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AUTOMATIC TRANSMISSION

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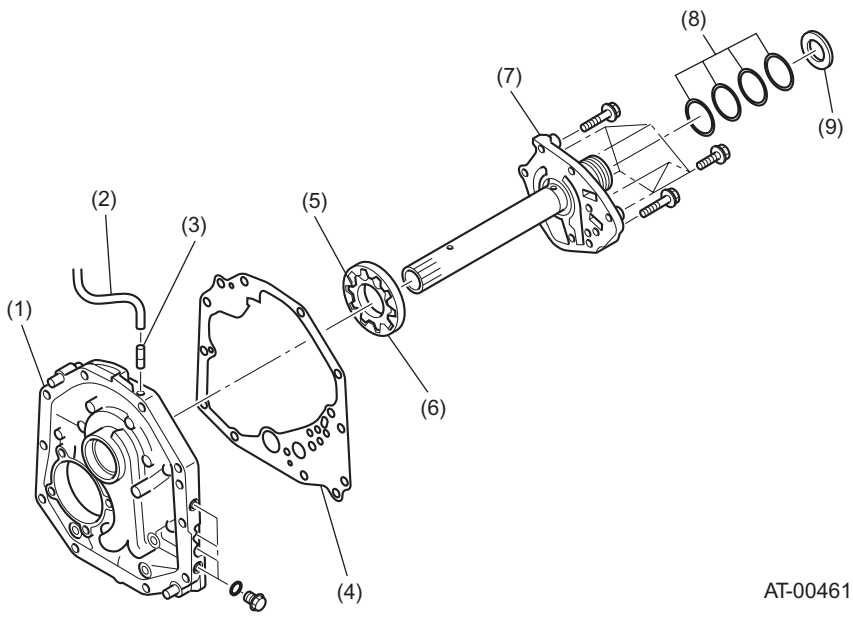
1. Oil Pump

A: CONSTRUCTION

The pump consists of a parachoid rotor pair, a housing and a cover. The inner rotor has nine teeth and the outer rotor has ten teeth.



AT-00461

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

B: FUNCTION

- The pump draws automatic transmission fluid (ATF) from the oil pan through the oil strainer located under the hydraulic control valve assembly. The ATF then flows through a passage in the transmission case, and after passing through the oil pump housing and oil pump cover, it enters the suction port.
- As the inner rotor rotates, the outer rotor also rotates. This motion causes the ATF to be sucked up through the suction port and discharged from the discharged port.
- The discharged ATF flows through a passage in the oil pump cover and then a passage in the oil pump housing. It then goes through a passage in the transmission case to the pressure regulator valve in the control valve assembly, from which the ATF is directed to various clutches, brakes, and torque converter lockup clutch for acting as hydraulic fluid and lubricating oil. Part of the ATF also flows, directly and after passing through the regulator valve, to the manual valve, from where it is distributed to the circuit corresponding to the range selected by the selector lever.
- As engine speed increases, the delivery rate of the oil pump also increases.

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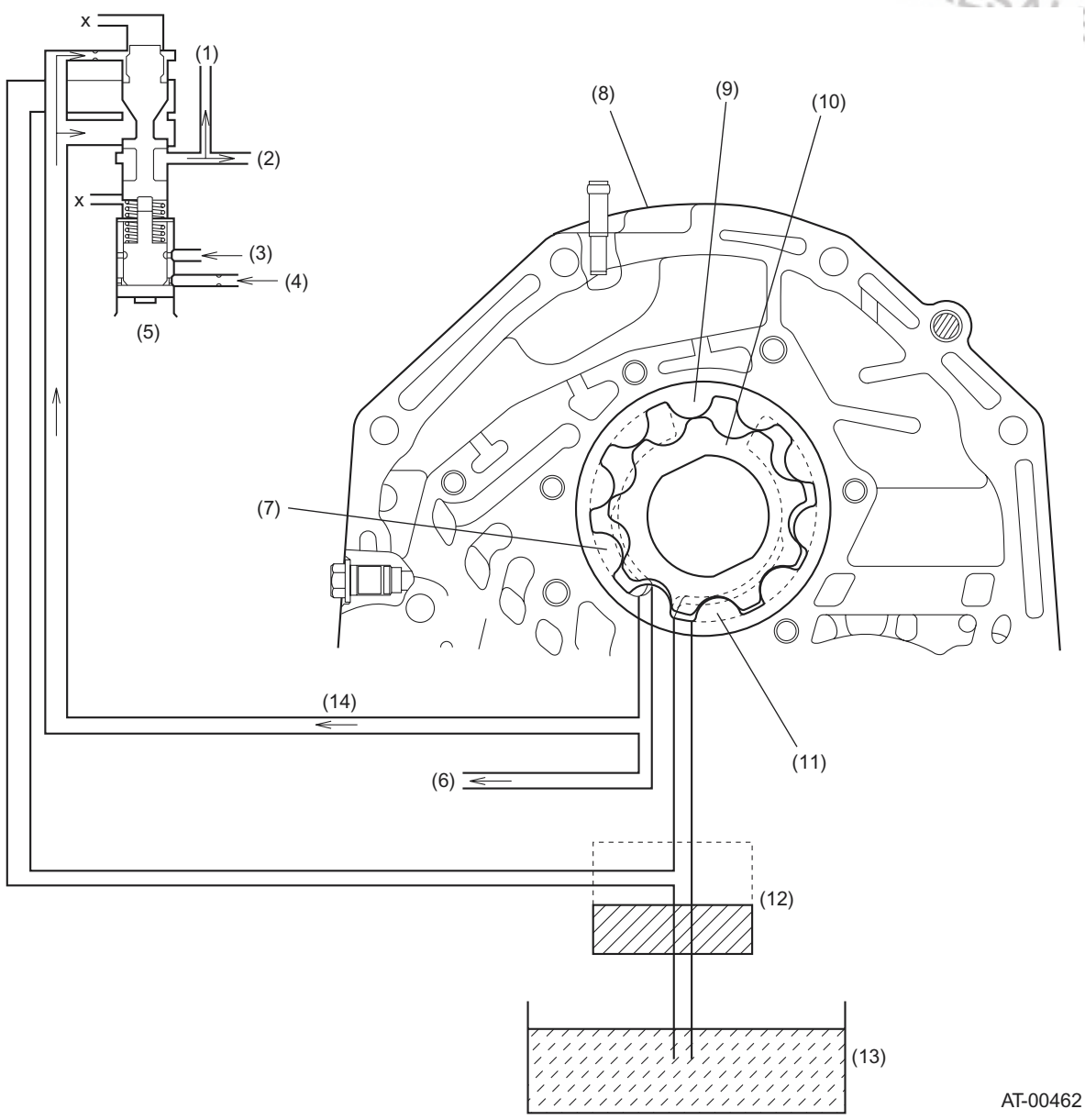

AT-00462

(1) To torque converter regulator valve
(2) To manual valve
(3) From reverse clutch
(4) From pressure modifier valve
(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

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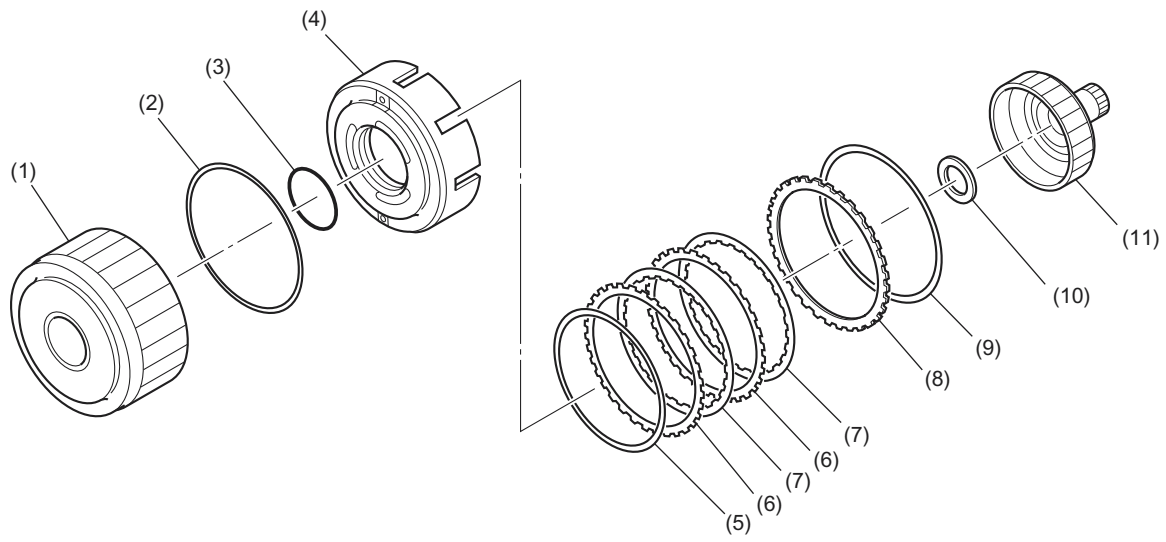
2. Reverse Clutch

A: CONSTRUCTION



AT-00463

(1) High clutch drum
(2) Lip seal
(3) D-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

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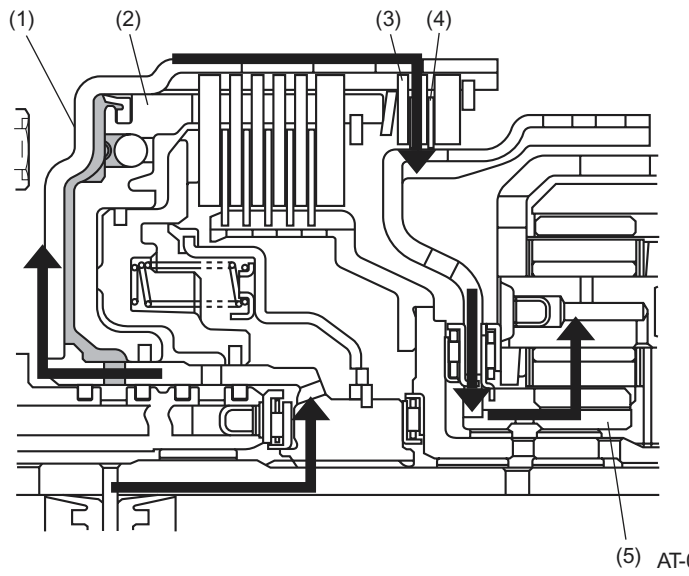
B: FUNCTION

1. WHEN REVERSE IS SELECTED

Hydraulic pressure from the hydraulic control valve is applied to the reverse clutch piston when a shift is made into the reverse. The drive and driven plates are pressed together by this pressure, so that the engine torque from the high clutch drum is transmitted to the front sun gear through the 2-4 brake hub.



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

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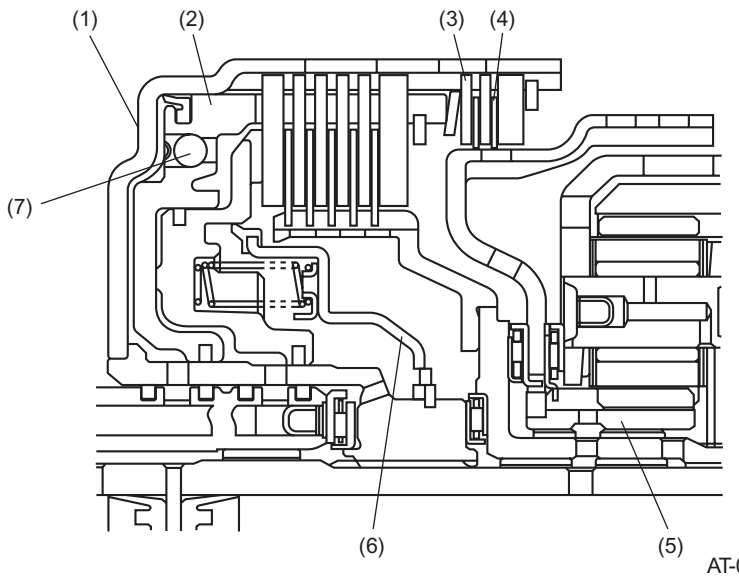
2. WHEN REVERSE IS NOT SELECTED

When the selector lever is in any position other than the reverse, no pressure is applied to the reverse clutch piston. Hence the drive and driven plates are separated from each other, transmitting no power to any element beyond them.

A check ball is built into the clutch piston. This check ball has a function of releasing the pressure which may build up in the fluid remaining behind the piston by centrifugal force generated by the idly rotating high clutch drum, thereby avoiding a half-engaged state of the clutch.



AT-00465

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

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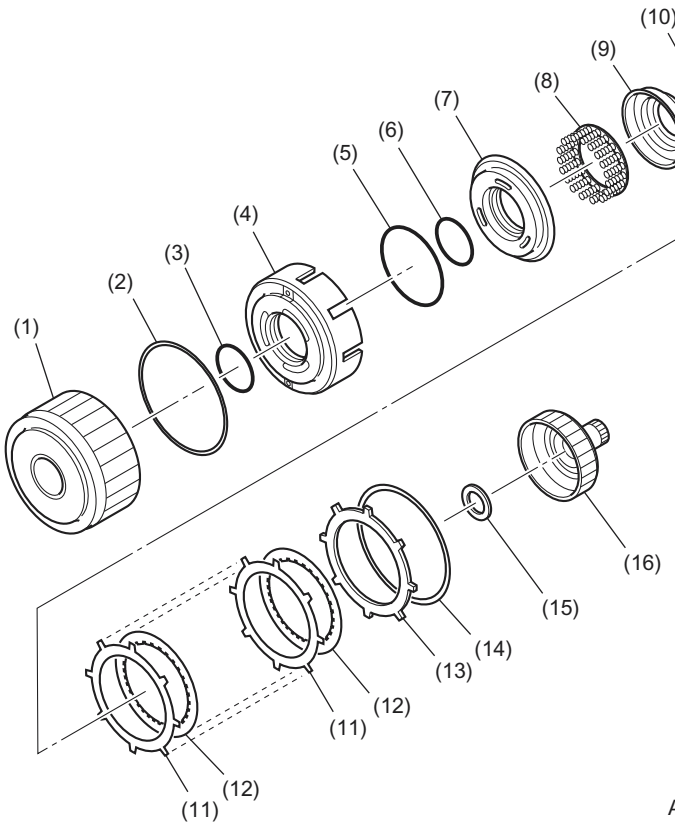
3. High Clutch

When the 3rd or 4th gear is selected, hydraulic pressures are applied to the high clutch from the shift valve and pressure regulator valve. The clutch's drive and driven plates are pressed together, thus transmitting the engine power from the input shaft to the front planetary carrier through the high clutch hub.

A cover is placed inside the piston, and the space between the piston and the cover is filled with ATF. When the high clutch is not in engagement, the centrifugal force generated in the ATF inside the cover cancels out the centrifugal force generated in the ATF remaining behind the high clutch piston, thus preventing incomplete disengagement of the clutch.
When the high clutch is engaged, the pressure pushing the clutch piston is much larger than the counteracting force of the ATF in the cover, so the clutch remains engaged.



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

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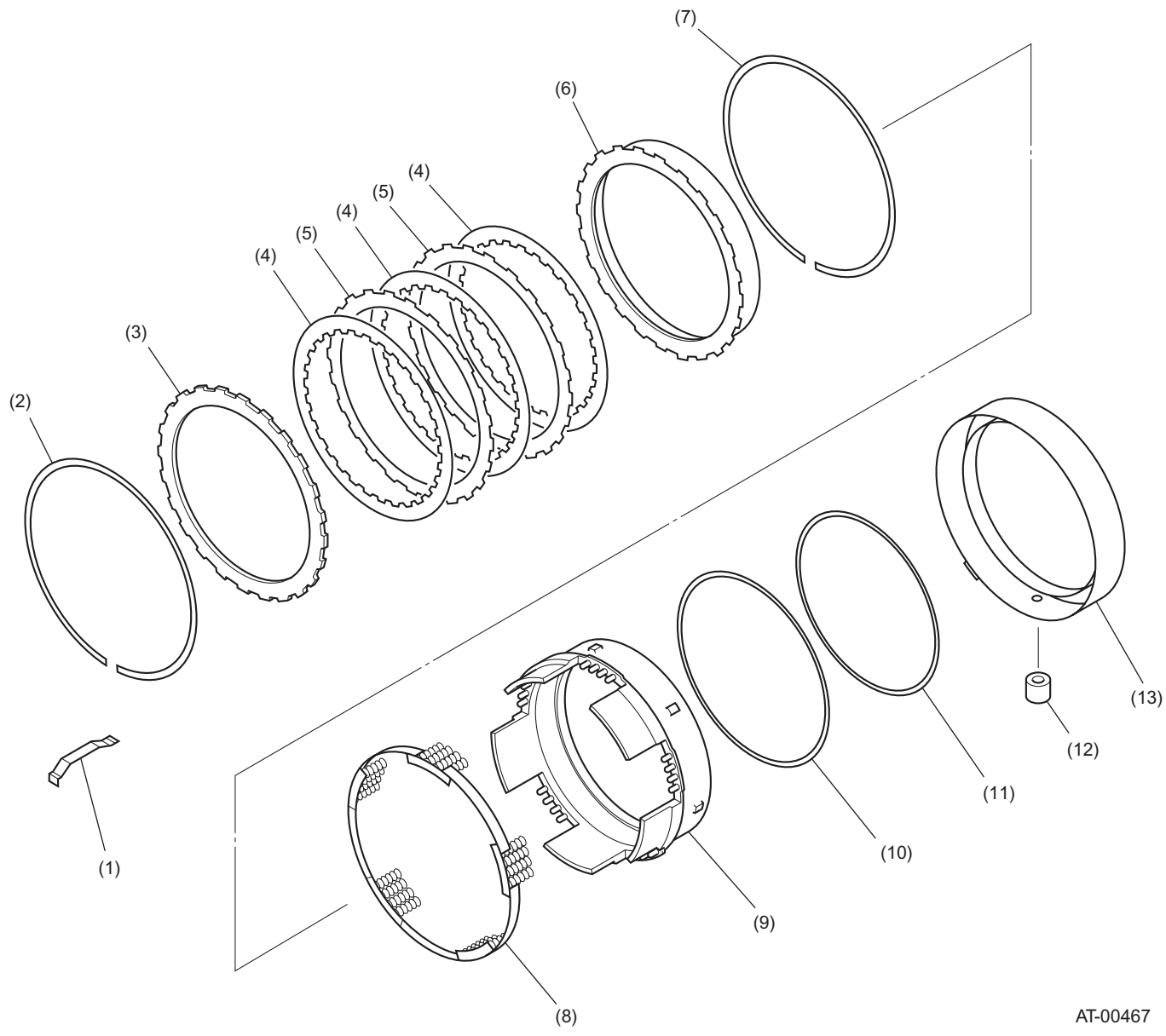
4. 2-4 Brake

A: CONSTRUCTION

The 2-4 brake consists of a 2-4 brake piston, a return spring, a pressure plate, drive plates and driven plates.
This brake is engaged by the hydraulic pressure from the transmission control valve and locks the front sun gear when the 2nd gear is selected in the D, 3 or 2 range, or when the 4th gear is selected in the D range.



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

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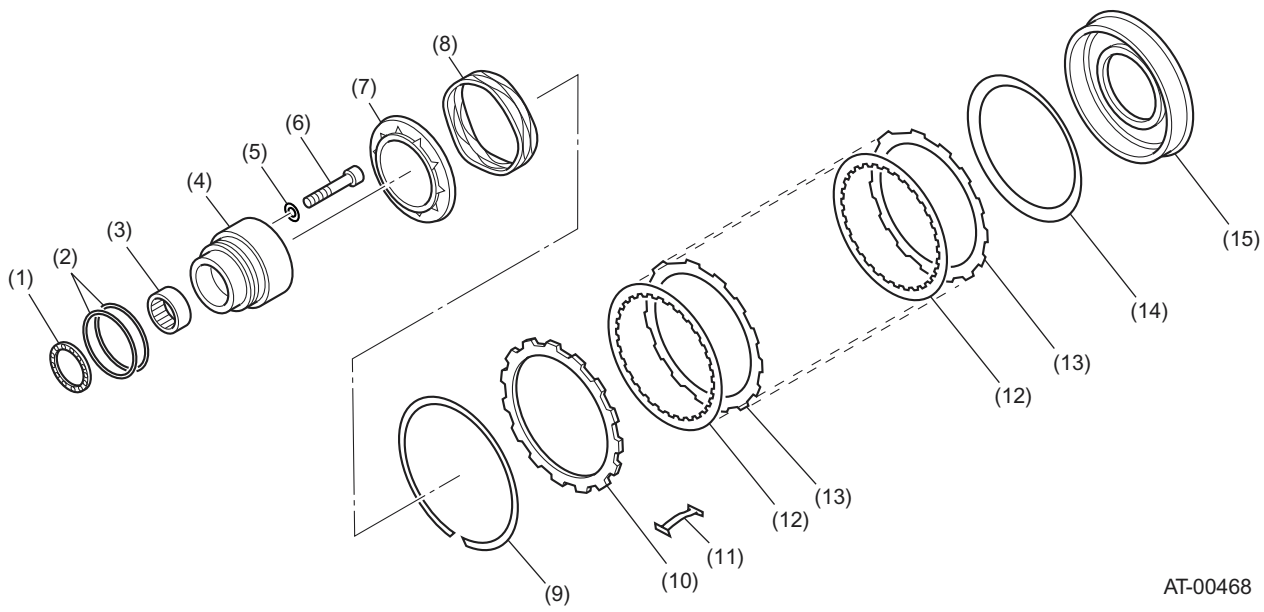
5. Low & Reverse Brake

A: CONSTRUCTION

The low & reverse brake consists of a piston, a dish plate, drive plates, driven plates, a retainer plate and a snap ring that are placed in a housing formed in the transmission case.



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

B: FUNCTION

When the 1st gear is selected in the 1 range or the reverse is selected, the pressure from the pressure regulator valve is applied to the low & reverse brake piston. The piston then presses the drive and driven plates together and causes the low clutch drum to lock.

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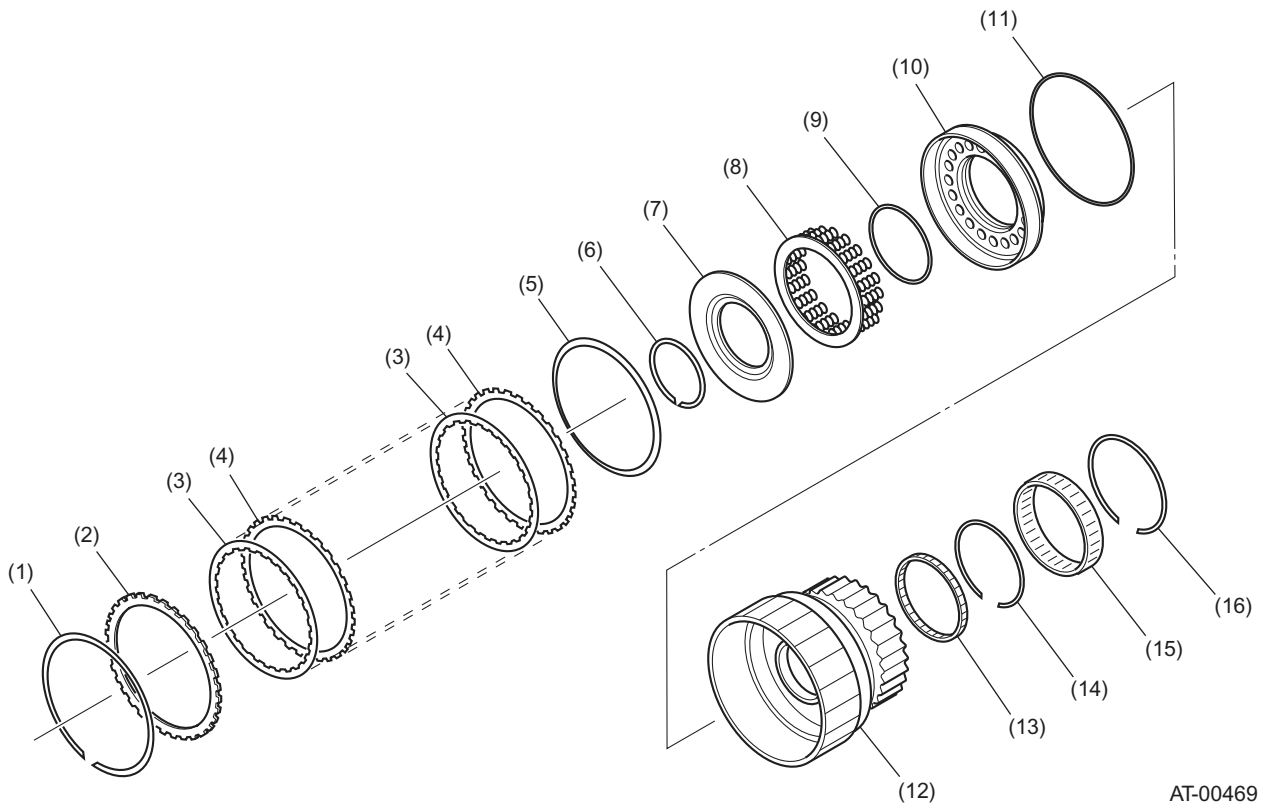
6. Low Clutch

A: CONSTRUCTION

The low clutch consists of a drum, a piston, return springs, a cover, drive plates, driven plates, a one-way clutch, and other sealing and retaining elements.
The low clutch drum is made of a press-formed metal sheet. The drum's outer race and sleeve are welded together to the drum by an electron beam welding technique.



(1) Snap ring
(2) Retaining plate
(3) Drive plate
(4) Driven plate
(5) Dish plate
(6) Snap ring
(7) Cover
(8) Return spring
(9) D-ring
(10) Low clutch piston
(11) D-ring
(12) Low clutch drum
(13) Needle bearing
(14) Snap ring
(15) One-way clutch
(16) Snap ring

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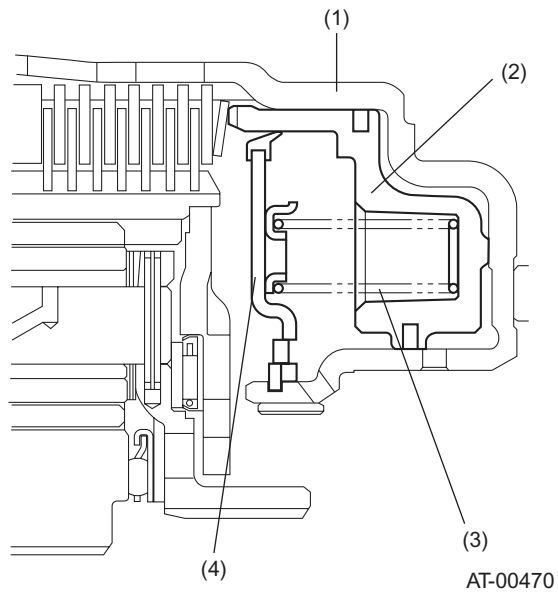
B: FUNCTION

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

A cover is placed inside the piston, and the space between the piston and the cover is filled with ATF. When the low clutch is not in engagement, the centrifugal force generated in the ATF inside the cover cancels out the centrifugal force generated in the ATF remaining behind the low clutch piston, thus preventing incomplete disengagement of the clutch.
When the low clutch is engaged, the pressure pushing the clutch piston is much larger than the counteracting force of the ATF in the cover, so the clutch remains engaged.



(1) Low clutch drum
(2) Low clutch piston
(3) Return spring
(4) Cover

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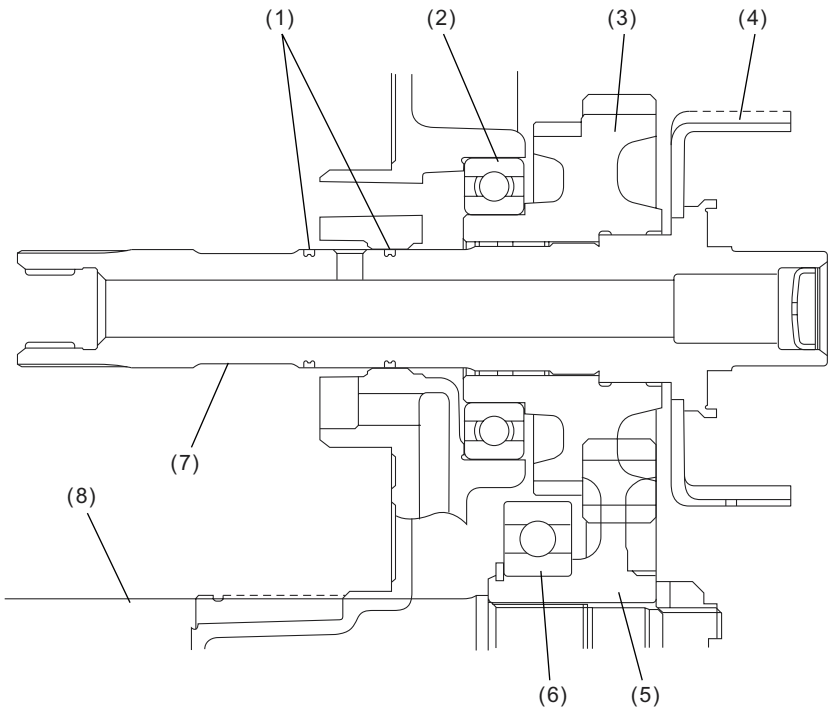
7. Reduction Gears

A: MPT MODELS

Engine torque is transmitted from the rear planetary carrier to the reduction drive shaft and the reduction drive gear. The torque is then transmitted to the front final gears through the reduction driven gear and drive pinion. The torque is also transmitted to the rear wheels from the transfer clutch hub (welded to the side of the reduction drive gear) through the transfer clutch and the following path:
rear drive shaft → propeller shaft → rear differential.



AT-01015

(1) Seal ring
(2) Ball bearing
(3) Reduction drive gear
(4) Transfer clutch hub
(5) Reduction driven gear
(6) Ball bearing
(7) Reduction drive shaft
(8) Drive pinion shaft

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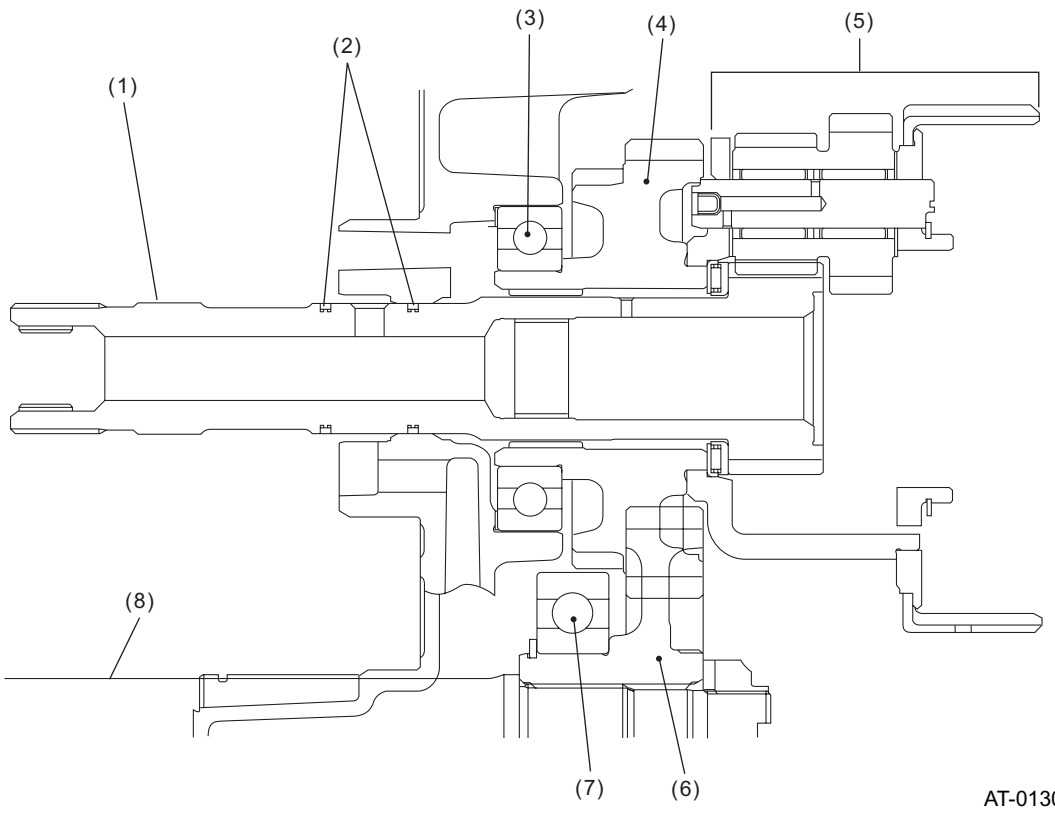
B: VTD MODELS

Engine power is transmitted from the rear planetary carrier to the intermediate shaft and the center differential assembly. The input force to the center differential is transmitted from the front sun gear, which is integrated with the intermediate shaft. The center differential front wheel side output is transmitted from the center differential carrier, which is integrated with the reduction drive gear. The rear wheel side output is transmitted from the rear sun gear in the center differential, which is integrated with the rear drive shaft. Power transmission to the front wheels is then transmitted to the final gear through the reduction driven gear and drive pinion. Power to the rear wheels is transmitted sequentially from the rear drive shaft to the propeller shaft, rear differential and rear wheel.



AT-01308

(1) Intermediate shaft
(2) Seal ring
(3) Ball bearing
(4) Reduction drive gear
(5) Center differential assembly
(6) Reduction driven gear
(7) Ball bearing
(8) Drive pinion shaft

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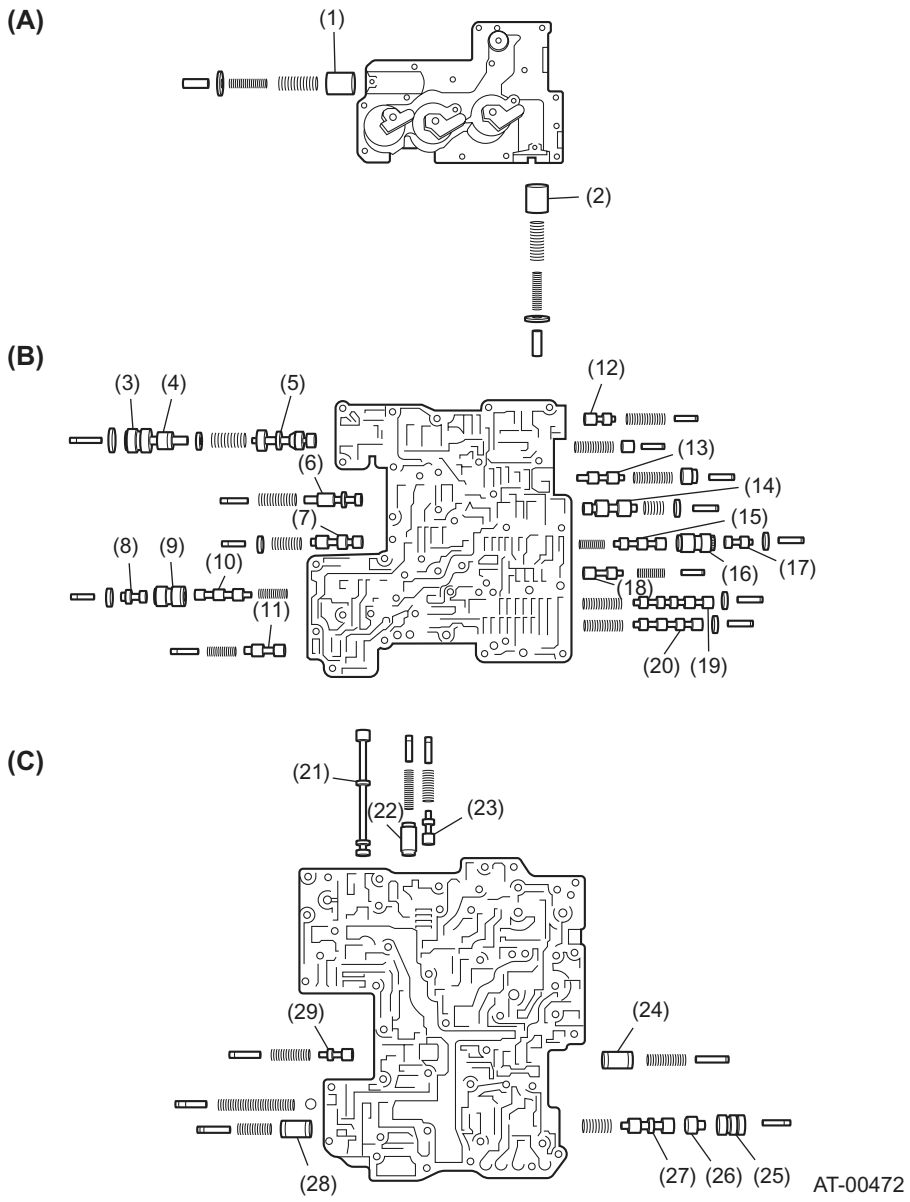
8. Hydraulic Control Valve

The hydraulic control system of the automatic transmission consists of an oil pump, valve bodies containing valves, clutches, fluid passages and pipes. The operation of the system is initiated by driver's manual inputs and electric inputs from the TCM.

A: CONSTRUCTION



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(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 inhibitor 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) Lockup control sleeve
(26) Lockup control plug
(27) Lockup control valve
(28) Modifier accumulator piston
(29) Pilot valve

(A) Upper valve body
(B) Middle valve body
(C) Lower valve body

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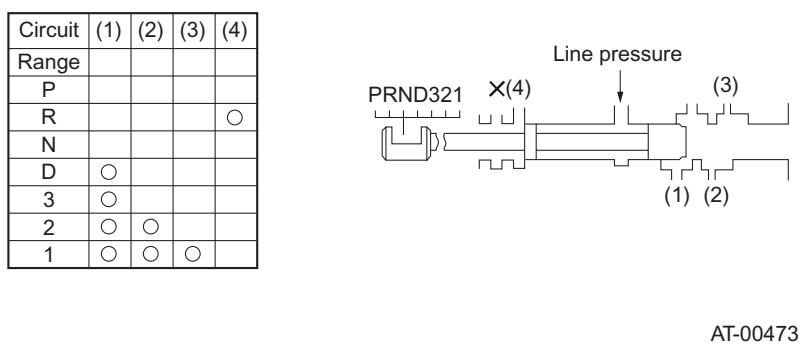
B: FUNCTION

Name	Function
Pressure regulator valve	Regulates the pressure of ATF delivered from the oil pump to an optimum level (line pressure) corresponding to vehicle running conditions.
Pressure modifier valve	Adjusts the pressure modifier output pressure depending on the driving condition to keep the line pressure at the optimum level.
Pressure modifier accumulator piston	Cushions the pressure modifier valve output pressure to remove pulsation in line pressure.
Line pressure relief valve	Prevents excessive rise of the line pressure.
Manual valve	Allows the line pressure to the circuit corresponding to the selected range.  When the valve is placed in the position allowing the line pressure to go nowhere, the pressure is released.
Pilot valve	Reduces the line pressure to create a constant pressure (pilot pressure) for use in controlling the line pressure, lockup pressure, and shifting and transfer clutch/brake pressures.
Torque converter clutch regulator valve	Prevents excessive rise of torque converter clutch pressure.
Lockup control valve	Engages or disengages the lockup clutch. Also regulates the lockup clutch engaging pressure to prevent lockup shocks.
Shift valve A	Simultaneously changes three different ATF passages using shift solenoid 1 output pressure which varies according to such operating condition factors as vehicle speed and throttle position. In combination with shift valve B, this valve creates 1st, 2nd, 3rd, and 4th speeds.
Shift valve B	Simultaneously changes three different ATF passages using shift solenoid 2 output pressure which varies according to such operating condition factors as vehicle speed and throttle position. In combination with shift valve A, this valve creates 1st, 2nd, 3rd, and 4th speeds.
Low clutch timing valve A	Switches the ATF passages when the 2-4 brake pressure rises to a certain level during 3rd-to-4th upshifting in order to drain the low clutch accumulator back-pressure and to release the low clutch. This ensures smoother shifting.
Low clutch timing valve B	Returns the low clutch timing valve A to the original position after 3rd-to-4th upshifting.
2-4 brake timing valve A	Switches the ATF passages when the high clutch pressure rises to a certain level during 2nd-to-3rd upshifting in order to drain the 2-4 brake accumulator A back-pressure and to release the 2-4 brake. This ensures smoother shifting.
2-4 brake timing valve B	Returns the 2-4 brake timing valve A to the original position after 2nd-to-3rd upshifting.
Reverse inhibitor valve	Allows the ATF in the low & reverse brake circuit to drain during forward driving at a speed higher than the predetermined value, preventing shifting into the reverse even when R range is selected.
1st reducing valve	Reduces the low-reverse brake pressure so as to reduce engine braking shock when changing from the 2nd to the 1st in the 2 range.

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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 damp shifting shocks when the low clutch is engaged and disengaged.
2-4 brake accumulator A	Modulates the 2-4 brake clutch pressure gradually to damp 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 rate during 3rd-to-4th upshifting to prevent timing variation which may occur when the low clutch timing valve A is switched (to damp shifting shocks).
High clutch accumulator A	Modulates the high clutch pressure gradually to damp shifting shocks when the high clutch is engaged and disengaged.
High clutch accumulator B	Slows down the high clutch pressure increase rate during 2nd-to-3rd upshifting to prevent timing variation which may occur when the 2-4 brake clutch timing valve A is switched (to damp shifting shocks).
Throttle accumulator A	Cushions the output pressure of the line pressure duty solenoid valve to remove pulsation.
Throttle accumulator B	Cushions the output pressure of the 2-4 brake duty solenoid valve to remove pulsation.

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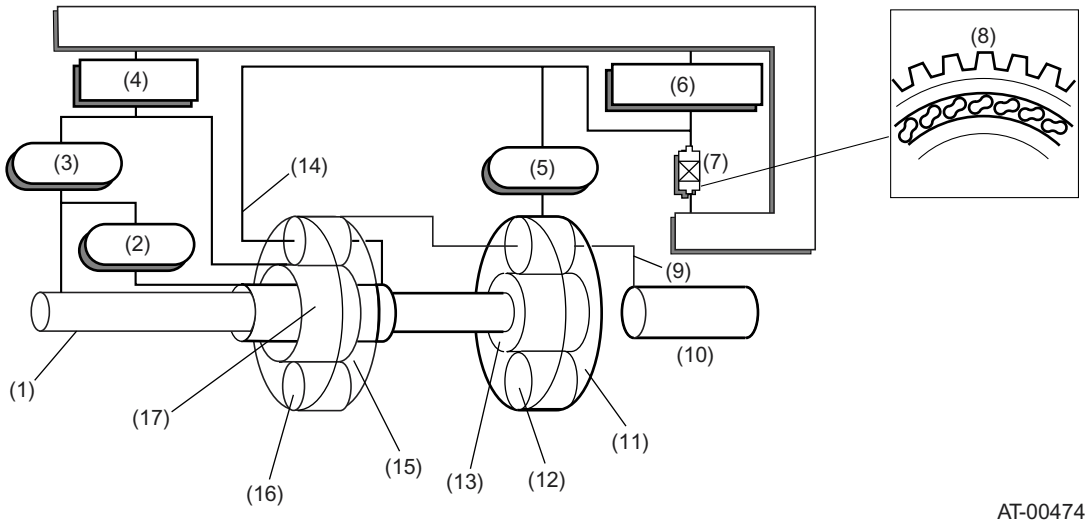
9. Gear Train

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.



AT-00474

(1) Input shaft
(2) High clutch (operates in 3rd and 4th speeds)
(3) Reverse clutch (operates while moving in reverse)
(4) 2-4 brake
(5) Low clutch
(6) Low & reverse brake
(7) One-way clutch
(8) Free/locked
(9) Rear planetary carrier
(10) MPT models: reduction drive shaft
VTD Models: intermediate shaft
(11) Rear internal gear
(12) Rear pinion gear
(13) Rear sun gear
(14) Front planetary carrier
(15) Front internal gear
(16) Front pinion gear
(17) Front sun gear

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B: OPERATION

1. OPERATION TABLE

Selector lever operation			Reverse clutch	2-4 brake	High clutch	Low clutch	Low & reverse brake	One-way clutch
	P							
	R		○				○	
	N							
	D	1ST				○		○
		2ND		○		○		
		3RD			○	○		
		4TH		○	○			
	3	1ST				○		○
		2ND		○		○		
		3RD			○	○		
		4TH		○	○			
	2	1ST						
		2ND		○		○		
		3RD			○	○		
		4TH		○	○			
	1	1ST				○	○	
		2ND		○		○		
		3RD			○	○		
		4TH		○	○			

AT-00868

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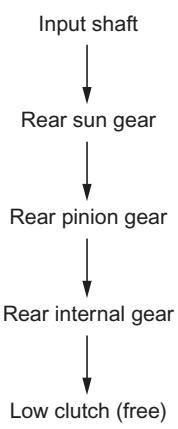
2. N RANGE

Since the rear sun gear and the high clutch drum are in mesh with the input shaft, they rotate together with the input shaft.
The high clutch drum does not transmit the torque to the planetary unit since the reverse clutch and the high clutch are not engaged.
The torque of the rear sun gear is transmitted to the rear internal gear through the pinion gear.
However, the torque of the rear sun gear is not transmitted to the rear planetary carrier since the low clutch is disengaged and, therefore, the rear internal gear is freewheeling.
As a result, the torque of the input shaft is not transmitted to the reduction drive shaft*.

*: MPT models only. VTD models are equipped with an intermediate shaft.

Operating condition of components	Power flow (in acceleration)
All clutches and brakes : disengaged	

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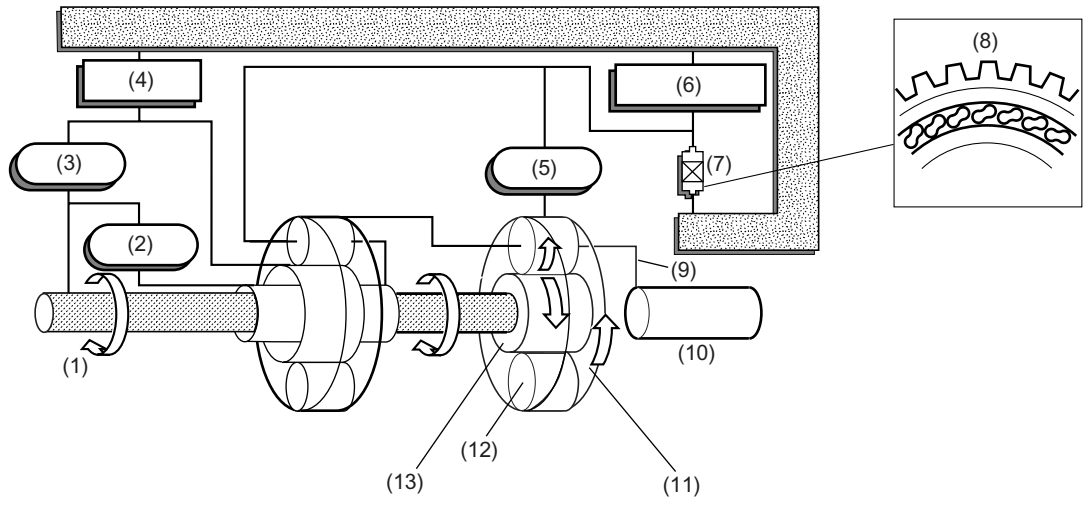

AT-00477

(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Low clutch
(6) Low & reverse brake
(7) One-way clutch
(8) No effect
(9) Rear planetary carrier
(10) MPT models: reduction drive shaft
VTD Models: intermediate shaft
(11) Rear internal gear
(12) Rear pinion gear
(13) Rear sun gear
(14) Input
(15) Output
(16) Lock
(17) Planetary gear components involved in power transmission

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3. P RANGE

All the clutches and brakes are free, just as in the N range. The parking pawl engages with the parking gear which forms an integral part of the reduction drive gear, preventing the gear from rotating.

Operating condition of components	Power flow (in acceleration)
All clutches and brakes : disengaged	Input shaft ↓ Rear sun gear ↓ Rear pinion gear ↓ Rear internal gear ↓ Low clutch (free) AT-00476

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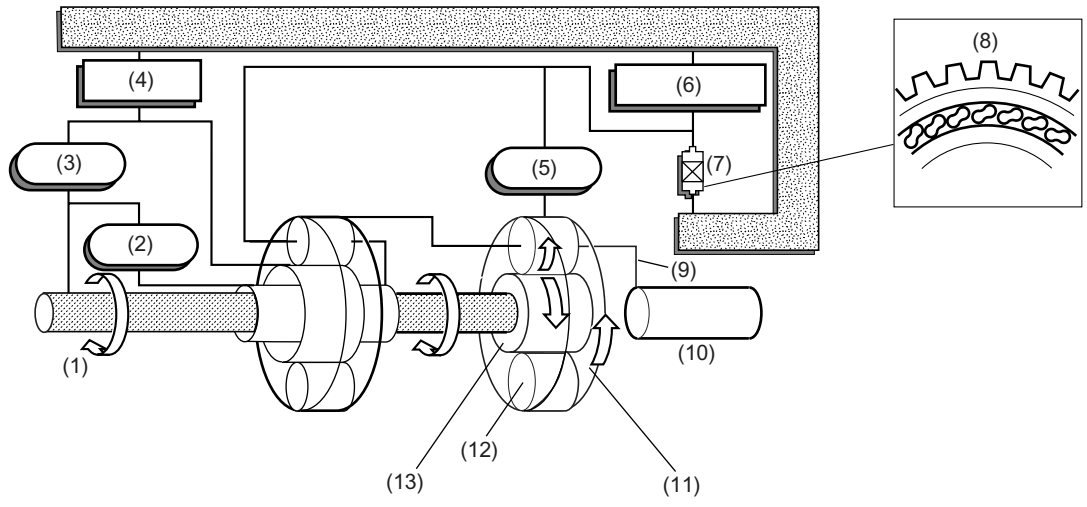

AT-00477

(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Low clutch
(6) Low & reverse brake
(7) One-way clutch
(8) No effect
(9) Rear planetary carrier
(10) MPT models: reduction drive shaft
VTD Models: intermediate shaft
(11) Rear internal gear
(12) Rear pinion gear
(13) Rear sun gear
(14) Input
(15) Output
(16) Lock
(17) Planetary gear components involved in power transmission

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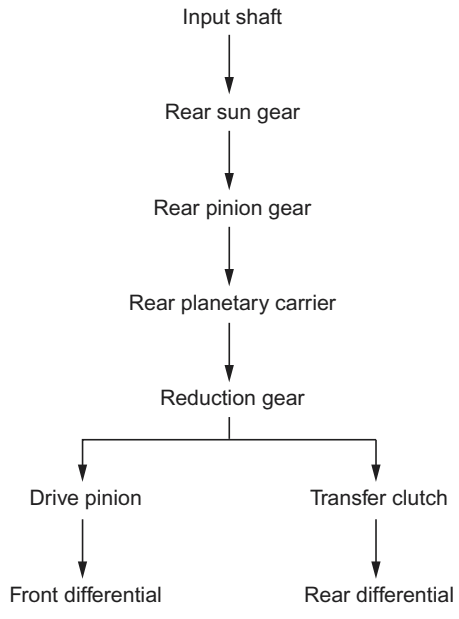
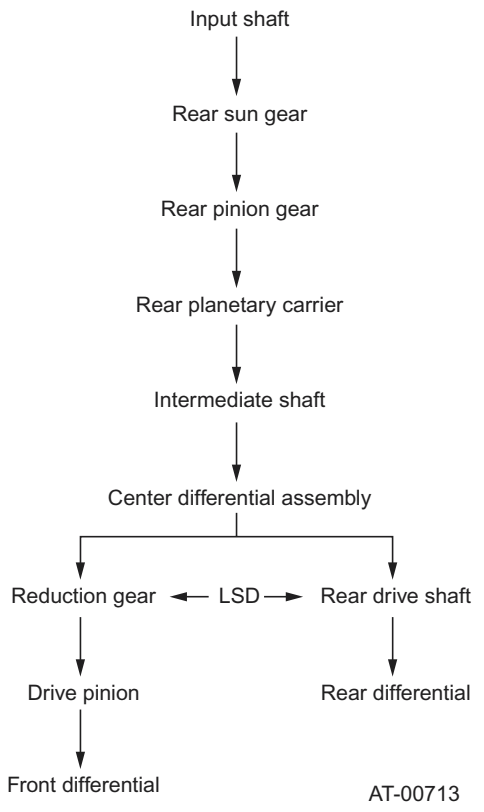
4. 1ST SPEED GEAR OF D OR 3 RANGE (D_1, 3_1)

When the 1st gear is selected in the D or 3 range, only the low clutch is engaged. In this state, the rear internal gear attempts to rotate counterclockwise but it is impossible by the action of the one-way clutch which locks the internal gear to the transmission case. As a result, rotation of the rear sun gear causes the pinion gears to rotate around the sun gear. This causes the planetary carrier to rotate. In this way, rotation of the input shaft is transmitted to the reduction drive shaft* after being subjected to speed reduction by the planetary gear train.
On the other hand, the rear internal gear rotates clockwise if the reverse driving force is applied to it by the reduction drive shaft* during coasting. This clockwise rotation of the internal gear causes the one-way clutch to freewheel. Since the power path between the reduction drive shaft* and the input shaft is lost as a result, no engine braking effect is available.

*: MPT models only. VTD models are equipped with an intermediate shaft.

Operating condition of components	
Low clutch : engaged One-way clutch : locked	
Power flow (in acceleration)	
MPT models	VTD models
	

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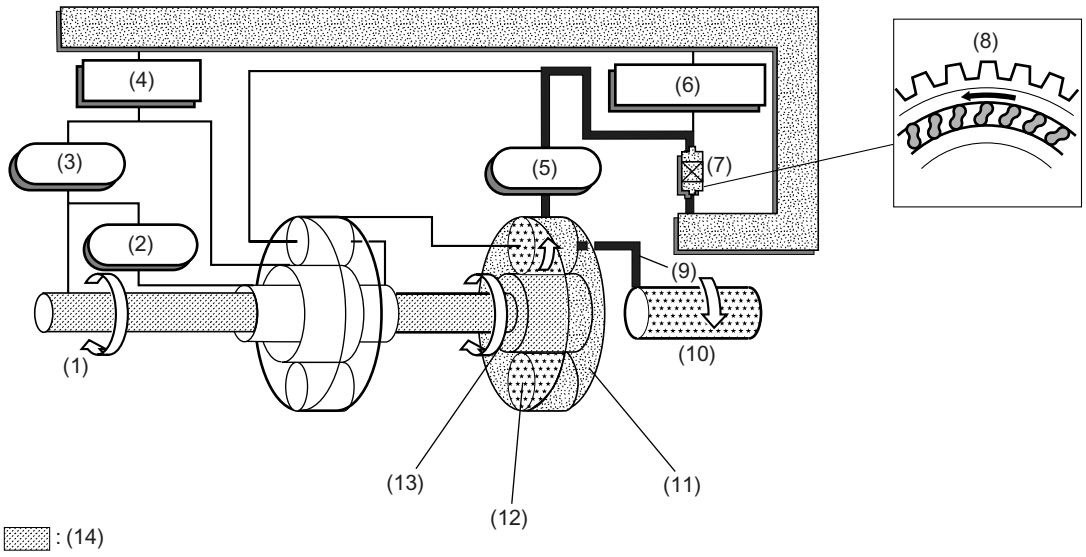

AT-00481

(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Low clutch
(6) Low & reverse brake
(7) One-way clutch
(8) Locked
(9) Rear planetary carrier
(10) MPT models: reduction drive shaft
VTD Models: intermediate shaft
(11) Rear internal gear
(12) Rear pinion gear
(13) Rear sun gear
(14) Input
(15) Output
(16) Locked
(17) Planetary gear components involved in power transmission

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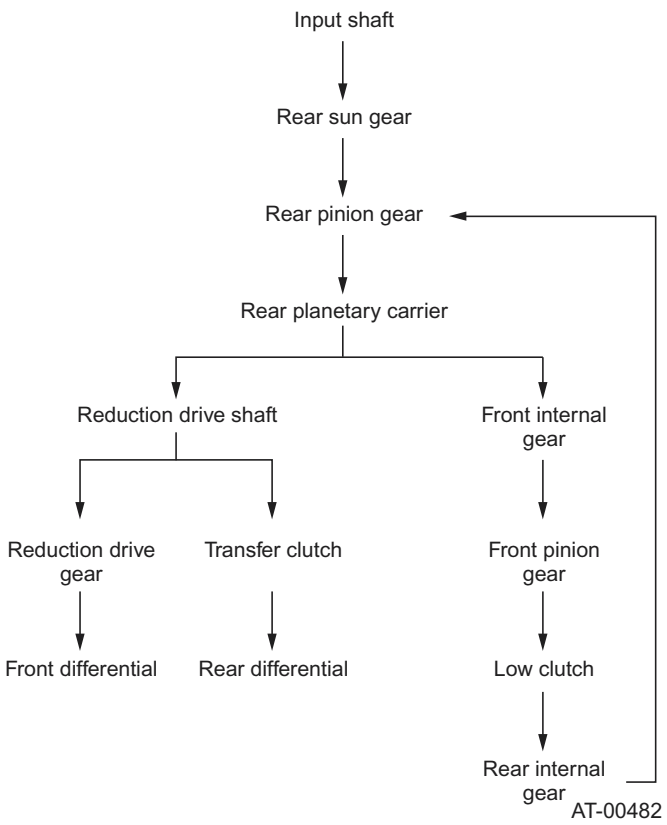
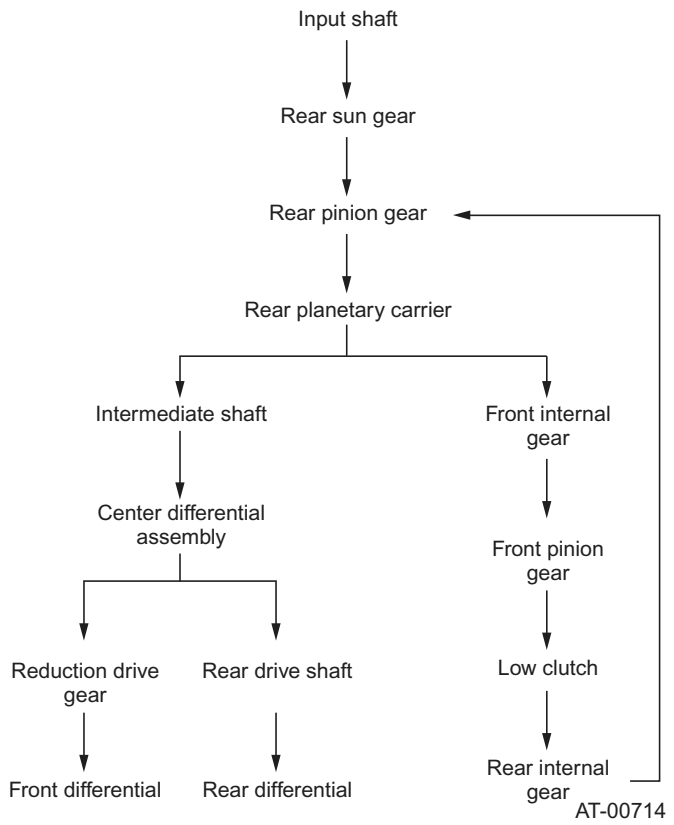
5. 2ND SPEED GEAR IN D, 3, 2 RANGE (D_2, 3_2, 2_2)

When the 2nd gear is selected in D, 3, or 2 range, the 2-4 brake and the low clutch are engaged. The front sun gear is now locked to the transmission case due to engagement of the 2-4 brake. In this state, the torque of the rear sun gear is transmitted to the rear internal gear through the path of the front internal gear, front pinion gears, low clutch drum and low clutch. At this time, the one-way clutch is freewheeling since the low clutch drum is rotating clockwise.
In this power flow configuration, the rear pinion gears are rotated by the rear internal gear at a speed faster than that available from the configuration for the 1st gear, so the rotation speed of the reduction drive shaft* is higher than that of the 1st gear.
Since the drive power is transmitted without passing through the one-way clutch in the 2nd gear, the backward driving force from the wheels is transmitted through the reduction drive shaft* to the input shaft; this makes the engine braking effect available.

*: MPT models only. VTD models are equipped with an intermediate shaft.

Operating condition of components	
Low clutch : engaged 2-4 brake : engaged	
Power flow (in acceleration)	
MPT models	VTD models
	

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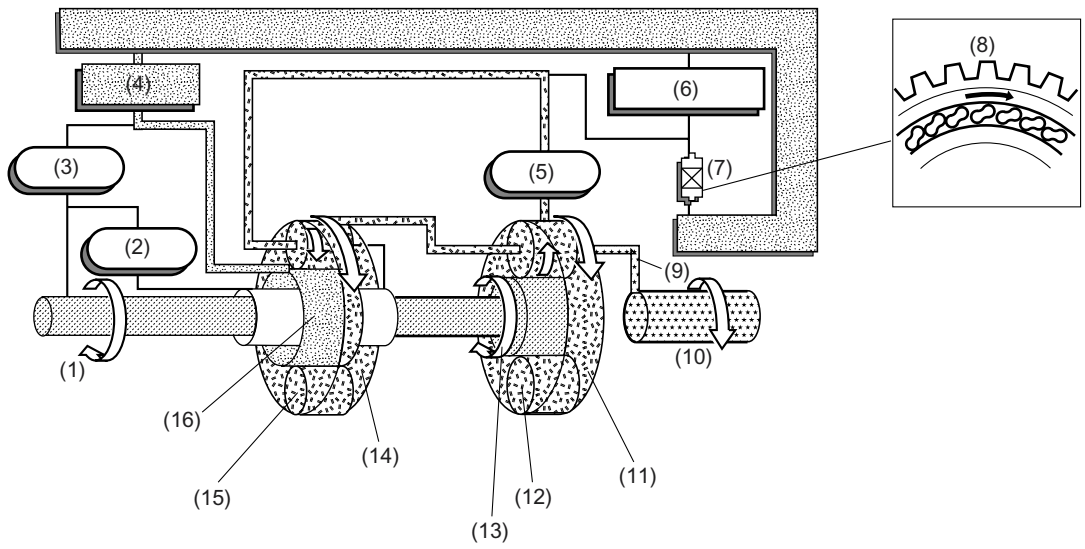

AT-00483

(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Low clutch
(6) Low & reverse clutch
(7) One-way clutch
(8) Free
(9) Rear planetary carrier
(10) MPT models: reduction drive shaft
VTD Models: intermediate shaft
(11) Rear internal gear
(12) Rear pinion gear
(13) Rear sun gear
(14) Front internal gear
(15) Front pinion gear
(16) Front sun gear
(17) Input
(18) Output
(19) Locked
(20) Planetary gear components involved in power transmission

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6. 3RD SPEED GEAR IN D OR 3 RANGE (D_3, 3_3)

When the 3rd gear is selected in the D or 3 range, the low clutch and the high clutch are engaged. The engaged high clutch rotates through its drum the front planetary carrier, and rotation of the carrier is transmitted to the rear internal gear through the engaged low clutch. In this power flow configuration, the rear sun gear and the rear internal gear rotate at the same speed since the rear pinion gears are solid on their axes and the whole planetary gear train rotates as a unit at the same speed as its sun gear. As a result, the input shaft and the reduction drive shaft* rotate at the same speed. In the 3rd gear, the one-way clutch is freewheeling because the low clutch is rotating clockwise. Since the drive power is transmitted without passing through the one-way clutch, the backward driving force from the wheels is transmitted through the reduction drive shaft* to the input shaft; this makes the engine braking effect available.

*: MPT models only. VTD models are equipped with an intermediate shaft.

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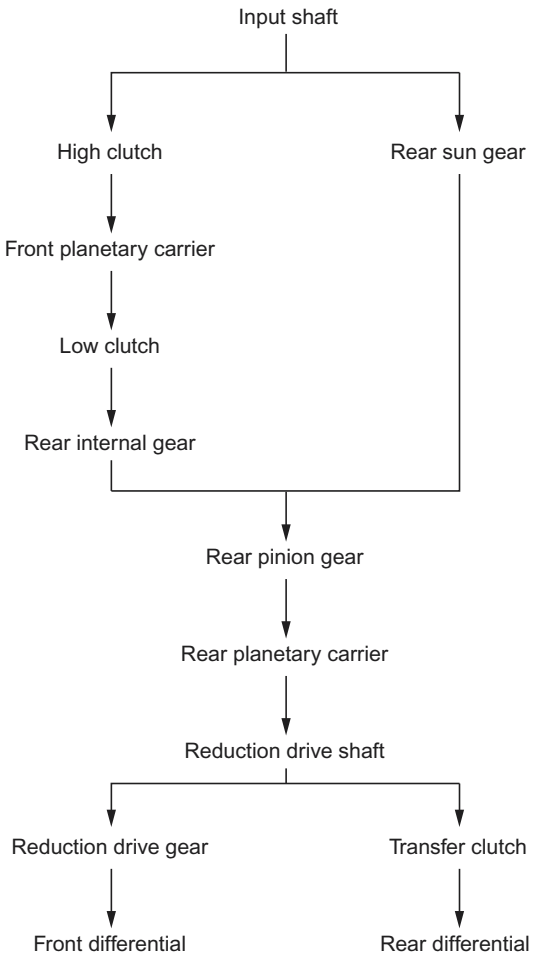
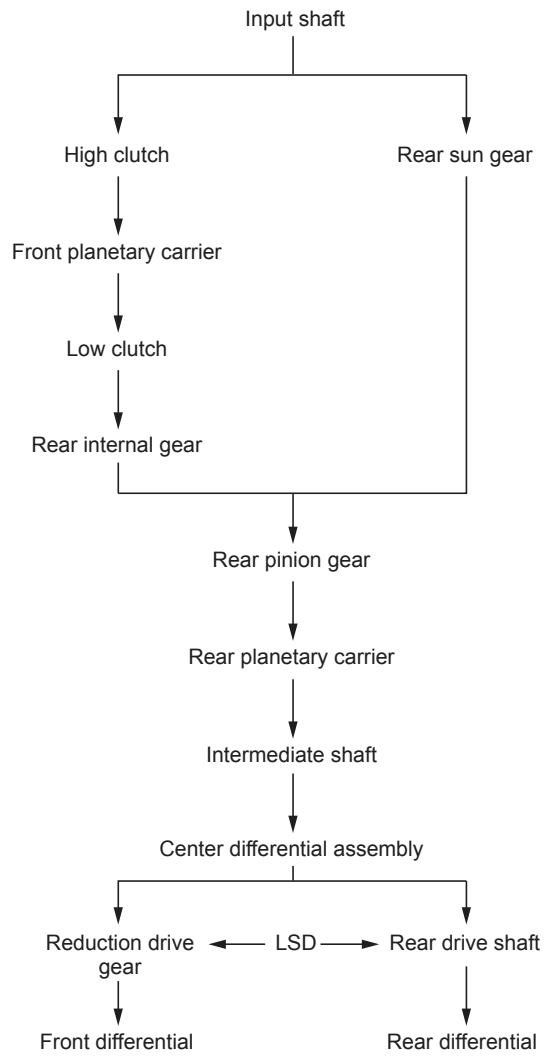
Operating condition of components	
High clutch : engaged Low clutch : engaged	
Power flow (in acceleration)	
MPT models	VTD models



AT-00484



AT-00715

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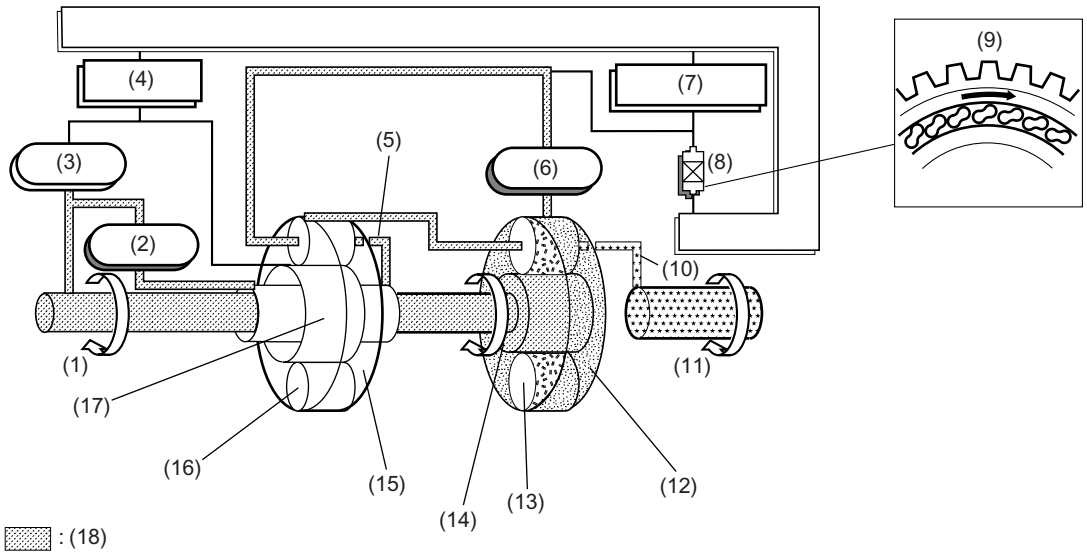

AT-00485

(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Front planetary carrier
(6) Low clutch
(7) Low & reverse brake
(8) One-way clutch
(9) Free
(10) Rear planetary carrier
(11) MPT models: reduction drive shaft
VTD Models: intermediate shaft
(12) Rear internal gear
(13) Rear pinion gear
(14) Rear sun gear
(15) Front internal gear
(16) Front pinion gear
(17) Front sun gear
(18) Input
(19) Output
(20) Locked
(21) Planetary gear components involved in power transmission

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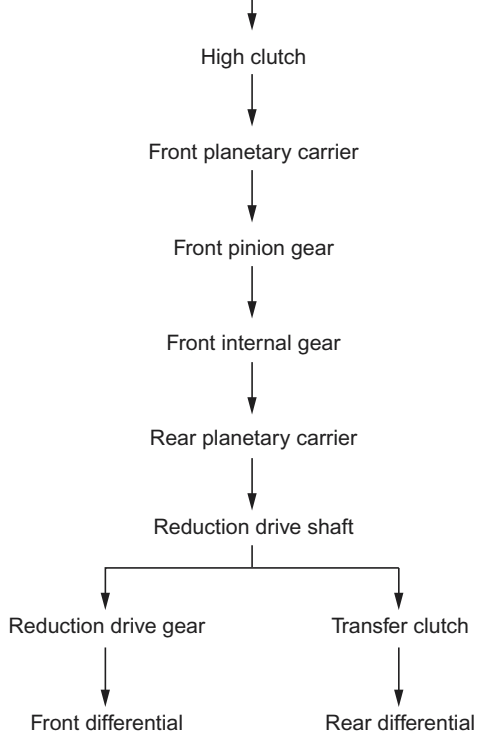
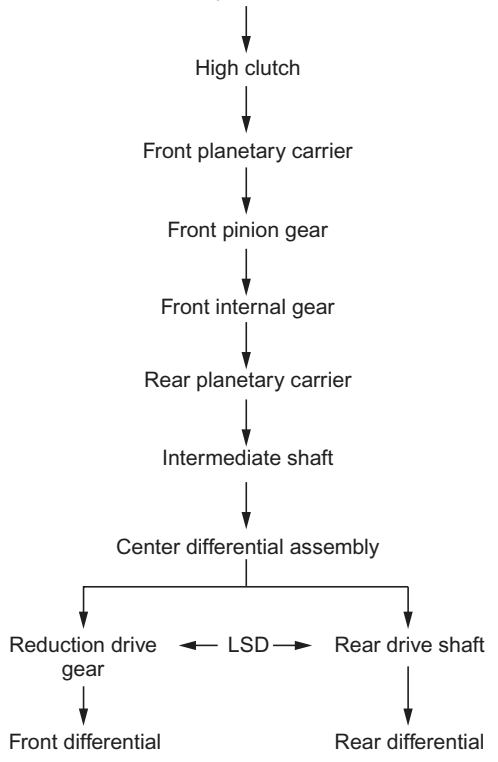
7. 4TH SPEED GEAR IN D RANGE (D_4)

When the 4th gear is selected in the D range, the high clutch and the 2-4 brake are engaged. The engaged high clutch causes the front planetary carrier to rotate, whereas the engaged 2-4 brake causes the front sun gear to be locked to the transmission case.
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.
In the 4th gear, the one-way clutch is freewheeling because the low clutch is rotating clockwise. Since the drive power is transmitted without passing through the one-way clutch, the backward driving force from the wheels is transmitted through the reduction drive shaft* to the input shaft; this makes the engine braking effect available.

*: MPT models only. VTD models are equipped with an intermediate shaft.

<table>
<tr><td colspan="2">Operating condition of components</td></tr>
<tr><td colspan="2">2-4 brake : engaged
High clutch : engaged</td></tr>
<tr><td colspan="2">Power flow (in acceleration)</td></tr>
<tr><td>MPT models
 
</td><td>VTD models
 
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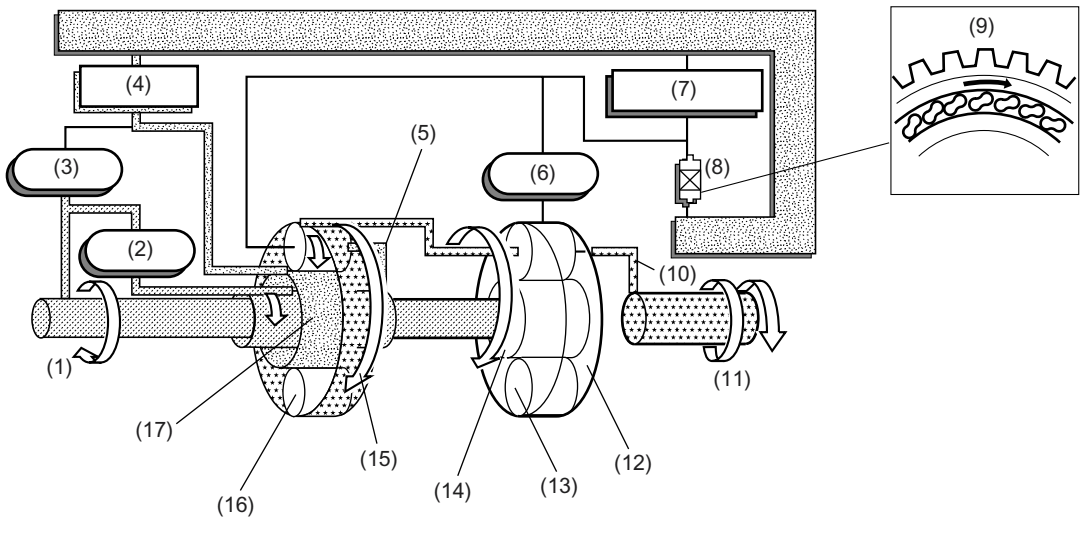
GEAR TRAIN



: (18)
: (19)
: (20)
: (21)

AT-00487

(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Front planetary carrier
(6) Low clutch
(7) Low & reverse brake
(8) One-way clutch
(9) Free
(10) Rear planetary carrier
(11) MPT models: reduction drive shaft
VTD Models: intermediate shaft
(12) Rear internal gear
(13) Rear pinion gear
(14) Rear sun gear
(15) Front internal gear
(16) Front pinion gear
(17) Front sun gear
(18) Input
(19) Output
(20) Locked
(21) Planetary gear components involved in power transmission

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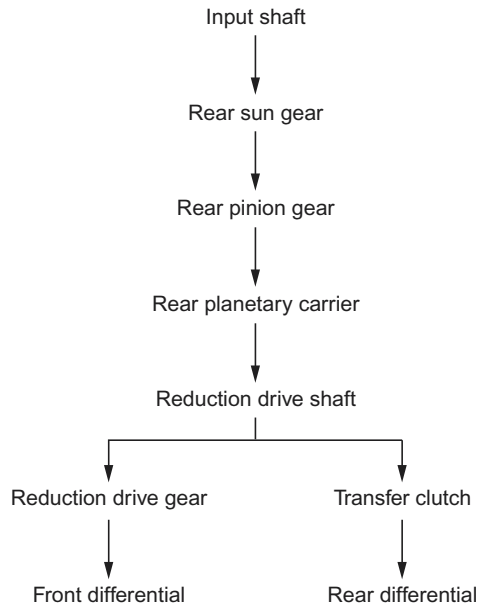
8. 1ST SPEED GEAR IN 1 RANGE (1_1)

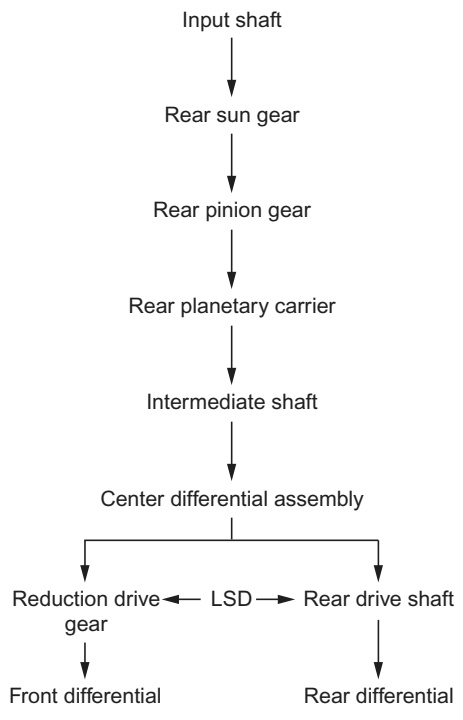
When the 1st gear is selected in the 1 range, both the low clutch and the low & reverse brake are engaged. Although the power flow configuration is the same as that with the 1st gear in the D or 3 range, the one-way clutch produces no freewheeling effect because the low & reverse brake is locking the rear internal gear always to the transmission case.
During coasting, therefore, the backward driving force from the wheels is transmitted through the reduction drive gear* to the input shaft. This means, unlike the 1st gear in D or 3 range, that the engine braking effect is available in this range.

*: MPT models only. VTD models are equipped with an intermediate shaft.

Operating condition of components	
Low clutch : engaged Low & reverse brake : engaged One-way clutch : no effect	
Power flow (in acceleration)	
MPT models	VTD models



AT-00488



AT-00717

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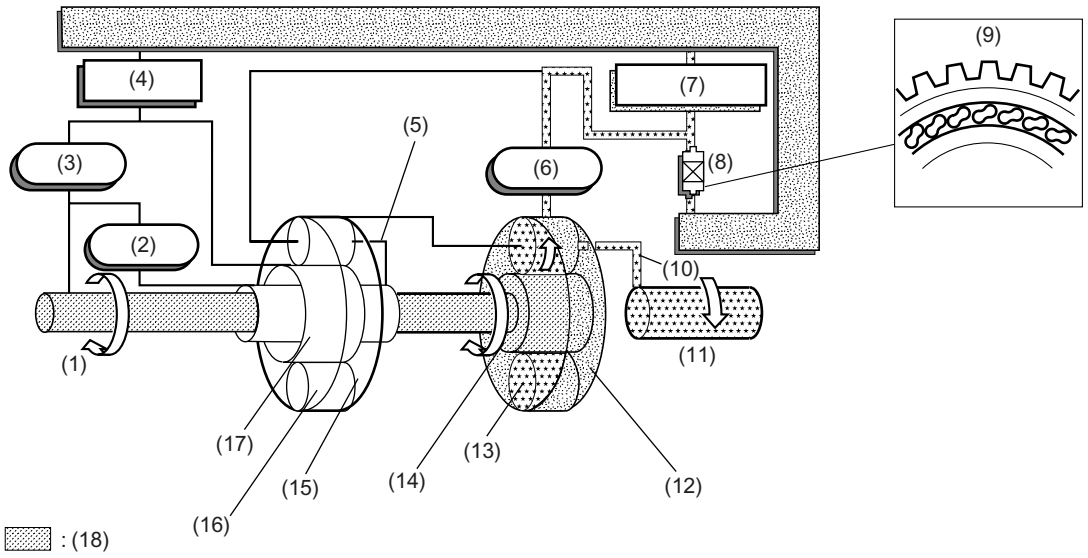

AT-00489

(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Front planetary carrier
(6) Low clutch
(7) Low & reverse brake
(8) One-way clutch
(9) no effect
(10) Rear planetary carrier
(11) MPT models: reduction drive shaft
VTD Models: intermediate shaft
(12) Rear internal gear
(13) Rear pinion gear
(14) Rear sun gear
(15) Front internal gear
(16) Front pinion gear
(17) Front sun gear
(18) Input
(19) Output
(20) Locked
(21) Planetary gear components involved in power transmission

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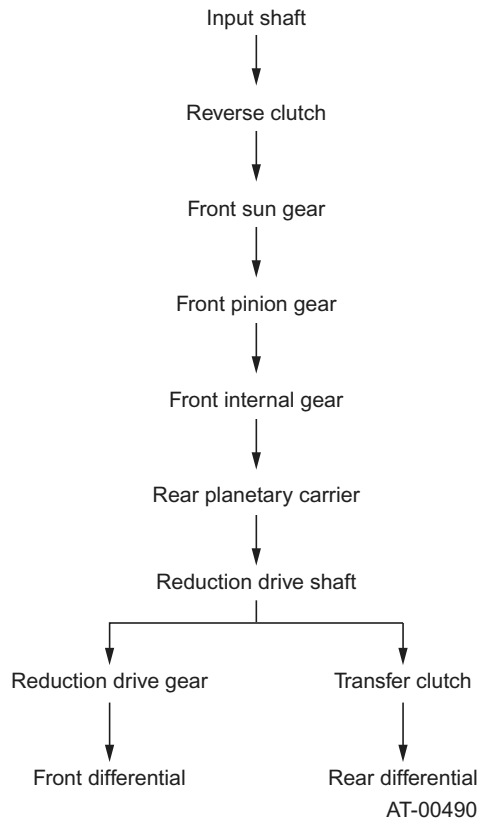
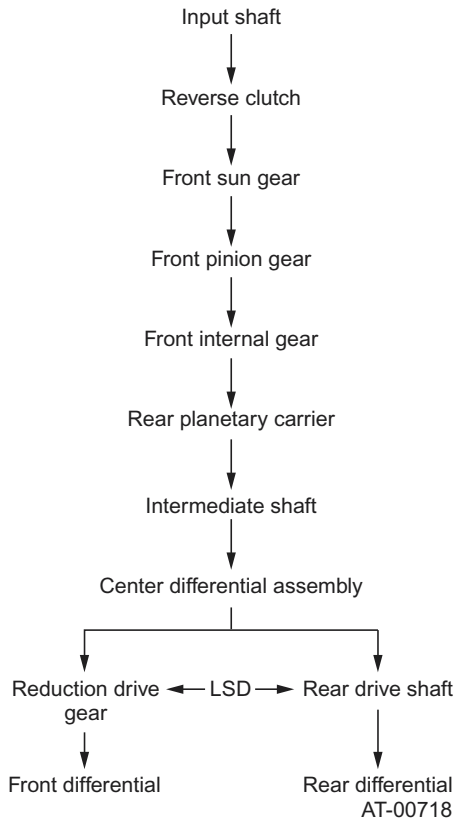
9. R RANGE

When the selector lever is placed in the R position, the reverse clutch and the low & reverse brake are engaged. The reverse clutch allows the input shaft torque to be transmitted to the front sun gear, while the low & reverse brake allows the low clutch drum to be interlocked with the transmission case.
The rotation of the front sun gear causes the front pinion gear to rotate in the opposite direction and therefore the front internal gear rotates in the same direction.
At this time, the rotation speed transmitted to the front internal gear is reduced through gearing between the front sun gear and the front pinion gears.
The one-way clutch produces no freewheeling effect because the low & reverse brake is in engagement.
In this range, since the power transmission is made without passing through the one-way clutch, the driving force from the wheels is transmitted through the reduction drive shaft* to the input shaft; this makes the engine braking effect available.

*: MPT models only. VTD models are equipped with an intermediate shaft.

<table>
<tr><td colspan="2">Operating condition of components</td></tr>
<tr><td colspan="2">Reverse clutch : engaged
Low & reverse brake : engaged</td></tr>
<tr><td colspan="2">Power flow (in acceleration)</td></tr>
<tr><td>MPT models
 
</td><td>VTD models
 
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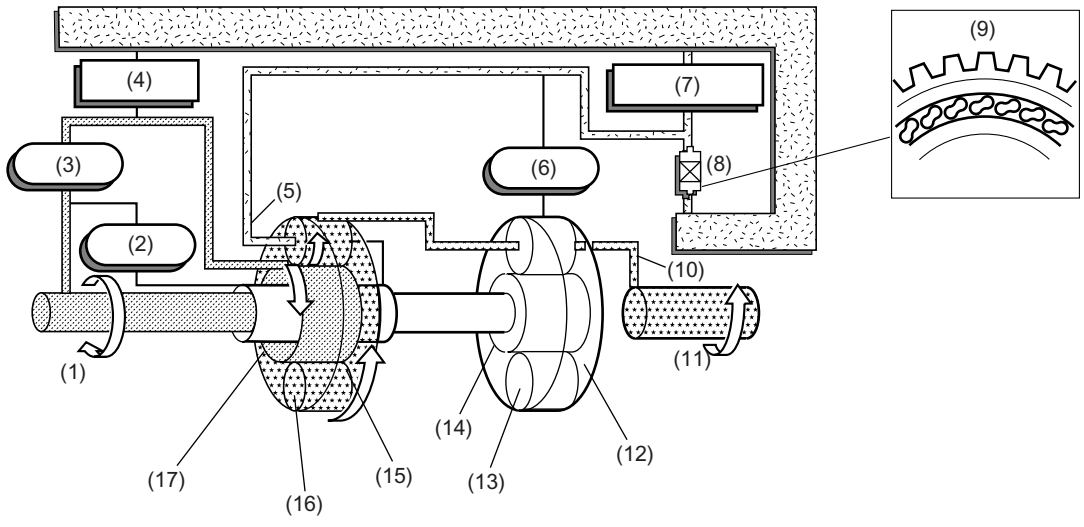

: (18)
: (19)
: (20)
: (21)

AT-00491

(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Front planetary carrier
(6) Low clutch
(7) Low & reverse brake
(8) One-way clutch
(9) no effect
(10) Rear planetary carrier
(11) MPT models: reduction drive shaft
VTD Models: intermediate shaft
(12) Rear internal gear
(13) Rear pinion gear
(14) Rear sun gear
(15) Front internal gear
(16) Front pinion gear
(17) Front sun gear
(18) Input
(19) Output
(20) Locked
(21) Planetary gear components involved in power transmission

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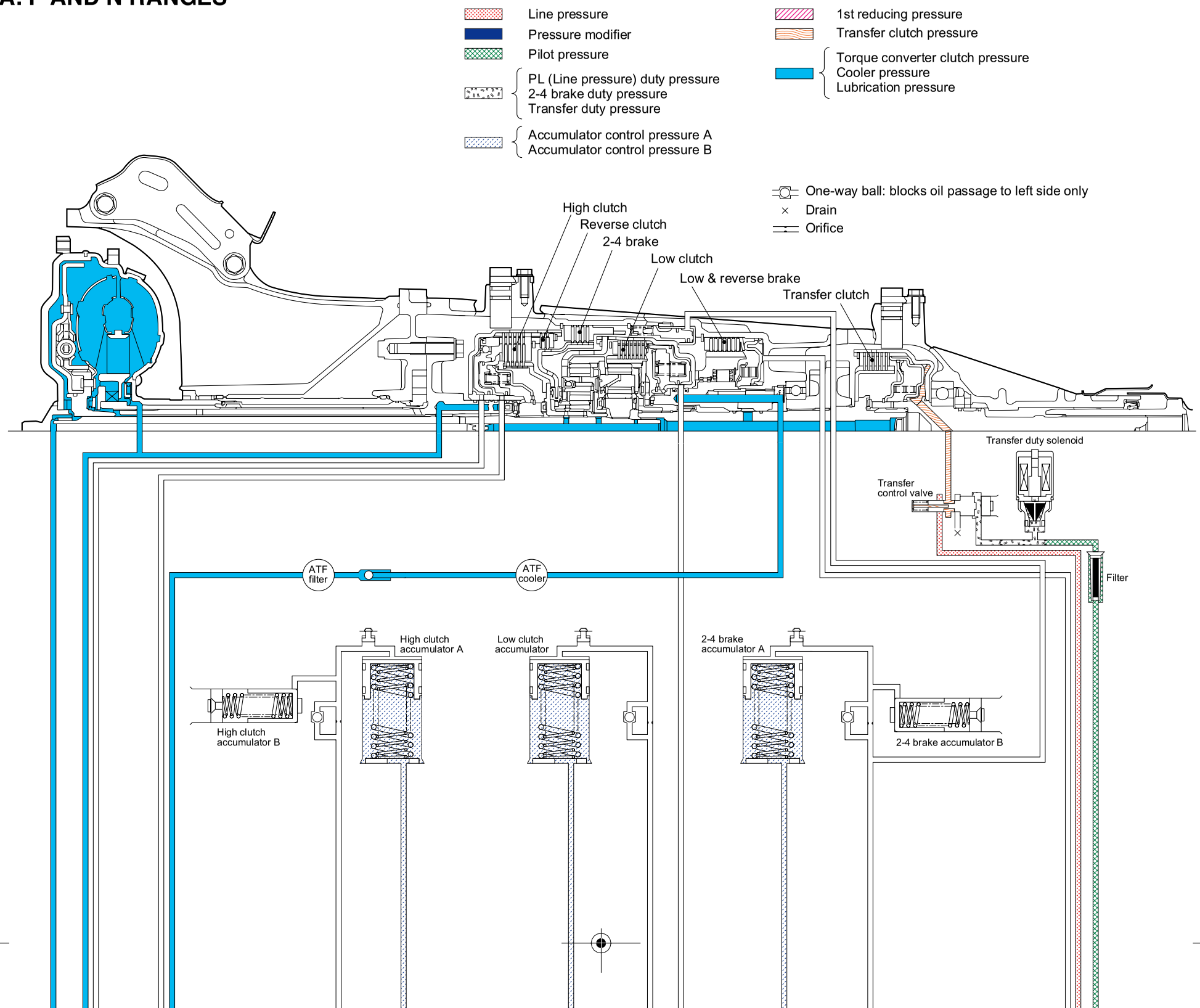
10.Schematic Drawings

A: P AND N RANGES



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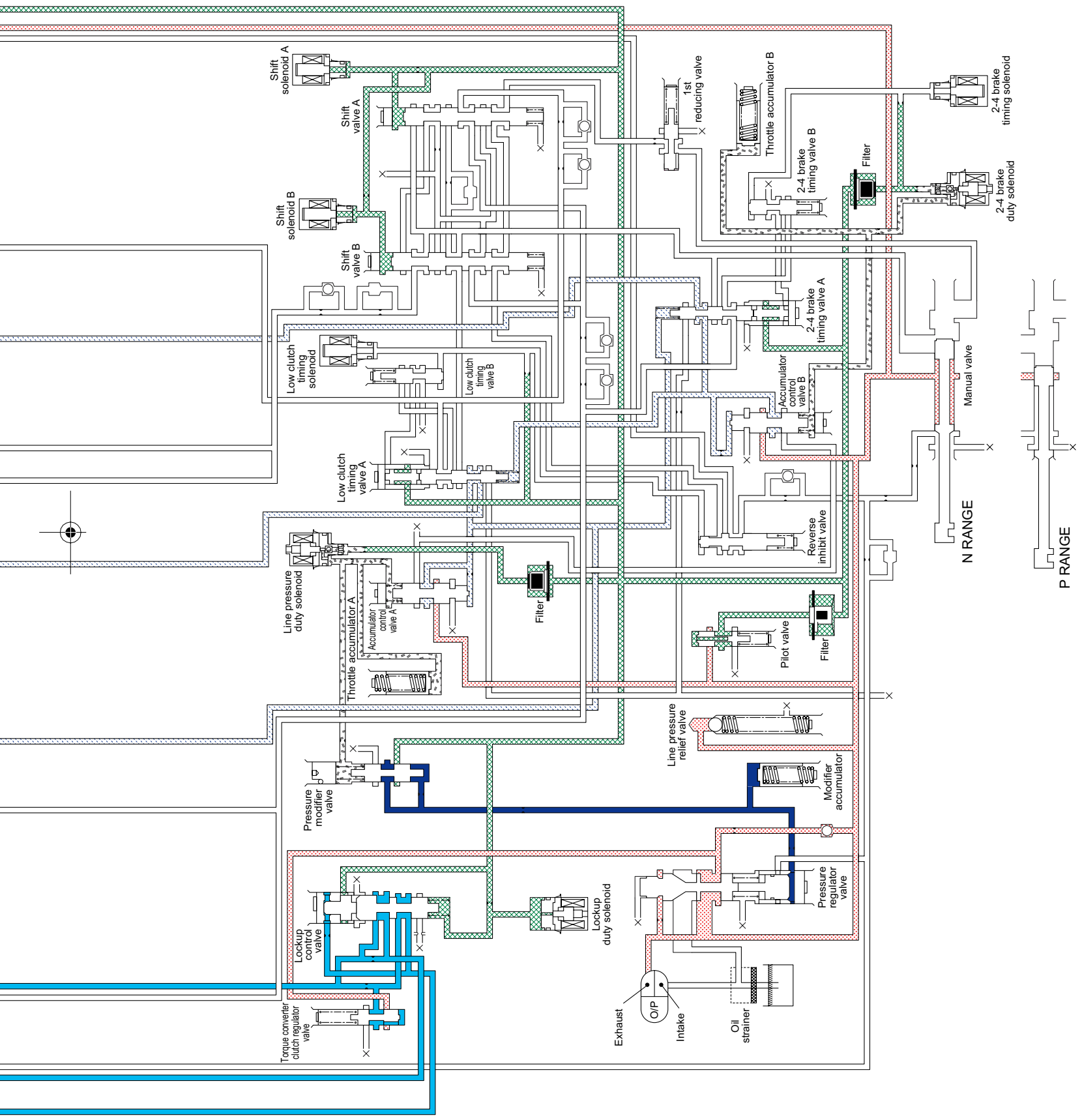
Shift solenoid A
Shift valve A
Shift solenoid B
Shift valve B
Low clutch timing solenoid
Low clutch timing valve B
Low clutch timing valve A
Line pressure duty solenoid
Throttle accumulator A
Accumulator control valve A
Filter
1st reducing valve
Throttle accumulator B
2-4 brake timing valve B
Filter
2-4 brake timing solenoid
2-4 brake duty solenoid
2-4 brake timing valve A
Accumulator control valve B
Manual valve
N RANGE
P RANGE
Reverse inhibit valve
Pilot valve
Filter
Line pressure relief valve
Modifier accumulator
Pressure modifier valve
Lockup control valve
Lockup duty solenoid
Pressure regulator valve
Torque converter clutch regulator valve
Exhaust
O/P
Intake
Oil strainer

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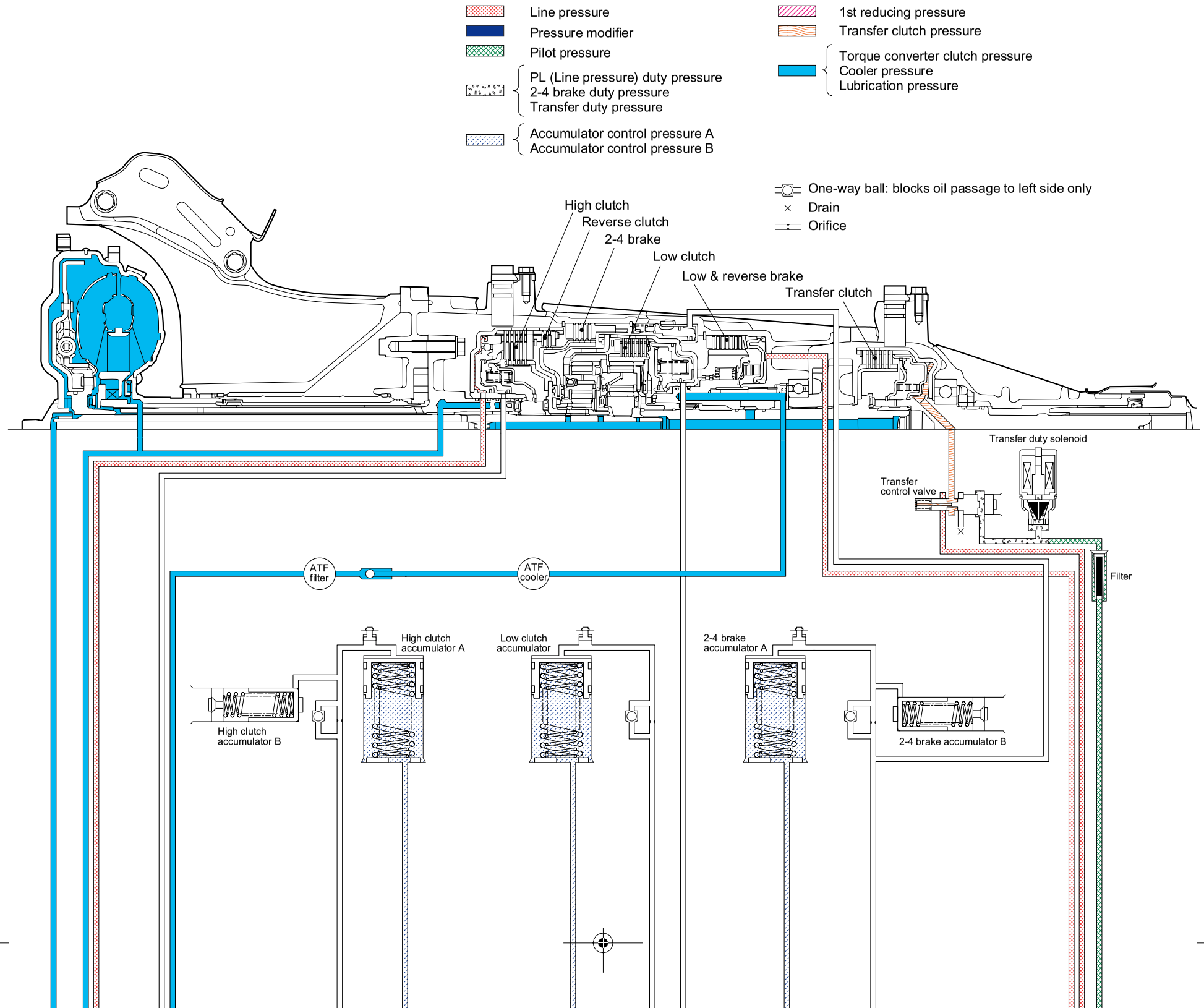
B: R RANGE



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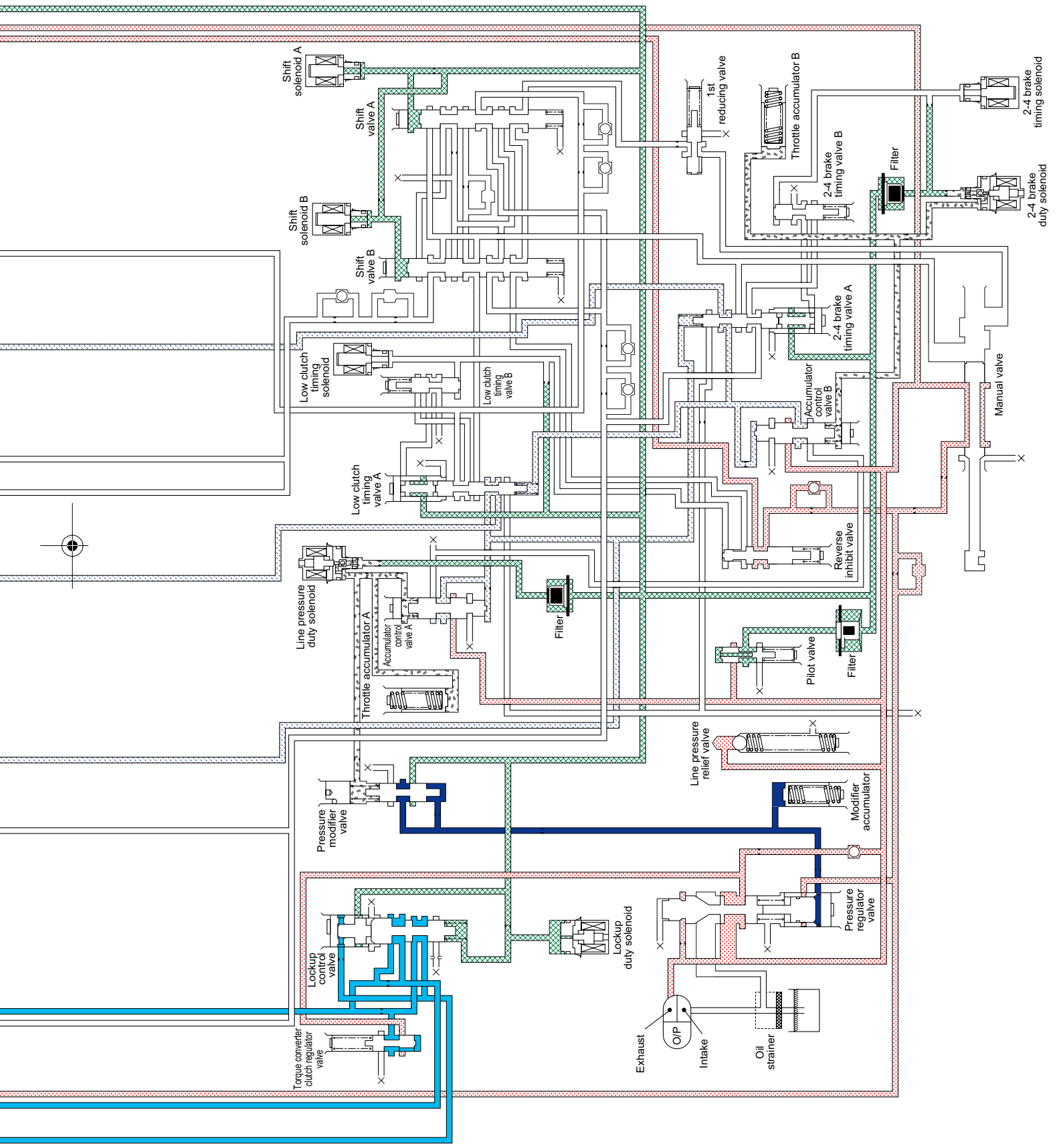

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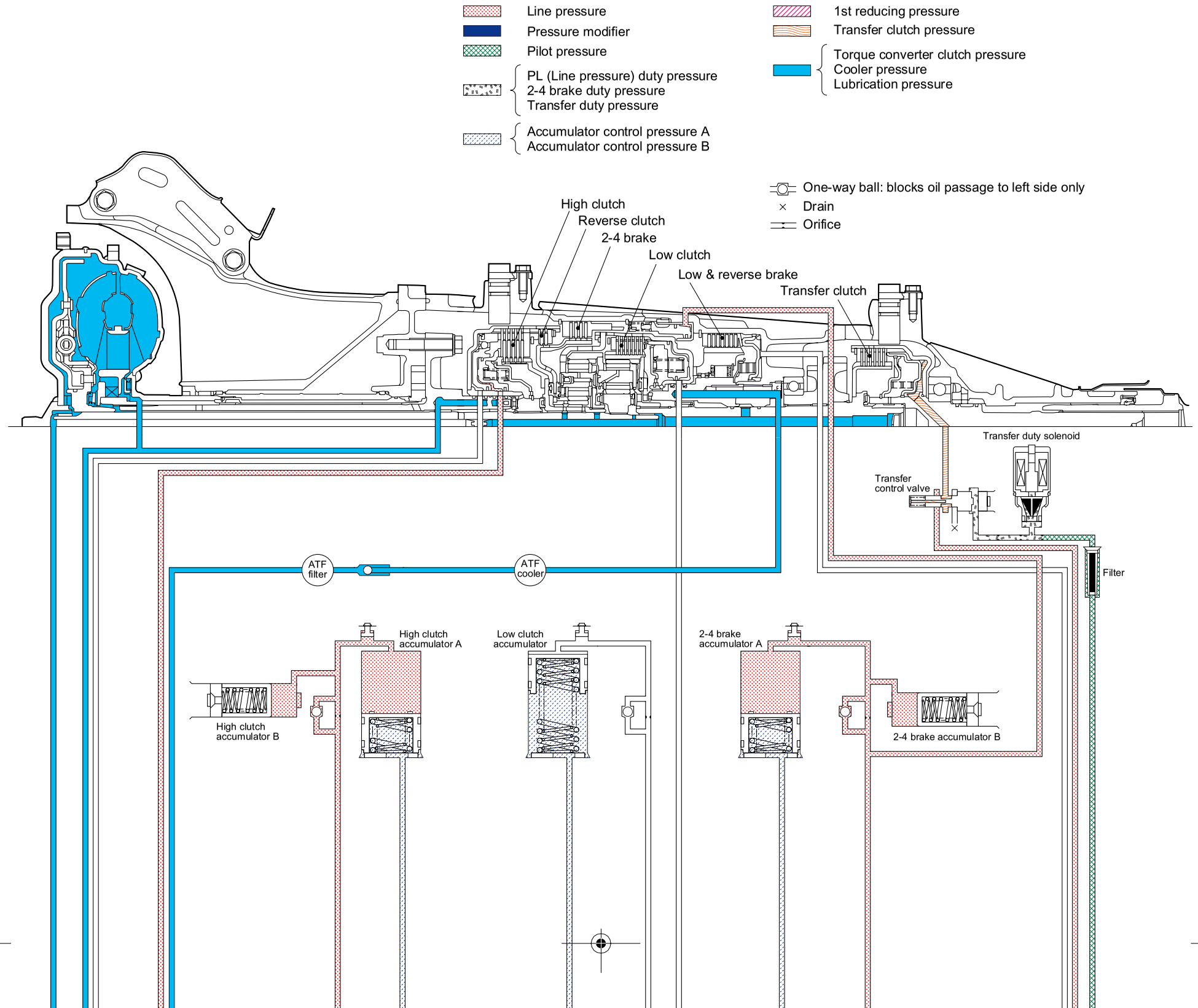
C: 4TH SPEED GEAR IN D RANGE (LOCKUP OFF)



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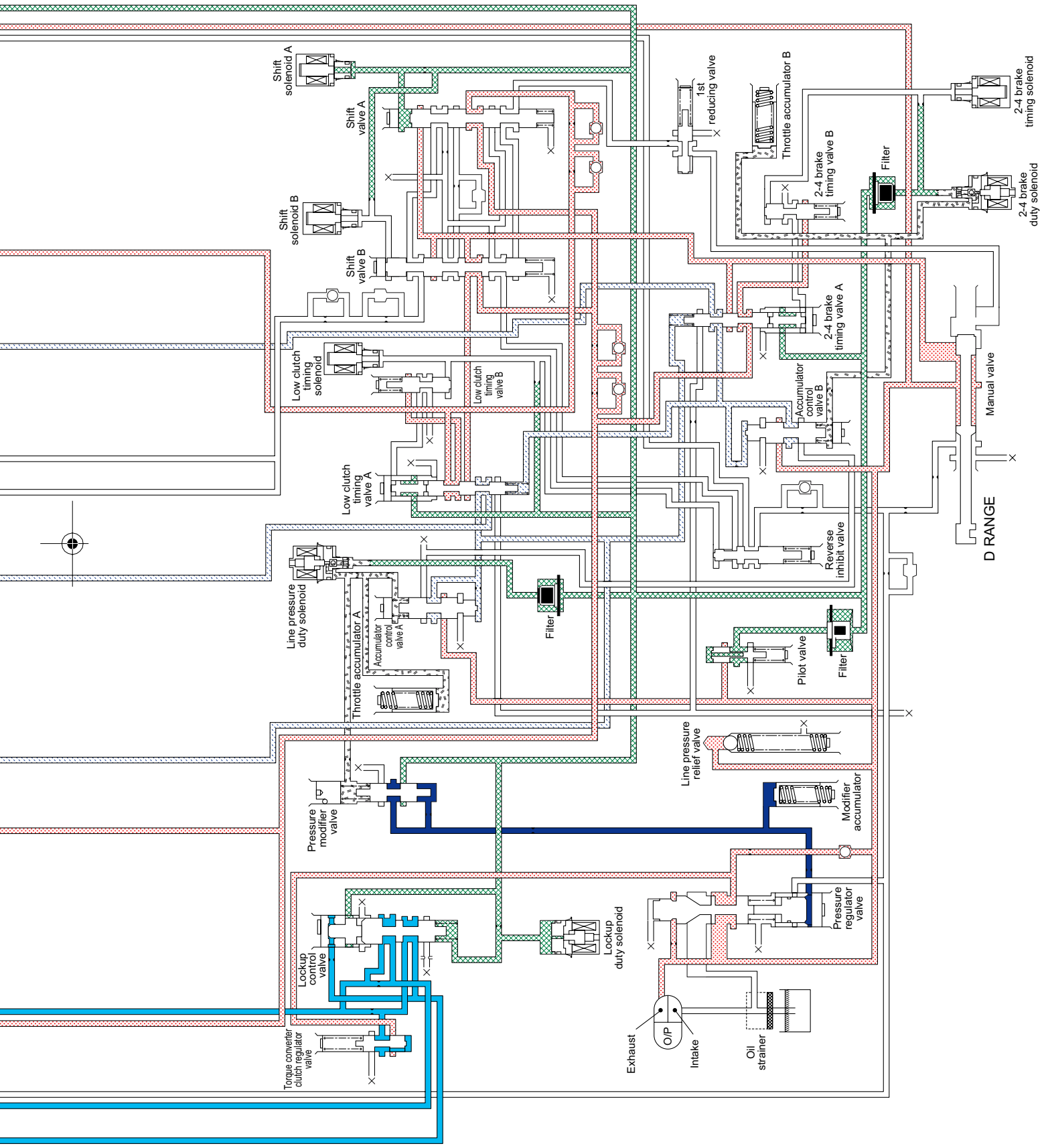
Shift solenoid A
Shift valve A
Shift solenoid B
Shift valve B
Low clutch timing solenoid
Low clutch timing valve B
Low clutch timing valve A
Line pressure duty solenoid
Throttle accumulator A
Accumulator control valve A
Filter
Torque converter clutch regulator valve
Lockup control valve
Pressure modifier valve
Lockup duty solenoid
Exhaust
O/P
Intake
Oil strainer
Pressure regulator valve
Line pressure relief valve
Modifier accumulator
Pilot valve
Filter
Reverse inhibit valve
Accumulator control valve B
2-4 brake timing valve A
1st reducing valve
Throttle accumulator B
2-4 brake timing valve B
Filter
2-4 brake timing solenoid
2-4 brake duty solenoid
Manual valve
D RANGE

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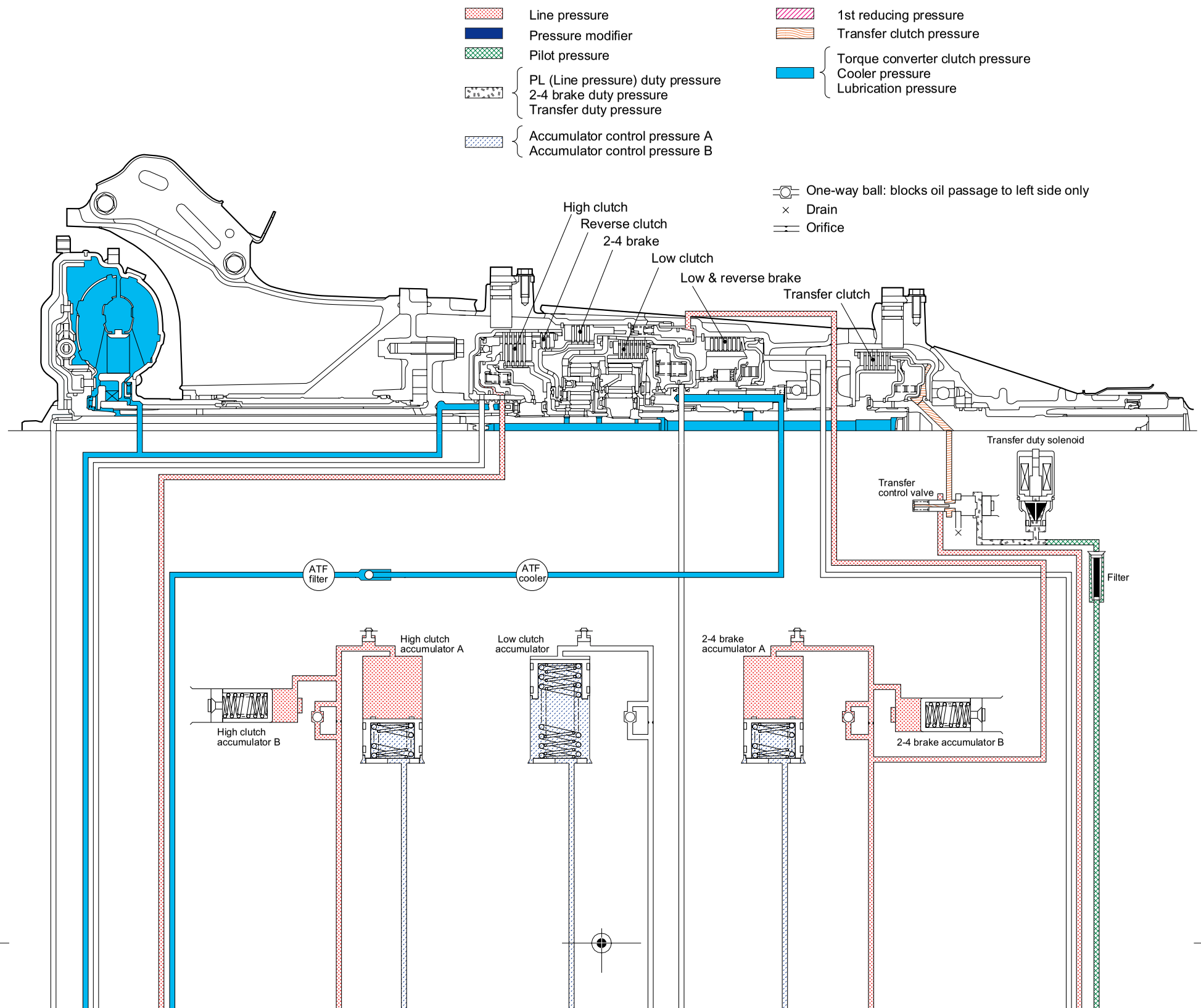
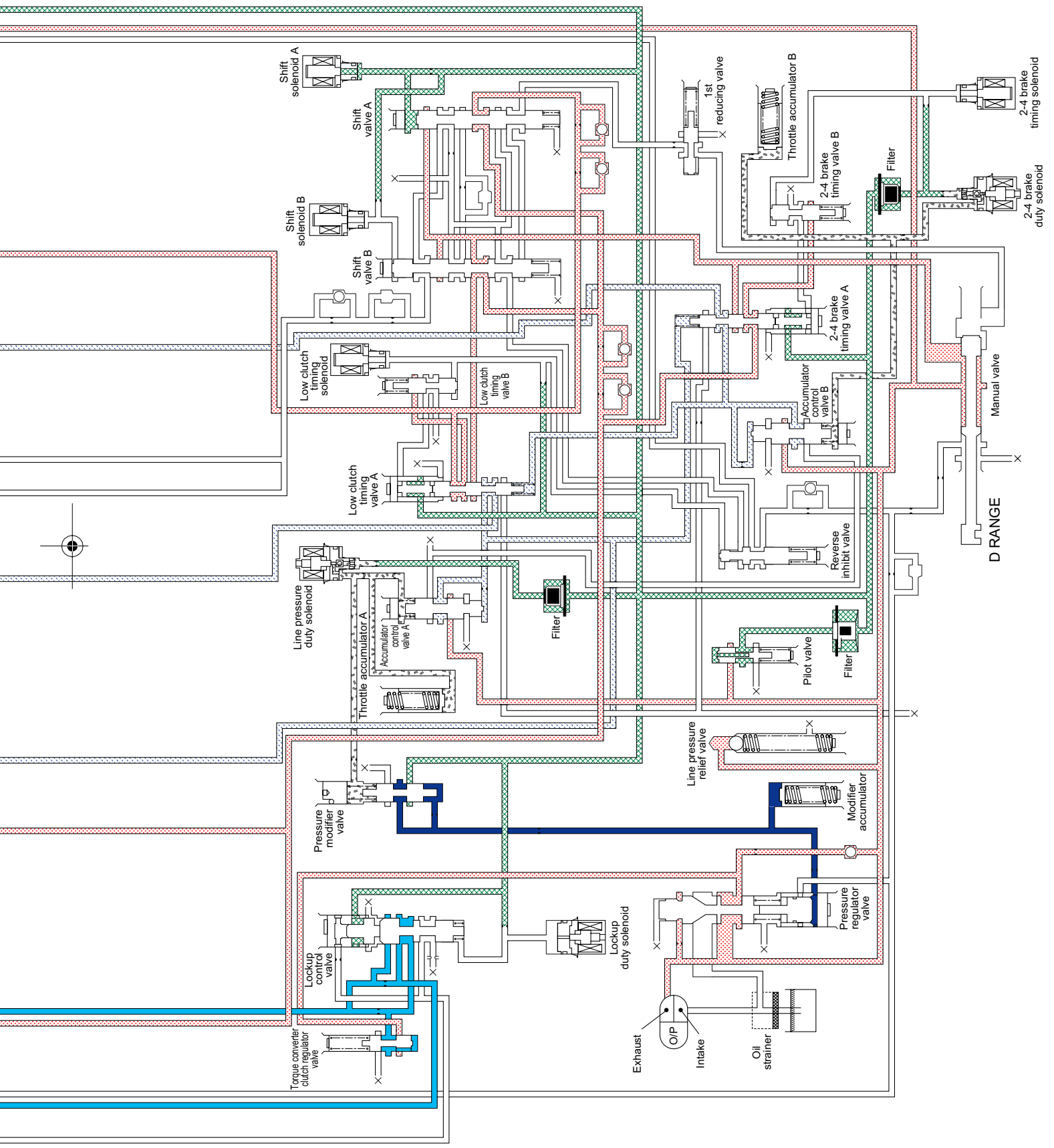
D: 4TH SPEED GEAR IN D RANGE (LOCKUP ON)



AT-01262


Shift solenoid A
Shift valve A
Shift solenoid B
Shift valve B
Low clutch timing solenoid
Low clutch timing valve B
Low clutch timing valve A
Line pressure duty solenoid
Throttle accumulator A
Accumulator control valve A
Filter
Pressure modifier valve
Lockup control valve
Torque converter clutch regulator valve
Lockup duty solenoid
Exhaust
O/P
Intake
Oil strainer
Pressure regulator valve
Modifier accumulator
Line pressure relief valve
Pilot valve
Filter
Reverse inhibit valve
Accumulator control valve B
2-4 brake timing valve A
Manual valve
D RANGE
1st reducing valve
Throttle accumulator B
2-4 brake timing valve B
Filter
2-4 brake timing solenoid
2-4 brake duty solenoid

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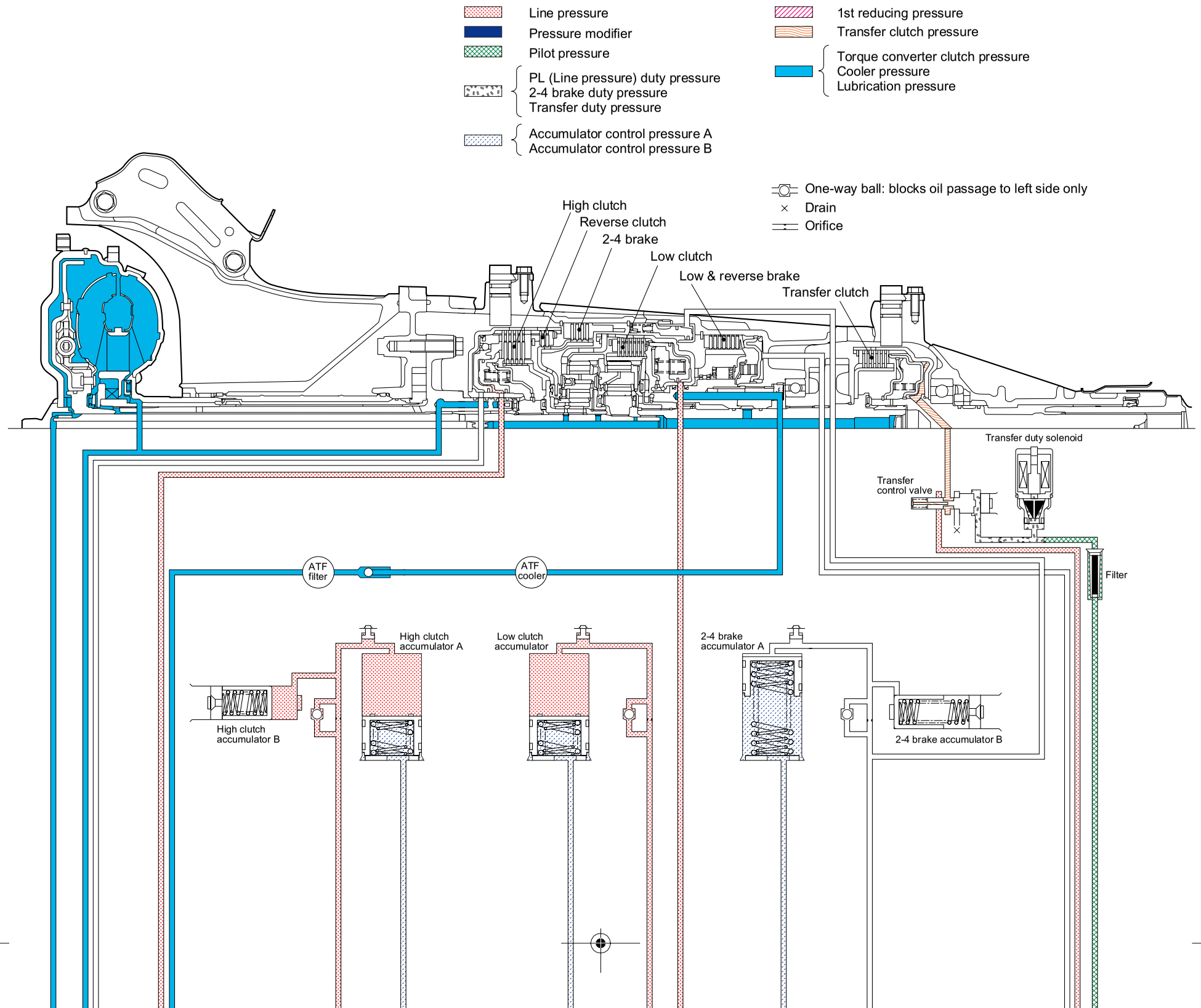
E: 3RD SPEED GEAR IN D AND 3 RANGES



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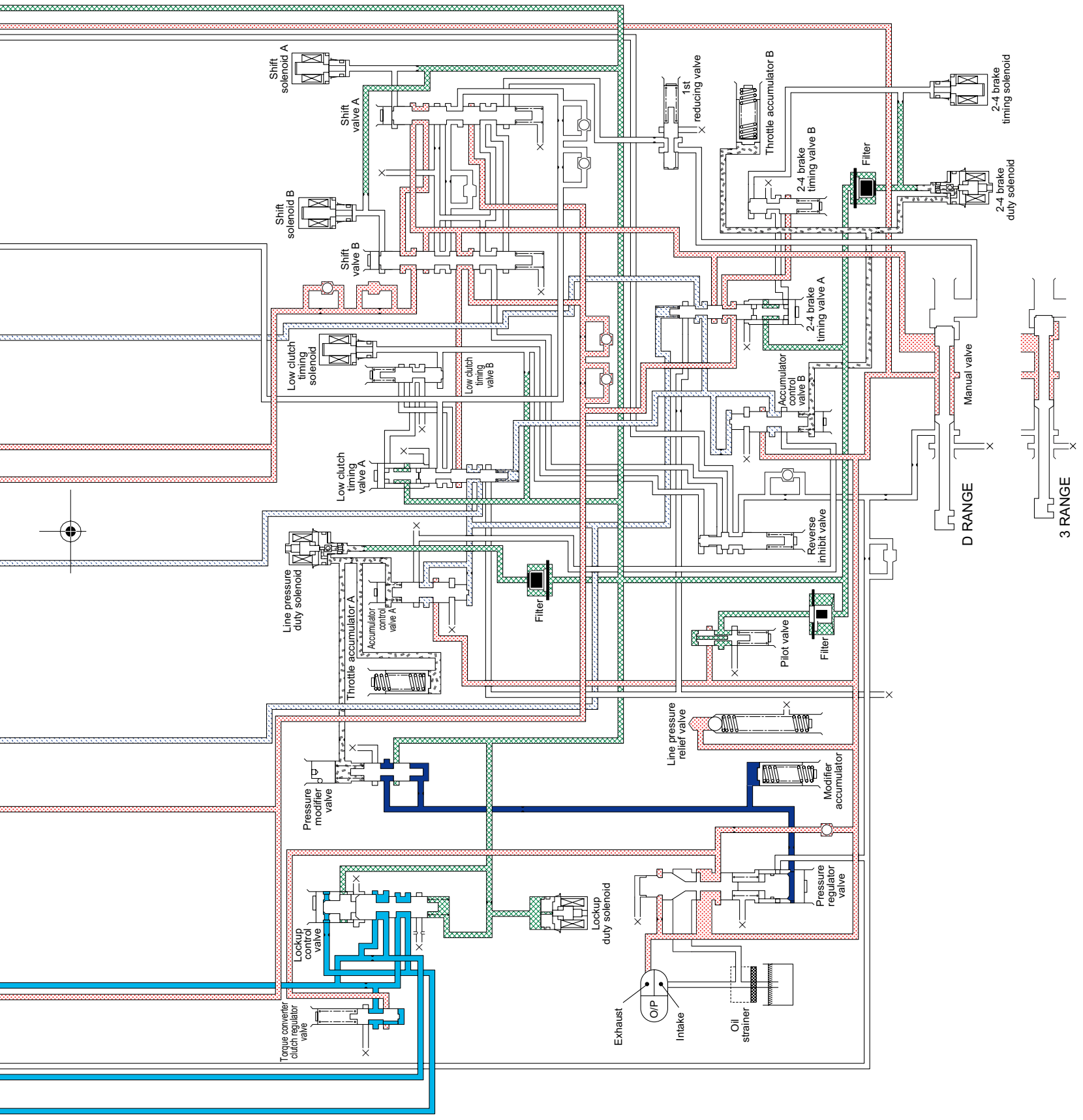
Shift solenoid A
Shift valve A
Shift solenoid B
Shift valve B
Low clutch timing solenoid
Low clutch timing valve B
Low clutch timing valve A
Line pressure duty solenoid
Throttle accumulator A
Accumulator control valve A
Filter
1st reducing valve
Throttle accumulator B
2-4 brake timing valve B
Filter
2-4 brake timing solenoid
2-4 brake duty solenoid
2-4 brake timing valve A
Accumulator control valve B
Manual valve
D RANGE
3 RANGE
Reverse inhibit valve
Pilot valve
Filter
Line pressure relief valve
Modifier accumulator
Pressure modifier valve
Lockup control valve
Lockup duty solenoid
Pressure regulator valve
Exhaust
O/P
Intake
Oil strainer
Torque converter clutch regulator valve

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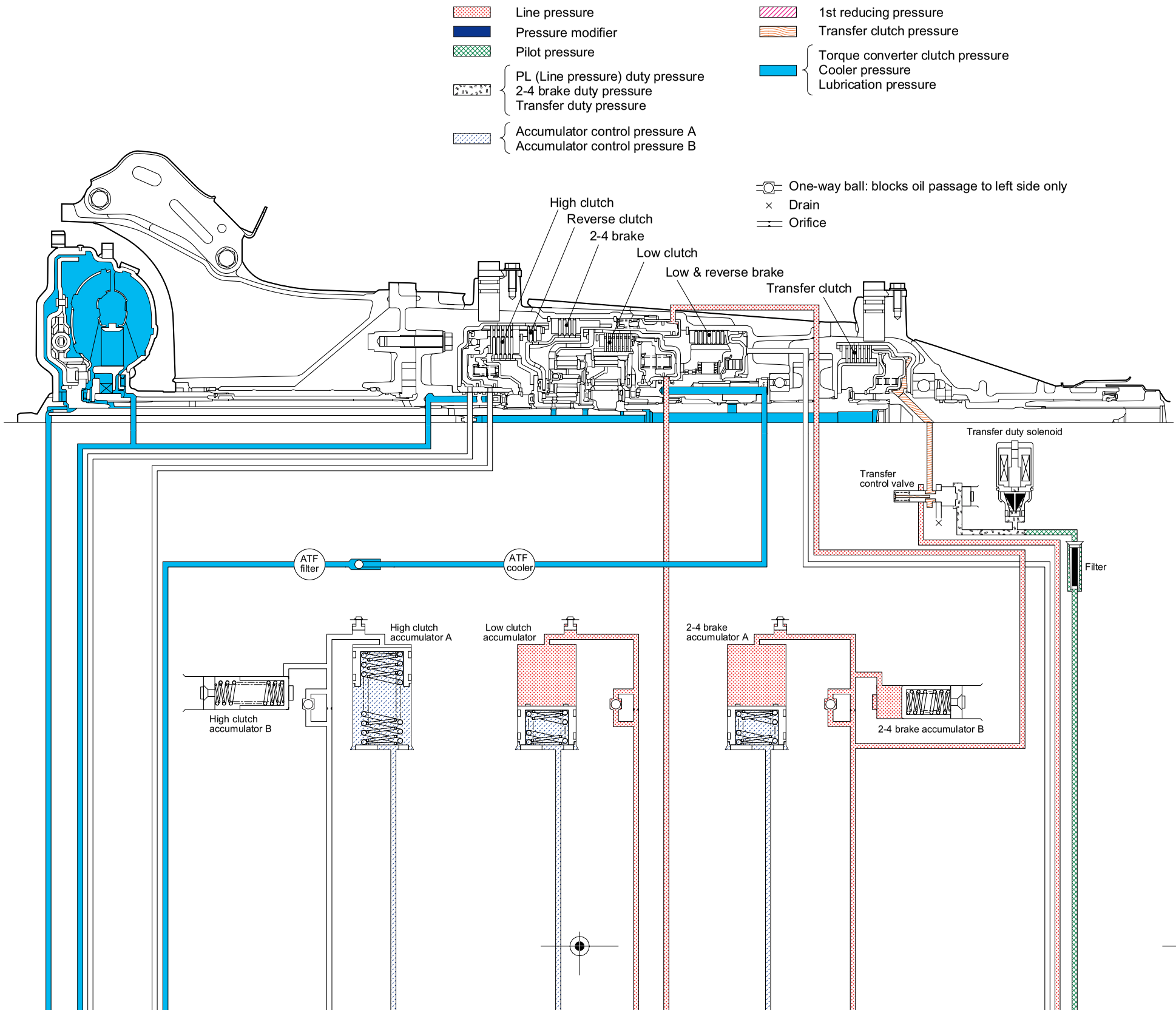
F: 2ND SPEED GEAR IN D, 3 AND 2 RANGES



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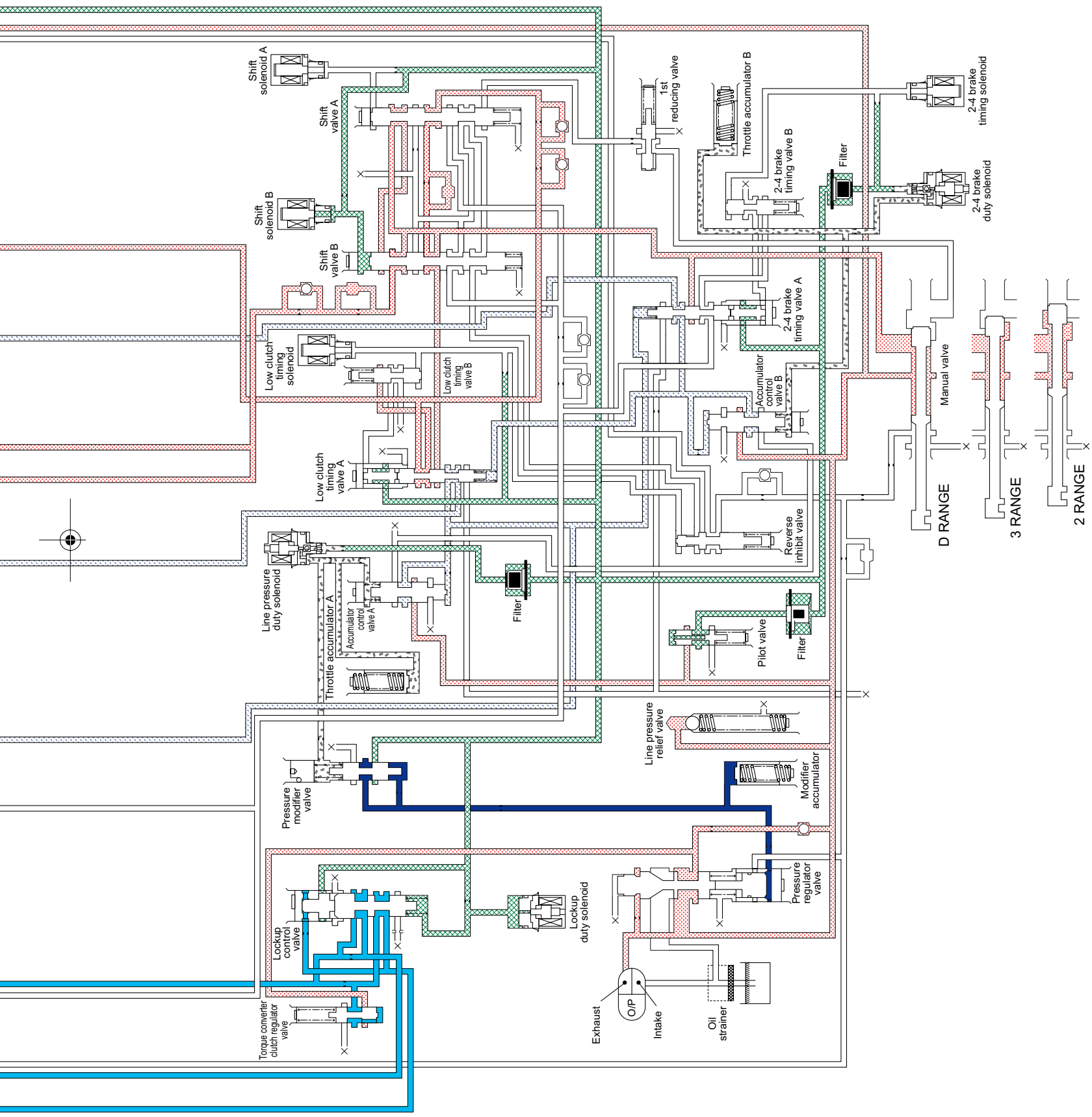
Shift solenoid A
Shift valve A
Shift solenoid B
Shift valve B
Low clutch timing solenoid
Low clutch timing valve B
Low clutch timing valve A
Line pressure duty solenoid
Throttle accumulator A
Accumulator control valve A
Filter
1st reducing valve
Throttle accumulator B
2-4 brake timing valve B
Filter
2-4 brake timing solenoid
2-4 brake duty solenoid
2-4 brake timing valve A
Accumulator control valve B
Manual valve
D RANGE
3 RANGE
2 RANGE
Reverse inhibit valve
Pilot valve
Filter
Line pressure relief valve
Modifier accumulator
Pressure modifier valve
Lockup control valve
Lockup duty solenoid
Pressure regulator valve
Torque converter clutch regulator valve
Exhaust
O/P
Intake
Oil strainer

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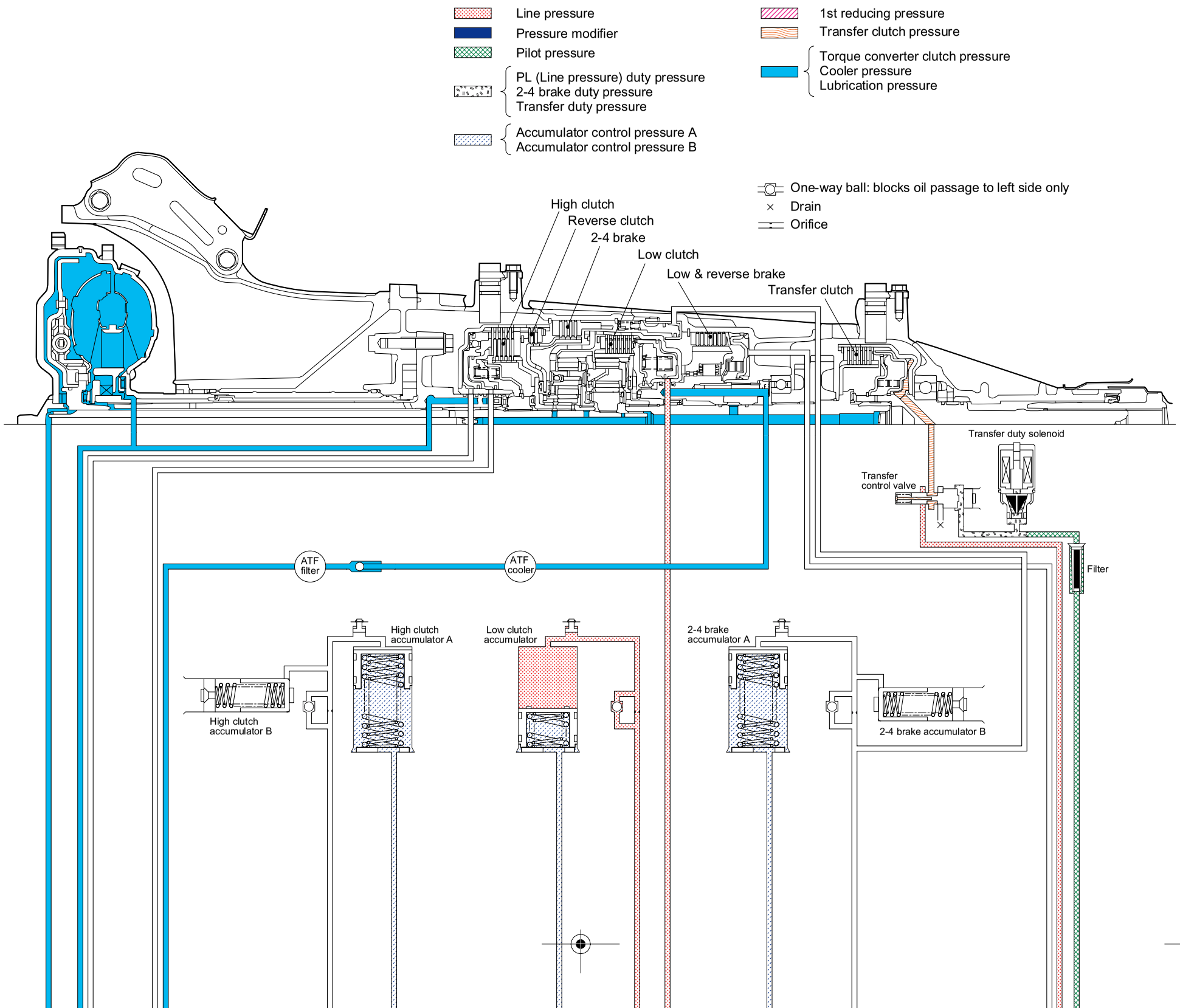
G: 1ST GEAR IN D, 3, AND 2 RANGES



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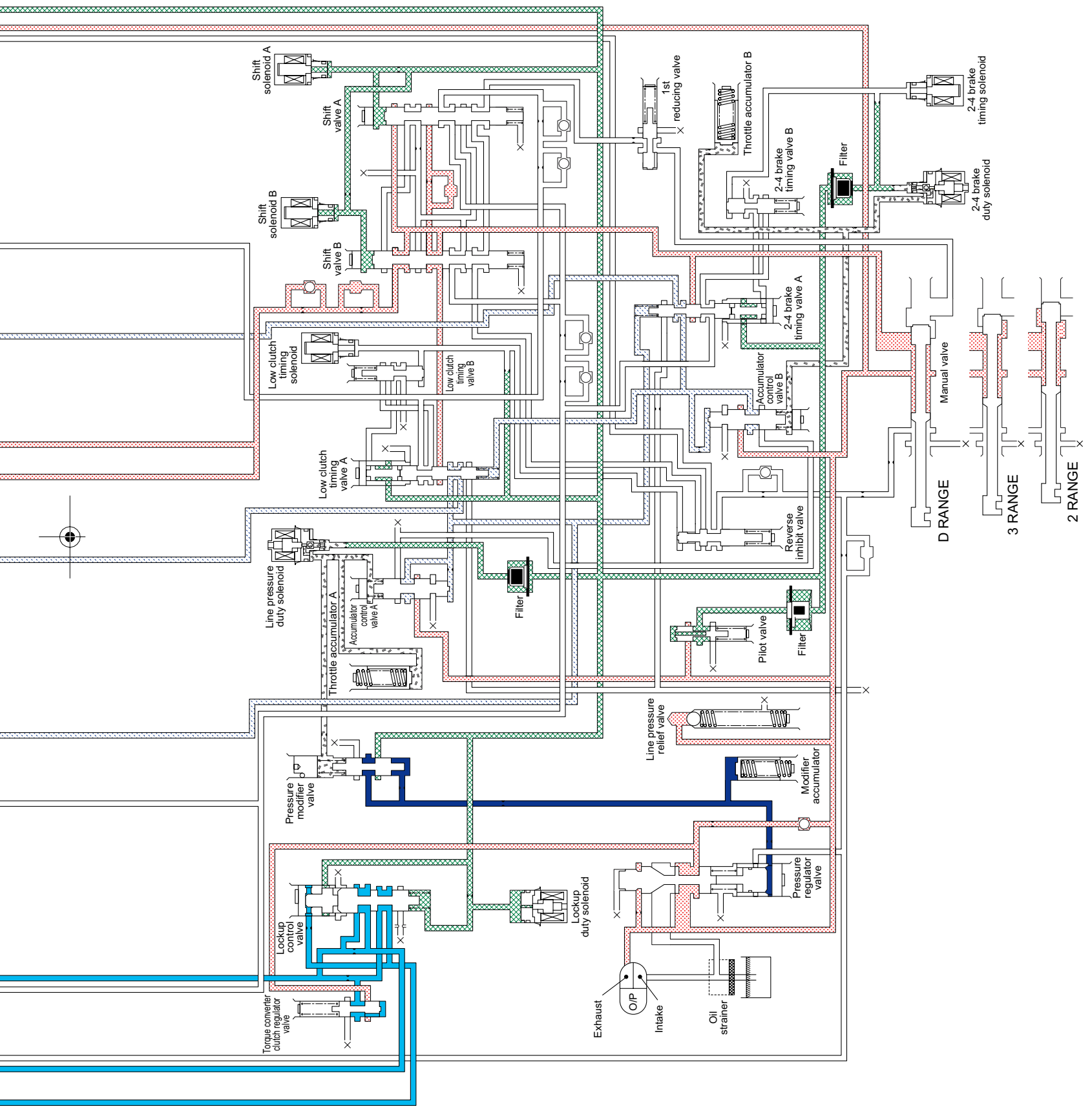
Shift solenoid A
Shift valve A
Shift solenoid B
Shift valve B
Low clutch timing solenoid
Low clutch timing valve B
Low clutch timing valve A
Line pressure duty solenoid
Throttle accumulator A
Accumulator control valve A
Filter
Pressure modifier valve
Torque converter clutch regulator valve
Lockup control valve
Lockup duty solenoid
Exhaust
O/P
Intake
Oil strainer
Pressure regulator valve
Modifier accumulator
Line pressure relief valve
Pilot valve
Filter
Reverse inhibit valve
Accumulator control valve B
2-4 brake timing valve A
Manual valve
D RANGE
3 RANGE
2 RANGE
1st reducing valve
Throttle accumulator B
2-4 brake timing valve B
Filter
2-4 brake timing solenoid
2-4 brake duty solenoid

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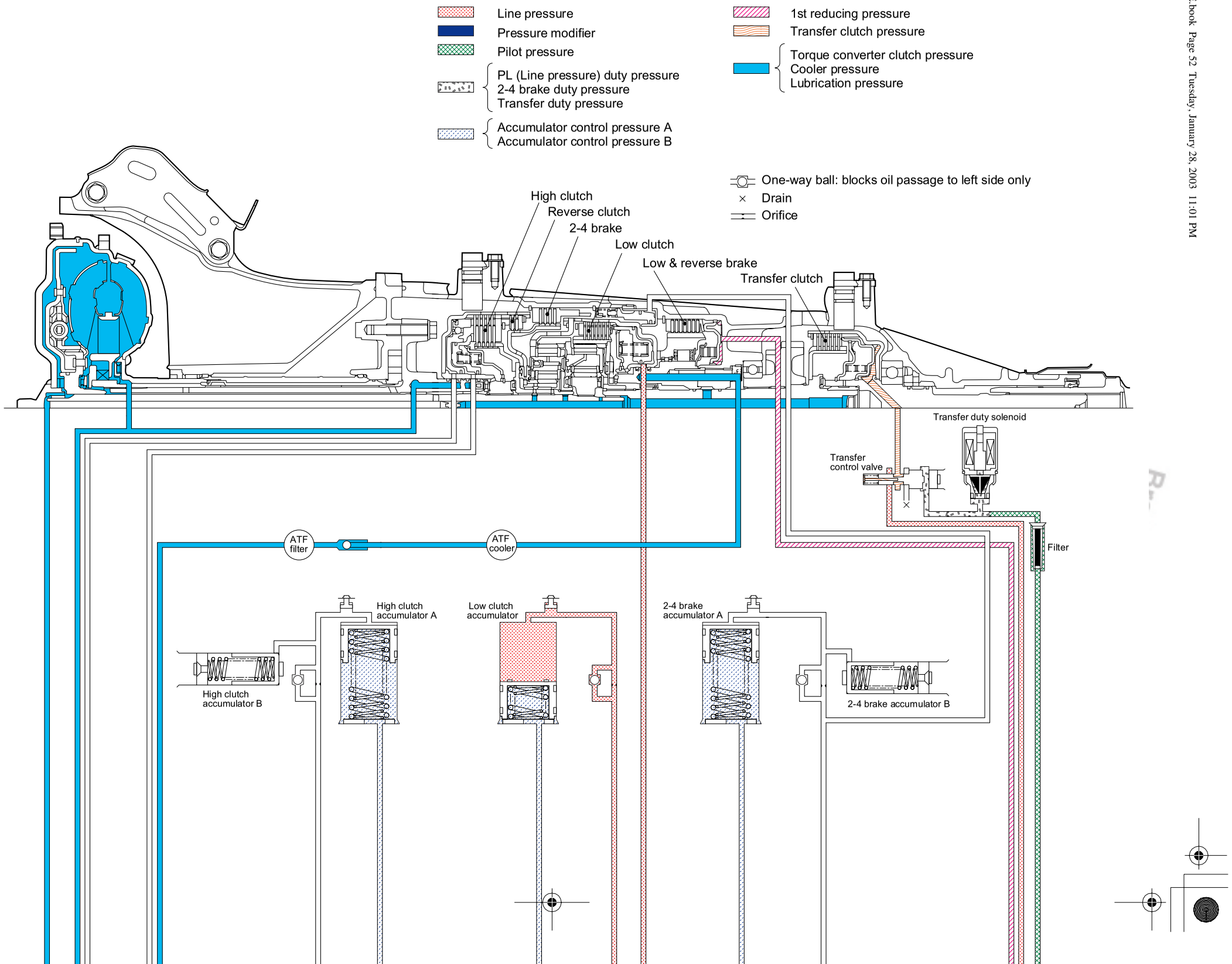
H: 1ST SPEED GEAR IN 1 RANGE



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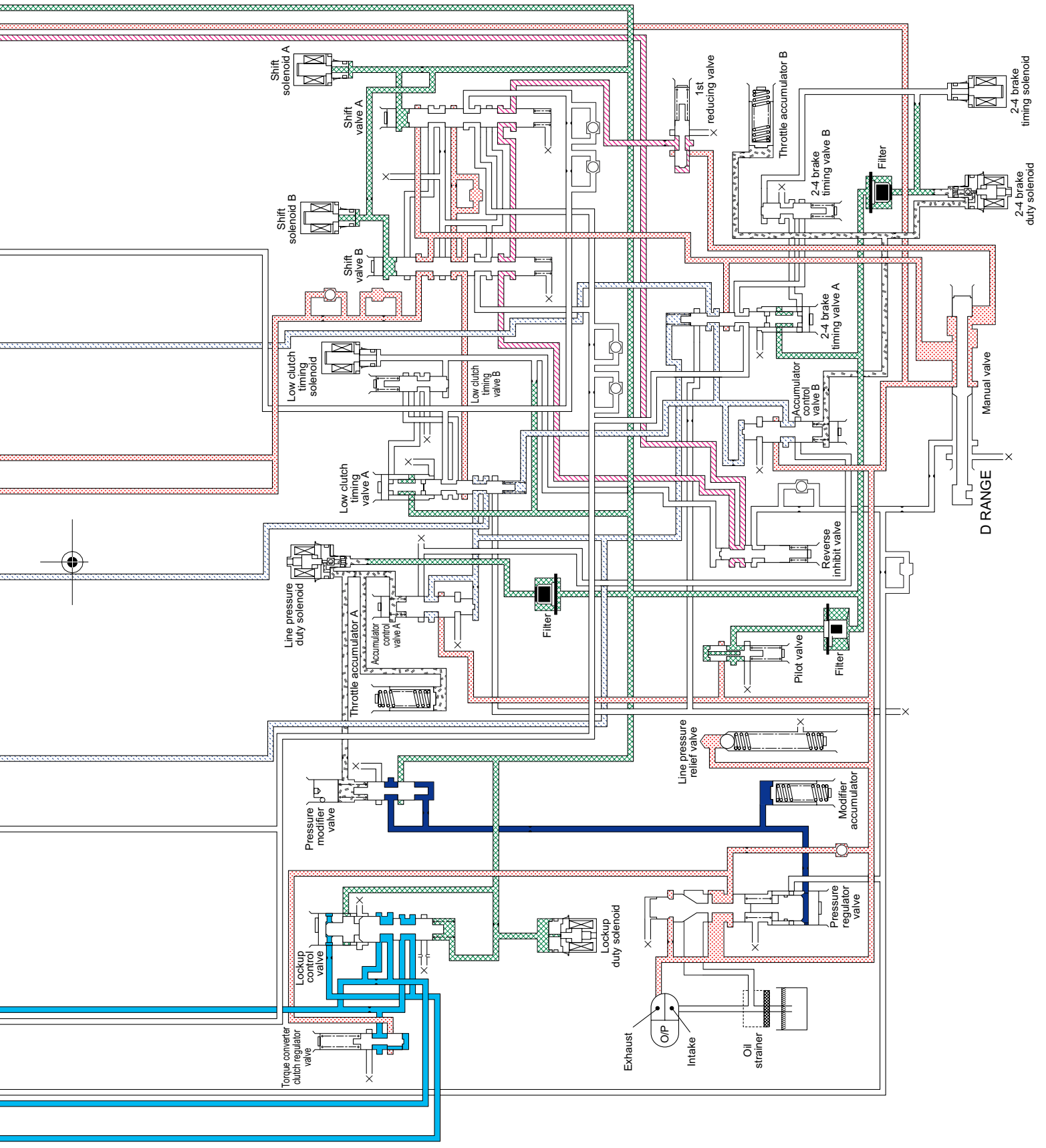
Shift solenoid A
Shift valve A
Shift solenoid B
Shift valve B
Low clutch timing solenoid
Low clutch timing valve B
Low clutch timing valve A
Line pressure duty solenoid
Throttle accumulator A
Accumulator control valve A
Filter
1st reducing valve
Throttle accumulator B
2-4 brake timing valve B
Filter
2-4 brake timing solenoid
2-4 brake duty solenoid
2-4 brake timing valve A
Accumulator control valve B
Manual valve
D RANGE
Reverse inhibit valve
Pilot valve
Filter
Line pressure relief valve
Modifier accumulator
Pressure modifier valve
Lockup control valve
Lockup duty solenoid
Pressure regulator valve
Torque converter clutch regulator valve
Exhaust
O/P
Intake
Oil strainer

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11.AWD Transfer System

A: MPT MODELS

1. GENERAL

This all-wheel-drive (AWD) transfer system uses an electronically controlled multi-plate type transfer clutch. The clutch is controlled by the TCM through the transfer hydraulic pressure control unit which consists of a duty-cycle-controlled solenoid valve and is located at the rear of the automatic transmission section together with the vehicle speed sensor.

The TCM has in its memory a set of duty ratio data, each defining at what ratio the transfer clutch should transmit the torque for a particular driving condition. Based on the driving condition information it receives from the corresponding sensors (vehicle speed, throttle opening, gear range, slip of wheels, etc.), the TCM selects an appropriate duty ratio from the memory and uses it to control the solenoid valve. The solenoid valve then regulates the pilot pressure of the transfer control valve which creates the pressure to the clutch from the line pressure. The clutch is engaged to a degree determined by the transfer clutch pressure thus created. Through this process, the torque from the engine is distributed to the rear wheels optimally according to driving conditions.

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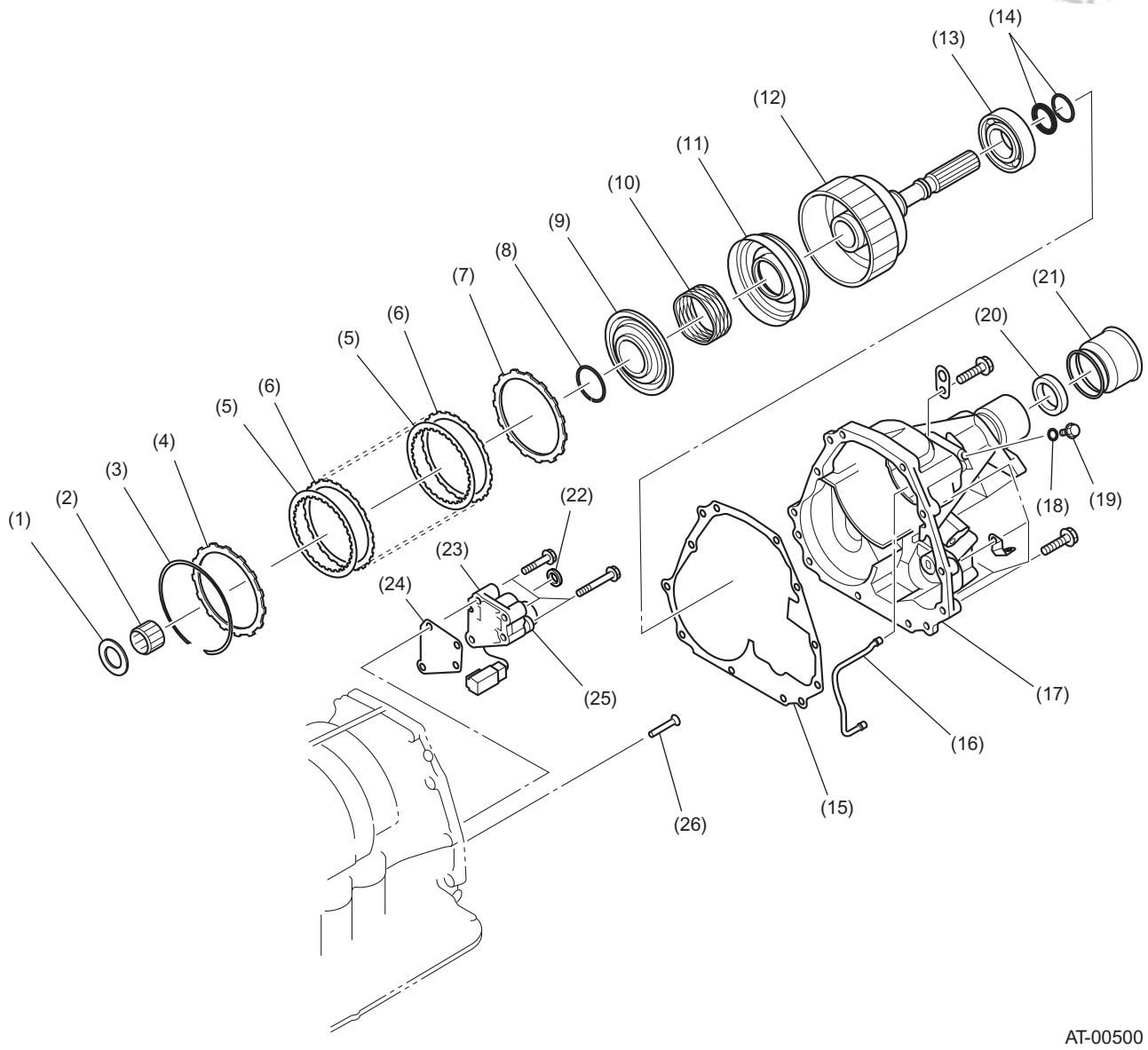

AT-00500

(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) Extension case
(18) O-ring
(19) Plug
(20) Oil seal
(21) Dust cover
(22) Transfer clutch seal
(23) Transfer control valve
(24) Transfer valve plate
(25) Transfer duty solenoid
(26) Inlet filter

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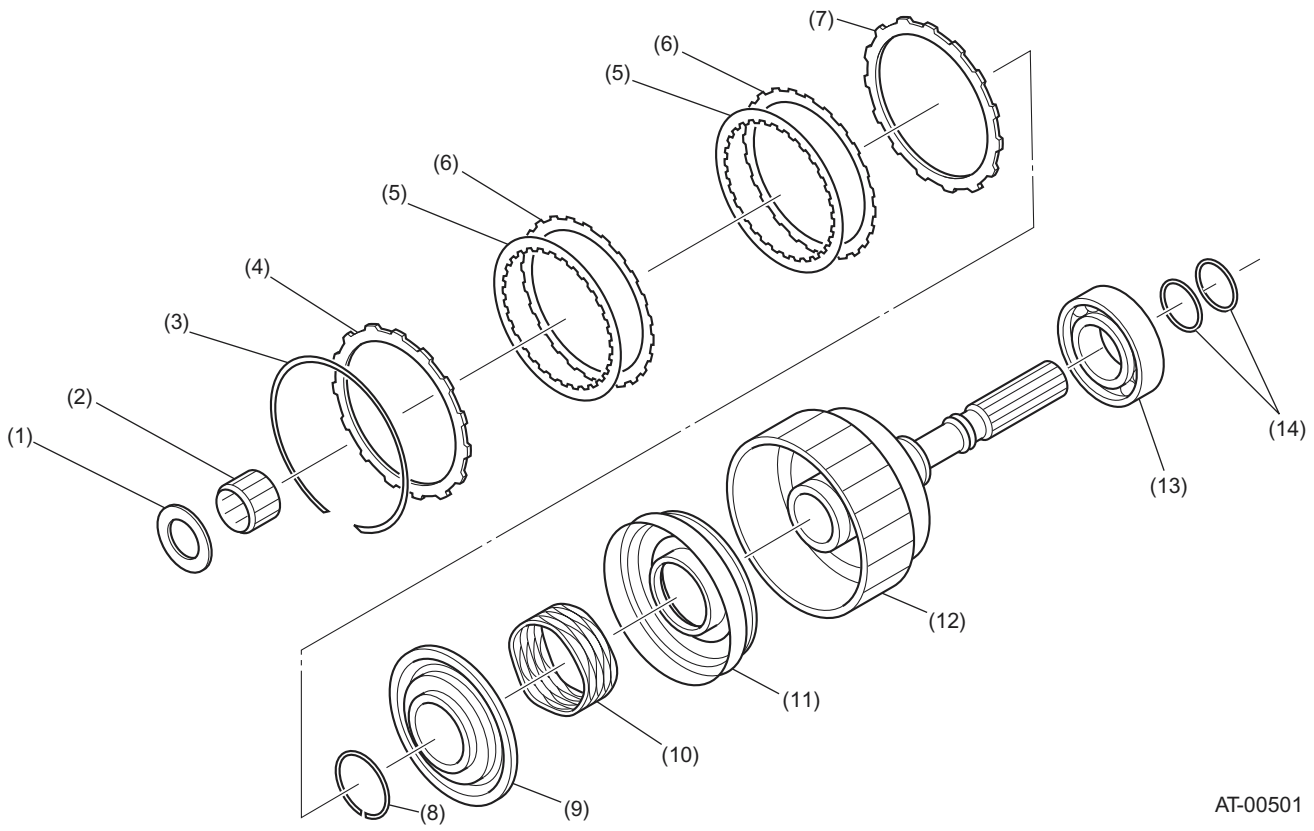
2. CONSTRUCTION

● Transfer clutch

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
(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

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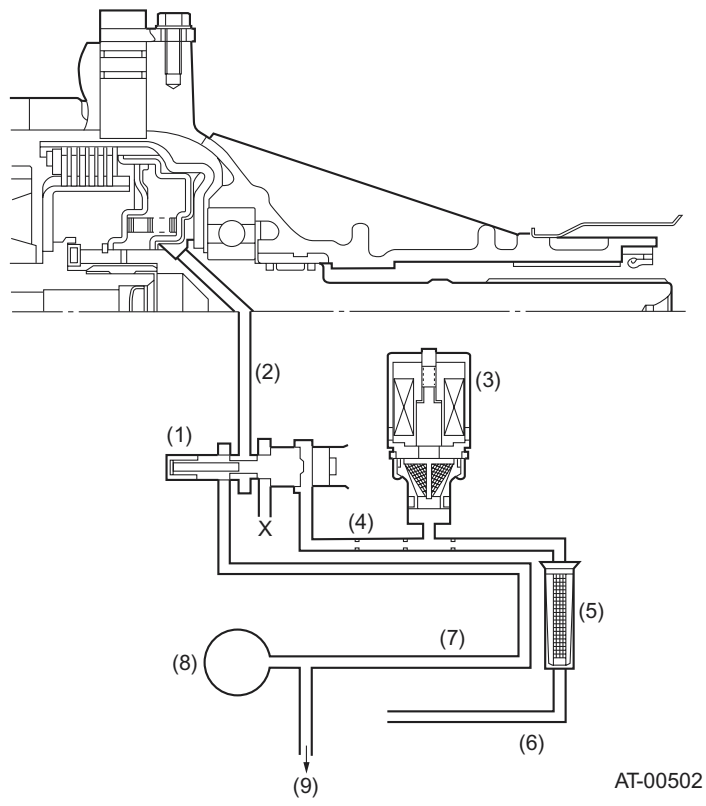
● Transfer hydraulic pressure control unit

The transfer hydraulic pressure control unit is bolted at the rear end of transmission case through the transfer valve plate.

The hydraulic pressures used for the transfer hydraulic pressure control unit (line pressure and pilot pressure) are supplied from the transmission's hydraulic control valve assembly through the passages formed in the transmission case.

The transfer duty solenoid adjusts the pilot pressure of the transfer clutch valve depending on the signals from the TCM. The transfer clutch valve in turn modulates the line pressure into the transfer clutch pressure before it is applied to the clutch piston.

The transfer clutch pressure adjusted in this way engages the clutch to different degrees according to driving conditions so that the optimum torque is distributed to the rear wheels.



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

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B: VTD MODELS

1. GENERAL

Used in the transfer of the VTD models is the SUBARU drive power distribution system which combines a compound planetary gear type center differential installed in the transfer case behind the transmission and a hydraulically operated multi-plate differential action limiting device (LSD) located between the output components of the center differential. Differential action limiting control is performed by the TCM according to driving and road surface conditions. This system allows combining stability provided by the AWD design with good operability.
The input torque is transmitted to the 1st sun gear of the center differential through the intermediate shaft. From the 1st sun gear, the torque is transmitted through the 1st pinion to the output carrier in the front wheel output components, and through the 2nd pinion to the 2nd sun gear in the rear wheel output components.
The center differential performs the differential functions of absorbing the speed difference between the front and rear wheels and also distributes drive forces to the front and rear wheels at a predetermined ratio. In normal conditions (when there is almost no difference in the speed between the front and rear wheels), the drive force distribution ratio is 45.5 % to the front wheels and 54.5 % to the rear wheels. The hydraulic multi-plate clutch connected in parallel with the center differential between the carrier and 2nd sun gear functions as a differential action limiting device (LSD) and also as a device that controls torque distribution according to driving conditions.
The differential action limiting control is based on the parameters that include the throttle angle, engine speed, vehicle speed, and speed ratio of front and rear wheels. The LSD clutch piston is operated by the fluid whose pressure is adjusted by the duty solenoid and the transfer control valve in the transfer case. According to the pressure applied to the piston, the torque distribution ratio changes from the ratio set for the center differential to the direct AWD ratio.
The speed of the front and rear wheels determine the basic signals for the differential action limiting control. The rear wheel speed is detected by sensor installed above the rear drive shaft and the front wheel speed is detected by the sensor on the parking gear above the reduction drive shaft gear.

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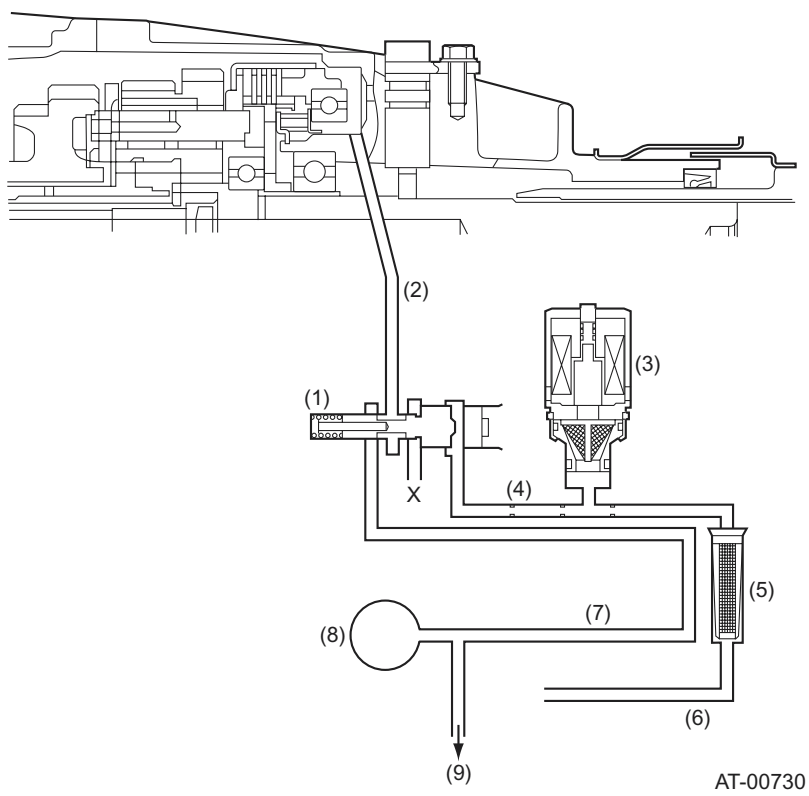

AT-00730

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

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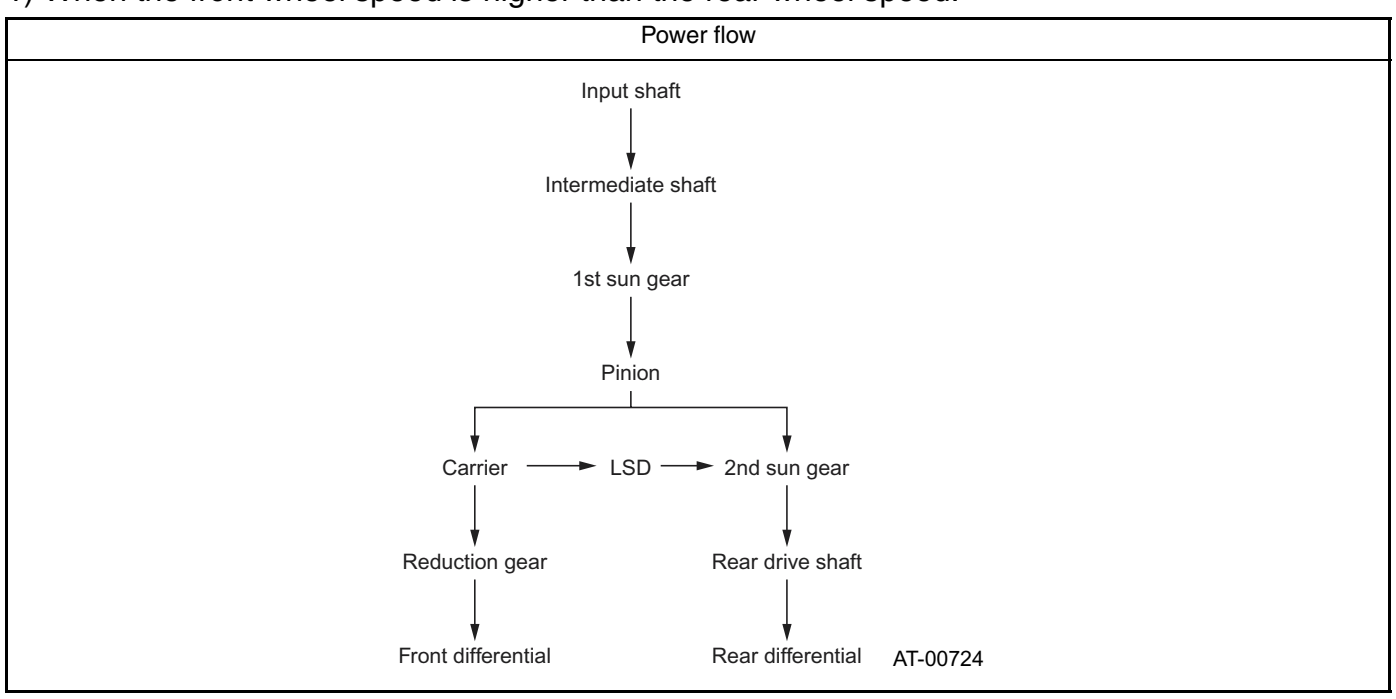
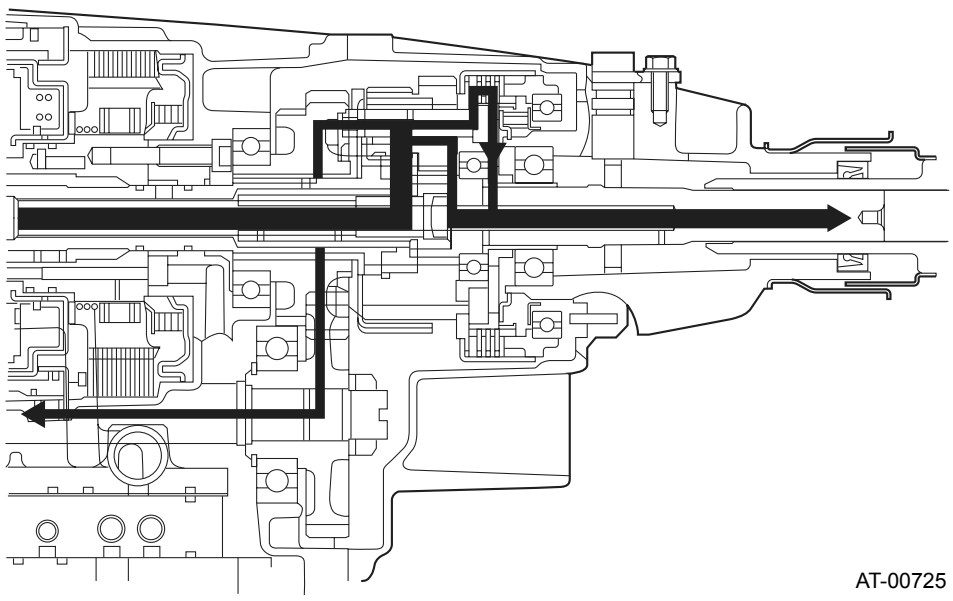
2. VARIABLE TORQUE DISTRIBUTION CENTER DIFFERENTIAL

The front-rear torque distribution ratio is basically determined by the gear tooth ratio of center differential's compound planetary gears and varied by changing the degree of engagement of the hydraulically operated multi-plate clutch that connects the center differential output elements according to driving conditions and road surface conditions.

1) When the front wheel speed is higher than the rear wheel speed:





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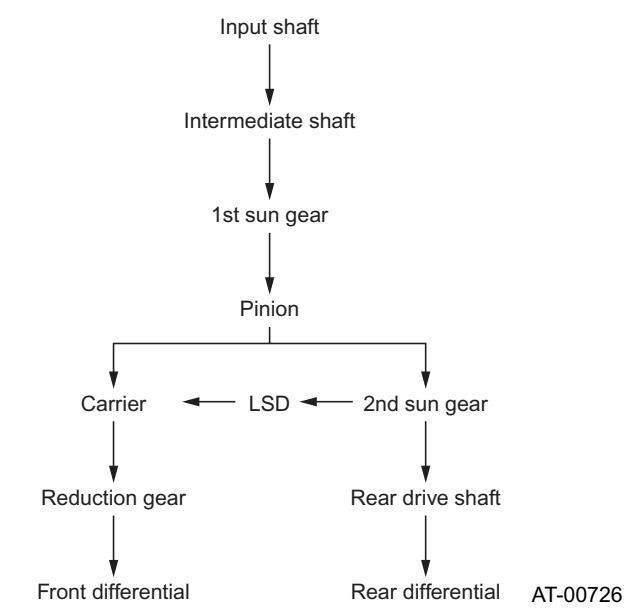
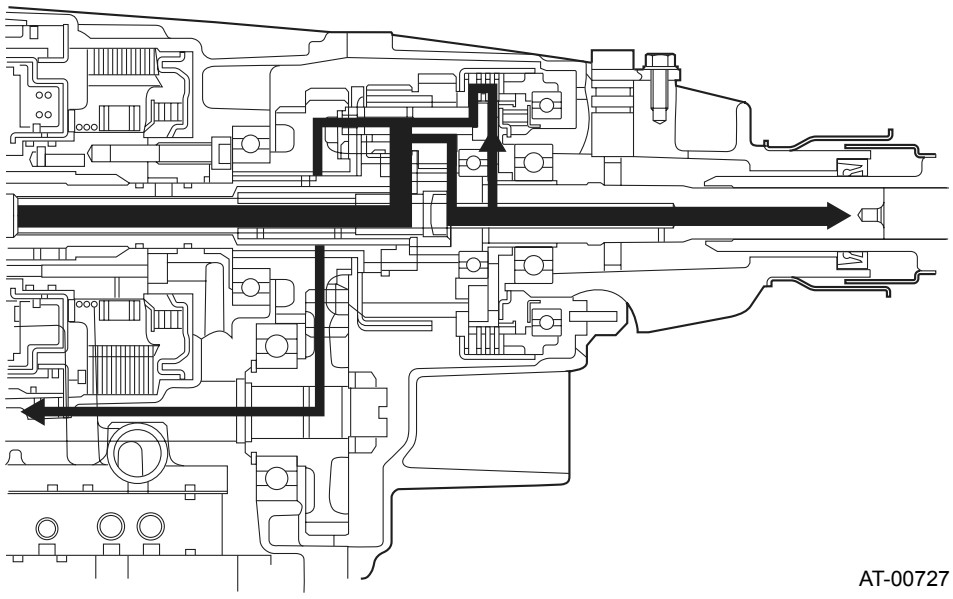
2) When the rear wheel speed is higher than the front wheel speed:

Power flow



AT-00726



AT-00727

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3. CENTER DIFFERENTIAL ASSEMBLY

The center differential is a compound planetary gear set without internally-toothed gears. The input torque from the automatic transmission is transmitted to the input element of the center differential (1st sun gear). The front wheel output elements of the center differential are connected to the carrier and the rear wheel output elements are connected to the 2nd sun gear.
The compound planetary gears uses helical gears for quiet operation and strength. The three pinions are arranged to ensure the best motion balance during operation.

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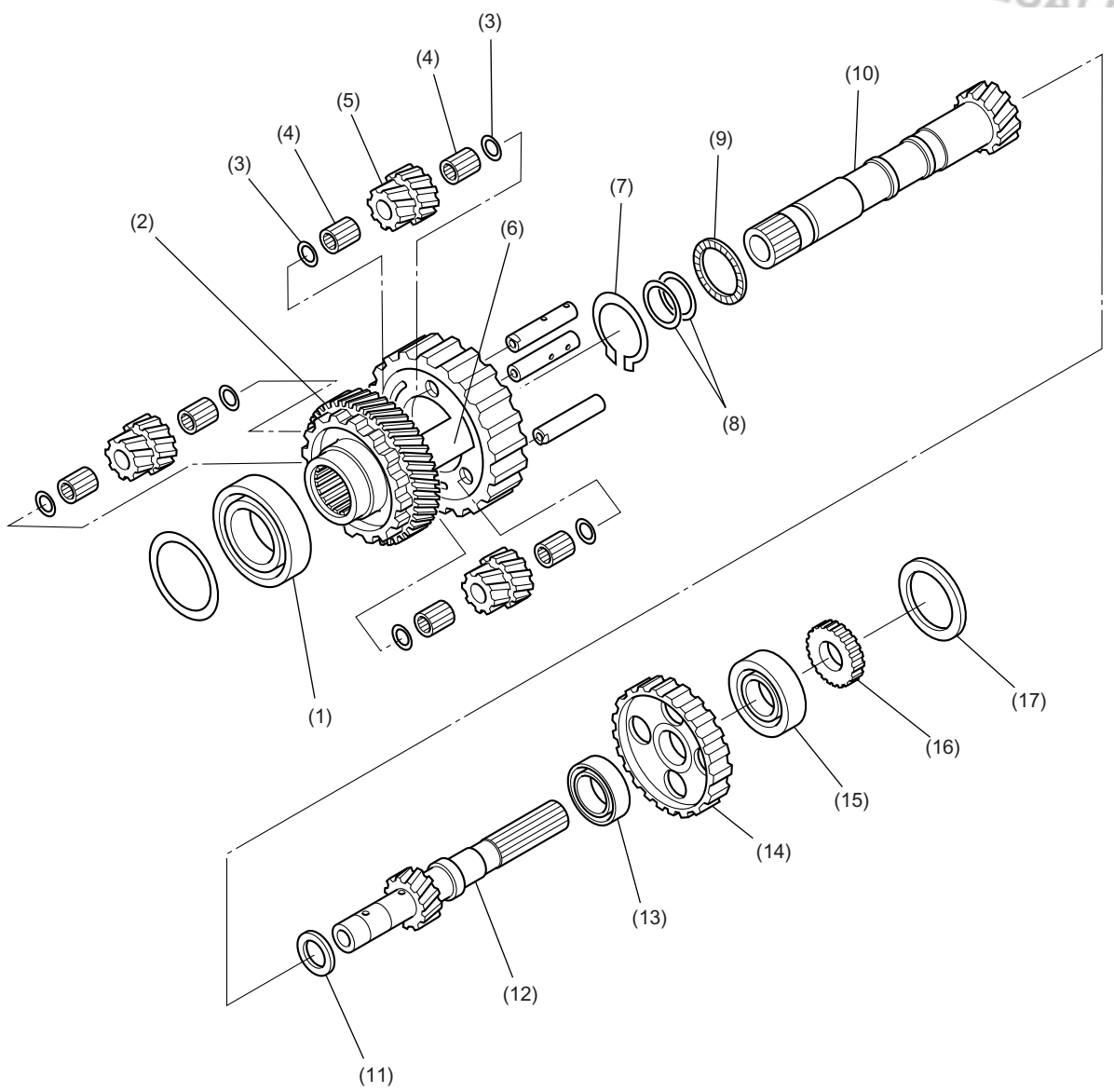

AT-00728

(1) Ball bearing
(2) Reduction drive gear
(3) Washer
(4) Needle bearing
(5) Pinion gear
(6) Carrier
(7) Snap ring
(8) Seal ring
(9) Thrust needle bearing
(10) Intermediate shaft
(11) Thrust washer
(12) Rear drive shaft
(13) Ball bearing
(14) Multi-plate clutch hub
(15) Ball bearing
(16) Revolution gear
(17) Rear drive shaft shim

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4. MULTI-PLATE CLUTCH (LSD)

The transfer's differential action limiting device (LSD) consists of a multi-plate clutch and a transfer hydraulic pressure control unit incorporating a transfer duty solenoid.
The transfer duty solenoid is an electromagnetic valve which is controlled by the TCM using various duty ratios stored in its memory as explained in "1. General".
The rear drive shaft has drilled oil passages for lubrication of multi-plate clutch and extension bushing and ball bearing in it.

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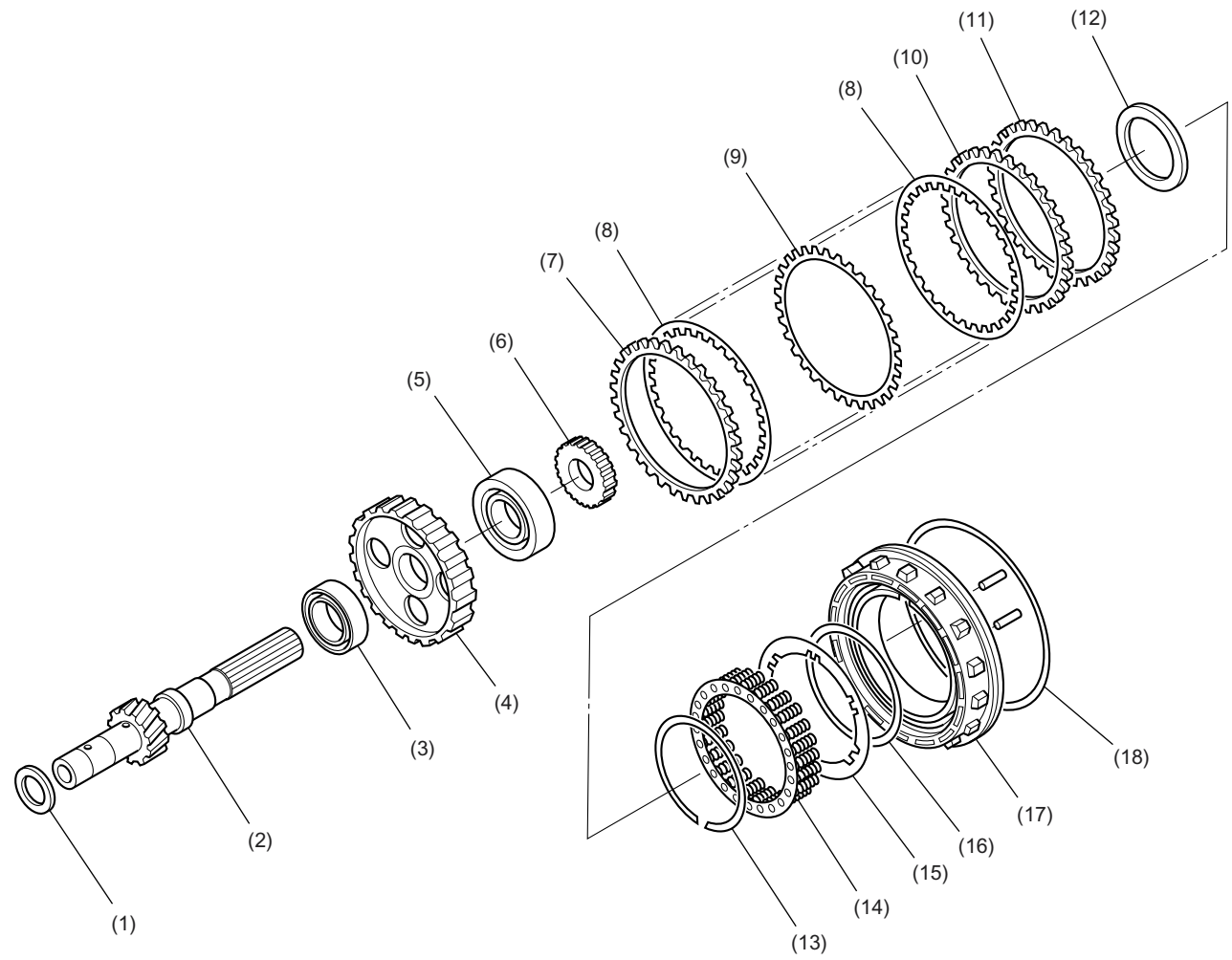

AT-00729

(1) Thrust washer
(2) Rear drive shaft
(3) Ball bearing
(4) Multi-plate clutch hub
(5) Ball bearing
(6) Revolution gear
(7) Driven plate (thicker)
(8) Drive plate
(9) Driven plate (thinner)
(10) Driven plate (thicker)
(11) Adjust plate
(12) Rear drive shaft shim
(13) Snap ring
(14) Spring retainer
(15) Plate
(16) O-ring
(17) Multi-plate clutch piston
(18) D-ring

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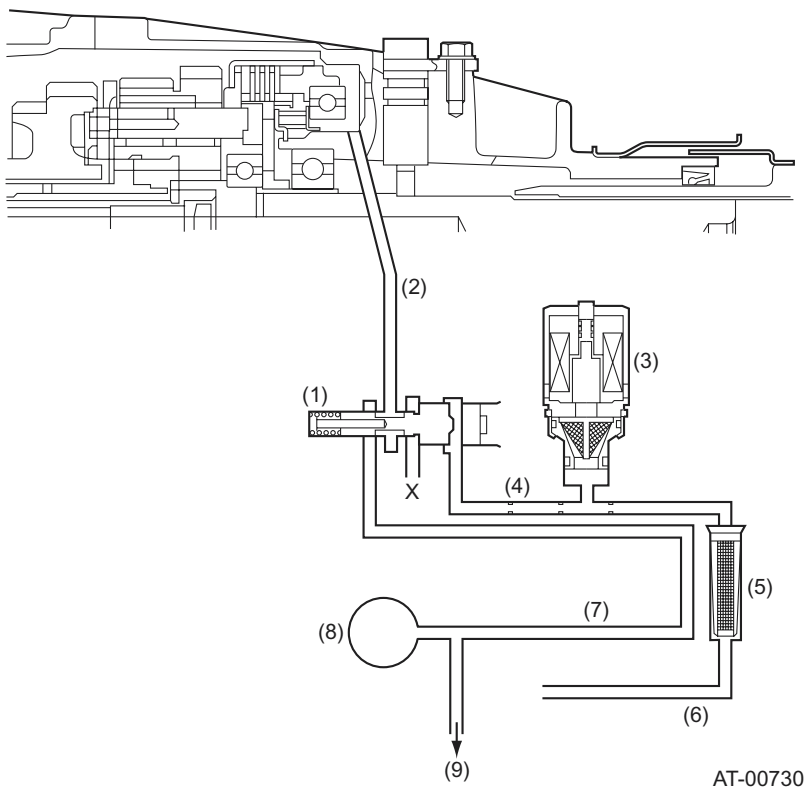
5. TRANSFER HYDRAULIC PRESSURE CONTROL UNIT

The transfer hydraulic pressure control unit is bolted at the rear end of transmission case through the transfer valve plate.
The hydraulic pressures used for the transfer hydraulic pressure control unit (line pressure and pilot pressure) are supplied from the transmission's hydraulic control valve assembly through the passages formed in the transmission case.
The transfer duty solenoid adjusts the pilot pressure of the transfer control valve depending on the signals from the TCM. The transfer control valve in turn modulates the line pressure into the transfer clutch pressure before it is applied to the clutch piston.
The transfer clutch pressure adjusted in this way engages the clutch to different degrees according to driving conditions so that the optimum torque is distributed to the rear wheels.



AT-00730

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

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12.Electrohydraulic Control System

A: DESCRIPTION

The electrohydraulic control system for the transmission and transfer consists of various sensors and switches, a transmission control module (TCM) and the hydraulic controlling units including solenoid valves. The system controls the automatic transmission operation, including gear shifting, lockup clutch operation, line pressure, automatic control pattern selection (Base and Power), and gear-shift timing. It also controls the operation of the transfer clutch. The TCM determines vehicle operating conditions from various input signals and controls a total of eight solenoids (shift solenoids 1 and 2, low clutch timing solenoid, 2-4 brake timing solenoid, line pressure duty solenoid, lockup duty solenoid, transfer duty solenoid and 2-4 brake duty solenoid) by sending appropriate signals to them.

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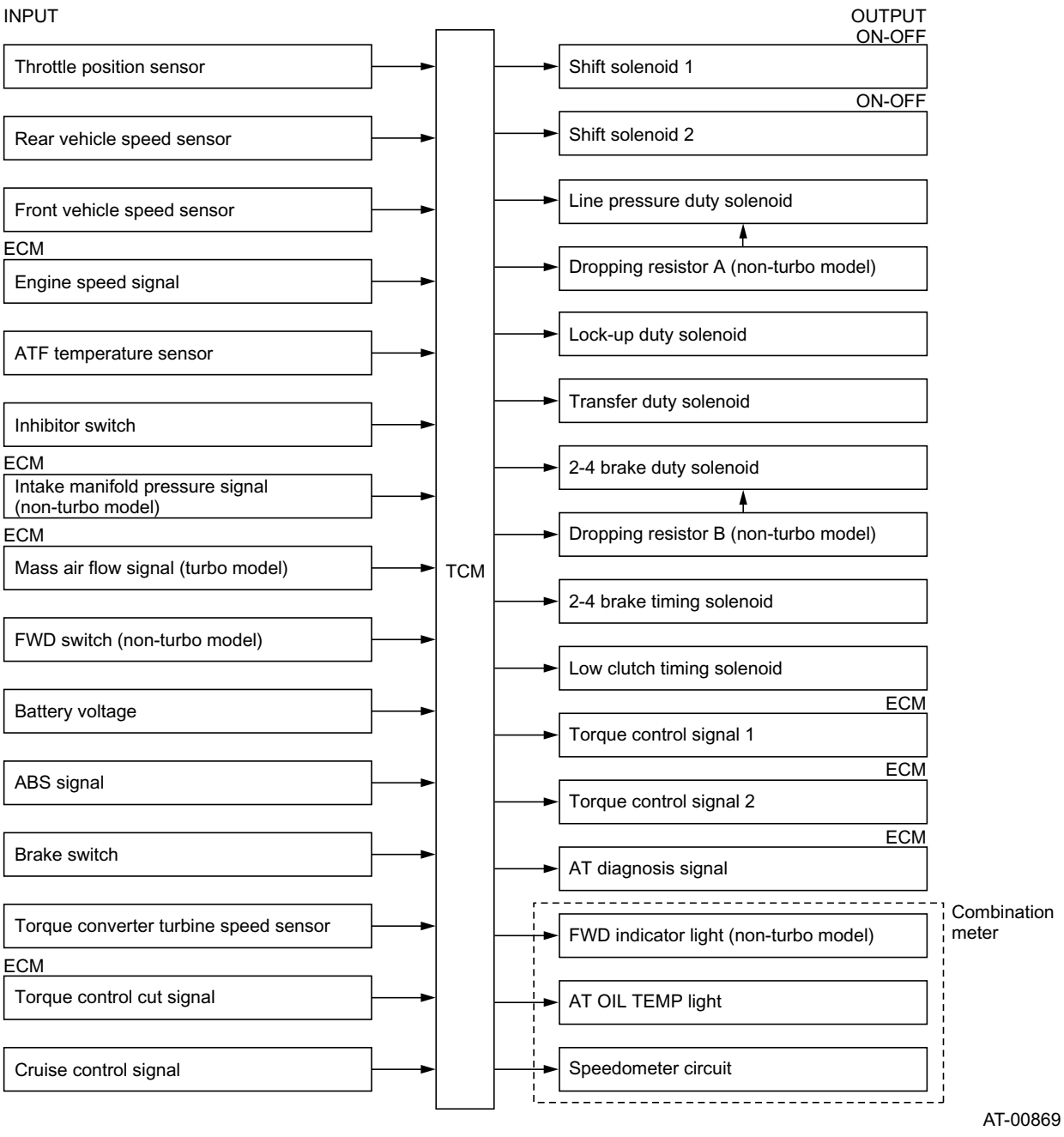

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B: INPUT SIGNALS

Signal name	Major function
Throttle position sensor	Indicates the throttle valve position. This signal is used to determine shift point, line pressure, and lockup engaging vehicle speed, which vary with engine load.
Front vehicle speed sensor (located on transmission case)	Indicates the vehicle speed. This signal is used for control of gear shifting, lockup engaging, line pressure, and transfer clutch operation.
Rear vehicle speed sensor (located on extension case)	Used to control transfer clutch, and also as backup signal in case of failure of front vehicle speed sensor.
Engine speed signal	Indicates the engine speed. This signal is used for control of lockup clutch to ensure smooth engagement.
Inhibitor switch	Used to determine gears and line pressures in each of ranges P, R, N, D, 3, 2 and 1.
ATF temperature sensor	Indicates the ATF temperature. This signal is used for inhibition of lockup, release of OD and determination of ATF temperature.
FWD switch (SOHC models)	Used for changing the mode from AWD to FWD. Also used for adapting the vehicle to FWD tester roller. Changeover from AWD to FWD can be made by inserting a fuse into the fuse holder.
ABS signal	Used when ABS is operating to optimize ABS control. In this control, transfer clutch torque load capacity is adjusted to eliminate the influence of engine braking and reduce the degree of coupling between front and rear wheels.
Cruise control signal	Indicates operation of cruise control system. It is used to expand 4th operating range.
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 engine control module (ECM) to TCM to temporarily inhibit the torque control when starting off with low coolant temperature.
Intake manifold pressure signal (SOHC models)	Used to determine line pressure of gear shifting.
Mass air flow signal (DOHC turbo models)	Used to determine line pressure of gear shifting.
Brake switch	If this signal is issued during downhill driving, TCM makes downshift control, causing the vehicle speed to be reduced.

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C: OUTPUT SIGNALS

Signal name	Function
Shift solenoid 1 and 2	Each of these signals controls gear speed by turning the corresponding solenoid ON/OFF. Activating timing is controlled for each solenoid to reduce shift shock.
Line pressure duty solenoid	Regulates the line pressure according to driving conditions.
Lockup duty solenoid	Regulates the hydraulic pressure of the lockup clutch to operate it in three modes (open, smooth and lockup).
Transfer duty solenoid	Regulates the hydraulic pressure of the transfer clutch to control the driving force to the rear drive shaft.
AT OIL TEMP light	Causes the light to illuminate when ATF becomes excessively hot (exceeds a set temperature level). This light is also used to display diagnostic trouble codes for the on-board diagnosis function.
2-4 brake duty solenoid	Regulates 2-4 brake operating pressure 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 during range selection and gear change.
Torque control signal 2	Reduces engine torque during range selection and gear change.

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D: CONTROL ITEMS

1. MPT MODELS

Control items			Description of control
Transmission control	Shifting control	Base shift control • Base pattern • Power pattern	Upshifting and downshifting are set for each range, gear and pattern according to throttle position and vehicle speed.
		ABS-in-operation control	Gear speed is determined according to vehicle speed when ABS signal and brake signal is input.
		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 is changed at a speed exceeding the preset value.
		Base pattern control	When throttle opening is changed at a speed less than the preset value, Base pattern is resumed.
	Lockup control	Base lockup control	Lockup ON is set for D-range 4th gear; ON/OFF is set for all gears (except D-range 4th) and patterns. Lockup control is performed according to throttle position and vehicle speed. (Basically lockup is OFF during gear shifting.)
		Smooth control	Smooth lockup is performed when lockup 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 lowered to a minimum so as to reduce engine cranking load.
	Shift timing control	Gear speed control	ON/OFF timing for shift solenoid is controlled.
		Lockup control	When shifting, the lockup 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 clutch pressure is regulated according to the throttle valve angle and vehicle speed.
	1 range control		Transfer clutch pressure is increased.
	Slip control		Immediately after detecting a slip, transfer clutch pressure is controlled to the same pressure as 1 range. (This control is canceled if V ≥ 60 km/h (37 MPH), or when throttle valve is closed fully.)
	Turning control		Transfer clutch pressure is reduced after detecting a turn.
	ABS-in-operation control		Transfer clutch pressure is adjusted to a set level immediately after reception of ABS signal.

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2. VTD MODELS

Control items			Description of control
Transmission control	Shifting control	Base shift control • Base pattern • Power pattern	Upshifting and downshifting are set for each range, gear and pattern according to throttle position and vehicle speed.
		ABS-in-operation control	Gear speed is determined according to vehicle speed when ABS signal and brake signal is input.
		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 is changed at a speed exceeding the preset value.
		Base pattern control	When throttle opening is changed at a speed less than the preset value, Base pattern is resumed.
	Lockup control	Base lockup control	Lockup ON is set for D-range 4th gear; ON/OFF is set for all gears (except D-range 4th) and patterns. Lockup control is performed according to throttle position and vehicle speed. (Basically lockup is OFF during gear shifting.)
		Smooth control	Smooth lockup is performed when lockup 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 lowered to a minimum so as to reduce engine cranking load.
	Shift timing control	Gear speed control	ON/OFF timing for shift solenoid is controlled.
		Lockup control	When shifting, the lockup clutch is temporarily released.
		Line-pressure control	When shifting, line pressure is controlled to the optimum level so as to reduce shifting shock.
AWD multi-plate clutch (LSD) control	Ordinary transfer control		Multi-plate clutch (LSD) pressure is regulated according to the torque input to the transfer and the driving condition.
	Start control		When starting, the LSD pressure is adjusted proportionately to the throttle value angle.
	Turning control		When the front and rear wheel speed ratio is less than the set value for a vehicle speed, the LSD pressure is decreased.
	Slip control		When a front or rear wheel starts slipping, the LSD pressure is decreased.
	ABS-in-operation control		The LSD pressure is adjusted to the set level immediately after reception of ABS signal.
	Base brake control		When the brake switch is ON and throttle valve is fully closed, the LSD pressure is lowered.
	1 range control		The LSD pressure is increased to improve driveability.

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E: THROTTLE POSITION SENSOR

The throttle position sensor provides electrical signals corresponding to throttle valve positions. The throttle valve angular position and accelerator depressing speed are detected by this throttle position sensor.

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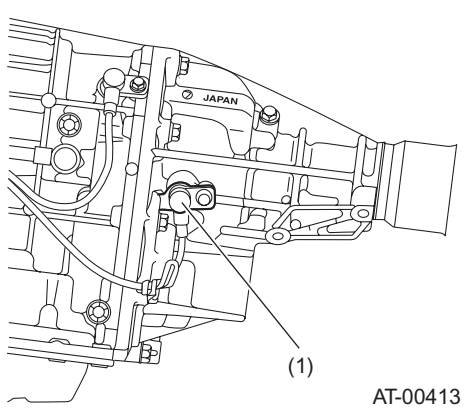
F: REAR VEHICLE SPEED SENSOR

1. MPT MODELS

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

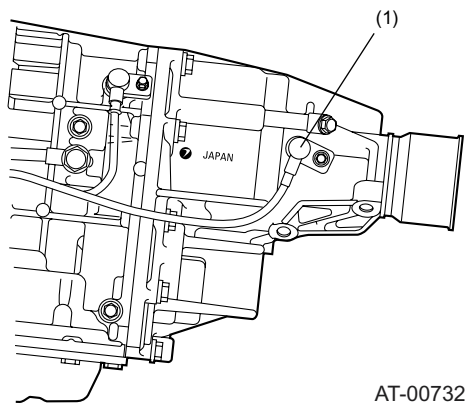


AT-00413

(1) Rear vehicle speed sensor

2. VTD MODELS

This vehicle speed sensor (output shaft speed sensor) is externally mounted on the extension case. It detects the rear wheel speed in terms of the peripheral speed of the rear drive shaft and sends sine wave signals (22 pulses per rotation) to the TCM.



AT-00732

(1) Rear vehicle speed sensor

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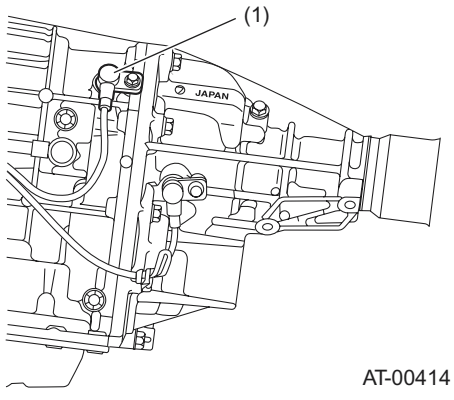
G: FRONT VEHICLE SPEED SENSOR

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

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

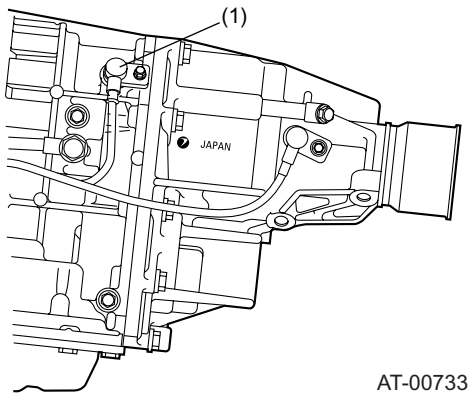
- MPT models



AT-00414

(1) Front vehicle speed sensor

- VTD models



AT-00733

(1) Front vehicle speed sensor

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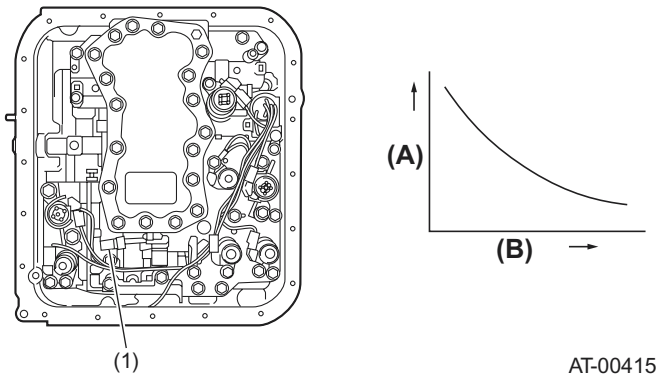
H: ATF TEMPERATURE SENSOR

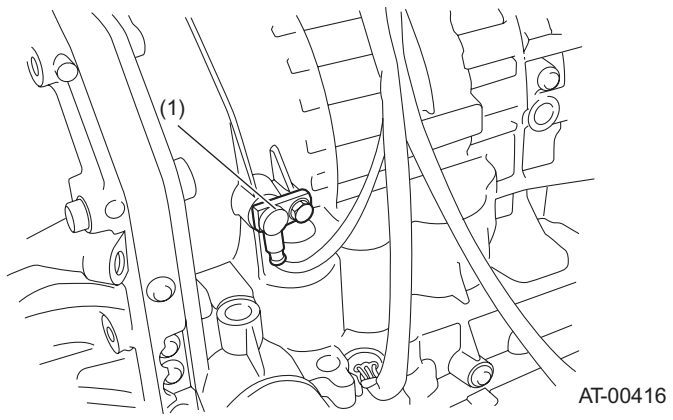
This sensor is integrated with the transmission harness and is mounted on the hydraulic control valve body of the transmission. It detects the temperature of ATF and outputs it as an electrical resistance signal. The output characteristics of the sensor are shown below.



(1) ATF temperature sensor **(A)** Resistance **(B)** Temperature

I: TORQUE CONVERTER TURBINE SPEED SENSOR

The torque converter turbine speed sensor (output shaft speed sensor) is externally mounted on the transmission case.
The sensor detects the torque converter turbine speed in terms of 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.



(1) Torque converter turbine speed sensor

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J: INHIBITOR SWITCH

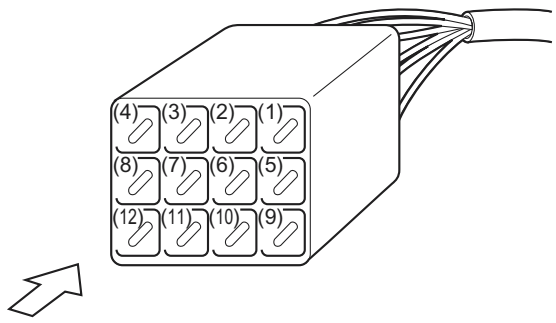
The inhibitor switch assures safety when starting the engine. This switch is mounted on the right side of the transmission case, and is operated by the selector lever.

When the selector lever is set to P or N, the electrical circuit in the inhibitor switch is closed and the starter circuit is completed for cranking the engine.

When the selector lever is in the R, D, 3, 2 or 1 range, the electrical circuit in the inhibitor switch is open. 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.

Inhibitor switch side connector



AT-00417

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)

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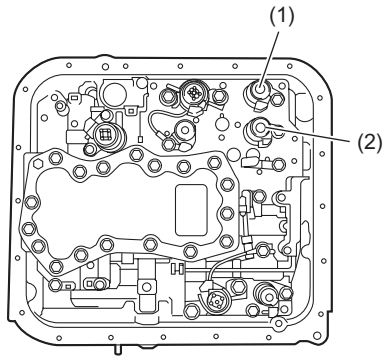
K: SHIFT SOLENOIDS 1 AND 2

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

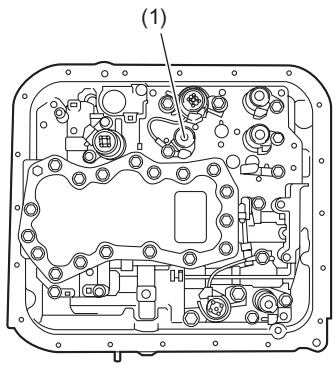


AT-00418

(1) Shift solenoid 2
(2) Shift solenoid 1

L: LOW-CLUTCH TIMING SOLENOID

This solenoid is mounted on the transmission hydraulic control valve body. It is turned ON or OFF according to signals from the TCM. It then controls the low clutch timing valve B and reverse inhibitor valve.



