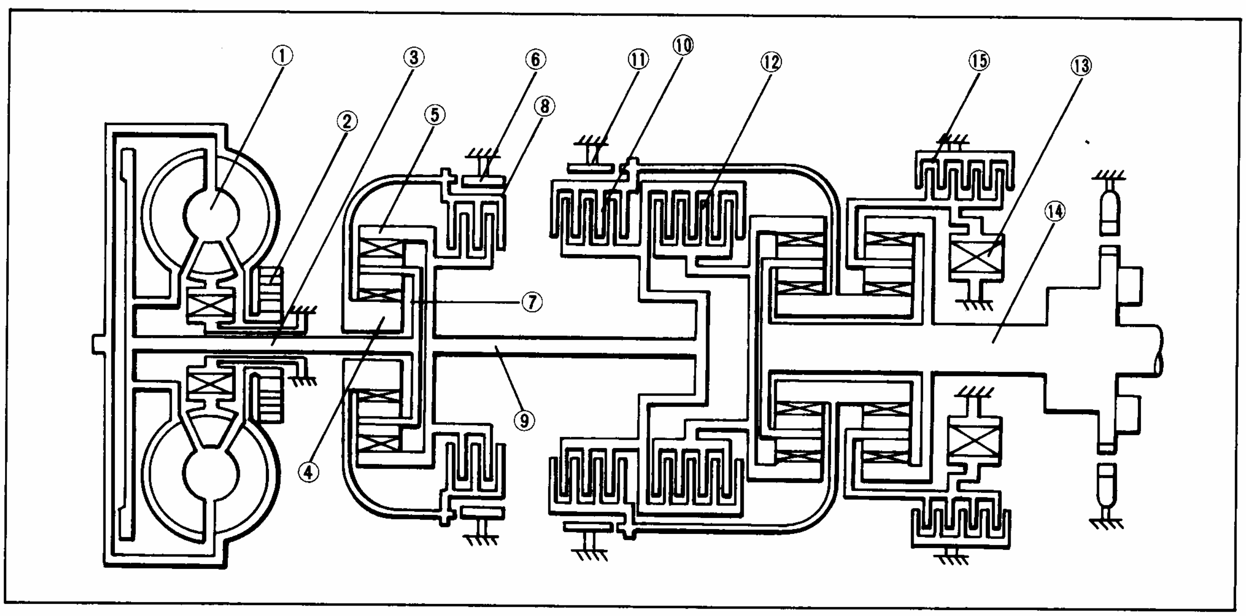
OPERATION TABLE

The individual transmission components operate as indicated in the table below for the respective gear positions.

Selector Position		Direct Clutch	OD Band Servo		Front Clutch	Rear Clutch	2nd Band Servo		Low & Reverse Brake	One-way Clutch
			Operation	Release			Operation	Release		
P		○	◎	○					○	
R		○	◎	○	○			○	○	
N		○	◎	○						
D	1st Gear	○	◎	○		○				○
	2nd Gear	○	◎	○		○	○			
	3rd Gear	○	◎	○	○	○	◎	○		
	OD (4th Gear)		○		○	○	◎	○		
2		○	◎	○		○	○			
1	2nd Gear	○	◎	○		○	○			
	1st Gear	○	◎	○		○			○	

The ◎ indications indicate operation although the band servos remain deactivated due to the large release pressure side area.

POWER TRANSMISSION MECHANISM DIAGRAM



1. Torque converter
2. Oil pump
3. Input shaft
4. OD sun gear
5. OD clutch hub
6. OD brake band
7. OD planetary pinion carrier
8. Direct clutch
9. Intermediate shaft
10. Front clutch
11. 2nd brake band
12. Rear clutch
13. One-way clutch
14. Output shaft
15. Low & reverse brake

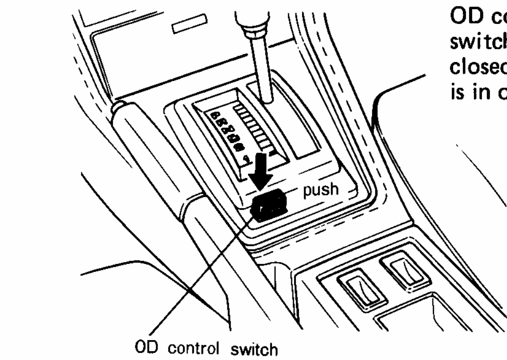
OVERDRIVE (OD) SYSTEM

1. OPERATION CONDITIONS

The overdrive system operates when all of the following conditions exist.

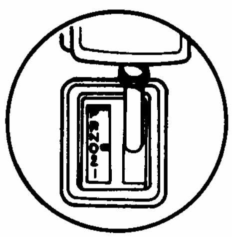
Condition

OD CONTROL SWITCH . . . ON

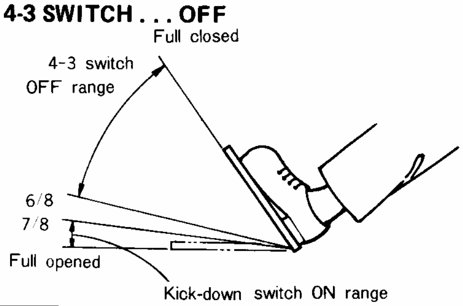


Note that the OD control switch is closed when it is in operation.

SHIFT TO "D" RANGE



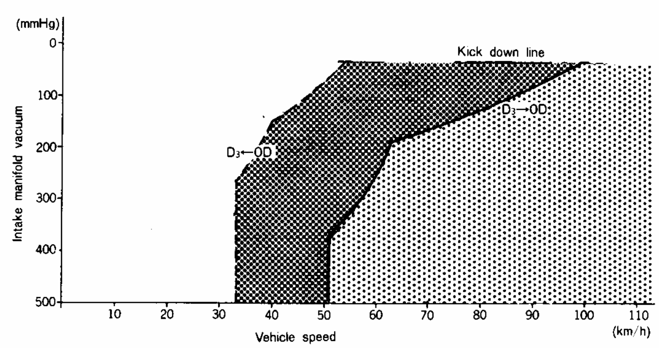
4-3 SWITCH . . . OFF



Note that, at 100 km/h or higher, the conditions are satisfied if the kick-down switch is not ON, even if the 4-3 switch is ON.

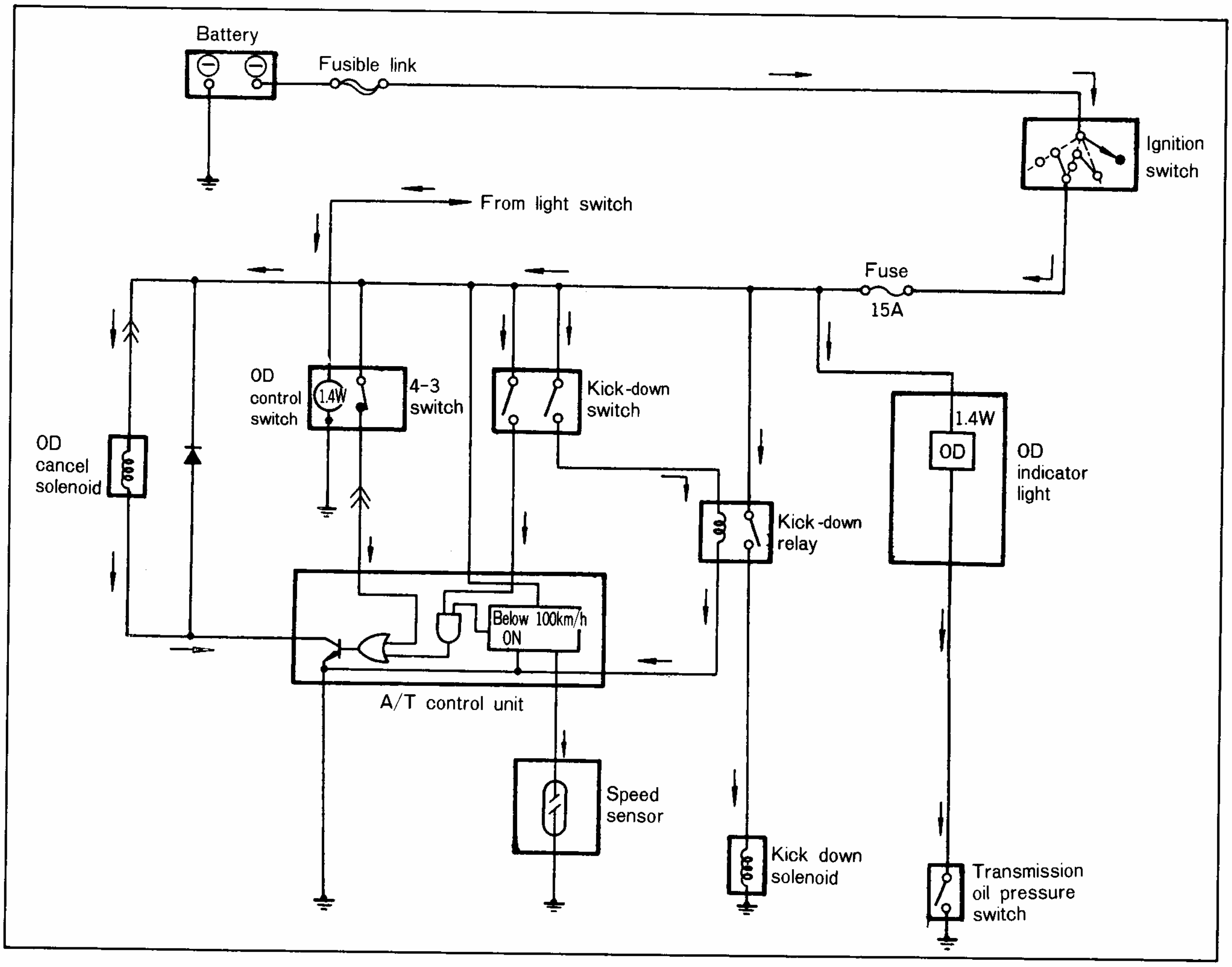
SHADED AREAS OF FIGURE

Note that the ░ portion indicates conditions when the OD system switches from OFF to ON.
Once the system functions, it will not be released until the ▒ portion is reached.



OD SYSTEM OPERATES

2. OD SYSTEM ELECTRIC CIRCUIT



The A/T control unit controls the operation of the OD cancel solenoid.

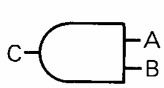
OD Cancel Solenoid Operation Conditions

If electricity is flowing to the OD cancel solenoid, the OD is cancelled.
Under what conditions, then, does electricity flow to the OD control switch?
Those conditions are explained below.

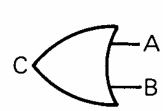
- Condition 1:
  When the OD control switch is closed (OD control switch OFF).
  At this time, electricity flows to the OD cancel solenoid under any condition, and the OD hydraulic path is cancelled, so there is no shift to the OD range.
  Even if the OD control switch is open, electricity may flow to it. This is condition 2.
- Condition 2:
  When, while the vehicle is travelling at 100 km/h or less, the 4-3 switch is ON.
  At an accelerator pedal opening of 6/8 or more, the 4-3 switch becomes ON.

Note
Explanation of  and  symbols used in the above wiring diagram of the control unit.

Example



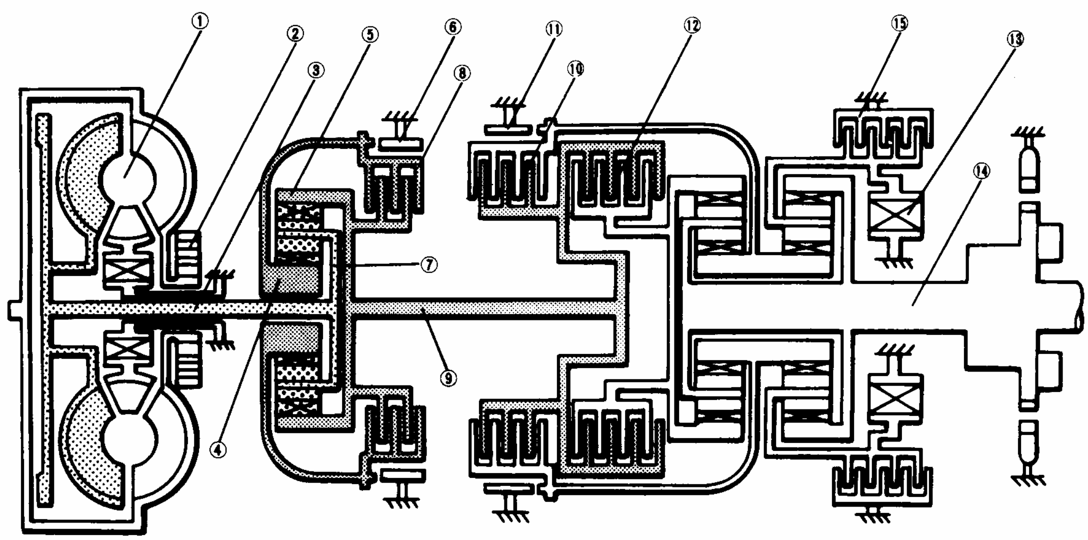
The flow of electricity to C is when electricity flows at the same time to A and B.



The flow of electricity to C is when electricity flows to A or B.
In other words, if electricity flows to A or B, it flows to C.

3. POWER FLOW OF OD GEAR TRAIN

(1) 1st to 3rd, and reverse condition (except OD)

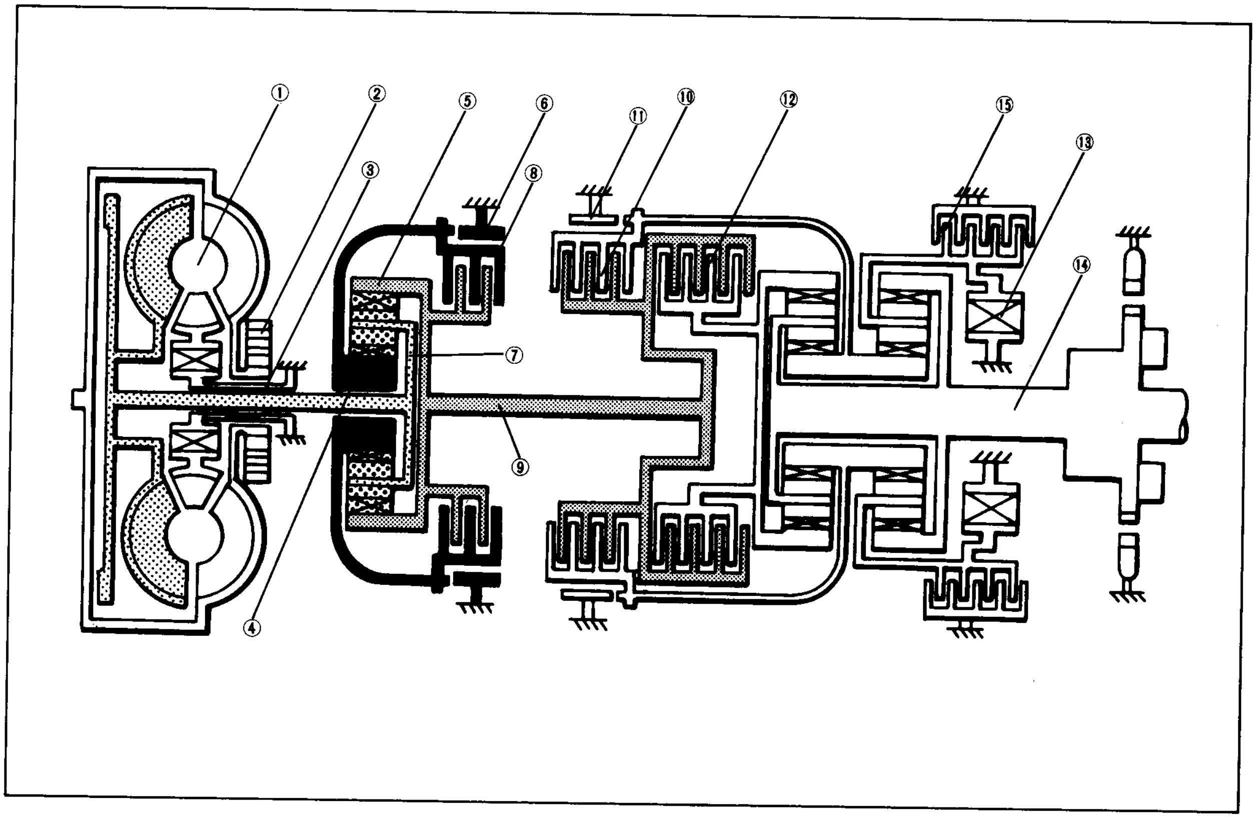


1. Torque converter
2. Oil pump
3. Input shaft
4. OD sun gear
5. OD clutch hub
6. OD brake band
7. OD planetary pinion carrier
8. Direct clutch
9. Intermediate shaft
10. Front clutch
11. 2nd brake band
12. Rear clutch
13. One-way clutch
14. Output shaft
15. Low & reverse brake

FIXED DIRECT CLUTCH (OD brake band is released.)

As a result of the operation of the direct clutch, the intermediate shaft, internal gear, direct clutch, connecting shell and sun gear become united.
Engine power is input, via the input shaft and OD carrier, to the pinion gear, but, because the internal gear and sun gear (meshed with the pinion gear) become united, the pinion does not rotate, it revolves.
As a result, the power from the input shaft is transmitted without change to the intermediate shaft; power transmission after that point is in the same way as for the 3N71B type.

(2) OD conditions



FIXED OD BRAKE BAND (Direct clutch is released.)

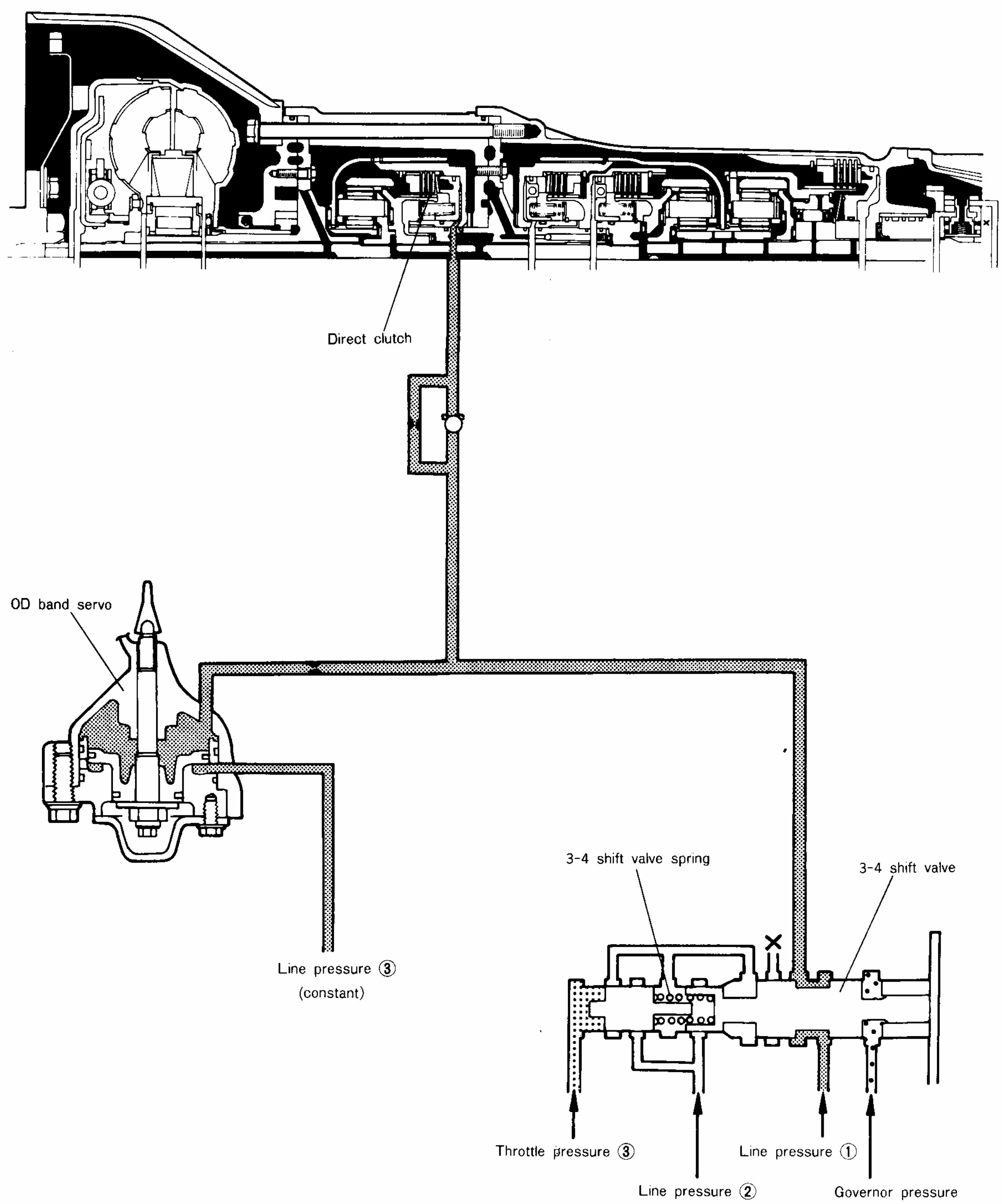
Because the OD brake band operates and the direct clutch does not operate, the connecting shell and sun gear remain fixed to the OD case and do not move.
As a result, the input via the OD carrier is transferred, the pinion gear rotates as it revolves around the sun gear, and power is transferred to the internal gear. The result is that the speed of the intermediate shaft increases.
Power transfer after the intermediate shaft is the same as for the D_3 range.

OPERATION OF VALVES AND HYDRAULIC PRESSURE

(1) 3-4 shift valve (4 = OD)

The 3-4 shift valve is located on the control body (upper), and function to shift between 3rd and 4th gears.

3rd condition



The 3-4 shift valve, as shown in the figure, moves to the right, the oil passage of line-pressure (1) expands, and hydraulic pressure is applied to the direct clutch and OD band servo open side.

Pushing valve to right		Pushing valve to left
• 3-4 Valve spring • Throttle pressure (3) • Line pressure (2)	➡ ⇦	• Governor pressure

Notes

a) The 3-4 valve spring usually pushes the 3-4 valve to the right, in other words in the direction in which there will be no OD.

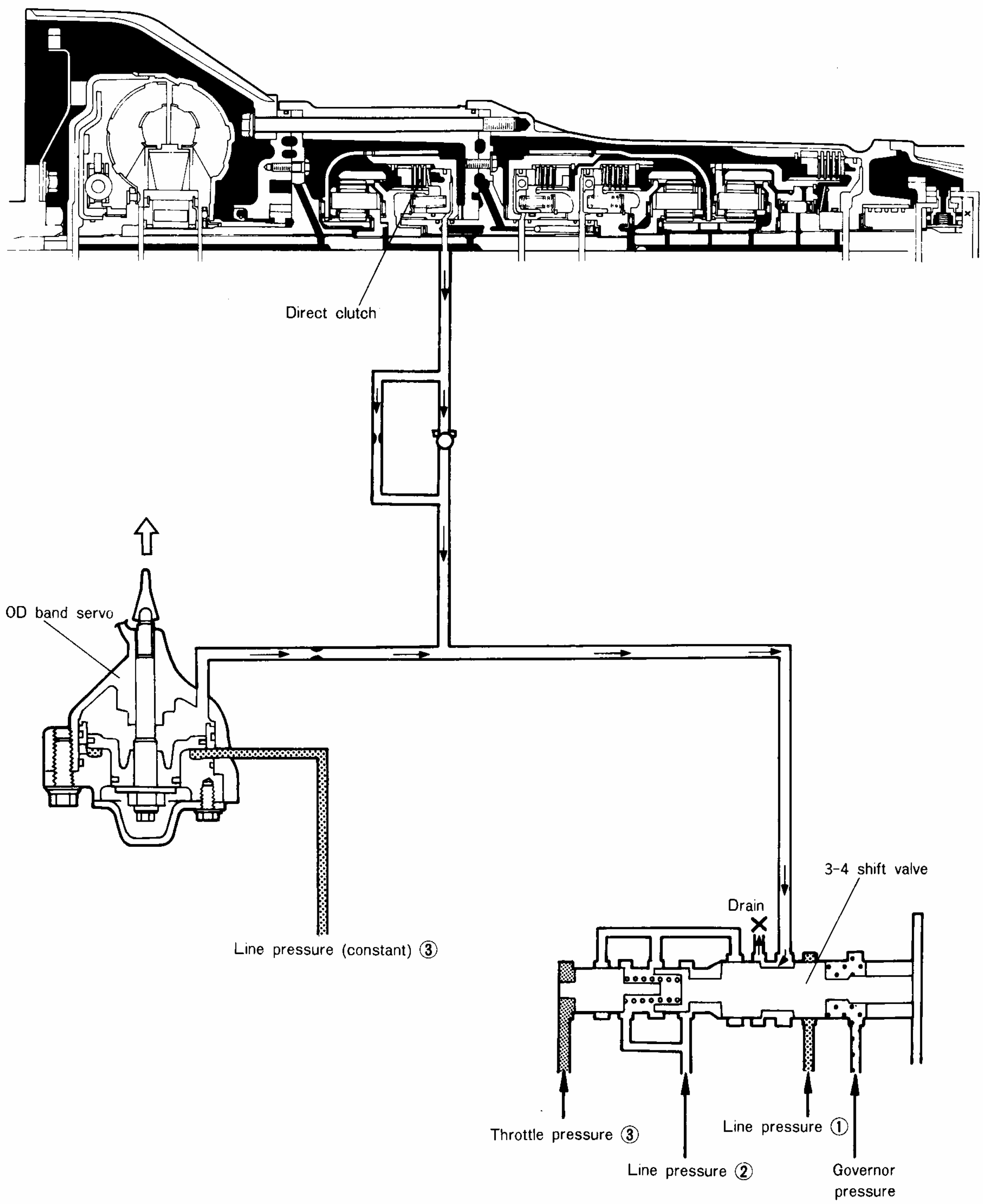
b) Throttle pressure (3)
- "Throttle pressure" is pressure proportional to engine load. In others words, on an up-grade, where engine load is great, throttle pressure also becomes great.
  As a consequence of throttle pressure becoming higher, the force which pushes the 3-4 valve toward the right also becomes higher, and the speed change is sent to the OD.

c) Line pressure (2)
- When the downshift (kickdown) solenoid functions, line pressure (2) is sent from the downshift (kickdown) solenoid valve.
  When this line pressure (2) is applied, there can absolutely be no pushing toward the left.

d) Governor pressure
- Governor pressure is pressure which is proportional to vehicle speed.

(1) 3-4 shift valve (cont.)

OD condition



The 3-4 shift valve, as shown in the figure, moves to the left, and line pressure (1) is closed. As a result of this action, the hydraulic pressure of the OD servo release side and the direct clutch is drained. However, because line pressure is usually applied to the OD band servo operation side, the OD band servo moves to the operation side.

