WORKSHOP MANUAL

NPR,NQR

AUTOMATIC TRANSMISSION

450-43LE

SECTION 7

ISUZU

ISUZU

International Service & Parts
Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

Applicable Model : NPR70,NQR70

This manual is applicable to 1999 year model and later vehicles.

THIS MANUAL INCLUDES THE FOLLOWING SECTIONS:

SECTION NO.	CONTENTS
7A 1	Construction and Function
7A 2	Diagnosis
7A 3	On-Vehicle Service
7A 4	Automatic Transmission Overhaul

SECTION 7A

AUTOMATIC TRANSMISSION

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

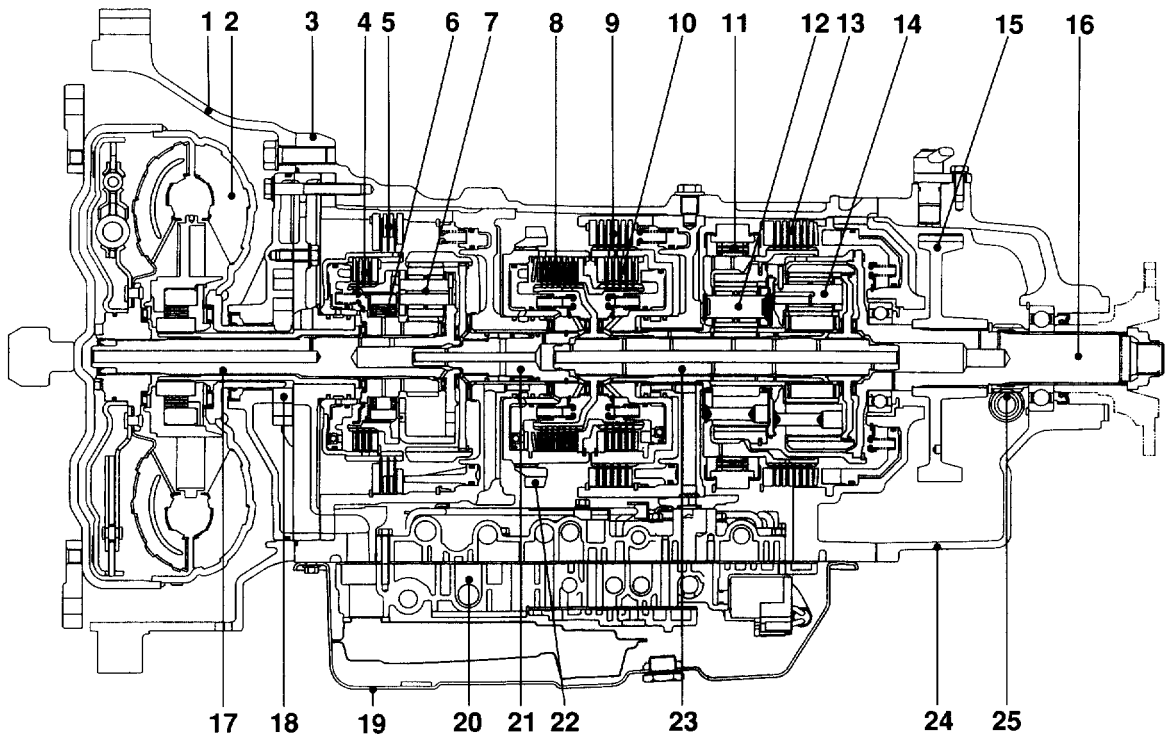
CONTENTS

7A1 CONSTRUCTION AND FUNCTION

CONTENTS

DESCRIPTION

CONSTRUCTION



1. Torque Converter Housing
2. Torque Converter
3. Transmission Case
4. Overdrive Direct Clutch
5. Overdrive Brake
6. Overdrive One-way Clutch
7. Overdrive Planetary Gear
8. Front Clutch
9. 2nd Brake
10. Rear Clutch
11. Front Planetary Gear
12. No.2 One-way Clutch
13. 1st and Reverse Brake
14. Rear Planetary Gear
15. Parking Lock Gear
16. Output Shaft
17. Overdrive Input Shaft
18. Oil Pump
19. Oil Pan
20. Valve Body
21. Input Shaft
22. PTO Drive Gear
23. Intermediate Shaft
24. Extension Housing
25. Speedometer Drive Gear

Figure 1. Construction of Automatic Transmission

The 450-43LE type automatic transmission is a four-speed automatic gear shift that is controlled electronically by the Transmission Control Module (TCM).

The TCM provides smooth and powerful driving performance by automatically selecting the optimum transmission characteristics and gear positions according to the accelerator (throttle) position, vehicle speed, and other conditions.

In an event of a malfunction of the vehicle speed sensor, throttle position sensor, solenoid or other components, it shifts to fail-safe control mode to maintain the drivability. In an event of a malfunction of the vehicle speed sensor, throttle position sensor, solenoid, engine rpm signal, etc., the TCM's self-diagnosis function allows faster troubleshooting to enhance the vehicle's serviceability.

The automatic transmission consists of the torque converter, oil pump, gear train, and valve bodies.

The torque converter is of the 3-element, 1-stage, and 2-phase type with a built-in lock-up clutch.

The gear train consists of 3 sets of multiple-plate clutches, 3 sets of multiple-plate brakes, 2 one-way clutches, and 3 sets of planetary gear each consisting of a sun gear, a pinion gear, and a ring gear.