AT-00419

(1) Low-clutch timing solenoid

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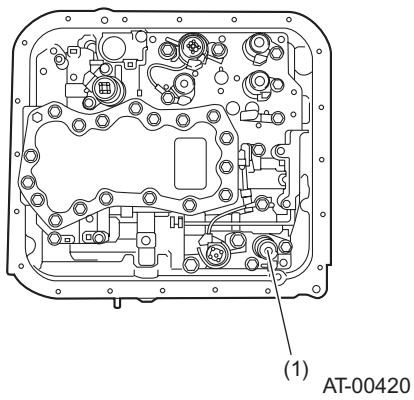
M: 2-4 BRAKE TIMING SOLENOID

This solenoid is mounted on the transmission hydraulic control valve body. It is turned ON or OFF according to signals from the TCM. It then controls the 2-4 brake timing valve B to decrease the change gear shock.

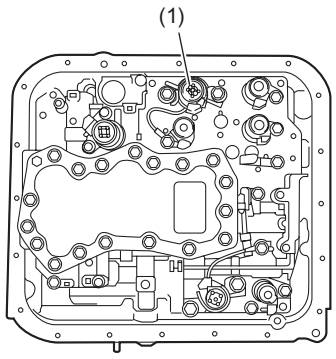


AT-00420

(1) 2-4 brake timing solenoid

N: LINE PRESSURE DUTY SOLENOID

This solenoid is mounted on the transmission hydraulic control valve body. Its duty ratio is controlled by signals from the 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.



AT-00421

(1) Line pressure duty solenoid

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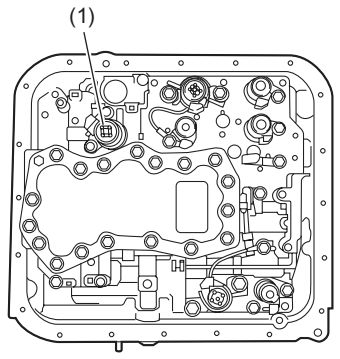
O: LOCKUP DUTY SOLENOID

This solenoid is mounted on the transmission hydraulic control valve body. Its duty ratio is controlled by signals from the TCM. It then controls the lockup control valve to provide smooth engagement and disengagement of the lockup clutch.

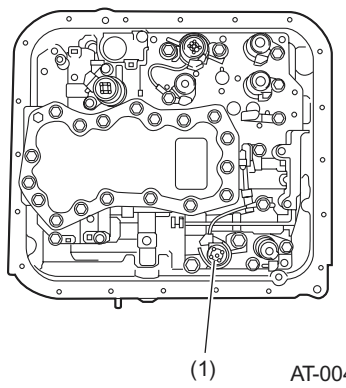


AT-00422

(1) Lockup duty solenoid

P: 2-4 BRAKE DUTY SOLENOID

This solenoid is mounted on the transmission hydraulic control valve body. Its duty ratio is controlled by signals from the TCM. It modulates the 2-4 brake pressure when the 2-4 brake is operated, reducing shifting shocks.



AT-00423

(1) 2-4 brake duty solenoid

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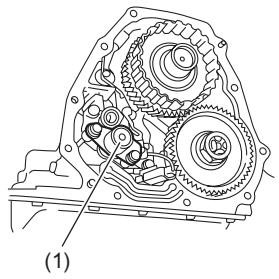
Q: TRANSFER DUTY SOLENOID

This solenoid is mounted on the transfer hydraulic pressure control unit on the rear end of transmission case. Its duty ratio is controlled by signals from the TCM. It then controls the transfer clutch/ control valve to control the pressure applied to the transfer clutch.

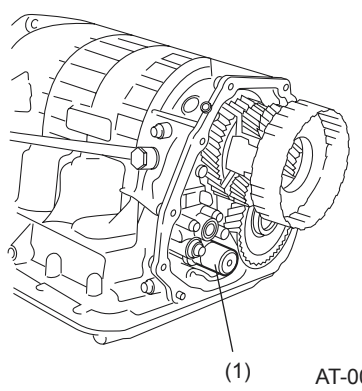
- MPT models



AT-00424

(1) Transfer duty solenoid

- VTD models



AT-00734

(1) Transfer duty solenoid

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13.Transmission Control Module (TCM)

The 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, lockup operation data, and transfer clutch torque data (duty ratios).

A: CONTROL SYSTEM

1. MPT MODELS

Control items		Input signals
Shifting control	Ordinary shift control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Engine speed rpm Inhibitor switch
	ABS-in-operation control	ABS signal Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Brake switch
	Hydraulic oil temperature control	ATF temperature sensor
	Reverse inhibition control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Inhibitor switch
	Shift pattern (Base/Power) select control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Inhibitor switch
	Hold control	Inhibitor switch
	Grade control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Brake switch Inhibitor switch Engine speed Intake manifold pressure
Lockup control	Ordinary lockup control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Engine speed Inhibitor switch
	Smooth control	Throttle position sensor
	Hydraulic oil temperature control	ATF temperature sensor

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Control items		Input signals
Oil pressure control	Ordinary pressure control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Engine speed Inhibitor switch ATF temperature sensor
	Shifting control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Engine speed Torque converter turbine speed sensor Inhibitor switch ATF temperature sensor
	Starting control	Engine speed ATF temperature sensor Inhibitor switch
	Learning control	Shift solenoid 1 Shift solenoid 2 Rear vehicle speed sensor Front vehicle speed sensor Throttle position sensor Torque converter turbine speed sensor ATF temperature sensor
AWD transfer clutch control	Ordinary transfer control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Inhibitor switch ATF temperature sensor FWD switch
	1 range control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Inhibitor switch
	Slip detection control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor
	Steering control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor
	ABS-in-operation control	ABS signal Rear vehicle speed sensor Front vehicle speed sensor Brake switch

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2. VTD MODELS

Control items		Input signals
Shifting control	Ordinary shift control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Engine speed Inhibitor switch
	ABS-in-operation control	ABS signal Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Brake switch
	Hydraulic oil temperature control	ATF temperature sensor
	Reverse inhibition control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Inhibitor switch
	Shift pattern (Base/Power) select control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Inhibitor switch
	Grade control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Brake switch Inhibitor switch Engine speed Mass air flow
Lockup control	Ordinary lockup control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Engine speed Inhibitor switch
	Smooth control	Throttle position sensor
	Hydraulic oil temperature control	ATF temperature sensor

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Control items		Input signals
Oil pressure control	Ordinary pressure control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Engine speed Inhibitor switch ATF temperature sensor
	Shifting control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Engine speed Torque converter turbine speed sensor Inhibitor switch ATF temperature sensor
	Starting control	Engine speed ATF temperature sensor Inhibitor switch
	Learning control	Shift solenoid 1 Shift solenoid 2 Rear vehicle speed sensor Front vehicle speed sensor Throttle position sensor Torque converter turbine speed sensor ATF temperature sensor
AWD multi-plate clutch (LSD) control	Ordinary transfer control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Inhibitor switch ATF temperature sensor
	1 range control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor Inhibitor switch
	Slip detection control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor
	Steering control	Throttle position sensor Rear vehicle speed sensor Front vehicle speed sensor
	ABS-in-operation control	ABS signal Rear vehicle speed sensor Front vehicle speed sensor Brake switch
	Base brake control	Throttle position sensor Front vehicle speed sensor Brake switch

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B: SCHEMATIC DIAGRAMS

1. SOHC MODELS

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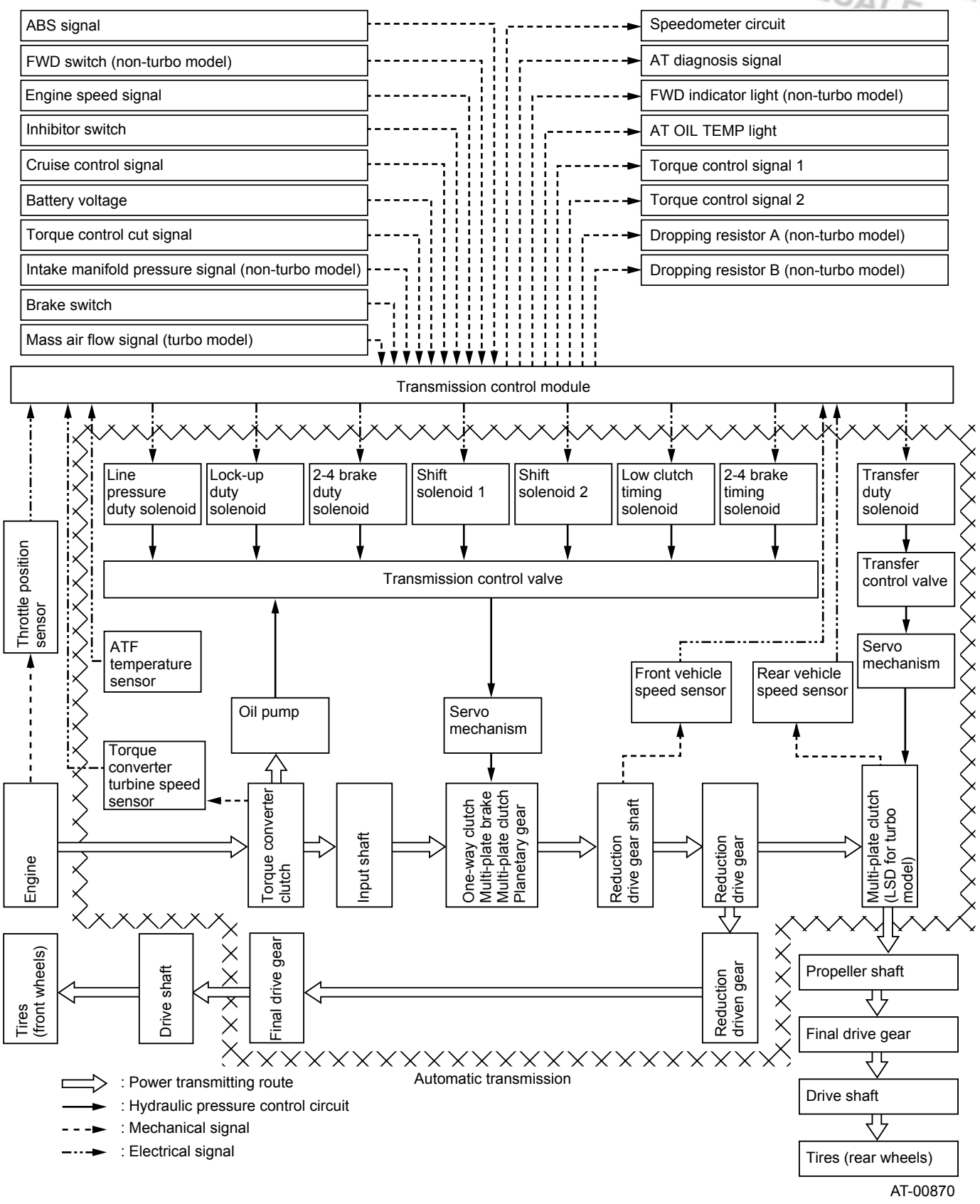
TRANSMISSION CONTROL MODULE (TCM)



AT-00870

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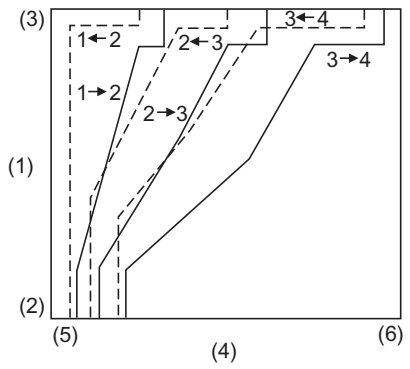
C: SHIFTING CONTROL

The TCM performs gear shifting control according to driving conditions by using the shift point characteristic data stored in its memory. Appropriate solenoids are operated at the proper timing corresponding to the shift pattern, throttle position, and vehicle speed for smooth shifting.

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

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



AT-00426

(1) Throttle opening
(2) Small
(3) Large
(4) Vehicle speed
(5) Low
(6) High

- The TCM activates both solenoids 1 and 2 in response to throttle and vehicle speed signals.
- Shift valves move in response to operation of the solenoids, supplying or interrupting the line pressure to each clutch.
- A shift to each gear takes place according to ON-OFF operation of both the solenoids as indicated in the table above.

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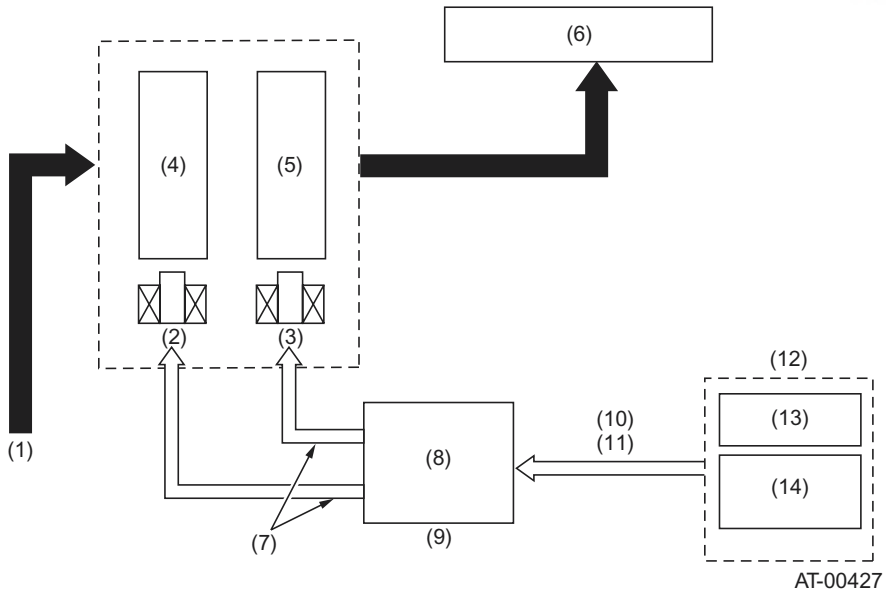

(1) ATF
(2) Solenoid 1
(3) Solenoid 2
(4) Shift valve A
(5) Shift valve B
(6) Shift clutch
(7) Shift command signal
(8) TCM
(9) Determination of optimum gear position (including selection of shift pattern)
(10) Throttle opening
(11) Vehicle speed
(12) Sensor
(13) Vehicle speed sensor
(14) Throttle position sensor

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D: LOCKUP CONTROL

● The TCM has pre-programmed lockup clutch engagement and disengagement conditions for each gear and shift pattern. The engagement and disengagement conditions are defined in terms of the throttle valve position and vehicle speed.

● The TCM controls the operation of the lockup clutch by means of the duty solenoid which in turn controls the lockup control valve as described below:

1. NON-LOCKUP OPERATION

The duty solenoid allows the pilot pressure (supplied from the pilot valve) to be applied to the “disengaging” end of the lockup control valve spool.The lockup control valve then opens the clutch disengaging circuit port to allow the lockup operating pressure (torque converter clutch regular pressure) to build up in the circuit. On the other hand, the valve opens the clutch engaging circuit’s port and allows the fluid in the circuit to flow to the ATF cooler, thus lowering the pressure in the circuit. As a result, the lockup clutch is disengaged due to difference in pressure between both circuits.

This operation is performed for all the speed gears except the 4th gear of the D range.

2. LOCKUP OPERATION

The duty solenoid allows the pilot pressure to be applied to the “engaging” end of the lockup control valve spool.The lockup control valve then opens the clutch engaging circuit’s port that communicates to the torque converter’s impeller chamber, allowing high pressure fluid to flow to the lockup clutch. The clutch then engages.

● The TCM controls the current to the duty solenoid by gradually changing the current. As a result, the lockup control valve also moves gradually, so the clutch engagement pressure increases smoothly. This causes the lockup clutch to become initially in a half-engaged state and then in a fully engaged state, thus preventing shock during engagement.

This operation is performed for all the speed gears.

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E: LINE-PRESSURE CONTROL

- The oil pump delivery pressure (line pressure) is regulated to a constant pressure by the pilot valve. This pressure is used as the pilot pressure for controlling spool valves.
- The pilot pressure applied to the pressure modifier valve is modulated into pressure modifier pressure at the line pressure duty solenoid by activating the pressure modifier valve.
- The pressure modifier valve is an auxiliary valve for the pressure regulator valve, and it creates a signal pressure (pressure modifier pressure). The pressure modifier pressure is used to regulate the line pressure to a level optimum for a particular driving condition.
- This pressure modifier pressure is applied to the pressure regulator valve which controls the oil pump delivery pressure.
- The pressure modifier pressure from the pressure modifier valve is cushioned by the pressure modifier accumulator to remove pulsation of the pressure.

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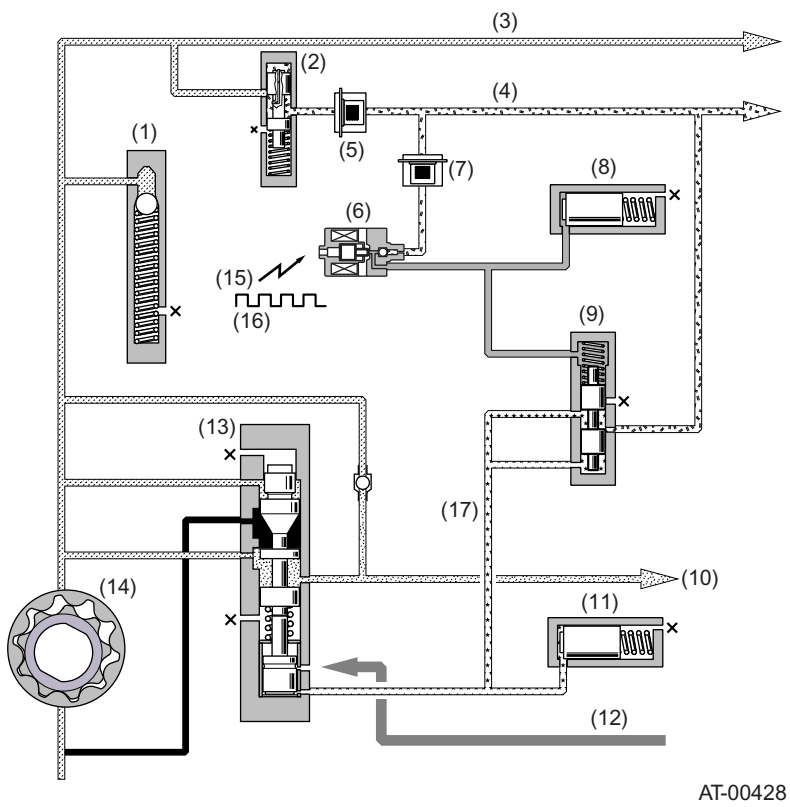

AT-00428

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

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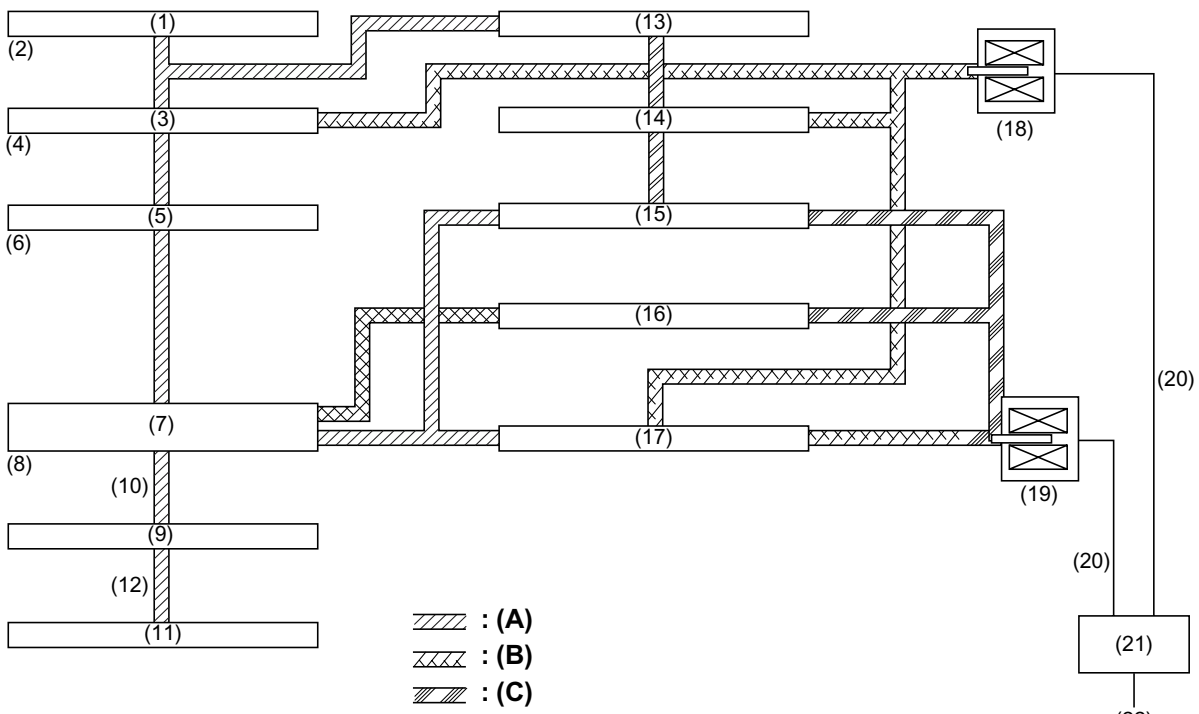
F: LINE-PRESSURE CONTROL DURING SHIFTING

The line pressure which engages shift clutches to create 1st to 4th speeds is controlled by the TCM to meet varying operating conditions.

During gear shifting, the TCM decreases the line pressure to a level that matches the selected gear in order to minimize shifting shock loads.



AT-00429

(1) Shift clutch
(2) Transient oil pressure to operate clutches
(3) Shift valve
(4) Shift select valve
(5) Manual valve
(6) Manual shift valve operated through selector lever
(7) Pressure regulator valve
(8) Line pressure optimally regulated for clutch operation
(9) Oil pump
(10) Line pressure built up by oil pump
(11) Oil pan
(12) Suction
(13) Low clutch accumulator
(14) Low clutch timing valve A
(15) Accumulator control valve A
(16) Pressure modifier valve
(17) Pilot valve
(18) Shift solenoids 1 and 2
(19) Line pressure duty solenoid
(20) Output signals
(21) TCM
(22) Throttle position, accelerator pedal depressing speed, etc.

(A) Line pressure
(B) Pilot pressure
(C) Line pressure duty pressure
(D) Modifier pressure
(E) Accumulator control

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During gear shifting, the TCM controls the line pressure as follows:

- The TCM receives signals such as throttle position signal and accelerator pedal speed signal. Based on these input signals, it issues a control signal to the line pressure duty solenoid.
- The pressure from the line pressure duty solenoid (line pressure duty pressure) is converted by the pressure modifier valve into a modifier pressure, and the modifier pressure is applied to the pressure regulator valve.
- The pressure regulator valve adjusts the oil-pump-generated line pressure according to the modifier pressure to make the line pressure matched to the driving condition.

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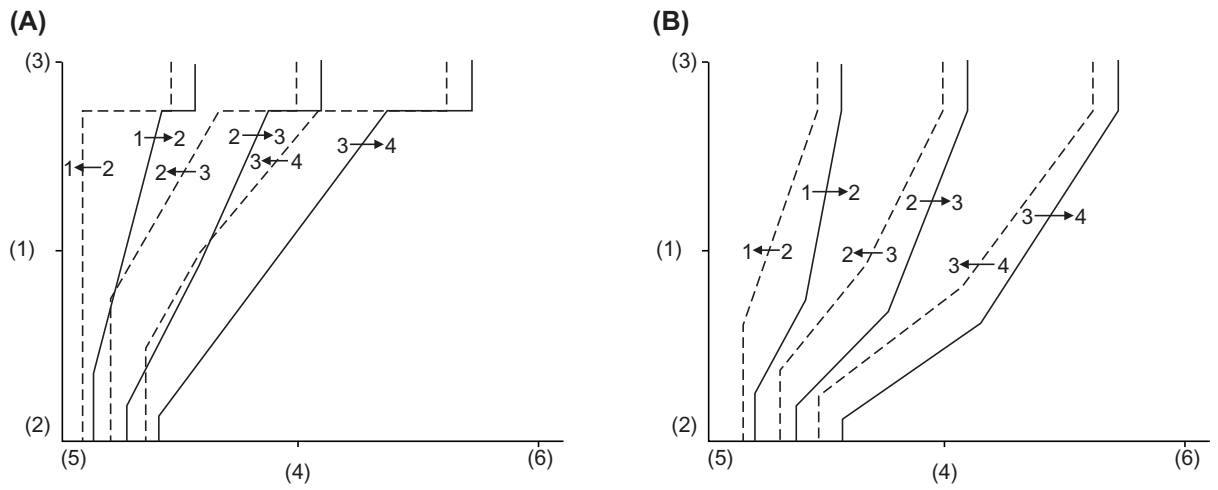
G: SHIFT PATTERN SELECTION CONTROL

The TCM changes its gear shift control pattern automatically between the Base pattern suitable for ordinary economy driving and the Power pattern suitable for climbing uphill or rapid acceleration.

In the Power pattern, the downshift point and upshift point are set higher than those of the Base pattern.

Selector lever position	Changeover from Base to Power pattern
D and 3 ranges	Performed automatically according to accelerator pedal depression speed.



AT-00430

(A) D range (Base pattern)
(1) Throttle opening
(2) Small
(3) Large

(B) D range (Power pattern)
(4) Vehicle speed
(5) Low
(6) High

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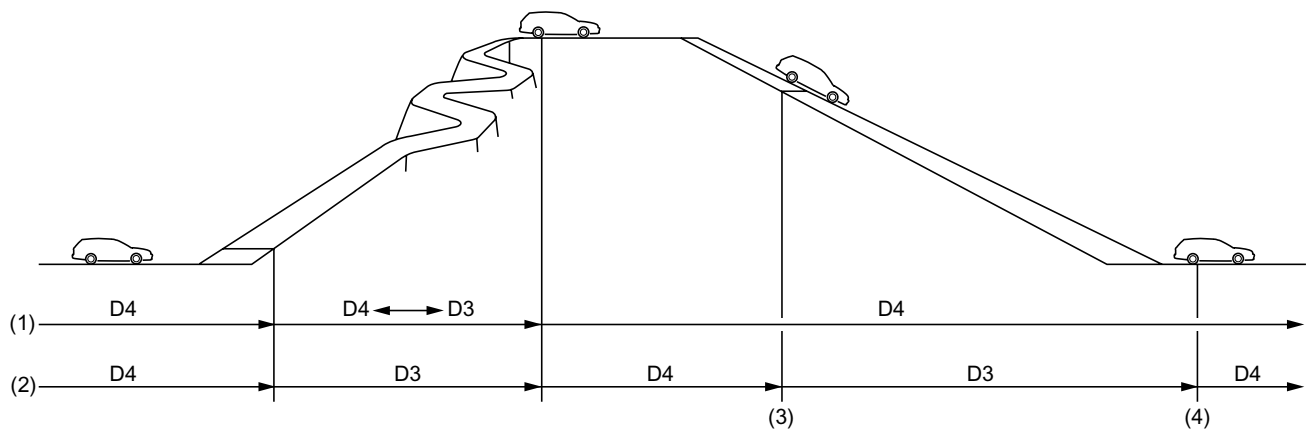
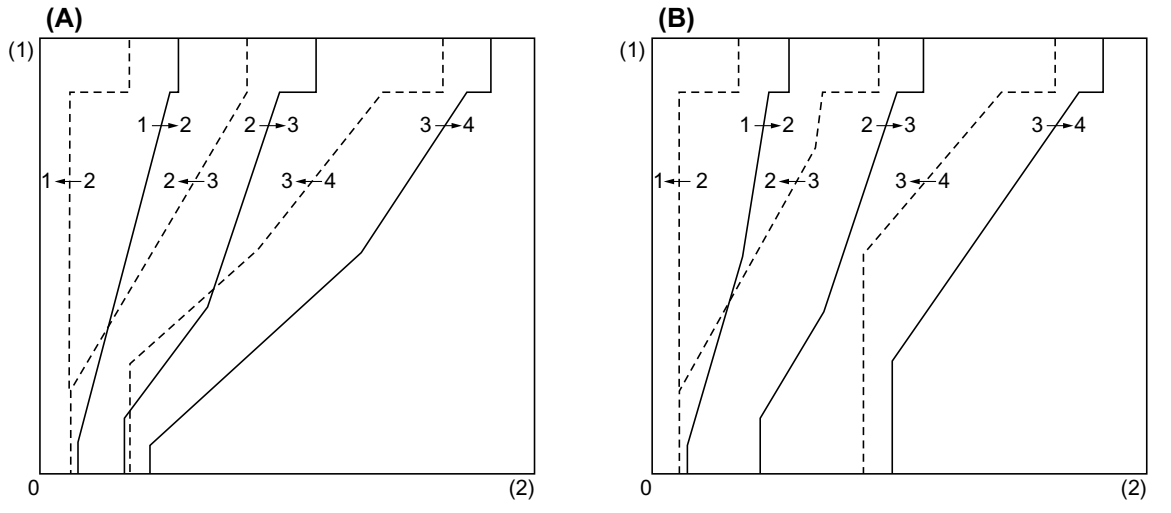
H: GRADE CONTROL

While the vehicle is driving up a hill, the gear is fixed to the 3rd to avoid repeated gear shift between the 3rd and 4th gears.
When the vehicle is descending a steep slope at a speed of approximately 80 km/h (50 MPH), a 4th to 3rd downshift occurs automatically when the brake pedal is depressed. This gearshift control is cancelled when the accelerator pedal is depressed.
The TCM performs these controls based mainly on the throttle opening, engine speed and vehicle speed.



AT-00431

(1) Without grade control
(2) With grade control
(3) Brake pedal ON
(4) Re-acceleration



AT-00432

(A) D range (Base pattern)
(1) Throttle opening

(B) D range (grade control pattern)
(2) Vehicle speed

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I: LEARNING CONTROL

The TCM has a learning control function with which it can adapt gear shift timing optimally to the current vehicle conditions by updating correction factors in the memory.
For this reason, gear shift shock may become larger after the power supply is interrupted (disconnection of battery, flat battery, etc.) or immediately after the ATF is replaced.
Larger gear shift shock after power supply interruption occurs because the correction data is reset to those for the new vehicle condition.
The TCM starts learning function again as soon as the power supply is restored. After driving for a while, therefore, the transmission will become able to make gear shifts at the optimum timing. Larger shift shock immediately after ATF change is caused by change in friction characteristics of the transmission internal parts. Also in this case, the transmission recovers shock-less gear shifting after driving for a while.

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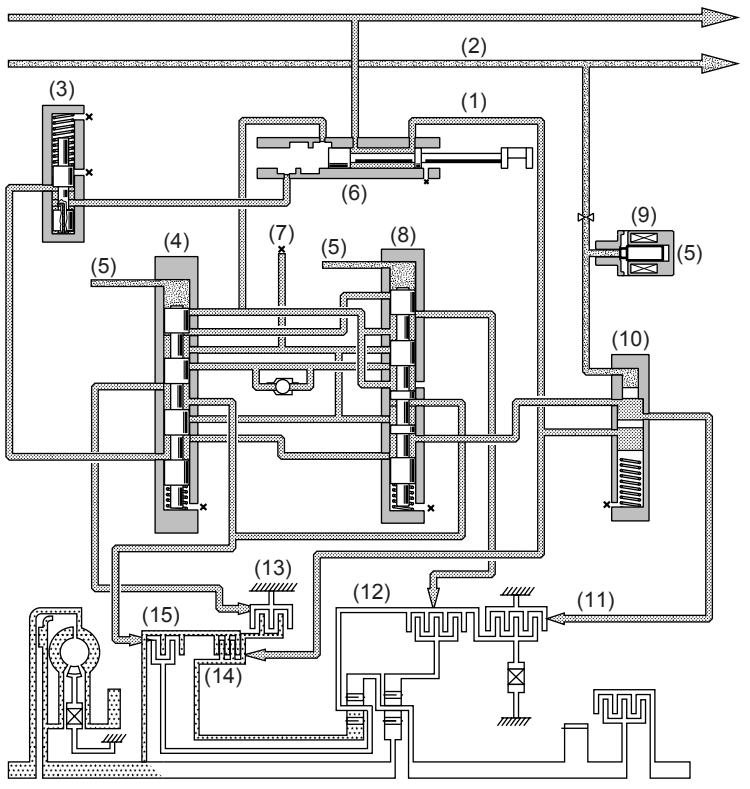
J: REVERSE INHIBITION CONTROL

This control prevents the transmission from shifting into the reverse gear when the select lever is accidentally placed in the R position, thus protecting the components such as reverse clutch from being damaged.

If the selector lever is moved to the R position during driving at a speed faster than the predetermined speed, the low clutch timing solenoid is energized. Then, the pilot pressure is supplied to the reverse inhibitor valve. This causes the reverse inhibitor 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 inhibitor valve.
As a result, the transmission is put into the neutral state, and the shifting into the reverse gear is inhibited.



AT-00433

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

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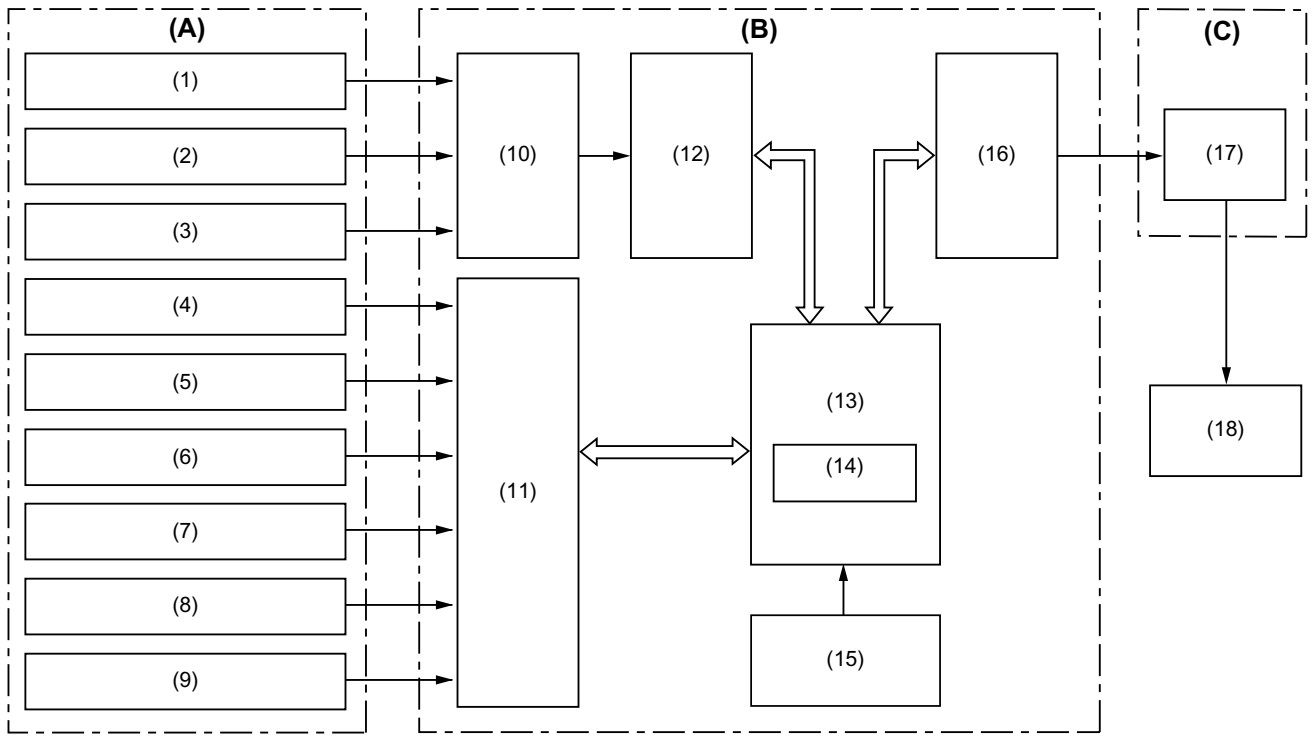
K: AWD TRANSFER CLUTCH CONTROL (MPT MODELS)



AT-00434

(A) Sensor
(1) Battery voltage
(2) Throttle position sensor
(3) ATF temperature sensor
(4) Rear vehicle speed sensor (rear wheel rpm)
(5) Front vehicle speed sensor (front wheel rpm)
(6) Inhibitor switch

(B) TCM
(7) FWD switch
(8) Brake switch
(9) ABS signal
(10) Input interface circuit
(11) Input interface circuit
(12) A/D converter

(C) Actuator
(13) CPU
(14) Memory
(15) Constant voltage power source
(16) Output interface circuit
(17) Transfer duty solenoid
(18) Transfer clutch

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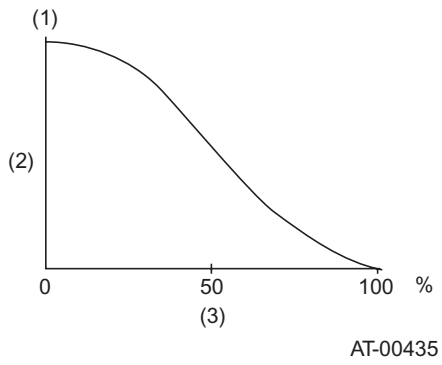
1. BASIC CONTROL

Type of control	Regulates transfer clutch pressure in response to throttle position and vehicle speed.
Gear position	1st thru 4th and reverse
Remarks	 AT-00435 (1) Ordinary control (2) Transfer clutch capacity (3) Duty-ratio

2. 1 RANGE CONTROL

Type of control	Increases transfer clutch pressure above basic control pressure
Gear position	1st speed
Remarks	—

3. SLIP CONTROL

Type of control	Increases transfer clutch pressure to the same level as in the 1 range immediately after a slip is detected.
Gear position	1st thru 4th and reverse
Remarks	Release: The transfer clutch pressure is lowered when a turn under turning control is detected while running faster than the set vehicle speed with fully closed throttle.

4. TURNING CONTROL

Type of control	Decreases transfer clutch pressure upon detection of a turn.
Gear position	1st thru 4th and reverse
Remarks	—

5. ABS CONTROL

Type of control	Regulates to the specified transfer clutch pressure quickly when the ABS signal is input.
Gear position	1st thru 4th and reverse
Remarks	—

6. P AND N RANGE CONTROL

Type of control	Regulates to the specified transfer clutch pressure immediately after a P or N range signal is input.
Gear position	P and N
Remarks	—

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L: AWD CENTER DIFFERENTIAL CONTROL (VTD MODELS)

1. CONTROL DESCRIPTION

The TCM controls the engagement of the center differential's multi-plate clutch (LSD) using maps that are pre-programmed based on the throttle opening and torque converter turbine speed. It selects a map according to driving conditions and use it as the control basis.

2. FLOW CONTROL

The torque input to the multi-plate clutch is calculated according to various factors such as intake manifold pressure, torque converter turbine speed and selected speed gear. Based on the calculation result, the basic coupling force of the clutch is determined.

3. START CONTROL

When the vehicle speed is 0 km/h (0 MPH), the TCM makes control to generate differential action limiting torque that is proportional to the throttle angle.
This enables the vehicle to start smoothly without swerving even on a slippery road.

4. TURNING CONTROL

The TCM makes a correction such that the engaging force of the multi-plate clutch is reduced as the steering angle increases.
This function is performed to improves turning performance at certain vehicle speed range.

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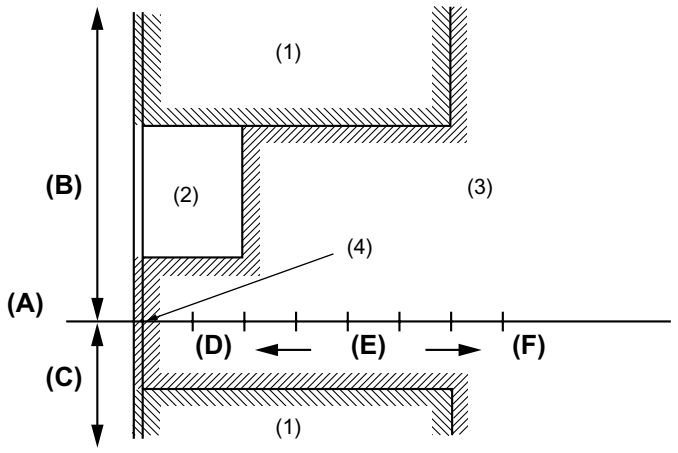
5. SLIP CONTROL

When front or rear wheels start slipping with the vehicle running slower than the predetermined speed, the TCM makes control to increase the differential action limiting torque.
This function maintains traction and improves driving stability.



AT-00737

(A) Front and rear wheel speed ratio
(B) Front wheel slip
(C) Rear wheel slip
(D) Low
(E) Vehicle speed
(F) High

(1) Slip control
(2) Turning control
(3) Flow control
(4) Start control

6. ABS CONTROL

When the TCM receives an ABS operation signal from the ABS unit, it adjusts the differential action limiting torque to the predetermined level and selects the gear appropriate for the vehicle speed in which the one-way clutch freewheels.
This function improves ABS control.

7. BASE BRAKE CONTROL

When the brake switch is ON and the throttle valve is fully closed, the TCM makes control to decrease the differential action limiting torque. The ABS control has priority over this control.
This function improves stability during braking.

8. 1 RANGE CONTROL

When the 1 range is selected, the TCM makes control to increase the differential action limiting torque.
This function improves driving performance and traction.

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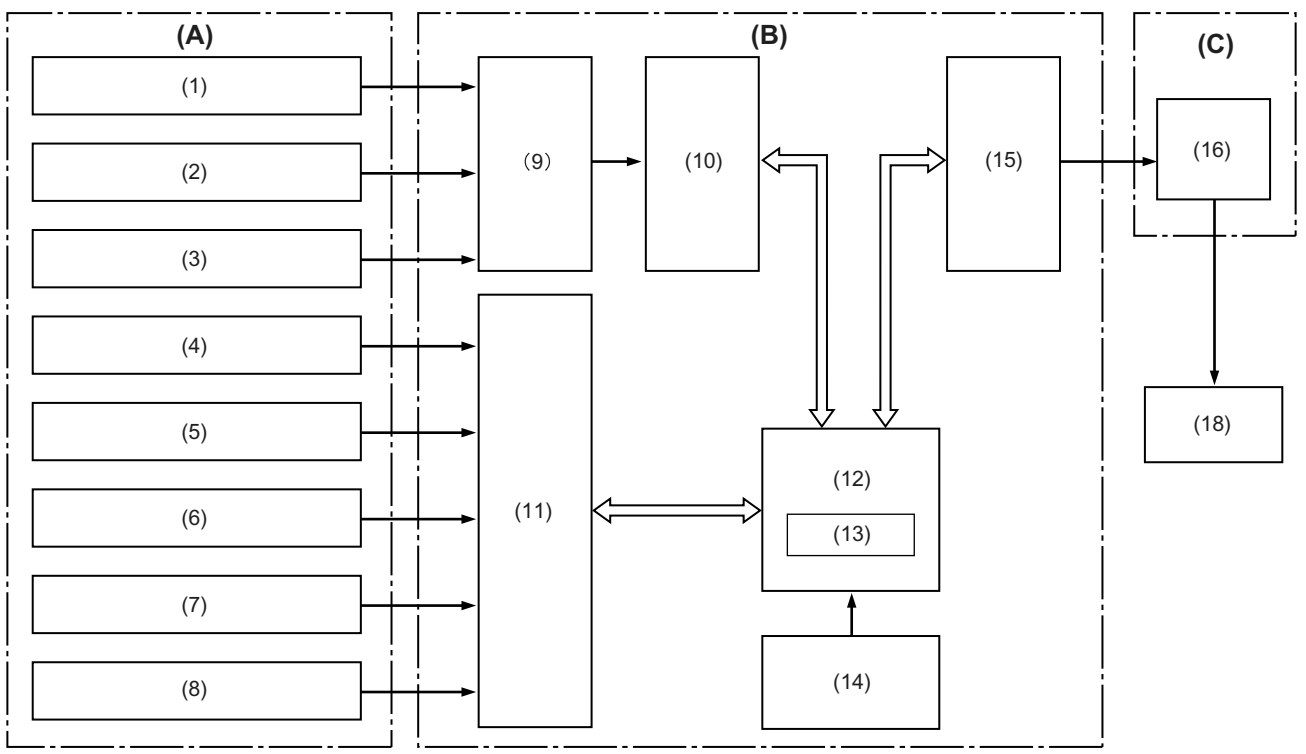
9. CONTROL SYSTEM

The TCM constantly monitors the driving conditions of the vehicle using the eight input signals. Based on the conditions it has determined, the TCM adjusts the duty ratio of current to the transfer duty solenoid thus changing the engagement of the multi-plate clutch. The input signals are used also for automatic transmission control.



AT-01250

(A) Sensor
(1) Power supply
(2) Throttle sensor
(3) ATF temperature sensor
(4) Rear vehicle speed sensor (rear wheel rpm)
(5) Front vehicle speed sensor (front wheel rpm)
(6) Inhibitor switch
(7) Brake switch
(8) ABS signal

(B) TCM
(9) Input interface circuit
(10) A/D converter
(11) CPU
(12) Memory
(13) Constant voltage power source
(15) Output interface circuit

(C) Actuator
(16) Transfer duty solenoid
(17) Multi-plate clutch (LSD)

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M: TRANSFER CONTROL

1. MPT MODELS

The transfer hydraulic pressure control unit includes a valve body attached to the side of the extension case through a gasket and separator plate.

The pressurized fluids for the transfer hydraulic pressure control (line pressure and pilot pressure) are supplied from the oil pump by way of the passages formed in the transmission case and then the passages in the extension case that lead to the hydraulic circuit in the transfer valve body.

The line pressure is regulated by the transfer control valve whose opening is controlled by the transfer pressure created by the transfer duty solenoid.

- The transfer duty solenoid is controlled by the TCM. The TCM changes the solenoid controlling duty ratio according to driving conditions.
- The transfer duty solenoid creates the transfer pressure from the pilot pressure. The transfer pressure is applied to the transfer control valve and adjusts the valve's opening.
- The line pressure directly led to the transfer control valve, on the other hand, is regulated by the transfer control valve and becomes the transfer clutch pressure.
- The transfer clutch pressure is applied to the transfer clutch and engages the clutch to a controlled degree.

In this way, the degree of transfer clutch engagement is varied so that optimum torque is distributed to the rear wheels according to vehicle driving conditions.

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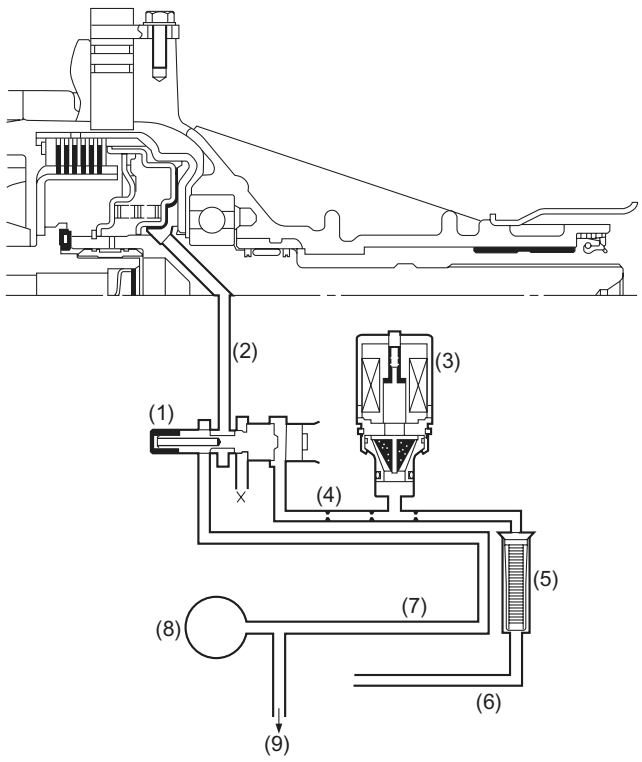

AT-00436

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

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2. VTD MODELS

The drive power distribution system includes a valve body attached to the side of the extension case through a gasket and separator plate.
The pressurized fluids for the drive power distribution system (line pressure and pilot pressure) are supplied from the oil pump by way of the passages formed in the transmission case and then the passages in the extension case that lead to the hydraulic circuit in the transfer valve body.

The line pressure is regulated by the transfer control valve whose opening is controlled by the transfer pressure created by the transfer duty solenoid.

- The pilot pressure created by passing through the pilot valve in the transmission's hydraulic control assembly is further regulated into the transfer pressure by the transfer duty solenoid.
- The transfer duty solenoid is controlled by the TCM. The TCM changes the solenoid controlling duty ratio according to driving conditions.
- The transfer pressure thus created is applied to the transfer control valve and adjusts the valve's opening.
- The line pressure directly led to the transfer control valve, on the other hand, is regulated by the transfer control valve and becomes the transfer clutch pressure.
- The transfer clutch pressure is applied to the multi-plate clutch (LSD) and engages the clutch to a controlled degree.

In this way, the degree of multi-plate clutch engagement is varied so that optimum torque is distributed to the rear wheels.

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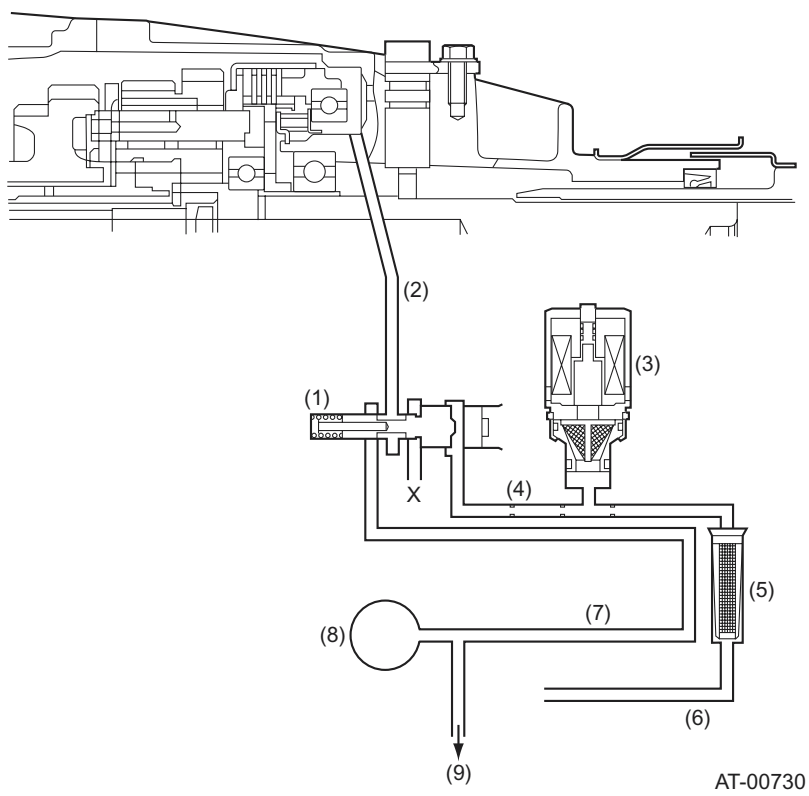

AT-00730

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

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14.On-board Diagnostics System

A: FUNCTION

The on-board diagnostics system detects and stores in the form of a code a fault that has occurred in any of the following input and output signal systems.

Rear vehicle speed sensor	Transfer duty solenoid	Low-clutch timing solenoid
Front vehicle speed sensor	ATF temperature sensor	Torque converter turbine speed sensor
Throttle position sensor	Engine speed signal circuit	—
Shift solenoid 1	Line pressure duty solenoid	—
Shift solenoid 2	AT load signal circuit	—
2-4 brake timing solenoid	Torque control signal circuit	—
Lockup duty solenoid	2-4 brake duty solenoid	—

If a fault has been detected, the system tells the fault by causing the AT OIL TEMP warning light to operate as follows:

- Repeated flashing at 4 Hz frequency ...Errors such as battery trouble
- Repeated flashing at 2 Hz frequency ...No faults in the system
- Flashing at different intervals and frequencies ...Diagnostic trouble codes of corresponding faults
- Continued illumination of light ...Fault in inhibitor switch, idle switch, or wiring

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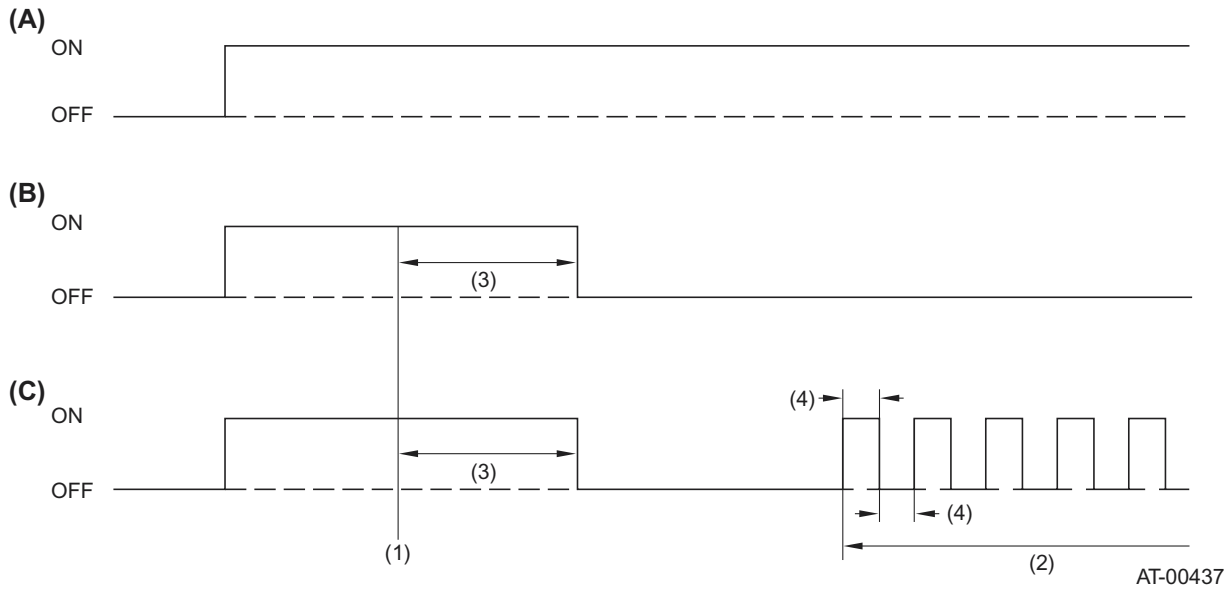
B: OPERATION OF AT OIL TEMP WARNING LIGHT

On starting the engine, the AT OIL TEMP warning light illuminates and then goes out as shown in the Normal diagram below. If any problem exists, the light continues flashing as shown in the Abnormal diagram below.



(A) Ignition switch ON (engine OFF)
(B) Normal
(C) Abnormal

(1) Engine cranking
(2) Blink
(3) 2 seconds
(4) 0.3 seconds

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15.Fail-safe Function

The fail-safe control function ensures minimum level of driveability even if a fault should occur in the vehicle speed sensors, throttle position sensor, inhibitor switch, or any of the solenoids.

- Front and rear vehicle speed sensors

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

If both the front and rear vehicle speed sensors become faulty, the vehicle is made to operate only in the 3rd speed.

- Throttle position sensor

If the throttle position sensor becomes faulty, control will be maintained by assuming that the throttle opening is at a certain angle.

- Inhibitor switch

If the TCM receives different signals simultaneously from a faulty inhibitor switch, it selects a range in the following priority:

D > N (P) > R > 3 > 2 > 1 >

- Shift solenoid 1 and 2

If a fault occurs in either of solenoids 1 and 2, both the solenoids are de-energized, and the gear is held in the 3rd. If both the solenoids should fail, the TCM invariably selects and keeps the 3rd gear.

- Line pressure duty solenoid

If the line pressure duty solenoid fails, the solenoid is de-energized and the line pressure is raised to the maximum to enable the vehicle to operate.

- Lockup duty solenoid

If the lockup duty solenoid fails, the solenoid is de-energized and the lockup clutch is disengaged.

- Transfer duty solenoid

When the transfer duty solenoid becomes faulty, it is de-energized. This causes maximum oil pressure to be applied to the transfer clutch so that the power is always transmitted to the rear axle (direct-coupled AWD condition).

- 2-4 brake duty solenoid

If a fault occurs in the 2-4 brake duty solenoid, the solenoid is de-energized and the usable gears are limited to the 1st and 3rd.

- Low-clutch timing solenoid

If a fault occurs in the low clutch timing solenoid, the solenoid is de-energized and the usable gears are limited to the 1st and 3rd.

- 2-4 brake timing solenoid

If a fault occurs in the 2-4 brake timing solenoid, the solenoid is de-energized and the usable gears are limited to the 1st and 3rd.

- Torque converter turbine speed sensor

If a fault occurs in the torque converter turbine speed sensor, the usable gears are limited to the 3rd.

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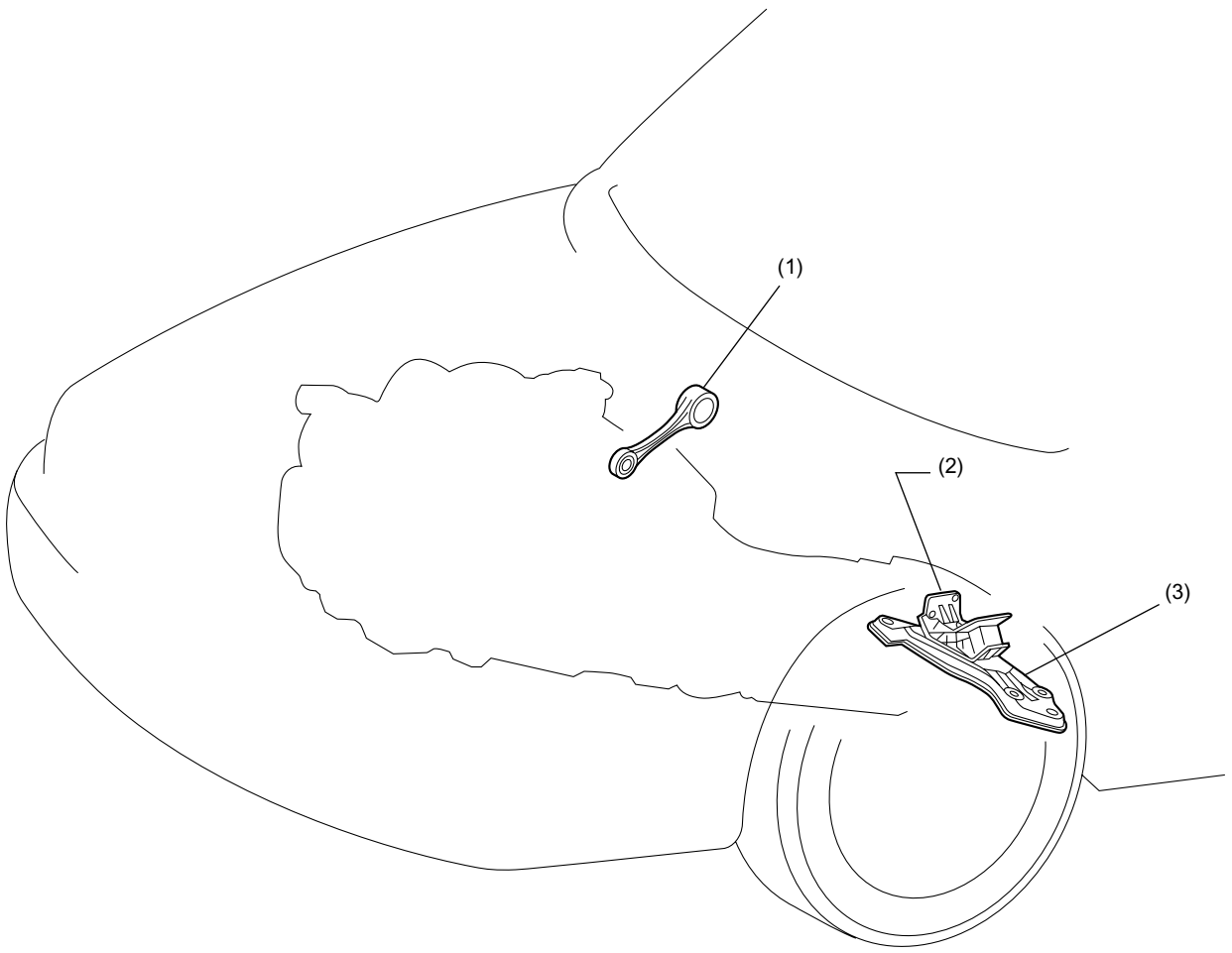
16.Transmission Mounting

A: GENERAL

The transmission mounting consists of a pitching stopper, cushion rubber, and a cross member. In addition to support the transmission, these components absorb noise and vibration caused by the transmission.



AT-00438

(1) Pitching stopper
(2) Cushion rubber
(3) Cross member

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MANUAL TRANSMISSION AND DIFFERENTIAL 5-SPEED (5MT)

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1. General

The Impreza's single-range manual transmission is of a full-time all-wheel-drive design integrating a transmission assembly, front differential, and transfer gear assembly with center differential into a single unit. The transmission creates five forward speeds and one reverse using the corresponding gears all provided with inertia lock-key type synchronizers.

The transmission and front differential are housed in an aluminum case which is split into right and left halves and constitutes also a clutch housing. Located at the rear and joined each other are the transfer case and extension case which house the transfer gears and center differential as well as part of the transmission assembly.

The major features of the transmission are as follows:

- The forward speed gears are helical gears featuring high tooth face strength, large tooth contact areas, and quiet operation.
- Reversing rotation is achieved by making a slidable reverse idler gear engage with both the reverse drive gear on the main shaft and the reverse driven gear integral with the 1st-2nd synchronizer hub on the drive pinion shaft.

The center differential compensates for the difference in front and rear axle speeds. It consists of a bevel gear set and a viscous coupling located at its rear end which are housed in a single case. The center differential, together with a pair of transfer gears, transmits the power from the transmission to the drive pinion shaft (front wheel drive shaft) and the propeller shaft. The viscous coupling functions as a differential-action-control element.

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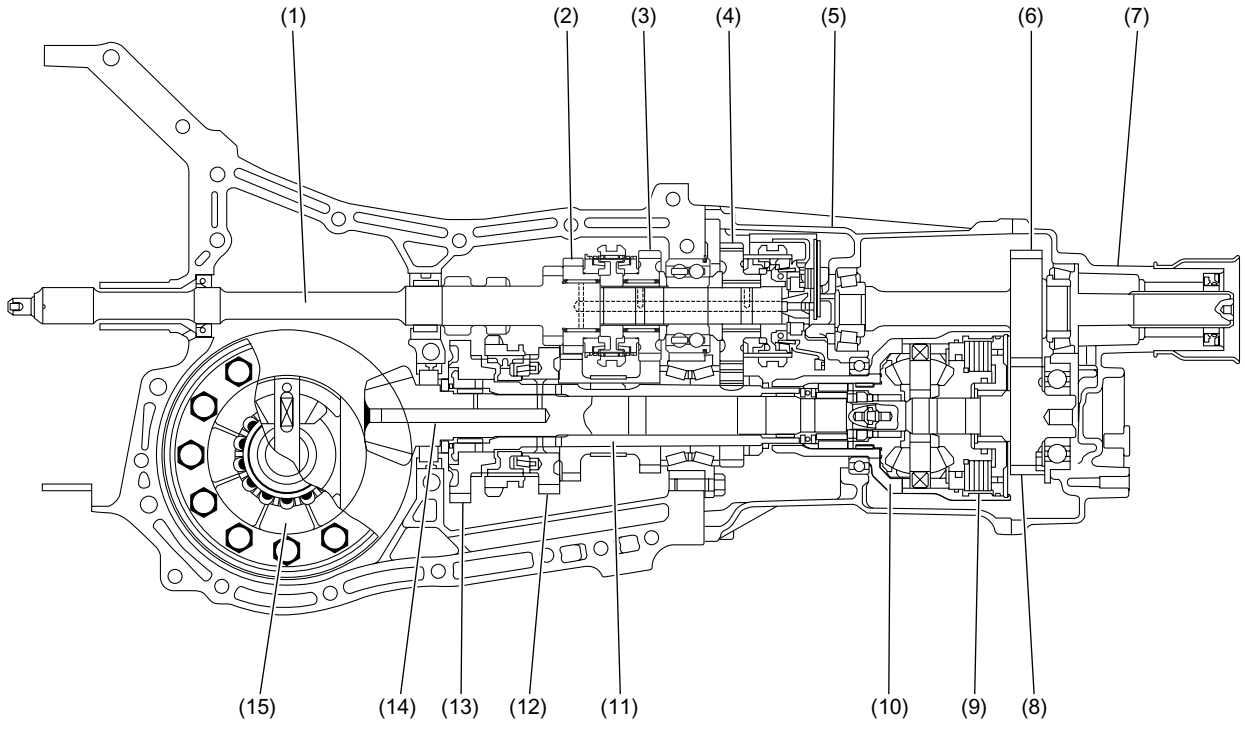

MT-00938

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

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2. Reverse Check Mechanism

Located in the transfer case, the reverse check mechanism prevents a direct 5th-to-reverse shift by using a selector arm and cam combination which allows the gear to be shifted into the reverse only after it has been returned once into the neutral.

A: CONSTRUCTION

The construction of the reverse check mechanism is as shown in the drawing on the opposing page.

The reverse check sleeve is bolted to the transfer case and houses the mechanism's main components.

The reverse accent shaft is slidable inside the reverse check sleeve and its smaller-diameter end is fitted with the reverse check cam. The cam is rotatable and axially movable on the shaft but its leftward movement is restricted by a step formed on the sleeve's inner wall.

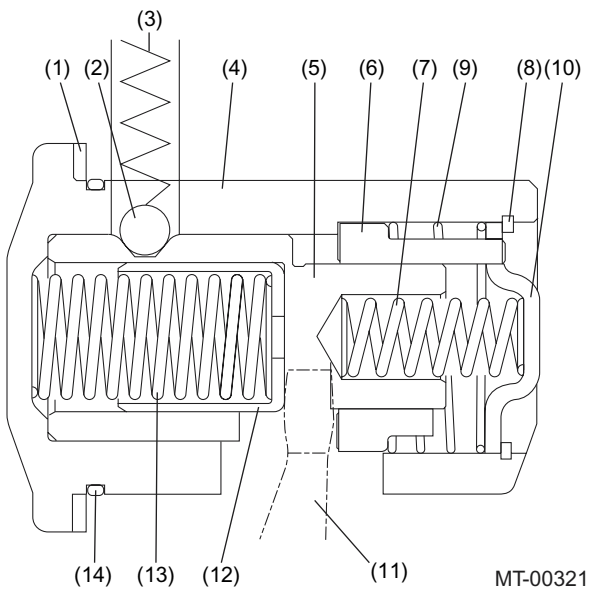
The reverse accent shaft has hollows in both ends. In the left end hollow are the 1st return spring and its cap and in the right end hollow is the reverse return spring which pushes the shaft leftward.

Around the check cam is the reverse check spring whose left end applies simultaneous leftward and rotational forces to the cam.

Both the reverse check spring and reverse return spring are retained at their right ends by the reverse check plate which is held in place by the snap ring.

The reverse accent shaft has a V-groove in which the detent ball is pressed by the reverse accent spring fitted through the hole in the reverse check sleeve.

The reverse check sleeve and reverse accent shaft have a slot and a notch at their bottoms, respectively, and the selector arm is inserted in the notch through the slot.



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

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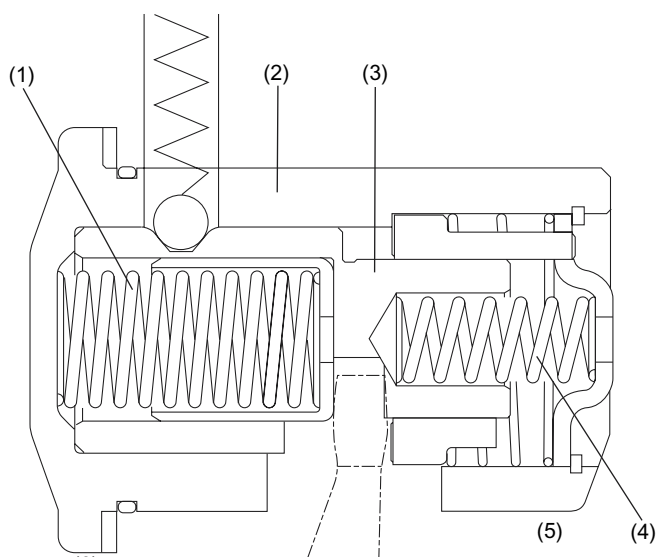
B: OPERATION

The drawing below shows the state of the reverse check mechanism when the selector arm is in the neutral position. The 1st and 2nd gears will be selected if the selector arm is moved leftward from this point to a stop and then turned in either way. A rightward movement of the arm to a stop will enable selection of the 5th and reverse gears. In the neutral position, the selector arm receives a rightward force (force toward the 5th and reverse gear side) from the 1st return spring and a leftward force (force toward the 1st and 2nd gear side) from the reverse return spring to stay in that position.

The following explanation describes how the selector arm and reverse check mechanism operate when the driver selects the 5th gear and then selects the reverse gear.



MT-00322

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

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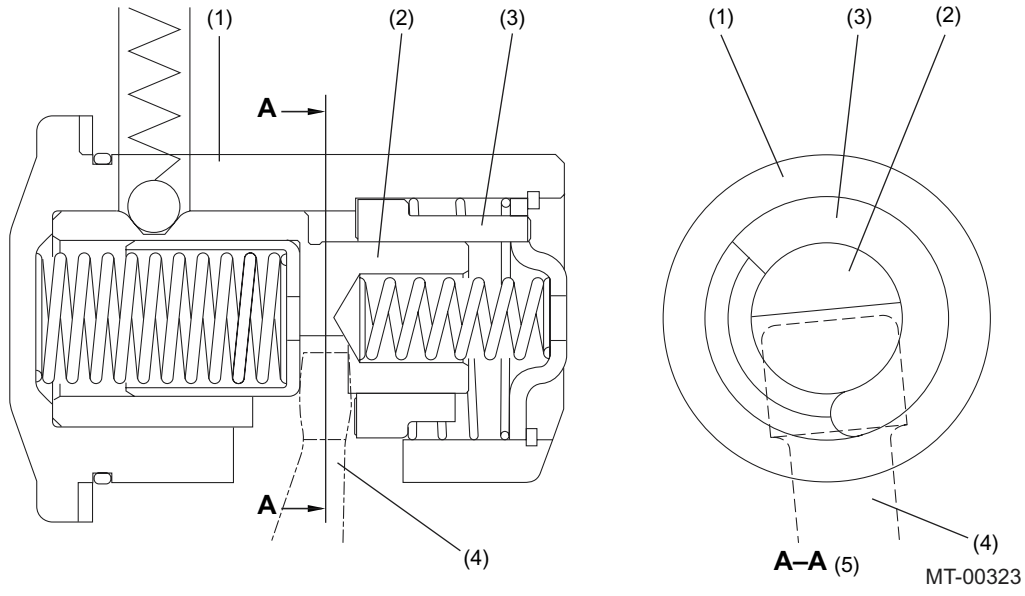
1. WHEN SELECTOR ARM IS MOVED TOWARD 5TH AND REVERSE GEAR SIDE

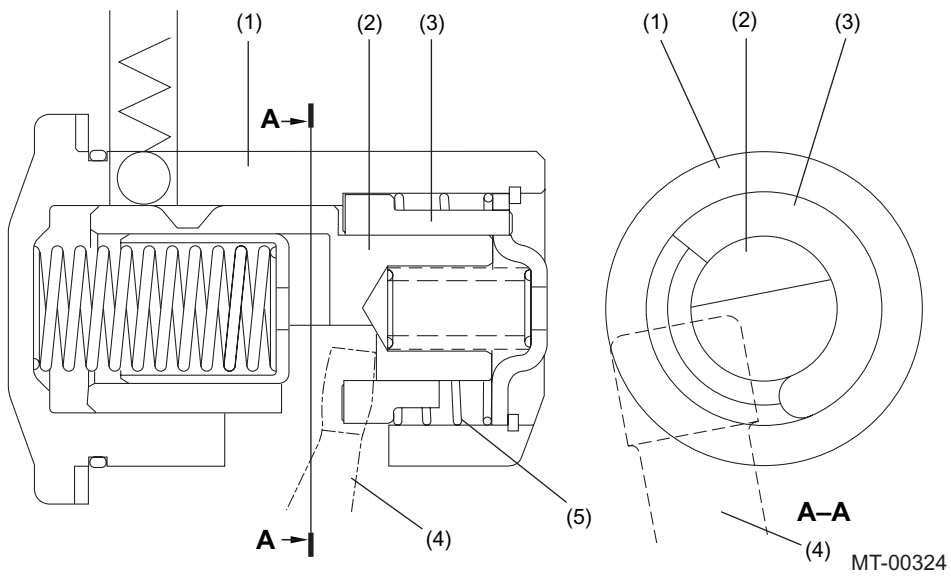
The selector arm moves rightward while pushing both the reverse accent shaft and reverse check cam simultaneously.



(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 GEAR

The selector arm is turned toward the 5th gear selection direction. When the arm clears the edge of the reverse check cam as it turns, the cam becomes free of the selector arm's pressure and returns to its original position by the force of the reverse check spring.



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

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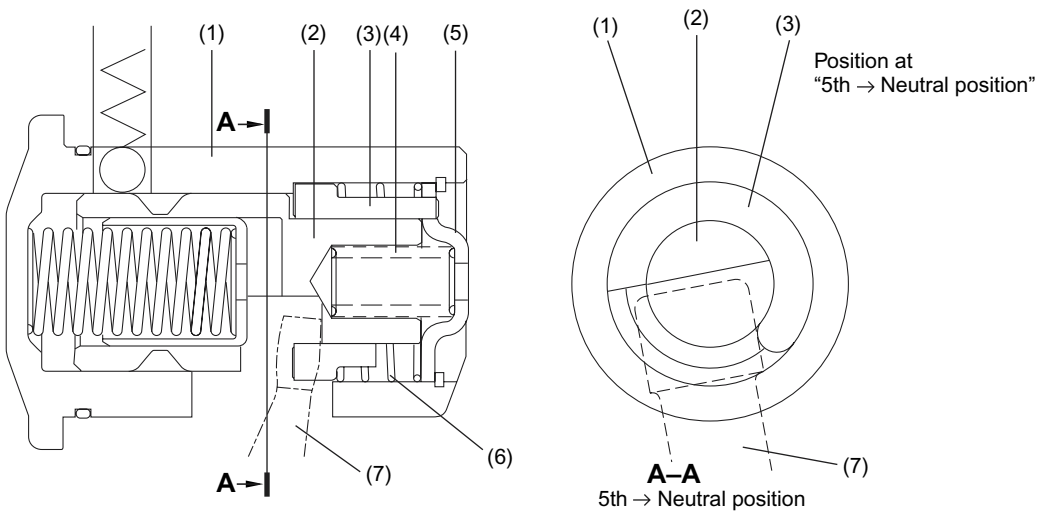
3. WHEN A SHIFT FROM 5TH TO REVERSE IS ATTEMPTED

The selector arm turns toward the reverse gear while pushing the reverse accent shaft rightward and the reverse check cam counterclockwise (as viewed in the direction of arrows A).

The reverse check cam, however, stops to rotate at a point where its stopper hits against the reverse check plate (this point corresponds to the neutral position in terms of the angle) and prevents the selector arm from moving toward the reverse gear selection direction. The selector arm is then axially pushed to the neutral position by the reverse accent shaft which is given a leftward force by the reverse return spring.



MT-00325

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

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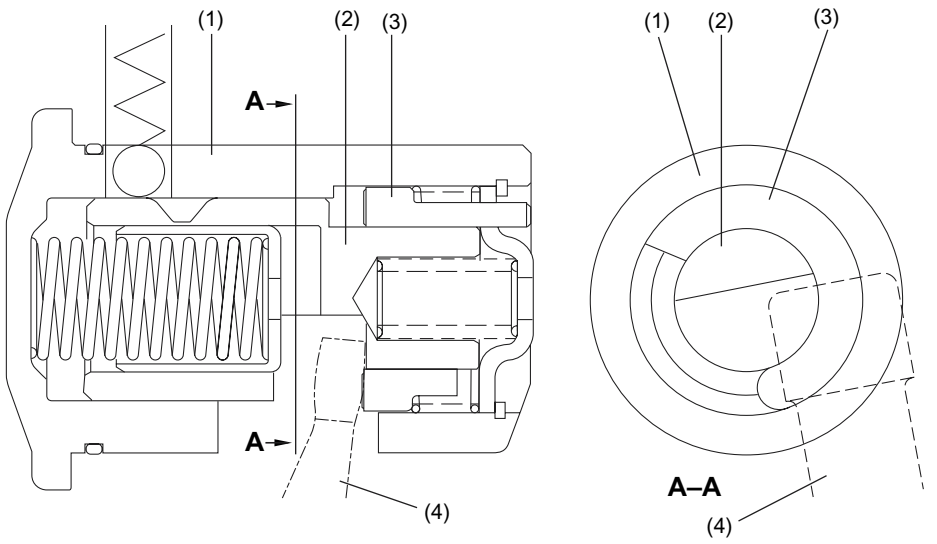
4. WHEN A SHIFT TO REVERSE IS MADE AFTER RETURN OF SELECTOR ARM TO NEUTRAL

As the ends of the reverse accent shaft and the reverse check cam are on the same plane, the selector arm now can turn toward the reverse gear selection direction after pushing leftward both the shaft and cam simultaneously.



MT-00326

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

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3. Center Differential

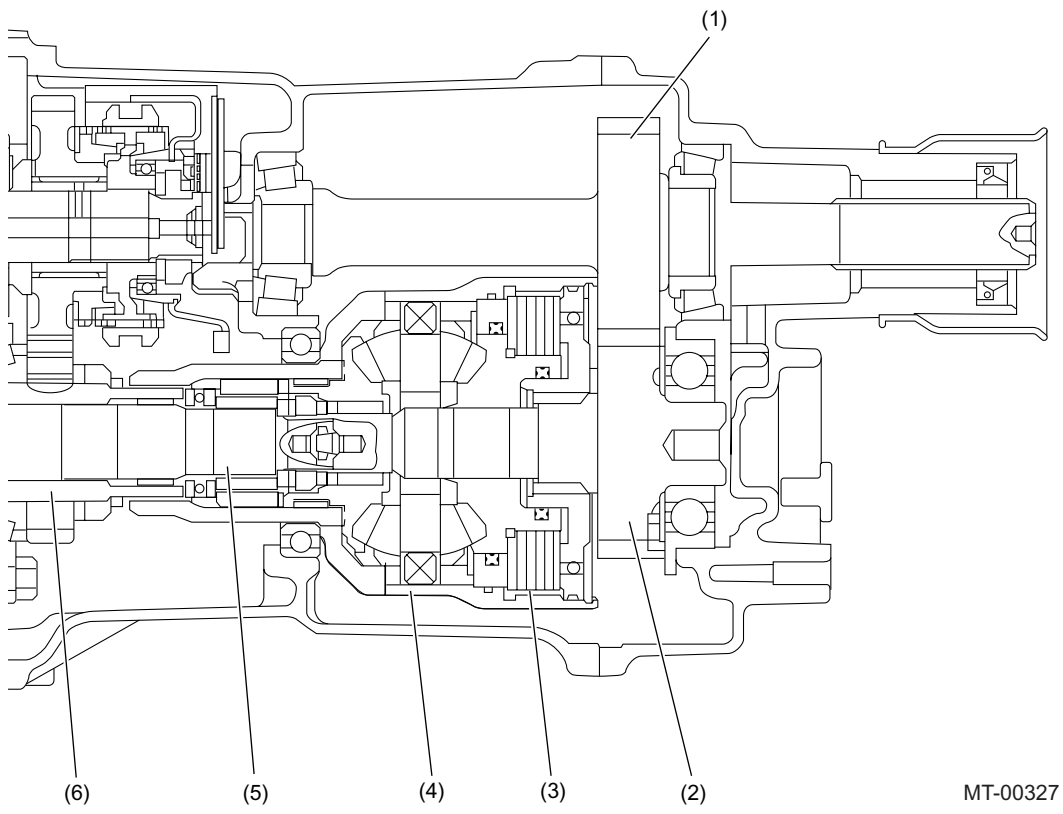
A: CONSTRUCTION

The center differential consists of a set of bevel gears and a viscous coupling.

The center differential has the following two functions: distributing the engine torque to the front and rear wheel drive shafts and absorbing the difference in rotating speed between the front and rear wheels.

The engine torque enters the center differential case from the transmission's driven shaft. The engine torque is then distributed through the bevel gear set directly to the drive pinion shaft and via the transfer drive and driven gears to the rear drive shaft.

The viscous coupling limits the bevel gear set's differential action when either front or rear wheels spin so that adequate torques are transmitted to the front and rear wheels and proper traction is obtained.



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

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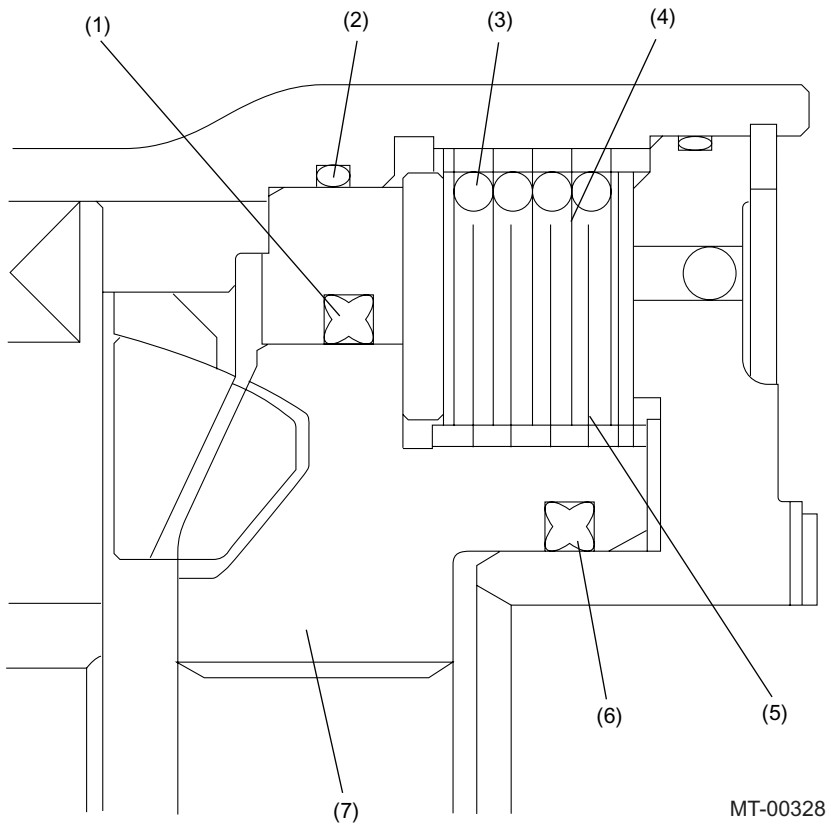
B: MECHANISM OF VISCOUS COUPLING

The viscous coupling consists of a number of alternately arranged inner and outer plates and air-and-silicone oil mixture filled into a sealed space that is formed by the center differential case and the rear side gear of the differential gear set. The inner plates have their inner perimeters splined to the side gear and the outer plates have their outer perimeters splined to the center differential case. The outer plates are held apart by spacer rings. There are no spacer rings between the inner rings, so the inner rings are movable slightly in axial directions. X-section rings are used to prevent leakage of silicone oil which would otherwise occur if the oil is pressurized due to large difference in front and rear axle speeds.



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

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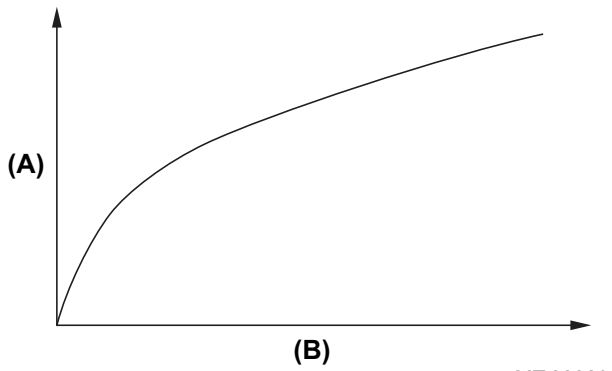
1. TORQUE CHARACTERISTICS

When a speed difference occurs between the center differential case and the rear side gear, a shear 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 rear side gear.

The greater the speed difference, the greater the shear force generated in the silicone oil. The relationship between the torque transmission and the speed difference is shown in the figure below. As can be seen from the figure, the smaller the speed difference, the smaller the torque transmission and the differential action.



MT-00329

(A) Driving torque

(B) Speed difference

2. HUMP PHENOMENON

Silicone oil is heated and expanded as differential action continues. This causes the pressure of air inside the viscous coupling to increase and the pressure of oil between plates to decrease. As a result, the inner and outer plates are pushed together. This direct plate-to-plate contact causes a non-viscous operation to occur, and this phenomenon is called “hump”.

The hump eliminates the rotating speed difference between the center differential case and the rear side gear (or locks the differential), so soon after it has occurred, the internal pressure and temperature drop. The viscous coupling then returns to the normal shear torque transmitting operation. (The hump phenomenon does not occur under normal operating conditions.)

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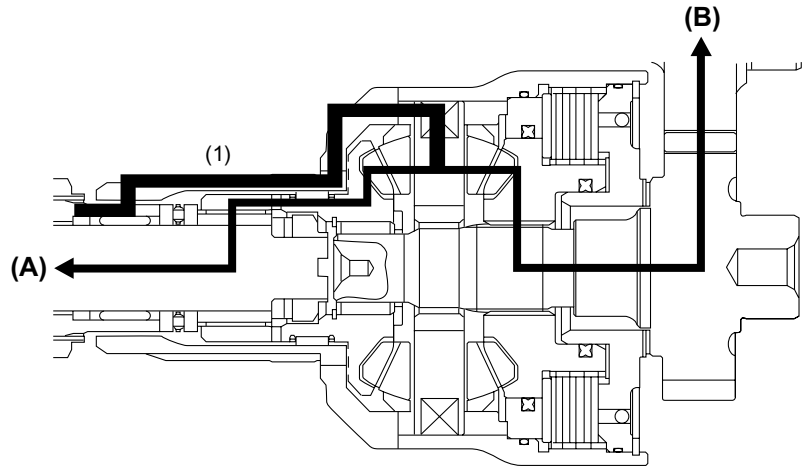
C: FUNCTION

When there is no speed difference between the front and rear wheels, the center differential delivers the engine torque to the front and rear wheels at a ratio of 50:50.
When a rotating speed difference occurs between the front and rear wheels, the center differential operates to absorb it in a controlled way by the function of the viscous coupling.

1. DURING NORMAL DRIVING

During straight-line driving on a flat road at a constant speed, all the four wheels rotate at the same speed. The center differential delivers engine torque evenly to the front and rear wheels. The viscous coupling does not generate shear torque because there is no relative movements between the inner and outer plates.



MT-00330

(1) Engine torque
(A) To front differential
(B) To rear differential

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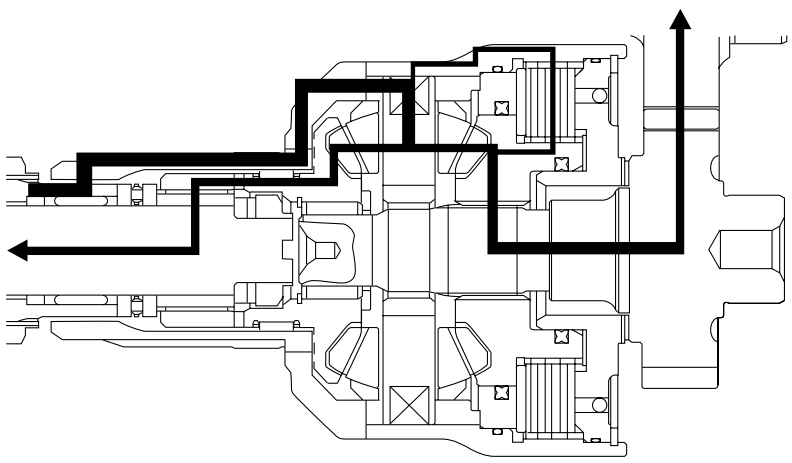
2. DURING TURNS AT LOW SPEEDS

During turns at low speeds, rotating speed difference occurs between the front and rear wheels, as well as between the left and right wheels. More particularly, the front wheels rotate faster than the rear wheels. The center differential then acts to absorb the speed difference to enable smooth driving.
Although the speed difference is small under this condition, operation of the viscous coupling causes more torque to be transmitted to the rear than to the front.



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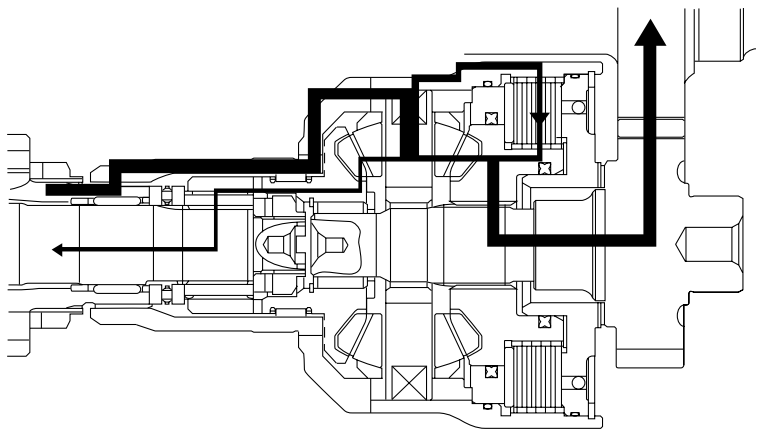
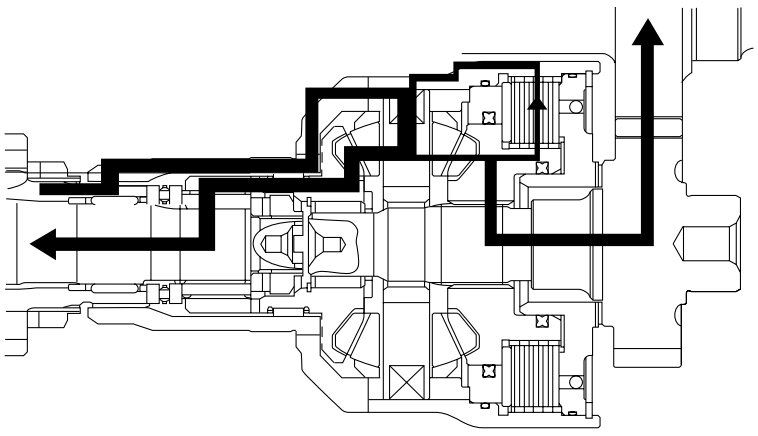
3. DRIVING ON ROUGH OR SLIPPERY ROADS

● When front wheels are on a slippery surface
When the front wheels begin to spin, the resulting speed difference between the front and rear drive shafts causes the viscous coupling to generate significant amount of shear torque. As a result, the torque distributed to the rear wheels becomes much larger than that distributed to the spinning front wheels. The traction and driving stability are thus ensured on a rough or slippery road.



MT-00332

● When rear wheels are on a slippery surface
When the vehicle is accelerated quickly from a standing start with the rear wheels on a slippery surface, the distribution of the vehicle weight on the front and rear wheels changes and the rear wheels start spinning. Due to the resulting speed difference between the front and rear drive shafts, the viscous coupling generates a significant amount of shear torque, now in the direction opposite to that generated when the front wheels are on a slippery surface. As a result, the torque distributed to the front wheels becomes much larger than that distributed to the rear wheels.



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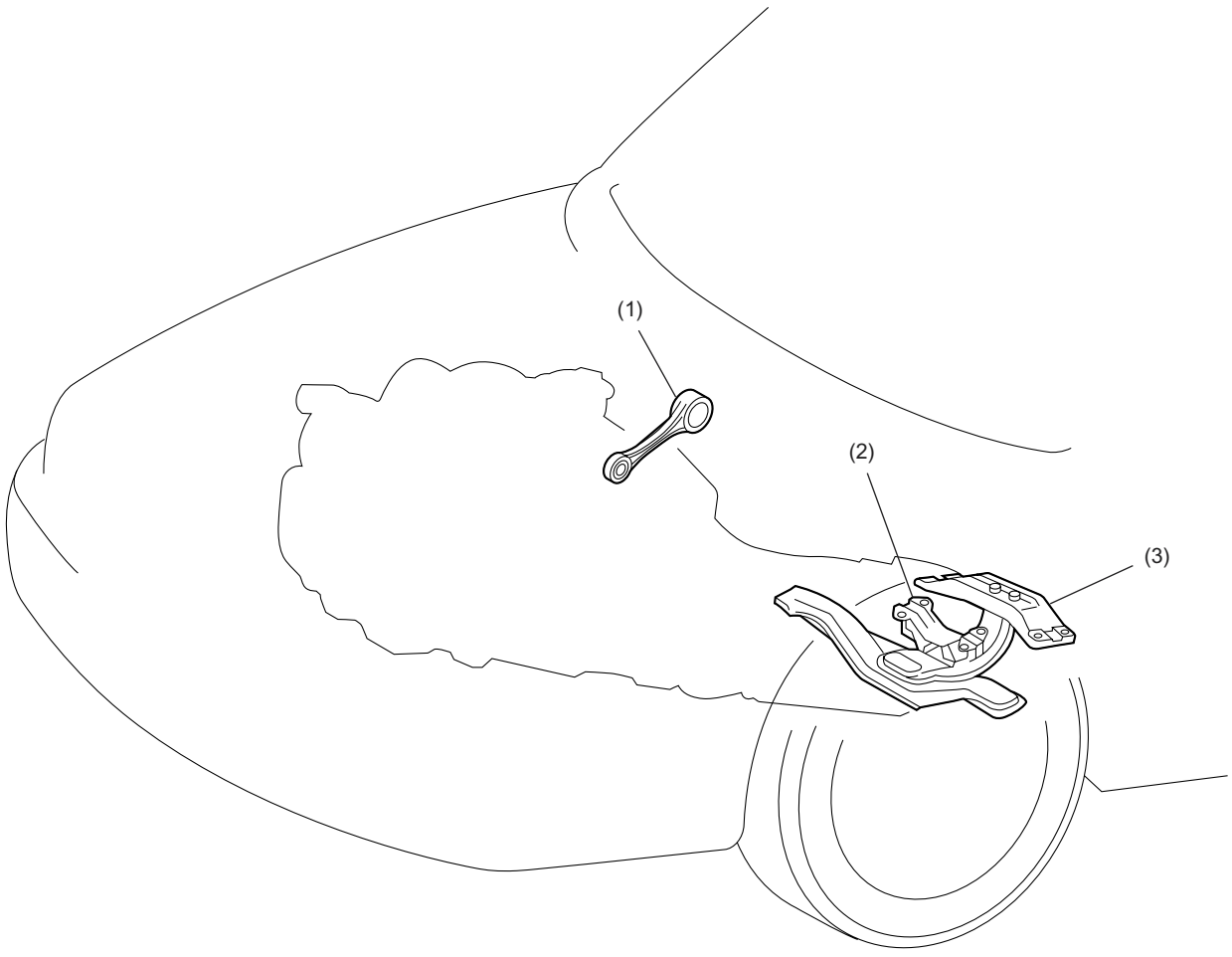
4. Transmission Mounting



MT-00334

(1) Pitching stopper
(2) Cushion rubber
(3) Cross member

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MANUAL TRANSMISSION AND DIFFERENTIAL 6-SPEED (6MT)

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1. General

The six-speed manual transmission has been newly developed to exploit the full potential of the STi model's engine and enable the model to have a surpassing driving performance.
The major features of this new transmission are as follows:

● The driver can make a gear shift with a smaller force than with conventional transmissions owing to the double-cone synchronizers employed for the 1st, 3rd and reverse gears and the triple-cone synchronizer employed for the 2nd gear. In addition, the synchronizing elements of the 2nd to 6th gears have splines with asymmetric chamfers in order to prevent generation of undesirable loads that would cause simultaneous engagement of two gears ("double meshing") as well as to ensure improved gear shift feeling.

● The reverse idler gear is a constant-mesh type with a new sub gear.

● The shift/select mechanism is of a parallel link design. It has shift rods each supported by a slidable ball bearing and provided with a detent mechanism that uses a plunger with a ball inside.

● The reverse check mechanism prevents unintended engagement of the reverse gear when the driver makes a shift into the 5th or 6th gear.

● The transmission case is split into three pieces lateral direction like that of the automatic transmission used in the standard model. It is highly rigid owing to appropriately arranged ribs.

● The oil pump incorporated in the transmission case ensures improved lubricating and cooling performance.

● An APTRAC type limited slip differential has been introduced for the front differential.

● The center differential uses a driver-controllable center differential which controls the drive power distribution to the front and rear wheels according to driving and road conditions.

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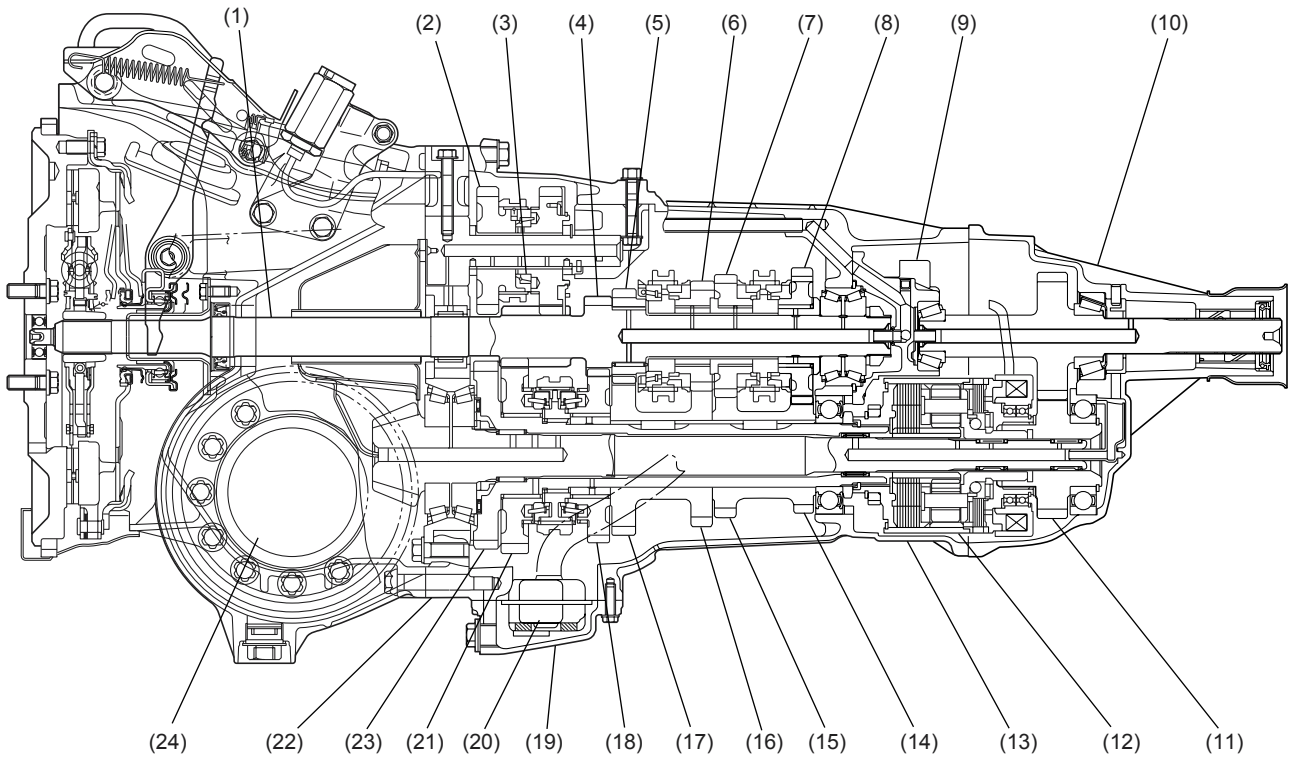
2. Cross Sectional View



MT-00981

(1) Main shaft
(2) Reverse idler gear
(3) 1st drive gear
(4) 2nd drive gear
(5) 3rd drive gear
(6) 4th drive gear
(7) 5th drive gear
(8) 6th drive gear
(9) Transfer driven gear
(10) Extension case
(11) Transfer drive gear
(12) Center differential assembly
(13) Transmission case
(14) 6th driven gear
(15) 5th driven gear
(16) 4th driven gear
(17) 3rd driven gear
(18) 2nd driven gear
(19) Oil pan
(20) Oil strainer
(21) 1st driven gear
(22) Adapter plate
(23) Reverse driven gear
(24) Front differential assembly

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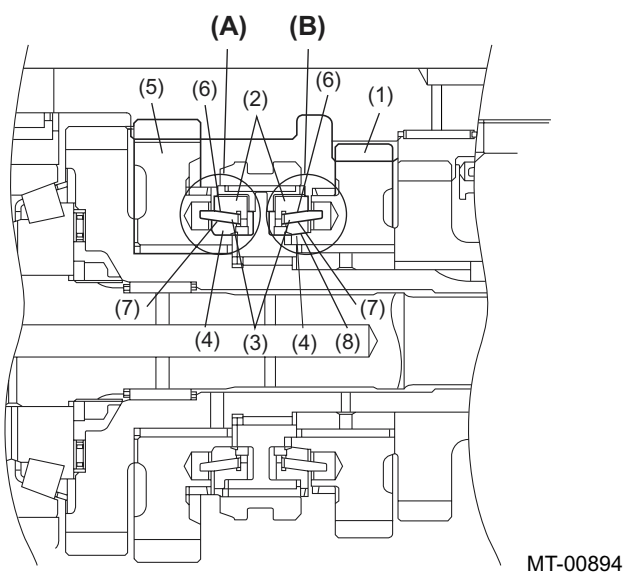
3. Triple-cone Synchronizer

A: CONSTRUCTION

The triple-cone synchronizer has three frictional interfaces - in addition to the two coaxial interfaces between the synchronizer cone and the inner and outer balk rings (which are same as those with a double-cone synchronizer), it has a third frictional interface between the inner surface of the inner balk ring and the cone on the 2nd driven gear. Thanks to an increased friction force, the triple-cone type produces larger synchronizing power than a double-cone type synchronizer. The main components of the triple-cone synchronizer are the outer balk ring, synchronizer cone, inner balk ring, and 2nd driven gear's cone.



(A) Double-cone synchronizer
(B) Triple-cone synchronizer
(1) 2nd driven gear
(2) Outer balk ring
(3) Synchronizer cone
(4) Inner balk ring
(5) 1st driven gear
(6) Cone surface 1
(7) Cone surface 2
(8) Cone surface 3

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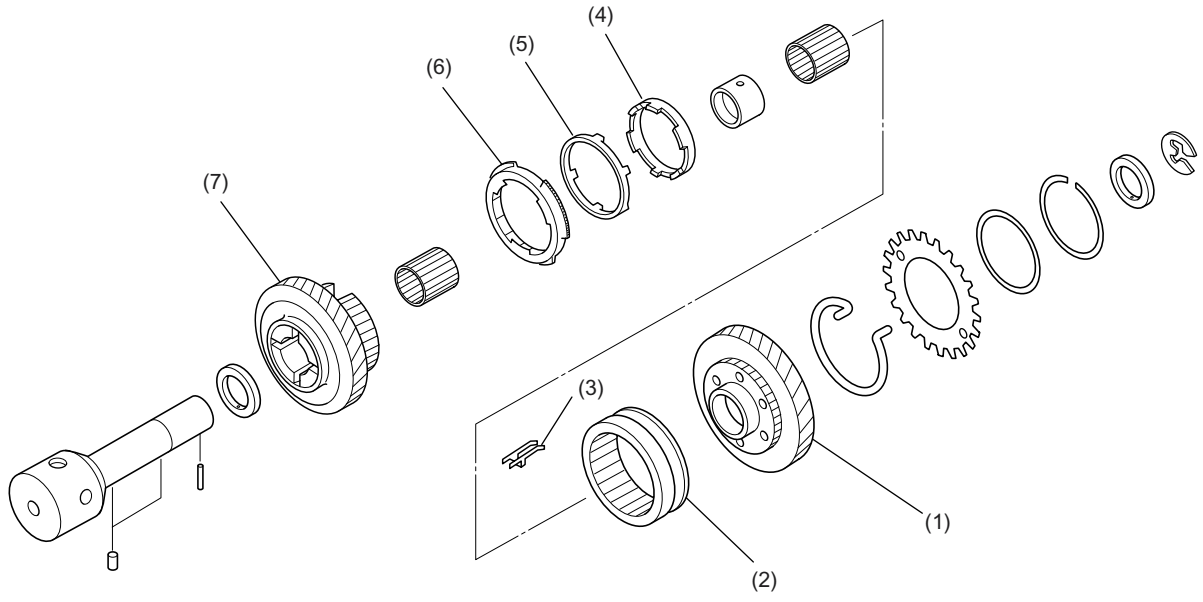
4. Reverse Idler Gear Assembly (with Synchronizing Mechanism)

- A constant-mesh type reverse gearing is used in the six-speed manual transmission.
- The reverse idler gear assembly is provided with a double-cone synchronizer.

Soon after disengagement of the clutch, the reverse gear remains rotating by an inertial force. If the driver makes a shift while the reverse gear is still rotating, an undesirable “gear clash” would occur.The double-cone synchronizer prevents this by synchronizing the speed of the No. 2 reverse idler gear with that of the reverse sleeve. It also allows the driver to make a smooth shift into the reverse gear.



MT-00984

(1) No. 1 reverse idler gear
(2) Reverse sleeve
(3) Insert key
(4) Inner balk ring
(5) Synchronizer cone
(6) Outer balk ring
(7) No. 2 reverse idler gear

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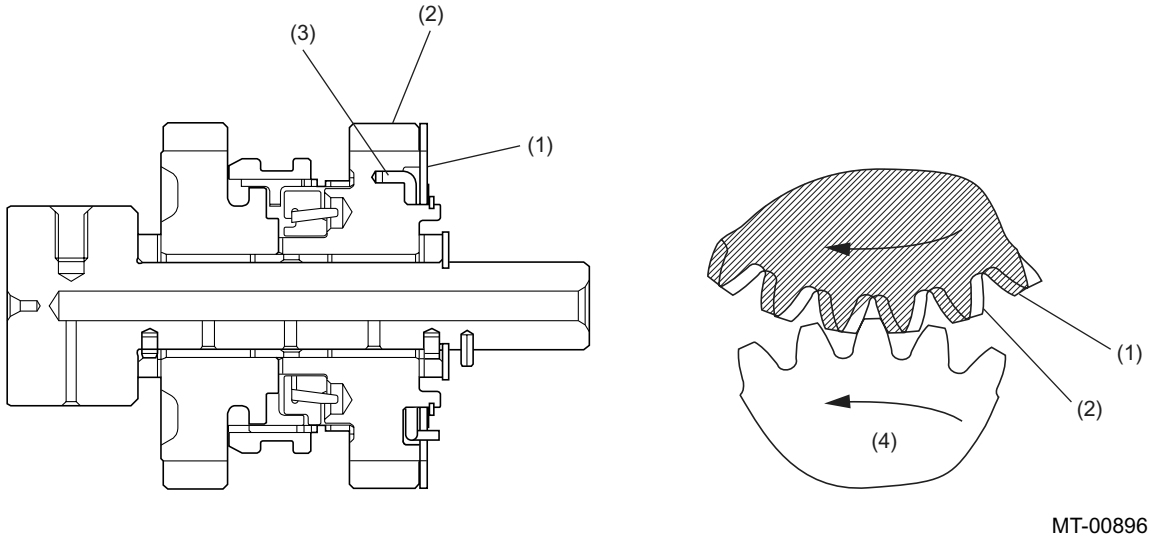
● To prevent rattling noise that may occur with the constant-mesh type reverse gearing, No.1 reverse idler gear is fitted with a sub gear that has the same number of teeth as the No. 1 reverse idler gear. The sub gear is preloaded in the rotating direction by a spring so that it functions to reduce backlash between gear teeth and consequent rattling noise when the No. 1 reverse gear meshes with the reverse drive gear.



(1) Sub gear
(2) No. 1 reverse idler gear
(3) Spring
(4) Reverse drive gear

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5. Shift and Select Mechanism

● The shifter fork and fork rods have a detent mechanism using a plunger with a ball in it and is supported with a slidable ball bearing. The detent mechanisms give the driver distinctive detent feeling and the slidable ball bearings help reduce the shift lever operating force.

● All shifter forks are made of aluminum die casting and the shifter arm shaft is formed as a hollow type to minimize the overall weight of the transmission.

● Gear double meshing is prevented by a mechanism that uses interlock blocks.

● The select return mechanism (which returns the selector lever to the neutral position) uses a U-shaped leaf spring.

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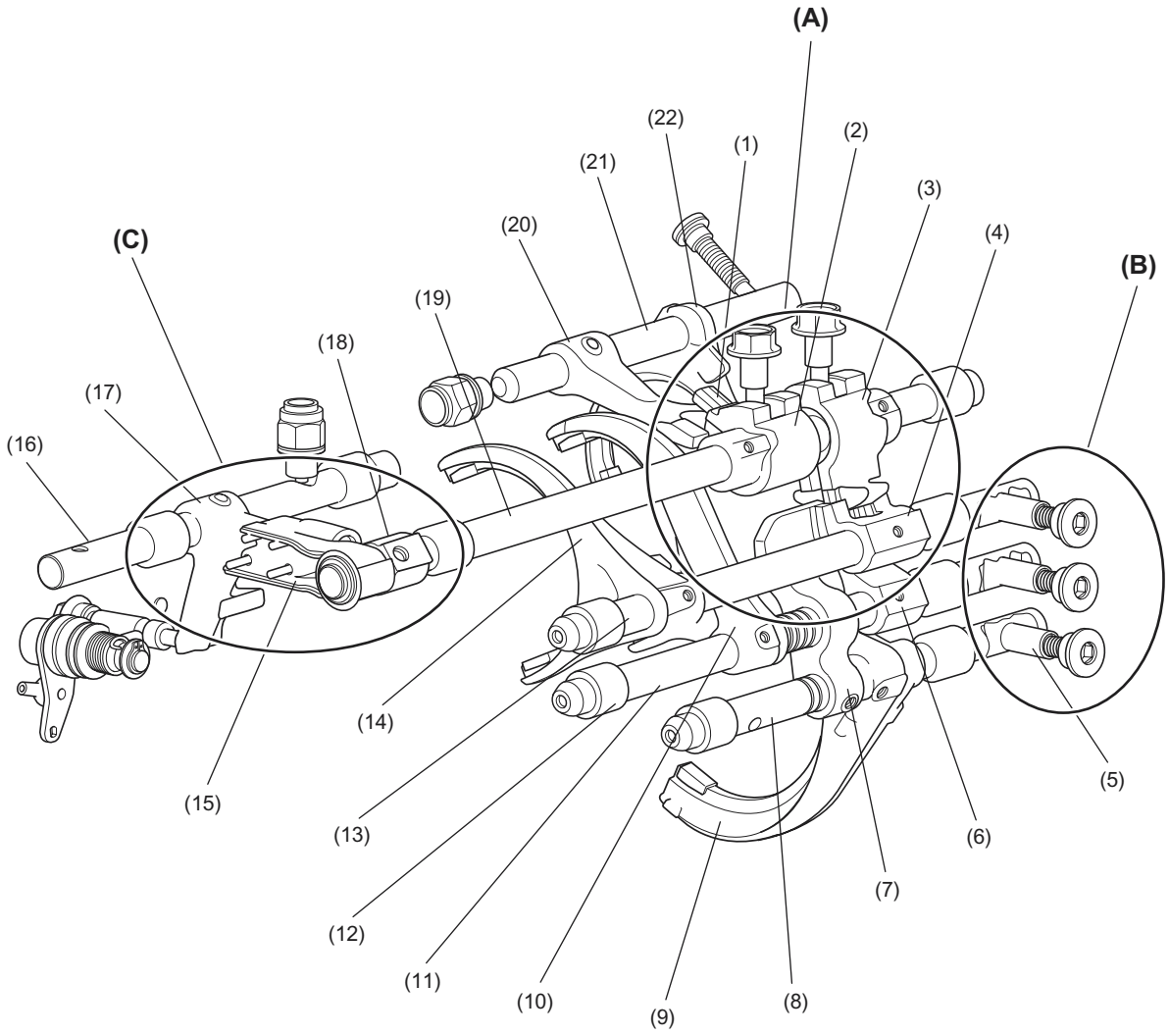

MT-00897

(A) Interlock mechanism
(B) Shift detent mechanism
(C) Select return mechanism

(1) Interlock arm
(2) Reverse interlock block
(3) Interlock block
(4) 5th-6th shifter arm
(5) Shifter plunger
(6) 3rd-4th shifter arm
(7) 1st-2nd shifter arm
(8) 1st-2nd shifter rod
(9) 1st-2nd shift fork
(10) 3rd-4th shift fork
(11) 3rd-4th shifter rod
(12) Slidable bearing
(13) 5th-6th fork rod
(14) 5th-6th shift fork
(15) Neutral set spring
(16) Shifter arm shaft
(17) No. 1 selector arm
(18) No. 2 selector arm
(19) Striking rod
(20) Reverse shifter arm
(21) Reverse fork rod
(22) Reverse shifter fork

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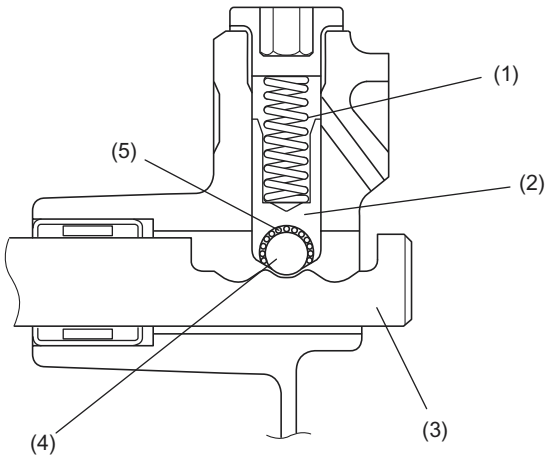
A: MECHANISM

1. SHIFT DETENT MECHANISM

The shift detent mechanism allows the driver to distinctively feel the shift into a gear. The mechanism also prevents the transmission from jumping out of gear.
The shift detent mechanism uses a plunger with a check ball in it. The check ball is held under a small bowl which has the function of reducing friction during a shift and with the detent mechanism on the fork rod, generating a force to retain a gear in the selected position.



MT-00898

(1) Spring
(2) Plunger
(3) Fork rod
(4) Check ball
(5) Bowl

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2. SELECT RETURN MECHANISM

The select return mechanism allows the shift lever to return to the neutral position.
The neutral set spring pinches between its two arms the four convex portions on the No. 1 selector arm to hold the shift lever always in the neutral position. When the driver moves the shift lever in a select direction, the No. 1 and No. 2 selector arms turn about their axes, changing their relative angle.
This causes a pair of diagonally opposing convex portions on the No. 1 selector arm to open the neutral set spring. When the driver then releases the shift lever, the opened neutral set spring pushes by its returning force the convex portions to bring the selector arms back to the neutral position.

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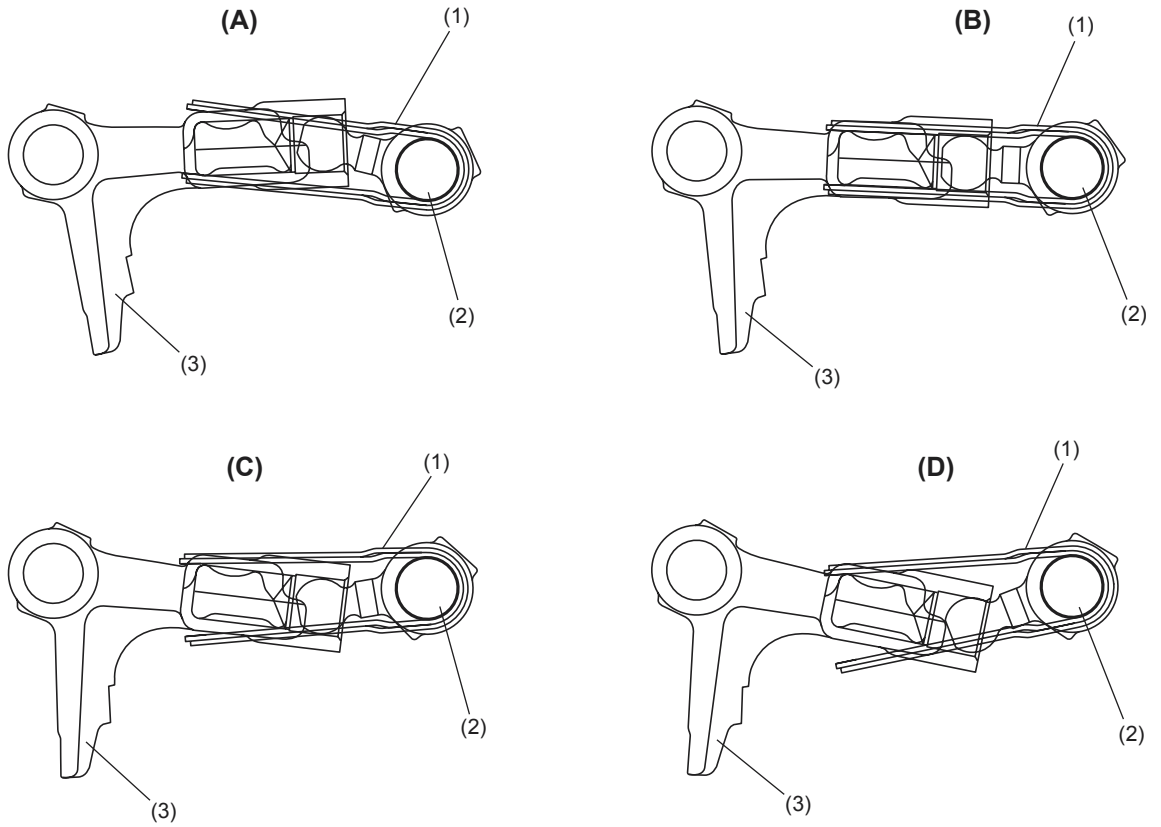

MT-00899

(1) Neutral set spring
(2) No. 2 selector arm
(3) No. 1 selector arm

(A) 1st-2nd
(B) Neutral/3rd-4th
(C) 5th-6th
(D) Reverse

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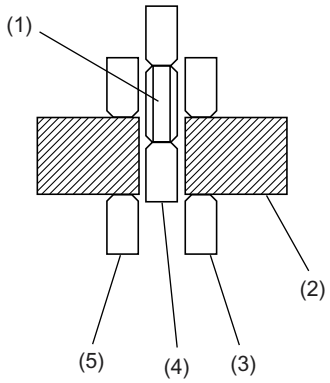
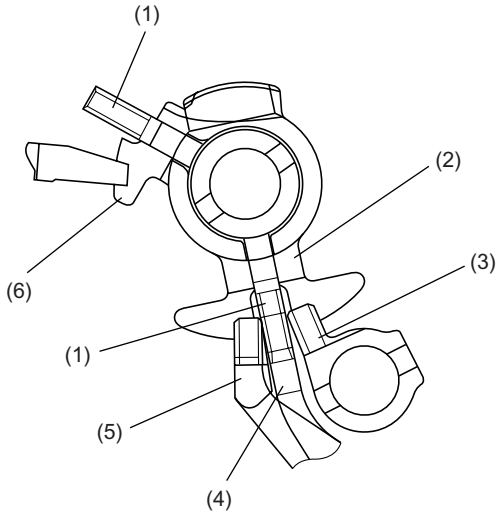
3. INTERLOCK MECHANISM (DOUBLE-MESHING PREVENTION MECHANISM)

The interlock mechanism makes it impossible to shift the transmission into two gears at once.
When the interlock arm selects the shifter arm corresponding to the gear into which the driver is going to make a shift, the interlock blocks also move in the same select direction, preventing the other shifter arms from being selected.
The gap between the two blocks is adjusted such that only one shifter arm can enter it, so the interlock blocks prevent the other two shifter arms from being selected even if the driver operates the shift lever in a way that otherwise would cause simultaneous engagement of two gears.

- **When shift lever is properly operated**





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(1) Interlock arm
(2) Interlock block
(3) 5th–6th shifter arm
(4) 3rd–4th shifter arm
(5) 1st–2nd shifter arm
(6) Reverse interlock block

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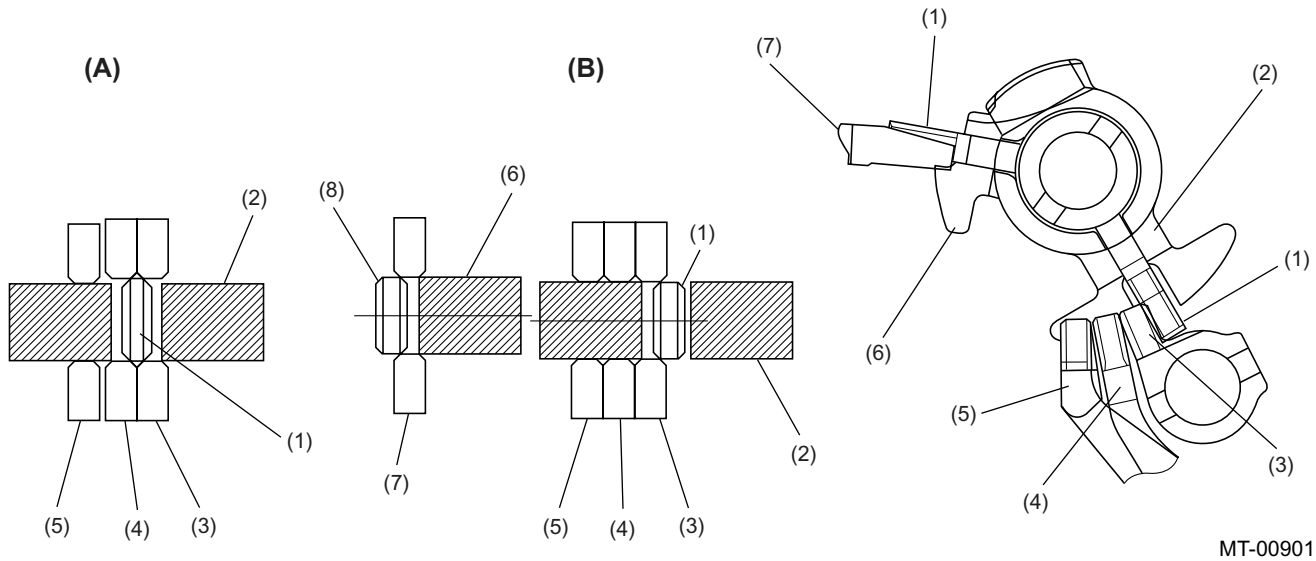
- **When “double meshing” is prevented**



(A) Preventing 3rd and 5th double meshing
(1) Interlock arm
(2) Interlock block
(3) 5th-6th shifter arm
(4) 3rd-4th shifter arm

(B) Preventing 6th and reverse double meshing
(5) 1st-2nd shifter arm
(6) Reverse interlock block
(7) Reverse shifter arm
(8) Reverse interlock block

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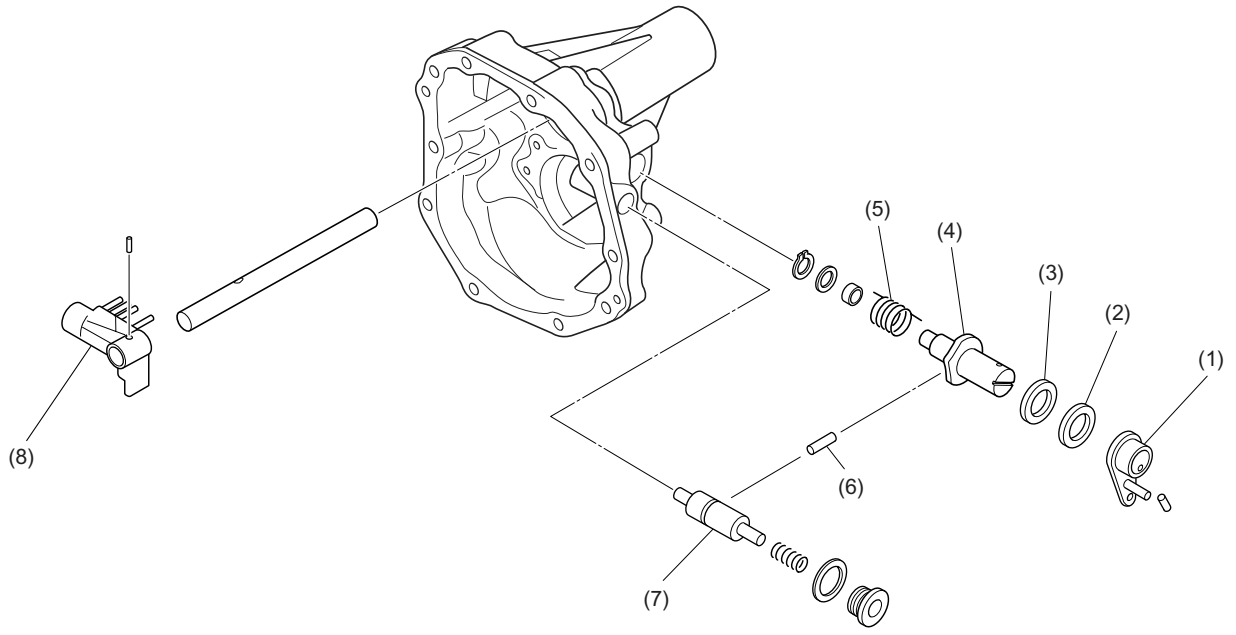
6. Reverse Check Mechanism

The reverse check mechanism prevents the reverse gear from being accidentally engaged when the driver makes a shift into the 5th or 6th gear. This mechanism is provided with a fail-safe function which enable shifting into reverse if the reverse check cable should be broken.

A: CONSTRUCTION

The reverse check mechanism is located inside the extension case.
It consists of a reverse check lever, oil seal, bearing, reverse check shaft, spring, plug and reverse check plug.



MT-00902

(1) Reverse check lever
(2) Oil seal
(3) Bearing
(4) Reverse check shaft
(5) Spring
(6) Interlock plunger
(7) Reverse check plunger
(8) No. 1 selector arm

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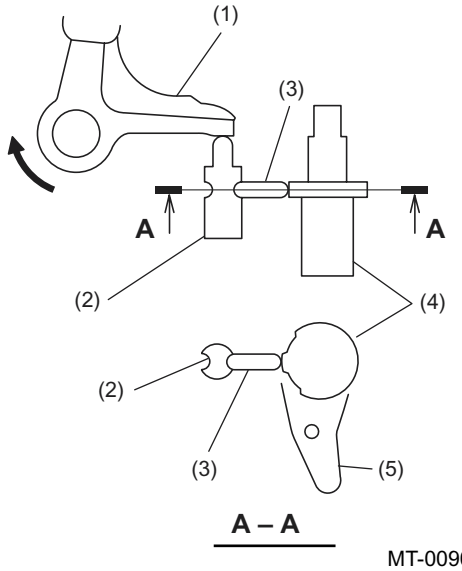
B: OPERATION

1. MAKING SHIFT INTO 5TH/6TH

When the shift lever is moved into the 5th or 6th position, the No. 1 selector arm comes into contact with the reverse check plunger, trying to move the reverse check plunger.
However, one end of the interlock plunger is in contact with the cam lobe on the reverse check shaft and the other end is held in the groove in the reverse check plunger, so the selector arm cannot move in the reverse gear selecting direction.



MT-00903

(1) No. 1 selector arm
(2) Reverse check plunger
(3) Interlock plunger
(4) Reverse check shaft
(5) Reverse check lever

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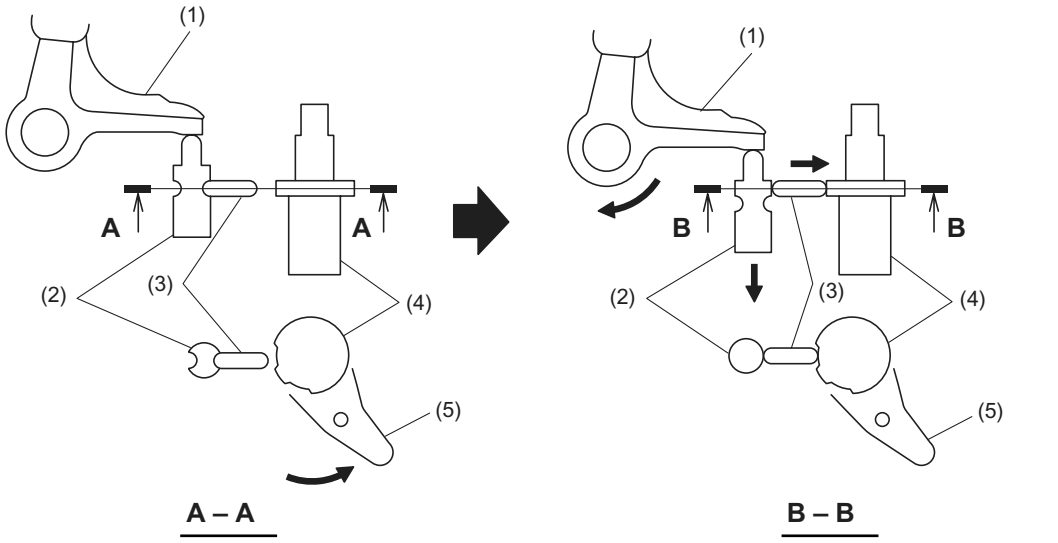
2. MAKING SHIFT INTO REVERSE

When making a shift into reverse, the driver lifts the slider on the shift lever. The upward movement of the slider causes, via the reverse check cable, the reverse check shaft to turn such that the cam lobe on the reverse check shaft becomes clear of the interlock plunger.
The interlock plunger can now move toward the reverse check shaft, allowing the selector arm to turn in the reverse gear selecting direction.



MT-00904

(1) Selector arm
(2) Reverse check plunger
(3) Interlock plunger
(4) Reverse check shaft
(5) Reverse check lever

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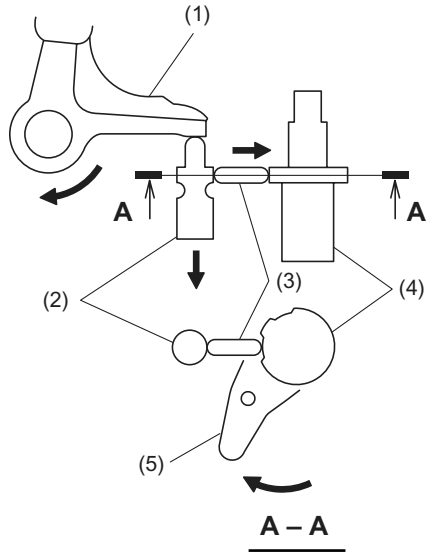
3. FAIL-SAFE OPERATION

Should the reverse check cable be broken, the reverse check shaft turns clockwise by a spring force, making the plunger get clear of the cam lobe of the reverse check shaft.
The plunger can now move toward the reverse check shaft, allowing the selector arm to turn in the reverse gear selecting direction.



MT-00905

(1) Selector arm
(2) Reverse check plunger
(3) Interlock plunger
(4) Reverse check shaft
(5) Reverse check lever

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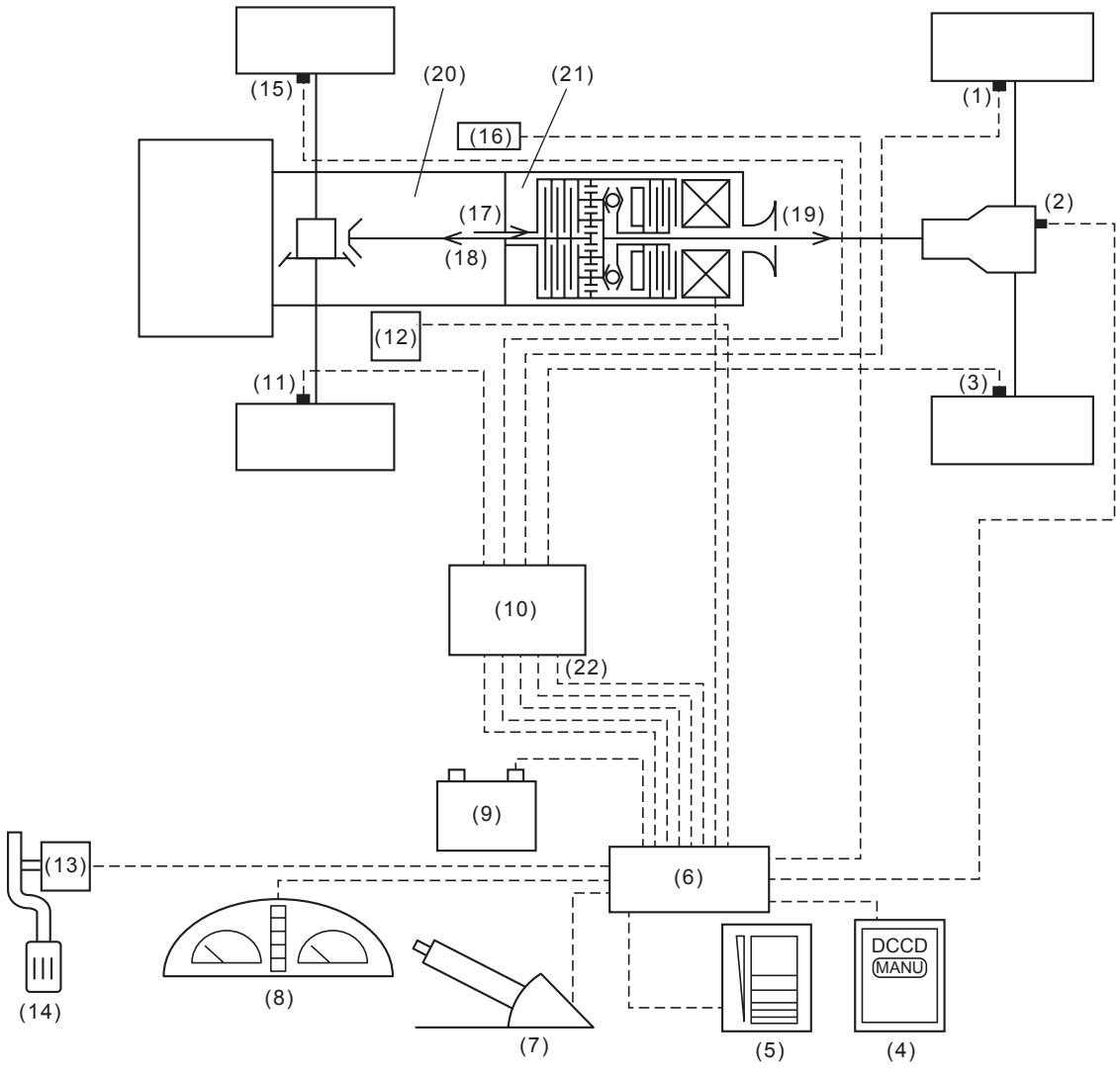
7. Driver-controllable Center Differential System

A: FEATURES

● The driver-controllable center differential system consists of a planetary gear set and electro-magnetically engaged variably controlled multi plate clutches, distributing the drive torque to the front and rear wheels at a ratio of 35 : 65. The driver can optionally change the locking rate of the center differential.

● The system optimally controls the restricting action of the center differential using a computer and works together with the ABS control.



MT-00982

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(1) Wheel speed sensor (RR)
(2) Rear differential oil temperature switch
(3) Wheel speed sensor (RL)
(4) Manual mode switch
(5) Control dial
(6) Driver-controllable center differential unit
(7) Parking brake switch
(8) Driver-controllable center differential indicator light
(9) Battery
(10) ABSCU & H/U
(11) Wheel speed sensor (FL)
(12) Brake light switch
(13) Throttle position sensor
(14) Accelerator pedal
(15) Wheel speed sensor (FR)
(16) Lateral G sensor
(17) Input from main reduction gear
(18) Front output
(19) Rear output
(20) Transmission assembly
(21) Center differential
(22) ABS monitor signal

Control	Auto mode	Manual mode
Hand brake control	yes	yes
Brake control	yes	yes
Center differential control	yes	yes
Fail-safe control	yes	yes
ABS control	yes	yes
Throttle respondent torque control	yes	yes
Slip control	yes	no
Tight cornering control	yes	yes
Volume control	no	yes
Cornering control	yes	no
Rear differential oil control	yes	yes

● Hand brake control
When the hand brake is operated, the current to the coil is lowered to forcibly free the center differential.

● Brake control
Controls the center differential restriction torque toward the free state in response to brake switch input.

● Center differential control
Based on throttle respondent torque control and slip control as basic controls, the differential restriction torque of the center differential is controlled between the free state and locked state through PWM control. Also, information received from other various switches and sensors are used in correcting the instruction torque for center differential control.

● Fail-safe control
If a failure such as breakage of the coil drive element is detected, the coil driving power is turned off and warning indication is given on the meter cluster at a 1 Hz cycle to call attention of the driver. If a failure occurs in any of the sensors, a fixed value is substituted for the value from the failed sensor to maintain control as usual, while activating a warning indication on the meter at a 1 Hz cycle to call attention of the driver.

● ABS control
When the ABS operates, the ABSCU & H/U outputs an activating signal to the center differential control unit to decrease the differential restriction torque of the driver-controllable center differential.

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- Throttle respondent torque control

Controls the restriction torque of the center differential in response to the throttle opening. The restriction torque of the center differential calculated for each mode is corrected using particular values, however, basically toward the locked state when the throttle is wide open or toward the free state when the throttle is fully closed.

- Slip control

Controls the restriction torque of the center differential based on the amount of slip derived from the speed of four wheels.

- Tight cornering control

A correction value is calculated from the left and right wheel speed ratio and applied to the restriction torque of center differential, which is derived from the throttle respondent, slip control, etc.

- Volume control

By operating the control dial, the driver can optionally control the restriction torque of the center differential.

- Cornering control

The restriction torque of center differential is controlled based on a value derived from the throttle opening, lateral G sensor, four wheel speeds, etc.

- Rear differential oil control

When the rear differential oil temperature rises and the oil temperature switch activates, the center differential restriction torque is controlled toward the free state.

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B: INPUT AND OUTPUT SIGNALS

Name	Function
Driver-controllable center differential	In response to the signal from the driver-controllable center differential control unit, the current is varied to change the transmitting torque of the multi-plate clutch and control the differential torque.
Driver-controllable center differential control unit	Processes the signals from various sensors and switches and controls the current to the driver-controllable center differential.
Lateral G sensor	Sends information on acceleration of the vehicle in lateral directions to the driver-controllable center differential control unit.
Driver-controllable center differential indicator light	Indicates the locking rate of the center differential in a range from 0% to 100%.
Manual mode switch	Switches the driver-controllable center differential control mode between auto and manual.
Control dial	Enables to manually select the locking rate of the center differential in a range from 0% to 100%.
Rear differential oil temperature switch	Sends a signal to the driver-controllable center differential control unit if the rear differential oil temperature rises abnormally.
Parking brake switch	Sends information on the parking brake operational status to the driver-controllable center differential control unit.
Stop light switch	Sends information on the brakes' operational status to the driver-controllable center differential control unit.
Throttle position sensor	Sends information on the throttle valve opening to the driver-controllable center differential control unit.
ABSCU & H/U	Sends ABS monitor signals to the driver-controllable center differential control unit.

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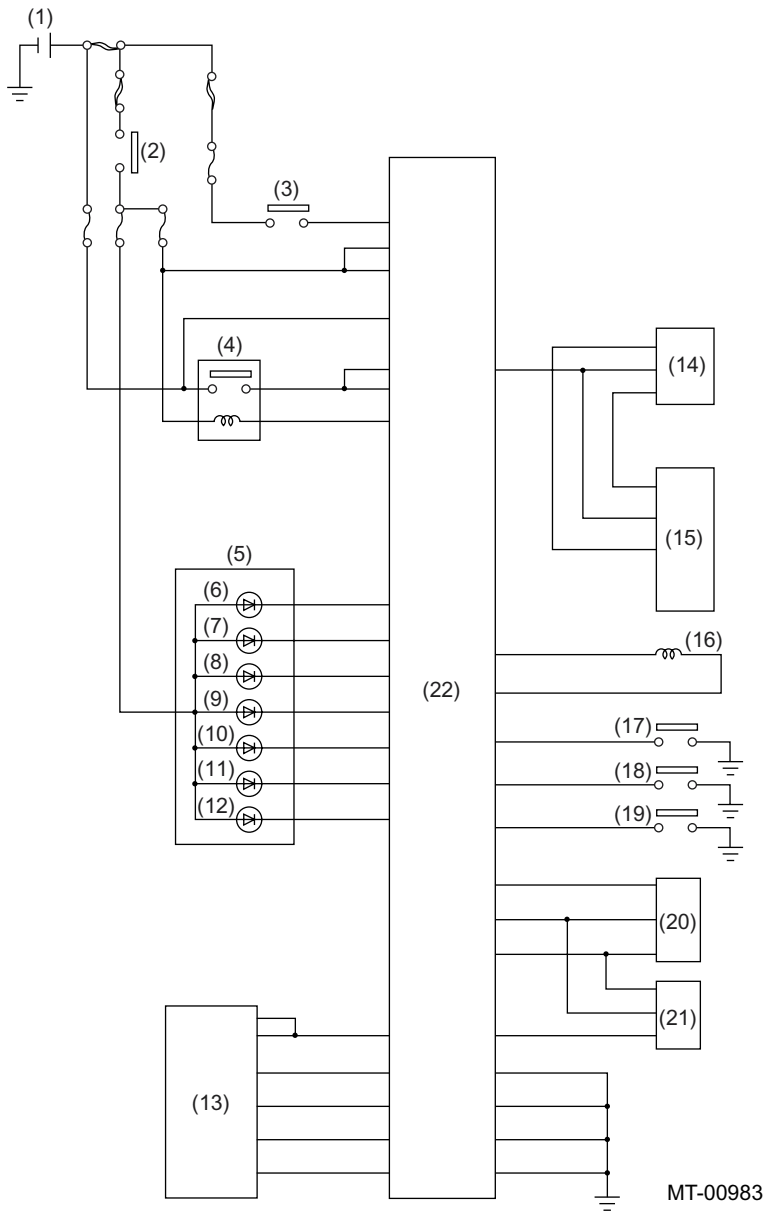

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(1) Battery
(2) Ignition relay
(3) Stop light switch
(4) Driver-controllable center differential relay
(5) Combination meter
(6) Driver-controllable center differential indicator light (0% locked)
(7) Driver-controllable center differential indicator light (15% locked)
(8) Driver-controllable center differential indicator light (35% locked)
(9) Driver-controllable center differential indicator light (65% locked)
(10) Driver-controllable center differential indicator light (85% locked)
(11) Driver-controllable center differential indicator light (100% locked)
(12) Indicator light
(13) ABSCU & HU
(14) Throttle position sensor
(15) Engine control unit
(16) Driver-controllable center differential
(17) Parking brake switch
(18) Manual mode switch
(19) Rear differential oil temperature switch
(20) Control dial
(21) Lateral G sensor
(22) Driver-controllable center differential control unit

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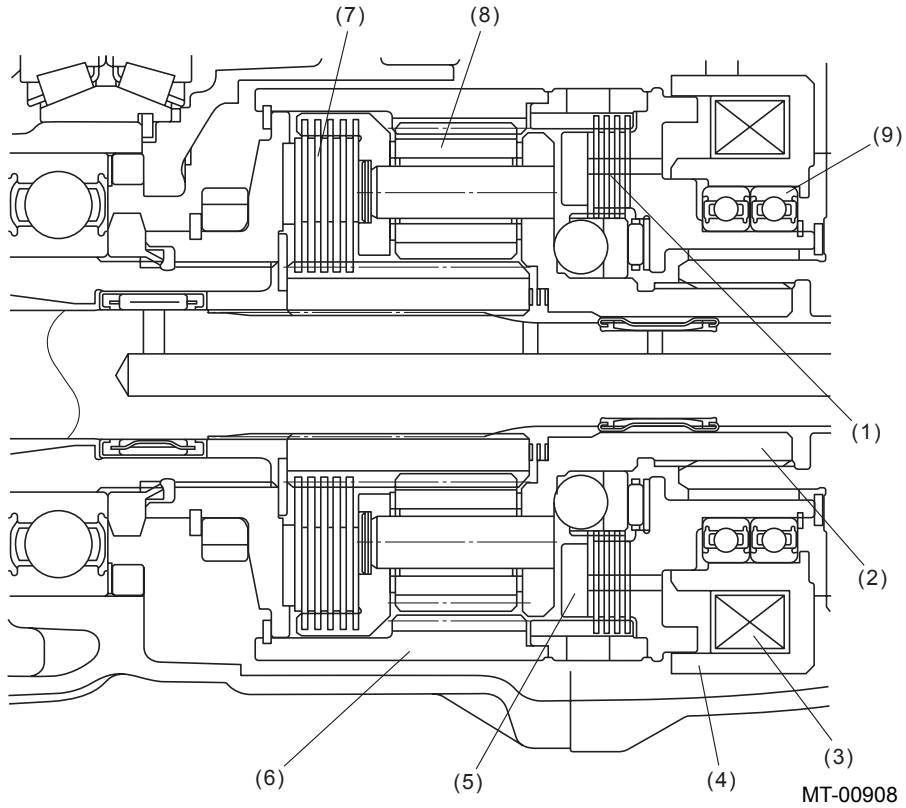
C: DRIVER-CONTROLLABLE CENTER DIFFERENTIAL

● The driver-controllable center differential consists of a differential case, planetary carrier, planetary gears, electro-magnetic coils, armature, main clutch (multi-plate clutch), pilot clutch, and ball bearings.

● The engine torque enters the differential case from the transmission's driven shaft. The torque from the differential case is divided into front and rear directions at the planetary carrier; the torque to the front is transferred from the planetary carrier through the planetary gears to the sun gear, while the torque to the rear is transferred from the transfer drive gear (integrated with the planetary carrier) through the driven gear to the propeller shaft.

● If either of the front or rear wheels spins, the driver-controllable center differential controls the differential action between the front and rear wheels.



(1) Pilot clutch
(2) Planetary carrier
(3) Electro-magnetic coil
(4) Electro-magnet
(5) Armature
(6) Differential case
(7) Main clutch
(8) Planetary gear
(9) Ball bearing

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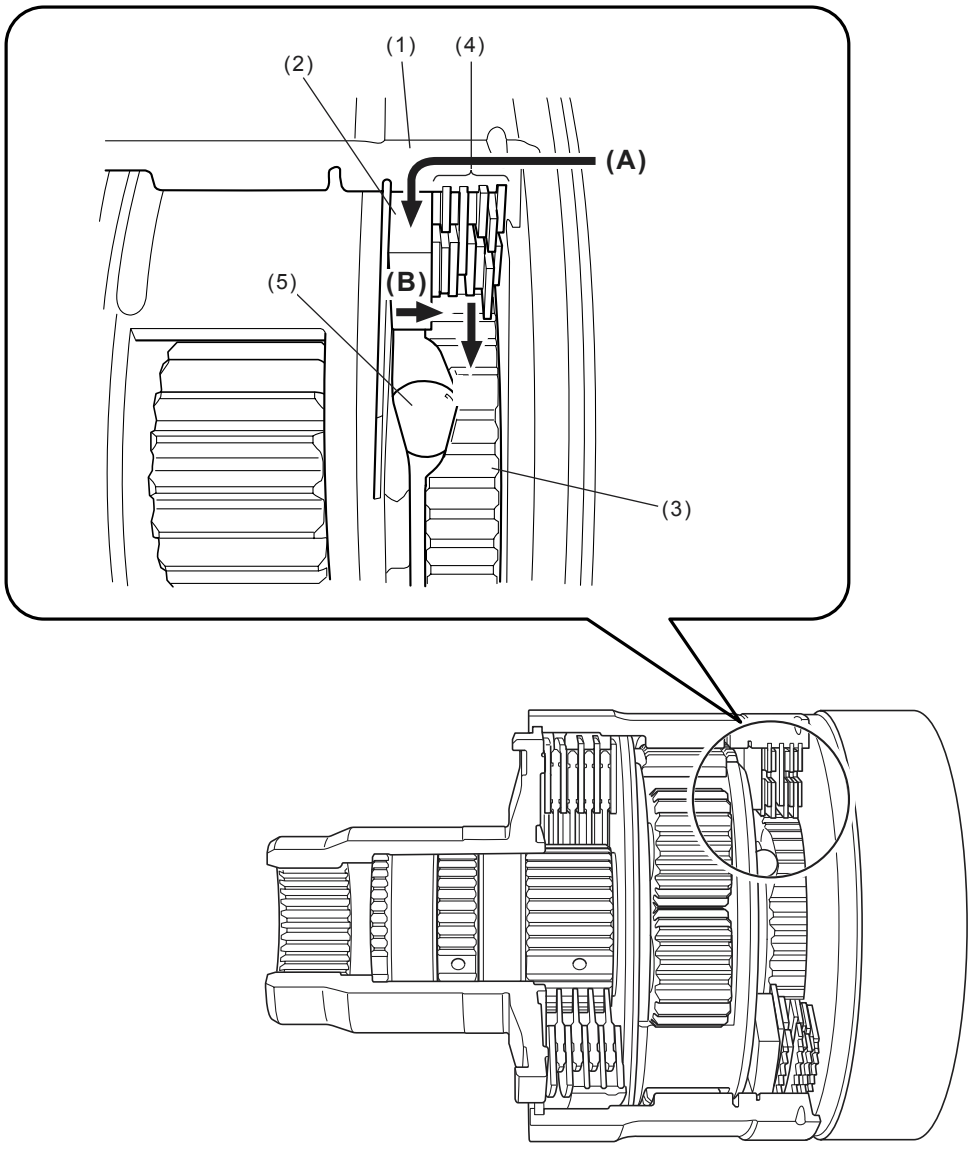
● When current flows through the electromagnetic coils, magnetism is generated at components in the following sequence: electromagnet, differential case, armature (A). The armature is moved to the right (B) by this magnetism causing the pilot clutch to engage, and a magnetic field is formed in the area from the electromagnet, differential case, armature, and to the pilot clutch.
The pilot clutch locks the differential case side and cam 1 side together, thus the rotational speed of the cam 1 and differential case are synchronized. The engagement of the pilot clutch is controlled by adjusting the current flowing through the electromagnetic coils.



MT-00910

(1) Differential case
(2) Armature
(3) Cam 1
(4) Pilot clutch
(5) Steel ball

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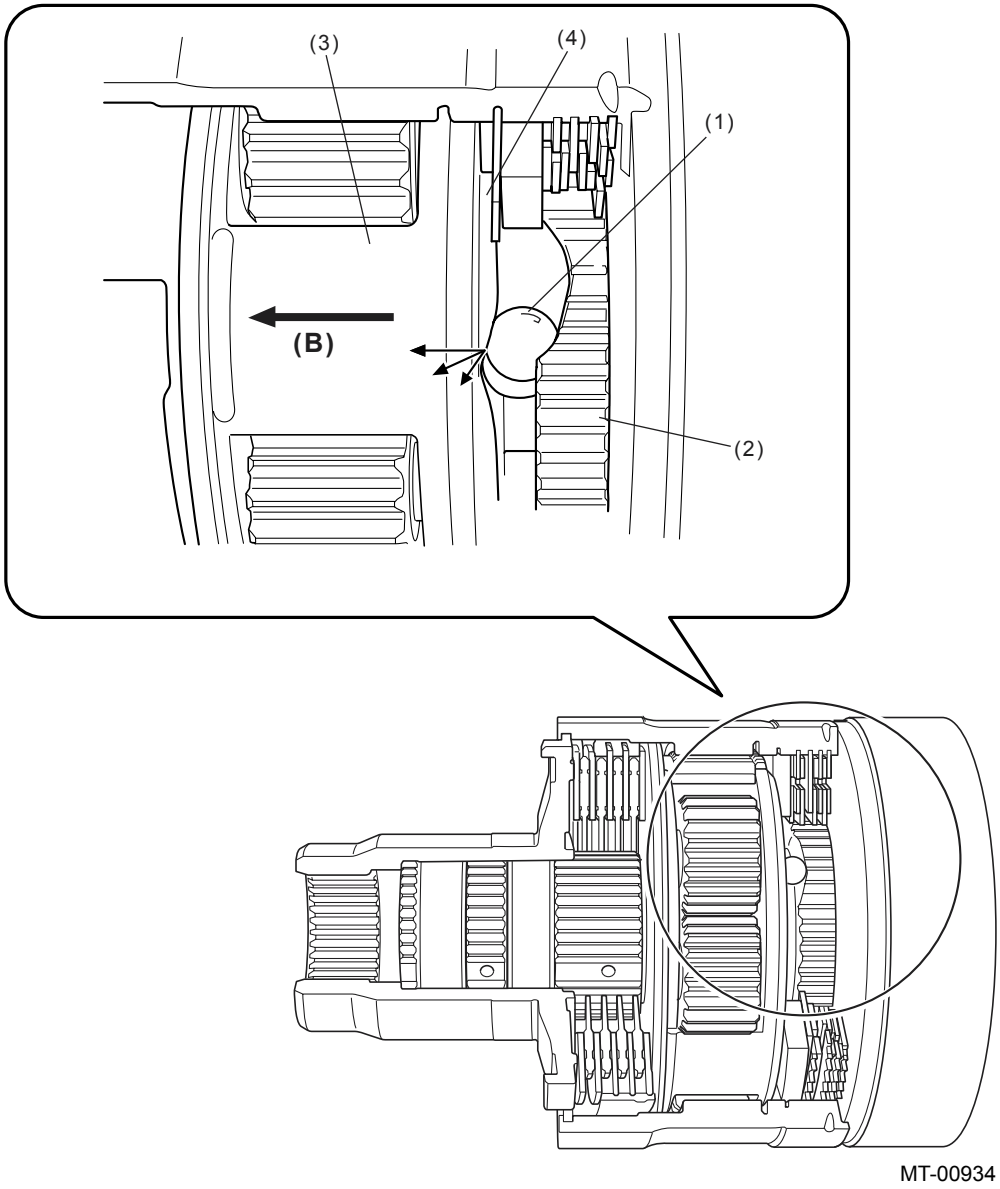
● When a speed difference occurs, a force (B) pushing the cam 2 to the left is generated at the steel balls sandwiched between cam 1 and cam 2, pushing the planetary carrier to the left.



(1) Steel ball
(2) Cam 1
(3) Planetary carrier
(4) Cam 2

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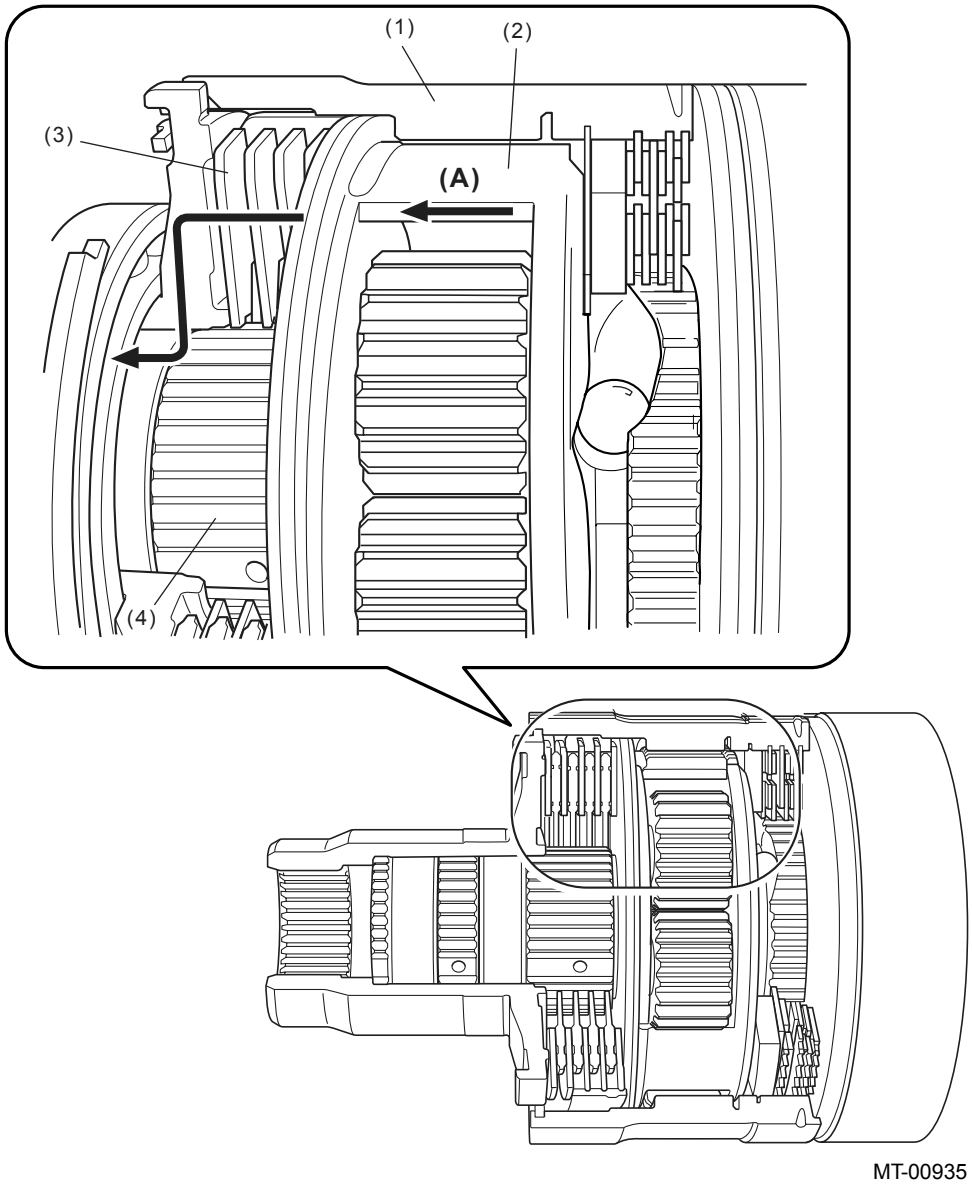
● When the planetary carrier moves to the left (A) , the main clutch is engaged. The main gear locks the planetary gears and the sun gear together to generate a differential action restriction torque.



MT-00935

(1) Differential case
(2) Planetary carrier
(3) Main clutch
(4) Sun gear

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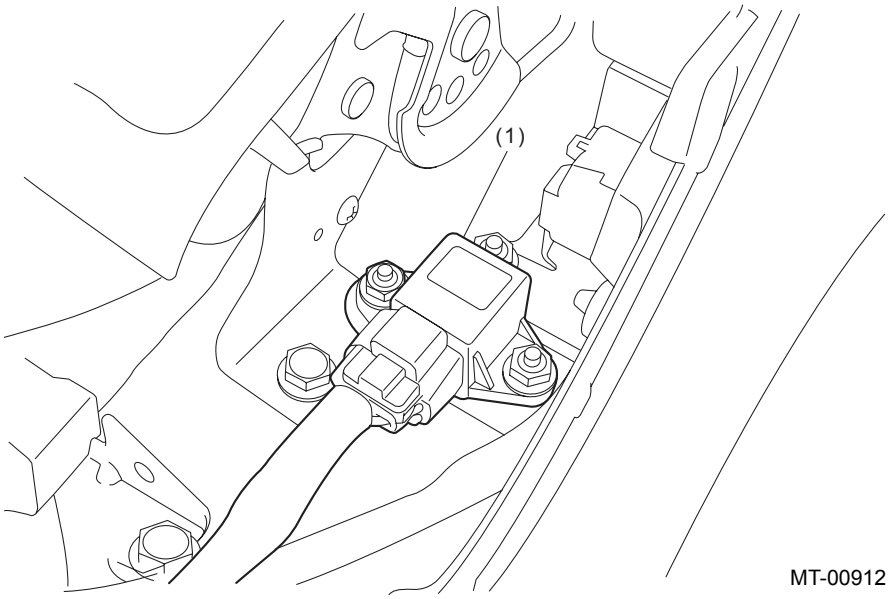
D: LATERAL G SENSOR

A lateral G sensor is installed to the body at inside the console. The lateral G sensor detects the acceleration of the vehicle in the lateral direction and controls the differential action restriction torque.



(1) Lateral G sensor

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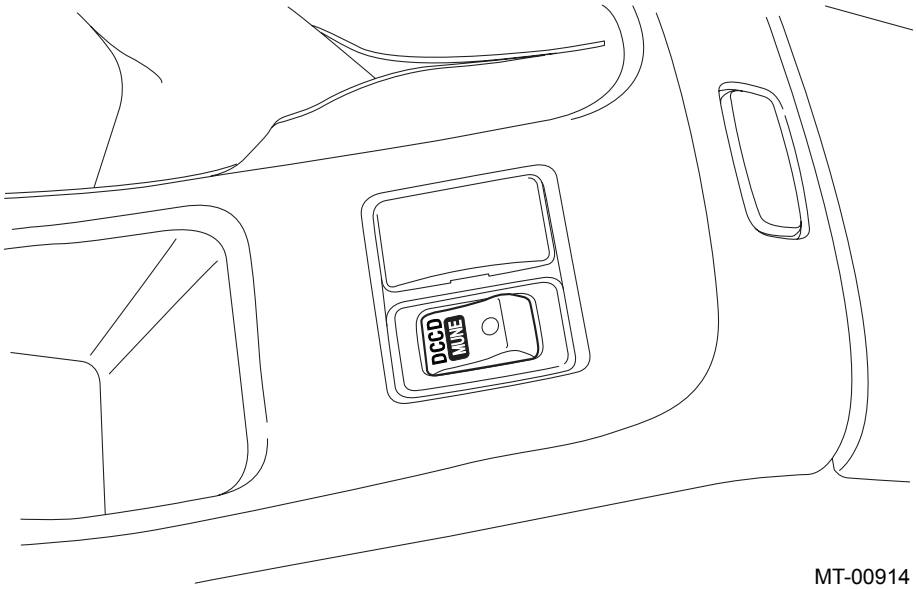
E: MANUAL MODE SWITCH

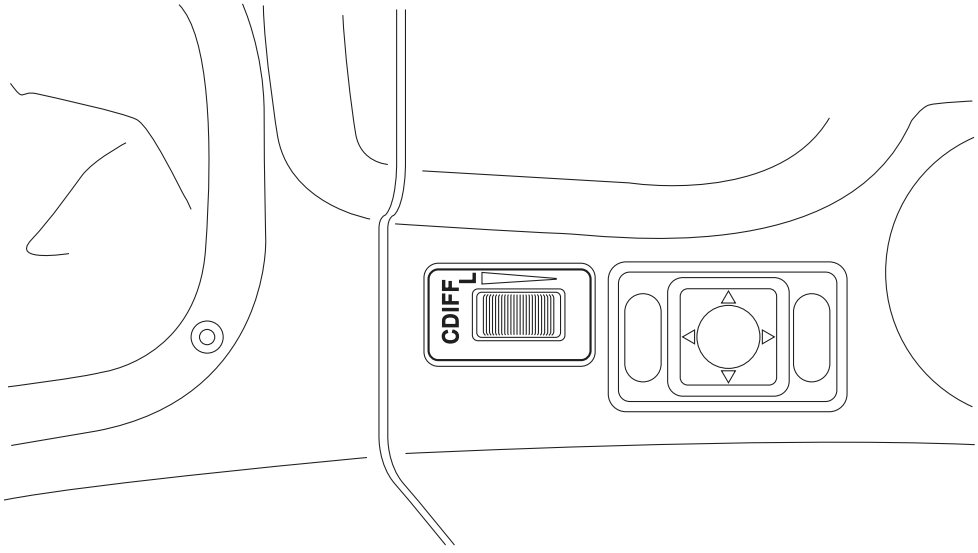
The manual mode switch enables the driver to select the mode (auto mode or manual mode) by pressing the switch each time.



MT-00914

F: CONTROL DIAL

A rotary type switch is provided on the center console enabling the driver to optionally set the front-rear differential action restricting torque in the range between locking rate 0% (free) to 100% (locked). Also, detents are provided between free and locked positions.



MT-00915

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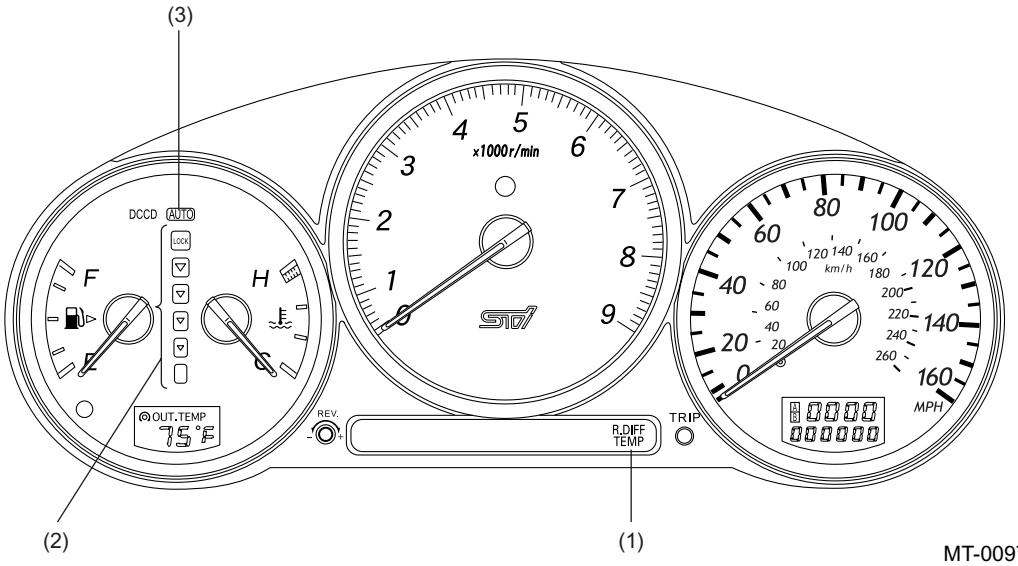
G: DRIVER-CONTROLLABLE CENTER DIFFERENTIAL INDICATOR LIGHT

Driver-controllable indicator lights which indicate the locking rate of the center differential are provided in the meter cluster.
When the driver-controllable center differential is in the auto mode the “AUTO” at the upper part of the meter cluster illuminates, and when in manual mode and the differential restriction torque is varied manually the driver-controllable center differential indicator lights illuminate.
If the control unit detects a fault in a component or unit during self diagnosis, the driver-controllable center differential indicator lights flash until the ignition switch is turned OFF.
Faulty components or units can be identified by reading diagnostic trouble codes (DTC), and faults which occurred in the past can be retrieved from the memory.



(1) Rear differential oil temperature warning light

(2) Driver-controllable center differential indicator light

(3) Driver-controllable differential auto mode indicator light

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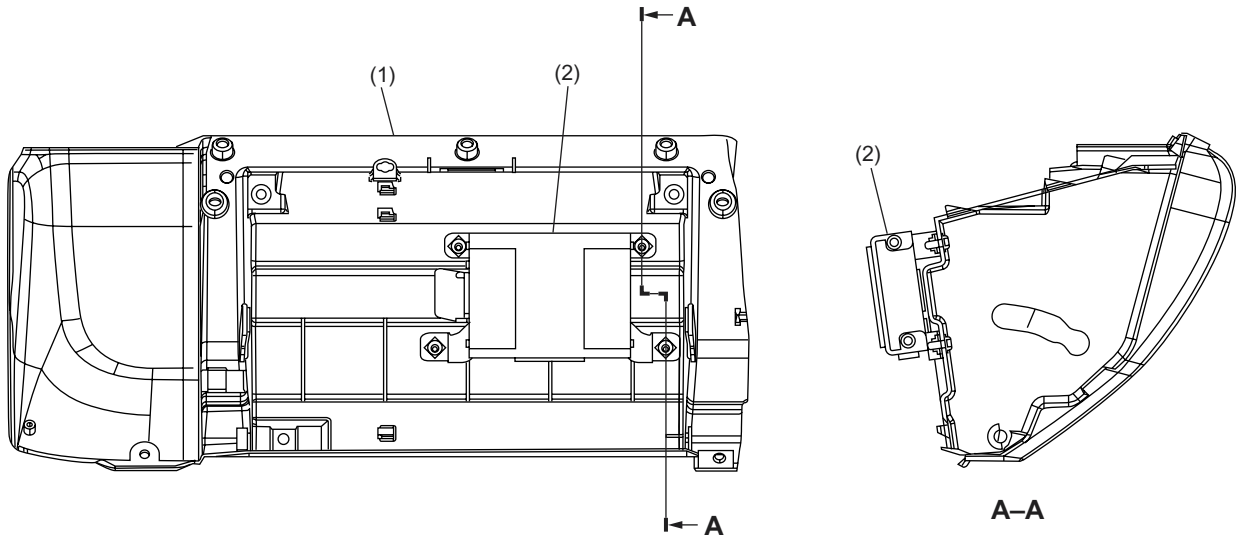
H: DRIVER-CONTROLLABLE CENTER DIFFERENTIAL CONTROL UNIT

The control unit is located behind the glove box at the front passenger's side.
If the control unit detects a fault in a component or unit during self diagnosis, the driver-controllable center differential indicator light (FREE light at the bottom) flashes until the ignition switch is turned OFF.
Faulty components or units can be identified by reading diagnostic trouble codes (DTC), and faults which occurred in the past can be retrieved from the memory. The differential restriction torque of the driver-controllable center differential is controlled based on signals from various sensors and switches, ABS monitor signals and ABS wheel speed signals (from four wheels) from the ABSCU & H/U, and by taking into account the conditions of the road surface and the vehicle.



MT-00978

(1) Glove box
(2) Driver-controllable center differential control unit

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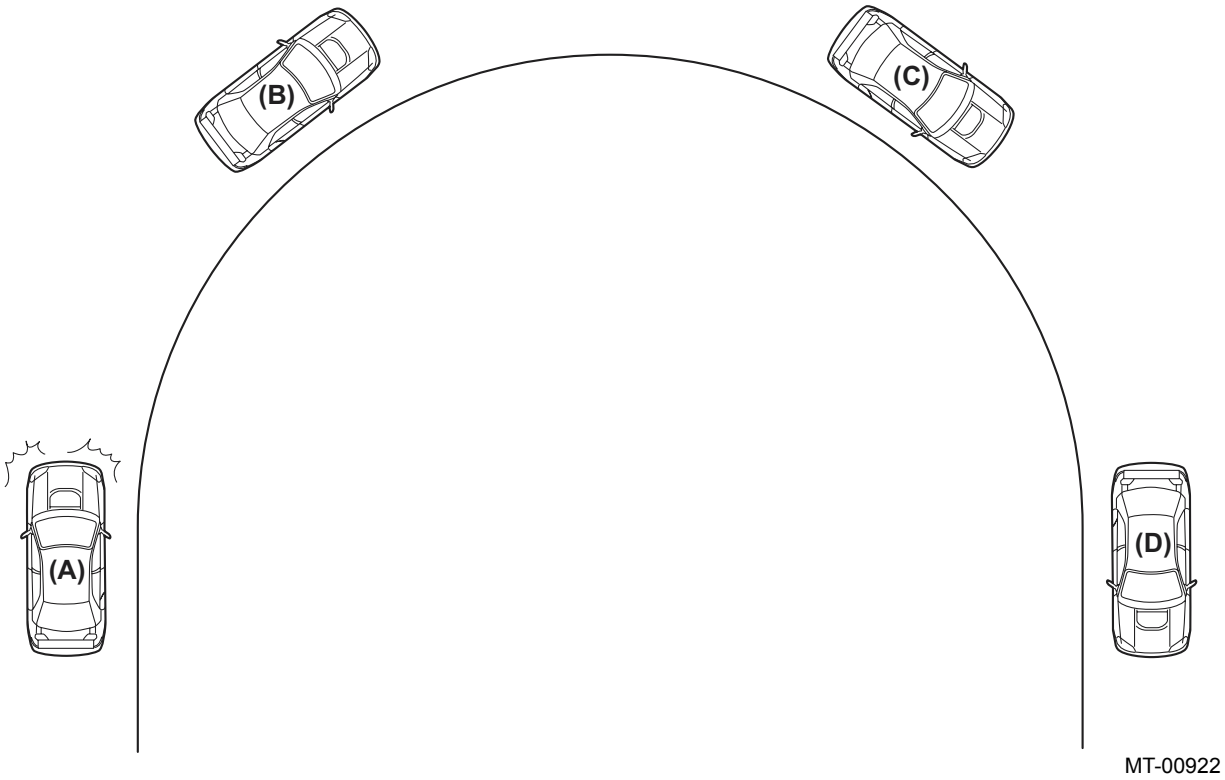
I: OPERATION

● When the vehicle is braked (A) while running:
To enhance safety of the vehicle during braking the restriction force of the center differential is controlled toward the free state.

● When the vehicle is in between the turn-in point (B) and clipping point (C):
When the vehicle is running from the turn-in point toward the clipping point, the throttle opening increases (vehicle accelerates) and a signal from the lateral G sensor is input. Accordingly the center differential restriction torque is gradually increased to improve the cornering ability.

● When the vehicle is in between the clipping point (C) and exit point (D):
When the vehicle is running past the clipping point toward the exit point, the input from the lateral G sensor decreases. Accordingly the control interprets this as the vehicle is tracking out from the corner and increases the restricting force of the center differential toward the locked state to maintain traction.



(A) Braking
(B) Turn-in point
(C) Clipping point
(D) Exit point

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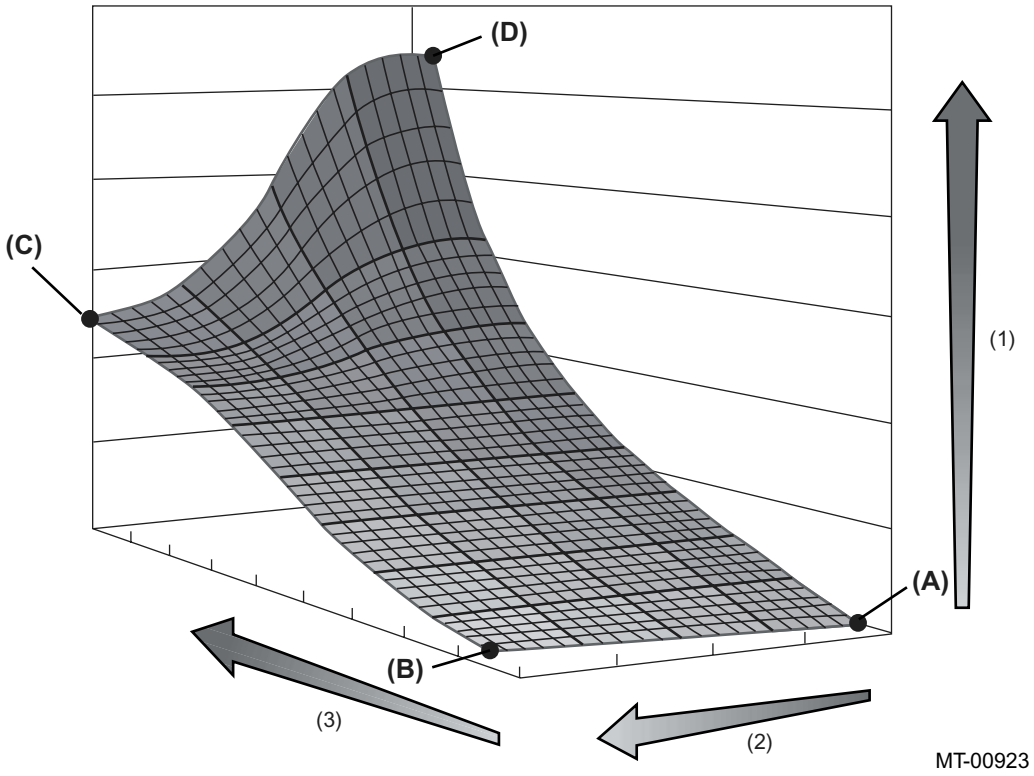

(A) Braking
(B) Turn-in point
(C) Clipping point
(D) Exit point

(1) Center differential restriction torque
(2) Lateral G
(3) Throttle opening

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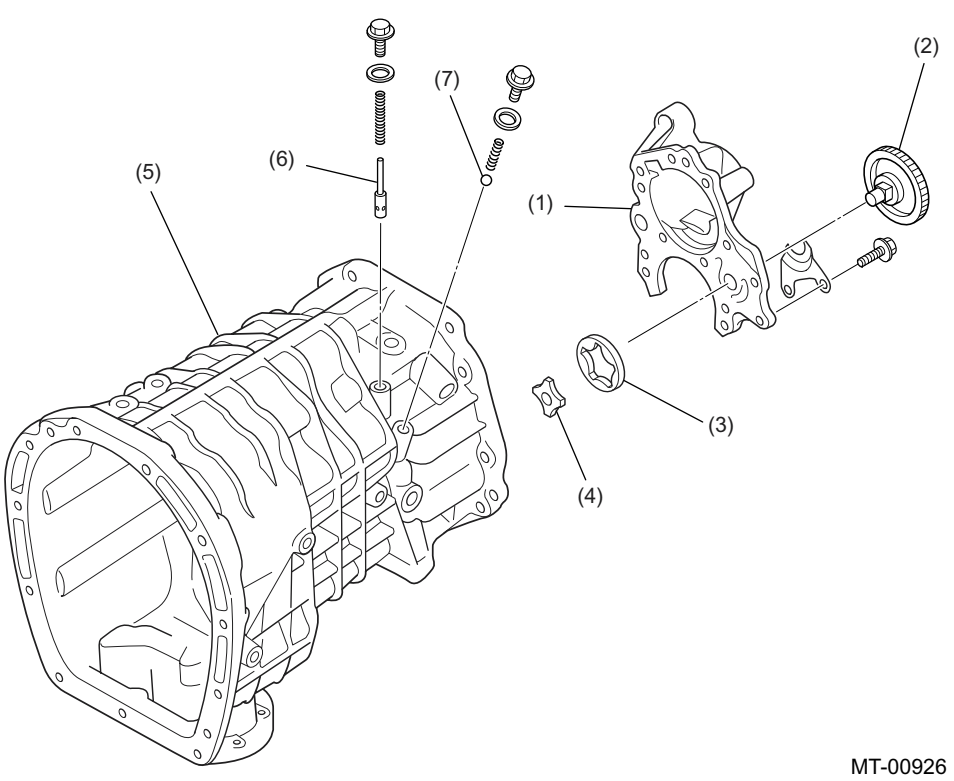
8. Oil Pump

A: CONSTRUCTION

The lubricating oil pump incorporated in the transmission case is of a trochoid type.
The pump consists of an inner rotor having four teeth, outer rotor having five teeth, oil pump cover and oil pump driven gear, which are all located at the rear of the transmission case.
The pump is driven by the drive gear located on the center differential, so the delivery rate varies with the speed of the center differential.
There are a pressure regulator valve and pressure relief valve on the delivery side of the pump.



MT-00926

(1) Oil pump cover
(2) Oil pump driven gear
(3) Outer rotor
(4) Inner rotor
(5) Transmission case
(6) Pressure regulator valve
(7) Pressure relief valve

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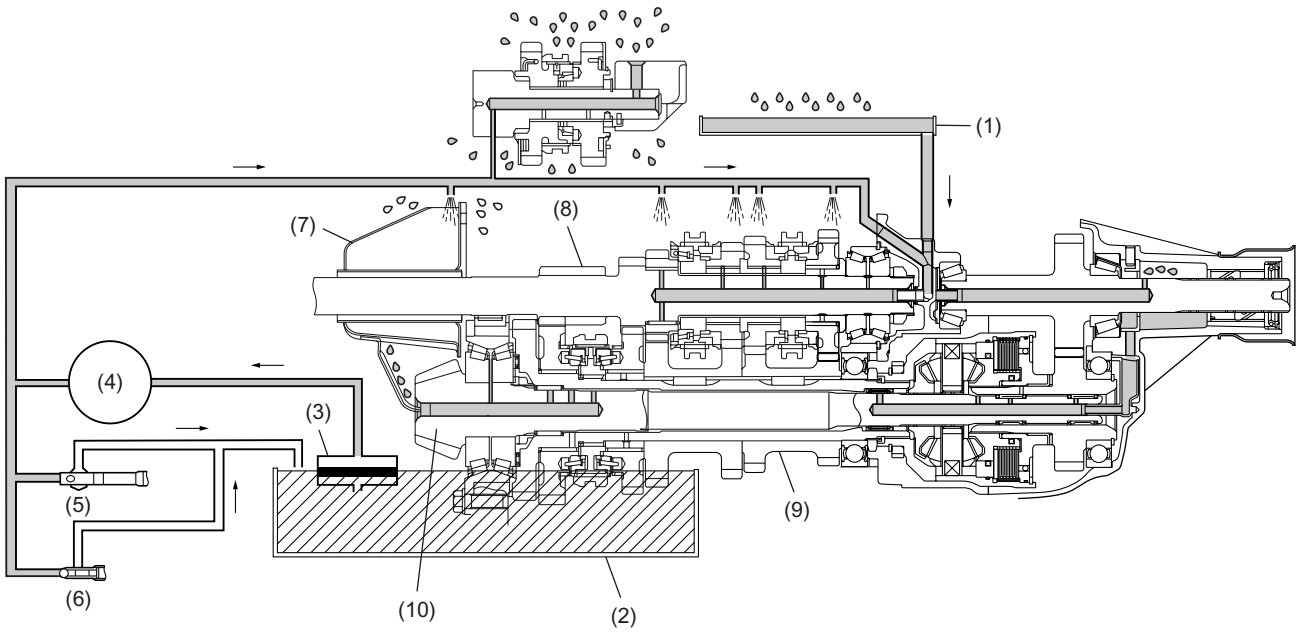
9. Lubrication System

A forced lubrication system using an oil pump has been employed to ensure adequate supply of oil to the components of the six-speed transmission.
The oil (gear oil) from the oil pump is distributed to the oil chamber, main shaft, drive pinion shaft, transfer gears, and other components.
The oil chamber has functions of accumulating oil and supplying with oil the central oil passage in the drive pinion shaft uninterruptedly.
In a conventional transmission without an oil chamber, the oil level is typically maintained at a height corresponding to the midpoint of the driven gear assembly. Such a large amount of gear oil (which has a relatively high viscosity) inflicts considerable frictional resistance on the gears when the transmission is operating. The use of the oil chamber can lower the oil level and thus reduce the friction between gears and oil by temporarily storing oil and supplying gears with it in an adequate amount.



MT-00927

(1) Oil guide
(2) Oil pan
(3) Oil strainer
(4) Oil pump
(5) Pressure regulator valve
(6) Pressure relief valve
(7) Oil chamber
(8) Main shaft
(9) Driven gear assembly
(10) Drive pinion shaft

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10.Front Differential (APTRAC Type Limited Slip Differential)

A: GENERAL

The limited slip differential (LSD) automatically limits the differential action and distributes torque to the left and right wheels adequately to enhance driving stability when the left and right wheels are rotating at speeds different from each other during driving on a slippery road (muddy, snow-covered or slushy road) or cornering.

B: CONSTRUCTION

In the APTRAC differential, there is a set of hexagonally-shaped cam followers placed between and kept in contact with the left and right face cams (which correspond to the side gears in a conventional differential).
The cam followers engage at their outer ends with the slots that are cut on the inner surface of the cage in the axial direction, so they can slide laterally in the slots but must rotate together with the cage. Since the cam followers push the face cams as the cage rotates, the input torque to the cage is transmitted to the axle shafts.
There are a needle bearing and thrust washer pair between the face cam on each side and cage. Moreover, there is a Belleville spring between one of the needle bearing and thrust washer pairs to give preloading, thus ensuring proper initial friction between the cam followers and face cams.

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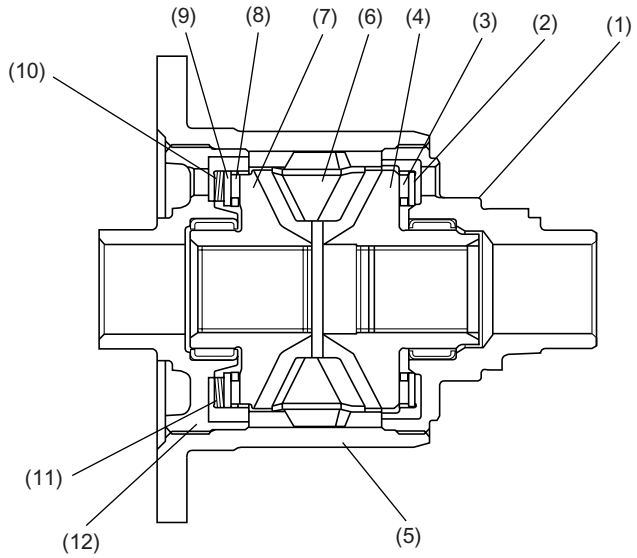

MT-00928

(1) Hub
(2) Thrust washer
(3) Thrust bearing
(4) Face cam
(5) Cage
(6) Cam follower
(7) Face cam
(8) Thrust bearing
(9) Thrust washer
(10) Belleville spring
(11) Shim
(12) Hub

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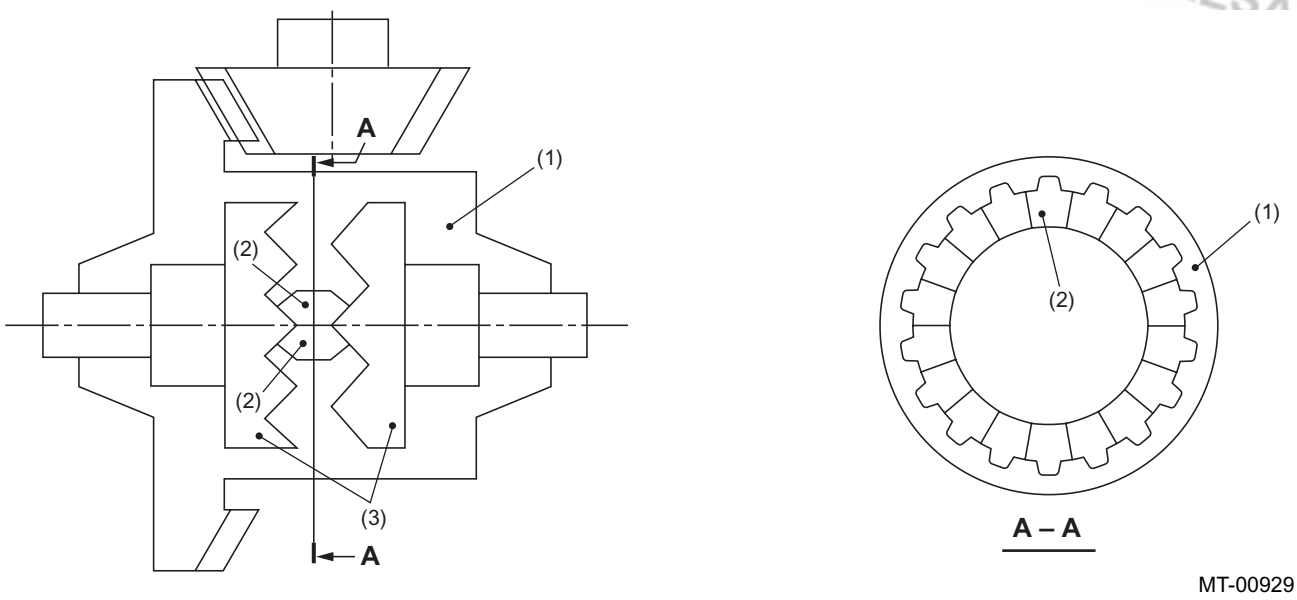

(1) Cage
(2) Cam follower
(3) Face cam

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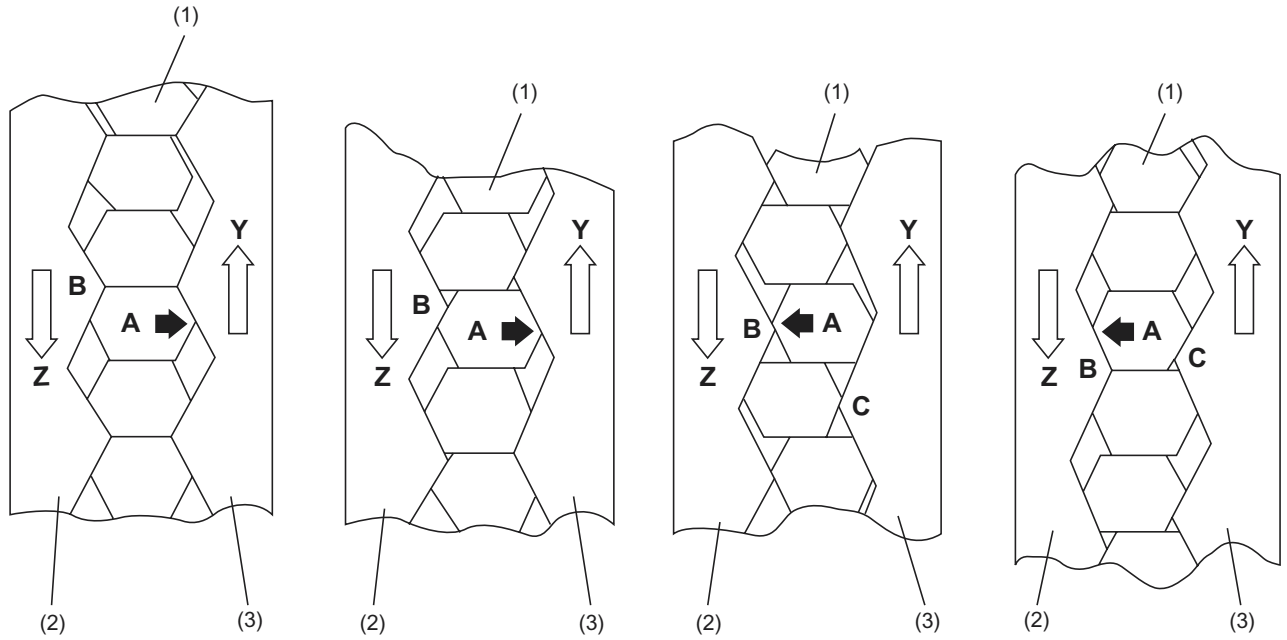
C: OPERATION

1. WHEN RIGHT AND LEFT WHEELS ROTATE AT DIFFERENT SPEEDS

If the left and right wheels move relative to each other in the direction of arrow Z and in the direction of arrow Y, respectively, the cam follower A is pushed by the slope B of the left face cam, moving to the right. Then the cam follower A is pushed by the slope C of the right face cam, now moving to the left.
Likewise, all the other cam followers also repeat rightward and leftward movements as long as the right and left wheels continue rotating at different speeds, so the vehicle can turn a corner smoothly.



MT-00930

(1) Cam follower
(2) Left face cam
(3) Right face cam

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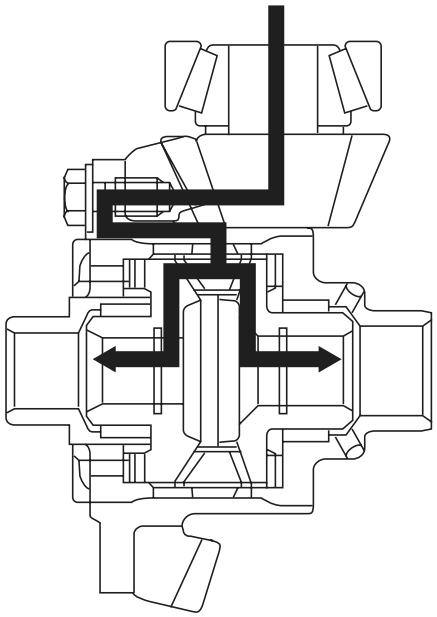
2. WHEN RIGHT AND LEFT WHEELS ROTATE AT THE SAME SPEED

During normal straight-ahead driving where the right and left wheels rotate at the same speed, the cage and cam followers rotate together, just as in conventional differentials. As a result, driving torque is distributed equally to the right and left side gears.



MT-00931

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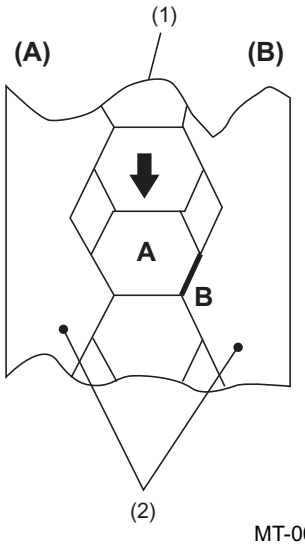
3. WHEN TRACTION IS DIFFERENT BETWEEN RIGHT AND LEFT WHEELS

For example, if the left wheel spins on a slippery surface and loses traction, the left face cam starts rotating at a speed faster than the right wheel.
Like when the right and left wheels rotate at different speeds mentioned earlier, the cam follower A starts moving to the left.
This time, however, as the right wheel has traction, the drive torque pushes the cam follower A strongly against the right face cam when it makes the cam follower get over the slope B of the face cam, generating a large friction force between the contacting surfaces (shown by a thick line in the drawing).
This large friction force allows the drive torque to be transmitted to the right wheel.
In this way, the APTRAC differential can keep the drive torque distributed to a wheel with traction even when the other wheel spins and loses traction.



MT-00932

(1) Cam follower
(2) Face cam
(A) High speed rotation
(B) Low speed rotation

D: SERVICE PROCEDURES FOR LSD

It is not recommended to disassemble this LSD assembly as components of this LSD assembly are not available individually.

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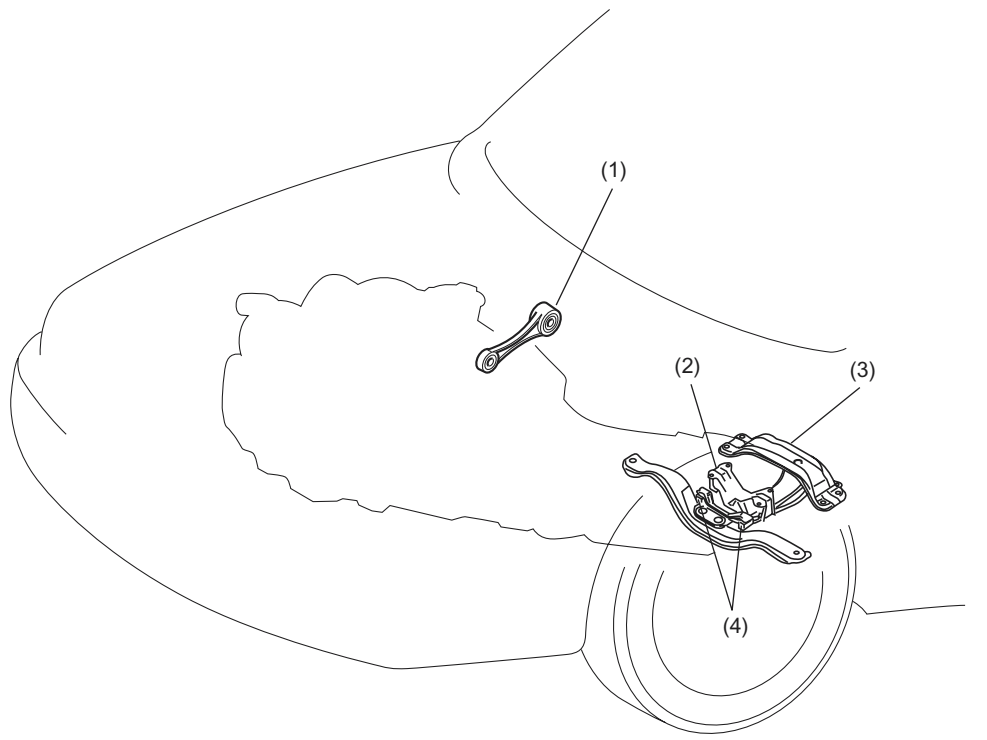
11.Transmission Mounting



MT-00933

(1) Pitching stopper
(2) Cushion rubber
(3) Cross member
(4) Dynamic damper

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AIRBAG SYSTEM

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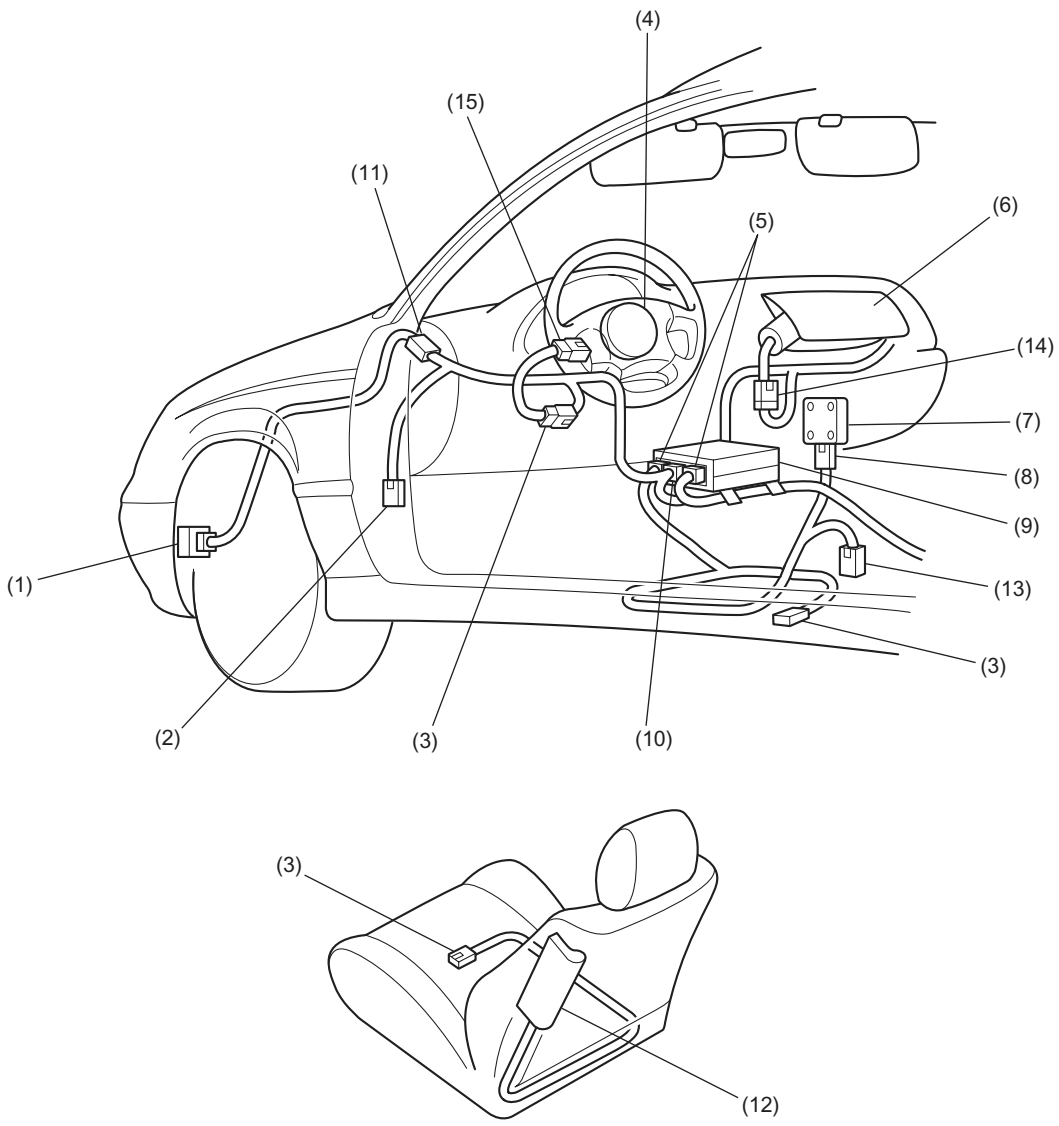
1. Airbag System

A: CONSTRUCTION



(1) Front sub sensor
(2) 6-pin connector (yellow)
(3) 2-pin connector (yellow)
(4) Airbag module (driver)
(5) 12-pin connector (yellow)
(6) Airbag module (passenger)
(7) Side airbag sensor
(8) 4-pin connector (yellow)
(9) Airbag control module
(10) 28-pin connector (yellow)
(11) 2-pin connector (yellow)
(12) Airbag module (side)
(13) 2-pin connector (black) (to seat belt pretensioner)
(14) 2-pin connector (yellow)
(15) 2-pin connector (black)

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B: FUNCTION

1. FRONT AIRBAG

The airbag system is provided as a driver and front passenger restraint system supplementary to the seat belts. When an impact greater than a set level is applied to the front of the vehicle, the airbag control module activates the airbag modules in response to the signal from the sensor. The airbag modules activate to inflate the airbags, thus preventing the driver's and passenger's upper bodies from directly hitting against the steering wheel, instrument panel and/or windshield.

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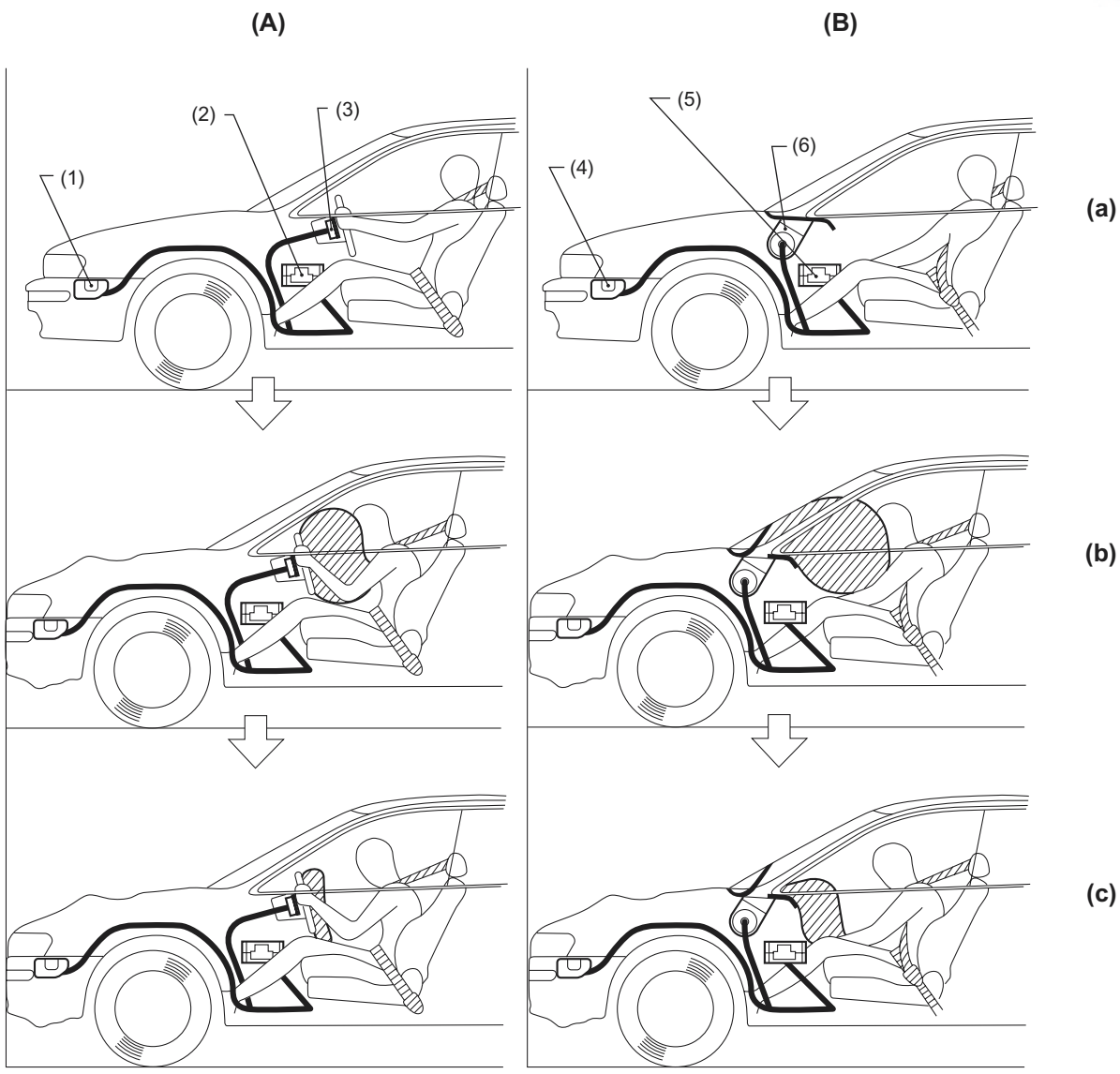
AIRBAG SYSTEM

AIRBAG SYSTEM



AB-00090

(A) Driver's side

(B) Passenger's side

(1) Front sub sensor

(2) Safety sensor and electric sensor

(3) Inflator

(4) Front sub sensor

(5) Safety sensor and electric sensor

(6) Inflator

(a) • Collision occurs.

(b) • Front sub sensor, electric sensor and safety sensor detect an impact greater than the set level.

• Inflators is ignited.

• Gas is generated.

• Airbag inflation completes.