Pushing valve to right

- 3-4 Valve spring
- Throttle pressure (3)

⇨

Pushing valve to left

⬅

- Governor pressure

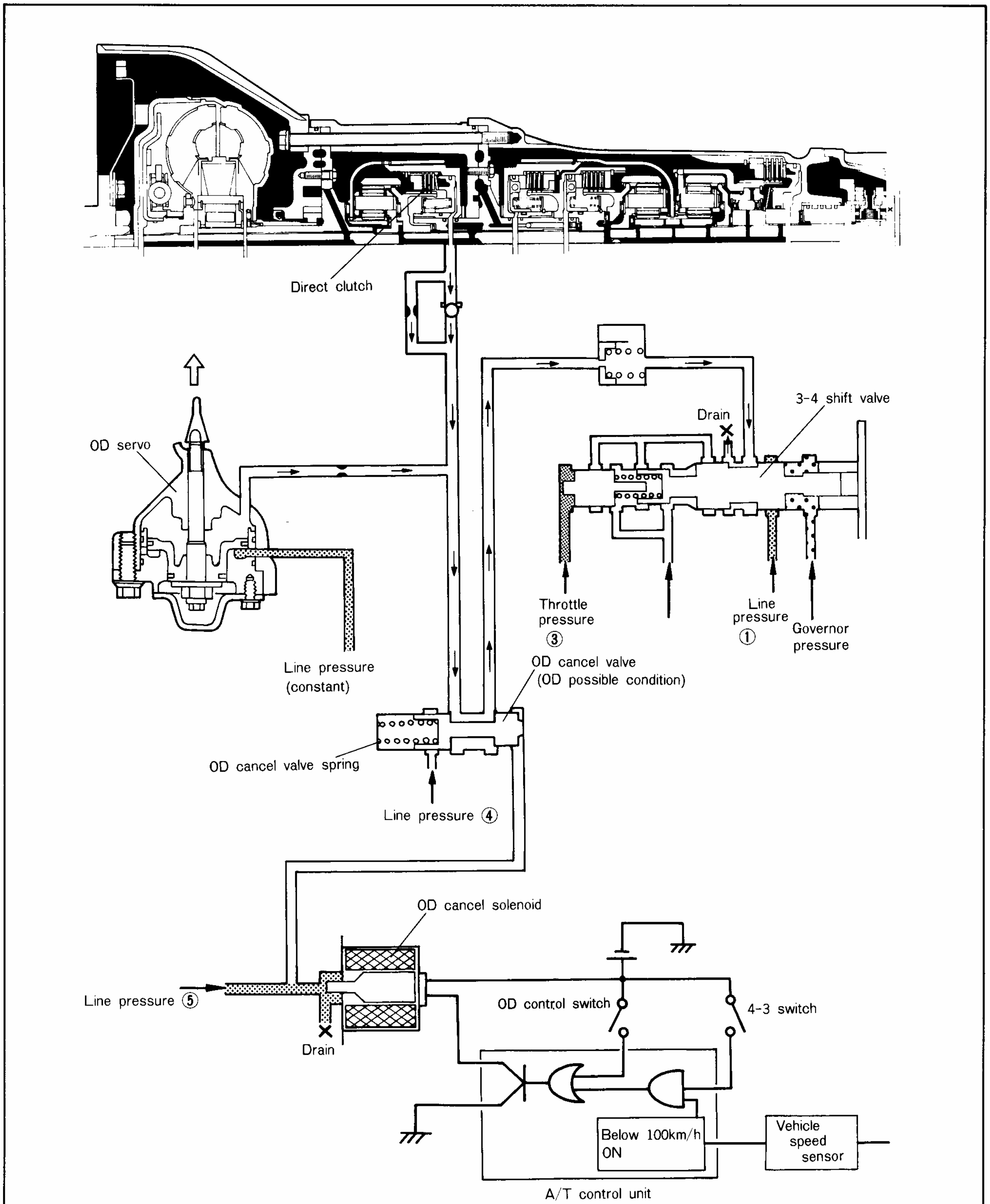
Note

When the vehicle speed is increased from the condition described on the page 7B—12 (line pressure (2) not applied), the governor pressure also increases accordingly.
When this governor pressure overcomes the forces pushing the valve toward the right, that is the 3-4 spring and the throttle pressure (2), the 3-4 shift valve is pushed to the left.

(2) OD cancel valve

The OD cancel valve is contained within the drum support. It functions to force the release of the OD running condition, or to prevent shifting to OD. It operates according to signals from the OD cancel solenoid.

OD condition



Because the OD cancel valve is pushed toward the right and the line pressure (4) is shut off, if the 3-4 shift valve changes from the 3rd gear condition to the OD condition, the condition would be such that shifting to OD would be possible.

Pushing OD cancel valve to right	**Pushing OD cancel valve to left**
OD cancel valve spring ➡	⇦ Not possible

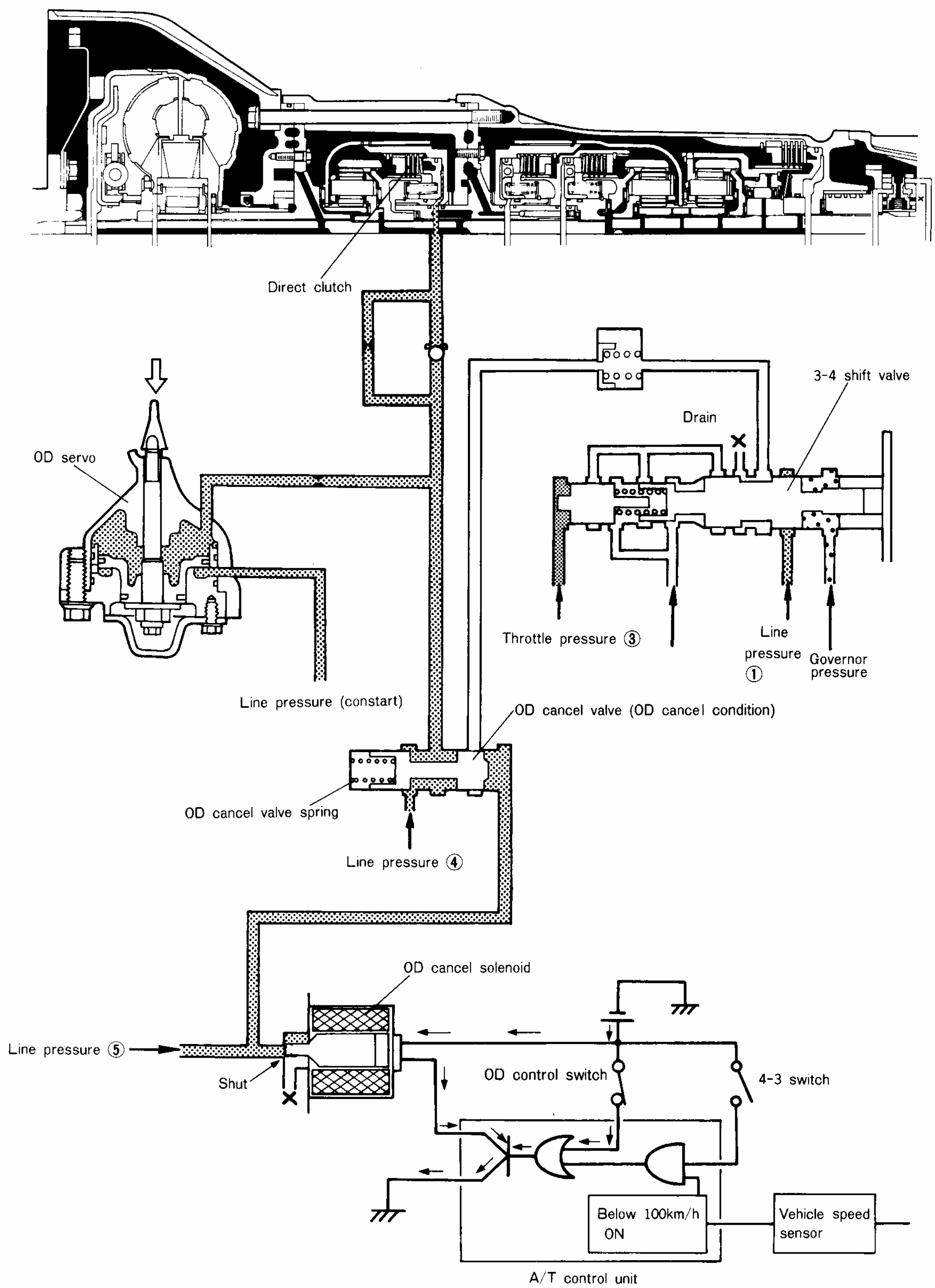
Note
Because current does not flow to the OD cancel valve, the line pressure (5) is drained, and pressure is not applied to the right side of the OD cancel solenoid.

Question:

- What happens when, in the condition in the figure left, current flows to the OD cancel solenoid and the line pressure (5) is not drained?

(2) OD cancel valve (cont.)

OD cancel condition



The OD cancel valve moves to the left, and the oil passage of line pressure (4) expands. As a result, hydraulic pressure is applied to the direct clutch and OD servo cancel side, and there is no shift to OD even if the 3-4 control valve becomes in the OD condition.

Pushing OD cancel valve to right

OD cancel valve spring

Pushing OD cancel valve to left

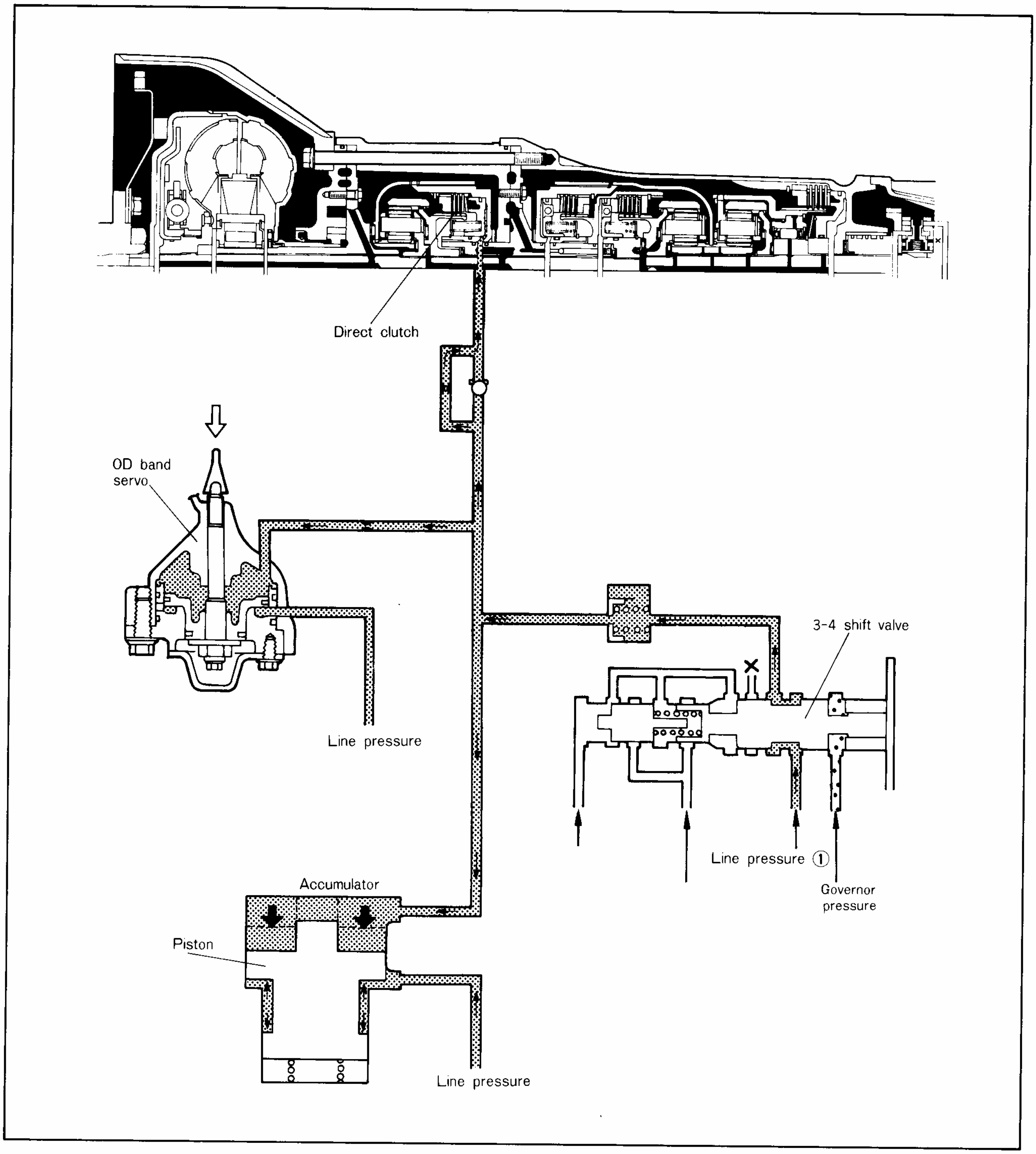
Line pressure (5)

Because current flows to the OD cancel solenoid, the drain passage is closed, and pressure to push the OD cancel valve to the left is generated.

Question:
Give two conditions under which current flows to the OD cancel solenoid.

(3) Accumulator

The accumulator is located on the outside of the OD case. It weakens the hydraulic pressure applied to the direct clutch from the OD during downshift, and thus lessens the impact "shock" of downshift.

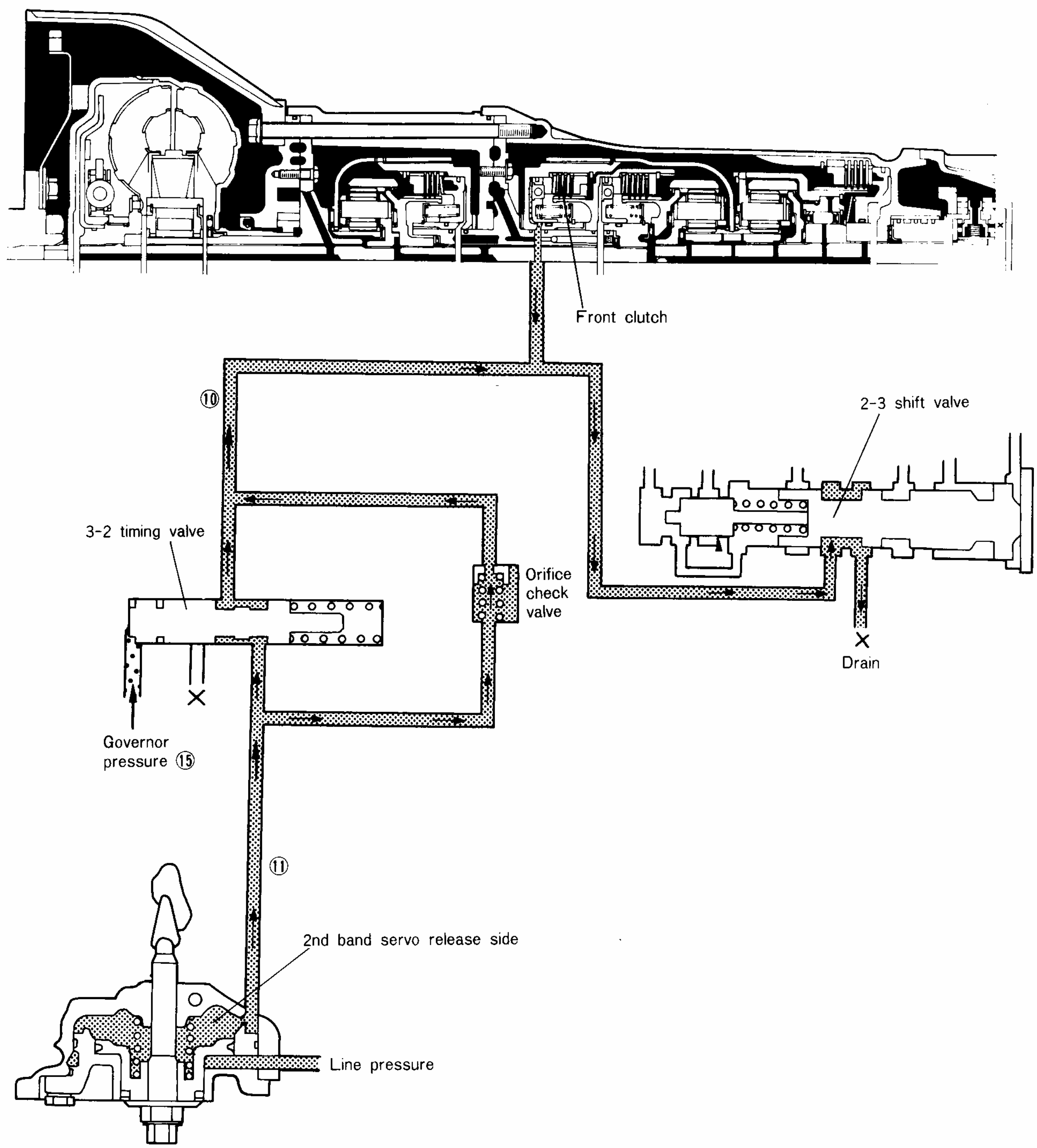


Downshift from OD

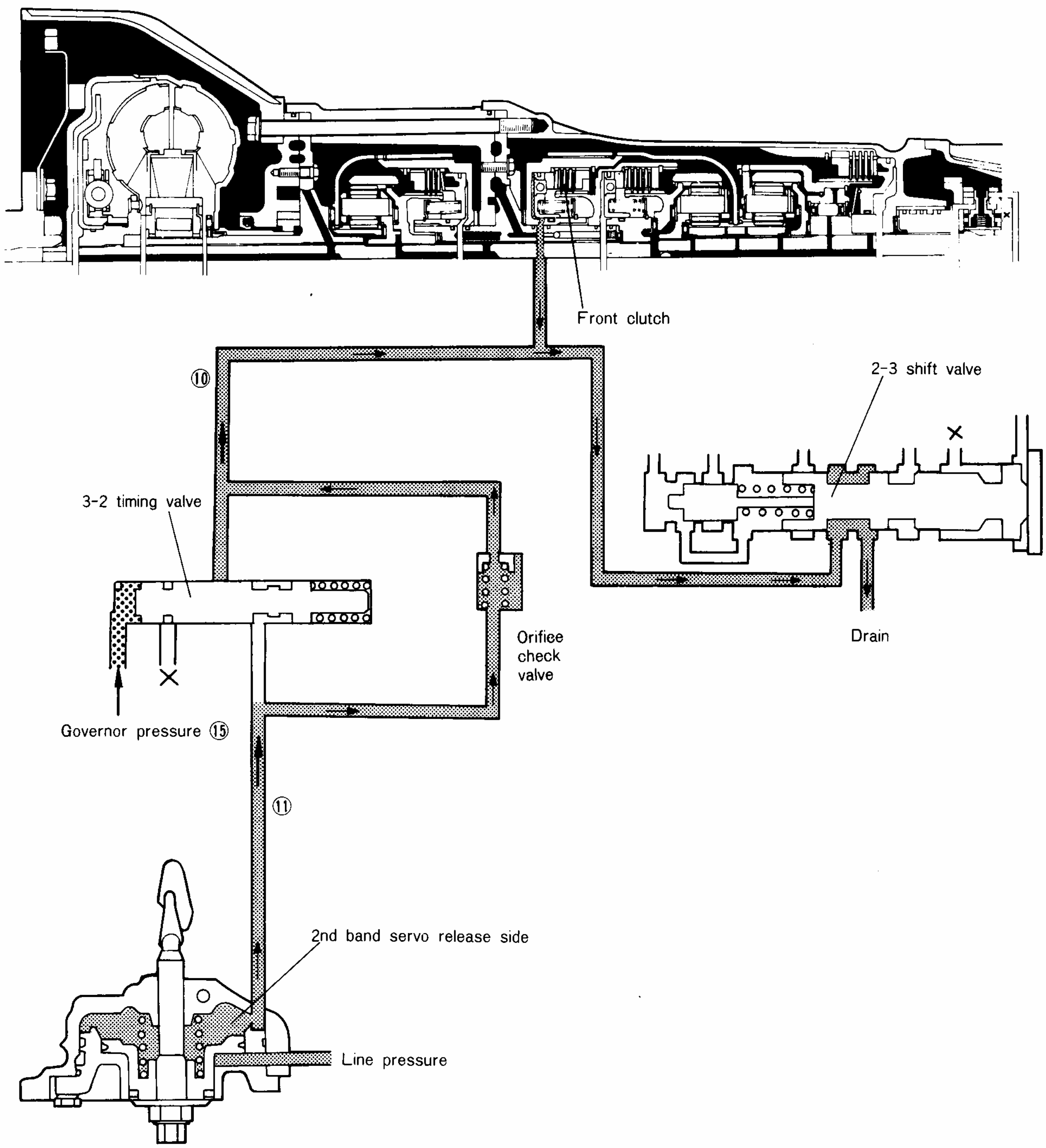
At the instant that the 3-4 shift valve moves to the right, the line pressure (1) tries to apply hydraulic pressure to the direct clutch and OD servo cancel side. At the same time, line pressure (1) is also applied to the upper part of the accumulator piston. When this happens, the piston moves downward, the line pressure (1) passage size becomes larger, and the hydraulic pressure there is temporarily weakened. When in that condition, the accumulator functions so that the direct clutch is connected slowly and smoothly, thus lessening the impact "shock" of speed reduction.

(4) 3-2 timing valve
The 3-2 timing valve functions, depending upon the vehicle speed, to change the closure of the 2nd band servo open side circuit, and thereby lessen the impact shock during 3-2 downshifts. This valve is located in the lower body of the control valve.

Operation
When the vehicle speed is vehicle speed is low, that is when the governor pressure is low, the pressure to the right by governor pressure is low, and, for that reason, the valve is pushed toward the left by spring force. In this condition, when there is a shift from 3rd to 2nd, the line pressure (10) is drained, and the line pressure (11) applied to the 2nd band servo is drained after passing through the valve closure part and the orifice of the orifice check valve.



When the vehicle speed is high, that is when the governor pressure is high, the governor pressure pushing to the right overcomes the spring force, the valve is pushed to the right, and the line pressure passage ((10) ↔ (11)) is closed.
When, in this condition, there is a downshift from 3rd to 2nd, the line pressure (11) applied to the 2nd band servo passes through the orifice of the orifice check valve only, and is drained slowly. When this happens, the band servo slowly and smoothly moves the brake band to the open side. As a result, the downshift impact shock is lessened.



LOCK-UP (LU) SYSTEM

1. LOCK-UP MECHANISM

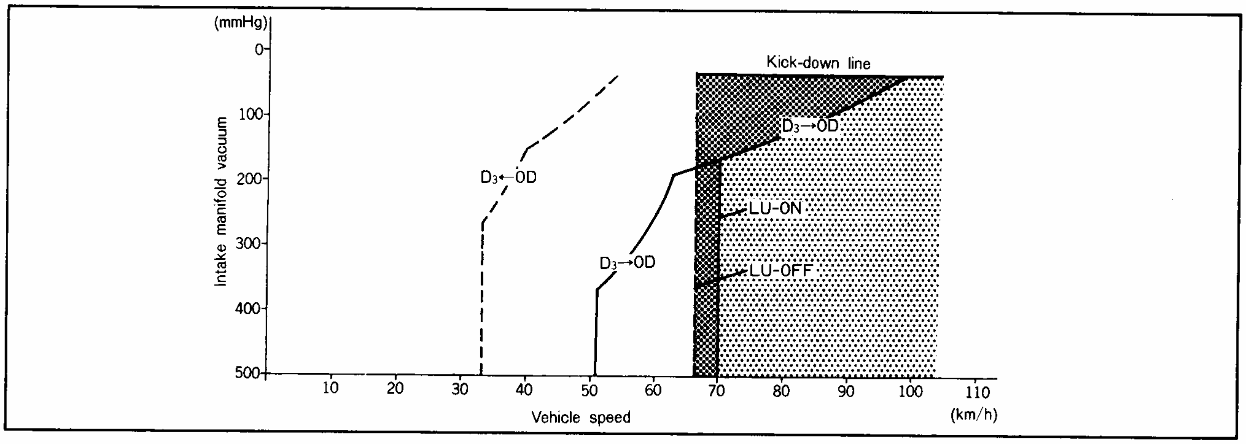
A rotation difference between the impeller and turbine revolutions was generated previously due to slippage in conventional torque converters because the power input from the engine was transmitted by the impeller via the ATF to the turbine. This Lock-Up Mechanism eliminates this rotation difference by directly linking the impeller and the turbine mechanically.

2. OPERATION CONDITIONS

The lock-up system operates when the following conditions all exist.

(1) OD in operation

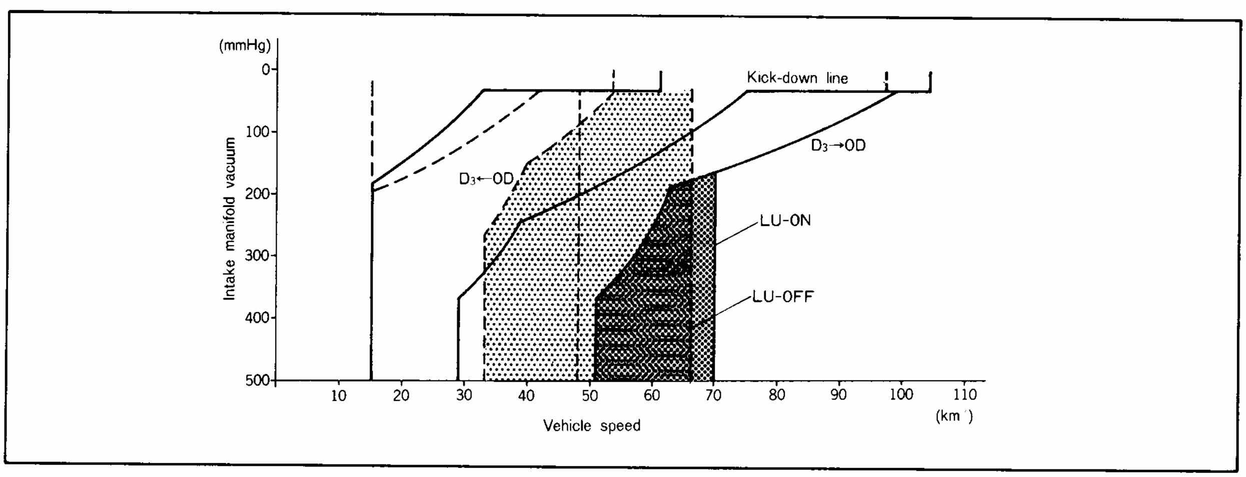
(2) Vehicle speed is 70 km/h or higher (when OFF → ON). Once the LU system has switched ON, it is not cancelled, as long as the OD is operating, until vehicle speed decreases to 62 km/h.
In other words, the ▒ area in the graph represents the conditions when the LU system switches from OFF to ON, and the ▓ area represents the conditions after it has once switched ON.



Notes

a) Because there is a close relationship between the lock-up system and the OD system, care should be taken not to confuse their conditions of operation. It may be easier to think of them, therefore, as two completely separate and distinct systems.

b) Depending upon the circumstances, the LU system may sometimes not operate even though the OD system is in the operation condition.
The ▓ area in the graph represents when the lock-up system switches for OFF to ON, and the ▒ area represents the condition, after the OD system has switched ON once, of the LU system being OFF, even though the OD system is ON.