TRANSMISSION SERIAL NUMBER

NUMBER PLATE LOCATION

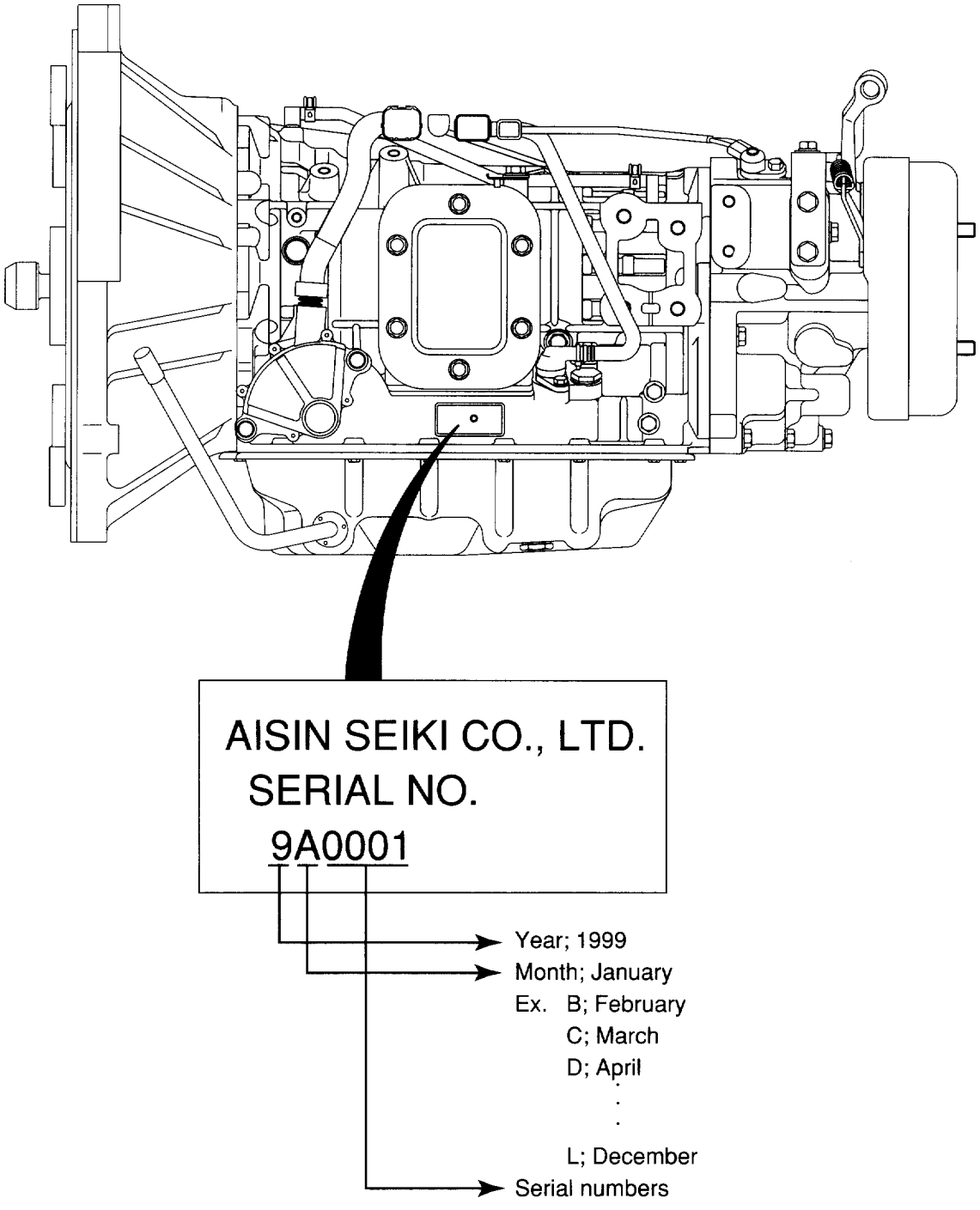
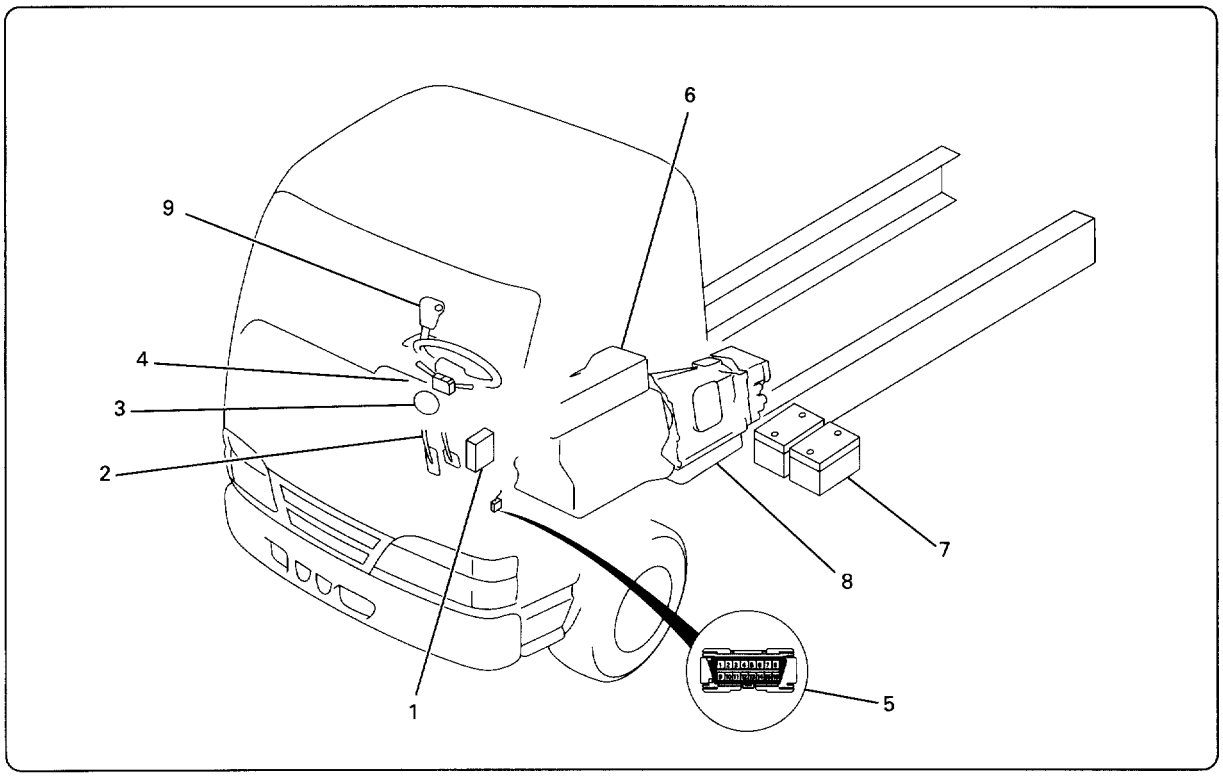


Figure 2. Number Plate Location

COMPONENT LOCATION



2. Pedal
- Throttle position sensor
- Kick down switch
- Brake switch

3. Speedometer
- Vehicle speed sensor-2

4. Instrument panel
- Exhaust brake switch

- Check trans light
- ATF temperature light

1. Transmission Control Module (TCM)

6. Engine
- Engine speed sensor
- Idle signal(from PCM)
- FICD signal

- Exhaust brake cut relay

7. Electrical source
- Ignition

8. Transmission
- No. 1 shift solenoid
- No. 2 shift solenoid
- Line pressure solenoid
- Lock-up solenoid
- Timing solenoid

- Vehicle speed sensor-1
- ATF thermosensor
- ATF thermo switch
- Inhibitor switch

5. Data link connector
- Diagnostic enable
- TECH 2

9. Control lever
- Overdrive OFF switch

: Signal direction

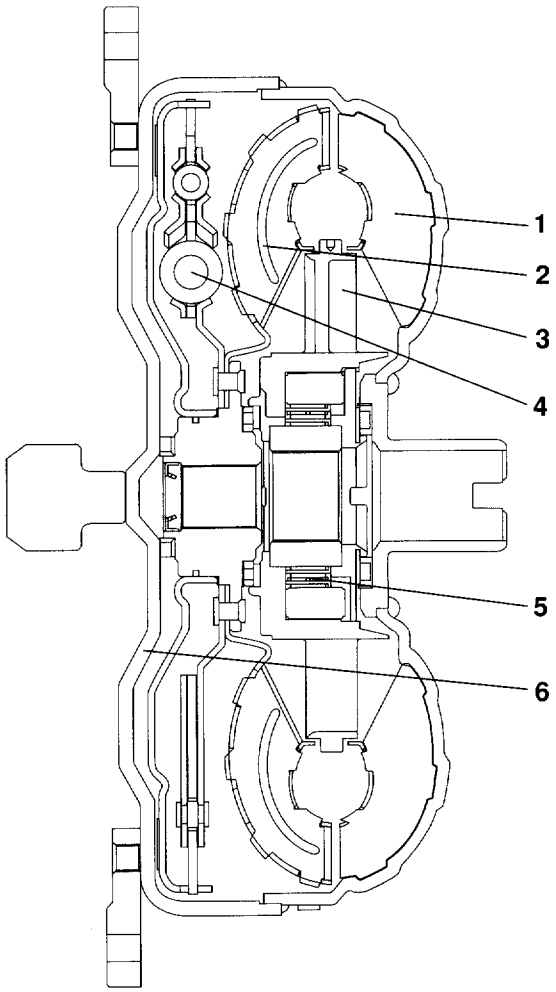
Figure 3. Component Location

STRUCTURE AND FUNCTION OF COMPONENT

TORQUE CONVERTER

(Figure 4)

- The torque converter transmits the engine torque to the transmission by way of oil (when the lock-up clutch is disengaged) or the lock-up piston (when the lock-up clutch is engaged).
- The torque converter is of the 3-element, 1-stage, and 2-phase type.
- "1-stage" means the output element consists of a single turbine runner.
  "2-phase" means the converter works as a torque converter against the pump impeller when the turbine runner speed is relatively low, and as a fluid coupling when the speed is high.



