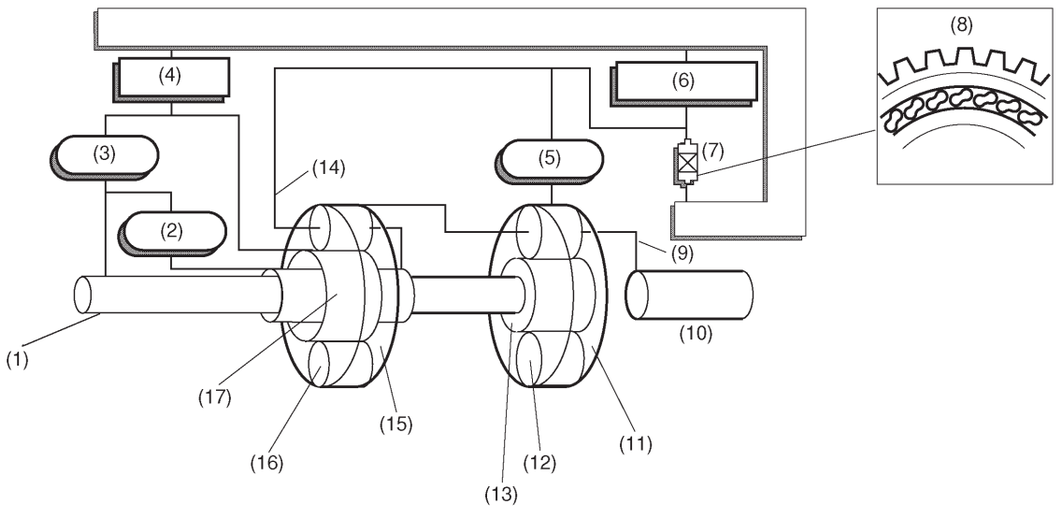
8. Power Train

A: CONSTRUCTION

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



B3H0929A

(1) Input shaft
(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

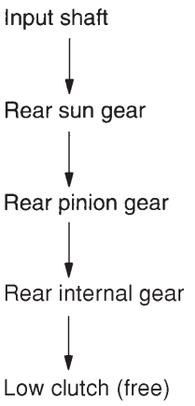
Selector lever operation			Rev./C	2-4/B	High/C	Low/C	Lo/ Rev./B	OWC
	P							
	R		○				○	
	N							
	D	1ST				○		○
		2ND		○		○		
		3RD			○	○		
		4TH		○	○			
	3	1ST				○		○
		2ND		○		○		
		3RD			○	○		
		4TH		○	○			
	2	1ST						
		2ND		○		○		
		3RD			○	○		
		4TH		○	○			
	1	1ST				○	○	○
		2ND		○		○		
	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

