**SUBARU**

# SVX

# 1992

Precaution for Supplemental Restraint System "Airbag"
The Supplemental Restraint System "Airbag" helps to reduce the risk or severity of injury to the driver in a frontal collision.
The Supplemental Restraint System consists of an airbag module (located in the center of the steering wheel), sensors, a control unit, warning light, wiring harness and spiral cable.
Information necessary to service the safety is included in the "5-5. SUPPLEMENTAL RESTRAINT SYSTEM" of this Service Manual.
WARNING:

- To avoid rendering the Airbag system inoperative, which could lead to personal injury or death in the event of a severe frontal collision, all maintenance must be performed by an authorized SVX dealer.
- Improper maintenance, including incorrect removal and installation of the Airbag system, can lead to personal injury caused by unintentional activation of the Airbag system.
- All Airbag system electrical wiring harnesses and connectors are covered with yellow outer insulation. Do not use electrical test equipment on any circuit related to the Supplemental Restraint System "Airbag".

Page

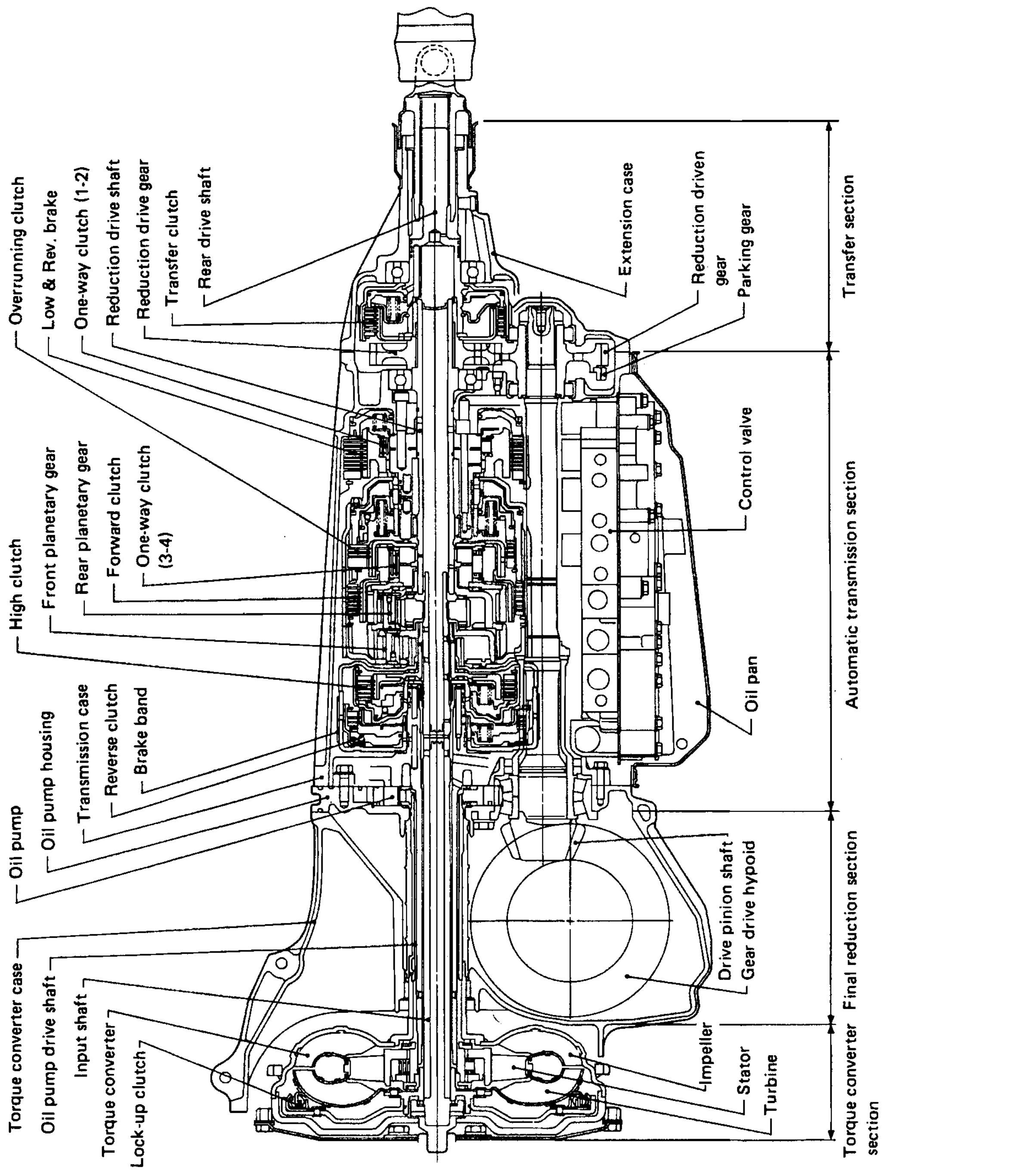
# M MECHANISM AND FUNCTION

## 1. General

This system utilizes a microcomputer for accurate control of the vehicle speed, engine brake operation, lock-up operation, gear shift timing and others. It corresponds to the throttle opening, actual vehicle speed, engine rpm and range position signal. Further, this system adopted an electronically controlled full-time AWD system designed uniquely for SUBARU.
The AWD system has a transfer hydraulic pressure control unit incorporating duty solenoid and a multi-plate transfer (MPT) consisting of a wet type multi-plate clutch on the rear of the automatic transmission section. The control unit stores optimum transfer clutch torque (duty ratio) data for various driving conditions. When actual driving conditions (vehicle speed, throttle opening, gear range, wheel slip, etc.) are detected by various sensors, the control unit selects the most suitable duty ratio from memory, and controls the transmitting torque of the transfer clutch by means of the hydraulic pressure controlling duty solenoid.

⟨Features⟩
1) Two one-way clutches and four accumulators are used to reduce gear shift shock and gear select shock, and a fully electronic control from 1st to 4th speeds, hydraulic oil pressure (line pressure), lock-up operation, etc.
2) A hydraulic lock-up type torque converter, variable delivery oil pump, gear train with two sets of simple planetary gears (permitting four forward and one reverse stage) are used to improve driving dynamics and fuel consumption.
3) A push-pull cable featuring less vibration to the high rigid transmission case and control unit is used for improved quietness during driving.
4) The transfer clutch capacity can be accurately controlled by means of the electronic control system. This is especially effective for eliminating tight corner braking phenomenon which occurs at low speeds, thereby achieving smooth driving.
5) An optimum rear wheel drive distribution is achieved which corresponds to engine output and gear shift position and improves fuel consumption and steering stability.
6) For the car equipped with ABS, the braking performance is improved by the control of the clutch and gear locking at a particular shift position through ABS operation-time control.

## CROSS SECTIONAL VIEW




C3-001

*Fig. 1*

# 2. Torque Converter

## A: CONSTRUCTION

- The torque converter is composed of impeller, turbine, stator, and lock-up clutch. It is filled with oil; therefore it must not be disassembled.
- The impeller is directly coupled to the crankshaft via a drive plate. A sleeve for driving the oil pump, which is the source of the hydraulic pressure for the automatic transmission, is welded to the rear of the impeller.
- The turbine transmits multiplied engine torque in the torque converter range, unmultiplied engine torque in the coupling range, or engine torque itself directly through the lock-up clutch to the automatic transmission via the input shaft spline fitted to the internal spline of the turbine hub.
- The stator incorporates a Sprague type one-way clutch. The stator is spline-fitted to the oil pump cover via the inner race of the one-way clutch, and secured to the torque converter case.

## B: FUNCTION

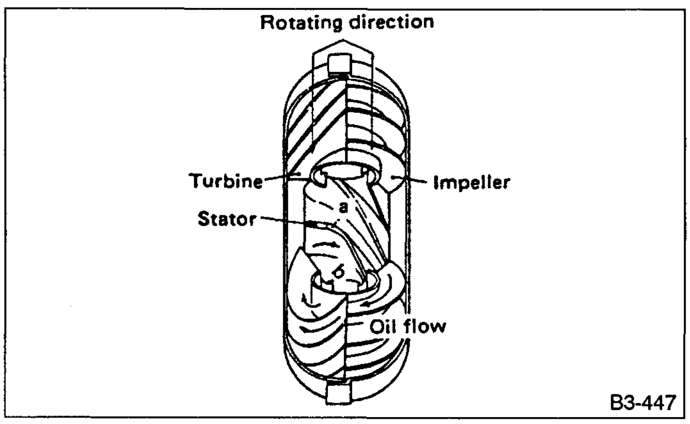



*Fig. 2 Function of torque converter*

When the impeller rotates, centrifugal force pushes out oil which then enters the turbine. The oil flows along the turbine blade and exerts force on the blade. This causes the turbine to rotate and power is transmitted to the input shaft.
If turbine speed is below impeller speed, the oil leaving the turbine flows in the direction impeding impeller rotation (a in Fig. 2). This direction is then changed by the stator so that the oil will assist impeller rotation (b in Fig. 2). With this action, the torque is multiplied.
The stator is subject to reverse torque when it changes the direction of oil flow, hence it must be secured to the casing. As turbine speed increases and approaches impeller speed, the oil from the turbine begins to push directly on the back of the stator blade. (This change-over point is called the "coupling point".) If the stator is still fixed under this condition, the oil flow will be impeded by the stator. To avoid this, the stator is mounted to the case via a one-way clutch so that it can rotate freely in the same direction as the impeller and turbine.

## C: PERFORMANCE

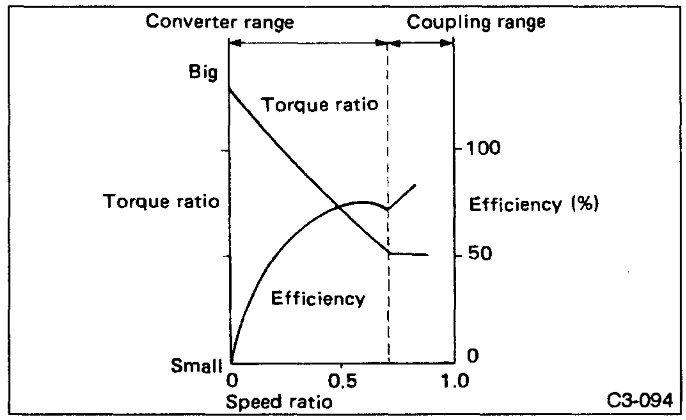



*Fig. 3*

The torque converter characteristics are shown in the above graph. The torque converter range refers to a range where the impeller and turbine rotate at different speeds and the torque is multiplied by a fixed stator. In the coupling range, on the other hand, the turbine rotates at high speed, and the stator is also rotating. The coupling range provides no torque multiplication because the torque converter functions as a fluid coupling in this range.
If the impeller (engine side) alone is rotating with stationary turbine (vehicle standstill) when the speed ratio is zero (0), this state is called the stall point. In this state, the torque ratio of impeller and turbine is the largest. The torque ratio in this state is called the stall torque ratio, and the engine rpm is called the stall rpm.

# 3. Lock-up Control System

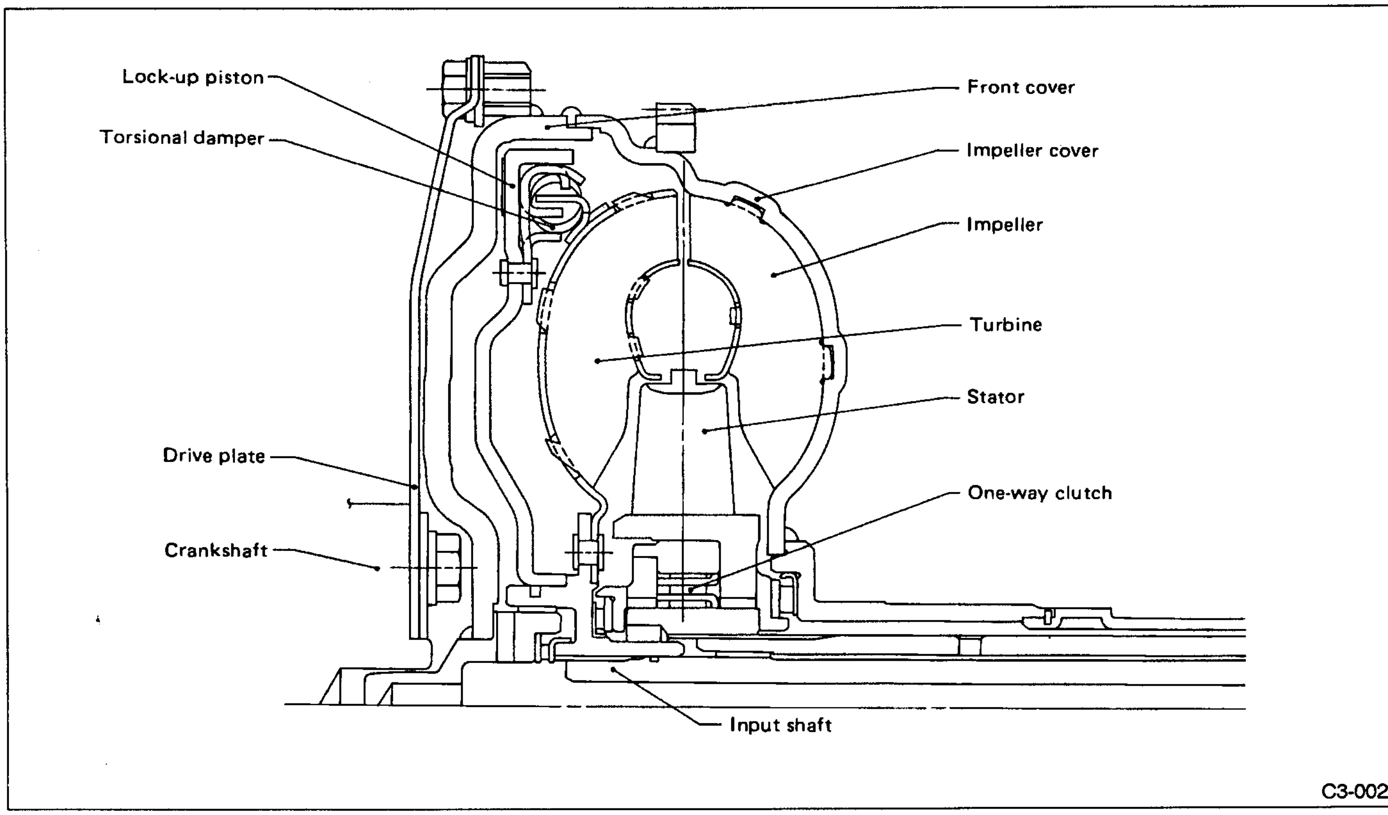



*Fig. 4*

## A: CONSTRUCTION

This system causes the impeller and turbine to be coupled directly without the aid of oil when the engine rpm reaches a certain level. This direct coupling eliminates torque converter slip and thus leads to a reduction in engine rpm, which in turn results in less fuel consumption and less noise.

The single plate type lock-up clutch is used, and the transition hydraulic oil pressure is controlled for reducing the lock-up shock of the clutch thereby achieving smooth lock-up operation.

The lock-up clutch is fitted with torsional dampers and the diaphragm spring friction washers are adopted for reducing the vibration and noise in the driving system.

## B: FUNCTION

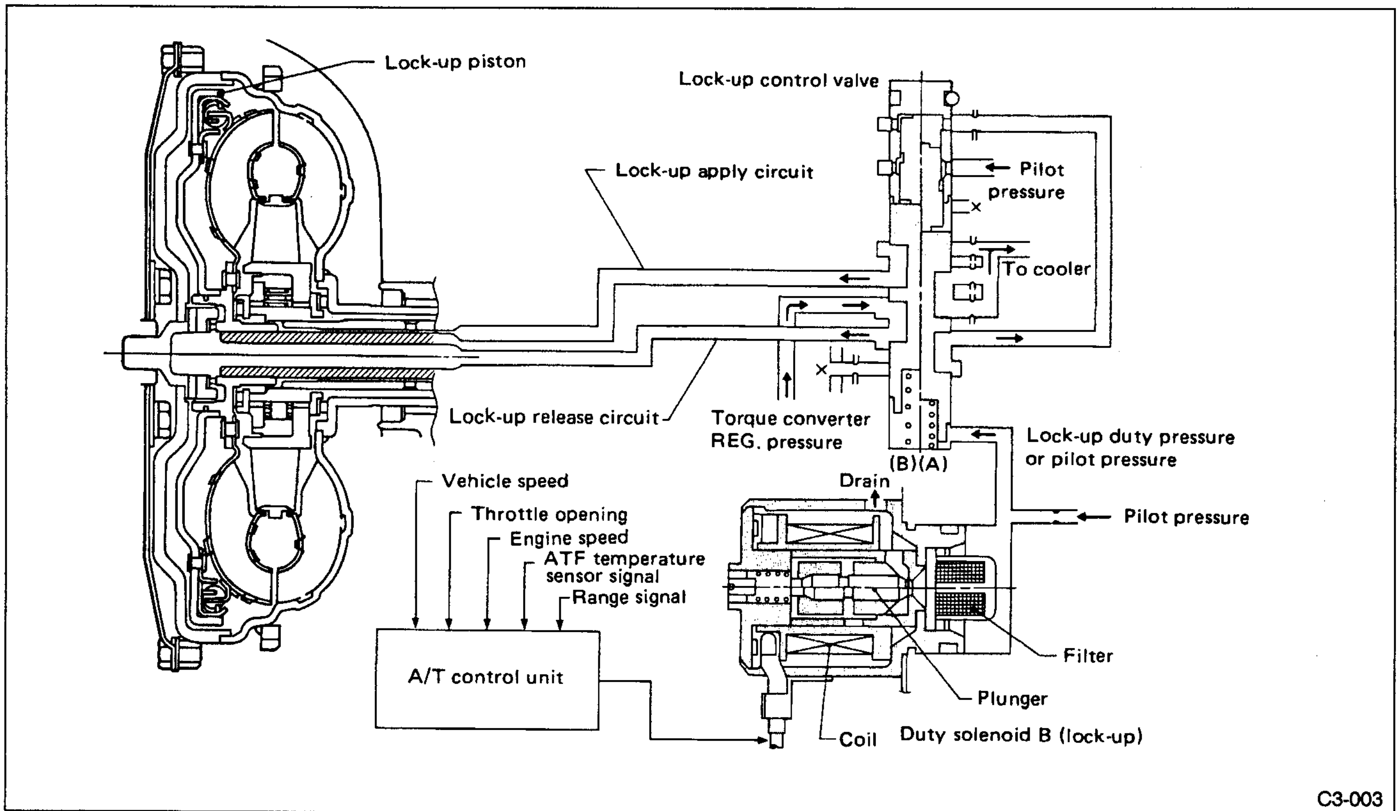



*Fig. 5*

**The lock-up control valve is pushed downward by torque converter REG pressure and pilot pressure. It is pushed upward by lock-up duty pressure and spring force.**

### 1. LOCK-UP OPERATION

Oil pressure at the lock-up control duty solenoid valve is drained (duty ratio 95%) by a signal from the automatic transmission control unit so that no lock-up duty pressure is developed and the lock-up control valve remains in condition (A). As a result, hydraulic oil flows into the lock-up apply circuit. On the other hand, the lock-up release circuit drains. This causes a pressure differential across the lock-up piston. The piston is then forced against the impeller cover and turned as an integral unit with the cover. Thus, power from the engine is directly transmitted to the transmission input shaft. That is, the transmission is directly coupled to the engine.

### 2. NON-LOCK-UP OPERATION

In this mode, the lock-up control duty solenoid is driven at a 5% duty ratio. This causes the lock-up duty pressure (pilot pressure) to be generated. With this pressure, the lock-up control valve is set to condition (B), and hydraulic oil flows into the lock-up release circuit. On the other hand, the lock-up apply circuit is connected to the oil cooler in the radiator. Accordingly, the relationship between "lock-up release pressure lock-up apply pressure" is established. As a result, the lock-up piston is forced to separate from the impeller cover, and power is transmitted from impeller to turbine to input shaft, as with an ordinary torque converter coupling.

### 3. SMOOTH CONTROL

When the lock-up clutch activates, the clutch partially engages. Lock-up apply pressure increases smoothly to engage the lock-up clutch.

### 4. NON-LOCK-UP OPERATION DURING "1ST SPEED", "N", "R" AND "P" POSITION

In this mode of operation, pilot pressure is generated, and the lock-up control valve is set to condition (B) where lock-up is inoperative.

# 4. Oil Pump

## A: CONSTRUCTION

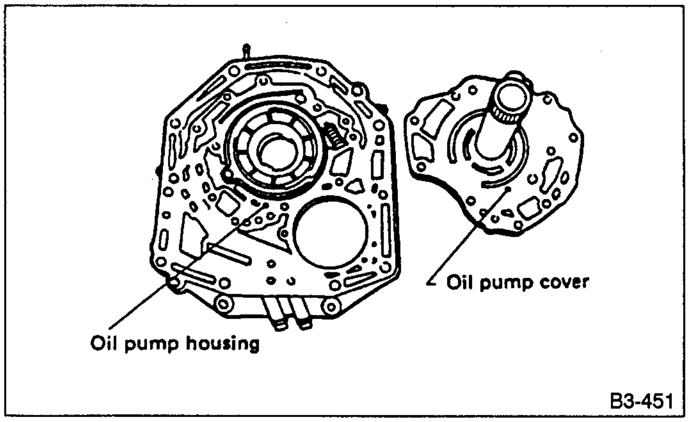



*Fig. 6*

The vane pump is housed in the oil pump housing. It consists of a rotor, vanes, vane rings, cam ring, control piston, return spring, seal ring and oil pump cover.
Hydraulic pressure (feedback pressure) from the oil passage ② of the pressure regulator valve is applied to the back of the control piston.

## B: FUNCTION

1) The automatic transmission fluid (ATF) is drawn through the oil strainer mounted under the control valve ASSY, and is routed to the transmission case, to the oil pump housing, and to the oil pump cover. It then goes to the suction port of section A shown in the Figure.
2) The ATF sucked into section A rotates in the direction of the arrow (driven directly by engine), and is compressed at the delivery side of section B. It is then discharged.
3) The discharged ATF flows from the oil pump cover to the oil pump housing. It then goes to the transmission case, the control valve and to the regulator valve, thus serving as hydraulic oil and lubricating oil for the torque converter, valves, clutch and brake.
4) As engine speed increases, the delivery rate of the vane pump also increases.
5) Feedback pressure from the regulator valve is applied to section C in the Figure. The cam ring position (the amount of eccentricity) is controlled by this pressure so that the pump delivery rate remains constant at speeds exceeding the preset pump speed.
6) As the cam ring position changes, the suction volume at section A varies. In this manner, the pump delivery volume is controlled.

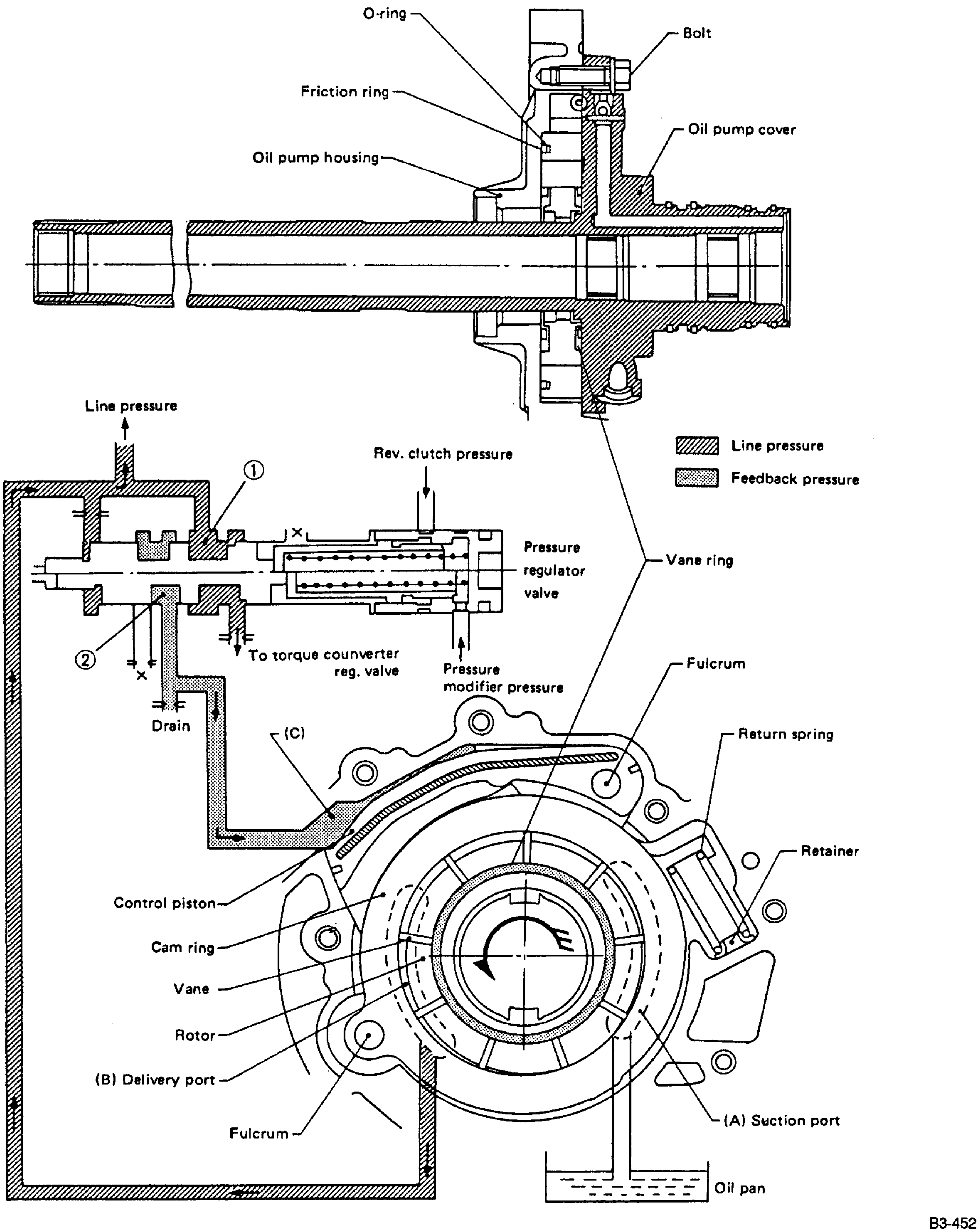

O-ring
Bolt
Friction ring
Oil pump cover
Oil pump housing
Line pressure
Rev. clutch pressure
Line pressure
Feedback pressure
①
Pressure
regulator
valve
Vane ring
②
To torque counverter
reg. valve
Pressure
modifier pressure
Fulcrum
Drain
(C)
Return spring
Retainer
Control piston
Cam ring
Vane
Rotor
(B) Delivery port
Fulcrum
(A) Suction port
Oil pan
B3-452

*Fig. 7*

# 5. Planetary Gear

## A: CONSTRUCTION

The planetary gear train uses two sets of simple planetary gears (front planetary gear and rear planetary gear), four sets of multi-plate clutches (reverse clutch, high clutch, forward clutch, and overrunning clutch), one brake band, one set of multi-plate brake, and two sets of one-way clutches (one-way clutch 1-2 and one-way clutch 3-4) in order to allow shifting of four forward speeds and one reverse speed.

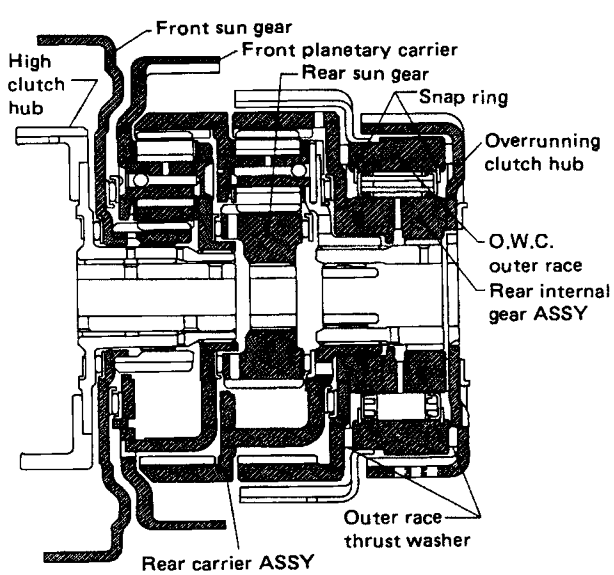



*Fig. 8*

Two sets of simple planetary gears are used to allow gear shifting from 1st speed to 4th speed or to reverse. Both the front and rear planetary gear carriers are made from pressed steel which is electron-beam welded to other structural members. The front planetary gear has three pinions while the rear planetary gear has four pinions. Both are part of an integral unit, and disassembling is not allowed.

## B: FUNCTION

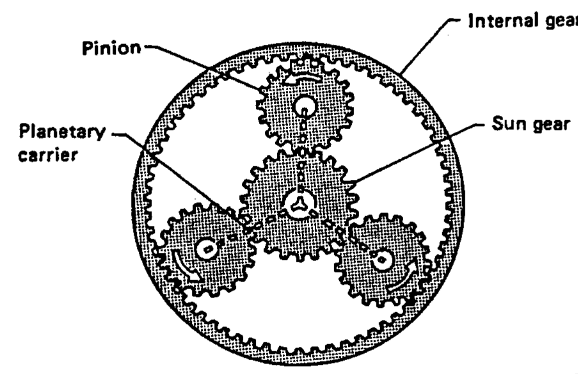



*Fig. 9*

The automatic transmission uses a planetary gear system instead of the parallel shaft (two shafts) gear system adopted in the manual transmission.
The advantage of the planetary gear system is that it is compact because it has only one center shaft. The gear ratio can be changed by simply locking or releasing or rotating certain portions, unlike the manual transmission that requires changing gear engagement.
The construction of the planetary gear is shown above. The sun gear is located at the center, and each of the pinion gears revolves around the sun gear while rotating on its axis. These gears are all enclosed in a large ring, called the internal gear. Each pinion gear is supported by a planetary carrier, so that the pinion gears revolve an equal amount in the same direction. As mentioned above, the planetary gear consists of four elements: the sun gear, pinion gears, internal gear, and planetary carrier. The gears are shifted by imposing certain conditions on two of the following three elements: sun gear, internal gear, and planetary carrier.
The clutches and brakes are used to impose the conditions on the planetary gear set.

# 6. Reverse Clutch

## A: CONSTRUCTION

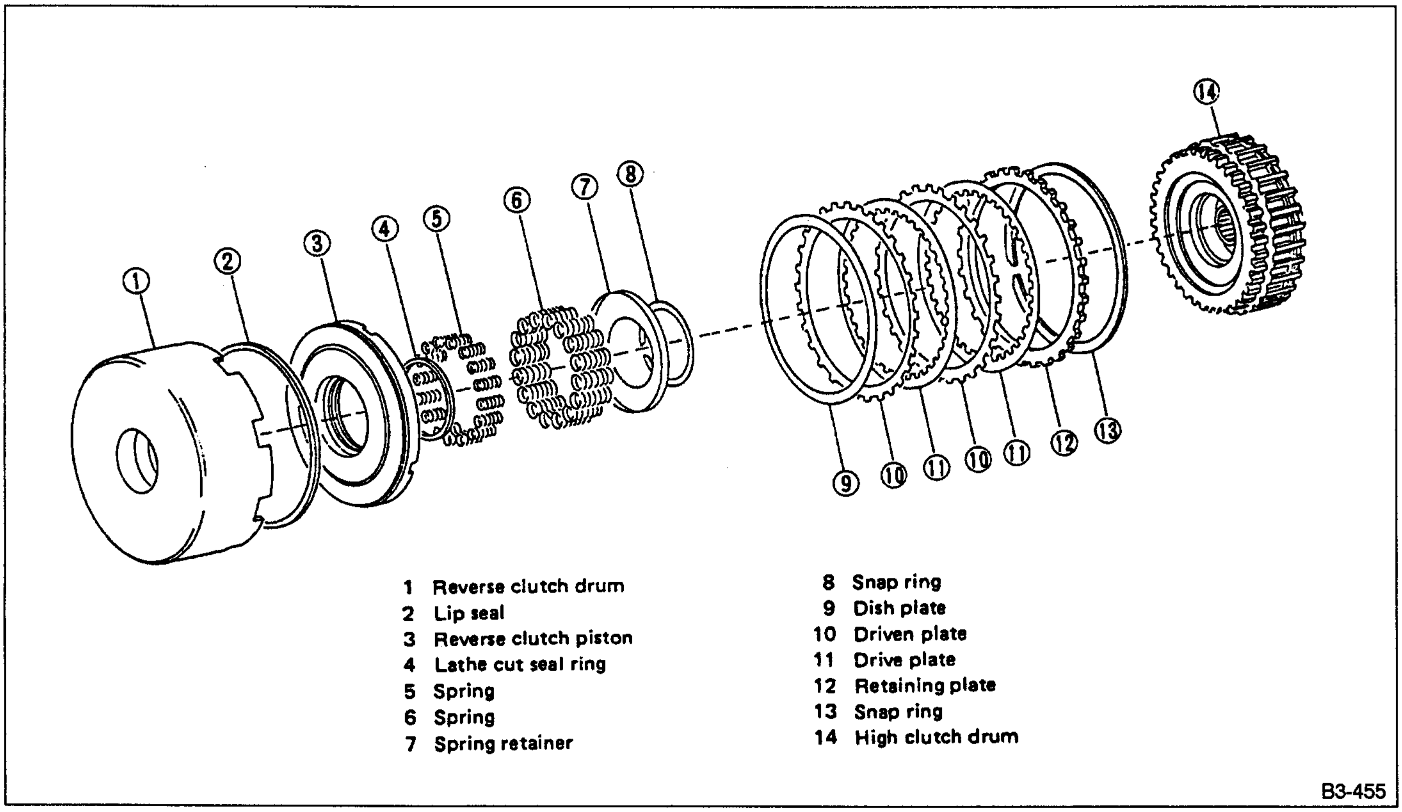



*Fig. 10*

## B: FUNCTION

### DURING OPERATION

Hydraulic pressure is applied to the reverse clutch piston ① from the control valve when shifting in reverse. The drive plate ② and driven plate ③ are connected by this pressure, and engine power from the high clutch drum ④ is transmitted to the front sun gear.

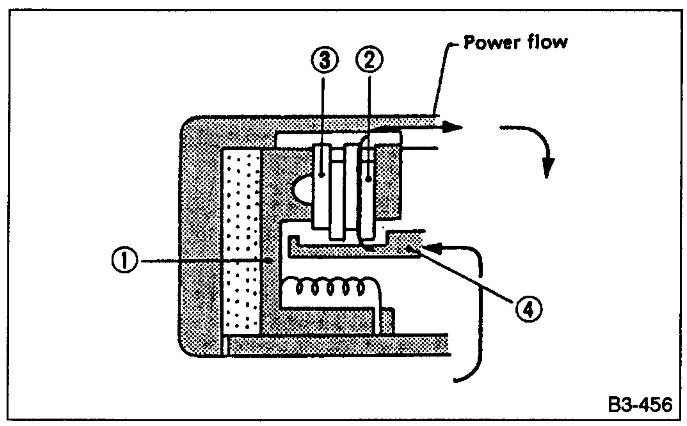



*Fig. 11*

**DURING NON-OPERATION**

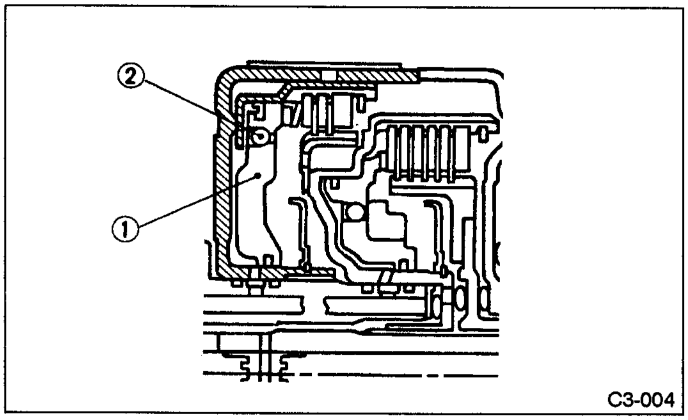



*Fig. 12*

When the shift lever is in any position other than reverse, no hydraulic pressure is applied to the reverse clutch piston ① . Hence the drive plate and driven plate are separated, and no power is transmitted.
The check ball ② is built into the clutch piston. This check ball releases oil pressure from the clutch piston while the drum rotates idle. It thus avoids build-up of residual pressure in the clutch drum and a resultant half-engaged clutch, which may otherwise be caused by centrifugal oil pressure.

# 7. High Clutch

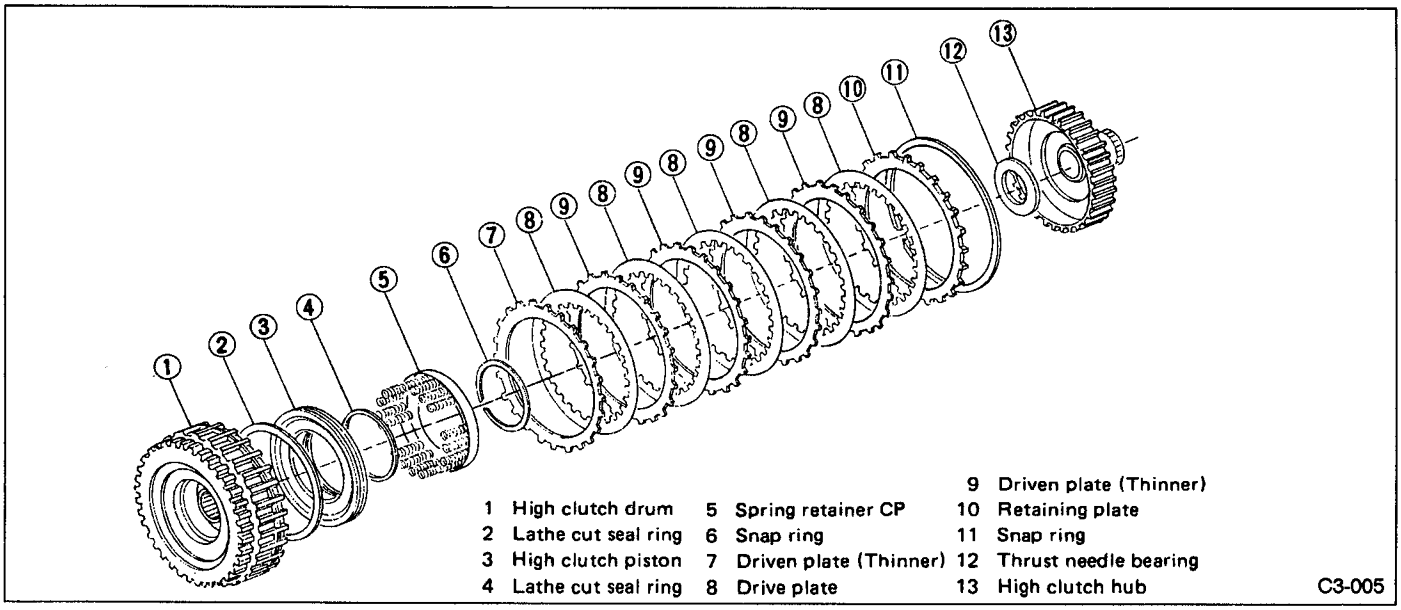



*Fig. 13*

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

# 8. Band Brake

## A: CONSTRUCTION

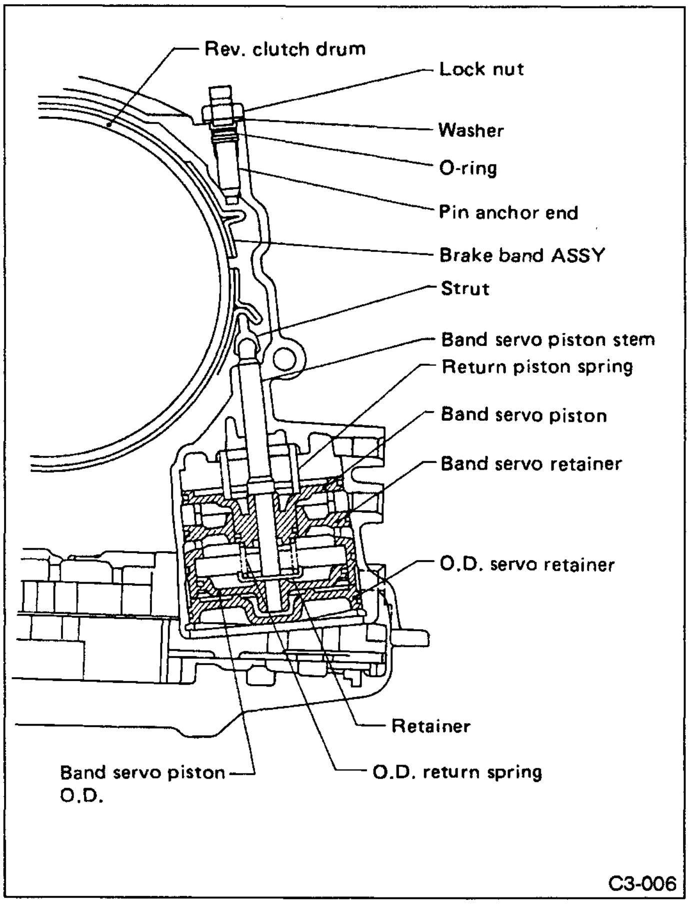



*Fig. 14*

The band brake consists of a flex type brake band, a band brake adjusting mechanism, two servo pistons, two retainers, two return springs, a stem, a strut, and others. The band brake can be adjusted as installed on the vehicle.

## B: FUNCTION

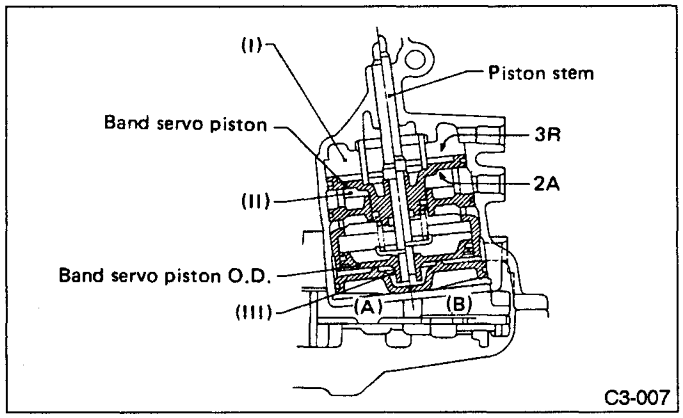



*Fig. 15*

One end of the brake band is secured to the transmission case via the brake band adjusting screw.
When no hydraulic pressure is applied to the servo piston from the hydraulic pressure controller, the servo piston and band servo piston O.D. are forced downward by the return spring, as shown in (A) of the Figure.
When hydraulic pressure 2A is applied to the servo chamber (II), it causes the band servo piston to come into contact with the stepped portion of the band servo piston stem, thereby pushing the band servo piston stem upward to state (B). Under this condition, the brake band slowly tightens the reverse clutch drum and fixes the front sun gear of the front planetary gear. (2nd speed state)
Next, when the release pressure 3R to the servo chamber (I) and the hydraulic operating pressure 2A to the servo chamber (II) are applied simultaneously, the band servo piston is pushed downward by the force of the return spring and the pressure difference between chamber (I) and chamber (II), caused by the difference in operating areas of the band servo pistons. Under this condition, state (A) is resumed, and the brake band loosens and releases the reverse clutch drum. (3rd speed state)

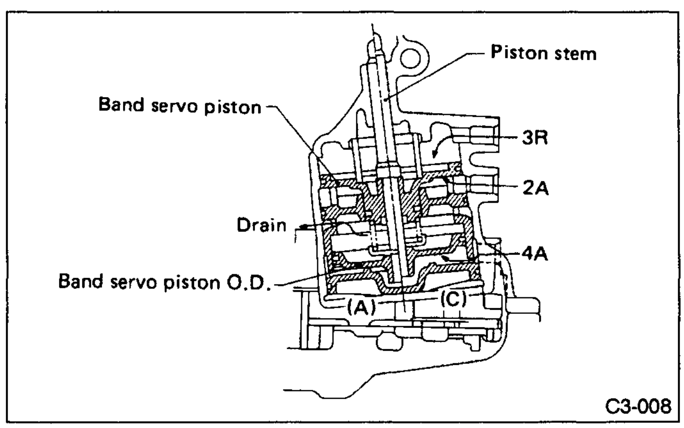



*Fig. 16*

When hydraulic pressure 4A is applied to the servo chamber (III) under the 3rd speed condition, the band servo piston O.D. is brought into contact with the retainer installed at the lower end of the band servo piston stem. Hence, the stem is pushed upward. As a result, state (C) is achieved where the brake band slowly tightens the reverse clutch drum and fixes the front sun gear of the front planetary gear. (4th speed state) The accumulator is built into the transmission case as shown in the Figure. When hydraulic pressures 2A, 3R, and 4A are applied from the hydraulic control unit to the respective servo chambers, the hydraulic shock loads are absorbed by the accumulator. This is because the accumulator piston moves slowly, and the brake band is tightened or released slowly. This results in smooth gearshift operation.

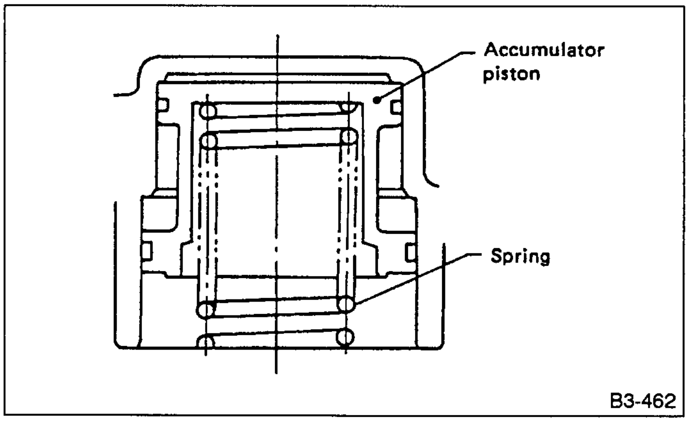



*Fig. 17*

# 9. One-way Clutch

## A: CONSTRUCTION

The one-way clutch (O.W.C.) is a Sprague type. Two clutches are used. One is mounted between the one-way clutch outer race and the rear internal gear ASSY. The other is located between the forward clutch drum and the one-way clutch inner race.

## B: FUNCTION

The former O.W.C. (3-4) is provided to prevent counterclockwise rotation (as viewed from the front) of the rear internal gear ASSY of the rear planetary gear during 1st, 2nd and 3rd speeds of the "D" range, "3" range, "2" range and "1st range". At the 4th speed of the "D" range, therefore, the rear internal gear ASSY rotates clockwise so that the O.W.C. rotates freely to ensure smooth transition between 3rd and 4th speeds.
On the other hand, the latter O.W.C. (1-2) is provided to prevent counterclockwise rotation (as viewed from the front) of the forward clutch ASSY during 1st speed of the "D" range and 1st speed of the "3" range. Therefore, when shifting from 1st speed of the "D" range or "3" range to 2nd speed, the forward clutch ASSY rotates clockwise. As a result, the O.W.C. now rotates freely ensuring smooth transition between 1st and 2nd speeds.

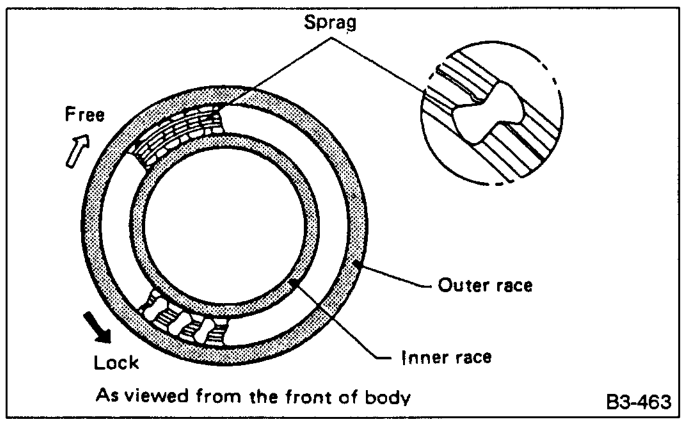



*Fig. 18*

# 10. Low & Reverse Brake

## A: CONSTRUCTION

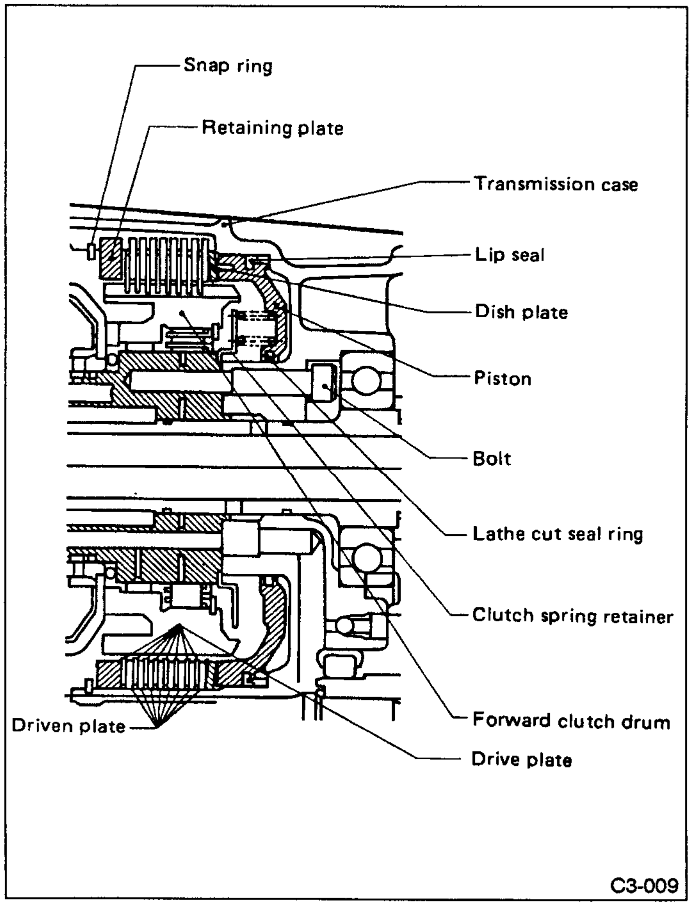



*Fig. 19*

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

## B: FUNCTION

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

# 11. Forward Clutch & Overrunning Clutch

## A: CONSTRUCTION

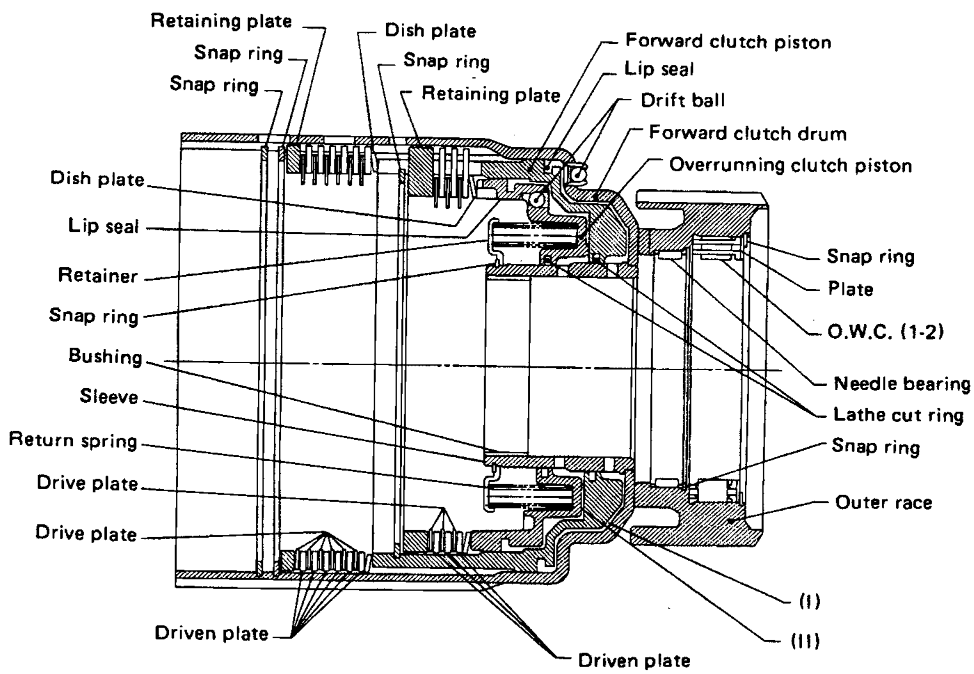



*Fig. 20*

The forward clutch drum is manufactured by pressing sheet metal. The clutch drum, outer race and sleeve are welded together by the electron beam welding technique. This clutch drum accommodates two multi-plate clutches (forward clutch and overrunning clutch). The overrunning clutch piston is mounted on the internal periphery of the forward clutch piston for common use of the return spring and reduction in size.

## B: FUNCTION

When hydraulic pressure is applied to the pressure chamber (I) from the hydraulic pressure controller during forward operation in the "D", "3", "2" range and "1st range", the forward clutch piston forces the overrunning clutch piston. This causes the drive and driven plates of the forward clutch to engage while causing the drive and driven plates of the overrunning clutch to slide forward.

A groove is provided on the outside of the retaining plate and driven plate of the overrunning clutch in which the forward clutch piston slides.

When hydraulic pressure is applied to the pressure chamber (II) from the hydraulic pressure controller during "3" range, "2" range or "1st range" operation, the forward clutch piston is forced onto the side of the forward clutch drum. The overrunning clutch piston, however, is moved to the left by the hydraulic pressure. This causes the drive and driven plates of the overrunning clutch to engage. When this occurs, the outside splines of the overrunning clutch retaining plate and driven plate fit into the internal spline grooves of the forward clutch. This allows power to be transmitted between the overrunning clutch hub and the forward clutch drum.

## 12. Input Shaft

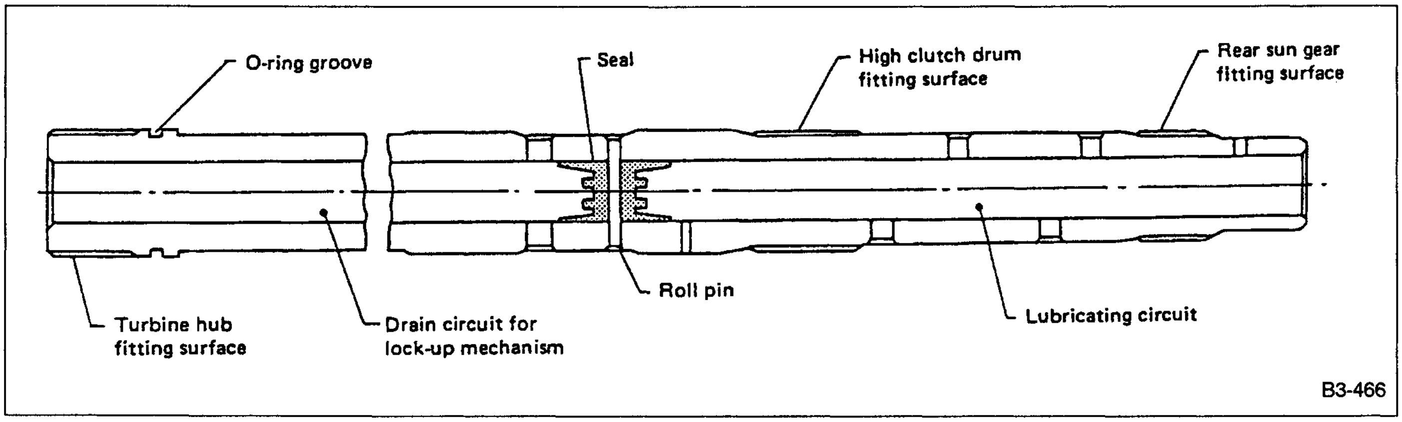



*Fig. 21*

The input shaft front end is spline-fitted to the torque converter turbine hub. The rear end is spline-fitted to the high clutch drum and rear sun gear. Power from the torque converter is transmitted to the high clutch drum and rear sun gear. The input shaft is hollow. A seal is fitted inside the shaft by a roll pin. The torque converter side of the shaft becomes the drain circuit for the lock-up mechanism. The other side becomes the lubricating circuit for the planetary gears and high clutch.

## 13. Reduction Gear

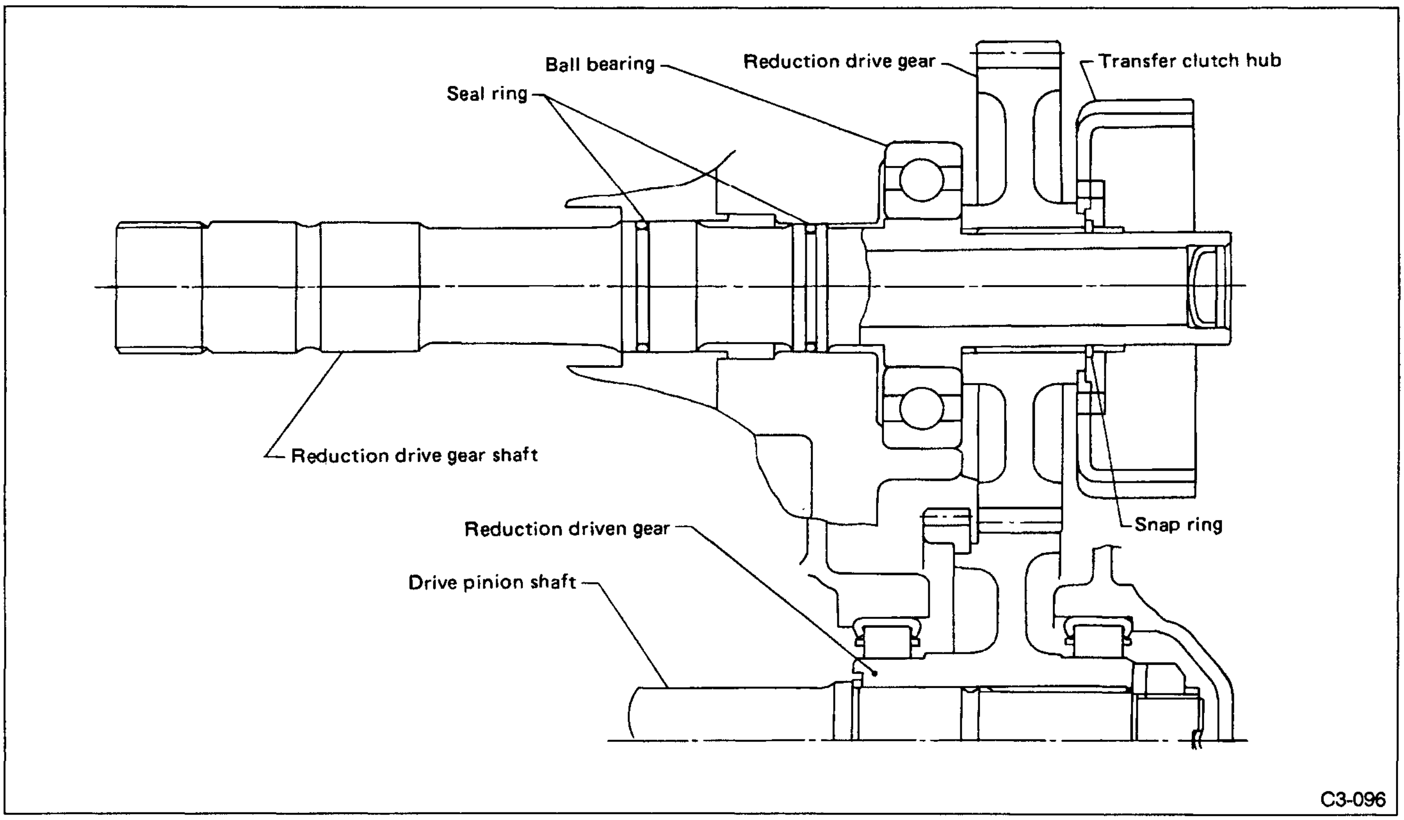



*Fig. 22*

Engine power is transmitted from the rear planetary carrier to the reduction drive shaft and the reduction drive gear. 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 from the transfer clutch hub, welded to the side of the reduction drive gear, and passes through the transfer clutch (multi-plate clutch), to the rear drive shaft → propeller shaft → rear differential → rear wheel.

