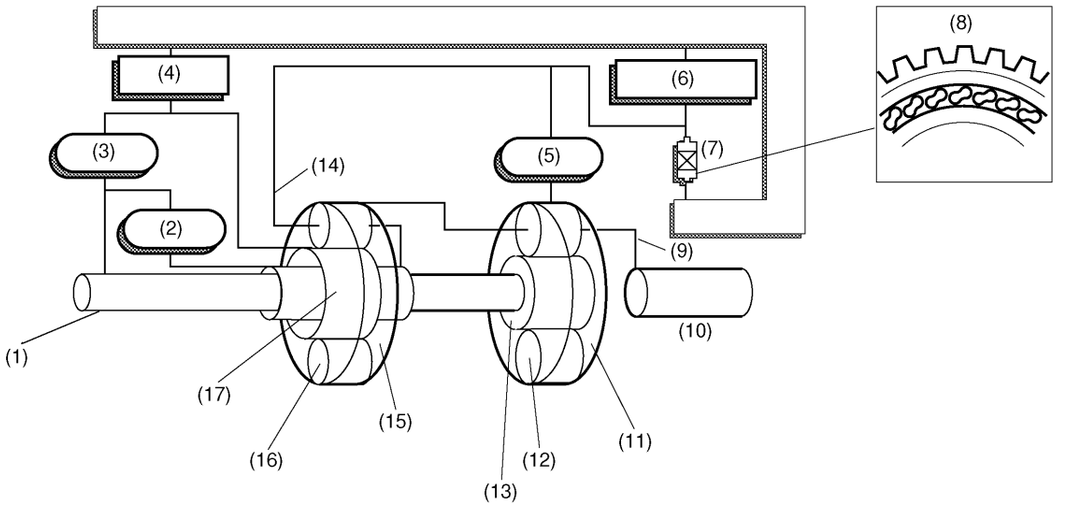
9. Gear Train

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.



B3H0929A

(1) Input shaft
(2) High clutch (Operates at 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) Reduction drive 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

B: OPERATION TABLE

1. NORTH AMERICAN MODEL

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		○	○			

B3H0998A

2. EXCEPT FOR NORTH AMERICAN MODEL

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		○	○			

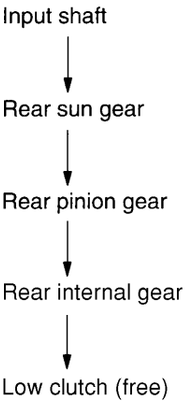
S3H0226B

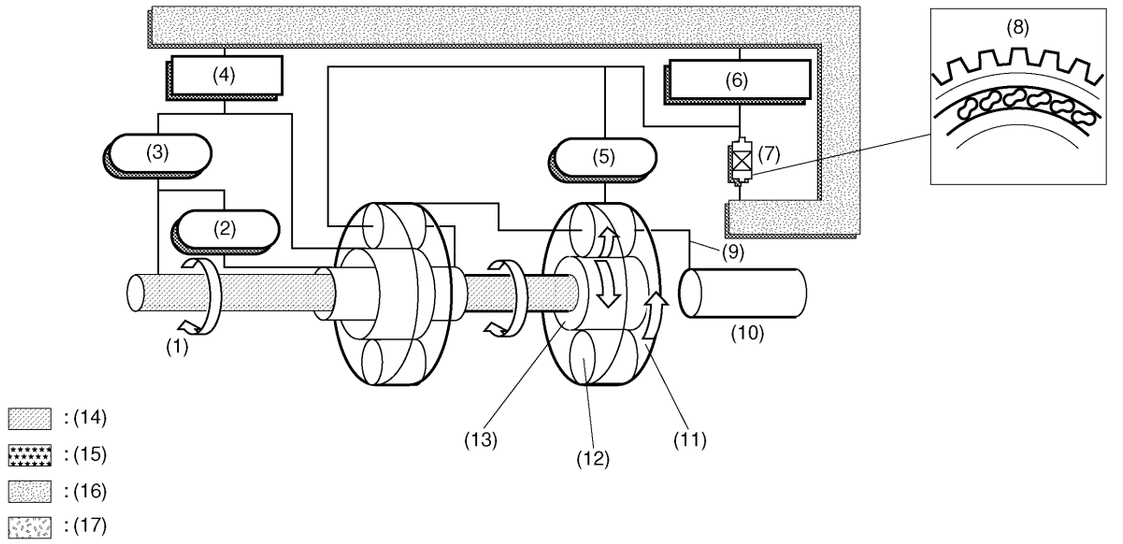
MEMO

C: N RANGE

Since the rear sun gear and the high clutch drum are in mesh with the input shaft, they rotate together with input shaft.
The high clutch drum does not transmit the 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	 S3H0192B