• Gas is discharged.

(c) • Airbags deflate.

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AIRBAG SYSTEM

2. SIDE AIRBAG

The side airbags provide the driver and front passenger with a restraint supplementary to that by the seat belts in the event of a side-on collision. When an impact greater than the set level is applied to either side of the vehicle, the airbag control module activates the corresponding side airbag module in response to the ignition signal sent from the side airbag sensor on the relevant side. The side airbag module operates to inflate the airbag, thus reducing the shock inflicted in the outside upper body (chest and head) of the driver or front passenger.

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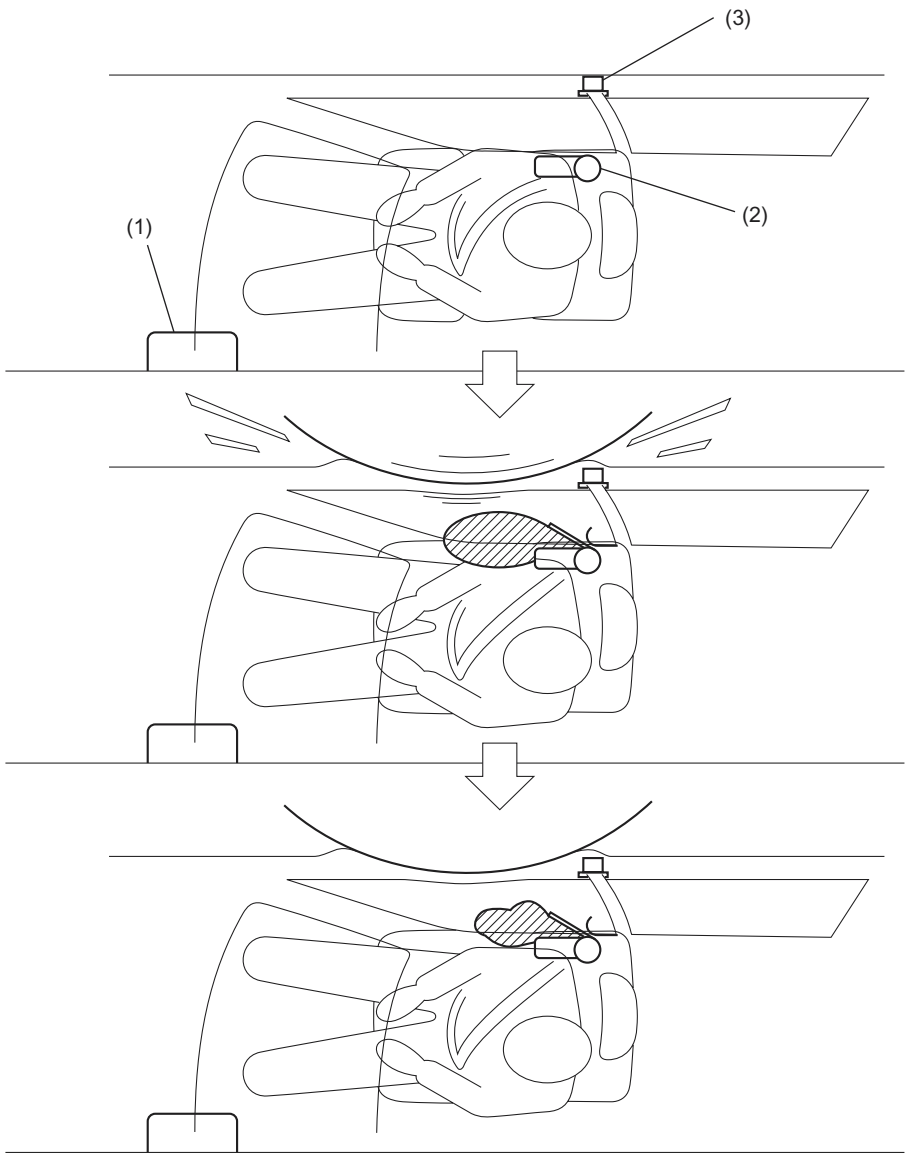
AIRBAG SYSTEM



(1) Airbag control module

(2) Inflator

(3) Side airbag sensor

(A) • Collision occurs.

(B) • The side airbag sensor detects an impact greater than the set level.
- Inflators is ignited.
- Gas is generated.
- Airbag inflation completes.
- Gas is discharged.

(C) • Airbags deflate.

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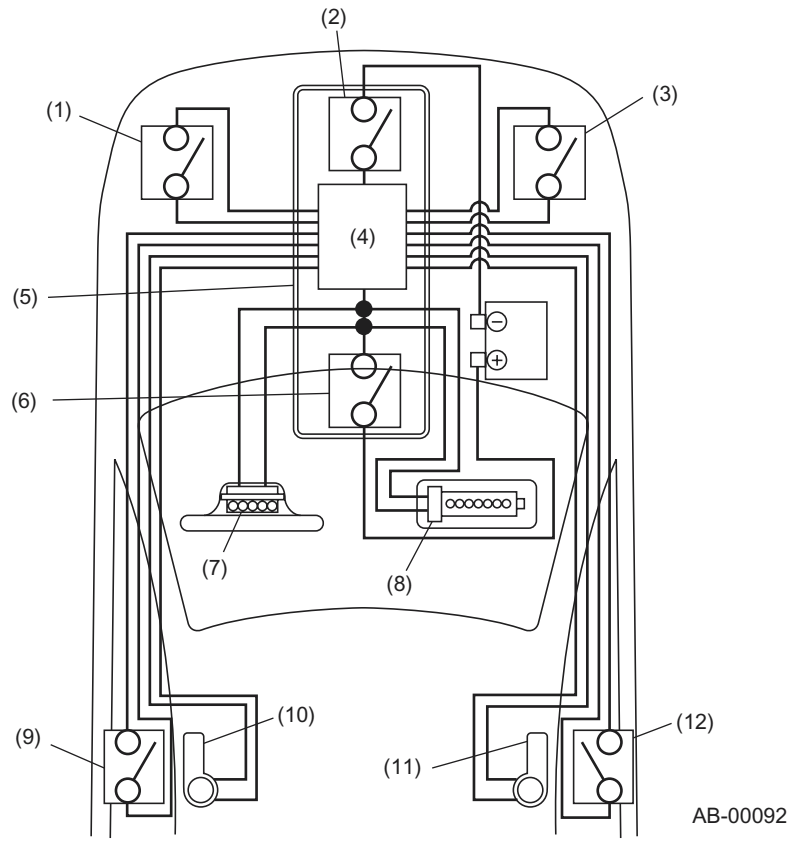
2. Construction

A: GENERAL

● The airbag system consists of an airbag control module, left and right front sub sensors, an electric sensor and safety sensor built into the control module, driver's and passenger's airbag modules each containing an inflator and airbag, and side airbag sensors and modules each containing an inflator and airbag (side airbag equipped models).

● Front airbag system:
A frontal impact exceeding the set level causes the safety sensor, electric sensor and one or both front sub sensors to input impact signals to the CPU. The CPU determines whether the airbags should be inflated or not based on these signals.

● Side airbag system:
Input of a side impact signal showing shock energy greater than the set level causes the airbag on the corresponding side to inflate.



(1) Front sub sensor LH
(2) Safety sensor
(3) Front sub sensor RH
(4) CPU
(5) Airbag control module
(6) Electric sensor
(7) Inflator (driver's seat)
(8) Inflator (passenger's seat)
(9) Side airbag sensor LH
(10) Side inflator LH
(11) Side inflator RH
(12) Side airbag sensor RH

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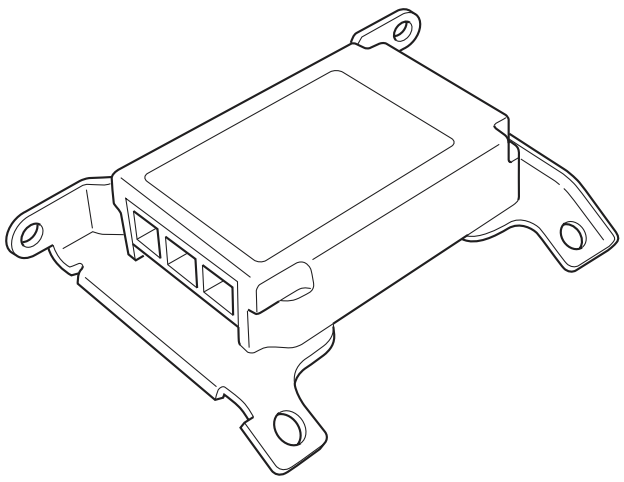
B: AIRBAG CONTROL MODULE

The airbag control module is installed in front of the front floor tunnel. It detects the vehicle's deceleration by receiving electrical signals from its inside safety and electric sensors as well as the front sub sensors and judges whether to inflate the airbags. This control module has a built-in self-diagnosis function. If a fault occurs inside the system, it lights up the airbag warning light in the combination meter. The fault data is stored in the control 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 control module in case of a battery voltage drop.



AB-00093

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C: AIRBAG SENSOR

The airbag control module and side airbag sensor contain an electric sensor and a safety sensor.

The electric sensor consists of a semiconductor type sensor which senses the deceleration caused by collision in terms of change in the electrical resistance of the impact sensing circuit.

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

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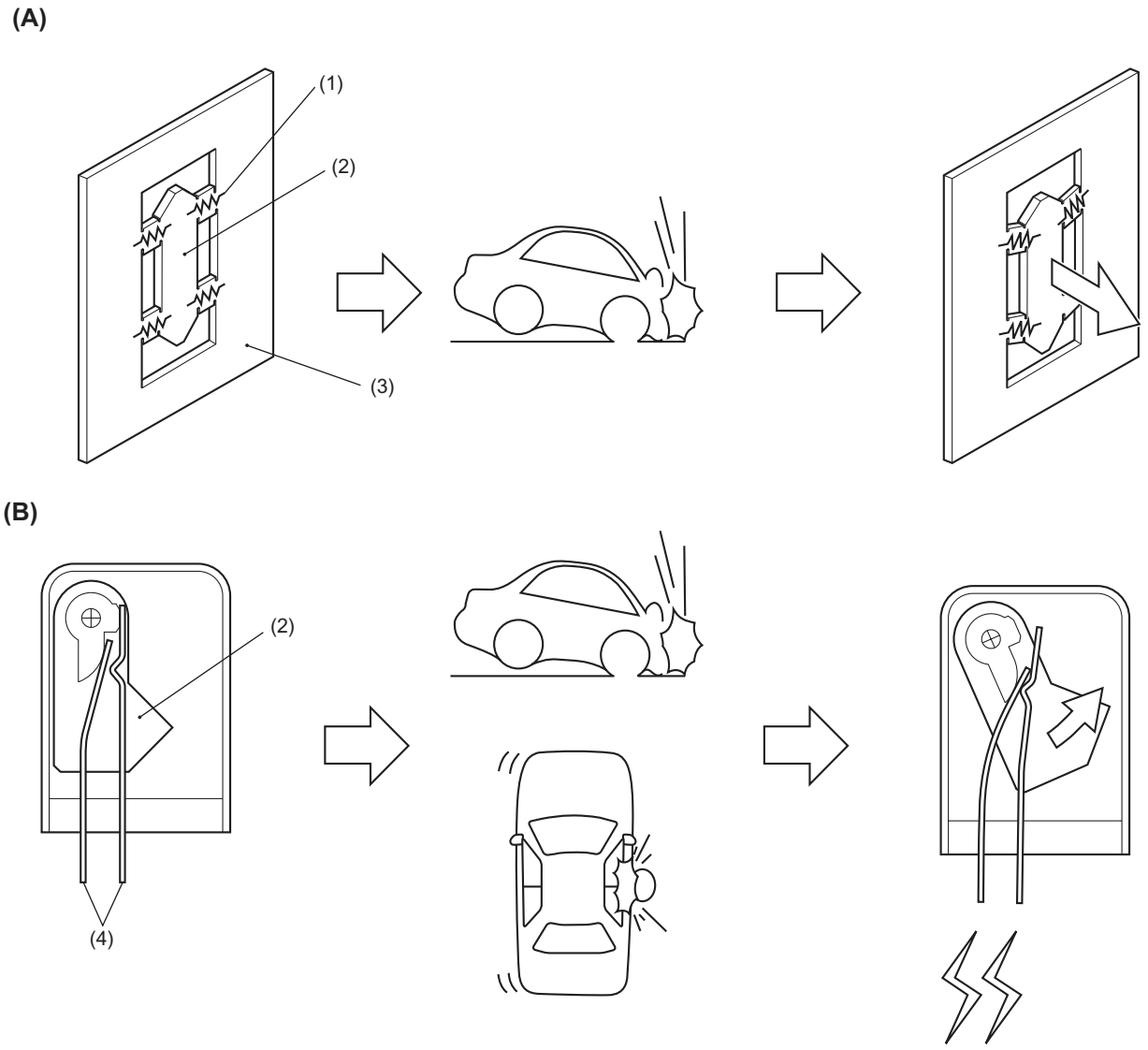

AB-00094

(A) Electric sensor
(B) Safety sensor

(1) Electrical resistance
(2) Mass
(3) Semiconductor
(4) Switch contacts

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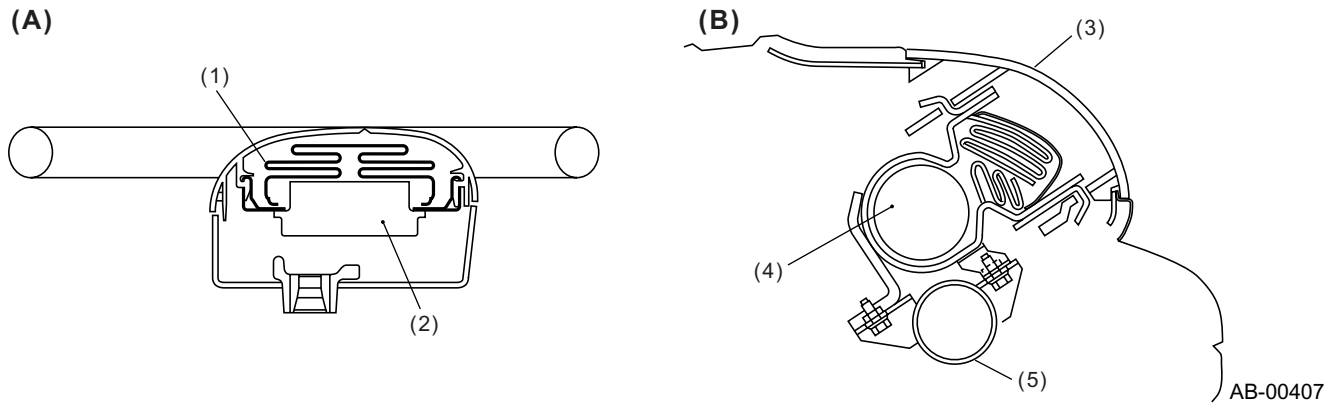
D: AIRBAG MODULE

1. FRONT AIRBAG

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



(A) Driver's module
(1) Air bag
(2) Inflator (Driver's seat)
(3) Airbag module lid

(B) Passenger's module
(4) Inflator (passenger)
(5) Steering support beam

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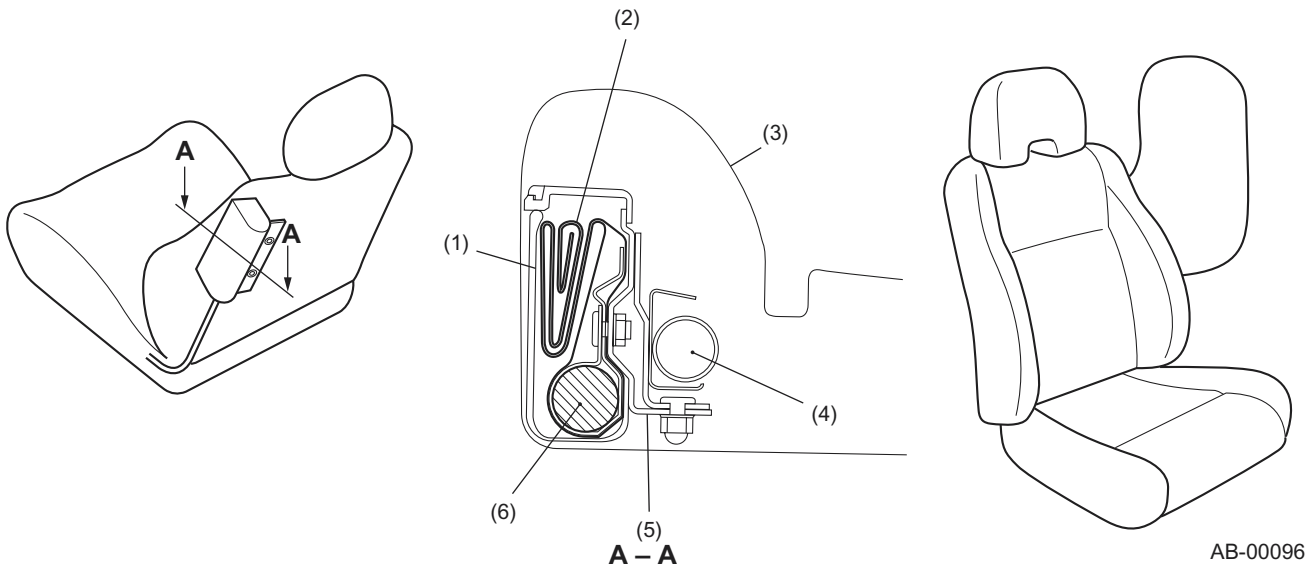
2. SIDE AIRBAG

A side airbag module is located at the outer side of each front seat backrest, and it contains an airbag and an inflator.
If a side-on collision occurs, the inflator produces a large volume of gas to inflate the airbag in a very short time.



(1) Cover
(2) Air bag
(3) Seat upholstery
(4) Seat frame
(5) Bracket
(6) Inflator

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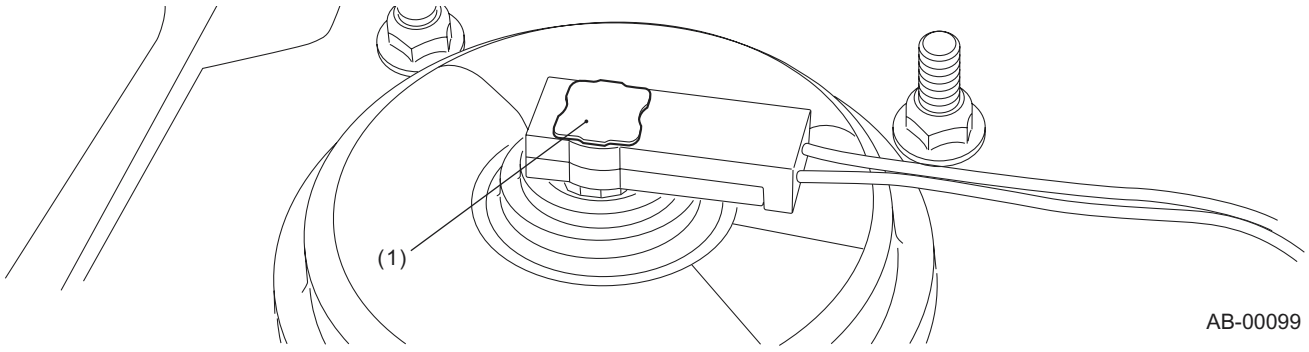
E: AIRBAG CONNECTORS

1. GENERAL

The airbag system uses connectors with a double lock mechanism and an incomplete coupling detection mechanism for enhanced reliability. If coupling is incomplete, the airbag warning light comes on in the combination meter.

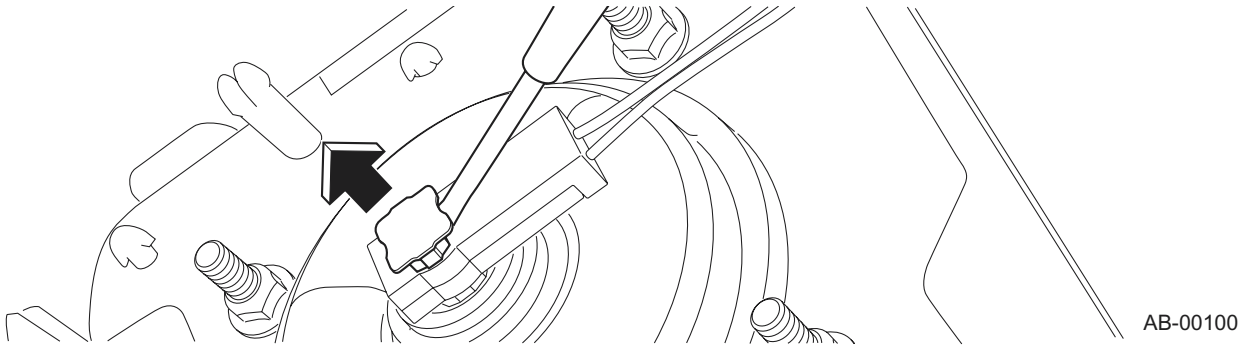
2. DRIVER'S AIRBAG MODULE-TO-ROLL CONNECTOR HARNESS CONNECTOR



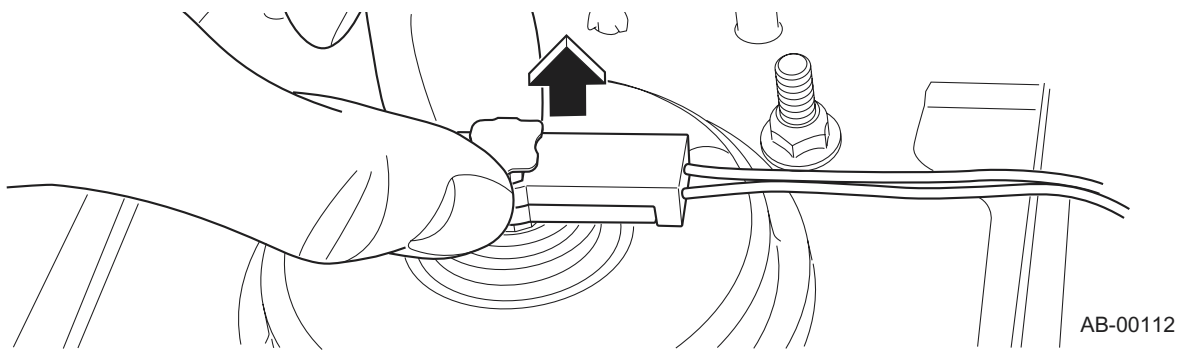
(1) Lock button

Disconnection:

1) Lift the lock button using a thin tipped tool like a miniature screwdriver.



2) Pull the connector out from the airbag module.



Connection:

Carefully insert the connector into the airbag module. Push the connector until a "click" is heard from the lock button.

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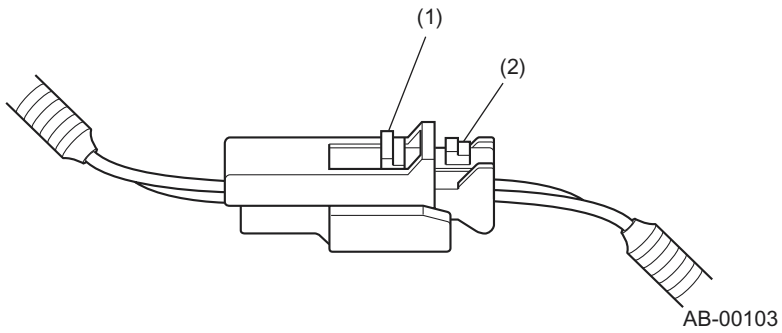
3. AIRBAG HARNESS-TO-AIRBAG HARNESS CONNECTOR



(1) Slide lock

(2) Lock arm

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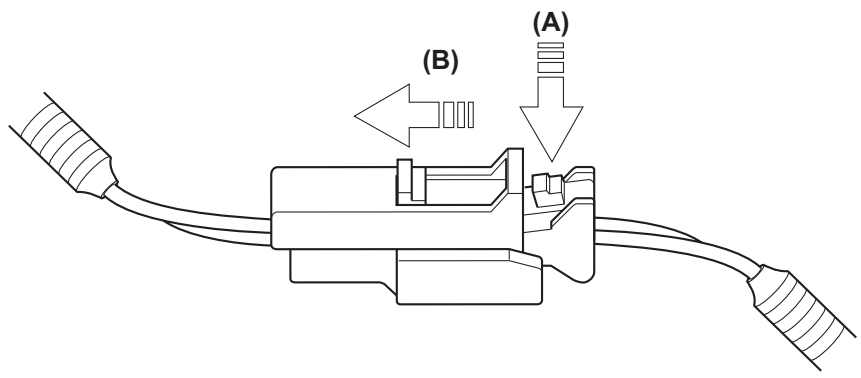
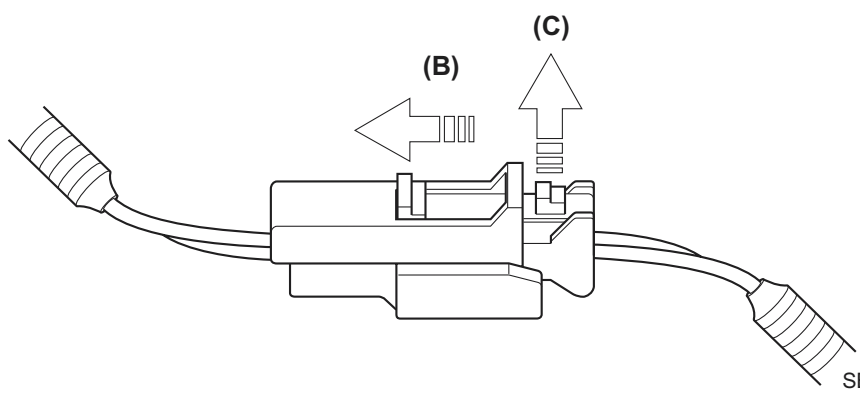
Disconnection:

1)



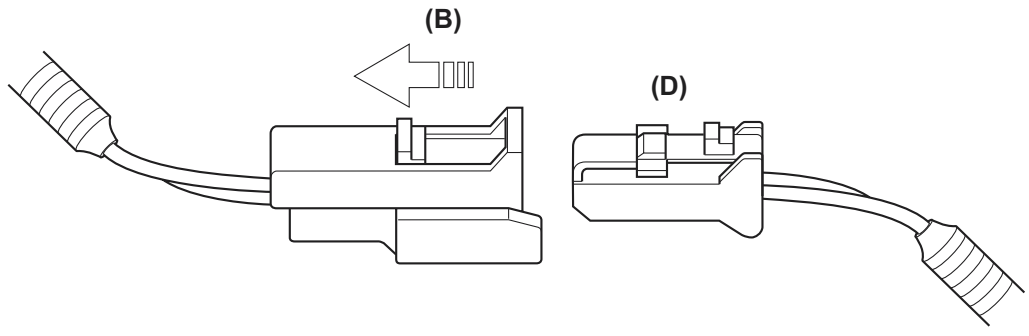
SB-00061

2)



SB-00062

3)



SB-00063

(A) Step 1: Push
(B) Step 2: Slide and hold
(C) Step 3: Release
(D) Step 4: Disconnect

Connection:

Insert the female side connector half into the other until a “click” is heard.

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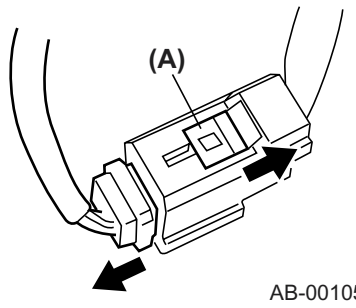
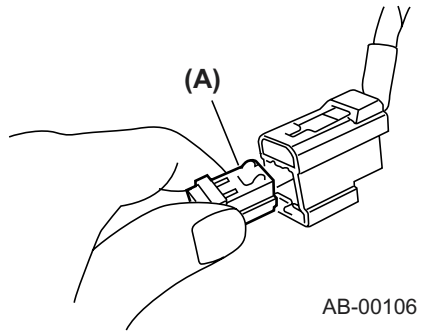
4. AIRBAG HARNESS-TO-BODY HARNESS CONNECTOR AND AIRBAG HARNESS TO FRONT SUB SENSOR HARNESS CONNECTOR

Disconnection:
Hold slide lock (A) moved in the direction of the arrow, then pull the female connector in the direction of the arrow.



AB-00105

Connection:
Push the connector (A) into the male connector carefully until a “click” is heard.



AB-00106

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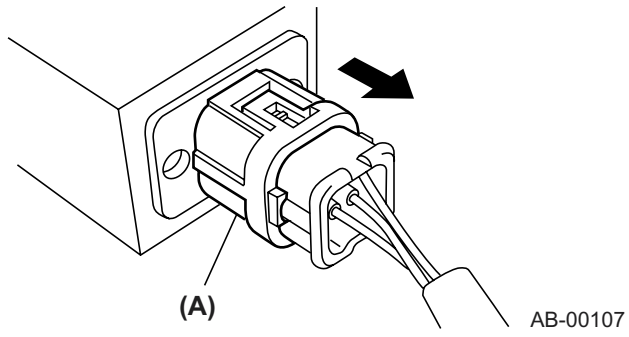
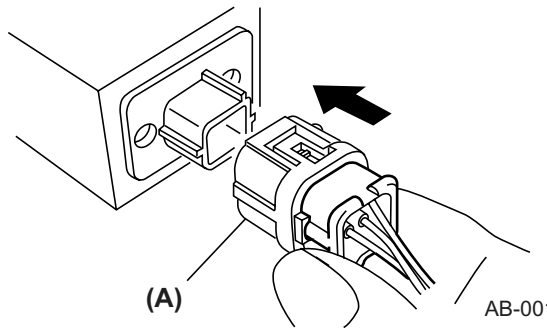
5. FRONT SUB SENSOR AND SIDE AIRBAG SENSOR CONNECTORS

Disconnection:
Holding the outer part (A), pull the connector in the direction of the arrow.



AB-00107

Connection:
Holding the inner part, push the connector into the socket carefully until a “click” is heard.Do not hold the outer part (A) as it moves back during connection of the connector.



AB-00108

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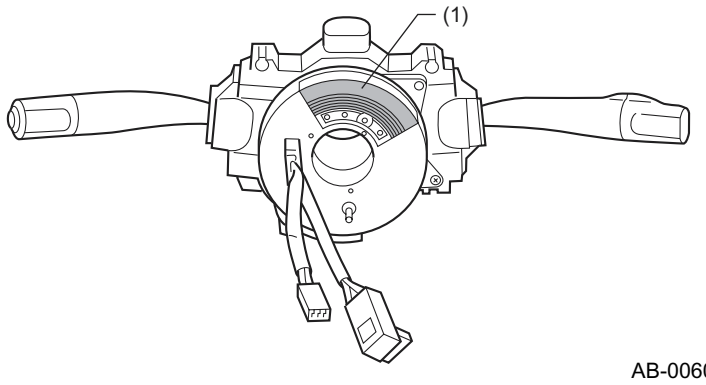
F: STEERING ROLL CONNECTOR

The steering roll connector is located between the steering column and steering wheel. The connector contains a spirally wound flat cable. The cable can follow rotational movements of the steering wheel and ensures connection between the airbag module in the steering wheel and the airbag harness through which electrical signals are transmitted from the airbag control module.

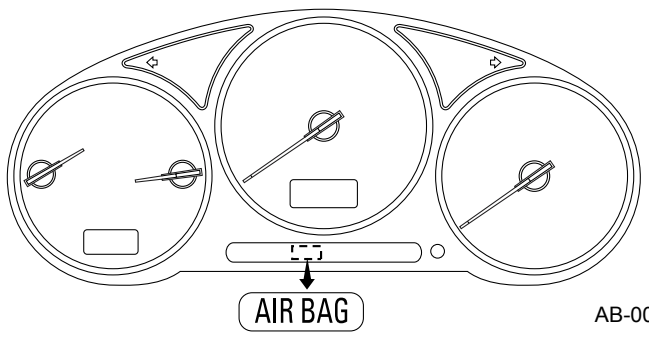


AB-00608

(1) Flat cable

G: AIRBAG WARNING LIGHT

The airbag warning light is located inside the combination meter. It illuminates if a poor connection in the airbag circuit occurs, or if the airbag control module detects an abnormal condition. When the airbag system is normal, this light comes on when the ignition switch is turned ON and then goes out about 7 seconds later.



AB-00412

H: WIRE HARNESS

The airbag harnesses are integrated into the body harness as follows:

- Front sub sensor harness: integrated into the front harness.
- Airbag main harness: integrated into the bulkhead harness.
- Pretensioner and side airbag harnesses: integrated into the rear harness.

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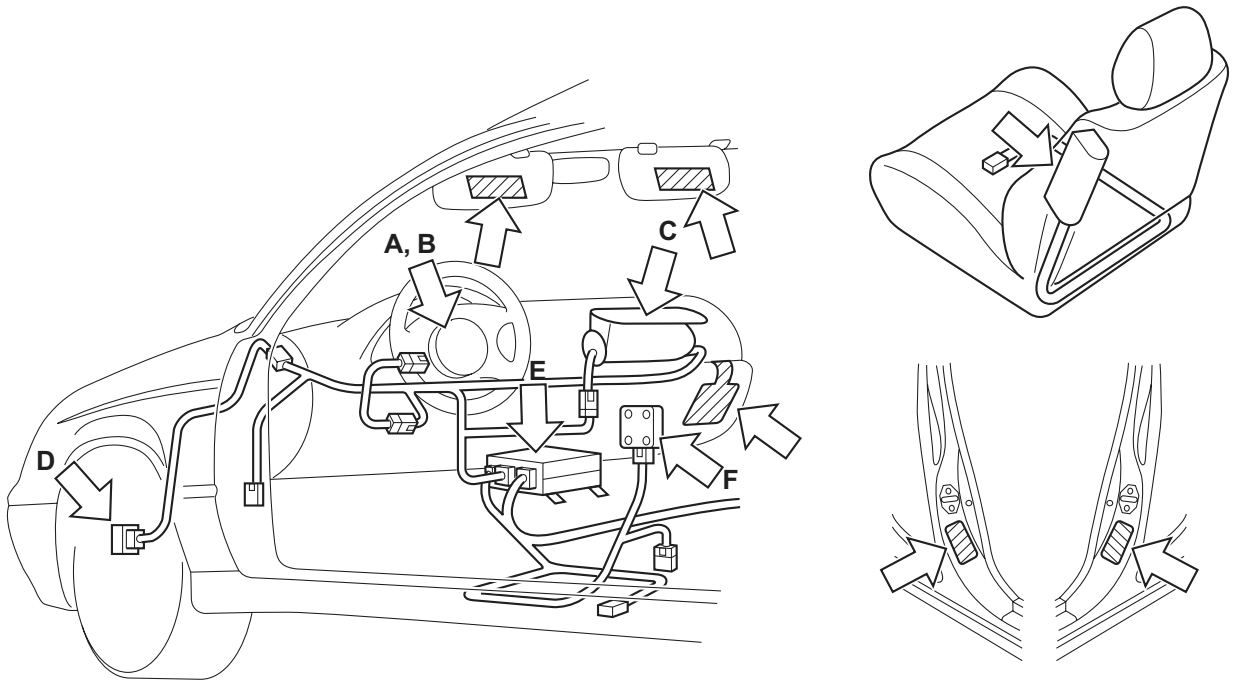
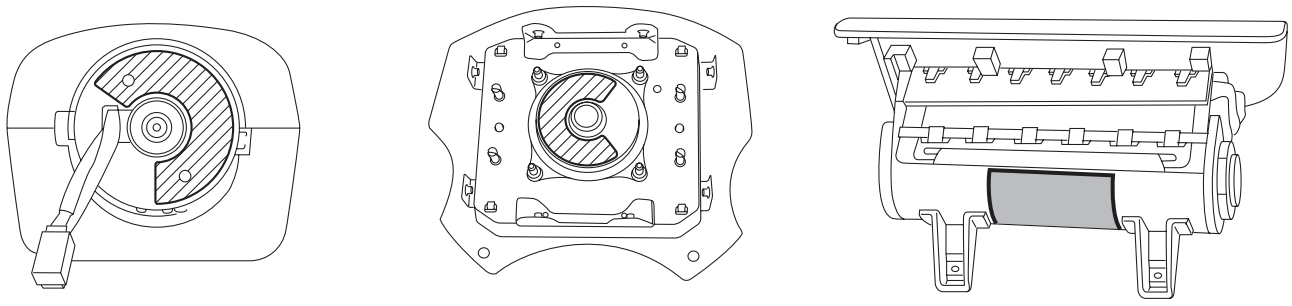
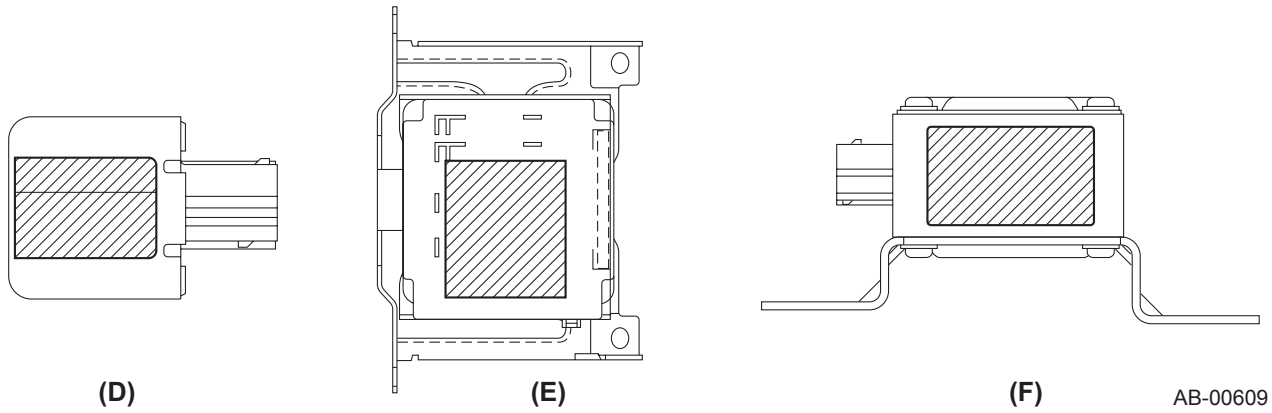
I: LOCATIONS OF WARNING AND CAUTION LABELS





(A) (B) (C)



(D) (E) (F)

AB-00609

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ABS

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1. Anti-lock Brake System (ABS)

A: FEATURE

● The 5.3i type ABS used in the Impreza has a hydraulic control unit, an ABS control module, a valve relay and a motor relay integrated into a single unit (called “ABSCM & H/U”) for circuit simplicity and reduced weight.

● The ABS electrically controls the brake fluid pressure to each wheel to prevent the wheel from locking during braking on slippery road surfaces, thereby enabling the driver to maintain the directional control.

● If the ABS becomes inoperative, a fail-safe system is activated to ensure same level of braking performance as with a conventional brake system. In that case, the warning light comes on to indicate that the ABS is malfunctioning.

● The ABS is a 4-sensor, 4-channel system. The front wheel system is an independent control design*1, while the rear wheel system is a select-low control design*2.

● Vehicles with Sports ABS have an additional function which independently controls*1 the rear wheels according to the value sent from the lateral G sensor. (STi models)

*1: A system which controls the left and right wheel brakes individually.
*2: A system which applies the same fluid pressure to both wheels if either of the left or right wheels starts to lock.The pressure is determined based on the lower of the frictional coefficients of both wheels.

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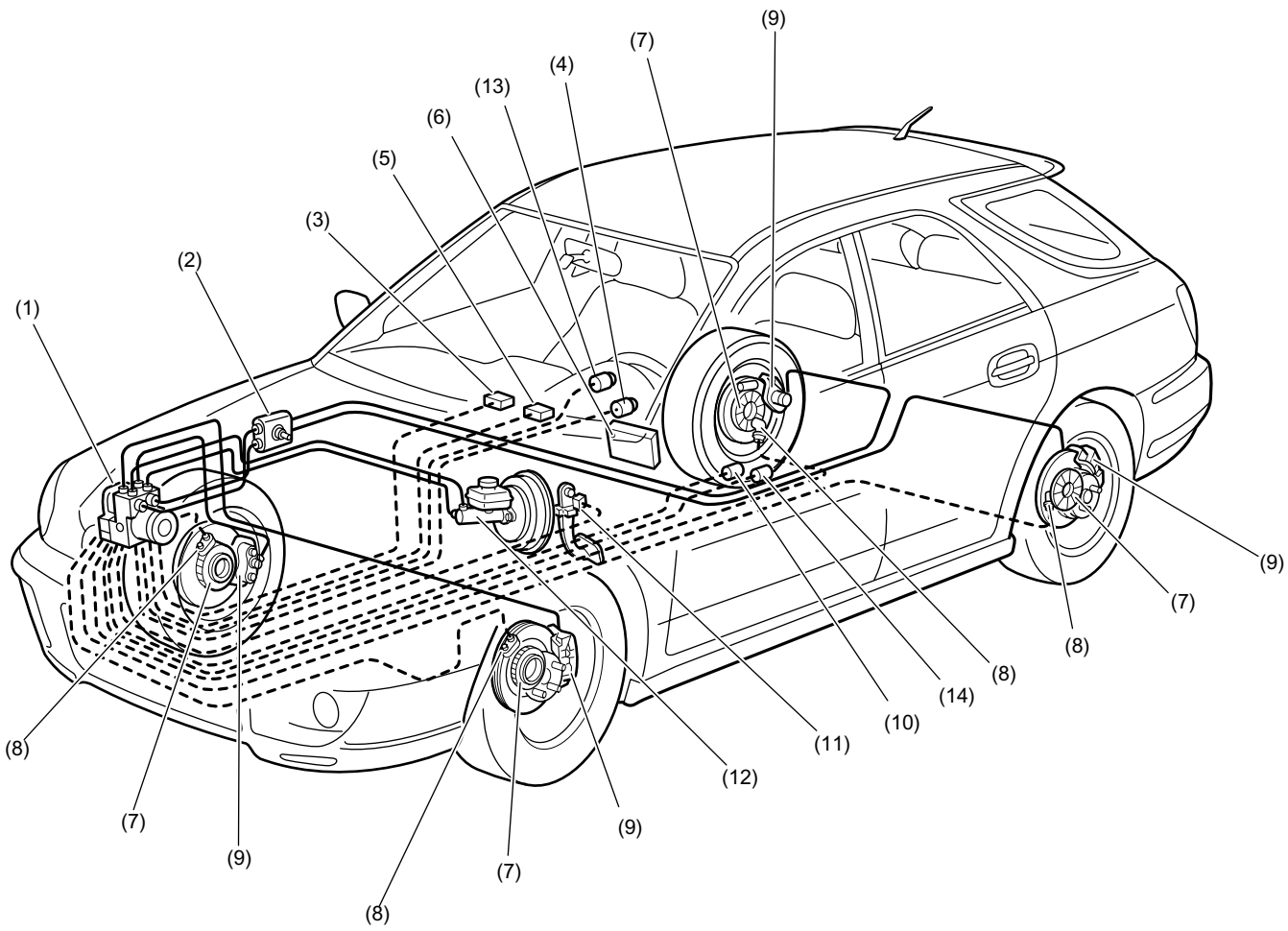

ABS00329

(1) ABS control module and hydraulic control unit (ABSCM & H/U)
(2) Two-way connector
(3) Diagnosis connector
(4) ABS warning light
(5) Data link connector (for SUBARU select monitor)
(6) Transmission control module (AT models only)
(7) Tone wheels
(8) ABS wheel speed sensor
(9) Wheel cylinder
(10) G sensor
(11) Stop light switch
(12) Master cylinder
(13) Brake & EBD warning light
(14) Lateral G sensor (STi)

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B: FUNCTIONS OF SENSORS AND ACTUATORS

Name		Function
ABS control module and hydraulic control unit (ABSCM & H/U)	ABSCM section	• It determines the conditions of the wheels and the vehicle body from the wheel speed data and controls the hydraulic unit depending on the result. • When the ABS is active, the ABSCM provides the automatic transmission control module with control signals which are used by the module for cooperative control of the vehicle with the ABSCM. • Whenever the ignition switch is placed at ON, the module performs a self diagnosis sequence. If anything wrong is detected, the module cuts off the system. • It communicates with the SUBARU select monitor.
	H/U section	• When the ABS is active, the H/U changes fluid passages to the wheel cylinders in response to commands from the ABSCM. • It constitutes the brake fluid passage from the master cylinder to the wheel cylinders together with the piping.
	Valve relay section	It serves as a power switch for the solenoid valves and motor relay coil. It operates in response to a command from the ABSCM.
	Motor relay section	It serves as a power switch for the pump motor. It operates in response to a command from the ABSCM.
ABS wheel speed sensors		These sensors detect the wheel speed in terms of a change in the density of the magnetic flux passing through them and convert it into an electrical signal. The electrical signal is sent to the ABSCM.
Tone wheels		They give a change in the magnetic flux density by the teeth around themselves to let the ABS wheel speed sensors generate electrical signals.
G sensor		It detects a change in acceleration in the longitudinal direction of the vehicle and outputs it to the ABSCM as a voltage signal.
Lateral G sensor (STi)		Converts the variation in lateral G on the vehicle into a change in capacity of the sensor condenser, and outputs a varying voltage to the ABS ECU.
Stop light signal		It provides information on whether the brake pedal is depressed or not to the ABSCM. The ABSCM uses it to determine ABS operation.
ABS warning light		It alerts the driver to an ABS fault. When the diagnosis connector and diagnosis terminal are connected, the light flashes to indicate a diagnostic trouble code stored in the ABSCM.
Automatic transmission control module		It provides gear controls (fixing the speed at 3rd or changing power transmission to front and rear wheels) in response to control signals from the ABSCM.
Brake warning light		It alerts the driver to an EBD fault. This warning light is also used for parking brake warning and brake fluid level warning.

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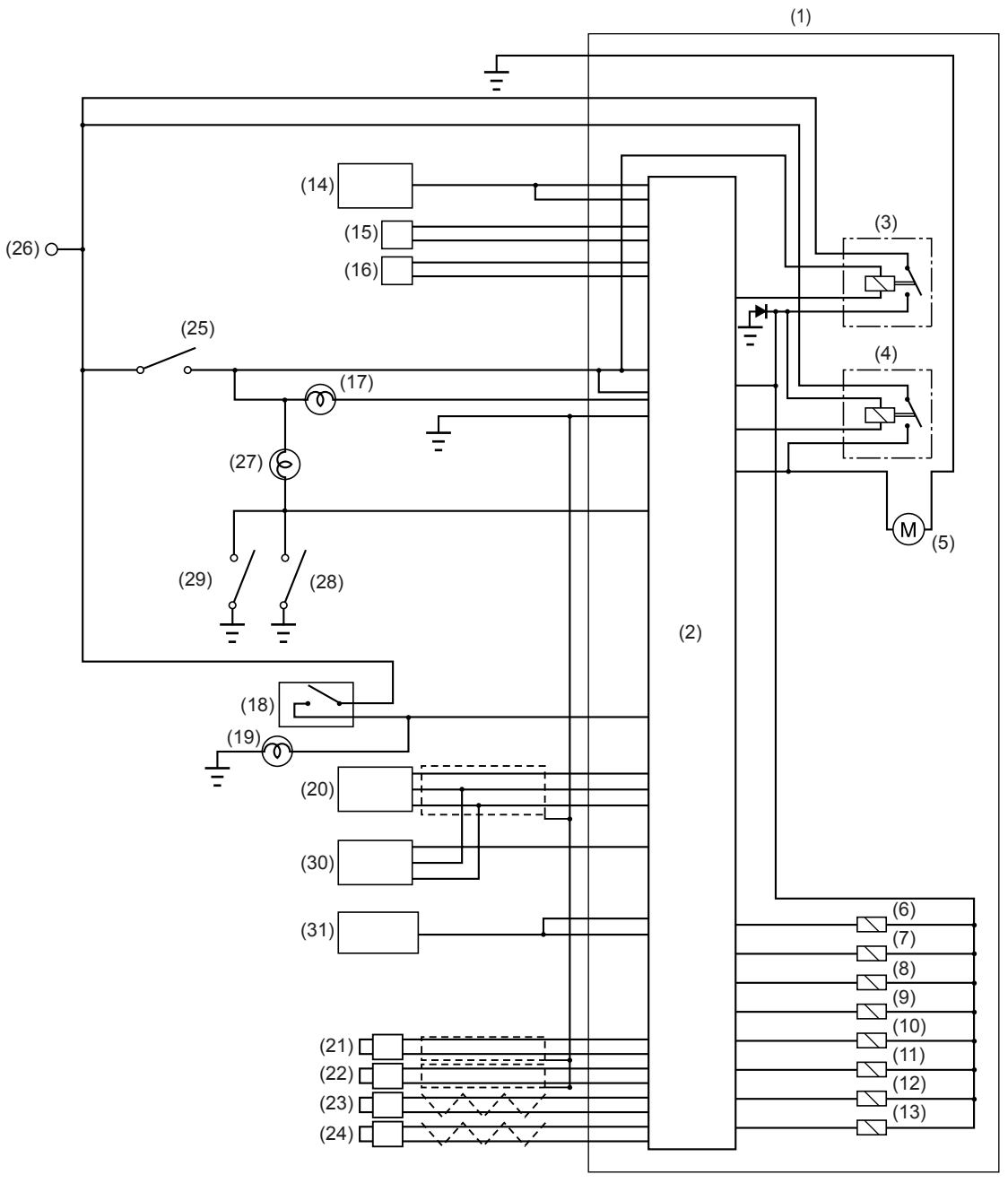

ABS00334

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(1) ABS control module and hydraulic control unit
(2) ABS control module section
(3) Valve relay
(4) Motor relay
(5) Motor
(6) Front left inlet solenoid valve
(7) Front left outlet solenoid valve
(8) Front right inlet solenoid valve
(9) Front right outlet solenoid valve
(10) Rear left inlet solenoid valve
(11) Rear left outlet solenoid valve
(12) Rear right inlet solenoid valve
(13) Rear right outlet solenoid valve
(14) Automatic transmission control module
(15) Diagnosis connector
(16) Data link connector
(17) ABS warning light
(18) Stop light switch
(19) Stop light
(20) G sensor
(21) Front left ABS wheel speed sensor
(22) Front right ABS wheel speed sensor
(23) Rear left ABS wheel speed sensor
(24) Rear right ABS wheel speed sensor
(25) IGN
(26) Battery
(27) Brake warning light
(28) Parking brake warning light
(29) Brake fluid level switch
(30) Lateral G sensor (STi)
(31) Driver-controllable center differential control unit

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C: PRINCIPLE OF ABS CONTROL

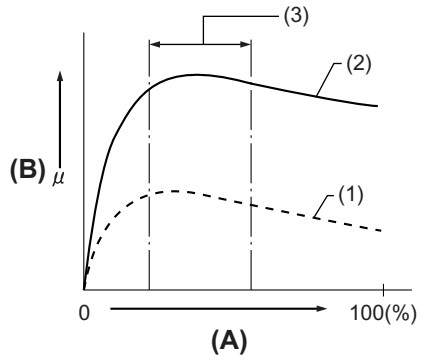
When the brake pedal is depressed during driving, the wheel speed decreases and the vehicle speed does as well. The decrease in the vehicle speed, however, is not always proportional to the decrease in the wheel speed. The non-correspondence between the wheel speed and vehicle speed is called “slip” and the magnitude of the slip is expressed by the “slip ratio” which is defined as follows:

Slip ratio = (Vehicle speed – Wheel speed)/Vehicle speed × 100%

When the slip ratio is 0%, the vehicle speed corresponds exactly to the wheel speed. When it is 100%, the wheels are completely locking (rotating at a zero speed) while the vehicle is moving.

The braking effectiveness is represented by the “coefficient of friction” between the tire and road surface.The larger the coefficient, the higher the braking effectiveness. The diagram below shows the relationship between the coefficient of friction and the slip ratio for two different road surface conditions (asphalt-paved road and icy road), assuming that the same tires are used for both the conditions and the vehicles are moving forward. Although the braking effectiveness (coefficient of friction) depends on the road surface condition as shown and also on the type of the tire, its peak range generally corresponds to the 8 — 30% range of the slip ratio.

The ABS controls the fluid pressure to each wheel so that a coefficient of friction corresponding to this slip ratio range is maintained.



ABS00007

(A) Slip ratio
(B) Coefficient of friction between tire and road surface
(1) Icy road
(2) Asphalt-paved road
(3) Control range by ABS

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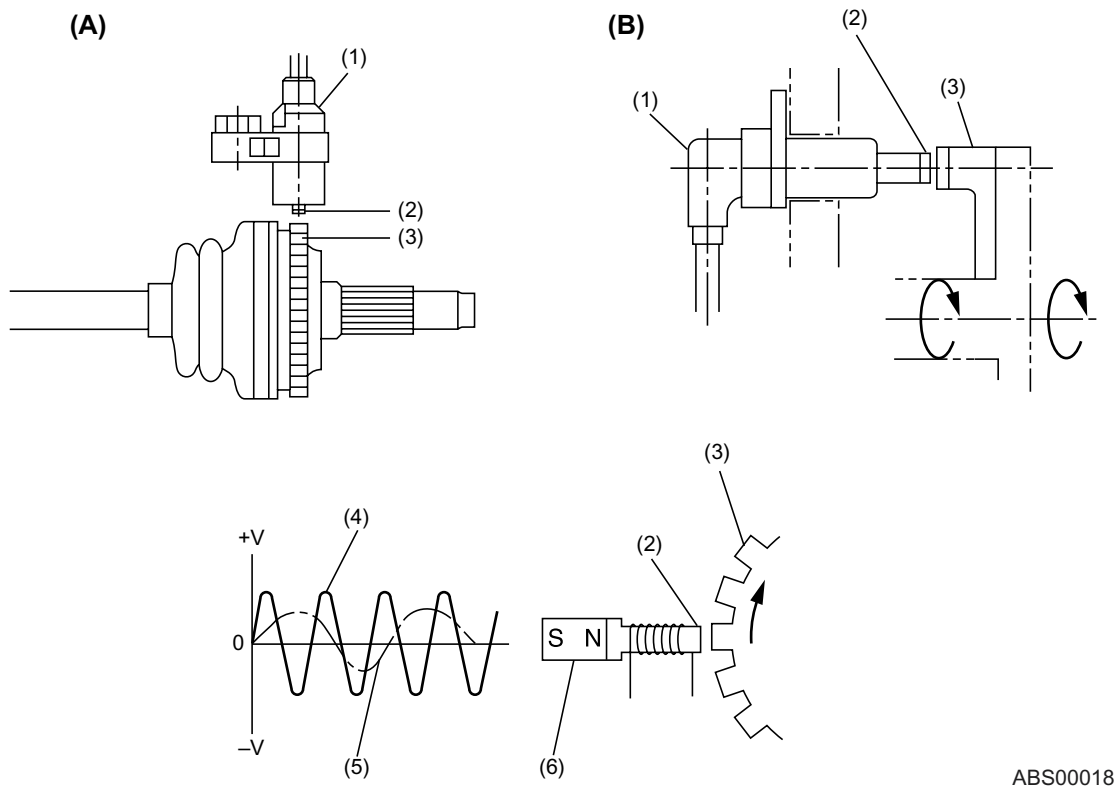
D: ABS WHEEL SPEED SENSOR

Each of the ABS wheel speed sensors detects the speed of the corresponding wheel. The sensor consists of a permanent magnet, coil and tone wheel. The magnetic flux produced by the permanent magnet changes as each tooth of the tone wheel (which rotates together with the wheel) passes in front of the magnet's pole piece. The changing magnetic flux induces voltages at a frequency corresponding to the wheel speed.



ABS00018

(A) Front
(B) Rear

(1) Sensor body
(2) Pole piece
(3) Tone wheels

(4) High-speed
(5) Low-speed
(6) Permanent magnet

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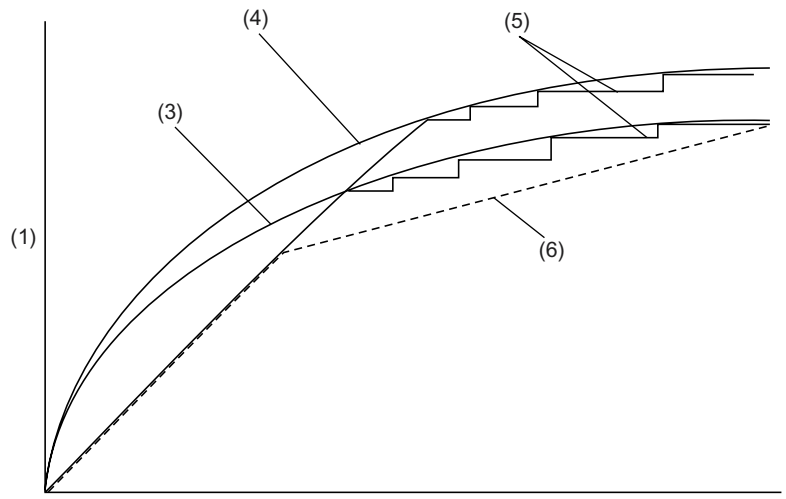
E: EBD (ELECTRONIC BRAKE FORCE DISTRIBUTION)

The EBD system utilizes the function of the conventional ABS. This system prevents premature locking of the rear wheels by using electronic control instead of a proportioning valve. The system provides a feature to optimize the brake force distribution to the front and rear wheels according to change in loading conditions or displacement of the center of gravity during deceleration.
The ABSCM calculates the optimum brake force distribution from the difference in speed between the front and rear wheels. Based on the results, the ABSCM controls the rear wheel brake pressure through the ABS hydraulic unit (H/U) to achieve the optimum brake force distribution suitable for the driving condition.
The proportioning valve is disused on EBD equipped vehicles.



ABS00019

(1) Brake force to rear wheels
(2) Brake force to front wheels
(3) Optimum brake force distribution for light loaded conditions
(4) Optimum brake force distribution for heavy loaded conditions
(5) EBD controlled brake force distribution
(6) PCV controlled brake force distribution (reference)

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

● ABS control module section (ABSCM)

The ABSCM contains two micro control modules (MCMs) which communicate with each other. Both the MCMs process the same program and each MCM monitors the other's outputs. If a mismatch occurs between their outputs, the ABSCM cuts off the system and activate the fail-safe function.

The ABSCM can store a maximum of 3 diagnostic trouble codes in a ROM. If more than 3 faults have occurred, only the 3 most recent failures are stored and others are erased. Trouble diagnostic trouble codes remain stored until they are internally or externally erased.
The ABSCM has a test routine (sequence control pattern) which facilitates checking of the hydraulic control unit.

● ABS control

Using primarily the wheel speed data from each ABS wheel speed sensor and secondarily the vehicle deceleration rate data from the G sensor as parameters, the ABSCM generates a simulated vehicle speed when there is a risk of wheel lock-up. Using the simulated vehicle speed (called "dummy" vehicle speed) as a reference, the ABSCM determines the state of the wheel in terms of the tendency toward lock-up.If the result shows that the wheels are about to lock, the ABSCM issues commands to energize or de-energize the solenoid valves and activate the motor pump of the H/U to modulate 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 the rear wheel fluid pressures based on the wheel which is the most likely to lock (select-low control). The STi models have an additional function which independently controls the rear wheels according to the value sent from the lateral G sensor.

● Functions available using SUBARU select monitor

When the SUBARU select monitor is connected, the ABSCM allows it
- To read out analog data
- To read out ON/OFF data
- To read out or erase diagnostic trouble codes
- To read out data showing conditions under which a trouble code has been stored (freeze frame data)
- To initiate ABS sequence control pattern

● Indication functions

Under the control of the ABSCM, the ABS warning light provides the following three indication functions:
- ABS fault alerting
- Diagnostic trouble code indication (by flashing in the diagnosis mode)
- Valve ON/OFF indication (when sequence control pattern is initiated)

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● Hydraulic control unit section (H/U)

The H/U is a fluid pressure controller consisting of, among others, a motor, solenoid valves, a housing and relays. It also constitutes passage of the two diagonally split brake circuits.

● The pump motor drives an eccentric cam which in turn moves the plunger pump to generate hydraulic pressure.

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

● The plunger pump, when operated, draws the brake fluid from the reservoir, lets the fluid in a wheel cylinder drain into the reservoir, and/or forces the fluid into the master cylinder.

● The outlet solenoid valve is a 2-position type. It opens or closes the brake fluid passage between a wheel cylinder and the reservoir according to commands from the ABSCM.

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

● The reservoir temporarily stores the brake fluid drained from a wheel cylinder when pressure “decrease” control is performed.

● The damper chamber suppresses brake fluid pulsation which would occur during pressure “decrease” control in the fluid discharged from the plunger pump to minimize kickbacks of the brake pedal.

● The valve relay controls power supply to the solenoid valves and motor relay in response to a command from the ABSCM. In normal (IG ON) condition, the relay is closed to supply power to the solenoid valves and motor relay. When an error occurs in the system, the valve relay is turned OFF to keep the fluid pressure circuit in the normal mode (non-ABS mode).

● The motor relay closes and supplies power to the pump motor in response to a command from the ABSCM during the ABS drive mode operations.

The H/U has four operating modes; normal mode (non-ABS mode), and three ABS active modes, i.e., “increase”, “hold” and “decrease” modes.

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1. DURING NORMAL BRAKING (ABS NOT ACTIVE)

Both the inlet and outlet solenoid valves are not energized.
This means that the inlet port of the inlet solenoid valve is open, whereas the outlet port of the outlet solenoid valve is closed. So the fluid pressure generated in the master cylinder is transmitted to the wheel cylinder, producing a brake force.

NOTE:
For simplicity of explanation, operation of the hydraulic control unit is represented by operation of a single wheel circuit.

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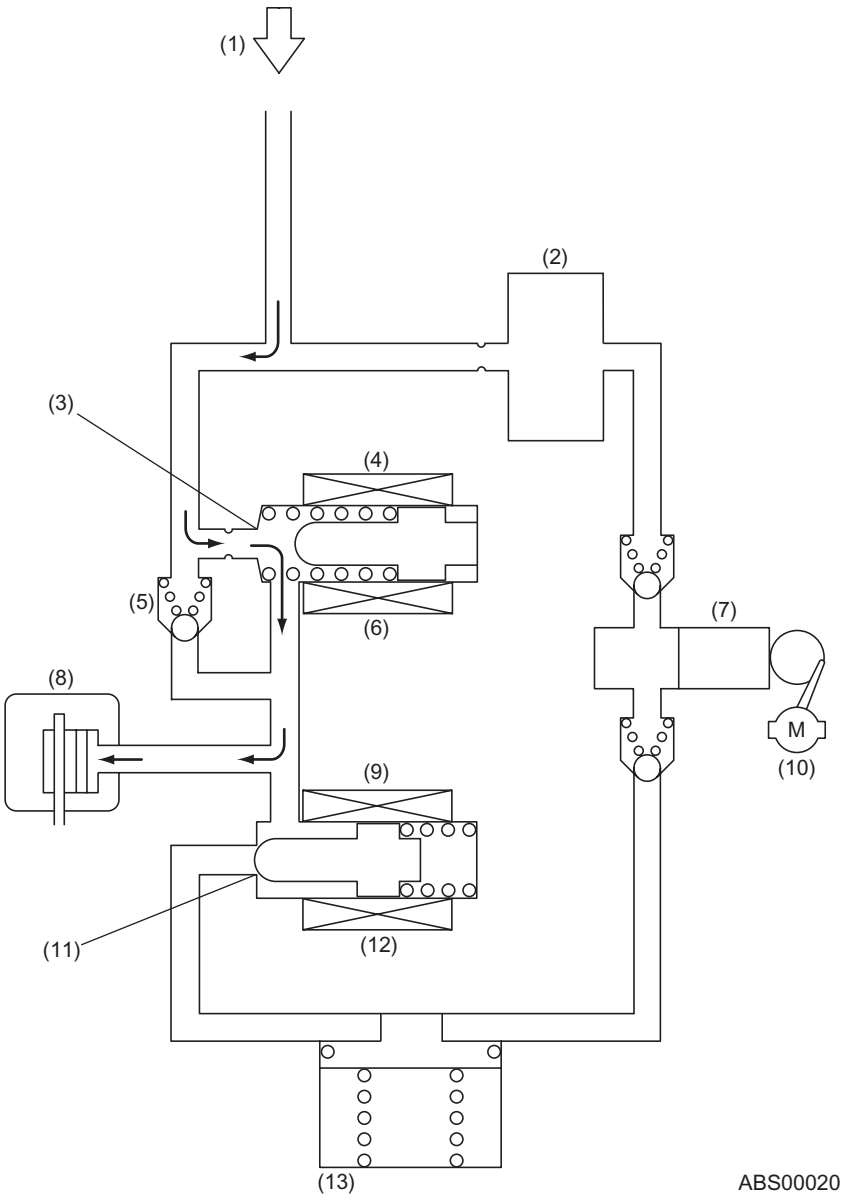

ABS00020

(1) From master cylinder
(2) Damper chamber
(3) Inlet port open
(4) Inlet solenoid valve
(5) Check valve
(6) Deenergized
(7) Pump
(8) Wheel cylinder
(9) Outlet solenoid valve
(10) Motor
(11) Outlet port closed
(12) Deenergized
(13) Reservoir

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2. PRESSURE “DECREASE” CONTROL (ABS ACTIVE)

Both the inlet and outlet solenoid valves are energized, which means that the inlet port is closed and the outlet port is open.
In this state, the wheel cylinder is isolated from the master cylinder but open to the reservoir, so the brake fluid in it can be drained into the reservoir, decreasing its pressure and reducing the braking force of the wheel.
The brake fluid collected in the reservoir is forced into the master cylinder by the pump.
During this phase of ABS operation, the pump motor continues operating.

NOTE:
For simplicity of explanation, operation of the H/U is represented by operation of a single wheel circuit.

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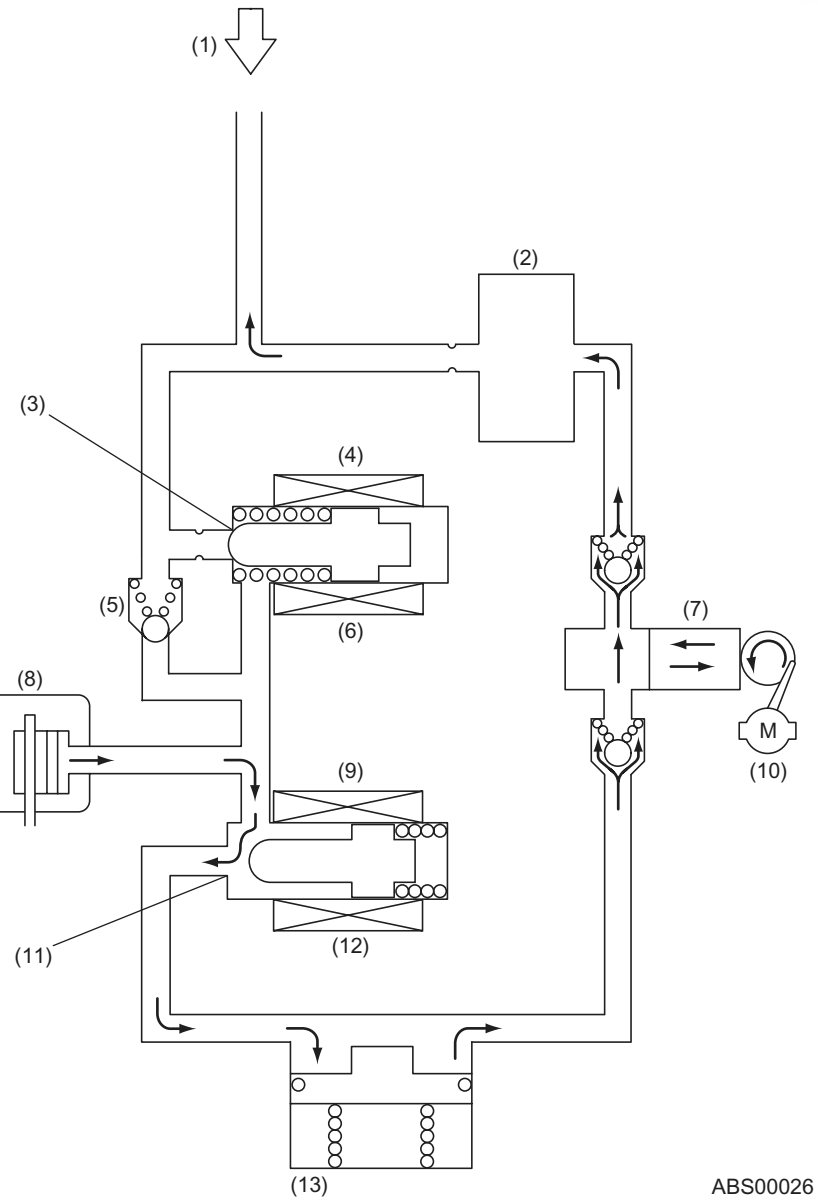

ABS00026

(1) From master cylinder
(2) Damper chamber
(3) Inlet port closed
(4) Inlet solenoid valve
(5) Check valve
(6) Energized
(7) Pump
(8) Wheel cylinder
(9) Outlet solenoid valve
(10) Motor
(11) Outlet port open
(12) Energized
(13) Reservoir

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3. PRESSURE "HOLD" CONTROL (ABS ACTIVE)

The inlet solenoid valve is energized, so the inlet port is closed.
On the other hand, the outlet solenoid valve is de-energized, so the output port is also closed. In this state, all the passages connecting the wheel cylinder, master cylinder and reservoir are blocked. As a result, the fluid pressure in the wheel cylinder is held unchanged.
During this phase of ABS operation, the pump motor continues operating.

NOTE:
For simplicity of explanation, operation of the H/U is represented by operation of a single wheel circuit.

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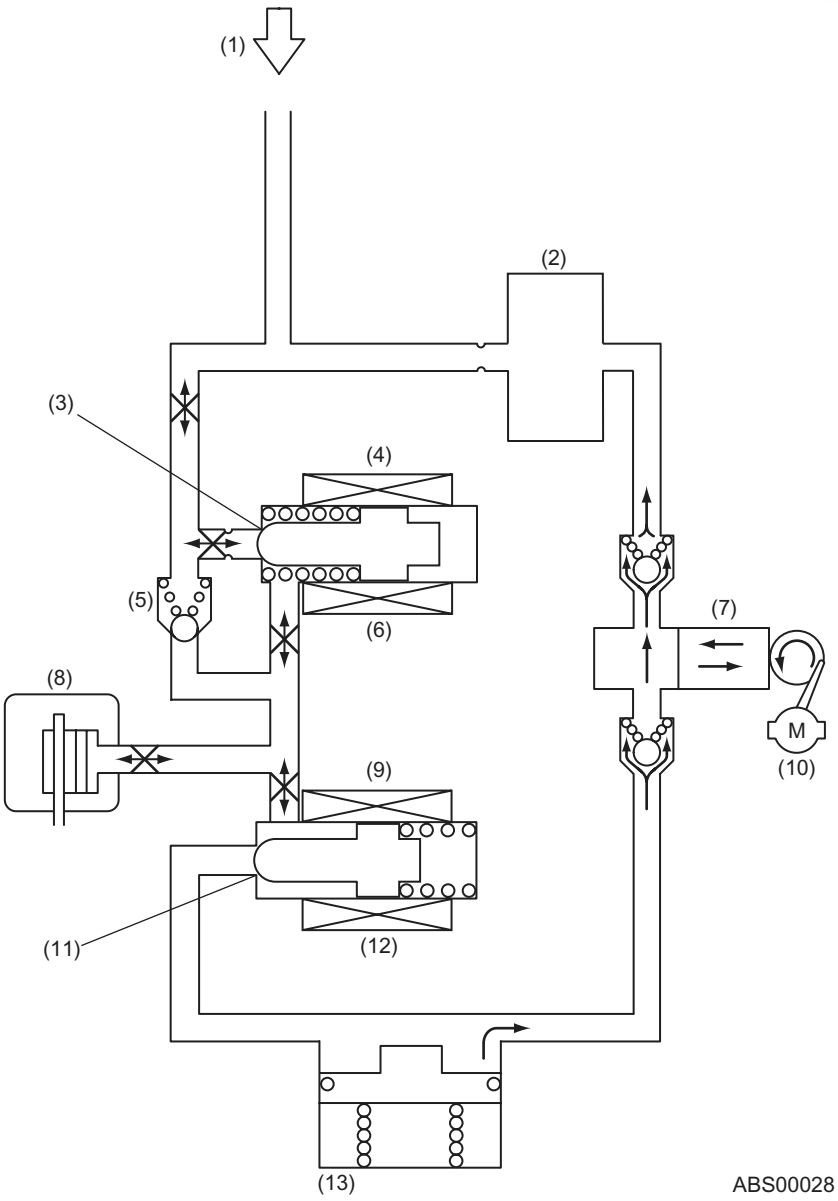

ABS00028

(1) From master cylinder
(2) Damper chamber
(3) Inlet port closed
(4) Inlet solenoid valve
(5) Check valve
(6) Energized
(7) Pump
(8) Wheel cylinder
(9) Outlet solenoid valve
(10) Motor
(11) Outlet port closed
(12) Deenergized
(13) Reservoir

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4. PRESSURE "INCREASE" CONTROL (ABS ACTIVE)

Both the inlet and outlet solenoid valves are de-energized, which means that the inlet port of the inlet solenoid valve is open, whereas the outlet port of the outlet solenoid valve is closed. So the fluid pressure generated in the master cylinder is transmitted to the wheel cylinder and increased fluid pressure in the wheel cylinder applies the brake with a larger force.
During this phase of ABS operation, the pump motor continues operating.

NOTE:
For simplicity of explanation, operation of the H/U is represented by operation of a single wheel circuit.

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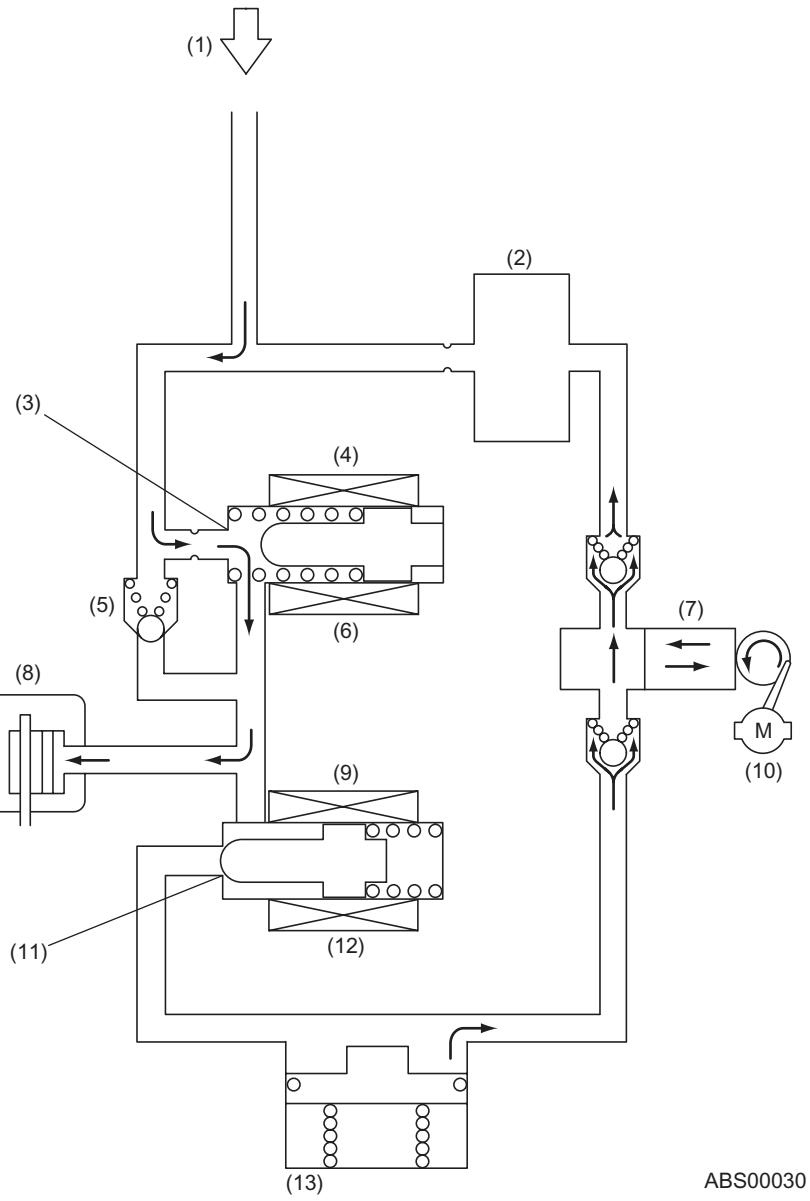

ABS00030

(1) From master cylinder
(2) Damper chamber
(3) Inlet port open
(4) Inlet solenoid valve
(5) Check valve
(6) Deenergized
(7) Pump
(8) Wheel cylinder
(9) Outlet solenoid valve
(10) Motor
(11) Outlet port closed
(12) Deenergized
(13) Reservoir

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G: ABS CONTROL CYCLE CURVES

Depressing the brake pedal increases the brake fluid pressure in each wheel cylinder, which in turn decreases the wheel speed (or increases the wheel deceleration rate). When the brake fluid pressure is increased to a level of point “A” of the brake fluid pressure curve in the diagram (at which the wheel deceleration rate exceeds threshold “$-b_0$”), the ABSCM makes a pressure “hold” control. At the same time, the ABSCM calculates a “dummy” vehicle speed which is a reference speed it uses in the next stage of control.

When the wheel speed then drops below the slip ratio setting, i.e., a speed lower than the “dummy” vehicle speed by the predetermined value (at point “B” of the pressure curve), the ABSCM makes a control to prevent the wheel from locking, or a pressure “decrease” control.

As the wheel cylinder pressure decreases, the wheel speed starts increasing (or the wheel acceleration rate starts rising). When the wheel acceleration rate exceeds threshold “$+b_{10}$” (at point “C” of the pressure curve), the ABSCM makes a pressure “hold” control. When the wheel acceleration rate exceeds threshold “$+b_{20}$” (at point “D” of the pressure curve), the ABSCM recognizes that wheel lock-up will not occur and then makes a pressure “increase” control.

When the wheel acceleration rate drops below threshold “$+b_{20}$”, (at point “E” of the pressure curve), the ABSCM starts pressure “hold” and “increase” control cycles at a given interval.
When the wheel deceleration rate then exceeds threshold “$-b_0$” (at point “F” of the pressure curve), the ABSCM immediately makes a pressure “decrease” control.

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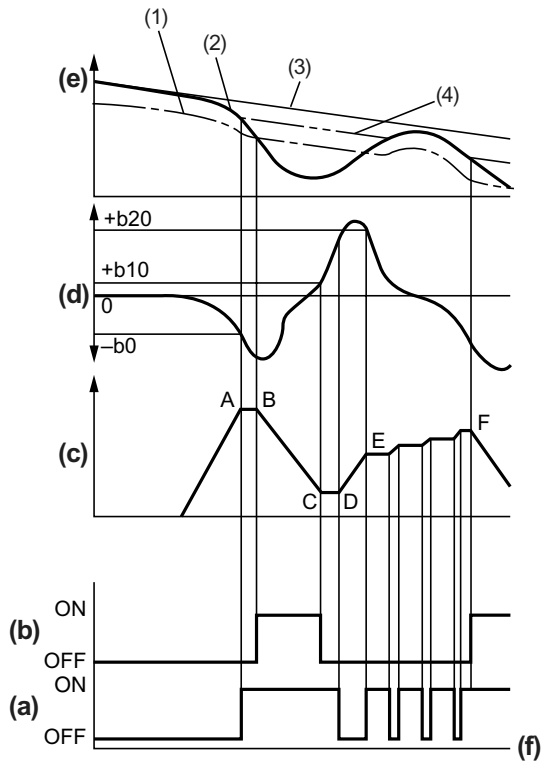

ABS00033

(a) Inlet valve
(b) Outlet valve
(c) Brake fluid pressure
(d) Wheel acceleration/deceleration
(e) Speed
(f) Time

(1) Slip ratio setting
(2) Wheel speed
(3) Vehicle speed
(4) Dummy vehicle speed

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

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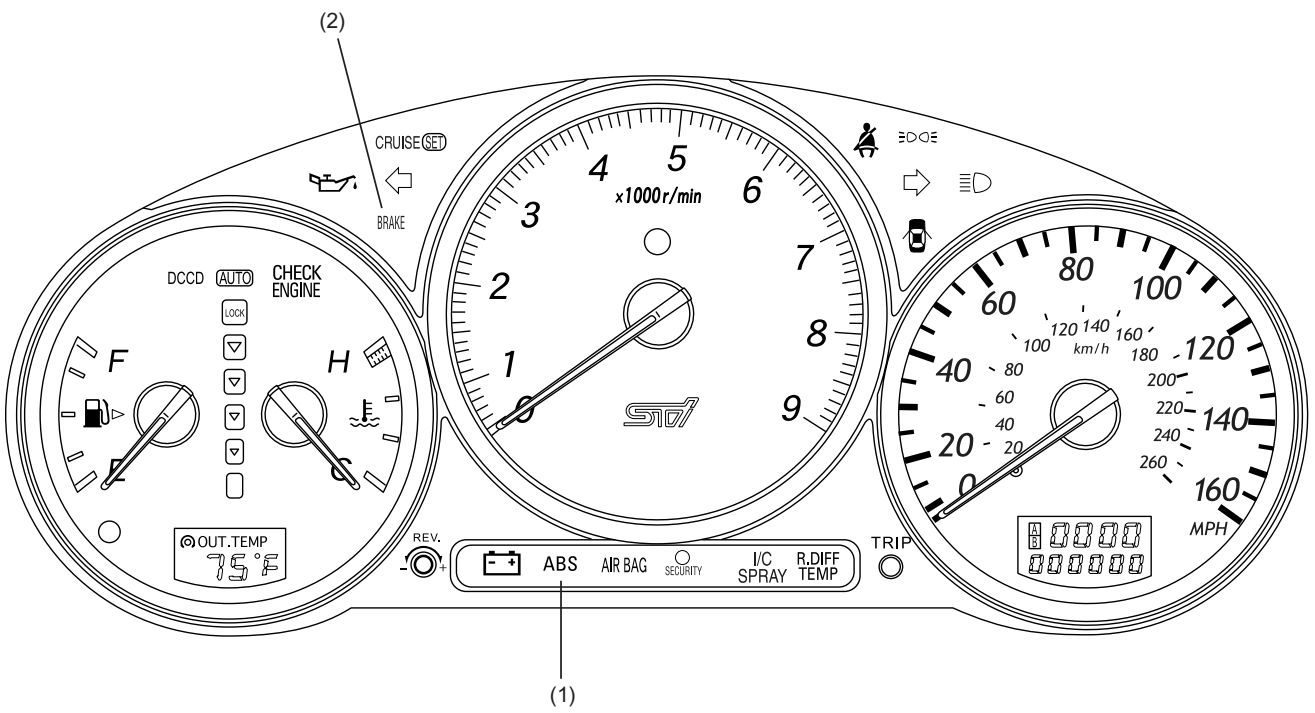
H: ABS WARNING LIGHT AND BRAKE WARNING LIGHT (ALSO FUNCTIONS AS EBD WARNING LIGHT)

When a fault occurs in the signal transmission system or the ABSCM, the ABS warning light and brake warning light in the combination meter come on. At the same time, the current to the hydraulic control unit is interrupted. The brake system then functions in the same manner as a system without ABS. The warning light utilizes a dual circuit design.

If the warning light comes on, one or more diagnostic trouble codes should be stored in the ABSCM. They must be identified using the warning light's code indicating function.



ABS00376

(1) ABS warning light
(2) Brake warning light (also functions as EBD warning light)

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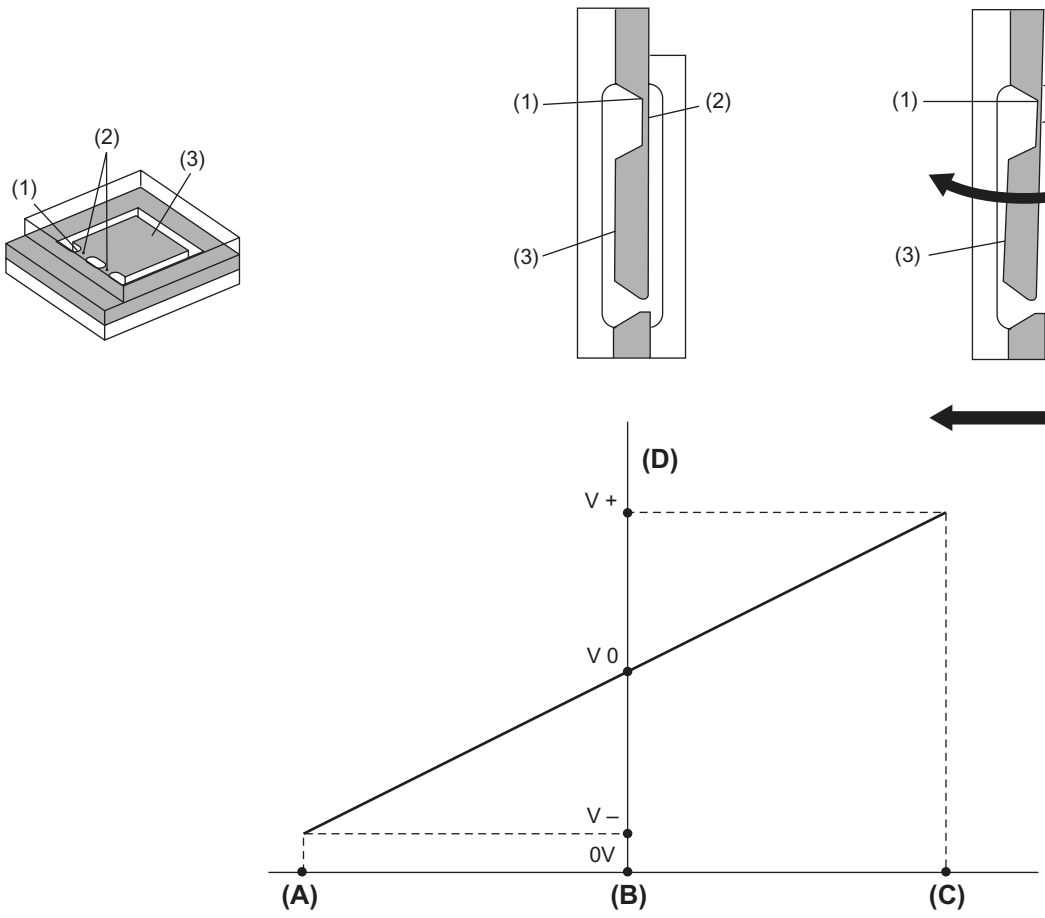
I: G SENSOR

The G sensor detects changes in the vehicle's acceleration/deceleration rate in the longitudinal direction.
A piezo-resistor is formed on the beam. When the mass area moves during acceleration and deceleration, the beam distorts causing the resistance of the piezo-resistor to change. This change is converted into change in voltage and sent to the ABSCM.



ABS00322

(1) Beam
(2) Piezo-resistor
(3) Mass area
(A) Accelerating
(B) Cruising
(C) Decelerating
(D) G sensor output voltage

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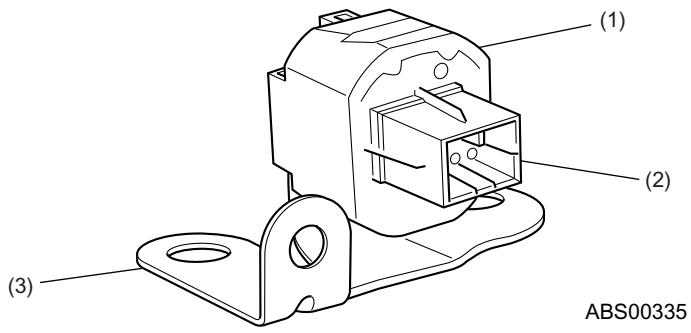
J: LATERAL G SENSOR

The lateral G sensor detects changes in the vehicle's acceleration rate in the lateral direction. Its operating principle, internal construction and operation are the same as those of the G sensor.



(1) Lateral G sensor
(2) Connector
(3) Bracket

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HVAC SYSTEM
(HEATER, VENTILATOR, AND A/C)

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1. Heater System

A: GENERAL

● The Impreza's HVAC system uses a semi-central control type integral air conditioning unit consisting of a thin-wall, high-performance heater core at the front and evaporator core at the rear. Being compact in size, this unit enables providing sufficient front passenger's legroom while ensuring a high air-distribution efficiency by minimizing air flow resistance in all air passages. Overall, the system can create comfortable interior air conditions quietly and in all seasons by its excellent heating, cooling, ventilating, and defrosting performances.

● There are four ventilation grilles in the dashboard; two trapezoidal grilles at the center and round grilles at both sides. The side grilles are rotatable for air flow direction adjustments.

● To ensure adequate ventilation, large-size air outlets are provided behind the side portions of the rear bumper where high-level vacuums are generated during driving.

● A clean air filter is placed at upstream of the blower fan.

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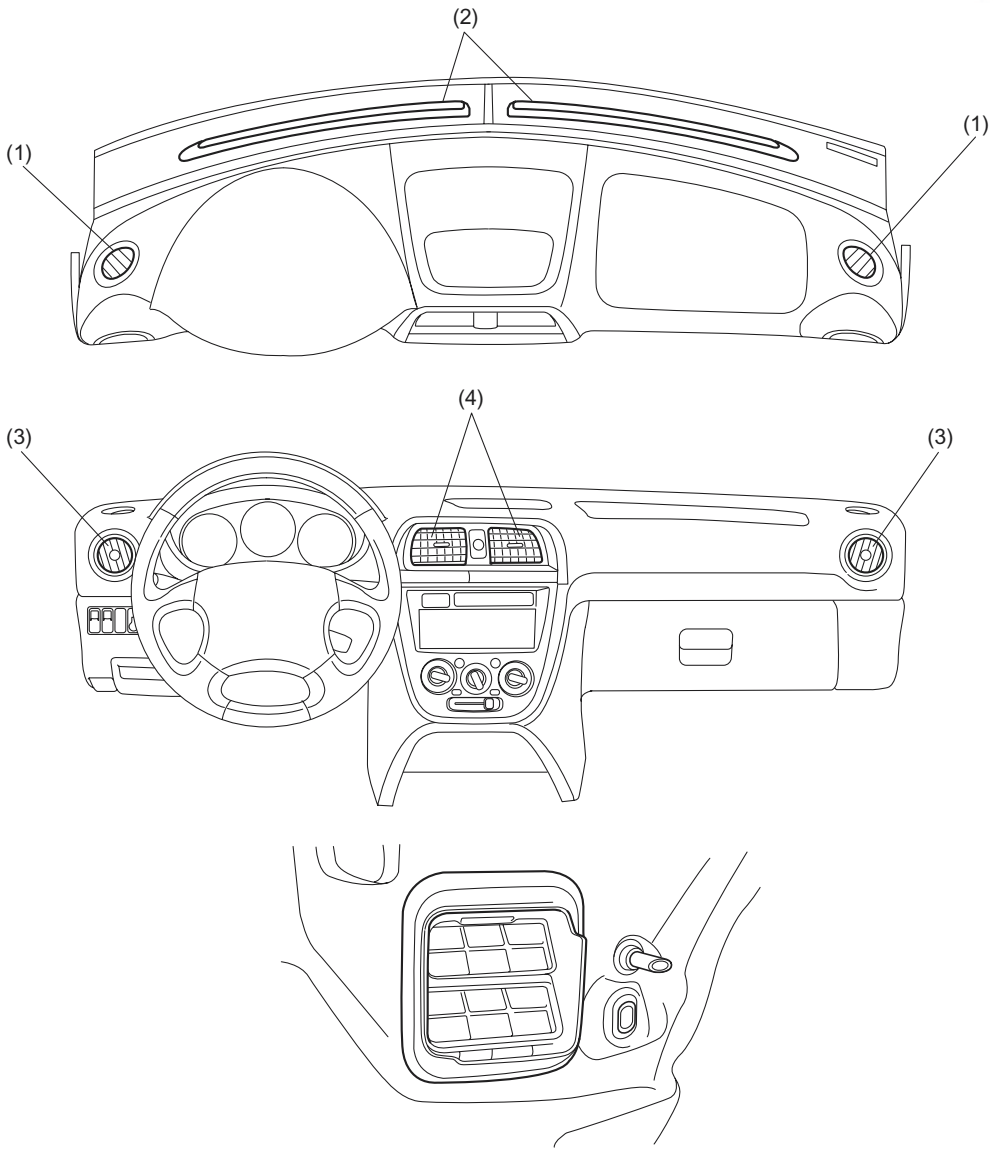

AC-00682

(1) Side defroster
(2) Front defroster
(3) Side ventilation grille
(4) Center ventilation grille

1. SPECIFICATIONS

Heating type	Heating performance (W)	Blower power consumption (W)	Maximum blower capacity (m^3/h)		
			VENT	HEAT	DEF
Outside air mixing type (full-air-mix type)	5000	200	450	280	300

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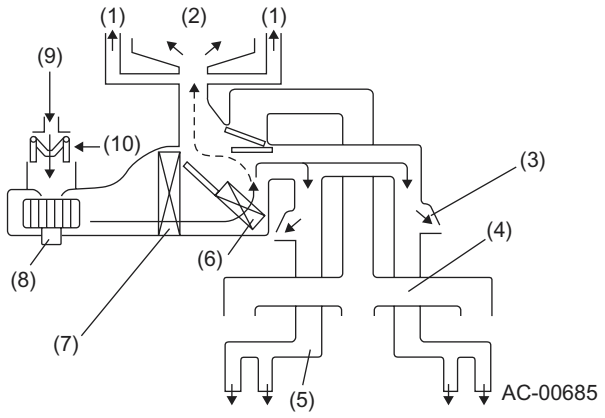
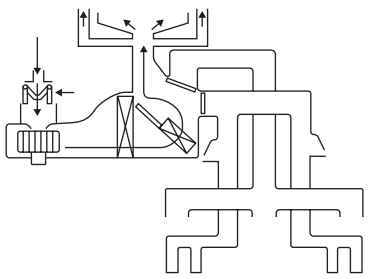
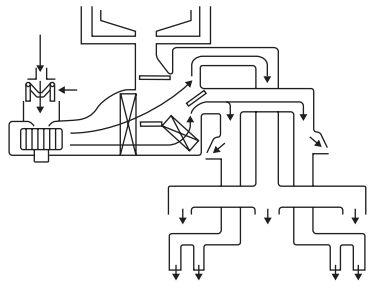
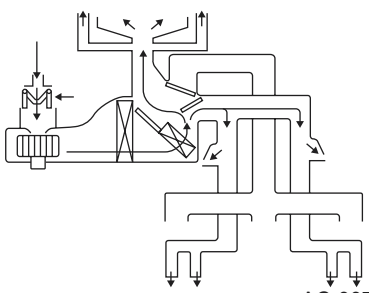
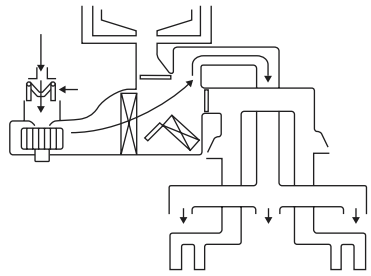
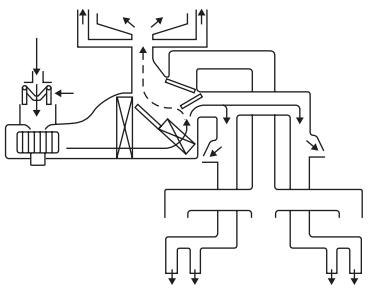
B: AIR FLOW MODES



(1) Side defroster
(2) Front defroster
(3) Foot duct
(4) Vent duct
(5) Rear heater duct
(6) Heater core
(7) Evaporator
(8) Blower motor
(9) Outside air
(10) Cabin air

	Switch position	Heater unit door operation		Switch position	Heater unit door operation
Air flow control	**DEF** AC-00119	 AC-00725	Air flow control	**BILEVEL** AC-00122	 AC-00728
	DEF/HEAT AC-00120	 AC-00726		**VENT** AC-00123	 AC-00729
	HEAT AC-00121	 AC-00727	FRESH/RECIRC switching	AC-00124	This switch/lever allows selecting either cabin-air-recirculation or fresh-air-introduction mode. **Models with automatic air conditioning** FRESH/RECIRC is changed each time the switch is pressed. Indicator ON: cabin air recirculation Indicator OFF: fresh air introduction **Models with manual air conditioning** Switched by operating the lever.

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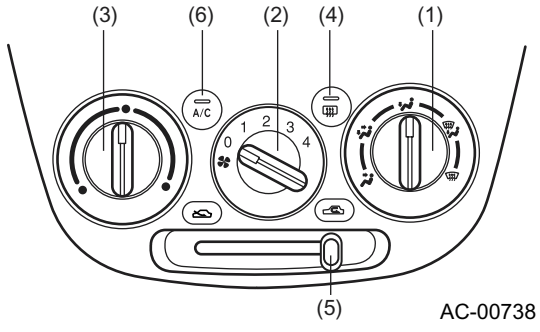
C: CONTROL PANEL

- The HVAC control panel is incorporated into the center panel.
- A rear window defogger switch is located in the control panel.

1. MODELS WITH MANUAL AIR CONDITIONING

- The control panel uses three large-diameter, dial type switches for easy operation and good visual recognition.



AC-00738

(1) Air flow control dial:
This switch allows selecting any of the five air flow modes.

AC-00127

(2) Fan speed control dial:
This switch allows turning on/off the blower and selecting any of the four blower speeds.

AC-00126

(3) Temperature control dial:
This switch allows stepless adjusting of the temperature of air delivered through ventilators.

(4) Rear window defogger switch:
This switch activates the rear defogger. When the switch is left on, a timer keeps the defogger activated for 15 minutes and then turns it off automatically.

(5) FRESH/RECIRC lever:
This lever allows selecting either cabin-air-recirculation or fresh-air-introduction.

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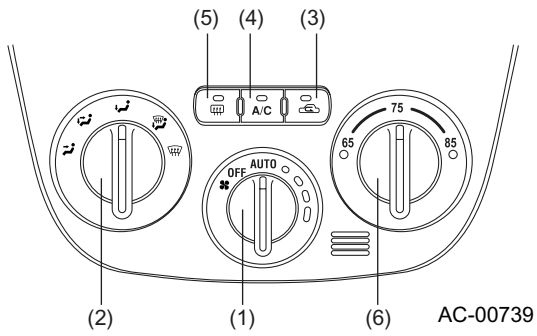
(6) Air conditioning switch:
This switch turns on or off the air conditioning compressor.

2. MODELS WITH AUTOMATIC AIR CONDITIONING

● The system changes air flow, adjusts temperature and makes switching between the cabin-air re-circulation and outside-air-introduction using servo motors.



AC-00739

(1) Fan speed control dial:
In automatic air conditioning mode, the system controls the blower speed automatically in accordance with sensor signals.
In manual air conditioning mode, this switch allows selecting any of the four blower speeds.

(2) Air flow control dial:
This switch allows selecting any of the five air flow modes.

AC-00127

(3) FRESH/RECIRC switch:
This switch allows selecting either cabin-air-recirculation or fresh-air-introduction.

(4) A/C switch:
This switch turns on or off the air conditioning compressor.

(5) Rear window defogger switch:
This switch activates the rear defogger. When the switch is left on, a timer keeps the defogger activated for 15 minutes and then turns it off automatically.

(6) Temperature control dial:
This switch allows adjusting the temperature of air delivered through ventilators.
There are 11 steps available for selection between positions 65 and 85 (vehicles for US) or between positions 20 and 30 (vehicles for Canada). The counterclockwise and clockwise extreme ends are the positions to keep the system in the maximum cooling and maximum heating operations, respectively.

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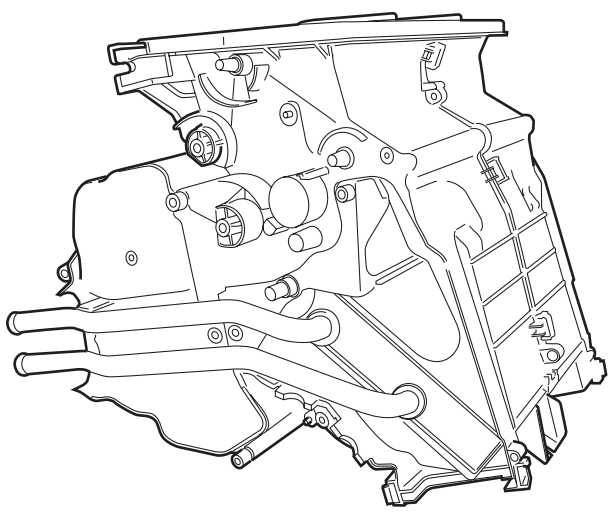
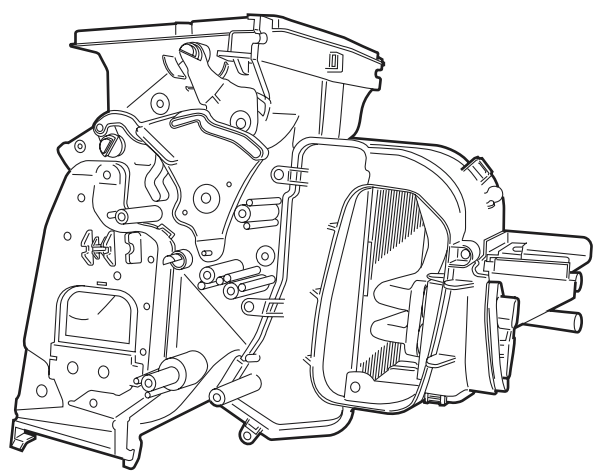
D: HEATER AND COOLING UNIT

● Having an evaporator core at the front and a heater core at the rear, this single unit combines both heating and cooling functions.

● The heater and cooling unit incorporates doors for creating different air flow modes and a door for mixing heated air and outside air.

● In the models with an automatic air conditioner, the air flow mode switching doors and air mixing door are moved by electric-motor-driven actuators. The actuators are centrally controlled using a local area network (LAN) system.
In the models without an air conditioner, the air flow mode switching doors and air mixing door are moved by cables through corresponding linkages.





AC-00483

1. SPECIFICATIONS

Heater core size	Heat output
163.9 × 200 × 25	5000W

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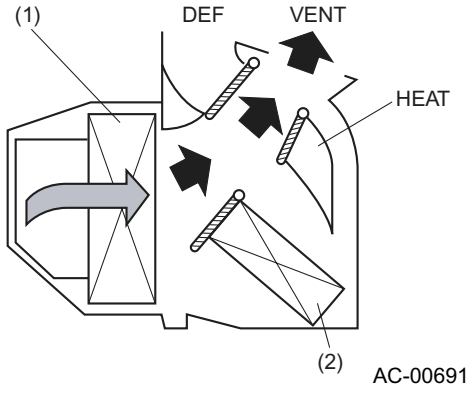
2. DESIGN FEATURES FOR EACH AIR FLOW MODE

1) Ventilation (VENT) mode

● The passage leading air from the evaporator to the ventilation outlet (VENT) is made straight to reduce air flow resistance.

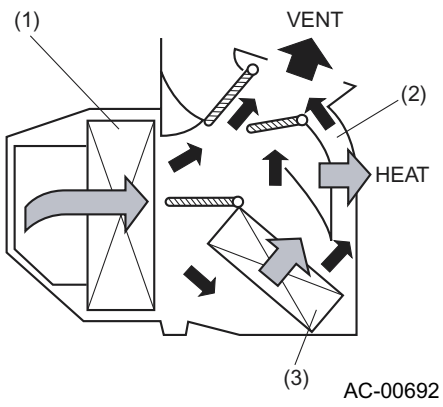
● When the air temperature is necessary to be adjusted, heated air is blown at right angles against the flow of cool air from the evaporator. This allows the airs to mix thoroughly.



(1) Evaporator
(2) Heater core

2) Foot/face (BILEVEL) mode

● Warm and cool air flows are created by structural means, namely, by forming sealing surface for air toward leg area on the heated air passage side and that for air toward the ventilation outlet (VENT) on the cooled air passage side.
To prevent an excessive difference in the temperature between the two air flows, a bypass passage is provided to allow part of heated air to flow toward the ventilation (VENT) outlet.



(1) Evaporator
(2) Bypass passage
(3) Heater core

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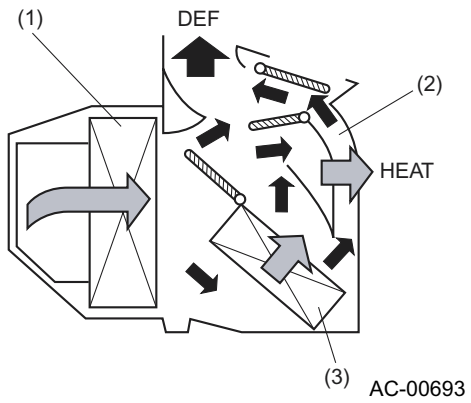
3) Heating (HEAT) mode

● Warm and cool air flows are created by structural means, namely, by forming sealing surface for air toward leg area on the heated air passage side and that for air toward the defroster (DEF) outlet on the cooled air passage side.
To prevent an excessive difference in the temperature between the two air flows, a bypass passage is provided to allow part of heated air to flow toward the ventilation (VENT) outlet.

● To maintain the passage toward the defroster (DEF) outlet even during the heating mode operation, the door of the passage toward leg area is fully opened to the make the passage also serve as a passage toward the defroster (DEF) outlet.

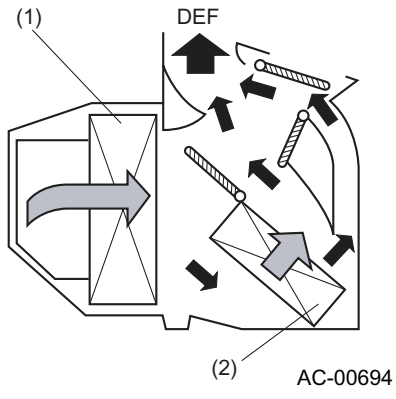


(1) Evaporator
(2) Bypass passage
(3) Heater core

4) Defroster (DEF) mode

● Air passages are designed in such a way that air flow resistance is minimized and defrosting performance is maximized.

● The air passages toward the defroster (DEF) outlet is long enough to ensure a same airflow rate at all defroster outlets.



(1) Evaporator
(2) Heater core

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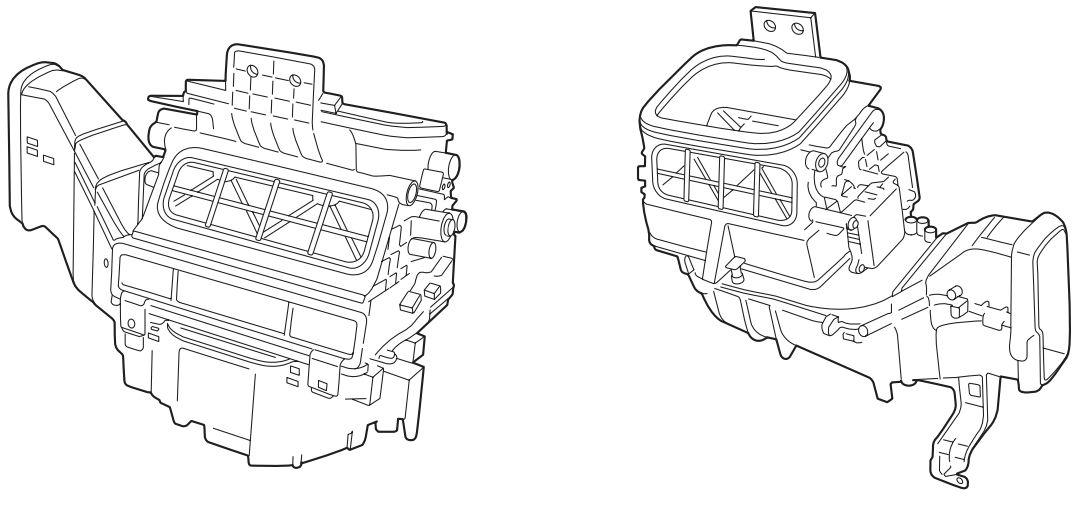
E: BLOWER UNIT

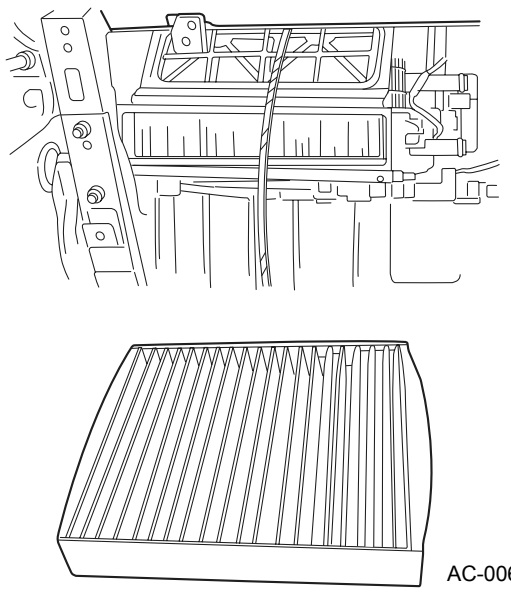
- The blower unit uses a low-noise-type motor.



AC-00478

F: FILTER

- Clean air filters are installed in models with automatic air conditioning. They can remove dust, cigarette smoke particles and other similar impurities in the air.



AC-00696

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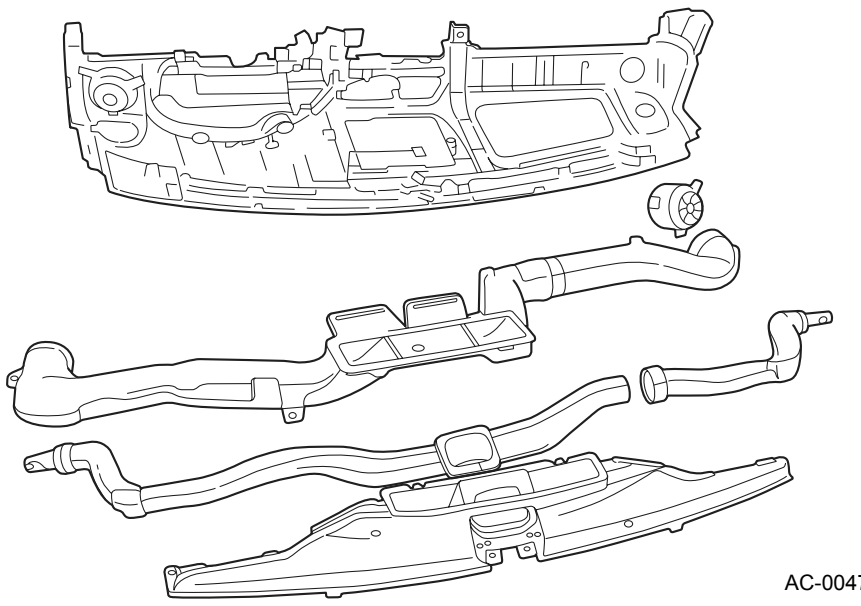
G: DUCT

- The ventilation duct and defroster duct are located behind the instrument panel. Both the ducts have been modified in the shape to reduce air flow resistance.
- Defrosting air flow is divided at the center, so that air can flow out evenly through a wide center defroster as well as right and left side defrosters.



AC-00479

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2. Cooling System

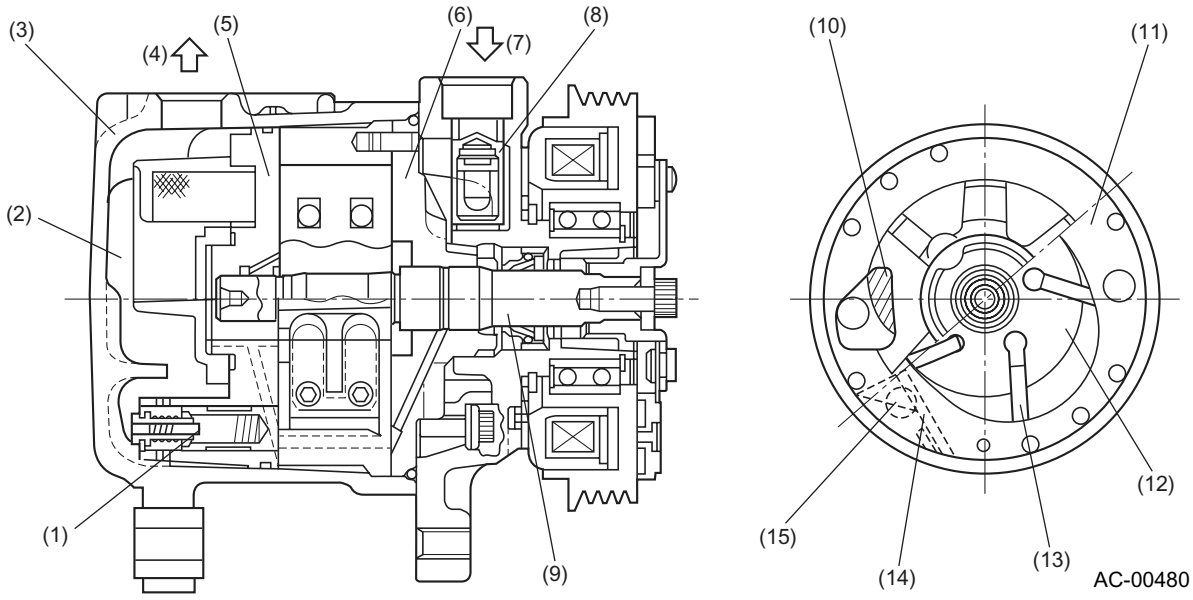
A: COMPRESSOR

The rotary type compressor consists of an integrally formed rotor and shaft, five vanes, and a cylinder.

As the rotor turns, the vanes that are movably fitted in the rotor slide over the wall of the oval-shaped cylinder while drawing, compressing, and discharging refrigerant gas.

The compressor shell has an oil separator at its rear end . High-pressure refrigerant gas having entered this chamber is separated from the oil it contains before flowing out through the compressors delivery port.

There is a check valve in the front housing to avoid reverse rotation of the compressor which would otherwise occur when the compressor is stopped.



(1) Oil cut-off valve
(2) Oil separator chamber
(3) Shell
(4) Discharge port
(5) Rear side plate
(6) Front side plate
(7) Suction port
(8) Check valve
(9) Shaft
(10) Suction port
(11) Cylinder
(12) Rotor
(13) Vane
(14) Discharge valve
(15) Discharge port

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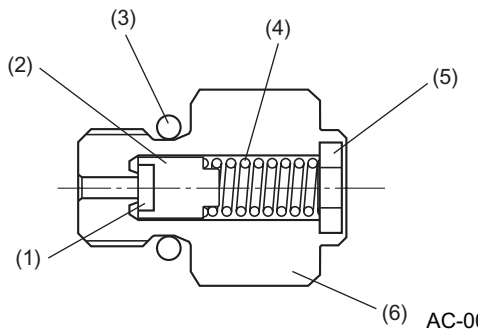
1. PRESSURE RELIEF VALVE

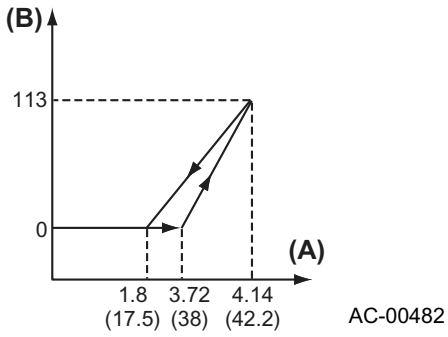
This valve opens if the pressure of the high-pressure refrigerant gas rises to a dangerously high level to release part of refrigerant into the atmosphere, thus protecting the compressor. The valve is designed to limit the amount of released gas to the necessary minimum.

Valve opening pressure: 3.72 MPa (38 kgf/cm^2)
Valve closing pressure: 1.8 MPa (17.5 kgf/cm^2)



(1) Seat rubber
(2) Seat cover
(3) O-ring
(4) Spring
(5) Cap
(6) Body

Operating characteristics



(A) Pressure MPa (kgf/cm^2)
(B) Leakage liters/min

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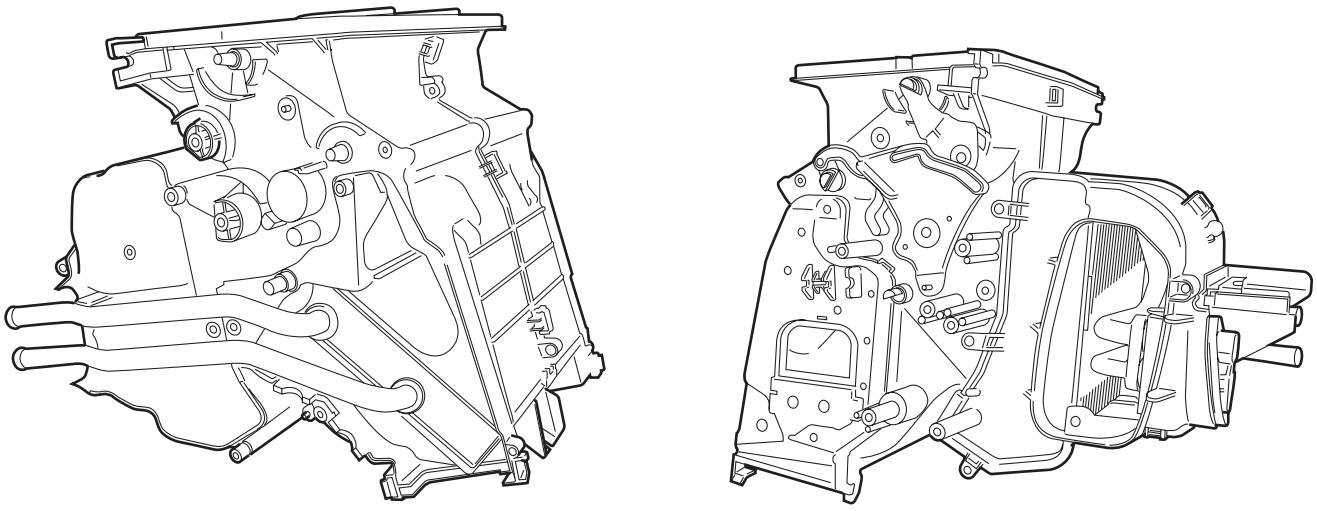
B: COOLING UNIT

The heater unit and cooling unit are integrated into a single heater and cooling unit.

The cooling section components of this unit include an evaporator, expansion valve, and case.



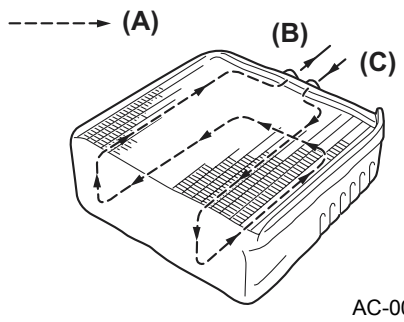
AC-00483

1. EVAPORATOR

The evaporator is a laminated type.

When a low-pressure, low-temperature refrigerant is sprayed by the expansion valve into the evaporator, it evaporates and cools the evaporator surfaces.

The cabin air is drawn by the blower and cooled down as it flows over the evaporator. The cooled air then flows passing through the heater unit and delivered into the cabin through vent outlets.



AC-00484

(A) Refrigerant flow

(B) Outlet

(C) Inlet

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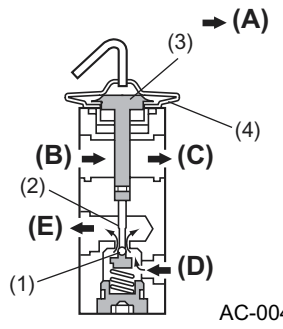
2. EXPANSION VALVE

The expansion valve regulates the flow of refrigerant such that heat exchange takes place optimally.

The expansion valve performs two functions; it sprays the high-pressure refrigerant from the condenser using a throttle valve, and it regulates the amount of the spray by changing opening of the throttle valve.

The expansion valve consists of such main components as a heat sensing cylinder, diaphragm, ball valve, spring, and adjusting screw.



AC-00485

(1) Ball valve
(2) Shaft
(3) Heat sensing cylinder
(4) Diaphragm

(A) Refrigerant flow
(B) From evaporator (low-pressure side)
(C) To compressor
(D) To liquid tank
(E) To evaporator (high-pressure side)

The heat (temperature) sensing cylinder is held in contact with the evaporator outlet pipe so that a pressure corresponding to the sensed temperature may be applied to the chamber above the diaphragm. There is a pressure equalizing hole which communicates with the chamber below the diaphragm to transmit changes in the refrigerant pressure to the chamber. The ball valve is linked with the diaphragm and moves according to changes in the balance between the force applied to the diaphragm and the tension of the spring.

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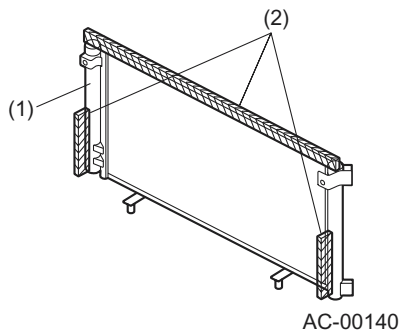
C: CONDENSER

The condenser used in the Impreza's air conditioning system is the newly developed "subcooling condenser" that integrates a multi-flow type condenser and a modulator (gas-liquid separator) into a single unit. The condenser has a high heat-exchange efficiency.

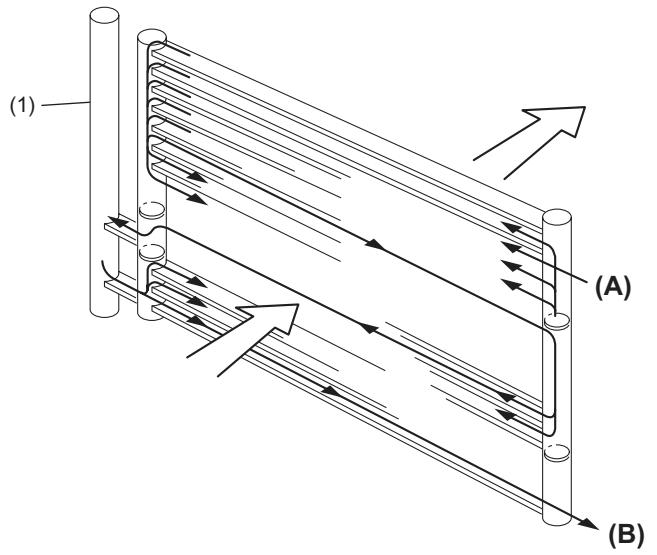


AC-00140

(1) Liquid tank
(2) Gasket

1. SUBCOOLING CONDENSER

The new subcooling condenser has a subcooling section where part of the refrigerant that remains in gas form is cooled and reduced into liquid form. This enables almost 100% of the refrigerant to be re-liquefied.



AC-00486

(1) Liquid tank
(A) Suction
(B) Discharge

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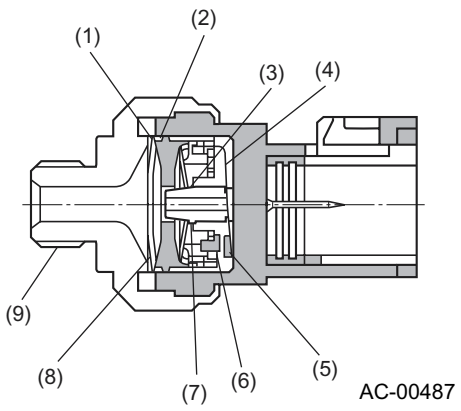
D: PRESSURE SWITCH

The pressure switch is a high-pressure side component of the refrigeration cycle (cooling cycle). It consists of a diaphragm that receives refrigerant gas pressure, a snap plate, a rod, and contacts that open both when the gas pressure is too low and when it is too high.

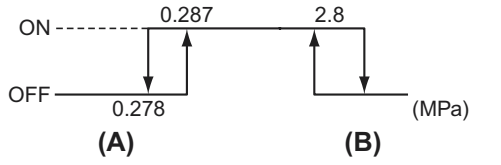
The pressure switch plays the following roles:
- Prevents “no-gas” operation due to leakage (when gas pressure is too low)
- Protects the system against abnormally high refrigerant pressure (when gas pressure is too high)



AC-00487

(1) Snap plate (high pressure)
(2) Disc
(3) Rod
(4) Leaf spring
(5) Contact
(6) Contact
(7) Snap plate (low pressure)
(8) Diaphragm
(9) Housing

ON-OFF pressures



AC-00488

(A) Low pressure
(B) High pressure

1. SPECIFICATIONS

Low limit pressure	OFF	Lower than 0.278 MPa (2.8 kgf/cm^2)
Normal pressure	Normal pressure	Between 0.287 and 2.8 MPa (2.8 and 28 kgf/cm^2)
High limit pressure	OFF	Higher than 2.8 MPa (28 kgf/cm^2)

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3. Manual Air Conditioning

A: GENERAL

1. SPECIFICATIONS

Item	Specifications			Remarks
Air conditioning	"Full-air-mix" type			
Cooling performance	Cooling capacity (W)		5100	
	Air flow rate (m^3/h)		450	
Refrigerant quantity	HFC-134a (g)		500±50	
Compressor	Type		Rotary type with vanes	Calsonic CR14
	Capacity (cm^3/rev)		144	
	Maximum permissible speed (rpm)		7000	
	Lubricant (amount contained in compressor in g)		DH-PR (180)	
Magnetic clutch	Type		Dry, single disc	
	Power consumption (W)		47	
	Pulley ratio		1:1.064 (crankshaft pulley diameter: 133 mm; compressor pulley diameter: 125 mm)	
	Belt		Polyurethane V-belt with four ribs	
Condenser	Type		Multi-flow type (with built-in liquid tank for subcooling)	
	Fan	Type	Electric-motor-driven axial flow fan	
		Fan diameter	320 mm (7+5 blades)	
		Power consumption (W)	120 × 2 (turbo models), 70 × 2 (non-turbo models)	
Evaporator	Type		Laminated	
	Expansion valve		External pressure equalizing type	
	Temperature control		Thermo AMP (amplifier)	
Other controls	Fast idle control system		Engine control module (ECM)	
	High and low pressure limit control		Low-pressure switch: Turns off compressor at a pressure lower than 0.278 MPa High pressure switch: Turns off compressor at a pressure higher than 2.8 MPa	
	High-speed limit control		Performed by ECM	
	Radiator and condenser fan control		Performed by ECM	

2. CONTROL PANEL

<Ref. to AC-5 — Heater System, CONTROL PANEL.>

3. THERMO AMP (AMPLIFIER)

The thermo AMP detects the temperature at the evaporator outlet to turn off the magnetic clutch circuit when the evaporator temperature drops to a certain level in order to prevent frost from forming on the evaporator.

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4. Automatic Air Conditioning

A: GENERAL

When the AUTO mode is selected, the automatic air conditioner controls the air temperature and air flow rate automatically.

The system can maintain a comfortable cabin air condition always when the temperature control dial is set in the vicinity of position “75” (vehicles for US) or position “25” (vehicles for Canada).

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1. SPECIFICATIONS

Item	Specifications			Remarks
Air conditioning	"Full-air-mix" type			
Cooling performance	Cooling capacity (W)		5000	
	Air flow rate (m^3/h)		450	
Refrigerant (g)	500±50			
Compressor	Type		Rotary type with vanes	Calsonic CR14
	Capacity (cm^3/rev)		144	
	Maximum permissible speed (rpm)		7000	
	Lubricant (amount contained in compressor in g)		DH-PR (180)	
Magnetic clutch	Type		Dry, single disc	
	Power consumption (W)		47	
	Pulley ratio		1:1.064 (crankshaft pulley diameter: 133 mm; compressor pulley diameter: 125 mm)	
	Belt		Polyurethane V-belt with four ribs	
Condenser	Type		Multi-flow type (with built-in liquid tank for subcooling)	
	Fan	Type	Electric-motor-driven axial flow fan	
		Fan diameter	320 mm (7+5 blades)	
		Power consumption (W)	120 × 2	
Evaporator	Type		Laminated	
	Expansion valve		External pressure equalizing type	
	Temperature control sensor		Thermistor	
Automatic control system	Temperature control		"Full-air-mix" system	
	Fan speed control		Automatic control: stepless Manual control: four steps	
	Air introduction selection		Manual (inside air recirculation/fresh air introduction)	
	Air outlet selection		Manual (ventilation, bi-level, heater, defroster and heater/defroster)	
Other controls	Fast idle control system		Engine control module (ECM)	
	High and low pressure limit control		Low-pressure switch: Turns off compressor at a pressure higher than 0.278 MPa High-pressure switch: Turns off compressor at a pressure higher than 2.8 MPa	
	High-speed limit control		Performed by ECM	
	Radiator and condenser fan control		Performed by ECM	
Diagnosis function	The auto A/C control module has a sensor and actuator diagnosis function.			
Other controls	Manual adjustment possible at maximum heating and maximum cooling positions			

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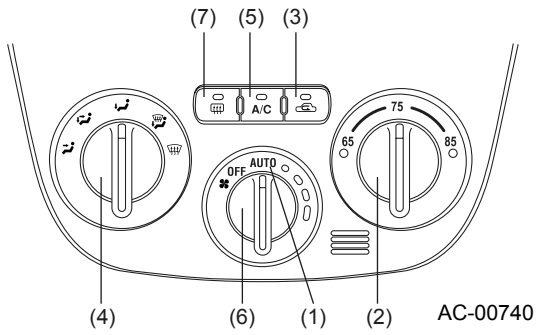
B: CONTROL PANEL

There are three dial-type switches and three push-button switches on the control panel.



AC-00740

(1) AUTO position of fan speed control dial:
When the fan speed control dial is placed in this position, the blower speed and air temperature is automatically controlled according to signals from various sensors.

(2) Temperature control dial:
The cabin temperature can be set in 11 steps between positions 65 and 85 (vehicles for US) or between positions 20 and 30 (vehicles for Canada). (The left and right ends are for fixing the system operation for maximum cooling and maximum heating.)

(3) FRESH/RECIRC switch:
Used to select either the outside-air-introduction or cabin-air-recirculation.

(4) Air flow control dial:
Used to change the air outlets. The air flow mode changes in the order shown below as the switch is turned clockwise.

AC-00127

(5) A/C switch:
Used to turn on and off the air conditioner compressor.

(6) Fan speed control dial:
Used to change the blower speed. When a speed is selected, the blower keeps that speed.

(7) Rear window defogger switch:
Used to active the rear window defogger. The defogger stays on for 15 minutes (unless manually turned off intermediately) and then is deactivated automatically.

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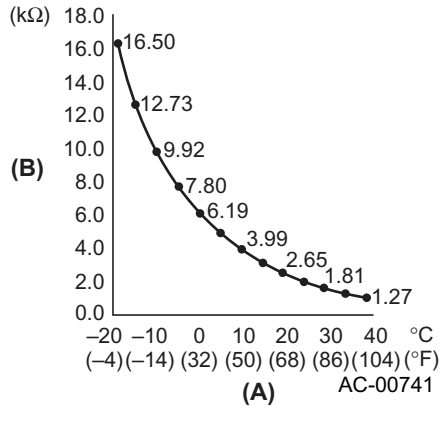
C: IN-VEHICLE SENSOR

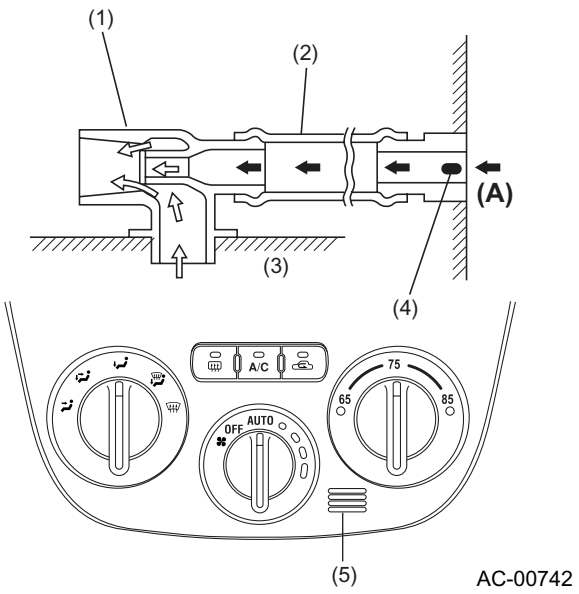
The in-vehicle sensor detects the cabin temperature and sends an electric signal corresponding to the temperature to the A/C control module.

This sensor consists of an aspirator and a thermistor, the resistance of which changes in inverse proportion to the temperature. The aspirator operates by a vacuum generated in the heater unit (only when the blower unit is turned on).



(A) Temperature

(B) Resistance



(1) Aspirator

(2) Aspirator duct

(3) Heater unit

(4) In-vehicle sensor

(5) Cabin air inlet

(A) Cabin air

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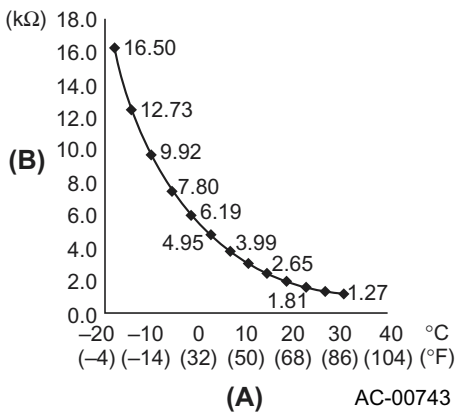
D: AMBIENT SENSOR

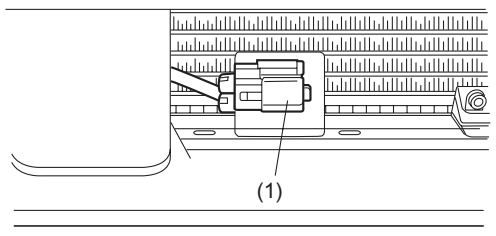
The ambient sensor uses a thermistor to detect the ambient temperature and outputs a signal corresponding the detected temperature to the auto A/C control module.
The thermistor is covered with a plastic molding to increase its thermal capacity, thus preventing it from being too sensitive to rapid changes in the temperature and enabling the sensor to output an average ambient temperature.



(A) Temperature

(B) Resistance

The ambient sensor is attached to the radiator lower panel at the portion where the radiator panel is located in such a way that it is exposed to outside air most efficiently.



AC-00712

(1) Ambient sensor

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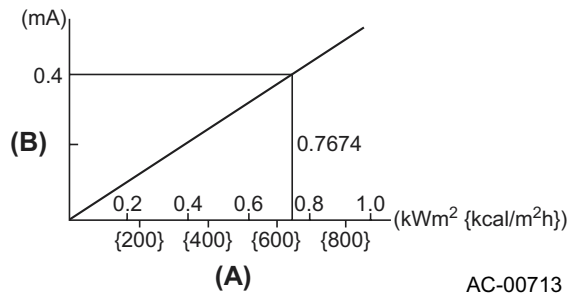
E: SUN-LOAD SENSOR

The sun-load sensor uses a photodiode which can convert change in the intensity of solar radiation into change in the electric current. The output signal of the sensor is sent to the auto A/C control module.

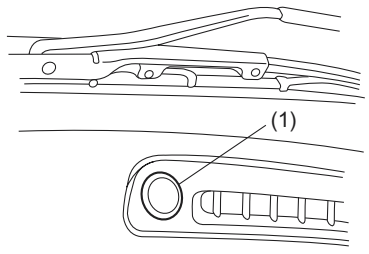
Sun-load sensor characteristics



(A) Solar radiation

(B) Photoelectric current

The sun-load sensor is attached to the front defroster grill.



(1) Sun-load sensor

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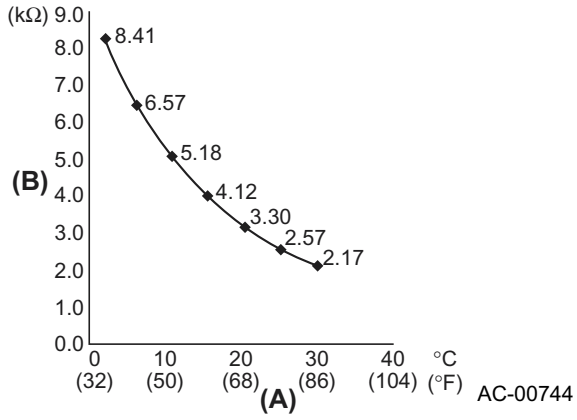
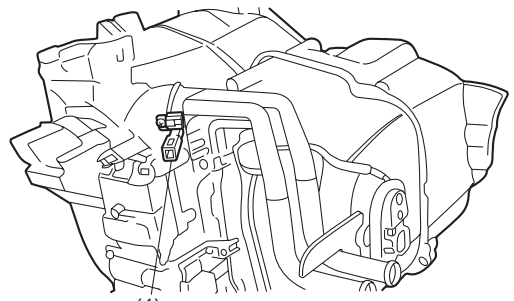
F: EVAPORATOR SENSOR

The evaporator sensor detects the temperature of the air that has passed over the evaporator and transmits a signal corresponding to the temperature to the auto A/C control module.



(A) Temperature

(B) Resistance



(1) Evaporator sensor connector

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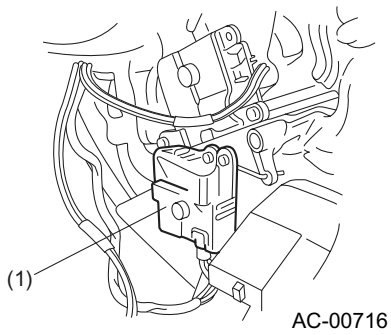
G: AIR MIX DOOR ACTUATOR

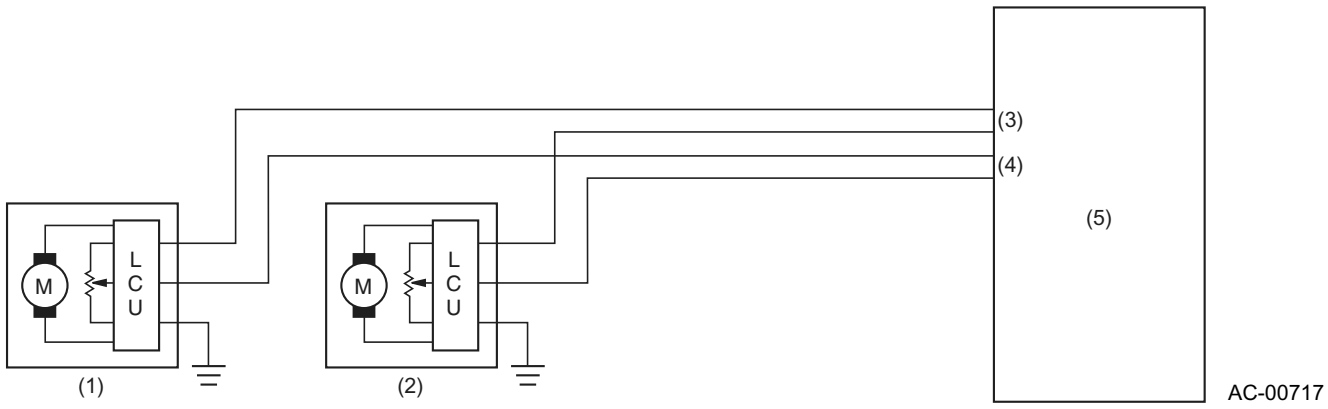
The air mix door actuator incorporates an electric motor which turns in one or the other direction in response to signals from the auto A/C control module. The motion of the electric motor is transmitted to the air mix door via a linkage to move the door to an appropriate position.



(1) Air mix door actuator

1. CONTROL SYSTEM

The air mix door actuator and mode door actuator have their own local control units (LCUs) so that they can be controlled through a single communication line by using the local area network (LAN) technology.
When each LCU receives from the auto A/C control module a control signal (a combination of two pulse signals with different amplitudes), it causes the corresponding door to move to a target position by calculating an appropriate amount of movement based on a door position signal. When the movement of the door has completed, the LCU sends a signal to the auto A/C control module to inform it of the fact.



(1) Air mix door actuator
(2) Mode door actuator
(3) Actuator power source
(4) LAN signal
(5) Auto A/C control module

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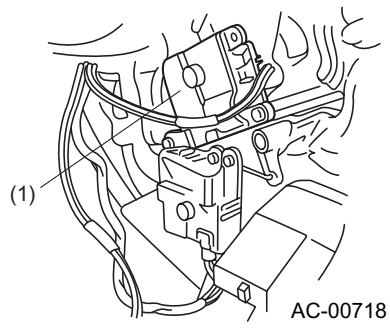
H: MODE DOOR ACTUATOR

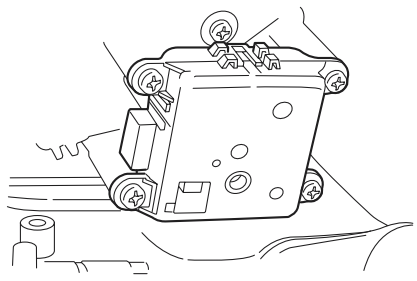
The mode door actuator incorporates an electric motor which turns in one or the other direction in response to signals from the auto A/C control module. The motion of the electric motor is transmitted to each mode door via a linkage and moves the door to the position appropriate for the selected air flow mode.



(1) Mode door actuator

I: FRESH/RECIRC DOOR ACTUATOR

The FRESH/RECIRC door actuator incorporates an electric motor which turns in one or the other direction in response to a signal from the auto A/C control module. The motion of the electric motor is transmitted to the FRESH/RECIRC door via a linkage to move the door to the outside-air introduction or cabin-air-recirculation position.



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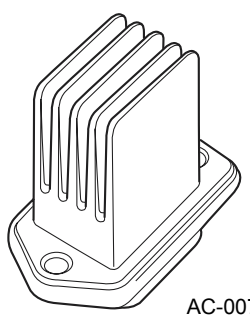
J: FAN CONTROL AMPLIFIER

The fan control amplifier uses a MOS* type field effect transistor. This amplifier steplessly regulates the blower motor voltage (in the range between approximately 3V and 12V) in response to gate voltage signals issued by the auto A/C control module.
Since this fan control amplifier features very small voltage drop, it can handle the maximum voltage for the maximum blower speed without need for a high-voltage relay.

*MOS = metal oxide semiconductor



AC-00720

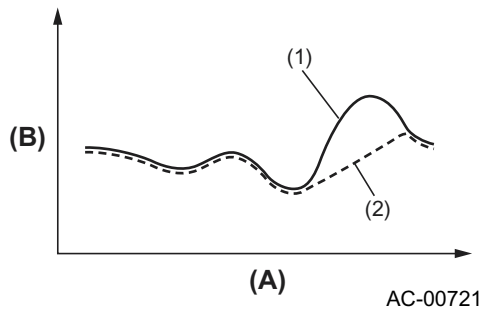
K: CONTROL SYSTEM

1. CORRECTION TO INPUT DATA

1) Correction to ambient sensor data

- The auto A/C control module receives ambient temperature data from the ambient sensor.
- If the ambient sensor data shows a rapid temperature rise by some causes such as heat from the radiator, the auto A/C control module performs a delay correction. By effecting this correction, the rate of temperature rise recognized by the auto A/C control module becomes slower than that detected by the ambient sensor. The auto A/C control module performs no correction when the ambient temperature drops.

Characteristics of correction to ambient sensor data



AC-00721

(1) Temperature detected by the sensor
(2) Outside air temperature after correction
(A) Time
(B) Outside air temperature

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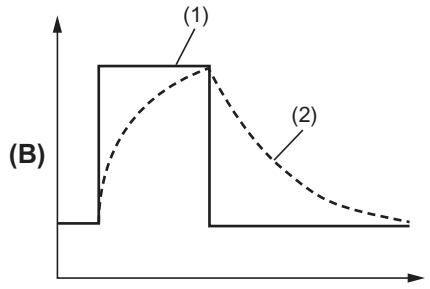
2) Correction to sun-load sensor data

- The auto A/C control module receives solar radiation intensity data from the sun-load sensor.
- If the solar radiation intensity changes rapidly when, for example, the vehicle enters or goes out of a tunnel, the auto A/C control module performs a correction that slows down the rate of change in the solar radiation intensity recognized by itself.
- The auto A/C control module performs this correction in such a way that the rate of change in the solar radiation intensity it recognizes becomes higher when the intensity differs much from the sensor-detected intensity than when the difference between the two intensities is little. Also, the auto A/C control module perform the correction such that the rate of change in the recognized intensity becomes higher when the detected intensity changes upward than when it changes downward.

This is to make the control match the way in which the human senses respond to change in the solar radiation intensity.

Characteristics of correction to sun-load sensor data



(1) Solar radiation intensity detected by the sensor
(2) Solar radiation intensity read by the ECM
(A) Time
(B) Solar radiation intensity

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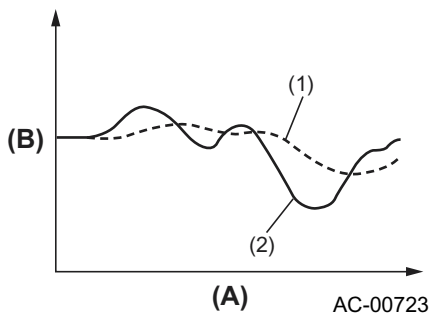
3) Correction to in-vehicle sensor data

- The auto A/C control module receives cabin temperature data from the in-vehicle sensors.
- To prevent the air temperature control from directly reflecting non-uniformity of the cabin temperature or effects of external thermal factors, the auto A/C control module performs a correction that slows down the rate of change in the cabin temperature recognized by itself.
- The auto A/C control module performs this correction in such a way that the rate of change in the cabin temperature it recognizes becomes higher when the temperature differs much from the sensor-detected temperature than when the difference between the two temperatures is little.

Characteristics of correction to in-vehicle sensor data

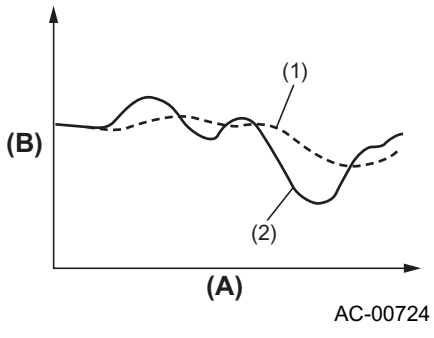


(1) Solar radiation intensity read by the ECM
(2) Solar radiation intensity detected by the sensor
(A) Time
(B) Cabin temperature

4) Correction to evaporator sensor data

- The auto A/C control module receives data of the evaporator downstream air temperature from the evaporator sensor.
- To prevent the air temperature control from directly reflecting non-uniformity of the evaporator downstream air temperature or effects of external disturbances, the auto A/C control module performs a correction that slows down the rate of change in the evaporator downstream air temperature recognized by itself.
- The auto A/C control module performs this correction in such a way that the rate of change in the evaporator downstream air temperature it recognizes becomes higher when the temperature differs much from the sensor-detected temperature than when the difference between the two temperatures is little.

Characteristics of correction to evaporator sensor data



(1) Temperature read by the ECM
(2) Temperature detected by the sensor
(A) Time
(B) Air temperature at downstream of evaporator

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BRAKE

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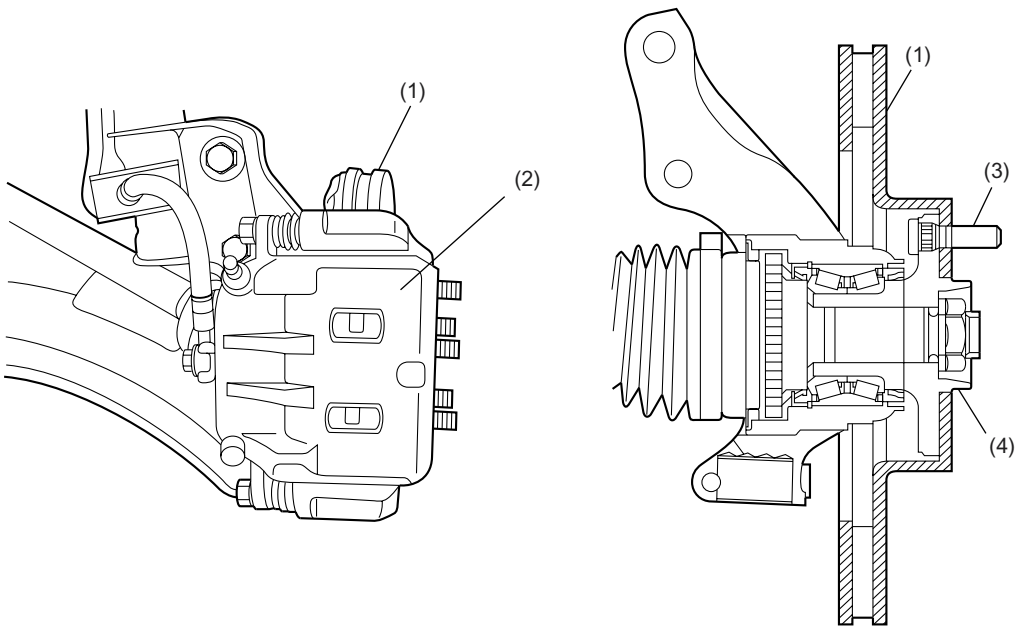
1. Front and Rear Disc Brakes

● The front disc brakes are of a ventilated disc type which features high heat dissipation and superb braking stability. In addition, disc brakes will quickly restore their original braking performance even when they get wet.

● On STi models, ventilated discs are used on both front and rear wheels.

● Each disc rotor, which is fitted on the outside of the hub, is secured together with the wheel using the hub bolts. This facilitates its removal and installation.

● The inner brake pad is provided with a wear indicator.



BR-00011

(1) Disc rotor
(2) Caliper body
(3) Hub bolt
(4) Hub

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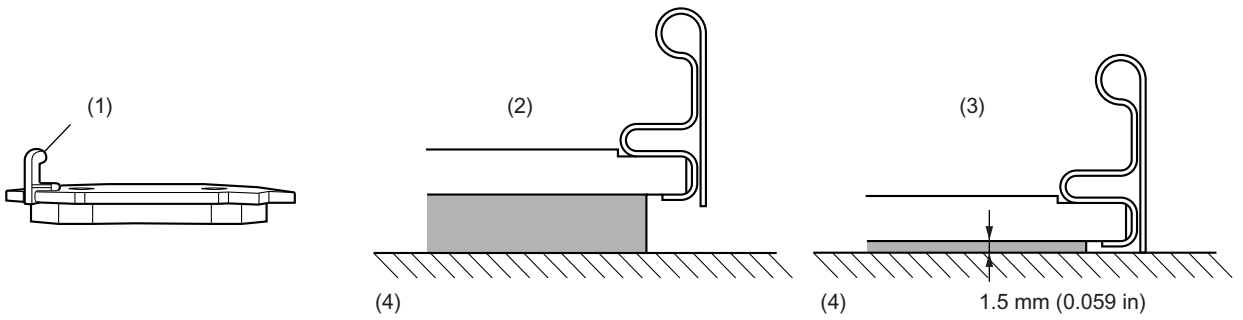
A: PAD WEAR INDICATOR

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 alerts the driver to the situation.



(1) Wear indicator
(2) New pad
(3) Worn pad
(4) Disc rotor

B: FRICTIONAL MATERIAL OF BRAKE PADS

The brake pads materials do not contain any asbestos which is harmful to human body.

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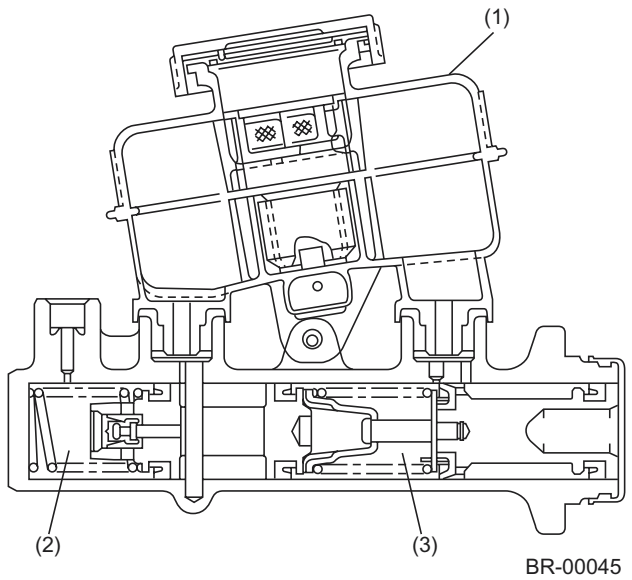
2. Master Cylinder

● There is a brake fluid reservoir tank on the master cylinder. The reservoir is completely sealed for extended service life of the brake fluid.



BR-00045

(1) Reservoir tank
(2) Secondary hydraulic chamber
(3) Primary hydraulic chamber

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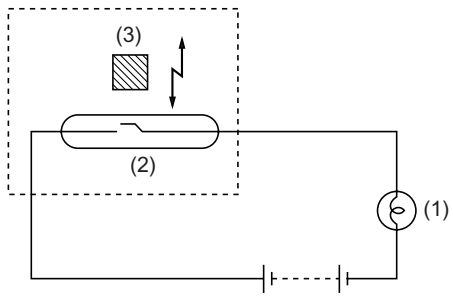
A: BRAKE FLUID LEVEL SWITCH

The brake fluid level switch is located inside the brake fluid reservoir tank and causes the brake system warning light on the combination meter to come on when the fluid level has dropped below the predetermined level.
The switch assembly consists of a reed switch (normally open) and a permanent magnet that is incorporated in a float.

When the brake fluid level is normal, the float is far above the reed switch, so the force of the magnet is unable to act on the reed switch. The warning light circuit, therefore, remains open.
When the brake fluid level drops to a level approximately 30 mm (1.18 in) below the maximum level and the float lowers accordingly, the magnet aligns with the reed switch, activating the reed switch contact. The warning light then comes on to warn the driver of the situation.
The warning light may, although momentarily, illuminate even when the brake fluid level is normal if the vehicle tilts or swing largely.



BR-00147

(1) Warning light
(2) Reed switch
(3) Permanent magnet

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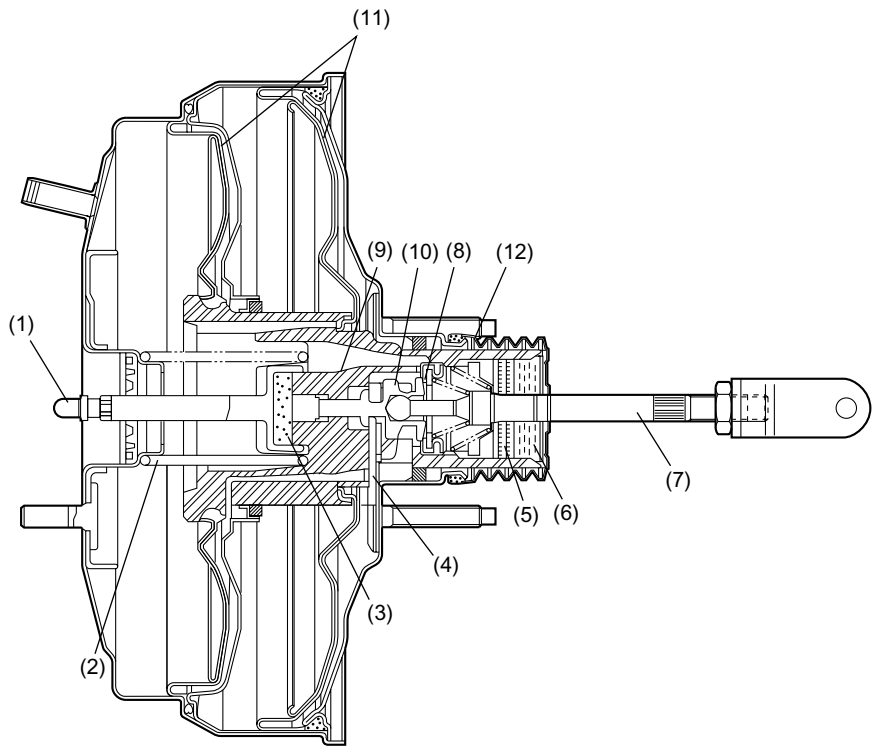
3. Brake Booster

The brake booster is a tandem type that uses two diaphragms.
By utilizing the differential pressure between the intake manifold vacuum and atmospheric pressure, a high braking force can be obtained even when the pedal depressing effort is small.
The brake booster is installed between the brake pedal and master cylinder. This contributes to improve the response to the brake pedal. If it fails, the brake servo effect is lost requiring a larger pedal effort, however, the braking force is still maintained.



BR-00057

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

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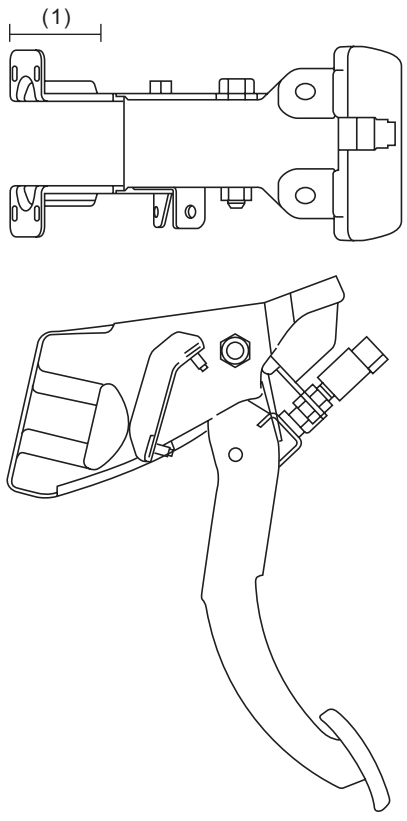
4. Brake Pedal

To minimize brake pedal rearward movement in case of a collision for extra safety, the shape of the brake pedal bracket has been changed.
An impact absorbing area is provided at the side of the pedal bracket.
In case of a front collision, the brake pedal bracket impact absorbing area deforms to minimize shock to the driver.



BR-00149

(1) Impact absorbing area

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BRAKE PEDAL

MEMO

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BODY STRUCTURE

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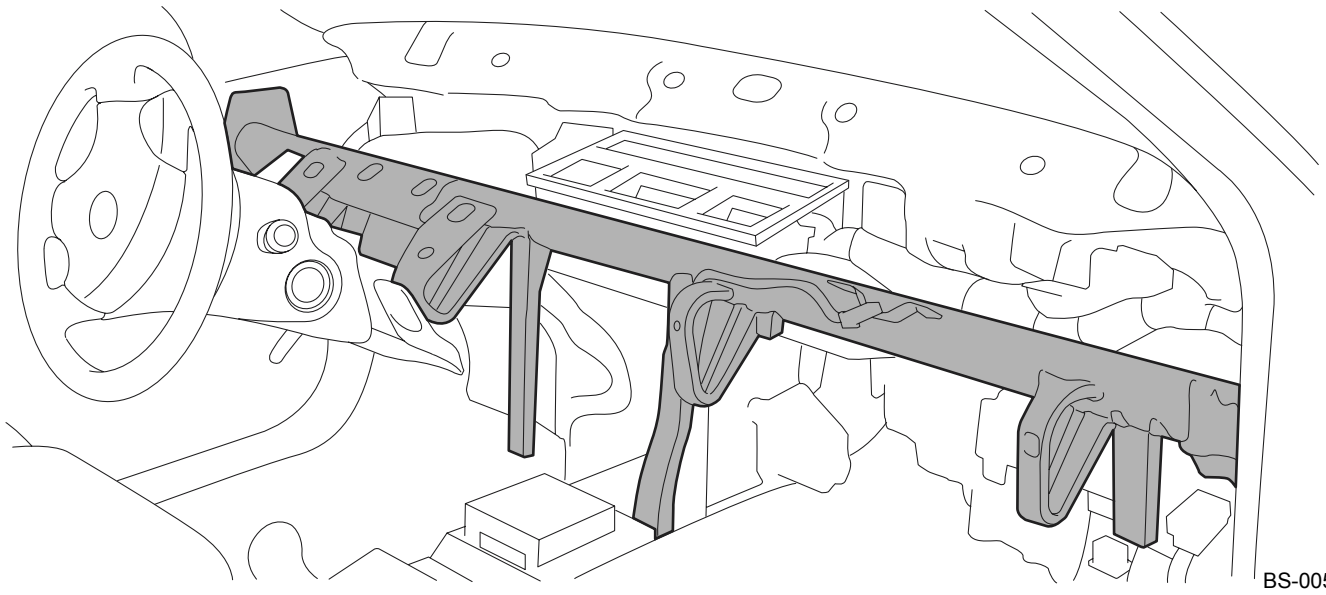
1. Steering Support Beam

A steering support beam is provided between the left and right front pillars for reinforced support of the steering column. It also minimizes vibration of the steering column and limits its extension to a minimum in the event of a collision.



BS-00559

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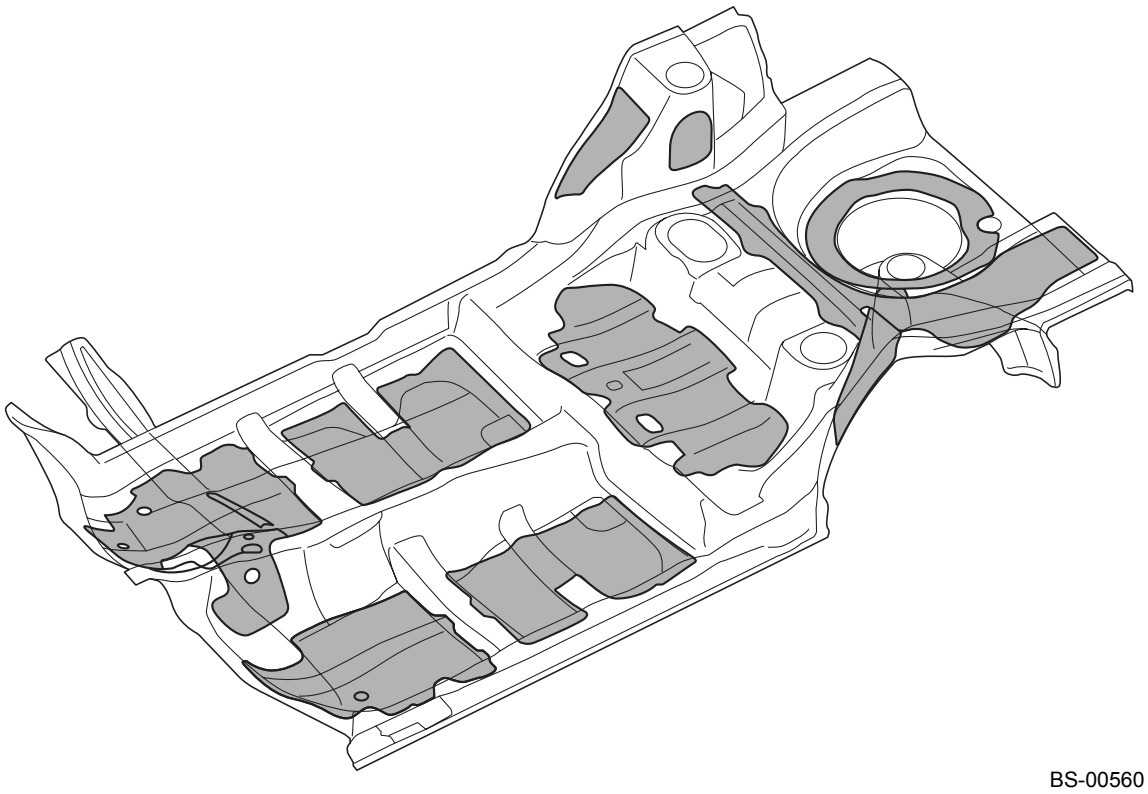
2. Quietness

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 ensure quietness of the passenger compartment.

A: SILENCER

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



BS-00560

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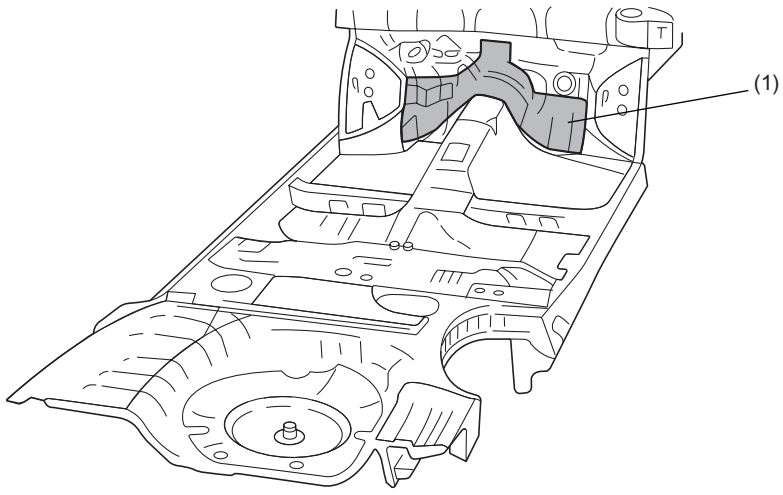
B: DUAL-WALL

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.



BS-00561

(1) Dual-wall

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3. Body Sealing

A: SEALED PARTS

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

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

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4. Painting

A: SPECIFICATIONS

Color name	Color code
PURE WHITE	51E
PREMIUM SILVER (M)	01G
DARK GREEN MICA	29W
SOLID RED	22G
REDDISH BLUE (M)	23W
GRAPHITE BLACK MICA	18L
WR BLUE MICA	02C
PURE WHITE/GRAY (M)	2L6 (51E/26D)
PREMIUM SILVER (M) / GRAY (M)	2L7 (01G/26D)
SOLID RED (M) / GRAY (M)	2K1 (22G/26D)
REDDISH BLUE (M) / GRAY (M)	2C3 (23W/26D)
DARK GREEN MICA / GRAY (M)	2C6 (29W/26D)

(M): Metallic

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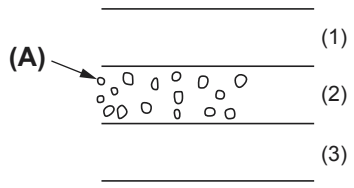
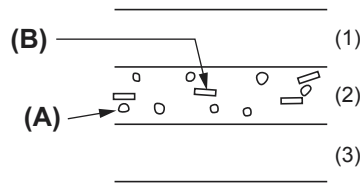
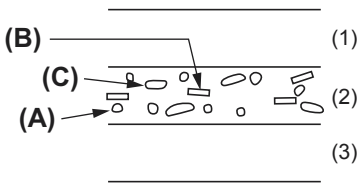
B: PAINT FILM STRUCTURE

Color name	Paint film structure	
• PURE WHITE • SOLID RED	 BS-00562	(1) Clear coat (2) Color base (3) Intermediate paint **(A)** Pigment
• PREMIUM SILVER (M) • GRAY (M) • REDDISH BLUE (M) (M): Metallic	 BS-00563	(1) Clear coat (2) Color base (3) Intermediate paint **(A)** Pigment **(B)** Aluminum pigment
• WR BLUE MICA • DARK GREEN MICA • GRAPHITE BLACK MICA	 BS-00564	(1) Clear coat (2) Color base (3) Intermediate paint **(A)** Pigment **(B)** Aluminum pigment **(C)** Colored mica

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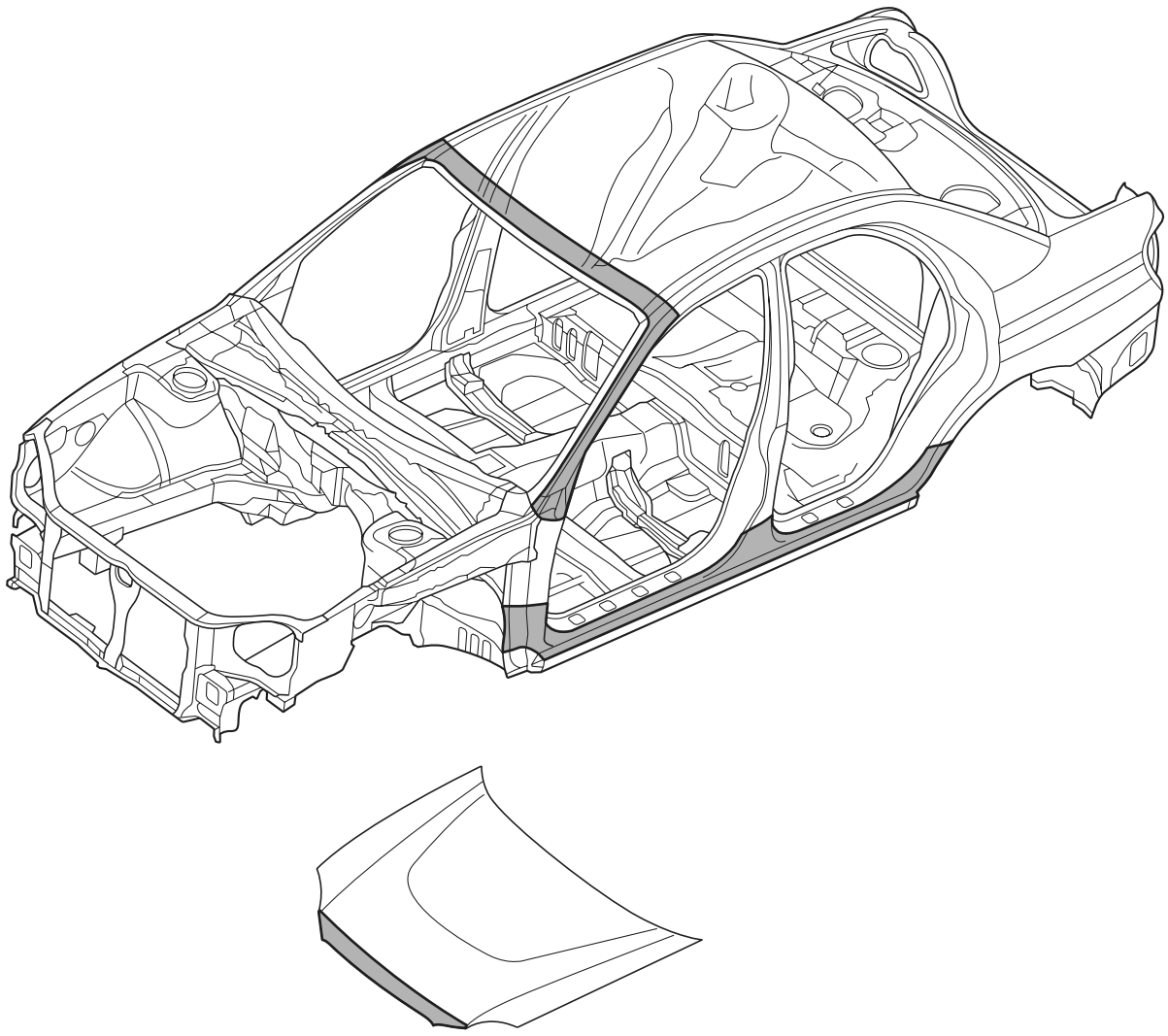
5. Anti Chipping Coat (ACC) Application



BS-00565

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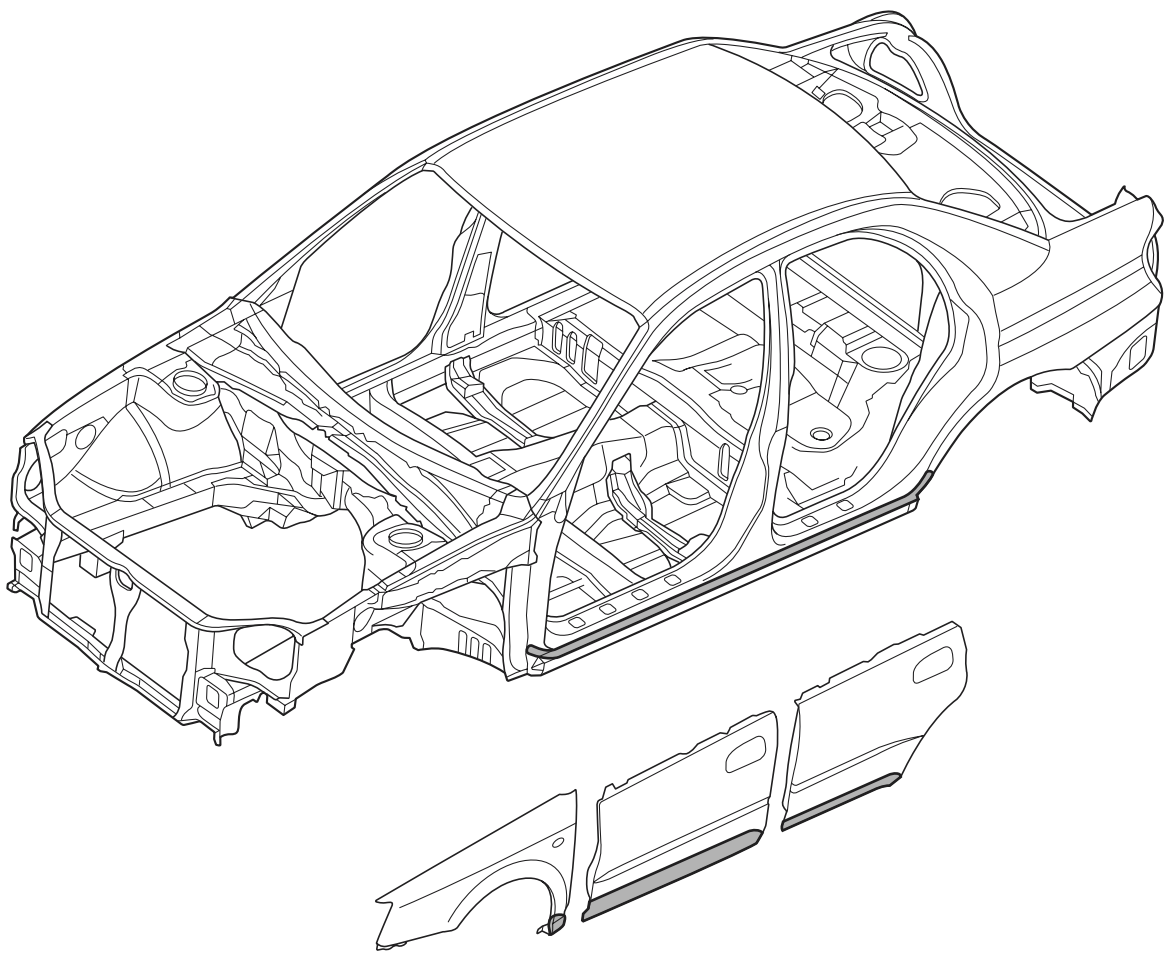
6. Stone Guard Coat (SGC) Application



BS-00597

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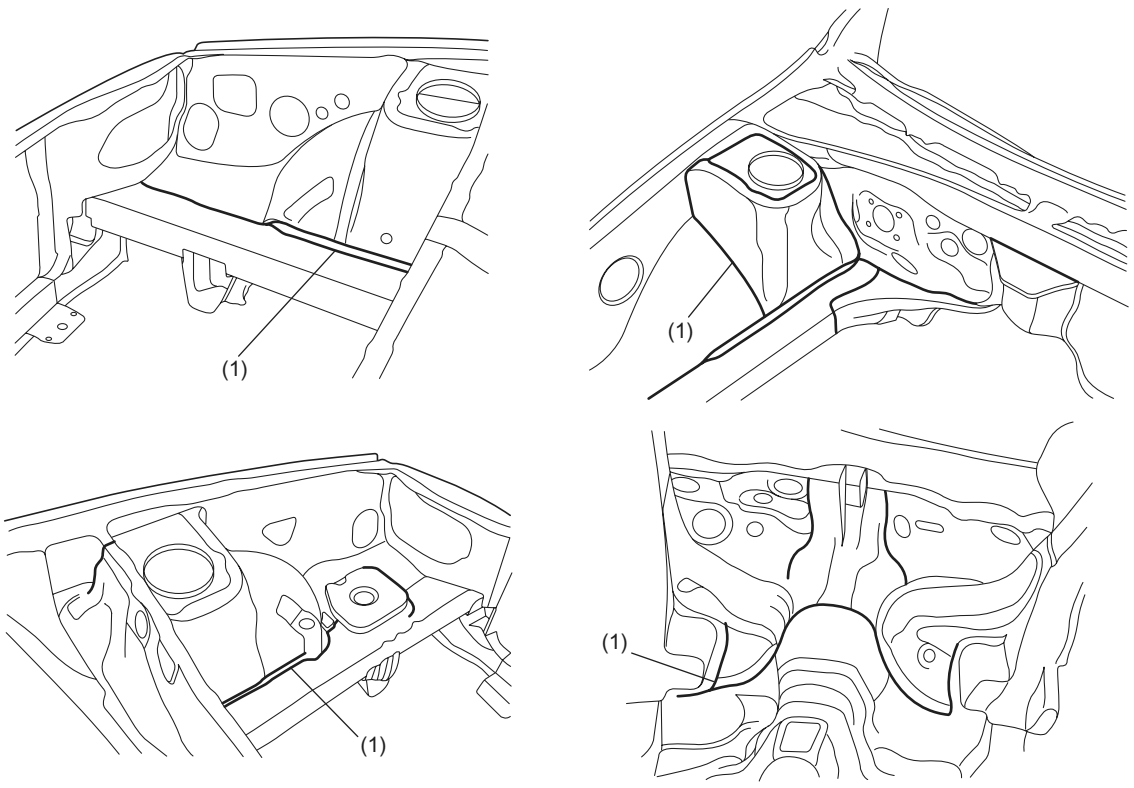
7. Sealer Application

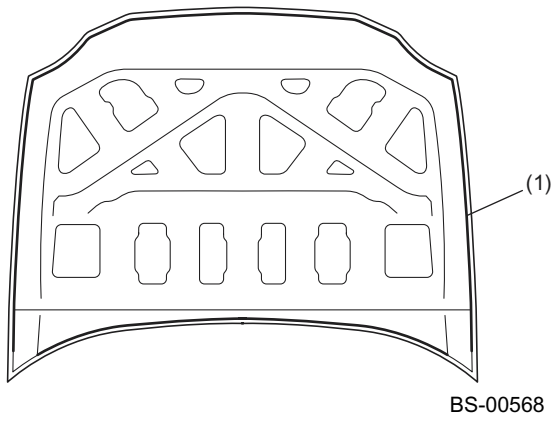
A: ENGINE COMPARTMENT



BS-00567

(1) Sealer

B: ENGINE HOOD



BS-00568

(1) Sealer

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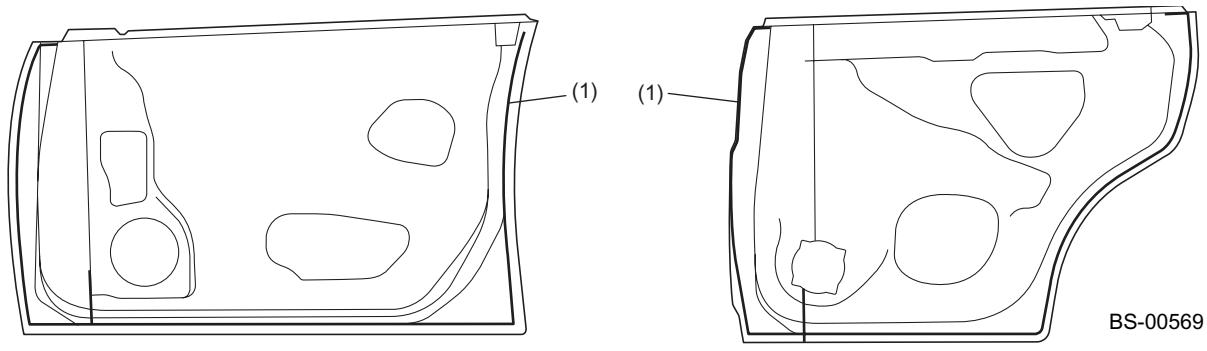
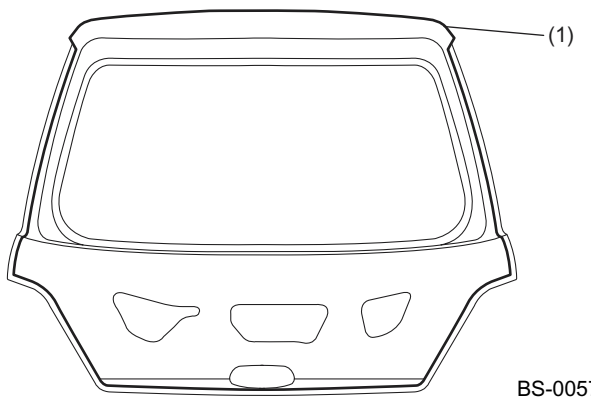
C: DOOR



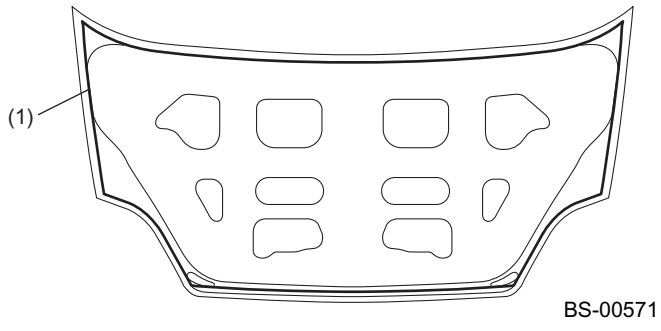
(1) Sealer

D: REAR GATE



(1) Sealer

E: TRUNK LID



(1) Sealer

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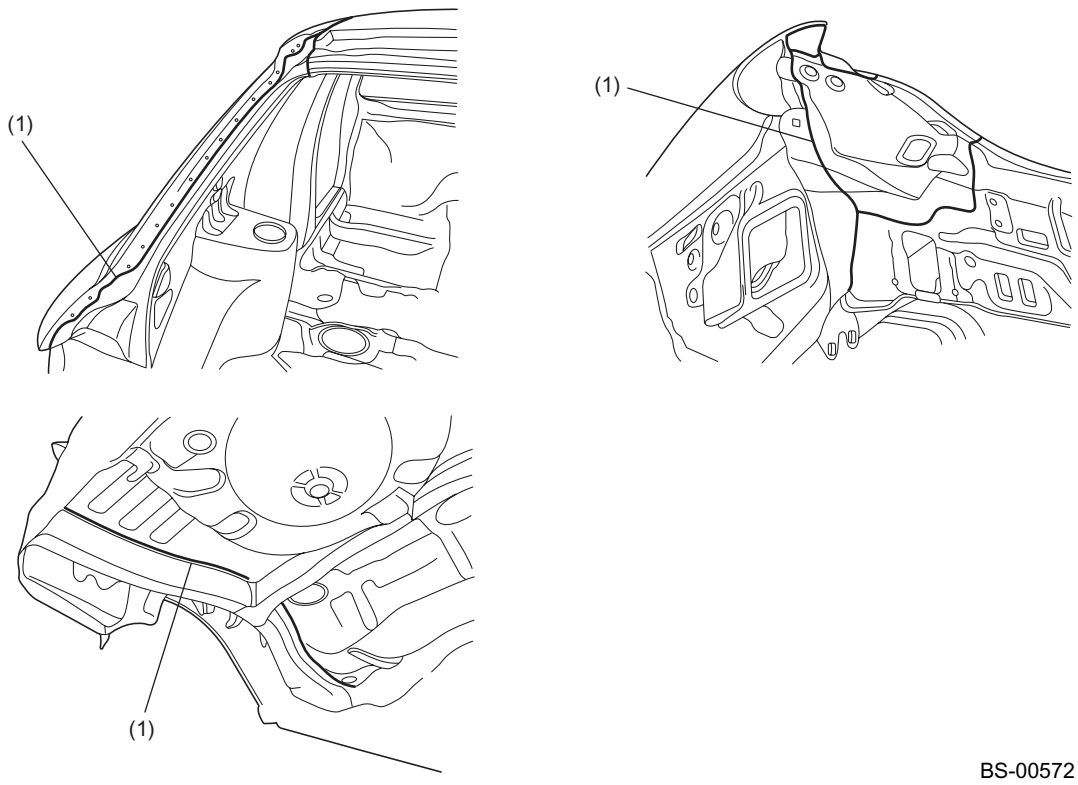
F: REAR END (WAGON)



BS-00572

(1) Sealer

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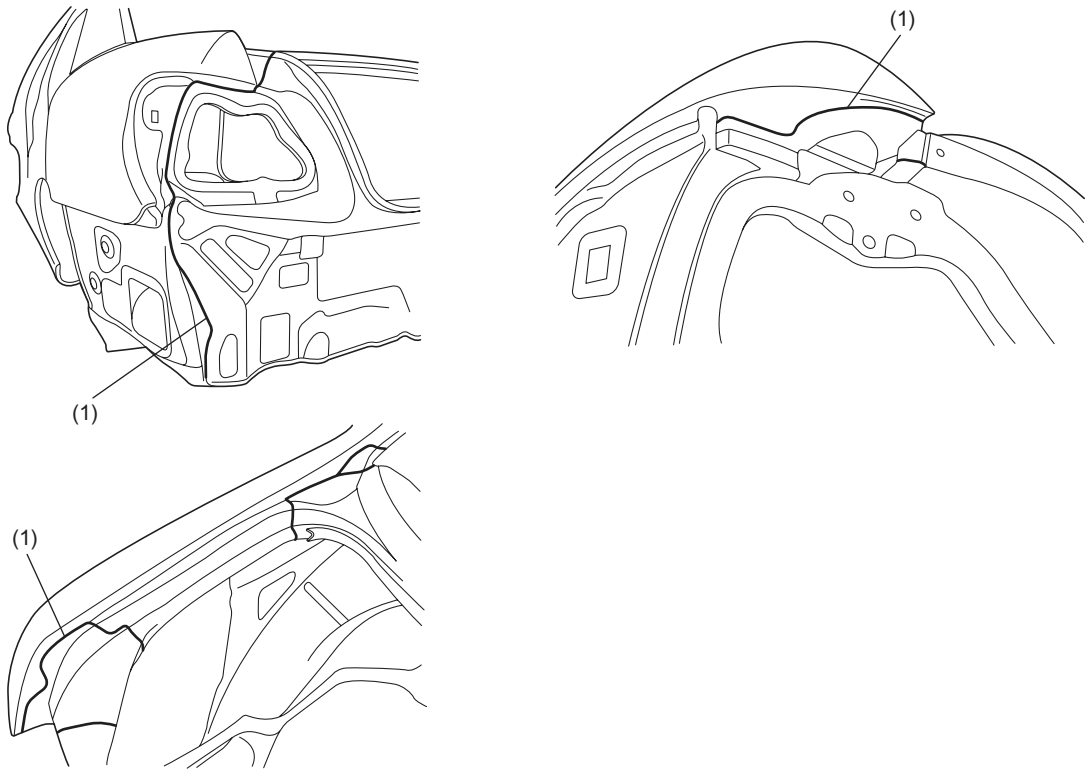
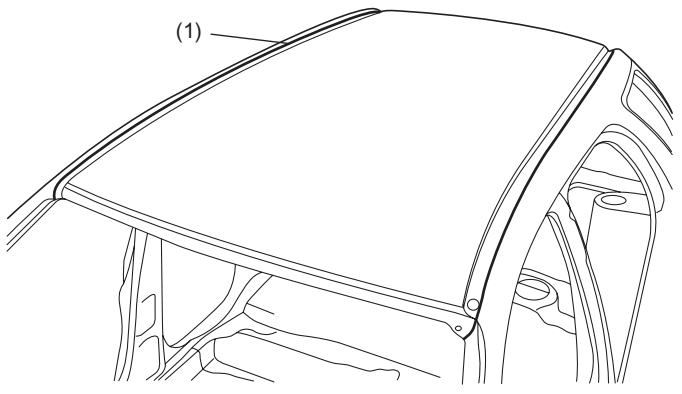
G: REAR END (SEDAN)



BS-00573

(1) Sealer

H: ROOF PANEL



BS-00574

(1) Sealer

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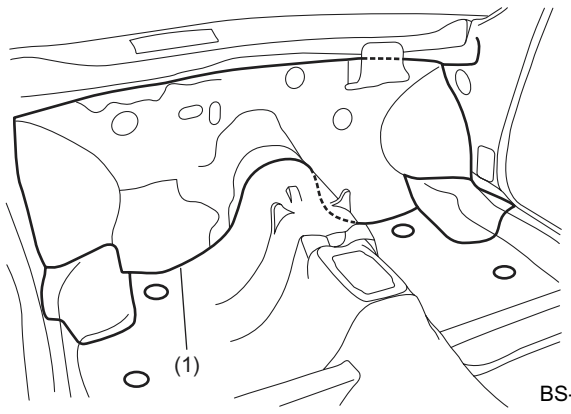
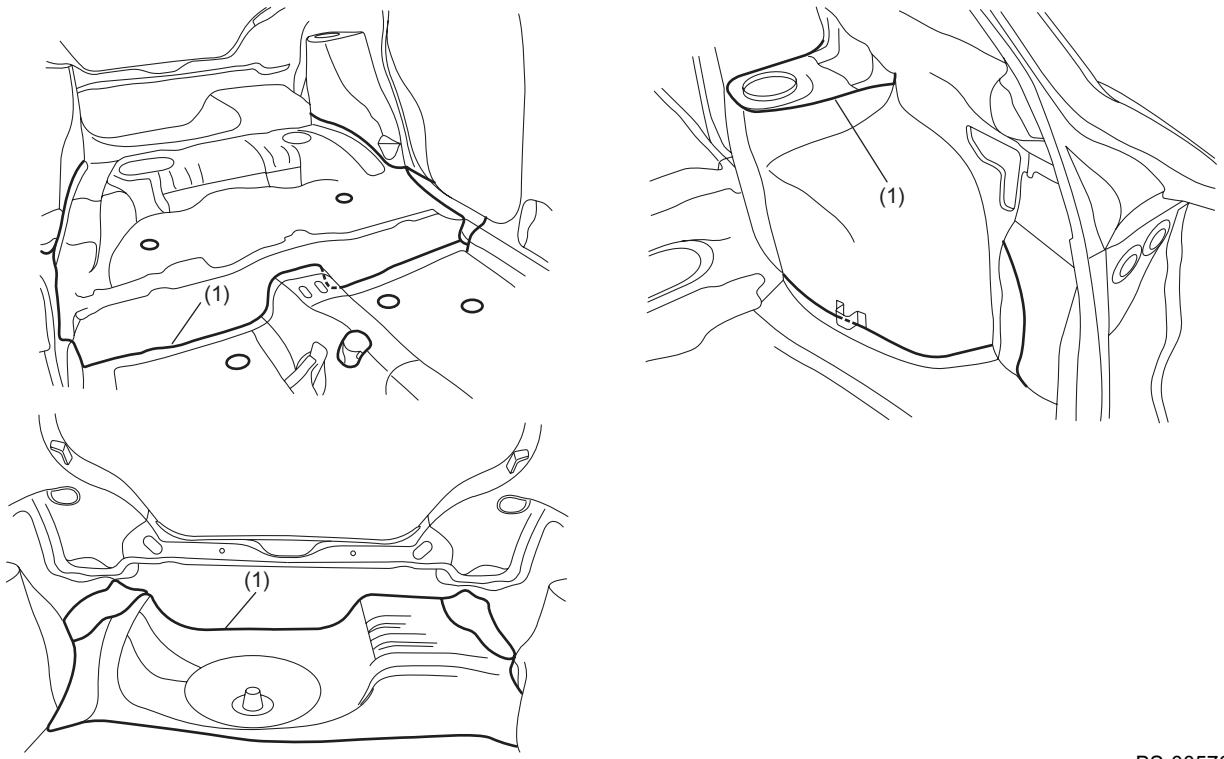
I: FRONT FLOOR



BS-00575

(1) Sealer

J: REAR FLOOR (WAGON)



BS-00576

(1) Sealer

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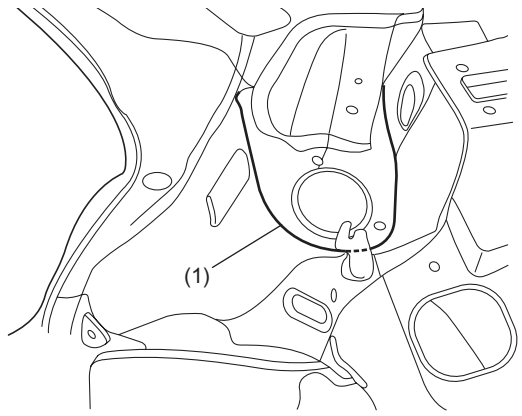
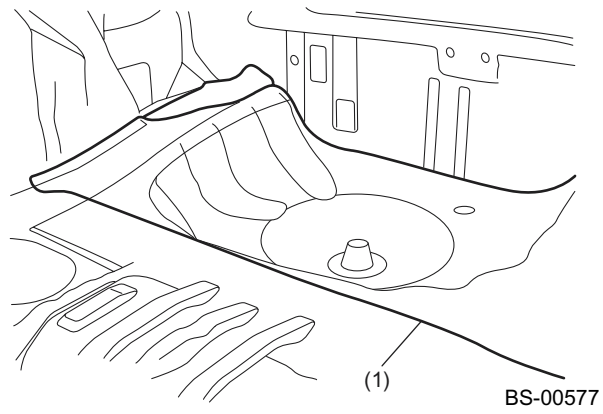
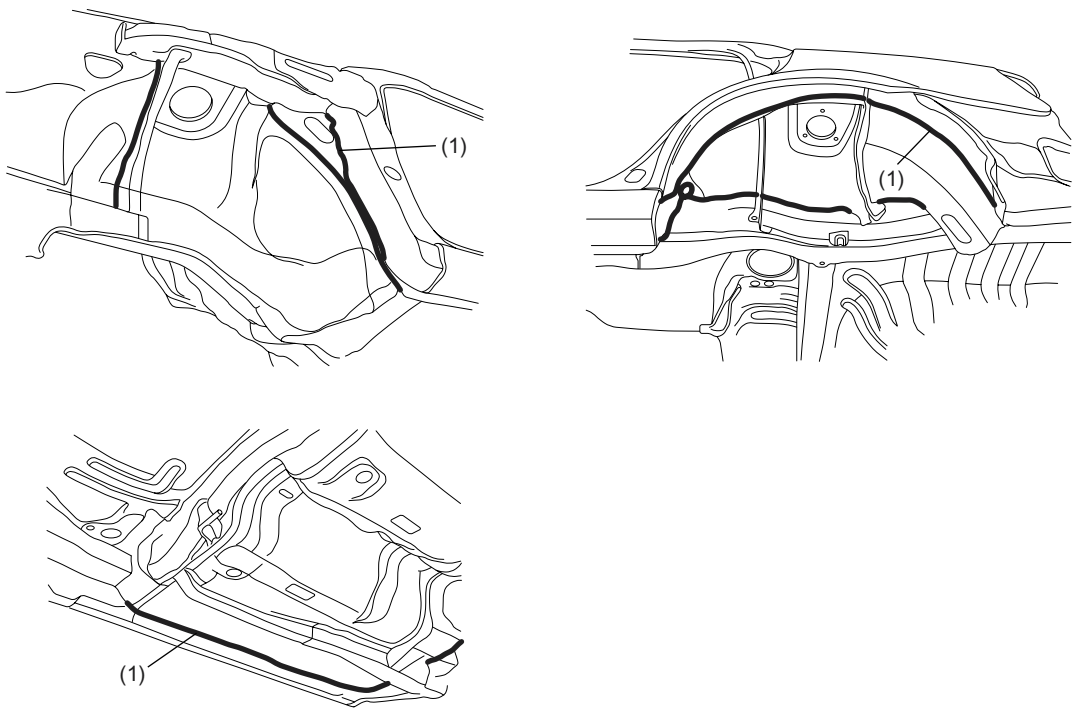
K: REAR FLOOR (SEDAN)





(1) Sealer

L: UNDER BODY



(1) Sealer

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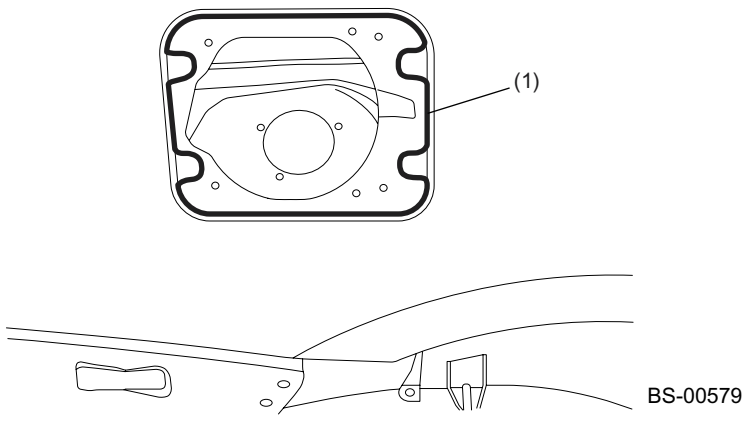
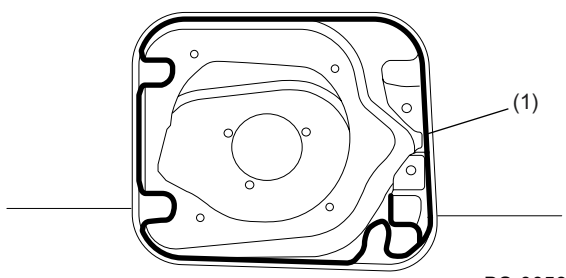
M: FUEL LID (WAGON)



(1) Sealer

N: FUEL LID (SEDAN)



(1) Sealer

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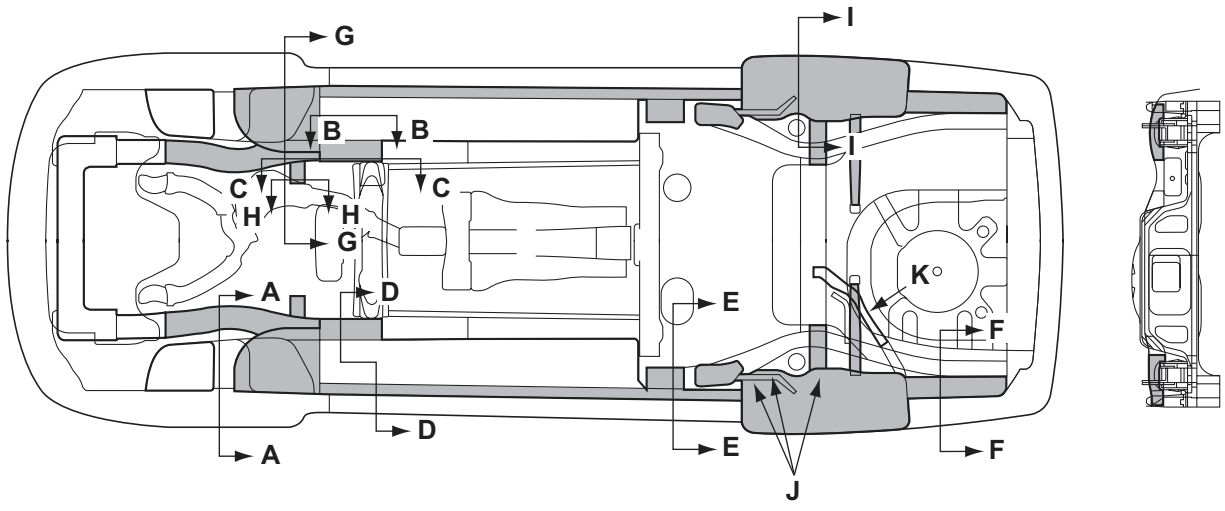
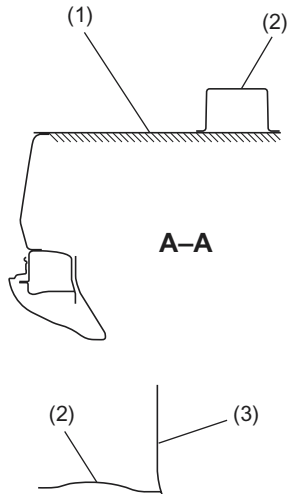
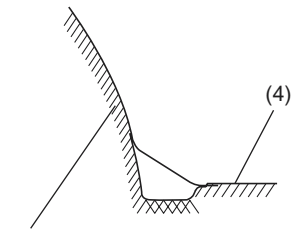
8. Anti-rust Wax (Bitumen Wax) Application

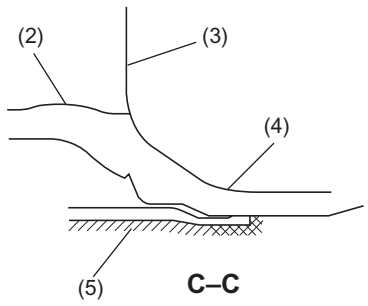




A–A



B–B



C–C

BS-00634

(1) Front suspension lower bracket
(2) Front side frame
(3) Toeboard
(4) Front floor
(5) Sub frame

A–A Body lower surface
B–B Section A
C–C Section B

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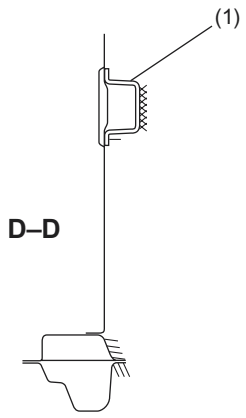
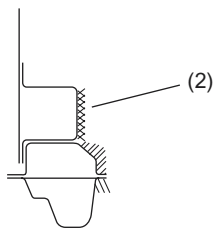
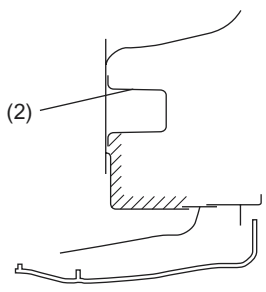
ANTI-RUST WAX (BITUMEN WAX) APPLICATION



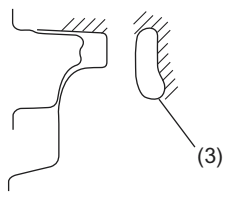
D–D



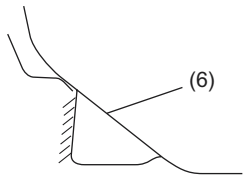
E–E



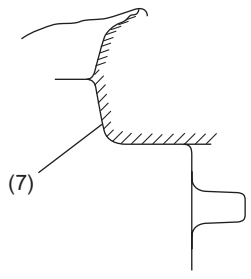
F–F



G–G



H–H



I–I

BS-00635

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(1) Front side frame
(2) Rear side frame
(3) Sub frame
(4) Toeboard
(5) Rear wheel apron

D–D Section C
E–E Section D
F–F Section E
G–G Section F
H–H Section G
I–I Section H

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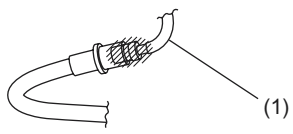
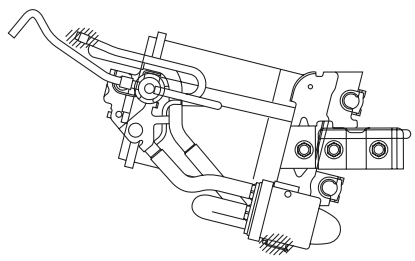
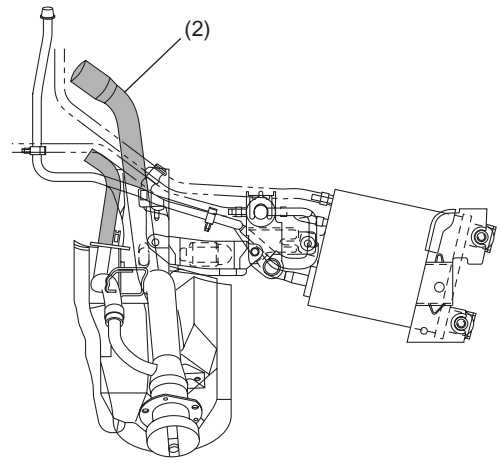
ANTI-RUST WAX (BITUMEN WAX) APPLICATION



(J)



(K)



BS-00583

(1) Brake pipe
(2) Filler pipe

(J) Detail J
(K) Detail K

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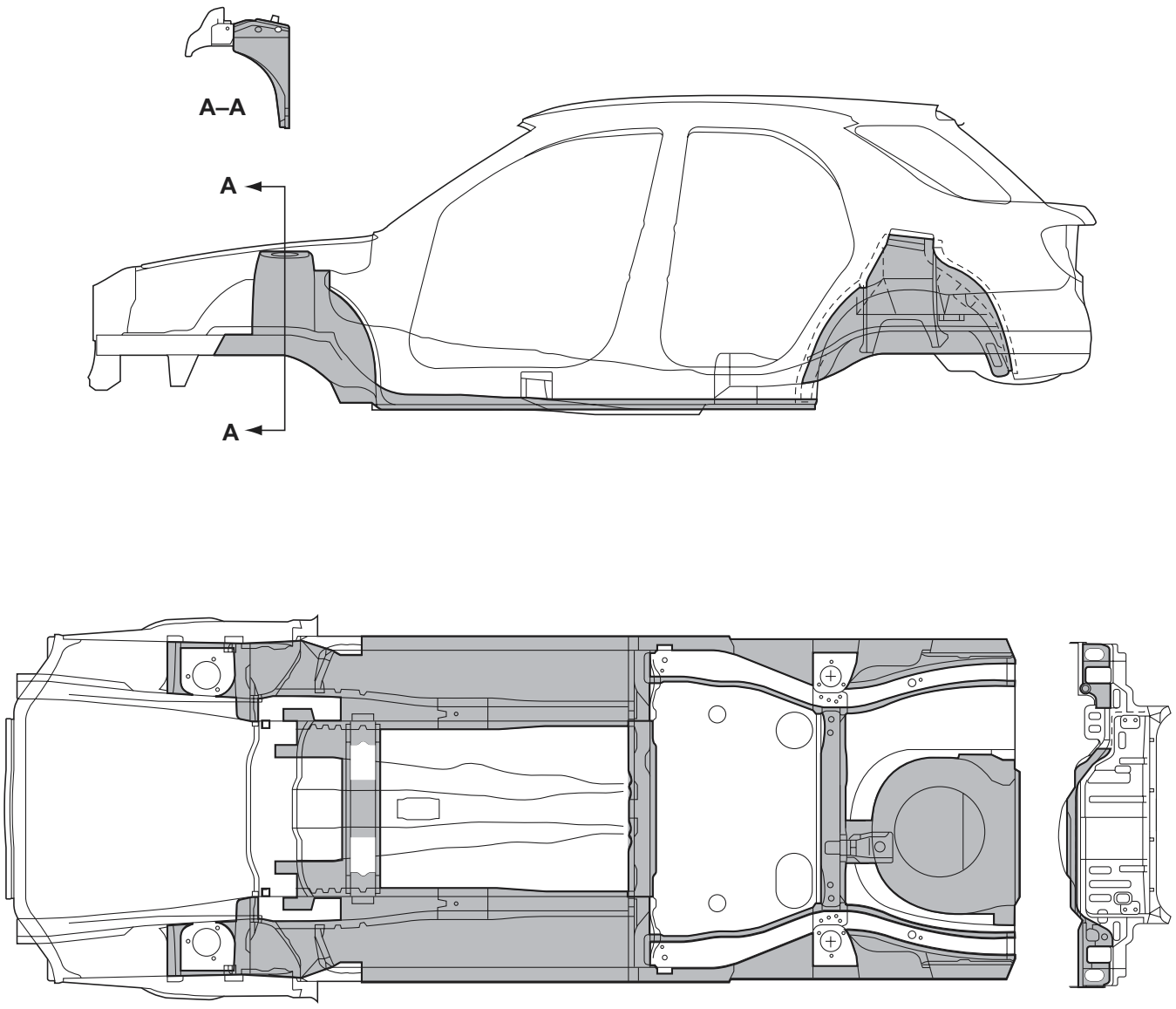
9. Polyvinyl Chloride (PVC) Application



BS-00584

A–A Section A

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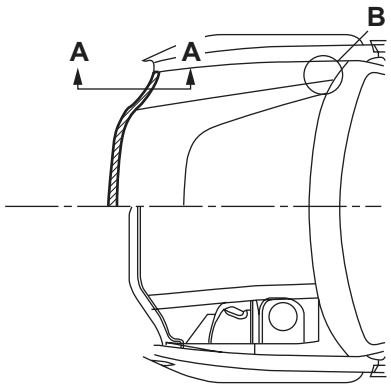
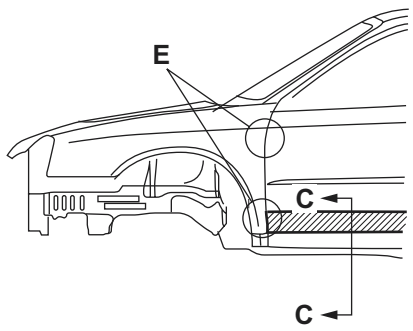
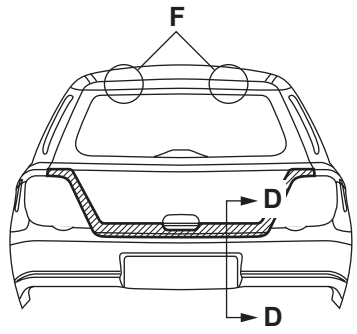
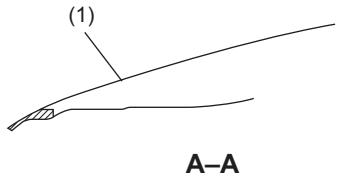
10.Hot Wax Application





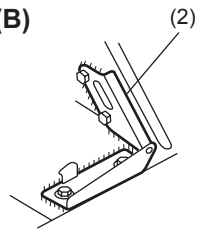
(a)



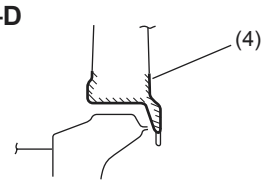


A–A

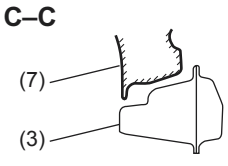
(B)



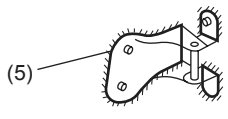
D–D



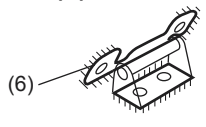
C–C



(E)



(F)



BS-00598

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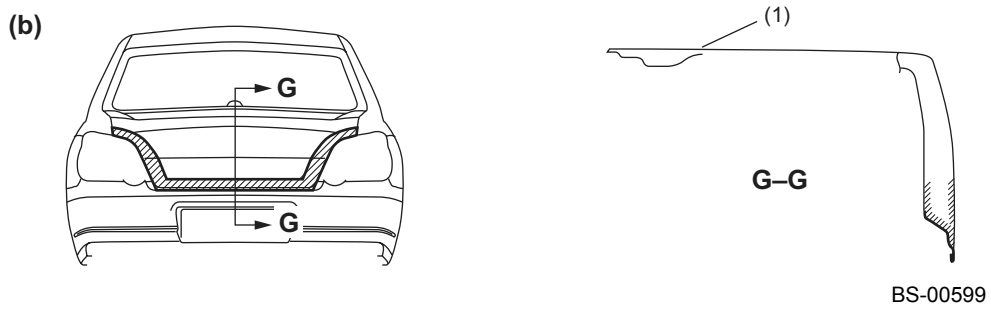
HOT WAX APPLICATION

(1) Engine hood panel
(2) Engine hood hinge
(3) Side sill
(4) Rear gate outer panel
(5) Front and rear door hinges
(6) Rear gate hinge
(7) Side door panel (includes rear door panel)

(a) Wagon
A–A Section A
(B) View B
C–C Section C
D–D Section D
(E) View E
(F) Detail F



BS-00599

(1) Trunk lid

(b) Sedan
G–G Section G

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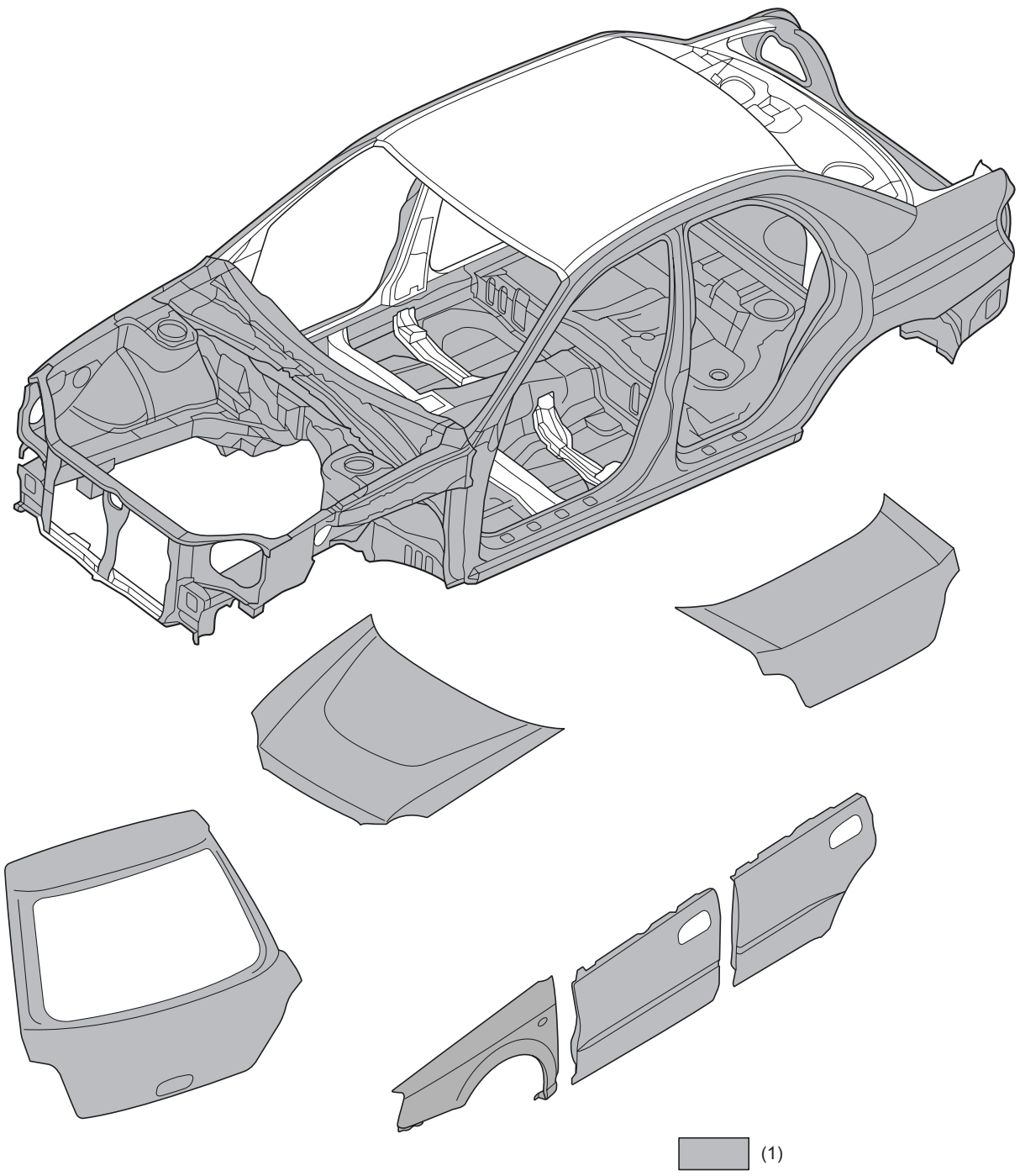
11.Galvanized Sheet Metal Parts



BS-00600

(1) Galvanized on both sides
(2) Non-turbo models

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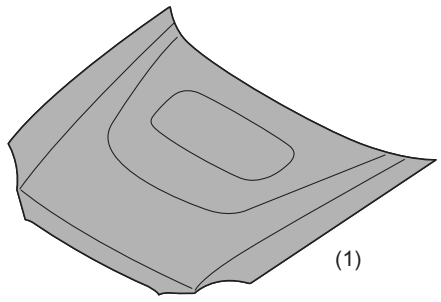
12.Aluminum Sheet Metal



BS-00588

(1) Turbo models

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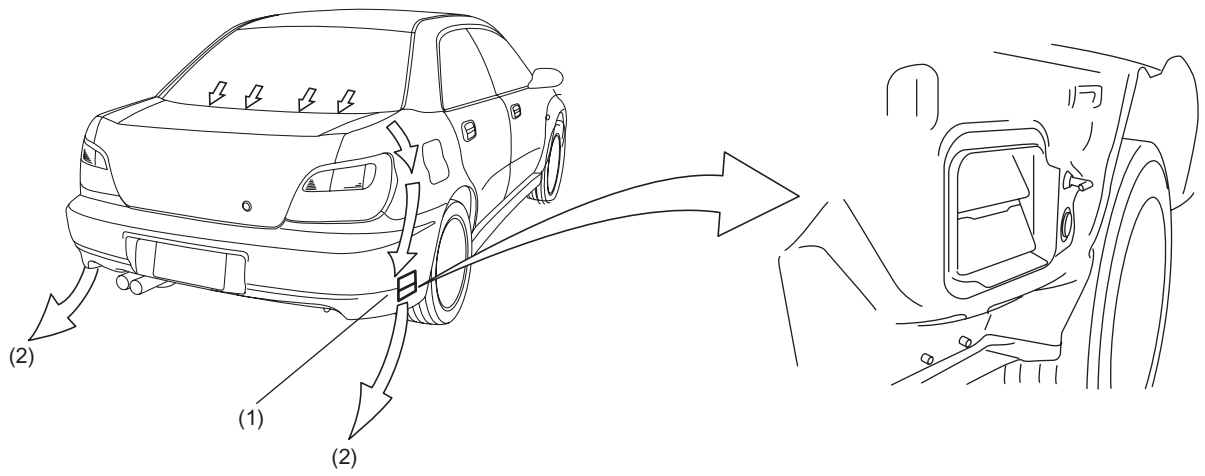
13.Ventilation

A: OUTLET PORT



BS-00589

(1) Outlet port
(2) Air flow

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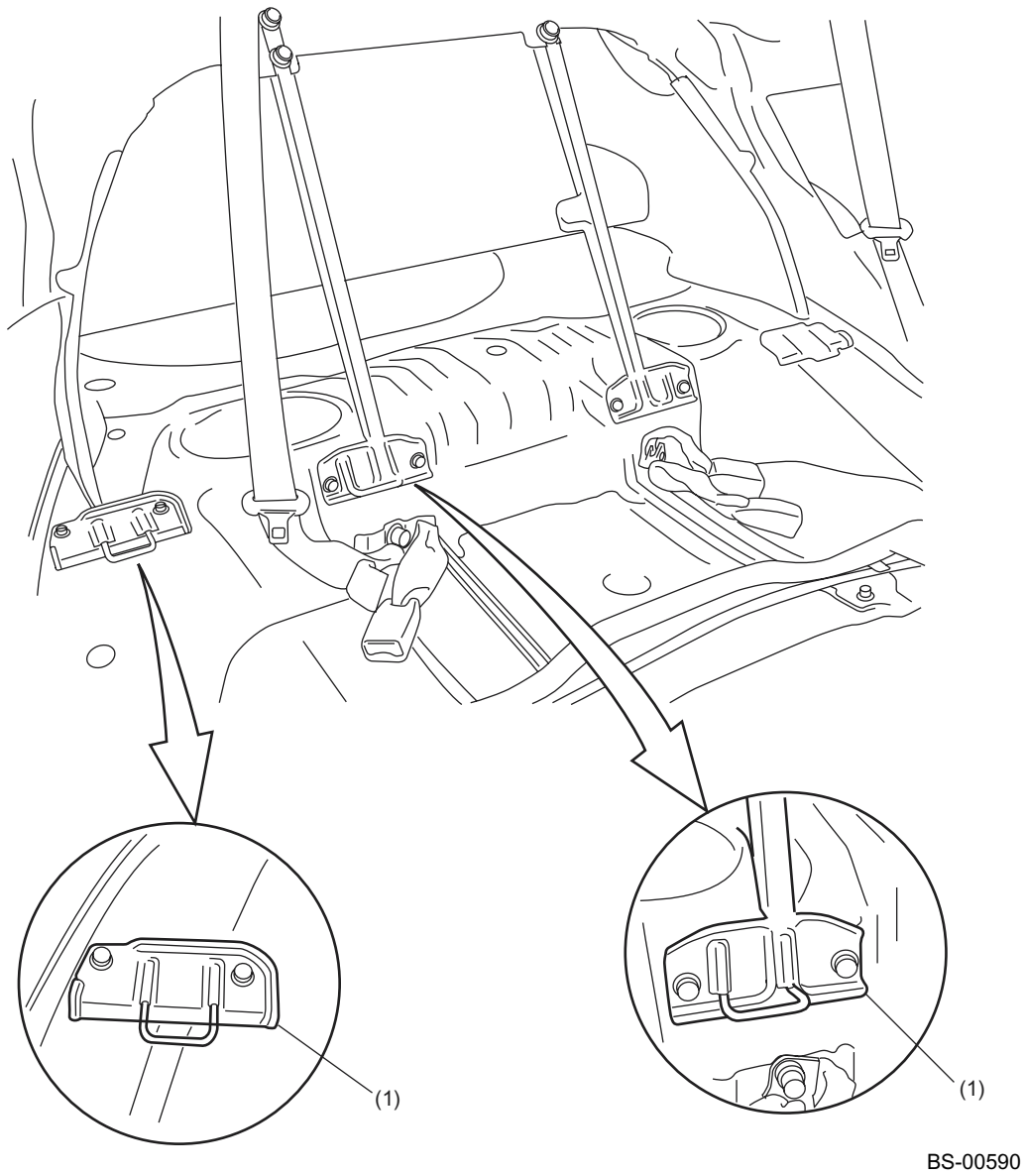
14.Child Seat Anchors

Child seat anchors are added to the rear floor panel in order to conform with the FMVSS225 (ISO-FIX) requirements for child restraint anchorage systems.