# 14. Final Reduction Gears

## 1. GENERAL

The hypoid drive gear is mounted to the cast iron oil pump housing by double taper roller bearings. The hypoid driven gear and the differential are mounted to the differential case. Both ends rotate and are supported by taper roller bearings in the converter case.

## 2. HYPOID GEAR

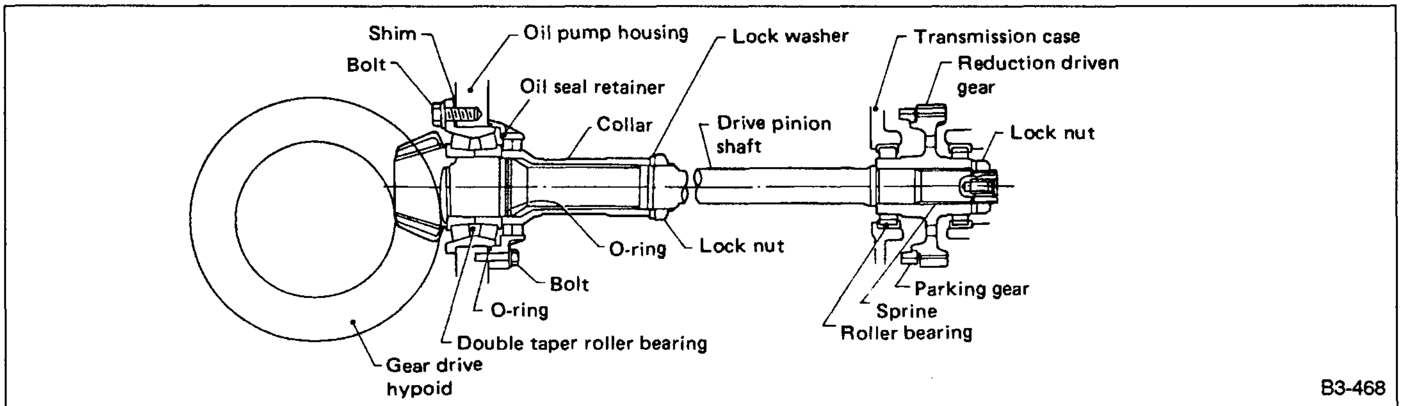



*Fig. 23*

The front end of the drive pinion shaft is supported by the double-taper roller bearing on the oil pump housing. The rear end is supported by two roller bearings on the transmission case and extension case. The double-taper roller bearing is preloaded by tightening the lock nut to a specified torque via the collar. The tooth contact of the hypoid gear is adjusted by changing the shim thickness between the double-taper roller bearing flange and oil pump housing.

The rear end of the drive pinion shaft is spline-fitted to the reduction driven gear, which is secured with a lock nut. The external helical spline has some lead, and the reduction driven gear is force-fitted to this shaft end.

## 3. DIFFERENTIAL GEAR

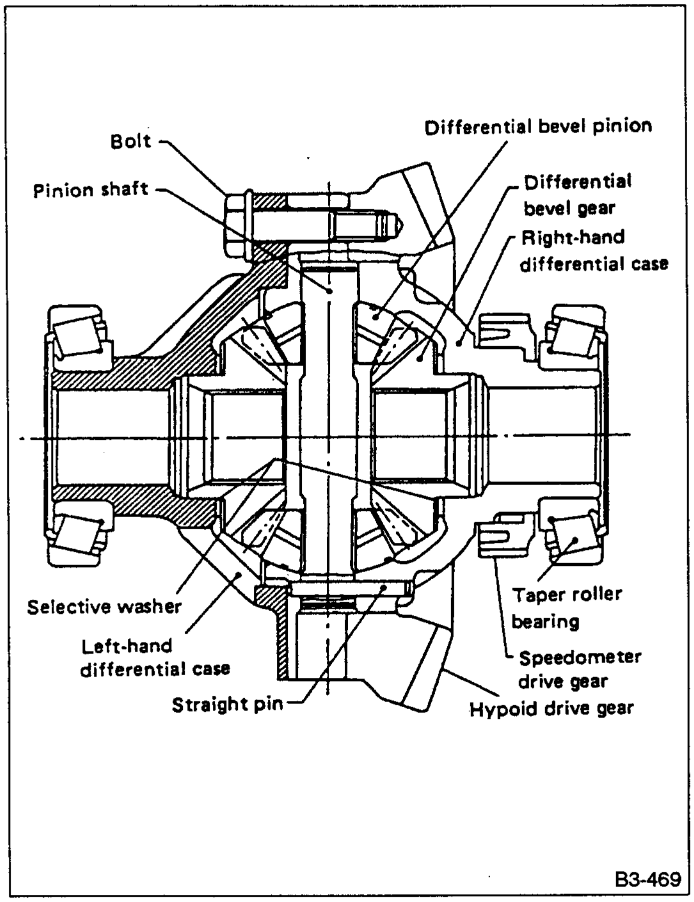



*Fig. 24*

The differential bevel gear is locked to the axle shaft by a clip.

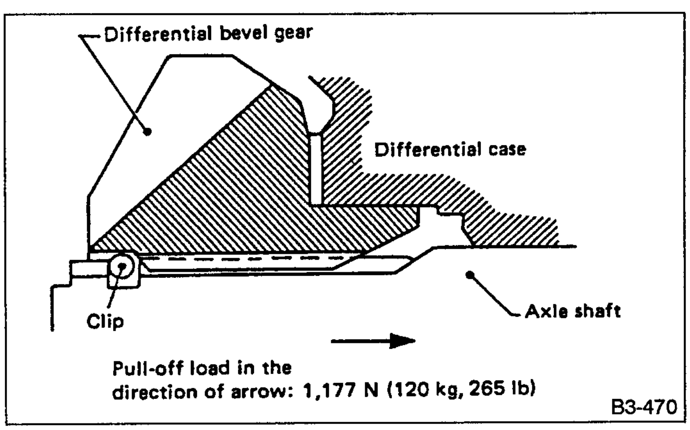



*Fig. 25*

## 4. SPEEDOMETER GEAR

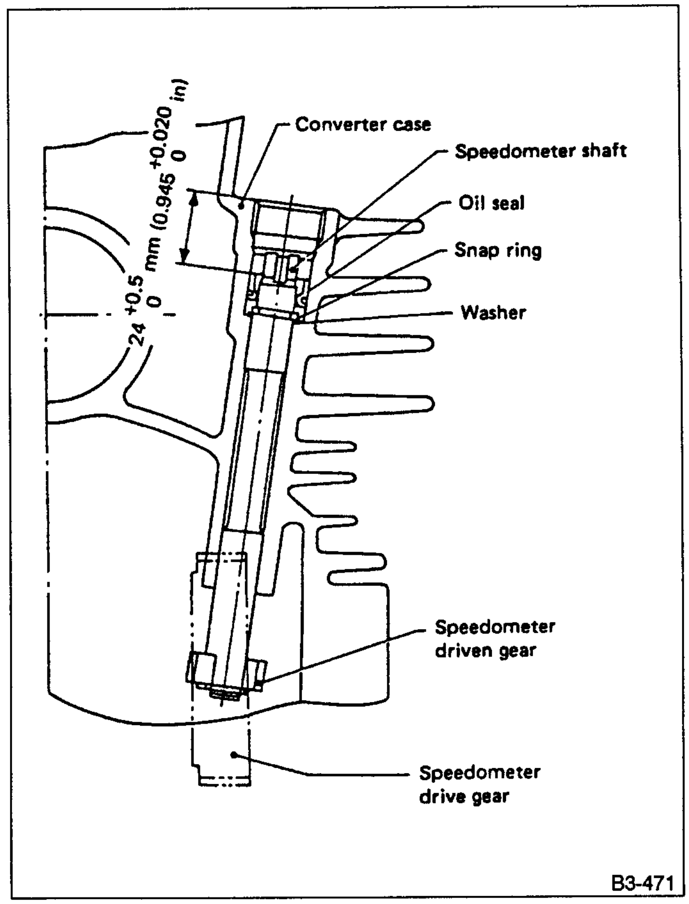



*Fig. 26*

The speedometer drive gear is mounted directly on the differential case, and the flexible cable is led from the right side of the converter case. With this arrangement, the speedometer drive and driven gears are properly lubricated.

## 15. Range Select Mechanism

The range select mechanism consists of a selector lever (on the floor/center console in the driver's compartment), push-pull cable, linkages, manual valve, parking pawl, etc.
When the selector lever is moved either forward or backward, the push-pull cable moves in the corresponding direction. This turns the manual shaft by way of the range selector lever. At this point, the pin at the end of the range selector lever turns the inhibitor switch arm to transmit a range signal to the control unit.
A manual plate and manual lever are attached to the manual shaft. The manual plate is fan-shaped and is provided with seven grooves on its edge corresponding to shift ranges (from "P" to "1"). A detent spring roller fits into the groove corresponding to the range selected. This regulates effort required to operate the selector lever.
A hydraulically controlled manual valve is installed on the lower pin of the manual lever. It slides in response to rotation of the manual shaft, thereby selecting an oil passage inside the lower valve body in response to the position (P, R, N, D, 3, 2 or 1) of the selector lever.
A parking rod located on the upper portion of the lever mechanically holds the output shaft when the selector lever is shifted to "P".
**A shift lock mechanism is incorporated in the selector lever mount. For the shift lock mechanism, see "3-3 Transmission Control System".**

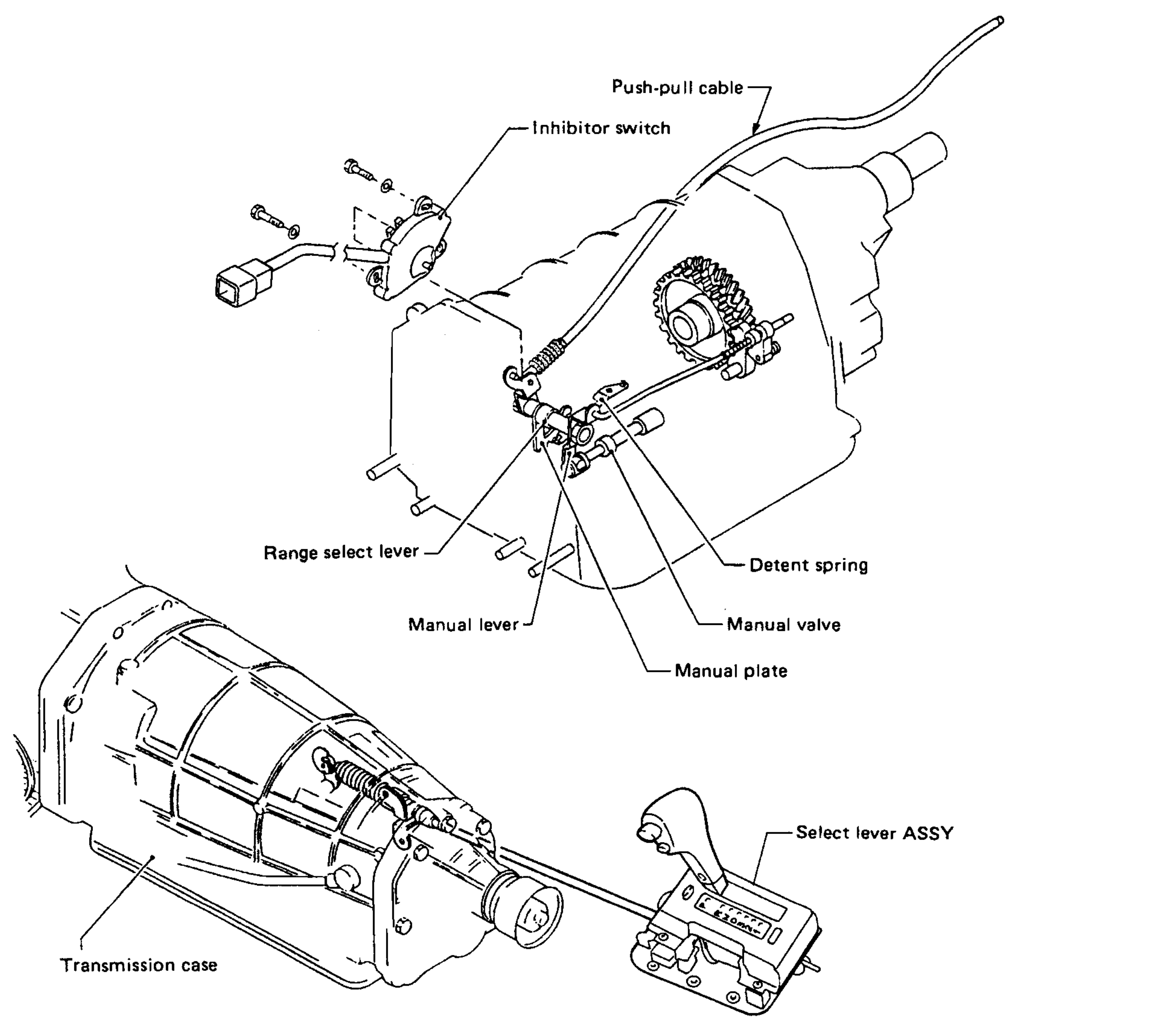



*Fig. 27*

## 16. Parking Mechanism

The end of the parking pawl engages mechanically with the gear groove of the parking gear. This gear is spline-fitted to the drive pinion shaft.
When the selector lever is set to "P", the manual lever connected to the manual shaft turns, moving the parking rod backward. A cam and spring are installed on the rear of the parking rod. The parking cam slides freely on the parking rod. The parking rod and cam contact the "V" groove of the actuator (secured to the transmission case) and the back of the parking pawl. With this arrangement, when the parking rod moves backward, the cam moves to the back of the parking pawl and the "V" groove of the actuator. The parking pawl turns in the direction of the parking gear using the parking pawl shaft as a pivot. It then engages with the parking gear groove.
If the end of the parking pawl rides over the tooth of the parking gear so that the parking cam does not move midway between the pawl and actuator, the parking rod will move to "P". This compresses the parking spring so that the parking cam is ready to move to "P". Under this condition, if the vehicle moves slightly, the parking gear will rotate to engage the pawl completely.
Except for the P range, the parking pawl is tensed by the parking pawl return spring in the direction that moves away from the parking gear.

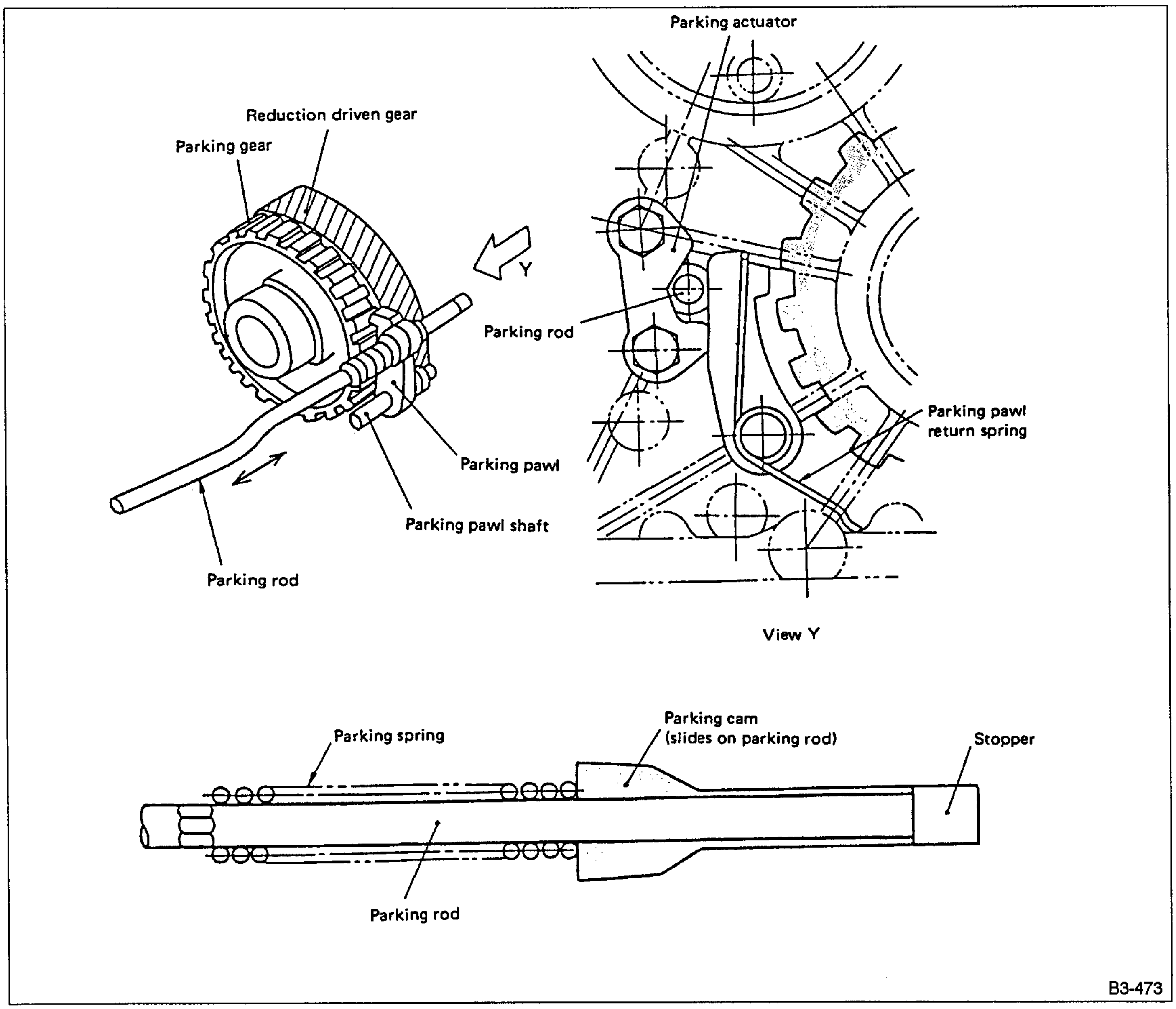



*Fig. 28*

# 17. AWD Transfer System

## 1. OUTLINE

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

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

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

The AWD transfer unit is housed in the extension case together with the bearing, rear drive shaft, etc.

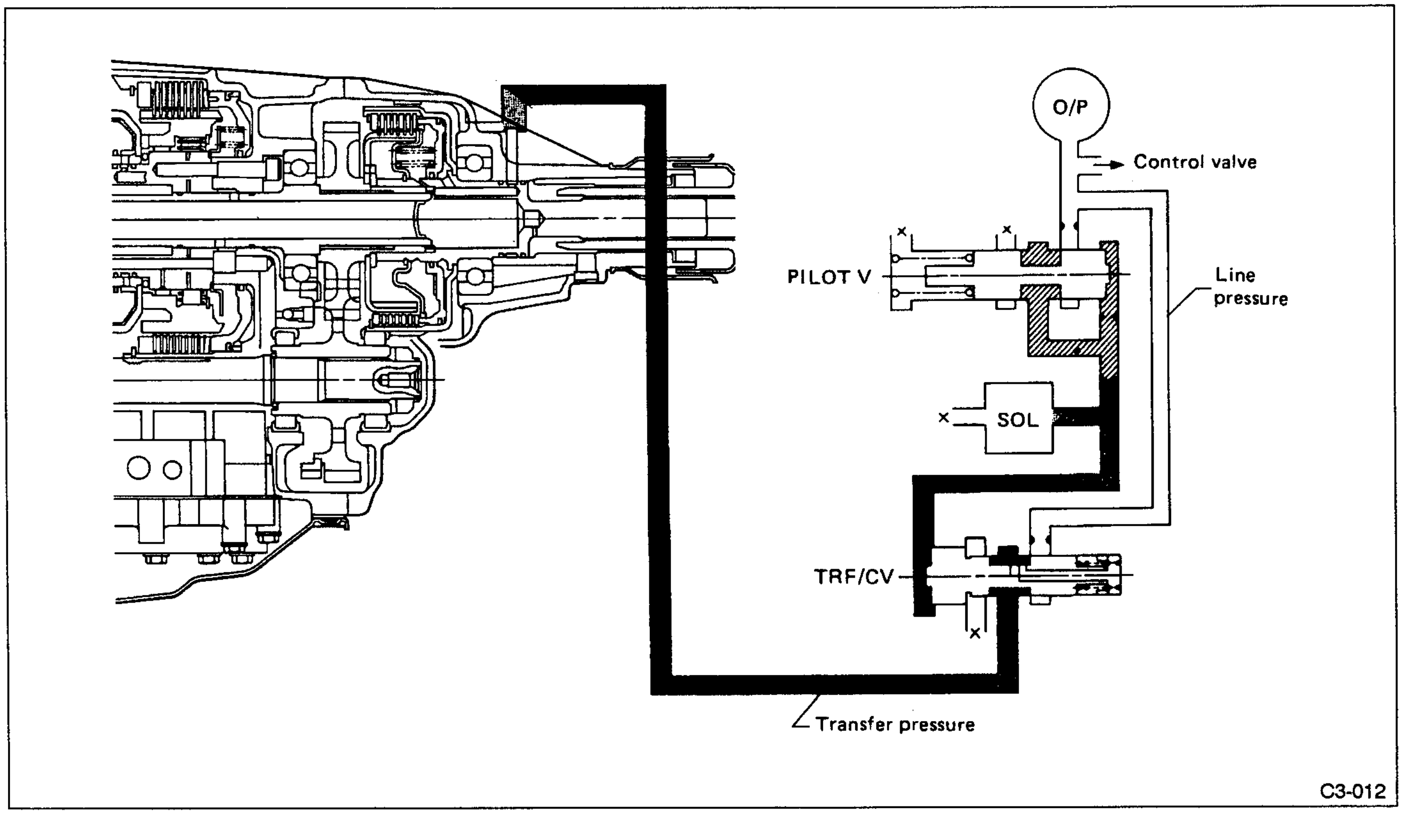



*Fig. 29*

## 2. TRANSFER CLUTCH (MULTI-PLATE CLUTCH)

The transfer unit consists of a hydraulic multi-plate clutch and a transfer hydraulic control system incorporating a duty solenoid valve. It is housed in the extension case together with the bearings, rear drive shaft, etc.

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

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

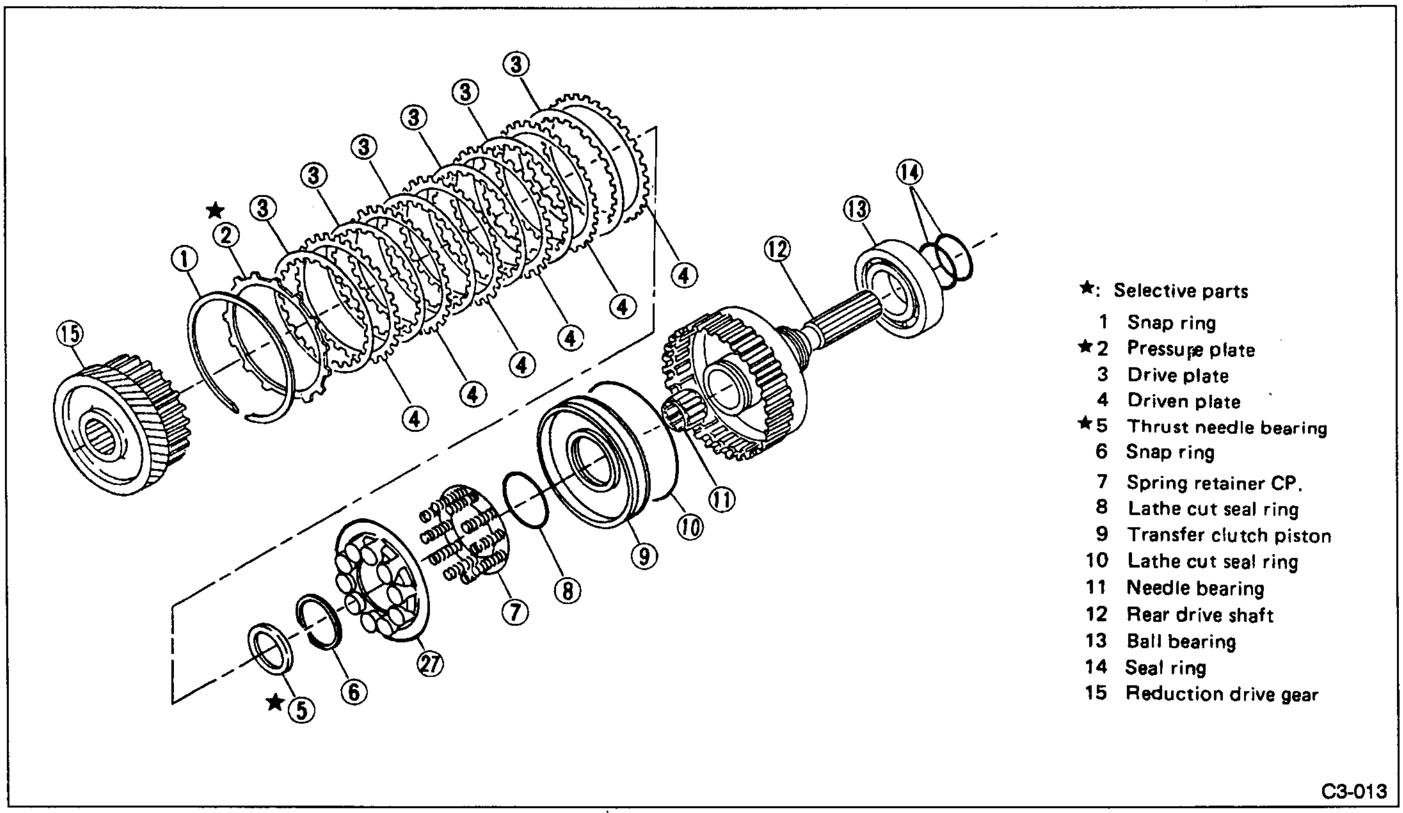



*Fig. 30*

### 3. TRANSFER OIL PRESSURE CONTROL DEVICE

The transfer valve body is bolted to the side of the extension case through two gaskets and one separate plate.

Operating oil for the transfer valve body is routed to the extension case through a pipe connecting the discharge circuit of the oil pump on the front of the transmission case to the rear of the case. It is then delivered to the oil pressure circuit provided in the plane on which the transfer valve body is mounted.

This line pressure is reduced to a fixed level by the pilot valve, and becomes the initial pressure of the duty solenoid C. Line pressure is also delivered to the transfer control valve where it is regulated by duty pressure variations to control the oil pressure so that optimum rear torque distribution is obtained according to running conditions.

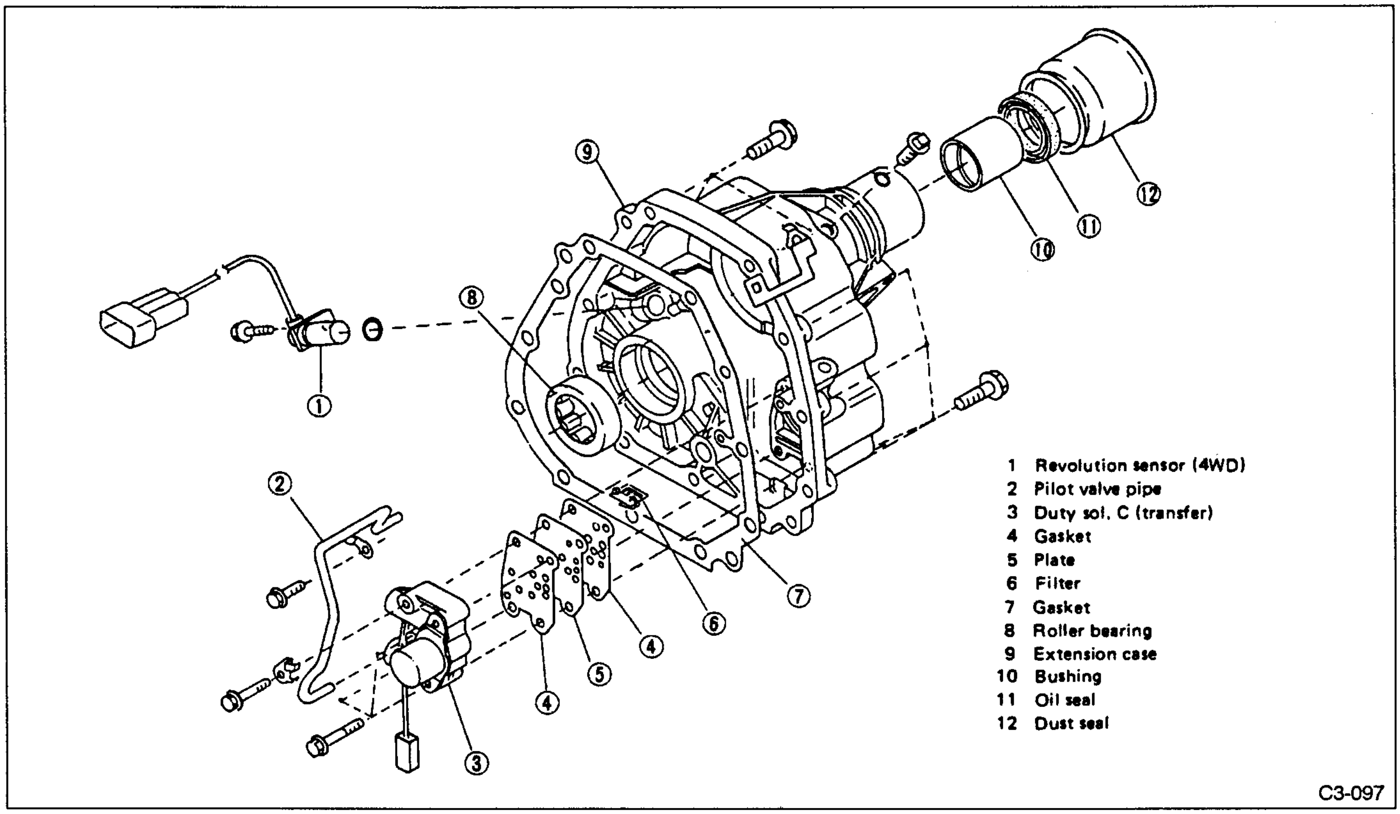



Fig. 31

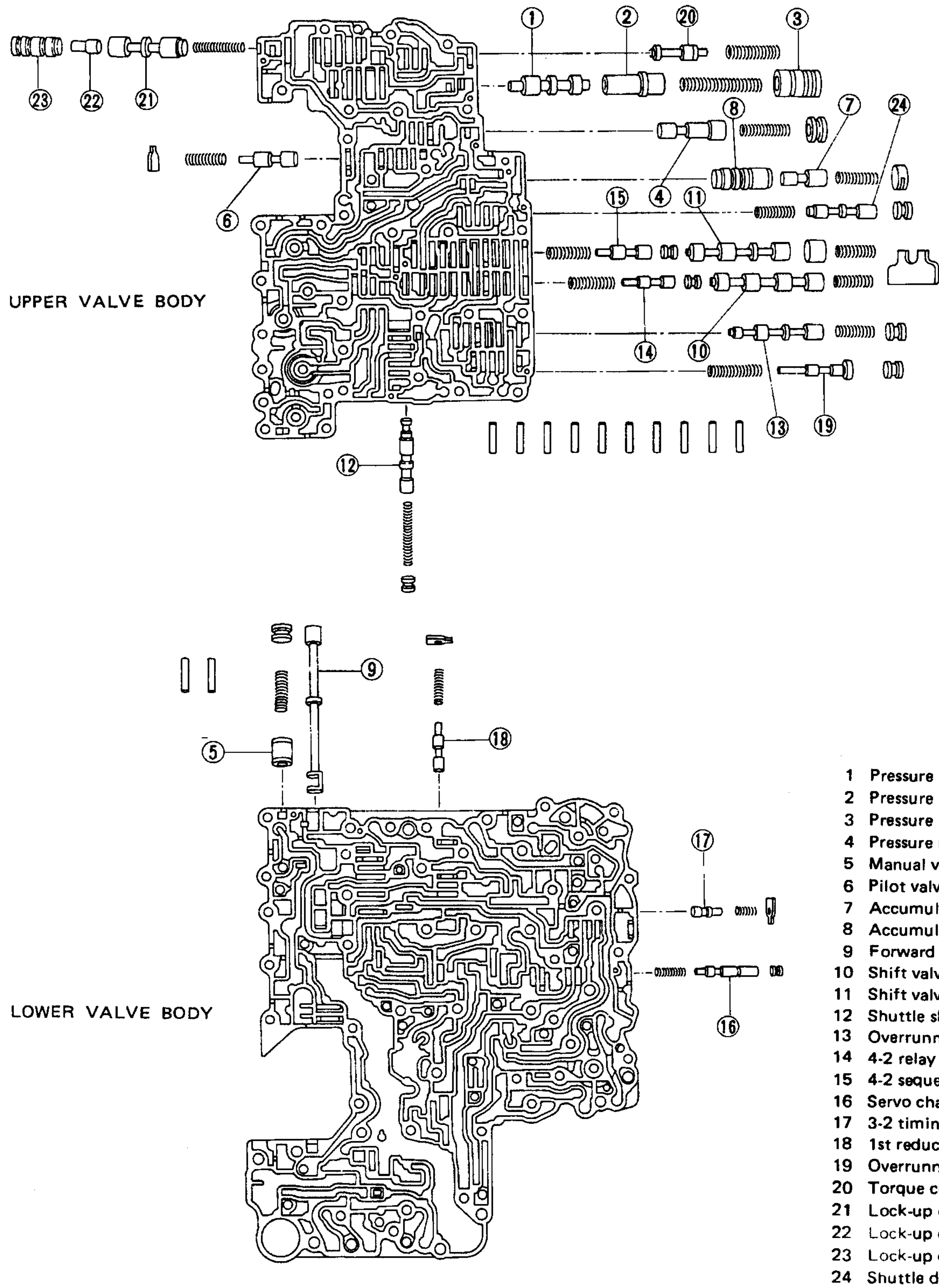
# 18. Hydraulic Control Valve

## A: GENERAL

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

## B: CONSTRUCTION

### 1. OVERALL




1 Pressure regulator valve
2 Pressure regulator plug
3 Pressure regulator sleeve plug
4 Pressure modifier valve
5 Manual valve
6 Pilot valve
7 Accumulator control plug
8 Accumulator control sleeve
9 Forward clutch control valve
10 Shift valve A
11 Shift valve B
12 Shuttle shift valve
13 Overrunning clutch control valve
14 4-2 relay valve
15 4-2 sequence valve
16 Servo charger valve
17 3-2 timing valve
18 1st reducing valve
19 Overrunning clutch reducing valve
20 Torque converter regulator
21 Lock-up control valve
22 Lock-up control plug
23 Lock-up control sleeve
24 Shuttle duty shift valve

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*Fig. 32*

## 2. VALVE BODY CONFIGURATION

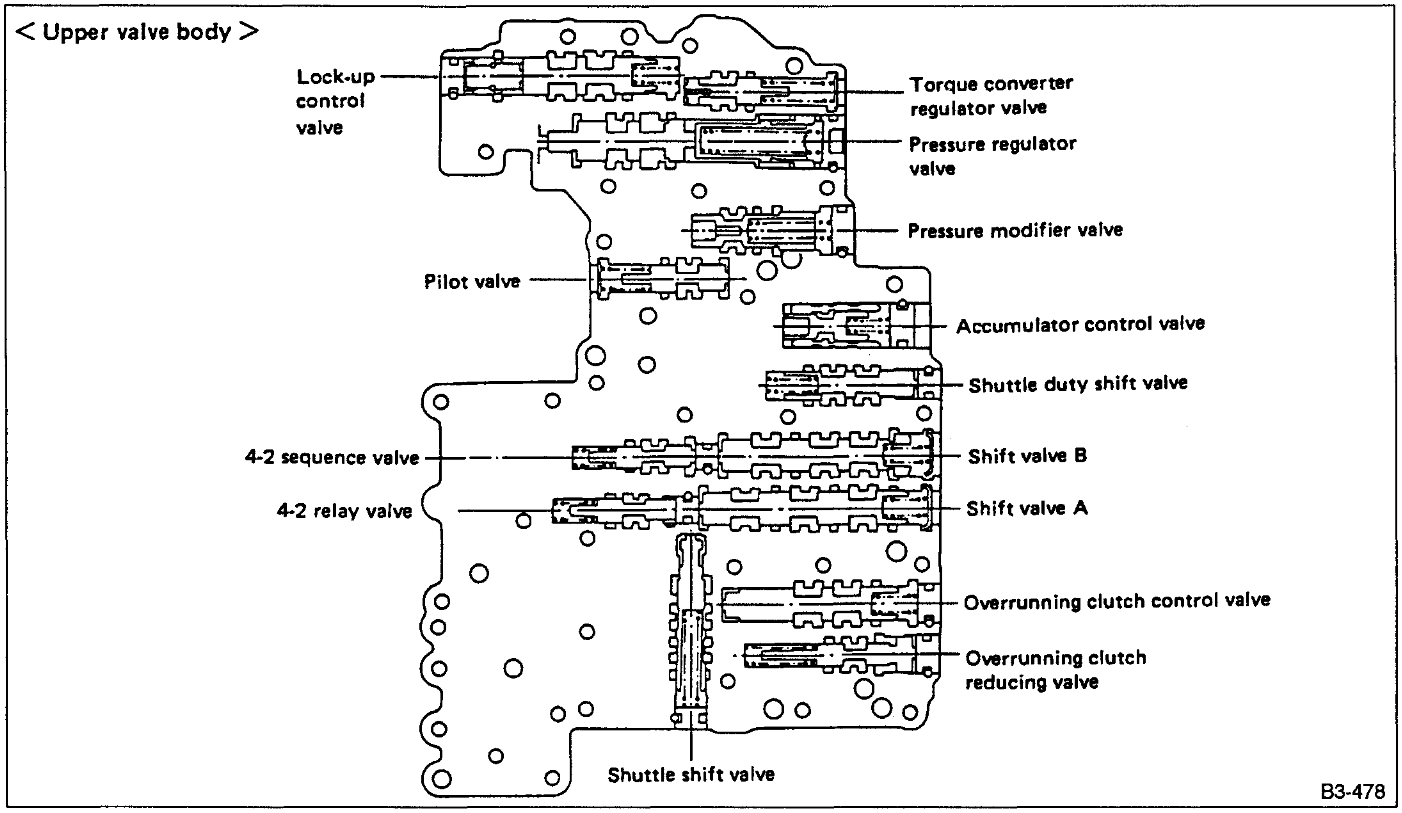



*Fig. 33*

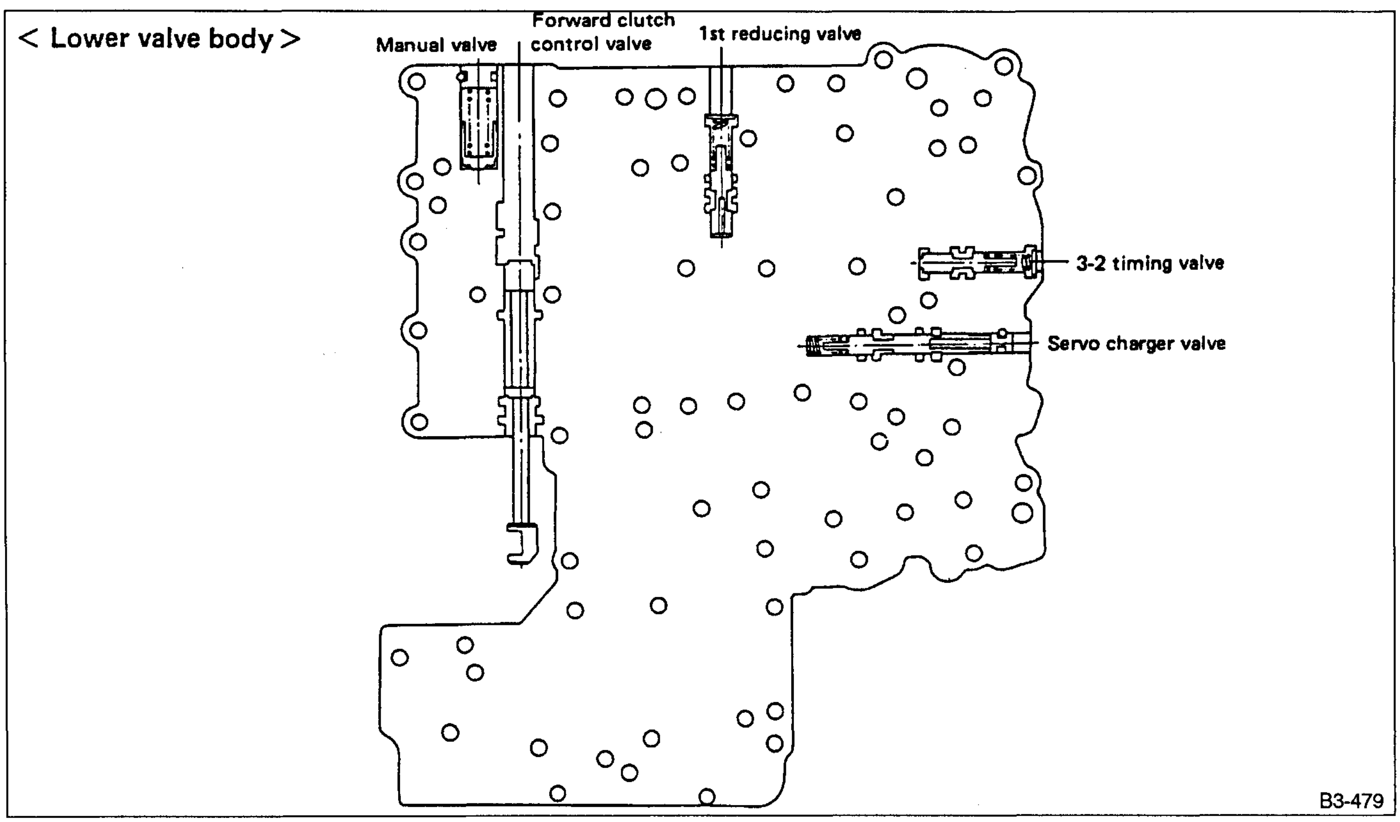



*Fig. 34*

## 3. RELATED PARTS (1)

The control valve body is fitted with Solenoid 1 (shift), Solenoid 2 (shift), Solenoid 3 (overrunning clutch), Duty solenoid A (line pressure), Duty solenoid B (lock-up) and an ATF temperature sensor.

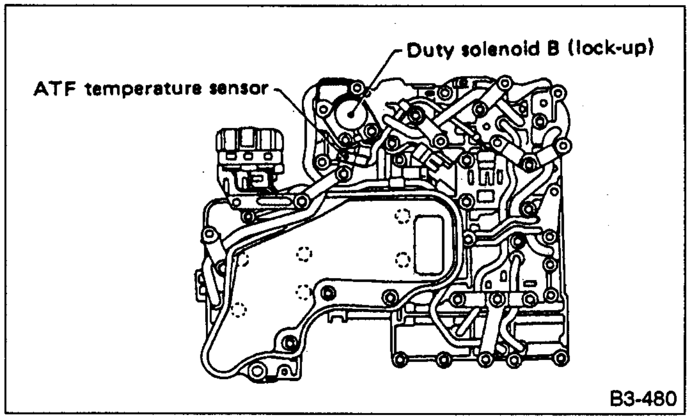



*Fig. 35*

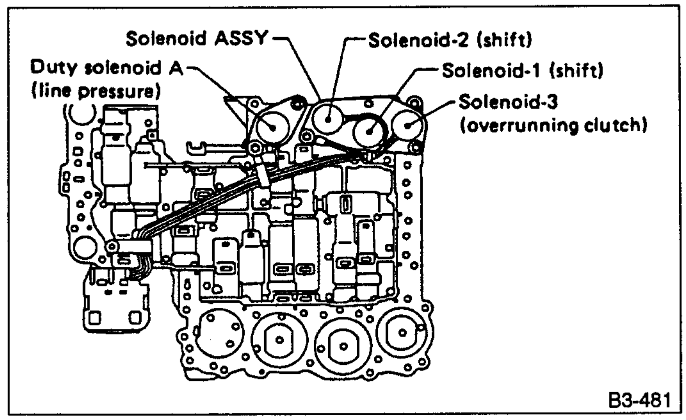



*Fig. 36*

## 4. RELATED PARTS (2)

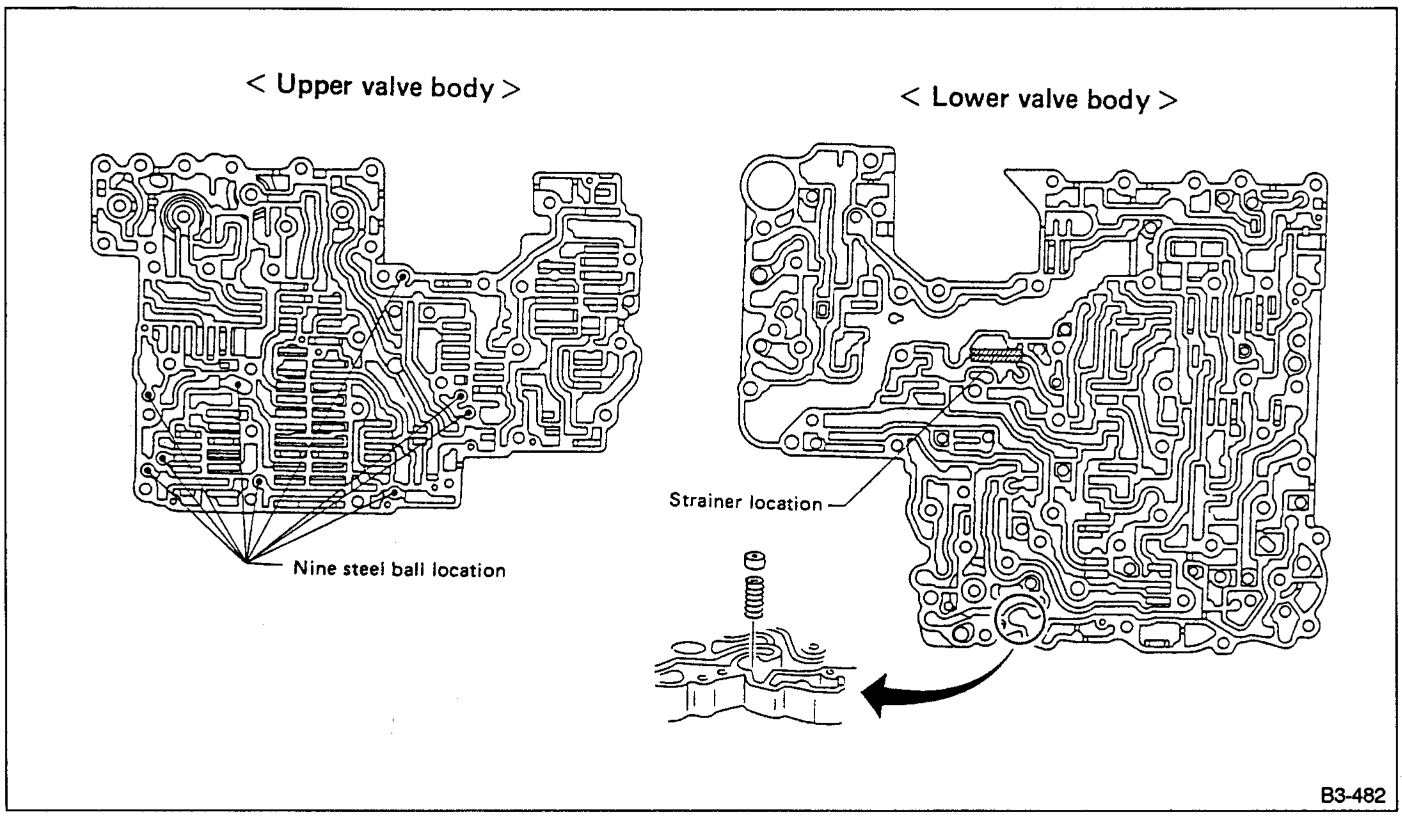



*Fig. 37*

## 5. RELATED PARTS (3)

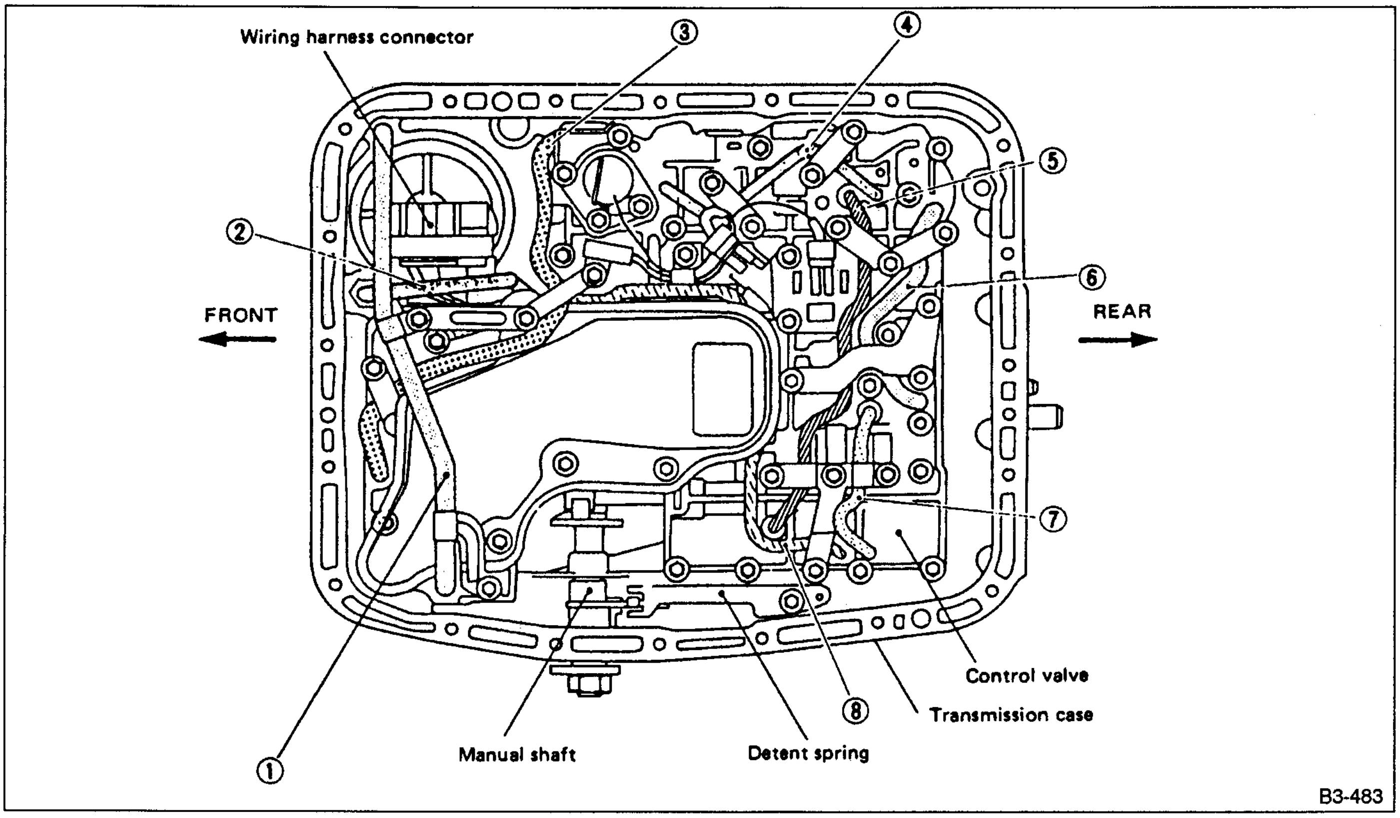



*Fig. 38*

⟨Pipe names⟩

| No. | Description | Hydraulic circuit |
|---|---|---|
| 1 | Oil cooler outlet pipe | Cooling line from control valve to oil cooler inside radiator |
| 2 | Transfer control pipe | Line-pressure supply line to transfer control valve |
| 3 | Reverse clutch pressure pipe | Accumulator circuit of reverse clutch pressure |
| 4 | 4A pressure pipe | 4A pressure circuit |
| 5 | 3R pressure pipe | 3R pressure circuit |
| 6 | Forward clutch pressure pipe | Supply line to N → D accumulator |
| 7 | Pilot pressure pipe | Pilot pressure supply line to shuttle shift valve |
| 8 | Pressure-modifier pressure pipe | Supply line to pressure modifier accumulator |

## C: FUNCTION

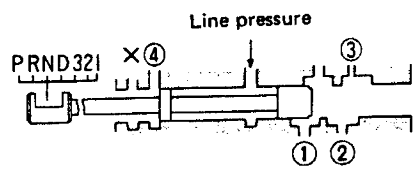
<table>
<tr><th>Name</th><th>Function</th></tr>
<tr><td>• Pressure regulator valve<br>• Pressure regulator plug<br>• Pressure regulator sleeve plug</td><td>Regulates the pressure of oil delivered from the oil pump to an optimum level (line pressure) corresponding to vehicle running conditions.</td></tr>
<tr><td>Pressure modifier valve</td><td>An auxiliary valve for the pressure regulator valve. This valve adjusts pressure used to regulate line pressure to an optimum level corresponding to running conditions.</td></tr>
<tr><td>Pressure modifier accumulator piston</td><td>Smoothes the pressure regulated by the pressure modifier valve to prevent pulsation in line pressure.</td></tr>
<tr><td>Pilot valve</td><td>Creates the constant pressure (pilot pressure) necessary to control line pressure, lock-up, overrunning clutch, 3- 2 timing, and gearshift operations from line pressure.</td></tr>
<tr><td>• Accumulator control plug<br>• Accumulator control sleeve</td><td>Adjusts accumulator back pressure to correspond to running conditions.</td></tr>
<tr><td>Manual valve</td><td>Delivers line pressure to each circuit corresponding to the selected position.
<table>
<tr><th>Circuit</th><th>①</th><th>②</th><th>③</th><th>④</th></tr>
<tr><td>Range</td><td></td><td></td><td></td><td></td></tr>
<tr><td>P</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R</td><td></td><td></td><td></td><td>O</td></tr>
<tr><td>N</td><td></td><td></td><td></td><td></td></tr>
<tr><td>D</td><td>O</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>O</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>O</td><td>O</td><td></td><td></td></tr>
<tr><td>1</td><td>O</td><td>O</td><td>O</td><td></td></tr>
</table>


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Fig. 39
When the valve is set in the "line pressure no delivery" position, the pressure is relieved.</td></tr>
<tr><td>Shift valve A</td><td>Simultaneously changes three different oil passages using shift solenoid 1 output pressure corresponding to such operating conditions as vehicle speed and throttle opening. Combined with shift valve B, this valve permits automatic shifting of 1st ⇄ 2nd ⇄ 3rd ⇉ 4th speeds.</td></tr>
<tr><td>Shift valve B</td><td>Simultaneously changes three different oil passages using shift solenoid 2 output pressure corresponding to such operating conditions as vehicle speed and throttle opening. Combined with shift valve A, this valve permits automatic shifting of 1st ⇄ 2nd ⇄ 3rd ⇇ 4th speeds.</td></tr>
<tr><td>Shuttle shift valve</td><td>Changes the 3-2 timing control and overrunning clutch control oil passages corresponding to the throttle opening. When the throttle is wide open, the overrunning clutch becomes inoperative to prevent interlocking at 4th speed.</td></tr>
<tr><td>Overrunning clutch control valve</td><td>Changes oil passages so as to prevent simultaneous operation of the overrunning clutch when the brake band is actuated at 4th speed. (Operation of overrunning clutch at "D" range 4th speed results in interlocking.)</td></tr>
</table>

| Name | Function |
| --- | --- |
| 4-2 relay valve | Memorizes the 4th speed position, and prevents gear shifting from 4th to 3rd to 2nd speeds due to combined operation of the 4-2 sequence valve, shift valve A and shift valve B when shifting down from 4th to 2nd speeds. |
| 4-2 sequence valve | Inhibits release of band servo operating pressure acting at 4th speed until the high clutch operating pressure and band servo release pressure (same hydraulic circuit) are drained when shifting down from 4th speed to 2nd speed. |
| Servo charger valve | The 2nd speed band servo actuating hydraulic circuit has an accumulator and one-way orifice for relieving shift shock when shifting from 1st speed to 2nd speed. The servo charger valve is installed to ensure sufficient oil flow when shifting down from 4th to 2nd speed, or from 3rd to 2nd speed. It operates at 3rd or higher speeds and supplies the 2nd speed band servo actuating pressure by bypassing the one-way orifice. |
| 3-2 timing valve | When shifting down from "D" range 3rd to "D" range 2nd speed, the timing valve retards the release of band-servo pressure and creates a temporary neutral condition so that vehicle speed can be changed smoothly. |
| "1st" Reducing valve | Reduces the low & reverse brake operating pressure so as to relieve engine braking shock when changing from "2" range 2nd speed to 1st speed. |
| Overrunning clutch reducing valve | Reduces the operating pressure applied to the overrunning clutch so as to relieve engine braking shock. In the "2" and "3" ranges, line pressure is applied to the valve to raise the pressure adjusting point, thereby increasing engine braking capacity. |
| Torque converter regulator valve | Prevents excessive rise of torque converter pressure. |
| • Lock-up control valve<br>• Lock-up control plug<br>• Lock-up control sleeve | Controls the operation of the lock-up function.<br>Smoothes the transition between the lock-up state and release state. |
| Shuttle duty shift valve | Changes the oil passage so that output pressure to the duty solenoid B (lock-up) will be applied to the lock-up valve in the "D" range 2nd, 3rd, or 4th speed.<br>(Lock-up at 1st speed is inhibited.)<br>* Lock-up control is not actuated if the lock-up solenoid does not generate output pressure when signaled from the control unit, even if the vehicle is in the "D" range 2nd, 3rd, or 4th speeds. |