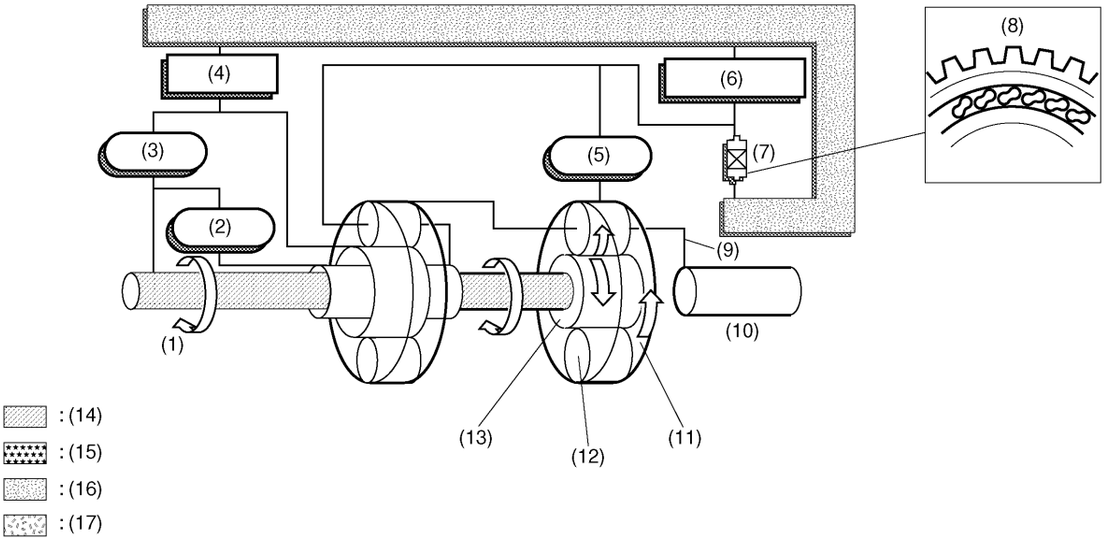
B3H0930A

(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) Locked
(17) Planetary gear component involved in power transmission

D: 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) S3H0193B



B3H0930A

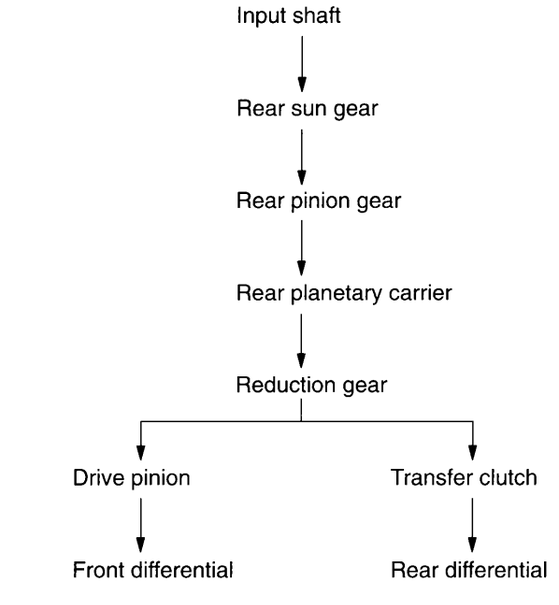
(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Low clutch
(6) Low & reverse brake
(7) One-way clutch
(8) No effect
(9) Rear planetary carrier
(10) MPT models: Reduction drive shaft
VTD models: Intermediate shaft
(11) Rear internal gear
(12) Rear pinion gear
(13) Rear sun gear
(14)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

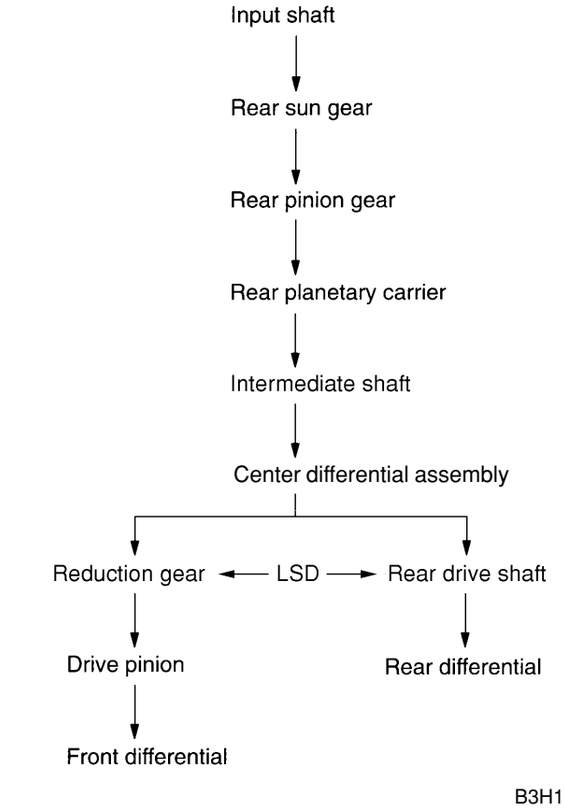
E: 1ST GEAR OF D OR 3 RANGE (D_1, 3_1) FOR NORTH AMERICAN MODEL

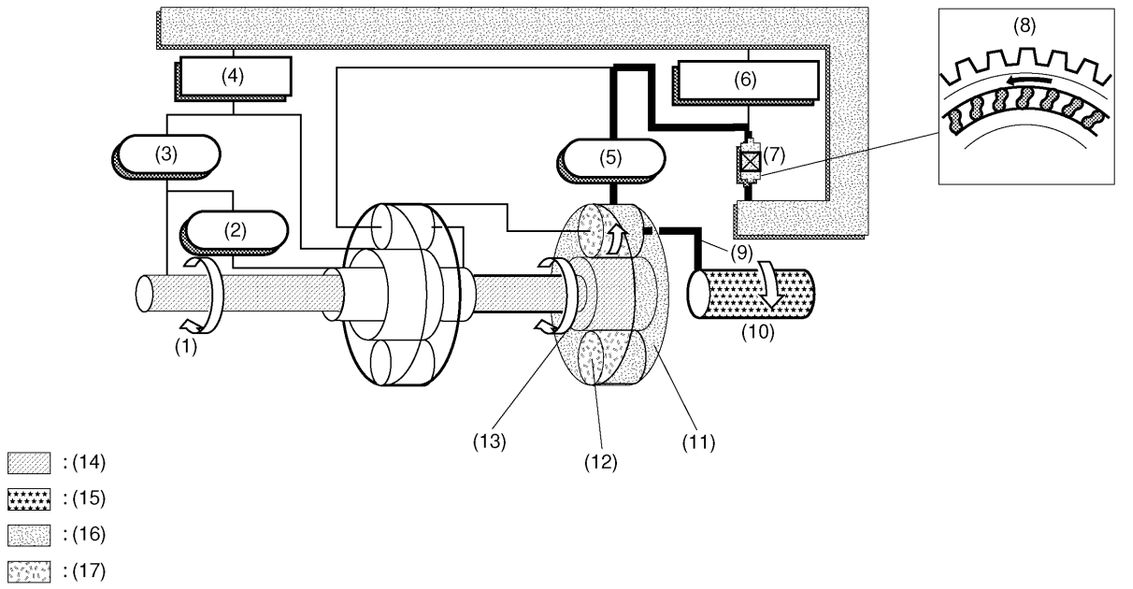
When the 1st gear is selected in the D or 3 range, only the low clutch is engaged. In this state, the rear internal gear attempts to rotate counterclockwise but it is impossible by the action of the one-way clutch which locks the internal gear to the transmission case. As a result, rotation of the rear 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**