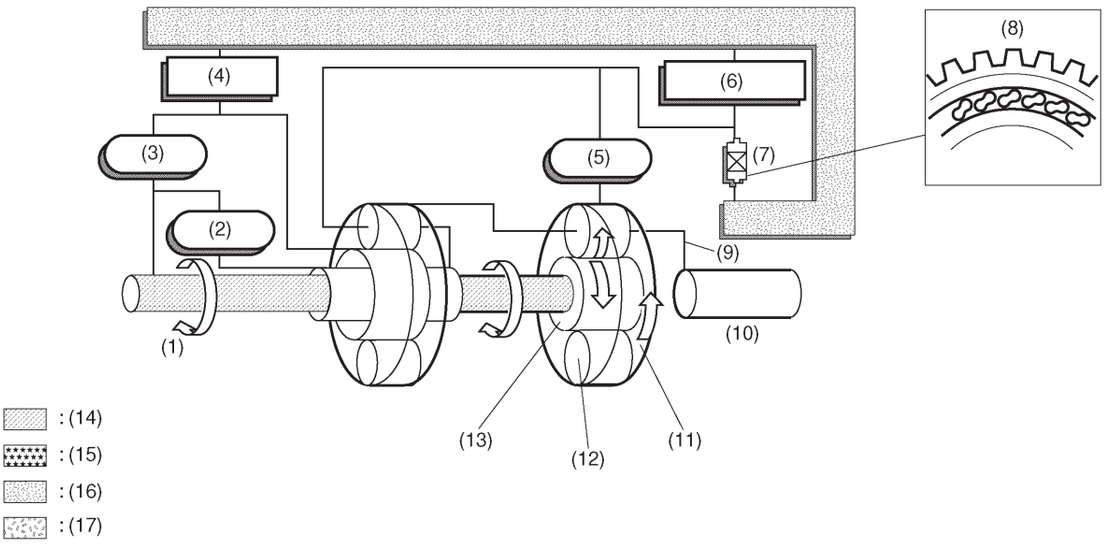
B3H0998A

MEMO

C: N RANGE

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

Operating condition of parts	Power flow (in acceleration)
All clutches and brakes are free	 S3H0192B



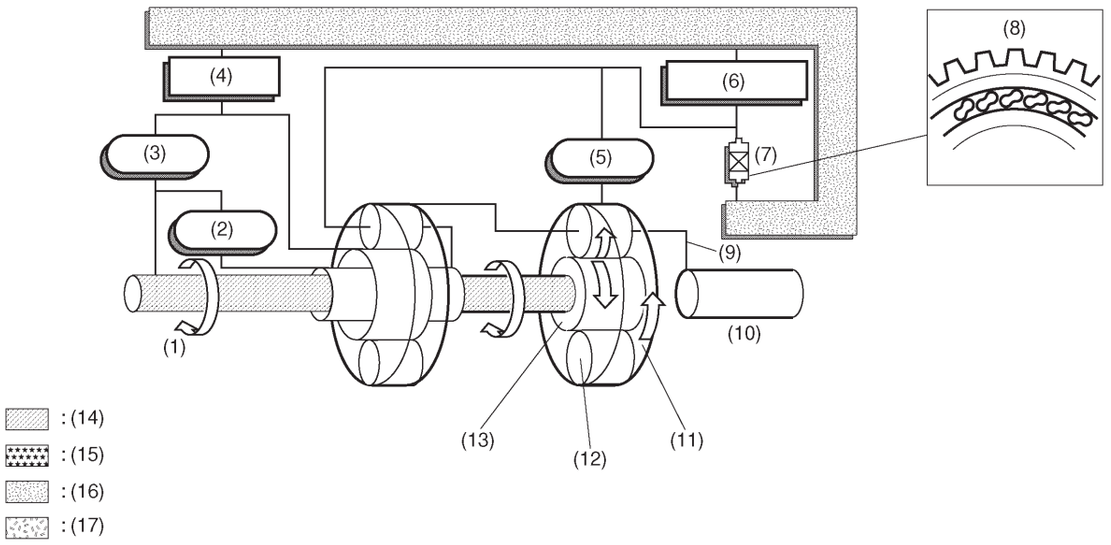
B3H0930A

(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) Reduction drive shaft
(11) Rear internal gear
(12) Rear pinion gear
(13) Rear sun gear
(14) Input
(15) Output
(16) Locked
(17) Component