# 19. Gearshifting Mechanism

## A: OPERATION TABLE

| Selector lever operation | | Rev./C | B/B | High/C | FWD/C | OWC (3-4) | OVR/C | Lo / Rev./B | OWC (1-2) |
|---|---|---|---|---|---|---|---|---|---|
| P | | | | | | | | | |
| R | | O | | | | | | O | |
| N | | | | | | | | | |
| D | 1ST | | | | O | O | | | O |
| D | 2ND | | O | | O | O | | | |
| D | 3RD | | | O | O | O | | | |
| D | 4TH | | O | O | O | | | | |
| 3 | 1ST | | | | O | O | | | O |
| 3 | 2ND | | O | | O | O | | | |
| 3 | 3RD | | | O | O | O | O | | |
| 3 | *1 4TH | | O | O | O | | | | |
| 2 | 1ST | | | | O | O | O | | O |
| 2 | 2ND | | O | | O | O | O | | |
| 2 | *1 3RD | | | O | O | O | O | | |
| 2 | *1 4TH | | O | O | O | | | | |
| 1 | 1ST | | | | O | O | O | O | |
| 1 | *1 2ND | | O | | O | O | O | | |
| 1 | *1 3RD | | | O | O | O | O | | |
| 1 | *1 4TH | | O | O | O | | | | |

*1: For prevention of engine over-revolution

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*Fig. 40*

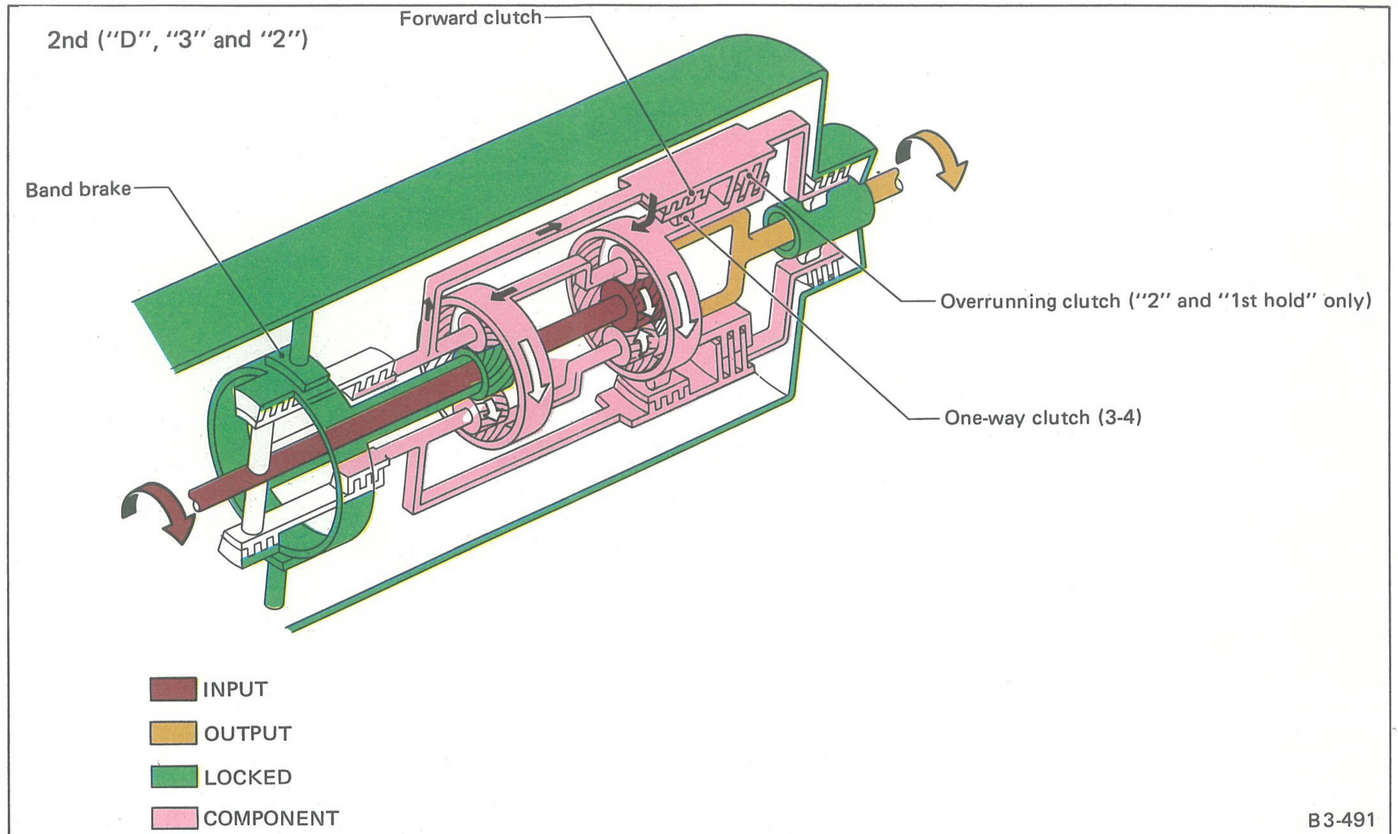
| | 1st | 2nd | 3rd | 4th | Rev. |
|---|---|---|---|---|---|
| Input member | $R_S$ | $R_S$ | $R_S$–$F_C$–$R_I$ | $R_S$–$F_C$ | $R_S$–$F_S$ |
| Output member | $F_I$–$R_C$ | $F_I$–$R_C$ | $F_I$–$R_C$ | $F_I$–$R_C$ | $F_I$–$R_C$ |
| Fixed member | $F_C$–$R_I$ | $F_S$ | | $F_S$ | $F_C$ |
| Free member | $F_S$ | $F_C$–$R_I$ | $F_S$ | $R_I$ | $R_I$ |
| Gear ratio | 2.785 | 1.545 | 1.000 | 0.694 | 2.272 |

Abbr.
- $F_S$ : Front sun gear
- $R_S$ : Rear sun gear
- $F_C$ : Front planetary carrier
- $R_C$ : Rear planetary carrier
- $F_I$ : Front internal gear
- $R_I$ : Rear internal gear

B3-486

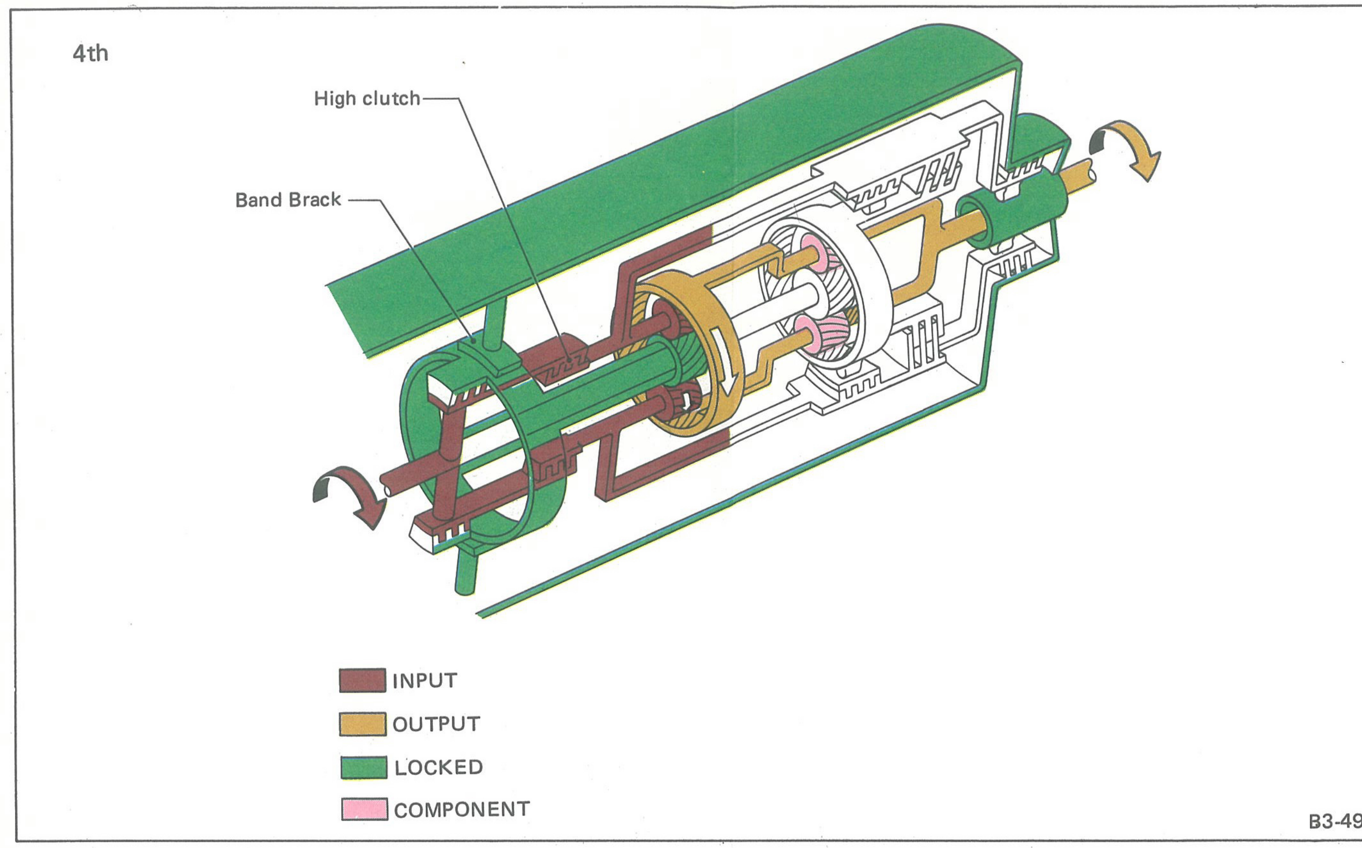
*Fig. 41*

2nd (“D”, “3” and “2”)



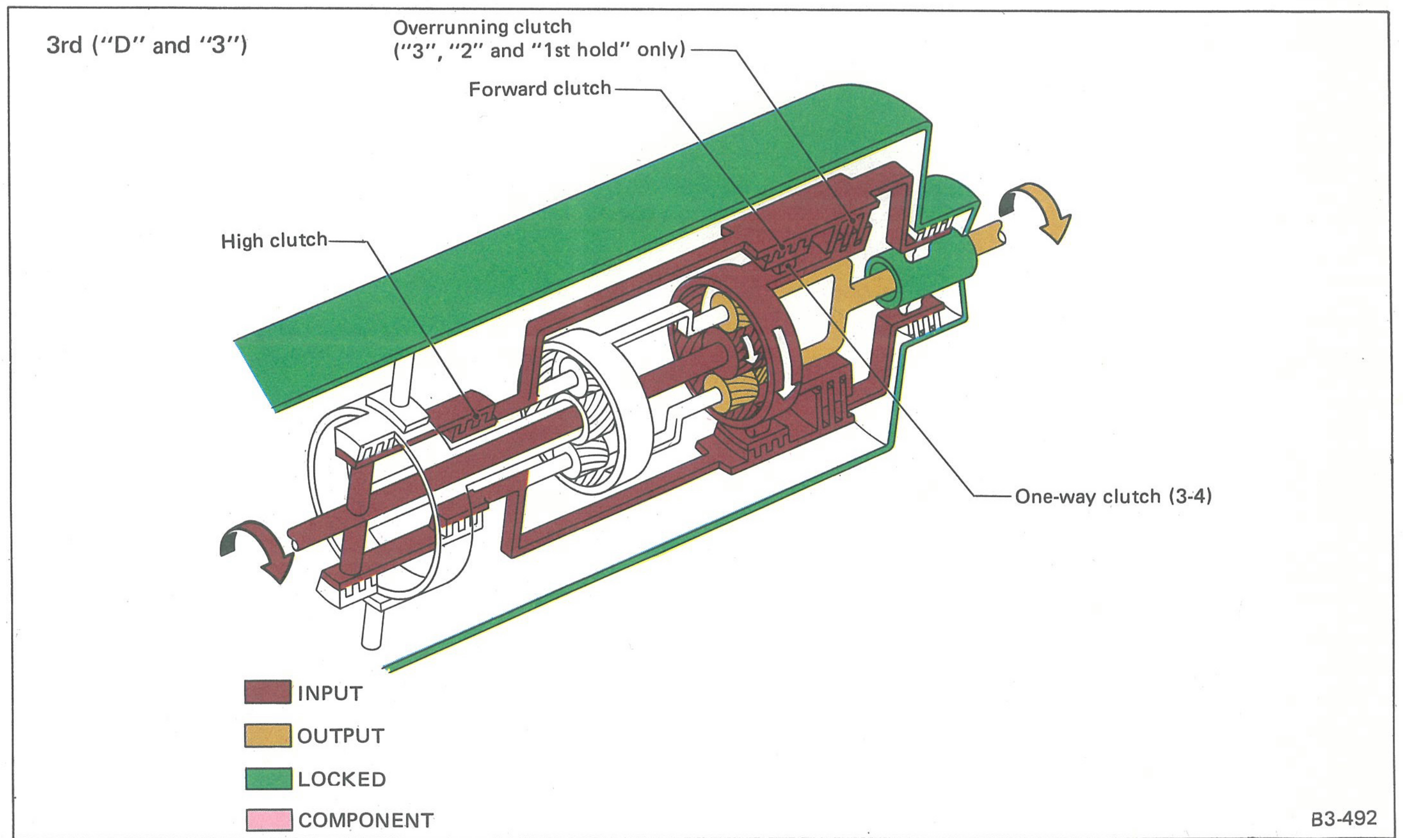

B3-491

4th



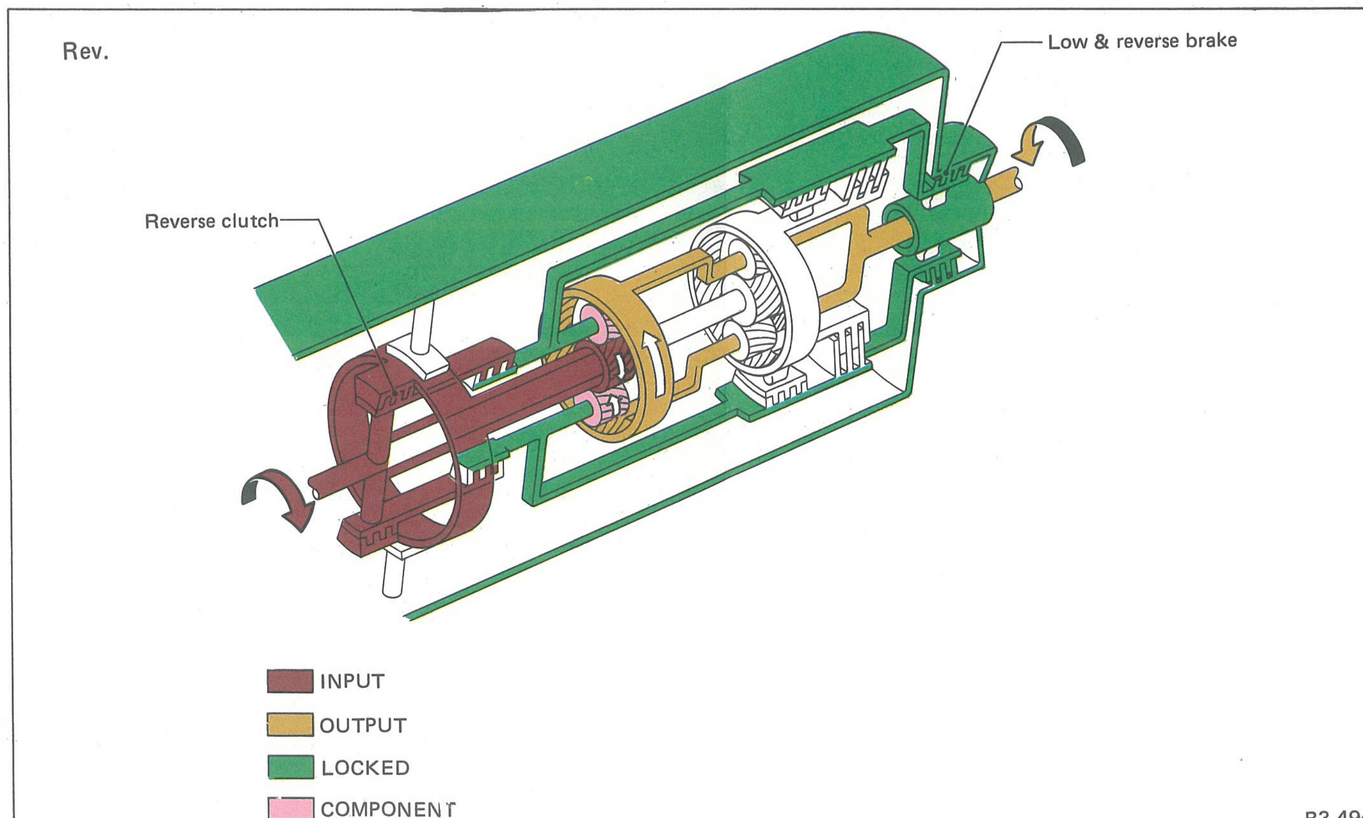

B3-493

3rd (“D” and “3”)




B3-492

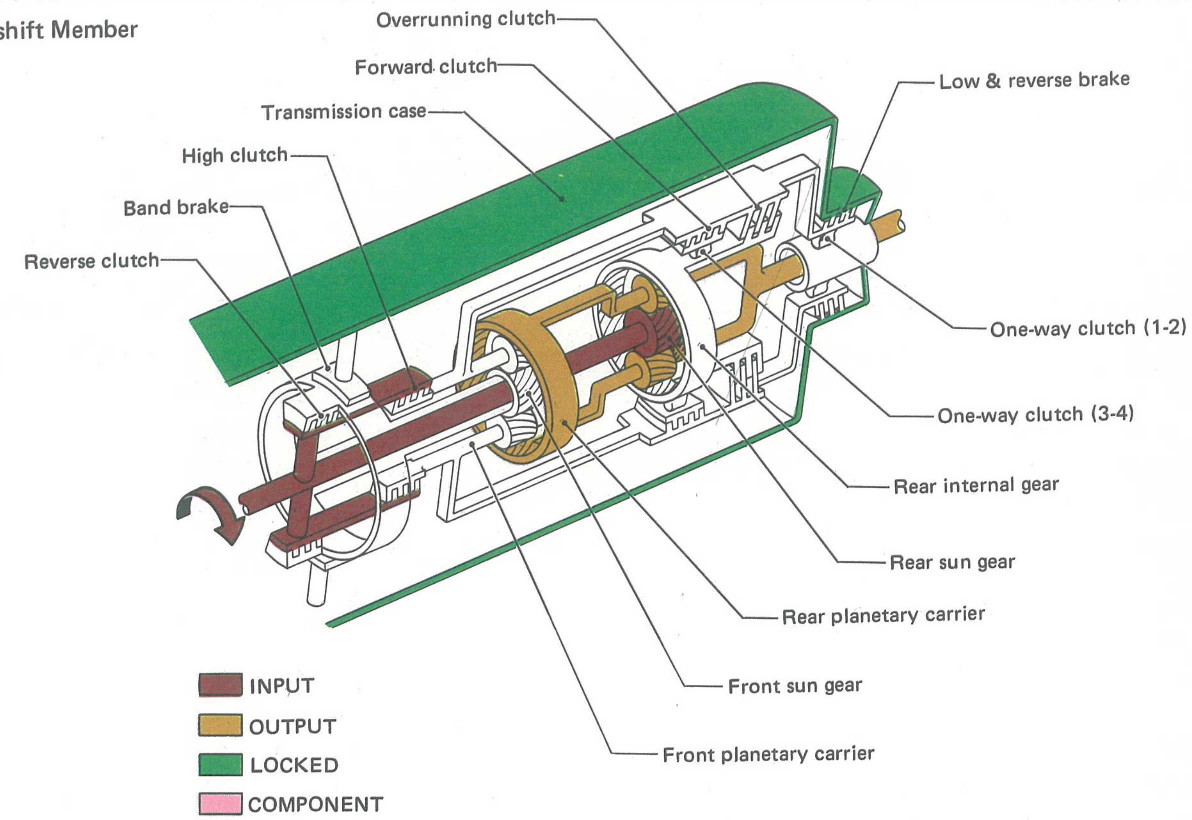
Rev.




B3-494

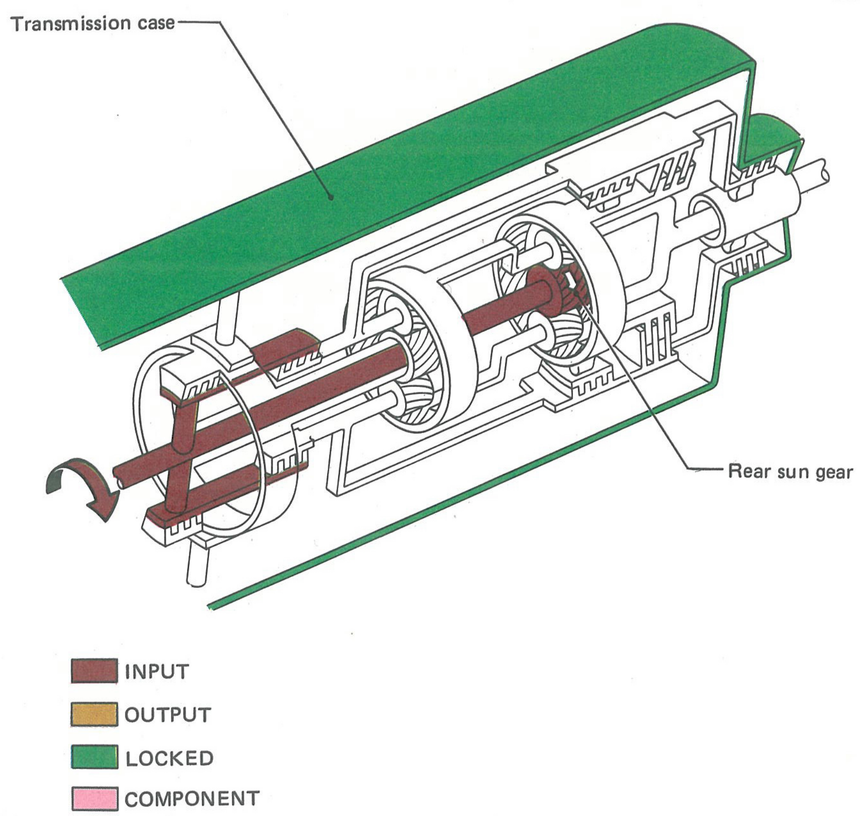
## B: SCHEMATIC DRAWING

Gearshift Member



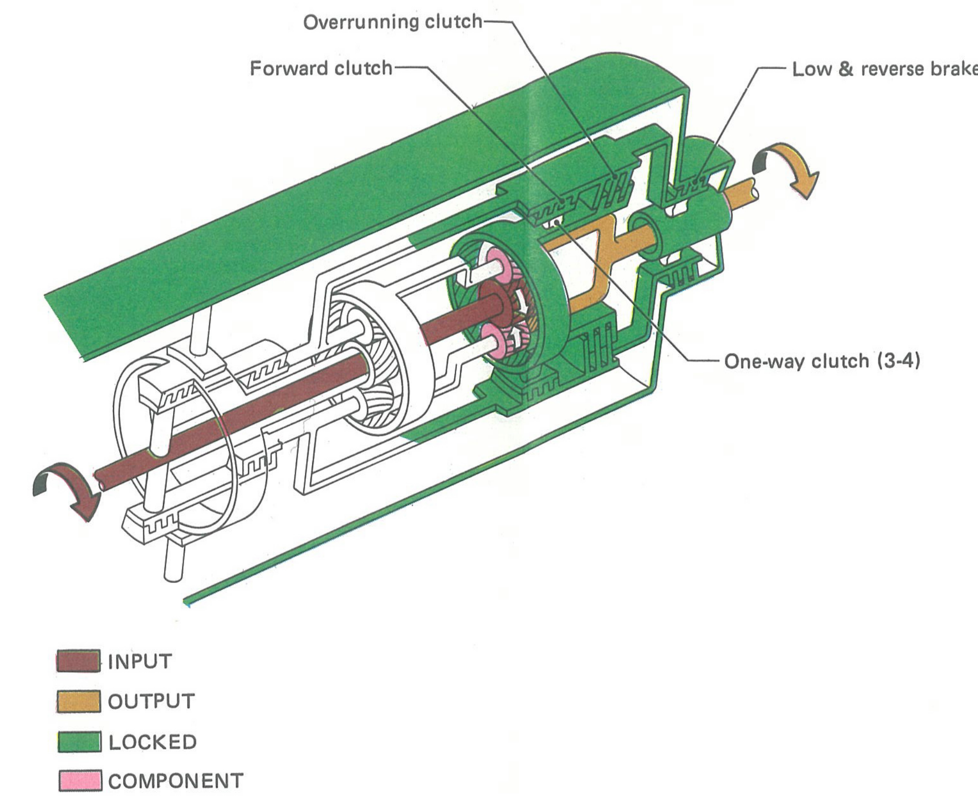

B3-487

"N" and "P"



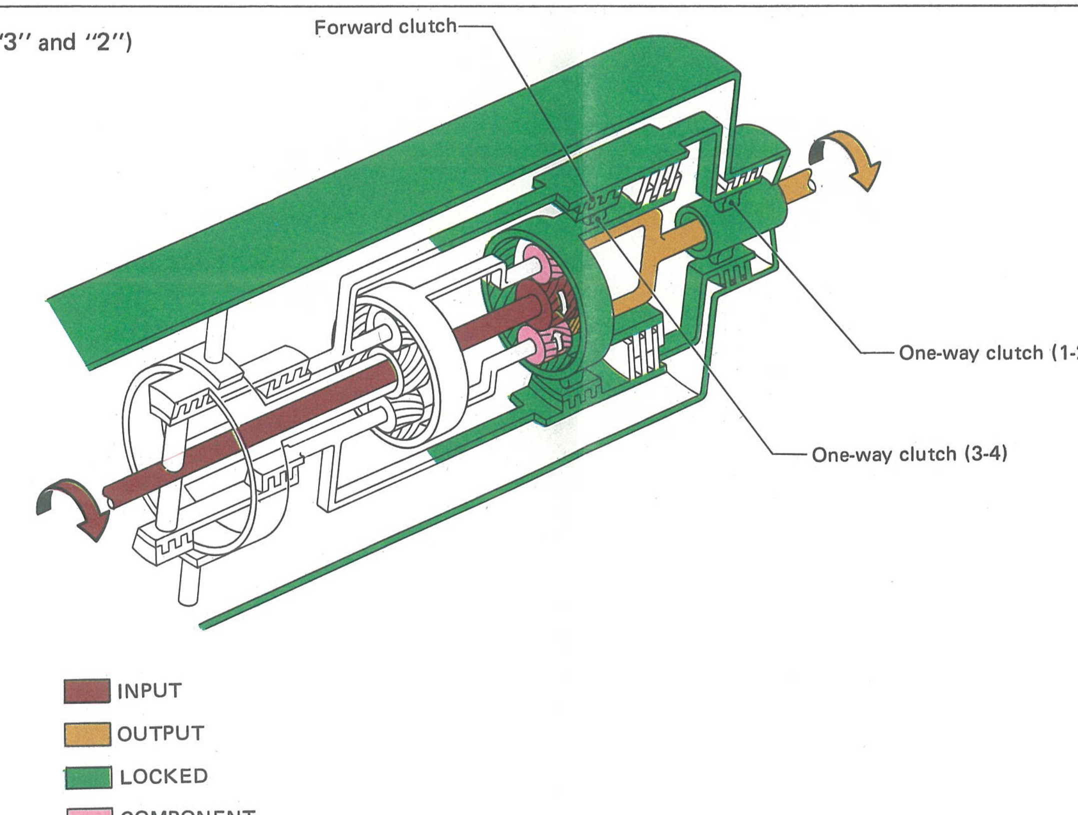

B3-488

1st ("1")




B3-489

1st ("D", "3" and "2")




B3-490

# 20. Power Train

## A: OPERATION

### 1. GENERAL

The gear train consists of two sets of planetary gears, four sets of multi-plate clutches, one brake band, one set of multi-plate brake and two sets of one-way clutches.

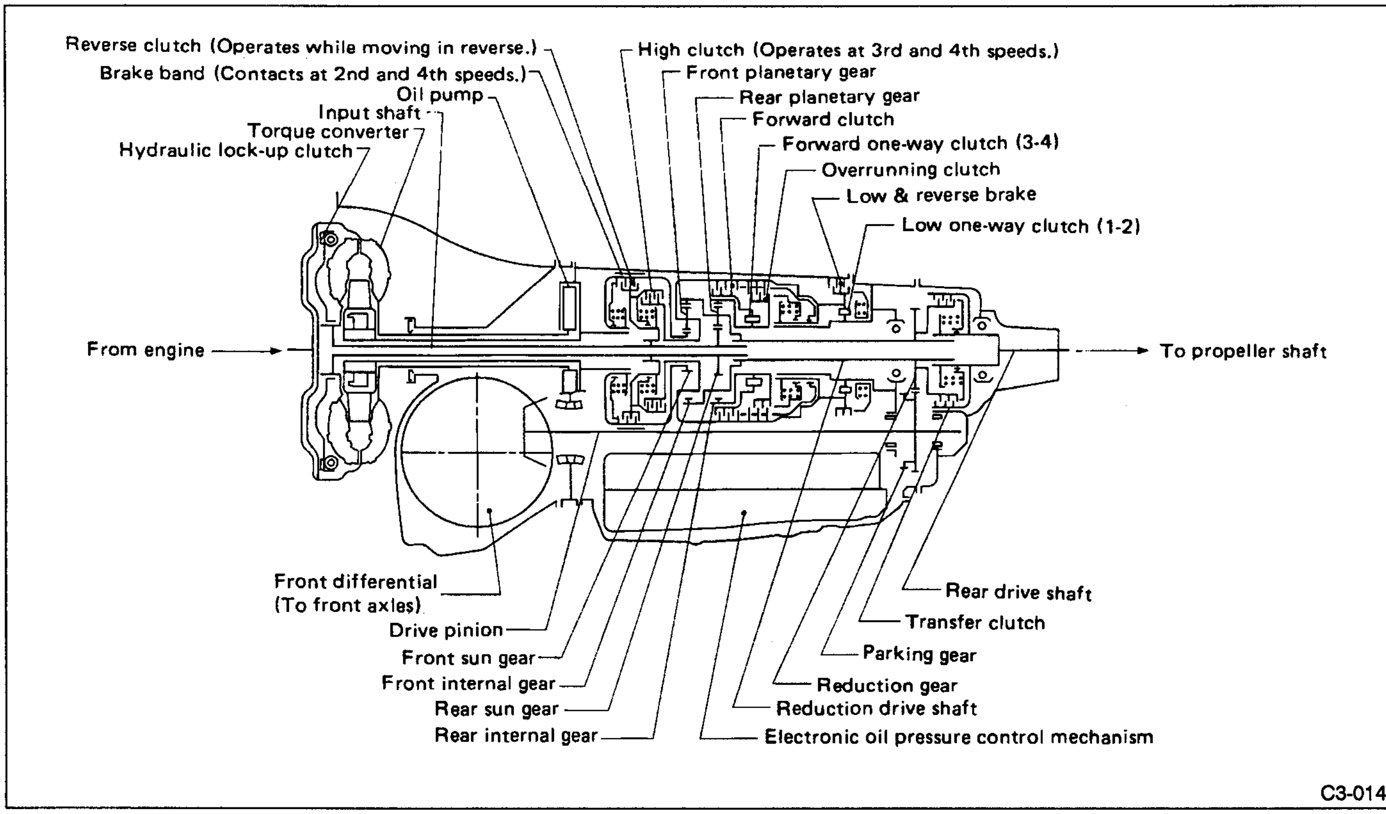



*Fig. 42*

### 2. N RANGE AND P RANGE

1) N range

Because both the forward clutch and reverse clutch are in the release positions, the power of the input shaft is not transmitted to the drive pinion or the rear drive shaft.

2) P range

All controls do not operate, just as in the N range. The parking pawl interlocked with the selector lever meshes with the parking gear to mechanically hold the output shaft stationary, thus locking the power train.

## 3. FIRST SPEED OF D, 3 OR 2 RANGE ($D_1$, $3_1$, $2_1$)

- When the throttle is open wide, as during acceleration in the low-speed range, the forward clutch, one-way clutch (3-4) and one-way clutch (1-2) operate to prevent the rear internal gear from turning in the reverse direction.
- While coasting, the rear internal gear turns normally and the one-way clutch (3-4) is released and idles. Therefore, no power is transmitted and the engine does not provide braking action.
- During deceleration, the overrunning clutch is applied and the one-way clutch (3-4) is prevented from idling; however, since the one-way clutch (1-2) is released and is idling, reverse power is not transmitted and engine braking is not performed.

| Operating condition of parts | | Power flow (in acceleration) |
|---|---|---|
| • Forward clutch | : Applied | • Input shaft ↓ • Rear sun gear ↓ • Rear pinion gear ↓ • Rear planetary carrier ↓ • Reduction gear → (• Drive pinion ↓ • Front differential) / (• Transfer clutch ↓ • Rear differential) |
| • One-way clutch (3-4) | : Operating | |
| • One-way clutch (1-2) | : Operating | |
| • Overrunning clutch | : Applied | |

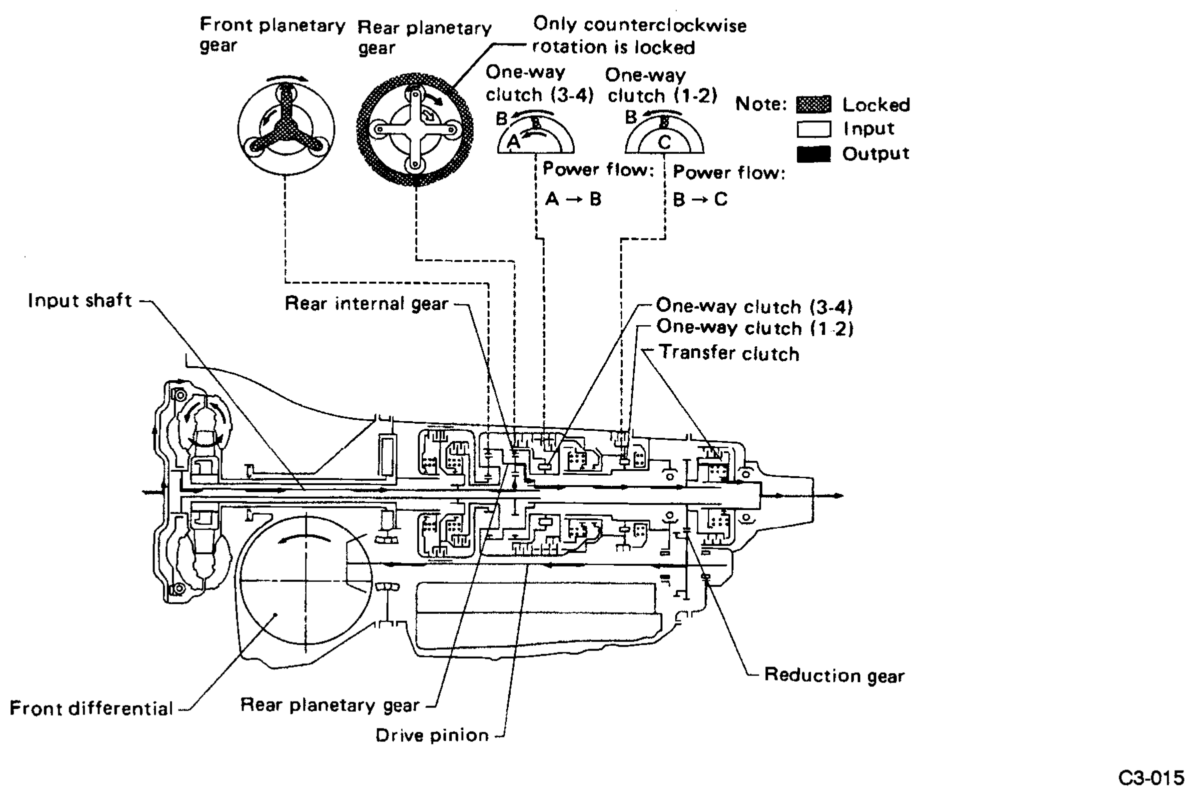
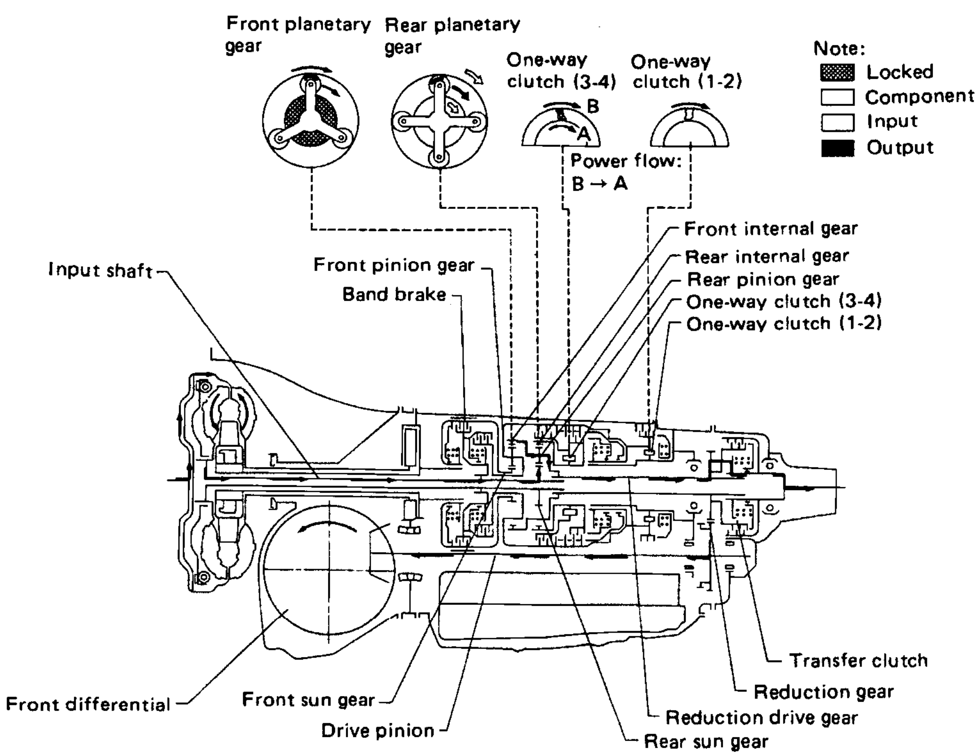



*Fig. 43*

## 4. SECOND SPEED OF D, 3 OR 2 RANGE ($D_2$, $3_2$, $2_2$)

- During acceleration, the forward clutch is applied and connects the front planetary gear to the internal gear through the one-way clutch (3-4). Power is transmitted from the input shaft to the rear sun gear, turning the rear planetary carrier (i.e. front internal gear). Also, since the band brake is applied and the front sun gear is locked, the rear internal gear turns normally through the front planetary carrier and the forward clutch and one-way clutch (3-4) that are connected to that carrier. Thus, speed increases in proportion to the rotation of the rear internal gear compared with the first speed.
- Since the rear internal gear turns normally while coasting, the one-way clutch (3-4) is released and idles. Accordingly, reverse power is not transmitted to the engine and engine braking is not provided.
- During deceleration at "2" range, the overrunning clutch operates to check idling of the one-way clutch (3-4). Reverse power is transmitted to the engine, providing engine braking action.

| Operating condition of parts | Power flow (in acceleration) |
|---|---|
| • Brake band : Applied<br>• Forward clutch : Applied<br>• One-way clutch (3-4) : Operating<br>• Overrunning clutch : Applied | Input shaft → Rear sun gear → Rear pinion gear → Rear planetary carrier<br>Rear planetary carrier → Reduction drive shaft → Reduction gear<br>Reduction gear → Drive pinion → Front differential<br>Reduction gear → Transfer clutch → Rear differential<br>Rear planetary carrier → Front internal gear → Front pinion gear → Front planetary carrier → Forward clutch → One-way clutch (3-4) → Rear internal gear → Rear pinion gear |




C3-016

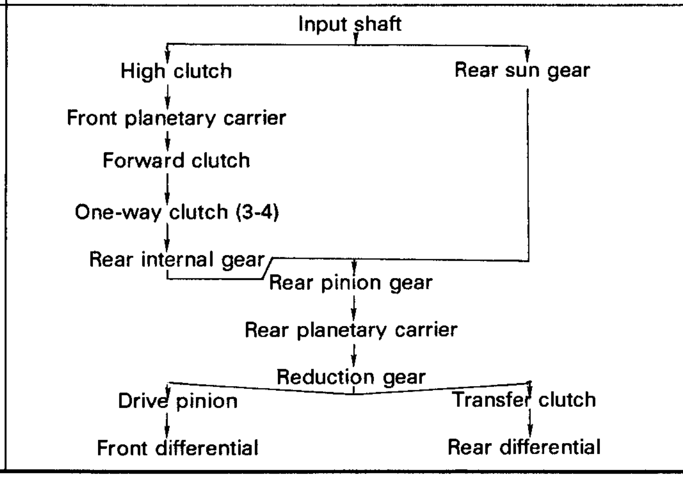
*Fig. 44*

## 5. THIRD SPEED OF D OR 3 RANGE ($D_3$, $3_3$)

- During acceleration, the high clutch is applied and the input shaft and front planetary carrier are connected. Further, the forward clutch and one-way clutch (3-4) operate to connect the front planetary carrier to the rear internal gear. Power is transmitted from the input shaft to the rear sun gear and rear internal gear. The rear sun gear and rear internal gear turn normally at the same speed. Therefore, the rear planetary carrier, rear sun gear and rear internal gear rotate normally as a unit.
- While coasting at "D", because the rear internal gear turns normally, the one-way clutch (3-4) idles in a released state. Thus, reverse power is not transmitted to the engine and engine braking action is not provided.
- During deceleration at "3", "2" or "1st" range, the overrunning clutch is applied and checks the reverse rotation of the one-way clutch (3-4). Thus, reverse power is transmitted to the engine and engine braking is performed.

| Operating condition of parts | |
|---|---|
| • High clutch | : Applied |
| • Forward clutch | : Applied |
| • One-way clutch (3-4) | : Operating |
| • Overrunning clutch ("3", "2' and "1st" ranges only) | : Applied |

Power flow (in acceleration)



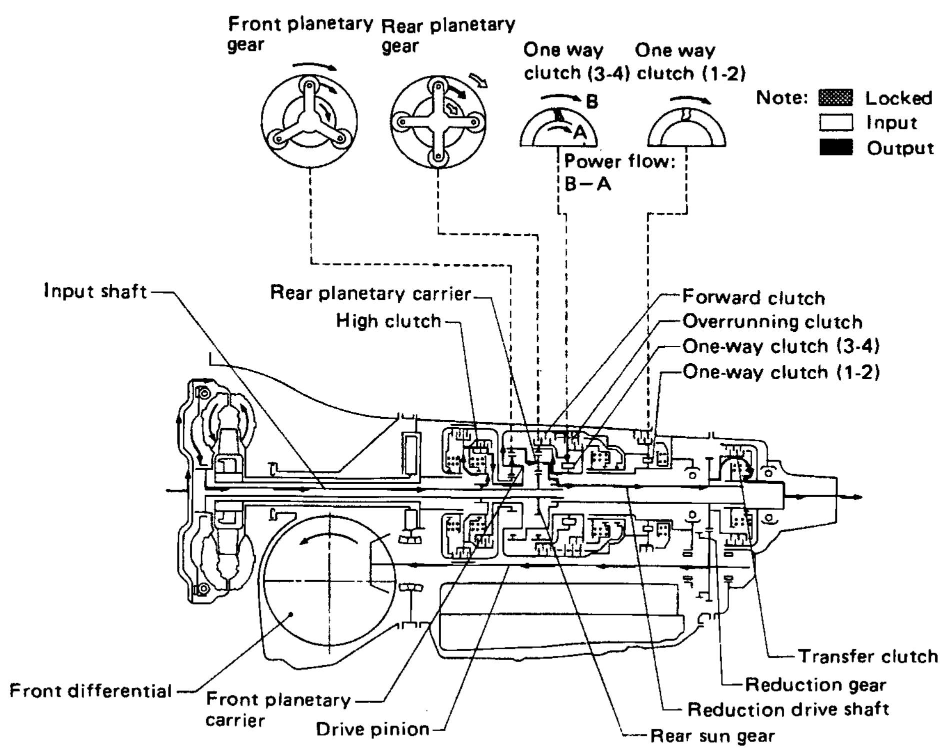




*Fig. 45*

## 6. FOURTH SPEED ($D_4$) OF D RANGE

- During acceleration, the high clutch is applied and connects the input shaft to the front planetary carrier. Also, the forward clutch is applied, but it runs idle due to the one-way clutch (3-4) and takes no part in power transmission. Power is transmitted from the input shaft to the front planetary carrier by the function of the high clutch.

When the front planetary carrier turns normally, because the front sun gear is held-stationary by the brake band, the speed of the front internal gear increases and is delivered to the meshing reduction drive shaft in normal rotation.

- While coasting, because power transmission does not go through the one-way clutch, reverse power is transmitted to the engine and engine braking is performed.

| Operating condition of parts | | Power flow (in acceleration) |
|---|---|---|
| • High clutch | : Applied | • Input shaft |
| • Brake band | : Contracted | ↓ • High clutch |
| • Forward clutch (Takes no part in power transmission.) | : Applied | ↓ • Front planetary carrier |
| | | ↓ • Front pinion gear |
| | | ↓ • Front internal gear |
| | | ↓ • Rear planetary carrier |
| | | ↓ • Reduction drive shaft |
| | | ↓ • Reduction gear |
| | | • Drive pinion ↓ • Front differential |
| | | • Transfer clutch ↓ • Rear differential |

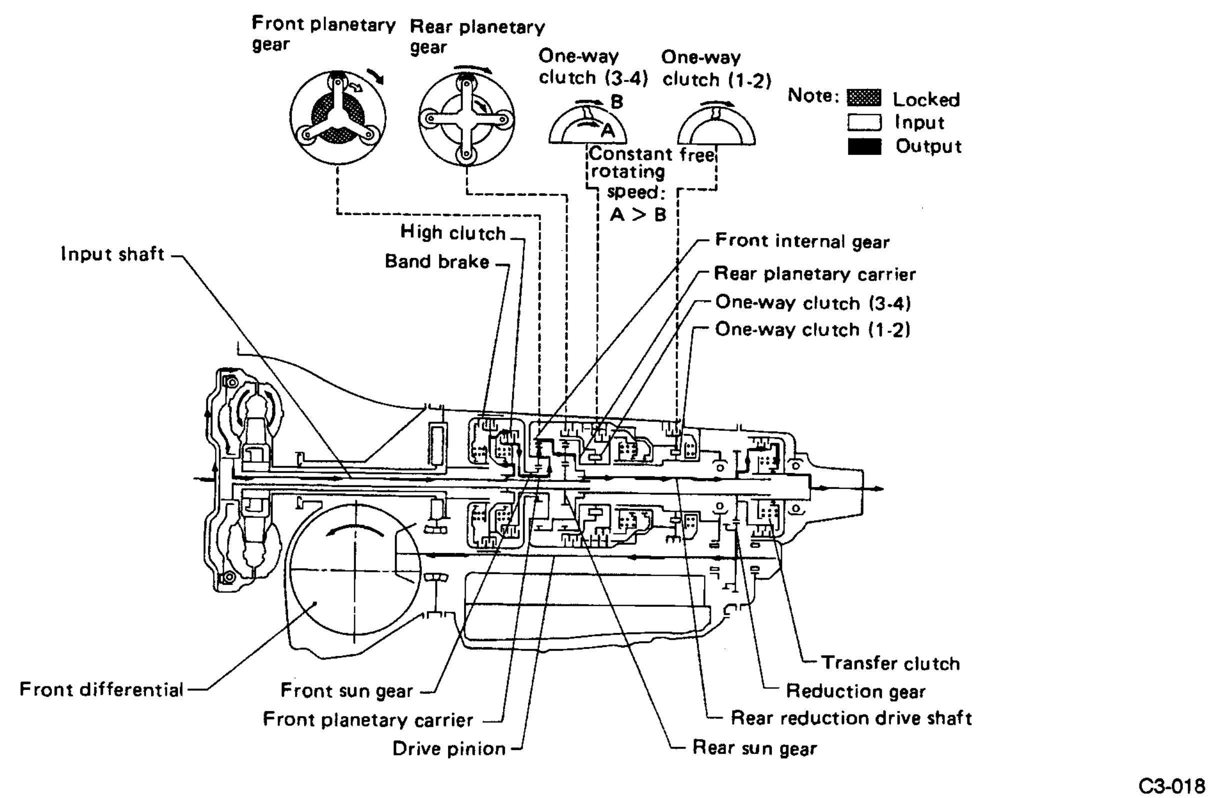



*Fig. 46*

## 7. FIRST SPEED OF 1 RANGE

- During acceleration, the forward clutch and overrunning clutch are applied and the front planetary carrier and rear internal gear are connected. Also, the low & reverse brake is applied so that the front planetary carrier and internal gear remain stationary.
  The power flow is the same as in the first speed of "D", "3" and "2" range (except for the following points) and engine braking is performed.
- The low & reverse brake operates in place of the one-way clutch (1-2) and locks the rear internal gear.
- In coasting and deceleration, low & reverse brake and overrunning clutch are operating, so that reverse power is transmitted to the engine and engine braking action is provided.

| Operating condition of parts | | Power flow (in acceleration) |
|---|---|---|
| • Forward clutch | : Applied | • Input shaft<br>↓<br>• Rear sun gear<br>↓<br>• Rear pinion gear<br>↓<br>• Rear planetary carrier<br>↓<br>• Reduction gear<br>↓ (two branches)<br>• Drive pinion → • Front differential<br>• Transfer clutch → • Rear differential |
| • One-way clutch (3-4) | : Applied (in acceleration) | |
| • Overrunning clutch | : Applied | |
| • Low & reverse brake | : Operating | |

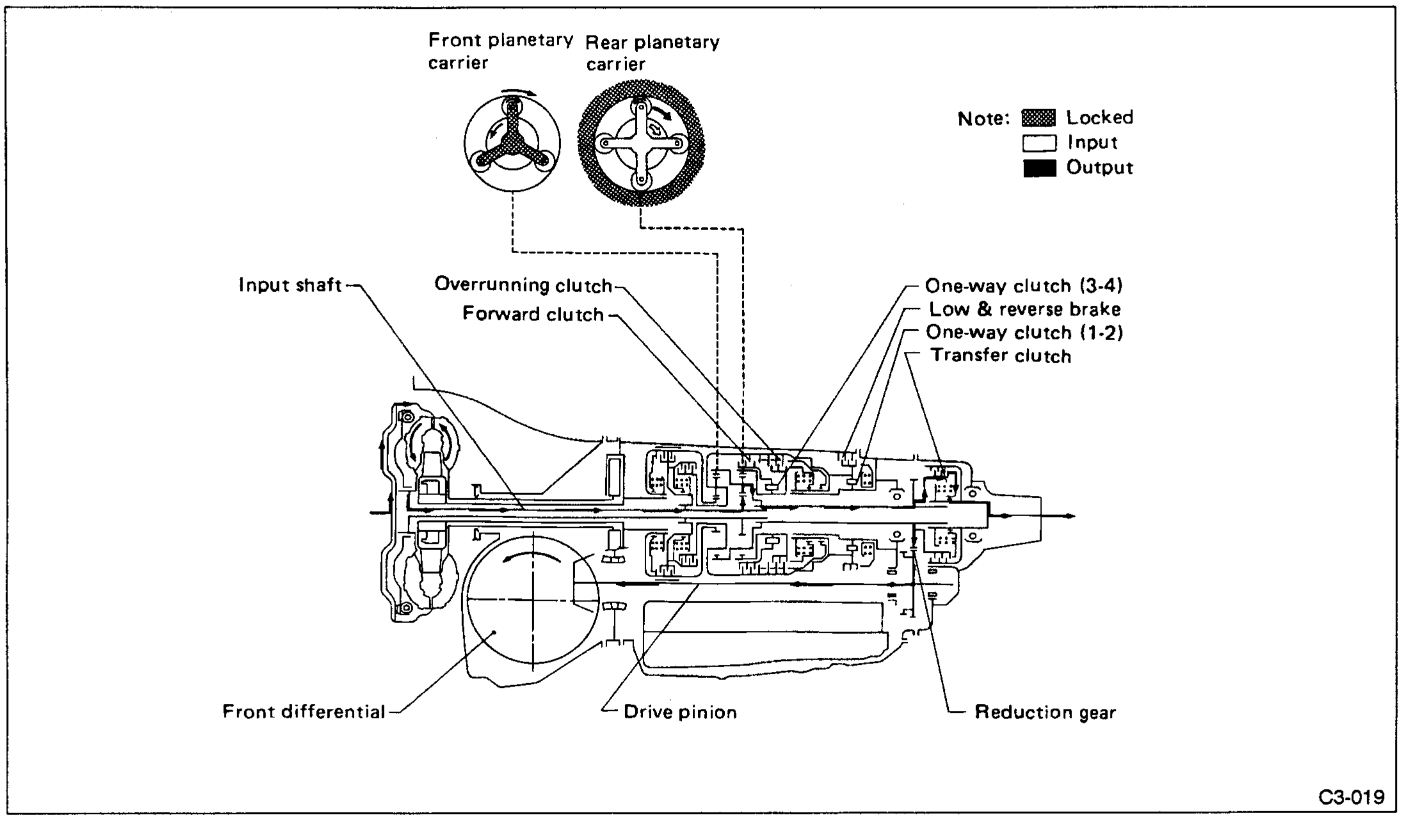



Fig. 47

## 8. R RANGE

The reverse clutch is applied and power is transmitted from the input shaft through the reverse clutch to the front sun gear. Also, the low & reverse brake operates to lock the front planetary carrier. Therefore, when the front sun gear turns normally, the front internal gear slows and reverses.

| Operating condition of parts | | Power flow |
|---|---|---|
| • Reverse clutch | : Applied | • Input shaft → • Reverse clutch → • Front sun gear → • Front pinion gear → • Front internal gear → • Reduction drive shaft → • Reduction gear → (• Drive pinion → • Front differential) / (• Transfer clutch → • Rear differential) |
| • Low & reverse brake | : Operating | |