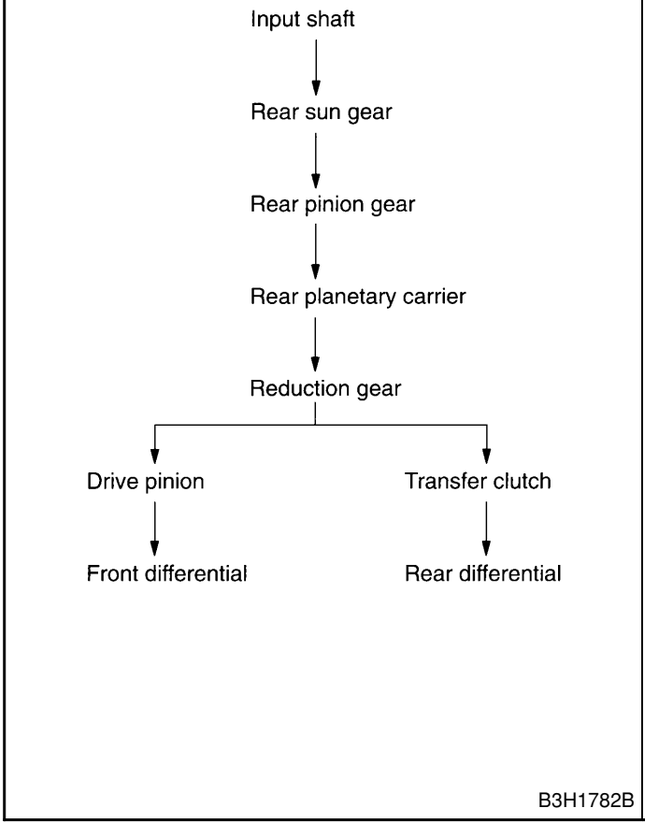
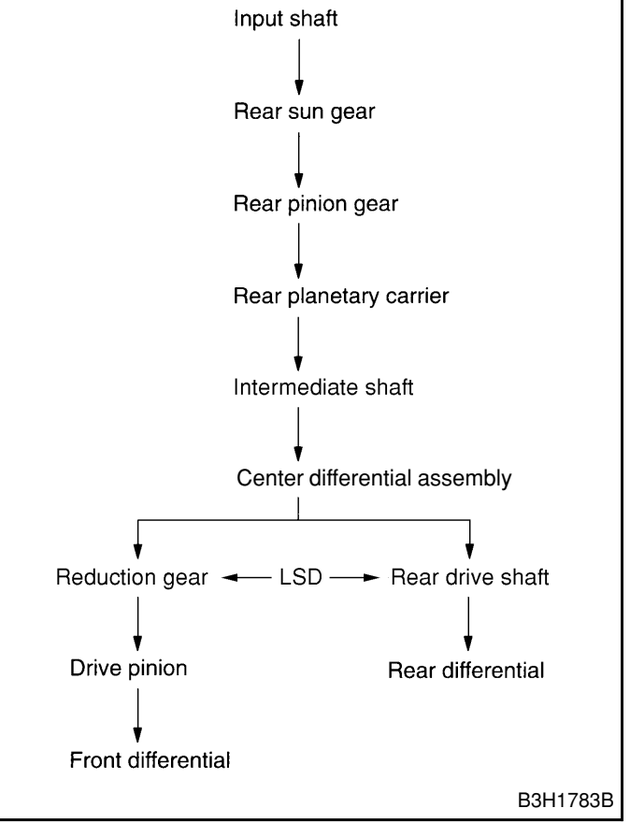
B3H0931A

(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 component involved in power transmission

F: 1ST SPEED OF D, 3 OR 2 RANGE (D_1, 3_1, 2_1) EXCEPT FOR NORTH AMERICAN MODEL

When the 1st gear is selected in the D, 3 or 2 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.

<table>
<tr><td colspan="2">Operating condition of components</td></tr>
<tr><td colspan="2">Low clutch : Engaged
One-way clutch : Locked</td></tr>
<tr><td colspan="2">Power flow (in acceleration)</td></tr>
<tr><td>MPT models
 