D: P RANGE

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

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

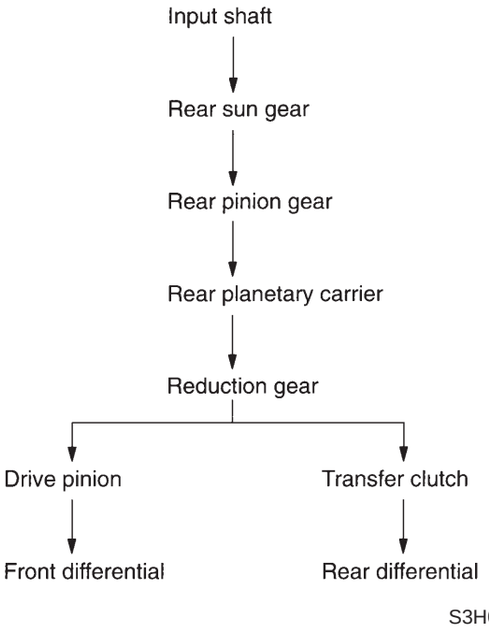


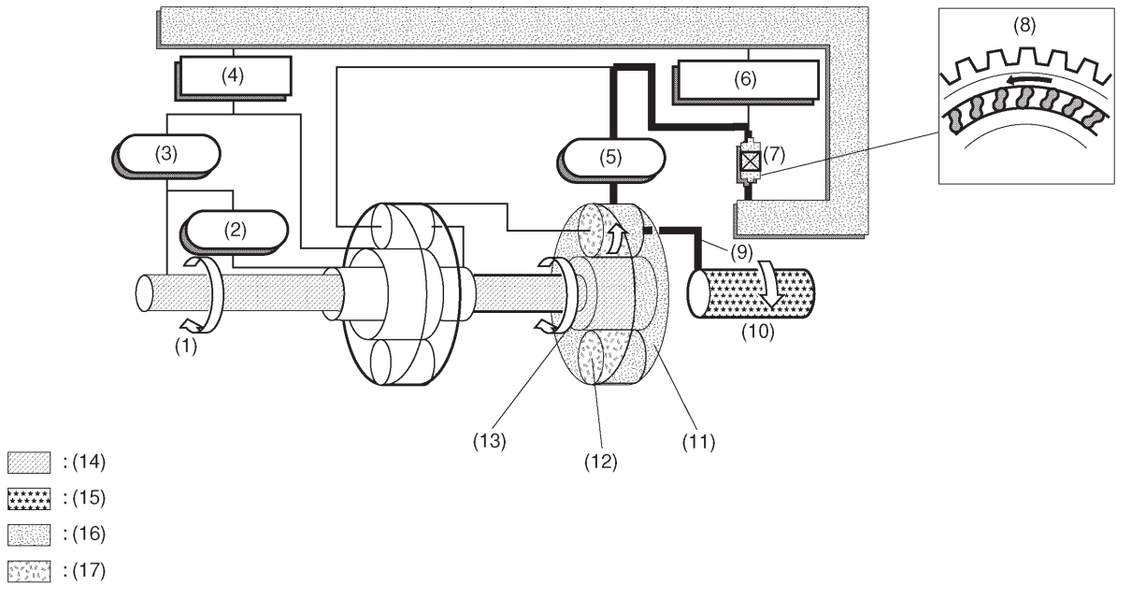
B3H0930A

(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) Reduction drive shaft
(11) Rear internal gear
(12) Rear pinion gear
(13) Rear sun gear
(14) Input
(15) Output
(16) Locked
(17) Component

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

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

Operating condition of parts	Power flow (in acceleration)
Low clutch : Engaged One-way clutch : Operating	 S3H0194B