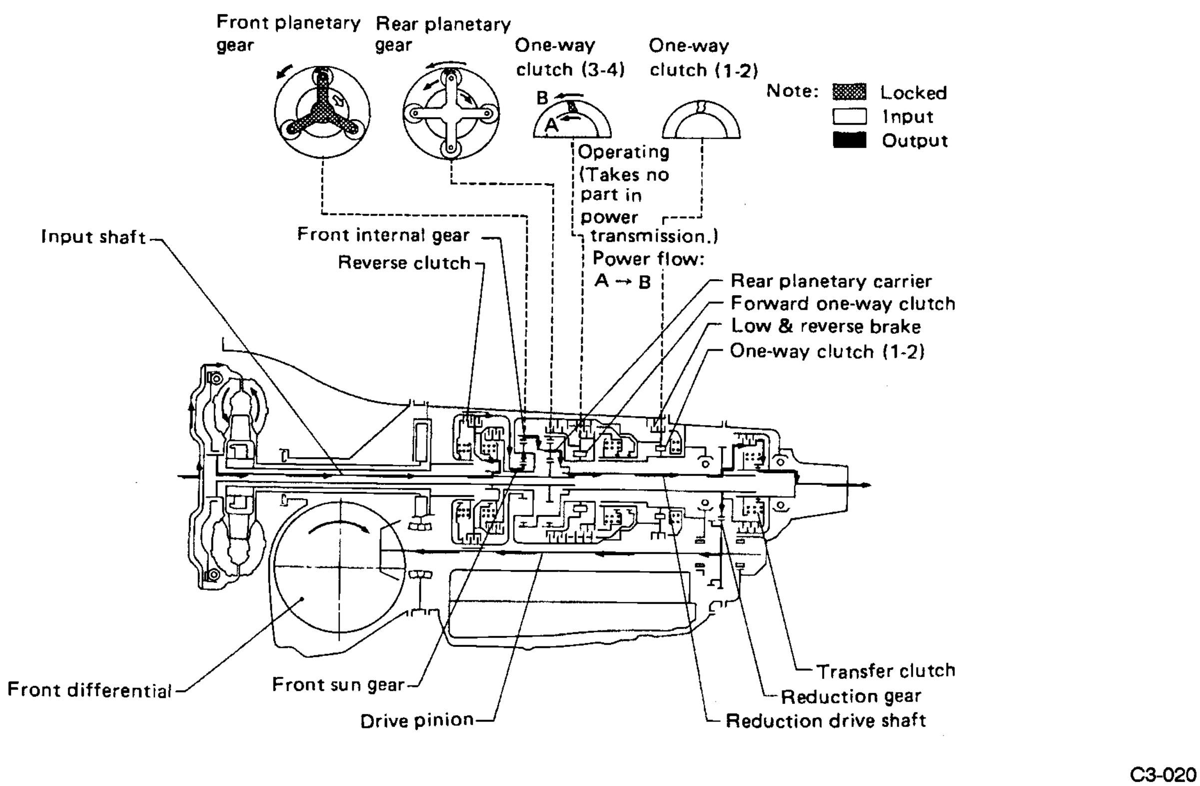
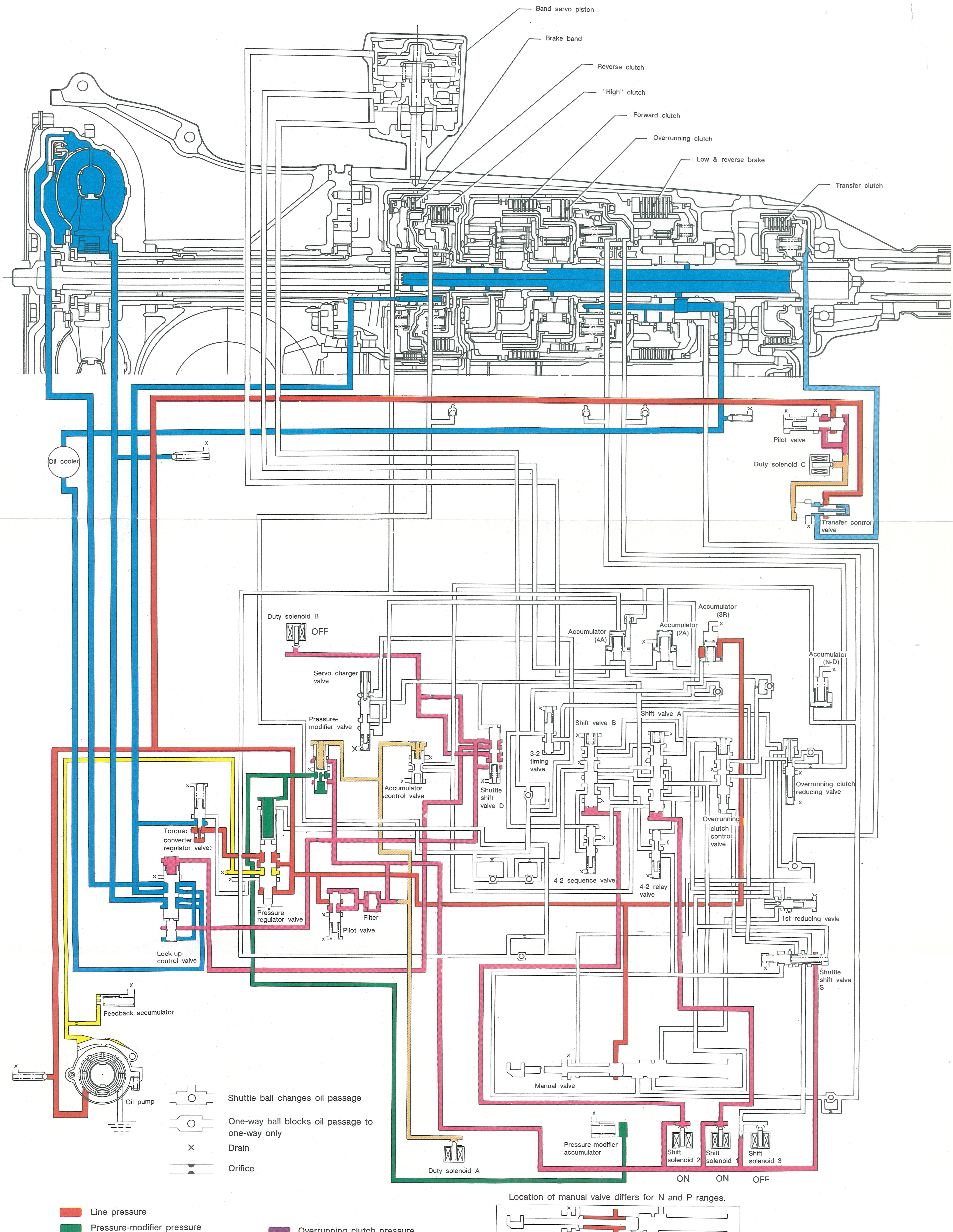



Fig. 48

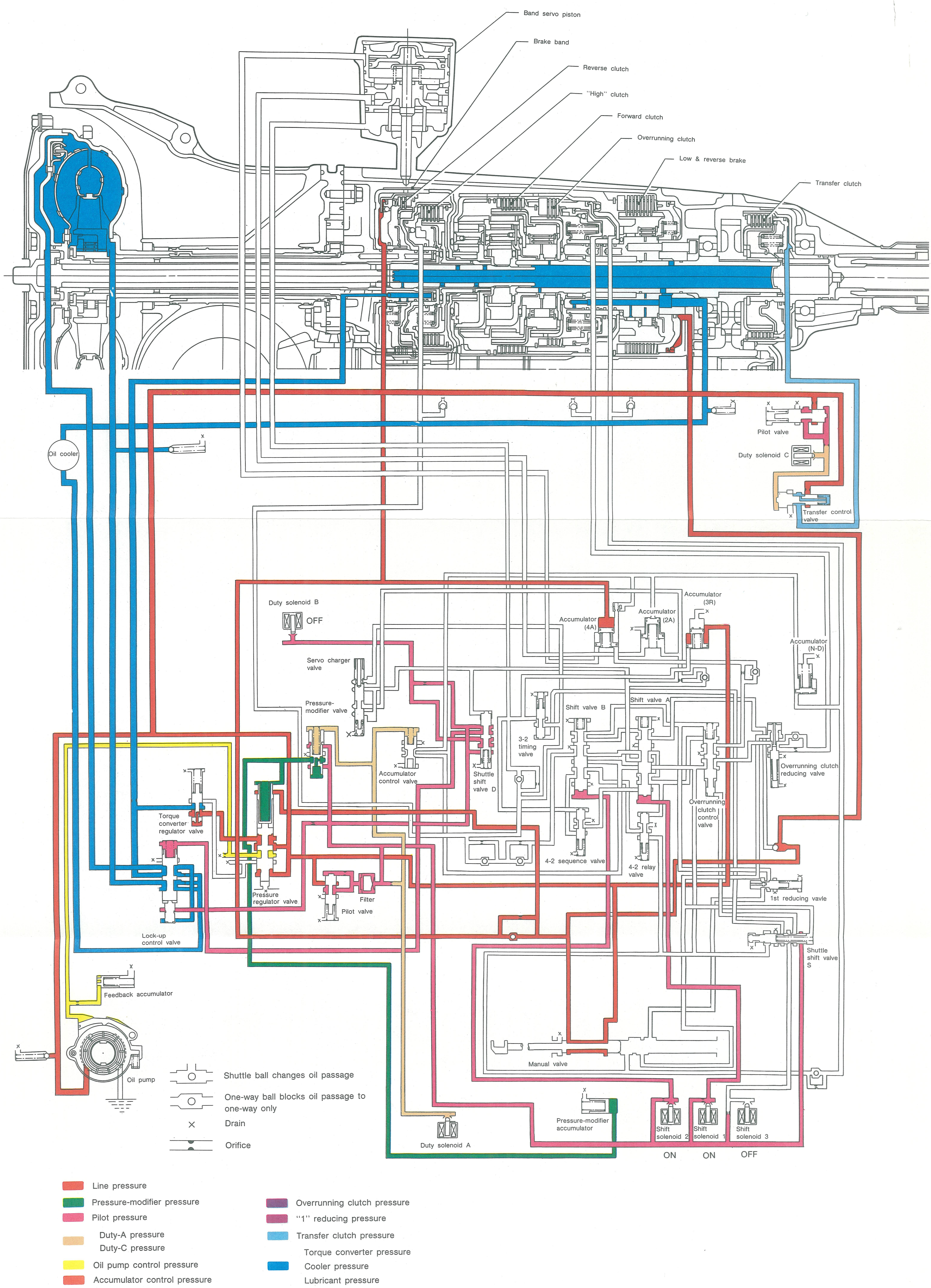
## B: SCHMATIC DRAWING

### 1. N RANGE AND P RANGE

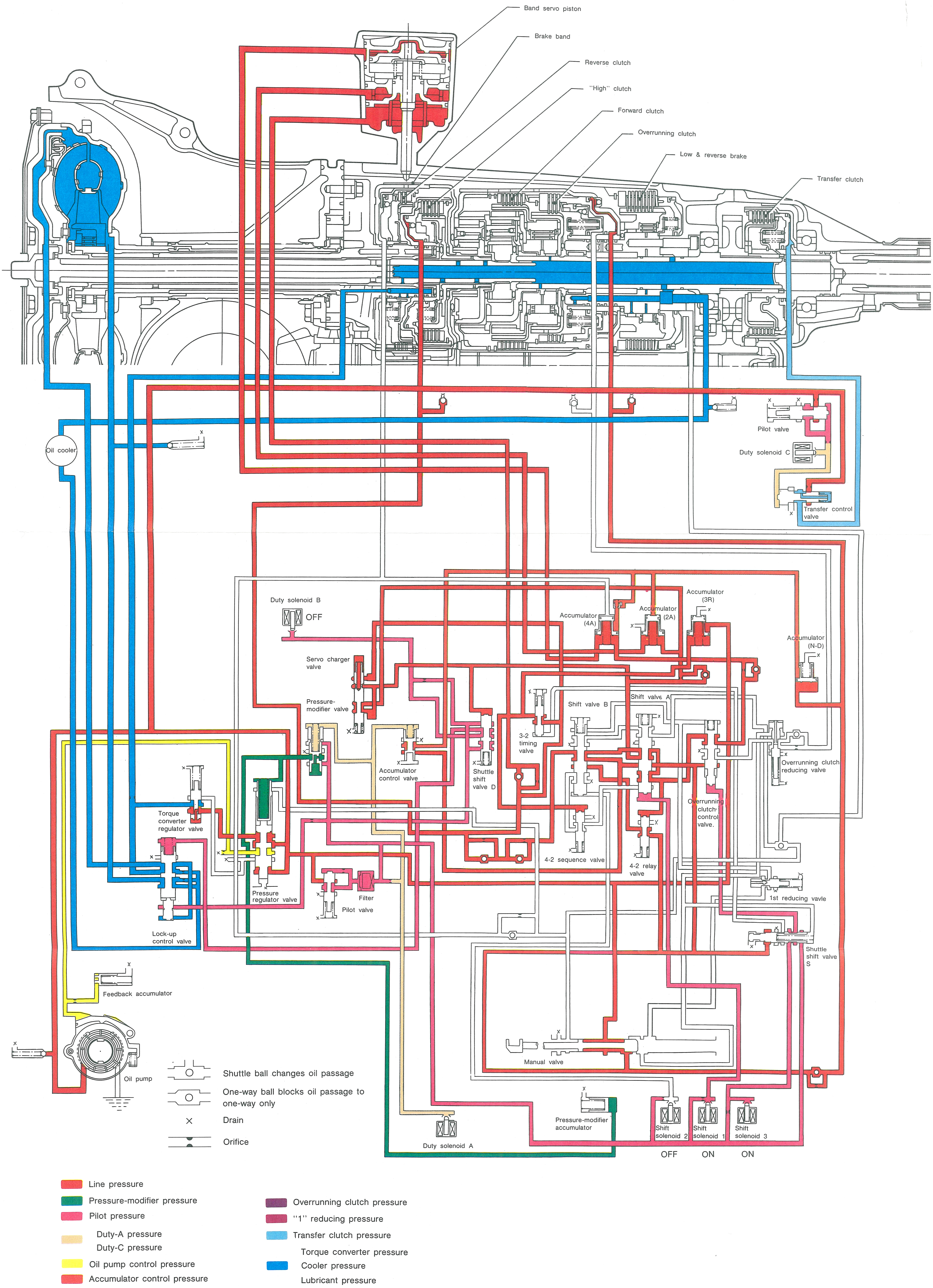



Line pressure
Pressure-modifier pressure
Pilot pressure
Duty-A pressure
Duty-C pressure
Oil pump control pressure
Accumulator control pressure
Overrunning clutch pressure
"1" reducing pressure
Transfer clutch pressure
Torque converter pressure
Cooler pressure
Lubricant pressure

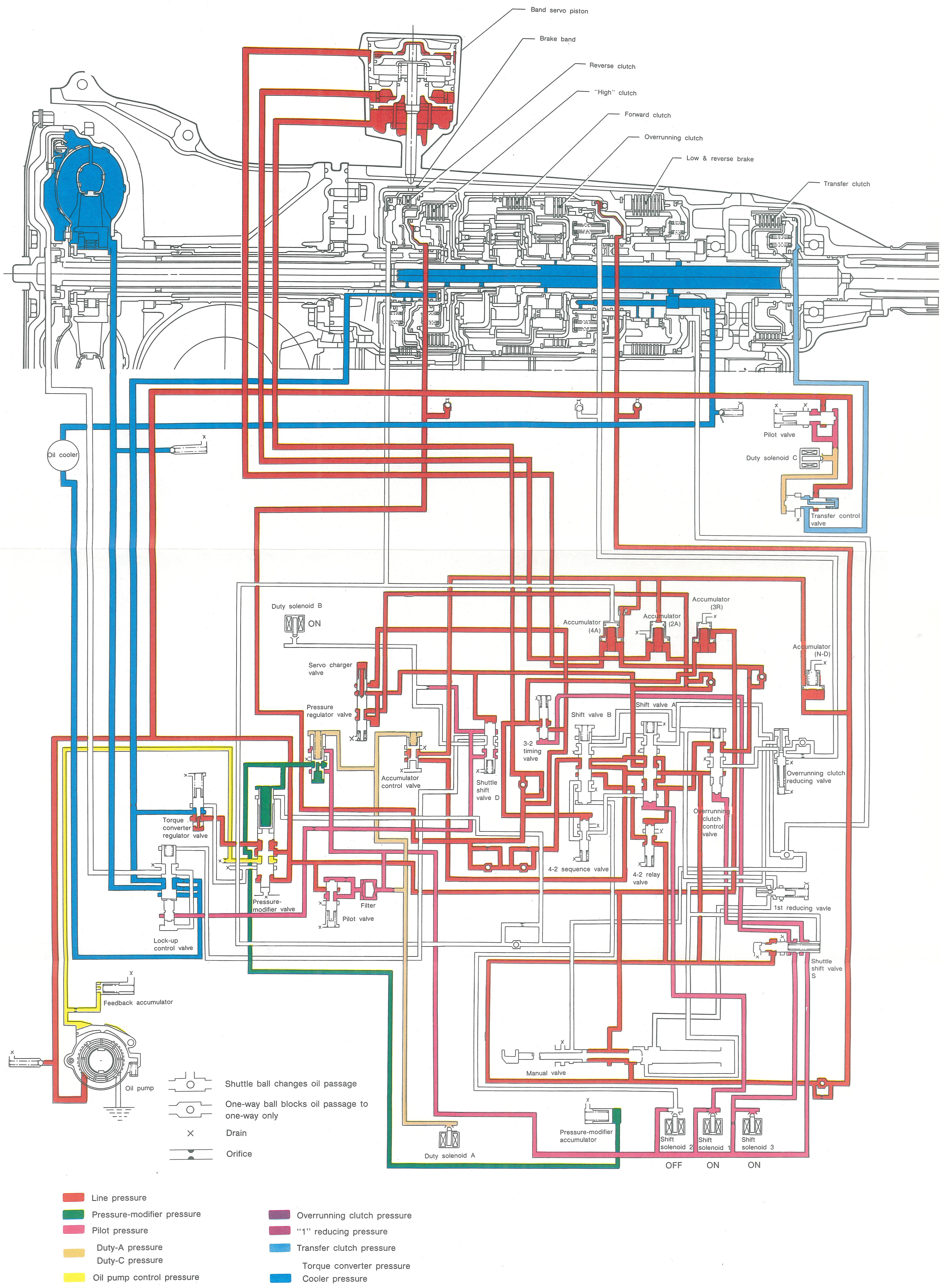
## 2. R RANGE


Band servo piston
Brake band
Reverse clutch
"High" clutch
Forward clutch
Overrunning clutch
Low & reverse brake
Transfer clutch
Pilot valve
Duty solenoid C
Transfer control valve
Oil cooler
Duty solenoid B
OFF
Servo charger valve
Pressure-modifier valve
Accumulator control valve
Accumulator (4A)
Accumulator (2A)
Accumulator (3R)
Accumulator (N-D)
Shift valve B
Shift valve A
3-2 timing valve
Shuttle shift valve D
Overrunning clutch reducing valve
Overrunning clutch control valve
Torque converter regulator valve
Pressure regulator valve
Filter
Pilot valve
4-2 sequence valve
4-2 relay valve
1st reducing vavle
Shuttle shift valve S
Lock-up control valve
Feedback accumulator
Oil pump
Manual valve
Pressure-modifier accumulator
Duty solenoid A
Shift solenoid 2
Shift solenoid 1
Shift solenoid 3
ON
ON
OFF
Shuttle ball changes oil passage
One-way ball blocks oil passage to one-way only
Drain
Orifice
Line pressure
Pressure-modifier pressure
Pilot pressure
Duty-A pressure
Duty-C pressure
Oil pump control pressure
Accumulator control pressure
Overrunning clutch pressure
"1" reducing pressure
Transfer clutch pressure
Torque converter pressure
Cooler pressure
Lubricant pressure

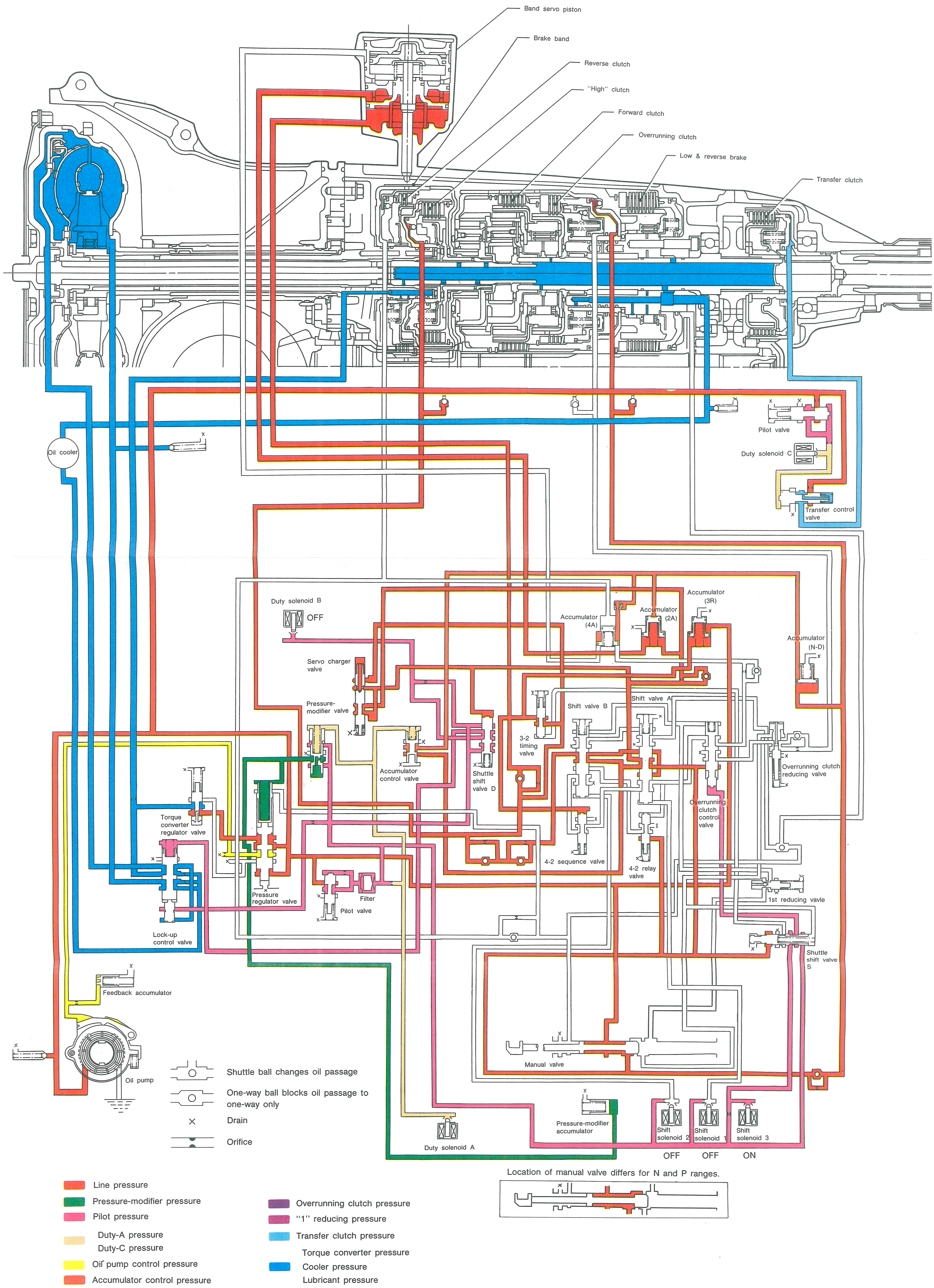
## 3. FOURTH SPEED OF D RANGE



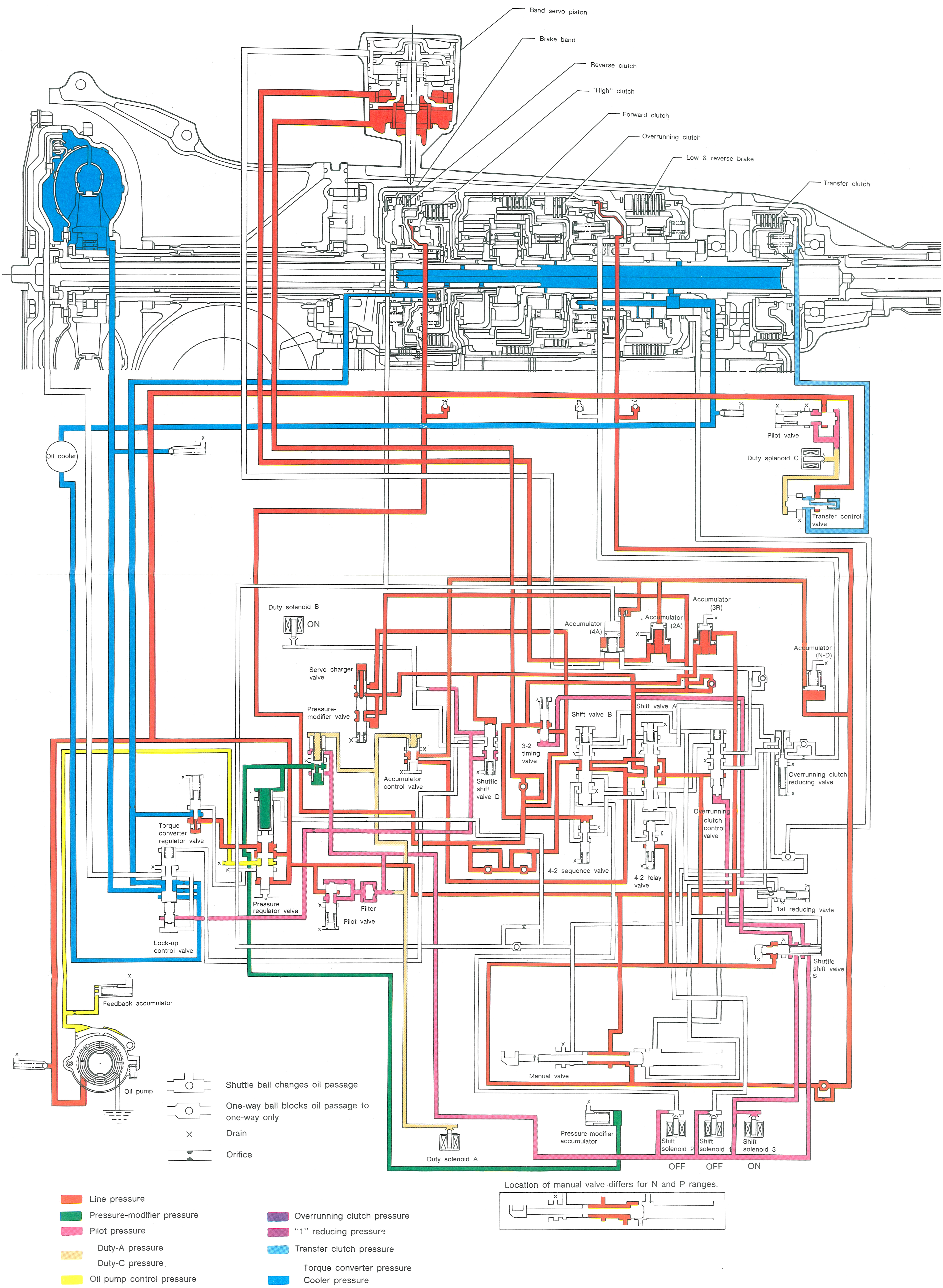
## 4. FOURTH SPEED OF D RANGE (LOCK-UP)



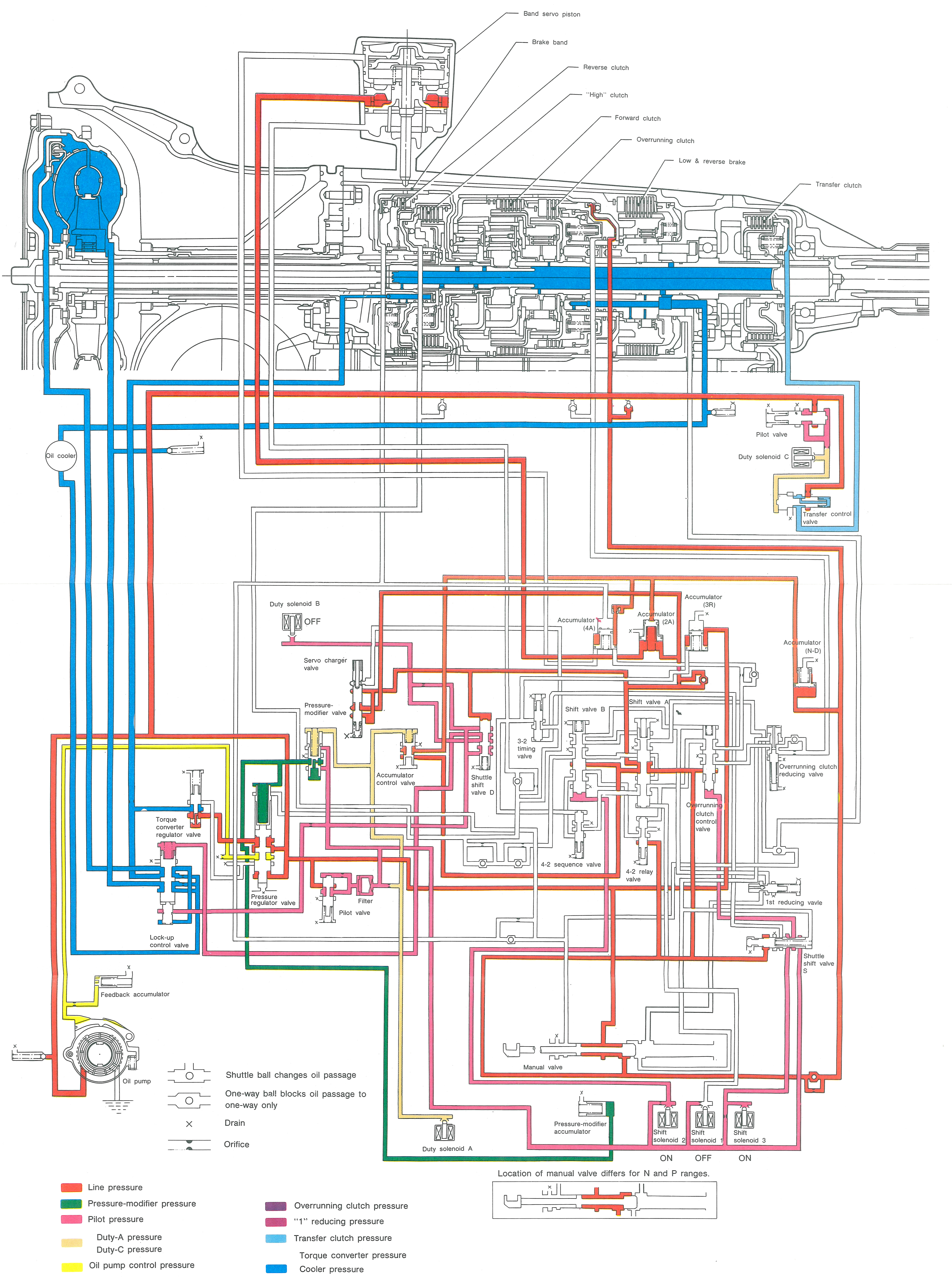
## 5. THIRD SPEED OF D OR 3 RANGE



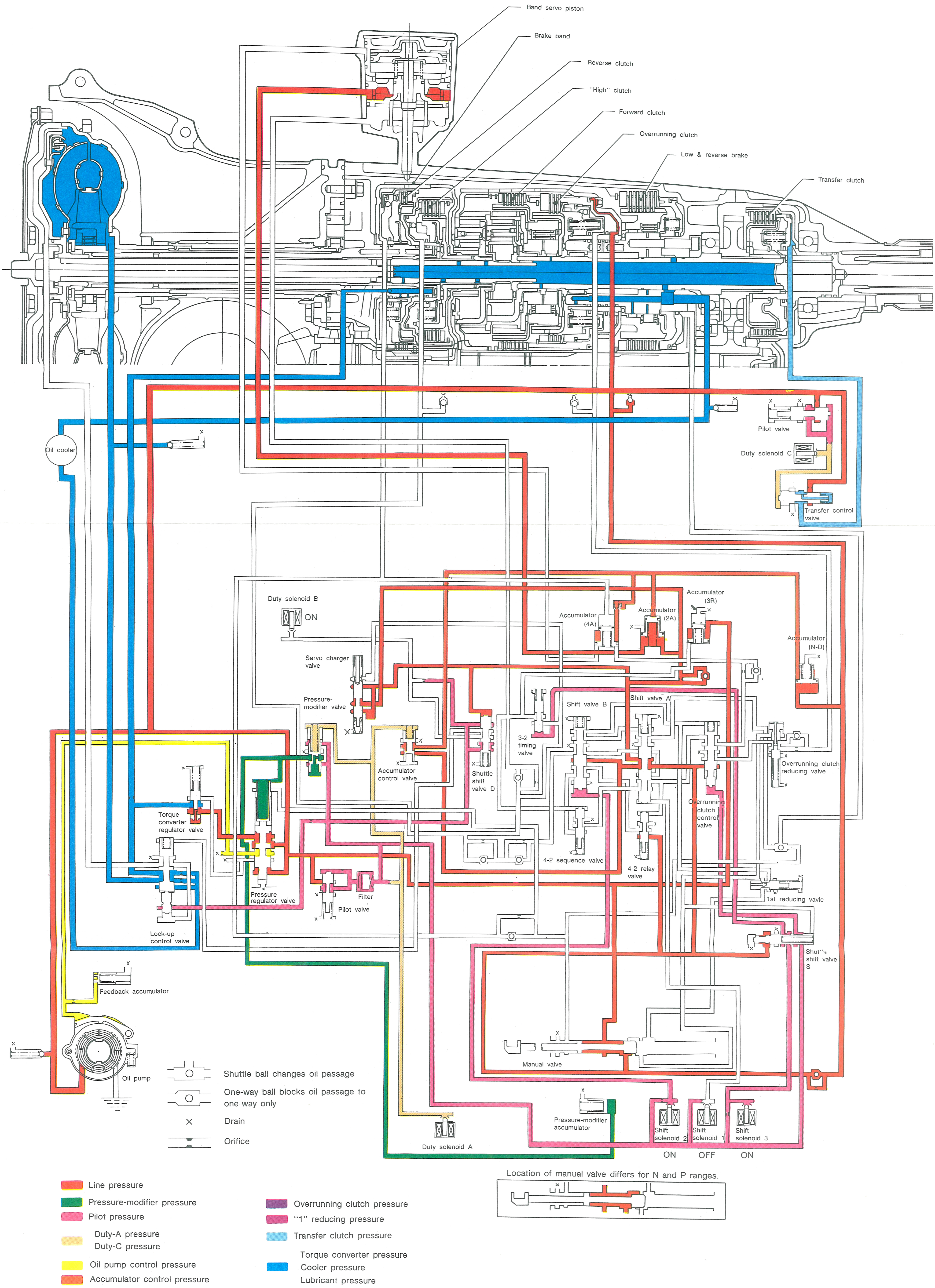
## 6. THIRD SPEED OF D OR 3 RANGE (LOCK-UP)



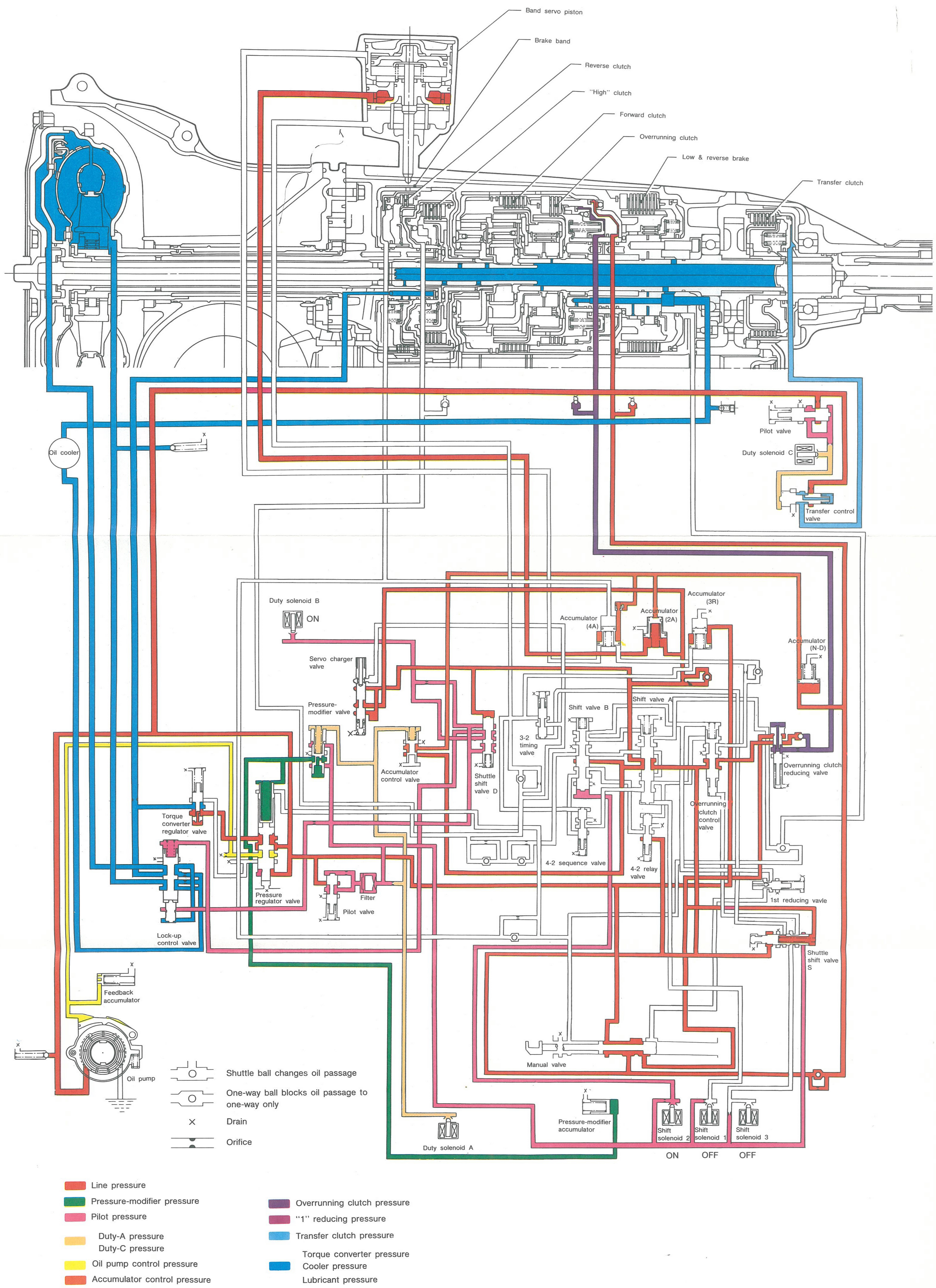
## 7. SECOND SPEED OF D OR 3 RANGE



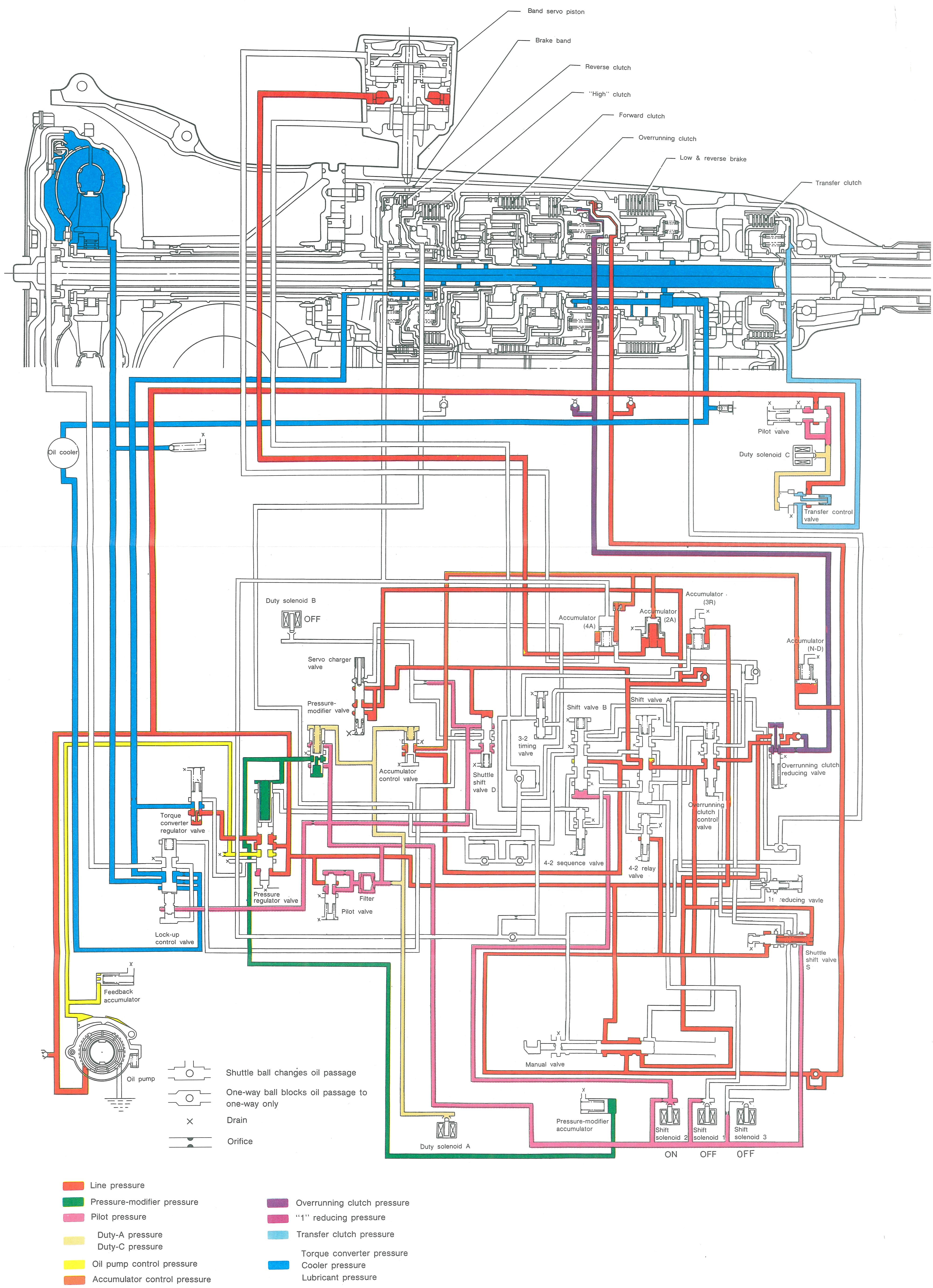
## 8. SECOND SPEED OF D OR 3 RANGE (LOCK-UP)



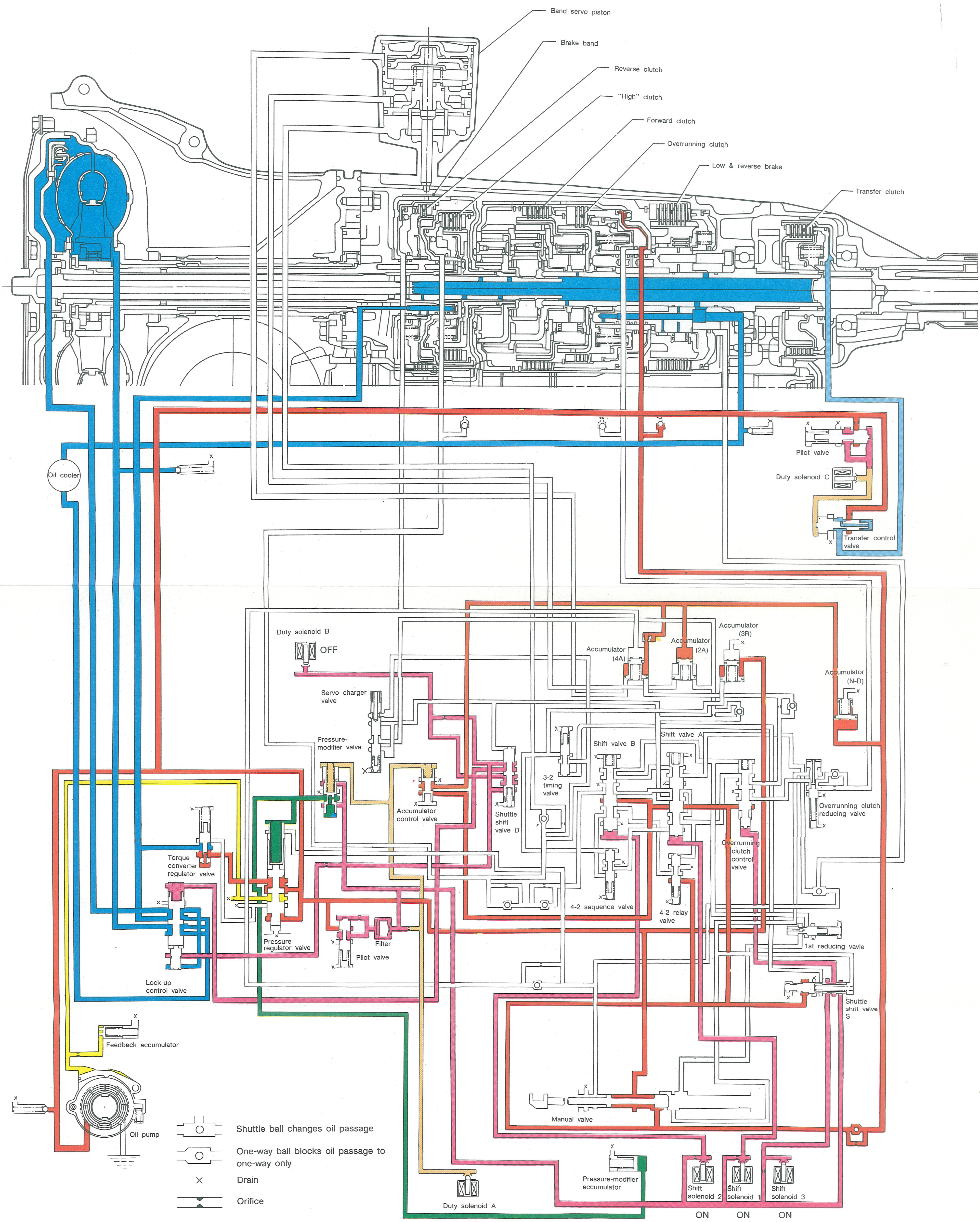
## 9. SECOND SPEED OF 2 RANGE



## 10. SECOND SPEED OF 2 RANGE (LOCK-UP)



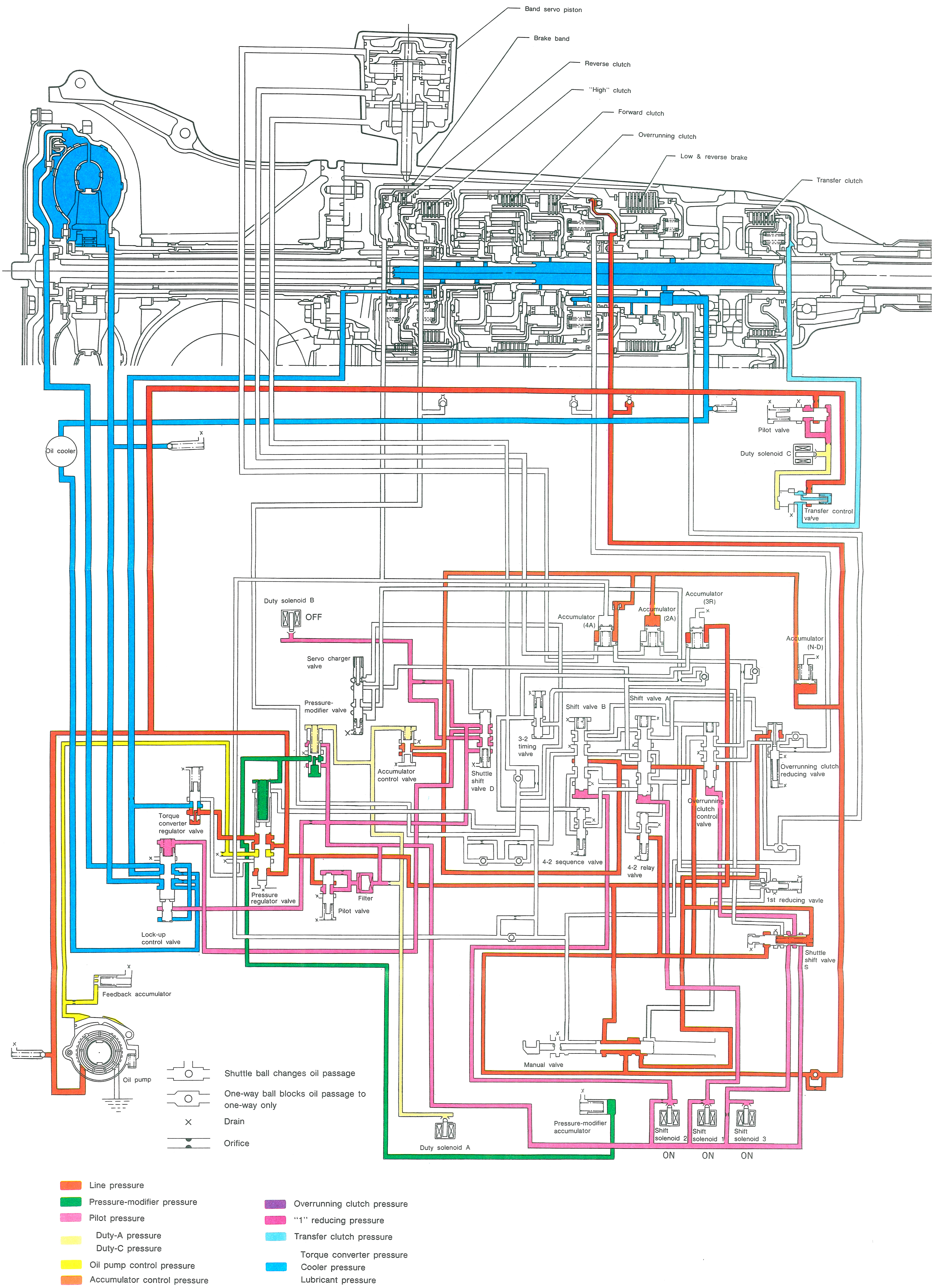
## 11. FIRST SPEED OF D OR 3 RANGE



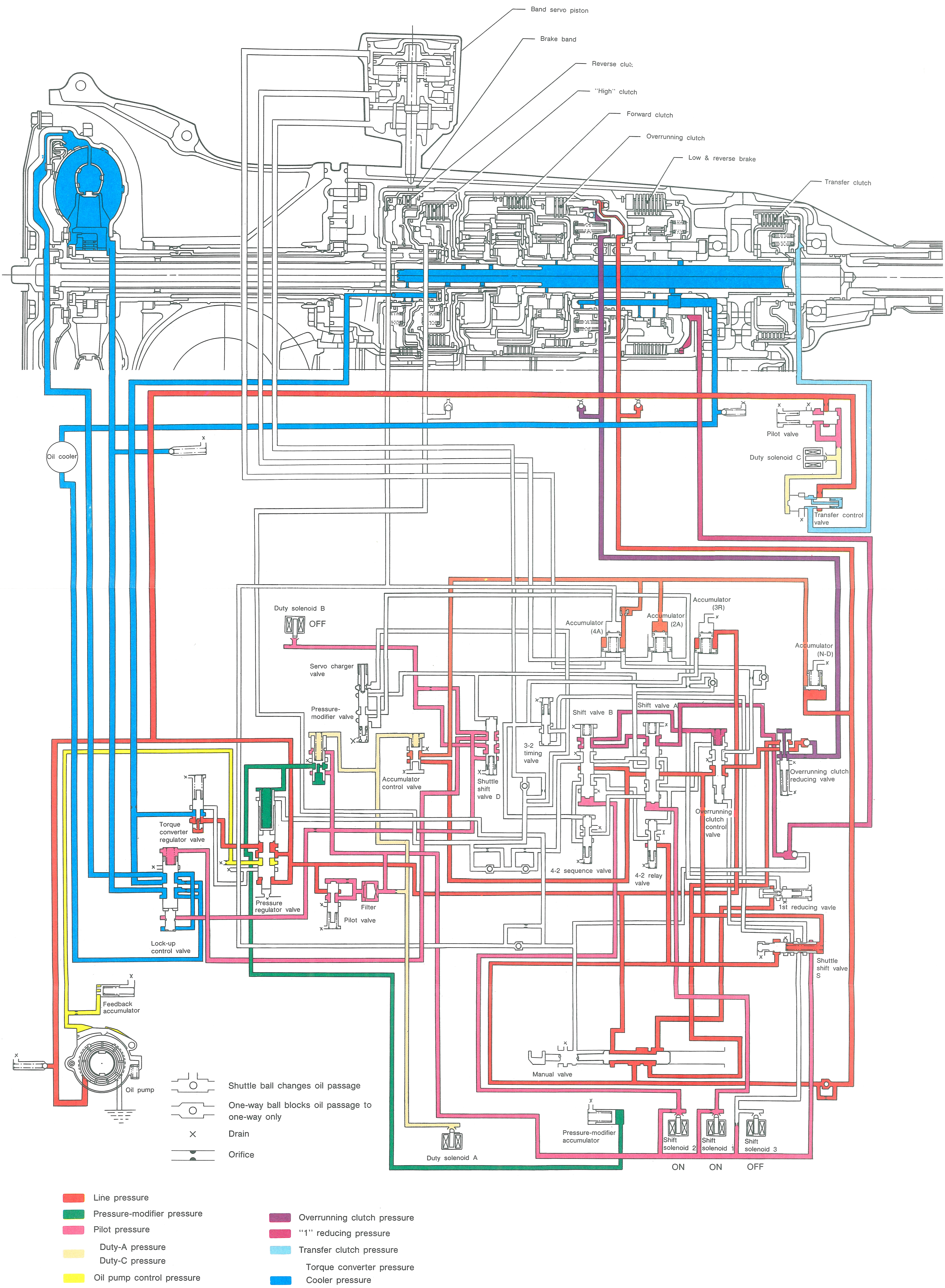

Location of manual valve differs for N and P ranges.

- Line pressure
- Pressure-modifier pressure
- Pilot pressure
- Duty-A pressure
- Duty-C pressure
- Oil pump control pressure
- Accumulator control pressure
- Overrunning clutch pressure
- "1" reducing pressure
- Transfer clutch pressure
- Torque converter pressure
- Cooler pressure
- Lubricant pressure

## 12. FIRST SPEED OF 2 RANGE



## 13. FIRST SPEED OF 1 RANGE



# 21. Electronic-Hydraulic Control System

## A: GENERAL

The electronic-hydraulic control system consists of various sensors and switches, a transmission control unit (TCU) and the hydraulic controller including solenoid valves. The system controls the transmission proper including shift control, lock-up control, overrunning clutch control, line pressure control, auto pattern select control and shift timing control. It also controls the AWD transfer clutch. In other words, the system detects various operating conditions from various input signals and sends output signals to shift solenoids 1, 2 and 3 and duty solenoids A, B and C (a total of six solenoids).

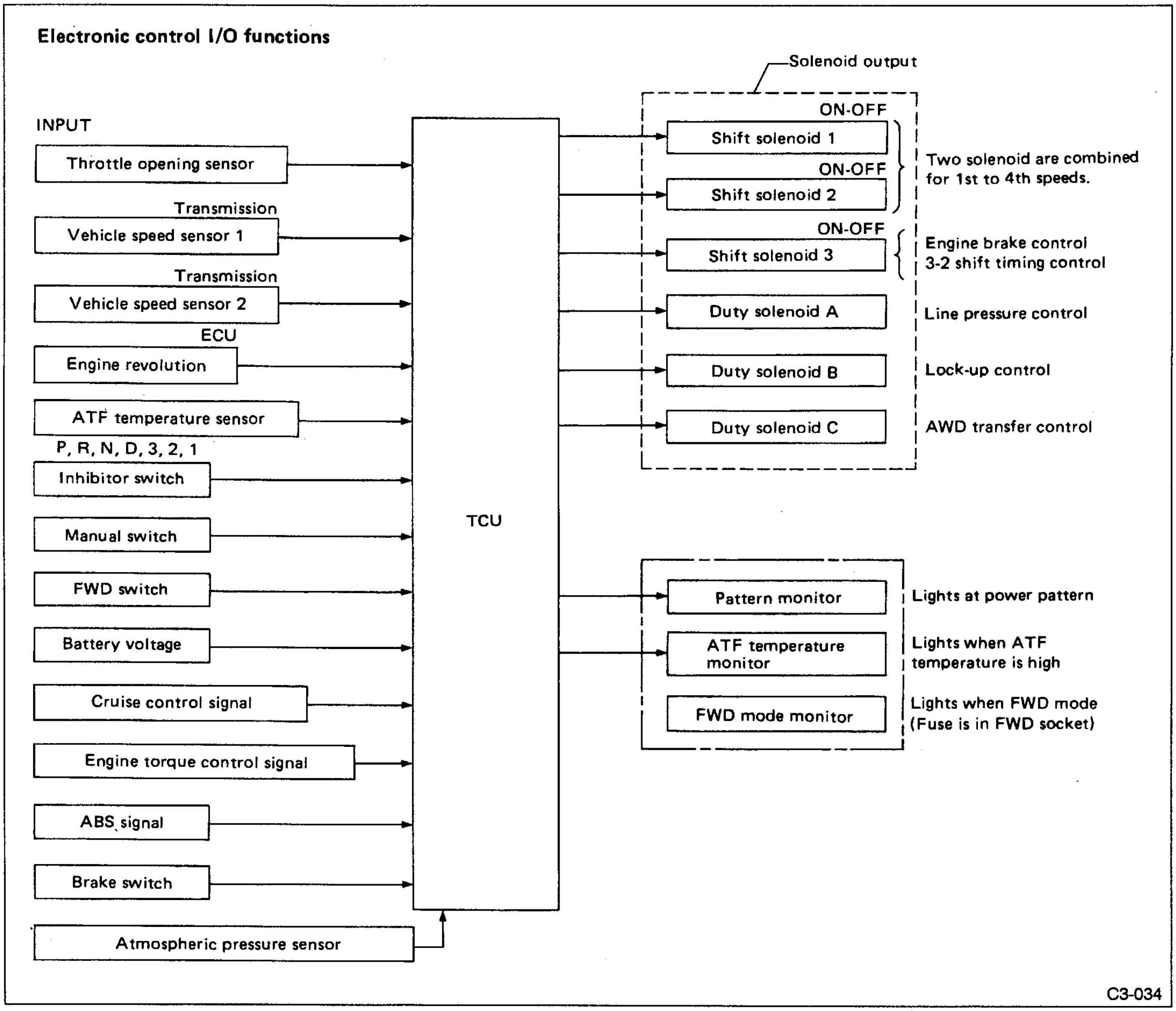



*Fig. 49*

## B: FUNCTION

### 1. INPUT SIGNAL

| Signal name | Major function |
|---|---|
| Throttle sensor | Detects throttle opening and determines shift point, line pressure and lock-up vehicle speed according to engine load. |
| Vehicle speed sensor 1 (mounted to transmission) | Detects vehicle speed. This signal is used to control shifting, lock-up, line pressure, and transfer clutch. |
| Vehicle speed sensor 2 (mounted to transmission) | Used to control transfer clutch and as backup in case of failure of vehicle speed sensor 1. |
| Engine revolution | Detects engine speed. This signal is used for lock-up clutch smooth, control at lock-up and to prevent engine overrunning at "2" and "1" range. |
| Inhibitor switch | Used to determine shifting and line pressure for respective ranges "P", "R", "N", "D", "3", "2" and "1". |
| Cruise switch (cruise control) | Detects operation of cruise control, and expands "4th" operating range. |
| ATF temperature sensor | Detects ATF temperature. This signal is used for inhibition of lock-up, release of OD and detection of ATF temperature. |
| Manual switch | Used to maintain the transmission in select range 2nd, 3rd when going up or down steep hills, running on sand, mud, or slippery surfaces. |
| FWD switch | Used to change the mode from AWD to FWD. Also used to adapt the vehicle to FWD tester roller. Changeover from AWD to FWD can be accomplished by inserting a fuse into the fuse holder. |
| ABS signal | When ABS is operating, to optimize ABS control, transfer clutch torque is controlled to eliminate the influence of engine braking and reduce the degree of coupling between front and rear wheels. |
| Atmospheric pressure sensor | Detects atmospheric pressure. This signal is used for decrease the shift shock at the high ground. |

### 2. OUTPUT SIGNAL

| Signal name | Function |
|---|---|
| Shift solenoids 1, 2 | Controls shift stage by turning solenoid ON/OFF. Relationship between solenoid operation and shifting stage is shown in Table below. When shifting, timing is controlled for each solenoid to reduce shock. |
| Shift solenoid 3 (Overrunning clutch) | Controls 3-2 shift timing and overrunning clutch operation. Shift timing is controlled by controlling release speed of oil pressure to reduce shock while downshifting. The overrunning clutch is controlled so that it will operate during coasting to apply engine brake. |
| Duty solenoid A (line pressure) | Regulates the line pressure according to driving conditions. |
| Duty solenoid B (lock-up) | Regulates the hydraulic pressure of the lock-up clutch and operates in three modes (open, smooth and lock-up). |
| Duty solenoid C (transfer pressure) | Regulates the hydraulic pressure of the transfer clutch and controls the driving force to the rear drive shaft. |
| "Power" indicator light | Indicates whether the shift pattern is "Normal" or "Power". The indicator lights in power mode. This light is also used for "self-diagnosis". |
| FWD pilot light | Lights when the "FWD switch" turned ON. |
| ATF temperature warning light | Lights when ATF becomes hot (exceeds a set temperature level). |
| Engine torque control signal | Reduces engine torque at racing select and gear change. |

## 3. CONTROL ITEM

| Control item | | | Description of control |
|---|---|---|---|
| Transmission control | Gear shift control | Normal shift control<br>● Normal pattern<br>● Power pattern | Upshifting and downshifting are set for each range, gear position and pattern according to throttle opening and vehicle speed. |
| | | Control with ABS | Gear is locked in 3rd position when ABS signal enters. |
| | | Control with cruise control | When cruise control is set, 4th gear operating range is expanded. |
| | | ATF low temperature control | Shifting into 4th gear is prevented when ATF temperature is below the preset value. |
| | | Manual control | Gear is held in selected range when manual switch is ON. (2 and 3 ranges only) |
| | Lock-up control | Normal lock-up control<br>● "Normal" : "D" range only<br>● "Power" : R, 3, 2 ranges | Lock-up ON/OFF is set for each range, gear position, and pattern according to throttle opening and vehicle speed. (Basically lock-up is OFF during gear shifting.) |
| | | Smooth control | Smooth lock-up is performed when lock-up is switched on. |
| | Overrunning clutch control | Engine brake control | Overrunning clutch is operated according to range, vehicle speed, and cruise control signals in order to apply engine brake properly. |
| | | 3-2 timing control | This control speeds the release of servo piston pressure 3R when shifting down from 3rd to 2nd, thereby preventing engine racing. |
| | Line pressure control | Ordinary control | Line pressure is regulated according to throttle opening, vehicle speed and range signals. |
| | | Shifting control | Line pressure is reduced when shifting to lessen shifting shock. |
| | | Starting control | Line pressure is at a minimum so as to reduce engine cranking load. |
| | Automatic pattern select control | Power pattern control (POWER light ON) | Power pattern is selected when throttle opening change speed exceeds the preset value. |
| | | Normal pattern control | When throttle opening is less than the preset value, normal pattern is resumed. |
| | Shift timing control | Shift step control | ON/OFF timing for shift solenoid is controlled. |
| | | Lock-up control | When shifting, the lock-up clutch is temporarily released. |
| | | Overrunning clutch control (3rd to 2nd: small throttle opening in coasting, 2nd to 1st: in coasting) | When shifting down, the overrunning clutch is temporarily disconnected to reduce shifting shock. |
| | | Line pressure control | When shifting, line pressure is controlled to the optimum level so as to reduce shifting shock. |
| AWD transfer clutch control | Ordinary transfer control | | Transfer oil pressure is regulated according to the throttle opening angle and vehicle speed. |
| | 1st range control | | Transfer oil pressure is increased. |
| | Slip control | | Immediately after detecting a slip, transfer oil pressure is controlled to the same pressure as 1st range.<br>(This control is canceled if V ≧ 60 km/h (37 MPH), or when throttle is closed fully.) |
| | Control it turns | | Transfer oil pressure is reduced after detecting the turn. |
| | ABS control | | Transfer oil pressure is adjusted to set level immediately after reception of ABS signal. |

### 4. POWER INDICATOR LIGHT

The automatic transmission equipped vehicle is capable of automatically selecting two driving patterns; a normal pattern suitable for ordinary driving and a power pattern suitable for driving uphill or rapid acceleration. The power indicator light lights when the power pattern is selected. See the table below:

| Selector lever position | Changeover from normal pattern to power pattern | Power indicator light ON/OFF |
|---|---|---|
| "D" range | Pattern is changed automatically according to depression of accelerator pedal. | • "Normal" pattern: OFF<br>• "Power" pattern: ON |

## C: COMPONENTS

### 1. THROTTLE SENSOR

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

### 2. VEHICLE SPEED SENSOR 1 (MOUNTED INSIDE THE TRANSMISSION)

**[AWD]**

The vehicle speed sensor (output shaft rotation sensor) is mounted to the extension case (from the outside of the case). The sensor outputs a pulse signal which is transmitted to the TCU where it is converted to vehicle speed.