</td><td>VTD models
 
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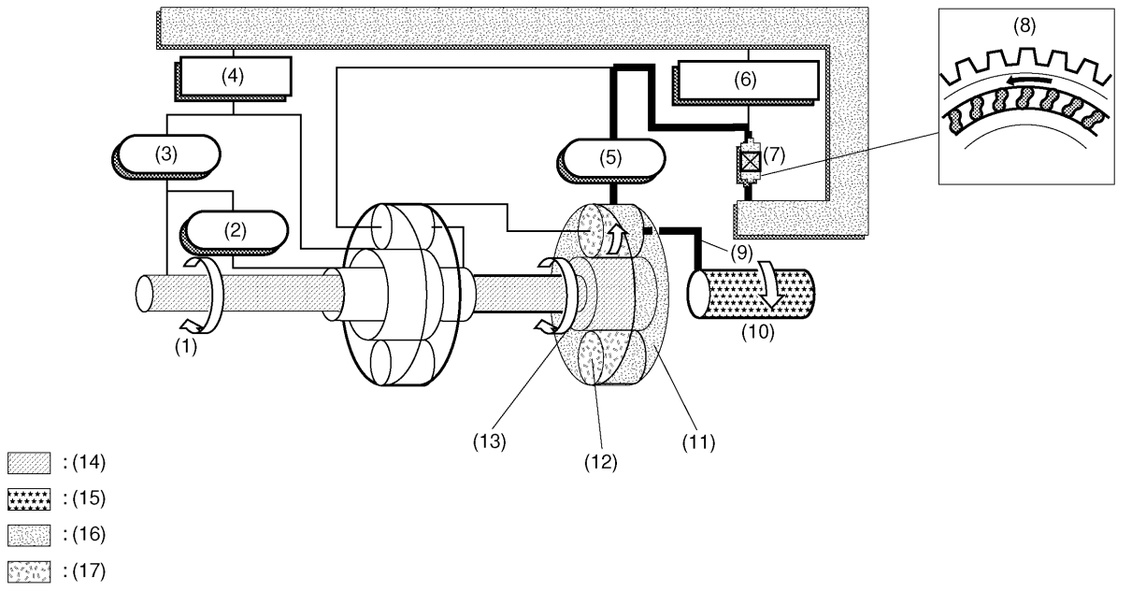


B3H0931A

(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 component involved in power transmission

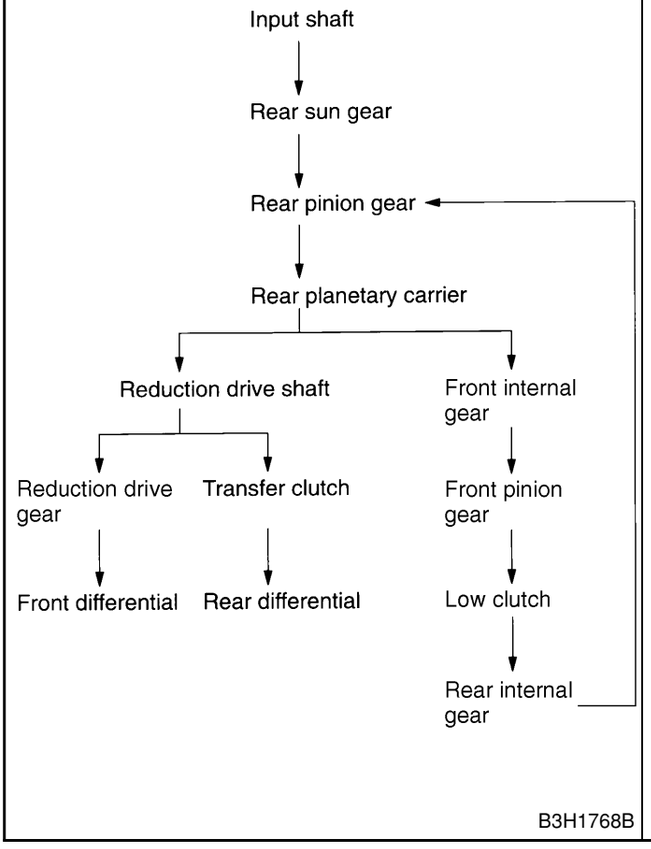
G: 2ND GEAR OF D, 3 OR 2 RANGE (D_2, 3_2, 2_2)

When the 2nd gear is selected in the 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.

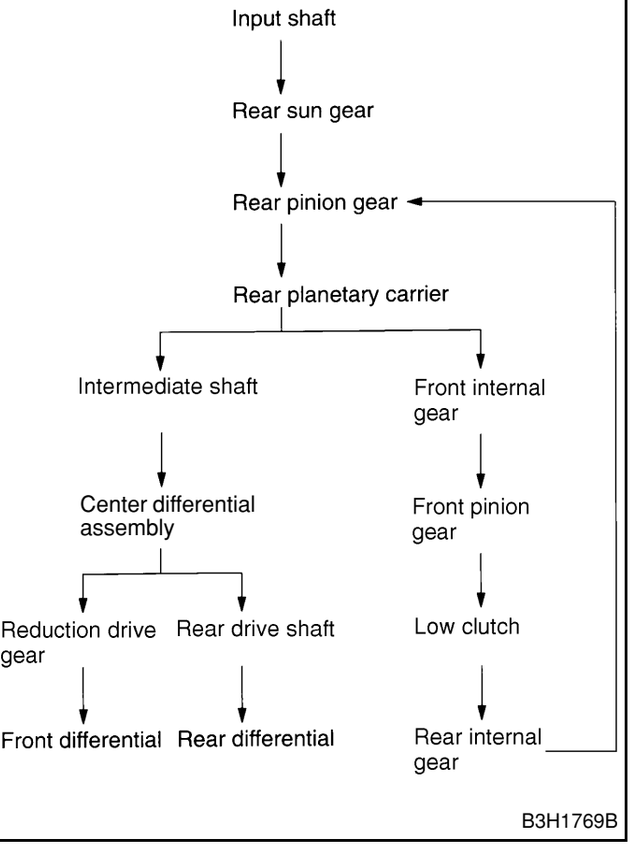
*: MPT models only. VTD models are equipped with an intermediate shaft.