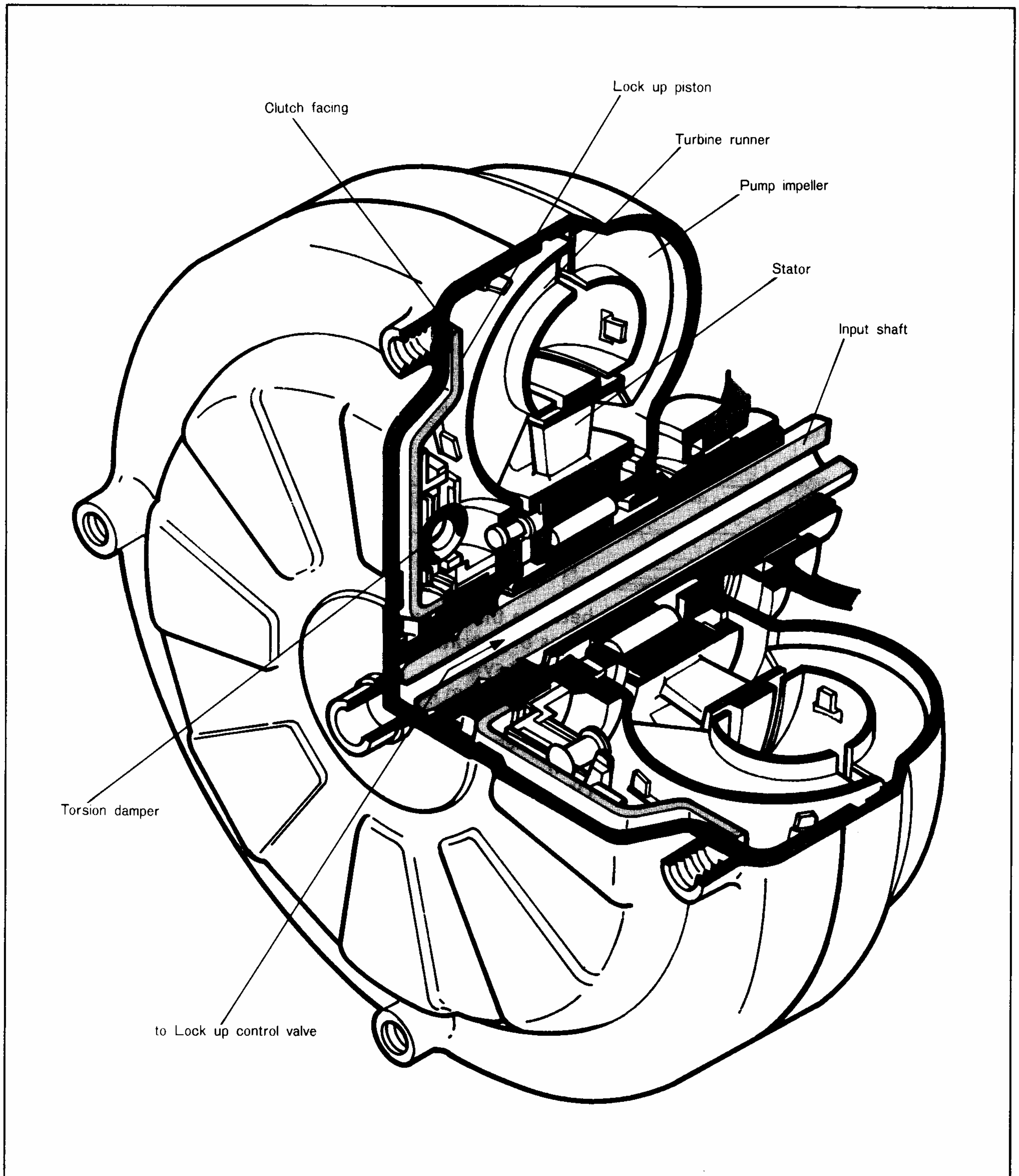


3. TORQUE CONVERTER

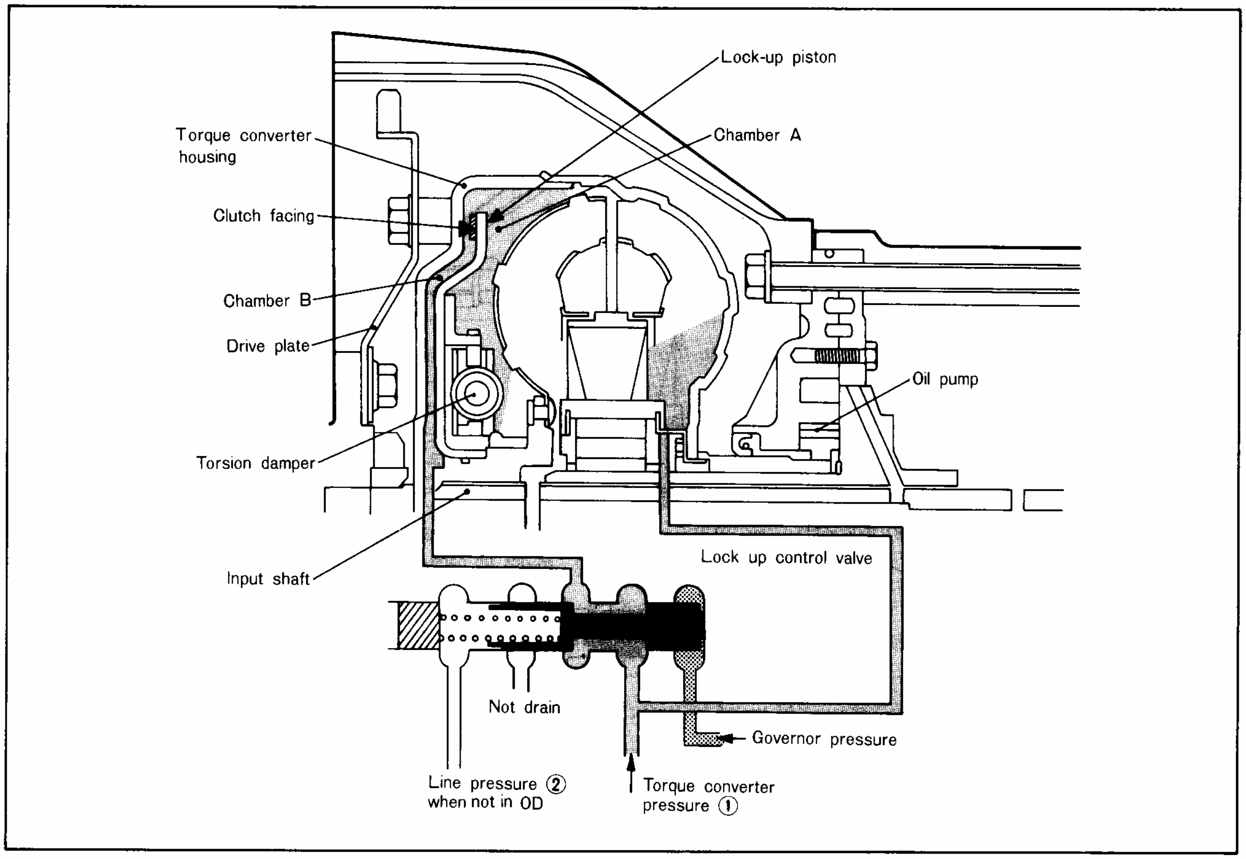
Within the torque converter of the L4N71B transmission, a lock-up piston, torsion damper, etc. have been added to the former converter.

When the lock-up operates, the clutch facing around the lock-up piston is pressed against the converter housing, and slippage caused by the fluid is entirely eliminated. In other words, the engine power is transmitted as is to the transmission.

There is a torsion damper located between the lock-up piston and the input shaft. This torsion damper functions in the same way as the torsion damper equipped on the clutch of the manual transmission.



4. UNLOCK (RELEASE) CONDITIONS



Because the lock-up control valve is pressed to the right, causing the torque converter pressure (1) to be applied to both A and B chambers within the converter, the lock-up piston moves away from the torque converter housing. In other words, the engine power is transmitted in the conventional way via the fluid to the input shaft.

Pushing LU control valve to right

LU control valve spring

Line pressure (2)

Constantly applied except in OD range.

Pushing LU control valve to left

Governor pressure

Notes

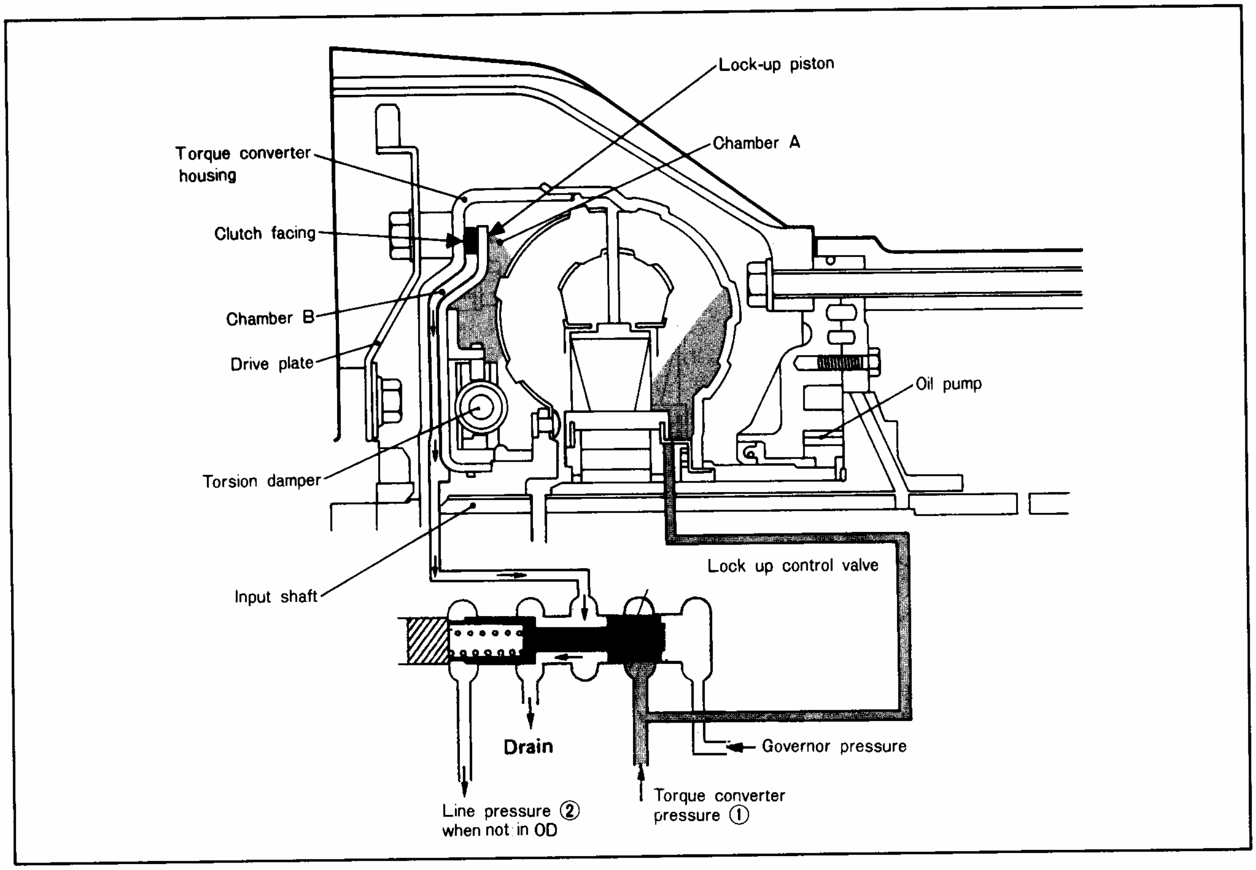
a) **Line pressure (2) is always applied to the LU control valve left side except in the OD range, but, because the force of line pressure (2) pushing the LU control valve to the right at that time is absolutely sure to be greater than the force of governor pressure pushing to the left, the LU control valve is always at the right. In other words, there will absolutely be no LU condition outside of the OD range.**

b) **Even if line pressure (2) is not applied, the valve is pushed to the right when the force of the LU control valve spring is greater than governor pressure.**

c) **Governor pressure is pressure which is proportional to vehicle speed. Thus, if the speed increases the pressure also becomes higher.**

d) **The LU control valve is located within the oil pump body.**

5. LOCK-UP CONDITIONS



At the instant that the LU control valve is pushed to the left, the drain passage expands and the fluid in chamber B is drained.
When this happens, torque converter pressure (1) applied to chamber A pushed the lock-up piston against the torque converter housing. When this occurs, engine power is input to the input shaft via the drive plate, clutch facing, lock-up piston and torsion damper (but not through the fluid).

Pushing LU control valve to right	**Pushing LU control valve to left**
LU control valve spring ⇨	⬅ Governor pressure

Notes

a) When line pressure (2) is not applied, the LU control valve is pushed to the right by the force of the LU control valve spring only. If the governor pressure overcomes this force, the LU control valve moves to the right, thus activating the LU condition.

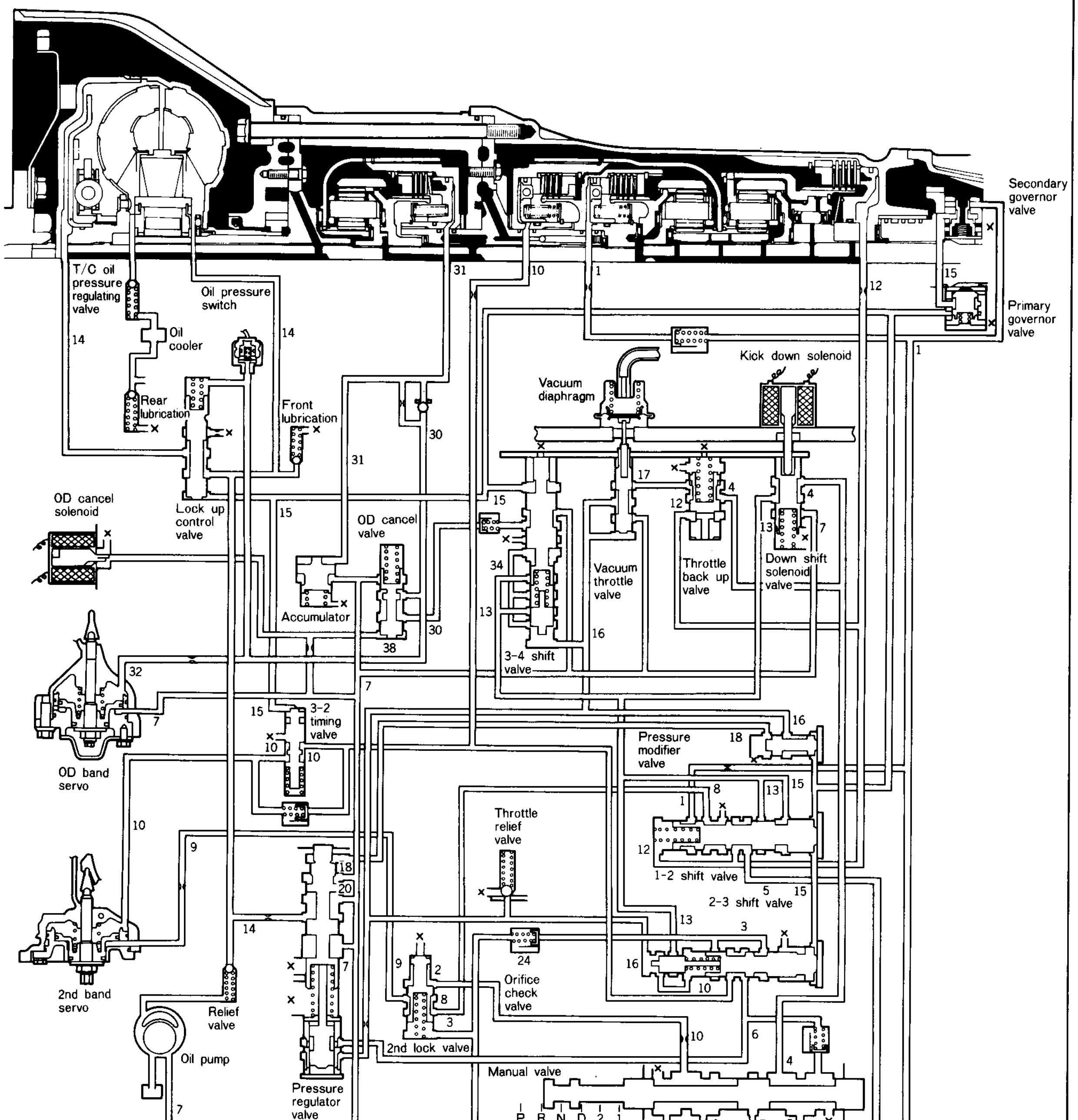
b) The governor pressure overcomes the LU control valve spring force when the vehicle speed is 70 km/h or higher.

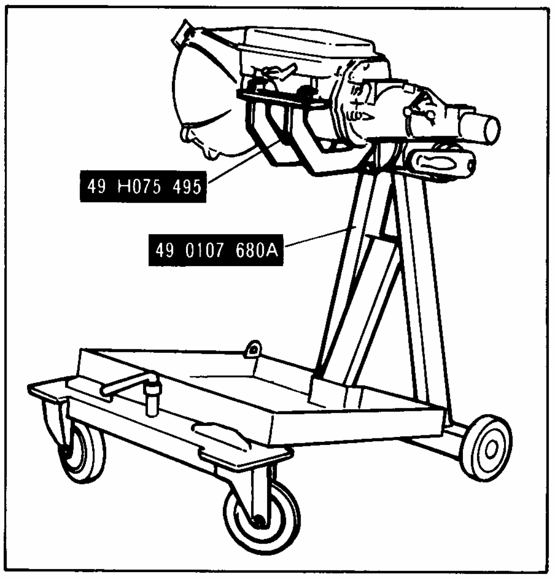
OD & LOCK-UP MECHANISM TROUBLESHOOTING

Trouble	Possible Cause
Does not shift to OD	• OD control switch malfunction • OD cancel solenoid malfunction • Insufficient governor pressure • Stuck OD cancel valve • Stuck 3-4 shift valve
Does not lock up.	• Insufficient governor pressure • Stuck lock-up valve • Exfoliated lock-up clutch facing
Does not shift down to 3 from OD.	• OD cancel solenoid malfunction • Improper adjustment of malfunction of 4-3 switch • Stuck 3-4 shift valve
Does not kickdown to 3 and 2 from OD.	• Improper adjustment of malfunction of kickdown switch
Slips when shifting to OD from 3.	• Improper OD band servo adjustment
Excessive OD to 3 and 2 downshift shock	• Stuck accumulator

HYDRAULIC CIRCUIT DIAGRAMS

NEUTRAL RANGE



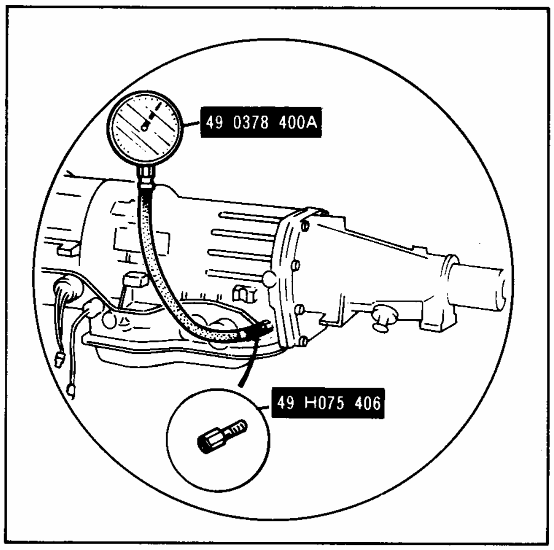


SPECIAL TOOLS

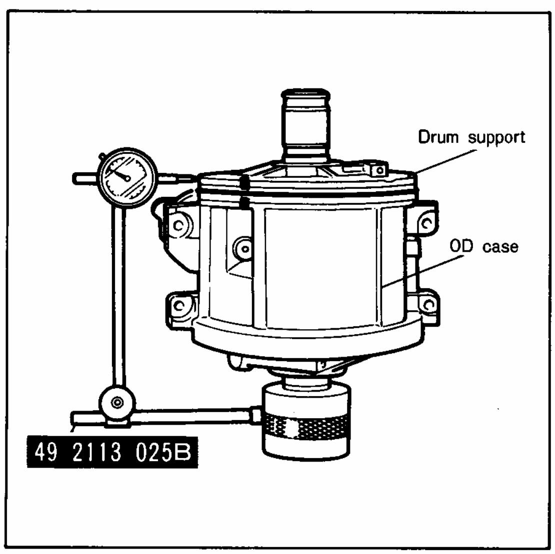
The service special tools used for the L4N71B automatic transmission are basically the same as those used for the 3N71B automatic transmission, but there are two new additions and one change.

New additions

1. **Transmission hanger** (49 H075 495)
   This has been newly added in order to make overhauling of the L4N71B automatic transmission faster and more efficient.
   As shown in the figure, it is used by installing it to the **engine stand** (49 0107 680A).



2. **Oil pressure gauge adapter** (49 H075 406)
   This is used when the governor pressure is measured.
   The governor pressure of the L4N71B automatic transmission is led from the rear part of the transmission, through the governor pressure pipe, to the front part.
   To rest the governor pressure, attach this **oil pressure gauge** (49 H075 406) to the rear of the governor pressure pipe and use the oil passage for the oil-pressure gauge.



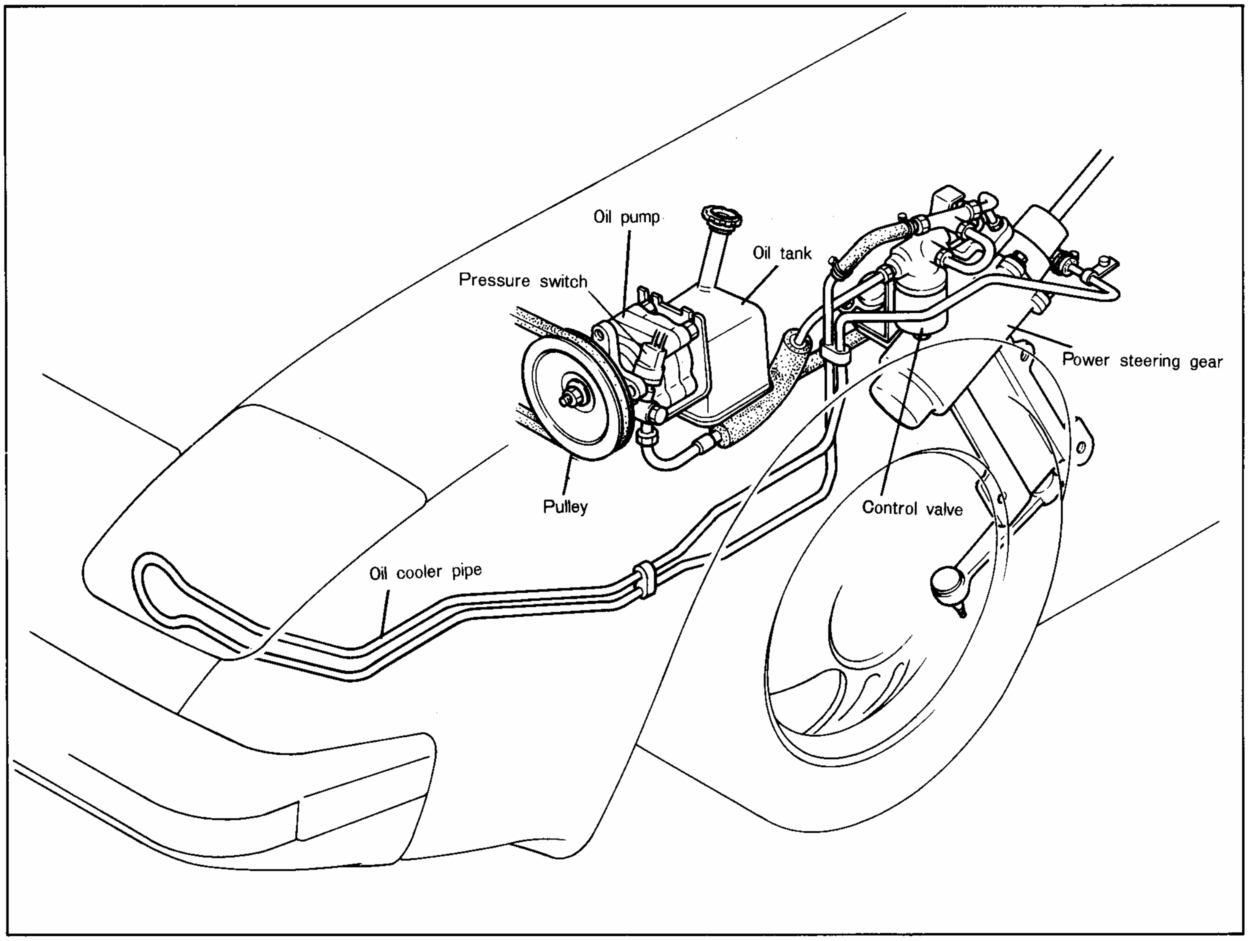
Changed item

1. **Oil pump assembling gauge** (49 2113 025B)
   When the L4N71B automatic transmission is assembled, the oil pump and drum support must be centered.
   Because the length of the rod of the **oil pump assembling gauge** (49 2113 025B) used until now is too short for drum support centering, the rod length has now been extended 70 mm (2.8 in).

POWER STEERING

STRUCTURAL VIEW 10B– 2
SPECIFICATIONS 10B– 2
SPEED-SENSING STEERING SYSTEM 10B– 3
CONSTRUCTION OF MAJOR PARTS 10B– 4
POWER STEERING OPERATION 10B– 5
OIL PUMP 10B– 9
CONTROL VALVE CONSTRUCTION 10B–12
CONTROL VALVE OPERATION 10B–13
CONTROLLER 10B–15
SERVICE POINTS OF POWER
STEERING 10B–16

STRUCTURAL VIEW



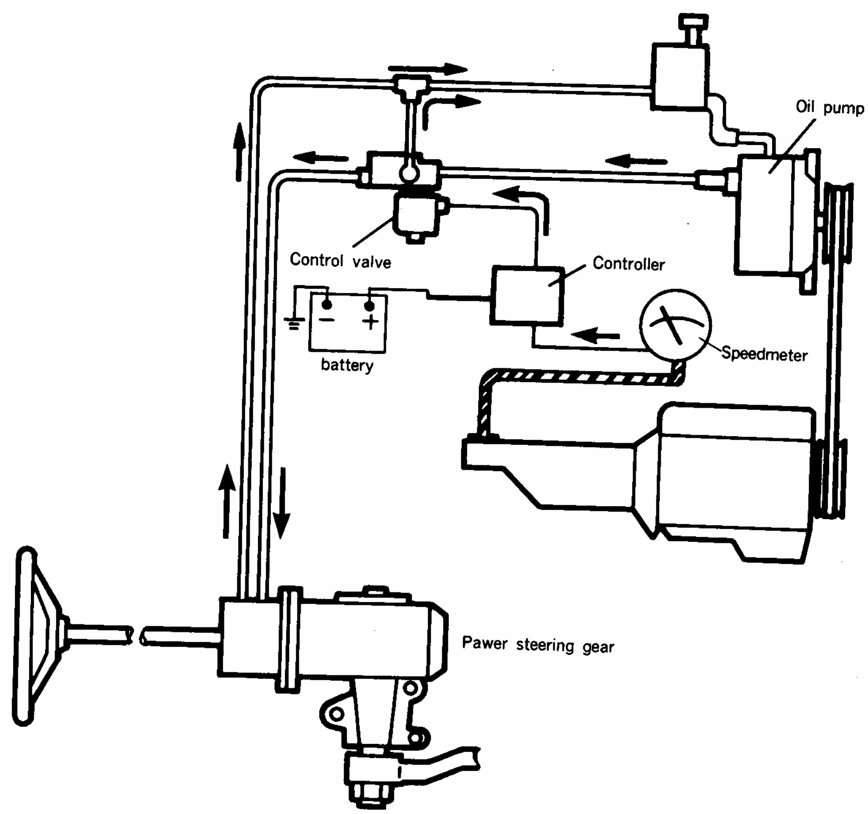
SPECIFICATIONS

Item		
Steering wheel	Outer diameter	380 mm (14.96 in)
	Lock to lock	3.0
Steering and linkage	Gear type	Ball nut type
	Gear ratio	15.83 : 1
	Shaft type	Regular type
Oil pump	Constant discharge	6.5 ± 0.5 liters/min. (1.69 ± 0.13 U. S. gallon, 397 ± 31 cu. in)
	Constant pressure	$7{,}000\,^{+500}_{-250}$ kPa ($995\,^{+71}_{-35}$ lb/in^2)
	Oil pump rpm	600 ~ 6,500 rpm
	Oil capacity	0.8 liters (0.21 U. S. gallon, 48.82 cu. in)
	Oil	ATF Type F (M2C33F)

SPEED-SENSING STEERING SYSTEM

OUTLINE

This system detects the vehicle speed by a vehicle-speed sensor located within the speedometer. Pulse signals are transmitted from the vehicle-speed sensor to a controller, these pulse signals are converted to electric current which activates the electromagnetic plunger incorporated within a solenoid, the constant discharge flow from the oil pump is regulated by a control valve which varies the supply flow to the steering gear, lightening the required steering effort at low speed and increasing it appropriately at high speed, and thereby suitable steering power is provided according to the vehicle speed.