The transfer clutch drum is connected directly to the rear wheel driving propeller shaft. Vehicle speed sensor 1 on the AWD model defects rear-wheel speed.

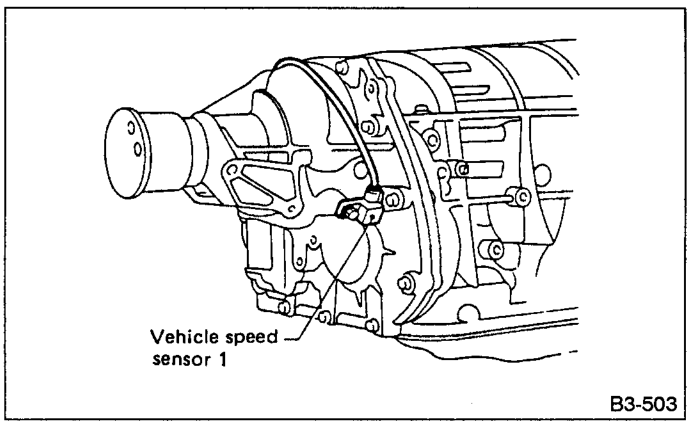



*Fig. 50*

### 3. VEHICLE SPEED SENSOR 2 (MOUNTED INSIDE THE TRANSMISSION)

**[AWD]**

The vehicle speed sensor (output shaft rotation sensor) is mounted to the torque converter case (from the outside of the case). The sensor outputs a pulse signal which is transmitted to the TCU where it is converted to vehicle speed.

The speedometer driven gear is connected directly to the front wheel driving differential case by speedometer drive gear. Vehicle speed sensor 2 on the AWD model detects front-wheel speed.

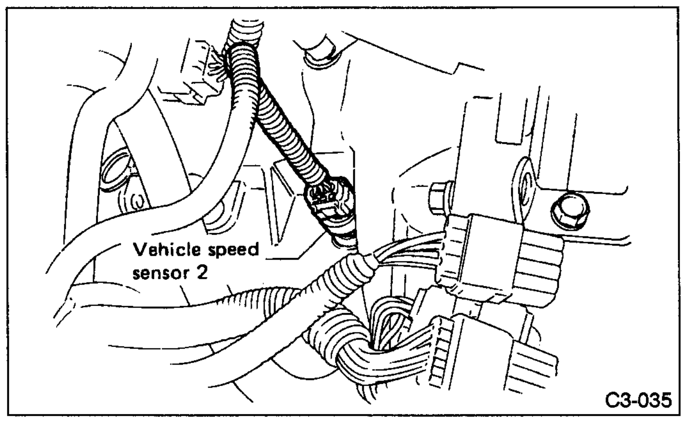



*Fig. 51*

## 4. ATF TEMPERATURE SENSOR

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

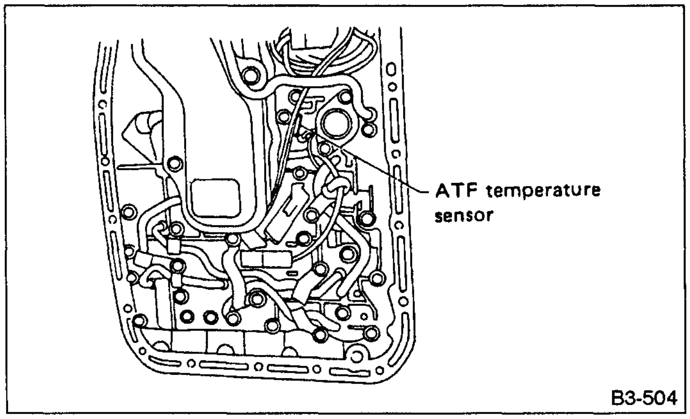



*Fig. 52*

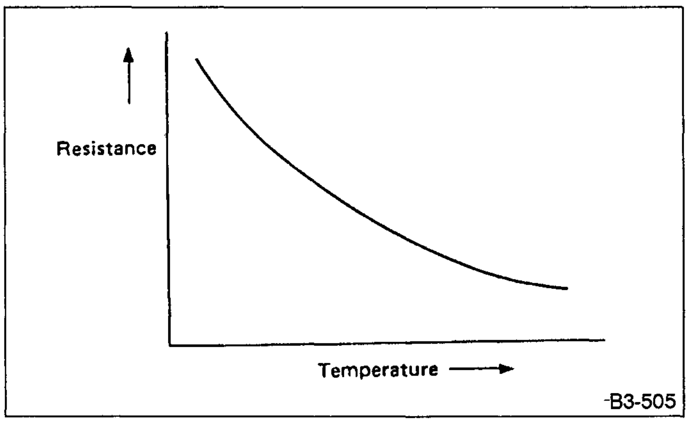



*Fig. 53*

## 5. INHIBITOR SWITCH

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

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

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

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

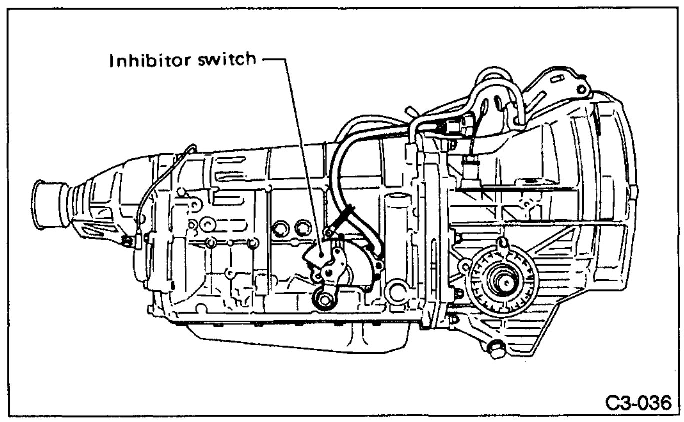



*Fig. 54*

| *PIN NO. | 4 | 3 | 2 | 1 | 8 | 7 | 6 | 5 | 12 | 11 | 10 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CODE POSITION | B | Lg | Br | LgY | YW | YB | LgR | WL | BW | BY | G | GW |
| P | O | O | | | | | | | O | O | | |
| R | O | | O | | | | | | | | O | O |
| N | O | | | O | | | | | O | O | | |
| D | O | | | | O | | | | | | | |
| 3 | O | | | | | O | | | | | | |
| 2 | O | | | | | | O | | | | | |
| 1 | O | | | | | | | O | | | | |

*: Connector T1

## 6. SOL. 1 (SHIFT) and SOL. 2 (SHIFT)

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

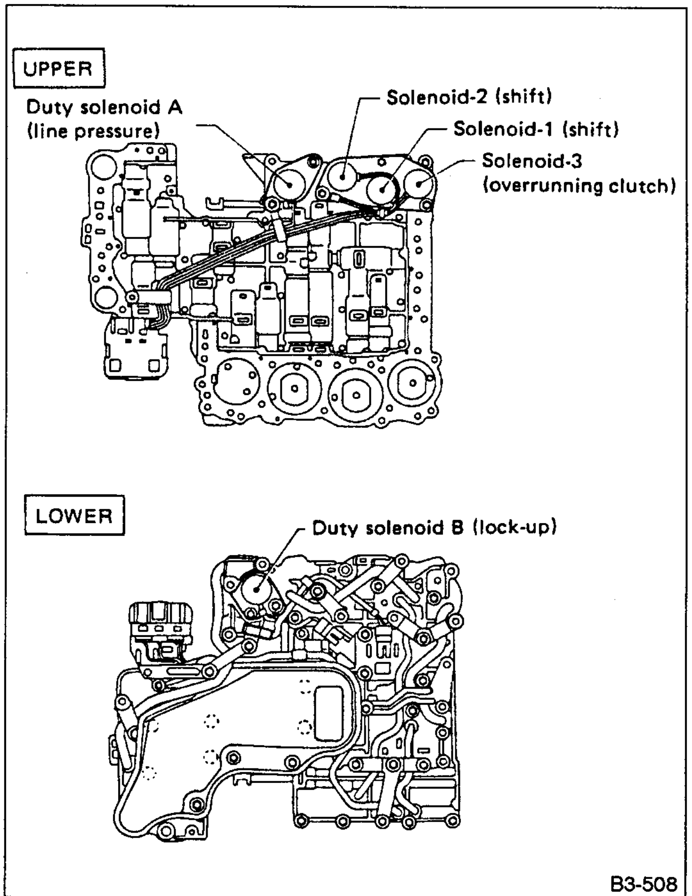



*Fig. 55*

## 7. SOL. 3 (OVERRUNNING CLUTCH)

This solenoid is also mounted to the control valve. It is turned ON or OFF according to the signal sent from the TCU. This operation controls the engagement and disengagement of the overrunning clutch.

## 8. DUTY SOL. A (LINE PRESSURE)

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

## 9. DUTY SOL. B (LOCK-UP)

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

## 10. DUTY SOL. C (TRANSFER)

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

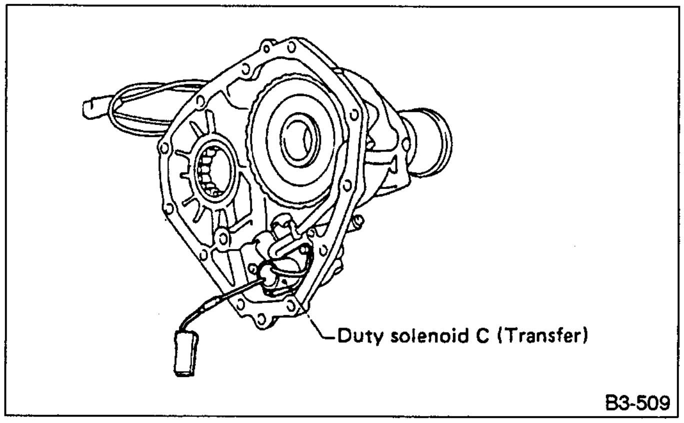



*Fig. 56*

# 22. Transmission Control Unit (TCU)

## A: GENERAL

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

### 1. CONTROL SYSTEM

| Input signal / Control item | Throttle sensor idle switch | Vehicle speed sensor 1 | Vehicle speed sensor 2 | Engine revolutions (rpm) | ATF temperature sensor | Inhibitor switch | Manual switch | FWD switch | Cruise control signal | ABS signal | Atmospheric pressure signal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Shift control (1) Ordinary shift control | O | O | O | O | | O | | | | | |
| (2) ABS operation control | | | | | | | | | | O | |
| (3) Cruise control operation | | | | | | | | | O | | |
| (4) Hydraulic oil temperature control | | | | | O | | | | | | |
| (5) Manual control | | | | | | O | O | | | | |
| 2. Lock-up control (1) Ordinary lock-up control | O | O | O | O | | O | | | O | | |
| (2) Smooth control | | O | O | O | | | | | | | |
| (3) Low oil temperature control | | | | | O | | | | | | |
| 3. Overrunning clutch control (1) Engine brake control | O | O | O | | | O | O | | O | | |
| (2) 3-2 timing control | O | O | O | | | | | | | | |
| 4. Line-pressure control (1) Ordinary line pressure control | O | O | O | O | O | O | O | | | | |
| (2) Shifting control | O | O | O | | | O | O | | | | O |
| (3) Starting control | | | | O | O | | | | | | |
| 5. Shift pattern select control (1) Power drive pattern control | O | O | O | | O | O | | | | | |
| (2) Return to normal drive pattern | O | O | O | | | O | | | | | |

| Input signal / Control item | Throttle sensor idle switch | Vehicle speed sensor 1 | Vehicle speed sensor 2 | Engine revolutions (rpm) | ATF temperature sensor | Inhibitor switch | Manual switch | FWD switch | Cruise control signal | ABS signal | Atmospheric pressure signal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6. Shift timing control (1) Shift range control | O | | | | | O | O | | | | |
| (2) Lock-up control | O | | | | | O | O | | | | |
| (3) Overrunning clutch control | O | | | | | O | O | | | | |
| (4) Line pressure control | O | O | O | | | O | O | | | | |
| 7. AWD transfer clutch control (1) Ordinary transfer control | O | O | O | | O | O | | O | | | |
| (2) Manual mode control | O | O | O | | | O | O | | | | |
| (3) Slip detection control | O | O | O | | | | | | | | |
| (4) Steering control | O | O | O | | | | | | | | |
| (5) ABS operating control | O | | | | | | | | | O | |

## 2. SYSTEM DIAGRAM

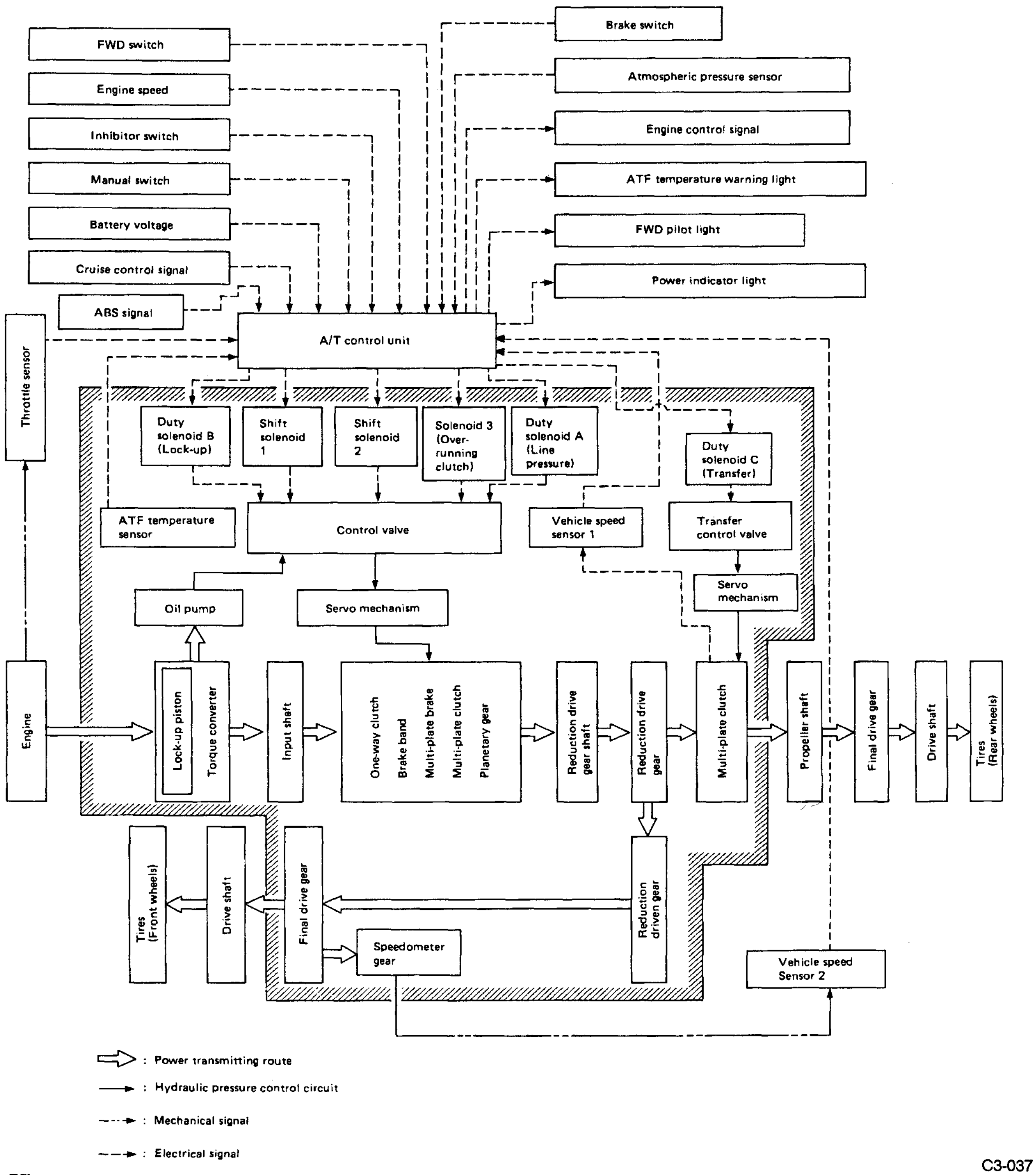



*Fig. 57*

## B: FUNCTION

### 1. SHIFT CONTROL

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

| | Solenoid 1 | Solenoid 2 |
|---|---|---|
| 1st | O | O |
| 2nd | X | O |
| 3rd | X | X |
| 4th | O | X |

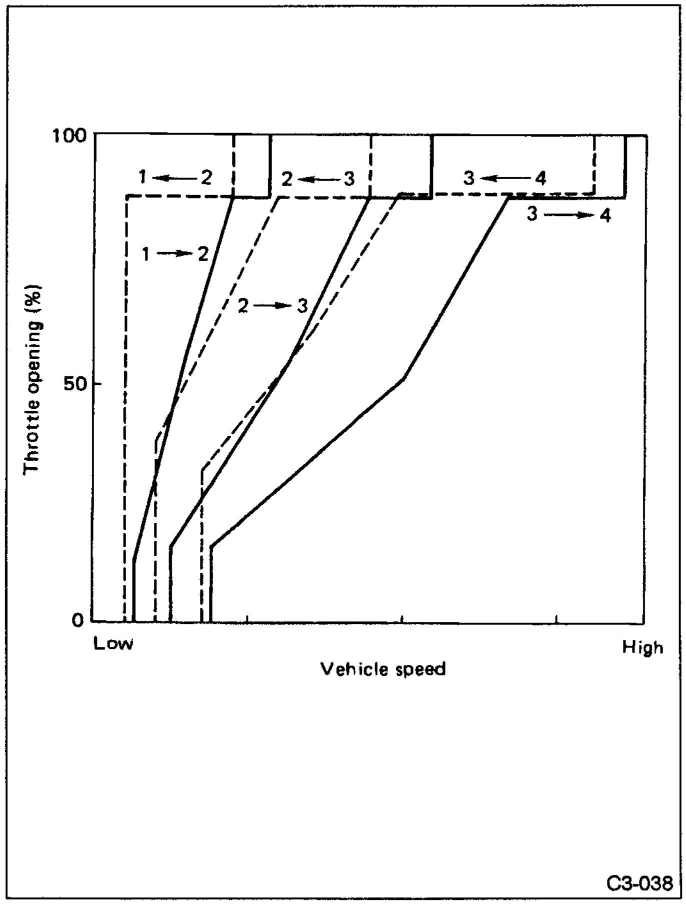



*Fig. 58*

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

① Control unit activates both solenoids 1 and 2 in response to throttle and vehicle speed signals.

② Shift valve moves in response to solenoid operation, supplying/interrupting clutch pressure to the line.

③ Gears are shifted by ON-OFF operation of both solenoids as indicated in Table.

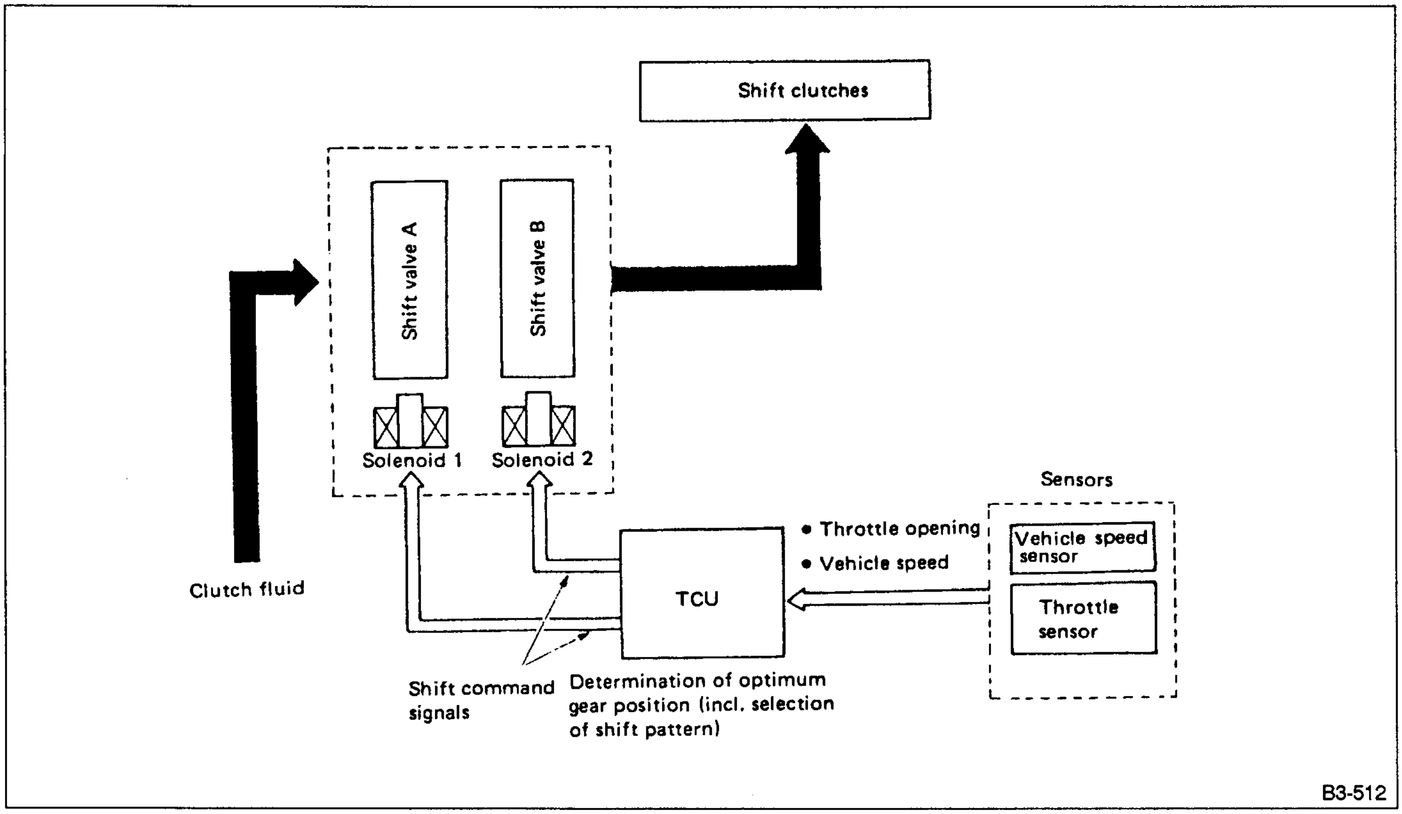

Shift clutches
Shift valve A
Shift valve B
Solenoid 1
Solenoid 2
Sensors
• Throttle opening
• Vehicle speed
Vehicle speed sensor
Throttle sensor
TCU
Clutch fluid
Shift command signals
Determination of optimum gear position (incl. selection of shift pattern)
B3-512

*Fig. 59*

## 2. 3-2 TIMING CONTROL

When shifting from 3rd to 2nd, the high clutch is disengaged. At the same time, oil pressure (which releases the brake band) is also released from the servo piston 3rd release chamber (3R).

At this point, the servo piston moves to release oil pressure from the 3rd release chamber (3R) and apply oil pressure to the 2nd apply chamber. This causes the brake band to be applied. In other words, high clutch "release" and brake band "application" are properly timed by electronic control. This eliminates engine rev-up under no load or hesitation.

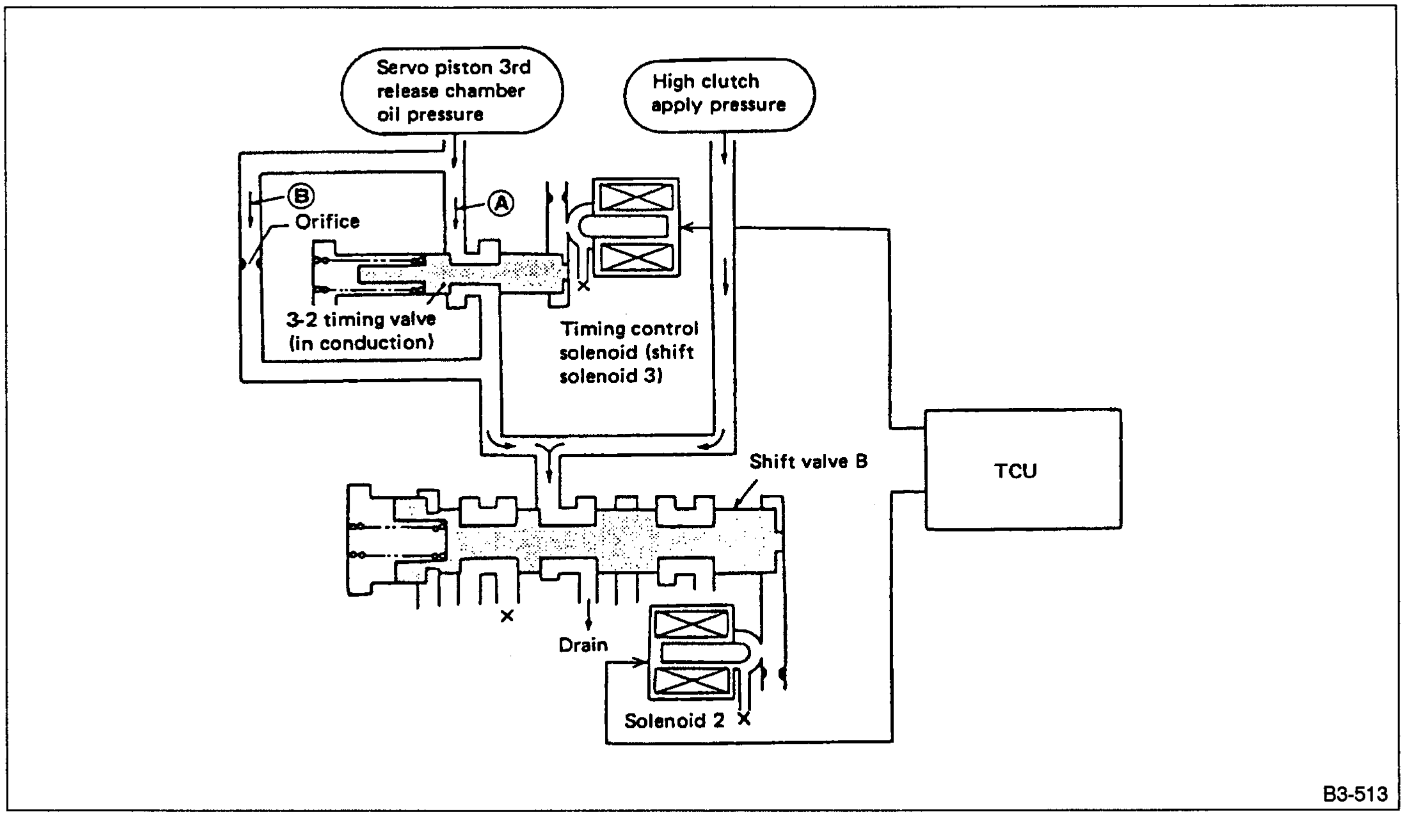



*Fig. 60*

- When the 3-2 timing valve conducts, oil pressure applied to the 3rd release chamber is quickly released through passage Ⓐ.
- When the 3-2 timing valve does not conduct, oil pressure applied to the 3rd release chamber is slowly released through passage Ⓑ (provided with an orifice).

## 3. LOCK-UP CONTROL

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

⟨When engaging and disengaging⟩

The shuttle duty shift valve is actuated by the hydraulic pressure from the shift valve A. It controls the position of the lock-up control valve for engaging or disengaging the lock-up clutch.

**(1) 1st gear, N, R, and P ranges**

Since no operating pressure is generated from the shift valve A, the shuttle duty shift valve sets the lock-up control valve in the "disengaging" position.

The lock-up operating pressure (torque converter regulator pressure) acts on the lock-up clutch disengaging circuit, while the engaging circuit communicates with the oil cooler circuit. Accordingly, the lock-up clutch is disengaged by the pressure difference.

**(2) 2nd, 3rd, and 4th gear**

The operating pressure generated by the shift valve A is applied to the shuttle duty shift valve, which pushes the lock-up control valve to the "engaging" position. Since the lock-up operating pressure is applied to the engaging side circuit while the disengaging circuit is drained, the lock-up clutch is engaged by the pressure difference.

⟨Smooth control⟩

The duty solenoid B is controlled by the TCU and controls the operation of the lock-up control valve. Because the lock-up operating pressure is controlled by the lock-up control valve, the force applied to the lock-up clutch is controlled for smooth clutch operation. When locking up, the clutch is set in the half-engaged state beforehand. After this, the lock-up operating pressure is gradually increased to achieve smooth locking up.

## 4. LINE-PRESSURE CONTROL

1) The oil pump delivery pressure (line pressure) is regulated to the constant pilot pressure by the pilot valve.
2) The pilot pressure applied to the pressure modifier valve is regulated by the line pressure controlling duty solenoid A and changed into the pressure modifier pressure.
3) The pressure modifier valve is an auxiliary valve for the pressure regulator valve, and it creates a signal pressure (pressure modifier pressure) for regulating the line pressure to an optimum pressure corresponding to the driving conditions.
4) This pressure modifier pressure is applied to the pressure regulator valve to control the oil pump delivery pressure.
5) The delivery pressure of the oil pump is regulated to an appropriate pressure (line pressure) corresponding to the driving condition to reduce the loss in the oil pump driving time and acceleration shock.
6) The pressure modifier pressure regulated by the pressure modifier valve is smoothed by the pressure modifier accumulator and pulsation in the line pressure is eliminated.

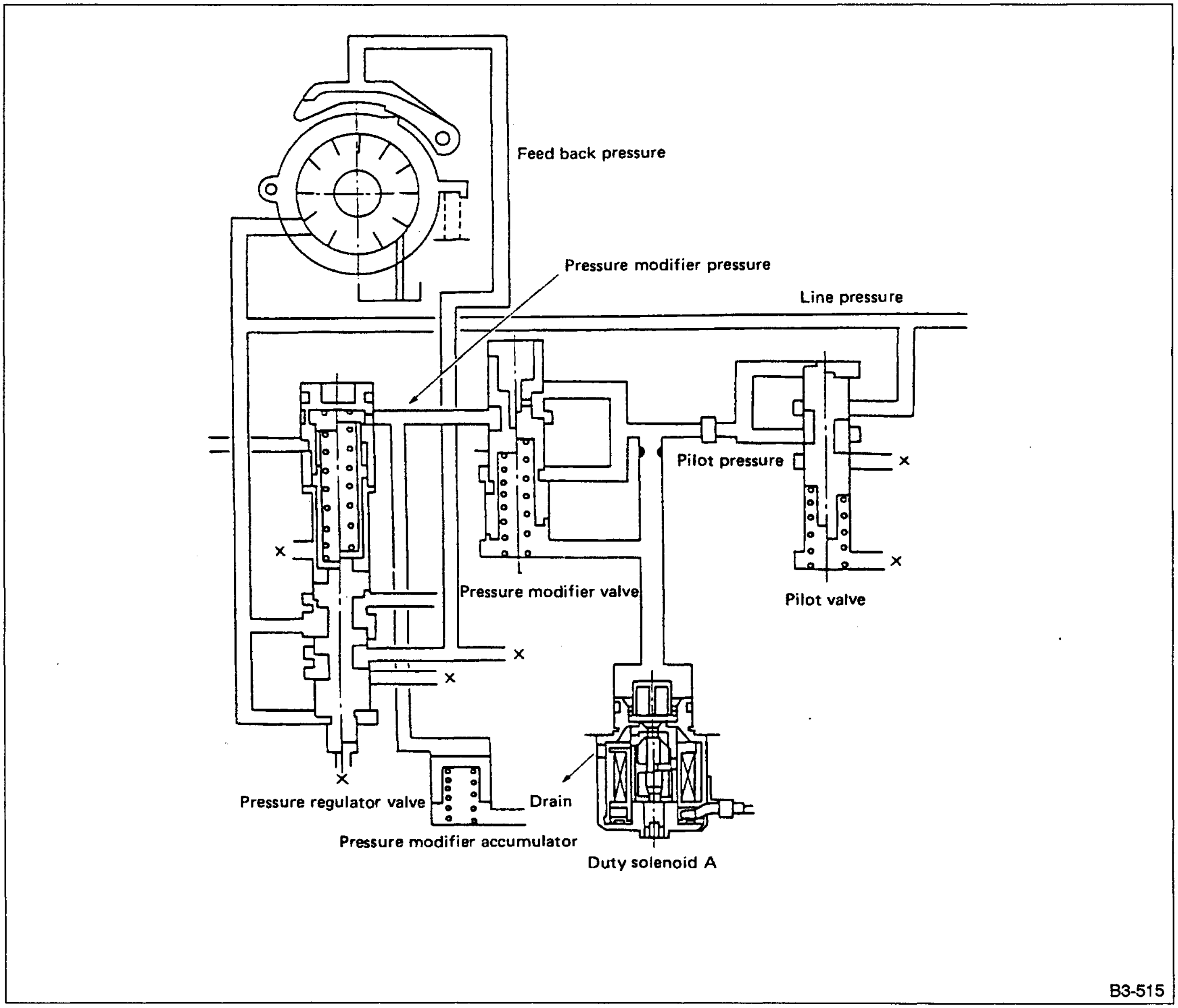



*Fig. 61*

## 5. LINE-PRESSURE SHIFTING CONTROL

Oil pressure which engages shift clutches (to provide 1st through 4th speeds) is electronically controlled to meet varying operating conditions.
In other words, line pressure decreases to match the selected shift position, minimizing shifting shock.

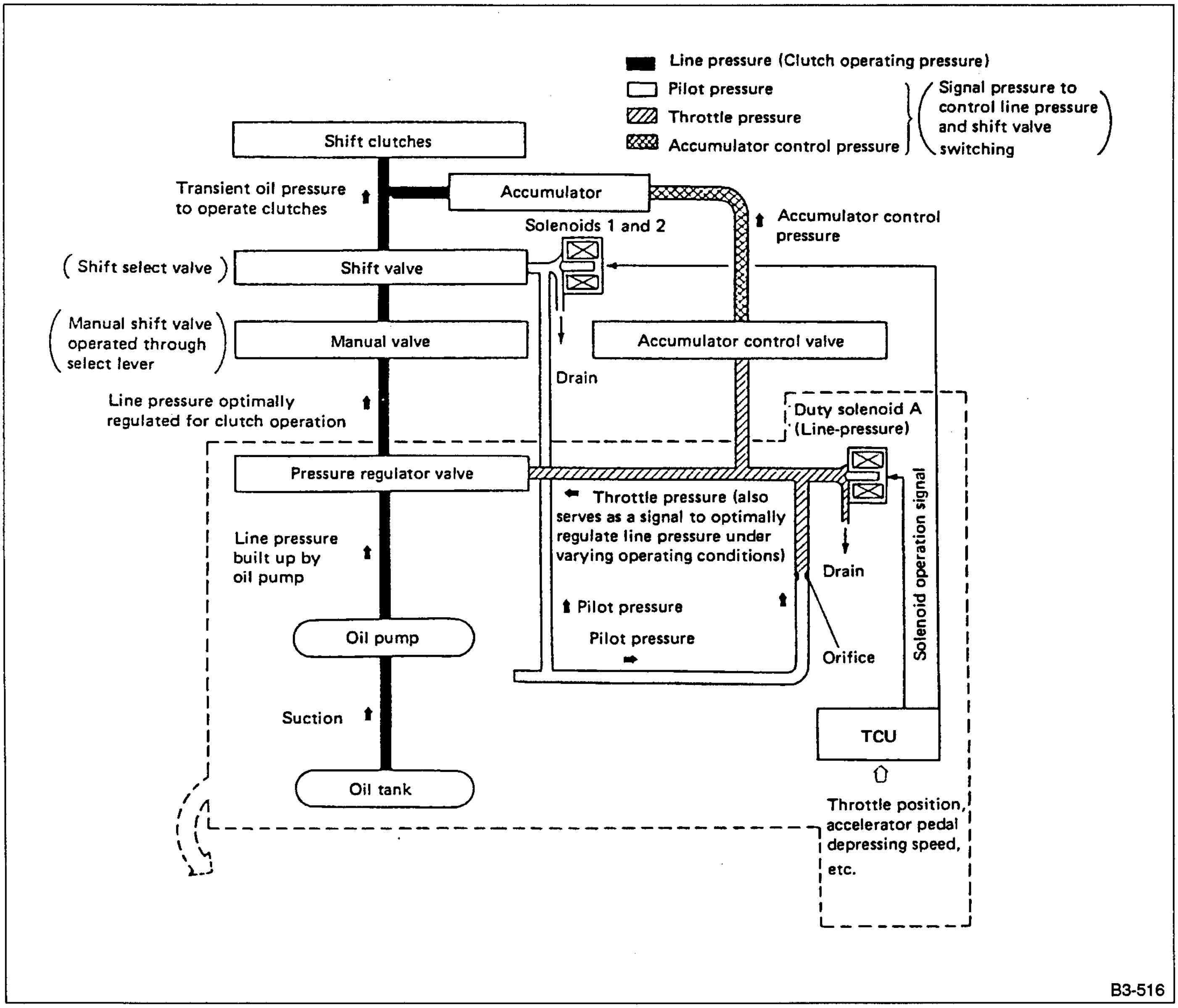



*Fig. 62*

- Electronic control of clutch oil pressure in summary

a. Solenoids activate through the TCU which receives various control signals (throttle signal, etc.)
b. Control signals are converted into throttle pressure, which is transmitted to the pressure regulator valve.
c. The pressure regulator valve optimally regulates line pressure (built-up by oil pump) in response to throttle pressure, matching varying operating conditions.

## 6. SHIFT PATTERN SELECT CONTROL

Shift pattern is selectable automatically between a normal pattern suitable for ordinary economy running and a power pattern suitable for climbing uphill or rapid acceleration.
In the power pattern, the shift down point and shift up point are set higher than those of the normal pattern.
When the power pattern is selected, the POWER indicator light in the meter lights up.

| Selector position | Changeover from normal to power pattern | Meter indication |
|---|---|---|
| D, 3, 2 range | Performed automatically corresponding to accelerator pedal depression. | • Normal pattern: OFF<br>• Power pattern: ON |

* This happens for the 3 or 2 range, only when the manual switch is OFF.

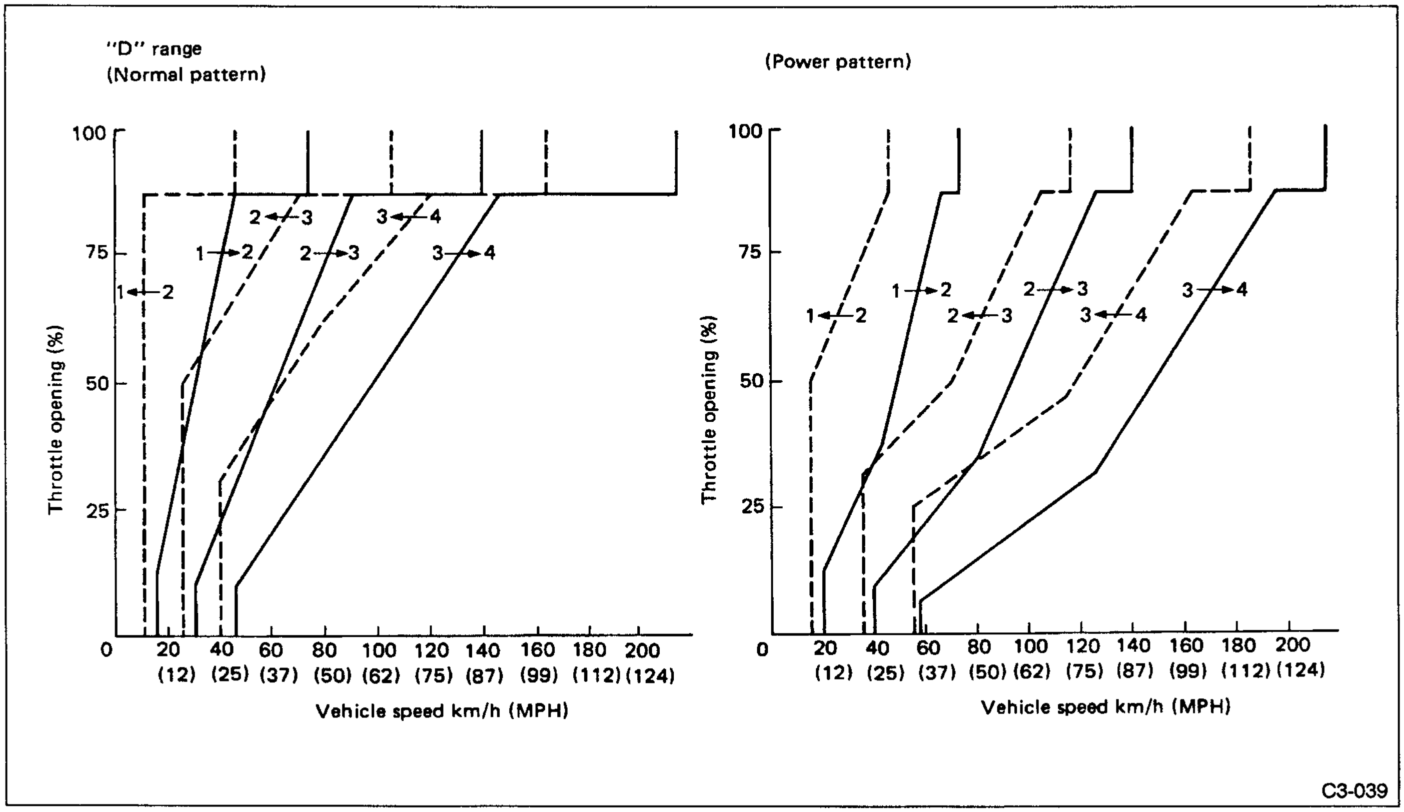



*Fig. 63*

① Normal pattern to power pattern

| Selector lever | D, 3, 2 range |
|---|---|
| Accelerator depression speed | Greater than set value |

Depending on throttle opening and vehicle speed, 16 areas as shown in the figure are set. Accelerator depression speed for pattern changeover is set for each area. When the accelerator depression speed exceeds this set value, the pattern changes from normal to power. This happens for the 3 or 2 range, only when the manual switch is OFF.

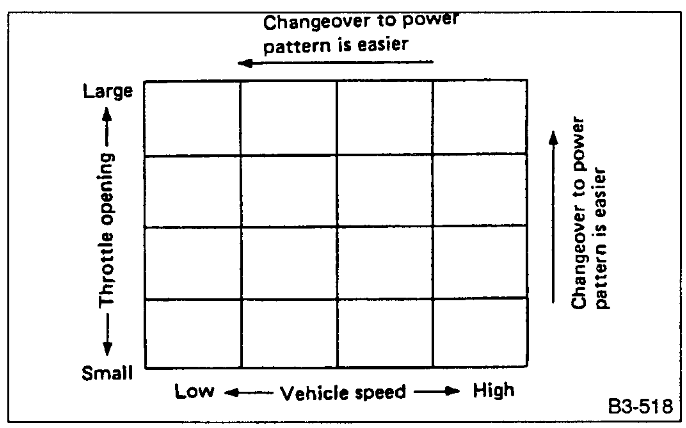



*Fig. 64*

② Power pattern to normal pattern
The power pattern is shifted to the normal pattern, depending on car speed. Shifting to the normal pattern is determined by the throttle position as shown in Figure below. Time lag in shifting is also determined by car speed. The maximum time lag is 3 seconds.

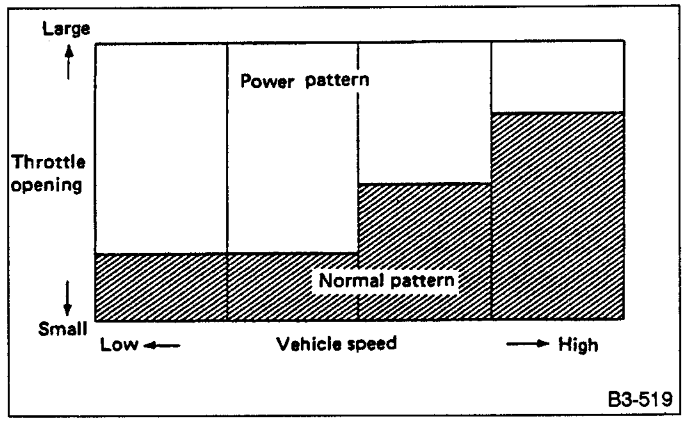



*Fig. 65*

## 7. ENGINE BRAKE CONTROL

The TCU controls the shift solenoid corresponding to such input signals as throttle opening, vehicle speed, shift range, and cruise control signals to automatically control the operation of the overrunning clutch and for positive application of engine brake.
1) In range D or 3, the overrunning clutch is kept inoperative by the action of the shuttle shift valve when the throttle opening is large. With small throttle valve opening, the overrunning clutch is engaged by the action of shift solenoid 3.
2) In range 2, the overrunning clutch is engaged by the operation of shift solenoid 3.
3) In range 1, the overrunning clutch is engaged irrespective of the operation of shift solenoid 3.

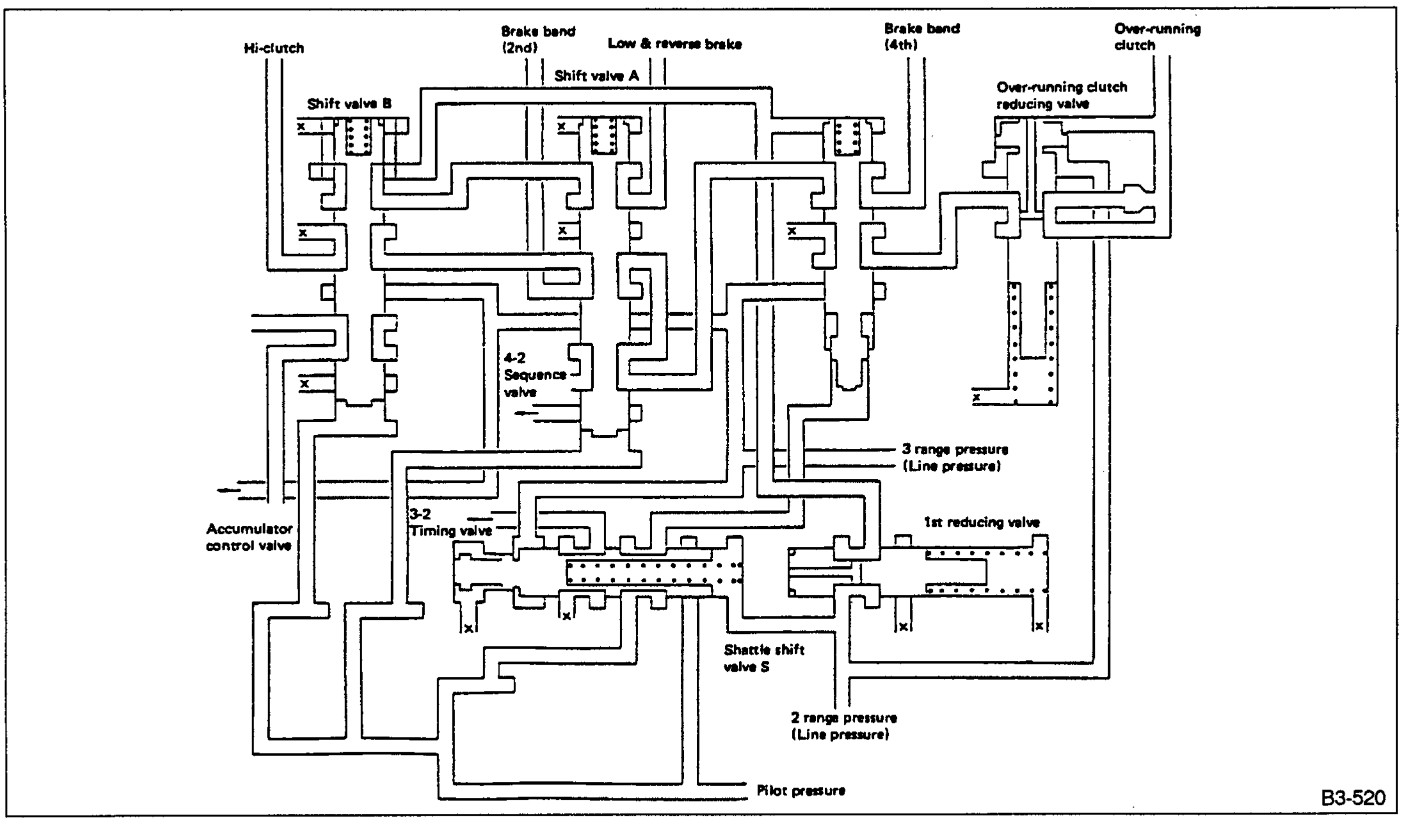
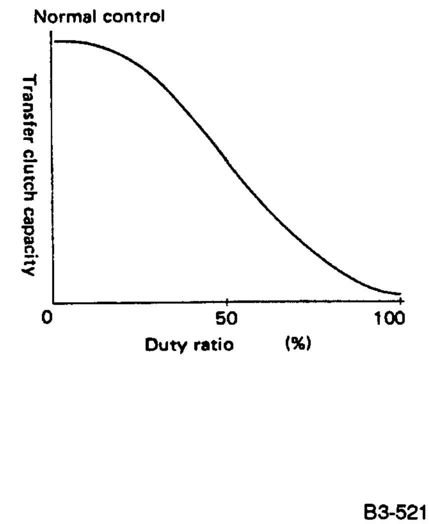



*Fig. 66*

## 8. 4WD TRANSFER CLUTCH CONTROL

| | | Type of control | Gear position | Remarks |
|---|---|---|---|---|
| 1 | Basic control | Regulates transfer oil pressure in response to throttle position and vehicle speed. | 1st thru 4th and reverse |  <br>*Fig. 67* |
| 2 | Control in 1st range | Increases transfer oil pressure (as compared with basic control 1 .) | 1st | |
| 3 | Control during "slip" detection | Returns transfer oil pressure to the same as in 1st range immediately after "slip" detection. | 1st thru 4th and reverse | Release:<br>At more than set vehicle speed and fully closed throttle |
| 4 | Control in turns | Decreases transfer oil pressure upon detection of vehicle turns. | 1st thru 4th and reverse | — |

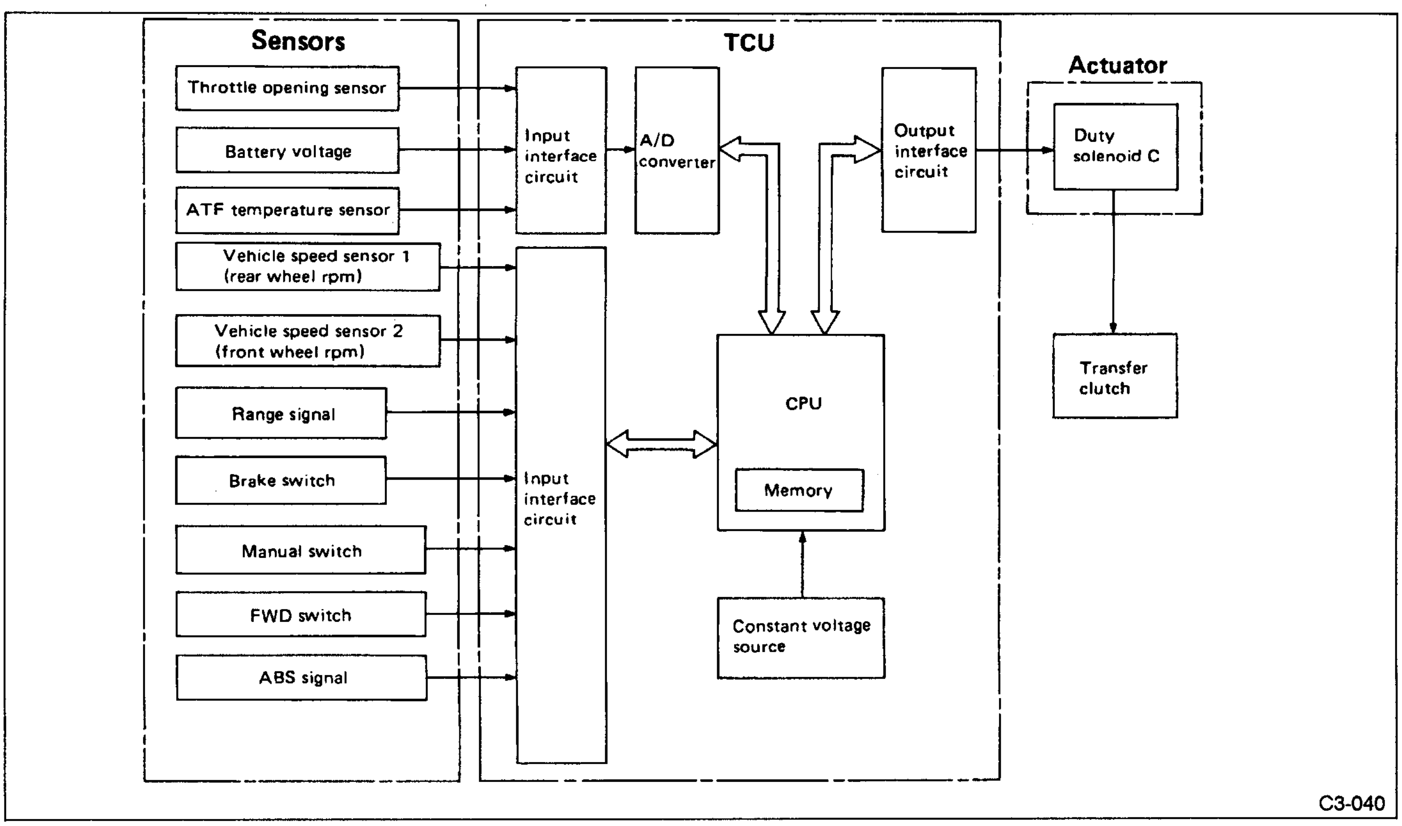



*Fig. 68*

● Transfer control

The transfer hydraulic pressure control unit is fitted with the transfer valve body attached to the side face of the extension case via gasket and separate plate.

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

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

(1) The line pressure regulated to a proper pressure corresponding to the driving condition is further regulated to a constant pilot pressure by the transfer pilot valve.