1. Pump Impeller
2. Turbine Runner
3. Stator
4. Lock-up Clutch
5. One-way Clutch
6. Converter Front Cover

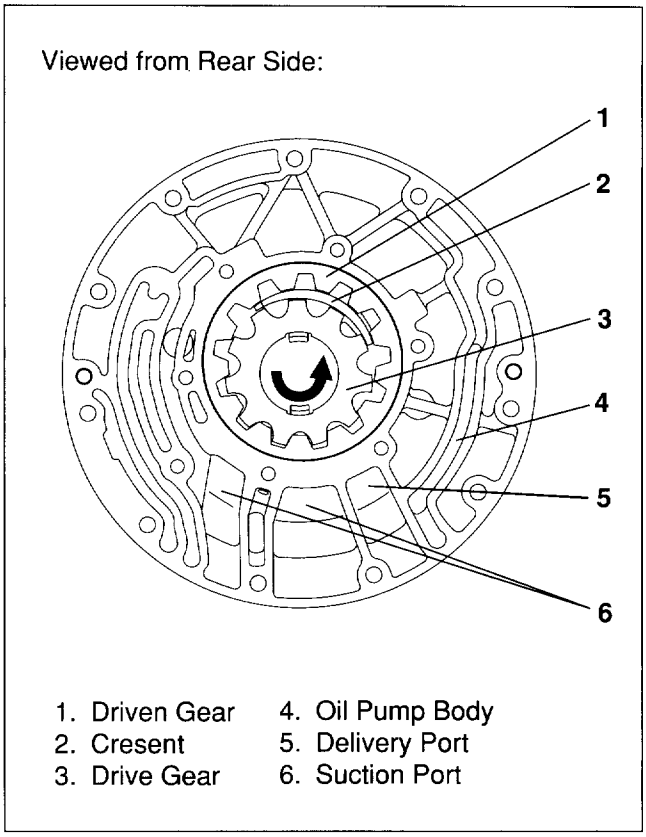
Figure 4. Torque Converter

OIL PUMP

(Figure 5)

Construction

- The oil pump is a high performance geared oil pump with a small number of teeth of a special profile.



1. Driven Gear
2. Cresent
3. Drive Gear
4. Oil Pump Body
5. Delivery Port
6. Suction Port

Figure 5. Construction of Oil Pump

Operation

- The drive gear is engaged with the extension sleeve of the torque converter. As it rotates in the direction of the arrow at the engine speed, the oil is drawn in and compressed before exiting from the delivery port.

SHAFT

(Figure 6)

Overdrive (O/D) input shaft

- The O/D input shaft (O/D planetary gear) is engaged with the turbine runner and the lock-up piston inside the torque converter. Therefore, the driving force of the engine reaching the torque converter is transmitted to the O/D planetary gear.
  The oil hole (A) inside the O/D input shaft serves as the torque converter operating pressure supply passage when the lock-up clutch is disengaged. It also serves as the lubricant supply passage to all parts.

Input shaft

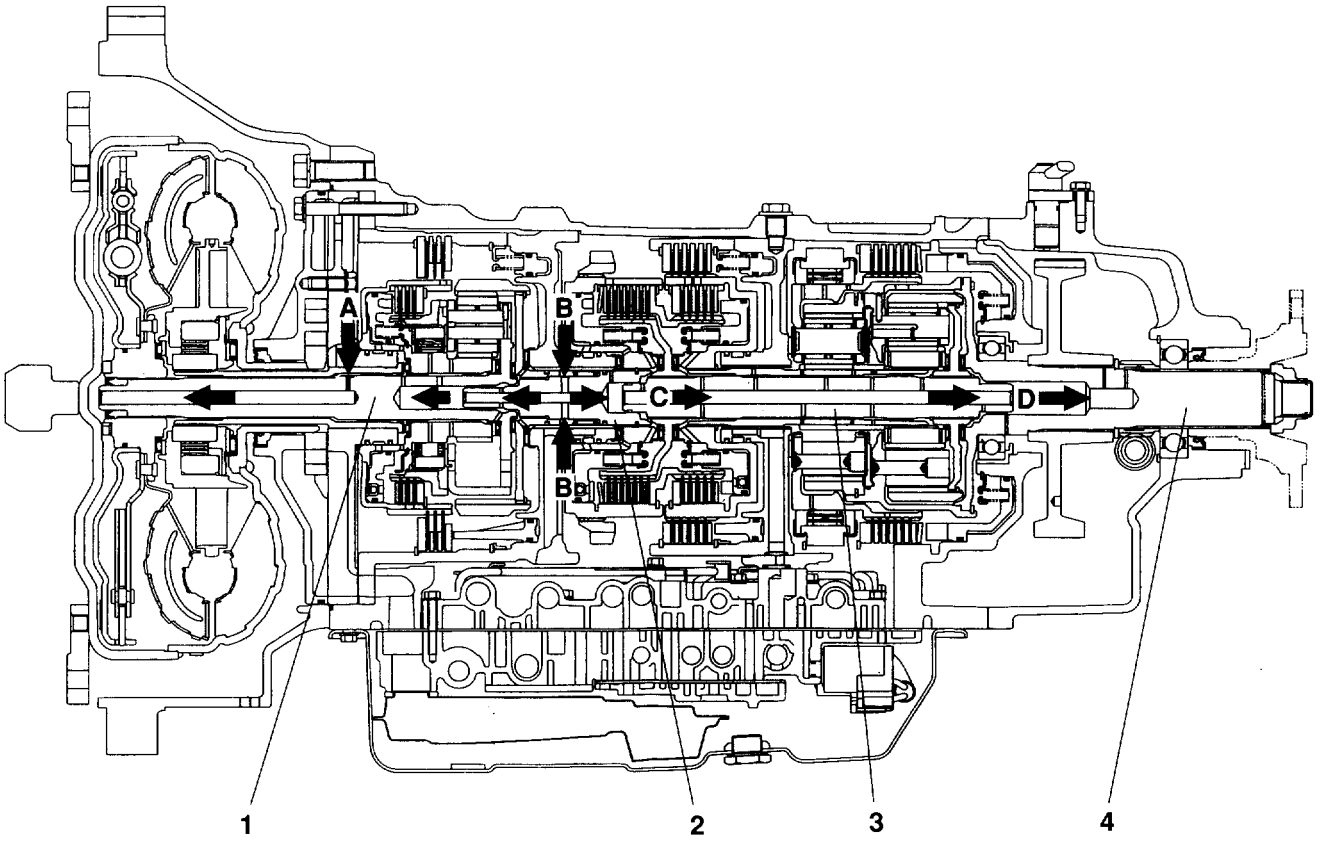
- The input shaft transmits the driving force from the O/D planetary gear to the front clutch.
  The oil hole (B) inside the input shaft is used to supply the oil, cooled by the oil cooler, to all parts as the lubricant.