BS-00590

(1) Anchor

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CRUISE CONTROL SYSTEM (non-STi)

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1. Cruise Control

A: OPERATION

● The cruise control system automatically controls the vehicle speed. It allows the vehicle to run at a constant speed without need for the driver to keep the accelerator pedal depressed.

● When the driver has activated the system and made a desired speed setting, the cruise control module compares the actual vehicle speed detected by the speed sensor (MT) or transmission control module (AT) with the preset speed in the memory, then generates a signal according to the difference between the two speeds.
This signal is transmitted to the actuator located in the engine compartment.
The actuator operates the throttle cam as necessary to keep the preset vehicle speed.

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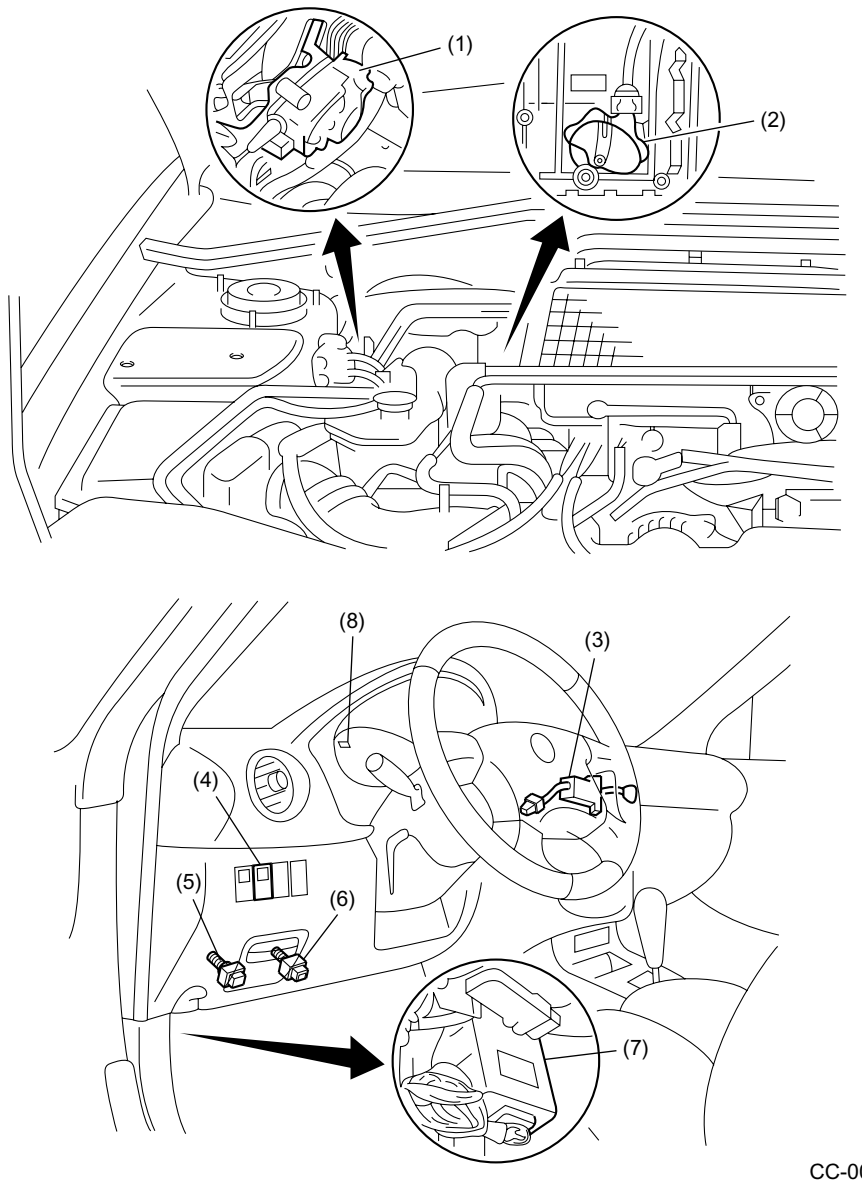
B: LOCATION OF COMPONENTS



CC-00194

(1) Actuator
(2) Inhibitor switch (AT)
(3) Command switch (cruise control lever)
(4) Main switch
(5) Clutch switch (MT)
(6) Stop and brake switch
(7) Control module
(8) Cruise indicator light and cruise set indicator light

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C: CONTROL AND OPERATION

Constant speed control	When actual vehicle speed is higher than the “set” speed, the motor in the actuator operates to move the throttle valve in the closing direction by the amount corresponding to the difference between the two speeds.When actual driving speed is lower than “set” speed, the motor operates to move the throttle valve in the opening enabling direction according to the difference in speed.
Speed setting control	When SET/COAST switch is pressed with main switch ON while the vehicle is being driven at a speed greater than 40 km/h (25 MPH), current flows to the actuator. This causes the clutch in the actuator to engage, enabling the motor to operate. The motor moves the throttle valve to the position corresponding to the accelerator pedal position. The vehicle is driven at the set speed.
Deceleration control	When SET/COAST switch is turned ON while the vehicle is cruising at a constant speed, the motor in the actuator rotates to move the throttle valve in the closing direction. This causes the vehicle to decelerate a certain amount. When the switch is turned OFF, the vehicle speed is stored in memory and the vehicle maintains that speed thereafter.
Acceleration control	When RESUME/ACCEL switch is turned ON while the vehicle is cruising at a constant speed, the motor in the actuator rotates to move the throttle valve in the opening direction. This causes the vehicle to accelerate by a certain amount. When the switch is turned OFF, the vehicle speed is stored in memory and the vehicle maintains that speed thereafter.
Resume control	When RESUME/ACCEL switch is turned ON after the cruise control is temporarily cancelled, vehicle speed returns to that speed which was stored in memory just before the cruise control is cancelled. This occurs only when the vehicle is running at a speed greater than 32 km/h (20 MPH). In the following cases, however, the set vehicle speed is completely cleared. Therefore, no resume control 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 into the cruise control module, the clutch is disengaged and the cruise control is deactivated. (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 (cruise control lever) pulled) (6) Ignition switch OFF signal (7) Main switch OFF signal
Low speed limit control	When the vehicle speed drops below 32 km/h (20 MPH), the cruise control is automatically cancelled. Cruise control at any speed lower than 40 km/h (25 MPH) cannot be effected.
Motor control	When the vehicle speed becomes 10 km/h (6 MPH) or more higher than the memorized speed while vehicle is running utilizing the cruise control (in a downgrade, for example), the actuator’s clutch is turned OFF so that the vehicle decelerates. When the vehicle’s speed decreases by 8 km/h (5 MPH) or more from the memorized speed, the clutch is turned ON again so that the cruise control resumes.

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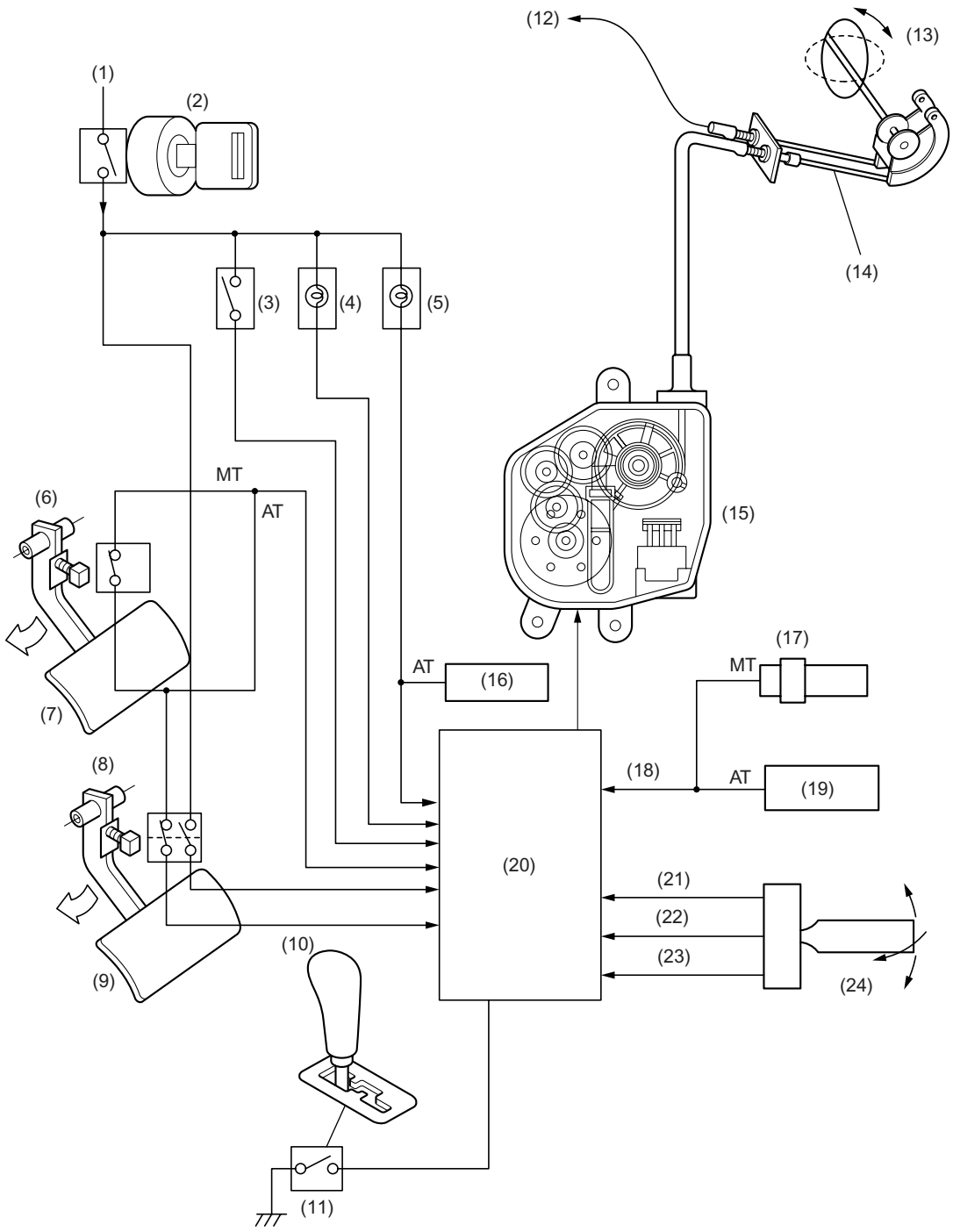
D: SCHEMATIC



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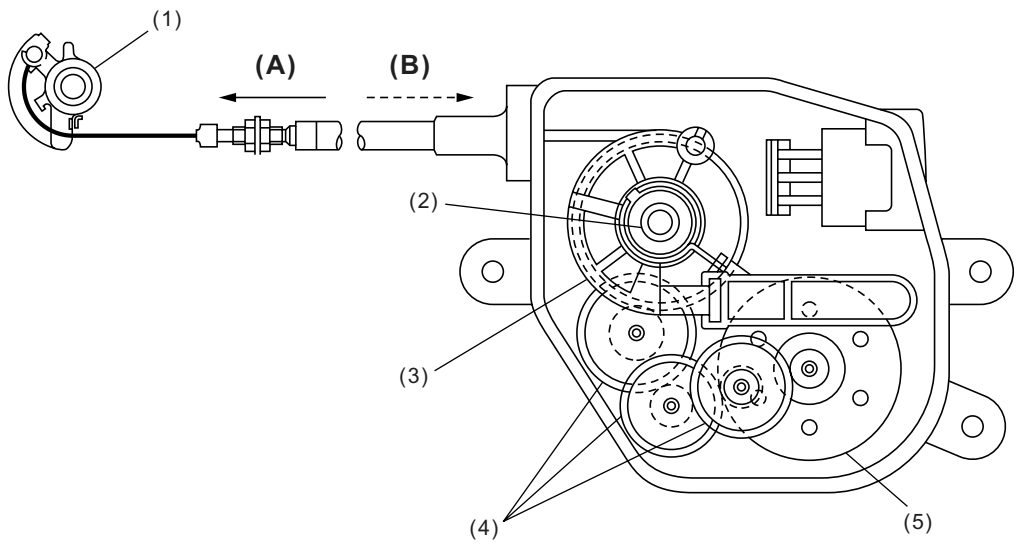
(1) Battery
(2) Ignition switch
(3) Main switch
(4) Cruise indicator light
(5) Cruise set indicator light
(6) Clutch switch (MT)
(7) Clutch pedal (MT)
(8) Stop and brake switch
(9) Brake pedal
(10) Selector lever
(11) Inhibitor switch (P and N)
(12) To accelerator pedal
(13) Engine throttle valve
(14) Cruise control cable
(15) Actuator
(16) TCM (AT)
(17) Vehicle speed sensor (MT)
(18) Vehicle speed signal
(19) TCM (AT)
(20) Cruise control module
(21) RESUME/ACCEL switch
(22) CANCEL switch
(23) SET/COAST switch
(24) Command switch (cruise control lever)

E: ACTUATOR

In response to 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.



CC-00159

(1) Throttle cam
(2) Clutch
(3) Pulley
(4) Gear
(5) Stepping motor
(A) Release
(B) Pulling direction

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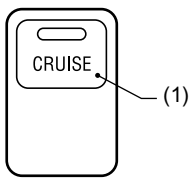
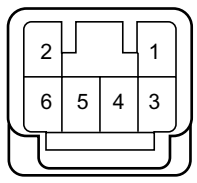
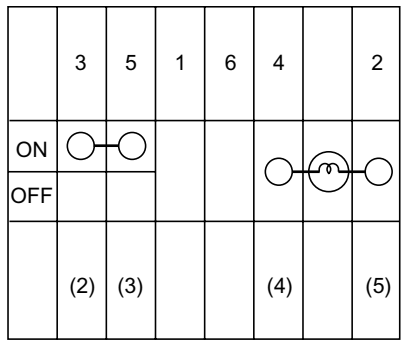
F: MAIN SWITCH

- The main switch is the main power supply switch of the cruise control module. The main switch contains a night illumination light.
- When the main switch is pressed, an indicator light in the combination meter illuminates.
- When the ignition switch is placed in the OFF position with the main switch ON, the main switch is also turned OFF. Even if the ignition switch is turned ON again, the main switch will stay in the OFF state.







CC-00193

(1) Illumination
(2) Ignition switch
(3) Control module
(5) Illumination power
(6) Illumination control

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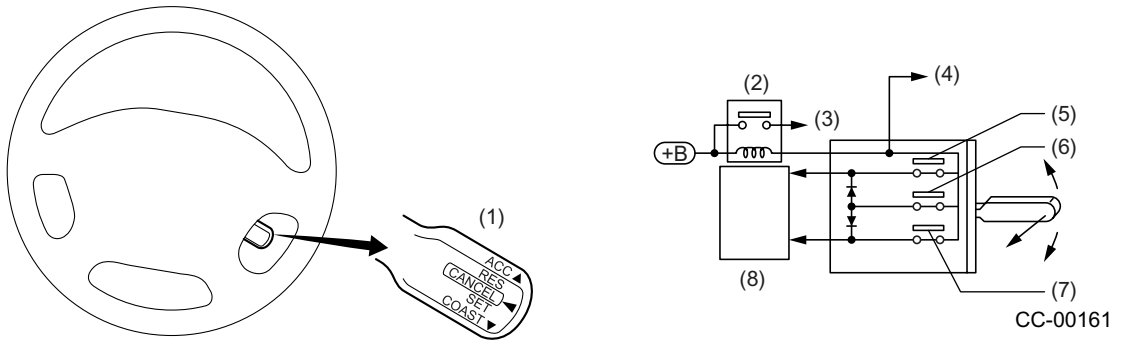
G: COMMAND SWITCH (CRUISE CONTROL LEVER)

- When the vehicle is driven with the cruise control activated, the command switch controls its operation. It inputs SET/COAST signal, ACCEL/RESUME signal or CANCEL signal to the cruise control module.
- When the cruise control is set, the SET indicator light in the combination meter illuminates.



(1) Command switch
(2) Horn relay
(3) Horn
(4) Horn switch
(5) SET/COAST
(6) CANCEL
(7) RESUME/ACCEL
(8) Control module

- The command switch is located on the right side of the steering wheel, so the driver can operate it without releasing hands from the steering wheel.
- The command switch is a self-returning lever type.

1. RESUME/ACCEL AND SET/COAST SWITCH

Each switch contact is held closed as long as the lever is kept pressed in the relevant direction and resulting current is applied as a signal to the control module.

2. CANCEL SWITCH

All the switch contacts are closed as long as the lever is pulled toward the CANCEL position (toward the driver). This causes the RESUME/ACCEL and SET/COAST ON signals to be sent to the control module simultaneously.

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H: CANCEL SIGNALS

The cancel signal deactivates the cruise control function. Operating any of the following switches results in generation of the cancel signal. On receiving the signal, the cruise control module cancels the cruise control function.

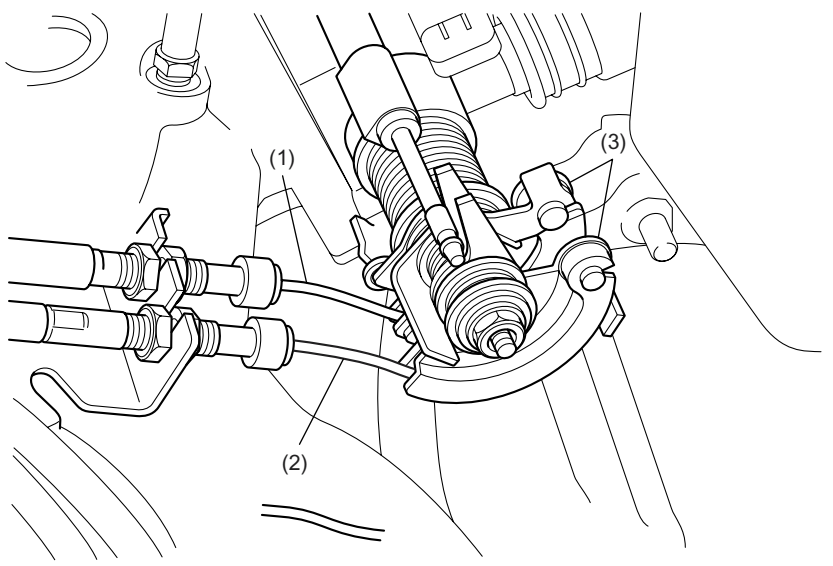
- Stop light switch
- Brake switch
- Clutch switch (MT models)
- Inhibitor switch (AT models)
- Main switch
- Command switch (CANCEL position)

I: VEHICLE SPEED SENSOR

The vehicle speed sensor is installed on the transmission, and sends signal to the cruise control module which uses it in controlling the cruise control function (MT models).

J: ENGINE THROTTLE

- The throttle body is equipped with two throttle cams. One 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, when one cam operates, the other may not.



CC-00162

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

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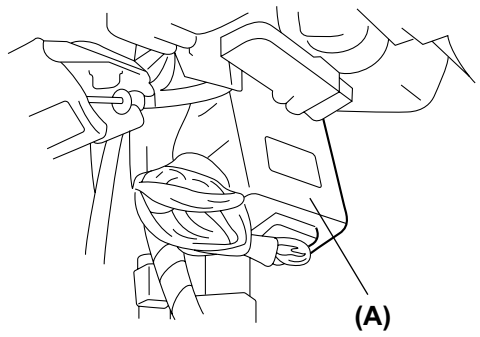
K: CONTROL MODULE

- Based on signals from the related switches and sensors, the cruise control module controls all the following control functions:

Constant speed control; speed setting control; deceleration control; acceleration control; resume control; manual cancel control; low speed limit control; stepping motor control; cruise control

- The control module (A) is located inside of the front pillar lower portion (driver side).



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L: FAIL-SAFE FUNCTION

The cruise control system has a fail-safe function that cancels the cruise control operation when any of the following conditions occurs.

1. CONFLICT BETWEEN CRUISE CONTROL SWITCHES AND CANCELLATION SIGNAL GENERATING SWITCHES

● The cruise control system is deactivated if any of the cruise control switches (SET/COAST, RESUME/ACCEL, and CANCEL switches) is turned ON while any of the cancellation signal generating switches (brake, stop light, clutch, and inhibitor switches) is being operated. The system is re-activated when the cruise control switch is turned OFF and then turn ON again after the cancellation signal generating switch has been returned to its released position.

● When the main switch is turned ON while any of the cruise control switches is in the ON position, the cruise control system is deactivated. The system deactivating function is retained until the main switch is turned OFF.

2. ABNORMALITIES IN ELECTRIC CIRCUITS

The cruise control system is deactivated and the set speed is also canceled if any of the following abnormalities occurs in the system's electric circuits.

The system deactivation function is retained until the ignition switch or the main switch is turned OFF.

● The stepping motor terminal is grounded or disconnected; or the stepping motor drive circuit is broken due to a short-circuit.

● The stepping motor clutch drive circuit is shorted.

● Vehicle speed variation in a 350 ms period exceeds ±10km/h.

● Fusion has occurred in an internal relay and is detected while the vehicle is running with the cruise control deactivated.

● The cruise control module becomes inoperative or its operation is faulty.

● There is discrepancy between the values stored in the two RAMs of the control module.

● An abnormality is detected as a result of the self-diagnosis performed after turning ON of the ignition switch.

3. ABNORMALITIES IN STEPPING MOTOR

The cruise control system is deactivated if either of the following abnormalities occurs in the stepping motor.

● The stepping motor does not operate properly.

● The stepping motor is energized for unduly long period and too frequently.

When the system is deactivated by any of these causes, it cannot be reactivated for 2 — 20 minutes after detection of the abnormal condition.

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CRUISE CONTROL SYSTEM (STi)

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1. Cruise Control

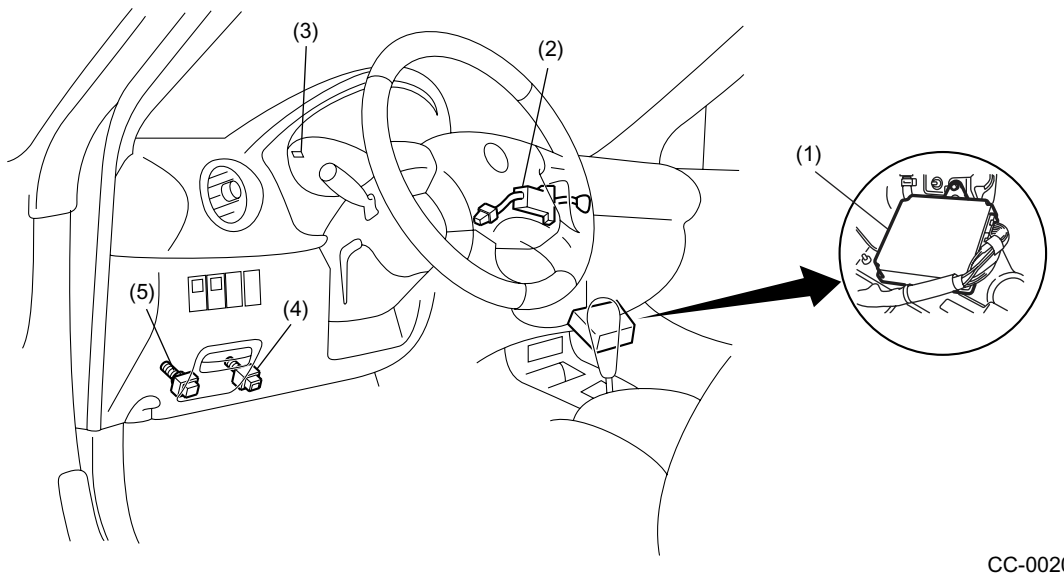
A: OPERATION

● The cruise control system automatically controls the vehicle speed. It allows the vehicle to run at a constant speed without need for the driver to keep the accelerator pedal depressed.

● The cruise control system is controlled by the engine control module (ECM).

● When the driver has activated the system and made a desired speed setting, the engine control module (ECM) compares the actual vehicle speed detected by the speed sensor with the preset speed in the engine control module (ECM) memory, and then generates a signal according to the difference between the two speeds.
This signal is transmitted to the electronic control throttle.
The electronic control throttle operates the throttle valve as necessary to keep the preset vehicle speed.

B: LOCATION OF COMPONENTS



CC-00205

(1) Engine control module (ECM)
(2) Cruise control command switch (with built-in MAIN switch)
(3) Cruise indicator light and cruise set indicator light
(4) Stop light and brake switch
(5) Clutch switch

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C: CONTROL AND OPERATION

Vehicle speed control	When the actual vehicle speed is higher than the set speed, the throttle valve of the electronic control throttle moves in the closing direction by the amount corresponding to the difference between the two speeds. When the actual vehicle speed is lower than the set speed, the throttle valve of the electronic control throttle moves in the opening direction by the amount corresponding to the difference between the two speeds.
Speed set function (SET function)	When the SET/COAST switch is pressed while the vehicle is running at a speed greater than 40 km/h (25 MPH) and the MAIN switch is ON, the cruise control is set at the current vehicle speed (this speed becomes the "memorized speed") and the vehicle maintains this speed thereafter.
Resume control function (RESUME function)	When the RESUME/ACCEL switch is turned ON after the cruise control is temporarily cancelled, the vehicle speed returns to the memorized speed which was stored just before the cruise control was cancelled. This occurs only when the vehicle is running at a speed greater than 32 km/h (20 MPH). In the following cases, however, the memorized speed is cleared. (1) Ignition switch is turned OFF (2) MAIN switch is turned OFF (3) Abnormality in the system is detected.
Deceleration control function (1) (COASTING function)	When the SET/COAST switch is pressed for a prolonged time while the vehicle is governed by the cruise control, the memorized speed of the cruise control is changed to the decreased vehicle speed value reached at the moment the switch is released. However, the cruise control is cancelled when the vehicle speed becomes lower than the lower limit of the speed setting range.
Deceleration control function (2) (TAP DOWN function)	When the SET/COAST switch is pressed for a short time while the vehicle is governed by the cruise control, the cruise control subtracts a certain amount from the memorized speed to obtain a new value. However, when the actual vehicle speed largely differs from the memorized speed, the actual speed becomes the new memorized speed of the cruise control.
Acceleration control function (1) (ACCELERATING function)	When the RES/ACCEL switch is pressed for a prolonged time while the vehicle is governed by the cruise control, the memorized speed of the cruise control is changed to the increased vehicle speed value reached at the moment the switch is released. However, when the vehicle speed is higher than the upper limit of the speed setting range, the upper limit becomes the memorized speed of the cruise control.
Acceleration control function (2) (TAP UP function)	When the RES/ACCEL switch is pressed for a short time while the vehicle is governed by the cruise control, the cruise control adds a certain amount to the memorized speed to obtain a new value. However, when the actual vehicle speed largely differs from the memorized speed, the cruise control maintains the former memorized speed.
Cruise control cancel function	When any of the following conditions is met, the cruise control is cancelled. (1) Stop light switch ON (brake pedal depressed) (2) Brake switch OFF (brake pedal depressed) (3) Clutch switch OFF (clutch pedal depressed) (4) Neutral switch ON (shift lever moved to neutral) (5) CANCEL switch ON (command switch pulled) (6) Ignition switch OFF (7) MAIN switch OFF (8) Transmission gear in 1st or reverse. (9) Actual vehicle speed drops below 32 km/h (20 MPH) (10) Abnormality in the system is detected

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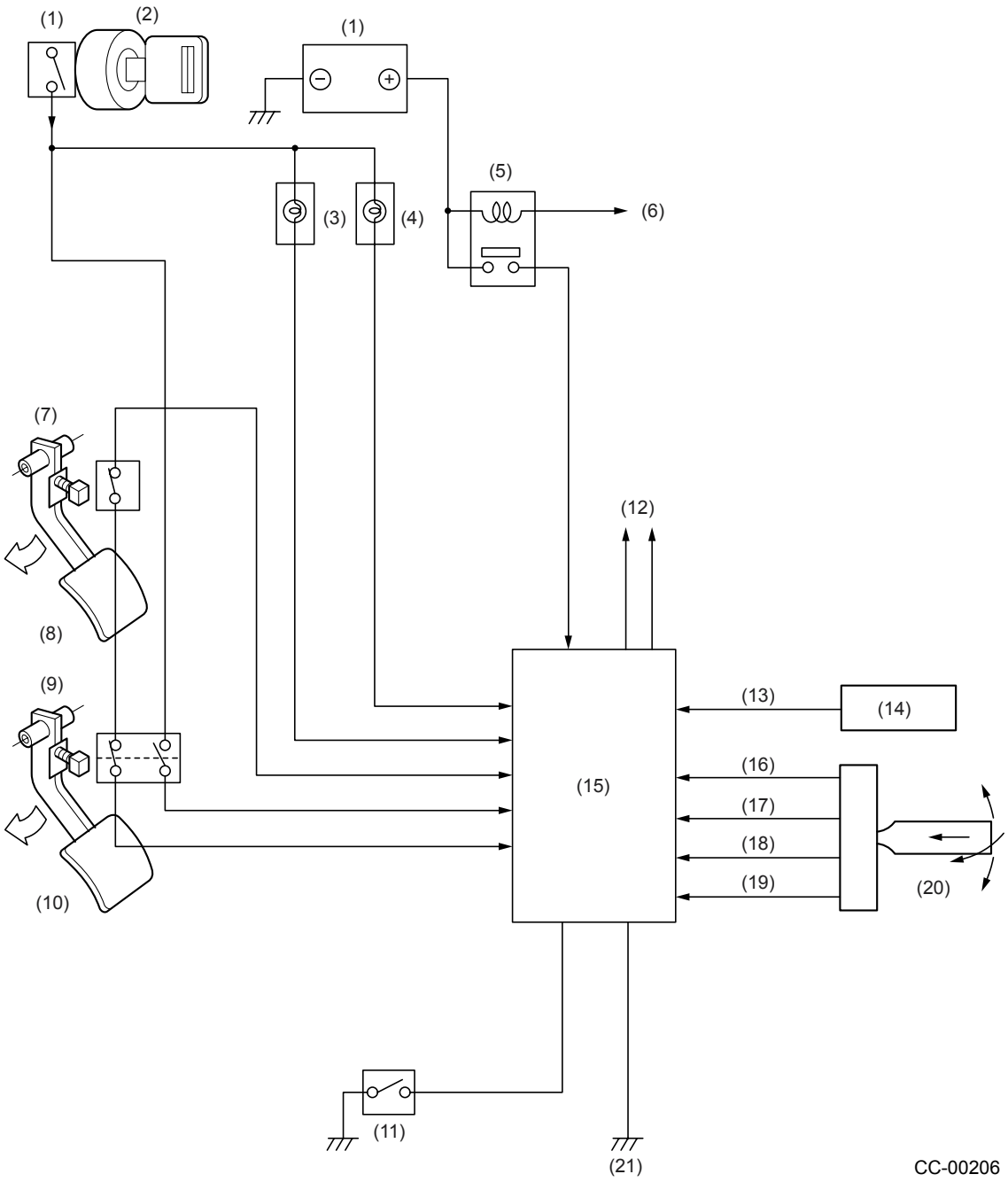
D: SCHEMATIC



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(1) Battery
(2) Ignition switch
(3) Cruise indicator light
(4) Cruise set indicator light
(5) Main relay
(6) Starter
(7) Clutch switch
(8) Clutch pedal
(9) Stop light and brake switch
(10) Brake pedal
(11) Neutral switch
(12) Electronic control throttle
(13) Vehicle speed sensor
(14) Vehicle speed signal
(15) Engine control module (ECM)
(16) MAIN switch
(17) RESUME/ACCEL switch
(18) CANCEL switch
(19) SET/COAST switch
(20) Cruise control command switch
(21) Ground

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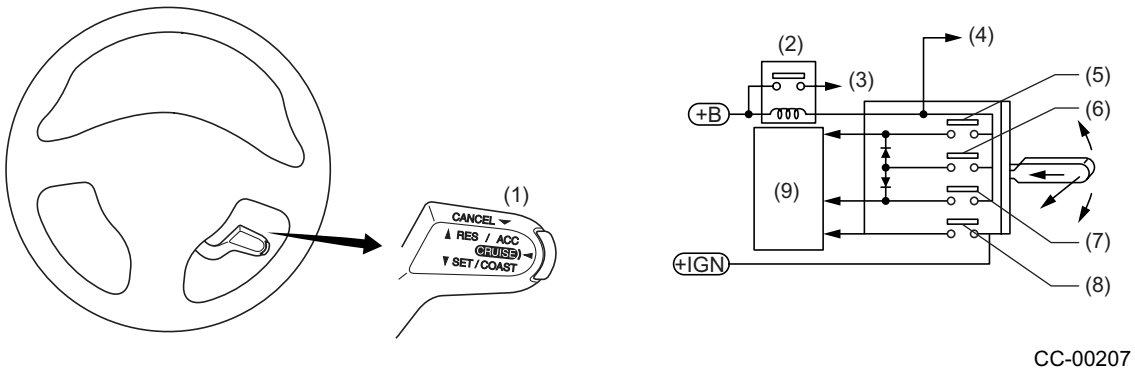
E: COMMAND SWITCH (CRUISE CONTROL LEVER)

● When the vehicle is driven with the cruise control activated, the command switch controls its operation. It inputs MAIN signal, SET/COAST signal, ACCEL/RESUME signal or CANCEL signal to the engine control module (ECM).

● When the cruise control MAIN switch is turned ON, the cruise set indicator light in the combination meter illuminates. Also, when the cruise control is set, the cruise indicator light in the combination meter illuminates.



CC-00207

(1) Command switch
(2) Horn relay
(3) Horn
(4) Horn switch
(5) SET/COAST
(6) CANCEL
(7) RESUME/ACCEL
(8) MAIN
(9) Engine control module (ECM)

● The command switch is located on the right side of the steering wheel, so the driver can operate it without releasing hands from the steering wheel.

● The command switch is a self-returning lever type.

1. MAIN SWITCH

When the switch is pushed once the cruise control system turns ON and becomes ready to set the cruise control. When the switch is pushed again the cruise control turns OFF.

2. RESUME/ACCEL AND SET/COAST SWITCH

Each switch contact is held closed as long as the lever is kept pressed in the relevant direction and resulting current is applied as a signal to the engine control module (ECM).

3. CANCEL SWITCH

All the switch contacts are closed as long as the lever is pulled toward the CANCEL position (toward the driver). This causes the RESUME/ACCEL and SET/COAST ON signals to be sent to the engine control module (ECM) simultaneously.

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F: CANCEL SIGNALS

The cancel signal deactivates the cruise control function. Operating any of the following switches results in generation of the cancel signal. On receiving the signal, the engine control module (ECM) cancels the cruise control function.

- Stop light switch
- Brake switch
- Clutch switch
- Neutral switch
- MAIN switch (OFF operation)
- Command switch (CANCEL position)
- Ignition switch (OFF operation)

G: VEHICLE SPEED SENSOR

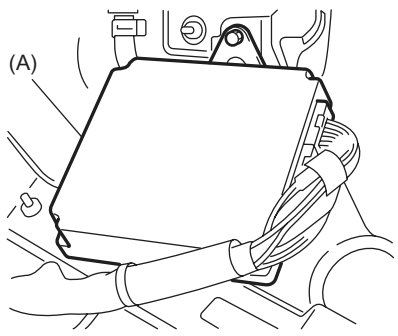
The vehicle speed sensor is installed on the transmission, and sends signal to the engine control module (ECM) which uses it in controlling the cruise control function.

H: ENGINE CONTROL MODULE (ECM)

- Based on signals from the related switches and sensors, the engine control module (ECM) controls all the following control functions:

Constant speed control; speed setting control; deceleration control; acceleration control; resume control; manual cancel control; low speed limit control; electronic control throttle control

- The engine control module (ECM) (A) is located in the legroom of the front passenger's seat.



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I: FAIL-SAFE FUNCTION

The cruise control system has a fail-safe function that cancels the cruise control operation when any of the following conditions occurs.

1. CONFLICT BETWEEN CRUISE CONTROL SWITCHES AND CANCELLATION SIGNAL GENERATING SWITCHES

● The cruise control system is deactivated if any of the cruise control switches (SET/COAST, RESUME/ACCEL, and CANCEL switches) is turned ON while any of the cancellation signal generating switches (brake, stop light, clutch, and neutral switches) is being operated. The system is re-activated when the cruise control switch is turned OFF and then turn ON again after the cancellation signal generating switch has been returned to its released position.

● When the MAIN switch is turned ON while any of the command switches is in the ON position, the cruise control system is deactivated. The system deactivating function is retained until the MAIN switch is turned OFF.

2. ABNORMALITIES IN ELECTRIC CIRCUITS

The cruise control system is deactivated and the set speed is also canceled if any of the following abnormalities occurs in the system's electric circuits.

● The system deactivation function is retained until the ignition switch is turned OFF.

● Abnormality of the command switch is detected.

● Abnormality of the stop light switch and brake switch is detected.

● Abnormality of the neutral switch is detected.

● Abnormality of the ignition switch is detected.

● Change in vehicle speed signal is detected.

● Abnormality in any of the engine related sensors is detected.

● Abnormality of the brake switch input circuit in the engine control module (ECM) is detected.

● The MAIN switch and command switch were already ON when the ignition switch is turned ON.

3. CRUISE CONTROL CANCEL FUNCTION

● When any of the following conditions is met, the cruise control is cancelled.

● To set the cruise control again, the vehicle speed must be returned to within the speed setting range and necessary conditions must be met.

● Abnormal engine speed acceleration is detected.

● The vehicle speed has dropped below the lower control limit during cruise control driving.

● The vehicle has been running at speed higher than the set speed for an abnormally long time during cruise controlled driving.

● The set speed became impossible to be maintained for some reason (steep upgrade, hand brake operation, abnormal engine power drop, etc.).

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CLUTCH SYSTEM

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1. General

A: NON-TURBO MODELS

● The clutch control operates the release fork using the hydraulic pressure generated in the master cylinder when the pedal is depressed. This ensures smooth and reliable clutch control with minimum frictional resistance.

● 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: TURBO MODELS

● On turbo models, a hydraulic control which is appropriate for increased clutch load is adopted, and a clutch orifice is added to the clutch master cylinder.

● The clutch control operates the release fork using the hydraulic pressure generated in the master cylinder when the clutch pedal is depressed.

● The clutch itself is a pull type clutch. When the clutch pedal is depressed, the self-aligning release bearing is caused to slide on a guide pulling 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 with respect to the clutch cover.

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CLUTCH

2. Clutch

A: CONSTRUCTION

1. NON-TURBO MODELS

Applying foot pressure to the clutch pedal moves the release lever. This causes the release bearing to slide on the guide, pressing the center of the diaphragm spring. The diaphragm 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.

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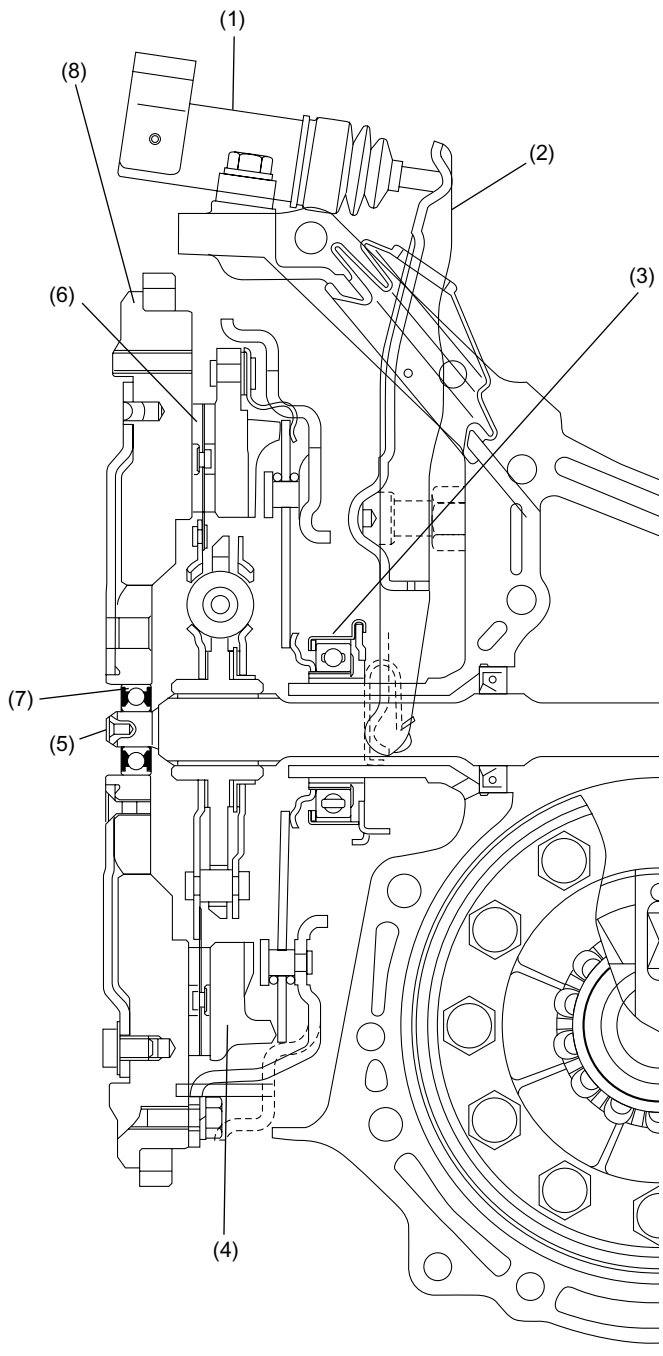
CLUTCH

• Non-turbo models



CL-00085

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

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2. TURBO MODELS

Applying foot pressure to the clutch pedal moves the release lever. This causes the release bearing to slide on the guide, pulling the center of the diaphragm spring. The diaphragm 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.

In the pull type clutch, the diaphragm spring has the point of action located inward from the tip, through which the pressure plate is pressed against the clutch disc. When the power transmission is to be interrupted, the diaphragm spring is forced to pivot on the tip and warp away from the pressure plate (on the principle of lever and fulcrum).

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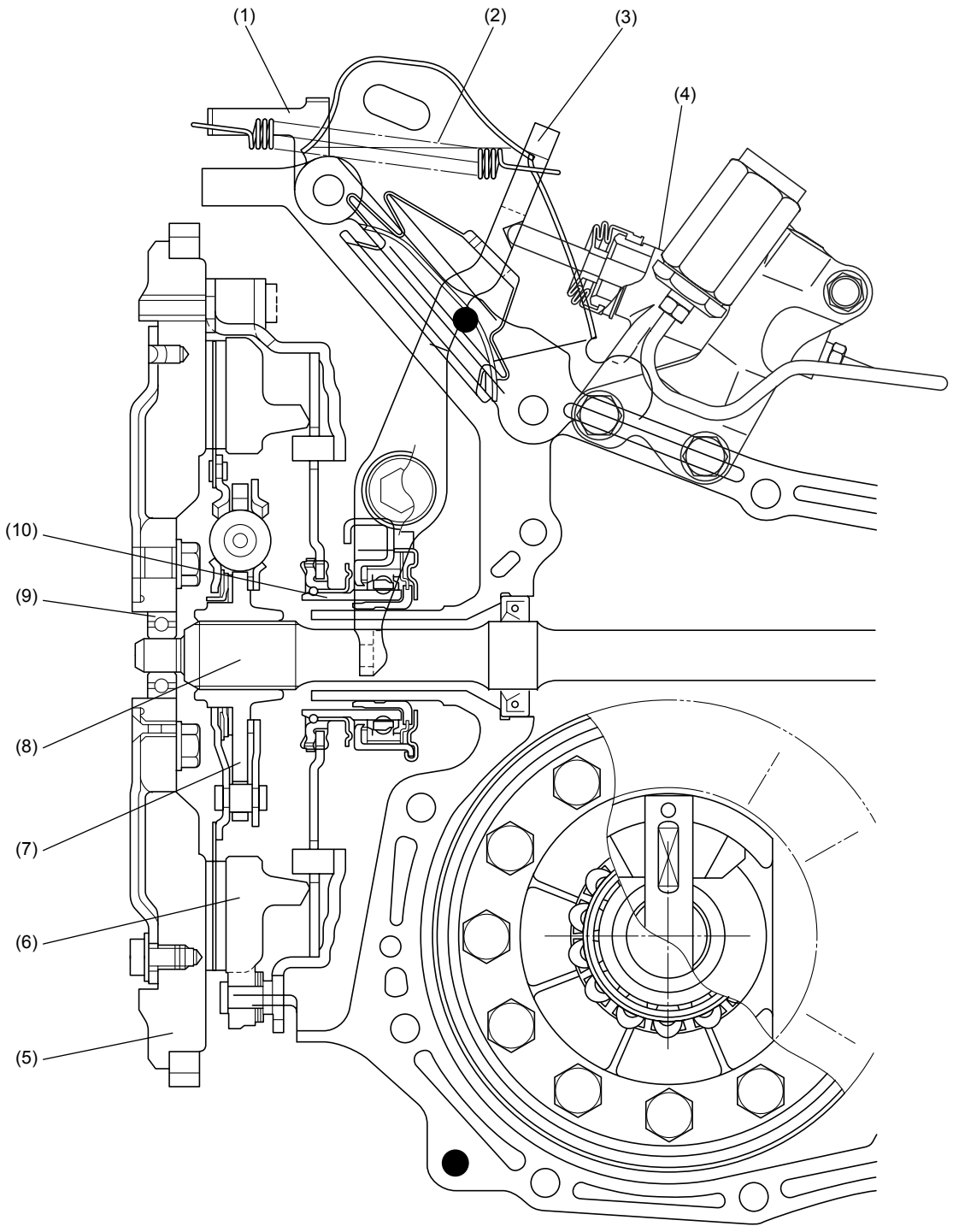
● 2.0 L turbo model



CL-00245

(1) Spring bracket
(2) Spring
(3) Release lever
(4) Operating cylinder
(5) Flywheel
(6) Clutch cover
(7) Clutch disc
(8) Transmission main shaft
(9) Ball bearing
(10) Release bearing

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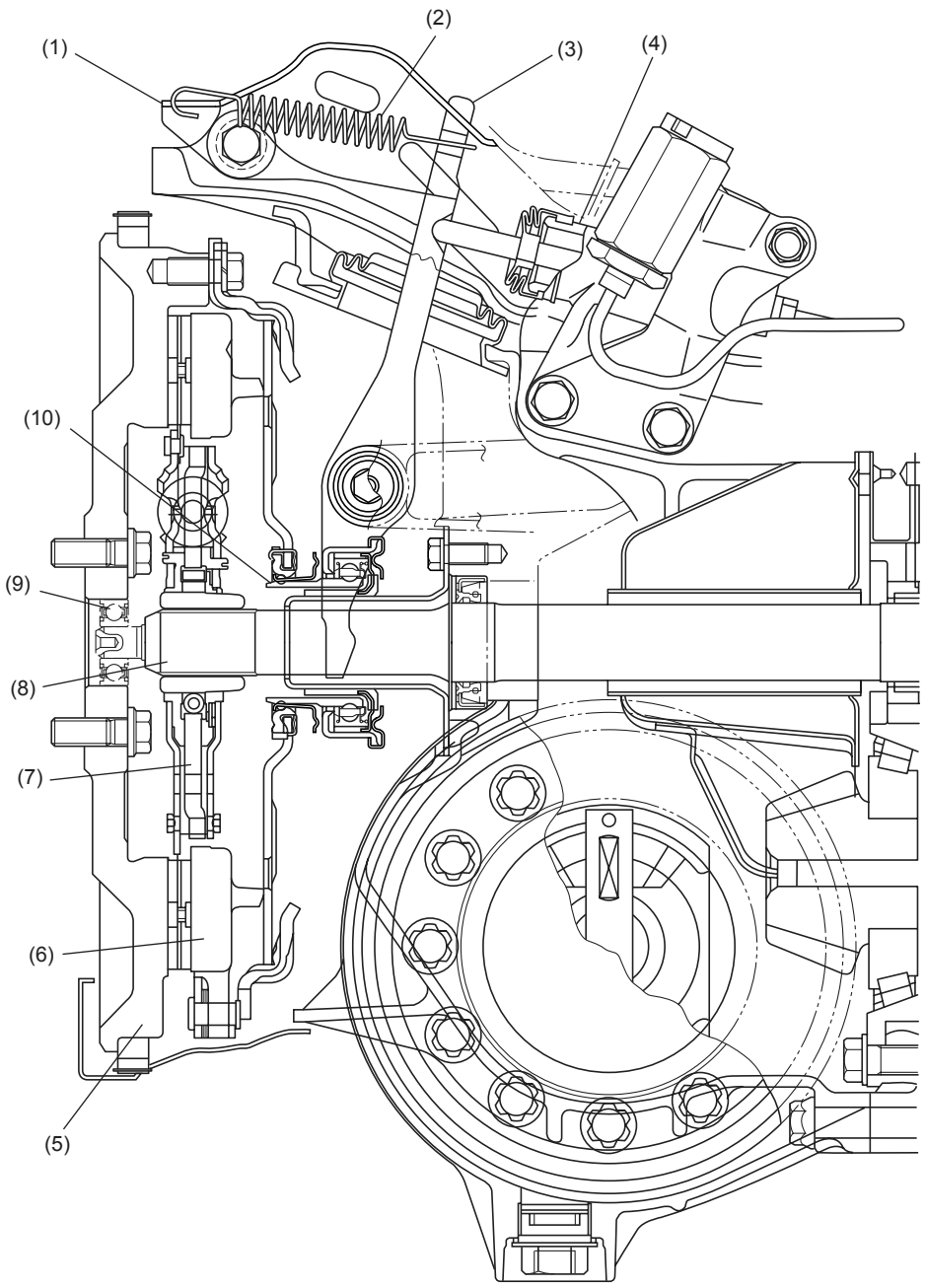
CLUTCH

• STi models



CL-00237

(1) Spring bracket
(2) Spring
(3) Release lever
(4) Operating cylinder
(5) Flywheel
(6) Clutch cover
(7) Clutch disc
(8) Transmission main shaft
(9) Ball bearing
(10) Release bearing

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3. Flywheel

A: GENERAL

1. STi MODELS

The flywheel is a conventional type which is directly connected to the crankshaft. It performs the functions of absorbing crankshaft rotational fluctuation and transmitting the engine torque to the clutch disc.

2. 2.5 L NON-TURBO AND 2.0 L TURBO MODELS

The flywheel is of a flexible type consisting of a drive plate, reinforcement, and mass flywheel.

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.

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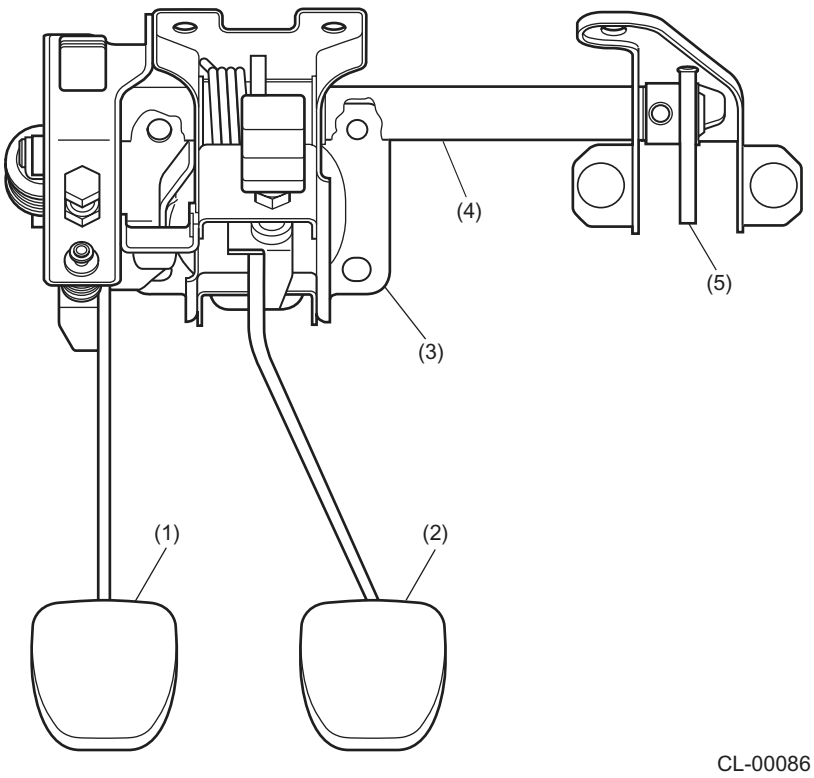
4. Hydraulic Clutch Pedal System

A: CONSTRUCTION

- The hydraulic clutch pedal is connected to the master cylinder via a rod.
- The clutch pedal and brake pedal are mounted on the same bracket.



CL-00086

(1) Clutch pedal
(2) Brake pedal
(3) Brake and clutch pedal bracket
(4) Rod
(5) Lever

- The clutch pedal has a mechanism that reduces the initial force required to depress the clutch pedal.
- A starter interlock mechanism is provided to prevent the engine from starting unless the clutch pedal is pressed.

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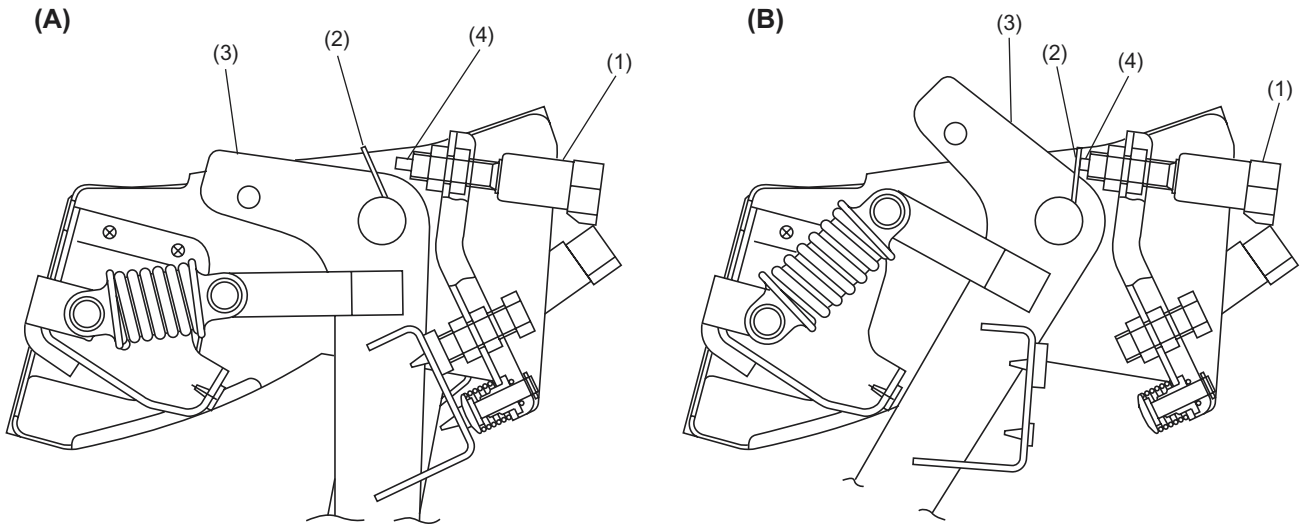
B: OPERATION

1. STARTER INTERLOCK MECHANISM

When the clutch pedal is fully depressed, the stopper on the pedal pushes the clutch switch pushrod inwards.
When the pushrod is pressed in, the switch turns ON and connects the ignition switch to the starter circuit enabling engine start.



CL-00138

(A) When clutch switch is OFF
(1) Clutch switch
(2) Stopper

(B) When clutch switch is ON
(3) Clutch pedal
(4) Pushrod

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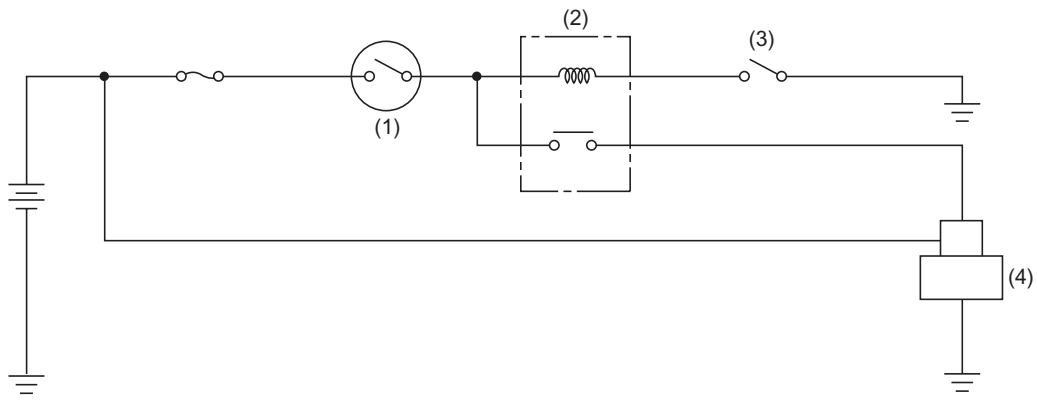
● CIRCUIT DIAGRAM



CL-00137

(1) Ignition switch
(2) Starter relay
(3) Clutch switch
(4) Starter motor

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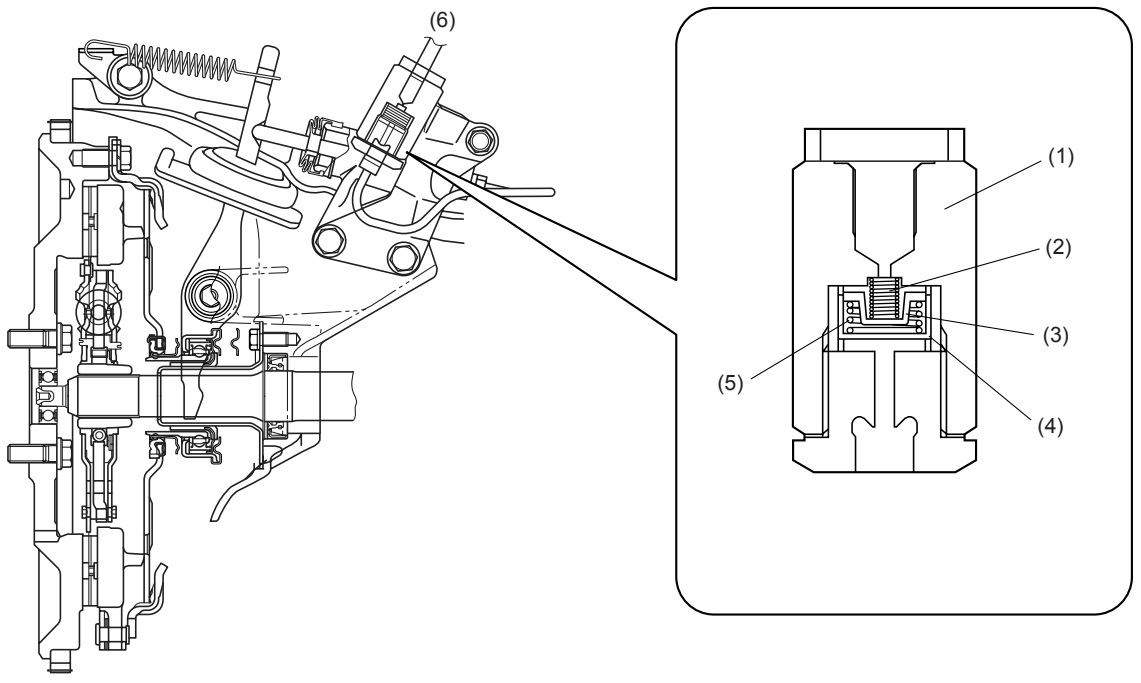
5. Fluid Control System (DOHC Turbo Models)

The clutch operating cylinder incorporates a temperature sensitive orifice unit which controls the clutch engaging speed depending on the fluid temperature to ensure smooth standing starts irrespective of atmospheric temperatures.

A: CONSTRUCTION

The orifice unit consists of an orifice retainer, an orifice valve, and two springs that support the orifice valve.
One of the springs is made of the shape memory alloy that prevents a delay in clutch response when the weather is cold and the oil viscosity is high.



CL-00242

(1) Body
(2) No. 2 spring
(3) Orifice valve
(4) Orifice retainer
(5) No. 1 spring
(6) To master cylinder

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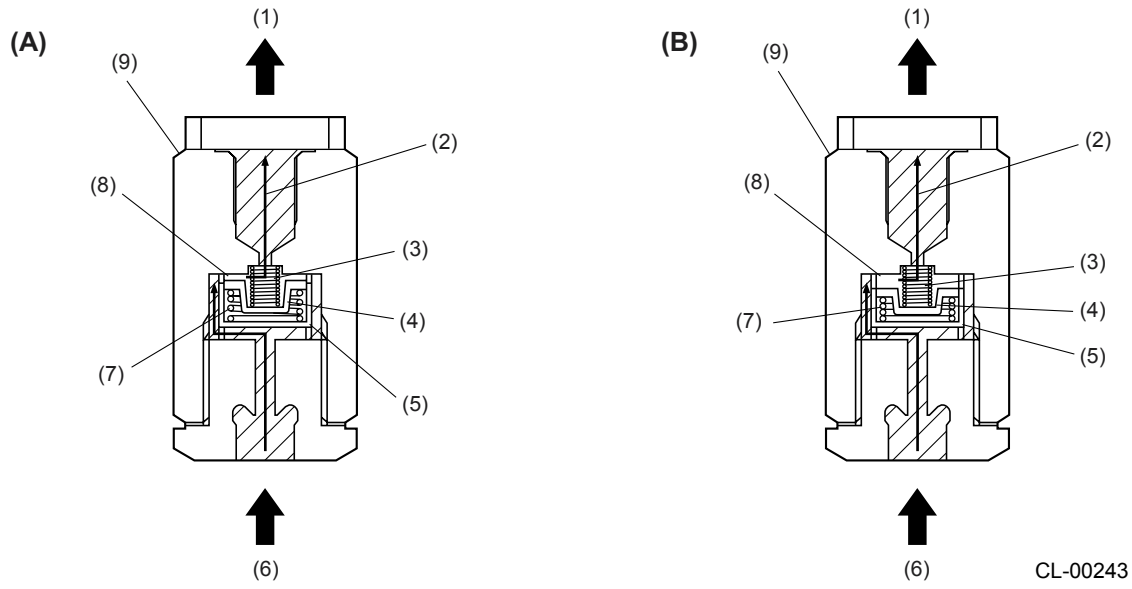
B: OPERATION

The No. 1 spring is made of a shape memory alloy that contracts and loses the tension when the temperature is low.
When the temperature is high, the orifice valve is kept in a raised position by the No. 1 spring, so the fluid passage is narrow. When the temperature drops, the No. 1 spring contracts, allowing the orifice valve to be pushed down by the No. 2 spring. Now, the fluid passage in the orifice unit opens wide.



(A) In high temperatures
(B) In low temperatures

(1) To master cylinder
(2) Flow of fluid with clutch pedal released
(3) No. 2 spring
(4) Orifice valve
(5) Orifice retainer
(6) From operating cylinder
(7) No. 1 spring
(8) Orifice gap
(9) Body

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COOLING
H4DOTC

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1. General

● The engine cooling system consists of a down-flow radiator which features high heat-dissipation performance, an electric-motor-driven fan, a water pump, a thermostat, and an engine coolant temperature sensor.

● The reservoir tank is made of translucent resin and enables easy confirmation of the coolant level. Also, coolant should be added to the reservoir tank when replenishment is necessary.

● The ECM controls the operation of the radiator main fan and sub fan depending on the signals from the engine coolant temperature sensor, vehicle speed sensor and A/C switch.

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2. Cooling Circuits

The cooling system operates in three different phases depending on the temperature of the engine coolant.

- 1st phase (thermostat closed)

When the engine coolant temperature is below 76 °C (169 °F), the thermostat remains closed. The coolant flows through the bypass and heater circuits. This permits the engine to warm up quickly.

- 2nd phase (thermostat open)

When the engine coolant temperature is above 76 — 80°C (169 — 176°F), the thermostat opens.The coolant flows through the radiator where it is cooled.

- 3rd phase (thermostat open and radiator fan operating)

When the engine coolant temperature sensor sends a signal indicating a temperature above 95 °C (203°F) to the ECM, it causes the radiator fan (or fans) to operate. When the engine is stopped after high-speed operation, vapor produced in the turbocharger cooling section flows from the coolant filler tank to the reservoir tank where it condenses back into water. Water is then absorbed by the coolant filler tank as the engine cools down.

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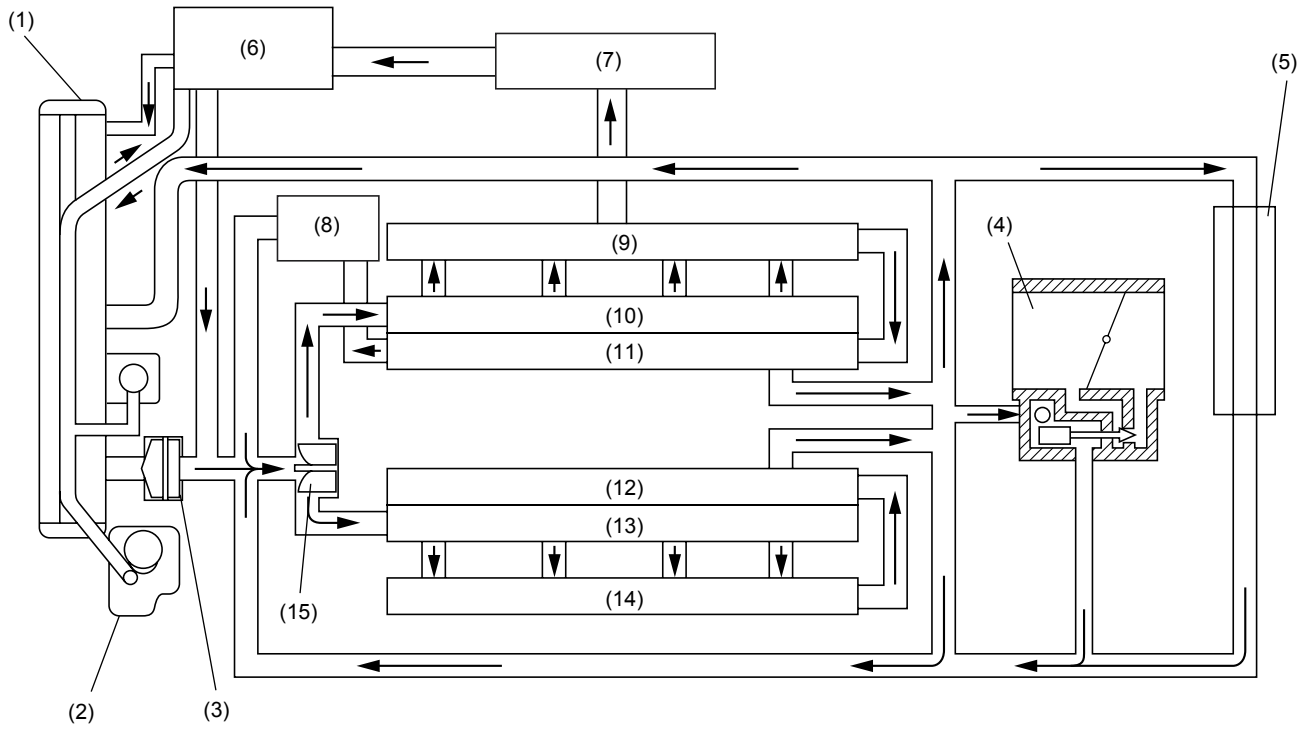
COOLING CIRCUITS



CO-00238

(1) Radiator
(2) Engine coolant reservoir tank
(3) Thermostat
(4) Throttle body
(5) Heater core
(6) Coolant filler tank
(7) Turbocharger
(8) Oil cooler (water cooled)
(9) Cylinder head RH
(10) Cylinder jacket RH
(11) Cylinder block RH
(12) Cylinder block LH
(13) Cylinder jacket LH
(14) Cylinder head LH
(15) Water pump

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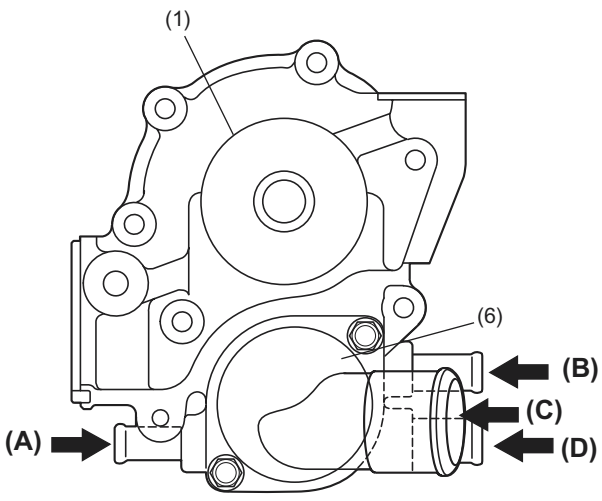
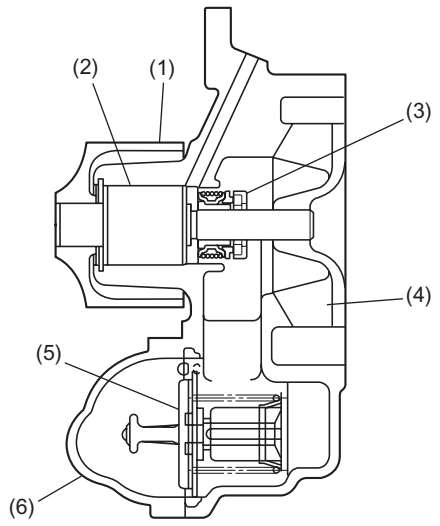
3. Water Pump

The water pump is located in the front portion of the left bank cylinder block and is driven by the engine through the timing belt. The thermostat is fitted into the coolant inlet at the bottom of the water pump. When the pump's impeller rotates, the coolant is drawn into the 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 then is discharged for circulation through a circuit depending on the coolant temperature.





CO-00068

(A) From engine oil cooler
(B) From water tank
(C) From radiator
(D) From heater

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

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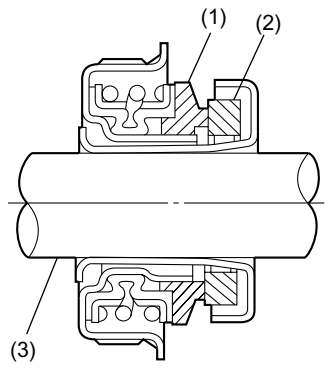
4. Mechanical Seal

The mechanical seal has its seat tightly fitted on the water pump shaft. Since it is a hermetic seal forming an integral part of the water pump, the water pump cannot be disassembled.



CO-00058

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

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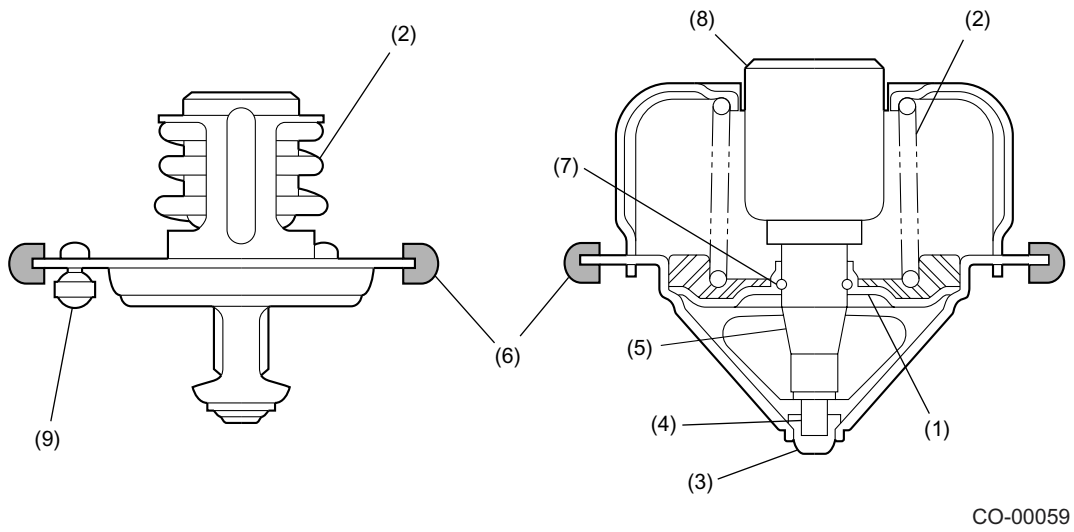
5. Thermostat

The thermostat has a totally-enclosed wax pellet which expands as the coolant temperature increases. It opens and closes accurately at the preset temperatures and features high durability.



CO-00059

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

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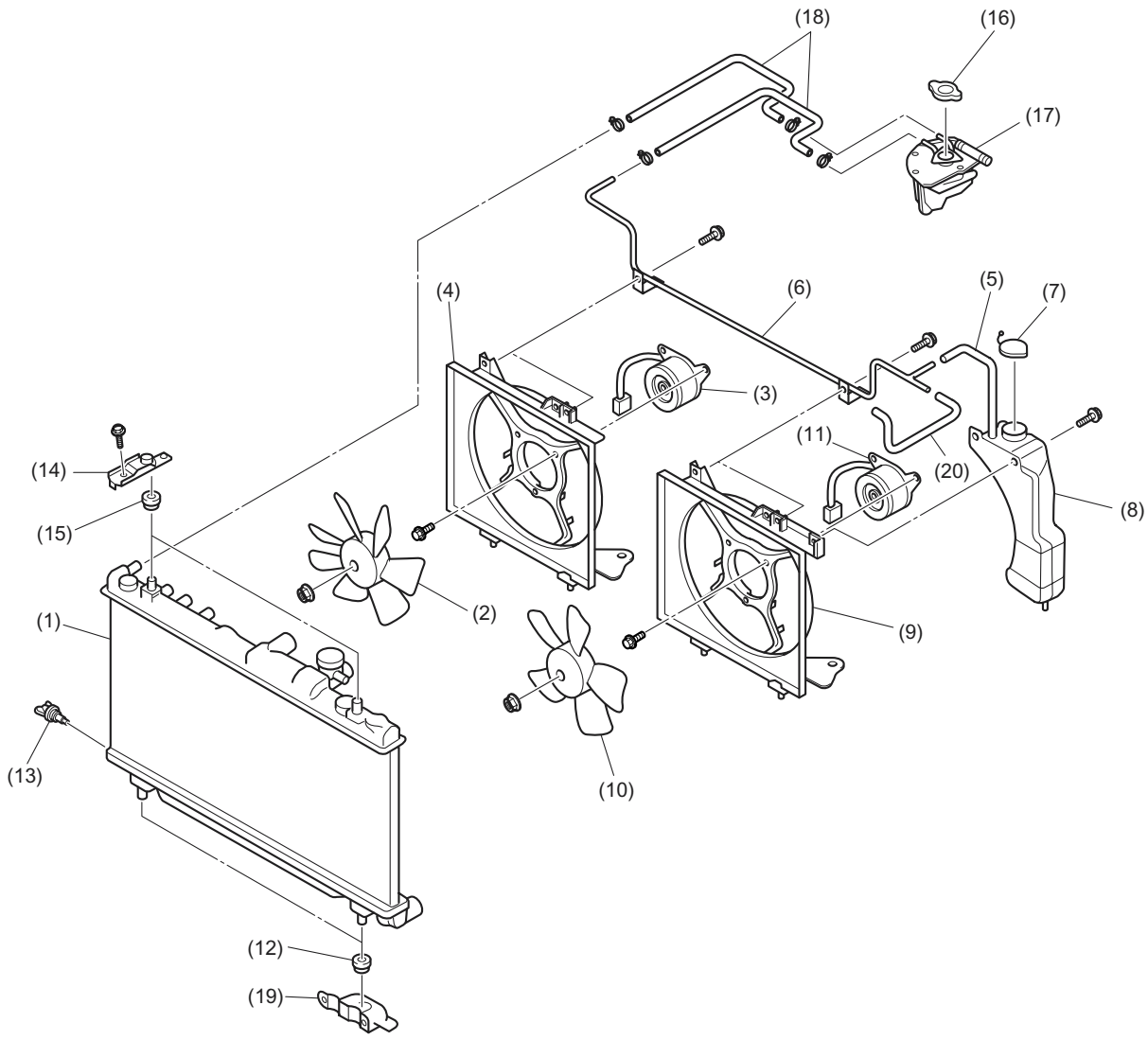
6. Radiator Fan

A: DESCRIPTION

Each radiator fan is made of plastic. It is driven by an electric motor which is retained on a shroud.



CO-00244

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RADIATOR FAN

(1) Radiator
(2) Radiator sub fan (models with A/C)
(3) Radiator sub fan motor (models with A/C)
(4) Radiator sub fan shroud (models with A/C)
(5) Overflow hose (A)
(6) Overflow pipe
(7) Reservoir tank cap
(8) Reservoir tank
(9) Radiator main fan shroud
(10) Radiator main fan
(11) Radiator main fan motor
(12) Lower cushion
(13) Drain plug
(14) Upper bracket
(15) Upper cushion
(16) Radiator cap (coolant filler tank cap)
(17) Coolant filler tank
(18) Coolant hose
(19) Lower bracket
(20) Overflow hose (B)

A/C: Air conditioning system

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B: FUNCTION

1. MODELS WITHOUT A/C

The ON-OFF control and Hi-Low control of the radiator fan is performed by the ECM which receives signals from the engine coolant temperature sensor.

Vehicle speed	Engine coolant temperature		
	Lower than 90°C (194°F)	Between 90 and 95°C (194 and 203°F)	Higher than 96°C (205°F)
	Operation of radiator fans	Operation of radiator fans	Operation of radiator fans
Lower than 19 km/h (12 MPH)	OFF	OFF	Low speed
Between 20 and 69 km/h (12 and 43 MPH)	OFF	OFF	High-Speed
Between 70 and 105 km/h (43 and 65 MPH)	OFF	OFF	High-Speed
Higher than 106 km/h (66 MPH)	OFF	OFF	High-Speed

2. MODELS WITH A/C

On models equipped with an air conditioning system, the ECM or ECM/TCM receives signals from the engine coolant temperature sensor, vehicle speed sensor and A/C switch, and based on these signals, the ECM controls the HIGH-LOW of the radiator main fan and sub fan.

Vehicle speed	A/C compressor	Engine coolant temperature					
		Lower than 90°C (194°F)		Between 90 and 95°C (194 and 203°F)		Higher than 96°C (205°F)	
		Operation of radiator fans		Operation of radiator fans		Operation of radiator fans	
		Main fan	Sub fan	Main fan	Sub fan	Main fan	Sub fan
Lower than 19 km/h (12 MPH)	OFF	OFF	OFF	OFF	OFF	Low-Speed	Low-Speed
	ON	Low-Speed	Low-Speed	High-Speed	High-Speed	High-Speed	High-Speed
Between 20 and 69 km/h (12 and 43 MPH)	OFF	OFF	OFF	OFF	OFF	High-Speed	High-Speed
	ON	High-Speed	High-Speed	High-Speed	High-Speed	High-Speed	High-Speed
Between 70 and 105 km/h (43 and 65 MPH)	OFF	OFF	OFF	OFF	OFF	High-Speed	High-Speed
	ON	Low-Speed	Low-Speed	Low-Speed	Low-Speed	High-Speed	High-Speed
Higher than 106 km/h (66 MPH)	OFF	OFF	OFF	OFF	OFF	High-Speed	High-Speed
	ON	OFF	OFF	Low-Speed	OFF	High-Speed	High-Speed

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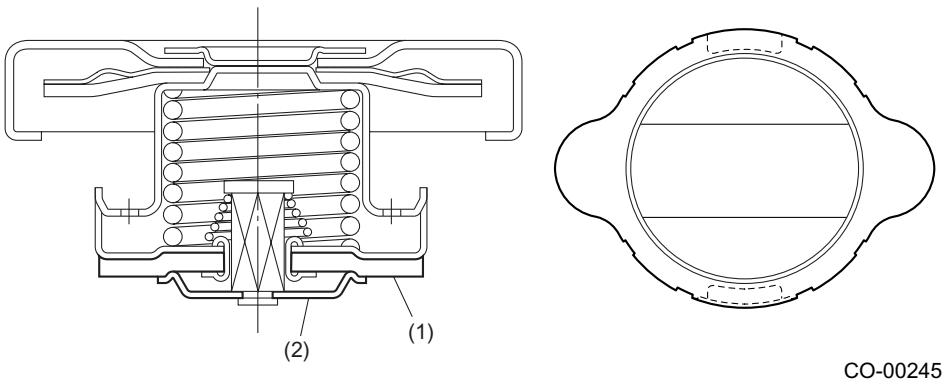
7. Radiator Cap

The radiator cap at the coolant filler tank side has a pressure valve and a vacuum valve. When the radiator inner pressure becomes higher than specified, the pressure valve opens to send coolant to the reservoir tank. Also, when the radiator inner pressure becomes lower than the atmospheric pressure during the cooling down phase, the vacuum valve opens to send back coolant from the reservoir tank to the radiator. These functions prevent damage to the radiator components.



CO-00245

(1) Pressure valve

(2) Vacuum valve

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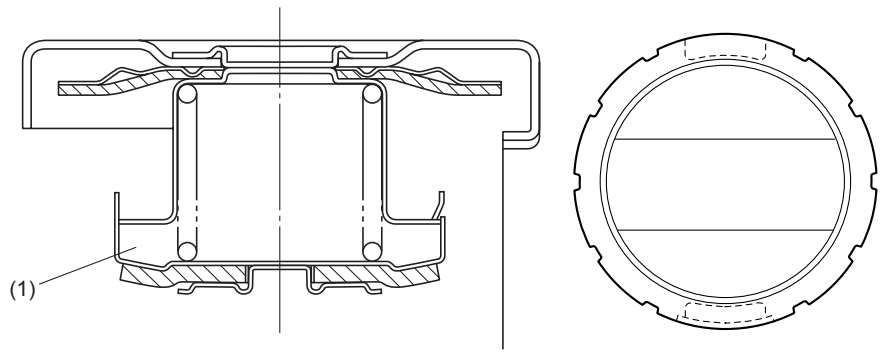
8. Relief Valve Cap

The relief valve cap at the radiator side has a pressure valve. When the radiator inner pressure becomes higher than specified, the pressure valve opens to send coolant to the reservoir tank. This function prevents damage to the radiator components.

CAUTION:
Due to the difference in construction, the relief valve cap cannot be used in place of the radiator cap at the coolant filler tank side. If the relief valve cap is fit on the coolant filler tank, overheating may occur.



CO-00246

(1) Pressure valve

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COOLING
H4SO

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1. General

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2. Cooling Circuits

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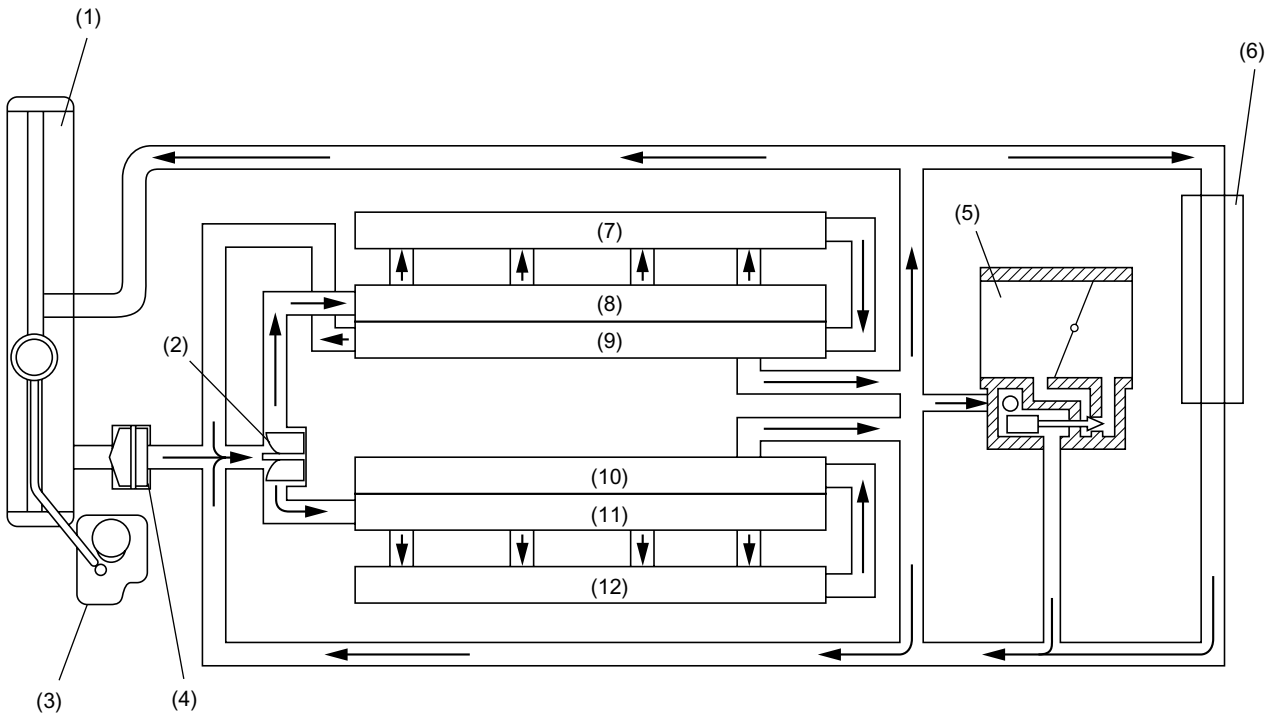
When the engine coolant temperature is above 76 — 80°C (169 — 176°F), the thermostat opens.The coolant flows through the radiator where it is cooled.

- 3rd phase (thermostat open and radiator fan operating)

When the engine coolant temperature sensor sends a signal indicating a temperature above 95°C (203°F) to the ECM, it causes the radiator fan (or fans) to operate.



CO-00066

(1) Radiator
(2) Water pump
(3) Engine coolant reservoir tank
(4) Thermostat
(5) Throttle body
(6) Heater core
(7) Cylinder head RH
(8) Cylinder jacket RH
(9) Cylinder block RH
(10) Cylinder block LH
(11) Cylinder jacket LH
(12) Cylinder head LH

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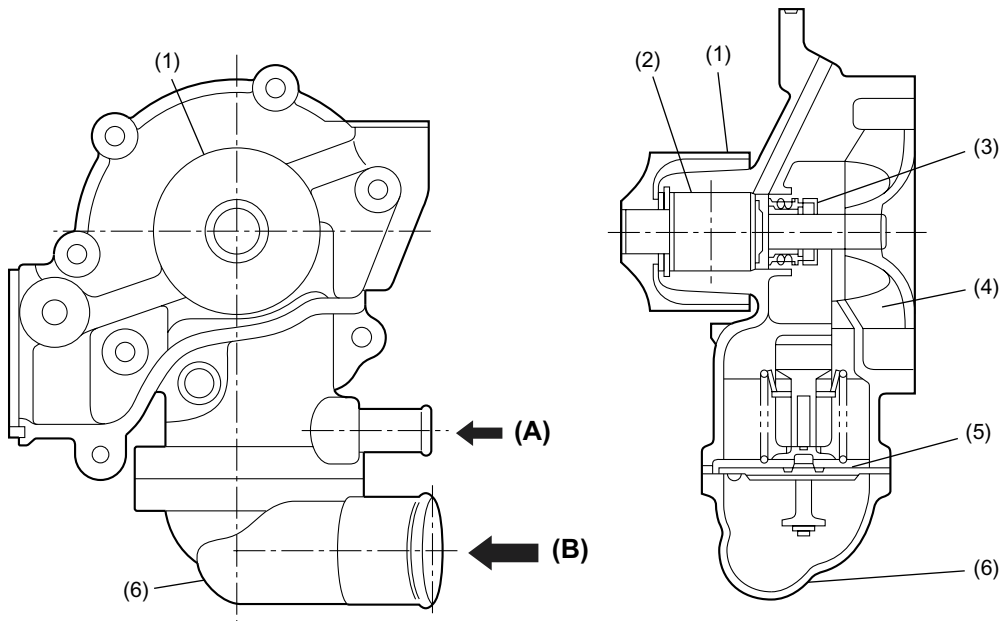
3. Water Pump



CO-00056

(A) From heater circuit
(B) From radiator

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

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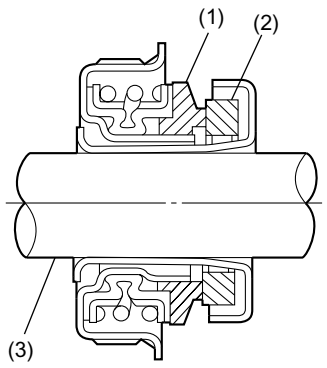
4. Mechanical Seal

The mechanical seal has its seat tightly fitted on the water pump shaft. Since it is a hermetic seal forming an integral part of the water pump, the water pump cannot be disassembled.



CO-00058

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

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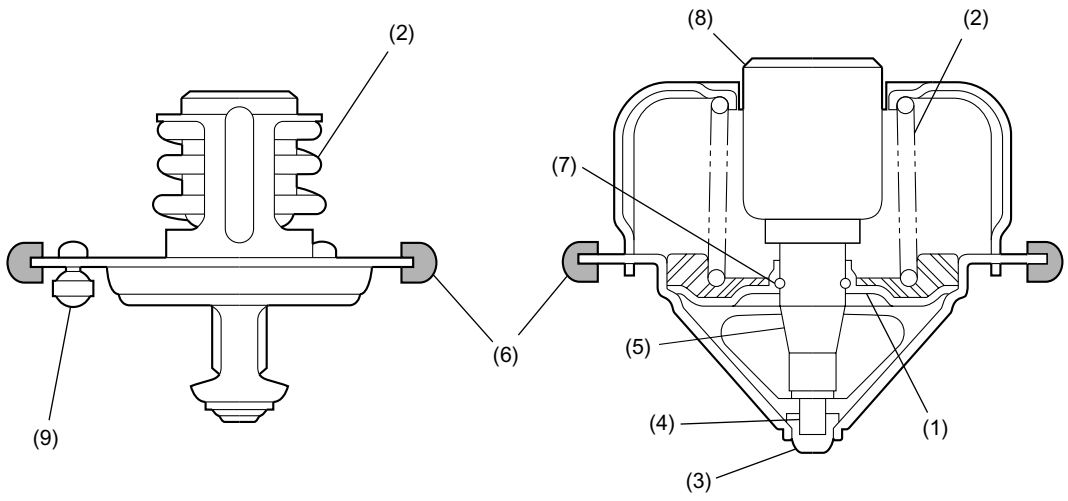
5. Thermostat

The thermostat has a totally-enclosed wax pellet which expands as the coolant temperature increases. It opens and closes accurately at the preset temperatures and features high durability.



CO-00059

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

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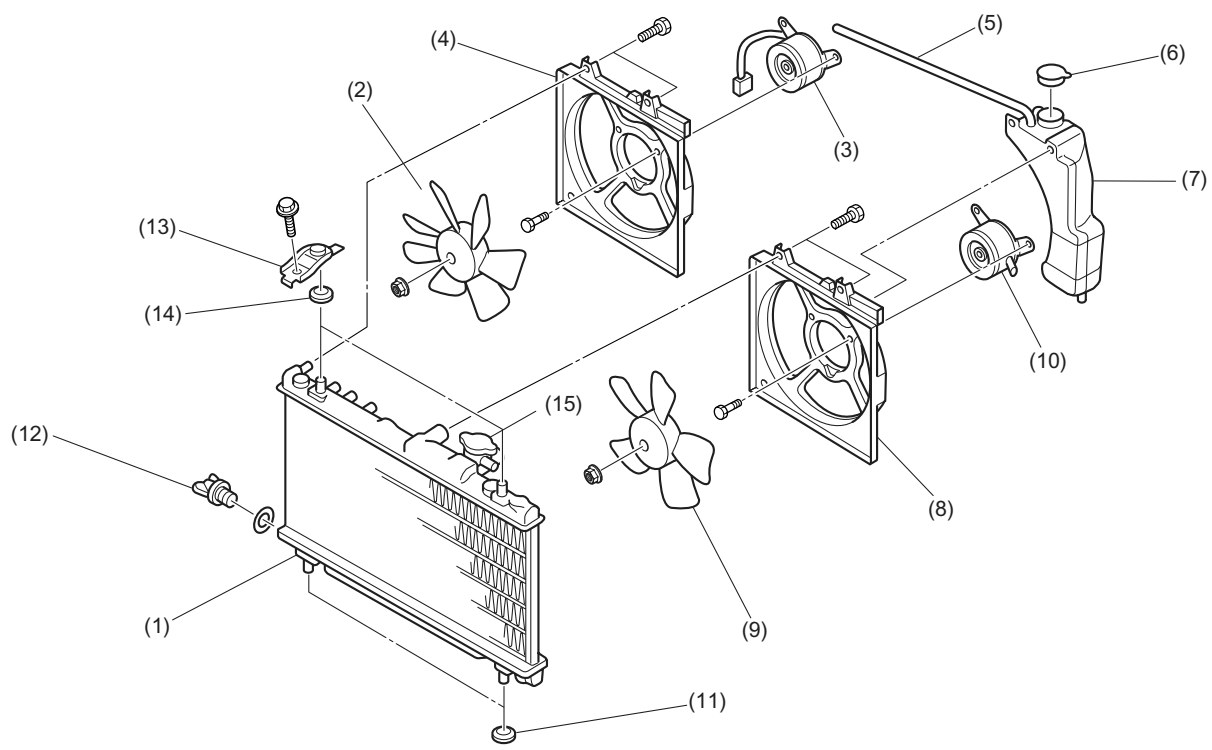
6. Radiator Fan

A: DESCRIPTION

Each radiator fan is made of plastic. It is driven by an electric motor which is retained on a shroud.



CO-00234

(1) Radiator
(2) Radiator sub fan (models with A/C)
(3) Radiator sub fan motor (models with A/C)
(4) Radiator subfan shroud (models with A/C)
(5) Overflow hose
(6) Reservoir tank cap
(7) Reservoir tank
(8) Radiator main fan shroud
(9) Radiator main fan
(10) Radiator main fan motor
(11) Lower cushion
(12) Drain plug
(13) Upper bracket
(14) Upper cushion
(15) Radiator cap
A/C: Air conditioning system

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B: FUNCTION

1. MODELS WITHOUT A/C

The ON-OFF control of the radiator fan is performed by the ECM which receives signals from the engine coolant temperature sensor and the vehicle speed sensor.

Vehicle speed	Engine coolant temperature		
	Lower than 95°C (203°F)	Between 96 and 99°C (205 and 210°F)	Higher than 100°C (212°F)
	Operation of radiator fans	Operation of radiator fans	Operation of radiator fans
Lower than 19 km/h (12 MPH)	OFF	ON	ON
Between 20 and 69 km/h (12 and 43 MPH)	OFF	ON	ON
Between 70 and 89 km/h (43 and 55 MPH)	OFF	OFF	ON
Higher than 90 km/h (56 MPH)	OFF	OFF	ON

2. MODELS WITH A/C

The ON-OFF control of the radiator main fan and sub fan is performed by the ECM which receives signals from the engine coolant temperature sensor, vehicle speed sensor and the A/C switch.

Vehicle speed	A/C compressor load	Engine coolant temperature					
		Lower than 95°C (203°F)		Between 96 and 99°C (205 and 210°F)		Higher than 100°C (212°F)	
		Operation of radiator fans		Operation of radiator fans		Operation of radiator fans	
		Main fan	Subfan	Main fan	Subfan	Main fan	Subfan
Lower than 19 km/h (12 MPH)	OFF	OFF	OFF	ON	OFF	ON	ON
	ON	ON	ON	ON	ON	ON	ON
Between 20 and 69 km/h (12 and 43 MPH)	OFF	OFF	OFF	ON	OFF	ON	ON
	ON	ON	ON	ON	ON	ON	ON
Between 70 and 89 km/h (43 and 55 MPH)	OFF	OFF	OFF	OFF	OFF	ON	ON
	ON	ON	OFF	ON	ON	ON	ON
Higher than 90km/h (56 MPH)	OFF	OFF	OFF	OFF	OFF	ON	ON
	ON	OFF	OFF	ON	OFF	ON	ON

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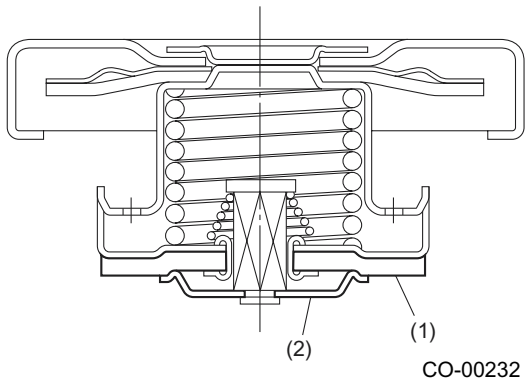
7. Radiator Cap

The radiator cap has a pressure valve and a vacuum valve. When the radiator inner pressure becomes higher than specified, the pressure valve opens to send coolant to the reservoir tank. Also, when the radiator inner pressure becomes lower than the atmospheric pressure during the cooling down phase, the vacuum valve opens to send back coolant from the reservoir tank to the radiator. These functions prevent damage to the radiator components.



CO-00232

(1) Pressure valve
(2) Vacuum valve

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COOLING
STi

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1. General

Specifications for tht STi models are the same as those for turbo models. <Ref. to CO(H4DOTC) — COOLING.>

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COMMUNICATION SYSTEM

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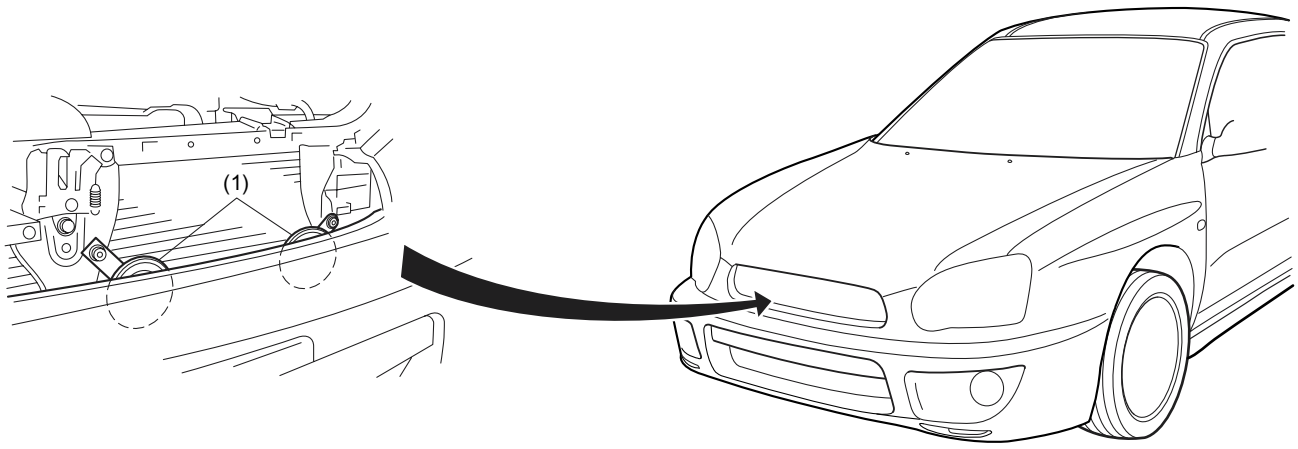
1. Horn

A: GENERAL



COM00015

(1) Horn

Two horns (high and low tone) are installed in front of the radiator.

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CONTROL SYSTEMS

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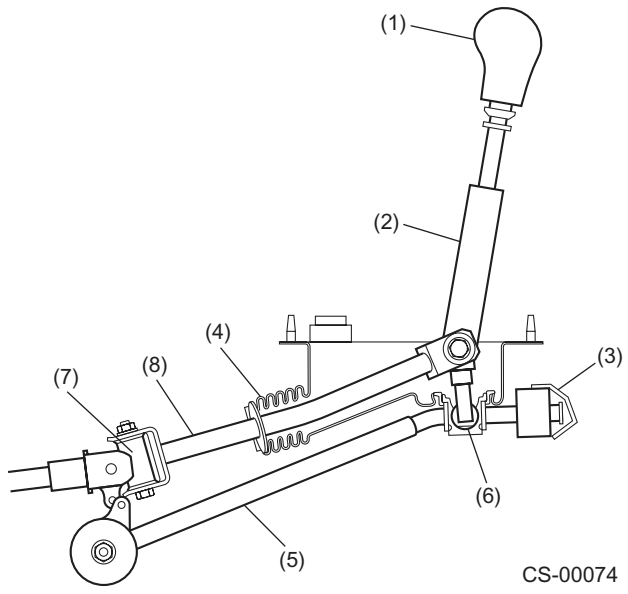
1. 5MT Gear Shift Lever

The manual transmission's gear shift lever system is a parallel link type whose stay is mounted through a cushion rubber.



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

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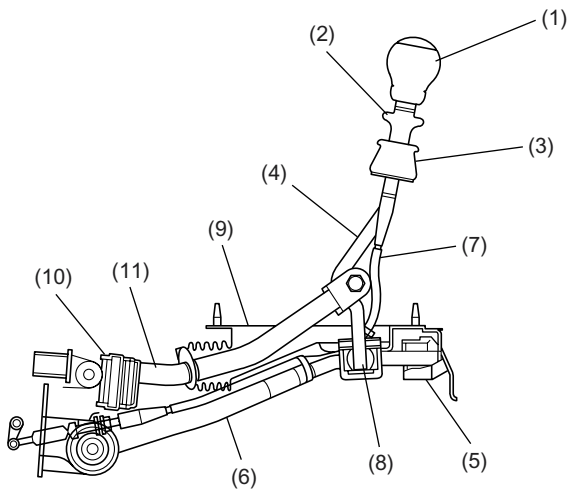
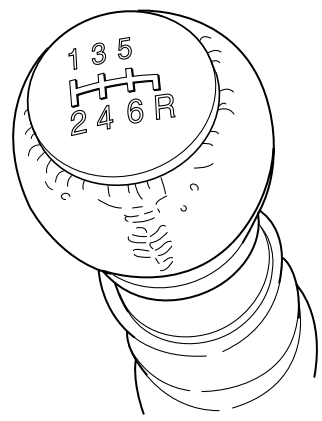
2. 6MT Gear Shift Lever

A: GENERAL

The six-speed manual transmission's control system has a gear shift lever specially designed for the use with it. The gearshift lever is complete with a parallel-link gear shift mechanism as is the case with the five-speed transmission's gearshift lever. To prevent accidental shifting to the reverse gear, the lever has a mechanism that allows a shift into reverse only after the slider has been pulled up.





CS-00248

(1) Knob
(2) Slider
(3) Holder
(4) Lever
(5) Cushion rubber
(6) Stay
(7) Reverse check cable
(8) Bushing
(9) Boot
(10) Joint
(11) Rod

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B: OPERATION

When shifting gear into reverse, the driver pulls the slider up (toward the knob). This causes the reverse check cable to move the reverse lever on the six-speed transmission to the lock release position. Since the reverse check system in the transmission then becomes in the state ready for a shift into reverse, the driver can move the gear shift lever to the reverse position.
Should the reverse check cable be severed, the spring in the holder pushes up the slider and keeps it in the raised position, alerting the driver to the abnormality. Since the reverse check system does not function under this condition, a voluntary or involuntary shift to the reverse position can take place without any restriction.

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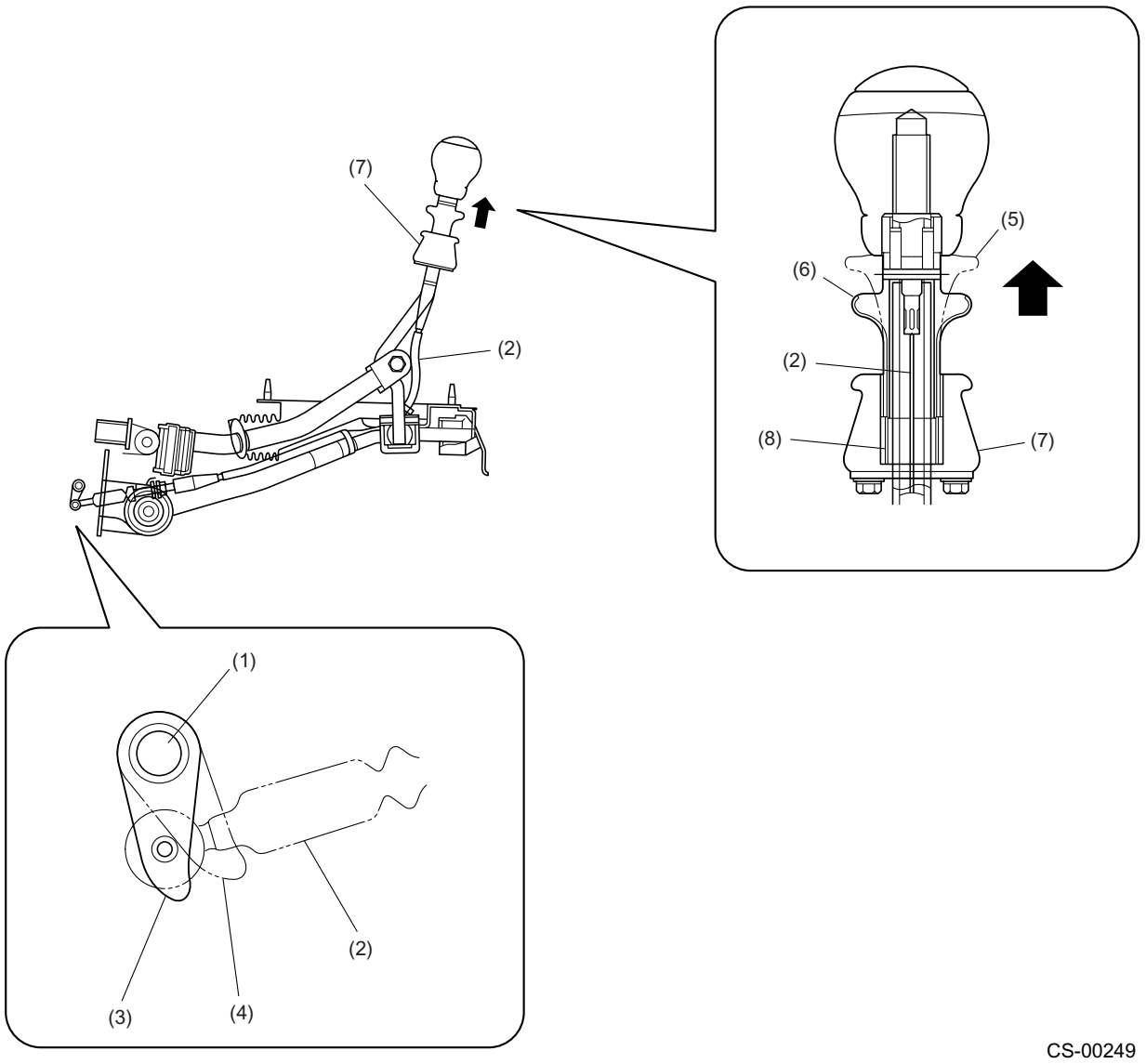
6MT GEAR SHIFT LEVER



CS-00249

(1) Reverse lever
(2) Reverse check cable
(3) Reverse select lock position
(4) Reverse select lock release position
(5) Slider (in reverse select lock release position or when cable is broken)
(6) Slider (in reverse select lock position)
(7) Holder
(8) Spring

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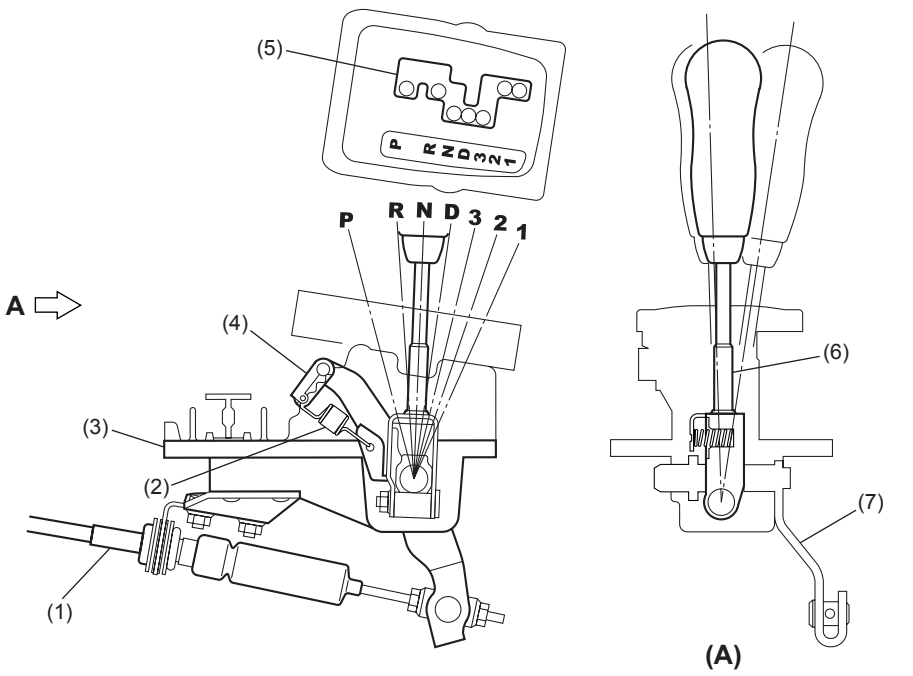
3. Select Lever

- The automatic transmission's select lever moves through seven positions.
- The select lever makes shift direction (longitudinal) movements as well as select direction (lateral) movements. The select lever is guided by a gate to make these movements.
- To transmit movements of the select lever to the transmission, a select cable is used.
- The select lever mechanism has a detent spring and a detent arm. It ensures more precise positioning of the select lever.



CS-00075

(1) Select cable
(2) Detent spring
(3) Base plate
(4) Detent arm
(5) Gate
(6) Select lever assembly
(7) Arm
(A) View A

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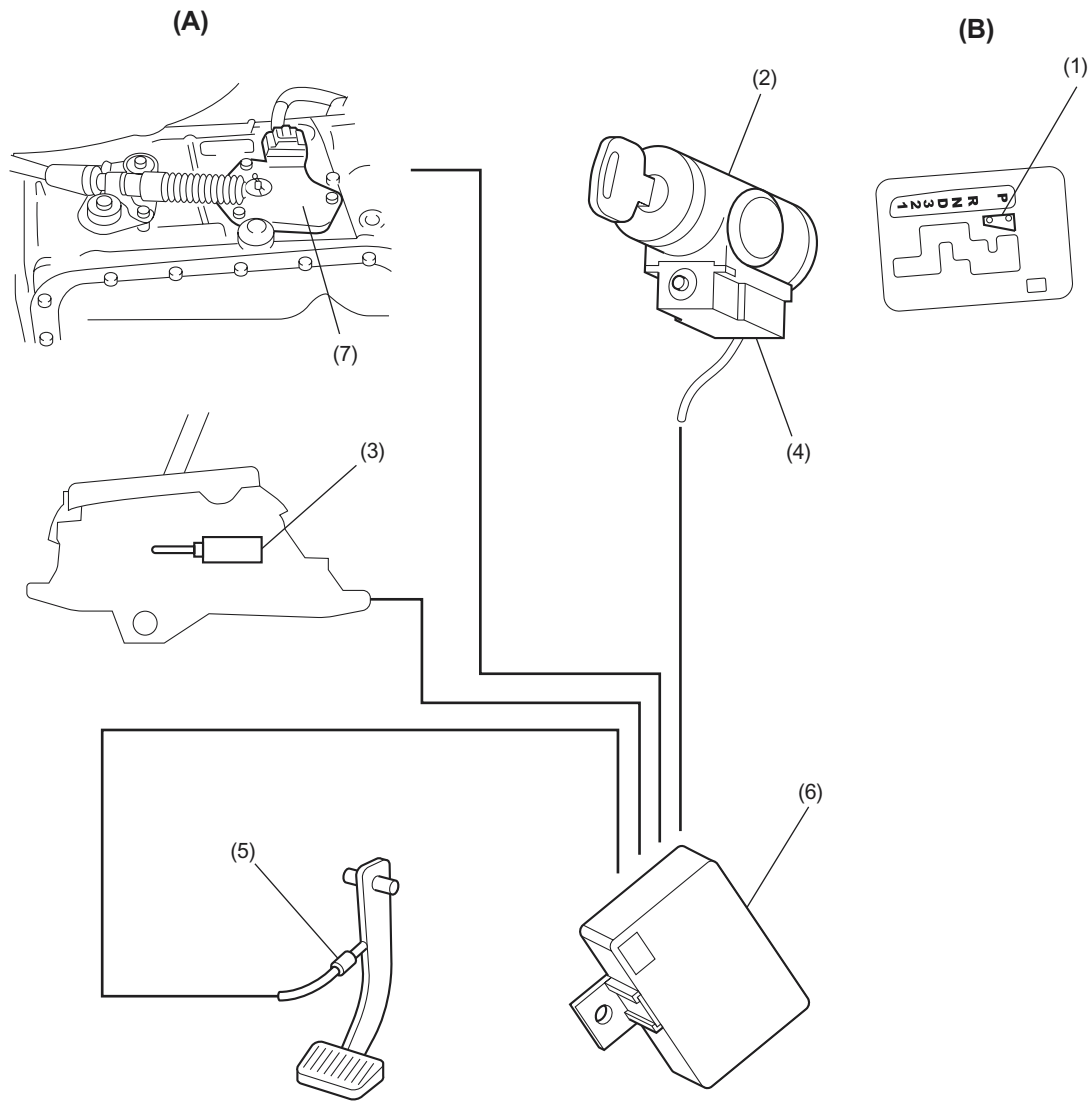
4. Shift Lock and Key Interlock System

A: GENERAL

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



CS-00264

(A) Shift lock system
(1) “P” position switch
(2) Key cylinder
(3) Shift lock solenoid
(4) Key lock solenoid

(B) Key interlock system
(5) Brake pedal switch
(6) Integrated module
(7) Inhibitor switch

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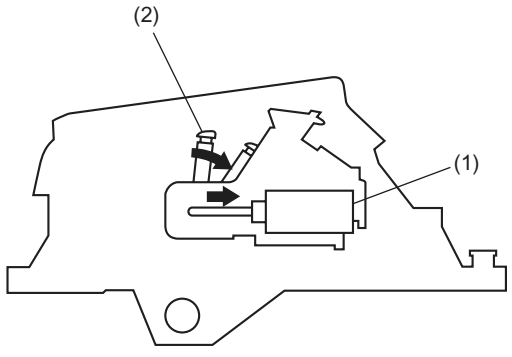
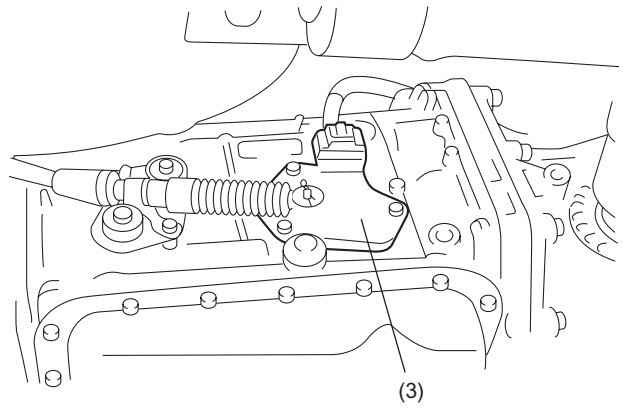
B: SHIFT LOCK SYSTEM OPERATION

The shift lock system has a solenoid-operated plunger (1). With the select lever in the “P” position, the plunger remains extended, holding the lock arm (2) in its raised (locking) position. When the brake pedal is depressed with the ignition switch in either the ON or START position, the solenoid is energized and the plunger is retracted. This causes the lock arm to tilt forward to the select lever release position. The select lever now can be moved to any other position. The “P” position of the select lever is detected by the inhibitor switch (3).





CS-00161

(1) Solenoid
(2) Lock arm
(3) Inhibitor switch

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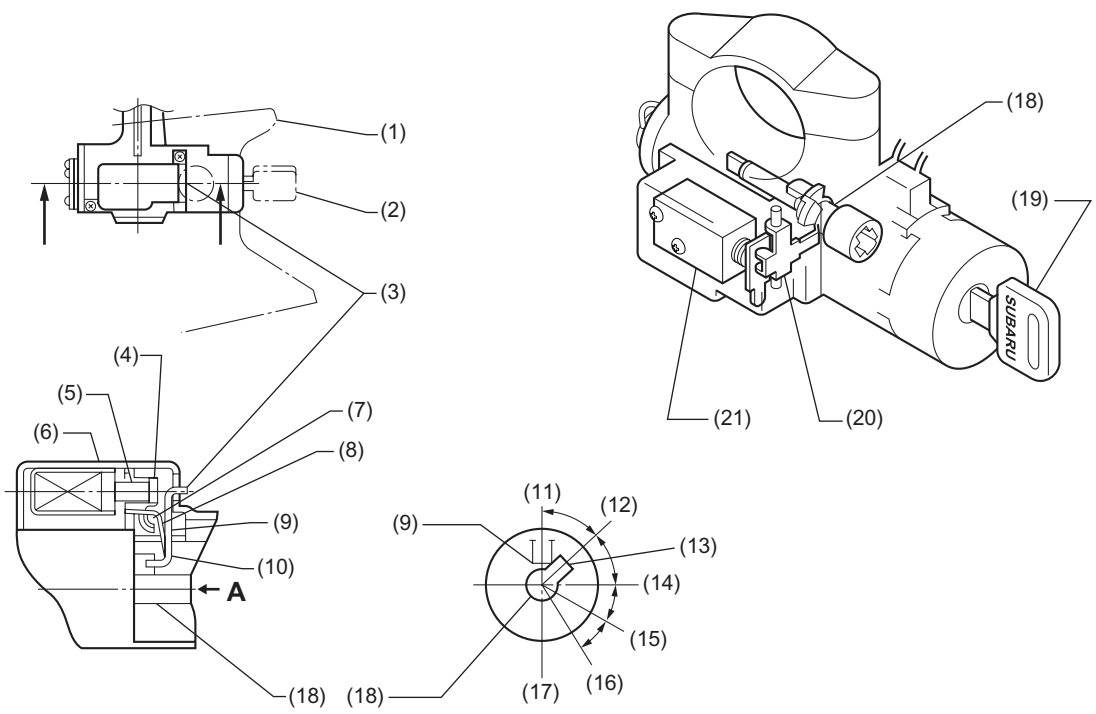
C: KEY INTERLOCK FUNCTION

● When the select lever is at any position other than “P”, the solenoid is energized and its pin is held extended. Being caused to stay in its upright position by extension of the pin, the interlock lever interferes with the stopper portion of the rotator which turns together with the ignition key. Thus, the ignition key cannot be rotated to the “LOCK” position.



CS-00078

(1) Column cover
(2) Key
(3) Push button
(4) Extended
(5) Solenoid pin
(6) Solenoid unit
(7) Lever fulcrum
(8) Lever spring
(9) Interlock lever
(10) Interlock activated
(11) Lock
(12) Interlock position
(13) Stopper
(14) ACC
(15) ON
(16) START
(17) View A
(18) Rotator
(19) Key
(20) Interlock lever
(21) Solenoid

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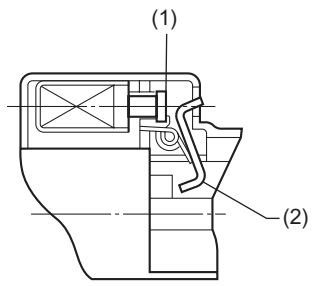
● When the select lever is moved to “P”, the “P” position switch in the select lever assembly operates, deenergizing the solenoid. As the push force of the solenoid pin is removed, the lever spring causes the interlock lever to tilt and become clear of the rotator's stopper. Then the key can be rotated to the “LOCK” position and removed from the ignition switch.



CS-00079

(1) Retracted
(2) Interlock deactivated

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DIFFERENTIALS

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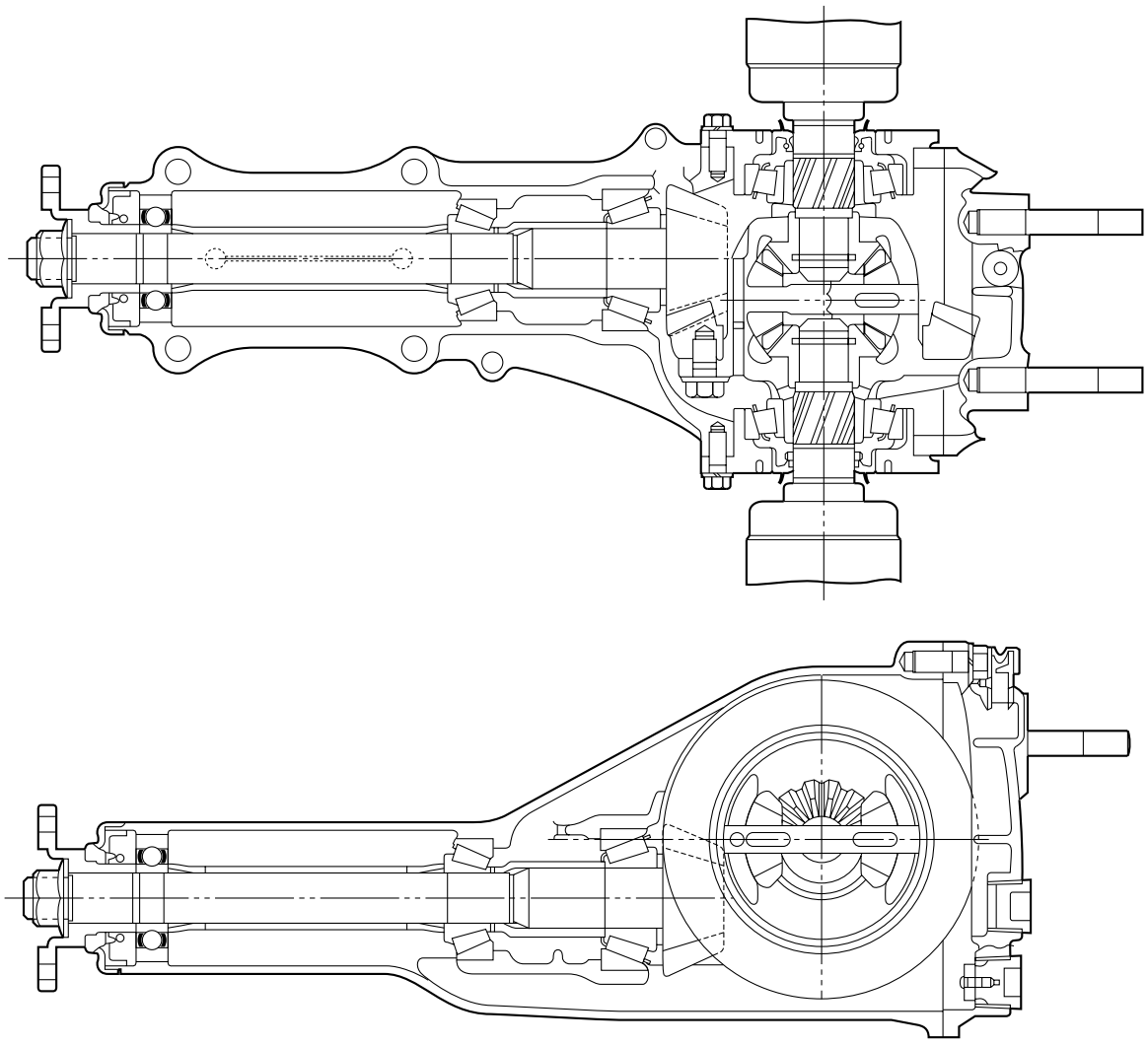
1. Rear Differential

A: EXCEPT STi MODELS

The drive gear is a hypoid gear with nominal diameter of 160 mm (6.30 in). The drive pinion shaft is supported by three bearings. The bearing preload is adjusted by selecting a spacer and washer combination of a proper thickness. The drive pinion height is adjusted by properly selecting the thickness of the washers located at the drive pinion neck using a dummy shaft and gauge.



DI-00231

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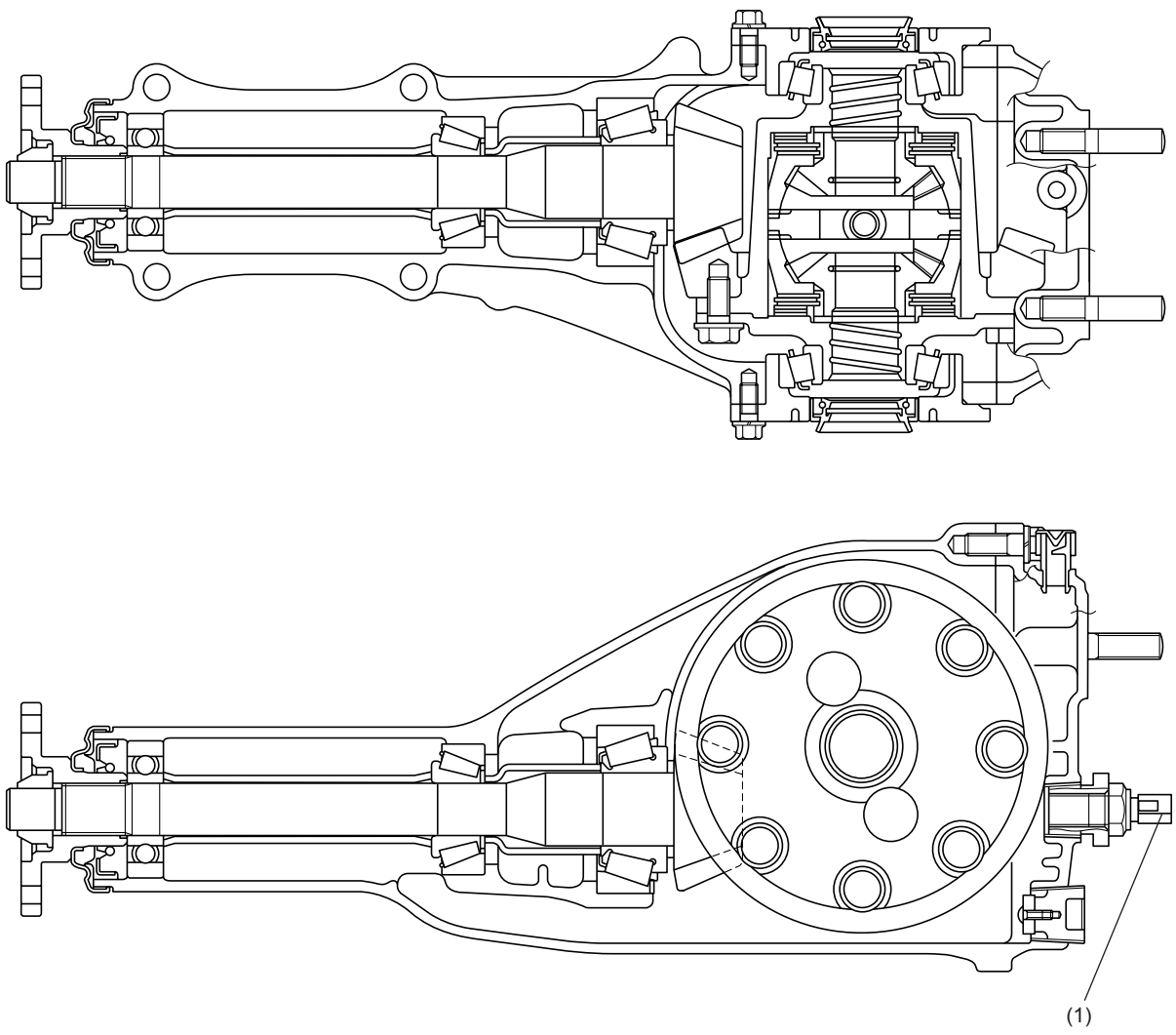
B: STi MODELS

The drive gear is a hypoid gear with nominal diameter of 180 mm (7.09 in). The drive pinion shaft is supported by three bearings. The bearing preload is adjusted by selecting a spacer and washer combination of a proper thickness. The drive pinion height is adjusted by properly selecting the thickness of the washers located at the drive pinion neck based on the value stamped on the drive pinion shaft rear end.

To deal with the enhanced engine power, the diameter of the companion flange (joint to the propeller shaft) is increased for additional rigidity.

Moreover, the rear differential oil temperature switch opens when the rear differential oil temperature exceeds 150° C (302° F) causing the rear differential oil temperature warning light in the combination meter to turn on and switch the center differential in the transmission toward differential lock operation.



DI-00330

(1) Rear differential oil temperature switch

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2. Limited Slip Differential (LSD) (Viscous Coupling Type)

A: GENERAL

The limited slip differential (LSD) automatically limits the differential action and distributes torque to the left and right wheels adequately to enhance driving stability when the left and right wheels are rotating at speeds different from each other during driving on a slippery road (muddy, snow-covered or slushy road) or cornering.

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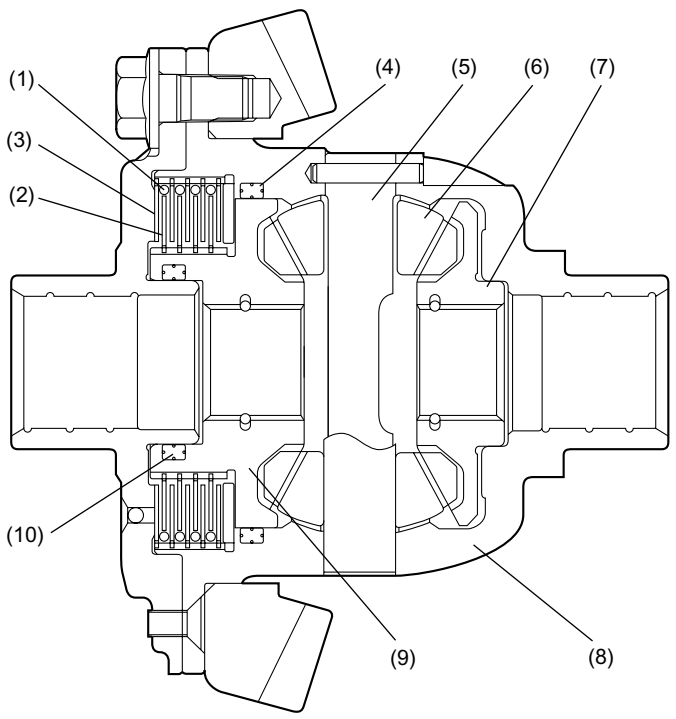
B: CONSTRUCTION

The V/C (viscous coupling) type LSD has outer plates and inner plates arranged alternately. Each outer plate is splined to the inside of the differential case at its outer periphery and each inner plate is splined to the outer circumference of the left side gear at its inner periphery.
The outer plates are held in position by spacer rings while the inner plates can slide in the axial direction along the spline teeth.
The space between the differential case and the left side gear is filled with a mixture of high viscosity silicone oil and air and hermetically sealed with X-rings.



DI-00295

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

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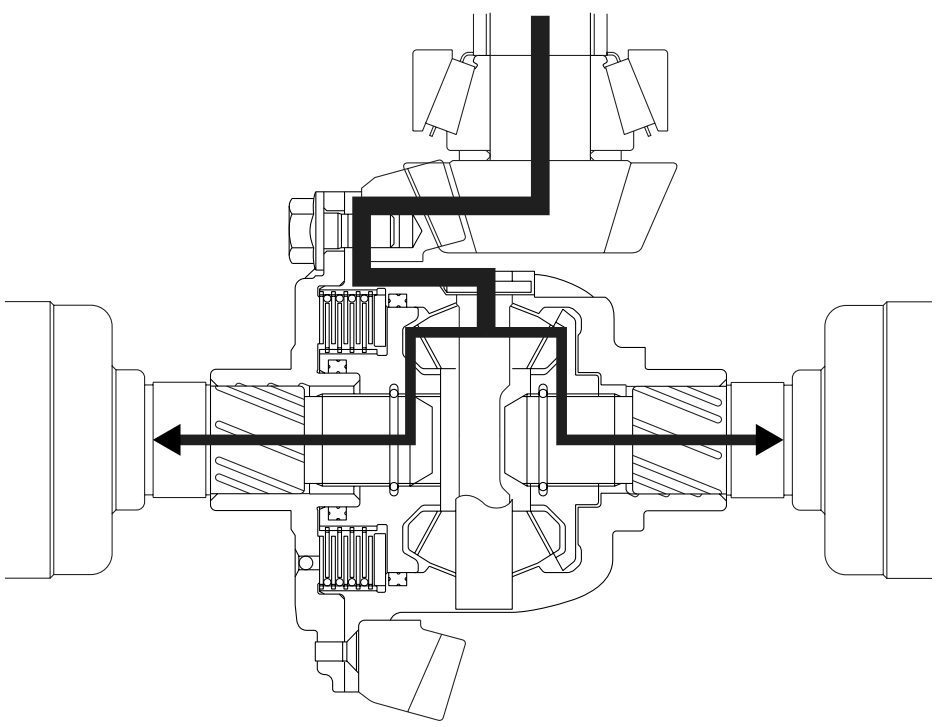
C: OPERATION

1. WHEN RIGHT AND LEFT WHEELS ROTATE AT THE SAME SPEED

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



DI-00296

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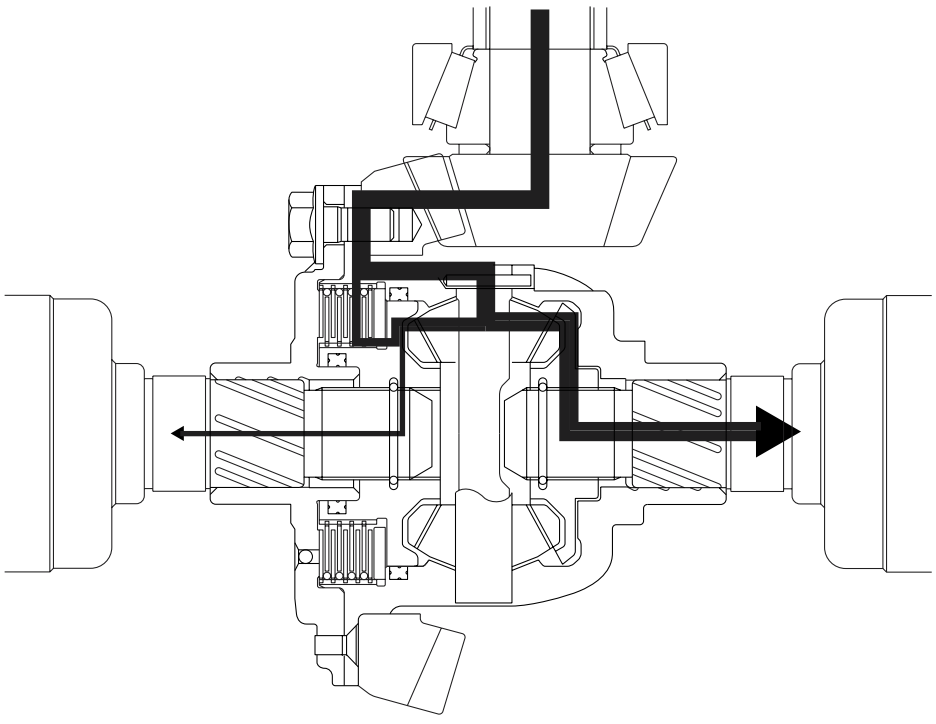
2. WHEN RIGHT AND LEFT WHEELS ROTATE AT DIFFERENT SPEEDS

When a speed difference occurs between the right and left wheels, the differential case and the left side gear do not rotate at the same speed any more. The speed difference between them corresponds to that between both the wheels. Because of the shear force caused in the silicone oil, a differential torque is then generated, which limits differential action.
For example, if the left wheel spins due to small road resistance, a speed difference occurs between the right and left wheels. Since there is the V/C between the differential case and left side gear, a differential torque corresponding to the speed difference is generated in the V/C. This differential torque is transferred from the left wheel to the right wheel. As a result, a greater driving torque is distributed to the right wheel which is rotating at a lower speed.
When the right wheel spins, the differential torque is transferred from the right wheel to the left wheel. Also in this case, a torque greater by the differential torque than the torque to the spinning wheel is transmitted to the wheel rotating at the lower speed.

When left wheel spins



DI-00297

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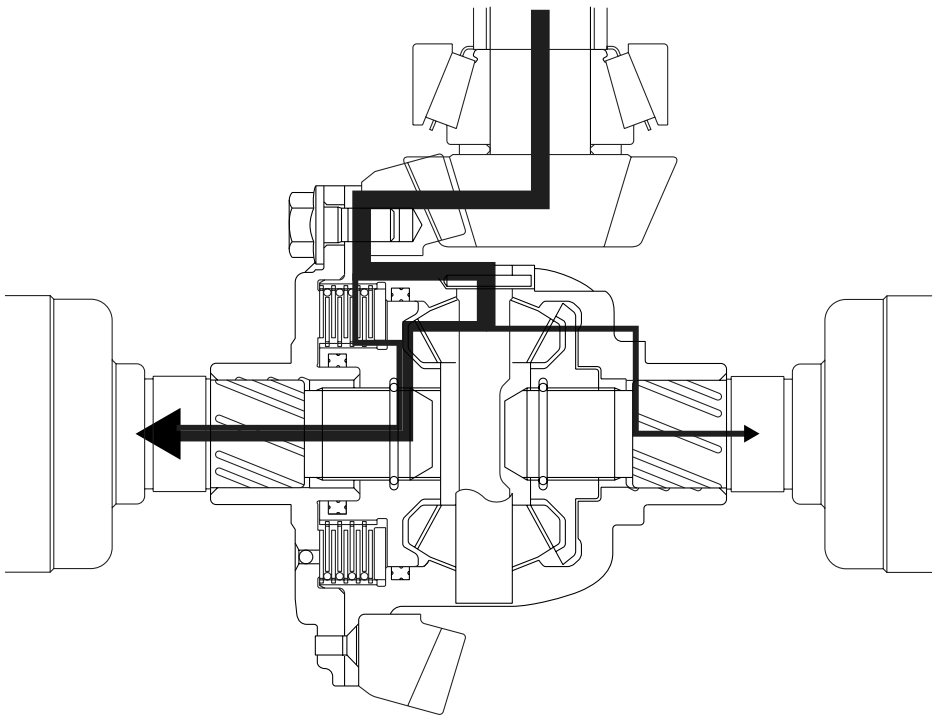
When right wheel spins



DI-00298

D: SERVICE PROCEDURES FOR LSD

It is not recommended to disassemble the LSD assembly as component parts of LSD assembly are not available individually.

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3. Limited Slip Differential (LSD) (Mechanical Type)

A: GENERAL

When controlling the differential action between left and right wheels during cornering or when either of the wheels spins due to slip or bumping, cams will expand the pressure rings to press the friction plates together, thus enabling the driving torque be transmitted to the non-spinning wheel too for more stable driving.
This differential is suitable for high powered and high output torque vehicles also because it responds to the acceleration pedal operation quickly.

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B: CONSTRUCTION

Pressure rings with V-grooves are assembled in the case of the mechanical differential. The four lugs (protrusions) on the periphery of the pressure rings fit in the grooves provided inside the differential case when the pressure rings are assembled, and the pressure rings can slide in axial directions.
The tips of the pinion shaft are chamfered to assemble the pinion shaft into the V-grooves of the pressure rings, forming V-shaped cams. Similar to the pressure rings, the friction plates and spring plates also have four lugs (protrusions) on the periphery and these lugs fit in the grooves provided inside the differential case when the plates are assembled.
On the internal circumference of the friction disks and spring plates there are 4 or 6 lugs (protrusions) which fit in the grooves provided on the outer circumference of the side gears, and the friction disks and spring plates can slide in axial directions.
These friction plates, friction disks, spring plates, spring disks are alternately arranged and form a clutch as a whole.
The spring plates and spring disks act as Belleville springs and provide initial torque. Moreover, thrust washers are inserted between the side gears and differential case halves to adjust clearance in the axial direction and prevent thrust from the side gears to work against the pressure rings.

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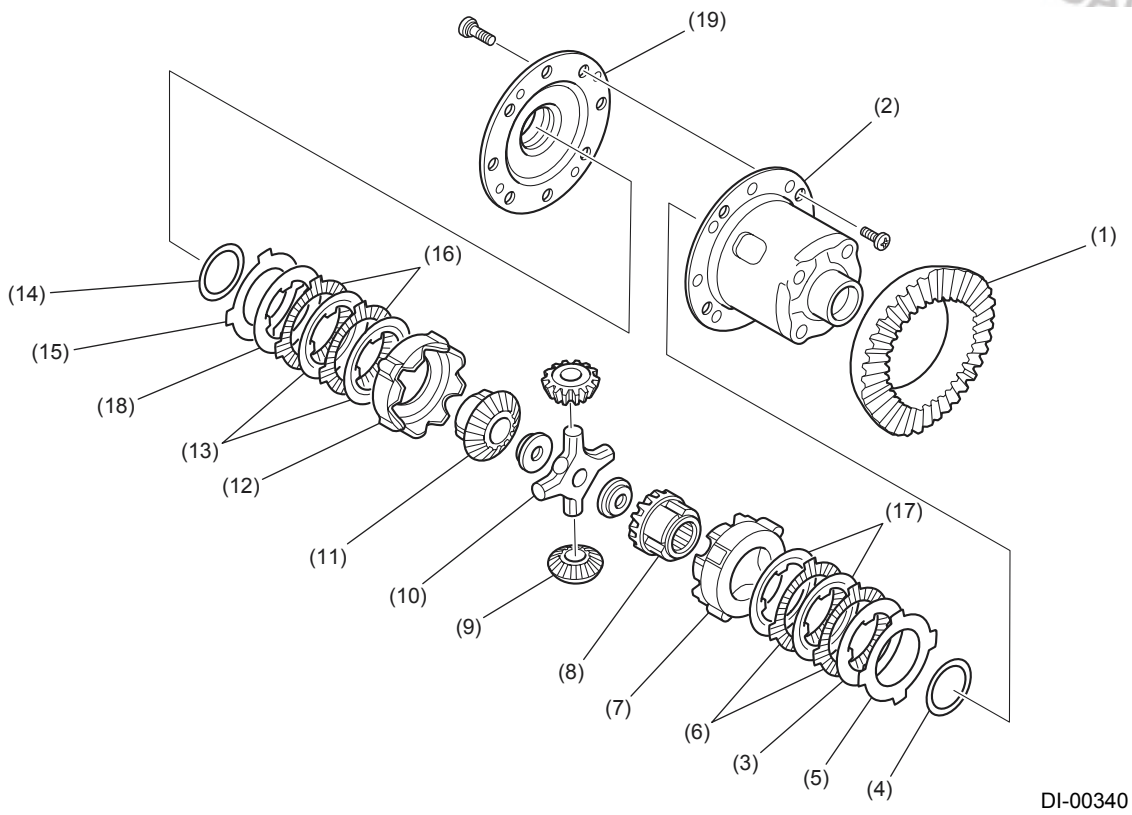
LIMITED SLIP DIFFERENTIAL (LSD) (MECHANICAL TYPE)



DI-00340

(1) Ring gear
(2) Differential case RH
(3) Spring disk
(4) Thrust washer
(5) Spring plate
(6) Friction plate
(7) Pressure ring
(8) Side gear
(9) Pinion
(10) Pinion shaft
(11) Side gear
(12) Pressure ring
(13) Friction plate
(14) Thrust washer
(15) Spring plate
(16) Friction disc
(17) Friction disk
(18) Spring disk
(19) Differential case LH

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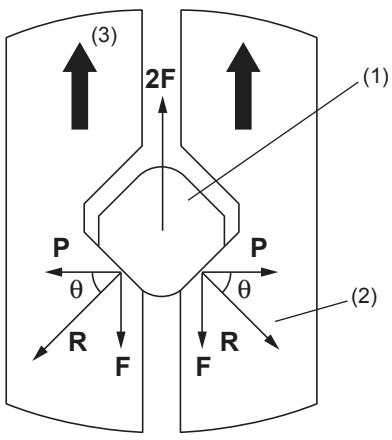
C: OPERATION

The torque transmitted from the crown gear to the differential case is then transmitted to the pressure rings via their four lugs (protrusions) causing the pressure rings and the differential to rotate as a unit.
The torque is further transmitted from the pressure rings to the V-shaped cams of the pinion shaft causing reaction force F opposing the rotational direction and load $P=F\cot\theta$ in the axial directions to be applied on the cam faces.
The reaction force F opposing the rotational direction is transmitted through the pinion gears to the side gears in the same way as a conventional differential. The force P in axial directions push open the pressure rings and act as engaging load for the multi-plate clutchs.
This load is needed as a force to cause friction between the friction plates and friction disks to let them work as clutchs.



DI-00341

(1) Pinion shaft

(2) Pressure ring

(3) Rotational direction

F: Reaction force that occur when the pressure rings cause the pinion shaft to rotate in driving direction.

P: Reaction force which the pressure rings receive from the pinion shaft in axial direction and this reaction force becomes the clutch engaging load.

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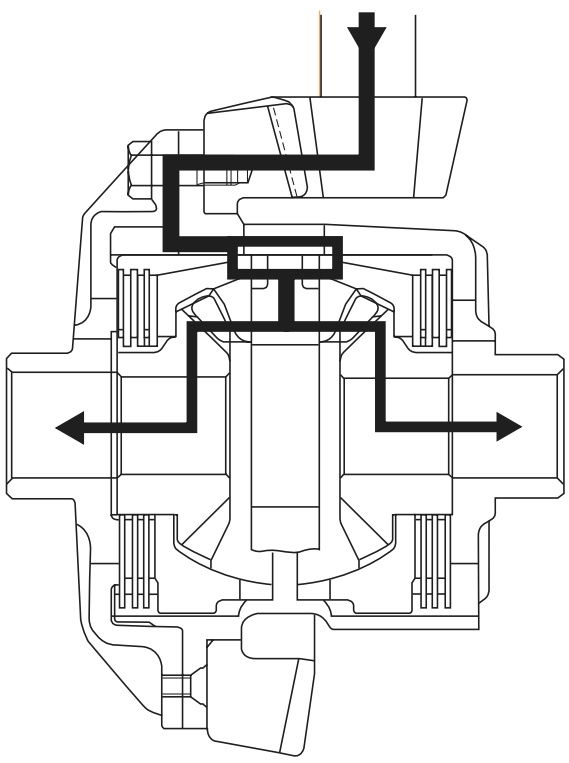
1. WHEN RIGHT AND LEFT WHEELS ROTATE AT THE SAME SPEED

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



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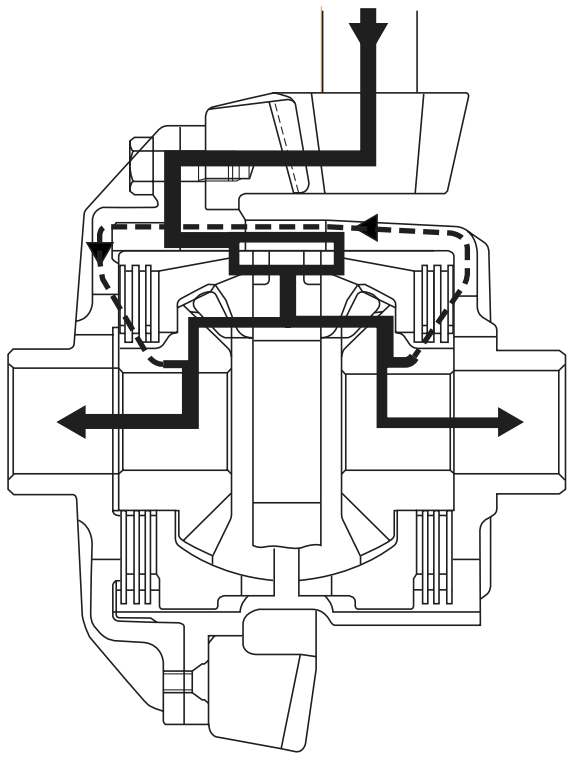
2. WHEN RIGHT AND LEFT WHEELS ROTATE AT DIFFERENT SPEEDS

The right differential bevel gear tries to turn faster than the differential case, however, since the right differential bevel gear is braked by the clutch, a part of the torque is transferred from the right differential bevel gear via the clutch to the differential case as shown by the broken line.
While the left wheel is not spinning and the differential bevel gear is turning at a low speed, the differential case is turning at a high speed, and in contrast with the right side, torque is transferred from the differential case via the clutch to the differential bevel gear.
As a result, the left side differential bevel gear receives a torque which is transferred from the right side differential bevel gear through the clutch, differential case, left side clutch and left side differential bevel gear, in addition to the torque transferred from the differential bevel pinion via the differential bevel gear.

When right wheel spins



DI-00343

D: SERVICE PROCEDURES FOR LSD

It is not recommended to disassemble the LSD assembly as component parts of LSD assembly are not available individually.

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DRIVE SHAFT SYSTEM

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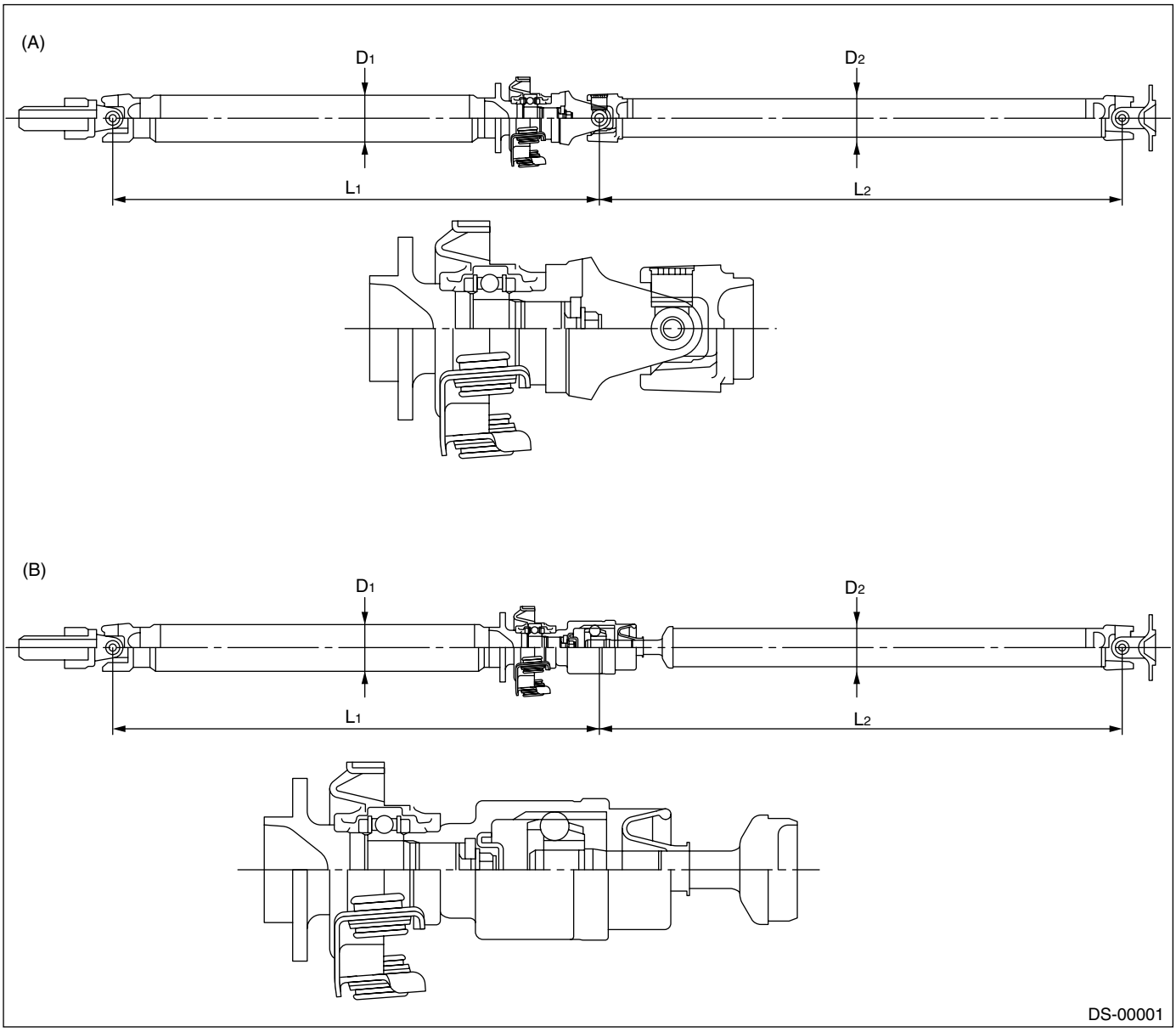
1. General Description

A: SPECIFICATIONS

1. PROPELLER SHAFT

Model		Non-turbo	Turbo (except STi)	STi
Propeller shaft type		UJ	DOJ	UJ
Front propeller shaft Joint-to-joint length: L_1 mm (in)	AT	584 (22.99)	579 (22.79)	—
	MT	643 (25.32)	638 (25.12)	574 (22.60)
Rear propeller shaft Joint-to-joint length: L_2 mm (in)		708 (27.87)	713 (28.07)	706 (27.80)
Outer diameter of tube: mm (in)	D_1	63.5 (2.500)		70 (2.756)
	D_2	57.0 (2.244)		



(A) UJ type (B) DOJ type

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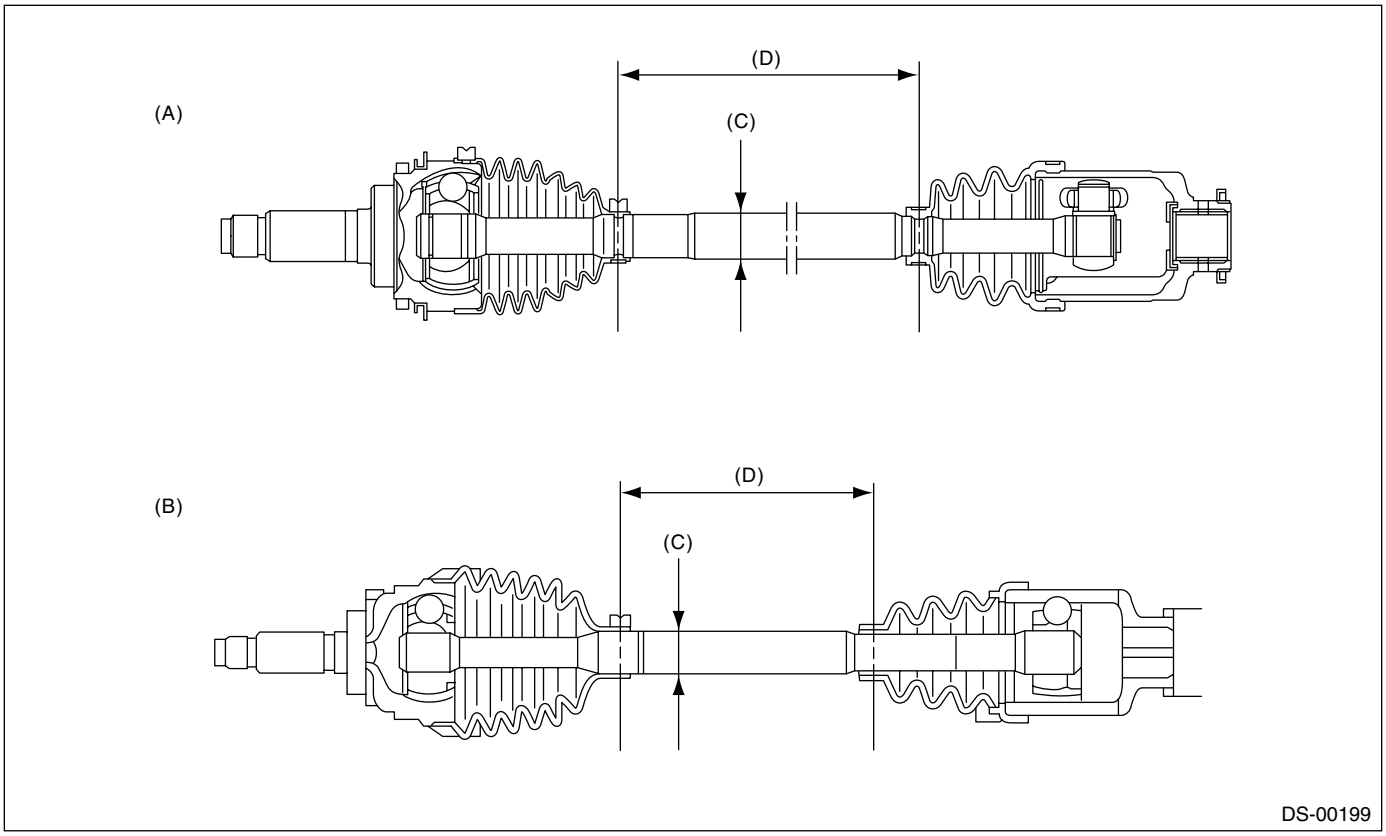
2. FRONT DRIVE SHAFT ASSEMBLY

Model		Type of drive shaft	Axle diameter ϕ D (mm)	Axle length L (mm)
Sedan	Non-turbo, Turbo AT	EBJ87+SFJ82	26 (1.02)	325
	Turbo MT (except STi)	EBJ87+SFJ82	28 (1.10)	325
	Turbo MT (STi)	BJ92+DOJ87	28 (1.10)	250
Wagon	Non-turbo, Turbo AT	EBJ87+SFJ82	26 (1.02)	314
	Turbo MT	EBJ87+SFJ82	28 (1.10)	314



(A) EBJ87+SFJ82
(B) BJ92+DOJ87
(C) Axle diameter
(D) Axle length

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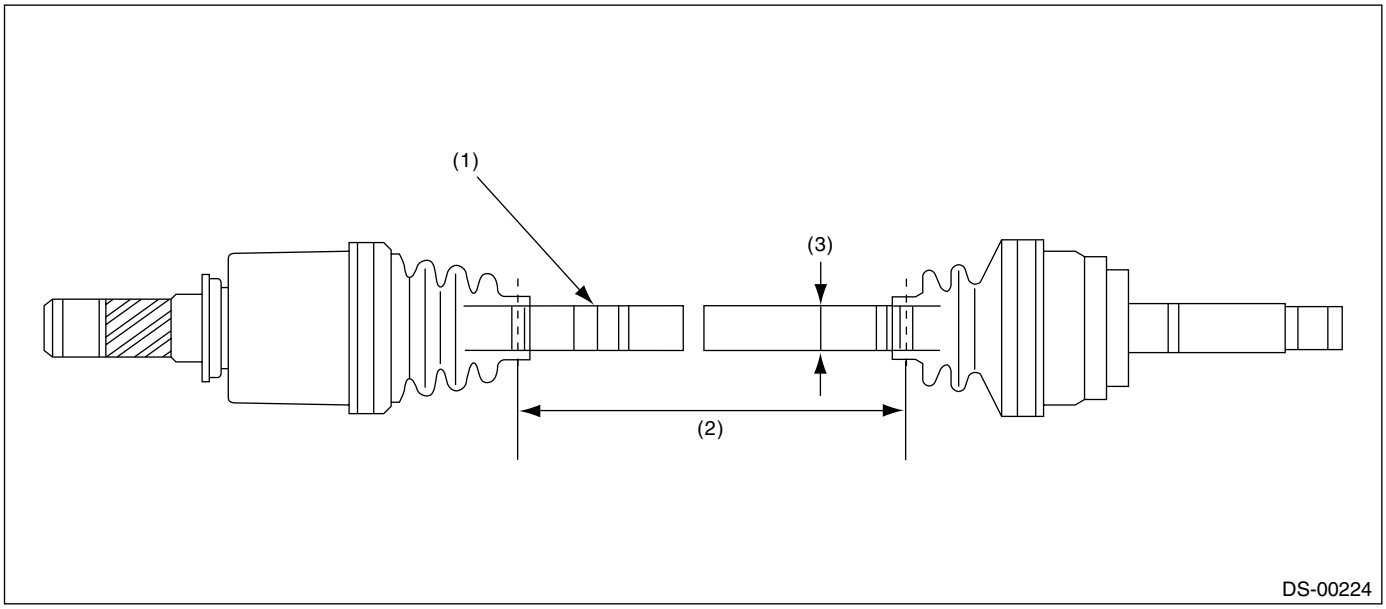
3. REAR DRIVE SHAFT ASSEMBLY

Type of drive shaft assembly	Model	No. of identification protrusion on shaft	Axle length (mm)	Axle diameter (mm)
EBJ82+DOJ82 RH	Sedan turbo	2 (Two)	363	24
EBJ82+DOJ82 LH		1 (One)	353	24
BJ79+DOJ79 RH	Sedan Non-turbo	2 (Two)	368	23
BJ79+DOJ79 LH		1 (One)	358	23
EBJ82+DOJ82 RH	Wagon turbo	2 (Two)	353	24
EBJ82+DOJ82 LH		1 (One)	343	24
BJ79+DOJ79 RH	Wagon Non-turbo	2 (Two)	358	23
BJ79+DOJ79 LH		1 (One)	348	23
BJ87+DOJ87	STi	1 (One)	295.2	25



(1) Identification protrusion (2) Axle length (3) Axle diameter

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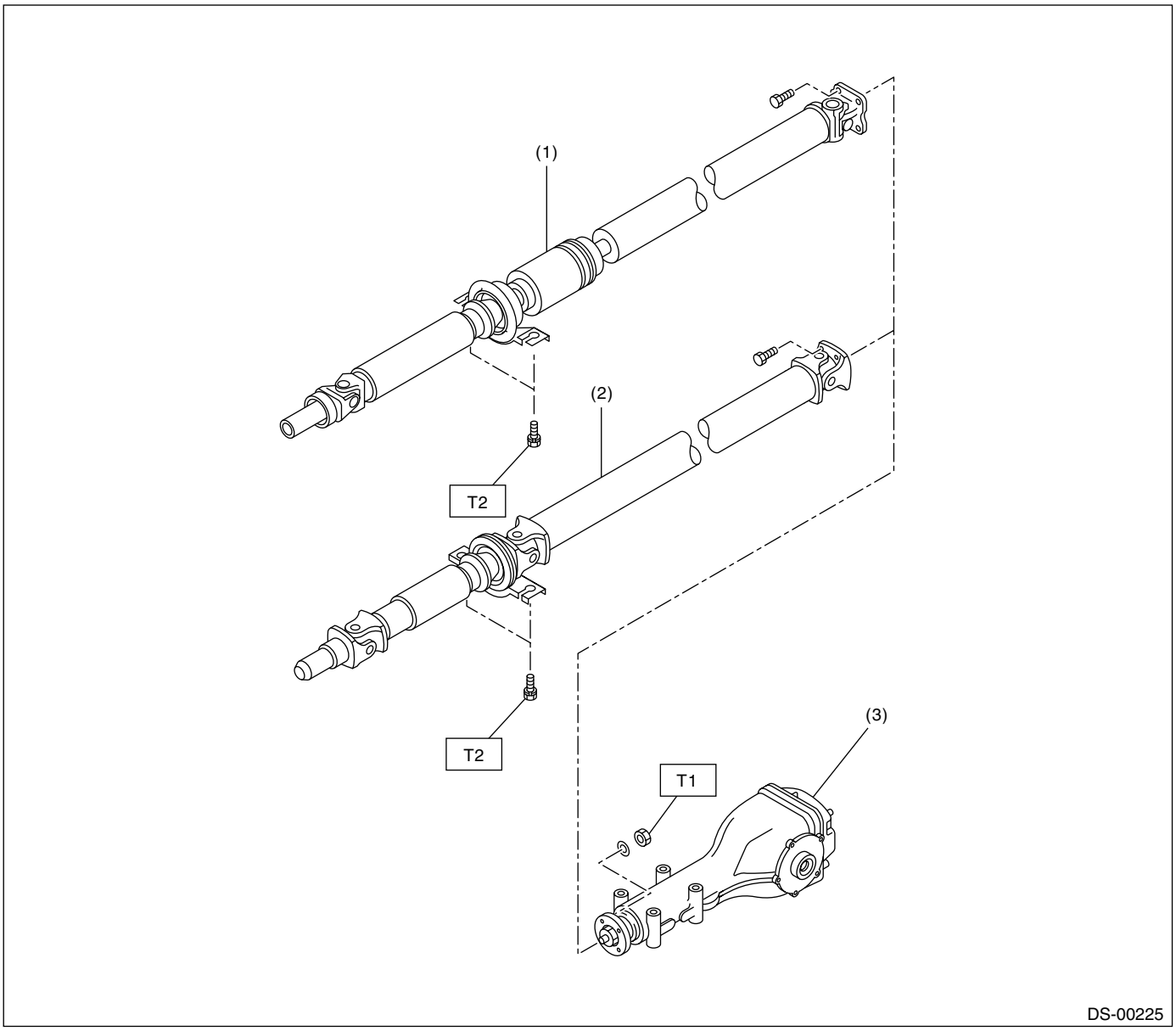
B: COMPONENT

1. PROPELLER SHAFT



(1) Propeller shaft (DOJ type)
(2) Propeller shaft (UJ type)
(3) Rear differential

Tightening torque: N·m (kgf-m, ft-lb)
T1: 38 (3.9, 28.3)
T2: 52 (5.3, 38.3)

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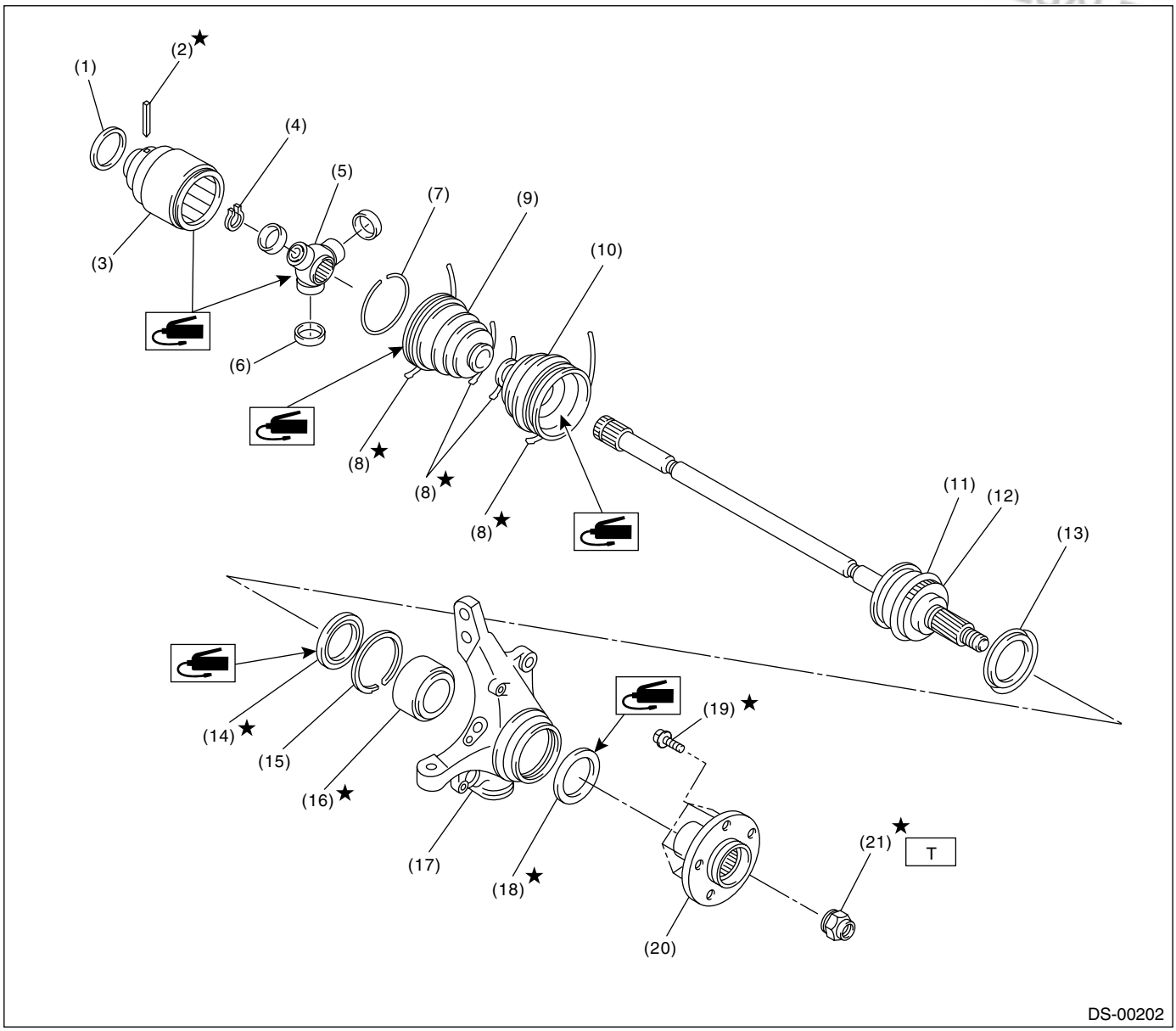
2. FRONT AXLE



(1) Baffle plate (SFJ)
(2) Spring pin
(3) Outer race (SFJ)
(4) Snap ring
(5) Trunnion
(6) Free ring
(7) Circlip
(8) Boot band
(9) Boot (SFJ)
(10) Boot (EBJ)
(11) EBJ ASSY
(12) Tone wheel
(13) Baffle plate
(14) Oil seal (IN)
(15) Snap ring
(16) Bearing
(17) Housing
(18) Oil seal (OUT)
(19) Hub bolt
(20) Hub
(21) Axle nut

Tightening torque: N·m (kgf-m, ft-lb)
T: 220 (22.4, 162)

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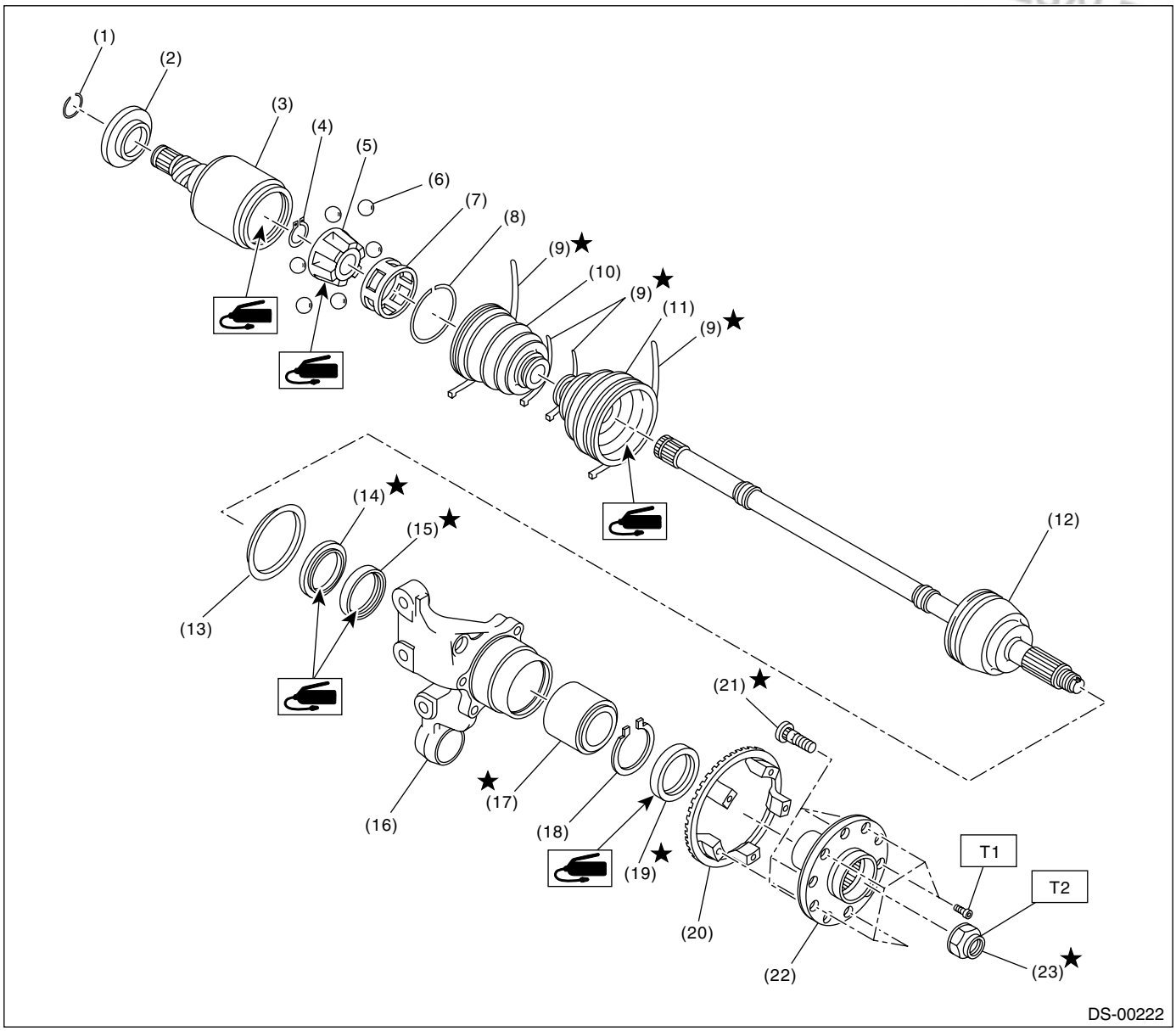
3. REAR AXLE



(1) Circlip
(2) Baffle plate (DOJ)
(3) Outer race (DOJ)
(4) Snap ring
(5) Inner race
(6) Ball
(7) Cage
(8) Circlip
(9) Boot band
(10) Boot (DOJ)
(11) Boot
(12) Non-turbo: BJ ASSY
Turbo: EBJ ASSY
(13) Baffle plate
(14) Oil seal (IN. No. 2)
(15) Oil seal (IN.)
(16) Housing
(17) Bearing
(18) Snap ring
(19) Oil seal (OUT)
(20) Tone wheel
(21) Hub bolt
(22) Hub
(23) Axle nut

Tightening torque: N·m (kgf-m, ft-lb)
T1: 13 (1.3, 9.4)
T2: 190 (19.4, 140)

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C: CAUTION

- Wear working clothing, including a cap, protective goggles, and protective shoes during operation.
- Remove contamination including dirt and corrosion before removal, installation or disassembly.
- Keep the disassembled parts in order and protect them from dust or dirt.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly, and replacement.
- Be careful not to burn your hands, because each part on the vehicle is hot after running.
- Use SUBARU genuine grease etc. or the equivalent. Do not mix grease etc. with that of another grade or from other manufacturers.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or safety stands at the specified points.
- Apply grease onto sliding or revolution surfaces before installation.
- Before installing snap rings, apply sufficient amount of grease to avoid damage and deformation.
- Before securing a part on a vise, place cushioning material such as wood blocks, aluminum plate, or shop cloth between the part and the vise.

D: PREPARATION TOOL

1. SPECIAL TOOLS

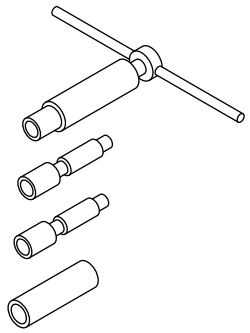
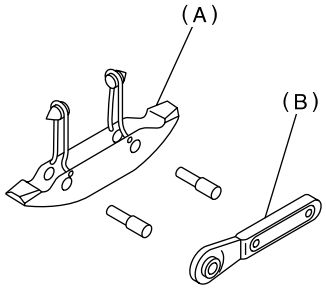
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-922431000	922431000	AXLE SHAFT INSTALLER	• Used for installing axle shaft into housing. • Used with ADAPTER (927390000).
 ST-925091000	925091000	BAND TIGHTENING TOOL	Used for tightening boot band. (A) Jig for band (B) Ratchet wrench

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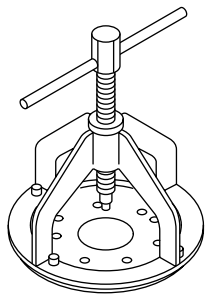
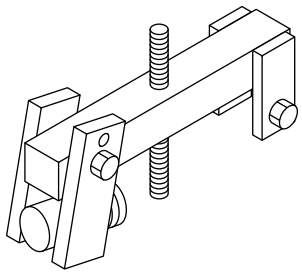
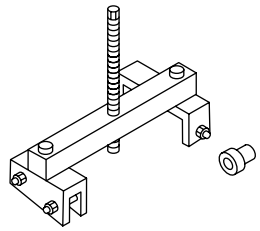
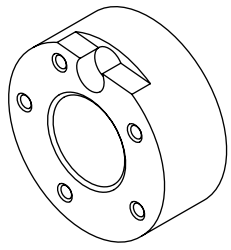
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-926470000	926470000	AXLE SHAFT PULLER	Used for removing axle shaft.
 ST-927060000	927060000	HUB REMOVER	• Used for removing front hub. • Used with HUB STAND (927080000).
 ST-927420000	927420000	HUB REMOVER	• Used for removing rear hub. • Used with HUB STAND (927080000).
 ST-927080000	927080000	HUB STAND	Used for disassembling and assembling hub bolt in hub.

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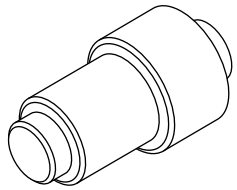
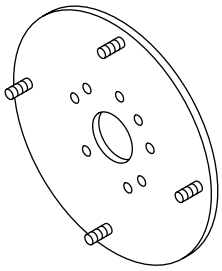
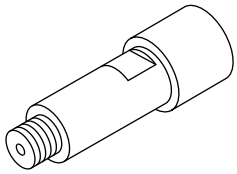
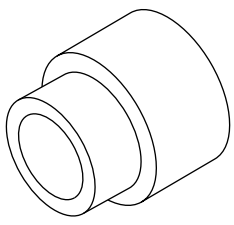
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-927100000	927100000	BEARING PULLER	• Used for disassembling and assembling front housing bearing. • Used with HOUSING STAND (927400000).
 ST-927140000	927140000	AXLE SHAFT PULLER PLATE	Same as plate 2 included in AXLE SHAFT PULLER (926470000).
 ST-927390000	927390000	ADAPTER	Used as an adapter for AXLE SHAFT INSTALLER (922431000).
 ST-927400000	927400000	HOUSING STAND	• Used for disassembling and assembling front housing bearing. • Used with BEARING PULLER (927100000).

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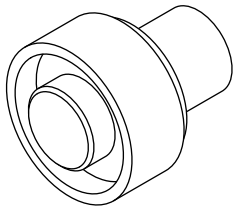
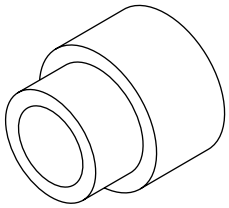
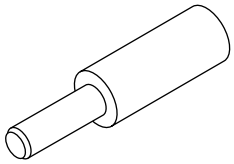
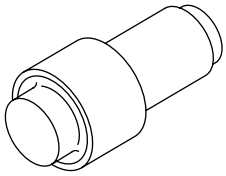
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-927410000	927410000	OIL SEAL INSTALLER	• Used for installing oil seal into front housing. • Used with HOUSING STAND (927400000).
 ST-927430000	927430000	HOUSING STAND	• Used for disassembling and assembling rear housing bearing. • Used with BEARING PULLER (927440000).
 ST-927120000	927120000	HUB INSTALLER	Used for installing hub.
 ST-927440000	927440000	BEARING REMOVER	• Used for disassembling and assembling rear wheel bearing. • Used with HOUSING STAND (927430000).

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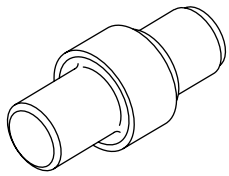
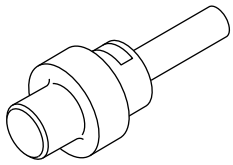
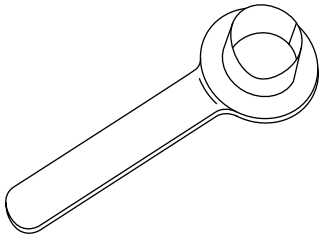
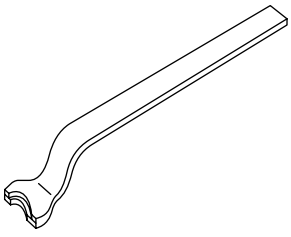
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-927460000	927460000	OIL SEAL INSTALLER	• Used for installing outer oil seal. • Used with HOUSING STAND (927430000).
 ST-927450000	927450000	HUB INSTALLER	• Used for pressing hub bearing into hub. • Used with HUB STAND (927080000).
 ST28099PA090	28099PA090	OIL SEAL PROTECTOR	• Used for installing rear drive shaft into rear differential. • For protecting oil seal.
 ST28099PA100	28099PA100	DRIVE SHAFT REMOVER	Used for removing rear drive shaft from rear differential.

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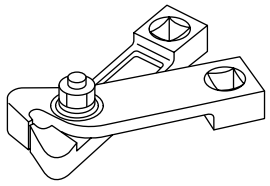
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST28099AC000	28099AC000	BOOT BAND PLIERS	Used for tightening front BJ boot band.

2. GENERAL PURPOSE TOOLS

TOOL NAME	REMERKS
Puller	Used for removing ball joint from knuckle arm.
Dial gauge	Used for inspecting propeller shaft run-out.
Snap ring pliers	Used for installing and removing snap ring.

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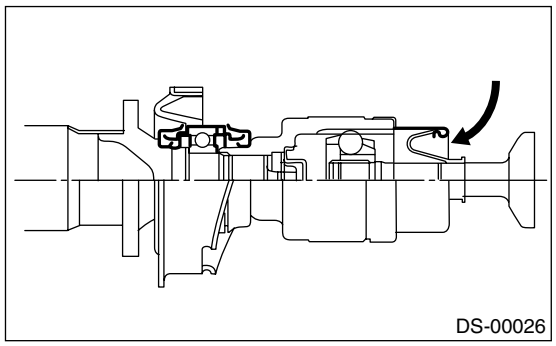
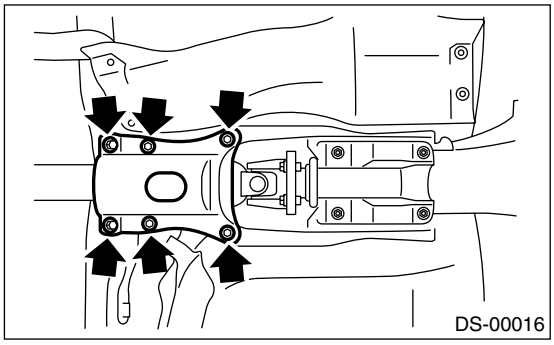
2. Propeller Shaft

A: REMOVAL

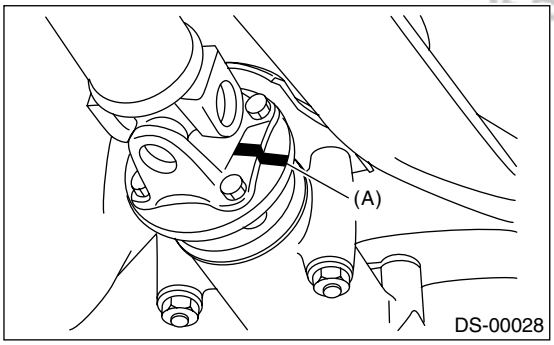
NOTE:
• Before removing the propeller shaft, wrap the metal parts with a cloth or rubber material.
• In case of DOJ type, before removing the propeller shaft, wrap the metal parts (installed at the rubber boot of center DOJ) with a cloth or rubber material, as shown in the figure. Rubber boot may be damaged due to interference with adjacent metal parts while bending the DOJ during removal.


DS-00026

1) Disconnect the ground cable from battery.
2) Move the select lever or gear shift lever to “N”.
3) Release the parking brake.
4) Jack-up the vehicle and support it with sturdy racks.
5) Remove the center exhaust pipes.
6) Remove the rear exhaust pipe and muffler.
7) Remove the differential mount front cover.


DS-00016

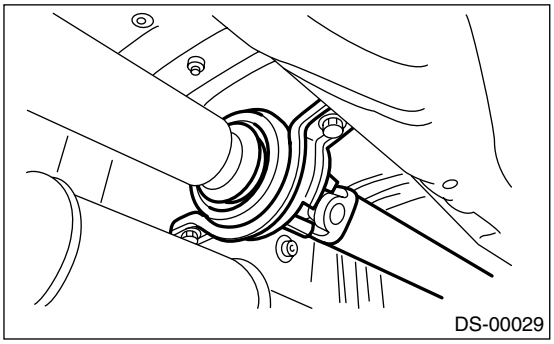
8) Make matching marks on affected parts before removal.



DS-00028

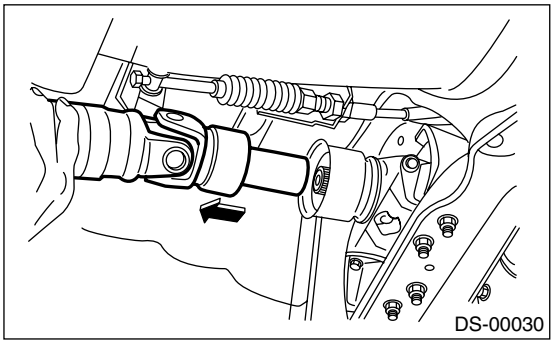
(A) Matching mark

9) Remove the three bolts which hold the propeller shaft to rear differential.
10) Remove the remaining bolt.
11) Remove the two bolts which hold the center bearing to vehicle body.


DS-00029

12) Remove the propeller shaft from transmission.

CAUTION:
• Be careful not to damage the oil seals and frictional surface of sleeve yoke.
• Cover the center exhaust pipe with a cloth to keep off any ATF or oil spilled from transmission when removing the propeller shaft.


DS-00030

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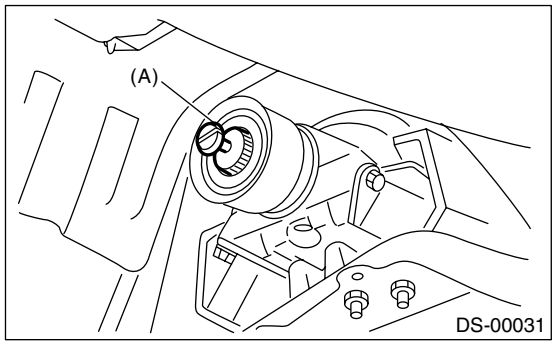
13) Install the extension cap to transmission.

NOTE:
If the extension cap is not available, place a vinyl bag over opening and fasten it with string to prevent gear oil or ATF from leaking.

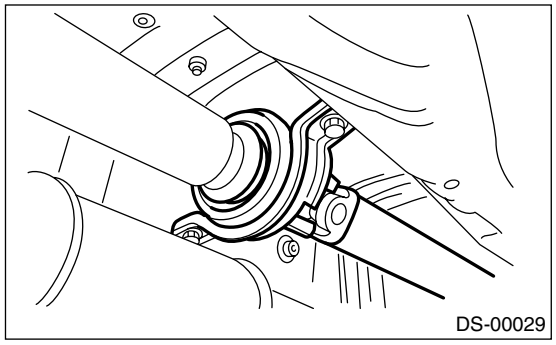


(A) Extension cap

B: INSTALLATION

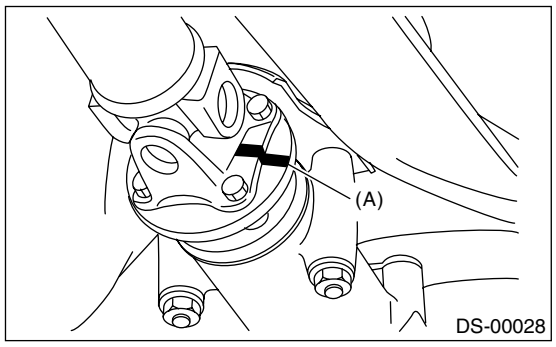
1) Insert the sleeve yoke into transmission, and then attach the center bearing to body.

Tightening torque:
52 N·m (5.3 kgf-m, 38.3 ft-lb)



2) Align the matching marks, and then connect the flange yoke and rear differential.

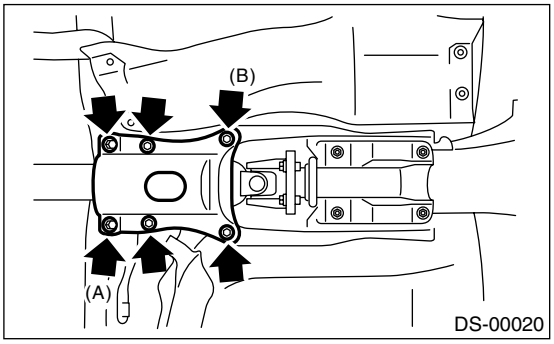
Tightening torque:
38 N·m (3.9 kgf-m, 28.3 ft-lb)



(A) Matching mark

3) Using new bolts, install the differential mount front cover.
(1) Temporarily tighten the bolt (A) while pushing cover forward.
(2) Tighten the bolt (B) to specified torque.
(3) Tighten the bolt (A) to specified torque.
(4) Tighten the remaining bolts to specified torque.

Tightening torque:
90 N·m (9.2 kgf-m, 66 ft-lb)



4) Install the center exhaust pipes.
5) Install the rear exhaust pipe and muffler.

C: INSPECTION

NOTE:
Do not disassemble the propeller shaft. Check the following and replace if necessary.