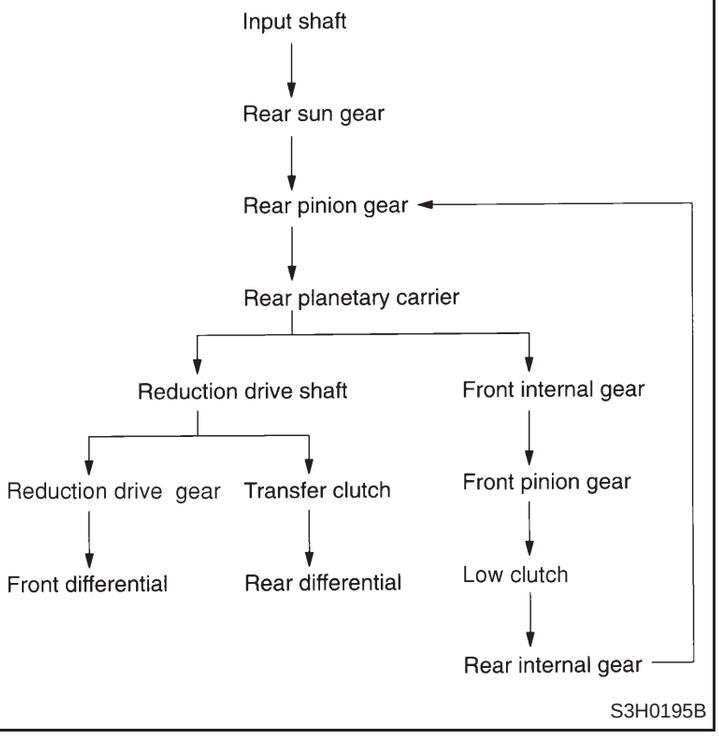


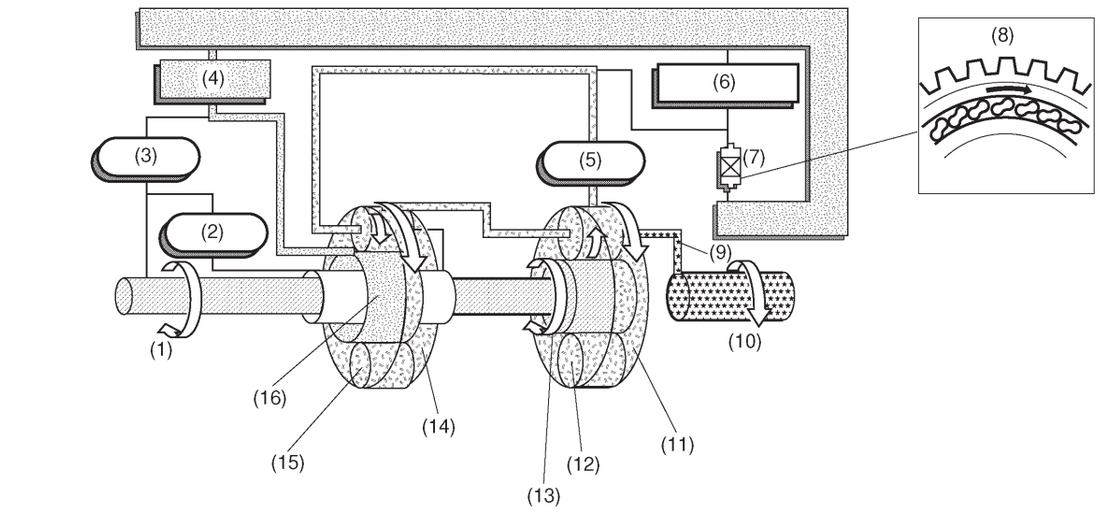
B3H0931A

(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) Reduction drive shaft
(11) Rear internal gear
(12) Rear pinion gear
(13) Rear sun gear
(14) Input
(15) Output
(16) Locked
(17) Component

