1. System Application

There are three emission control systems which are as follows:

- Crankcase emission control system
- Exhaust emission control system
  - Three-way catalyst system
  - A/F control system
  - Ignition control system

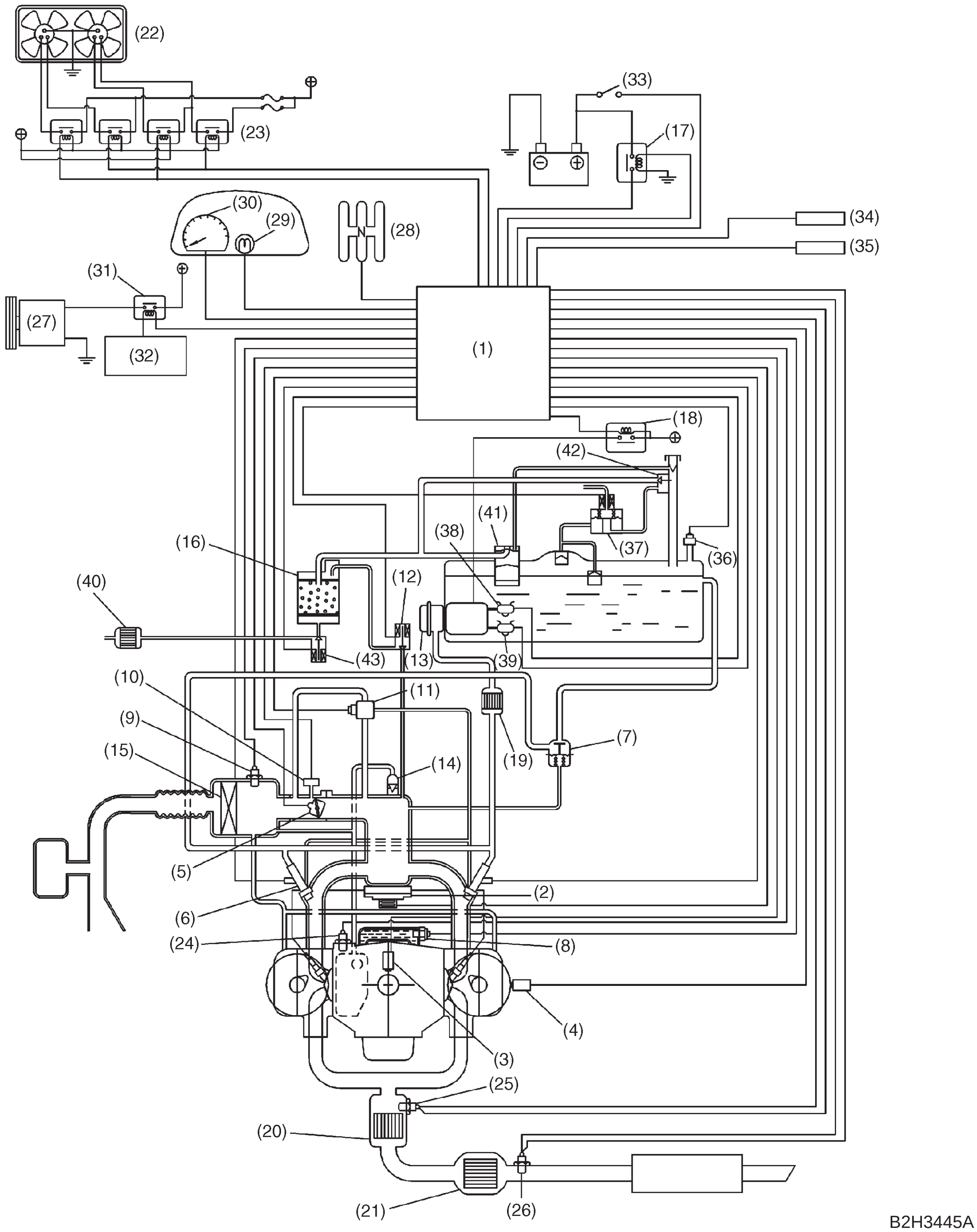
- Evaporative emission control system
  - ORVR (On-board Refueling Vapor Recovery) System

Item			Main components	Function
Crankcase emission control system			PCV valve	Draws blow-by gas into intake manifold from crankcase and burns it together with air-fuel mixture. Amount of blow-by gas to be drawn in is controlled by intake manifold pressure.
Exhaust emission control system	Catalyst system	Front	Three-way catalyst	Oxidizes HC and CO contained in exhaust gases as well as reducing NOx.
		Rear		
	A/F control system		ECM (Engine control module)	Receives input signals from various sensors, compares signals with stored data, and emits a signal for optimal control of air-fuel mixture ratio.
			Front oxygen (A/F) sensor	Detects quantity of oxygen contained exhaust gases.
			Rear oxygen sensor	Detects density of oxygen contained exhaust gases.
			Throttle position sensor	Detects throttle position.
			Intake manifold pressure sensor*1	Detects absolute pressure of intake manifold.
			Intake air temperature sensor*1	Detects intake air temperature of air cleaner case.
			Intake air temperature and pressure sensor*2	Detects absolute pressure of intake manifold.
				Detects intake air temperature of intake manifold.
	Ignition control system		ECM	Receives various signals, compares signals with basic data stored in memory, and emits a signal for optimal control of ignition timing.
			Crankshaft position sensor	Detects engine speed (Revolution).
			Camshaft position sensor	Detects reference signal for combustion cylinder discrimination.
			Engine coolant temperature sensor	Detects coolant temperature.
			Knock sensor	Detects engine knocking.
Evaporative emission control system			Canister	Absorbs evaporative gas which occurs in fuel tank when engine stops, and sends it to combustion chambers for a complete burn when engine is started. This prevents HC from being discharged into atmosphere.
			Purge control solenoid valve	Receives a signal from ECM and controls purge of evaporative gas absorbed by canister.
			Pressure control solenoid valve	Receives a signal from ECM and controls evaporative gas pressure in fuel tank.
ORVR system			Vent valve	Controls evaporation pressure in fuel tank.
			Drain valve	Closes the evaporation lline by receiving a signal from ECM to check the evaporation gas leak.

*1: MT vehicles
*2: AT vehicles

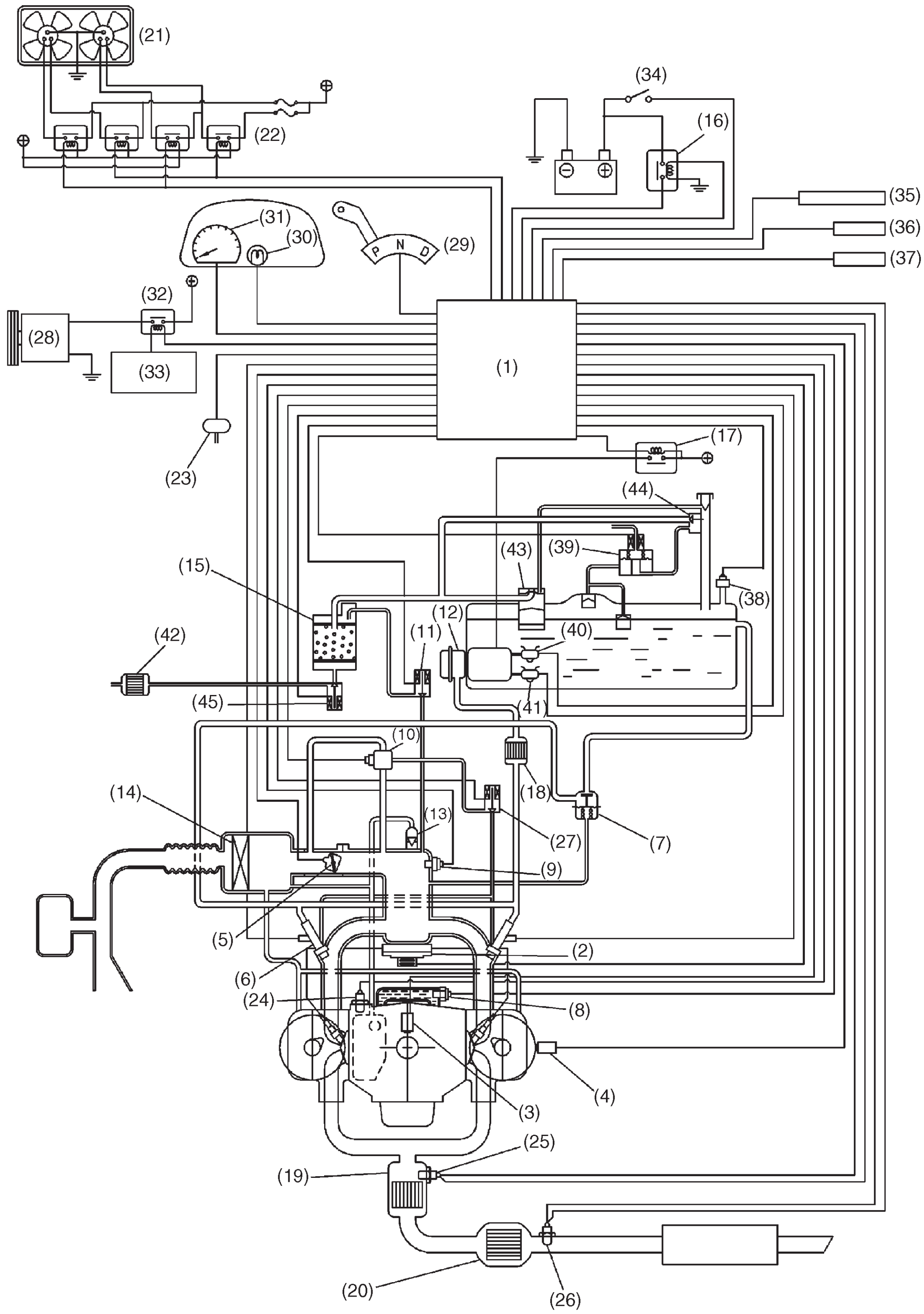
2. Schematic Drawing

A: MT VEHICLES



(1) Engine control module (ECM)
(2) Ignition coil & ignitor ASSY
(3) Crankshaft position sensor
(4) Camshaft position sensor
(5) Throttle position sensor
(6) Fuel injectors
(7) Pressure regulator
(8) Engine coolant temperature sensor
(9) Intake air temperature sensor
(10) Intake manifold pressure sensor
(11) Idle air control solenoid valve
(12) Purge control solenoid valve
(13) Fuel pump
(14) PCV valve
(15) Air cleaner
(16) Canister
(17) Main relay
(18) Fuel pump relay
(19) Fuel filter
(20) Front catalytic converter
(21) Rear catalytic converter
(22) Radiator fan
(23) Radiator fan relay
(24) Knock sensor
(25) Front oxygen (A/F) sensor
(26) Rear oxygen sensor
(27) A/C compressor
(28) Neutral switch
(29) CHECK ENGINE malfunction indicator lamp (MIL)
(30) Tachometer
(31) A/C relay
(32) A/C control module
(33) Ignition switch
(34) Vehicle speed sensor
(35) Data link connector
(36) Fuel tank pressure sensor
(37) Pressure control solenoid valve
(38) Fuel temperature sensor
(39) Fuel level sensor
(40) Drain filter
(41) Vent valve
(42) Shut valve
(43) Drain valve

B: AT VEHICLES



B2H3446A

(1) Engine control module (ECM)
(2) Ignition coil & ignitor ASSY
(3) Crankshaft position sensor
(4) Camshaft position sensor
(5) Throttle position sensor
(6) Fuel injectors
(7) Pressure regulator
(8) Engine coolant temperature sensor
(9) Intake air temperature and pressure sensor
(10) Idle air control solenoid valve
(11) Purge control solenoid valve
(12) Fuel pump
(13) PCV valve
(14) Air cleaner
(15) Canister
(16) Main relay
(17) Fuel pump relay
(18) Fuel filter
(19) Front catalytic converter
(20) Rear catalytic converter
(21) Radiator fan
(22) Radiator fan relay
(23) Atmospheric pressure sensor
(24) Knock sensor
(25) Front oxygen (A/F) sensor
(26) Rear oxygen sensor
(27) Air assist injector solenoid valve
(28) A/C compressor
(29) Inhibitor switch
(30) CHECK ENGINE malfunction indicator lamp (MIL)
(31) Tachometer
(32) A/C relay
(33) A/C control module
(34) Ignition switch
(35) Transmission control module (TCM)
(36) Vehicle speed sensor
(37) Data link connector
(38) Fuel tank pressure sensor
(39) Pressure control solenoid valve
(40) Fuel temperature sensor
(41) Fuel level sensor
(42) Drain filter
(43) Vent valve
(44) Shut valve
(45) Drain valve

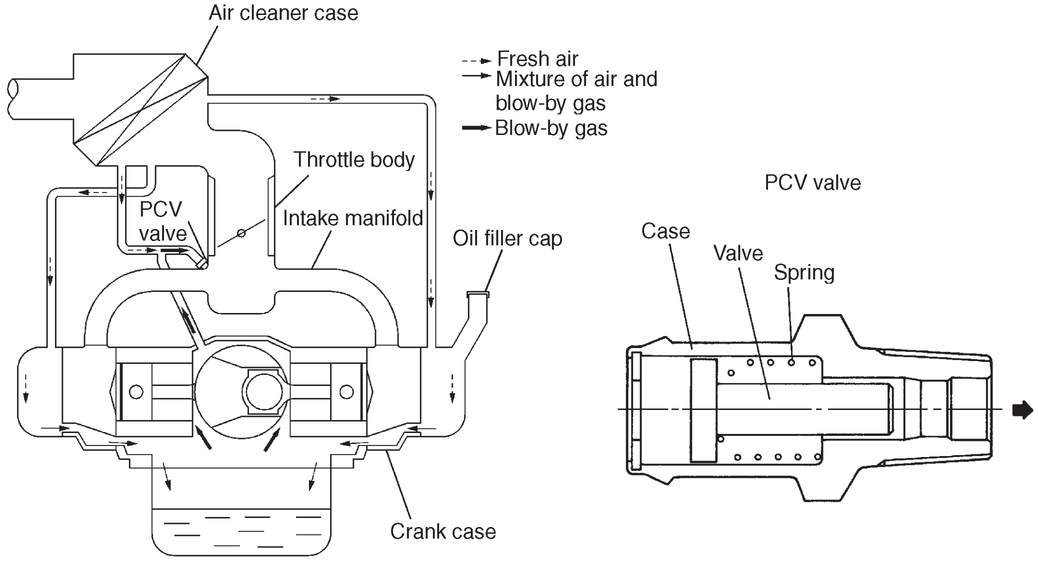
3. Crankcase Emission Control System

- The positive crankcase ventilation (PCV) system is employed to prevent air pollution which will be caused by blow-by gas being emitted from the crankcase.
The system consists of a sealed oil filler cap, rocker covers with fresh air inlet, connecting hoses, PCV valve and an air intake duct.

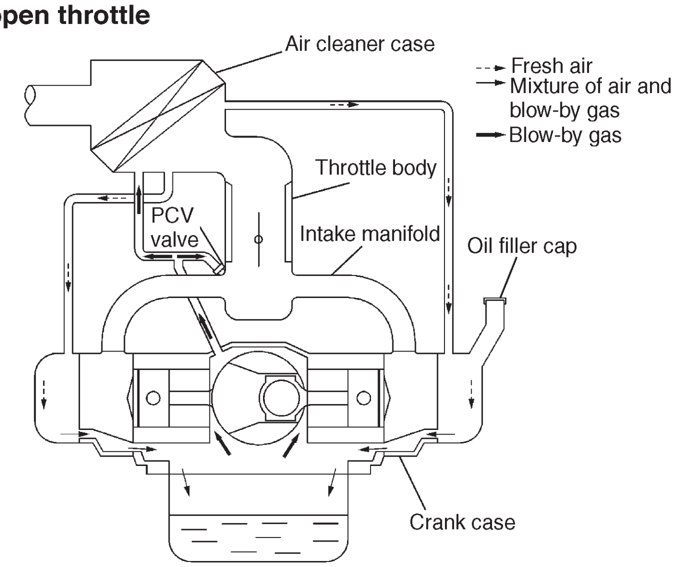
- At the part throttle, the blow-by gas in the crankcase flows into the intake manifold through the connecting hose of crankcase and PCV valve by the strong vacuum of the intake manifold. Under this condition, the fresh air is introduced into the crankcase through connecting hose of rocker cover.

- At wide open throttle, a part of blow-by gas flows into the air intake duct through the connecting hose and is drawn to the throttle chamber, because under this is condition, the intake manifold vacuum is not so strong as to introduce all blow-by gases increasing with engine speed directly through the PCV valve.

At the part throttle



At the wide open throttle



B2H3534A

4. Three-way Catalyst

- The basic material of three-way catalyst is platinum (Pt), rhodium (Rh) and palladium (Pd), and a thin coat of their mixture is applied onto honeycomb or porous ceramics of an oval shape (carrier). To avoid damaging the catalyst, only unleaded gasoline should be used.
- The catalyst is used to reduce HC, CO and NOx in exhaust gases, and permits simultaneous oxidation and reduction. To obtain an excellent purification efficiency on all components HC, CO and NOx, a balance should be kept among the concentrations of the components. These concentrations vary with the air-fuel ratio.
- The air-fuel ratio needs to be controlled to a value within the very narrow range covering around the stoichiometric mixture ratio to purify the components efficiently.

5. A/F Control System

- The air/fuel control system compensates for the basic amount of fuel injection in response to a signal sent from the front oxygen sensor to provide proper feedback control of the mixture. Thus, the stoichiometric mixture ratio is maintained to provide effective operation of the three-way catalyst. The basic amount of fuel injection is preset according to engine speed and loads, as well as the amount of intake air.

- This system also has a “learning” control function which stores the corrected data in relation to the basic amount of fuel injection in the memory map. A new air-fuel ratio correction is automatically added for quick response to the deviation of the air-fuel ratio. Thus, the air-fuel ratio is optimally maintained under various conditions while stabilizing exhaust gases, improving driving performance and compensating for changes in sensors’ performance quality with elapse of time.

<Ref. to 2-7 [M5C0].>

6. Ignition Control System

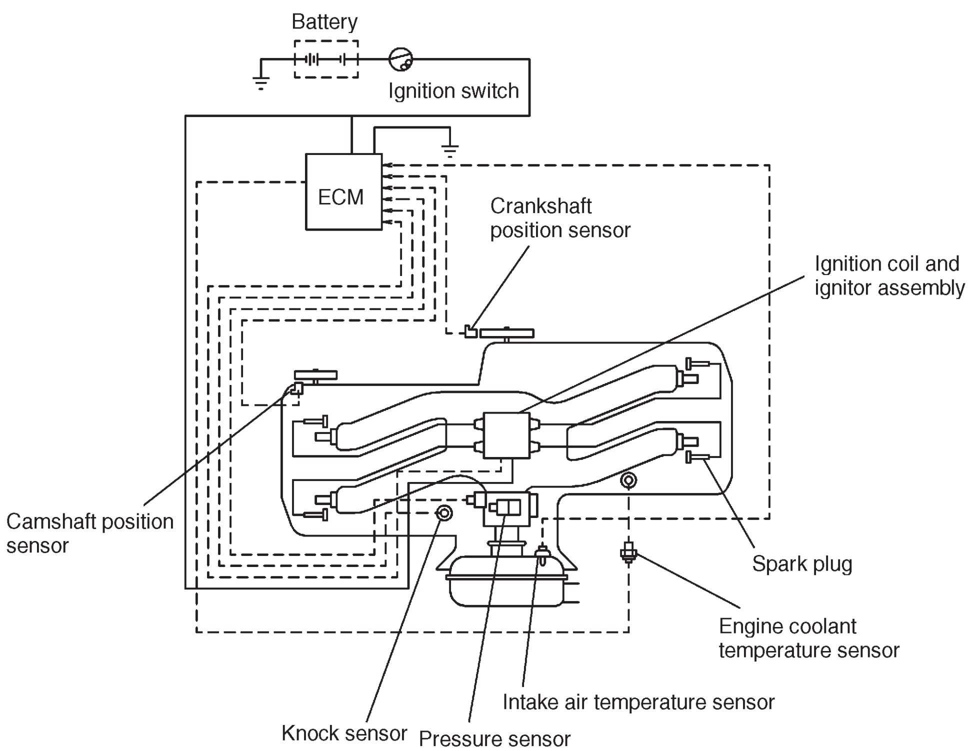
A: MT VEHICLES

- The ignition control system is controlled by the ECM.

The ECM determines the optimal ignition timing according to signals sent from various sensors (which monitor the operating conditions of the engine), and sends a signal to the ignitor.

- The ECM has a “closed-loop” control function with map which provides superb transient characteristics for responsive ignition timing control.

<Ref. to 2-7 [M6D0].>

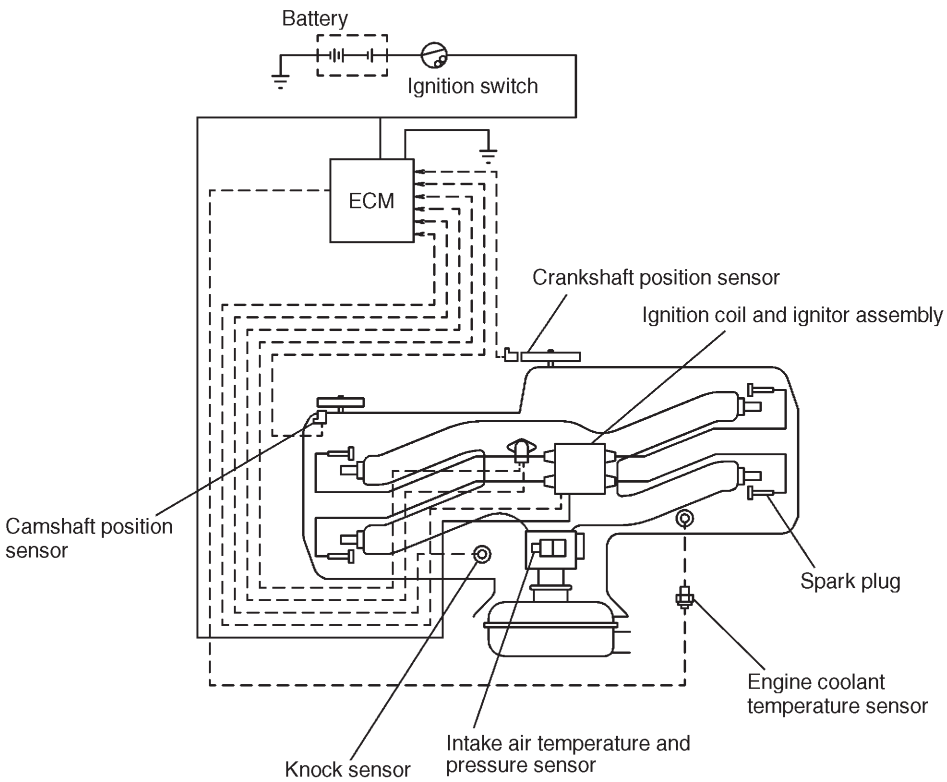


B2H3535A

B: AT VEHICLES

- The ignition control system is controlled by the ECM.
The ECM determines the optimal ignition timing according to signals sent from various sensors (which monitor the operating conditions of the engine), and sends a signal to the ignitor.
- The ECM has a “closed-loop” control function with map which provides superb transient characteristics for responsive ignition timing control.

<Ref. to 2-7 [M6D0].>

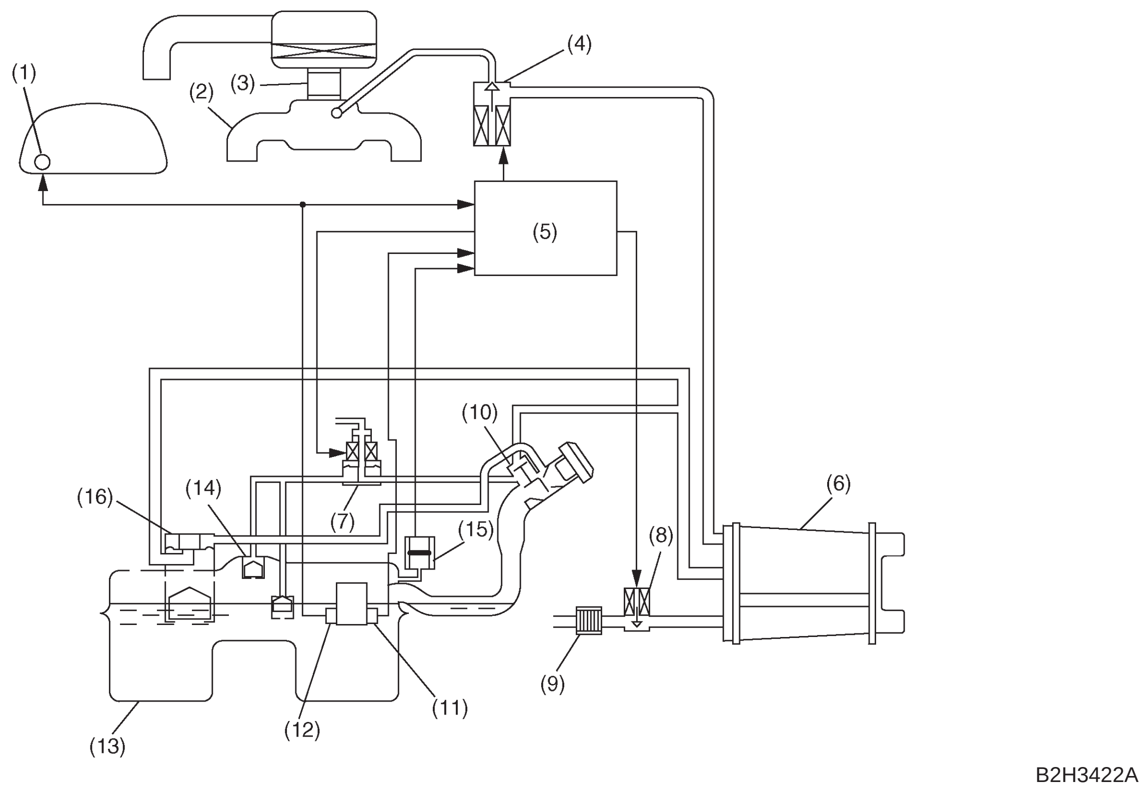


B2H3536A

7. Evaporative Emission Control System

A: GENERAL

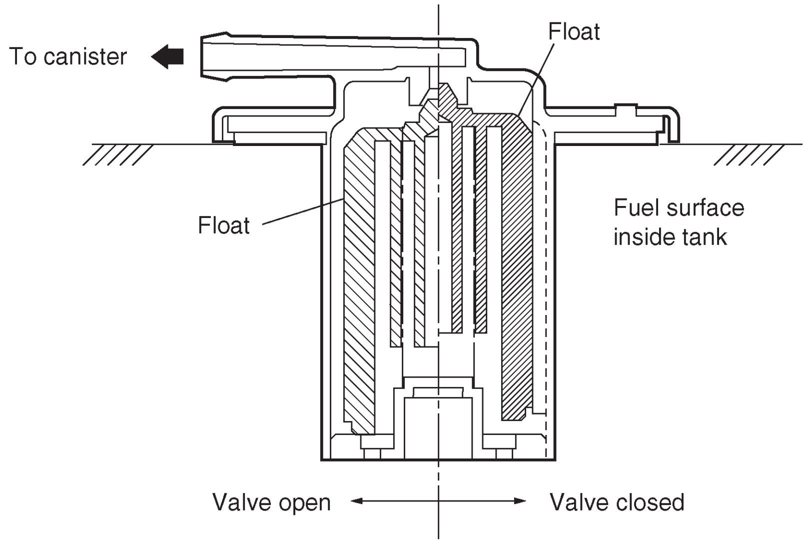
- The evaporative emission control system is employed to prevent evaporative fuel from being discharged into ambient atmosphere. This system includes a canister, purge control solenoid valve, fuel cut valve, their connecting lines, etc.
- Gasoline vapor evaporated from the fuel in the fuel tank is introduced into the canister through the evaporation line, and is absorbed on activated carbon in it. A fuel cut valve is also incorporated on the fuel tank line.
- The purge control solenoid valve is controlled by the ECM and provides optimal purge control according to the engine condition.
- A pressure control solenoid valve incorporated in the fuel tank evaporation line controls the pressure/vacuum in the fuel tank according to the pressure/vacuum sensed by the fuel tank pressure sensor.



(1)	Fuel gauge	(7)	Pressure control solenoid valve	(13)	Fuel tank
(2)	Intake manifold	(8)	Drain valve	(14)	Fuel cut valve
(3)	Throttle body	(9)	Drain filter	(15)	Fuel tank pressure sensor
(4)	Purge control solenoid valve	(10)	Shut valve	(16)	Vent valve
(5)	Engine control module (ECM)	(11)	Fuel temperature sensor		
(6)	Canister	(12)	Fuel level sensor		

B: FUEL CUT VALVE

The fuel cut valve is built onto the evaporation pipe of the fuel tank cap. The rising level of the fuel from the fuel tank causes the float to move up and close the cap hole so that no fuel can enter during evaporation line.

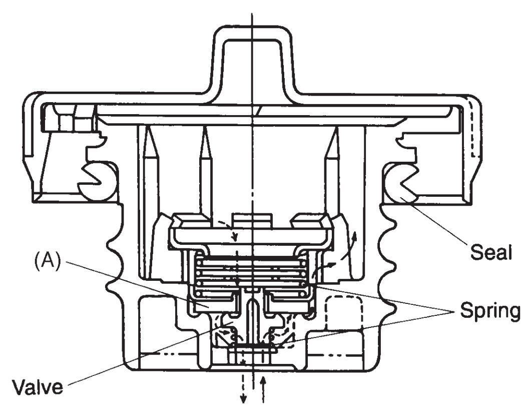


B2H3342A

C: FUEL CAP

The relief valve is adopted to prevent the development of vacuum in the fuel tank which may occur in case of trouble in the fuel vapor line.

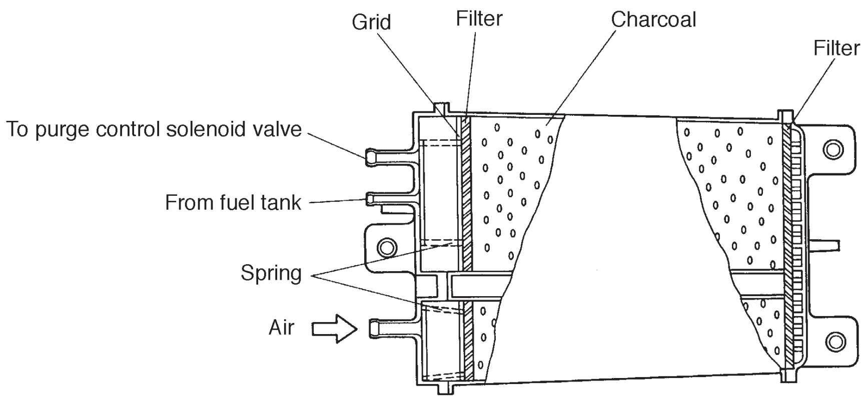
In normal condition, the filler pipe is sealed at (A) and at the packing pressed against the filler pipe end. As vacuum develops in the fuel tank, atmospheric pressure forces the spring down to open the valve; consequently air is led into the fuel tank controlling the inside pressure.



B2H0395A

D: CANISTER

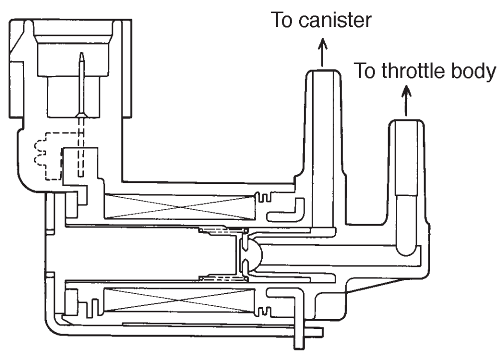
The canister temporarily stores the evaporation gas. When the purge control solenoid valve is opened from a signal sent from the ECM, the evaporation gas is sent into the collector chamber after being mixed with fresh external air.



H2H1164B

E: PURGE CONTROL SOLENOID VALVE

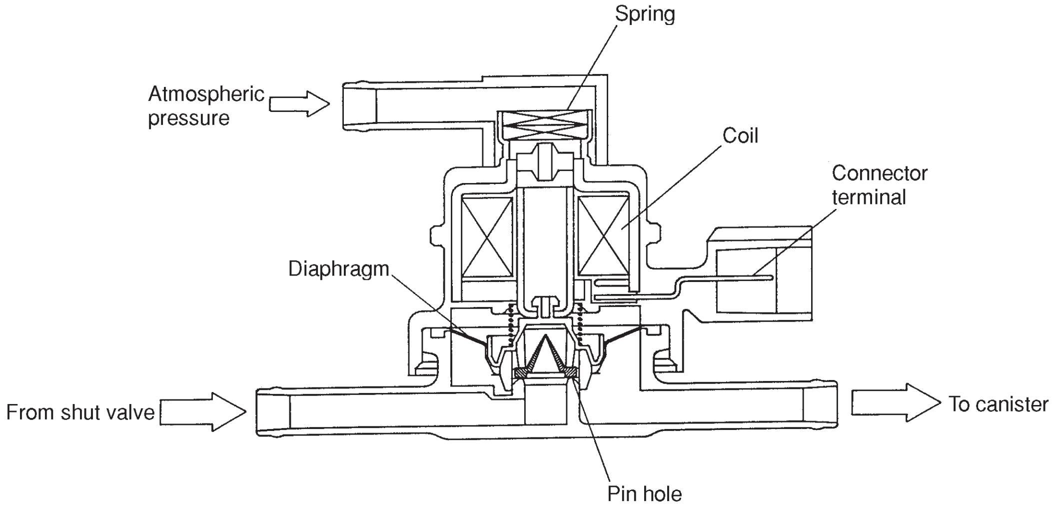
The purge control solenoid valve is on the evaporation line between canister and throttle body. It is installed at the under side of intake manifold.



B2H0426

F: PRESSURE CONTROL SOLENOID VALVE

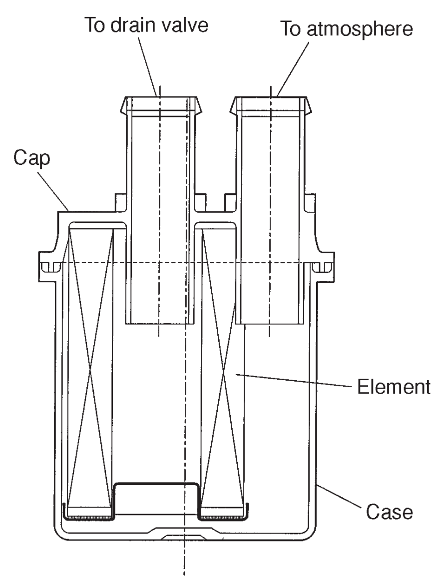
The fuel tank pressure control solenoid valve located in the evaporation line between the shut valve on fuel filler pipe and the canister adjusts the pressure inside the fuel tank under the control of ECM.
When the tank internal pressure is increased and becomes greater than atmospheric pressure, the valve is opened to introduce evaporation gas into the canister to purge.
On the other hand, when the tank internal pressure becomes smaller than atmospheric pressure, external air is taken from the drain valve into the canister.
Also, the pressure control solenoid valve can be electrically closed for system diagnosis.



B2H1719A

G: DRAIN FILTER

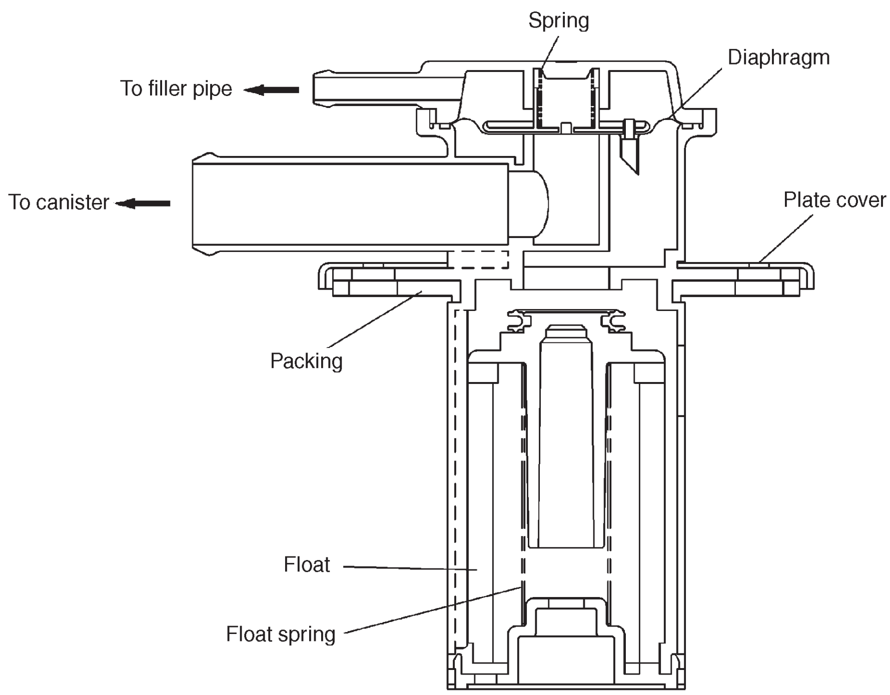
The drain filter is installed at the air inlet port of the vent control solenoid valve to clean the air taken in the canister through the vent control solenoid valve.



S2H0874

H: VENT VALVE

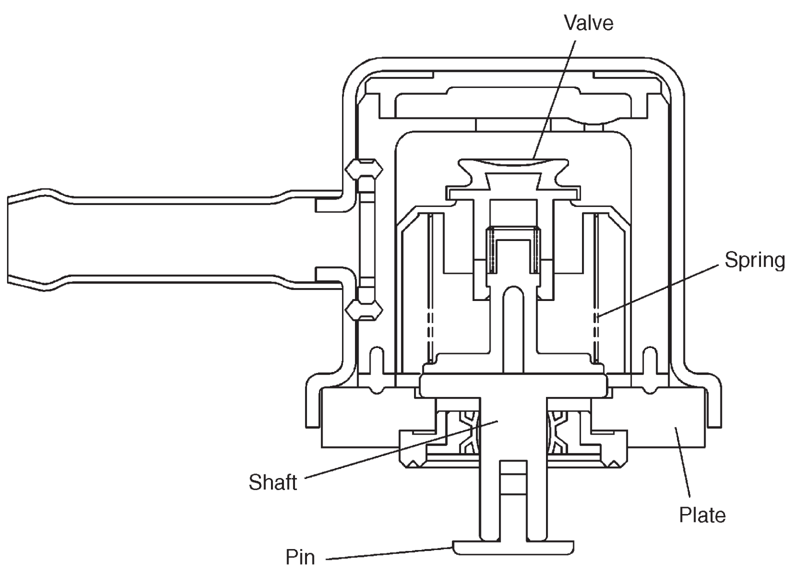
Vent valve is located on the fuel tank. During filling the fuel tank, evaporation gas is introduced to the canister through vent valve.
When the evaporation pressure overcomes atmospheric pressure and spring force which are applied to the back side of the diaphragm, the port is opened. Also, the float in the vent valve is to stop the fuel which is supplied when the tank is filled up. Increasing fuel level raises the float to close the port.



B2H3424A

I: SHUT VALVE

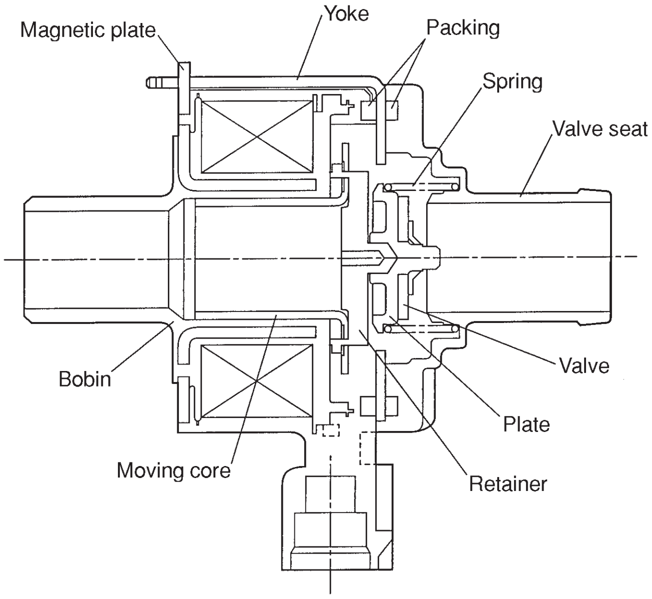
Shut valve is located on the upper side of fuel filler pipe. When a filler gun is inserted into the filler pipe, the shut valve is closes the evaporation line.



B2H3423A

J: DRAIN VALVE

The drain valve is located on the line connecting the drain filter and canister, at a point just below the drain filter. The drain valve is forcibly closed by a signal from the ECM while the evaporation system diagnosis is being conducted.



B2H1770

8. On-board Refueling Vapor Recovery (ORVR) System

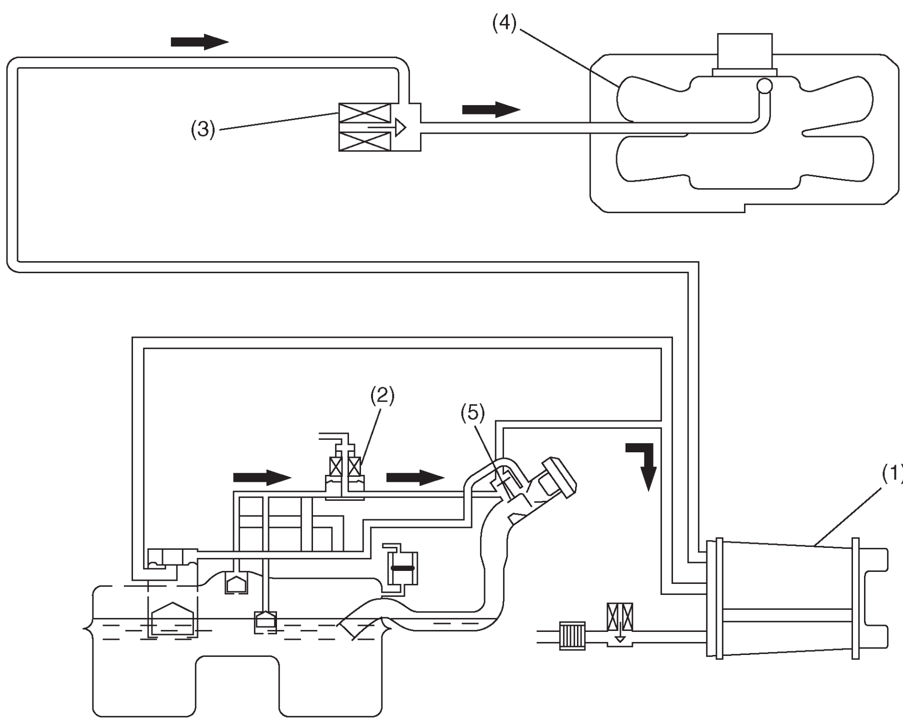
A: GENERAL

The on-board refueling vapor recovery system allows the fuel evaporation gas in the fuel tank to be introduced directly into the canister through the vent valve when the fuel tank inside pressure increases as a result of refueling.
The diagnosis of the system is performed by monitoring the fuel tank inside pressure detected by the fuel tank pressure sensor while forcibly closing the drain valve.

B: OPERATION

- While driving

Since the back side of the diaphragm in the pressure control solenoid valve is open to the atmosphere, the diaphragm is held pressed by the atmospheric pressure in the position where only the external air is introduced into the canister. When the evaporation gas pressure acting on the other side of the diaphragm increases and overcomes the atmospheric pressure, it pushes the diaphragm and opens a port through which the evaporation gas makes its way to the canister.

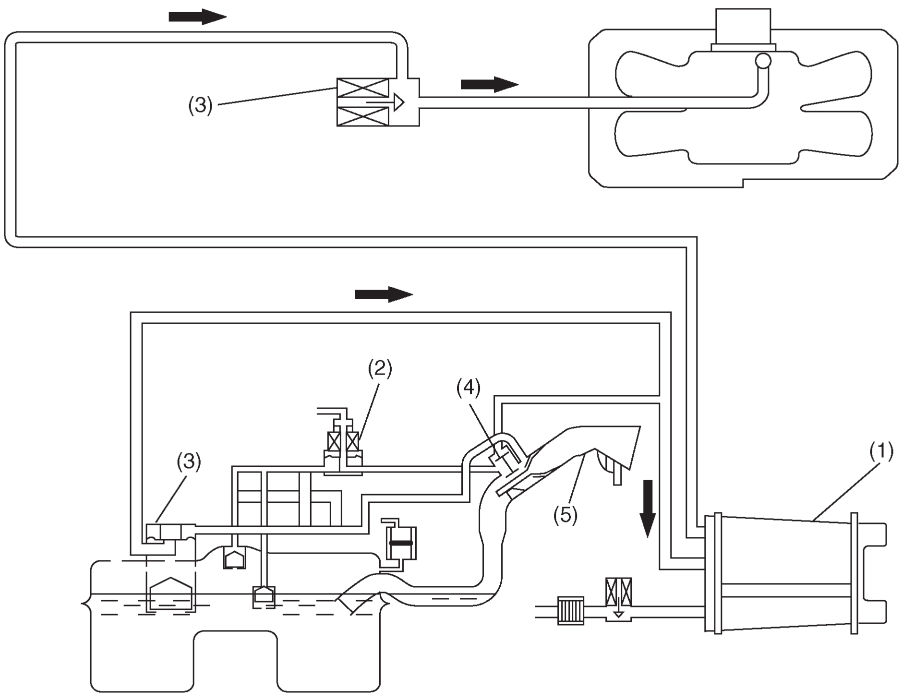


B2H3537A

(1) Canister
(2) Pressure control solenoid valve
(3) Purge control solenoid valve
(4) Intake manifold
(5) Shut valve: opened

● While refueling

As fuel is filled in to fuel tank, internal pressure is increased. When internal pressure overcomes atmospheric pressure, port of the vent valve is opened, and evaporation gas is introduced into the canister through the vent line. Fuel vapor is absorbed by a chacoal in the canister and purified air is discharged from the drain valve. When a filler gun is inserted, the shut valve closes the evaporation line.

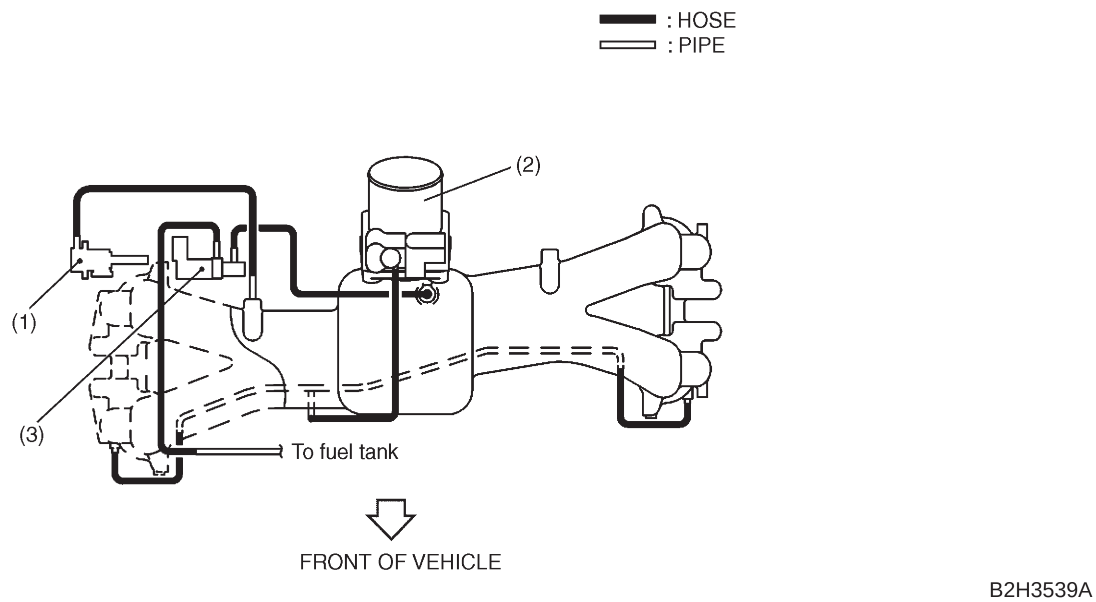


(1) Canister
(2) Pressure control solenoid valve
(3) Vent valve
(4) Shut valve: closed
(5) Filler gun

9. Vacuum Fitting

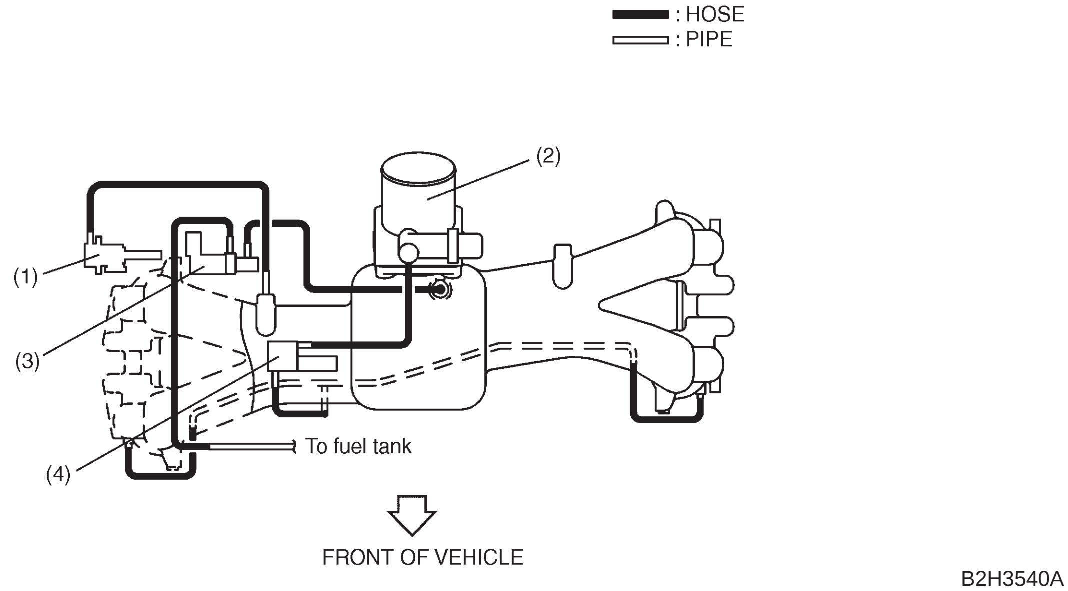
The hose and pipe connections of intake manifold, throttle body and related parts are as shown in the illustration.

A: MT VEHICLES



(1) Pressure regulator
(2) Throttle body
(3) Purge control solenoid valve

B: AT VEHICLES



(1) Pressure regulator

(2) Throttle body

(3) Purge control solenoid valve

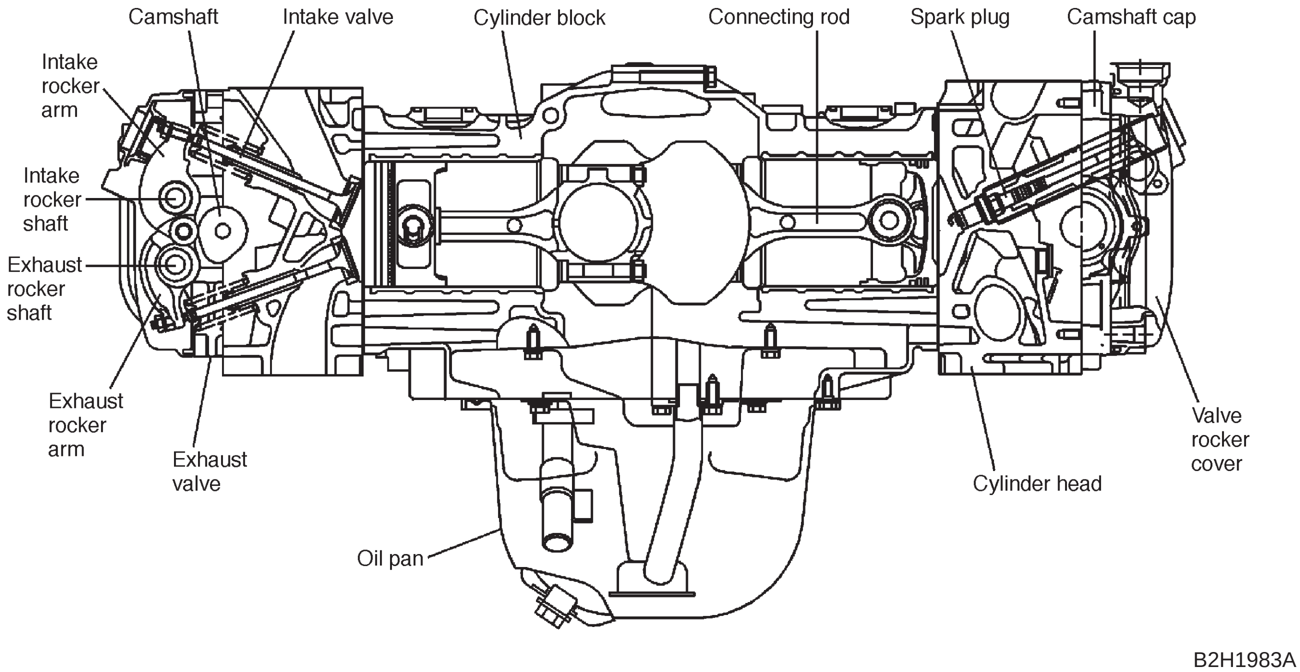
(4) Air assist injector solenoid valve

1. General

The engine is made from aluminum alloy and is horizontally opposed. It is a 4-stroke cycle, water-cooled, SOHC 16-valve engine. The fuel system utilizes an MFI (multiple fuel injection) design.

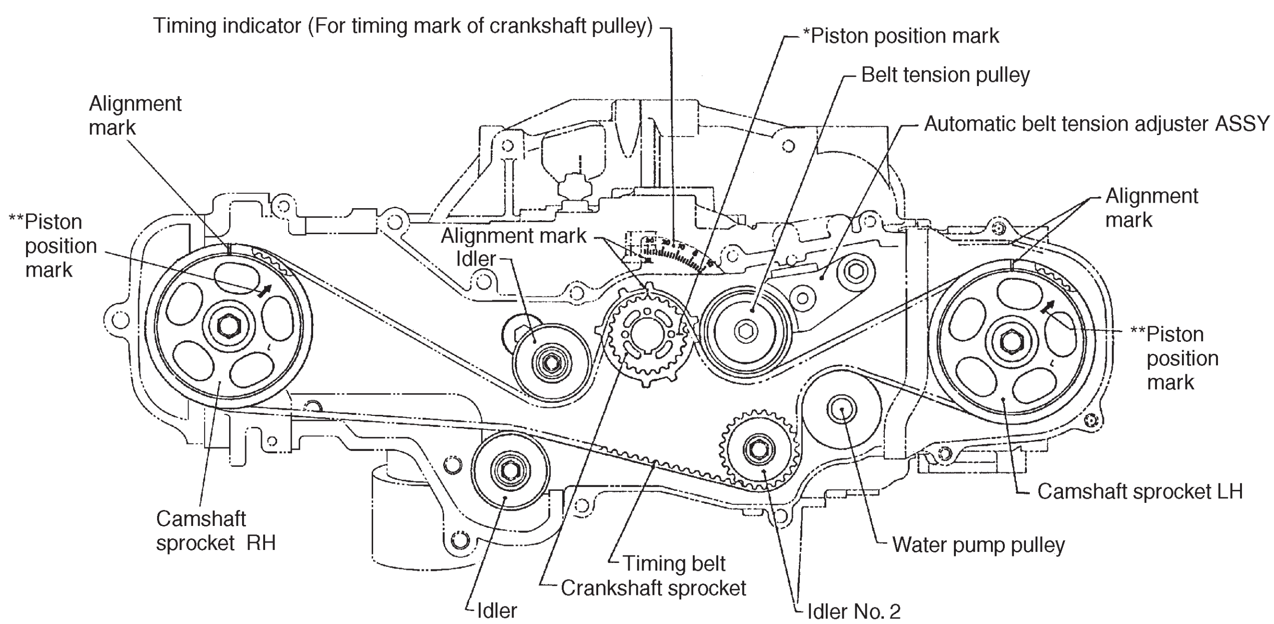
A summary of the major construction and function features is as follows:

- The cylinder head is a center-plug type that utilizes pentroof combustion chambers. The four-valve design is provided with two intake valves and two exhaust valves per cylinder. The intake and exhaust ports are arranged in a cross-flow design.
- The valve side of the rocker arm is provided with a valve rocker adjust screw & nut. Turning of this screw can adjust valve clearance.
- A single timing belt drives two camshafts on the left and right banks and the engine coolant pump on the left bank. Belt tension is automatically adjusted by belt tension adjuster to eliminate maintenance.
- The crankshaft is supported by five bearings to provide high rigidity and strength.
- The cylinder block is made from aluminum die cast which is integrated with cast-iron cylinder liners.



2. Timing Belt

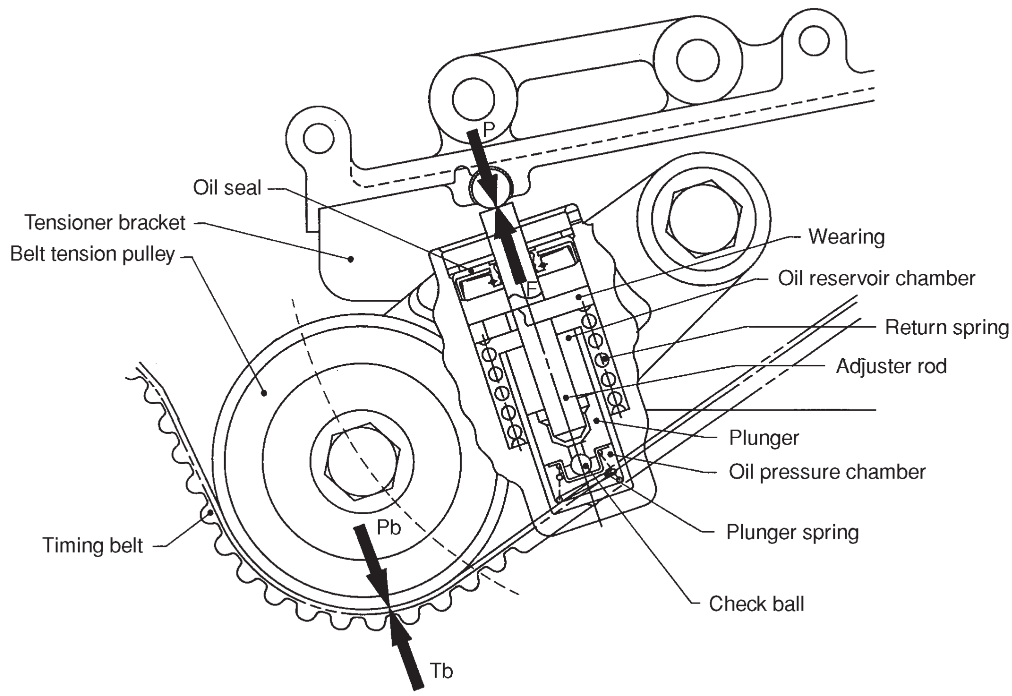
- A single timing belt drives two camshafts (one in the left bank and one in the right bank). The back of the belt also drives the water pump.
- The timing belt teeth have a specially designed round profile to provide quiet operation. The timing belt is composed of a strong and inflexible core wire, a wear-resistant canvas and heat-resistant rubber material.
- A hydraulic automatic belt tensioner adjuster constantly maintains specified belt tension to properly drive the camshafts, as well as to provide a “maintenance-free” advantage.



NOTE:
*: #1 piston is set at TDC (Top Dead Center) when piston-position mark on crankshaft sprocket is aligned with mark on cylinder block.
**: #1 piston is set at TDC (Top Dead Center) on compression stroke when piston-position mark on camshaft sprocket is aligned with mark on belt cover.

3. Automatic Belt Tension Adjuster Assembly

The automatic belt tension adjuster assembly mechanism consists of an automatic belt tension adjuster assembly and a tensioner bracket and maintains the timing belt tension automatically at a specified level to ensure positive transmission of driving power, reduction of noise and improvement of belt life.
The cylinder of the automatic belt tension adjuster assembly incorporates an adjuster rod, wear ring, plunger spring, return spring, check ball and silicone oil.
The automatic belt tension adjuster assembly is so constructed as to apply tension to the timing belt by means of leverage.
The belt is tensioned by the turning moment of the automatic belt tension adjuster assembly which is produced by the push rod pressurized by the return spring in the cylinder.



B2H1694A

- Timing belt tensioning action (which follows slackening of belt)

If the adjuster rod is pushed upward by the return spring, the oil in the reservoir chamber which is pressurized by the plunger spring to a fixed pressure level pushes open the check ball and flows into the oil pressure chamber.
Thrust F of the adjuster rod acts on the tensioner bracket, which causes the belt tension pulley to pivot counterclockwise on the fulcrum of the automatic belt tension adjuster assembly, applying tension Pb to the timing belt.

- Timing belt tension balancing action

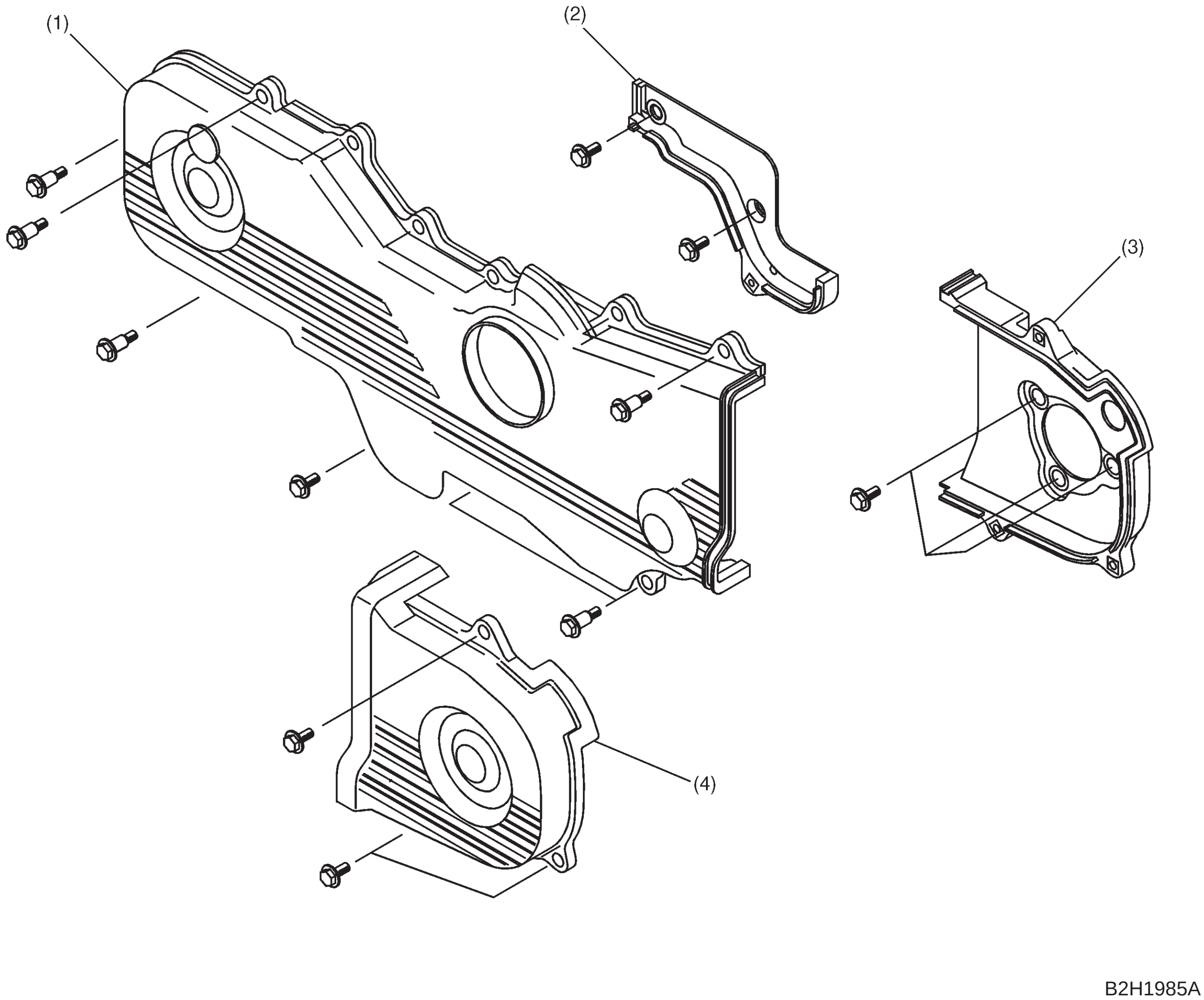
When the belt tension pulley is pushed against the timing belt with Pb, reaction force Tb of the timing belt generates reaction force P at the acting point of the adjustor rod.
This force pushes in the adjuster rod up to a point where it is balanced with the thrust F of the adjuster rod plus the pressure generated by the oil enclosed in the oil pressure chamber, thus the timing belt tension being kept constant.

- Overtension correction action (action for slackening the timing belt)

If the tension of the timing belt increases above the specified level, force P becomes larger than thrust F and silicone oil is returned from the oil pressure chamber to the reservoir chamber little by little until P is balanced again with F, thus maintaining timing belt tension at the specified level at all times.

4. Belt Cover

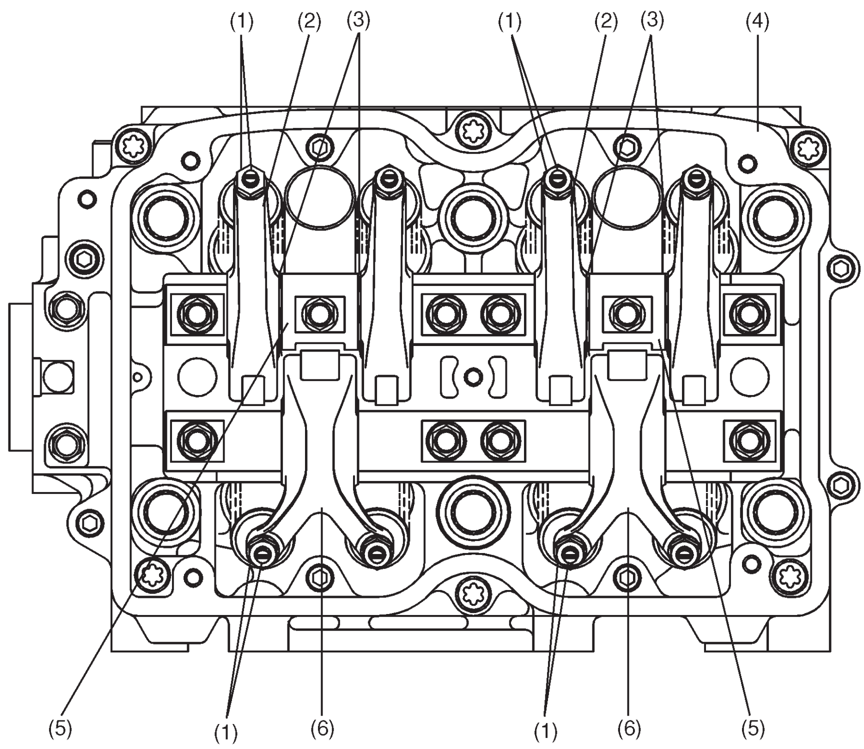
- The belt cover is made of synthetic resin molding which is lightweight and heat resistant. It has a totally enclosed design that utilizes rubber packing at the mating surface of the cylinder block. This eliminates the chance of dust and liquid from entering the interior.
- A floating design is utilized by placing rubber mounting between the cylinder block and belt cover to prevent the noise and vibration of transmission.
- The front belt cover has a graduated line for ignition-timing confirmation.



(1) Front belt cover
(2) Belt cover No. 2 (RH)
(3) Belt cover No. 2 (LH)
(4) Belt cover (LH)

5. Valve Rocker Assembly

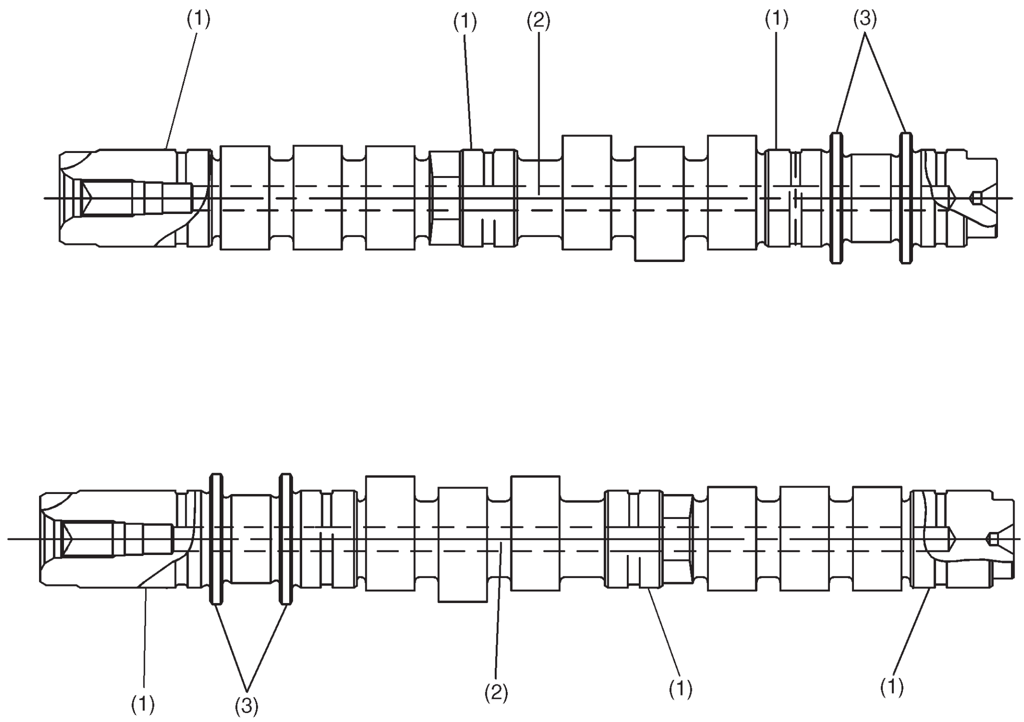
- The intake valve rocker arms and the exhaust valve rocker arms are installed on the respective rocker shafts which are retained by the camshaft caps.
- The valve side of the rocker arm is provided with a value rocker adjust screw & nut. Turning of this screw can adjust valve clearance.
- The exhaust valve rocker arms have a “Y”- letter design, and each arm operates two exhaust valves.
- The rocker shaft has an oil passage in it.



(1)	Valve rocker adjust screw & nut	(4)	Camshaft cap
(2)	Intake valve rocker arm	(5)	Supporter
(3)	Wave washer	(6)	Exhaust valve rocker arm

6. Camshaft

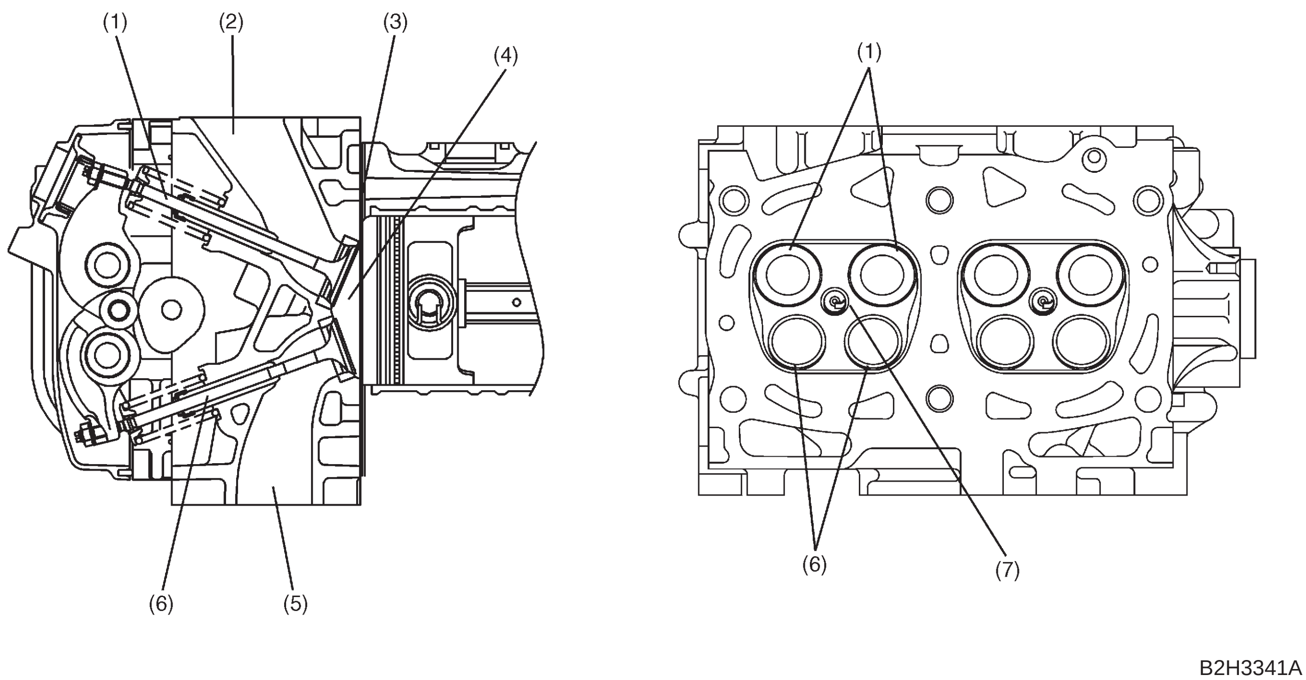
- The right-hand camshaft is supported by three journals inside the cylinder head while the left-hand camshaft is supported by four journals.
- The two flanges on the camshaft receive thrust force to ensure an accurate end play of the camshaft.
- The camshaft has an oil passage in it.



(1)	Journal
(2)	Oil passage
(3)	Shaft flange

7. Cylinder Head

- The cylinder head is made from aluminium die casting.
- Combustion chamber in the cylinder head is a compact, pentroof design and spark plug is located at the center of combustion chamber which feature a wide “squish” area for increased combustion efficiency.
- Four valves (two intake and two exhaust), which are arranged in a cross-flow design, are used per cylinder.
- The cylinder head gasket is a metallic one consisting of three layers of the stainless steel sheets. It has better heat resistance and gas sealability and higher reliability.



(1) Intake valve
(2) Intake port
(3) Squish area
(4) Combustion chamber
(5) Exhaust port
(6) Exhaust valve
(7) Spark plug

8. Cylinder Block

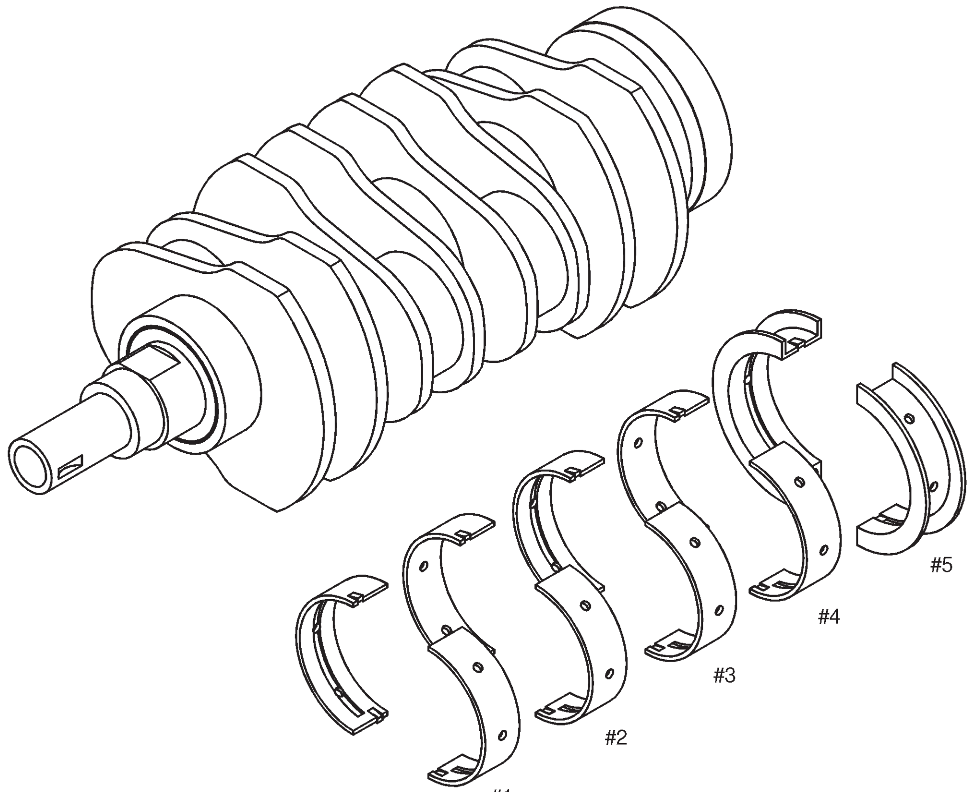
● The cylinder block is made from aluminum die casting. The cylinder perimeter has an open-deck design which is lightweight, highly rigid and has superb cooling efficiency.

● The cylinder liners are made from cast iron and are dry types which are totally cast with aluminum cylinder block. Five main journal block designs are employed to increase stiffness and quiet operation.

● The oil pump is located in the front center of the cylinder block and the engine coolant pump is located at the front of the right-cylinder bank. At the rear of the right-cylinder block is a separator which eliminates oil mist contained in the blow-by gas.

9. Crankshaft

The crankshaft is supported by five bearings to provide high rigidity and strength. The corners of the crankshaft journals and webs, as well as the crank pins and webs, are finished with fillet-roll work to increase stiffness. The five crankshaft bearings are made from aluminum alloy and the No. 5 bearing is provided with a flanged metal to receive thrust force.



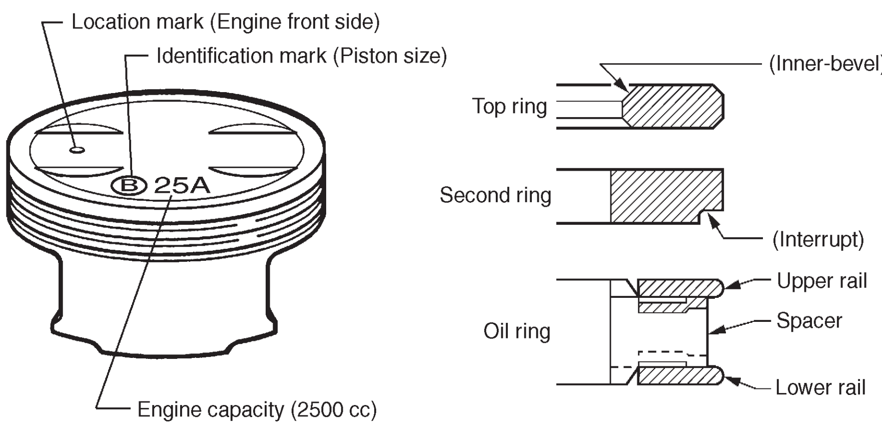
10. Piston

● The piston skirt has a “slipper” design to reduce weight and sliding friction. The oil control ring groove utilizes a thermal design.

● The piston pin is located in an offset position. The Nos. 1 and 3 pistons are offset in the lower direction while the Nos. 2 and 4 pistons are offset in the upper direction.

● The piston head is recessed for both the intake and exhaust valves. It also has symbols used to identify the location and the direction of installation. By commonization in shape of a recess for the intake valve and a recess for the exhaust valve, the piston is common to the right and left banks.

● Three piston rings are used for each piston-two compression rings and one oil ring. The top piston ring has an inner-bevel design and the second piston ring has an interrupt design to reduce oil consumption.

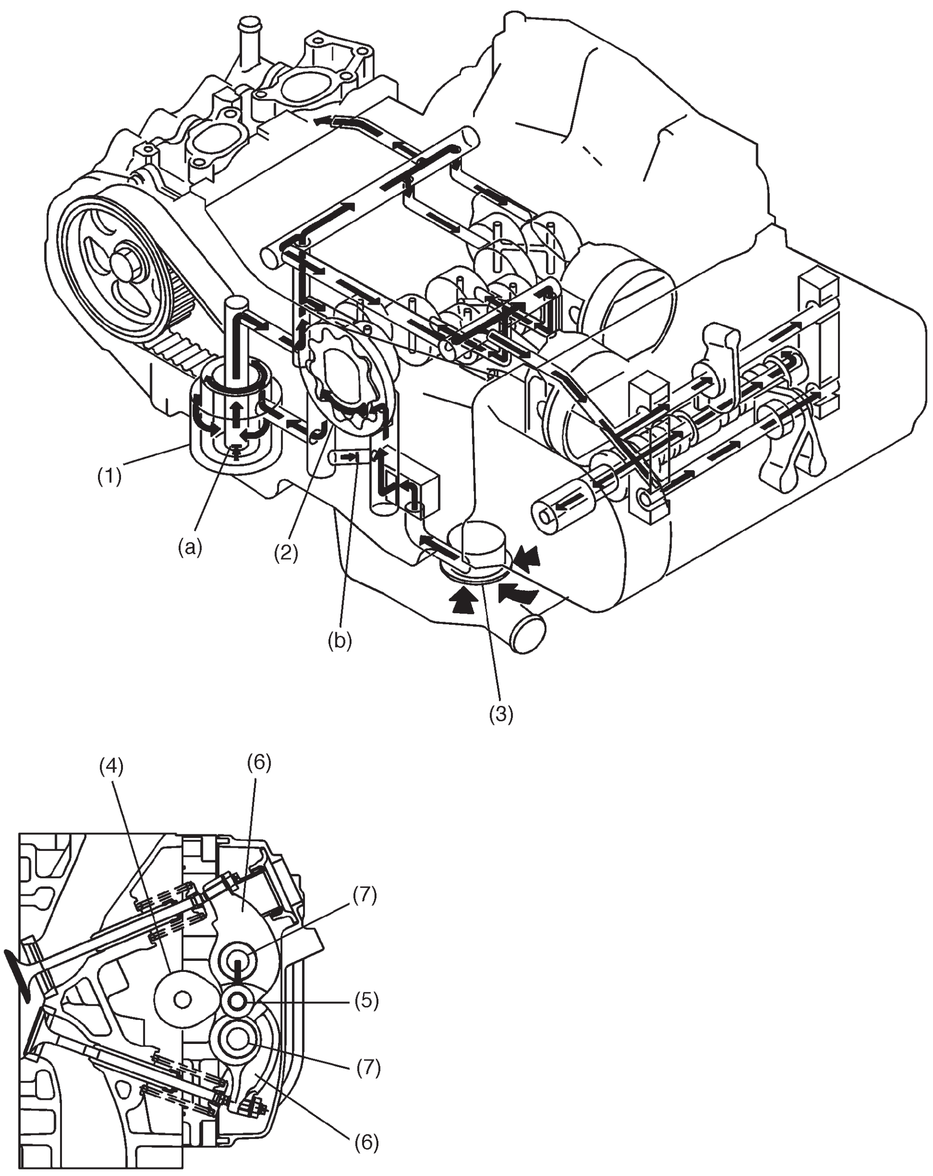


B2H3411A

MEMO

1. General

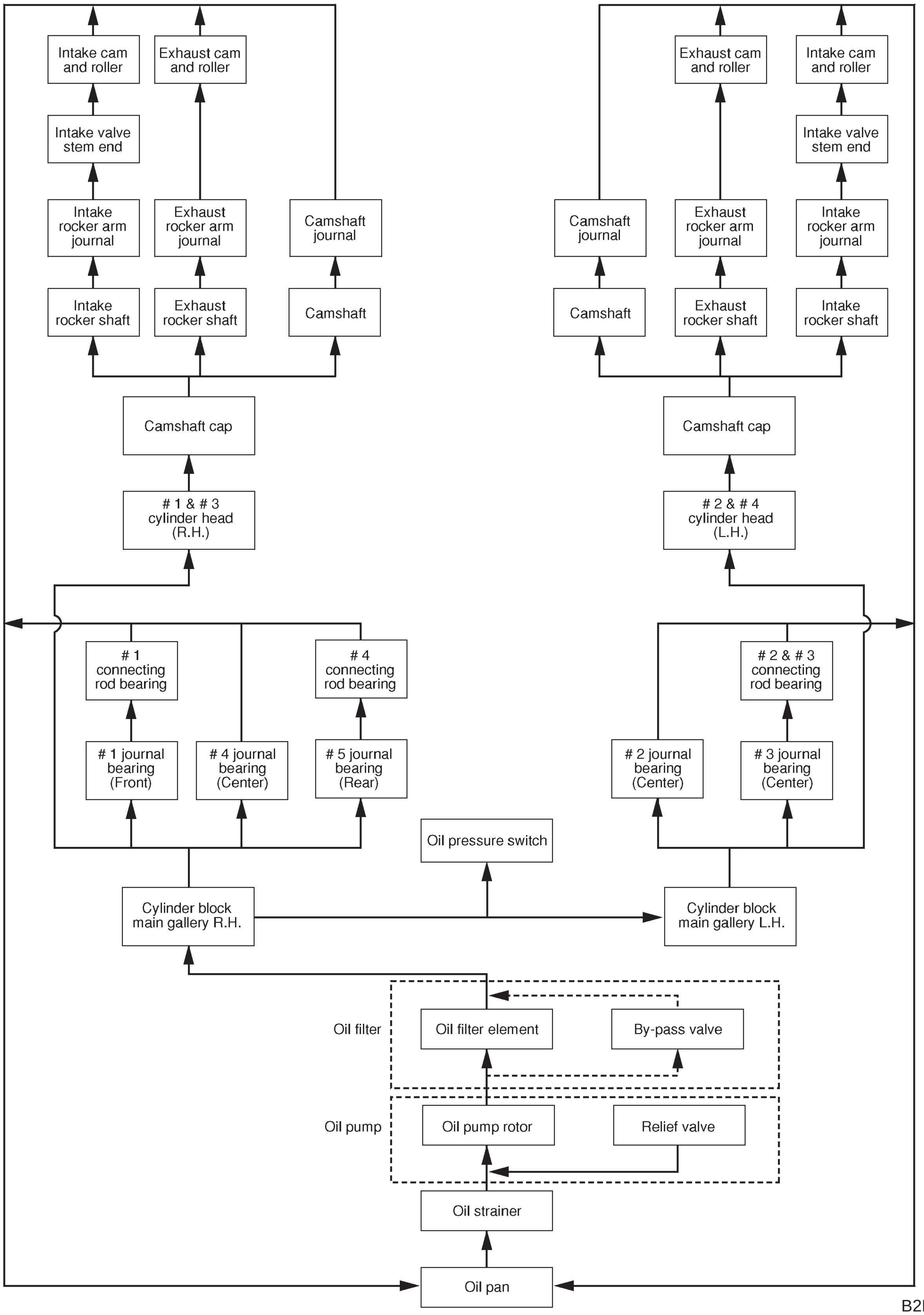
- The lubrication system is a force-fed circulating design and oil pressure is regurated by relief valve built-in the oil pump.
- The oil pump utilizes a thin, large-diameter trochoid design to accomodate the high engine output. This pump is directly driven by the crankshaft.
- The full-flow, paper element type oil filter is provided to improve engine reliability and has a built-in by-pass valve to bypass the engine oil if filter is clogged.
- The oil pan is provided with baffle plates to eliminate the effect of oil suction caused by oil level variations during operation.
- Engine oil discharged from oil pump is delivered to the journal bearings, connecting rod bearings, etc., via the oil passage (on the lower right side of the cylinder block), oil filter, and the oil gallery (on the right of the cylinder block) to provide proper lubrication and cooling.
- Engine oil is also fed under pressure to the cylinder head valve mechanism after the flow is regulated by the orifice provided in the oil gallery.



(1) Oil filter
(2) Oil pump
(3) Oil strainer
(4) Camshaft
(5) Roller
(6) Rocker arm
(7) Rocker shaft

(a) By-pass valve: 157 kPa (1.6 kg/cm^2, 23 psi)
(b) Relief valve: 490 kPa (5.0 kg/cm^2, 71 psi)

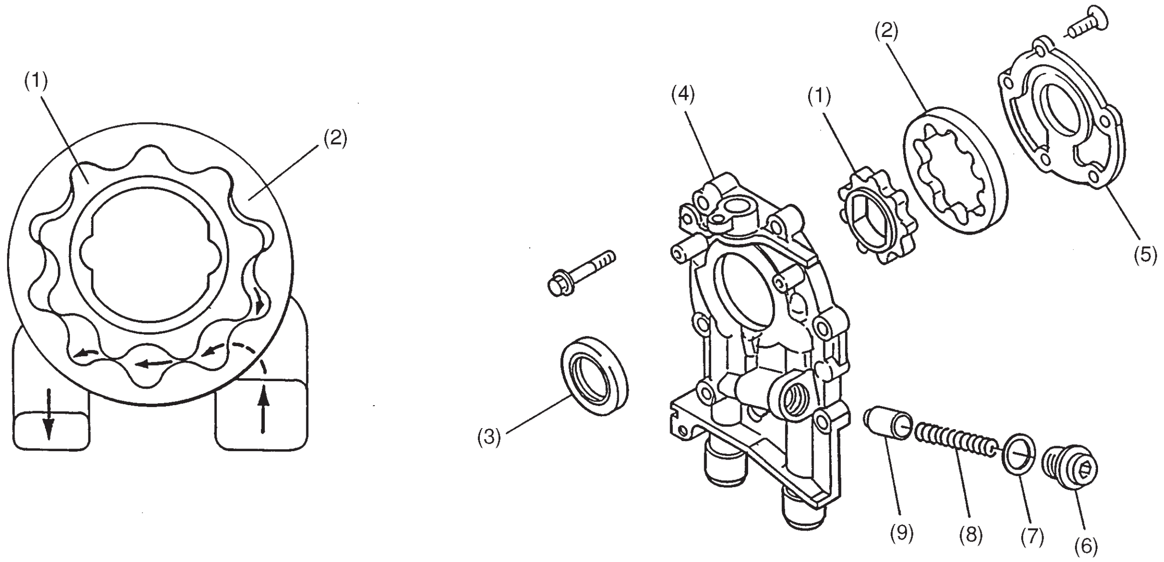
2. Lubrication Lines



B2H1965A

3. Oil Pump

- The trochoid oil pump utilizes an internal oil circulation design which is accomplished by an inner rotor and outer rotor built into the pump body. When the inner rotor is driven by the crankshaft, the outer rotor is rotated, changing the size of the space between the two rotors (because of the different number of teeth used on the rotors).
- Engine oil is sucked into the large space created near the inlet side. It is then carried over to the discharge port and discharged due to it being gradually pressurized as the space carrying it becomes smaller. Oil pressure is regulated by the relief valve located on the discharge side. Excess oil is directly returned to the suction port.

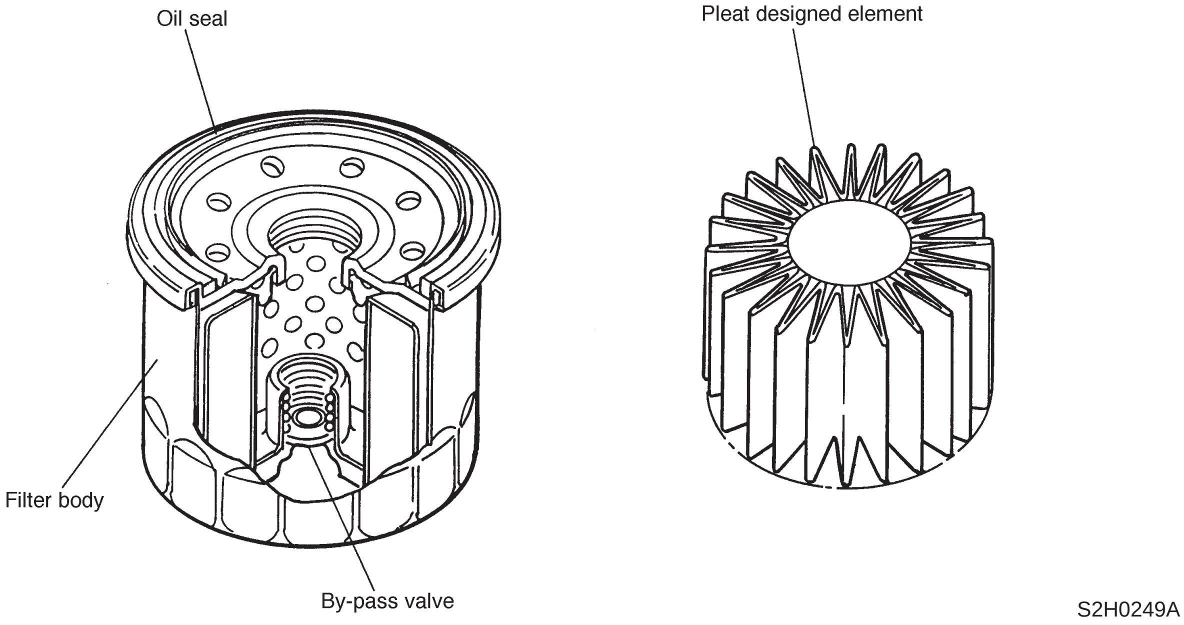


S2H0851A

(1) Inner rotor
(2) Outer rotor
(3) Oil seal
(4) Oil pump case
(5) Oil pump cover
(6) Plug
(7) Washer
(8) Relief valve spring
(9) Relief valve

4. Oil Filter

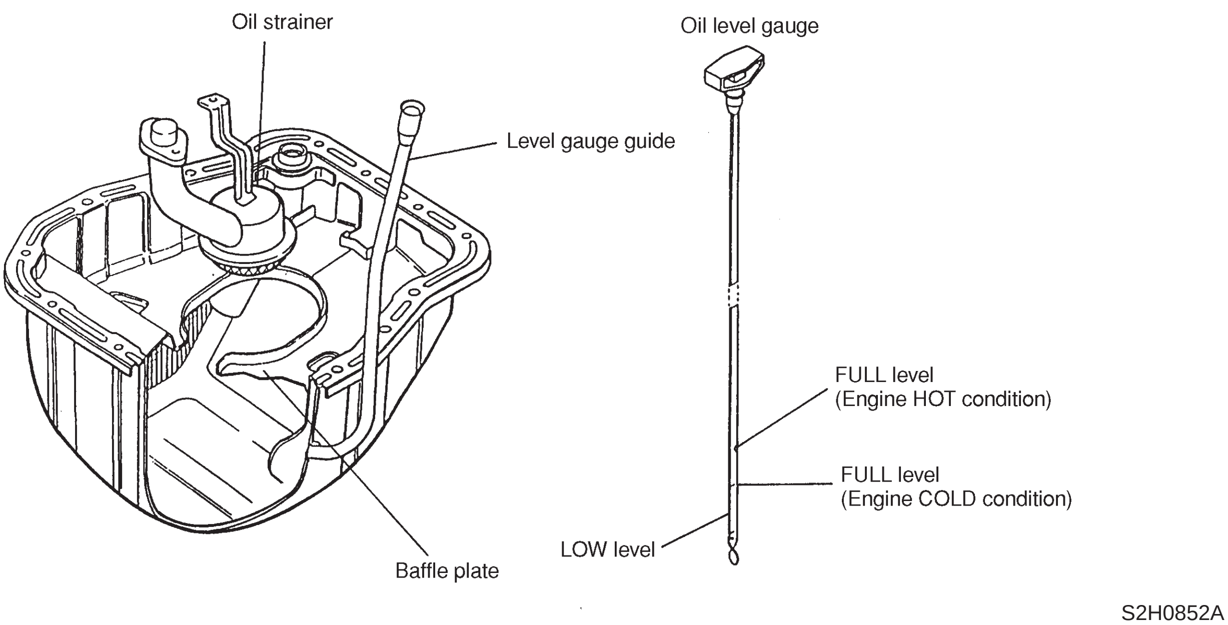
The oil filter is a full-flow cartridge type that utilizes a paper element. It also has a built-in by-pass valve. The filter element has a special pleat design to increase the effective filtering area.



5. Oil Pan & Oil Strainer

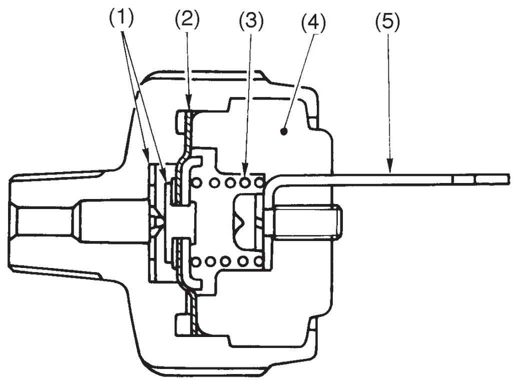
● The oil pan is joined to the cylinder block via liquid gasket. The oil strainer is a metal net type and removes large foreign particles from the engine oil. It is located in the middle of the oil pan. The pipe from the strainer is connected to the suction port on the left side of the cylinder block.

● Baffle plate is placed in the oil pan and the lower side of the cylinder block to stabilize the oil level and strengthen the oil pan.



6. Oil Pressure Switch

The oil pressure switch is located on the front right upper portion of the cylinder block. The purpose of this switch is to monitor the operation of the oil pump as well as the lubricating oil pressure when the engine is running.



(1) Contact point
(2) Diaphragm
(3) Spring
(4) Molded portion
(5) Terminal

1) When oil pressure does not build up (with ignition switch “ON”):
The diaphragm is pushed toward the cylinder block by spring force (equivalent to the specified oil pressure). This closes the contact point to illuminate the oil pressure warning light in the combination meter.

2) When oil pressure reaches the specified value (after engine starts):
After oil pressure reaches the specified value of [14.7 kPa (0.15 kg/cm^2, 2.1 psi)], the diaphragm, pushed by oil pressure, overcomes the spring force. This opens the contact point to turn the oil pressure warning light OFF.

1. General

- The engine cooling system consists of a down-flow radiator which features high heat-dissipation performance, an electric motor fan, a water pump, a thermostat, and an engine coolant temperature sensor.
- The reserve tank is designed to eliminate the need for replenishing coolant.
- On models without an air conditioner, the ECM sends an ON or OFF switch signal to the radiator fan in response to signals from the engine coolant temperature sensor. On models with an air conditioner, the ECM sends ON or OFF switch signals to the radiator main fan and sub fan in response to signals from the engine coolant temperature sensor, vehicle speed sensor 2 and A/C switch.

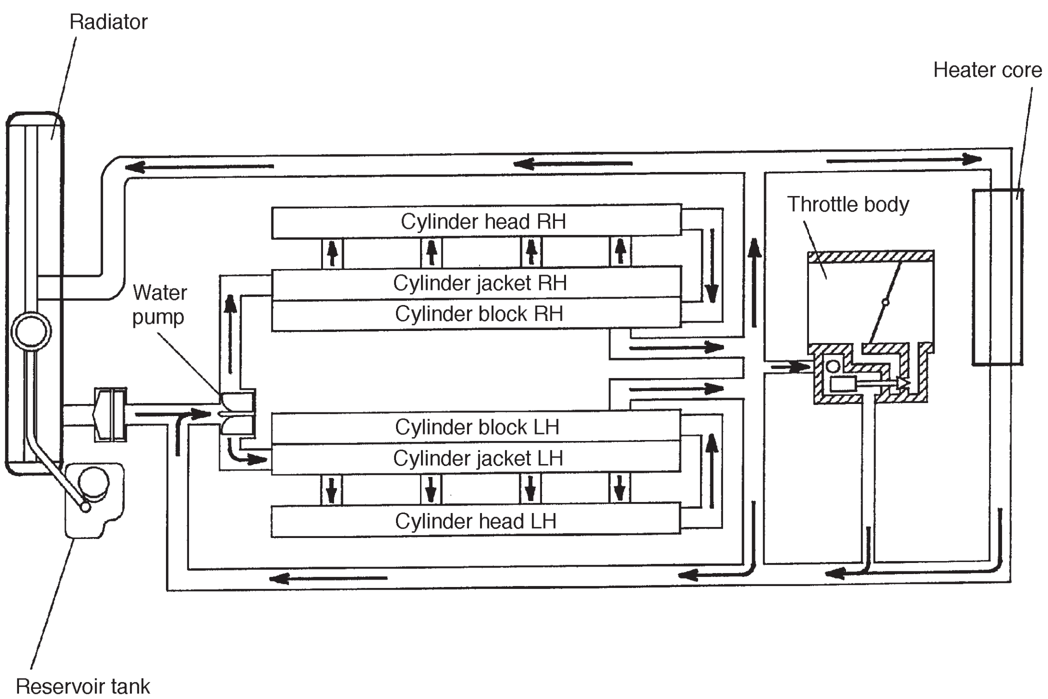
2. Cooling Lines

This cooling system operates in three steps depending on the temperature of the engine coolant flowing through the cooling circuit.

● 1st step ... With thermostat closed
At the engine coolant temperature of below 76°C (169°F), the thermostat remains closed and the engine coolant flows through the bypass and heater circuits.
This permits the engine to warm up quickly.

● 2nd step ... With thermostat opened
When the engine coolant temperature is above 76 – 80°C (169 – 176°F), the thermostat opens and the engine coolant flows through the radiator where it is cooled.

● 3rd step ... With radiator fan operating
When the engine coolant temperature rises above 95°C (203°F), the ECM sends ON signal to the radiator fan in response to signal from the engine coolant temperature sensor and the radiator fan rotates.

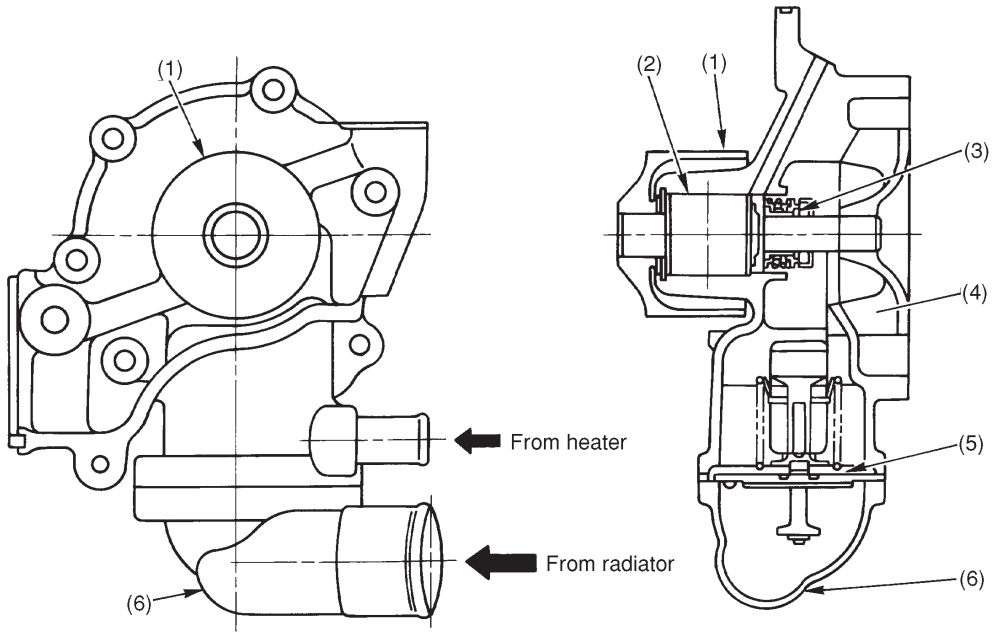


B2H2915A

3. Water Pump

A: MECHANISM

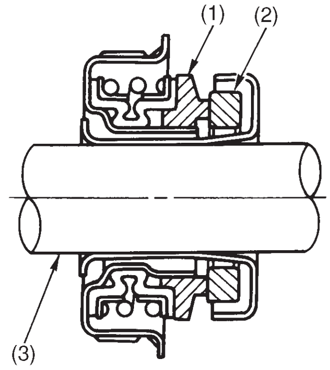
The water pump is located on the left front portion of the cylinder block and is driven by the timing belt. The thermostat is built into the engine coolant inlet located on the lower side of the water pump. When the impeller rotates, engine coolant is drawing into the water pump from the lower pipe (which is connected to the radiator hose) via the thermostat. It then flows along the perimeter of the impeller and is delivered to the engine's engine coolant passage.



(1) Pulley	(3) Mechanical seal	(5) Thermostat
(2) Ball bearing	(4) Impeller	(6) Thermostat case

4. Mechanical Seal

The mechanical seal has its seat pressed into the water pump shaft to form the seal and water pump as a single unit. With this design, the water pump cannot be disassembled.

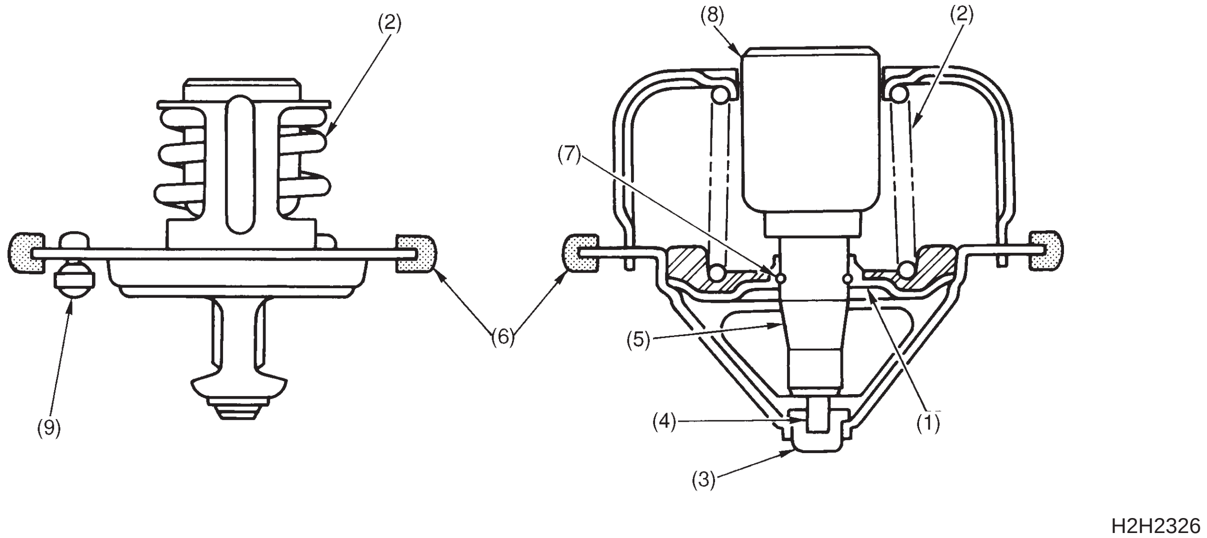


H2H2325

(1) Carbon seal
(2) Ceramics seat
(3) Water pump shaft

5. Thermostat

The thermostat is powered to open the valve by a totally-enclosed wax pellet which expands with increased temperature. It provides the sure open-close operation of the valve and features high durability.

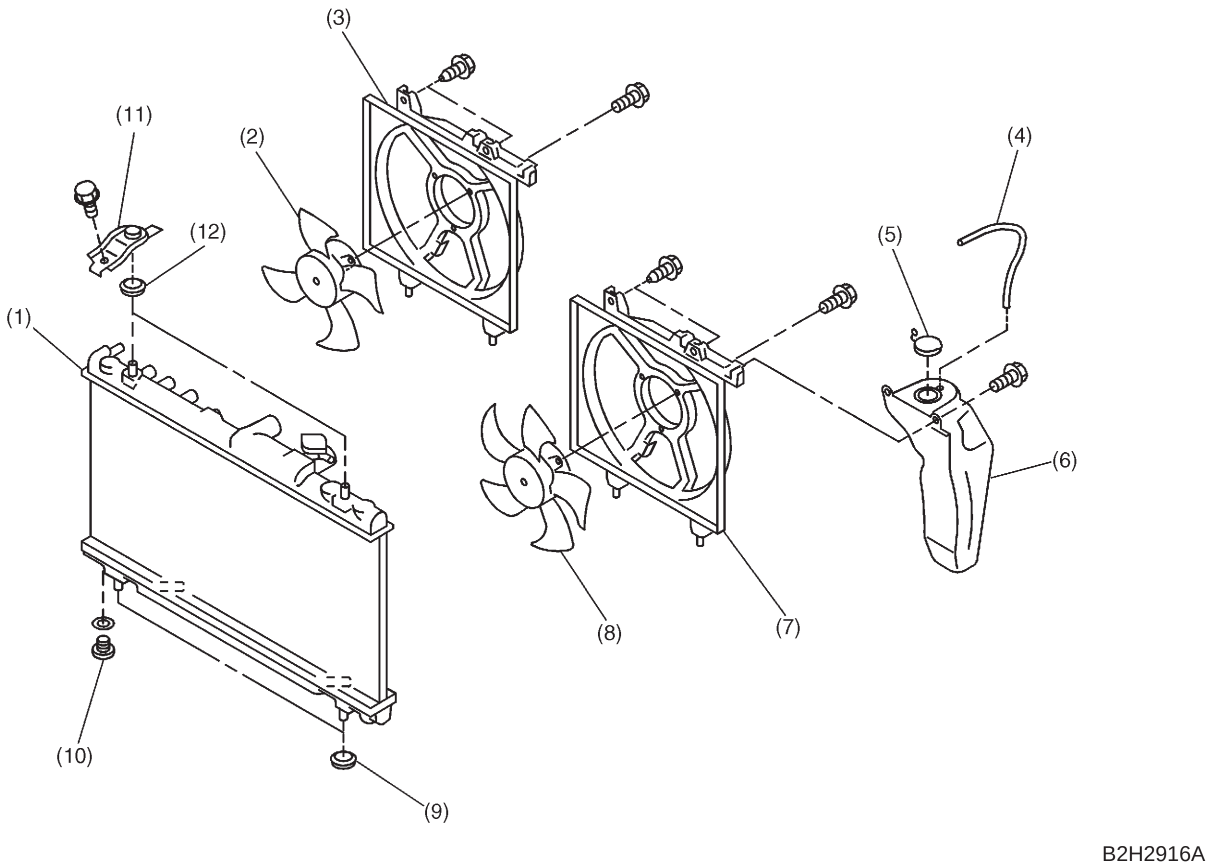


(1) Valve	(4) Piston	(7) Stop ring
(2) Spring	(5) Guide	(8) Wax element
(3) Stopper	(6) Gum packing	(9) Jiggle valve

6. Radiator Fan

A: DESCRIPTION

- The radiator fan is made of plastic. That is installed to the electric motor, and is located onto radiator straight by shroud.
- The vehicle without air conditioning has the radiator main fan only. Thus, the vehicle with air conditioning has the radiator sub fan, too.



(1)	Radiator	(7)	Radiator main fan shroud
(2)	Radiator sub fan and sub fan motor assembly	(8)	Radiator main fan and main fan motor assembly
(3)	Radiator sub fan shroud	(9)	Lower cushion
(4)	Over flow hose	(10)	Drain plug
(5)	Reservoir tank cap	(11)	Upper bracket
(6)	Reservoir tank	(12)	Upper cushion

B: FUNCTION

1. WITHOUT A/C MODEL

The ON-OFF control of the radiator fan is governed by the ECM which receives signals sent from the engine coolant temperature sensor.

Vehicle speed	Engine coolant temperature		
	Less than 95°C (Less than 203°F)	Between 95 and 99°C (Between 203 and 210°F)	More than 100°C (More than 212°F)
	Operation of radiator main fan	Operation of radiator main fan	Operation of radiator main fan
Less than 19 km/h (Less than 12 MPH)	OFF	ON	ON
Between 20 and 69 km/h (Between 12 and 43 MPH)	OFF	ON	ON
Between 70 and 89 km/h (Between 43 and 55 MPH)	OFF	OFF	ON
More than 90 km/h (More than 56 MPH)	OFF	OFF	ON

2. WITH A/C MODEL

On models which are equipped with an air conditioning system, the ECM receives signals sent from the engine coolant temperature sensor, vehicle speed sensor 2 and A/C switch. These signals simultaneously turn ON or OFF the radiator main fan and radiator sub fan.

Vehicle speed	A/C compressor	Engine coolant temperature					
		Less than 95°C (Less than 203°F)		Between 95 and 99°C (Between 203 and 210°F)		More than 100°C (More than 212°F)	
		Operation of radiator fan		Operation of radiator fan		Operation of radiator fan	
		Main	Sub	Main	Sub	Main	Sub
Less than 19 km/h (Less than 12 MPH)	OFF	OFF	OFF	ON	OFF	ON	ON
	ON	ON	ON	ON	ON	ON	ON
Between 20 and 69 km/h (Between 12 and 43 MPH)	OFF	OFF	OFF	ON	OFF	ON	ON
	ON	ON	ON	ON	ON	ON	ON
Between 70 and 89 km/h (Between 43 and 55 MPH)	OFF	OFF	OFF	OFF	OFF	ON	ON
	ON	ON	OFF	ON	ON	ON	ON
More than 90 km/h (More than 56 MPH)	OFF	OFF	OFF	OFF	OFF	ON	ON
	ON	OFF	OFF	ON	OFF	ON	ON

1. General

● The Multipoint Fuel Injection (MFI) system is a system that supplies the optimum air-fuel mixture to the engine for all the various operating conditions through the use of the latest electronic technology.

With this system fuel, which is pressurized at a constant pressure, is injected into the intake air port of the cylinder head. The injection quantity of fuel is controlled by an intermittent injection system where the electro-magnetic injection valve (fuel injector) opens only for a short period of time, depending on the quantity of air required for one cycle of operation. In actual operation, the injection quantity is determined by the duration of an electric pulse applied to the fuel injector and this permits simple, yet highly precise metering of the fuel.

● Further, all the operating conditions of the engine are converted into electric signals, and this results in additional features of the system, such as large improved adaptability, easier addition of compensating element, etc.

The MFI system also has the following features:

● Reduced emission of harmful exhaust gases

● Reduced in fuel consumption

● Increased engine output

● Superior acceleration and deceleration

● Superior startability and warm-up performance in cold weather since compensation is made for coolant and intake air temperature.

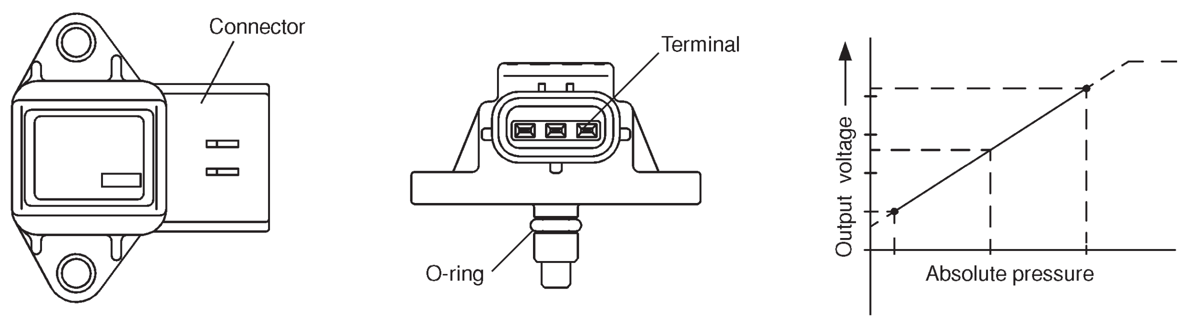
2. Air Line (MT Vehicles)

A: GENERAL

Air which is drawn in and filtered by the air cleaner is metered and sent to the throttle body. From the throttle body, the air is regulated by the open-close operation of the throttle valve and is delivered to the intake manifold. It is then distributed to the respective cylinders to mix with fuel injected by the fuel injectors. Thus, the air-fuel mixture is delivered into the cylinder. Part of the air branched at the upstream of the throttle body is sent to the idle air control solenoid valve which regulates engine idle speed.

B: INTAKE MANIFOLD PRESSURE SENSOR

- The intake manifold pressure sensor is connected directly to the throttle body, and constantly measures the absolute pressure of the intake manifold. The pressure that is measured is converted into an electrical signal, and is sent to the ECM. The ECM controls the fuel injection and ignition timing based on the intake manifold absolute pressure signal from the pressure sensor.



B2H1966A

C: THROTTLE BODY

In response to the depressing stroke of the accelerator pedal, the throttle body opens/closes its valve to regulate the air volume to be taken in the combustion chamber.

During idling, the throttle valve is almost fully closed and the air flow through the throttle body is less than that passing through the carburetor.

More than half of the air necessary for idling is supplied to the intake manifold via the idle air control solenoid valve.

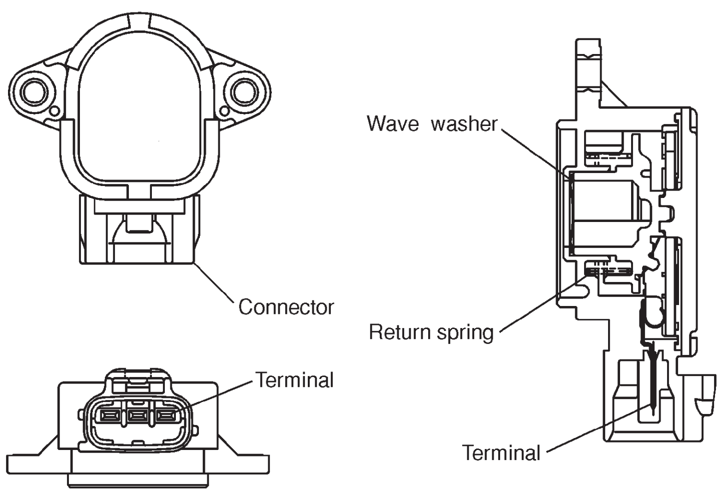
And the idle air control solenoid valve properly controls the engine idle speed, so it does not need to be adjusted.

D: THROTTLE POSITION SENSOR

● A throttle position sensor is provided with a potentiometer which is interlocked with the throttle valve shaft.

● This throttle position sensor sends the ECM a potentiometer output signal corresponding to the opening of the throttle valve. When the level of this signal exceeds a predetermined value, the ECM interprets it as complete closure of the throttle valve and makes a control most suitable for the engine operation with the throttle valve fully closed. For correcting error of this signal, the ECM is provided with a learning function.

● Thus, the ECM precisely controls the air-fuel ratio during acceleration and deceleration as well as engine idling.

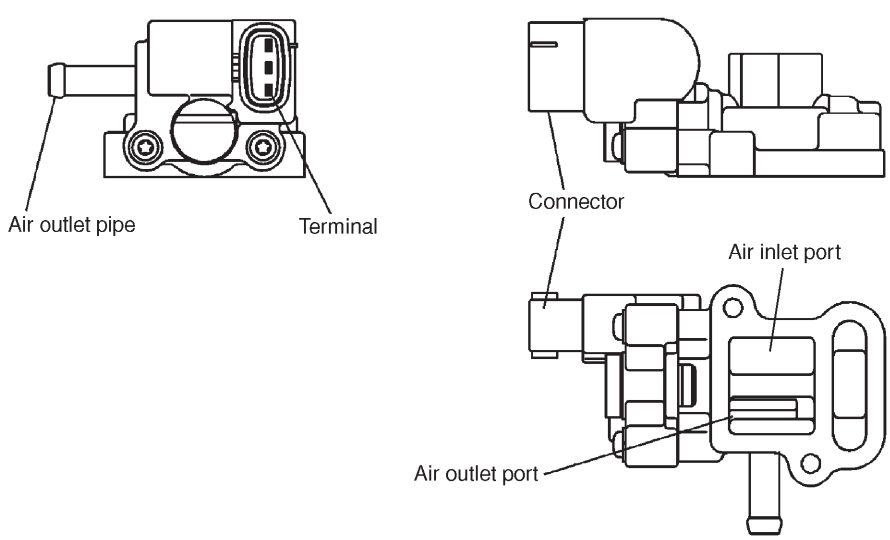


B2H1967A

E: IDLE AIR CONTROL SOLENOID VALVE

● The idle air control solenoid valve is incorporated in the throttle body and regulates the amount of intake air which bypasses the throttle valve built into the throttle body. It is activated by a signal sent from the ECM to mainly maintain engine idle speed to the target engine speed.

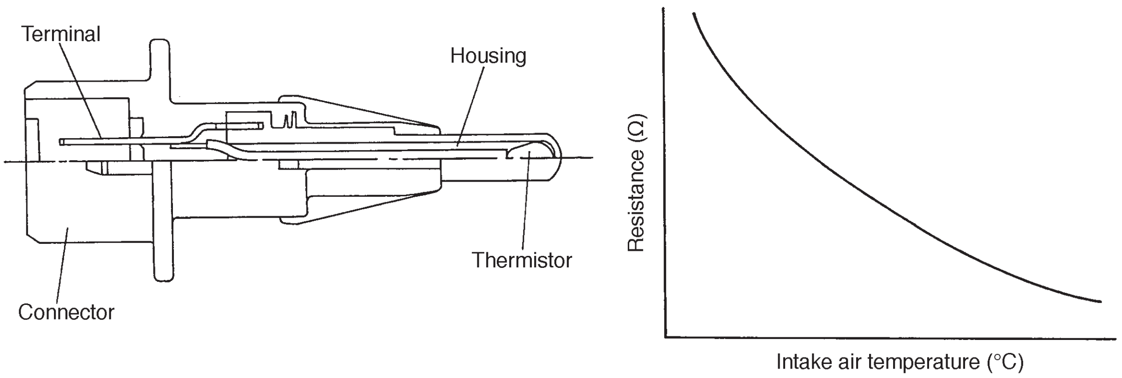
● The idle air control solenoid valve is a rotary valve solenoid type which consists of a coil, rotary valve, spring and housing. The housing is integral with the throttle body and is provided with the opening area of bypass air port which is changed by the rotary valve.



B2H1968B

F: INTAKE AIR TEMPERATURE SENSOR

- The intake air temperature sensor is mounted on the air cleaner case for detecting the temperature of the intake air introduced through the air intake duct. The ECM uses the resistance signal from the sensor to correct the fuel injection amount.



B2H1428

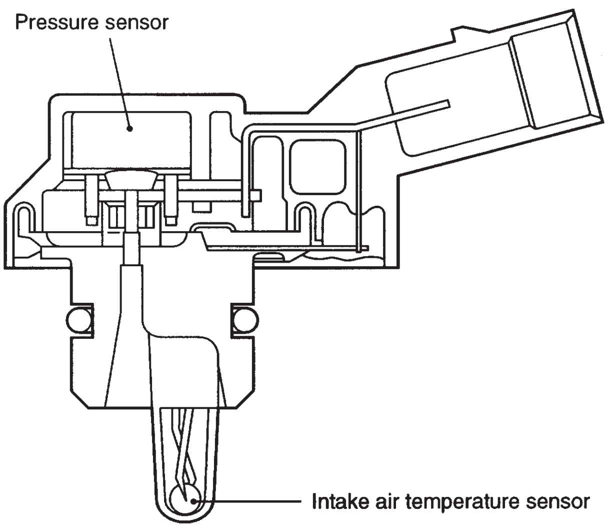
3. Air Line (AT Vehicles)

A: GENERAL

Air which is drawn in and filtered by the air cleaner is metered and sent to the throttle body. From the throttle body, the air is regulated by the open-close operation of the throttle valve and is delivered to the intake manifold. It is then distributed to the respective cylinders to mix with fuel injected by the fuel injectors. Thus, the air-fuel mixture is delivered into the cylinder. Part of the air branched at the upstream of the throttle body is sent to the idle air control solenoid valve which regulates engine idle speed.

B: PRESSURE SENSOR

● The pressure sensor is of the type that is made integral with an intake air temperature sensor and is mounted on the intake manifold to measure the absolute air pressure in the intake manifold as well as it’s temperature.
The measured pressure and temperature of the air is then coverted into electrical signals and sent to the ECM. The ECM uses those signals from the sensor to control injection and ignition timing as well as the fuel injection amount.

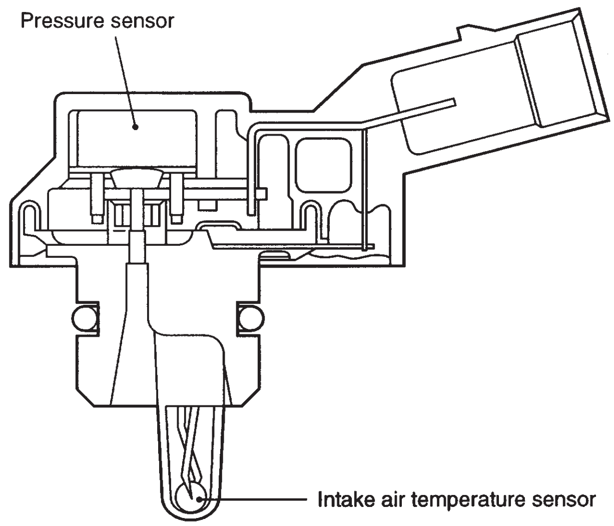


H2H2825A

C: INTAKE AIR TEMPERATURE SENSOR

- The intake air temperature sensor is of the type that is made integral with a pressure sensor and is mounted on the intake manifold to measure the temperature of the intake air introduced through the air intake duct as well as it's pressure.