(2) The pilot pressure is regulated to the transfer duty pressure by the duty solenoid C whose duty ratio is controlled by the TCU corresponding to the driving condition. (The transfer duty pressure varies with the degree of duty control.)

(3) The transfer duty pressure is applied to the transfer control valve.

(4) The line pressure is led also to the transfer control valve where the pressure is regulated to the transfer clutch pressure by the transfer duty pressure. (The transfer clutch pressure varies with the transfer duty pressure.)

(5) The transfer clutch pressure is applied to the transfer clutch and causes the clutch to be engaged.

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

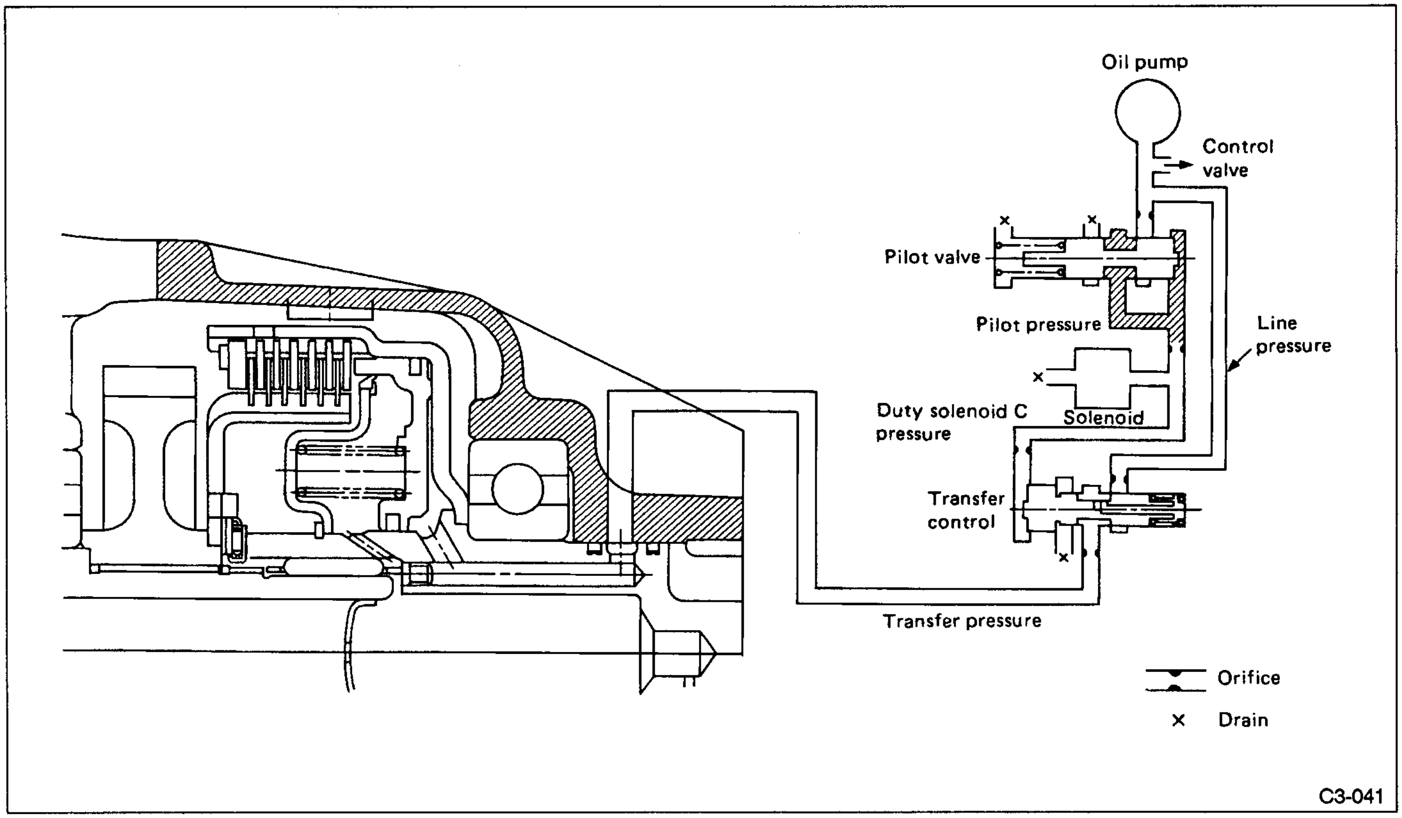



*Fig. 69*

# 23. Self-diagnosis System

## 1. FUNCTION

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

① Vehicle speed sensor 1
② Vehicle speed sensor 2
③ Throttle sensor
④ Shift solenoid 1
⑤ Shift solenoid 2
⑥ Shift solenoid 3
⑦ Duty solenoid B
⑧ Duty solenoid C
⑨ ATF temperature sensor
⑩ Ignition pulse
⑪ Duty solenoid A
⑫ Atmospheric pressure sensor

The results of self-diagnosis are displayed by flashing power indicator lamp.

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

## 2. OPERATION OF INDICATOR LAMP

If trouble occurs in any of the self-diagnosis items, the following display appears on the power indicator only once directly after starting the engine.

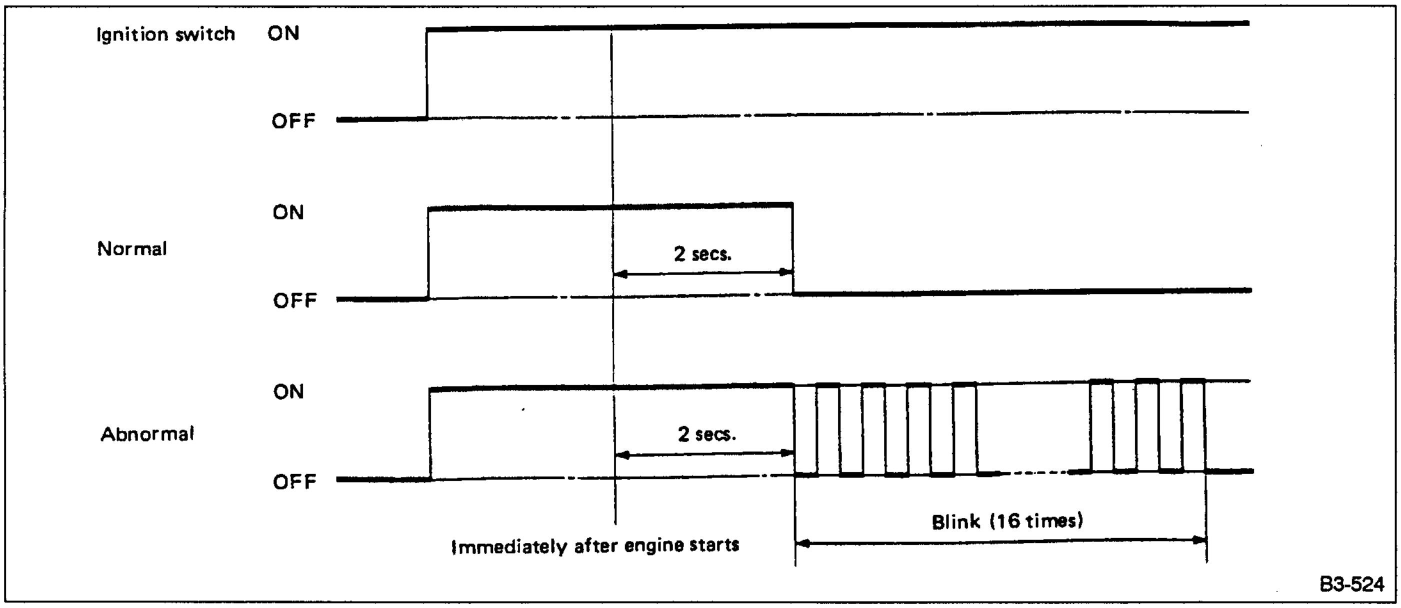



*Fig. 70*

### 3. TROUBLE CODE

| TROUBLE CODE | ITEM |
|---|---|
| 11 | Duty solenoid A |
| 12 | Duty solenoid B |
| 13 | Shift solenoid 3 |
| 14 | Shift solenoid 2 |
| 15 | Shift solenoid 1 |
| 21 | ATF temperature sensor |
| 22 | Atmospheric sensor |
| 23 | Engine revolution signal |
| 24 | Duty solenoid C |
| 25 | Engine torque control signal |
| 31 | Throttle sensor |
| 32 | Vehicle speed sensor 1 |
| 33 | Vehicle speed sensor 2 |

### 4. SELECT MONITOR

Various data and ON/OFF signals being processed in the TCU can be monitored by connecting the select monitor to the select monitor terminal located under the instrument panel. The trouble codes of the present and past problems can be indicated using a particular code.
Function Mode

| Function mode | Description | Abbrev. | Unit |
|---|---|---|---|
| 01 | Source voltage | VB | V |
| 02 | Rear wheel speed | VSP 1 | m/h |
| 03 | Rear wheel speed | VSP 1 | km/h |
| 04 | Front wheel speed | VSP 2 | m/h |
| 05 | Front wheel speed | VSP 2 | km/h |
| 06 | Engine rpm | EREV | rpm |
| 07 | ATF temperature | ATFT | °F |
| 08 | ATF temperature | ATFT | °C |
| 09 | Throttle opening | THSEN | V |
| 10 | Gear position | GEAR | GEAR |
| 11 | Line pressure duty | PLDTY | % |
| 12 | Lock-up duty | LUDTY | % |
| 13 | AWD duty | 4WDTY | % |
| 14 | Atmospheric pressure sensor | BARO.P | mmHg |

# 24. Fail-safe Function

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

1) Vehicle speed sensor

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

2) Throttle sensor

If throttle sensor becomes faulty, throttle will be set to the predetermined position.

3) Inhibitor switch

If two signals are inputted due to inhibitor switch failure, the vehicle can be driven under the following priority.

D 〉 N (P) R 3 2 1

4) Shift sol. 1 and 2

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

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

5) Shift sol. 3 (Overrunning clutch)

If the overrunning clutch solenoid fails, the solenoid is turned OFF. The overrunning clutch will engage so that the engine brake will be applied when reducing vehicle speed.

6) Duty sol. A (Line pressure)

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

7) Duty sol. B (Lock-up)

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

8) Duty sol. C (Transfer)

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

# S SPECIFICATIONS AND SERVICE DATA

## A: SPECIFICATIONS

| | | | | |
|---|---|---|---|---|
| Torque converter | Type | | Symmetric, 3-element, single stage, 2 phase torque converter coupling | |
| | Stall torque ratio | | 1.85 — 1.95 | |
| | Nominal diameter | | 246 mm (9.69 in) | |
| | Stall speed (at sea level) | | 2,350 — 2,750 rpm | |
| | One-way clutch | | Sprague type one-way clutch | |
| Automatic transmission | Transmission | Type | 4-forward, 1-reverse, double-row planetary gears | |
| | | Control element | Multi-plate clutch | 4 sets |
| | | | Multi-plate brake | 1 set |
| | | | Band brake | 1 set |
| | | | One-way clutch (sprag type) | 2 sets |
| | | Gear ratio | 1st | 2.785 |
| | | | 2nd | 1.545 |
| | | | 3rd | 1.000 |
| | | | 4th | 0.694 |
| | | | Reverse | 2.272 |
| | | Tooth number of planetary gear | Front sun gear | 33 |
| | | | Front pinion | 21 |
| | | | Front internal gear | 75 |
| | | | Rear sun gear | 42 |
| | | | Rear pinion | 17 |
| | | | Rear internal gear | 75 |

| | | | | |
|---|---|---|---|---|
| Automatic transmission | Transmission | Selector position | P (Park) | Transmission in neutral, output member immovable, and engine start possible |
| | | | R (Reverse) | Transmission in reverse for backing |
| | | | N (Neutral) | Transmission in neutral, and engine start possible |
| | | | D (Drive) | Automatic gear change 1st ⇄ 2nd ⇄ 3rd ⇄ 4th |
| | | | 3 (3rd) | Automatic gear change 1st ⇄ 2nd ⇄ 3rd ← 4th |
| | | | 2 (2nd) | Automatic gear change 1st ⇄ 2nd ← 3rd ← 4th |
| | | | 1 (1st) | 1st gear locked (Deceleration 4th → 3rd → 2nd → 1st possible) |
| | | Control method | Hydraulic remote control | |
| | Oil pump | Type | Variable-capacity type vane pump | |
| | | Driving method | Driven by engine | |
| | | Number of vanes | 9 pieces | |
| | Hydraulic control | Type | Electronic/hydraulic control [Four forward speed changes by electrical signals of car speed and accelerator (throttle) opening] | |
| | | Fluid | Automatic transmission fluid (ATF) DEXRON II | |
| | | Fluid capacity | AWD: 9.5 ℓ (10.0 US qt, 8.4 Imp qt) | |
| | Lubrication | Lubrication system | Forced feed lubrication with oil pump | |
| | | Oil | Automatic transmission fluid (above-mentioned) | |
| | Cooling | Cooling system | Liquid-cooled cooler incorporated in radiator | |
| | Harness | Inhibitor switch | 12 poles | |
| | | Transmission harness | poles | AWD ... 13 |
| | Transfer | Transfer clutch | Hydraulic multi-plate clutch | |
| | | Control method | Electronic, hydraulic type | |
| | | Lubricant | The same Automatic transmission fluid used in Automatic transmission | |
| | | 1st reduction gear ratio | 1.000 (47/47) | |
| Final reduction | Final gear ratio | Front drive | AWD: 3.545 (39/11) | |
| | | Rear drive | AWD: 3.545 (39/11) | |
| | Speedometer gear ratio | | AWD: 0.8 (20/25) | |
| | Lubrication oil | | API, GL-5 | |
| | Oil capacity | Front drive | 1.2 ℓ (1.3 US qt, 1.1 Imp qt) | |
| | | Rear drive | 0.8 ℓ (0.8 US qt, 0.7 Imp qt) | |
| ATF cooling system | Radiation capacity | | 2.163 kW (1,860 kcal/h, 7,380 BTU/h) | |

## B: ADJUSTING PARTS

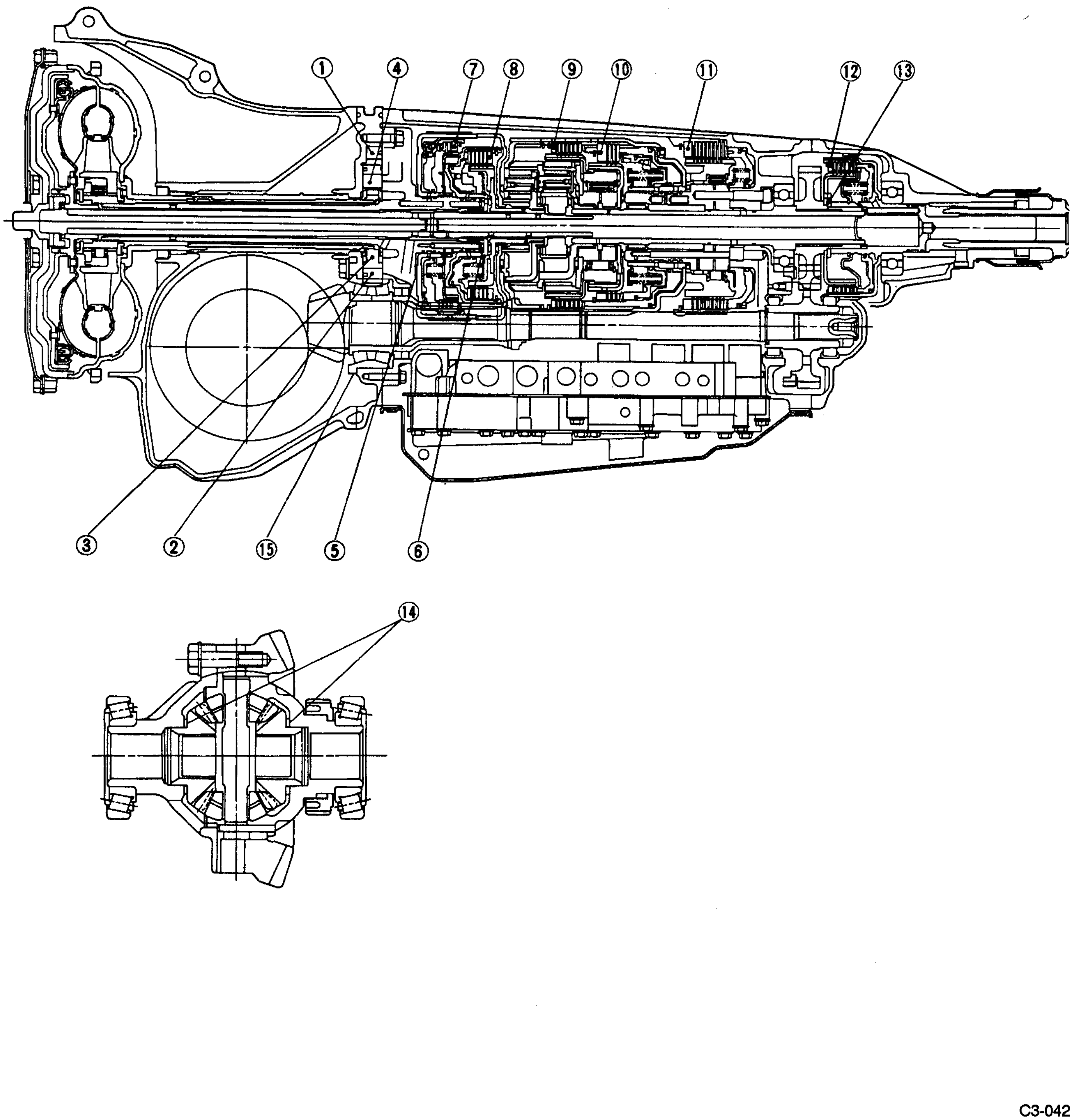
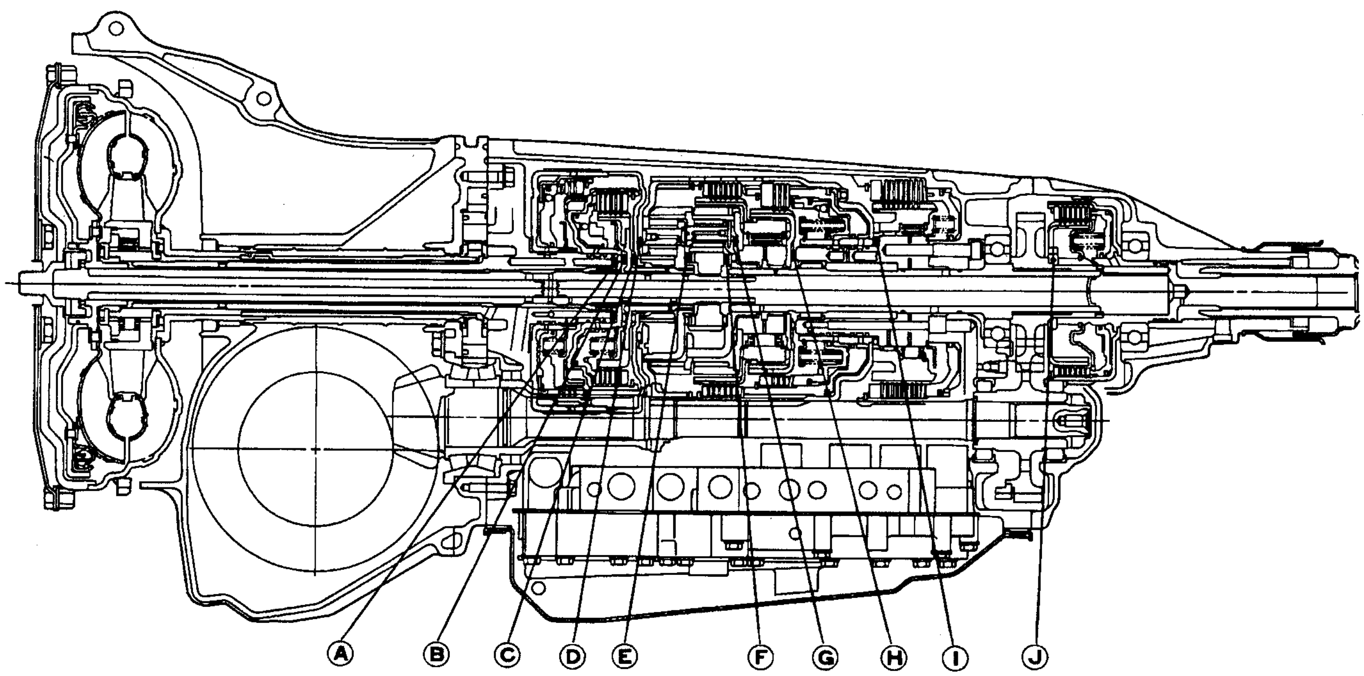



*Fig. 71*

| No. | Part Name | Part Number | Dimension mm (in) | Application |
|---|---|---|---|---|
| 1 | CONTROL PISTON | 31235AA000 — 030 | $13.5^{-0.030}_{-0.037}$ ($0.5315^{-0.0012}_{-0.0015}$), $13.5^{-0.023}_{-0.030}$ ($0.5315^{-0.0009}_{-0.0012}$),<br>$13.5^{-0.016}_{-0.023}$ ($0.5315^{-0.0006}_{-0.0009}$), $13.5^{-0.009}_{-0.016}$ ($0.5315^{-0.0004}_{-0.0006}$) | Adjusting side clearance of oil pump |
| 2 | CAM RING | 31241AA000 — 030 | $17^{-0.010}_{-0.017}$ ($0.6693^{-0.0004}_{-0.0007}$), $17^{-0.003}_{-0.010}$ ($0.6693^{-0.0001}_{-0.0004}$),<br>$17^{+0.004}_{-0.003}$ ($0.6693^{+0.0002}_{-0.0001}$), $17^{+0.011}_{+0.004}$ ($0.6693^{+0.0004}_{+0.0002}$) | Adjusting side clearance of oil pump |
| 3 | VANE (Oil pump) | 31243AA000 — 030 | $17^{-0.030}_{-0.037}$ ($0.6693^{-0.0012}_{-0.0015}$), $17^{-0.023}_{-0.030}$ ($0.6693^{-0.0009}_{-0.0012}$),<br>$17^{-0.016}_{-0.023}$ ($0.6693^{-0.0006}_{-0.0009}$), $17^{+0.016}_{+0.009}$ ($0.6693^{+0.0006}_{+0.0004}$) | Adjusting side clearance of oil pump |
| 4 | ROTOR (Oil pump) | 31240AA000 — 030 | $17^{-0.030}_{-0.037}$ ($0.6693^{-0.0012}_{-0.0015}$), $17^{-0.023}_{-0.030}$ ($0.6693^{-0.0009}_{-0.0012}$),<br>$17^{-0.016}_{-0.023}$ ($0.6693^{-0.0006}_{-0.0009}$), $17^{+0.016}_{+0.009}$ ($0.6693^{+0.0006}_{+0.0004}$) | Adjusting side clearance of oil pump |
| 5 | THRUST WASHER (Reverse clutch) | 31299AA000 — 060 | 0.7, 0.9, 1.1, 1.3, 1.5, 1.7, 1.9<br>(0.028, 0.035, 0.043, 0.051, 0.059, 0.067, 0.075) | Adjusting end play of reverse clutch drum |
| 6 | BEARING RANGE | 803031021 — 27 | 0.8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0<br>(0.031, 0.039, 0.047, 0.055, 0.063, 0.071, 0.079) | Adjusting total end play |
| 7 | RETAINING PLATE | 31567AA000, 020 — 050 | 4.6, 4.8, 5.0, 5.2, 5.4 (0.181, 0.189, 0.197, 0.205, 0.213) | Adjusting clearance of reverse clutch |
| 8 | RETAINING PLATE | 31567AA190 — 260 | 3.6, 3.8, 4.0, 4.2, 4.4, 4.6, 4.8, 5.0<br>(0.142, 0.150, 0.157, 0.165, 0.173, 0.181, 0.189, 0.197) | Adjusting clearance of high clutch |
| 9 | RETAINING PLATE | 31567AA010, 060 — 110 | 8.0, 8.2, 8.4, 8.6, 8.8, 9.0, 9.2<br>(0.315, 0.323, 0.331, 0.339, 0.346, 0.354, 0.362) | Adjusting clearance of forward clutch |
| 10 | RETAINING PLATE | 31567AA120 — 180 | 8.0, 8.2, 8.4, 8.6, 8.8, 9.0, 9.2<br>(0.315, 0.323, 0.331, 0.339, 0.346, 0.354, 0.362) | Adjusting clearance of overrunning clutch |
| 11 | RETAINING PLATE No. 2 | 31667AA180 — 250 | 6.5, 6.8, 7.1, 7.4, 7.7, 8.0, 8.2, 8.4<br>(0.256, 0.268, 0.280, 0.291, 0.303, 0.315, 0.323, 0.331) | Adjusting clearance of low & reverse clutch |
| 12 | PRESSURE PLATE (Front) | 31593AA150 — 180 | 3.3, 3.7, 4.1, 4.5<br>(0.130, 0.146, 0.161, 0.177) | Adjusting clearance of transfer clutch |
| 13 | THRUST BEARING (35 x 53 x T) | 806535020 — 090 | 3.8, 4.0, 4.2, 4.4, 4.6, 4.8, 5.0<br>(0.150, 0.157, 0.165, 0.173, 0.181, 0.189, 0.197) | Adjusting end play of transfer clutch |
| 14 | WASHER (38.1 x 50 x T) | 803038021 — 023 | 0.95, 1.00, 1.05<br>(0.0374, 0.0394, 0.0413) | Adjusting backlash of differential bevel gear |
| 15 | DRIVE PINION SHIM | 31451AA050 — 100 | 0.15, 0.175, 0.2, 0.225, 0.275, 1.25<br>(0.0059, 0.0069, 0.008, 0.0089, 0.0108, 0.0492) | Adjusting drive pinion height |

## C: LOCATION AND INSTALLING DIRECTION OF THRUST NEEDLE BEARING AND WASHER



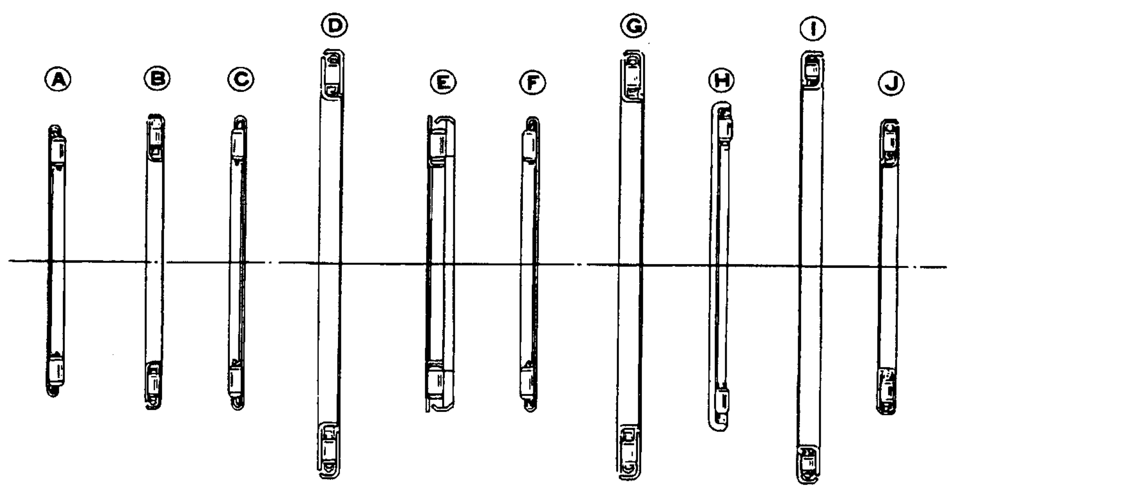
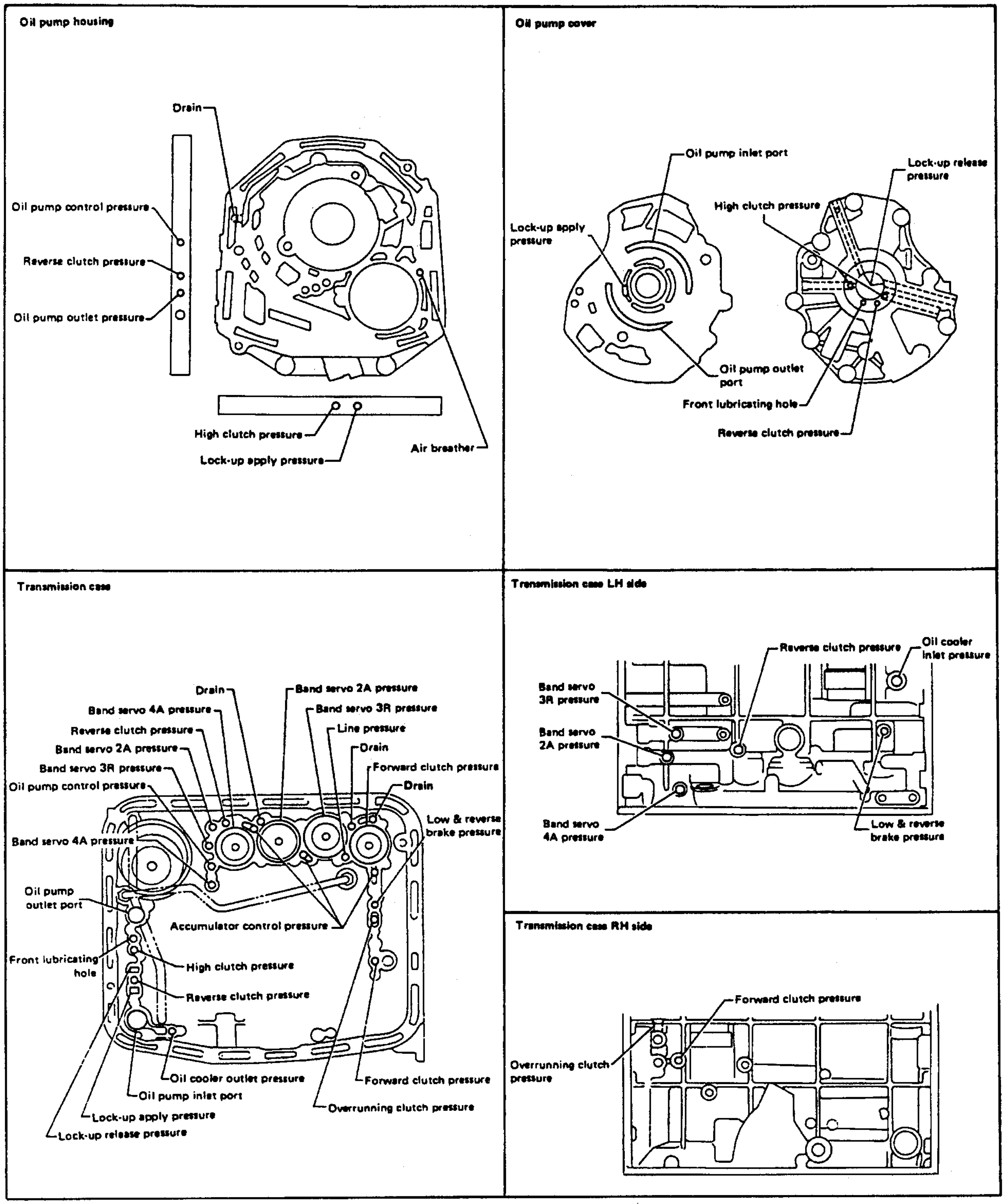



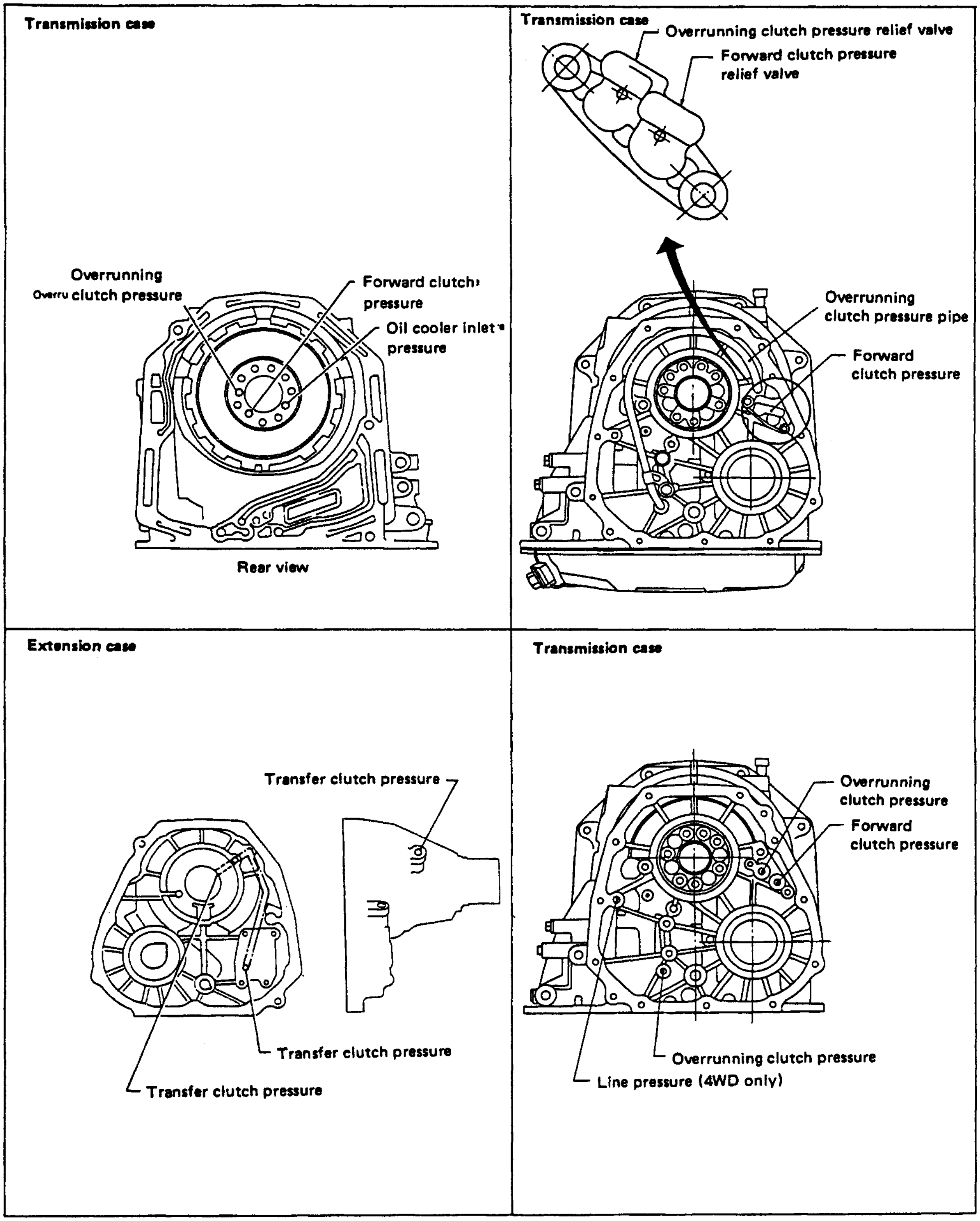

Fig. 72

## D: FLUID PASSAGES




B3-527

*Fig. 73*

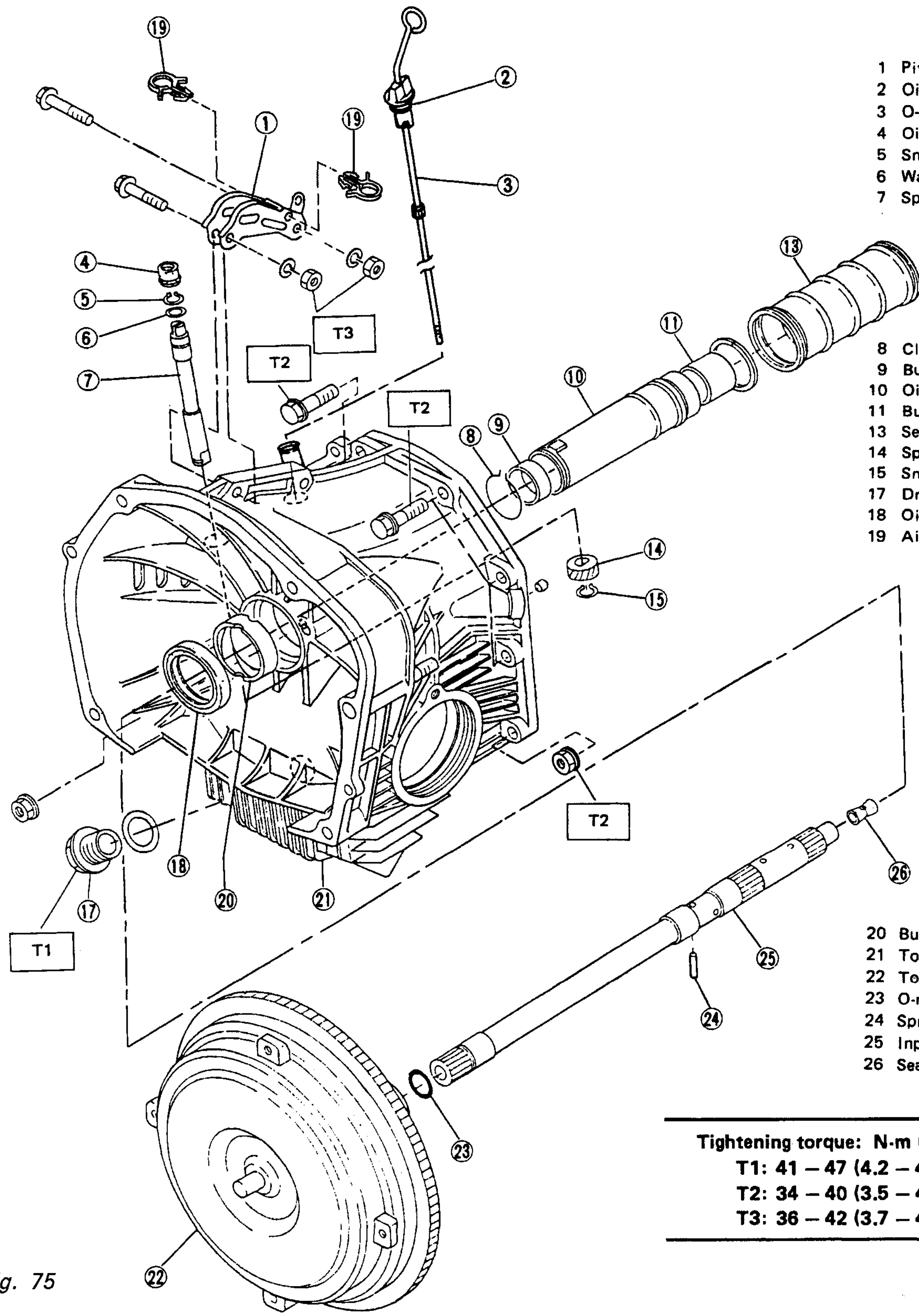

Transmission case
Overrunning
clutch pressure
Forward clutch
pressure
Oil cooler inlet
pressure
Rear view
Transmission case
Overrunning clutch pressure relief valve
Forward clutch pressure
relief valve
Overrunning
clutch pressure pipe
Forward
clutch pressure
Extension case
Transfer clutch pressure
Transfer clutch pressure
Transfer clutch pressure
Transmission case
Overrunning
clutch pressure
Forward
clutch pressure
Overrunning clutch pressure
Line pressure (4WD only)

B3-528

*Fig. 74*

# C COMPONENT PARTS

## 1. Torque Converter and Converter Case




1 Pitching stopper bracket
2 Oil level gauge
3 O-ring
4 Oil seal
5 Snap ring
6 Washer
7 Speedometer shaft
8 Clip
9 Bushing
10 Oil pump shaft
11 Bushing
13 Seal pipe
14 Speedometer driven gear
15 Snap ring
17 Drain plug
18 Oil seal
19 Air breather hose clip
20 Bushing
21 Torque converter case
22 Torque converter
23 O-ring
24 Spring pin
25 Input shaft
26 Seal

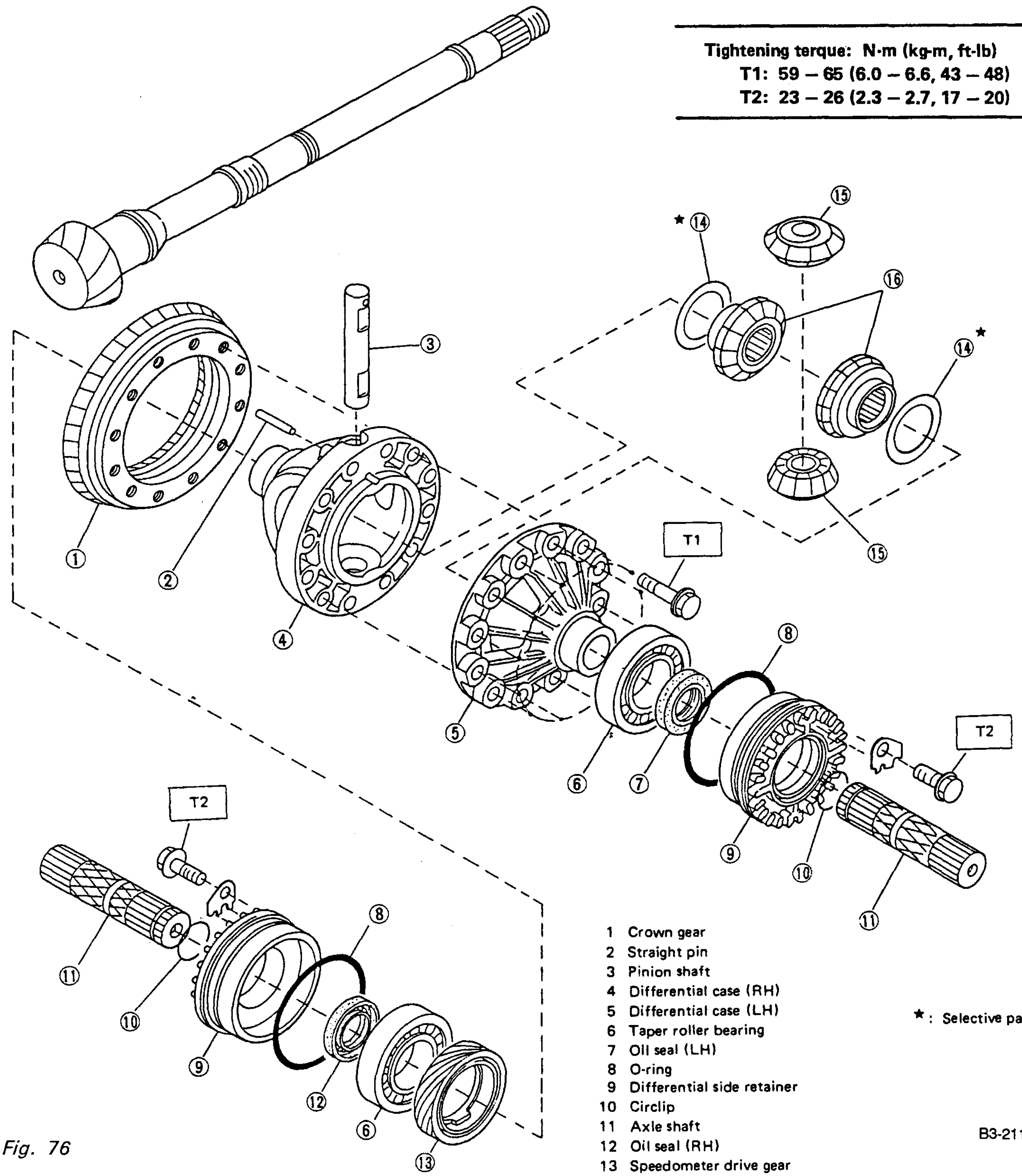
**Tightening torque: N·m (kg-m, ft-lb)**
**T1: 41 – 47 (4.2 – 4.8, 30 – 35)**
**T2: 34 – 40 (3.5 – 4.1, 25 – 30)**
**T3: 36 – 42 (3.7 – 4.3, 27 – 31)**

C3-044

*Fig. 75*

## 2. Differential Case

Tightening torque: N·m (kg-m, ft-lb)
T1: 59 – 65 (6.0 – 6.6, 43 – 48)
T2: 23 – 26 (2.3 – 2.7, 17 – 20)

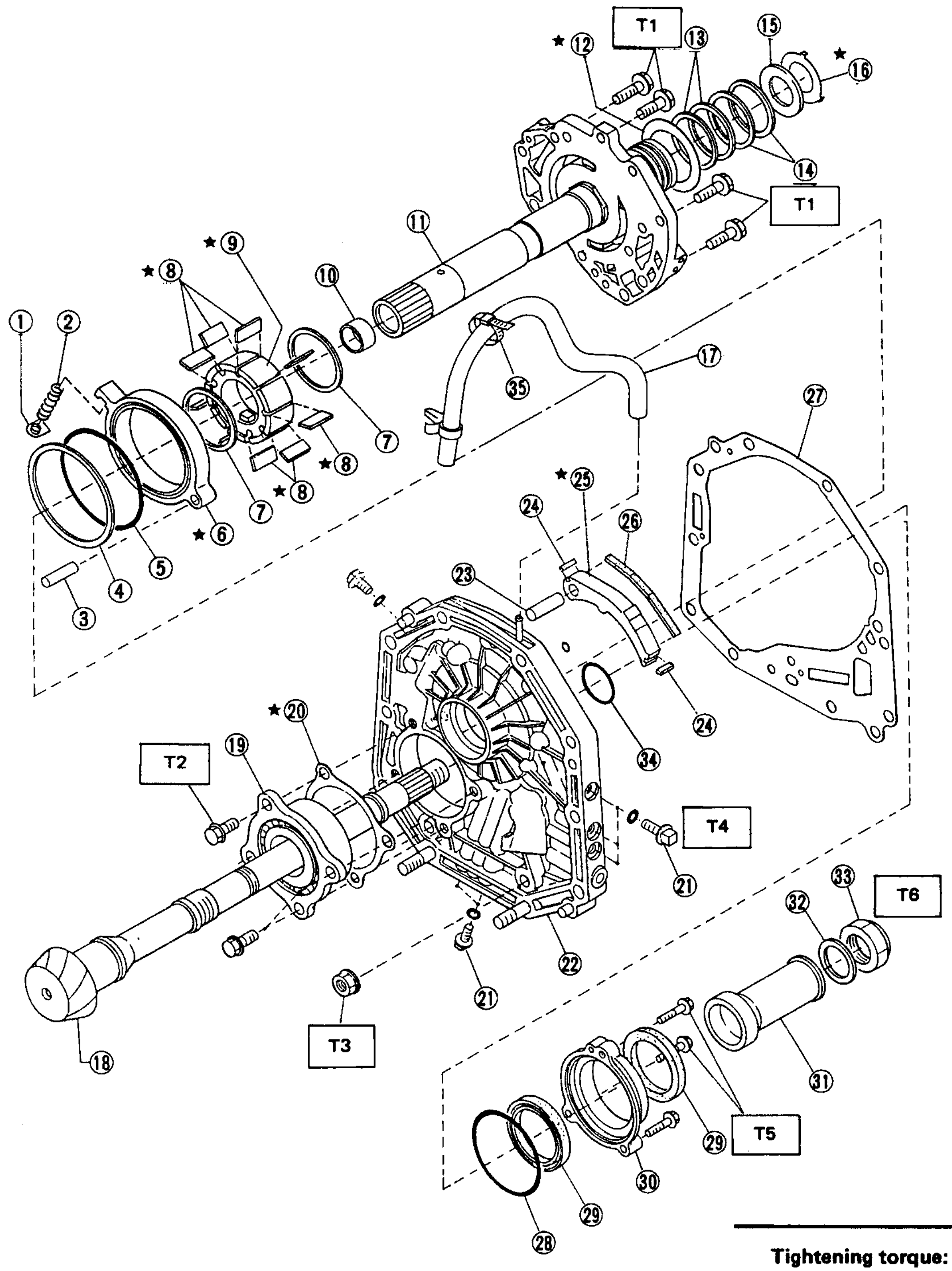



1 Crown gear
2 Straight pin
3 Pinion shaft
4 Differential case (RH)
5 Differential case (LH)
6 Taper roller bearing
7 Oil seal (LH)
8 O-ring
9 Differential side retainer
10 Circlip
11 Axle shaft
12 Oil seal (RH)
13 Speedometer drive gear
★14 Washer
15 Differential bevel pinion
16 Differential bevel gear

★: Selective parts

*Fig. 76*

# 3. Oil Pump




★: Selective parts

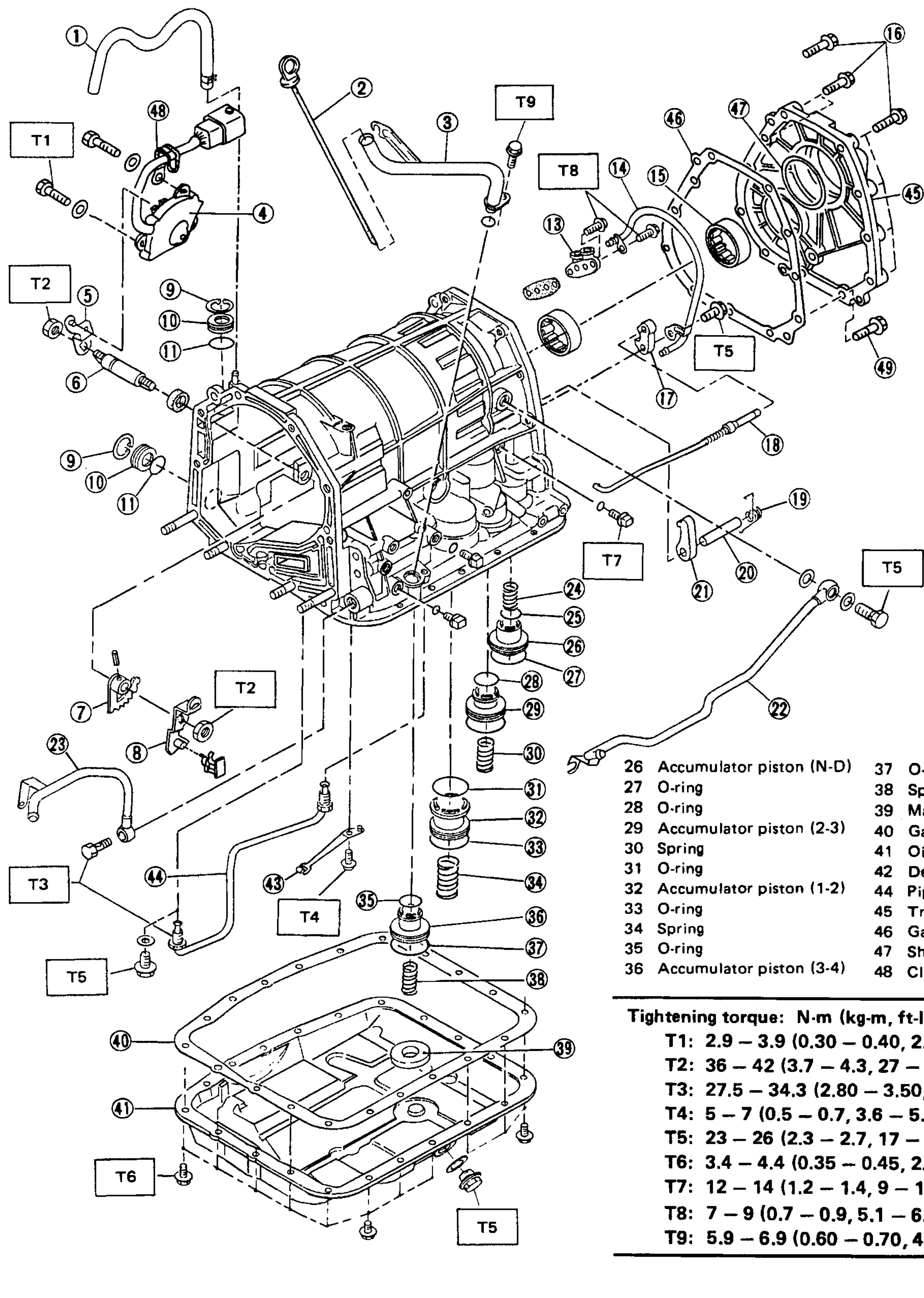
1 Retainer
2 Return spring
3 Pin
4 Friction ring
5 O-ring
★6 Cam ring
7 Vane ring
★8 Vane
★9 Rotor
10 Bushing
11 Oil pump cover
★12 Thrust washer
13 Seal ring (R)
14 Seal ring (H)
15 Thrust needle bearing
★16 Thrust washer
17 Air breather hose
18 Drive pinion shaft
19 Roller bearing
★20 Shim
21 Test plug
22 Oil pump housing
23 Pin
24 Side seal
★25 Control piston
26 Plane seal
27 Gasket
28 O-ring
29 Oil seal
30 Oil seal retainer
31 Drive pinion collar
32 Lock washer
33 Lock nut
34 O-ring
35 Band clip

**Tightening torque: N·m (kg-m, ft-lb)**
**T1: 23 – 26 (2.3 – 2.7, 17 – 20)**
**T2: 36 – 42 (3.7 – 4.3, 27 – 31)**
**T3: 38 – 44 (3.9 – 4.5, 28 – 33)**
**T4: 12 – 14 (1.2 – 1.4, 9 – 10)**
**T5: 6 – 8 (0.6 – 0.8, 4.3 – 5.8)**
**T6: 108 – 118 (11.0 – 12.0, 80 – 87)**

C3-098

*Fig. 77*

# 4. Transmission Case, Transmission Cover and Control Device



1 Air breather hose
2 Oil level gauge
3 Oil charge pipe
4 Inhibitor switch
5 Range select lever
6 Manual shaft
7 Manual plate
8 Manual lever
9 Snap ring
10 Plug
11 O-ring
12 Oil seal
13 Releaf valve
14 Pipe
15 Roller bearing
16 Flange bolt
17 Parking support
18 Parking rod
19 Return spring
20 Shaft
21 Parking pawl
22 Inlet pipe
23 Outlet pipe
24 Spring
25 O-ring
26 Accumulator piston (N-D)
27 O-ring
28 O-ring
29 Accumulator piston (2-3)
30 Spring
31 O-ring
32 Accumulator piston (1-2)
33 O-ring
34 Spring
35 O-ring
36 Accumulator piston (3-4)
37 O-ring
38 Spring
39 Magnet
40 Gasket
41 Oil pan
42 Detent spring
44 Pipe
45 Transmission cover
46 Gasket
47 Shim
48 Clip

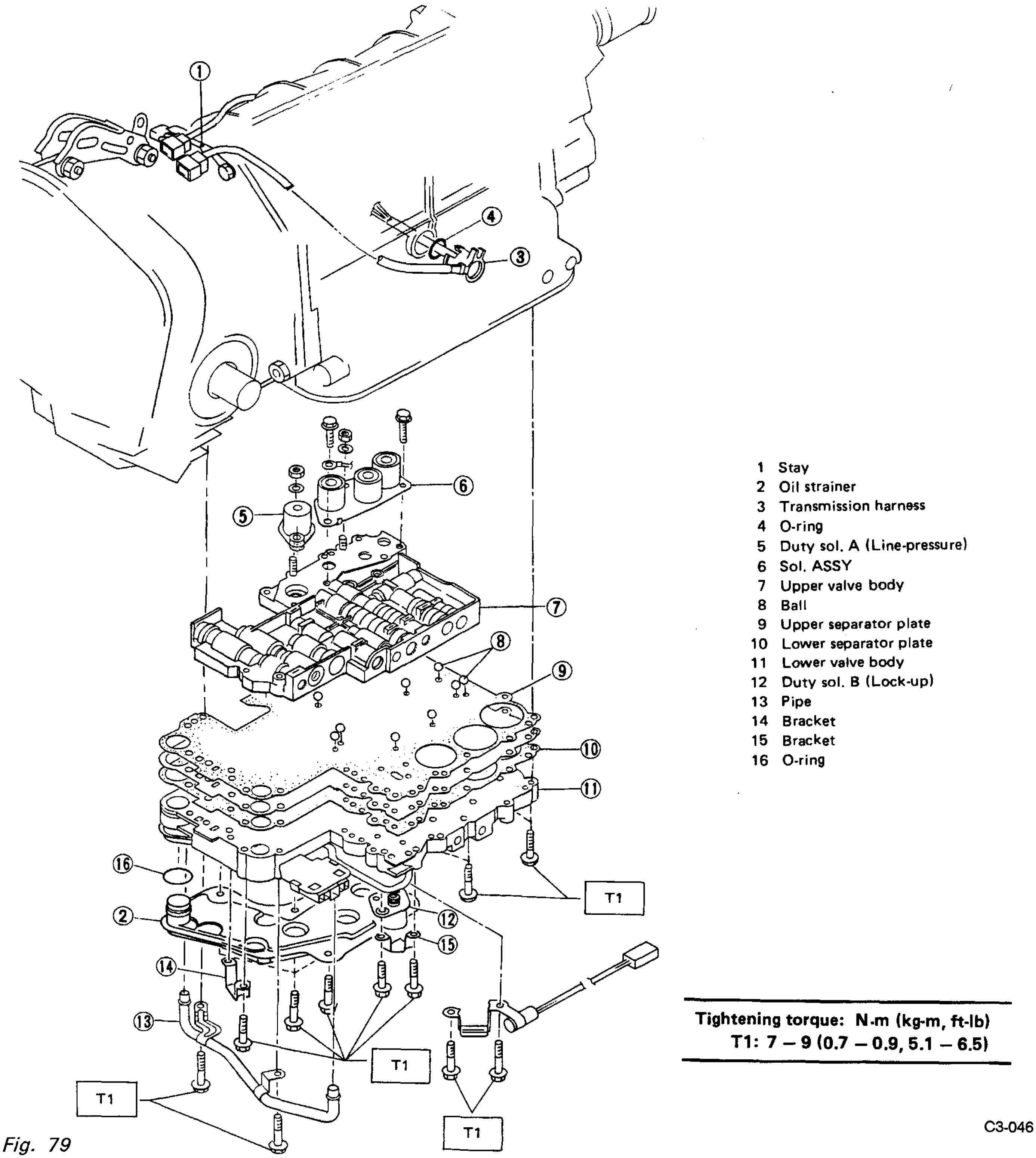
**Tightening torque: N·m (kg-m, ft-lb)**