1) Tube surfaces for dents or cracks
2) Splines for deformation or abnormal wear
3) Joints for non-smooth operation or abnormal noise
4) Center bearing for free play, noise or non-smooth operation
5) Oil seals for abnormal wear or damage
6) Center bearing for breakage

Check the following points with propeller shaft installed in vehicle.

1. JOINTS AND CONNECTIONS

1) Remove the center exhaust pipes.
2) Remove the heat shield cover.
3) Check for any looseness of the yoke flange mounting bolts which connect to rear differential and center bearing bracket mounting bolts.

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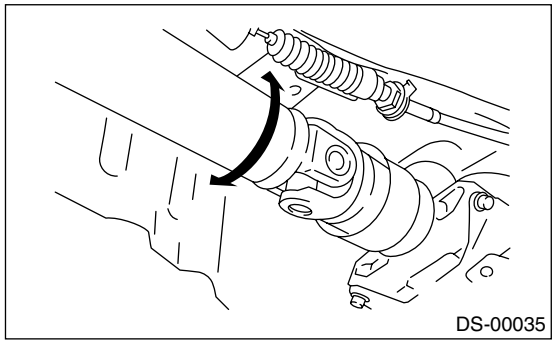
2. SPLINES AND BEARING LOCATIONS

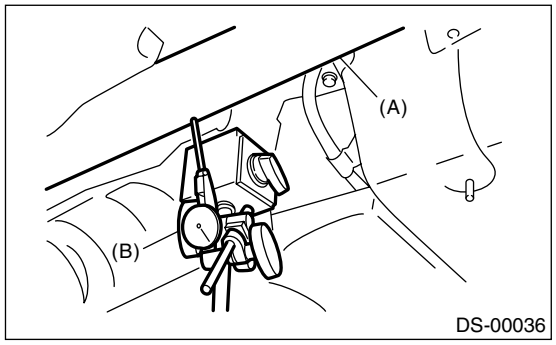
1) Remove the center exhaust pipes.
2) Remove the rear exhaust pipe and muffler.
3) Remove the heat shield cover.
4) Turn the propeller shaft by hand to see if abnormal free play exists at splines. Also move the yokes to see if abnormal free play exists at spiders and bearings.


DS-00035

3. RUNOUT OF PROPELLER SHAFT

1) Remove the center exhaust pipes.
2) Remove the rear exhaust pipe and muffler.
3) Remove the heat shield cover.
4) Set the dial gauge with its indicator stem at center of propeller shaft tube.
5) Turn the propeller shaft slowly by hands to check for “runout” of propeller shaft.

Runout:
Limit 0.6 mm (0.024 in)

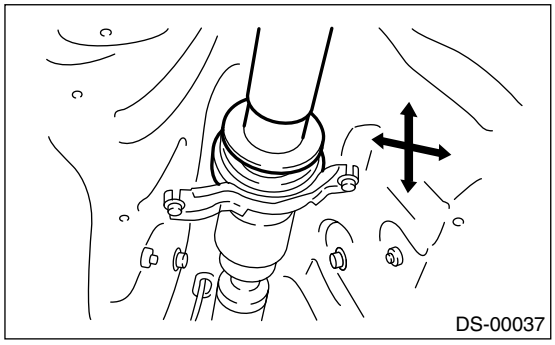


DS-00036

(A) Propeller shaft
(B) Dial gauge

4. CENTER BEARING FREE PLAY

1) Remove the front and center exhaust pipes.
2) Remove the rear exhaust pipe and muffler.
3) Remove the heat shield cover.
4) Move the propeller shaft near center bearing up and down, and left and right with your hand to check for any abnormal bearing free play.


DS-00037

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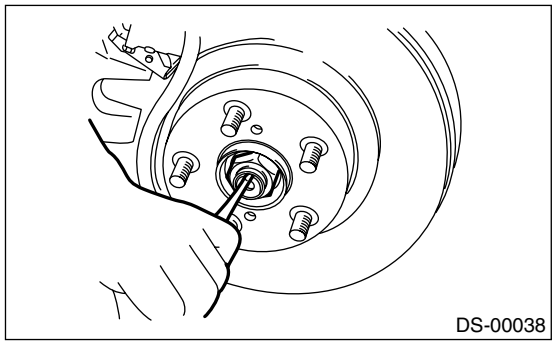
3. Front Axle

A: REMOVAL

1) Lift-up the vehicle and remove the front wheels.
2) Unlock the axle nut.

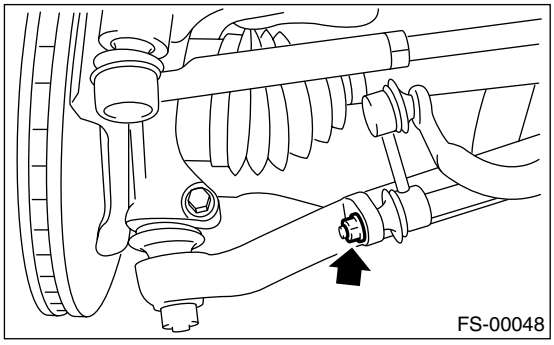


3) Remove the axle nut using a socket wrench while depressing the brake pedal.

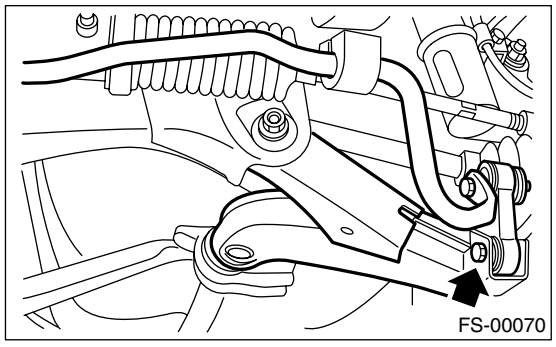
CAUTION:
Remove the axle nut with vehicle weight not applied on axle. Failure to follow this rule may damage the wheel bearings.

4) Remove the stabilizer link.

SEDAN:



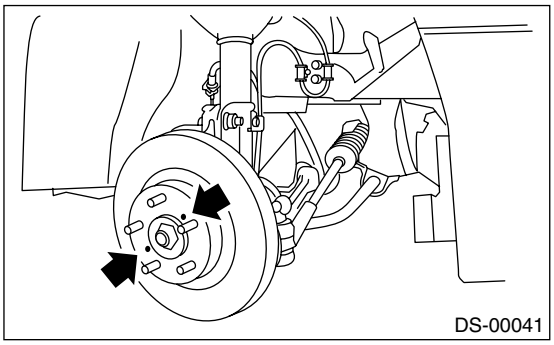
WAGON:



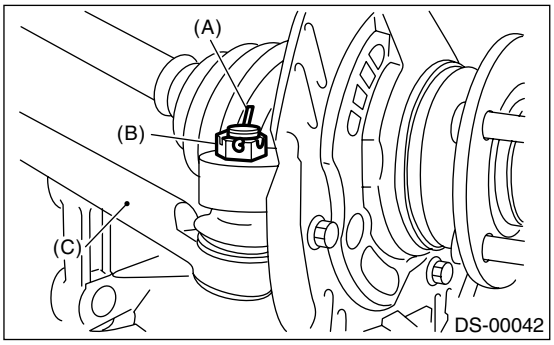
5) Remove the disc brake caliper from housing, and suspend it from strut using a wire.

6) Remove the disc rotor from hub.

NOTE:
If the disc rotor seizes up within hub, drive disc rotor out by installing an 8-mm bolt in screw hole on rotor.

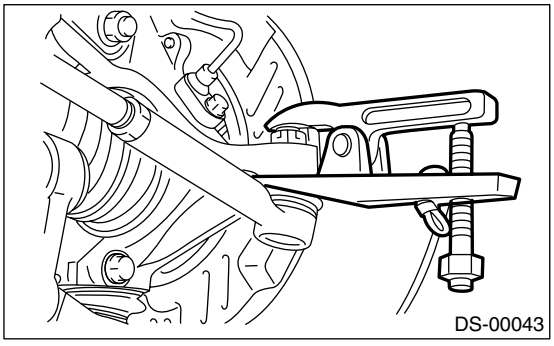


7) Remove the cotter pin and castle nut which secure tie-rod end to housing knuckle arm.



(A) Cotter pin
(B) Castle nut
(C) Tie-rod

8) Using a puller, remove the tie-rod ball joint from knuckle arm.



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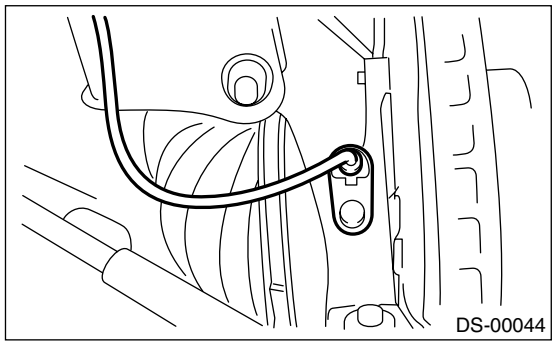
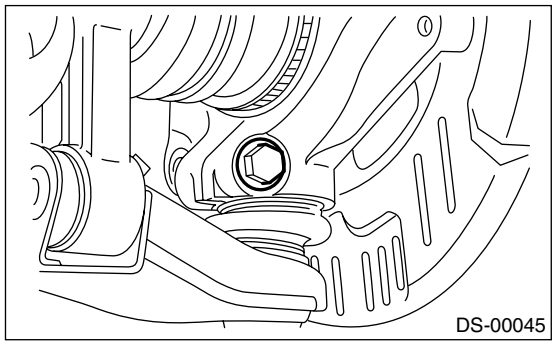
9) Remove the ABS wheel speed sensor assembly and harness.



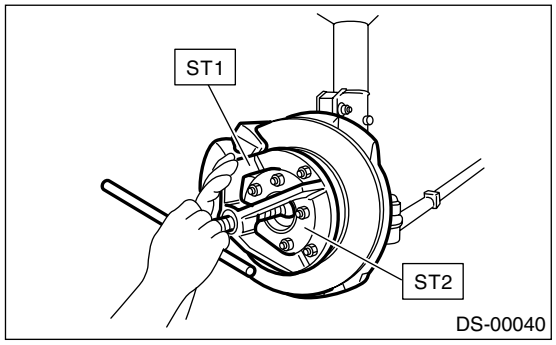
10) Remove the transverse link ball joint from housing.



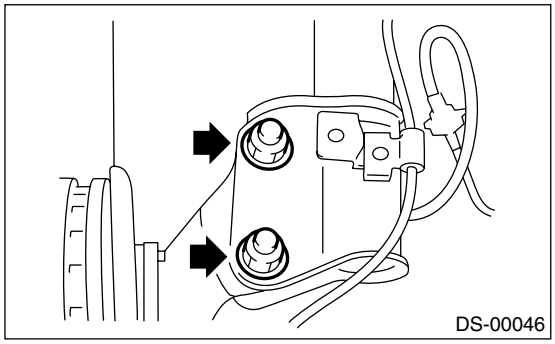
11) Remove the front drive shaft assembly from hub. If it is hard to remove, use the STs.

ST1	926470000	AXLE SHAFT PULLER
ST2	927140000	AXLE SHAFT PULLER PLATE

CAUTION:
• Be sure to replace the differential side retainer oil seal at transmission side with a new one when removing the front drive shaft.
• Suspend the front drive shaft to vehicle body using a wire.



12) After scribing an alignment mark on the camber adjusting bolt head, remove the bolts which connect the housing and strut, and disconnect the housing from strut.



B: INSTALLATION

1) Temporarily tighten the front axle to front strut.
2) Insert the front drive shaft into front axle.
3) Temporarily tighten the axle nut.
4) Install the transverse link ball joint to housing.

Tightening torque:
50 N·m (5.1 kgf-m, 37 ft-lb)

5) While aligning the alignment mark on the camber adjusting bolt head, tighten the housing and strut using a new self-locking nut.

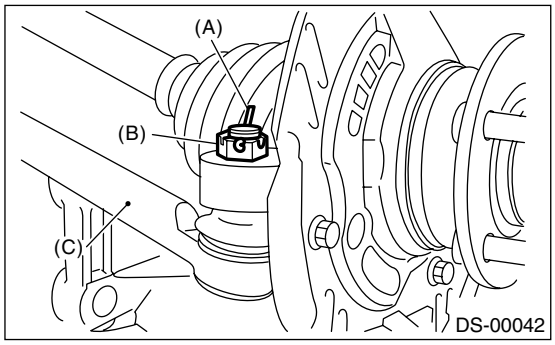
Tightening torque:
175 N·m (17.8 kgf-m, 129 ft-lb)

6) Connect the tie-rod end ball joint to the knuckle arm with a castle nut.

Tightening torque:
27.0 N·m (2.75 kgf-m, 19.9 ft-lb)

CAUTION:
When connecting, do not hit the cap at bottom of tie-rod with hammer.

7) Tighten the castle nut to specified torque and tighten further within 60° until the pin hole is aligned with the slot in nut. Bend the cotter pin to lock.



(A) Cotter pin
(B) Castle nut
(C) Tie-rod

8) Install the disc rotor on hub.

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9) Install the disc brake caliper on housing.

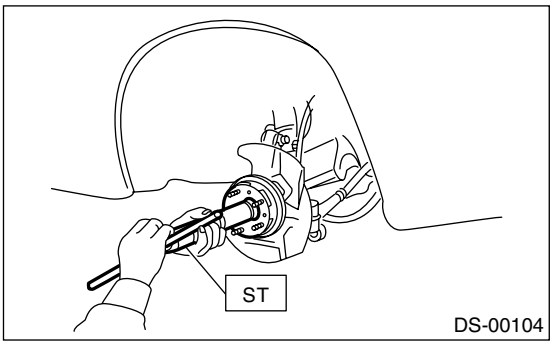
Tightening torque:
Except STi model
80 N·m (8.2 kgf-m, 59 ft-lb)
STi model
155 N·m (15.8 kgf-m, 114.3 ft-lb)

10) Connect the stabilizer link.

Tightening torque:
Except STi model
30 N·m (3.1 kgf-m, 22 ft-lb)
STi model
45 N·m (4.6 kgf-m, 33 ft-lb)

CAUTION:
Use a new self-locking nut.

11) Using the ST1 and ST2, pull the front drive shaft into place.
ST1 922431000 AXLE SHAFT INSTALLER
ST2 927390000 ADAPTER

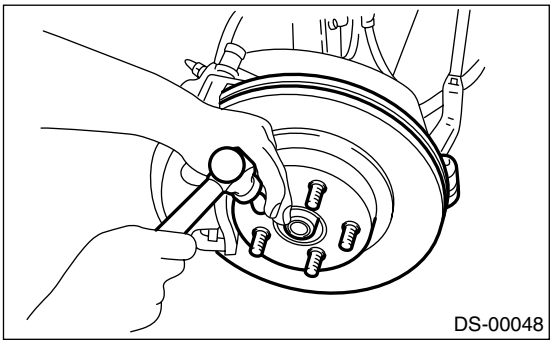


12) While depressing the brake pedal, tighten a new axle nut to specified torque and lock it securely.

Tightening torque:
220 N·m (22.4 kgf-m, 162 ft-lb)

CAUTION:
Be sure to tighten the axle nut to specified torque. Do not overtighten it as this may damage the wheel bearing.

13) After tightening the axle nut, lock it securely.



14) Install the ABS wheel speed sensor on housing.

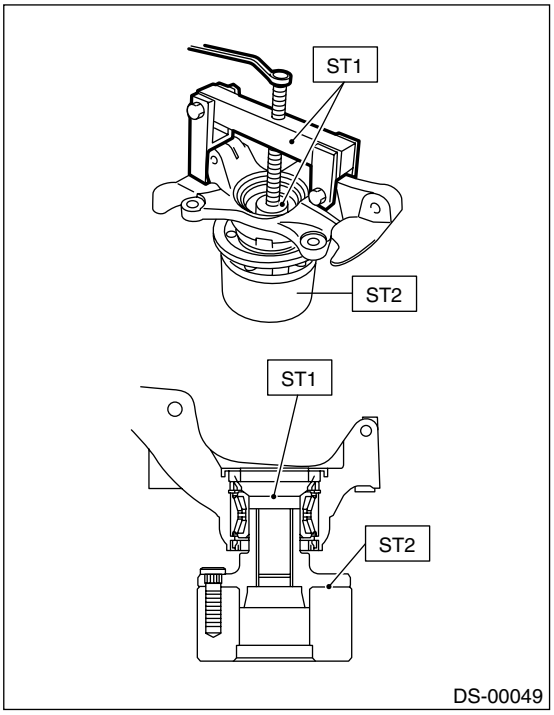
Tightening torque:
33 N·m (3.4 kgf-m, 24.3 ft-lb)

15) Install the wheel and tighten the wheel nuts to specified torque.

Tightening torque:
90 N·m (9.2 kgf-m, 66 ft-lb)

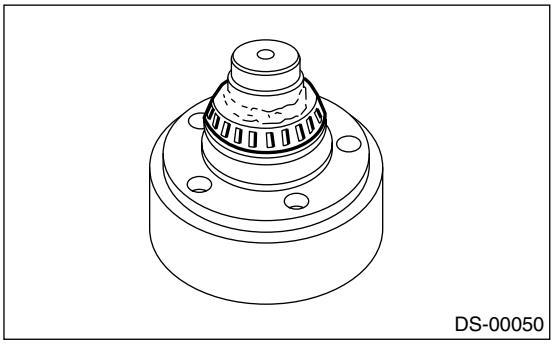
C: DISASSEMBLY

1) Using the ST1, support the housing and hub securely.
2) Attach the ST2 to housing and drive the hub out.
ST1 927060000 HUB REMOVER
ST2 927080000 HUB STAND



If the inner bearing race remains in hub, remove it with a suitable tool (commercially available).

NOTE:
Be careful not to scratch the polished area of hub.



CAUTION:
Do not reuse the bearing if the hub was removed.

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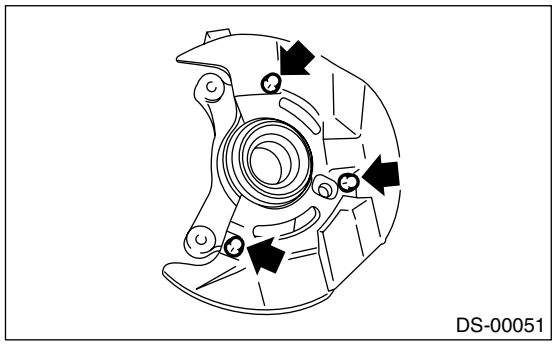
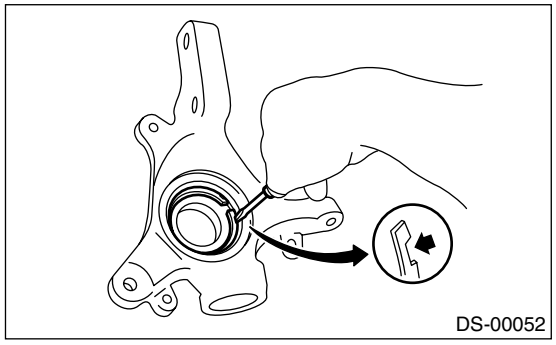
3) Remove the disc cover from housing.

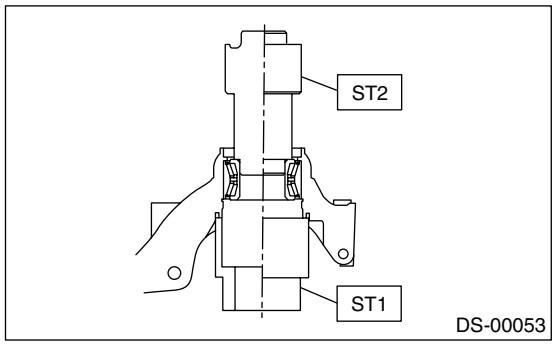


4) Using a standard screwdriver, remove the outer and inner oil seals.
5) Using a flat tip screwdriver, remove the snap ring.

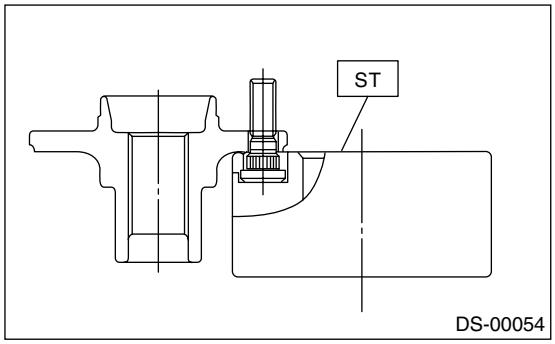
NOTE:
Be careful not to damage the housing at removal.



6) Using the ST1, support the housing securely.
7) Using the ST2, hold the inner race to drive out the outer race of bearing.
ST1 927400000 HOUSING STAND
ST2 927100000 BEARING PULLER



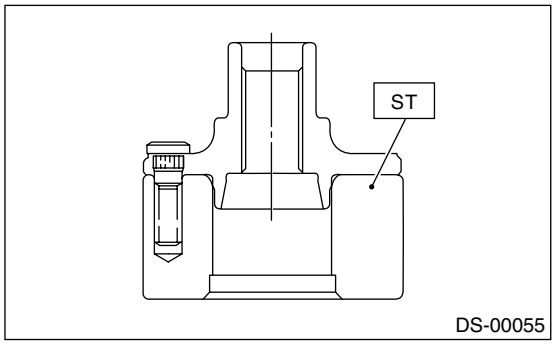
8) Using the ST and a hydraulic press, drive the hub bolts out.
ST 927080000 HUB STAND



D: ASSEMBLY

NOTE:
When the hub is to be removed from housing, replace the bearing set and oil seal with new ones.

1) Attach the hub to ST securely.
ST 927080000 HUB STAND



2) Using a hydraulic press, press new hub bolts until their seating surfaces contact the hub.

NOTE:
Use 12 mm (0.47 in) dia. holes in HUB STAND to prevent bolts from tilting.

3) Clean dust or foreign particles from inside of housing.
4) Using the ST1 and ST2, press a new bearing into place.
ST1 927400000 HOUSING STAND
ST2 927100000 BEARING PULLER

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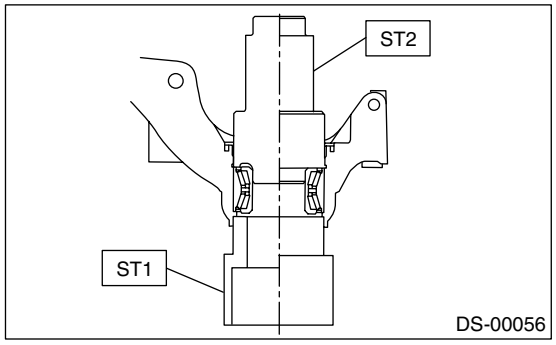
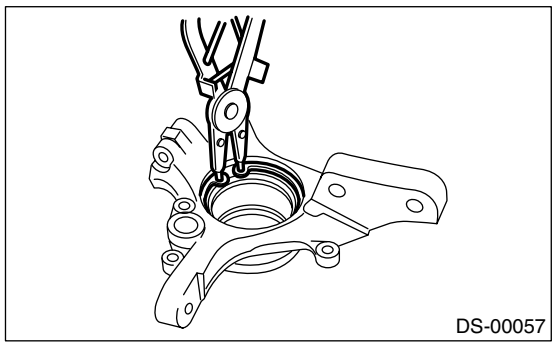
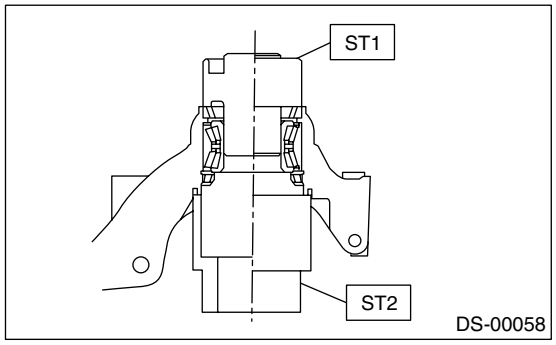
NOTE:
Be careful not to remove the plastic lock from inner race when installing the bearing.



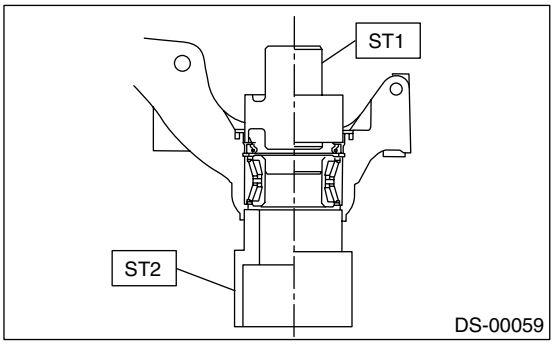
5) Using pliers, install the snap ring firmly.



6) Using the ST1 and ST2, press the outer oil seal until it contacts the bottom of housing.
ST1 927410000 OIL SEAL INSTALLER
ST2 927400000 HOUSING STAND



7) Using the ST1 and ST2, press the inner oil seal until it contacts the circlip.
ST1 927410000 OIL SEAL INSTALLER
ST2 927400000 HOUSING STAND



8) Invert the ST and housing.
ST 927400000 HOUSING STAND
9) Apply sufficient grease to the oil seal lip.

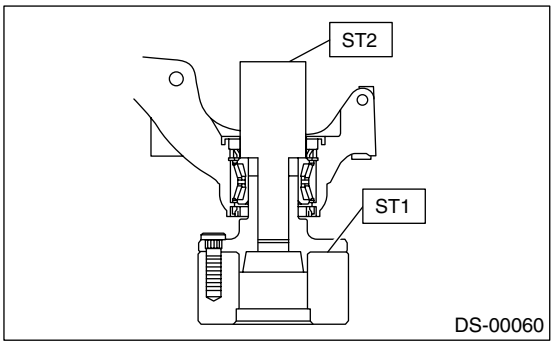
Specified grease:
SHELL 6459N

NOTE:
- If specified grease is not available, remove the bearing grease and apply Auto Rex A instead.
- Do not mix different types of grease.

10) Install the disc cover to housing with three bolts.

Tightening torque:
18 N·m (1.8 kgf-m, 13.0 ft-lb)

11) Attach the hub to ST1 securely.
12) Clean dust or foreign particles from the polished surface of hub.
13) Using the ST2, press the bearing into hub by driving the inner race.
ST1 927080000 HUB STAND
ST2 927120000 HUB INSTALLER



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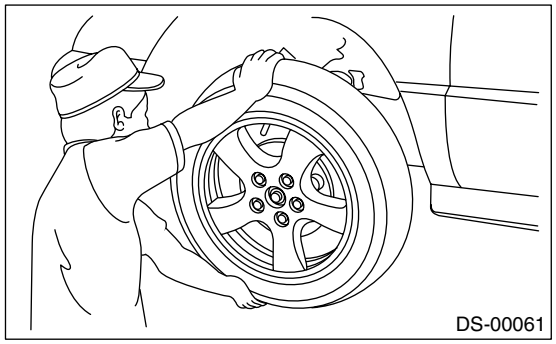
E: INSPECTION

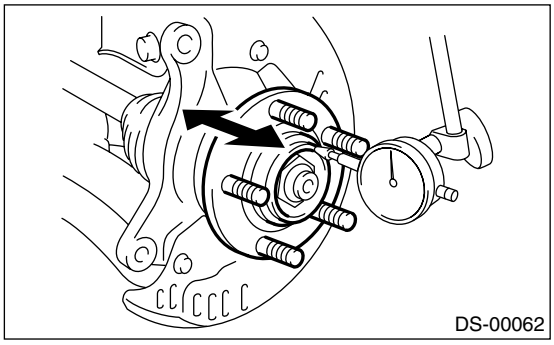
1) Moving the front tire up and down by hand, check there is no backlash in bearing, and check the wheel rotates smoothly.



2) Inspect the lean of axis direction using a dial gauge. Replace the hub bearing if the load range exceeds the limitation.

Limit:

Maximum: 0.05mm (0.0020 in)



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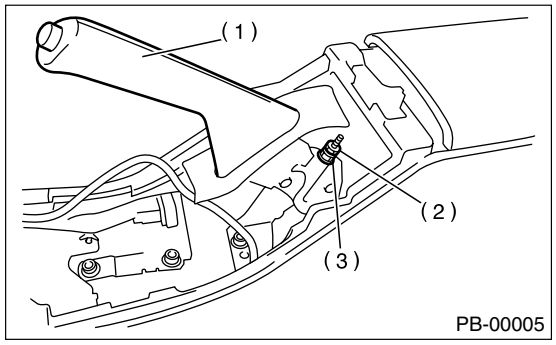
4. Rear Axle

A: REMOVAL

1) Disconnect the ground cable from battery.
2) Lift-up the vehicle, and remove the rear wheel.
3) Unlock the axle nut.
4) Remove the axle nut using a socket wrench with parking brake applied.

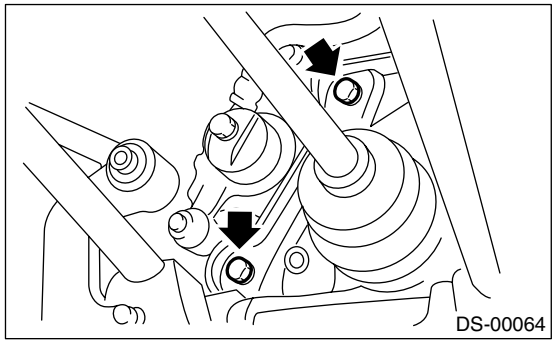
CAUTION:
Remove the axle nut with vehicle weight not applied on axle. Failure to follow this rule may damage the wheel bearings.

5) Return the parking brake lever and loosen the adjusting nut.



(1) Parking brake lever
(2) Lock nut
(3) Adjusting nut

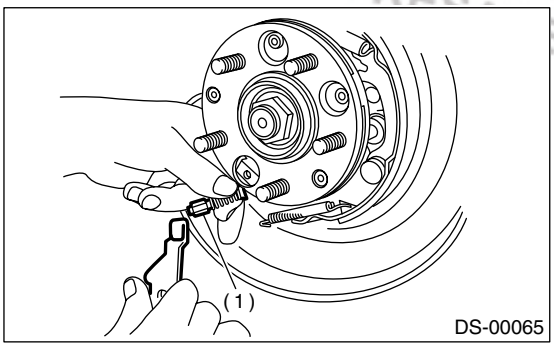
6) Remove the disc brake caliper from back plate, and suspend it from strut using a piece of wire.



7) Remove the disc rotor from hub.

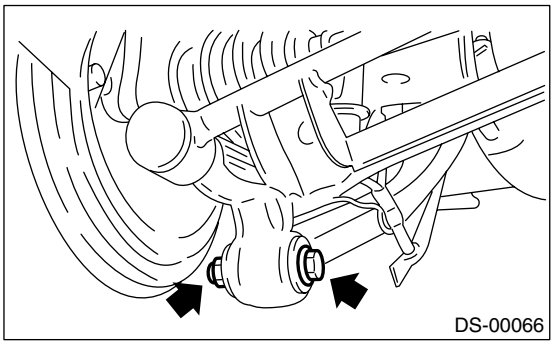
NOTE:
If the disc rotor seizes up within hub, drive it out by installing an 8-mm bolt into bolt hole in disc rotor.

8) Disconnect the parking brake cable end.

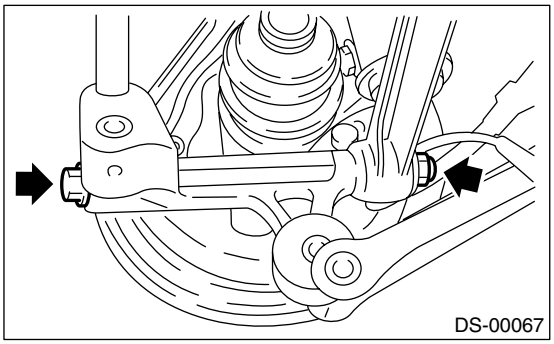


(1) Cable end

9) Disconnect the rear stabilizer from rear lateral link.
10) Remove the bolts which secure the trailing link assembly to rear housing.



11) Remove the bolts which secure the lateral assembly to rear housing.



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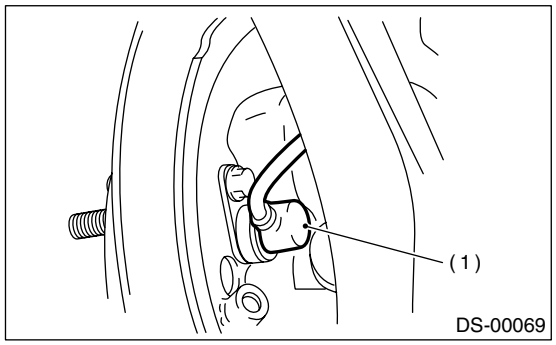
12) Remove the rear ABS wheel speed sensor from back plate.

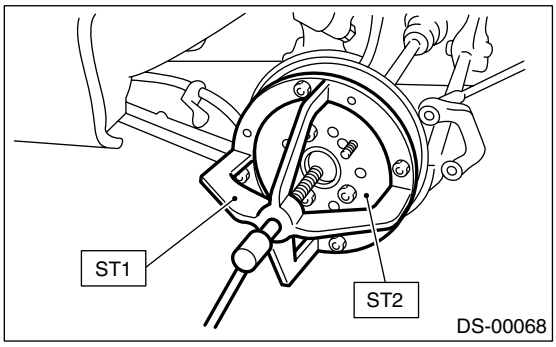


(1) ABS wheel speed sensor

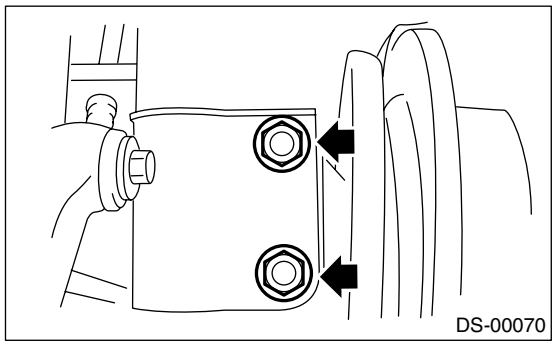
13) Disengage the BJ from housing splines, and then remove the rear drive shaft assembly.
If it is hard to remove, use the STs.

ST1	926470000	AXLE SHAFT PULLER
ST2	927140000	AXLE SHAFT PULLER PLATE

NOTE:
- Be careful not to damage the oil seal lip when removing the rear drive shaft.
- When the rear drive shaft is to be replaced, also replace the inner oil seal with a new one.



14) Remove the bolts which secure the rear housing to strut, and separate the two.

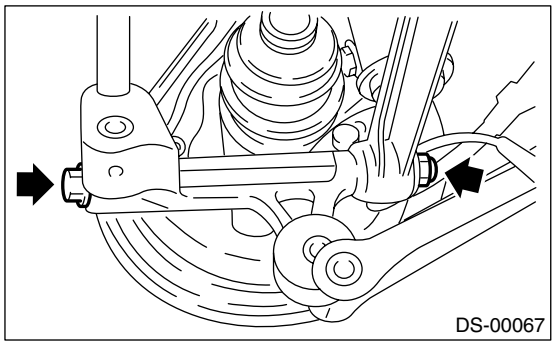


B: INSTALLATION

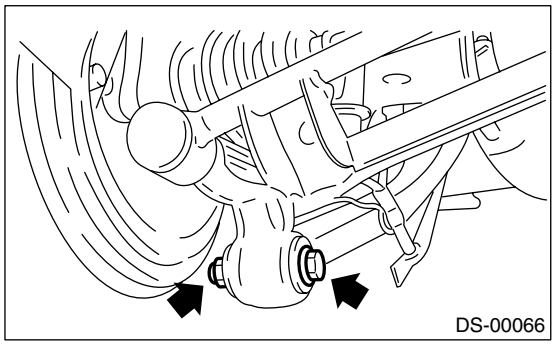
1) Temporarily tighten the rear axle to strut.
2) Insert the rear drive shaft into rear axle.

NOTE:
Be careful not to damage the inner oil seal lip.

3) Temporarily tighten the axle nut.
4) Using a new self-locking nut, temporarily tighten the rear housing assembly and lateral link assembly.



5) Using a new self-locking nut, temporarily tighten the rear housing assembly and trailing link assembly.



6) Tighten the rear housing assembly and strut assembly using a new self-locking nut.

Tightening torque:
200 N·m (20.4 kgf-m, 148 ft-lb)

7) Using a new self-locking nut, install the rear stabilizer and rear lateral link.

Tightening torque:
44 N·m (4.5 kgf-m, 32.5 ft-lb)

8) Connect the parking brake cable to parking brake.
9) Install the disc rotor on rear housing assembly.

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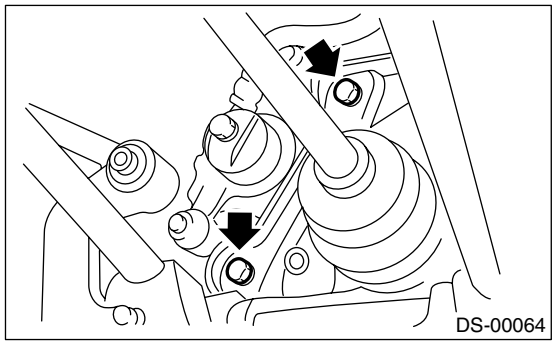
10) Install the disc brake caliper on back plate.

Tightening torque:
Except STi model
52 N·m (5.3 kgf-m, 38.3 ft-lb)
STi model
65 N·m (6.6 kgf-m, 47.9 ft-lb)

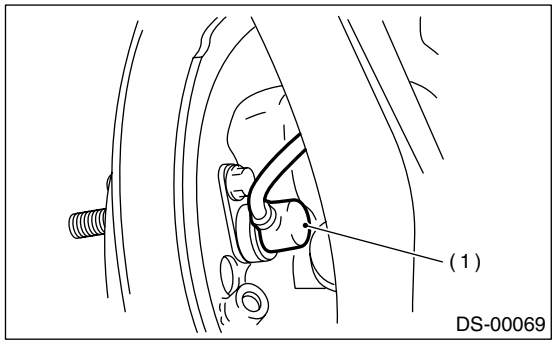


11) Adjust the parking brake lever stroke by turning the adjuster.
12) While applying the parking brake, tighten a new axle nut using a socket wrench. Lock the axle nut after tightening.

Tightening torque:
190 N·m (19.4 kgf-m, 140 ft-lb)

CAUTION:
Do not overtighten it as this may damage the wheel bearing.

13) Install rear ABS wheel speed sensor.



(1) ABS wheel speed sensor

14) Install the wheel and tighten the wheel nuts to specified torque.

Tightening torque:
90 N·m (9.2 kgf-m, 66 ft-lb)

15) Make the tires contact the ground fully.

CAUTION:
Make the tires contact the ground fully and the vehicle be in curb weight whenever carrying out the tightening of bush portions.

16) Tighten the installation bolt of rear housing assembly and lateral link assembly.

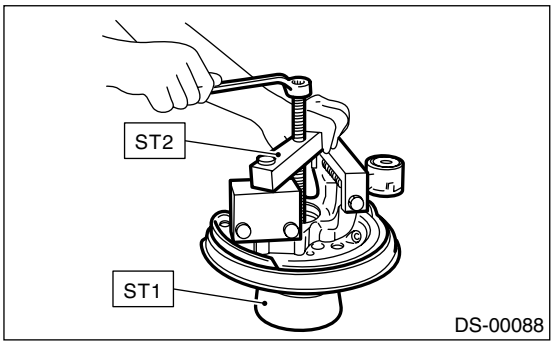
Tightening torque:
140 N·m (14.3 kgf-m, 103 ft-lb)

17) Tighten the installation bolt of rear housing assembly and trailing link assembly.

Tightening torque:
90 N·m (9.2 kgf-m, 66 ft-lb)

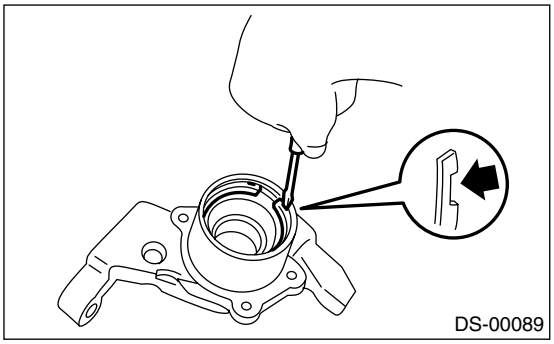
C: DISASSEMBLY

1) Using the ST1 and ST2, remove the hub from rear housing.
ST1 927080000 HUB STAND
ST2 927420000 HUB REMOVER



2) Remove the back plate from rear housing.
3) Using a standard screwdriver, remove the outer and inner oil seals.
4) Using a flat tip screwdriver, remove the snap ring.

NOTE:
Be careful not to damage the housing at removal.



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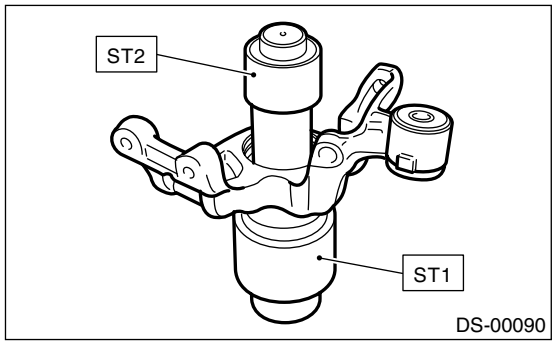
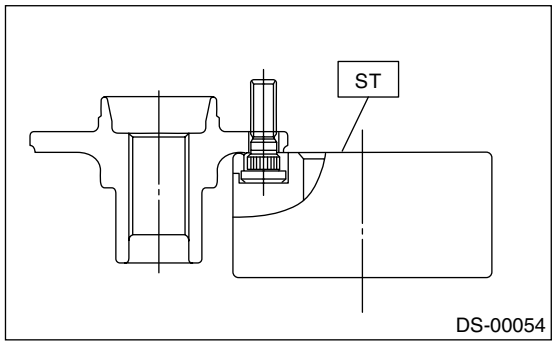
5) Using the ST1 and ST2, remove the bearing by pressing the inner race.
ST1 927430000 HOUSING STAND
ST2 927440000 BEARING REMOVER



6) Remove the tone wheel bolts, and then remove the tone wheel from hub.
7) Using the ST, press the hub bolt out.
ST 927080000 HUB STAND

CAUTION:
Be careful not to hammer the hub bolts. This may deform the hub.



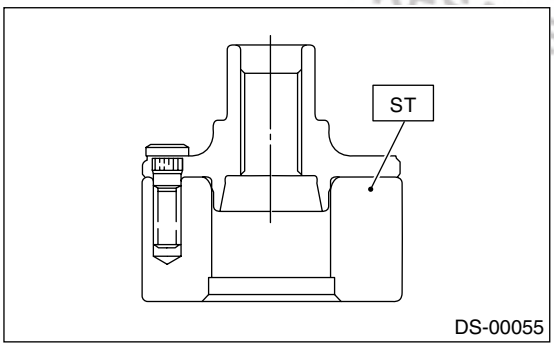
D: ASSEMBLY

NOTE:
When the hub is to be removed from housing, replace the bearing set and oil seal with new ones.

1) Using the ST, press the new hub bolt into place.

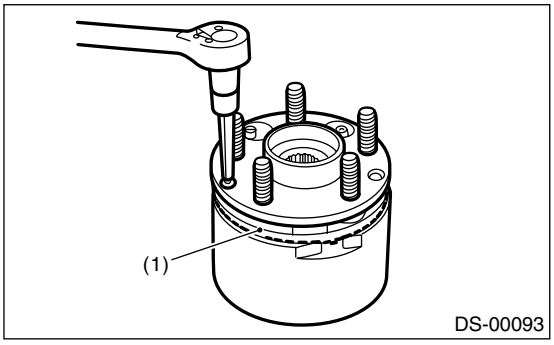
NOTE:
- Ensure the hub bolt closely contacts the hub.
- Use a 12 mm (0.47 in) hole in the ST to prevent the hub bolt from tilting during installation.

ST 927080000 HUB STAND



2) Remove foreign particles (dust, rust, etc.) from mating surfaces of the hub tone wheel, and then install the tone wheel to hub.

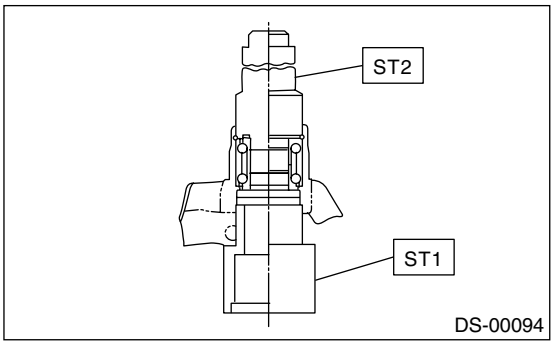
NOTE:
- Ensure the tone wheel closely contacts the hub.
- Be careful not to damage the tone wheel teeth.



(1) Tone wheel

3) Clean the housing interior completely. Using the ST1 and ST2, press the bearing into housing.
ST1 927430000 HOUSING STAND
ST2 927440000 BEARING REMOVER

NOTE:
Be careful not to remove the plastic lock from inner race when installing the bearing.



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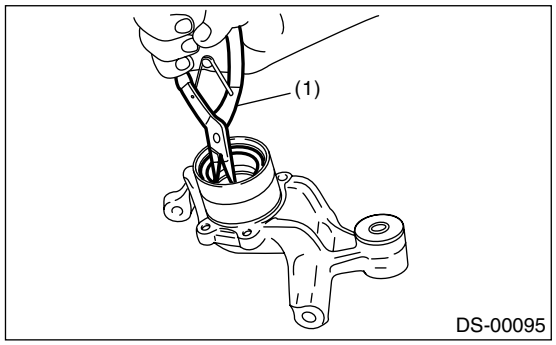
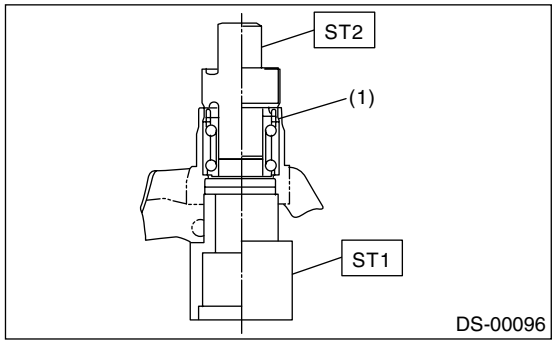
4) Using pliers, install the snap ring firmly.



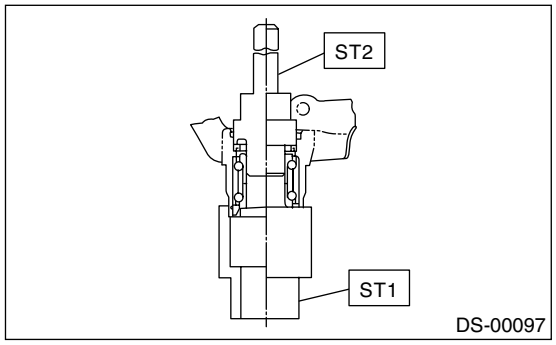
(1) Pliers

5) Using the ST1 and ST2, press the outer oil seal until it comes in contact with snap ring.
ST1 927430000 HOUSING STAND
ST2 927460000 OIL SEAL INSTALLER

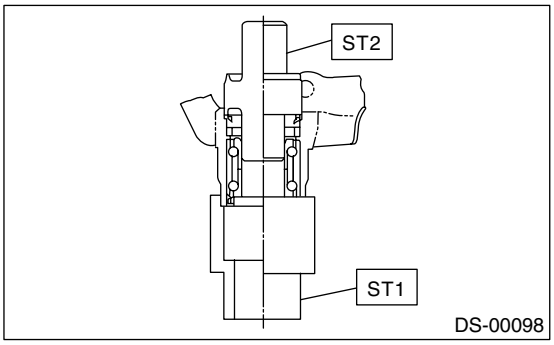


(1) Snap ring

6) Invert both ST1 and housing.
7) Using the ST2, press the inner oil seal into housing until it touches the bottom.
ST1 927430000 HOUSING STAND
ST2 927460000 OIL SEAL INSTALLER



8) Using the ST1 and ST2, press the sub seal into place.
ST1 927430000 HOUSING STAND
ST2 927460000 OIL SEAL INSTALLER



9) Apply sufficient grease to oil seal lip.

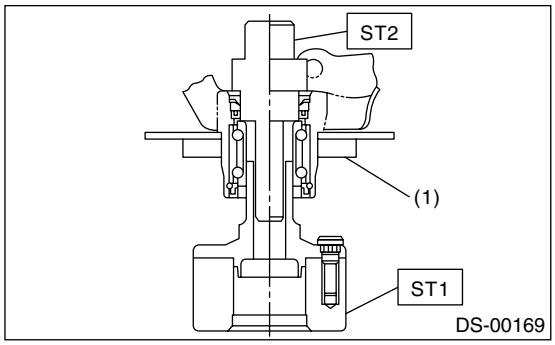
Specified grease:
SHELL 6459N

NOTE:
• If specified grease is not available, remove the bearing grease and apply Auto Rex A instead.
• Do not mix different types of grease.

10) Install the back plate to rear housing.

Tightening torque:
52 N·m (5.3 kgf-m, 38.3 ft-lb)

11) Using the ST1 and ST2, press the bearing into hub.
ST1 927080000 HUB STAND
ST2 927450000 HUB INSTALLER



(1) Back plate

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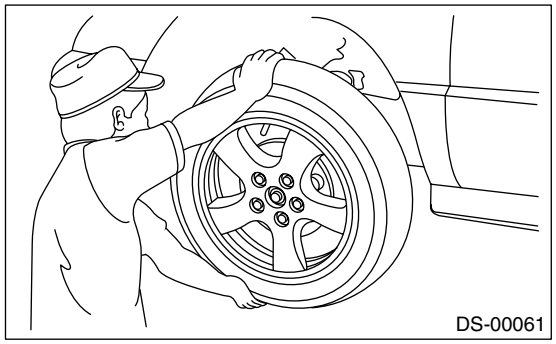
E: INSPECTION

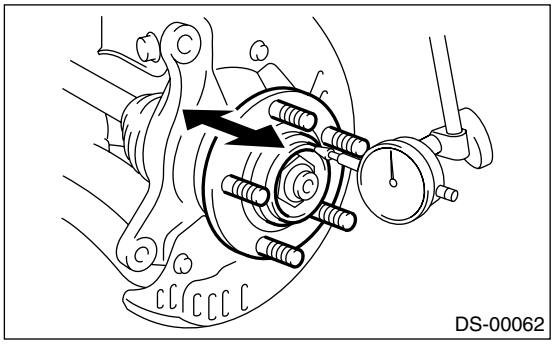
1) Moving the front tire up and down by hand, check there is no backlash in bearing, and check the wheel rotates smoothly.



2) Inspect the lean of axis direction using a dial gauge. Replace the hub bearing if the load range exceeds the limitation.

Limit:

Maximum: 0.05mm (0.0020 in)



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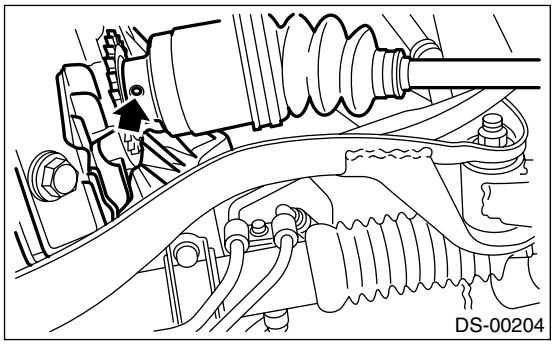
5. Front Drive Shaft

A: REMOVAL

1) Jack-up the vehicle, support it with rigid racks, and then remove the front wheel cap and wheels.
2) Raise the caulking portion of axle nut.
3) Depress the brake pedal and remove the axle nut using a socket wrench.

CAUTION:
Be sure to loosen the axle nut after removing the wheel from vehicle. Failure to follow this rule may damage the wheel bearings.

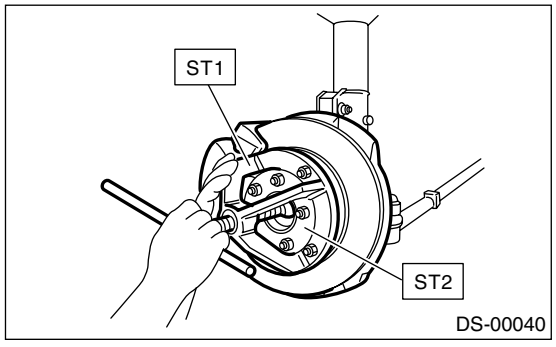
4) Remove the stabilizer link from transverse link.
5) Disconnect the transverse link from housing.
6) Remove the spring pin which secures the transmission spindle to SFJ.



7) Remove the front drive shaft assembly. If it is hard to remove, use the ST1 and ST2.

ST1	926470000	AXLE SHAFT PULLER
ST2	927140000	AXLE SHAFT PULLER PLATE

CAUTION:
• Be careful not to damage the oil seal lip and tone wheel when removing the front drive shaft.
• When the front drive shaft is to be replaced, also replace the inner oil seal.



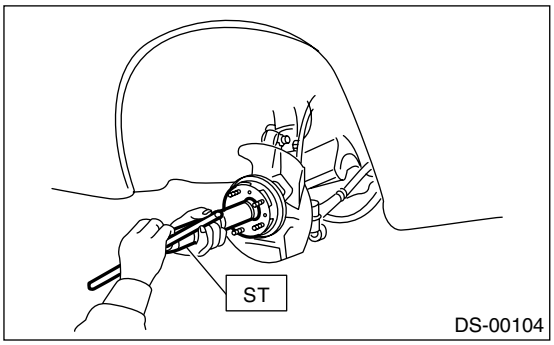
B: INSTALLATION

1) Insert the BJ into hub splines.

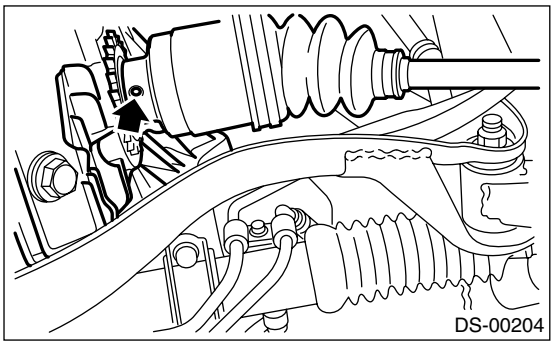
CAUTION:
Be careful not to damage the inner oil seal lip and tone wheel.

2) Using the ST1 and ST2, pull the drive shaft into place.

ST1	922431000	AXLE SHAFT INSTALLER
ST2	927390000	ADAPTER



3) Tighten the axle nut temporarily.
4) Install the SFJ on transmission spindle and drive a new spring pin into place.



5) Connect the transverse link to housing.

Tightening torque:
50 N·m (5.1 kgf-m, 37 ft-lb)

6) Install the stabilizer bracket.
7) While depressing the brake pedal, tighten the axle nut to specified torque.

Tightening torque:
220 N·m (22.4 kgf-m, 162 ft-lb)

CAUTION:
• Always tighten the axle nut before installing wheel on vehicle. If the tire is installed and comes in contact with ground when axle nut is loose, wheel bearings may be damaged.
• Be sure to tighten the axle nut to specified torque. Do not overtighten it as this may damage the wheel bearing.

8) After tightening the axle nut, caulk and lock it.

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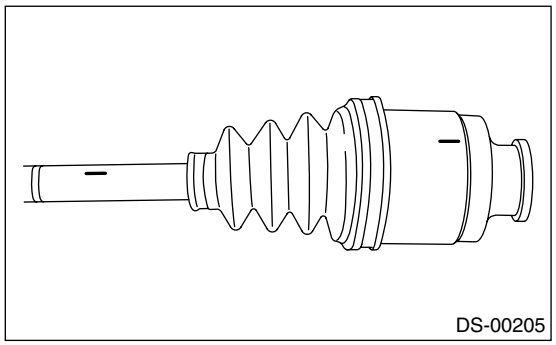
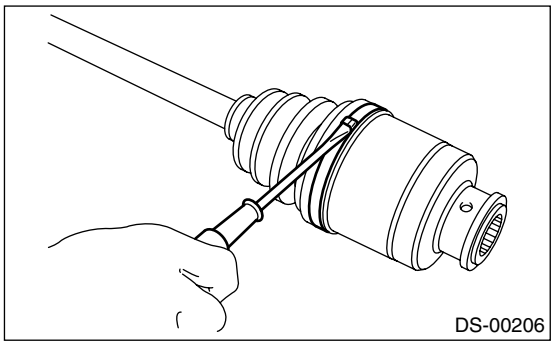
C: DISASSEMBLY

1) Place alignment marks on shaft and outer race.

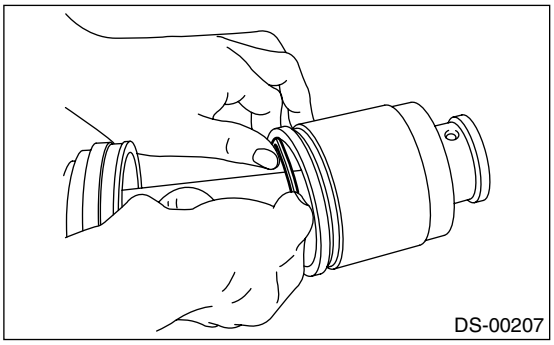

DS-00205

2) Remove the SFJ boot band and boot.

CAUTION:
Be careful not to damage the boot.


DS-00206

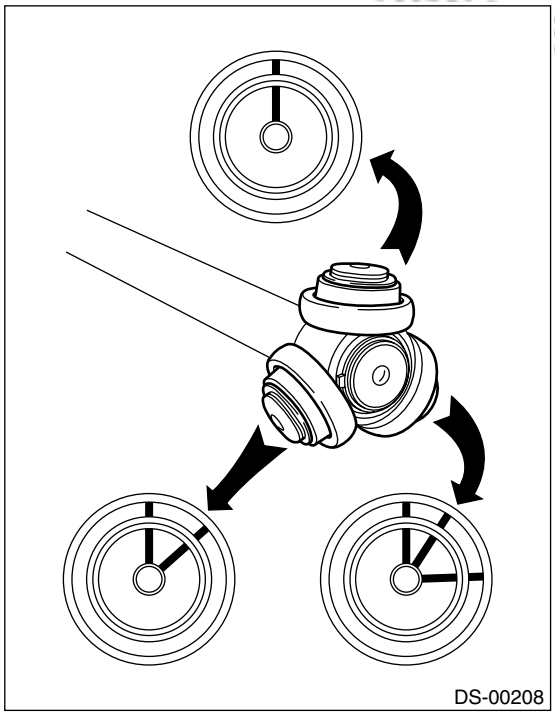
3) Remove the circlip from SFJ outer race using a screwdriver.


DS-00207

4) Remove the SFJ outer race from shaft assembly.
5) Wipe off the grease.

CAUTION:
The grease is a special grease. Do not confuse with other greases.

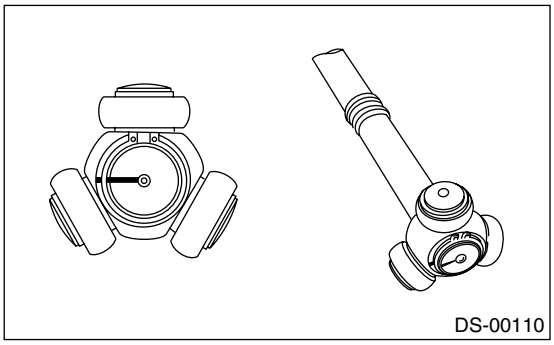
6) Place alignment marks on free ring and trunnion.


DS-00208

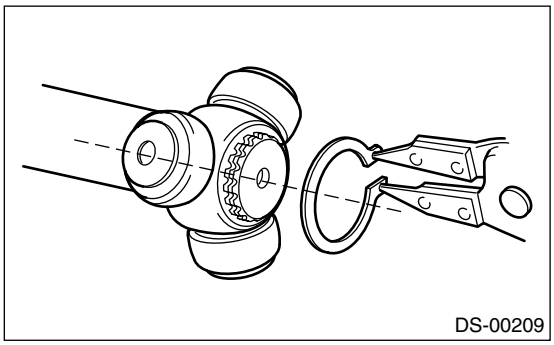
7) Remove the free ring from trunnion.

CAUTION:
Be careful with the free ring position.

8) Place an alignment mark on trunnion and shaft.


DS-00110

9) Remove the snap ring and trunnion.


DS-00209

CAUTION:
Be sure to wrap the shaft splines with vinyl tape to prevent the boot from scratches.

10) Remove the SFJ boot.

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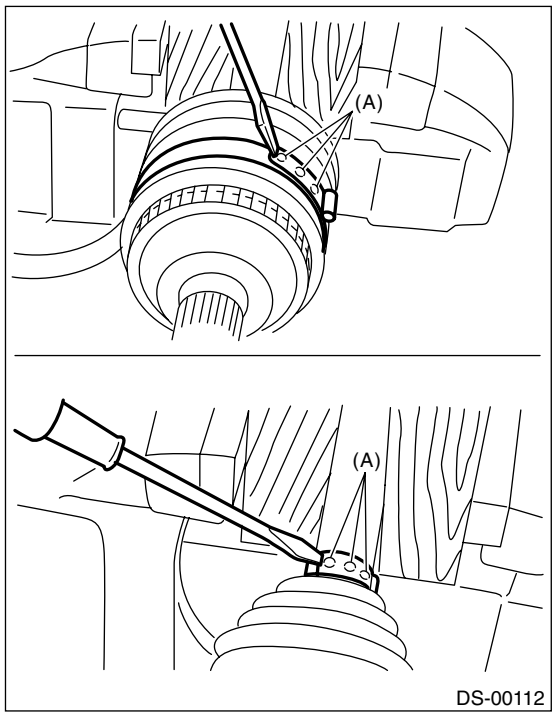
11) Place the drive shaft in a vise between wooden blocks.

CAUTION:
Do not place the drive shaft directly in a vise; use wooden block.

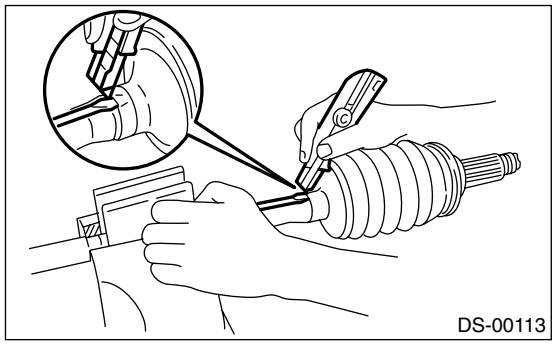
12) Raise the boot band claws by means of screwdriver and hammer.



(A) Boot band claws

13) Cut and remove the boot.

CAUTION:
The boot must be replaced with a new one whenever it is removed.



NOTE:
Further disassembly of axle is impossible because the BJ cannot be disassembled.

D: ASSEMBLY

NOTE:
Use specified grease.

BJ side:
NTG2218 (Part No. 28093AA000)

SFJ side:
SSG6003 (Part No. 28093TA000)

DOJ side:
VU-3A702 (Part No. 23223GA050)

1) Place the BJ boot and small boot band on BJ side of shaft.

CAUTION:
Be sure to wrap the shaft splines with vinyl tape to prevent the boot from scratches.

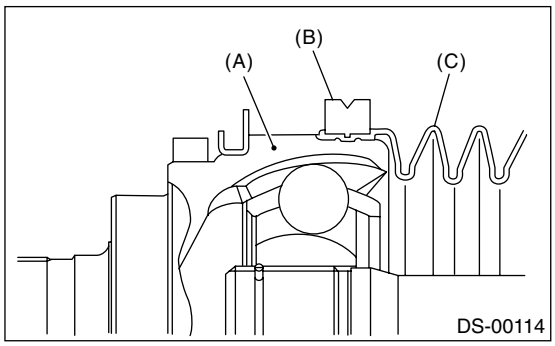
2) Place the drive shaft in a vise.

CAUTION:
Do not place the drive shaft directly in a vise; use wooden blocks.

3) Apply a coat of specified grease [60 to 70 g (2.12 to 2.47 oz)] to BJ.
4) Apply an even coat of specified grease [20 to 30 g (0.71 to 1.06 oz)] to entire inner surface of boot. Also apply grease to shaft.

NOTE:
BJ installation surface of BJ boot shall be cleaned so as to be free from grease and other substances.

5) Install the boot projecting portion to BJ groove.



(A) BJ
(B) Large boot band
(C) Boot

6) Set the large boot band in place.

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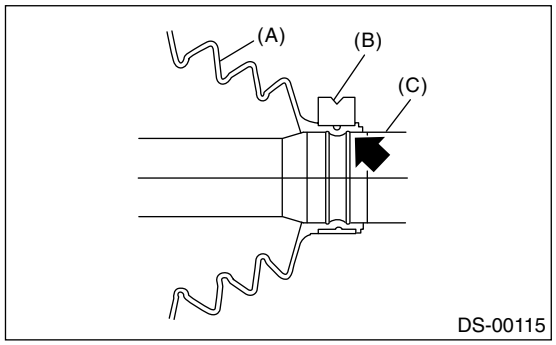
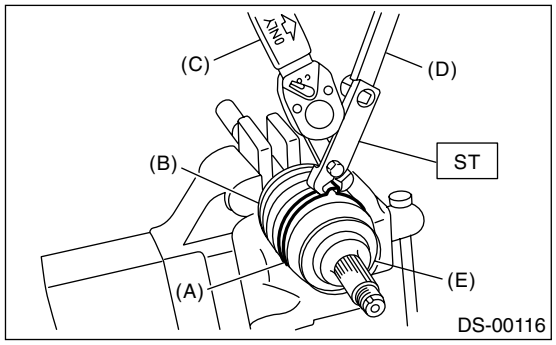
7) Install the boot projecting portion to shaft groove.



(A) Boot
(B) Small boot band
(C) Shaft

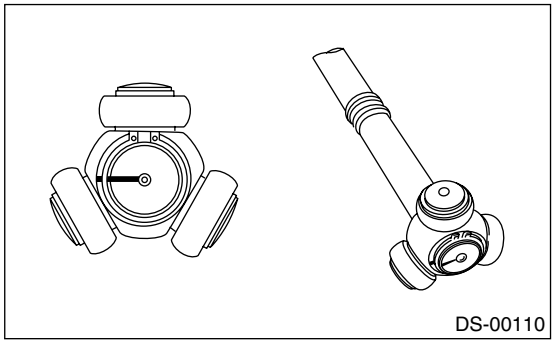
8) Tighten the boot bands using the ST, torque wrench and socket flex handle.
ST 28099AC000 BOOT BAND PLIER



(A) Large boot band
(B) Boot
(C) Torque wrench
(D) Socket flex handle
(E) BJ

Tightening torque:
Large boot band
157 N·m (16.0 kgf-m, 116 ft-lb) or more
Small boot band
133 N·m (13.6 kgf-m, 98 ft-lb) or more

9) Place the SFJ boot at the center of shaft.
10) Align the alignment marks, and then install the trunnion on shaft.

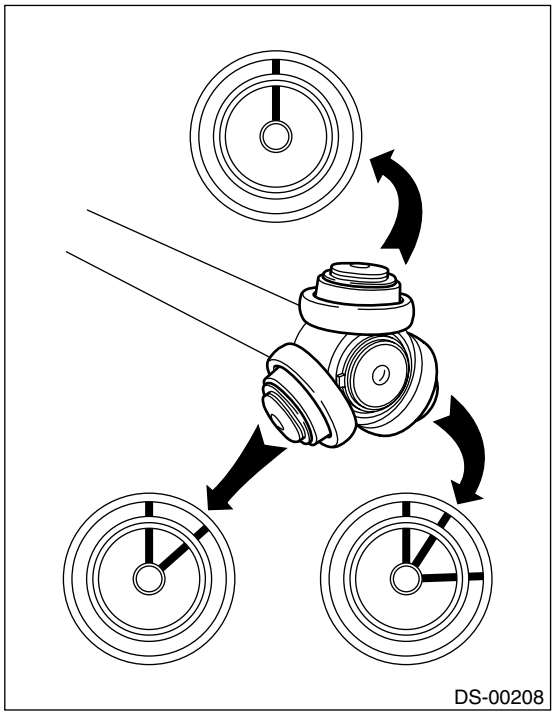


11) Install the snap ring to shaft.

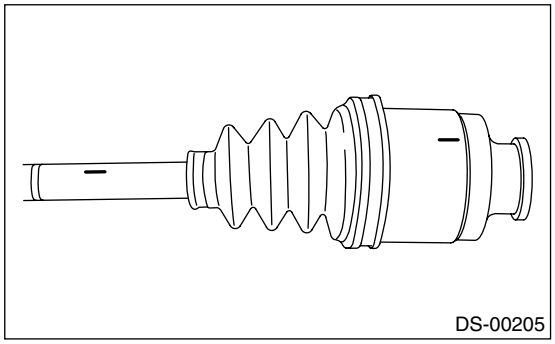
CAUTION:
Confirm that the snap ring is completely fitted in shaft groove.

12) Fill 100 to 110 g (3.53 to 3.88 oz) of specified grease into the interior of SFJ outer race.
13) Apply a coat of specified grease to free ring and trunnion.
14) Align the alignment marks on free ring and trunnion, and then install the free ring.

CAUTION:
Be careful with the free ring position.



15) Align the alignment marks on shaft and outer race, and then install the outer race.



16) Install the circlip in the groove on SFJ outer race.

CAUTION:
Pull the shaft lightly and assure the circlip is completely fitted in groove.

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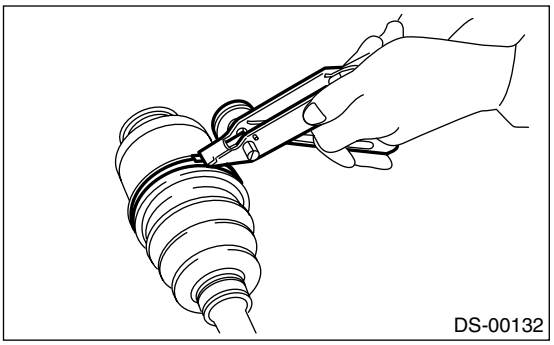
17) Apply an even coat of the specified grease 30 to 40 g (1.06 to 1.41 oz) to the entire inner surface of boot.
18) Install the SFJ boot taking care not to twist it.

CAUTION:
• SFJ installation surface of SFJ boot shall be cleaned so as to be free from grease and other substances.
• When installing the SFJ boot, position the outer race of SFJ at center of its travel.

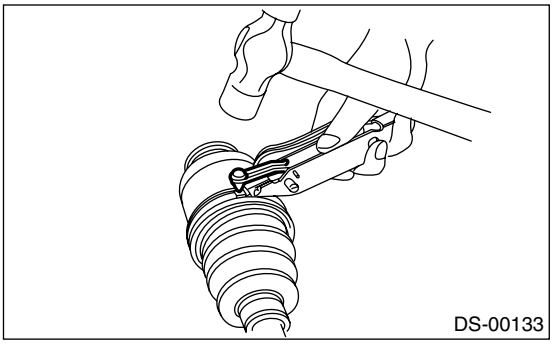
19) Put a new band through the clip and wind twice in alignment with band groove of boot.
20) Tighten the band by using the ST.
ST 925091000 BAND TIGHTENING TOOL

NOTE:
Tighten the band until it cannot be moved by hand.


DS-00132

21) Tap on the clip with punch provided at the end of ST.
ST 925091000 BAND TIGHTENING TOOL

CAUTION:
Tap to an extent that the boot underneath is not damaged.


DS-00133

22) Cut off the band with an allowance of about 10 mm (0.39 in) left from clip, and bend this allowance over clip.

CAUTION:
Be careful so that the end of band is in close contact with clip.

23) Extend and retract the SFJ to provide equal grease coating.

E: INSPECTION

Check the removed parts for damage, wear, corrosion etc. If faulty, repair or replace.
1) DOJ (Double Offset Joint)
Check seizure, corrosion, damage, wear and excessive play.
2) SFJ (Shudder-less Freering tripod Joint)
Check seizure, corrosion, damage and excessive play.
3) Shaft
Check excessive bending, twisting, damage and wear.
4) BJ (Bell Joint)
Check seizure, corrosion, damage and excessive play.
5) Boot
Check for wear, warping, breakage or scratches.
6) Grease
Check for discoloration or fluidity.

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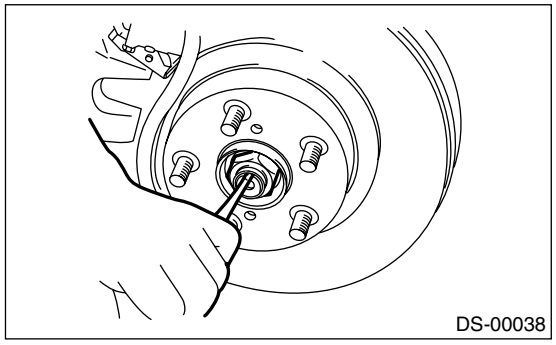
6. Rear Drive Shaft

A: REMOVAL

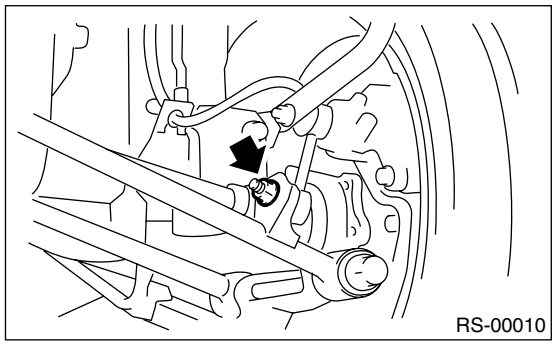
1) Disconnect the ground cable from battery.
2) Lift-up the vehicle, and remove the rear wheel.
3) Unlock the axle nut.



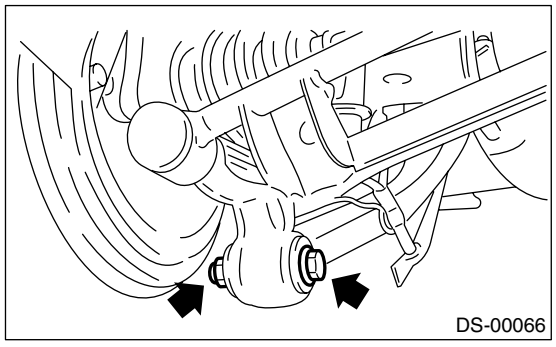
4) Remove the axle nut using a socket wrench with parking brake applied.

CAUTION:
Remove the axle nut with vehicle weight not applied on axle.

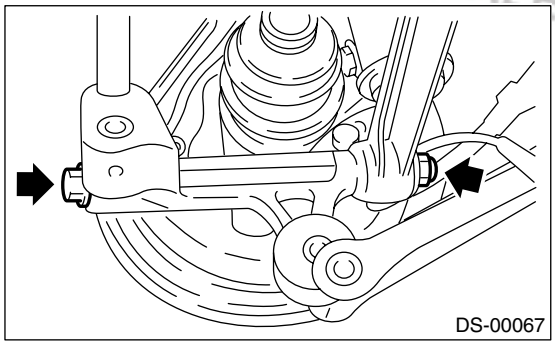
5) Disconnect the stabilizer link.



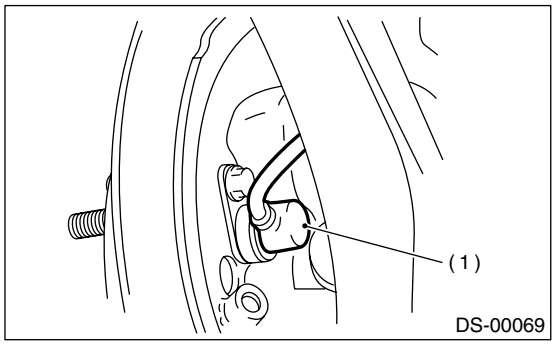
6) Remove the bolt which secures the trailing link to housing.



7) Remove the bolts which secure the front lateral link and rear lateral link to housing.



8) Remove the rear ABS wheel speed sensor from back plate.

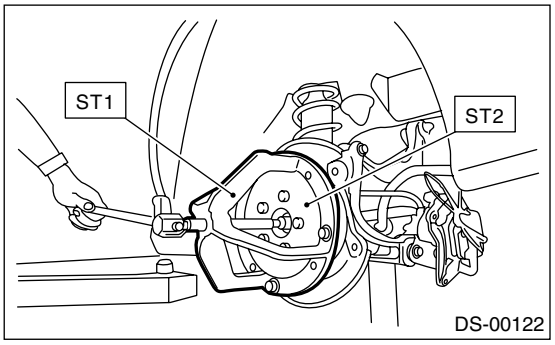


(1) ABS wheel speed sensor

9) Remove the rear drive shaft from rear axle. If it is hard to remove, remove the brake disk rotor using the ST1 and ST2.

ST1	926470000	AXLE SHAFT PULLER
ST2	927140000	AXLE SHAFT PULLER PLATE

CAUTION:
- **Do not hammer the drive shaft when removing.**
- **Do not damage the oil seal and tone wheel.**



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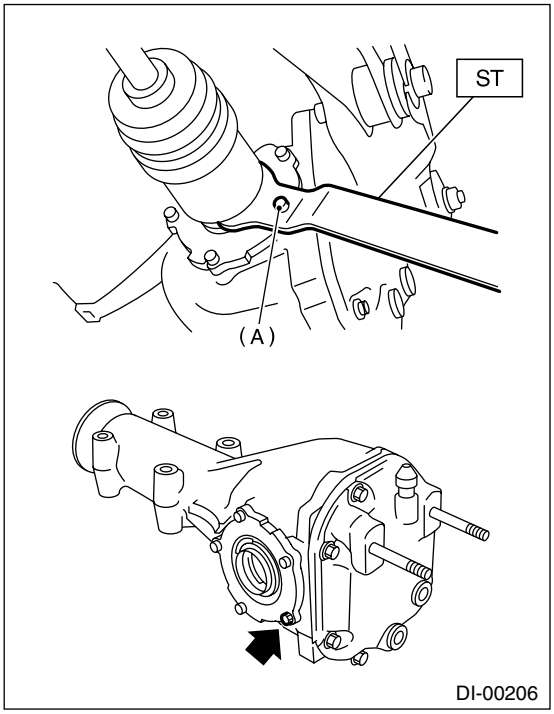
10) Remove the rear drive shaft from rear differential using the ST.
ST 208099PA100 DRIVE SHAFT REMOVER

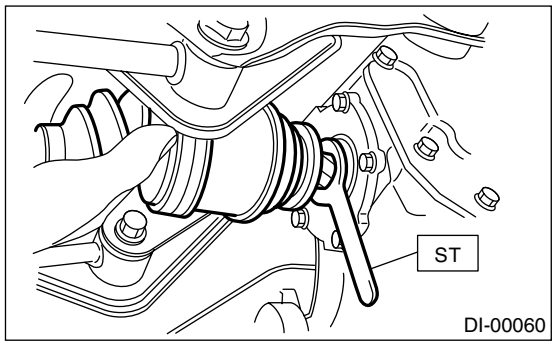
NOTE:
Fit the ST to the bolt (A) as shown in the figure to avoid damage on the side bearing retainer.



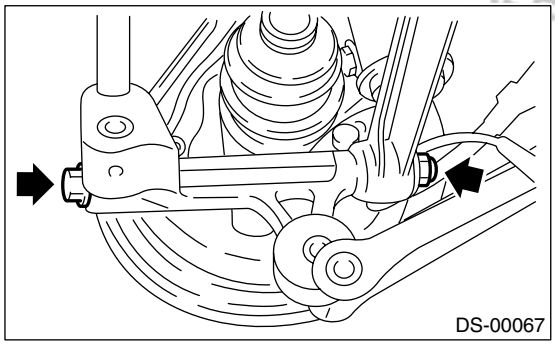
(A) Bolt

B: INSTALLATION

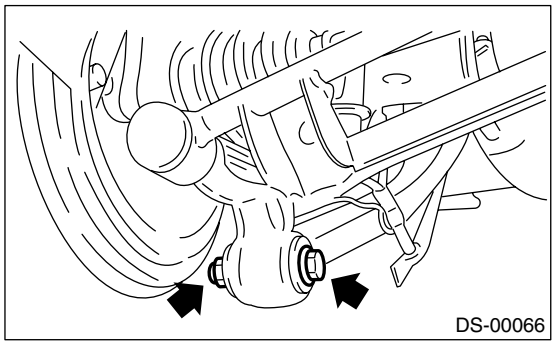
1) Insert the rear drive shaft into rear axle.
2) Temporarily tighten the axle nut.
3) Install the rear drive shaft to rear differential using the ST.
ST 28099PA090 OIL SEAL PROTECTOR



4) Temporarily tighten the front lateral link and rear lateral link to housing using a new self-locking nuts.

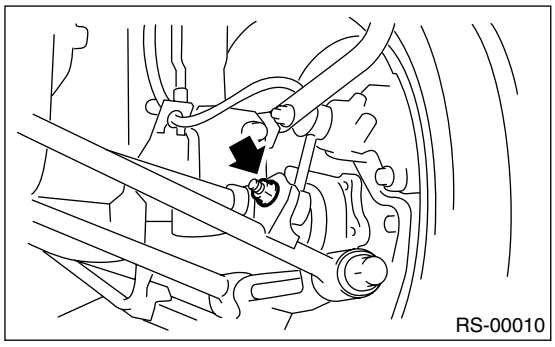


5) Temporarily tighten the trailing link to housing using a new self-locking nut.



6) Install the stabilizer link.

Tightening torque:
Except STi model
30 N·m (3.1 kgf-m, 22 ft-lb)
STi model
45 N·m (4.6 kgf-m, 33 ft-lb)



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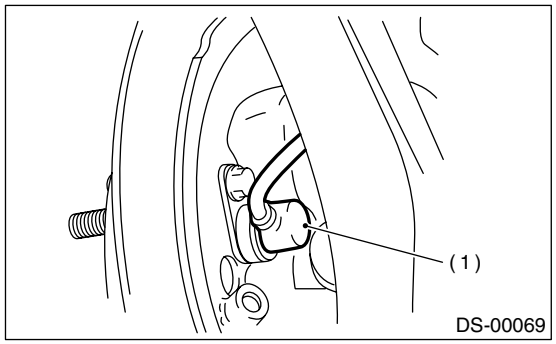
7) Install the ABS wheel speed sensor.

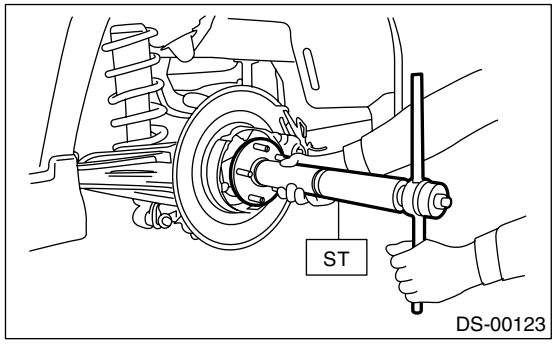
Tightening torque:
32 N·m (3.3 kgf-m, 24 ft-lb)



(1) ABS wheel speed sensor

8) Using the ST1 and ST2, pull the rear drive shaft into place.

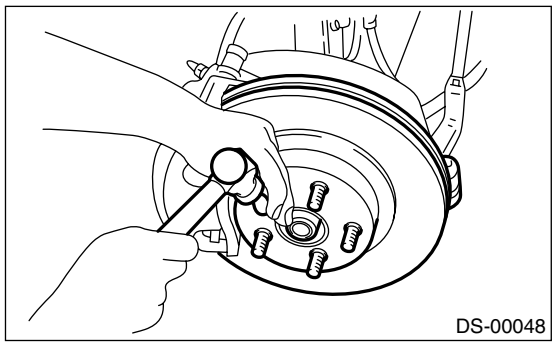
ST1	922431000	AXLE SHAFT INSTALLER
ST2	927390000	ADAPTER



9) Tighten a new axle nut to the specified torque with parking brake applied.

Tightening torque:
190 N·m (19.4 kgf-m, 140 ft-lb)

10) Lock the axle nut.



11) Install the wheel.

Tightening torque:
88 N·m (9.0 kgf-m, 65 ft-lb)

12) Make the tires contact the ground fully.

CAUTION:
Make the tires contact the ground fully and the vehicle be in curb weight whenever carrying out the tightening of bush portions.

13) Tighten the installation bolt of rear housing assembly and lateral link assembly.

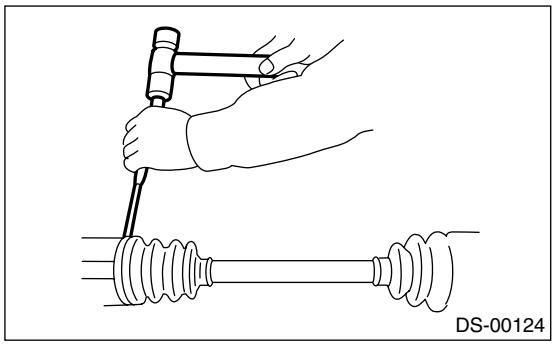
Tightening torque:
140 N·m (14.3 kgf-m, 103 ft-lb)

14) Tighten the installation bolt of rear housing assembly and trailing link assembly.

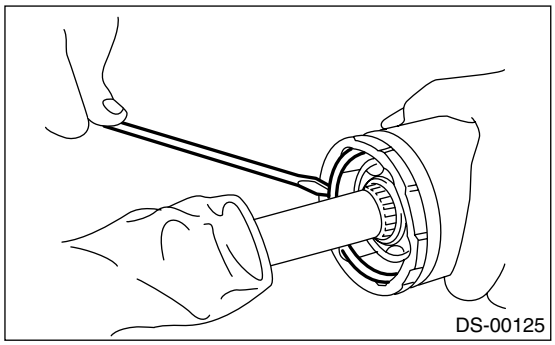
Tightening torque:
90 N·m (9.2 kgf-m, 66 ft-lb)

C: DISASSEMBLY

1) Straighten the bent claw of larger end of DOJ boot.
2) Loosen the band by means of screwdriver or pliers with care of not damaging boot.



3) Remove the boot band on the small end of DOJ boot in the same manner.
4) Remove the larger end of DOJ boot from DOJ outer race.
5) Pry and remove the round circlip located at neck of DOJ outer race with a screwdriver.



6) Take out the DOJ outer race from shaft assembly.
7) Wipe off the grease, and then take out the balls.

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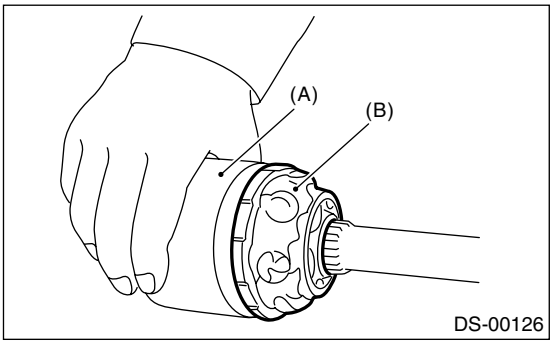
NOTE:
• The grease is a special grease (grease for constant velocity joint). Do not confuse with other greases.
• Disassemble with exercising care not to lose balls (6 pcs).



(A) Outer race
(B) Grease

8) To remove the cage from inner race, turn the cage by a half pitch to the track groove of inner race, and shift the cage.
9) Remove the snap ring, which fixes the inner race to shaft, by using pliers.
10) Take out the DOJ inner race.
11) Take off the DOJ cage from shaft and remove the DOJ boot.
12) Wrap the shaft splines with vinyl tape.
13) Remove the BJ boot in the same procedure as DOJ boot.

NOTE:
Further disassembly of axle is impossible because the BJ cannot be disassembled.

D: ASSEMBLY

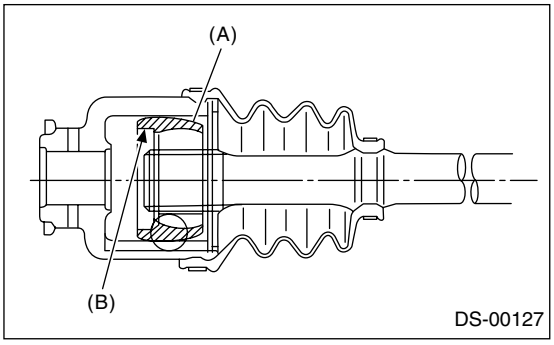
NOTE:
Use specified grease.

BJ side:
Except STi model:
Molylex No. 2 (Part No. 723223010)
STi model:
NTG2218-M (Part No. 28395FE010)

DOJ side:
VU-3A702 (Yellow) (Part No. 23223GA050)

1) Install the BJ boot in specified position, and fill it with 60 to 70 g (2.12 to 2.47 oz) of specified grease.
2) Place the DOJ boot at the center of shaft.
3) Wrap the shaft splines with vinyl tape.
4) Insert the DOJ cage onto shaft.

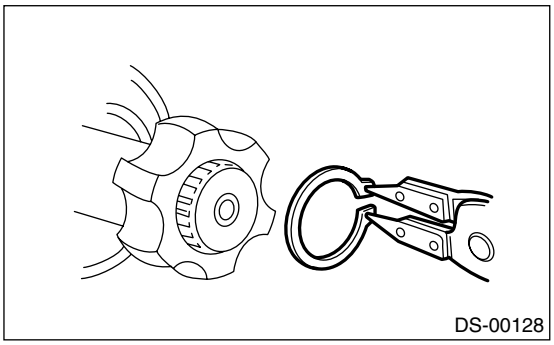
NOTE:
Insert the cage with cut-out portion facing the shaft end, since the cage has an orientation.



(A) Cage
(B) Cut-out portion

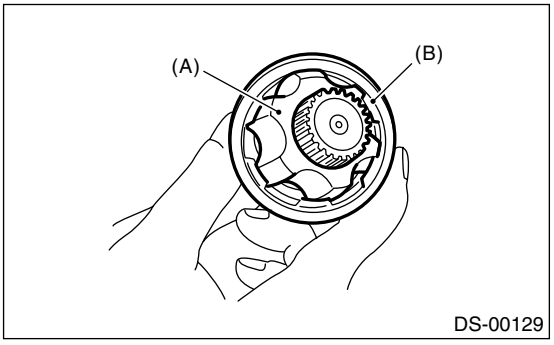
5) Install the DOJ inner race on shaft, and fit the snap ring with pliers.

NOTE:
Confirm the snap ring is completely fitted in shaft groove.



6) Install the cage, which was previously fitted, to inner race fixed upon shaft.

NOTE:
Fit the cage with protruded part aligned with the track on inner race, and then turn by a half pitch.



(A) Inner race
(B) Cage

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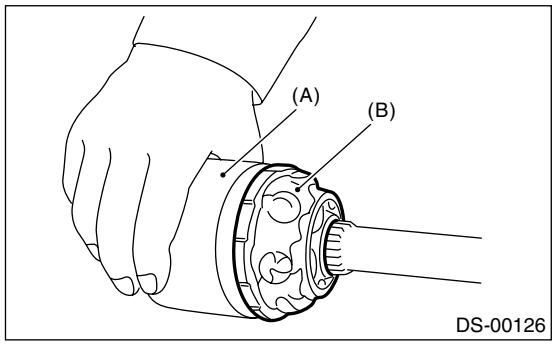
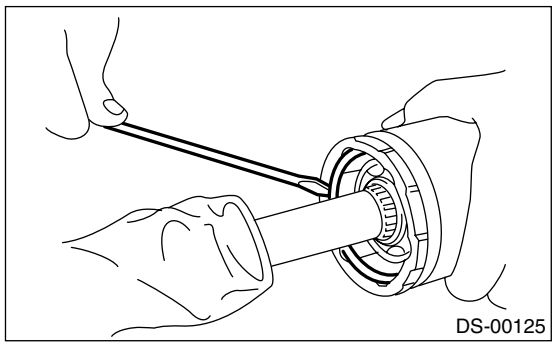
7) Fill 80 to 90 g (2.82 to 3.17 oz) of specified grease into the interior of DOJ outer race.
8) Apply a coat of specified grease to cage pocket and six balls.
9) Insert six balls into cage pocket.
10) Align the outer race track and ball positions and place in the part where shaft, inner race, cage and balls are previously installed, and then fit the outer race.



(A) Outer race
(B) Grease

11) Install the circlip in the groove on DOJ outer race.

NOTE:
• Assure the balls, cage and inner race are completely fitted in the outer race of DOJ.
• Exercise care not to place the matched position of circlip in ball groove of outer race.
• Pull the shaft lightly and assure that the circlip is completely fitted in groove.



12) Apply an even coat of the specified grease [20 to 30 g (0.71 to 1.06 oz)] to the entire inner surface of boot. Also apply grease to shaft.
13) Install the DOJ boot taking care not to twist it.

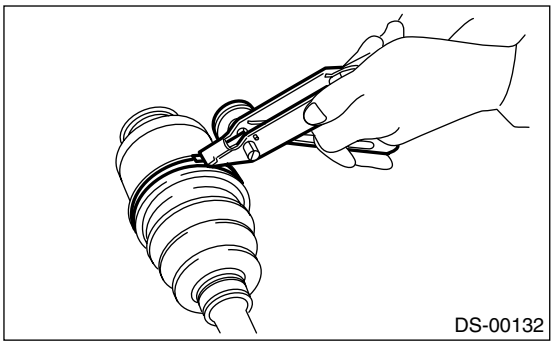
NOTE:
• Inside of the larger end of DOJ boot and boot groove shall be cleaned so as to be free from grease and other substances.
• When installing the DOJ boot, position the outer race of DOJ at center of its travel.

14) Put a new band through the clip and wind twice in alignment with band groove of boot.

NOTE:
When tightening the boot, exercise care so that air within boot is appropriate.

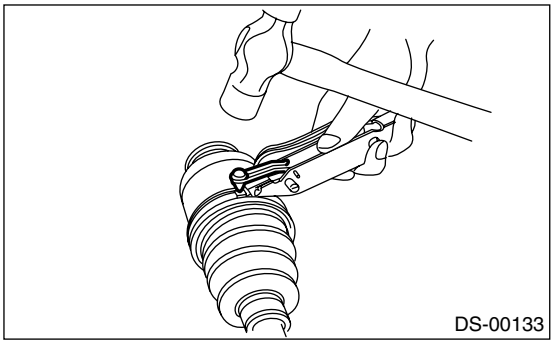
15) Tighten the band using the ST.
ST 925091000 BAND TIGHTENING TOOL

NOTE:
Tighten the band until it cannot be moved by hand.



16) Tap on the clip with the punch provided at the end of ST.
ST 925091000 BAND TIGHTENING TOOL

NOTE:
Tap to an extent that the boot underneath is not damaged.



17) Cut off the band with an allowance of about 10 mm (0.39 in) left from clip, and bend this allowance over the clip.

NOTE:
Be careful so that the end of band is in close contact with clip.

18) Fix up the boot on BJ in the same manner.
19) Extend and retract the DOJ to provide equal grease coating.

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E: INSPECTION

Check the removed parts for damage, wear, corrosion, etc. If faulty, repair or replace.
1) DOJ (Double Offset Joint)
Check seizure, corrosion, damage, wear and excessive play.
2) Shaft
Check excessive bending, twisting, damage and wear.
3) BJ (Bell Joint)
Check seizure, corrosion, damage and excessive play.
4) Boot
Check for wear, warping, breakage or scratches.
5) Grease
Check for discoloration or fluidity.

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7. General Diagnostic Table

A: INSPECTION

NOTE:
Vibration while cruising may be caused by an unbalanced tire, improper tire inflation pressure, improper wheel alignment, etc.

Symptom	Possible cause	Remedy
1. Vibration of propeller shaft NOTE: Vibration is caused by propeller shaft during operation and is transferred to vehicle body. Generally vibration increase in proportion to vehicle speed.	(1) Worn or damaged universal joint.	Replace.
	(2) Unbalanced propeller shaft due to bend or dent.	Replace.
	(3) Loose installation of propeller shaft.	Retighten.
	(4) Worn or damaged center bearing and damaged center mounting rubber.	Replace.
2. Tapping when starting and noise while cruising, caused by propeller shaft	(1) Worn or damaged universal joint.	Replace.
	(2) Worn spline of sleeve yoke.	Replace.
	(3) Loose installation of propeller shaft.	Retighten.
	(4) Loose installation of joint.	Replace.
	(5) Worn or damaged center bearing and damaged center mounting rubber.	Replace.

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EXTERIOR BODY PANELS

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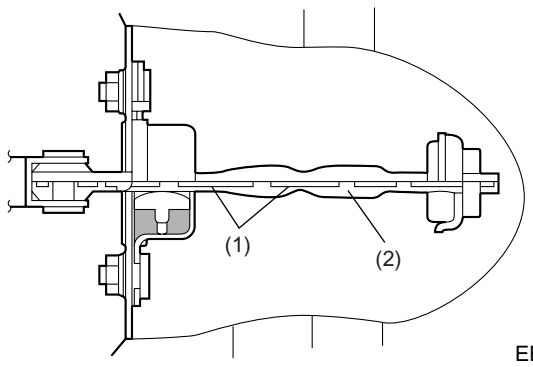
1. Door

A: DOOR CHECKER

The door checkers are of a type that uses a molded resin part.



EB-00113

(1) Sheet metal
(2) Resin

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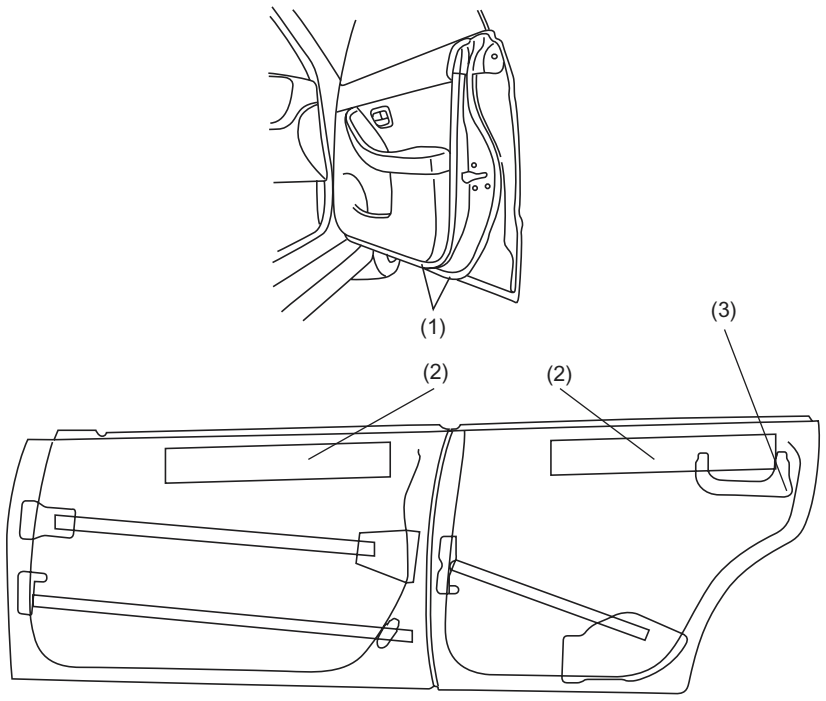
B: DOOR CONSTRUCTION

- All the front and rear doors have in their inside a side door beam, window shoulder area reinforcement and a reinforcement latch.
- The dual sealing provided at the bottom of front doors ensure tight closure.



EB-00114

(1) Dual sealing
(2) Reinforcement plate
(3) Outer handle bracket

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EMISSION CONTROL
(AUX. EMISSION CONTROL DEVICES)
H4DOTC

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1. System Overview

There are three emission control systems which are as follows:

- Crankcase emission control system
- Exhaust emission control system
  - Three-way catalytic converter
  - Air/fuel (A/F) control system
  - Ignition control system
- Evaporative emission control system

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Item			Main components	Function
Crankcase emission control system			Positive crankcase ventilation (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	Catalytic converter	Pre	Catalytic converter	Oxidizes HC and CO contained in exhaust gases as well as reducing NOx.
		Front		
		Rear		
	Air/fuel (A/F) control system		Engine control module (ECM)	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 density of oxygen contained exhaust gases.
			Rear oxygen sensor	Detects density of oxygen contained in exhaust gases.
			Throttle position sensor	Detects throttle opening.
			Manifold absolute pressure sensor	Detects absolute pressure of intake manifold.
			Mass air flow and intake air temperature sensor	Detects amount of intake air.
				Detects intake air temperature at air cleaner case.
	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 releases 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 line by receiving a signal from ECM to check the evaporation gas leak.

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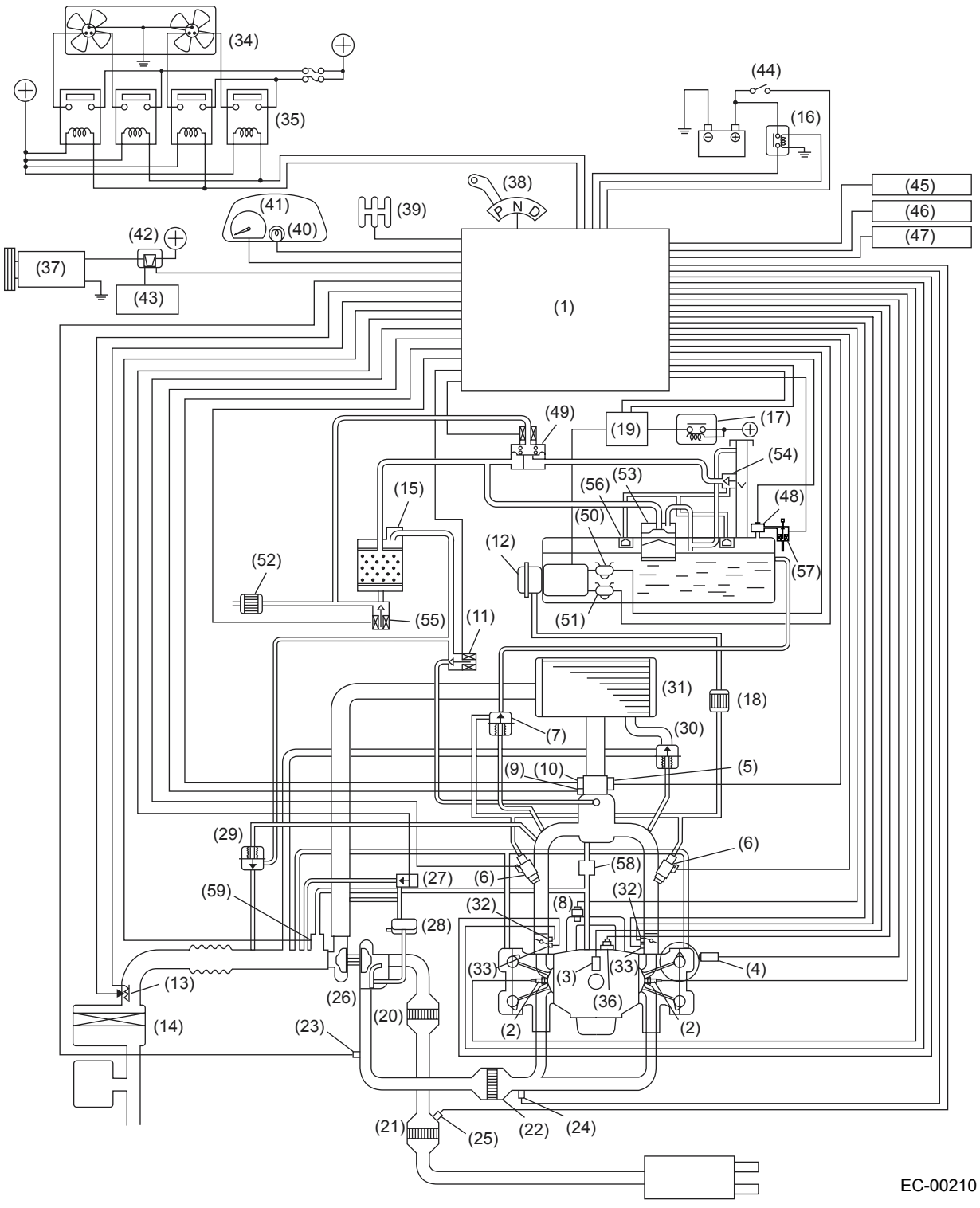
2. Schematic Diagrams



EC-00210

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(1) Engine control module (ECM)
(2) Ignition coil and igniter assembly
(3) Crankshaft position sensor
(4) Camshaft position sensor
(5) Throttle position sensor
(6) Fuel injector
(7) Pressure regulator
(8) Engine coolant temperature sensor
(9) Manifold absolute pressure sensor
(10) Idle air control solenoid valve
(11) Purge control solenoid valve
(12) Fuel pump
(13) Mass air flow and intake air temperature sensor
(14) Air cleaner element
(15) Canister
(16) Main relay
(17) Fuel pump relay
(18) Fuel filter
(19) Fuel pump control unit
(20) Front catalytic converter
(21) Rear catalytic converter
(22) Pre-catalytic converter
(23) Exhaust temperature sensor
(24) Front oxygen (A/F) sensor
(25) Rear oxygen sensor
(26) Turbocharger
(27) Wastegate control solenoid valve
(28) Wastegate controller
(29) Purge valve
(30) Air bypass valve
(31) Intercooler
(32) Tumble generator valve position sensor
(33) Tumble generator valve actuator
(34) Radiator fan
(35) Radiator fan relay
(36) Knock sensor
(37) A/C compressor
(38) Inhibitor switch (AT models)
(39) Neutral position switch (MT models)
(40) Engine malfunction indicator light (MIL)
(41) Tachometer
(42) A/C relay
(43) A/C control module
(44) Ignition switch
(45) Transmission control module (TCM)
(46) Vehicle speed sensor
(47) Data link connector
(48) Fuel tank pressure sensor
(49) Pressure control solenoid valve
(50) Fuel temperature sensor
(51) Fuel level sensor
(52) Drain filter
(53) Vent valve
(54) Shut-off valve
(55) Drain valve
(56) Fuel cut valve
(57) Fuel tank sensor control valve
(58) PCV valve
(59) PCV diagnosis connector

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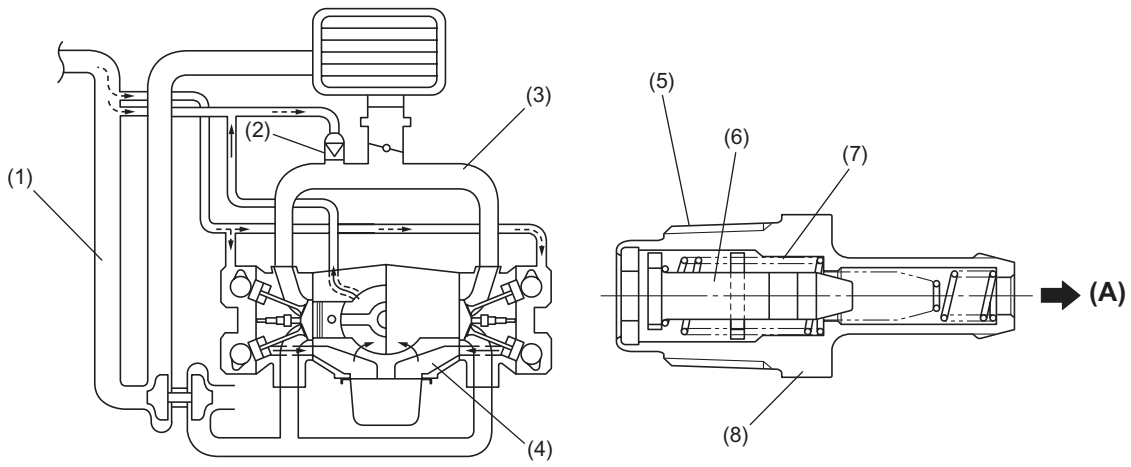
3. Crankcase Emission Control System

● The positive crankcase ventilation (PCV) system prevents 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, a PCV valve and an air intake duct.

● In a part-throttle condition, 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 created in the intake manifold. Under this condition, fresh air is introduced into the crankcase through the connecting hose of the rocker cover.

● In a wide-open-throttle condition, a part of blow-by gas flows into the air intake duct through the connecting hose and is drawn into the throttle chamber, because under this is condition, the intake manifold vacuum is not strong enough to introduce through the PCV valve all blow-by gases that increase in the amount with engine speed.

● The PCV hose is provided with a leak detection function.



EC-00211

(1) Intake duct
(2) PCV valve
(3) Intake manifold
(4) Crankcase
(5) Case
(6) Valve
(7) Spring
(8) PCV valve
(A) To intake manifold

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4. Three-way Catalytic Converter

● The basic materials of the three-way catalytic converter are platinum (Pt), rhodium (Rh) and palladium (Pd), and a thin coat of their mixture is applied onto a honeycomb or porous ceramic (carrier). To avoid damaging the catalytic converter, only unleaded gasoline should be used.

● The catalytic converter reduces HC, CO and NOx in exhaust gases through chemical reactions (oxidation and reduction). These harmful components are reduced most efficiently when their concentrations are in a certain balance. These concentrations vary with the air-fuel ratio. The ideal air-fuel ratio for reduction of these components is the stoichiometric ratio.

● Therefore, the air-fuel ratio needs to be controlled to around the stoichiometric ratio to purify the exhaust gases most efficiently.

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5. Air/Fuel (A/F) Control System

● The air/fuel (A/F) control system makes a correction to the basic fuel injection duration in accordance with the signals from the front oxygen (A/F) sensor and the rear oxygen sensor so that the stoichiometric ratio is maintained, thus ensuring most effective exhaust gas purification by the three-way catalytic converter. Different basic fuel injection durations are preset for various engine speeds 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 fuel injection in the memory map. This allows an appropriate air-fuel ratio correction to be added automatically in quick response to any situation that requires such an effect. Thus, the air-fuel ratio is optimally maintained under various conditions while purifying exhaust gases most effectively, improving driving performance and compensating for changes in sensors' performance over time.

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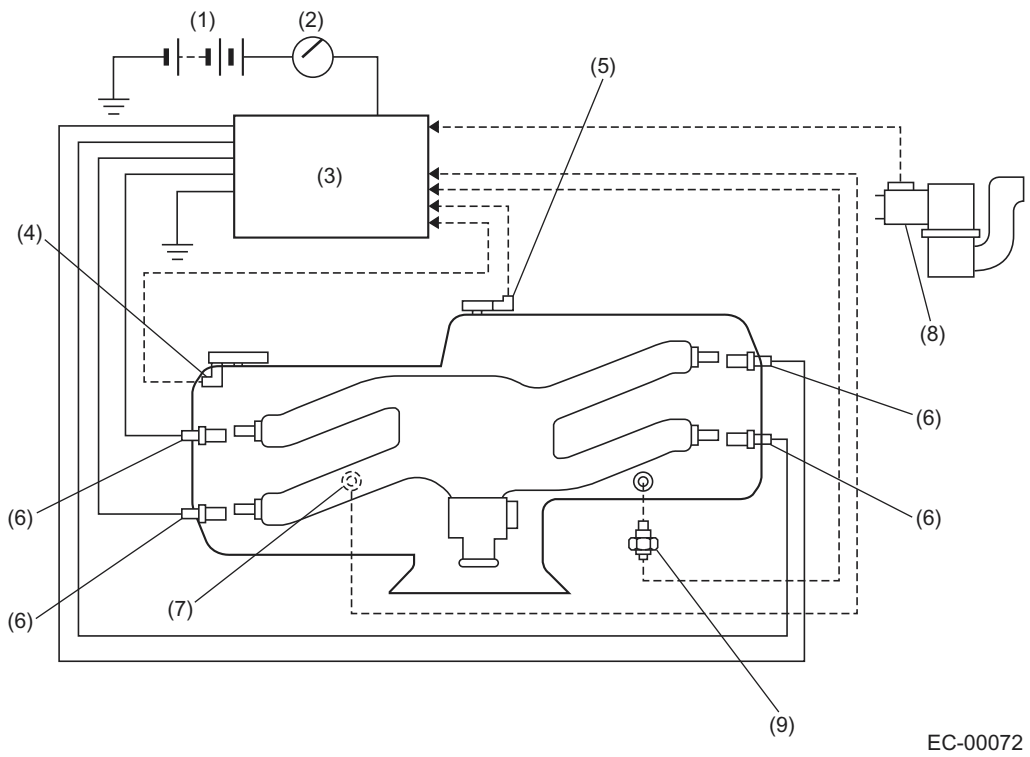
6. Ignition Control System

● The ignition system is controlled by the ECM.
The ECM monitors the operating condition of the engine using the signals from the sensors and switches shown below and determines the ignition timing most appropriate for each engine operating condition. Then it sends a signal to the igniter, commanding generation of a spark at that timing.

● The ECM uses a preprogrammed map for a “closed-loop” control which provides its ignition timing control with excellent transient characteristics, i.e., highly responsive ignition timing control.



EC-00072

(1) Battery
(2) Ignition switch
(3) ECM
(4) Camshaft position sensor
(5) Crankshaft position sensor
(6) Ignition coil and igniter assembly
(7) Knock sensor
(8) Mass air flow and intake air temperature sensor
(9) Engine coolant temperature sensor

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7. Evaporative Emission Control System

A: GENERAL

● The evaporative emission control system prevents fuel vapors from escaping into atmosphere. This system includes a canister, purge control solenoid valve, fuel cut valve, and the lines connecting them.
● Fuel vapors in the fuel tank is introduced into the canister through the evaporation line, and are absorbed by activated carbon in it. The fuel cut valve is also incorporated in the fuel tank line.
● The purge control solenoid valve is controlled optimally by the ECM according to the engine condition.

● The pressure control solenoid valve incorporated in the fuel tank evaporation line regulates the pressure/vacuum in the fuel tank under the control of the ECM which uses the signal from the fuel tank pressure sensor.

● The diagnosis of the evaporative emission control system is performed by turning each solenoid valve ON/OFF to vary the pressure inside the fuel tank and measure this pressure change with the fuel tank pressure sensor in order to check for leaks and proper valve operation.

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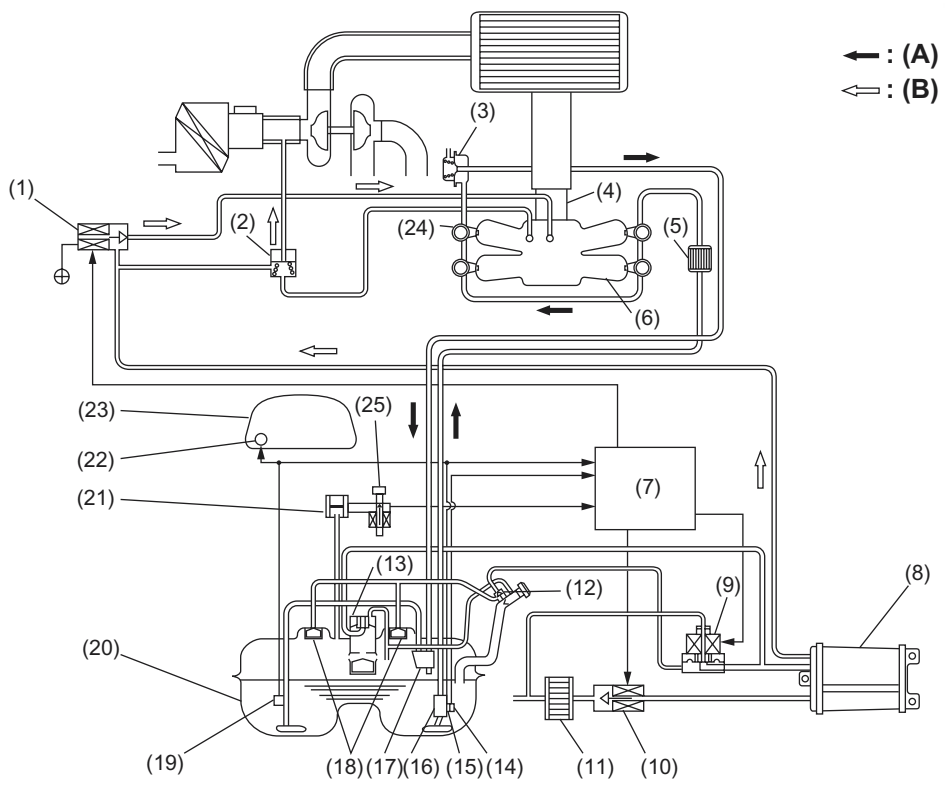
EVAPORATIVE EMISSION CONTROL SYSTEM



FU-00790

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

(A) Fuel line
(B) Fuel evaporation line

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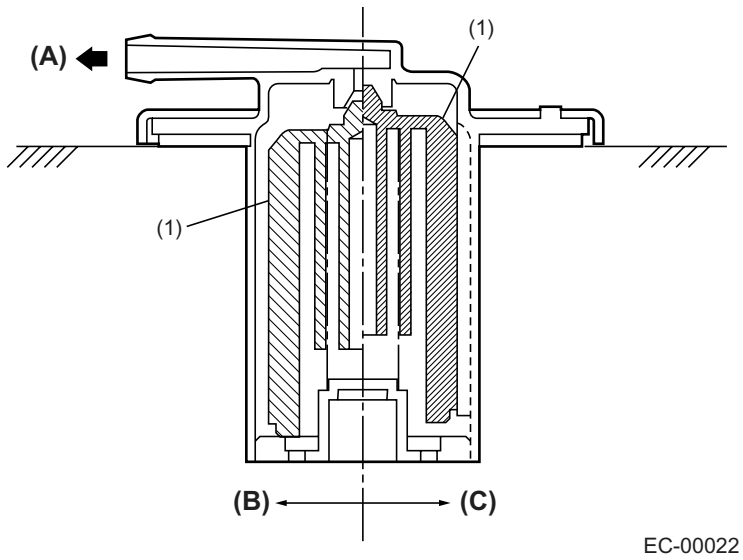
B: FUEL CUT VALVE

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



EC-00022

(1) Float

(A) To canister
(B) Valve open
(C) Valve closed

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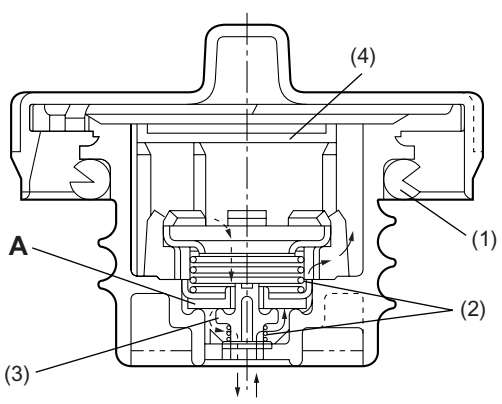
C: FUEL TANK CAP

The fuel tank cap has a relief valve which prevents development of vacuum in the fuel tank in the event of a problem with the fuel vapor line.

When there is no problem with the fuel vapor line, the filler pipe is sealed at the portion (A) and by the seal pressed against the filler pipe end. If vacuum develops in the fuel tank, the atmospheric pressure forces the spring down to open the valve; consequently outside air flows into the fuel tank, thus controlling the inside pressure.



EC-00023

(1) Seal
(2) Spring
(3) Valve
(4) Filter

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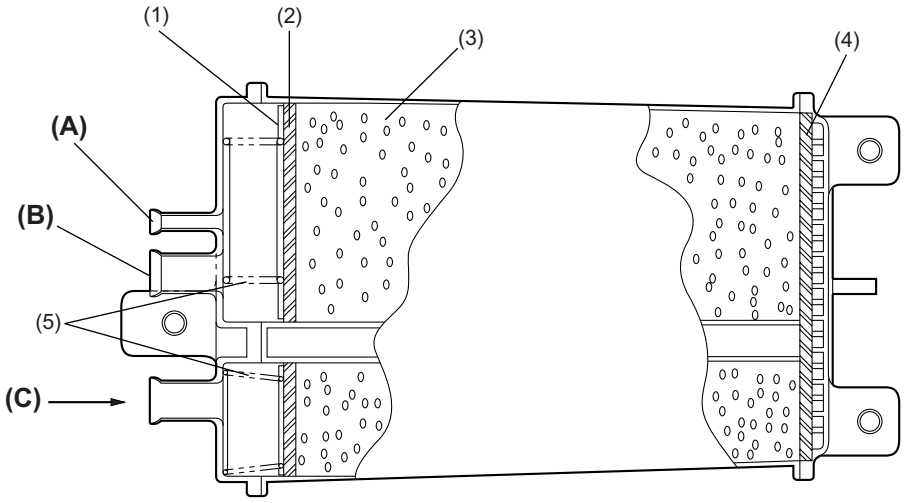
D: CANISTER

The charcoal filled in the canister temporarily stores fuel vapors. When the purge control solenoid valve is opened by a signal from the ECM, the external fresh air entering the canister carries the fuel vapors into the collector chamber.



EC-00024

(1) Grid
(2) Filter
(3) Activated charcoal
(4) Filter
(5) Spring

(A) To purge control solenoid valve
(B) From fuel tank
(C) Air

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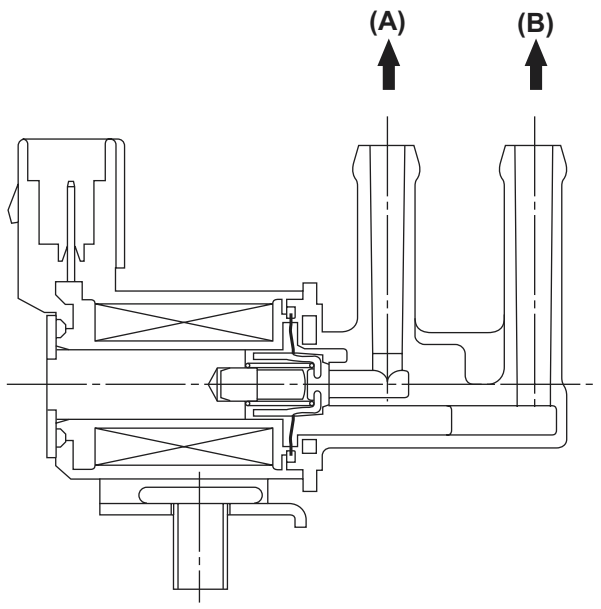
E: PURGE CONTROL SOLENOID VALVE

The purge control solenoid valve is on the evaporation line between the canister and intake manifold. The valve is installed under the intake manifold and lets the evaporative gas absorbed by the canister be drawn into the intake manifold.



EC-00074

(A) To canister
(B) To intake manifold

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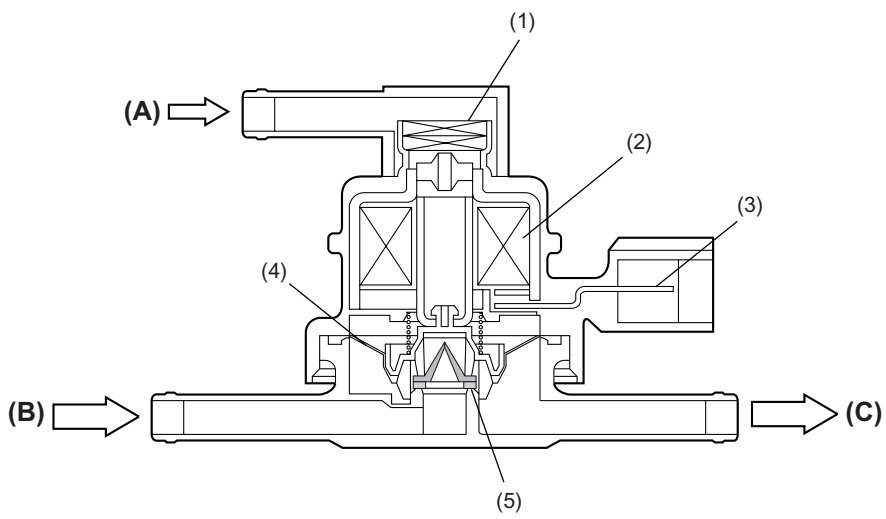
F: PRESSURE CONTROL SOLENOID VALVE

The fuel tank pressure control solenoid valve is located in the evaporation line between the canister and the fuel tank. It adjusts the fuel tank inside pressure under the control of the ECM.
When the tank inside pressure becomes higher than the atmospheric pressure, the valve is opened allowing fuel vapors to be introduced into the canister.
On the other hand, when the tank inside pressure becomes lower than the atmospheric pressure, external air is taken from the drain valve into the canister.
The pressure control solenoid valve can also be electrically closed for diagnosis of the evaporative emission control system.



EC-00026

(1) Filter
(2) Coil
(3) Connector terminal
(4) Diaphragm
(5) Valve

(A) Atmospheric pressure
(B) Shut-off valve
(C) To fuel tank

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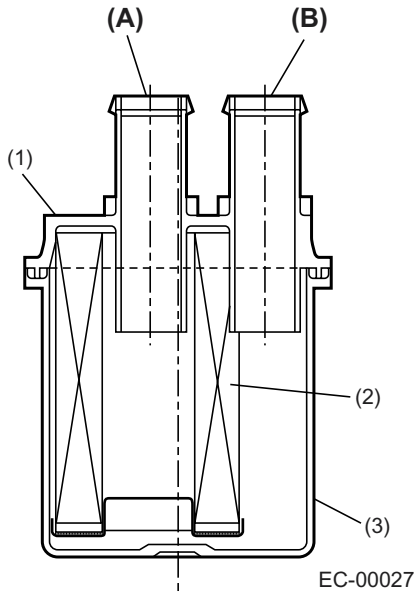
G: DRAIN FILTER

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



(1) Cap
(2) Element
(3) Case

(A) To drain valve
(B) To atmosphere

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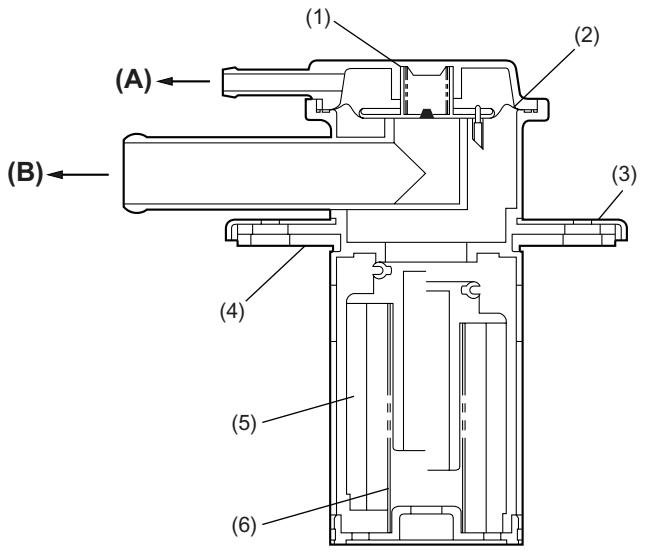
H: VENT VALVE

The vent valve is located in the fuel tank. During filling the fuel tank, fuel vapors are introduced into the canister through the vent valve.
When the fuel vapor pressure becomes higher than the atmospheric pressure and overcomes the spring force which is applied to the back side of the diaphragm, the port toward the canister is opened. The vent valve also contains a float which closes the port toward the canister when the fuel level rises.



EC-00028

(1) Spring
(2) Diaphragm
(3) Plate cover
(4) Packing
(5) Float
(6) Float spring

(A) To filler pipe
(B) To canister

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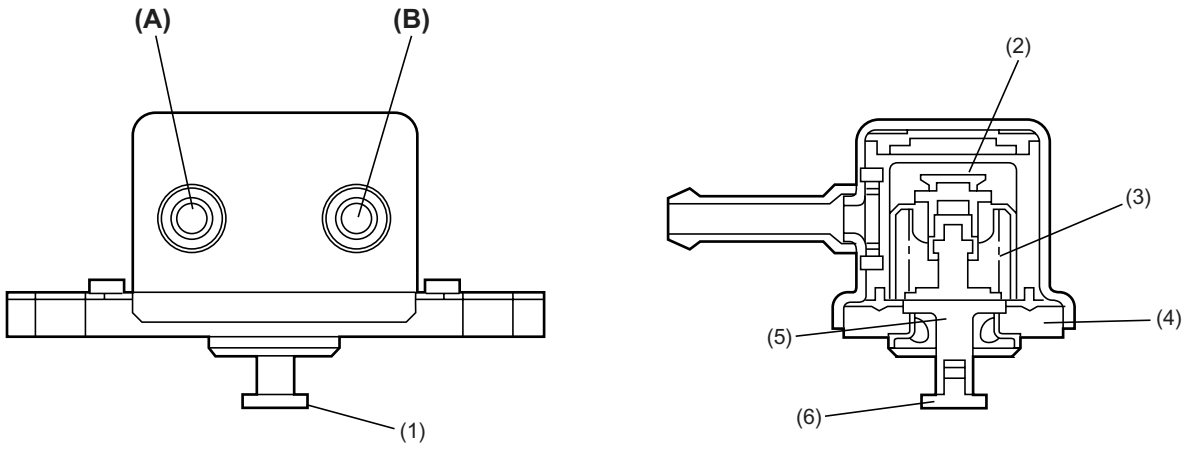
I: SHUT-OFF VALVE

The shut-off valve is located at the top of the fuel filler pipe. When a filler gun is inserted into the filler pipe, the shut-off valve closes the evaporation line.



EC-00029

(1) Pin
(2) Valve
(3) Spring
(4) Plate
(5) Shaft
(6) Pin

(A) To canister
(B) To fuel tank

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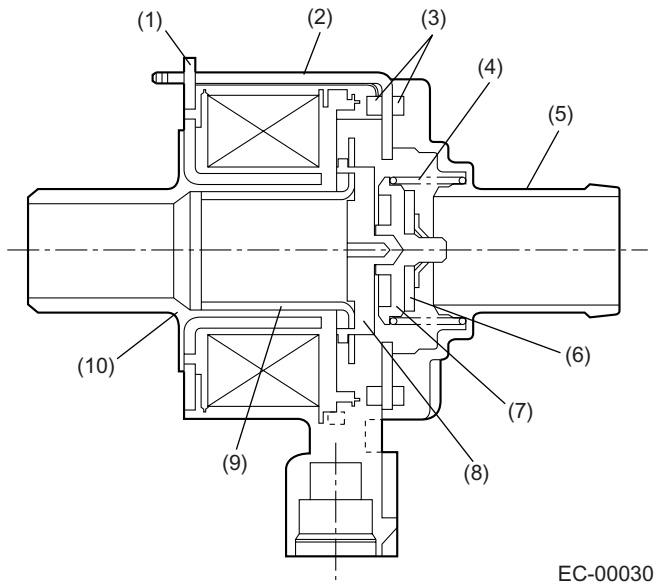
J: DRAIN VALVE

The drain valve is located on the line connecting the drain filter and canister, 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.



EC-00030

(1) Magnetic plate
(2) Yoke
(3) Packing
(4) Spring
(5) Valve seat
(6) Valve
(7) Plate
(8) Retainer
(9) Moving core
(10) Bobbin

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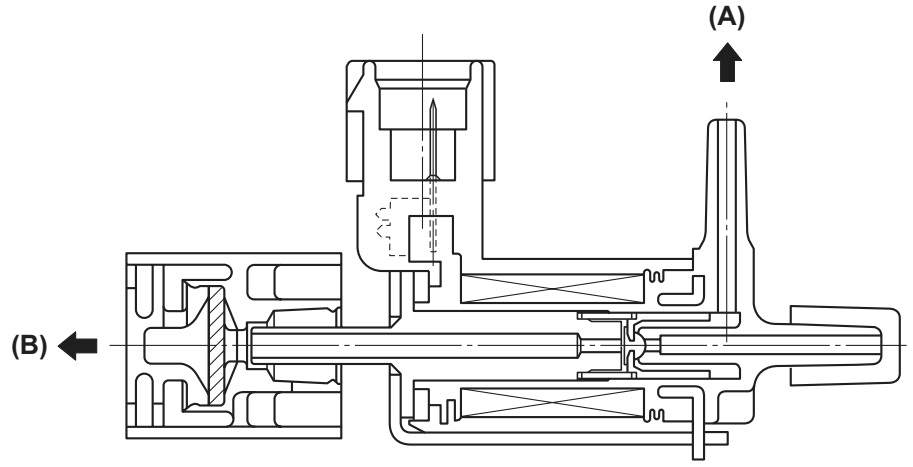
K: FUEL TANK SENSOR CONTROL VALVE

The fuel tank sensor control valve is installed on the top of the fuel tank and its one end is connected to the fuel tank pressure sensor while its other end is open to the atmosphere.
Normally the passage to the fuel tank pressure sensor is open to the atmosphere, however, the passage is closed when the ECM sends a signal to make a diagnosis of the evaporative emission control system.



EC-00214

(A) Fuel tank pressure sensor
(B) Atmosphere

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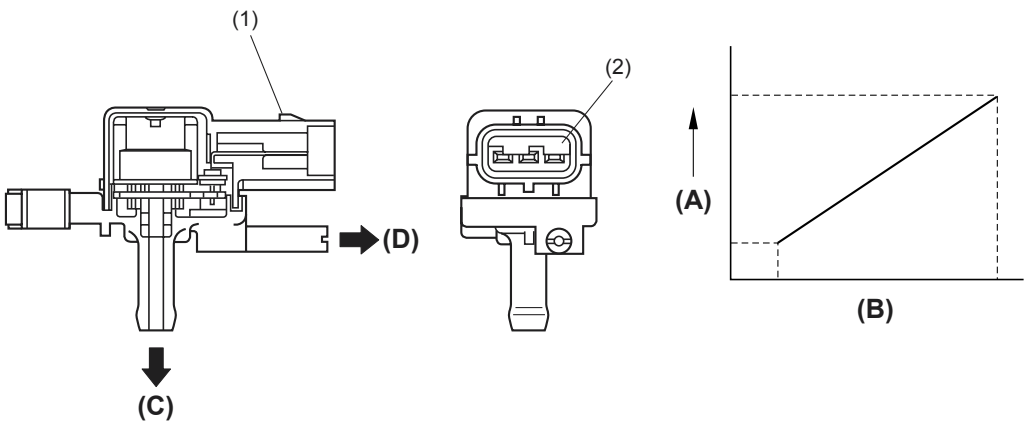
L: FUEL TANK PRESSURE SENSOR

The fuel tank pressure sensor is installed on the top of the fuel tank and measures the pressure in the fuel tank.
The measured pressure is converted into an electrical signal and sent to the ECM for diagnosis of the evaporative emission control system.



EC-00213

(1) Connector
(2) Terminal

(A) Output voltage
(B) Input pressure
(C) To fuel tank
(D) To fuel tank sensor control valve

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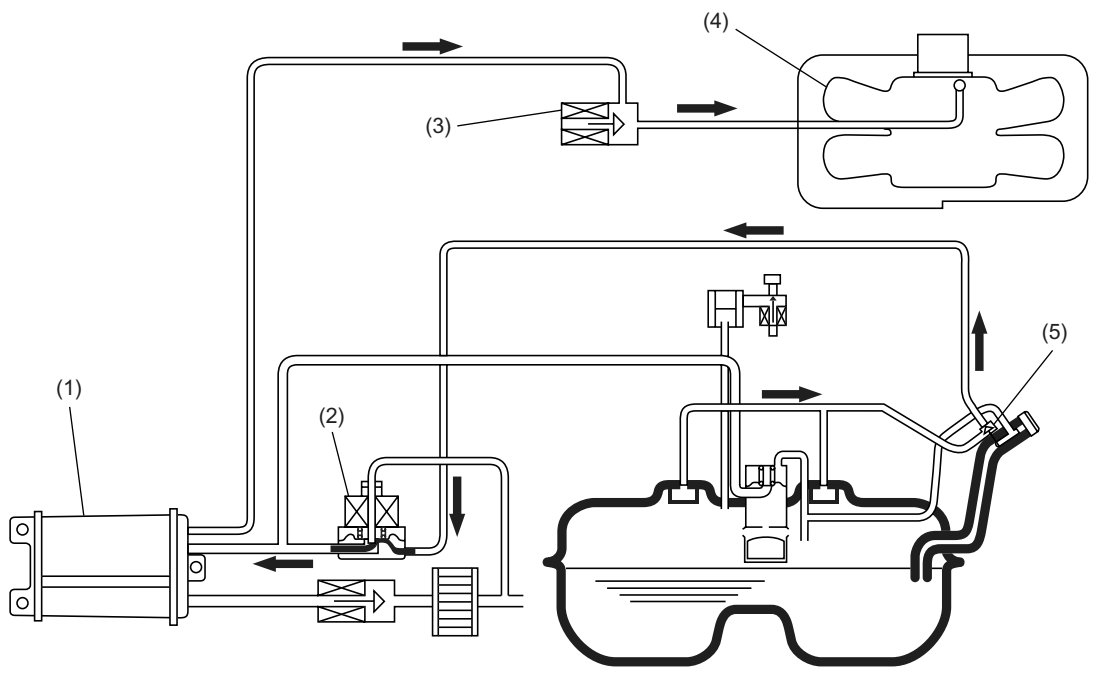
8. On-board Refueling Vapor Recovery (ORVR) System

A: GENERAL

The on-board refueling vapor recovery system allows the fuel vapors 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 data from 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 fuel vapor pressure acting on the other side of the diaphragm increases and overcomes the atmospheric pressure, it pushes the diaphragm and opens the port through which the fuel vapors make their way to the canister.



EC-00032

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

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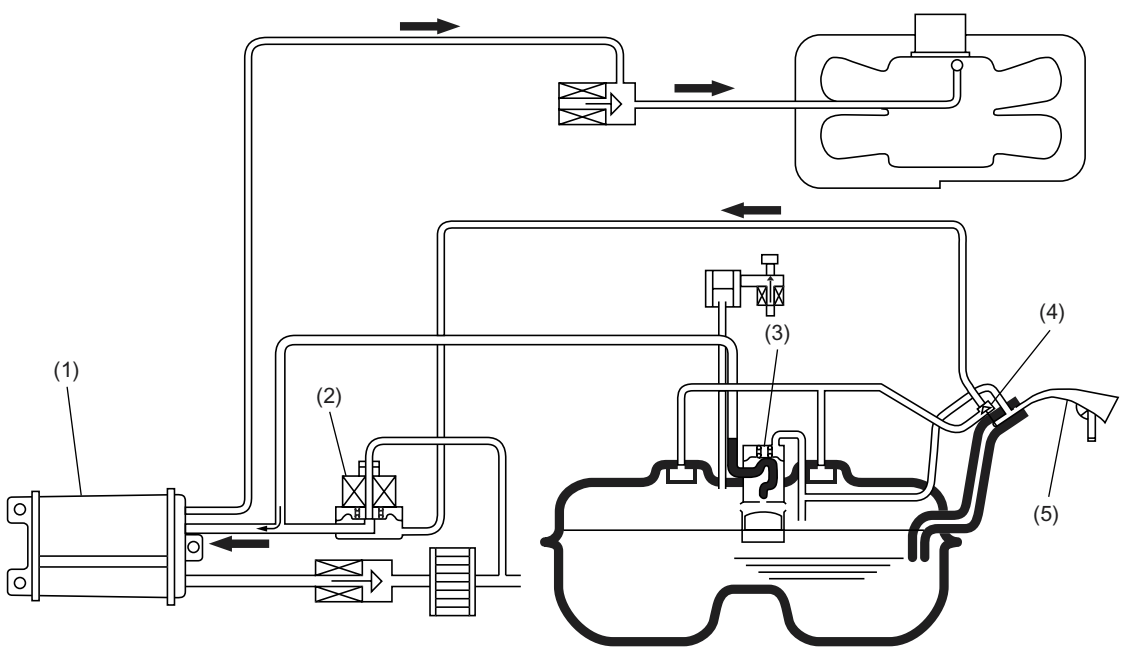
● While refueling

As the fuel enters the fuel tank, the tank inside pressure increases. When the inside pressure becomes higher than the atmospheric pressure, the port of the vent valve opens, allowing the fuel vapors to be introduced into the canister through the vent line. The fuel vapors are absorbed by charcoal in the canister, so the air discharged from the drain valve contains no fuel. When a filler gun is inserted, the shut-off valve closes the evaporation line.



EC-00033

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

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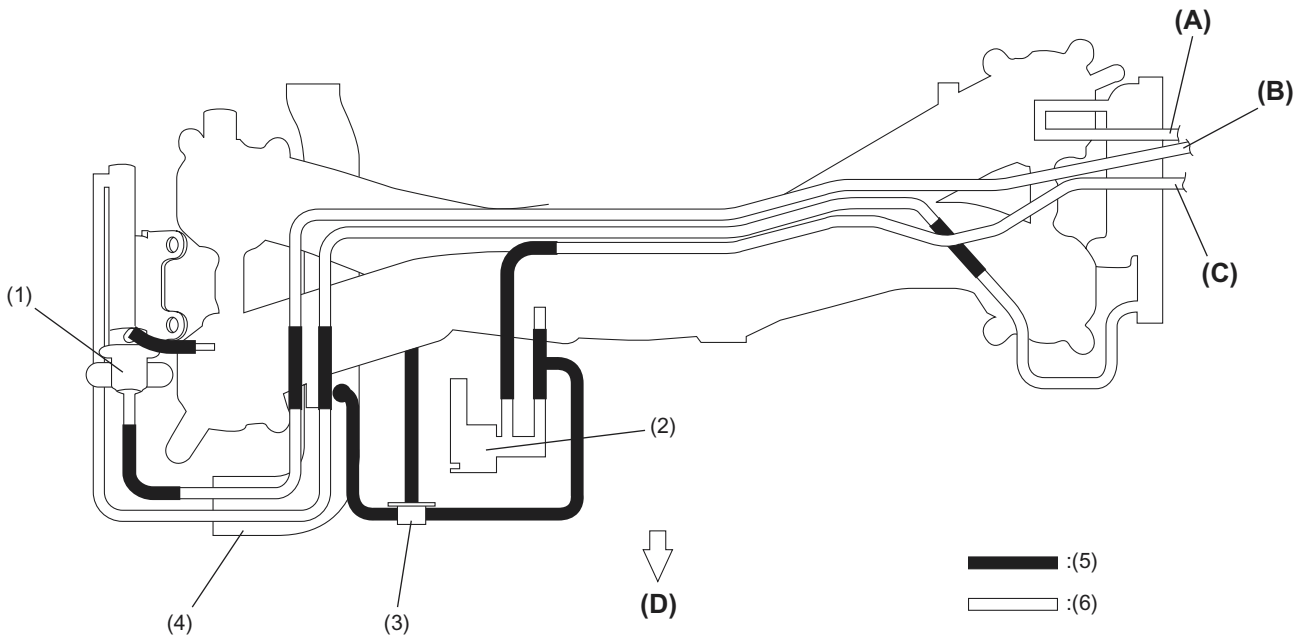
9. Vacuum Connections

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



EC-00212

(1) Pressure regulator
(2) Purge control solenoid valve
(3) Purge valve
(4) Intake duct
(5) Hose
(6) Pipe

(A) Delivery pipe
(B) Return pipe
(C) Evaporation pipe
(D) Front of vehicle

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EMISSION CONTROL
(AUX. EMISSION CONTROL DEVICES)
H4SO

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1. System Overview

There are three emission control systems which are as follows:

- Crankcase emission control system
- Exhaust emission control system
  - Three-way catalytic converter
  - Air/fuel (A/F) control system
  - Ignition control system
- Evaporative emission control system
- On-board refueling vapor recovery (ORVR) system

Item			Main components	Function
Crankcase emission control system			Positive crankcase ventilation (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	Catalytic converter	Front	Three-way catalytic converter	Oxidizes HC and CO contained in exhaust gases as well as reducing NOx.
		Rear		
	Air/fuel (A/F) control system		Engine control module (ECM)	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 density of oxygen contained exhaust gases.
			Rear oxygen sensor	Detects density of oxygen contained in exhaust gases.
			Throttle position sensor	Detects throttle opening.
			Manifold absolute pressure sensor	Detects absolute pressure of intake manifold.
			Intake air temperature sensor	Detects intake air temperature of air cleaner case.
	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 releases 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 line by receiving a signal from ECM to check the evaporation gas leak.

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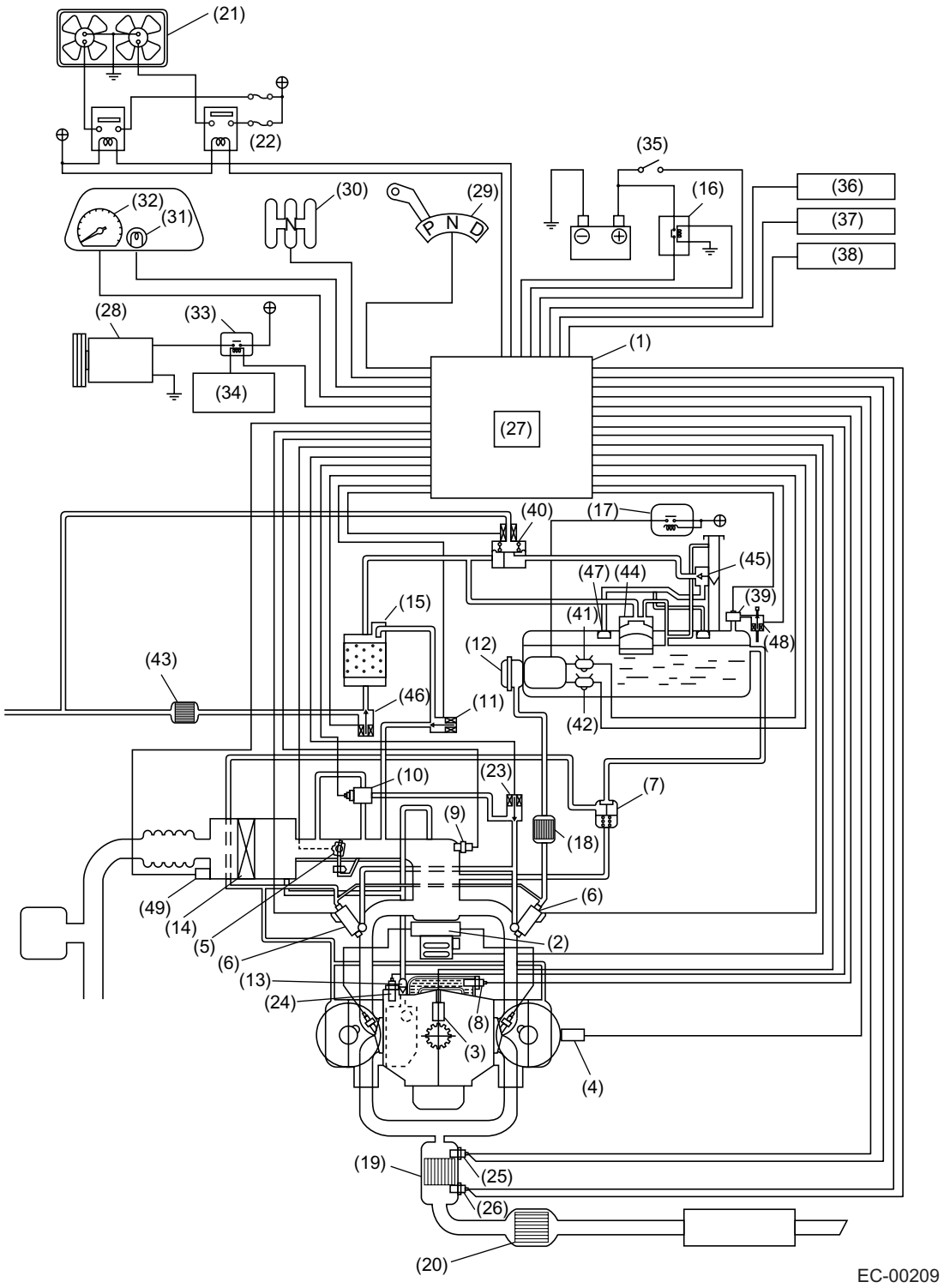
2. Schematic Diagrams



EC-00209

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(1) Engine control module (ECM)
(2) Ignition coil and igniter assembly
(3) Crankshaft position sensor
(4) Camshaft position sensor
(5) Throttle position sensor
(6) Fuel injector
(7) Pressure regulator
(8) Engine coolant temperature sensor
(9) Manifold absolute pressure sensor
(10) Idle air control solenoid valve
(11) Purge control solenoid valve
(12) Fuel pump
(13) PCV valve
(14) Air cleaner element
(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) Air assist injector solenoid valve
(24) Knock sensor
(25) Front oxygen (A/F) sensor
(26) Rear oxygen sensor
(27) Atmospheric pressure sensor
(28) A/C compressor
(29) Inhibitor switch (AT models only)
(30) Neutral switch (MT models only)
(31) Engine malfunction indicator light
(32) Tachometer
(33) A/C relay
(34) A/C control module
(35) Ignition switch
(36) Transmission control module (TCM) (AT models only)
(37) Vehicle speed sensor
(38) Data link connector
(39) Fuel tank pressure sensor
(40) Pressure control solenoid valve
(41) Fuel temperature sensor
(42) Fuel level sensor
(43) Drain filter
(44) Vent valve
(45) Shut-off valve
(46) Drain valve
(47) Fuel cut valve
(48) Fuel tank sensor control valve
(49) Intake air temperature sensor

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3. Crankcase Emission Control System

● The positive crankcase ventilation (PCV) system prevents 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, a PCV valve and an air intake duct.

● In a part-throttle condition, 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 created in the intake manifold. Under this condition, fresh air is introduced into the crankcase through the connecting hose of the rocker cover.

● In a wide-open-throttle condition, a part of blow-by gas flows into the air intake duct through the connecting hose and is drawn into the throttle chamber, because under this is condition, the intake manifold vacuum is not strong enough to introduce through the PCV valve all blow-by gases that increase in the amount with engine speed.

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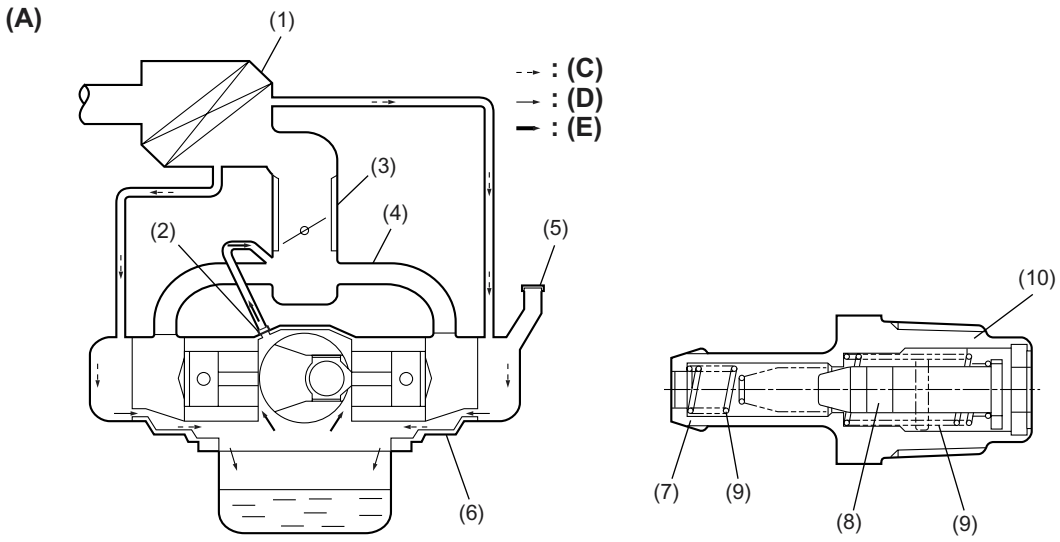
CRANKCASE EMISSION CONTROL SYSTEM



EC-00018

(1) Air cleaner case
(2) PCV valve
(3) Throttle body
(4) Intake manifold
(5) Oil filler cap
(6) Crankcase
(7) Case
(8) Valve
(9) Spring
(10) PCV valve

(A) Part-throttle condition
(B) Wide-open-throttle condition
(C) Outside air
(D) Mixture of air and blow-by gas
(E) Blow-by gas

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4. Three-way catalytic converter

● The basic materials of the three-way catalytic converter are platinum (Pt), rhodium (Rh) and palladium (Pd), and a thin coat of their mixture is applied onto a honeycomb or porous ceramic (carrier). To avoid damaging the catalytic converter, only unleaded gasoline should be used.

● The catalytic converter reduces HC, CO and NOx in exhaust gases through chemical reactions (oxidation and reduction). These harmful components are reduced most efficiently when their concentrations are in a certain balance. These concentrations vary with the air-fuel ratio. The ideal air-fuel ratio for reduction of these components is the stoichiometric ratio.

● Therefore, the air-fuel ratio needs to be controlled to around the stoichiometric ratio to purify the exhaust gases most efficiently.

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5. Air/Fuel (A/F) Control System

● The air/fuel (A/F) control system makes a correction to the basic fuel injection duration in accordance with the signals from the front oxygen (A/F) sensor and the rear oxygen sensor so that the stoichiometric ratio is maintained, thus ensuring most effective exhaust gas purification by the three-way catalytic converter. Different basic fuel injection durations are preset for various engine speeds 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 fuel injection in the memory map. This allows an appropriate air-fuel ratio correction to be added automatically in quick response to any situation that requires such an effect. Thus, the air-fuel ratio is optimally maintained under various conditions while purifying exhaust gases most effectively, improving driving performance and compensating for changes in sensors' performance over time.

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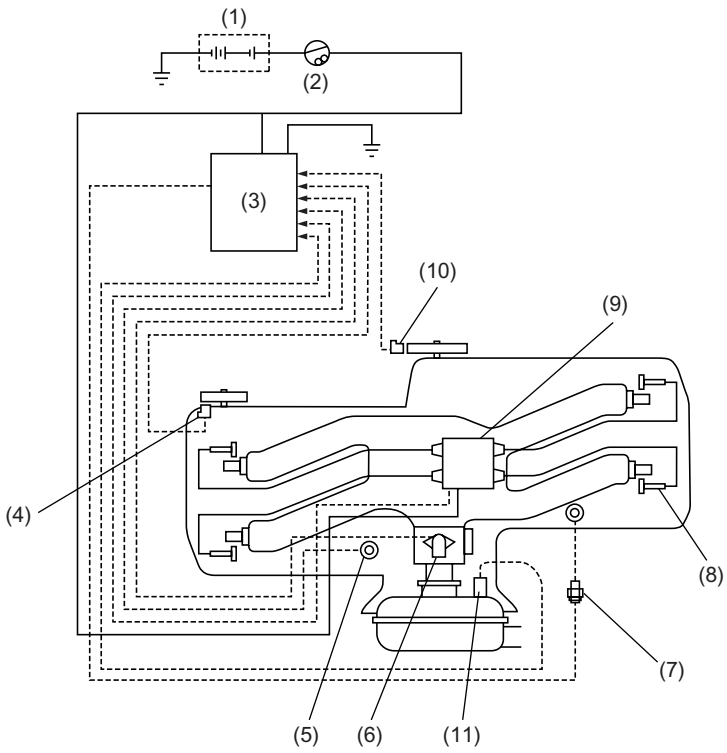
6. Ignition Control System

● The ignition system is controlled by the ECM.
The ECM monitors the operating condition of the engine using the signals from the sensors and switches shown below and determines the ignition timing most appropriate for each engine operating condition. Then it sends a signal to the igniter, commanding generation of a spark at that timing.

● The ECM uses a preprogrammed map for a “closed-loop” control which provides its ignition timing control with excellent transient characteristics, i.e., highly responsive ignition timing control.



EC-00189

(1) Battery
(2) Ignition switch
(3) ECM
(4) Camshaft position sensor
(5) Knock sensor
(6) Manifold absolute pressure sensor
(7) Engine coolant temperature sensor
(8) Spark plug
(9) Ignition coil and igniter assembly
(10) Crankshaft position sensor
(11) Intake air temperature sensor

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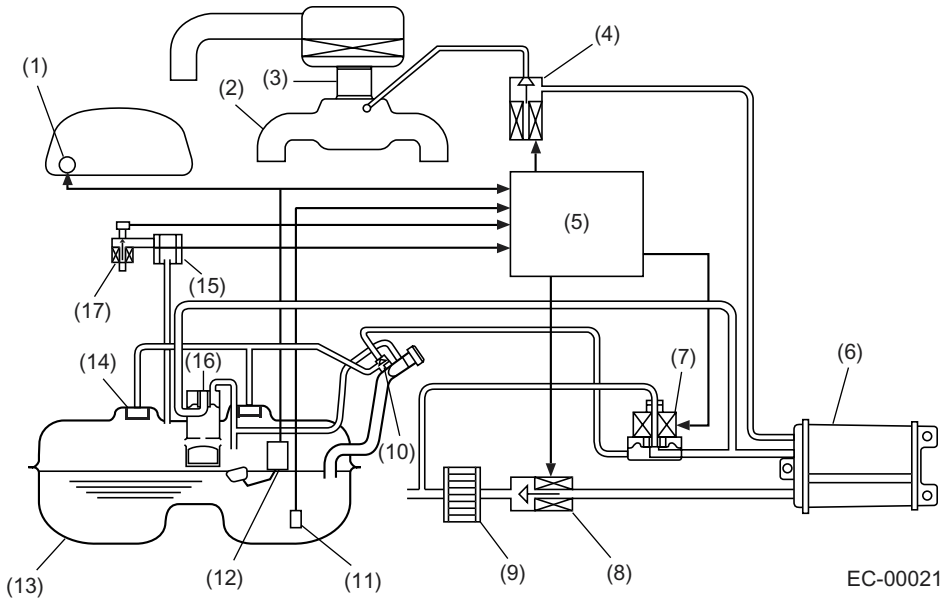
7. Evaporative Emission Control System

A: GENERAL

● The evaporative emission control system prevents fuel vapors from escaping into atmosphere. This system includes a canister, purge control solenoid valve, fuel cut valve, and the lines connecting them.
● Fuel vapors in the fuel tank is introduced into the canister through the evaporation line, and are absorbed by activated carbon in it. The fuel cut valve is also incorporated in the fuel tank line.
● The purge control solenoid valve is controlled optimally by the ECM according to the engine condition.
● The pressure control solenoid valve incorporated in the fuel tank evaporation line regulates the pressure/vacuum in the fuel tank under the control of the ECM which uses the signal from the fuel tank pressure sensor.
● The diagnosis of the evaporative emission control system is performed by turning each solenoid valve ON/OFF to vary the pressure inside the fuel tank and measure this pressure change with the fuel tank pressure sensor in order to check for leaks and proper valve operation.



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

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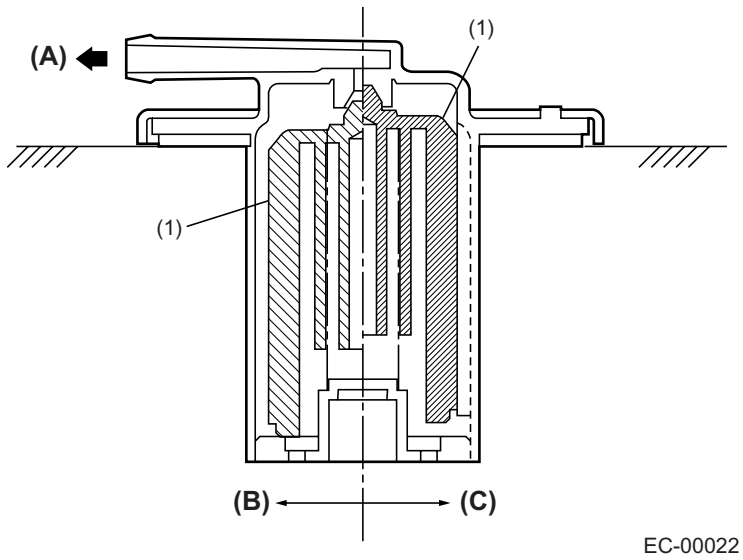
B: FUEL CUT VALVE

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



EC-00022

(1) Float

(A) To canister
(B) Valve open
(C) Valve closed

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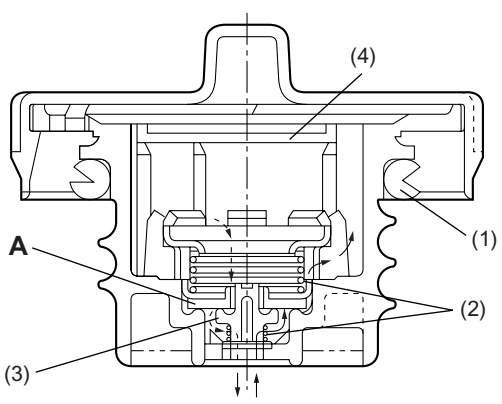
C: FUEL TANK CAP

The fuel tank cap has a relief valve which prevents development of vacuum in the fuel tank in the event of a problem with the fuel vapor line.

When there is no problem with the fuel vapor line, the filler pipe is sealed at the portion (A) and by the seal pressed against the filler pipe end. If vacuum develops in the fuel tank, the atmospheric pressure forces the spring down to open the valve; consequently outside air flows into the fuel tank, thus controlling the inside pressure.



EC-00023

(1) Seal
(2) Spring
(3) Valve
(4) Filter

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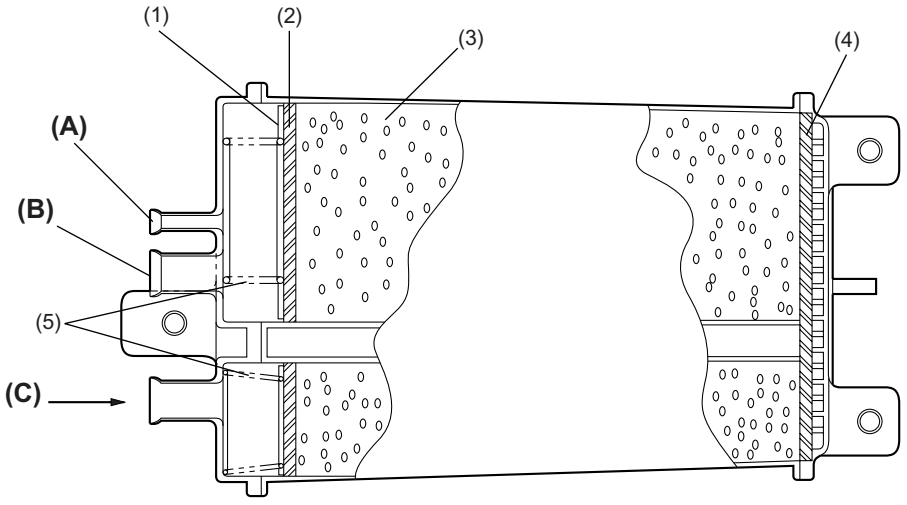
D: CANISTER

The charcoal filled in the canister temporarily stores fuel vapors. When the purge control solenoid valve is opened by a signal from the ECM, the external fresh air entering the canister carries the fuel vapors into the intake manifold.



EC-00024

(1) Grid
(2) Filter
(3) Activated charcoal
(4) Filter
(5) Spring

(A) To purge control solenoid valve
(B) From fuel tank
(C) Air

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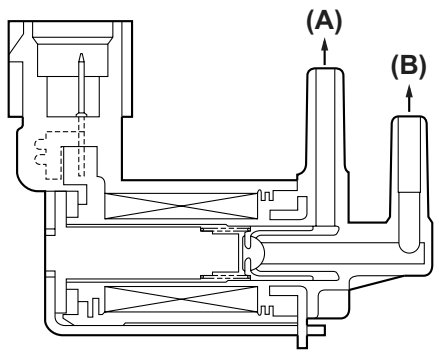
E: PURGE CONTROL SOLENOID VALVE

The purge control solenoid valve is on the evaporation line between the canister and intake manifold. The valve is installed under the intake manifold.



EC-00025

(A) To canister

(B) To intake manifold

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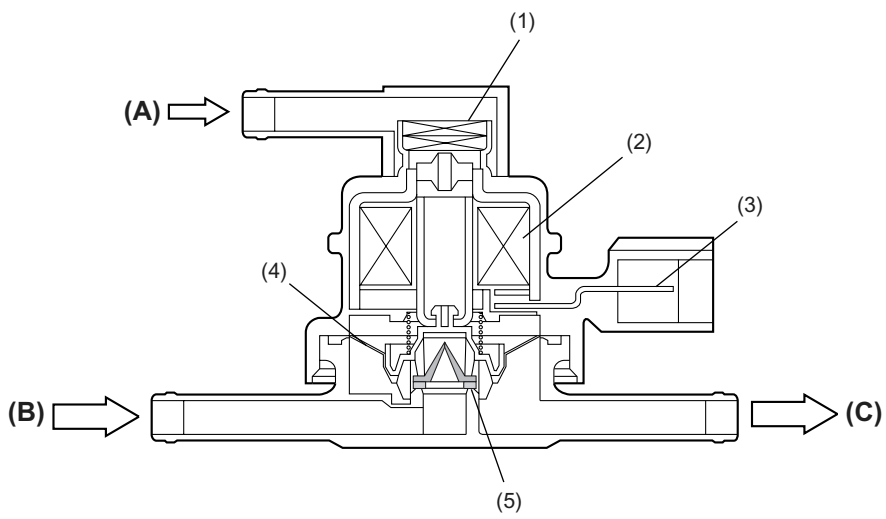
F: PRESSURE CONTROL SOLENOID VALVE

The fuel tank pressure control solenoid valve is located in the evaporation line between the canister and the fuel tank.
When the tank inside pressure becomes higher than the atmospheric pressure, the valve is opened allowing fuel vapors to be introduced into the canister.
On the other hand, when the tank inside pressure becomes lower than the atmospheric pressure, external air is taken from the drain valve into the canister.
The pressure control solenoid valve can also be electrically closed for diagnosis of the evaporative emission control system.



EC-00026

(1) Filter
(2) Coil
(3) Connector terminal
(4) Diaphragm
(5) Valve

(A) Atmospheric pressure
(B) Shut-off valve
(C) To fuel tank

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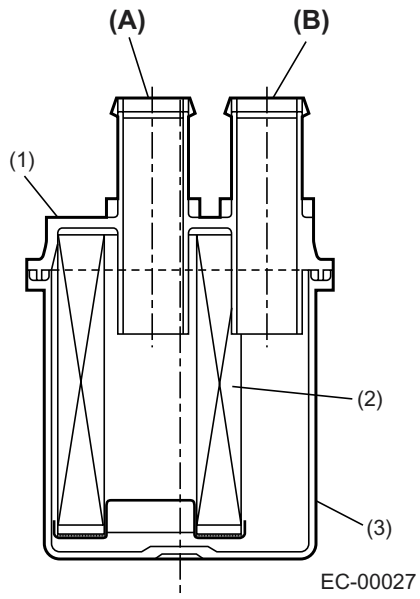
G: DRAIN FILTER

The drain filter is installed at the air inlet port of the drain valve. It cleans the air taken in the canister through the drain valve.



(1) Cap
(2) Element
(3) Case

(A) To drain valve
(B) To atmosphere

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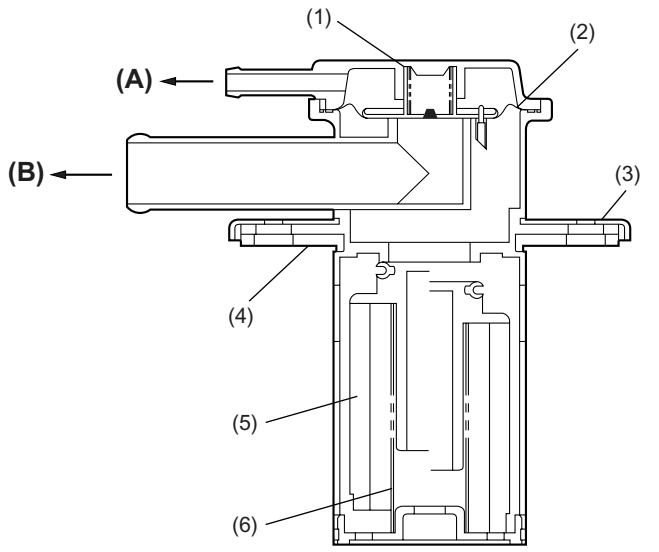
H: VENT VALVE

The vent valve is located in the fuel tank. During filling the fuel tank, fuel vapors are introduced into the canister through the vent valve.
When the fuel vapor pressure becomes higher than the atmospheric pressure and overcomes the spring force which is applied to the back side of the diaphragm, the port toward the canister is opened. The vent valve also has a float which rises and block the port toward the canister when the fuel is full.



EC-00028

(1) Spring
(2) Diaphragm
(3) Plate cover
(4) Packing
(5) Float
(6) Float spring

(A) To filler pipe
(B) To canister

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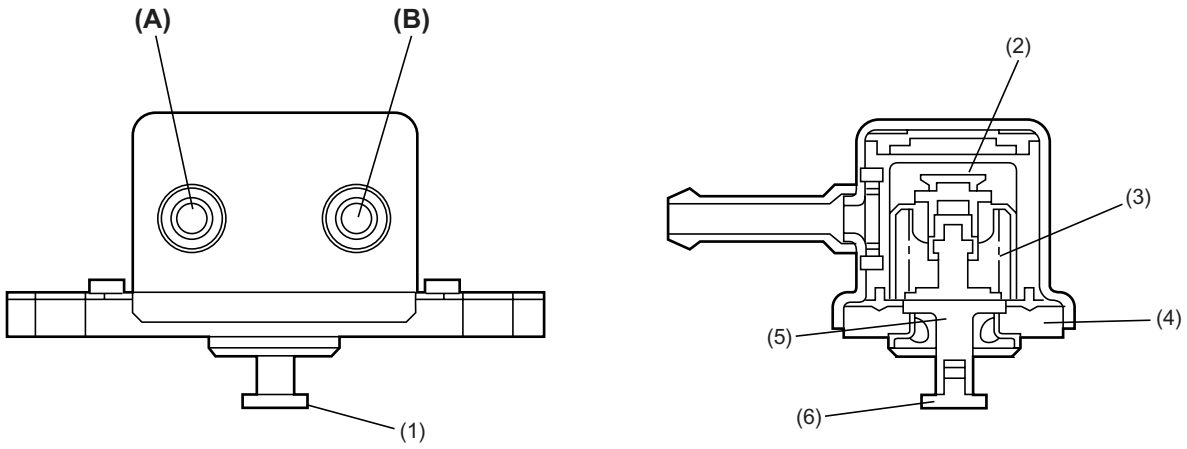
I: SHUT-OFF VALVE

The shut-off valve is located at the top of the fuel filler pipe. When a filler gun is inserted into the filler pipe, the shut-off valve closes the evaporation line.



EC-00029

(1) Pin
(2) Valve
(3) Spring
(4) Plate
(5) Shaft
(6) Pin

(A) To canister
(B) To fuel tank

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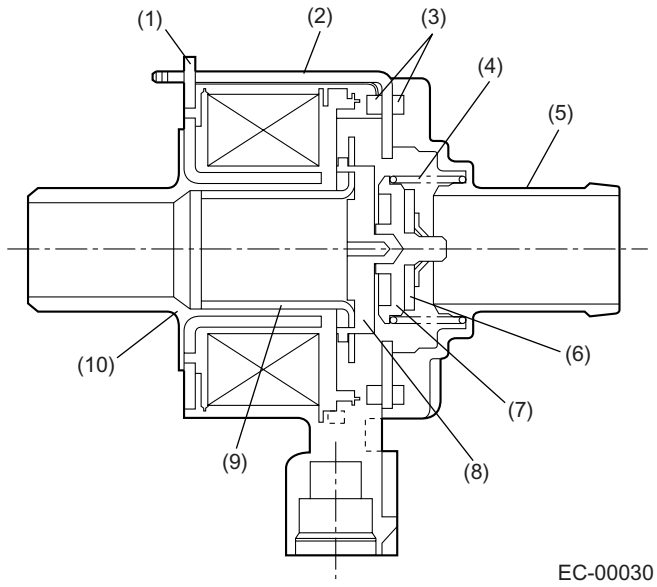
J: DRAIN VALVE

The drain valve is located on the line connecting the drain filter and canister, 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.



EC-00030

(1) Magnetic plate
(2) Yoke
(3) Packing
(4) Spring
(5) Valve seat
(6) Valve
(7) Plate
(8) Retainer
(9) Moving core
(10) Bobbin

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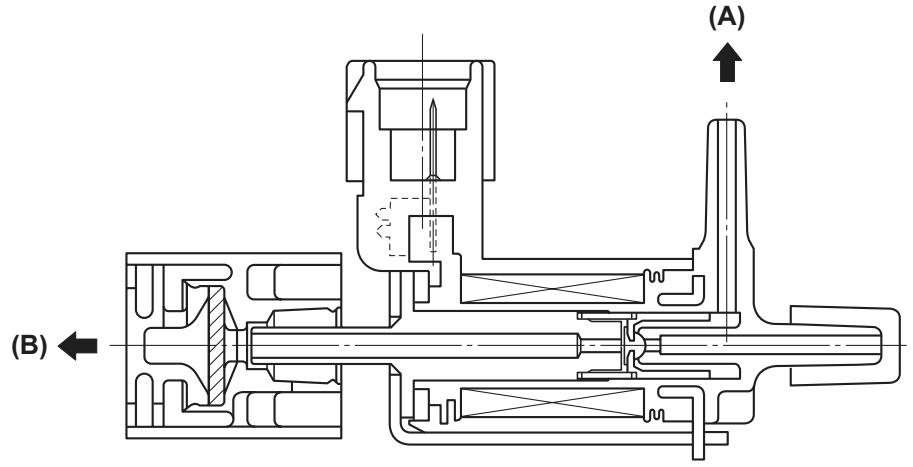
K: FUEL TANK SENSOR CONTROL VALVE

The fuel tank sensor control valve is installed on the top of the fuel tank and its one end is connected to the fuel tank pressure sensor while its other end is open to the atmosphere.
Normally the passage to the fuel tank pressure sensor is open to the atmosphere, however, the passage is closed when the ECM sends a signal to make a diagnosis of the evaporative emission control system.



EC-00214

(A) Fuel tank pressure sensor
(B) Atmosphere

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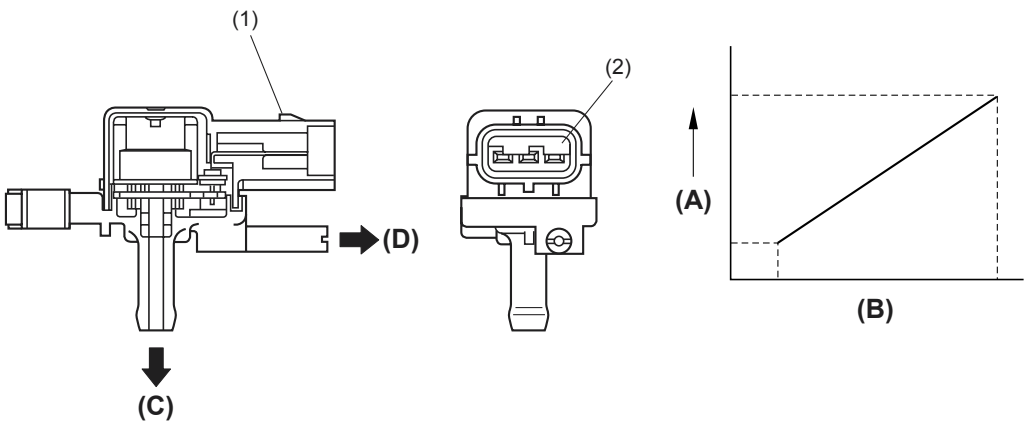
L: FUEL TANK PRESSURE SENSOR

The fuel tank pressure sensor is installed on the top of the fuel tank and measures the pressure in the fuel tank.
The measured pressure is converted into an electrical signal and sent to the ECM for diagnosis of the evaporative emission control system.



EC-00213

(1) Connector
(2) Terminal

(A) Output voltage
(B) Input pressure
(C) To fuel tank
(D) To fuel tank sensor control valve

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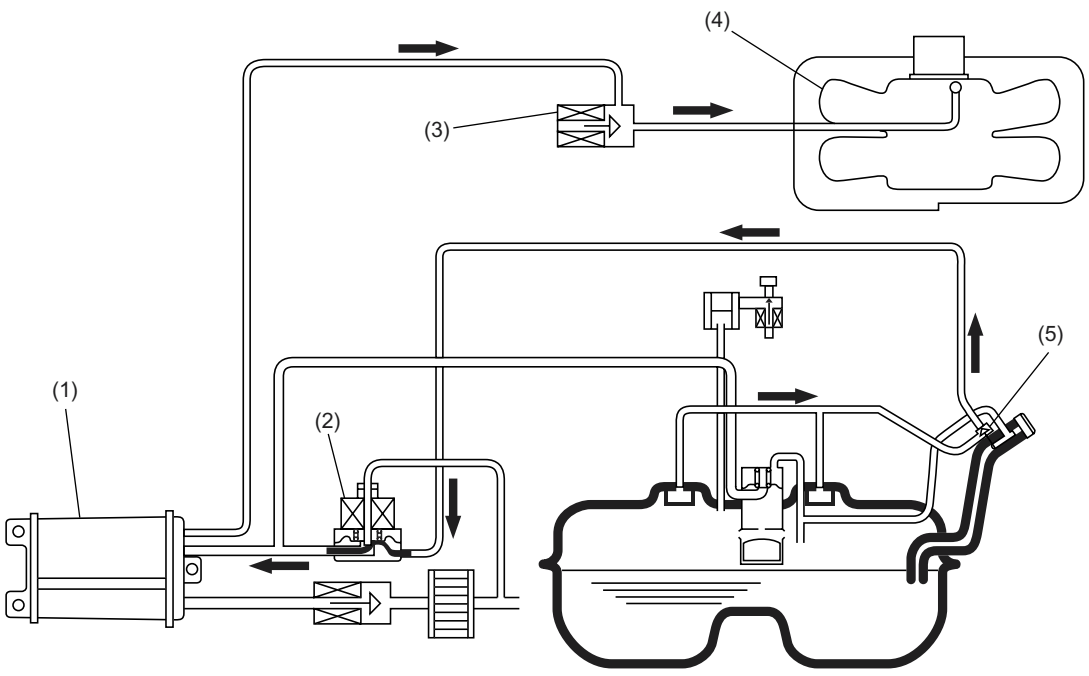
8. On-board Refueling Vapor Recovery (ORVR) System

A: GENERAL

The on-board refueling vapor recovery system allows the fuel vapors 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 data from 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 fuel vapor pressure acting on the other side of the diaphragm increases and overcomes the atmospheric pressure, it pushes the diaphragm and opens the port through which the fuel vapors make their way to the canister.



EC-00032

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

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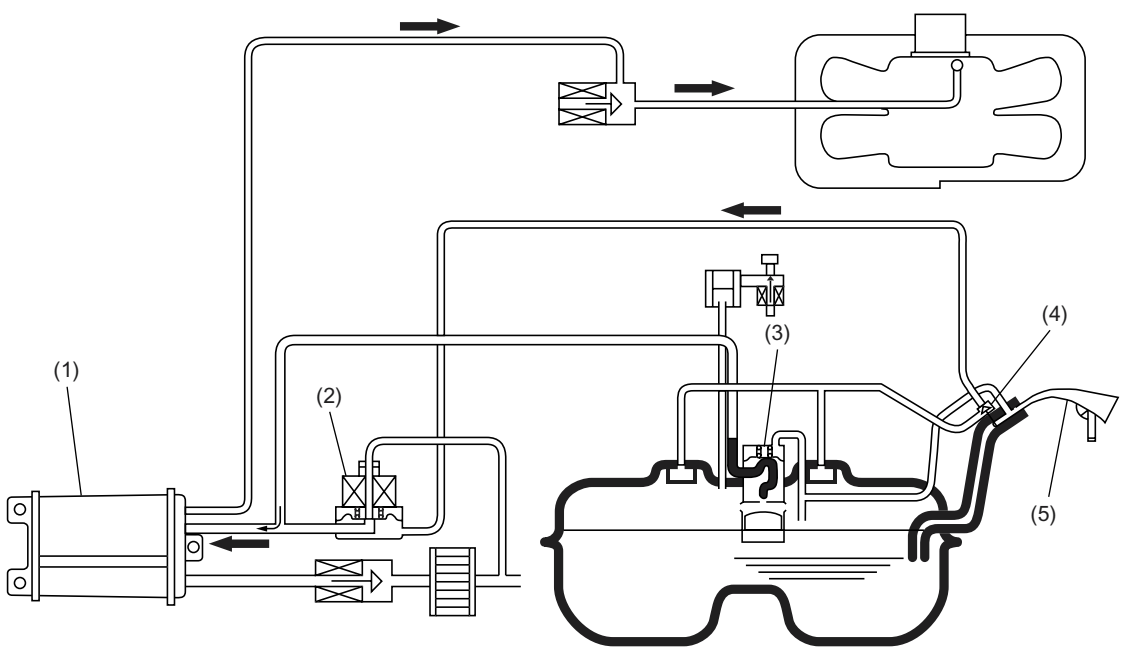
● While refueling

As the fuel enters the fuel tank, the tank inside pressure increases. When the inside pressure becomes higher than the atmospheric pressure, the port of the vent valve opens, allowing the fuel vapors to be introduced into the canister through the vent line. The fuel vapors are absorbed by charcoal in the canister, so the air discharged from the drain valve contains no fuel. When a filler gun is inserted, the shut-off valve closes the evaporation line.



EC-00033

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

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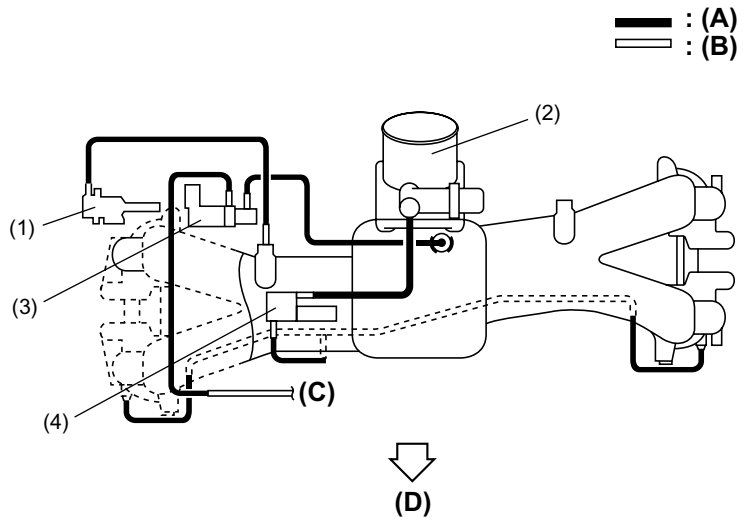
9. Vacuum Connections

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



EC-00034

(1) Pressure regulator
(2) Throttle body
(3) Purge control solenoid valve
(4) Air assist injector solenoid valve

(A) Hose
(B) Pipe
(C) To canister
(D) Front of vehicle

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EMISSION CONTROL
(AUX. EMISSION CONTROL DEVICES)

STi

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1. General

Specifications for the STi models are the same as those for turbo models. <Ref. to EC(H4DOTC) — EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES).>

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EXTERIOR INTERIOR TRIM

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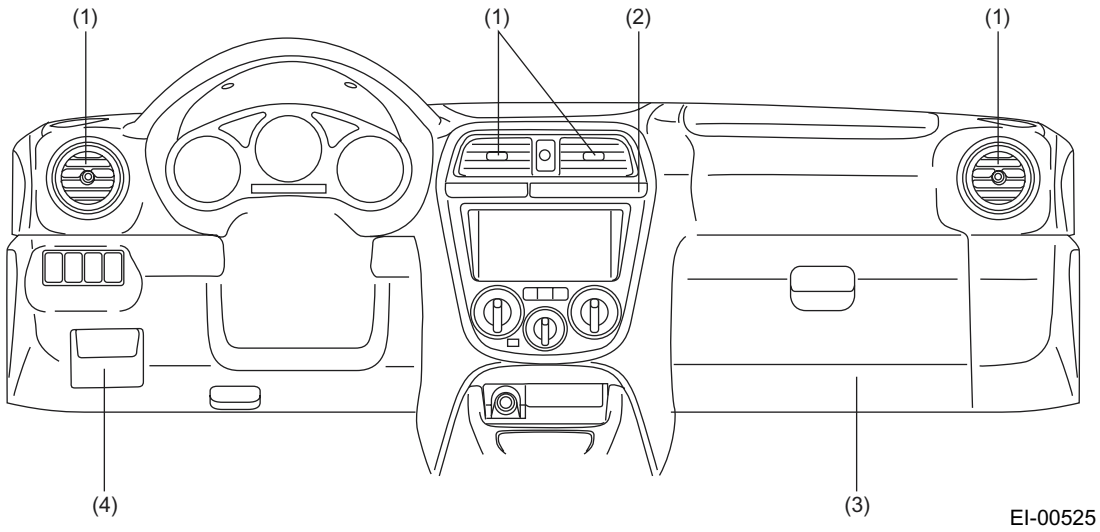
1. Instrument Panel

- A cup holder is provided on the dashboard.
- A coin tray is provided.
- The vent grills are barrel type.
- The dashboard lower cover is fitted with a knee cover.



EI-00525

(1) Barrel type vent grill
(2) Cup holders
(3) Glove box
(4) Coin tray

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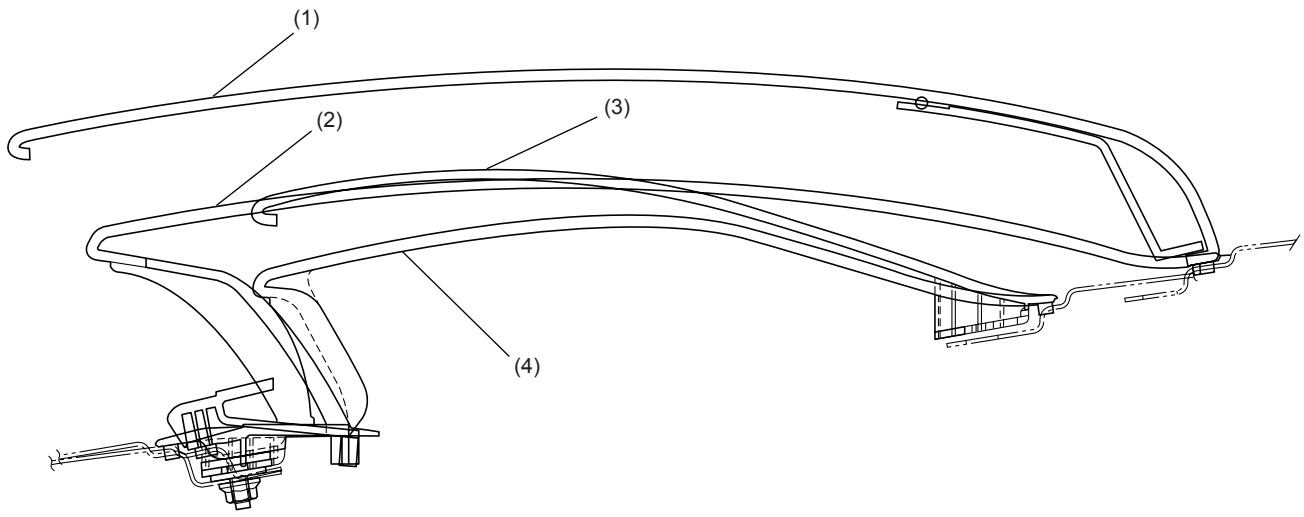
2. Front Hood Grille

The opening is widened to enhance the cooling performance of the intercooler.



EI-00527

(1) New type for STi
(2) New type for standard models
(3) Earlier type for STi
(4) Earlier type for standard models

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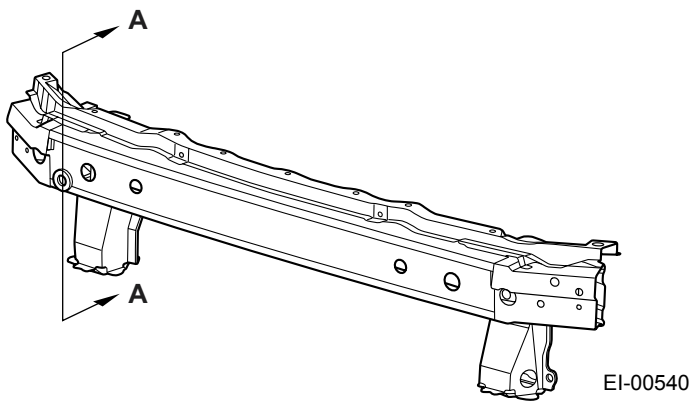
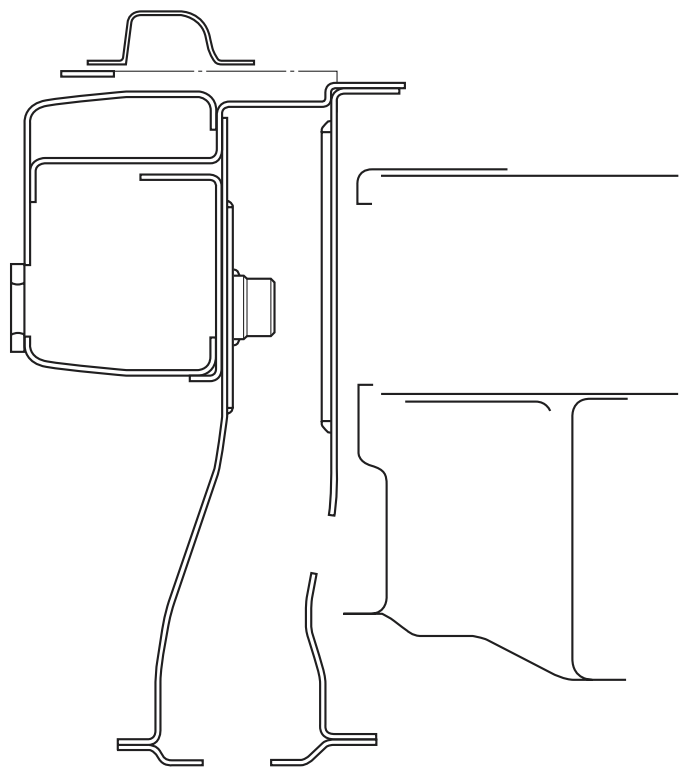
3. Front Bumper Beam Assembly

A bumper beam assembly is placed inside the front bumper. The beam assembly is fastened to the chassis frame with bolts and nuts and absorbs the shock energy in case of a front collision to enhance safety of the vehicle.



EI-00540



A–A

EI-00531

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ENTERTAINMENT

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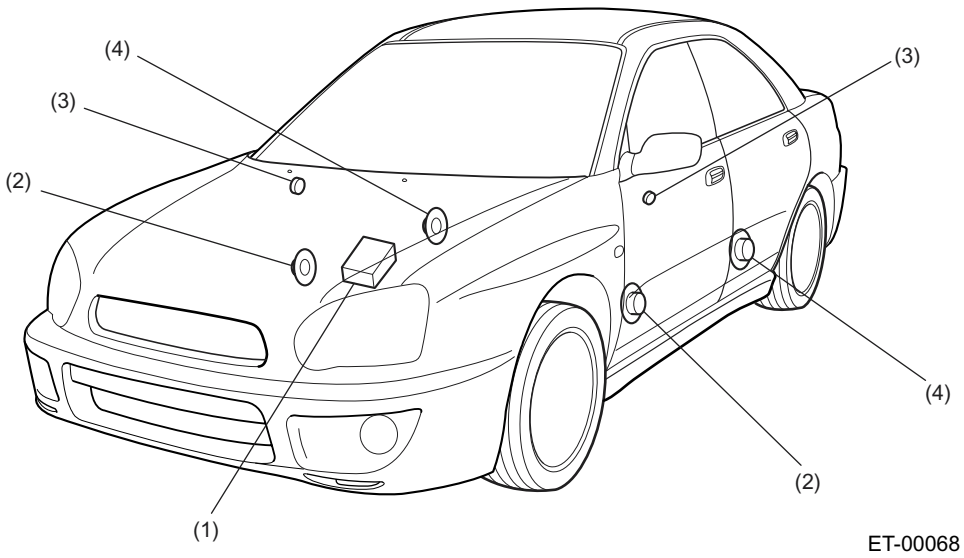
1. Audio System

A: GENERAL

- The audio unit is either a 2-DIN type or 1-DIN type depending on the model grade.
- Either a 4 speaker system consisting of 2 front speakers and 2 rear speakers, or a 6 speaker system consisting of 4 front speakers and 2 rear speakers is equipped depending on the model grade.



ET-00068

(1) Audio unit
(2) Front speaker
(3) Front tweeter
(4) Rear speaker

1. ANTENNA

- An on-glass antenna is equipped on all models.
- The antenna amplifier is installed at the bottom of the rear left pillar on sedan models or at the rear left side of the roof on wagon models.

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EXHAUST
H4DOTC

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1. General

● The exhaust system consists of left and right exhaust manifolds, a front joint pipe, a turbocharger joint pipe, a center exhaust pipe, a rear exhaust pipe and a muffler. The pre catalytic converter is incorporated in the turbocharger joint pipe, the front catalytic converter is incorporated in the center exhaust pipe, and the rear catalytic converter is incorporated in the rear exhaust pipe.

● The exhaust system features an excellent sound suppression design; the rear exhaust pipe has a chamber in addition to a large capacity muffler.

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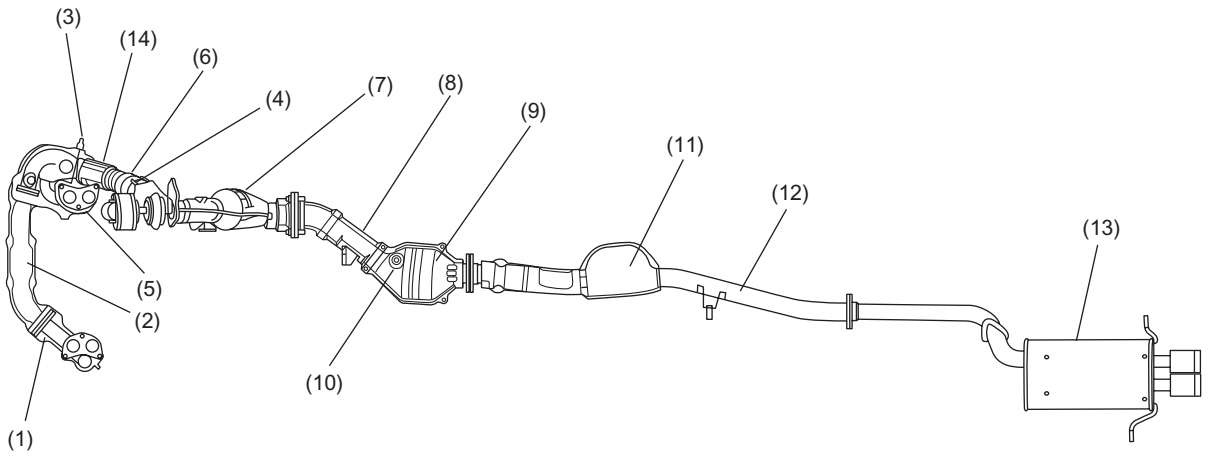
2. Construction



EX-00198

(1) Exhaust manifold (LH)
(2) Front joint pipe
(3) Front oxygen (A/F) sensor
(4) Exhaust temperature sensor
(5) Exhaust manifold (RH)
(6) Pre catalytic converter
(7) Front catalytic converter
(8) Center exhaust pipe
(9) Rear catalytic converter
(10) Rear oxygen sensor
(11) Chamber
(12) Rear exhaust pipe
(13) Muffler
(14) Turbocharger joint pipe

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EXHAUST
H4SO

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1. General

● The exhaust system consists of front exhaust pipes, three-way catalytic converters, a center exhaust pipe, a rear exhaust pipe and a muffler. The front catalytic converter and rear catalytic converter are 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 engines exhaust ports. The exhaust system also has chambers in addition to the muffler.

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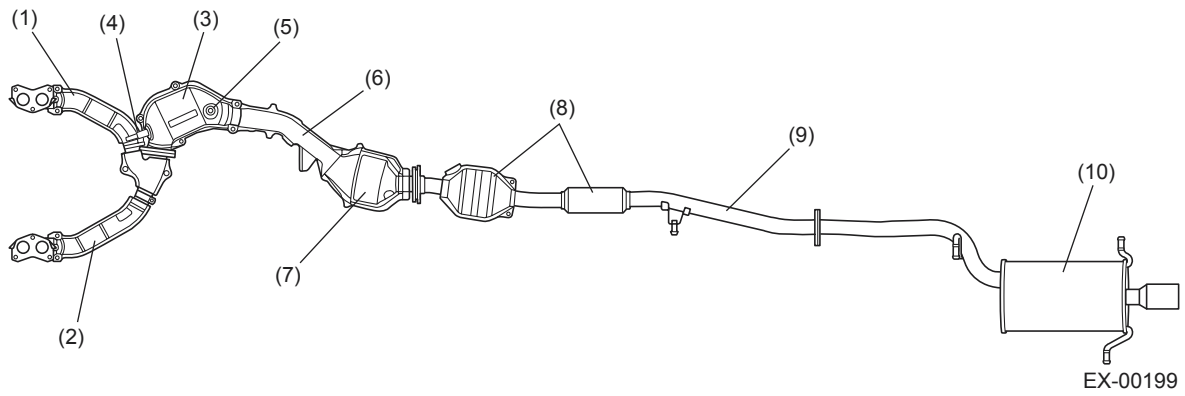
2. Construction



(1) Front exhaust pipe RH
(2) Front exhaust pipe LH
(3) Front catalytic converter
(4) Front oxygen (A/F) sensor
(5) Rear oxygen sensor
(6) Center exhaust pipe
(7) Rear catalytic converter
(8) Chamber
(9) Rear exhaust pipe
(10) Muffler

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EXHAUST
STi

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1. General

Specifications for the STi models are the same as those for turbo models. <Ref. to EX(H4DOTC) — EXHAUST.>

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FRONT SUSPENSION

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1. Front Suspension

A: GENERAL

The front suspension is a strut-type independent suspension, with cylindrical double-acting, low-pressure-gas-filled dampers and coil springs. The top of each strut assembly is attached to the body through a rubber cushion. Used in combination with other rubber cushions, this rubber cushion effectively insulate vibration and shock and thus improves ride comfort.

The transverse link is an L shaped arm design to increase steering stability and reduce road noise. The transverse link has a maintenance-free ball joint fitted by a castle nut at its outer end. The front of the link's inner end is fitted to the front crossmember through a rubber cushion and the rear of the inner end is bolted to the vehicle body through a rubber cushion.

The front crossmember is bolted to the vehicle body.

The stabilizer for wagon models is attached to the front crossmember through rubber cushions and its right and left ends are connected to the stabilizer links through rubber bushings. The lower end of the stabilizer link is connected to the transverse link through rubber bushings.

The stabilizer for sedan models is attached to the front crossmember through rubber cushions and its right and left ends are connected to the stabilizer links through ball joints. The lower end of the stabilizer link is connected to the transverse link through a ball joint.

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

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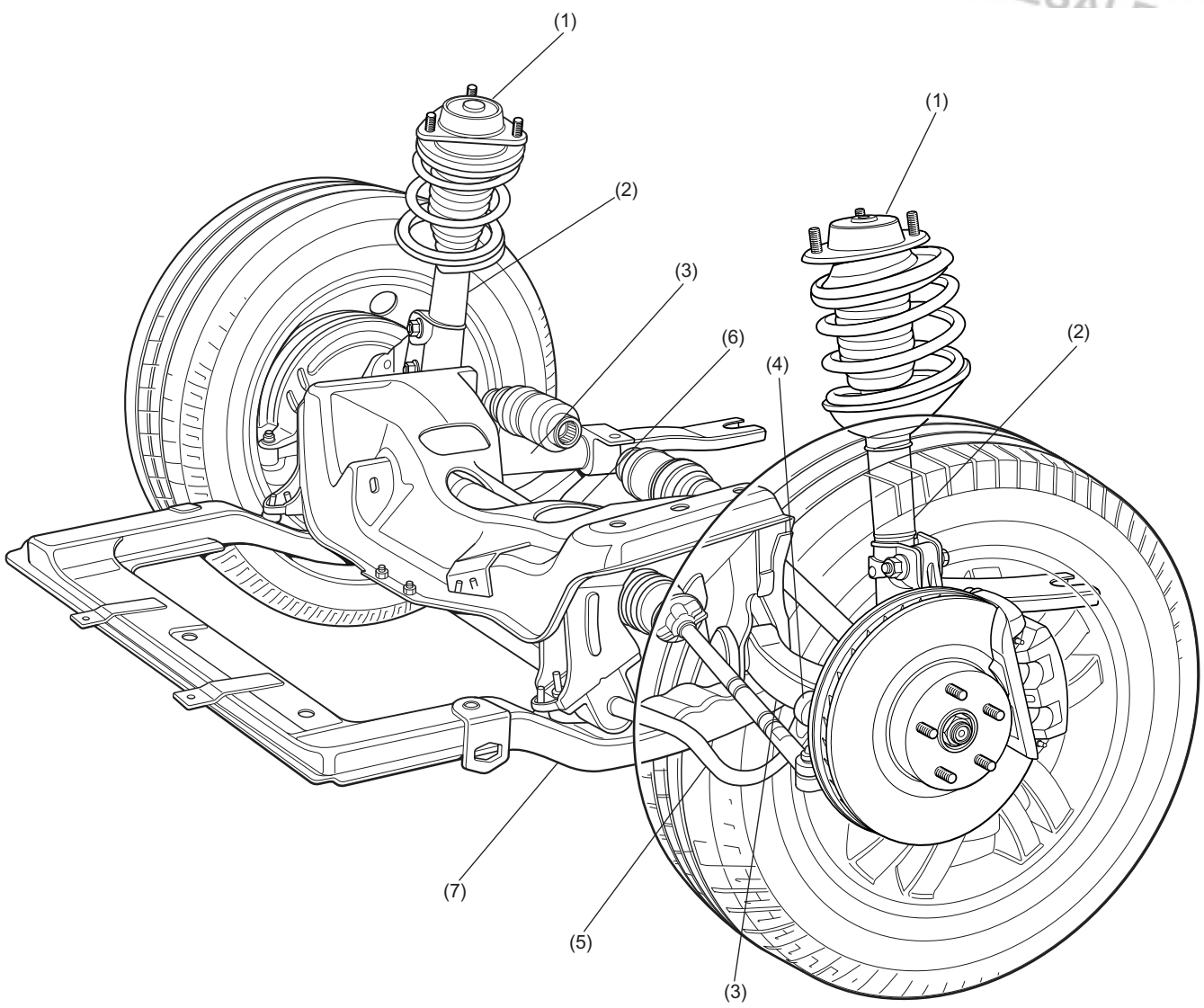
FRONT SUSPENSION



FS-00077

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

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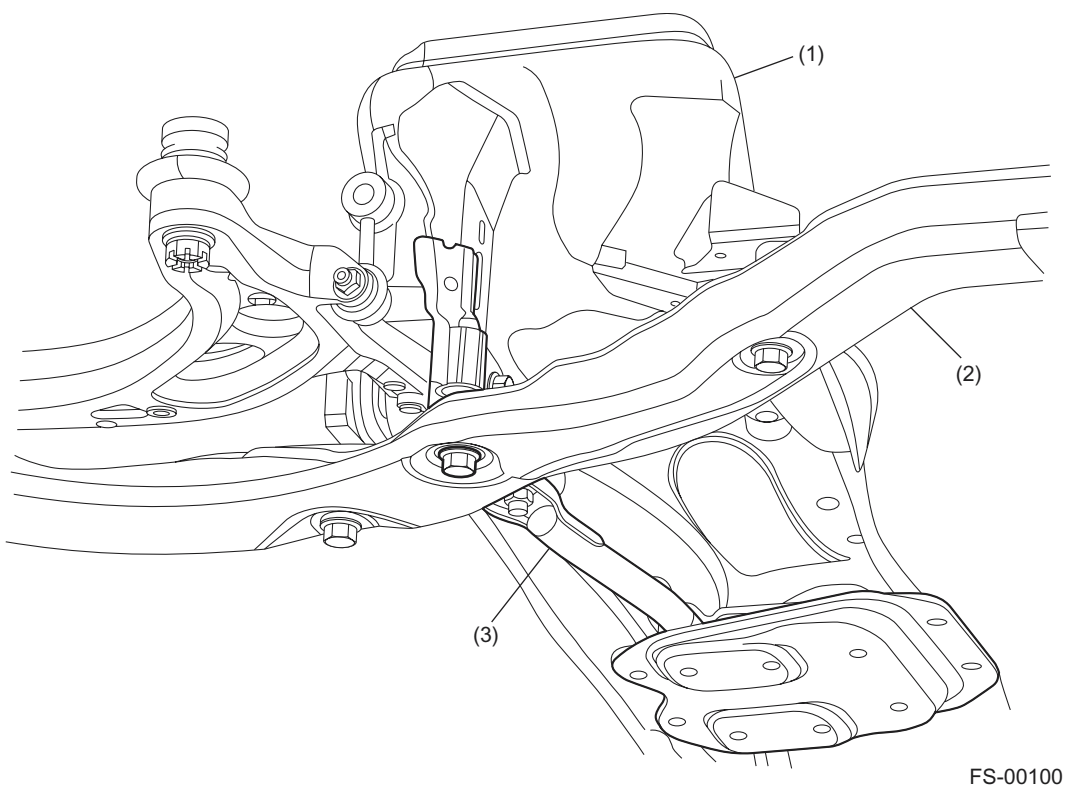
FRONT SUSPENSION

On the STi model, the shape of the front crossmember is changed and the number of fastening points to the sub frame is increased to improve steering stability.