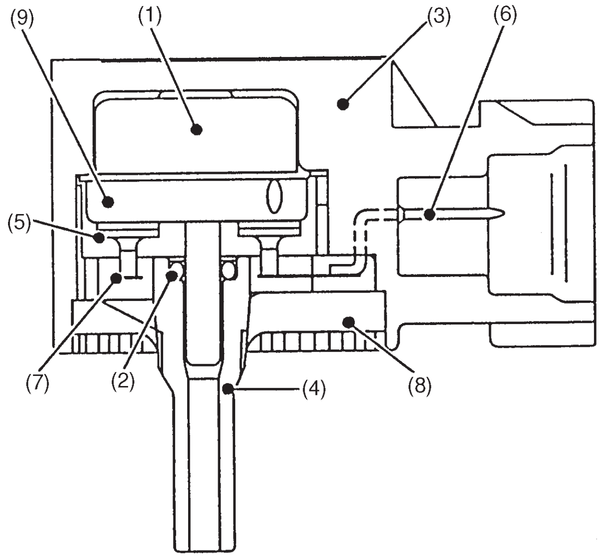
The measured temperature and pressure of the air is then coverted into electrical signals and sent to the ECM. The ECM uses those signals from the sensor to control the fuel injection amount as well as injection and ignition timing.



H2H2825A

D: ATMOSPHERIC PRESSURE SENSOR

The atmospheric pressure sensor receives the atmospheric pressure, converts the pressure values into signals, and sends the signals to ECM.



(1) Sensor unit	(6) Terminal
(2) O-ring	(7) Inner lead
(3) Case	(8) Resin
(4) Pipe	(9) Metal lid
(5) Through capacity	

E: THROTTLE BODY

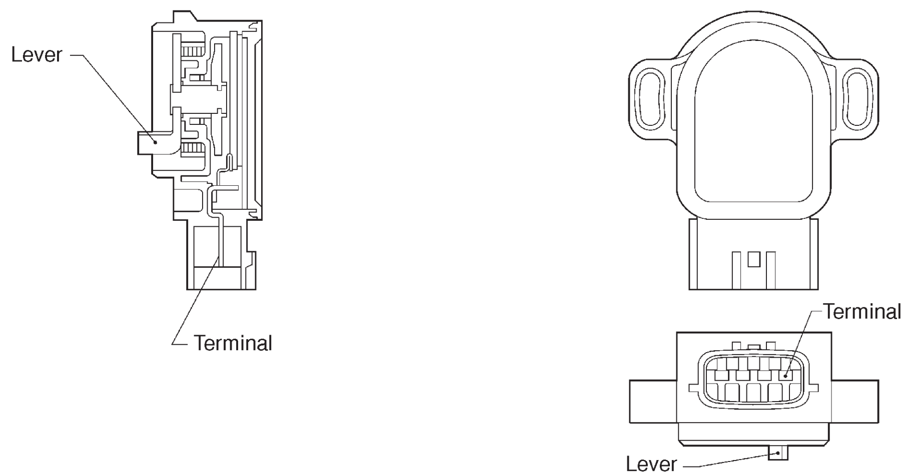
- In response to the depressing stroke of the throttle pedal, the throttle body opens/closes its valve to regulate the air volume to be taken in the combustion chamber.
- During idling, the throttle valve is almost fully closed and the air flow through the throttle body is less than that passing through the carburetor.
- More than half of the air necessary for idling is supplied to the intake manifold via the idle air control solenoid valve.
- And the idle air control solenoid valve properly controls the engine idle speed, so it does not need to be adjusted.

F: THROTTLE POSITION SENSOR

● A throttle position sensor is provided with a potentiometer which is interlocked with the throttle valve shaft.

● This throttle position sensor sends the ECM a potentiometer output signal corresponding to the opening of the throttle valve. When the level of this signal exceeds a predetermined value, the ECM interprets it as complete closure of the throttle valve and makes a control most suitable for the engine operation with the throttle valve fully closed. For correcting error of this signal, the ECM is provided with a learning function.

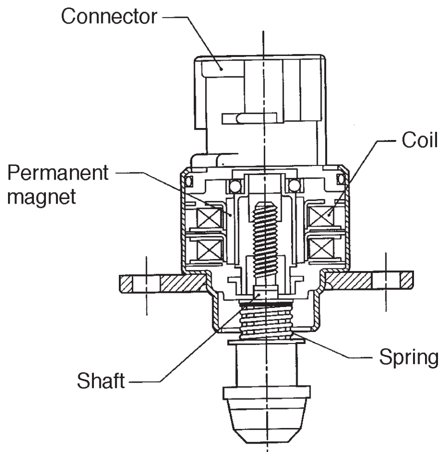
● Thus, the ECM precisely controls the air-fuel ratio during acceleration and deceleration as well as engine idling.



B2H2004A

G: IDLE AIR CONTROL SOLENOID VALVE

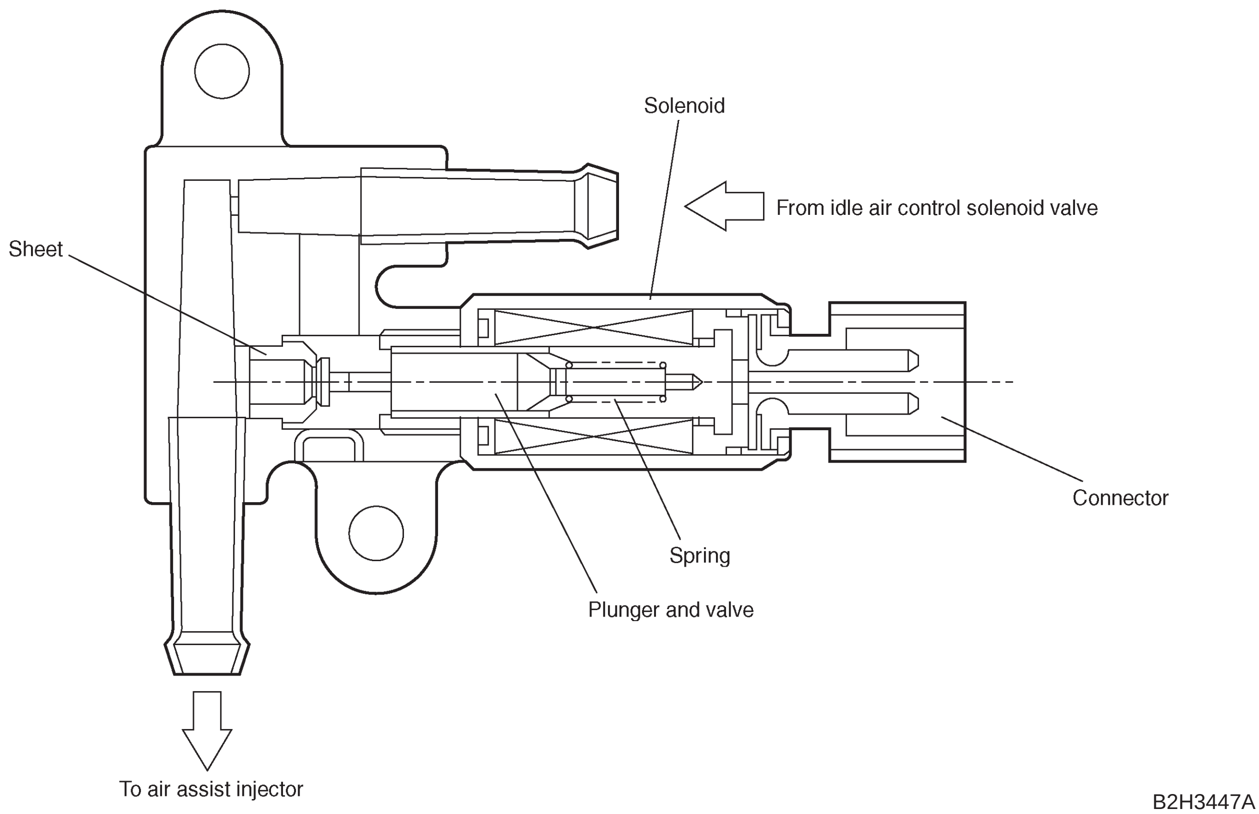
- The idle air control solenoid valve is incorporated in the throttle body and regulates the amount of intake air which bypasses the throttle valve built into the throttle body. It is activated by a signal sent from the ECM to mainly maintain engine idle speed to the target engine speed.
- The idle air control solenoid valve is a “stepping motor” type solenoid valve which consists of coils, shaft, permanent magnet, spring and housing. The housing is integral with the throttle body.
- In stepping motor type air control solenoid valve, current flows sequentially through a series of paired coils which are arranged face to face with the shaft between, while alternating the polarity for each pair of coils.
- The shaft is provided with threads at the rear end around which permanent magnets are arranged.
- As current flows through a series of paired coils sequentially while alternating the polarity, the N and S poles of the permanent magnets of the shaft end are repelled by the same poles of the coils, which causes the shaft to turn.
The shaft, provided with threads, goes upward or downward like a screw when it is turned.
- This upward and downward motions of the shaft open or close the valve port, adjusting the amount of bypass air.
- The shaft changes its turning direction when the current flowing direction is reversed.



B2H2005A

H: AIR ASSIST INJECTOR SOLENOID VALVE

The air assist injector solenoid valve is located in the piping between the throttle body and the air assist injector and secured on the intake manifold.
This solenoid valve is opened or closed according to signals from ECU, adjusting the air flow rate supplied to the air assist injector.

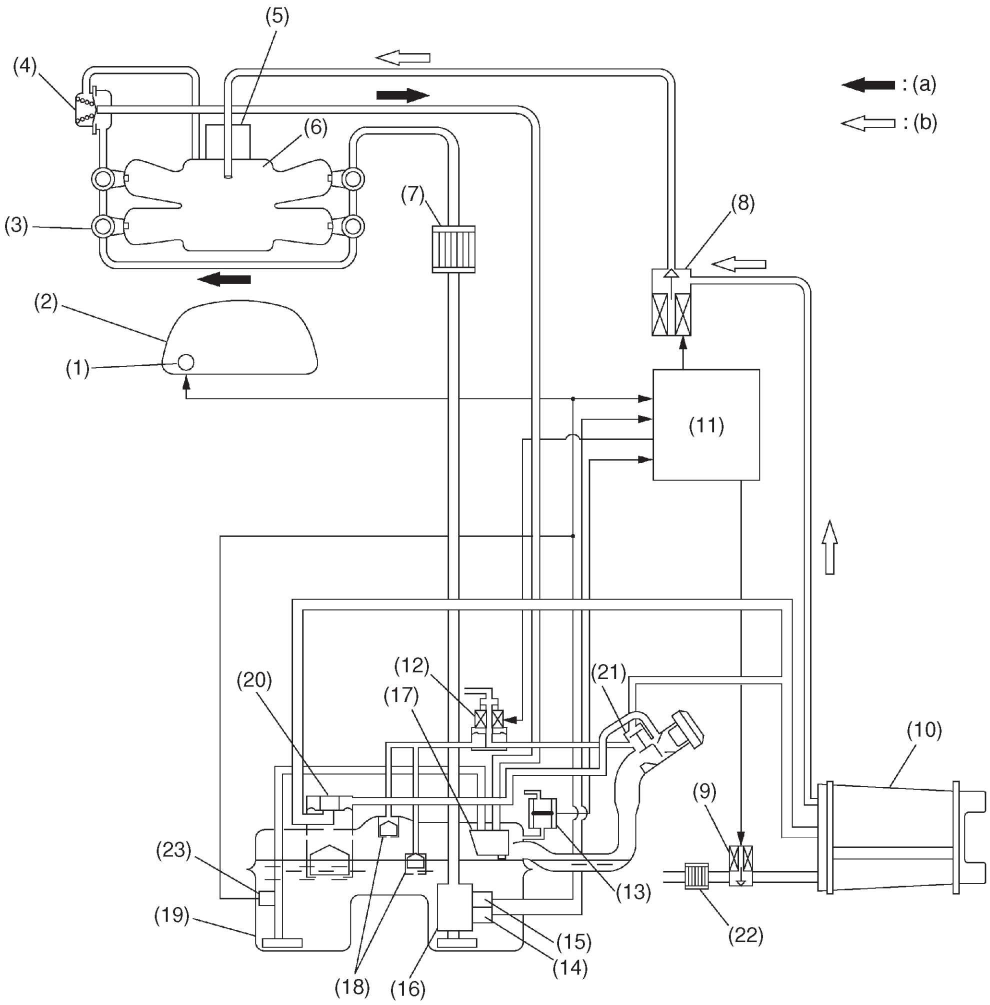


4. Fuel Line

A: GENERAL

- Fuel pressurized by the fuel pump built into the fuel tank is delivered to fuel injectors by way of the fuel pipe and fuel filter. Fuel is regulated to the optimum pressure level by the pressure regulator on the way to the injectors.
- From the injectors, fuel is injected into the intake port of each cylinder where it is mixed with intake air, and is then delivered to the respective cylinders.

Fuel injection timing and the amount of fuel injected is regulated by the ECM.

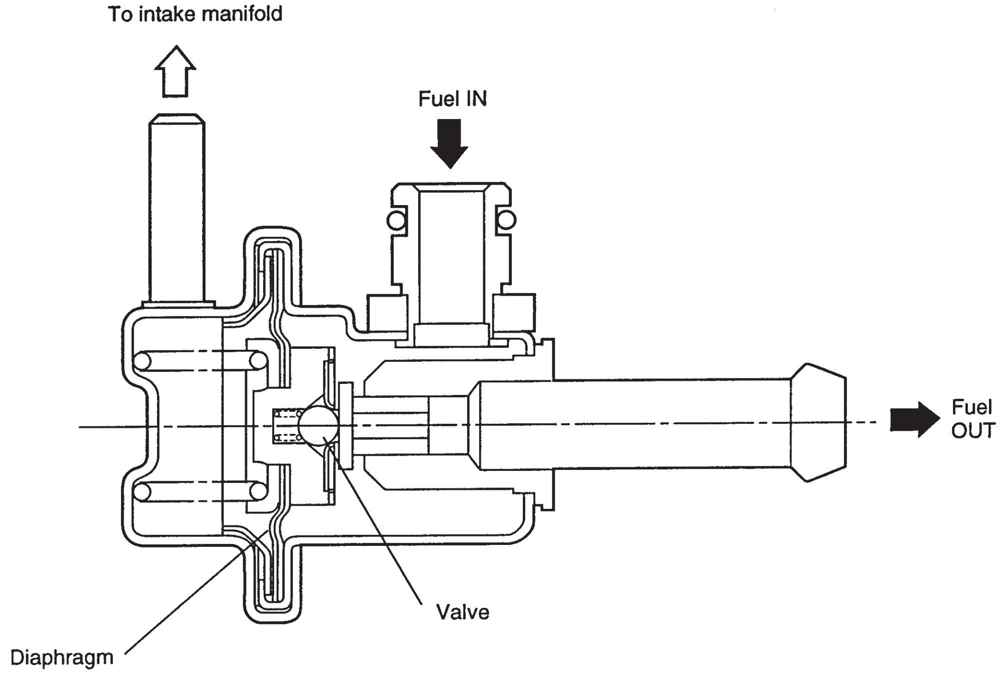


B2H3444A

(1)	Fuel gauge	(10)	Canister	(19)	Fuel tank
(2)	Combination meter	(11)	ECM	(20)	Vent valve
(3)	Fuel injector	(12)	Pressure control solenoid valve	(21)	Shut valve
(4)	Pressure regulator	(13)	Fuel tank pressure sensor	(22)	Drain filter
(5)	Throttle body	(14)	Fuel temperature sensor	(23)	Fuel sub level sensor
(6)	Intake manifold	(15)	Fuel level sensor		
(7)	Fuel filter	(16)	Fuel pump	(a)	Fuel line
(8)	Purge control solenoid valve	(17)	Jet pump	(b)	Evaporation line
(9)	Drain valve	(18)	Fuel cut valve		

B: PRESSURE REGULATOR

- The pressure regulator is divided into the fuel chamber and the spring chamber by the diaphragm as illustrated below. Fuel is fed to the fuel chamber through the fuel inlet connected with the injector. A difference in pressure between the fuel chamber and the spring chamber connected with the intake manifold causes the diaphragm to be pushed down, and fuel is fed back to the fuel tank through the return line.
- By returning fuel so as to balance the above pressure difference and the spring force, the fuel pressure is kept at a constant level 294 kPa (3.00 kg/cm^2, 43.0 psi): MT vehicle, 299.1 kPa (3.05 kg/cm^2, 43.4 psi): AT vehicle against the intake manifold pressure.



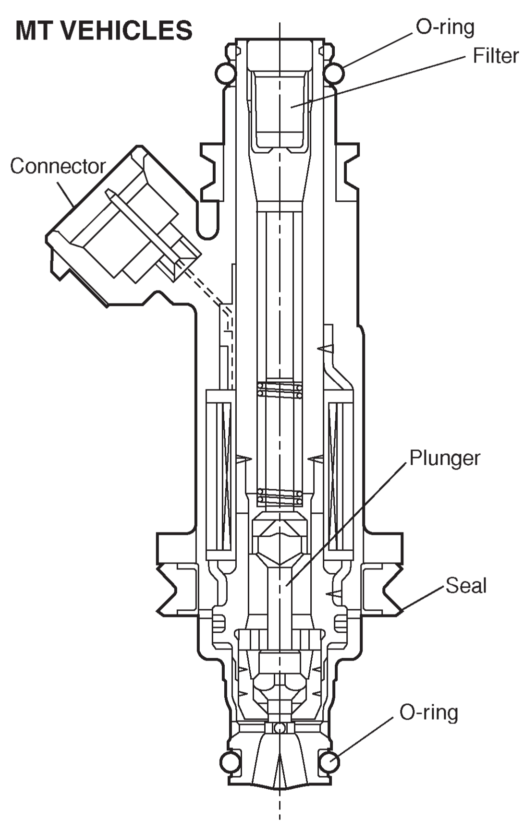
S2H0623

C: FUEL INJECTOR

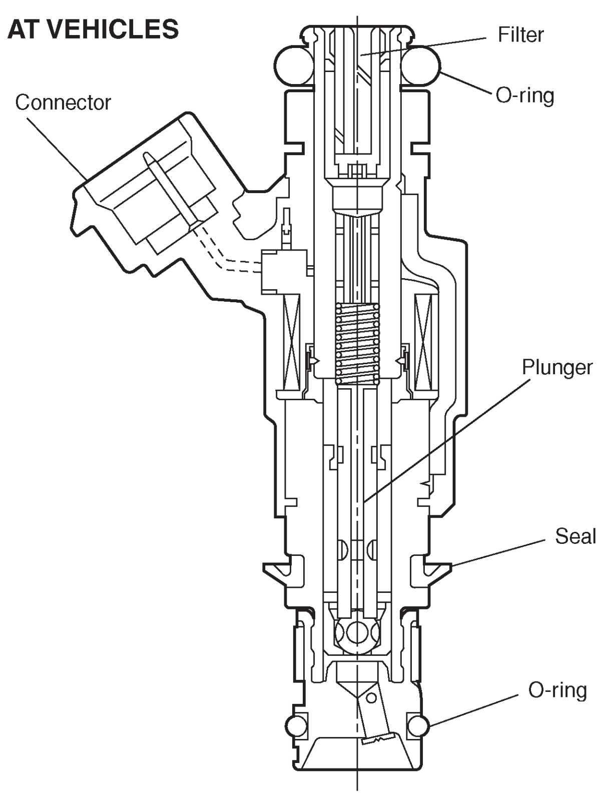
- The MFI system employs a top feed type fuel injector with air assist system.
- The top feed type fuel injector is installed in the fuel pipe to allow cooling of the injector by the fuel.
- The features of this type of fuel injector are as follows:

1) High heat resistance
2) Low driving noise
3) Easy to service
4) Small size

- The fuel injector injects fuel according to the valve open signal received from the ECM.
- The nozzle is attached on the top of the fuel injector. The needle valve is lifted by the solenoid coil through the plunger on arrival of the valve open signal.
- Since the injection opening, the lifted level of valve and the regulator-controlled fuel pressure are kept constant, the amount of fuel to be injected can be controlled only by the valve open signal from the ECM.
- Fuel is atomized using air supplied from the idle air control solenoid valve, which contributes to not only higher combustion efficiency and higher output but also cleaner exhaust emission.



B2H3517A

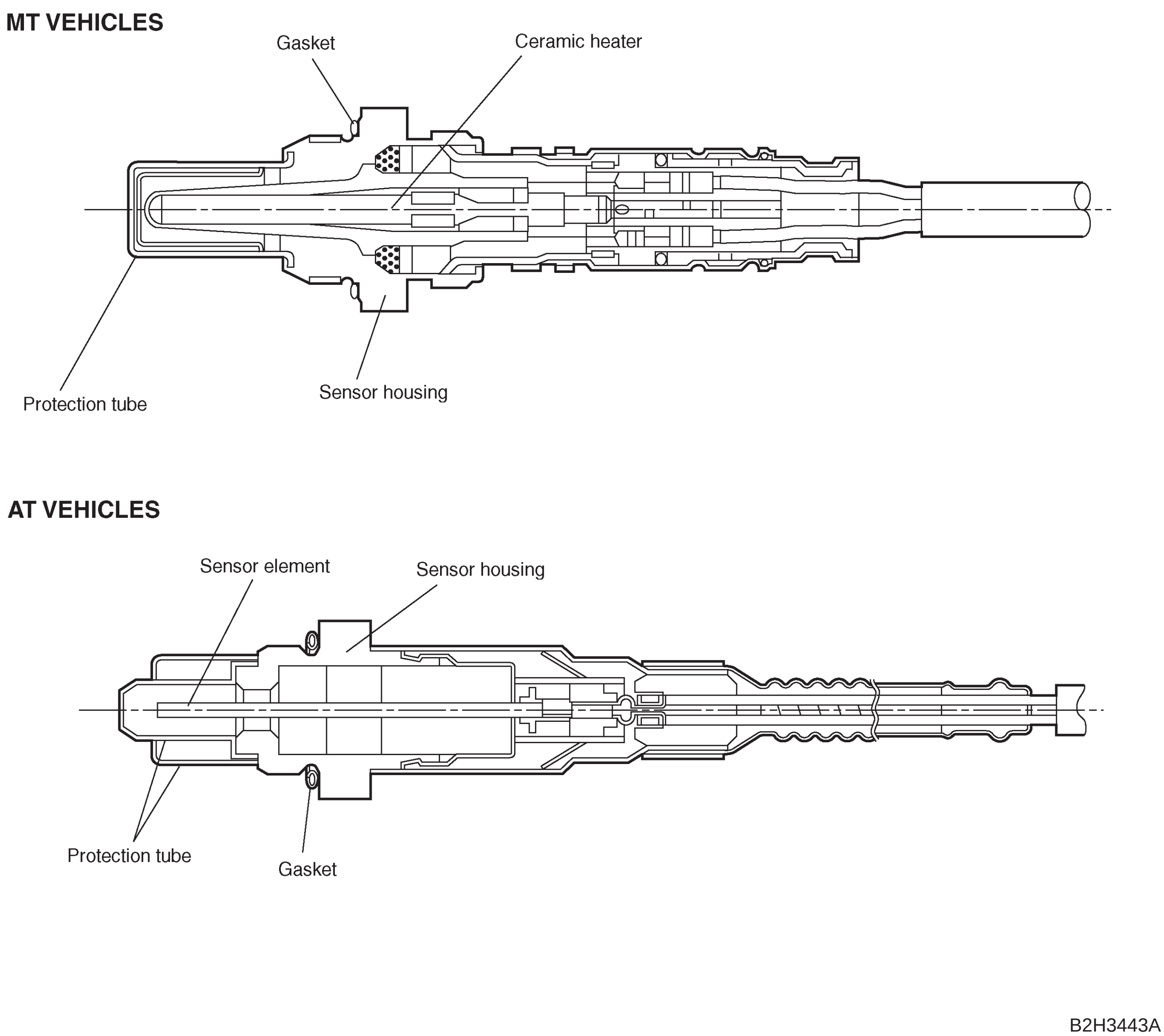


B2H3442A

5. Sensor and Switch

A: FRONT OXYGEN (A/F) SENSOR

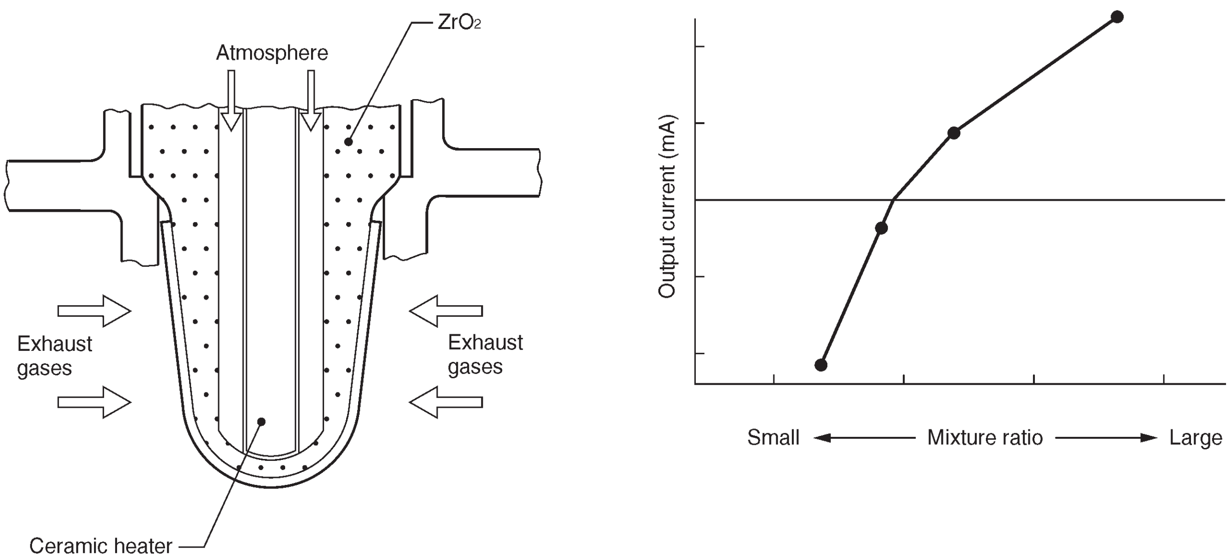
- The front oxygen (A/F) sensor uses zirconium oxide (ZrO_2) which is a solid electrolyte, at portions exposed to exhaust gas.
- The zirconium oxide has the property of generating electromotive force when contacting an oxygen ion, and the electromotive force generated varies depending on the amount of oxygen ion.
- The front oxygen (A/F) sensor detects the amount of oxygen in exhaust gases in a linear form by making use of this property. The sensor housing is grounded to the exhaust pipe, and the inside is connected to the ECM through the harness.
- A ceramic heater is employed to improve performance at low temperature.



● When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases reacts almost completely through the catalytic action of the platinum coating on the surface of the zirconia tube. This results is a very large difference in the oxygen concentration between the inside and outside, and the electromotive force generated is large.

● When a lean air-fuel mixture is burnt in the cylinder, oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen concentration. The electromotive force is very small.

● The difference in oxygen concentration changes greatly in the vicinity of the optimum air-fuel ratio, and hence the change in the electromotive force is also large. By inputting this information into the ECM, the air-fuel ratio of the supplied mixture can be determined easily. The front oxygen (A/F) sensor does not generate much electromotive force when the temperature is low. The characteristics of the electromotive force stabilize at temperature of approximately 700°C (1,292°F).



B2H2006A

B: REAR OXYGEN SENSOR

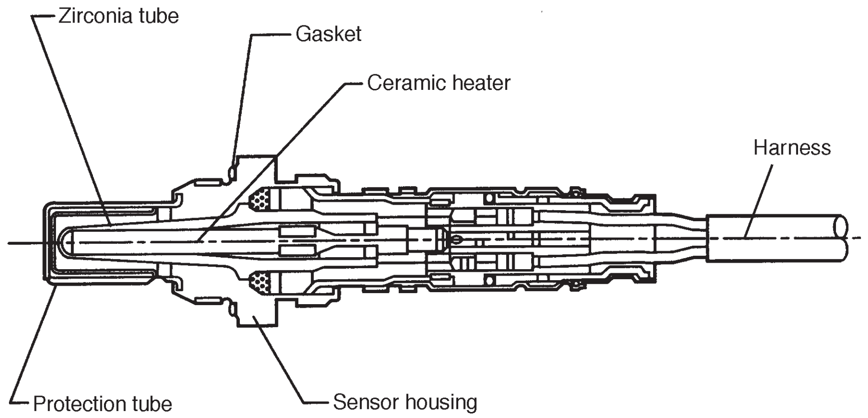
● The rear oxygen sensor is used to sense oxygen concentration in the exhaust gas. If the fuel ratio is leaner than the stoichiometric ratio in the mixture (i.e. excessive amount of air), the exhaust gas contains more oxygen. To the contrary, if the fuel ratio is richer than the stoichiometric ratio, the exhaust gas contains hardly any oxygen.

● Therefore, examination of the oxygen concentration in exhaust gas makes it possible to show whether the air/fuel ratio is leaner or richer than the stoichiometric ratio.

● The rear oxygen sensor has a zirconia tube (ceramic) which generates voltage if there is a difference in oxygen concentration between the inside and outside of the tube. Platinum is coated on the inside and outside of the zirconia tube for the purpose of catalysis and electrode provision. The sensor housing is grounded to the exhaust pipe, and the inside is connected to the ECM through the harness.

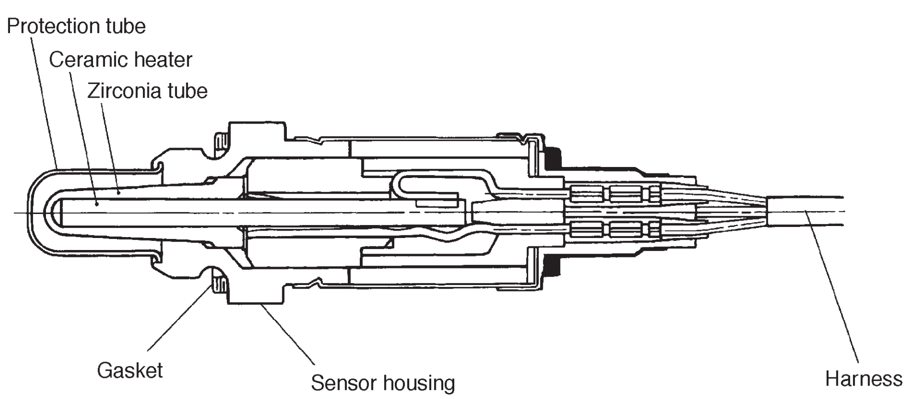
● A ceramic heater is employed to improve performance at low temperature.

MT VEHICLES



B2H1993B

AT VEHICLES

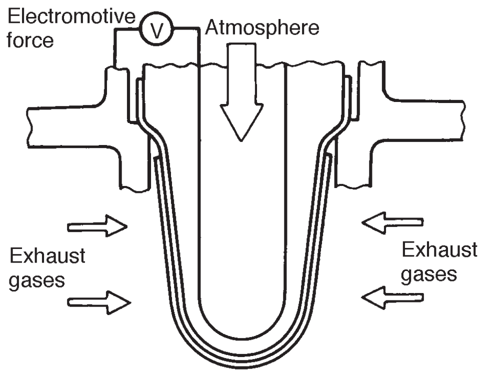


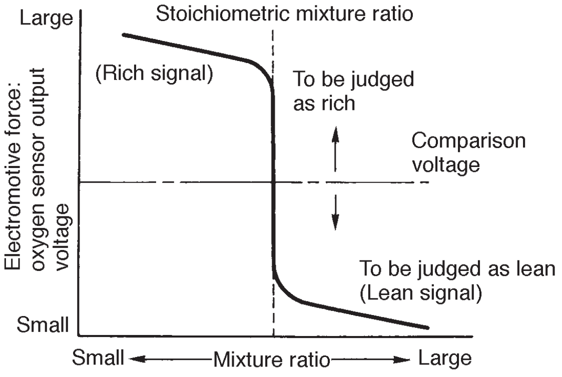
B2H3810A

● When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases reacts almost completely through the catalytic action of the platinum coating on the surface of the zirconia tube. This results is a very large difference in the oxygen concentration between the inside and outside, and the electromotive force generated is large.

● When a lean air-fuel mixture is burnt in the cylinder, oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen concentration. The electromotive force is very small.

● The difference in oxygen concentration changes greatly in the vicinity of the optimum air-fuel ratio, and hence the change in the electromotive force is also large. By inputting this information into the ECM, the air-fuel ratio of the supplied mixture can be determined easily. The oxygen sensor does not generate much electromotive force when the temperature is low. The characteristics of the electromotive force stabilize at temperature of approximately 300 to 400°C (572 to 752°F).

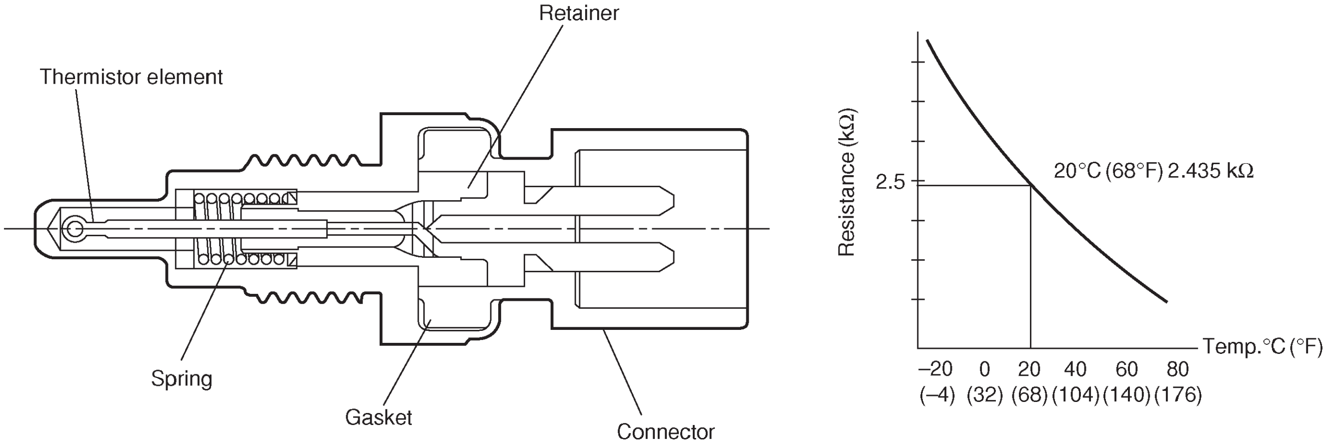




G2H0038

C: ENGINE COOLANT TEMPERATURE SENSOR

- The engine coolant temperature sensor is located on the engine coolant pipe which is made of aluminum alloy. Its thermistor changes resistance with respect to temperature. A engine coolant temperature signal converted into resistance is transmitted to the ECM to control the amount of fuel injection, ignition timing, purge control solenoid valve, etc.

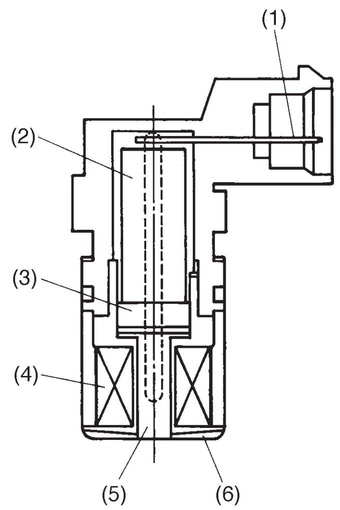


B2H3452A

D: CRANKSHAFT POSITION SENSOR

1. MT VEHICLES

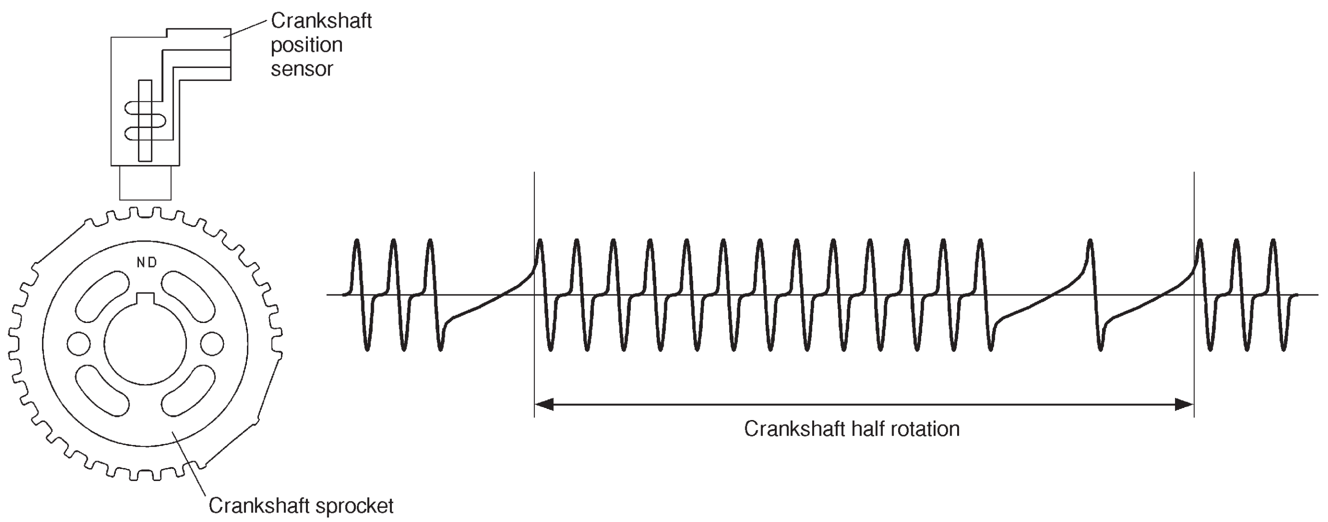
- The crankshaft position sensor is installed on the oil pump, located in the front center portion of the cylinder block, to detect the crankshaft position. It is designed so that the ECM accurately reads the number of pulses which occur when protrusions provided at the perimeter of the crankshaft sprocket (rotating together with the crankshaft) cross the crankshaft position sensor.
- The crankshaft position sensor is a molded type which consists of a magnet, core, coil, terminals, etc.



B2H0407B

(1) Terminal	(4) Coil
(2) Yoke core	(5) Core
(3) Magnet	(6) Cover

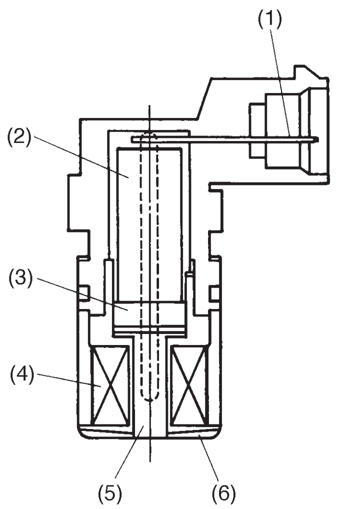
- Crankshaft rotation causes these protrusions to cross the crankshaft position sensor so that magnetic fluxes in the coil change with the change in air gap between the sensor pickup and the sprocket. The change in air gap induces an electromotive force which is transmitted to the ECM.



B2H3811A

2. AT VEHICLES

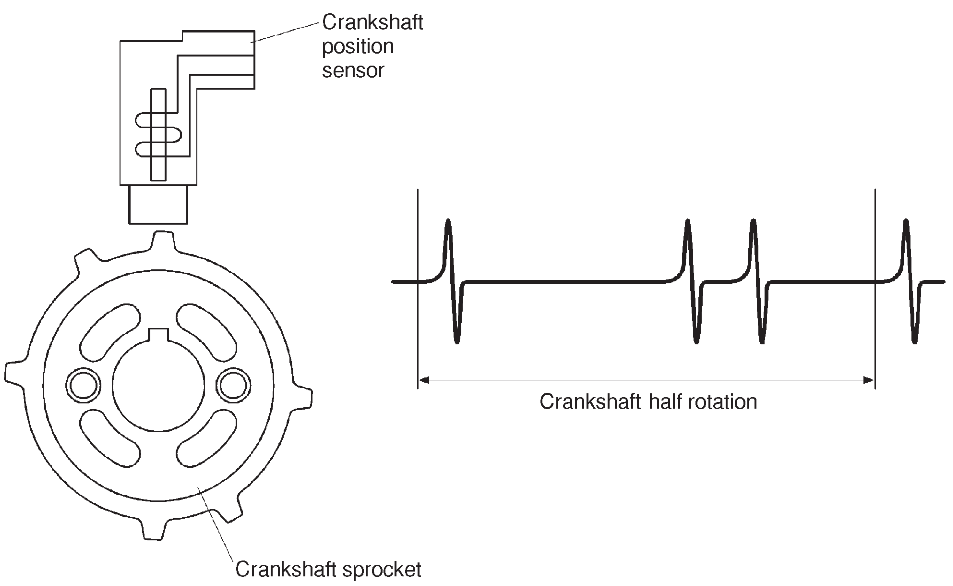
- The crankshaft position sensor is installed on the oil pump, located in the front center portion of the cylinder block, to detect the crankshaft position. It is designed so that the ECM accurately reads the number of pulses which occur when protrusions provided at the perimeter of the crankshaft sprocket (rotating together with the crankshaft) cross the crankshaft position sensor.
- The crankshaft position sensor is a molded type which consists of a magnet, core, coil, terminals, etc.



B2H0407B

(1) Terminal	(4) Coil
(2) Yoke core	(5) Core
(3) Magnet	(6) Cover

- Crankshaft rotation causes these protrusions to cross the crankshaft position sensor so that magnetic fluxes in the coil change with the change in air gap between the sensor pickup and the sprocket. The change in air gap induces an electromotive force which is transmitted to the ECM.



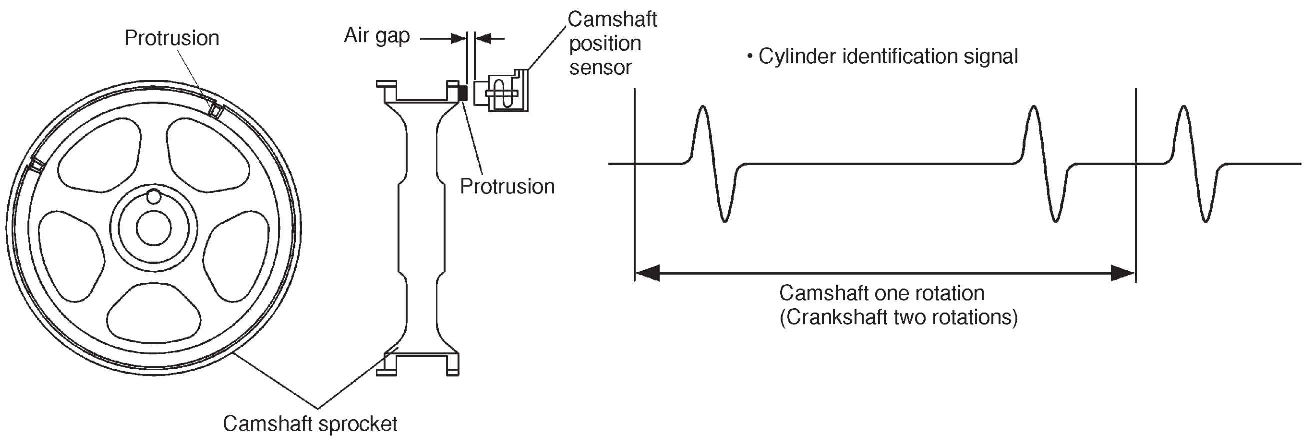
B2H1995A

E: CAMSHAFT POSITION SENSOR

1. MT VEHICLES

- The camshaft position sensor is located on the left-hand camshaft support to detect the combustion cylinder at any one moment.
- It is designed so that the ECM accurately reads the number of pulses which occur when protrusions provided on the back of the left hand camshaft-drive sprocket cross the sensor.

Internal construction and the basic operating principle of the camshaft position sensor are similar to those of the crankshaft position sensor. A total of seven protrusions (one each at two locations, two at one location and three at one location) are arranged in four equal parts of the sprocket, as shown below.

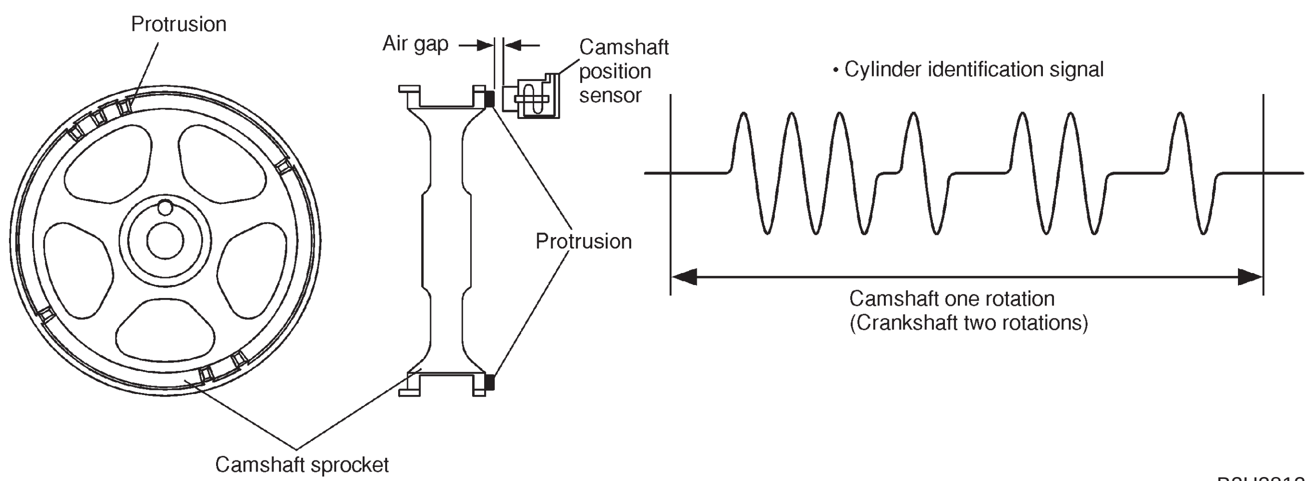


B2H1996A

2. AT VEHICLES

- The camshaft position sensor is located on the left-hand camshaft support to detect the combustion cylinder at any one moment.
- It is designed so that the ECM accurately reads the number of pulses which occur when protrusions provided on the back of the left hand camshaft-drive sprocket cross the sensor.

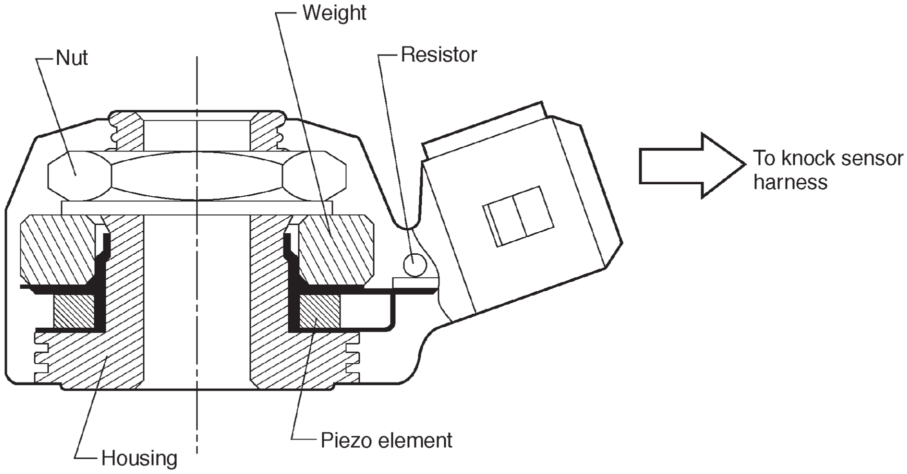
Internal construction and the basic operating principle of the camshaft position sensor are similar to those of the crankshaft position sensor. A total of seven protrusions (one each at two locations, two at one location and three at one location) are arranged in four equal parts of the sprocket, as shown below.



B2H3812A

F: KNOCK SENSOR

- The knock sensor is installed on the cylinder block, and senses knocking signals.
- This knock sensor is a piezo-electric type which converts knocking vibrations into electric signals.
- It consists of a piezo-electric element, weight, and case. If knocking occurs in the engine, the weight in the case moves causing the piezo-electric element to generate a voltage.
- The knock sensor is connected to the bulkhead harness through the knock sensor harness.

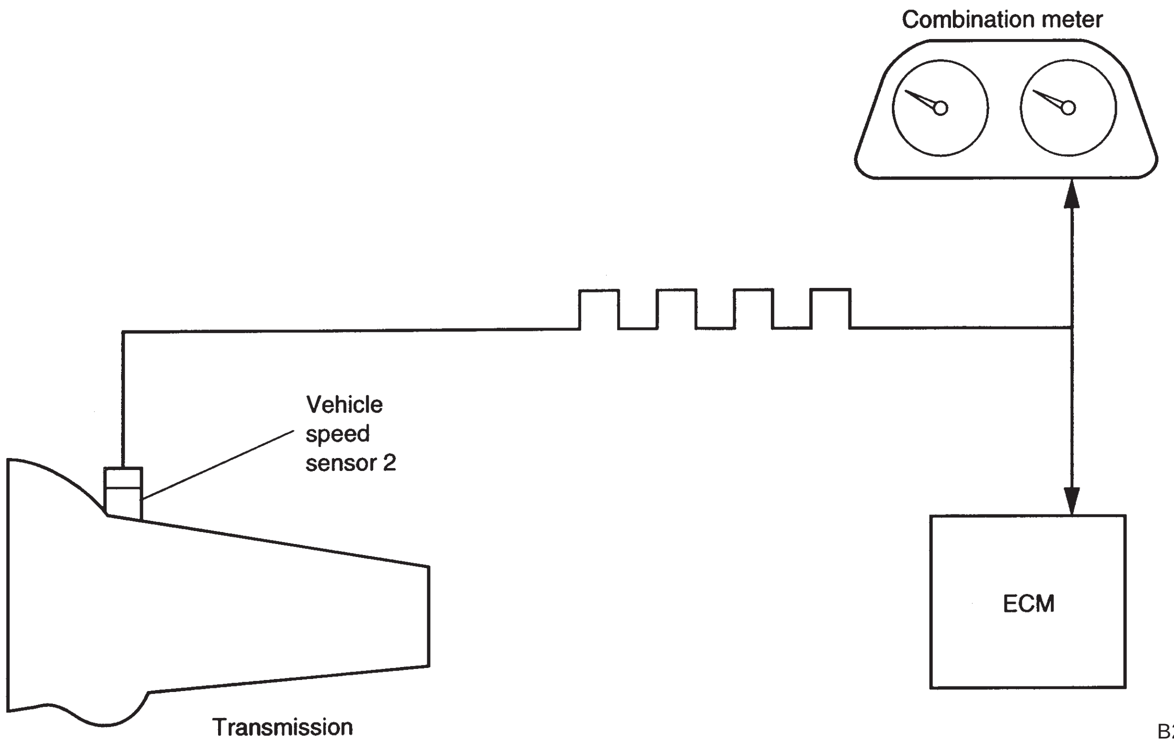


B2H1998A

G: VEHICLE SPEED SENSOR 2

1. MT VEHICLES

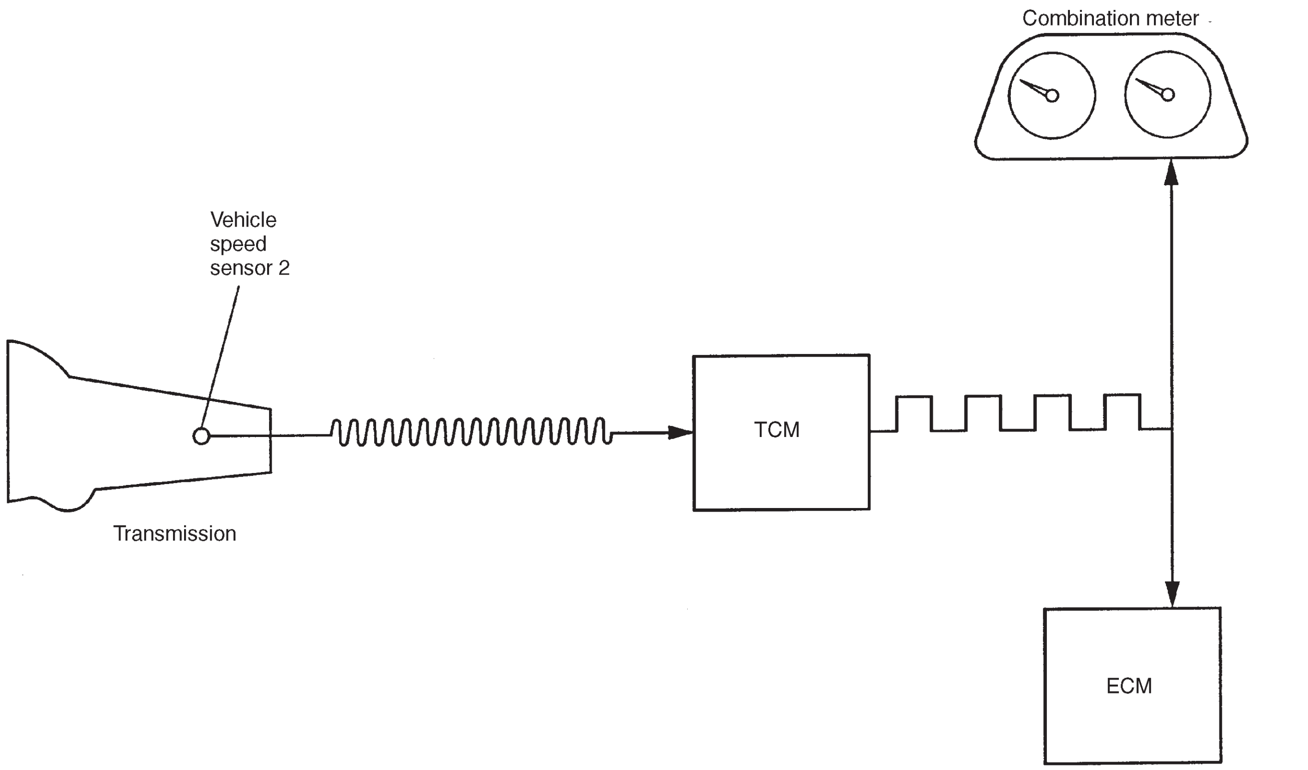
- The vehicle speed sensor 2 is a pick-up type output sensor, and mounted on the transmission.
- The vehicle speed sensor 2 generates a 4-pulse signal for every rotation of the front differential and send it to the ECM and the combination meter.



B2H2458A

2. AT VEHICLES

- The vehicle speed sensor 2 is a pick-up type output sensor, and mounted on the transmission.
- The vehicle speed sensor 2 generates a 16-pulse signal for every rotation of the front differential and send it to the TCM. The signal sent to the TCM is converted there in a 4-pulse signal, and then sent to the ECM and the combination meter.



B2H2459A

6. Control System

A: GENERAL

The ECM (Engine Control Module) receives signals sent from various sensors and switches to judge the engine operating condition and emits output signals to provide the optimum control and/or functioning of various systems.

Major items governed by the ECM are as follow:

- Fuel injection control
- Ignition system control
- Idle air control
- Canister purge control*
- Radiator fan control
- Fuel pump control
- Air conditioner cut control
- On-board diagnosis function

*: Canister purge control is described under “Chapter 2-1 Emission Control”.

B: INPUT AND OUTPUT SIGNALS

1. MT VEHICLES

	Unit	Function
Input signal	Intake manifold pressure sensor	Detects the amount of intake air (Measure the absolute pressure).
	Intake air temperature sensor	Detects the temperature of intake air.
	Throttle position sensor	Detects the throttle position.
	Front oxygen (A/F) sensor	Detects the amount of oxygen in exhaust gases at the above of front catalytic converter.
	Rear oxygen sensors	Detects the density of oxygen in exhaust gases behind the front catalytic converter.
	Crankshaft position sensor	Detects crankshaft position.
	Camshaft position sensor	Detects the relative cylinder positions.
	Engine coolant temperature sensor	Detects the engine coolant temperature.
	Knock sensor	Detects engine knocking.
	Vehicle speed sensor 2	Detects vehicle speed.
	Ignition switch	Detects ignition switch operation.
	Starter switch	Detects the condition of engine cranking.
	Neutral position switch (MT)	Detects gear position being in the neutral.
	Heater circuit of front and rear oxygen sensor	Detects the abnormal for heater circuit of front and rear oxygen sensor.
	A/C switch	Detects the ON-OFF operation of the A/C switch.
	Fuel temperature sensor	Detects the temperature of the fuel in fuel tank.
	Fuel level sensor	Detects the level of the fuel in fuel tank.
	Fuel tank pressure sensor	Detects the evaporation gas pressure in fuel tank.
	Small light switch	Detects the ON-OFF operation of the light switch.
	Blower fan switch	Detects the ON-OFF operation of the blower fan switch.
	Rear defogger switch	Detects the ON-OFF operation of the rear defogger switch.
Output signal	Fuel Injector	Inject fuel.
	Ignition signal	Turns primary ignition current ON or OFF.
	Fuel pump relay	Turns the fuel pump relay ON or OFF.
	A/C control relay	Turns A/C control relay ON or OFF.
	Radiator fan control relay	Turns radiator fan control relay ON or OFF.
	Idle air control solenoid valve	Adjusts the amount of idle air flowing through the throttle valve.
	Malfunction indicator lamp	Indicates trouble.
	Purge control solenoid valve	Controls the purge of evaporative gas absorbed by canister.
	Power supply	Control the ON/OFF switching of main relay.
	Pressure control solenoid valve	Controls the evaporation gas pressure in fuel tank.
	Drain valve	Closes the evaporation line between the fuel tank and canister to detect the leak of evaporation gases.

2. AT VEHICLES

	Unit	Function
Input signal	Intake air temperature and pressure sensor	Detects the temperature of intake and amount of intake air (Measure the absolute pressure).
	Atmospheric pressure sensor	Detects the amount of intake air (Measure the atmospheric pressure).
	Throttle position sensor	Detects the throttle position.
	Front oxygen (A/F) sensor	Detects the amount of oxygen in exhaust gases at the above of front catalytic converter.
	Rear oxygen sensor	Detects the density of oxygen in exhaust gases behind the front catalytic converter.
	Crankshaft position sensor	Detects crankshaft position.
	Camshaft position sensor	Detects the relative cylinder positions.
	Engine coolant temperature sensor	Detects the engine coolant temperature.
	Knock sensor	Detects engine knocking.
	Vehicle speed sensor 2	Detects vehicle speed.
	Ignition switch	Detects ignition switch operation.
	Starter switch	Detects the condition of engine cranking.
	Park/Neutral position switch	Detects shift positions.
	Torque control signal	Controls the engine torque.
	Heater circuit of front and rear oxygen sensor	Detects the abnormal for heater circuit of front and rear oxygen sensor.
	Diagnostics of AT	Detects the self-diagnostics of AT.
	A/C switch	Detects the ON-OFF operation of the A/C switch.
	Fuel temperature sensor	Detects the temperature of the fuel in fuel tank.
	Fuel level sensor	Detects the level of the fuel in fuel tank.
	Fuel tank pressure sensor	Detects the evaporation gas pressure in fuel tank.
	Small light switch	Detects the ON-OFF operation of the light switch.
	Blower fan switch	Detects the ON-OFF operation of the blower fan switch.
	Rear defogger switch	Detects the ON-OFF operation of the rear defogger switch.
Output signal	Fuel Injector	Inject fuel.
	Ignition signal	Turns primary ignition current ON or OFF.
	Fuel pump relay	Turns the fuel pump relay ON or OFF.
	A/C control relay	Turns A/C control relay ON or OFF.
	Radiator fan control relay	Turns radiator fan control relay ON or OFF.
	Idle air control solenoid valve	Adjusts the amount of idle air flowing through the throttle valve.
	Malfunction indicator lamp	Indicates trouble.
	Purge control solenoid valve	Controls the purge of evaporative gas absorbed by canister.
	Power supply	Control the ON/OFF switching of main relay.
	Pressure control solenoid valve	Controls the evaporation gas pressure in fuel tank.
	Drain valve	Closes the evaporation line between the fuel tank and canister to detect the leak of evaporation gases.

C: FUEL INJECTION CONTROL

- The ECM receives signals emitted from various sensors to control the amount of fuel injected and the fuel injection timing. Sequential fuel injection control is utilized over the entire engine operating range except during engine starts.
- The amount of fuel injected by the injector valve is dependent upon the length of time it remains open. The optimum fuel injection timing is determined by transmitting a signal to the injector from the ECM according to varying engine operations. Feedback control is also accomplished by means of a learning control. As a result, the fuel injection control system is highly responsive and accurate in design and structure.
- The sequential fuel injection system is designed so that fuel is injected at a specific time to provide maximum air intake efficiency for each cylinder. In other words, fuel injection is completed just before the intake valve begins to open.

1. FUEL INJECTION CHARACTERISTICS

Fuel injection timing is basically expressed as indicated below:

- During engine starts:
Duration of fuel injection = Duration of fuel injection during engine starts
- During normal operation:
Basic duration of fuel injection x correction factors + voltage correction time
    - Basic duration of fuel injection ..... The basic length of time fuel is injected. This is determined by two factors – the amount of intake air detected by the mass air flow sensor and the engine speed (rpm) monitored by the crankshaft position sensor.
    - Duration of fuel injection during engine starts ..... Determined according to the engine coolant temperature detected by a signal emitted from the engine coolant temperature sensor to improve starting ability.
    - Voltage correction time ..... Compensates for the fuel injector's time lag affected by the battery voltage.

2. CORRECTION FACTORS

Correction factors are used to correct the basic duration of fuel injection so that the air-fuel ratio meets the requirements of varying engine operations.
These correction factors are classified as follows:

- Air-fuel ratio coefficient:

Allotted to provide the optimum air-fuel ratio in relation to engine speed and the basic amount of fuel injected.

- Start increment coefficient:

Increases the amount of fuel injected only when cranking the engine, which improves starting ability.

- Engine coolant temperature increment coefficient:

Used to increase the amount of fuel injected in relation to a signal emitted from the engine coolant temperature sensor for easier starting of a cold engine. The lower the engine coolant temperature, the greater the increment rate.

- After-start increment coefficient:
  - Increases the amount of fuel injected for a certain period of time immediately after the engine starts to stabilize engine operation.
  - The amount of fuel to be compensated for depends on the water temperature during engine starting.

- Full increment coefficient:

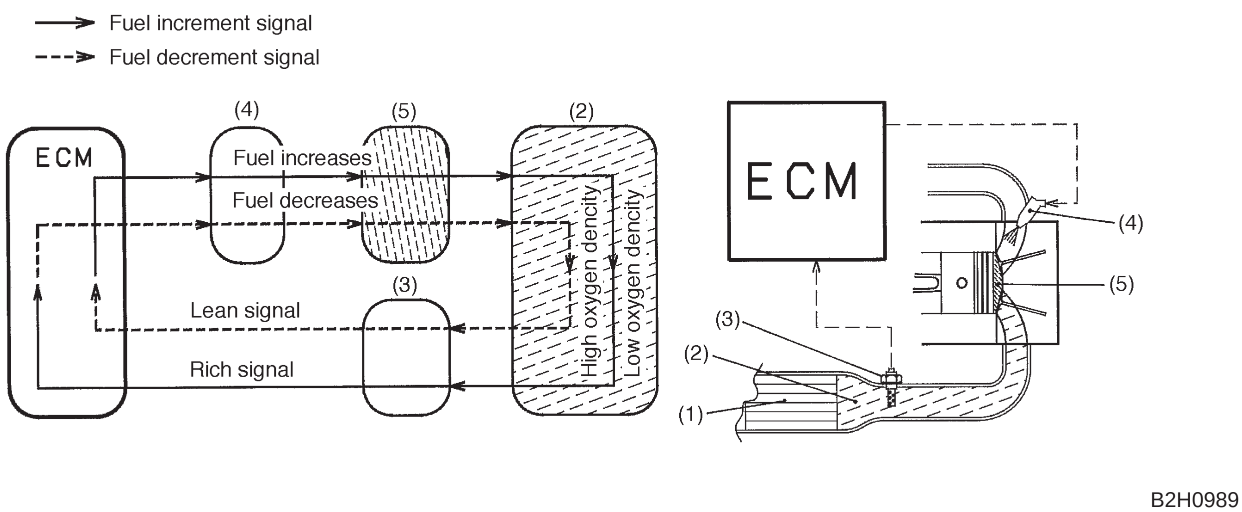
Increases the amount of fuel injected by a signal emitted from the throttle position sensor in relation to a signal emitted from the mass air flow sensor.

- Acceleration increment coefficient:

Compensates for time lags of air flow measurement and/or fuel injection during acceleration to provide quick response.

3. AIR-FUEL RATIO FEEDBACK COEFFICIENT

This feedback coefficient utilizes the front oxygen sensor's electromotive force (voltage) as a signal to be entered into the ECM. When low voltage is entered, the ECM judges it as a lean mixture, and when high voltage is entered, it is judged as a rich mixture. In other words, when the air-fuel ratio is richer than the stoichiometric mixture ratio, the amount of fuel injected is decreased. When it is leaner, the amount of fuel injected is increased. In this way, the air-fuel ratio is compensated so that it comes as close to the stoichiometric mixture ratio as possible on which the three-way catalyst acts most effectively. (CO, HC and NOx are also reduced when the air-fuel ratio is close to stoichiometric mixture ratio.)



(1) Front catalyst	(4) Fuel injector
(2) Exhaust gas	(5) Combustion chamber
(3) Front oxygen (A/F) sensor	

4. LEARNING CONTROL SYSTEM

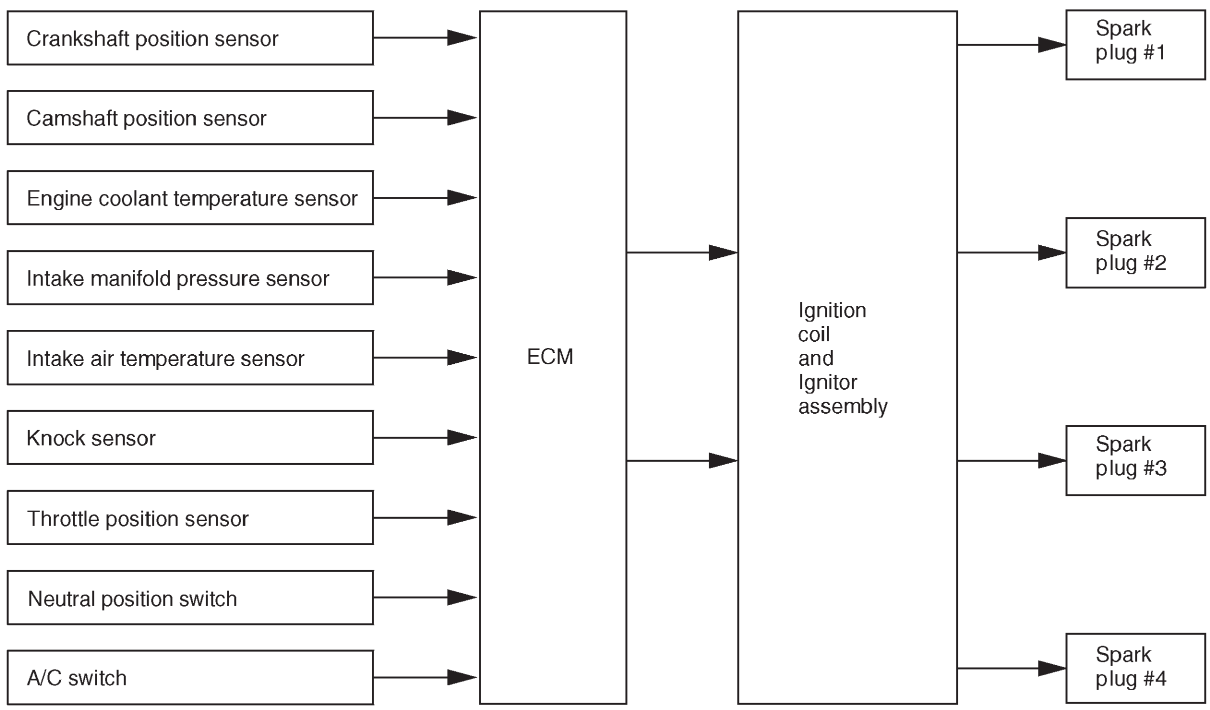
- In a conventional air-fuel feedback control system, the basic amount of fuel injected (according to engine speed and various loads) is stored in the memory. After the ECM receives a signal emitted from the oxygen sensor, the basic amount of fuel injected is corrected so that it is close to the stoichiometric mixture ratio. This means that the greater the air-fuel ratio is corrected, the lesser the control accuracy.
- In SUBARU engines, however, an air-fuel ratio learning control system constantly memorizes the amount of correction required in relation to the basic amount of fuel to be injected (the basic amount of fuel injected is determined after several cycles of fuel injection), so that the correction affected by feedback control is minimized. Thus, quick response and accurate control of variations in air-fuel ratio, sensors' and actuators' characteristics during operation, as well as in the air-fuel ratio with the time of engine operation, are achieved. In addition, accurate control contributes much to stability of exhaust gases and driving performance.

D: IGNITION SYSTEM CONTROL

1. MT VEHICLES

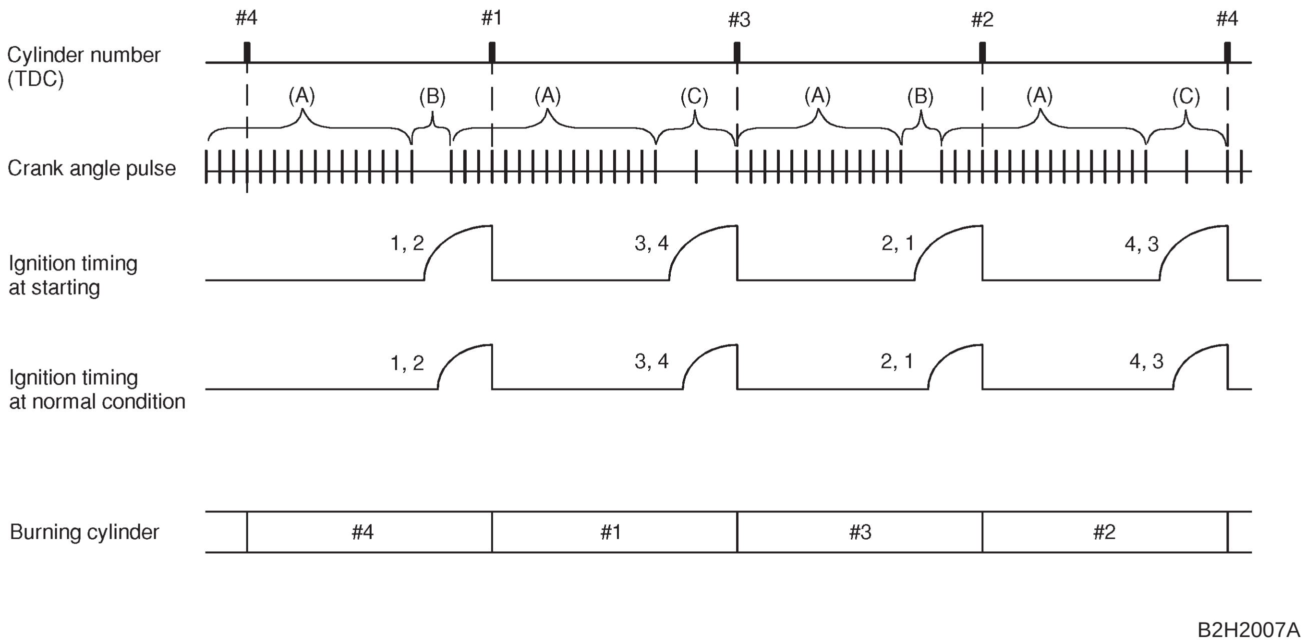
- The ECM receives signals emitted from the pressure sensor, engine coolant temperature sensor, intake air temperature sensor, crankshaft position sensor, etc., to judge the operating condition of the engine. It then selects the optimum ignition timing stored in the memory and immediately transmits a primary current OFF signal to the ignitor to control the ignition timing.
- This system control type features a quick-to-response learning control method by which data stored in the ECM memory is processed in comparison with information emitted from various sensors and switches.
- Thus, the ECM constantly provides the optimum ignition timing in relation to output, fuel consumption, exhaust gas, etc., according to various engine operating conditions, etc.
- Ignition control under starting conditions

Engine speed fluctuates at the starting condition, so the ECM cannot control the ignition timing. When such a condition exists, ignition timing is fixed at 10° BTDC by using the 10° signal.



B2H3448A

- Within the range (A), the crank angle signal is input every 10° rotation of the crankshaft.
- The discrimination between the cylinder groups is accomplished by detecting the ranges (B) and (C) where no signals are input.
- The ECM judges that the No. 1 and No. 2 cylinders are at TDC when detecting the range (B), and that the No. 3 and No. 4 cylinders are at TDC when detecting the range (C).



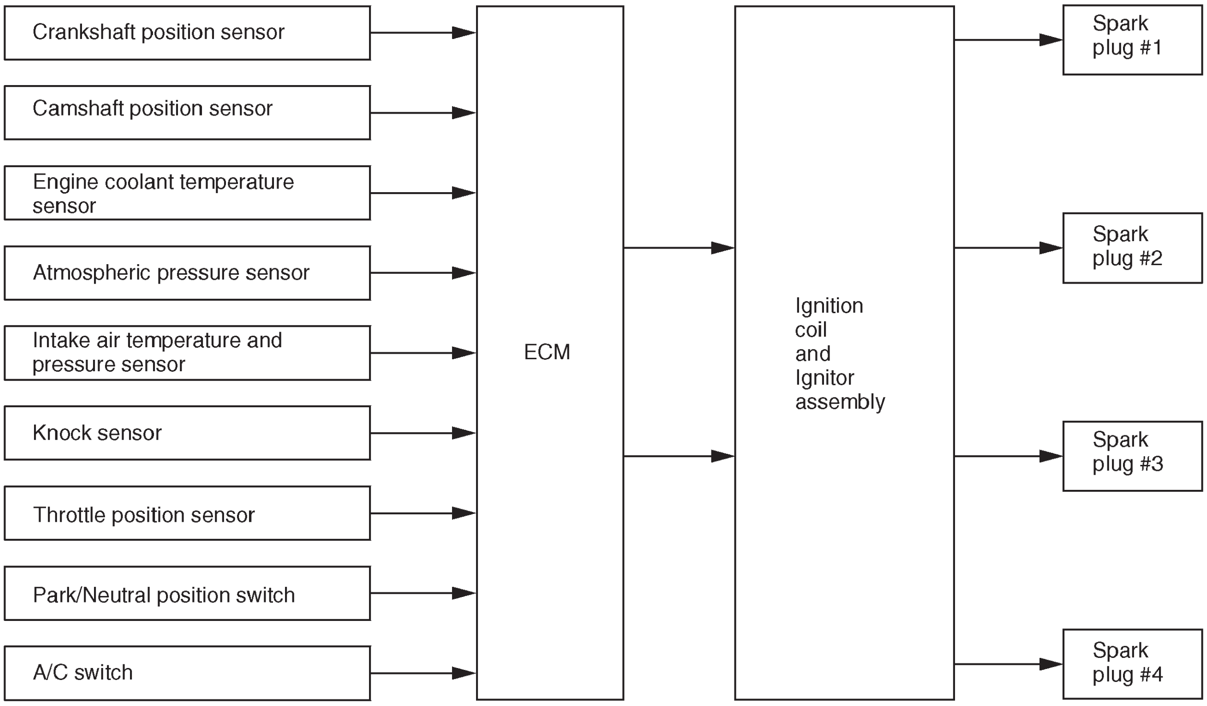
2. AT VEHICLES

● The ECM receives signals emitted from the pressure sensor, engine coolant temperature sensor, intake air temperature sensor, crankshaft position sensor, etc., to judge the operating condition of the engine. It then selects the optimum ignition timing stored in the memory and immediately transmits a primary current OFF signal to the ignitor to control the ignition timing.

● This system control type features a quick-to-response learning control method by which data stored in the ECM memory is processed in comparison with information emitted from various sensors and switches.

● Thus, the ECM constantly provides the optimum ignition timing in relation to output, fuel consumption, exhaust gas, etc., according to various engine operating conditions, etc.

● Ignition control under starting conditions
Engine speed fluctuates at the starting condition, so the ECM cannot control the ignition timing. When such a condition exists, ignition timing is fixed at 10° BTDC by using the 10° signal.



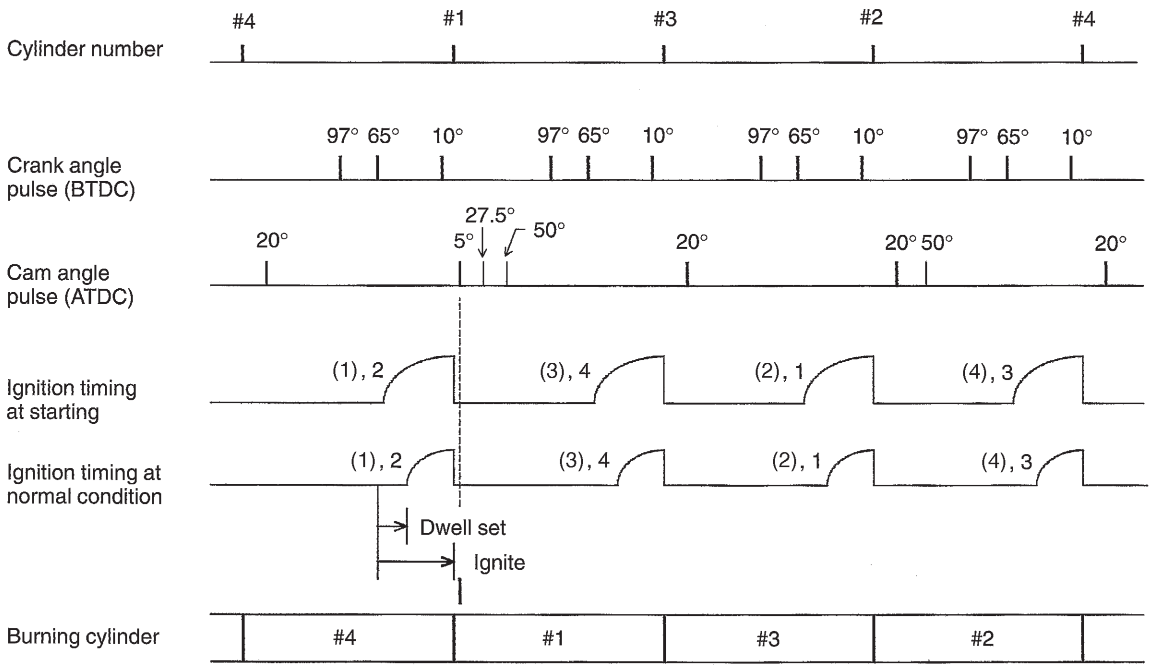
B2H3449A

- Ignition control under normal engine conditions

Between the 97° signal and the 65° signal, the ECM measures the engine speed, and by using this data it decides the dwell set timing and ignition timing according to the engine condition.

- Ignition control under starting conditions

Engine speed fluctuate at the starting condition, so the ECM cannot control the ignition timing. When such a condition exists, ignition timing is fixed at 10° BTDC by using the 10° signal.

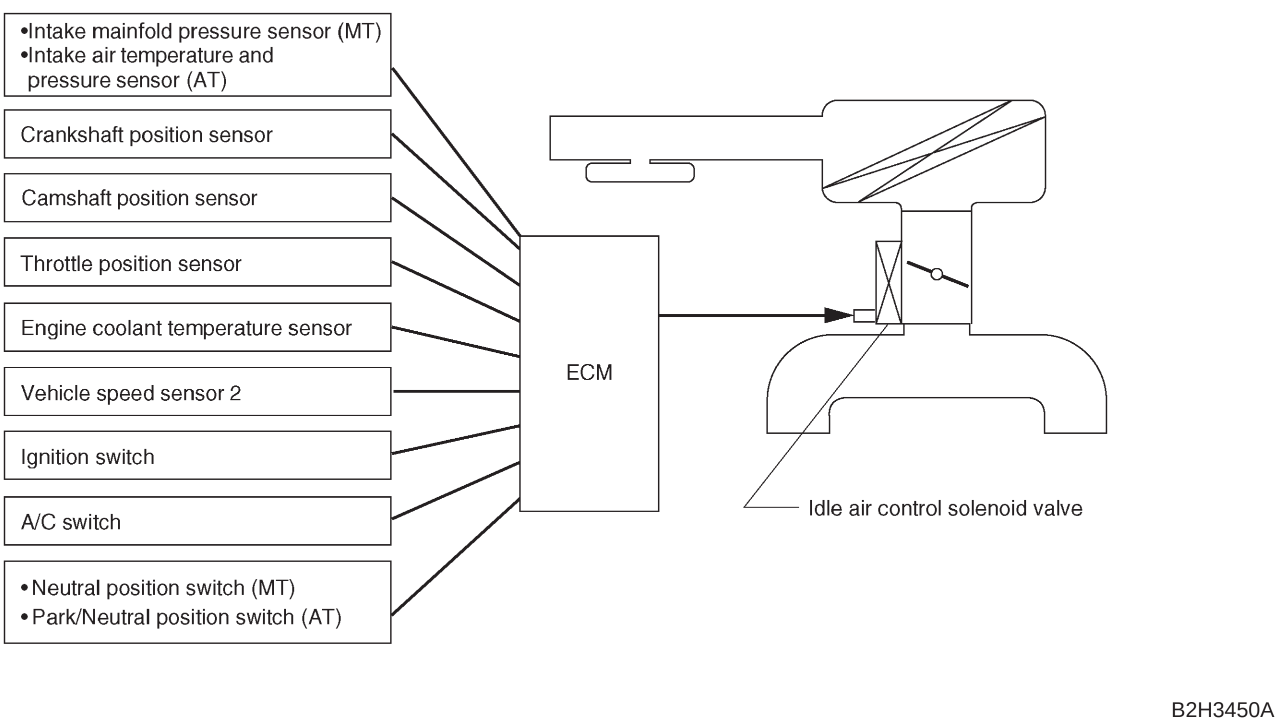


B2H0410A

E: IDLE AIR CONTROL

- The ECM activates the idle air control solenoid valve in advance to control the amount of by-pass air flowing through the throttle valve in relation to signals emitted from the crankshaft position sensor, engine coolant temperature sensor, pressure sensor and A/C switch. etc., so that the proper idle speed specified for each engine load is achieved.
- The idle air control solenoid valve utilizes a duty solenoid design which the opening area of by-pass port is changed by the amount of rotary valve moving. For this reason, the by-pass air flow is regulated by controlling the duty ratio. The relationship between the duty ratio, rotary valve moving and by-pass air flow is as follows:
  - Duty ratio (high) → Increases rotary valve moving and by-pass air flow.
- Bypass air control features the following advantages:
  - Compensation for engine speed under A/C (air conditioning) system and electrical loads.
  - Increase in idle speed during early stage of warm up period.
  - A dashpot function during the time the throttle valve is quickly closed.
  - Prevention of engine speed variations over time.

Diagram



F: CANISTER PURGE CONTROL

- The ECM receives signals emitted from the engine coolant temperature sensor, vehicle speed sensor 2 and crankshaft position sensor to control the purge control solenoid.
Canister purge takes place during operation of the vehicle except under certain conditions (during idle, etc.).
- The purge line is connected to the throttle chamber to purge fuel evaporation gas from the canister according to the amount of intake air.

7. On-board Diagnosis System

A: GENERAL

- The on-board diagnosis system detects and indicates a fault in various inputs and outputs of the complex electronic control. The malfunction indicator lamp (CHECK ENGINE light) on the instrument panel indicates occurrence of a fault or trouble.
- When the malfunction indicator lamp comes on by the ECM having diagnosed occurrence of faults, the diagnostic trouble code (DTC) and the freeze frame engine condition are stored in the ECM.
- On the OBD-II conformable car, it is necessary to connect the Subaru Select Monitor (SSM) or General Scan Tool (GST) to data link connector in order to check the DTC.
- The SSM and GST not only can read out the DTC but also can erase the DTC or read out the freeze frame data and other pieces of engine data.
- Further, against such a failure or sensors as may disable the drive, the fail-safe function is provided to ensure the minimal driveability.

B: FAIL-SAFE FUNCTION

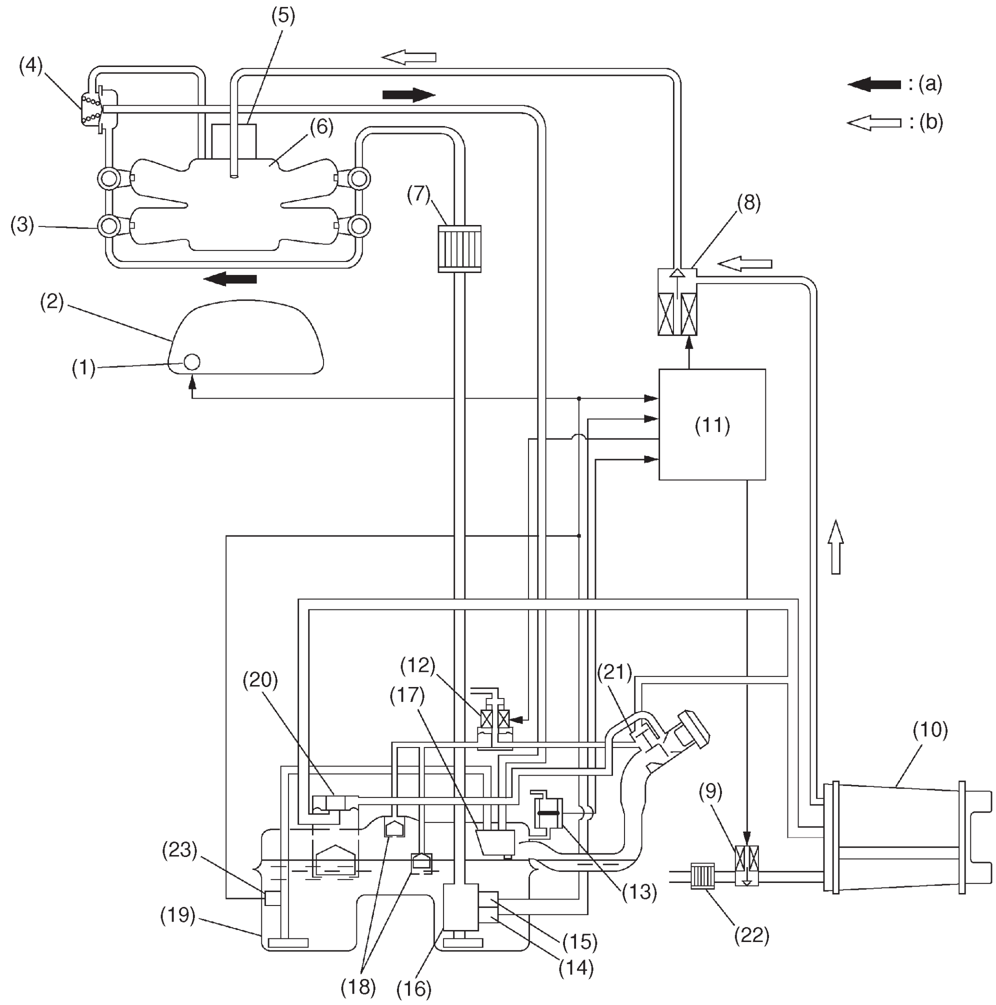
For the part which has been judged faulty in the on-board diagnosis, the ECM generates the associated pseudo signal (only when convertible to electric signal) and carries out the computational processing. In this fashion, the fail-safe function is performed.

MEMO

1. Fuel Lines

The fuel lines consist of a delivery line, return line, and an evaporation line.

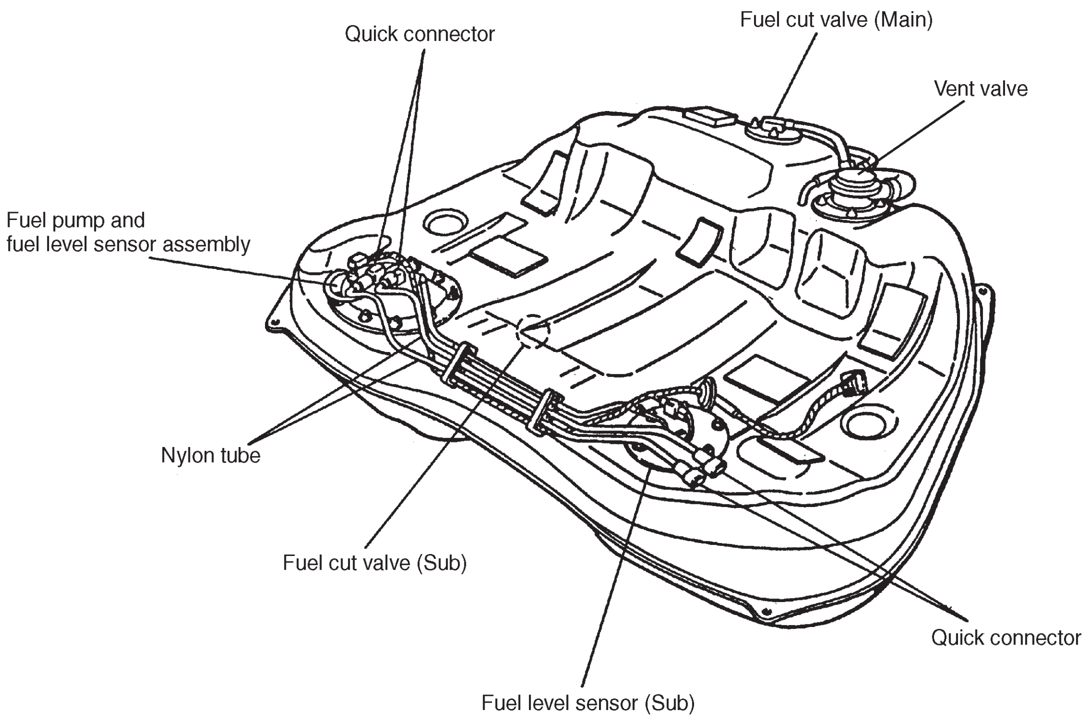
- The delivery line supplies fuel from the fuel tank to the intake manifold and consists of a pump filter, fuel pump and fuel filter.
- The return line returns excess fuel to the fuel tank via the pressure regulator to maintain a constant level of fuel pressure.
- The evaporation line consists of a purge control solenoid valve, vent valve and canister. Two fuel cut valves are additionally provided.
- The fuel tank is equipped with a jet pump so that the fuel level of both fuel tank chambers can always be kept equal.
- For evaporation line, refer to chapter 2-1. <Ref. to 2-1 [M800]>.



(1)	Fuel gauge
(2)	Combination meter
(3)	Fuel injector
(4)	Pressure regulator
(5)	Throttle body
(6)	Intake manifold
(7)	Fuel filter
(8)	Purge control solenoid valve
(9)	Drain valve
(10)	Canister
(11)	ECM
(12)	Pressure control solenoid valve
(13)	Fuel tank pressure sensor
(14)	Fuel temperature sensor
(15)	Fuel level sensor
(16)	Fuel pump
(17)	Jet pump
(18)	Fuel cut valve
(19)	Fuel tank
(20)	Vent valve
(21)	Shut valve
(22)	Drain filter
(23)	Fuel sub level sensor

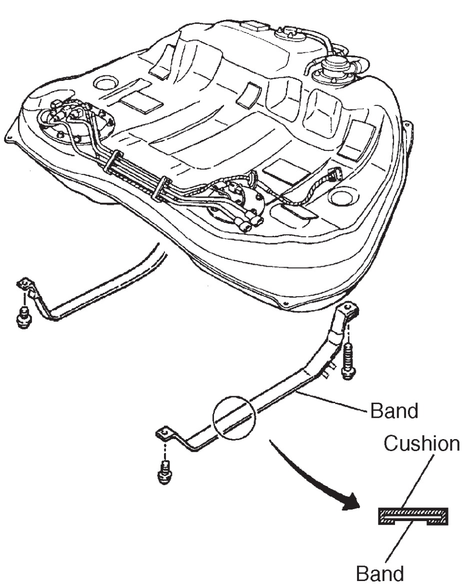
2. Fuel Tank

The fuel tank has two chambers, and is provided with a suction jet pump which transfers fuel from one chamber to another. Each fuel chamber has a built-in fuel sub level sensor.



B2H3651A

The fuel tank is located under the rear seat and secured with hold down bands. The fuel tank utilizes a dented design to prevent interference with the rear differential.

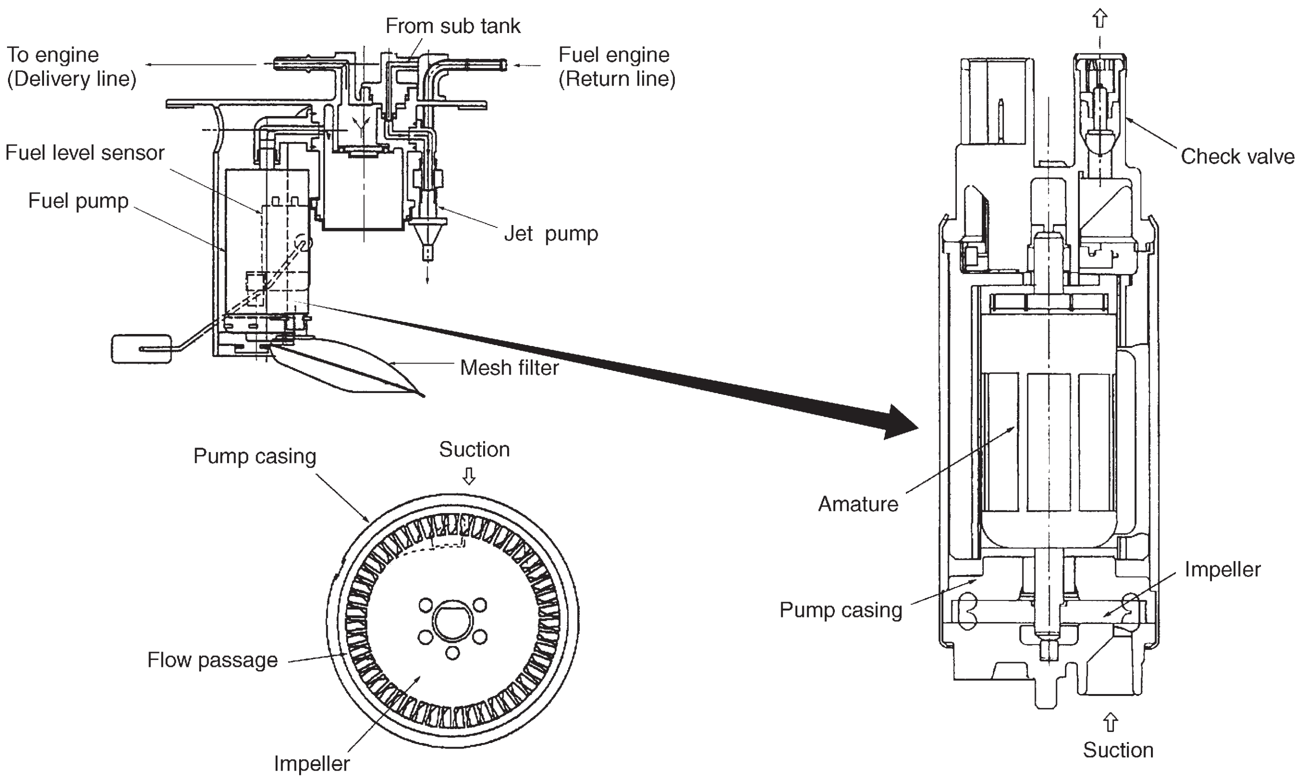


B2H3652A

3. Fuel Pump and Fuel Level Sensor Assembly

A: FUEL PUMP

The impeller type fuel pump consists of a motor, impeller, pump casing, pump cover, relief valve, check valve and pump filter. It is built into the fuel tank together with the fuel level sensor to provide quiet operation.

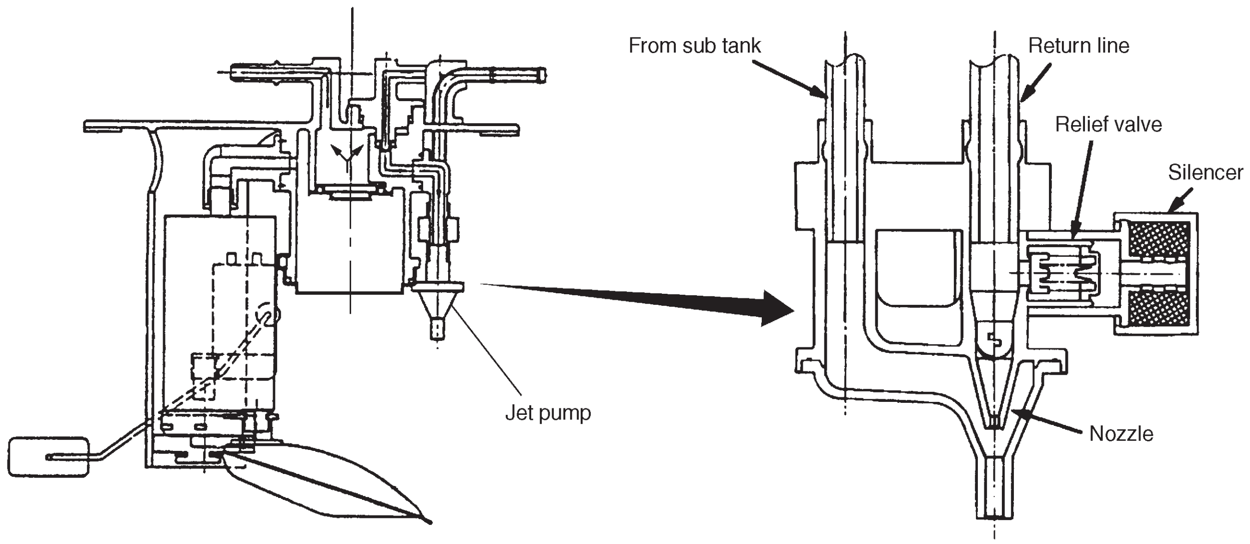


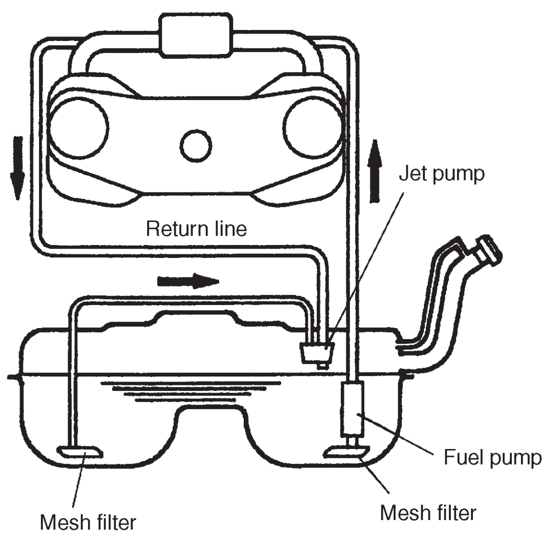
B2H3653A

- When the engine starts, fuel pump relay activates. This operates the motor to rotate the impeller.
- Fuel entering a vane groove of the impeller flows along the fuel passage and into the next vane groove by centrifugal force. During the time fuel flows from one groove to the next, a pressure differential is produced by friction of the flow.
- Thus, fuel pressure increases while the action is described above is repeated, and fuel is discharged from the pump casing. Fuel under pressure then passes through the clearance between the armature and the magnet and is discharged from the fuel pump.
- As fuel discharge pressure reaches the specified value, the relief valve opens. This discharges fuel under pressure into the fuel tank. Fuel from the fuel tank then returns to the suction port and passes through the fuel pump. This action of fuel flow is repeated. In this manner, the relief valve prevents an abnormal increase in fuel pressure.
- When the engine and fuel pump stop, spring force acts on the check valve to close the discharge port so that fuel pressure remains in the fuel delivery line.

B: JET PUMP

- The jet pump utilizes the velocity of fuel returning from the engine to produce negative pressure inside the jet pump.
- This negative pressure allows fuel to be sucked up.
- When the return line nozzle is clogged, the fuel sent back through the return line flows back into the fuel tank via the relief valve.

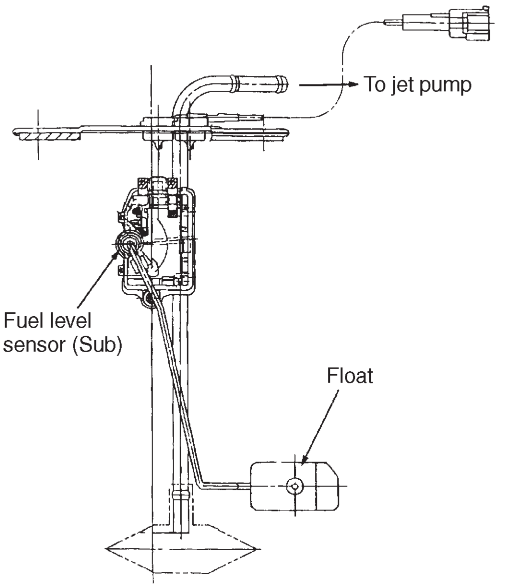




B2H3654A

4. Fuel Sub Level Sensor

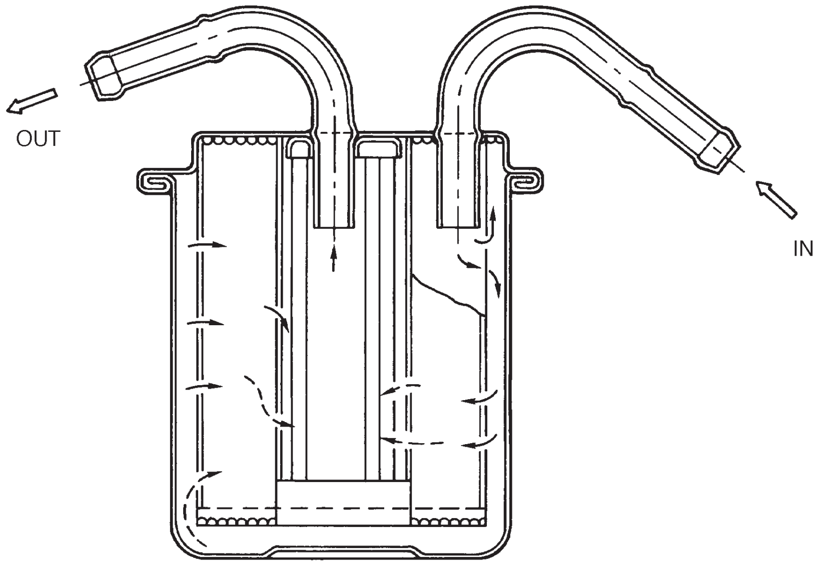
The fuel sub level sensor detects the level of fuel tank chamber located other side of fuel pump and act as a fuel distribution line when jet pump is in function to make the levels of both fuel tank chambers equal.



B2H2912A

5. Fuel Filter

The fuel filter utilizes a pressure-withstanding, cartridge design. It has a filter element built into the metal case. With this design, fuel flows from the perimeter of the element to the interior of the filter.



G2H0059

1. Clutch

A: OUTLINE

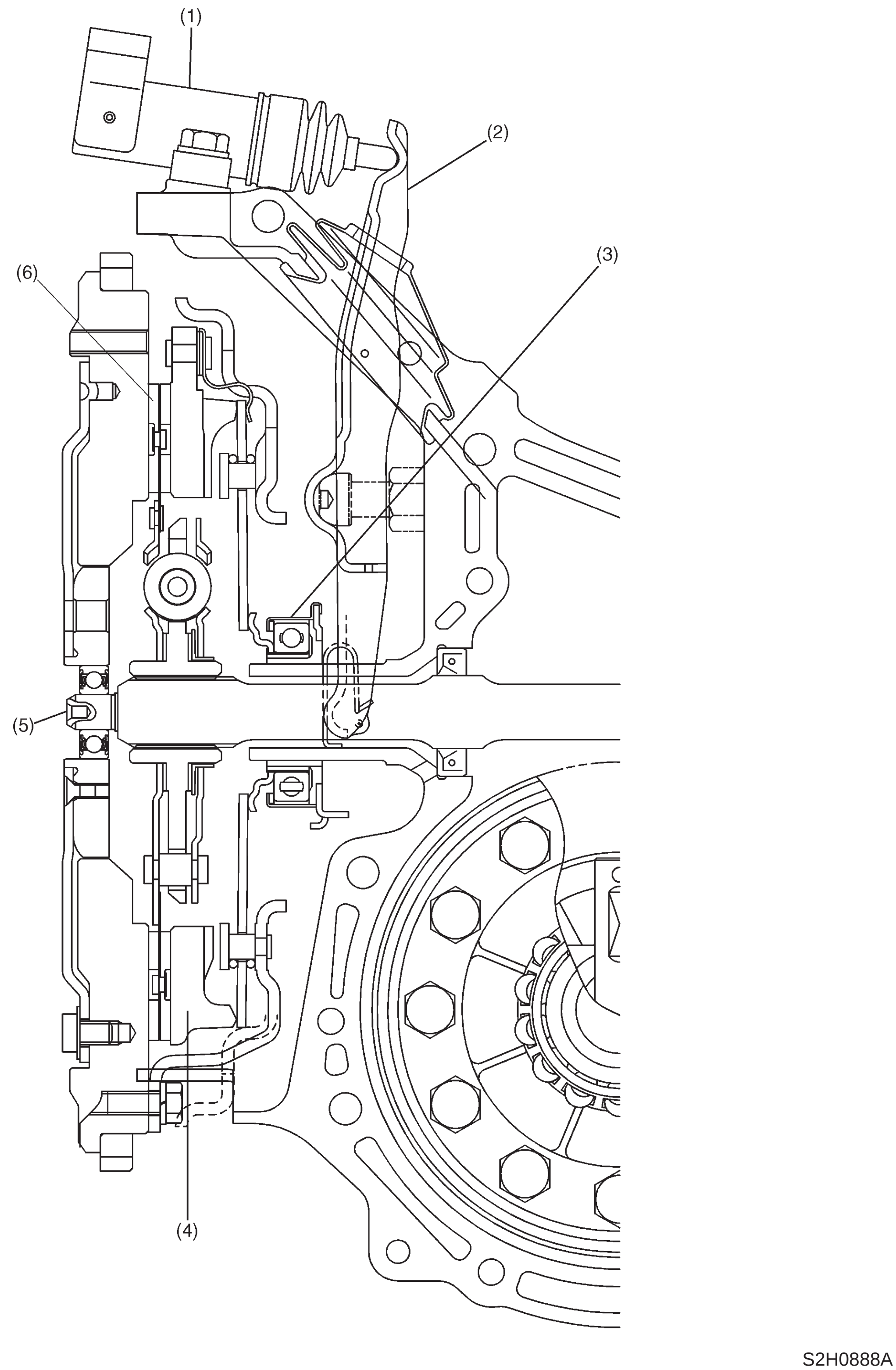
- All models adopt a hydraulic control due to increased clutch load.
- The clutch control operates the release fork using the hydraulic pressure which the master cylinder generates by converting the pedal depressing force.
- The clutch itself is a push type clutch. When the clutch pedal is depressed, the self-aligning release bearing is caused to slide on a guide pressing the center of the diaphragm spring. The warped diaphragm spring disengages the pressure plate from the clutch disc.
The clutch using a diaphragm spring has the advantage of little variation in push load even when the clutch disc facing is worn.
The diaphragm spring is located inside the clutch cover.
- The clutch has a clutch disc between the flywheel and the pressure plate.
- Inside the clutch cover, there is a diaphragm spring and a pressure plate combined with each other by means of strap plates, which also serve to prevent the pressure plate from turning.

B: OPERATION

Applying foot pressure to the clutch pedal moves the release lever. This causes the release bearing to slide on the guide, pressing the diaphragm spring in the center. The spring is warped and the force having pressed the pressure plate is lost. As a result, the flywheel, clutch disc and pressure plate are disengaged, disconnecting the driving power.

The push type clutch has the point of action at the tips of the diaphragm spring fingers, through which the pressure plate is pressed to the clutch disc. When the power transmission is to be interrupted, the diaphragm spring is forced to warp using the pivots established on the inward side of the spring finger tips (on the principle of the lever and fulcrum) to disengage the pressure plate from the clutch disc.

C: CROSS SECTIONAL VIEW



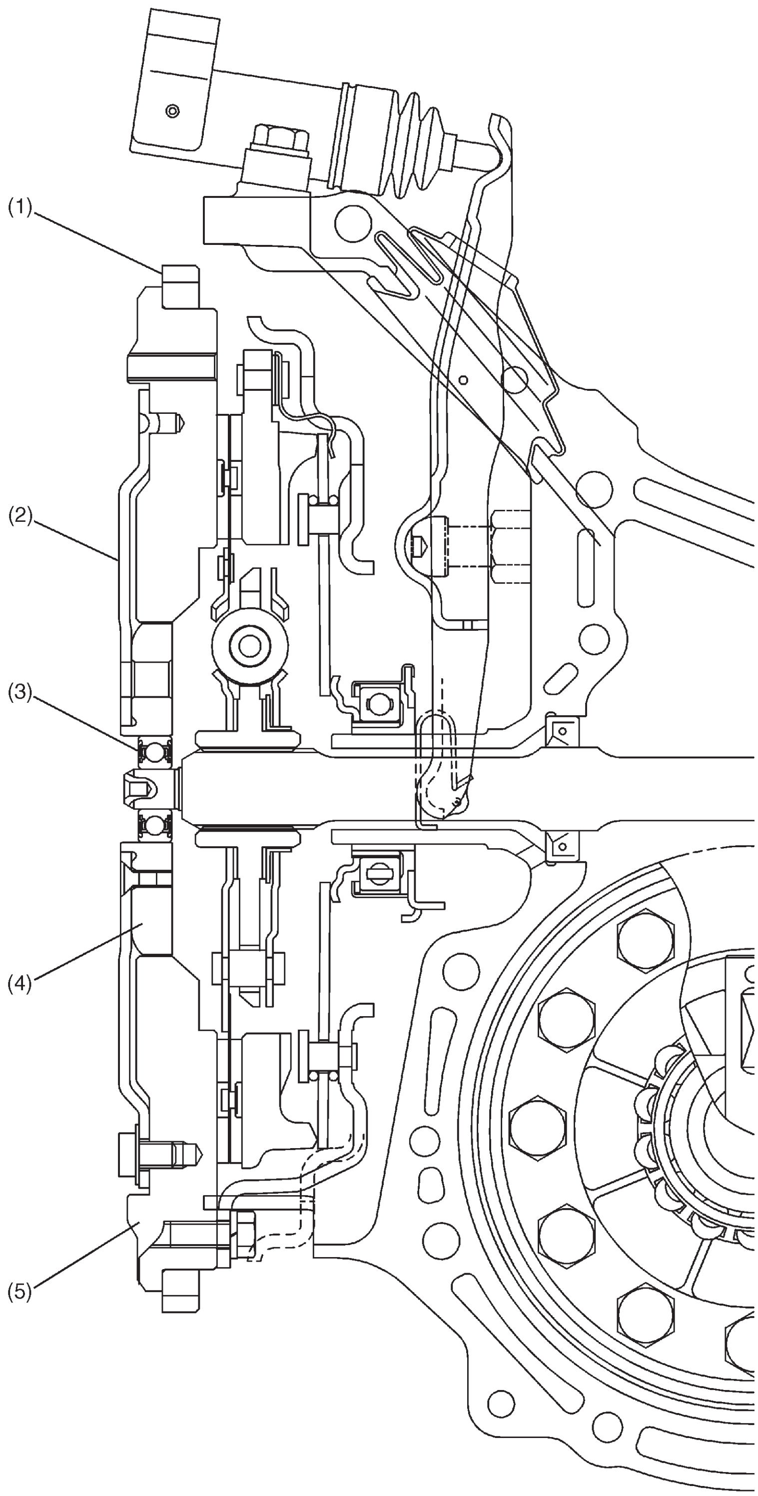
(1) Operating cylinder
(2) Release lever
(3) Release bearing
(4) Clutch cover
(5) Transmission main shaft
(6) Clutch disc

2. Flywheel

A: OUTLINE

The flywheel is of a flexible type which is composed of a drive plate, reinforcement, mass flywheel, etc.

This type of flywheel is characterized by less vibration and less noise, since it transmits the engine power from the crankshaft to the clutch disc through the drive plate and mass flywheel.

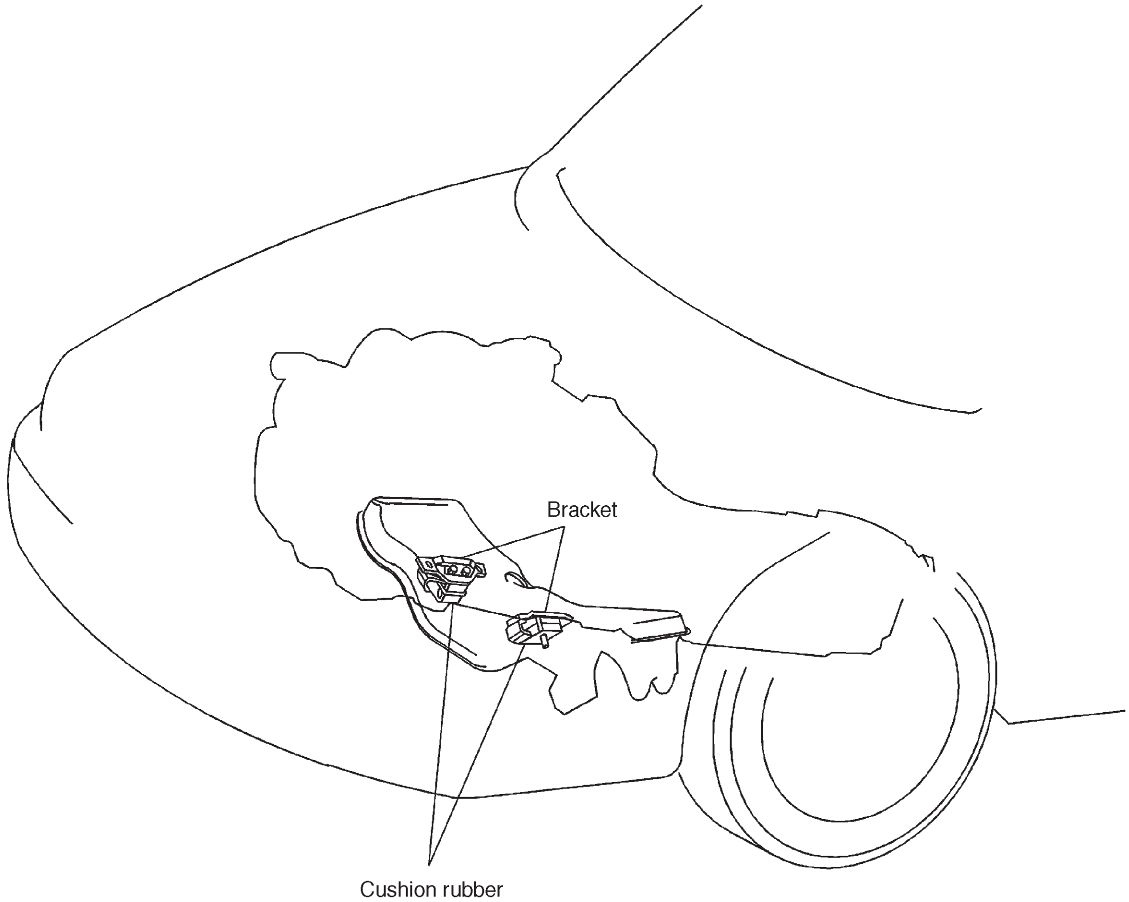


(1) Ring gear
(2) Drive plate
(3) Ball bearing
(4) Reinforcement
(5) Mass flywheel

MEMO

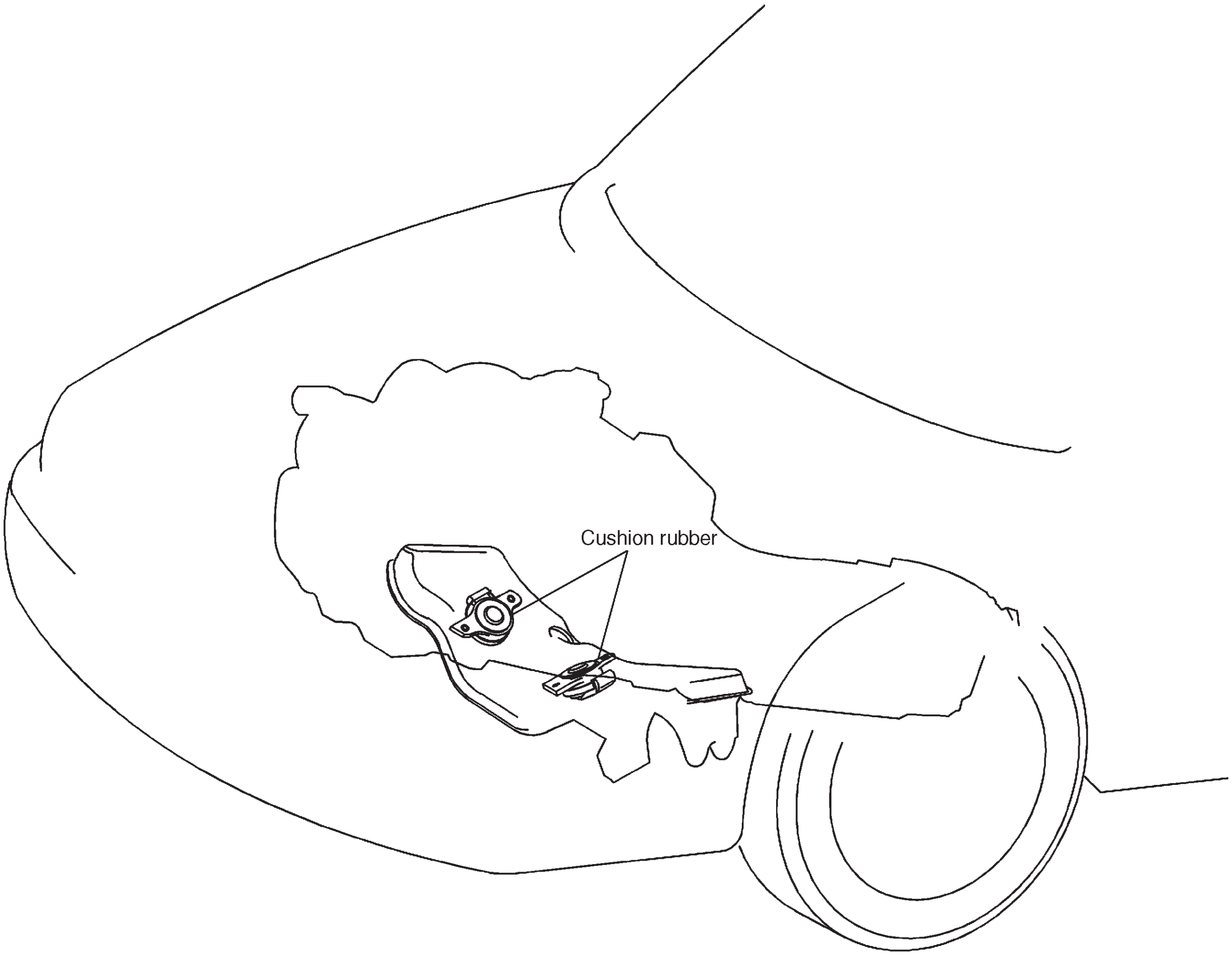
1. Engine Mounting System

A: STANDARD TYPE (BRIGHTON AND L AT VEHICLES)



B2H3142B

B: LIQUID-FILLED TYPE (EXCEPT BRIGHTON AND L AT VEHICLES)



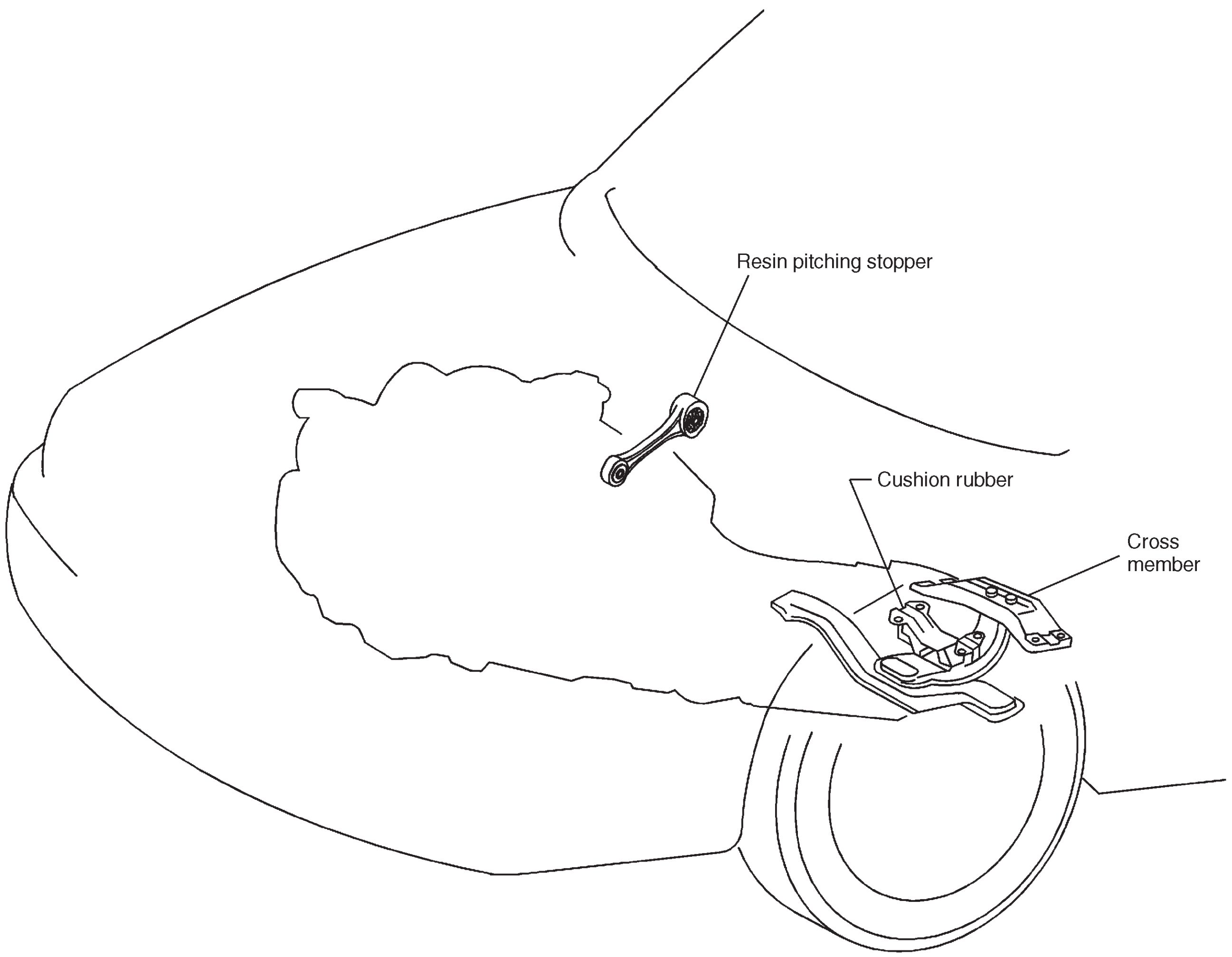
B2H3143A

2. Transmission Mounting System

A: EXCEPT OUTBACK

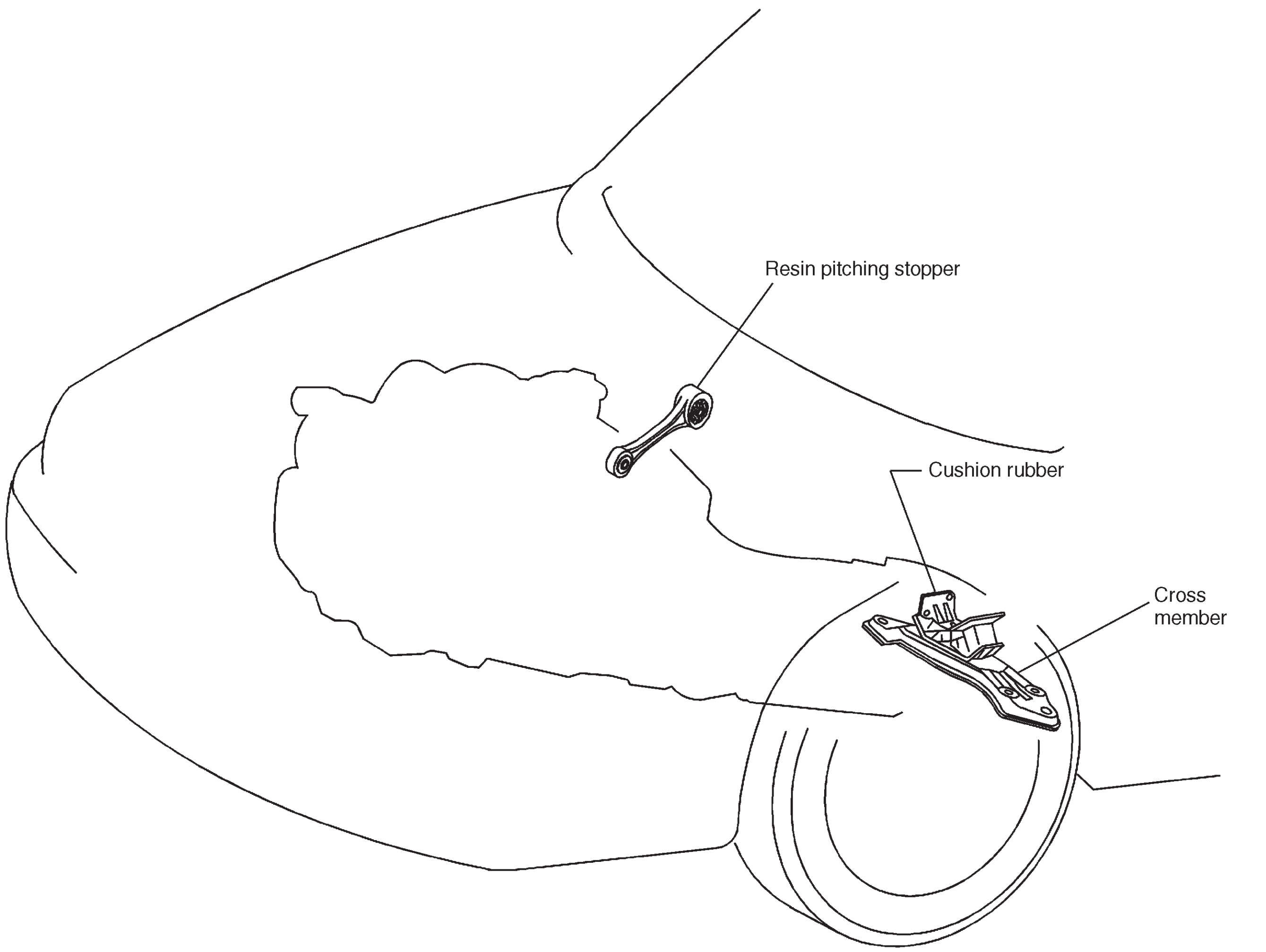
The pitching stopper made of resin is a non-adjusting type with a slot provided on the transmission end to be used as a bolt hole.