Intermediate shaft

- The intermediate shaft transmits the driving force from the front clutch to the rear planetary gear.
  The oil passage (C) inside the intermediate shaft is used to supply the oil to all parts as the lubricant.

Output shaft

- The output shaft transmits the driving force reaching the front and rear planetary gears to the propeller shaft. The output shaft is engaged with the front planetary ring gear and the rear planetary carrier. The parking gear, which is used to fix the output shaft and detect rotation, is also engaged by way of spline.
  The oil passage (D) inside the output shaft is used to supply the lubricant to all parts.



1. Overdrive Input Shaft
2. Input Shaft
3. Intermediate Shaft
4. Output Shaft

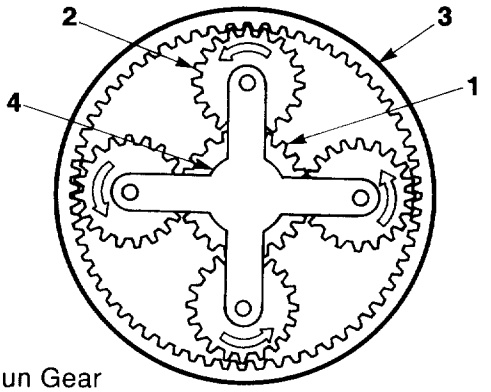
Figure 6. Shaft

GEAR SHIFTING MECHANISM

- The 450-43LE type transmission combines three sets of planetary gears, three sets of multi-plate clutches and multi-plate brakes, and two sets of one-way clutches to achieve forward (4 speeds) and backward (1 speed) gear shifting.

Principle of gear shifting

- The automatic transmission uses three sets of planetary gears unlike the parallel gears that are used in the manual transmission.
- Planetary gears have the advantage of a compact configuration because of the way they are constructed with a single central shaft (one axis).
- Also, unlike the manual transmission gears that require changing of gear mesh, the gear ratio of the planetary gears can be changed more easily by locking, releasing or rotating only some of their parts.
- A planetary gear is made up of a sun gear at its center and pinion gears each of which rotates about its own center and also along the sun gear.
- Also, since the pinion gears are further supported by the planetary carrier, they rotate as a unit in the same direction and at the same rate.
- As shown in the figure, each planetary gear is constructed of three elements; a sun gear, pinion gears, a ring gear, and a planetary carrier. Gear shifting is achieved by conditioning two of the three elements, namely the sun gear, internal gear, and the planetary carrier.
- The planetary gears are locked by the clutch, brake, and one-way clutch, according to the gear shifting.



1. Sun Gear
2. Pinion Gear
3. Ring Gear
4. Planetary Carrier

Figure 7. Planetary Gear

Overdrive Direct Clutch

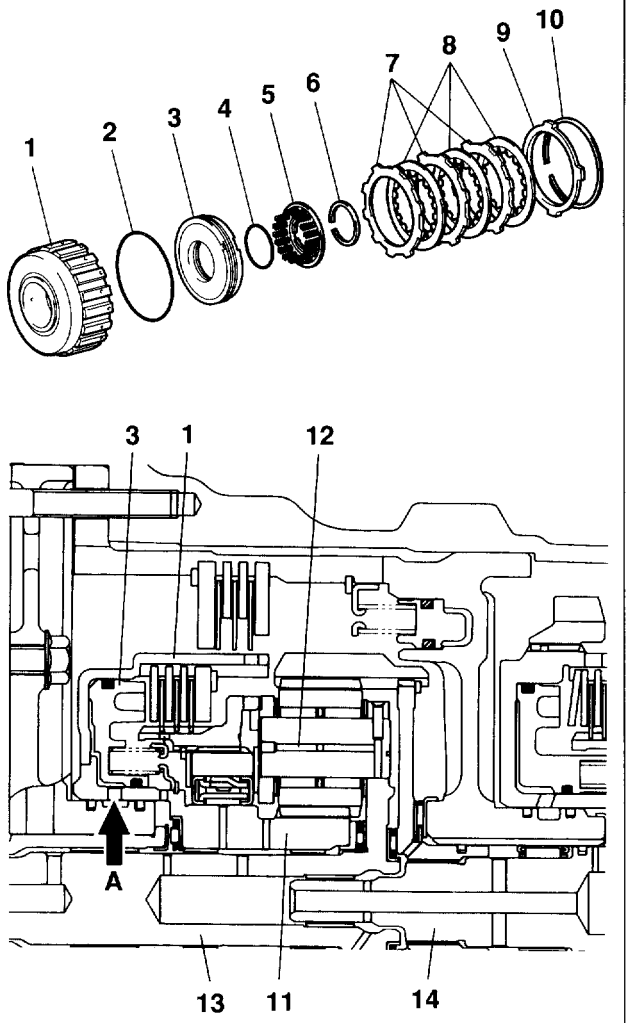
(Figure 8)

When engaged

- The operating pressure (A), switched by the control valve, acts on the O/D direct clutch piston (3) to connect the clutch disk (8) and clutch plate (7). This also connects the O/D sun gear (11) and O/D planetary carrier (12). As the result, the entire O/D planetary gear works as a unit to transmit the engine torque from the O/D input shaft (13) to the input shaft (14).

When disengaged

- Since the operating pressure is not sent to the O/D direct clutch piston (3) when disengaging it, the clutch piston is returned by the return spring (5).
- The clutch plate (7) separates from the clutch disk (8) cutting the power transmission.



1. O/D Direct Clutch Drum
2. O-ring
3. O/D Direct Clutch Piston
4. O-ring
5. O/D Direct Clutch Return Spring
6. Snap Ring
7. Clutch Plate
8. Clutch Disc
9. Clutch Flange
10. Snap Ring
11. O/D Planetary Sun Gear
12. O/D Planetary Carrier
13. O/D Input Shaft
14. Input Shaft

A. Operating Pressure

Figure 8. Overdrive Direct Clutch

Front Clutch

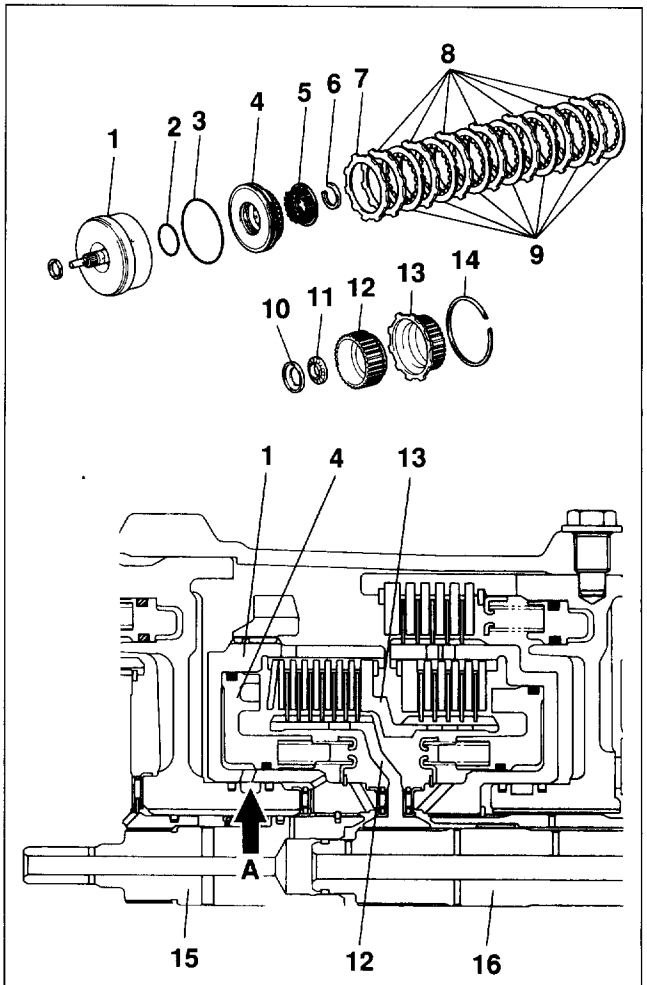
(Figure 9)

When engaged

- The operating pressure (A), switched by the control valve, acts on the front clutch piston (4) to connect the clutch disk (9) and clutch plate (8). As the result, the engine torque is transmitted from the input shaft (15) to the front clutch hub (12).