CONSTRUCTION OF MAJOR PARTS

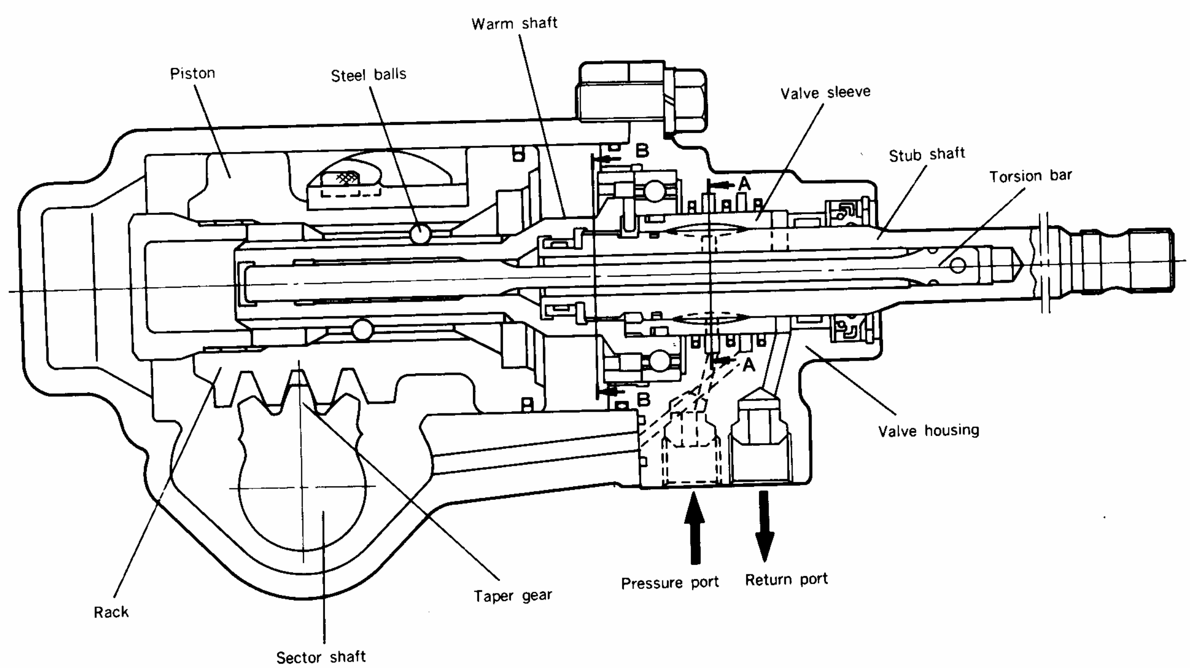
POWER STEERING CONSTRUCTION

The power steering system described here in is a rotary-valve type ball-screw integral power steering system. The system consists of the steering gear section, the power cylinder section, the control valve section, and the reaction section.

The steering gear section is of the same construction as the ball-screw manual steering, and is composed of a worm shaft, a piston (ball nut), sector shaft, etc.
When the steering wheel is turned, the movement is transmitted via the steering shaft, stub shaft, and torsion bar to turn the worm shaft. (In the manual steering system the rotational force is transmitted directly to the worm shaft from the stud shaft.) The balls then cause the piston to move in the worm shaft's axial direction. The piston rack engages the sector shaft, thus causing the sector shaft to turn as the piston moves. The rotation of the steering wheel is thus transmitted to the steering link via the pitman arm mounted to the end of the sector shaft, making steering possible.

The worm shaft is a male screw and the piston is a female screw. They are both quench-hardened and then precision cut to give their screw grooves a special cross-sectional shape. A number of steel balls are interposed between the two parts, and these steel balls roll in the grooves and recirculate via the ball tube mounted to the piston.

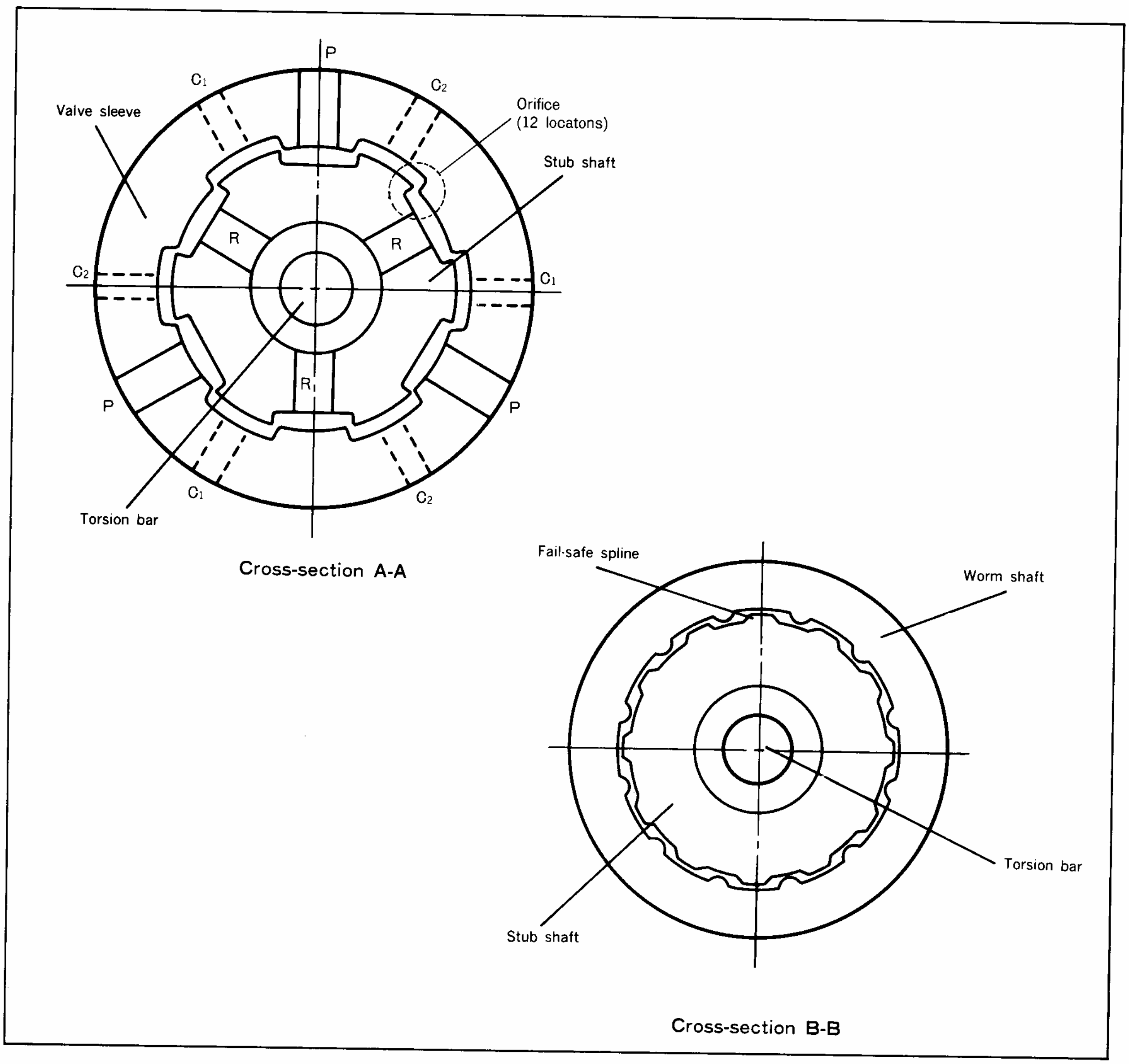
The taper gear tooth surfaces are tapered 4.5° with respect to the sector shaft center axis, and this angle results in perfect meshing of the piston rack. The reason for tapering the tooth surfaces 4.5° is to ajust the meshing of the piston rack and the sector shaft taper gear. The meshing of the rack and taper gear can be easily adjusted by tightening or loosening the adjusting screw located at the top of the sector shaft.



For the power cylinder section the inside of the steering gear box has been worked into a cylinder, and inside this there is a piston with the added function of a ball nut, thus making this a double-acting power cylinder.

The control valve section is a four-port, three-position open center type rotary valve, and it is composed of a valve sleeve and a stub shaft.
The valve sleeve and the stub shaft fit together with an appropriate amount of clearance so that they can both turn. There are six grooves running up and down the inside of the valve sleeve and the outside of the stub shaft in the axial direction; this provides orifices in 12 locations and oil passages are provided in each of the balance positions to allow oil to flow to the pressure port (P), return port (R), and left and right cylinders (C_1, C_2). There is a notch in the end of the sleeve into which a pin press-fit into the worm shaft fits to allow the worm shaft and the sleeve to turn as a unit.

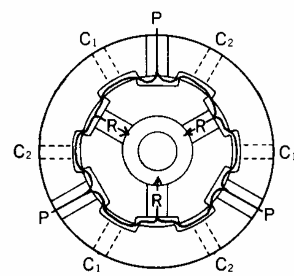
The reaction section consists of a torsion bar. One end of the torsion bar is secured to the worm shaft by a special press-fitting method and the other end is secured to the stub shaft with a pin. Although the stub shaft and the worm shaft are relatively displaced when the torsion bar is twisted, the amount of displacement is limited by the contact of the stub shaft fail-safe spline against the worm shaft fail-safe spline.

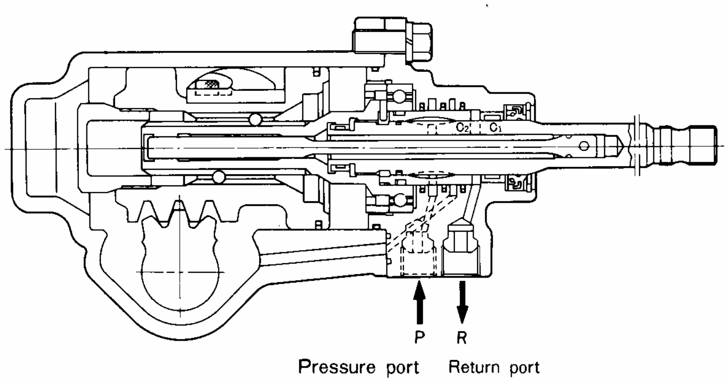


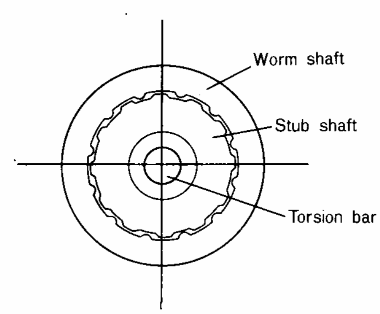
POWER STEERING OPERATION

DURING NEUTRAL (STRAIGHT-AHEAD DRIVING)

Illustrates the operation during neutral. The oil supplied from the pump flows from the pressure port through the circular groove inside the valve housing and into the three oil passages provided in the valve sleeve in the axial direction. However, because all of the orifice gaps are the same size and the resistance is equal throughout the circuit, the oil flows through the three oil passages provided in the stub shaft in the radial direction and through the clearance between the stub shaft and the torsion bar, and then once again out of the return port via the three oil passages provided in the stub shaft in the radial direction.
Therefore, there is no difference in the operating pressures applied to the left and right cylinders and the piston does not move.

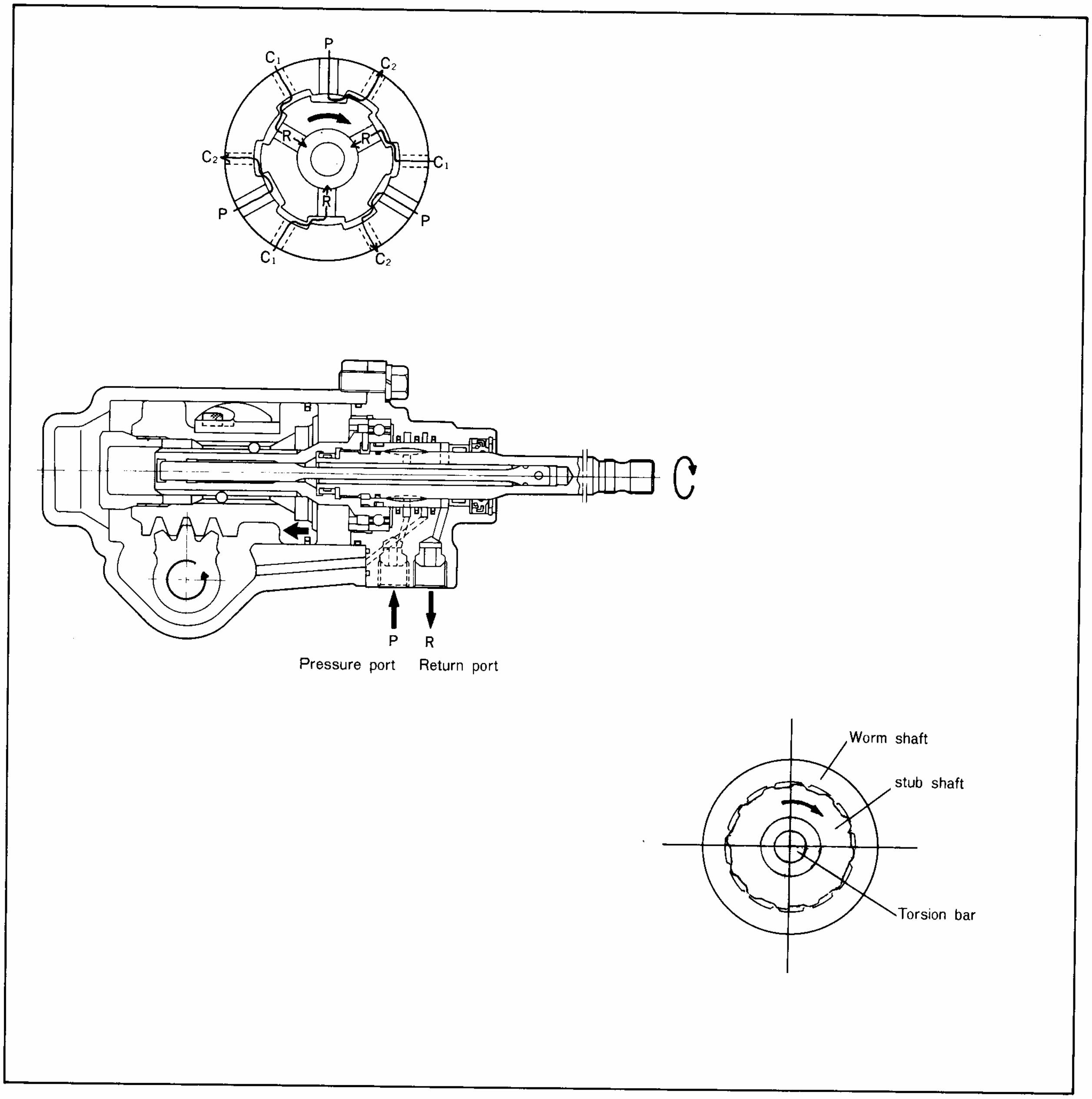






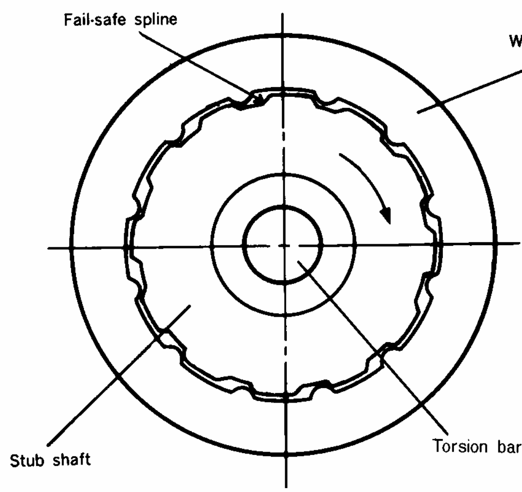
WHEN TURNING

When the steering wheel is turned to the right, for example, because the reaction force of the tires work on the worm shaft via the link, the pitman arm, the sector shaft, the piston, etc., the torsion bar twists and the stub shaft turns to the right with respect to the worm shaft. Because the sleeve and the worm shaft are a single unit, the openings of the orifices for the right-turn direction become smaller and the flow of oil out of the return port is limited, thus increasing the pressure in the right cylinder circuit. The piston, therefore, is forced to move to the left, and accompanying this movement of the piston, the rotational force of the sector shaft is supplemented.
When the piston moves, the twisted torsion bar returns to the neutral condition and the relative displacement which appeared between the valve sleeve and the stub shaft also returns to the neutral condition. In this way, when the steering wheel is turned at a certain speed to a desired angle, the tires connected via the sector shaft, pitman arm, link, etc., will turn at a corresponding speed to a corresponding position. In addition, the reaction force of the torsion bar causes the stub shaft to return to the neutral position, and this force is also transmitted to the steering wheel to give the driver an appropriate steering feel.



MANUAL STEERING

Even if there is no pressure because the engine is stopped or in the event of a pump malfunction, oil leakage, or any other reason, manual steering will still be possible because the stub shaft fail-safe spline is in contact with the fail-safe spline of the worm shaft.



OIL PUMP

EXPLANATION OF OPERATION OF OIL PUMP

Construction and operation of oil pump assembly

This oil pump is the vane pump type, and is united with the oil reservoir. A flow-control valve and relief valve are included.

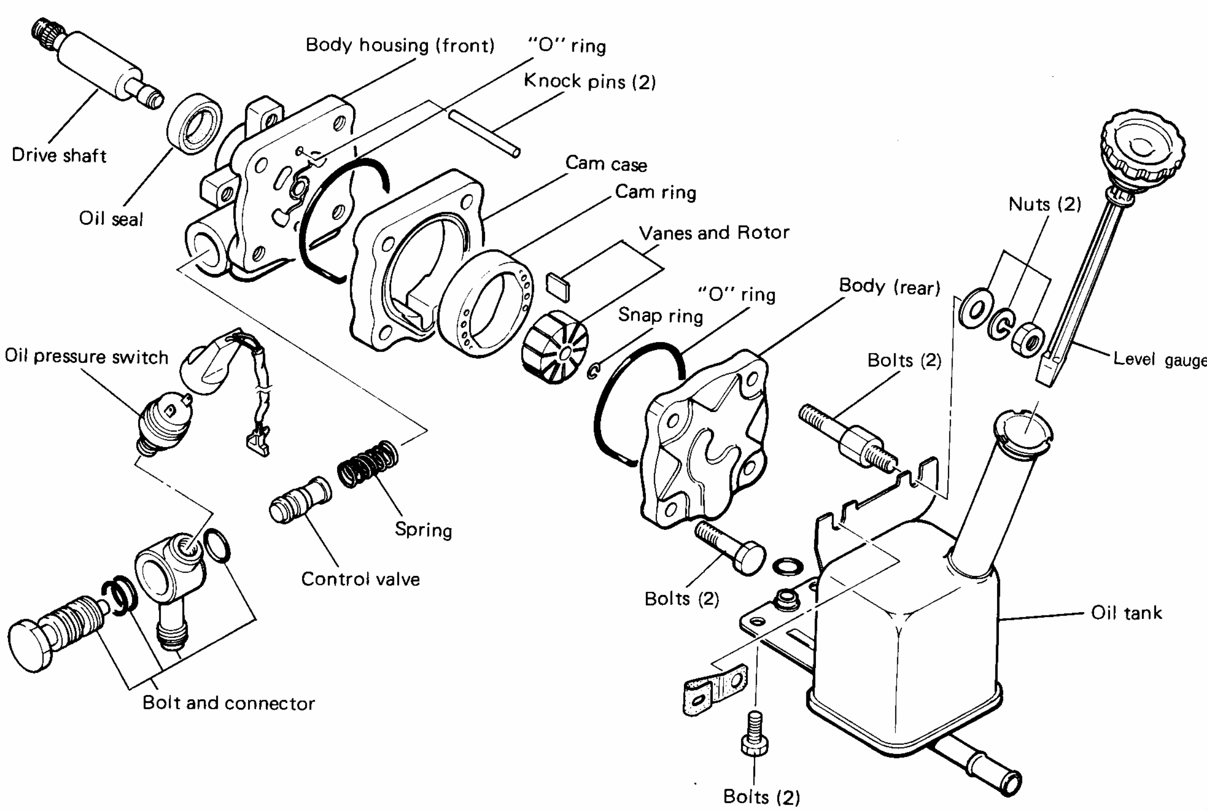
There is a hydraulic pressure switch for idle-up at the pump discharge connector.

OIL PUMP (VANE PUMP)

This pump is composed of a rotor, cam ring, and 10 vanes.

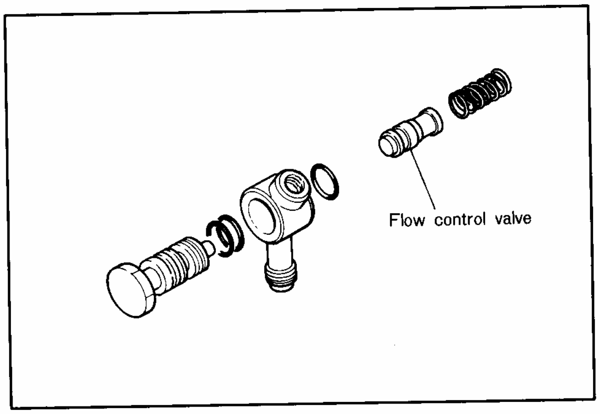
When the rotor turns, centrifugal force causes the vanes, located in the grooves of the rotor, to be forced out radially and pressed against the inner wall of the cam ring.

The tips of the vanes move against the oval inner wall of the cam ring; oil passes through the oval grooves, enters the chamber formed by the rotor, cam ring and vanes, and is continuously discharged.

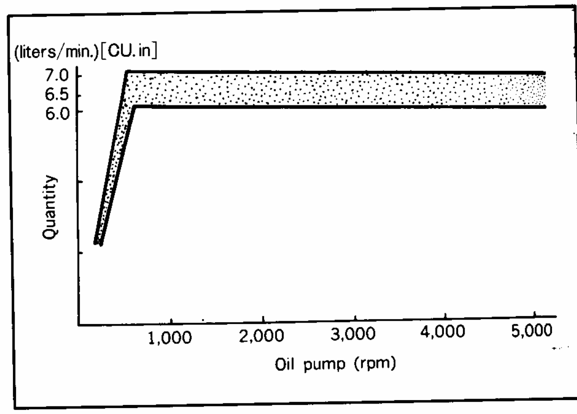


FLOW CONTROL VALVE

The flow control valve is located in the pump housing.

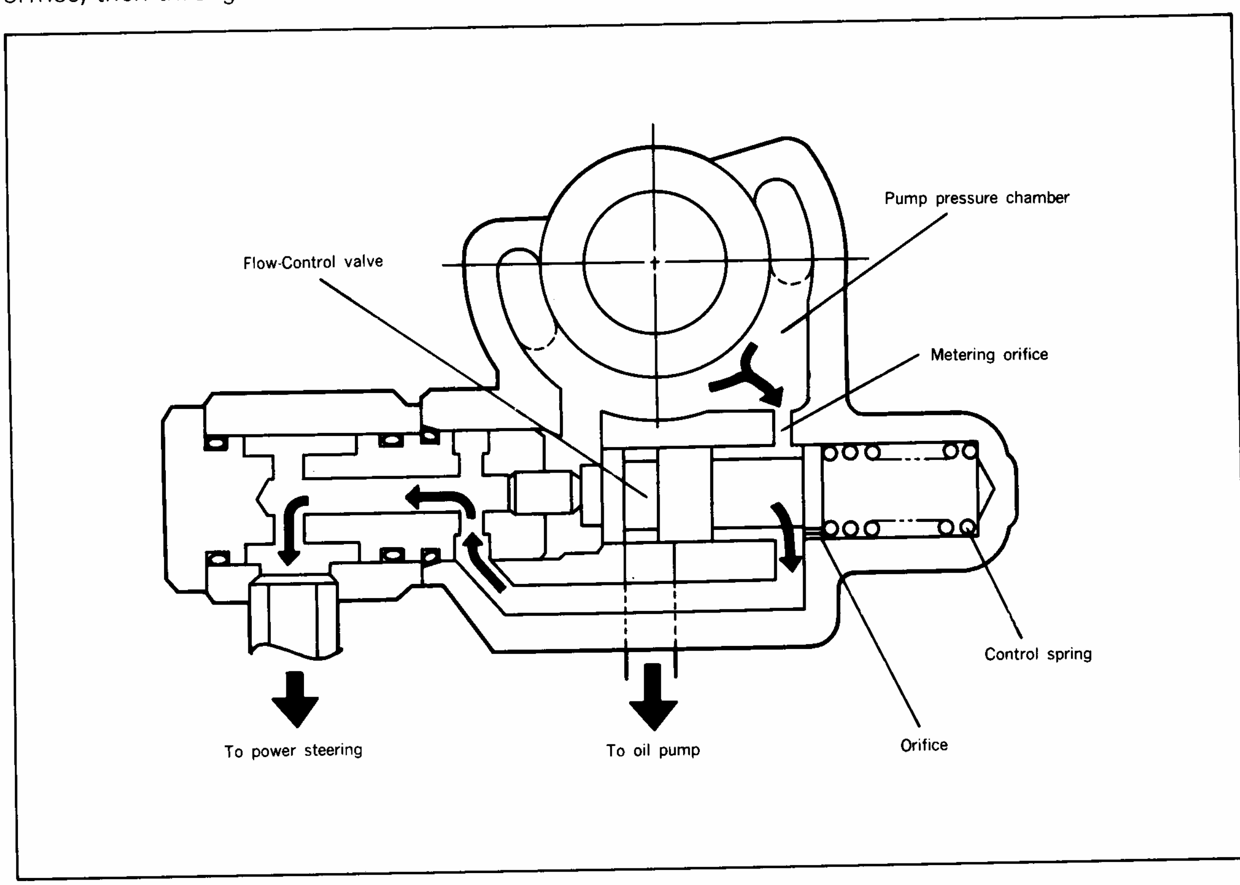


The characteristics of the flow control valve.