1. MT MODEL



B2H3144A

2. AT MODEL

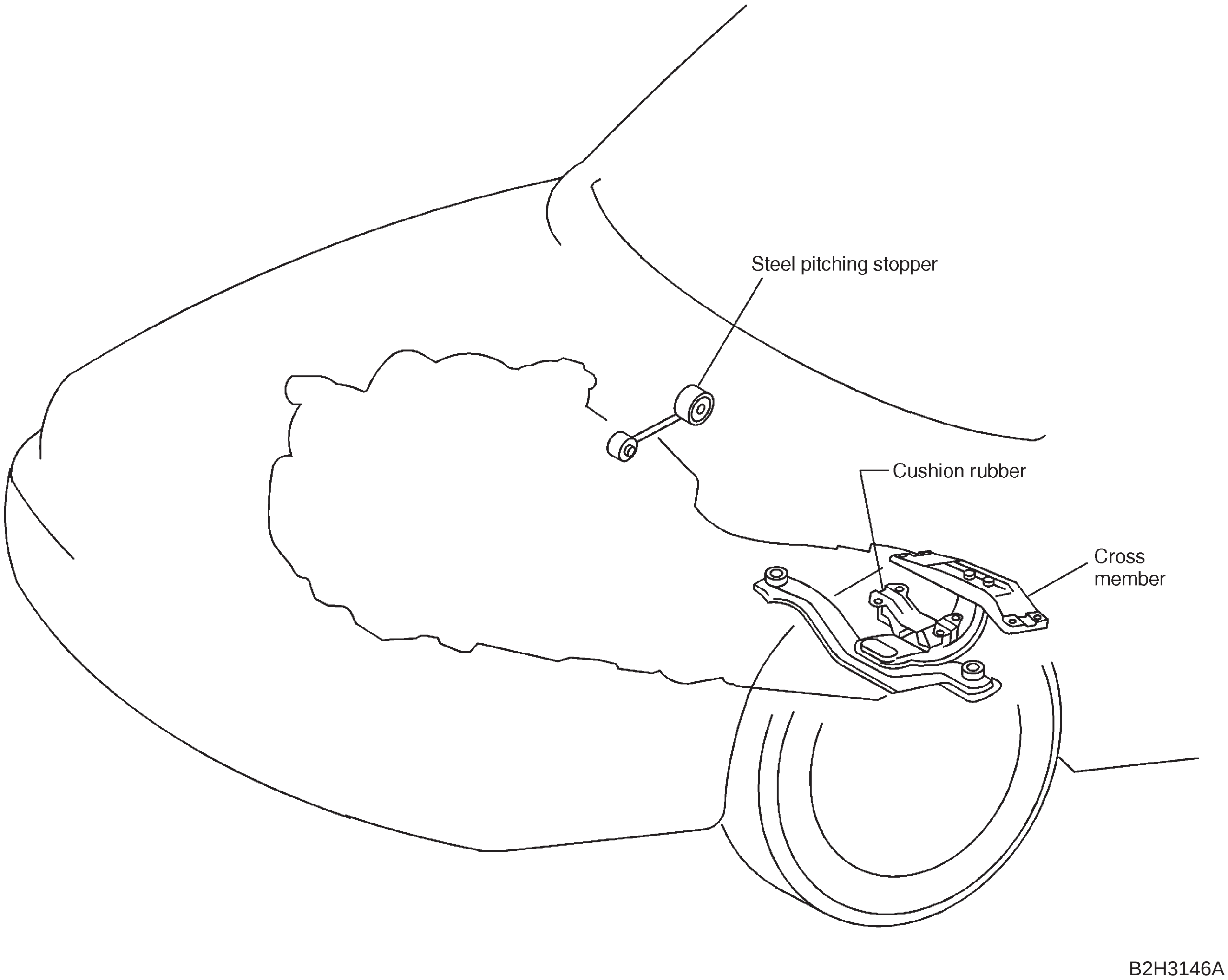


B2H3145A

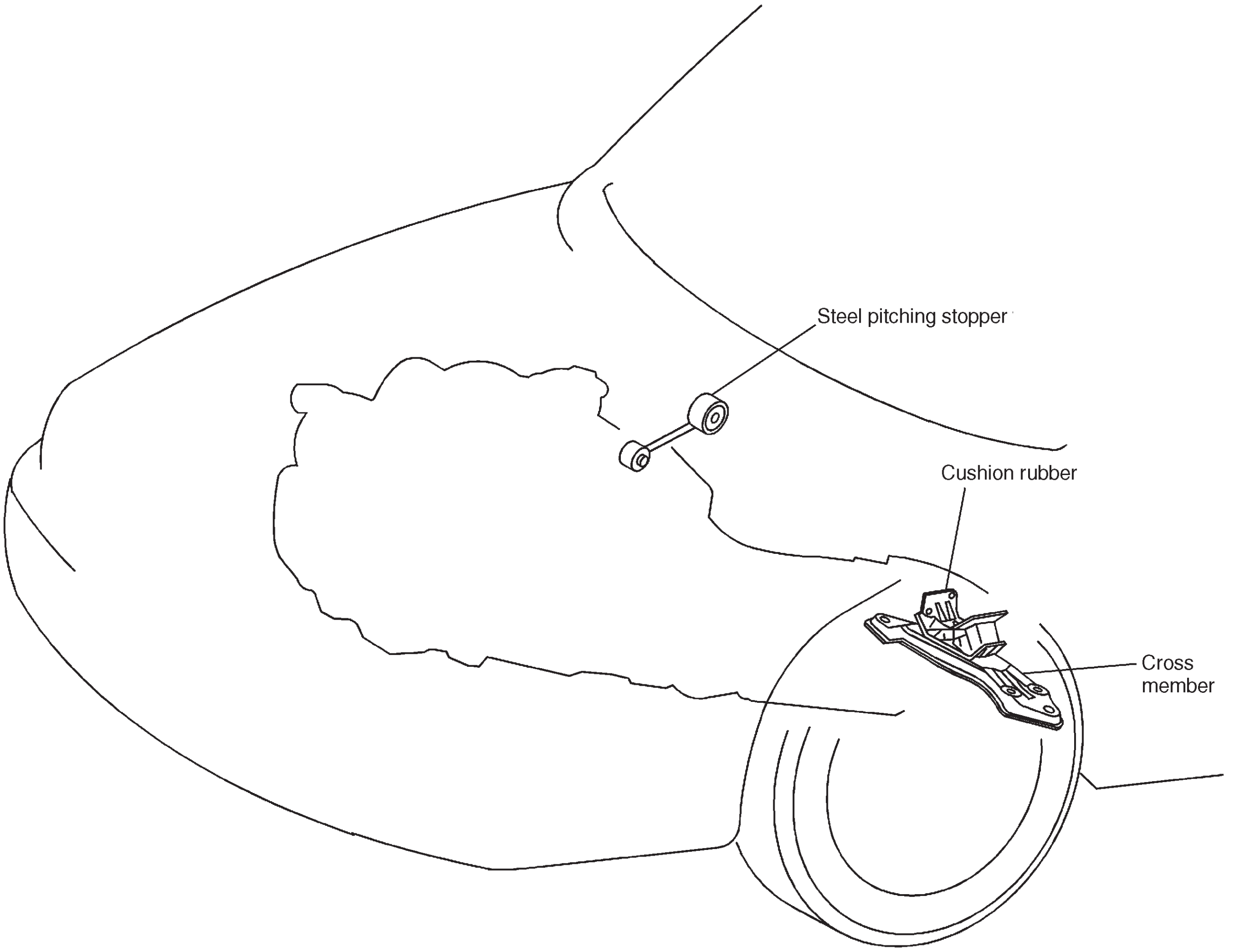
B: OUTBACK

The pitching stopper made of steel is a non-adjusting type with a slot provided on the transmission end to be used as a bolt hole.

1. MT MODEL



2. AT MODEL



B2H3147A

MEMO

1. General

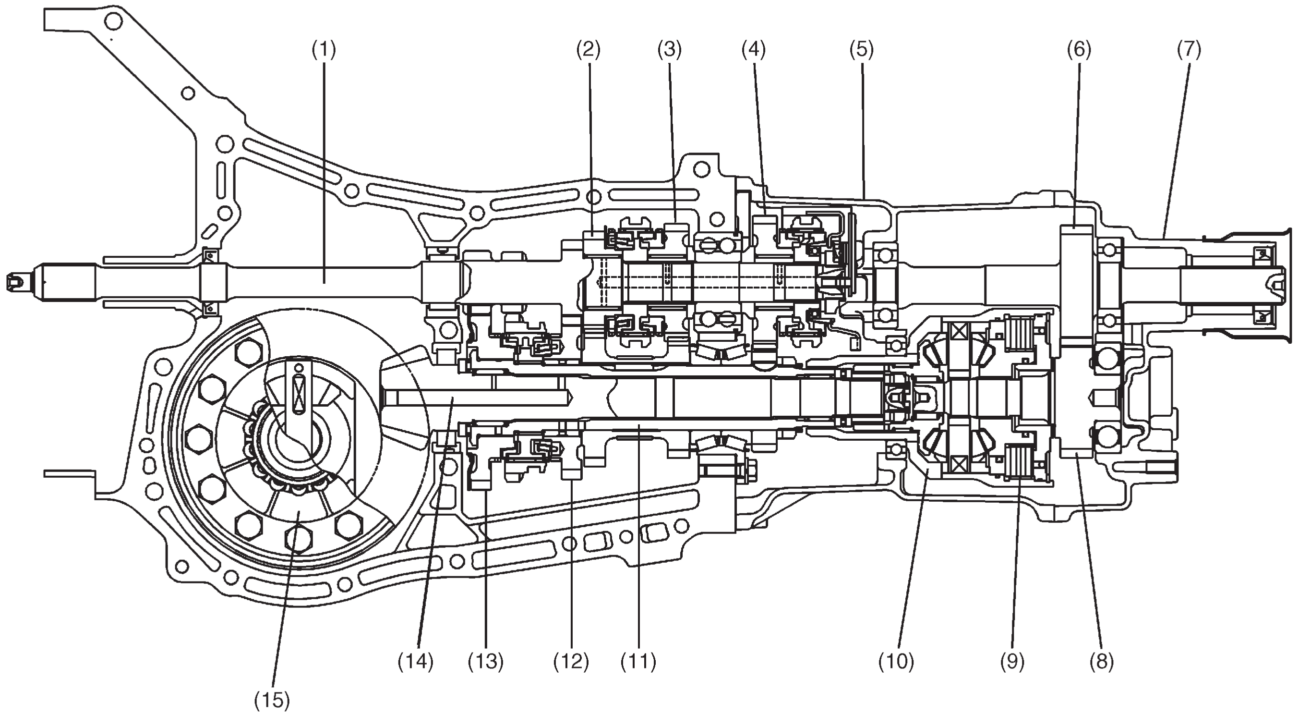
The transmission provides five forward speeds and one reverse speed and utilizes a floor shift lever design for gear selection. All forward gears are provided with synchromesh mechanisms that utilize inertia lock-key designs.

The transmission is unitized with the differential and housed in an aluminum case which is unitized with the clutch housing. The aluminum case is divided into left and right halves. Major features of the transmission are as follows: The clutch shaft has been extended to form a mainshaft, the countershaft combines the function of the final reduction drive pinion shaft, and the hypoid gear is "offset" to form a compact power train design. The forward gears are helical and feature high tooth-face strength, high engagement ratios and quiet operation. Reverse direction is achieved by engaging a selective-sliding reverse idler gear with the drive gear on the mainshaft and the driven gear on the 1st-2nd synchronizer hub of the drive pinion shaft. The 1st gear on the pinion side utilize sub-gear to reduce noise.

It is a compact, "full-time" transmission that utilizes a center differential provided with a viscous coupling at the rear of a transfer unit. The viscous coupling serves as a differential-action control.

The center differential utilizes a highly reliable, bevel gear. It not only delivers an equal amount of drive power to both the front and rear, but controls the difference in rotating speed between the front and rear wheels. A viscous coupling and center differential gears are located in the center differential case to connect the front and rear wheel drive shafts. With this arrangement, the transfer system realized a compact construction.

In addition, the viscous-coupling serves as a differential-action control to eliminate a mechanical lock mechanism.



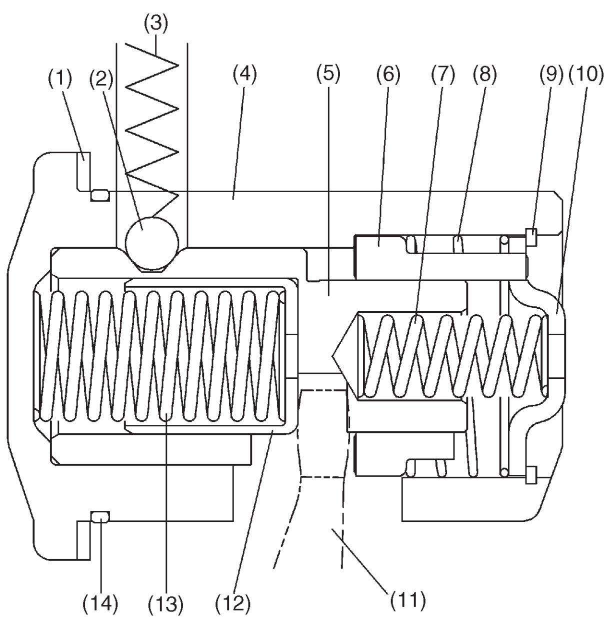
(1)	Main shaft	(7)	Extension	(13)	1st driven gear
(2)	3rd drive gear	(8)	Transfer drive gear	(14)	Drive pinion shaft
(3)	4th drive gear	(9)	Viscous coupling	(15)	Front differential ASSY
(4)	5th drive gear	(10)	Center differential with viscous coupling		
(5)	Transfer case	(11)	Driven shaft		
(6)	Transfer driven gear	(12)	2nd driven gear		

2. Reverse Check Mechanism

A: CONSTRUCTION

The reverse check sleeve is bolted to the transfer case. The reverse accent shaft is inserted in the reverse check sleeve. On the smaller-diameter side of this reverse accent shaft, the reverse check cam is loosely mounted so that it can rotate, and the reverse check sleeve holds the reverse check cam in place with its stepped part.

The reverse return spring, which is inserted in the reverse accent shaft presses the shaft to the left. Further, the reverse check spring is placed in between the reverse check cam and reverse check sleeve, which forces the reverse check cam to the left and in the direction of rotation. Both springs are held down with the reverse check plate that is attached to the reverse check sleeve with the snap ring. The reverse accent shaft has a groove for reverse accent, in which the ball and reverse accent spring are put through a hole drilled in the reverse check sleeve.



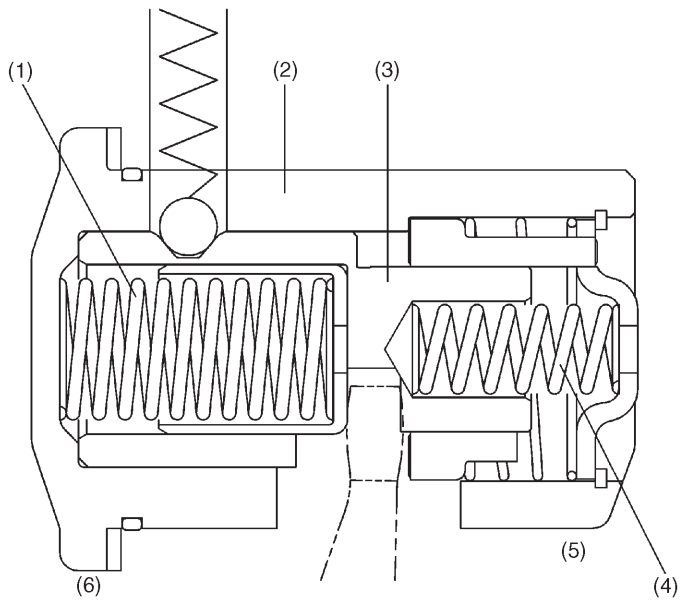
B3H1007A

(1)	Select adjust shim	(6)	Reverse check cam	(11)	Selector arm
(2)	Ball	(7)	Reverse return spring	(12)	Spring cap
(3)	Reverse accent spring	(8)	Reverse check spring	(13)	1st return spring
(4)	Reverse check sleeve	(9)	Snap ring	(14)	O-ring
(5)	Reverse accent shaft	(10)	Reverse check plate		

B: OPERATION

The reverse check sleeve and reverse accent shaft have a notch, and the selector arm is placed between the notches. The position of the selector arm shown is the neutral position (hereafter referred to as (N) position). The point where the selector arm stops when moved to the left is the 1st and 2nd position. On the contrary, the point where the selector arm stops when moved to the right is the 5th and reverse position.

The selector arm is pushed back to the (N) position by the 1st return spring from the 1st and 2nd side, and by the reverse return spring from the 5th and reverse side.

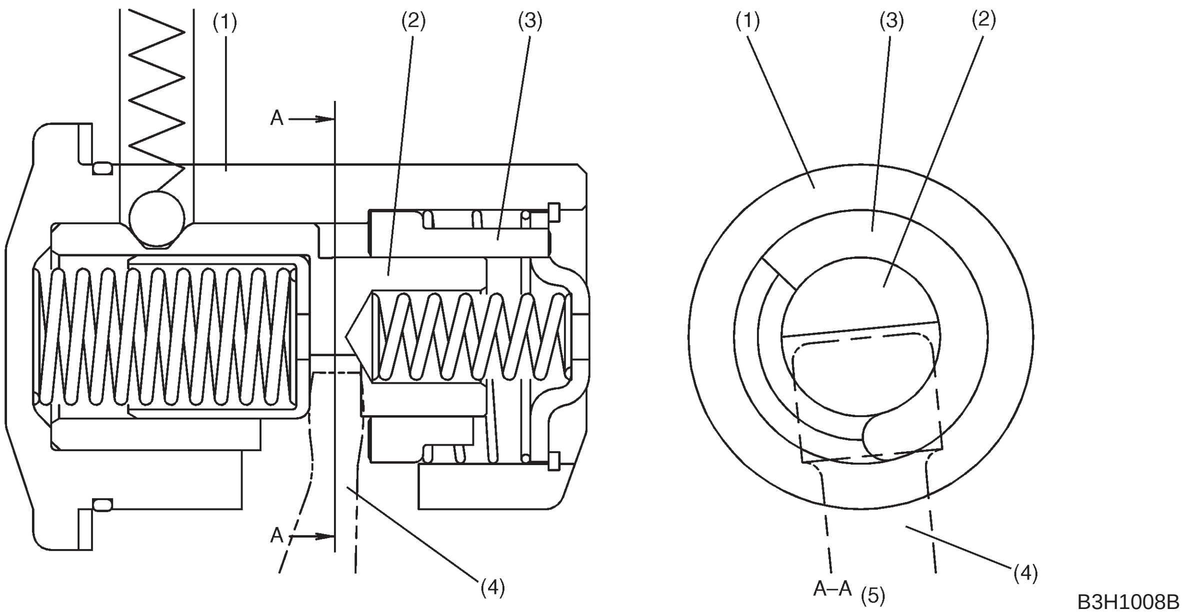


B3H1007B

(1) 1st return spring	(3) Reverse accent shaft	(5) 5th and reverse side
(2) Reverse check sleeve	(4) Reverse return spring	(6) 1st and 2nd side

1. WHEN 5TH AND REVERSE SIDE IS SELECTED

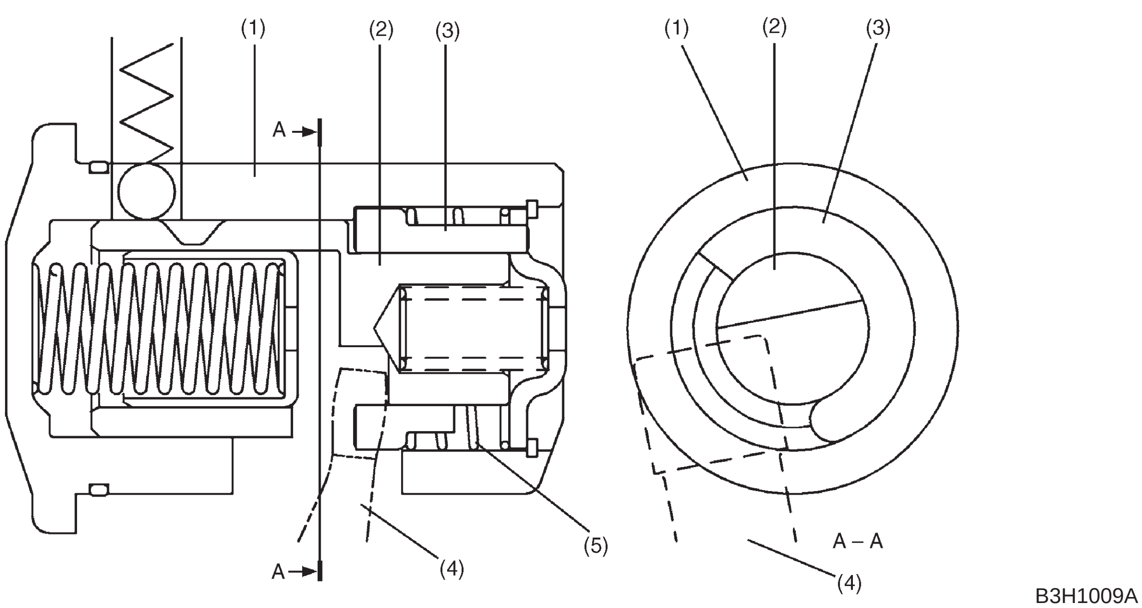
The selector arm pushes the reverse accent shaft and reverse check cam simultaneously and moves to the 5th and reverse side.



(1) Reverse check sleeve
(2) Reverse accent shaft
(3) Reverse check cam
(4) Selector arm
(5) Neutral position

2. WHEN SHIFT IS MADE TO 5TH

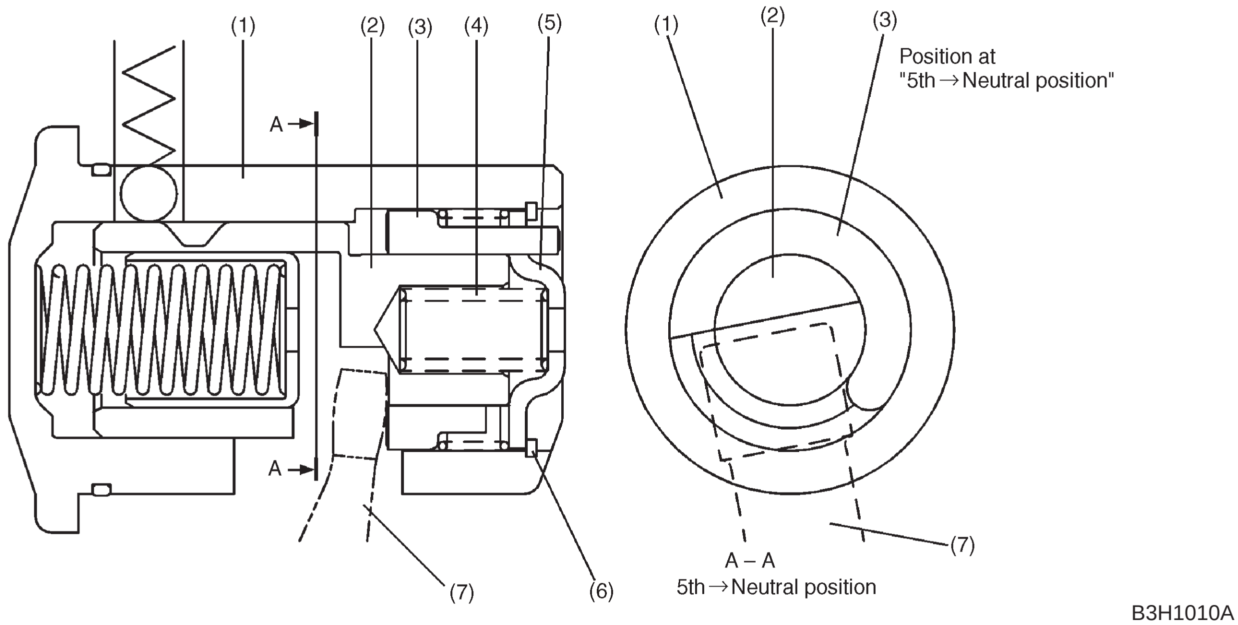
The selector arm moves to the 5th side pushing the reverse accent shaft. When the selector arm pulls out of the reverse check cam, the reverse check cam is returned to the original position by the reverse check spring.



(1) Reverse check sleeve
(2) Reverse accent shaft
(3) Reverse check cam
(4) Selector arm
(5) Reverse check spring

3. WHEN SHIFT IS MADE FROM 5TH TO REVERSE

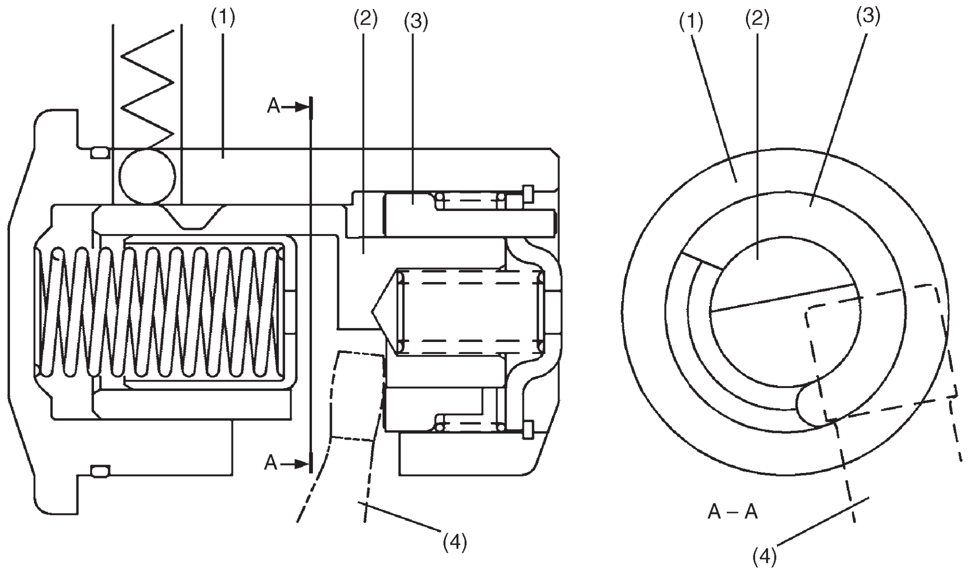
The selector arm moves to the reverse side pushing the reverse accent shaft and runs against the selector cam that has already returned. The reverse check cam has a stopper, which hits against the reverse check plate Thus, the reverse check cam cannot rotate further. Accordingly, the selector arm comes to a stop at a point where it has turned the reverse check cam to a certain degree (i.e., (N) position), and the reverse check cam is pushed back to the (N) position by the reverse accent shaft (i.e., the reverse return spring).



(1) Reverse check sleeve
(2) Reverse accent shaft
(3) Reverse check cam
(4) Reverse return spring
(5) Reverse check plate
(6) Snap ring
(7) Selector arm

4. WHEN SHIFT IS MADE TO REVERSE

The selector arm again moves to the 5th and reverse side. When the shift is made to reverse, the selector arm moves to the reverse position while pushing the reverse accent shaft and reverse check cam together.



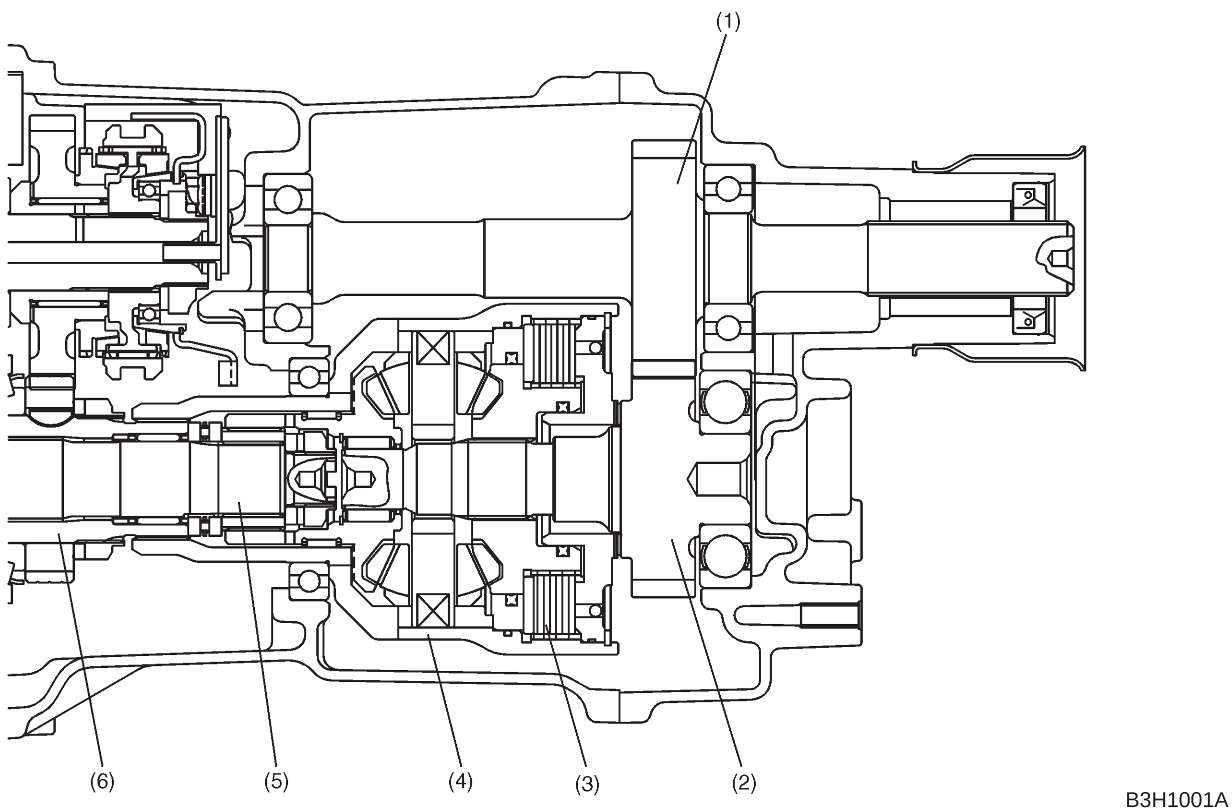
(1) Reverse check sleeve
(2) Reverse accent shaft
(3) Reverse check cam
(4) Selector arm

3. Center Differential

A: CONSTRUCTION

The center differential is composed of a mechanical differential and a viscous coupling and transmits the power from the transfer drive gear to the drive pinion shaft and the driven shaft.

The center differential has in general two functions; distributing engine torque to the front and rear wheel drive shafts equally, and absorbing the difference in rotating speed between the front and rear wheels during turns.
The differential with a viscous coupling, however, has the following function in addition to the above-mentioned functions. It generates viscous torque when spinning front or rear wheels have caused a rotating speed difference between the front and rear axles, limiting the differential action so that the optimum drive torque distribution may be attained.

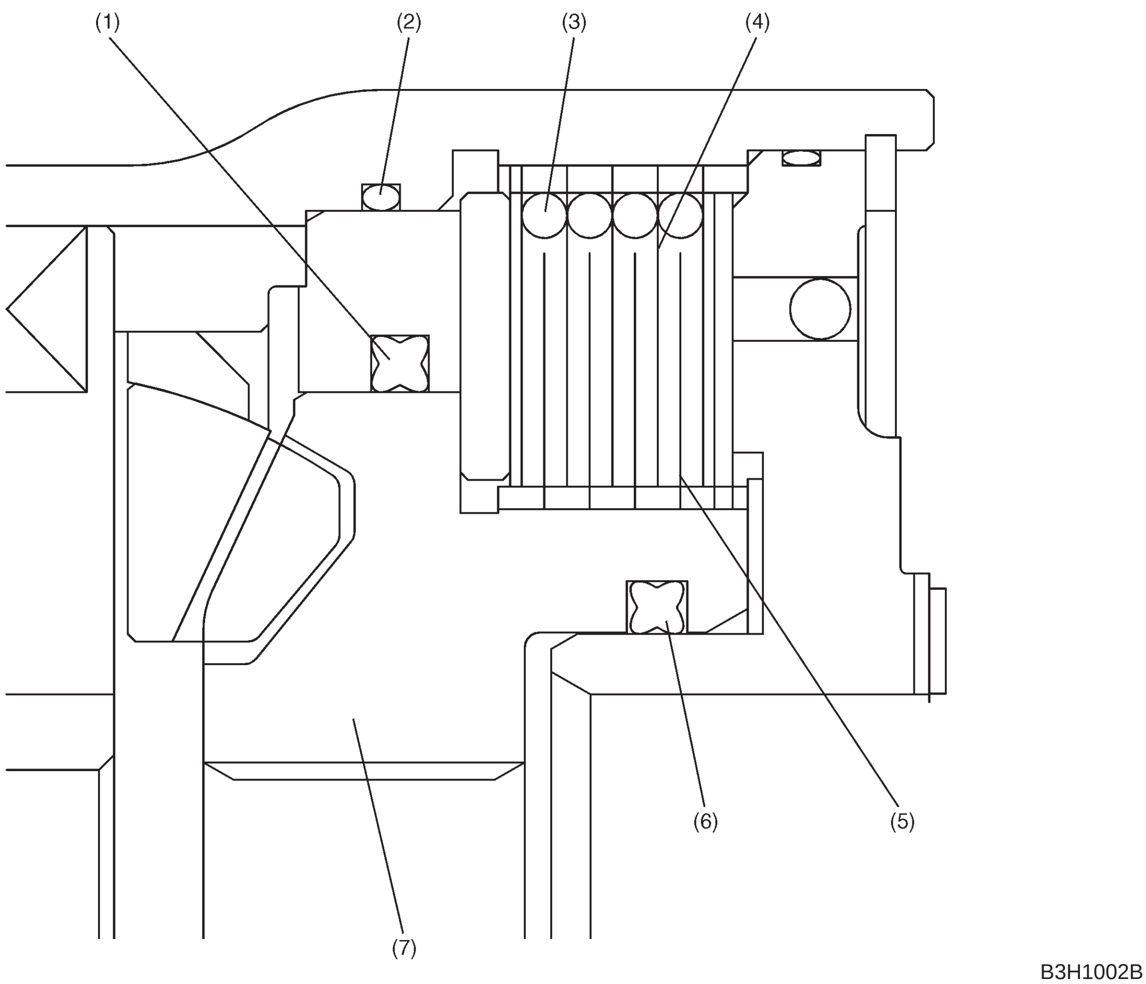


(1)	Transfer driven gear	(4)	Center differential with viscous coupling
(2)	Transfer drive gear	(5)	Drive pinion shaft
(3)	Viscous coupling	(6)	Driven shaft

B: MECHANISM OF VISCOUS COUPLING

The viscous coupling housing contains a number of inner and outer plates which are arranged alternately. The inner plate has its internal perimeter fitted to the external side gear (rear) splines while the outer plate has its external perimeter fitted to the internal center differential case splines. A spacer ring is provided to position the perimeter of the outer plate. The inner plate has no spacer ring and moves slightly between the adjacent outer plates, along the side gear (rear) splined in the axial direction.

A mixture of silicone oil and air is sealed in the space inside the center differential case. An “X” seal ring prevents silicone oil from entering the transmission. This could occur when silicone oil is highly pressurized due to an increase in rotating speed difference between the front and rear wheels.

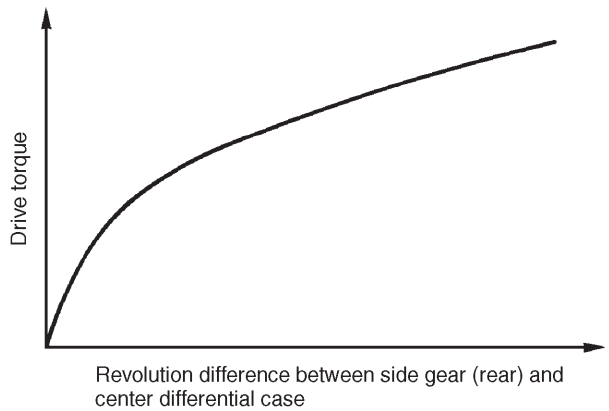


(1) X-ring
(2) O-ring
(3) Spacer ring
(4) Outer plate
(5) Inner plate
(6) X-ring
(7) Side gear (rear)

1. TORQUE CHARACTERISTICS

When a difference in rotating speed between the center differential case and the side gear (rear) occurs, a viscous shearing force is generated in the silicone oil placed between the outer and inner plates. The torque is then transmitted by the silicone oil between the center differential case and the side gear (rear).

The greater the difference in rotating speed between the center differential case and the side gear (rear), the greater the shearing force of the silicone oil. The relationship between the torque transmission and rotation speed difference is shown in the figure. As can be seen from the figure, the smaller the rotating speed difference, the lesser the torque transmission and the differential-action.



B3H1723A

2. “HUMP” PHENOMENON

Silicone oil is heated and expands as differential action continues. This crushes air inside the viscous coupling so that the silicone oil “charging rate” will increase. As differential action continues, internal pressure will abruptly increase so that inner and outer plates (alternately arranged) come in contact. This causes quick torque transmission to occur, which is called a “hump” phenomenon.

The “hump” phenomenon eliminates the rotating speed difference between the center differential case and side gear (rear) (which results in a state similar to “direct coupling”). This in turn decrease internal pressure and temperature. The viscous coupling returns to the normal operation. (The “hump” phenomenon does not occur under normal operating conditions.)

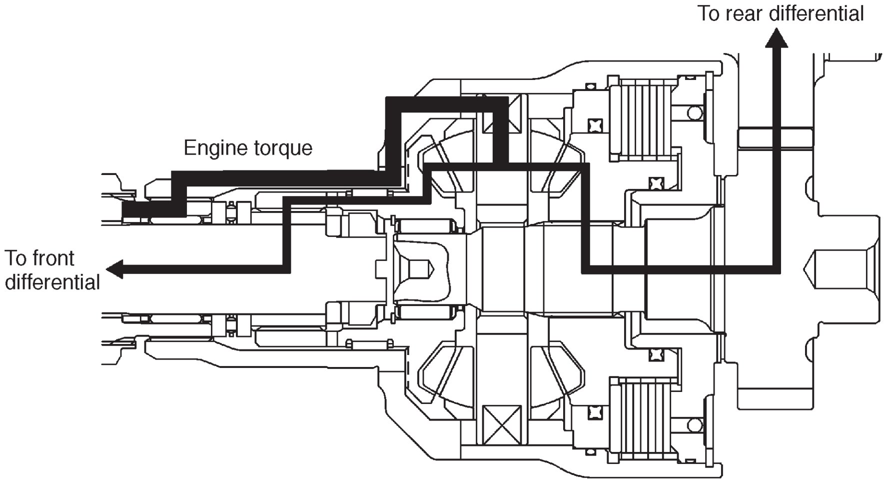
C: FUNCTION

During normal driving (when there is no speed difference between the front and rear wheels), the center differential delivers drive power to the front and rear wheels at a torque ratio of 50:50.

When a rotating speed difference occurs between the front and rear wheels, the center differential action is controlled by viscous coupling so that optimum drive forces are automatically distributed to the two.

1. DURING NORMAL DRIVING

During normal straight driving (on flat roads at constant speed), all four wheels rotate at the same speed. The center differential delivers engine torque to the front and rear drive axles. The viscous coupling does not perform the differential-action control because there is no rotating speed difference between the front and rear drive shafts.

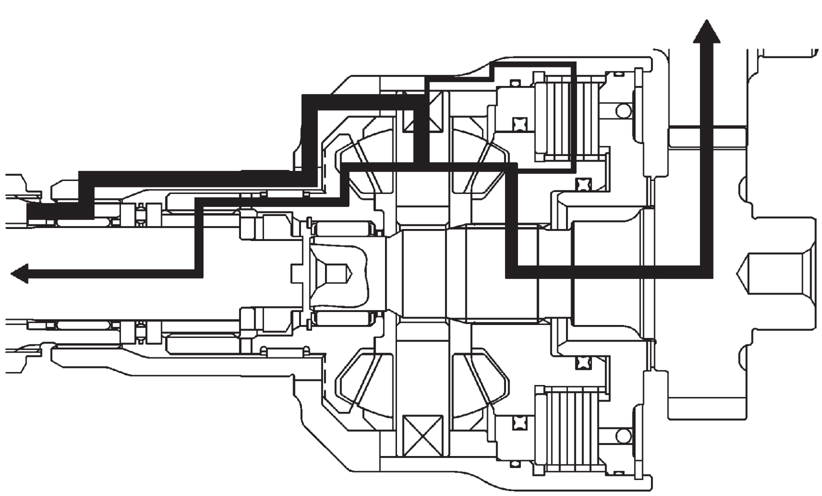


B3H1003A

2. DURING TURNS AT LOW SPEEDS

During turns at low speeds, a rotating speed difference occurs between the front and rear wheels, as well as the left and right wheels. In other words, the front wheels rotate faster than the rear wheels. When there is a small rotating speed difference (when vehicle speed is low), the center differential acts to absorb the rotating speed difference, making it possible to drive smoothly.

Although a slight rotating speed difference is transmitted to the viscous coupling, less torque transmission occurs because of the small rotating speed difference.

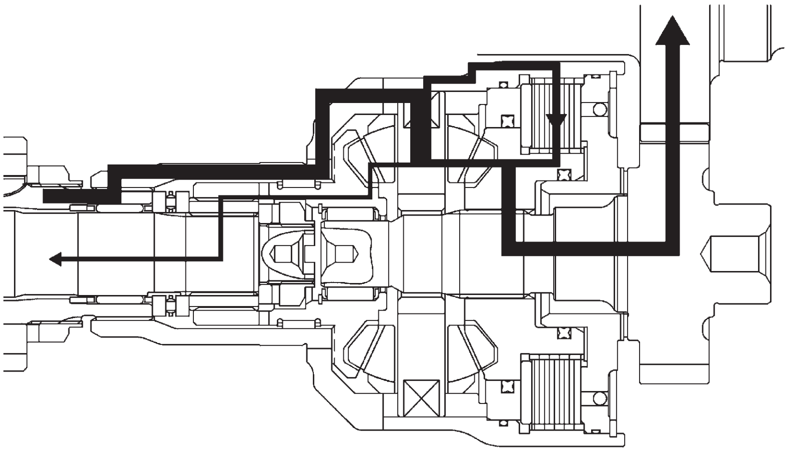


B3H1004

3. DRIVING ON ROUGH ROAD AND LOW “μ” ROAD

● When front wheel is on slippery surface

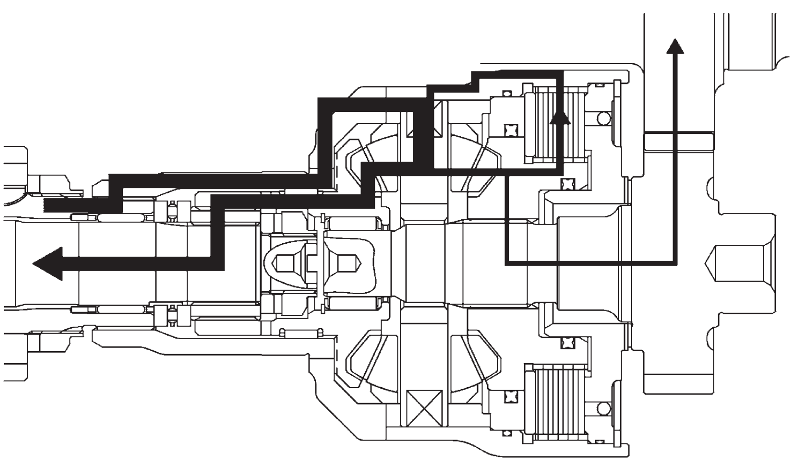
When the front wheels begins to spin during rough-road driving, the rotating speed difference between the shafts is increased by the differential’s action. At this point, the viscous coupling delivers large torque to the differential on the side which is not spinning. In this way, driving stability on rough roads is increased.



B3H1006

● When rear wheel is on slippery surface

During rapid acceleration from standing starts on a slippery (low “μ”) road, front and rear wheel weight distribution changes. When the rear wheels begin to spin, the rotating speed difference between the two shafts increase simultaneously. This causes the viscous coupling to activate to that more torque is transmitted to the front wheels than to the rear. In addition, the center-differential’s action is also restricted. In this way, acceleration performance during standing starts on low “μ” roads is greatly enhanced.



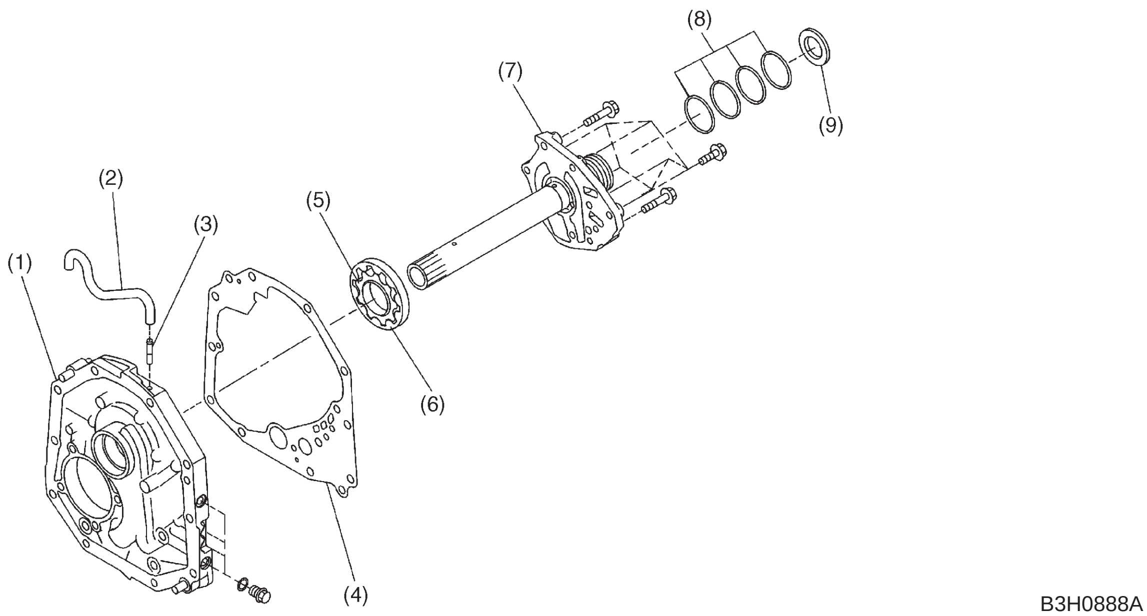
B3H1005

MEMO

1. Oil Pump

A: CONSTRUCTION

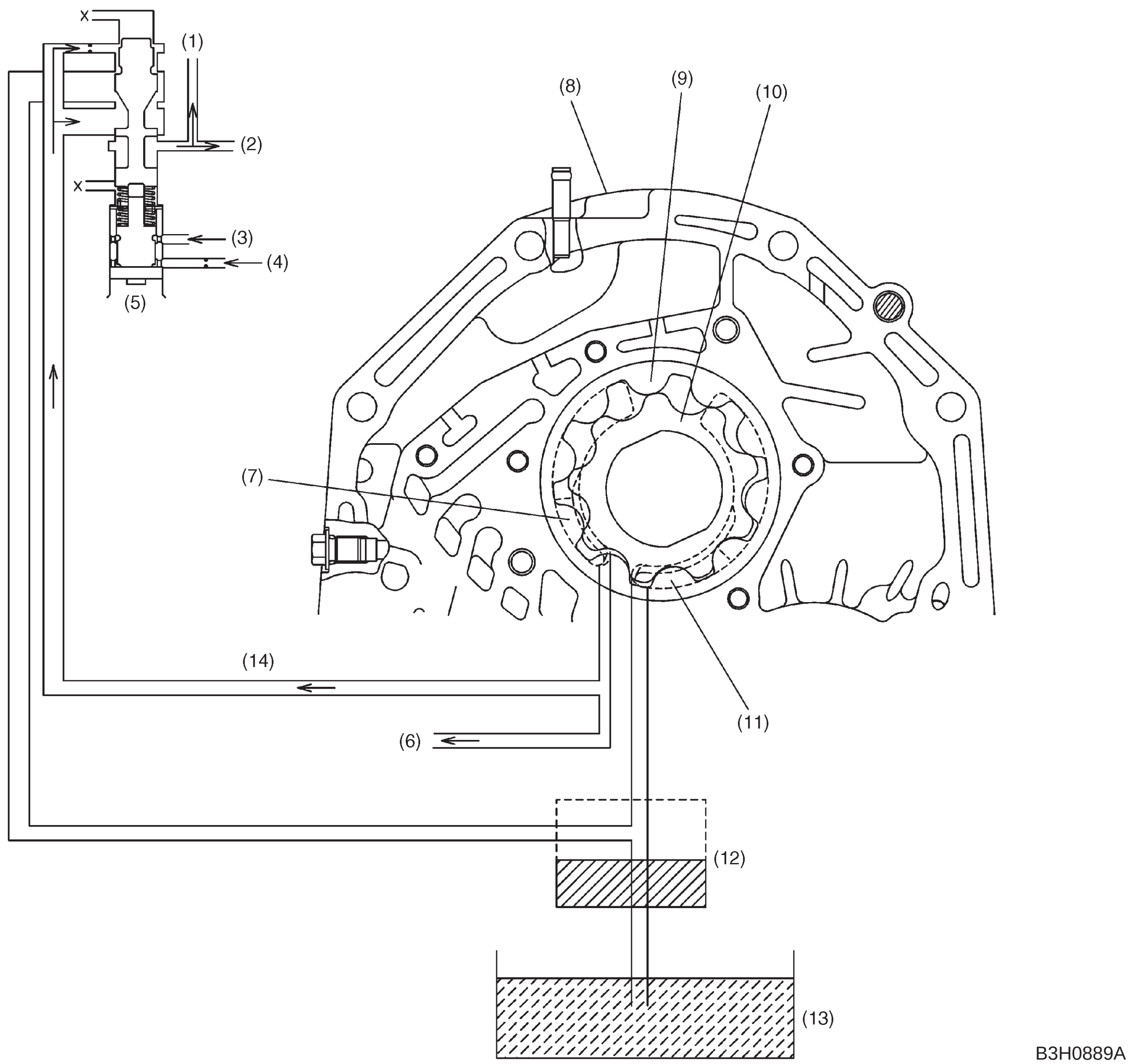
The trochoid pump is housed in the oil pump housing. It consists of a inner rotor (9 teeth), outer rotor (10 teeth) and oil pump cover.



(1)	Oil pump housing	(4)	Gasket	(7)	Oil pump cover
(2)	Hose	(5)	Inner rotor	(8)	Seal ring
(3)	Nipple	(6)	Outer rotor	(9)	Thrust bearing

B: FUNCTION

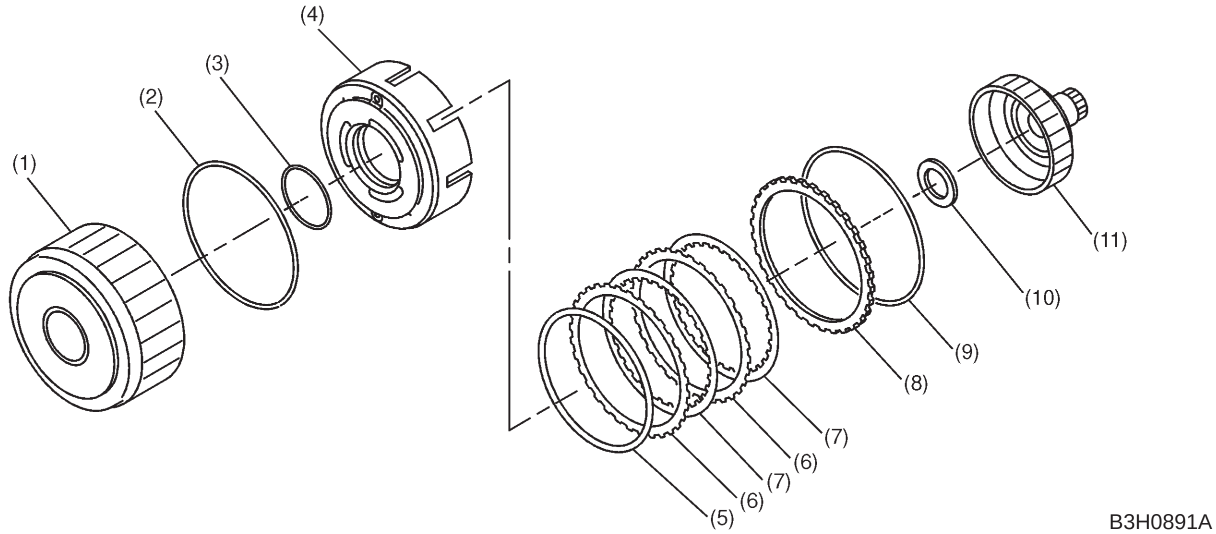
- The automatic transmission fluid (ATF) is drawn through the oil strainer mounted under the control valve ASSY, and is routed to the transmission case, to the oil pump housing, and to the oil pump cover. It then goes to the suction port.
- As the inner rotor rotates, the outer rotor also rotates. This motion causes ATF to be sucked up through the suction port and discharged under pressure from the discharged port.
- The discharged ATF flows from the oil pump cover to the oil pump housing. It then goes to the transmission case, the control valve and to the regulator valve, thus serving as hydraulic oil and lubricating oil for the torque converter clutch, valves, clutch.
- As engine speed increases, the delivery rate of the trochoid pump also increases.



(1) To torque converter regulator valve
(2) To manual valve
(3) From reverse clutch
(4) From pressure modifier pressure
(5) Pressure regulator valve
(6) To manual valve
(7) Delivery port
(8) Oil pump housing
(9) Outer rotor
(10) Inner rotor
(11) Suction port
(12) Oil strainer
(13) Oil pan
(14) Line pressure

2. Reverse Clutch

A: CONSTRUCTION

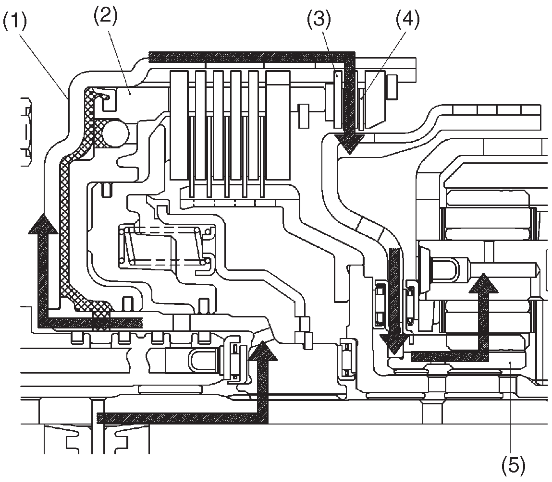


(1) High clutch drum
(2) Lip seal
(3) Lathe cut seal ring
(4) Reverse clutch piston
(5) Dish plate
(6) Driven plate
(7) Drive plate
(8) Retaining plate
(9) Snap ring
(10) Thrust needle bearing
(11) High clutch hub

B: FUNCTION

1. DURING OPERATION

Hydraulic pressure is applied to the reverse clutch piston from the control valve when shifting in reverse. The drive plate and driven plate are connected by this pressure, and engine power from the high clutch drum is transmitted to the front sun gear through the 2-4 brake hub.



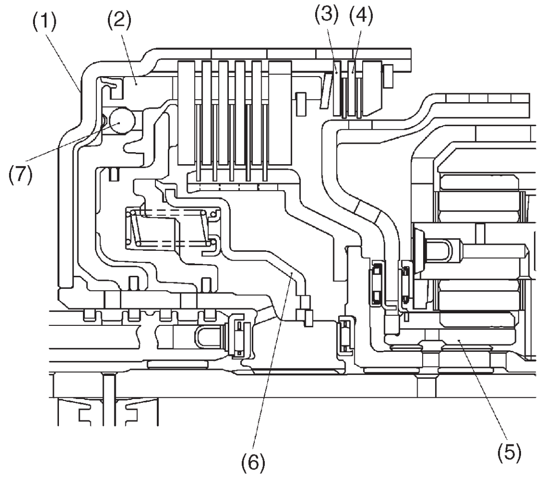
B3H0892A

(1) High clutch drum
(2) Reverse clutch piston
(3) Driven plate
(4) Drive plate
(5) Front sun gear

2. DURING NON-OPERATION

When the shift lever is in any position other than reverse, no hydraulic pressure is applied to the reverse clutch piston. Hence the drive plate and driven plate are separated, and no power is transmitted.

The check ball is built into the clutch piston. This check ball releases oil pressure from the clutch piston while the drum rotates idle. It thus avoids build-up of residual pressure in the clutch drum and a resultant half-engaged clutch, which may otherwise be caused by centrifugal oil pressure.



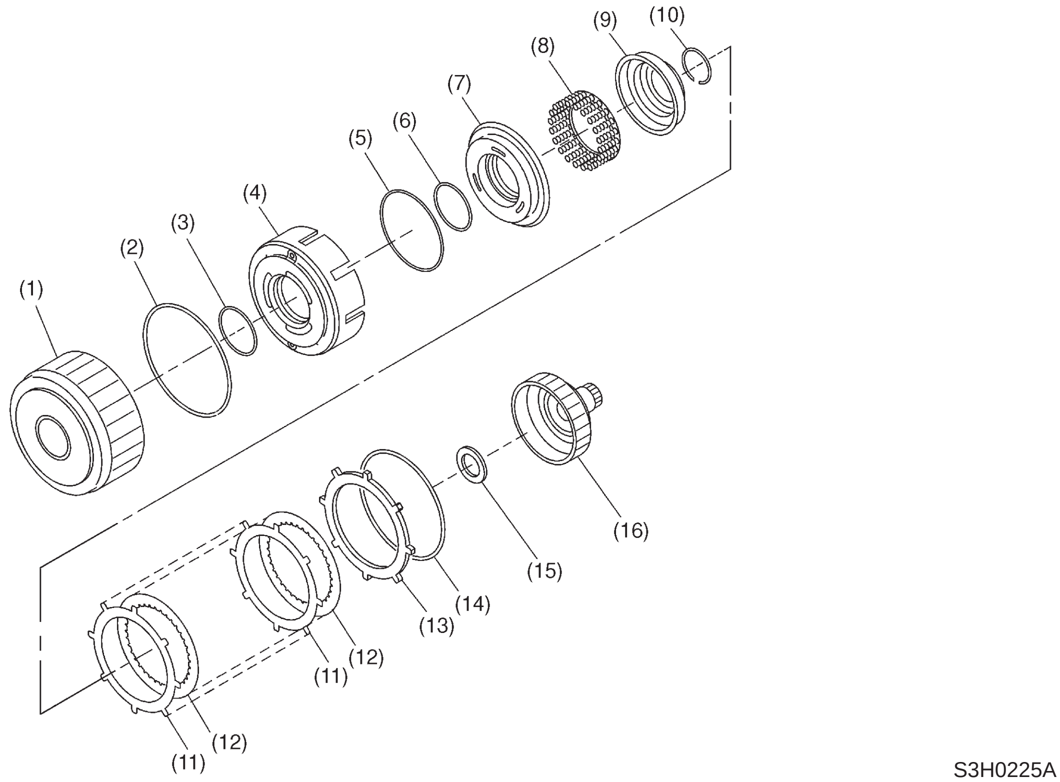
B3H0893A

(1) High clutch drum
(2) Reverse clutch piston
(3) Driven plate
(4) Drive plate
(5) Front sun gear
(6) Cover
(7) Check ball

3. High Clutch

In 3rd and 4th speed operation, hydraulic pressure is applied to the high clutch from the control valve and another hydraulic pressure controller. The clutch plates (drive and driven plates) are connected by this hydraulic pressure, and engine power from the input shaft is transmitted to the front planetary carrier through the high clutch hub.

A cover is placed inside the piston, and the space between the high clutch piston and the cover is filled with ATF. The centrifugal force of this ATF, when the high clutch is not in engagement, acts to cancel the centrifugal force generated by ATF remaining in the oil chamber in the high clutch piston, which otherwise is likely to push the piston, preventing the clutch from being disengaged completely.
When the high clutch is in operation, the piston is not pushed back because a large hydraulic pressure is being applied on it, thereby the high clutch being kept engaged.

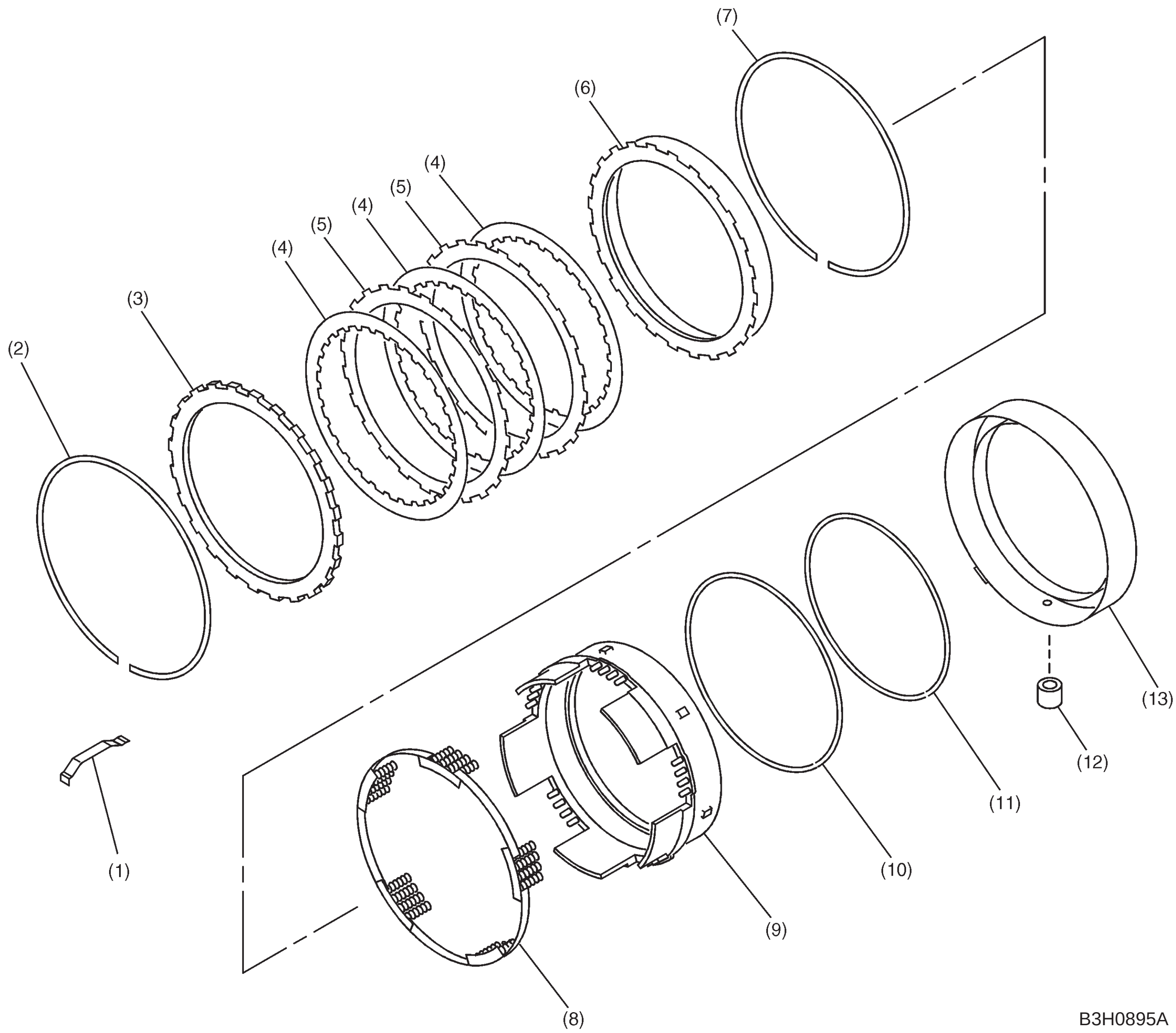


(1)	High clutch drum	(7)	High clutch piston	(13)	Retaining plate
(2)	Lathe cut seal ring (outer)	(8)	Spring retainer	(14)	Snap ring
(3)	Lathe cut seal ring (inner)	(9)	Cover	(15)	Thrust needle bearing
(4)	Reverse clutch piston	(10)	Snap ring	(16)	High clutch hub
(5)	Lathe cut seal ring (outer)	(11)	Driven plate		
(6)	Lathe cut seal ring (inner)	(12)	Drive plate		

4. 2-4 Brake

A: CONSTRUCTION

The 2-4 brake is composed of a 2-4 brake piston, spring retainer, pressure plate, drive plates and driven plates.
This clutch operates with hydraulic pressure from the transmission control valve to fix the front sun gear when the 2nd gear is selected in D, 3 or 2 range, or when the 4th gear is selected in D range.

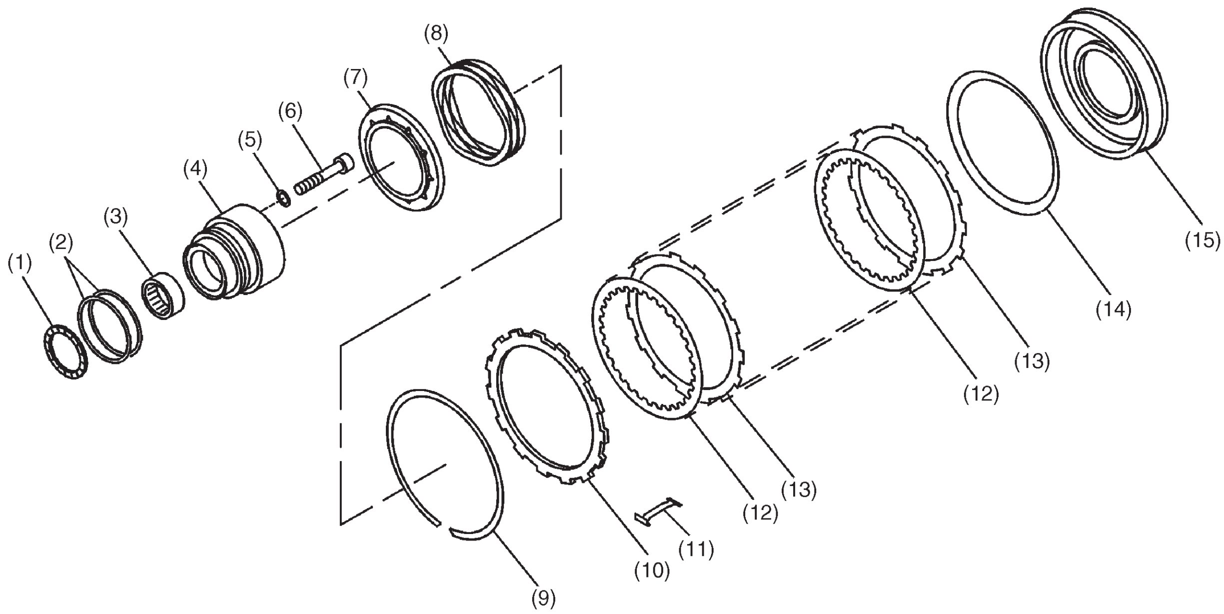


(1)	Leaf spring	(8)	Spring retainer
(2)	Snap ring	(9)	2-4 brake piston
(3)	Retaining plate	(10)	Lathe cut seal ring
(4)	Drive plate	(11)	Lathe cut seal ring
(5)	Driven plate	(12)	2-4 brake piston seal
(6)	Pressure rear plate	(13)	2-4 brake piston retainer
(7)	Snap ring		

5. Low & Reverse Brake

A: CONSTRUCTION

The piston, dish plate, drive plate, driven plate, retaining plate and snap ring are mounted directly to the transmission case. The spring retainer which is integral with the spring is secured to the inner race of the transmission case engagement surface.



(1)	Thrust bearing	(6)	Bolt	(11)	Leaf spring
(2)	Seal ring	(7)	Spring retainer	(12)	Drive plate
(3)	Needle bearing	(8)	Return spring	(13)	Driven plate
(4)	One-way clutch inner race	(9)	Snap ring	(14)	Dish plate
(5)	Washer	(10)	Retaining plate	(15)	Low & reverse brake piston

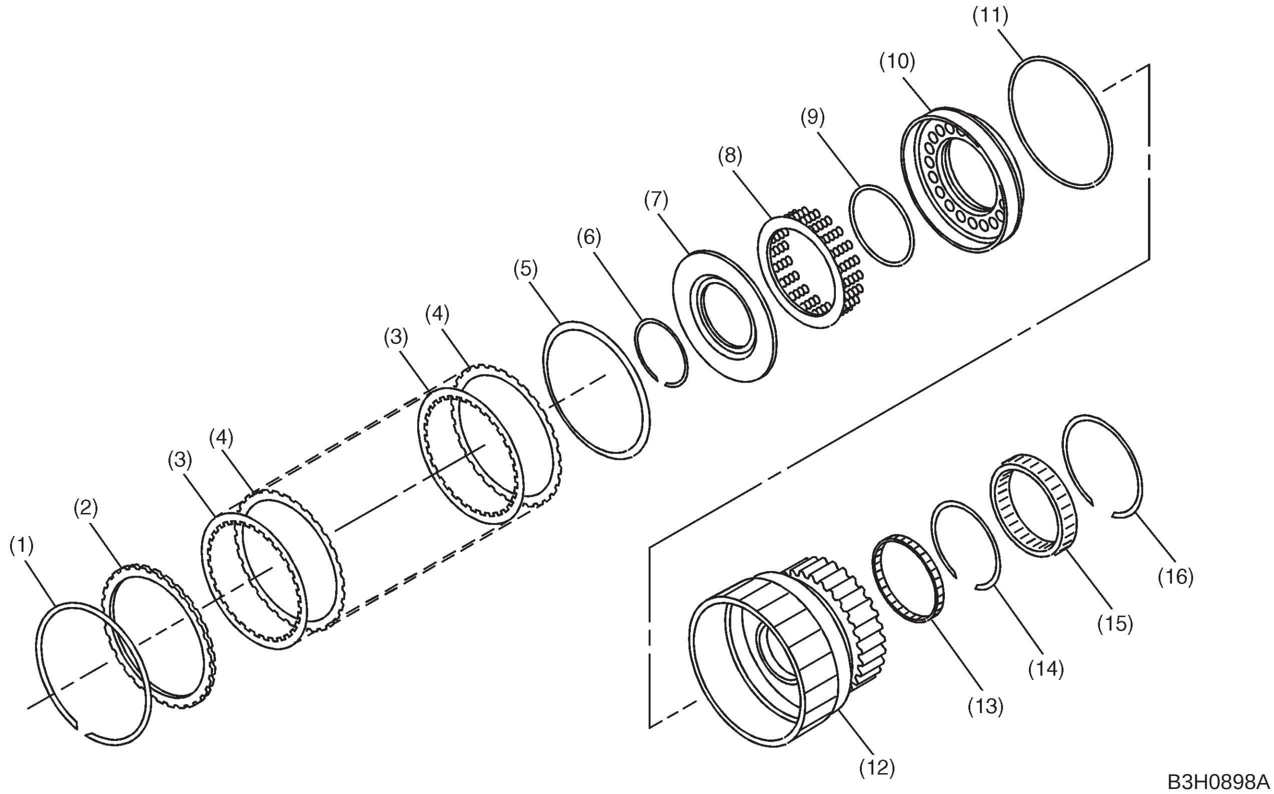
B: FUNCTION

During 1st speed of the “1st”, and reverse, hydraulic pressure from the hydraulic pressure controller is applied to the low & reverse piston. This pressure causes the drive plate and driven plate to engage, and the low clutch to be fixed.

6. Low Clutch

A: CONSTRUCTION

The low clutch consists of a clutch drum, clutch piston, return spring, cover, drive plates, driven plates, etc.
The low clutch drum is manufactured by pressing sheet metal. The clutch drum, outer race and sleeve are welded together by the electron beam welding technique.

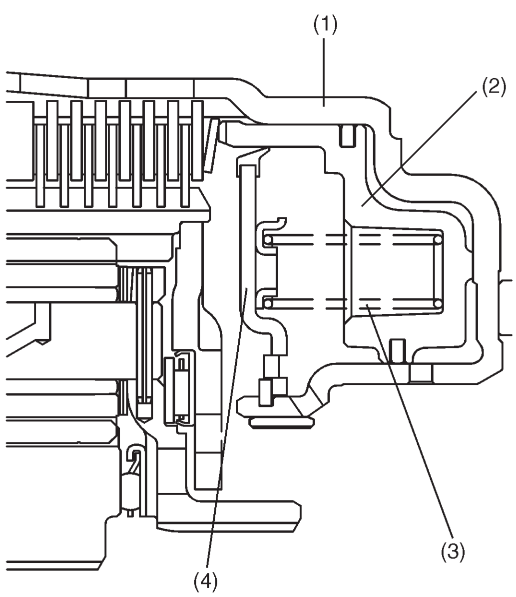


(1)	Snap ring	(7)	Cover	(13)	Needle bearing
(2)	Retainer	(8)	Spring retainer	(14)	Snap ring
(3)	Drive plate	(9)	Lathe cut seal ring	(15)	One-way clutch
(4)	Driven plate	(10)	Low clutch piston	(16)	Snap ring
(5)	Dish plate	(11)	Lathe cut seal ring		
(6)	Snap ring	(12)	Low clutch drum		

B: FUNCTION

The low clutch operates in “D” (1st, 2nd, 3rd speed), “3” (1st, 2nd, 3rd speed), “2” and “1” ranges. This clutch engages when the hydraulic pressure from the transmission control valve is applied to the low clutch piston, transmitting the power to the reduction drive shaft.

A cover is placed inside the piston, and the space between the low clutch piston and the cover is filled with ATF. The centrifugal force of this ATF, when the low clutch is not in engagement, acts to cancel the centrifugal force generated by ATF remaining in the oil chamber in the low clutch piston, which otherwise is likely to push the piston, preventing the clutch from being disengaged completely.
When the low clutch is in operation, the piston is not pushed back because a large hydraulic pressure is being applied on it, thereby the low clutch being kept engaged.



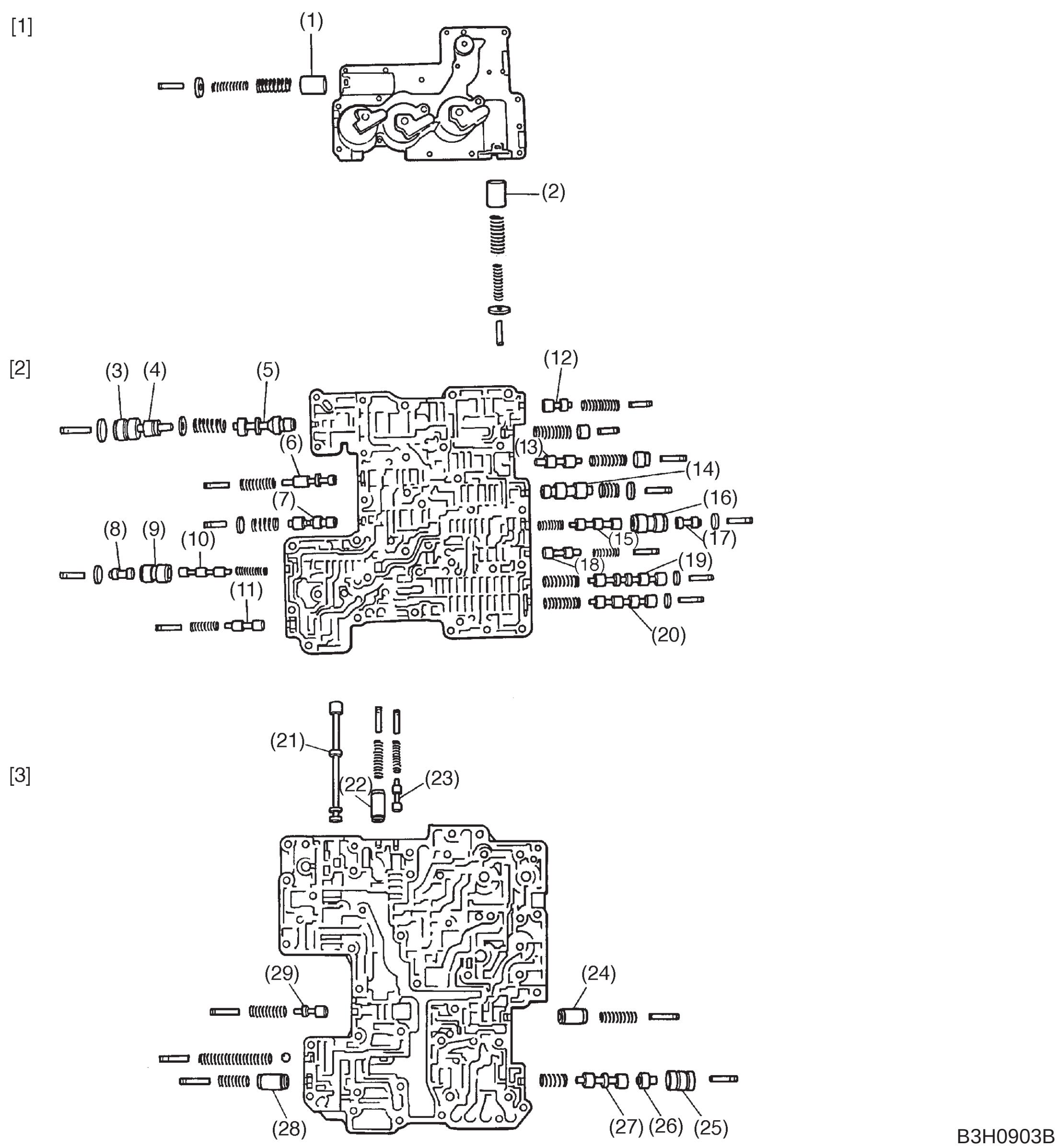
B3H0899A

(1) Low clutch drum
(2) Low clutch piston
(3) Spring retainer
(4) Cover

7. Hydraulic Control Valve

The hydraulic control system consists of an oil pump, control valve bodies, clutches and connecting passages and pipes. When it is activated manually, or automatically by the electronic control system, it hydraulically controls the gearshifting mechanism.

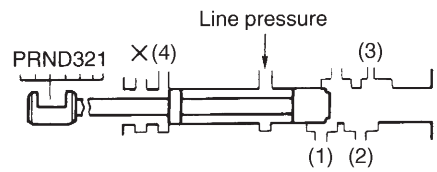
A: CONSTRUCTION



(1) High clutch accumulator piston B
(2) 2-4 brake accumulator piston B
(3) Pressure regulator sleeve
(4) Pressure regulator plug
(5) Pressure regulator valve
(6) Reverse inhibit valve
(7) Accumulator control valve B
(8) 2-4 brake timing plug A
(9) 2-4 brake timing sleeve A
(10) 2-4 brake timing valve A
(11) 2-4 brake timing valve B
(12) Torque converter regulator valve
(13) Pressure modifier valve
(14) Accumulator control valve A
(15) Low clutch timing valve A
(16) Low clutch timing sleeve A
(17) Low clutch timing plug A
(18) Low clutch timing valve B
(19) Shift valve B
(20) Shift valve A
(21) Manual valve
(22) Throttle accumulator piston B
(23) 1st reducing valve
(24) Throttle accumulator piston A
(25) Lock-up control sleeve
(26) Lock-up control plug
(27) Lock-up control valve
(28) Modifier accumulator piston
(29) Pilot valve

[1] Upper valve body
[2] Middle valve body
[3] Lower valve body

B: FUNCTION

<table>
<tr><th>Name</th><th>Function</th></tr>
<tr><td>Pressure regulator valve</td><td>Regulates the pressure of ATF delivered from the oil pump to an optimum level (line pressure) corresponding to vehicle running conditions.</td></tr>
<tr><td>Pressure modifier valve</td><td>Adjusts the pressure modifier pressure depending on the driving condition to keep the line pressure at the optimum level.</td></tr>
<tr><td>Pressure modifier accumulator piston</td><td>Smoothes the pressure regulated by the pressure modifier valve to prevent pulsation in line pressure.</td></tr>
<tr><td>Line pressure relief valve</td><td>Prevents excessive rise of the line pressure.</td></tr>
<tr><td>Manual valve</td><td>Delivers line pressure to each circuit corresponding to the selected position.
<table>
<tr><th>Circuit / Range</th><th>(1)</th><th>(2)</th><th>(3)</th><th>(4)</th></tr>
<tr><td>P</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R</td><td></td><td></td><td></td><td>○</td></tr>
<tr><td>N</td><td></td><td></td><td></td><td></td></tr>
<tr><td>D</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>○</td><td>○</td><td></td><td></td></tr>
<tr><td>1</td><td>○</td><td>○</td><td>○</td><td></td></tr>
</table>


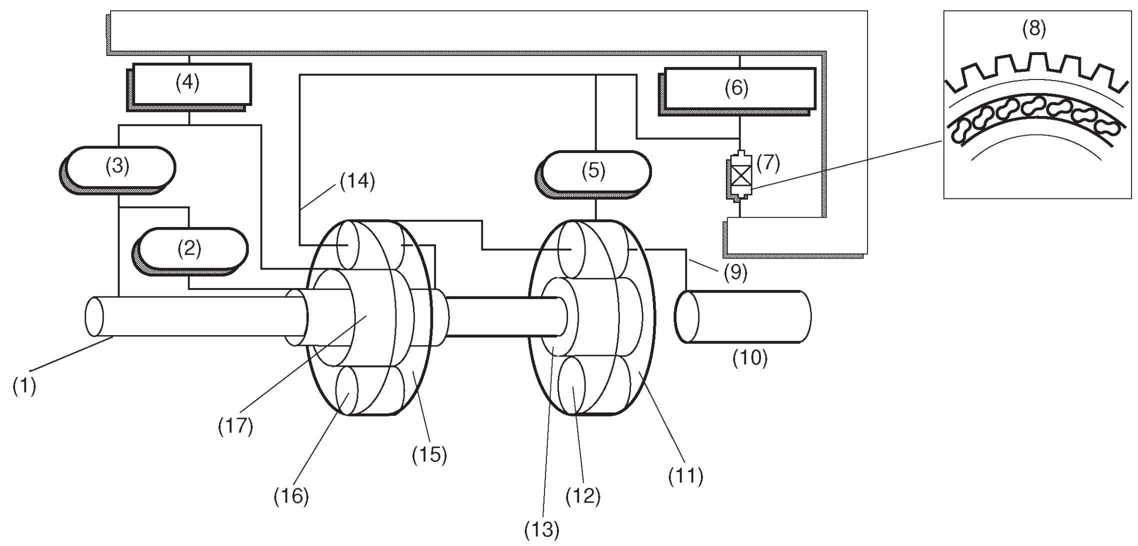
B3H0504
When the valve is set in the “line pressure no delivery” position, the pressure is relieved.</td></tr>
<tr><td>Pilot valve</td><td>Generates by reducing the line pressure a constant pressure (pilot pressure) use for controlling the line pressure, lock-up pressure, clutch/brake pressure during shifting and the transfer.</td></tr>
<tr><td>Torque converter clutch regulator valve</td><td>Prevents excessive rise of torque converter clutch pressure.</td></tr>
<tr><td>Lock-up control valve</td><td>Engages or disengages the lock-up clutch.
Also regulates the lock-up clutch engaging pressure to prevent lock-up shocks.</td></tr>
<tr><td>Shift valve A</td><td>Simultaneously changes three different ATF passages using shift solenoid 1 output pressure corresponding to such operating conditions as vehicle speed and throttle position. Combined with shift valve B, this valve permits automatic shifting of 1st 2nd 3rd 4th speeds.</td></tr>
<tr><td>Shift valve B</td><td>Simultaneously changes three different ATF passages using shift solenoid 2 output pressure corresponding to such operating conditions as vehicle speed and throttle position. Combined with shift valve A, this valve permits automatic shifting of 1st 2nd 3rd 4th speeds.</td></tr>
<tr><td>Low clutch timing valve A</td><td>Switches the ATF passages when the 2-4 brake pressure rises to a certain level during upshifting from 3rd to 4th speed, in order to drain the low clutch accumulator back-pressure and to release the low clutch. This operation ensures smoother shifting.</td></tr>
<tr><td>Low clutch timing valve B</td><td>Returns the low clutch timing valve A to the original position after 3rd to 4th speed upshifting.</td></tr>
<tr><td>2-4 brake timing valve A</td><td>Switches the ATF passages when the high clutch pressure rises to a certain level during upshifting from 2nd to 3rd speed, in order to drain the 2-4 brake accumulator A back-pressure and to release the 2-4 brake. This operation ensures smoother shiftings.</td></tr>
<tr><td>2-4 brake timing valve B</td><td>Returns the 2-4 brake timing valve A to the original position after 2nd to 3rd speed upshifting.</td></tr>
<tr><td>Reverse inhibit valve</td><td>Allows ATF in the low & reverse brake circuit to drain during forward driving at a speed higher than the predetermined value, preventing shifting into reverse even if “R” range is selected.</td></tr>
<tr><td>“1st” Reducing valve</td><td>Reduces the low-reverse brake operating pressure so as to relieve engine braking shock when changing from 2 range 2nd speed to 1st speed.</td></tr>
</table>

Name	Function
Accumulator control valve A	Regulates the accumulator control A pressure (low clutch accumulator A back-pressure, high clutch accumulator A back-pressure, 2-4 brake timing control signal pressure) depending upon driving conditions.
Accumulator control valve B	Regulates the accumulator control B pressure (2-4 brake accumulator A back-pressure, low clutch timing control signal pressure) depending upon driving conditions.
Low clutch accumulator	Modulates the low clutch pressure gradually to damper the shifting shocks when the low clutch is engaged and disengaged.
2-4 brake accumulator A	Modulates the 2-4 brake clutch pressure gradually to damper the shifting shocks when the 2-4 brake clutch is engaged and disengaged.
2-4 brake accumulator B	Slows down the 2-4 brake clutch pressure increase speed during 3rd to 4th speed upshifting to prevent the timing variations which may occur when the low clutch timing valve A is switched (to damper shifting shocks).
High clutch accumulator A	Modulates the high clutch pressure gradually to damper the shifting shocks when the high clutch is engaged and disengaged.
High clutch accumulator B	Slows down the high clutch pressure increase speed during 2nd to 3rd speed upshifting to prevent the timing variations which may occur when the 2-4 brake clutch timing valve A is switched (to damper shifting shocks).
Throttle accumulator A	Smoothes the output pressure of the line pressure duty solenoid valve to prevent the pulsation.
Throttle accumulator B	Smoothes the output pressure of the 2-4 brake duty solenoid valve to prevent the pulsation.

8. Power Train

A: CONSTRUCTION

The gear train consists of two sets of planetary gears, three sets of multi-plate clutches, two sets of multi-plate brakes and one set of one-way clutch.



B3H0929A

(1)	Input shaft	(7)	One-way clutch	(13)	Rear sun gear
(2)	High clutch (Operates at 3rd and 4th speeds.)	(8)	Free/Locked	(14)	Front planetary carrier
(3)	Reverse clutch (Operates while moving in reverse.)	(9)	Rear planetary carrier	(15)	Front internal gear
(4)	2-4 brake	(10)	Reduction drive shaft	(16)	Front pinion gear
(5)	Low clutch	(11)	Rear internal gear	(17)	Front sun gear
(6)	Low & reverse brake	(12)	Rear pinion gear		

B: OPERATION TABLE

Selector lever operation			Rev./C	2-4/B	High/C	Low/C	Lo/Rev./B	OWC
	P							
	R		○				○	
	N							
	D	1ST				○		○
		2ND		○		○		
		3RD			○	○		
		4TH		○	○			
	3	1ST				○		○
		2ND		○		○		
		3RD			○	○		
		4TH		○	○			
	2	1ST						
		2ND		○		○		
		3RD			○	○		
		4TH		○	○			
	1	1ST				○	○	○
		2ND		○		○		
		3RD			○	○		
		4TH		○	○			

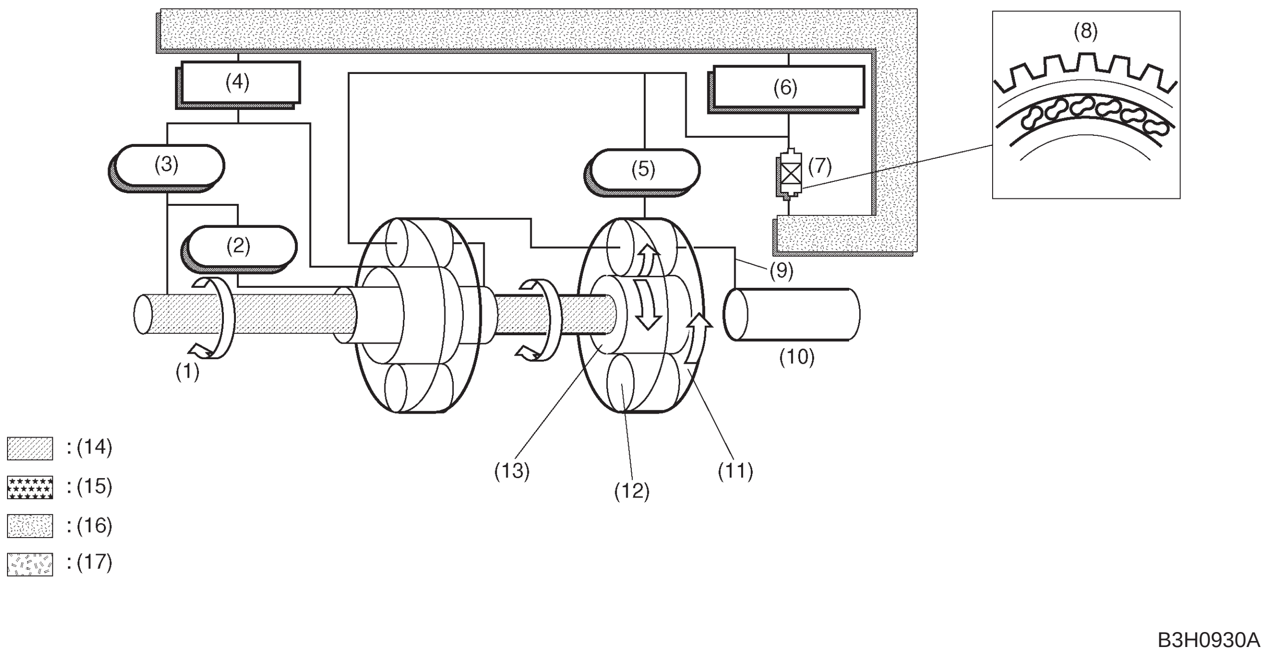
B3H0998A

MEMO

C: N RANGE

Since the rear sun gear and the high clutch drum are in mesh with the input shaft, they rotate together with input shaft.
The high clutch drum does not transmit the rotation torque to the planetary unit since the reverse clutch and the high clutch are in the free state.
The rotation torque of the rear sun gear is transmitted to the rear internal gear through the pinion gear.
However, the rotation torque of the rear sun gear is not transmitted to the rear planetary carrier since the rear internal gear idles because of disengaged low clutch.
Accordingly, the rotation torque of the input shaft is not transmitted to the reduction drive shaft.

Operating condition of parts	Power flow (in acceleration)
All clutches and brakes are free	Input shaft ↓ Rear sun gear ↓ Rear pinion gear ↓ Rear internal gear ↓ Low clutch (free) S3H0192B

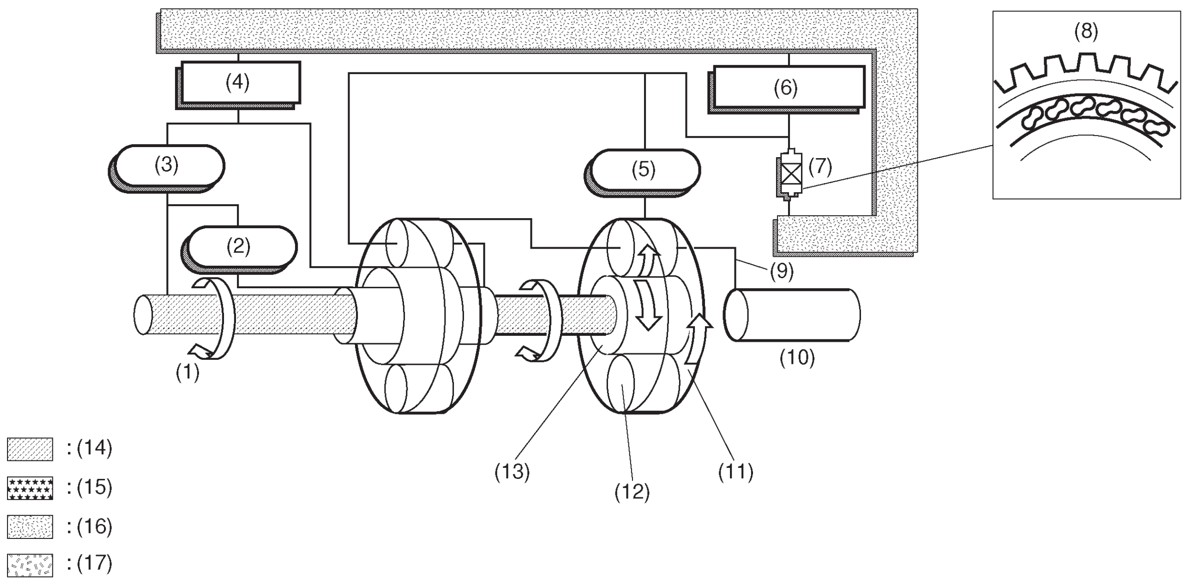


(1)	Input shaft	(7)	One-way clutch	(13)	Rear sun gear
(2)	High clutch	(8)	No effect	(14)	Input
(3)	Reverse clutch	(9)	Rear planetary carrier	(15)	Output
(4)	2-4 brake	(10)	Reduction drive shaft	(16)	Locked
(5)	Low clutch	(11)	Rear internal gear	(17)	Component
(6)	Low & reverse brake	(12)	Rear pinion gear		

D: P RANGE

All controls do not operate, just as in the N range. The parking pawl locks the power train by pawling the parking gear which is integrated with the reduction drive gear.

Operating condition of parts	Power flow (in acceleration)
All clutches and brakes are free	Input shaft ↓ Rear sun gear ↓ Rear pinion gear ↓ Rear internal gear ↓ Low clutch (free) S3H0193B

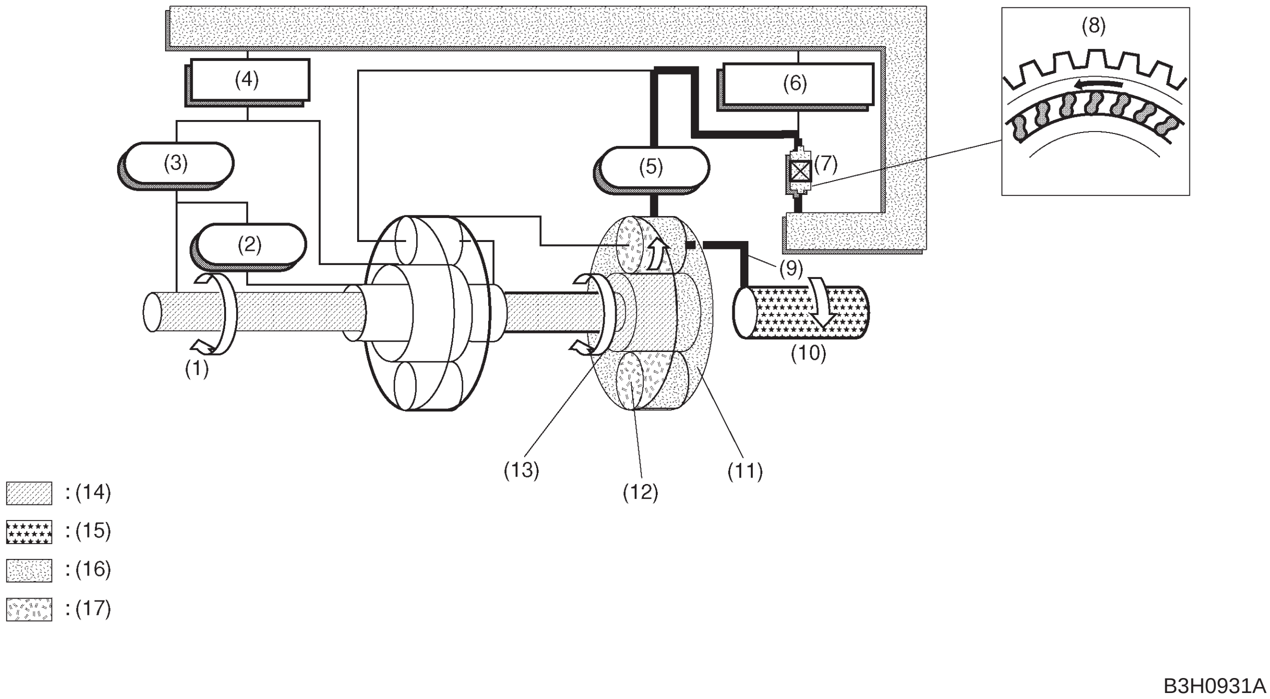


(1)	Input shaft	(7)	One-way clutch	(13)	Rear sun gear
(2)	High clutch	(8)	No effect	(14)	Input
(3)	Reverse clutch	(9)	Rear planetary carrier	(15)	Output
(4)	2-4 brake	(10)	Reduction drive shaft	(16)	Locked
(5)	Low clutch	(11)	Rear internal gear	(17)	Component
(6)	Low & reverse brake	(12)	Rear pinion gear		

E: FIRST SPEED OF D OR 3 RANGE (D_1, 3_1)

At 1st speed of these ranges, only the low clutch is in engagement. The rear internal gear which rotates idlly in P and N ranges tries to rotate counterclockwise due to engaged low clutch. However, this is blocked by the one-way clutch and secured to the transmission case.
Therefore, the rotation of the rear sun gear is converted to the revolution of the pinion gears around the sun gear, causing the planetary carrier to rotate. In this way, the rotation of the input shaft is transmitted to the reduction drive shaft after subjected to speed reduction by the planetary gear.
On the other hand, the rear internal gear rotates clockwise if the reverse driving force is applied from the reduction drive shaft during coasting. This rotation frees the one-way clutch. Accordingly, since the connection between the reduction drive shaft and the input shaft is lost, the engine braking effect is not available.

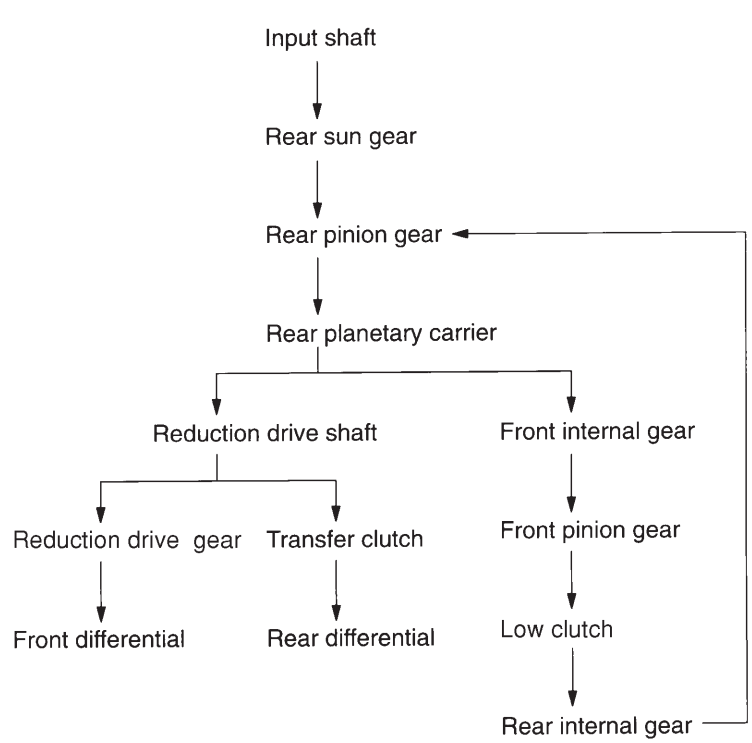
Operating condition of parts	Power flow (in acceleration)
Low clutch : Engaged One-way clutch : Operating	Input shaft → Rear sun gear → Rear pinion gear → Rear planetary carrier → Reduction gear Reduction gear → Drive pinion → Front differential Reduction gear → Transfer clutch → Rear differential S3H0194B



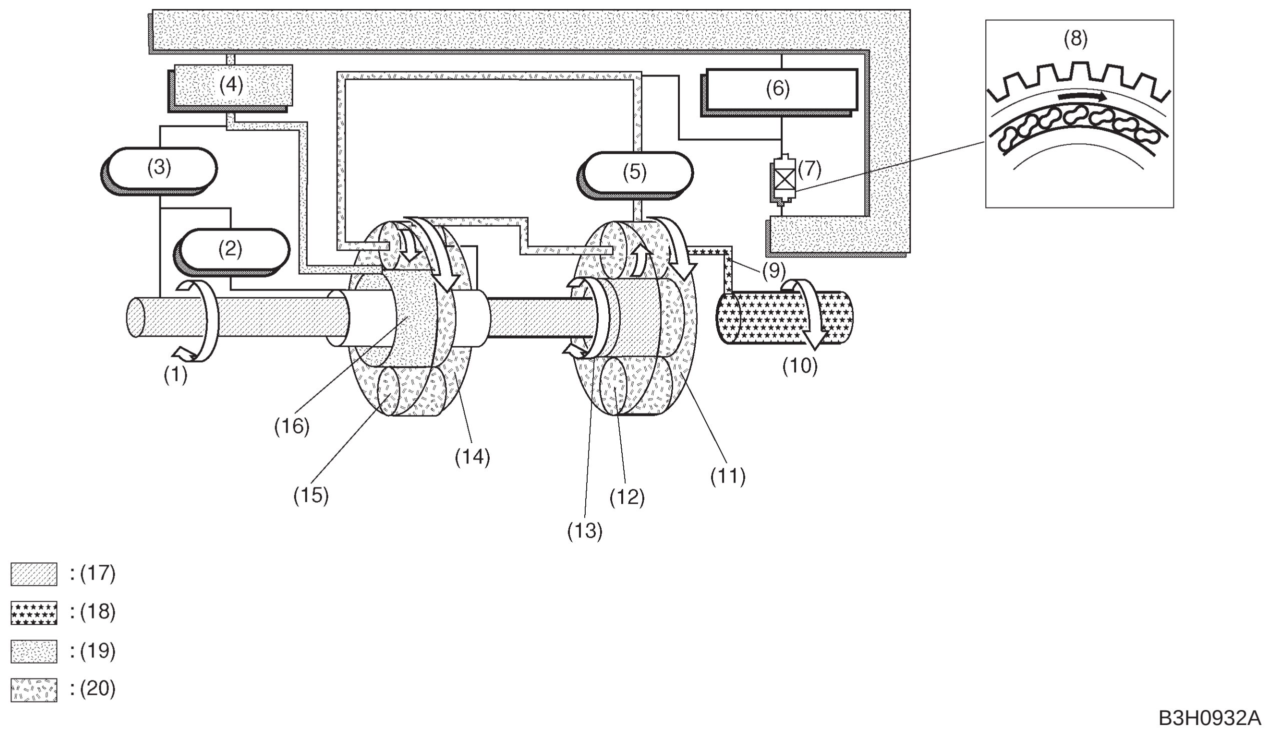
(1)	Input shaft	(7)	One-way clutch	(13)	Rear sun gear
(2)	High clutch	(8)	Locked	(14)	Input
(3)	Reverse clutch	(9)	Rear planetary carrier	(15)	Output
(4)	2-4 brake	(10)	Reduction drive shaft	(16)	Locked
(5)	Low clutch	(11)	Rear internal gear	(17)	Component
(6)	Low & reverse brake	(12)	Rear pinion gear		

F: SECOND SPEED OF D, 3 OR 2 RANGE (D_2, 3_2, 2_2)

At 2nd speed, the 2-4 brake as well as the low clutch is in engagement. In addition to the elements operating at 1st speed, the front sun gear which idles at 1st speed is connected to the transmission case because of engaged 2-4 brake. In this state, the rotation torque of the rear sun gear is transmitted to the rear internal gear through the front internal gear, front pinion gears, low clutch drum and low clutch. At this time, the one-way clutch is free since the low clutch drum rotates clockwise. For this reason, the rotation speed is higher than that at 1st gear by an amount of rear internal gear rotation speed.
At 2nd speed, the driving power is transmitted without being affected by the one-way clutch. Therefore, the back driving force from the reduction drive shaft is transmitted to the input shaft, thus the engine braking effect being available.

<table>
<tr><th>Operating condition of parts</th><th>Power flow (in acceleration)</th></tr>
<tr><td>Low clutch : Engaged
2-4 brake : Engaged</td><td>

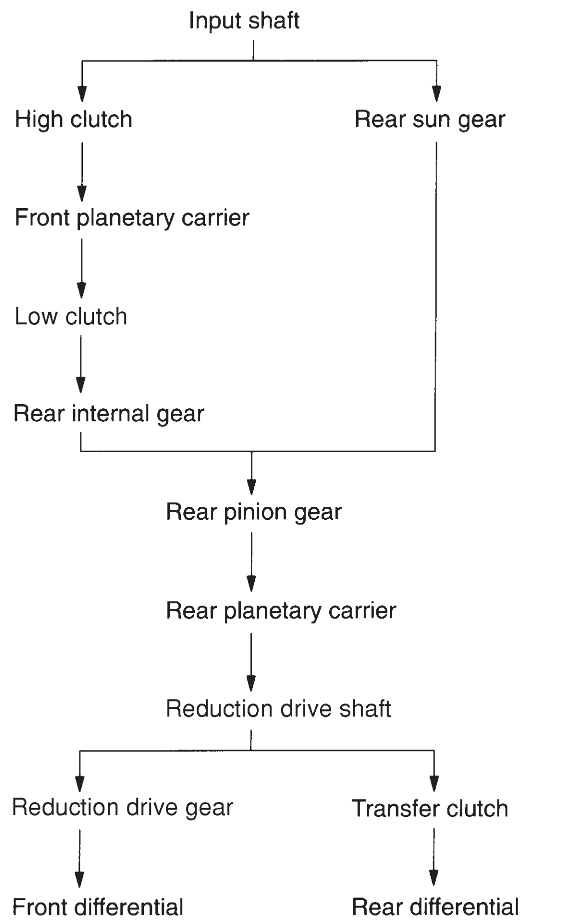
S3H0195B</td></tr>
</table>



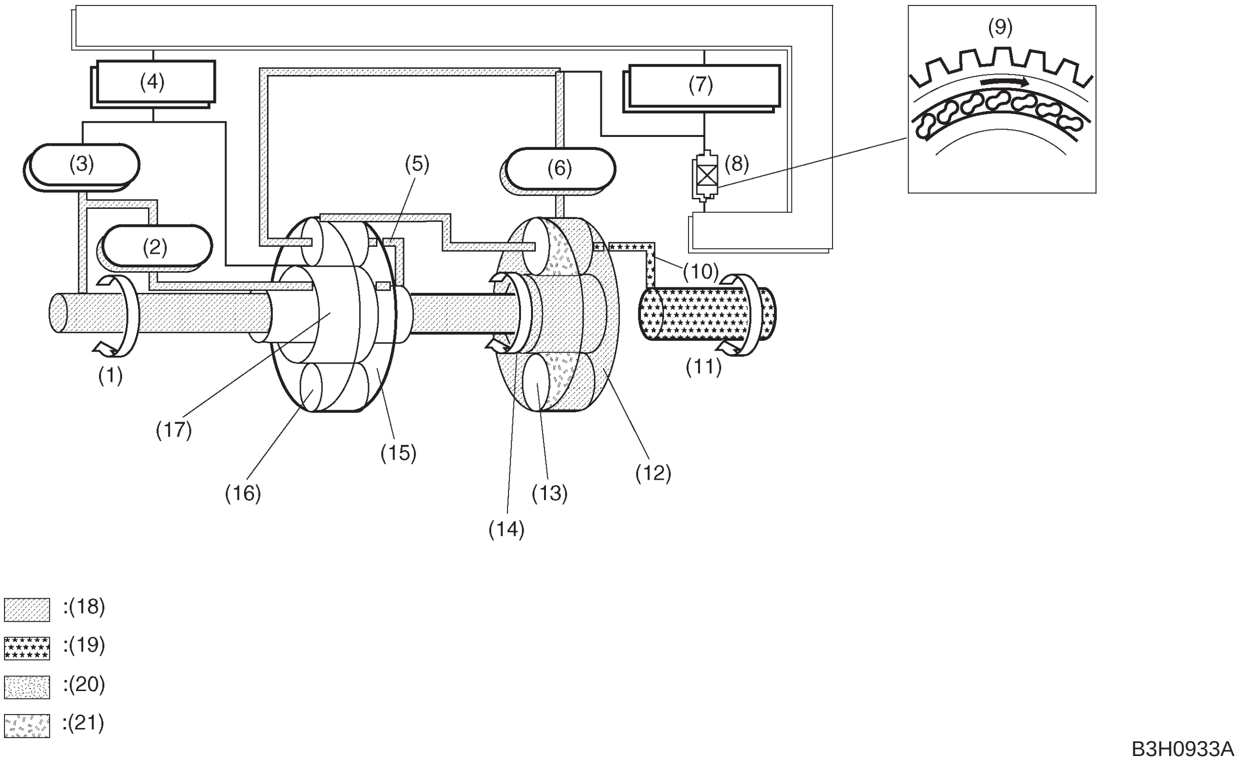
(1)	Input shaft	(8)	Free	(15)	Front pinion gear
(2)	High clutch	(9)	Rear planetary carrier	(16)	Front sun gear
(3)	Reverse clutch	(10)	Reduction drive shaft	(17)	Input
(4)	2-4 brake	(11)	Rear internal gear	(18)	Output
(5)	Low clutch	(12)	Rear pinion gear	(19)	Locked
(6)	Low & reverse clutch	(13)	Rear sun gear	(20)	Component
(7)	One-way clutch	(14)	Front internal gear		

G: THIRD SPEED OF D OR 3 RANGE (D_3, 3_3)

At 3rd speed, the low clutch and the high clutch are thrown into engagement. With the high clutch engaged, the high clutch drum rotates, which is turn rotates the rear internal gear through the front planetary carrier, low clutch drum and low clutch. This means that the rear sun gear and the rear internal gear rotates at the same speed. That is, the rear pinion gears stop rotation on its axis and resolve around the sun gear as a planetary assembly.
As a result, the input shaft and the reduction drive shaft rotate at the same speed.
The one-way clutch is released because the low clutch rotates clockwise. Since the driving power is transmitted without being affected by the one-way clutch, the back driving force from the reduction drive shaft is transmitted to the input shaft, thus the engine braking effect being available.

Operating condition of parts		Power flow (in acceleration)
High clutch	: Engaged	
Low clutch	: Engaged	

S3H0196B



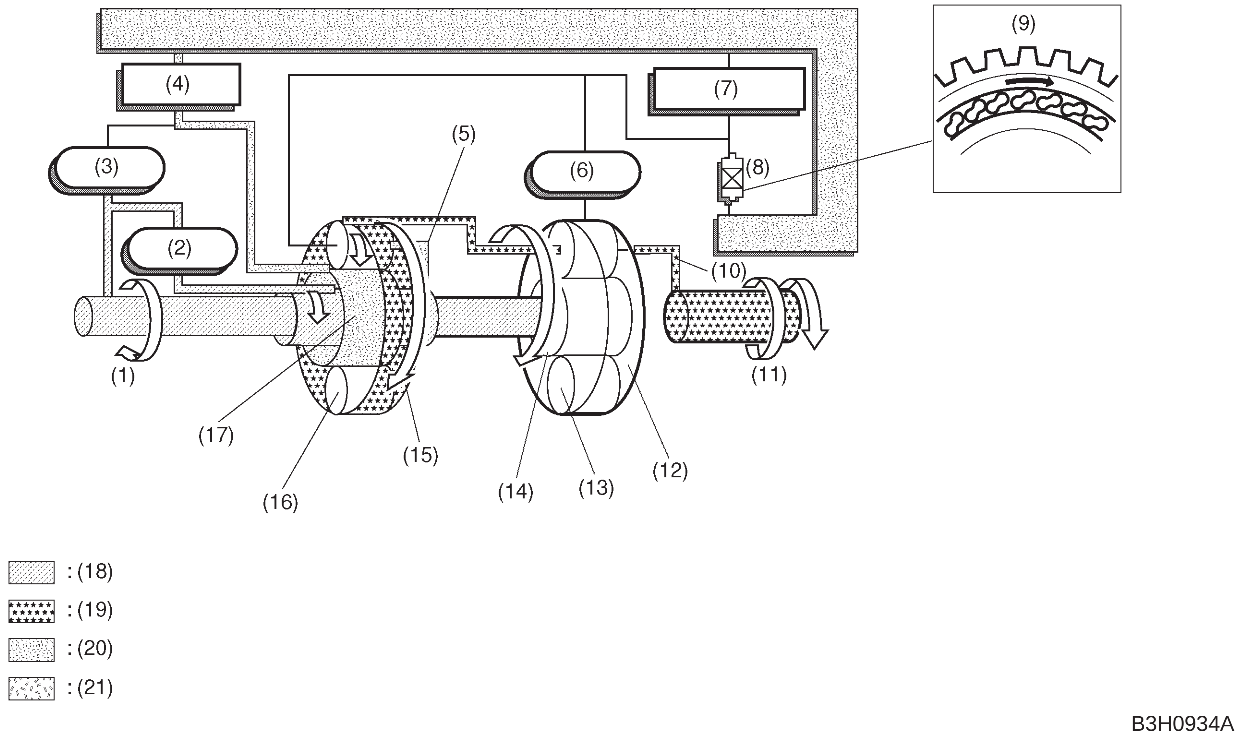
(1)	Input shaft	(8)	One-way clutch	(15)	Front internal gear
(2)	High clutch	(9)	Free	(16)	Front pinion gear
(3)	Reverse clutch	(10)	Rear planetary carrier	(17)	Front sun gear
(4)	2-4 brake	(11)	Reduction drive shaft	(18)	Input
(5)	Front planetary carrier	(12)	Rear internal gear	(19)	Output
(6)	Low clutch	(13)	Rear pinion gear	(20)	Locked
(7)	Low & reverse brake	(14)	Rear sun gear	(21)	Component

H: FOURTH SPEED OF D RANGE (D_4)

At 4th speed, the high clutch and the 2-4 brake are thrown into engagement. The engaged high clutch causes the front planetary carrier to rotate. The engaged 2-4 brake causes the front sun gear which idles at 3rd speed to be locked.
The front planetary carrier rotates at the same speed as the input shaft. The rotation of the front planetary carrier causes the front pinion gears to revolve around the stationary front sun gear, which causes the front internal gear to rotate faster than the input shaft.
As a result, the reduction drive shaft is driven at a higher speed than the input shaft.

The one-way clutch is free because the low clutch rotates clockwise. Since the driving power is transmitted without being affected by the one-way clutch, the back driving force from the reduction drive shaft is transmitted to the input shaft, thus the engine braking effect being available.

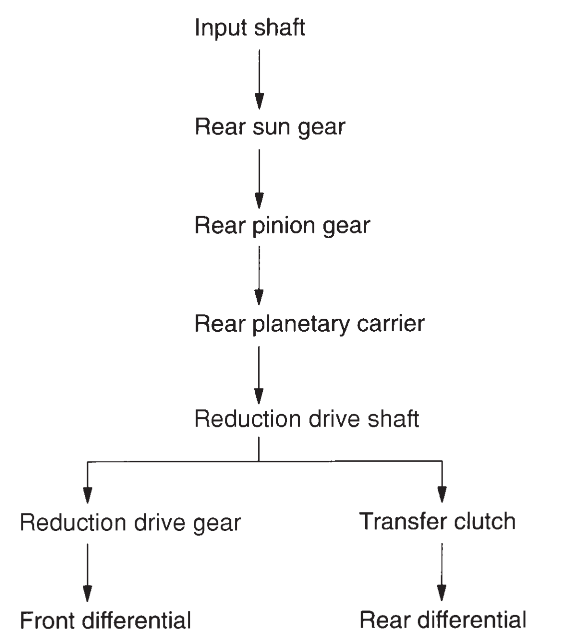
Operating condition of parts	Power flow (in acceleration)
2-4 brake : Engaged High clutch : Engaged	Input shaft ↓ High clutch ↓ Front planetary carrier ↓ Front pinion gear ↓ Front internal gear ↓ Rear planetary carrier ↓ Reduction drive shaft ↓ Reduction drive gear → Front differential ↓ Transfer clutch → Rear differential S3H0197B



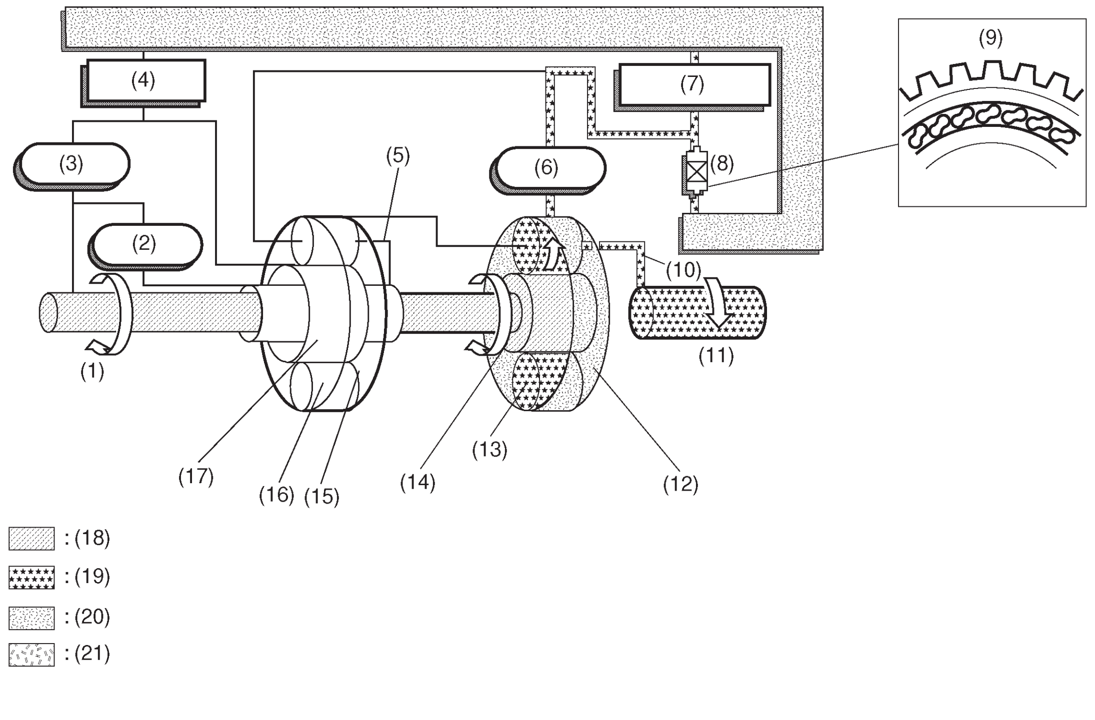
(1)	Input shaft	(8)	One-way clutch	(15)	Front internal gear
(2)	High clutch	(9)	Free	(16)	Front pinion gear
(3)	Reverse clutch	(10)	Rear planetary carrier	(17)	Front sun gear
(4)	2-4 brake	(11)	Reduction drive shaft	(18)	Input
(5)	Front planetary carrier	(12)	Rear internal gear	(19)	Output
(6)	Low clutch	(13)	Rear pinion gear	(20)	Locked
(7)	Low & reverse brake	(14)	Rear sun gear	(21)	Component

I: FIRST SPEED OF 1 RANGE

At 1st speed of this range, the low clutch and the low & reverse brake are thrown into engagement. The 1st speed in this range shows the same operation as the 1st speed in the D or 3 range. However, the one-way clutch produces no effect because the low & reverse brake is operated.
The rear internal gear is always interlocked with the transmission case by the engaged low & reverse brake.
During coasting, therefore, the back driving force from the reduction drive gear is transmitted to the input shaft. This means, unlike the 1st speed in D or 3 range, that the engine braking effect is available in this range.