When disengaged

- Since the operating pressure is not sent to the front clutch piston (4) when disengaging it, the clutch piston is returned by the return spring (5).
- The clutch plate (8) separates from the clutch disk (9) cutting the power transmission.



1. Front Clutch Drum
2. O-ring
3. O-ring
4. Front Clutch Piston
5. Front Clutch Return Spring
6. Snap Ring
7. Clutch Cushion Plate
8. Clutch Plate
9. Clutch Disk
10. Thrust Bearing Race
11. Thrust Bearing
12. Front Clutch Hub
13. Rear Clutch Hub
14. Snap Ring
15. Input Shaft
16. Intermediate Shaft

A. Operating Pressure

Figure 9. Front Clutch

Rear Clutch

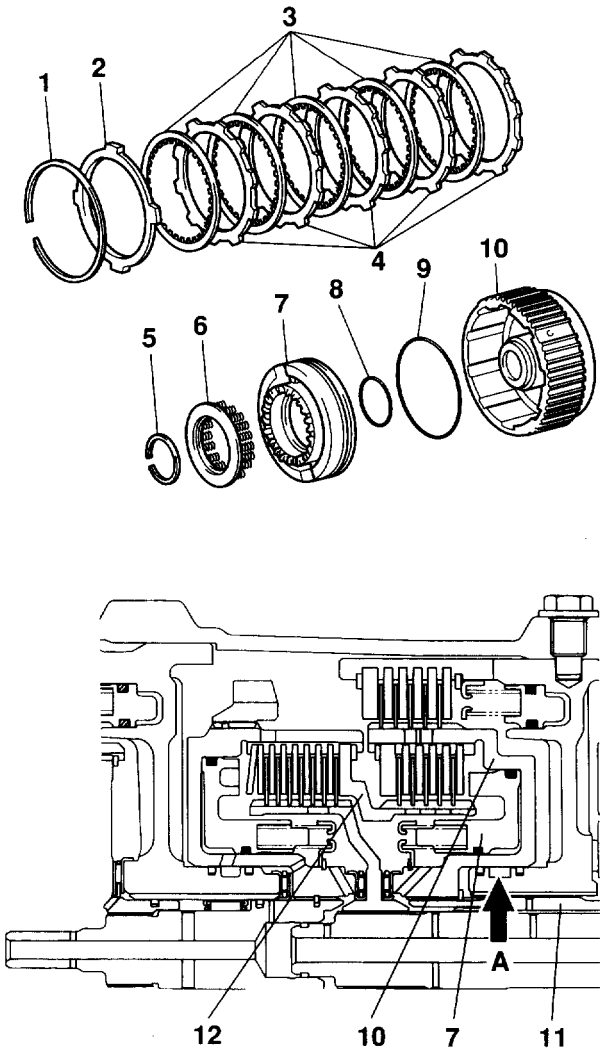
(Figure 10)

When engaged

- The operating pressure (A), switched by the control valve, acts on the rear clutch piston (7) to connect the clutch disk (3) and clutch plate (4). As the result, the engine torque is transmitted from the front clutch hub (12) to the front sun gear (11).

When disengaged

- Since the operating pressure is not sent to the rear clutch piston (7) when disengaging it, the clutch piston is returned by the return spring (6).
- The clutch plate (4) separates from the clutch disk (3) cutting the power transmission.



1. Snap Ring
2. Clutch Flange
3. Clutch Disk
4. Clutch Plate
5. Snap Ring
6. Rear Clutch Piston Return Spring
7. Rear Clutch Piston
8. O-ring
9. O-ring
10. Rear Clutch Drum
11. Front Planetary Sun Gear
12. Rear Clutch Hub

A. Operating Pressure

Figure 10. Rear Clutch

Overdrive Brake

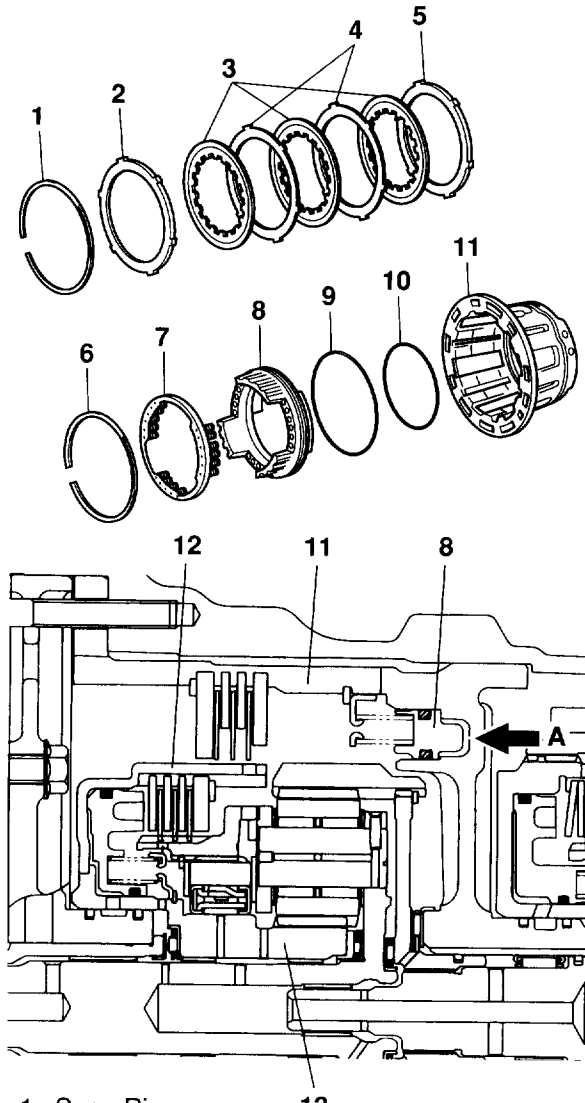
(Figure 11)

When engaged

- The operating pressure (A), switched by the control valve, acts on the O/D brake piston (8) to connect the clutch disk (3) and brake plate (4 and 5). This also locks the O/D direct clutch (12) to the O/D case (11). As the result, the O/D planetary sun gear (13) is locked in position.

When disengaged

- Since the operating pressure is not sent to the O/D brake piston (8) when disengaging it, the clutch piston is returned by the return spring (7).
- The brake plate (4 and 5) separates from the clutch disk (3) cutting the power transmission.