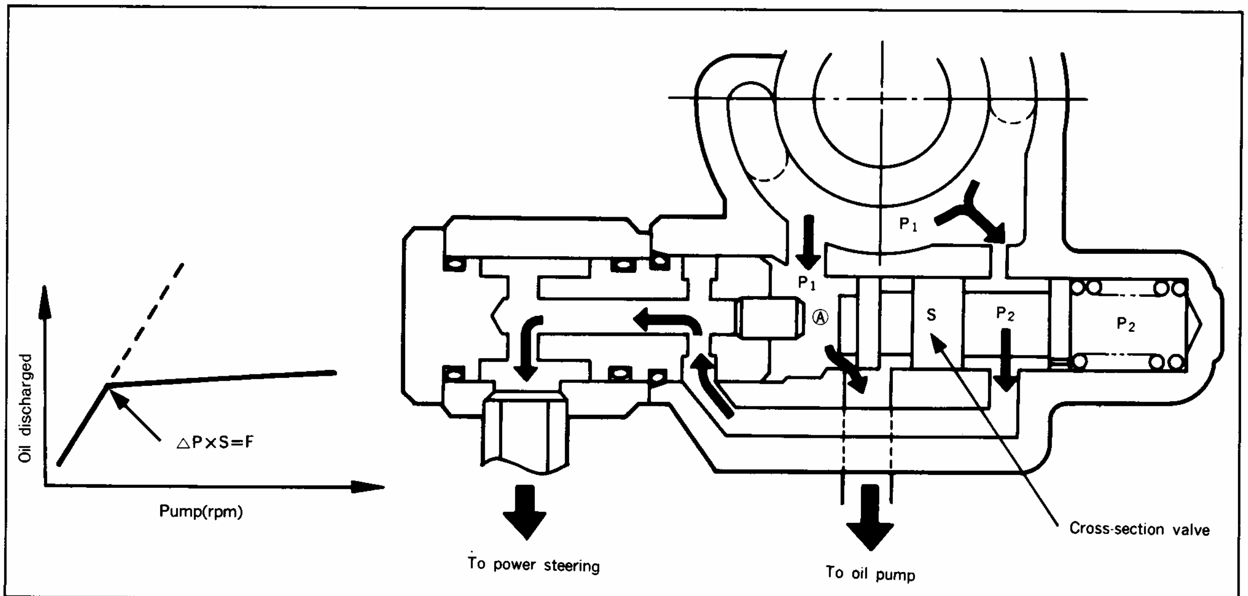


Flow Control Valve Operation

The oil discharged by the oil pump is sent to the pump pressure chamber, passes through the metering orifice, then through the control valve, and is supplied to the power steering.



If, at this time, as a result of the amount of oil passing through the metering orifice, a pressure difference ($\Delta P = P_1 - P_2$) occurs before or after, and the oil amount increases, (ΔP) will also increase. (When the oil pump rpm increases and the discharge amount increases, this pressure difference (ΔP) overcomes ($\Delta PXS \geqq F$) the initial reaction (F) of the control spring, moving the flow-control valve to the right, and the passage which passes through the pressure chamber (A) to the pump inlet port expands, thus maintaining the flow supplied to the control valve at a constant amount.

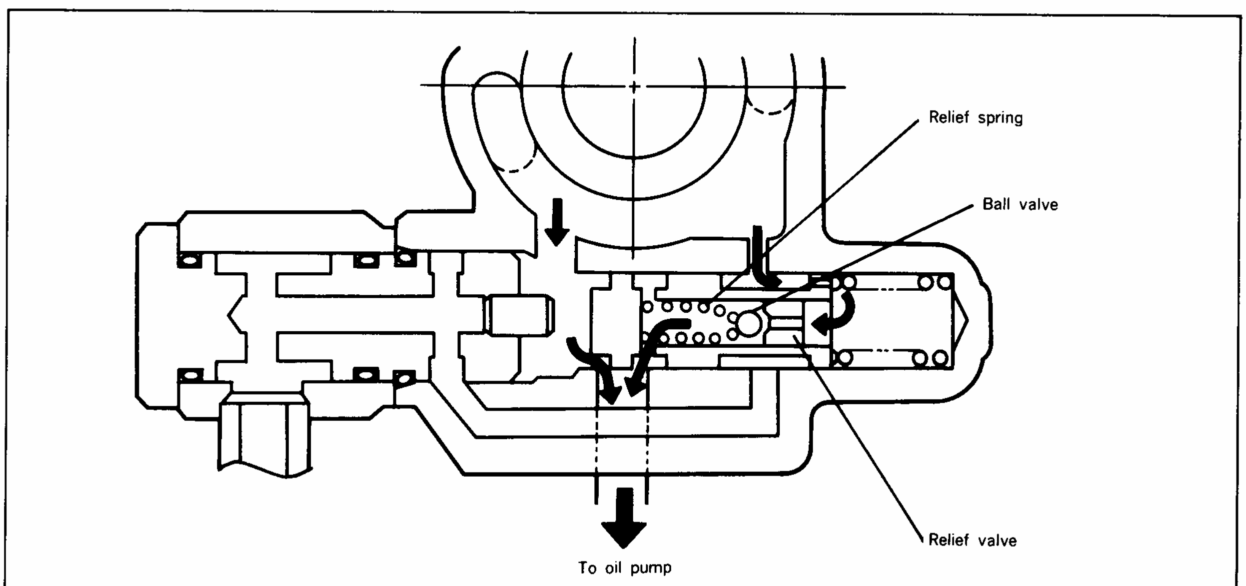


RELIEF VALVE

This valve is designed to regulate the maximum oil pressure. It is composed of a relief valve, ball valve, and relief spring, and is located within the flow-control valve.

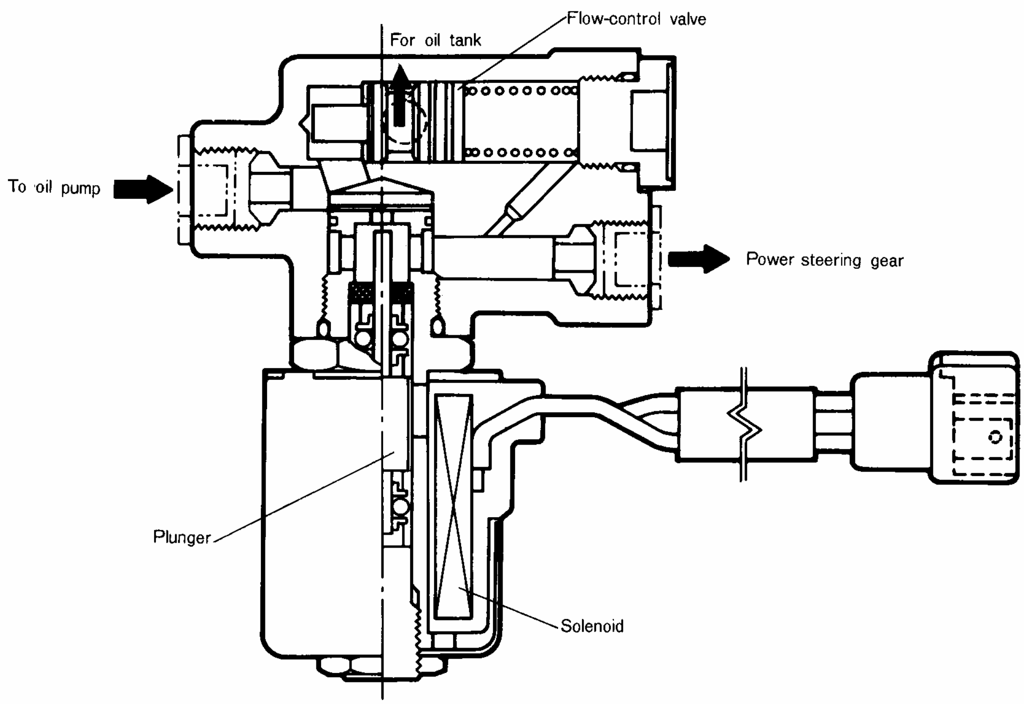
When the system oil pressure reaches the specified value, the ball valve opens, and a portion of the oil passes through the orifice and is discharged to the pump inlet port.

When this happens, the flow-control valve moves to the right because the pressure at its right side decreases as a result of the orifice's contraction effect, and thus almost all of the oil discharged from the pump is caused to escape to the pump inlet port.



CONTROL VALVE CONSTRUCTION

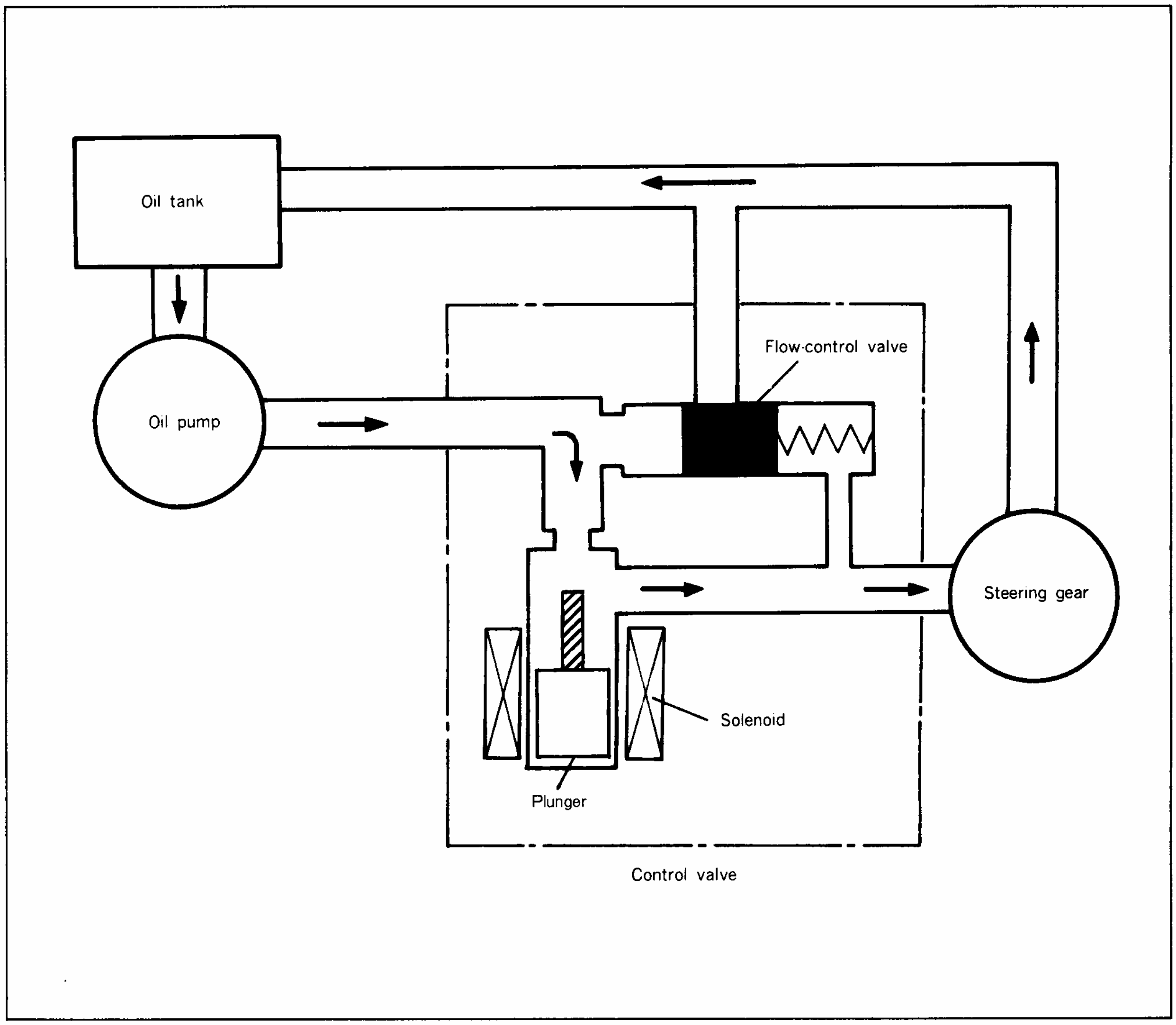
The amount of flow from the oil pump is controlled by the rod activated by the solenoid, and this regulated flow is supplied to the power steering gear.



CONTROL VALVE OPERATION

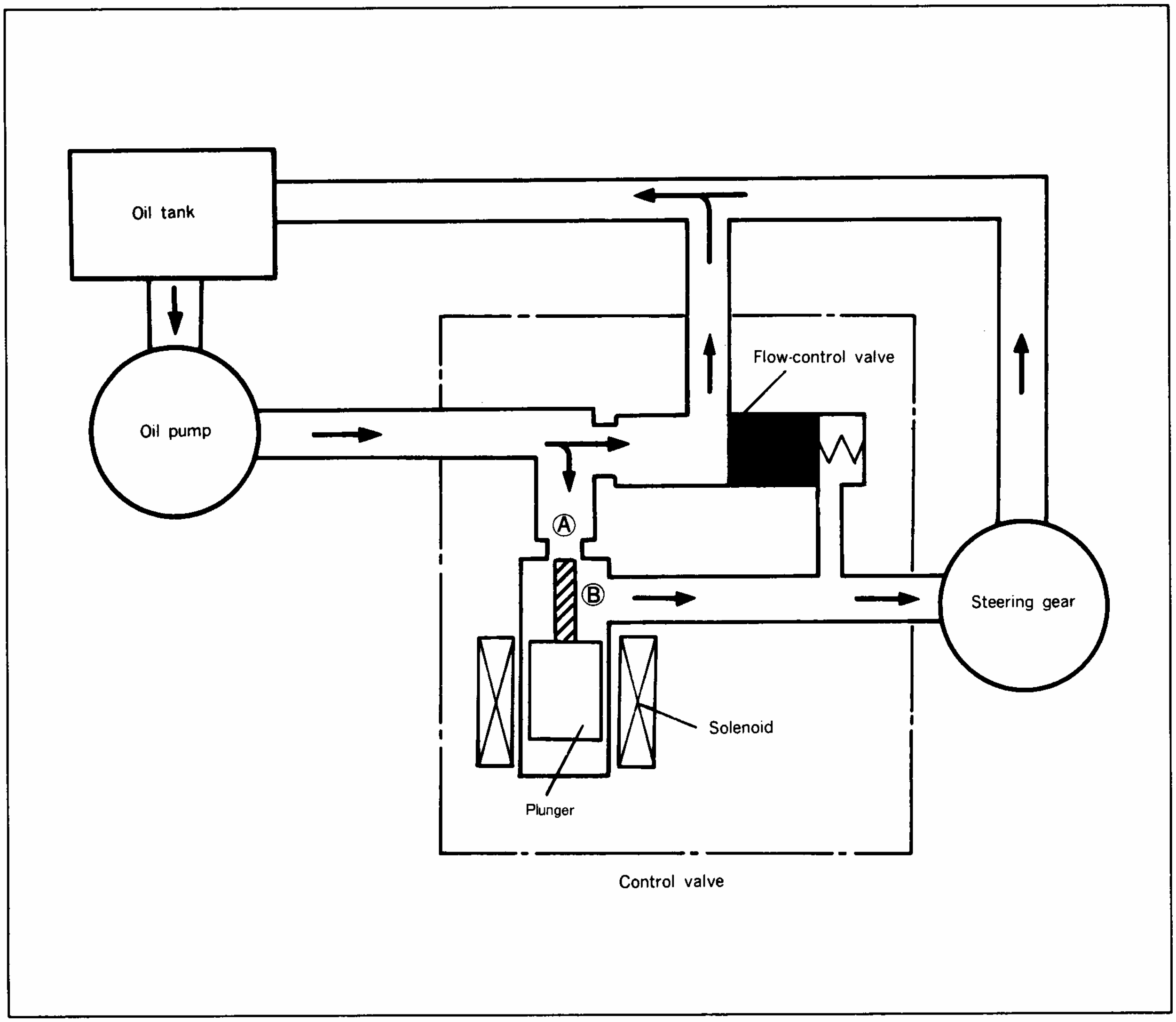
AT LOW SPEED

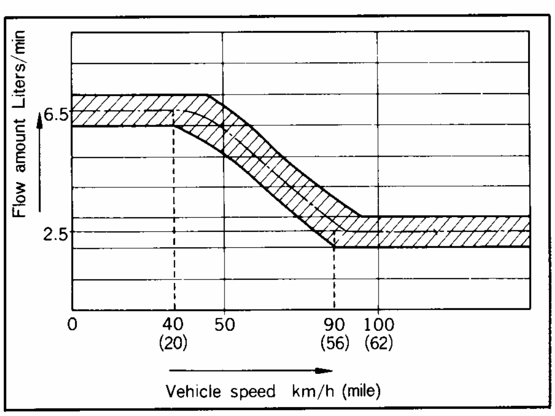
With the electromagnetic plunger of the solenoid at the lower side and the opening wide, almost all of the oil discharged from the oil pump is supplied to the power steering gear after passing through the orifice.



AT HIGH SPEED

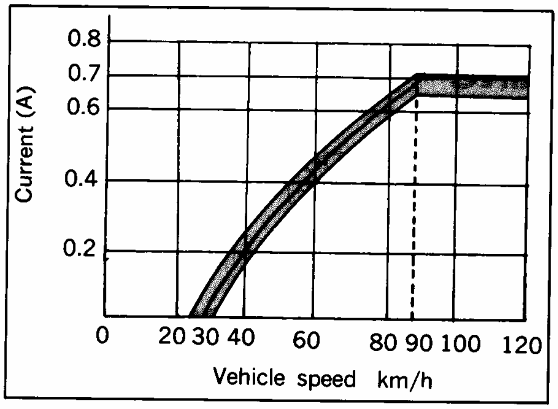
The solenoid is activated by signals from the controller, and the electromagnetic plunger moves to the upper side in response to the increase of the vehicle speed. At this time, a difference between the pressures of chamber A and chamber B occurs, the flow-control valve overcomes spring pressure and operates, the bypass passage opens, the oil is caused to bypass the tank, and the flow supplied to the power steering gear decreases.





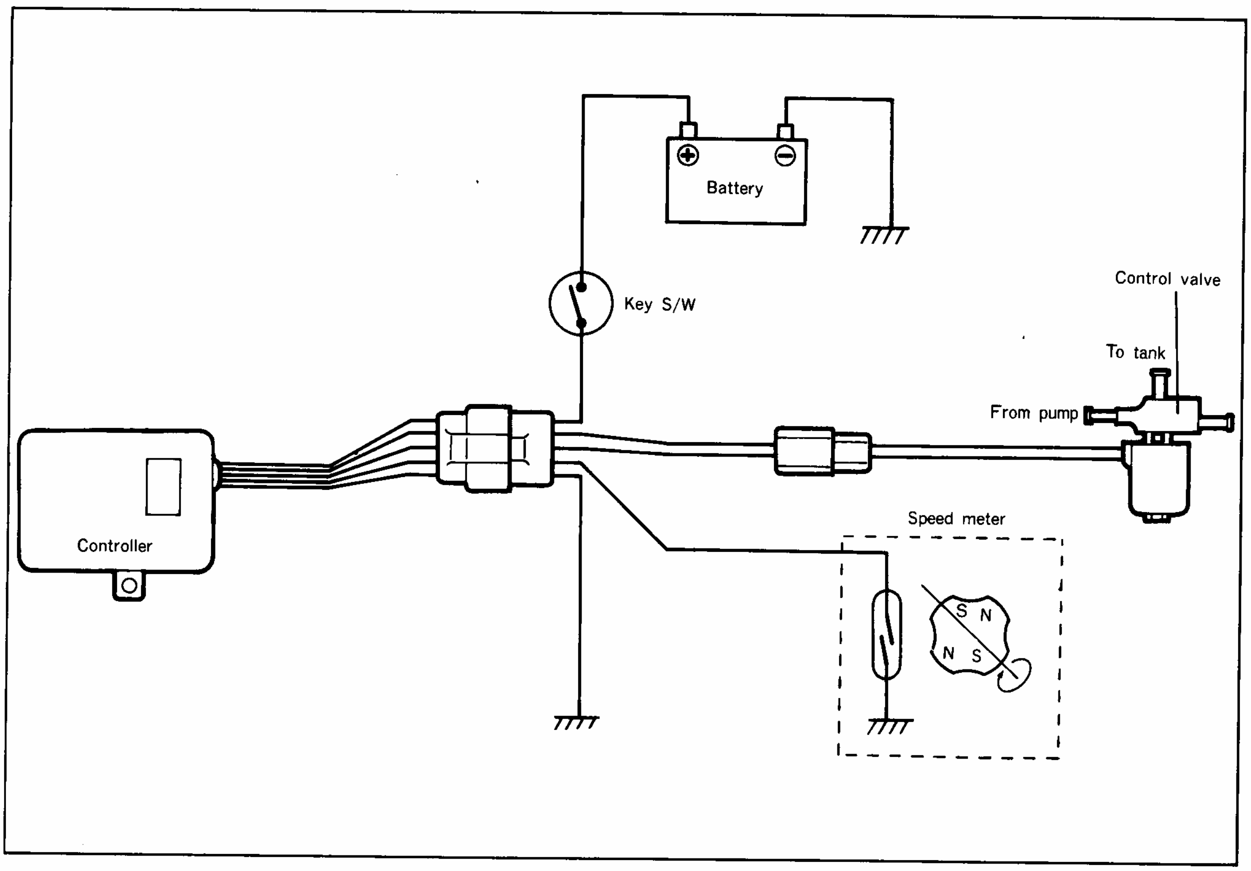
AT CONSTANT SPEED

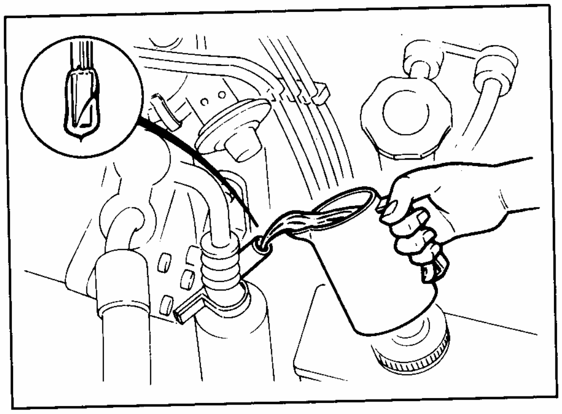
Changes from low speed to high speed or from high speed to low speed change continuously. The changes in the flow amount at various speeds are shown in the diagram at the left.



CONTROLLER

Pulse signals proportional to the vehicle speed from the vehicle-speed sensor are input and are converted to electric current to activate the control valve. Depending on the speed of the vehicle, the current flowing from the controller to the solenoid of the control valve is as shown in the figure at the left.





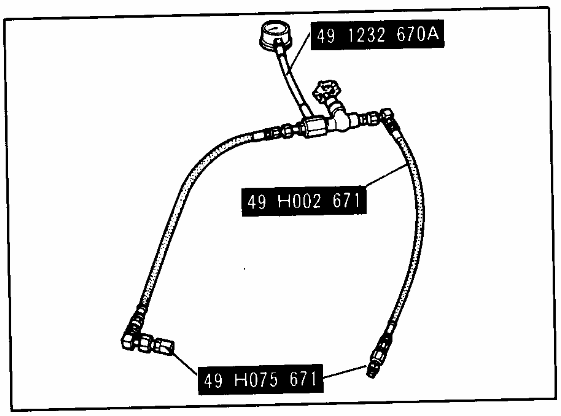
SERVICE POINTS OF POWER STEERING

FLUID LEVEL INSPECTION

Add ATF type F (M2C33F) metting specifications if necessary.

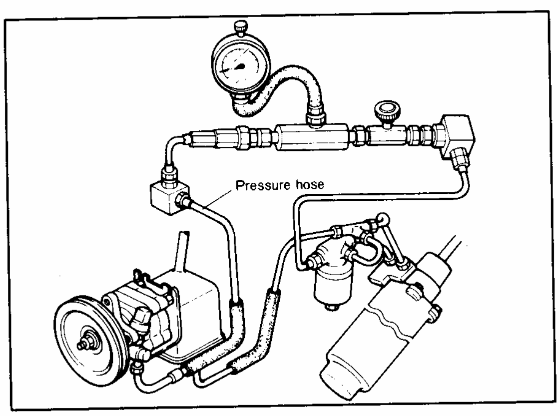
AIR BLEEDING

Procedures for air bleeding the power steering are included in the workshop manual.



PRESSURE INSPECTION

To check the hydraulic pressure of the pump, use the special gauge (49 H002 671, 49 H075 671 and 49 1232 670A), referring to the workshop manaul. The pressure should be 6,500 kPa (924 psi) at the engine revolution of 1,000 ~ 1,500 rpm and the fluid temperature of 50 ~ 60°C (122 ~ 140°F).