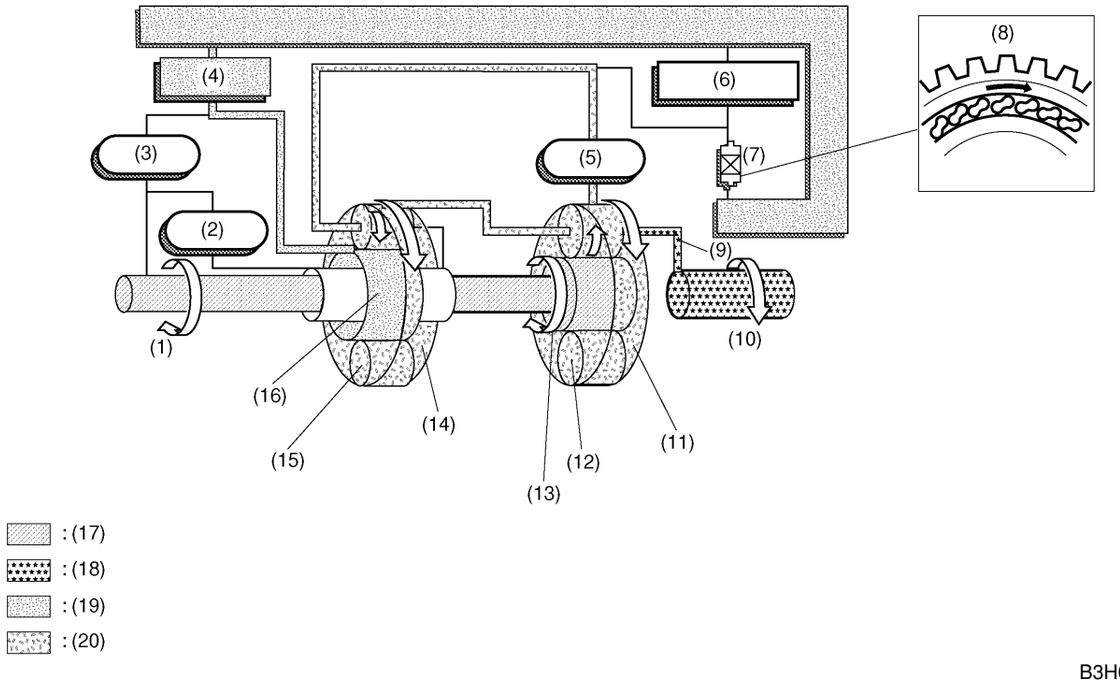
Operating condition of components
Low clutch : Engaged 2-4 brake : Engaged
Power flow (in acceleration)

MPT models



VTD models





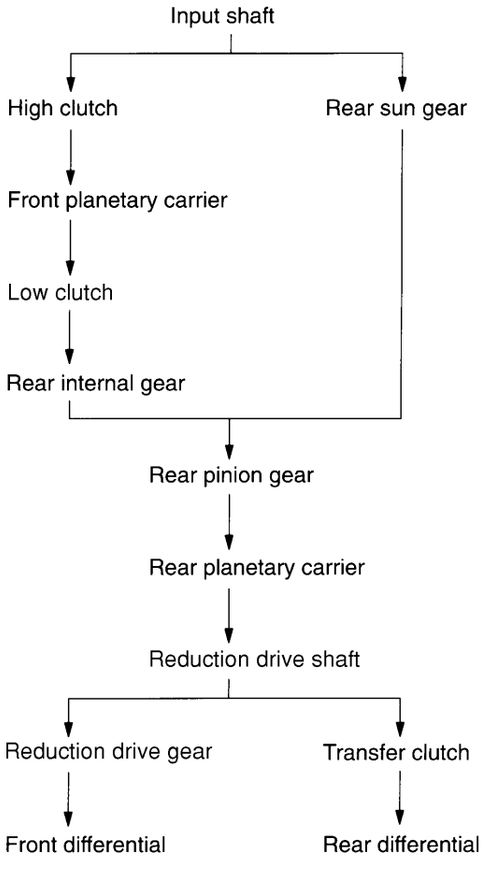
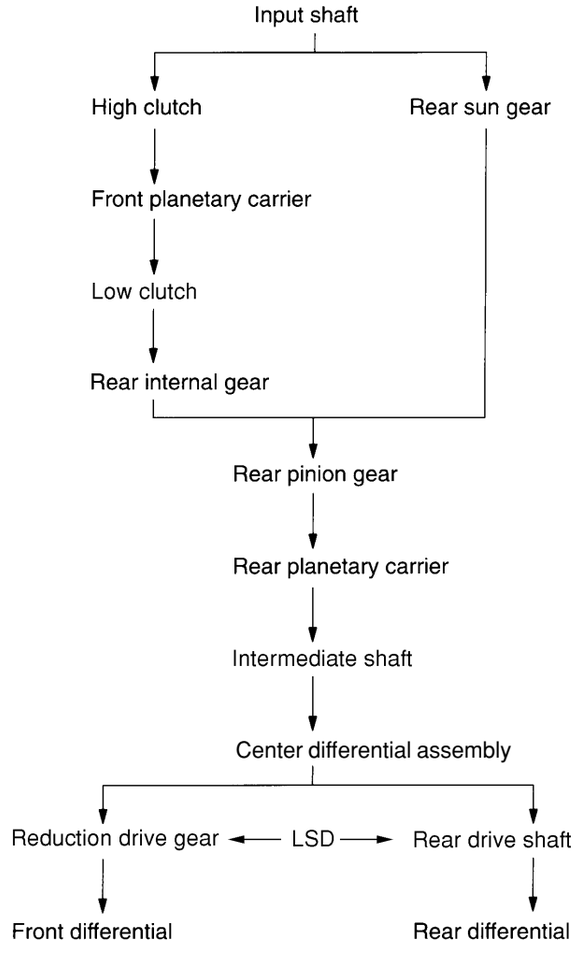
B3H0932A