<table>
<tr><th>Operating condition of parts</th><th>Power flow (in acceleration)</th></tr>
<tr><td>Low clutch : Engaged
Low & reverse brake : Engaged
One-way clutch : Operating</td><td>

S3H0198B</td></tr>
</table>

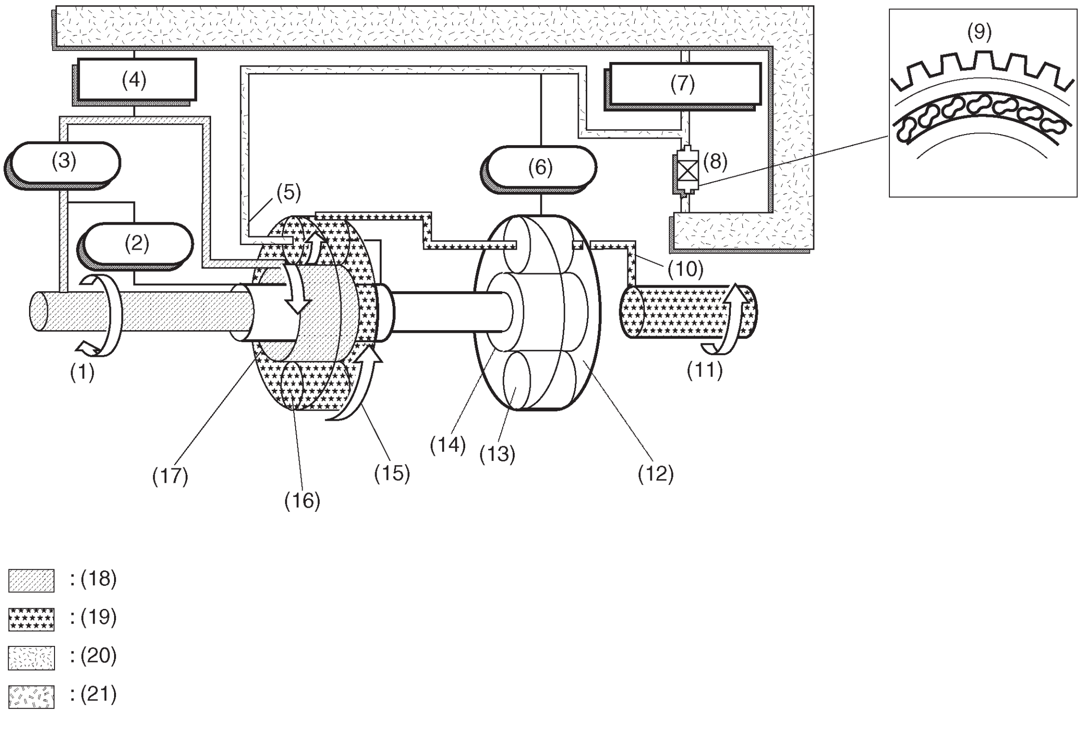


(1)	Input shaft	(8)	One-way clutch	(15)	Front internal gear
(2)	High clutch	(9)	No effect	(16)	Front pinion gear
(3)	Reverse clutch	(10)	Rear planetary carrier	(17)	Front sun gear
(4)	2-4 brake	(11)	Reduction drive shaft	(18)	Input
(5)	Front planetary carrier	(12)	Rear internal gear	(19)	Output
(6)	Low clutch	(13)	Rear pinion gear	(20)	Locked
(7)	Low & reverse brake	(14)	Rear sun gear	(21)	Component

J: R RANGE

In “R” range, the reverse clutch and the low & reverse brake are thrown into engagement. The engaged reverse clutch allows the front sun gear to rotate, while the engaged low & reverse brake allows the low clutch drum to be interlocked with the transmission case.
The rotation of the input shaft causes the front sun gear to rotate, which in turn causes the front pinion gears to rotate in the reverse direction. Thus, the rotation torque of the input shaft is transmitted to the front internal gear.
At this time, the rotation speed transmitted to the front internal gear is reduced by the front sun gear and the front pinion gears.
The one-way clutch produces no effect because the low & reverse brake is in engagement.
In this range, since the power transmission is made without influence of the one-way clutch, the back driving force from the reduction drive shaft is transmitted to the input shaft, thus the braking effect of the engine being available.

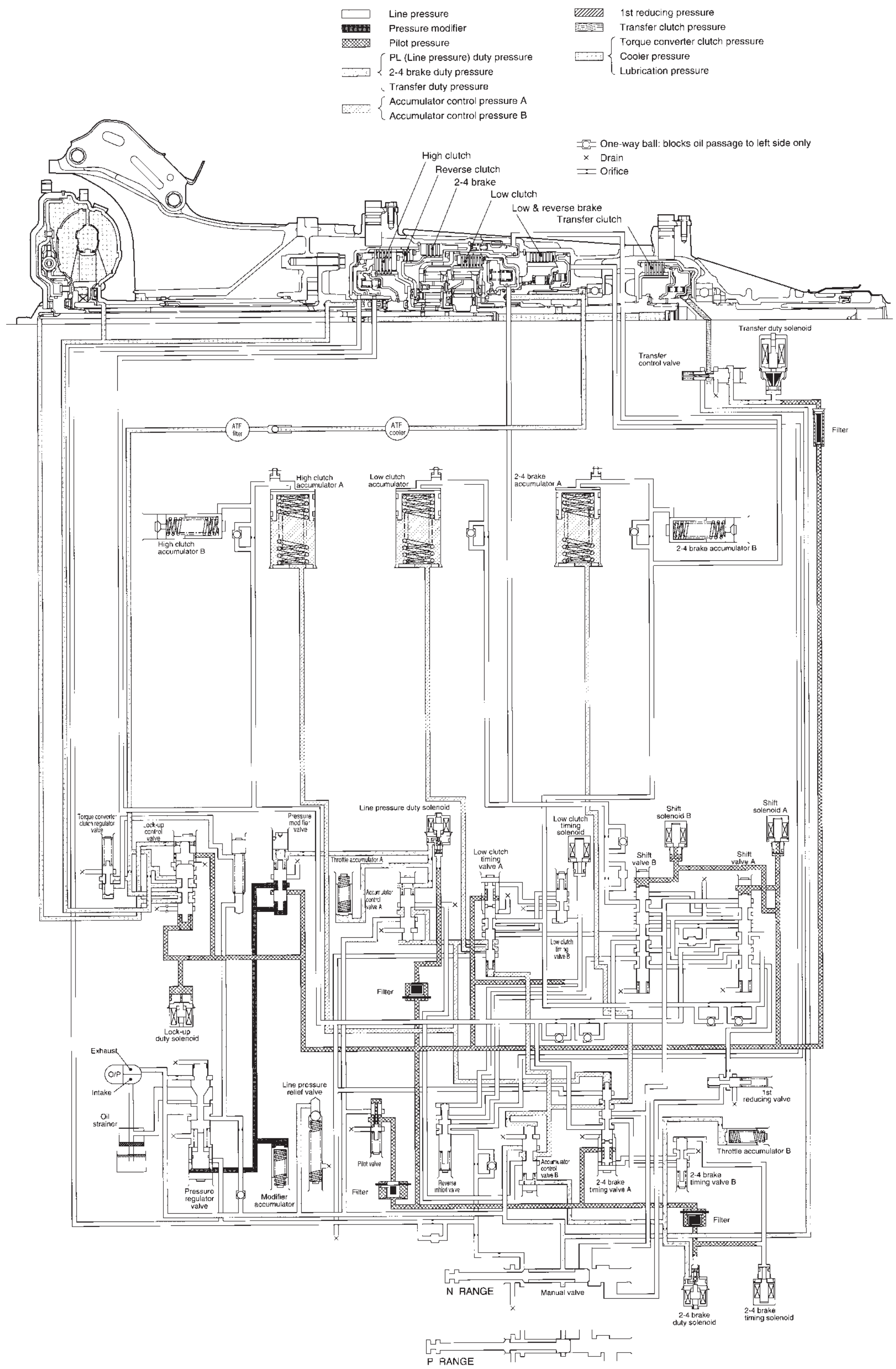
Operating condition of parts	Power flow (in acceleration)
Reverse brake : Engaged Low & reverse brake : Engaged	Input shaft ↓ Reverse clutch ↓ Front sun gear ↓ Front pinion gear ↓ Front internal gear ↓ Rear planetary carrier ↓ Reduction drive shaft ↓ Reduction drive gear → ↓ Front differential ↓ Transfer clutch → ↓ Rear differential S3H0199B



(1)	Input shaft	(8)	One-way clutch	(15)	Front internal gear
(2)	High clutch	(9)	No effect	(16)	Front pinion gear
(3)	Reverse clutch	(10)	Rear planetary carrier	(17)	Front sun gear
(4)	2-4 brake	(11)	Reduction drive shaft	(18)	Input
(5)	Front planetary carrier	(12)	Rear internal gear	(19)	Output
(6)	Low clutch	(13)	Rear pinion gear	(20)	Locked
(7)	Low & reverse brake	(14)	Rear sun gear	(21)	Component

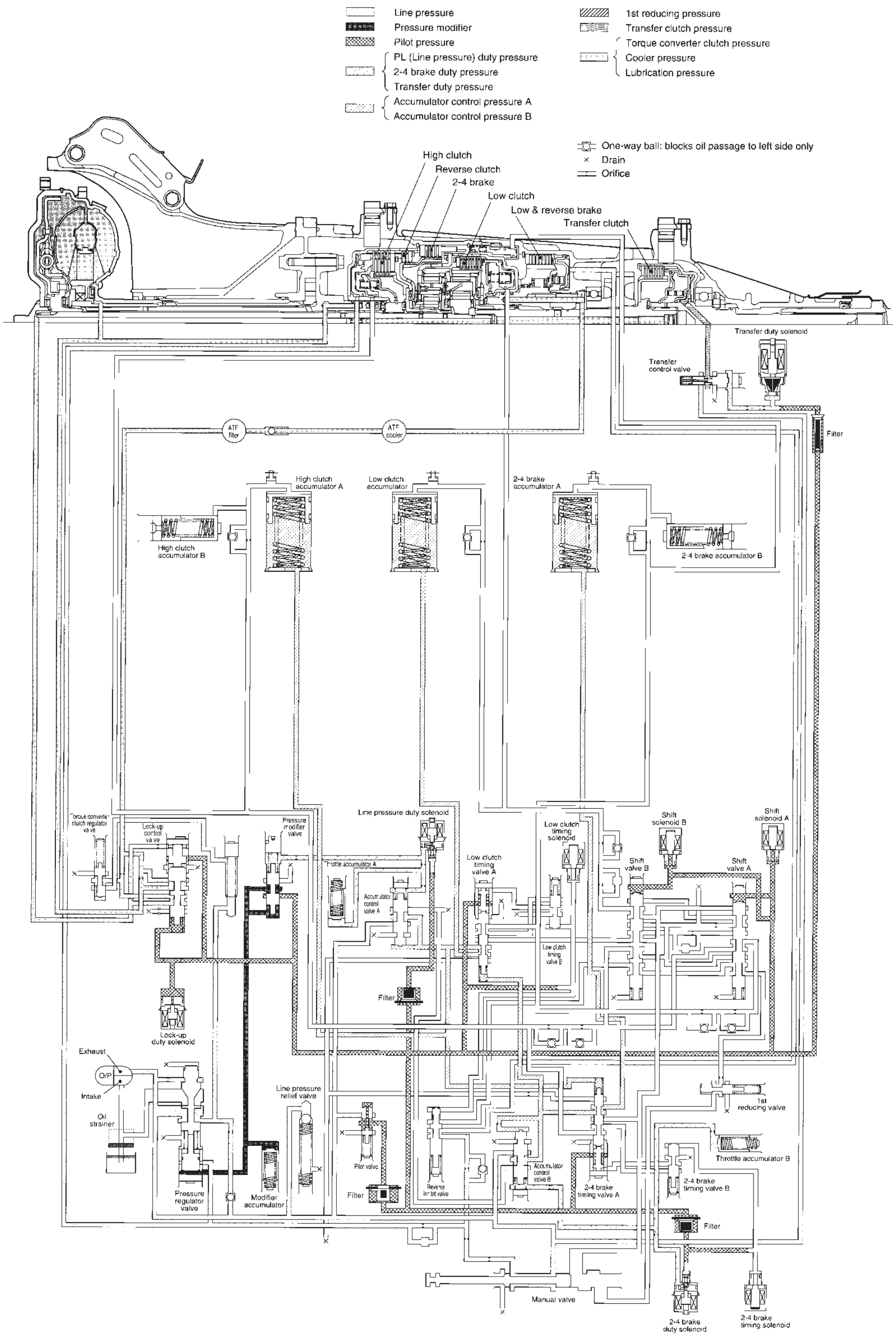
9. Schematic Drawing

A: P AND N RANGE



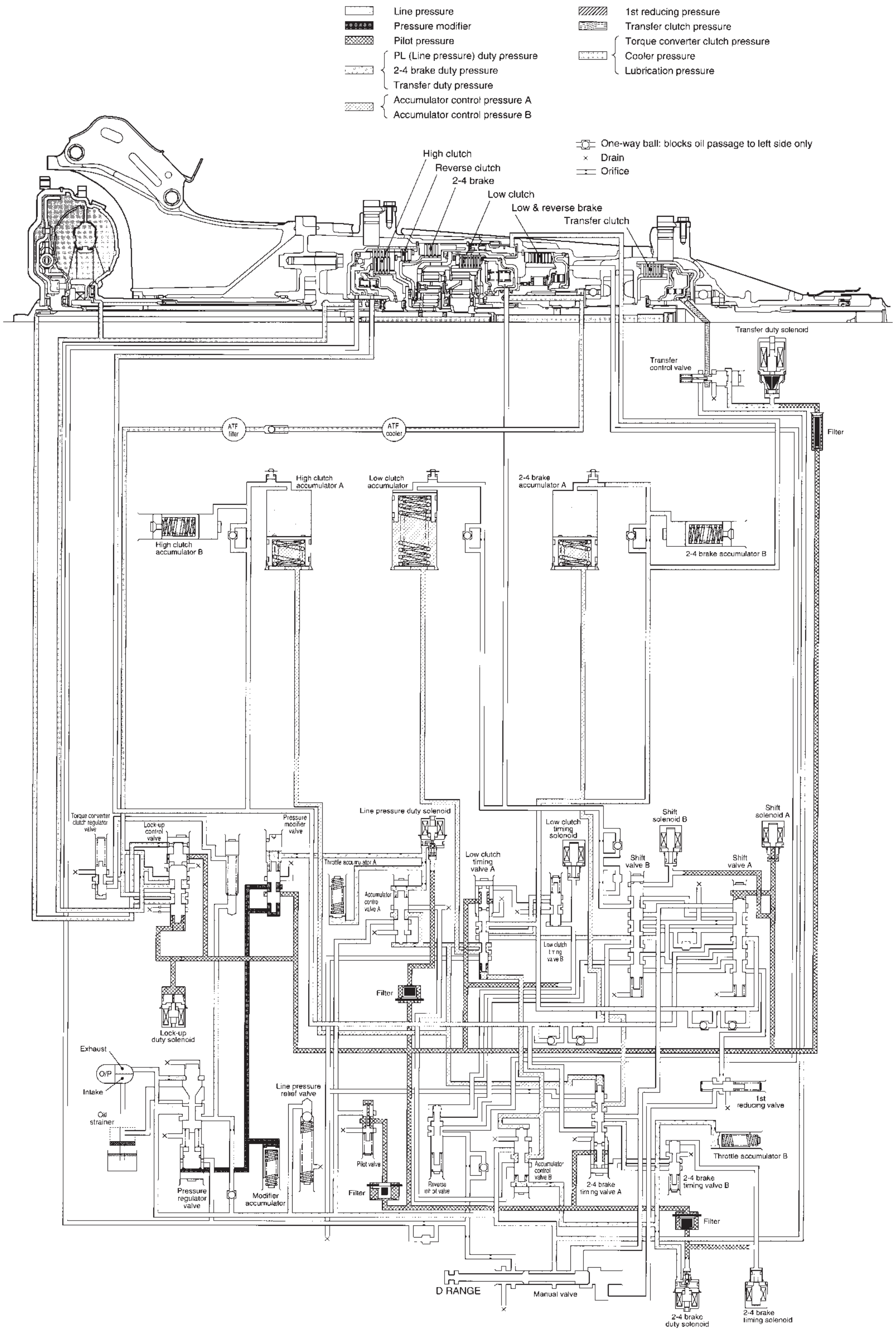
B3H0920A

B: R RANGE



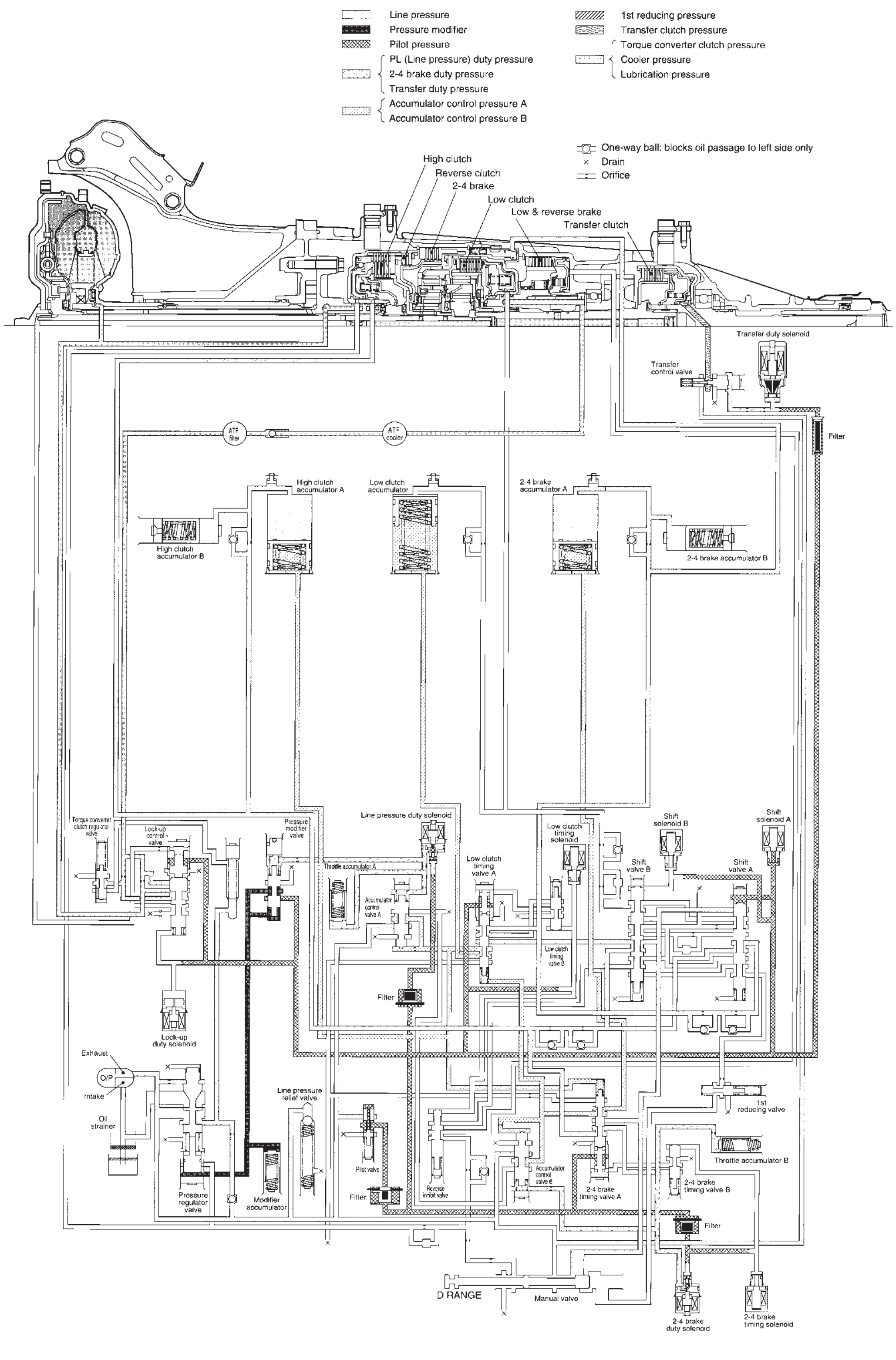
B3H0927A

C: FOURTH SPEED OF D RANGE (LOCK UP OFF)



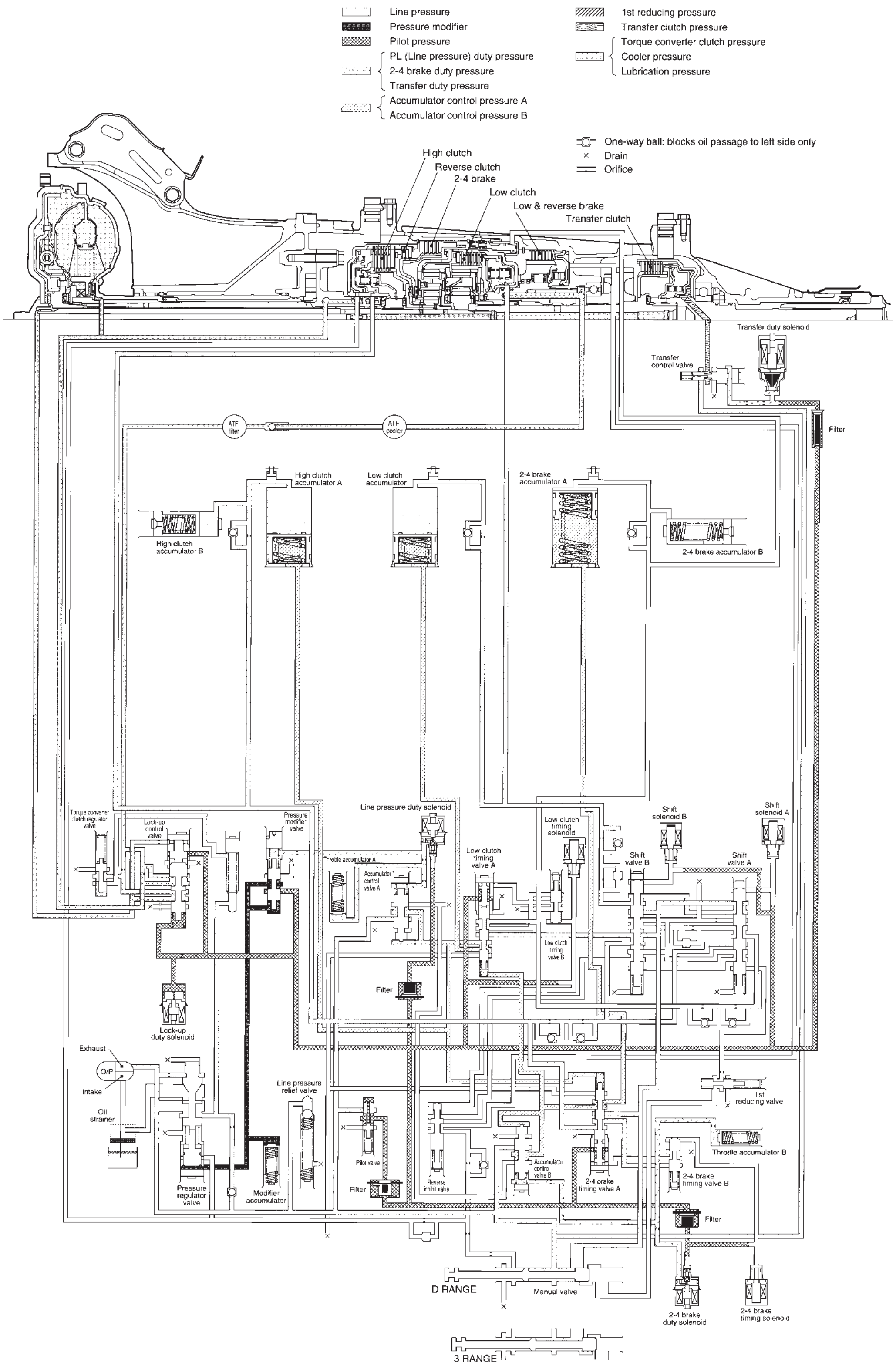
B3H0924A

D: FOURTH SPEED OF D RANGE (LOCK UP ON)



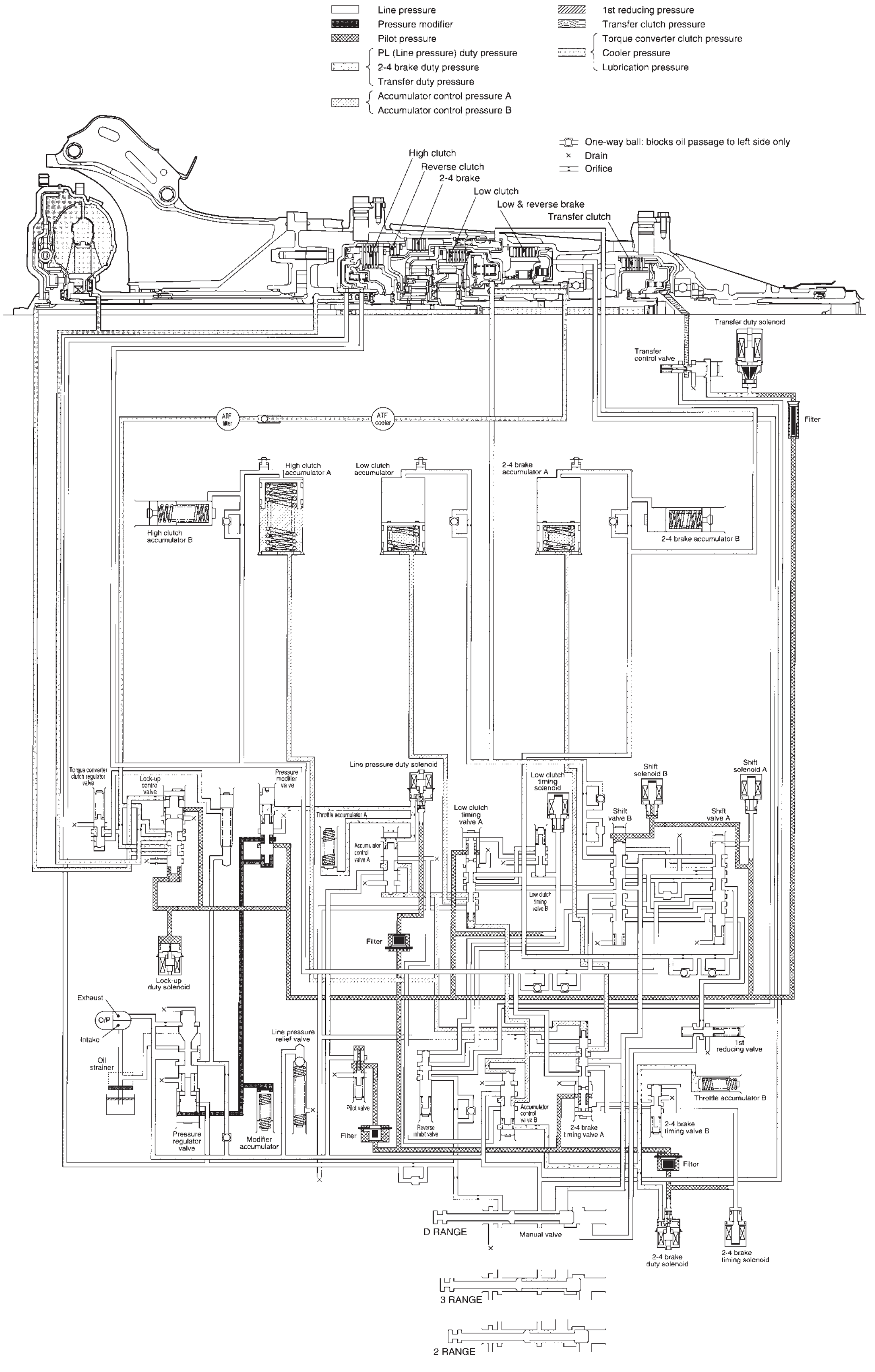
B3H0925A

E: THIRD SPEED OF D AND 3 RANGE



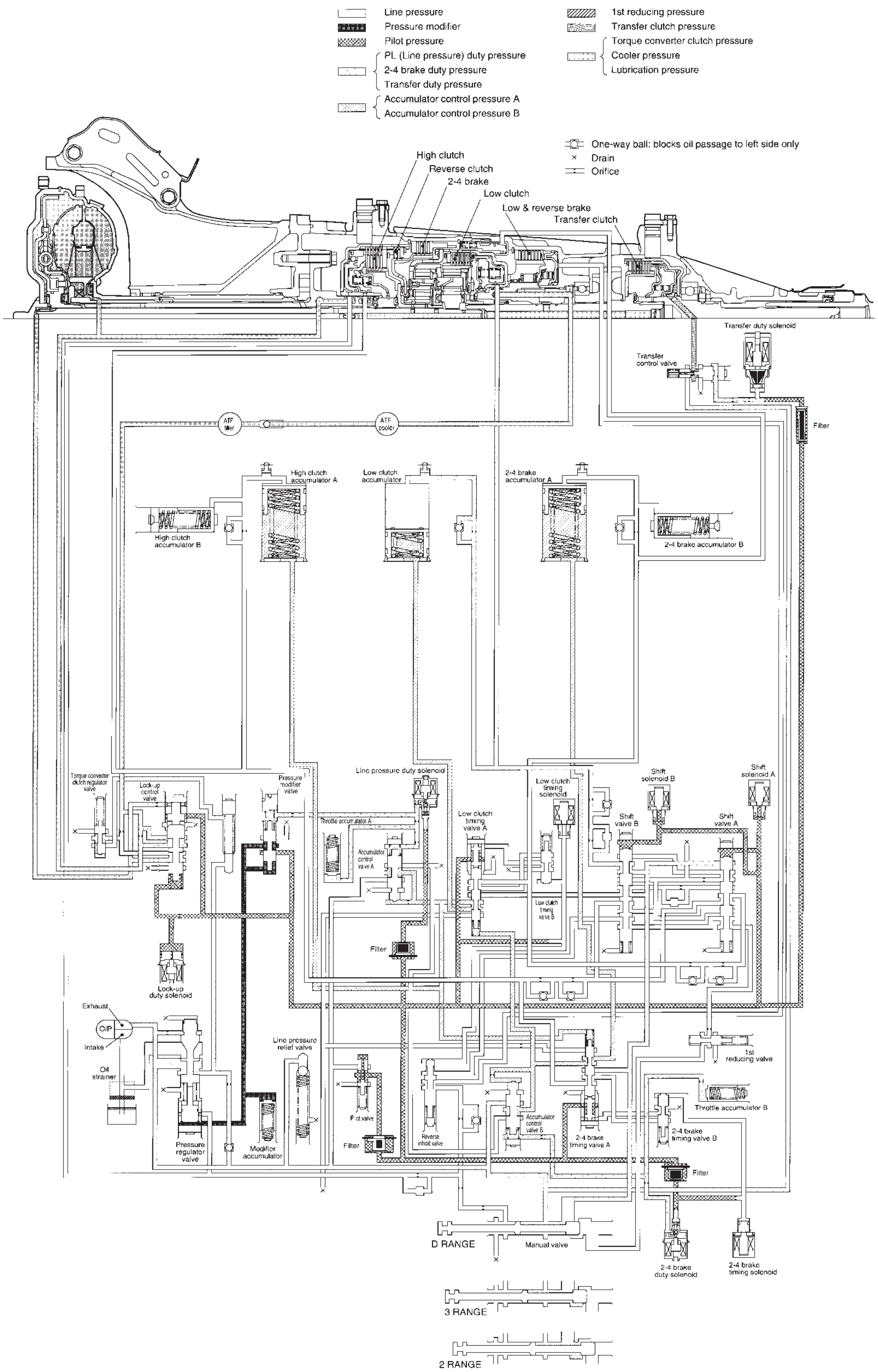
B3H0923A

F: SECOND SPEED OF D, 3 AND 2 RANGE



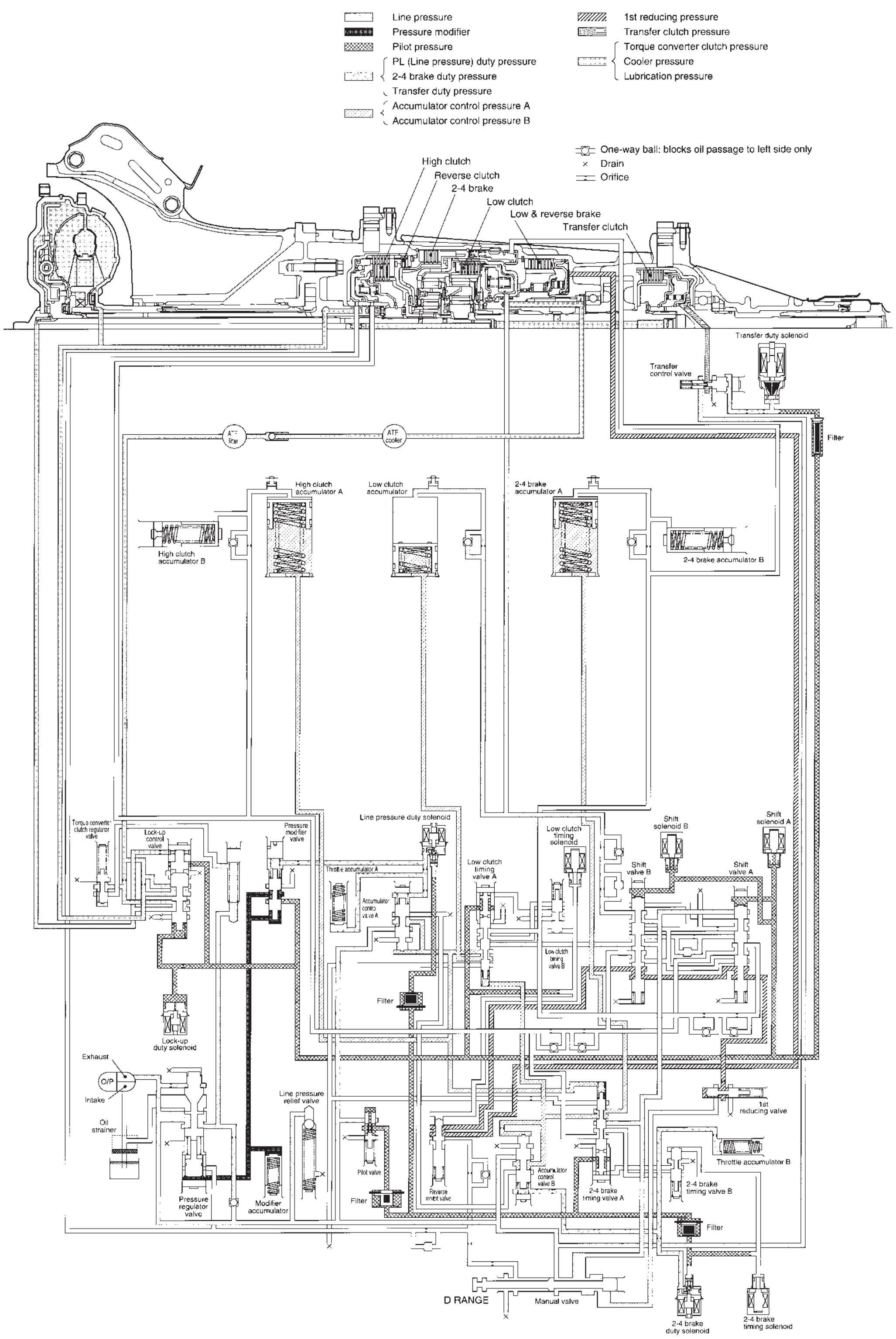
B3H0922A

G: FIRST SPEED OF D AND 3 RANGE



B3H0921A

H: FIRST SPEED OF 1 RANGE



B3H0926A

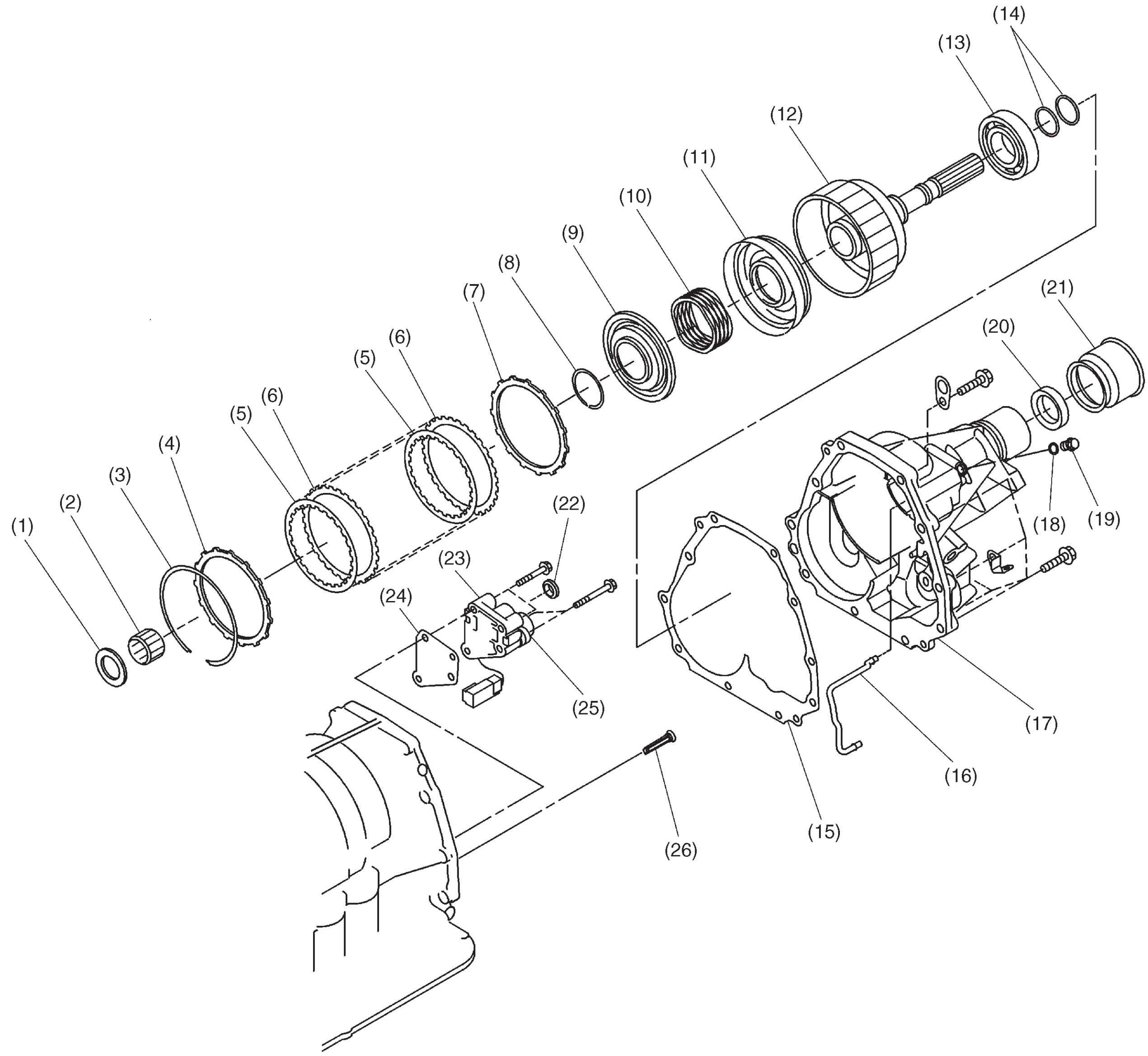
10. AWD Transfer System

A: OUTLINE

This is the electronically controlled MP-T (multi-plate transfer) type AWD transfer system, originally designed for SUBARU, consisting of a transfer hydraulic pressure control unit incorporating a vehicle speed sensor, control unit, and duty solenoid and a transfer clutch (hydraulic multi-plate clutch).

The control unit stores optimum transfer clutch torque data for a variety of driving conditions. When actual driving conditions (vehicle speed, throttle opening, gear range, wheel slip, etc.) are detected by various sensors, the control unit selects a duty ratio most suitable to the given condition from the memory. It then controls the operation of the transfer clutch by means of the hydraulic pressure which controls the duty solenoid and provides optimum rear torque distribution.

Various sensors and the control unit also serve as gear shift control, lock-up control and hydraulic pressure control.



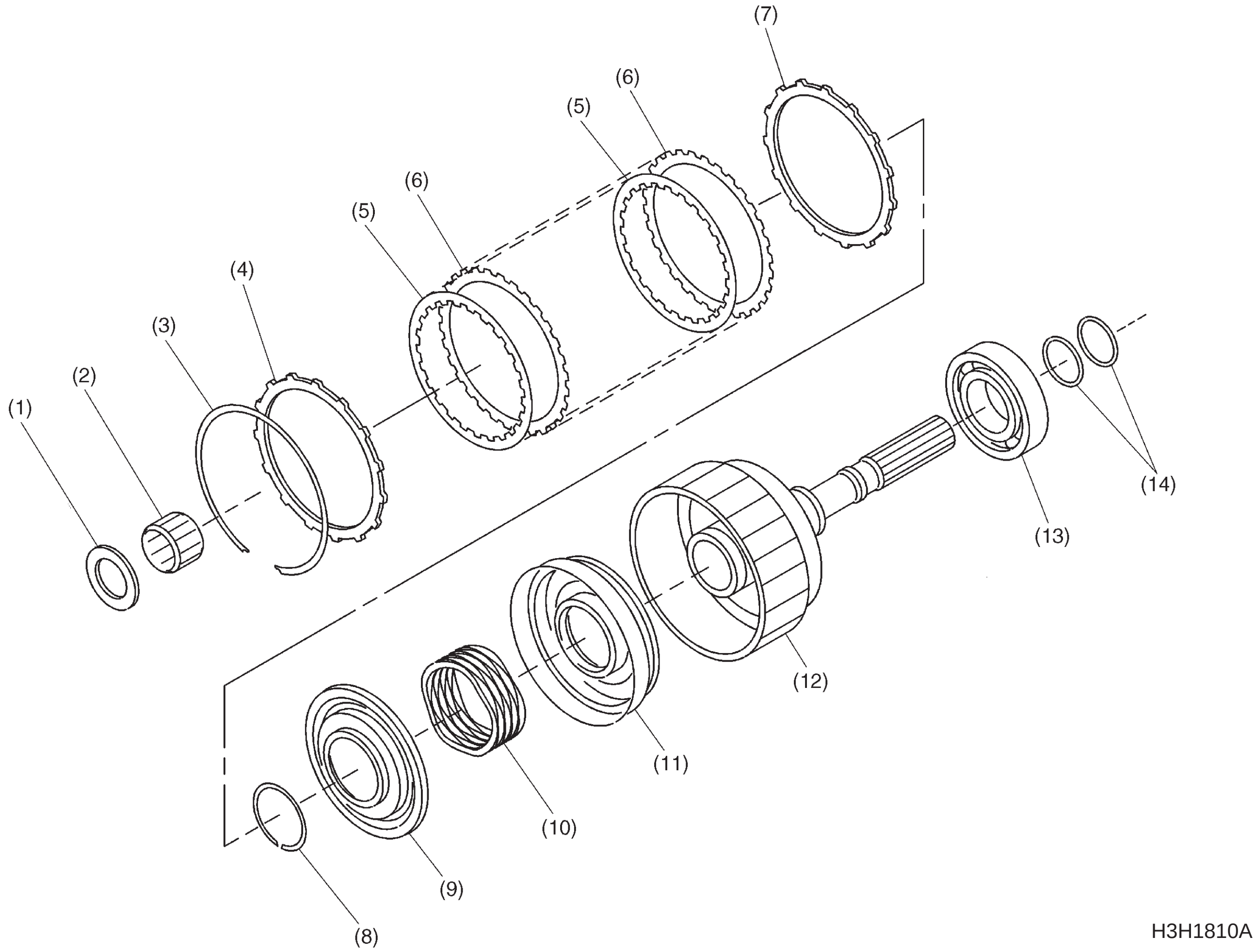
(1) Thrust bearing
(2) Needle bearing
(3) Snap ring
(4) Pressure plate
(5) Drive plate
(6) Driven plate
(7) Pressure plate
(8) Snap ring
(9) Transfer piston seal
(10) Return spring
(11) Transfer clutch piston
(12) Rear drive shaft
(13) Ball bearing
(14) Seal ring
(15) Gasket
(16) Transfer clutch pipe
(17) Extention case
(18) O-ring
(19) Plug
(20) Oil seal
(21) Dust cover
(22) Transfer clutch seal
(23) Transfer clutch valve
(24) Transfer valve plate
(25) Transfer duty solenoid
(26) Inlet filter

B: TRANSFER CLUTCH (MULTI-PLATE CLUTCH)

The transfer unit consists of a hydraulic multi-plate clutch and a transfer hydraulic control system incorporating a transfer duty solenoid, rear drive shaft, etc.

The transmission control unit has duty ratios memorized in advance according to running conditions. In order to obtain the optimum transfer torque for the running condition, the oil pressure that is applied to the drive plates and driven plates is controlled by applying oil pressure to the transfer piston from the transfer oil pressure control device including the duty solenoid.

Also, the transfer clutch drum and rear drive shaft are joined to each other by welding. The rear drive shaft has drilled oil passages for transfer clutch control and also for lubrication of extension bushing and ball bearing in it.

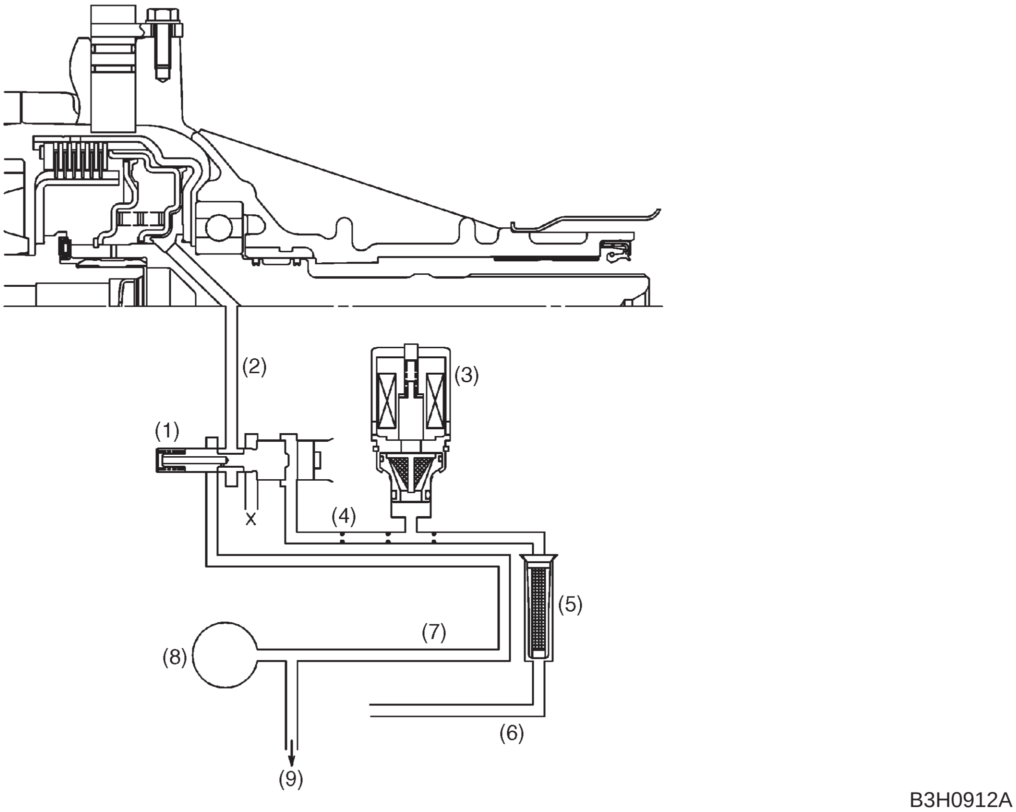


(1)	Thrust bearing	(6)	Driven plate	(11)	Transfer clutch piston
(2)	Needle bearing	(7)	Pressure plate	(12)	Rear drive shaft
(3)	Snap ring	(8)	Snap ring	(13)	Ball bearing
(4)	Pressure plate	(9)	Transfer piston seal	(14)	Seal ring
(5)	Drive plate	(10)	Return spring		

C: TRANSFER OIL PRESSURE CONTROL DEVICE

The transfer control valve body is bolted the rear end of transmission case through transfer valve plate.
Hydraulic pressure used in the transfer valve body (line pressure and pilot pressure) are supplied from the transmission control valve body through the transmission case.

The transfer duty solenoid modulates the pilot pressure into the transfer duty pressure depending on the signals from transmission control module (TCM).
The transfer duty pressure in turn modulates the line pressure into the transfer clutch pressure before it is sent to the transfer control valve.
The transfer clutch pressure puts the transfer clutch into engagement depending on the driving conditions so that the optimum torque may be distributed to the rear wheels.

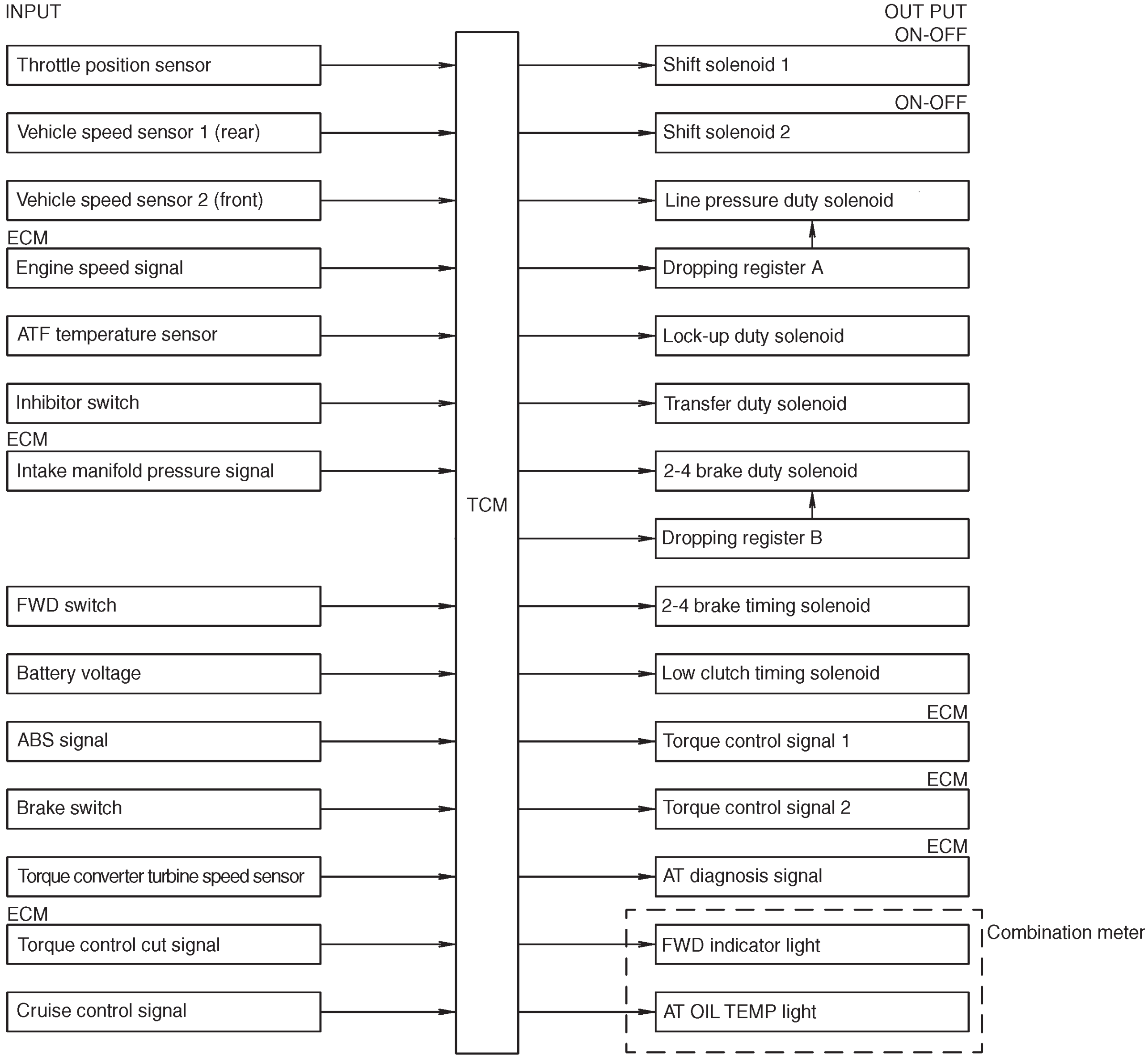


(1)	Transfer control valve	(4)	Transfer pressure	(7)	Line pressure
(2)	Transfer clutch pressure	(5)	Filter	(8)	Oil pump
(3)	Transfer duty solenoid	(6)	Pilot pressure	(9)	Control valve

11. Electronic-Hydraulic Control System

A: GENERAL

The electronic-hydraulic control system consists of various sensors and switches, a transmission control module (TCM) and the hydraulic controller including solenoid valves. The system controls the transmission proper including shift control, lock-up control, timing control, reverse inhibit control, engine control, line pressure control, auto pattern select control and shift timing control. It also controls the AWD transfer clutch. In other words, the system detects various operating conditions from various input signals and sends output signals to shift solenoids 1 and 2, low clutch timing solenoid, 2-4 brake timing solenoid, line pressure, lock-up, transfer and 2-4 brake duty solenoids (a total of eight solenoids).



S3H0185B

B: INPUT SIGNAL

Signal name	Major function
Throttle position sensor	Detects throttle position and determines shift point, line pressure and lock-up vehicle speed according to engine load.
Vehicle speed sensor 2 (front) (mounted to transmission)	Detects vehicle speed. This signal is used to control shifting, lock-up, line pressure, and transfer clutch.
Vehicle speed sensor 1 (rear) (mounted to extension case)	Used to control transfer clutch and as backup in case of failure of vehicle speed sensor 2.
Engine speed signal	Detects engine speed. This signal is used for lock-up clutch smooth, control at lock-up.
Inhibitor switch	Used to determine shifting and line pressure for respective ranges “P”, “R”, “N”, “D”, “3”, “2” and “1”.
ATF temperature sensor	Detects ATF temperature. This signal is used for inhibition of lock-up, release of OD and detection of ATF temperature.
FWD switch	Used to change the mode from AWD to FWD. Also used to adapt the vehicle to FWD tester roller. Changeover from AWD to FWD can be accomplished by inserting a fuse into the fuse holder.
ABS signal	When ABS is operating, to optimize ABS control, transfer clutch torque is controlled to eliminate the influence of engine braking and reduce the degree of coupling between front and rear wheels.
Cruise control signal	Detects operation of cruise control, and expands “4th” operating range.
Intake manifold pressure signal	Used to determine line pressure of shift change.
Torque converter turbine speed sensor	Tells the rotation speed of the input shaft. The proportion of this speed to the vehicle speed determines whether shifting should be made or not.
Torque control cut signal	Sent from ECM to TCM to inhibit the torque control.

C: OUTPUT SIGNAL

Signal name	Function
Shift solenoids 1, 2	Controls shift stage by turning solenoid ON/OFF. Relationship between solenoid operation and shifting stage is shown in Table below. When shifting, timing is controlled for each solenoid to reduce shock.
Line pressure duty solenoid	Regulates the line pressure according to driving conditions.
Lock-up duty solenoid	Regulates the hydraulic pressure of the lock-up clutch and operates in three modes (open, smooth and lock-up).
Transfer duty solenoid	Regulates the hydraulic pressure of the transfer clutch and controls the driving force to the rear drive shaft.
AT OIL TEMP light	Lights when ATF becomes hot (exceeds a set temperature level). This light is also used for “on-board diagnostics”.
2-4 brake duty solenoid	Regulates 2-4 brake duty pressure when 2-4 brake is operated to reduce shifting shocks.
2-4 brake timing solenoid	Switches on or off the pressure acting on 2-4 brake timing valve B to control the release timing of the 2-4 brake
Low clutch timing solenoid	Switches on or off the pressure acting on the low clutch timing valve B to control the release timing of the low clutch. Also switches on or off the pressure acting on the reverse inhibit valve to control the reverse inhibit function.
Torque control signal 1	Reduces engine torque at racing select and gear change.
Torque control signal 2	Reduces engine torque at racing select and gear change.

D: CONTROL ITEM

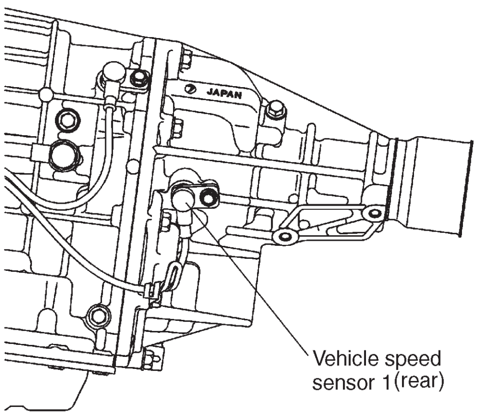
Control item			Description of control
Transmission control	Gear shift control	Normal shift control ● Normal pattern ● Power pattern	Upshifting and downshifting are set for each range, gear position and pattern according to throttle position and vehicle speed.
		Control with ABS	Gear is locked in 3rd position when ABS signal enters.
		ATF low temperature control	Shifting into 4th gear is prevented when ATF temperature is below the preset value.
	Automatic pattern select control	Power pattern control	Power pattern is selected when throttle opening change speed exceeds the preset value.
		Normal pattern control	When throttle opening is less than the preset value normal pattern is resumed.
	Lock-up control	Normal lock-up control	Lock-up ON/OFF is set for 4th gear, gear position, and pattern according to throttle position and vehicle speed. (Basically lock-up is OFF during gear shifting.)
		Smooth control	Smooth lock-up is performed when lock-up is switched on.
	Line pressure control	Ordinary control	Line pressure is regulated according to throttle position, vehicle speed and range signals.
		Shifting control	Line pressure is regulated when shifting to lessen shifting shock.
		Starting control	Line pressure is at a minimum so as to reduce engine cranking load.
	Shift timing control	Shift step control	ON/OFF timing for shift solenoid is controlled.
		Lock-up control	When shifting, the lock-up clutch is temporarily released.
		Line pressure control	When shifting, line pressure is controlled to the optimum level so as to reduce shifting shock.
AWD transfer clutch control	Ordinary transfer control		Transfer oil pressure is regulated according to the throttle position angle and vehicle speed.
	1st range control		Transfer oil pressure is increased.
	Slip control		Immediately after detecting a slip, transfer oil pressure is controlled to the same pressure as 1st range. (This control is canceled if V $\geq$ 60 km/h (37 MPH), or when throttle is closed fully.)
	Control it turns		Transfer oil pressure is reduced after detecting the turn.
	ABS control		Transfer oil pressure is adjusted to set level immediately after reception of ABS signal.

E: THROTTLE POSITION SENSOR

The throttle position sensor provides electrical signals corresponding to the throttle position. The throttle position and accelerator depression speed are detected by this throttle position sensor output.

F: VEHICLE SPEED SENSOR 1 (REAR)

The vehicle speed sensor (output shaft rotation sensor) is mounted to the extension case (from the outside of the case). It detects the rear wheel speed based on the peripheral speed of the transfer clutch drum and sends sine wave signals (30 pulses per rotation) to TCM.

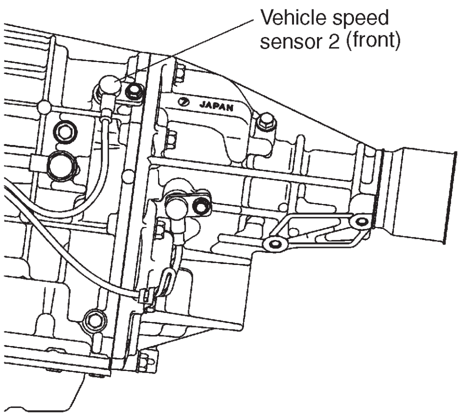


B3H0915A

G: VEHICLE SPEED SENSOR 2 (FRONT)

The vehicle speed sensor (output shaft rotation sensor) is mounted to the transmission case (from the outside of the case). It detects the front wheel speed and sends sine wave signals (16 pulses per rotation) to TCM.

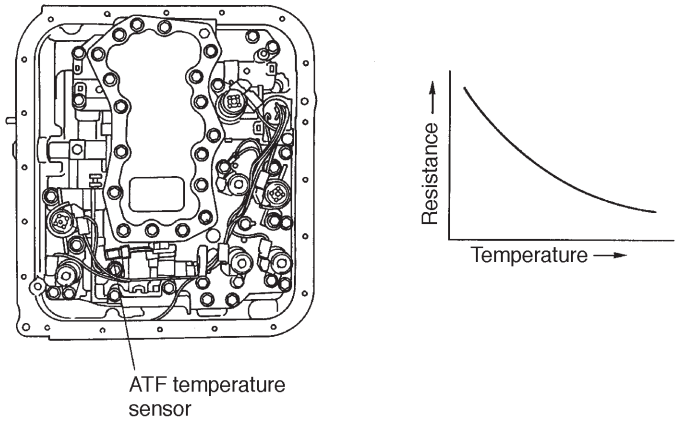
The TCM converts the signals into 4-pulse normal wave signals and outputs them to the engine control module (ECM) and the combination meter.



B3H0915B

H: ATF TEMPERATURE SENSOR

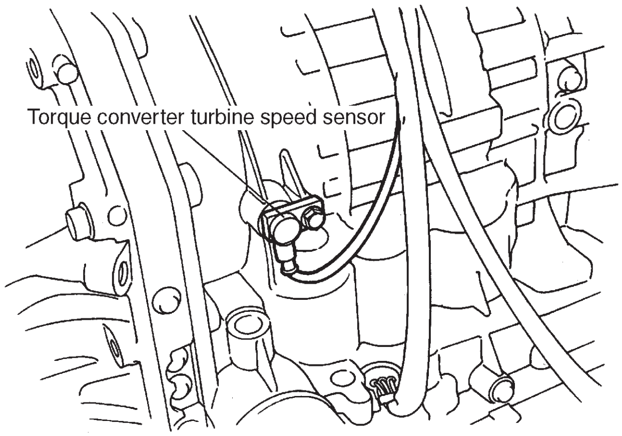
This sensor is mounted to the control valve in the transmission. It detects temperature change as an analog electrical signal. The output characteristics of the sensor are shown below.



B3H0916A

I: TORQUE CONVERTER TURBINE SPEED SENSOR

The torque converter turbine speed sensor (output shaft rotation sensor) is mounted to the transmission case (from the outside of the case).
The sensor reads the rotation speed of the periphery of the high clutch drum coupled to the input shaft, and sends sine wave signals (32 pulses per rotation) to the TCM. The TCM calculates the proportion of the input shaft speed to the vehicle speed and determines whether the shifting is to be made or not.



B3H0999A

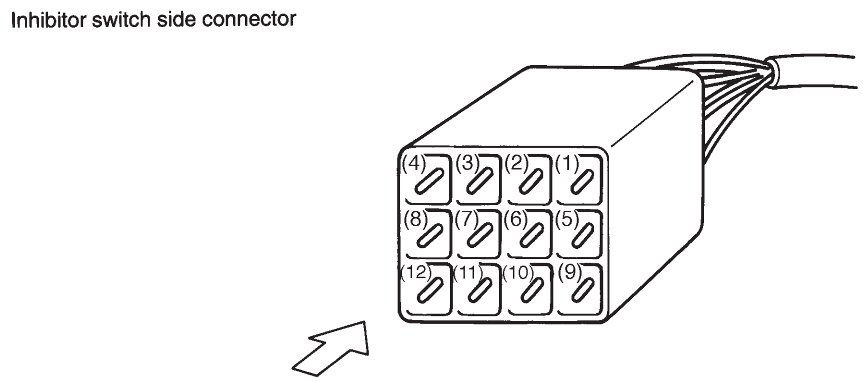
J: INHIBITOR SWITCH

The inhibitor switch assures safety when starting the engine. This switch is mounted on the right side of the transmission case, and is operated by the range selector lever.

When the selector lever is set to “P” or “N”, the electrical circuit is connected in the inhibitor switch and the starter circuit is energized for cranking the engine.

When the selector lever is set to “R”, “D”, “3”, “2”, or “1” range, the electrical circuit is disconnected in the inhibitor switch. Hence engine cranking is disabled. In the “R” range, the backup light circuit is completed in the switch, and the backup lights come on.

In addition to the above function, the inhibitor switch incorporates a circuit for detecting the selected range position and sending the range signal to the TCM.

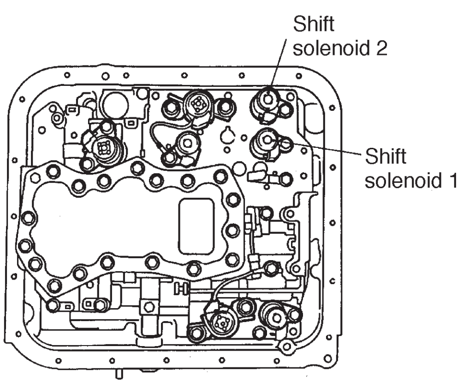


B3H0016B

Range position	Pin No.
P	(4) – (3) (12) – (11)
R	(4) – (2) (10) – (9)
N	(4) – (1) (12) – (11)
D	(4) – (8)
3	(4) – (7)
2	(4) – (6)
1	(4) – (5)

K: SHIFT SOLENOID 1 AND 2

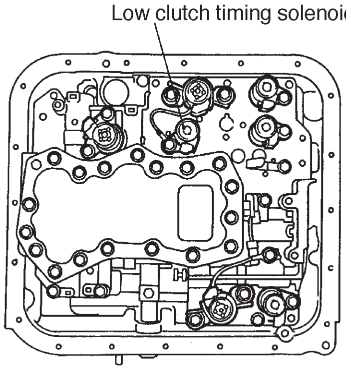
These solenoids are mounted to the control valve. They are turned ON or OFF according to signals sent from the TCM. The gear positions are changed according to the ON and OFF condition of these solenoids.



B3H0994A

L: LOW CLUTCH TIMING SOLENOID

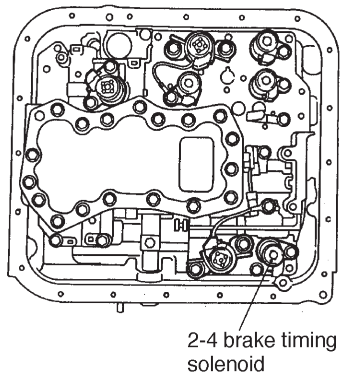
This solenoid is mounted to the control valve, and it is turned ON or OFF according to the signal sent from the TCM. It then controls the low clutch timing valve B and reverse inhibit valve.



B3H0994B

M: 2-4 BRAKE TIMING SOLENOID

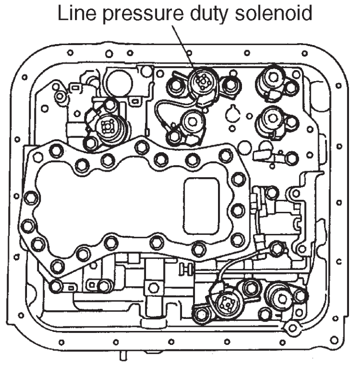
This solenoid is mounted to the control valve, and it is turned ON or OFF according to the signal sent from the TCM. It then controls the 2-4 brake timing valve B for decreasing the change gear shock.



B3H0994C

N: LINE PRESSURE DUTY SOLENOID

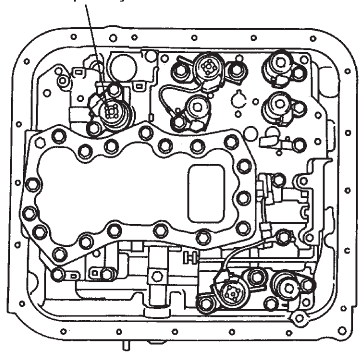
This solenoid is mounted to the control valve, and its duty ratio is controlled by the signal sent from TCM. This solenoid then controls the pressure modifier valve and accumulator control valve A to adjust the line pressure to an optimum pressure level suitable for operating conditions.



B3H0994G

O: LOCK-UP DUTY SOLENOID

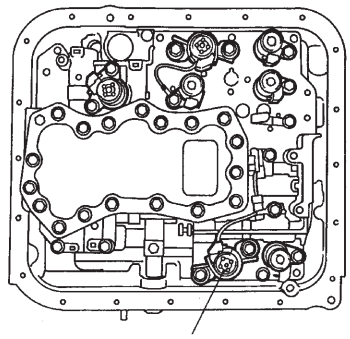
This solenoid is mounted to the control valve, and its duty ratio is controlled by the signal sent from TCM. It then controls the lock-up control valve to provide smooth engagement and disengagement of the lock-up clutch.



B3H0994H

P: 2-4 BRAKE DUTY SOLENOID

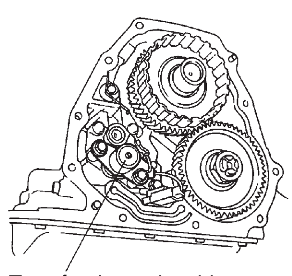
This solenoid is mounted to the control valve, and its duty ratio is controlled by the signal sent from TCM. It modulates the 2-4 brake duty pressure when the 2-4 brake is operated, reducing shifting shocks.



B3H0994I

Q: TRANSFER DUTY SOLENOID

This solenoid is mounted to the transfer control valve on the rear end of transmission case, and its duty ratio is controlled by the signal sent from TCM. It then controls the transfer control valve for controlling the transfer clutch hydraulic oil pressure.



B3H0995B

12. Transmission Control Module (TCM)

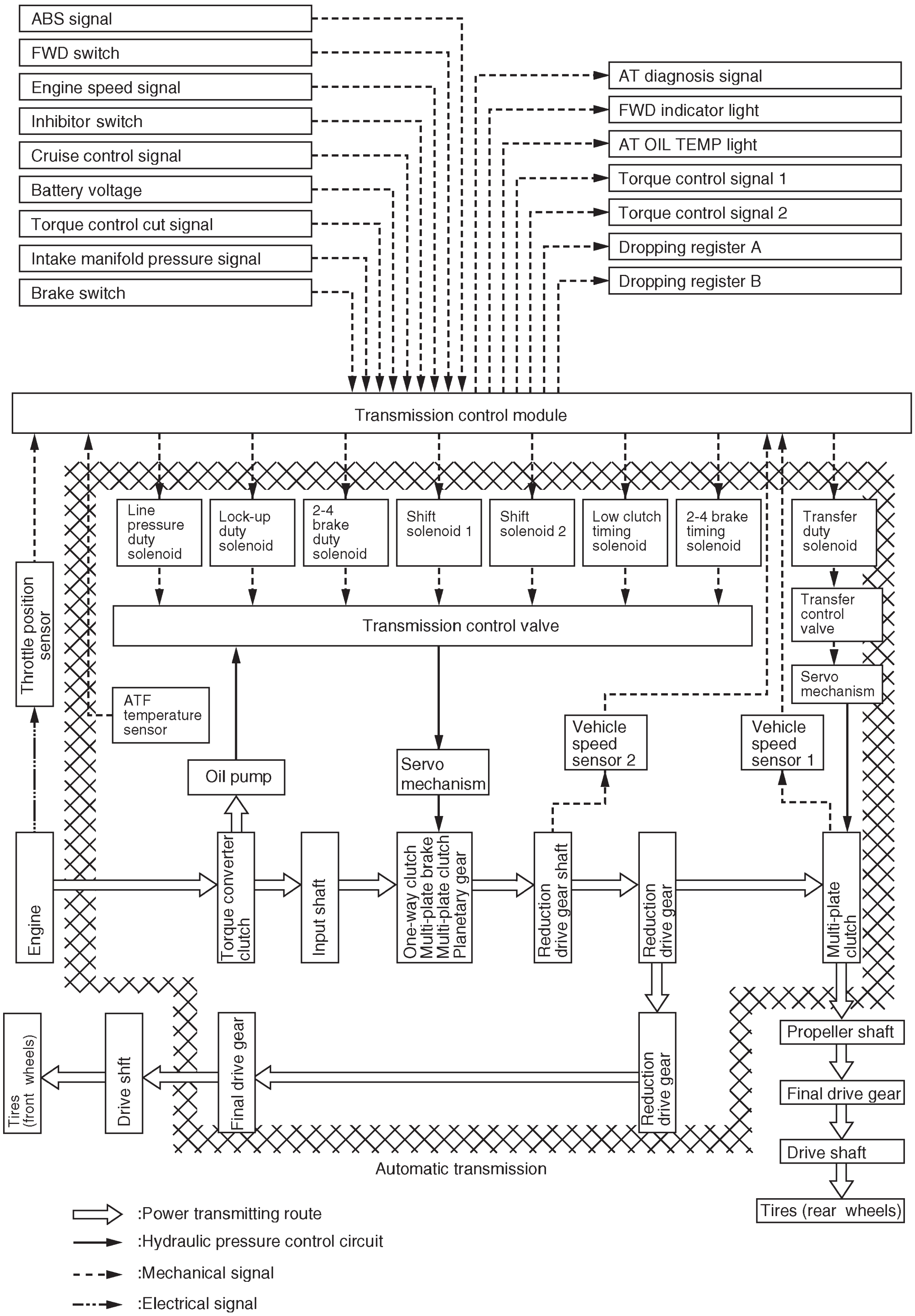
TCM receives various sensor signals and determines the running conditions of the vehicle. It then sends control signals to each solenoid according to the preset gearshift characteristic data, lock-up operation data, and transfer clutch torque data (duty ratio).

A: CONTROL SYSTEM

Control item		Input signal
Shift control	Ordinary shift control	Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Engine speed Inhibitor switch
	ABS operation control	ABS signal Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Brake switch
	Hydraulic oil temperature control	ATF temperature sensor
	Reverse inhibit control	Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Inhibitor switch
	Shift pattern select control	Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Inhibitor switch
	Grade control	Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Brake switch Inhibitor switch
Lock-up control	Ordinary lock-up control	Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Engine speed Inhibitor switch
	Smooth control	Throttle position sensor
	Hydraulic oil temperature control	ATF temperature sensor
Oil pressure control	Ordinary pressure control	Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Engine speed Inhibitor switch ATF temperature sensor
	Shifting control	Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Engine speed Torque converter turbine speed sensor Inhibitor switch ATF temperature sensor
	Starting control	Engine speed ATF temperature sensor Inhibitor switch

Control item		Input signal
Oil pressure control	Learning control	Shift solenoid A Shift solenoid B Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Throttle position sensor Torque converter turbine speed sensor ATF temperature sensor
AWD transfer clutch control	Ordinary transfer control	Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Torque converter turbine speed sensor Inhibitor switch ATF temperature sensor FWD switch
	1st range control	Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Torque converter turbine speed sensor Inhibitor switch
	Slip detection control	Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front)
	Steering control	Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front)
	ABS operation control	ABS signal Throttle position sensor Vehicle speed sensor 1 (rear) Vehicle speed sensor 2 (front) Brake switch

B: SYSTEM DIAGRAM

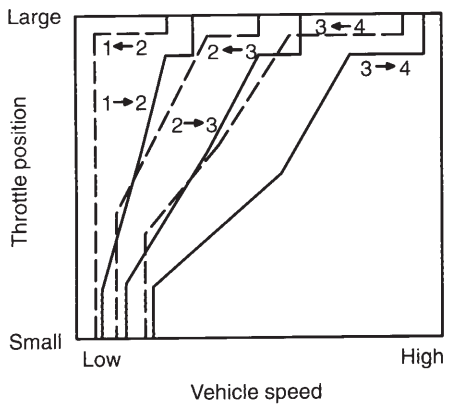


B3H1673A

C: SHIFT CONTROL

Gearshifting is controlled in response to driving conditions, according to the shift point characteristic data stored in the TCM. Solenoids are operated at the proper time corresponding to the shift pattern, throttle position, and vehicle speed for smooth shifting.

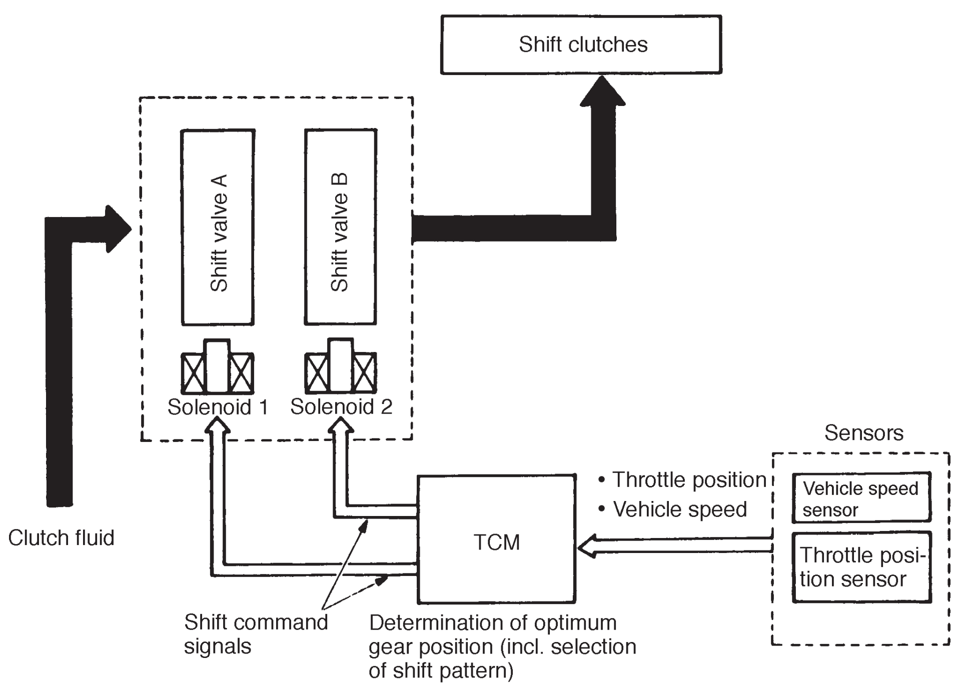
NOTE:
When oil temperature is below approximately 10°C (50°F), the vehicle cannot be shifted to the 4th gear.



	Solenoid 1	Solenoid 2
1st	ON	ON
2nd	OFF	ON
3rd	OFF	OFF
4th	ON	OFF

G3H0752

- Control module activates both solenoids 1 and 2 in response to throttle and vehicle speed signals.
- Shift valve moves in response to solenoid operation, supplying/interrupting clutch pressure to the line.
- Gears are shifted by ON-OFF operation of both solenoids as indicated in Table.



G3H0753

D: LOCK-UP CONTROL

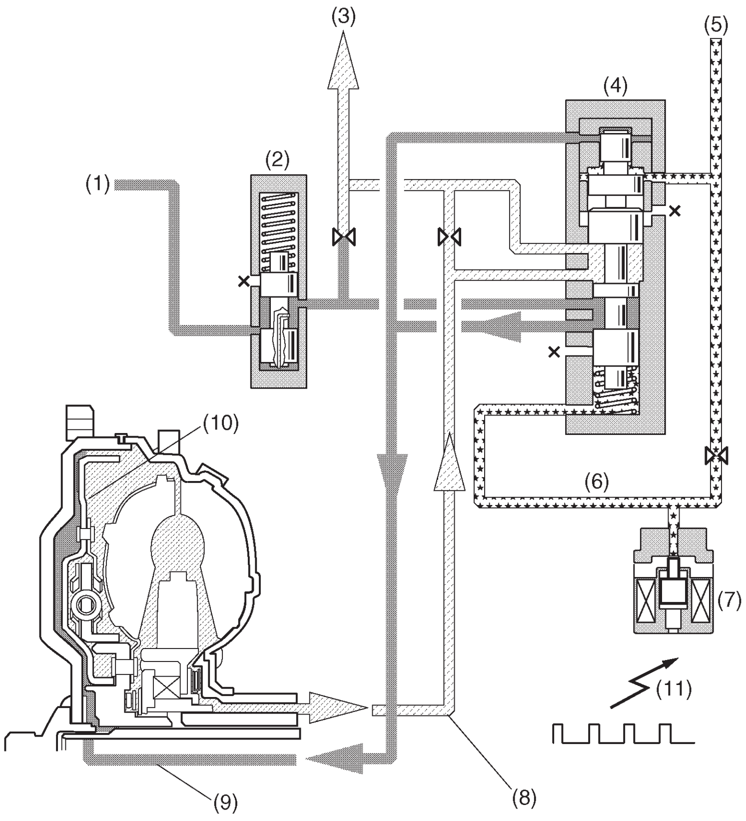
The lock-up engaging and disengaging conditions are set for 4th gear shift range, gear position and shift pattern and correspond to the throttle position and vehicle speed, and the duty solenoid electronically controlled by TCM controls the lock-up clutch. The lock-up clutch engagement and disengagement are controlled by the lock-up control valve.

<When engaging and disengaging>

The lock-up control valve engages and disengages the lock-up clutch by adjusting the hydraulic pressure.

1. NON-LOCK-UP OPERATION

The transmission control module (TCM) sends output signals to the lock-up duty solenoid. This causes the amount of ATF drained from the lock-up duty solenoid valve to be reduced, which increases the lock-up duty pressure.
The increased lock-up duty pressure moves the lock-up control valve upwards, connecting the torque converter regulator valve to the torque converter control valve release port.
Therefore, the oil pressure from the torque converter regulator valve flows through the lock-up control valve release port to the torque converter clutch and the torque converter apply circuit. As a result, the lock-up piston is forced to separate from the impeller cover, and power is transmitted from impeller to turbine to input shaft, as with an ordinary torque converter clutch coupling.

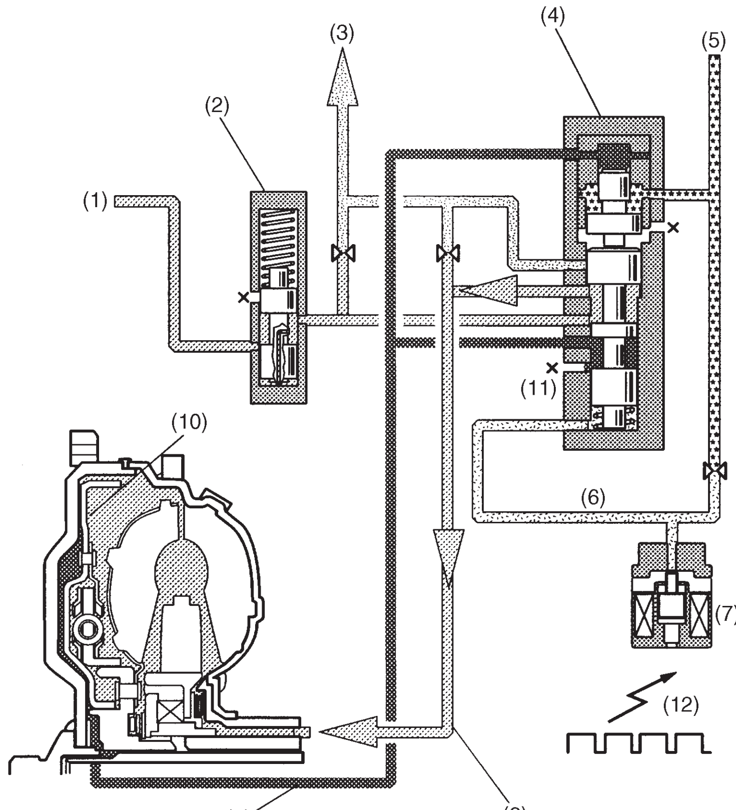


B3H1650A

(1)	From pressure regulator valve
(2)	Torque converter regulator valve
(3)	To ATF cooler
(4)	Lock-up control valve
(5)	Pilot pressure
(6)	Lock-up duty pressure
(7)	Lock-up duty solenoid
(8)	Lock-up apply circuit
(9)	Lock-up release circuit
(10)	Lock-up clutch
(11)	Output signal

2. LOCK-UP OPERATION

The transmission control module (TCM) sends output signal to the lock-up duty solenoid. Since the lock-up duty solenoid operates in proportion to the duty ratio, the amount of ATF drained from there is increased, thus lock-up duty pressure being reduced.
As a result, the lock-up control valve moves downward, which connects the torque converter regulator valve and the lock-up control valve apply port to each other.
In this condition, the oil pressure from the torque converter valve flows through the lock-up control valve apply port to the torque converter and the torque converter clutch. This causes a pressure differential across the lock-up piston. The piston is then forced against the impeller cover and turned as an integral unit with the cover. Thus, power from the engine is directly transmitted to the transmission input shaft. That is, the transmission is directly coupled to the engine.



(1) From pressure regulator valve	(5) Pilot pressure	(9) Lock-up release circuit
(2) Torque converter regulator valve	(6) Lock-up duty pressure	(10) Lock-up clutch
(3) To ATF cooler	(7) Lock-up duty solenoid	(11) Drain
(4) Lock-up control valve	(8) Lock-up apply circuit	(12) Output signal

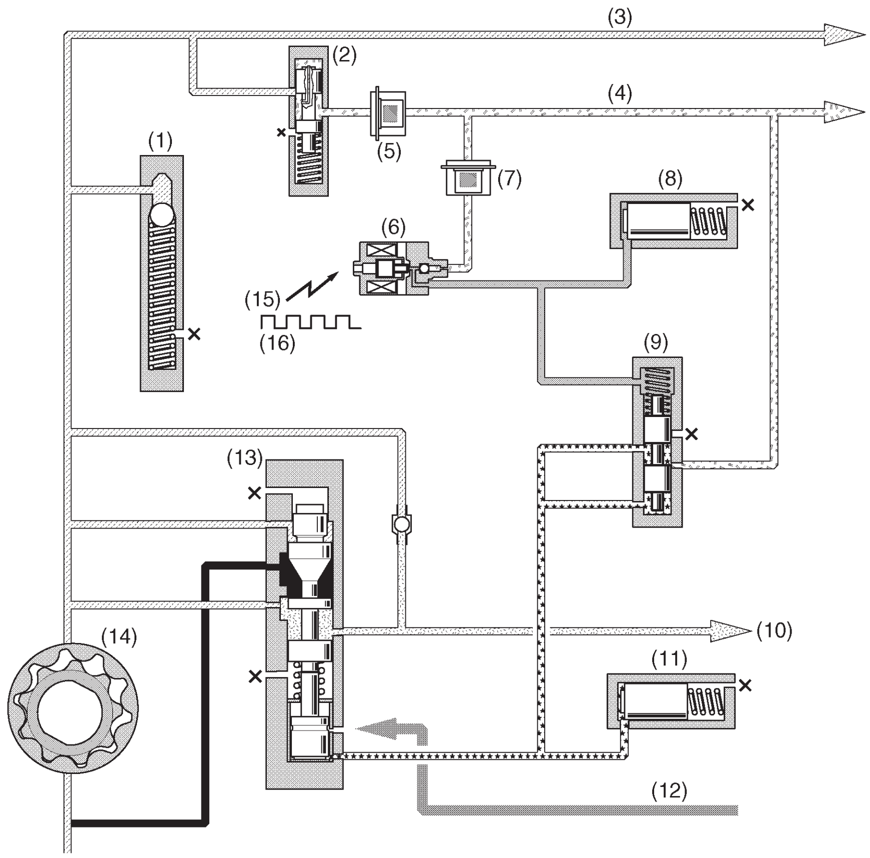
<Smooth control>

The lock-up duty solenoid is controlled by the TCM and controls the operation of the lock-up control valve. Because the lock-up operating pressure is controlled by the lock-up control valve, the force applied to the lock-up clutch is controlled for smooth clutch operation.

When locking up, the clutch is set in the half-engaged state beforehand. After this, the lock-up operating pressure is gradually increased to achieve smooth locking up.

E: LINE-PRESSURE CONTROL

- The oil pump delivery pressure (line pressure) is regulated to the constant pilot pressure by the pilot valve.
- The pilot pressure applied to the pressure modifier valve is regulated by the line pressure controlling line pressure duty solenoid and changed into the pressure modifier pressure.
- The pressure modifier valve is an auxiliary valve for the pressure regulator valve, and it creates a signal pressure (pressure modifier pressure) for regulating the line pressure to an optimum pressure corresponding to the driving conditions.
- This pressure modifier pressure is applied to the pressure regulator valve to control the oil pump delivery pressure.
- The pressure modifier pressure regulated by the pressure modifier valve is smoothed by the pressure modifier accumulator and pulsation in the line pressure is eliminated.



B3H0937A

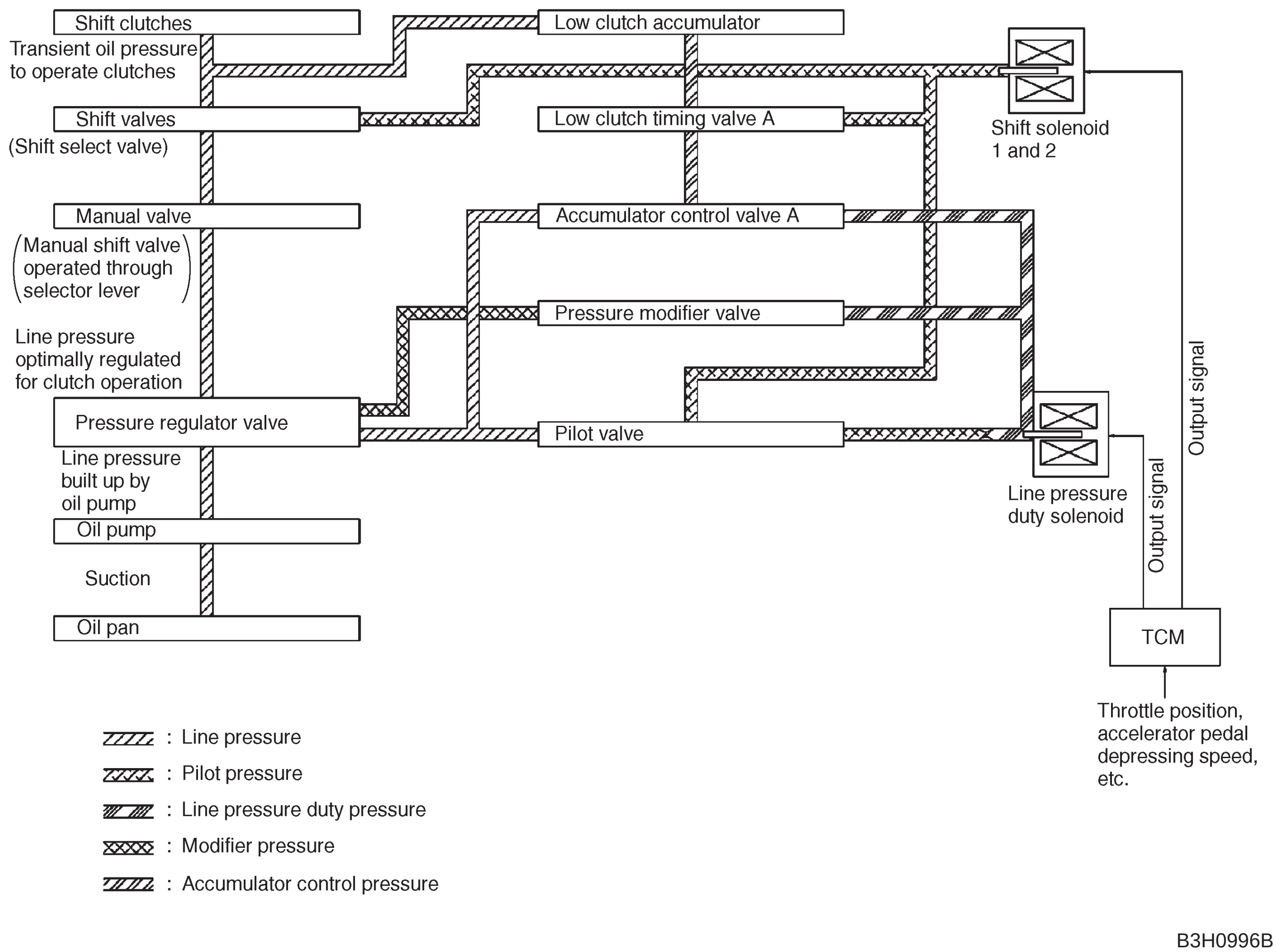
(1)	Relief valve	(7)	Filter	(13)	Pressure regulator valve
(2)	Pilot valve	(8)	Accumulator	(14)	Oil pump
(3)	Line pressure	(9)	Pressure modifier valve	(15)	ON
(4)	Pilot pressure	(10)	To oil cooler circuit	(16)	OFF
(5)	Filter	(11)	Accumulator		
(6)	Line pressure duty solenoid	(12)	From R range pressure circuit		

F: LINE-PRESSURE SHIFTING CONTROL

1. FUNCTION

Oil pressure which engages shift clutches (to provide 1st through 4th speeds) is electronically controlled to meet varying operating conditions.

In other words, line pressure decreases to match the selected shift position, minimizing shifting shock.



2. ELECTRONIC CONTROL OF CLUTCH OIL PRESSURE IN SUMMARY

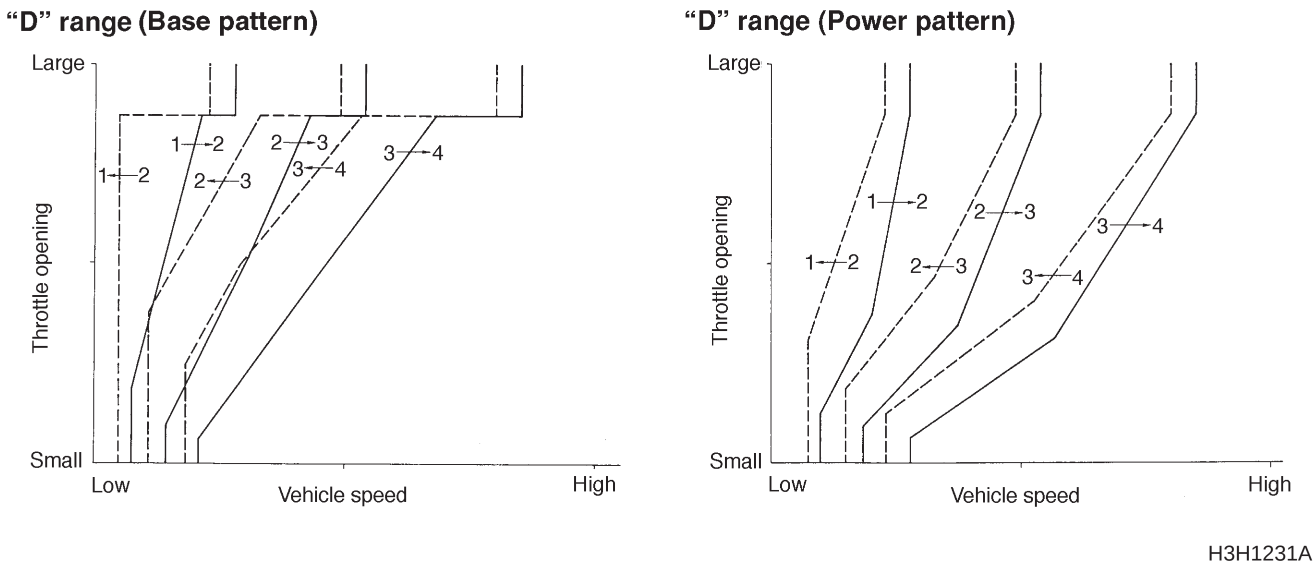
- Solenoids activate through the TCM which receives various control signals (throttle signal, etc.)
- Control signals are converted into line pressure duty pressure, which is transmitted to the pressure modifier valve.

G: SHIFT PATTERN SELECT CONTROL

Shift pattern is selectable automatically between a base pattern suitable for ordinary economy running and a power pattern suitable for climbing uphill or rapid acceleration.

In the power pattern, the shift down point and shift up point are set higher than those of the base pattern.

Selector position	Changeover from base to power pattern
D, 3 range	Performed automatically corresponding to accelerator pedal depression.

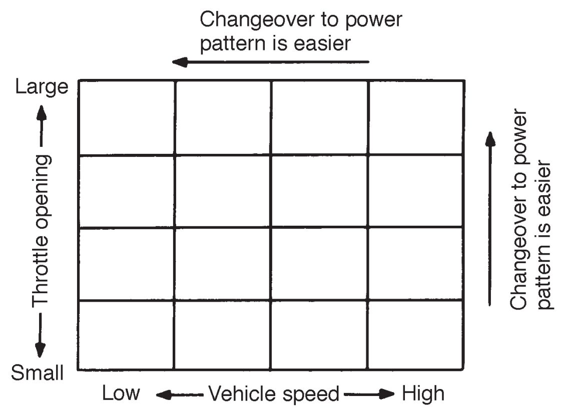


1. BASE PATTERN TO POWER PATTERN

Select lever	D, 3 range
Accelerator depression speed	Greater than set value

Depending on throttle opening and vehicle speed, 16 areas as shown in the figure are set. Accelerator depression speed for pattern changeover is set for each area.

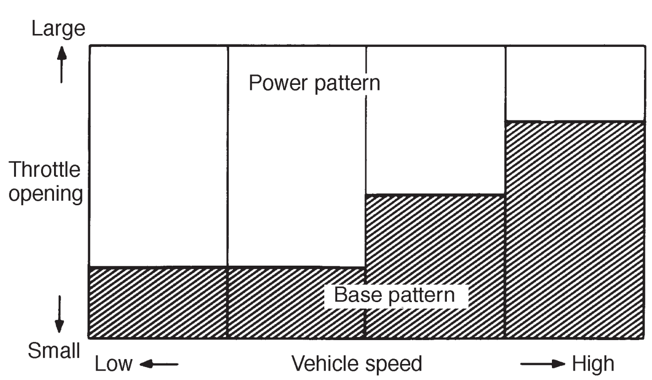
When the accelerator depression speed exceeds this set value, the pattern changes from base to power.



G3H0248

2. POWER PATTERN TO BASE PATTERN

The power pattern is shifted to the base pattern, depending on car speed. Shifting to the base pattern is determined by the throttle position as shown in Figure below. Time lag in shifting is also determined by car speed. The maximum time lag is 3 seconds.

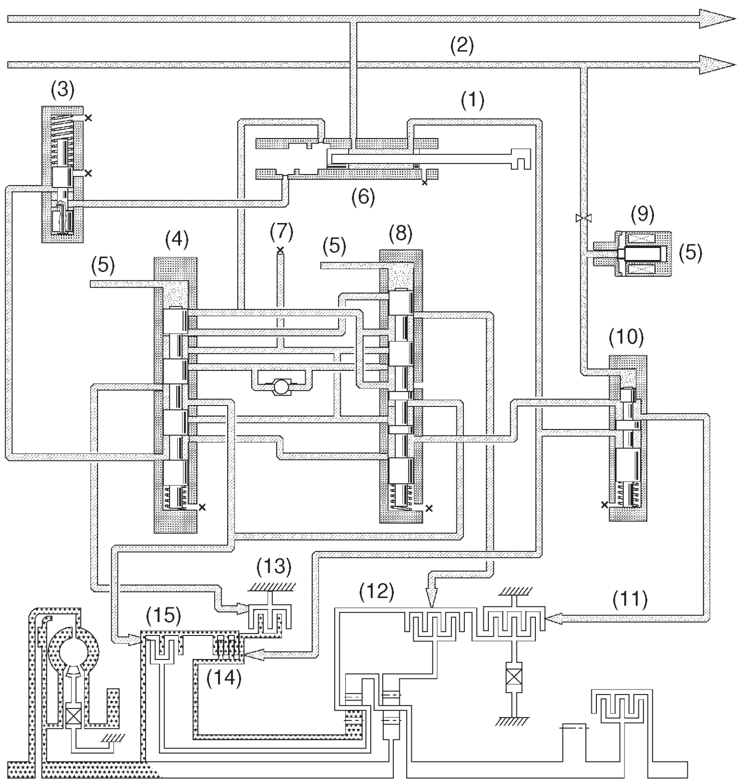


B3H1763A

H: REVERSE INHIBIT CONTROL

This control prevents the transmission from shifting into reverse when the select lever is accidentally placed in “R” range, protecting the components such as reverse clutch against damage.

If “R” range is selected during driving at a speed higher than the predetermined, the low clutch timing solenoid is energized.
Then, the pilot pressure is supplied to the reverse inhibit valve. This causes the reverse inhibit valve to move downward, closing the low & reverse brake port.
In this condition, the low & reverse brake does not engage since the ATF flowing from the manual valve is blocked by the reverse inhibit valve.
As a result, the transmission is put into Neutral, and the shifting into reverse is inhibited.

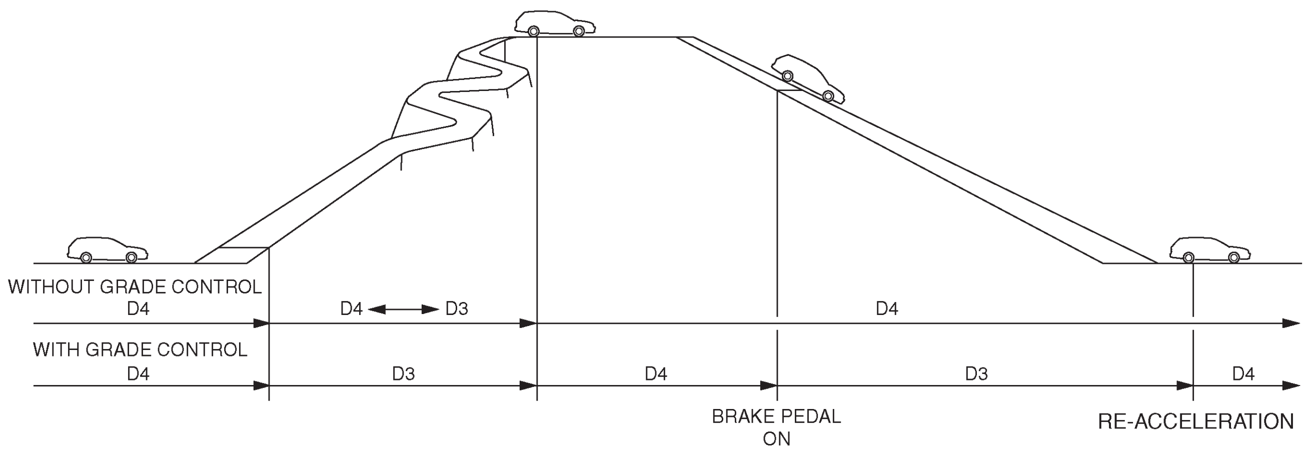


B3H1739A

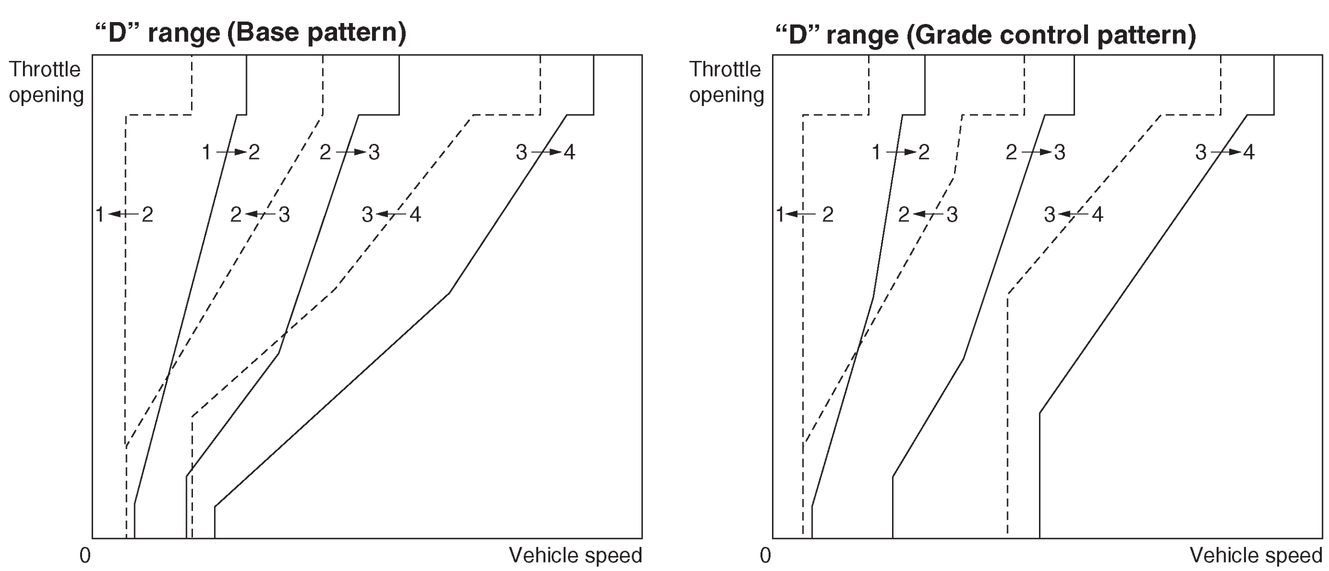
(1)	Line pressure	(6)	Manual valve (P range)	(11)	Low & reverse brake (Release)
(2)	Pilot pressure	(7)	Drain	(12)	Low clutch
(3)	1st reducing valve	(8)	Shift valve B	(13)	2-4 brake
(4)	Shift valve A	(9)	Low clutch timing solenoid	(14)	Reverse clutch
(5)	ON	(10)	Reverse inhibit valve	(15)	High clutch

I: GRADE CONTROL

While a vehicle is driving up a hill, gear position is fixed to 3rd gear for avoiding busy up and down shift between 3rd – 4th gears.
When a vehicle is descending a steep hill under the designated vehicle speed (approximately 50 miles/hour), 4th gear downshifts to 3rd gear automatically by depressing the brake pedal.
This gearshift control is released by re-accelerating with depressing the accelerator pedal.
These controls are doing this based on the combination of throttle opening angle, engine speed, vehicle speed and so on.



B3H1751A

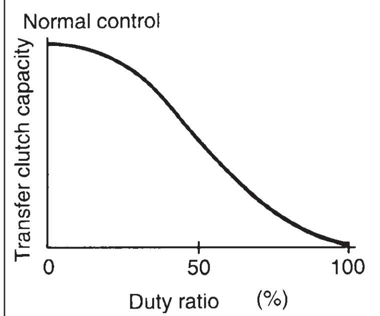


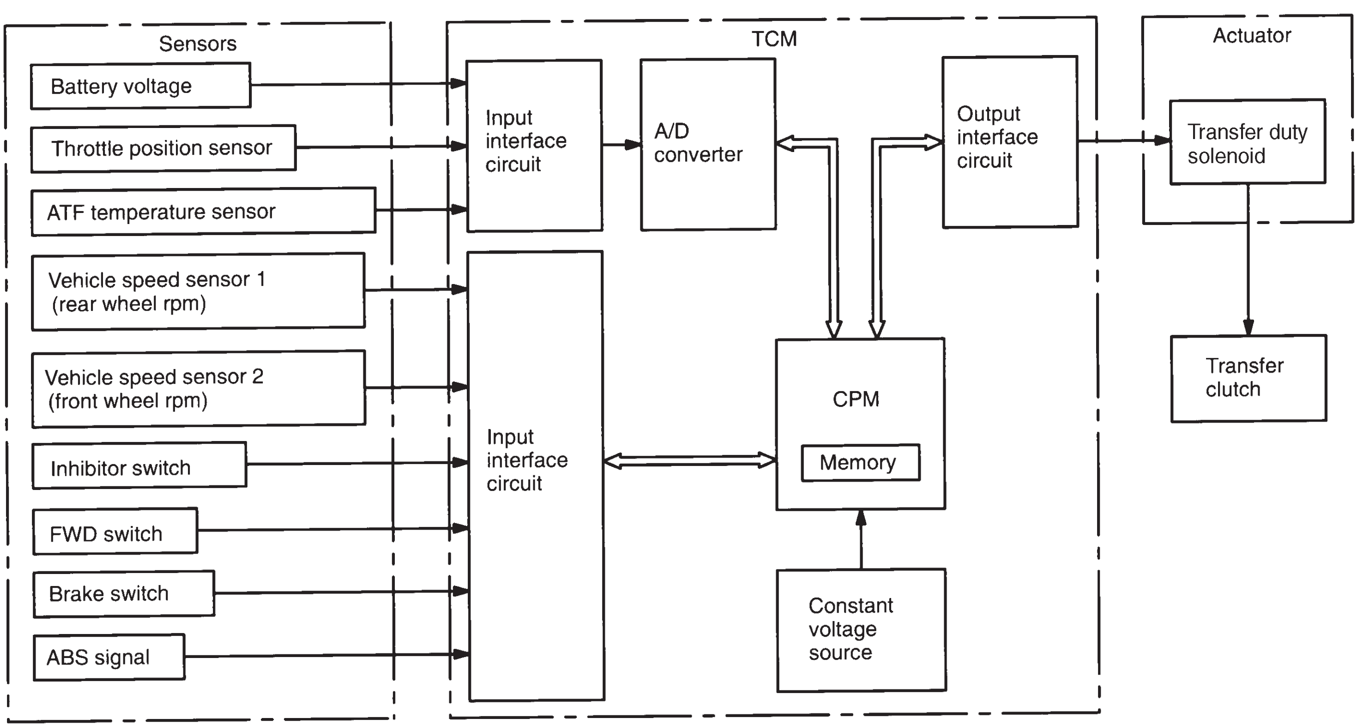
B3H1755A

J: LEARNING CONTROL

This transmission is provided with a learning control function which allows the transmission hydraulic pressure to be so controlled that the transmission makes a shift at the optimum shifting point according to the vehicle conditions.
For this reason, there may be cases where shift shocks become larger after the power supply is once interrupted (disconnection of battery terminal, flat battery, etc) or immediately after the ATF is replaced.
Once power supply is interrupted, the hydraulic pressure correction values so far learnt and stored are erased and the system is initialized (reset to the new vehicle conditions).
The system starts the learning again as soon as the power supply is restored, and after driving for a while, the transmission becomes shiftable at the optimum shifting points.
Lager shift shocks immediately after ATF change are caused by the change in friction characteristics of the transmission internal parts.
Also in this case, therefore, the transmission becomes shiftable at the optimum shifting points after driving for a while.

K: AWD TRANSFER CLUTCH CONTROL

Control item		Type of control	Gear position	Remarks
1	Basic control	Regulates transfer oil pressure in response to throttle position and vehicle speed.	1st thru 4th and reverse	 B3H0314
2	Control in 1st range	Increases transfer oil pressure above basic control pressure	1st	–
3	Control during “slip” detection	Increases transfer oil pressure to the same as in 1st range immediately after “slip” detection.	1st thru 4th and reverse	Release: At more than set vehicle speed and fully closed throttle
4	Control in turns	Decreases transfer oil pressure upon detection of vehicle turns.	1st thru 4th and reverse	–
5	Control in ABS operation	Regulates to the specified transfer oil pressure quickly when the ABS signal is input.	1st thru 4th and reverse	–
6	Control in P and N range	Regulates to the specified transfer oil pressure quickly when shifted to the P or N range.	P and N	–



B3H0315A

L: TRANSFER CONTROL

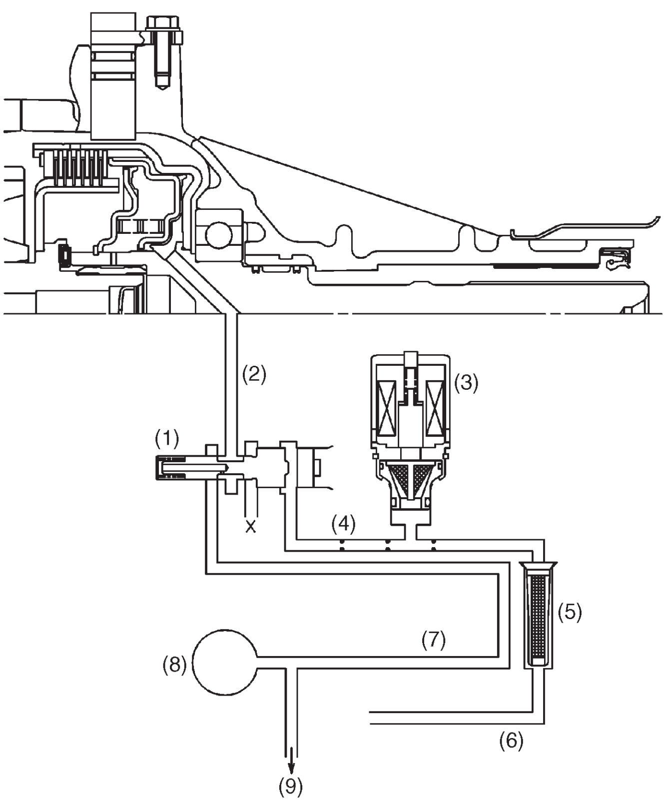
The transfer hydraulic pressure control module is fitted with the transfer valve body attached to the rear end face of the transmission case via separate plate.

The hydraulic oil of the transfer hydraulic pressure control module is led from the oil pump delivery pressure circuit on the transmission case front to the transmission case rear. From there it is further fed to the hydraulic circuit of the transfer valve body.

The hydraulic oil pressure (line pressure) is regulated by the transfer duty solenoid and transfer control valve for obtaining optimum rear torque distribution corresponding to the driving conditions.

- The pilot pressure is regulated to the transfer duty pressure by the transfer duty solenoid whose duty ratio is controlled by the TCM corresponding to the driving condition. (The transfer duty pressure varies with the degree of duty control.)
- The transfer duty pressure is applied to the transfer control valve.
- The line pressure is led also to the transfer control valve where the pressure is regulated to the transfer clutch pressure by the transfer duty pressure. (The transfer clutch pressure varies with the transfer duty pressure.)
- The transfer clutch pressure is applied to the transfer clutch and causes the clutch to be engaged.

In this way, the transfer clutch pressure is varied so that optimum rear torque distribution can be achieved which corresponds to the vehicle driving conditions.



B3H0912A

(1)	Transfer control valve	(4)	Transfer pressure	(7)	Line pressure
(2)	Transfer clutch pressure	(5)	Filter	(8)	Oil pump
(3)	Transfer duty solenoid	(6)	Pilot pressure	(9)	Control valve

13. On-board Diagnostics System

A: FUNCTION

The on-board diagnostics system is capable of detecting any trouble which has occurred in any of the following input and output signal systems.

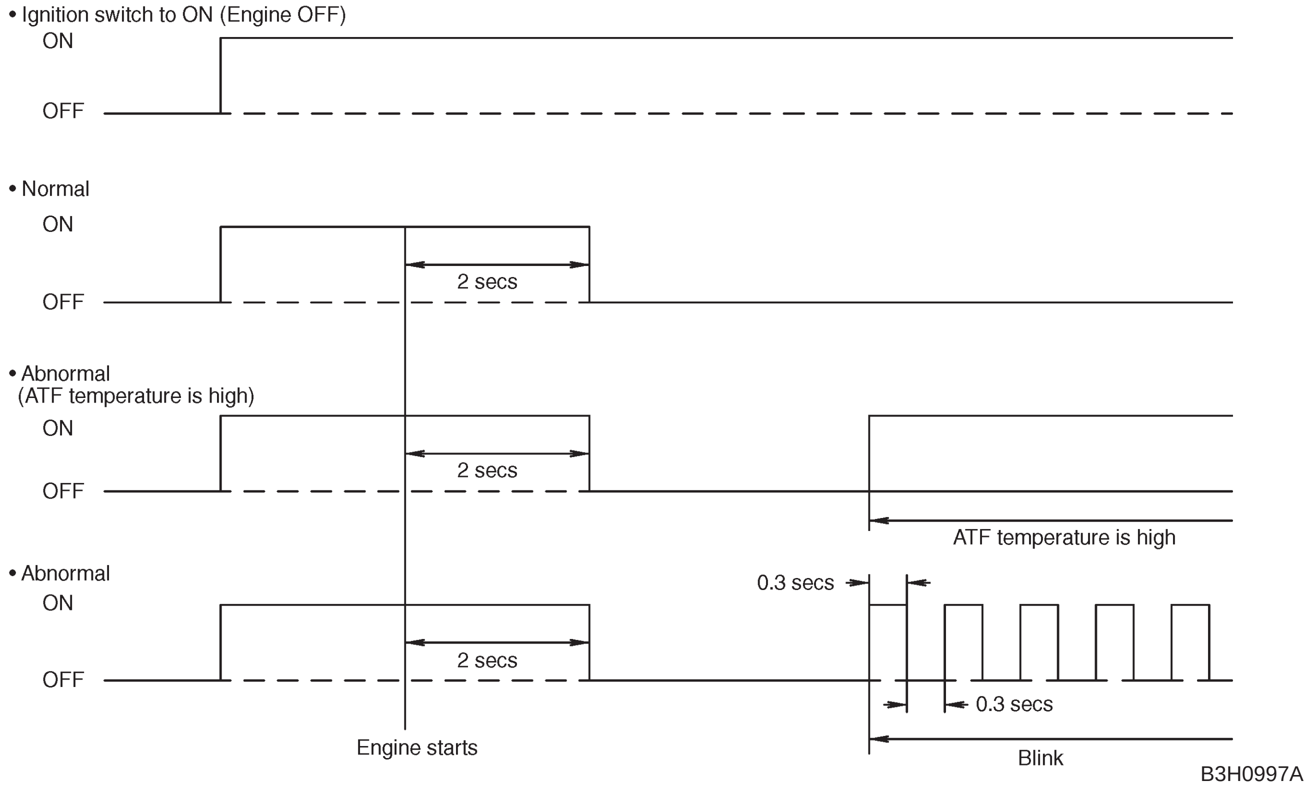
ITEM	Vehicle speed sensor 1 (rear)	Transfer duty solenoid	Low clutch timing solenoid
	Vehicle speed sensor 2 (front)	ATF temperature sensor	Torque converter turbine speed sensor
	Throttle position sensor	Engine speed signal	–
	Shift solenoid 1	Line pressure duty solenoid	–
	Shift solenoid 2	Intake manifold pressure signal	–
	2-4 brake timing solenoid	Torque control signal	–
	Lock-up duty solenoid	2-4 brake duty solenoid	–

The results of on-board diagnostics are displayed by flashing ATF Temperature indicator lamp.

- Repeated flashing at 4 Hz ...Error such as battery trouble
- Repeated flashing at 2 Hz ...Normal
- Output of trouble code ...Check faulty portion
- Continued lighting of lamp ...Error in inhibitor switch, idle switch, or wiring

B: OPERATION OF INDICATOR LAMP

On starting the engine, AT OIL TEMP indicator lamp illuminates as shown below.
If any trouble occurs, the lamp continues flashing until ignition switch is turned to ON position (engine turned off).



C: TROUBLE CODE

TROUBLE CODE	ITEM
11	Engine speed signal
27	ATF temperature sensor
31	Throttle position sensor
33	Vehicle speed sensor 2 (front)
36	Torque converter turbine speed sensor
38	Torque control signal
45	Intake manifold pressure signal
71	Shift solenoid 1
72	Shift solenoid 2
73	Low clutch timing solenoid
74	2-4 brake timing solenoid
75	Line pressure duty solenoid
76	2-4 brake duty solenoid
77	Lock-up duty solenoid
79	Transfer duty solenoid
93	Vehicle speed sensor 1 (rear)

D: SELECT MONITOR

Various data and ON/OFF signals being processed in the TCM can be monitored by connecting the select monitor to the select monitor terminal located under the instrument panel.

14. Fail-safe Function

A fail-safe function is provided to maintain driveability even if trouble should occur in the vehicle speed sensor, throttle position sensor, inhibitor switch, or any of the solenoids.

- VEHICLE SPEED SENSOR 1 AND 2

A dual speed-sensing system is used. The speed signal is taken from the transmission (output shaft speed sensor). Even if one sensor system fails, the vehicle can be controlled normally with the other sensor system.

If both front and rear vehicle speed sensors become faulty, the transmission is fixed in 3rd speed.

- THROTTLE POSITION SENSOR

If throttle position sensor becomes faulty, the throttle opening is fixed at the preset angle.

- INHIBITOR SWITCH

If the plural number of signals are inputted simultaneously due to inhibitor switch failure, the TCM makes it possible to drive the vehicle in the following conditions.

Order of priority: D > N (P) > R > 3 > 2 > 1 >

Selector position	P	R	N	D	3	2	1
Input signal	P range signal and other signal	R range signal and other signal	N range signal and other signal	D range signal and other signal	3 range signal and other signal	2 range signal and other signal	1 range signal and other signal
Driving condition	P	R	N	D	3	2	1

- SHIFT SOLENOID 1 AND 2

If trouble occurs in either of solenoids 1 and 2, both solenoids are turned OFF, and the vehicle is made driveable in the 3rd hold range.

If both solenoids should fail, the mechanical hydraulic circuit is used.

- LINE PRESSURE DUTY SOLENOID

If line pressure duty solenoid fails, the solenoid is turned OFF and line pressure is raised to maximum to enable vehicle operation.

- LOCK-UP DUTY SOLENOID

If lock-up duty solenoid fails, the solenoid is turned OFF and lock-up is released.

- TRANSFER DUTY SOLENOID

When the transfer duty solenoid becomes inoperative, it turns OFF. This causes maximum oil pressure to be applied to the transfer clutch so that the power is always transmitted to rear axles. (Direct-coupling AWD)

- 2-4 BRAKE DUTY SOLENOID

If any trouble occurs in the 2-4 brake duty solenoid, the solenoid is turned off and the vehicle is made drivable in the 1st and 3rd speeds.

- LOW-CLUTCH TIMING SOLENOID

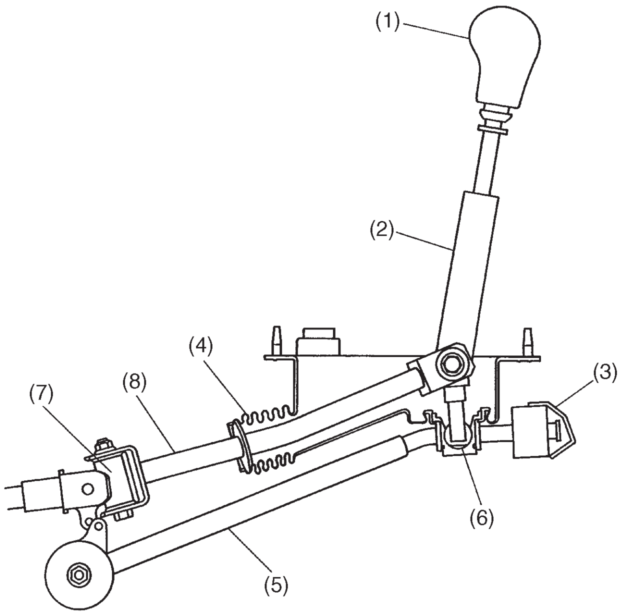
If any trouble occurs in the low clutch timing solenoid, the solenoid is turned off and the vehicle is made drivable in the 1st and 3rd speeds.

- 2-4 BRAKE TIMING SOLENOID

If any trouble occurs in the 2-4 brake timing solenoid, the solenoid is turned off and the vehicle is made drivable in the 1st and 3rd speeds.

1. Gear Shift Lever

The gearshift lever system is a parallel link type whose stay is rubber-mounted.

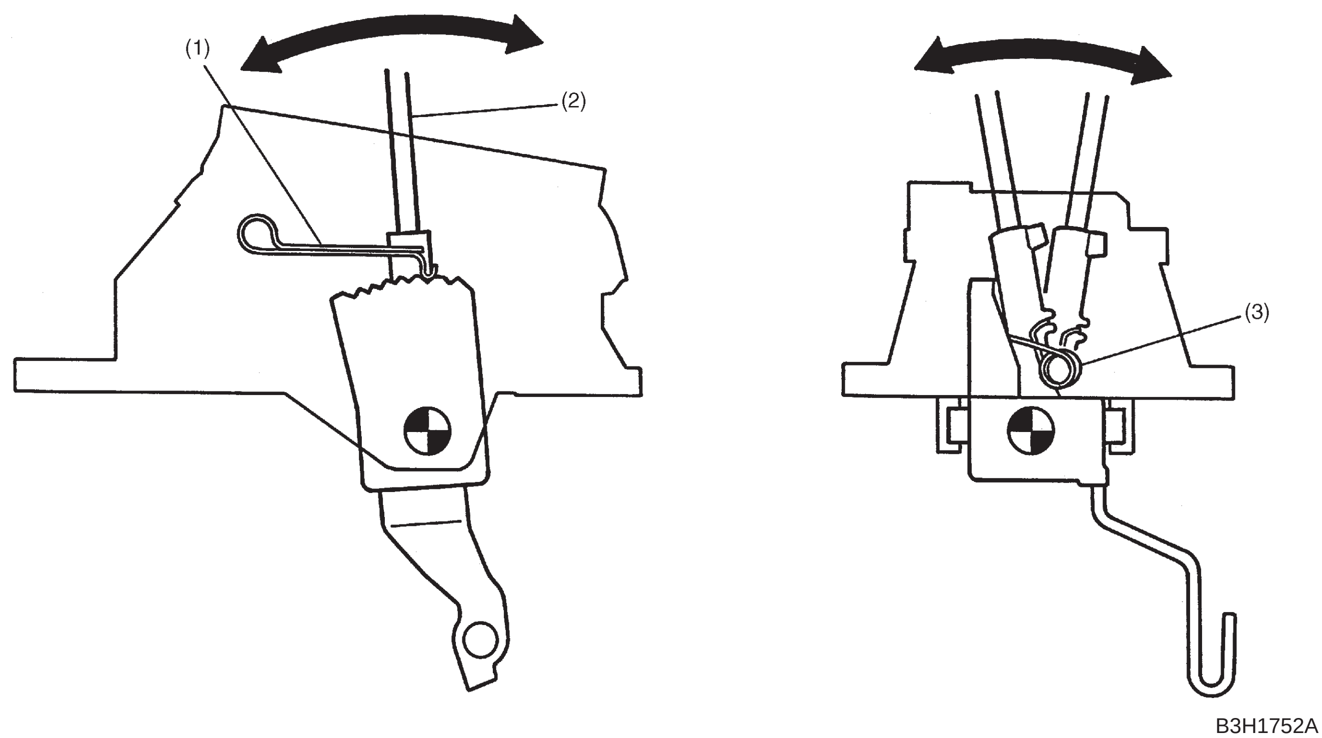


B3H1502A

(1) Knob	(5) Stay
(2) Lever	(6) Bush
(3) Cushion rubber	(7) Joint
(4) Boot	(8) Rod

2. Select Lever

- The selector lever moves through seven positions.
- The selector lever makes movements in a shift direction (longitudinally) as well as movements in a select direction (laterally). These movements are directly restricted by the gate.
- For connecting the selector lever and the transmission, a push-pull cable is employed.
- The newly installed detent spring ensures more punctual selector lever operation.
- For base plate, a plastic one is used.