1. Snap Ring
2. Brake Flange
3. Clutch Disk
4. Brake Plate
5. Brake Plate
6. Snap Ring
7. O/D Brake Return Spring
8. O/D Brake Piston
9. O-ring
10. O-ring
11. O/D Case
12. O/D Direct Clutch
13. O/D Planetary Sun Gear

A. Operating Pressure

Figure 11. Overdrive Brake

2nd Brake

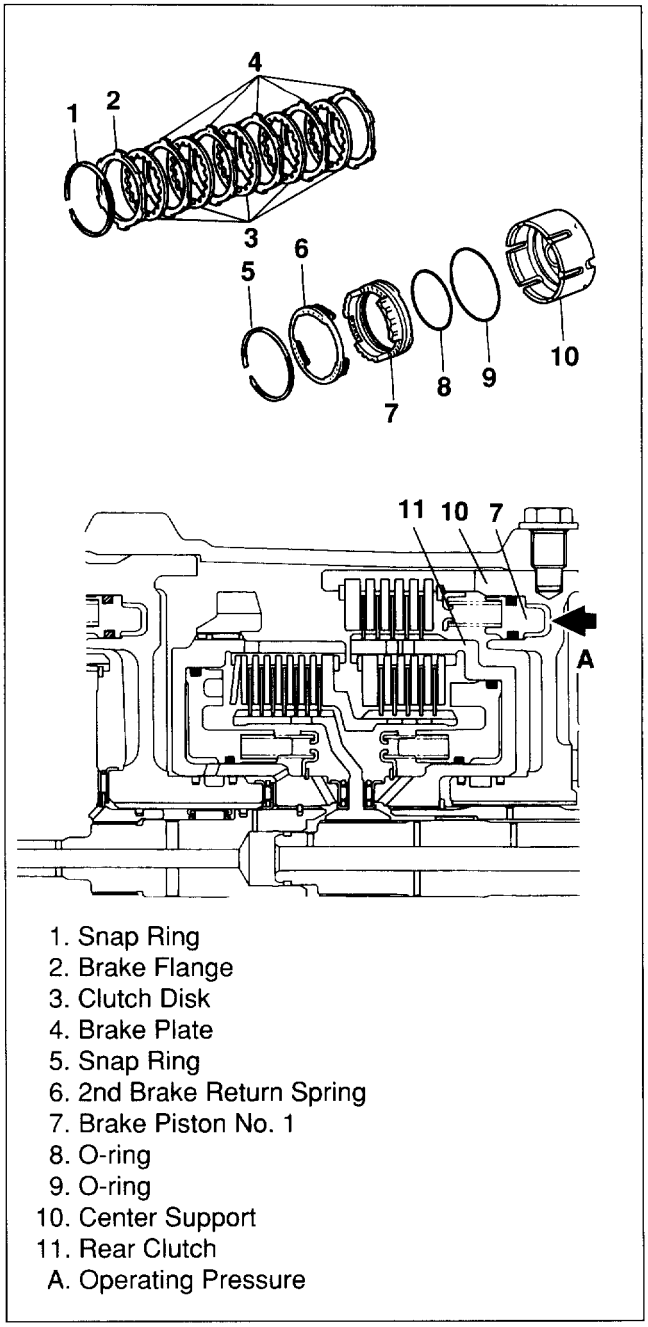
(Figure 12)

When engaged

- The operating pressure (A), switched by the control valve, acts on the brake piston No. 1 (7) to connect the clutch disk (3) and brake plate (4). This also locks the rear clutch (11) to the center support (10).

When disengaged

- Since the operating pressure is not sent to the brake piston No. 1 (7) when disengaging it, the brake piston is returned by the return spring (6).
- The brake plate (4) separates from the clutch disk (3) cutting the power transmission.



1. Snap Ring
2. Brake Flange
3. Clutch Disk
4. Brake Plate
5. Snap Ring
6. 2nd Brake Return Spring
7. Brake Piston No. 1
8. O-ring
9. O-ring
10. Center Support
11. Rear Clutch

A. Operating Pressure

Figure 12. 2nd Brake

1st and Reverse Brake

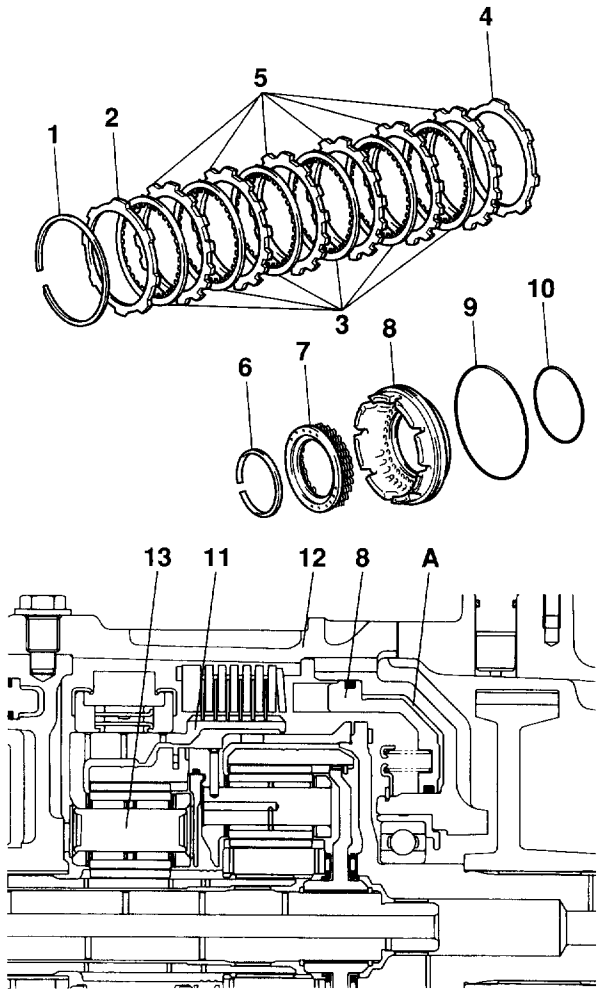
(Figure 13)

When engaged

- The operating pressure (A), switched by the control valve, acts on the 1st and reverse brake piston (8) to connect the clutch disk (3) and brake plate (5). This also locks the 1st and reverse brake hub (11) to the transmission case (12). As the result, the front planetary carrier (13) is locked in position.

When disengaged

- Since the operating pressure is not sent to the 1st and reverse brake piston (8) when disengaging it, the brake piston is returned by the return spring (7).
- The brake plate (5) separates from the clutch disk (3) cutting the power transmission.



1. Snap-Ring
2. Brake Flange
3. Clutch Disk
4. Brake Cushion Plate
5. Brake Plate
6. Snap Ring
7. 1st and Reverse Brake Return Spring
8. 1st and Reverse Brake Piston
9. O-ring
10. O-ring
11. 1st and Reverse Brake Hub
12. Transmission Case
13. Front Planetary Carrier

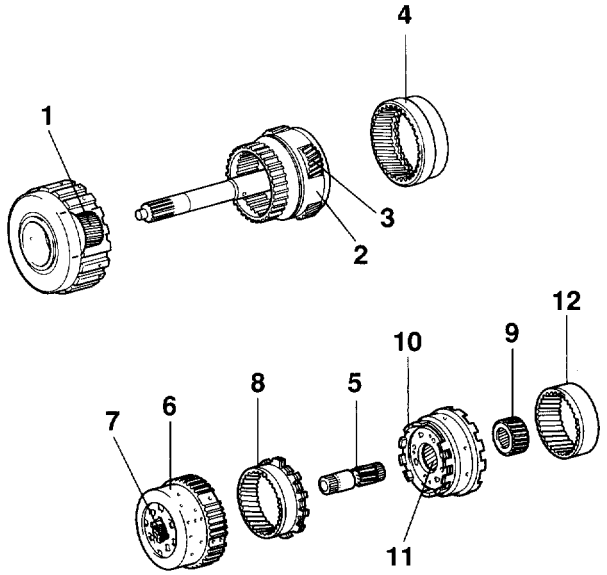
A. Operating Pressure

Figure 13. 1st and Reverse Brake

Planetary Gear

(Figure 14)

- Three sets of Simpson type planetary gears are used to achieve the total of five gear ratios including 4 forward and 1 backward ratios.