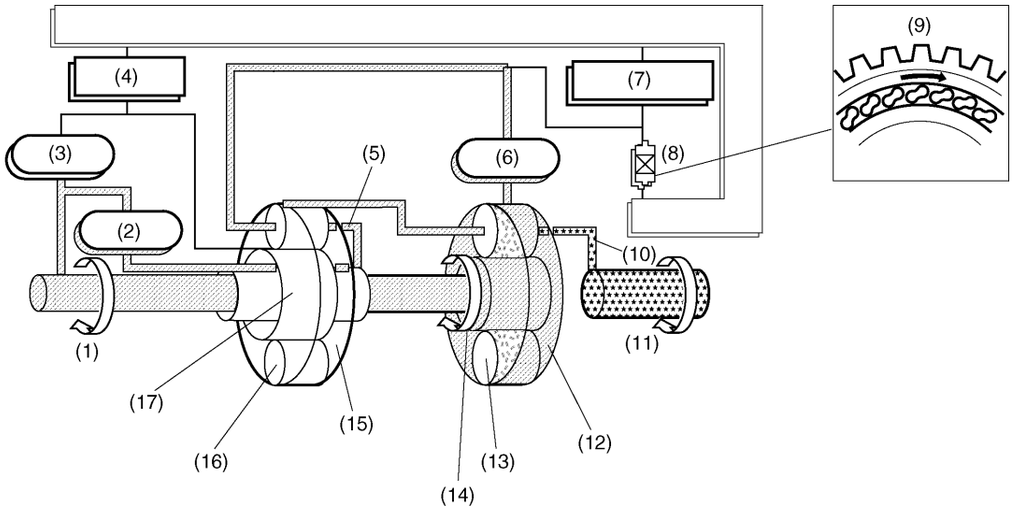
(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Low clutch
(6) Low & reverse clutch
(7) One-way clutch
(8) Free
(9) Rear planetary carrier
(10) MPT models: Reduction drive shaft
VTD models: Intermediate shaft
(11) Rear internal gear
(12) Rear pinion gear
(13) Rear sun gear
(14) Front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

H: 3RD GEAR OF 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.

Operating condition of components	
High clutch : Engaged Low clutch : Engaged	
Power flow (in acceleration)	
MPT models	**VTD models**
 B3H1784B	 B3H1785B



B3H0933A

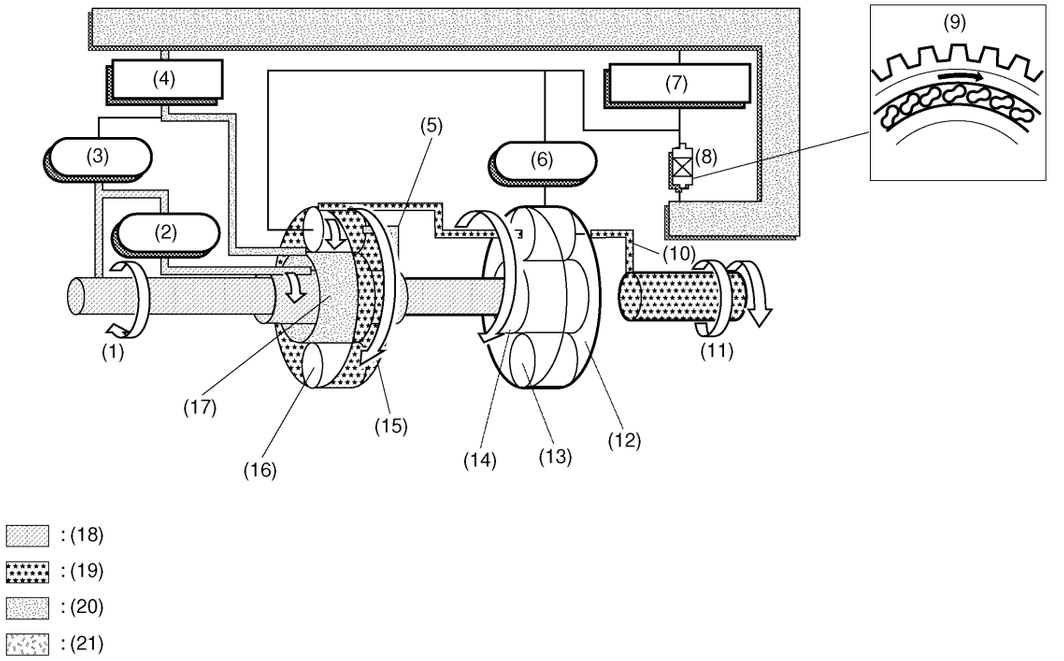
(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Front planetary carrier
(6) Low clutch
(7) Low & reverse brake
(8) One-way clutch
(9) Free
(10) Rear planetary carrier
(11) MPT models: Reduction drive shaft
VTD models: Intermediate shaft
(12) Rear internal gear
(13) Rear pinion gear
(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 component involved in power transmission

I: 4TH GEAR OF 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.

Operating condition of components	
2-4 brake : Engaged High clutch : Engaged	
Power flow (in acceleration)	
MPT models	**VTD models**
Input shaft ↓ High clutch ↓ Front planetary carrier ↓ Front pinion gear ↓ Front internal gear ↓ Rear planetary carrier ↓ Reduction drive shaft ↓ Reduction drive gear → Front differential Transfer clutch → Rear differential	Input shaft ↓ High clutch ↓ Front planetary carrier ↓ Front pinion gear ↓ Front internal gear ↓ Rear planetary carrier ↓ Intermediate shaft ↓ Center differential assembly ↓ Reduction drive gear ← LSD → Rear drive shaft ↓ ↓ Front differential Rear differential
B3H1786B	B3H1787B