(1) Detent spring

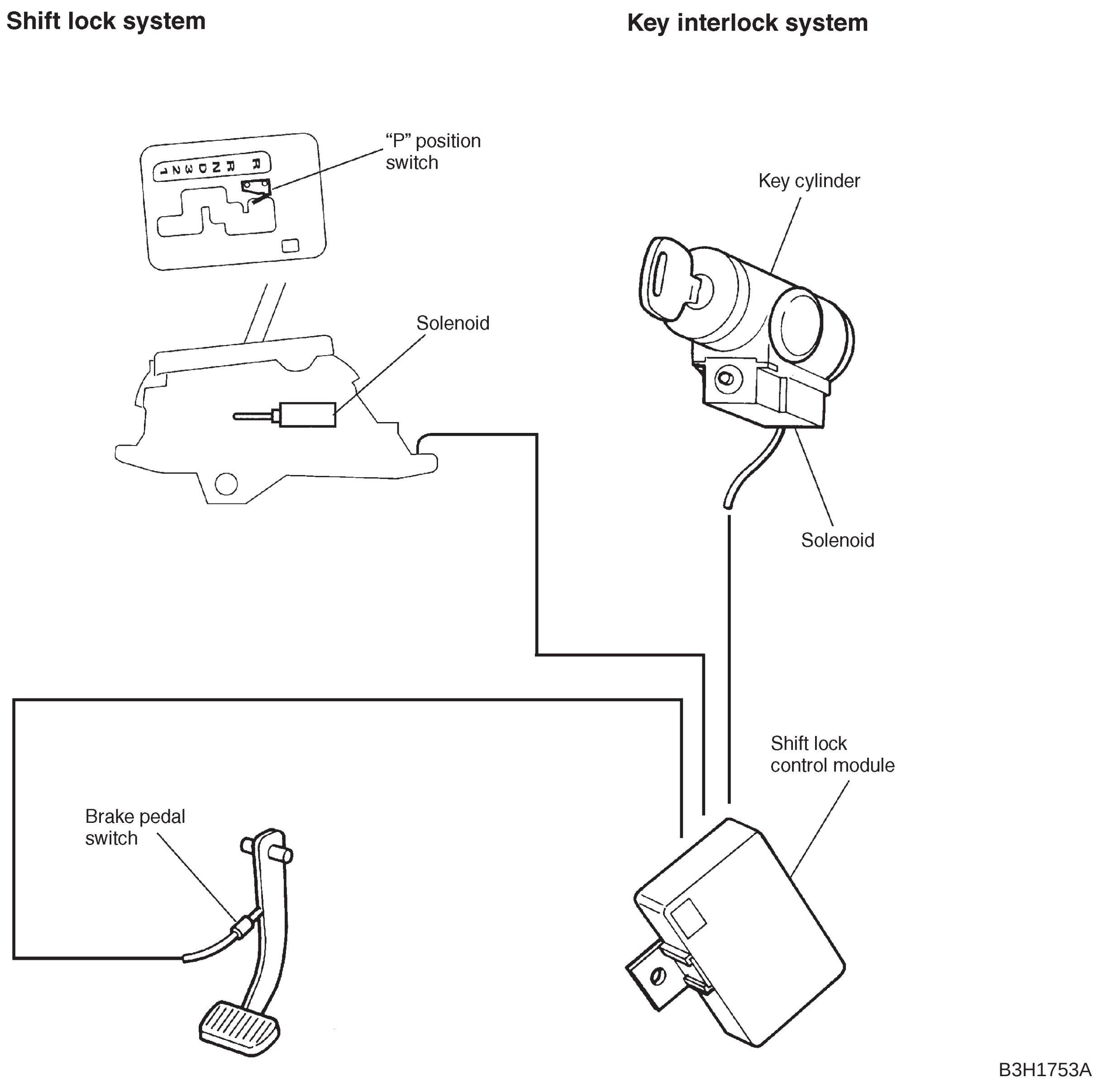
(2) Lever

(3) Lateral spring

3. Shift Lock System (With Key Interlock)

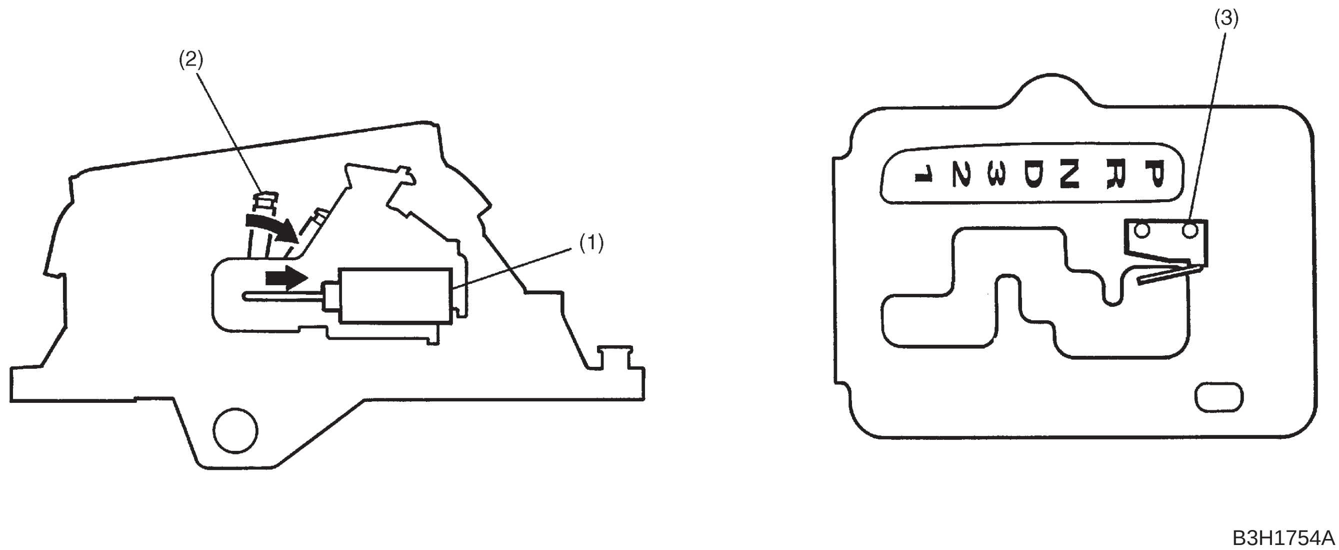
A: GENERAL

To increase safety during “standing start”, a shift lock system is utilized to prevent shifting of the selector lever from “P” to any other position unless the brake pedal is depressed. This system is also provided with a key interlock which prevents removal of the ignition key from the key cylinder unless the selector lever is set at “P”.



B: SHIFT LOCK SYSTEM

The selector lever can be moved from “P” to any other position in the following cases:
When the brake pedal is depressed with the ignition switch in either ON or START position; this operates the solenoid (1), causing the lock arm (2) to fall forward. In this condition, the selector lever is operable. The ignition key can be rotated from the “ACC” to the “LOCK” position and then removed from its key cylinder only when the selector lever is set at “P”.



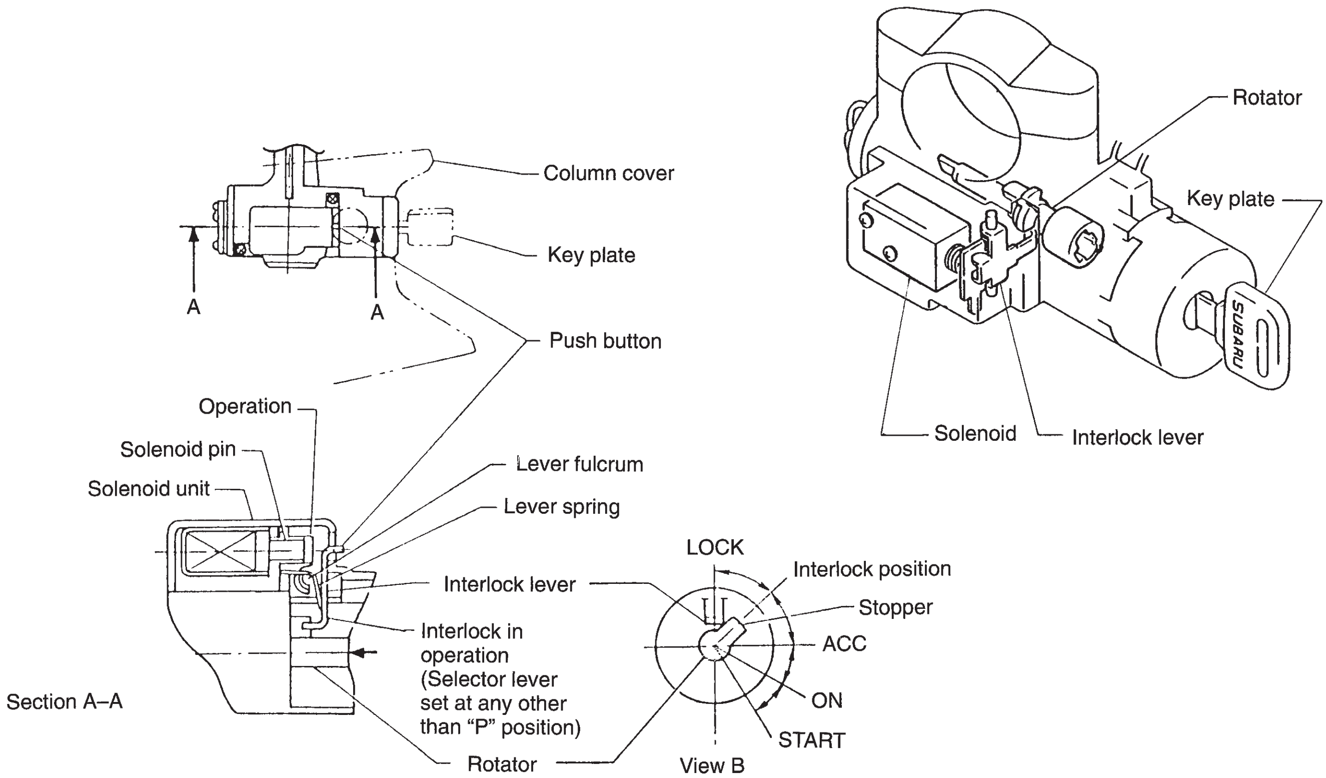
(1) Solenoid:
Activates to release shift lock when the brake pedal is depressed so that selector lever can be moved from “P” to any other position.

(2) Lock arm:
Directly restricts the movement of the select lever when the shift lock is active. When the solenoid is operated, it releases the shift lock, making it possible to operate the selector lever.

(3) “P” position switch:
Detects “P” position of select lever.

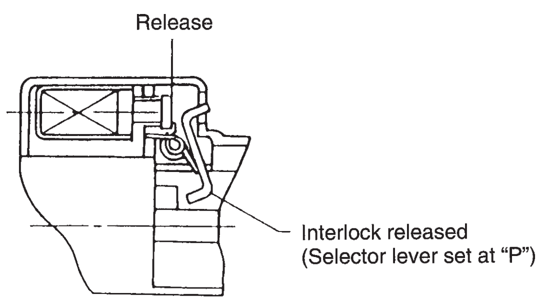
C: KEY INTERLOCK

● When the selector lever is set at any position other than “P”, the solenoid pin is ready for operation so that the interlock lever comes in contact with the rotator which turns together with the key plate. Thus, the ignition key is prevented from rotating up to the “LOCK” position.



G3H0260

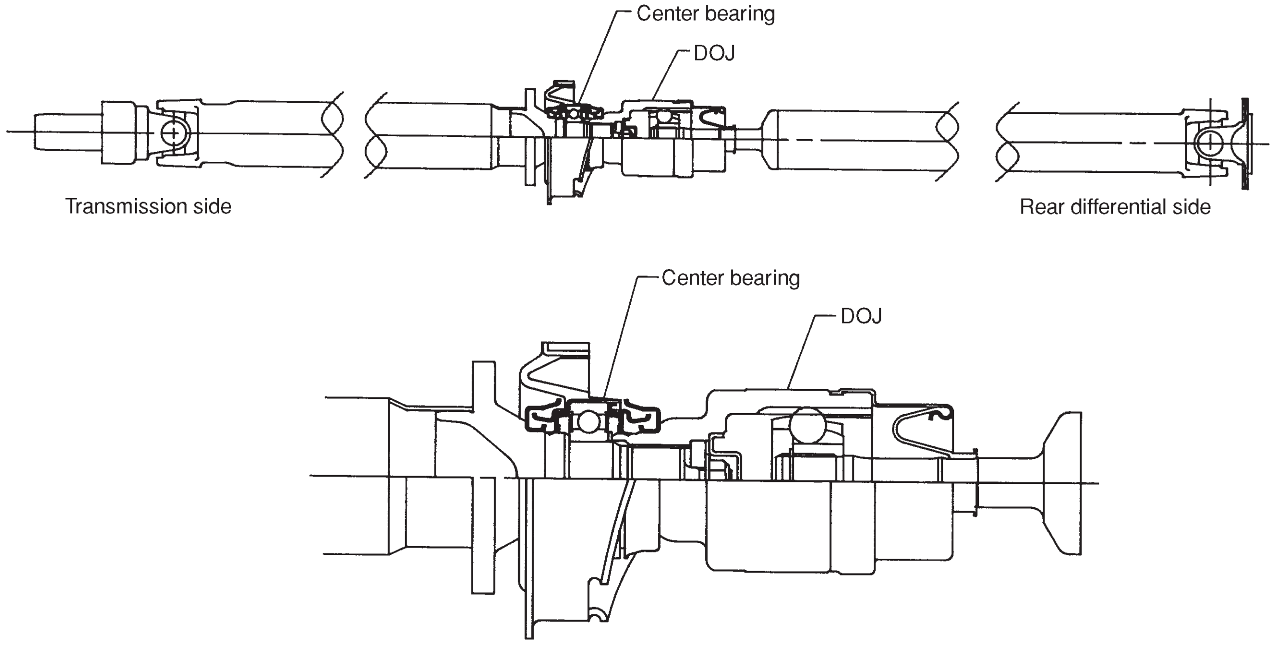
● When the selector lever is moved to “P”, P position switch in the selector lever assembly turned ON, and the solenoid pin moves to the release position so that the lever spring disengages the interlock lever from the rotator’s stopper. As a result, the key plate can be rotated to the “LOCK” position. The key plate can be inserted into or removed from the “LOCK” position only.



G3H0261

1. Propeller Shaft

The constant-velocity joint propeller shaft is installed to provide quiet operation of drive line components. The center joint is a DOJ (double offset joint) type which extends and retracts in the axial direction.

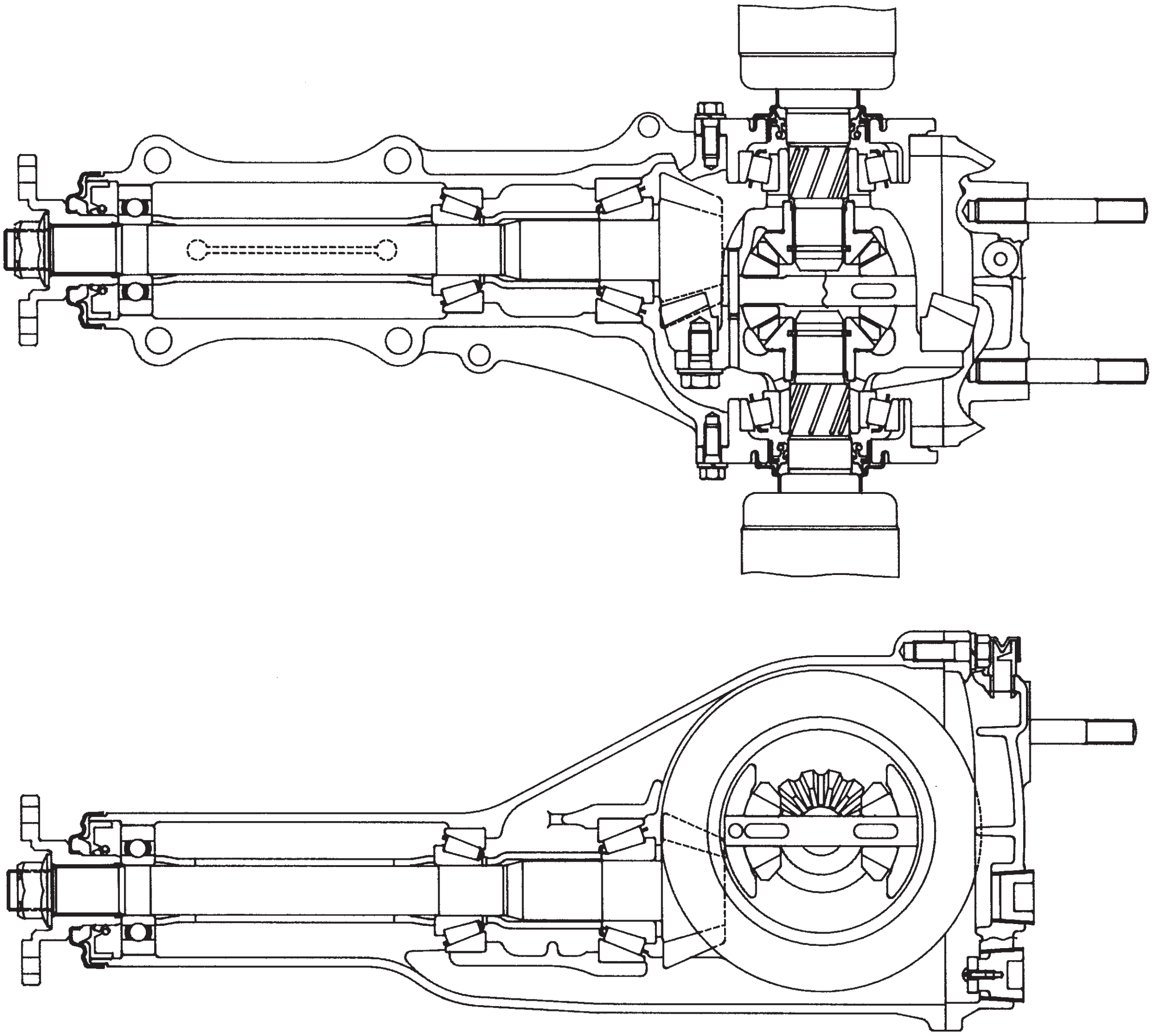


S3H0008A

2. Rear Differential

A: T-TYPE (BRIGHTON, L AND OUTBACK)

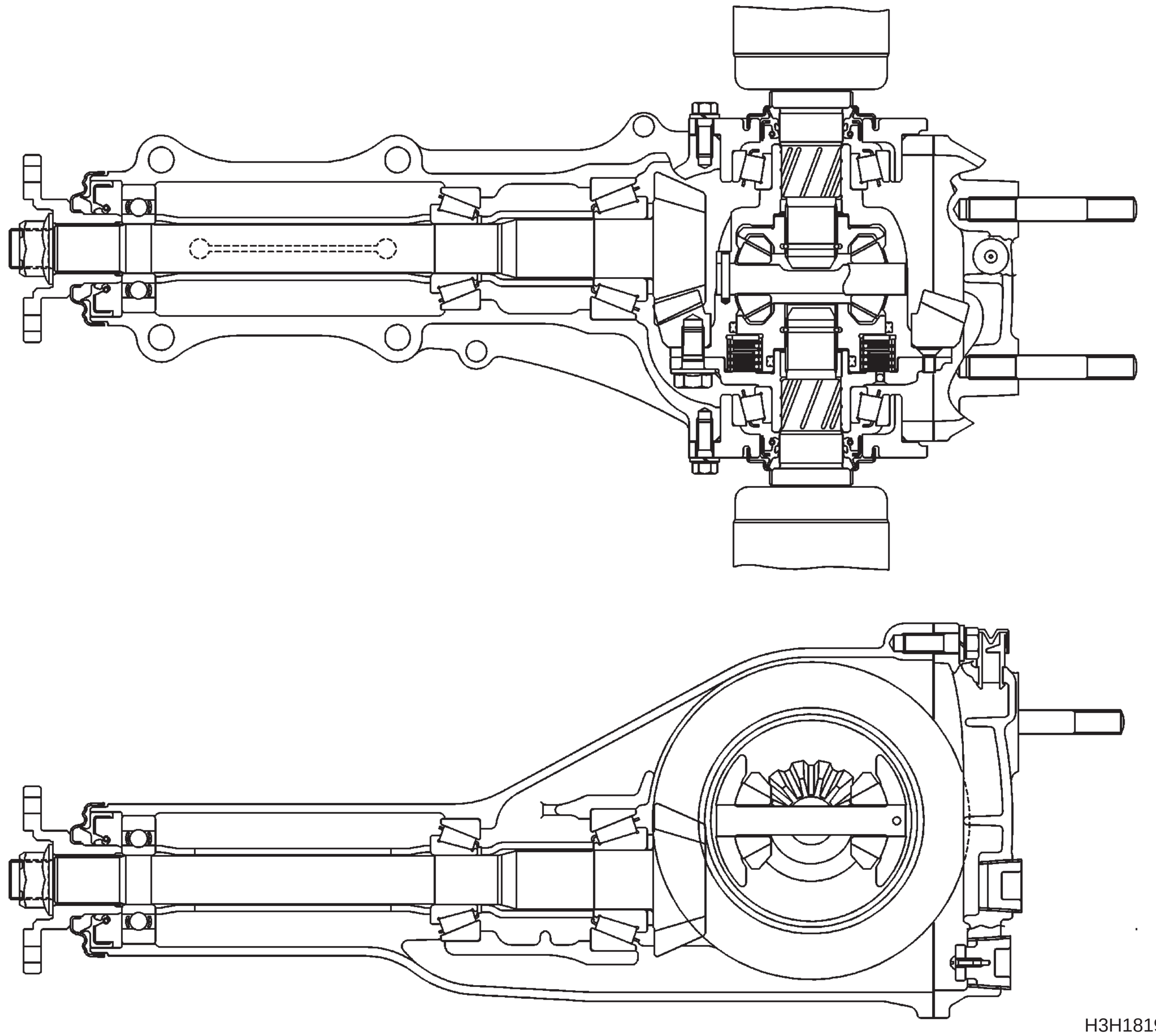
A hypoid drive gear with a nominal diameter of 160 mm (6.30 in) is used and the drive pinion shaft is supported on three bearings, the bearing preload being adjusted by a selective spacer and washer. The drive pinion height is adjusted by selecting washers located at the drive pinion neck using Dummy Shaft and Gauge.



S3H0020

B: T-TYPE (GT, OUTBACK–CW, OUTBACK–LTD AND OUTBACK SEDAN)

The rear differential is a limited slip differential (LSD) incorporating outer plates, inner plates, and viscous coupling with silicon oil.



H3H1819

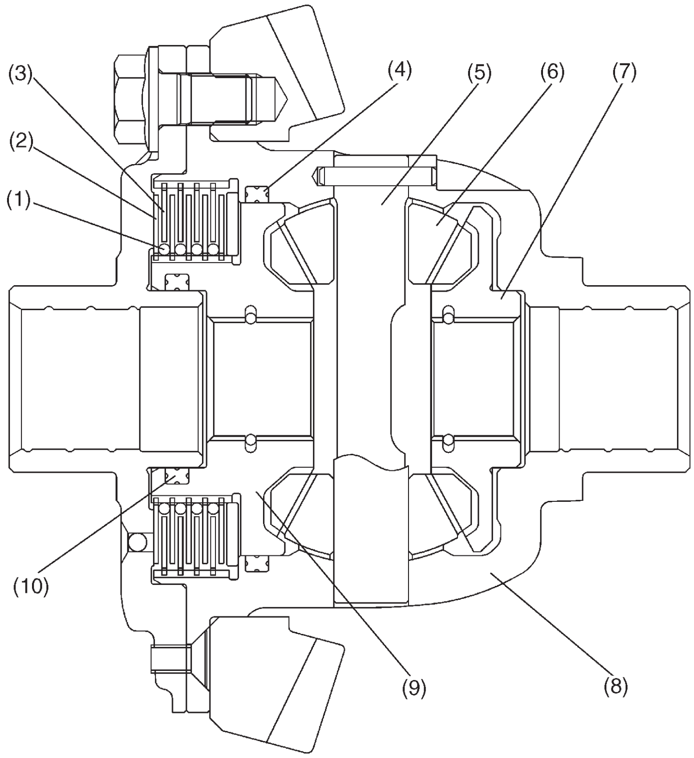
3. Limited Slip Differential (LSD)

A: OUTLINE

The limited slip differential is of a viscous coupling (V/C) type in which the differntial torque distribution to the left and right wheels is automatically limited to enhance the driving stability when a rotation speed differnce between the left and right wheels occurs during driving on a slippery road (muddy, snow-covered or slushy road) or cornering.

B: STRUCTURE

This V/C type LSD has outer plates and inner plates incorporated one after the other between the differential case and side gear (LH). The former is spline-coupled to the inside of the differential case at its outer periphery and the latter is spline-coupled to the outer circumference of the side gear (LH) at its inner periphery.
The inner plates are held in position by spacer rings while the outer rings slide in the axial direction along the spline.
The space between the differential case and side gear (LH) is filled with a mixture of high viscosity silicone oil and air and hermetically sealed with X-ring.



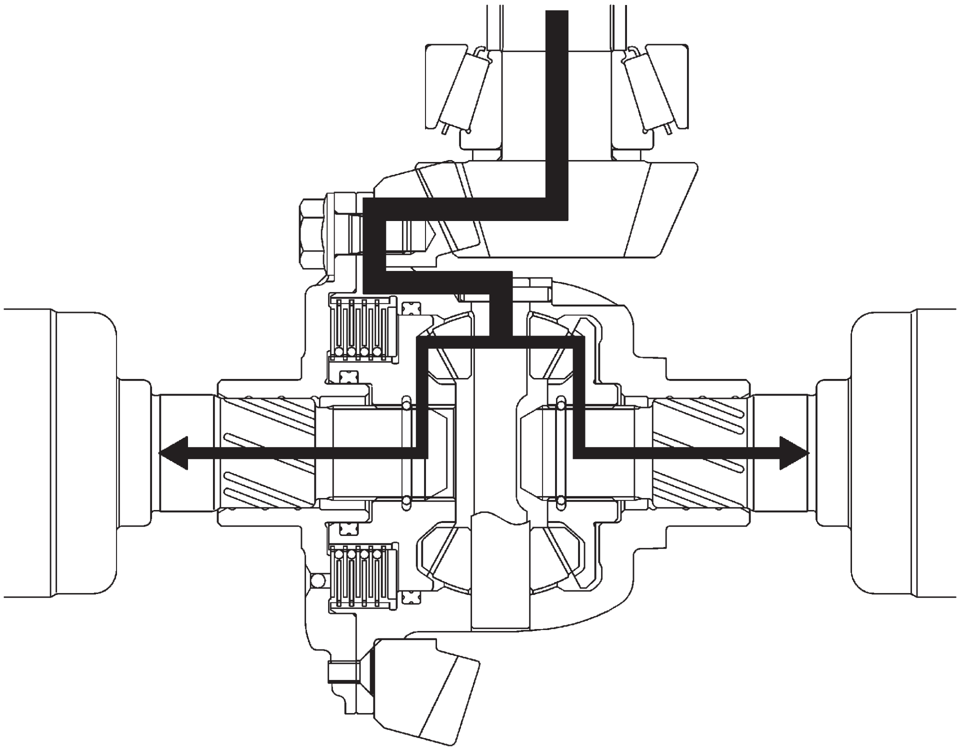
S3H0174B

(1)	Spacer ring	(6)	Pinion gear
(2)	Inner plate	(7)	Side gear (RH)
(3)	Outer plate	(8)	Differential case
(4)	X-ring	(9)	Side gear (LH)
(5)	Pinion shaft	(10)	X-ring

C: OPERATION

1. WHEN RIGHT AND LEFT WHEELS TURN AT EQUAL SPEED.

During normal straight-road driving where the right and left wheels run at an equal speed, the differential case and side gears rotate together, just as in conventional differentials. As a result, driving torque is transmitted equally to the right and left side gears.

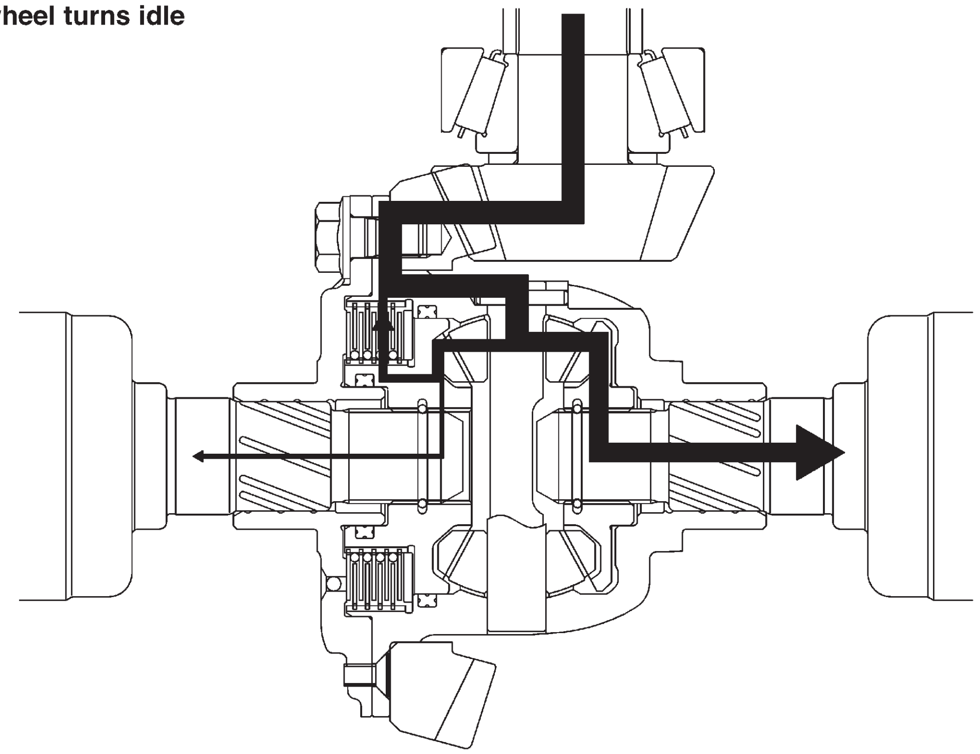


S3H0175

2. WHEN RIGHT AND LEFT WHEELS TURN AT DIFFERENT SPEEDS.

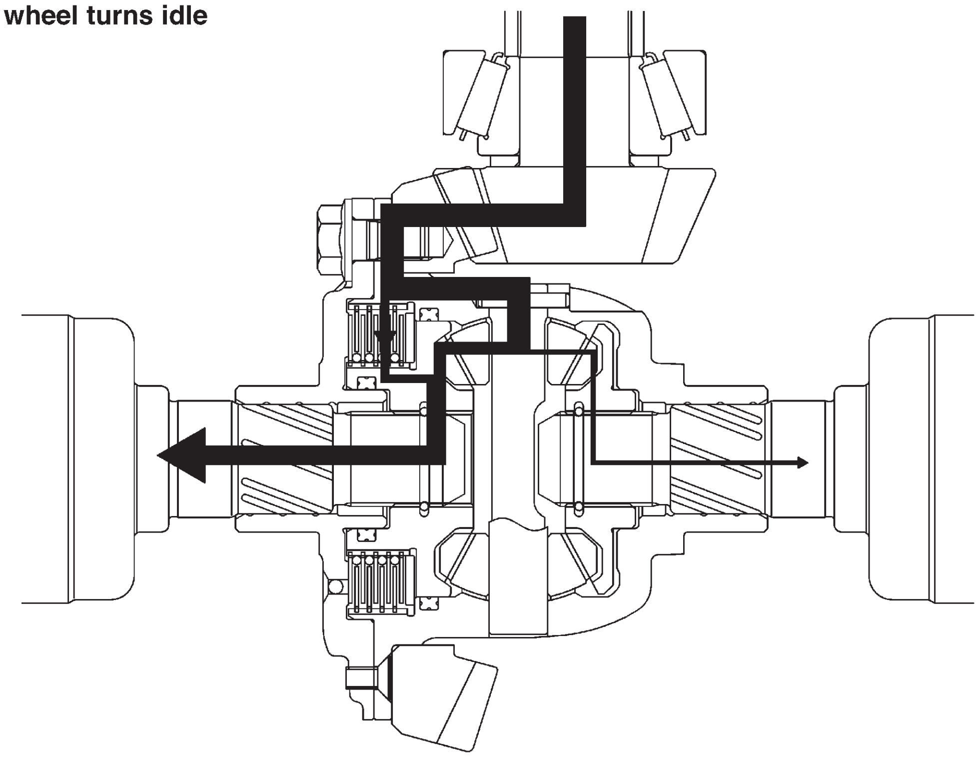
When a speed difference occurs between the right and left wheels, the differential case and V/C side gear (LH) turn relatively at the same speed difference as that between the rear dirve shaft. Because of the shearing force caused in the silicon oil, a differential torque is generated, which controls differential operation (idle rotation). For example, if the left wheel turns idle due to a difference in the road resistance, a speed difference occurs between the right and left wheels. Since the V/C is installed between the right and left wheels, a differential torque is generated in the V/C corresponding to this speed difference, and this differential torque is transferred from the left wheel to the right wheel. Accordingly, a greater driving force is transferred to the right wheel which is rotating at a lower speed.
When the right wheel turns idle (spins), the differential torque is transferred from the right wheel to the left wheel. That is, also in this case, a greater driving force corresponding to the differntial torque is transmitted to the wheel having a lower rotating speed.

When left wheel turns idle



S3H0176A

When right wheel turns idle



S3H0177A

D: SERVICE PROCEDURES FOR LSD

The component parts of LSD assembly are not available as piece parts.

Therefore, it is recommended to not disassemble LSD assembly.

1. Front Suspension

A: OUTLINE

The front suspension is a strut-type independent suspension, with cylindrical double-acting oil damper and coil spring. The top of the strut assembly's is mounted on the body through the cushion rubber, which has resulted in elimination of any vibration by combined use of other rubbers to improve passenger comfort. This type also maintains a wide distance between the upper and lower supporting points and makes adjustment of the caster unnecessary.

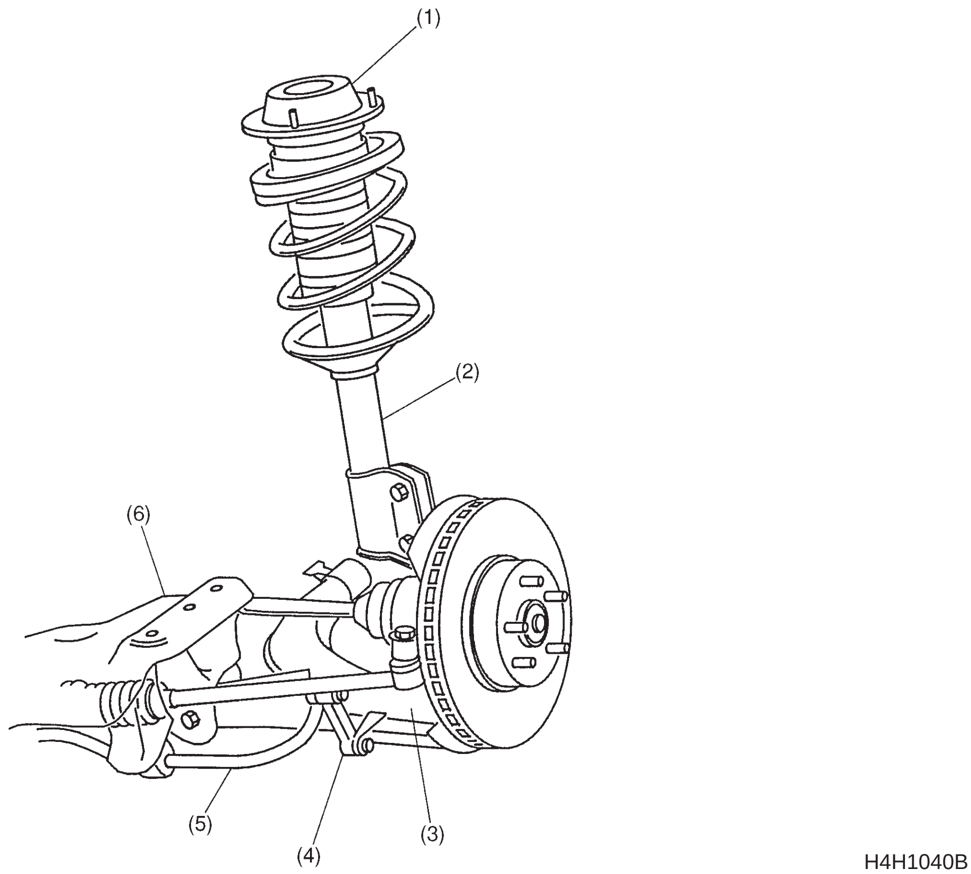
The transverse link utilizes an “L” arm design to increase steering stability and reduce road noise. The transverse link has a maintenance free ball joint with a nut fitting at the outer end, and the inner end front side fitted to the front crossmember through the cushion rubber. The rear side of the inner end is bolted to the vehicle body through a fluid-filled bushing.

The front crossmember is bolted to the vehicle body.

The stabilizer is attached to the front crossmember through the cushion rubbers and its ends are connected to the stabilizer links through the rubber bushings.

The lower end of the stabilizer link is connected to the transverse link through rubber bushings.

A camber angle adjustment mechanism, which uses eccentric bolts, is provided at the joint of the damper strut and housing.



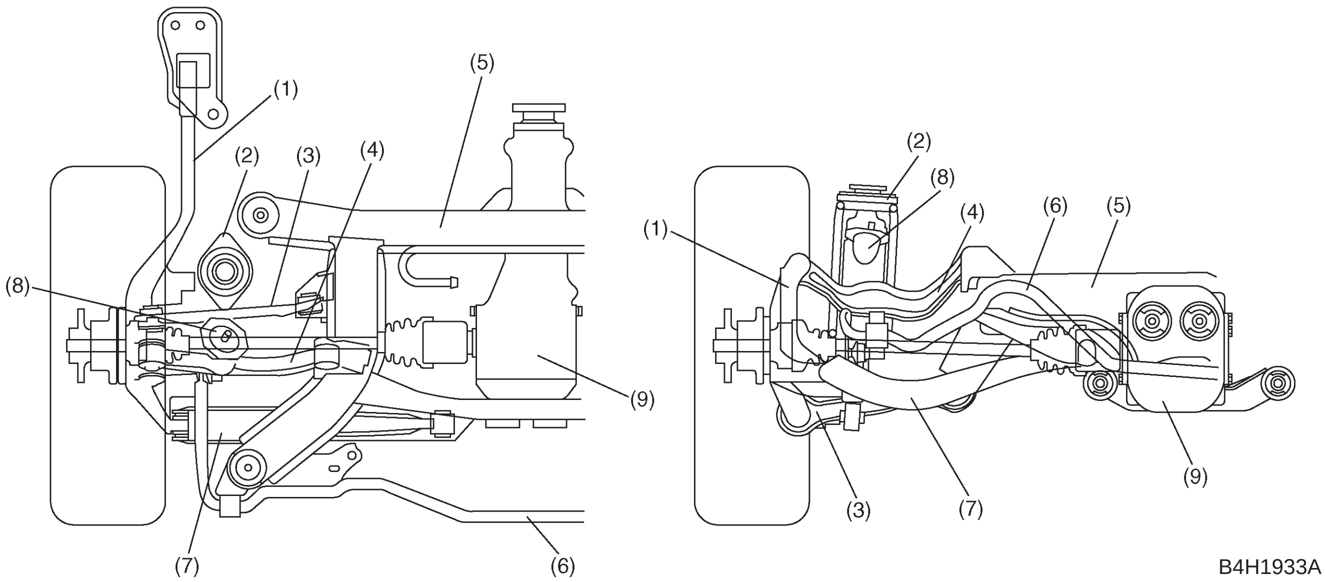
(1) Strut mount	(4) Stabilizer link
(2) Strut	(5) Stabilizer
(3) Transverse link	(6) Front crossmember

2. Rear Suspension

A: OUTLINE

The rear suspension is a multilink type. This type of suspension is characterized by smaller changes in camber and toe-in which are likely affected by the suspension vertical strokes and longitudinal and lateral forces, which allows full use of tire performance and ensures higher kinetic performance and stability of the vehicle.

This suspension is also characterized by quieter operation because of the link front, link rear, link upper and rear differential being attached to the sub frame which in turn is installed to the body through heavy duty bushings.



(1) Rear arm	(4) Link upper	(7) Link rear
(2) Shock absorber and coil spling	(5) Sub frame	(8) Helper
(3) Link front	(6) Stabilizer	(9) Rear differential

Part Name	Feature	Function
Rear arm	Made of cast iron to maintain rigidity.	Supports longitudinal dynamic load.
Link front	Made of sheet metal with U-shaped section to maintain rigidity.	Supports lateral dynamic load.
Link rear	Made of sheet metal with U-shaped section to maintain rigidity.	Supports lateral dynamic load.
Link upper	Made of cast iron to maintain rigidity against impact from helper when suspension is bumped.	Supports lateral dynamic load.
Shock absorber and coil spring	Overall length is maintained shortest possible to eliminate protrusion toward inside the passenger compartment.	Supports and controls vertical dynamic load.
Stabilizer	Ball joint type stabilizer link is used to stabilize transient rolling characteristics of the body.	Controls body rolling.
Helper	Installed to the body independently of shock absorber to avoid its protrusion toward inside the passenger compartment.	Combined with link upper to serve as vehicle bump stopper.
Sub frame	Installed to the body through heavy-duty bushings for quieter operation.	Supports link front, link rear, link upper and rear differential.

MEMO

1. Front Axle

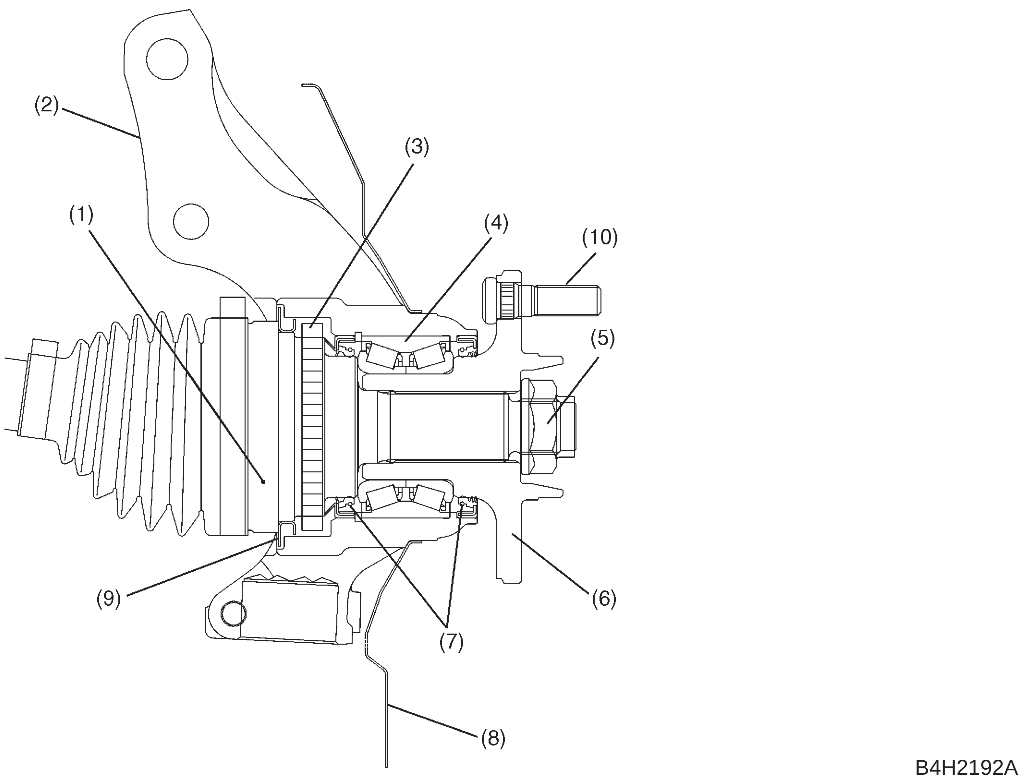
A: GENERAL

● The inboard end of the axle shaft is connected to the transmission via a constant velocity joint (shudder-less freering tripod joint: SFJ) which provides flexible capabilities in the longitudinal direction while the outboard end is supported by taper roller bearings located inside the housing via a bell joint (BJ) which features a large operating angle.
Since the drive shaft employs constant velocity joints, it provides smooth, even rotation of the drive wheels without any vibration.

● The bearing utilizes a preloaded, non-adjustable tapered roller unit design.
The hub is fitted to the tapered roller bearing inside the housing.

● The BJ's spindle is "serration-fitted" to the hub and is clinched to it with axle nuts.

● The disc rotor is an external mounting type. It is secured together with the disc wheel using hub bolts to facilitate maintenance of the disc rotor.

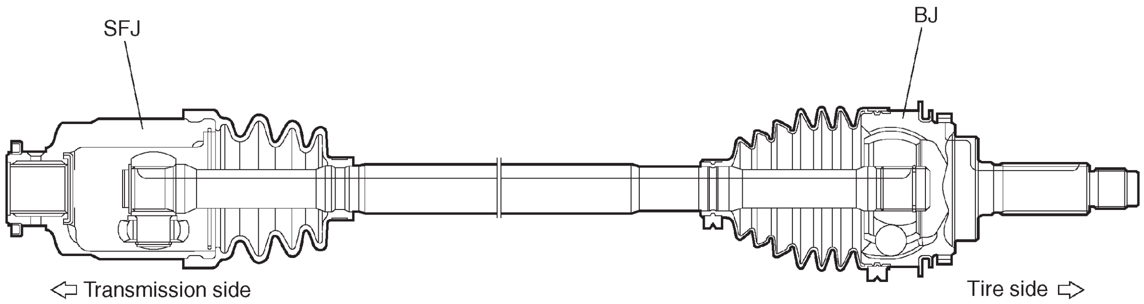


(1)	BJ (Bell Joint)	(5)	Axle nut	(9)	Baffle plate
(2)	Housing	(6)	Hub	(10)	Hub bolt
(3)	Tone wheel	(7)	Oil seal		
(4)	Bearing	(8)	Brake back plate		

B: FRONT DRIVE SHAFT

- The constant-velocity joint on the differential side is a shudder-less freering tripod joint (SFJ) which can be disassembled for maintenance. It provides the maximum operating angle of 25° and can also be moved in the axial direction.
- For the constant-velocity joint on the tire side, the bell joint (BJ) is adopted.

The maximum operating angle of BJ is 47.5°.

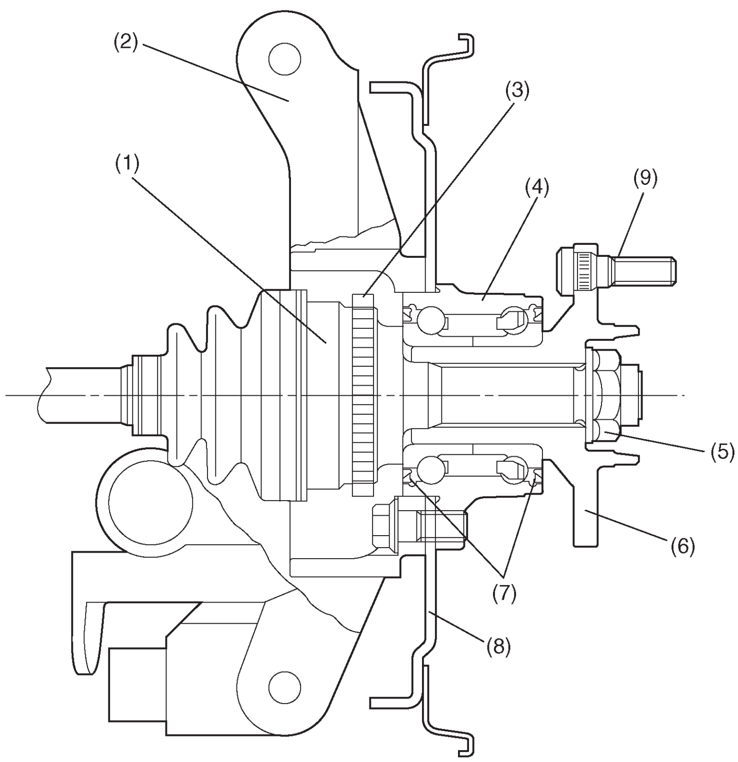


B4H2193A

2. Rear Axle

A: GENERAL

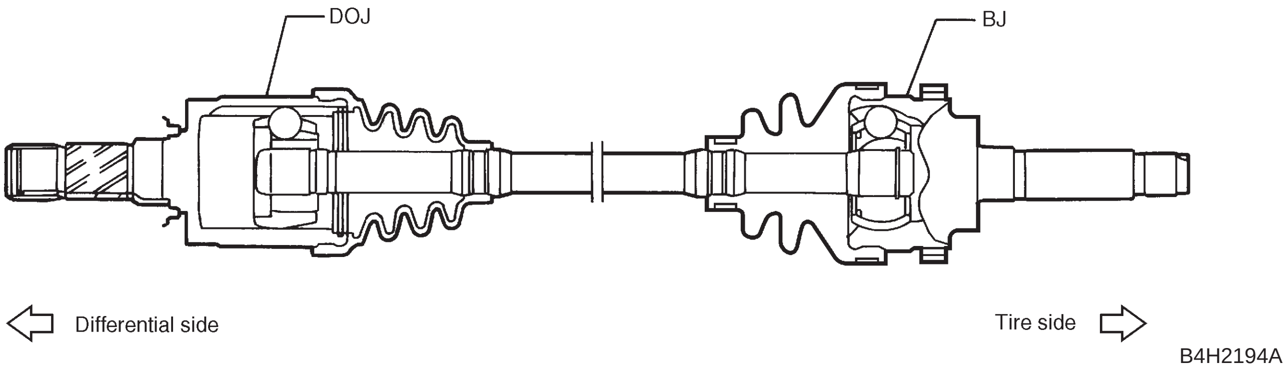
- The inboard end of the axle shaft is connected to the transmission via a constant velocity joint (double offset joint: DOJ) which provides flexible capabilities in the longitudinal direction.
- The outboard end is supported by hub unit bearing via a bell joint (BJ) which features a large operating angle. Since the drive shaft employs constant velocity joints, it provides smooth, even rotation of the drive wheels without any vibration.
- The hub unit bearing is used which has its outer race integrated with a mounting flange.
The hub unit bearing is bolted to the rear arm with brake back plate in between.
The oil seals are incorporated in the bearing.
The bearing is a preloaded, non-adjustable angular contact ball unit type.
- The BJ's spindle is "serration-fitted" to the hub and is clinched to it with axle nuts.
- The disc rotor and drum are an external mounting type. It is secured together with the disc wheel using hub bolts to facilitate maintenance of the disc rotor and drum.



(1) BJ (Bell Joint)
(2) Rear arm
(3) Tone wheel
(4) Hub unit bearing
(5) Axle nut
(6) Hub
(7) Oil seal
(8) Brake back plate
(9) Hub bolt

B: REAR DRIVE SHAFT

- The constant-velocity joint on the differential side is a double offset joint (DOJ) which can be disassembled for maintenance. It provides the maximum operating angle of 23° and can be moved in the axial direction.
- The constant-velocity joint on the tire side is a bell joint (BJ) which provides a maximum operating angle of 42°.

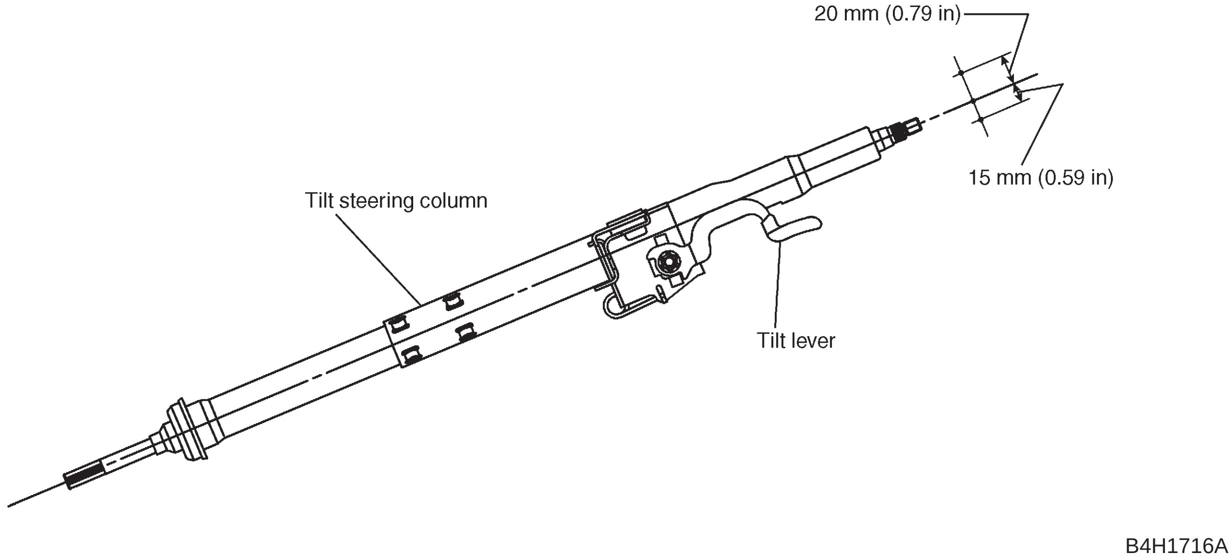


MEMO

1. Tilt Steering Column

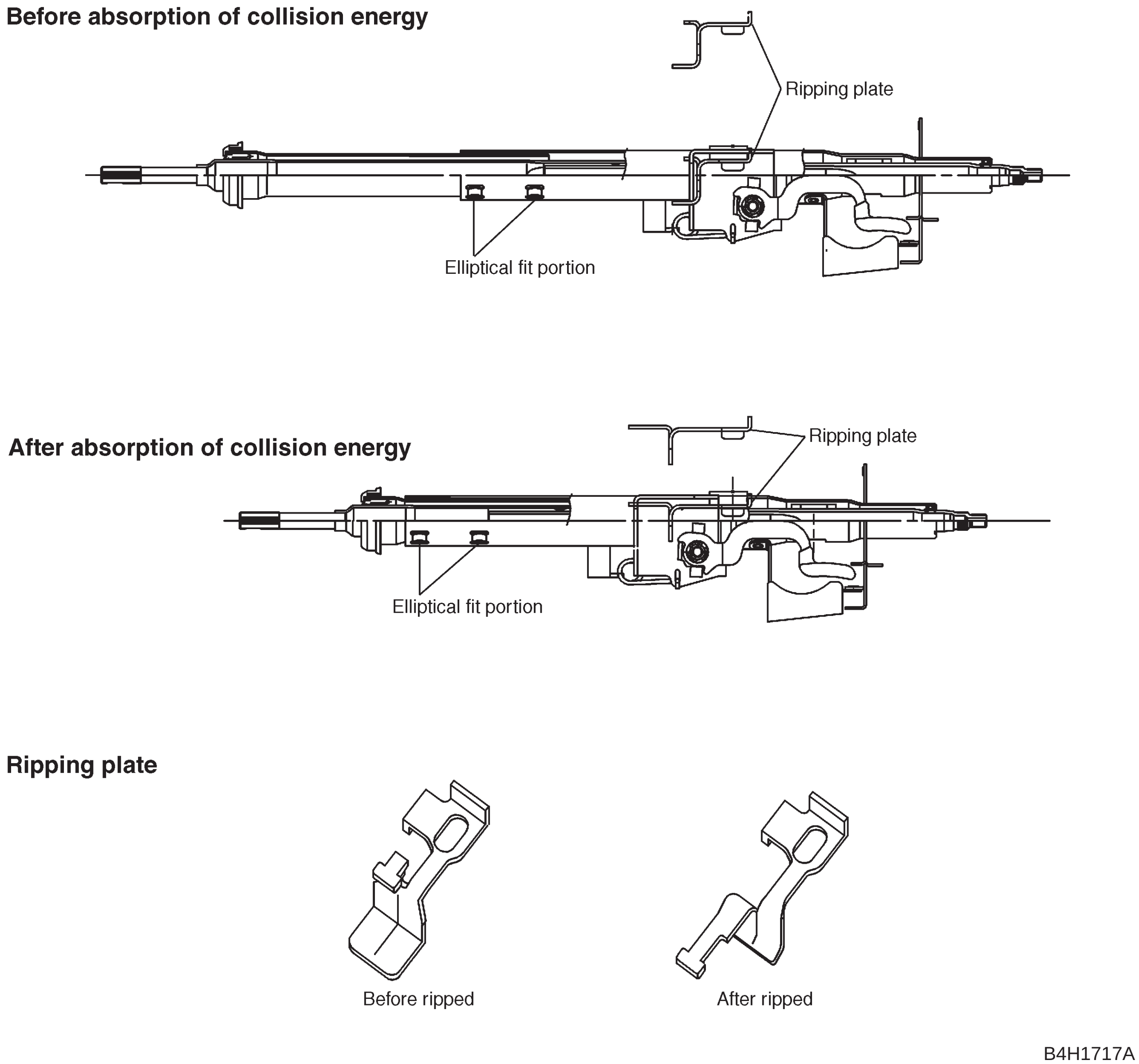
A: TILT MECHANISM

● The steering wheel vertical position can easily be adjusted within 35 mm (1.38 in) range, by using the tilt lever to release the steering column and locking it at the desired position.



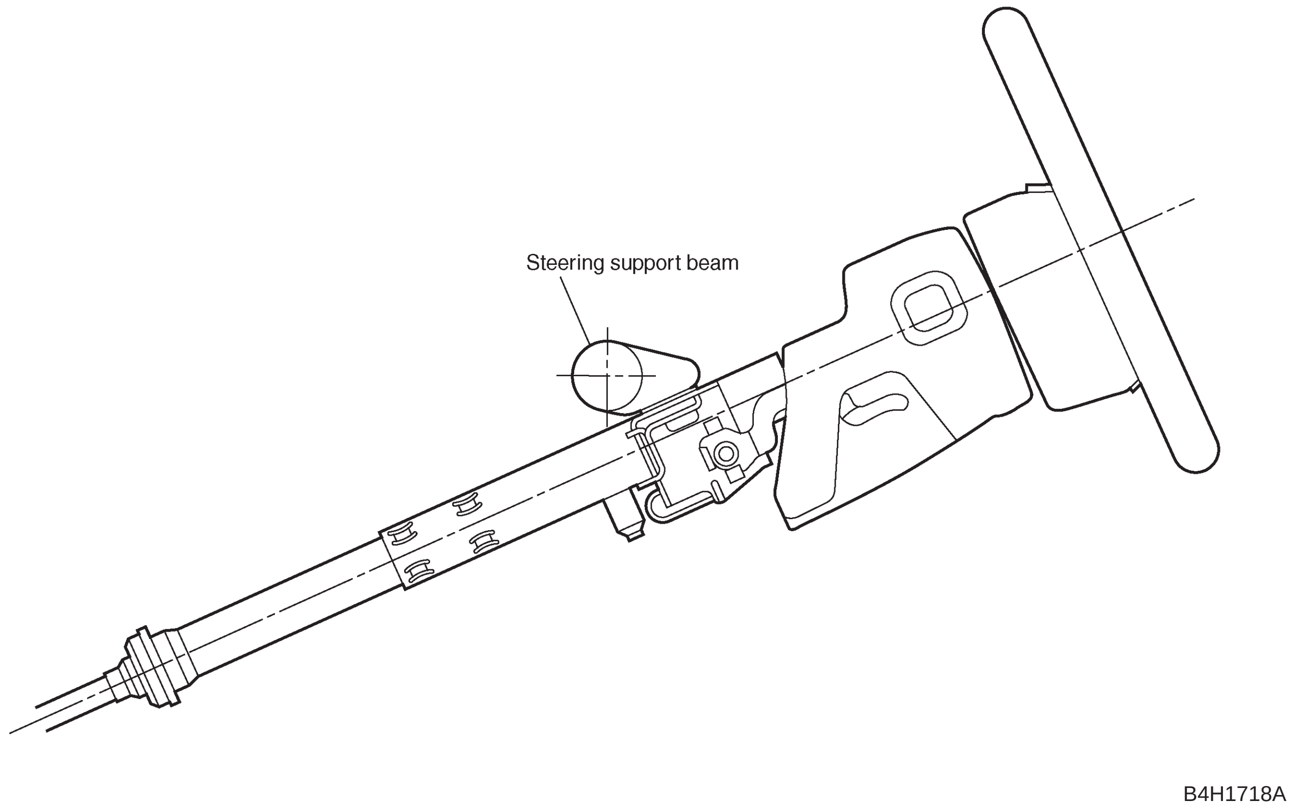
B: ENERGY-ABSORBING MECHANISM

- To absorb the engine backward energy in the event of a collision, an elliptical fit type column pipe has been adopted. The energy is absorbed by collapse of the elliptical fit portions as their surfaces come in contact with each other and receive the bend load.
- To absorb the energy of shock on the drive in the event of a collision, an ripping plate has been adopted between the tilt bracket to be secured to the steering support beam and the column. The ripping plate is deformed as it is ripped, and continues to stably absorb the energy.



C: STEERING SUPPORT BEAM

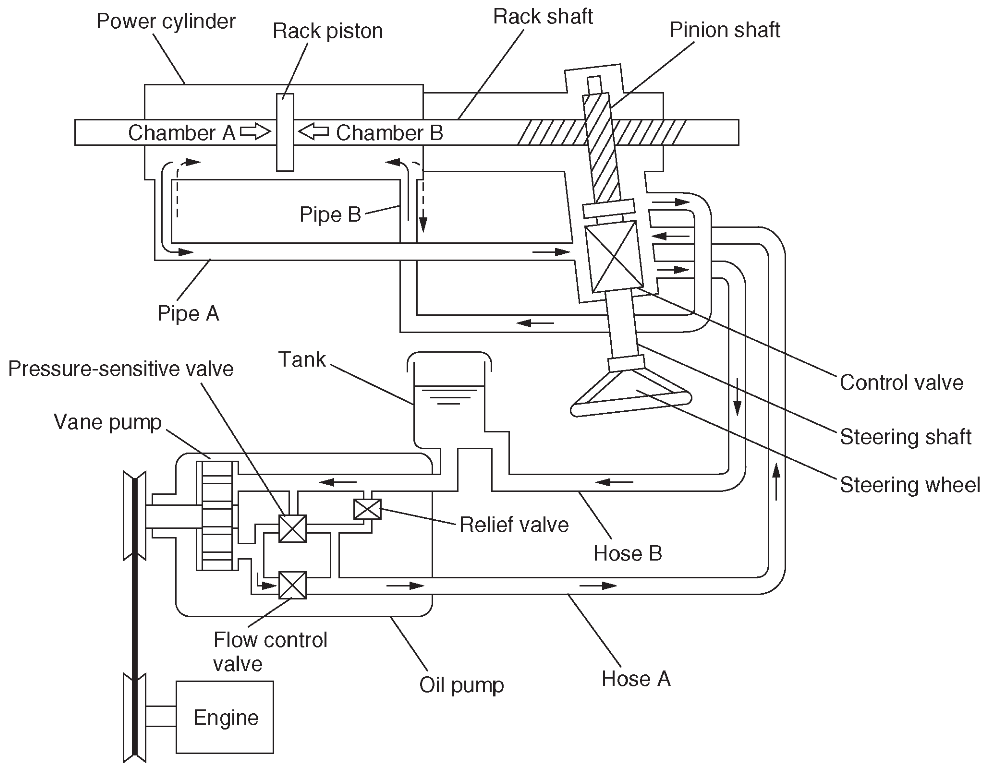
The steering column is held by a support beam located close to the steering wheel to reduce the overhang. The upper bearing is also located close to the steering wheel to increase supporting rigidity, as well as to reduce the problem of a shaking or shimmying wheel.



2. Power Steering System

A: HYDRAULIC SYSTEM

- Oil pump is belt-driven from the engine to discharge oil under pressure.
- When the steering wheel is not being turned, the pressure-sensitive valve operates to drain oil, relieving the pressure in the pump.
- Oil under pressure is controlled by the oil pump in response to engine speed and is delivered to control valve via hose A.
- When the steering wheel is turned, control valve connected to the pinion shaft activates to form an oil flow circuit corresponding to the rotation direction of the steering wheel. Oil will then be delivered to chamber A or B via pipe A or B.
- Oil in chamber A or B acts on rack piston to produce the force required to move rack shaft to the left or the right. This helps reduce the effort required to operate the steering wheel.
- Movement of rack piston in turn causes oil in the other chamber to return to tank via pipe A or B, control valve and hose B.
  - If the hydraulic system becomes inoperative, the steering shaft will then be connected to the pinion shaft mechanically via control valve. Thus, the steering shaft can act as one similar to a manual steering system to move the rack and pinion.
  - To control the maximum oil pressure setting, relief valve is built into the oil pump to release excess oil pressure.



B4H1719A

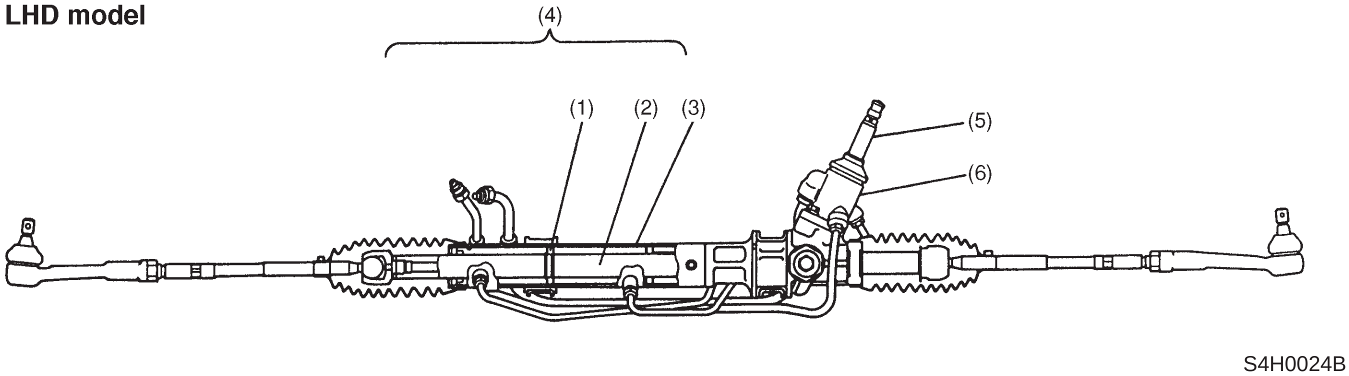
B: GEARBOX ASSEMBLY

1. POWER CYLINDER

The gearbox is integrated with a built-in control valve and power cylinder. The rack shaft is used as a power cylinder piston and a rotary control valve is located in such a manner as to enclose the pinion shaft.

The control valve and power cylinder are connected to each other by two pipes through which hydraulic oil flows.

LHD model



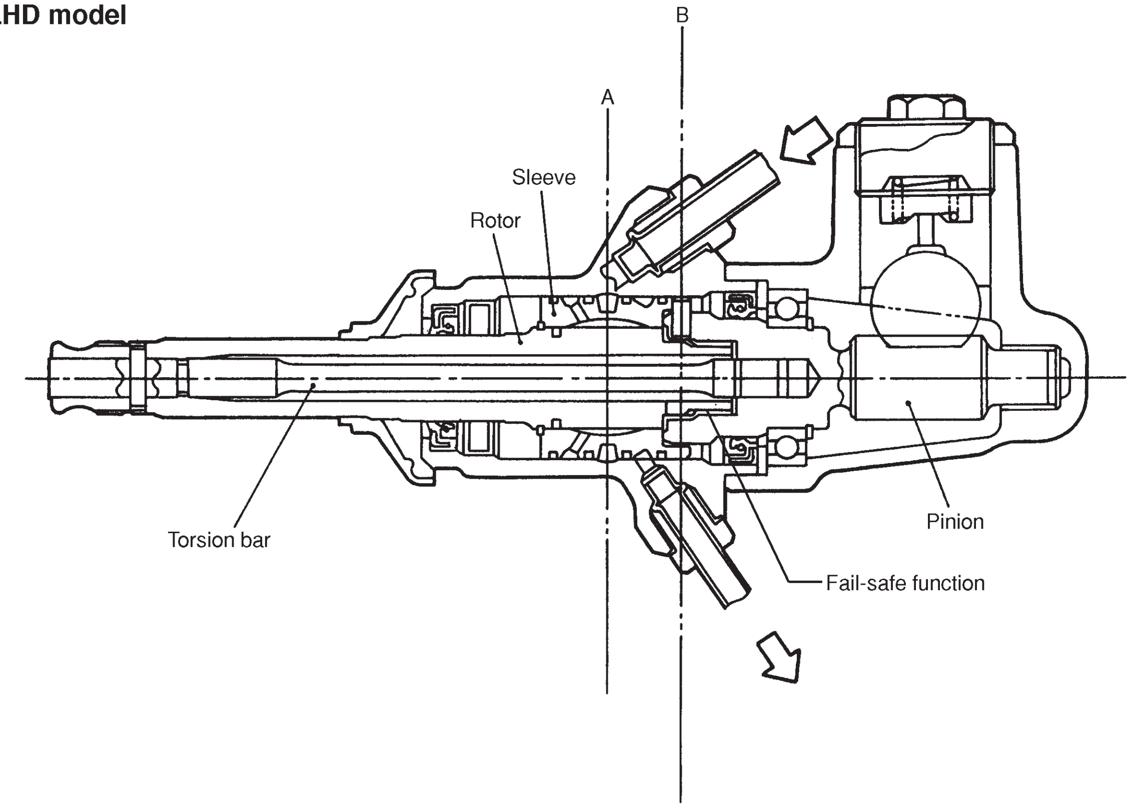
(1) Piston
(2) Rack shaft
(3) Cylinder
(4) Power cylinder
(5) Pinion shaft
(6) Control valve

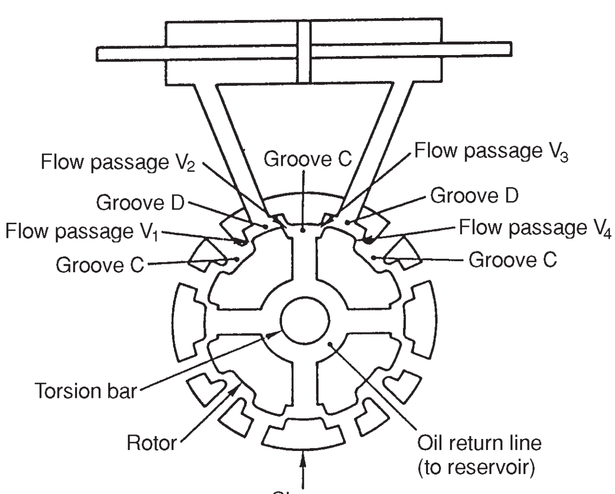
2. CONTROL VALVE

The control valve consists of a rotor (which rotates together with the steering shaft), a pinion (which is connected to the rotor and torsion bar), and a sleeve (which rotates together with the pinion). Oil grooves C and D are located in the rotor and sleeve to form oil flow passages V_1 through V_4.

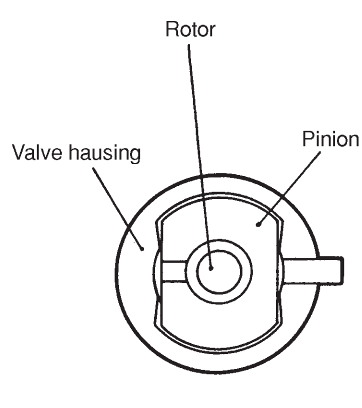
The pinion and rotor are meshed with adequate clearance. They utilize a fail-safe design.

LHD model





Cross-section view A of oil passage switching circuit



Fail-safe function
Cross-section view B

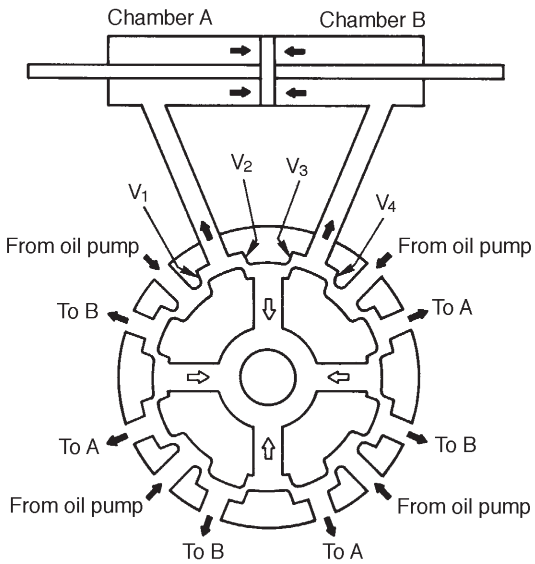
S4H0025B

● Operating principle

When the torsion bar twists in relation to the steering force, a relative rotational displacement occurs between the rotor and sleeve. This displacement changes the cross-sectional area of oil passages V_1, V_2, V_3 and V_4, which in turn switches oil passages and controls oil pressure.

- ● When no steering force is applied:
  The rotor and sleeve are held at the neutral position. Oil passages V_1, V_2 and V_3, which are formed by valve grooves C and D are open equally. Under this condition, oil delivered from the oil pump returns to the oil reservoir so that neither oil pressure builds up nor does the power cylinder activate.

LHD model



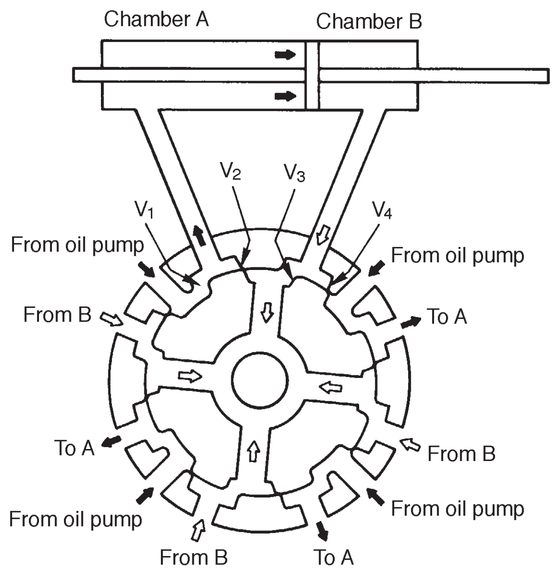
When no steering force is applied.

G4H0011

- When steering force is applied:

When the steering wheel is turned to the right, for example, oil passages V_1 and V_3 open while oil passages V_2 and V_4 nearly close.
At this point, oil under pressure in chamber A increases in response to the throttle position of oil passages V_2 and V_4 so that the rack piston moves to the right. Oil in chamber B, on the other hand, is discharged through oil passage V_3 returning to the oil reservoir.

LHD model



When steering force is applied.

G4H0012

- Fail-safe function

If oil pressure fails to build up due to a broken oil pump drive belt, torque is transmitted from the valve rotor to the pinion by way of the fail-safe function.

C: OIL PUMP & TANK

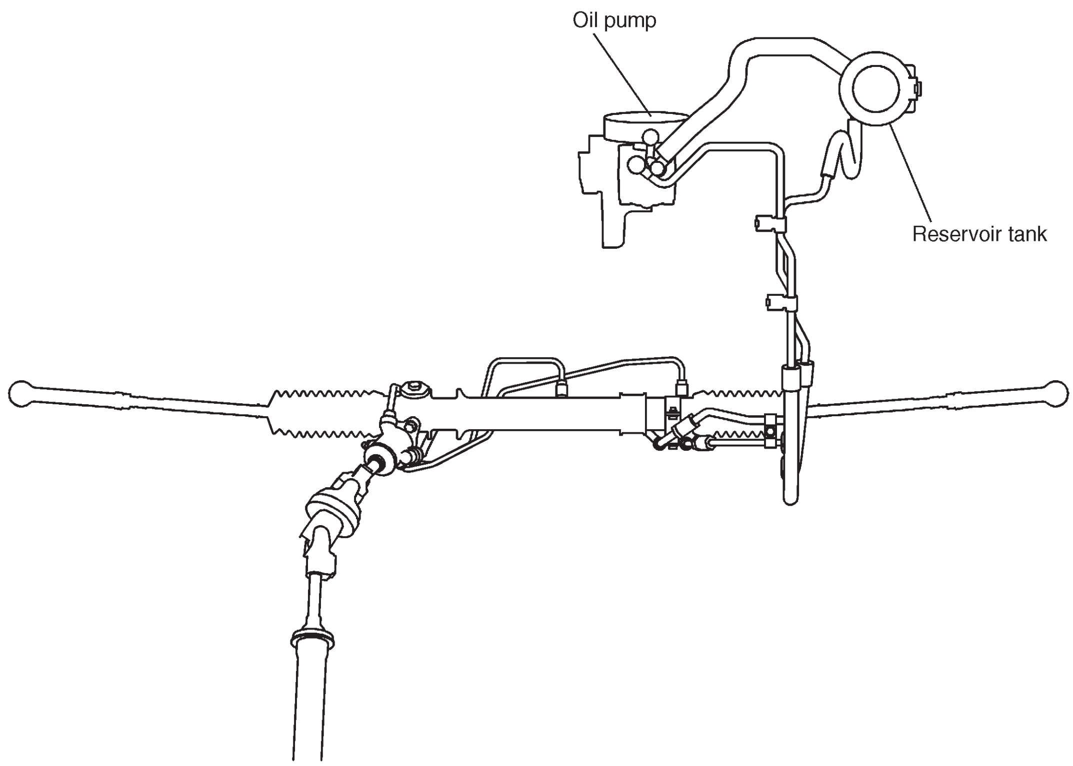
The oil pump is belt-driven from the engine.

The reservoir tank is mounted on the body.

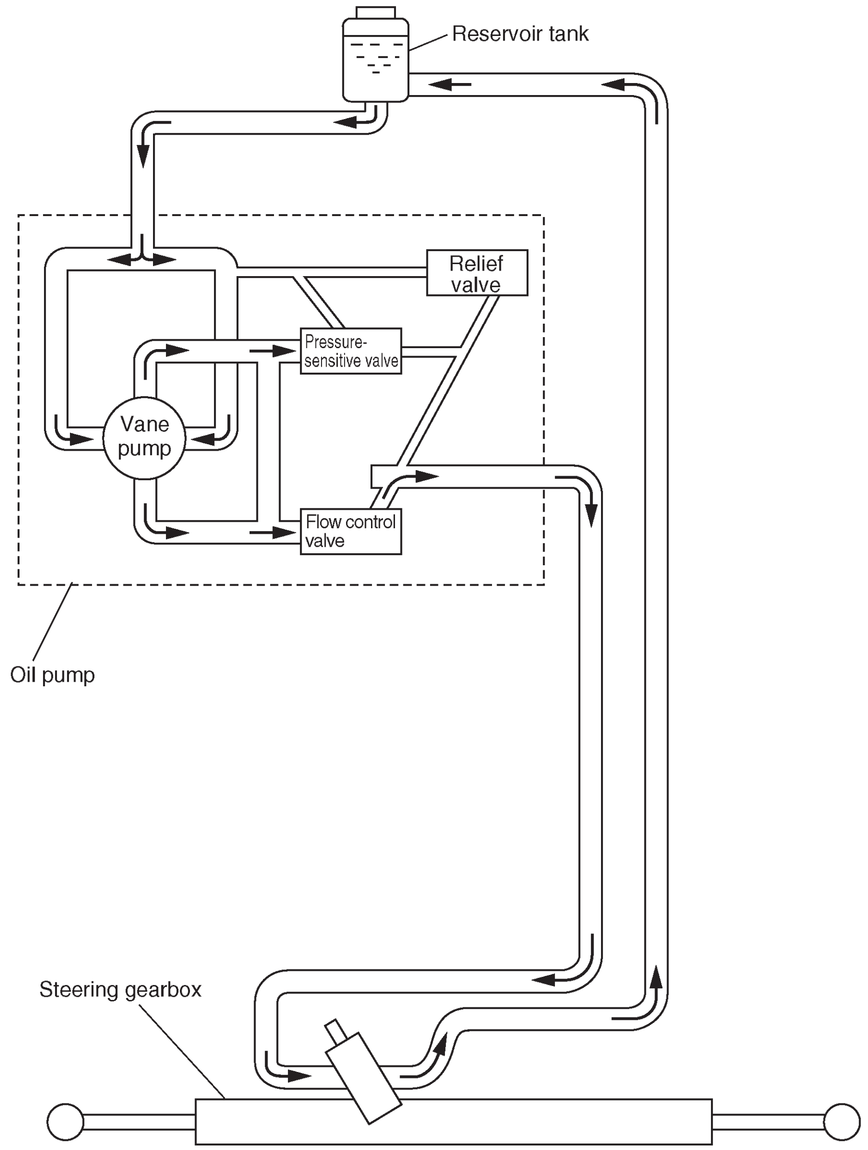
The oil pump is the vane type.

The oil pump incorporates the flow control valve, pressure-sensitive valve, and relief valve that control the flow rate and pressure of the oil.

- The flow control valve controls the flow rate of discharged oil corresponding to an engine speed.
- The pressure-sensitive valve helps to decrease the pressure in the pump when the steering wheel is not being turned.
- The relief valve relieves the pressure when the pressure in the system becomes too high such as when the steering wheel is turned all the way.



B4H1720A

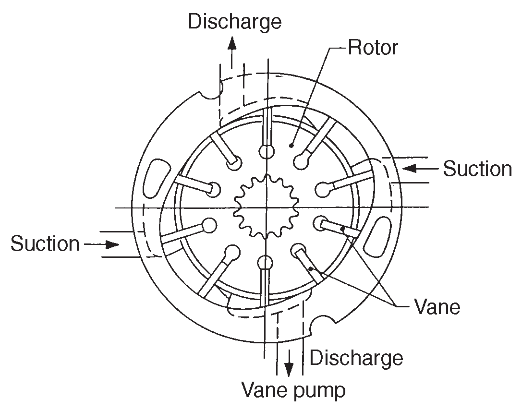

Reservoir tank
Relief valve
Pressure-sensitive valve
Vane pump
Flow control valve
Oil pump
Steering gearbox

B4H1764A

1. VANE PUMP

The vane pump consists of a rotor, cam rings, and ten vanes.

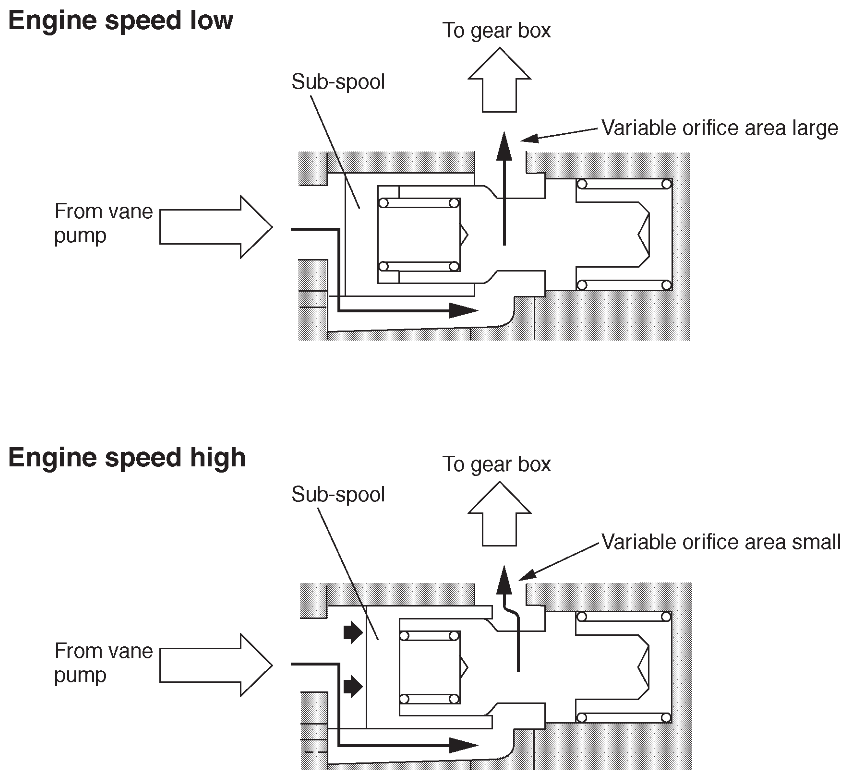
When the rotor rotates, the vane located in each groove of the rotor is radially swung out by centrifugal force and pressed against the cam ring. The tip of the vane slides along the inner oval wall of the cam ring so that oil is delivered to the chamber formed by the rotor, cam ring and vane by way of a pea-shaped groove. Oil from the chamber is discharged into the oil circuit via the discharge port.



H4H1188B

2. FLOW CONTROL VALVE

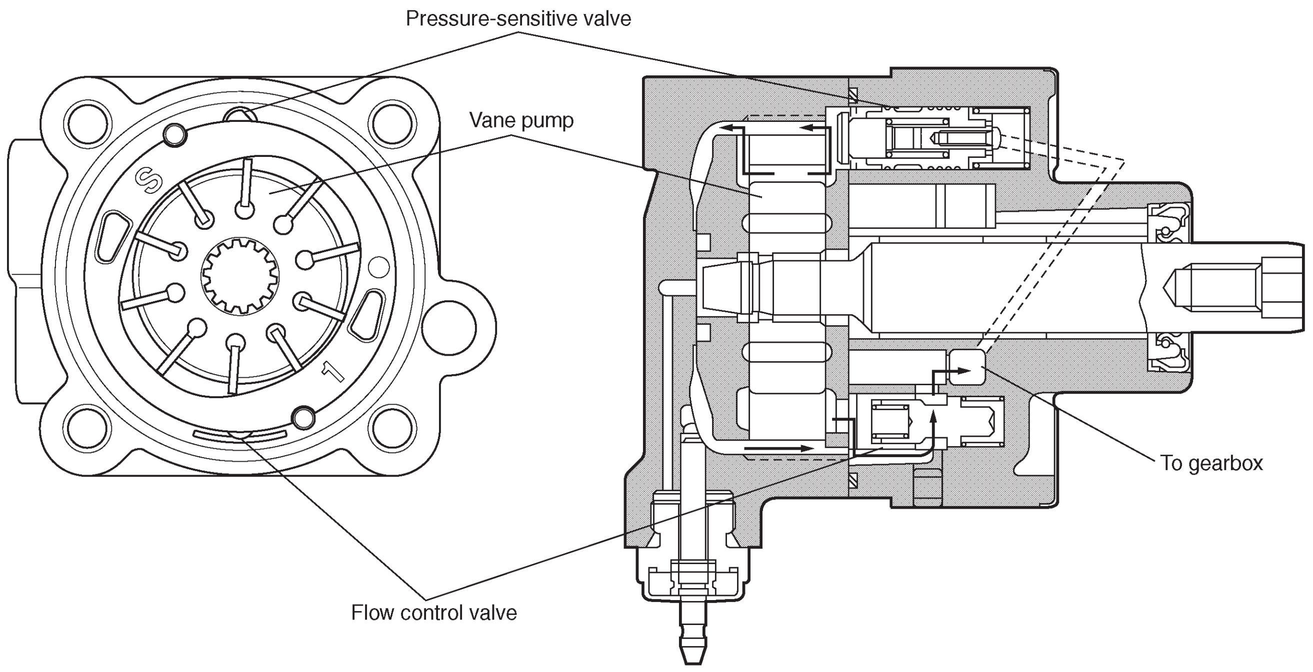
● The flow control valve consists of a sub-spool which is pushed to the right by the fluid pressure as the pump discharge rate becomes higher with the engine speed increase. When the sub-spool is shifted to the right, some area of the variable orifice is covered by the spool, thus the discharge rate being reduced.



B4H1721A

3. PRESSURE-SENSITIVE VALVE

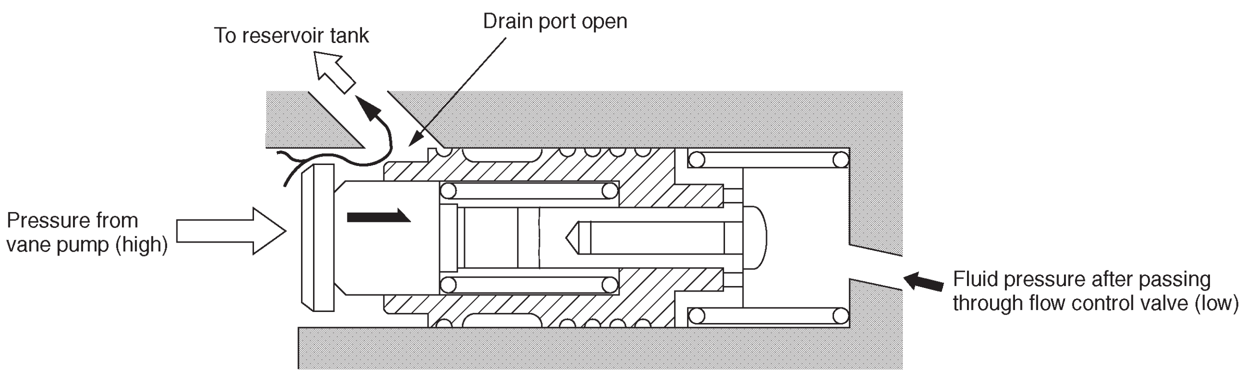
● The pressure-sensitive valve is exposed on its left end directly to the vane pump discharge pressure and on its right end to the fluid pressure which has just passed through the flow control valve and will be led to the gear box.



B4H1722A

● When the steering wheel is not being turned, the fluid which has passed through the flow control valve is led to the gear box but returned to the reservoir tank without acting on the control valve in the gear box. Accordingly, the pressure does not build up.

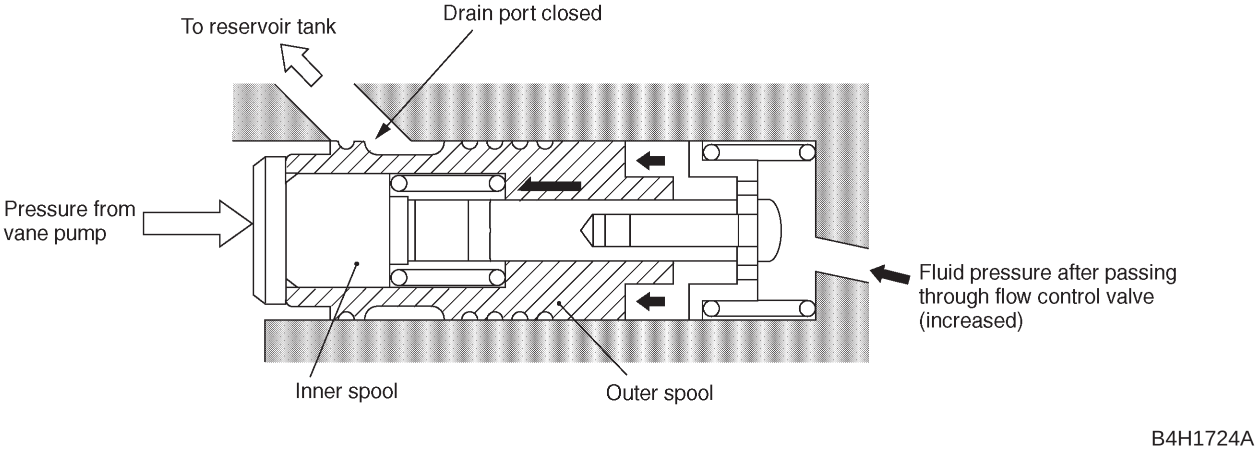
For this reason, the vane pump discharge pressure acting on the left end of the pressure-sensitive valve assembly is higher than the pressure acting on the right end (the pressure just having passed through the flow control valve). This causes the pressure-sensitive valve assembly to move to the right. Accordingly, the drain port which has been closed by the outer spool is opened, the pressure inside the pump thereby being reduced.



B4H1723A

● When the steering wheel is turned, the fluid which has passed through the flow control valve and flown into the steering gear builds up its pressure, because it is used as a power source assisting the steering effort.

The inner spool of the pressure-sensitive valve assembly is kept pressed to the right by the vane pump discharge pressure acting on its left end. In this condition, as the fluid pressure acting on the right end is increased by the steering operation, the outer spool is moved to the left, closing the drain port. Therefore, the pump internal pressure is increased, and a higher pressure required for assisting the steering effort is supplied to the gear box.

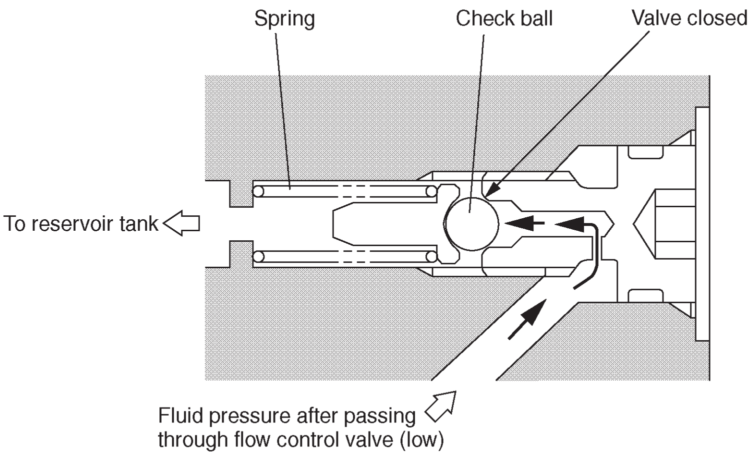


4. RELIEF VALVE

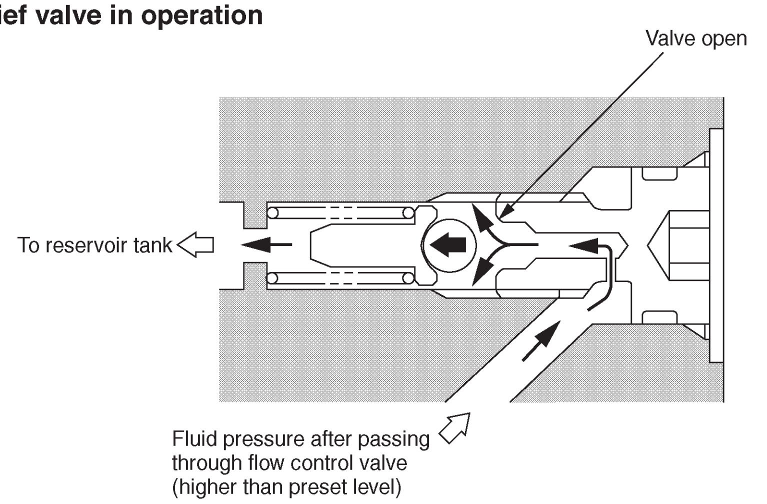
The relief valve is composed of a check ball and a tension spring. The check ball is exposed, on the right side, to the fluid pressure regulated by the flow control valve (fluid pressure supplied to the steering gear box). At the left side, it is subjected to the spring tension and normally closes the passage for the said fluid pressure.

If the pressure in that passage is increased abnormally high for some reason (for example, the steering wheel has been fully turned to its stopper) and overcomes the spring tension, the ball is pushed to the left, and the oil is drained into the reservoir tank, thus the pressure in the passage being relieved.

Relief valve not in operation



Relief valve in operation

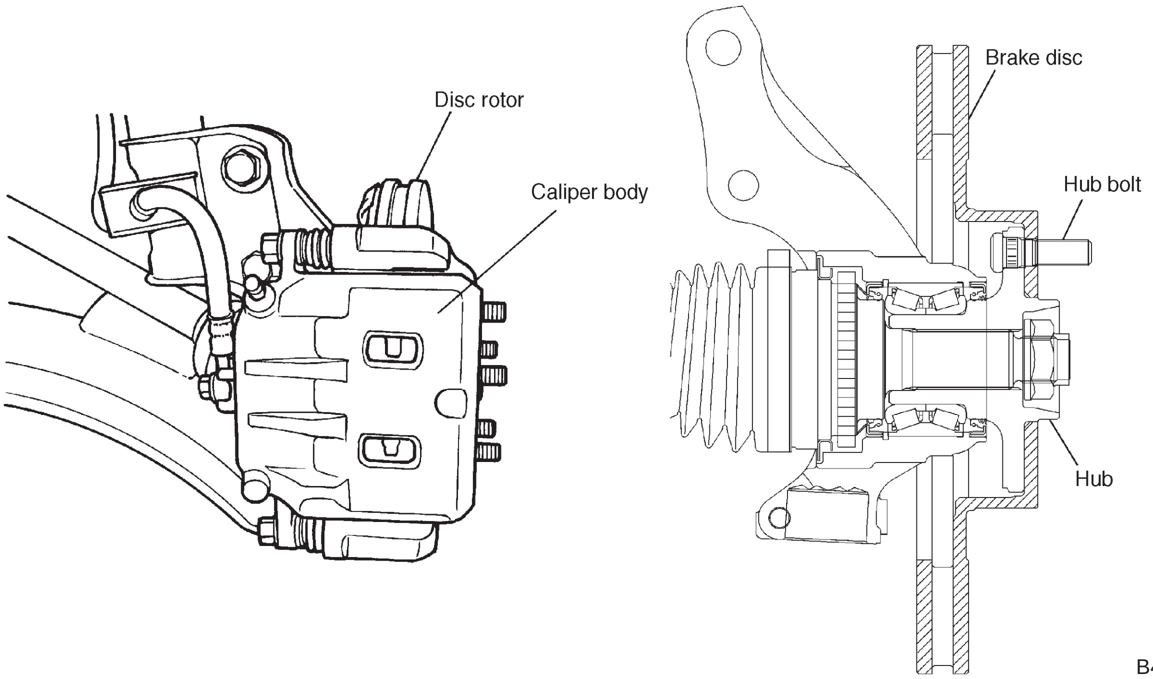


B4H1778A

MEMO

1. Disc Brake

- The front brakes are ventilated disc types which feature high heat dissipation and superb braking stability. In addition, the front brake quickly restores the original braking performance even when wet.
- The brake disc, which is externally mounted, is secured together with the disc wheel using the hub bolts, to facilitate removal or installation when servicing the vehicle.
- The inner brake pad is provided with an indicator which indicates pad wear limits.

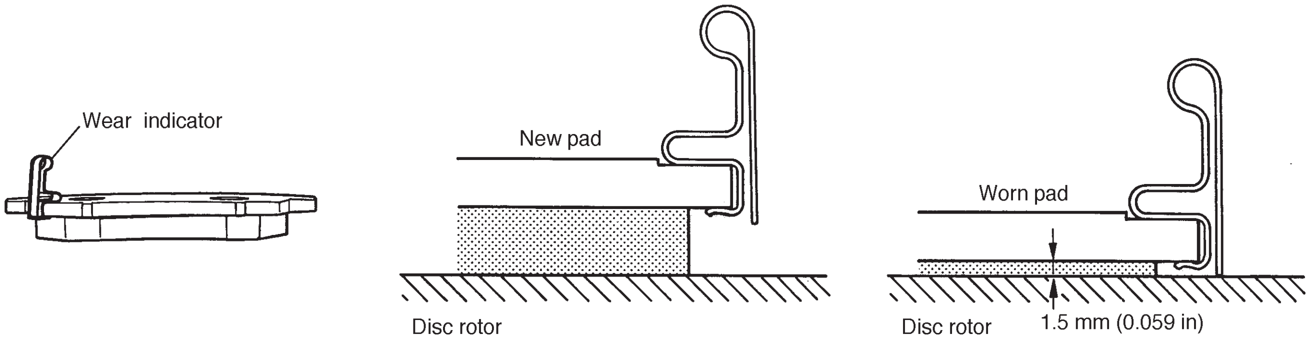


B4H2195A

A: PAD WEAR INDICATOR

A wear indicator is provided on the inner disc brake pads. When the pad wears down to 1.5 mm (0.059 in) the tip of the wear indicator comes into contact with the disc rotor, and makes a squeaking sound as the wheel rotates.

This indicates that the pad needs to be replaced.



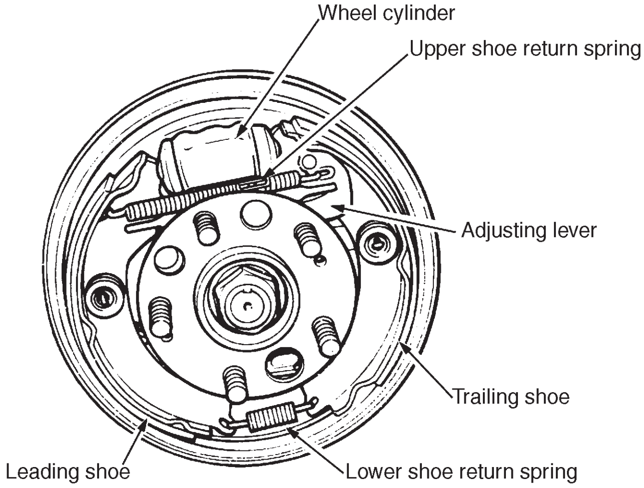
H4H1056A

B: FRICTIONAL MATERIAL OF BRAKE PADS

Frictional brake pad materials do not contain asbestos and are not harmful.

2. Rear Drum Brake

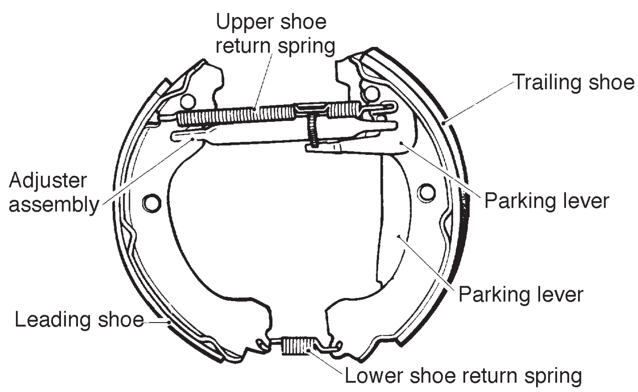
- The drum brake is a leading-trailing type. When fluid pressure is applied to the wheel cylinder, the piston moves to expand the leading and trailing shoes while the lower shoe return spring joint acts as a pivot. Thus, the shoes come in contact with the inner surface of the drum, producing braking action.
- When brakes are applied during the forward movement, the tip of the brake leading shoe lining is pressed against the inner surface of the drum so as to oppose the drum direction. This increases the braking force. The trailing shoe, however, undergoes a force that pushes back so that braking force applied to the trailing shoe decreases.
The above shoe operation is reversed while the vehicle is backing up, with the braking force exerted on the trailing shoe greater than that on the leading shoe. It follows that there is no difference in braking force between the directions in which the vehicle moves.
- An inspection hole with a rubber cap is provided in the back plate for easier inspection of the wear of the linings.



B4H1628A

A: AUTOMATIC ADJUSTER

The brake lining-to-drum clearance is automatically compensated for by the automatic adjuster. When the brake shoe is contracting after expansion, the adjuster lever rotates the adjuster assembly's screw to lengthen adjuster assembly so that the clearance is maintained at the specified value.

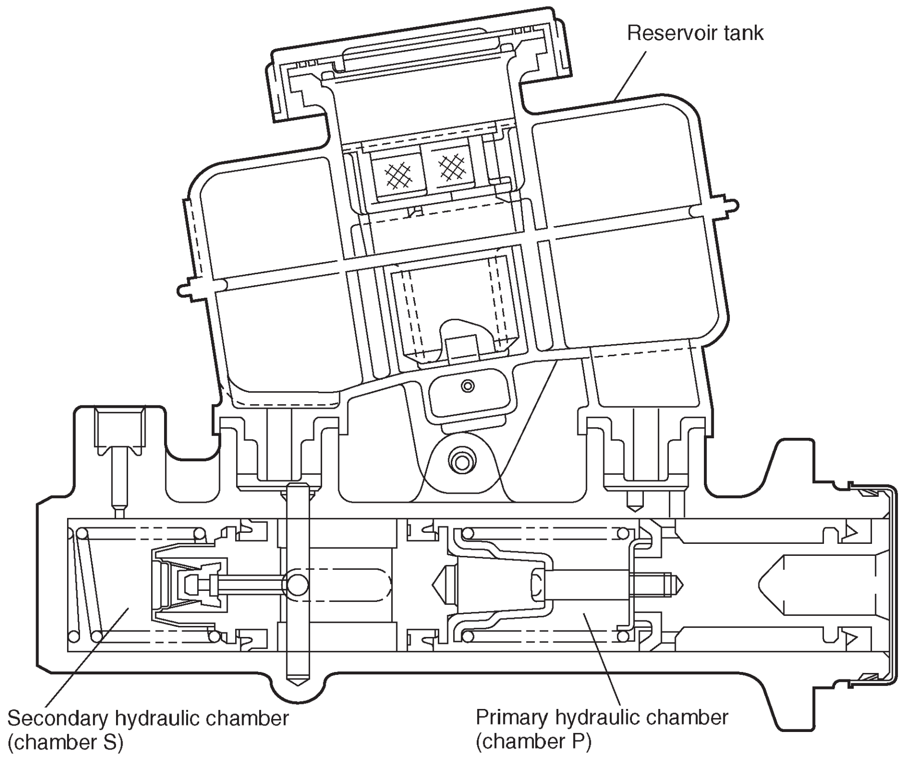


G4H0035

3. Master Cylinder

● A sealed reservoir tank is adopted to extend the service life of the brake fluid.

● The fluid level indicator is built into the reservoir tank for easy and correct monitoring of the fluid level when adding brake fluid.

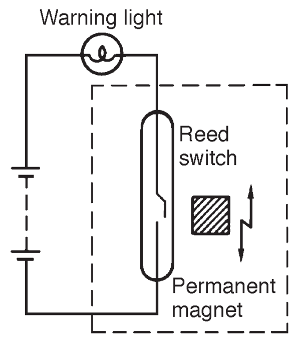


B4H1934B

A: BRAKE FLUID LEVEL INDICATOR

Under normal conditions, the float remains above the reed switch, and the magnetic force from the permanent magnet in the float is unable to activate it. Therefore, the circuit is kept open, and the warning light remains off. The float lowers as the brake fluid level lowers, and if it falls below the specified fluid level [approx. 30 mm (1.18 in) below the MAX level line], the reed switch will be activated by the permanent magnet, closing the circuit. In this event, the warning light comes on and warns the driver of a reduction of the brake fluid level.

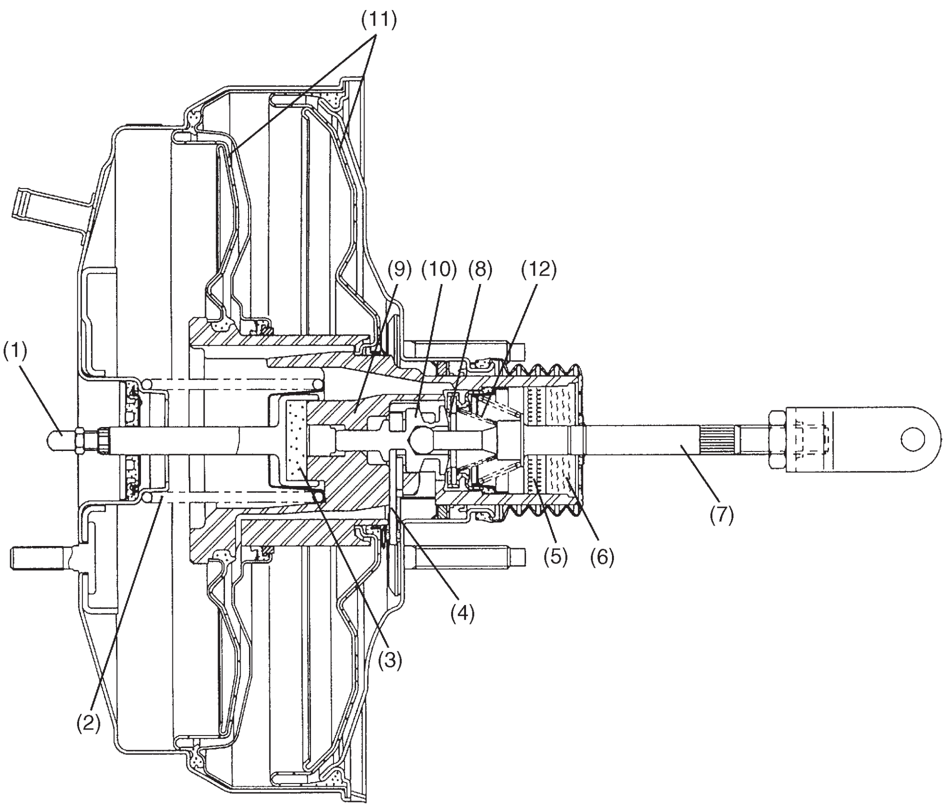
However, the warning light may be lighted momentarily even when the brake fluid surface is still above the specified level, if the vehicle body tilts or swings largely.



G4H0038

4. Brake Booster

The brake booster is a tandem type that utilizes two small diameter diaphragms to provide high brake boosting effects.

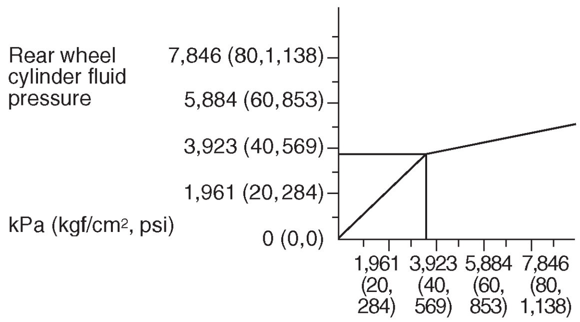


B4H1936A

(1)	Push rod	(5)	Filter	(9)	Valve body
(2)	Return spring	(6)	Silencer	(10)	Plunger valve
(3)	Reaction disc	(7)	Operating rod	(11)	Diaphragm plate
(4)	Key	(8)	Poppet valve	(12)	Valve return spring

5. Proportioning Valve

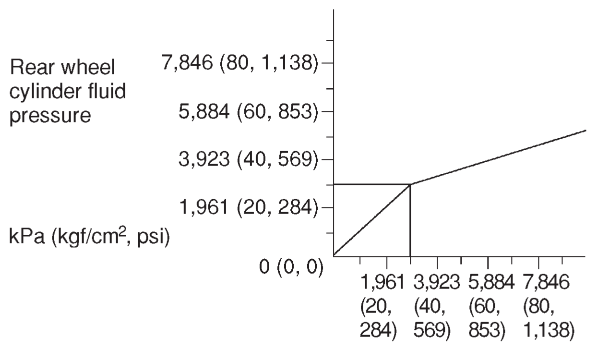
Rear drum brake model



Master cylinder fluid pressure kPa (kgf/cm^2, psi)
In case of split point 3,677kPa (37.5 kgf/cm^2,533 psi)

B4H2221A

Rear disc brake model



Master cylinder fluid pressure kPa (kgf/cm^2, psi)
In case of split point 2,942 kPa (30 kgf/cm^2, 427 psi)

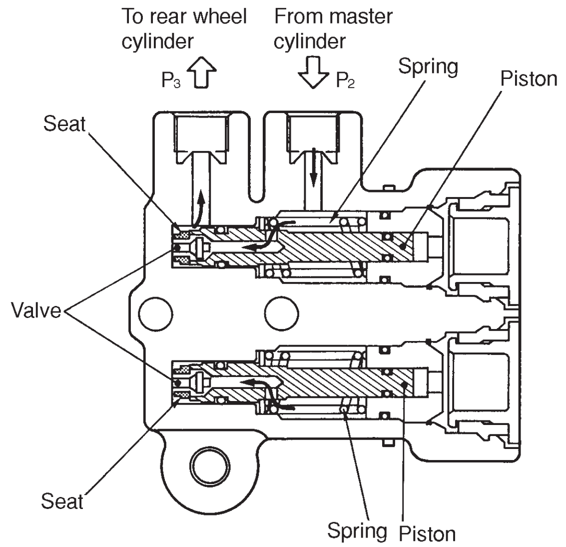
B4H1942A

A: OPERATION

1) Operation before the split point

Piston is held by spring so that valve is kept away from valve seat.

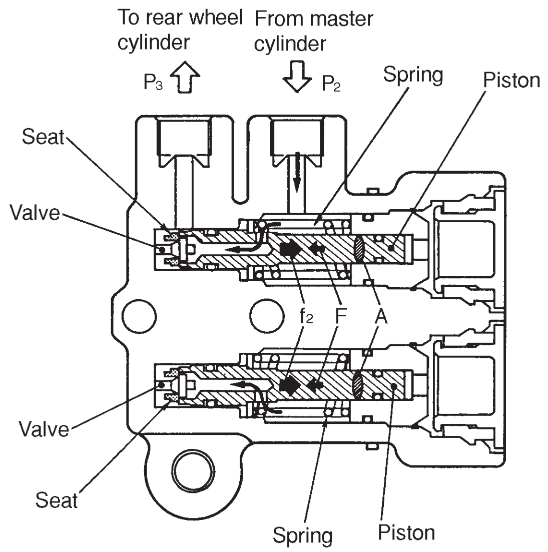
Under this condition, fluid pressure “P_3” to rear wheel cylinders equals fluid pressure “P_2” from master cylinder.



H4H1127B

2) Operation near the split point

- Force “f_1”, applied to piston by spring, is one-half of spring force “F”. In other words, “f_1” = “F”.
- Force “f_2” is also applied to piston in the direction opposite to spring force “F” due to fluid pressure “P_2” generated by master cylinder according to cross sectional area “A”.
- Force “f_2” increases respondingly with fluid pressure “P_2”. When “f_2” is greater than, piston moves in direction opposite to spring force “F”. This causes valve to come in contact with valve seat, blocking fluid passage.



H4H1128B

3) Immediately before fluid passage is closed, fluid pressure “P_2” is held equal to pressure “P_3”. When brake pedal is depressed to increase fluid pressure “P_2”, piston moves in the same direction as spring force “F”, opening fluid passage.

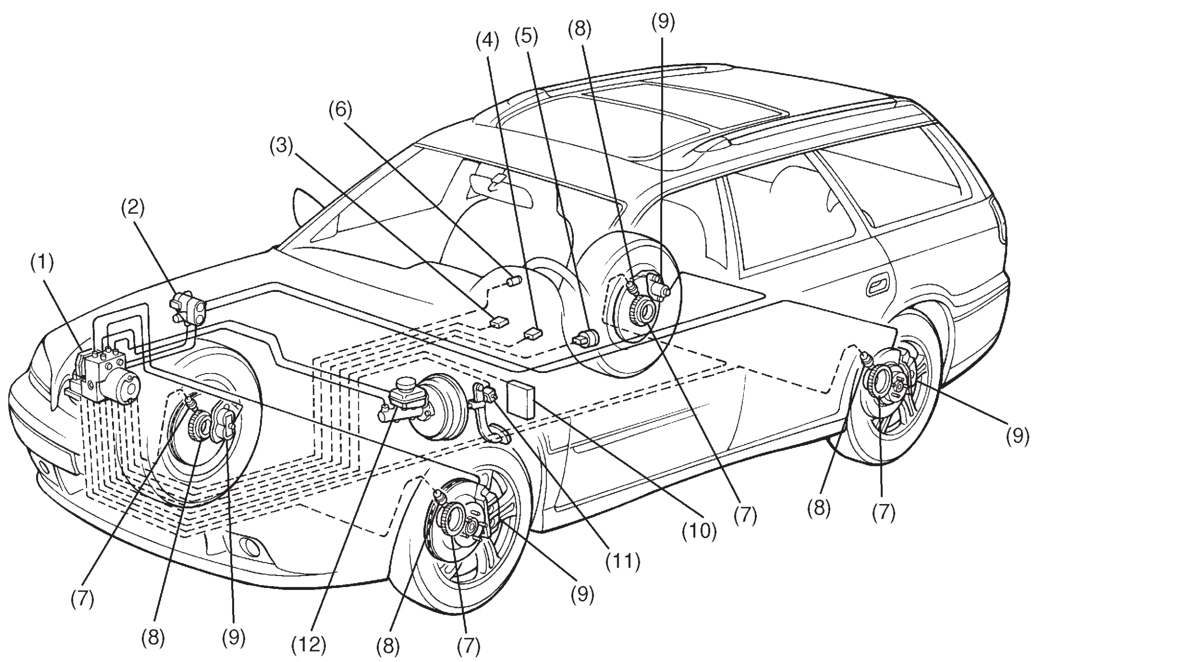
However, since fluid passage is closed again immediately after pressure “P_2” equals “P_3”, pressure “P_3” is held at a value of less than pressure “P_2”.

6. Anti-lock Brake System (ABS)

A: FEATURE

- This ABS 5.3i type incorporates the hydraulic control unit, ABS control module, valve relay and motor relay in one unit for better productivity and lightweight.
- The ABS (Anti-lock brake system) electrically controls brake fluid pressure to prevent wheel “lock” during braking on slippery road surfaces, thereby improving directional/steering stability.
- If the ABS becomes inoperative, the fail-safe system activates to ensure it acts as a conventional brake system. The warning light also comes on to indicate that the ABS is malfunctioning.
- The front-and-rear wheels utilize a 4-sensor, 4-channel control design: the front wheels have an independent control design*1 and the rear wheels have a select low control design*2.

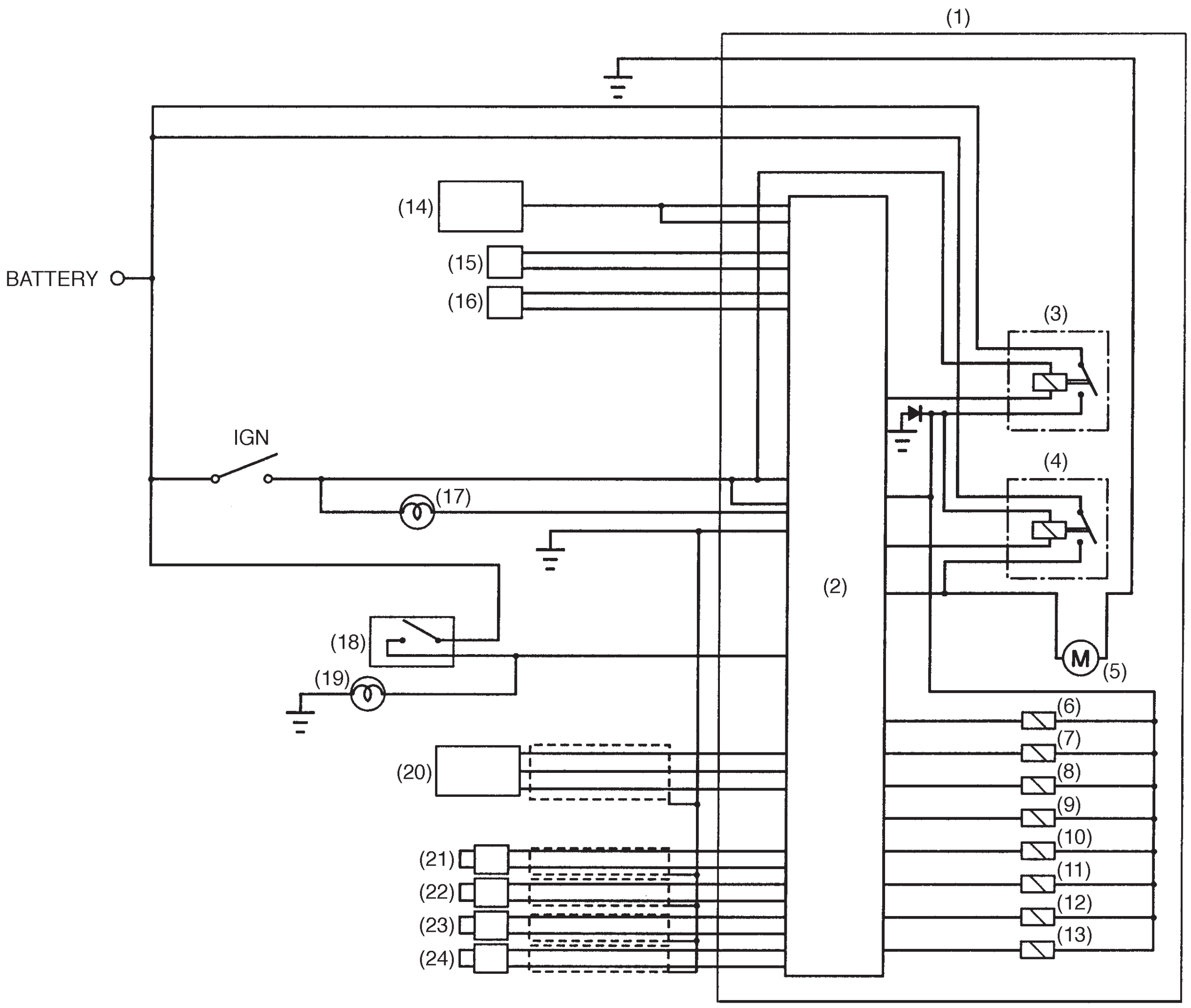
*1: A system which independently controls fluid pressure to left and right front wheels.
*2: A system which provides the same fluid pressure control for the two rear wheels if either wheel starts to “lock.”



(1)	ABS control module and hydraulic control unit (ABSCM & H/U)	(5)	G sensor	(9)	Wheel cylinder
(2)	Proportioning valve	(6)	ABS warning light	(10)	Transmission control module (only AT vehicle)
(3)	Diagnosis connector	(7)	Tone wheel	(11)	Brake switch
(4)	Data link connector (for SUBARU select monitor)	(8)	ABS sensor	(12)	Master cylinder

B: FUNCTIONS OF SENSORS AND ACTUATORS

Name		Function
ABS control module and hydraulic control unit (ABSCM & H/U)	ABSCM-section	● Calculates to determine the conditions of the wheels and body from the wheel speeds and makes a proper decision suitable for the current situation to control the hydraulic unit. ● In the ABS operation mode, the module outputs a cooperative control signal to the AT control module. (AT vehicles only) ● Whenever the ignition switch is placed at ON, the module makes a self diagnosis. When anything wrong is detected, the module cuts off the system. ● Communicates with the Subaru select monitor.
	H/U-section	In the ABS operation mode, the H/U changes fluid passages to control the fluid pressure of the wheel cylinders in response to an instruction from the ABSCM. The H/U also constitutes the brake fluid passage from the master cylinder to the wheel cylinders together with pipings.
	Valve relay-section	Serves as a power switch for the solenoid valve and motor relay coil in response to an instruction from the ABSCM.
	Motor relay-section	Serves as a power switch for the pump motor in response to an instruction from the ABSCM.
Wheel speed sensor (ABS sensor)		Detects the wheel speed in terms of a change in the magnetic flux density passing through the sensor, converts it into an electrical signal, and outputs the electrical signal to the ABSCM.
Tone wheel		Gives a change in the magnetic flux density by the teeth around the tone wheel to let the ABS sensor generate an electrical signal.
G sensor		Detects a change in G in the longitudinal direction of the vehicle and outputs it to the ABSCM in terms of a change in voltage.
Stop light switch		Transmits the information on whether the brake pedal is depressed or not to the ABSCM for use as a condition in determining ABS operation.
ABS warning light		Alerts the driver to an ABS fault. When the diagnosis connector and diagnosis terminal are connected, the light flashes to indicate a trouble codes in response to an instruction from the ABSCM.
AT control module (TCM) (AT vehicles only)		Provides shift controls (fixing the speed at 3rd or changing front and rear wheel transmission characteristics) in response to an instruction from the ABSCM.