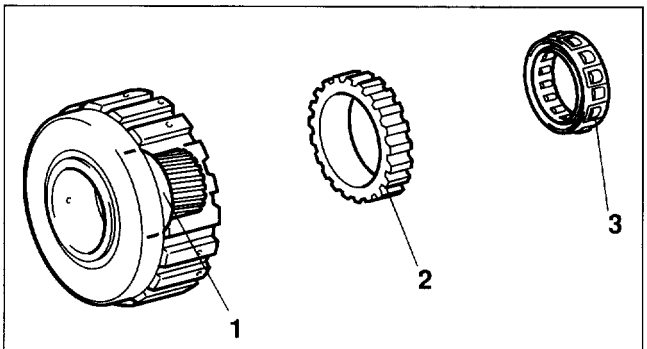
1. O/D Sun Gear
2. O/D Planetary Carrier
3. O/D Pinion Gear
4. O/D Ring Gear
5. Front Sun Gear
6. Front Planetary Carrier
7. Front Pinion Gear
8. Front Ring Gear
9. Rear Sun Gear
10. Rear Planetary Carrier
11. Rear Pinion Gear
12. Rear Ring Gear

Figure 14 Planetary Gear

Overdrive (O/D) One-way clutch

(Figure 15)

- The O/D one-way clutch is locked during acceleration in 1st, 2nd or 3rd speed to maintain the O/D sun gear fixed to the O/D planetary carrier.
- The O/D one-way clutch idles in 4th speed.



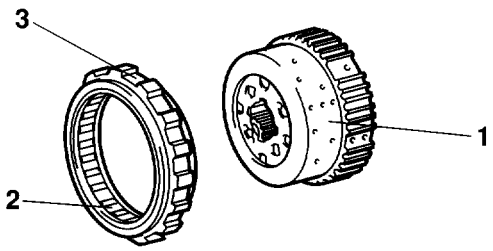
1. O/D Direct Clutch Drum and O/D One-way Clutch Inner Race
2. O/D One-way Clutch Outer Race
3. O/D One-way Clutch

Figure 15 O/D One-way Clutch

One-way Clutch No.2

(Figure 16)

- The one-way clutch No.2 is locked during acceleration in 1st speed to fix the front planetary carrier.
- It idles in 2nd, 3rd and 4th speeds.



1. Front Planetary Carrier and One-way Clutch No. 2 Inner Race
2. One-way Clutch No. 2
3. One-way Clutch No. 2 Outer Race

Figure 16 One-way Clutch No.2

ACCUMULATOR

- The accumulator helps a smooth increase of the operating pressure in the respective friction element to ease the gear shifting shock.
- During a gear shift, the accumulator control pressure regulated by the respective accumulator control valve is applied to the back of the accumulator to ease the gear shifting shock.