**T1: 2.9 – 3.9 (0.30 – 0.40, 2.2 – 2.9)**
**T2: 36 – 42 (3.7 – 4.3, 27 – 31)**
**T3: 27.5 – 34.3 (2.80 – 3.50, 20.3 – 25.3)**
**T4: 5 – 7 (0.5 – 0.7, 3.6 – 5.1)**
**T5: 23 – 26 (2.3 – 2.7, 17 – 20)**
**T6: 3.4 – 4.4 (0.35 – 0.45, 2.5 – 3.3)**
**T7: 12 – 14 (1.2 – 1.4, 9 – 10)**
**T8: 7 – 9 (0.7 – 0.9, 5.1 – 6.5)**
**T9: 5.9 – 6.9 (0.60 – 0.70, 4.3 – 5.1)**

C3-045

*Fig. 78*

# 5. Control Valve and Harness Routing

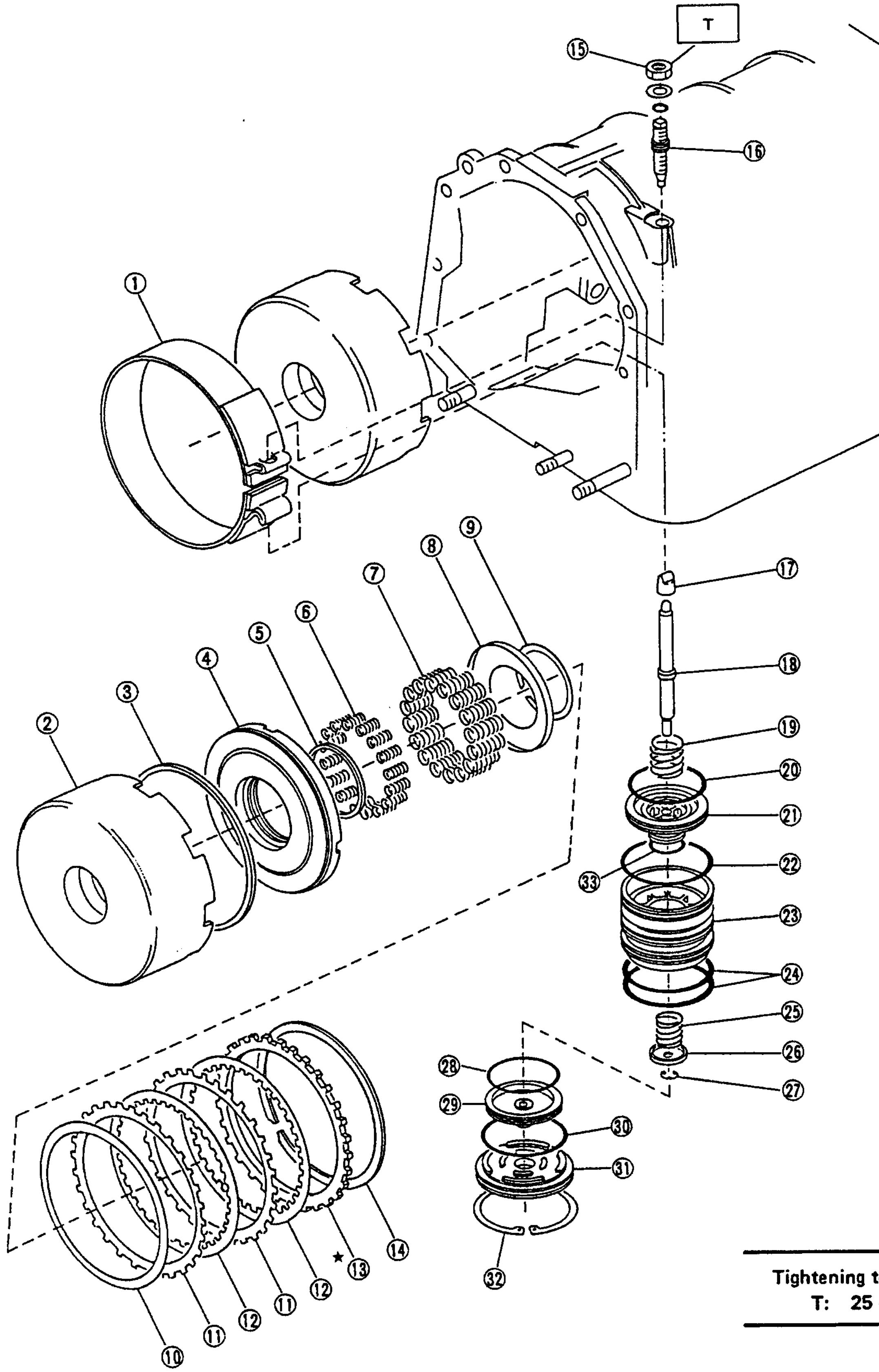



1 Stay
2 Oil strainer
3 Transmission harness
4 O-ring
5 Duty sol. A (Line-pressure)
6 Sol. ASSY
7 Upper valve body
8 Ball
9 Upper separator plate
10 Lower separator plate
11 Lower valve body
12 Duty sol. B (Lock-up)
13 Pipe
14 Bracket
15 Bracket
16 O-ring

**Tightening torque: N·m (kg-m, ft-lb)**
**T1: 7 – 9 (0.7 – 0.9, 5.1 – 6.5)**

*Fig. 79*

# 6. Reverse Clutch and Band Brake




★: Selective parts

1 Brake band
2 Reverse clutch drum
3 Lip seal
4 Piston
5 Lathe cut seal ring
6 Spring
7 Spring
8 Spring retainer
9 Snap ring
10 Dish plate
11 Driven plate
12 Drive plate
★13 Retaining plate
14 Snap ring
15 Lock nut
16 Brake band adjusting screw
17 Strut
18 Band servo piston stem
19 Spring
20 Lathe cut seal ring
21 Band servo piston (1-2)
22 O-ring
23 Retainer
24 O-ring
25 Spring
26 Retainer
27 Circlip
28 Lathe cut seal ring
29 Band servo piston (3-4)
30 O-ring
31 O.D. servo retainer
32 Snap ring
33 Lathe cut seal ring

Tightening torque: N·m (kg-m, ft-lb)
T: 25 – 28 (2.5 – 2.9, 18 – 21)

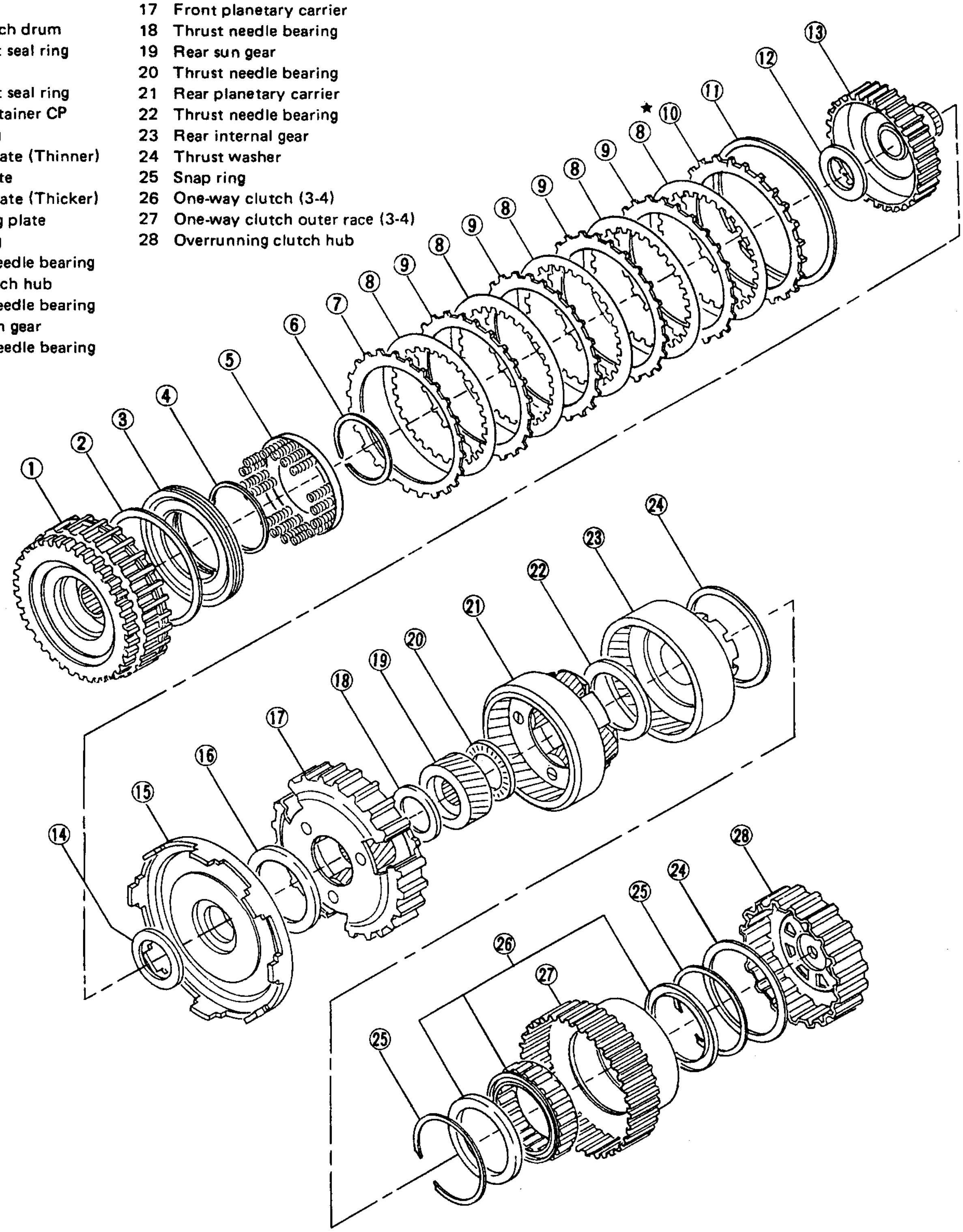
B3-215

*Fig. 80*

# 7. High Clutch and Planetary Gear

★: Selective parts

1 High clutch drum
2 Lathe cut seal ring
3 Piston
4 Lathe cut seal ring
5 Spring retainer CP
6 Snap ring
7 Driven plate (Thinner)
8 Drive plate
9 Driven plate (Thicker)
★10 Retaining plate
11 Snap ring
12 Thrust needle bearing
13 High clutch hub
14 Thrust needle bearing
15 Front sun gear
16 Thrust needle bearing
17 Front planetary carrier
18 Thrust needle bearing
19 Rear sun gear
20 Thrust needle bearing
21 Rear planetary carrier
22 Thrust needle bearing
23 Rear internal gear
24 Thrust washer
25 Snap ring
26 One-way clutch (3-4)
27 One-way clutch outer race (3-4)
28 Overrunning clutch hub



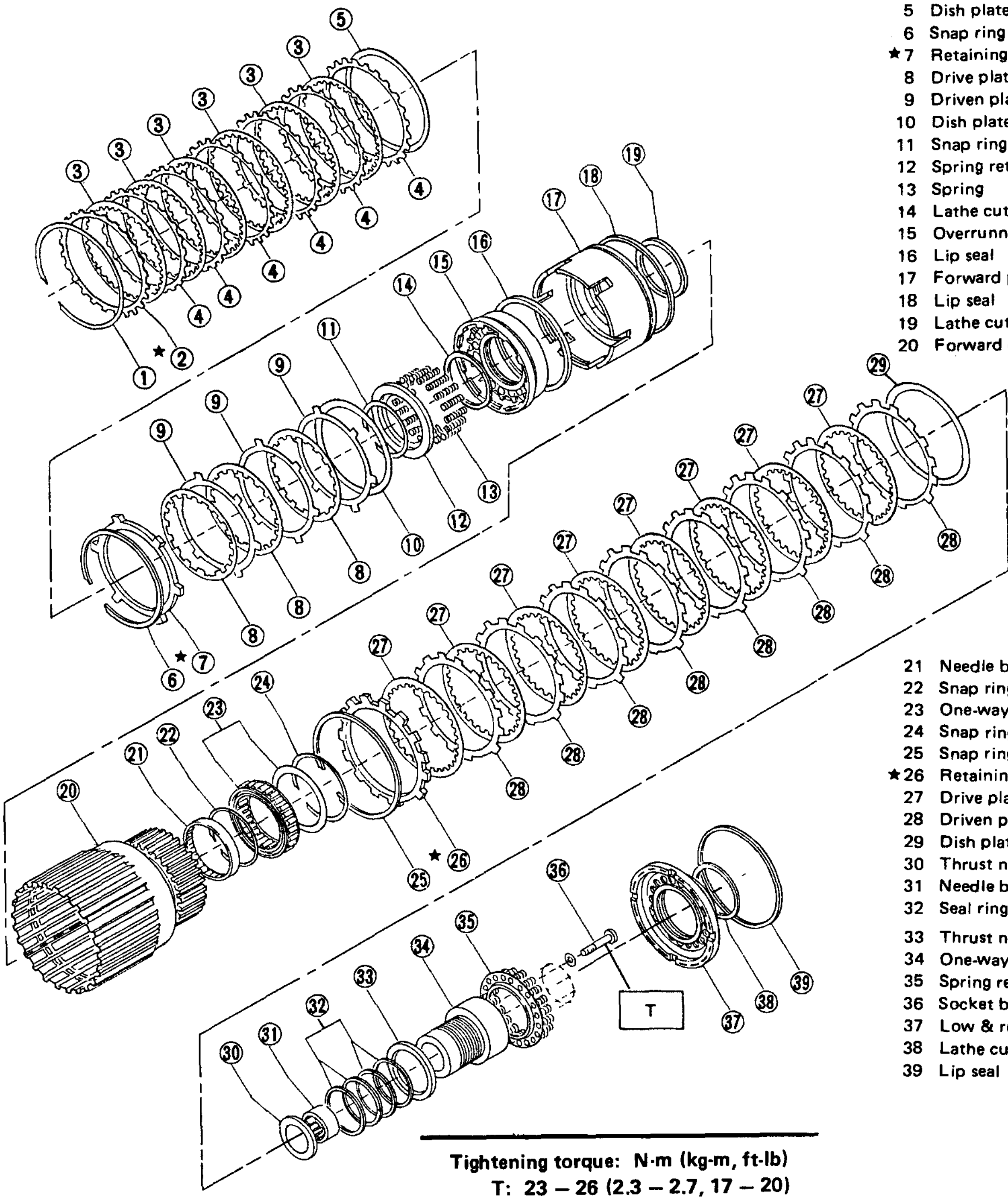
C3-047

*Fig. 81*

# 8. Forward Clutch and Low & Reverse Brake

★: Selective parts

1 Snap ring
★2 Retaining plate
3 Drive plate
4 Driven plate
5 Dish plate
6 Snap ring
★7 Retaining plate
8 Drive plate
9 Driven plate
10 Dish plate
11 Snap ring
12 Spring retainer
13 Spring
14 Lathe cut seal ring
15 Overrunning piston
16 Lip seal
17 Forward piston
18 Lip seal
19 Lathe cut seal ring
20 Forward clutch drum



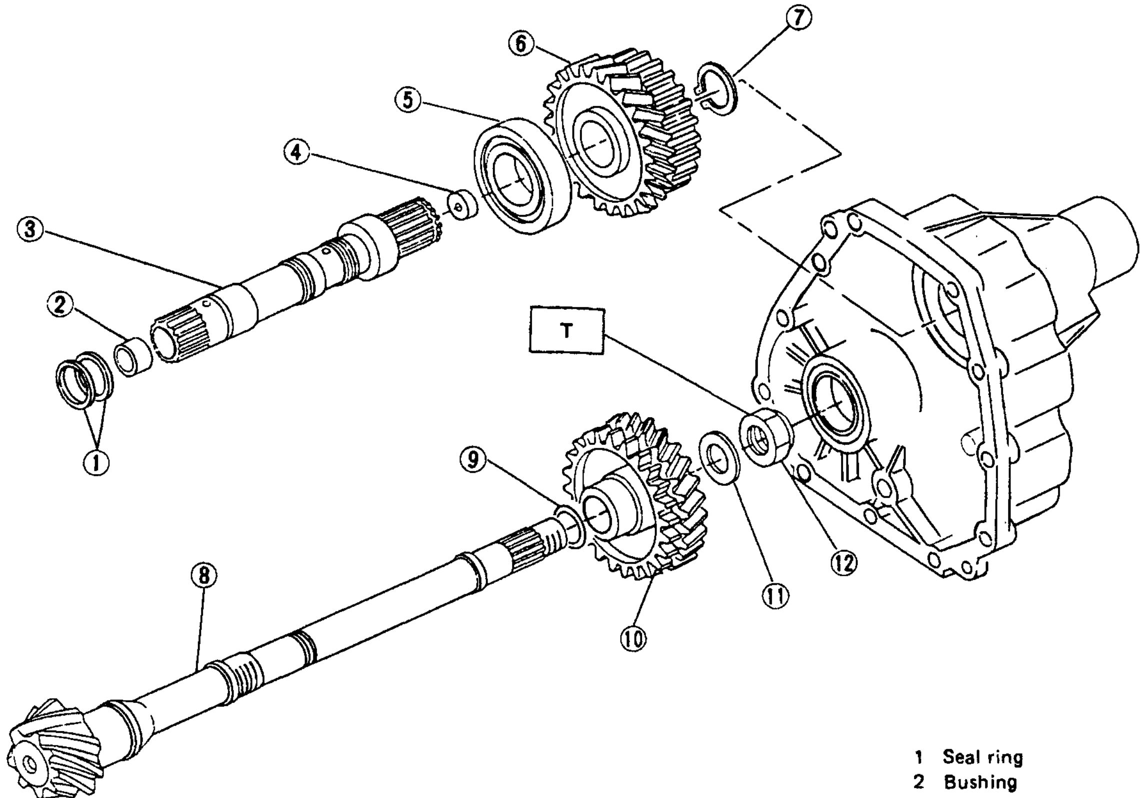

21 Needle bearing
22 Snap ring
23 One-way clutch (1-2)
24 Snap ring
25 Snap ring
★26 Retaining plate
27 Drive plate
28 Driven plate
29 Dish plate
30 Thrust needle bearing
31 Needle bearing
32 Seal ring
33 Thrust needle bearing
34 One-way clutch inner race (1-2)
35 Spring retainer CP
36 Socket bolt
37 Low & reverse piston
38 Lathe cut seal ring
39 Lip seal

**Tightening torque: N·m (kg-m, ft-lb)**
**T: 23 – 26 (2.3 – 2.7, 17 – 20)**

C3-048

*Fig. 82*

# 9. Reduction Gear



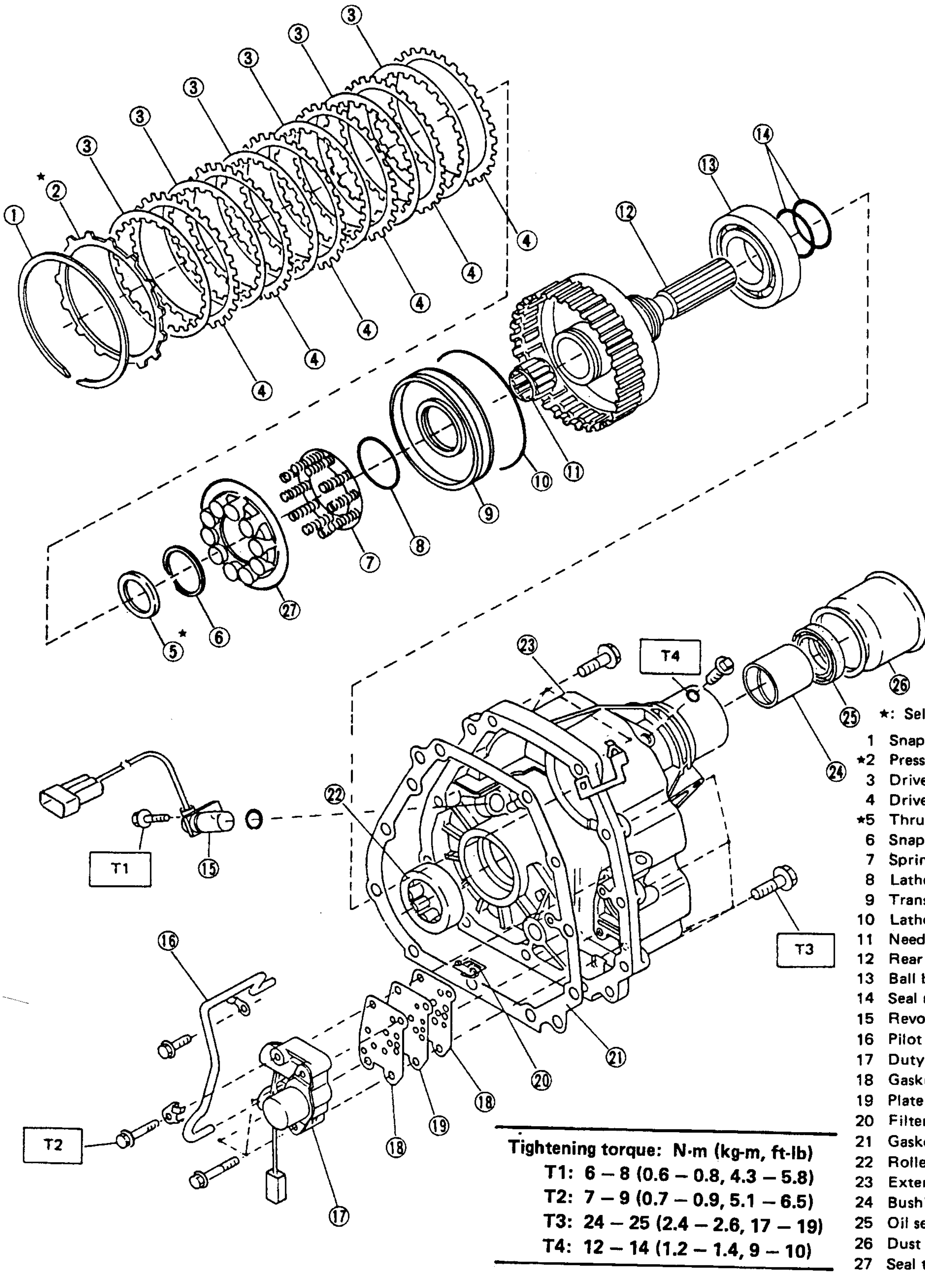

Tightening torque: N·m (kg-m, ft-lb)
T: 98±5 (10±0.5, 72.3±3.6)

1 Seal ring
2 Bushing
3 Reduction drive shaft
4 Plug
5 Ball bearing
6 Reduction drive gear
7 Snap ring
8 Drive pinion shaft
9 Washer
10 Reduction driven gear
11 Lock washer
12 Lock nut

C3-049

*Fig. 83*

# 10. Transfer and Extension




*: Selective parts

1 Snap ring
*2 Pressure plate
3 Drive plate
4 Driven plate
*5 Thrust needle bearing
6 Snap ring
7 Spring retainer CP
8 Lathe cut seal ring
9 Transfer clutch piston
10 Lathe cut seal ring
11 Needle bearing
12 Rear drive shaft
13 Ball bearing
14 Seal ring
15 Revolution sensor (4WD)
16 Pilot valve pipe
17 Duty sol. C (transfer clutch)
18 Gasket
19 Plate
20 Filter
21 Gasket
22 Roller bearing
23 Extension case
24 Bushing
25 Oil seal
26 Dust seal
27 Seal transfer piston

**Tightening torque: N·m (kg-m, ft-lb)**

T1: 6 – 8 (0.6 – 0.8, 4.3 – 5.8)
T2: 7 – 9 (0.7 – 0.9, 5.1 – 6.5)
T3: 24 – 25 (2.4 – 2.6, 17 – 19)
T4: 12 – 14 (1.2 – 1.4, 9 – 10)

C3-099

*Fig. 84*

# W SERVICE PROCEDURE

## 1. Precaution

When disassembling or assembling the automatic transmission, observe the following instructions.

1) Workshop

Provide a place that is clean and free from dust. Principally the conventional workshop is suitable except for a dusty place. In a workshop where grinding work, etc. which produces fine particles is done, make independent place divided by the vinyl curtain or the equivalent.

2) Worktable

The size of 1 x 1.5 m (40 x 60 in) is large enough to work, and it is more desirable that its surface be covered with flat plate like iron plate which is not rusted too much.

3) Cleaning of exterior

(1) Clean the exterior surface of transmission with steam and/or kerosene prior to disassembly, however it should be noted that vinyl tape be placed on the airbreather or oil level gauge to prevent infiltration of the steam into the transmission and also the cleaning job be done away from the place of disassembly and assembly.

(2) Partial cleaning will do, depending on the extent of disassembly (such as when disassembly is limited to some certain parts).

4) Disassembly, assembly and cleaning

(1) Disassemble and assemble the transmission while inspecting the parts in accordance with the Troubleshooting.

(2) During job, don't use gloves. Don't clean the parts with rags: Use chamois or nylon cloth.

(3) Pay special attention to the air to be used for cleaning. Get the moisture and the dust rid of the air as much as possible. Be careful not to scratch or dent any part while checking for proper operation with an air gun.

(4) Complete the job from cleaning to completion of assembly as continuously and speedily as possible in order to avoid occurrence of secondary troubles caused by dust. When stopping the job unavoidably cover the parts with clean chamois or nylon cloth to keep them away from any dust.

(5) Use kerosene, white gasoline or the equivalent as washing fluid. Use always new fluid for cleaning the automatic transmission parts and never reuse. The used fluid is usable in disassemble and assemble work of engine and manual transmission.

(6) Although the cleaning should be done by dipping into the washing fluid or blowing of the pressurized washing fluid, the dipping is more desirable. (Do not rub with a brush.) Assemble the parts immediately after the cleaning without exposure to the air for a while. Besides in case of washing rubber parts, perform the job quickly not to dip them into the washing fluid for long time.

(7) Apply the automatic transmission fluid (ATF) onto the parts immediately prior to assembly, and the specified tightening torque should be observed carefully.

(8) Use vaseline if it is necessary to hold parts in the position when assembling.

(9) Drain ATF and differential gear oil into a saucer so that the conditions of fluid and oil can be inspected.

(10) Do not support axle drive shaft, stator shaft, input shaft or various pipes when moving transmission from one place to another.

(11) Always discard old oil seals and bushings, and install new ones.

(12) Do not reuse old pipes, gaskets, plugs (1/8'), spring pins, etc. Install new ones.

(13) Be sure to replace parts which are damaged, worn, scratched, discolored, etc.

# 2. On-Car Service

## A: INSPECTION

### 1. ATF LEVEL

1) Raise ATF temperature to 60 to 80°C (140 to 176°F) from 40 to 60°C (104 to 140°F) (when cold) by driving a distance of 5 to 10 km (3 to 6 miles).

**The level of ATF varies with fluid temperature. Pay attention to the fluid temperature when checking oil level.**

2) Ensure the vehicle is level. After selecting all positions (P, R, N, D, 3, 2, 1), set the selector leveler in "P" range. Measure fluid level with the engine idling.

**After running, idle the engine for one or two minutes before measurement.**

3) If the fluid level is below the center between upper and lower marks, add the recommended ATF until the fluid level is found within the specified range (above the center between upper and lower marks). When the transmission is hot, the level should be above the center of upper and lower marks, and when it is cold, the level should be found below the center of these two marks.

**a. Use care not to exceed the upper limit level.**

**b. ATF level varies with temperature. Remember that the addition of fluid to the upper limit mark when the transmission is cold will result in the overfilling of fluid.**

4) Fluid temperature rising speed

- By idling the engine
  Time for rising temperature to 60°C (140°F) with atmospheric temperature of 0°C (32°F): More than 25 minutes

(Reference)
Time for temperature rise to 30°C (86°F) with atmospheric temperature of 0°C (32°F): Approx. 8 minutes

- By running the vehicle
  Time for temperature rise to 60°C (140°F) with atmospheric temperature of 0°C (32°F): More than 10 minutes

5) Method for checking fluid level upon delivery or at periodic inspection.
Check fluid level after a warm-up run of approx. 10 minutes. During the warm-up period, the automatic transmission functions can also be checked.

### 2. DIFFERENTIAL GEAR OIL LEVEL

1) Ensure the vehicle

**Do not check the oil level nor add oil to the case with the front end of the vehicle jacked up; this will result in an incorrect reading of the oil level.**

2) Check whether the oil level is between the upper (F) and lower (L) marks. If it is below the lower limit mark, add oil until the level reaches the upper mark.

### 3. OIL LEAKAGE

It is difficult to accurately determine the precise position of a oil leak, since the surrounding area also becomes wet with oil. The places where oil seals and gaskets are used are as follows:

⟨Jointing portion of the case⟩
- Transmission case and oil pump housing jointing portion
- Converter case and oil pump housing jointing portion
- Transmission case and extension case jointing portion

<u>Converter housing</u>
- Engine crankshaft oil seal
- Torque converter impeller sleeve oil seal
- ATF cooler pipe connector
- Torque converter

<u>Converter case</u>
- Converter case
- Axle shaft oil seal
- O-ring on the outside diameter of axle shaft oil seal holder
- O-ring on the differential oil gauge
- Differential oil drain plug
- Speedometer cable mounting portion
- Location of steel balls

<u>Oil pump housing</u>
- Oil pump housing (Defective casting)
- O-ring on the test plugs
- Checking blind plugs
- Differential gear breather

<u>Automatic transmission case</u>
- Transmission case (Defective casting)
- Mating surface of oil pan
- O-ring on the test plugs
- Checking blind plugs (steel balls)
- Oil supply pipe connector
- ATF cooler pipe connector and gasket
- Oil pan drain plug
- O-ring on the transmission harness holder
- O-ring on the oil pump plugs
- ATF breather
- Shift lever oil seal

<u>Extension case</u>
- Extension case (Defective casting)
- O-ring on the revolution sensor
- Rear drive shaft oil seal
- Checking blind plugs (steel ball)
- O-ring on the testing

<u>Transmission cover</u>
- Transmission cover (Defective casting)

The point listed above should be checked for fluid leak. Checking method is as follows:

(1) Place the vehicle in the pit, and check whether the leaking oil is ATF or not. The ATF is wine red in color, and can be discriminated easily from engine oil and gear oil.

(2) Wipe clean the leaking oil and dust from a suspectable area, using a noninflammable organic solvent such as carbon tetrachloride.

(3) Run the engine to raise the fluid temperature, and set the selector lever to "D" in order to increase the

fluid pressure and quickly detect a leaking point. Also check for fluid leaks while shifting selector lever to "R", "2", and "1".

## B: ADJUSTMENT

### 1. BRAKE BAND

If the following abnormal shifting conditions are noted in a road test, the brake band must be adjusted.

| Improper brake band clearances and their symptoms | |
|---|---|
| Clearance | Problem |
| 1. Too wide | Upshift from 1st directly to 3rd gear occurs. |
| 2. Wide | • Engine rpm increases abruptly while upshifting from 1st to 2nd gear or 3rd to 4th gear.<br>• Time lag of at least one second occurs during kickdown operation from 3rd to 2nd gear. |
| 3. Small | "Braking" symptom occurs while upshift- ing from 2nd to 3rd gear. |
| 4. Too small | Upshifts from 2nd to 4th gear and downshifts from 4th to 2nd gear occur repeatedly. |

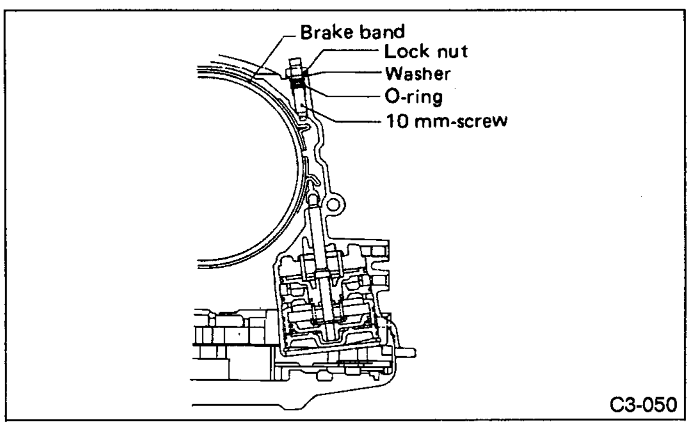



*Fig. 85*

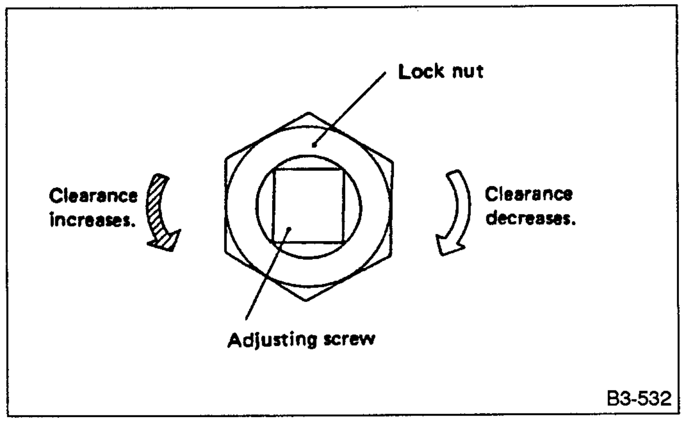



*Fig. 86*

- Adjustment of the adjusting screw

1) Using a socket wrench, immobilize the end of the 10 mm screw projecting on the left side of the transmission case, and loosen the nut with a double-end wrench.
In the case of occurrence of problems 1) and 2) mentioned previously, perform the adjustment by loosening or tightening the nut within a range of 3/4 turn from this state.

| Tool No. | Tool Name |
|---|---|
| 398603610 | SOCKET WRENCH |

**Do not loosen excessively; otherwise, the band strut on the servo piston will drop off.**

2) In case of the occurrence of problems 1 and 4 mentioned previously, perform the adjustment as follows:
Adjusting procedure: Tighten adjust screw to 9 N•m (0.9 kg- m, 6.5 ft-lb) torque, then back off three turns.
**Do not tighten the adjusting screw with an excessively large torque.**

3) With the adjusting screw immobilized, tighten the lock nut to 25 — 28 N•m (2.5 — 2.9 kg-m, 18 — 21 ft-lb) torque.

### 2. INHIBITOR SWITCH

The inhibitor switch allows the back-up lights to turn on when the selector lever is in the R range and the starter motor to start when the lever is in the N or P range. It

also monitors the input signal electronically controlled for each range and turns on the corresponding range light on the instrument panel.
When light operation, driving condition or starter motor operation is erroneous, first check the shift linkage for improper operation. If the shift linkage is functioning properly, check the inhibitor switch.
⟨Inspection⟩
(1) Disconnect cable end from selector lever.
(2) Disconnect inhibitor switch connector.
(3) Check continuity in inhibitor switch circuits with selector lever moved to each position.

| Pin No. | 4 | 3 | 2 | 1 | 8 | 7 | 6 | 5 | 12 | 11 | 10 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lead color / Position | B | Lg | Br | LgY | YW | YB | LgR | WL | BW | BY | G | GW |
| P | O | O | | | | | | | O | O | | |
| R | O | | O | | | | | | | | O | O |
| N | O | | | O | | | | | O | O | | |
| D | O | | | | O | | | | | | | |
| 3 | O | | | | | O | | | | | | |
| 2 | O | | | | | | O | | | | | |
| 1 | O | | | | | | | O | | | | |
| | Signal sent to AT control unit | | | | | | | | Ignition circuit | | Back-up light circuit | |

**Also check that continuity in ignition circuit does not exist when selector lever is in R, 3, 2 and 1 ranges.**

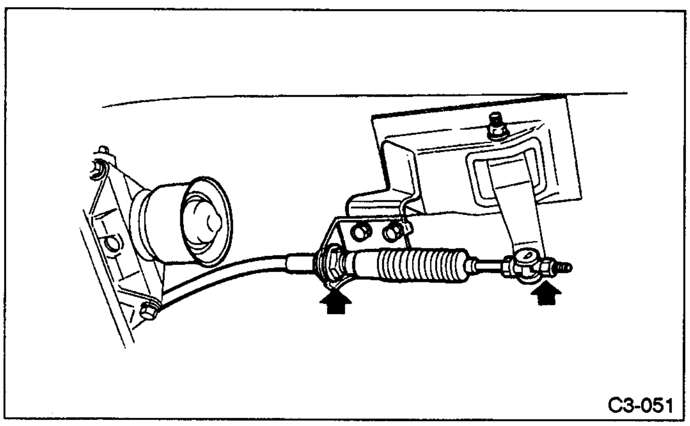



*Fig. 87*

(4) Check if there is continuity at equal points when the selector lever is turned 1.5° in both directions from the N range.
If there is continuity in one direction and the continuity in the other or if there is continuity at unequal points, adjust the inhibitor switch.

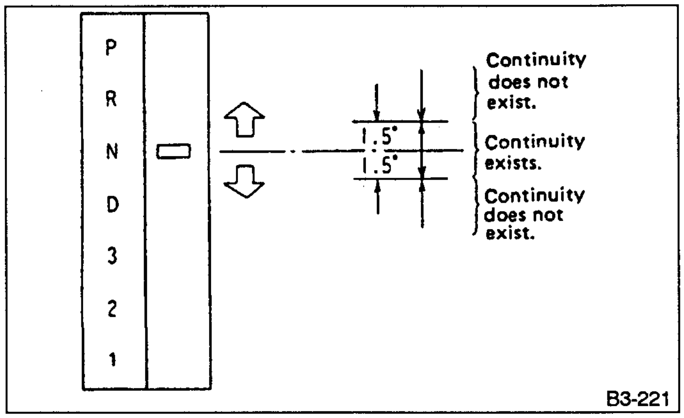



*Fig. 88*

⟨Adjustment⟩
(1) Loosen the three inhibitor switch securing bolts.
(2) Shift the selector lever to the N range.
(3) Insert STOPPER PIN (499267300) as vertical as possible into the holes in the inhibitor switch lever and switch body.
(4) Tighten the three inhibitor switch bolts.

**Tightening torque:**
**3 — 4 N·m**
**(0.3 — 0.4 kg-m, 2.2 — 2.9 ft-lb)**

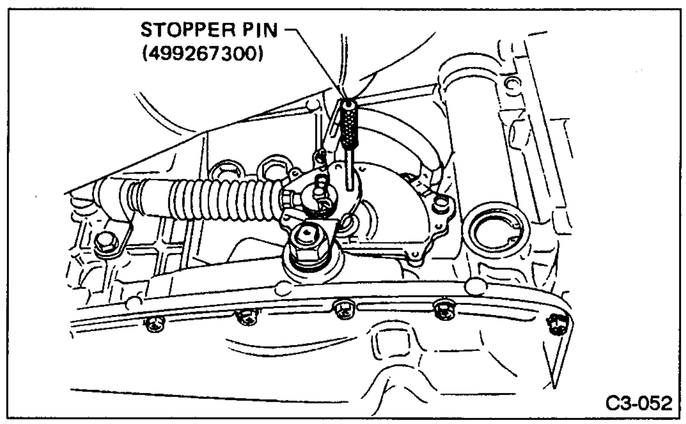



*Fig. 89*

(5) Repeat the above checks. If the inhibitor switch is determined to be "faulty", replace it.

## 3. SENSOR (in transmission)

1) Check each sensor, solenoid and ground system for short circuits.

- **Standard values**

| Part name | Terminal | Resistance (Ω) |
|---|---|---|
| Vehicle speed sensor 1 | 9 — 16 | Approx. 600 |
| ATF temperature sensor | 5 — 12 | 100 — 6 k,<br>2.5 k/20°C (68°F) |
| Duty solenoid A<br>(Line-pressure solenoid) | 7 — 4 8 | Approx. 3 |
| Duty solenoid B<br>(Lock-up solenoid) | 6 — 4 8 | Approx. 12 |
| Shift solenoid 1 | 3 — 4 8 | Approx. 25 |
| Shift solenoid 2 | 2 — 4 8 | Approx. 25 |
| Shift solenoid 3 | 1 — 4 8 | Approx. 25 |
| Duty solenoid C<br>(Transfer clutch solenoid) | 11 — 4 8 | Approx. 12 |

**If part is faulty, its resistance valve will be different from the standard value indicated above.**

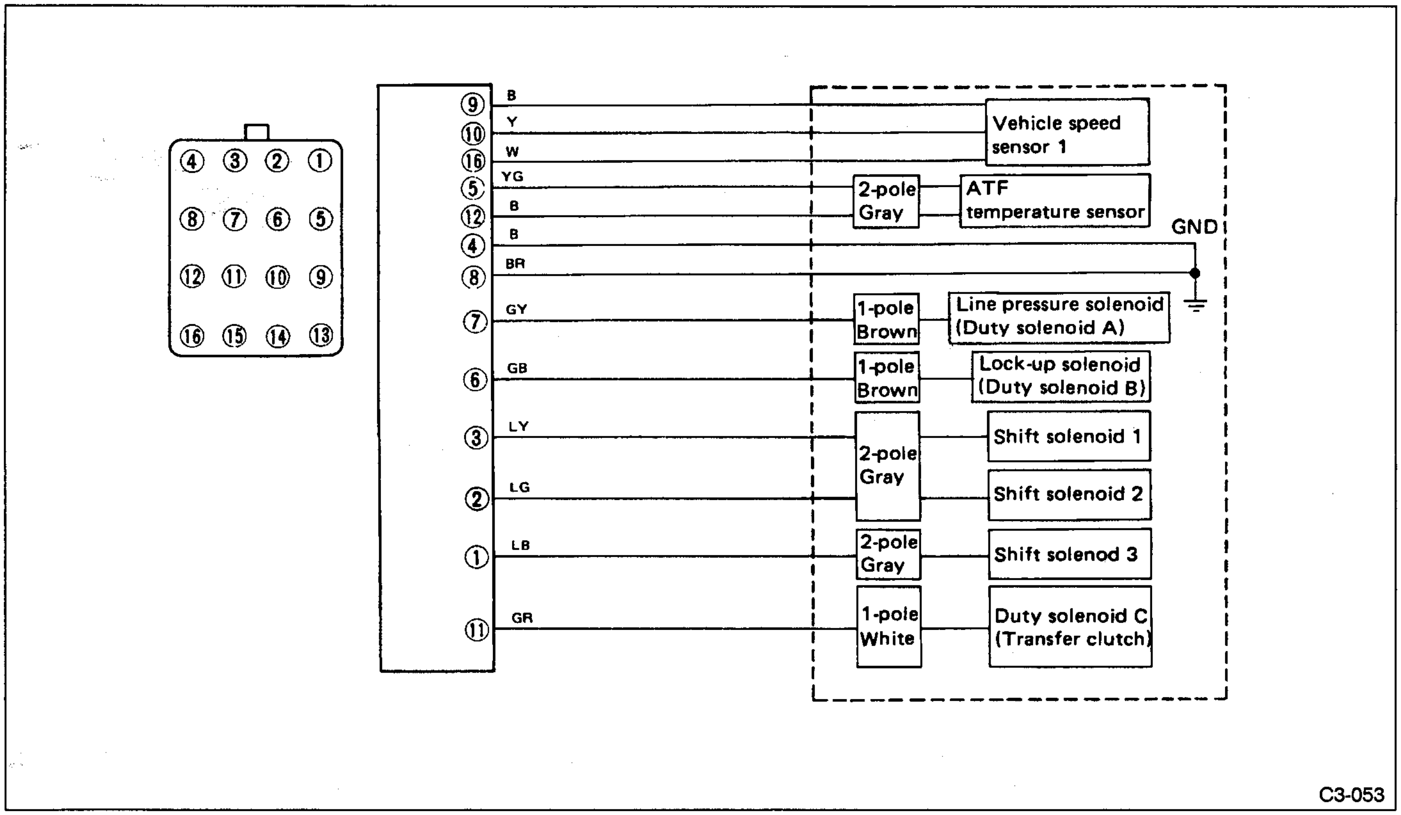



*Fig. 90*

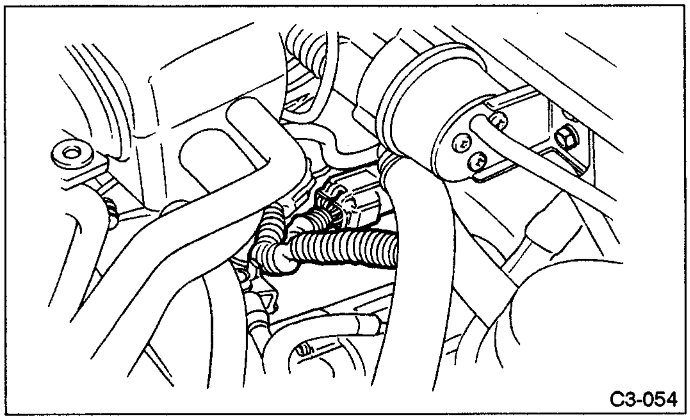



*Fig. 91*

## C: REMOVAL AND INSTALLATION

### 1. SHIFT SOLENOID, DUTY SOLENOID AND VALVE BODY

1) Removal

(1) Clean transmission exterior.

(2) Drain ATF completely.

**Tighten ATF drain plug after draining ATF.**

**Tightening torque:**
**23 — 26 N•m (2.3 — 2.7 kg-m, 17 — 20 ft-lb)**

(3) Remove oil pan and gasket.

**Drain oil into a container.**

(4) Disconnect solenoid valve connectors.

Remove connectors from clips and disconnect connectors at 5 places.

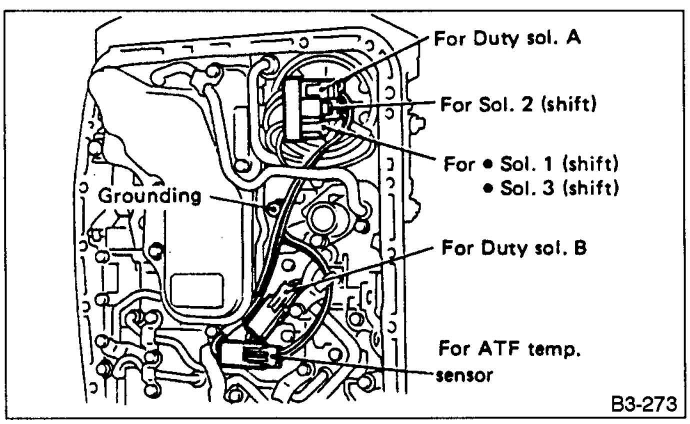



*Fig. 92*

(5) Remove oil strainer.

Disconnect oil pipe by removing the two bolts, and remove four bolts and oil strainer.

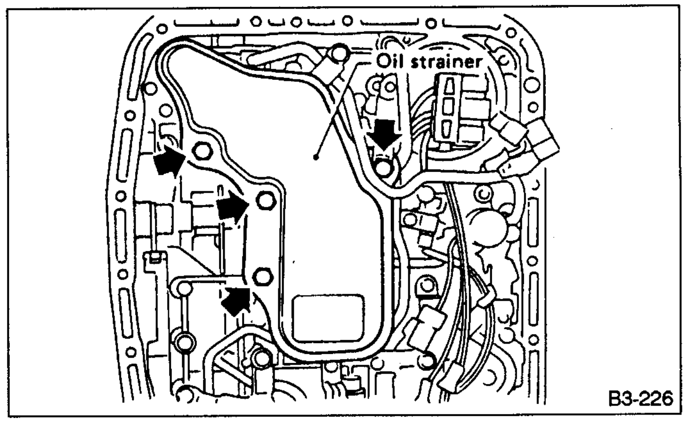



*Fig. 93*

**Be careful because oil flows from oil strainer.**

(6) Remove control valve body.

Remove 8 long bolts (Black) and 11 short bolts (Yellow).

**Be careful because oil flows from valve body.**

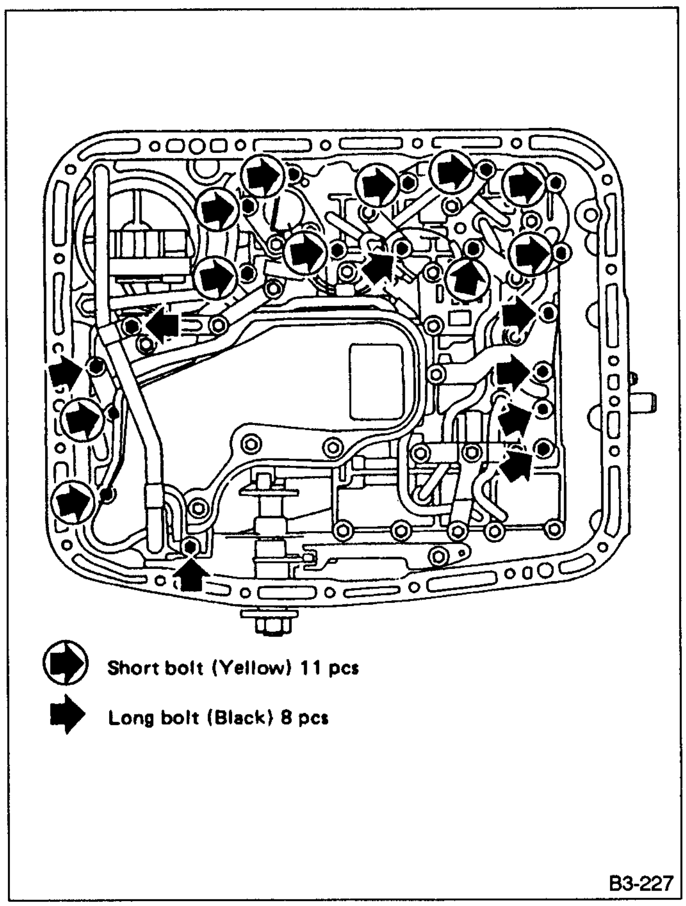



*Fig. 94*

(7) Remove shift solenoids 1, 2, and 3, and duty solenoid A.

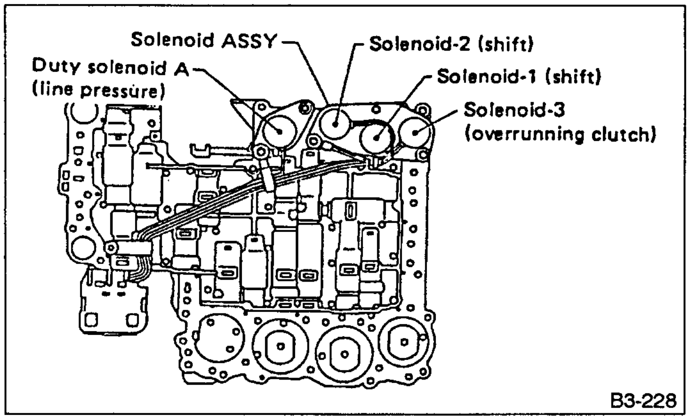



*Fig. 95*

2) Installation

(1) Install duty solenoid B (lock-up).

**Tighten bolts shown by solid arrows. The two bolts and brackets shown by arrows " XX " must be tightened later.**

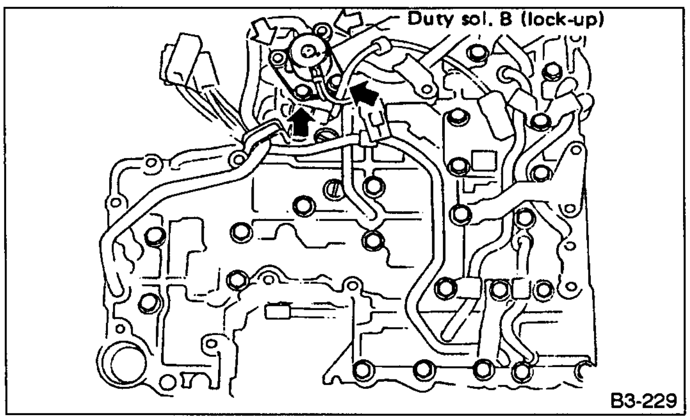



*Fig. 96*

(2) Install solenoid valves.
Shift solenoids, 1, 2 and 3, and duty solenoid A (line pressure).

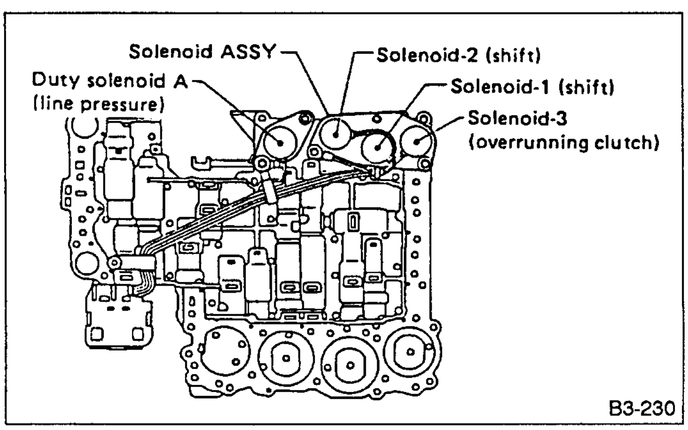



*Fig. 97*

(3) Install valve body.

**Tightening torque:**
**8 N·m (0.8 kg-m, 5.8 ft-lb)**

**a. Secure accumulator springs using vaseline.**
**b. Align manual valve connections.**
**c. Tighten duty solenoid B (lock-up) bracket and two bolts (also used to tighten valve body).**

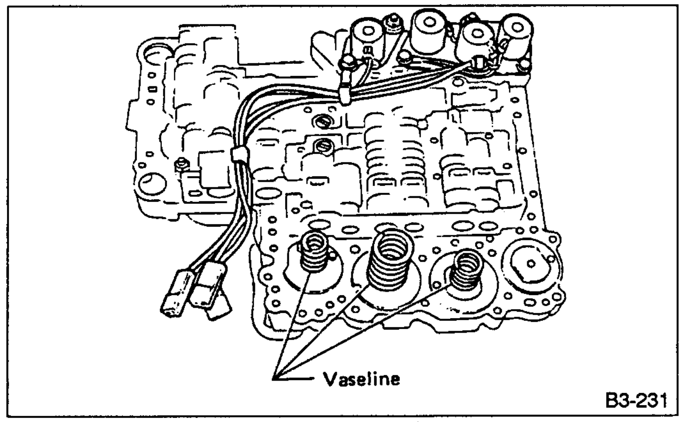



*Fig. 98*

(4) Install oil strainer.
Also install oil pipe and harness connector bracket.

**Tightening torque:**
**7 — 9 N·m (0.7 — 0.9 kg-m, 5.1 — 6.5 ft-lb)**

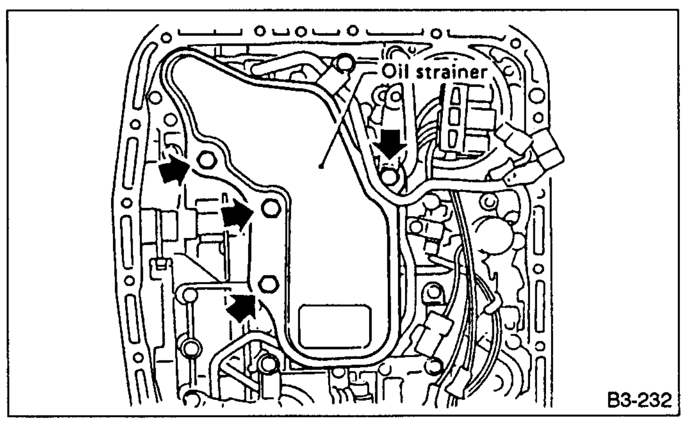



*Fig. 99*

(5) Connect harness connectors at 5 places.
Connect connectors of same color, and secure connectors to valve body using clips.

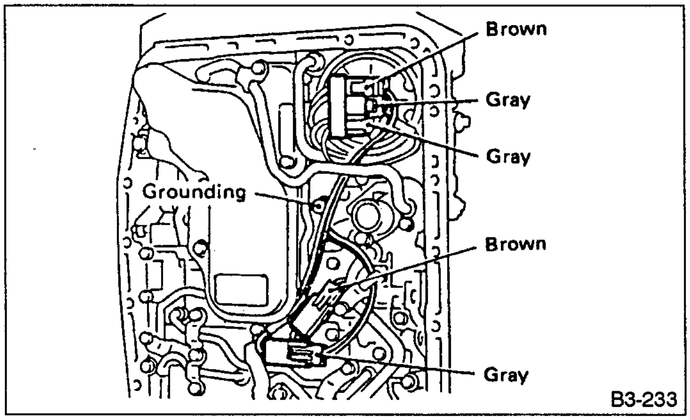



*Fig. 100*

(6) Install oil pan & gasket.

---

**Tightening torque:**
**3.4 — 4.4 N·m (0.35 — 0.45 kg-m, 2.5 — 3.3 ft-lb)**

---

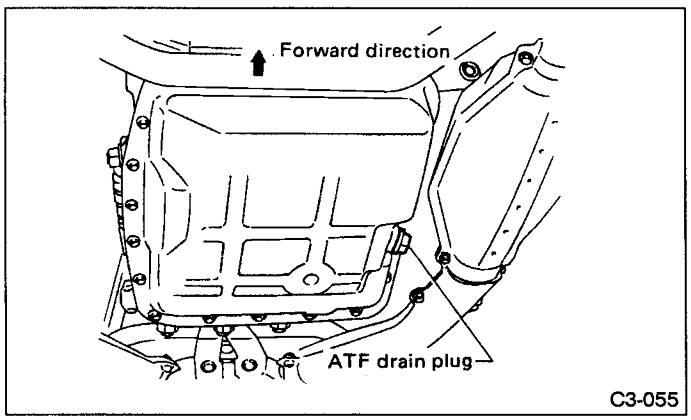



*Fig. 101*

(7) Add and check ATF.

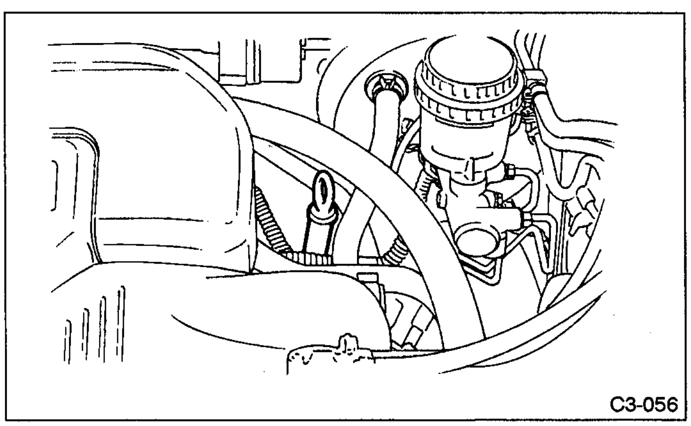



*Fig. 102*

## 2. DUTY SOLENOID C AND TRANSFER VALVE BODY

1) Removal

(1) Remove pitching stopper.