S4H0019A

(1)	ABS control module and hydraulic control unit	(9)	Front right outlet solenoid valve	(17)	ABS warning light
(2)	ABS control module section	(10)	Rear left inlet solenoid valve	(18)	Stop light switch
(3)	Valve relay	(11)	Rear left outlet solenoid valve	(19)	Stop light
(4)	Motor relay	(12)	Rear right inlet solenoid valve	(20)	G sensor
(5)	Motor	(13)	Rear right outlet solenoid valve	(21)	Front left ABS sensor
(6)	Front left inlet solenoid valve	(14)	Transmission control module (only AT module)	(22)	Front right ABS sensor
(7)	Front left outlet solenoid valve	(15)	Diagnosis connector	(23)	Rear left ABS sensor
(8)	Front right inlet solenoid valve	(16)	Data link connector	(24)	Rear right ABS sensor

C: THEORY OF ABS CONTROL

When the brake pedal is depressed during operation, wheel speed as well as vehicle speed decreases. The difference which occurs between wheel speed and vehicle speed is called the “slip” phenomenon. The magnitude of this action is expressed by “slip” the ratio of which is determined by the following equation:

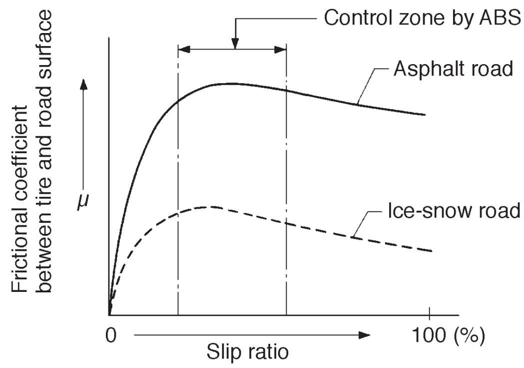
Slip ratio = Vehicle speed – Wheel speed / Vehicle speed x 100 %

When the “slip” ratio is 0 % vehicle speed equals wheel speed and the wheel rotates without any slippage. When the “slip” is 100 % the wheel locks and does not rotate (wheel speed = 0) although vehicle speed exists.

The relationship between the frictional force of a wheel in the fore-and-aft direction and the “slip” ratio is shown by two characteristic curves in figure.

These curves are determined by the relationship between the wheel and road surface. Where the same type of wheel are used; the curve shown by a solid line indicates wheels driven on asphalt or paved roads, the curve shown by dotted lines refers wheels subjected to slippery (snowy or icy) roads.

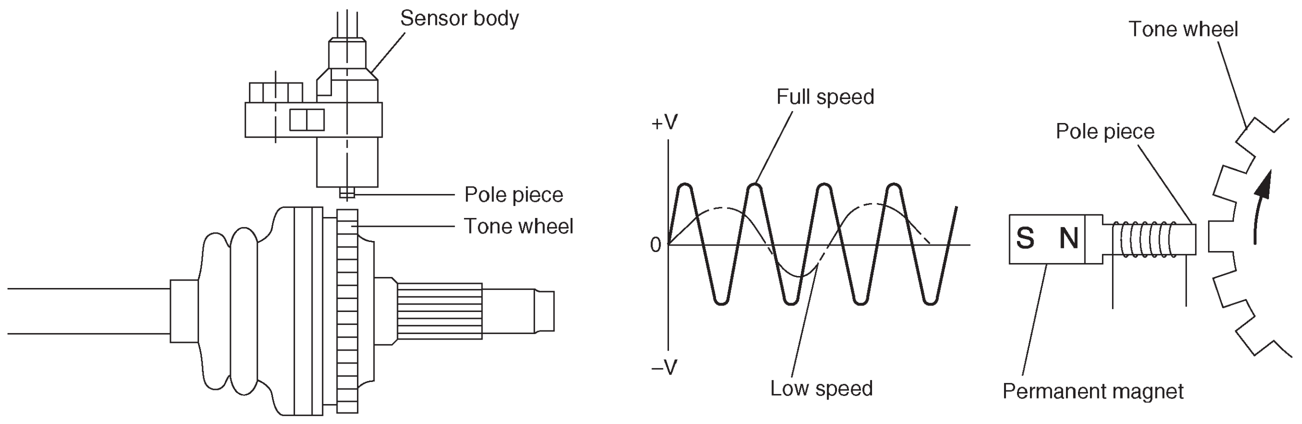
When different types of wheels are used, although the road surface is the same, these curves will change. In general, the frictional coefficient between wheel and road surface in relation to an increase in the “slip ratio” will reach the maximum value in the 8 – 30 % range and will tend to decrease after that.



G4H0064

D: ABS SENSOR

The ABS sensor detects wheel speed and consists of a permanent magnet, coil, tone wheel, etc. The magnetic flux produced by the permanent magnet varies with the tone wheel (which rotates together with the wheel) and the sensor emits an alternating voltage corresponding with the wheel speed by electromagnetic induction.



B4H2197A

E: ABS CONTROL MODULE AND HYDRAULIC CONTROL UNIT (ABSCM&H/U)

- **ABS CONTROL MODULE SECTION (ABSCM)**

The ABSCM is a digital control type electronic control module accommodating two microcontrol modules (MCMs); master and slave. Both MCMs process the same program and monitor the respective outputs, and when a mismatch occurs, cut off the system to activate the fail-safe function.

A maximum of 3 trouble codes are stored in the EEP ROM and if 3 or more areas fail, then only the 3 most recent failures are stored. The trouble codes remain stored until they are erased.
This ABSCM induces a sequence control pattern and facilitates the checking of the hydraulic unit.

- ABS control

Based on the four wheel speed signals, the ABSCM calculates a simulated body speed or body deceleration rate, while referencing the G sensor output as an auxiliary means, and compares them with the wheel speeds and wheel deceleration rates. If it determines that the wheels are about to lock, it controls the solenoid valve or motor pump of the H/U to adjust the brake fluid pressures that act on the wheel cylinders, thereby preventing the wheels from locking.
The ABSCM controls the right and left front wheel fluid pressures independently and controls the rear wheel fluid pressures on the basis of the wheel which is more likely to lock (Select-low control).

- Select monitor associated functions

The Subaru select monitor may be used to perform the following operations.
  - To read out analog data
  - To read out ON/OFF data
  - To read out or erase trouble code
  - To read out status information in the event of trouble (Freeze frame data)
  - To initiate ABS sequence control pattern

- Indication functions

The ABS warning light can be made to indicate the following three states.
  - ABS trouble
  - Flashes to indicate trouble codes in diagnosis mode.
  - Valve ON/OFF when sequence control pattern is in effect

● HYDRAULIC CONTROL UNIT SECTION (H/U)

The H/U is a fluid pressure controller comprising a motor, solenoid valve, housing, relay, etc. It constitutes two diagonally independent brake fluid circuits for a cross piping vehicle.

● The pump motor rotates an eccentric cam to let the plunger pump generate a hydraulic pressure.

● The housing accommodates the pump motor, solenoid valve, reservoir, etc., and also constitutes a brake fluid passage.

● The plunger pump is a hydraulic pump which drains off the brake fluid which, when the pressure is reduced, is discharged to the reservoir, and sends it toward the master cylinder.

● The solenoid valve is a 2-position type solenoid valve which switches the brake fluid passages between the wheel and master cylinder and reservoir sides in response to an instruction from the ABSCM.

● The inlet solenoid valve is duty-controlled to reduce brake fluid pulsation for lower ABS operation noise.

● The reservoir is a fluid chamber which temporarily stores the brake fluid to be discharged from the wheel cylinder when the pressure is reduced.

● The damper chamber suppresses the pulsation of the brake fluid which, when the pressure is reduced, is discharged from the plunger pump, thereby minimizing the kickbacks to the brake pedal.

● The valve relay controls the solenoid valve and motor relay energizing power supply in response to an instruction from the ABSCM. In normal (IG ON) condition, the relay is actuated to supply power to the solenoid valve and motor relay. When an error occurs in the system, the valve relay is forced to OFF to keep the fluid pressure circuit in the normal mode (normal brake mode).

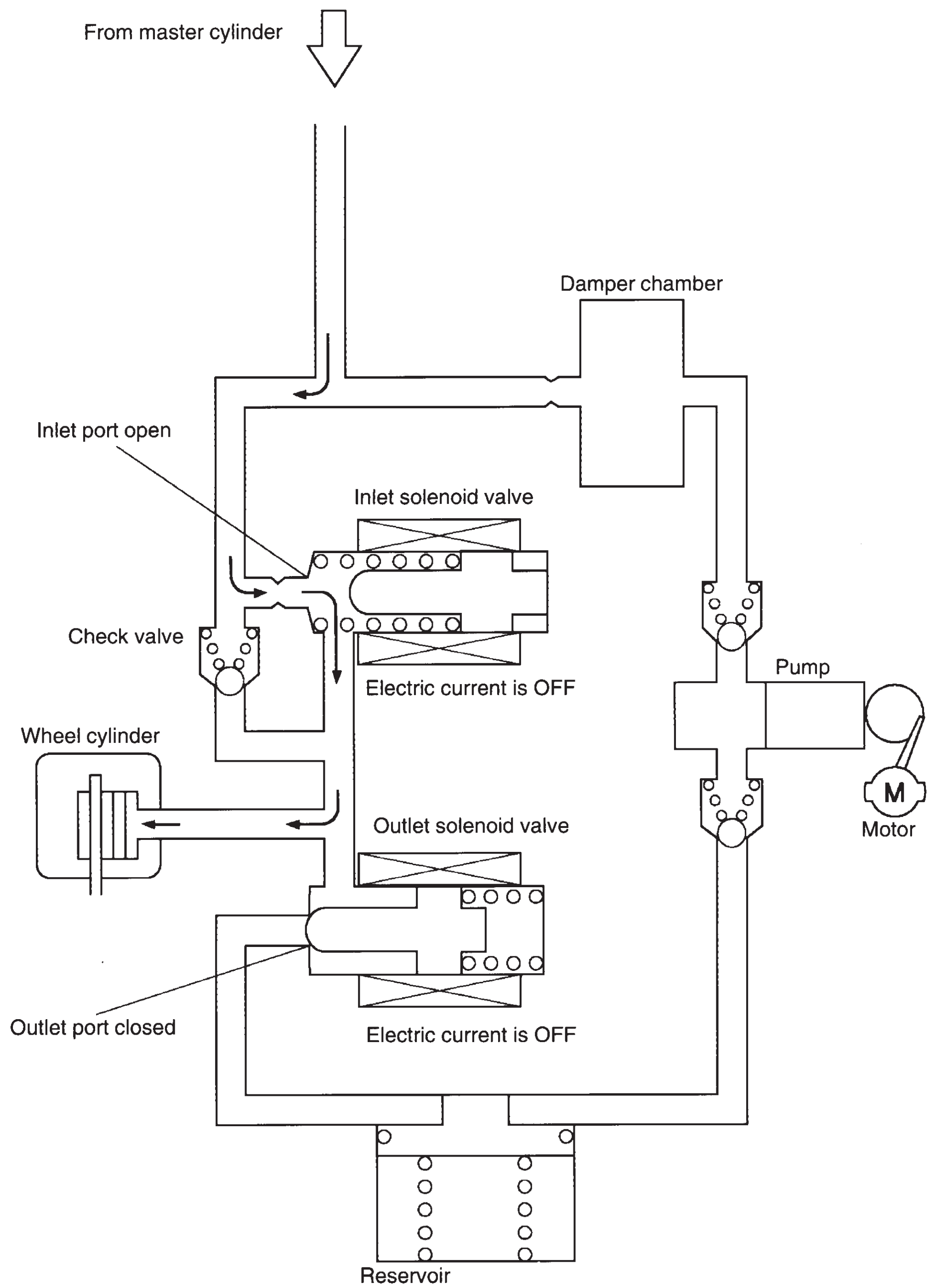
● The motor relay supplies power to the pump motor to operate the plunger pump in response to an instruction from the ABSCM in the ABS control mode.

The H/U has four operating modes; normal mode (control OFF: normal brake mode), “increase”, “hold” and “decrease” modes (control ON in all the three modes).

1. DURING NORMAL BRAKING

Since no current is supplied to the inlet and outlet solenoid valves, no solenoid valve attracting force is generated. So the valves remain stationary.
Accordingly, the inlet port of the inlet solenoid valve is in an opened state, whereas the outlet port of the outlet solenoid valve is in a closed state. So the fluid pressure of the master cylinder is transmitted to the wheel cylinder to produce a brake force in the wheel cylinder.

NOTE:
Explained with one wheel’s control as an example

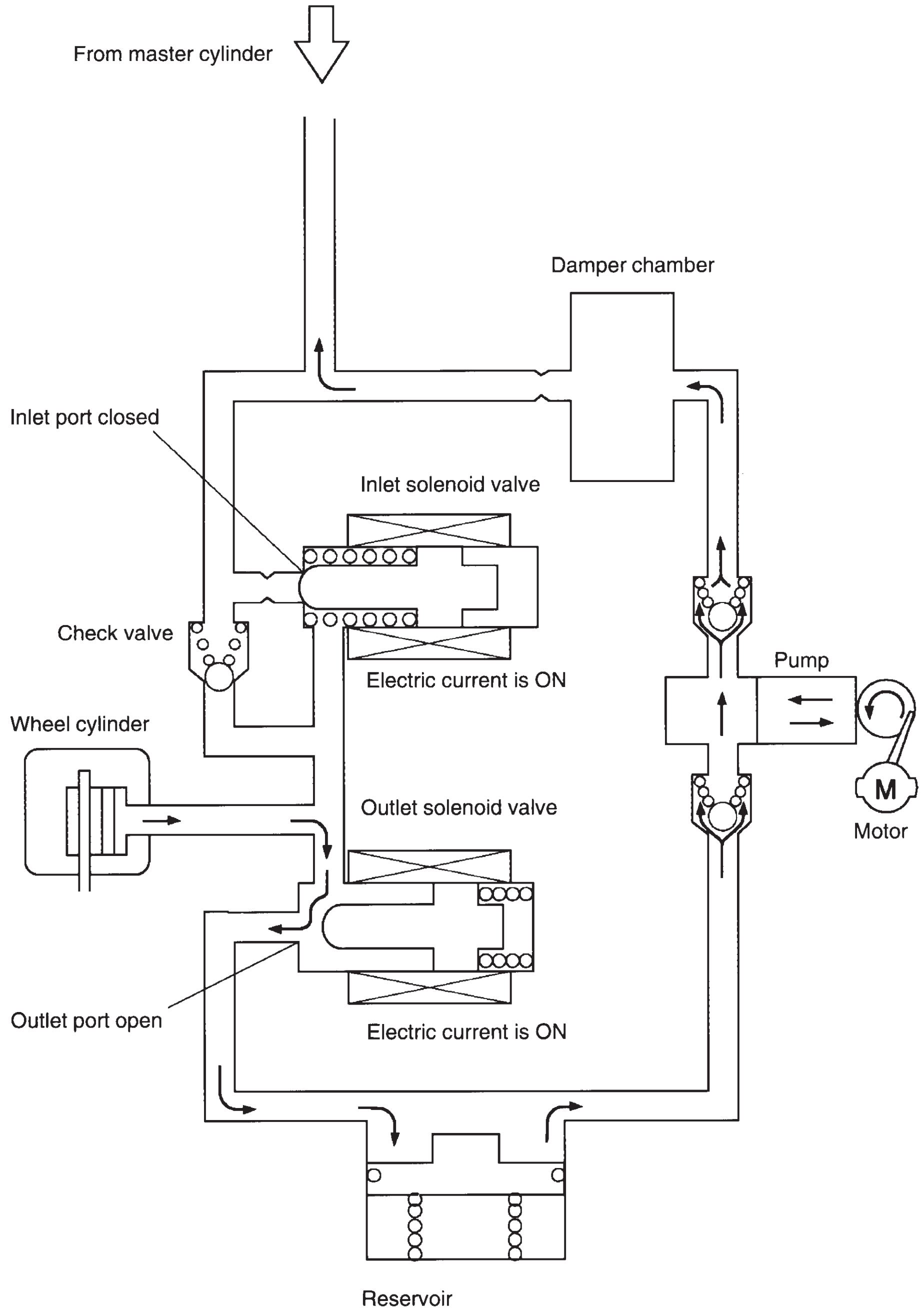


B4H0989

2. PRESSURE “DECREASE” ACTION WITH ABS IN OPERATION

Current is supplied to the inlet and outlet solenoid valves, and the generated solenoid valve attracting forces close the inlet port and open the outlet port.
Accordingly, the wheel cylinder is isolated from the master cylinder and becomes clear to the reservoir, allowing the brake fluid to flow to the reservoir. So the fluid pressure of the wheel cylinder is decreased.
The brake fluid collected in the reservoir is fed to the master cylinder by the pump.

NOTE:
Explained with one wheel’s control as an example

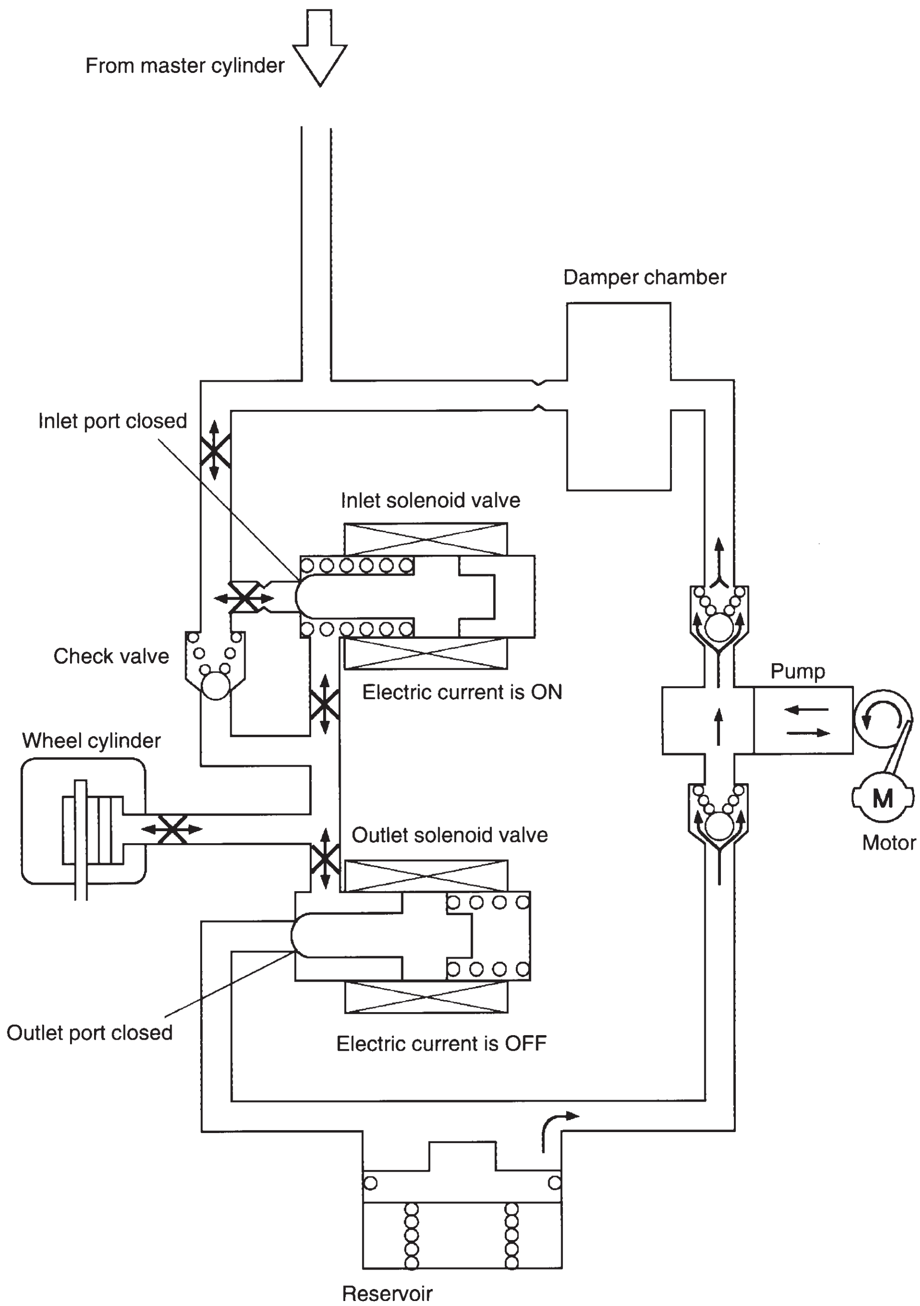


B4H0990

3. PRESSURE “HOLD” ACTION WITH ABS IN OPERATION

Current is supplied to the inlet solenoid valve, and the generated solenoid valve attracting force closes the inlet port.
Since no current is supplied to the outlet solenoid valve, the output port remains in a closed state.
As a result, the wheel cylinder, master cylinder and reservoir are blocked, and the fluid pressure of the wheel cylinder is maintained constant.
During ABS operation, the pump motor continues to operate.

NOTE:
Explained with one wheel’s control as an example

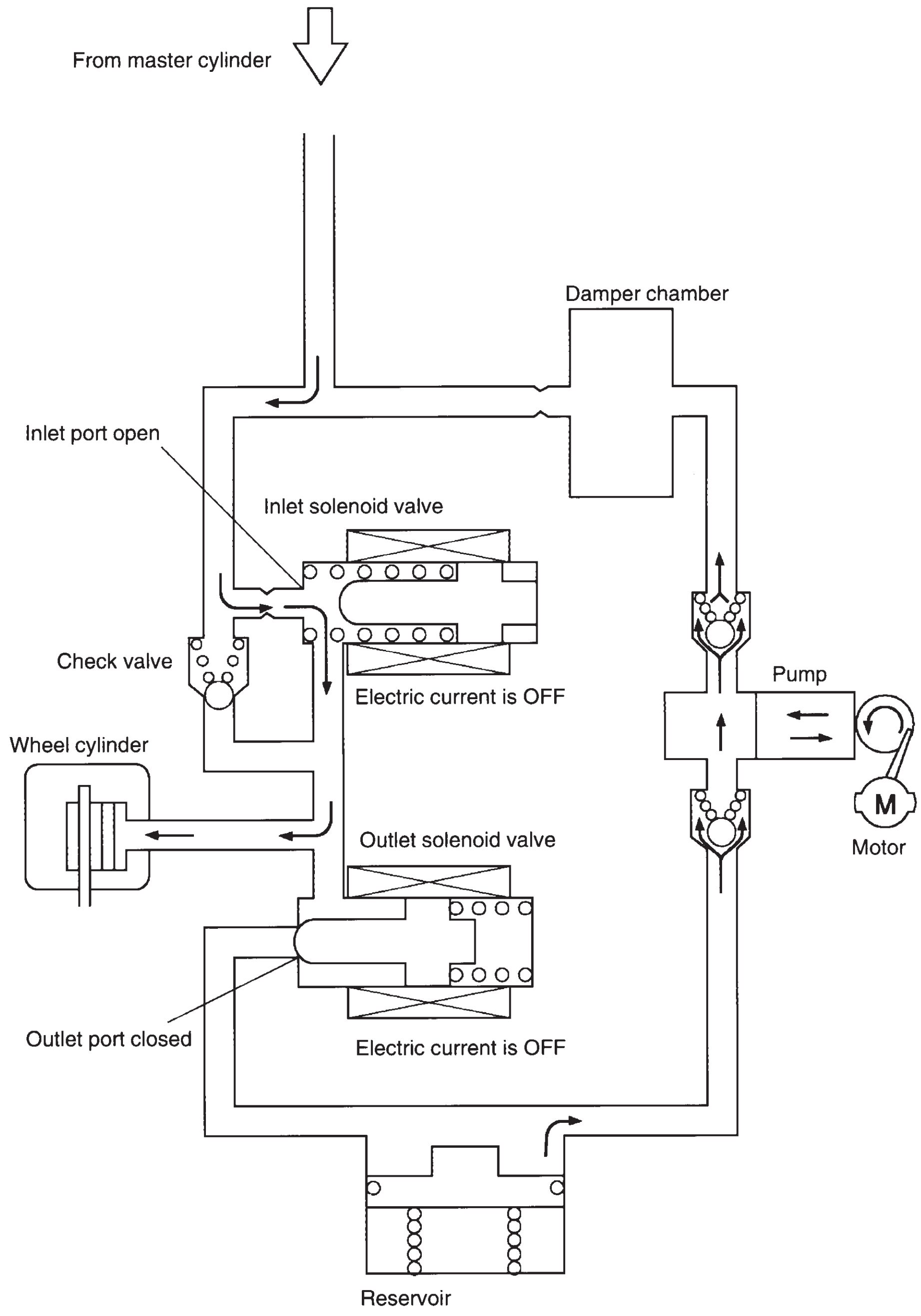


B4H0991

4. PRESSURE “INCREASE” ACTION WITH ABS IN OPERATION

Since no current is supplied to the inlet and outlet solenoid valves, no solenoid valve attracting force is generated. So the valves remain stationary.
Accordingly, the inlet port of the inlet solenoid valve is in an opened state, whereas the outlet port of the outlet solenoid valve is in a closed state. So the fluid pressure of the master cylinder is transmitted to the wheel cylinder to increase the brake force in the wheel cylinder.
During ABS operation, the pump motor continues to operate.

NOTE:
Explained with one wheel’s control as an example



B4H0992

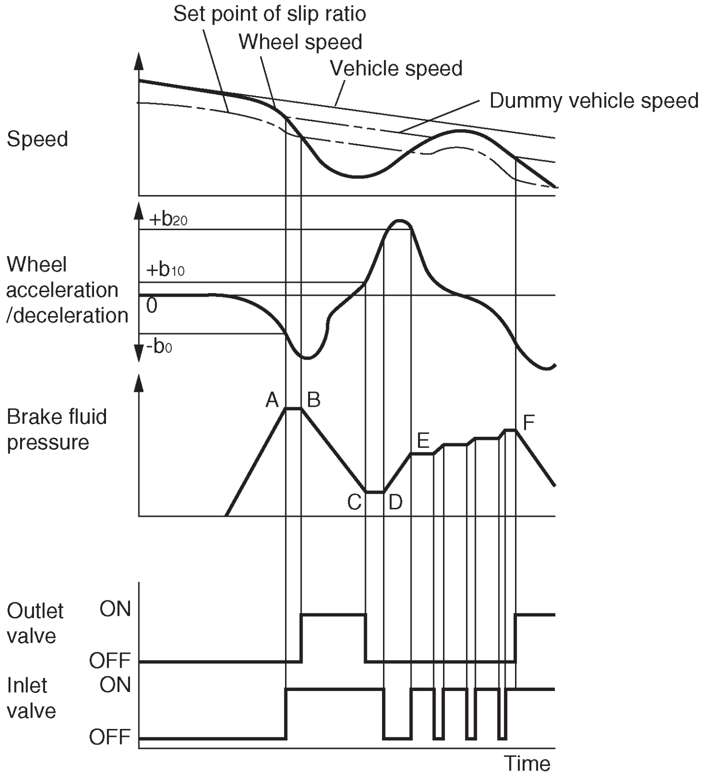
F: ABS CONTROL CYCLE CURVES

As the brake pedal is depressed, brake fluid pressure increases correspondingly, which in turn decreases wheel speed. When brake fluid pressure reaches point “A” (where wheel deceleration exceeds “– b_0”), the control module transmits signal to hold the brake fluid pressure in wheel cylinder at that point. At the same time, the control module computes a “dummy” vehicle speed. When the wheel speed drops below the slip ratio setting (= speed less than the dummy vehicle speed based on the predetermined value) at point “B” of the brake fluid pressure, the control module then transmits signal to prevent wheel lock-up. This causes the brake fluid pressure to decrease.

After brake fluid pressure is decreased, wheel acceleration increases. When it exceeds the wheel acceleration setting “+ b_{10}” at point “C” (brake fluid pressure), the control module transmits signal to hold the brake fluid pressure at that point. When wheel acceleration setting value “+ b_{20}” is exceeded and when brake fluid pressure is at point “D”, the control module judges that wheel lock-up will not occur and then transmits signal to increase brake fluid pressure.

When wheel acceleration drops below “+b_{20}” (point “E”) (which occurs due to a brake fluid pressure increase), signals are sent so that “holding pressure” and “increasing pressure” may be cycled in a given interval.

When wheel deceleration exceeds “– b_0”, at point “F” of the brake fluid pressure, the control module immediately transmits signal to decrease brake fluid pressure.



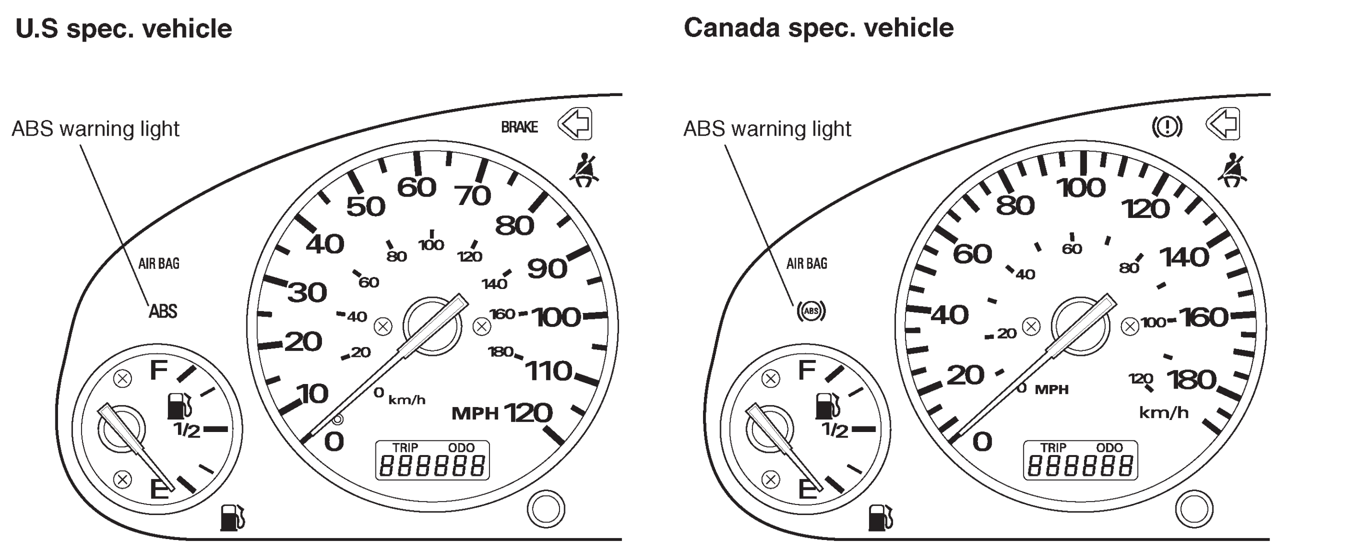
B4H2239A

Brake fluid Pressure	Inlet valve	Outlet valve
Increase	OFF	OFF
Hold	ON	OFF
Decrease	ON	ON

G: ABS WARNING LIGHT

When a signal system or the ABS control module becomes inoperative, the warning light in the combination meter comes on to indicate that the system or control module is malfunctioning. At the same time, current flowing through the hydraulic control unit is interrupted so that the brake system functions as a conventional brake system. The circuit through which the warning light comes on utilizes a dual system design.

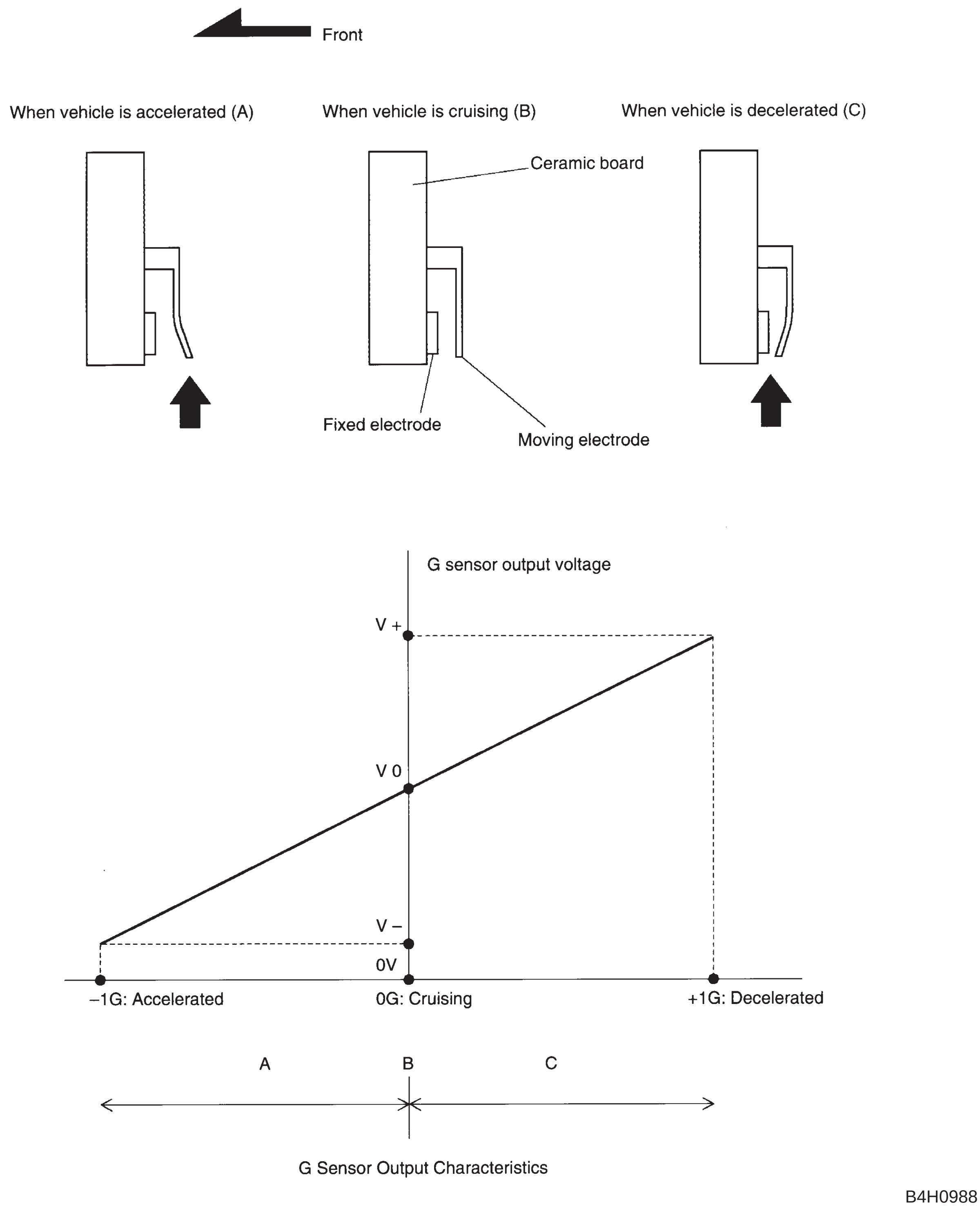
If the warning light comes on upon detection of a system malfunction, call a trouble code and identify it using the warning light.



B4H2198A

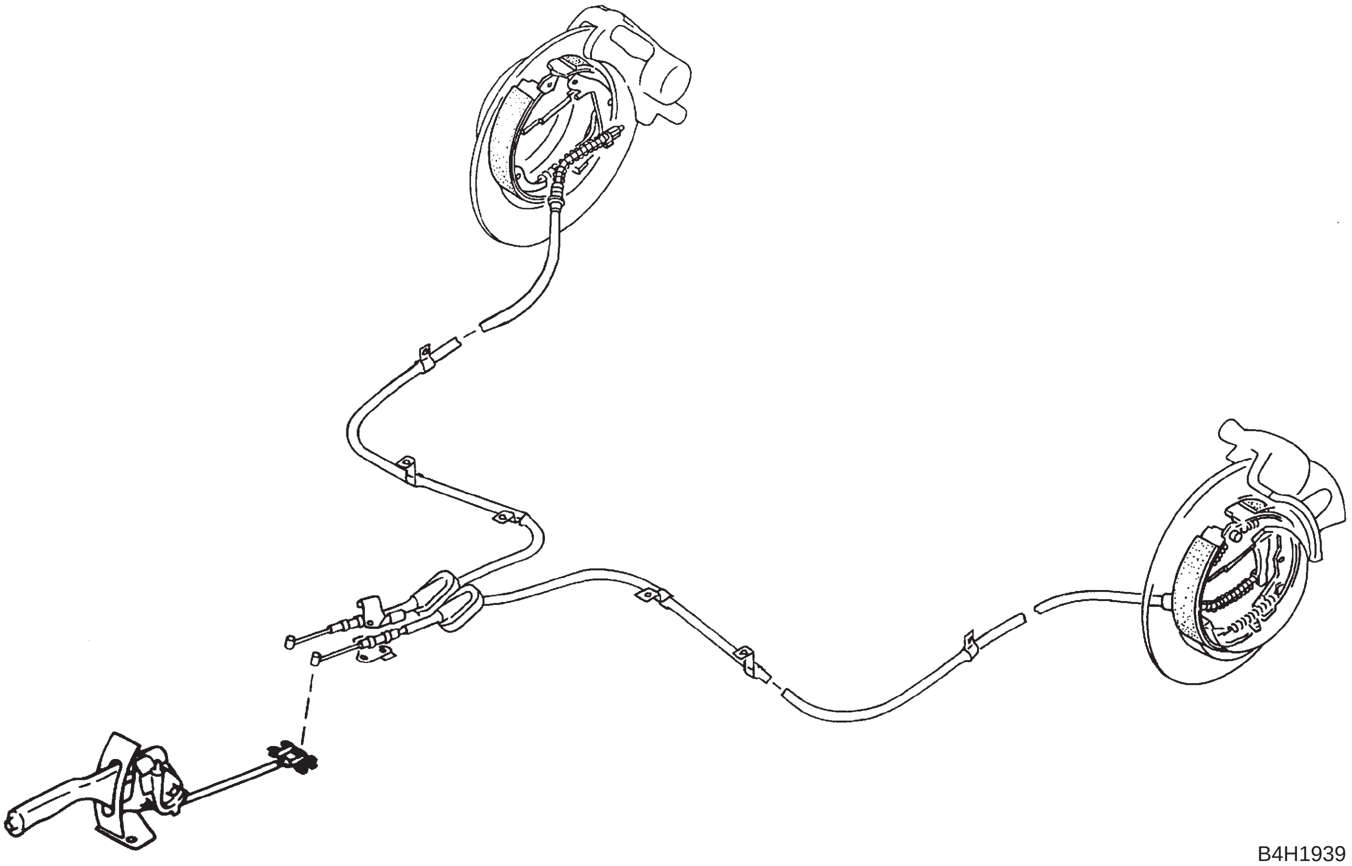
H: G SENSOR

The G sensor detects a change in G in the longitudinal direction.
It detects the motion of the moving electrode built into the sensor in terms of a change in the capacitance of the capacitor and outputs it to the ABSCM in terms of a change in voltage.



7. Parking Brake (Rear Disc Brake)

The rear disc brake has its parking brake drum housed in the disc rotor for improved performance.



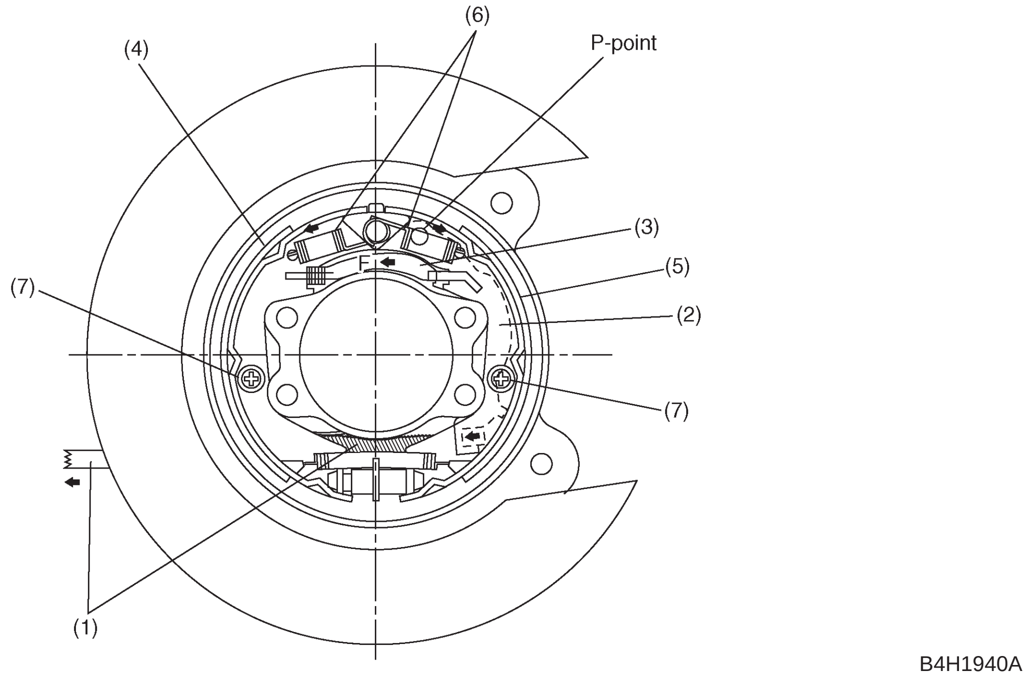
B4H1939

A: OPERATION

1. SET PARKING BRAKE

When the parking brake lever is pulled, lever located on the end of the parking brake cable moves strut in the direction of “F” with point “P” utilized as a fulcrum.

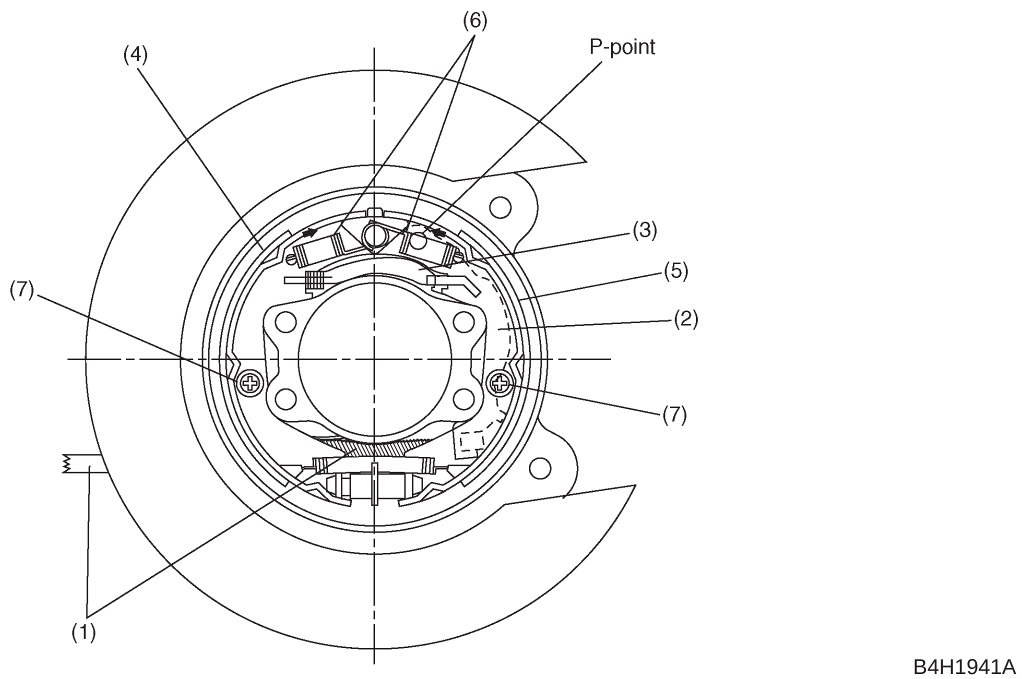
The strut then presses brake shoes A and B against the drum. These brake shoes utilize a floating design and are lightly supported by hold-down pins. The force applied to brake shoe A, and the reaction force of “F” applied to brake shoe B via point “P” provide brake application when the shoes are pressed against the brake drum.



(1) Parking brake cable
(2) Lever
(3) Strut
(4) Brake shoe A
(5) Brake shoe B
(6) Shoe return spring
(7) Shoe hold down pin

2. RELEASE PARKING BRAKE

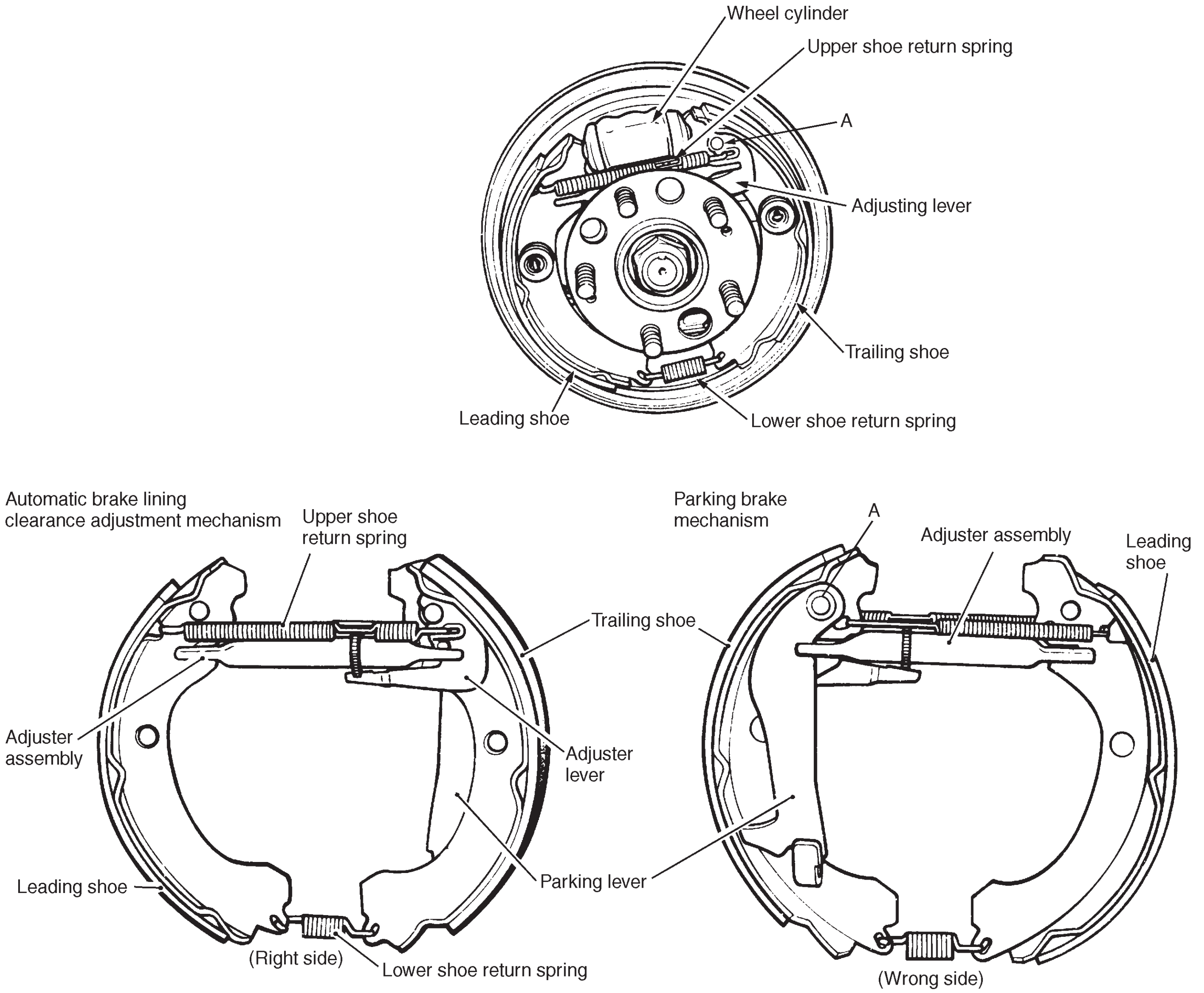
When the parking brake lever is released, parking brake cable is loosened. This returns brake shoes A and B to their original position from the tension of return spring so that the parking brake is released.



(1) Parking brake cable
(2) Lever
(3) Strut
(4) Brake shoe A
(5) Brake shoe B
(6) Shoe return spring
(7) Shoe hold down pin

8. Parking Brake (Rear Drum Brake)

When the parking brake lever is moved up, a lever in the drum brake moves with point “A” as a fulcrum so that the trailing shoe expands. The leading shoe also expands by way of the adjuster assembly. In this way, braking force will occur.



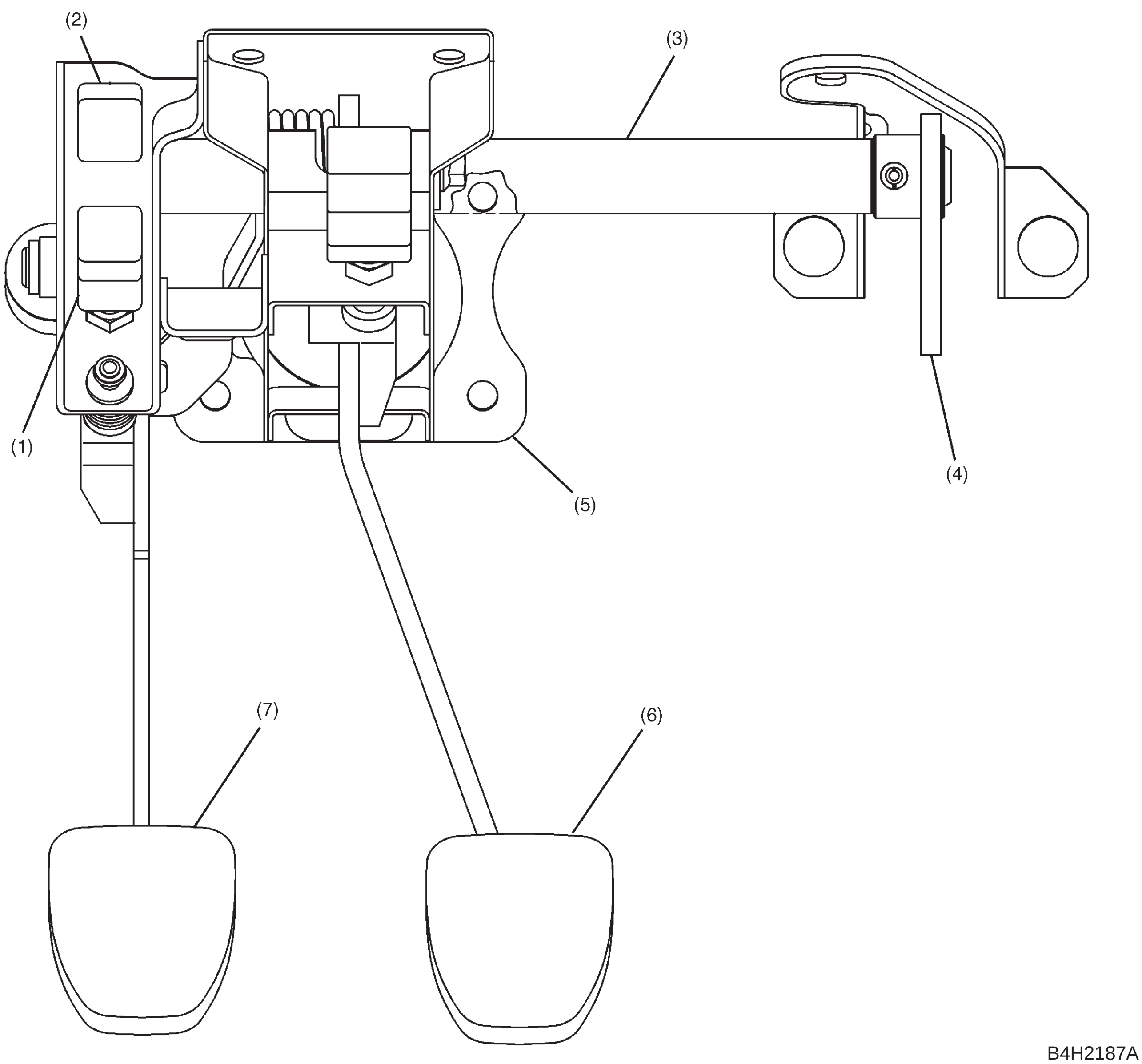
B4H1632A

MEMO

1. Hydraulic Clutch Pedal System

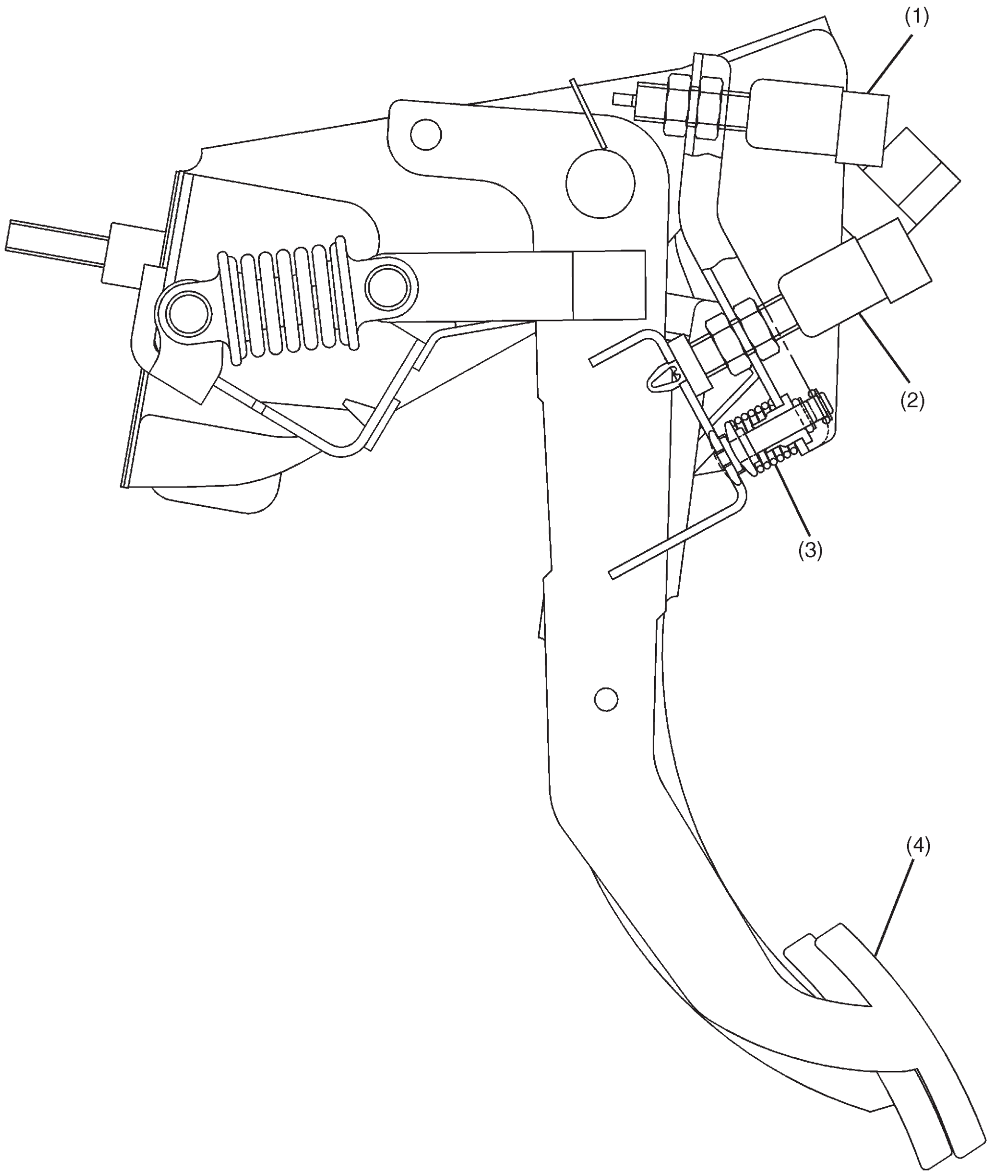
A: CONSTRUCTION

- The hydraulic clutch pedal is connected to the master cylinder (which produces oil pressure) via a rod.
- The clutch pedal and brake pedal are secured to the same bracket. (LHD model only)



(1) Clutch switch (With cruise control)
(2) Clutch switch (Starter interlock)
(3) Rod
(4) Lever
(5) Brake and clutch pedal bracket
(6) Brake pedal
(7) Clutch pedal

- The initial pedal effort reducing mechanism is adopted.



(1) Clutch switch (Starter interlock)
(2) Clutch switch (With cruise control)
(3) Initial pedal effort reducing mechanism
(4) Clutch pedal

B: OPERATION

The operating principle of the hydraulic clutch pedal system is similar to that of a mechanical clutch pedal system except that a return spring returns the clutch pedal to the original position.

MEMO

1. Heater System

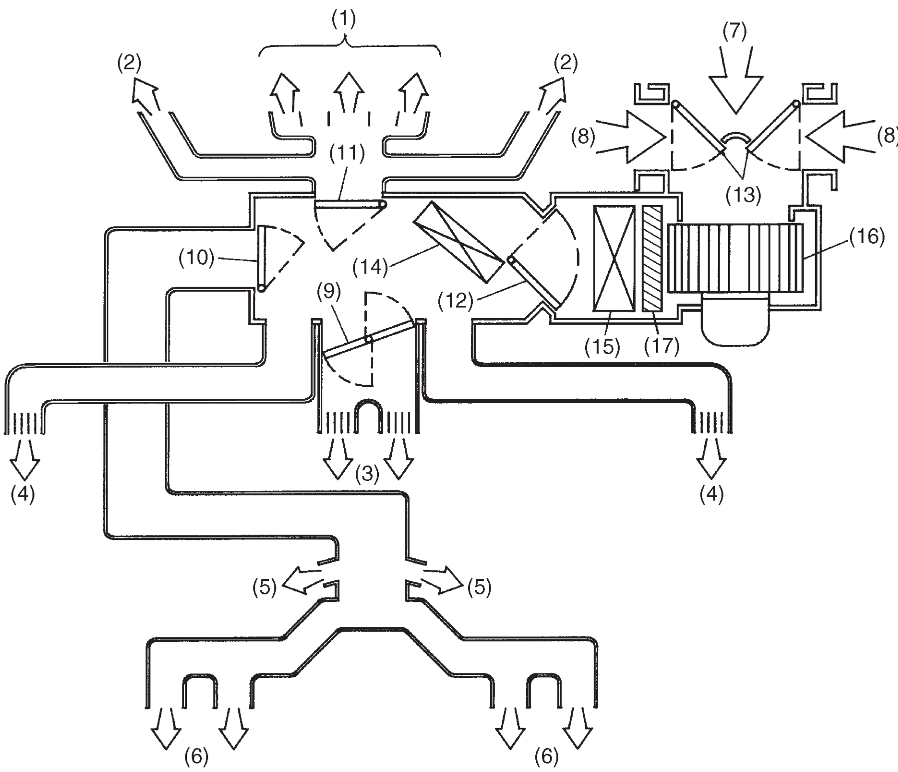
The heater control unit is located in the middle portion of the instrument panel.

The heater unit is provided with mode doors and an air mix door. The intake unit is provided with an intake door and blower motor. The heater unit and the intake unit are regulated by their control units.

Fresh outside air is introduced into the compartment through the center and side ventilator grilles when the blower fan is operated.

All models are equipped with the front side window defroster.

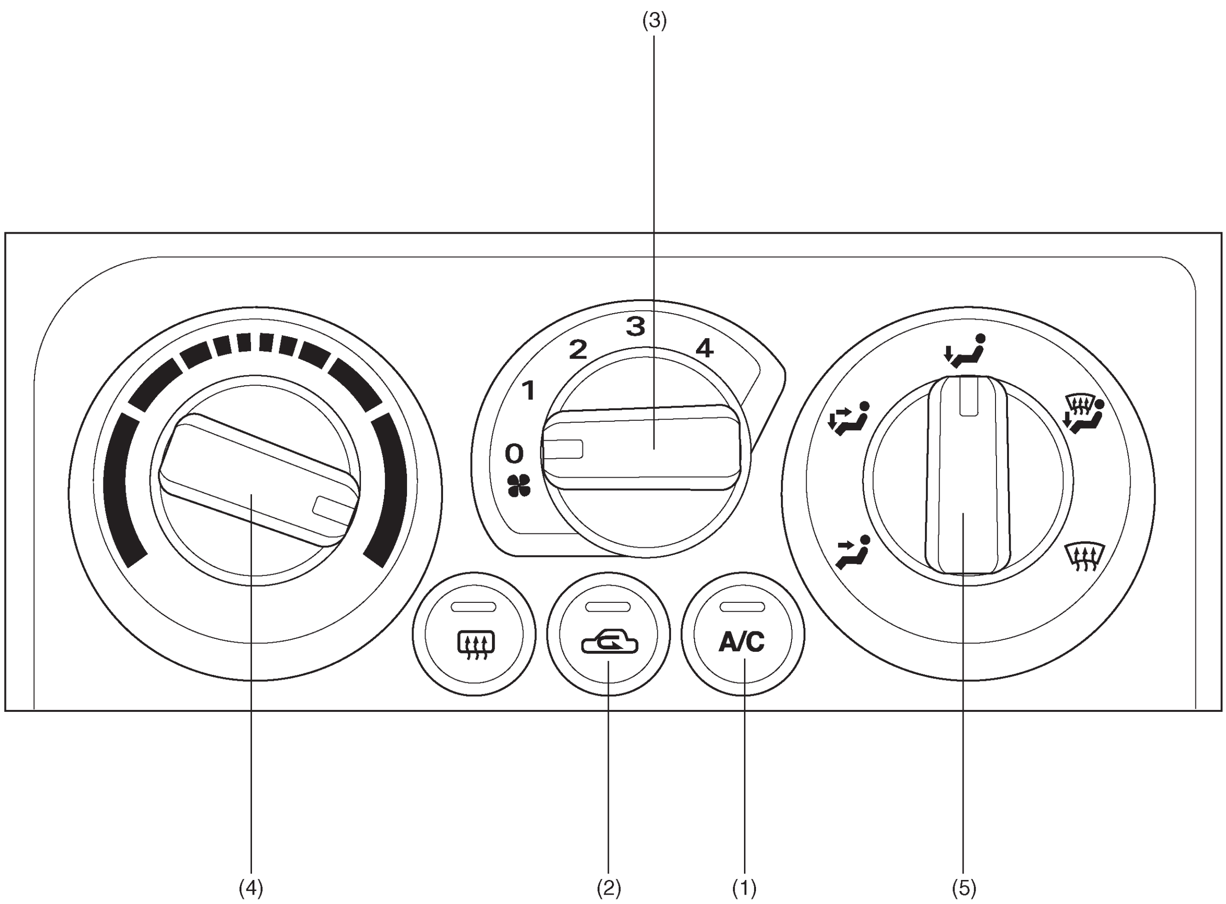
A filter is optionally provided in front of the evaporator inlet.



B4H2189A

(1)	Front defroster outlet	(7)	Fresh inlet air	(13)	Intake door
(2)	Side defroster outlet	(8)	Recirc air	(14)	Heater core
(3)	Center outlet	(9)	Vent door	(15)	Evaporator (A/C model)
(4)	Side outlet	(10)	Heater door	(16)	Blower fan
(5)	Front heater outlet	(11)	Defroster door	(17)	Filter (Option)
(6)	Rear heater outlet	(12)	Air mix door		

2. Switch Function

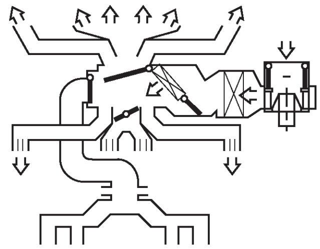
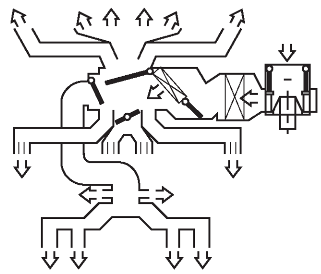
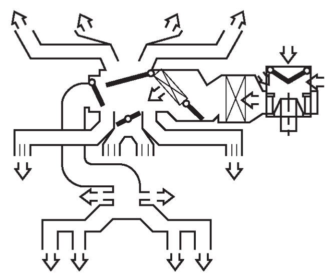
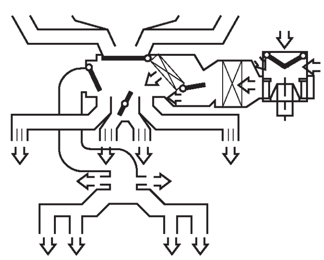
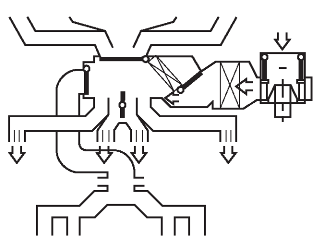


(1)	A/C switch	Indicator	*ON		OFF		
		Compressor	ON		OFF		
		*: When fan switch is “ON”, indicator light and compressor turn “ON”.					
(2)	Recirc switch	Indicator	ON		OFF		
		Intake door position	Recirc		Fresh		
(3)	Fan switch	Switch position	1	2	3	4	
		Fan speed	1st (slow)	2nd	3rd	4th (fast)	
(4)	Temperature control switch	Outlet air temperature can be variably controlled form COLD to HOT.					
(5)	Mode selector switch	Switch position					
		Air outlet	Vent	Vent Heat	Heat	DEF Heat	DEF

B4H1503A

3. Mode Selector Switch and Air Flow

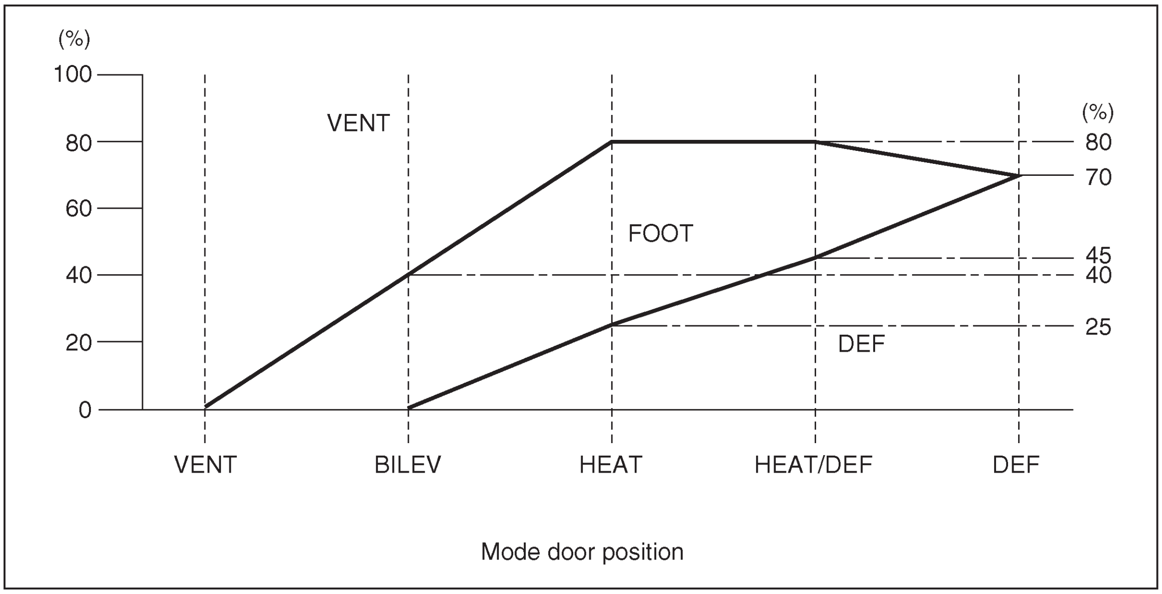
A: AIR FLOW

Mode selector switch position	Air flow
 DEF	
 DEF/HEAT	
 HEAT	
 BI-LEVEL	
 VENT	

B4H2241A

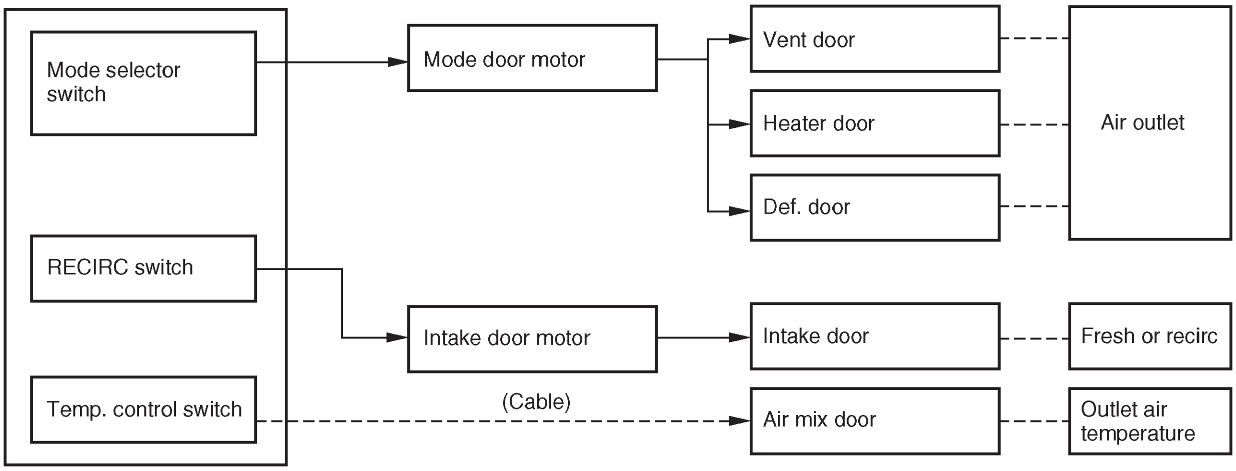
B: AIR DISTRIBUTION RATIO

Figure shows air distribution ratios corresponding to mode door position.



B4H1513B

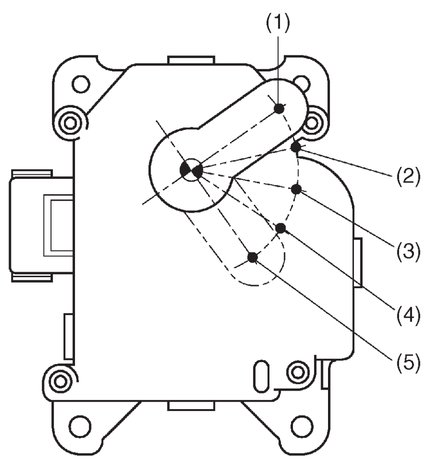
C: SYSTEM FLOW



B4H0046A

4. Mode Door Control

The servo motor for the mode door control is installed on the driver's side lateral of the heater unit. Operation of the mode selector switch sends a signal to the servo motor. This makes a clockwise or counterclockwise rotation of the servo motor, which causes the mode door to operate through a link.

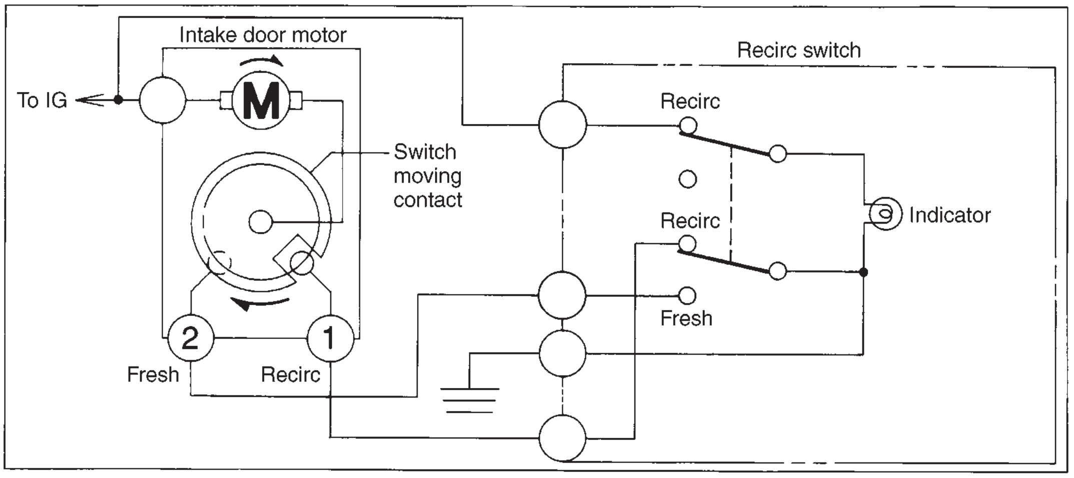


B4H1505A

(1) DEF position
(2) DEF/HEAT position
(3) HEAT position
(4) VENT/HEAT position
(5) VENT position

5. Intake Door Control

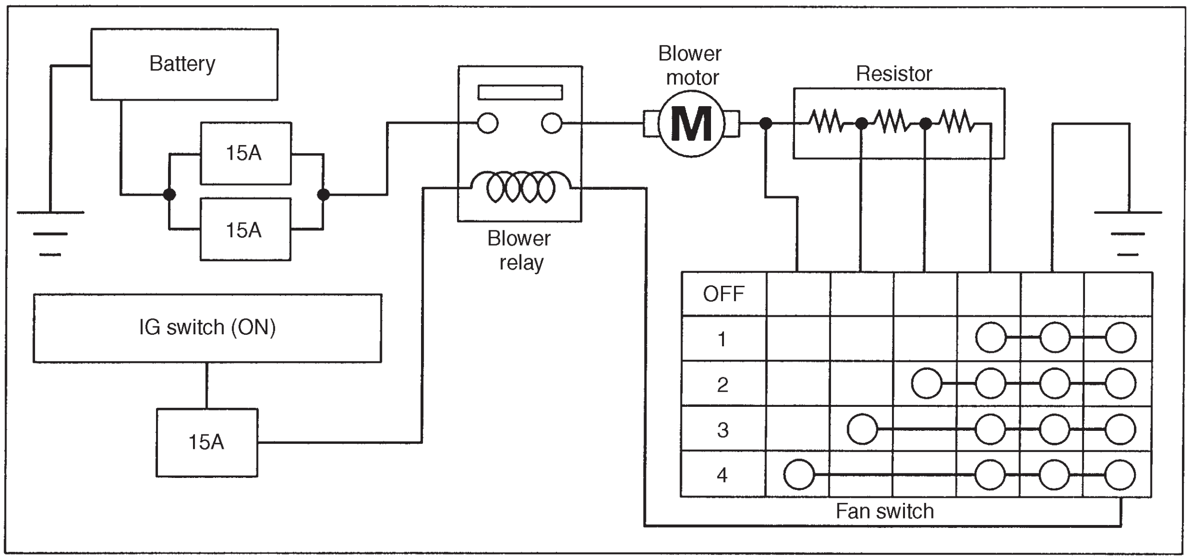
Intake door motor is located on the upper part of the intake unit. It opens and closes the intake door with a rod and a link. When the RECIRC switch is set to ON (the RECIRC indicator light), the ground line of the intake door motor is switched to terminal 2 from terminal 1, and the motor starts to rotate because the position switch contacts built into it are set to the current flow position . The contacts turn along with the motor. When they reach the non-contact flow position, the motor will stop. The motor always turns in the same direction. When the RECIRC switch is set to OFF (the RECIRC indicator does not light), follow the same operation.



G4H0741

6. Blower System

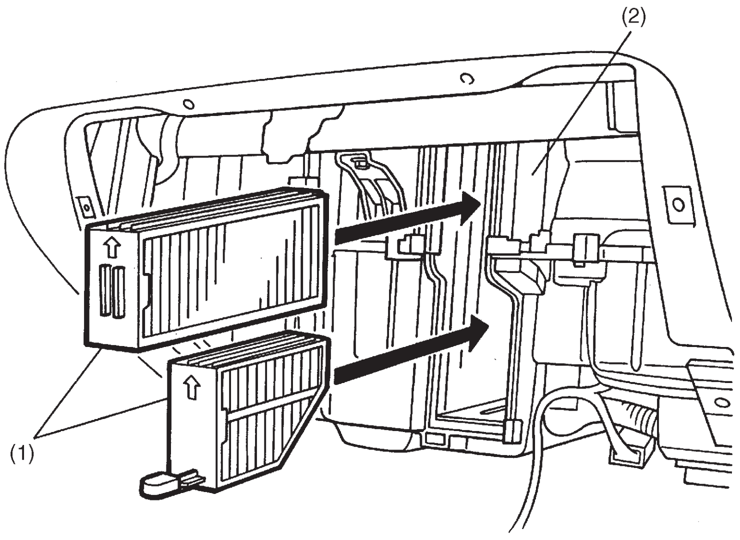
Operation of the blower relay is controlled by turning ON and OFF the ignition switch. When the ignition switch is ON and the fan switch is operated from 1st to 4th speed, electric current from the battery goes through the blower motor, the resistor, the fan switch and ground. The resistor is switched by the position of the fan switch, and controls the blower motor speed from 1st to 4th.



H4H1097A

7. Filter

In the cooling unit, a filter is provided in front of the evaporator inlet (optional).
It is possible that the air conditioner fails to exhibit its full performance if the filter is clogged with dust and dirt in the outside air. Be sure to replace the filter with a new one at the specified interval.



B4H2191A

(1) Filter
(2) Cooling unit

MEMO

1. Air Conditioning Cycle

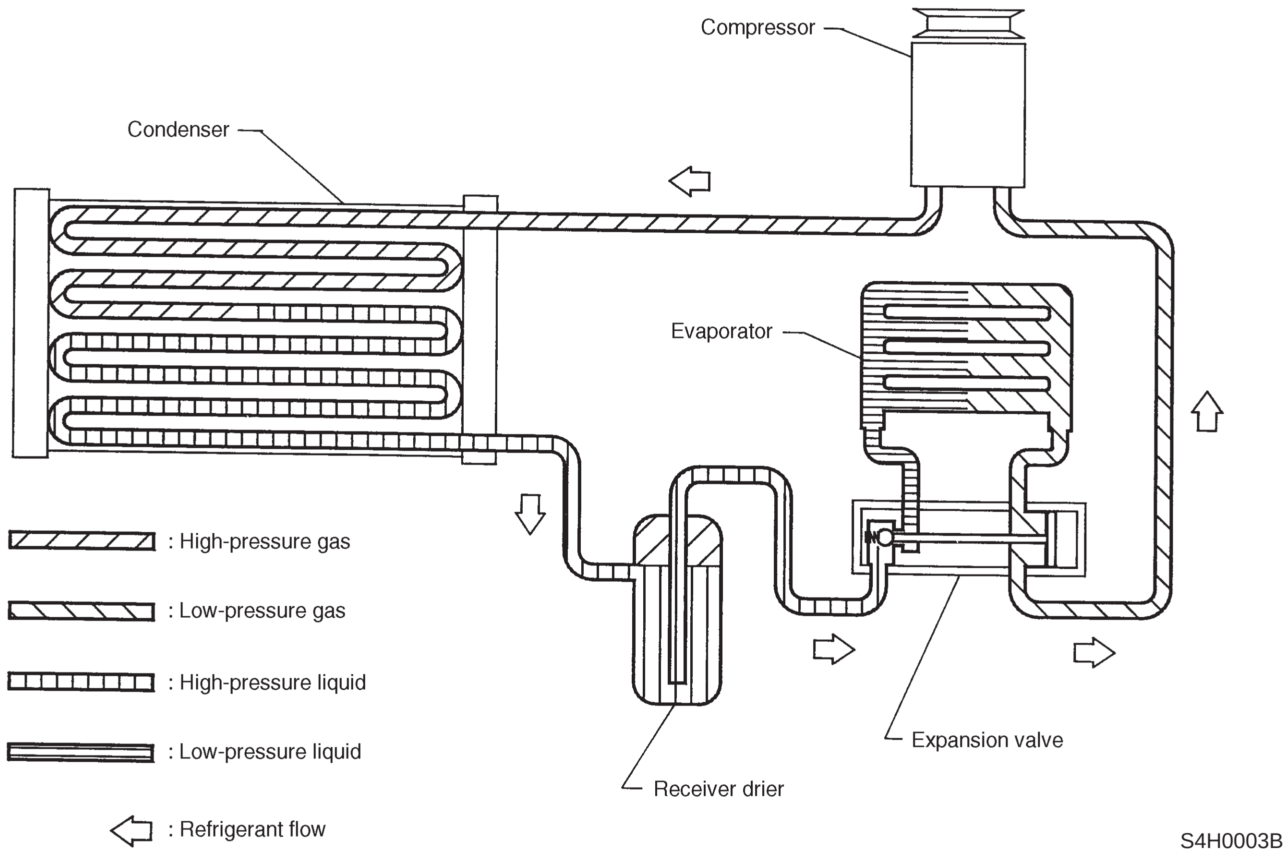
A: GENERAL

The refrigerant flows in the standard pattern, that is, through the compressor, the condenser, the receiver drier, through the evaporator, and back to the compressor.

The refrigerant flow through the evaporator coil is controlled by an internally equalized expansion valve, located inside the evaporator case.

The compressor repeats on and off to maintain the evaporator temperature within a specified range. When the evaporator coil temperature falls below a specified point, the thermo control amplifier interrupts the compressor operation. When the evaporator coil temperature rises above the specification, the thermo control amplifier allows compressor operation.

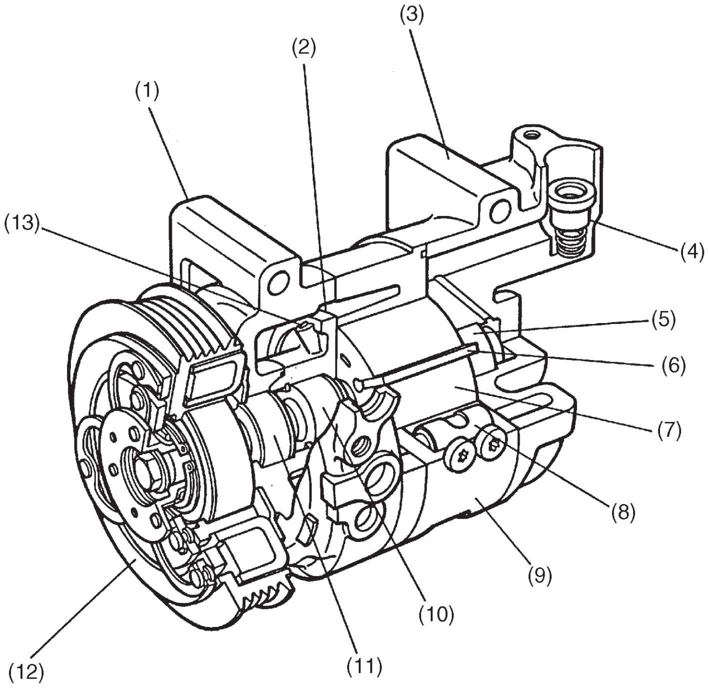
The refrigerant system is protected against excessively high or low pressures by the dual switch. If the system pressure rises above, or falls below the specifications, the dual switch opens to interrupt compressor operation.



2. Compressor

A: GENERAL

The vane rotary type compressor has five vanes fitted in the rotor mounted on the shaft. The centrifugal force produced by rotation of the rotor in the elliptical cylinder causes the vanes to move out and change the volumes in the areas surrounded by the rotor and cylinder. Suction, compression and discharge take place 10 times per rotation. A roll type valve is used on the discharge side only. Shaft seals are provided for the shaft and front head to maintain air tightness in the compressor. A trigger valve is provided in the side block to apply a back pressure to the vanes. The compressor is charged with the specified quantity of compressor oil which is forced to all the parts for lubrication by the discharge pressure of the refrigerant.



S4H0307A

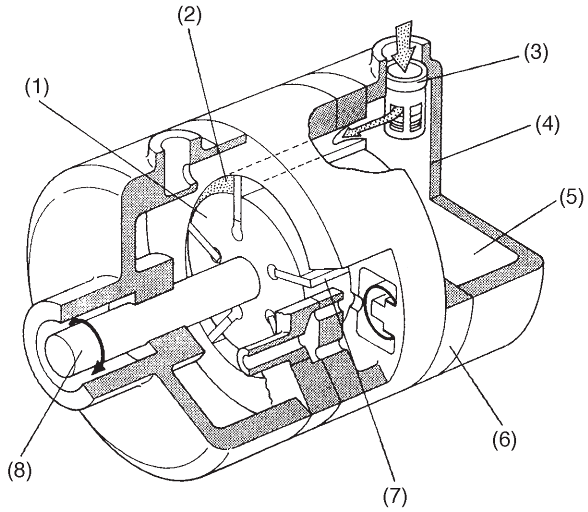
(1)	Front head	(6)	Vane	(11)	Shaft seal
(2)	Side block	(7)	Rotor	(12)	Magnet clutch
(3)	Rear head	(8)	Roll valve	(13)	Trigger valve
(4)	Check valve	(9)	Cylinder		
(5)	Rear bearing	(10)	Front bearing		

B: FUNCTION

Rotation of the shaft changes the volumes in the areas surrounded by the rotor, vanes, cylinder and side block, thereby accomplishing the functions of suction, compression and discharge.

1) Suction:

The low-pressure gaseous refrigerant forced out from the evaporator by rotation of the compressor passes from the suction side of the rear head through the check valve and enters the low pressure chamber in the rear head. The gaseous refrigerant is drawn into the cylinder by rotation of the vanes from the two suction ports provided in the side block. Air tightness in the cylinder chamber is maintained by the compressor oil.

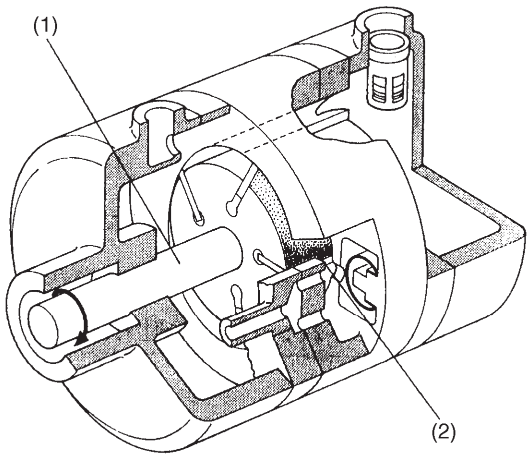


B4H0745A

(1) Rotor	(4) Rear head	(7) Vane
(2) Refrigerant	(5) Low-pressure chamber	(8) Drive shaft
(3) Check valve	(6) Rear side block	

2) Compression:

Further rotation after suction makes the cylinder chamber smaller, thus the compression starts.

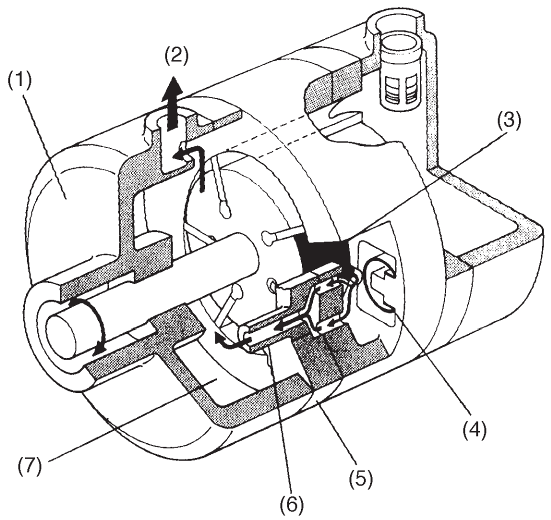


B4H0746A

(1) Drive shaft (2) Refrigerant

3) Discharge:

When the refrigerant pressure in the cylinder chamber exceeds the high pressure value, the roll valve opens to discharge the refrigerant through the pipe portion jointly provided in the front side block into the high pressure chamber in the front head. The gaseous refrigerant in the high pressure chamber is led through a baffle to separate the compressor oil contained in the gaseous refrigerant before it is forced to the high pressure piping.

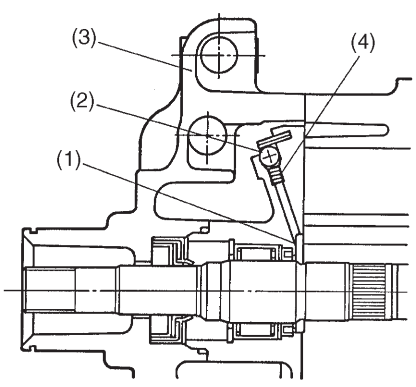


B4H0747A

(1) Front head	(4) Roll valve	(7) High-pressure chamber
(2) Refrigerant (Discharging)	(5) Front side block	
(3) Refrigerant (High-pressure)	(6) Pipe	

C: TRIGGER VALVE

This mechanism is designed to maintain proper vane back pressure to allow the vanes to move out with ease when the compressor starts. The trigger valve is provided in the side block, and a ditch called the K-ditch is provided in the side block rotor surface. The trigger valve has a ball combined with a spring. When vane chattering readily occurs like when the compressor starts or when the difference between the high and low pressures is small, spring action causes the valve to open to provide additional back pressure to the vanes, thereby assuring smooth operation.

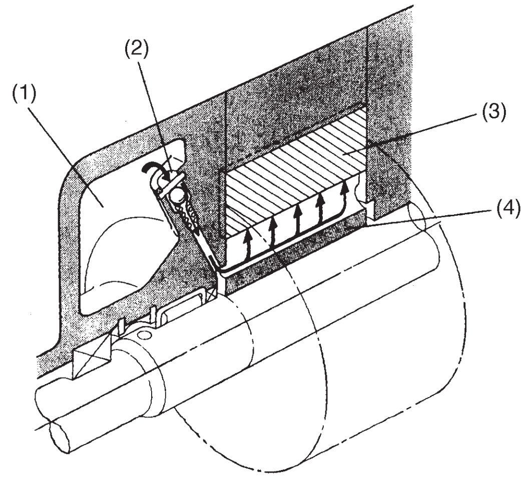


S4H0308A

(1) K-ditch	(3) Front head
(2) Check ball	(4) Spring

1) When compressor starts or when load is low:

When the compressor starts or when the load is low (the high pressure value is low), the trigger valve is opened by spring action to apply the pressure of the high pressure chamber to the back plane of vane to prevent vane chattering.

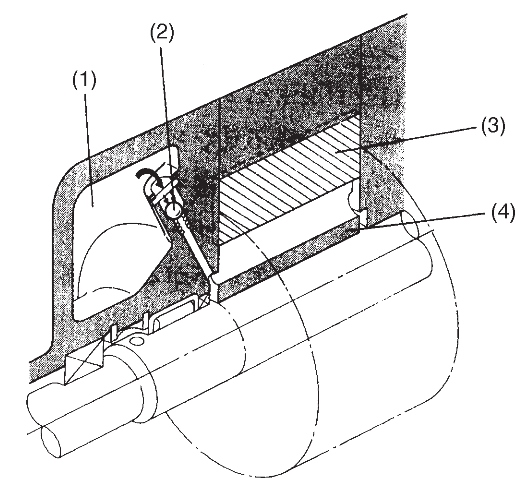


B4H0749A

(1) High-pressure chamber
(2) Trigger valve (Open)
(3) Valve
(4) Rotor

2) When compressor is in regular operation:

When the pressure in the high pressure chamber of the compressor increases, the pressure difference closes the trigger valve against spring action. The oil port pressure of the side block is applied to the back plane of vane to maintain proper back pressure.

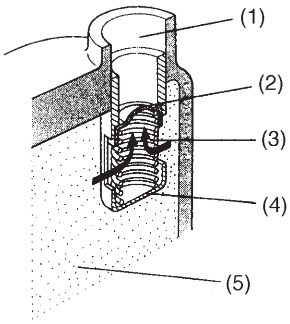


B4H0750A

(1) High-pressure chamber
(2) Trigger valve (Shut)
(3) Valve
(4) Rotor

D: CHECK VALVE

A plate and spring are provided on the suction side of the rear head. When there is a large difference between the high and low pressures immediately after the compressor has stopped, reverse rotation of the compressor could cause counter flow to the evaporator, as no suction valve is provided. For this reason, a check valve is provided to prevent counter flow. Immediately after the compressor has stopped, the high pressure refrigerant forces the check valve up to close the suction side piping passage and prevent counter flow from the high to low pressure side.

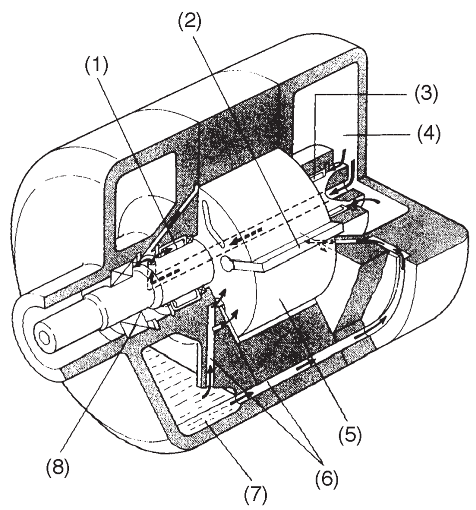


B4H0751A

(1) Refrigerant suction port	(3) Spring	(5) Refrigerant
(2) Plate	(4) Check valve	

E: LUBRICATION

The oil in all the parts is forced up from the bottom of the front side block along the oil passages by the pressure on the high pressure side to lubricate the rotor front end. The oil passed through the oil port at the bottom of the cylinder lubricates the rear end of the rotor. The oil that has lubricated each of the ends of the rotor is returned to the low pressure side by the internal pressure of the compressor.
The oil contained in the gaseous refrigerant returned from the evaporator passes through the low pressure chamber and lubricates the rear bearing. Furthermore, the oil passes through the guide hole provided in the drive shaft and lubricates the front bearing and shaft seal before returning to the suction portion of the cylinder.
Since the pressure in the suction portion of the cylinder is slightly lower than that in the low pressure side, the oil that has lubricated all the parts is returned to the suction chamber.



B4H0752A

(1) Front bearing
(2) Vane
(3) Rear bearing
(4) Low-pressure chamber
(5) Rotor
(6) Oil port
(7) High-pressure chamber
(8) Shaft seal

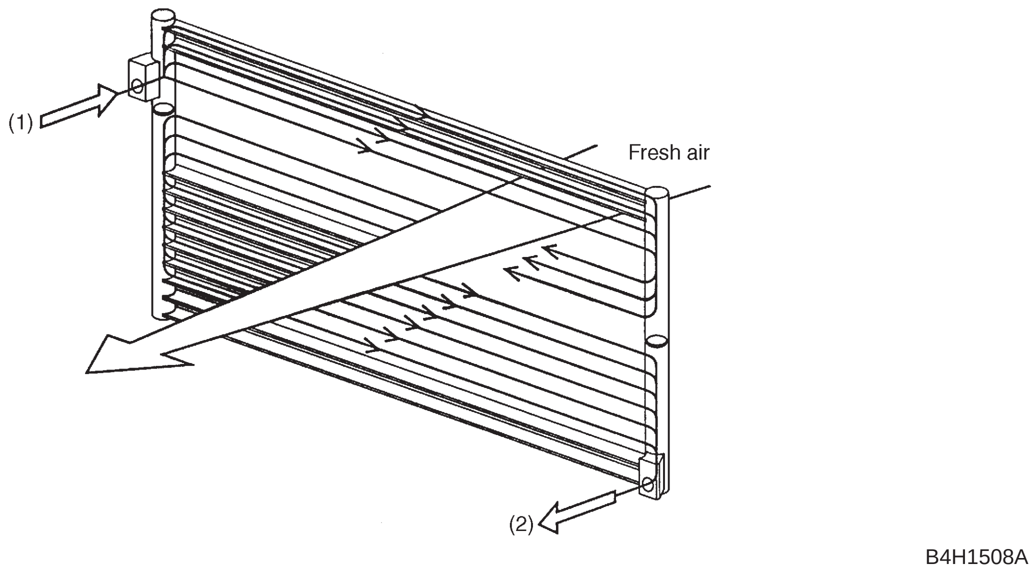
3. Condenser

A: MECHANISM

The high-temperature and high-pressure gaseous refrigerant discharged from the compressor is cooled down and turned into the liquid state in the condenser which is cooled by the ambient air delivered by the cooling fan.

The condenser is composed of tubes and radiating fins.

The heat from hot refrigerant radiates to the ambient air when high-temperature gaseous refrigerant passes through the condenser tubes.



(1) Refrigerant inlet (High pressure gas refrigerant)

(2) Refrigerant outlet (High pressure liquid refrigerant)

4. Receiver Drier

A: MECHANISM

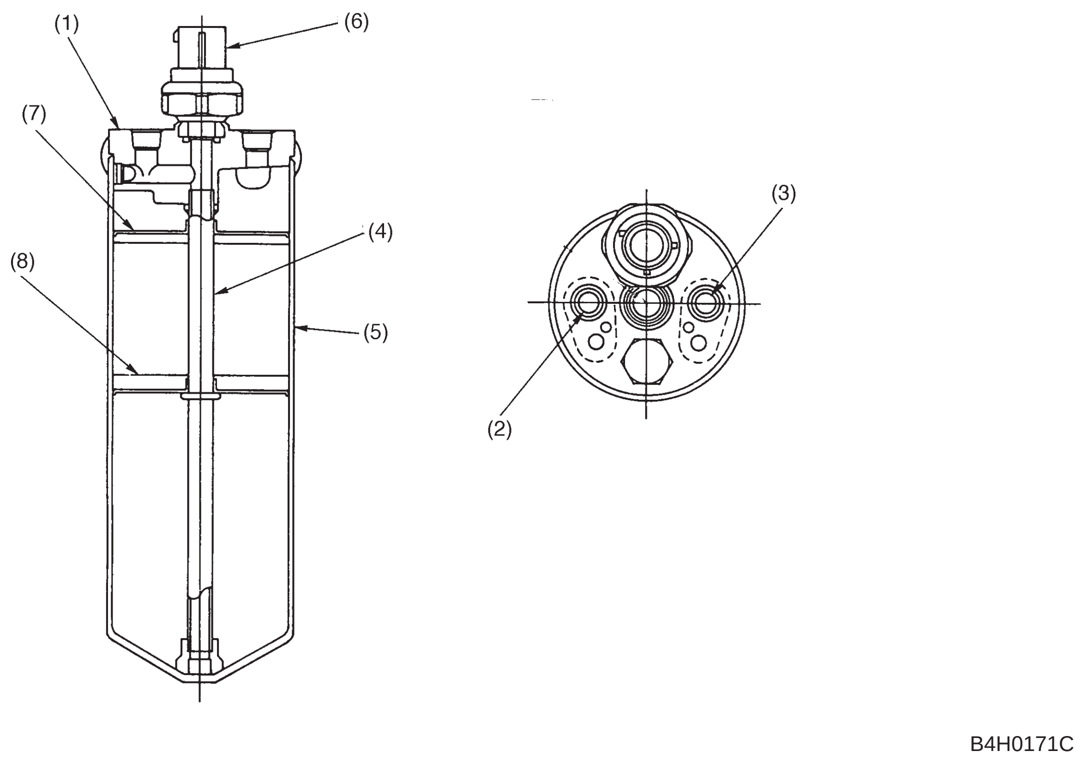
The amount of refrigerant circulating varies with the heat load changes. The receiver drier supplies the amount of refrigerant necessary for the cycle according to such changes.

1) It removes bubbles from the condensed refrigerant so that only liquid refrigerant may be delivered to the expansion valve. (If bubbles are present, the refrigerant passing through the expansion valve varies in quantity, temperature, and pressure, resulting in insufficient cooling.)

2) It removes moisture from the refrigerant.

3) It removes foreign substance from the refrigerant.

The receiver-drier consists of a strainer to remove foreign substance, desiccant to absorb moisture from refrigerant.



(1)	Head block – flat	(5)	Body
(2)	Inlet	(6)	Dual switch
(3)	Outlet	(7)	Strainer
(4)	Inside pipe	(8)	Cushion strainer

5. Dual Switch

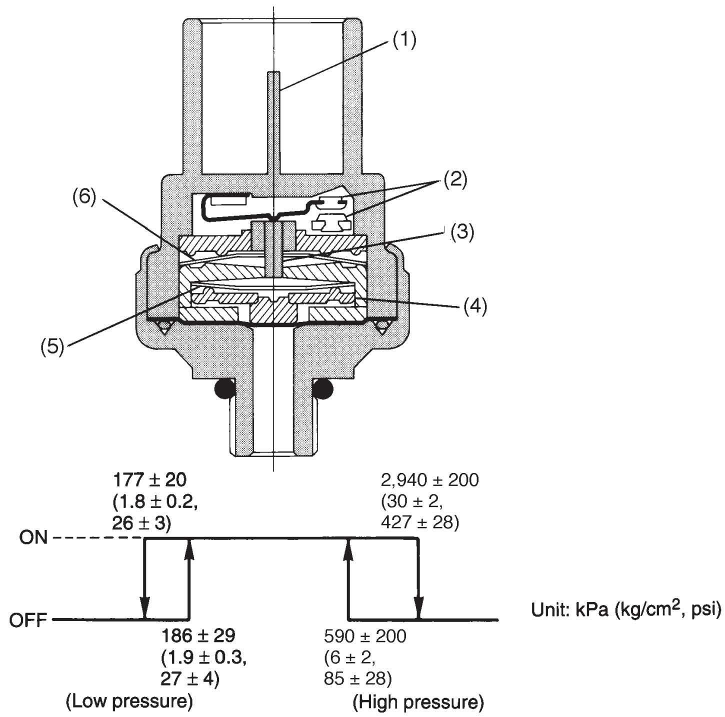
The dual switch is located on the high pressure line above the receiver dryer. When an abnormal pressure occurs in the high pressure line, the dual switch is forced to OFF to stop operation of the compressor.

- When the pressure is abnormally low [177 kPa (1.8 kg/cm^2, 26 psi) or less]

The dual switch is forced to OFF to prevent operation of the compressor when there is no gas caused by leakage of the refrigerant.

- When the pressure is abnormally high [2,940 kPa (30 kg/cm^2, 427 psi) or more]

The dual switch is forced to OFF to protect the air-conditioning cycle parts.

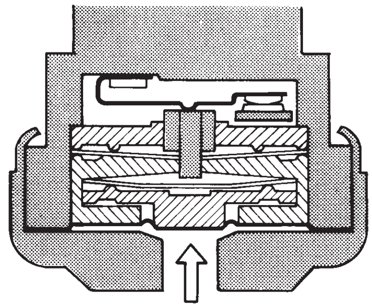


B4H0172C

(1) Point terminal
(2) Contact point
(3) Guide pin
(4) Press guide
(5) High pressure disc
(6) Low pressure disc

A: DURING NORMAL OPERATION (CONTACT POINT IS ON)

When the refrigerant pressure is applied from inside the housing to the seal film, a force is exerted from the stopper, guide head, high pressure disc and high pressure internal lid to the low pressure disc to set the low pressure guide pin free, causing the moving contact to be ON.

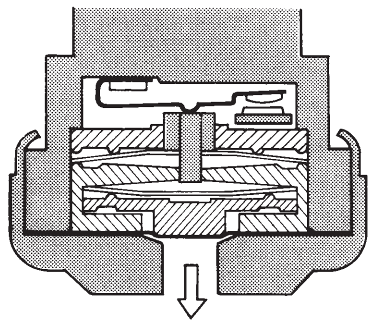


Normal pressure

B4H0173

B: DURING ABNORMAL LOW-PRESSURE OPERATION

If the refrigerant pressure falls, the pressure on the seal film is lost, and the force exerted from the stopper, guide head, high pressure disc and high pressure internal lid to the low pressure disc decreases, and the low pressure disc rotates back, pressing the guide pin down and causing the moving contact to be OFF.



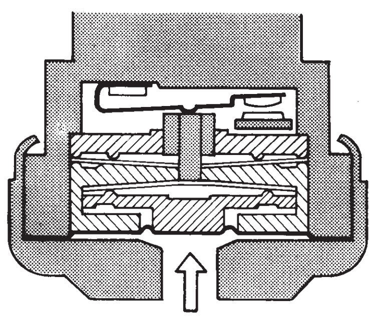
Abnormal low pressure

Approx. 177 kPa (1.8 kg/cm^2, 26 psi) or less

B4H0174

C: DURING ABNORMAL HIGH-PRESSURE OPERATION

If the refrigerant pressure becomes abnormally high, a force is exerted from the seal film to the guide head and press guide, and the high pressure disc rotates back, pressing the guide pin down and causing the moving contact to be OFF.



Abnormal high pressure

Approx. 2,940 kPa (30 kg/cm^2, 427 psi) or more

B4H0175

6. Evaporator

A: MECHANISM

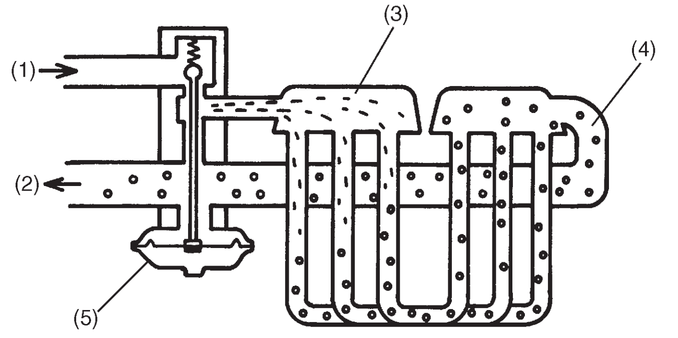
An airstream produced by a blower passes through the cooling fins and tubes. This air is warmer than the refrigerant and gives up its heat to the fins, tubes and then to the refrigerant itself. As the low pressure refrigerant moves through the evaporator, heat given up by the air passing through the evaporator causes the refrigerant to begin to boil. By the time the refrigerant has passed through the evaporator, it becomes a vapor. As the heat is absorbed by the boiling refrigerant, the fins and tubes turn cold and in turn cool the air passing over them. Moisture contained in the air condenses to water drops as it passes around the cooling tubes and fins of the evaporator. Water and dirt are then discharged outside the vehicle through the drain hose.

The evaporator is a laminated type and consists of thin, rectangular aluminum plates arranged in many layers and fins that are attached between them. The operation of the evaporator is as follows:

Misty refrigerant (very close to liquid form) from the expansion valve at a low pressure, enters the lower tube of the evaporator, where it soaks up heat from the compartment. The refrigerant boils and vaporizes quickly due to the rapid heat exchange. Then the refrigerant is pushed upward by the force of the bubble generated during the exchange and passes evaporating into the upper tube. When it reaches to upper tank, the refrigerant is in a thoroughly vaporized form.

The evaporator has a single tank, and its surface has been given a multiple treatment.

- Rustproof treatment
- Waterproof treatment
- Moldproof treatment



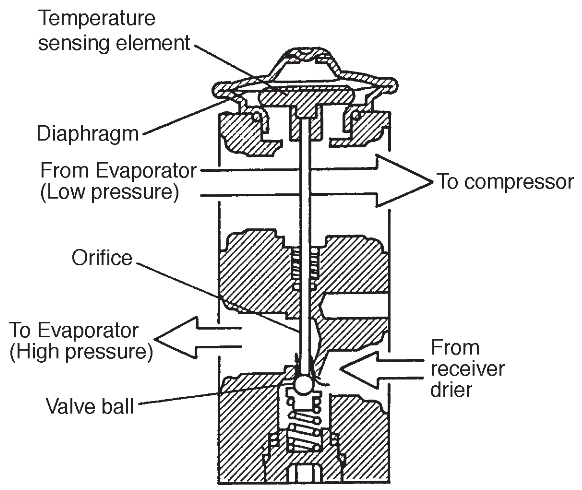
B4H1511A

(1) From receiver drier
(2) To compressor
(3) Misty refrigerant
(4) Vapor
(5) Expansion valve

7. Expansion Valve

A: MECHANISM

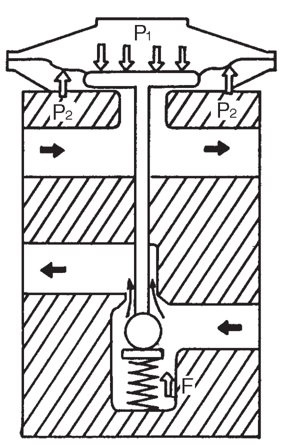
The expansion valve is attached to the evaporator inlet and outlet pipe. It converts high pressure liquid refrigerant which comes from the liquid tank to misty, low pressure refrigerant, and delivers to the evaporator. Being at low pressure and low temperature, the liquid refrigerant evaporates in the evaporator removing heat from the compartment. It automatically controls the flow rate of refrigerant to obtain the necessary cooling ability required by the fluctuating heat load.
The refrigerant temperature is sensed by the temperature sensing element installed at the low pressure refrigerant passage in the expansion valve, and the flow rate of the refrigerant is controlled by changing the lift of the valve ball at the high pressure side.



H4H1123A

B: FUNCTION

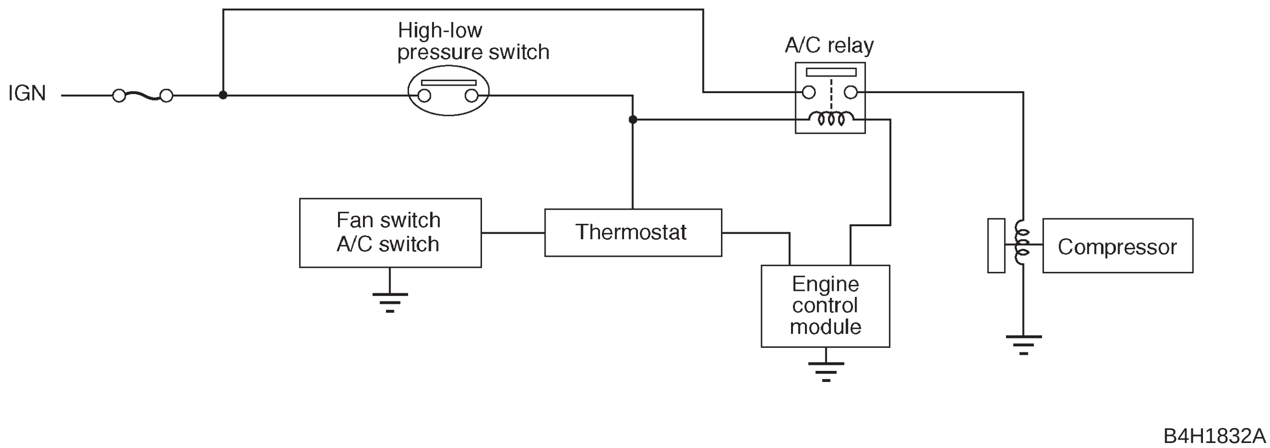
If the heat load of the air conditioner system increases, the refrigerant temperature at the evaporator outlet rises and therefore increases the pressure P_1 at around the temperature sensing area. As this pressure P_1 becomes higher than the resultant force of evaporator outlet (low pressure side) pressure P_2 and the spring force F ($P_1 > P_2 + F$), the diaphragm is pressed down, opening the valve ball connected to the diaphragm to increase the flow of the refrigerant.
If the heat load decreases, the action contrary to the one mentioned above takes place, closing the valve to decrease the flow of the refrigerant.



H4H1124

8. Compressor Clutch “ON” Delay System

When air conditioning system relay operates, a signal is entered into engine control module. Engine control module then judges engine operation and activates A/C relay. Maximum clutch “ON” delay occurs 0.8 seconds after A/C relay activates.



9. Compressor Control System

A: GENERAL

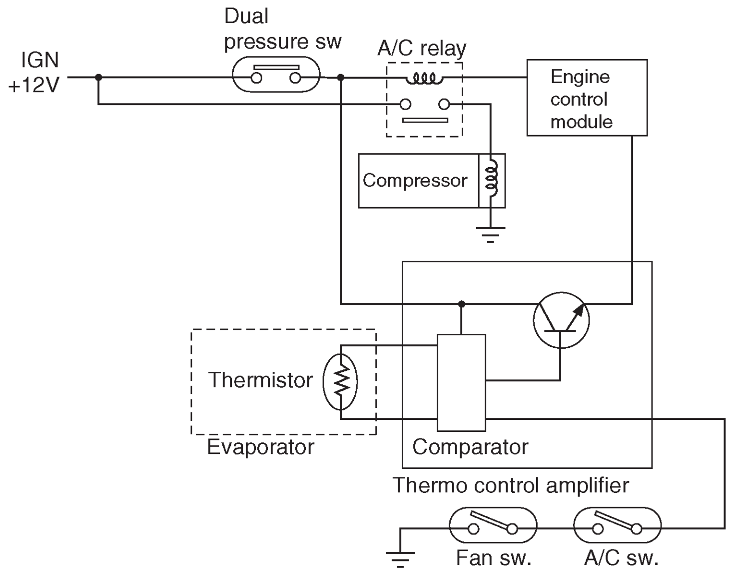
1) When the A/C switch and fan switch are turned ON, the A/C relay activates. The compressor is turned on, and then the main and sub fans also operate. Blower relay operates to direct the air flowrate determined by FAN switch position.

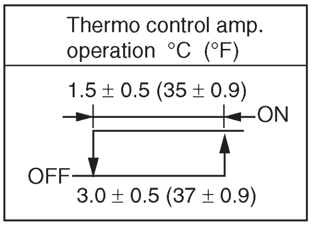
2) The thermo amplifier activates to stop the compressor clutch and main and sub fans.

3) When the “High-Low” pressure switch operates, the compressor clutch is stop and the main and sub fans are stop.

B: THERMO CONTROL AMPLIFIER

The thermo control amplifier disconnects the magnet clutch circuit to prevent the evaporator from becoming frosted when the temperature of the evaporator fin drops close to “3°C (37°F)”. As the evaporator is cooled, the thermistor (located on the evaporator fin) interrupts the “base” current of the amplifier. This in turn deenergizes the A/C relay coil, which in turn disconnects the magnet clutch circuit.



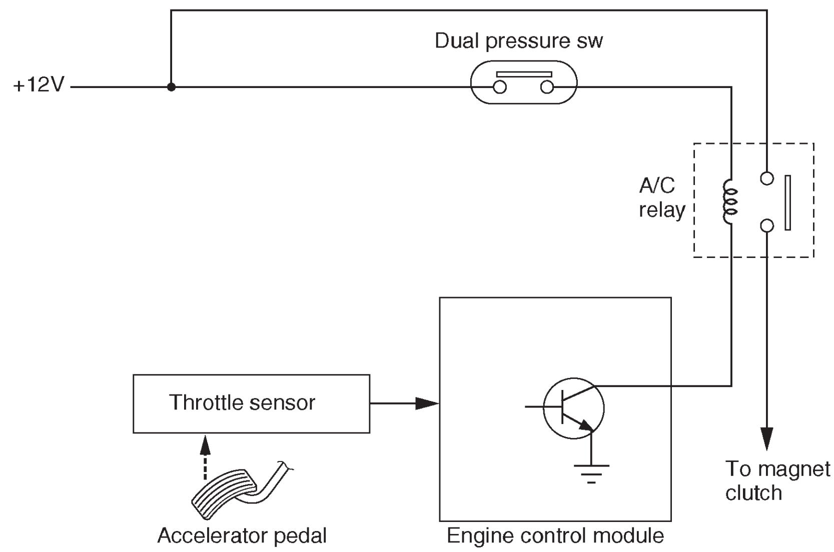


B4H2242A

C: ACCELERATION CUT SYSTEM

The A/C switch turns the A/C system ON or OFF. The on-off operation of the switch is transmitted to the ECM.

The A/C relay breaks the current flow to the compressor, through the use of an output signal from the ECM, for a certain period of time when a "full-throttle" signal (emitted from the throttle sensor) enters the ECM while the compressor is operating. This prevents the degradation of acceleration performance and stabilizes the main fuse box located on the left side of the engine compartment.

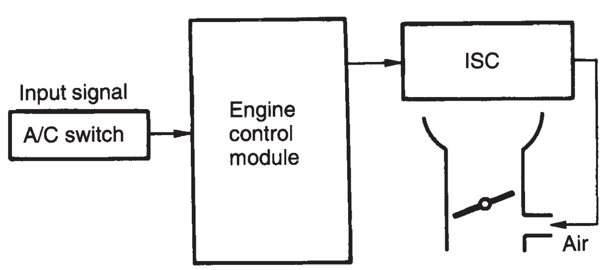


B4H1834A

D: I.S.C.

The I.S.C. increases engine idle speed when the compressor is turned ON.

The Engine Control module activates the idle speed control solenoid valve in advance to control the amount of by-pass air flowing through the throttle body in relation to the signal emitted from the A/C switch, so that the proper idle speed specified for each engine load is achieved.



B4H0181

E: FAN CONTROL

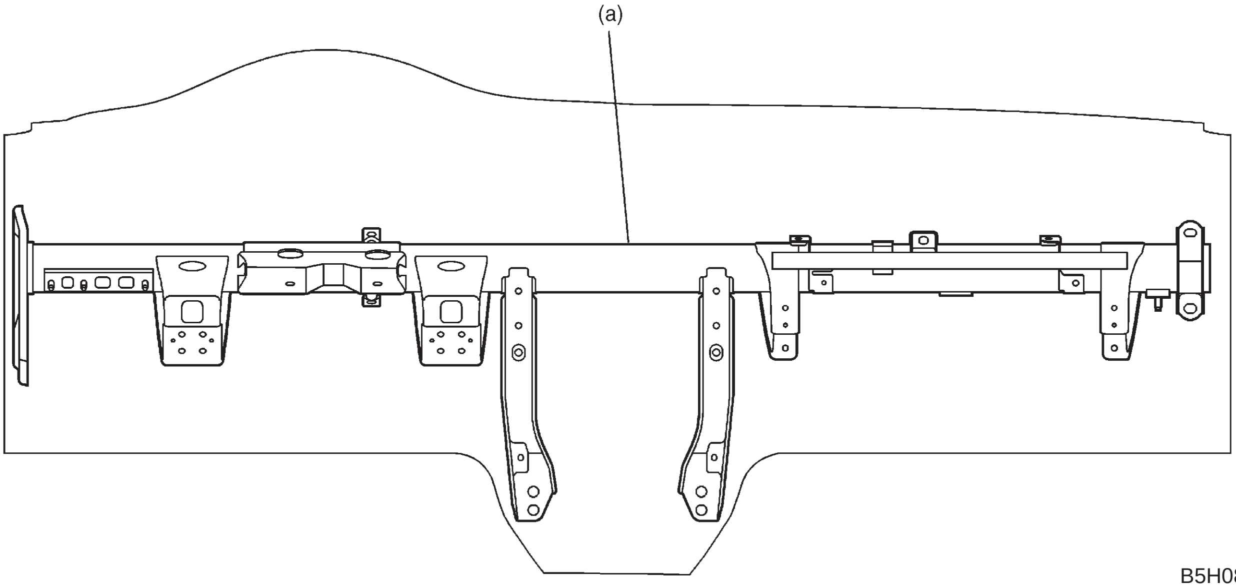
The main fan and sub fan are switch turn ON and OFF, according to the operating modes shown in the following table.

Vehicle speed	A/C compressor	Engine coolant temperature					
		Less than 95°C (Less than 203°F)		Between 95 and 99°C (Between 203 and 210°F)		More than 100°C (More than 212°F)	
		Operation of radiator fan		Operation of radiator fan		Operation of radiator fan	
		Main	Sub	Main	Sub	Main	Sub
Less than 19 km/h (Less than 12 MPH)	OFF	OFF	OFF	ON	OFF	ON	ON
	ON	ON	ON	ON	ON	ON	ON
Between 20 and 69 km/h (Between 12 and 43 MPH)	OFF	OFF	OFF	ON	OFF	ON	ON
	ON	ON	ON	ON	ON	ON	ON
Between 70 and 105 km/h (Between 43 and 65 MPH)	OFF	OFF	OFF	OFF	OFF	ON	ON
	ON	ON	OFF	ON	ON	ON	ON
More than 106 km/h (More than 66 MPH)	OFF	OFF	OFF	OFF	OFF	ON	ON
	ON	OFF	OFF	ON	OFF	ON	ON

1. Steering Support Beam

A steering support beam (a) is provided between the left and right front pillars to reinforce the steering column.

It also minimizes vibration and steering column extension in a collision.



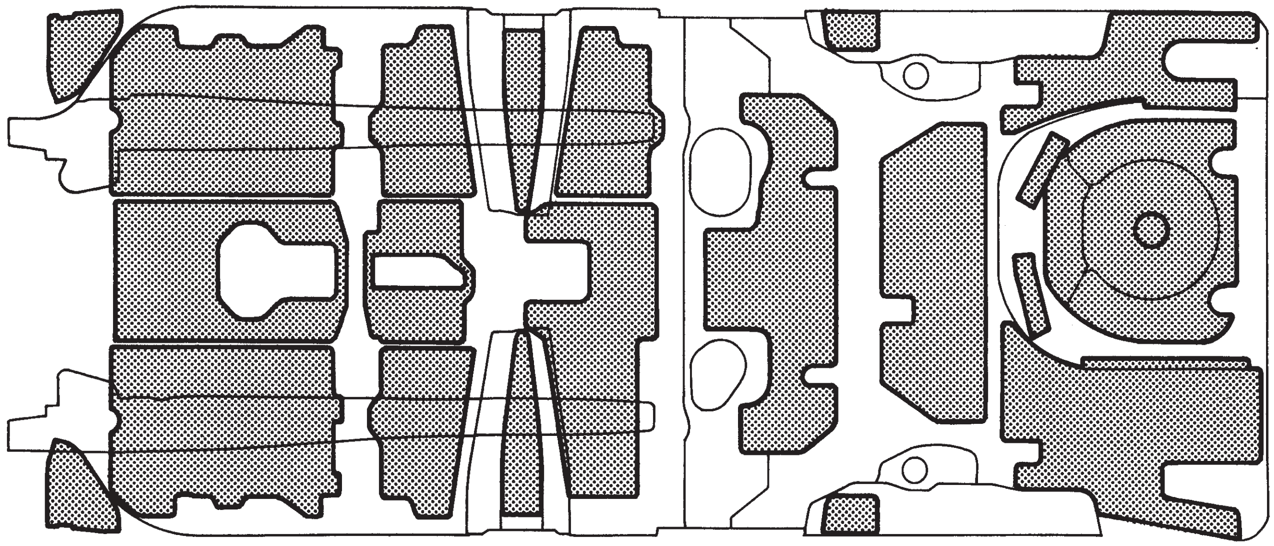
B5H0830A

2. Quietness

Silencers, dual-wall panels, sound-absorbing materials, etc. are utilized in conjunction with a high-rigidity and vibration/noise-proof body structure in order to provide a quiet passenger compartment.

A: SILENCERS

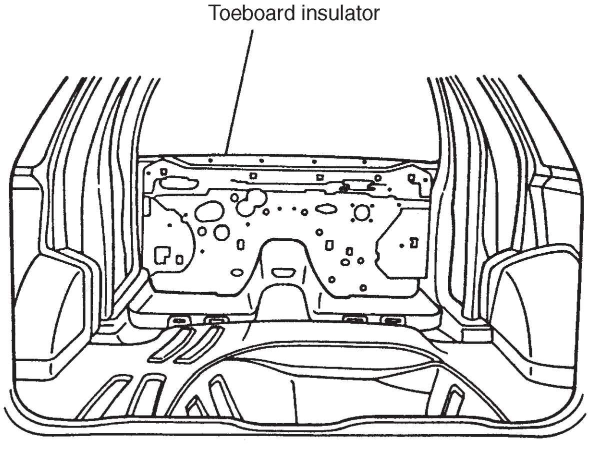
They (= asphalt sheets) minimize the transmission of noise/vibration into the passenger compartment.



B5H0612

B: DUAL-WALL TOEBOARD

The toeboard is a dual-wall design consisting of an asphalt sheet placed between two steel panels to reduce the transmission of noise and vibration from the engine compartment to the passenger compartment.



B5H0613A

3. Body Sealing

A: SEALED PARTS

All gauge hole and other holds used during the body manufacturing process are plugged to prevent entry of water and dust.

Any time the vehicle body has been repaired, etc., the affected holds should be properly plugged with the use of the specified plugs.