Also, a reinforcement part (front support arm) has been added to the front suspension crossmember.



FS-00100

(1) Front crossmember
(2) Subframe
(3) Front support arm

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B: CONSTRUCTION

1. TRANSVERSE LINK

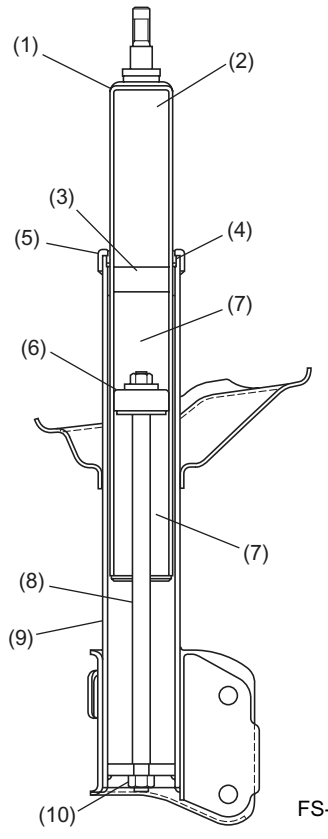
● All the sedans have a wider transverse link than wagons for enhanced handling stability. This contributes to increased tread.

● The STi model's "L" shaped transverse link are made of an aluminum alloy forging. The caster angle is increased and solid hard-type rear bushings are used. Reducing the unsprung weight, they help improve both handling stability and riding comfort.

2. STRUT

● All models except STi use struts with low-pressure-gas-filled dampers that feature stable shock attenuating performance. They improve ride quality and reduce vibration and noise.

● On the STi model, upside-down type struts with its shock absorber's top and bottom ends reversed are used. This arrangement is advantageous in increasing rigidity as it allows the diameter of the damping tube (which corresponds to the piston rod in the conventional arrangement) to be increased to an almost same diameter as the strut's outer tube diameter.



FS-00101

(1) Damping tube
(2) Gas
(3) Free piston
(4) Oil seal
(5) Cap
(6) Piston
(7) Oil
(8) Piston rod
(9) Outer tube
(10) Nut

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FRONT SUSPENSION

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FUEL INJECTION
(FUEL SYTEMS)

H4DOTC

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1. General

● The Multipoint Fuel Injection (MFI) system supplies optimum air-fuel mixture under every engine operating condition through the use of the latest electronic control technology.

This system pressurizes the fuel to a constant pressure and injects it into each intake air port in the cylinder head. The injection quantity of fuel is controlled by an intermittent injection system where an electro-magnetic injection valve or injector opens for a short period that is precisely controlled depending on the quantity of air appropriate for each condition of operation. In actual control, an optimum fuel injection quantity is achieved by varying the duration of an electric pulse applied to the injector. This way of control enables simple, yet highly precise metering of the fuel.

● The engine control module (ECM) that controls the fuel injection system corrects the fuel injection amount depending on the vehicle speed, throttle opening, coolant temperature and other vehicle-operation-related information. The ECM receives the information in the form of electric signals from the corresponding sensors and switches.

The MFI system also has the following features:

● Reduced exhaust emissions
● Reduced fuel consumption
● Increased engine output
● Quick response to accelerator and brake pedal operation
● Superior startability and warm-up performance in cold weather due to corrective controls made according to coolant and intake air temperatures

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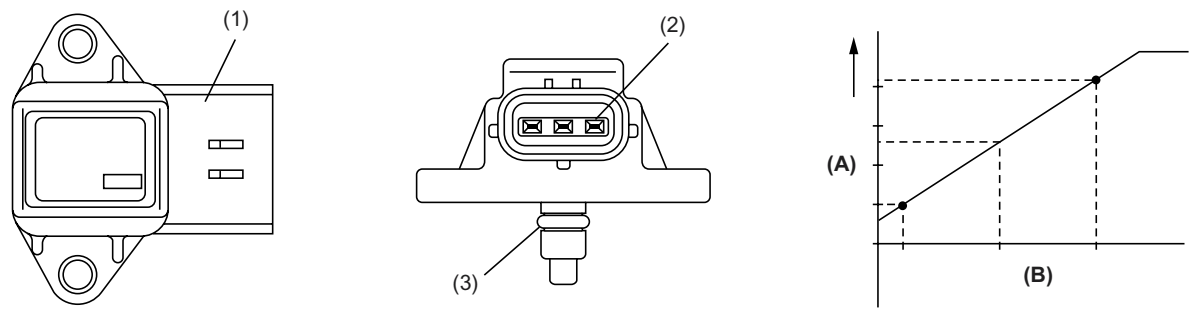
2. Air Line

A: GENERAL

The air filtered by the air cleaner enters the throttle body where it is regulated in the volume by the throttle valve and then enters the intake manifold. It is then distributed to each cylinder where the air is mixed with fuel injected by the injector. During idling operation, air flows into the cylinder through the idle air control solenoid valve, bypassing the throttle valve. This enables controlling the engine idling speed properly.

B: MANIFOLD ABSOLUTE PRESSURE SENSOR

The manifold absolute pressure sensor is attached to the top of the throttle body, and continuously sends to the engine control module (ECM) voltage signals that are proportional to intake manifold absolute pressures. The ECM controls the fuel injection and ignition timing based on the intake manifold absolute pressure signals in addition to other signals from many sensors and other control modules.



FU-00343

(1) Connector
(2) Terminal
(3) O-ring

(A) Output voltage
(B) Absolute pressure

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C: THROTTLE BODY

● In response to operation of the accelerator pedal, the throttle valve in the throttle body opens/closes to regulate the volume of the air drawn into the combustion chamber.

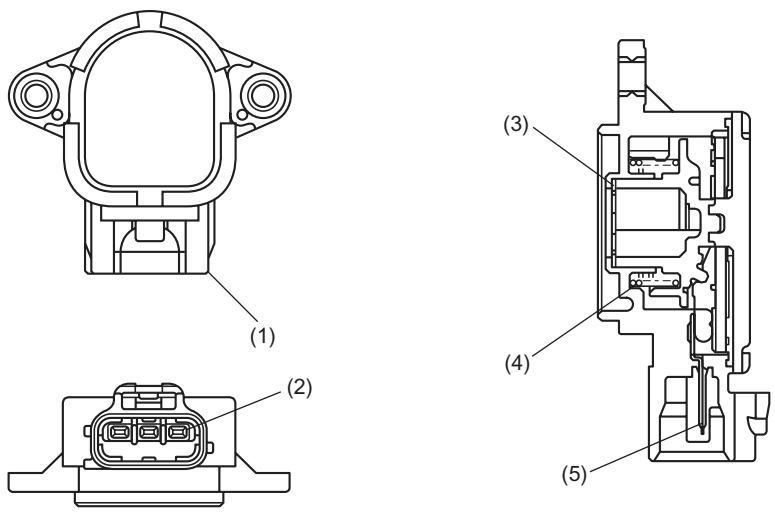
● During idling the throttle valve is almost fully closed and the volume of air passing the throttle valve becomes less than the amount of air that pass through the idle air control solenoid valve.

● More than half of the air necessary for idling is supplied to the intake manifold via the idle air control solenoid valve which controls properly the engine idling speed, so the idling speed needs not be adjusted.

D: THROTTLE POSITION SENSOR

● The throttle position sensor is mounted in the throttle body and linked to the throttle valve.

● The throttle position sensor sends the ECM voltage signal corresponding to the opening of the throttle valve. When the sensor's output voltage exceeds a predetermined level, the ECM interprets it as complete closure of the throttle valve. When the output voltage is at another predetermined level, the ECM recognizes that the throttle valve is at a wide open position. Since the output characteristics of the sensor change over years, the ECM is provided with a learning function to be able to interpret signals into throttle valve angles always correctly.



FU-00344

(1) Connector
(2) Terminal
(3) Wave washer
(4) Return spring
(5) Terminal

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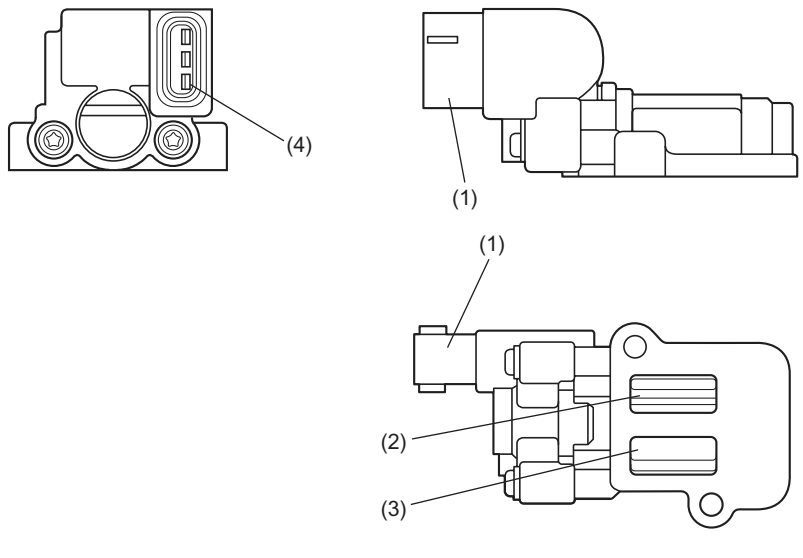
E: IDLE AIR CONTROL SOLENOID VALVE

● The idle air control solenoid valve is located in the throttle body and regulates the amount of intake air that flows bypassing the throttle valve into the intake manifold during engine idling. It is activated by a signal from the ECM in order to maintain the engine idling speed at a target speed.

● The idle air control solenoid valve is a solenoid-actuated rotary valve consisting of a coil, rotary valve, spring and housing. The housing is an integral part of the throttle body and provided with a bypass air port whose opening area is changed by the rotary valve.



FU-00345

(1) Connector
(2) Outlet port
(3) Inlet port
(4) Terminal

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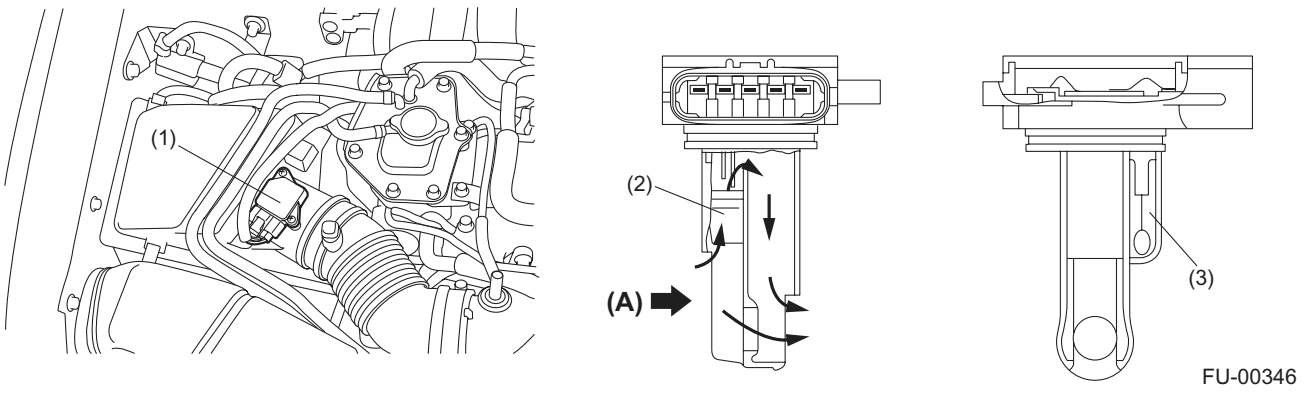
F: MASS AIR FLOW AND INTAKE AIR TEMPERATURE SENSOR

The mass air flow and the intake air temperature sensors are integrated into a single unit. The unit is mounted on the air cleaner case and measures the amount as well as the temperature of the intake air.
The measured amount and temperature are converted into electrical signals and sent to the ECM. The ECM uses these signals to control injection and ignition timing as well as the fuel injection amount.



(1) Mass air flow and intake air temperature sensor
(2) Mass air flow sensor
(3) Intake air temperature sensor
(A) Air

G: TUMBLE GENERATOR VALVE

- A tumble generator valve is provided on each engine bank, between the intake manifold and intake air ports. The right bank tumble generator valve has butterfly valves for the #1 and #3 cylinders and the left bank tumble generator valve has those for the #2 and #4 cylinders. The two butterfly valves in each tumble generator valve are fitted on a single shaft that is driven by an actuator.

- The tumble generator valves are controlled by the ECM according to the coolant temperature and the time elapsed after start of the engine. When the engine is started, the butterfly valves are moved to the closing ends. In this state, the intake air flows at very high speeds passing through narrowed passages in the directions determined by the individual intake air ports in the cylinder head. This creates tumbling air motions in the cylinders, which enables lean mixtures to be ignited and thus harmful exhaust emissions to be reduced during engine start. The tumble generator valves are fully open when the engine is operating at an ordinary driving speed, allowing intake air to flow without being changed in direction and velocity.

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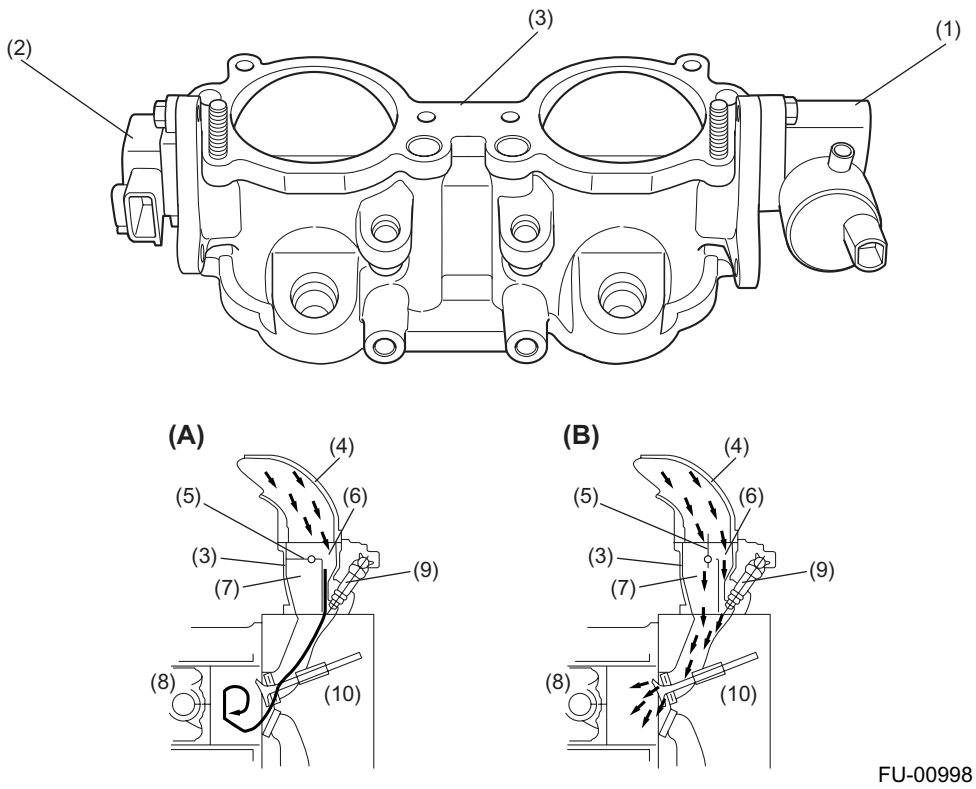

FU-00998

(A) Activated
(B) Not activated
(1) Actuator
(2) Tumble generator valve position sensor
(3) Tumble generator housing
(4) Intake manifold
(5) Tumble generator valve
(6) Tumble generating air passage
(7) Intake main air passage
(8) Piston
(9) Injector
(10) Cylinder Head

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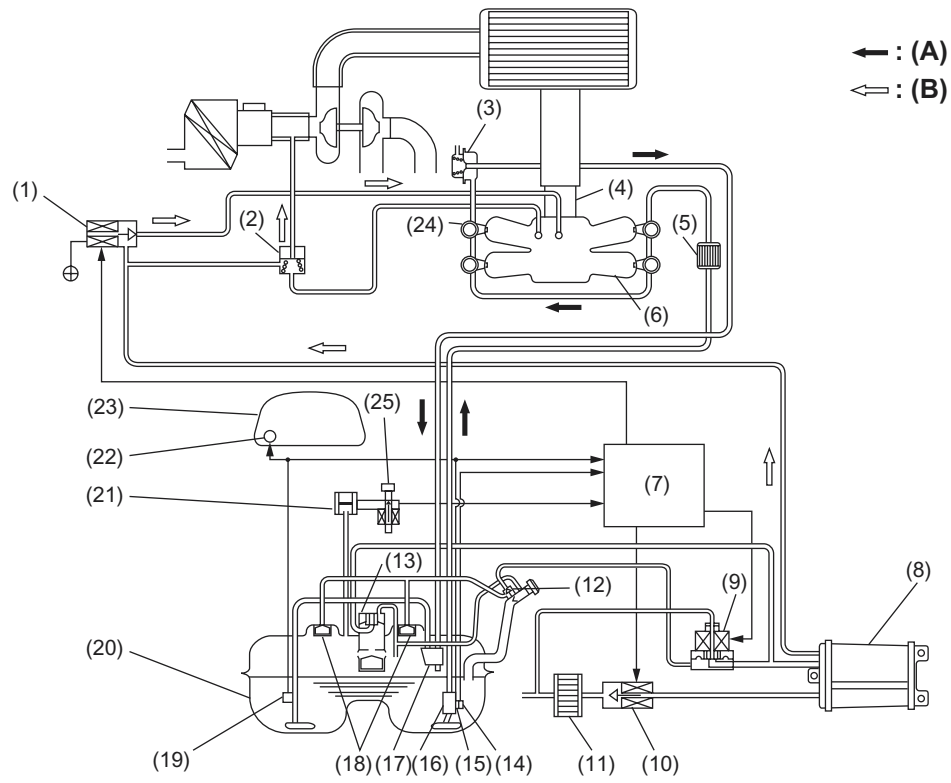
3. Fuel System

A: GENERAL

● The fuel pressurized by the fuel tank inside pump is delivered to each fuel injector by way of the fuel pipe and fuel filter. Fuel injection pressure is regulated to an optimum level by the pressure regulator.

● Each injector injects fuel into the intake port of the corresponding cylinder where the fuel is mixed with air. The mixture then enters the cylinder.

Fuel injection amount and timing are regulated by the ECM.



FU-00790

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

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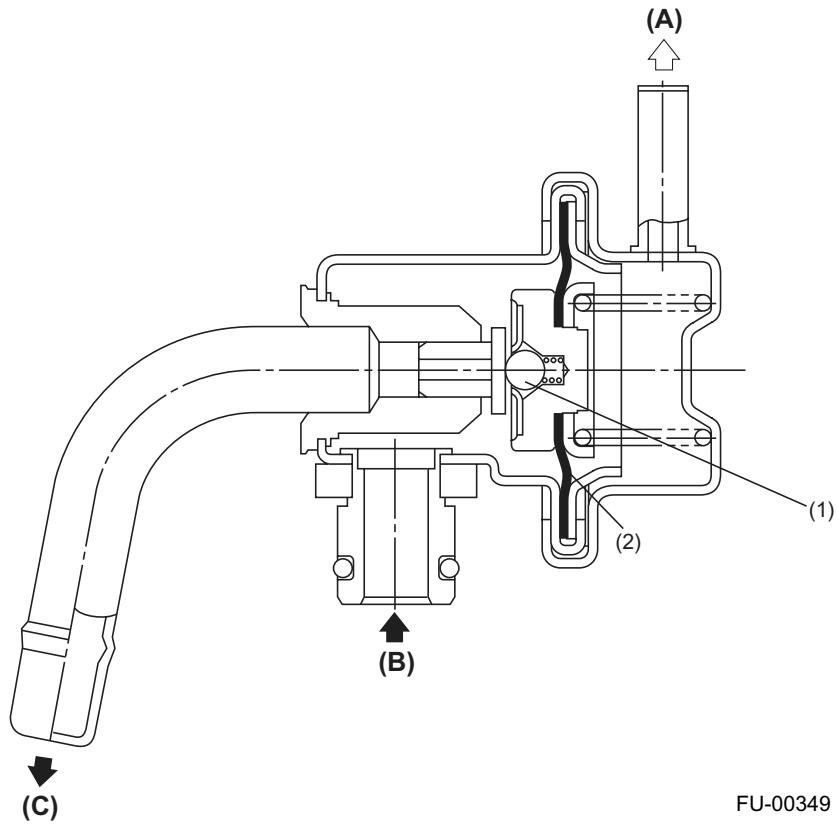
B: PRESSURE REGULATOR

The pressure regulator is installed at the injector end of the fuel supply line. It has a fuel chamber and spring chamber separated by a diaphragm. The fuel chamber is connected to the fuel supply line and the spring chamber is connected to the intake manifold. Fuel chamber also has a relief valve connected to the fuel return line through which fuel returns to the fuel tank. When the intake manifold vacuum increases, the diaphragm is pulled and the relief valve opens to decrease the fuel supply line pressure (or fuel injection pressure). When the intake manifold vacuum decreases, the diaphragm is pushed by the spring to increase the fuel supply line pressure. Thus, the difference between the fuel injection pressure and the intake manifold vacuum is kept at a constant level of 294 kPa (3.00 kgf/cm^2, 43.0 psi) to precisely control the amount of injected fuel.



FU-00349

(A) To intake manifold
(B) Fuel IN
(C) Fuel OUT

(1) Relief valve
(2) Diaphragm

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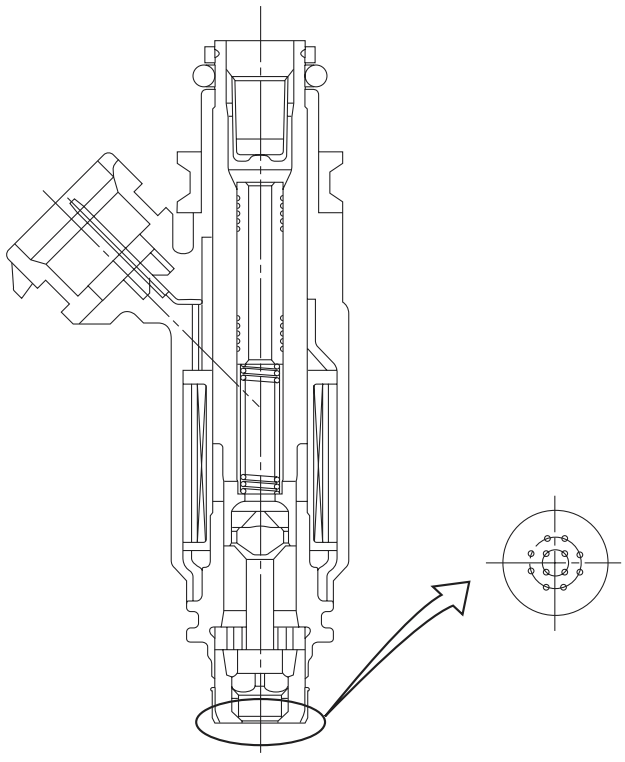
C: FUEL INJECTOR

- The MFI system employs top feed type fuel injectors.
- Each injector is installed in the fuel pipe in such a way that the injector is cooled by 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 injector injects fuel according to the valve open signal from the ECM. The needle valve is lifted by the solenoid which is energized on arrival of the valve open signal.
- Since the injector's nozzle hole area, the lift of valve and the fuel pressure are kept constant, the amount of fuel injected is controlled only by varying the duration of the valve open signal from the ECM.
- The multi-hole nozzle makes it possible for the injector to produce fine fuel particles, which enhances the combustion efficiency and output performance of the engine.



FU-00350

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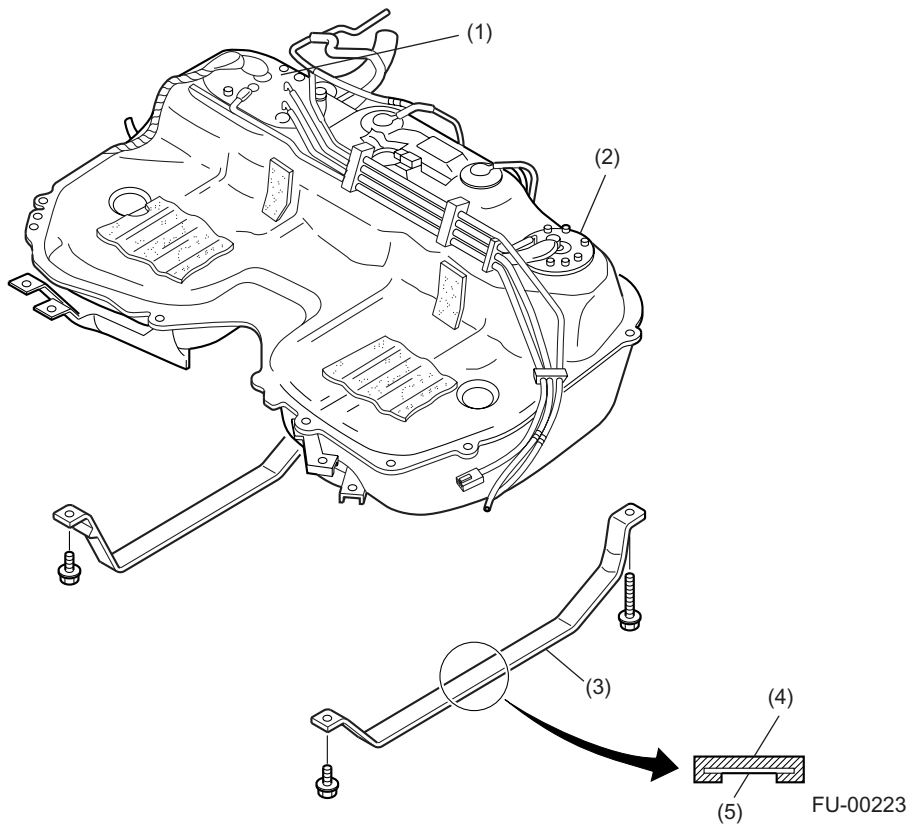
D: FUEL TANK

The fuel tank utilizes a two-compartment design to ensure sufficient capacity without interfering with the rear differential. It is provided with a suction jet pump (included in the fuel pump and fuel level sensor assembly) which transfers fuel from one compartment to the other.

Each compartment has an individual fuel level sensor. The fuel tank is located under the rear seat and secured with hold-down bands.



(1) Fuel pump and fuel level sensor assembly
(2) Fuel sub level sensor
(3) Band
(4) Cushion
(5) Steel

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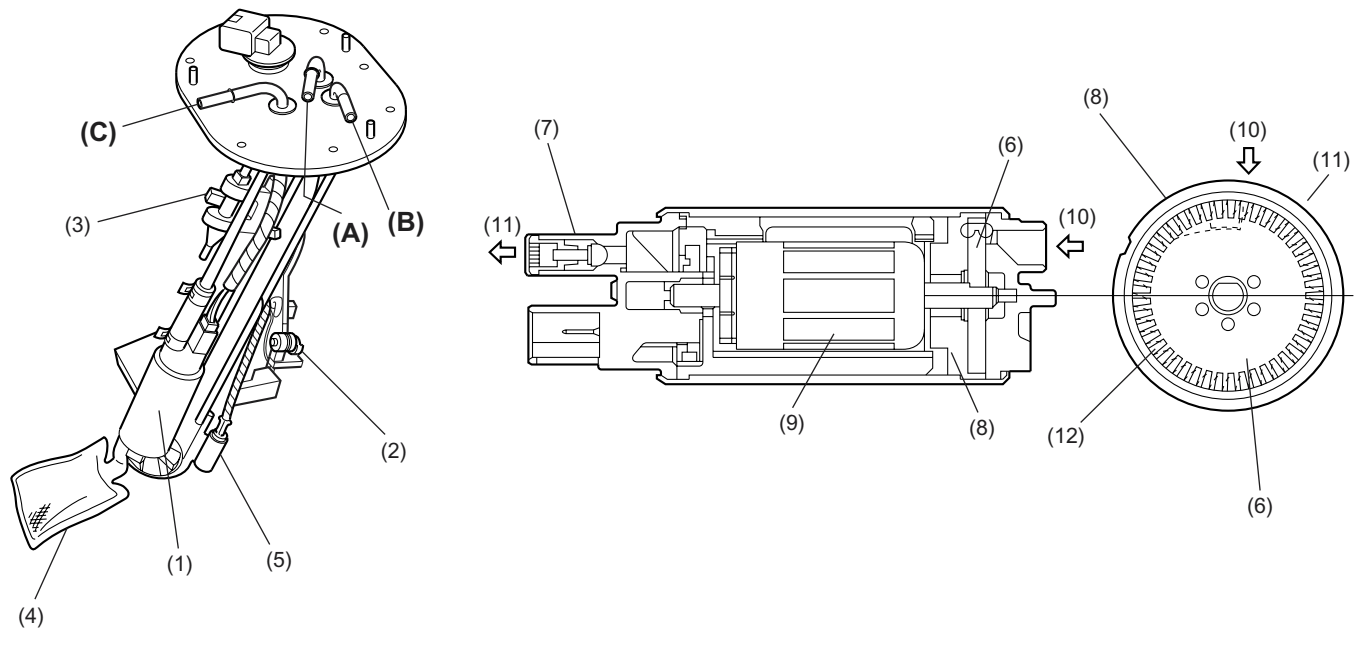
E: FUEL PUMP AND FUEL LEVEL SENSOR ASSEMBLY

1. FUEL PUMP

The fuel pump consists of a motor, impeller, pump casing, pump cover, check valve and filter. It is located in the fuel tank and combined with the fuel level sensor into a single unit. The operation of this impeller type pump is very quiet.



FU-00791

(1) Fuel pump
(2) Fuel level sensor
(3) Jet pump
(4) Mesh filter
(5) Fuel temperature sensor
(6) Impeller
(7) Check valve
(8) Pump casing
(9) Motor armature
(10) Suction
(11) Discharge
(12) Vane groove
(A) From engine (return line)
(B) From sub tank
(C) To engine (delivery line)

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- When the ignition switch is turned ON, fuel pump relay is activated. Then the motor operates to rotate the impeller.
- As the impeller rotates, fuel in a vane groove of the impeller flows along the fuel passage into the next vane groove by centrifugal force. When fuel flows from one groove to the next, a pressure difference occurs due to friction. This creates a pumping effect.
- The fuel pushed up by rotation of the impeller then passes through the clearance between the armature and the magnet of the motor and is discharged through the check valve.
- When the fuel discharge pressure reaches the specified level, the relief valve opens and excess fuel is released into the fuel tank. In this manner, the relief valve prevents an abnormal increase in fuel pressure.
- When the engine and the fuel pump stop, spring force acts on the check valve to close the discharge port, so that the fuel pressure in the fuel delivery line is retained.

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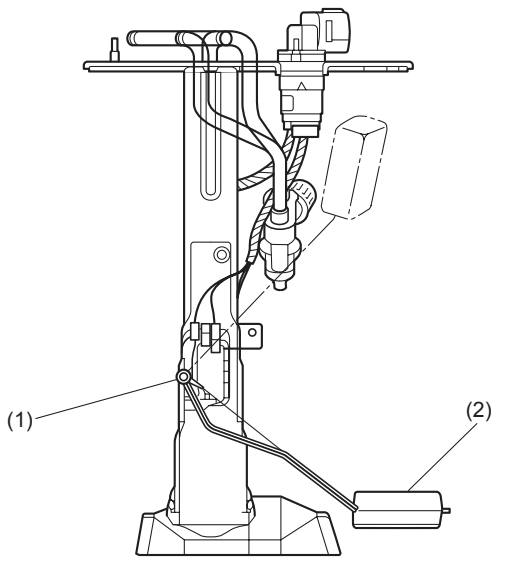
2. FUEL LEVEL SENSOR

The fuel level sensor is integrated with the fuel pump which is located in the fuel tank. The sensor outputs an electric resistance signal that varies with movement of its float to indicate the level of the fuel remaining in the tank.



FU-00351

(1) Fuel level sensor
(2) Float

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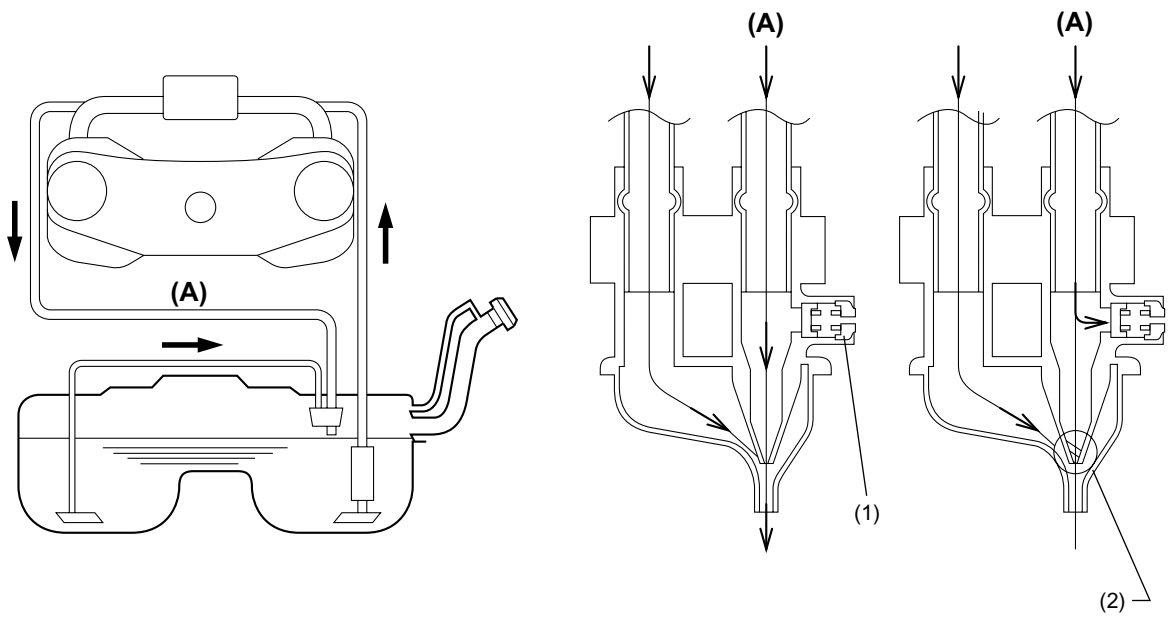
3. JET PUMP

● The jet pump utilizes the velocity of fuel returning from the engine to produce negative pressure in it.

● Using the pumping effect produced by the negative pressure, the jet pump transfers fuel from the sub-compartment to the main compartment of the fuel tank.

● 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.



FU-00226

(1) Relief valve
(2) Nozzle

(A) Return line

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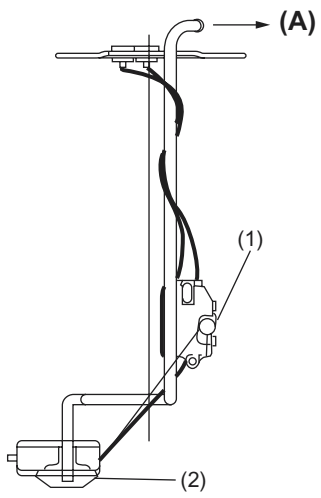
F: SUB-COMPARTMENT FUEL LEVEL SENSOR

This sensor detects the level of the fuel in the sub-compartment (the compartment in which the fuel pump is not located) and acts as part of the fuel transfer line when the jet pump is in operation to maintain the fuel in both compartments at the same level.



FU-00227

(1) Fuel level sensor
(2) Float

(A) To jet pump

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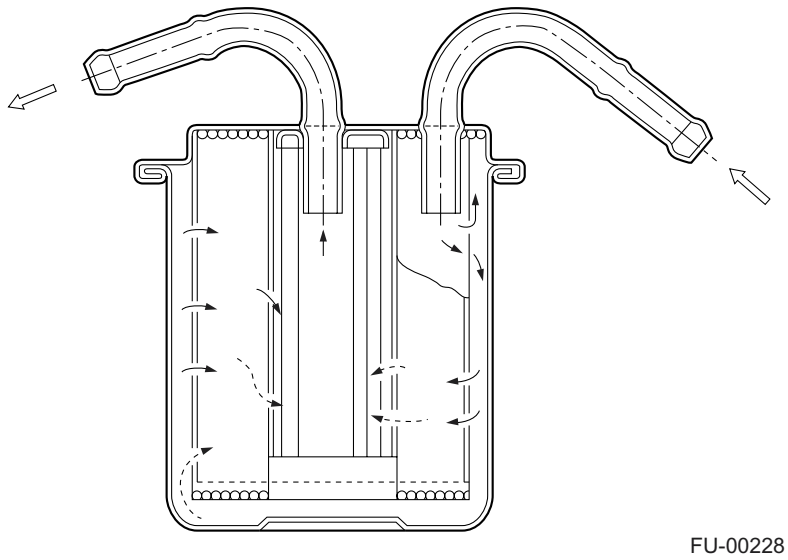
G: FUEL FILTER

The fuel filter located in the engine compartment is a pressure-withstanding, cartridge type. It has a filter element in a metal case. The fuel entering the filter flows from the perimeter of the element to the center of the filter and goes out from there.



FU-00228

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4. Sensors and Switches

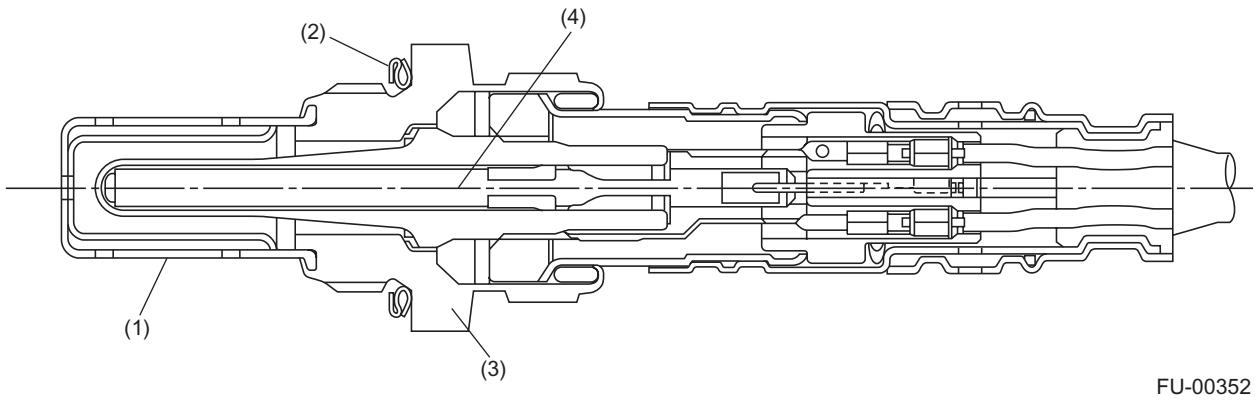
A: FRONT OXYGEN (A/F) SENSOR

• 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 its both sides are exposed to oxygen ions of different concentration and the magnitude of this electromotive force depends on how much the difference is.
The front oxygen (A/F) sensor detects the amount of oxygen in exhaust gases by making use of this property of the zirconium oxide material.

• The zirconium oxide material is formed into a closed end tube and its external surface is exposed to exhaust gases with smaller oxygen ion concentration, whereas its internal surface is exposed to atmospheric air. The external surface has a porous platinum coating. The sensor housing is grounded to the exhaust pipe and the inside is connected to the ECM through the harness to be able to use the current output from the sensor.

• The sensor incorporates a ceramic heater to improve its performance at low temperatures.



FU-00352

(1) Protection tube
(2) Gasket
(3) Sensor housing
(4) Ceramic heater

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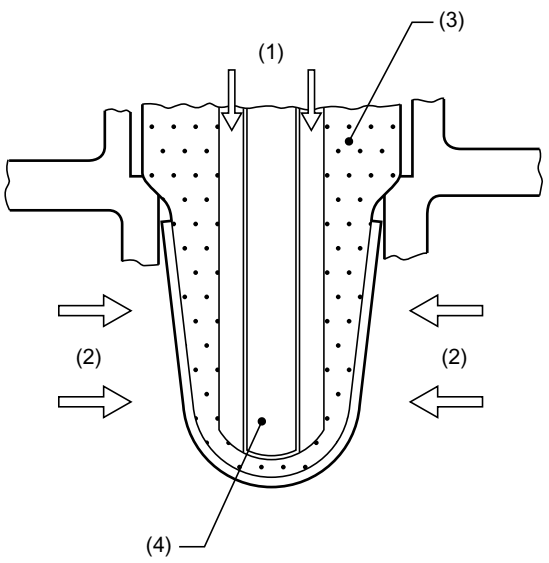
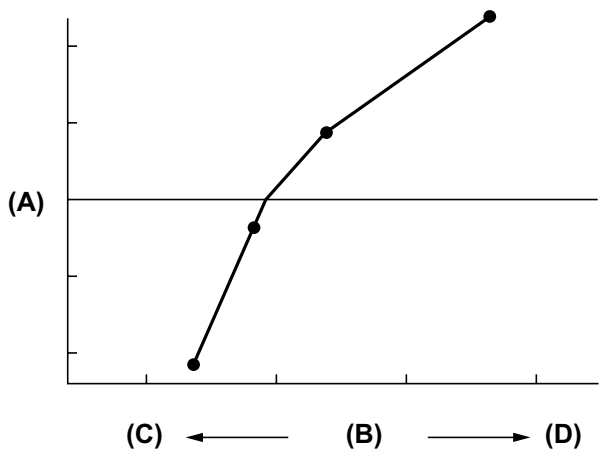
● When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases is almost completely used in the catalytic reaction by the platinum coating on the external surface of the zirconia tube. This results in a very large difference in the oxygen ion concentration between the inside and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

● When a lean air-fuel mixture is burnt in the cylinder, relatively large amount of oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen ion concentration between the tube's internal and external surfaces. The electromotive force in this case is very small.

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





FU-00230

(1) Atmospheric air
(2) Exhaust gases
(3) ZrO_2
(4) Ceramic heater

(A) Electromotive force
(B) Air/fuel ratio
(C) Lean
(D) Rich

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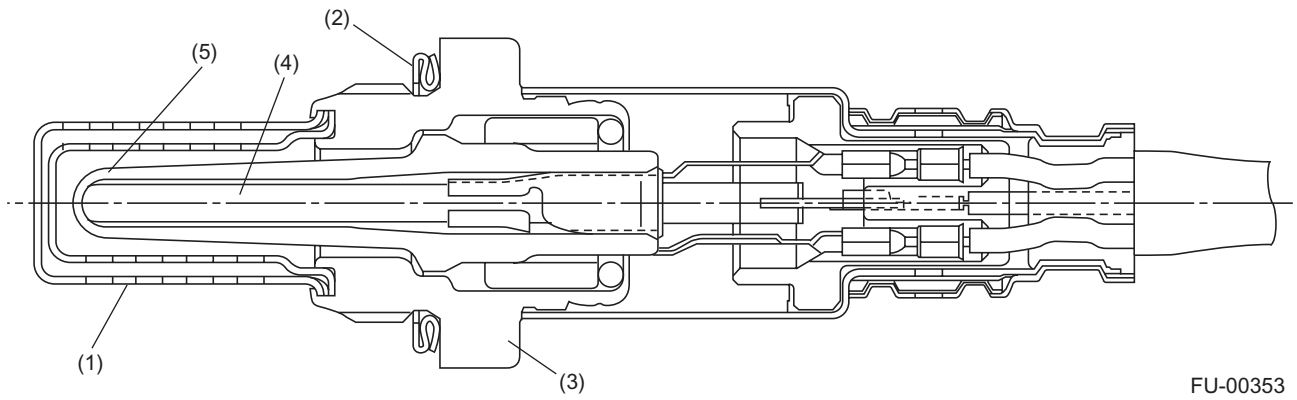
B: REAR OXYGEN SENSOR

- The rear oxygen sensor is used to sense oxygen concentration in the exhaust gas. If the air-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 almost no oxygen.
- Detecting the oxygen concentration in exhaust gas using the oxygen sensor makes it possible to determine 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 ion concentration between the inside and outside of the tube. Platinum is coated on the inside and outside of the zirconia tube as a catalysis and electrode material. 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 temperatures.



FU-00353

(1) Protection tube
(2) Gasket
(3) Sensor housing
(4) Ceramic heater
(5) Zirconia tube

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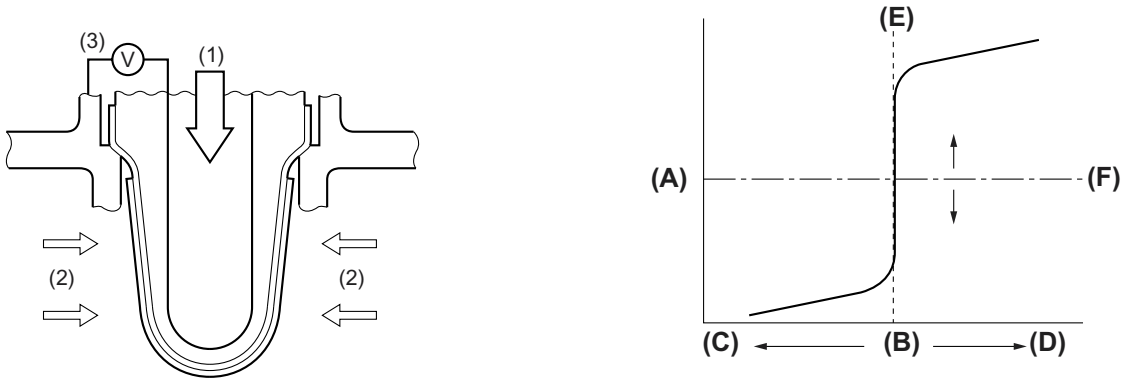
● When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases is almost completely used in the catalytic reaction by the platinum coating on the external surface of the zirconia tube. This results in a very large difference in the oxygen ion concentration between the inside and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

● When a lean air-fuel mixture is burnt in the cylinder, relatively large amount of oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen ion concentration between the tube's internal and external surfaces. The electromotive force in this case is very small.

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



FU-01010

(1) Atmospheric air
(2) Exhaust gases
(3) Electromotive force

(A) Electromotive force
(B) Air/fuel ratio
(C) Lean
(D) Rich
(E) Stoichiometric ratio
(F) Comparison voltage

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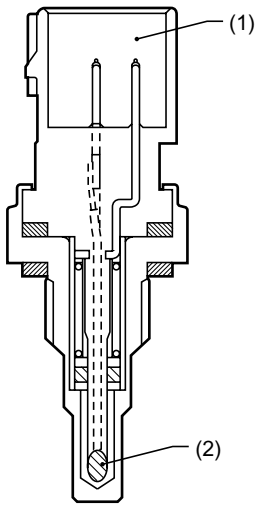
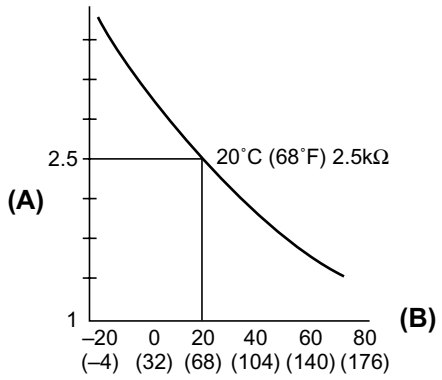
C: ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor is located on the engine coolant pipe. The sensor uses a thermistor whose resistance changes inversely with temperature. Resistance signals as engine coolant temperature information are transmitted to the ECM to make fuel injection, ignition timing, purge control solenoid valve and other controls.





FU-00233

(1) Connector
(2) Thermistor element

(A) Resistance (kΩ)
(B) Temperature °C (°F)

D: EXHAUST GAS TEMPERATURE SENSOR

The exhaust gas temperature sensor is located on the joint pipe and used to monitor the condition of the pre-catalytic converter.

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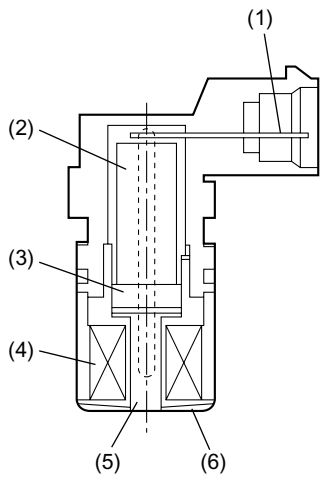
E: CRANKSHAFT POSITION SENSOR

● The crankshaft position sensor is installed on the oil pump which is located in the front center portion of the cylinder block. The sensor generates a pulse when one of the teeth on the perimeter of the crankshaft sprocket (rotating together with the crankshaft) passes in front of it. The ECM determines the crankshaft angular position by counting the number of pulses.

● The crankshaft position sensor is a molded type which consists of a magnet, core, coil, terminals and other components as illustrated below.



FU-00234

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

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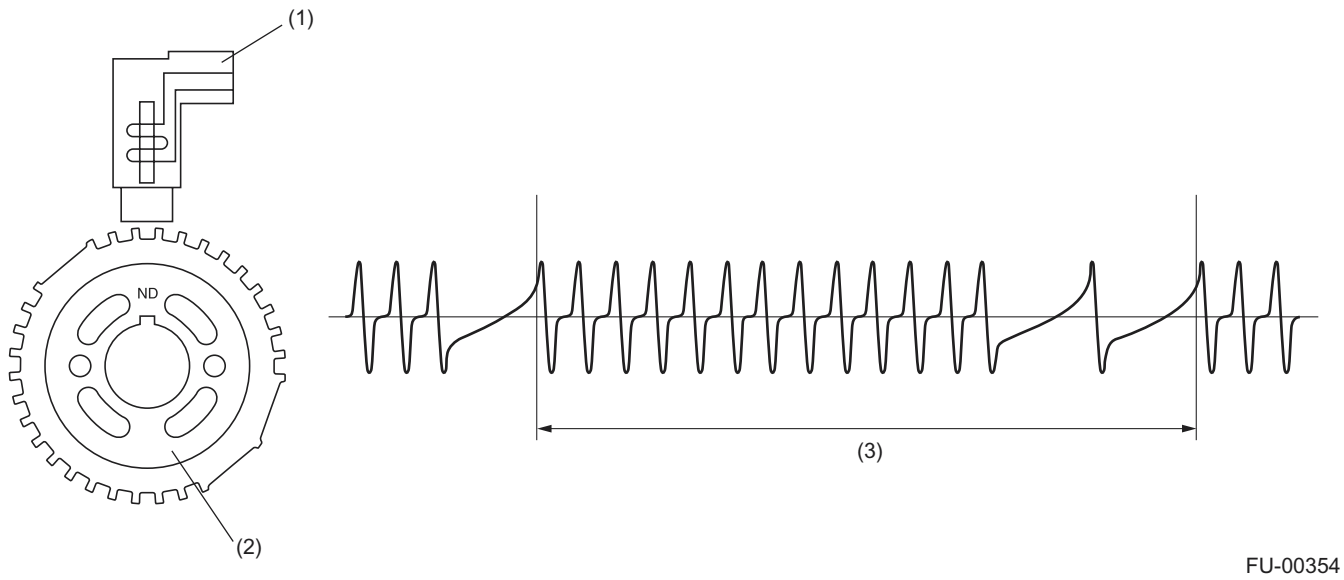
● As the crankshaft rotates, each tooth aligns with the crankshaft position sensor. At that time, the magnetic flux in the sensor's coil changes since the air gap between the sensor pickup and the sprocket changes. This change in magnetic flux induces a voltage pulse in the sensor and the pulse is transmitted to the ECM.



FU-00354

(1) Crankshaft position sensor
(2) Crankshaft sprocket
(3) Crankshaft half rotation

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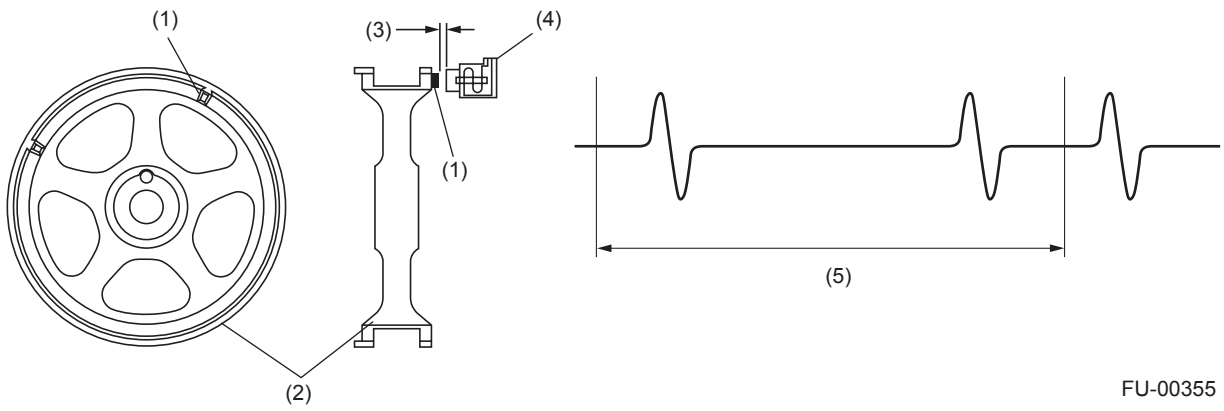
F: CAMSHAFT POSITION SENSOR

● The camshaft position sensor is located on the left-hand camshaft support. This sensor detects the combustion cylinder at any given moment.

● The sensor generates a pulse when one of the bosses on the back of the left-hand camshaft drive sprocket passes in front of the sensor. The ECM determines the camshaft angular position by counting the number of pulses. Internal construction and the basic operating principle of the camshaft position sensor are similar to those of the crankshaft position sensor. Two bosses are provided on the sprocket as shown below.



(1) Boss
(2) Camshaft sprocket
(3) Air gap
(4) Camshaft position sensor
(5) Camshaft one rotation (crankshaft two rotations)

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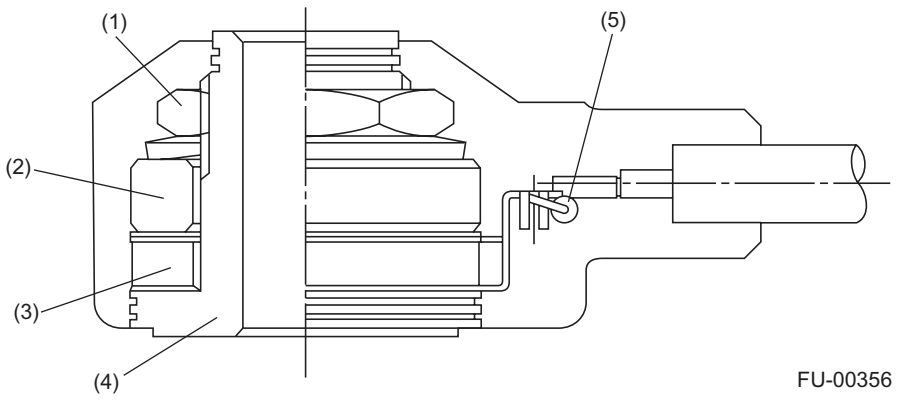
G: KNOCK SENSOR

- The knock sensor is installed on the cylinder block, and senses knocking that occurs in the engine.
- The sensor is a piezo-electric type which converts vibration resulting from knocking into electric signals.
- In addition to a piezo-electric element, the sensor has a weight and case as its components. If knocking occurs in the engine, the weight in the case moves causing the piezo-electric element to generate a voltage.
- The knock sensor harness is connected to the engine harness.



FU-00356

(1) Nut
(2) Weight
(3) Piezo-electric element
(4) Housing
(5) Resistor

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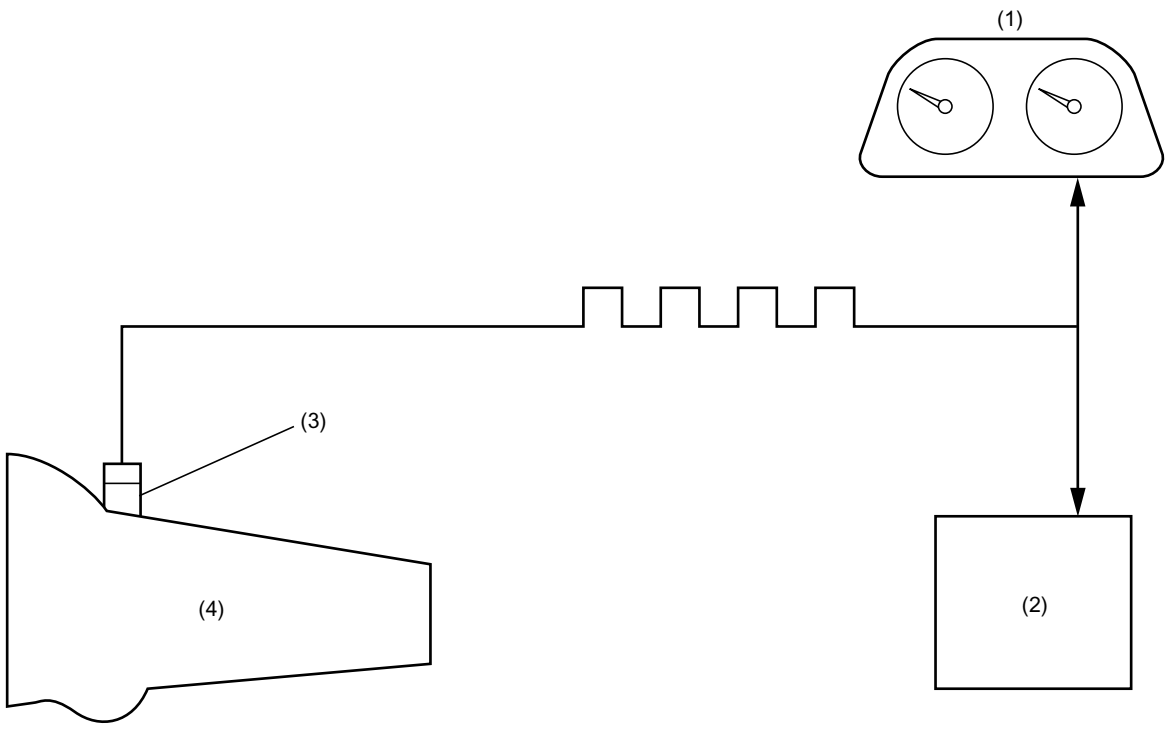
H: VEHICLE SPEED SENSOR

1. MT MODELS

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



FU-00238

(1) Combination meter
(2) ECM
(3) Vehicle speed sensor
(4) Transmission

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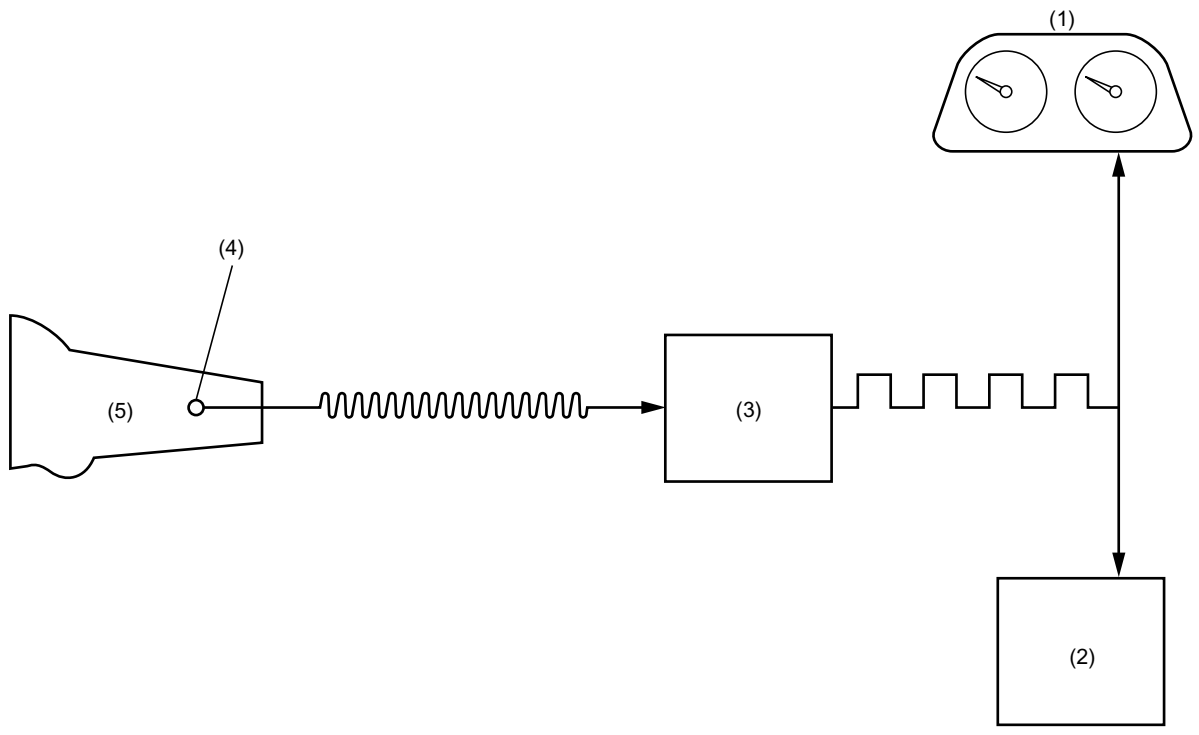
2. AT MODELS

- The vehicle speed sensor is mounted on the transmission.
- The vehicle speed sensor generates a 16-pulse signal for every rotation of the front differential and send it to the transmission control module (TCM). The signal sent to the TCM is converted there into a 4-pulse signal, and then sent to the ECM and the combination meter.



FU-00239

(1) Combination meter
(2) ECM
(3) TCM
(4) Vehicle speed sensor
(5) Transmission

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5. Control System

A: GENERAL

The ECM receives signals from various sensors, switches, and other control modules. Using these signals, it determines the engine operating conditions and if necessary, emits signals to one or more systems to control them for optimum operation.

Major control items of the ECM are as follow:

- Fuel injection control
- Ignition control
- Idle air control
- Fuel pump control
- Canister purge control*1
- Radiator fan control*2
- On-board diagnosis function

*1: Canister purge control is described under EC(H4DOTC) — EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES), Evaporative Emission Control System.

*2: Radiator fan control is described under CO(H4DOTC) — COOLING.

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B: INPUT AND OUTPUT SIGNALS

Signal	Unit	Function
Input signals	Manifold absolute pressure sensor	Detects the amount (measures the absolute pressure) of intake air .
	Mass air flow and intake air temperature sensor	Detects the temperature and amount of intake air.
	Throttle position sensor	Detects the throttle valve position.
	Front oxygen (A/F) sensor	Detects the density of oxygen in exhaust gases at the upstream of the front catalytic converter.
	Rear oxygen sensor	Detects the density of oxygen in exhaust gases at the downstream of the front catalytic converter.
	Exhaust gas temperature sensor	Detects the exhaust gas temperature.
	Tumble generator valve position sensor	Detects the tumble generator valve position.
	Crankshaft position sensor	Detects the crankshaft angular position.
	Camshaft position sensor	Detects the combustion cylinder.
	Engine coolant temperature sensor	Detects the engine coolant temperature.
	Knock sensor	Detects engine knocking.
	Vehicle speed sensor	Detects the vehicle speed.
	Ignition switch	Detects operation of the ignition switch.
	Starter switch	Detects the condition of engine cranking.
	Neutral position switch (MT)	Detects that the gear is in neutral.
	Inhibitor switch (AT)	Detects shift positions.
	Heater circuit of front and rear oxygen sensors	Detects abnormality in the heater circuit of the front and rear oxygen sensors.
	Diagnostics of TCM (AT)	Detects the self-diagnostics of TCM.
	Torque control signal (AT)	Controls engine torque.
	A/C switch	Detects ON-OFF operation of the A/C switch.
	Fuel level sensor	Detects the fuel level in the fuel tank.
	Fuel temperature sensor	Detects the temperature of the fuel in the fuel tank.
	Fuel tank pressure sensor	Detects the evaporation gas pressure in the fuel tank.
	Small light switch	Detects ON-OFF operation of the small light switch.
	Blower fan switch	Detects ON-OFF operation of the blower fan switch.
	Rear defogger switch	Detects ON-OFF operation of the rear defogger switch.

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Signal	Unit	Function
Output signals	Fuel injector	Activates an injector.
	Ignition signal	Turns the primary ignition current ON or OFF.
	Fuel pump control unit	Controls the fuel pump.
	A/C control relay	Turns ON or OFF the A/C control relay.
	Radiator fan control relay	Turns ON or OFF the radiator fan control relay.
	Idle air control solenoid valve	Adjusts the amount of air flowing through the bypass line in the throttle body.
	Waste gate control solenoid valve	Controls supercharging pressure
	Tumble generator valve actuator	Operates the tumble generator valve.
	Engine malfunction indicator light (MIL)	Indicates existence of abnormality.
	Purge control solenoid valve	Controls purge of evaporative gas absorbed by the canister.
	Pressure control solenoid valve	Controls evaporation pressure in fuel tank.
	Drain valve	Closes the evaporation line between the fuel tank and canister to detect leakage of evaporation gases.
	Power supply	Controls ON/OFF of the main power supply relay.

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C: FUEL INJECTION CONTROL

● The ECM receives signals from various sensors and based on them, it determines the amount of fuel injected and the fuel injection timing. It performs the sequential fuel injection control over the entire engine operating range except during start-up of the engine.

● The amount of fuel injected depends upon the length of time the injector stays open. The fuel injection duration is determined according to varying operating condition of the engine. For the purpose of achieving highly responsive and accurate fuel injection duration control, the ECM performs a new feedback control that incorporates a learning feature as detailed later.

● The sequential fuel injection control is performed such that fuel is injected accurately at the time when the maximum air intake efficiency can be achieved for each cylinder (i.e., fuel injection is completed just before the intake valve begins to open).

1. FUEL INJECTION DURATION

Fuel injection duration is basically determined as indicated below:

● While cranking the engine:
The duration defined below is used.
  ● Duration of fuel injection during engine start-up ..... Determined according to the engine coolant temperature detected by the engine coolant temperature sensor.

● During normal operation:
The duration is determined as follows:
Basic duration of fuel injection × 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 manifold absolute pressure sensor and the engine speed monitored by the crankshaft position sensor.
  ● Correction factors ..... See the next section.
  ● Voltage correction time ..... This is added to compensate for the time lag before operation of injector that results from variation in the battery voltage.

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2. CORRECTION FACTORS

The following factors are used to correct the basic duration of fuel injection in order to make the air-fuel ratio meet the requirements of varying engine operating conditions:

- Air-fuel ratio feedback factor:

This factor is used to correct the basic duration of fuel injection in relation to the actual engine speed. (See the next section for more details.)

- Start increment factor:

This factor is used to increase the fuel injection duration only while the engine is being cranked to improve its startability.

- Coolant-temperature-dependent increment factor:

This factor is used to increase the fuel injection duration depending on engine coolant temperature signals to facilitate cold starting. The lower the coolant temperature, the greater the increment.

- After-start increment factor:
  - This factor is used to increase the fuel injection duration for a certain period immediately after start of the engine to stabilize engine operation.
  - The increment depends on the coolant temperature at the start of the engine.

- Wide-open-throttle increment factor:

This factor is used to increase the fuel injection duration depending on the relationship between the throttle position sensor signal and manifold absolute pressure sensor signal.

- Acceleration increment factor:

This factor is used to increase the fuel injection duration to compensate for a time lag between air flow measurement and fuel injection control for better engine response to driver's pedal operation during acceleration.

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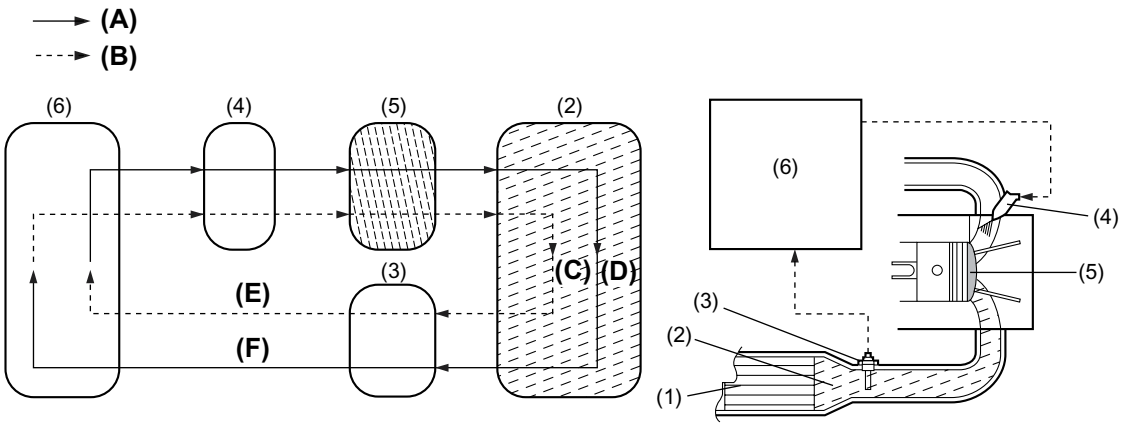
3. AIR-FUEL RATIO FEEDBACK FACTOR

The ECM creates this factor utilizing the front oxygen (A/F) sensor signal. When the signal voltage is high, the air-fuel ratio is richer than the stoichiometric ratio. The ECM then makes the fuel injection duration shorter by modifying the factor. When the voltage is low showing that the mixture is lean, the ECM modifies the factor to make the injection duration longer. In this way, the air-fuel ratio is maintained at a level close to the stoichiometric ratio at which the three-way catalytic converter acts most effectively.



FU-00240

(1) Front catalytic converter
(2) Exhaust gases
(3) Front oxygen (A/F) sensor
(4) Fuel injector
(5) Combustion chamber
(6) ECM

(A) Injection duration increment signal
(B) Injection duration decrement signal
(C) High oxygen density
(D) Low oxygen density
(E) Lean signal
(F) Rich signal

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4. LEARNING FEATURE

The air-fuel ratio feedback control includes a learning feature which contributes to more accurate and responsive control.

● In the air-fuel ratio feedback control, the ECM calculates the necessary amount of correction based on data from the oxygen sensor and adds the result to the basic duration (which is stored in the ECM's memory for each condition defined by the engine speed and various loads.)

● Without a learning feature, the ECM carries out the above-mentioned process every time. This means that if the amount of necessary correction is large, the air-fuel ratio feedback control becomes less responsive and less accurate.

● The learning feature enables the ECM to store the amount of correction into memory and add it to the basic fuel injection duration to create a new reference fuel injection duration. Using the reference duration as the basic duration for the injection a few times later, the ECM can reduce the amount of correction and thus make its feedback control more accurate and responsive to changes in the air-fuel ratio due to difference in driving condition and sensor/actuator characteristics that may result from unit-to-unit variation or aging over time.

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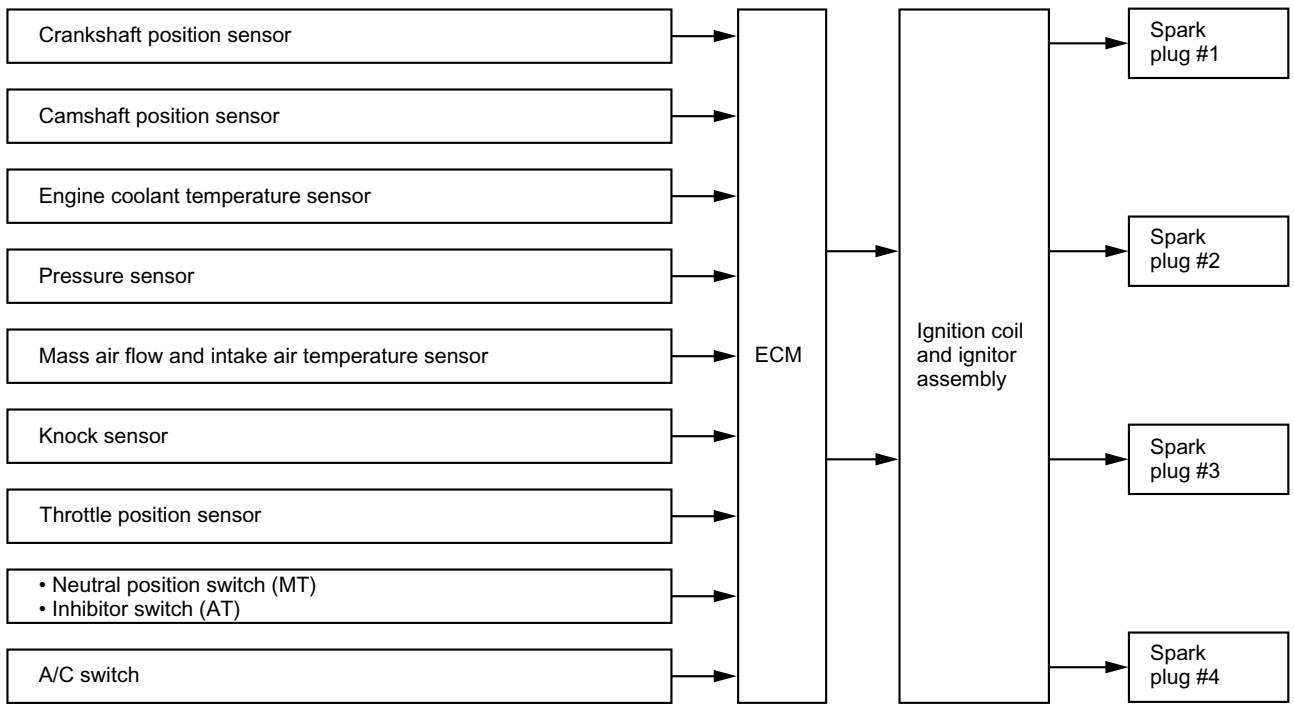
D: IGNITION CONTROL

• The ECM determines operating condition of the engine based on signals from the manifold absolute pressure sensor, engine coolant temperature sensor, intake air temperature sensor, crankshaft position sensor and other sources. The ECM then selects the ignition timing most appropriate for the condition thus determined from those stored in its memory and outputs at that timing a primary current OFF signal to the igniter to initiate ignition.

• This control uses a quick-to-response learning feature by which the data stored in the ECM memory is processed in comparison with information from various sensors and switches.

• Thus, the ECM can always perform optimum ignition timing taking into account the output, fuel consumption, exhaust gas, and other factors for every engine operating condition.

• Ignition control during start-up
Engine speed fluctuates during start of the engine, so the ECM cannot control the ignition timing. During that period, the ignition timing is fixed at 10° BTDC by using the 10° signal from the crankshaft position sensor.



FU-00357

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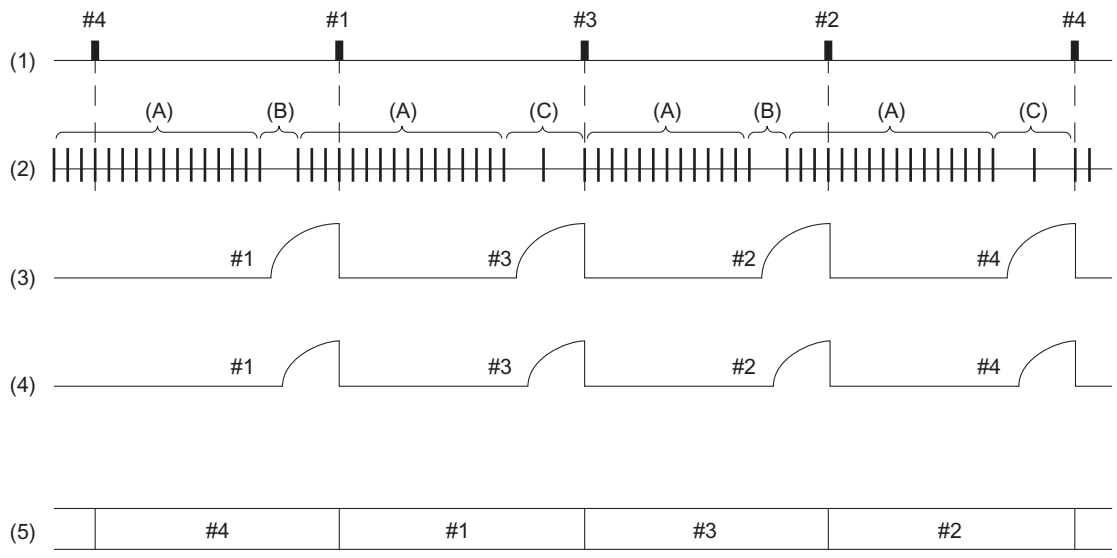
- The ECM identifies cylinders at TDC and determines ignition timing as follows:
  - Within the range (A), the crank angle signal is input every 10° rotation of the crankshaft.
  - The ECM discriminates a TDC cylinder group from the other by detecting the ranges (B) and (C) where no signals are input.
  - The ECM judges that the No. 1 and No. 2 cylinders are at TDC when it detects the range (B), and that the No. 3 and No. 4 cylinders are at TDC when it detects the range (C).



FU-00358

(1) Cylinder number (TDC)
(2) Crank angle pulse
(3) Ignition timing at starting
(4) Ignition timing at normal condition
(5) Cylinder at combustion

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E: IDLE AIR CONTROL

- The ECM activates the idle air control solenoid valve to control the bypass air flowing through the bypass passage in the throttle body depending on signals from the crankshaft position sensor, engine coolant temperature sensor, manifold absolute pressure sensor and A/C switch so that the proper idle speed for each engine load is achieved.

- The idle air control solenoid valve uses a duty-ratio-controlled solenoid which can continuously vary the opening area of the rotary valve. As the ECM increases the duty ratio, opening of the rotary valve increases so that the bypass air flow increases, and the engine idling speed becomes higher as a result.

- The bypass air control is necessary for:
  - Increasing idling speed when the air conditioning system and/or electrical loads are turned on.
  - Increasing idling speed during early stage of warm up period.
  - Obtaining dashpot function when the throttle valve is quickly closed.
  - Prevention of engine speed variation during idling.

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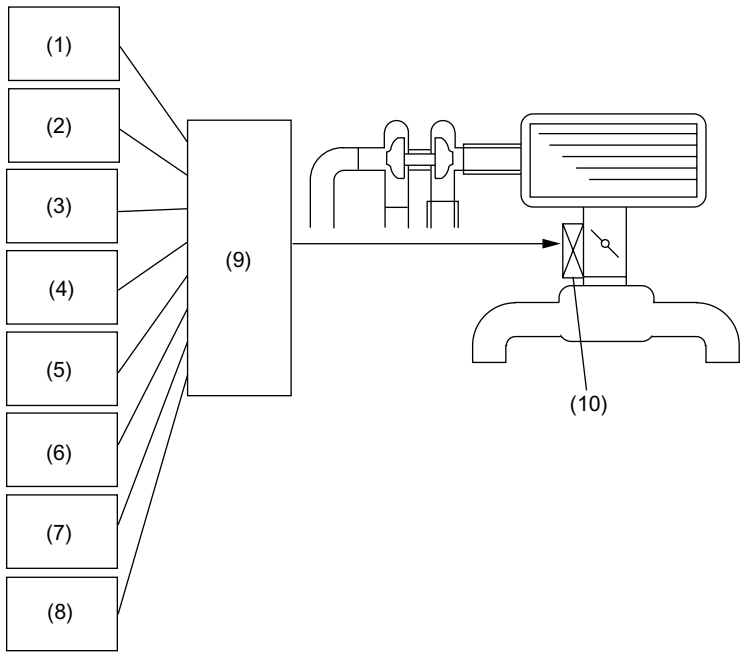

FU-00359

(1) Crankshaft position sensor
(2) Camshaft position sensor
(3) Throttle position sensor
(4) Engine coolant temperature sensor
(5) Vehicle speed sensor
(6) Ignition switch
(7) A/C switch
(8) Neutral position switch (MT)
Inhibitor switch (AT)
(9) ECM
(10) Idle air control solenoid valve

F: FUEL PUMP CONTROL

Using the signal from the crankshaft position sensor, the ECM controls operation of the fuel pump by turning its relay ON or OFF. To improve safety, the fuel pump is stopped if the engine stalls with the ignition switch ON.

Ignition switch ON	Fuel pump relay	Fuel pump
A certain period of time after ignition switch is turned ON	ON	Operates
While cranking the engine	ON	Operates
While engine is operating	ON	Operates
When engine stops	OFF	Does not operate

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6. On-board Diagnosis System

A: GENERAL

• The on-board diagnosis system detects and indicates a fault by generating a code corresponding to each fault location. The engine malfunction indicator light on the combination meter indicates occurrence of a fault or abnormality.

• When the engine malfunction indicator light comes on as a result of detection of a fault by the ECM, the corresponding diagnostic trouble code (DTC) and 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 the data link connector in order to check the DTC.

• The SSM and GST can erase DTCs. This can also read freeze frame data in addition to other pieces of engine data.

• If there is a failure involving sensors which may affect drive control of the vehicle, the fail-safe function ensures minimum level of driveability.

B: FAIL-SAFE FUNCTION

For a sensor or switch which has been judged faulty in the on-board diagnosis, the ECM, if appropriate, generates an associated pseudo signal to keep the vehicle operational. (The control becomes degraded.)

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FUEL INJECTION
(FUEL SYTEMS)
H4SO

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1. General

● The Multipoint Fuel Injection (MFI) system supplies optimum air-fuel mixture under every engine operating condition through the use of the latest electronic control technology.

This system pressurizes the fuel to a constant pressure and injects it into each intake air port in the cylinder head. The injection quantity of fuel is controlled by an intermittent injection system where an electro-magnetic injection valve or injector opens for a short period that is precisely controlled depending on the quantity of air appropriate for each condition of operation. In actual control, an optimum fuel injection quantity is achieved by varying the duration of an electric pulse applied to the injector. This way of control enables simple, yet highly precise metering of the fuel.

● The engine control module (ECM) that controls the fuel injection system corrects the fuel injection amount depending on the vehicle speed, throttle opening, coolant temperature and other vehicle-operation-related information. The ECM receives the information in the form of electric signals from the corresponding sensors and switches.

The MFI system also has the following features:

● Reduced exhaust emissions
● Reduced fuel consumption
● Increased engine output
● Quick response to accelerator and brake pedal operation
● Superior startability and warm-up performance in cold weather due to corrective controls made according to coolant and intake air temperatures

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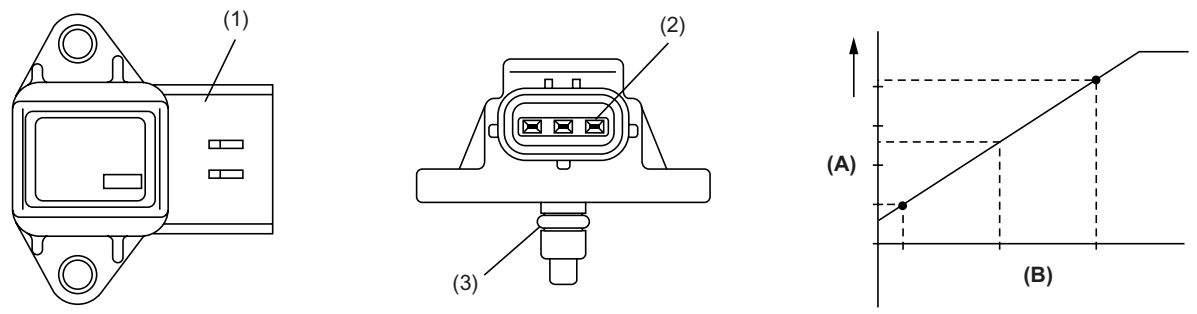
2. Air Line

A: GENERAL

The air filtered by the air cleaner enters the throttle body where it is regulated in the volume by the throttle valve and then enters the intake manifold. It is then distributed to each cylinder where the air is mixed with fuel injected by the injector. During idling operation, air flows into the cylinder through the idle air control solenoid valve, bypassing the throttle valve. This enables controlling the engine idling speed properly.

B: MANIFOLD ABSOLUTE PRESSURE SENSOR

The manifold absolute pressure sensor is attached to the top of the throttle body, and continuously sends to the engine control module (ECM) voltage signals that are proportional to intake manifold absolute pressures. The ECM controls the fuel injection and ignition timing based on the intake manifold absolute pressure signals in addition to other signals from many sensors and other control modules.



FU-00343

(1) Connector
(2) Terminal
(3) O-ring

(A) Output voltage
(B) Absolute pressure

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C: THROTTLE BODY

● In response to operation of the accelerator pedal, the throttle valve in the throttle body opens/closes to regulate the volume of the air drawn into the combustion chamber.

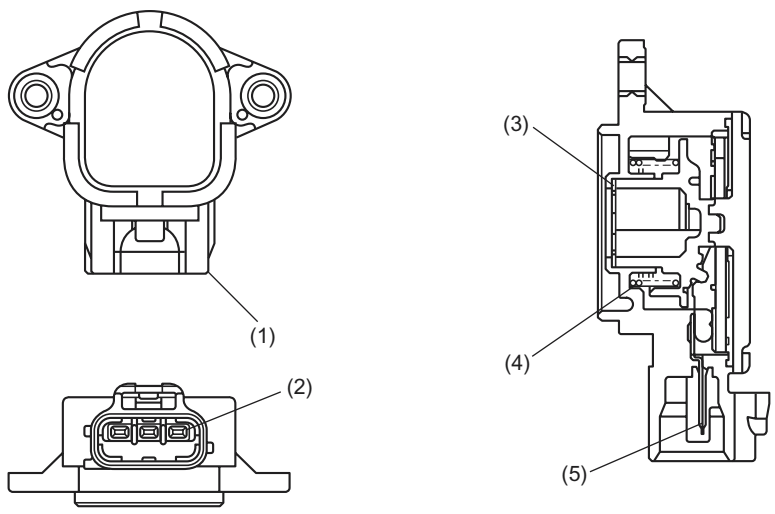
● During idling the throttle valve is almost fully closed and the volume of air passing the throttle valve becomes less than the amount of air that pass through the idle air control solenoid valve.

● More than half of the air necessary for idling is supplied to the intake manifold via the idle air control solenoid valve which controls properly the engine idling speed, so the idling speed needs not be adjusted.

D: THROTTLE POSITION SENSOR

● The throttle position sensor is mounted in the throttle body and linked to the throttle valve.

● The throttle position sensor sends the ECM voltage signal corresponding to the opening of the throttle valve. When the sensor's output voltage exceeds a predetermined level, the ECM interprets it as complete closure of the throttle valve. When the output voltage is at another predetermined level, the ECM recognizes that the throttle valve is at a wide open position. Since the output characteristics of the sensor change over years, the ECM is provided with a learning function to be able to interpret signals into throttle valve angles always correctly.



FU-00344

(1) Connector
(2) Terminal
(3) Wave washer
(4) Return spring
(5) Terminal

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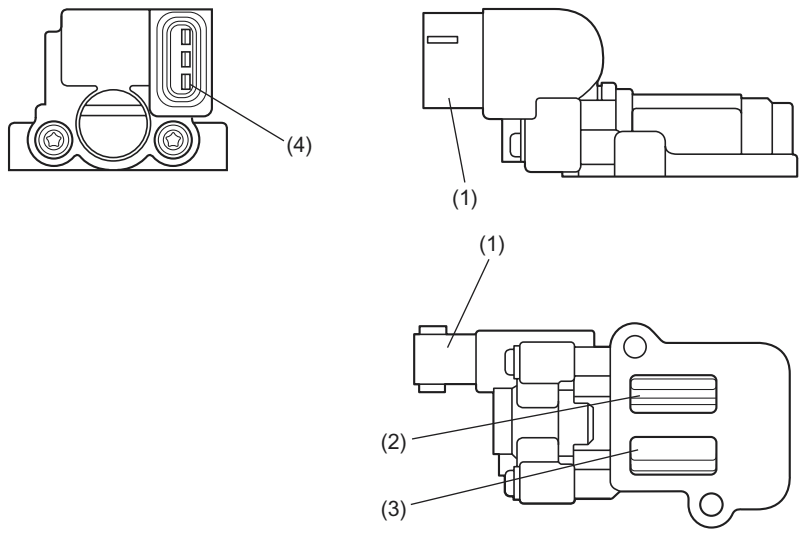
E: IDLE AIR CONTROL SOLENOID VALVE

● The idle air control solenoid valve is located in the throttle body and regulates the amount of intake air that flows bypassing the throttle valve into the intake manifold during engine idling. It is activated by a signal from the ECM in order to maintain the engine idling speed at a target speed.

● The idle air control solenoid valve is a solenoid-actuated rotary valve consisting of a coil, rotary valve, spring and housing. The housing is an integral part of the throttle body and provided with a bypass air port whose opening area is changed by the rotary valve.



FU-00345

(1) Connector
(2) Outlet port
(3) Inlet port
(4) Terminal

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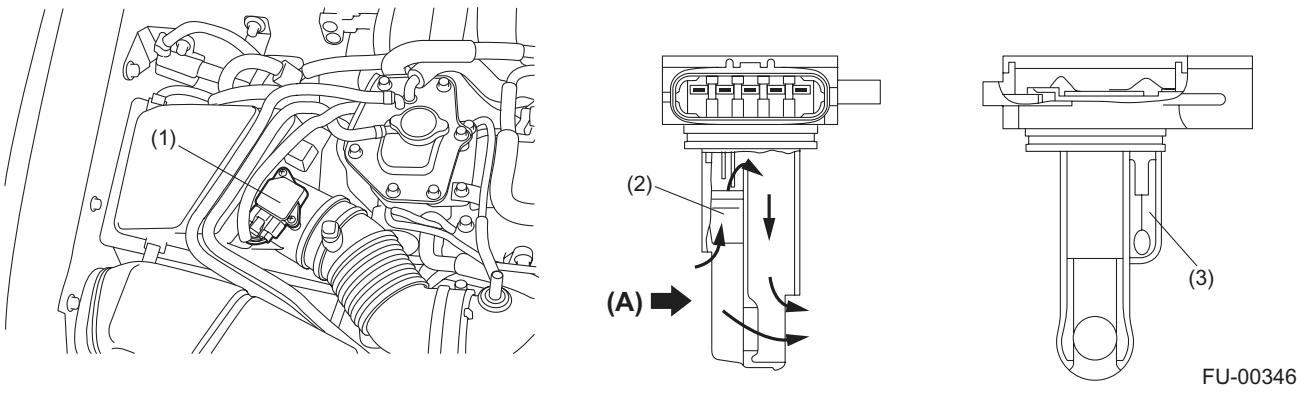
F: MASS AIR FLOW AND INTAKE AIR TEMPERATURE SENSOR

The mass air flow and the intake air temperature sensors are integrated into a single unit. The unit is mounted on the air cleaner case and measures the amount as well as the temperature of the intake air.
The measured amount and temperature are converted into electrical signals and sent to the ECM. The ECM uses these signals to control injection and ignition timing as well as the fuel injection amount.



(1) Mass air flow and intake air temperature sensor
(2) Mass air flow sensor
(3) Intake air temperature sensor
(A) Air

G: TUMBLE GENERATOR VALVE

- A tumble generator valve is provided on each engine bank, between the intake manifold and intake air ports. The right bank tumble generator valve has butterfly valves for the #1 and #3 cylinders and the left bank tumble generator valve has those for the #2 and #4 cylinders. The two butterfly valves in each tumble generator valve are fitted on a single shaft that is driven by an actuator.

- The tumble generator valves are controlled by the ECM according to the coolant temperature and the time elapsed after start of the engine. When the engine is started, the butterfly valves are moved to the closing ends. In this state, the intake air flows at very high speeds passing through narrowed passages in the directions determined by the individual intake air ports in the cylinder head. This creates tumbling air motions in the cylinders, which enables lean mixtures to be ignited and thus harmful exhaust emissions to be reduced during engine start. The tumble generator valves are fully open when the engine is operating at an ordinary driving speed, allowing intake air to flow without being changed in direction and velocity.

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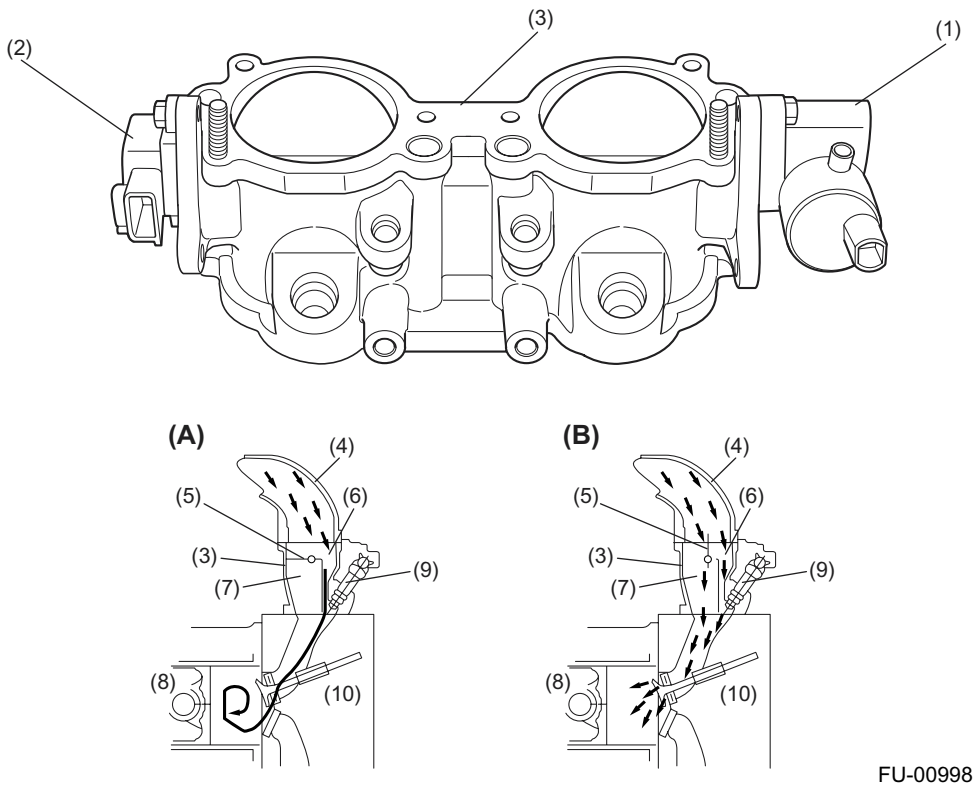

FU-00998

(A) Activated
(B) Not activated
(1) Actuator
(2) Tumble generator valve position sensor
(3) Tumble generator housing
(4) Intake manifold
(5) Tumble generator valve
(6) Tumble generating air passage
(7) Intake main air passage
(8) Piston
(9) Injector
(10) Cylinder Head

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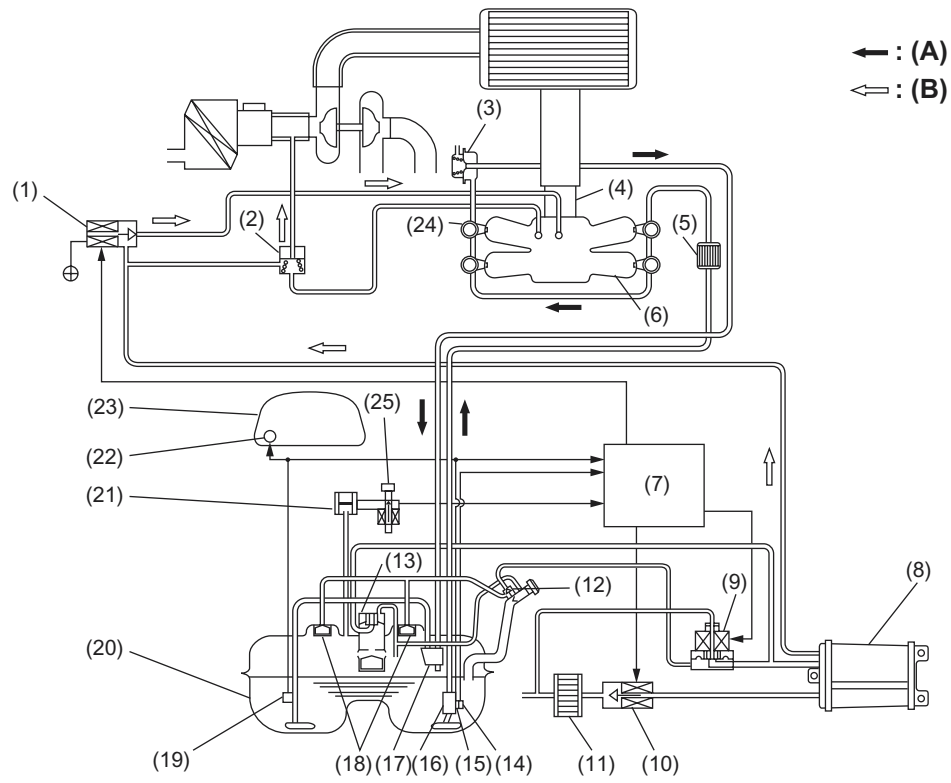
3. Fuel System

A: GENERAL

● The fuel pressurized by the fuel tank inside pump is delivered to each fuel injector by way of the fuel pipe and fuel filter. Fuel injection pressure is regulated to an optimum level by the pressure regulator.

● Each injector injects fuel into the intake port of the corresponding cylinder where the fuel is mixed with air. The mixture then enters the cylinder.

Fuel injection amount and timing are regulated by the ECM.



FU-00790

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

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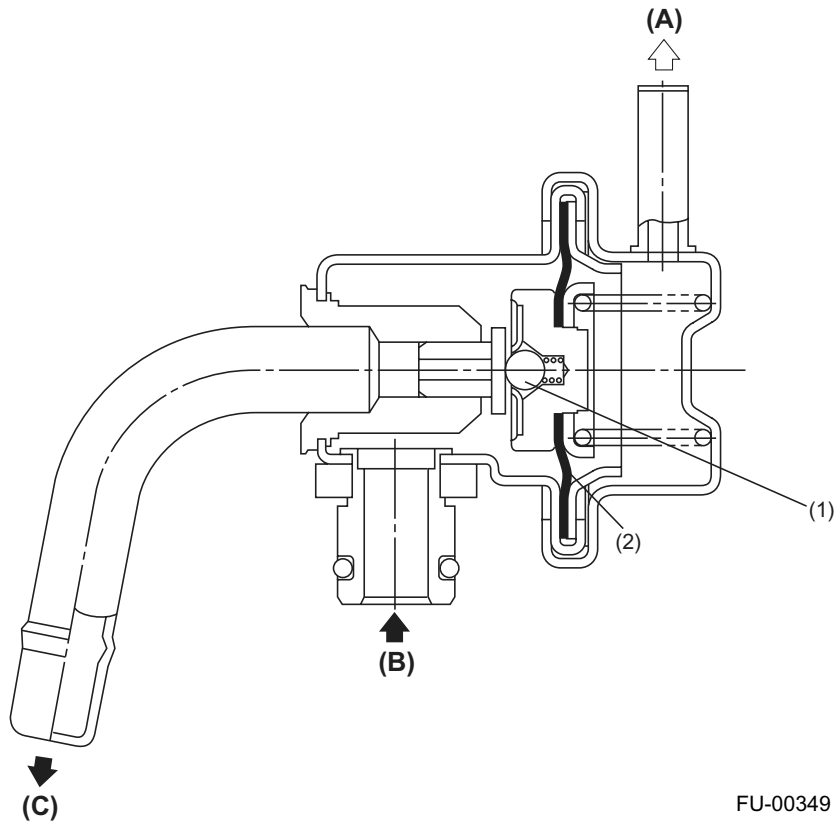
B: PRESSURE REGULATOR

The pressure regulator is installed at the injector end of the fuel supply line. It has a fuel chamber and spring chamber separated by a diaphragm. The fuel chamber is connected to the fuel supply line and the spring chamber is connected to the intake manifold. Fuel chamber also has a relief valve connected to the fuel return line through which fuel returns to the fuel tank. When the intake manifold vacuum increases, the diaphragm is pulled and the relief valve opens to decrease the fuel supply line pressure (or fuel injection pressure). When the intake manifold vacuum decreases, the diaphragm is pushed by the spring to increase the fuel supply line pressure. Thus, the difference between the fuel injection pressure and the intake manifold vacuum is kept at a constant level of 294 kPa (3.00 kgf/cm^2, 43.0 psi) to precisely control the amount of injected fuel.



FU-00349

(A) To intake manifold
(B) Fuel IN
(C) Fuel OUT

(1) Relief valve
(2) Diaphragm

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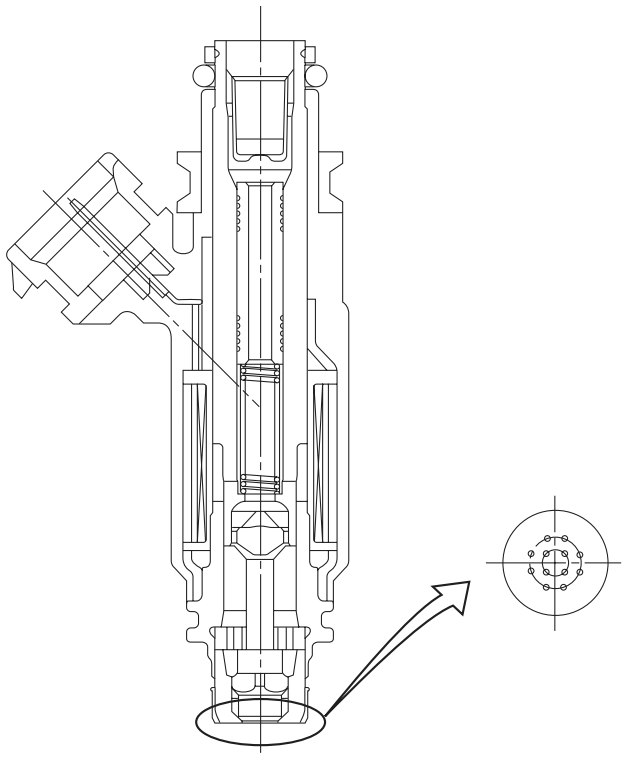
C: FUEL INJECTOR

- The MFI system employs top feed type fuel injectors.
- Each injector is installed in the fuel pipe in such a way that the injector is cooled by 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 injector injects fuel according to the valve open signal from the ECM. The needle valve is lifted by the solenoid which is energized on arrival of the valve open signal.
- Since the injector's nozzle hole area, the lift of valve and the fuel pressure are kept constant, the amount of fuel injected is controlled only by varying the duration of the valve open signal from the ECM.
- The multi-hole nozzle makes it possible for the injector to produce fine fuel particles, which enhances the combustion efficiency and output performance of the engine.



FU-00350

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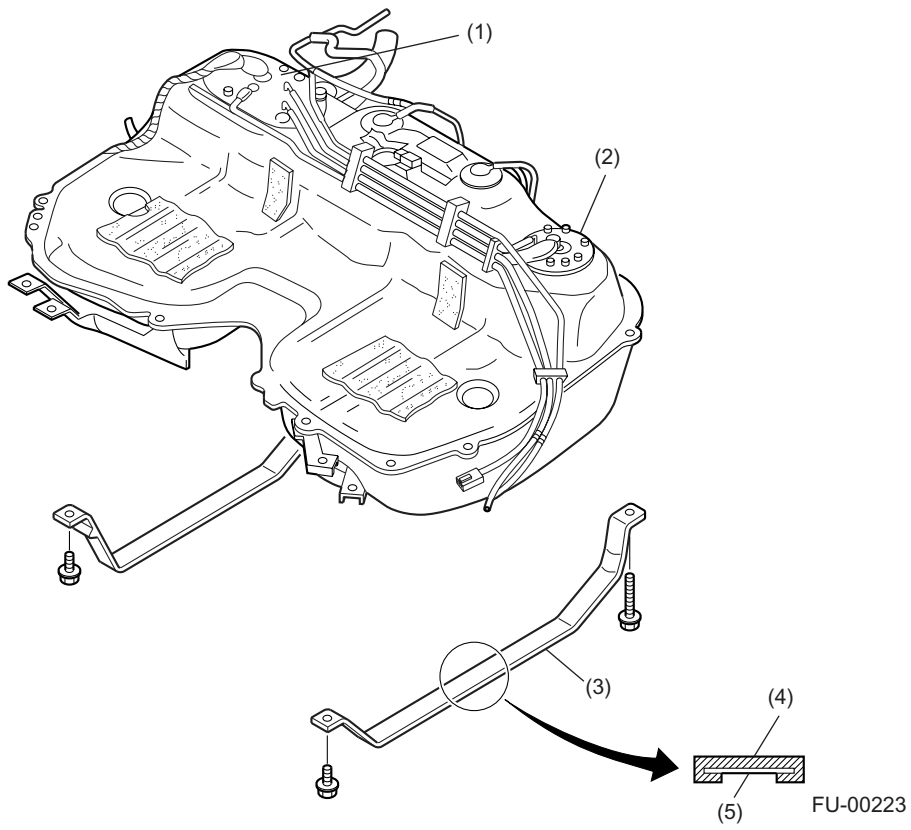
D: FUEL TANK

The fuel tank utilizes a two-compartment design to ensure sufficient capacity without interfering with the rear differential. It is provided with a suction jet pump (included in the fuel pump and fuel level sensor assembly) which transfers fuel from one compartment to the other.

Each compartment has an individual fuel level sensor. The fuel tank is located under the rear seat and secured with hold-down bands.



(1) Fuel pump and fuel level sensor assembly
(2) Fuel sub level sensor
(3) Band
(4) Cushion
(5) Steel

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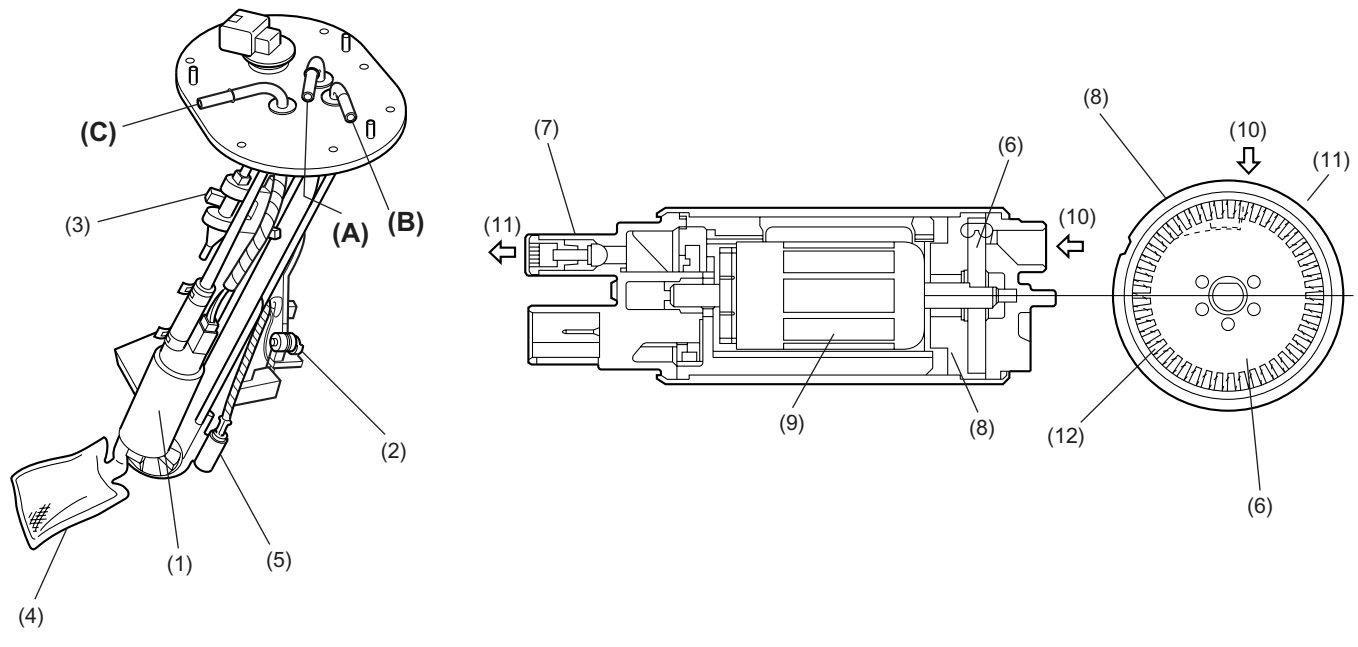
E: FUEL PUMP AND FUEL LEVEL SENSOR ASSEMBLY

1. FUEL PUMP

The fuel pump consists of a motor, impeller, pump casing, pump cover, check valve and filter. It is located in the fuel tank and combined with the fuel level sensor into a single unit. The operation of this impeller type pump is very quiet.



FU-00791

(1) Fuel pump
(2) Fuel level sensor
(3) Jet pump
(4) Mesh filter
(5) Fuel temperature sensor
(6) Impeller
(7) Check valve
(8) Pump casing
(9) Motor armature
(10) Suction
(11) Discharge
(12) Vane groove
(A) From engine (return line)
(B) From sub tank
(C) To engine (delivery line)

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- When the ignition switch is turned ON, fuel pump relay is activated. Then the motor operates to rotate the impeller.
- As the impeller rotates, fuel in a vane groove of the impeller flows along the fuel passage into the next vane groove by centrifugal force. When fuel flows from one groove to the next, a pressure difference occurs due to friction. This creates a pumping effect.
- The fuel pushed up by rotation of the impeller then passes through the clearance between the armature and the magnet of the motor and is discharged through the check valve.
- When the fuel discharge pressure reaches the specified level, the relief valve opens and excess fuel is released into the fuel tank. In this manner, the relief valve prevents an abnormal increase in fuel pressure.
- When the engine and the fuel pump stop, spring force acts on the check valve to close the discharge port, so that the fuel pressure in the fuel delivery line is retained.

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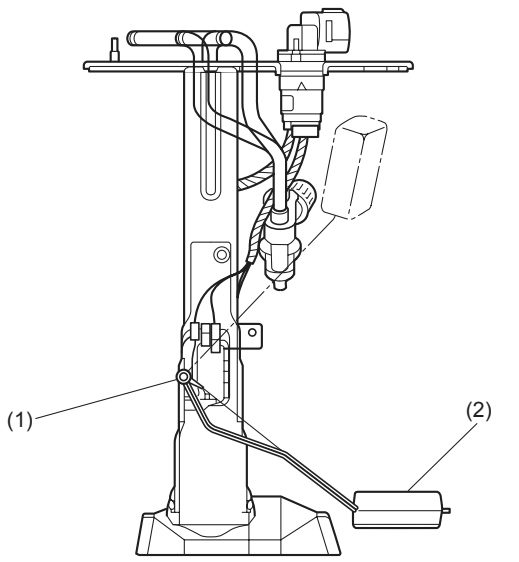
2. FUEL LEVEL SENSOR

The fuel level sensor is integrated with the fuel pump which is located in the fuel tank. The sensor outputs an electric resistance signal that varies with movement of its float to indicate the level of the fuel remaining in the tank.



FU-00351

(1) Fuel level sensor
(2) Float

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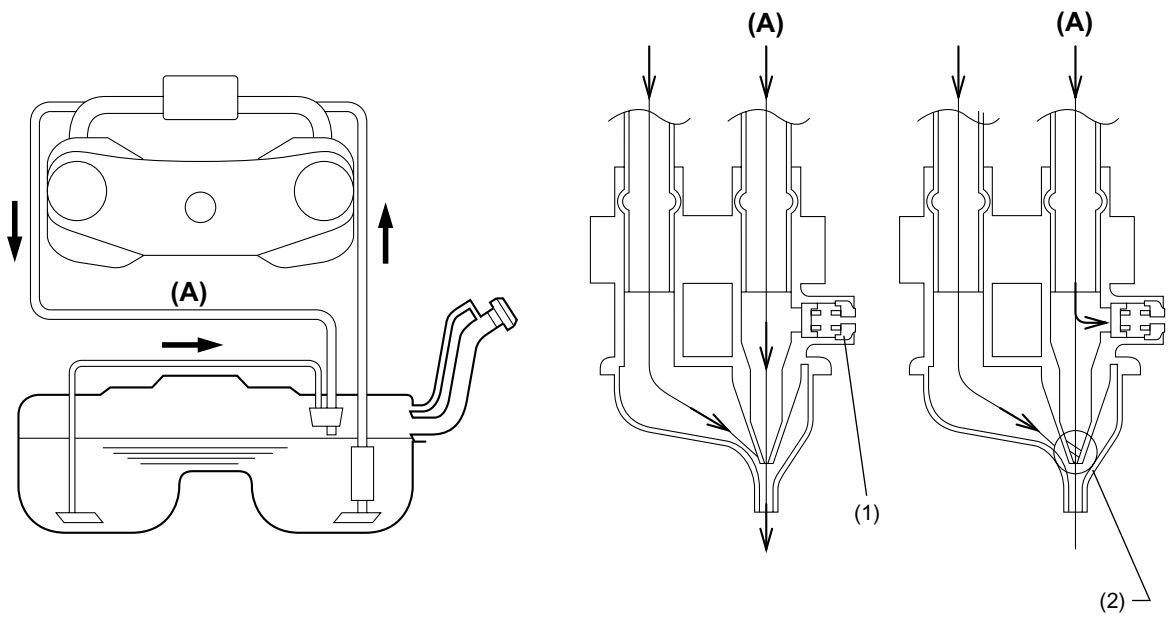
3. JET PUMP

● The jet pump utilizes the velocity of fuel returning from the engine to produce negative pressure in it.

● Using the pumping effect produced by the negative pressure, the jet pump transfers fuel from the sub-compartment to the main compartment of the fuel tank.

● 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.



FU-00226

(1) Relief valve
(2) Nozzle

(A) Return line

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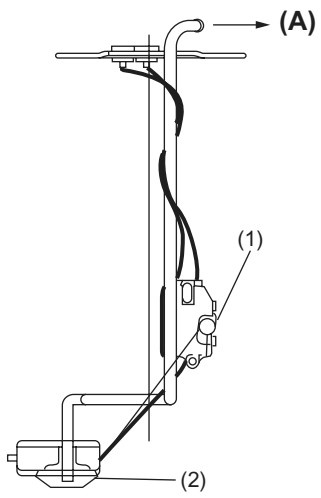
F: SUB-COMPARTMENT FUEL LEVEL SENSOR

This sensor detects the level of the fuel in the sub-compartment (the compartment in which the fuel pump is not located) and acts as part of the fuel transfer line when the jet pump is in operation to maintain the fuel in both compartments at the same level.



FU-00227

(1) Fuel level sensor
(2) Float

(A) To jet pump

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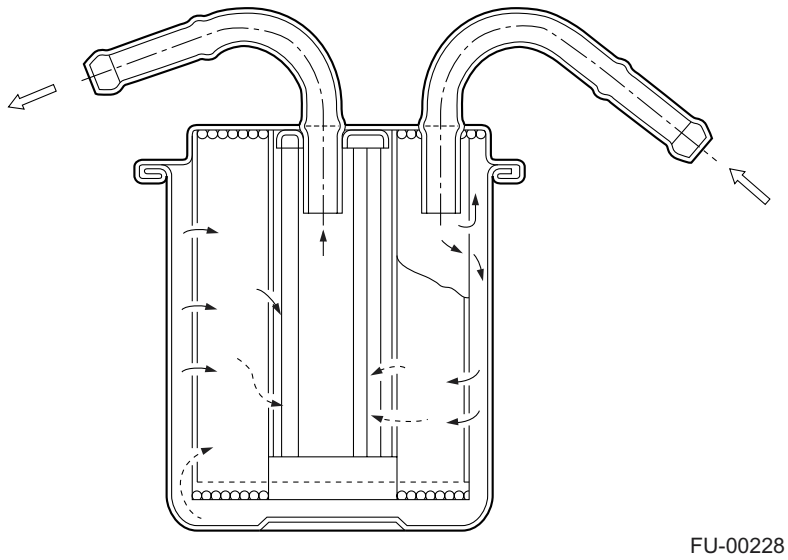
G: FUEL FILTER

The fuel filter located in the engine compartment is a pressure-withstanding, cartridge type. It has a filter element in a metal case. The fuel entering the filter flows from the perimeter of the element to the center of the filter and goes out from there.



FU-00228

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4. Sensors and Switches

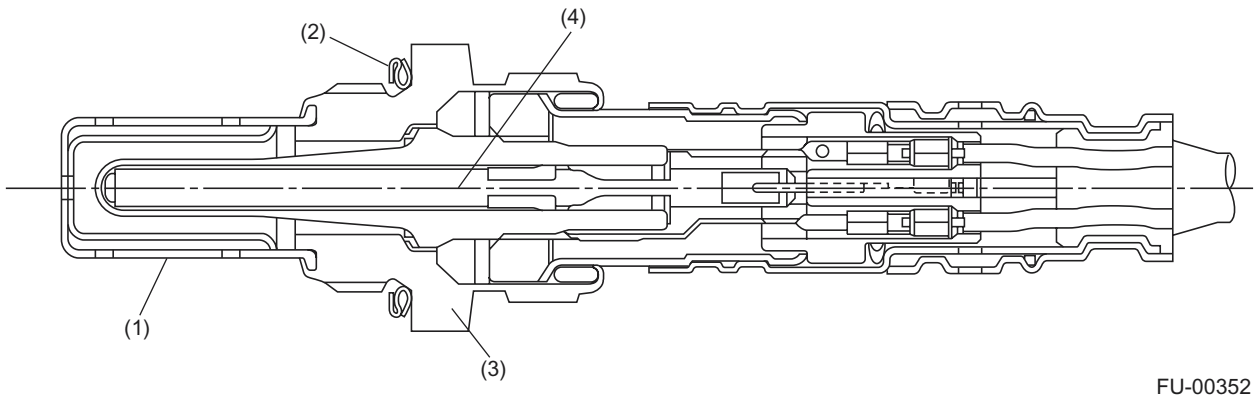
A: FRONT OXYGEN (A/F) SENSOR

• 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 its both sides are exposed to oxygen ions of different concentration and the magnitude of this electromotive force depends on how much the difference is.
The front oxygen (A/F) sensor detects the amount of oxygen in exhaust gases by making use of this property of the zirconium oxide material.

• The zirconium oxide material is formed into a closed end tube and its external surface is exposed to exhaust gases with smaller oxygen ion concentration, whereas its internal surface is exposed to atmospheric air. The external surface has a porous platinum coating. The sensor housing is grounded to the exhaust pipe and the inside is connected to the ECM through the harness to be able to use the current output from the sensor.

• The sensor incorporates a ceramic heater to improve its performance at low temperatures.



FU-00352

(1) Protection tube
(2) Gasket
(3) Sensor housing
(4) Ceramic heater

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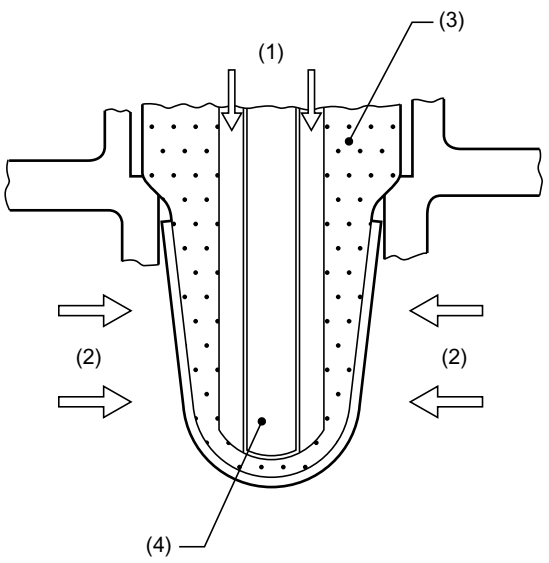
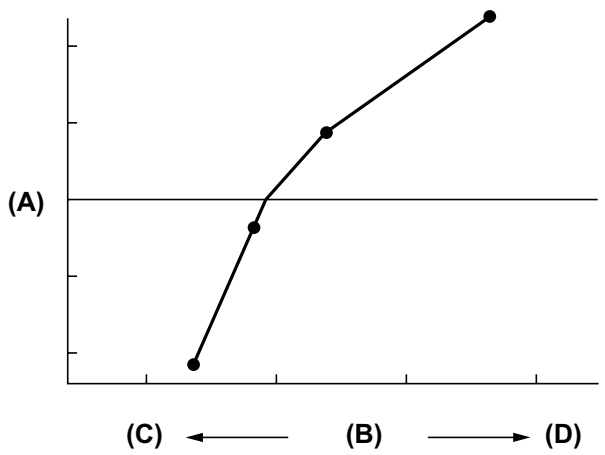
● When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases is almost completely used in the catalytic reaction by the platinum coating on the external surface of the zirconia tube. This results in a very large difference in the oxygen ion concentration between the inside and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

● When a lean air-fuel mixture is burnt in the cylinder, relatively large amount of oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen ion concentration between the tube's internal and external surfaces. The electromotive force in this case is very small.

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





FU-00230

(1) Atmospheric air
(2) Exhaust gases
(3) ZrO_2
(4) Ceramic heater

(A) Electromotive force
(B) Air/fuel ratio
(C) Lean
(D) Rich

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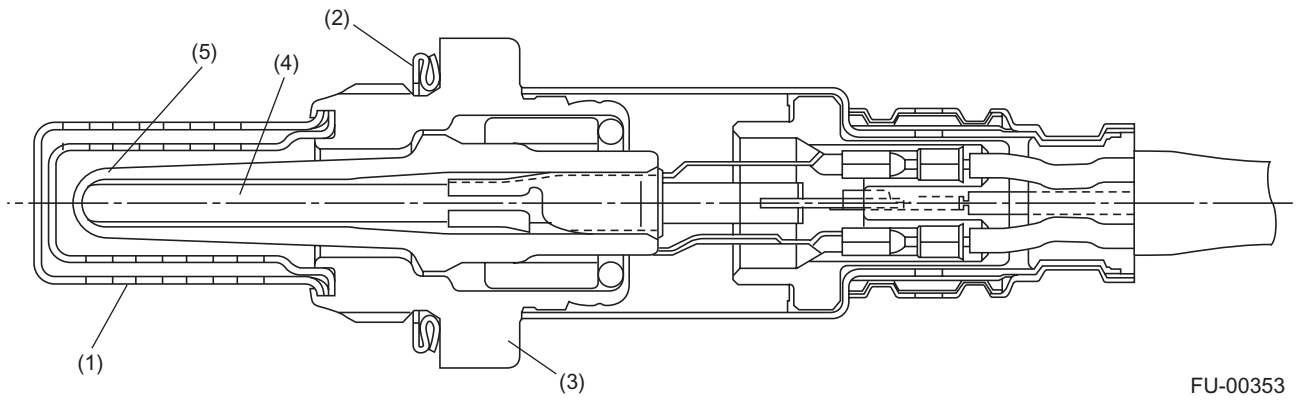
B: REAR OXYGEN SENSOR

- The rear oxygen sensor is used to sense oxygen concentration in the exhaust gas. If the air-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 almost no oxygen.
- Detecting the oxygen concentration in exhaust gas using the oxygen sensor makes it possible to determine 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 ion concentration between the inside and outside of the tube. Platinum is coated on the inside and outside of the zirconia tube as a catalysis and electrode material. 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 temperatures.



FU-00353

(1) Protection tube
(2) Gasket
(3) Sensor housing
(4) Ceramic heater
(5) Zirconia tube

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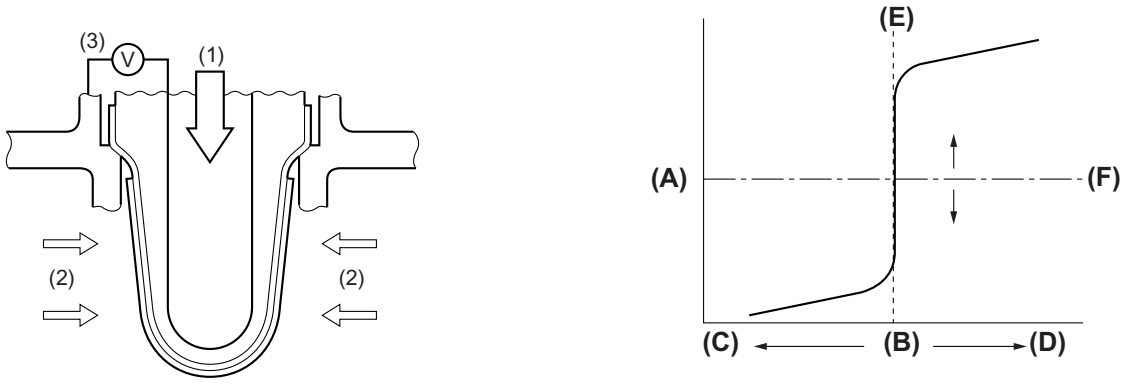
● When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases is almost completely used in the catalytic reaction by the platinum coating on the external surface of the zirconia tube. This results in a very large difference in the oxygen ion concentration between the inside and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

● When a lean air-fuel mixture is burnt in the cylinder, relatively large amount of oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen ion concentration between the tube's internal and external surfaces. The electromotive force in this case is very small.

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



FU-01010

(1) Atmospheric air
(2) Exhaust gases
(3) Electromotive force

(A) Electromotive force
(B) Air/fuel ratio
(C) Lean
(D) Rich
(E) Stoichiometric ratio
(F) Comparison voltage

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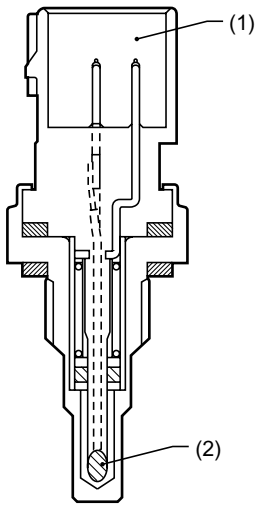
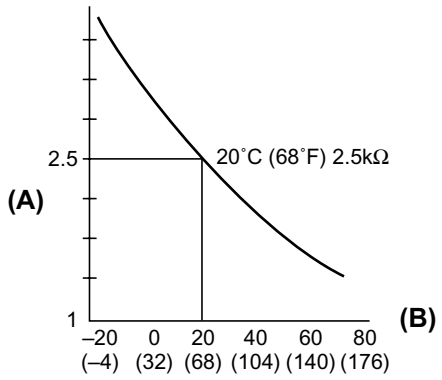
C: ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor is located on the engine coolant pipe. The sensor uses a thermistor whose resistance changes inversely with temperature. Resistance signals as engine coolant temperature information are transmitted to the ECM to make fuel injection, ignition timing, purge control solenoid valve and other controls.





FU-00233

(1) Connector
(2) Thermistor element

(A) Resistance (kΩ)
(B) Temperature °C (°F)

D: EXHAUST GAS TEMPERATURE SENSOR

The exhaust gas temperature sensor is located on the joint pipe and used to monitor the condition of the pre-catalytic converter.

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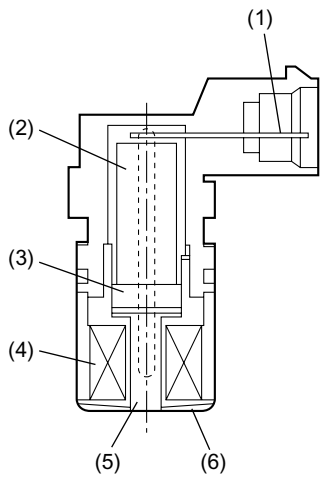
E: CRANKSHAFT POSITION SENSOR

● The crankshaft position sensor is installed on the oil pump which is located in the front center portion of the cylinder block. The sensor generates a pulse when one of the teeth on the perimeter of the crankshaft sprocket (rotating together with the crankshaft) passes in front of it. The ECM determines the crankshaft angular position by counting the number of pulses.

● The crankshaft position sensor is a molded type which consists of a magnet, core, coil, terminals and other components as illustrated below.



FU-00234

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

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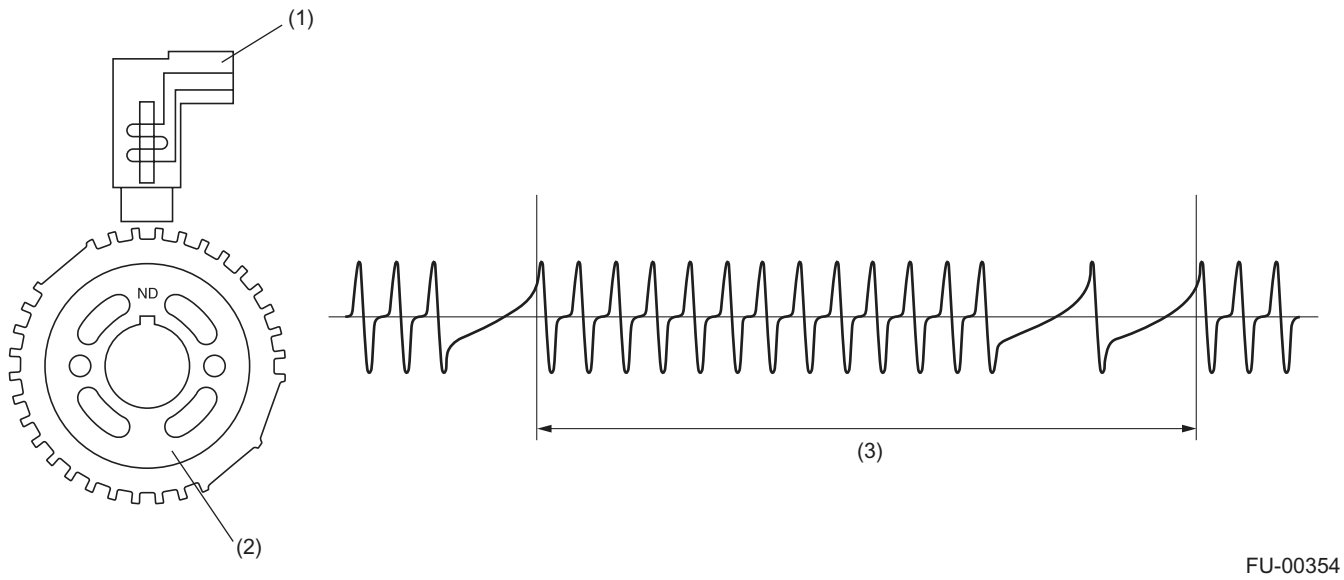
● As the crankshaft rotates, each tooth aligns with the crankshaft position sensor. At that time, the magnetic flux in the sensor's coil changes since the air gap between the sensor pickup and the sprocket changes. This change in magnetic flux induces a voltage pulse in the sensor and the pulse is transmitted to the ECM.



FU-00354

(1) Crankshaft position sensor
(2) Crankshaft sprocket
(3) Crankshaft half rotation

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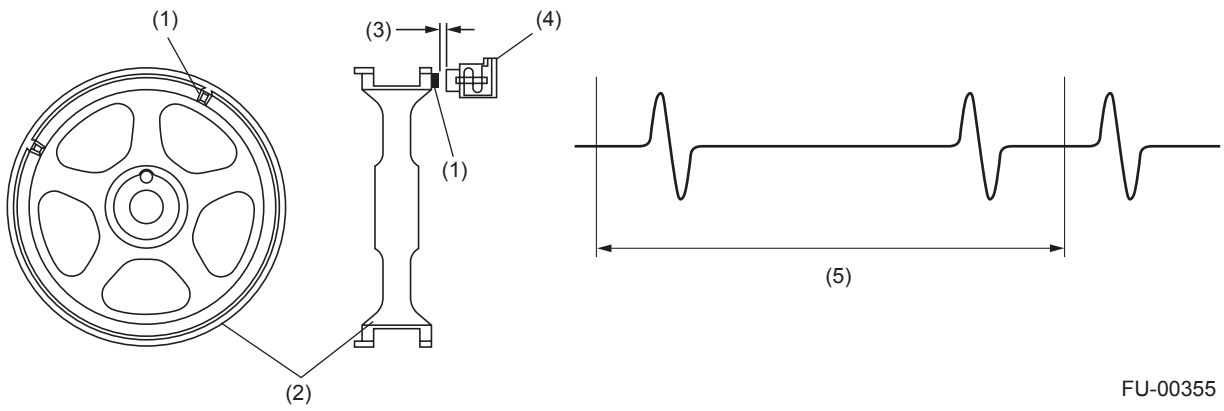
F: CAMSHAFT POSITION SENSOR

● The camshaft position sensor is located on the left-hand camshaft support. This sensor detects the combustion cylinder at any given moment.

● The sensor generates a pulse when one of the bosses on the back of the left-hand camshaft drive sprocket passes in front of the sensor. The ECM determines the camshaft angular position by counting the number of pulses. Internal construction and the basic operating principle of the camshaft position sensor are similar to those of the crankshaft position sensor. Two bosses are provided on the sprocket as shown below.



(1) Boss
(2) Camshaft sprocket
(3) Air gap
(4) Camshaft position sensor
(5) Camshaft one rotation (crankshaft two rotations)

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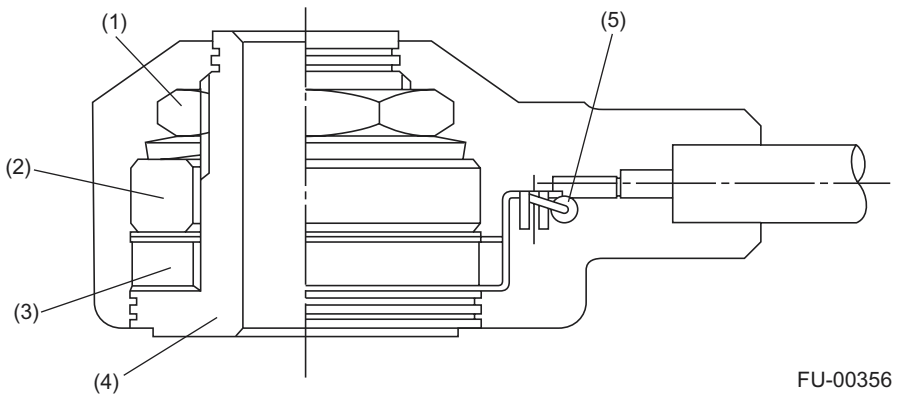
G: KNOCK SENSOR

- The knock sensor is installed on the cylinder block, and senses knocking that occurs in the engine.
- The sensor is a piezo-electric type which converts vibration resulting from knocking into electric signals.
- In addition to a piezo-electric element, the sensor has a weight and case as its components. If knocking occurs in the engine, the weight in the case moves causing the piezo-electric element to generate a voltage.
- The knock sensor harness is connected to the engine harness.



FU-00356

(1) Nut
(2) Weight
(3) Piezo-electric element
(4) Housing
(5) Resistor

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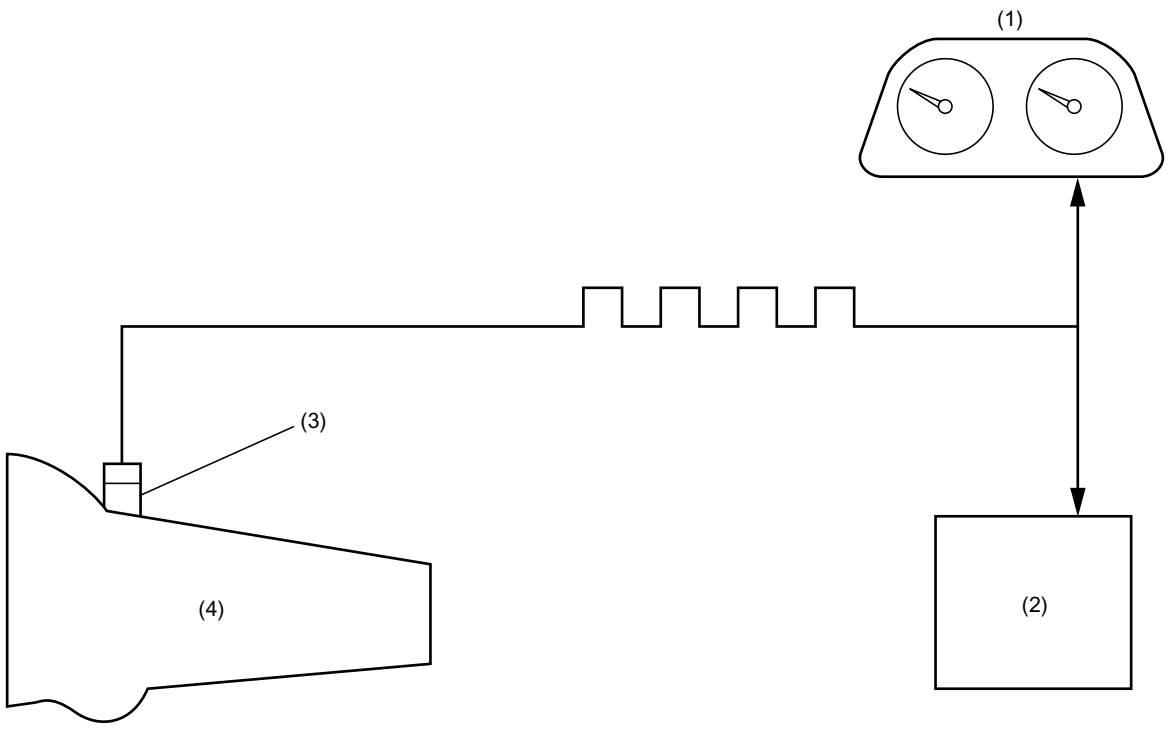
H: VEHICLE SPEED SENSOR

1. MT MODELS

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



FU-00238

(1) Combination meter
(2) ECM
(3) Vehicle speed sensor
(4) Transmission

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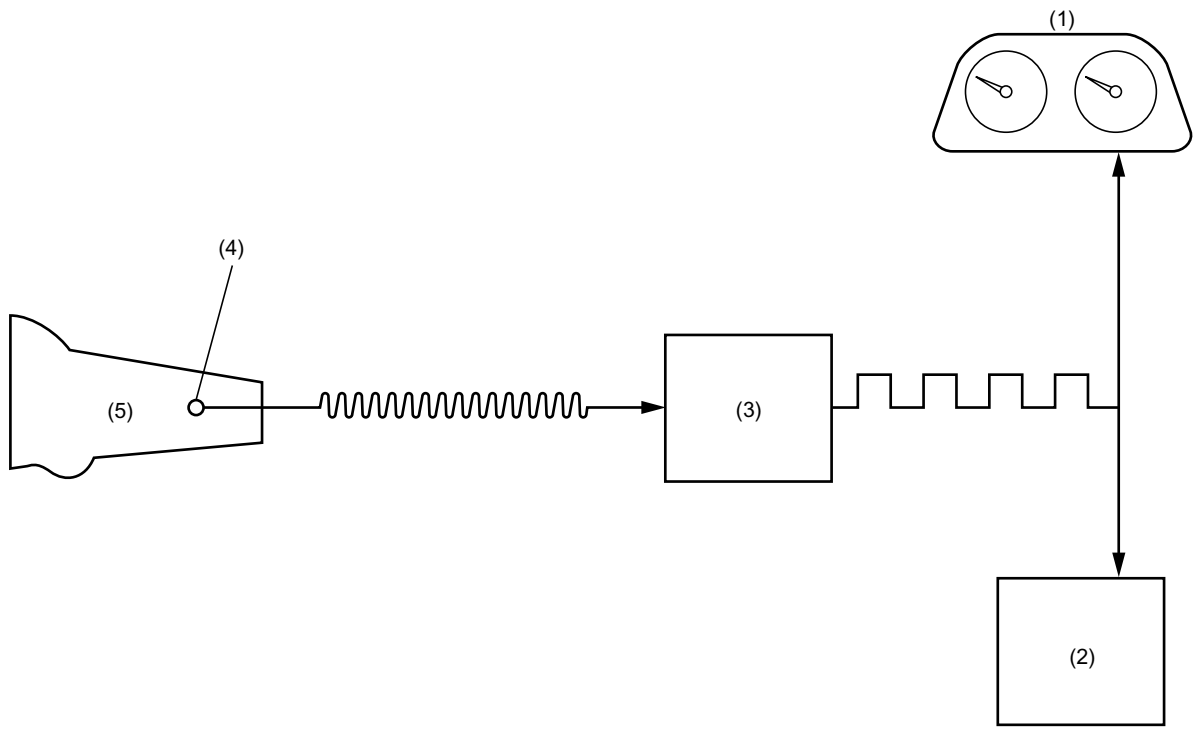
2. AT MODELS

- The vehicle speed sensor is mounted on the transmission.
- The vehicle speed sensor generates a 16-pulse signal for every rotation of the front differential and send it to the transmission control module (TCM). The signal sent to the TCM is converted there into a 4-pulse signal, and then sent to the ECM and the combination meter.



FU-00239

(1) Combination meter
(2) ECM
(3) TCM
(4) Vehicle speed sensor
(5) Transmission

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5. Control System

A: GENERAL

The ECM receives signals from various sensors, switches, and other control modules. Using these signals, it determines the engine operating conditions and if necessary, emits signals to one or more systems to control them for optimum operation.

Major control items of the ECM are as follow:

- Fuel injection control
- Ignition control
- Idle air control
- Fuel pump control
- Canister purge control*1
- Radiator fan control*2
- On-board diagnosis function

*1: Canister purge control is described under EC(H4DOTC) — EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES), Evaporative Emission Control System.

*2: Radiator fan control is described under CO(H4DOTC) — COOLING.

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B: INPUT AND OUTPUT SIGNALS

Signal	Unit	Function
Input signals	Manifold absolute pressure sensor	Detects the amount (measures the absolute pressure) of intake air .
	Mass air flow and intake air temperature sensor	Detects the temperature and amount of intake air.
	Throttle position sensor	Detects the throttle valve position.
	Front oxygen (A/F) sensor	Detects the density of oxygen in exhaust gases at the upstream of the front catalytic converter.
	Rear oxygen sensor	Detects the density of oxygen in exhaust gases at the downstream of the front catalytic converter.
	Exhaust gas temperature sensor	Detects the exhaust gas temperature.
	Tumble generator valve position sensor	Detects the tumble generator valve position.
	Crankshaft position sensor	Detects the crankshaft angular position.
	Camshaft position sensor	Detects the combustion cylinder.
	Engine coolant temperature sensor	Detects the engine coolant temperature.
	Knock sensor	Detects engine knocking.
	Vehicle speed sensor	Detects the vehicle speed.
	Ignition switch	Detects operation of the ignition switch.
	Starter switch	Detects the condition of engine cranking.
	Neutral position switch (MT)	Detects that the gear is in neutral.
	Inhibitor switch (AT)	Detects shift positions.
	Heater circuit of front and rear oxygen sensors	Detects abnormality in the heater circuit of the front and rear oxygen sensors.
	Diagnostics of TCM (AT)	Detects the self-diagnostics of TCM.
	Torque control signal (AT)	Controls engine torque.
	A/C switch	Detects ON-OFF operation of the A/C switch.
	Fuel level sensor	Detects the fuel level in the fuel tank.
	Fuel temperature sensor	Detects the temperature of the fuel in the fuel tank.
	Fuel tank pressure sensor	Detects the evaporation gas pressure in the fuel tank.
	Small light switch	Detects ON-OFF operation of the small light switch.
	Blower fan switch	Detects ON-OFF operation of the blower fan switch.
	Rear defogger switch	Detects ON-OFF operation of the rear defogger switch.

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Signal	Unit	Function
Output signals	Fuel injector	Activates an injector.
	Ignition signal	Turns the primary ignition current ON or OFF.
	Fuel pump control unit	Controls the fuel pump.
	A/C control relay	Turns ON or OFF the A/C control relay.
	Radiator fan control relay	Turns ON or OFF the radiator fan control relay.
	Idle air control solenoid valve	Adjusts the amount of air flowing through the bypass line in the throttle body.
	Waste gate control solenoid valve	Controls supercharging pressure
	Tumble generator valve actuator	Operates the tumble generator valve.
	Engine malfunction indicator light (MIL)	Indicates existence of abnormality.
	Purge control solenoid valve	Controls purge of evaporative gas absorbed by the canister.
	Pressure control solenoid valve	Controls evaporation pressure in fuel tank.
	Drain valve	Closes the evaporation line between the fuel tank and canister to detect leakage of evaporation gases.
	Power supply	Controls ON/OFF of the main power supply relay.

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C: FUEL INJECTION CONTROL

● The ECM receives signals from various sensors and based on them, it determines the amount of fuel injected and the fuel injection timing. It performs the sequential fuel injection control over the entire engine operating range except during start-up of the engine.

● The amount of fuel injected depends upon the length of time the injector stays open. The fuel injection duration is determined according to varying operating condition of the engine. For the purpose of achieving highly responsive and accurate fuel injection duration control, the ECM performs a new feedback control that incorporates a learning feature as detailed later.

● The sequential fuel injection control is performed such that fuel is injected accurately at the time when the maximum air intake efficiency can be achieved for each cylinder (i.e., fuel injection is completed just before the intake valve begins to open).

1. FUEL INJECTION DURATION

Fuel injection duration is basically determined as indicated below:

● While cranking the engine:
The duration defined below is used.
  ● Duration of fuel injection during engine start-up ..... Determined according to the engine coolant temperature detected by the engine coolant temperature sensor.

● During normal operation:
The duration is determined as follows:
Basic duration of fuel injection × 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 manifold absolute pressure sensor and the engine speed monitored by the crankshaft position sensor.
  ● Correction factors ..... See the next section.
  ● Voltage correction time ..... This is added to compensate for the time lag before operation of injector that results from variation in the battery voltage.

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2. CORRECTION FACTORS

The following factors are used to correct the basic duration of fuel injection in order to make the air-fuel ratio meet the requirements of varying engine operating conditions:

- Air-fuel ratio feedback factor:

This factor is used to correct the basic duration of fuel injection in relation to the actual engine speed. (See the next section for more details.)

- Start increment factor:

This factor is used to increase the fuel injection duration only while the engine is being cranked to improve its startability.

- Coolant-temperature-dependent increment factor:

This factor is used to increase the fuel injection duration depending on engine coolant temperature signals to facilitate cold starting. The lower the coolant temperature, the greater the increment.

- After-start increment factor:
  - This factor is used to increase the fuel injection duration for a certain period immediately after start of the engine to stabilize engine operation.
  - The increment depends on the coolant temperature at the start of the engine.

- Wide-open-throttle increment factor:

This factor is used to increase the fuel injection duration depending on the relationship between the throttle position sensor signal and manifold absolute pressure sensor signal.

- Acceleration increment factor:

This factor is used to increase the fuel injection duration to compensate for a time lag between air flow measurement and fuel injection control for better engine response to driver's pedal operation during acceleration.

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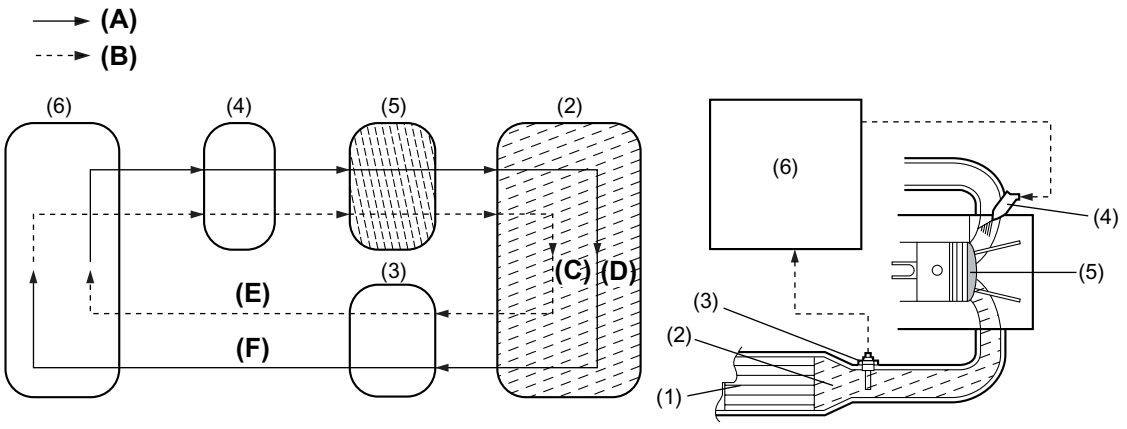
3. AIR-FUEL RATIO FEEDBACK FACTOR

The ECM creates this factor utilizing the front oxygen (A/F) sensor signal. When the signal voltage is high, the air-fuel ratio is richer than the stoichiometric ratio. The ECM then makes the fuel injection duration shorter by modifying the factor. When the voltage is low showing that the mixture is lean, the ECM modifies the factor to make the injection duration longer. In this way, the air-fuel ratio is maintained at a level close to the stoichiometric ratio at which the three-way catalytic converter acts most effectively.



FU-00240

(1) Front catalytic converter
(2) Exhaust gases
(3) Front oxygen (A/F) sensor
(4) Fuel injector
(5) Combustion chamber
(6) ECM

(A) Injection duration increment signal
(B) Injection duration decrement signal
(C) High oxygen density
(D) Low oxygen density
(E) Lean signal
(F) Rich signal

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4. LEARNING FEATURE

The air-fuel ratio feedback control includes a learning feature which contributes to more accurate and responsive control.

● In the air-fuel ratio feedback control, the ECM calculates the necessary amount of correction based on data from the oxygen sensor and adds the result to the basic duration (which is stored in the ECM's memory for each condition defined by the engine speed and various loads.)

● Without a learning feature, the ECM carries out the above-mentioned process every time. This means that if the amount of necessary correction is large, the air-fuel ratio feedback control becomes less responsive and less accurate.

● The learning feature enables the ECM to store the amount of correction into memory and add it to the basic fuel injection duration to create a new reference fuel injection duration. Using the reference duration as the basic duration for the injection a few times later, the ECM can reduce the amount of correction and thus make its feedback control more accurate and responsive to changes in the air-fuel ratio due to difference in driving condition and sensor/actuator characteristics that may result from unit-to-unit variation or aging over time.

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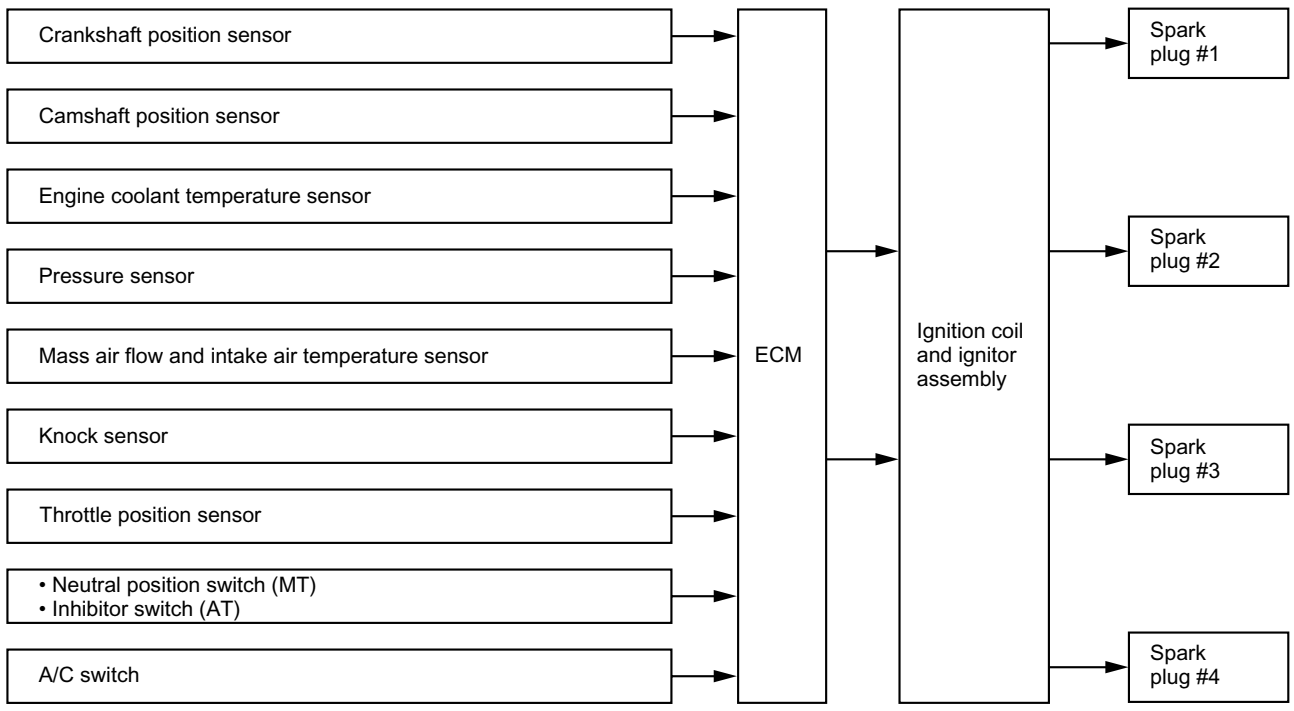
D: IGNITION CONTROL

• The ECM determines operating condition of the engine based on signals from the manifold absolute pressure sensor, engine coolant temperature sensor, intake air temperature sensor, crankshaft position sensor and other sources. The ECM then selects the ignition timing most appropriate for the condition thus determined from those stored in its memory and outputs at that timing a primary current OFF signal to the igniter to initiate ignition.

• This control uses a quick-to-response learning feature by which the data stored in the ECM memory is processed in comparison with information from various sensors and switches.

• Thus, the ECM can always perform optimum ignition timing taking into account the output, fuel consumption, exhaust gas, and other factors for every engine operating condition.

• Ignition control during start-up
Engine speed fluctuates during start of the engine, so the ECM cannot control the ignition timing. During that period, the ignition timing is fixed at 10° BTDC by using the 10° signal from the crankshaft position sensor.



FU-00357

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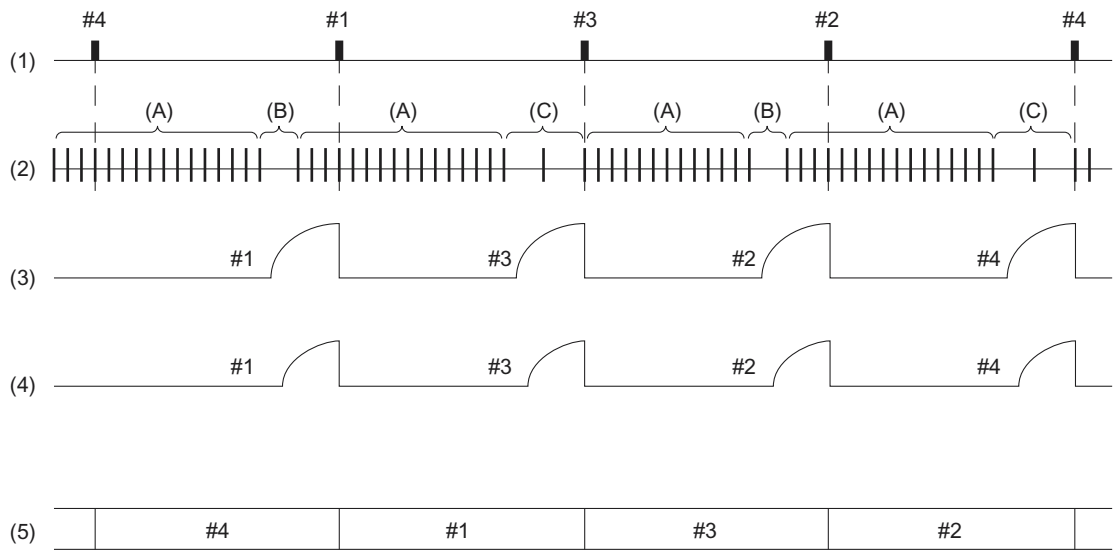
- The ECM identifies cylinders at TDC and determines ignition timing as follows:
  - Within the range (A), the crank angle signal is input every 10° rotation of the crankshaft.
  - The ECM discriminates a TDC cylinder group from the other by detecting the ranges (B) and (C) where no signals are input.
  - The ECM judges that the No. 1 and No. 2 cylinders are at TDC when it detects the range (B), and that the No. 3 and No. 4 cylinders are at TDC when it detects the range (C).



FU-00358

(1) Cylinder number (TDC)
(2) Crank angle pulse
(3) Ignition timing at starting
(4) Ignition timing at normal condition
(5) Cylinder at combustion

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E: IDLE AIR CONTROL

- The ECM activates the idle air control solenoid valve to control the bypass air flowing through the bypass passage in the throttle body depending on signals from the crankshaft position sensor, engine coolant temperature sensor, manifold absolute pressure sensor and A/C switch so that the proper idle speed for each engine load is achieved.

- The idle air control solenoid valve uses a duty-ratio-controlled solenoid which can continuously vary the opening area of the rotary valve. As the ECM increases the duty ratio, opening of the rotary valve increases so that the bypass air flow increases, and the engine idling speed becomes higher as a result.

- The bypass air control is necessary for:
  - Increasing idling speed when the air conditioning system and/or electrical loads are turned on.
  - Increasing idling speed during early stage of warm up period.
  - Obtaining dashpot function when the throttle valve is quickly closed.
  - Prevention of engine speed variation during idling.

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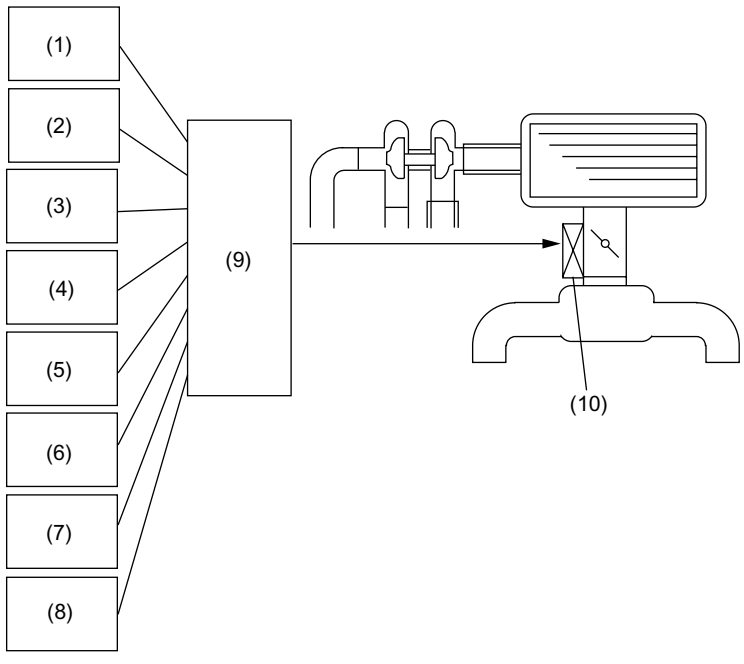

FU-00359

(1) Crankshaft position sensor
(2) Camshaft position sensor
(3) Throttle position sensor
(4) Engine coolant temperature sensor
(5) Vehicle speed sensor
(6) Ignition switch
(7) A/C switch
(8) Neutral position switch (MT)
Inhibitor switch (AT)
(9) ECM
(10) Idle air control solenoid valve

F: FUEL PUMP CONTROL

Using the signal from the crankshaft position sensor, the ECM controls operation of the fuel pump by turning its relay ON or OFF. To improve safety, the fuel pump is stopped if the engine stalls with the ignition switch ON.

Ignition switch ON	Fuel pump relay	Fuel pump
A certain period of time after ignition switch is turned ON	ON	Operates
While cranking the engine	ON	Operates
While engine is operating	ON	Operates
When engine stops	OFF	Does not operate

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6. On-board Diagnosis System

A: GENERAL

• The on-board diagnosis system detects and indicates a fault by generating a code corresponding to each fault location. The engine malfunction indicator light on the combination meter indicates occurrence of a fault or abnormality.

• When the engine malfunction indicator light comes on as a result of detection of a fault by the ECM, the corresponding diagnostic trouble code (DTC) and 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 the data link connector in order to check the DTC.

• The SSM and GST can erase DTCs. This can also read freeze frame data in addition to other pieces of engine data.

• If there is a failure involving sensors which may affect drive control of the vehicle, the fail-safe function ensures minimum level of driveability.

B: FAIL-SAFE FUNCTION

For a sensor or switch which has been judged faulty in the on-board diagnosis, the ECM, if appropriate, generates an associated pseudo signal to keep the vehicle operational. (The control becomes degraded.)

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FUEL INJECTION
(FUEL SYTEMS)
STi

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1. General

● The Multipoint Fuel Injection (MFI) system supplies optimum air-fuel mixture under every engine operating condition through the use of the latest electronic control technology.

This system pressurizes the fuel to a constant pressure and injects it into each intake air port in the cylinder head. The injection quantity of fuel is controlled by an intermittent injection system where an electro-magnetic injection valve or injector opens for a short period that is precisely controlled depending on the quantity of air appropriate for each condition of operation. In actual control, an optimum fuel injection quantity is achieved by varying the duration of an electric pulse applied to the injector. This way of control enables simple, yet highly precise metering of the fuel.

● The engine control module (ECM) that controls the fuel injection system corrects the fuel injection amount depending on the vehicle speed, throttle opening, coolant temperature and other vehicle-operation-related information. The ECM receives the information in the form of electric signals from the corresponding sensors and switches.

The MFI system also has the following features:

● Reduced exhaust emissions
● Reduced fuel consumption
● Increased engine output
● Quick response to accelerator and brake pedal operation
● Superior startability and warm-up performance in cold weather due to corrective controls made according to coolant and intake air temperatures

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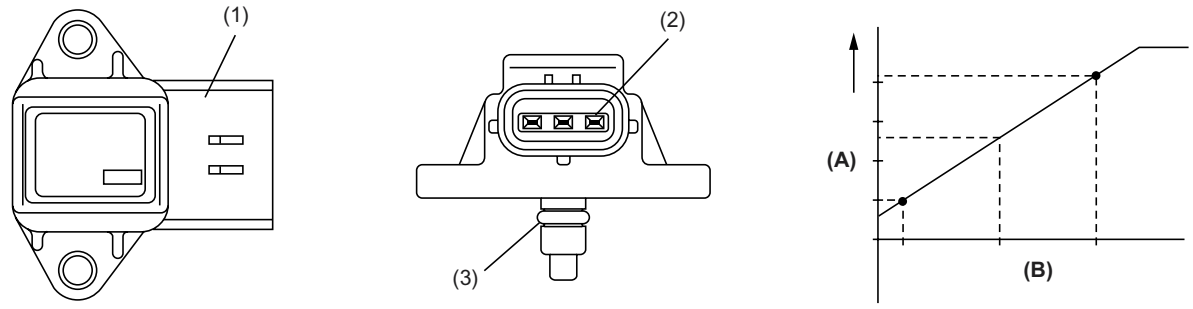
2. Air Line

A: GENERAL

The air filtered by the air cleaner enters the throttle body where it is regulated in the volume by the throttle valve and then enters the intake manifold. It is then distributed to each cylinder where the air is mixed with fuel injected by the injector.

B: MANIFOLD ABSOLUTE PRESSURE SENSOR

The manifold absolute pressure sensor is attached to the top of the throttle body, and continuously sends to the engine control module (ECM) voltage signals that are proportional to intake manifold absolute pressures. The ECM controls the fuel injection and ignition timing based on the intake manifold absolute pressure signals in addition to other signals from many sensors and other control modules.



FU-00343

(1) Connector
(2) Terminal
(3) O-ring

(A) Output voltage
(B) Absolute pressure

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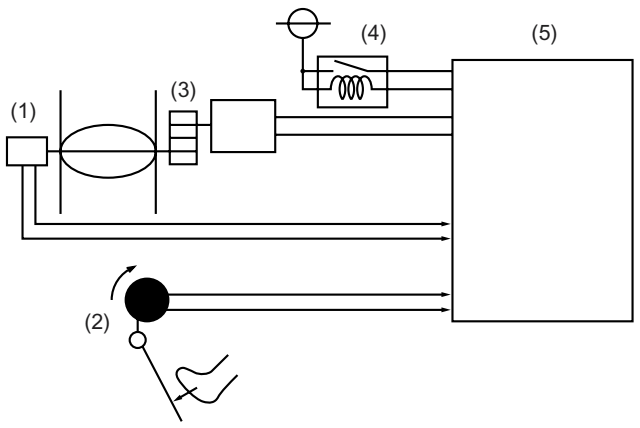
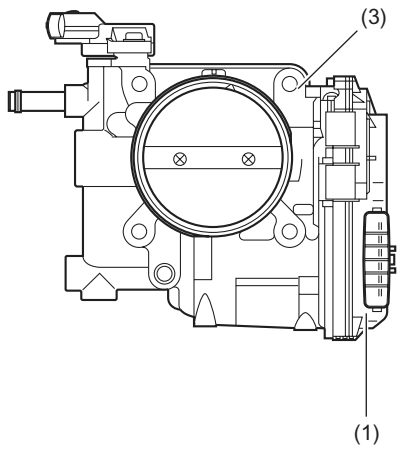
C: ELECTRONIC CONTROL THROTTLE SYSTEM

- The electronic control throttle system consists of an accelerator pedal position sensor mounted on the accelerator pedal, a throttle position sensor and a throttle motor mounted on the throttle body, and the ECM which controls these components.
- The movement of the accelerator pedal is converted into electrical signals by the accelerator pedal position sensor and sent to the ECM.
- Based on these signals the ECM controls the throttle motor to open and close the throttle valve.





FU-01069

(1) Throttle position sensor
(2) Accelerator pedal position sensor
(3) Electronic control throttle assembly
(4) Electronic control throttle relay
(5) ECM

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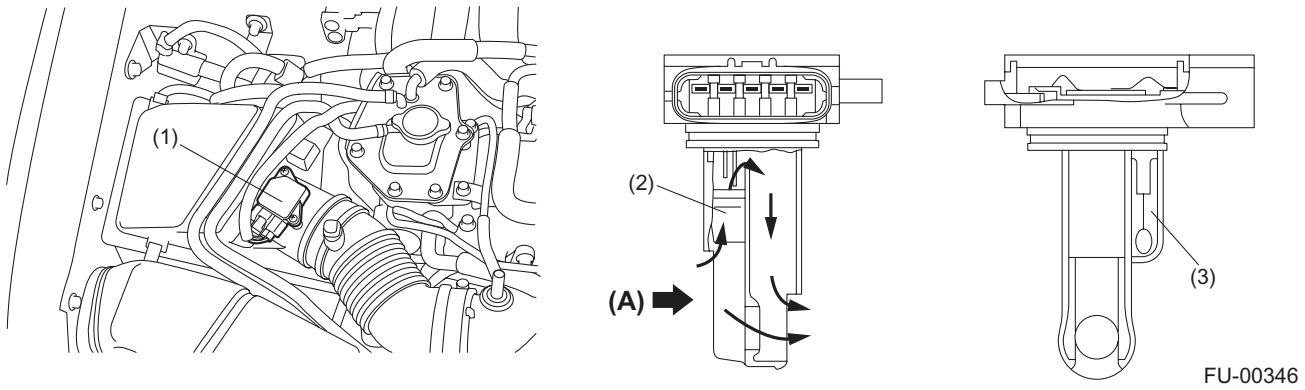
D: MASS AIR FLOW AND INTAKE AIR TEMPERATURE SENSOR

The mass air flow and the intake air temperature sensors are integrated into a single unit. The unit is mounted on the air cleaner case and measures the amount as well as the temperature of the intake air.
The measured amount and temperature are converted into electrical signals and sent to the ECM. The ECM uses these signals to control injection and ignition timing as well as the fuel injection amount.



(1) Mass air flow and intake air temperature sensor
(2) Mass air flow sensor
(3) Intake air temperature sensor
(A) Air

E: TUMBLE GENERATOR VALVE

- A tumble generator valve is provided on each engine bank, between the intake manifold and intake air ports. The right bank tumble generator valve has butterfly valves for the #1 and #3 cylinders and the left bank tumble generator valve has those for the #2 and #4 cylinders. The two butterfly valves in each tumble generator valve are fitted on a single shaft that is driven by an actuator.

- The tumble generator valves are controlled by the ECM according to the coolant temperature and the time elapsed after start of the engine. When the engine is started, the butterfly valves are moved to the closing ends. In this state, the intake air flows at very high speeds passing through narrowed passages in the directions determined by the individual intake air ports in the cylinder head. This creates tumbling air motions in the cylinders, which enables lean mixtures to be ignited and thus harmful exhaust emissions to be reduced during engine start. The tumble generator valves are fully open when the engine is operating at an ordinary driving speed, allowing intake air to flow without being changed in direction and velocity.

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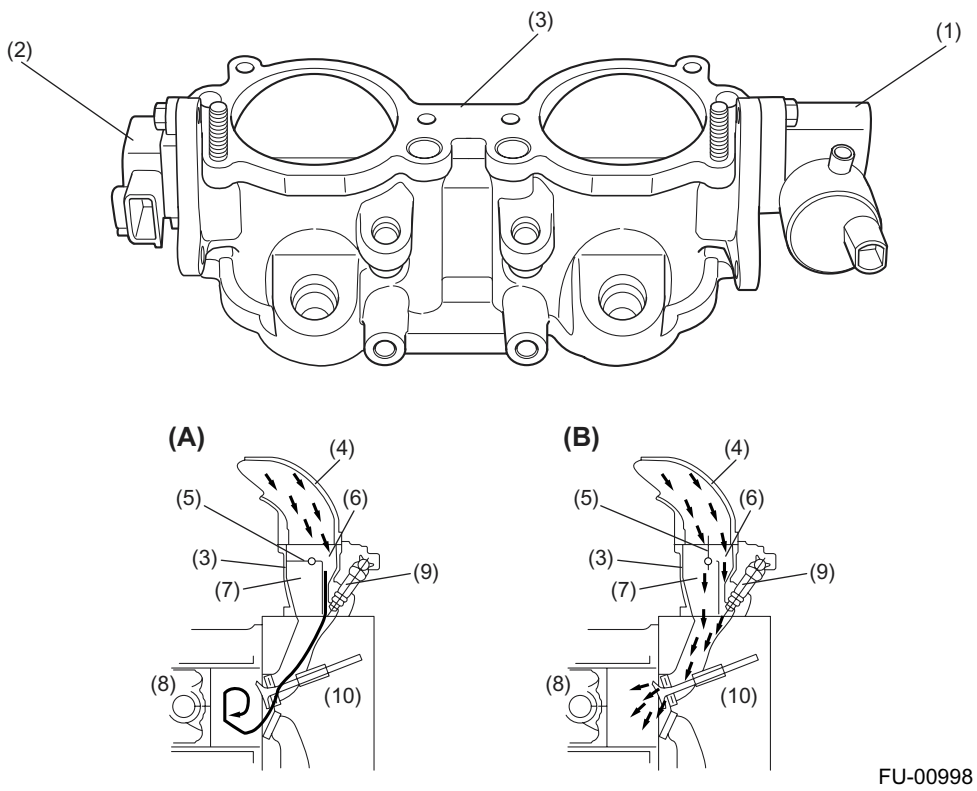
AIR LINE

FUEL INJECTION (FUEL SYSTEM)



FU-00998

(A) Activated
(B) Not activated

(1) Actuator
(2) Tumble generator valve position sensor
(3) Tumble generator housing
(4) Intake manifold
(5) Tumble generator valve
(6) Tumble generating air passage
(7) Intake main air passage
(8) Piston
(9) Injector
(10) Cylinder Head

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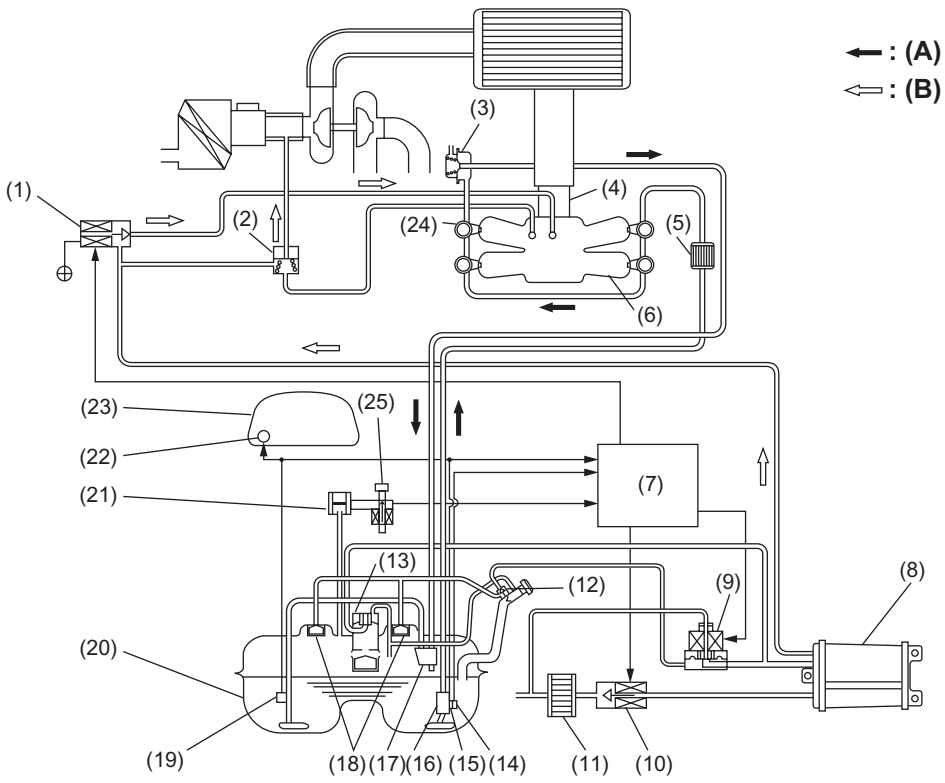
3. Fuel System

A: GENERAL

● The fuel pressurized by the fuel tank inside pump is delivered to each fuel injector by way of the fuel pipe and fuel filter. Fuel injection pressure is regulated to an optimum level by the pressure regulator.

● Each injector injects fuel into the intake port of the corresponding cylinder where the fuel is mixed with air. The mixture then enters the cylinder.

Fuel injection amount and timing are regulated by the ECM.



FU-00790

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

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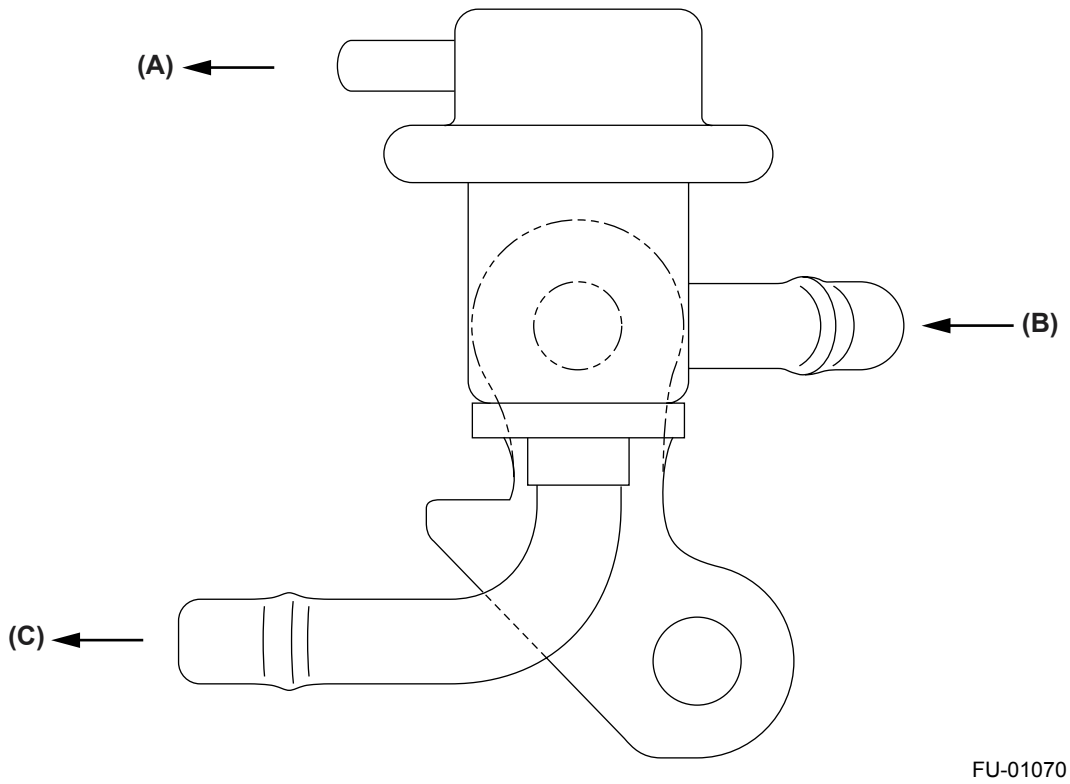
B: PRESSURE REGULATOR

The pressure regulator is installed at the injector end of the fuel supply line. It has a fuel chamber and spring chamber separated by a diaphragm. The fuel chamber is connected to the fuel supply line and the spring chamber is connected to the intake manifold. Fuel chamber also has a relief valve connected to the fuel return line through which fuel returns to the fuel tank. When the intake manifold vacuum increases, the diaphragm is pulled and the relief valve opens to decrease the fuel supply line pressure (or fuel injection pressure). When the intake manifold vacuum decreases, the diaphragm is pushed by the spring to increase the fuel supply line pressure. Thus, the difference between the fuel injection pressure and the intake manifold vacuum is kept at a constant level of 294 kPa (3.00 kgf/cm^2, 43.0 psi) to precisely control the amount of injected fuel.



FU-01070

(A) To intake manifold
(B) Fuel IN
(C) Fuel OUT

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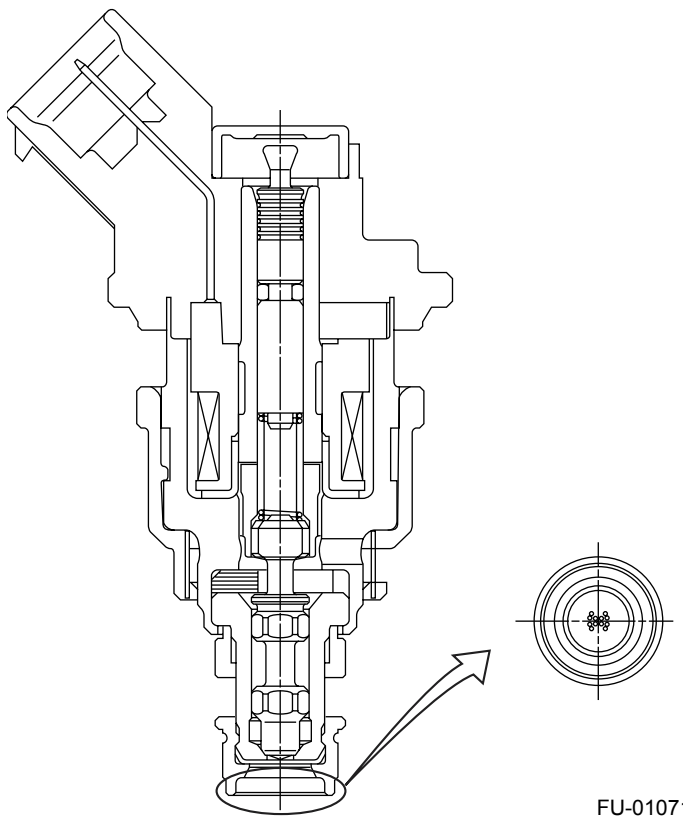
C: FUEL INJECTOR

- The MFI system employs side feed type fuel injectors.
- Each injector is installed in the fuel pipe in such a way that the injector is cooled by 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 injector injects fuel according to the valve open signal from the ECM. The needle valve is lifted by the solenoid which is energized on arrival of the valve open signal.
- Since the injector's nozzle hole area, the lift of valve and the fuel pressure are kept constant, the amount of fuel injected is controlled only by varying the duration of the valve open signal from the ECM.
- The multi-hole nozzle makes it possible for the injector to produce fine fuel particles, which enhances the combustion efficiency and output performance of the engine.



FU-01071

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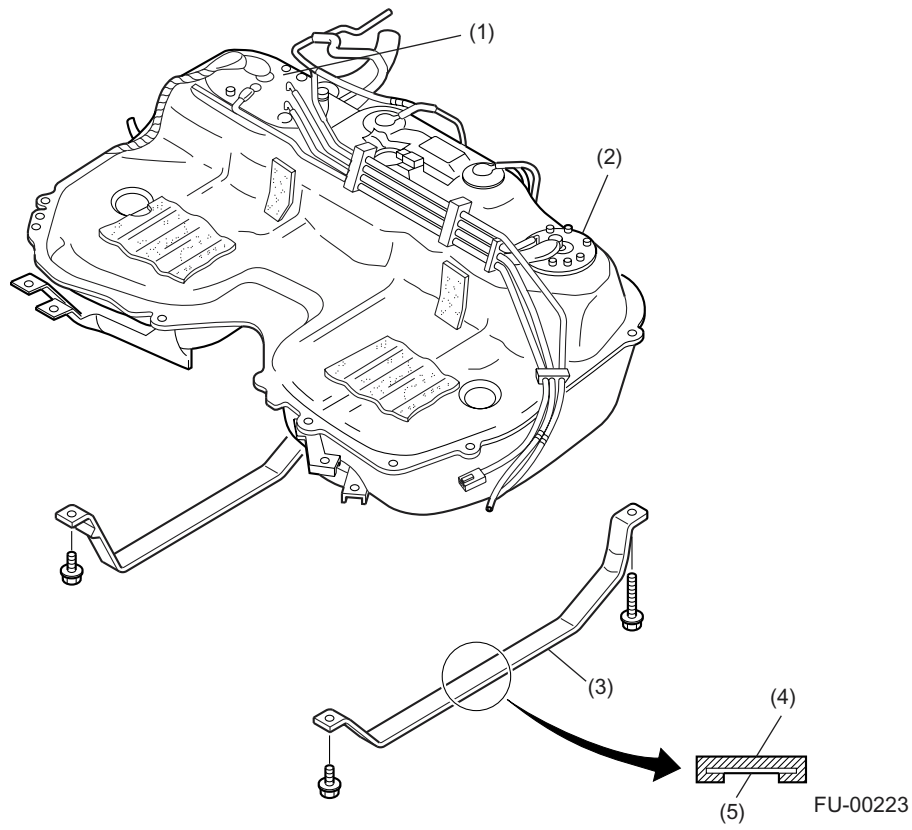
D: FUEL TANK

The fuel tank utilizes a two-compartment design to ensure sufficient capacity without interfering with the rear differential. It is provided with a suction jet pump (included in the fuel pump and fuel level sensor assembly) which transfers fuel from one compartment to the other.

Each compartment has an individual fuel level sensor. The fuel tank is located under the rear seat and secured with hold-down bands.



(1) Fuel pump and fuel level sensor assembly
(2) Fuel sub level sensor
(3) Band
(4) Cushion
(5) Steel

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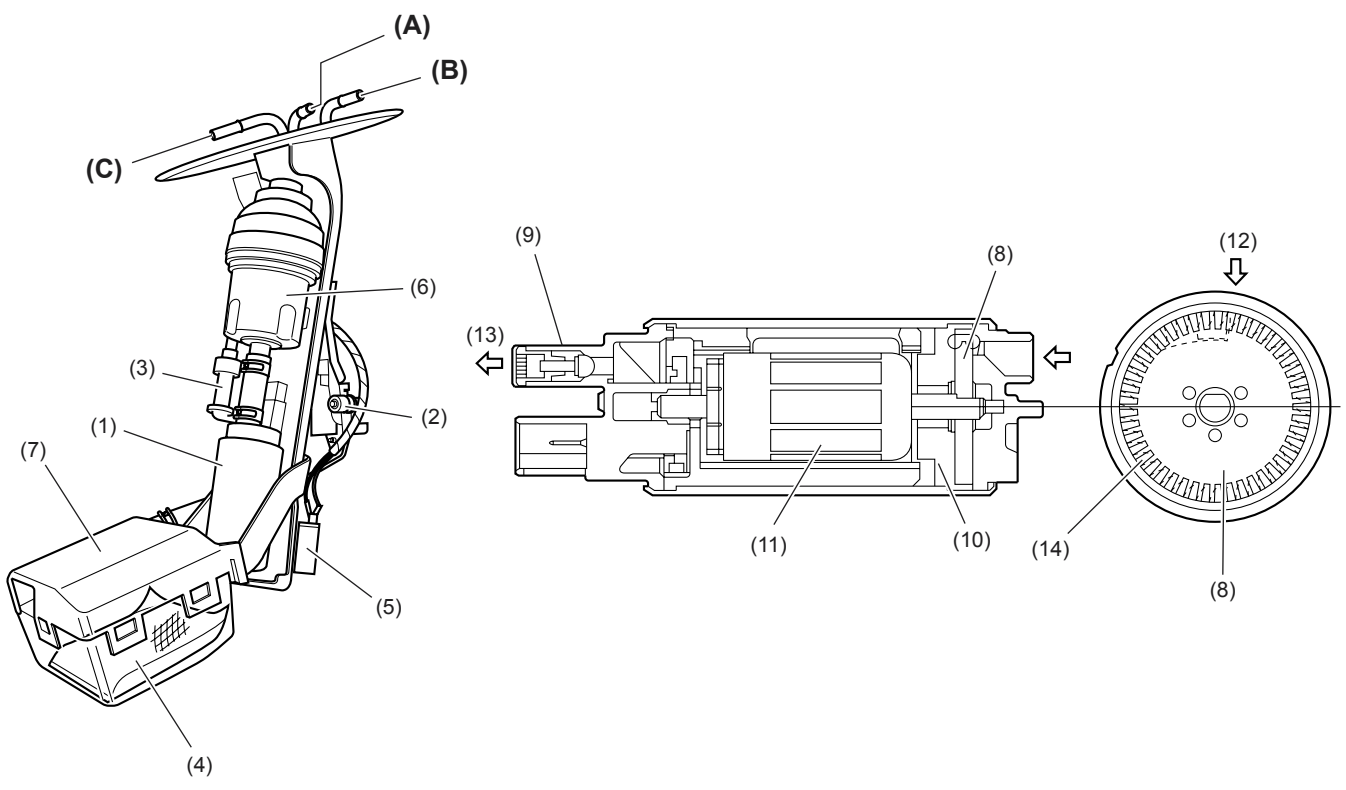
E: FUEL PUMP AND FUEL LEVEL SENSOR ASSEMBLY

1. FUEL PUMP

The fuel pump consists of a motor, impeller, pump casing, pump cover, check valve and filter. It is located in the fuel tank and combined with the fuel level sensor into a single unit. The operation of this impeller type pump is very quiet.



FU-01072

(1) Fuel pump
(2) Fuel level sensor
(3) Jet pump
(4) Mesh filter
(5) Fuel temperature sensor
(6) Cartridge filter
(7) Chamber
(8) Impeller
(9) Check valve
(10) Pump casing
(11) Motor armature
(12) Suction
(13) Discharge
(14) Vane groove

(A) From engine (return line)
(B) From sub tank
(C) To engine (delivery line)

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- When the ignition switch is turned ON, fuel pump relay is activated. Then the motor operates to rotate the impeller.
- As the impeller rotates, fuel in a vane groove of the impeller flows along the fuel passage into the next vane groove by centrifugal force. When fuel flows from one groove to the next, a pressure difference occurs due to friction. This creates a pumping effect.
- The fuel pushed up by rotation of the impeller then passes through the clearance between the armature and the magnet of the motor and is discharged through the check valve.
- When the fuel discharge pressure reaches the specified level, the relief valve opens and excess fuel is released into the fuel tank. In this manner, the relief valve prevents an abnormal increase in fuel pressure.
- When the engine and the fuel pump stop, spring force acts on the check valve to close the discharge port, so that the fuel pressure in the fuel delivery line is retained.

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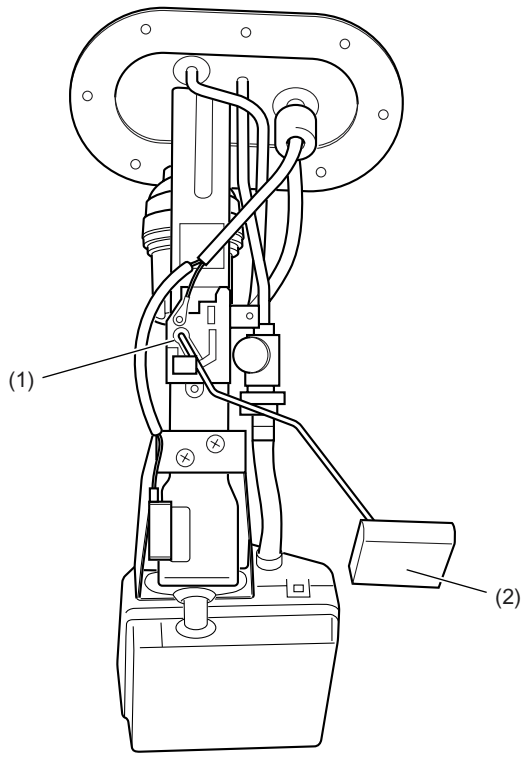
2. FUEL LEVEL SENSOR

The fuel level sensor is integrated with the fuel pump which is located in the fuel tank. The sensor outputs an electric resistance signal that varies with movement of its float to indicate the level of the fuel remaining in the tank.



FU-01073

(1) Fuel level sensor
(2) Float

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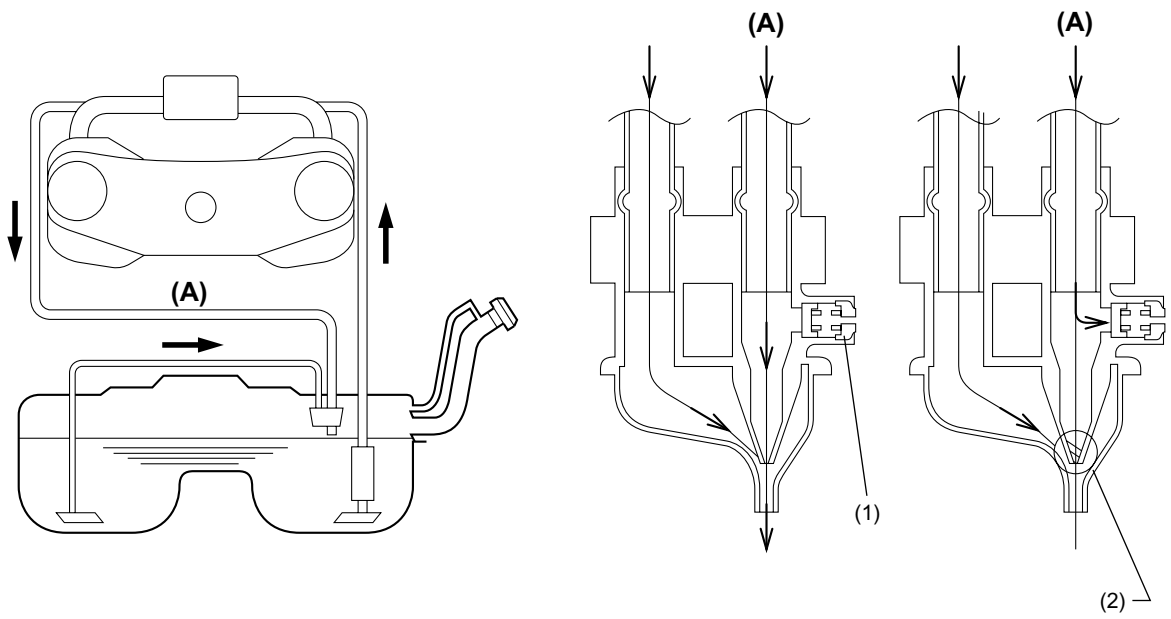
3. JET PUMP

● The jet pump utilizes the velocity of fuel returning from the engine to produce negative pressure in it.

● Using the pumping effect produced by the negative pressure, the jet pump transfers fuel from the sub-compartment to the main compartment of the fuel tank.

● 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.



FU-00226

(1) Relief valve
(2) Nozzle

(A) Return line

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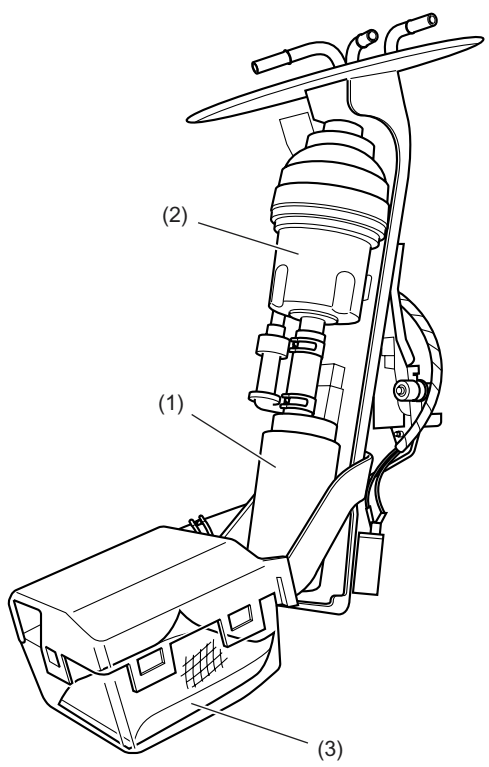
4. FUEL FILTER

There are two different types of fuel filters inside fuel tank, forming integral part of the fuel pump. The filter at the inlet of the fuel pump is a mesh type which removes relatively large particles in the fuel before it enters the pump. The filter at the outlet of the pump is a pressure resistant cartridge type whose inside filtering element can remove small particles in the pressurized fuel.



FU-01074

(1) Fuel pump
(2) Cartridge filter
(3) Mesh filter

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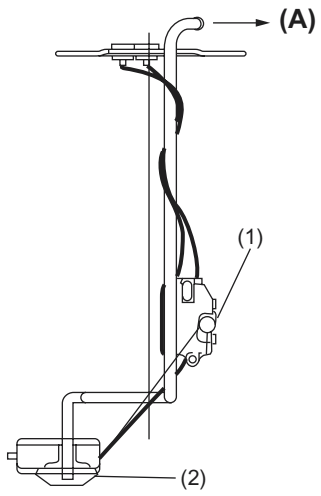
F: SUB-COMPARTMENT FUEL LEVEL SENSOR

This sensor detects the level of the fuel in the sub-compartment (the compartment in which the fuel pump is not located) and acts as part of the fuel transfer line when the jet pump is in operation to maintain the fuel in both compartments at the same level.



FU-00227

(1) Fuel level sensor
(2) Float

(A) To jet pump

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4. Sensors and Switches

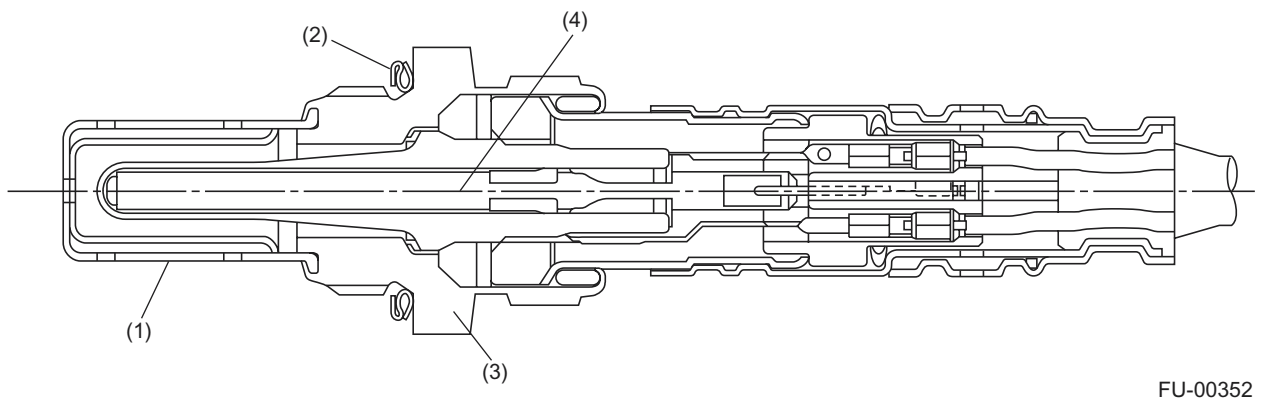
A: FRONT OXYGEN (A/F) SENSOR

● 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 its both sides are exposed to oxygen ions of different concentration and the magnitude of this electromotive force depends on how much the difference is.
The front oxygen (A/F) sensor detects the amount of oxygen in exhaust gases by making use of this property of the zirconium oxide material.

● The zirconium oxide material is formed into a closed end tube and its external surface is exposed to exhaust gases with smaller oxygen ion concentration, whereas its internal surface is exposed to atmospheric air. The external surface has a porous platinum coating. The sensor housing is grounded to the exhaust pipe and the inside is connected to the ECM through the harness to be able to use the current output from the sensor.

● The sensor incorporates a ceramic heater to improve its performance at low temperatures.



FU-00352

(1) Protection tube
(2) Gasket
(3) Sensor housing
(4) Ceramic heater

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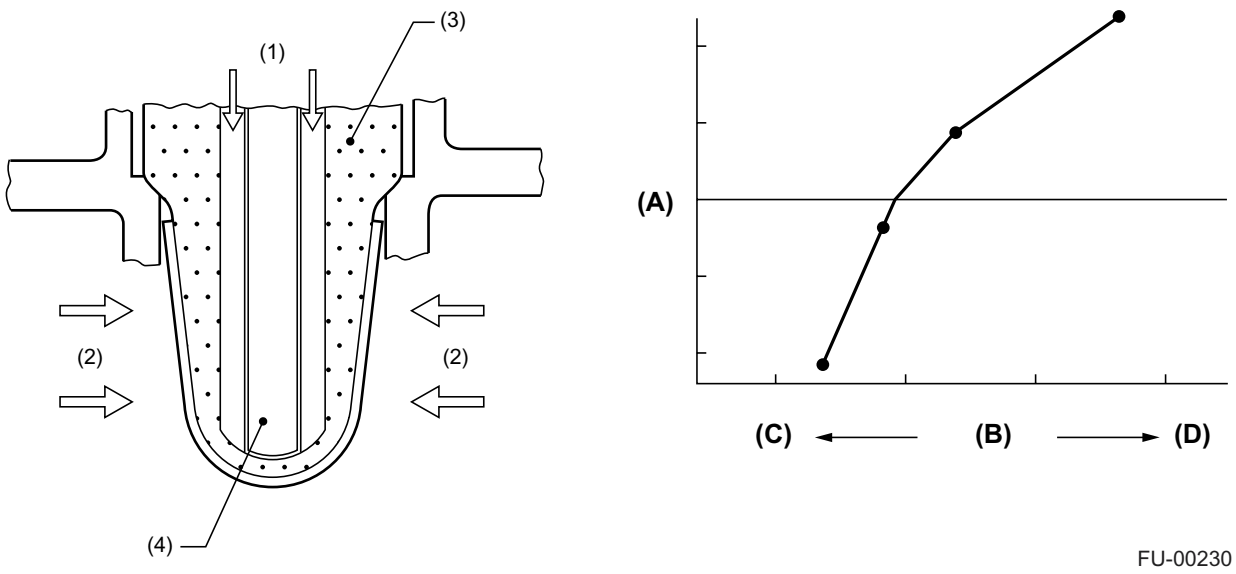
• When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases is almost completely used in the catalytic reaction by the platinum coating on the external surface of the zirconia tube. This results in a very large difference in the oxygen ion concentration between the inside and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

• When a lean air-fuel mixture is burnt in the cylinder, relatively large amount of oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen ion concentration between the tube's internal and external surfaces. The electromotive force in this case is very small.

• The difference in oxygen concentration changes drastically in the vicinity of the stoichiometric air-fuel ratio, and hence the change in the electromotive force is also large. By using this information, the ECM can determine the air-fuel ratio of the supplied mixture easily. The front oxygen (A/F) sensor does not generate much electromotive force when the temperature is low. The output characteristics of the sensor stabilize at a temperature of approximately 700°C (1,292 °F).



(1) Atmospheric air
(2) Exhaust gases
(3) ZrO_2
(4) Ceramic heater

(A) Electromotive force
(B) Air/fuel ratio
(C) Lean
(D) Rich

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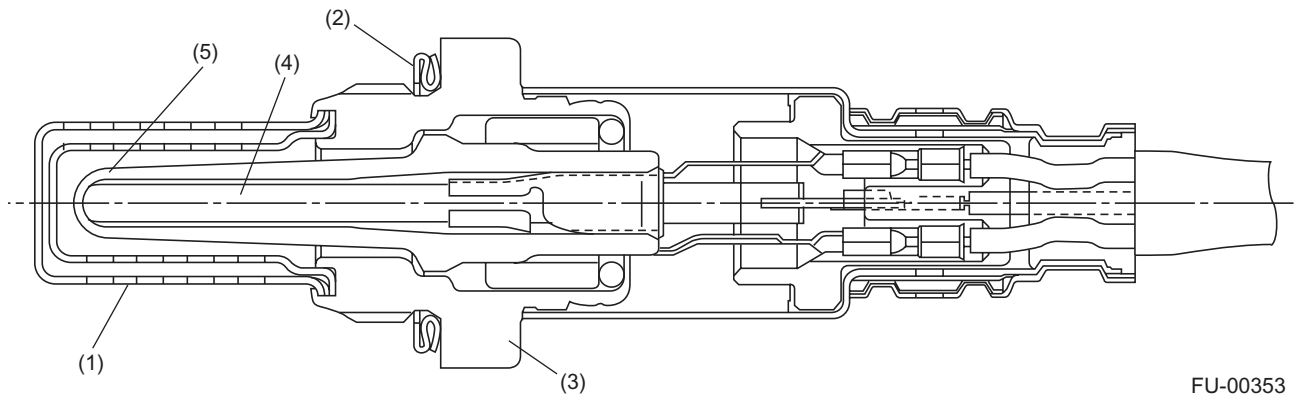
B: REAR OXYGEN SENSOR

● The rear oxygen sensor is used to sense oxygen concentration in the exhaust gas. If the air-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 almost no oxygen.

● Detecting the oxygen concentration in exhaust gas using the oxygen sensor makes it possible to determine 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 ion concentration between the inside and outside of the tube. Platinum is coated on the inside and outside of the zirconia tube as a catalysis and electrode material. 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 temperatures.



FU-00353

(1) Protection tube
(2) Gasket
(3) Sensor housing
(4) Ceramic heater
(5) Zirconia tube

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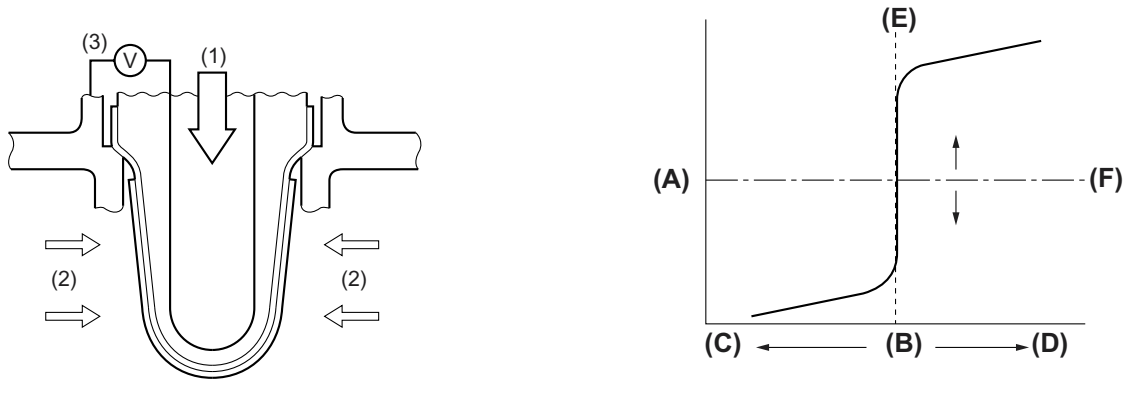
● When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases is almost completely used in the catalytic reaction by the platinum coating on the external surface of the zirconia tube. This results in a very large difference in the oxygen ion concentration between the inside and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

● When a lean air-fuel mixture is burnt in the cylinder, relatively large amount of oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen ion concentration between the tube's internal and external surfaces. The electromotive force in this case is very small.

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



FU-01010

(1) Atmospheric air
(2) Exhaust gases
(3) Electromotive force

(A) Electromotive force
(B) Air/fuel ratio
(C) Lean
(D) Rich
(E) Stoichiometric ratio
(F) Comparison voltage

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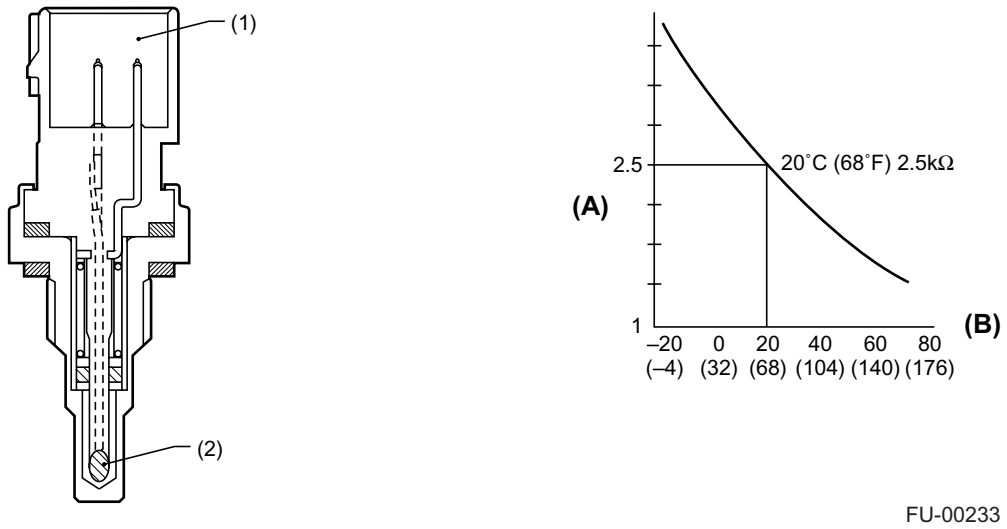
C: ENGINE COOLANT TEMPERATURE SENSOR

The engine coolant temperature sensor is located on the engine coolant pipe. The sensor uses a thermistor whose resistance changes inversely with temperature. Resistance signals as engine coolant temperature information are transmitted to the ECM to make fuel injection, ignition timing, purge control solenoid valve and other controls.