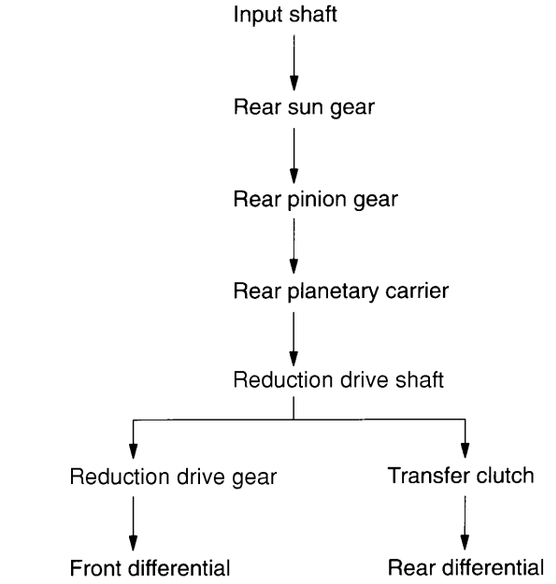
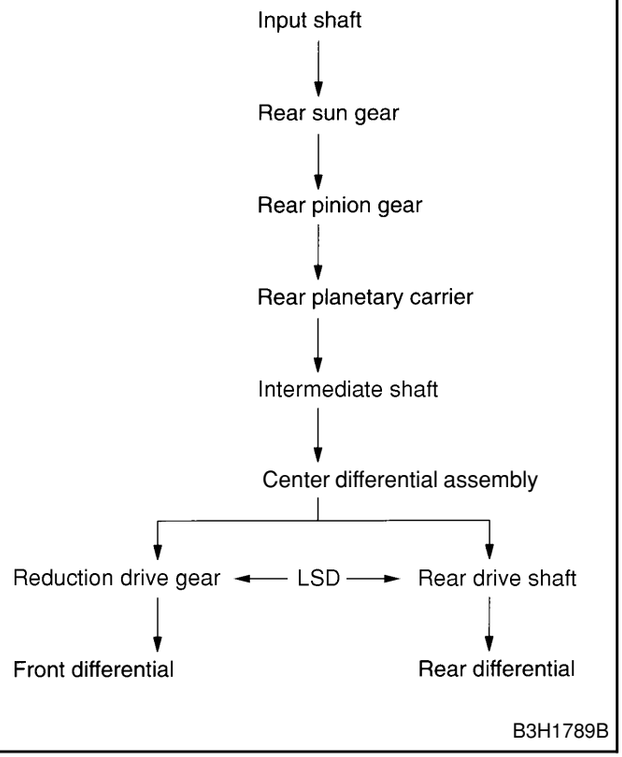


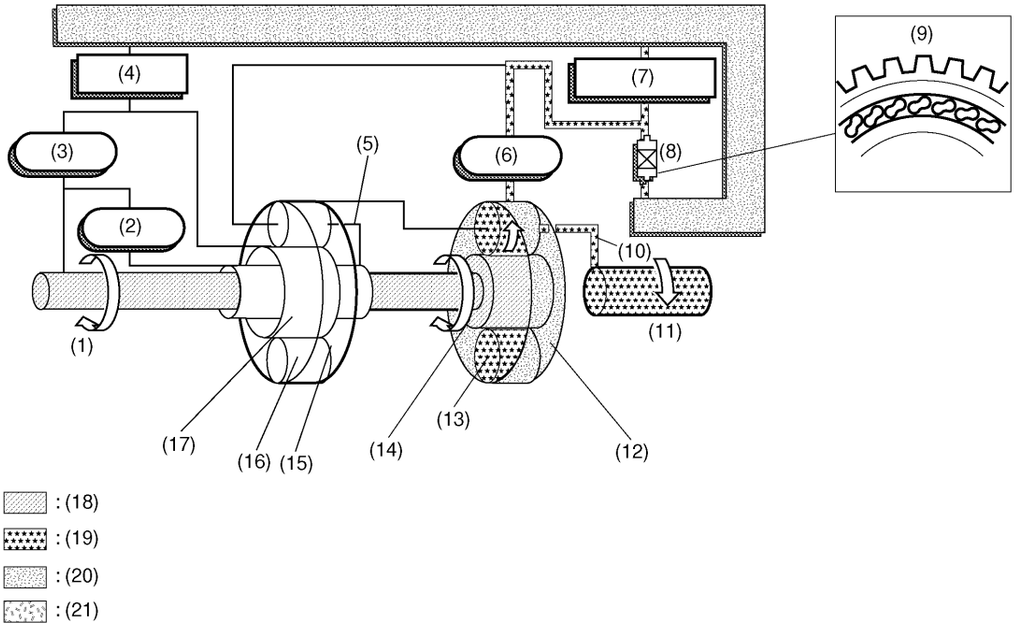
B3H0934A

(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

J: 1ST GEAR OF 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.

Operating condition of components	
Low clutch : Engaged Low & reverse brake : Engaged One-way clutch : Operating	
Power flow (in acceleration)	
MPT models	**VTD models**
	



B3H0936A

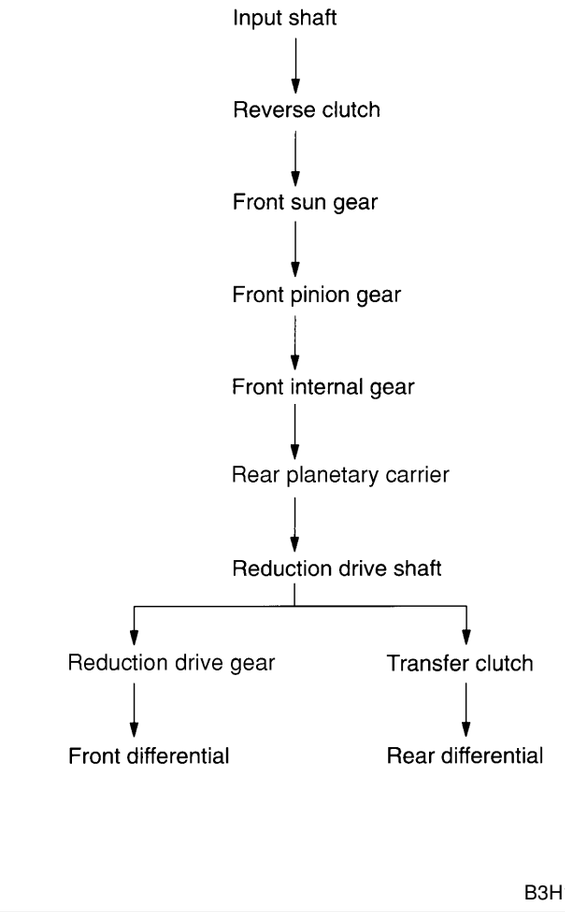
(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Front planetary carrier
(6) Low clutch
(7) Low & reverse brake
(8) One-way clutch
(9) No effect
(10) Rear planetary carrier
(11) MPT models: Reduction drive shaft
VTD models: Intermediate shaft
(12) Rear internal gear
(13) Rear pinion 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 component involved in power transmission