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

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

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

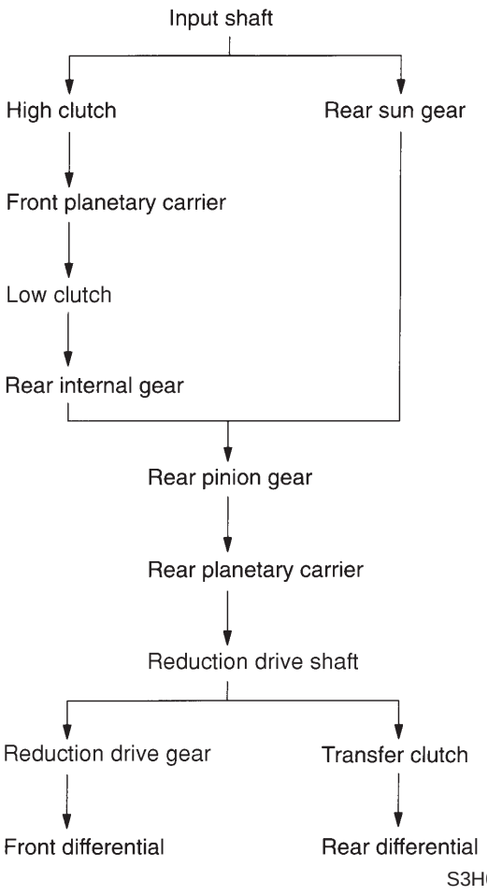


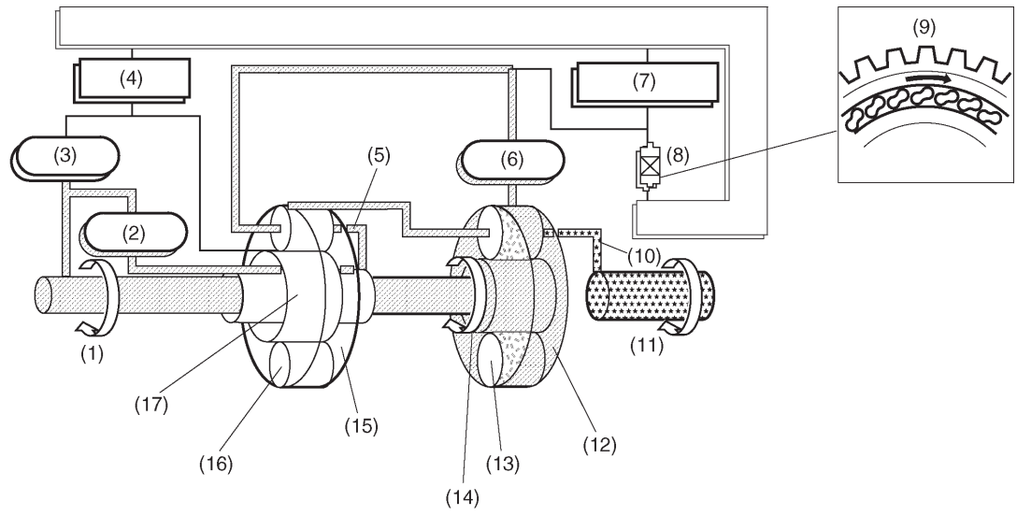
B3H0932A

(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) Reduction drive 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) Component

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

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

Operating condition of parts	Power flow (in acceleration)
High clutch : Engaged Low clutch : Engaged	 S3H0196B



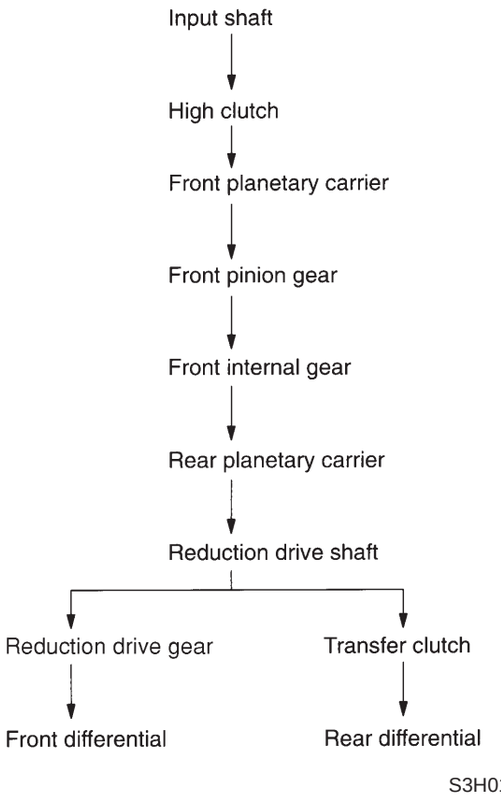
B3H0933A

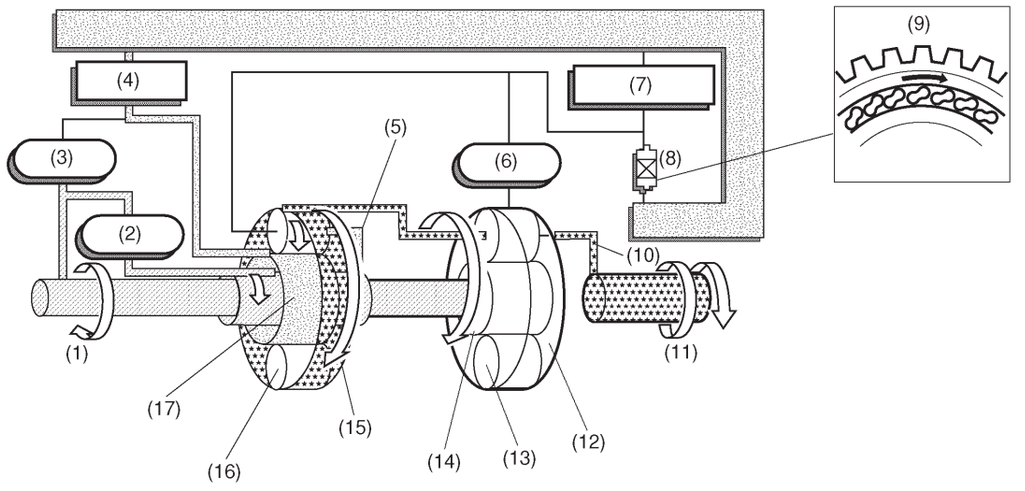
(1) Input shaft
(2) High clutch
(3) Reverse clutch
(4) 2-4 brake
(5) Front planetary carrier
(6) Low clutch
(7) Low & reverse brake
(8) One-way clutch
(9) Free
(10) Rear planetary carrier
(11) Reduction drive shaft
(12) Rear internal gear
(13) Rear pinion gear
(14) Rear sun gear
(15) Front internal gear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