FU-00233

(1) Connector
(2) Thermistor element

(A) Resistance (kΩ)
(B) Temperature °C (°F)

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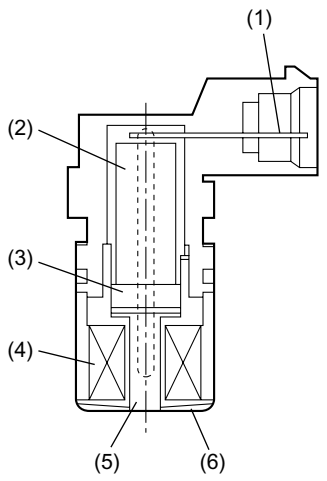
D: CRANKSHAFT POSITION SENSOR

● The crankshaft position sensor is installed on the oil pump which is located in the front center portion of the cylinder block. The sensor generates a pulse when one of the teeth on the perimeter of the crankshaft sprocket (rotating together with the crankshaft) passes in front of it. The ECM determines the crankshaft angular position by counting the number of pulses.

● The crankshaft position sensor is a molded type which consists of a magnet, core, coil, terminals and other components as illustrated below.



FU-00234

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

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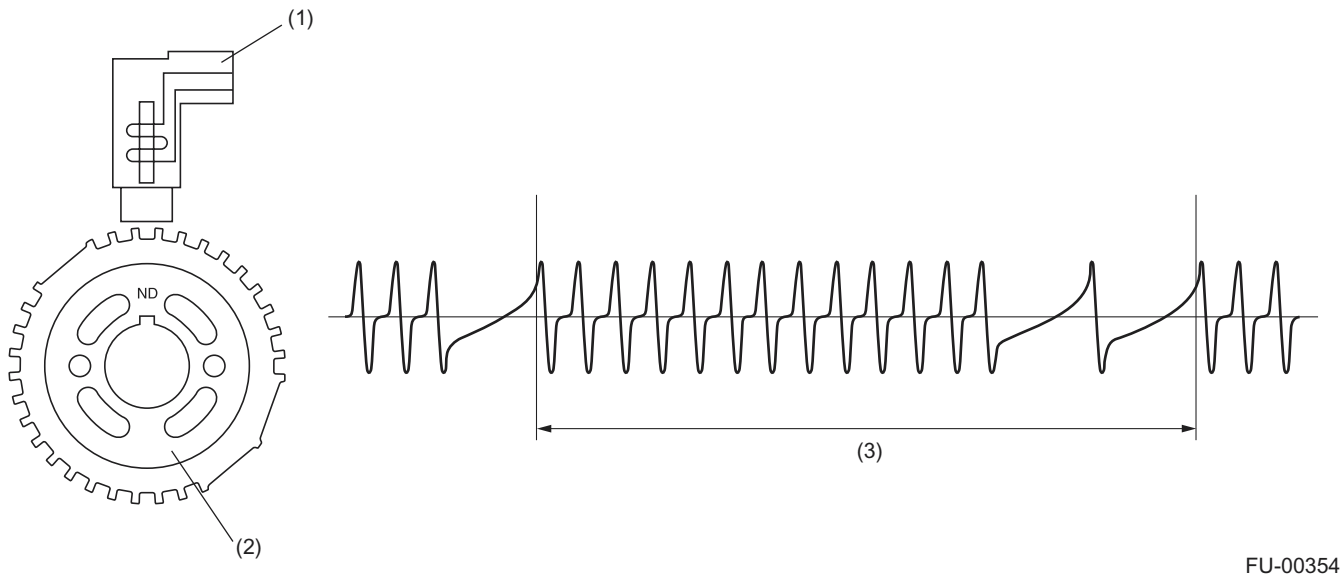
● As the crankshaft rotates, each tooth aligns with the crankshaft position sensor. At that time, the magnetic flux in the sensor's coil changes since the air gap between the sensor pickup and the sprocket changes. This change in magnetic flux induces a voltage pulse in the sensor and the pulse is transmitted to the ECM.



FU-00354

(1) Crankshaft position sensor
(2) Crankshaft sprocket
(3) Crankshaft half rotation

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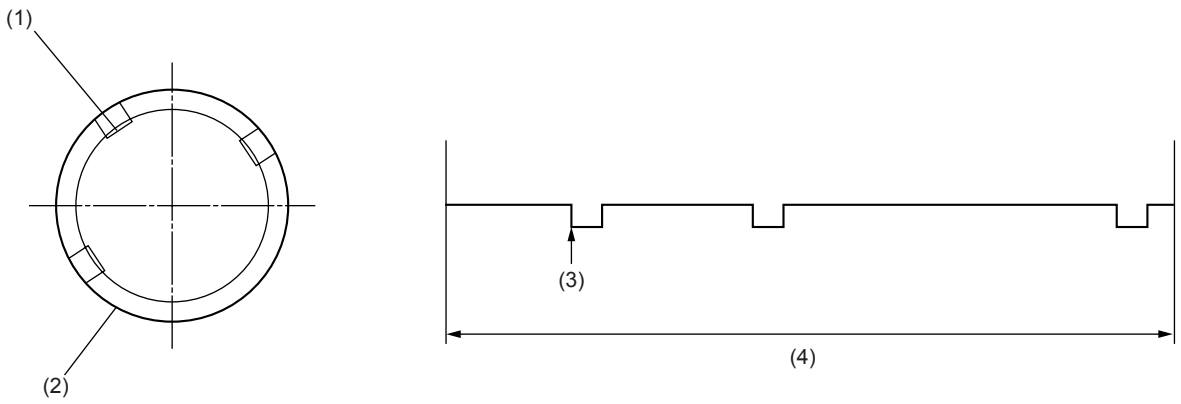
E: CAMSHAFT POSITION SENSOR

● The camshaft position sensor is located on the cylinder head. It detects the combustion cylinder at any given moment.

● The sensor generates a pulse when one of the slots in the camshaft passes in front of the sensor. The ECM detects the camshaft position by measuring the pulse.
Three slots are provided in the camshaft as shown below.



FU-01151

(1) Slot
(2) Camshaft
(3) Detection point
(4) Camshaft one rotation (crankshaft two rotations)

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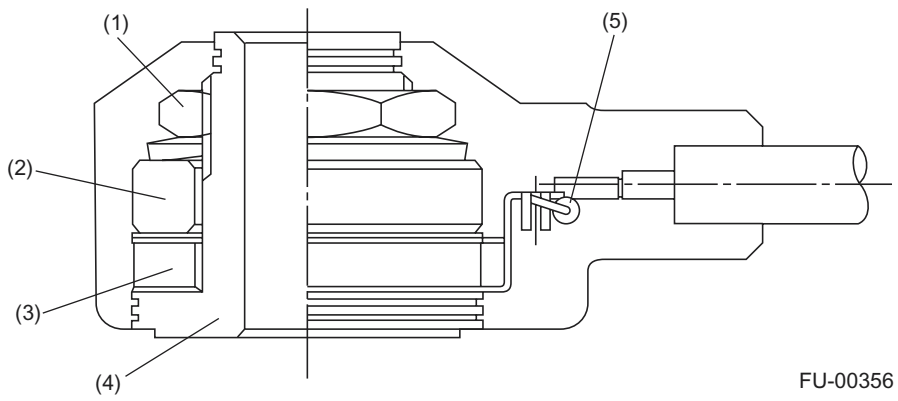
F: KNOCK SENSOR

- The knock sensor is installed on the cylinder block, and senses knocking that occurs in the engine.
- The sensor is a piezo-electric type which converts vibration resulting from knocking into electric signals.
- In addition to a piezo-electric element, the sensor has a weight and case as its components. If knocking occurs in the engine, the weight in the case moves causing the piezo-electric element to generate a voltage.
- The knock sensor harness is connected to the engine harness.



FU-00356

(1) Nut
(2) Weight
(3) Piezo-electric element
(4) Housing
(5) Resistor

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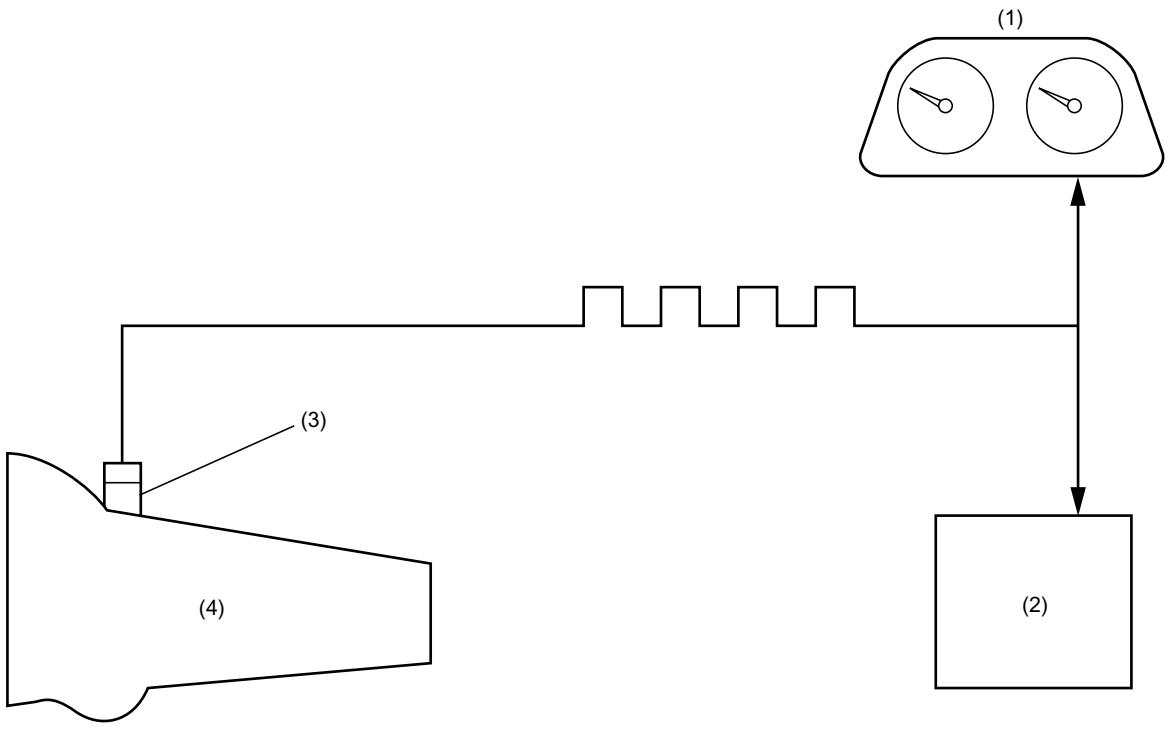
G: VEHICLE SPEED SENSOR

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



FU-00238

(1) Combination meter
(2) ECM
(3) Vehicle speed sensor
(4) Transmission

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5. Control System

A: GENERAL

The ECM receives signals from various sensors, switches, and other control modules. Using these signals, it determines the engine operating conditions and if necessary, emits signals to one or more systems to control them for optimum operation.

Major control items of the ECM are as follow:

- Fuel injection control
- Ignition control
- Idle air control
- Fuel pump control
- Canister purge control*1
- Radiator fan control*2
- On-board diagnosis function

*1: Canister purge control is described under EC(H4DOTC) — EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES), Evaporative Emission Control System.

*2: Radiator fan control is described under CO(H4DOTC) — COOLING.

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B: INPUT AND OUTPUT SIGNALS

Signal	Unit	Function
Input signals	Manifold absolute pressure sensor	Detects the amount (measures the absolute pressure) of intake air .
	Mass air flow and intake air temperature sensor	Detects the temperature and amount of intake air.
	Throttle position sensor	Detects the throttle valve position.
	Front oxygen (A/F) sensor	Detects the density of oxygen in exhaust gases at the upstream of the front catalytic converter.
	Rear oxygen sensor	Detects the density of oxygen in exhaust gases at the downstream of the front catalytic converter.
	Tumble generator valve position sensor	Detects the tumble generator valve position.
	Crankshaft position sensor	Detects the crankshaft angular position.
	Camshaft position sensor	Detects the combustion cylinder.
	Engine coolant temperature sensor	Detects the engine coolant temperature.
	Knock sensor	Detects engine knocking.
	Vehicle speed sensor	Detects the vehicle speed.
	Ignition switch	Detects operation of the ignition switch.
	Starter switch	Detects the condition of engine cranking.
	Neutral position switch	Detects that the gear is in neutral.
	Heater circuit of front and rear oxygen sensors	Detects abnormality in the heater circuit of the front and rear oxygen sensors.
	A/C switch	Detects ON-OFF operation of the A/C switch.
	Fuel level sensor	Detects the fuel level in the fuel tank.
	Fuel temperature sensor	Detects the temperature of the fuel in the fuel tank.
	Fuel tank pressure sensor	Detects the evaporation gas pressure in the fuel tank.
	Small light switch	Detects ON-OFF operation of the small light switch.
	Blower fan switch	Detects ON-OFF operation of the blower fan switch.
	Rear defogger switch	Detects ON-OFF operation of the rear defogger switch.
Output signals	Fuel injector	Activates an injector.
	Ignition signal	Turns the primary ignition current ON or OFF.
	Fuel pump control unit	Controls the fuel pump.
	A/C control relay	Turns ON or OFF the A/C control relay.
	Radiator fan control relay	Turns ON or OFF the radiator fan control relay.
	Waste gate control solenoid valve	Controls supercharging pressure
	Tumble generator valve actuator	Operates the tumble generator valve.
	Engine malfunction indicator light (MIL)	Indicates existence of abnormality.
	Purge control solenoid valve	Controls purge of evaporative gas absorbed by the canister.
	Pressure control solenoid valve	Controls evaporation pressure in fuel tank.
	Drain valve	Closes the evaporation line between the fuel tank and canister to detect leakage of evaporation gases.
	Power supply	Controls ON/OFF of the main power supply relay.

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C: FUEL INJECTION CONTROL

● The ECM receives signals from various sensors and based on them, it determines the amount of fuel injected and the fuel injection timing. It performs the sequential fuel injection control over the entire engine operating range except during start-up of the engine.

● The amount of fuel injected depends upon the length of time the injector stays open. The fuel injection duration is determined according to varying operating condition of the engine. For the purpose of achieving highly responsive and accurate fuel injection duration control, the ECM performs a new feedback control that incorporates a learning feature as detailed later.

● The sequential fuel injection control is performed such that fuel is injected accurately at the time when the maximum air intake efficiency can be achieved for each cylinder (i.e., fuel injection is completed just before the intake valve begins to open).

1. FUEL INJECTION DURATION

Fuel injection duration is basically determined as indicated below:

● While cranking the engine:
The duration defined below is used.
  ● Duration of fuel injection during engine start-up ..... Determined according to the engine coolant temperature detected by the engine coolant temperature sensor.

● During normal operation:
The duration is determined as follows:
Basic duration of fuel injection × 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 manifold absolute pressure sensor and the engine speed monitored by the crankshaft position sensor.
  ● Correction factors ..... See the next section.
  ● Voltage correction time ..... This is added to compensate for the time lag before operation of injector that results from variation in the battery voltage.

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2. CORRECTION FACTORS

The following factors are used to correct the basic duration of fuel injection in order to make the air-fuel ratio meet the requirements of varying engine operating conditions:

- Air-fuel ratio feedback factor:

This factor is used to correct the basic duration of fuel injection in relation to the actual engine speed. (See the next section for more details.)

- Start increment factor:

This factor is used to increase the fuel injection duration only while the engine is being cranked to improve its startability.

- Coolant-temperature-dependent increment factor:

This factor is used to increase the fuel injection duration depending on engine coolant temperature signals to facilitate cold starting. The lower the coolant temperature, the greater the increment.

- After-start increment factor:
  - This factor is used to increase the fuel injection duration for a certain period immediately after start of the engine to stabilize engine operation.
  - The increment depends on the coolant temperature at the start of the engine.

- Wide-open-throttle increment factor:

This factor is used to increase the fuel injection duration depending on the relationship between the throttle position sensor signal and manifold absolute pressure sensor signal.

- Acceleration increment factor:

This factor is used to increase the fuel injection duration to compensate for a time lag between air flow measurement and fuel injection control for better engine response to driver's pedal operation during acceleration.

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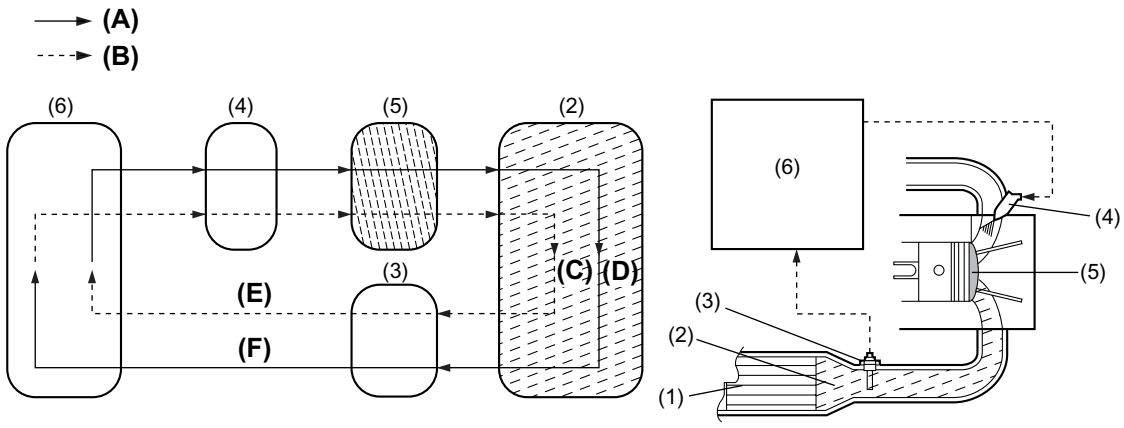
3. AIR-FUEL RATIO FEEDBACK FACTOR

The ECM creates this factor utilizing the front oxygen (A/F) sensor signal. When the signal voltage is high, the air-fuel ratio is richer than the stoichiometric ratio. The ECM then makes the fuel injection duration shorter by modifying the factor. When the voltage is low showing that the mixture is lean, the ECM modifies the factor to make the injection duration longer. In this way, the air-fuel ratio is maintained at a level close to the stoichiometric ratio at which the three-way catalytic converter acts most effectively.



FU-00240

(1) Front catalytic converter
(2) Exhaust gases
(3) Front oxygen (A/F) sensor
(4) Fuel injector
(5) Combustion chamber
(6) ECM

(A) Injection duration increment signal
(B) Injection duration decrement signal
(C) High oxygen density
(D) Low oxygen density
(E) Lean signal
(F) Rich signal

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4. LEARNING FEATURE

The air-fuel ratio feedback control includes a learning feature which contributes to more accurate and responsive control.

● In the air-fuel ratio feedback control, the ECM calculates the necessary amount of correction based on data from the oxygen sensor and adds the result to the basic duration (which is stored in the ECM's memory for each condition defined by the engine speed and various loads.)

● Without a learning feature, the ECM carries out the above-mentioned process every time. This means that if the amount of necessary correction is large, the air-fuel ratio feedback control becomes less responsive and less accurate.

● The learning feature enables the ECM to store the amount of correction into memory and add it to the basic fuel injection duration to create a new reference fuel injection duration. Using the reference duration as the basic duration for the injection a few times later, the ECM can reduce the amount of correction and thus make its feedback control more accurate and responsive to changes in the air-fuel ratio due to difference in driving condition and sensor/actuator characteristics that may result from unit-to-unit variation or aging over time.

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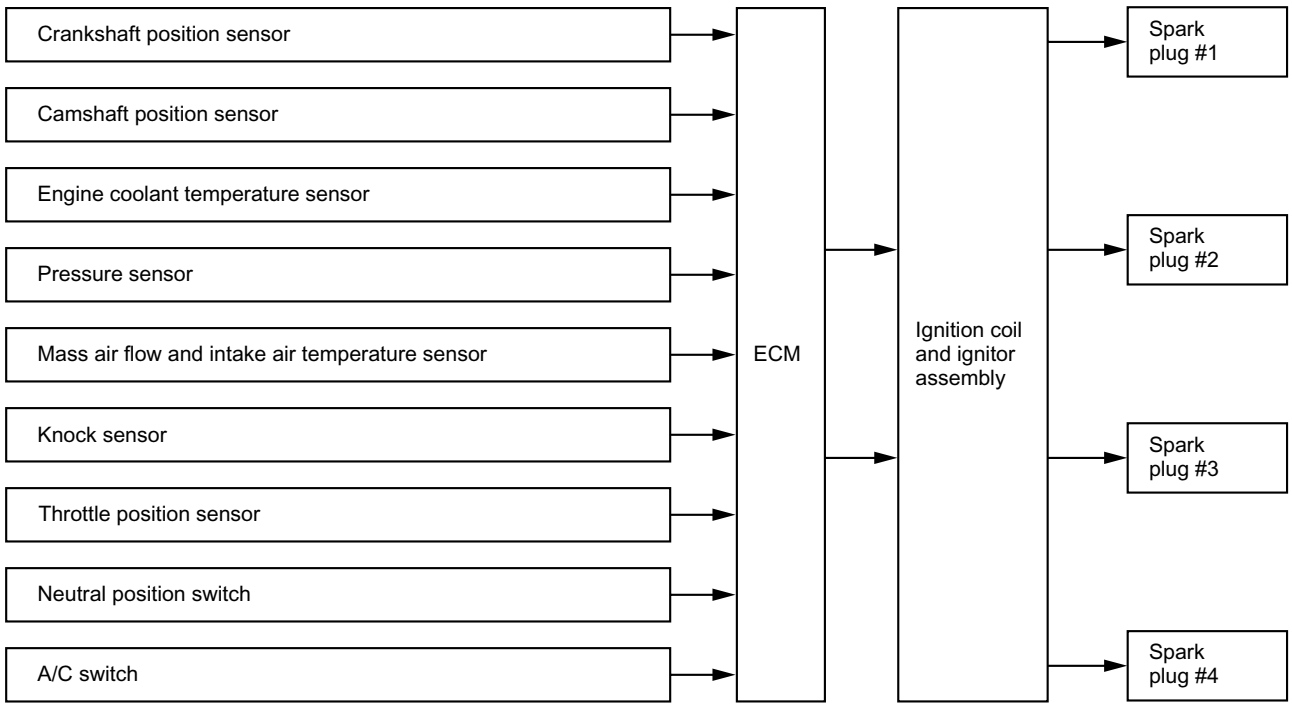
D: IGNITION CONTROL

● The ECM determines operating condition of the engine based on signals from the manifold absolute pressure sensor, engine coolant temperature sensor, intake air temperature sensor, crankshaft position sensor and other sources. The ECM then selects the ignition timing most appropriate for the condition thus determined from those stored in its memory and outputs at that timing a primary current OFF signal to the igniter to initiate ignition.

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

● Thus, the ECM can always perform optimum ignition timing taking into account the output, fuel consumption, exhaust gas, and other factors for every engine operating condition.

● Ignition control during start-up
Engine speed fluctuates during start of the engine, so the ECM cannot control the ignition timing. During that period, the ignition timing is fixed at 10° BTDC by using the 10° signal from the crankshaft position sensor.



FU-01075

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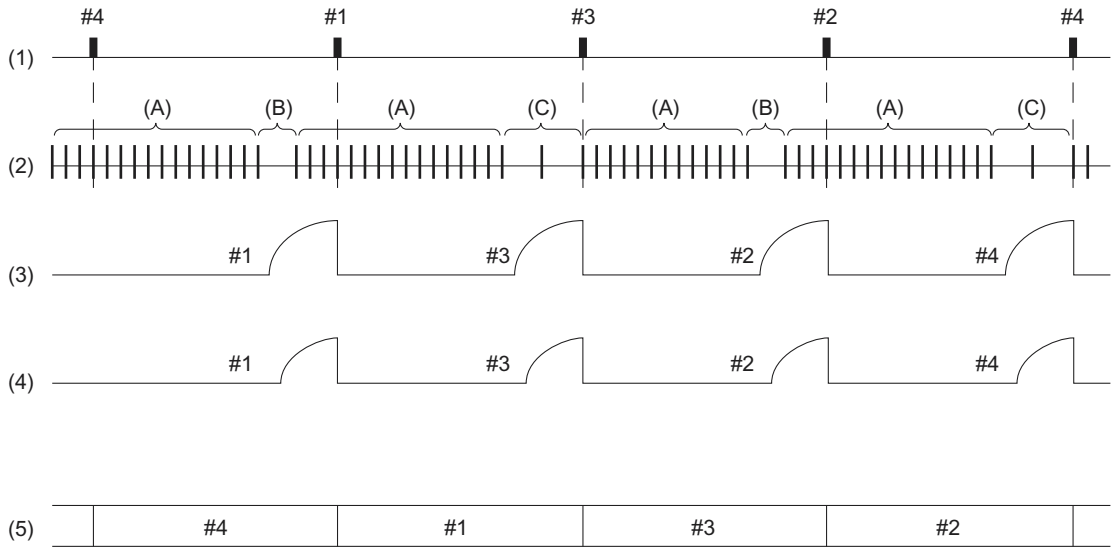
- The ECM identifies cylinders at TDC and determines ignition timing as follows:
  - Within the range (A), the crank angle signal is input every 10° rotation of the crankshaft.
  - The ECM discriminates a TDC cylinder group from the other by detecting the ranges (B) and (C) where no signals are input.
  - The ECM judges that the No. 1 and No. 2 cylinders are at TDC when it detects the range (B), and that the No. 3 and No. 4 cylinders are at TDC when it detects the range (C).



FU-00358

(1) Cylinder number (TDC)
(2) Crank angle pulse
(3) Ignition timing at starting
(4) Ignition timing at normal condition
(5) Cylinder at combustion

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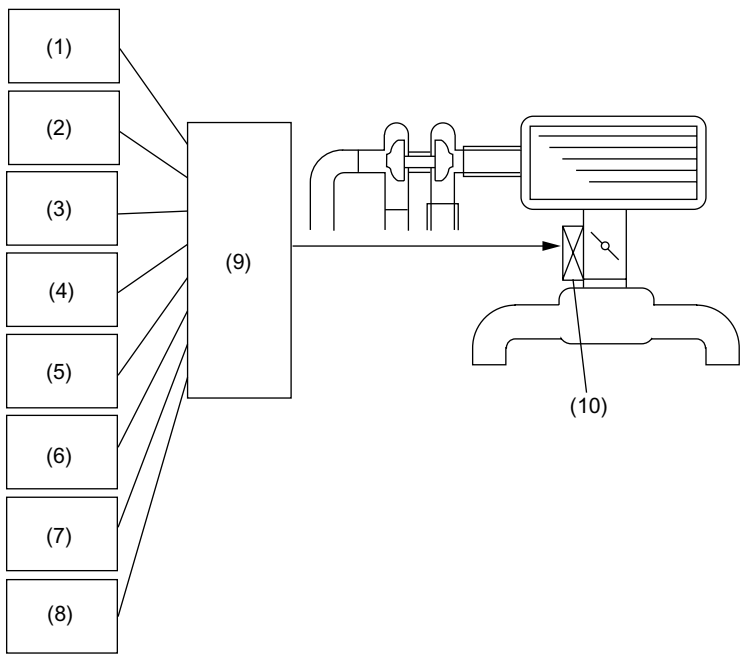
E: IDLE AIR CONTROL

• The ECM controls the electronic control throttle based on signals from the crankshaft position sensor, engine coolant temperature sensor, manifold absolute pressure sensor and A/C switch so that the proper idle speed for each engine load is achieved.



FU-00359

(1) Crankshaft position sensor
(2) Camshaft position sensor
(3) Throttle position sensor
(4) Engine coolant temperature sensor
(5) Vehicle speed sensor
(6) Ignition switch
(7) A/C switch
(8) Neutral position switch
(9) ECM
(10) Electronic control throttle

F: FUEL PUMP CONTROL

Using the signal from the crankshaft position sensor, the ECM controls operation of the fuel pump by turning its relay ON or OFF. To improve safety, the fuel pump is stopped if the engine stalls with the ignition switch ON.

Ignition switch ON	Fuel pump relay	Fuel pump
A certain period of time after ignition switch is turned ON	ON	Operates
While cranking the engine	ON	Operates
While engine is operating	ON	Operates
When engine stops	OFF	Does not operate

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6. On-board Diagnosis System

A: GENERAL

• The on-board diagnosis system detects and indicates a fault by generating a code corresponding to each fault location. The engine malfunction indicator light on the combination meter indicates occurrence of a fault or abnormality.

• When the engine malfunction indicator light comes on as a result of detection of a fault by the ECM, the corresponding diagnostic trouble code (DTC) and 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 the data link connector in order to check the DTC.

• The SSM and GST can erase DTCs. This can also read freeze frame data in addition to other pieces of engine data.

• If there is a failure involving sensors which may affect drive control of the vehicle, the fail-safe function ensures minimum level of driveability.

B: FAIL-SAFE FUNCTION

For a sensor or switch which has been judged faulty in the on-board diagnosis, the ECM, if appropriate, generates an associated pseudo signal to keep the vehicle operational. (The control becomes degraded.)

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GLASS / WINDOWS / MIRRORS

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1. Power Window

A: CONSTRUCTION

- The power window system consists of regulator motors and switches for individual doors, relays and a circuit breaker unit.
- Each door window opens/closes by pushing down/pulling up the switch.
- Only the driver's door window switch has a 2-stage mechanism:
  - When the switch is pushed lightly and held in the pushed position, 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 the ON position.

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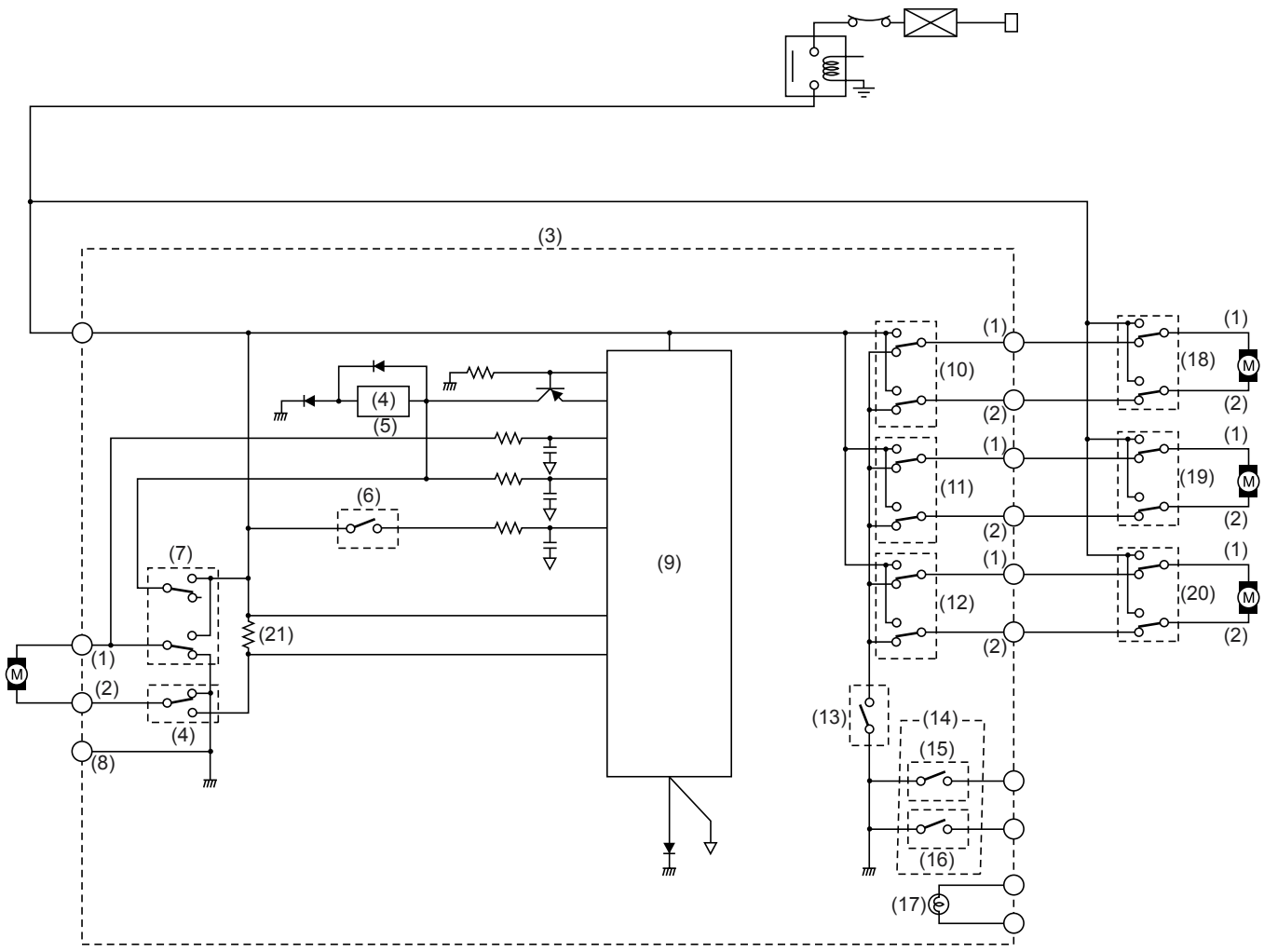
B: SCHEMATIC DRAWINGS



GW-00247

(1) Raise
(2) Lower
(3) Power window main switch
(4) Lowering relay
(5) Relay 1
(6) Automatic lowering switch
(7) Switch 1
(8) Ground
(9) Automatic circuit
(10) Passenger
(11) Rear left
(12) Rear right
(13) Power window lock
(14) Door lock
(15) Unlock
(16) Lock
(17) Lamp 1
(18) Passenger's switch
(19) Rear left passenger's switch
(20) Rear right passenger's switch
(21) Current detection resistor

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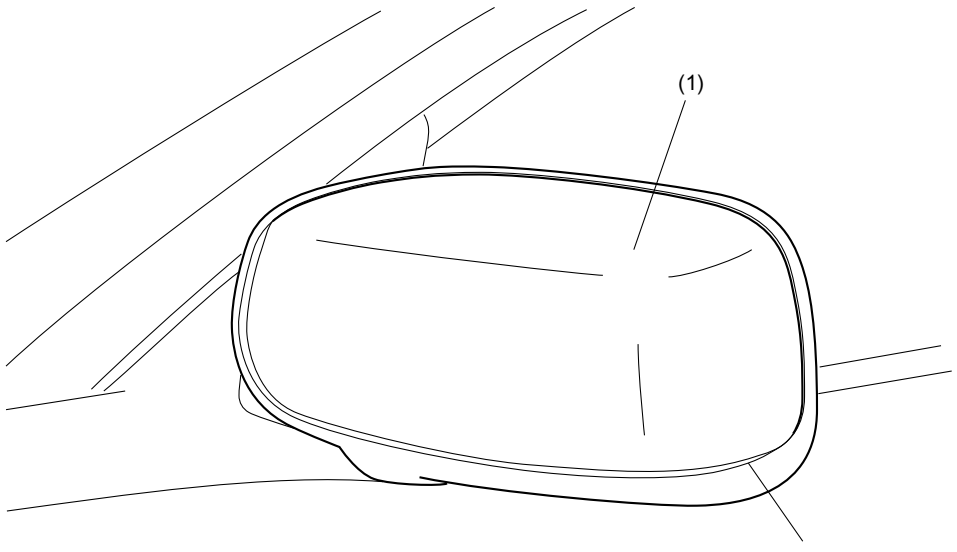
2. Door Mirrors

A: GENERAL

The shape of the door mirrors is modified and the door mirrors are now provided with a scalp cap. When driving in rain, droplets that have fallen on the door mirrors are drained through the groove in the door mirrors, thus preventing droplets from being splashed on the mirror glass by wind turbulence.
The scalp cap can be replaced individually when damaged, contributing to reduce repair cost.



(1) Scalp cap
(2) Groove

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INSTRUMENTATION DRIVER INFO

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1. Combination Meter

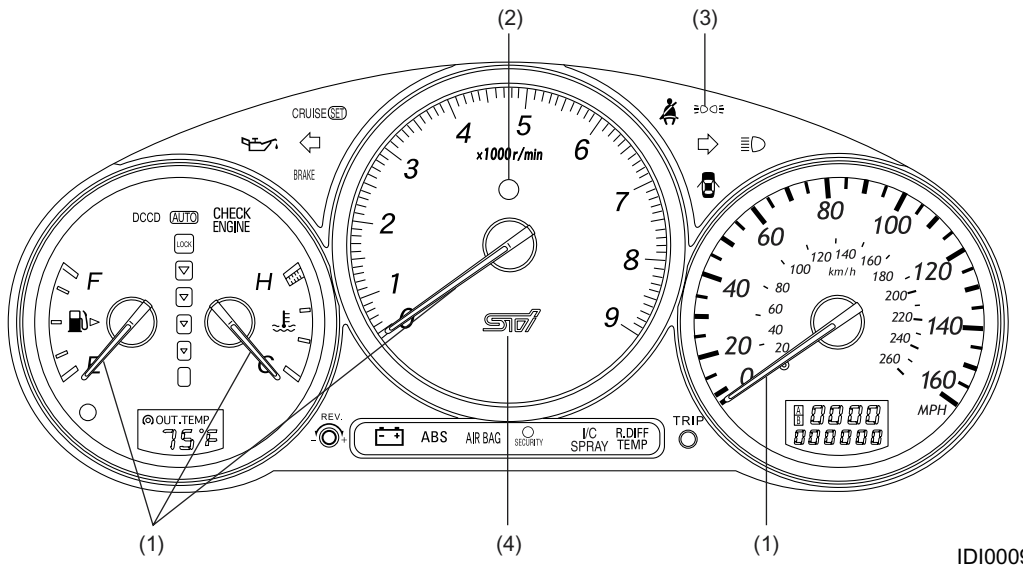
A: RED LUMINESCENT METER

To increase the product's desirability and visibility, a red luminescent meter is used on the STi models.

- Red LEDs are used for meter illumination.
- The brightness of the meter display area can be properly adjusted to meet various conditions.
- An indicator which illuminates when the lighting switch is turned to the next position from OFF is provided.

1. OPERATION

When the ignition switch is turned ON, the meter needle illuminates first and indicates the minimum position. Then the needle moves to the maximum position and the REV indicator flashes. After this the needle returns to the minimum position and the illumination and LCD turns ON. Finally the STi logo illuminates.



IDI00093

(1) Needle
(2) REV indicator
(3) Lights ON indicator
(4) STi logo

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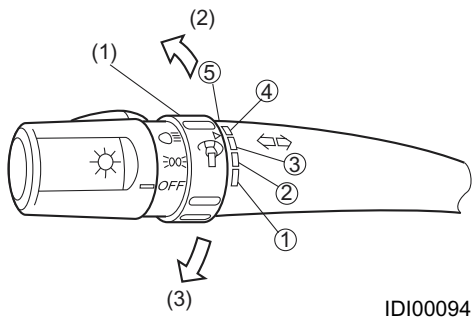
2. BRIGHTNESS ADJUSTMENT

The illumination brightness can be adjusted by selecting any of the five steps of the lighting switch dial.



IDI00094

(1) Adjustment dial
(2) Brighter
(3) Darker

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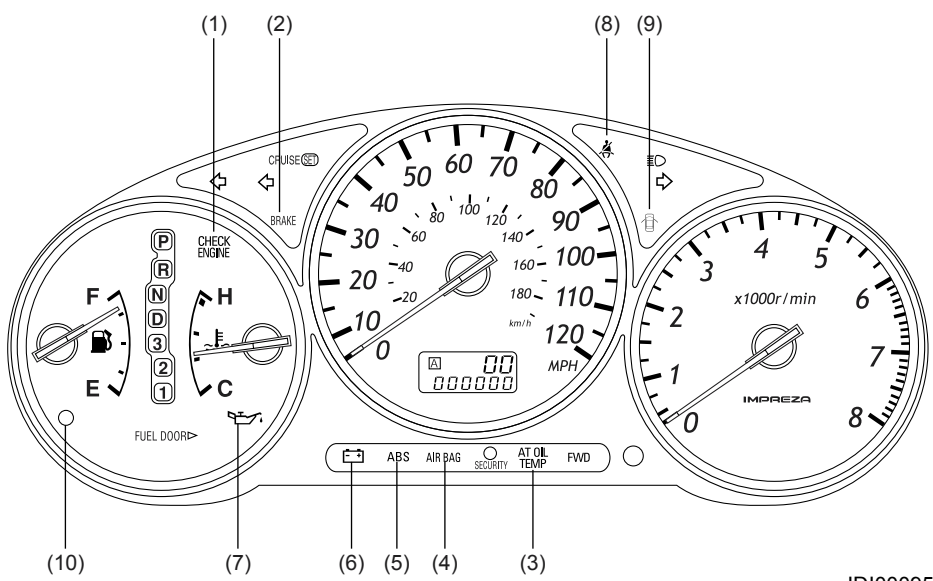
B: WARNING AND INDICATOR LIGHTS



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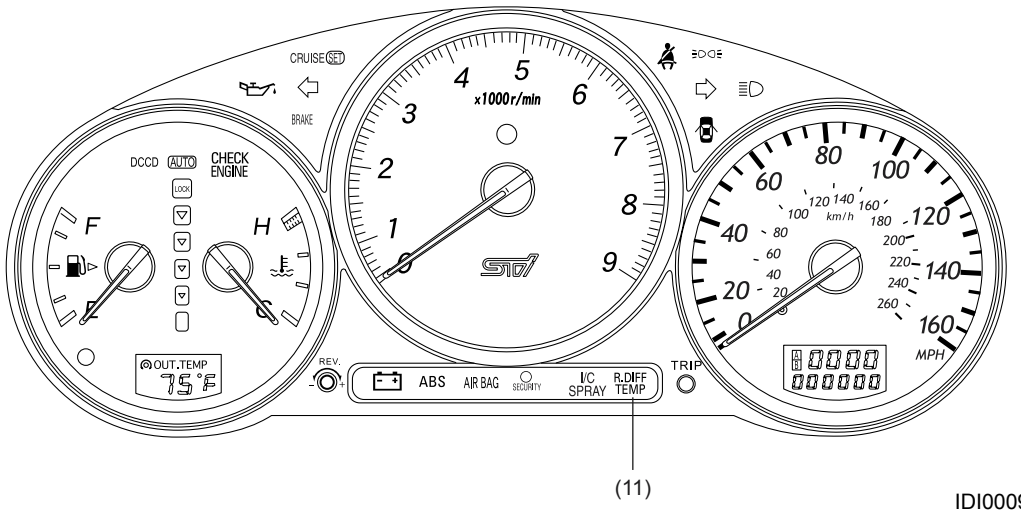

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(1) CHECK ENGINE warning light
This light illuminates if a fault occurs in the MFI (Multiple point Fuel Injection) system.

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

(3) AT OIL TEMP warning light
This warning light illuminates when the ATF temperature exceeds 150°C (302°F); it blinks when a fault occurs in the AT control system.

(4) AIR BAG system warning light
This warning light illuminates if a fault occurs in the airbag system.

(5) ABS warning light
This warning light illuminates if a fault occurs in any electrical component of the ABS (Anti-lock Brake System).

(6) Charge warning light
This warning light illuminates when a fault occurs in the charging system while the engine is running.

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

(8) Seat belt warning light
This light stays illuminated for about 6 seconds after the ignition switch has been turned ON.

(9) Door open warning light
This warning light illuminates when one or more doors and/or rear gate are not completely closed.

(10) Low fuel warning light
This light illuminates when the quantity of the fuel remaining in the tank has decreased to 9 liters (2.4 US gal, 2.0 Imp gal) or less.

(11) Rear differential oil temperature warning light
This warning light illuminates when the rear differential oil temperature exceeds 150°C (302°F).

When everything is normal, the warning and indicator lights should be ON or OFF as shown below according to ignition switch positions.

Warning/Indicator light			Ignition switch position			
			LOCK/ACC	ON	ST	While engine is running
(1)	CHECK ENGINE		OFF	ON	ON	OFF
(2)	Brake fluid level / parking brake		OFF	ON	ON	*1
(3)	AT OIL TEMP		OFF	ON	ON	OFF
(4)	AIR BAG		OFF	*2	*2	*2
(5)	ABS		OFF	*3	*3	*3
(6)	Charge		OFF	ON	ON	OFF
(7)	Oil pressure		OFF	ON	ON	OFF
(8)	Seat belt		OFF	*4	*4	*4
(9)	Door or rear gate open	• Open	ON	ON	ON	ON
		• Closed	OFF	OFF	OFF	OFF
(10)	Low fuel level		OFF	*5	*5	*5
(11)	Rear differential oil temperature		OFF	ON	ON	OFF

*1: This warning light comes ON when the parking brake is applied.
*2: This warning light comes ON for about 6 seconds, and then goes out.
*3: This warning light comes ON for about 2 seconds, and then goes out.
*4: This warning light stays illuminated for about 6 seconds after the ignition switch has been turned ON if the drivers seat belt is NOT fastened.
*5: This light illuminates when the quantity of the fuel remaining in the tank has decreased to 9 liters (2.4 US gal, 2.0 Imp gal) or less.

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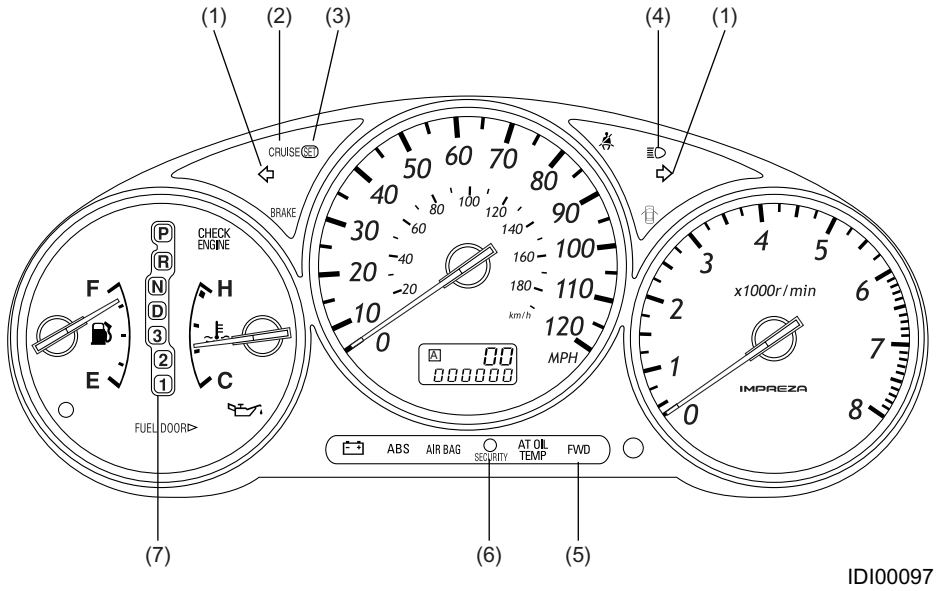
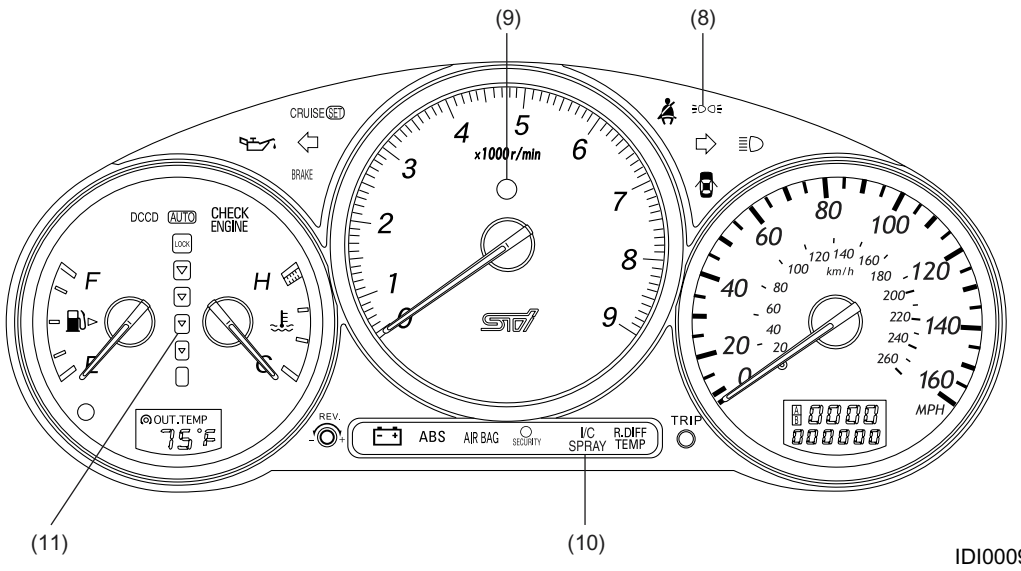
COMBINATION METER

C: TELLTALE LIGHTS



IDI00097



IDI00098

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(1) Turn signal indicator
This indicator blinks in unison with the corresponding turn signal lights when the turn signal switch is operated.

(2) CRUISE indicator
This indicator illuminates when the cruise control main switch is turned ON.

(3) SET indicator
This indicator illuminates when the cruise control main switch is turned ON and the SET/COAST switch on the command switch is turned ON.

(4) Headlight beam indicator
This indicator illuminates when the headlights are in the high-beam position.

(5) FWD indicator
This indicator illuminates when the drive mode is changed from AWD to FWD (with the fuse installed in the FWD switch).

(6) Security indicator
This indicator illuminates when the security system is armed.

(7) AT selector lever position indicator
The indicator corresponding to the present AT select lever position illuminates when the ignition switch is in any position other than ACC and LOCK.

(8) Lighting switch indicator
Turns on when the lighting switch is turned to the next position from OFF.

(9) REV indicator
This indicator illuminates while the preset engine speed is exceeded.

(10) Intercooler water spray level warning light
This warning light illuminates when the water level in the intercooler water spray tank lowers.

(11) Driver-controllable center differential indicator
Indicates the degree of differential lock engagement in six steps. The AUTO light illuminates when auto is selected.

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When everything is normal, the telltales should be ON, OFF or in other states as shown below according to ignition switch position.

Telltale lights			Ignition switch position			
			LOCK/ACC	ON	ST	While engine is running
(1)	Turn signal		OFF	Blink	Blink	Blink
(2)	CRUISE		OFF	OFF	OFF	ON
(3)	SET		OFF	OFF	OFF	*1
(4)	Headlight beam	• High beam	OFF	ON	ON	ON
		• Low beam	OFF	OFF	OFF	OFF
(5)	FWD	• FWD	OFF	ON	ON	ON
		• 4WD	OFF	OFF	OFF	OFF
(6)	Security		*2	OFF	OFF	OFF
(7)	AT selector lever position		OFF	ON	ON	ON
(8)	Lighting switch		OFF	*3	*3	*3
(9)	REV indicator		OFF	OFF	OFF	*4
(10)	Intercooler water spray level		OFF	*5	*5	*5
(11)	Driver-controllable center differential		OFF	*6	*6	*6

*1: This light illuminates when the SET/COAST switch is turned ON while driving at 40 km/h (25 MPH) or higher.
*2: This light illuminates when the security system is armed.
*3: Turns on when the lighting switch is turned to the next position from OFF.
*4: This light illuminates while the preset engine speed is exceeded.
*5: This light illuminates when the water level in the tank lowers to 0.4 liters.
*6: Indicates the current degree of differential lock engagement.

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D: SPEEDOMETER

1. GENERAL

- The speedometer system is an electrical type that uses electric signals from the speed sensor in MT models or the transmission control module in AT models.
- The vehicle speed sensor is installed on the manual transmission.
- Since the system does not use mechanical components such as rotating cable, there are no opportunities of occurring such problems as meter needle vibration and cable disconnection. Also, it does not constitute any means of mechanical noise transmission.
- The odometer and trip meter readings appear on a liquid crystal display (LCD).

2. OPERATION

MT models: The vehicle speed sensor sends vehicle speed signals (4 pulses per rotation of speed sensor's driven shaft) to the speedometer drive circuit and odometer/trip meter drive circuit in the speedometer.

AT models: The TCM sends vehicle speed signals (4 pulses per rotation of output shaft) to the speedometer drive circuit and odometer/trip meter drive circuit in the speedometer.

NOTE:
Signals from the speed sensor or TCM are also used by the engine control module, automatic transmission control module, etc.

3. SPECIFICATIONS

Speedometer	Type	Electric pulse type.
	Indication	Needle points to 60 km/h (37.3 MPH) when 2,548 pulses are input per minute.
Odometer	Type	Pulse count type
	Display	LCD/6 digits; 0 to 999,999 km (mile).
	Indication	Counts up 1 km per 2,548 pulses (1 mile per 4,104 pulses). (Count down is impossible.)
Trip meter	Type	Pulse count type
	Display	LCD/4 digits; 0 to 999.9 km (mile) and 1000 to 9999 km (mile).
	Indication	Counts up 1 km per 2,548 pulses (1 mile per 4,104 pulses). (To change the trip meter from A to B or B to A, push the knob momentarily. To return the trip meter to zero indication, keep the knob pushed for more than 1 second.)

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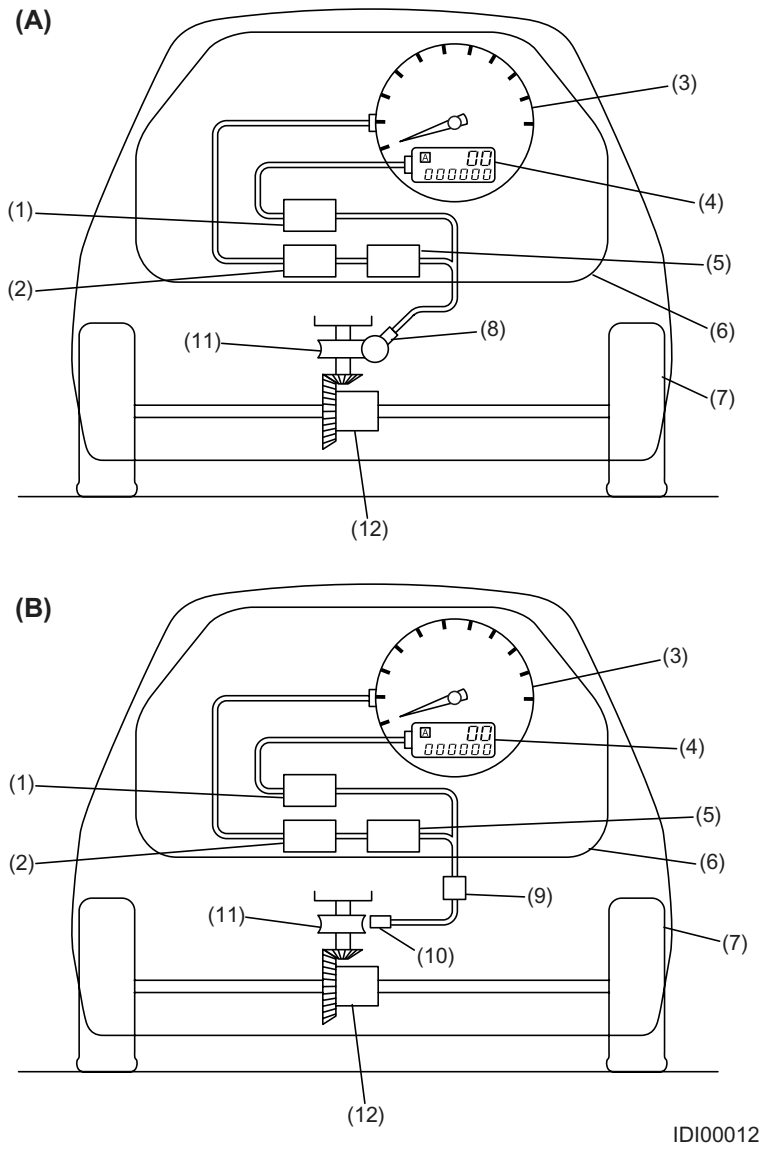
4. SYSTEM DIAGRAM



IDI00012

(A) MT models
(B) AT models
(1) Odometer/trip meter drive circuit
(2) Speedometer movement
(3) Speedometer
(4) Odometer/trip meter
(5) Speedometer drive circuit
(6) Combination meter
(7) Front wheel
(8) Speed sensor
(9) TCM
(10) Electromagnetic pick-up
(11) Gear for the speed sensor
(12) Differentials

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E: VEHICLE SPEED SENSOR

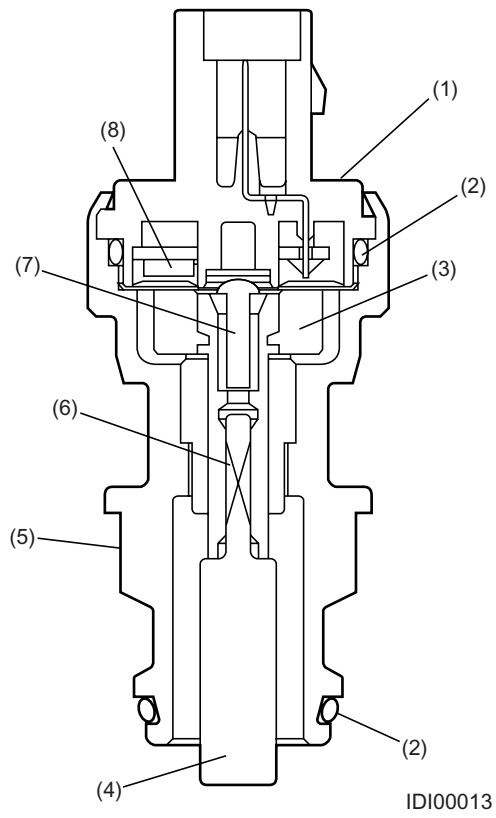
The vehicle speed sensor uses a Hall IC pick-up to generate speed signals (MT models).

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

The sensor generates 4 pulses per rotation of the speed sensor driven shaft and send them to the speedometer.

1. CONSTRUCTION

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



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

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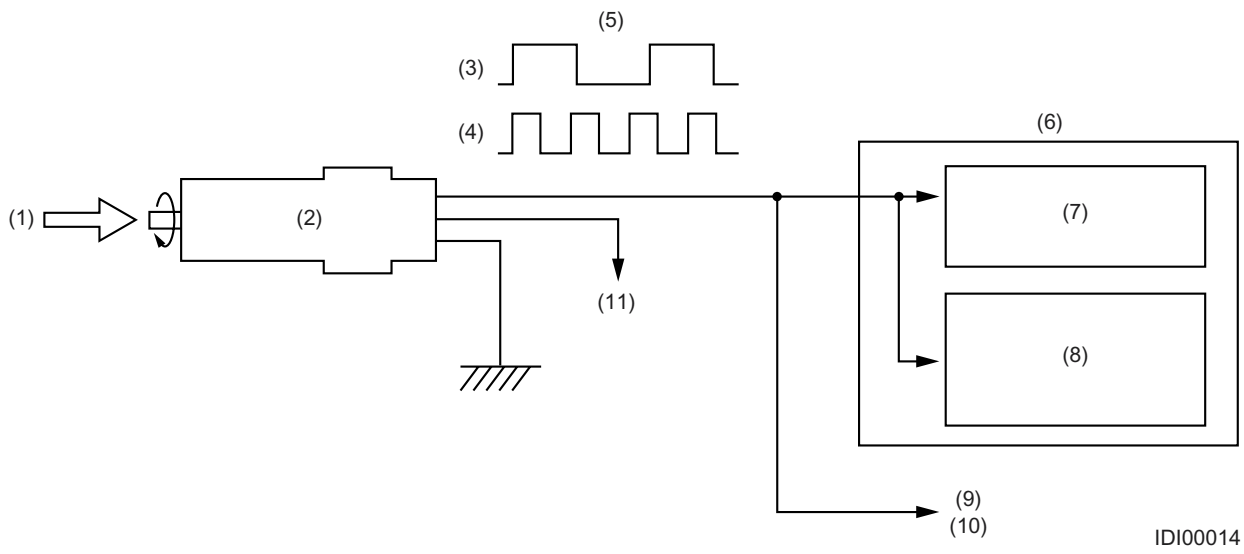
2. OPERATION

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

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

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



IDI00014

(1) Revolution of transmission output gear
(2) Vehicle speed sensor
(3) Low-speed
(4) High-speed
(5) Signal (4 pulses per revolution)
(6) Combination meter
(7) Speedometer drive circuit
(8) Odometer and trip meter drive circuit
(9) Engine control unit
(10) Cruise control module
(11) Ignition switch

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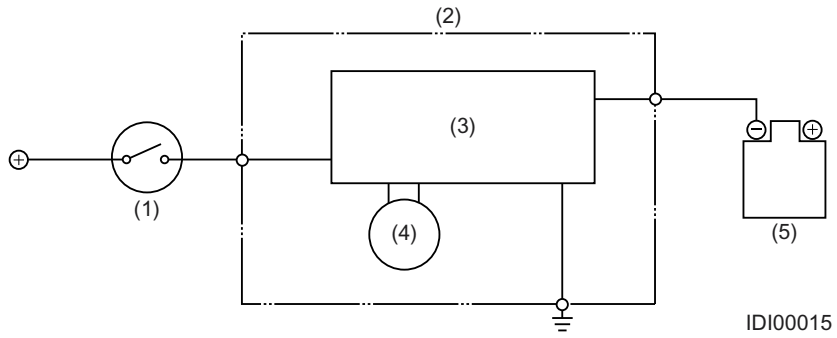
F: TACHOMETER

The tachometer drive circuit is connected to the engine speed sensing circuit in the engine control module.

When the engine speed increases or decreases, the voltage of the circuit also increases or decreases, changing the magnetic force of the tachometer drive coil.

The tachometer needle then moves in accordance with change in the engine speed.



(1) Ignition switch
(2) Combination meter
(3) Tachometer drive circuit
(4) Tachometer
(5) ECM

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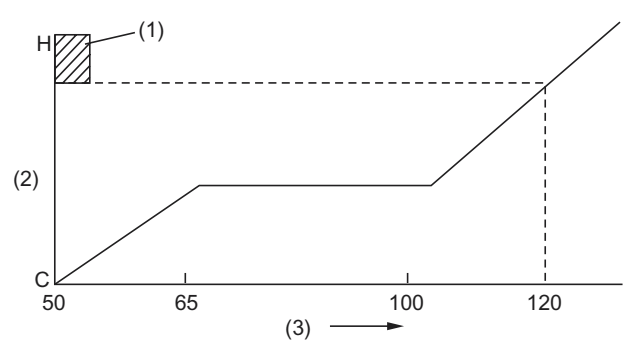
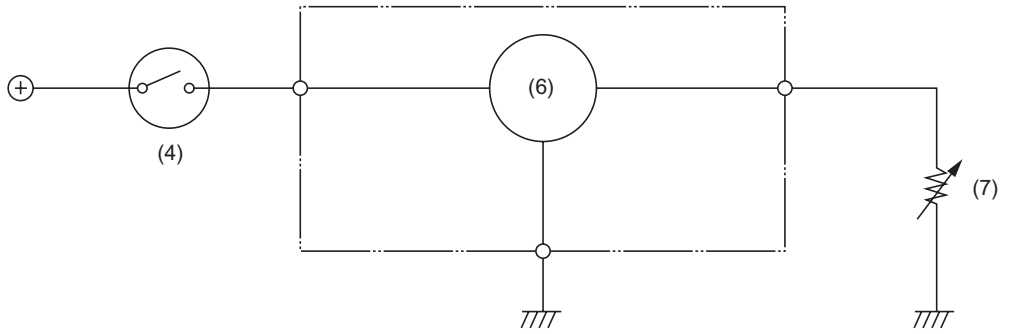
G: WATER TEMPERATURE GAUGE

- The water temperature signal is sent from the water temperature sensor located on the engine.
- The resistance of the water temperature sensor changes according to the engine coolant temperature. Therefore, the current sent to the water temperature gauge also changes according to the engine coolant temperature. As the change in current causes the magnetic force of the coil to change, the gauge's needle moves according to the engine coolant temperature.
- When the coolant is at a normal operating temperature of approx. 70 to 100°C (158 to 212°F), the gauge's needle stays in the middle of the indication range as shown below.





IDI00016

(1) Red zone
(2) Indication
(3) Temperature (°C)
(4) Ignition switch
(5) Combination meter
(6) Water temperature gauge
(7) Engine coolant temperature sensor

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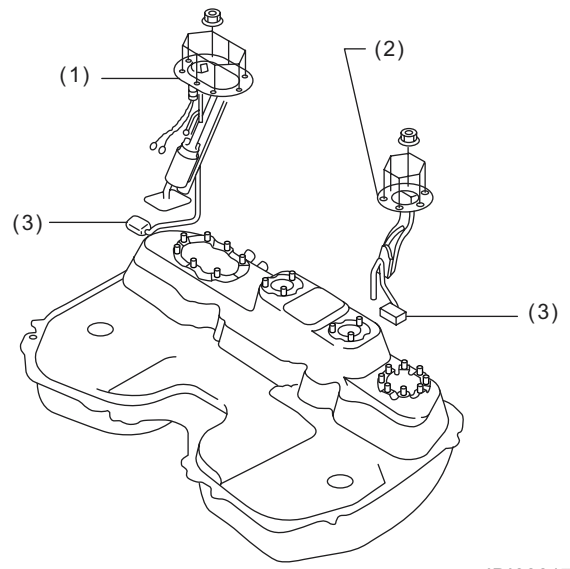
H: FUEL GAUGE

1. GENERAL

● The fuel gauge unit consists of a float and a potentiometer whose resistance varies depending on movement of the float. It is located inside the fuel tank and forms an integral part of the fuel pump. The fuel gauge for models except STi indicates the fuel level in the tank even when the ignition switch is in the LOCK position. The fuel gauge for STi models indicates the fuel level in the tank when the ignition switch is in the ON position.

● All models are equipped with two fuel level sensors. These sensors are installed in the fuel tank, one on the right side and the other on the left side. Two sensors are necessary because the fuel tank is divided into main and sub tank compartments.



IDI00017

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

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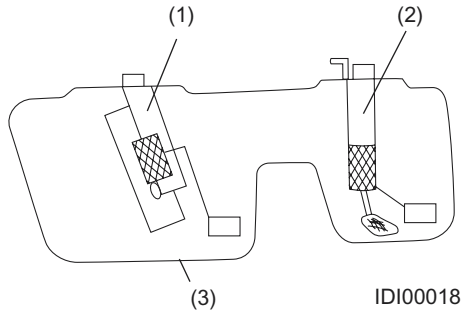
2. OPERATION

The low fuel warning light operates as follows:

The ECM continually monitors the resistance signal from the fuel level sensor. It turns on the low fuel warning light in the combination meter if a resistance value corresponding to the critical fuel level is detected for a certain time while driving.

This monitoring time has been decided to avoid false operation of the warning light which may happen when a large part of remaining fuel is collected temporarily in the sub tank compartment.



(1) Main fuel level sensor
(2) Sub fuel level sensor
(3) Fuel tank

3. SPECIFICATIONS

	Fuel level	Resistance
Main fuel level sensor	Full	0.5 — 2.5Ω
	1/2	20.7 — 24.7Ω
	Empty	50.0 — 52.0Ω
Sub fuel level sensor	Full	0.5 — 2.5Ω
	1/2	19.5 — 23.5Ω
	Empty	42.0 — 44.0 Ω

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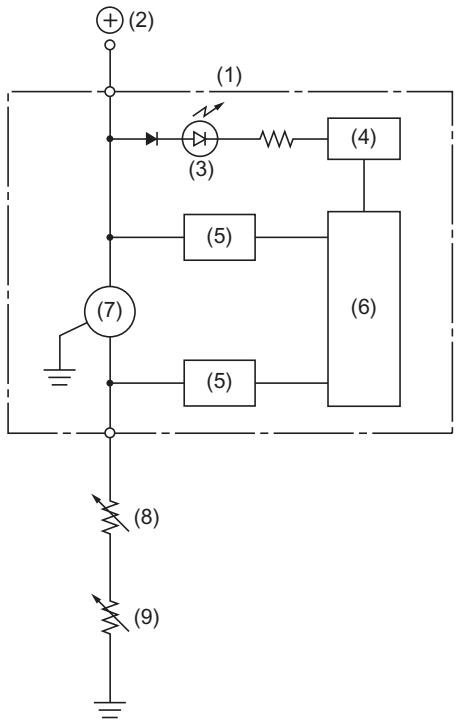
4. SCHEMATIC DRAWINGS



IDI00019

(1) Combination meter
(2) Ignition switch
(3) Low fuel warning light
(4) Driver circuit
(5) Interface
(6) CUSTOM CPU
(7) Fuel gauge
(8) Sub fuel level sensor
(9) Main fuel level sensor

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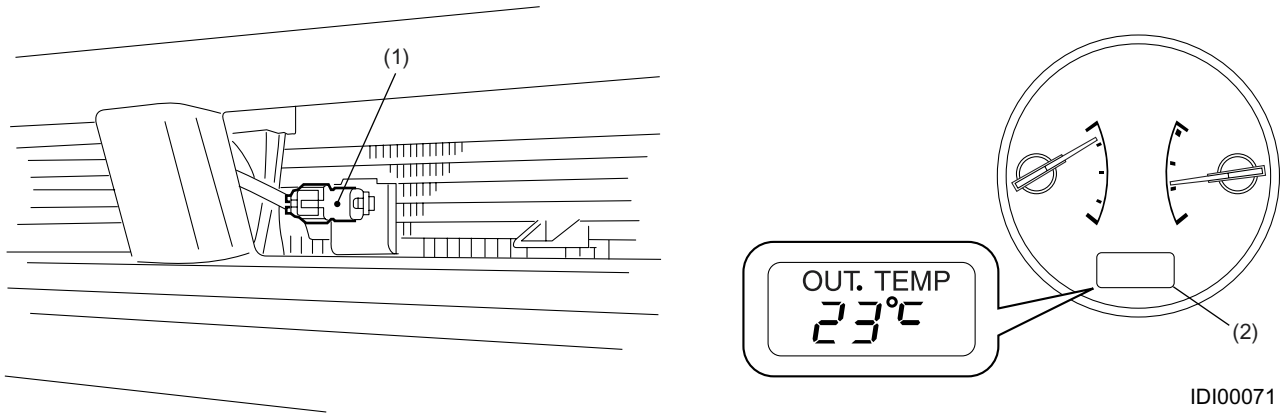
2. Outside Air Temperature Display

A: CONSTRUCTION

The outside air temperature display system consists of an ambient sensor, the CUSTOM CPU and a liquid crystal display installed in the combination meter. The ambient sensor detects the outside air temperature using the built-in thermistor which varies its resistance according to change in ambient temperature, and sends signals to the CUSTOM CPU.
As soon as the ignition switch is turned ON, the CUSTOM CPU compares the temperature data sent from the ambient sensor with the one that was stored in its memory when the ignition switch was turned OFF last time and it causes the lower of the temperatures to be displayed. However, if 60 minutes or more time has passed between the last turning OFF and the next turning ON of the ignition switch, the temperature that is displayed is a sensor-provided temperature.
When the vehicle is running slowly, the heat released from the engine compartment raises the temperature of the air around the ambient sensor and this affects the temperature data the sensor sends to the CUSTOM CPU. The CPU then makes a special control using the vehicle speed data, i.e., when the vehicle is running at a speed slower than 10 km/h, the CPU uses the temperature that was detected during the most recent vehicle's movement at a speed exceeding 10 km/h rather than a temperature currently being provided by the ambient sensor.



(1) Ambient sensor
(2) Outside air temperature display

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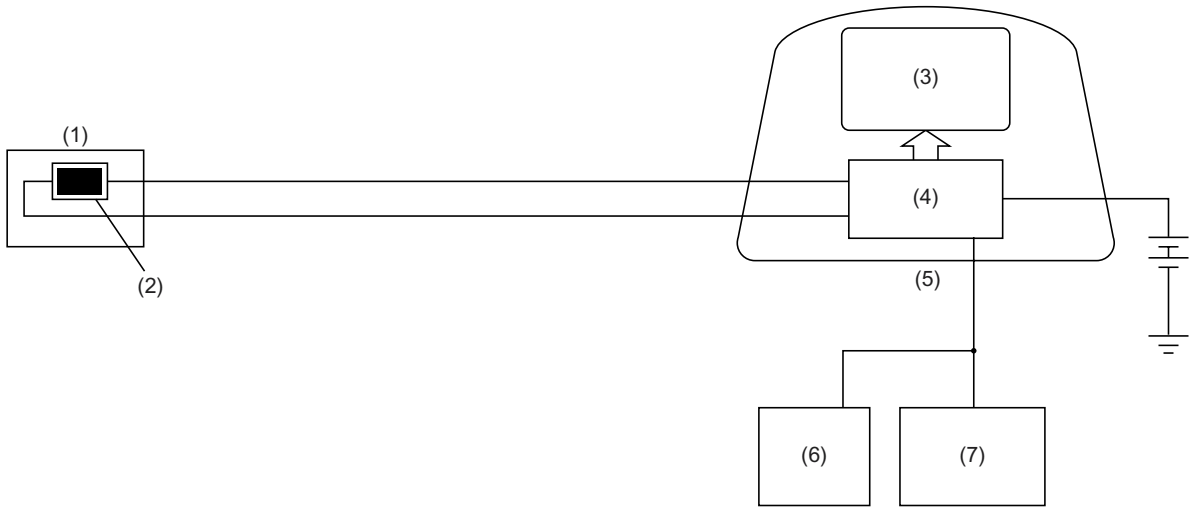
B: SCHEMATIC DRAWINGS



IDI00021

(1) Ambient sensor
(2) Thermistor
(3) Outside air temperature display
(4) CUSTOM CPU
(5) Combination meter
(6) Vehicle speed sensor (MT)
(7) Transmission control module (AT)

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IGNITION
H4DOTC

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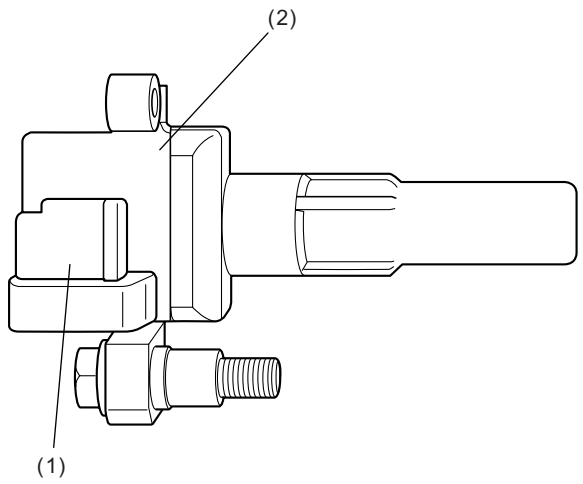
1. Ignition Coil

The engine uses a direct ignition system with one ignition coil mounted for each cylinder.
The secondary terminal of the ignition coil is in contact with the spark plug terminal. Since no spark plug cable is used, secondary voltage drop, leaks, or other problems that are inherent in a system using spark plug cables do not occur. The result is high performance and high reliability.



IG-00040

(1) Connector
(2) Ignition coil

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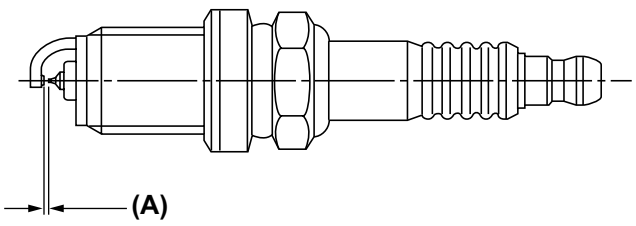
2. Spark Plug

The spark plug has a platinum tipped electrode. The thread diameter is 14 mm (0.551 in) and the gap is controlled to a value between 0.7 and 0.8 mm (0.028 and 0.031 in).



IG-00041

(A) Gap : Between 0.7 and 0.8 mm (0.028 and 0.031 in)

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IGNITION
H4SO

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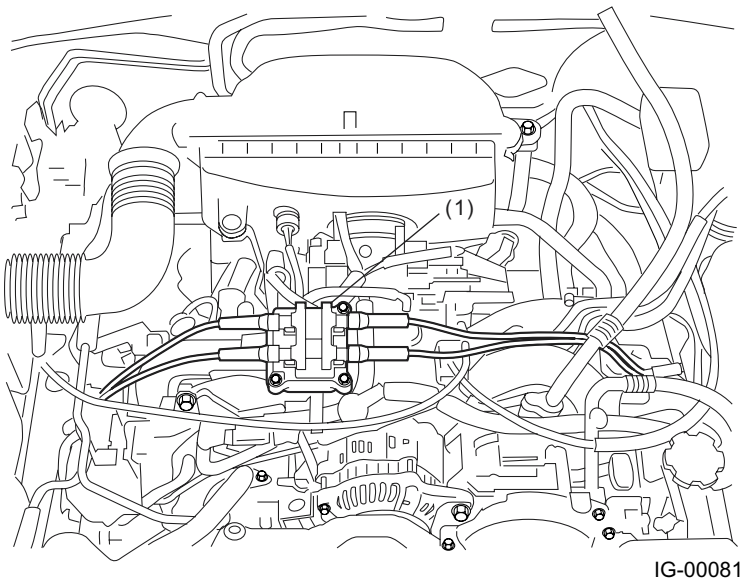
1. Ignition Coil

Ignition coils are made integral with an igniter. The ignition system is of a dual-ignition-coil design, each coil causing two plugs to generate sparks simultaneously. In response to the signal from the ECM, the ignitor supplies current to an ignition coil and the ignition coil supplies high-voltage current to a pair of spark plugs (#1 and #2 or #3 and #4) simultaneously.



IG-00081

(1) Ignition coil and igniter assembly

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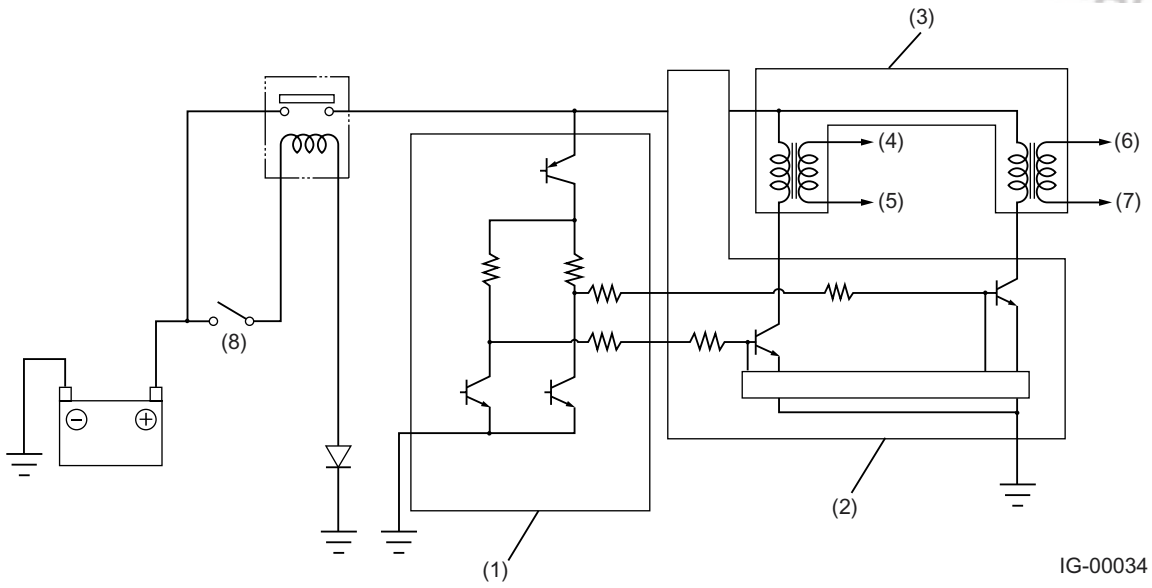
IGNITION COIL



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

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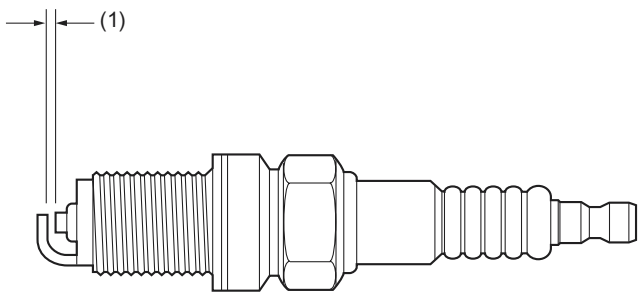
2. Spark Plug

The spark plug's thread diameter is 14 mm (0.551 in) and the gap is controlled to a value between 1.0 and 1.1 mm (0.039 and 0.043 in).



IG-00035

(1) Gap: 1.0 — 1.1 mm (0.039 — 0.043 in)

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IGNITION
STi

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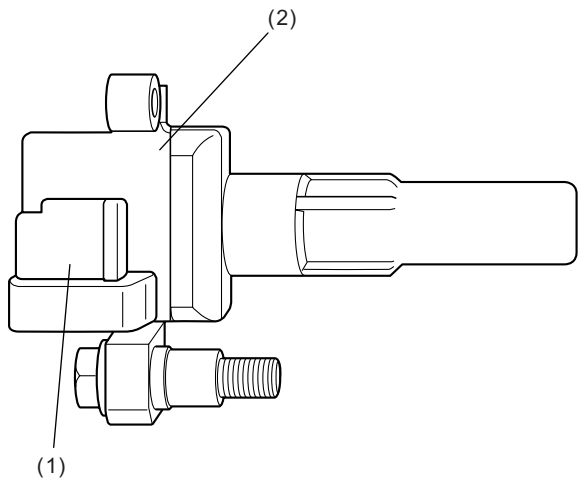
1. Ignition Coil

The engine uses a direct ignition system with one ignition coil mounted for each cylinder.
The secondary terminal of the ignition coil is in contact with the spark plug terminal. Since no spark plug cable is used, secondary voltage drop, leaks, or other problems that are inherent in a system using spark plug cables do not occur. The result is high performance and high reliability.



IG-00040

(1) Connector
(2) Ignition coil

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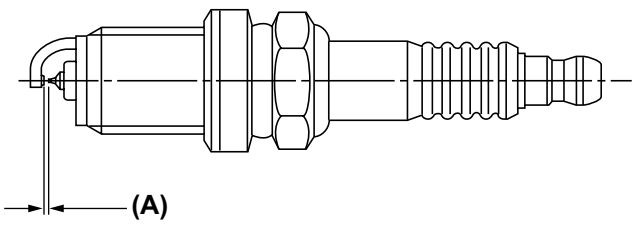
2. Spark Plug

The spark plug has a iridium tipped electrode. The thread diameter is 14 mm (0.551 in) and the gap is controlled to a value between 0.7 and 0.8 mm (0.028 and 0.031 in).



IG-00041

(A) Gap : Between 0.7 and 0.8 mm (0.028 and 0.031 in)

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INTAKE (INDUCTION)
H4DOTC

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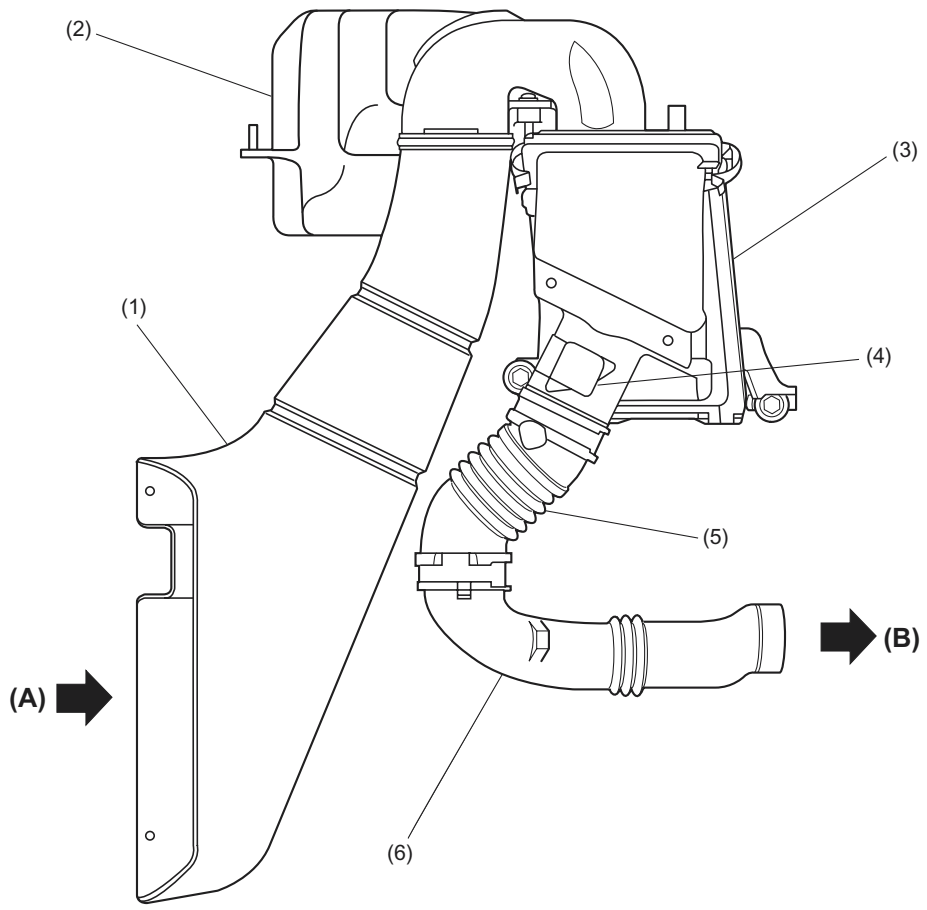
1. Intake System

A: GENERAL

The intake system consists of an intake duct, a resonator chamber, and an air cleaner element housed in its case. The resonator, located upstream of the air cleaner case, effectively reduces the intake noise level.



IN-00184

(1) Intake duct
(2) Resonator chamber
(3) Air cleaner case
(4) Mass air flow and intake air temperature sensor
(5) Intake boot
(6) Intake duct

(A) Outside air
(B) To turbocharger

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2. Turbocharger System

A: GENERAL

- The turbocharger system consists of a water-cooled turbocharger, air-cooled intercooler, waste-gate control solenoid valve, etc.
- The turbine rotated by exhaust gas pressure rotates the compressor.
- As a result, the intake air is compressed by the compressor before it is delivered to the intake manifold.
- This turbocharger system controls the supercharging pressure according to changes in the atmospheric pressure. Even at a high altitude, therefore, the system offers stable performance without being affected by variations in atmospheric pressure.

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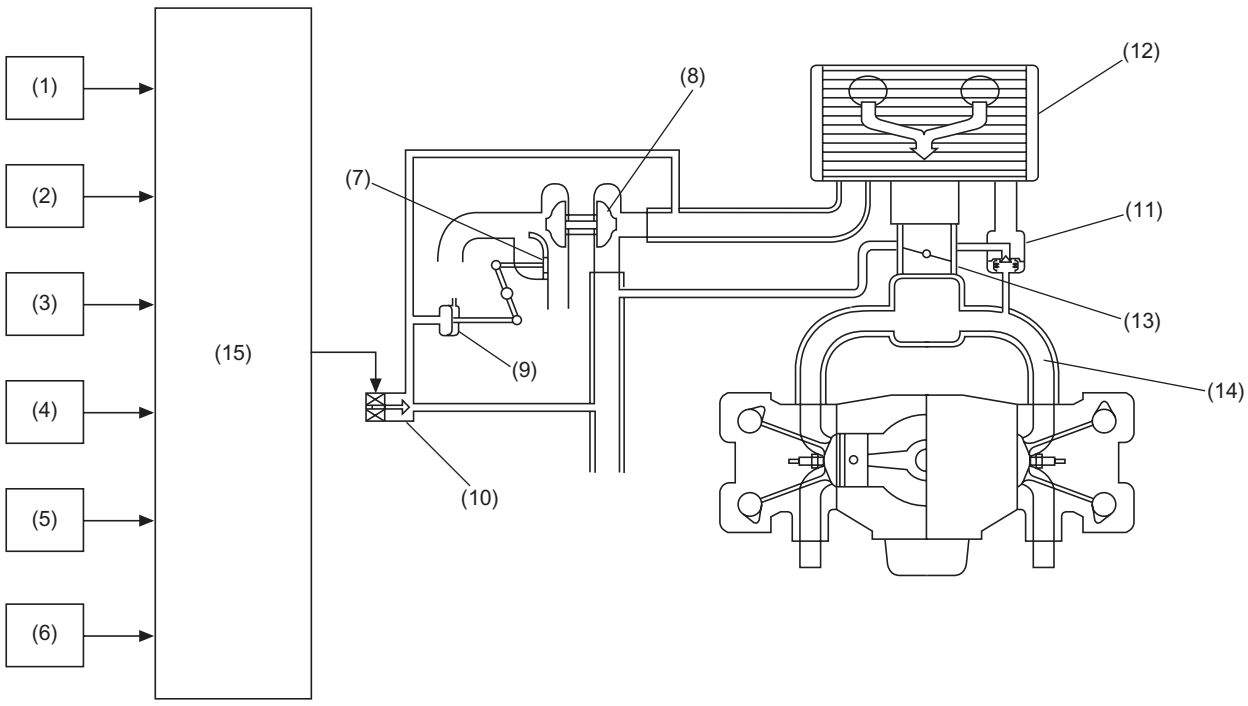
NOT FOR RESALE

TURBOCHARGER SYSTEM

INTAKE (INDUCTION)



IN-00046

(1) Manifold absolute pressure sensor
(2) Crankshaft position sensor
(3) Camshaft position sensor
(4) Throttle position sensor
(5) Engine coolant temperature sensor
(6) Mass air flow and intake air temperature sensor
(7) Wastegate valve
(8) Turbocharger unit
(9) Wastegate controller
(10) Wastegate control solenoid valve
(11) Air bypass valve
(12) Intercooler
(13) Throttle body
(14) Intake manifold
(15) ECM

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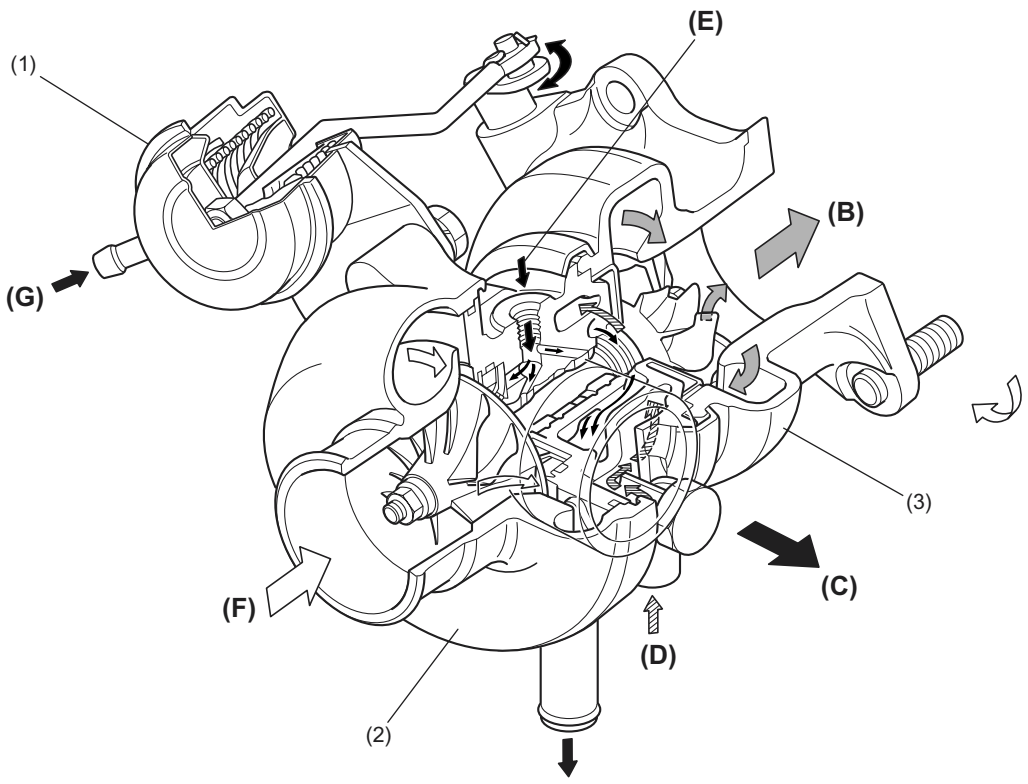
B: TURBOCHARGER UNIT

The turbocharger is water-cooled. It utilizes a wastegate valve to adjust its supercharging pressure to an optimum level. The turbine is housed in a lightweight, thin-wall, heat-resistant casting. The compressor housing is made of thin-wall, aluminum alloy casting. The shaft for turbine and compressor is supported by a full-floating metal bearing system.



IN-00047

(1) Wastegate controller
(2) Compressor housing
(3) Turbine housing

(A) Lubricating oil outlet
(B) Exhaust gas outlet
(C) Air outlet port
(D) Engine coolant inlet
(E) Lubricating oil inlet
(F) Air inlet
(G) Wastegate valve operation pressure

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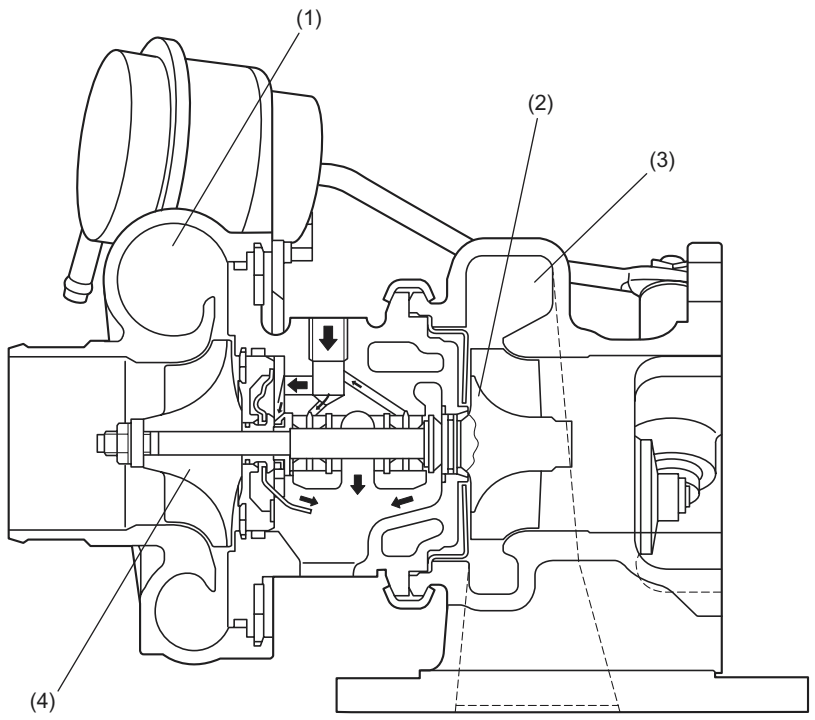
C: LUBRICATION OF TURBOCHARGER

The turbocharger is lubricated by engine oil branched out from the oil pump. To cope with very high speed of the turbocharger turbine and the compressor shaft which may reach a maximum of several hundred thousands of rpm, full-floating type bearings are used which can form adequate oil films on their inside and outside during running.

Further the oil supplied to the turbocharger also plays a role of cooling the turbine so that heat from exhaust gas does not transmitted to the bearings.



IN-00048

(1) Compressor housing
(2) Turbine wheel
(3) Turbine housing
(4) Compressor impeller

D: COOLING OF TURBOCHARGER

The turbocharger unit is cooled by engine coolant, which enhances the reliability and durability of the unit. The engine coolant from the coolant drain hose located under the cylinder head is led by a pipe to the coolant passage provided in the turbocharger bearing housing. After cooling the bearing housing, the engine coolant is led into the coolant filler tank through a pipe.

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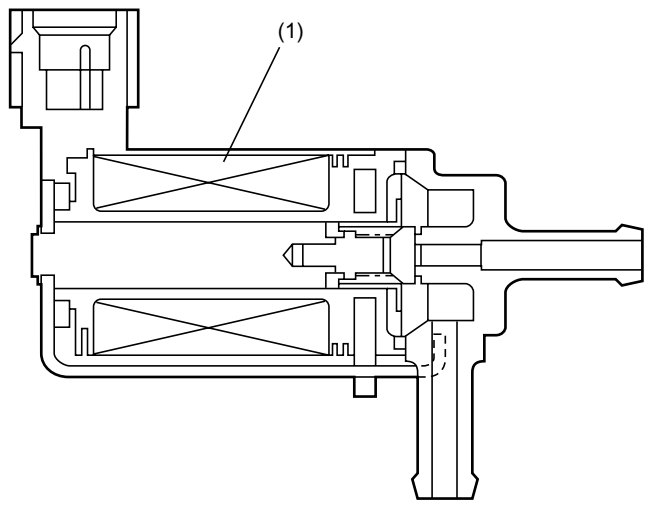
E: WASTEGATE CONTROL SOLENOID VALVE

The wastegate control solenoid valve switches the intake air pressure passages to the wastegate controller in response to signals from the ECM. When the solenoid valve is closed, the intake air pressure upstream of the turbocharger unit is applied to the wastegate controller. When the solenoid valve is opened, the intake air pressure downstream of the turbocharger unit (supercharged air pressure) is applied to the wastegate controller.



IN-00055

(1) Coil

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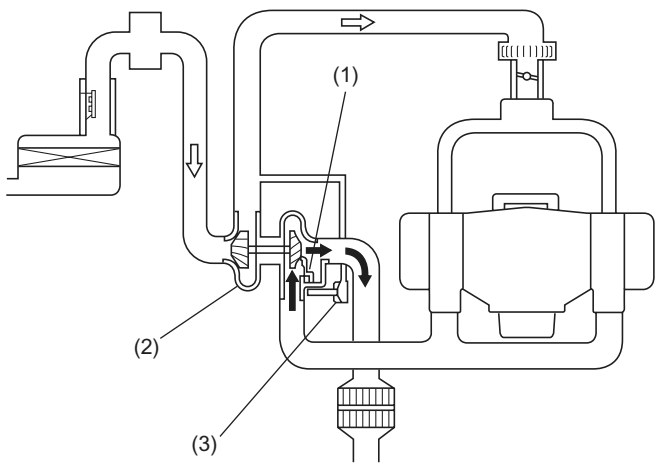
F: REGULATION OF SUPERCHARGING PRESSURE

1. BASIC FUNCTION OF THE WASTEGATE VALVE

When the engine speed increases as the throttle valve opens, the amount of exhaust gas increases. This increases the speed of the turbine (approx. 20,000 to 150,000 rpm), the supercharging pressure and the engine output.

If the resultant supercharging pressure is extremely high, however, it may cause knocking and an excessively high thermal load on such engine components as pistons. In the worst case, the engine may be damaged or broken. To prevent this, the wastegate valve and its controller are provided. By sensing the supercharging pressure, the wastegate valve controller controls the operation of the wastegate valve to maintain the supercharging pressure below a predetermined level.



IN-00049

(1) Wastegate valve
(2) Turbocharger
(3) Wastegate valve controller

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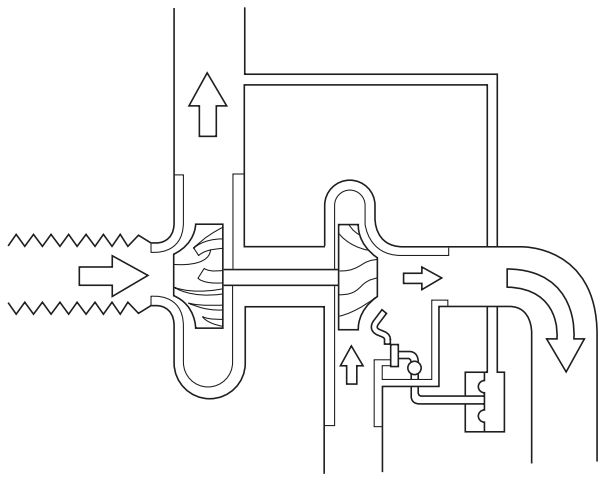
While the supercharging pressure is lower than the predetermined level, the wastegate valve is closed so that entire exhaust gas is directed to the turbine.



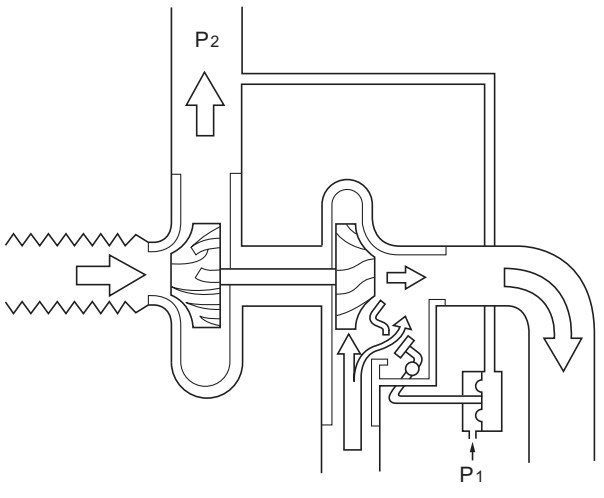
IN-00050

When the supercharging pressure reaches the predetermined level, the wastegate controller lets the supercharging pressure press the diaphragm. This causes the wastegate valve to open through a linkage. With the wastegate valve open, part of the exhaust gas is allowed to flow into the exhaust gas pipe that bypasses the passage to the turbine.

This decreases the exhaust gas pressure that rotates the turbine and keeps the supercharging pressure constant.

- It means $P_2 - P_1$ = constant.

P_1: Atmospheric pressure
P_2: Supercharging pressure



IN-00051

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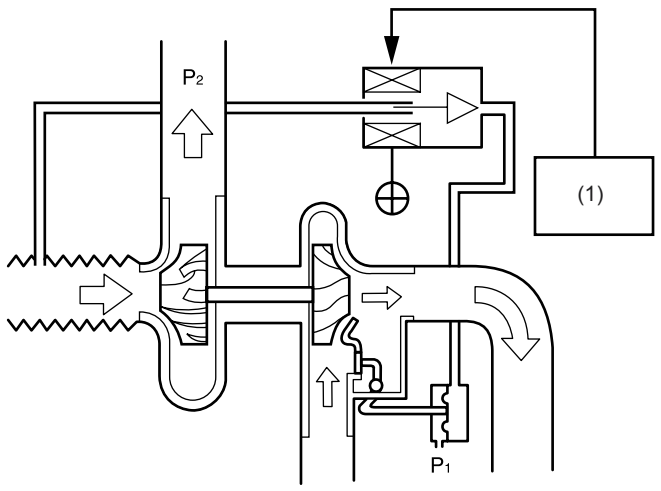
2. CONCEPT OF THE WASTEGATE VALVE CONTROL

At high altitudes, the atmospheric pressure (P_1) is low, so that the supercharging pressure (P_2) is also low in a conventional system. The wastegate solenoid valve operates in such a way that a constant supercharging pressure (P_2) is maintained by acting in response to change in the atmospheric pressure.



IN-00187

(1) ECM

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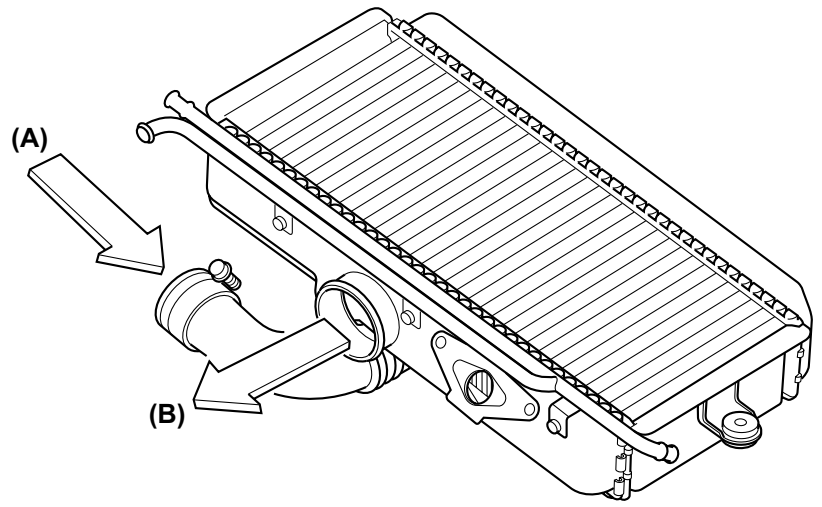
G: INTERCOOLER

• Since the intake air having passed through the turbocharger unit is heated to a very high temperature, the air itself is expanded, resulting in a lower supercharging charging efficiency. The intercooler is provided just before the throttle body to cool down the intake air and improve the boosting efficiency.

• The intercooler is an air cooled type. The air delivered from the air intake duct provided at the engine hood flows through the core and cools the intake air passing through the intercooler.



IN-00185

(A) From turbocharger
(B) To throttle body

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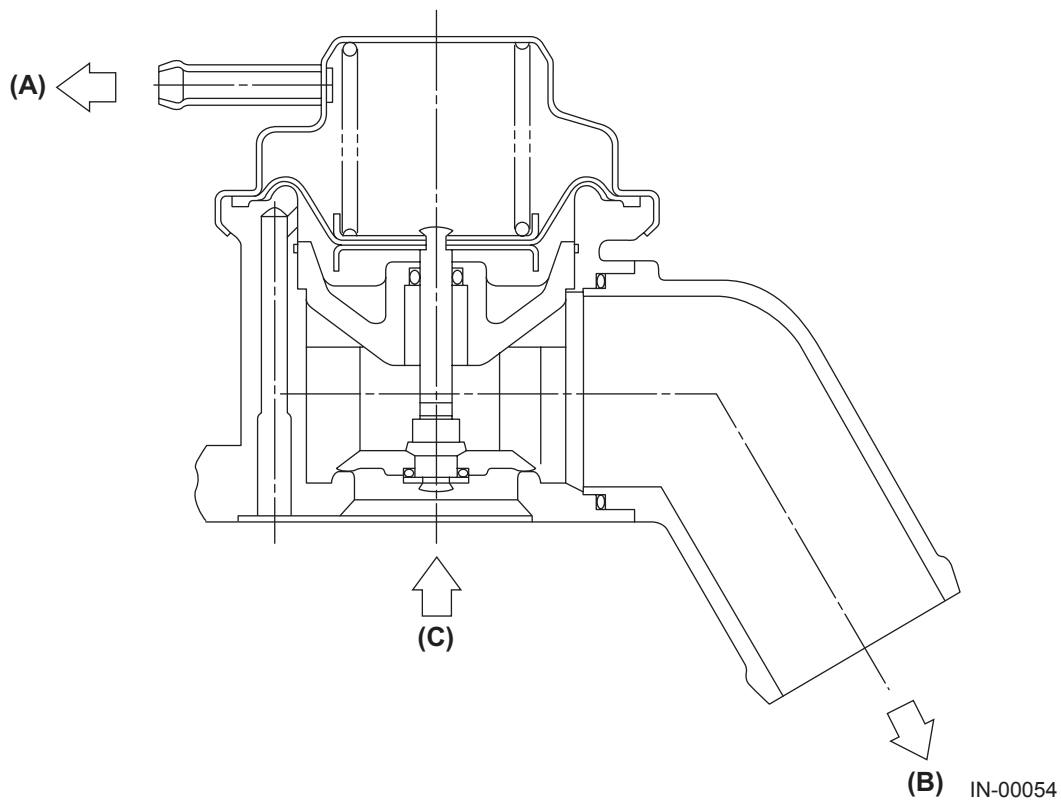
H: AIR BYPASS VALVE

When a throttle valve is suddenly closed, low air suction noise may occur due to a sudden rise of the air pressure in the passage between the turbocharger and throttle body. To prevent this, an air bypass valve and air passage are provided. The air bypass valve, actuated by the vacuum created by a sudden closure of the throttle valve, allows the suction air to bypass the turbocharger and flow directly upstream, thus lowering the pressure in the air passage.



(A) To intake manifold
(B) To turbocharger inlet duct
(C) From intercooler

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INTAKE (INDUCTION)
H4SO

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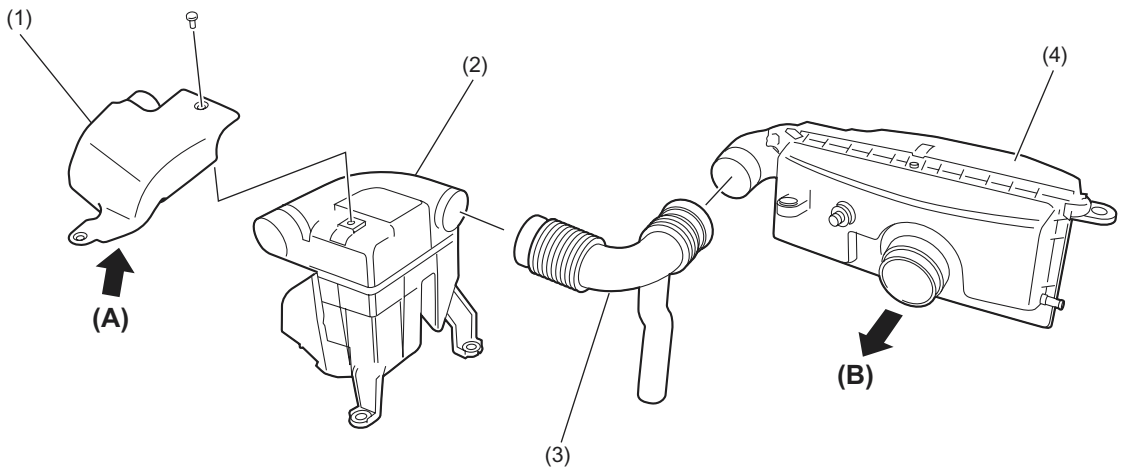
1. General

The intake system consists of an intake duct, a resonator chamber, and an air cleaner element housed in its case. The resonator, located upstream of the air cleaner case, effectively reduces the intake noise level.



IN-00189

(1) Intake duct
(2) Resonator chamber
(3) Intake duct
(4) Air cleaner case

(A) Outside air
(B) To throttle body

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INTAKE (INDUCTION)
STi

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1. General

Specifications for the STi models are the same as those for turbo models. <Ref. to IN(H4DOTC) — INTAKE (INDUCTION).>

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LIGHTING SYSTEM

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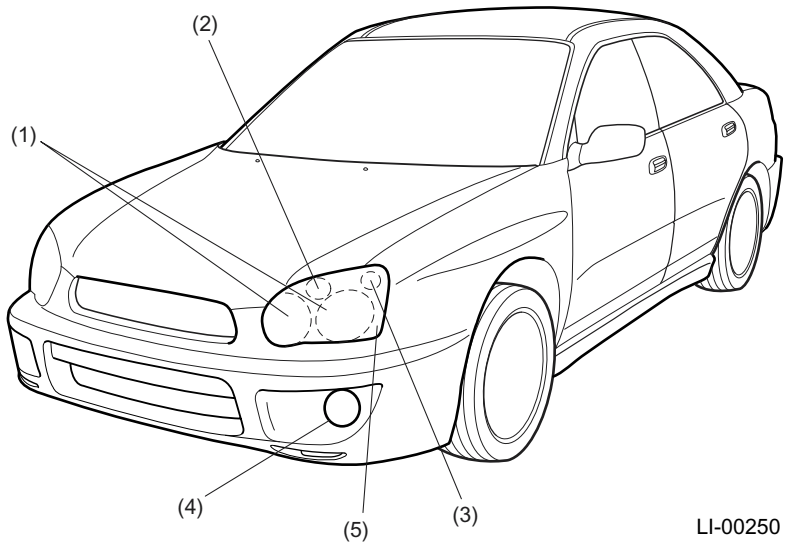
1. Front

A: GENERAL



(1) Headlight
(2) Turn signal/hazard warning light
(3) Clearance/parking/front side marker light
(4) Front fog light
(5) Front side reflex reflector

- The headlight is a four bulb type with either two HID type low beam bulbs and two halogen high beam bulbs on STi models, or with four halogen bulbs on models except STi; multiple aspect reflectors are used on all models. The reflector controls the distribution of the light and no lens cutting is done on the shield for all models.
- The front turn signal/hazard warning light and clearance/parking/front side marker light are incorporated into the headlight.
- The fog light is of a projector type.

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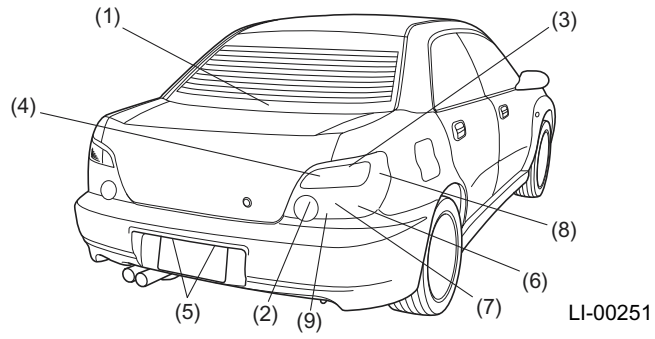
2. Rear

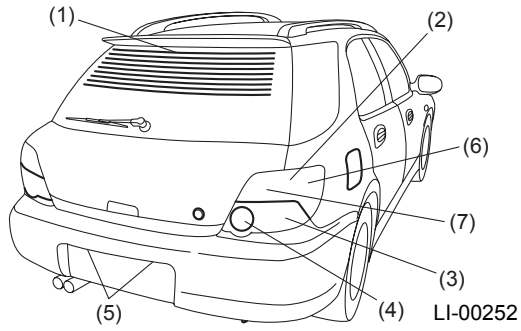
A: GENERAL

Sedan models



(1) High mount stop light
(2) Stop light
(3) Turn signal/hazard warning light
(4) Backup light
(5) License plate light
(6) Stop/tail/rear side marker light
(7) Tail light
(8) Rear side reflex reflector
(9) Rear reflex reflector

Wagon models



(1) High mount stop light
(2) Stop/tail/rear side marker light
(3) Turn signal/hazard warning light
(4) Backup light
(5) License plate light
(6) Rear side reflex reflector
(7) Rear reflex reflector

- The rear turn signal/hazard warning light, stop/tail/rear side marker light, and the backup light are incorporated into the rear combination light. The rear side reflex reflector and rear reflex reflector are also incorporated into the rear combination light.
- The high mount stop light is installed to the bottom inside of the rear window on sedans (rear of the rear spoiler on vehicles with a rear spoiler), and to the top inside of the rear gate on wagons.

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LUBRICATION
H4DOTC

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1. General

● The lubrication system force-circulates engine oil throughout the engine using an oil pump. The oil pressure is regulated by the relief valve built into the oil pump.

● The oil pump is a thin, large-diameter trochoid rotor type which can accommodate the engine's high output. The pump is directly driven by the crankshaft.

● The engine oil is cleaned by a full-flow, paper element type oil filter. The filter has a bypass valve which allows the engine oil to flow bypassing the filter if it is clogged.

● The inside of the oil pan is fitted with a baffle plate which reduces changes in the oil level due to movement of the vehicle, thus ensuring uninterrupted suction of oil.

● The engine oil discharged from the oil pump is delivered to the journal bearings, connecting rod bearings, and other parts requiring lubrication and cooling via the vertical passage in the right bank of the cylinder block, the oil filter, and the oil galleries in the right and left banks of the cylinder block.

● The engine oil is also distributed to each cylinder head valve mechanism at a proper flow rate achieved by metering by the orifice provided in each oil gallery.

● An oil cooler is installed to keep the engine oil in an optimum temperature range and prevent degradation of lubrication performance.

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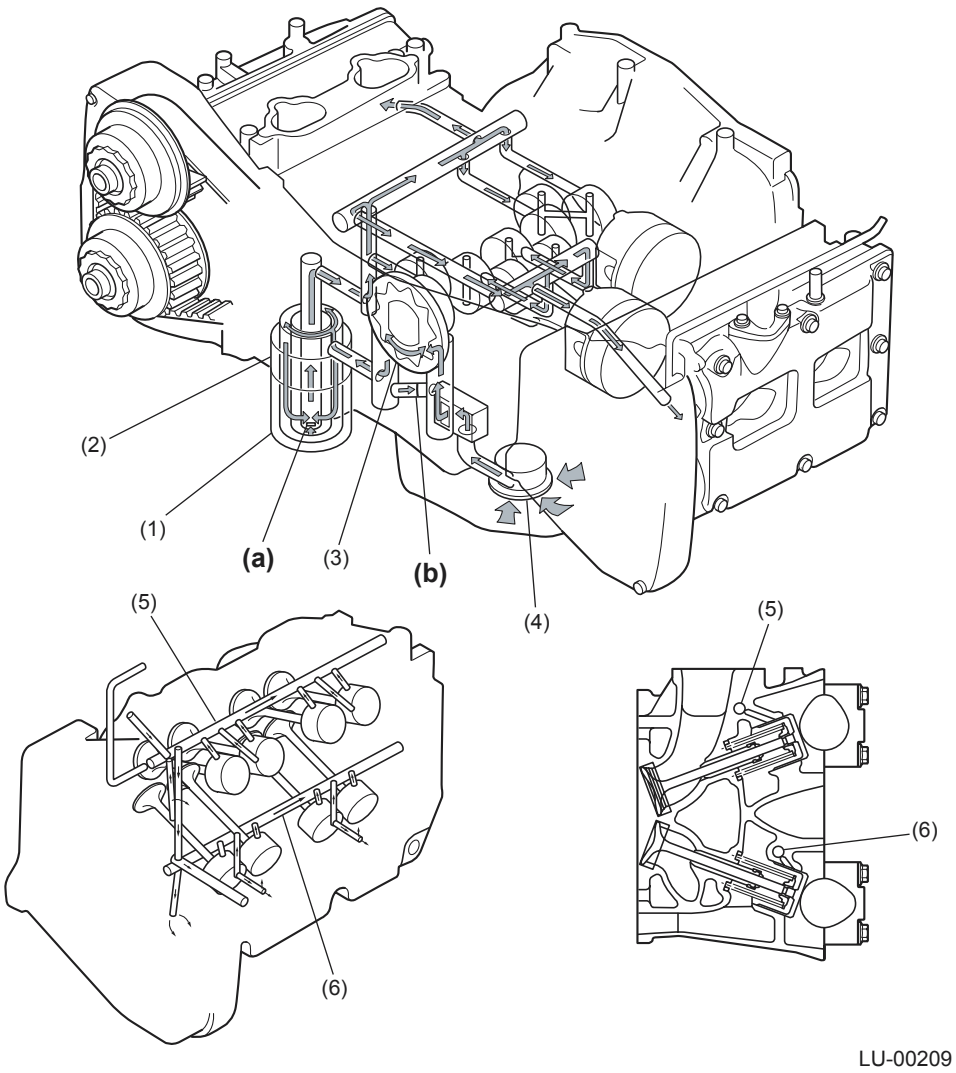

LU-00209

(1) Oil filter
(2) Oil cooler (water cooled)
(3) Oil pump
(4) Oil strainer
(5) Intake gallery
(6) Exhaust gallery
(a) Bypass valve opening pressure: 157 kPa (1.6 kgf/cm^2, 23 psi)
(b) Relief valve opening pressure: 588 kPa (6.0 kgf/cm^2, 85 psi)

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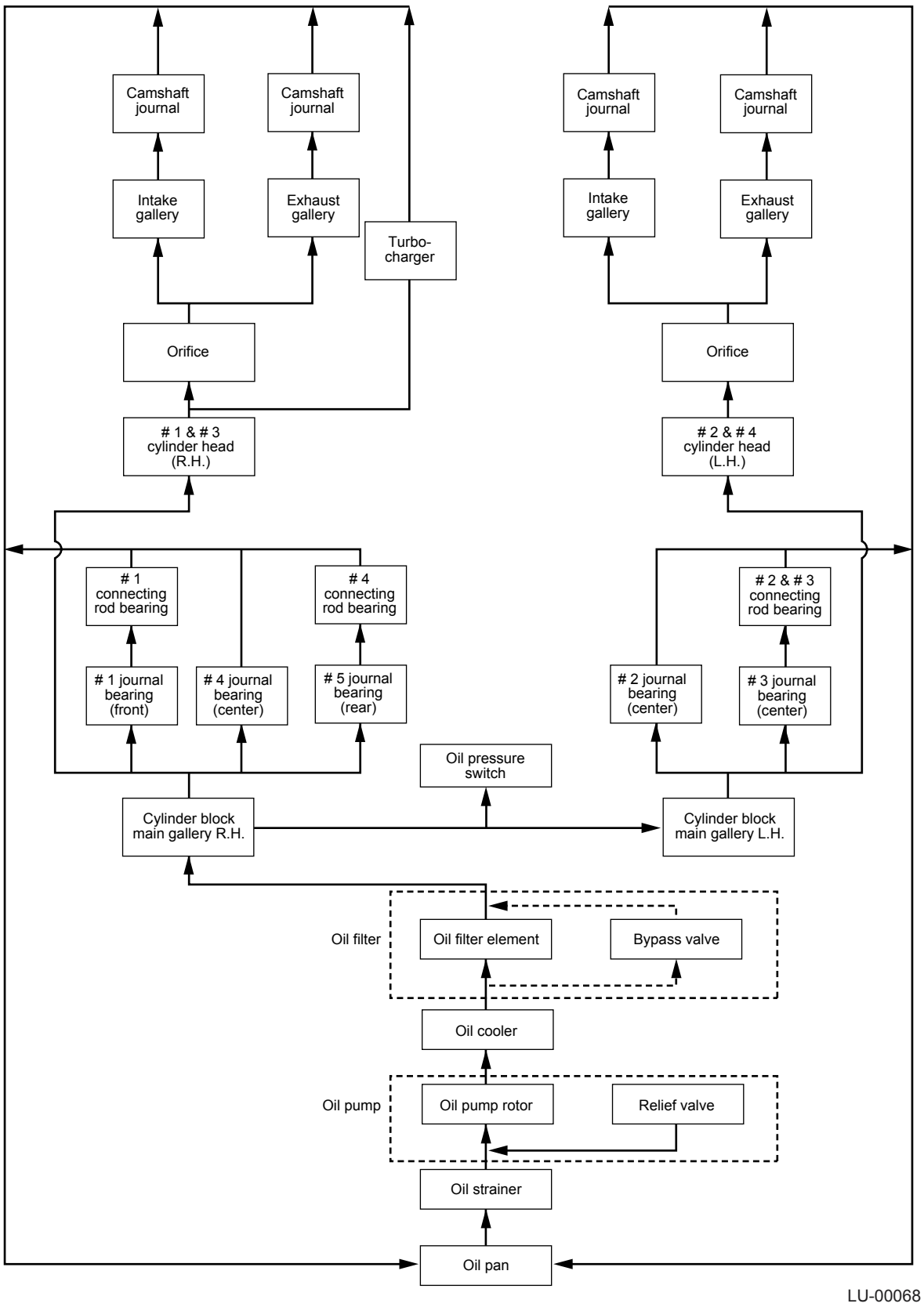
2. Engine Oil Flow



LU-00068

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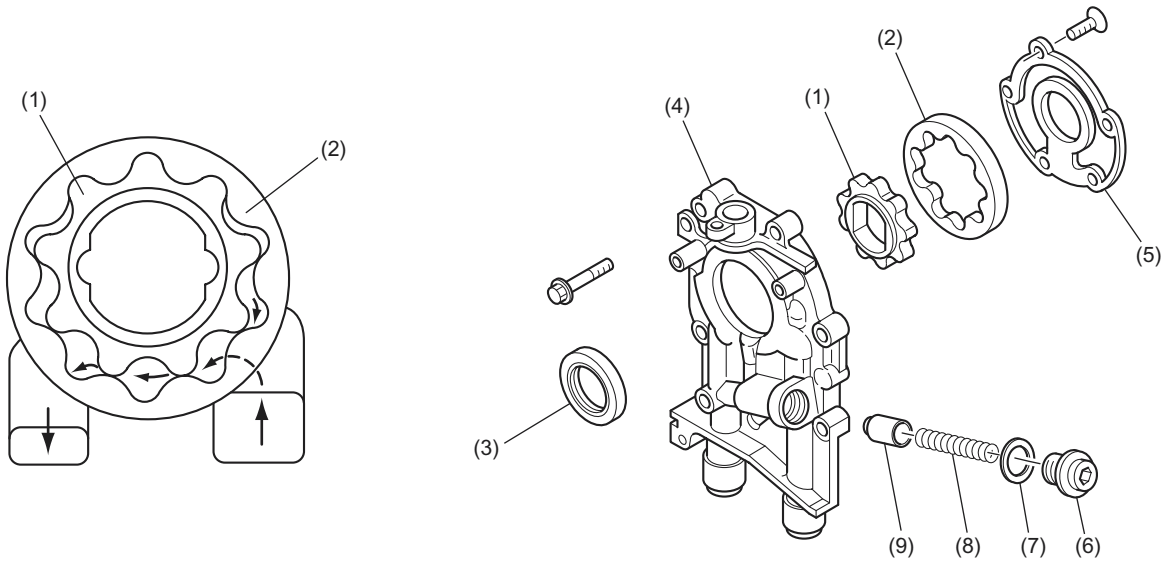
3. Oil Pump

● The oil pump is a trochoid rotor type consisting of an inner rotor and outer rotor assembled with each other in a pump body. When the inner rotor is driven by the crankshaft, the outer rotor is rotated, changing the space between it and the inner rotor. The change in the space occurs because of the difference in the number of teeth between the rotors.

● Engine oil is carried from the inlet port to the discharge port. As the pump rotates, the space carrying the oil becomes smaller, thus the oil is pressurized and discharged from the outlet port.

● A relief valve is built in the oil pump at its discharge side. When the oil pressure becomes 588 kPa (6.0 kgf/cm^2, 85 psi) or higher, the relief valve regulates the pressure by sending excessive oil back to the inlet side.



LU-00058

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

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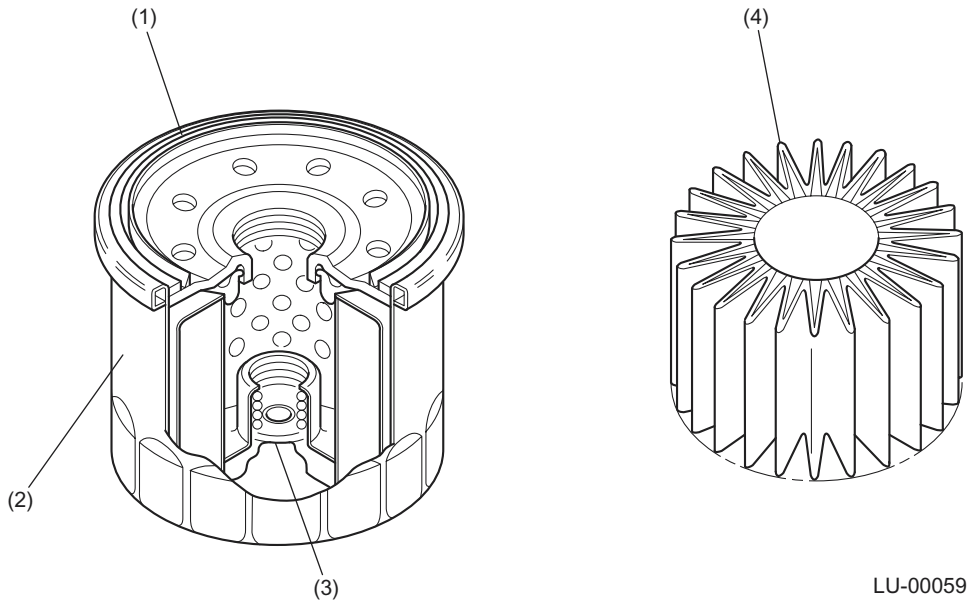
4. Oil Filter

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



(1) Oil seal
(2) Filter body
(3) Bypass valve
(4) Pleated element

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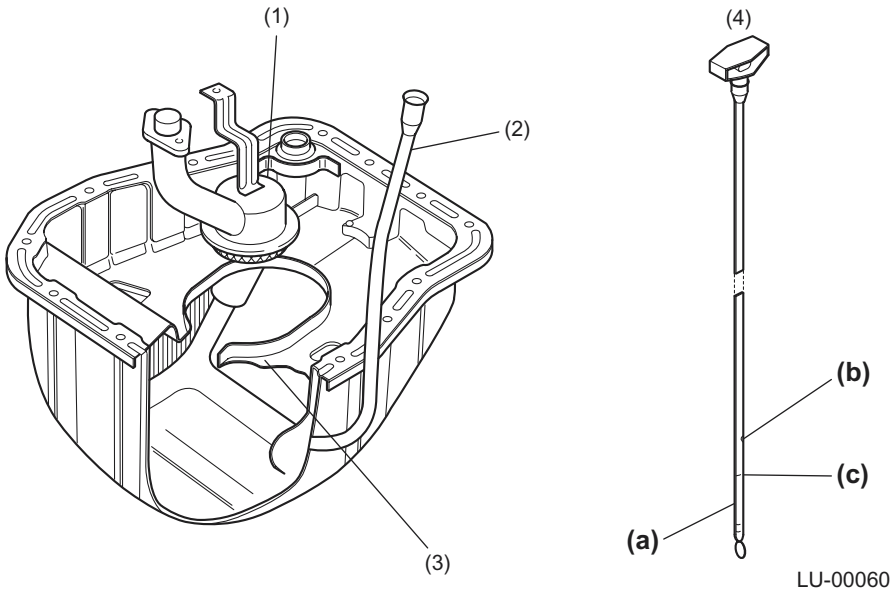
5. Oil Pan and Oil Strainer

● The oil pan is attached to the cylinder block using liquid gasket for sealing. 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 inlet port of the oil pump in the left bank of the cylinder block.

● There is a baffle plate in the oil pan, near the bottom of the cylinder block. It stabilizes the oil level and reinforces the oil pan.



(1) Oil strainer
(2) Level gauge guide
(3) Baffle plate
(4) Oil level gauge

(a) LOW level
(b) FULL level (engine HOT condition)
(c) FULL level (engine COLD condition)

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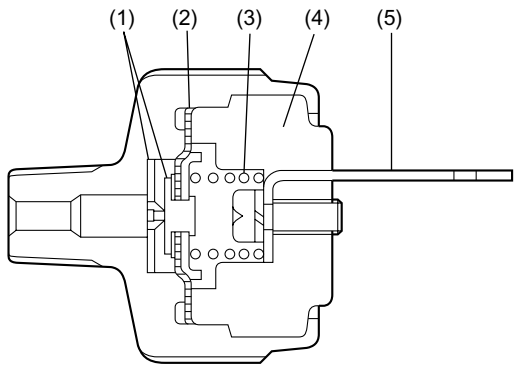
6. Oil Pressure Switch

The oil pressure switch is located in the front upper portion of the right cylinder block bank. 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.



LU-00061

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

1) When oil pressure does not build up (immediately after ignition switch is turned ON):
The diaphragm is pushed toward the cylinder block by the spring force (a force equivalent to the specified oil pressure). This closes the contact points, causing the oil pressure warning light in the combination meter to illuminate.

2) When oil pressure reaches the specified value (after engine starts):
After reaching the specified value of 14.7 kPa (0.15 kgf/cm^2, 2.1 psi), the oil pressure pushes the diaphragm overcoming the spring force. This opens the contact points and the oil pressure warning light goes out.

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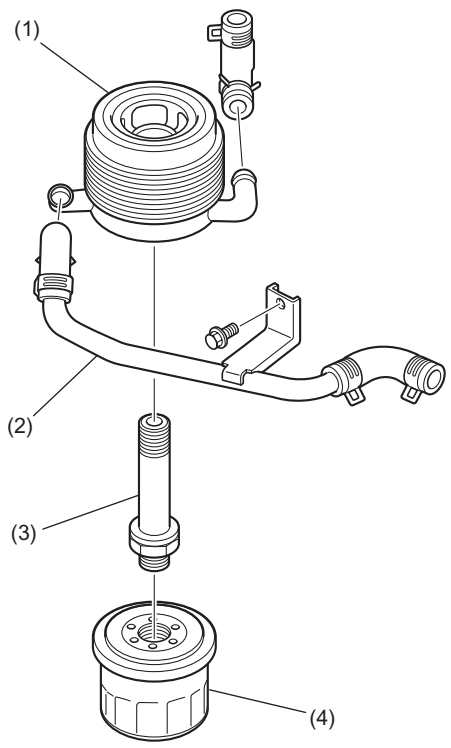
7. Oil Cooler

The oil cooler used in turbo models is of a water cooled type. It serves to maintain engine oil in proper temperature range and so prevent degradation of lubricating oil performance.



LU-00067

(1) Oil cooler
(2) Water pipe
(3) Connector
(4) Oil filter

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LUBRICATION
H4SO

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1. General

● The lubrication system force-circulates engine oil throughout the engine using an oil pump. The oil pressure is regulated by the relief valve built into the oil pump.

● The oil pump is a thin, large-diameter trochoid rotor type which can accommodate the engine's high output. The pump is directly driven by the crankshaft.

● The engine oil is cleaned by a full-flow, paper element type oil filter. The filter has a bypass valve which allows the engine oil to flow bypassing the filter if it is clogged.

● The inside of the oil pan is fitted with a baffle plate which reduces changes in the oil level due to movement of the vehicle, thus ensuring uninterrupted suction of oil.

● The engine oil discharged from the oil pump is delivered to the journal bearings, connecting rod bearings, and other parts requiring lubrication and cooling via the vertical passage in the right bank of the cylinder block, the oil filter, and the oil galleries in the right and left banks of the cylinder block.

● The engine oil is also distributed to each cylinder head valve mechanism at a proper flow rate achieved by metering by the orifice provided in each oil gallery.

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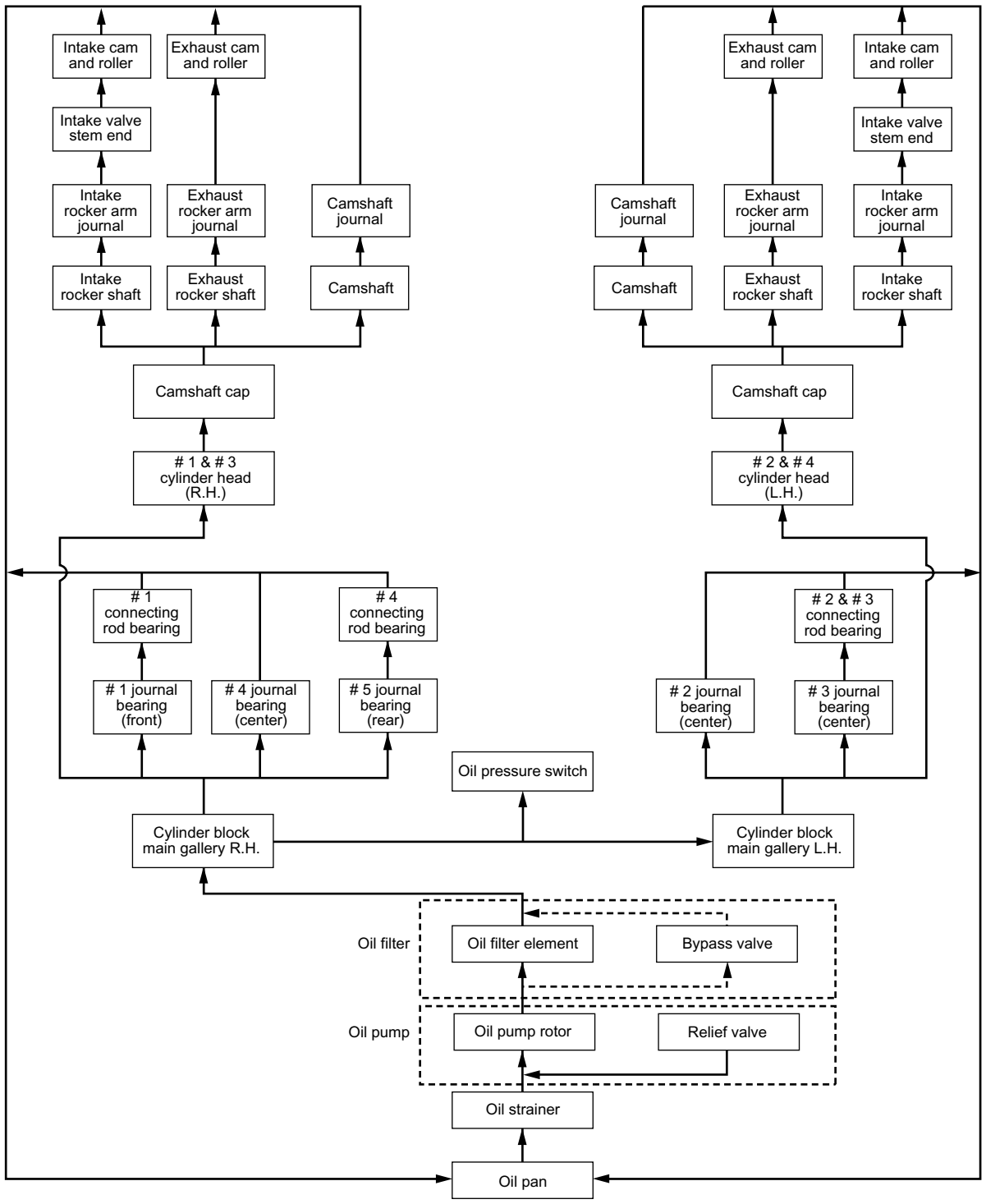
2. Engine Oil Flow



LU-00144

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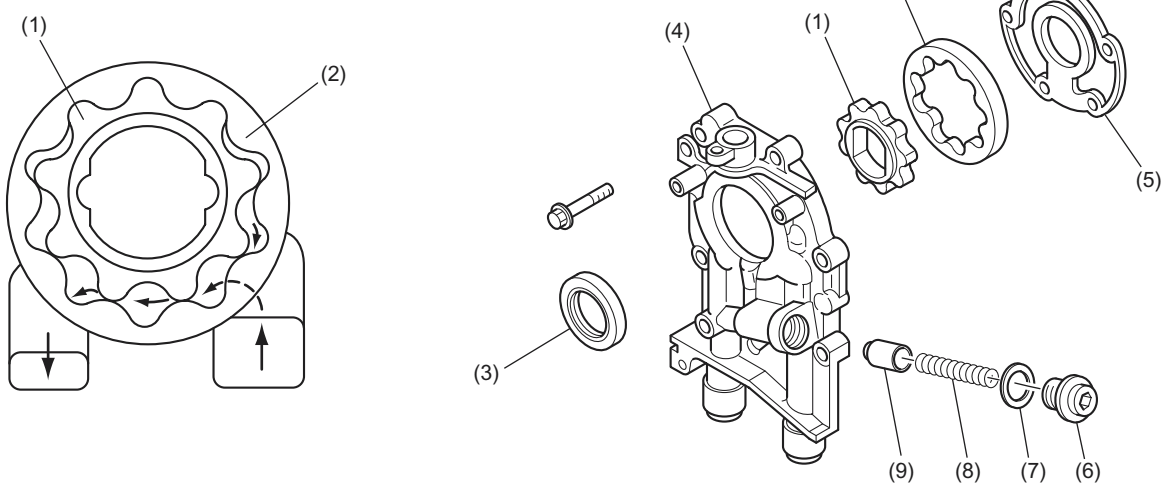
3. Oil Pump

● The oil pump is a trochoid rotor type consisting of an inner rotor and outer rotor assembled with each other in a pump body. When the inner rotor is driven by the crankshaft, the outer rotor is rotated, changing the space between it and the inner rotor. The change in the space occurs because of the difference in the number of teeth between the rotors.

● Engine oil is carried from the inlet port to the discharge port. As the pump rotates, the space carrying the oil becomes smaller, thus the oil is pressurized and discharged from the discharge port. A relief valve is built in the oil pump at its discharge side. When the oil pressure becomes 490 kPa (5.0 kgf/cm^2, 71 psi) or higher, the relief valve regulates the pressure by sending excessive oil back to the inlet side.



LU-00058

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

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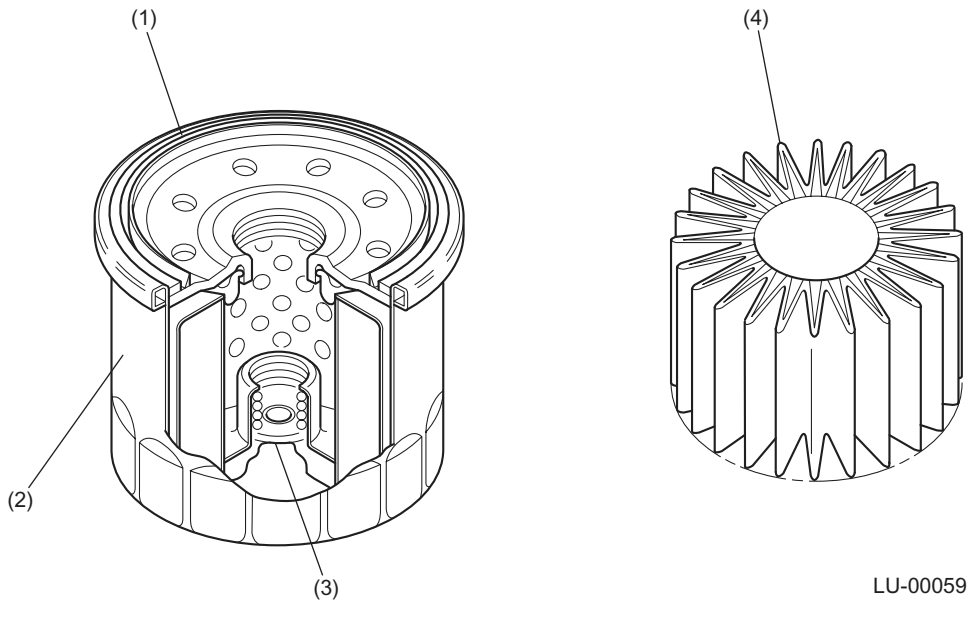
4. Oil Filter

The oil filter is a full-flow filtering, cartridge type that utilizes a paper element. It also has a built-in bypass valve. If the filter gets clogged causing the oil pressure to rise to 157 kPa (1.6 kgf/cm^2, 23 psi) or higher, the bypass valve opens and detours the engine oil to flow around the filter. The filter element has a special pleat design to increase the effective filtering area.



(1) Oil seal
(2) Filter body
(3) Bypass valve
(4) Pleated element

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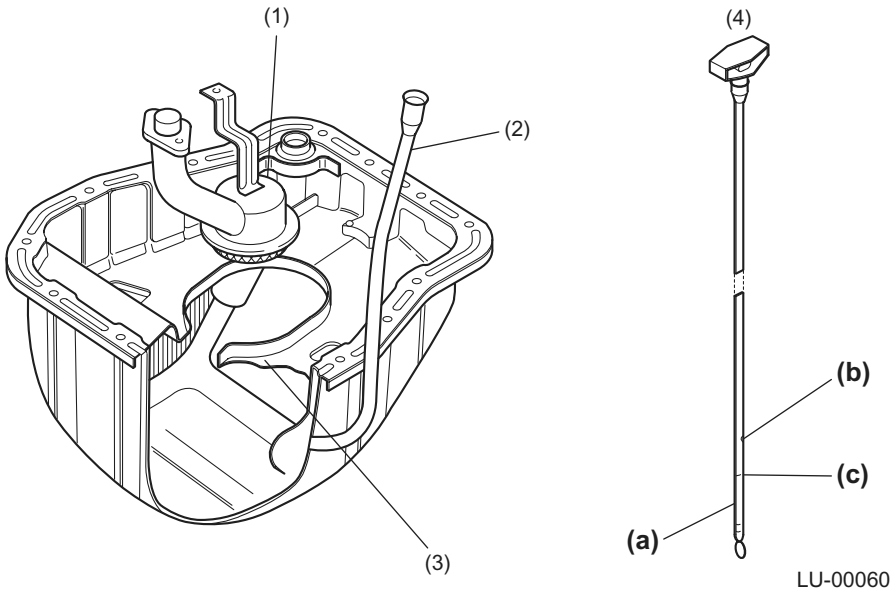
5. Oil Pan and Oil Strainer

● The oil pan is attached to the cylinder block using liquid gasket for sealing. 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 of the oil pump in the left bank of the cylinder block.

● There is a baffle plate in the oil pan, near the bottom of the cylinder block. It stabilizes the oil level and reinforces the oil pan.



(1) Oil strainer
(2) Level gauge guide
(3) Baffle plate
(4) Oil level gauge

(a) LOW level
(b) FULL level (engine HOT condition)
(c) FULL level (engine cold condition)

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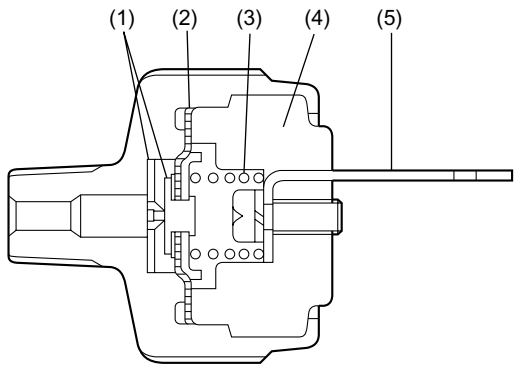
6. Oil Pressure Switch

The oil pressure switch is located in the front upper portion of the right cylinder block bank. 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.



LU-00061

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

1) When oil pressure does not build up (immediately after ignition switch is turned ON):
The diaphragm is pushed toward the cylinder block by the spring force (a force equivalent to the specified oil pressure). This closes the contact points, causing the oil pressure warning light in the combination meter to illuminate.

2) When oil pressure reaches the specified value (after engine starts):
After reaching the specified value of 14.7 kPa (0.15 kgf/cm^2, 2.1 psi), the oil pressure pushes the diaphragm overcoming the spring force. This opens the contact points and the oil pressure warning light goes out.

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LUBRICATION
STi

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1. General

● The lubrication system force-circulates engine oil throughout the engine using an oil pump. The oil pressure is regulated by the relief valve*1 built into the oil pump.

● The oil pump is a thin, large-diameter trochoid rotor type which can accommodate the engine's high output. The pump is directly driven by the crankshaft.

● The engine oil is cleaned by a full-flow, paper element type oil filter. The filter has a bypass valve*2 which allows the engine oil to flow bypassing the filter if it is clogged.

● The inside of the oil pan is fitted with a baffle plate which reduces changes in the oil level due to movement of the vehicle, thus ensuring uninterrupted suction of oil.

● The engine oil discharged from the oil pump is delivered to the journal bearings, connecting rod bearings, and other parts requiring lubrication and cooling via the vertical passage in the right bank of the cylinder block, the oil filter, and the oil galleries in the right and left banks of the cylinder block.

● The engine oil is also distributed to each cylinder head valve mechanism at a proper flow rate achieved by metering by the orifice provided in each oil gallery.

● An oil cooler is installed to keep the engine oil in an optimum temperature range and prevent degradation of lubrication performance.

*1: Relief valve opening pressure: 588 kPa (6.0 kgf/cm^2, 85 psi)
*2: Bypass valve opening pressure:157 kPa (1.6 kgf/cm^2, 23 psi)

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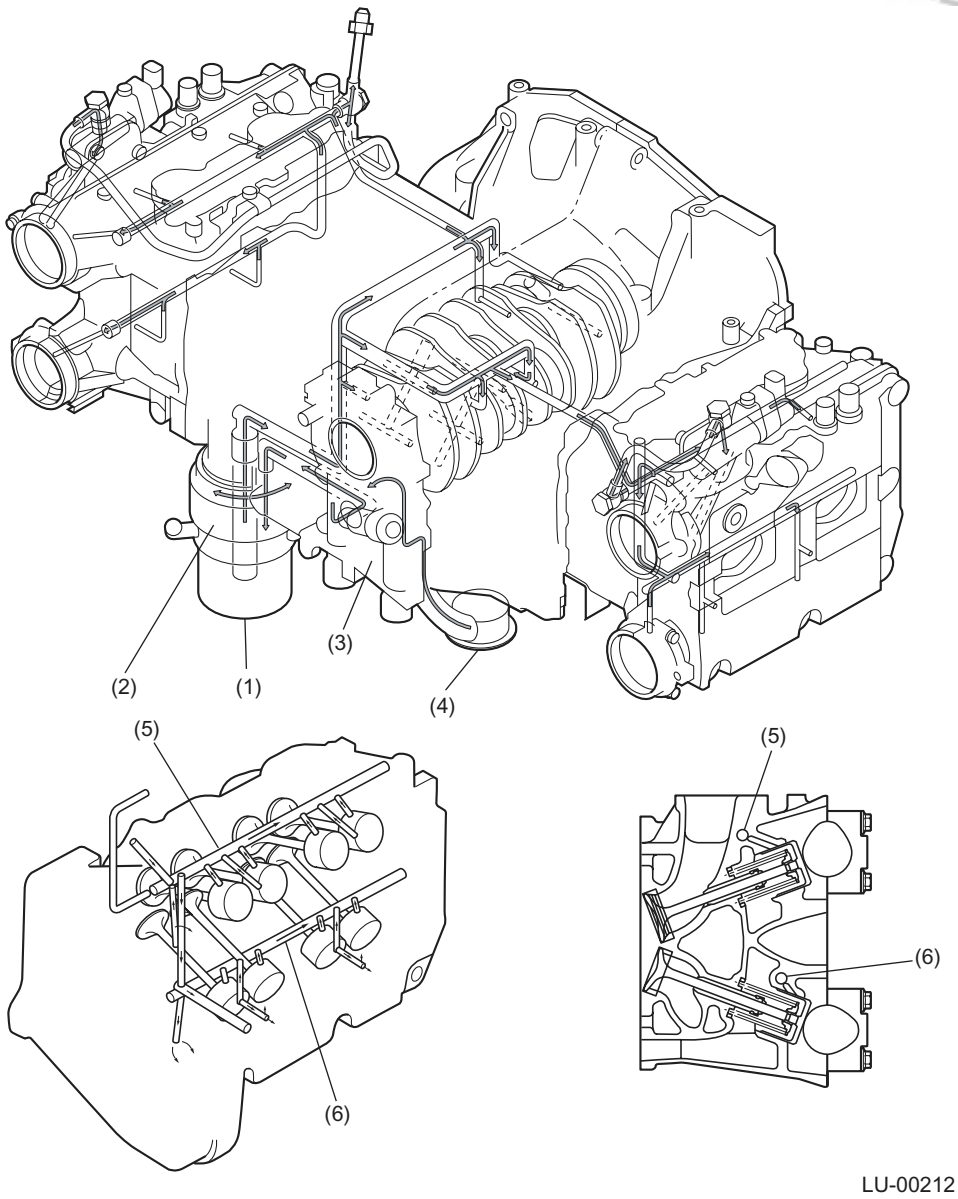

LU-00212

(1) Oil filter
(2) Oil cooler (water cooled)
(3) Oil pump
(4) Oil strainer
(5) Intake gallery
(6) Exhaust gallery

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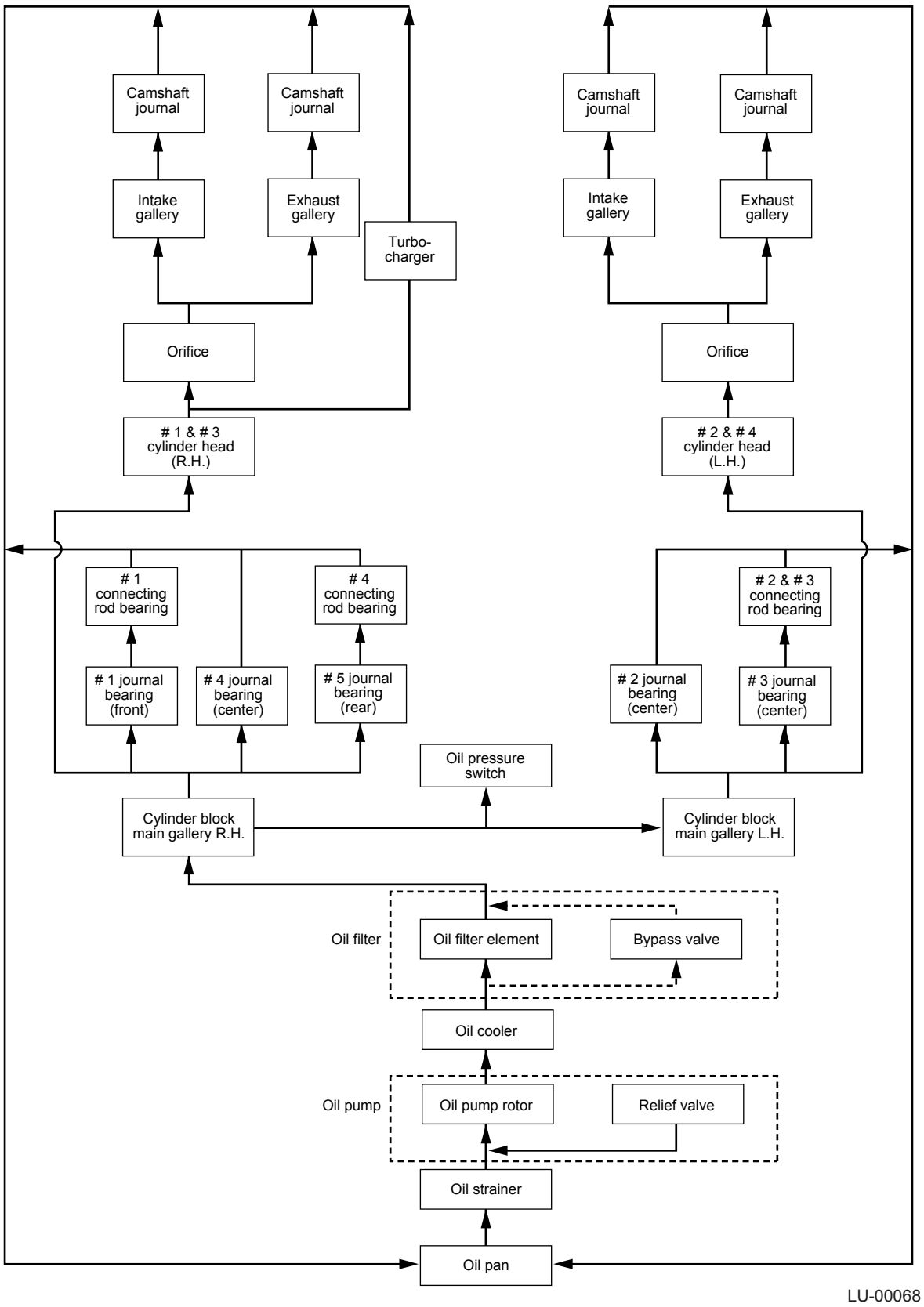
2. Engine Oil Flow



LU-00068

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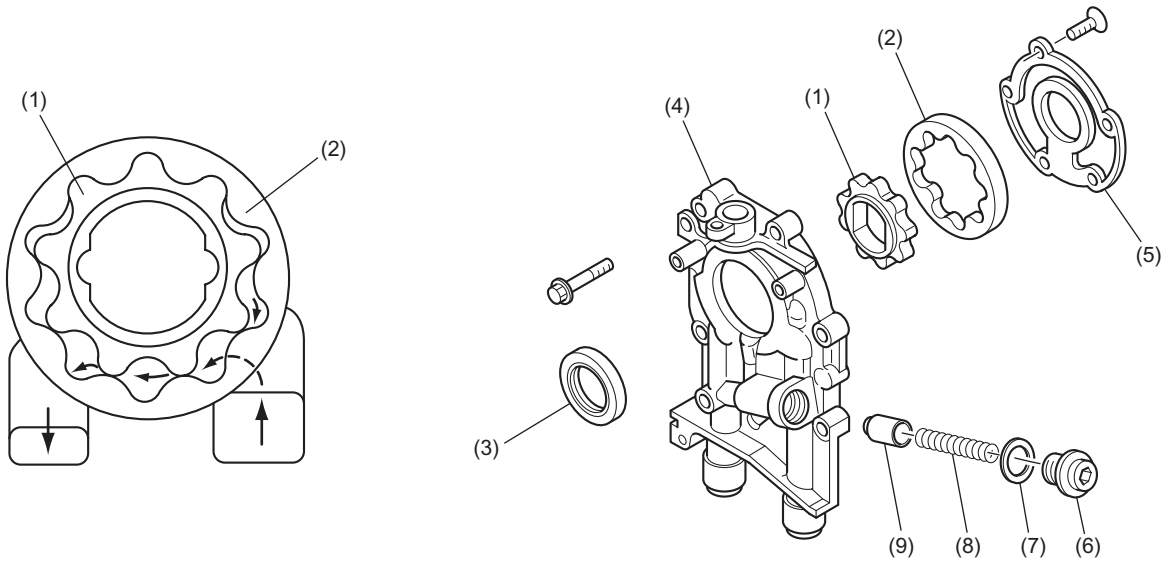
3. Oil Pump

● The oil pump is a trochoid rotor type consisting of an inner rotor and outer rotor assembled with each other in a pump body. When the inner rotor is driven by the crankshaft, the outer rotor is rotated, changing the space between it and the inner rotor. The change in the space occurs because of the difference in the number of teeth between the rotors.

● Engine oil is carried from the inlet port to the discharge port. As the pump rotates, the space carrying the oil becomes smaller, thus the oil is pressurized and discharged from the outlet port.

● A relief valve is built in the oil pump at its discharge side. When the oil pressure becomes 588 kPa (6.0 kgf/cm^2, 85 psi) or higher, the relief valve regulates the pressure by sending excessive oil back to the inlet side.



LU-00058

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

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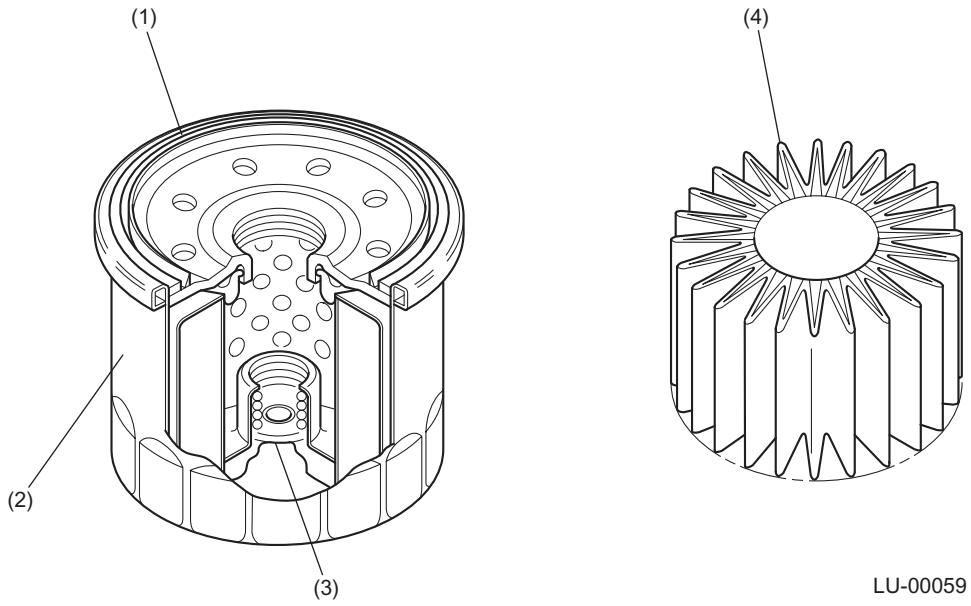
4. Oil Filter

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



(1) Oil seal
(2) Filter body
(3) Bypass valve
(4) Pleated element

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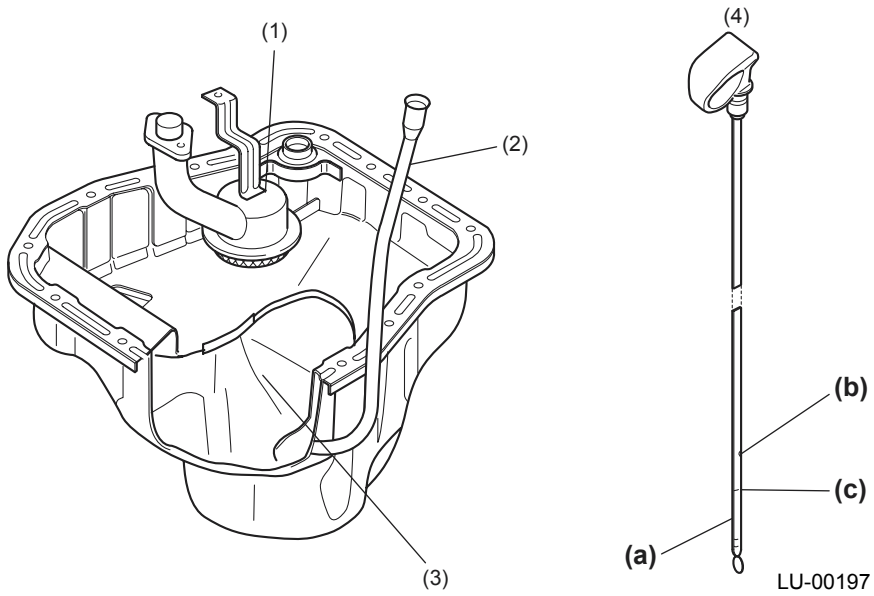
5. Oil Pan and Oil Strainer

● The oil pan is attached to the cylinder block using liquid gasket for sealing. 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 inlet port of the oil pump in the left bank of the cylinder block.

● There is a baffle plate in the oil pan, near the bottom of the cylinder block. It stabilizes the oil level and reinforces the oil pan.



(1) Oil strainer
(2) Level gauge guide
(3) Baffle plate
(4) Oil level gauge

(a) LOW level
(b) FULL level (engine HOT condition)
(c) FULL level (engine COLD condition)

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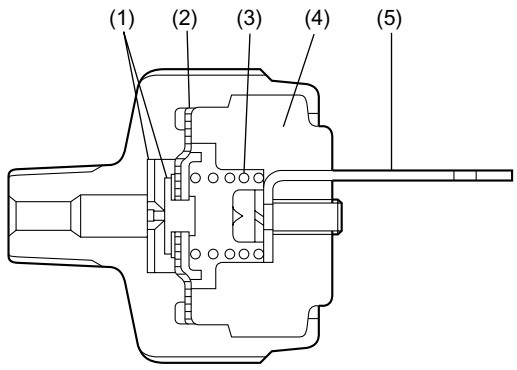
6. Oil Pressure Switch

The oil pressure switch is located in the front upper portion of the right cylinder block bank. 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.



LU-00061

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

1) When oil pressure does not build up (immediately after ignition switch is turned ON):
The diaphragm is pushed toward the cylinder block by the spring force (a force equivalent to the specified oil pressure). This closes the contact points, causing the oil pressure warning light in the combination meter to illuminate.

2) When oil pressure reaches the specified value (after engine starts):
After reaching the specified value of 14.7 kPa (0.15 kgf/cm^2, 2.1 psi), the oil pressure pushes the diaphragm overcoming the spring force. This opens the contact points and the oil pressure warning light goes out.

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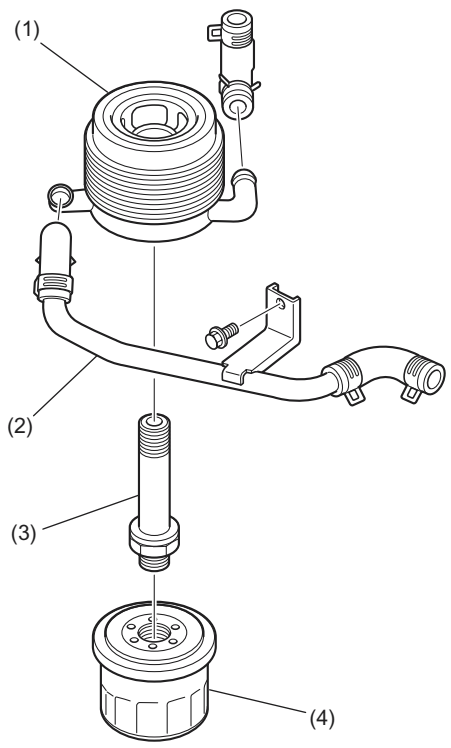
7. Oil Cooler

The oil cooler used in turbo models is of a water cooled type. It serves to maintain engine oil in proper temperature range and so prevent degradation of lubricating oil performance.



LU-00067

(1) Oil cooler
(2) Water pipe
(3) Connector
(4) Oil filter

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MECHANICAL
H4DOTC

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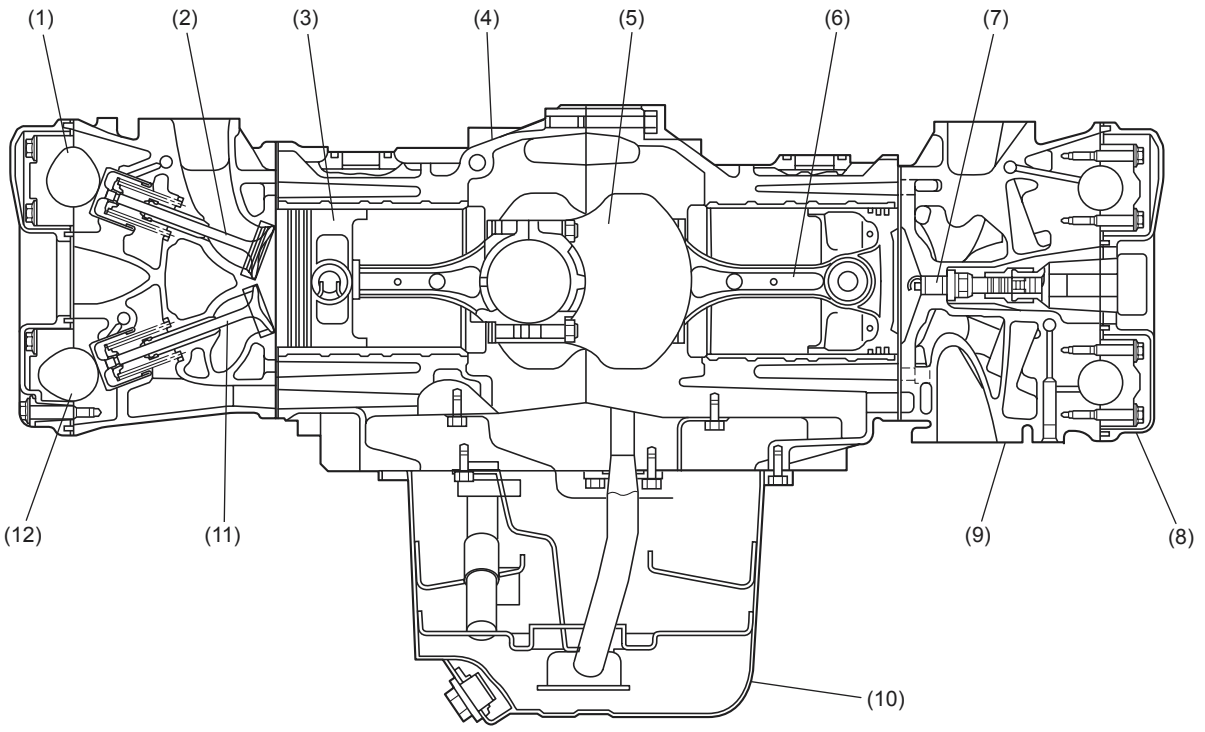
1. General

The engine used in this vehicle is of a horizontally opposed, four-cylinder design. This four-stroke-cycle, water-cooled, DOHC turbocharged engine uses a total of 16 valves and its main components are made of aluminum alloy. It is fueled by a multiple fuel injection system.

The engine's major structural and functional features are as follows:

- The cylinder head forms pentroof combustion chambers, each having a spark plug located at its center and two each of intake and exhaust valves (four valves per cylinder). The intake and exhaust ports are located in a cross-flow arrangement.
- A single timing belt drives four camshafts on the left and right banks and the engine coolant pump on the left bank. Belt tension is automatically adjusted by a belt tension adjuster, eliminating need for a manual adjustment.
- The crankshaft is supported by five bearings with high rigidity and strength.
- The cylinder block is an aluminum die casting fitted with iron die-cast cylinder liners.



ME-00761

(1) Intake camshaft
(2) Intake valve
(3) Piston
(4) Cylinder block
(5) Crankshaft
(6) Connecting rod
(7) Spark plug
(8) Valve rocker cover
(9) Cylinder Head
(10) Oil pan
(11) Exhaust valve
(12) Exhaust camshaft

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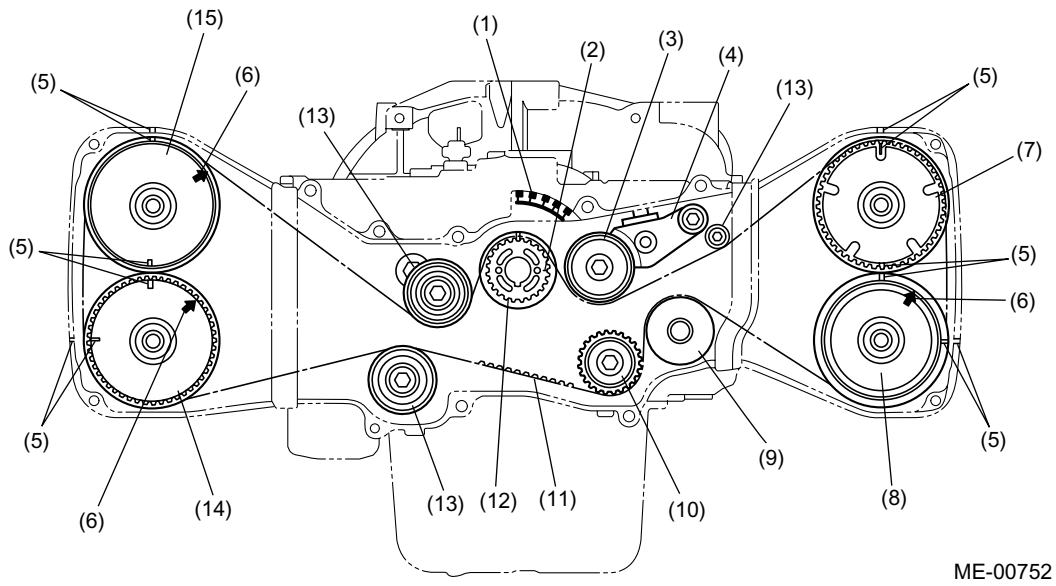
2. Timing Belt

● A single timing belt drives four camshafts (intake and exhaust camshafts on each bank). The belt also drives the water pump by its non-toothed side.
● The timing belt teeth have a specially designed round profile which contributes to quiet operation. The timing belt is made of strong and inflexible core cords, wear-resistant canvas and heat-resistant rubber material.
● A hydraulic automatic belt tension adjuster always keeps the belt taut to the specified tension. Any manual belt tension adjustment is unnecessary.



ME-00752

(1) Timing indicator (for timing mark of crankshaft pulley)
(2) *Piston position mark
(3) Belt tension pulley
(4) Automatic belt tension adjuster assembly
(5) Alignment mark
(6) **Piston position mark
(7) Intake camshaft sprocket LH
(8) Exhaust camshaft sprocket LH
(9) Water pump pulley
(10) Idler No. 2
(11) Timing belt
(12) Crankshaft sprocket
(13) Idler
(14) Exhaust camshaft sprocket RH
(15) Intake camshaft sprocket RH

NOTE:
*: The #1 piston is set at the top dead center (TDC) when the piston-position mark on the crankshaft sprocket is aligned with the mark on cylinder block.
**: The #1 piston is set at TDC on the compression stroke when the piston-position mark on the camshaft sprocket is facing directly upward.

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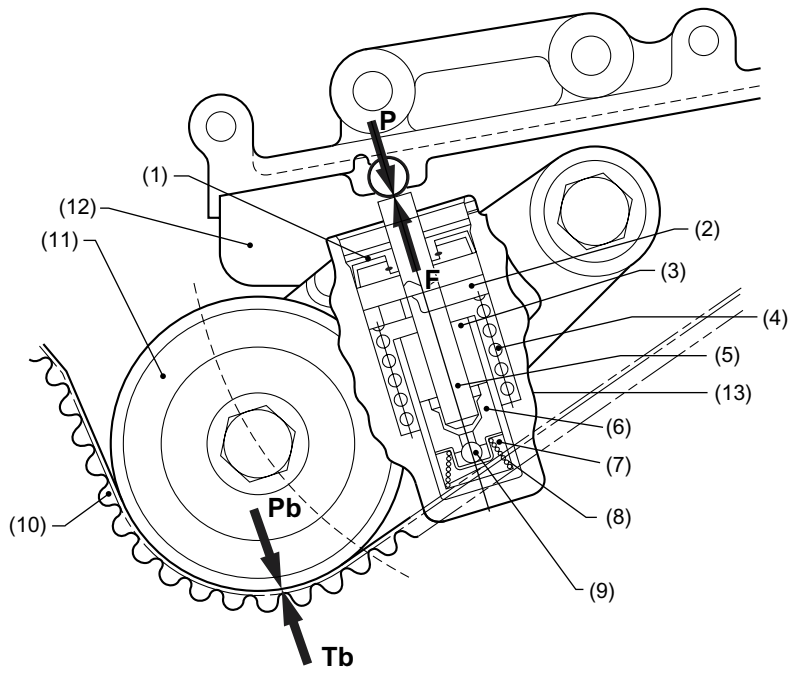
3. Automatic Belt Tension Adjuster

The automatic belt tension adjuster consists of a tensioner unit and a bracket. It maintains the timing belt tension automatically at a specified level to enable the belt to transmit power correctly, reduce operating noise and increase the life of the belt.
The cylinder of the tensioner unit incorporates an adjuster rod, wear ring, plunger spring, return spring, check ball and silicone oil.
The automatic belt tension adjuster gives tension to the belt by a levering action which is produced by the push force of the tensioner unit's adjuster rod. It operates in the process detailed below.



ME-00314

(1) Oil seal
(2) Wear ring
(3) Oil reservoir chamber
(4) Return spring
(5) Adjuster rod
(6) Plunger
(7) Oil pressure chamber
(8) Plunger spring
(9) Check ball
(10) Timing belt
(11) Belt tension pulley
(12) Tensioner bracket
(13) Cylinder

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● Timing belt tensioning action

When the belt becomes slack, 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 certain level, pushes open the check ball and flows into the oil pressure chamber to keep the pressure constant.
The thrust force F resulting from extension of the adjuster rod applies a counterclockwise torque to the tensioner bracket, which causes the belt tension pulley at its end to turn in the same direction. This applies tensioning pressure Pb to the timing belt.

● Timing belt tension balancing action

When the belt tension pulley is pushed against the timing belt with pressure Pb, reaction force Tb of the timing belt generates the reaction force P at the point on which the adjustor rod force is acting. This force P pushes the adjuster rod until it balances with the sum of the thrust force F and the pressure of the oil in the oil pressure chamber. Therefore, the timing belt tension is kept constant.

● Over-tension correction action

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

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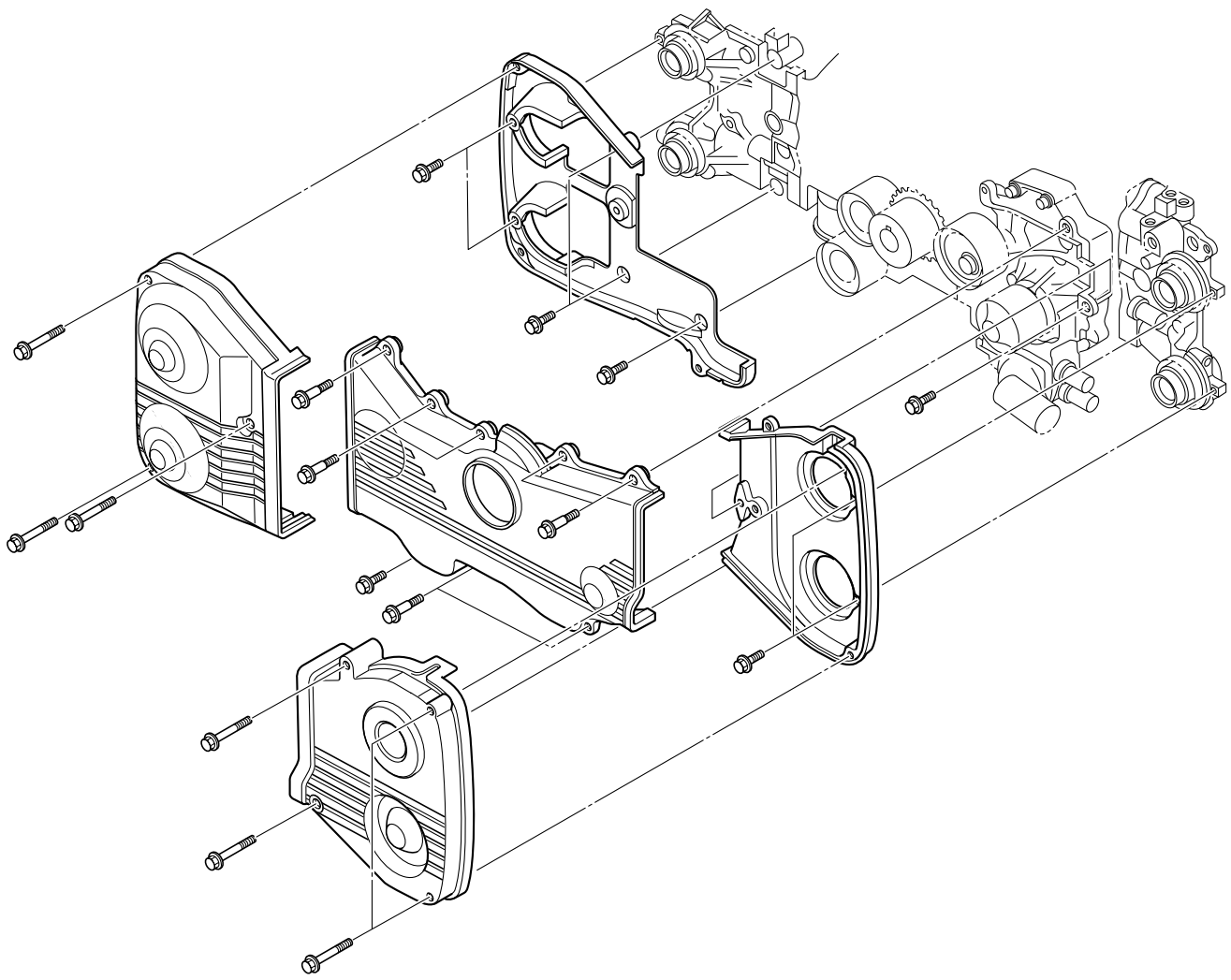
4. Belt Cover

- The belt cover is made of lightweight, heat resistant synthetic resin molding. It constitutes a totally enclosed housing with its cylinder block mating edges sealed with rubber gaskets. This effectively protects the inside components from dust and liquid.
- Rubber seals used between the cylinder block and the belt cover effectively reduces transmission of noise and vibration.
- The front belt cover has a line mark for ignition-timing checking.



ME-00343

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5. Camshaft

The DOHC engine uses four camshafts in all; intake and exhaust camshafts on each of the right and left banks.

The cam lobe noses are finished by “chill” treatment to increase wear resistance and anti-scuffing properties.

Each camshaft is supported at its three journals and held in position by three camshaft caps. Each camshaft has a flange which fits in the corresponding groove in the cylinder head to receive thrust forces generated in the camshaft.

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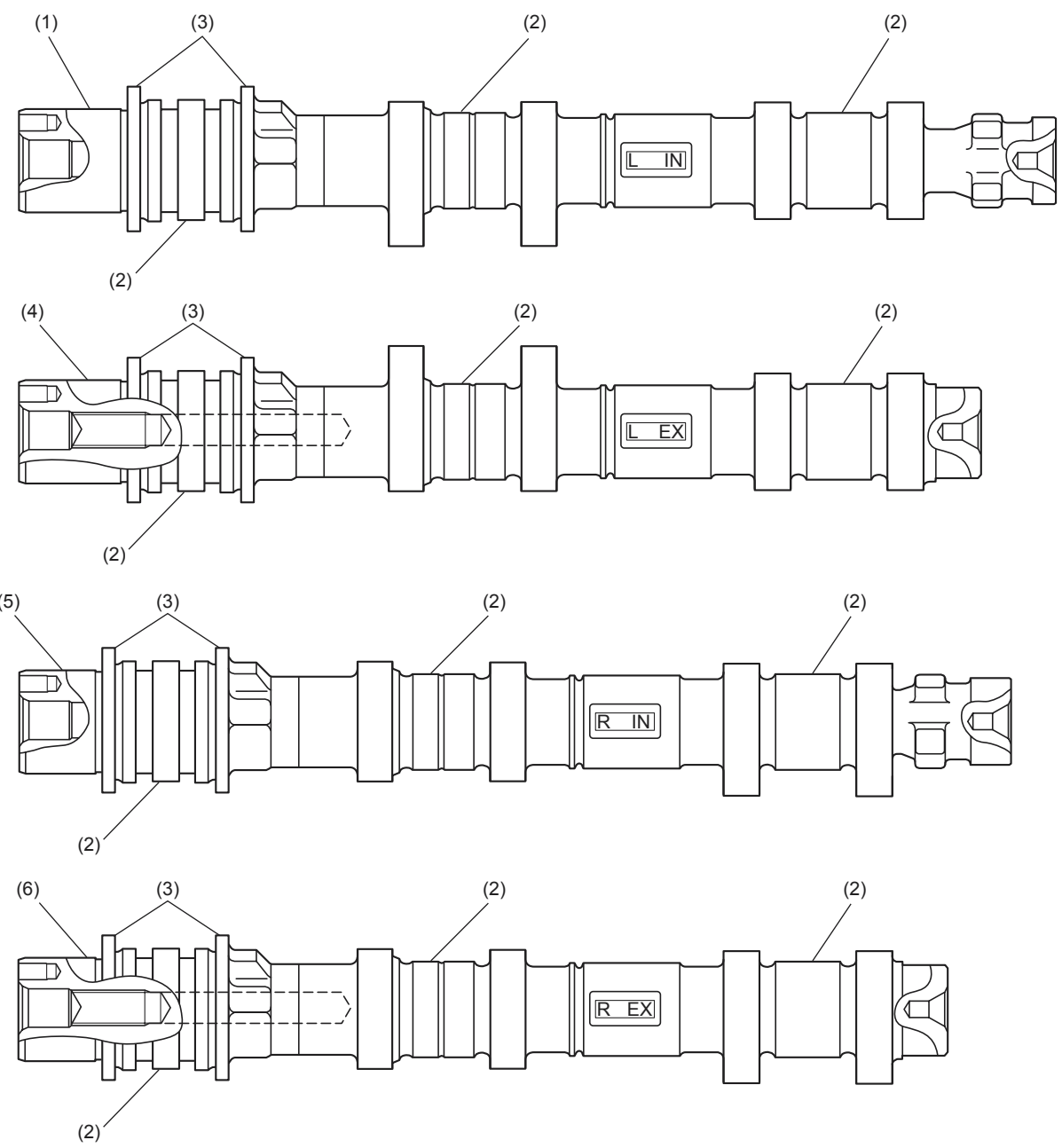

ME-00743

(1) Intake camshaft LH
(2) Journal
(3) Flange
(4) Exhaust camshaft LH
(5) Intake camshaft RH
(6) Exhaust camshaft RH

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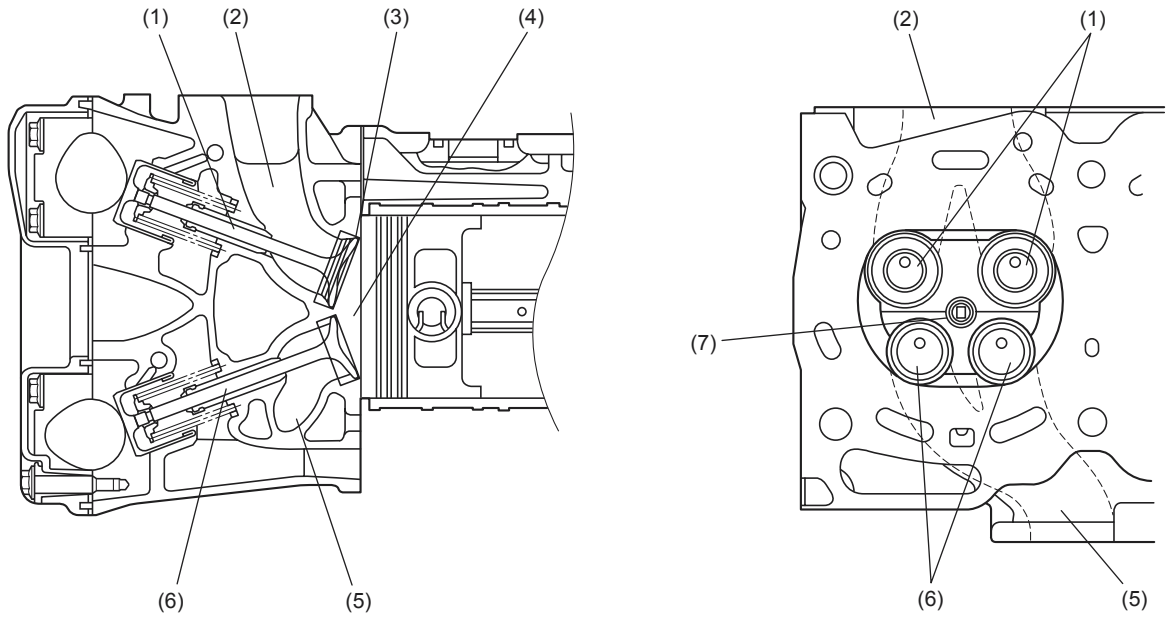
6. Cylinder Head

- The cylinder head is made of aluminum die casting.
- Each combustion chamber in the cylinder head is a compact, pentroof design. The spark plug is located at the center of the combustion chamber, which contributes to creation of a wide “squish area” for increased combustion efficiency.
- The two intake and two exhaust valves are arranged on opposite sides for a cross-flow feature.
- The cylinder head gasket is a metallic gasket consisting of three layers of the stainless steel sheets. The gasket is highly resistant to heat and maintains high level of sealing performance for a long period.



ME-00762

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

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7. Cylinder Block

● The cylinder block is made of aluminum die casting. Its open-deck design provides it with such advantageous features as relatively small weight, high rigidity and excellent cooling efficiency.

● The cylinder liners are made of cast iron. They are dry type which means their outer surfaces are entirely in contact with the cylinder block.

● The cylinder block supports the crankshaft at its five journals. The journal supporting portions are designed such that sufficient stiffness and quiet operation are ensured.

● 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 left-cylinder bank. At the rear of the right-cylinder bank is an oil separator which removes oil mist contained in blow-by gas.

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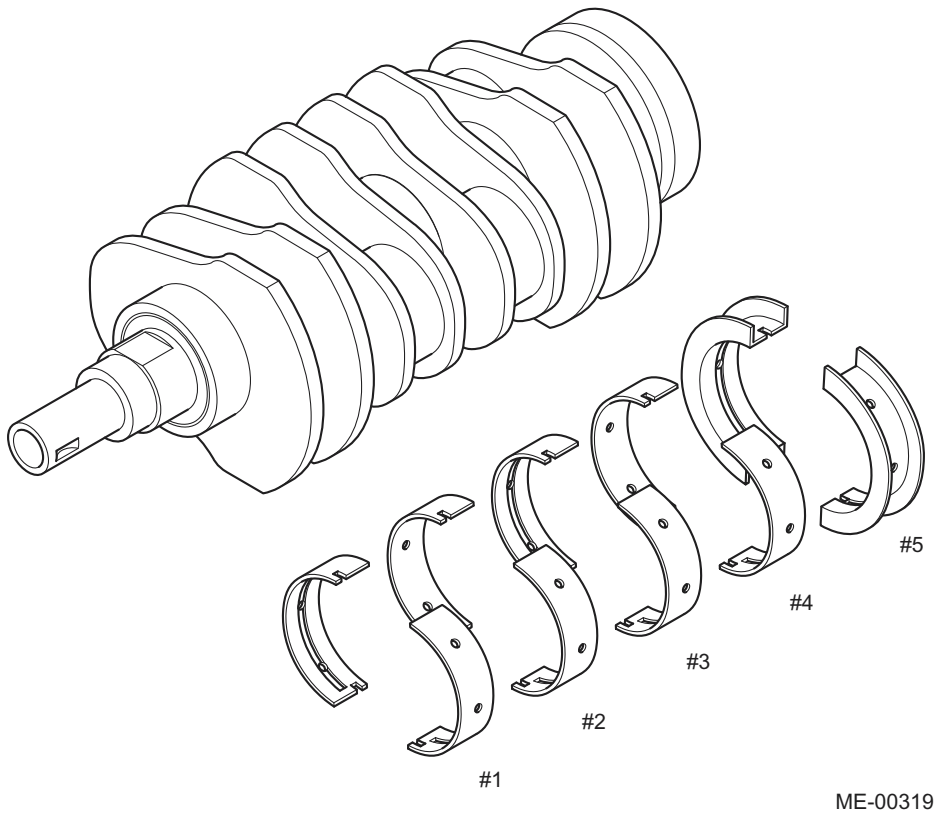
8. Crankshaft

The crankshaft is supported in the cylinder block by five bearings. Each corner formed by a journal or pin and a web is finished by fillet-rolling method which increases strength of that area. The five crankshaft bearings are made of aluminum alloy and the No. 5 bearing is provided with a flanged metal to support thrust forces.



ME-00319

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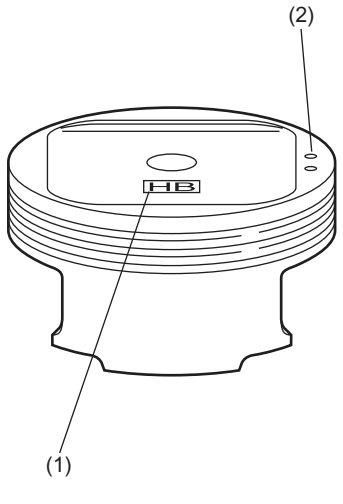
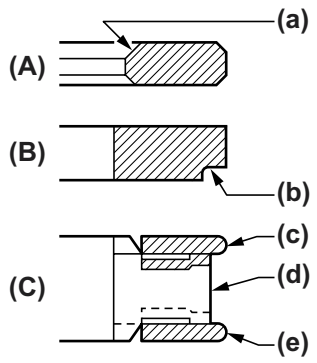
9. Piston

- The pistons are of a slipper skirt design for reduced weight and friction. The oil control ring groove utilizes a thermal design.
- The piston pin is offset either downward (Nos. 1 and 3 pistons) or upward (Nos. 2 and 4 pistons).
- The piston head has recesses to prevent interference with the intake and exhaust valves. It also has engraved marks to identify the piston size and the direction of installation. All the pistons are common in their design.
- Three piston rings are used for each piston — two compression rings and one oil control ring.The top piston ring has inner bevels and the second piston ring has a cut on the bottom outside to reduce oil consumption.





ME-00346

(1) Identification mark
(2) Location mark (engine front side)

(A) Top ring
(B) Second ring
(C) Oil ring

(a) Inner-bevel
(b) Cut
(c) Upper rail
(d) Spacer
(e) Lower rail

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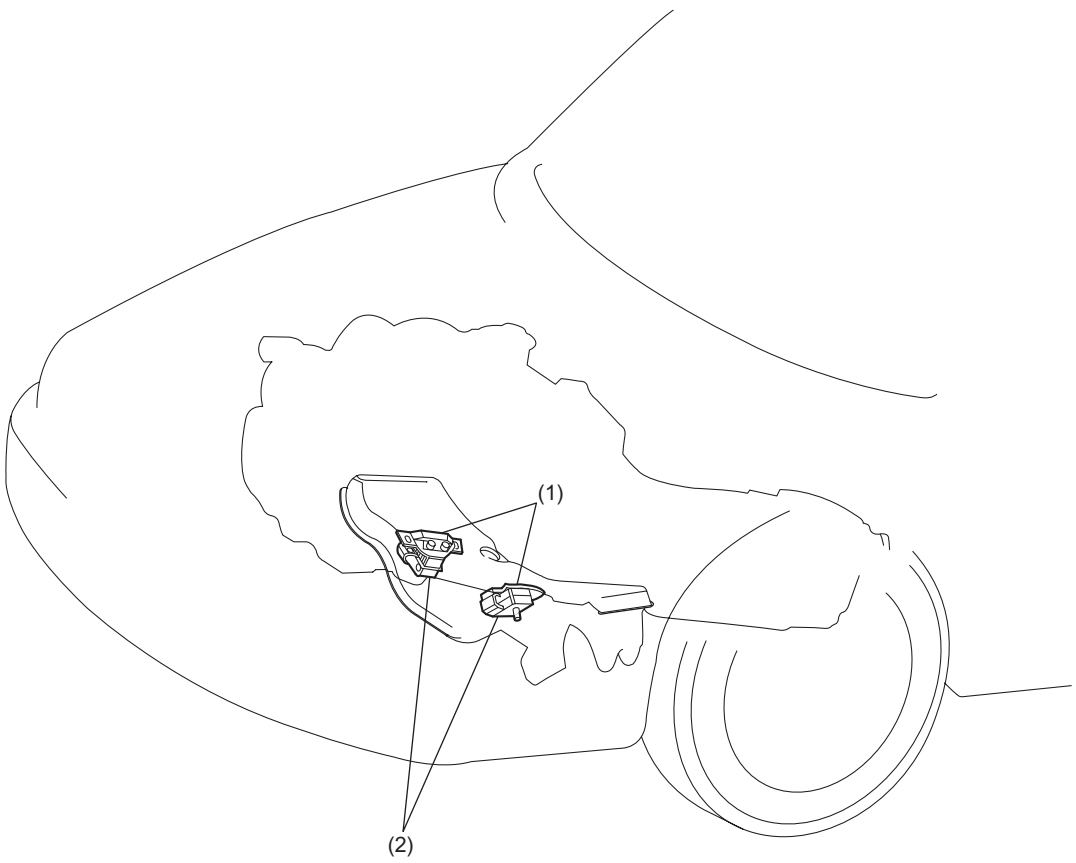
10.Engine Mounting



ME-00321

(1) Bracket
(2) Cushion rubber

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MECHANICAL
H4SO

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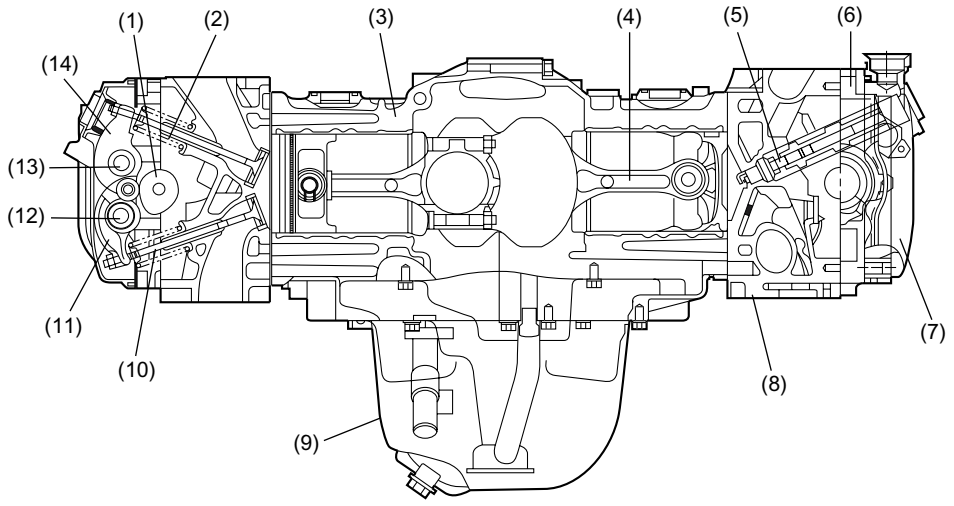
1. General

The engine used in this vehicle is of a horizontally opposed, four-cylinder design. This four-stroke-cycle, water-cooled, SOHC engine uses a total of 16 valves and its main components are made of aluminum alloy. It is fueled by a multiple fuel injection system.

The engine's major structural and functional features are as follows:

- The cylinder head forms pentroof combustion chambers, each having a spark plug located at its center and two each of intake and exhaust valves (four valves per cylinder). The intake and exhaust ports are located in a cross-flow arrangement.
- There are a screw and nut at the valve end of each rocker arm. They are used for adjusting the 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 a belt tension adjuster, eliminating need for a manual adjustment.
- The crankshaft is supported by five bearings with high rigidity and strength.
- The cylinder block is an aluminum die casting fitted with iron die-cast cylinder liners.



ME-00312

(1) Camshaft
(2) Intake valve
(3) Cylinder Block
(4) Connecting rod
(5) Spark plug
(6) Camshaft cap
(7) Valve rocker cover
(8) Cylinder Head
(9) Oil pan
(10) Exhaust valve
(11) Exhaust rocker arm
(12) Exhaust rocker shaft
(13) Intake rocker shaft
(14) Intake rocker arm

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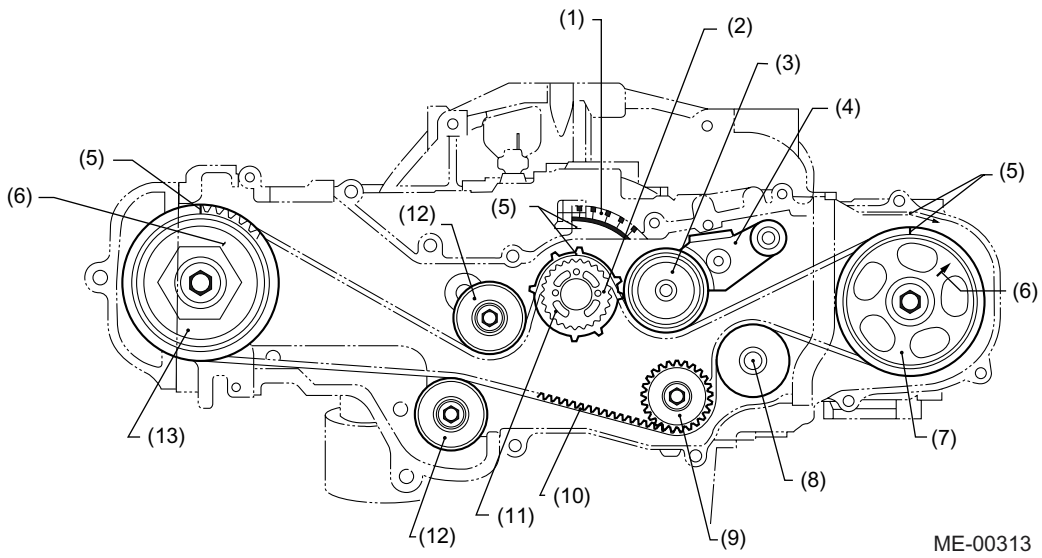
2. Timing Belt

● A single timing belt drives two camshafts (one in the left bank and one in the right bank). The belt also drives the water pump by its non-toothed side.

● The timing belt teeth have a specially designed round profile which contributes to quiet operation. The timing belt is made of strong and inflexible core cords, wear-resistant canvas and heat-resistant rubber material.

● A hydraulic automatic belt tension adjuster always keeps the belt taut to the specified tension. Any manual belt tension adjustment is unnecessary.



(1) Timing indicator (for timing mark of crankshaft pulley)
(2) *Piston position mark
(3) Belt tension pulley
(4) Automatic Belt Tension Adjuster
(5) Alignment mark
(6) **Piston position mark
(7) Camshaft sprocket LH
(8) Water pump pulley
(9) Idler No. 2
(10) Timing Belt
(11) Crankshaft sprocket
(12) Idler
(13) Camshaft sprocket RH

NOTE:
*: The #1 piston is at TDC when the piston position mark on the crankshaft sprocket is aligned with the timing mark on the cylinder block.
**: The #1 piston is at TDC on the compression stroke when the piston position mark on the camshaft sprocket is aligned with the timing mark on the belt cover.

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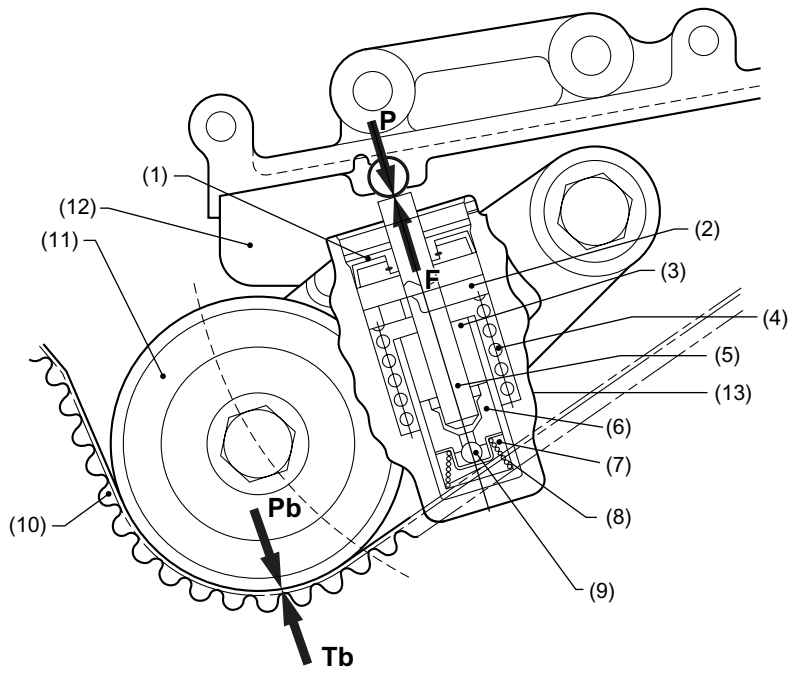
3. Automatic Belt Tension Adjuster

The automatic belt tension adjuster consists of a tensioner unit and a bracket. It maintains the timing belt tension automatically at a specified level to enable the belt to transmit power correctly, reduce operating noise and increase the life of the belt.
The cylinder of the tensioner unit incorporates an adjuster rod, wear ring, plunger spring, return spring, check ball and silicone oil.
The automatic belt tension adjuster gives tension to the belt by a levering action which is produced by the push force of the tensioner unit's adjuster rod. It operates in the process detailed below.



ME-00314

(1) Oil seal
(2) Wear ring
(3) Oil reservoir chamber
(4) Return spring
(5) Adjuster rod
(6) Plunger
(7) Oil pressure chamber
(8) Plunger spring
(9) Check ball
(10) Timing Belt
(11) Belt tension pulley
(12) Tensioner bracket
(13) Cylinder

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● Timing belt tensioning action

When the belt becomes slack, 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 certain level, pushes open the check ball and flows into the oil pressure chamber to keep the pressure constant. The thrust force F resulting from extension of the adjuster rod applies a counterclockwise torque to the tensioner bracket, which causes the belt tension pulley at its end to turn in the same direction. This applies tensioning pressure Pb to the timing belt.

● Timing belt tension balancing action

When the belt tension pulley is pushed against the timing belt with pressure Pb, reaction force Tb of the timing belt generates the reaction force P at the point on which the adjustor rod force is acting. This force P pushes the adjuster rod until it balances with the sum of the thrust force F and the pressure of the oil in the oil pressure chamber. Therefore, the timing belt tension is kept constant.

● Over-tension correction action

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

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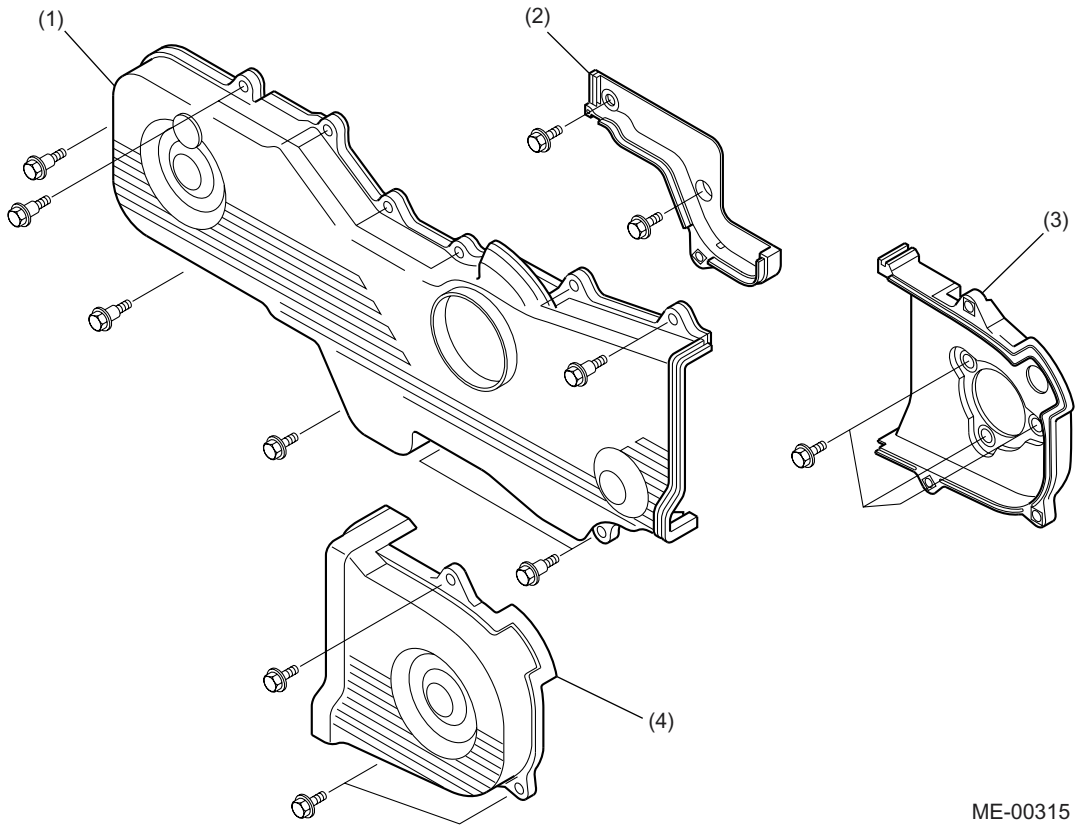
4. Belt Cover

● The belt cover is made of lightweight, heat resistant synthetic resin molding. It constitutes a totally enclosed housing with its cylinder block mating edges sealed with rubber gaskets. This effectively protects the inside components from dust and liquid.