BODY ELECTRICAL SYSTEM

FEATURES 15– 2
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LOCATION OF RELAYS AND UNITS 15– 7
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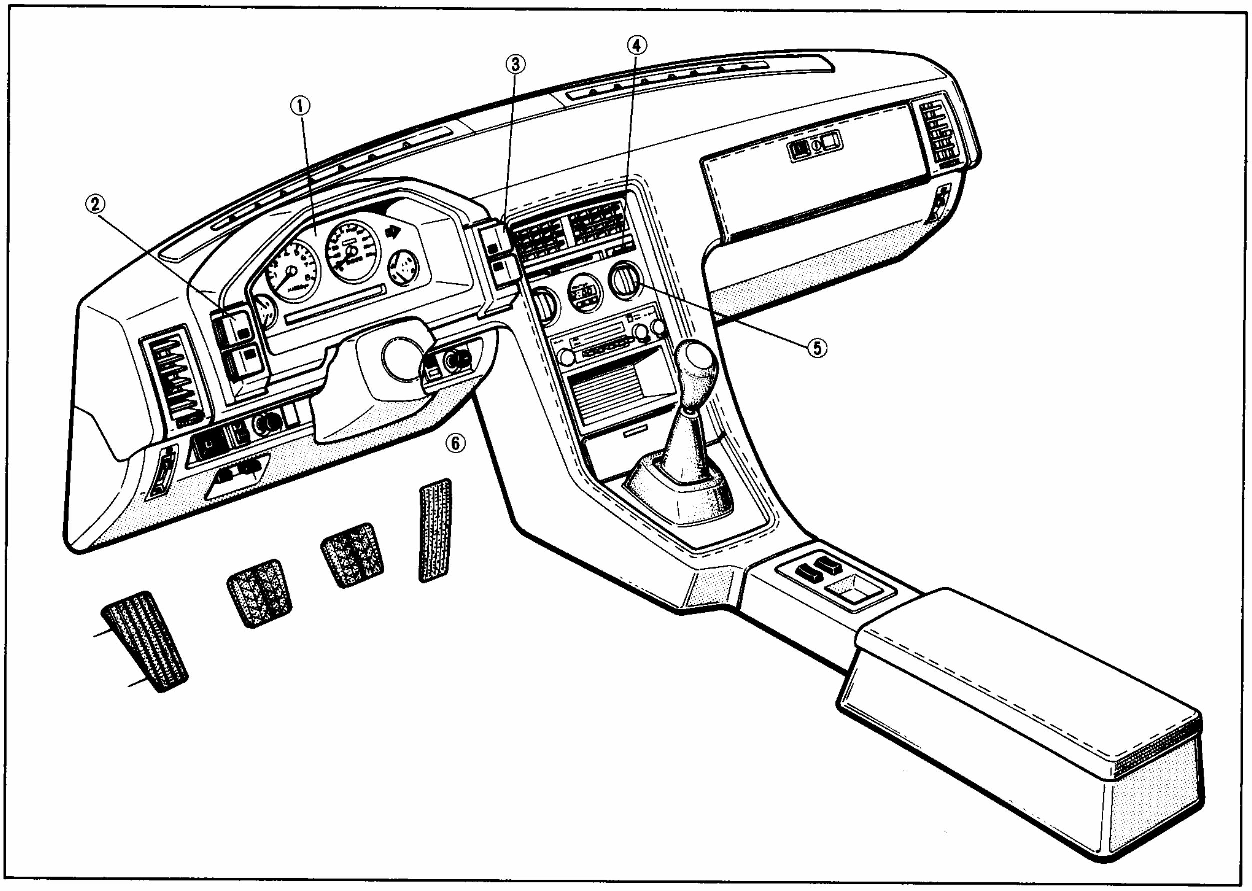
HEATER SYSTEM 15–10

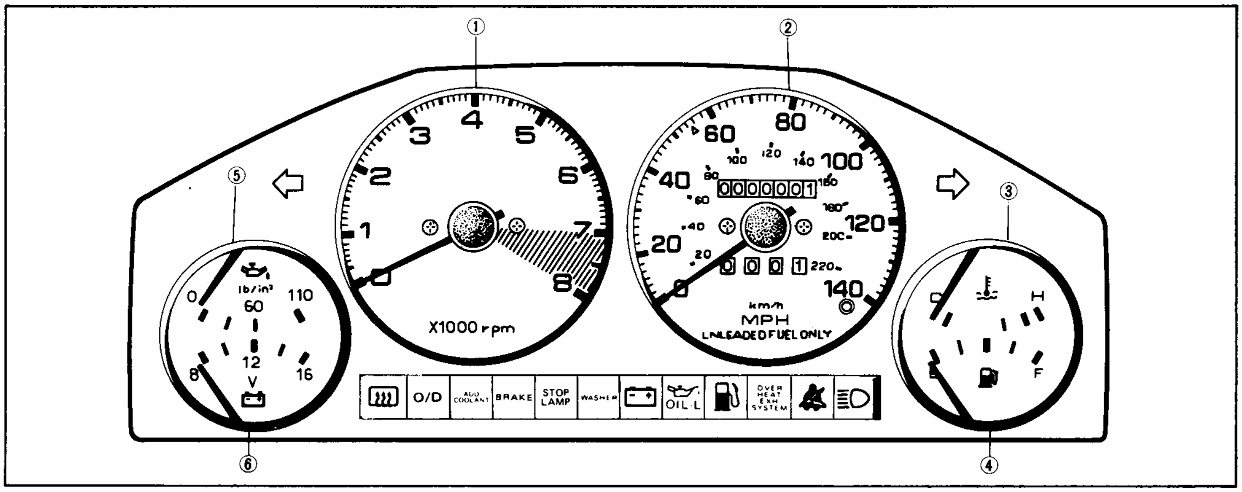
FEATURES

1. The combination meter & instrument panel has a new design.
2. A cluster switch has been newly provided.
3. A fuel low-level warning light has been provided.
4. The heater blower control switch has been changed from 3 positions to 4 positions.
5. A new audio system has been equipped.
6. A logical mode control system has been provided for the heater and air-conditioner.



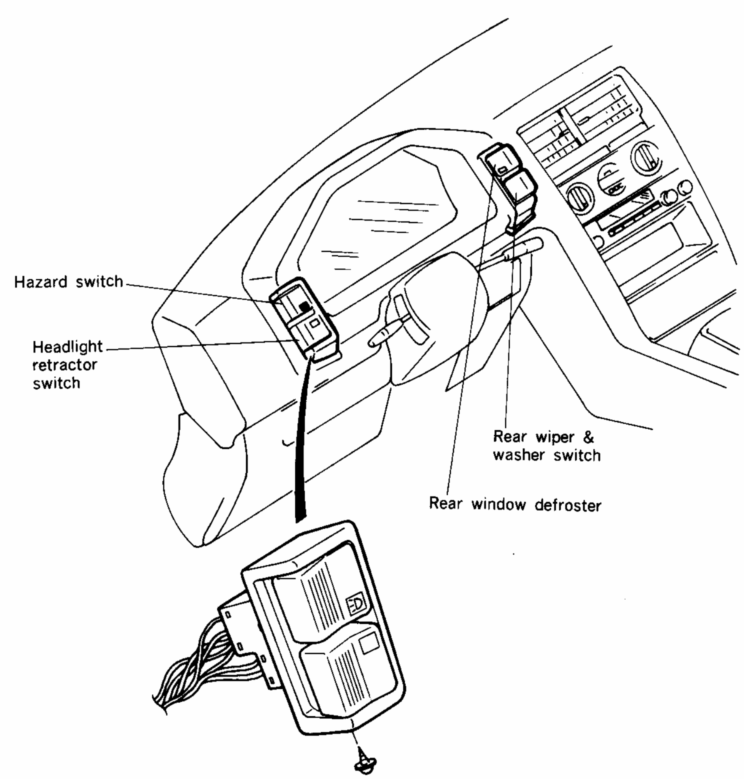
1 Combination meter
2 Cluster switch (left)
3 Cluster switch (right)
4 Air-conditioner switch & recirc. switch
5 Temperature-control switch
6 Blower-control switch

COMBINATION METER

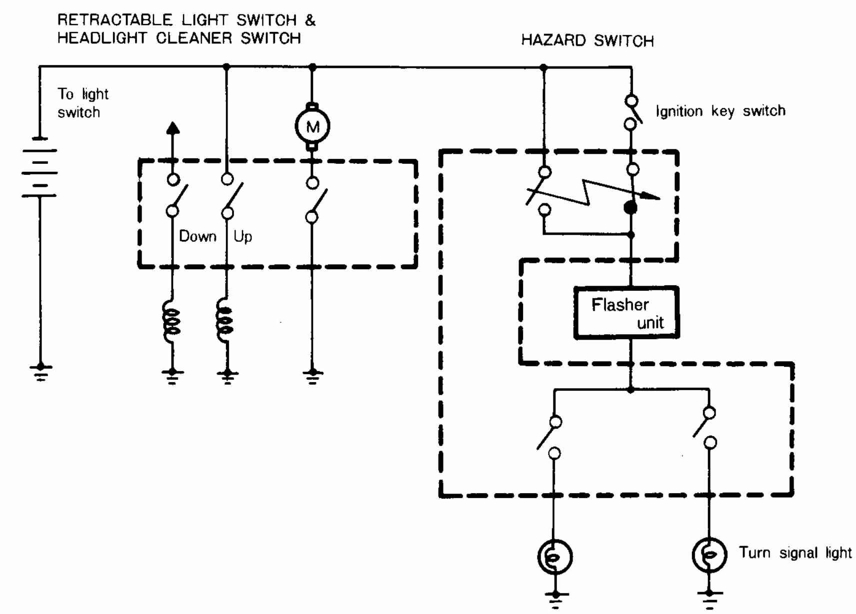


1 Tachometer
2 Speedometer
3 Water temperature gauge
4 Fuel gauge
5 Oil pressure gauge
6 Voltmeter

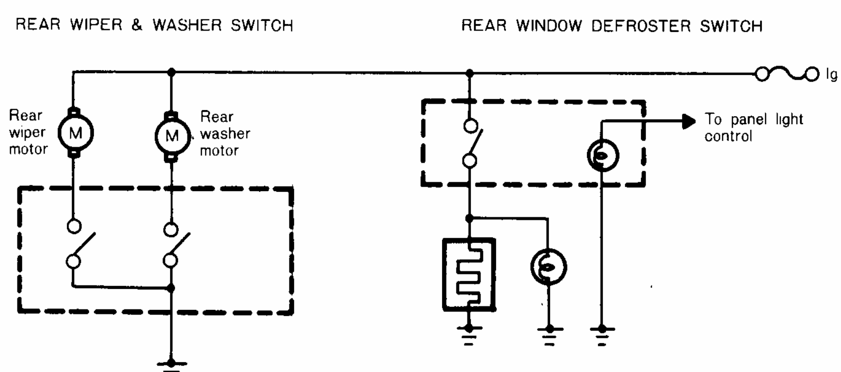
CLUSTER SWITCHES



CIRCUIT DIAGRAM OF LEFT CLUSTER SWITCH

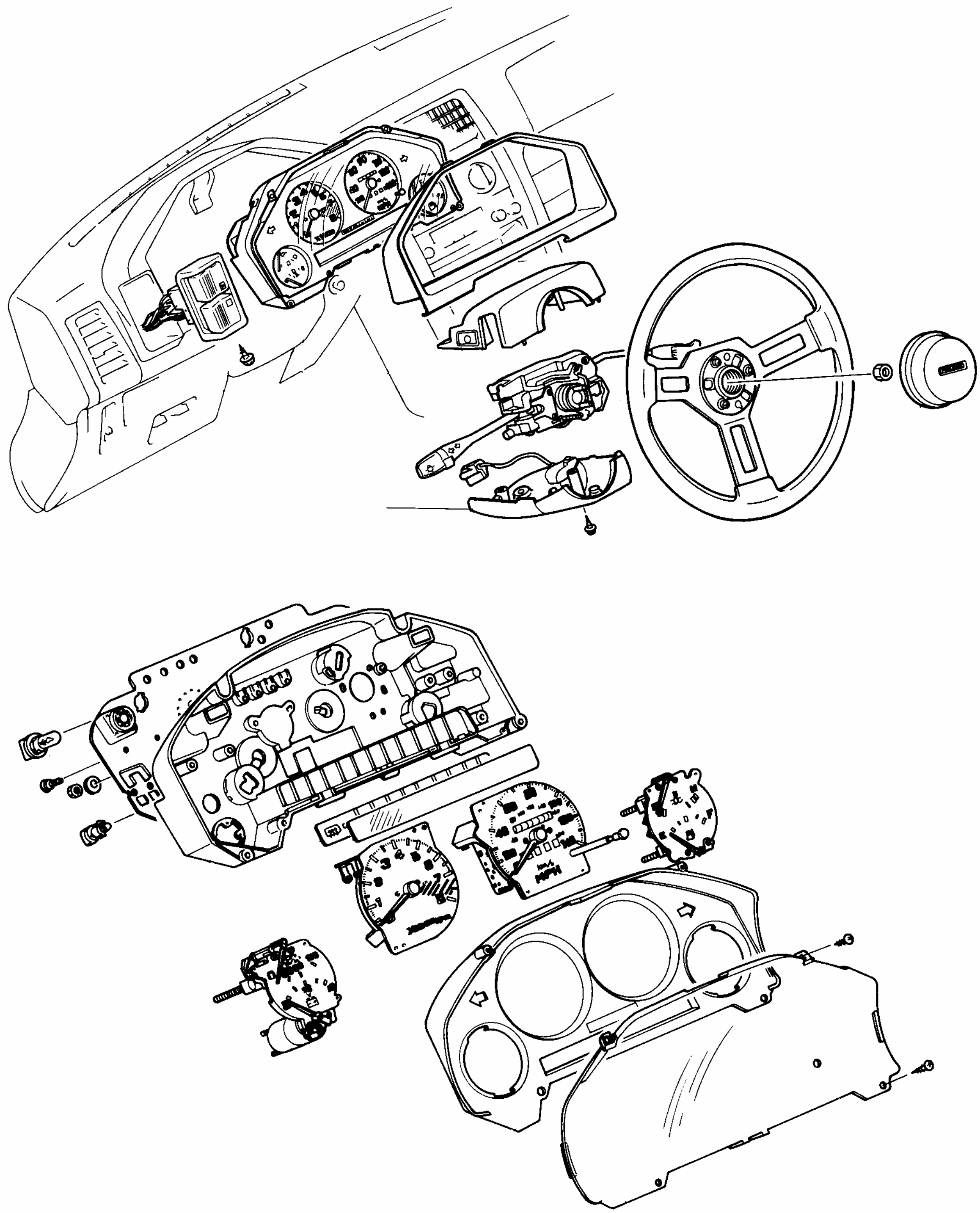


CIRCUIT DIAGRAM OF RIGHT CLUSTER SWITCH

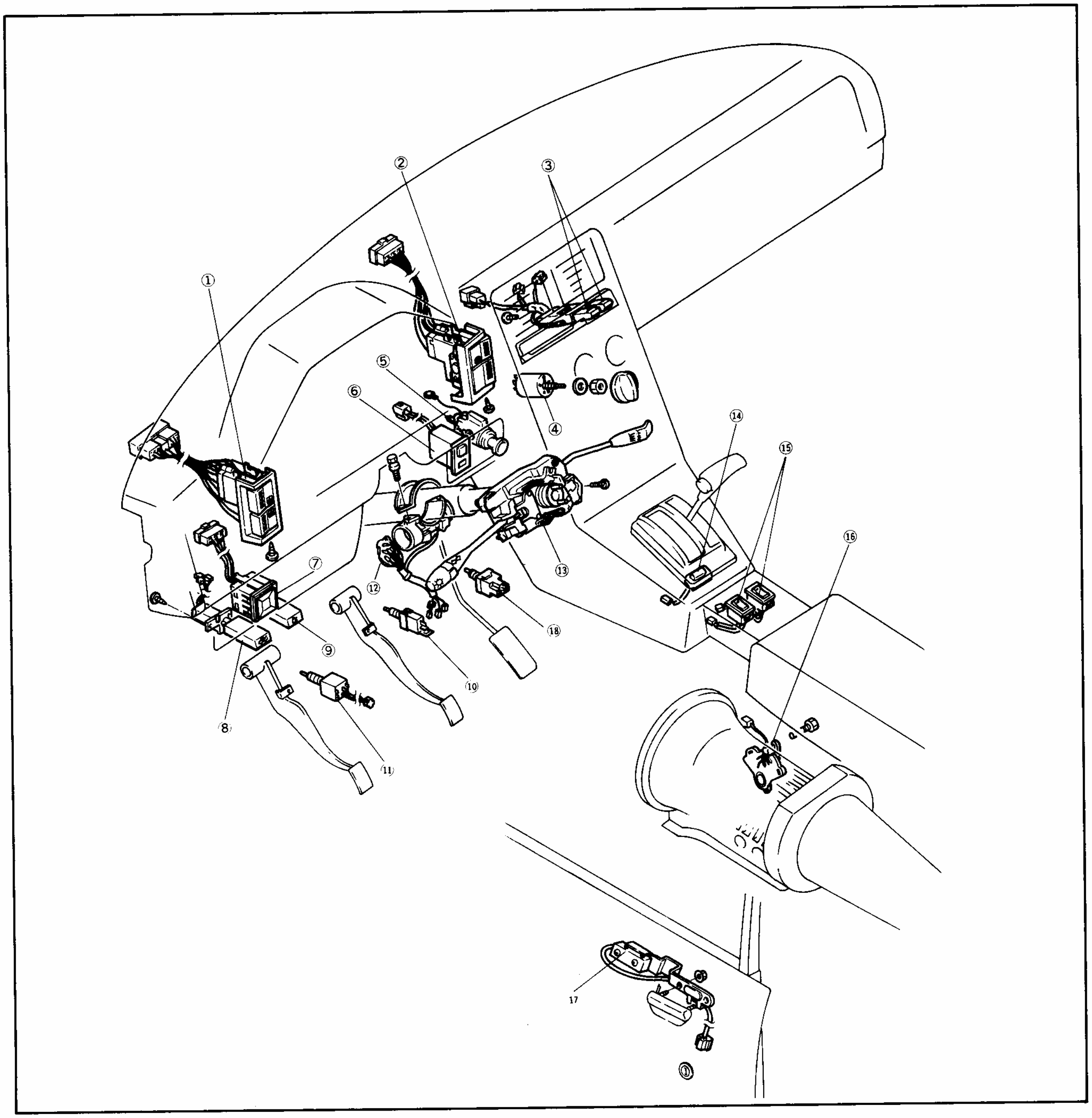


Removal and disassembly of the combination meter

When removing the combination meter, the cluster switches and meter hood must first be removed.

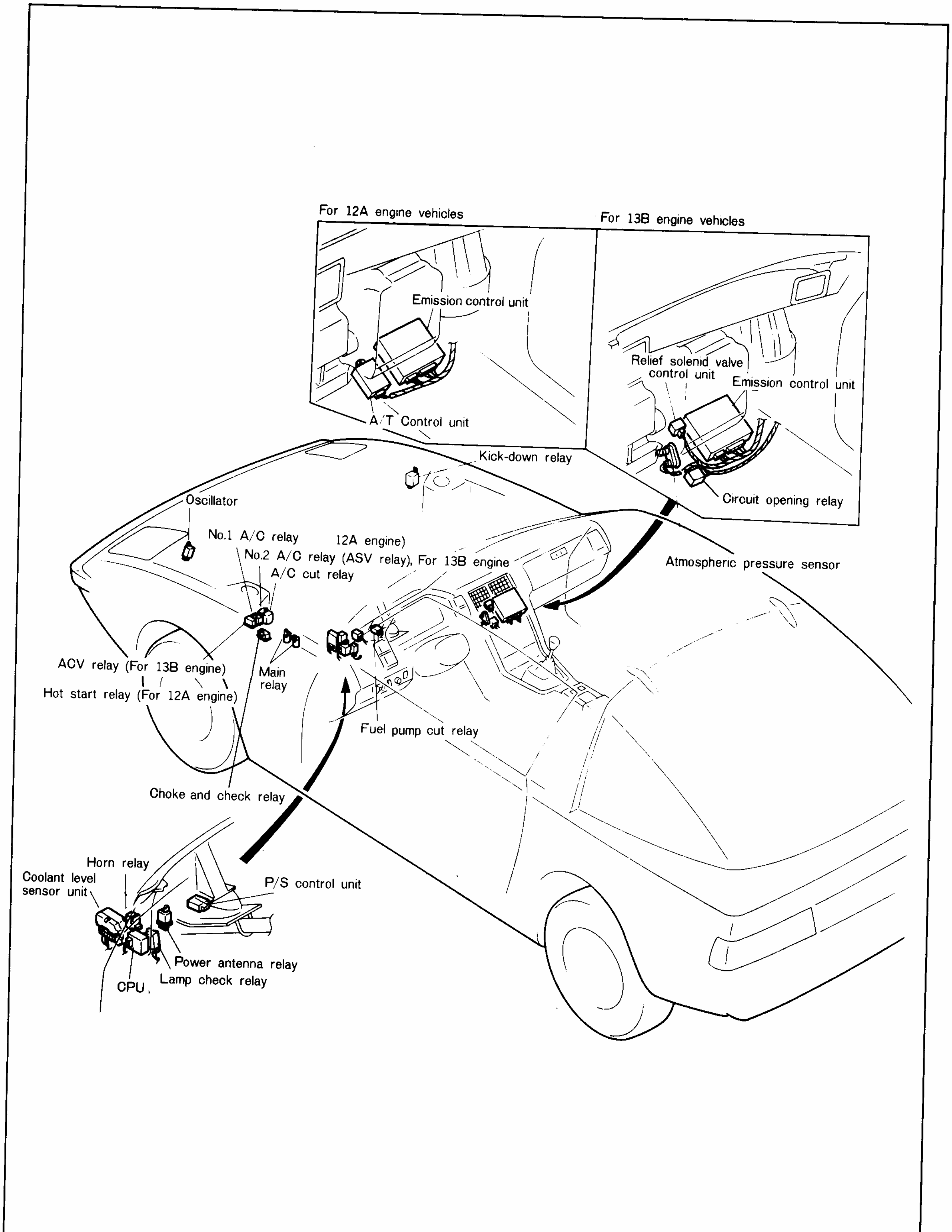


LOCATION OF SWITCHES



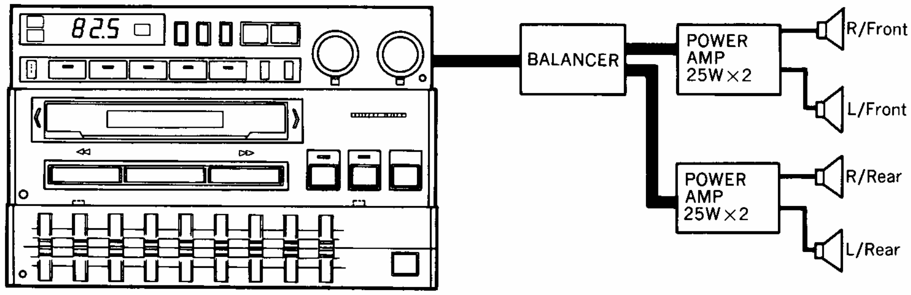
1 Cluster switch (hazard, retractable light & headlight cleaner)
2 Cluster switch (rear defroster, rear wiper & washer)
3 Air con. & mode-control switch
4 Blower switch
5 Cigarette lighter
6 Cruise-control main switch
7 Remove-control mirror switch
8 Remote glass hatchback opener switch
9 Remote full door opener switch
10 Stop light switch
11 Clutch switch
12 Ignition key switch
13 Combination switch (light, turn, wiper & washer, horn)
14 Overdrive switch (for 4AT vehicles)
15 Power-window switch
16 Inhibitor switch
17 Outer door handle switch
18 Kick-down switch

LOCATION OF RELAYS AND UNITS



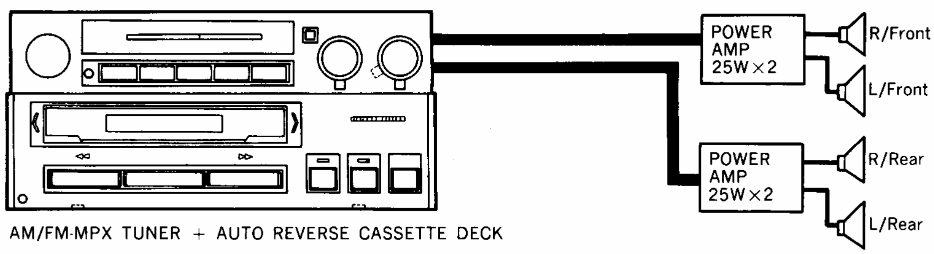
NEW AUDIO SYSTEM

SYSTEM 1



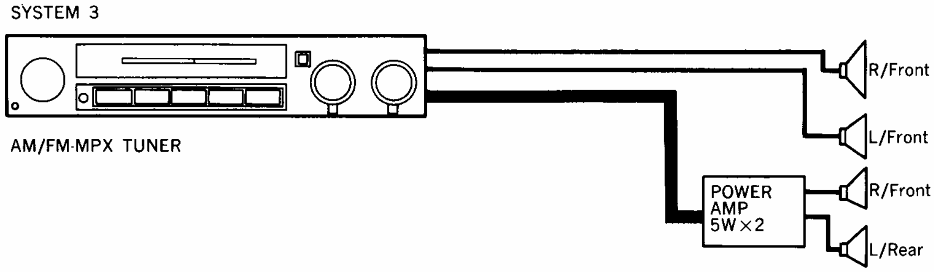
AM/FM-MPX ET TUNER + AUTO REVERSE CASSETTE DECK + GRAPHIC EQUALIZER

SYSTEM 2



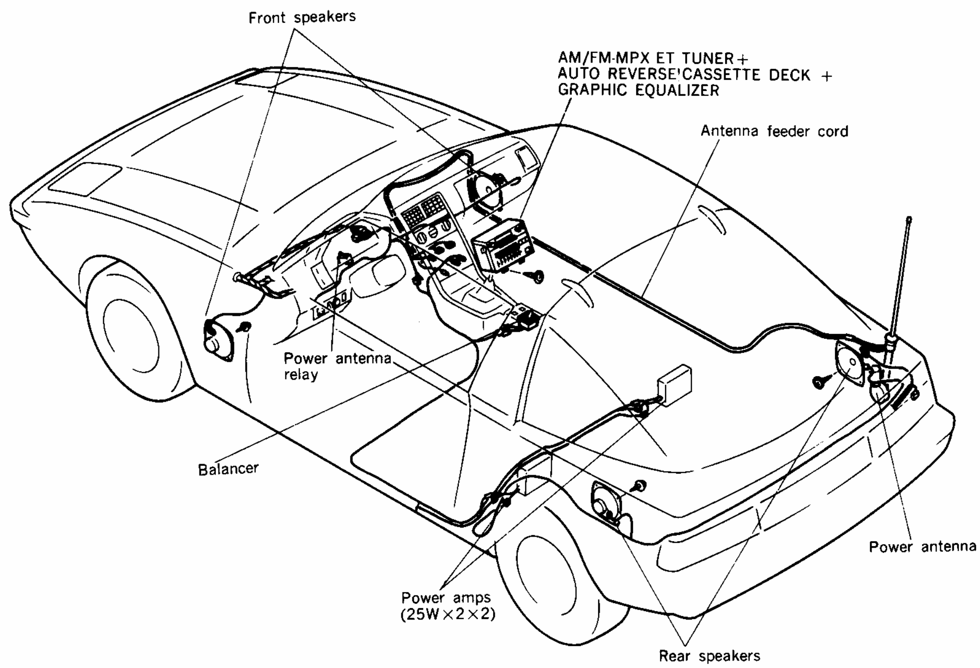
AM/FM-MPX TUNER + AUTO REVERSE CASSETTE DECK

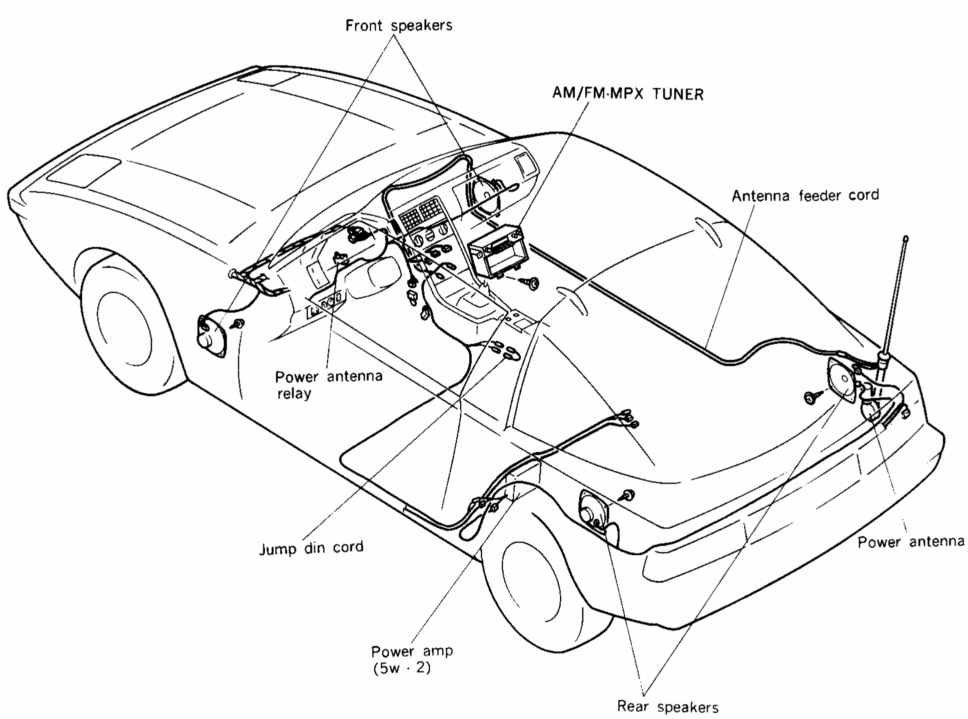
SYSTEM 3



AM/FM-MPX TUNER

AUDIO SYSTEM STRUCTURAL VIEW



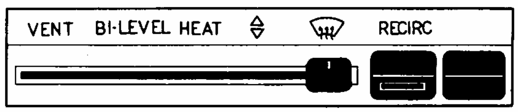


HEATER SYSTEM

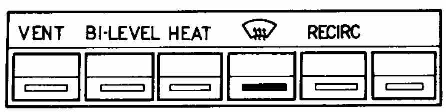
FEATURES

1. The FRESH/REC switching is done by a motor for all vehicles (all grades).
2. The switching of mode is done, depending upon the model grade, either by motor or, as in the past, manually by wire.
3. Operation of the temperature control wire is done by the round knob.
4. The air-flow control of the blower is changed from 3 steps to 4 steps.