H: FOURTH SPEED OF D RANGE (D_4)

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

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

Operating condition of parts	Power flow (in acceleration)
2-4 brake : Engaged High clutch : Engaged	 S3H0197B

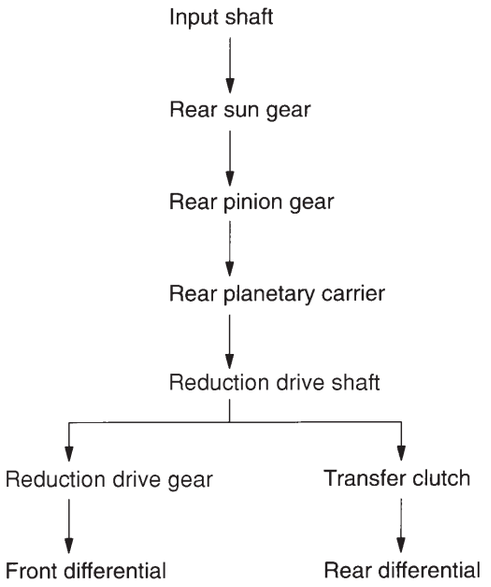


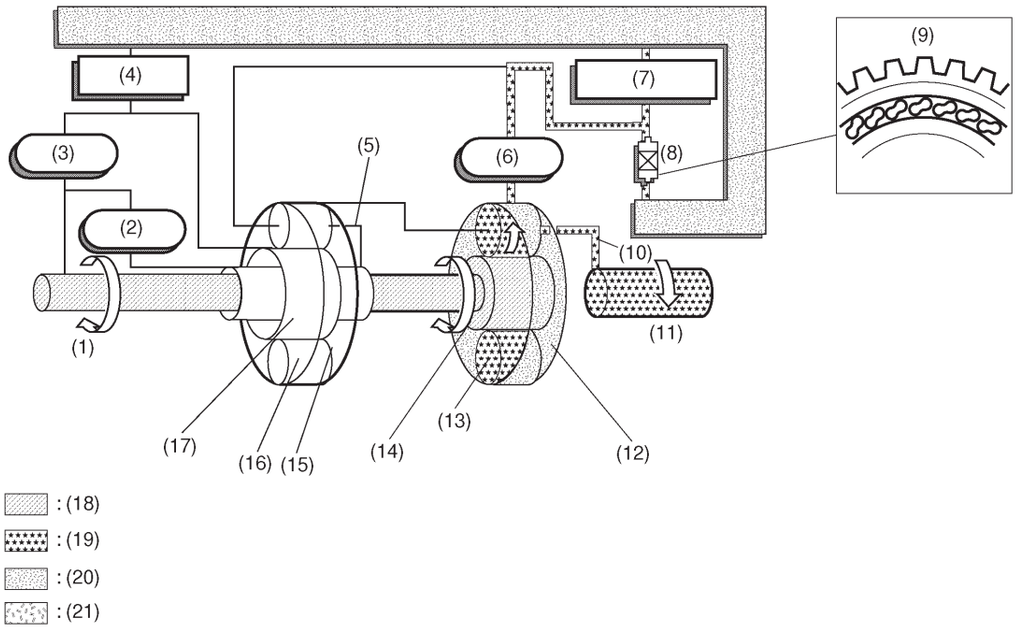
B3H0934A

(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) Reduction drive 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) Component

I: FIRST SPEED OF 1 RANGE

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

Operating condition of parts		Power flow (in acceleration)
Low clutch	: Engaged	
Low & reverse brake	: Engaged	
One-way clutch	: Operating	