● Rubber seals used between the cylinder block and the belt cover effectively reduces transmission of noise and vibration.

● The front belt cover has a line mark for ignition-timing checking.



ME-00315

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

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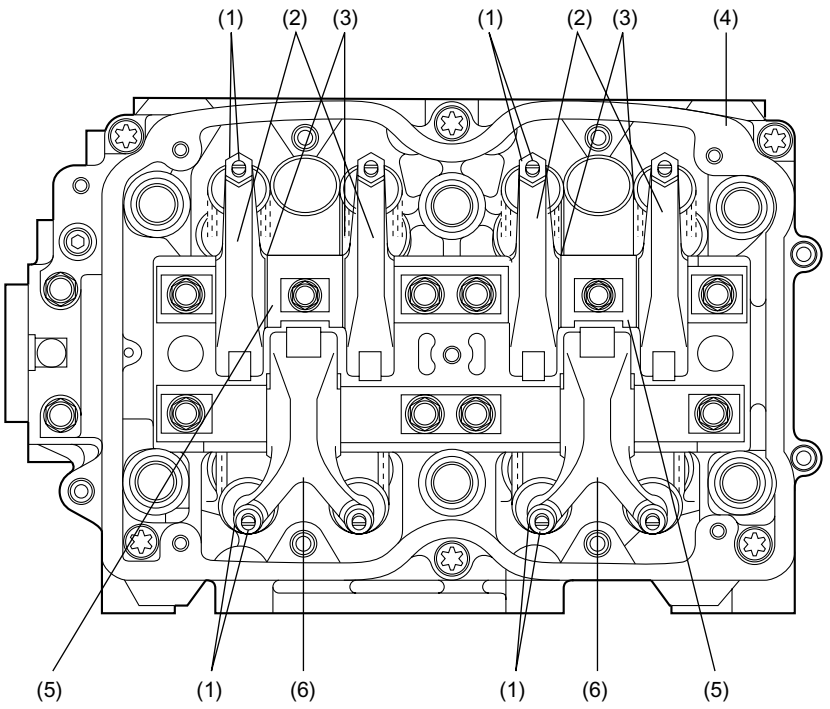
5. Valve Rocker Assembly

- The intake valve rocker arms and the exhaust valve rocker arms are installed on their own rocker shafts both of which are retained by the camshaft caps.
- The valve end of each rocker arm is provided with valve rocker adjusting screw and nut. Turning of this screw adjusts the valve clearance.
- The exhaust valve rocker arms are Y-shaped, and each arm operates two exhaust valves simultaneously.
- Each rocker shaft has an oil passage in it.



ME-00316

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

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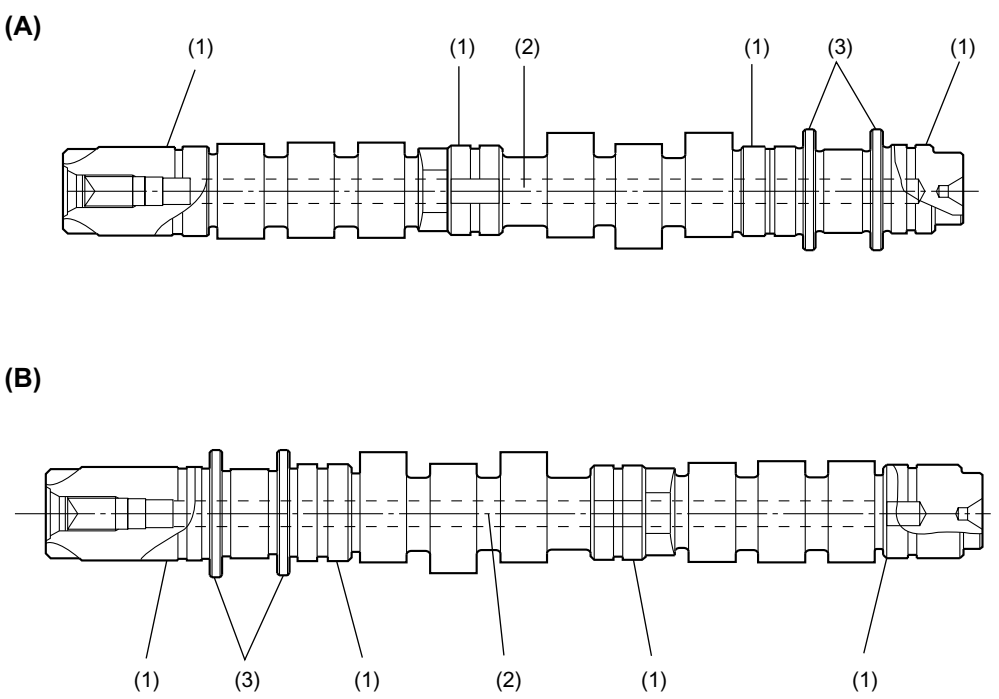
6. Camshaft

- The camshaft is supported inside the cylinder head at four journals.
- The two flanges on each camshaft supports thrust forces to limit the end play of the camshaft within the tolerance.
- Each camshaft has an oil passage in it.



(A) RH
(B) LH

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

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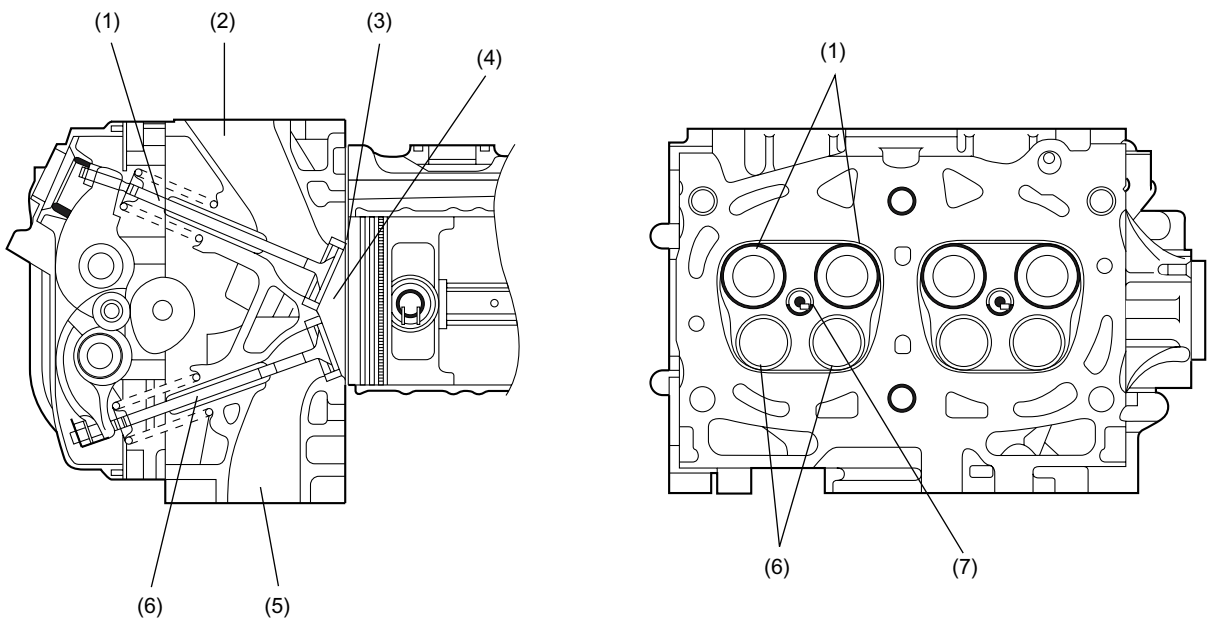
7. Cylinder Head

- The cylinder head is made of aluminum die casting.
- Each combustion chamber in the cylinder head is a compact, pentroof design. The spark plug is located at the center of the combustion chamber, which contributes to creation of a wide “squish area” for increased combustion efficiency.
- The two intake and two exhaust valves are arranged on opposite sides for a cross-flow feature.
- The cylinder head gasket is a metallic gasket. The gasket is highly resistant to heat and maintains high level of sealing performance for a long period.



ME-00318

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

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8. Cylinder Block

● The cylinder block is made of aluminum die casting. Its open-deck design provides it with such advantageous features as relatively small weight, high rigidity and excellent cooling efficiency.

● The cylinder liners are made of cast iron. They are dry type which means their outer surfaces are entirely in contact with the cylinder block.

● The cylinder block supports the crankshaft at its five journals. The journal supporting portions are designed such that sufficient stiffness and quiet operation are ensured.

● 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 left-cylinder bank. At the rear of the right-cylinder bank is an oil separator which removes oil mist contained in blow-by gas.

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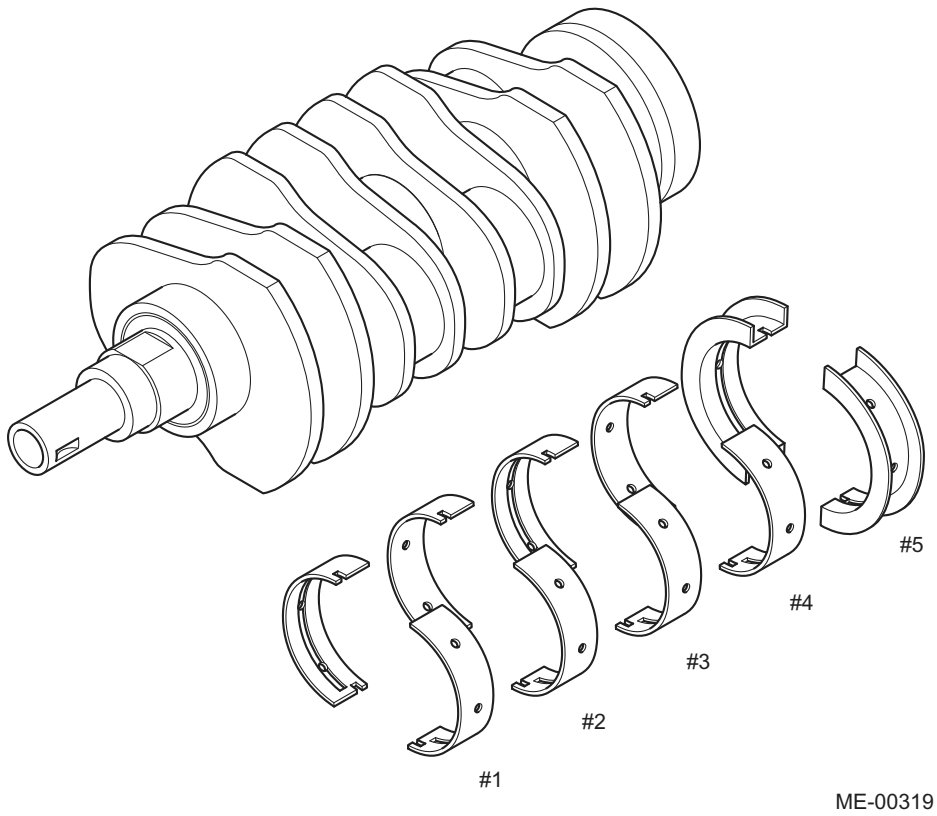
9. Crankshaft

The crankshaft is supported in the cylinder block by five bearings. Each corner formed by a journal or pin and a web is finished by fillet-rolling method which increases strength of that area. The five crankshaft bearings are made of aluminum alloy and the No. 5 bearing is provided with a flanged metal to support thrust forces.



ME-00319

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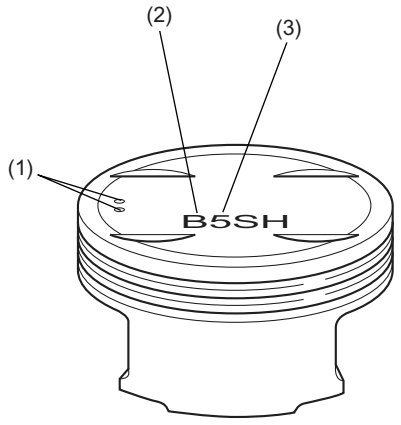
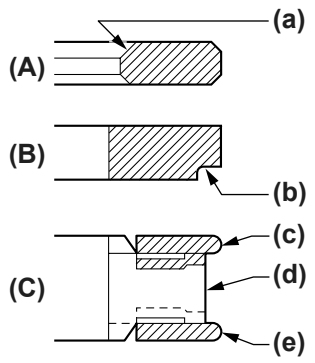
10.Piston

- The pistons are of a slipper skirt design for reduced weight and friction. The oil control ring groove utilizes a thermal design.
- The piston pin is offset either downward (Nos. 1 and 3 pistons) or upward (Nos. 2 and 4 pistons).
- The piston head has recesses to prevent interference with the intake and exhaust valves. It also has engraved marks to identify the piston size and the direction of installation. All the pistons are common in their design.
- Three piston rings are used for each piston — two compression rings and one oil control ring. The top piston ring has inner bevels and the second piston ring has an interrupt (cut) on the bottom outside to reduce oil consumption.





ME-00348

(1) Location mark (engine front side)
(2) Identification mark (piston size)
(3) Engine displacement

(A) Top ring
(B) Second ring
(C) Oil ring

(a) Inner-bevel
(b) Cut
(c) Upper rail
(d) Expander
(e) Lower rail

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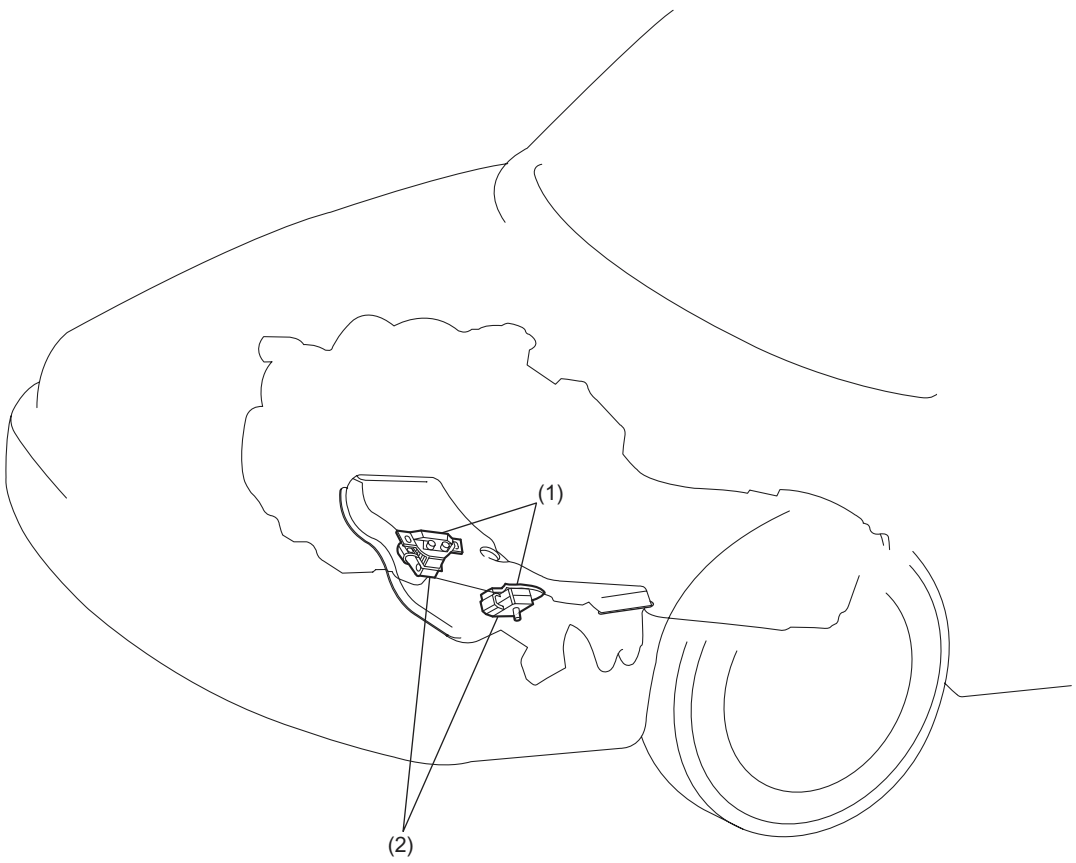
11.Engine Mounting



ME-00321

(1) Bracket
(2) Cushion rubber

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MECHANICAL
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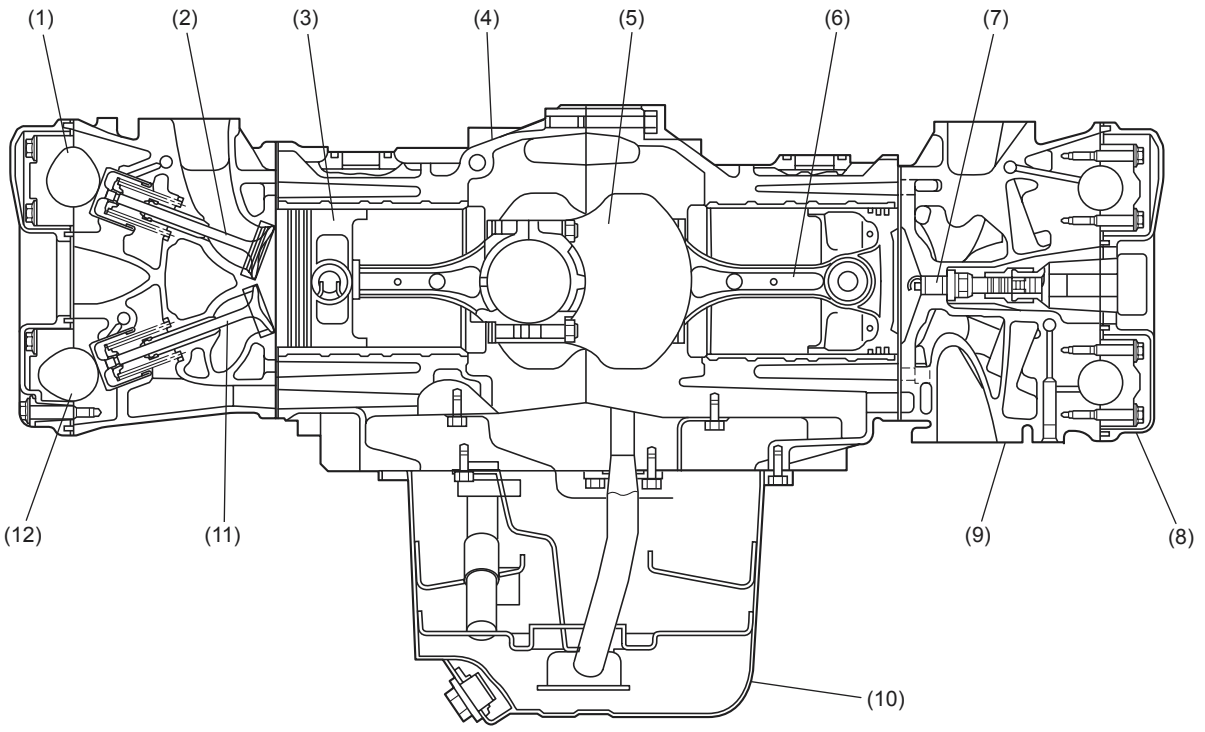
1. General

The engine used in this vehicle is of a horizontally opposed, four-cylinder design. This four-stroke-cycle, water-cooled, DOHC turbocharged engine uses a total of 16 valves and its main components are made of aluminum alloy. It is fueled by a multiple fuel injection system.

The engine's major structural and functional features are as follows:

- The cylinder head forms pentroof combustion chambers, each having a spark plug located at its center and two each of intake and exhaust valves (four valves per cylinder). The intake and exhaust ports are located in a cross-flow arrangement.
- A single timing belt drives four camshafts on the left and right banks and the engine coolant pump on the left bank. Belt tension is automatically adjusted by a belt tension adjuster, eliminating need for a manual adjustment.
- The crankshaft is supported by five bearings with high rigidity and strength.
- The cylinder block is an aluminum casting fitted with cast iron cylinder liners.



ME-00761

(1) Intake camshaft
(2) Intake valve
(3) Piston
(4) Cylinder block
(5) Crankshaft
(6) Connecting rod
(7) Spark plug
(8) Valve rocker cover
(9) Cylinder Head
(10) Oil pan
(11) Exhaust valve
(12) Exhaust camshaft

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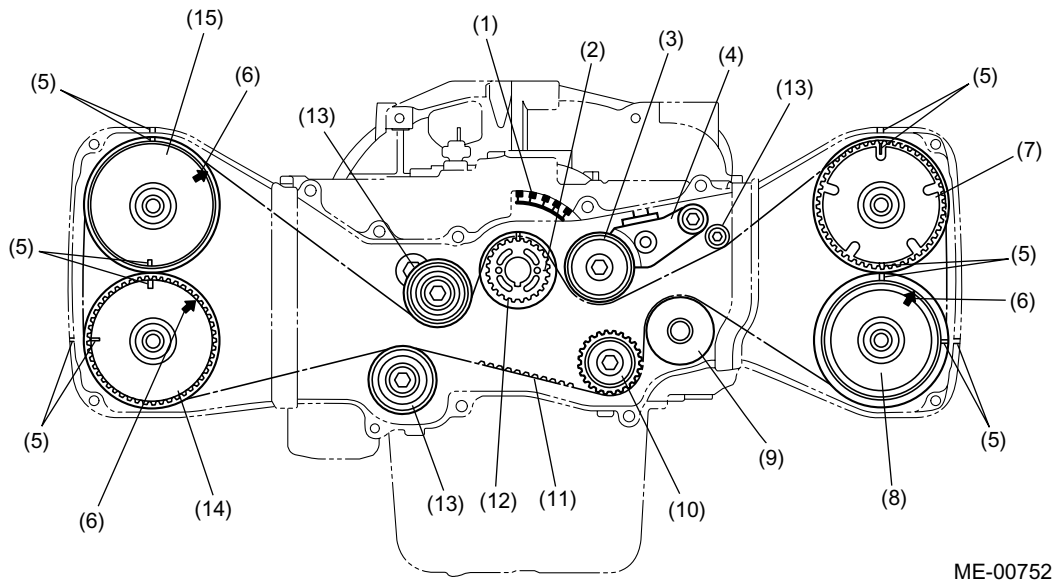
2. Timing Belt

● A single timing belt drives four camshafts (intake and exhaust camshafts on each bank). The belt also drives the water pump by its non-toothed side.
● The timing belt teeth have a specially designed round profile which contributes to quiet operation. The timing belt is made of strong and inflexible core cords, wear-resistant canvas and heat-resistant rubber material.
● A hydraulic automatic belt tension adjuster always keeps the belt taut to the specified tension. Any manual belt tension adjustment is unnecessary.



ME-00752

(1) Timing indicator (for timing mark of crankshaft pulley)
(2) *Piston position mark
(3) Belt tension pulley
(4) Automatic belt tension adjuster assembly
(5) Alignment mark
(6) **Piston position mark
(7) Intake camshaft sprocket LH
(8) Exhaust camshaft sprocket LH
(9) Water pump pulley
(10) Idler No. 2
(11) Timing belt
(12) Crankshaft sprocket
(13) Idler
(14) Exhaust camshaft sprocket RH
(15) Intake camshaft sprocket RH

NOTE:
*: The #1 piston is set at the top dead center (TDC) when the piston-position mark on the crankshaft sprocket is aligned with the mark on cylinder block.
**: The #1 piston is set at TDC on the compression stroke when the piston-position mark on the camshaft sprocket is facing directly upward.

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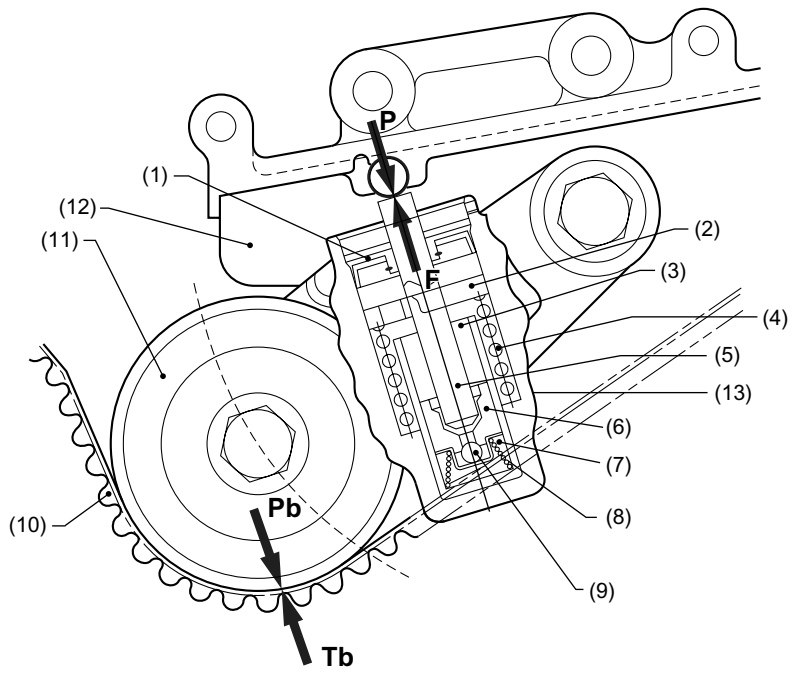
3. Automatic Belt Tension Adjuster

The automatic belt tension adjuster consists of a tensioner unit and a bracket. It maintains the timing belt tension automatically at a specified level to enable the belt to transmit power correctly, reduce operating noise and increase the life of the belt.
The cylinder of the tensioner unit incorporates an adjuster rod, wear ring, plunger spring, return spring, check ball and silicone oil.
The automatic belt tension adjuster gives tension to the belt by a levering action which is produced by the push force of the tensioner unit's adjuster rod. It operates in the process detailed below.



ME-00314

(1) Oil seal
(2) Wear ring
(3) Oil reservoir chamber
(4) Return spring
(5) Adjuster rod
(6) Plunger
(7) Oil pressure chamber
(8) Plunger spring
(9) Check ball
(10) Timing belt
(11) Belt tension pulley
(12) Tensioner bracket
(13) Cylinder

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● Timing belt tensioning action

When the belt becomes slack, 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 certain level, pushes open the check ball and flows into the oil pressure chamber to keep the pressure constant.
The thrust force F resulting from extension of the adjuster rod applies a counterclockwise torque to the tensioner bracket, which causes the belt tension pulley at its end to turn in the same direction. This applies tensioning pressure Pb to the timing belt.

● Timing belt tension balancing action

When the belt tension pulley is pushed against the timing belt with pressure Pb, reaction force Tb of the timing belt generates the reaction force P at the point on which the adjustor rod force is acting. This force P pushes the adjuster rod until it balances with the sum of the thrust force F and the pressure of the oil in the oil pressure chamber. Therefore, the timing belt tension is kept constant.

● Over-tension correction action

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

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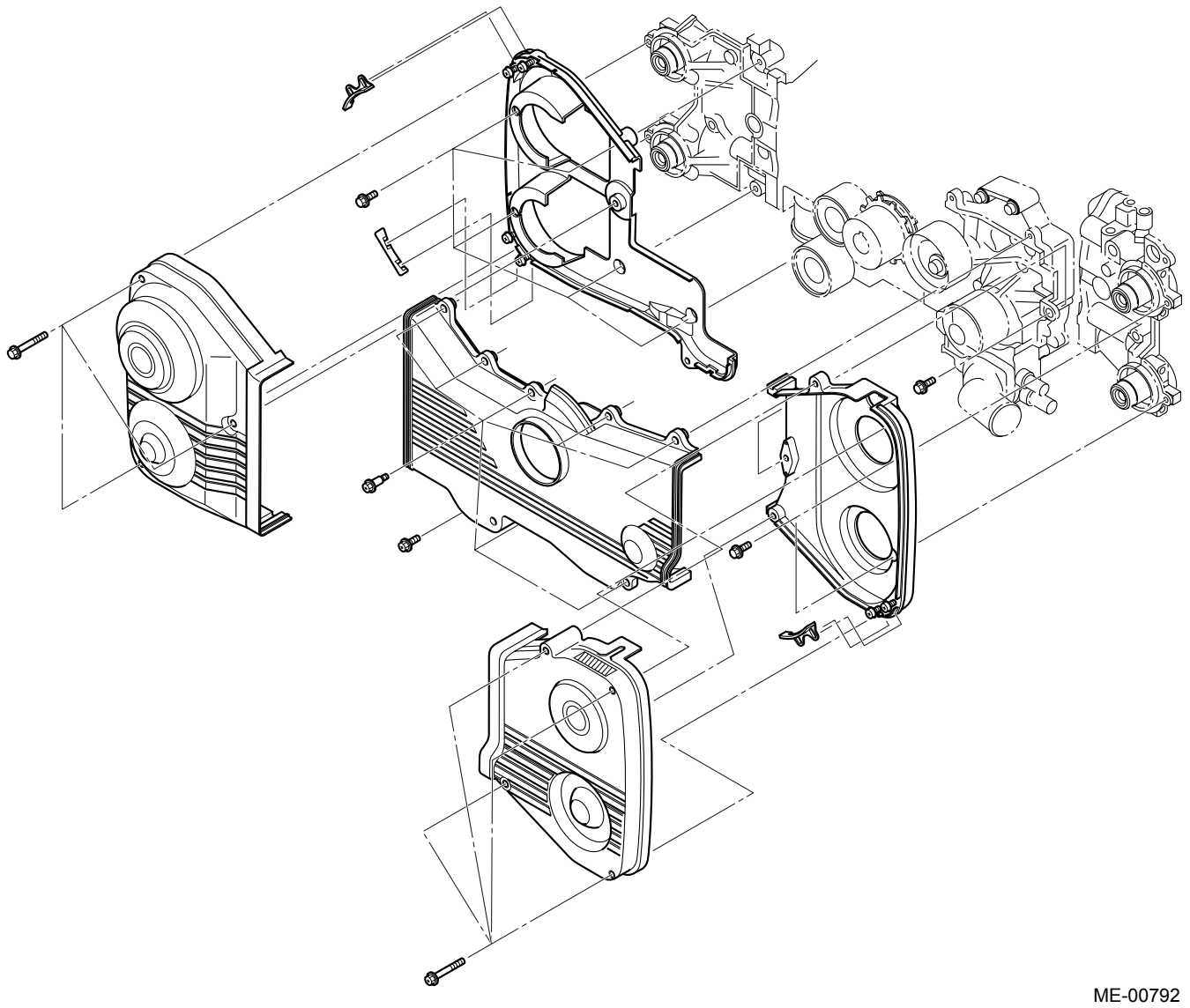
4. Belt Cover

- The belt cover is made of lightweight, heat resistant synthetic resin molding. It constitutes a totally enclosed housing with its cylinder block mating edges sealed with rubber gaskets. This effectively protects the inside components from dust and liquid.
- Rubber seals used between the cylinder block and the belt cover effectively reduces transmission of noise and vibration.
- The front belt cover has a line mark for ignition-timing checking.



ME-00792

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5. Camshaft

The DOHC engine uses four camshafts in all; intake and exhaust camshafts on each of the right and left banks.

The camshafts are of a composite material type using sintered steel for cam lobes and carbon steel for pipe part.

The sintered steel cams are very high in the resistance to wear, which enables the cam lift to be increased. In addition, use of the sintered steel cams contributes to reduction in weight.

Each camshaft is supported at its three journals and held in position by three camshaft caps. Each camshaft has a flange which fits in the corresponding groove in the cylinder head to receive thrust forces generated in the camshaft.

With the engines for the STi models, each intake camshaft has slots at the rear end for the variable valve timing position sensor.

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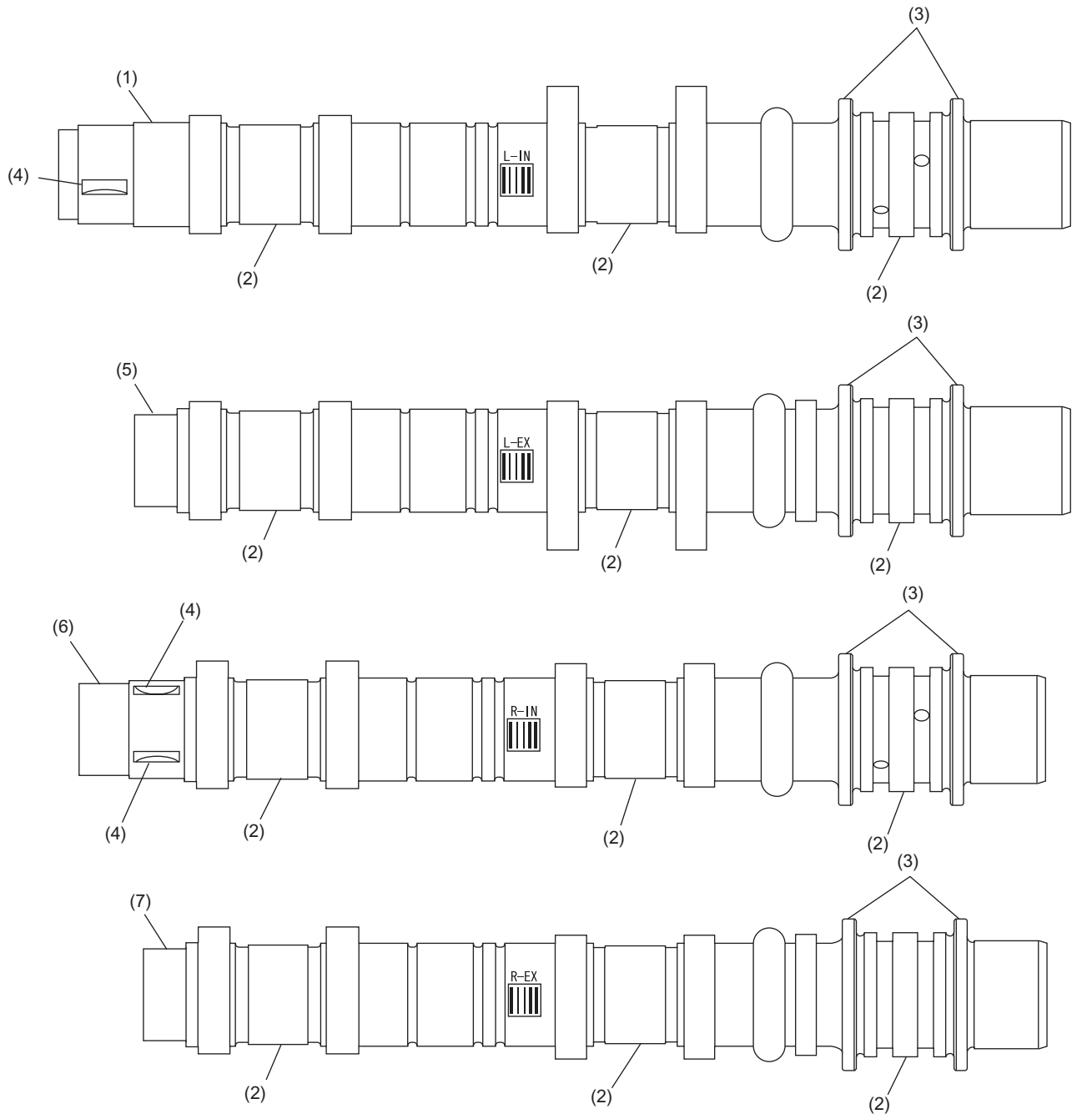

ME-00790

(1) Intake camshaft LH
(2) Journal
(3) Flange
(4) Slots for variable timing position sensor
(5) Exhaust camshaft LH
(6) Intake camshaft RH
(7) Exhaust camshaft RH

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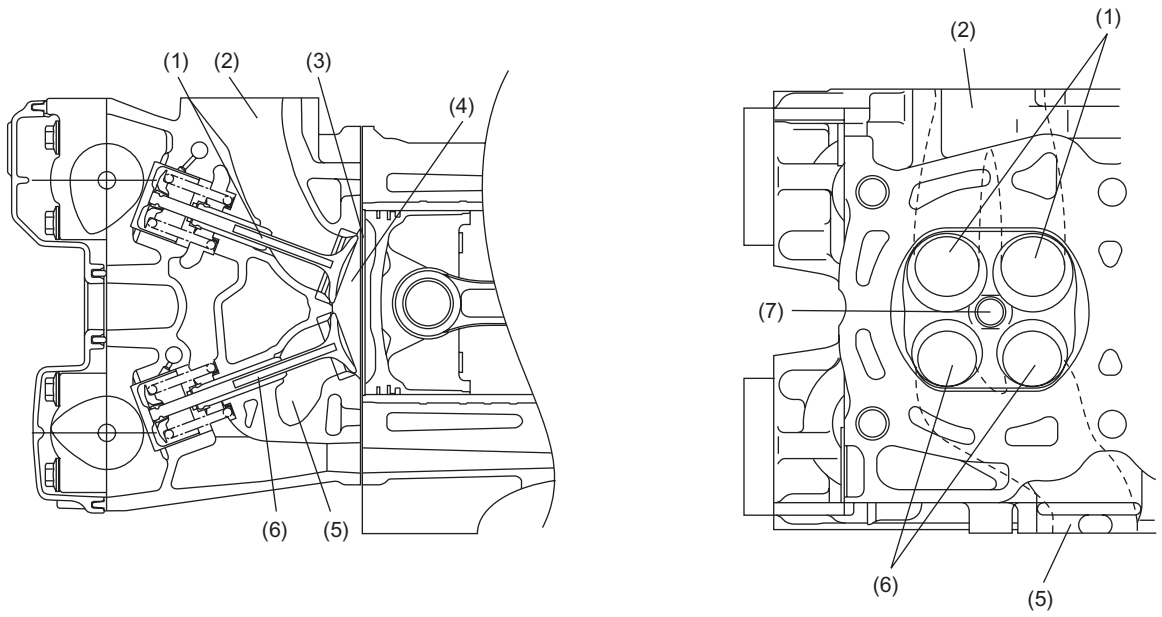
6. Cylinder Head

- The cylinder head is made of aluminum casting.
- Each combustion chamber in the cylinder head is a compact, pentroof design. The spark plug is located at the center of the combustion chamber, which contributes to creation of a wide “squish area” for increased combustion efficiency.
- The two intake and two exhaust valves are arranged on opposite sides for a cross-flow feature.
- The cylinder head gasket is a metallic gasket consisting of three layers of the stainless steel sheets. The gasket is highly resistant to heat and maintains high level of sealing performance for a long period.



ME-00793

(1) Intake valve (hollow type)
(2) Intake port
(3) Squish area
(4) Combustion chamber
(5) Exhaust port
(6) Exhaust valve (sodium-filled)
(7) Spark plug

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7. Cylinder Block

● With the engine for the STi model that generates increased torque outputs, the cylinder block uses a semi-closed deck design which can hold the cylinder liners with higher rigidity.

● The cylinder liners are made of cast iron. They are dry type which means their outer surfaces are entirely in contact with the cylinder block.

● The cylinder block supports the crankshaft at its five journals. The journal supporting portions are designed such that sufficient stiffness and quiet operation are ensured.

● Sintered material is fit in the casting at the #5 journal to achieve further quietness.

● 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 left-cylinder bank. At the rear of the right-cylinder bank is an oil separator which removes oil mist contained in blow-by gas.

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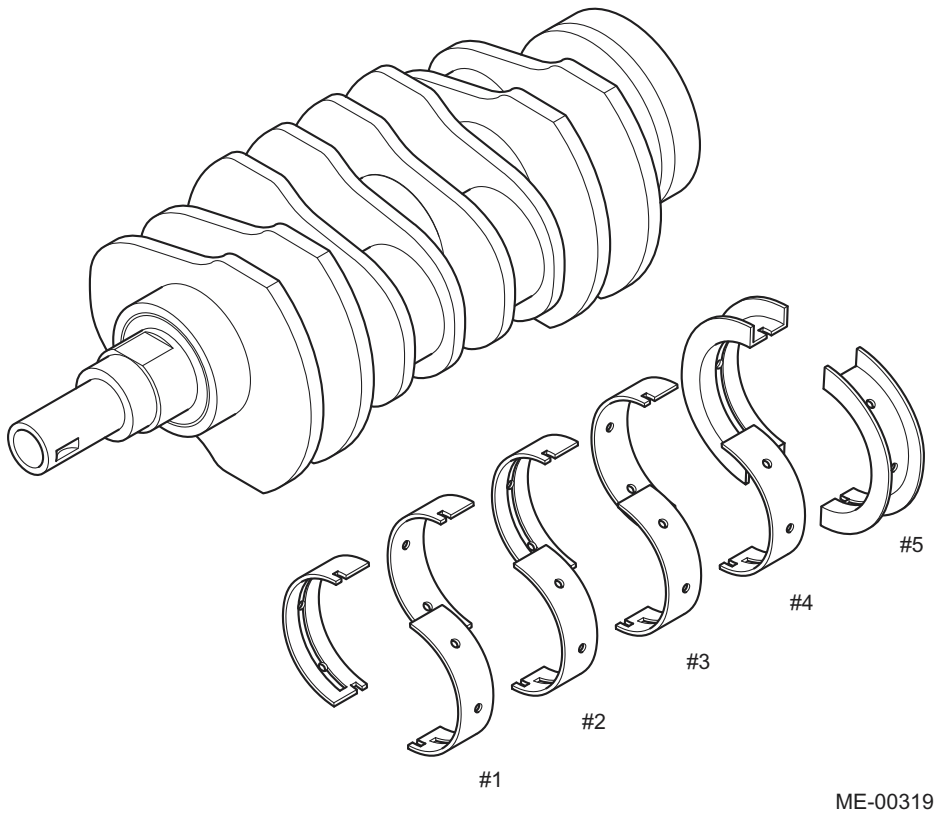
8. Crankshaft

The crankshaft is supported in the cylinder block by five bearings. Each corner formed by a journal or pin and a web is finished by fillet-rolling method which increases strength of that area. The five crankshaft bearings are made of aluminum alloy and the No. 5 bearing is provided with a flanged metal to support thrust forces.



ME-00319

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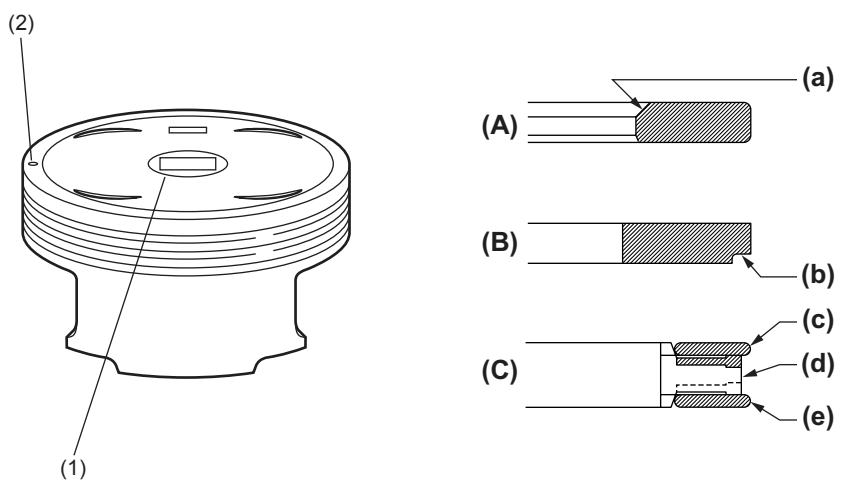
9. Piston

● The pistons are of a slipper skirt design for reduced weight and friction. The oil control ring groove utilizes a thermal design.

● The piston pin is offset either downward (Nos. 1 and 3 pistons) or upward (Nos. 2 and 4 pistons).

● The piston head has recesses to prevent interference with the intake and exhaust valves. It also has engraved marks to identify the piston size and the direction of installation. All the pistons are common in their design.

● Three piston rings are used for each piston — two compression rings and one oil control ring.The top piston ring has inner bevels and the second piston ring has a cut on the bottom outside to reduce oil consumption.



ME-00791

(1) Identification mark
(2) Location mark (engine front side)

(A) Top ring
(B) Second ring
(C) Oil ring

(a) Inner-bevel
(b) Cut
(c) Upper rail
(d) Spacer
(e) Lower rail

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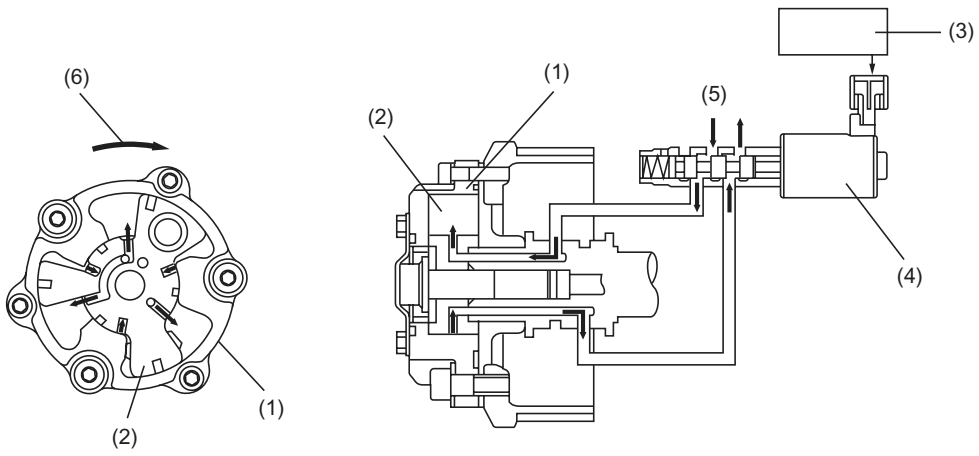
10.Variable Valve Timing System

This engine has a variable valve timing system, which adjusts the opening and closing timings of the intake valves optimally by continuously changing the phase angle of the camshaft sprocket relative to the camshaft.

- The ECM determines the optimal cam angle relative to the crank angle by making reference to the engine speed, vehicle speed, throttle opening and other relevant parameters.
- Under the control of the ECM, the oil flow control valve moves its spool to switch the hydraulic passage to/from the advance and retard chambers that are formed in the camshaft sprocket to change continuously the phase angle between the camshaft sprocket and camshaft.

A: PHASE ANGLE ADVANCES

In response to an advance signal from the ECM, the oil flow control valve moves its spool such that hydraulic pressure is applied to the advance chamber in the camshaft sprocket. The sprocket is then turned in the direction in which its phase angle advances relative to the camshaft.



ME-00747

(1) Variable valve timing controller (attached to camshaft sprocket)
(2) Vane (attached to intake camshaft)
(3) ECM
(4) Oil flow control valve
(5) Oil pressure
(6) Turns in advance direction

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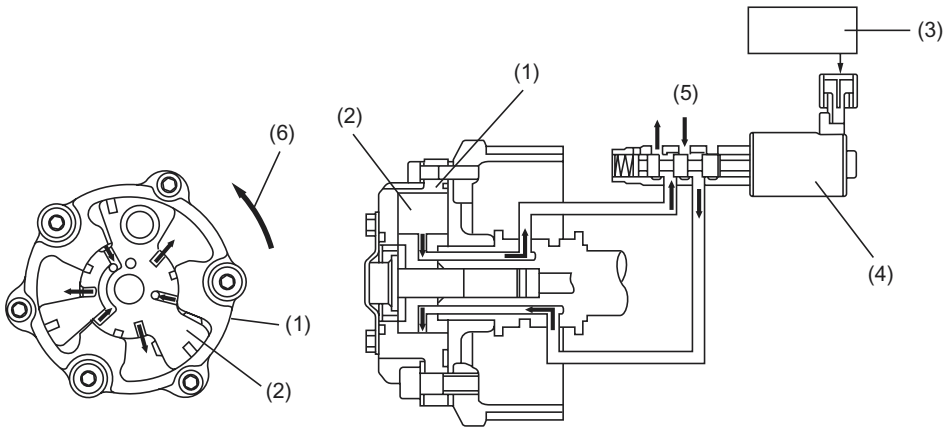
B: PHASE ANGLE RETARDS

In response to a retard signal from the ECM, the oil flow control valve moves its spool such that hydraulic pressure is applied to the retard chamber in the camshaft sprocket. The sprocket is then turned in the direction in which its phase angle retards relative to the camshaft.



ME-00748

(1) Variable valve timing controller (attached to camshaft sprocket)
(2) Vane (attached to intake camshaft)
(3) ECM
(4) Oil flow control valve
(5) Oil pressure
(6) Turns in retard direction

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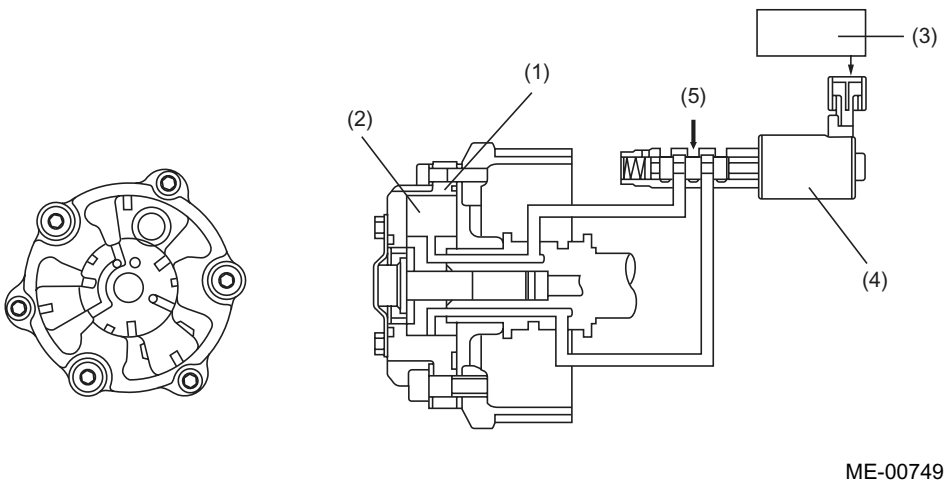
C: A CERTAIN PHASE ANGLE IS RETAINED

When the ECM issues a signal to keep the phase angle unchanged, the oil flow control valve moves its spool to the position at which the hydraulic pressures to/from both the chambers are blocked. The pressures in the chambers are thus maintained, so the phase angle does not change and the intake valves' opening and closing timings also remain unchanged.



ME-00749

(1) Variable valve timing controller (attached to camshaft sprocket)
(2) Vane (attached to intake camshaft)
(3) ECM
(4) Oil flow control valve
(5) Oil pressure

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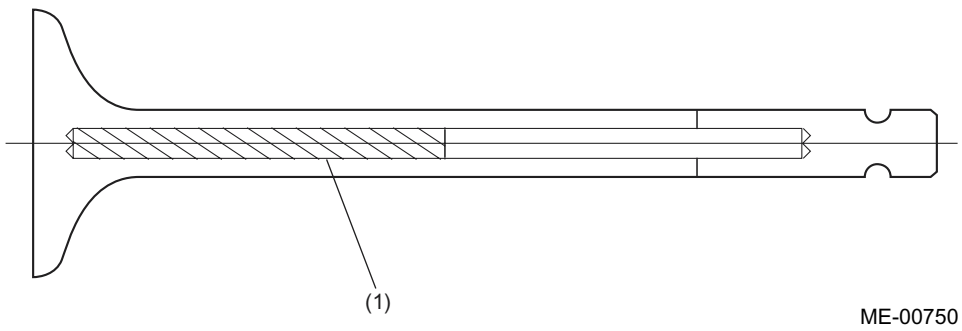
11.Sodium-filled Exhaust Valves

Each exhaust valve contains pure sodium in its hollow stem. Sodium has high thermal conductivity. The entrapped sodium will liquefy at high temperatures and move inside the stem as the valve is operated. Thus the sodium will effectively transfer heat from the valve head to the valve stem, contributing to cooling down the valve head faster.



ME-00750

(1) Pure sodium

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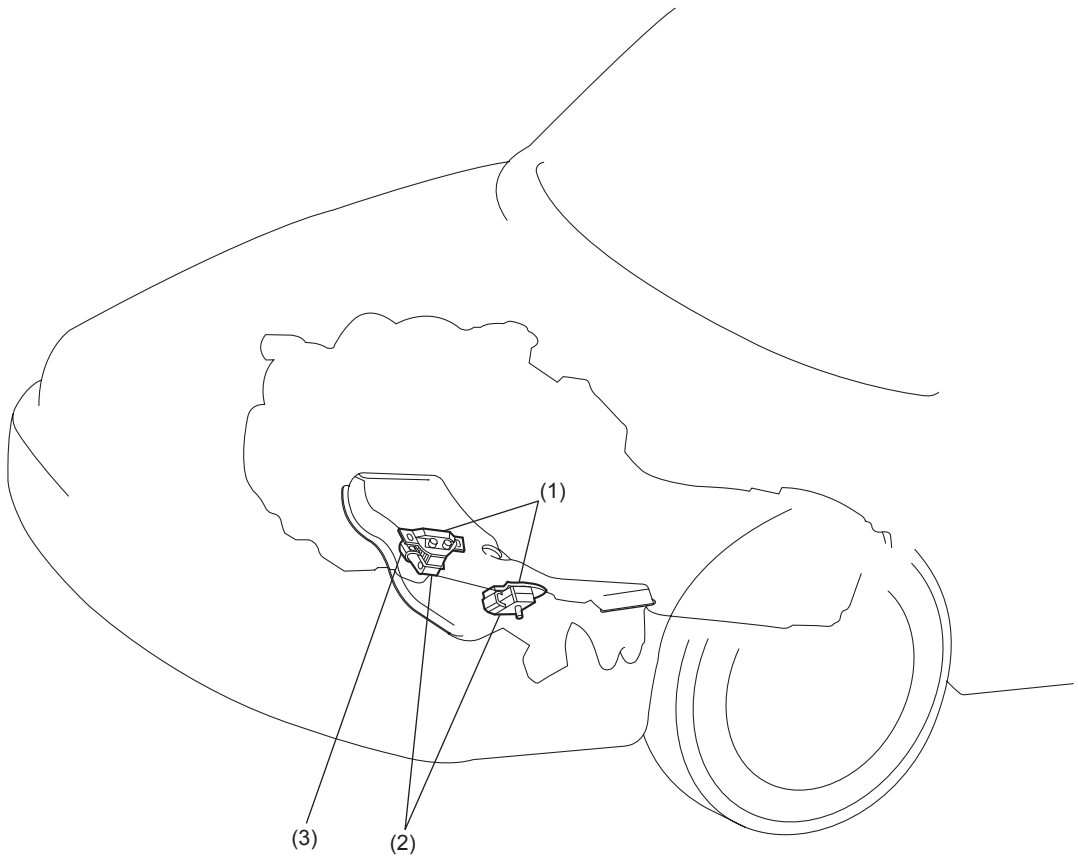
12.Engine Mounting



ME-00797

(1) Bracket
(2) Cushion rubber
(3) Heat shield cover (RH side only)

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PARKING BRAKE

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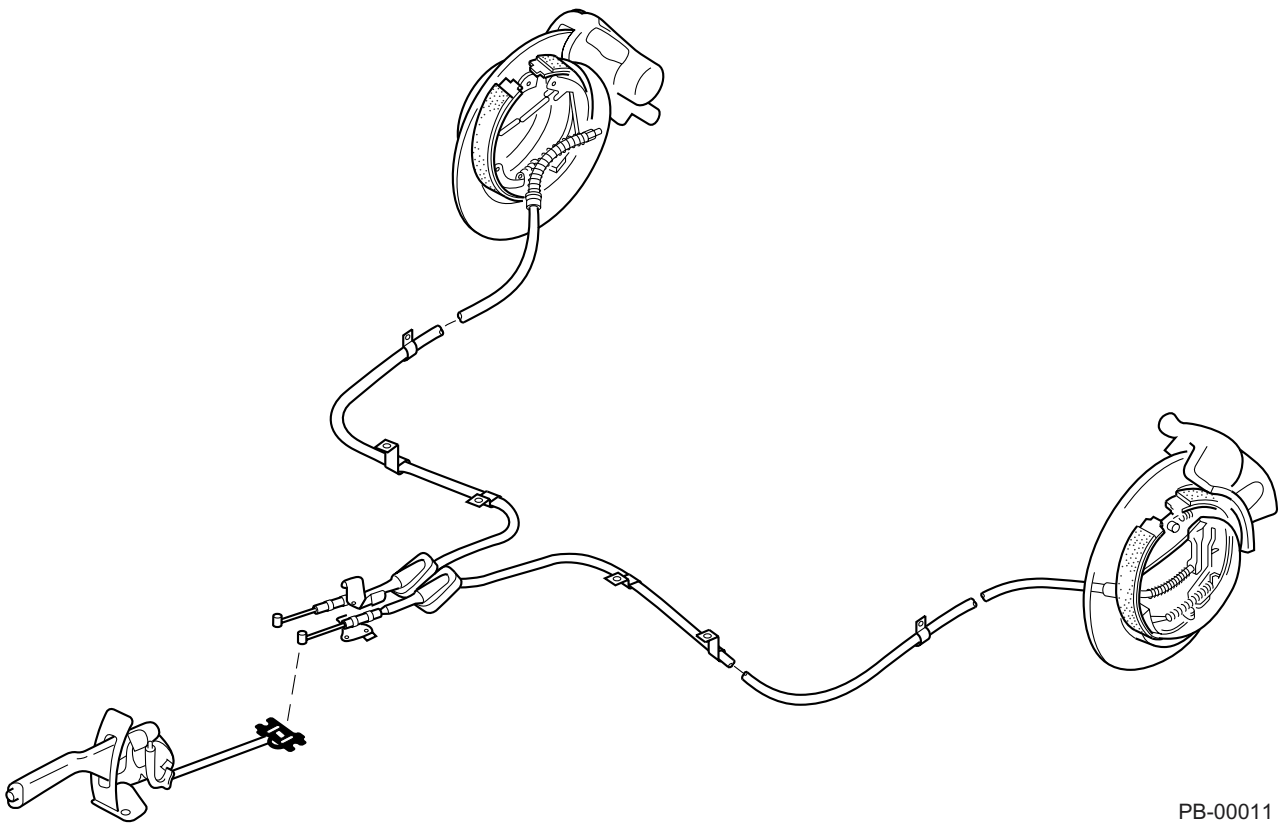
1. Parking Brake

The parking brakes are applied by manually operating the lever to mechanically control the rear wheels through a cable.
Each rear disc brake rotor contains a drum brake mechanism which is used exclusively for the parking brake.



PB-00011

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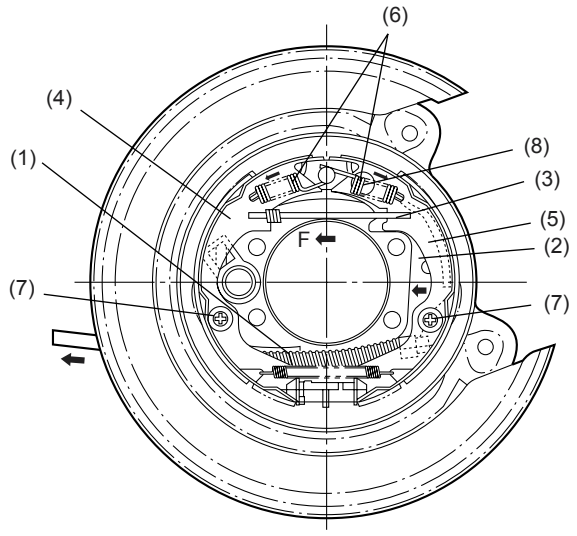
PARKING BRAKE

A: OPERATION

1. SETTING

When the parking brake lever is pulled, the shoe actuating lever to which the end of the parking brake cable is connected turns the strut in direction “F” around point “P”.

The strut then presses the brake shoes A and B against the drum. These brake shoes utilize a floating design and are movably supported by hold-down pins. The force applied to brake shoe A and the reaction force “F” applied to the brake shoe B via point “P” press them against the brake drum.



PB-00012

(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) Point “P”

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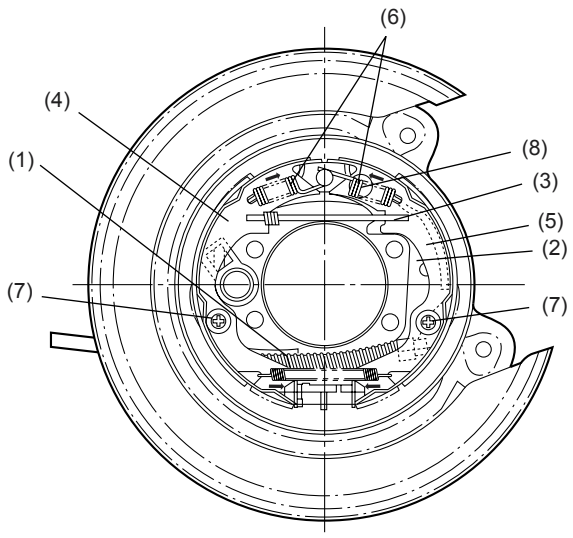
PARKING BRAKE

2. RELEASING

When the parking brake lever is returned to the release position and the parking brake cables are slackened, the brake shoes A and B are moved back to their original positions by the tension of return springs, so that the parking brake is released.



PB-00018

(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) Point “P”

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POWER ASSISTED SYSTEM (POWER STEERING)

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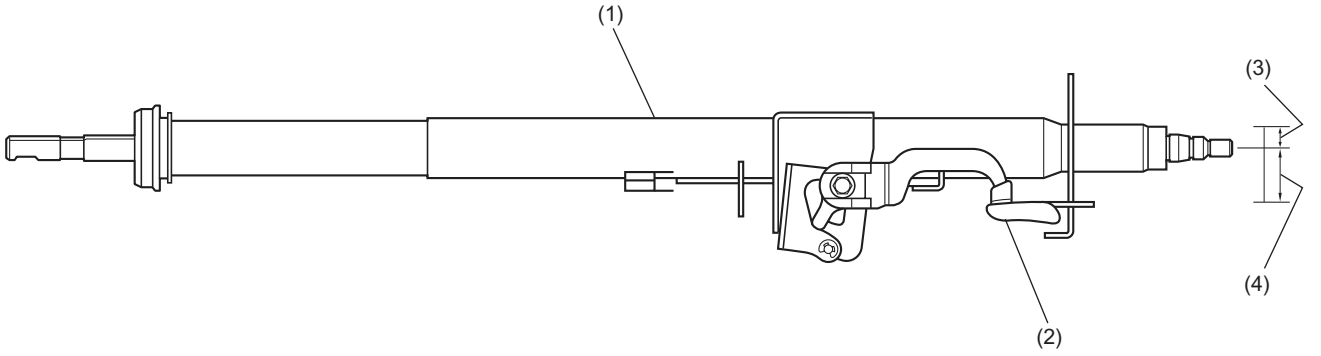
1. Tilt Steering Column

A: TILT MECHANISM

● The steering wheel vertical position can be adjusted within a 50 mm (1.97 in) range by using the tilt lever to unlock the steering column and lock it again at the desired position.



PS-00435

(1) Tilt steering column
(2) Tilt lever
(3) 10 mm (0.39 in)
(4) 40 mm (1.58 in)

B: ENERGY-ABSORBING MECHANISM

● To absorb the backward movement energy generated in the engine compartment in the event of a frontal collision, a press-fitted pipes type steering column jacket has been adopted.
When an impact load exceeding a certain level is applied to the steering column, jacket A slides on jacket B.
Since jacket B is press-fitted in jacket A, friction generated between them absorbs the impact.
The column bending load is supported by the press-fitted jackets.

● Another measure to alleviate impact on the driver in the event of a collision is the wire which is located between the tilt pin and the distance plate attached to the steering support beam. When a large impact load is applied to the steering column, the wire is deformed progressively. The impact energy is absorbed during this process.

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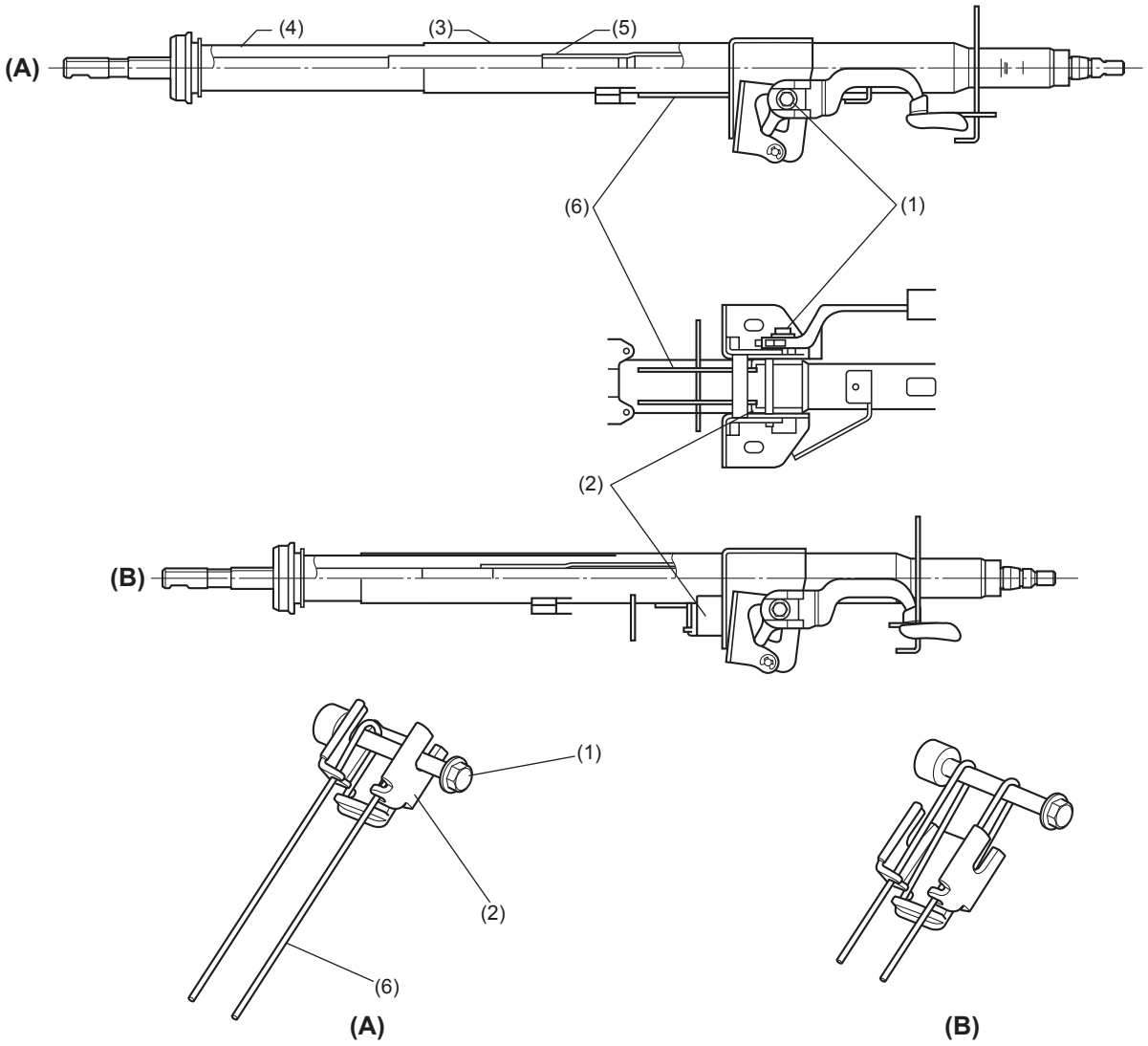

PS-00438

(A) Before absorption of impact energy
(B) After absorption of impact energy

(1) Tilt pin
(2) Distance plate
(3) Jacket A
(4) Jacket B
(5) Shaft
(6) Wire

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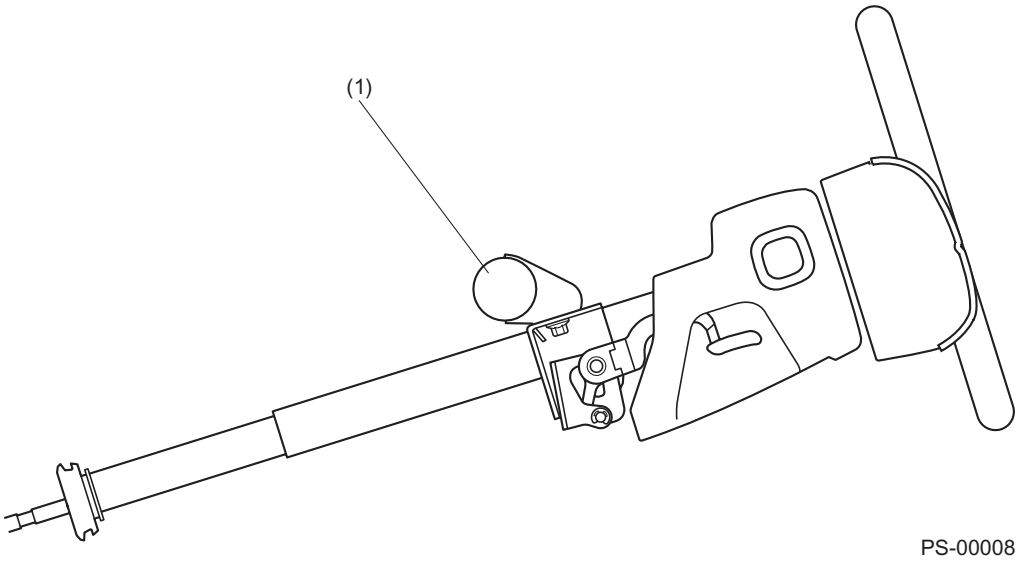
C: STEERING SUPPORT BEAM

● The steering column is held in position by a support beam which is installed crosswise in the vehicle body at a level close to the steering wheel to reduce the overhang distance of the steering wheel from the supporting point of the column. The steering shaft upper bearing is also located close to the steering wheel to increase supporting efficiency as well as to minimize vibration of the steering wheel.



(1) Steering support beam

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2. Power Steering System

A: HYDRAULIC SYSTEM

- The fluid pump is directly driven by the engine through a belt.
- The fluid flow is maintained almost constant regardless of change in the engine speed by the function of the flow control valve. The flow-regulated fluid is delivered to the control valve through hose A.
- When the steering wheel is turned, the rotary control valve connected to the pinion shaft opens the hydraulic circuit corresponding to the direction in which the steering wheel is turned. The fluid then flows into chamber A or B via pipe A or B.
- The fluid pressure in chamber A or B acts on the rack piston in the same direction as that in which the rack shaft is moved by rotation of the steering wheel. This helps reduce the effort required of the driver to operate the steering wheel.
- Movement of the rack piston causes the fluid in the other chamber to return to the reservoir tank via pipe A or B, control valve, and hose B.
  - As the steering shaft is connected to the pinion shaft mechanically via the rotary control valve, the steering system can operate as a manual system even if the hydraulic system becomes inoperative.
  - To control the maximum fluid pressure, a relief valve is built into the fluid pump to prevent build-up of an excessive fluid pressure.

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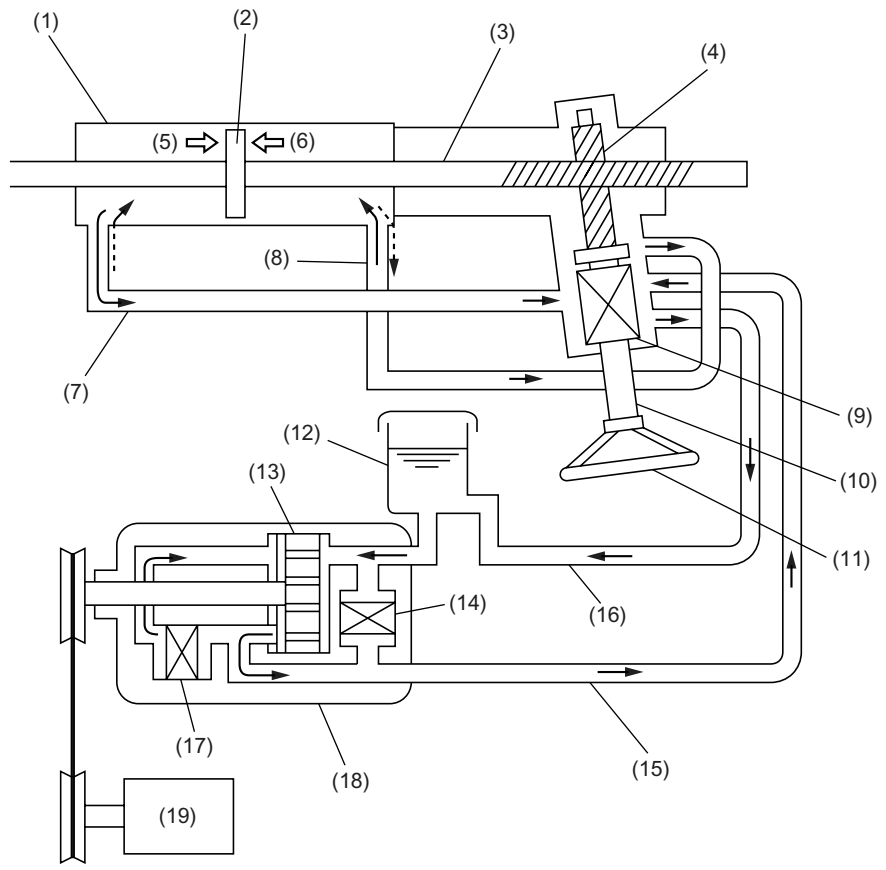
POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)



PS-00191

(1) Power cylinder
(2) Rack piston
(3) Rack shaft
(4) Pinion shaft
(5) Chamber A
(6) Chamber B
(7) Pipe A
(8) Pipe B
(9) Control valve
(10) Steering shaft
(11) Steering wheel
(12) Tank
(13) Vane pump
(14) Relief valve
(15) Hose A
(16) Hose B
(17) Pump control valve
(18) Fluid pump
(19) Engine

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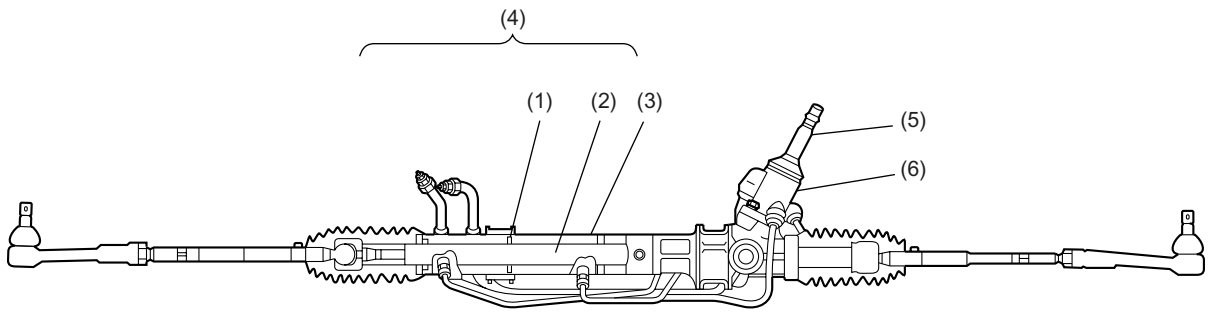
B: GEARBOX ASSEMBLY

1. POWER CYLINDER

The gearbox integrates the control valve and power cylinder into a single unit. The rack shaft serves as a power cylinder piston. The rotary control valve is located around the pinion shaft.

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



PS-00192

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

2. ROTARY CONTROL VALVE

The rotary 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). The rotor and sleeve have grooves C and D, respectively, which form fluid passages V_1 through V_4.

The pinion is in mesh with the rotor with adequate clearance, which enable the rack to be moved manually by rotating the steering shaft (fail-safe feature).

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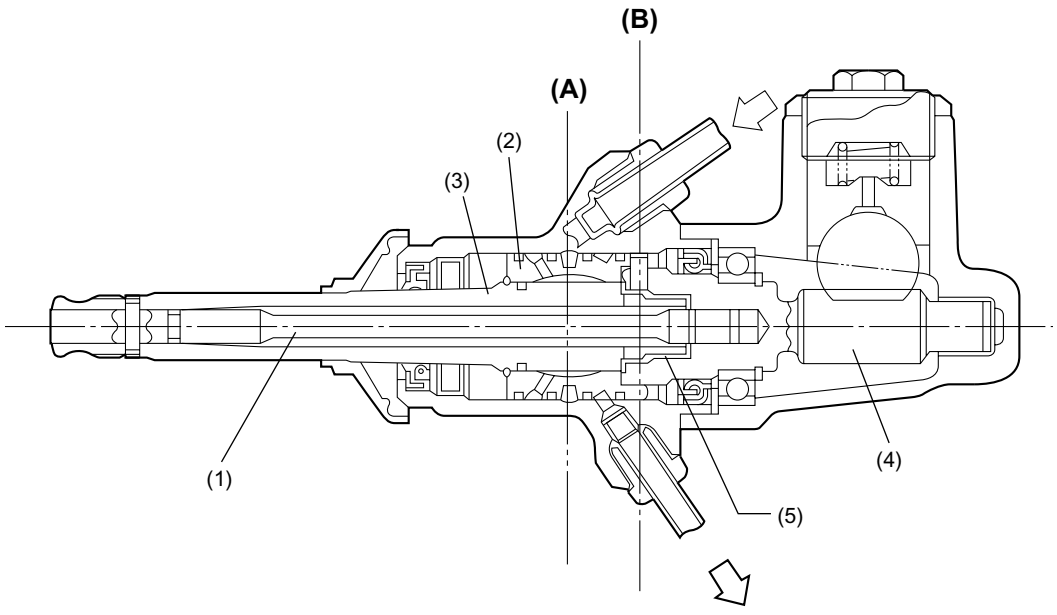
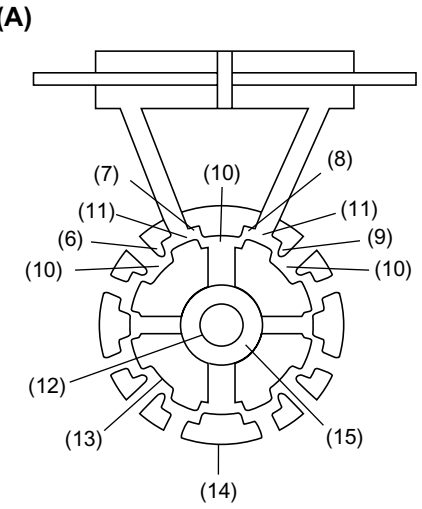
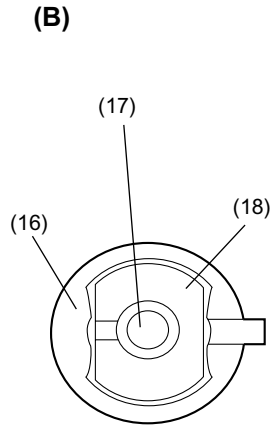
POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)







PS-00011

(1) Torsion bar
(2) Sleeve
(3) Rotor
(4) Pinion
(5) Pinion-to-rotor engagement (fail-safe feature)
(6) Fluid passage V_1
(7) Fluid passage V_2
(8) Fluid passage V_3
(9) Fluid passage V_4
(10) Groove C
(11) Groove D
(12) Torsion bar
(13) Rotor
(14) Sleeve
(15) Fluid return line (to reservoir tank)
(16) Pinion
(17) Torsion bar
(18) Rotor

(A) Cross-sectional view A (fluid passage switching circuit)
(B) Cross-sectional view B (pinion-to-rotor engagement)

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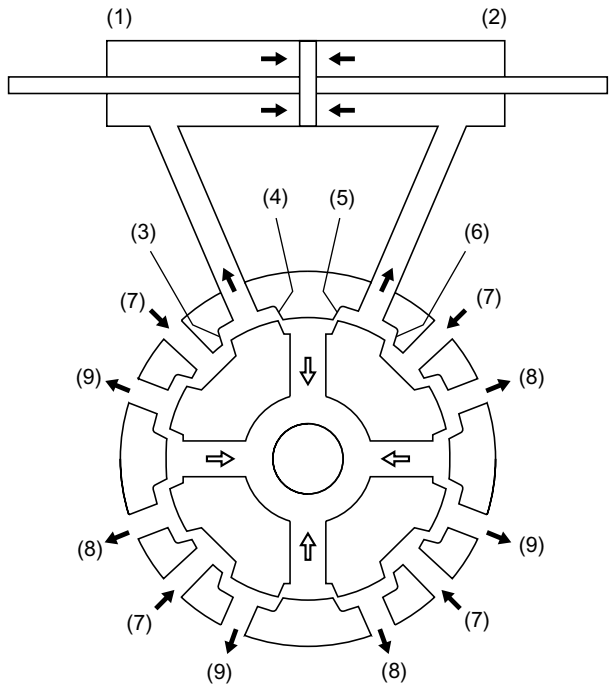
- Principle of operation

When the torsion bar is twisted by a rotational force applied to the steering wheel, the relative position between the rotor and sleeve changes. This changes the cross-sectional area of fluid passages V_1, V_2, V_3 and V_4. The fluid passages are thus switched and the fluid pressure is controlled in accordance with the operation of the steering wheel.

- When no steering force is applied:
  The rotor and sleeve are held at the neutral position. Fluid passages V_1, V_2, V_3 and V_4, which are formed by grooves C and D are open equally. Under this condition, the fluid from the pump returns to the reservoir tank so that neither fluid pressure builds up nor the rack piston moves in the power cylinder.



PS-00012

(1) Chamber A
(2) Chamber B
(3) V_1
(4) V_2
(5) V_3
(6) V_4
(7) From fluid pump
(8) To A
(9) To B

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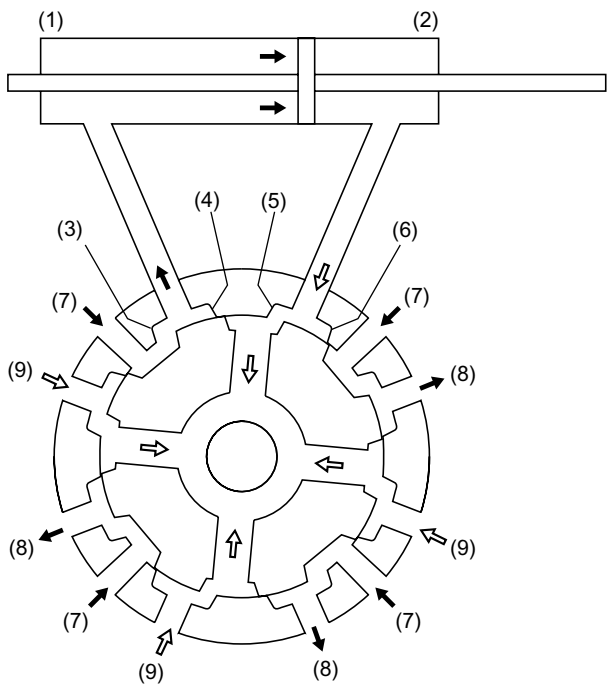
- When steering force is applied:

When the steering wheel is turned to the right, for example, fluid passages V_1 and V_3 are opened while fluid passages V_2 and V_4 are nearly closed.
At this point, the fluid pressure in chamber A of the power cylinder increases depending on the degree of closure of fluid passages V_2 and V_4 so that the rack piston moves to the right. The fluid in chamber B, on the other hand, is drained through fluid passage V_3 into the reservoir tank.



PS-00013

(1) Chamber A
(2) Chamber B
(3) V_1
(4) V_2
(5) V_3
(6) V_4
(7) From fluid pump
(8) To A
(9) From B

- Fail-safe function

If fluid pressure fails to build up due to, for example, a broken fluid pump drive belt, the steering wheel rotating torque is transmitted from the valve rotor to the pinion through mechanical engagement between them.

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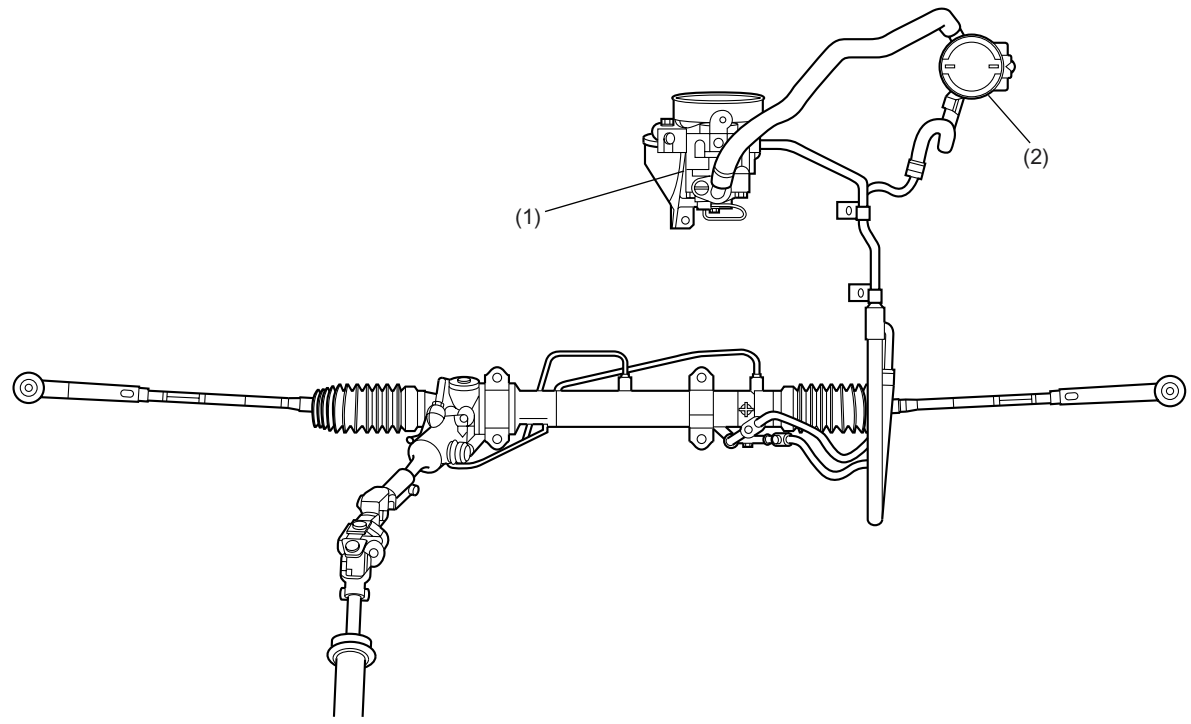
C: FLUID PUMP AND RESERVOIR TANK

The fluid pump is a vane type driven by the engine via belt.

The reservoir tank is mounted on the vehicle body.

The fluid pump incorporates the flow control valve and relief valve, each performing the following functions:

- The flow control valve regulates the flow rate of discharged fluid to a constant level irrespective of the engine speed.
- The relief valve protects the system from an excessively high pressure which may occur, for example, when the steering wheel is turned all the way.



PS-00014

(1) Fluid pump
(2) Reservoir tank

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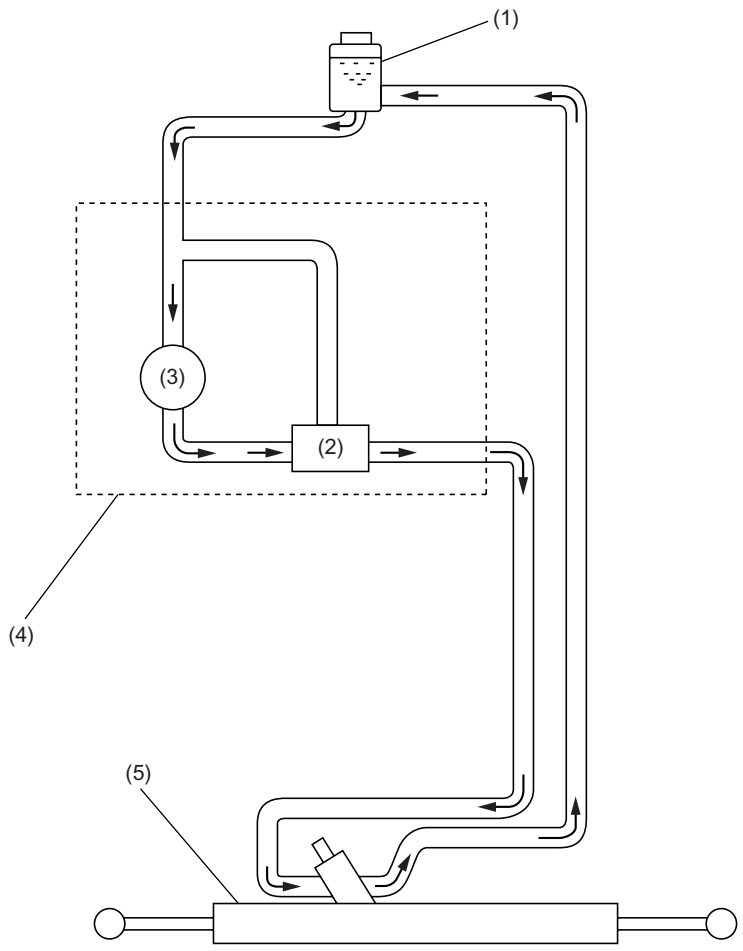
POWER STEERING SYSTEM

POWER ASSISTED SYSTEM (POWER STEERING)



PS-00015

(1) Reservoir tank
(2) Flow control and relief valve assembly
(3) Vane pump
(4) Fluid pump assembly
(5) Steering gearbox

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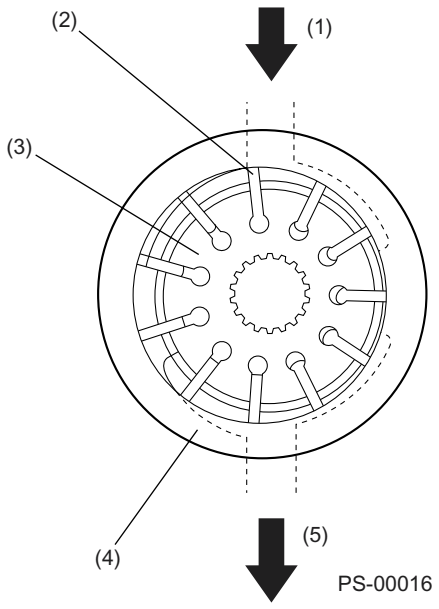
● The fluid pump is belt-driven by the engine. The fluid flow is controlled according to the engine speed so that an adequate steering resistance is given during high-speed operation.
The fluid pump is a variable capacity type vane pump whose delivery rate per rotation decreases as the engine speed increases. The pump is integral with a pump control valve and relief valve.

● The vane pump consists of a rotor, a cam ring, and eleven vanes.
When the rotor rotates, the vane in each slot of the rotor is radially moved out by centrifugal force and pressed against the cam ring. The fluid from the suction port is confined in chambers formed between two adjacent vanes and carried to the discharge port. Since the cam ring is movable in relation to the rotor, the volume of each chamber is variable. This enables the delivery rate per rotation of the pump to be changed.



(1) Suction
(2) Vane
(3) Rotor
(4) Cam ring
(5) Discharge

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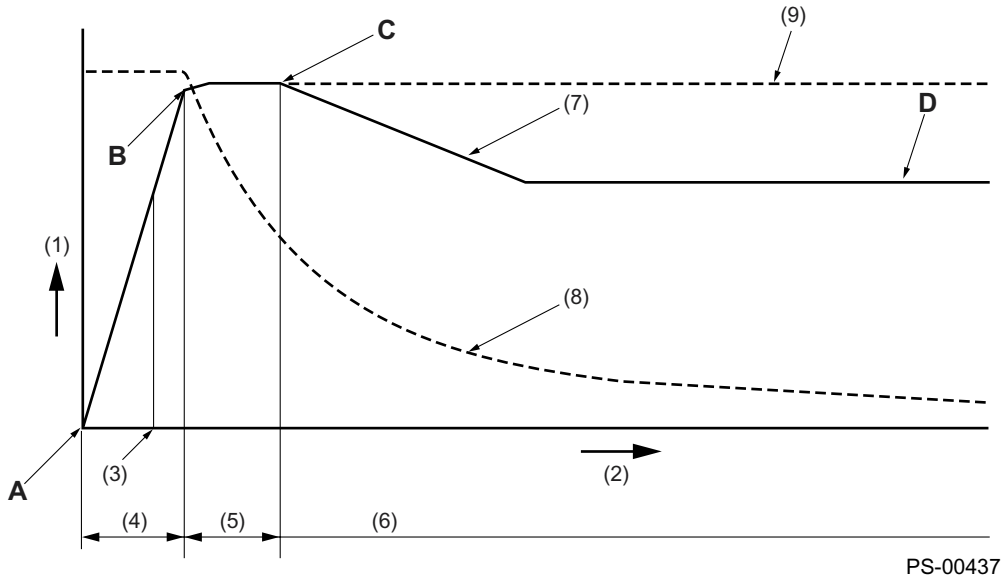
● **Flow control**

The variable capacity pump changes its delivery rate per rotation by changing the degree of eccentricity of the cam ring according to its rotating speed (engine speed).
On turbo models, a constant flow as shown with the broken line in the drawing below is maintained.



PS-00437

(1) Fluid flow
(2) Pump speed
(3) Idling
(4) Low-speed
(5) Mid-speed
(6) High-speed
(7) Delivery rate per unit time
(8) Delivery rate per rotation of pump
(9) Turbo models

NOTE:
In the following description, pump speed ranges will be indicated using the speed points A through D shown in the drawing above.

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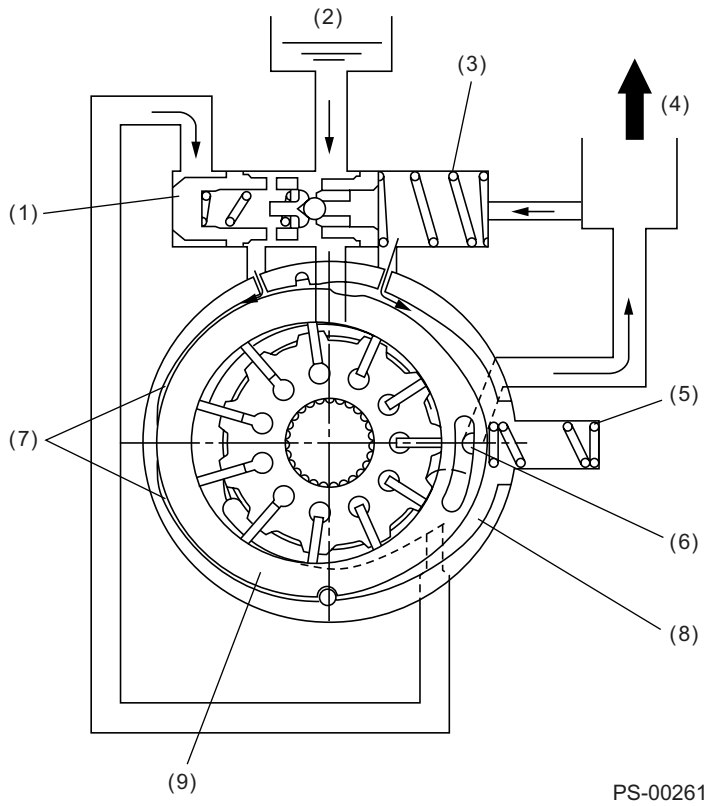
Low-range-speed operation (A — B range)

In this speed range, as well as in all the other speed ranges, two different pump discharge pressures are always applied to the control valve; one is directly led from the discharge port to the left end of the valve and the other is led through an orifice (variable orifice) to the right end of the valve. Since the orifice has a pressure reducing effect, the latter pressure is lower than the former.

When the pump is operating at a low speed, its discharge pressure is also low, resulting in only small difference between the two pressures. In this condition, the valve stays pushed leftward by the spring, allowing the non-pressurized tank fluid to enter chamber A. To chamber B, on the other hand, the orifice-reduced discharge pressure is applied, so the cam ring is pushed leftward by the cam ring spring. This makes the eccentricity of the cam ring a maximum and, therefore, the delivery rate per rotation of the pump become a maximum.



PS-00261

(1) Control valve
(2) Reservoir tank fluid
(3) Control valve spring
(4) Gear box
(5) Cam ring spring
(6) Variable orifice
(7) Pressure chamber A
(8) Pressure chamber B
(9) Cam ring

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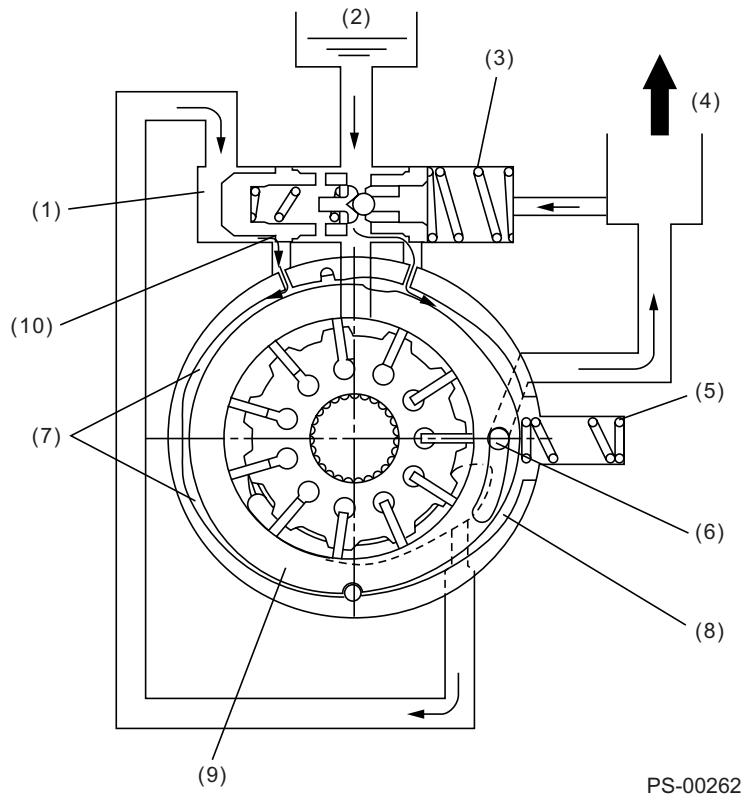
Mid- to high-range-speed operation (B — D range)

During mid-range speed operation, the pump increases its delivery rate. Since the pressure before passing through the variable orifice increases, the control valve moves rightward, overcoming the tension of the control valve spring. This movement of the control valve allows the pressure upstream of the variable orifice to be directed to chamber A after being adjusted to a necessary pressure* by the port opening area created by the control valve. On the other hand, chamber B receives the reservoir pressure (suction pressure). This means that the pressure in chamber A is higher than that in chamber B. As a result, the cam ring moves rightward against the tension of the cam spring. This causes the delivery rate per rotation of the pump to be reduced, so that the flow rate of the fluid to the steering gear box decreases accordingly.

The above control is performed when the pump is operating at a speed in the B - D range.

* The "necessary pressure" for chamber A is a pressure required to move the cam ring to the position corresponding to each predetermined flow rate (pump delivery rate). The pressure is obtained by changing the port opening area appropriately through displacement of the control valve. The displacement of the control valve is determined by how much the pressure before the variable orifice is different from that after the orifice.



PS-00262

(1) Control valve
(2) Reservoir tank fluid
(3) Control valve spring
(4) Gear box
(5) Cam ring spring
(6) Variable orifice
(7) Pressure chamber A
(8) Pressure chamber B
(9) Cam ring
(10) Opening

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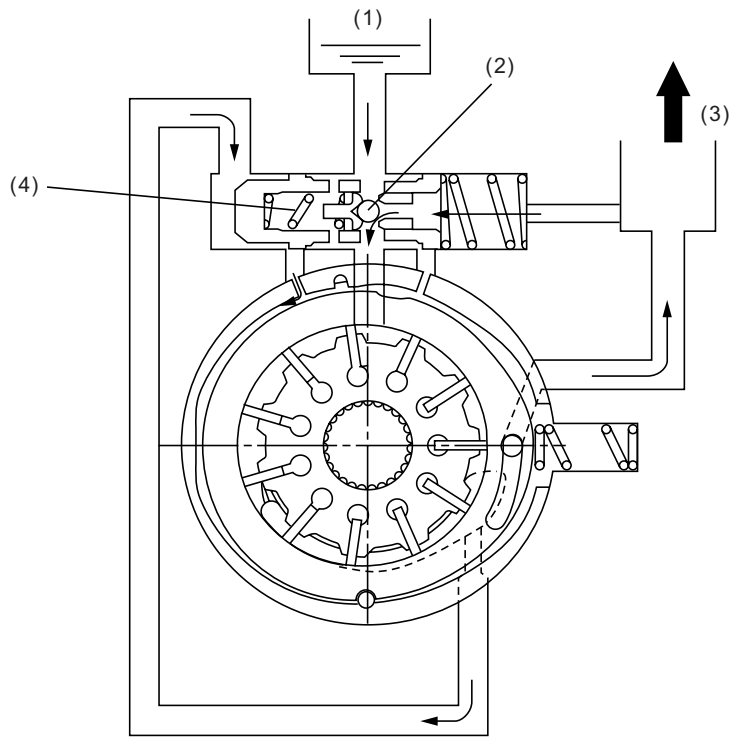
Maximum pressure control

When the overall delivery rate of the pump exceeds a preset value, the relief valve opens to allow part of the discharged fluid to flow toward the suction side of the pump, thereby controlling the maximum pressure.



PS-00263

(1) Reservoir tank fluid
(2) Relief valve
(3) Gear box
(4) Relief spring

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REAR SUSPENSION

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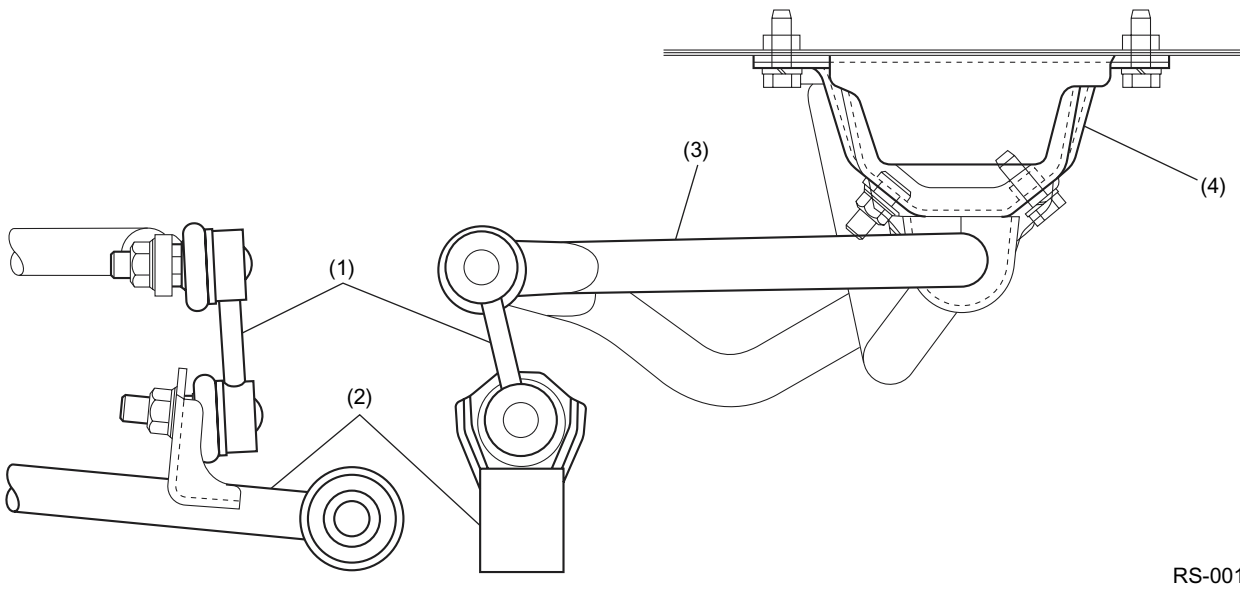
1. Rear Suspension

A: GENERAL

The rear suspension is an independent, dual link strut type. The suspension on each side consists of two parallel arranged lateral links, a trailing link, and a strut assembly. The strut assembly consists of a cylindrical double-acting low pressure gas and oil-filled damper and coil spring.

The respective component parts of this suspension are optimally designed to act in response to vertical, lateral and longitudinal loads transmitted from the tires. Thus, riding comfort and steering stability are substantially enhanced.

- Longitudinal loads act on each trailing link.
- Vertical loads act on each coil spring, strut and rubber mount.
- Lateral loads act on the two lateral links on each side.
- The crossmember is installed on the body frame via bushings.
- The stabilizer that extends to the rear of the crossmember, is installed on the body frame via a bracket and to the wheel side end of each rear lateral link via a stabilizer link.
- On the STi model, the stabilizer link has been changed from a resin made part to a ball joint type.



RS-00106

(1) Stabilizer link
(2) Rear lateral link
(3) Stabilizer
(4) Bracket

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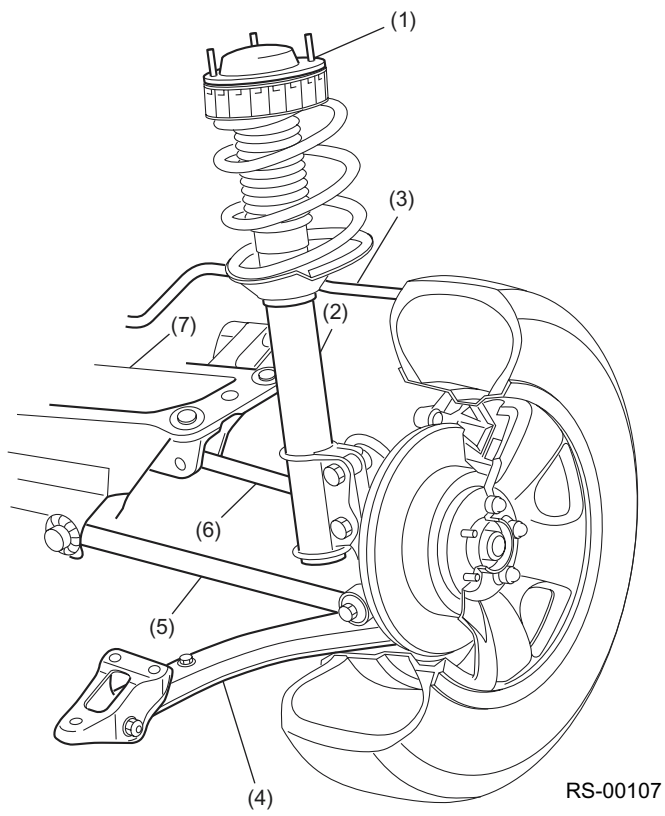
REAR SUSPENSION



(1) Strut mount
(2) Strut
(3) Stabilizer
(4) Trailing link
(5) Front lateral link
(6) Rear lateral link
(7) Rear crossmember

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B: CONSTRUCTION

1. LATERAL LINKS

● All the sedans have longer lateral links than wagons for enhanced handling stability. This contributes to increased tread.

● Unsprung weight has been made smaller than the previous model by using a pair of steel-pipe lateral links. They improve ride quality and reduce vibration and noise.

2. STRUTS

● The dampers used in the struts are of a gas-filled type that features stable shock attenuating performance. They improve ride quality and reduce vibration and noise.

● Each strut has at its top a new type strut mount. The strut mounts effectively disperse input forces from coil springs so that vibration and noise are reduced and riding comfort is improved. The body attaching flange of each strut mount is adequately rigid, which helps improve handling stability.

● The helper made of highly durable urethane enhances handling stability when the vehicle is loaded. It also satisfies riding comfort and anti-roll rigidity requirements simultaneously.

● On the STi model, upside-down type struts with its shock absorber's top and bottom ends reversed are used. This arrangement is advantageous in increasing rigidity as it allows the diameter of the damping tube (which corresponds to the piston rod in the conventional arrangement) to be increased to an almost same diameter as the strut's outer tube diameter.

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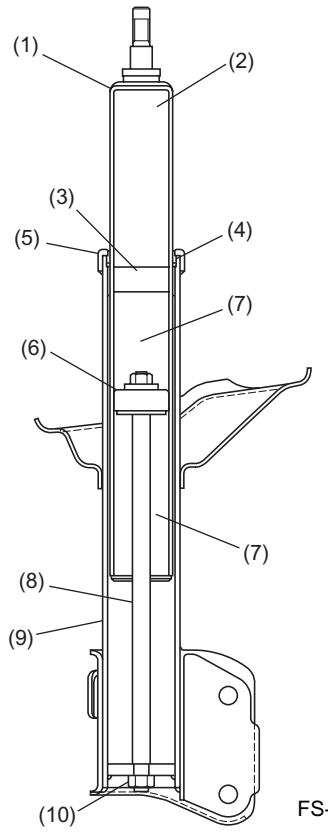
REAR SUSPENSION



FS-00101

(1) Damping tube
(2) Gas
(3) Free piston
(4) Oil seal
(5) Cap
(6) Piston
(7) Oil
(8) Piston rod
(9) Outer tube
(10) Nut

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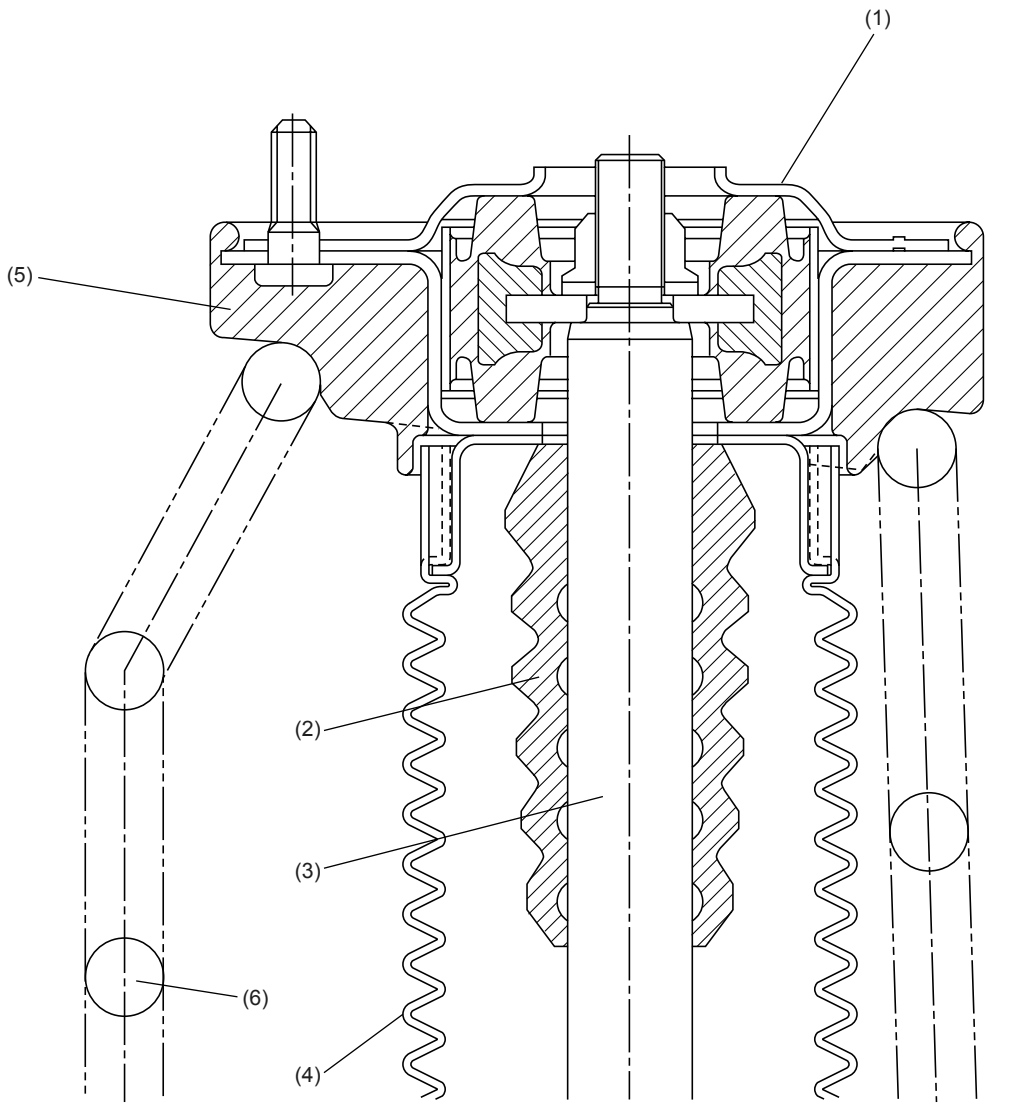
REAR SUSPENSION



RS-00108

(1) Strut mount
(2) Helper
(3) Damper strut
(4) Dust cover
(5) Rubber seat
(6) Coil spring

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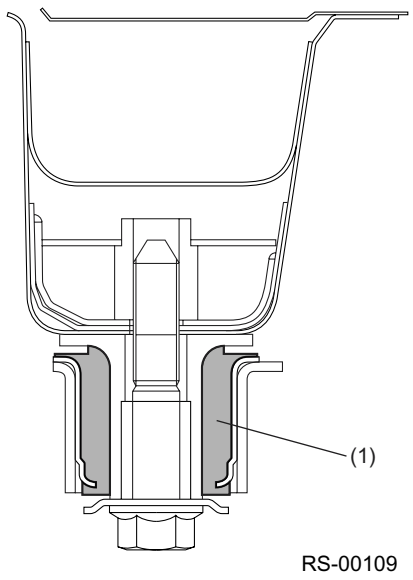
3. REAR CROSSMEMBER BUSHING

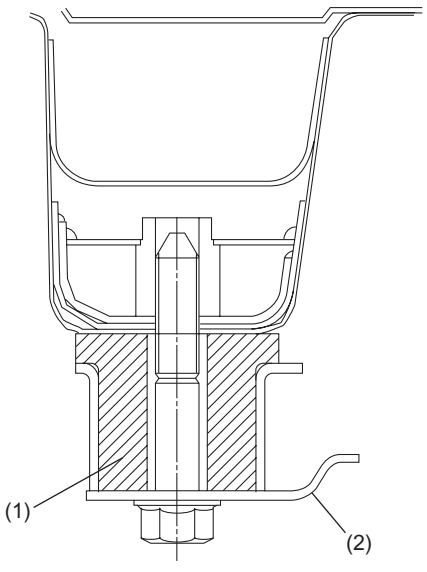
To improve vibration and noise damping, the shape of the bushing used on the rear crossmember of all models except STi has been changed.



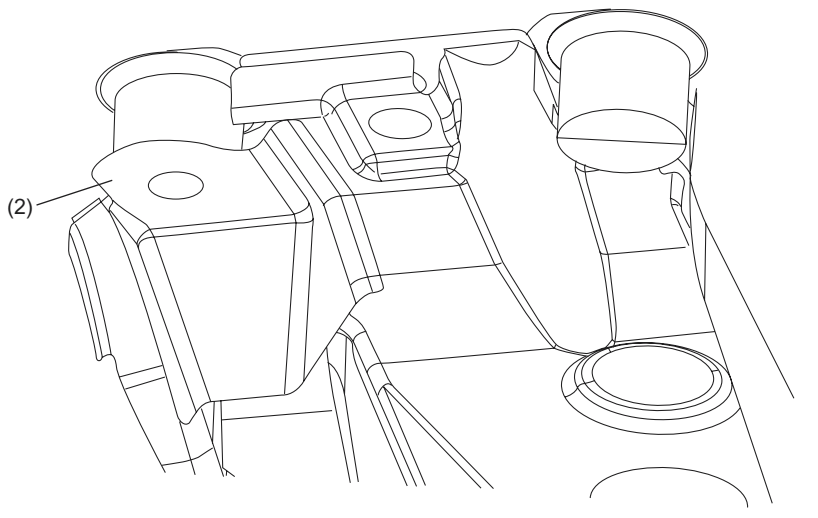
RS-00109

(1) Rubber bushing

On STi models, the rubber bushing is replaced with a metal spacer. This is fastened together with the rigidity supplement bracket which is added to the rear cross member.



(1) Metal spacer



RS-00114

(2) Rear cross member reinforcement bracket

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REAR SUSPENSION

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SEAT BELT SYSTEM

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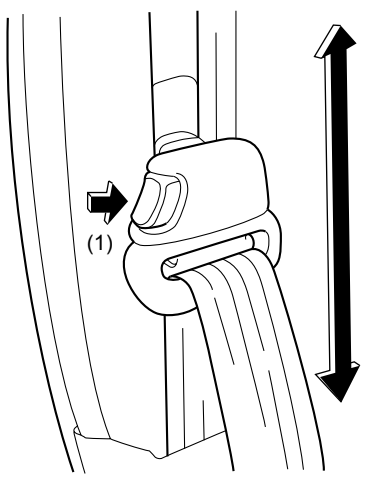
1. Seat Belt

A: ADJUSTABLE SHOULDER BELT ANCHOR

1. FRONT

Each front seat belt system has an adjustable shoulder belt anchor which allows the occupant to select the most appropriate anchor height from among the five positions in a 100 mm (3.94 in) range.



SB-00098

(1) Push

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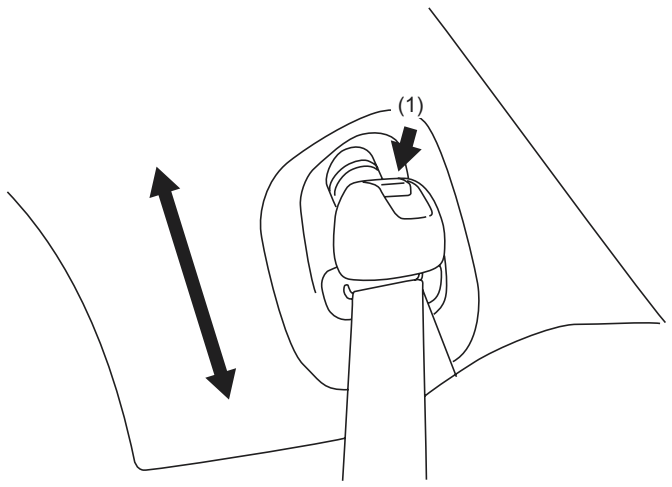
2. REAR

The side rear seat belt system has an adjustable shoulder belt anchor which allows the occupant to select the most appropriate anchor height from among the three positions in a 36 mm (1.4 in) range.



SB-00099

(1) Push

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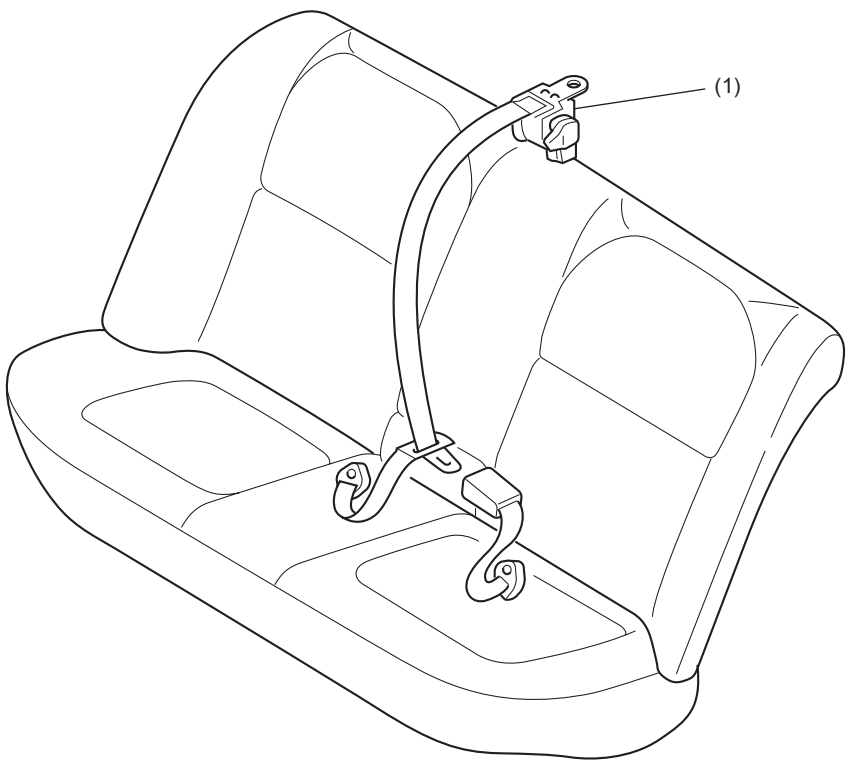
B: REAR CENTER THREE-POINT TYPE SEAT BELT

1. SEDAN MODELS

A three-point type seat belt is available for the center seating position of the rear seat.
The retractor for the seat belt is installed on the luggage shelf behind the seating position.



SB-00143

(1) Retractor

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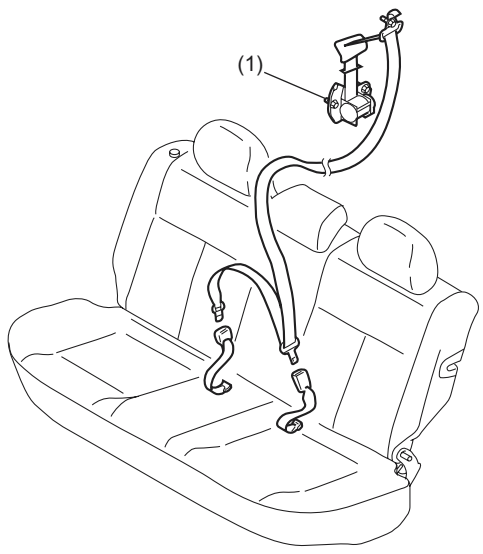
2. WAGON MODELS

A three-point type seat belt is available for the center seating position of the rear seat.
The retractor is installed inside the right rear quarter panel.



SB-00101

(1) Retractor

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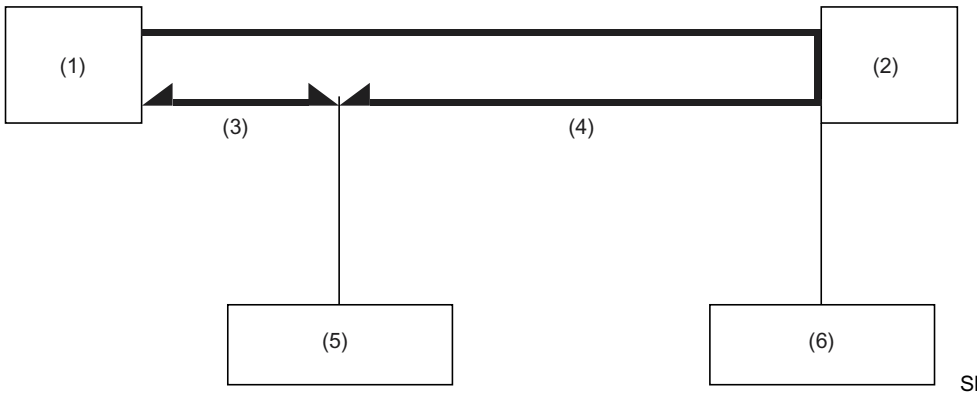
C: AUTOMATIC RETRACTOR

When the front passenger's seat belt or any of the rear seat belts is drawn out completely, its retractor is placed in the automatic locking mode which is used when installing a child restraint system. In this mode, the belt can be retracted but cannot be extended. When the belt is retracted to a certain length, this mode is cancelled and normal operation is restored.



SB-00102

(1) Fully retracted
(2) Fully extended
(3) Normal mode (belt can be retracted and pulled out)
(4) Automatic lock mode (belt can be retracted but cannot be pulled out)
(5) Automatic locking mode to normal mode changeover
(6) Normal locking mode to automatic locking mode changeover

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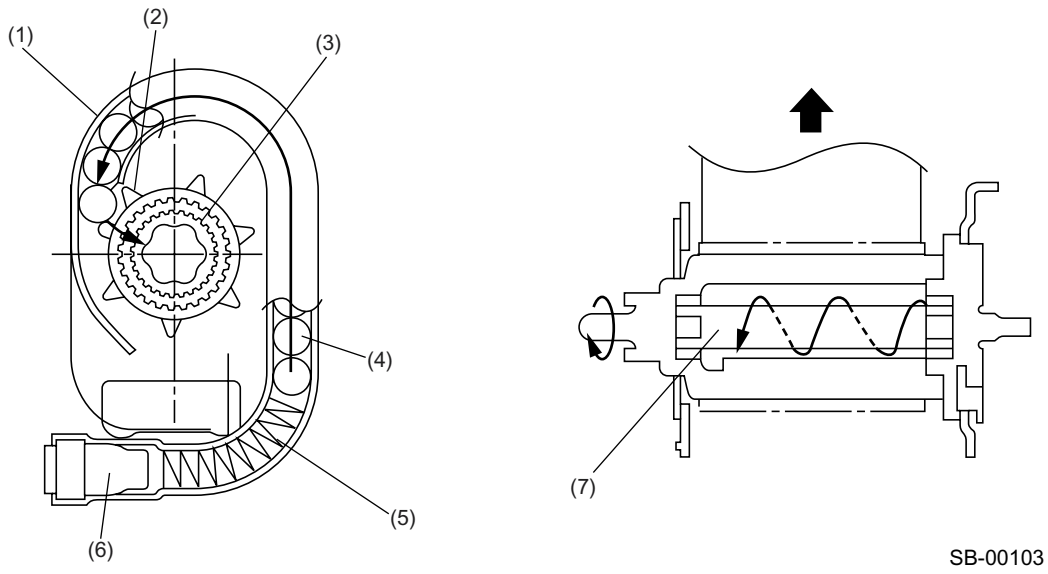
D: PRETENSIONER

1. CONSTRUCTION

The driver's and front passenger's seat belts are equipped with seat belt pretensioners. The pretensioners use the front sub sensors and the airbag control module inside sensors to control their operation. If the sensors detect an impact exceeding the predetermined level during a frontal or front-angled collision, the front seat belts are quickly rewound by the retractors to take up slacks for maximum restraining of the seat occupants. If the load placed on a seat belt exceeds the predetermined level, the torsion bar twists to allow the belt to be pulled out, thus lessening the load imposed on the belt wearer's chest. Once the seat belt pretensioner has been activated, the seat belt retractor remains locked and prevents the seat belt from being pulled out.

The gas generator is activated.
The generated gas pushes the steel balls.
Moving steel balls cause the ring gear to rotate.



SB-00103

(1) Tube
(2) Ring gear
(3) Pinion
(4) Steel ball
(5) Spring
(6) Gas generator
(7) Torsion bar

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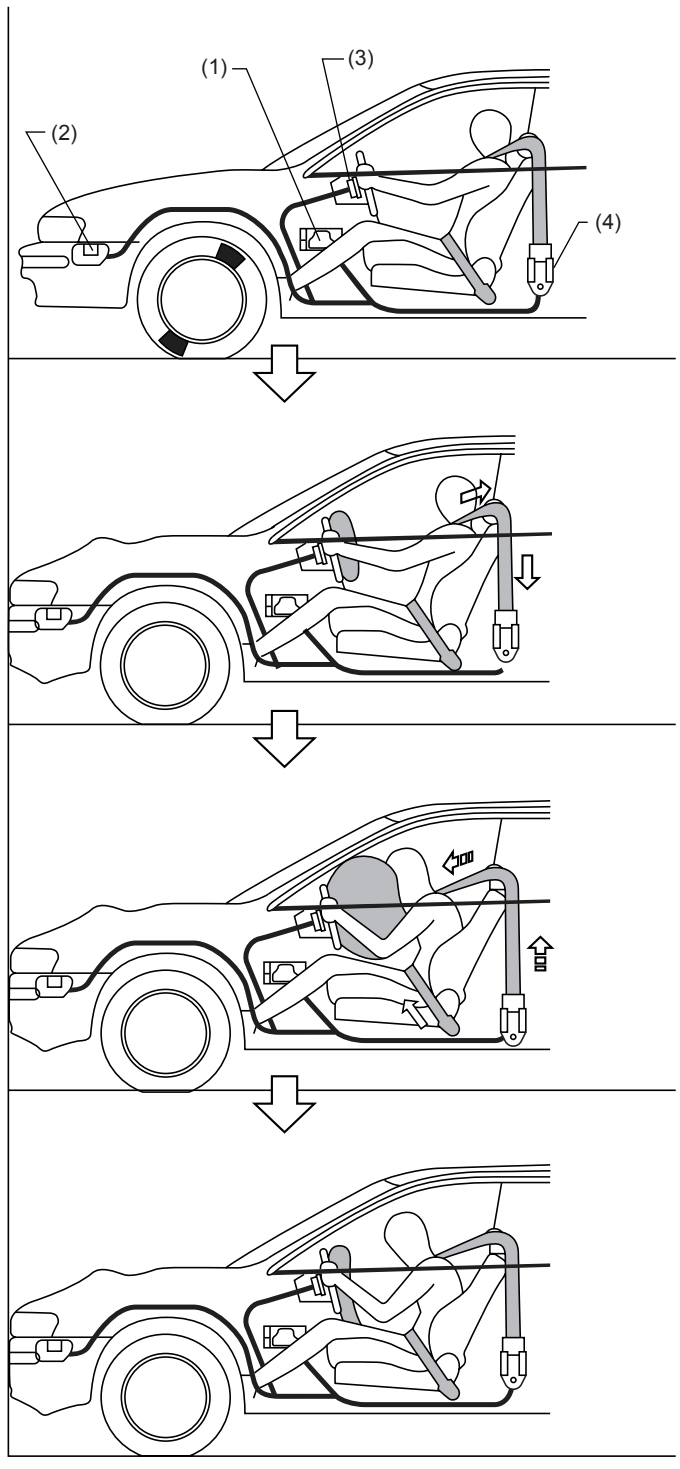
2. FUNCTION



SB-00105

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(A) • Collision occurs

(B) • Front sub sensor, electric sensor and safety sensor detect an impact greater than the set level.
• Operation of pretensioner
• Airbags start to inflate

(C) • Load limiter operates

(D) • Operation complete

(1) Safety sensor and electric sensor

(2) Front sub sensor

(3) Air bag

(4) Retractor with pretensioner

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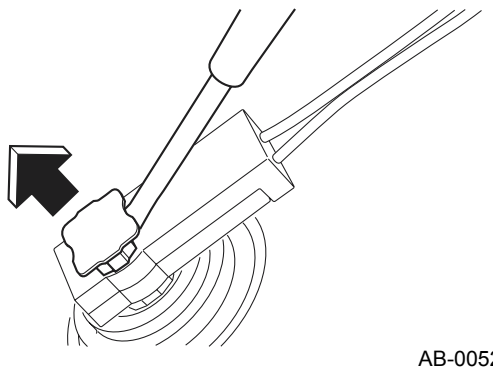
3. PRETENSIONER CONNECTOR

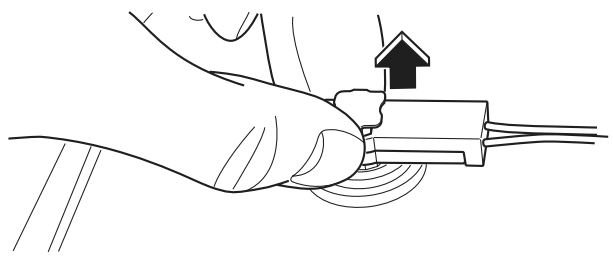
Disconnection:

1) Lift the lock button using a thin tipped tool like a miniature screwdriver.



AB-00529

2) Pull the connector out from the connection point.



AB-00528

Connection:

Carefully insert the connector into the connection point. Push the connector until a “click” is heard from the lock button.

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STARTING/CHARGING SYSTEMS
H4DOTC

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1. General

Specifications for DOHC turbo models are the same as those for SOHC models. <Ref. to SC(H4SO) — STARTING/CHARGING.>

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STARTING/CHARGING SYSTEMS
H4SO

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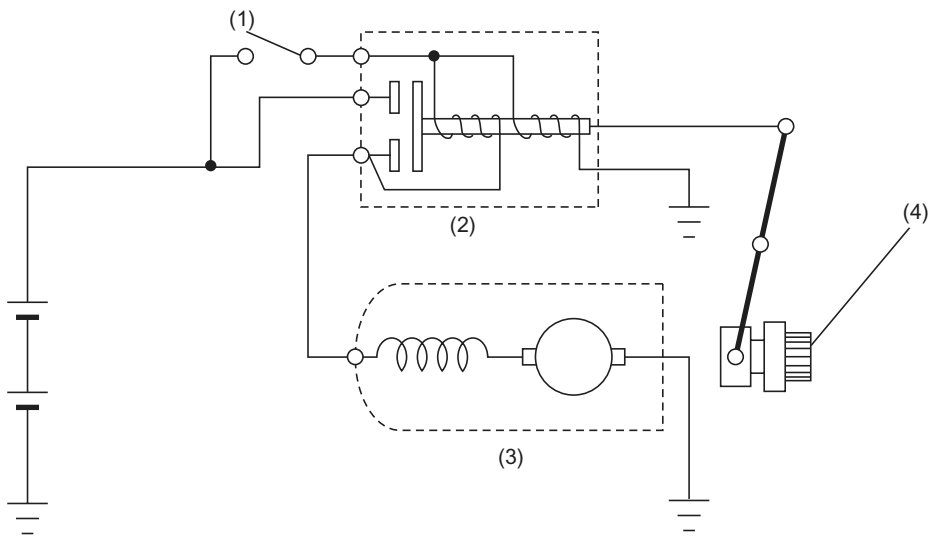
1. Starter

The starter is of a reduction type. Its output is as shown below.

Displacement	Output kW	
	MT	AT
2.0 L	1.0	1.4
2.5 L	1.0	1.4



SC-00056

(1) Starter switch
(2) Magnet switch
(3) Starter
(4) Pinion

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2. Generator

The generator has a built-in regulator which provides diagnostic functions in addition to a voltage regulating function as follows:

1) Voltage regulation

The on-off operation of transistor connects and disconnects the field current circuit, providing a constant level of output voltage.

2) Diagnosis warning

When any of the following problems occur, the charge lamp illuminates.

(1) No voltage generation
Brush wear exceeds specified wear limits, field coil circuit is broken, etc.

(2) Excessive output
Output voltage is greater than (approx) 16 volts.

(3) Terminal B disconnection
Harness is disconnected from generator terminal B.

(4) Terminal S disconnection
Harness is disconnected from generator terminal S. In this case, voltage is slightly greater than specified regulated voltage; however, voltage regulation is still controlled and the battery is prevented from becoming overcharged.

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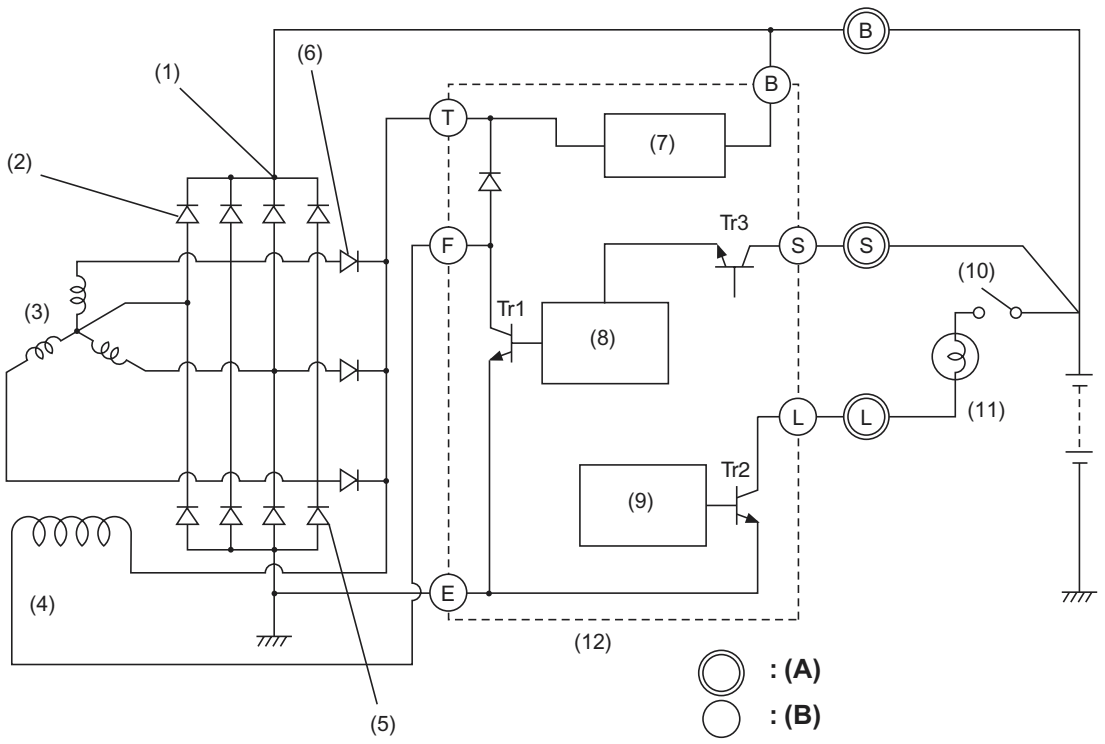

SC-00057

(1) Positive side diodes (3 pcs.)
(2) Additional diodes (2 pcs.)
(3) Stator coil
(4) Field coil
(5) Negative side diodes (3 pcs.)
(6) Trio diodes (3 pcs.)
(7) Energizing circuit
(8) Constant voltage circuit
(9) Diagnostic and warning circuit
(10) Ignition switch
(11) Charge light
(12) IC regulator

(A) Generator terminal
(B) Regulator terminal

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3. Battery

The battery is located in the left front part of the engine compartment. It is held on a tray by the battery holder.

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STARTING/CHARGING SYSTEMS
STi

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1. General

Specifications for the STi models are the same as those for SOHC models. <Ref. to SC(H4SO) — STARTING/CHARGING.>

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SEATS

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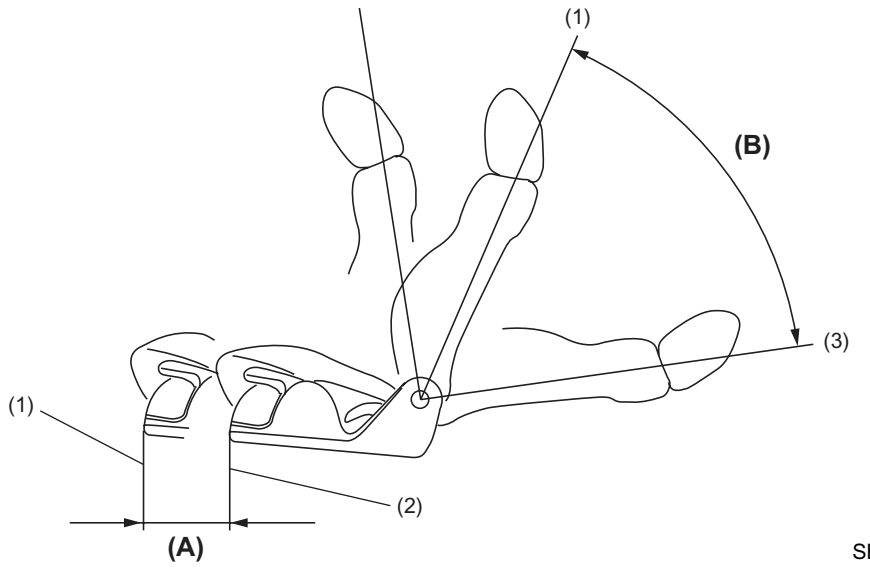
1. Front Seat

A: ADJUSTMENT

- The height of each headrest is adjustable to any of the 3 positions available.
- The angle of each backrest is adjustable to any of the 40 positions available at 2° steps.
- The front seat can be slid back and forth to one of the 16 positions available at 13.5 mm (0.53 in) steps.



SE-00237

(1) 1st position
(2) 17th position
(3) 41st position

(A) 16 × 13.5 mm (0.53 in)
(B) 40 × 2°

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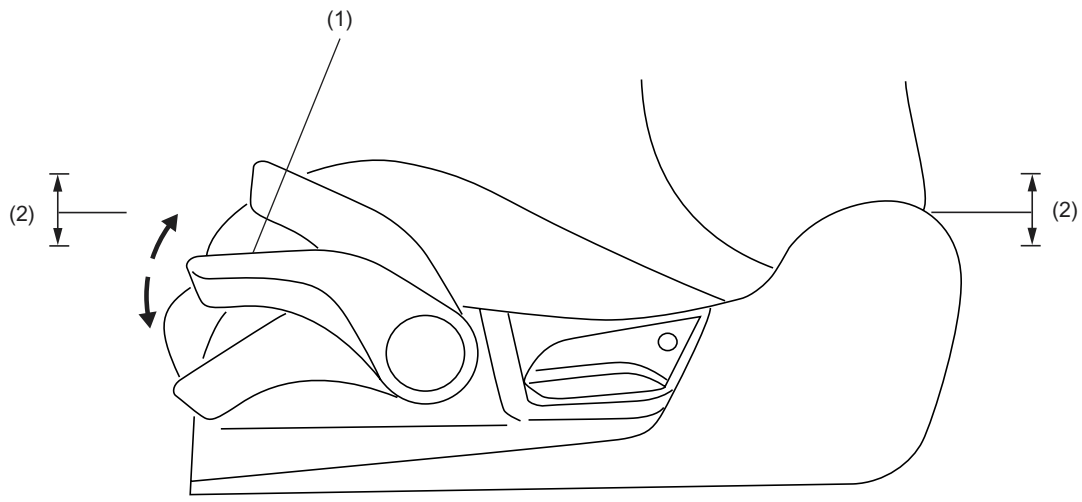
B: HEIGHT ADJUSTER

The driver's seat is provided with a height adjuster. This adjuster allows adjusting the seat height within a range of 42 mm (1.65 in).
Both the seat cushion and backrest rises every time the lifter lever is pulled up; they lowers every time the lever is pushed down.
The lever is enlarged for easier operation.



SE-00325

(1) Lifter lever
(2) 42 mm (1.65 in)

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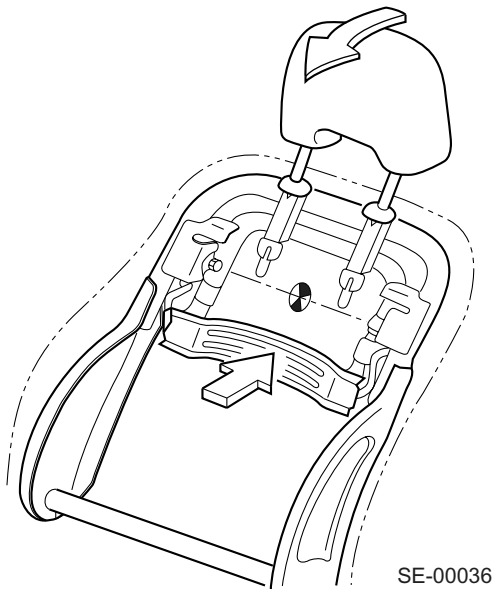
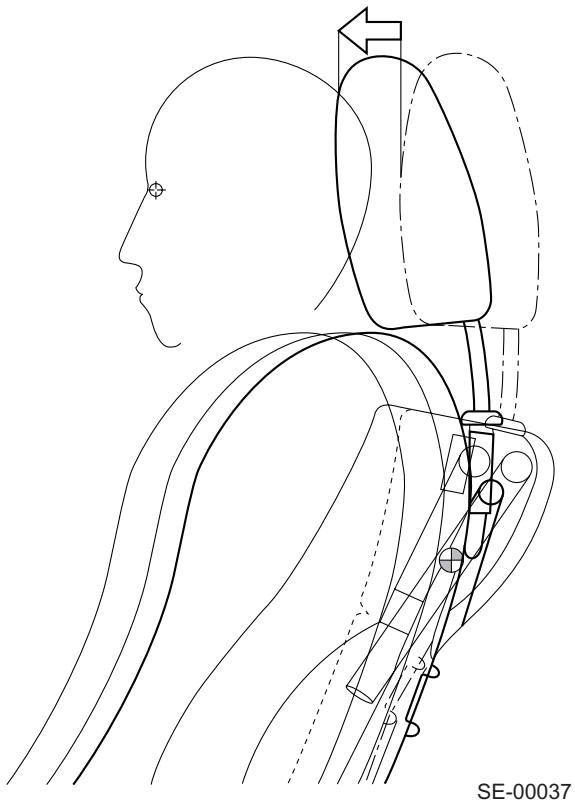
C: ACTIVE HEAD REST

In case of rear-end collision, the head rest moves forward to immediately support the passenger's head to reduce the possibility of injury to the neck.



SE-00036



SE-00037

1) In case of rear-end collision, the passenger's body will move rearward by the impact.
2) When the body moves rearward, the thrust receiving plate inside the seat is pressed in.
3) When the thrust receiving plate is pressed in, the head rest moves forward due to a levering action.

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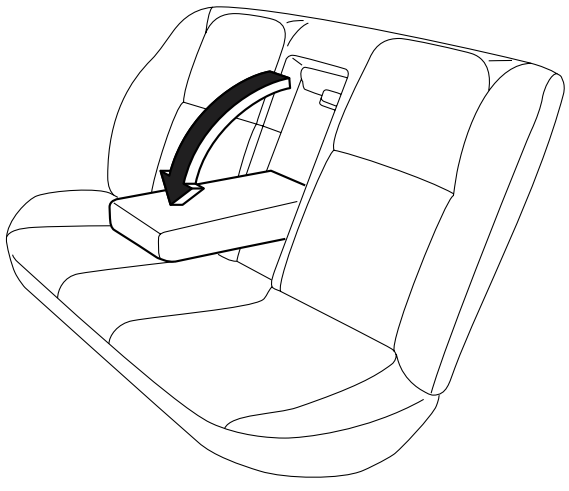
2. Rear Seat

A: OPERATION

1. SEDAN MODELS

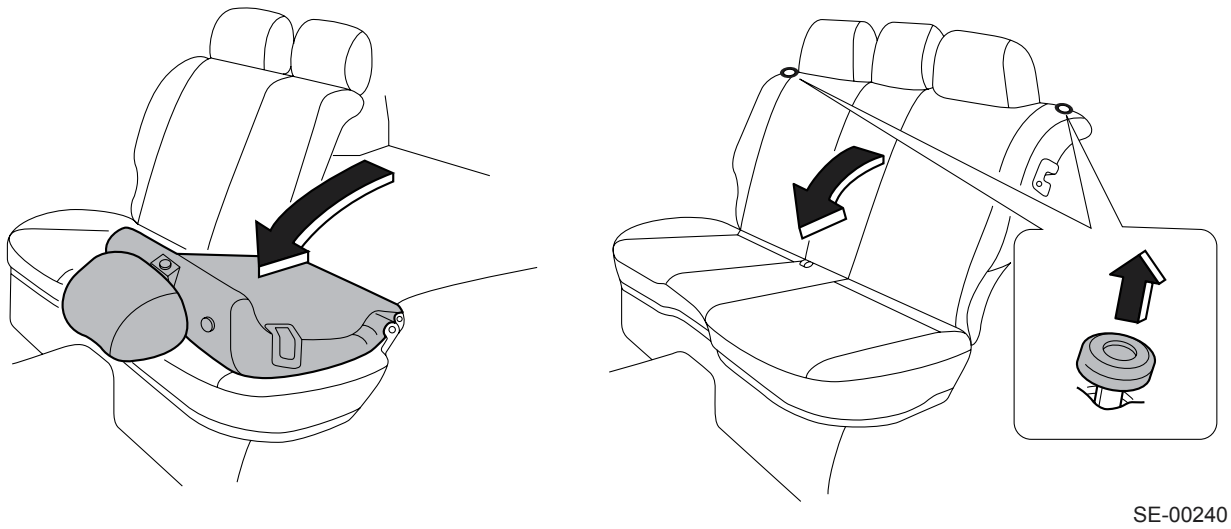
A trunk-through hatch is provided behind the seatback. It is accessed by folding down the central portion of the seatback which also serves as an armrest in its down position.



SE-00239

2. WAGON MODELS

Unlock the seatback by pulling the release knob and then fold the seatback down.



SE-00240

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SECTION 9
MECHANISM AND FUNCTION

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SECURITY AND LOCKS

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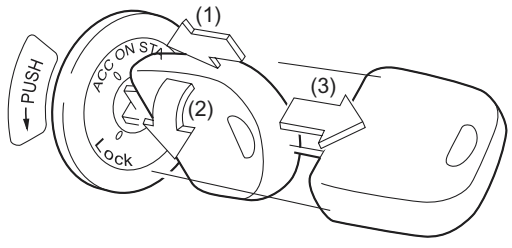
1. Ignition Switch

A: GENERAL

1. IGNITION SWITCH

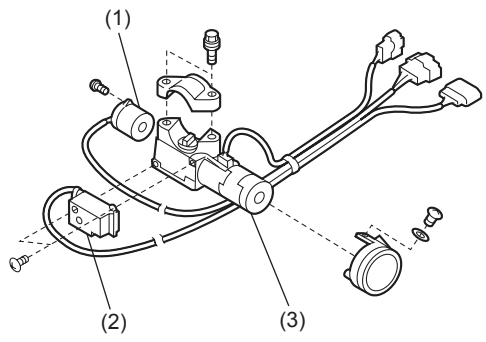
● The ignition switches on the MT models have a safety mechanism that prevents inadvertent locking of the steering wheel during driving. The driver cannot turn the ignition key from “ACC” to “LOCK” unless the key is pushed inward at the “ACC” position (arrow 1 in the drawing below).



SL-00031

● The ignition switches on the AT models have a key interlock mechanism to avoid locking of the steering wheel during driving. The ignition key can be turned to the “LOCK” position only when the select lever is in the P position.

NOTE:
Should the key be impossible to turn to “LOCK” when the select lever is in the P position due to failure of the key interlock mechanism, the interlocking can be cancelled by operating the release lever located on the underside of the steering column.



SL-00032

(1) Ignition switch
(2) Key interlock solenoid (AT)
(3) Ignition key cylinder

2. KEY REMINDER CHIME

The reminder chime sounds when the driver’s door opens and the ignition key is in the “LOCK” or “ACC” position. The chime stops when the key is removed from the ignition switch.

3. IGNITION SWITCH ILLUMINATION

The ignition switch illumination turns off 10 seconds after the driver’s door is closed.
The integrated module controls the off delay function.

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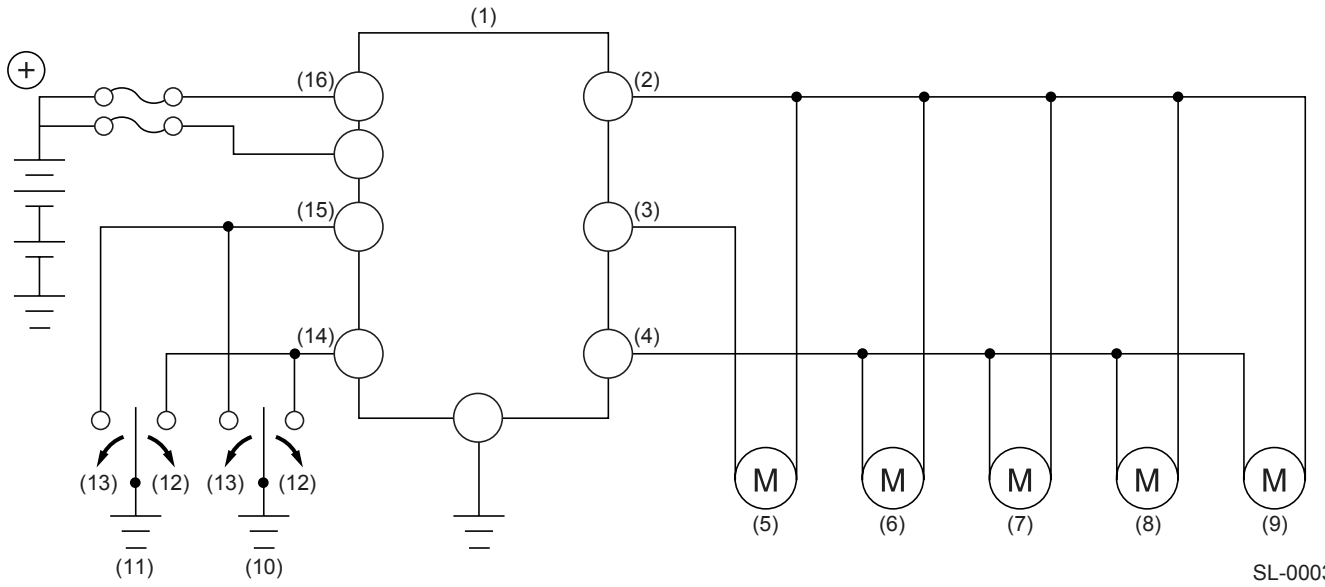
2. Power Door Lock

A: CONSTRUCTION

● The power door lock system consists of an integrated module, driver's and front passenger's door lock switches, front door lock actuators, rear door lock actuators, and a rear gate lock actuator.

● When the driver's/front passenger's door is locked or unlocked using the door lock switch, the other doors and the rear gate are also locked or unlocked automatically.

B: SCHEMATIC DRAWINGS



SL-00033

(1) Integrated module
(2) Lock output
(3) Unlock output (driver's door)
(4) Unlock output (except driver's door)
(5) Front LH actuator
(6) Front RH actuator
(7) Rear LH actuator
(8) Rear RH actuator
(9) Rear gate lock actuator
(10) Front passenger's door lock switch
(11) Driver's door lock switch
(12) Unlock
(13) Locked
(14) Unlock switch
(15) Lock switch
(16) Battery

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3. Keyless Entry System

A: CONSTRUCTION

● The keyless entry system consists of a transmitter, keyless entry control module (with a built-in antenna), integrated module, door lock actuators, door switches, horn, buzzer, and interior light.

● The keyless entry system operates on a radio frequency, so its transmitter can be used in almost all directions relative to the vehicle.

B: FUNCTION

1. DOOR LOCKING

1) Push the transmitter's LOCK button once.

2) All doors are locked.

3) Check that the buzzer sounds once and the hazard warning lights flash once.

2. DOOR UNLOCKING (DRIVER'S DOOR)

1) Push the transmitter's UNLOCK button once.

2) The driver's door is unlocked and the interior light turns ON (when the interior light switch is set at the DOOR position).

NOTE:
The interior light illuminates for 30 seconds and then goes out. (However, if a door locking procedure is performed again during this period, the lights will go out immediately.)

3) Check that the buzzer sounds twice and the hazard warning lights flash twice.

3. DOOR UNLOCKING (ALL DOORS)

1) Push the transmitter's UNLOCK button 2 times within 5 seconds.

2) All doors are unlocked.

3) Check that the buzzer sounds twice and the hazard warning lights flash twice.

4. SELF POSITION DETECTION FUNCTION

1) Push the transmitter's UNLOCK button 3 times within 5 seconds.

2) Check that the horn sounds once and the hazard warning lights flash 3 times.

5. PANIC ALARM SETTING

1) Push the transmitter's UNLOCK button for more than 2 seconds.

2) The horn sounds continuously and the hazard warning lights will flash. To stop the horn, push any button on the transmitter.

6. ANSWER BACK (BUZZER SIGNALING) ON/OFF SELECTION

1) Push the transmitter's UNLOCK button.

2) Push the transmitter's LOCK and UNLOCK buttons simultaneously for more than 2 seconds to activate the answer back function and push them again to deactivate it.

3) When the answer back function is activated, the buzzer will sound once and the hazard warning lights flash once. When it is deactivated, the buzzer will sound twice and the hazard warning lights flash twice.

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7. DOOR OPEN WARNING FUNCTION

The buzzer sounds five times and the hazard warning lights flash five times if the transmitter's LOCK button is pressed with any door or the rear gate open.

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4. Security System

A: FEATURES

● The security system protects the vehicle from a theft action (unauthorized entry into the vehicle). Upon detection of such an action, it gives audible and visible alarms by causing the horn to sound and the hazard warning lights to flash. It also immobilizes the vehicle by disabling the starter circuit.

● Unauthorized entry is monitored through the switches on the doors, rear gate and trunk lid. If one of the switches is turned ON, the system interprets it as an attempt of unauthorized entry and gives alarms while disabling the starter circuit.

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

1. WARNING

● When activated, the security system causes the hazard warning lights to flash and the horn to sound intermittently. In addition, the security indicator light on combination meter flashes fast and the starter motor circuit is disabled.

● The alarms automatically turn OFF after 30 seconds. However, they will be reactivated if the vehicle is tampered with again.

● The alarms are activated when a door, rear gate or trunk lid is opened without using the keyless entry transmitter. (When the system is armed, a warning is given even if a door is opened by operating the inner door handle.)

● The alarms are also activated when an impact on vehicle body is sensed.

2. HOW TO ARM THE SYSTEM

1) Remove the key from the ignition switch.

2) Close all the windows. Close and all doors, rear gate, and the trunk lid.

3) Push the transmitter's LOCK button.

4) The buzzer will sound once and the hazard warning lights flash once.

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

5) Confirm that the security indicator light blinks slowly (once every two seconds). If any of the doors or the rear gate is not properly closed, the system warns the driver of this by causing the buzzer to sound five times, the hazard warning lights to flash five times, and the security indicator to flash rapidly. When the door, rear gate or trunk lid is closed, it will be automatically locked and the security system starts working. The indicator light blinks every 2 seconds when the system is armed and continues to blink until the system is disarmed.

3. HOW TO DISARM THE SYSTEM

1) Push keyless entry transmitter's UNLOCK button.

2) The buzzer will sound twice and the hazard warning lights flash twice.

3) The security indicator light turns OFF.

4) The interior light will illuminate for 30 seconds and then turns OFF. (However, if a system arming procedure is performed during this period, the interior light will turn OFF.)

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4. HOW TO STOP ALARMS

Push the transmitter's UNLOCK button or turn the ignition switch from "LOCK to "ON" repeatedly 3 times at an interval shorter than 5 seconds.

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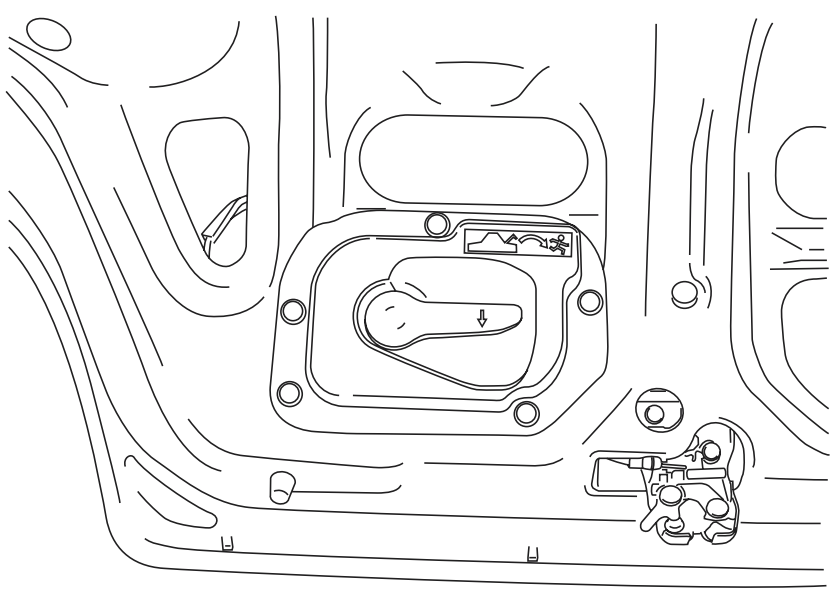
5. Trunk Lid Release Handle

A: GENERAL

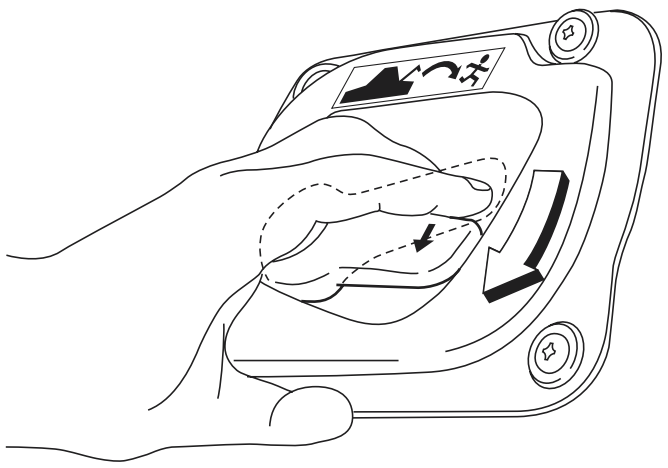
- The trunk lid release handle is a device designed to open the trunk lid from inside the trunk.
- In the event children or adults become locked inside the trunk, the handle allows them to open the lid.
- The handle is located on the inside of the trunk lid.
- The handle is made of material that remains luminescent for approximately an hour in the dark trunk space after it is exposed to ambient light event for a short time.



SL-00168

B: OPERATION

To open the trunk lid from inside the trunk, press the yellow handle downward as indicated by the arrow on the handle, this operation unlocks the trunk lid. Then push up the lid.



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SPEED CONTROL SYSTEMS
H4DOTC

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1. General

Specifications for DOHC turbo models are the same as those for SOHC models. <Ref. to SP(H4SO) — SPEED CONTROL SYSTEM.>

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SPEED CONTROL SYSTEMS
H4SO

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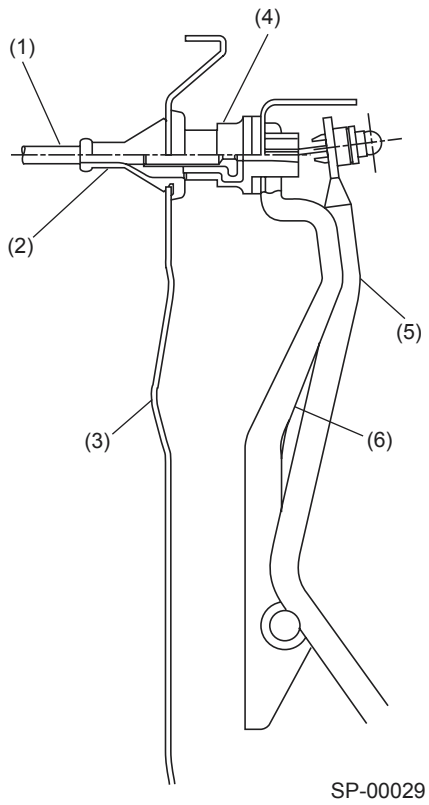
1. General

The accelerator outer cable is secured to the accelerator pedal bracket rather than to the toeboard. Securing the outer cable in this way has a merit of making the ratio of throttle valve movement to cable stroke less variable. This arrangement is also effective to prevent uneven cable return movement that may result from deformation of the toeboard or improper installation of the accelerator pedal and, therefore, to improve safety.

In addition, the floating type casing cap through which the cable is attached to the bracket reduces vibration of the pedal, thus improving quietness.



SP-00029

(1) Accelerator cable
(2) Grommet
(3) Toeboard
(4) Casing cap (floating type)
(5) Accelerator pedal
(6) Bracket

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SPEED CONTROL SYSTEMS
STi

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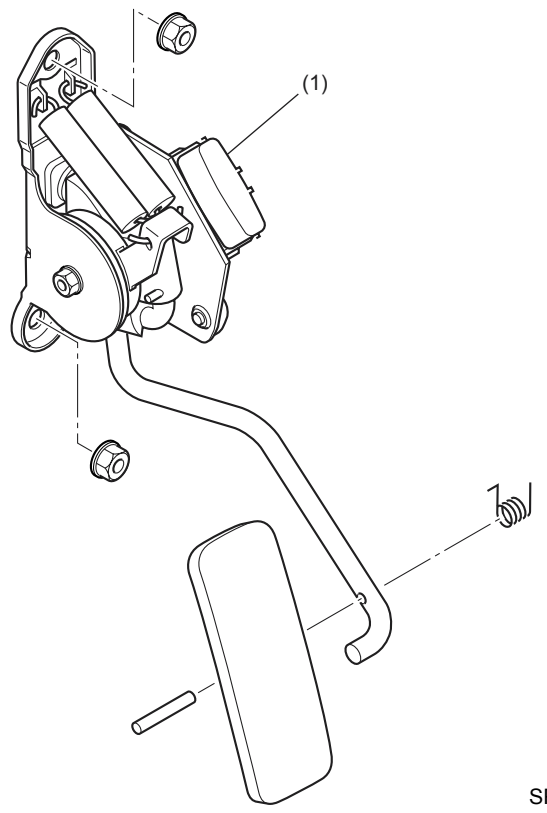
1. General

An electronically controlled throttle is adopted.
The movement of the accelerator pedal is converted into electrical signals by the accelerator pedal position sensor and these signals are sent to the ECM.

The ECM controls the operation of the throttle body based on the signals from the accelerator pedal position sensor and on other driving conditions.



SP-00050

(1) Accelerator pedal position sensor

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SPECIFICATIONS

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1. Impreza

A: DIMENSIONS

Model			Sedan	Wagon	OUTBACK	STi
Overall length		mm (in)	4,415 (173.8)			
Overall width		mm (in)	1,740 (68.4)	1,695 (66.7)	1,710 (67.3)	1,740 (68.1)
Overall height (at C.W.)		mm (in)	1,440 (56.7)	1,485 (58.5)	1,495 (58.9)	1,430 (56.3)
Compartment	Length	mm (in)	1,890 (74.4)	1,845 (72.6)		1,890 (74.4)
	Width	mm (in)	1,380 (54.3)			
	Height	mm (in)	1,180 (46.5), 1,125 (44.3)*2	1,200 (47.2), 1,150 (45.3)*2	1,200 (47.2), 1,150 (45.3)*2	1,180 (46.5)
Wheelbase		mm (in)	2,525 (99.4)			2,540 (100.0)
Tread	Front	mm (in)	1,485 (58.5)	1,465 (57.7)	1,460 (57.5)	1,490 (58.7)
	Rear	mm (in)	1,475 (58.1), 1,480 (58.3)*1	1,455 (57.3)	1,455 (57.3)	1,485 (58.5)
Minimum road clearance		mm (in)	150 (5.9), 155 (6.1)*1	150 (5.9), 155 (6.1)*1	160 (6.3)	145 (5.7)

*1: WRX
*2: With sun roof

B: ENGINE

Model	Turbo 2.0 L	2.5 L	STi
Engine type	Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine		
Valve arrangement	Overhead camshaft type		
Bore × Stroke mm (in)	92 × 75 (3.62 × 2.95)	99.5 × 79 (3.92 × 3.11)	
Displacement cm^3 (cu in)	1,994 (121.67)	2,457 (149.9)	
Compression ratio	8.0±0.2	10.0±0.2	8.2±0.2
Firing order	1 — 3 — 2 — 4		
Idle speed at Park/Neutral position rpm	750±100	MT: 650±100 AT: 700±100	700±100
Maximum output kW (HP)/rpm	169 (227)/6,000	123 (165)/5,600	224 (300)/6,000
Maximum torque N· m (kgf-m, ft-lb)/rpm	294 (30.0, 217)/4,000	226 (23.0, 166)/4,000	407 (41.5, 300)/4,000

C: ELECTRICAL

Model		Turbo 2.0 L	2.5 L	STi
Ignition timing at idling BTDC		12° ±10°	MT: 10° ±8° AT: 15° ±8°	17° ±10°
Spark plug	Type and manufacturer	NGK: PFR6G	CHAMPION: RC10YC4 (standard) NGK: BKR5E-11 NGK: BKR6E-11	NGK : IFLR6B
Generator		12 V — 75 A		12 V — 90 A
Battery	Type and capacity (5HR)	MT: 12 V — 48 AH (55D23L) AT: 12 V — 52 AH (65D23L)	MT: 12 V — 48 AH (55D23L) AT: 12 V — 52 AH (75D23L)	12 V — 48 AH (55D23L)

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D: TRANSMISSION

Model			Turbo 2.0 L		2.5 L		STi
Transmission type			5MT	4AT	5MT	4AT	6MT
Clutch type			DSPD	TCC	DSPD	TCC	DSPD
Gear ratio		1st	3.454	2.785	3.454	2.785, 3.027*1	3.636
		2nd	1.947	1.545	2.062	1.545, 1.619*1	2.375
		3rd	1.366	1.000	1.448	1.000	1.761
		4th	0.972	0.694	1.088	0.694	1.346
		5th	0.738	—	0.780	—	0.971
		6th	—	—	—	—	0.756
		Reverse	3.333	2.272	3.333	2.272	3.545
		Dual range	—	—	—	—	—
Reduction gear (Front drive)	1st reduction	Type of gear	—	Helical	—	Helical	—
		Gear ratio	—	1.000	—	1.000	—
	Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
		Gear ratio	3.900	4.111	3.900, 4.111*1	4.111, 4.444*1	3.900
Reduction gear (Rear drive)	Transfer reduction	Type of gear	Helical	—	Helical	—	Helical
		Gear ratio	1.100	—	1.000	—	1.000
	Final reduction	Type of gear	Hypoid	Hypoid	Hypoid	Hypoid	Hypoid
		Gear ratio	3.545	4.111	3.900, 4.111*1	4.111, 4.444*1	3.900

5MT: 5-forward speeds with synchromesh and 1-reverse
4AT: Electronically controlled fully-automatic, 4-forward speeds and 1-reverse
6MT: 6-forward speeds with synchromesh and 1-reverse
DSPD: Dry Single Plate Diaphragm
TCC: Torque Converter Clutch
*1: Sedan model

E: STEERING

Model			TS	RS, OUTBACK, WRX	STi
Type			Rack and Pinion		
Turns, lock to lock			3.2	3.0	2.7
Minimum turning circle	m (ft)	Curb to curb	10.2 (33.5)	10.8 (35.4)	
		Wall to wall	11.1 (36.3)	11.7 (38.3)	

F: SUSPENSION

Front	Macpherson strut type, Independent, Coil spring
Rear	Dual-link type, Independent, Coil spring

G: BRAKE

Model	Turbo 2.0 L, 2.5 L	STi
Service brake system	Dual circuit hydraulic with vacuum suspended power unit	
Front	Ventilated disc brake	
Rear	Disc brake	Ventilated disc brake
Parking brake	Mechanical on rear brakes	

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H: TIRE

Model	TS	RS, OUTBACK, WRX	STi
Rim size	15 × 6JJ	16 × $6^1/_2$JJ	17 × $7^1/_2$JJ
Tire size	P195/60R15 87H	P205/55R16 89V	225/45R17 90W
Type	Steel belted radial, Tubeless		

I: CAPACITY

Model			Turbo 2.0 L		2.5 L		STi
			5MT	4AT	5MT	4AT	6MT
Fuel tank		ℓ (US gal, Imp gal)	60 (15.9, 13.2)				
Engine oil	Total capacity	ℓ (US qt, Imp qt)	4.5 (4.8, 4.0)		4.0 (4.2, 3.5)		4.5 (4.8, 4.0)
	Engine oil amount for refill	ℓ (US qt, Imp qt)	Approx. 4.5 (4.8, 4.0)		Approx. 4.0 (4.2, 3.5)		Approx. 4.5 (4.8, 4.0)
Transmission gear oil		ℓ (US qt, Imp qt)	3.5 (3.7, 3.1)	—	3.5 (3.7, 3.1)	—	4.1 (4.3, 3.6)
ATF		ℓ (US qt, Imp qt)	—	9.3 (9.8, 8.2)	—	9.3 (9.8, 8.2)	—
Front differential gear oil		ℓ (US qt, Imp qt)	—	1.2 (1.3, 1.1)	—	1.2 (1.3, 1.1)	—
Rear differential gear oil		ℓ (US qt, Imp qt)	0.8 (0.8, 0.7)				1.0 (1.1, 0.9)
Power steering fluid		ℓ (US qt, Imp qt)	0.7 (0.7, 0.6)				
Engine coolant		ℓ (US qt, Imp qt)	7.7 (8.1, 6.8)	7.6 (8.0, 6.7)	7.0 (7.4, 6.2)	6.9 (7.3, 6.1)	7.7 (8.1, 6.8)

J: WEIGHT

1. FOR U.S. MODEL

Sedan

Model			2.5 L		Turbo 2.0L		
			RS		WRX		
			5MT	4AT	5MT		
Curb weight (C.W.)	Front	kgf (lb)	778 (1,715)	803 (1,770)	826 (1,820)	832 (1,834)	833 (1,836)
	Rear	kgf (lb)	567 (1,250)	567 (1,250)	573 (1,265)	586 (1,292)	588 (1,297)
	Total	kgf (lb)	1,345 (2,965)	1,370 (3,020)	1,399 (3,085)	1,418 (3,126)	1,421 (3,133)
Gross axle weight (G.A.W.)	Front	kgf (lb)	939 (2,070)	939 (2,070)	998 (2,200)	998 (2,200)	998 (2,200)
	Rear	kgf (lb)	907 (2,000)	907 (2,000)	916 (2,020)	916 (2,020)	916 (2,020)
	Total	kgf (lb)	1,778 (3,920)	1,778 (3,920)	1,837 (4,050)	1,837 (4,050)	1,837 (4,050)
Option	Power window		❍	❍	❍	❍	❍
	Power door lock		❍	❍	❍	❍	❍
	Cruise control		❍	❍	❍	❍	❍
	ABS		❍	❍	❍	❍	❍
	Air conditioner		❍	❍	❍	❍	❍
	Cold W package		—	—	—	❍	❍
	Sun roof		—	—	—	❍	❍
	Dual airbag		❍	❍	❍	❍	❍
	Side airbag		—	—	❍	❍	❍
	Rear spoiler		—	—	—	❍	❍
	Seat in pure hide		—	—	—	—	❍
	Front LSD		—	—	—	—	—
	Aluminum wheel	Gold color	—	—	—	—	—
		Silver color	—	—	—	—	—

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Model			Turbo 2.0 L			Turbo 2.5 L	
			WRX			STi	
			4AT			6MT	
Curb weight (C.W.)	Front	kgf (lb)	850 (1,875)	857 (1,889)	858 (1,891)	863 (1,903)	863 (1,903)
	Rear	kgf (lb)	574 (1,265)	586 (1,292)	588 (1,297)	613 (1,351)	613 (1,351)
	Total	kgf (lb)	1,424 (3,140)	1,443 (3,181)	1,446 (3,188)	1,476 (3,254)	1,476 (3,254)
Gross axle weight (G.A.W.)	Front	kgf (lb)	998 (2,200)	998 (2,200)	998 (2,200)	1,030 (2,271)	1,030 (2,271)
	Rear	kgf (lb)	916 (2,020)	916 (2,020)	916 (2,020)	920 (2,028)	920 (2,028)
	Total	kgf (lb)	1,837 (4,050)	1,837 (4,050)	1,837 (4,050)	1,880 (4,145)	1,880 (4,145)
Option	Power window		❍	❍	❍	❍	❍
	Power door lock		❍	❍	❍	❍	❍
	Cruise control		❍	❍	❍	❍	❍
	ABS		❍	❍	❍	❍	❍
	Air conditioner		❍	❍	❍	❍	❍
	Cold W package		—	❍	❍	—	—
	Sun roof		—	❍	❍	—	—
	Dual airbag		❍	❍	❍	❍	❍
	Side airbag		❍	❍	❍	❍	❍
	Rear spoiler		—	❍	❍	—	—
	Seat in pure hide		—	—	❍	—	—
	Front LSD		—	—	—	❍	❍
	Aluminum wheel	Gold color	—	—	—	❍	—
		Silver color	—	—	—	—	❍

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Wagon

Model			2.5 L		2.5 L	
			TS		OUTBACK	
			5MT	4AT	5MT	4AT
Curb weight (C.W.)	Front	kgf (lb)	778 (1,715)	801 (1,765)	783 (1,725)	805 (1,775)
	Rear	kgf (lb)	603 (1,330)	605 (1,335)	601 (1,325)	603 (1,330)
	Total	kgf (lb)	1,381 (3,045)	1,406 (3,100)	1,384 (3,050)	1,408 (3,105)
Gross axle weight (G.A.W.)	Front	kgf (lb)	939 (2,070)	939 (2,070)	939 (2,070)	939 (2,070)
	Rear	kgf (lb)	953 (2,100)	953 (2,100)	953 (2,100)	953 (2,100)
	Total	kgf (lb)	1,833 (4,040)	1,833 (4,040)	1,833 (4,040)	1,833 (4,040)
Option	Power window		❍	❍	❍	❍
	Power door lock		❍	❍	❍	❍
	Cruise control		❍	❍	❍	❍
	ABS		❍	❍	❍	❍
	Air conditioner		❍	❍	❍	❍
	Cold W package		—	—	—	—
	Sun roof		—	—	—	—
	Dual airbag		❍	❍	❍	❍
	Side airbag		—	—	—	—
	Rear spoiler		—	—	—	—
	Seat in pure hide		—	—	—	—
	Roof rail		❍	❍	❍	❍

Model			Turbo 2.0 L			
			WRX			
			5MT		4AT	
Curb weight (C.W.)	Front	kgf (lb)	826 (1,820)	826 (1,820)	851 (1,875)	851 (1,875)
	Rear	kgf (lb)	610 (1,345)	610 (1,345)	610 (1,345)	610 (1,345)
	Total	kgf (lb)	1,436 (3,165)	1,436 (3,165)	1,461 (3,220)	1,461 (3,220)
Gross axle weight (G.A.W.)	Front	kgf (lb)	998 (2,200)	998 (2,200)	998 (2,200)	998 (2,200)
	Rear	kgf (lb)	953 (2,100)	953 (2,100)	953 (2,100)	953 (2,100)
	Total	kgf (lb)	1,901 (4,190)	1,901 (4,190)	1,901 (4,190)	1,901 (4,190)
Option	Power window		❍	❍	❍	❍
	Power door lock		❍	❍	❍	❍
	Cruise control		❍	❍	❍	❍
	ABS		❍	❍	❍	❍
	Air conditioner		❍	❍	❍	❍
	Cold W package		—	❍	❍	—
	Sun roof		—	—	—	—
	Dual airbag		❍	❍	❍	❍
	Side airbag		❍	❍	❍	❍
	Rear spoiler		—	—	—	—
	Seat in pure hide		—	—	—	—
	Roof rail		❍	❍	❍	❍

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2. FOR CANADA MODEL

Sedan

Model			2.5 L		Turbo 2.0 L		
			RS		WRX		
			5MT	4AT	5MT		
Curb weight (C.W.)	Front	kgf (lb)	780 (1,720)	805 (1,775)	825 (1,820)	832 (1,834)	833 (1,836)
	Rear	kgf (lb)	570 (1,256)	570 (1,256)	576 (1,270)	586 (1,292)	588 (1,297)
	Total	kgf (lb)	1,350 (2,976)	1,375 (3,031)	1,401 (3,090)	1,418 (3,126)	1,421 (3,133)
Gross axle weight (G.A.W.)	Front	kgf (lb)	939 (2,070)	939 (2,070)	998 (2,200)	998 (2,200)	998 (2,200)
	Rear	kgf (lb)	907 (2,000)	907 (2,000)	916 (2,020)	916 (2,020)	916 (2,020)
	Total	kgf (lb)	1,778 (3,920)	1,778 (3,920)	1,837 (4,050)	1,837 (4,050)	1,837 (4,050)
Option	Power window		❍	❍	❍	❍	❍
	Power door lock		❍	❍	❍	❍	❍
	Cruise control		❍	❍	❍	❍	❍
	ABS		❍	❍	❍	❍	❍
	Air conditioner		❍	❍	❍	❍	❍
	Cold W package		—	—	—	—	—
	Sun roof		—	—	—	❍	❍
	Dual airbag		❍	❍	❍	❍	❍
	Side airbag		—	—	❍	❍	❍
	Rear spoiler		❍	❍	❍	❍	❍
	Seat in pure hide		—	—	—	—	❍
	Front LSD		—	—	—	—	—
	Aluminum wheel	Gold color	—	—	—	—	—
		Silver color	—	—	—	—	—

Model			Turbo 2.0 L			Turbo 2.5 L	
			WRX			STi	
			4AT			6MT	
Curb weight (C.W.)	Front	kgf (lb)	851 (1,875)	857 (1,889)	858 (1,891)	866 (1,909)	866 (1,909)
	Rear	kgf (lb)	576 (1,270)	586 (1,292)	588 (1,297)	618 (1,363)	618 (1,363)
	Total	kgf (lb)	1,427 (3,145)	1,443 (3,181)	1,446 (3,188)	1,484 (3,272)	1,484 (3,272)
Gross axle weight (G.A.W.)	Front	kgf (lb)	998 (2,200)	998 (2,200)	998 (2,200)	1,030 (2,271)	1,030 (2,271)
	Rear	kgf (lb)	916 (2,020)	916 (2,020)	916 (2,020)	920 (2,028)	920 (2,028)
	Total	kgf (lb)	1,837 (4,050)	1,837 (4,050)	1,837 (4,050)	1,880 (4,145)	1,880 (4,145)
Option	Power window		❍	❍	❍	❍	❍
	Power door lock		❍	❍	❍	❍	❍
	Cruise control		❍	❍	❍	❍	❍
	ABS		❍	❍	❍	❍	❍
	Air conditioner		❍	❍	❍	❍	❍
	Cold W package		—	—	—	—	—
	Sun roof		—	❍	❍	—	—
	Dual airbag		❍	❍	❍	❍	❍
	Side airbag		❍	❍	❍	❍	❍
	Rear spoiler		❍	❍	❍	—	—
	Seat in pure hide		—	—	❍	—	—
	Front LSD		—	—	—	❍	❍
	Aluminum wheel	Gold color	—	—	—	❍	—
		Silver color	—	—	—	—	❍

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Wagon

Model			2.5 L		2.5 L	
			TS		OUTBACK	
			5MT	4AT	5MT	4AT
Curb weight (C.W.)	Front	kgf (lb)	778 (1,715)	801 (1,765)	783 (1,725)	805 (1,775)
	Rear	kgf (lb)	603 (1,330)	605 (1,335)	601 (1,325)	603 (1,330)
	Total	kgf (lb)	1,381 (3,045)	1,406 (3,100)	1,384 (3,050)	1,408 (3,105)
Gross axle weight (G.A.W.)	Front	kgf (lb)	939 (2,070)	939 (2,070)	939 (2,070)	939 (2,070)
	Rear	kgf (lb)	953 (2,100)	953 (2,100)	953 (2,100)	953 (2,100)
	Total	kgf (lb)	1,833 (4,040)	1,833 (4,040)	1,833 (4,040)	1,833 (4,040)
Option	Power window		❍	❍	❍	❍
	Power door lock		❍	❍	❍	❍
	Cruise control		❍	❍	❍	❍
	ABS		❍	❍	❍	❍
	Air conditioner		❍	❍	❍	❍
	Cold W package		—	—	—	—
	Sun roof		—	—	—	—
	Dual airbag		❍	❍	❍	❍
	Side airbag		—	—	—	—
	Rear spoiler		—	—	—	—
	Seat in pure hide		—	—	—	—
	Roof rail		❍	❍	❍	❍

Model			Turbo 2.0 L			
			WRX			
			5MT			4AT
Curb weight (C.W.)	Front	kgf (lb)	826 (1,820)	832 (1,834)	833 (1,836)	851 (1,875)
	Rear	kgf (lb)	610 (1,345)	620 (1,367)	622 (1,372)	610 (1,345)
	Total	kgf (lb)	1,436 (3,165)	1,452 (3,201)	1,455 (3,208)	1,461 (3,220)
Gross axle weight (G.A.W.)	Front	kgf (lb)	998 (2,200)	998 (2,200)	998 (2,200)	998 (2,200)
	Rear	kgf (lb)	953 (2,100)	953 (2,100)	953 (2,100)	953 (2,100)
	Total	kgf (lb)	1,901 (4,190)	1,901 (4,190)	1,901 (4,190)	1,901 (4,190)
Option	Power window		❍	❍	❍	❍
	Power door lock		❍	❍	❍	❍
	Cruise control		❍	❍	❍	❍
	ABS		❍	❍	❍	❍
	Air conditioner		❍	❍	❍	❍
	Cold W package		—	—	—	—
	Sun roof		—	❍	❍	—
	Dual airbag		❍	❍	❍	❍
	Side airbag		❍	❍	❍	❍
	Rear spoiler		—	—	—	—
	Seat in pure hide		—	—	❍	—
	Roof rail		❍	❍	❍	❍

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SUNROOF
T-TOP CONVERTIBLE TOP (SUNROOF)

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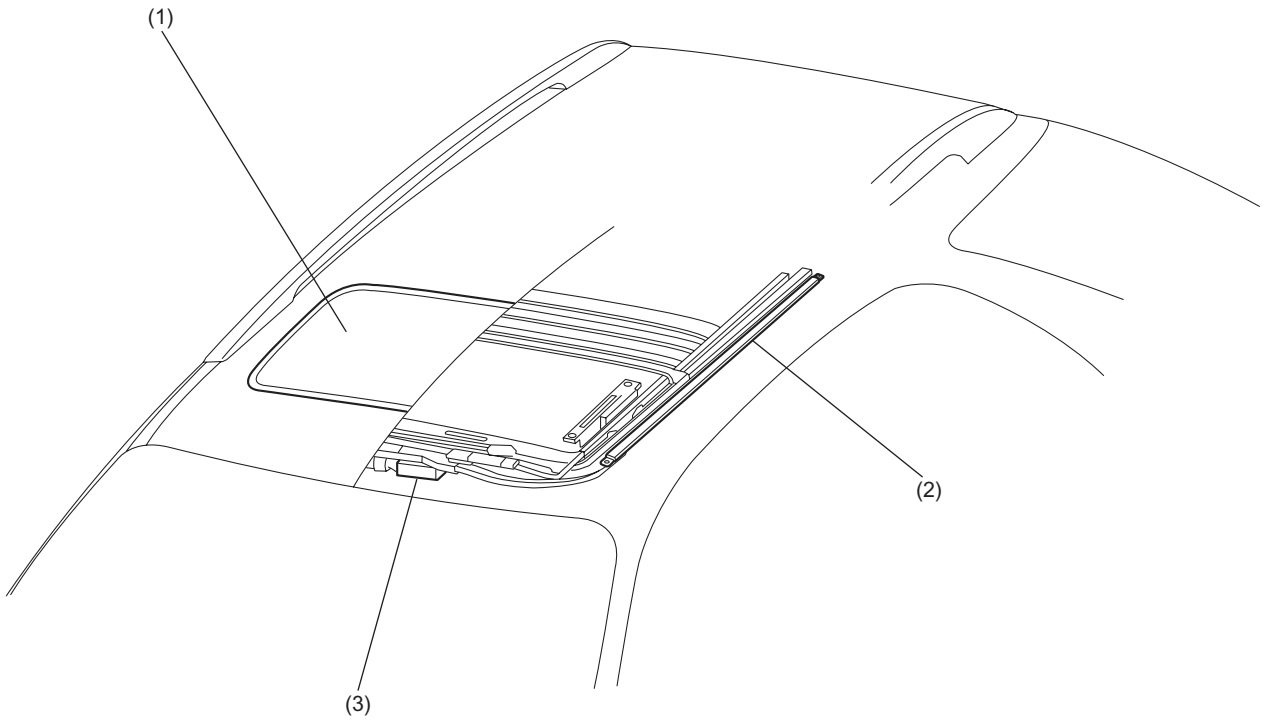
1. Sunroof

A: GENERAL



SR-00073

(1) Glass lid
(2) Frame
(3) Motor

The sunroof has both tilting and sliding mechanisms. The tilting mechanism raises or lowers the rear of the glass lid when the tilt switch is operated; the sliding mechanism moves the lid backward to open or forward to close when the OPEN/CLOSE switch is operated.

The sunroof has the following features:

● Reduced thickness of the sunroof provides extra overhead clearance in the passenger compartment.

● Extensive use of aluminum die castings for sunroof components contributes to reduction in weight.

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B: FUNCTION

1. SUNROOF TILTING AND SLIDING OPERATION

● With the sunroof fully closed, pushing the rear side of the tilt switch causes the rear end of the sunroof lid to rise by 50 mm (1.97 in). Pushing then the front side of the switch causes the lid to lower to the original position.

● Pushing the OPEN/CLOSE switch rearward causes the sunroof lid to slide rearward and open. Pushing the switch forward causes the glass lid to move forward and stop at a point 150 mm (5.91 in) before the fully closed position. Pushing the switch again closes the lid completely.

2. SUNSHADE OPERATION

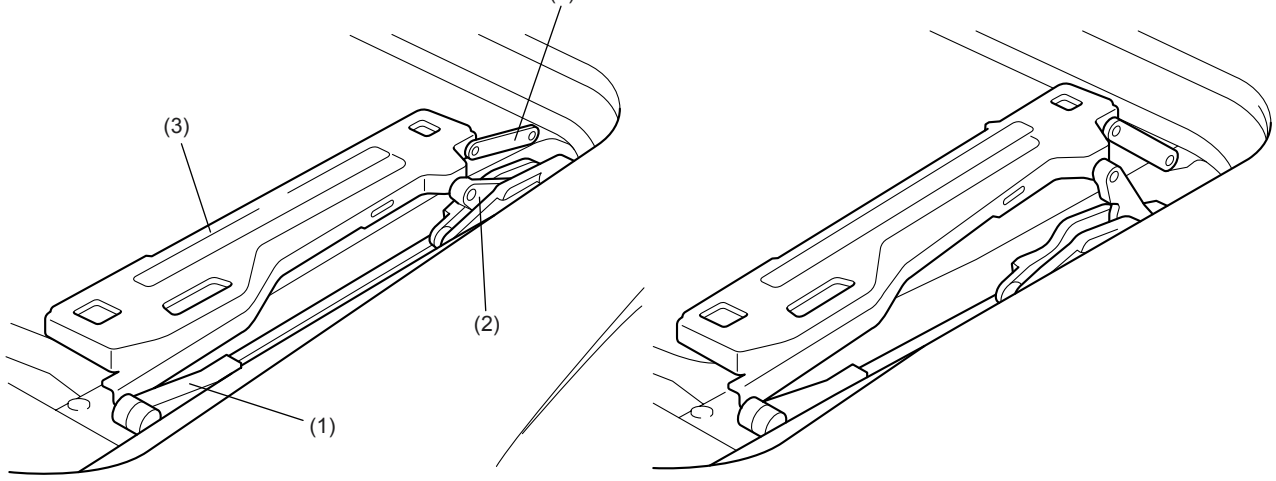
● The sun shade can be opened or closed manually when the sunroof is closed.

● The sun shade, if closed, moves rearward together with the glass lid when the OPEN side of the OPEN/CLOSE switch is pushed.

C: SLIDING AND TILTING MECHANISMS

The motor installed at the front of the sunroof frame rotates a pinion gear to move the drive wire.

This opens, closes, tilts up or tilts down the glass lid by way of the rear guide connected to the drive wire.



SR-00042

(A) Fully closed position
(B) Tilted up position
(1) Front guide
(2) Rear guide
(3) Lid bracket
(4) Link

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TRANSFER CASE

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1. Center Differential

Regarding the construction and operation of the center differential, refer to 5MT or 6MT.
<Ref. to 5MT, Center Differential.> <Ref. to 6MT, Driver-controllable Center Differential System.>

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2. AWD Transfer System

Regarding the construction and operation of the AWD transfer system, refer to 4AT. <Ref. to 4AT, AWD Transfer System.>

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3. Oil Pump

Regarding the construction and operation of the oil pump, refer to 6MT. <Ref. to 6MT, Oil Pump.>

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WHEEL AND TIRE SYSTEM

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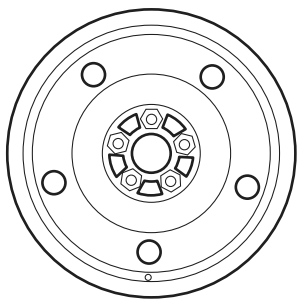
1. General

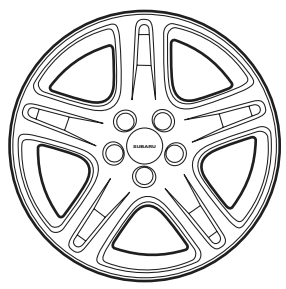
According to the model grade, the tire size is either of the following three types: P195/60R15, P205/55R16 or 225/45R17.
Steels wheels are provided with a full wheel cap, and aluminum wheels are provided with a center cap.
Four types of disk wheels are provided for model grades.

A: TIRE & WHEEL

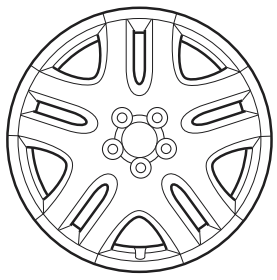
Specifications		Tire size	Rim size	Aluminum / steel
Front and rear	TS	P195/60R15 87H	15×6JJ	Steel (A)
	RS, WRX, OUTBACK	P205/55R16 89H	16×6 1/2JJ	Steel (B), aluminum (C)
	STi	225/45R17 90W	17×7 1/2JJ	Aluminum (D)



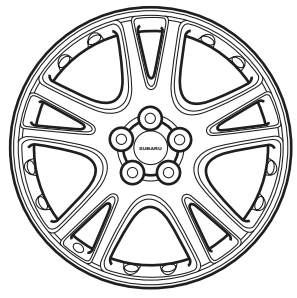
(A)



(B)



(C)



(D)

WT-00036

(A) Steel wheel for TS
(B) Steel wheel for RS and WRX
(C) Aluminum wheel for OUTBACK
(D) Aluminum wheel for STi

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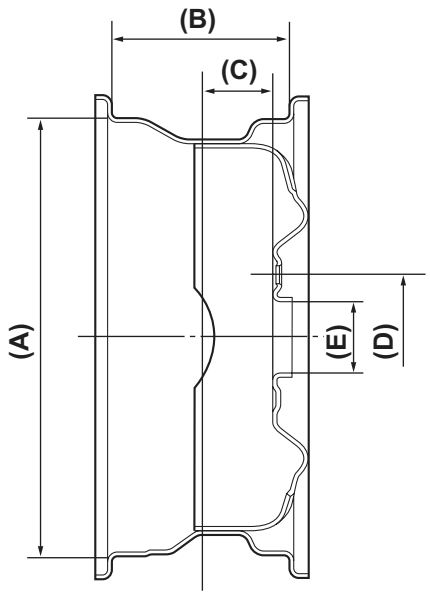
Size	A mm	B mm (in)	C mm	D		E mm
				mm	Hole	
15× 6JJ	∅380.2	152.0 (6)	55	∅100	5	∅56
16× 6 1/2JJ	∅405.6	165.5 (6.5)	48	∅100	5	∅56
16× 6 1/2JJ	∅405.6	165.5 (6.5)	55	∅100	5	∅56
17× 7JJ	∅436.6	178.0 (7)	55	∅100	5	∅56
17× 7 1/2JJ	∅436.6	190.5 (7.5)	53	∅100	5	∅56



WT-00031

(A) Rim diameter
(B) Rim width
(C) Offset
(D) P.C.D. (bolt hole pitch circle diameter)
(E) Center hole diameter

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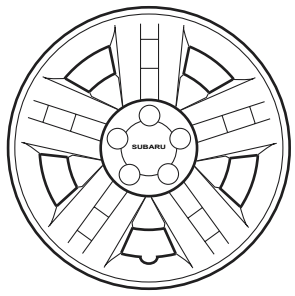
B: WHEEL CAP

Steels wheels are provided with a wheel cap.



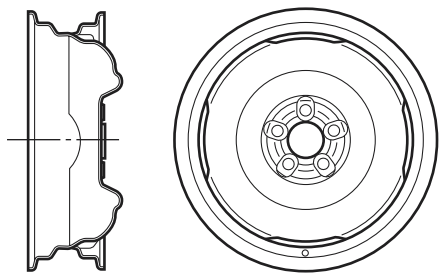
(A) WT-00037

(A) Wheel cap for 15 × 6JJ

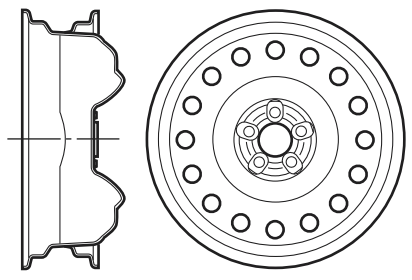
C: SPARE TIRE

A light and compact temporary type spare tire is equipped on all models.

Specifications	Tire size	Rim size
T-type tire	T135/70D16 100M	16 × 4T
	T155/70D17 102M	17 × 4T



(A)



(B)

WT-00038

(A) 16 × 4T

(B) 17 × 4T

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WIPER AND WASHER SYSTEMS

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1. Front Wiper and Washer

A: GENERAL

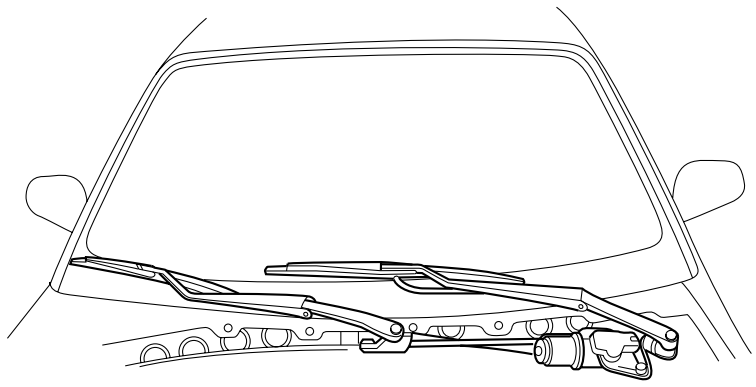
1. FRONT WIPER

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 the HI and LOW speed modes and the INTERMITTENT mode. The operation modes can be selected by turning the wiper switch incorporated in the combination switch.

3) In the INTERMITTENT mode, the intermittent unit installed behind the combination switch controls the front wiper operation interval.

4) The front wiper system uses a modular construction in which the wiper motor forms an integral part of the linkage. The motor is installed on the body through rubber mounting.



WW-00159

5) The size of the motor is minimized by changing the stator shape, coil windings and the magnet.

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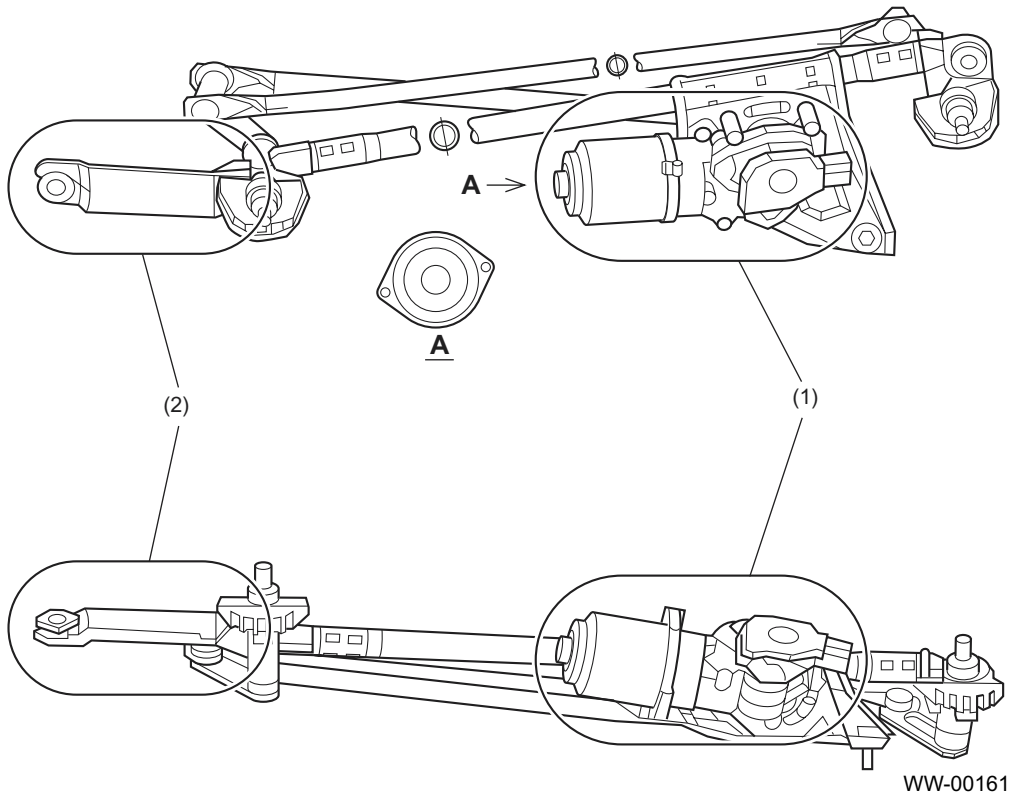
6) The mounting bracket is modified. In case of a personal accident, the bracket area breaks when hit by a person to absorb the impact and lessen the degree of injury.



(1) Motor
(2) Bracket

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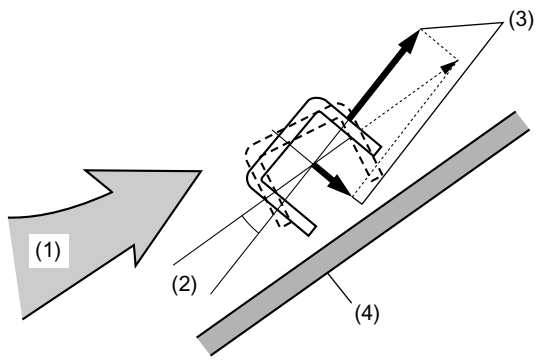
7) The driver's side wiper arm is angled to disperse the force applied to the wiper arm by the air flow. A part of the dispersed force acts to press the wiper blade against the windshield helping to prevent the wiper blade being lifted up.



WW-00043

(1) Air flow
(2) Angle of twist
(3) Dispersed force
(4) Windshield

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2. FRONT WASHER SYSTEM

1) The washer system consists of a washer tank, a motor and pump unit, 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 and pump unit is installed at the bottom of the washer tank.

4) The washer nozzles are installed on the hood. Each nozzle has two spray holes.

5) Each washer nozzle is provided with a check valve which is located just below it.

3. SPECIFICATIONS

Washer tank	Capacity			4.0 ℓ (4.2 US qt, 3.5 Imp qt)
Wiper motor	Rated voltage			12 V
	No-load current			4 A or less
	Speed [2.0 N· m (20 kg-cm, 17 in-lb)]		HIGH	66±6 rpm
			LOW	43±5 rpm
	Locked rotor characteristics	HIGH	Torque	29.4 N· m (300 kg-cm, 2.2 ft-lb) or more
			Current	36.0 A or less
		LOW	Torque	34.3 N· m (350 kg-cm, 2.5 ft-lb)
			Current	31.5 A or less
Wiper blade	Length	Driver's side		550 mm (21.65 in)
		Passenger's side		425 mm (19.69 in)

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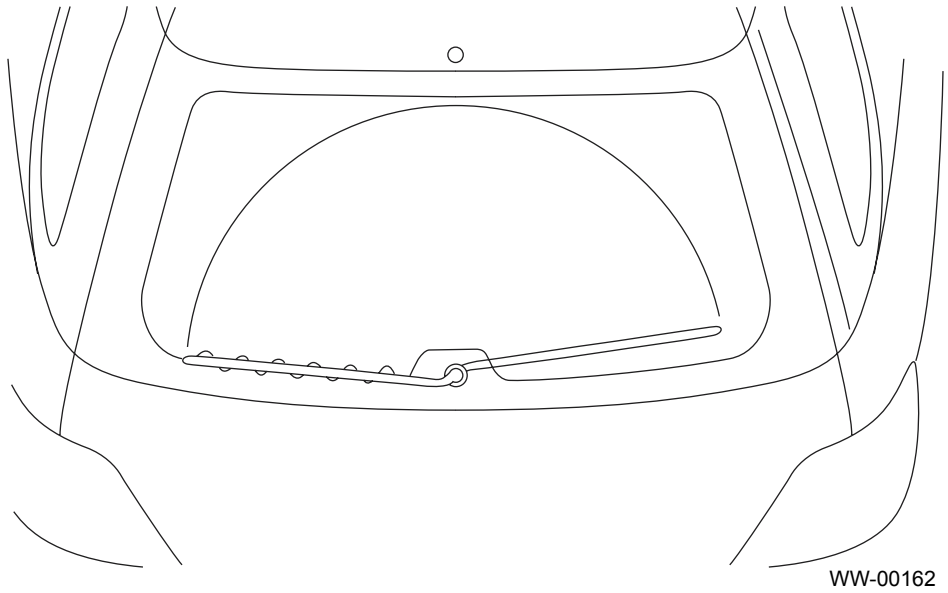
2. Rear Wiper and Washer

A: GENERAL

1. REAR WIPER

1) The rear wiper operates intermittently at a 10-second interval.
2) The rear wiper operates over a 168-degree angle.



WW-00162

2. REAR WASHER SYSTEM

1) The same washer tank is shared by the front and rear washer systems.

2) The washer motor and pump unit is installed at the bottom of the washer tank, adjacent to the front washer's unit.

3) The washer nozzle is installed on the upper portion of rear gate panel. The nozzle has two spray holes.

4) The washer nozzle is provided with a check valve which is located just below it.

3. SPECIFICATIONS

Wiper motor	Rated voltage	12 V
	No-load current	2 A or less
	Speed [at 0.5 N· m (5 kg-cm, 4.3 in-lb)]	25 rpm or more
	Locked rotor current	13 A or less
Wiper blade	Length	375 mm (14.76 in)