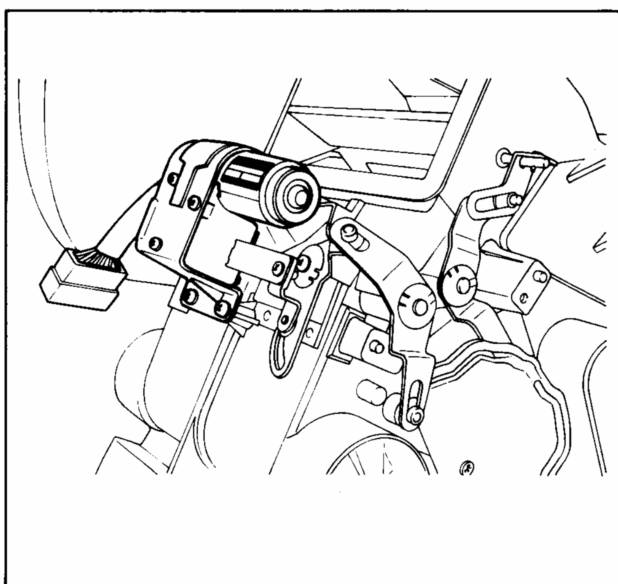
LEVER CONTROL TYPE



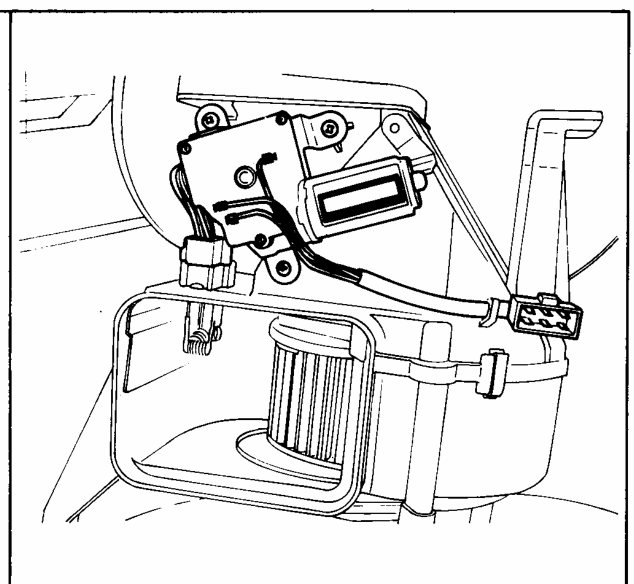
LOGICAL CONTROL TYPE



MODE-CONTROL MOTOR

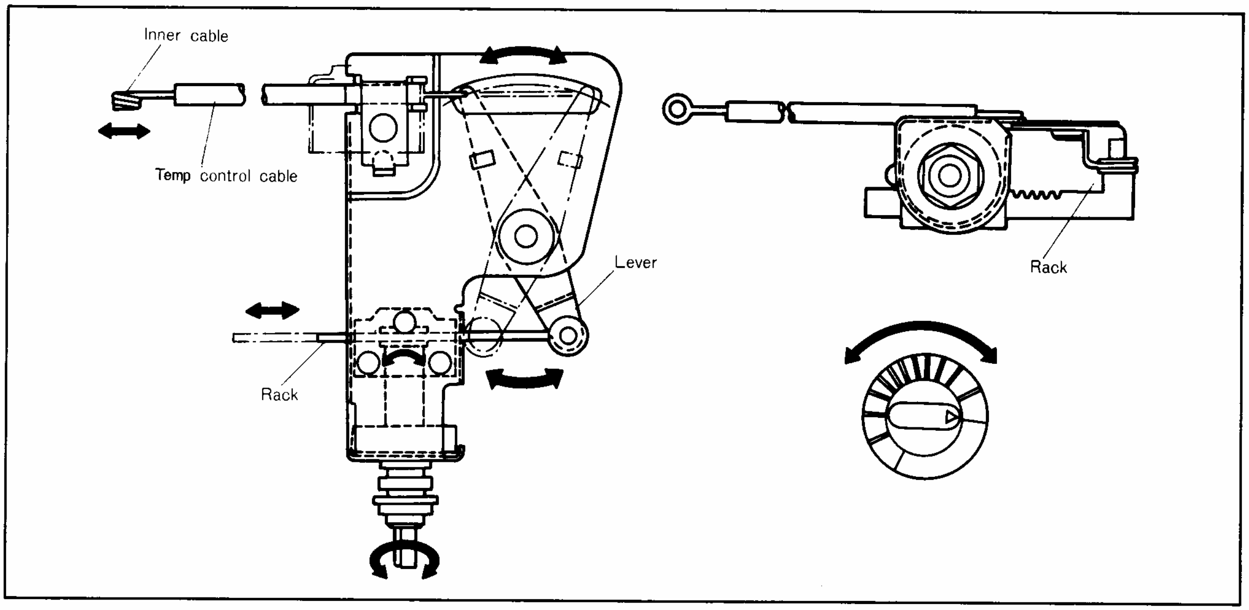


FRESH-REC CONTROL MOTOR



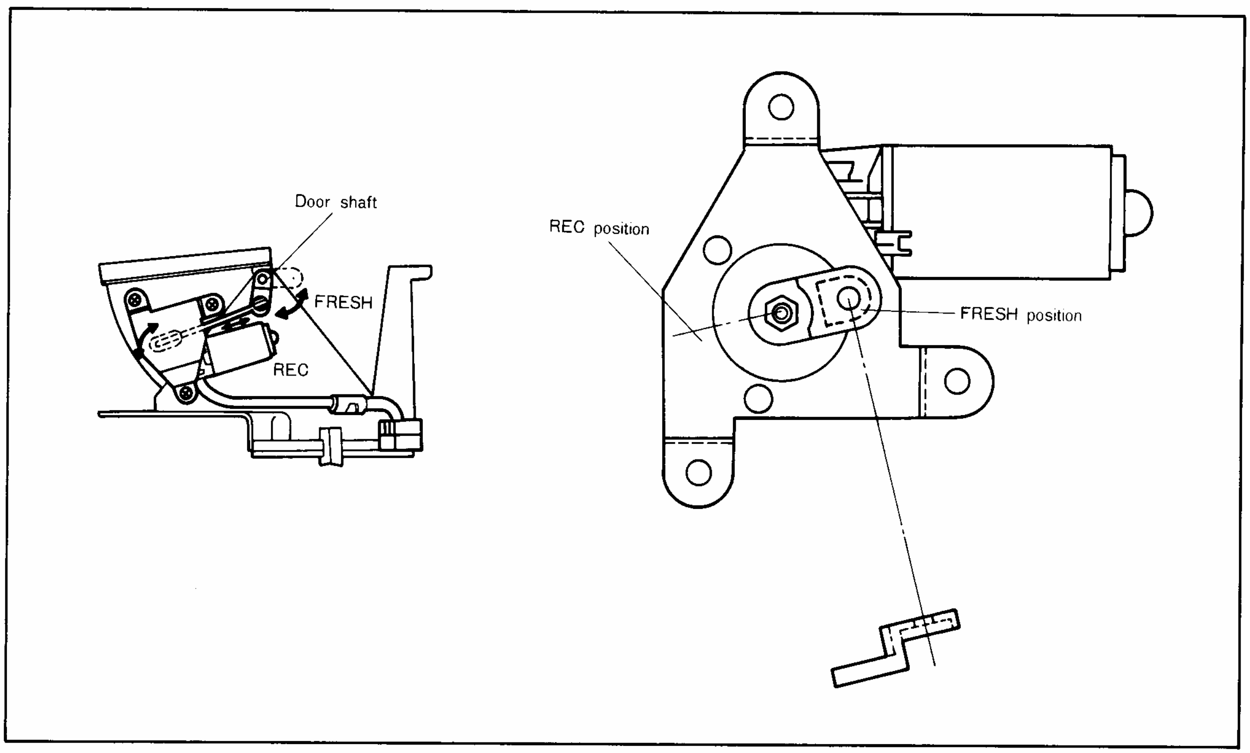
TEMPERATURE CONTROL

The temperature is controlled by a mechanism by which the control cable is pushed and pulled by turning the knob.
When the knob is turned as shown in the figure, the rack is moved either to the left or to the right by the gear on the knob shaft. This movement of the rack causes the lever interlocked with the rack to move. The temperature-control cable is connected to the opposite and of the lever, and the inner cable is pushed and pulled by the lever.



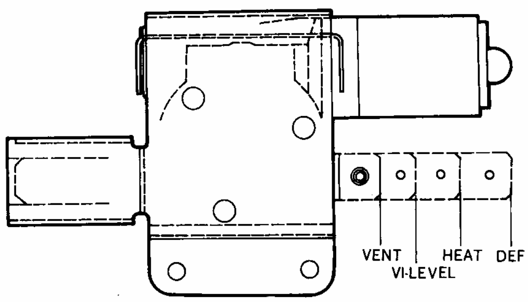
FRESH-RECIRC. CONTROL MOTOR

The fresh-recirc. control motor is installed next to the blower unit. The selector door is opened and closed by the motor's power.



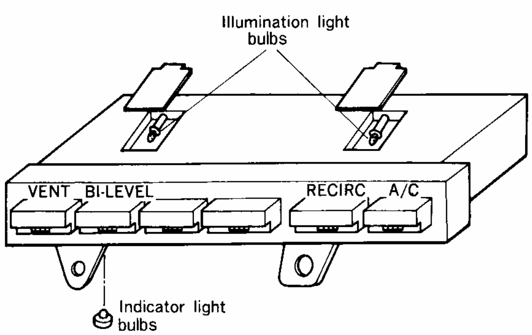
MODE-CONTROL MOTOR

When the mode-control button is pressed, the motor's rack moves, as shown in the figure, to each position respectively. The rack pushes and pulls the mode-control link to select each mode.



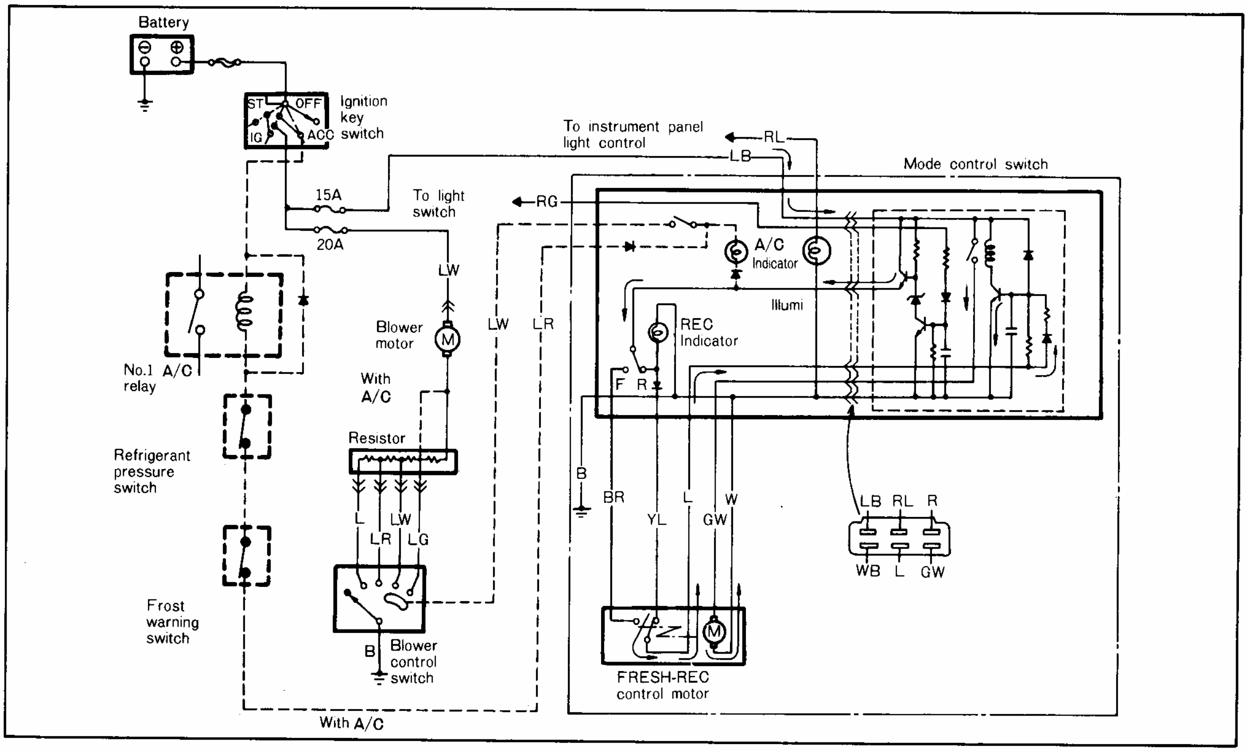
MODE-CONTROL SWITCHES

The mode-control switches, which are located together with the air-conditioner switch and recirculation switch, can be used for one-touch control of air conditioning.
The air-conditioner switch and recirculation switch are switched ON when pressed once, and are switched OFF when pressed once again. When ON, the indicator light will illuminate.
The mode-control switches are switched ON when pressed once, and will not be switched OFF unless a different switch is pressed. In other words, one of the switches is always ON. The illumination of the indicator light indicates that the switch is ON. There is, in addition, an illumination light for nighttime lighting.



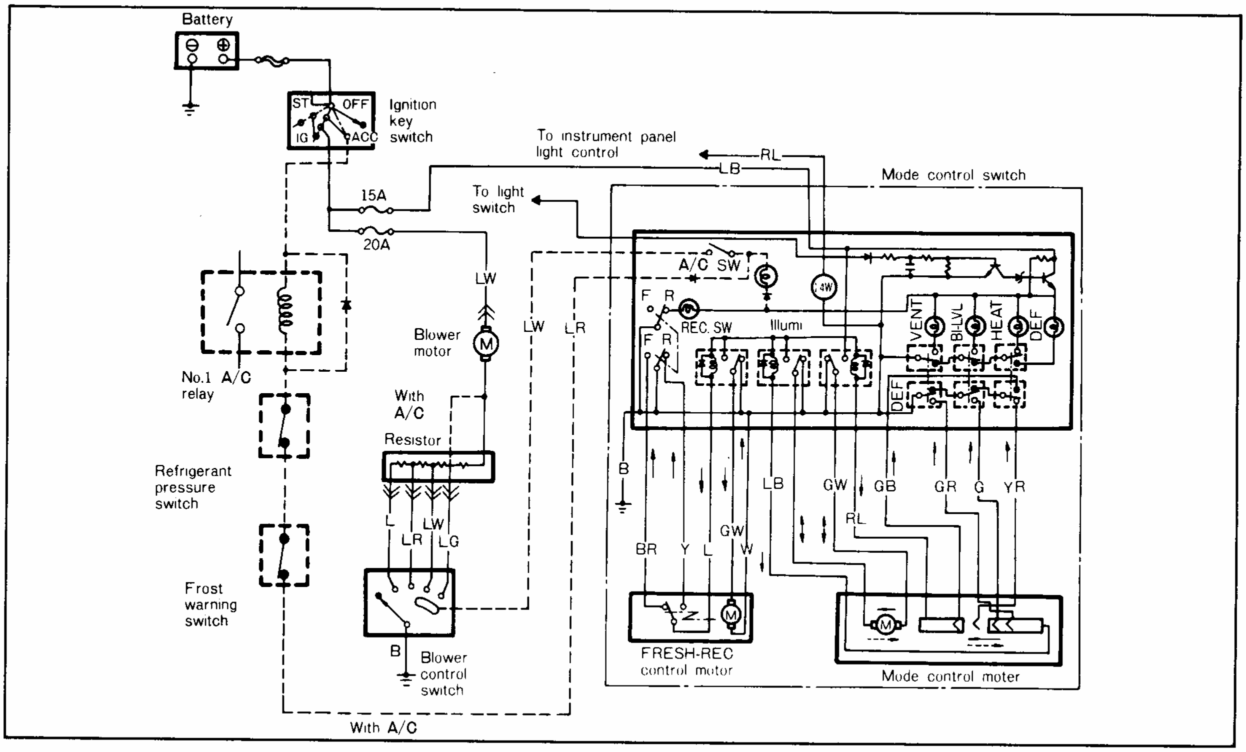
Circuit diagram (lever control type)

Indicates ON condition of RECIRC. switch.



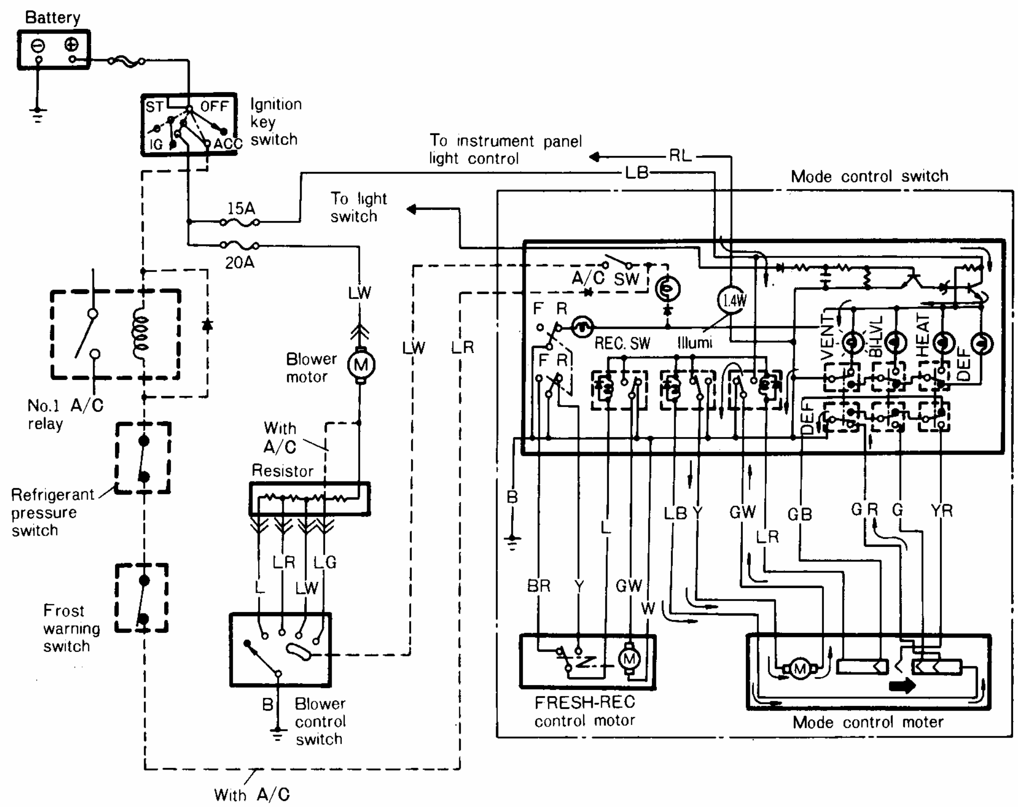
Logical control type

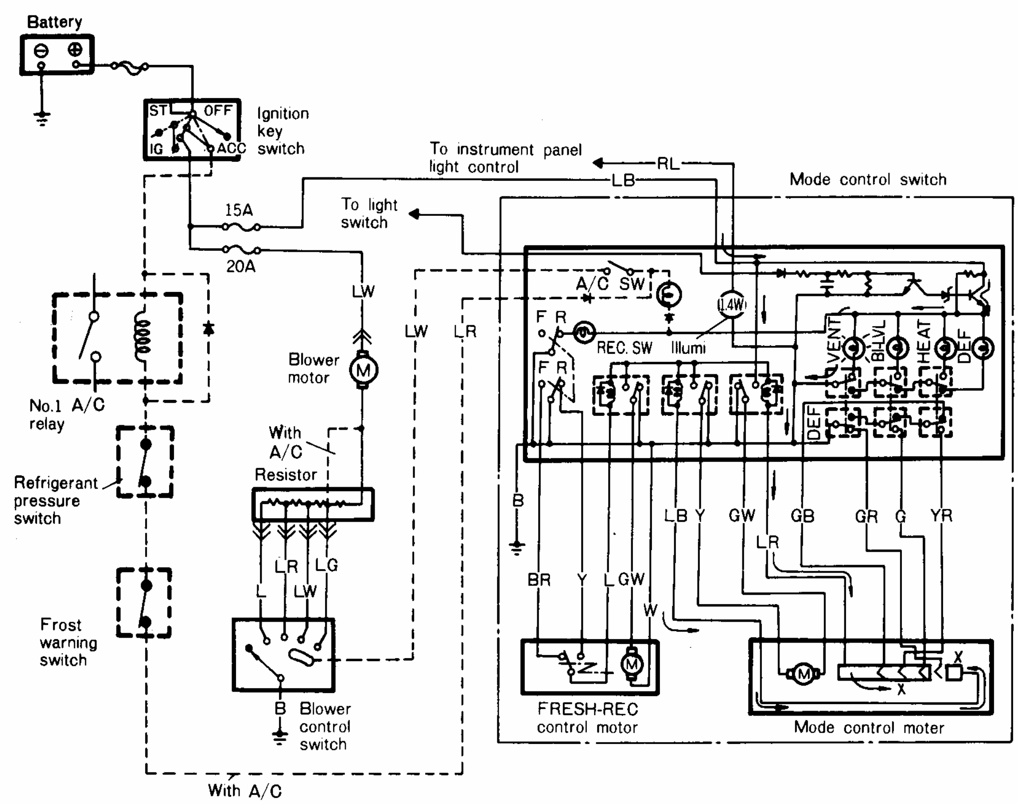
Indicates ON condition of HEAT switch.



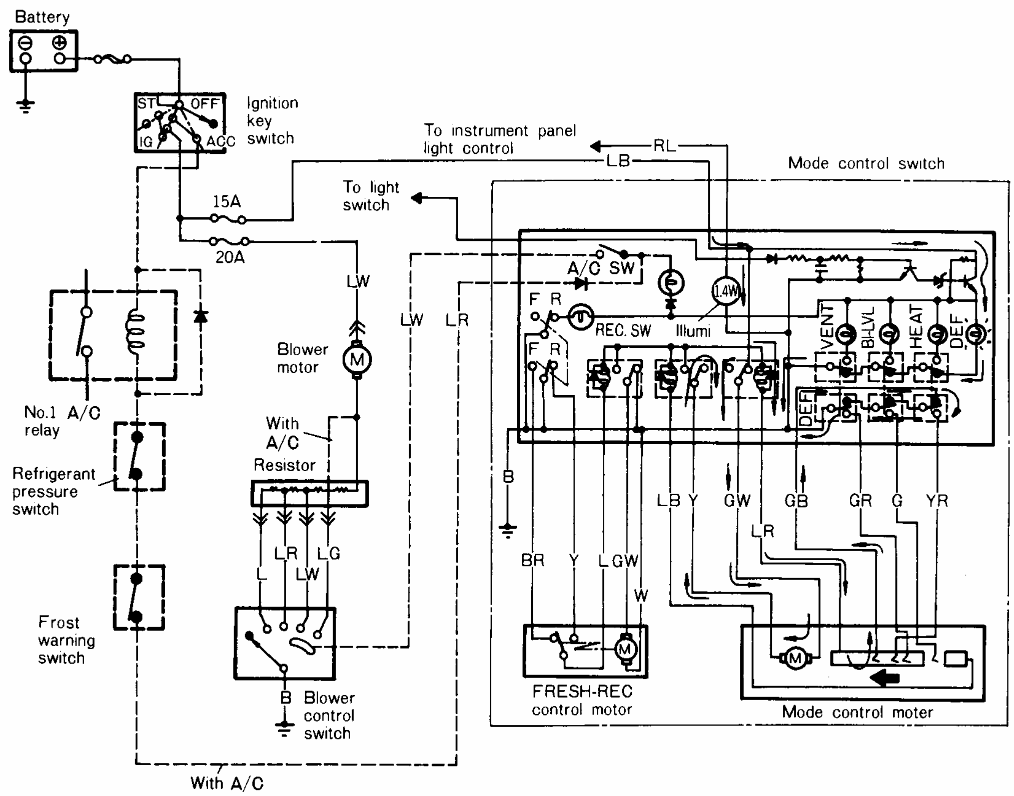
Logical control type operation examples

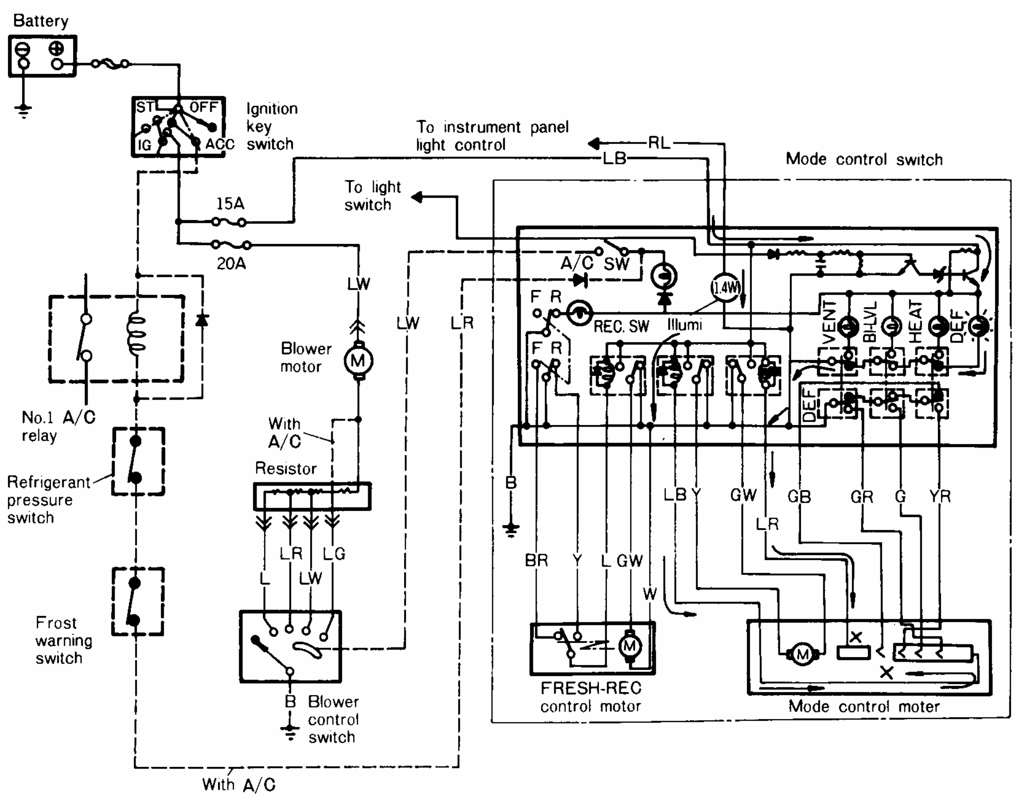
Operation when the VENT switch is pressed while the HEAT switch is ON