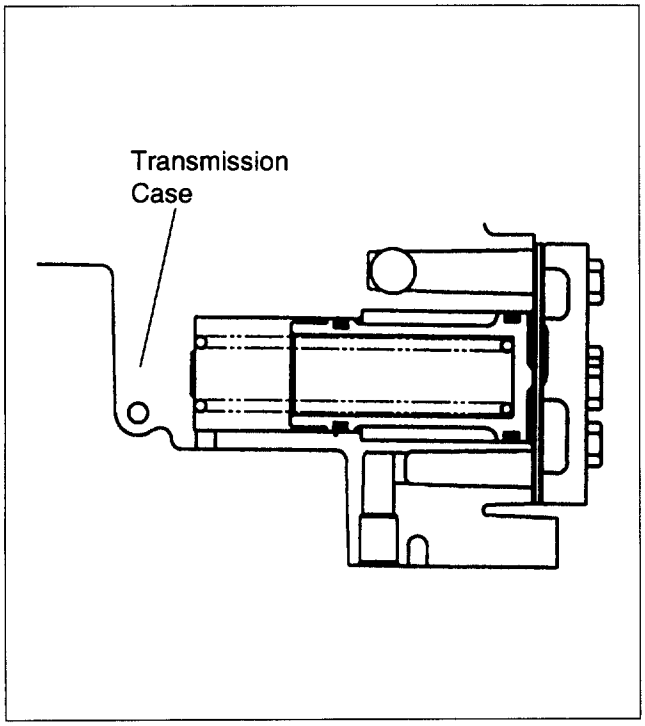


Figure 17. Front Clutch Accumulator

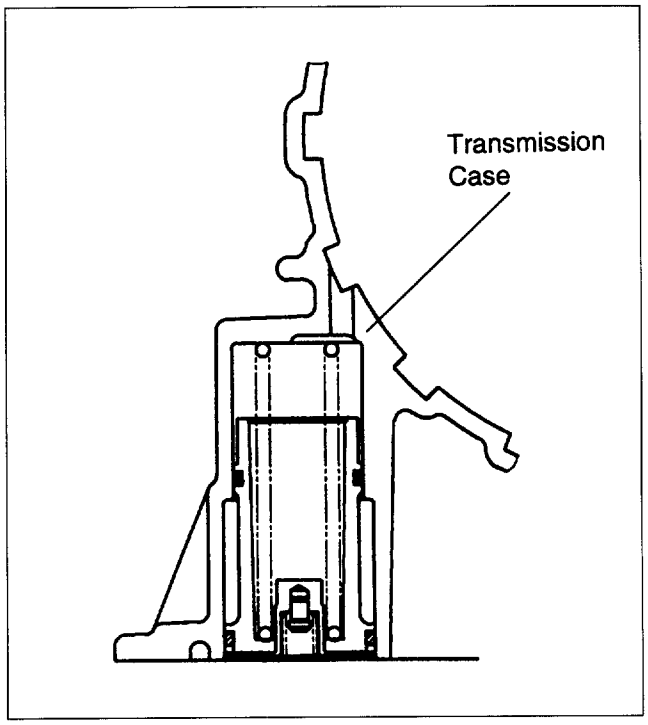


Figure 18. Rear Clutch Accumulator

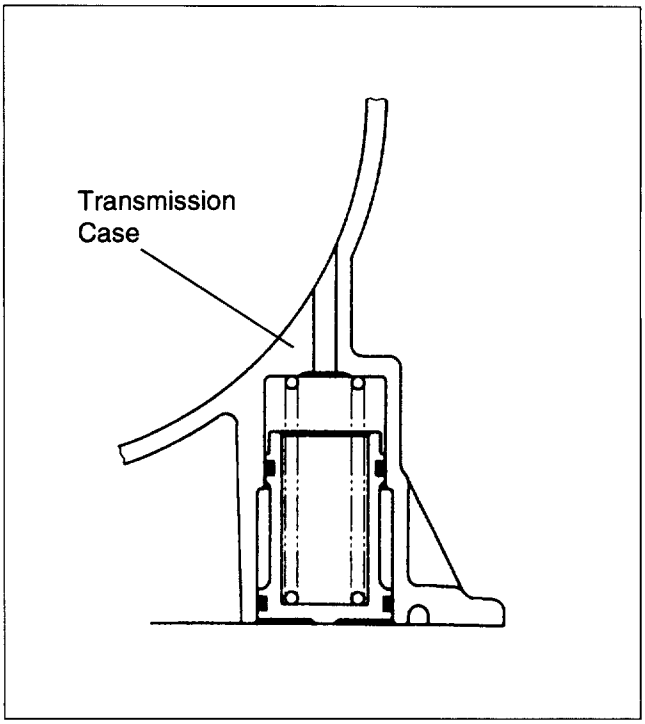


Figure 19. Overdrive Brake Accumulator

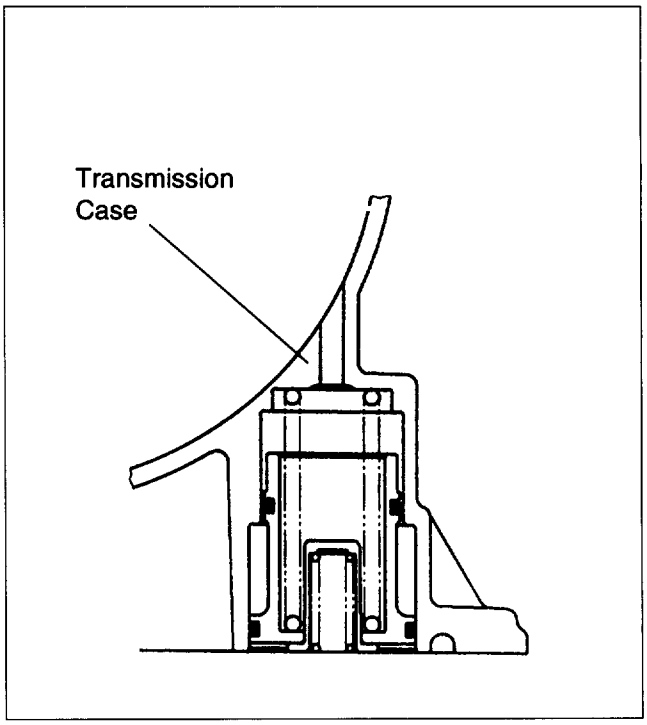


Figure 20. 2nd Brake Accumulator

SOLENOID

No.1 and No.2 Shift Solenoids

(Figure 21)

- These solenoids are fitted in the lower part of the valve body. They are turned on or off by a signal from the TCM to control the gear shifting.
- The ON/OFF combinations of the two solenoids are used to control the gear position as shown below.

Gear Position / Solenoid	1st gear	2nd gear	3rd gear	4th gear
No.1 shift solenoid	ON	ON	OFF	OFF
No.2 shift solenoid	OFF	ON	ON	OFF

Timing Solenoid

(Figure 21)

- This solenoid is fitted in the lower part of the valve body. It is turned on or off by a signal from the TCM to control the timing during 2nd and 3rd gear shifting.

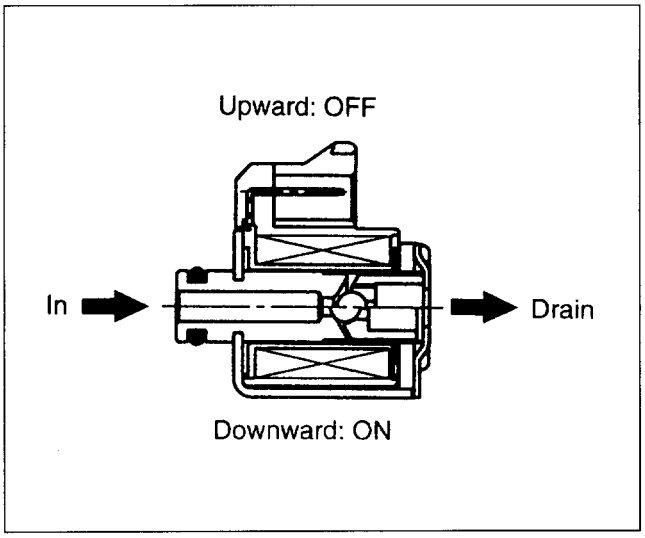


Figure 21. No.1, No.2 Shift Solenoids and Timing Solenoid

Lock-up solenoid

(Figure 22)

- This solenoid is fitted in the lower part of the valve body. It controls the lock-up oil pressure by a signal from the TCM according to the duty cycle.

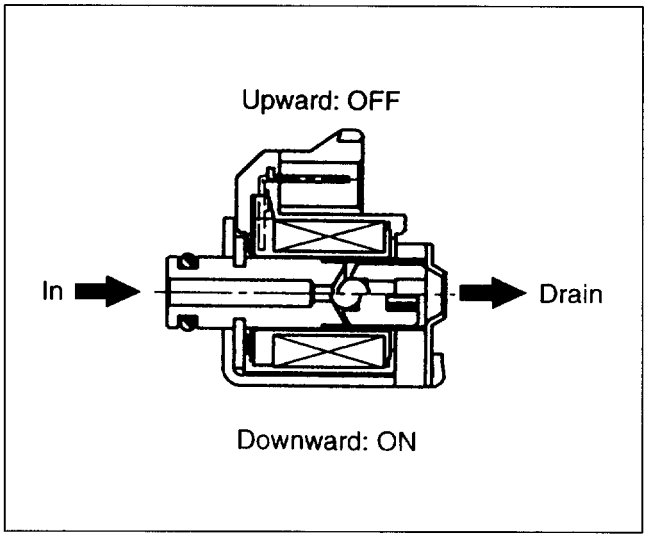


Figure 22. Lock-up Solenoid

Line Pressure Solenoid

(Figure 23)

- This solenoid is fitted in the upper part of the valve body and integrally consists of the electromagnetic component and the pressure regulating valve. It controls the line pressure by a signal from the TCM according to the electric current.

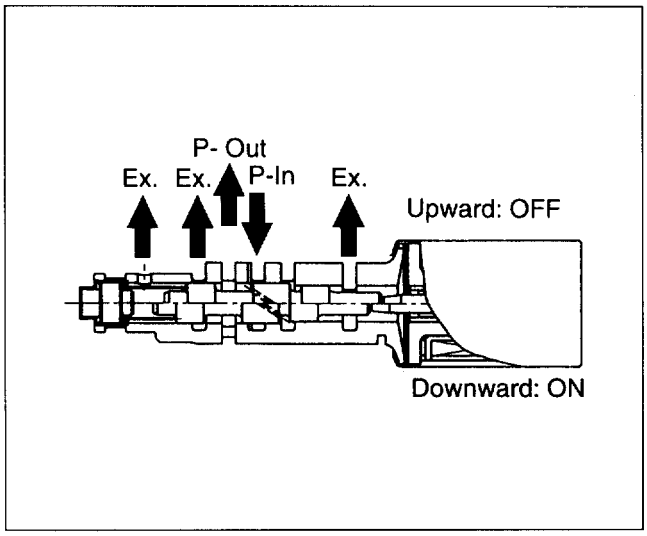


Figure 23. Line Pressure Solenoid