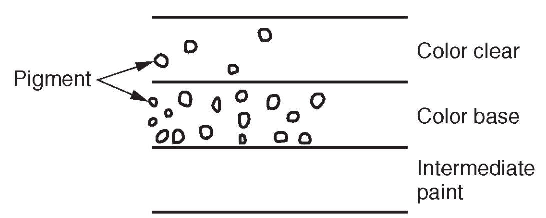
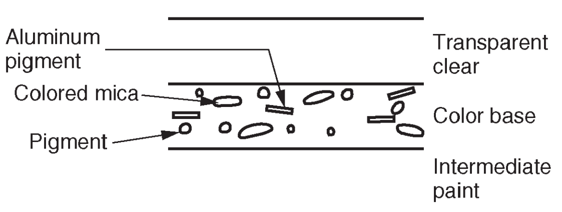
4. Painting

A: SPECIFICATION

Color name	Color code
CREAM WHITE	82X
DARK RED MICA	841
GREEN GRAY (M)	444
DARK GREEN MICA	83N
NEW DARK BLUE MICA	466
WARM GRAY OPAL	89N
BLACK MICA	54A
RIO RED	946
★ NEW DARK BLUE MICA / WARM GRAY OPAL	8Y8 (466 / 89N)
★ DARK GREEN MICA / WARM GRAY OPAL	8K4 (83N / 89N)
★ BLACK MICA / WARM GRAY OPAL	8Y7 (54A / 89N)
★ CREAM WHITE / WARM GRAY OPAL	8Y3 (82X / 89N)
★ DARK RED MICA / WARM GRAY OPAL	8X5 (841 / 89N)
★ GREEN GRAY (M) / WARM GRAY OPAL	8X7 (444 / 89N)

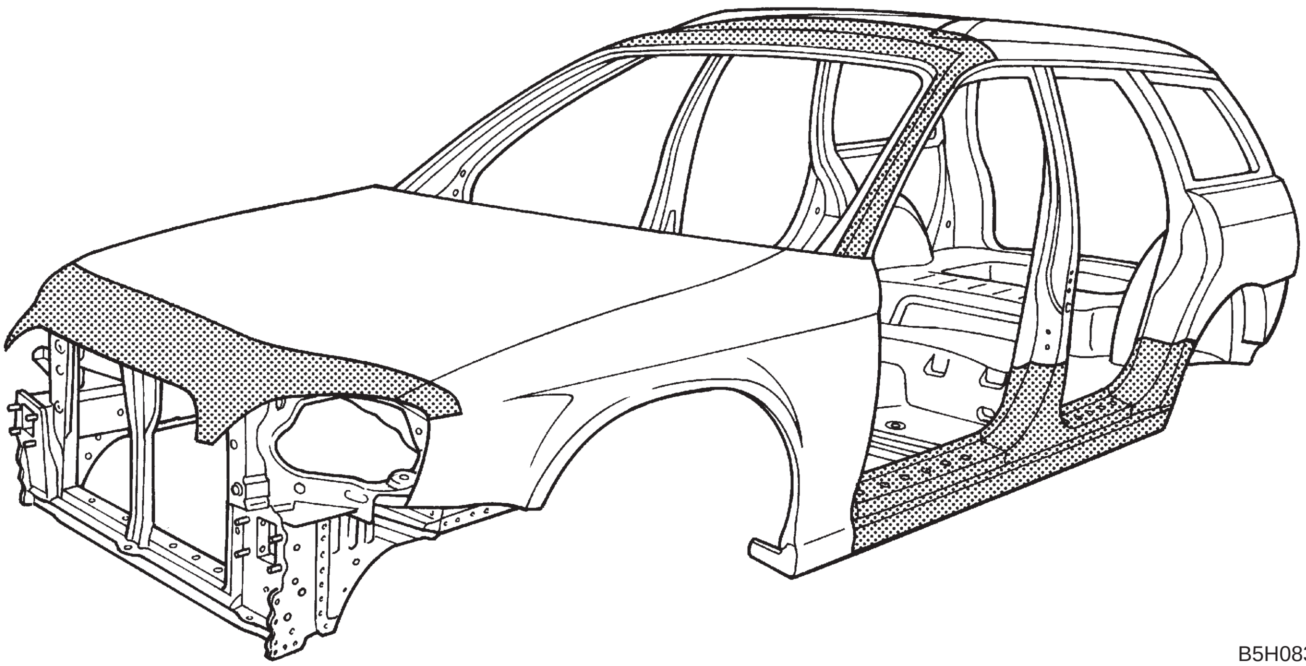
(M): Metallic
★: 2-tone

B: PAINT FILM STRUCTURE

Color name	Paint film structure
• CREAM WHITE • RIO RED	
• BLACK MICA • DARK GREEN MICA • NEW DARK BLUE MICA • DARK RED MICA • WARM GRAY OPAL • GREEN GRAY (M) (M): Metallic	

B5H0614B

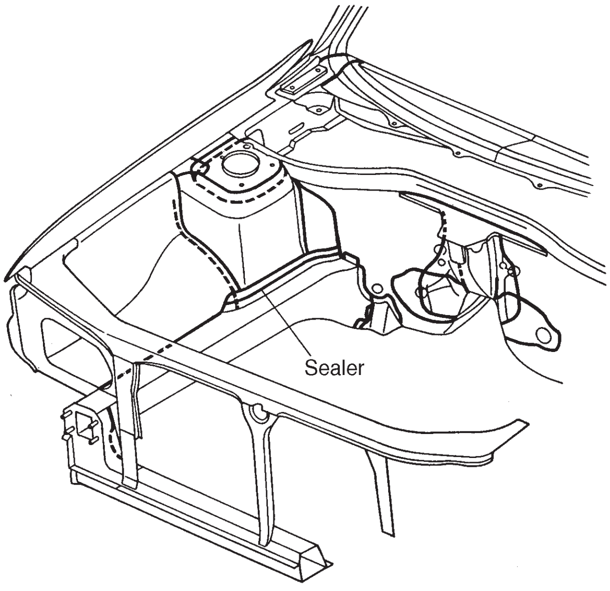
5. Anti Chipping Coat (ACC) Application



B5H0831

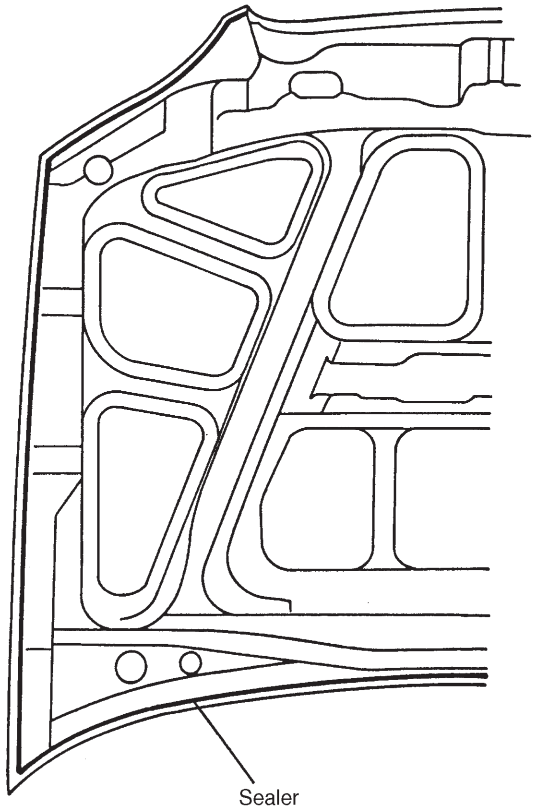
6. Sealer Application

A: ENGINE ROOM



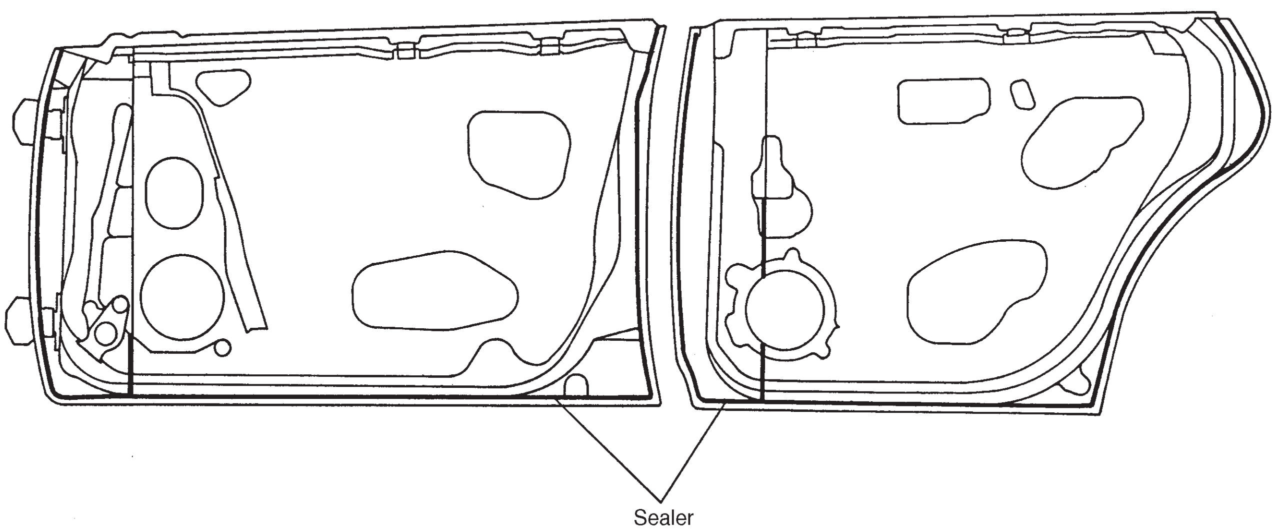
B5H0616A

B: FRONT HOOD



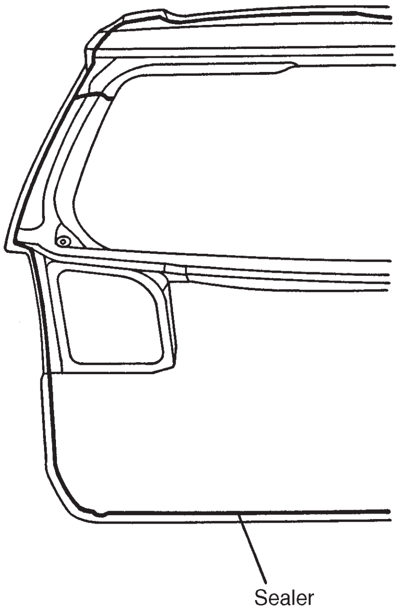
B5H0617A

C: DOOR



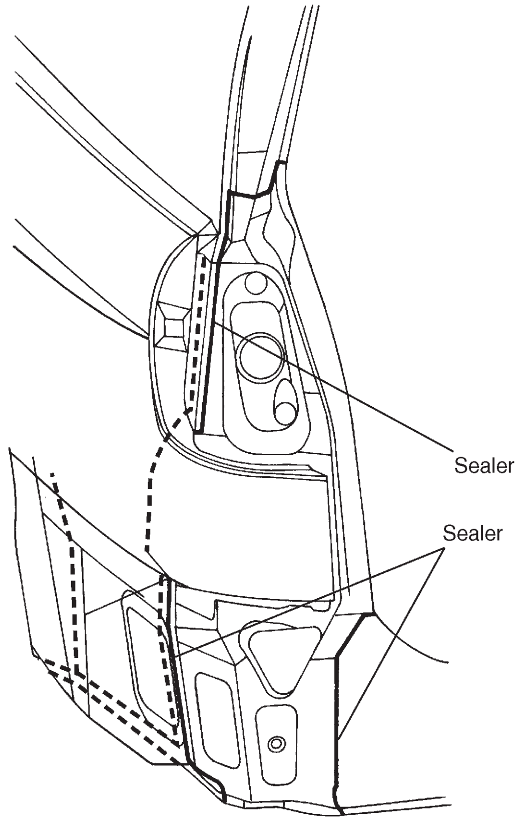
B5H0618A

D: REAR GATE



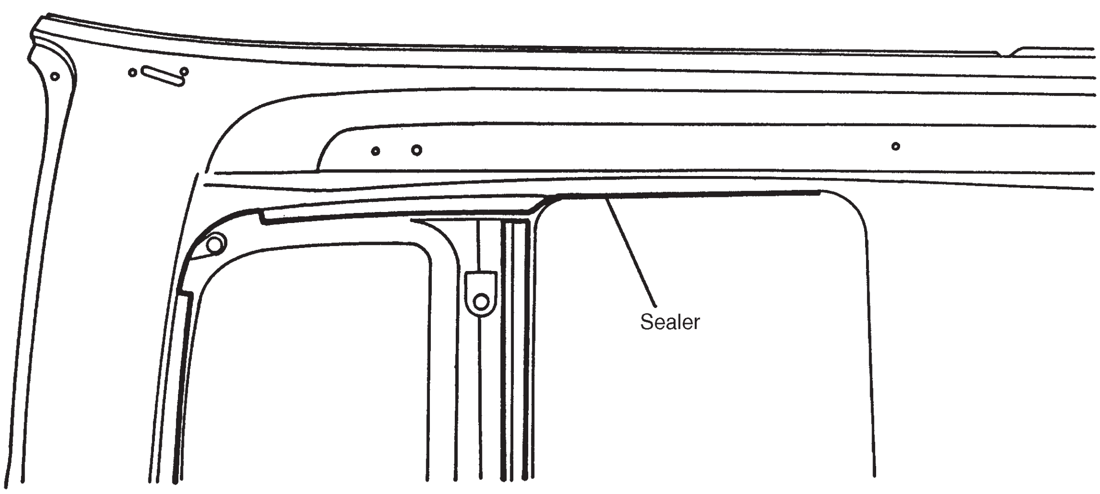
B5H0619A

E: REAR END (WAGON)



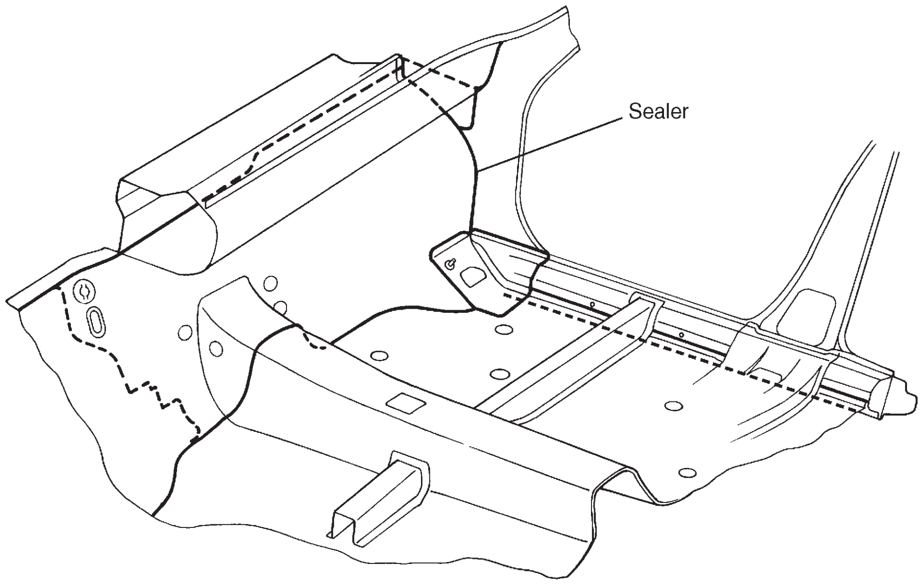
B5H0832A

F: ROOF PANEL (WAGON SUN ROOF)



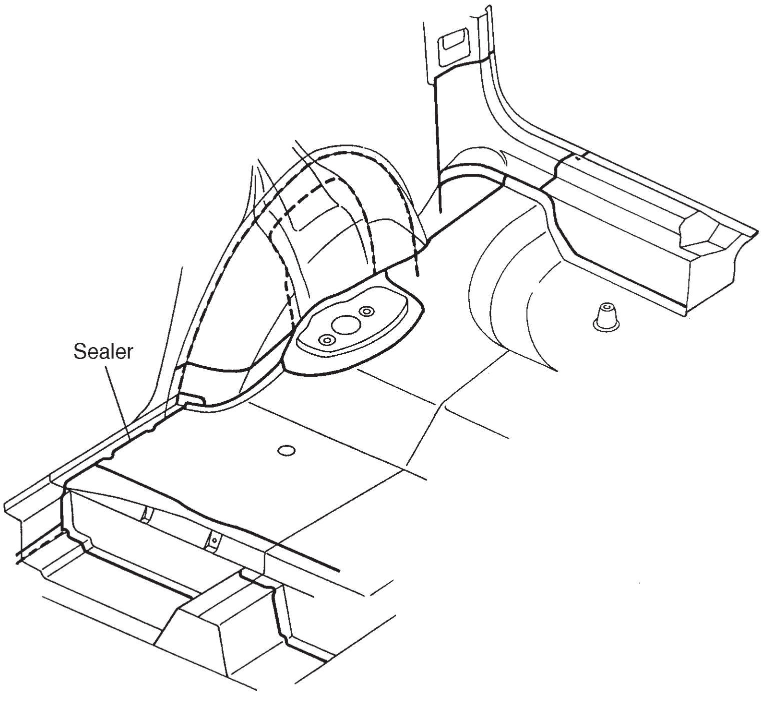
B5H0621A

G: FRONT FLOOR



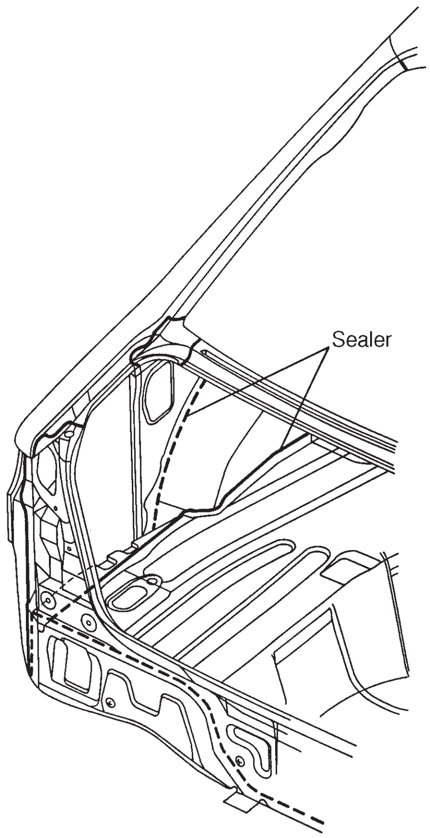
B5H0833A

H: REAR FLOOR



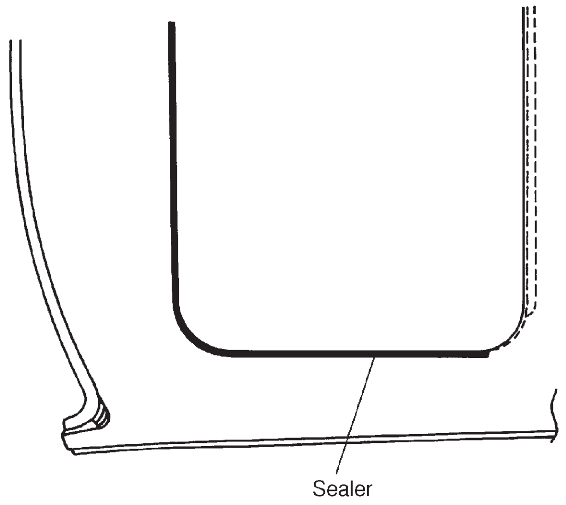
B5H0623A

I: REAR END (SEDAN)



B5H0788A

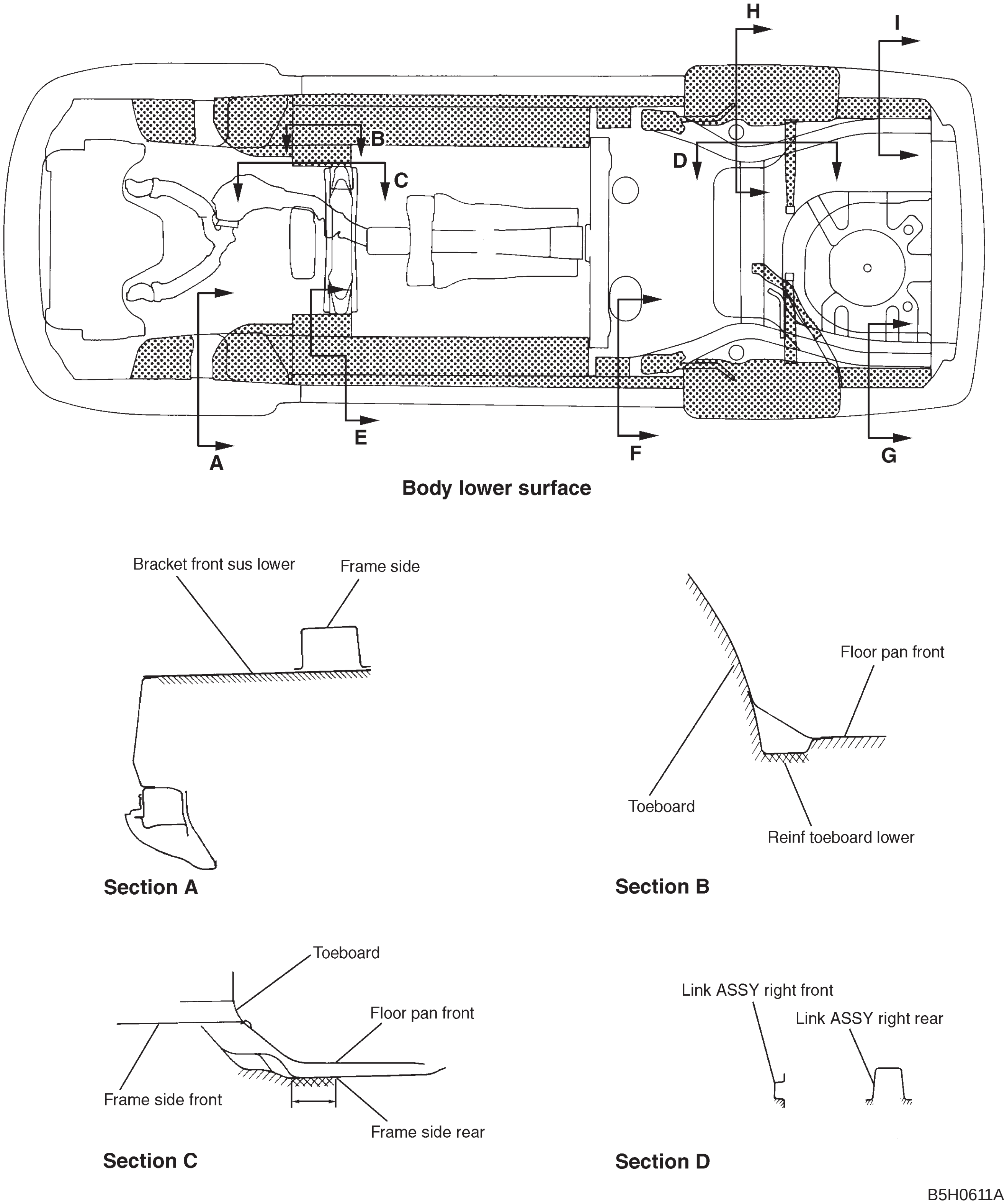
J: ROOF PANEL (SEDAN SUN ROOF)

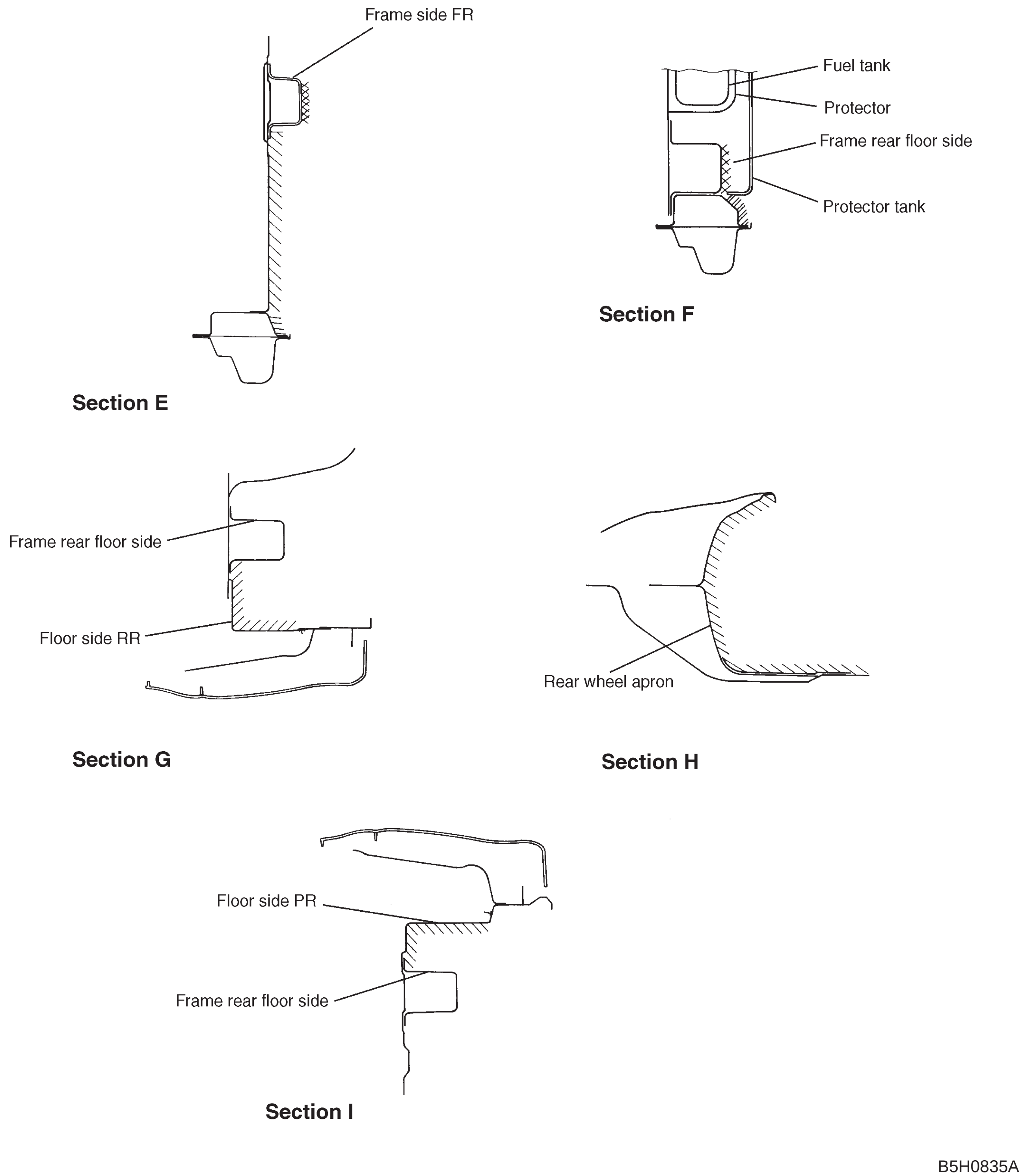


B5H0834A

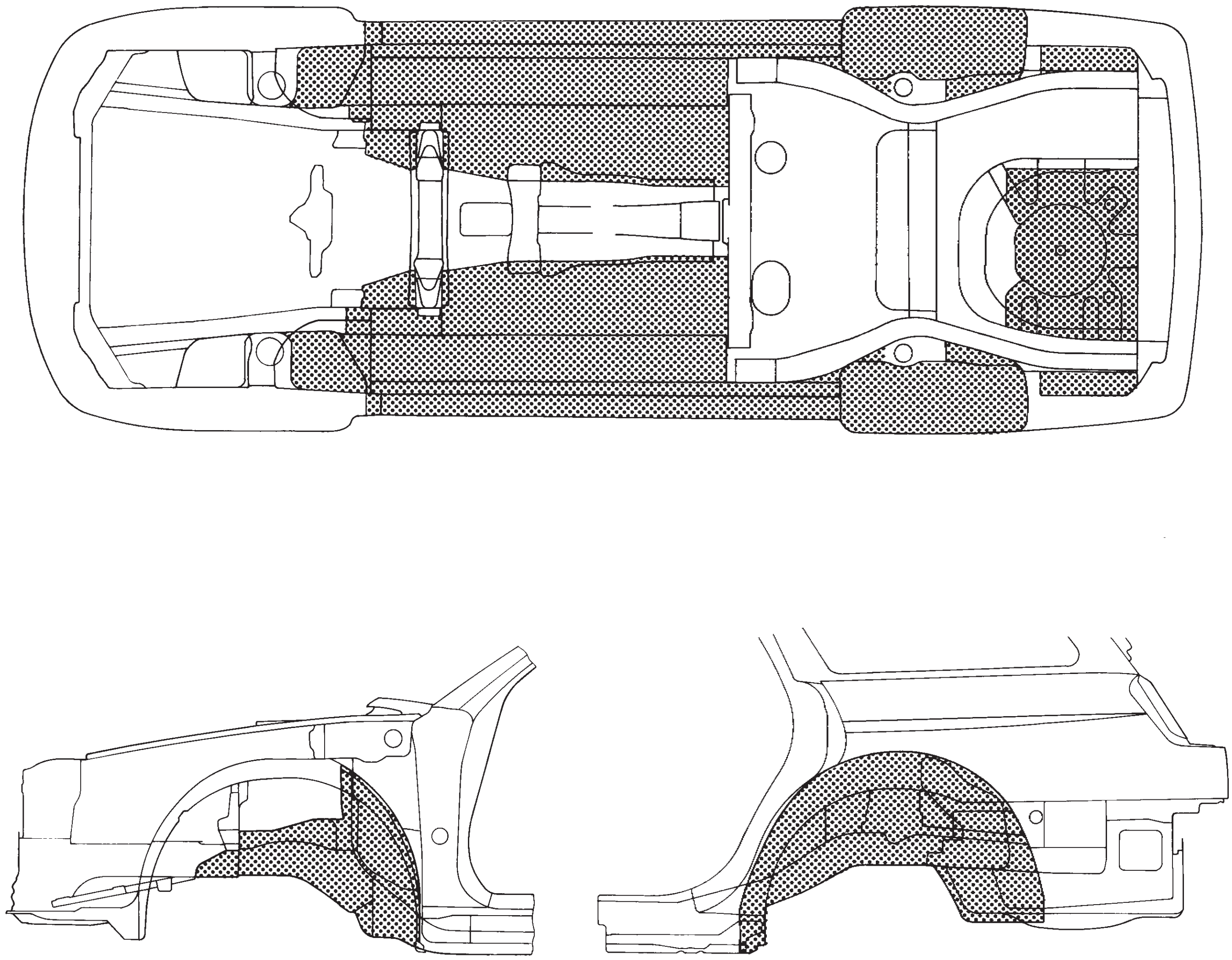
MEMO

7. Anti-rust Wax (Bitumen Wax) Application



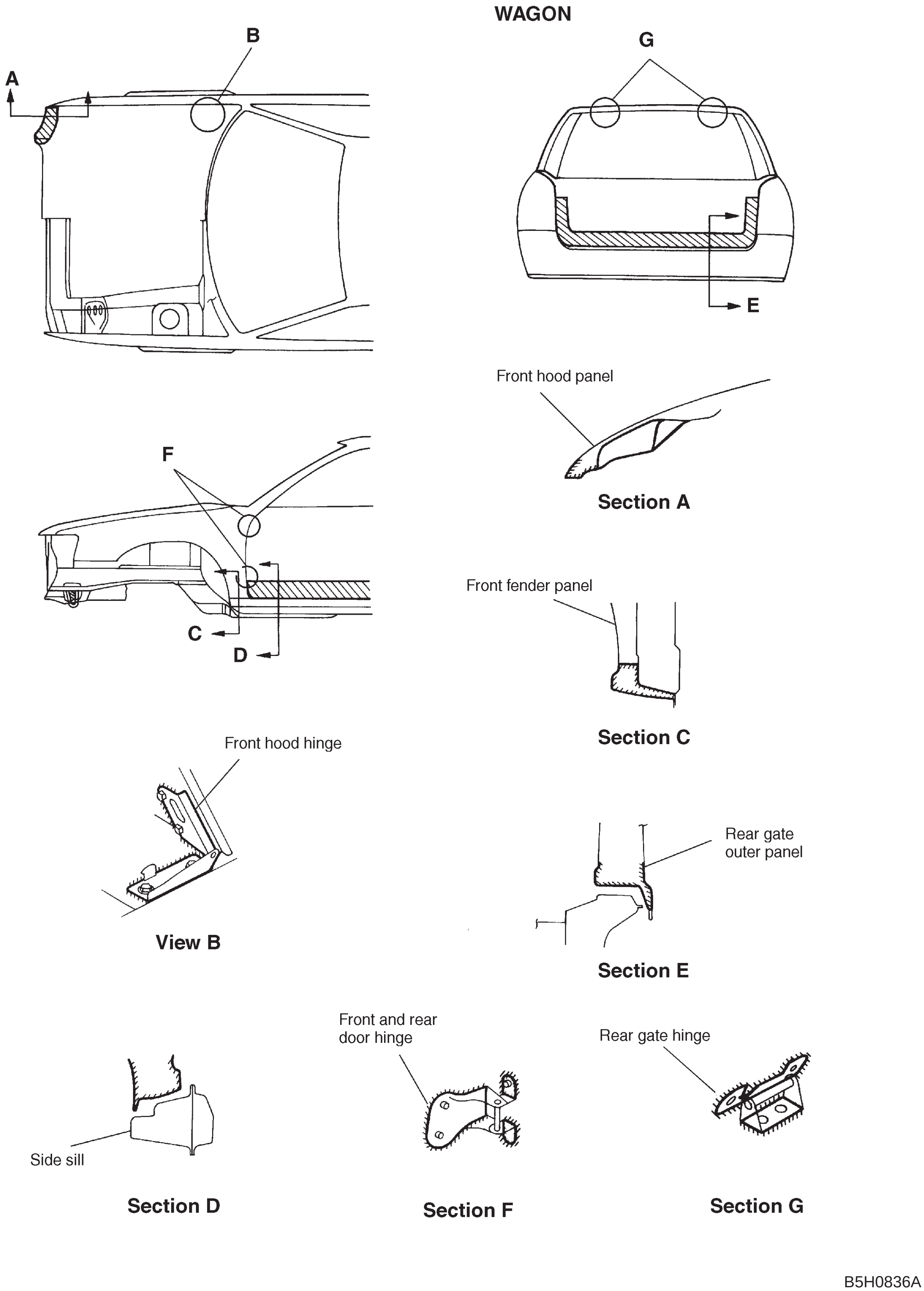

Frame side FR
Section E
Fuel tank
Protector
Frame rear floor side
Protector tank
Section F
Frame rear floor side
Floor side RR
Section G
Rear wheel apron
Section H
Floor side PR
Frame rear floor side
Section I
B5H0835A

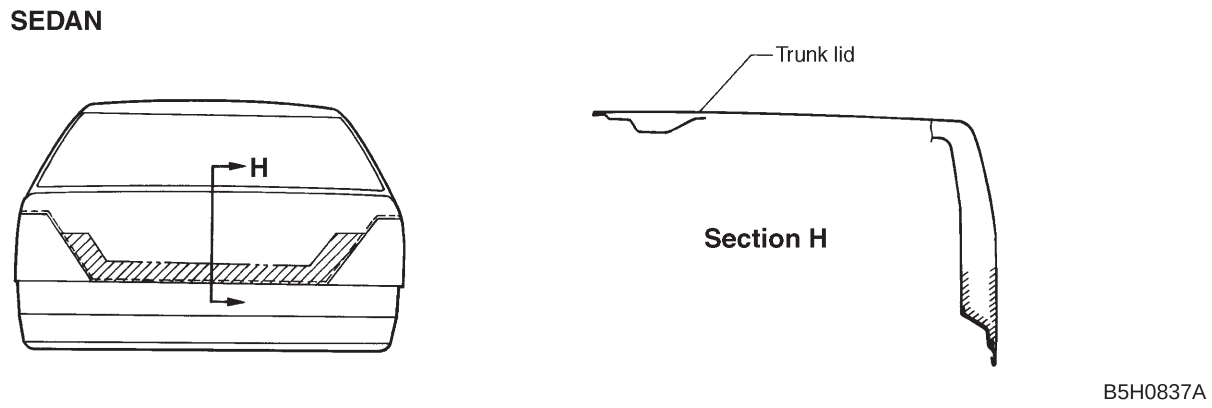
8. Polyvinyl Chloride (PVC) Application



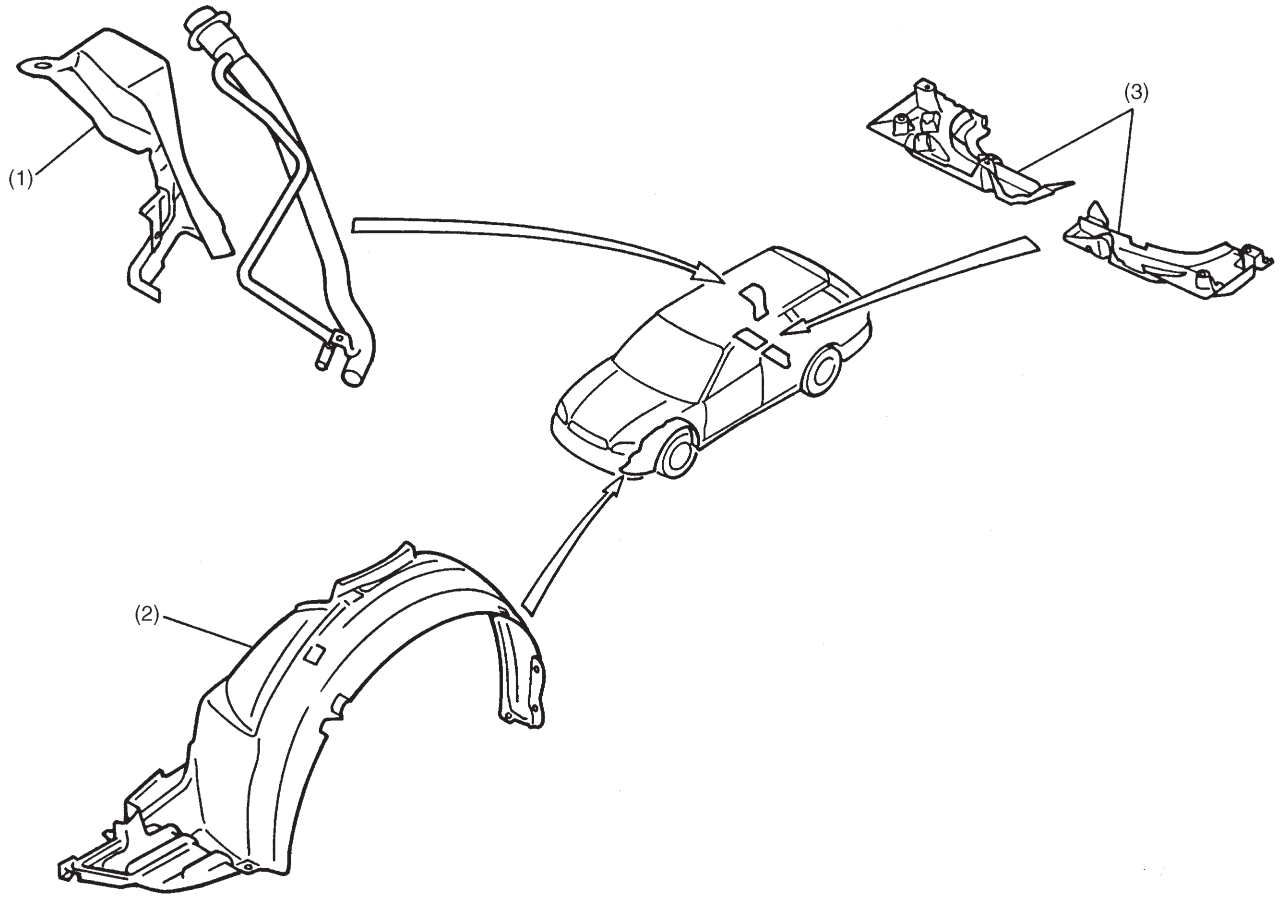
B5H0624

9. Hot Wax Application



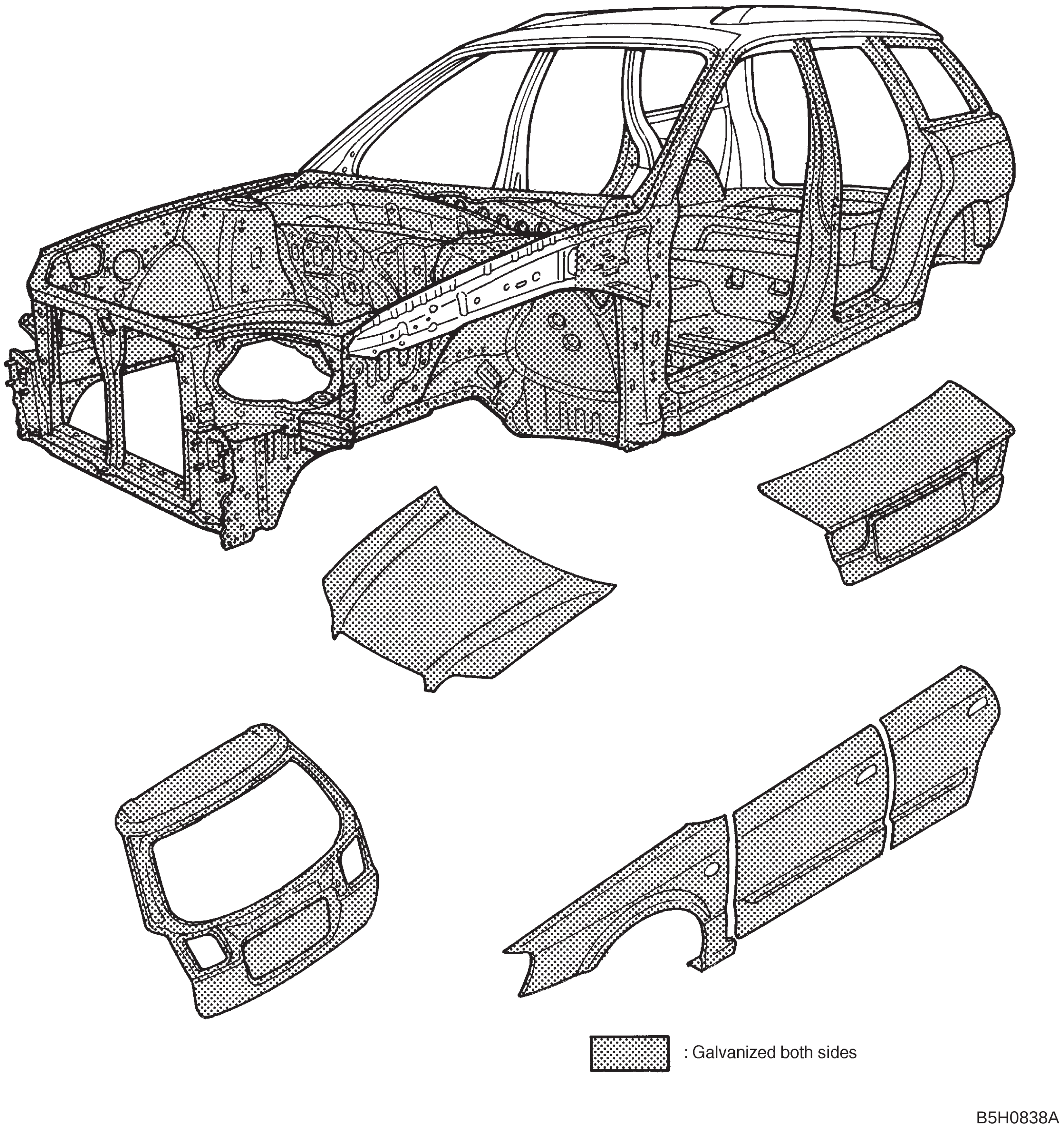

SEDAN
H
Trunk lid
Section H
B5H0837A

10. Rustproof Parts



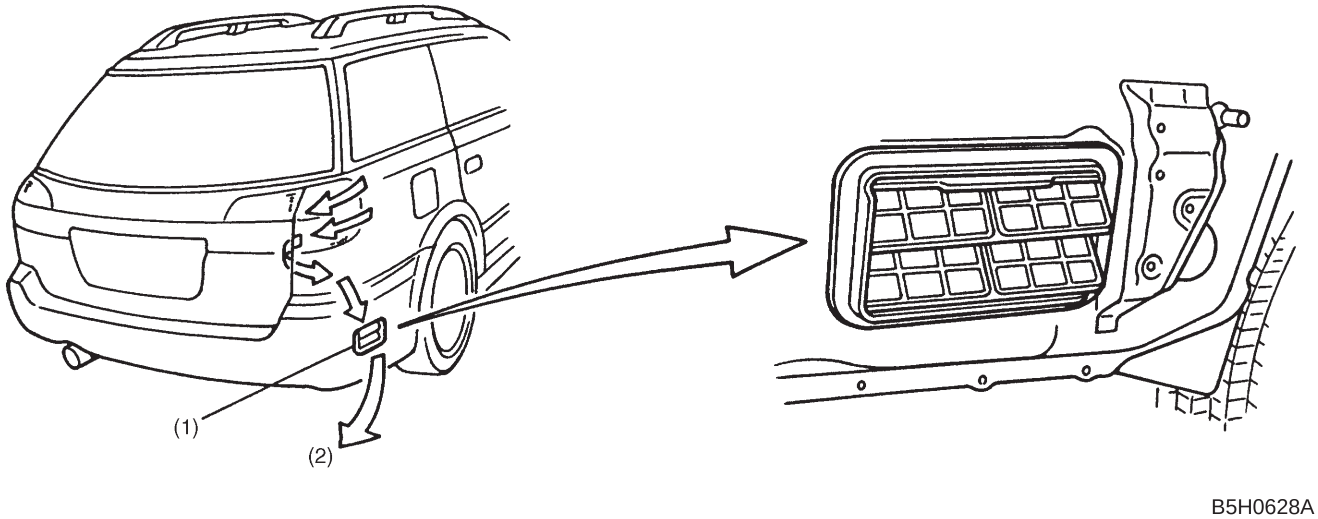
(1) Fuel pipe protector
(2) Front mud guard
(3) Fuel tank protector

11. Galvanized Sheet Metal Application



12. Ventilation

A: AIR OUTLET PORT



(1) Air outlet port

(2) Air flow

13. Sunroof

A: SEDAN

1. DESCRIPTION

The sunroof has two operating mechanisms. One raises the rear of the glass lid for ventilation and the other fully opens the glass lid.

The sunroof also has the following features:

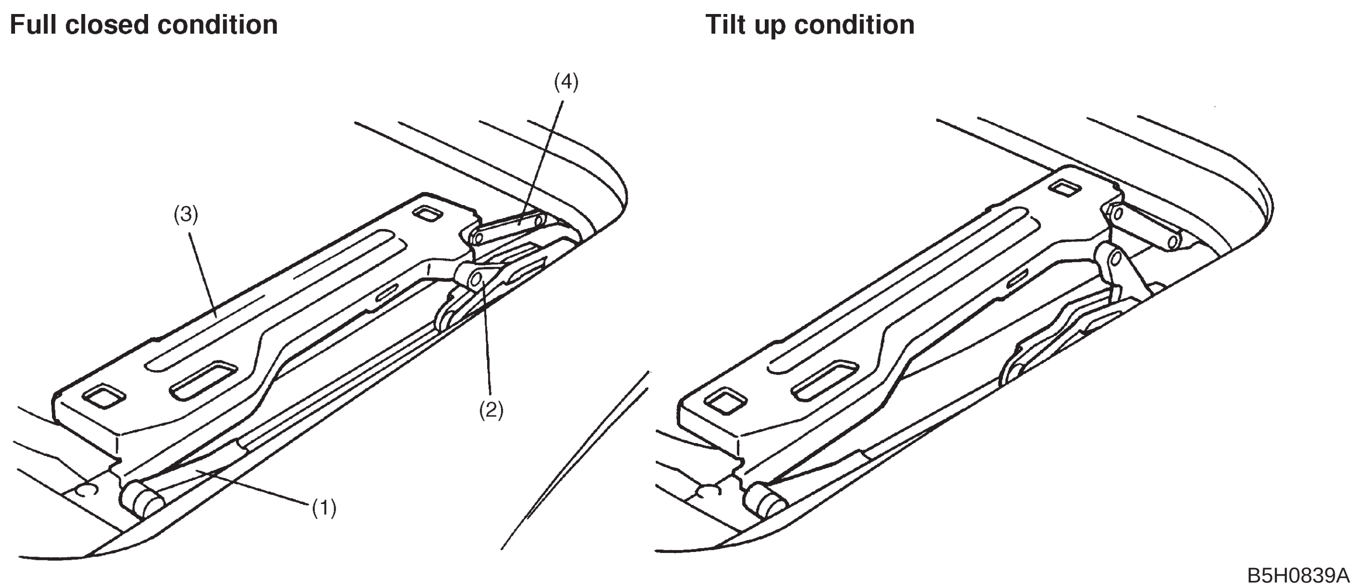
- The reduced thickness of the roof provides extra-overhead clearance in the passenger compartment.
- Die-cast aluminium is used for sun roof components, thus reducing weight.

Operation (Operating time)	When opened:	Fully closed → tilted-down → Pause after tilt-down → Slide to rear in tilted-down mode → Fully open (Fully closed → 0.5 – 1.5 sec → Pause after tilt-down → 4.0 – 6.5 sec → Fully open)
	When closed:	Fully open → Slides to front in tilted-down mode → Pause with 150 mm (5.91 in) open → From tilt-down to tilt-up while sliding → Fully colsed (Fully open → 1.5 – 2.5 sec → Pause with 150 mm (5.91 in) open → 2.5 – 4.5 sec → Fully closed)

2. SLIDE AND TILT-UP MECHANISM

The motor installed at the front of the sunroof frame rotates the pinion gear to slide the driving wire.

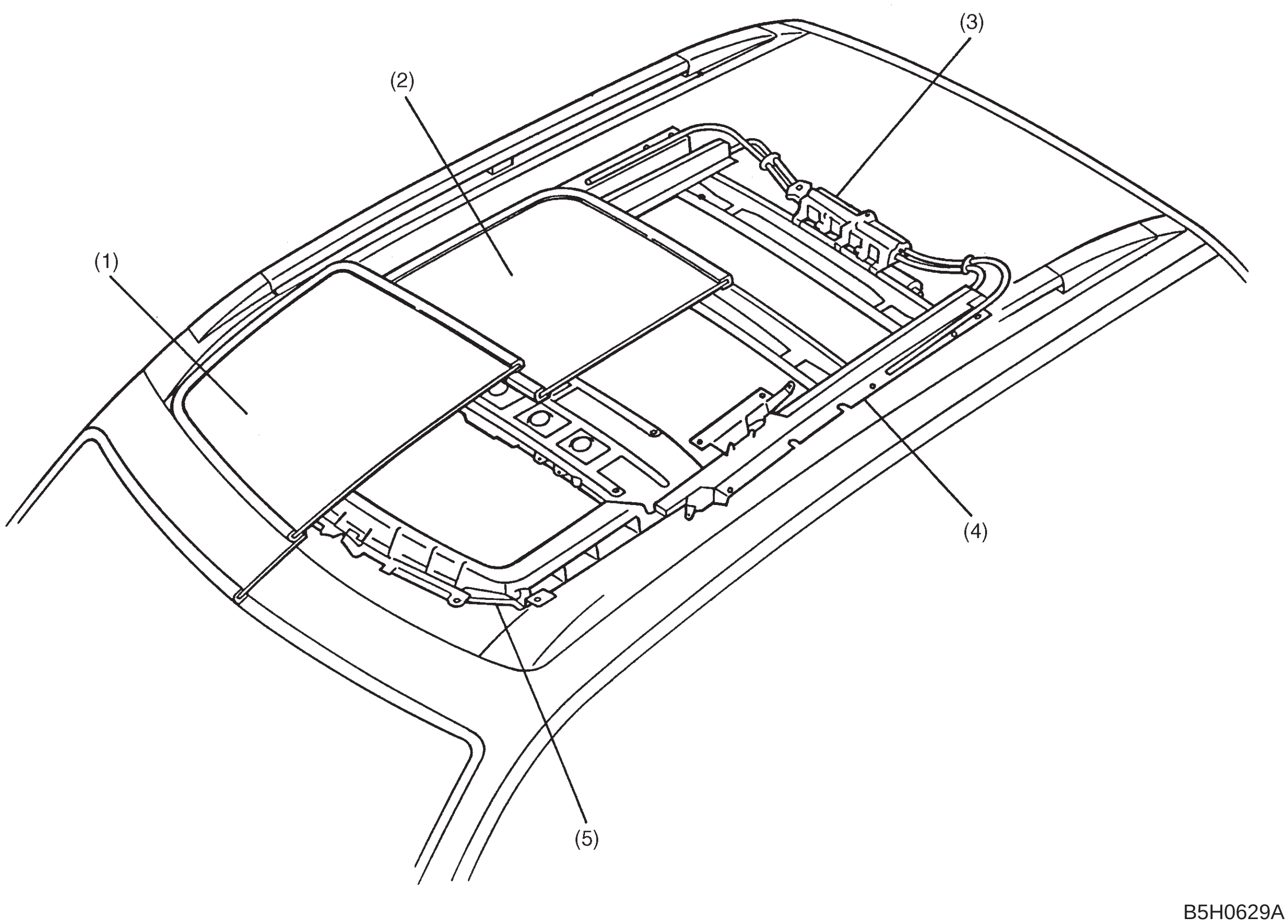
This will open, close, tilt up or tilt down the glass lid through the rear guide connected to the driving wire.



(1) Front guide
(2) Rear guide
(3) Lid bracket
(4) Link

B: WAGON

1. DESCRIPTION



(1) Front glass lid
(2) Rear glass lid
(3) Motor
(4) Rear frame
(5) Front frame

- The front sunroof is a tilt up type glass sunroof and can rise to height of 50 mm (1.97 in).
- The rear sunroof is a sliding type glass sunroof and has an opening of 340 mm (13.39 in) in length and 632 mm (24.88 in) in width.
- The sunroof consists of a 4 mm (0.16 in) thick glass lid and sunshade.

2. FUNCTION

● OPEN / CLOSE OPERATION

● When the sunroof is fully closed, if the sunroof switch OPEN button continues to be depressed, the rear end of the front glass lid will tilt up 50 mm (1.97 in) and then come to a stop. If the switch is kept pressed again, the rear glass lid continues to open until it reaches a point 200 mm (7.87 in) away from the front brim of the opening.
The glass lid goes to fully open position if the sunroof switch is pressed again.

● When the sunroof is fully open, if the sunroof switch CLOSE button continues to be depressed, the rear glass lid continues to close until it reaches a point still 150 mm (5.91 in) away from the front brim of the opening.
The rear glass lid goes to fully closed position if the sunroof switch is pressed again.
The sunroof switch is kept pressed again, the front glass lid goes to fully closed position.

● SUNSHADE OPERATION

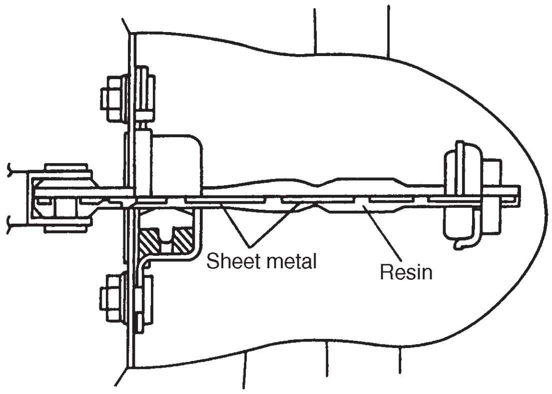
● The front sunshade can manually be opened or closed regardless of the position of the front glass lid.

● The rear sunshade automatically opened/closed in combination with the opened/closed operation of the glass lid. When the glass lid is fully closed, the sunshade can be opened/closed manually

1. Door

A: DOOR CHECKER

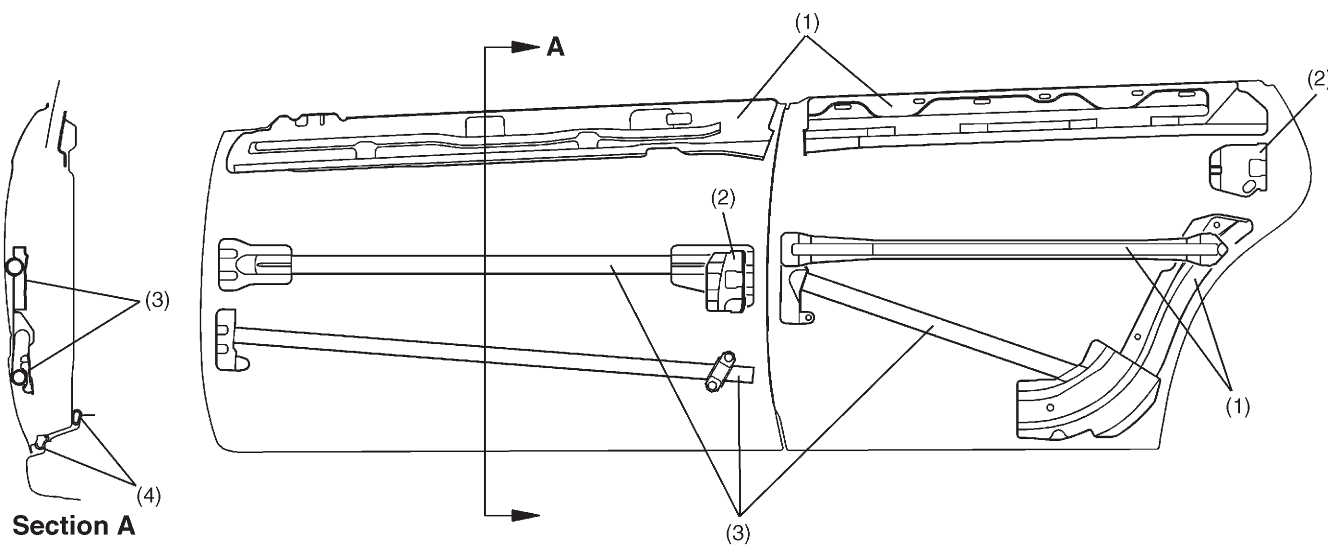
A resin molding type door checker is introduced.



S5H0001A

B: DOOR CONSTRUCTION

- All front and rear doors are fitted with side door beams, inner reinforcements and a reinforcement latch.
- Dual sealing is adopted.



B5H0821A

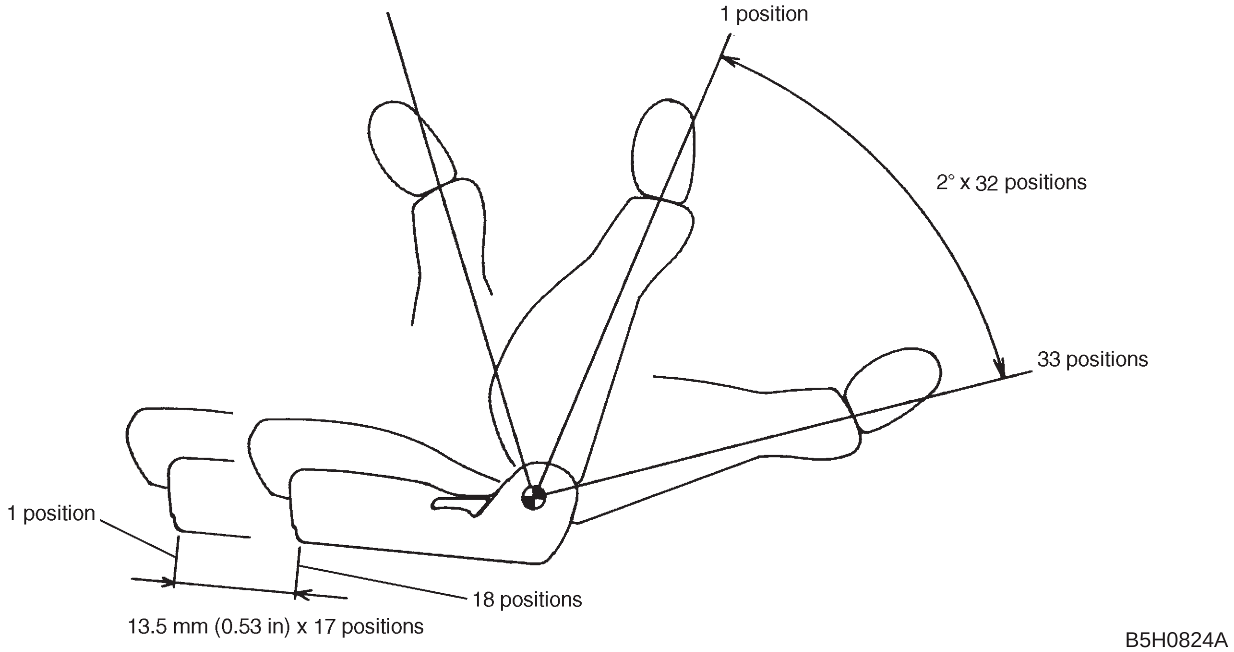
(1) Inner reinforcement	(3) Side door beam
(2) Reinforcement latch	(4) Dual sealing

1. Front Seat

A: ADJUSTMENT

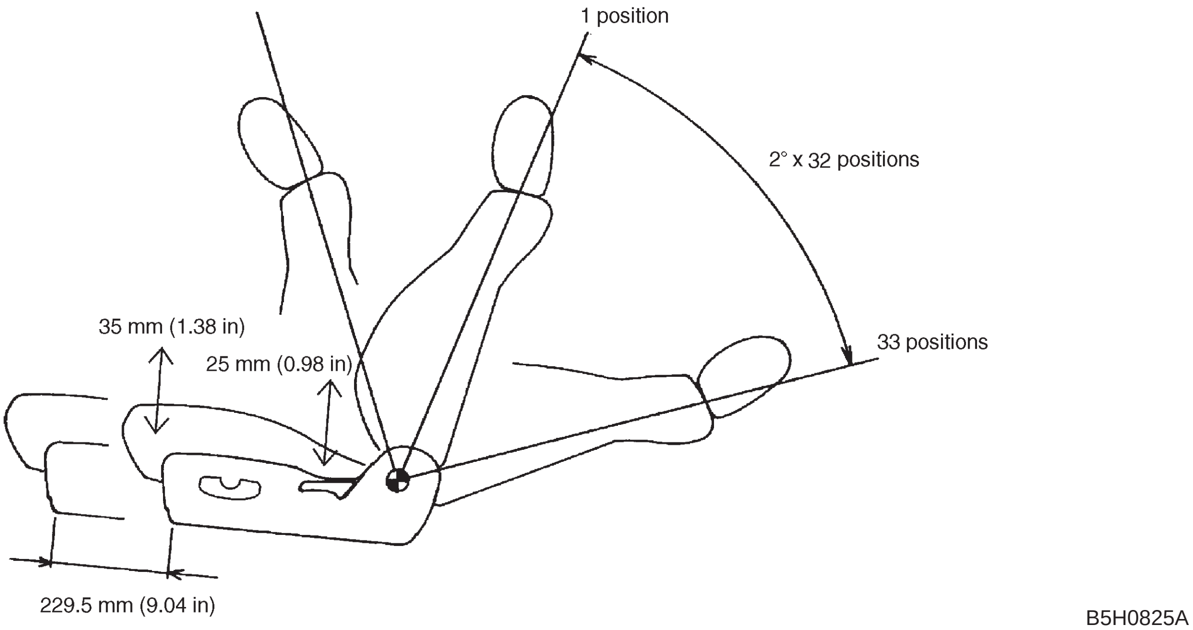
1. CONVENTIONAL SEAT

- The height of each headrest is adjustable to 4 positions at 18 mm (0.71 in) steps.
- The angle of each backrest is adjustable to 32 positions at 2° steps.
- The front seat can be slid back and forth to one of 17 positions at 13.5 mm (0.53 in) steps.



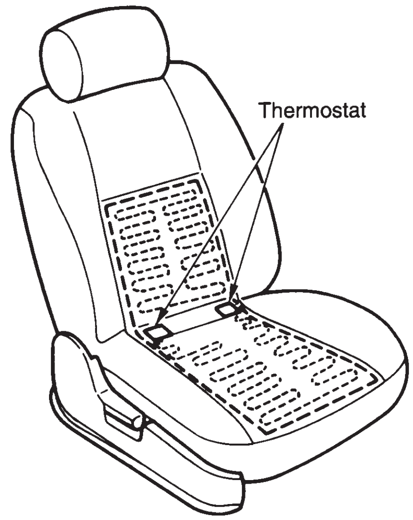
2. POWER SEAT

- Driver's seat is equipped with power adjustment mechanisms to provide fore-aft of front seat and height or angle adjustment of cushion using corresponding switch as desired.
- The height of each headrest is adjustable to 4 positions at 18 mm (0.71 in) steps.
- The angle of each backrest is adjustable to 32 positions at 2° steps.
- The front seat can be slid back and forth to between 229.5 mm (9.04 in).
- The front portion height of seat cushion can be adjusted to between 35 mm (1.38 in).
- The rear portion height of seat cushion can be adjusted to between 25 mm (0.98 in).



B: SEAT HEATER

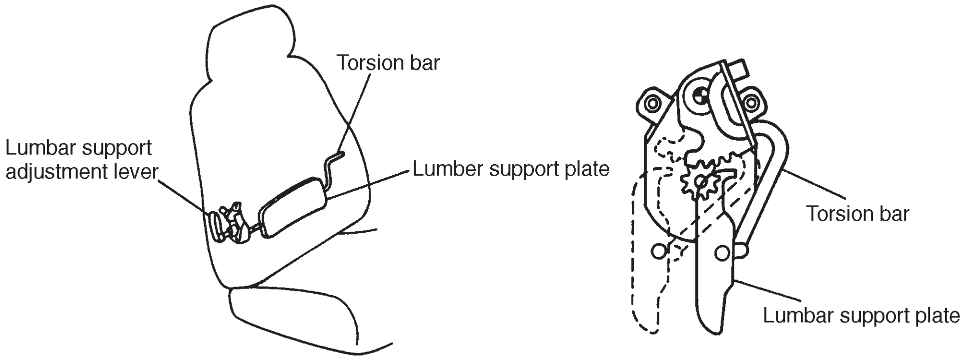
The seat accommodates an electric heater (comprising wire-like heating elements buried under the seat surface skin) to directly warm the body. Temperature control switchover can be made in two stages; high and low (high circuit for quick warming and low circuit for preservation of warmth). Two thermostats are provided for each seat as temperarure control and safety devices.



G5H0503

C: LUMBAR SUPPORT

The lumbar support adjustment lever can set the loin supporting section of the backrest to free position in the fore-and-aft direction.



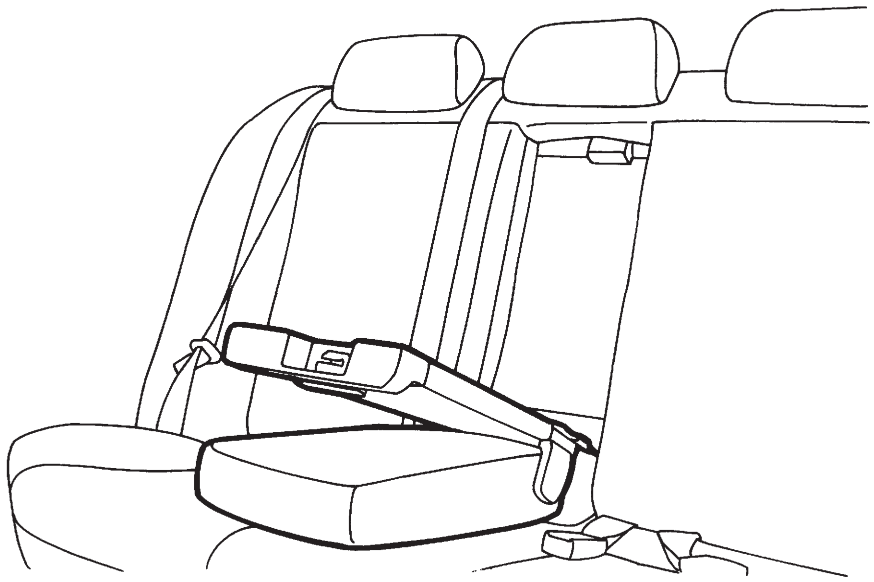
S5H0005A

2. Rear Seat

A: OPERATION

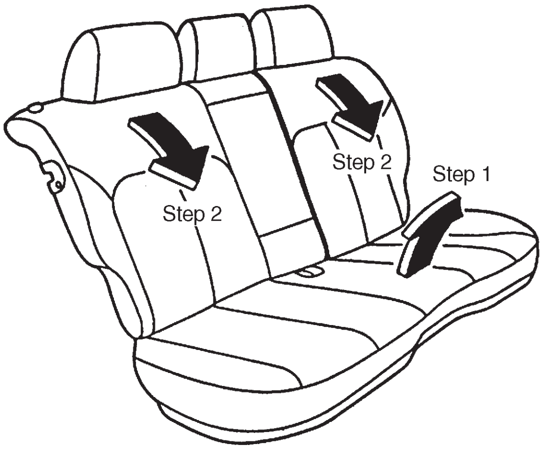
SEDAN

Provided with a center trunk through and arm rest.



WAGON

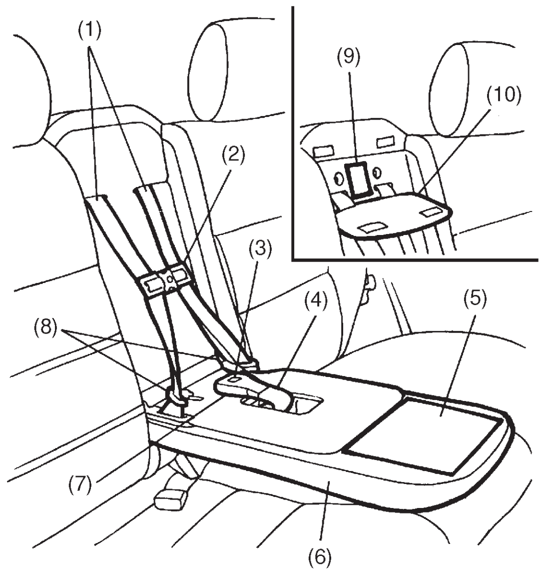
Provided with a foldable seat.



B5H0826A

B: BUILT-IN CHILD RESTRAINT

Built-in child restraint is designed for use only by children who weigh between 9.05 kg (20 lb.) and 18.09 kg (40 lb.), whose height is 1100 mm (44.3 in) or less, who are capable of sitting upright alone and whose shoulder height is less than the shoulder belt slot.



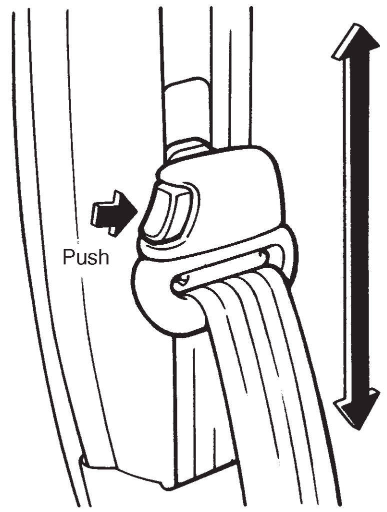
B5H0827A

(1) Lap-shoulder belt
(2) Chest clip
(3) Release button
(4) Crotch belt
(5) Warning label
(6) Child restraint cushion
(7) Belt buckle
(8) Tongue plates
(9) Maximum shoulder height indicator label
(10) Removable pad

3. Seat Belt

A: ADJUSTABLE SHOULDER ANCHOR

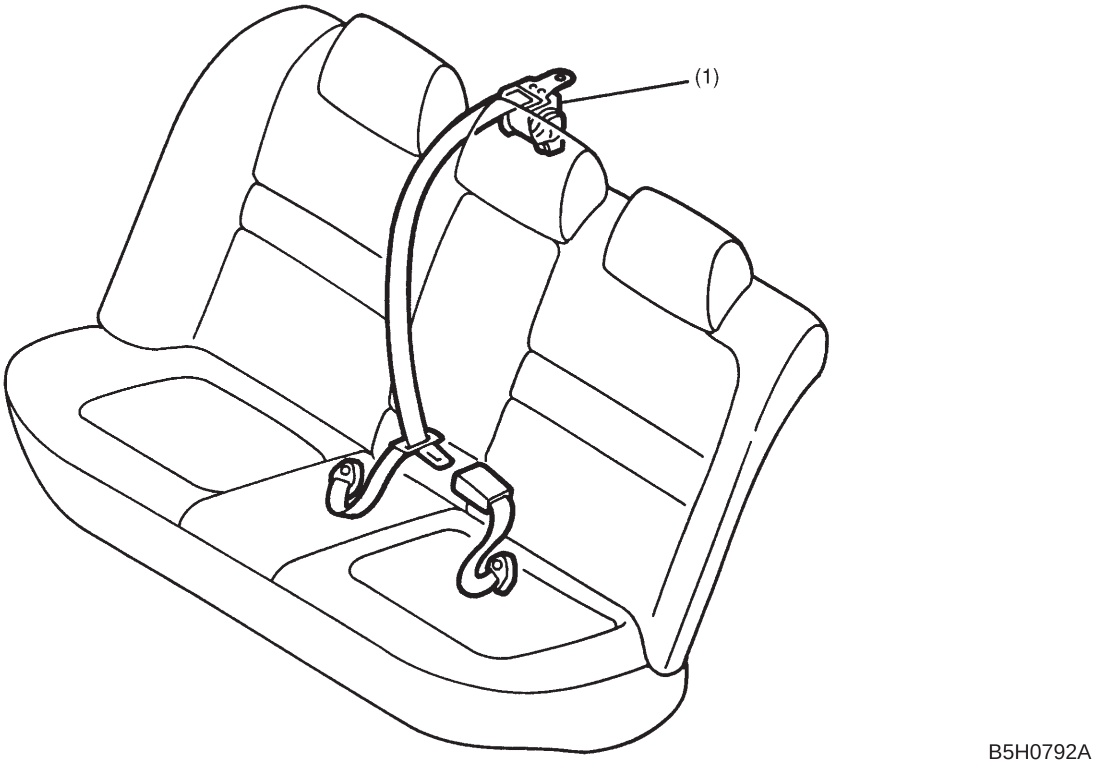
The front seat belt has a mechanism that allows the occupant to select the most appropriate shoulder anchor height from among the five positions [changeable within 129 mm (5.08 in) range].



B5H0605A

B: REAR CENTER THREE-POINT TYPE SEAT BELT (SEDAN)

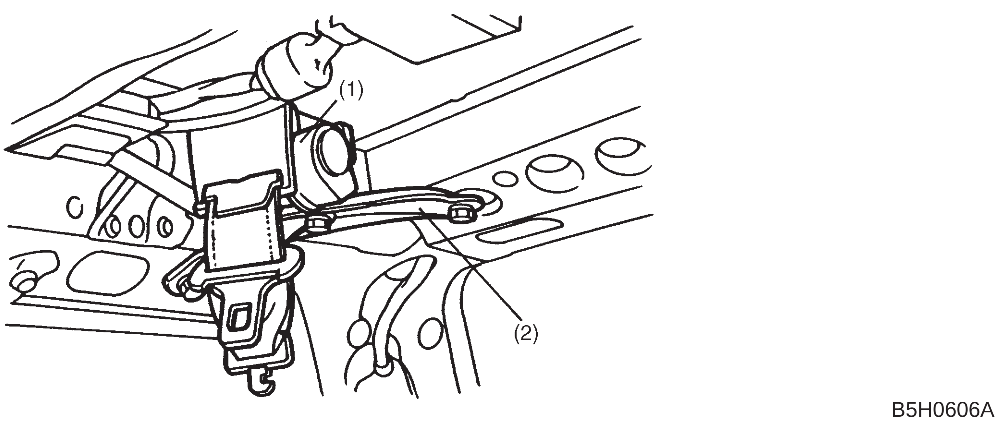
A three-point type seat belt is available for a passenger who sits at the center of the rear seat. The ELR is installed on the luggage shelf at the center of the vehicle.



(1) ELR

C: REAR CENTER THREE-POINT TYPE SEAT BELT (WAGON)

A three-point type seat belt is available for a passenger who sits at the center of the rear seat. The ELR is installed on the ceiling at the rear right of the vehicle.



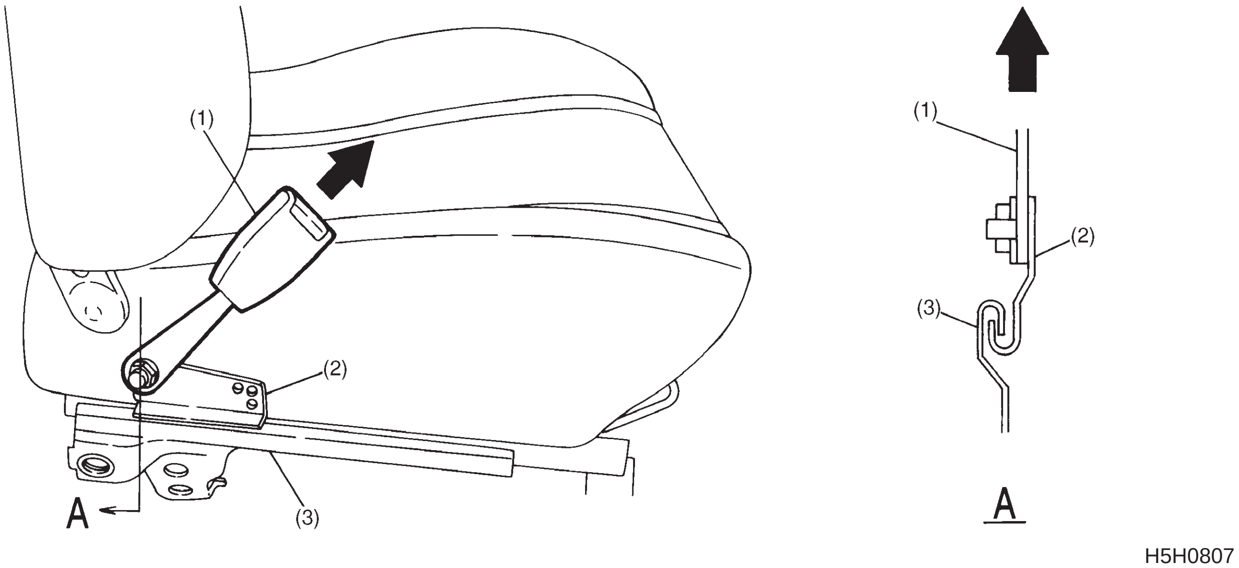
(1) ELR

(2) Bracket

D: BELT IN SEAT

The front inner belt is now integral with the front seat. This keeps the relative positions of the occupant and the front inner belt always constant, irrespective of the adjustments of the front seat position.

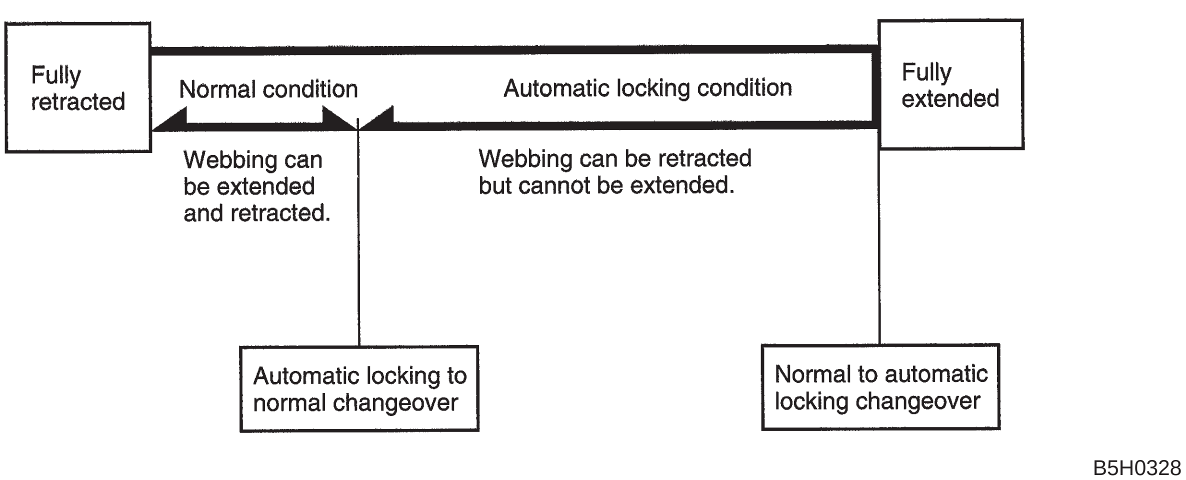
When an impact is applied to the occupant in a collision, the inner belt is pulled together with the upper hook in the direction of the arrow to engage the upper hook with the lower hook. As a result, the impact load is transmitted to the vehicle body and dispersed.



(1) Inner belt
(2) Upper hook
(3) Lower hook

E: AUTOMATIC ELR

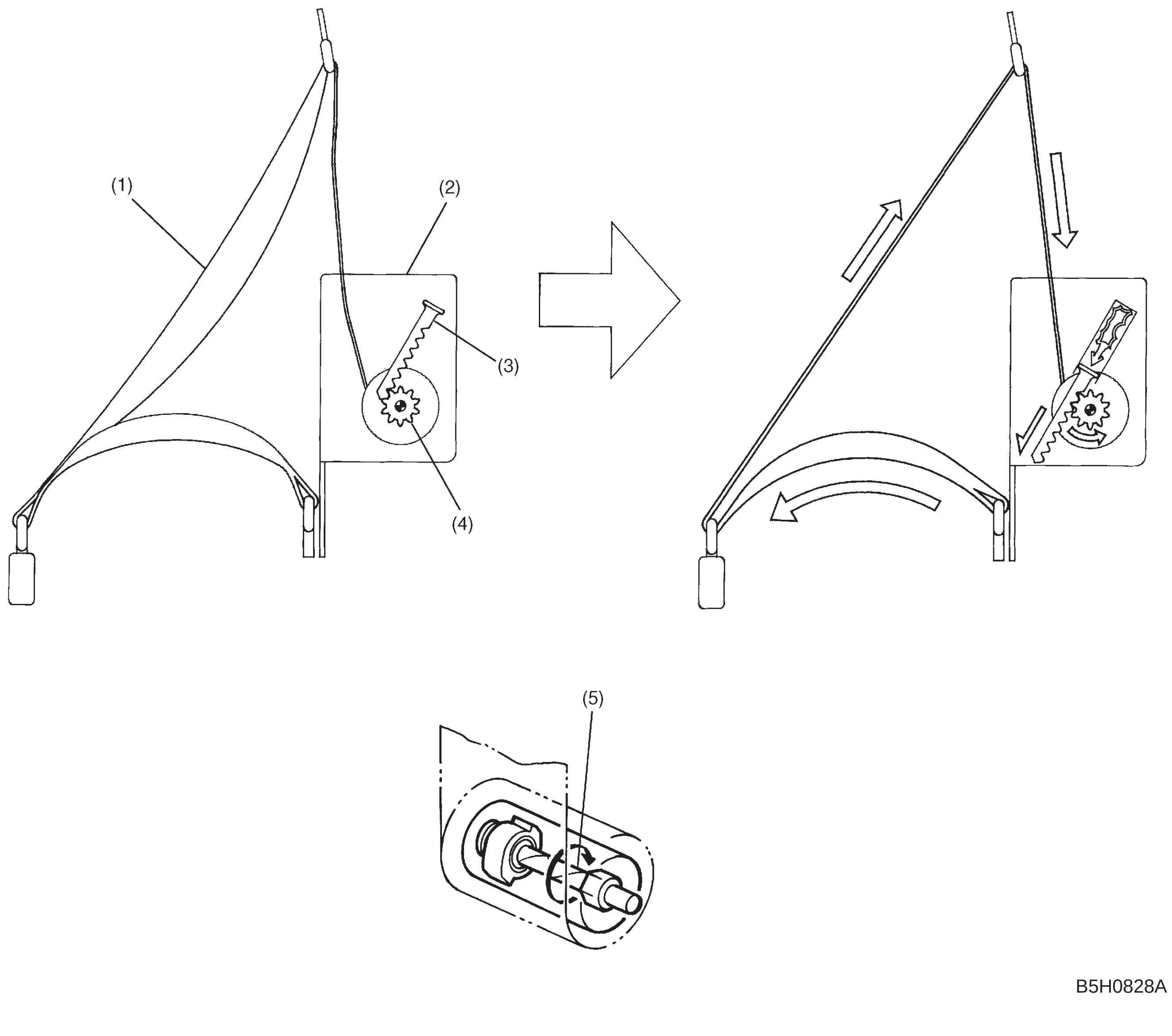
When the webbing of the front seat belt (passenger side) and rear seat belts (right and left side) are once drawn out completely, its retractor is changed to the automatic locking condition to securely install the child restraint system. In this condition, the webbing can be retracted but cannot be extended. When the belt is retracted to some extent, this condition is released.



F: PRETENSIONER

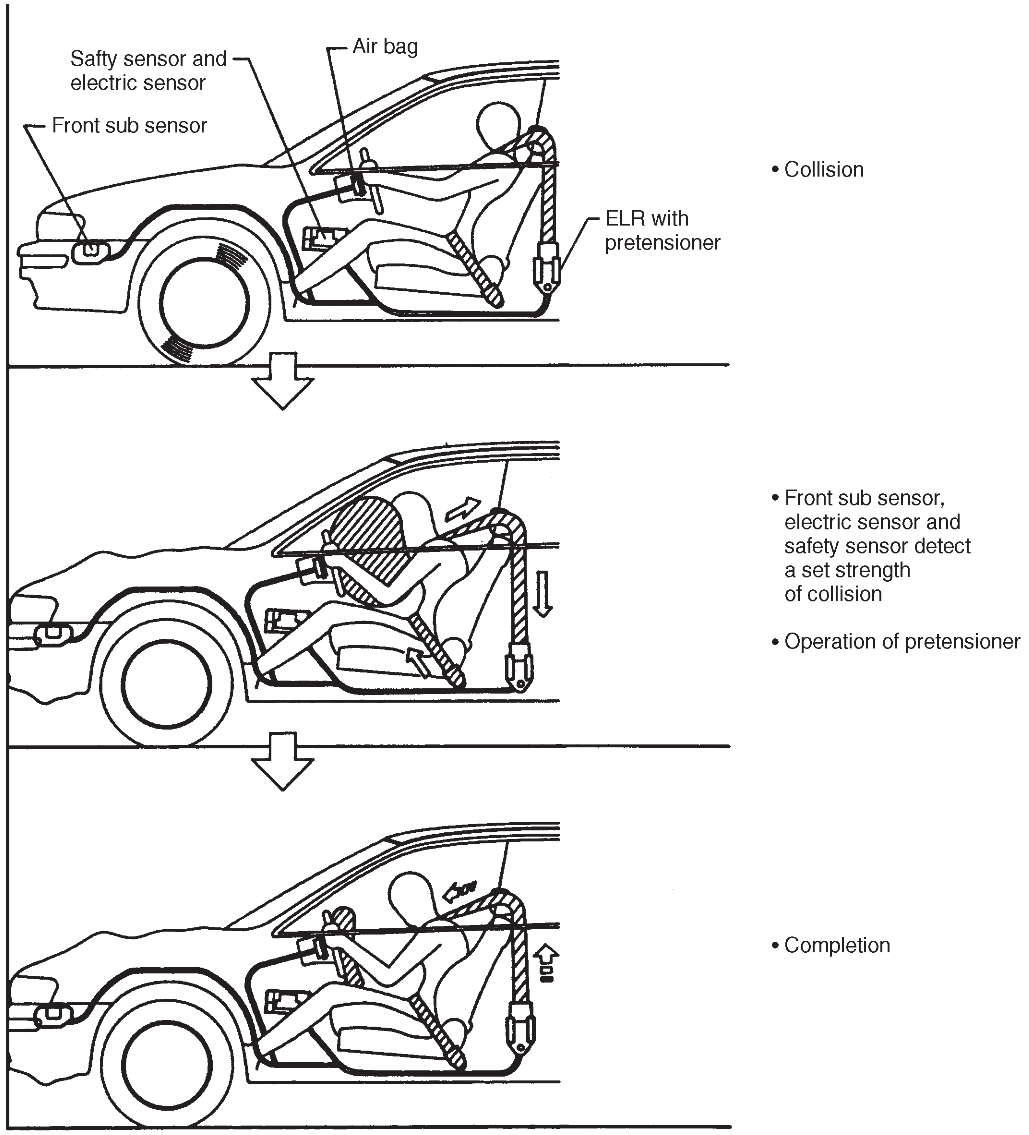
1. CONSTRUCTION

The driver side and front passenger side seat belts are equipped with seat belt pretensioner. The pretensioner sensor consists of the front sub sensor and a sensor inside the airbag control module. If the sensors detect a certain predetermined amount of force during a frontal or front-angled collision, the front seat belt is quickly drawn back in by the retractor to take up the slack so that the belt effectively restrains the front seat occupant. If the force applied on the seat belt becomes excessive and exceeds a predetermined value, the torsion bar is twisted to allow the webbing to be reeled out, thus lessening the load imposed on the thorax. Once the seat belt pre-tensioner has been activated, the seat belt retractor remains being locked.



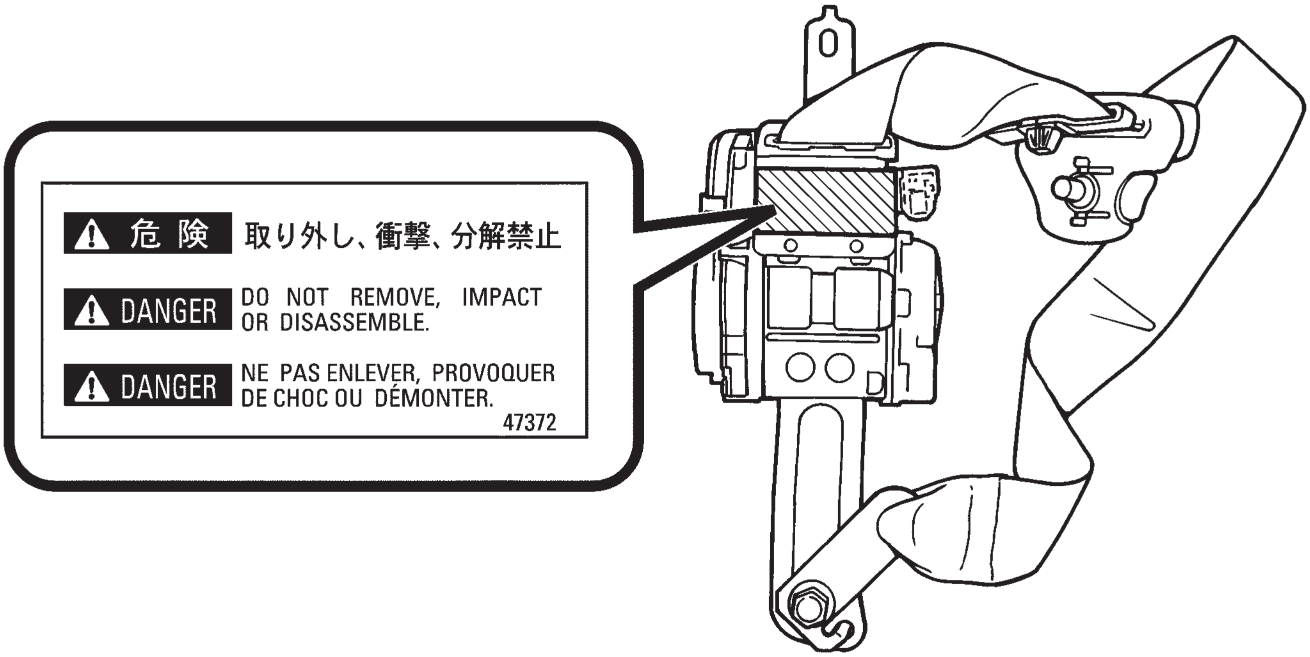
(1) Webbing
(2) ELR
(3) Rack
(4) Pinion gear
(5) Torsion bar

2. FUNCTION



B5H0630A

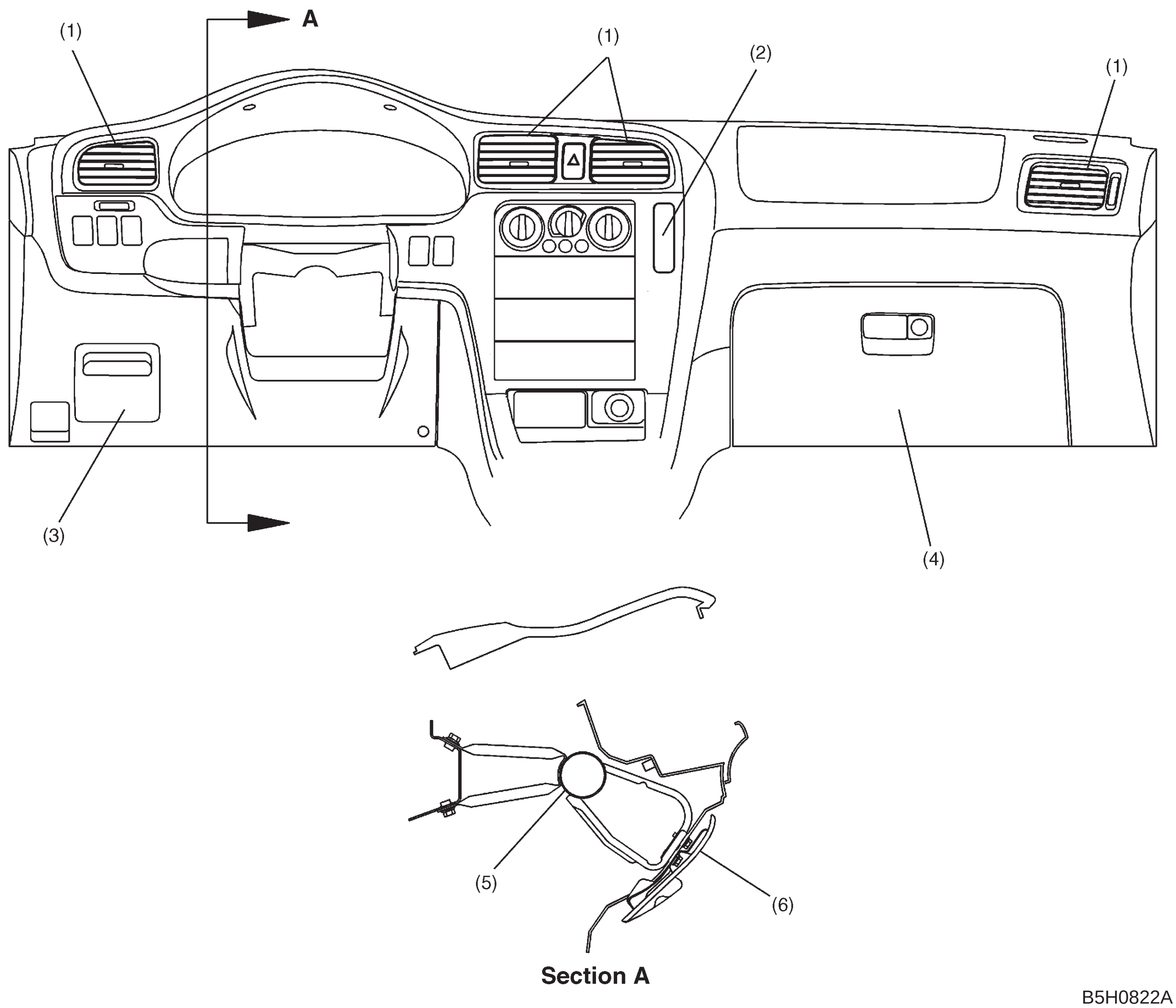
3. CAUTION LABEL



B5H0829

1. Instrument Panel

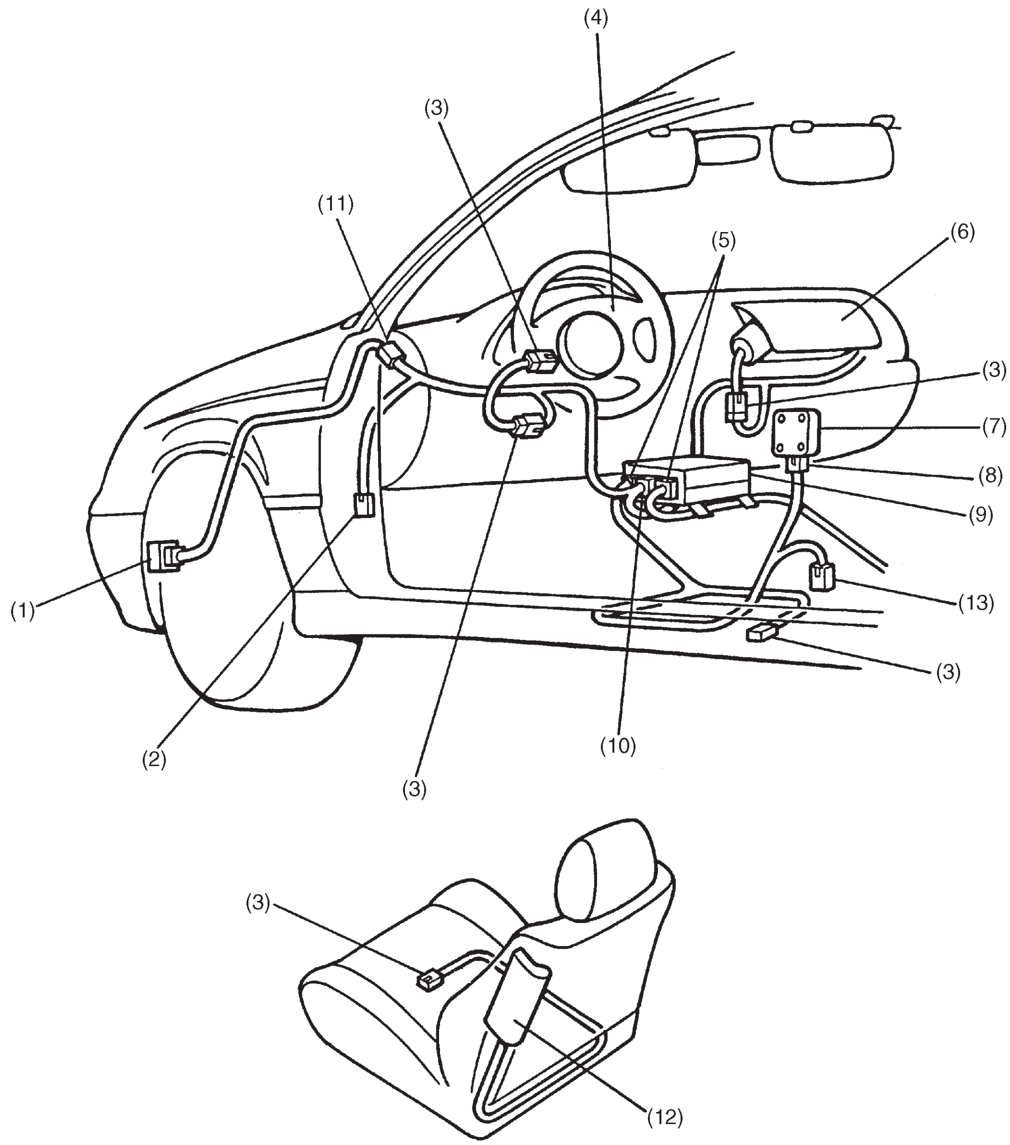
- A cup holder is equipped.
- A glove compartment is equipped.
- A coin tray is equipped.
- Barrel type vent grills are adopted.
- A knee pad is equipped in the lower cover.
- A support beam connecting the left and right pillars is installed at the back of the instrument panel. The instrument panel is mounted on the support beam.



(1)	Barrel type vent grill	(4)	Glove compartment
(2)	Cup holder	(5)	Steering support beam
(3)	Coin tray	(6)	Knee pad

1. SRS Airbag System

A: INSTALLATION

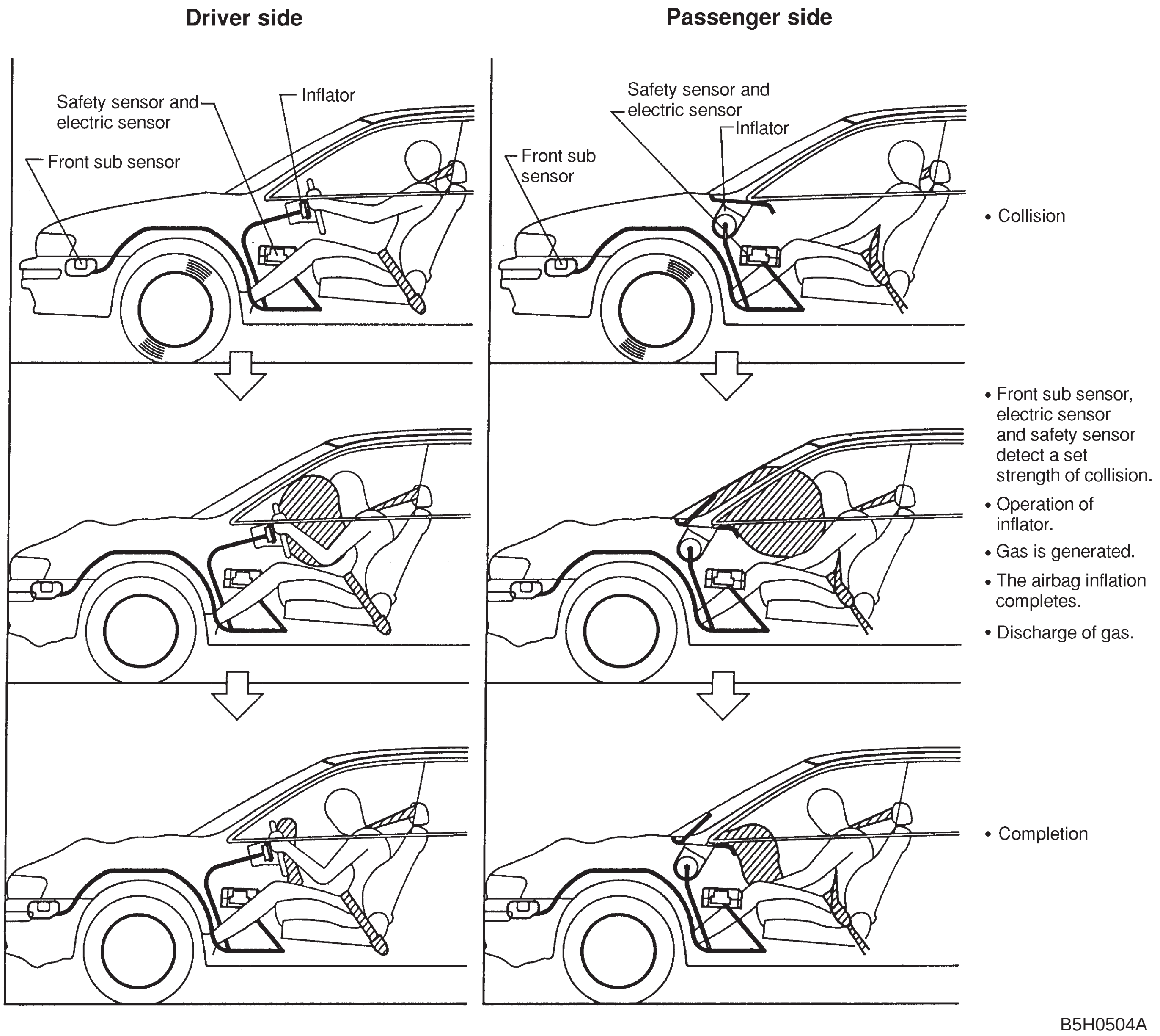


(1) Front sub sensor
(2) 7 poles connector (Yellow)
(3) 2 poles connector (Yellow)
(4) Airbag module (Driver)
(5) 12 poles connector (Yellow)
(6) Airbag module (Passenger)
(7) Side airbag sensor
(8) 4 poles connector (Yellow)
(9) Airbag control module
(10) 28 poles connector (Yellow)
(11) 2 poles connector (Blue)
(12) Airbag module (Side)
(13) 2 poles connector (Yellow) (To pretensioner seat belt)

B: FUNCTION

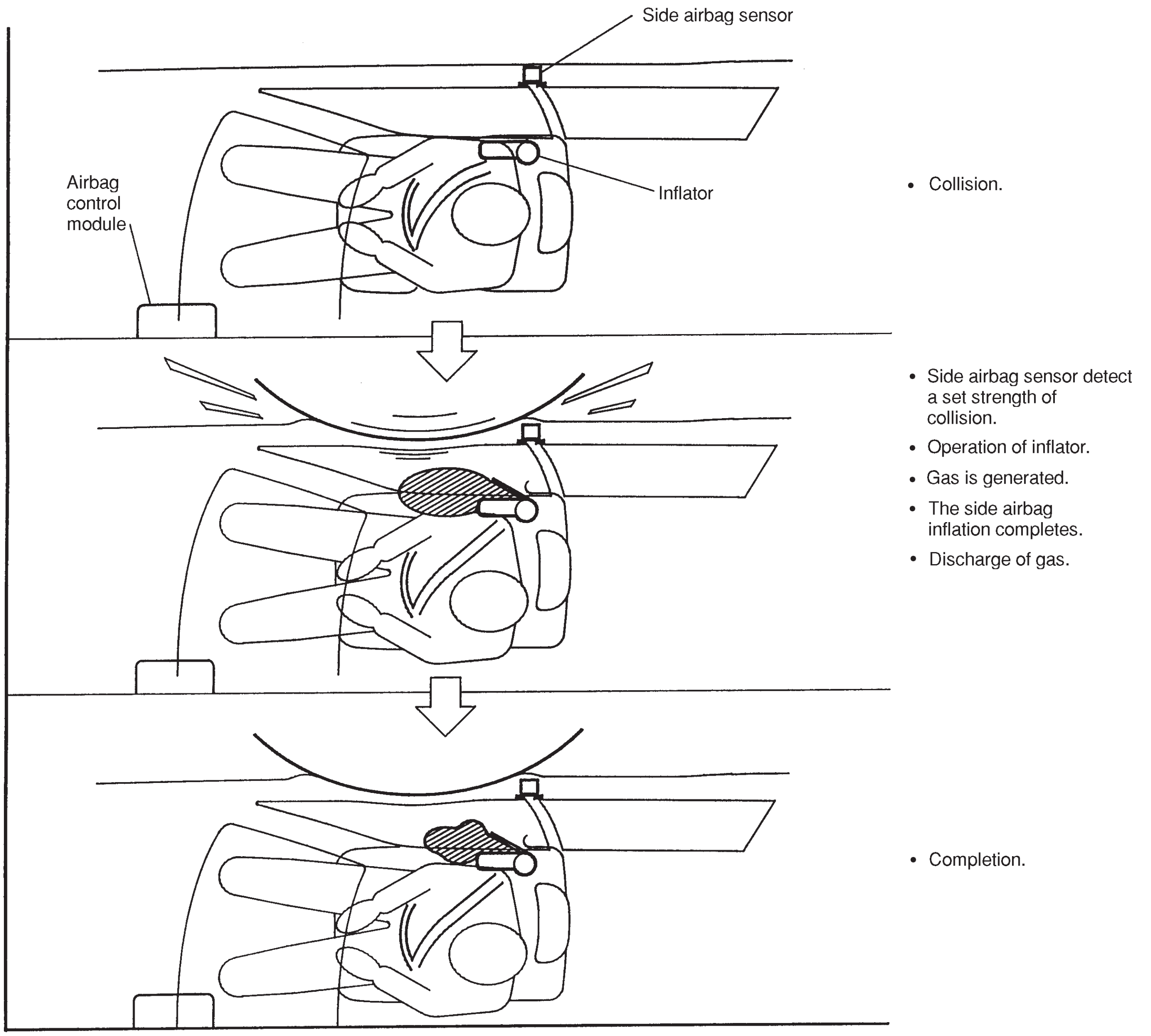
1. FRONT AIRBAG

The SRS airbag is provided as an auxiliary driver and passenger front seat restraint system to be used in combination with the seat belt. When an impact greater than a set level is applied to the front of the vehicle, the sensor senses it and generates an electrical pulse to inflate the bag in the airbag module, thus preventing the upper bodies of the driver and passenger in the front seat from impacting the steering wheel, instrument panel and windshield.



2. SIDE AIRBAG

The SRS side airbag is provided as an auxiliary driver and passenger front seat restraint system to be used in combination with the seat belt. When an impact greater than a set level is applied to the side of the vehicle, the side airbag sensor senses it and send the ignition permit signal to airbag control module, then inflated the side airbag module, thus preventing the outside upper bodies (chest area) of the driver and passenger in the front seat from impacting the front door.



B5H0505A

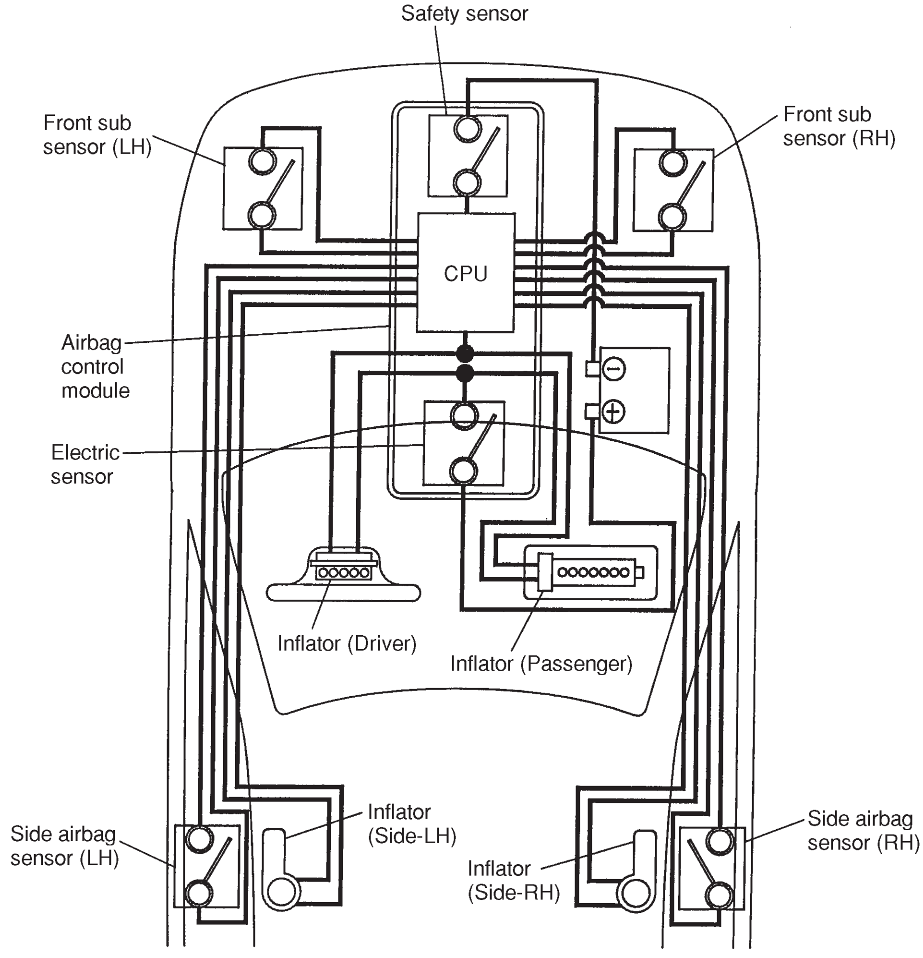
2. Construction

A: GENERAL

● The SRS airbag consists of an airbag control module, left and right front sub sensors, electric sensor and safety sensor built into the control module, airbag modules of driver and passenger containing an inflator and airbag, and side airbag sensor and side airbag module containing an inflator and airbag (Side airbag equipped model).

● FRONT AIRBAG SYSTEM:
A frontal impact causes the safety sensor, electric sensor and front sub sensor to input an impact signal to the CPU. The CPU judges whether the airbags should be inflated or not based on these input signal values.

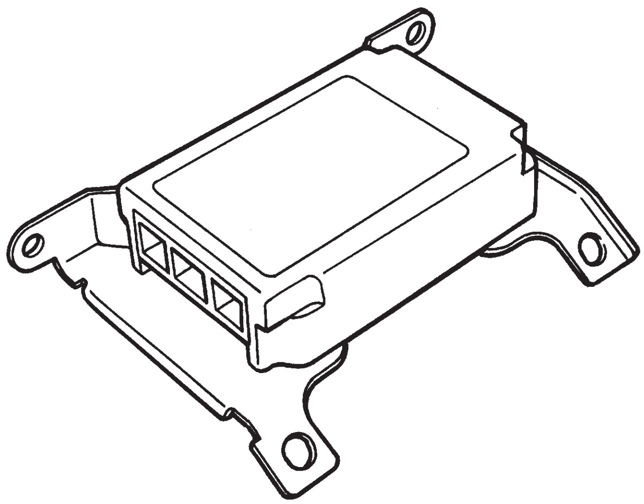
● SIDE AIRBAG SYSTEM:
Input of a side impact signal that exceeds a preset value causes the airbag on the side that received the impact to inflate.



B5H0552

B: AIRBAG CONTROL MODULE

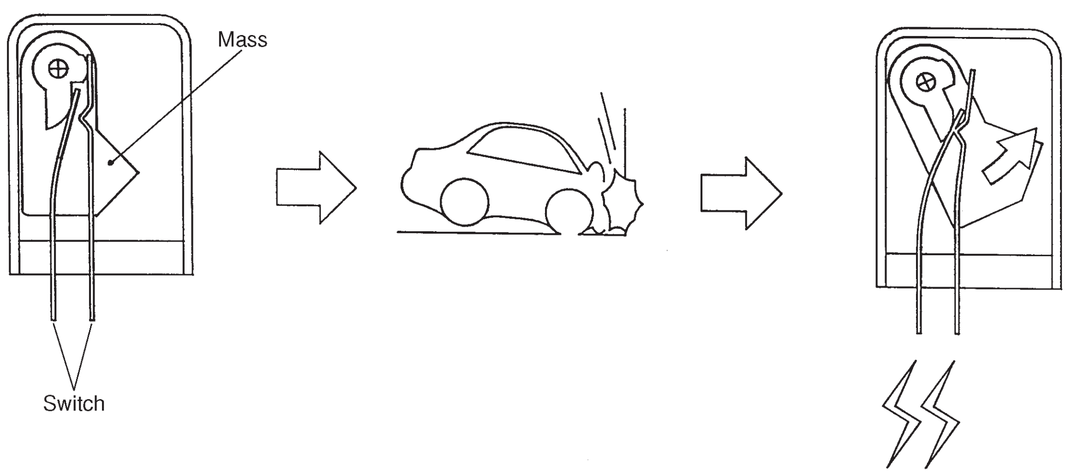
The airbag control module is installed ahead of the front floor tunnel. It detects the vehicle's deceleration by receiving electrical signals from the sensors and judges whether to fire the airbag. This control module has a built-in self-diagnosis function. If a trouble occurs inside the system, it lights up the airbag warning light in the combination meter. The trouble data is stored in the module. A back-up power supply is provided for possible damage to the battery during an accident, and a boosting circuit is built into the module in case of a battery voltage drop.



S5H0010

C: FRONT SUB SENSOR

One front sub sensor is installed on both left and right sides ahead of the front wheel apron wall. Front sub sensor is the pendulum type sensor. If the sensor receives a frontal impact exceeding a certain limit, the mass in the sensor revolves forward to turn the switch ON.



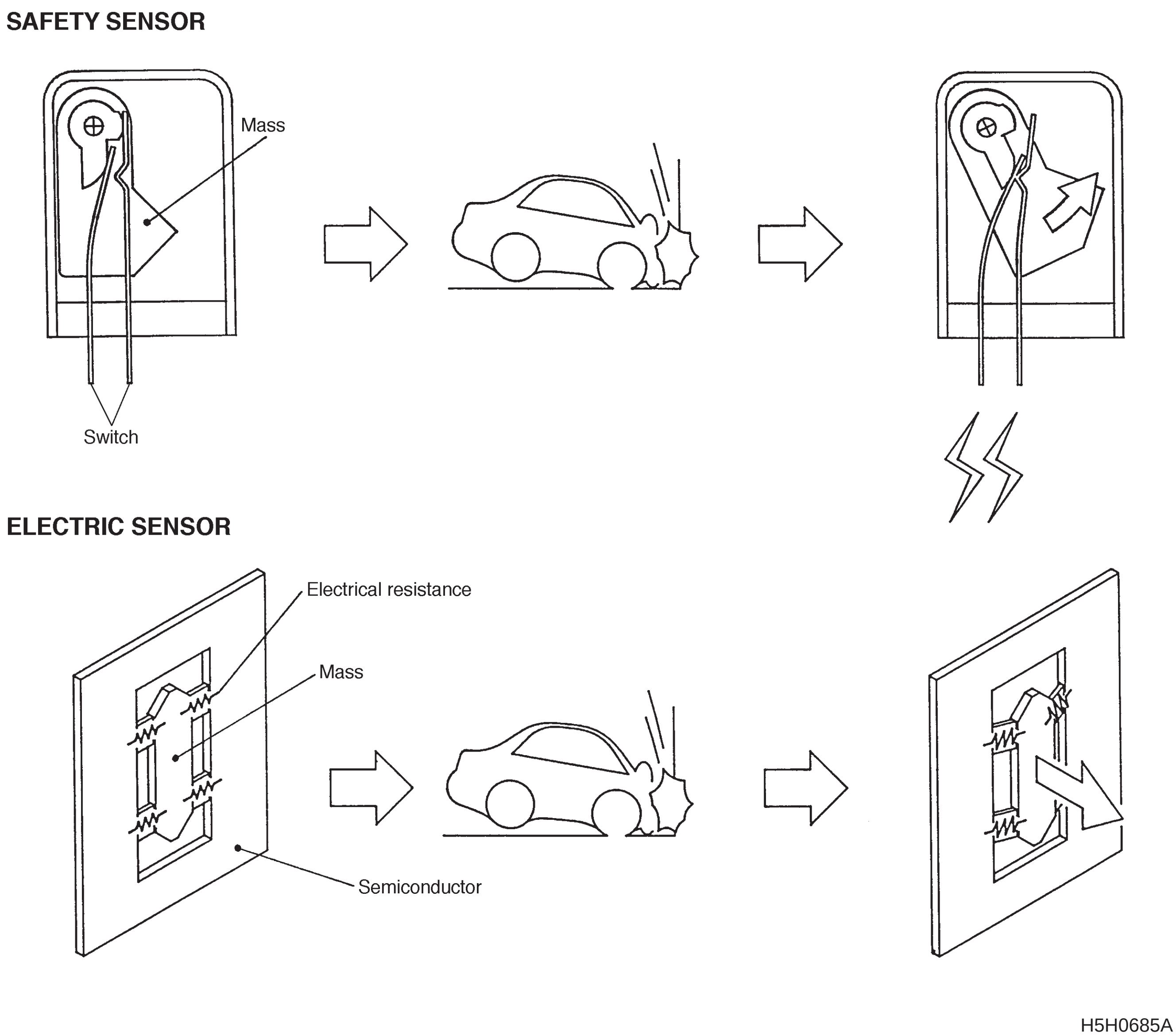
B5H0507A

D: AIRBAG SENSOR

Safety sensor and electric sensor are built into the airbag control module and side airbag sensor.

Safety sensor is the pendulum type sensor. If the sensor receives a frontal or side impact exceeding a certain limit, the mass in the sensor moves forward to turn the switch ON.

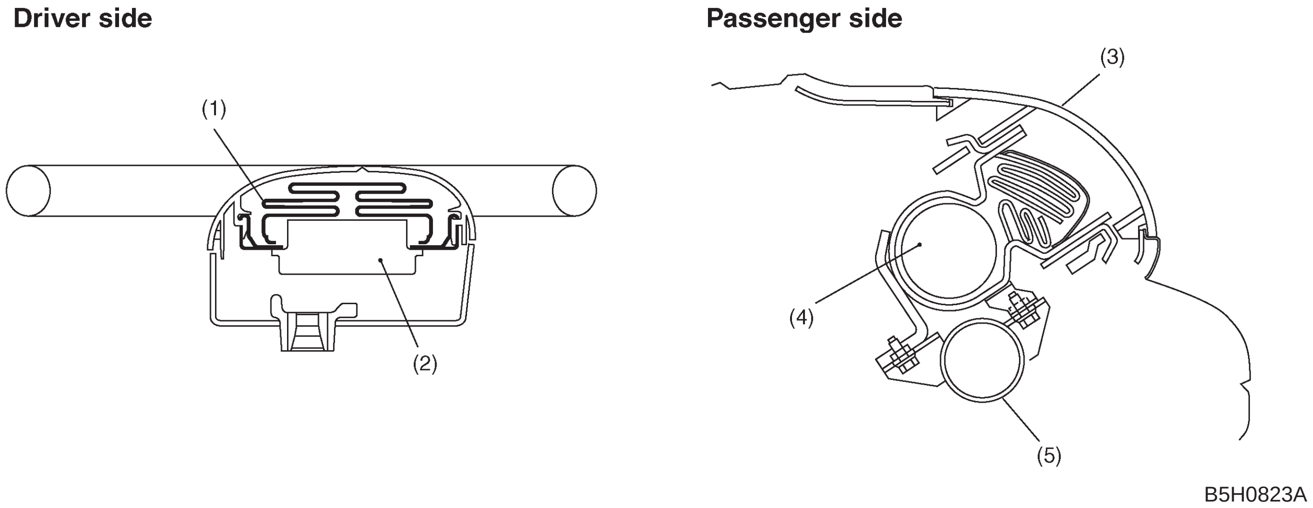
The electric sensor consists of the semiconductor type sensor which senses the deceleration at collision by the change of the electrical resistance and the impact sensing circuit.



E: AIRBAG MODULE

1. FRONT AIRBAG

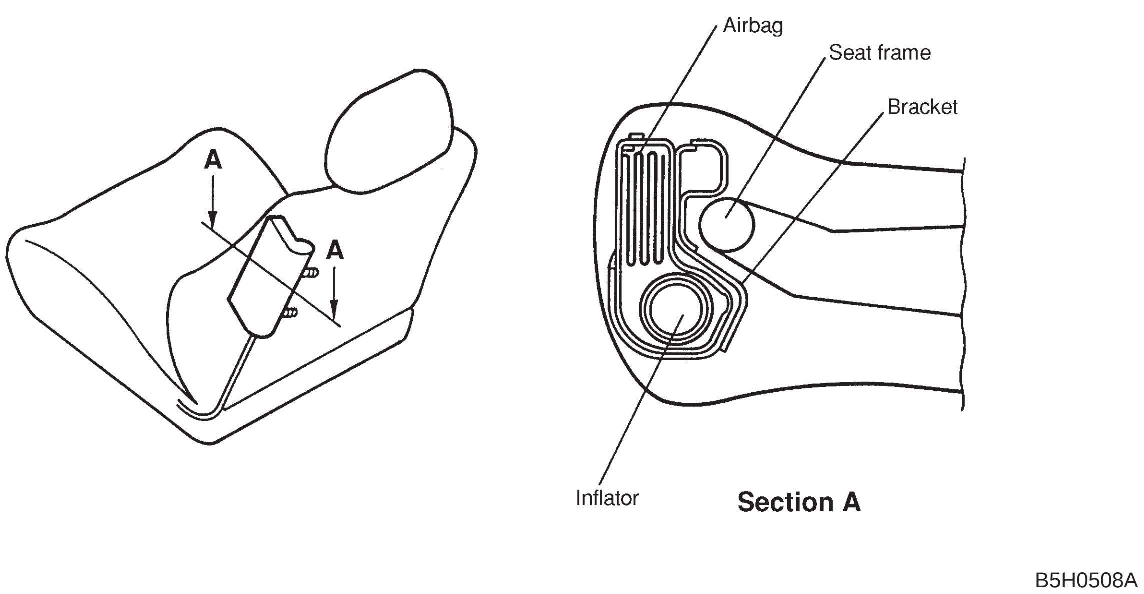
The driver's airbag module is located at the center of the steering wheel, and passenger's airbag module is located at upper side of instrument panel, and it each contains an airbag and inflator. If a collision occurs, the inflator produces a large volume of gas inflating the airbag in a very short time.



(1) Airbag
(2) Inflator (Driver)
(3) Airbag module lid
(4) Inflator (Passenger)
(5) Steering support beam

2. SIDE AIRBAG

The side airbag module is located at the outside of the front backrest, and it contains an airbag and an inflator.
If a side collision occurs, the inflator produces a large volume of gas inflating the airbag in a very short time.