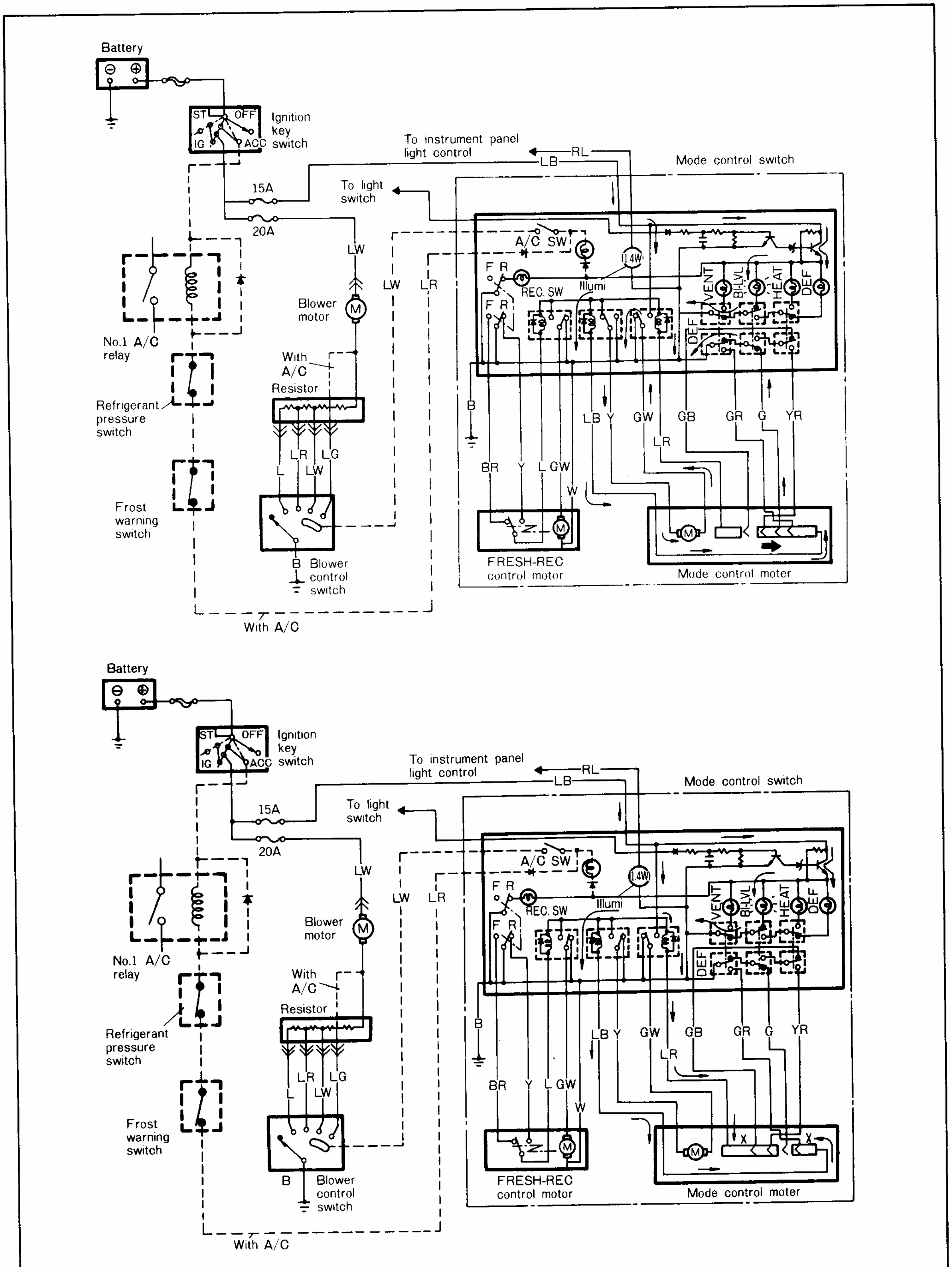


Operation when the DEF switch is pressed while the VENT switch is ON

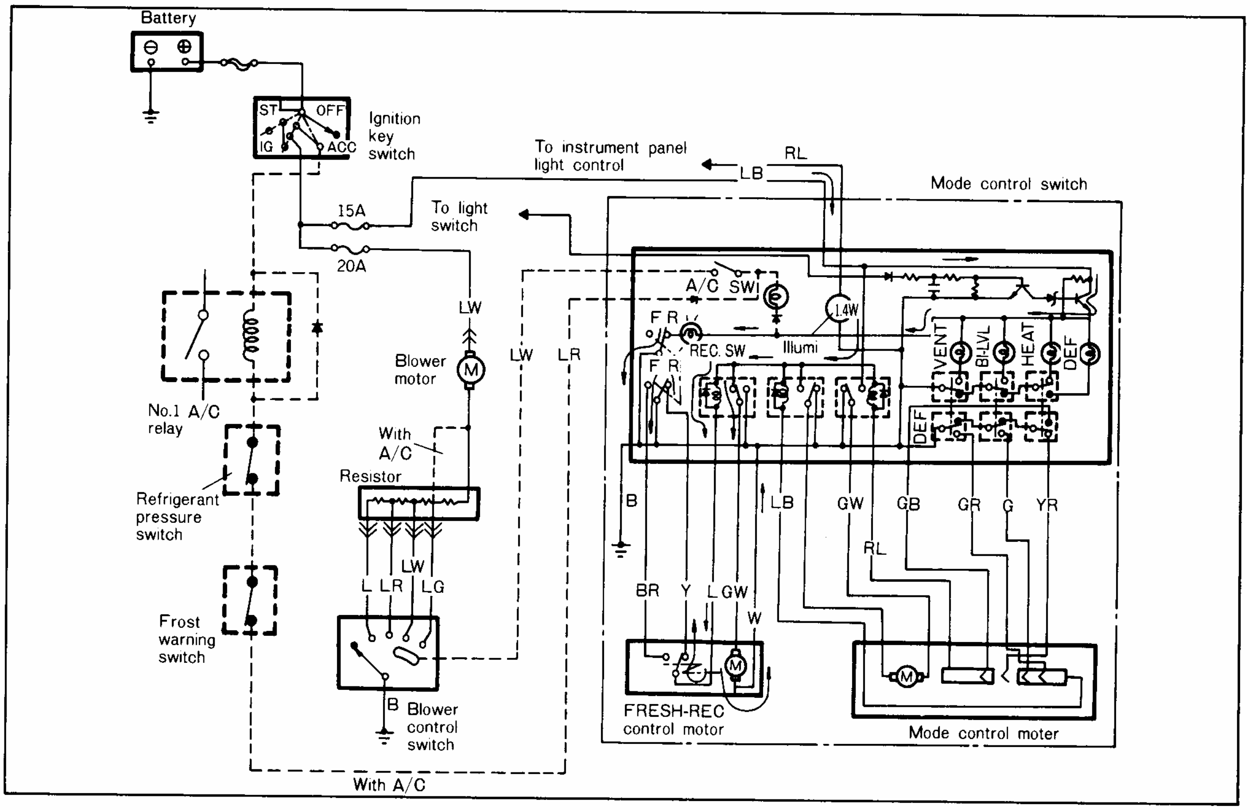




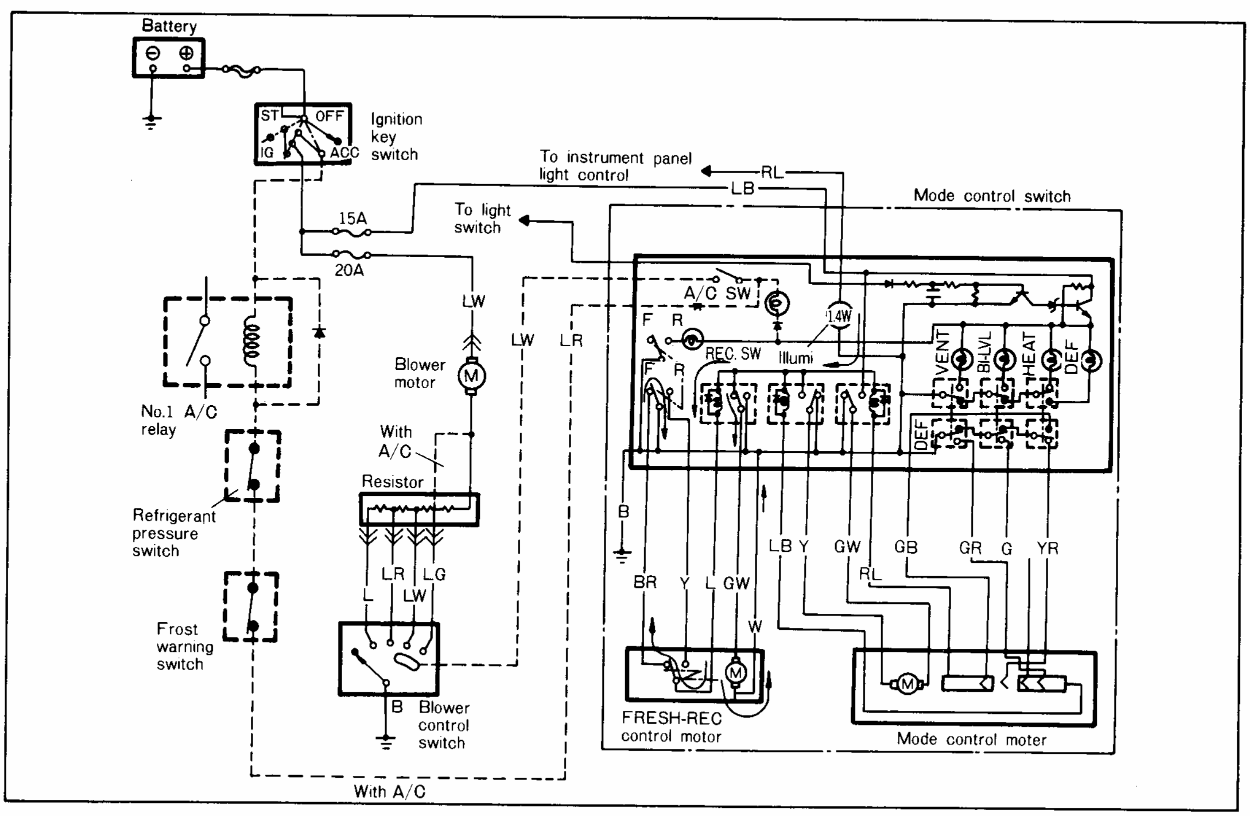
Operation when the BI-LEVEL switch is pressed while the DEF switch is ON



Operation when the RECIRC. switch is pressed



Operation when the RECIRC. switch is pressed once again (FRESH)



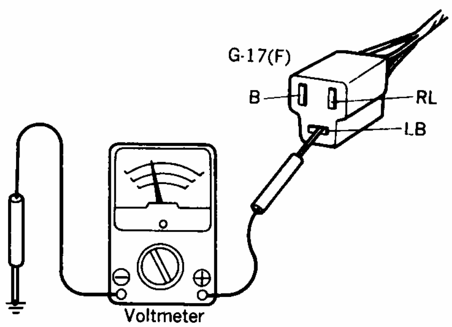
Troubleshooting Guide

The RECIRC switch does not switch the air flow from outside air to inside air or vice-versa.

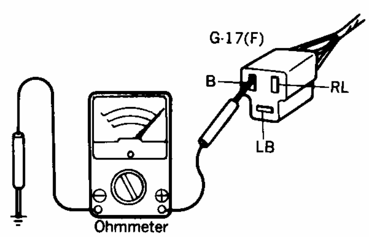
↓

Can the motor be heard?
- Yes → The connecting rod of the recirculation motor is not in position, or the adjustment is incorrect. → Repair or replace
- No ↓

Has the air-conditioner fuse (15A) failed?
- Yes → Replace fuse and check for short
- No ↓



Is there voltage equivalent to battery voltage in the power source line (LB) when the ignition key is at the ON position?
- No → Check the line (LB) between the fuse block and the switch.
- Yes ↓

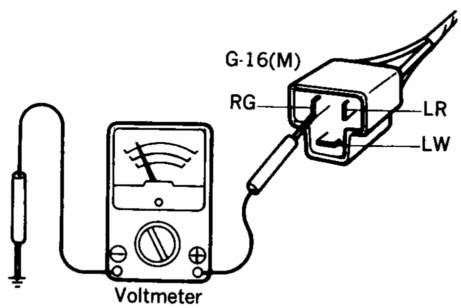


Is there continuity between the ground line (B) and body ground?
- No → Repair ground line
- Yes ↓

Remove the mode-control switch, and check by using the checker (49 9200 030).
Is the control switch normal?
- No → Replace the control switch assembly
- Yes ↓

Possibly a malfunction of the recirculation motor or poor contact of the connector.

The indicator lights do not illuminate, or are too bright.



Is there voltage equivalent to battery voltage in the indicator light power line (RG) when the light switch is switched ON?

- No → Check, and repair if necessary, the line (RG) leading to the light switch.
- Yes ↓

Remove the mode-control switch, and check by using the checker (49 9200 030).
Is the control switch normal?

- Yes → There may be poor contact of the mode-control switch connector.
- No ↓

Replace the mode control switch assembly

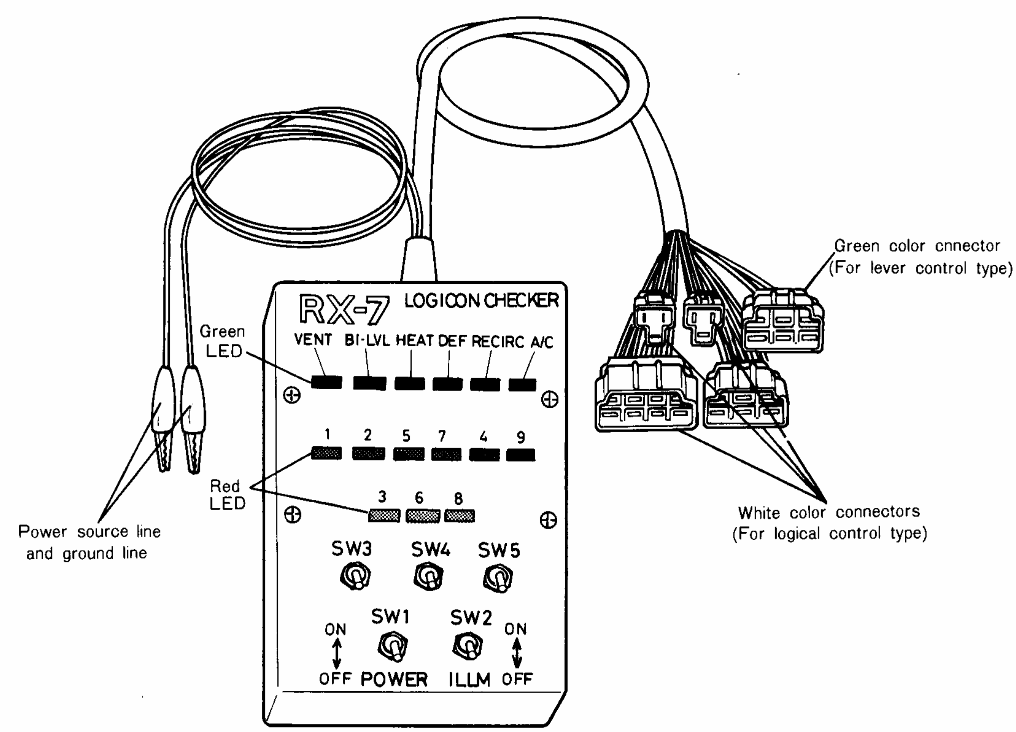
The recirculation motor functions but the mode control does not function. **(Logic control type only)**

- Can the motor be heard?
  - Yes → The connecting rod of the motor may not be in position. → Repair or replace.
  - No → Is the connector which connects the mode-control motor and mode-control switch connected correctly?
    - No → Connect the connector securely.
    - Yes → Remove the mode-control switch, and check by using the checker (49 9200 030). Is the control switch normal?
      - No → Replace the mode-control switch assembly
      - Yes → There may be a malfunction of the mode-control motor.

One of the mode controls does not function. **(Logical control type only)**

- Check the mode-control switch by using the checker (49 9200 030). Is the control switch normal?
  - No → Replace the mode control switch assembly
  - Yes → Possibly a malfunction of the mode-control motor, or poor contact of the connector.

LOGICON CHECKER (49 9200 030) PARTS IDENTIFICATION



HOW TO USE THE LOGICON CHECKER (for the logical control type)

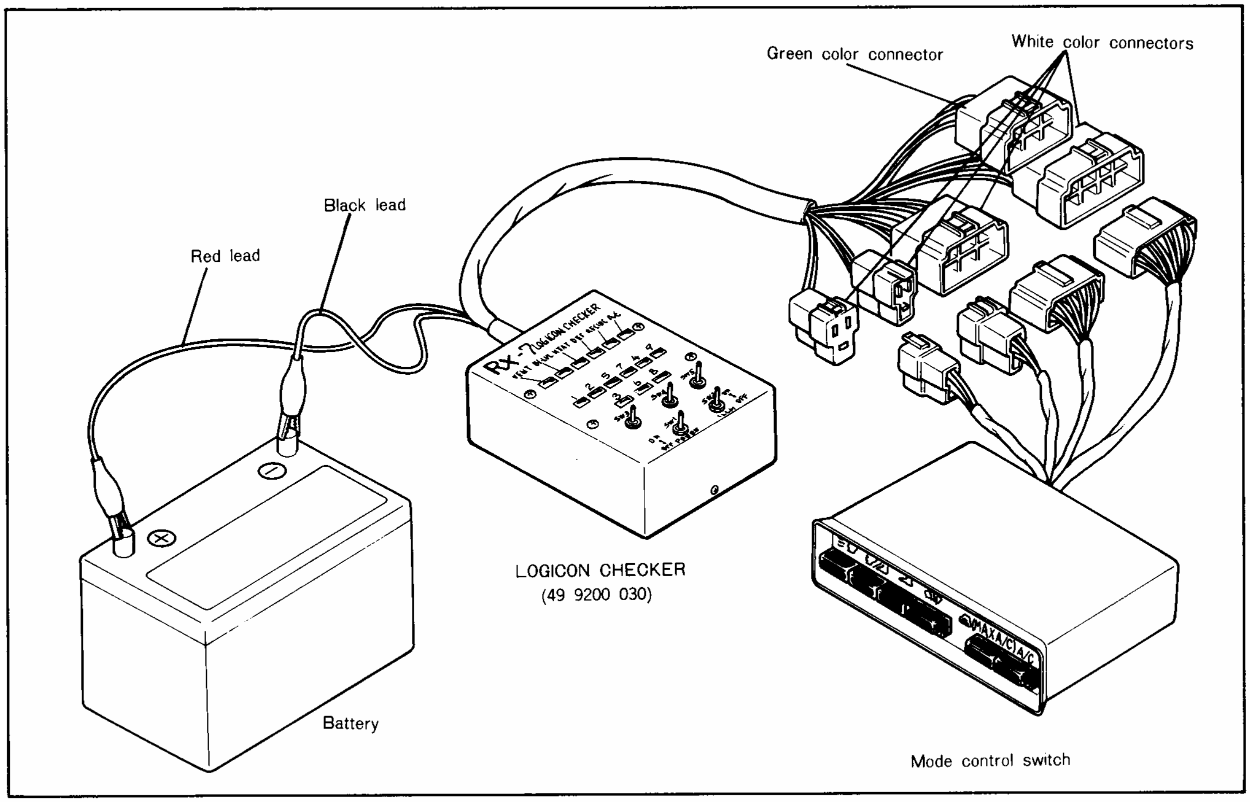
1. Set each switch of the checker as shown in the figure above.
2. Connect the red wire to the positive (+) terminal of the battery, ana the black wire to the negative (−) terminal of the battery.
3. Securely connect each connector of the mode-control switch to the white connectors of the checker.
4. Set the power switch to the ON position.
   At this time red LEDs No. 3, 4, 6 and 8, and then No. 1 LED, will illuminate. (If, however, the green RECIRC LED is illuminated, the No. 1 LED will go off.)
   And, if one of the control switches is switched ON, the green LED corresponding to that switch will illuminate.
5. Press the control switches in order, and check whether or not the green LED (at the checker) corresponding to each switch respectively illuminates. If it does not illuminate, the problem is in the mode-control switch itself.

Note

a) The red No. 1 LED will go off when, while using the checker, the RECIRC switch is switched ON, but this is a normal function.

b) The red No. 4 LED will remain continuously illuminated during the time that the power switch is ON.

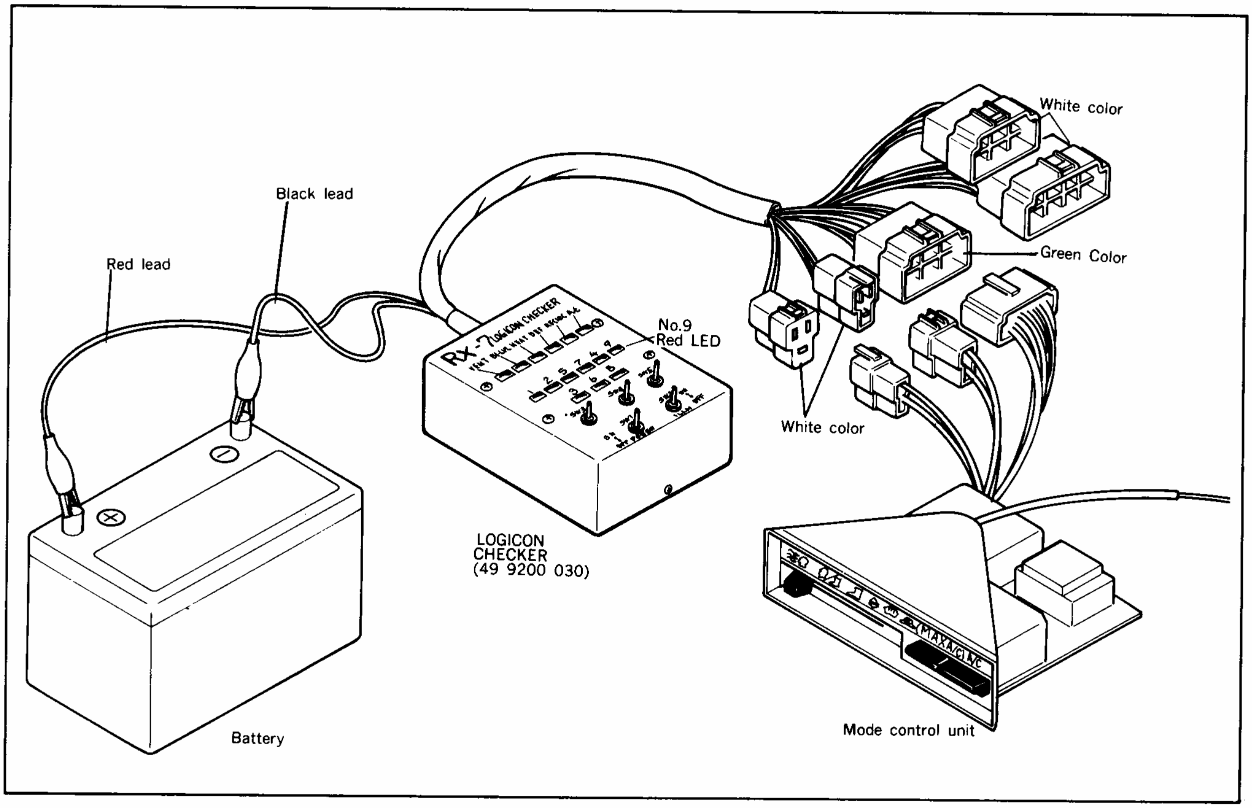
LOGICON CHECKER CONNECTIONS



6. Operate SW3, SW4 and SW5 of the checker and make the following checks.
   - Check whether or not LED No. 2 illuminates and LED No. 3 goes off when the SW3 lever is moved to the upper position.
   - Check whether or not LED No. 5 illuminates and LED No. 7 goes off when the SW 4 lever is moved to the upper position.
   - Check whether or not LED No. 7 illuminates and LED No. 8 goes off when the SW5 lever is moved to the upper position.

   If the red LEDs do not function as described above, the problem is in the mode-control switch itself.
7. Set the illumination switch to ON (by moving the lever to the upper position).
   Check to be sure that the indicator light of the control switch is dimmed at this time.
   In this condition, once again make the test described in step 5, and check to be sure that the indicator light of each mode switch is dimmed.
   If it does not, the problem is in the mode-control switch itself.

How to Use the Logicon Checker (lever control type)



1. Set each of the checker switches as shown in the figure above.
2. Connect the red wire from the power source to the positive (+) terminal of the battery, and the black wire to the negative (−) terminal.
3. Connect the 6T connector of the mode-control switch to the 6T connector of the checker, and connect the two 3T connectors to the white 3T connectors of the checker.
4. Switch the AIC and RECIRC mode-control switches OFF. Then, switch the power switch of the checker ON.
5. When the RECIRC mode-control switch is switched ON, the No. 9 red LED of the checker will illuminate, and, at the same time, the indicator light of the switch knob will also illuminate.
   When the A/C switch is switched ON, the green LED (A/C) of the checker will illuminate, and, at the same time, the indicator light of the switch knob will also illuminate.
   (All LEDs, except the RECIRC and A/C, will be extinguished.)
   If the procedure is not in the order described, the problem is in the mode-control switch itself.
6. Switch ON the illumination switch. (Move the lever to the upper position.)
   At this time, check to be sure that the A/C switch and RECIRC switch indicator lights become dim when the VENT, BI-LEVEL and HEAT indicator lights illuminate.
   If they do not, the problem is in the mode-control switch itself.

RX-7

ENGINE .... GROUP 1
LUBLICATING SYSTEM .... GROUP 2
COOLING SYSTEM .... GROUP 3
FUEL, INTAKE, EXHAUST AND EMISSION
CONTROL SYSTEM ... GROUP 4A (12A ENGINE)
GROUP 4B (13B ENGINE)
ENGINE ELECTRICAL SYSTEM .... GROUP 5
AUTOMATIC TRANSMISSION .... GROUP 7B
POWER STEERING .... GROUP 10B
BODY ELECTRICAL SYSTEM .... GROUP 15

626 DIESEL

ENGINE .... GROUP 1
LUBLICATING SYSTEM .... GROUP 2
COOLING SYSTEM .... GROUP 3
FUEL SYSTEM .... GROUP 4
ENGINE ELECTRICAL .... GROUP 5
TROUBLE DIAGNOSIS .... GROUP T.D.

626 GASOLINE

EMISSION CONTROL SYSTEM .... GROUP 1A
BODY ELECTRICAL .... GROUP 15

GLC

ENGINE .... GROUP 1
EMISSION CONTROL SYSTEM .... GROUP 1A
FUEL SYSTEM .... GROUP 4

B2000

EMISSION CONTROL SYSTEM .... GROUP 4