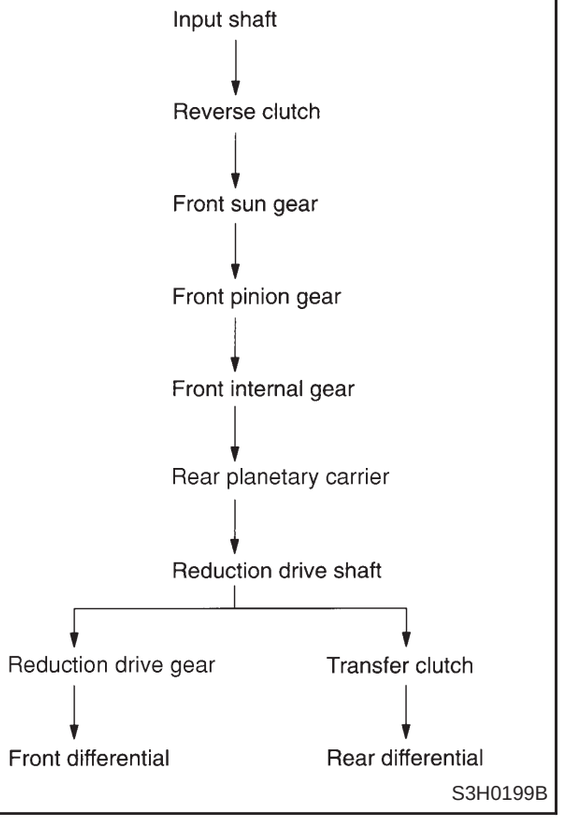


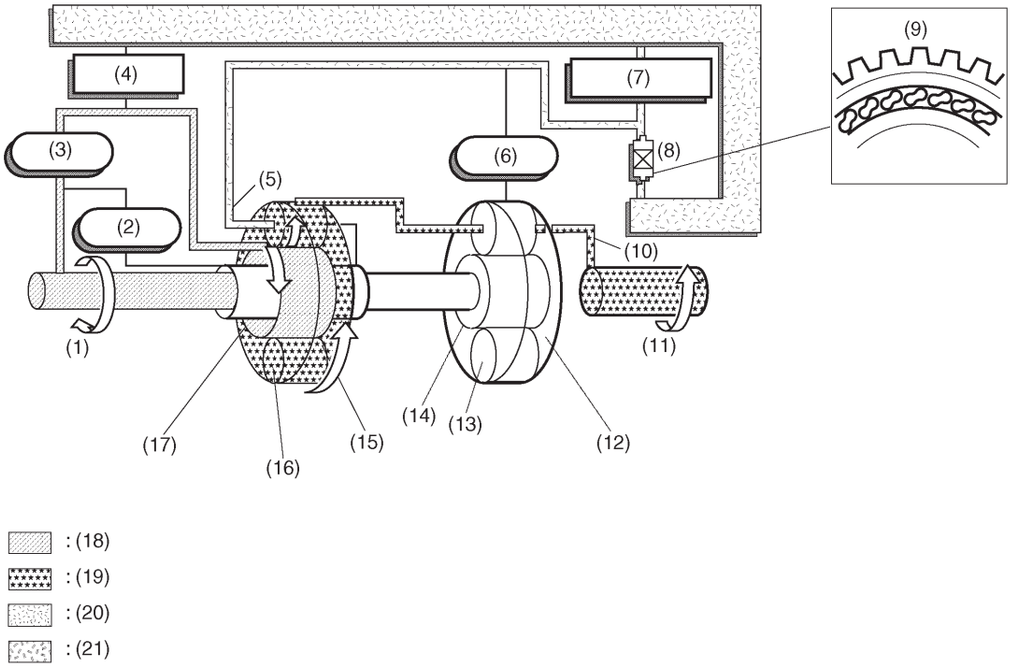
B3H0936A

(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) Reduction drive 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) Component

J: R RANGE

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

Operating condition of parts	Power flow (in acceleration)
Reverse brake : Engaged Low & reverse brake : Engaged	 S3H0199B



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) Reduction drive 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) Component