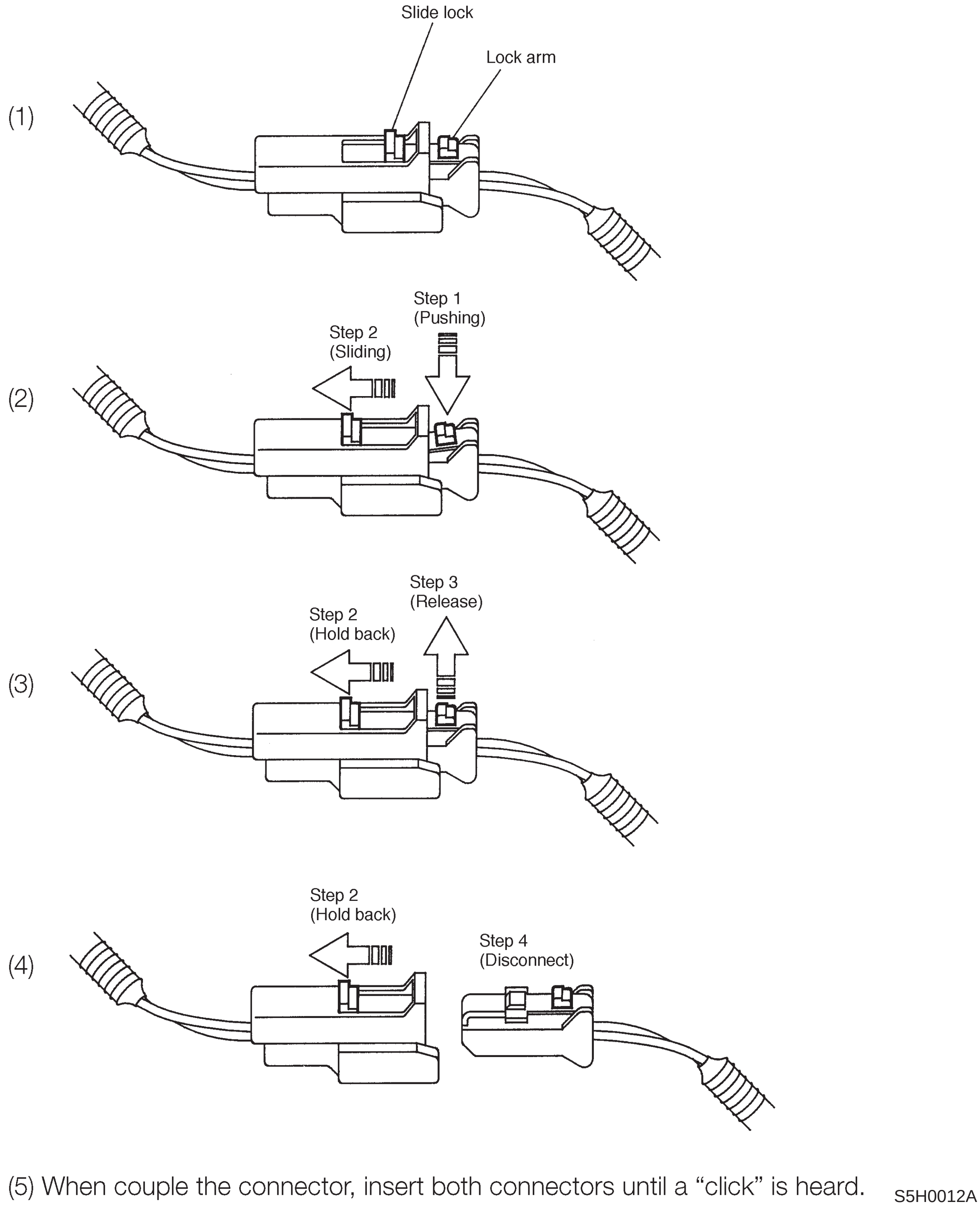


F: AIRBAG CONNECTOR

1. DISCRIPTION

The SRS airbag adopts a connector which has a double lock mechanism and coupling error detection mechanism for enhanced reliability. If coupling is incomplete, the airbag warning light comes on in the combination meter.

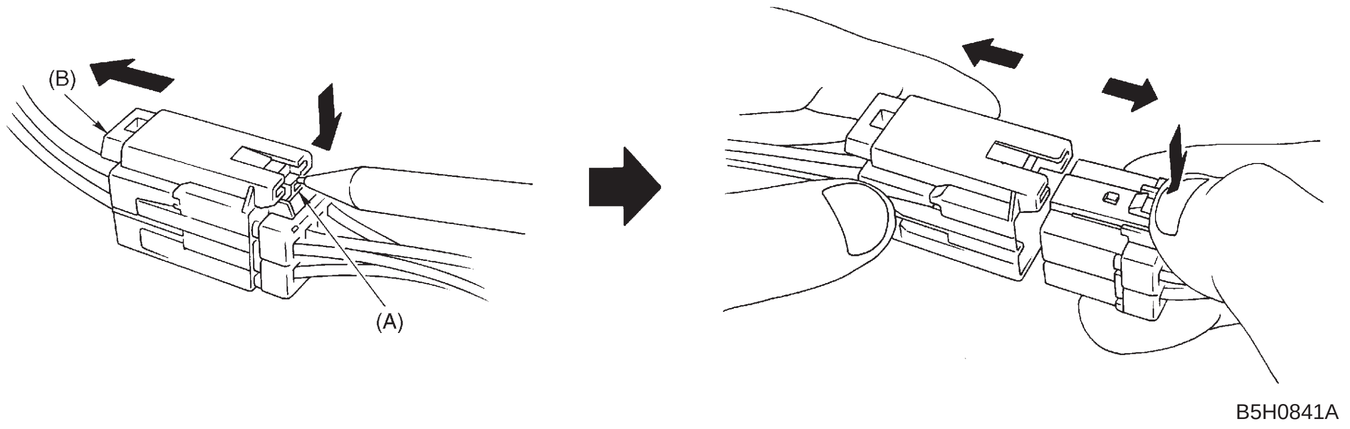
2. DISCONNECTION (AIRBAG HARNESS TO AIRBAG HARNESS)



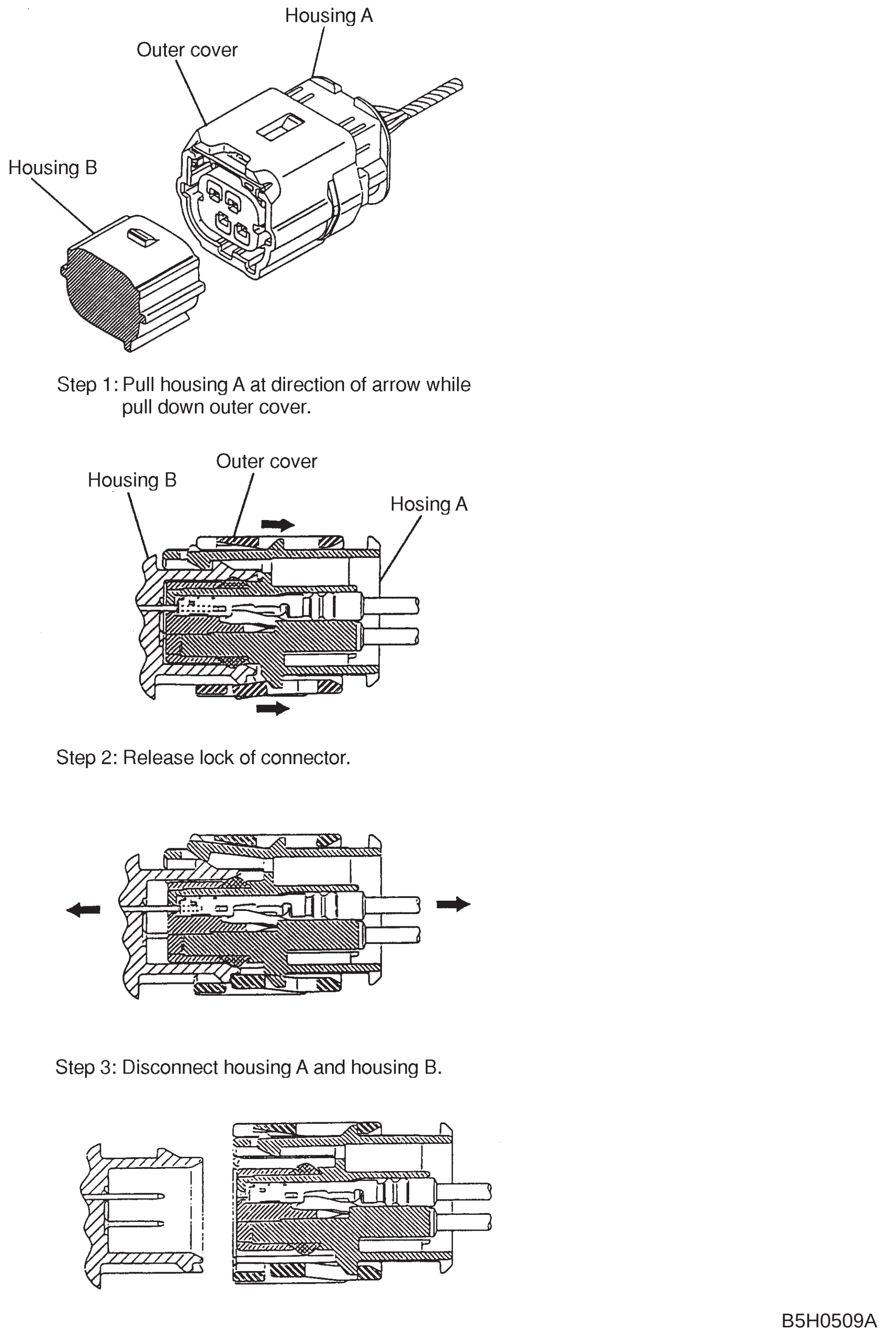
3. DISCONNECTION (AIRBAG HARNESS TO BODY HARNESS)

To disconnect the connector, press lever (A) to pop green lever (B) out, this unlocks the double lock system. Then separate the connector by pulling both sides while holding the connector sections and pressing in lever (A).

To couple the connector, insert both connectors until a “click” is heard, then push in the green lever (B) until a “click” is heard; this applies the double lock.

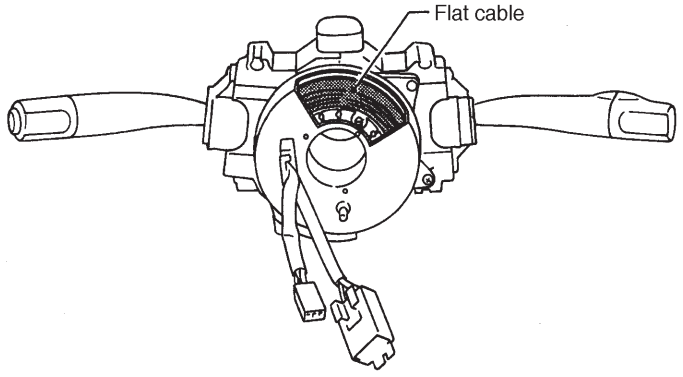


4. DISCONNECTION (FRONT SUB SENSOR AND SIDE AIRBAG SENSOR)



G: STEERING ROLL CONNECTOR

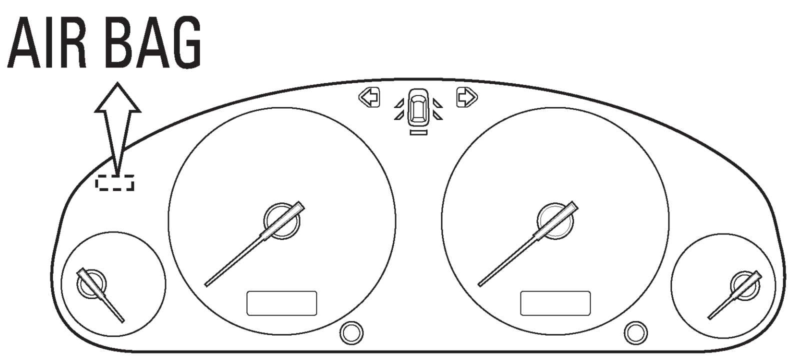
The steering roll connector is located between the steering column and steering wheel. A flat cable stored in a spiral form transmits the electrical signal from the airbag control module to the steering wheel from the body harness.



S5H0013A

H: AIRBAG WARNING LIGHT

The airbag warning light is located inside the combination meter. It illuminates if a poor connection occurs, or if the airbag control module detects an abnormality, When the airbag system is normal, this light goes out about 7 seconds after turning the ignition switch ON.

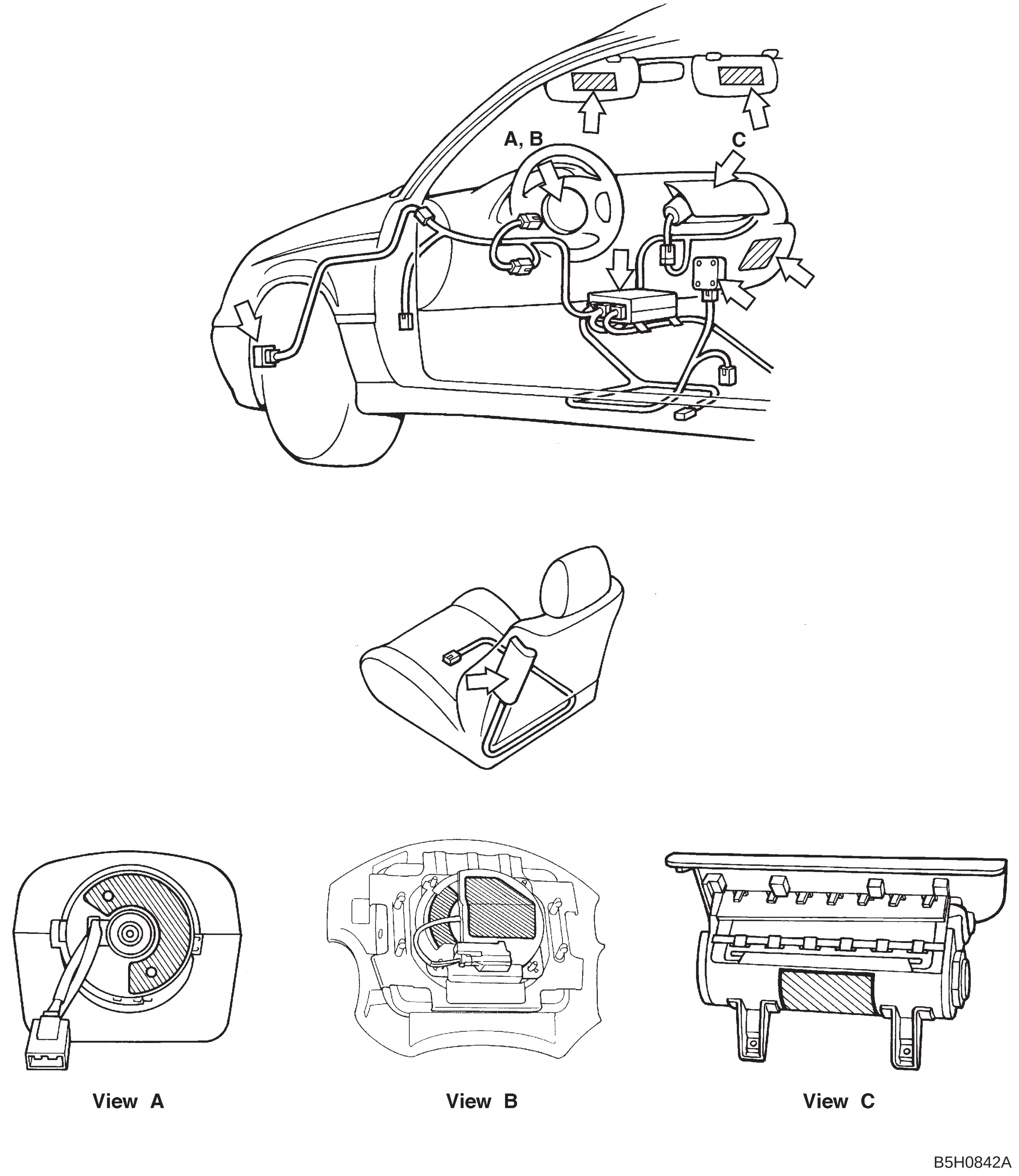


B5H0633

I: WIRE HARNESS

The wire harness of the SRS airbag is entirely covered with a yellow protective tube, and can easily be identified from harnesses of other systems.

J: LOCATIONS OF WARNING AND CAUTION LABELS

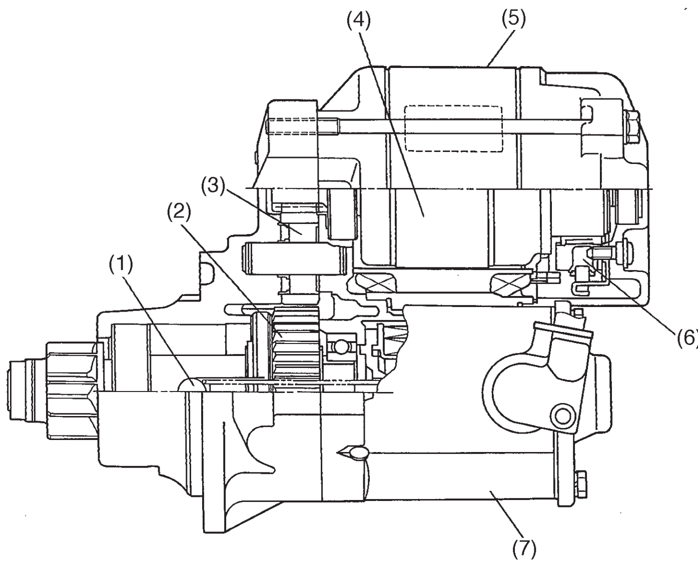


MEMO

1. Starter

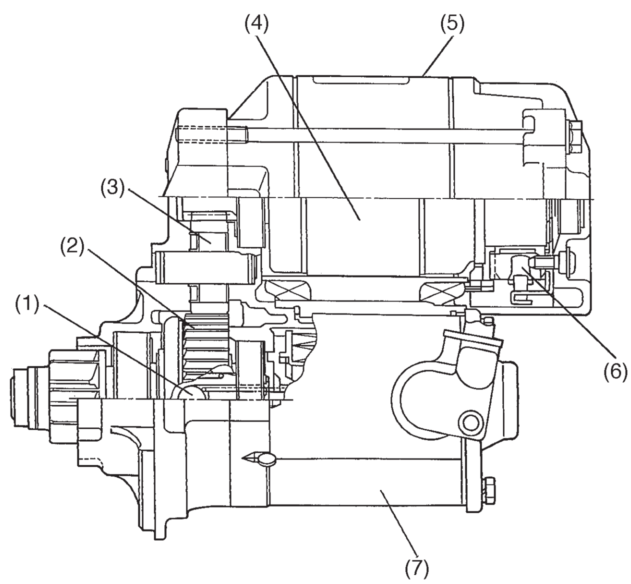
The starter is of reduction type. Its output is 1.0 kW on the MT model and 1.4 kW on the AT model.

A: MT VEHICLES



B6H0326C

B: AT VEHICLES

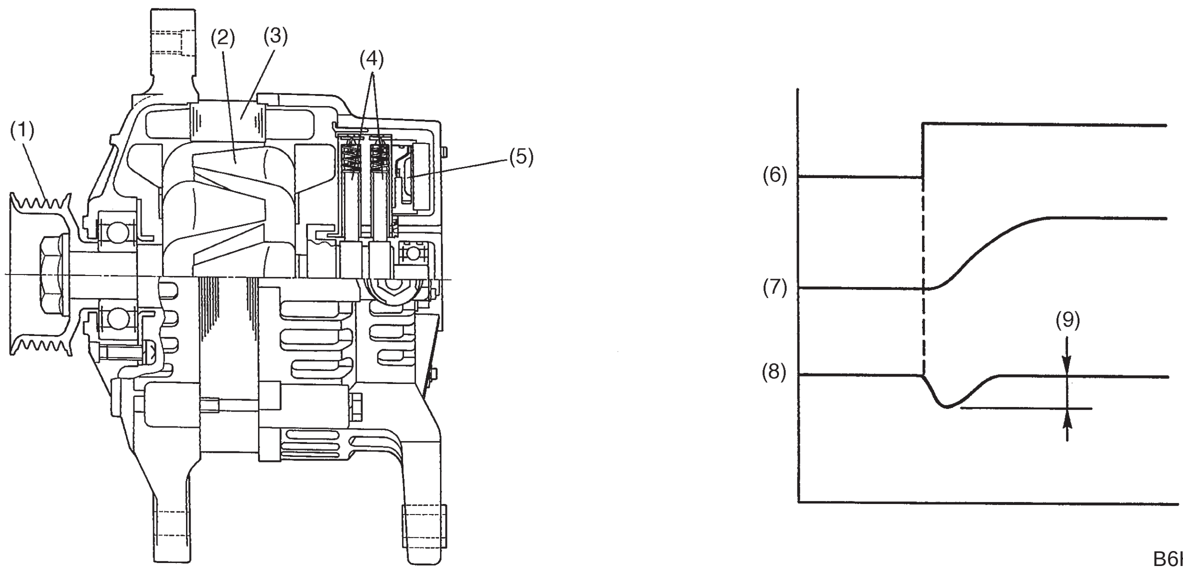


B6H0327C

(1) Steel ball
(2) Over running clutch
(3) Retainer
(4) Armature
(5) Yoke
(6) Brush holder
(7) Magnet switch

2. Generator

The generator incorporates an IC regulator which features a “load response control”. The load response control circuit function to gradually increase the generator output when an additional electric load such as headlights or blower fan is applied to the engine in the idling state. This prevents a sharp drop in engine idling speed and ensures an improved comfort while the engine is idling.



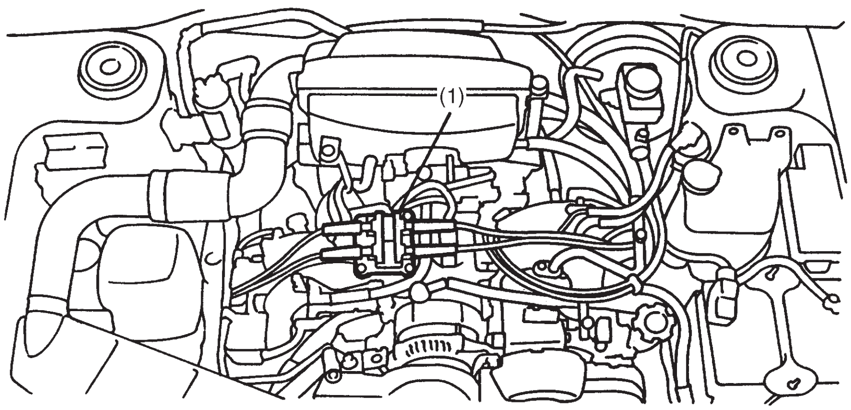
(1) Pulley
(2) Rotor
(3) Stator coil
(4) Brush
(5) IC regulator

(6) Electric load
(7) Alternator output
(8) Engine idle speed
(9) Amplitude

3. Ignition Coil and Ignitor

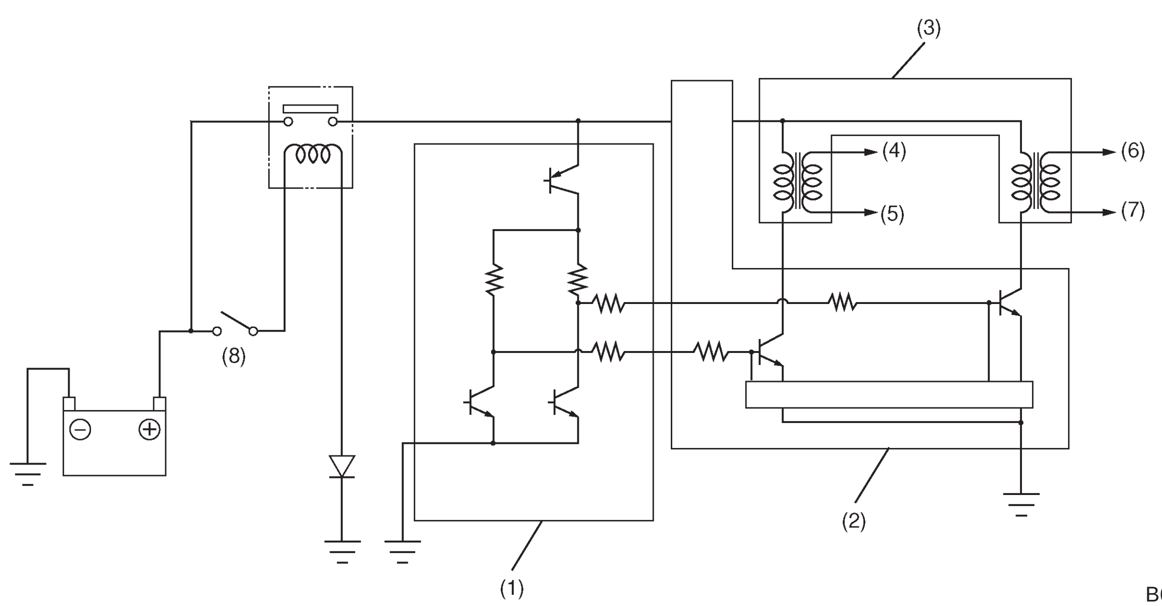
The ignition coil is of the type that is made integral with an ignitior.

The ignition system is of a 2-cylinder simultaneous ignition design. In response to the signal from the ECM, the ignitor supplies another signal to the ignition coil to ignite a pair of cylinders #1 and #2 or #3 and #4 simultaneously.



B6H1294A

(1) Ignition coil and ignitor ASSY



B6H0806C

(1) ECM
(2) Ignitor
(3) Ignition coil
(4) Spark plug #1
(5) Spark plug #2
(6) Spark plug #3
(7) Spark plug #4
(8) Ignition switch

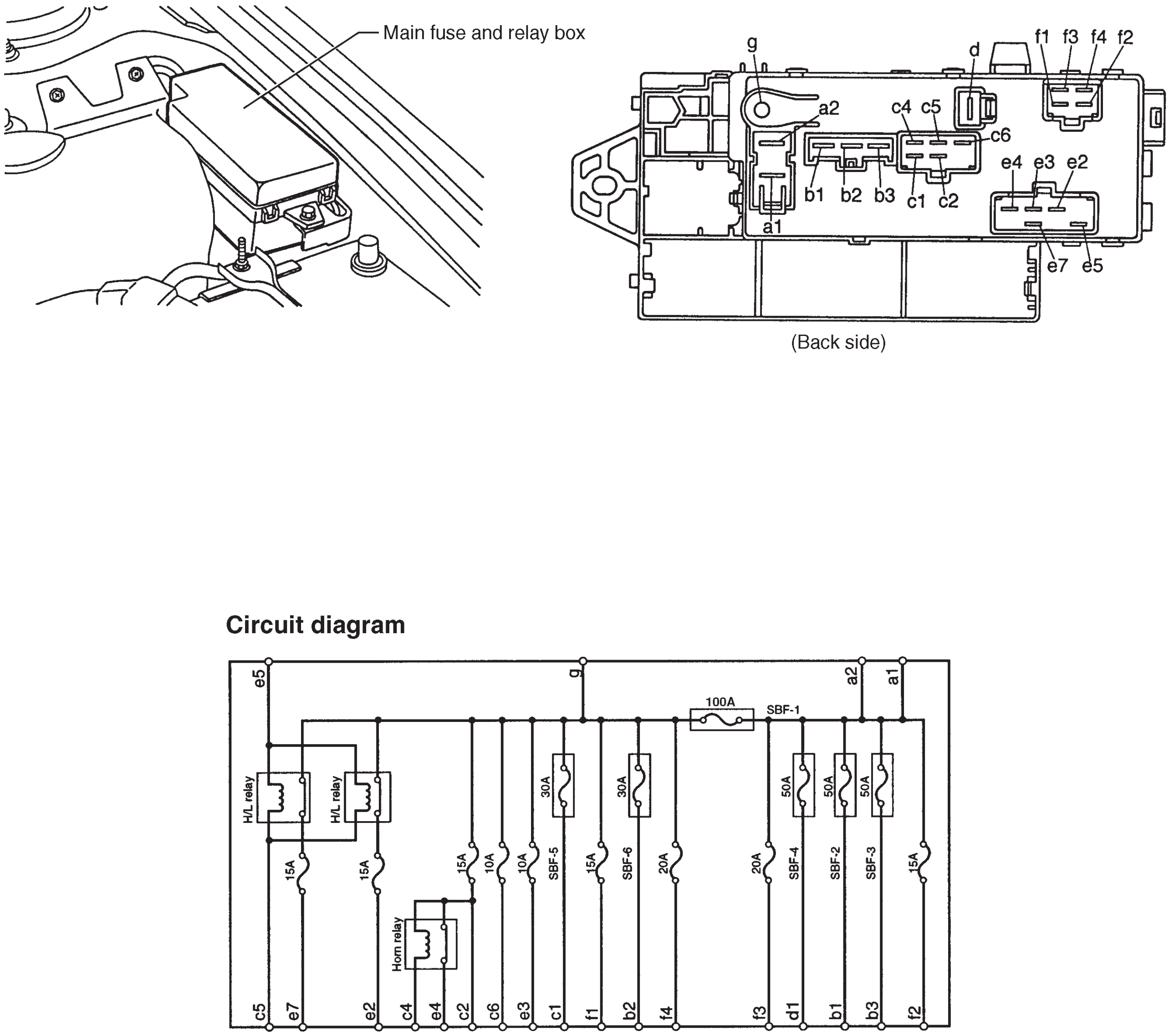
1. Fuse

A: MAIN FUSE AND RELAY BOX

The main fuse and relay box is installed at the rear of the battery on left side of the engine compartment.

The fuses, relays and fusible links are installed in the box as described below.

NOTE:
The distined connection points shown are for a typical case. For details, refer to the Wiring Diagram Manual.

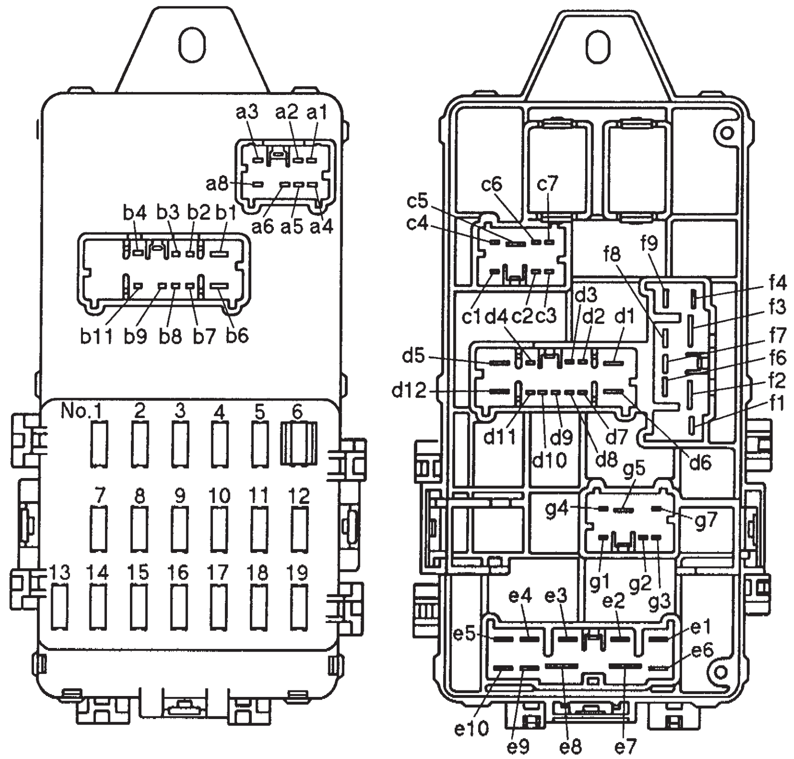


S6H0024A

B: JOINT BOX

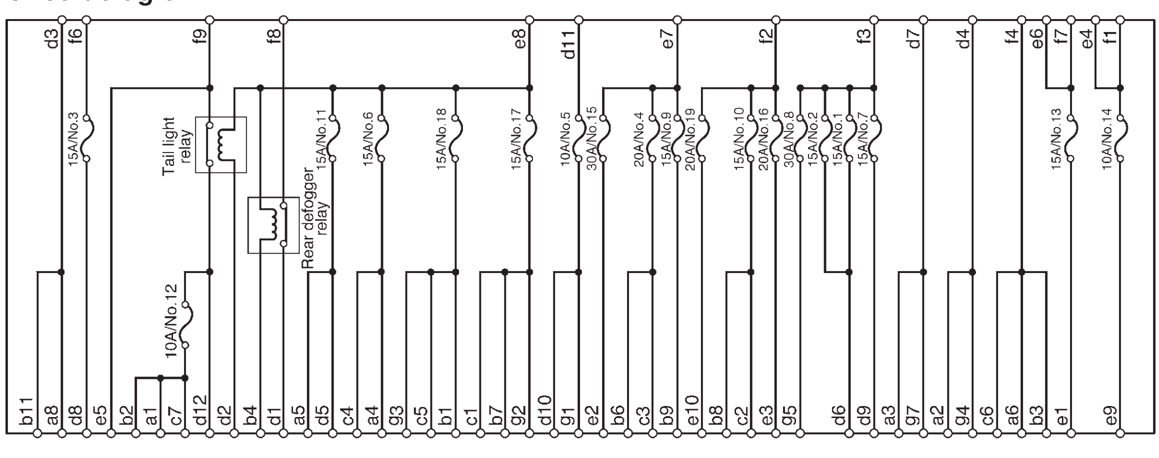
The joint box is installed under the instrument panel on driver’s side.

The fuses are installed in the joint box as described below.



(Face) (Back side)

Circuit diagram



B6H1163A

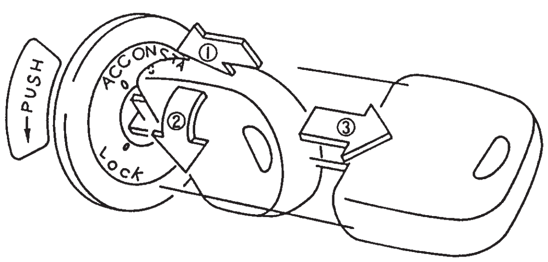
2. Ignition Switch

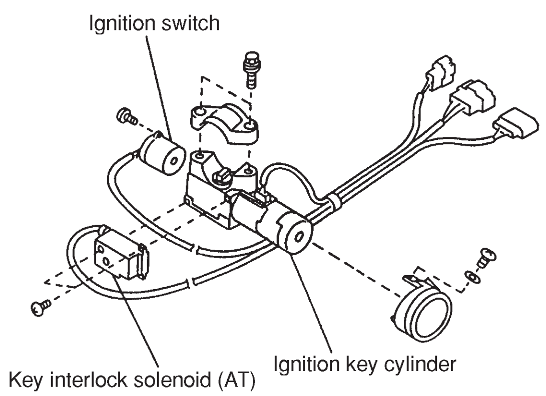
A: DESCRIPTION

The ignition key warning system is adopted.

- When driver opens the door with the ignition key in “LOCK” or “ACC” position, warning alarm sounds to warn the driver
- In manual transmission vehicle, two stage steering lock is adopted to improve safety in key operation. When turning the ignition key from “ACC” to “LOCK” position, it is necessary to push the key into the key cylinder (arrow 1 in the illustration) and then turn the key to “LOCK” position (arrow 2).
- Automatic transmission vehicles are equipped with a key interlock mechanism to prevent erroneous operation. Ignition key can be turned to “LOCK” position only when select lever is set to P position.

NOTE:
If the key cannot be turned to “LOCK” position although select lever is in P position (because of key interlock system failure), the key interlock system must be cancelled by key interlock release lever which is located at the lower side of the steering column.





S6H0134A

3. Front Wiper and Washer

A: DESCRIPTION

1. FRONT WIPER

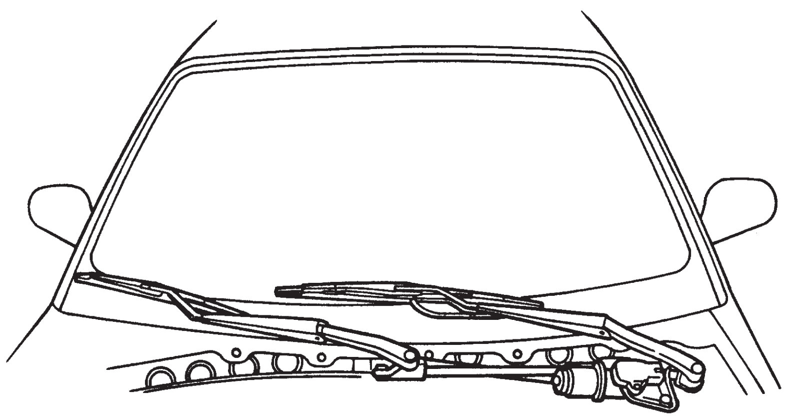
1) The front wiper is of a tandem type featuring wide wiping area. The blade is installed to the arm by means of U-hook joint to improve serviceability.

2) The front wiper operates in three modes of speed; HI, LOW and INTERMITTENT.

The operation speed can be changed by turning the wiper switch incorporated in the combination switch.

3) The intermittent unit which controls the front wiper operation interval is installed behind the combination switch.

4) The front wiper system is of a modular construction with the wiper motor integrated with the link, and is installed on the body through a rubber mount.



B6H1164

2. FRONT WASHER SYSTEM

1) The washer system consists of a washer tank, motor and a pair of nozzles.

2) The washer tank is installed at the front of the strut mount on the left side of the engine compartment.

3) The washer motor is installed directly at the lower position of the washer tank.

4) The washer nozzles are installed on the engine hood, and each nozzle has two injection ports.

5) The check value is installed just below each of the washer nozzles.

3. SPECIFICATION

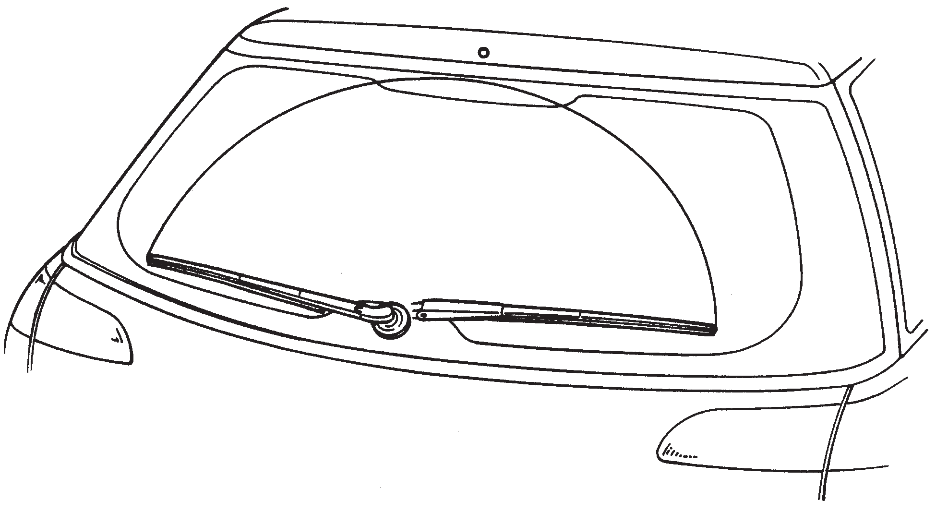
Washer Tank	Capacity			4.0 liters (4.2 US qt, 3.5 Imp qt)
Wiper Motor	Standard voltage			12 V
	No-load current			4 A or less
	Speed [at 2.0 N·m (20 kg-cm, 17 in-lb)]		HIGH	65 ± 5 rpm
			LOW	45 ± 5 rpm
	Locked rotor characteristics	HIGH	Torque	29.4 N·m (300 kg-cm, 2.2 ft-lb)
			Current	31.5 A or less
		LOW	Torque	34.3 N·m (350 kg-cm, 2.5 ft-lb)
			Current	36.0 A or less
Wiper Blade	Blade length	Driver’s side		550 mm (21.65 in)
		Passenger’s side		500 mm (19.69 in)

4. Rear Wiper and Washer

A: DESCRIPTION

1. REAR WIPER

1) The rear wiper has 168 degree wide wiping area.



B6H1165

2) The wiper blade is attached to the arm by means of U-hook joint in the same way as the front wiper blade.

2. REAR WASHER SYSTEM

1) The washer tank of the rear washer system is shared with the front washer system.

2) The washer motor is installed at the bottom of the washer tank, adjacent to the front washer motor.

3) The washer nozzle is installed on the upper portion of rear gate panel, and nozzle has two injection ports.

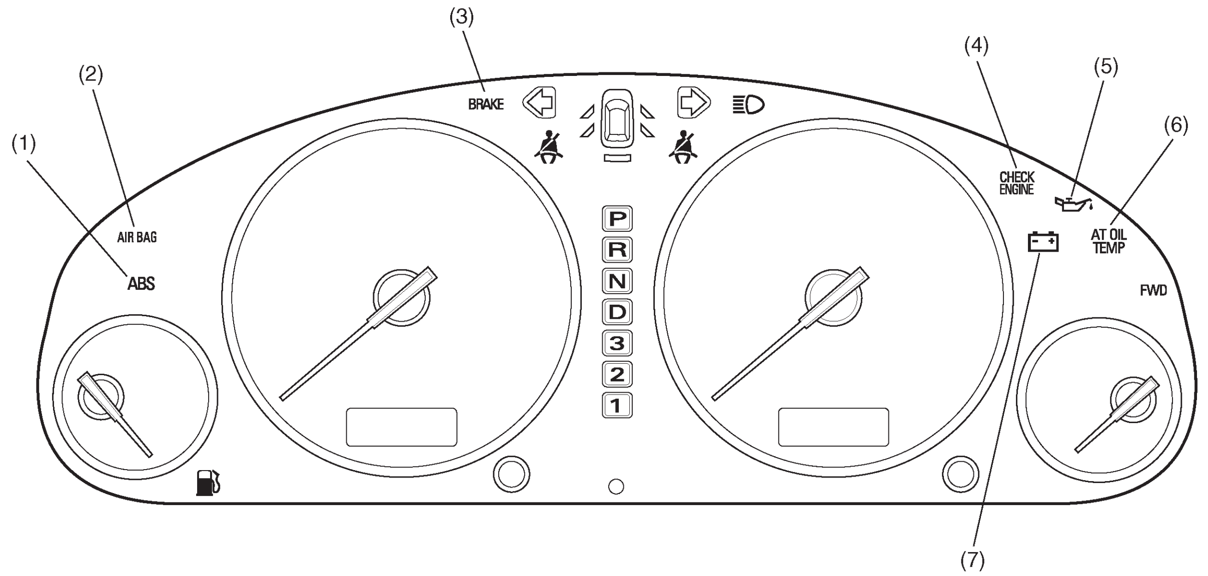
4) The check valve is installed just below the washer nozzle.

3. SPECIFICATION

Wiper Motor	Standard voltage	12 V
	No-load current	2 A or less
	Speed [at 0.5 N·m (5 kg-cm, 4.3 in-lb)]	30 ± 5 rpm or more
	Locked rotor current	13 A or less
Wiper Blade	Blade length	375 mm (14.76 in)

5. Combination Meter

A: WARNING AND INDICATOR LIGHT



B6H1295A

(1) ABS warning light
This light illuminates when trouble occurs in electrical components of ABS (Anti-lock Brake System).

(2) AIR BAG system warning light
This light illuminates when trouble occurs in Airbag system.

(3) Brake fluid level warning / parking brake indicator light
This light illuminates when the fluid level in the brake reservoir tank lowers under specified level and/or when parking brake is applied.

(4) CHECK ENGINE warning light
This light illuminates when trouble occurs in MFI (Multiple point Fuel Injection) system.

(5) Oil pressure warning light
This light illuminates when the engine oil pressure decreases below 14.7 kPa (0.15 kg/cm^2, 2.1 psi).

(6) AT oil temperature warning light
This light illuminates when the ATF temperature exceeds 150°C (302°F).

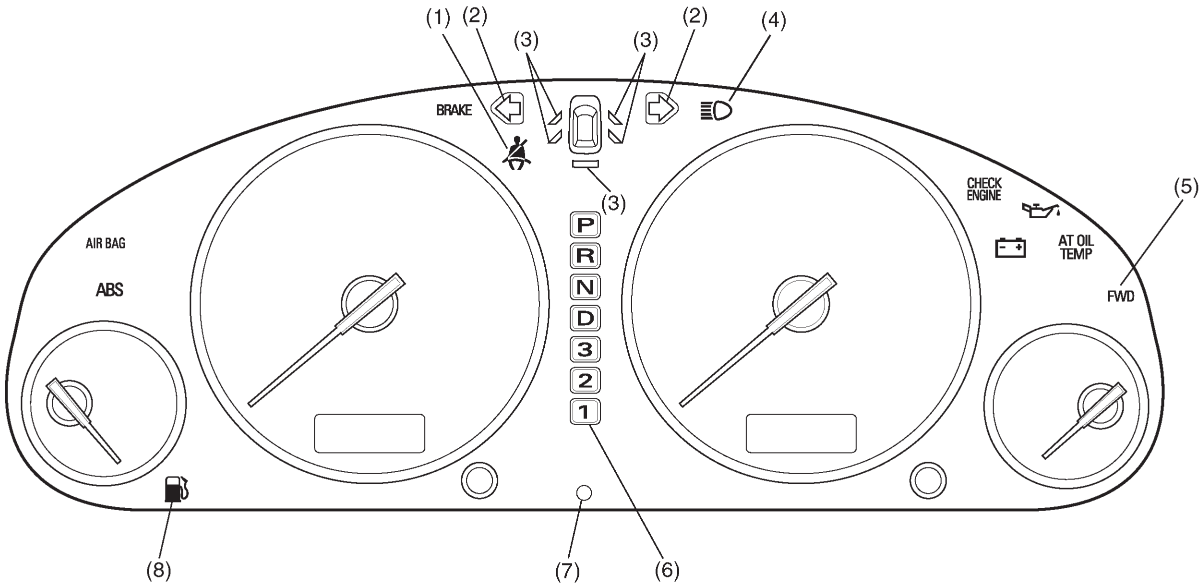
(7) Charge indicator light
This light illuminates when trouble occurs in charging system during engine running.

According to ignition switch position, the warning and indicator lights will come on and/or go off under normal conditions as follows:

Warning/Indicator light	Ignition switch position			
	LOCK/ACC	ON	ST	While engine is running
(1) ABS	OFF	*3	ON	OFF
(2) AIR BAG	OFF	*2	ON	*2
(3) Brake fluid level / parking brake	OFF	ON	ON	*4
(4) Malfunction indicator (CHECK ENGINE)	OFF	*1	ON	OFF
(5) Oil pressure	OFF	ON	ON	OFF
(6) AT oil temperature	OFF	ON	ON	OFF
(7) Charge	OFF	ON	ON	OFF

*1:Light comes ON before engine starts, and stay OFF after engine has stopped.
*2:Light comes ON for about seven seconds, and goes out.
*3:Light comes ON for about two seconds, and goes out.
*4:Light comes ON when parking brake is applied.

B: TELLTALE (GRAPHIC MONITOR)



B6H1295B

(1) Seat belt warning light
This light illuminates about 6 seconds after ignition switch turns ON if the driver's seat belt is not fastened.

(2) Turn signal indicator light
This light blinks (and turn signal light flashes) when the turn signal switch is turned ON.

(3) Door open warning light
This light illuminates when one or more doors and/or rear gate or trunk lid are not fully closed.

(4) Headlight beam indicator light
This light illuminates when the headlight is in high-beam position.

(5) FWD indicator light
This light illuminates when the center differential locks (with the fuse installed in the center differential locking circuit).

(6) AT selector lever position indicator
The light corresponding to the selected AT select lever position illuminates when the ignition switch is in other than ACC and LOCK positions.

(7) Security indicator light
This light illuminates when the security system is operating

(8) Low fuel warning light
This light illuminates when the fuel amount in fuel tank is lower than 10 liters (2.6 US gal, 2.2 lmp gal).

According to ignition switch position, the telltales will come on and/or go off under normal conditions as follows:

Telltale light			LOCK/ACC	ON	ST	While engine is running
(1)	Seat belt		OFF	*2	*2	*2
(2)	Turn signal		OFF	Blink	Blink	Blink
(3)	Door open/rear gate or trunk lid open	● Open	ON	ON	ON	ON
		● Shut	OFF	OFF	OFF	OFF
(4)	Headlight beam	● High beam	OFF	ON	ON	ON
		● Low beam	OFF	OFF	OFF	OFF
(5)	FWD	● FWD	OFF	ON	ON	ON
		● AWD	OFF	OFF	OFF	OFF
(6)	AT selector lever position		OFF	ON	ON	ON
(7)	Security		*3	OFF	OFF	OFF
(8)	Low fuel		OFF	*1	*1	*1

*1:Light illuminates when the fuel amount in fuel tank is lower than 10 liters (2.6 US gal, 2.2 Imp gal).
*2:Light illuminates about 6 seconds after ignition switch turns to ON if the driver’s seat belt is NOT fastened.
*3:Light blinks when arm the security system.

C: SPEEDOMETER

1. DESCRIPTION

- The speedometer system is an electric type; it uses electrical wire and drives the speedometer according to electrical signals from speed sensor (MT model) or TCM (AT model).
- The speed sensor is installed on the manual transmission.
- For this reason, meter trouble (meter hand vibration, cable disconnection, etc.) is eliminated and transmission mechanical noise is decreased.
- The odometer and tripmeter are displayed by LCD (Liquid crystal display).

2. OPERATION

MT model: The speed sensor sends the vehicle speed signal (4 pulses per one turn of speed sensor driven shaft) to the speedometer drive circuit and odometer/tripmeter drive circuit in the speedometer.

AT model: The TCM sends the vehicle speed signal (4 pulses) to the speedometer drive circuit and odometer/tripmeter drive circuit in the speedometer.

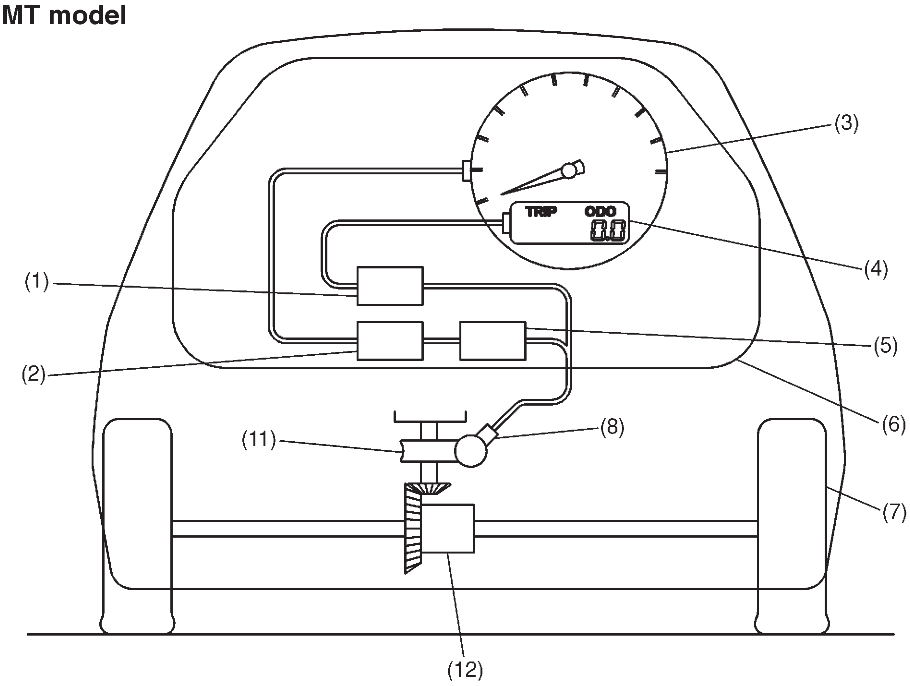
NOTE:
The output signal from speed detection circuit is also used in engine control module, automatic transmission control module, etc.

3. SPECIFICATION

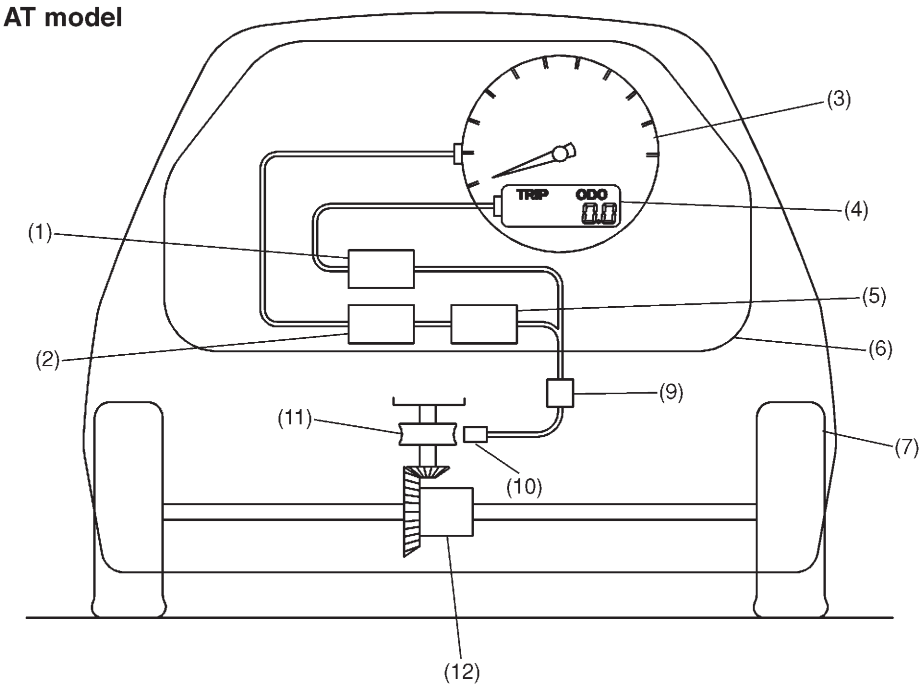
Speedometer	Type	Electric pulse type
	Indication	Hand points to 60 km/h (72 miles) when 2,548 pulses are input per minute.
Odometer	Type	Pulse count type.
	Display	LCD/6 digits; 0 to 999,999 km (mile)
	Indication	Count up 1 km per 2,548 pulses. (Count down is impossible.)
Trip meter	Type	Pulse count type.
	Display	LCD/4 digits; 0 to 999.9 km (mile)
	Indication	Count up 1 km per 2,548 pulses (Push knob is adopted to return the trip meter to zero indication.)

4. SYSTEM DIAGRAM

MT model



AT model



B6H1167B

(1) ODO/TRIP drive circuit
(2) Speedometer movement
(3) Speedometer
(4) ODO/TRIP meter
(5) Speedometer drive circuit
(6) Combination meter
(7) Front wheel
(8) Speed sensor
(9) TCM
(10) Electro magnetic pick-up
(11) Gear for the speed sensor
(12) Differential

D: SPEED SENSOR

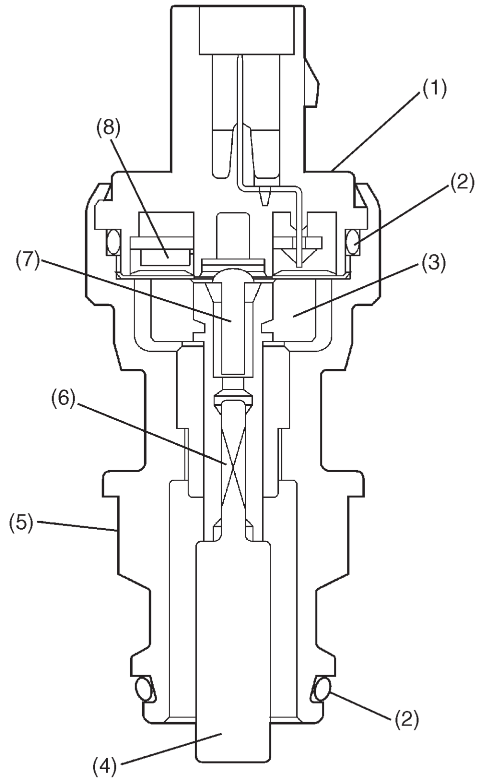
The speed sensor is a Hall IC pick-up type revolution sensor. (MT model)

This sensor is installed on the transmission case and detects the transmission output gear rotation speed.

4 pulses are sent to speedometer per rotation of speed sensor driven shaft.

1. CONSTRUCTION

The speed sensor consists of a Hall IC, magnet ring, driven shaft, spring, etc.



B6H0911A

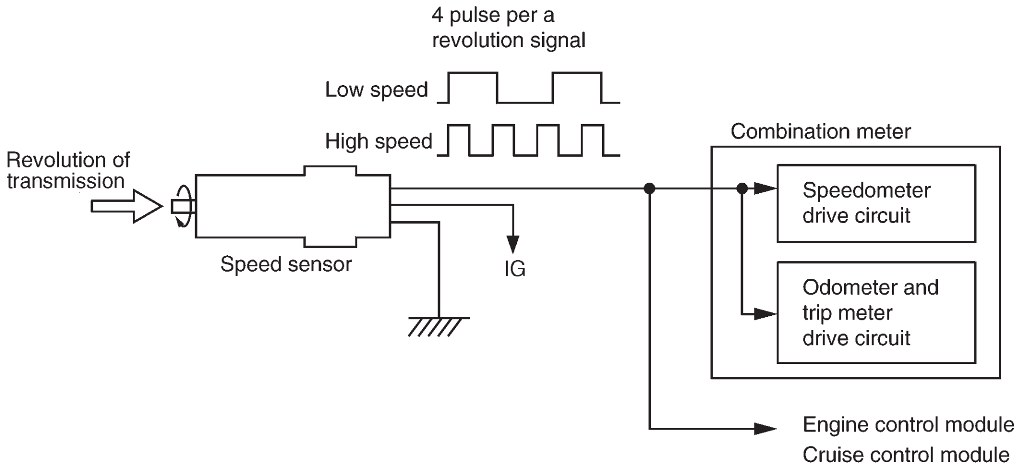
(1) Upper case	(4) Driven key	(7) Rivet
(2) O-ring	(5) Lower case	(8) Hall IC
(3) Magnet	(6) Driven shaft	

2. OPERATION

As the driven key rotates, the magnet turns to change the magnetic field of the Hall IC.

The Hall IC generates a signal corresponding to a change in the magnetic field.

One turn of the driven key in the speed sensor sends 4 pulses of square wave signal to the combination meter, engine control module and cruise control module.



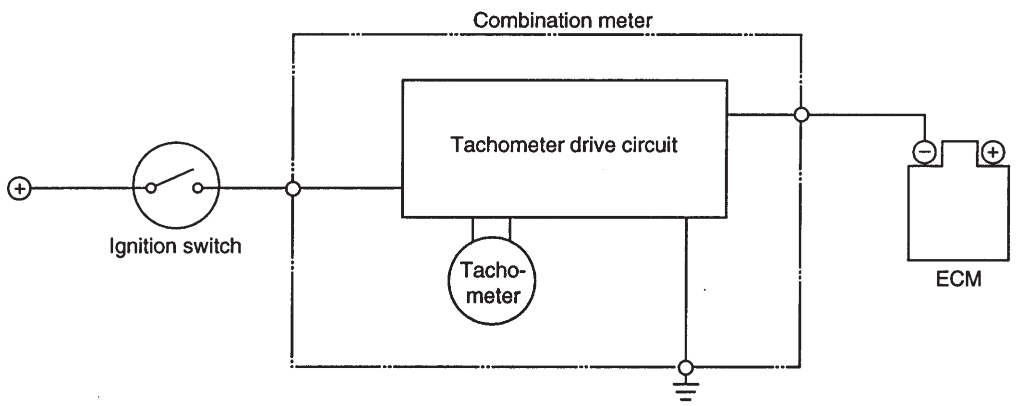
B6H0912B

E: TACHOMETER

The tachometer drive circuit connects to engine revolution detecting circuit in engine control module.

When the engine revolution increases/decreases, the voltage of this circuit also increases/decreases, changing the magnetic force of tachometer drive coil.

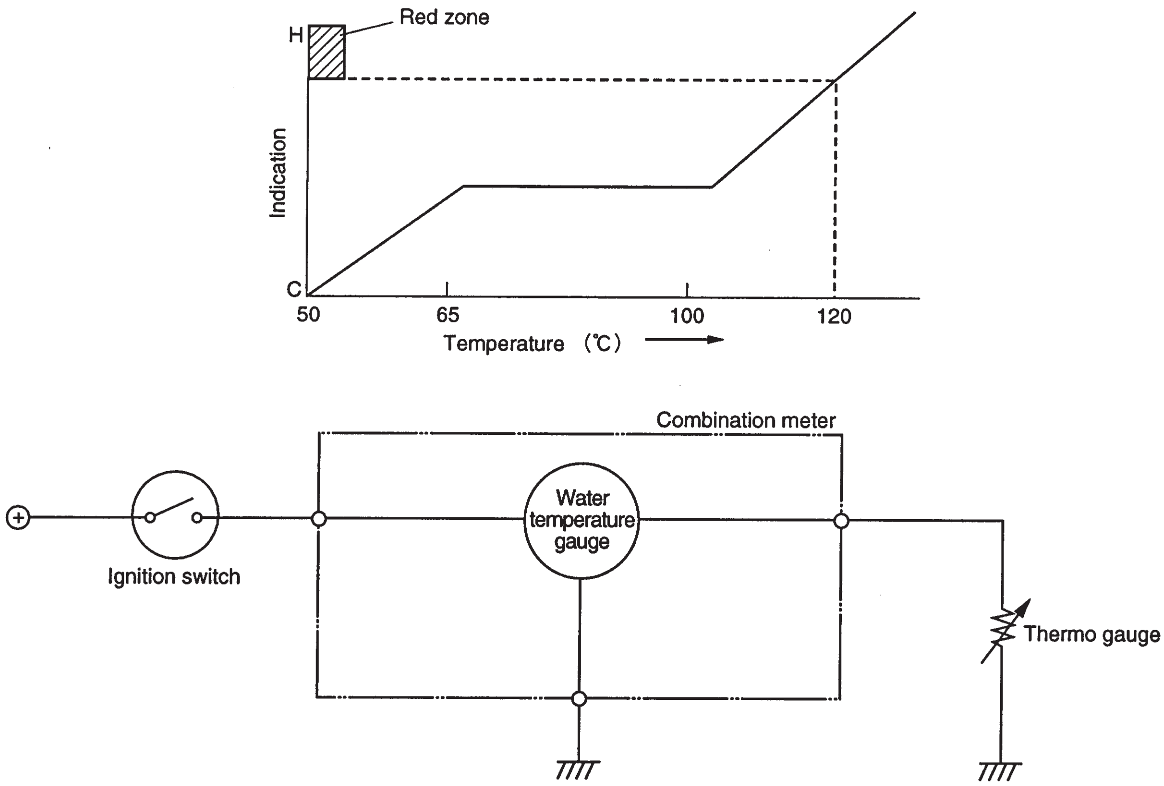
Thus, the tachometer hand moves together with engine revolution change.



H6H0419

F: WATER TEMPERATURE GAUGE

- The water temperature gauge is a cross-coil type.
- The water temperature signal is input from thermo gauge installed on the engine.
- The resistance of thermo gauge changes according to engine coolant temperature. Therefore, the current input to water temperature gauge also changes according to engine coolant temperature. Accordingly, gauge hand moves in proportion to the change in magnetic force of coil.
- When the water temperature is at approx. 70 to 100 °C (158 to 212 °F)[normal operating temperature], the meter hand is stable in the middle of indication range as shown in the graph below.

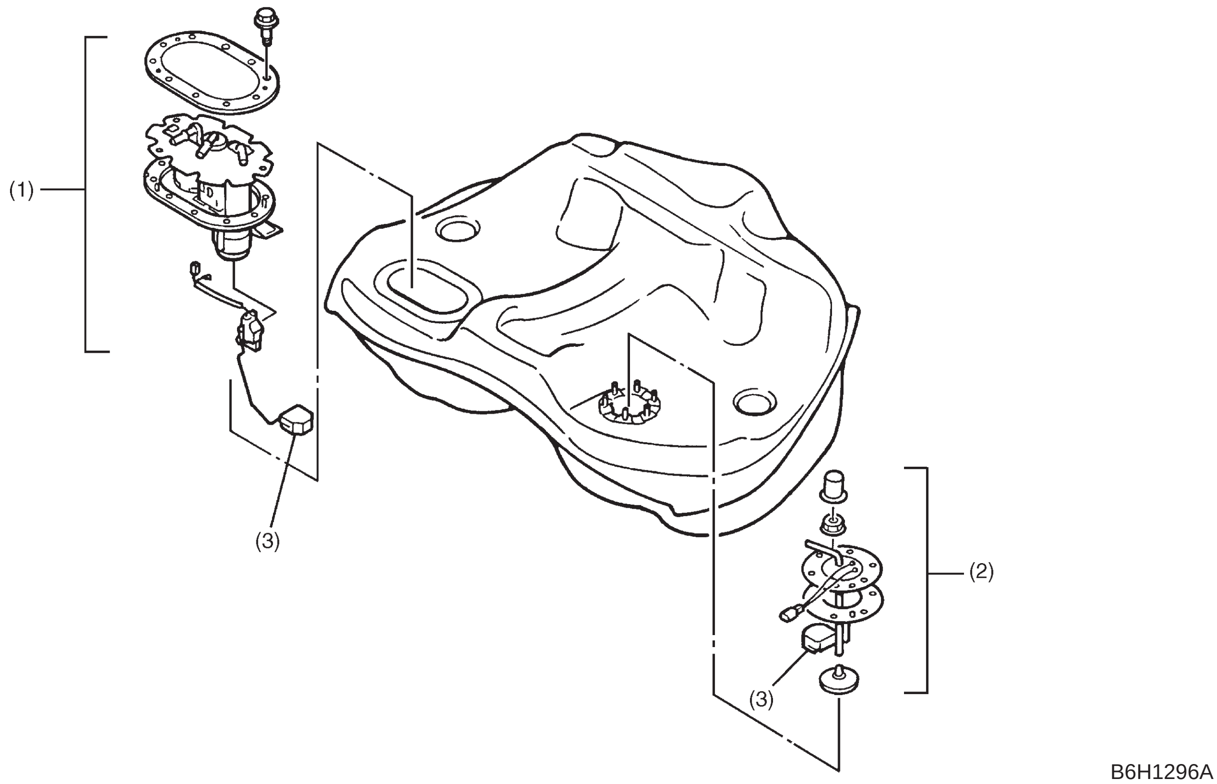


H6H0420

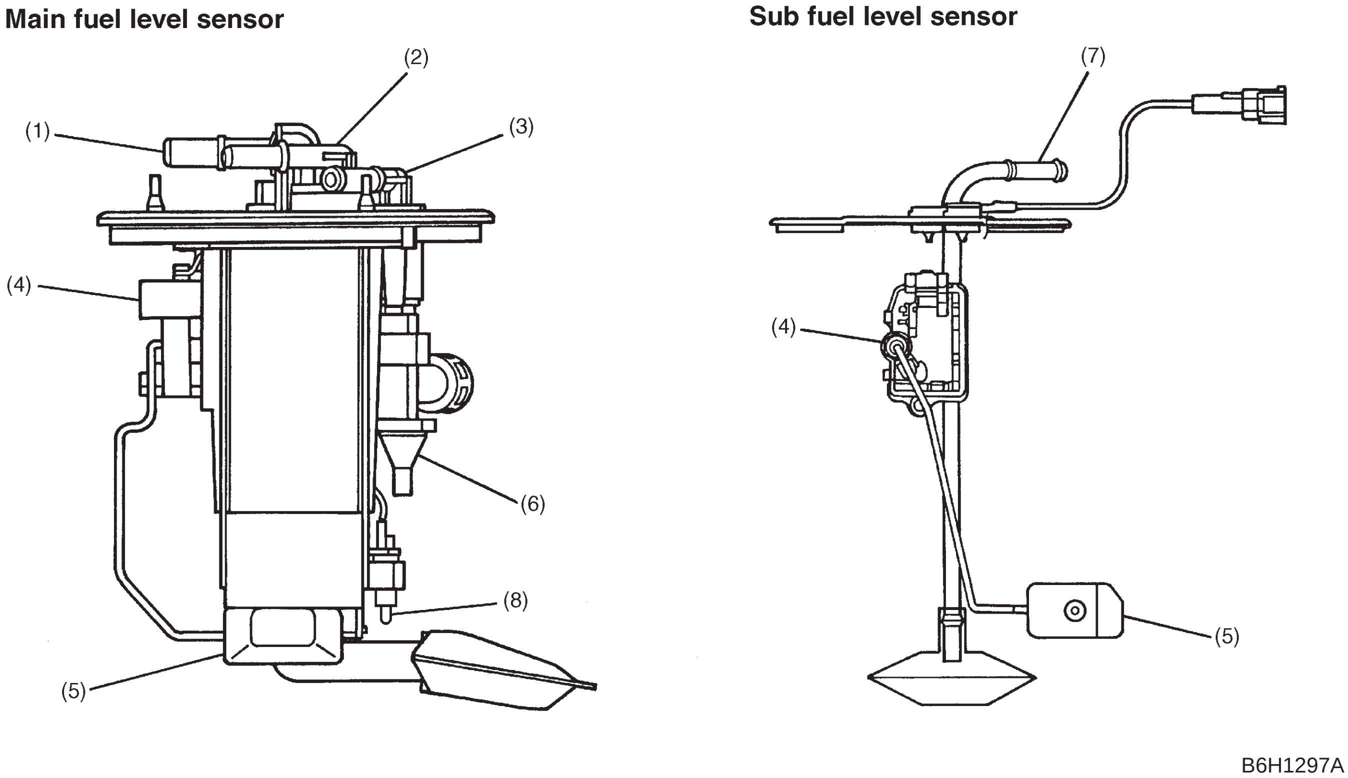
G: FUEL GAUGE

1. GENERAL

- The fuel meter unit consists of a float and a potentiometer that varies in resistance values depending on movement of the float, and is installed inside the fuel tank, integral with the fuel pump. The fuel gauge indicates the fuel level in the tank even when the ignition switch is in LOCK position.
- All models are equipped with two fuel level sensors. Two fuel level sensors are installed in the fuel tank, one each at the right and left side, because the fuel tank is divided into main and sub tank area.
- The low fuel sensor (warning light switch) is installed in the main fuel level sensor.



(1) Main fuel level sensor
(2) Sub fuel level sensor
(3) Float



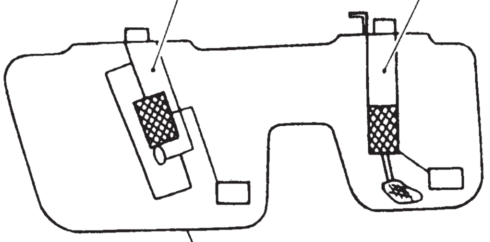
(1) To engine
(2) From engine
(3) From sub tank
(4) Level sensor
(5) Float
(6) Jet pump
(7) To jet pump
(8) Gas sensor

2. OPERATION

Low fuel warning light operation

The ECM continually monitors the resistance signal input from the fuel level sensor, and turns on the low fuel warning light in the combination meter when the resistance value corresponding to the critical fuel level (approx. 76 Ω) is registered successively for about 10 minutes or during a 10 km driving.

In this system, therefore, an erroneous warning of low fuel level is avoided which may happen when a large part of remaining fuel is collected temporarily in the sub-tank.

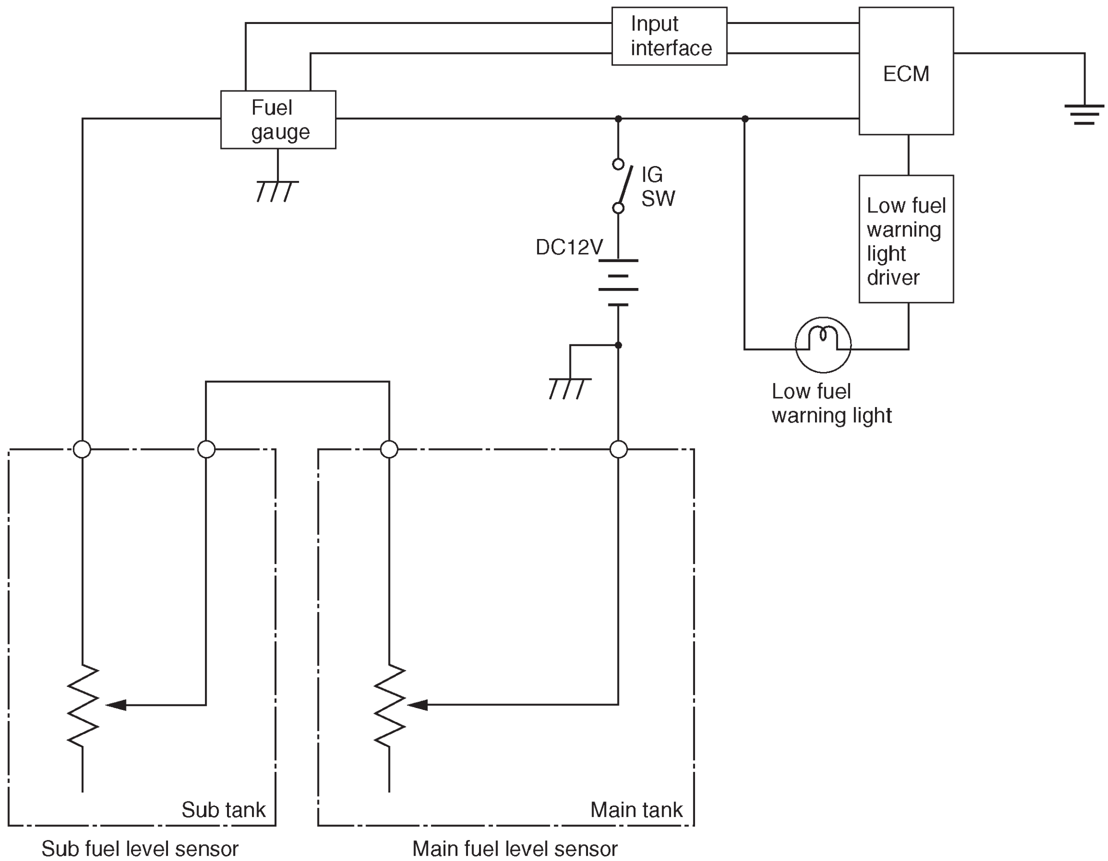


B6H0026B

3. SPECIFICATION

	Fuel amount	Resistance
Main unit	FULL	0.5–2.5 Ω
	1/2	18.5–22.5 Ω
	EMPTY	52.5–54.5 Ω
Sub unit	FULL	0.5–2.5 Ω
	1/2	23.6–27.6 Ω
	EMPTY	39.5–41.5 Ω

4. CIRCUIT DIAGRAM



B6H1281A

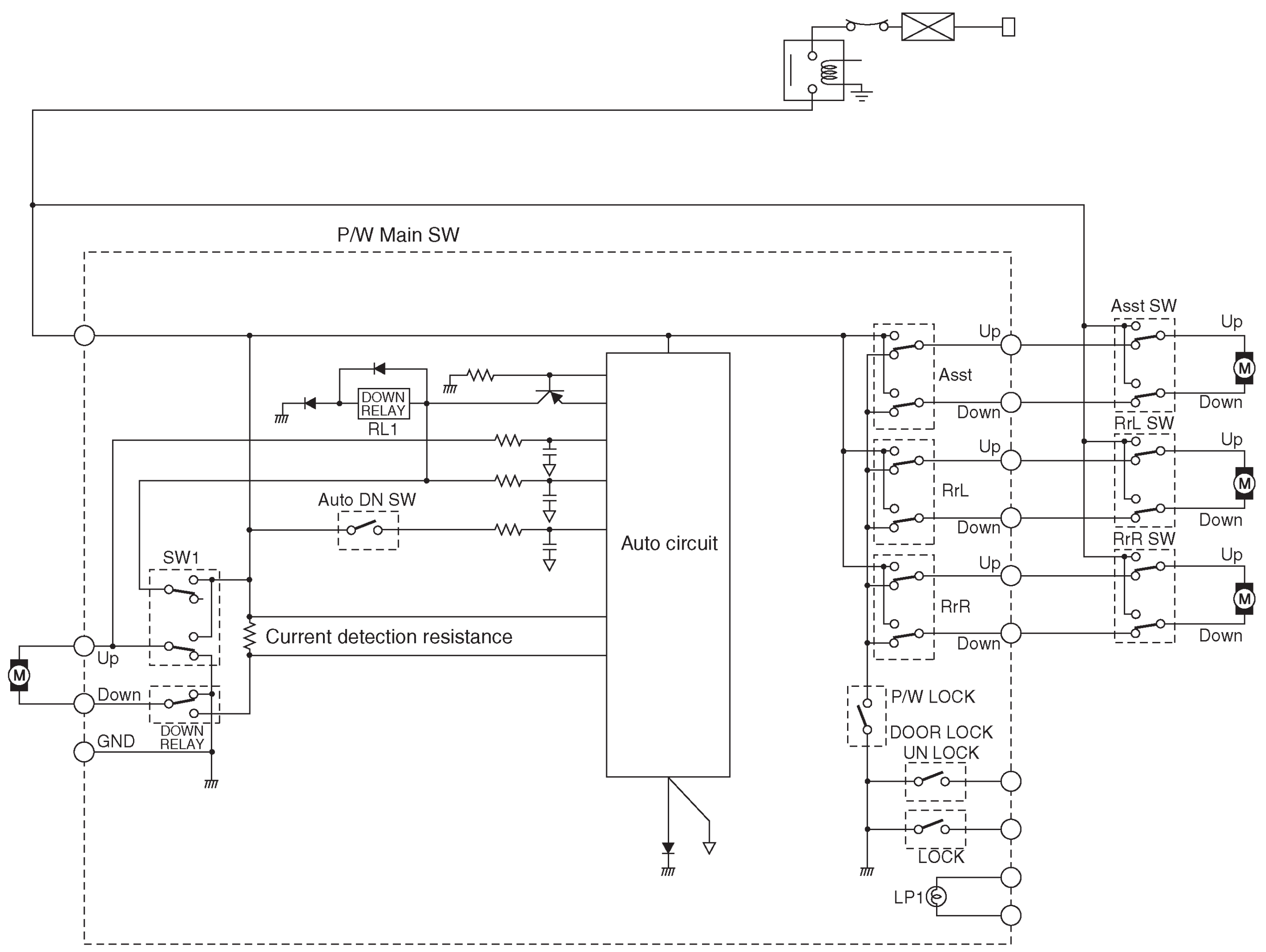
6. Power Window

A: CONSTRUCTION

- The power window system consists of regulator motor and switch (installed in each door), relay and circuit breaker unit.
- Each door window opens/closes by pushing down/pulling up the switch.
- Only driver's door window switch has a 2-stage mechanism;
  - When the switch is pushed down to "one click" position and held there, the window continues to lower until the switch is released.
  - When the switch is pushed down fully, the window lowers to the end position automatically.

NOTE:
For the sake of safety, the power window system is designed to operate only when the ignition switch is in ON position.

B: CIRCUIT DIAGRAM

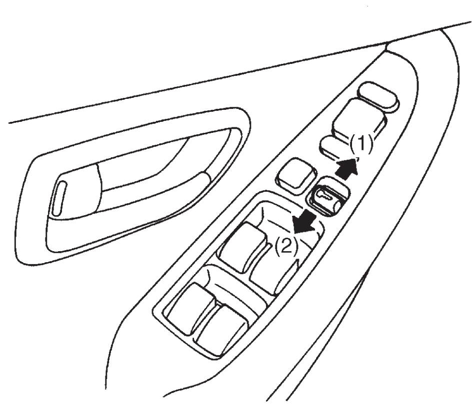


B6H1306A

7. Power Door Lock

A: CONSTRUCTION

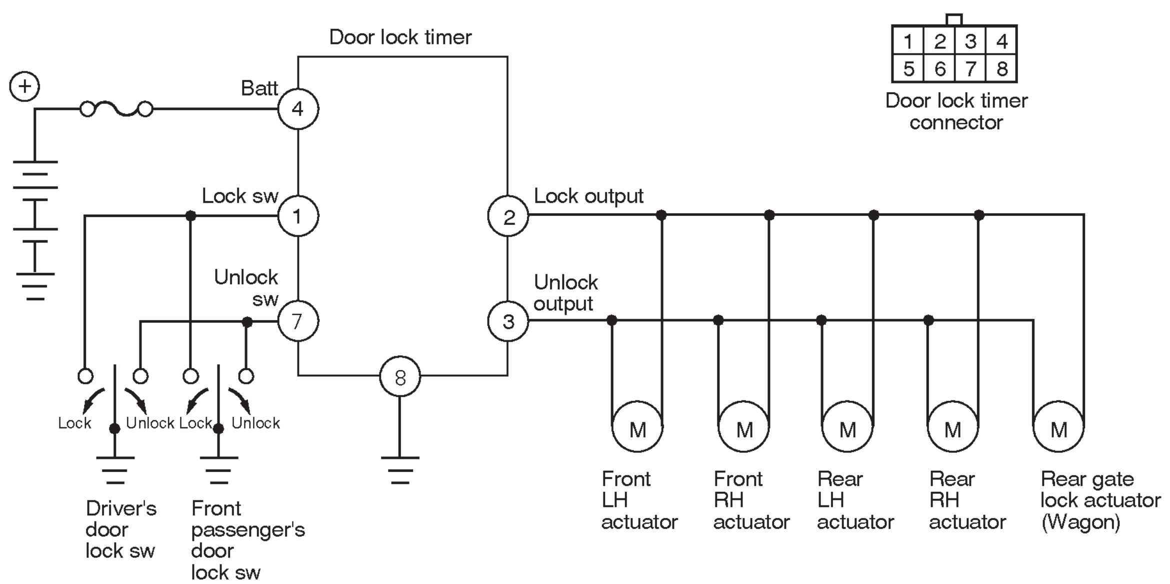
The power door lock system consists of driver's and front passenger's door lock switches, front door lock actuators, rear door lock actuators, and rear gate lock actuator (WAGON).



B6H1298A

(1) Unlock
(2) Lock

B: CIRCUIT DIAGRAM



B6H0759B

8. Keyless Entry

A: CONSTRUCTION

- The keyless entry system is of radio wave-operated type which is less affected by the direction in which the transmitter is operated. Thus, the system can be operated from any directions.
- The keyless entry system consists of a transmitter, keyless entry control module (with integrated antenna), door lock actuator, door switch, horn and room light.

B: FUNCTION

1. DOOR LOCK PROCEDURE

- Push LOCK button once.
- All doors are locked.
- Check that horn chirps once.

2. DOOR UNLOCK PROCEDURE (DRIVER'S DOOR)

- Push UNLOCK button once.
- The driver's door is unlocked and the room light turns ON, (When room light switch is set at the middle position).

NOTE:
Room light will illuminate for 30 seconds and then turn OFF. (However, if ignition switch is turned ON or locking procedure is performed again during this period of time, room light will turn OFF immediately.)

- Check that horn chirps twice.

3. DOOR UNLOCK PROCEDURE (ALL DOORS)

- Push UNLOCK button twice.
- All doors are unlocked.
- No sign is given even after all doors are unlocked.

4. PANIC ALARM SETTING

- Push LOCK button for more than 2 seconds.
- The horn sounds continuously. To stop the sounding horn, push any remote transmitter button.

5. ANSWER BACK (HORN CHIRP) ON/OFF SELECTION

- Push LOCK and UNLOCK buttons simultaneously for more than 2 seconds.
- When answer back is turned ON, the horn will chirp once. When answer back is turned OFF, the horn will chirp twice.

6. DOOR WARNING

- With any door, rear gate or trunk lid opened, press the LOCK button.
- Horn chirps three times.

9. Security System

A: FEATURES

● The security system detects a theft action (unauthorized entry into the vehicle), and gives an alarm of that situation by letting the horn sound and the small light blink, and immobilizes the vehicle by interrupting the starter circuit.

● An unauthorized entry is monitored by the switches which are installed on all the doors and the rear gate or the trunk lid. When one of the switch is turned ON, this system judges it as on unauthorized entry into the vehicle being attempted, gives an alarm and immobilizes the vehicle.

● An unauthorized entry is also monitored by the impact sensor.
The system operates in the same manner as mentioned above whenever the impact sensor senses an impact on the vehicle.

1. SYSTEM OPERATION

1) The security system will give the following alarm:

● The small light blinks and the horn sounds intermittently. In addition, the security indicator light blinks fast and the starter motor is inhibited to operate.

● The alarm automatically turns OFF after 30 seconds; however, the alarm will be reactivated if the vehicle is tampered with again.

2) The alarm is activated when:

● The door, rear gate or trunk lid is opened without using transmitter. (even if the door is opened by releasing the inside door handle or the trunk lid is opened by operating the trunk lid release lever.)

● Dealing an impact is sensed on vehicle body.

2. HOW TO ARM THE SYSTEM

1) Remove the key from the ignition switch.
2) Make sure that the trunk lid is closed.
3) Close all windows. Close and lock all doors and rear gate.
4) Push transmitter LOCK button.
5) The horn will chirp once and small light will blink once.

NOTE:
The system can be armed even if the windows are open.

6) Confirm that the security indicator light comes to blink. (If this indicator light remains illuminated, it is an indication that the any door, rear gate or trunk lid is not properly closed. Resume the procedure from beginning.) If during this 5 seconds time period, the door is unlocked by key and the ignition switch is turned ON, the system will disarm. The indicator light blinks every 2 seconds while the system is being armed, and continues to blink until the system is disarmed.

3. HOW TO DISARM THE SYSTEM

1) Push transmitter UNLOCK button.

2) The horn will chirp twice and small light will blink twice.

3) Security indicator light turns OFF.

4) Room light will illuminate for 30 seconds and then turn OFF. (However, if ignition switch is turned ON or arming procedure is performed again, room light will turn OFF.)

4. HOW TO STOP ALARMS

Push transmitter UNLOCK button or turn the ignition switch from ON to LOCK position repeatedly three times.

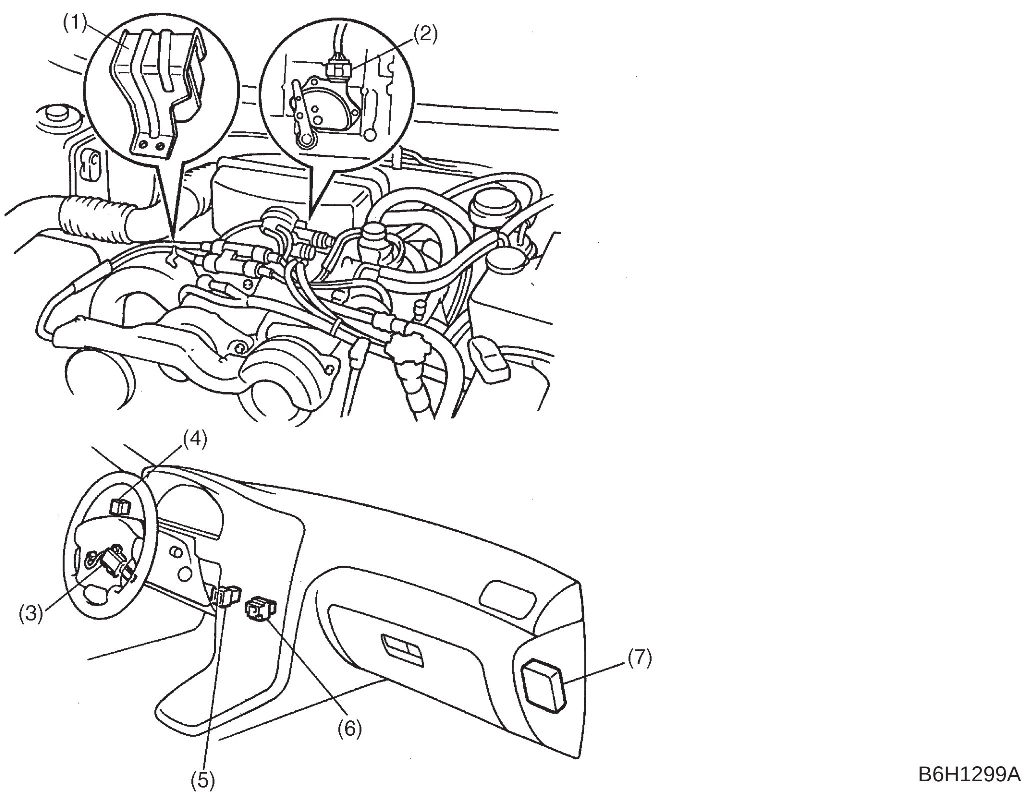
10. Cruise Control

A: OPERATION

● The cruise control automatically controls vehicle speed and allows the vehicle to run at a constant speed without depressing the accelerator pedal.

● The cruise control module compares the actual vehicle speed detected by the speed sensor (MT) or TCM (AT) with the speed preset in the memory when the set switch was turned on, then generates a signal according to the difference between the two speeds.
This signal is transmitted to the actuator located at the engine compartment.
The actuator operates the throttle cam, keeping the vehicle speed constant.

B: COMPONENT LOCATION

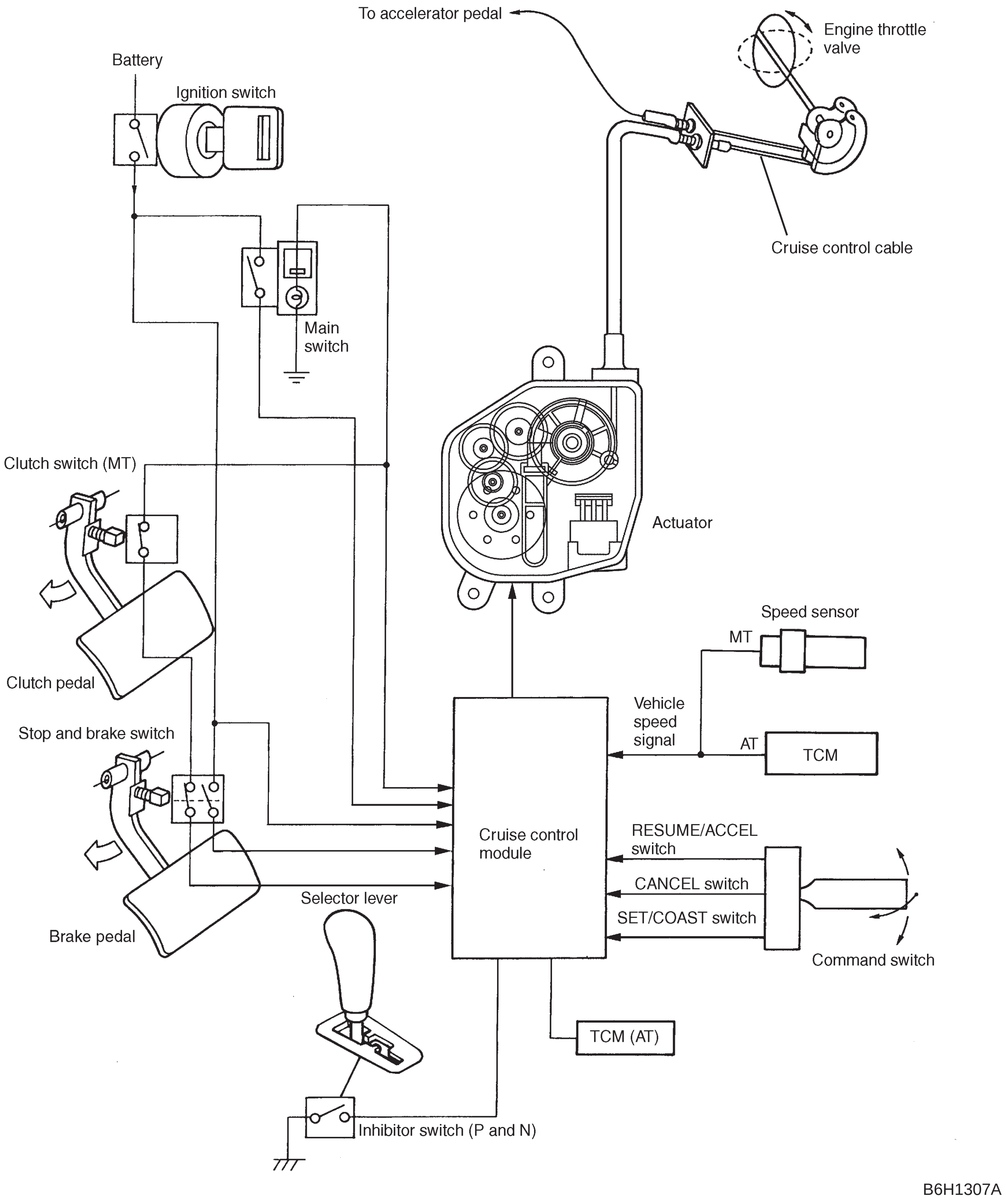


(1) Actuator
(2) Inhibitor switch (AT)
(3) Command switch
(4) Main switch
(5) Clutch switch (MT)
(6) Stop and brake switch
(7) Control module

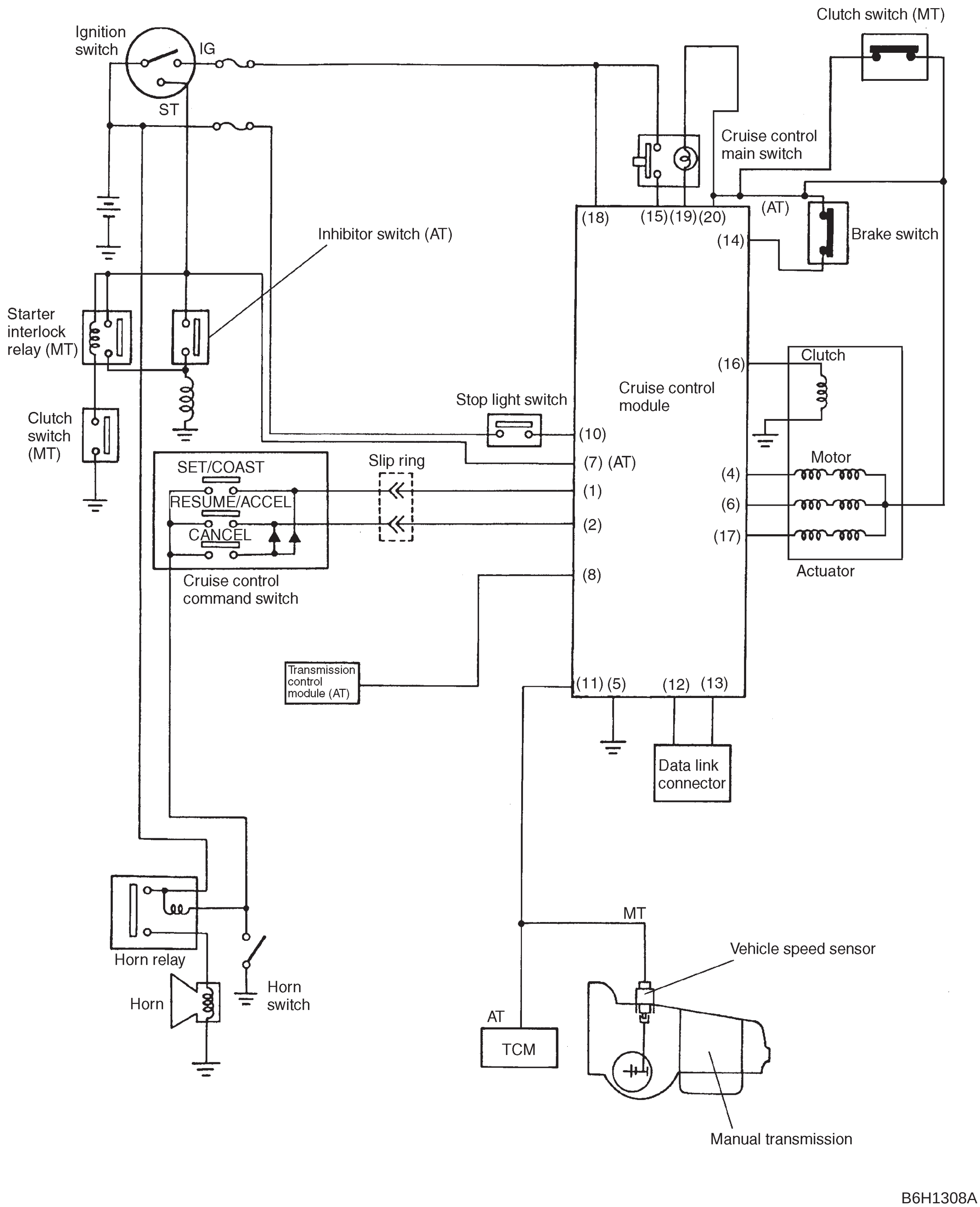
C: CONTROL AND OPERATION

Constant speed control	When actual driving speed is higher than “set” speed, the motor in the actuator operates to move the throttle valve toward the close position by the amount corresponding to the difference between two speeds. When actual driving speed is lower than “set” speed, the motor operates to move the throttle valve toward the “open” direction according to the difference.
“Set” control	When SET/COAST switch is pressed with main switch ON while vehicle is being driven at a speed greater than 40 km/h (25 MPH), current flows to the actuator. This then causes the clutch in the actuator to engage, operating the motor. The motor moves the throttle valve to the position corresponding to accelerator pedal depression. Thus, vehicle is being driven at constant speed.
Deceleration control	When SET/COAST switch is turned ON while vehicle is cruising, the motor in the actuator rotates to move the throttle valve toward the “close” direction. This causes the vehicle to decelerate. When the switch is turned OFF, vehicle speed is stored in memory and vehicle is constantly driven at that speed.
Acceleration control	When RESUME/ACCEL switch is turned ON while vehicle is cruising, the motor in the actuator rotates to move the throttle valve toward the “open” direction. This causes vehicle to accelerate. When the switch is turned OFF, vehicle speed is stored in memory and vehicle is constantly driven at that speed.
Resume control	When RESUME/ACCEL switch is turned ON after cruise control is released, vehicle speed returns to that speed which was stored in memory just before cruise control was released. However, this occurs only when vehicle is being driven at a speed greater than 32 km/h (20 MPH). In the following cases, however, the set vehicle speed is cleared. Therefore, no resume operation is performed. (1) Ignition switch is turned OFF (2) Main switch is turned OFF
Manual cancel control	When any of the following signals is entered, the clutch disengages, cancelling the cruise control. (1) Stop light switch ON signal (Brake pedal depressed) (2) Brake switch OFF signal (Brake pedal depressed) (3) Clutch switch OFF signal (Clutch pedal depressed – MT) (4) Inhibitor switch ON signal (Selector lever set to “N” – AT) (5) CANCEL switch ON signal (Command switch pulled) (6) Ignition switch OFF signal (7) Main switch OFF signal
Low speed limit control	When vehicle speed drops below 32 km/h (20 MPH), cruise control is automatically cancelled. Cruise control at speed lower than 40 km/h (25 MPH) cannot be effected.
Motor control	When vehicle speed increases 10 km/h (6 MPH) greater than memorized speed while vehicle is cruising (downgrade, etc.), actuator’s clutch is turned OFF so that vehicle decelerates. When vehicle decelerates by more than 8 km/h (5.0 MPH) from the memorized speed, the clutch is turned ON so that cruise control resumes.

D: SCHEMATIC


To accelerator pedal
Engine throttle valve
Battery
Ignition switch
Cruise control cable
Main switch
Clutch switch (MT)
Actuator
Speed sensor
MT
Clutch pedal
Vehicle speed signal
Stop and brake switch
AT
TCM
RESUME/ACCEL switch
Cruise control module
CANCEL switch
Selector lever
SET/COAST switch
Brake pedal
Command switch
TCM (AT)
Inhibitor switch (P and N)
B6H1307A

E: CIRCUIT DIAGRAM



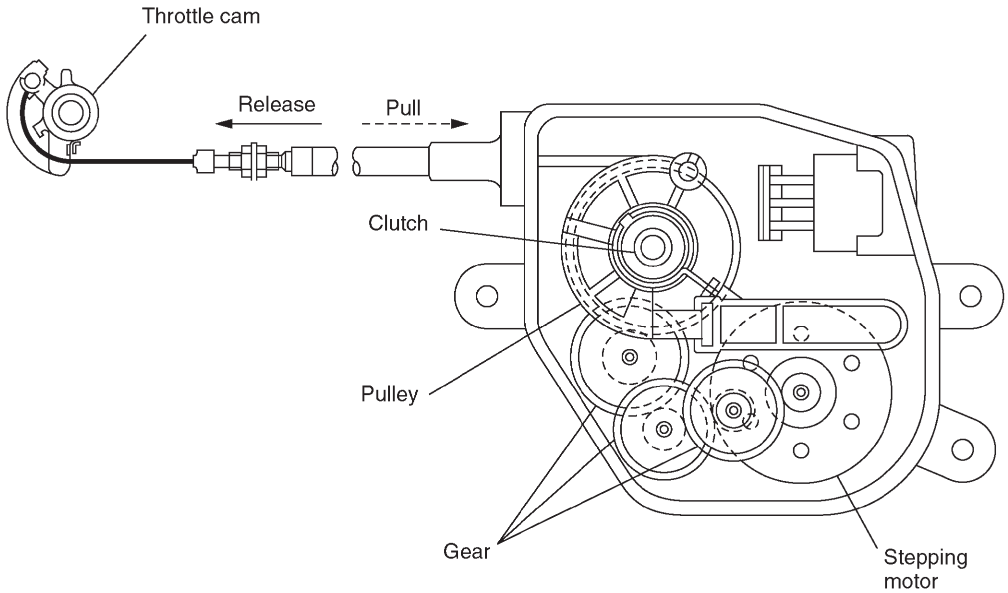
F: SYSTEM CONSTRUCTION

Unit	Name	Function	Set	Cancel	Resume	Coast	Vehicle speed
Input signal (sensors)	Main switch	Supplies battery voltage to control module after main switch is turned ON (with ignition switch ON).	○	○	○	○	○
	SET/ COAST switch	Sends a SET/COAST signal to control module.	○			○	
	RESUME/ ACCEL switch	Sends a RESUME/ACCEL signal to control module.			○		
	CANCEL switch	Simultaneously sends SET/ COAST and RESUME/ACCEL signals to control module.		○			
	Brake switch (NC)	Disconnects power supply to clutch and stepping motor.	○	○			
	Stop light switch (NO)	Sends a cancel signal to control module.	○	○			
	Clutch switch (NC) or inhibitor switch (NO)	Sends a cancel signal to control module.	○	○			
	Vehicle speed sensor	Detects vehicle speed.	○	○	○	○	○
Control section	Built-in relay	A safety device to protect system from damage.	○	○	○	○	○
Output signal	Stepping motor (PULL)	Controls vehicle speed.	○		○		○
	Stepping motor (RELEASE)	Controls vehicle speed.		○		○	○
	Clutch	Cruise control set cancel.	○	○	○	○	○

NC:Normal close
NO:Normal open

G: ACTUATOR

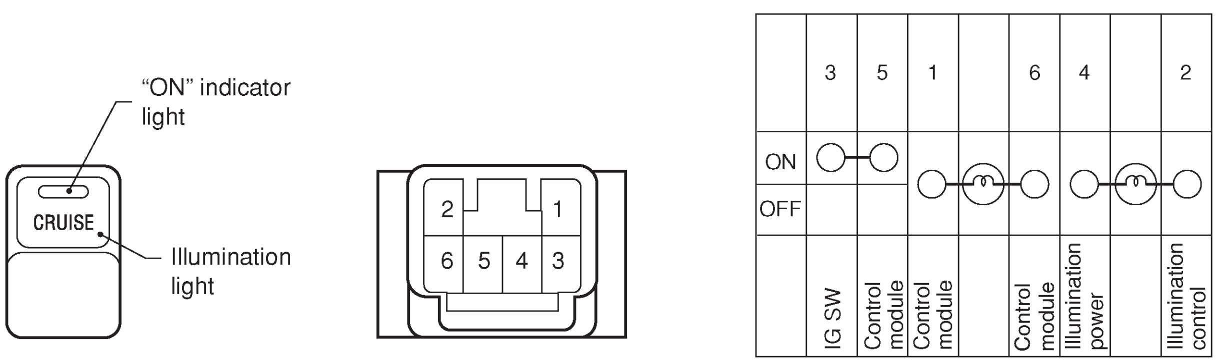
When receiving a signal from the cruise control module, the clutch in the actuator is turned ON. This causes the stepping motor to operate, pulling the throttle cam for speed control.



B6H1309A

H: MAIN SWITCH

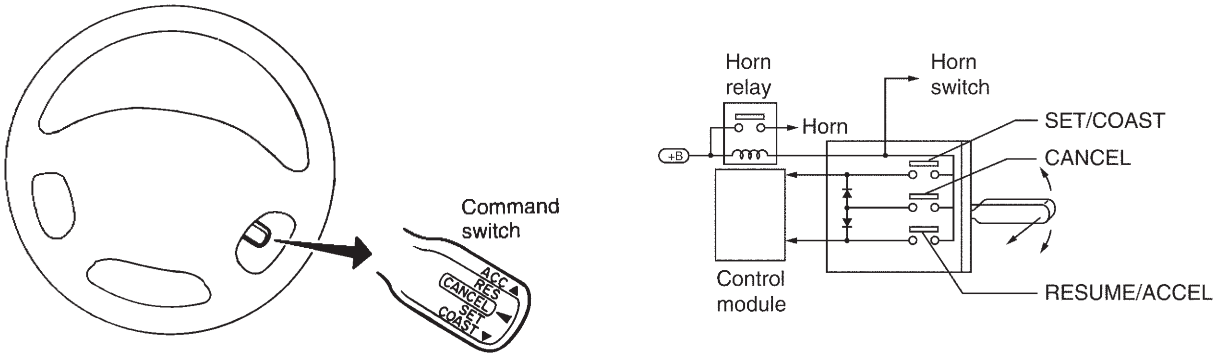
- The main switch is the main power supply switch of the cruise control module and has a built-in power indicator and night illumination light.
- When the ignition switch is placed in the OFF position with the main switch at ON, the main switch is also simultaneously forced to OFF. In this condition, even if the ignition switch is placed in the ON position again, the main switch will stay in the OFF state.



B6H1173B

I: COMMAND SWITCH

● When the vehicle is in the cruise control mode, the command switch controls its operation. It inputs SET/COAST signal, ACCEL/RESUME signal or CANCEL signal to the cruise control module.



B6H1310A

● The command switch is located on the right side of the steering wheel and can be operated without releasing your hand from the steering wheel.

● The command switch is an auto return lever type.

1. RESUME/ACCEL AND SET/COAST SWITCH

The switch is caused to be ON as long as the lever is kept pressed in any of the positions, and outputs it as a signal to the control module.

2. CANCEL SWITCH

The switch is caused to be ON as long as the lever is pulled toward CANCEL (toward you), and outputs RESUME/ACCEL and SET/COAST ON signals simultaneously.

J: CANCEL SIGNALS

The cancel signal cancels the cruise mode. When any of the following switches is operated, the cruise control module cancels the cruise mode.

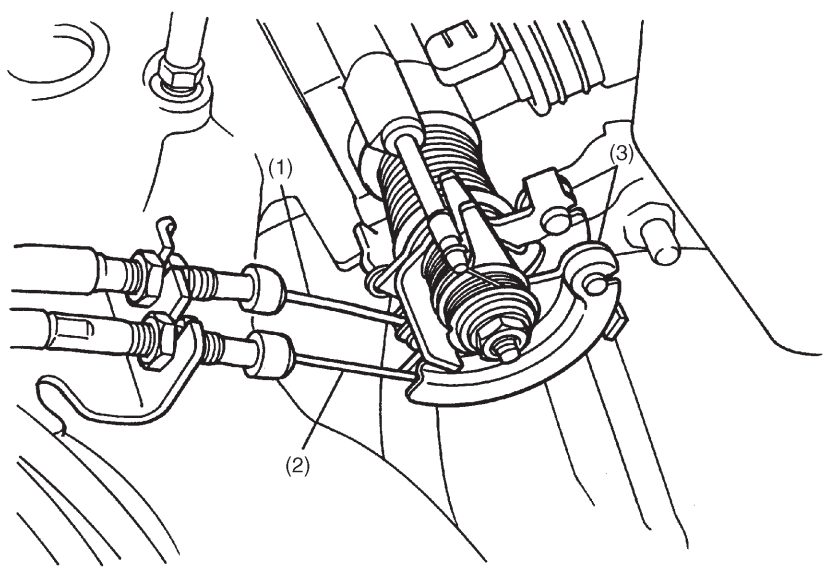
- Stop light switch
- Brake switch
- Clutch switch (MT model)
- Inhibitor switch (AT model)
- Main switch
- Command switch (CANCEL position)

K: VEHICLE SPEED SENSOR

Vehicle speed sensor is installed on the transmission, and sends signal to the cruise control module (MT model).

L: ENGINE THROTTLE

- The throttle body is equipped with two throttle cams. One cam is used during acceleration and the other during cruising, in order to open or close the throttle valve.
- These cams operate independently of each other. In other words, while one cam operates, the other does not.

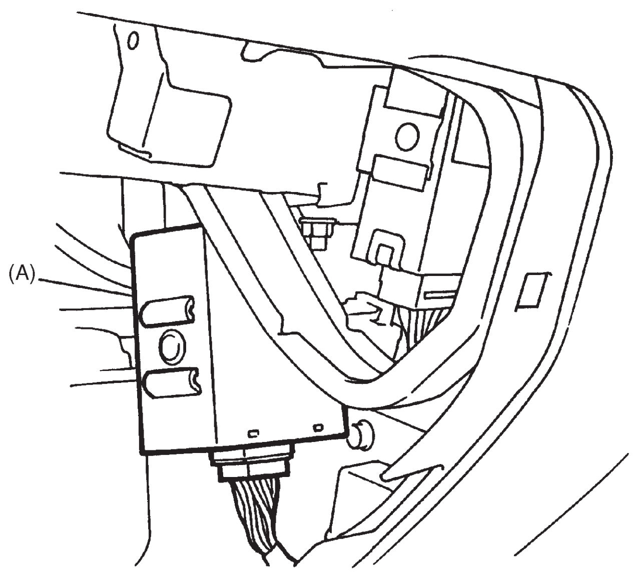


B6H1300A

(1) Accelerator cable
(2) Cruise control cable
(3) Throttle cam

M: CONTROL MODULE

- Based on the signals from the individual switches, sensors, etc., the control module controls all of the cruise control functions described below.
(Constant speed control, set control, deceleration control, acceleration control, resume control, manual cancel control, low speed limiter control, stepping motor control, clutch control)
- The control module (A) is installed at inside of front pillar lower (Passenger side).



B6H1301A

N: FAIL-SAFE FUNCTION

1. CANCELLING FUNCTION WHEN CANCEL SWITCH (SIGNALS) ARE IN ABNORMAL CONDITION

- Group 1 switches: SET/COAST switch ON, RESUME/ACCEL switch ON and CANCEL switch ON
- Group 2 switches: Brake switch OFF, Stop Light switch ON, Clutch switch OFF and Inhibitor switch ON

1) When at least one of the group 1 switches and one of the group 2 switches are operated simultaneously, the system is cancelled and held in the non-operating state. When the switches in groups 1 and 2 are turned from ON to OFF (except brake and clutch switches which are turned from OFF to ON) and then the switches in group 1 are turned ON, the system starts operation.

2) If the cruise main switch is turned ON with at least one switch in group 1 turned ON, the system does not operate and remains in that state until the cruise main switch is turned OFF.

2. CANCELLING FUNCTION WHEN THE SYSTEM CIRCUIT IS IN ABNORMAL CONDITION

In the following states, the system is cancelled and the memorized speed is also cancelled. After cancellation of the system, the cancelling function is held until the IG switch or cruise main switch is turned OFF.

1) The stepping motor terminal is grounded or opened.
Or the stepping motor driving circuit is shorted or opened.

2) The stepping motor clutch driving circuit is grounded.

3) The vehicle speed signal varies more than ±10 km/h (6 MPH) per 360 m sec.

4) The fused internal relay is detected while the vehicle is not in cruise control operation.

5) The internal circuit of the cruise control module stops its operation in an abnormal condition.

6) There is a discrepancy between the values stored in RAM inside the cruise control module.

7) An abnormal condition is detected by self-diagnosis of the cruise control module which is performed when ignition switch is turned ON.

3. CANCELLING FUNCTION WHEN THE STEPPING MOTOR IS IN ABNORMAL CONDITION

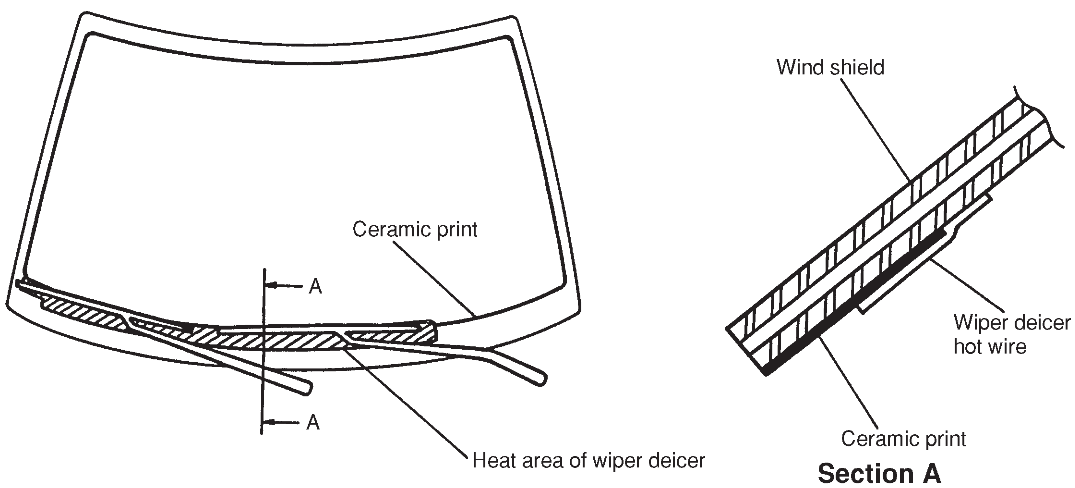
1) The cruise control is cancelled when an improper stepping motor is detected.

2) The cruise control is cancelled when unduly long and frequent energization of stepping motor is detected.
The system is held in this state for 2 to 20 minutes.

11. Wiper Deicer

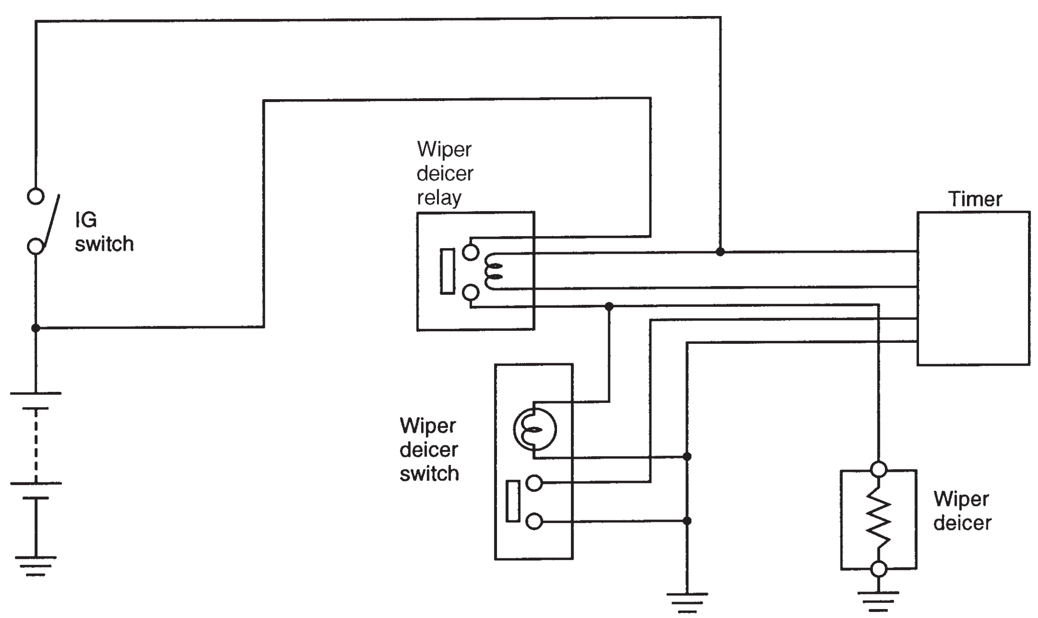
A: CONSTRUCTION

The wiper deicer system is activated when its wiper deicer switch is turned ON and heats with a heater wire the lower part of the windshield to melt the ice that blocks the wiper blades.
The system turns off automatically in 15 minutes after the wiper deicer switch is turned ON.



B6H0857A

B: CIRCUIT DIAGRAM

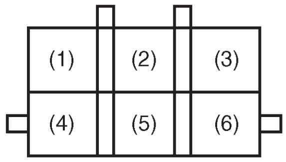


B6H0858

12. Towing Power Connector

A: DESCRIPTION

Power for trailer lights (for camping car, etc.) can be taken out through this connector.



B6H1305A

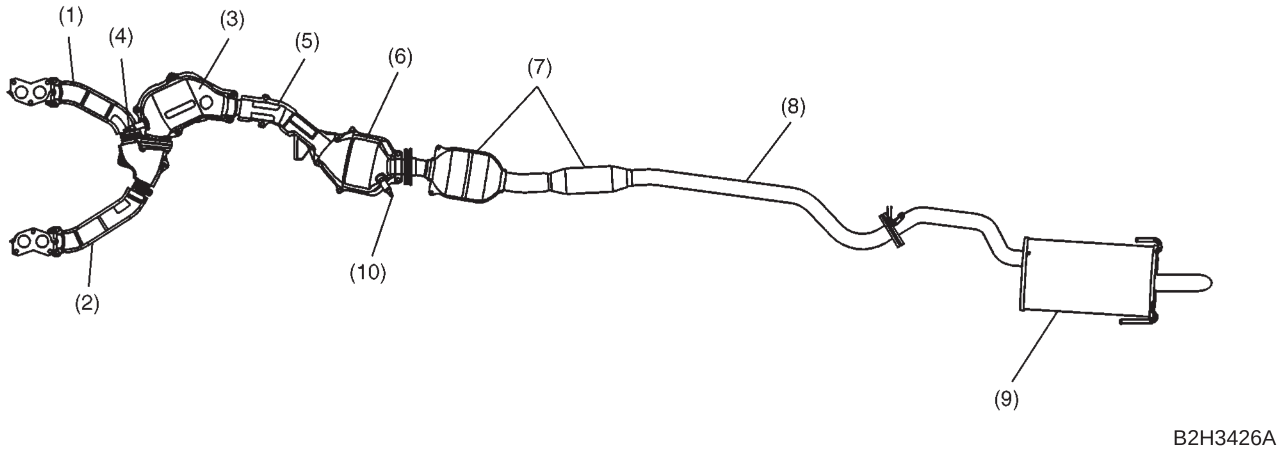
(1) Battery +B
(2) Turn signal RH
(3) Stop light
(4) Turn signal LH
(5) Tail light
(6) Ground

MEMO

1. General

The exhaust system consists of a front exhaust pipe catalytic converter(s), a center exhaust pipe, a rear exhaust pipe and a muffler. The front catalytic converter is located immediately behind the front exhaust pipe, and the rear catalytic converter is incorporated in the center exhaust pipe.

The exhaust system features an improved sound suppression design; the two branches of the front exhaust pipe join at a point almost equal in distance from the engine's exhaust ports and the rear exhaust pipe has a resonance chamber in addition to a large capacity muffler.



(1)	Front exhaust pipe RH	(6)	Rear catalytic converter
(2)	Front exhaust pipe LH	(7)	Resonance chamber
(3)	Front catalytic converter	(8)	Rear exhaust pipe
(4)	Front oxygen (A/F) sensor	(9)	Muffler
(5)	Center exhaust pipe	(10)	Rear oxygen sensor

FOREWORD

1. How to use this manual

- The description of this area is provided with four types of titles different in size as shown below. The Title No. or Symbol prefixes each title in order that the construction of the article and the flow of explanation can be easily understood.

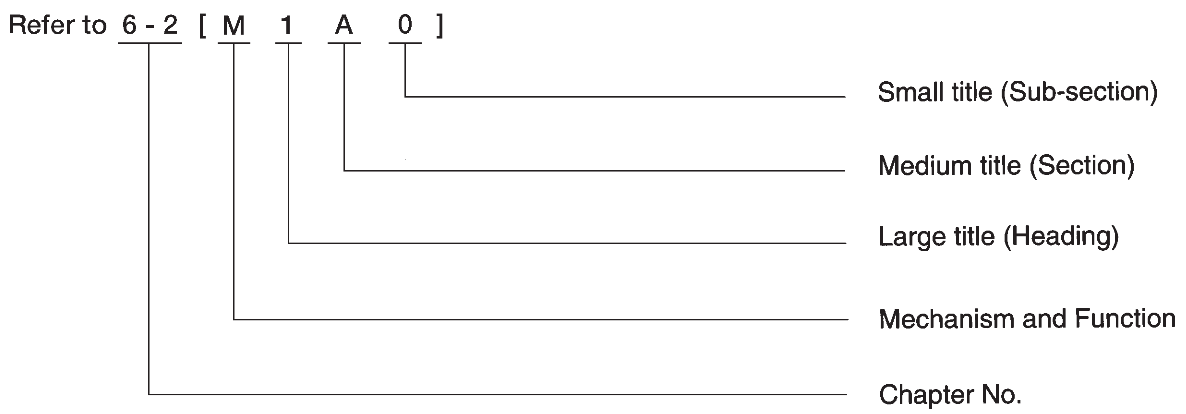
[Example of each title]

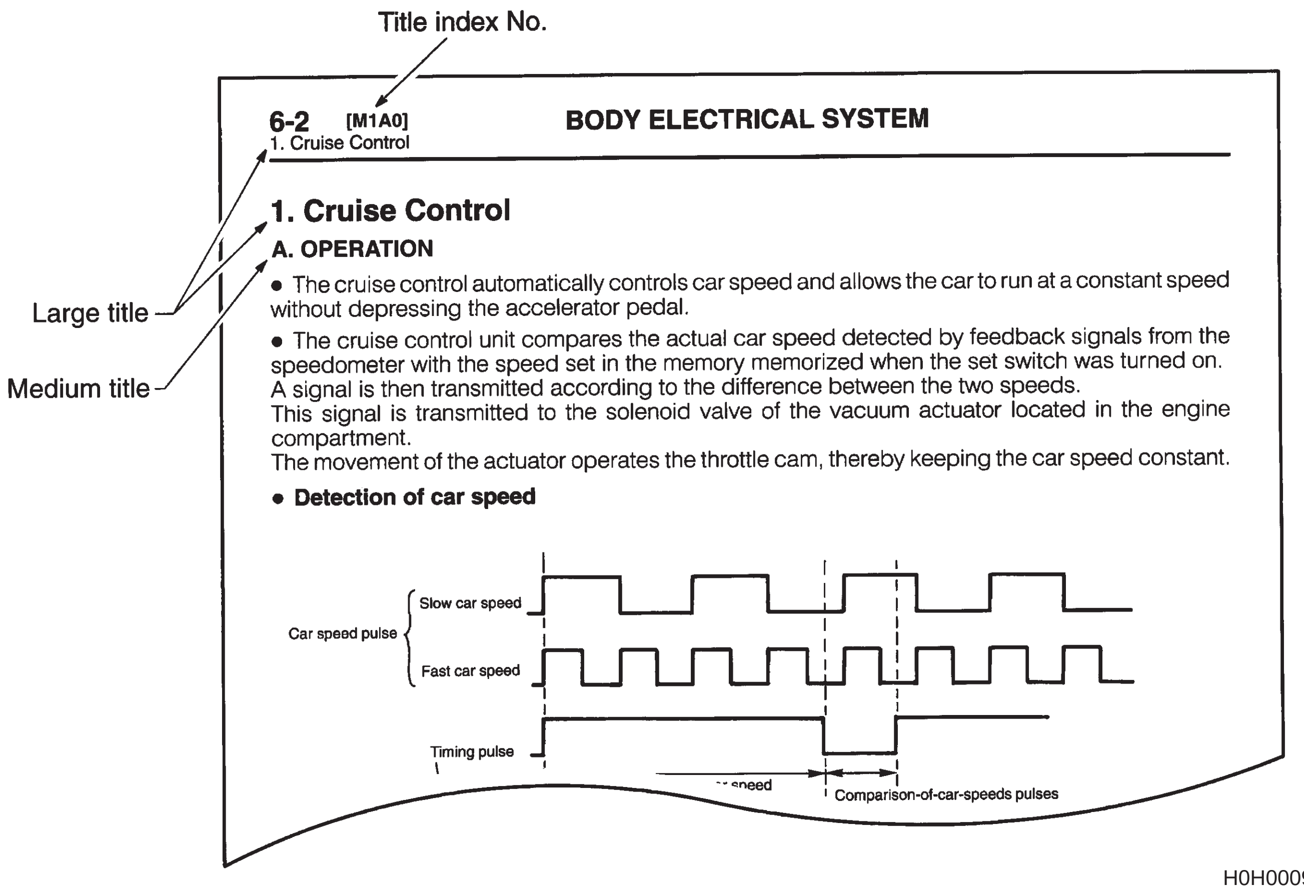
● Area title	M. Mechanism and Function
● Large title (Heading)	1. Fuel Line (to denote the main item of explanation)
● Medium title (Section)	A. GENERAL (to denote a derivative item of explanation)
● Small title (Sub-section)	1. 2000 cc MODEL (to denote a derivative item of explanaion)

FOREWORD

- The Title Index No. is indicated on the top left (or right) side of the page as the book is opened. This is useful for retrieving the necessary portion.

(Example of usage)





H0H0009