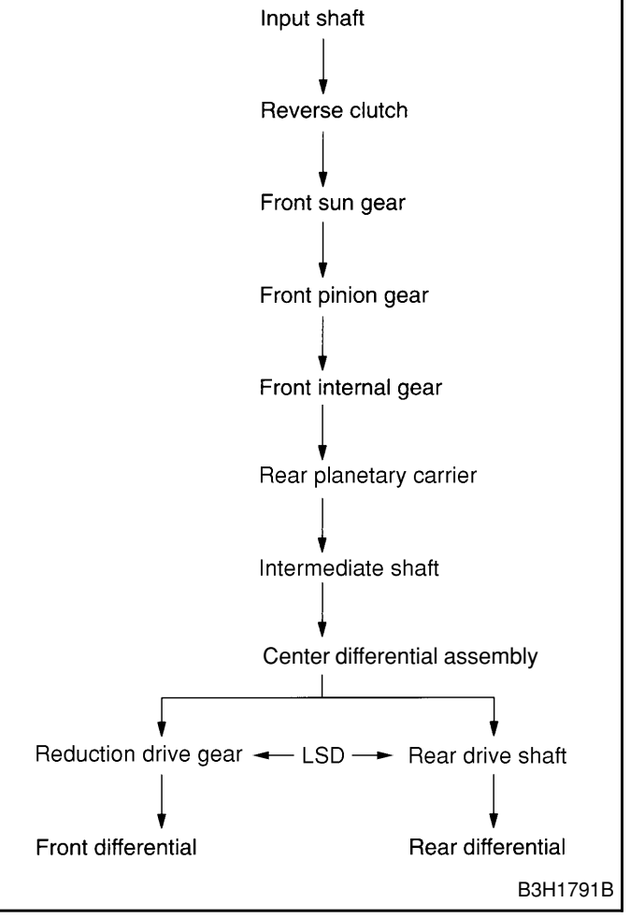
K: R RANGE

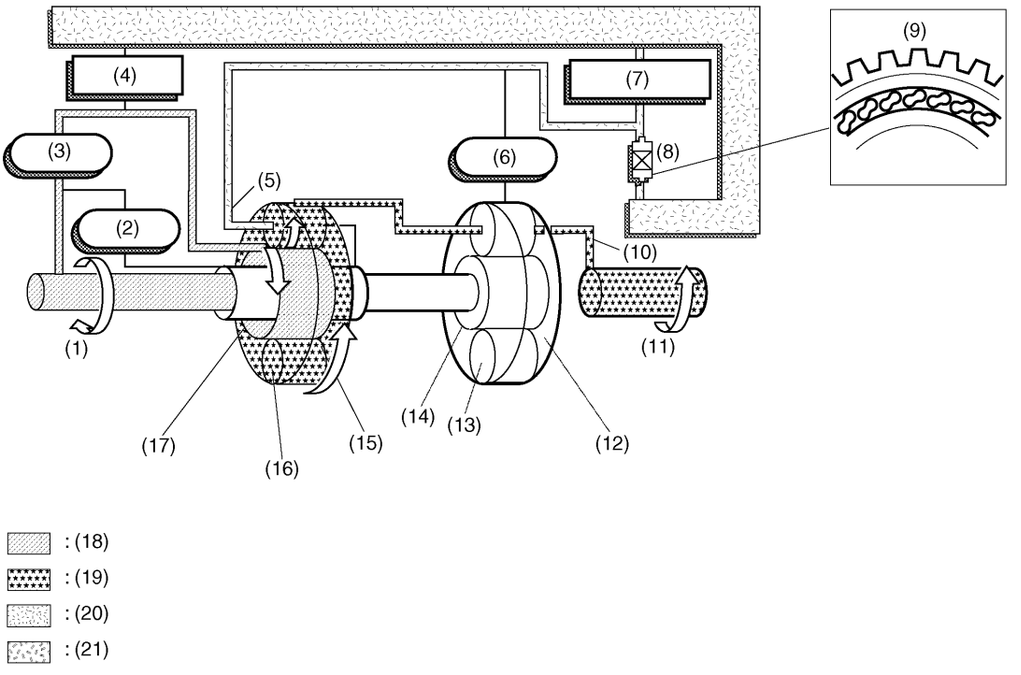
When the selector lever is placed in the R position, the reverse clutch and the low & reverse brake are engaged. The reverse clutch allows the input shaft torque to be transmitted to the front sun gear, while the low & reverse brake allows the low clutch drum to be interlocked with the transmission case.
Rotation of the front sun gear causes the front pinion gears to rotate in the reverse driving 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.

Operating condition of components	
Reverse clutch : Engaged Low & reverse brake : Engaged	
Power flow (in acceleration)	
MPT models	**VTD models**







B3H0935A

(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 component involved in power transmission