(2) Remove $O_2$ sensor connector from bracket, and disconnect $O_2$ sensor connector.

**a. Be sure not to damage $O_2$ sensor connector and harness.**

(3) Raise car and drain ATF.

(4) Remove front exhaust pipe and rear exhaust pipe with center catalyst.

**For removal of exhaust system, refer to "2-9 EXHAUST SYSTEM" [W3A0] [W4A0].**

**a. Be sure not to damage $O_2$ sensor harness when removing front exhaust pipe.**

(5) Remove front exhaust cover.

(6) Remove propeller shaft.

**For removal of propeller shaft, refer to "3-4 AWD SYSTEM" [W1B0].**

**Before removing propeller shaft, scribe alignment marks on propeller shaft and rear differential coupling.**

**a. Be sure not to bend propeller shaft when removing. Before removing propeller shaft, wrap metal parts (installed at the rubber boot of center DOJ) with a cloth or rubbered material. Rubber boot may be damaged due to interference with adjacent metal parts while bending the DOJ during removal.**

**b. Be sure to use an empty oil can to catch oil flowing out when removing propeller shaft.**

**c. Be sure not to damage oil seals and the frictional surface of sleeve yoke.**

**d. Be sure to plug the opening in transmission after removal of propeller shaft.**

(7) Remove rear crossmember.

- Support transmission using a transmission jack and raise slightly.
- Remove bolts and nuts as shown in Figure 103.

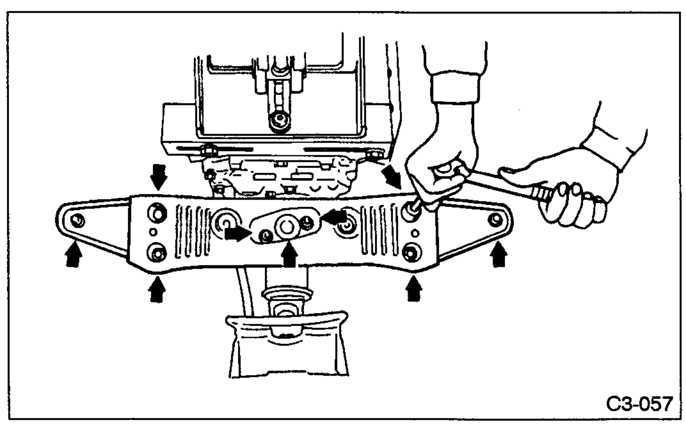



*Fig. 103*

(8) Remove vehicle speed sensor 1.

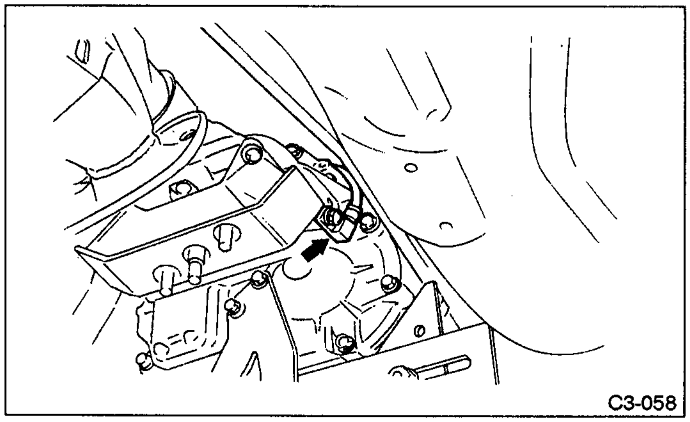



*Fig. 104*

(9) Remove extension & gasket.
- Remove gear select cable nut.
- Move gear select cable so that extension bolts can be removed.

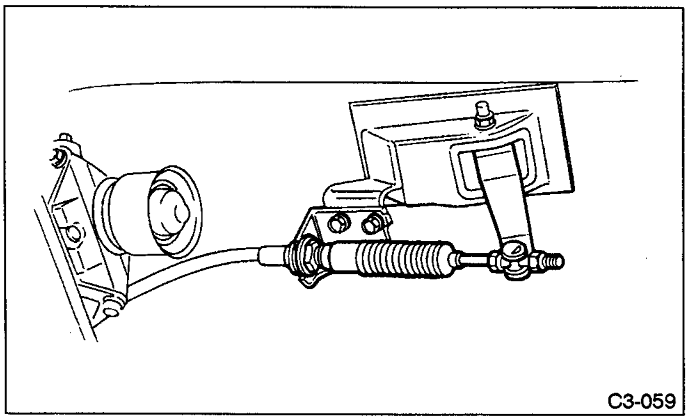



*Fig. 105*

- Remove bolts.
- Remove extension and disconnect duty solenoid C connector.

**a. Use a container to catch oil flowing from extension.**
**b. Do not force extension back before disconnecting solenoid connector. Otherwise, harness may be damaged.**

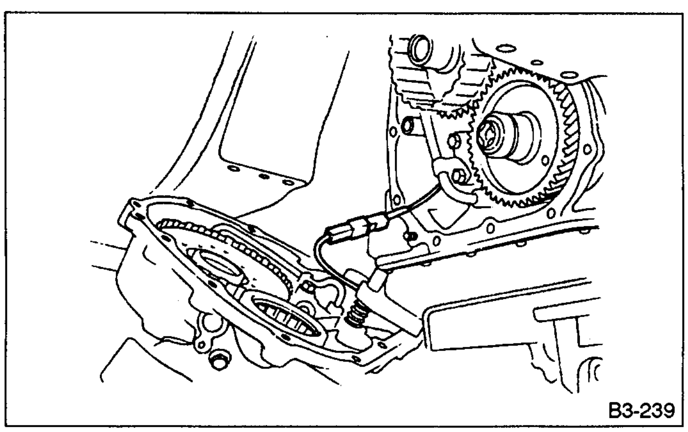



*Fig. 106*

(10) Remove duty solenoid C & transfer valve body from extension.
- Remove transfer clutch drum.

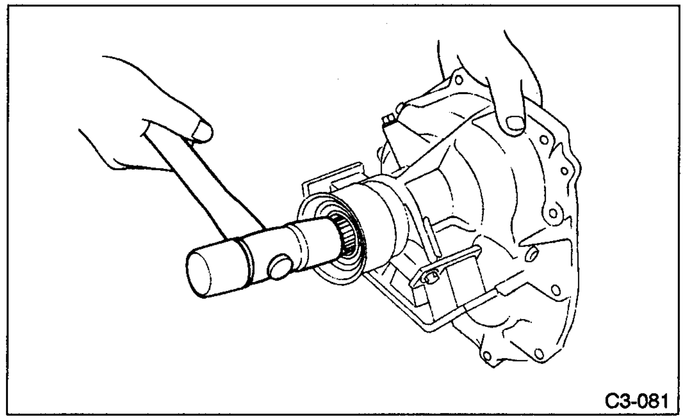



*Fig. 107*

- Remove clamp which secures pipe.
- Remove bolts.

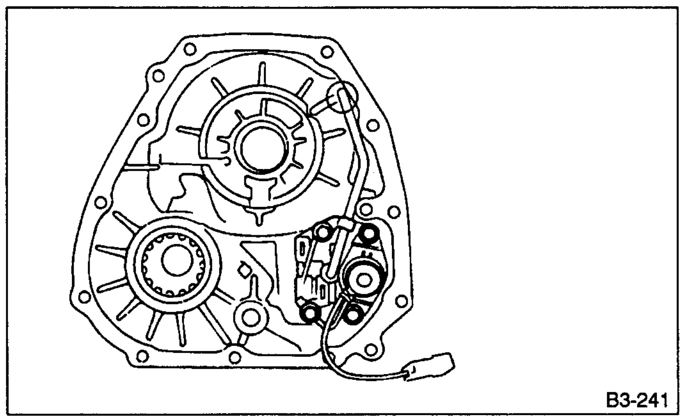



*Fig. 108*

2) Installation

(1) Install duty solenoid C & transfer valve body.
- Install duty solenoid C & transfer valve body.
- Install pipe and clamp.

---

**Tightening torque:**
**7 — 9 N·m (0.7 — 0.9 kg-m, 5.1 — 6.5 ft-lb)**

---

- Install clutch drum.

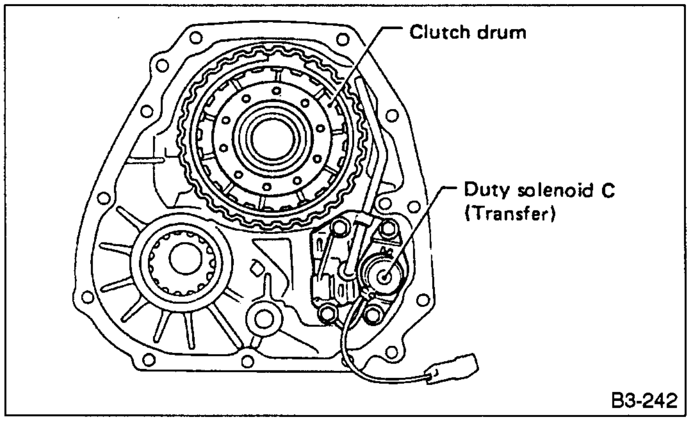



*Fig. 109*

(2) Install extension.
- Connect connector.
- Tighten 11 bolts.

---

**Tightening torque:**
**23 — 26 N•m (2.3 — 2.7 kg-m, 17 — 20 ft-lb)**

---

- Install gear select cable.

---

**Tightening torque:**
**10 — 18 N•m (1.0 — 1.8 kg-m, 7 — 13 ft-lb)**

---

(3) Install vehicle speed sensor 1.

---

**Tightening torque:**
**6 — 8 N•m (0.6 — 0.8 kg-m, 4.3 — 5.8 ft-lb)**

---

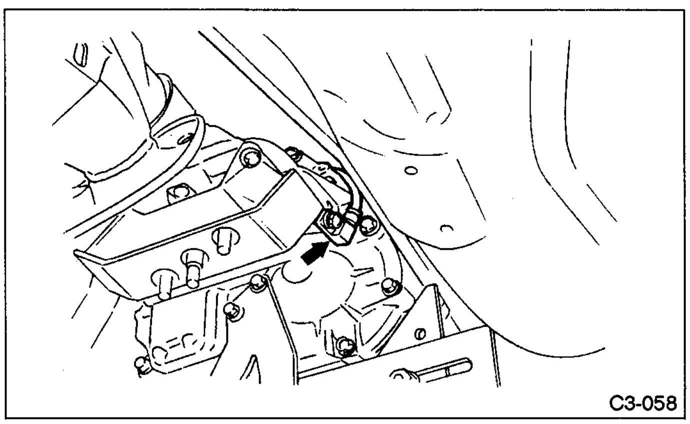



*Fig. 110*

(4) Install rear crossmember.
- Tighten bolts.

---

**Tightening torque:**
**Crossmember to body**
**54 — 83 N•m (5.5 — 8.5 kg-m, 40 — 61 ft-lb)**
**Crossmember to cushion**
**13 — 23 N•m (1.3 — 2.3 kg-m, 9 — 17 ft-lb)**

---

- Low and remove transmission jack.

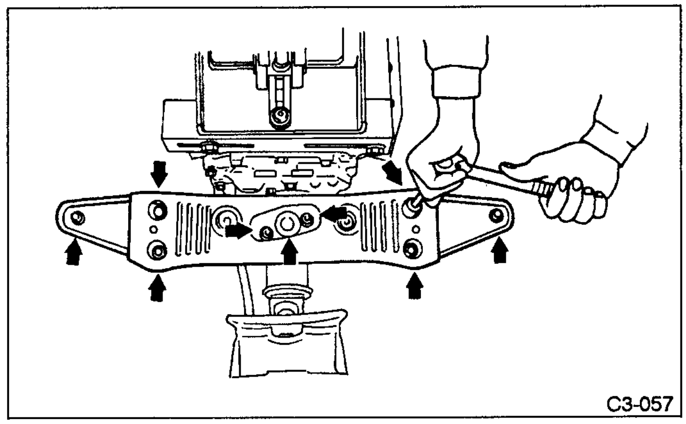



*Fig. 111*

(5) Install propeller shaft.

---

**Tightening torque:**
**N•m (kg-m, ft-lb)**
**At rear differential:**
**18 — 27 (1.8 — 2.8, 13 — 20)**
**At center bearing:**
**34 — 44 (3.5 — 4.5, 25 — 33)**

---

**Align marks on propeller shaft and rear differential coupling.**

(6) Install front exhaust pipe

---

**Tightening torque:**
**N•m (kg-m, ft-lb)**
**At engine:**
**25 — 34 (2.5 — 3.5, 18 — 25)**
**At hanger:**
**25 — 34 (2.5 — 3.5, 18 — 25)**
**At front and rear connections:**
**13 — 23 (1.3 — 2.3, 9 — 17)**

---

(7) Lower and remove jack.
(8) Connect the following parts:
- $O_2$ sensor connector
- Vehicle speed sensor1 connector
- Multi-connector

(9) Install pitching stopper.

---

**Tightening torque:**
**N•m (kg-m, ft-lb)**
**47 — 67 (4.8 — 6.8, 35 — 49) (Body side)**
**44 — 54 (4.5 — 5.5, 33 — 40) (Engine side)**

---

(10) Replenish ATF and check oil level. Check for leaks.

# 3. Performance Test

## A: NECESSARY TEST GAUGES

1) Tachometer (It is desirable to be able to read to 50 rpm.).
2) Vacuum gauge (It is used for measuring intake manifold vacuum.).
3) OIL PRESSURE GAUGE (498575400).
4) OIL PRESSURE ADAPTER (498897200).
5) Stop watch.

## B: STALL TEST

### 1. GENERAL

The stall test is of extreme importance in diagnosing the condition of the automatic transmission and the engine. It should be conducted to measure the engine stall speeds in all shift ranges except the P and N ranges.

Purposes of the stall test

1) To check the operation of the automatic transmission clutch.
2) To check the operation of the torque converter.
3) To check engine performance.

### 2. TEST METHODS

Preparations before test

① Check that throttle valve opens fully.
② Check that engine oil level is correct.
③ Check that coolant level is correct.
④ Check that ATF level is correct.
⑤ Check that differential gear oil level is correct.
⑥ Increase ATF temperature to 60 — 80°C (140 — 176°F) by idling the engine for approximately 30 minutes (with selector lever set to "N" or "P").

1) Install an engine tachometer at a location visible from the driver's compartment and mark the stall speed range on the tachometer scale.
2) Place the wheel chocks at the front and rear of all wheels and engage the parking brake.
P.108
3) Move the manual linkage to ensure it operates properly, and shift the selector lever to the D range.
4) While forcibly depressing the foot brake pedal, gradually depress the accelerator pedal until the engine operates at full throttle.

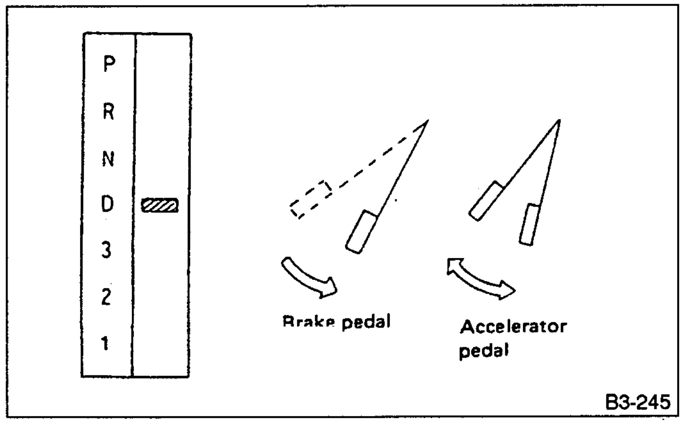



*Fig. 112*

5) When the engine speed is stabilized, read that speed quickly and release the accelerator pedal.
6) Shift the selector lever to Neutral, and cool down the engine by idling it for more than one minute.
7) Record the stall speed.
8) Perform the stall tests with the selector lever in the 3, 2 and R ranges.

**a. Do not continue the stall test for MORE THAN FIVE SECONDS at a time (from closed throttle, fully open throttle to stall speed reading). Failure to follow this instruction causes the engine oil and ATF to deteriorate and the clutch and brake band to be adversely affected.**

**Be sure to cool down the engine for at least one minute after each stall test with the selector lever set in the P or N range and with the idle speed lower than 1,200 rpm.**

**b. If the stall speed is higher than the specified range, attempt to finish the stall test in as short a time as possible, in order to prevent the automatic transmission from sustaining damage.**

**Specifications**

**Stall speed (at sea level):**
**2,350 — 2,750 rpm**

### 3. EVALUATION

| Stall speed (at sea level) | Position | Cause |
|---|---|---|
| Less than specifications | D, R, 2 | • Throttle valve not fully open<br>• Erroneous engine operation<br>• Torque converter's one-way clutch slipping |
| Greater than specifications | D only | • Line pressure too low<br>• Forward clutch slipping<br>• One-way clutch (1 - 2) malfunctioning<br>• One-way clutch (3-4) malfunctioning |
| | R only | • Line pressure too low<br>• Reverse clutch slipping<br>• Low & reverse brake slipping |
| | 2 only | • Line pressure too low<br>• Forward clutch slipping<br>• Brake band slipping |
| | R, D, 2 | • Line pressure too low<br>• ATF insufficient |

## C: TIME LAG TEST

### 1. GENERAL

If the selector lever is shifted while the engine is idling, there will be a certain time elapse or lag before the shock can be felt. This is used for checking the condition of the forward clutch, reverse clutch, low & reverse brake, forward one-way clutch and low one-way clutch.

**CAUTION:**

**(a) Perform the test at normal operation fluid temperature (60 to 80°C or 140 to 176°F).**

**(b) Be sure to allow a one minute interval between tests.**

**(c) Make three measurements and take the average value.**

### 2. TEST METHODS

1) Fully apply the parking brake.
2) Start the engine.
Check idling speed (A/C OFF)
  "N" range: 610± 100 rpm
3) Shift the selector lever from "N" to "D" range.
Using a stop watch, measure the time it takes from shifting the lever until the shock is felt.
  Time lag: Less than 1.2 seconds
4) In same manner, measure the time lag for "N" → "R".
  Time lag: Less than 1.5 seconds

### 3. EVALUATION

1) If "N" → "D" time lag is longer than specified:
- Line pressure too low
- Forward clutch worn
- Low one-way clutch not operating properly

2) If "N" → "R" time lag is longer than specified:
- Line pressure too low
- Reverse clutch worn
- Low & Rev. brake worn
- Forward one-way clutch not operating properly

## D: LINE PRESSURE TEST

### 1. GENERAL

If the clutch or the brake band shows a sign of slippage or shifting sensation is not correct, the line pressure should be checked.
- Excessive shocks during upshifting or shifting takes place at a higher point than under normal circumstances, may be due to the line pressure being too high.
- Slippage or inability to operate the car may, in most cases, be due to loss of oil pressure for the operation of the clutch, brake band or control valve.

1) Line pressure measurement (under no load)
**a. Before measuring line pressure, jack-up front wheels (front-wheel-drive model) or all wheels (4-wheel drive model).**
**b. Maintain temperature of ATF at approximately 60 to 80°C (140 to 176°F) during measurement.**
**(ATF will reach the above temperature after idling the engine for approximately 30 minutes with shift lever in "N" or "P".)**
2) Line pressure measurement (under heavy load)
**a. Before measuring line pressure, apply both foot and parking brakes with all wheels chocked (Same as for "stall" test conditions).**
**b. Measure line pressure when selector lever is in "R", "D", "2" and "1" with engine under stall conditions.**
**c. Measure line pressure within 5 seconds after shifting the selector lever to each position. (If line pressure needs to be measured again, allow the engine to idle and then stop. Wait for at least one minute before measurement.)**
**d. Maintain the temperature of ATF at approximately 60 to 80°C (140 to 176°F) during measurement. (ATF will reach the above temperature after idling the engine for approximately 30 minutes with the selector lever in "N" or "P".)**

### 2. TEST METHODS

1) Temporarily attach the OIL PRESSURE GAUGE ASSY (498575400) to a suitable place in the driver's compartment.

2) Remove the test plug and install OIL PRESSURE GAUGE ADAPTER (498897200) instead.

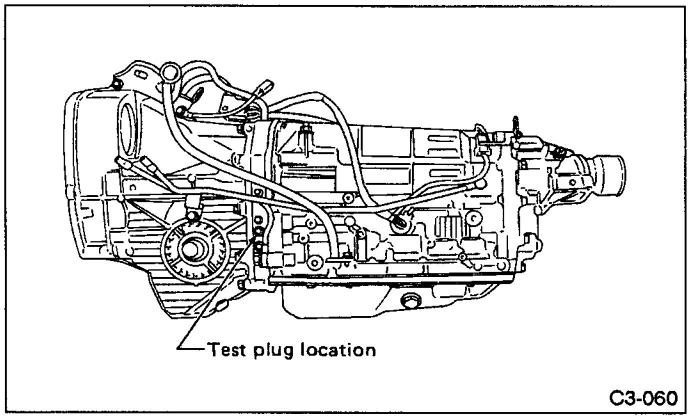



*Fig. 113*

3) Connect OIL PRESSURE GAUGE ADAPTER (498897200) with OIL PRESSURE GAUGE ASSY (498575400).
4) Start the engine and warm it up.
5) Check line pressure in accordance with the following chart.

## 3. EVALUATION

Under no load: "P", "R", "D", "3", "2" and "1"
Under full load: "R", "D", "3", "2" and "1"
(With engine running at stall speed)
⟨Standard line pressure⟩

Unit: kPa ($kg/cm^2$, psi)

| | Min. line pressure | Max. line pressure |
|---|---|---|
| Range | 510 — 710 rpm | Stall rpm |
| P | 441 — 569 (4.5 — 5.8, 64 — 82) | — |
| R | 588 — 686 (6.0 — 7.0, 85 — 100) | 1,422 — 1,589 (14.5 — 16.2, 206 — 230) |
| N | 441 — 569 (4.5 — 5.8, 64 — 82) | — |
| D | 441 — 569 (4.5 — 5.8, 64 — 82) | 1,128 — 1,255 (11.5 — 12.8, 164 — 182) |
| 3 | 441 — 569 (4.5 — 5.8, 64 — 82) | 1,128 — 1,255 (11.5 — 12.8, 164 — 182) |
| 2 | 441 — 569 (4.5 — 5.8, 64 — 82) | 1,128 — 1,255 (11.5 — 12.8, 164 — 182) |
| 1 | 441 — 569 (4.5 — 5.8, 64 — 82) | 1,128 — 1,255 (11.5 — 12.8, 164 — 182) |
| Accelerator pedal | Full-closed | Fully-open |

## E: TRANSFER CLUTCH PRESSURE TEST

Check transfer clutch pressure in accordance with the following chart in the same manner as with line pressure.
Under no load: "R" and "D" ranges
Under heavy load:
"R" and "D" ranges in AWD mode
"R" and "D" ranges in FWD mode

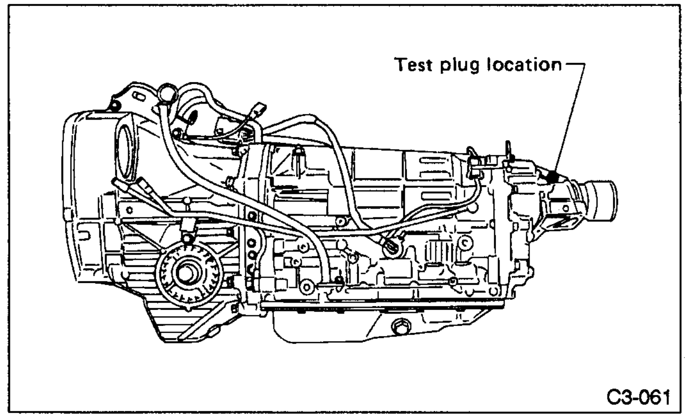



*Fig. 114*

*Unit: kPa ($kg/cm^2$, psi)*

| | AWD mode | | FWD mode |
|---|---|---|---|
| | Low pressure side | High pressure side | High pressure side |
| Range | 510 — 710 rpm | Stall rpm | Stall rpm |
| R | 49 — 78 (0.5 — 0.8, 7 — 11) | 716 — 785 (7.3 — 8.0, 104 — 114) | 0 (0, 0) |
| D | 49 — 78 (0.5 — 0.8, 7 — 11) | 716 — 785 (7.3 — 8.0, 104 — 114) | 0 (0, 0) |
| Accelerator pedal | Fully-closed | Fully-open | Fully-open |

If oil pressure is not produced or if it does not change in the AWD mode, the duty solenoid C or transfer valve assembly may be malfunctioning. If oil pressure is produced in the FWD mode, the problem is similar to that in the AWD mode.

## F: ROAD TEST

### 1. GENERAL

Road tests should be conducted to properly diagnose the condition of the automatic transmission.

**When performing test, do not exceed posted speed limit.**

### 2. CHECKING FOR SHIFT PATTERNS

Check "kick-down" and engine brake operation.

**D-range: 1st ⇆ 2nd ⇆ 3rd ⇆ 4th**
**3-range: 1st ⇆ 2nd ⇆ 3rd ⇆ 4th (Manual switch OFF)**
**2nd ⇆ 3rd ⇆ 4th (Manual switch ON)**
**2-range: 1st ⇆ 2nd ⇆3rd ⇆ 4th (Manual switch OFF)**
**2nd ⇆ 3rd ⇆ 4th (Manual switch ON)**
**1-range: 1st ⇆ 2nd ⇆ 3rd ⇆ 4th**

### 3. CHECK FOR THE 4WD FUNCTION

If "tight-corner braking" occurs when the steering wheel is fully turned at low speed:

1) Determine the applicable trouble code and check the corresponding duty solenoid C (transfer) for improper operation.
2) If the solenoid is operating properly, check transfer clutch pressure.
3) If oil pressure is normal but "tight-corner braking" occurs:
Check the transfer control valve for sticking, and the transfer clutch facing for wear.
(Refer to Disassembly and Inspection of the Transmission.)

### 4. AUTOMATIC SHIFT CHARACTERISTICS

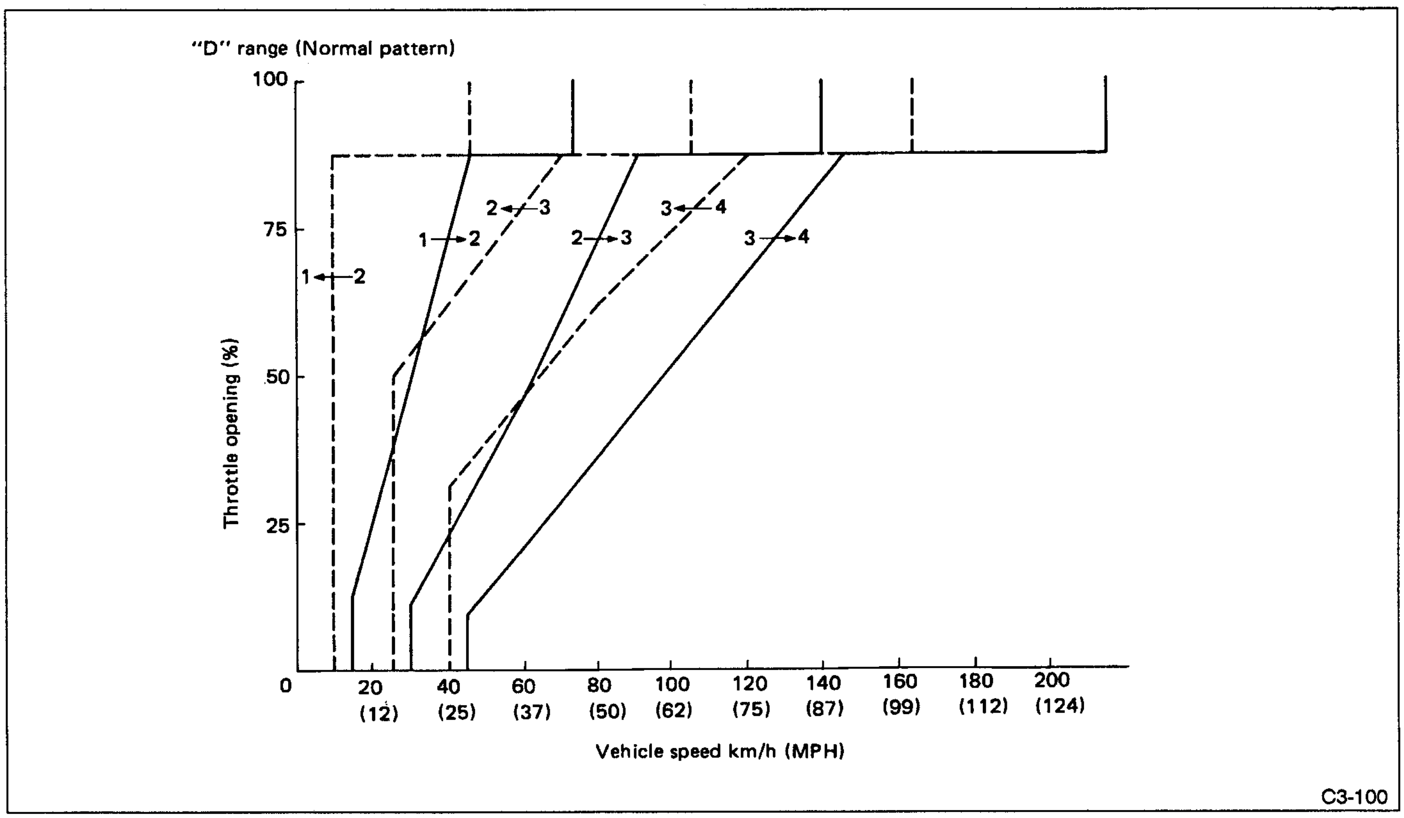



*Fig. 115*

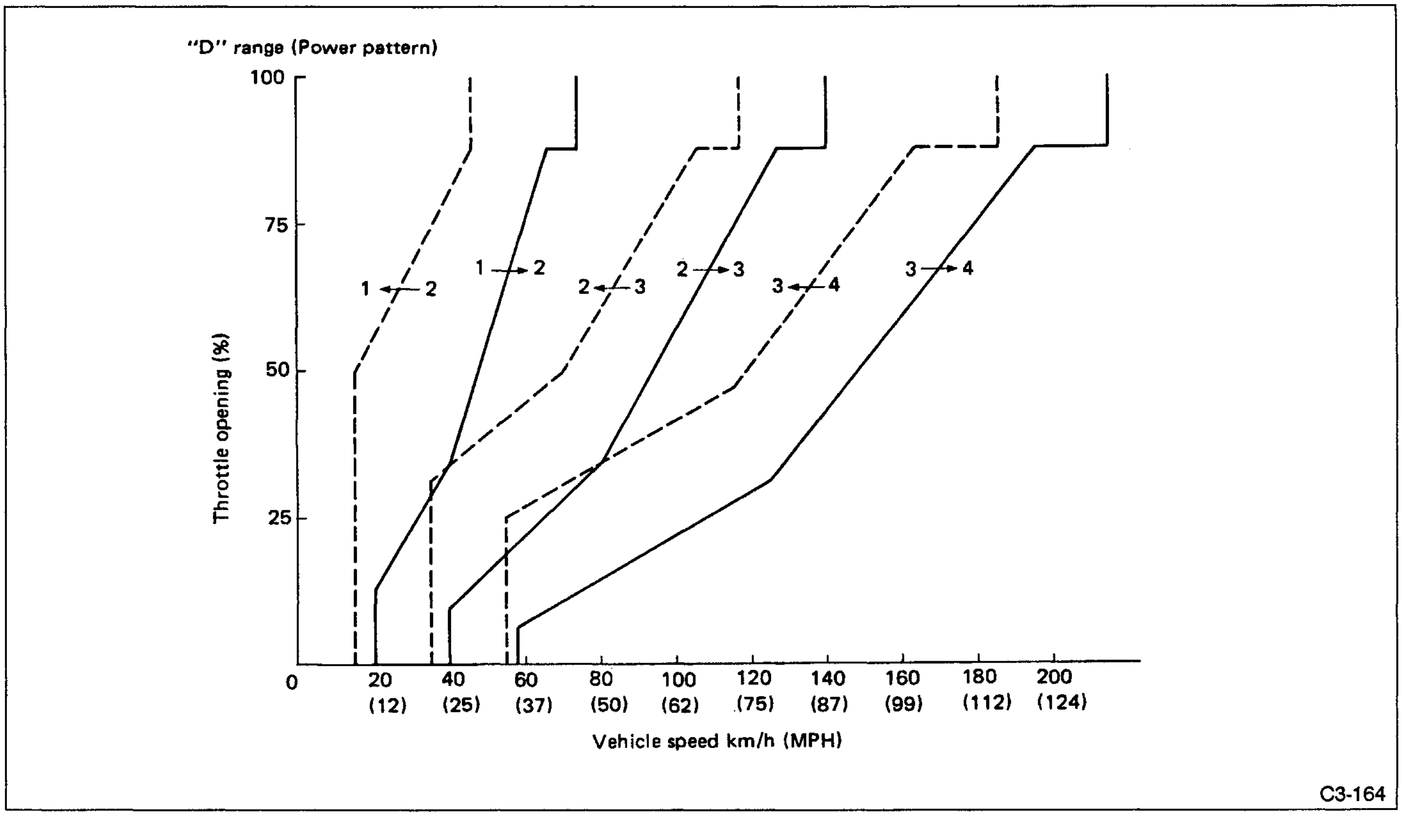

"D" range (Power pattern)
100
75
50
25
0
Throttle opening (%)
1 ← 2
1 → 2
2 ← 3
2 → 3
3 ← 4
3 → 4
20 (12)
40 (25)
60 (37)
80 (50)
100 (62)
120 (75)
140 (87)
160 (99)
180 (112)
200 (124)
Vehicle speed km/h (MPH)
C3-164

*Fig. 116*

# 4. Overall Transmission

## SECTIONS THAT CAN BE DETACHED/ASSEMBLED

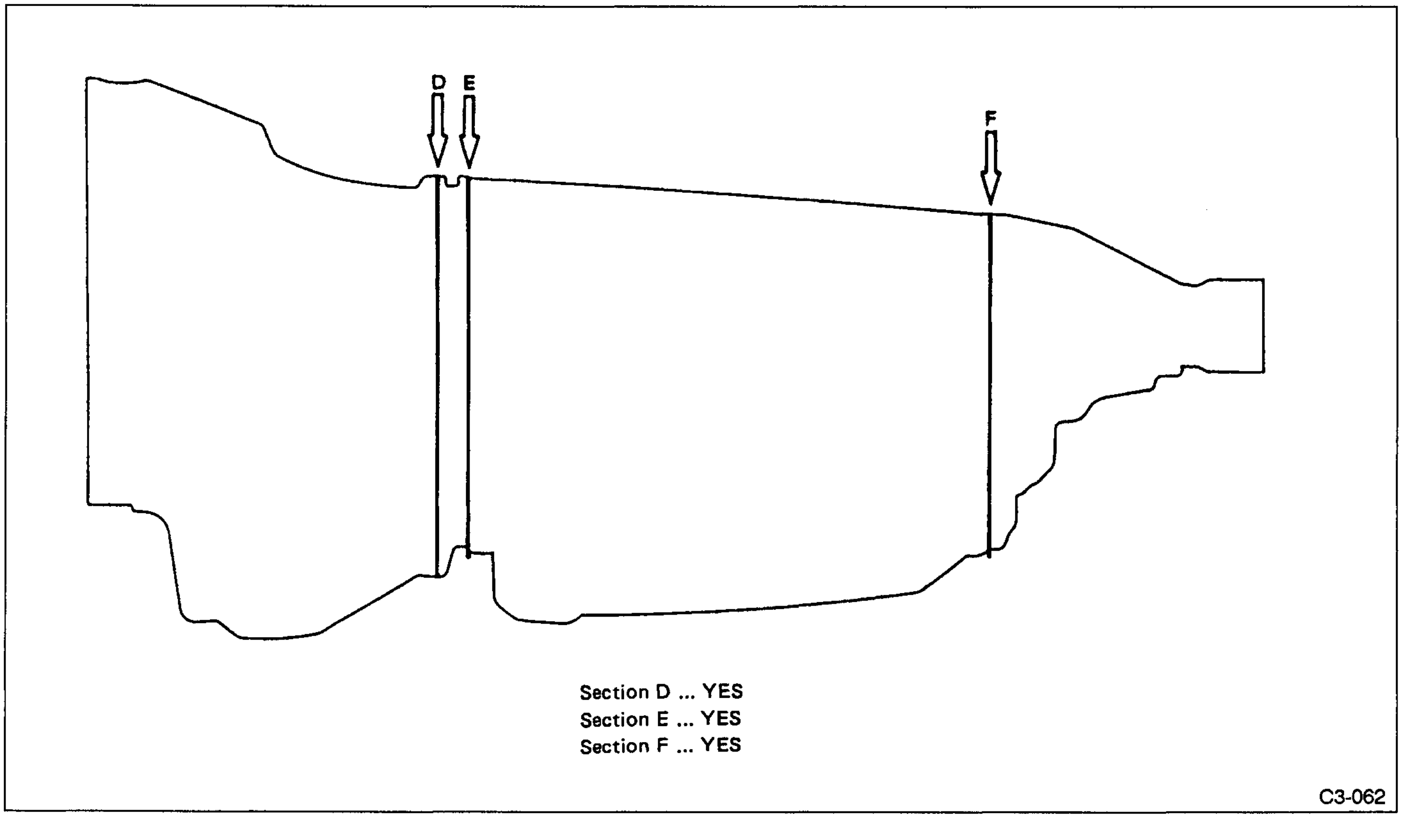



*Fig. 117*

## A: DISASSEMBLY

### 1. EXTERNAL PARTS

1) Place the transmission unit on a workbench, with the oil pan facing down.
**Be careful not to bend or damage external parts.**
2) Remove the drain plug, and drain differential oil. Tighten the plug temporarily after draining.

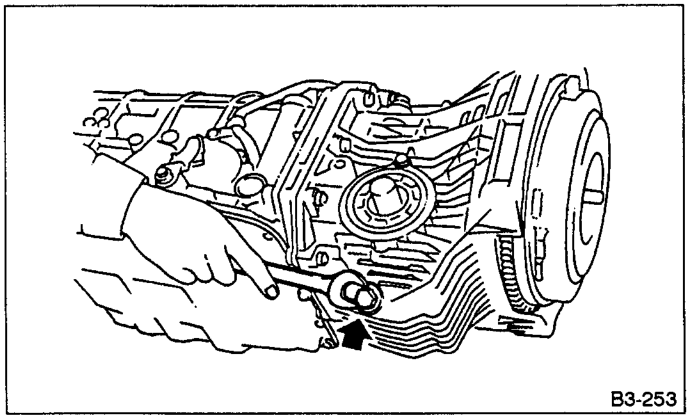


*Fig. 118*

3) Remove the drain plug, and drain automatic transmission fluid (ATF). Tighten the plug temporarily after draining.

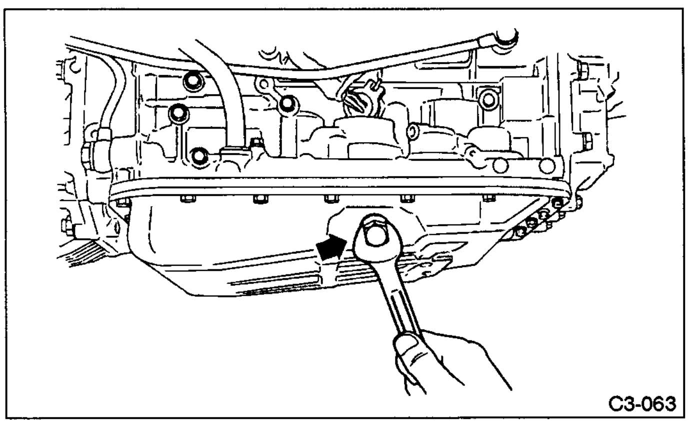


*Fig. 119*

4) Extract the torque converter.
**a. Extract the torque converter horizontally. Be careful not to scratch the bushing inside the oil pump shaft.**
**b. Note that oil pump shaft also comes out.**

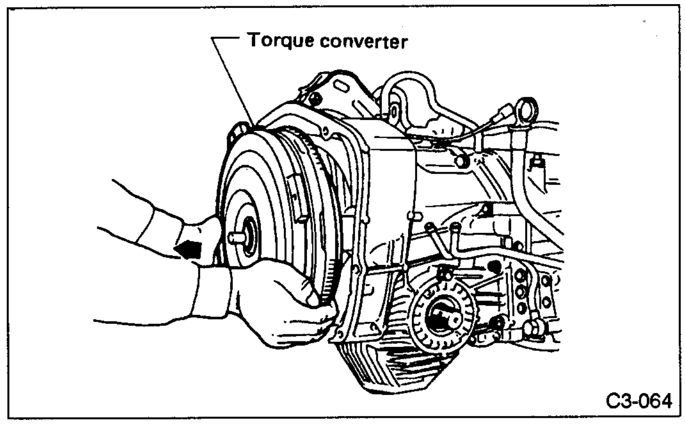


*Fig. 120*

5) Remove the input shaft.
**Be careful not to scratch the bushing.**

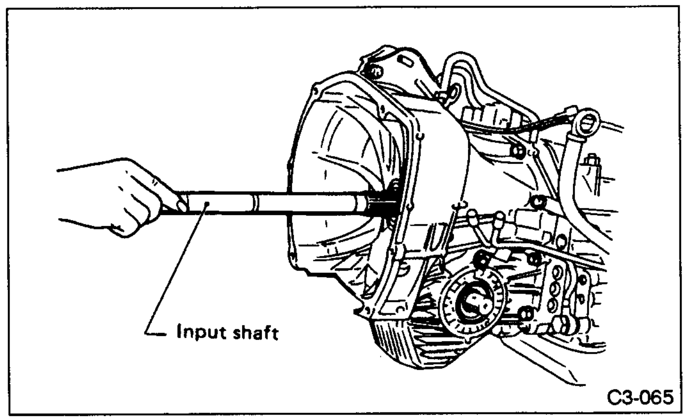


*Fig. 121*

6) Disconnect the air breather hose from the pitching stopper bracket.

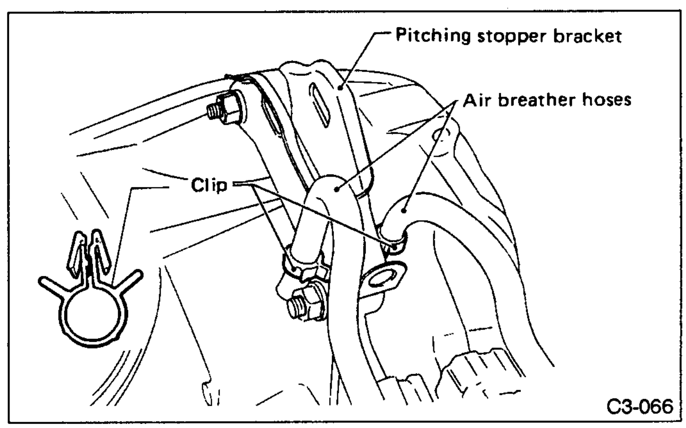


*Fig. 122*

7) Remove the pitching stopper bracket.

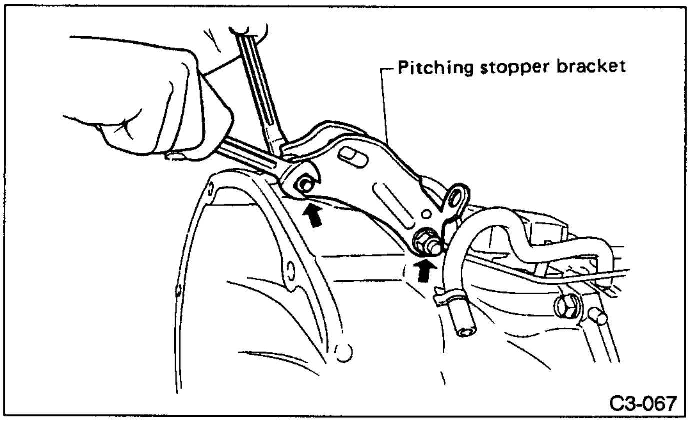



*Fig. 123*

8) Disconnect the air breather hose.

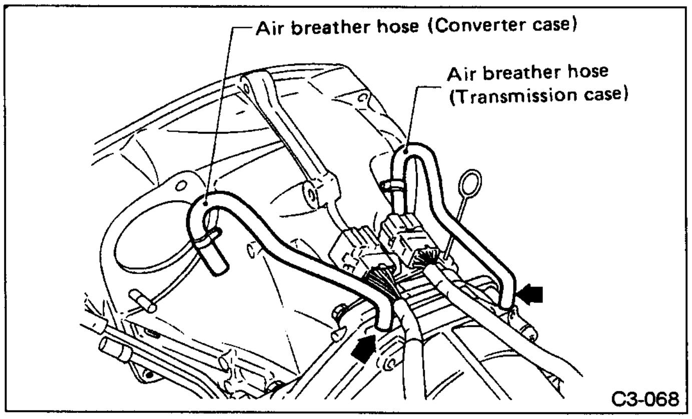



*Fig. 124*

9) Remove the oil charger pipe, and remove the O-ring from the flange face. Attach the O-ring to the pipe.

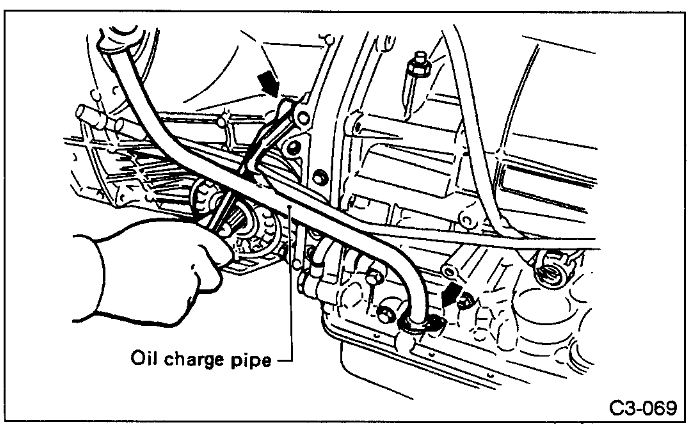



*Fig. 125*

10) Remove the oil cooler inlet and outlet pipes.

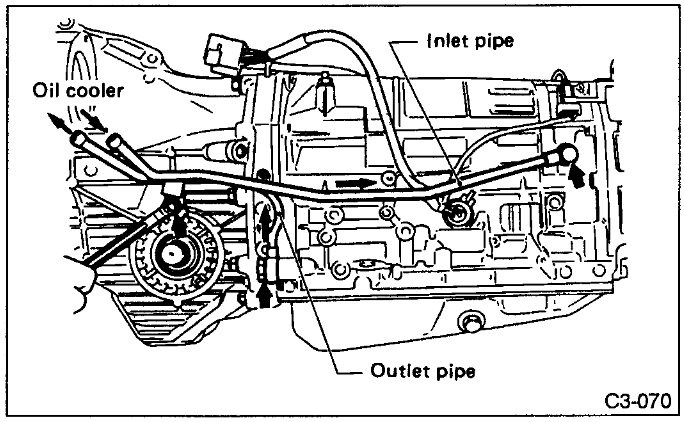



*Fig. 126*

11) Remove the harnesses from the bracket.

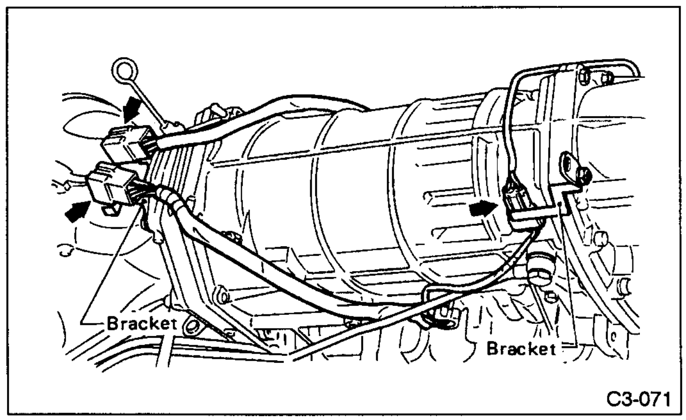



*Fig. 127*

## 2. SEPARATION OF EACH SECTION

1) Separation of converter case and transmission case sections

**a. Separate these cases while tapping lightly on the housing.**
**b. Be careful not to damage the oil seal and bushing inside the converter case by the oil pump cover.**

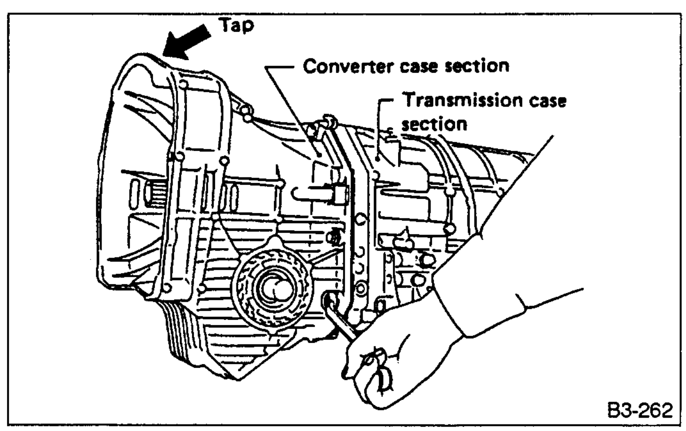



*Fig. 128*

2) Separation of transmission case and extension sections.

(1) Remove the vehicle speed sensor 1.

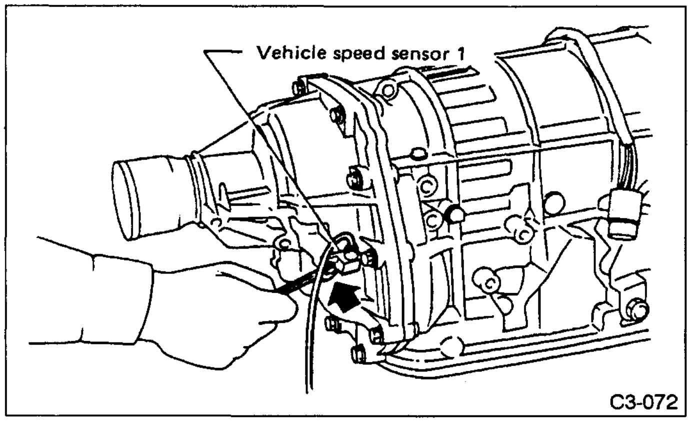



*Fig. 129*

(2) While pulling the extension slightly, disconnect the connector for the duty solenoid C (transfer).

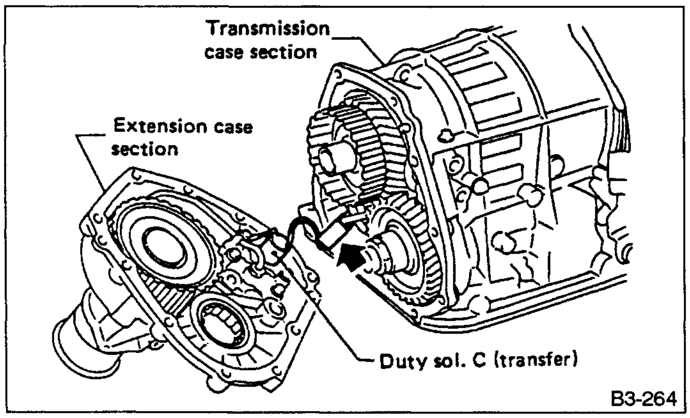



*Fig. 130*

3) Separate both sections.

## 3. TRANSMISSION CASE SECTION

1) Remove the reduction drive gear ASSY.

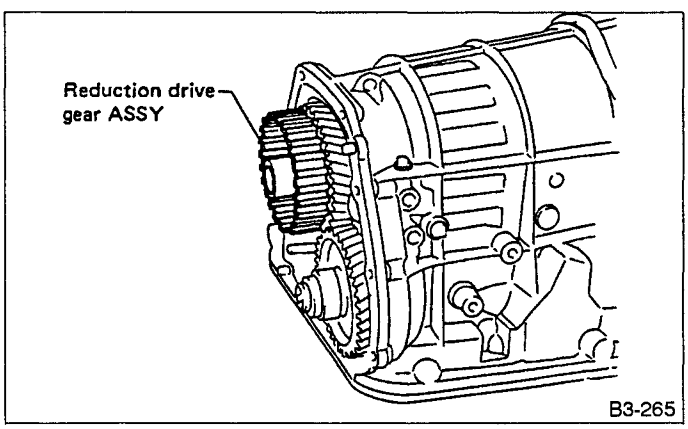



*Fig. 131*

2) Remove the reduction driven gear:
- Straighten the staked portion, and remove the lock nut.

**Set the range selector lever to "P".**

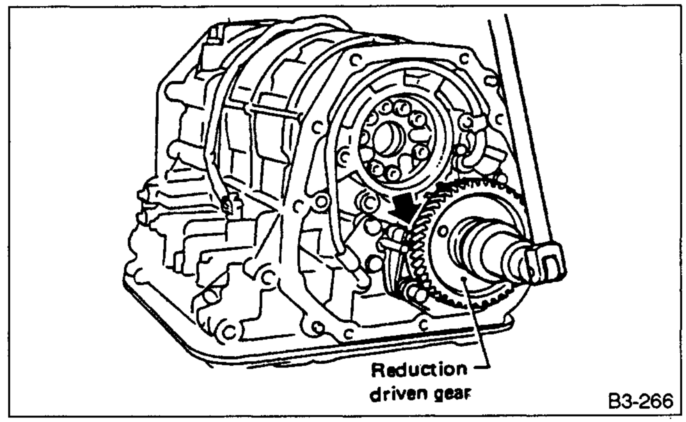



*Fig. 132*

- Using the PULLER SET (899524100), extract the reduction driven gear.

**Drill two holes in the puller.**

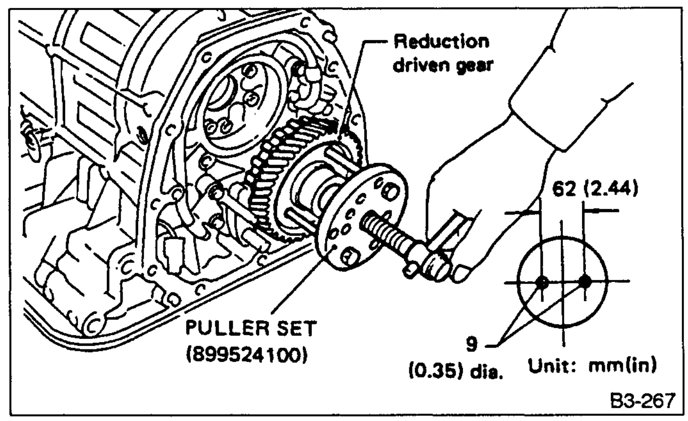



*Fig. 133*

3) Remove the parking pawl, return spring and shaft.

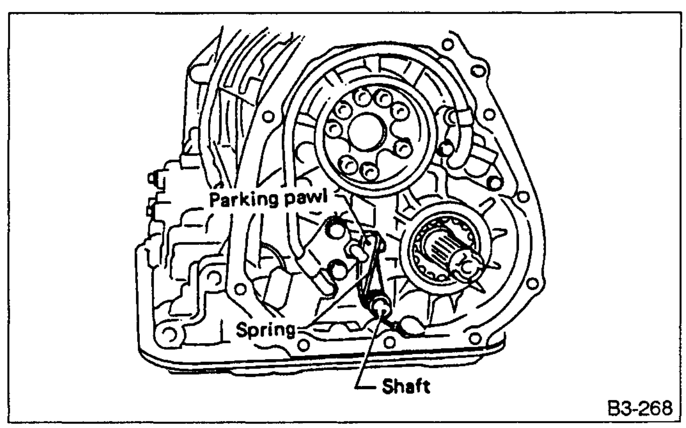



*Fig. 134*

4) Loosen the taper roller bearing mounting bolts.

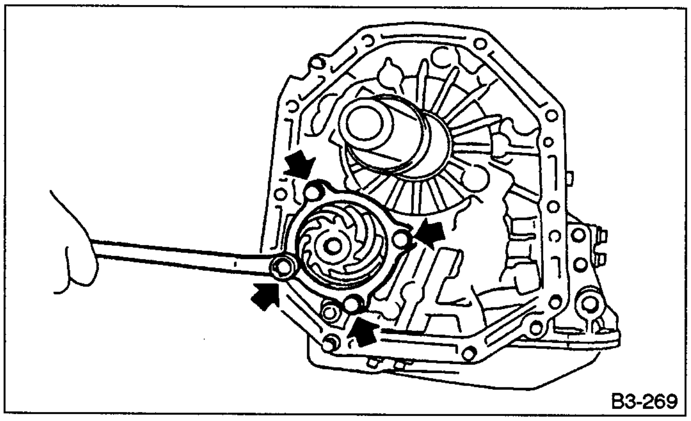



*Fig. 135*

5) Place two wooden blocks on the workbench, and stand the transmission case with its rear end facing down.

**a. Be careful not to scratch the rear mating surface of the transmission case.**

**b. Note that the parking rod and drive pinion protrude from the mating surface.**

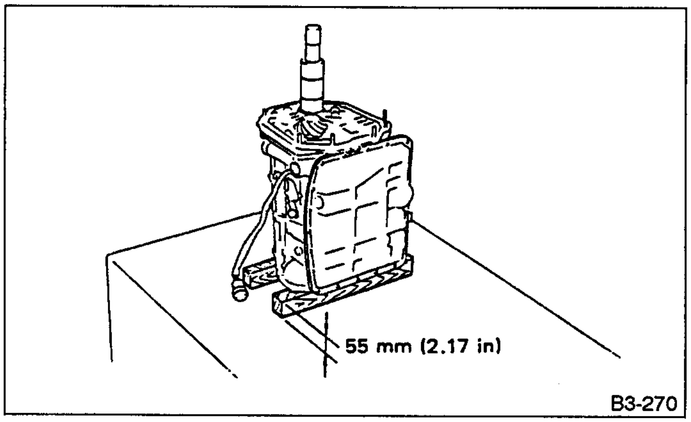



*Fig. 136*

6) Remove the oil pan and gasket.

**Tap the corners of the oil pan when removing.**

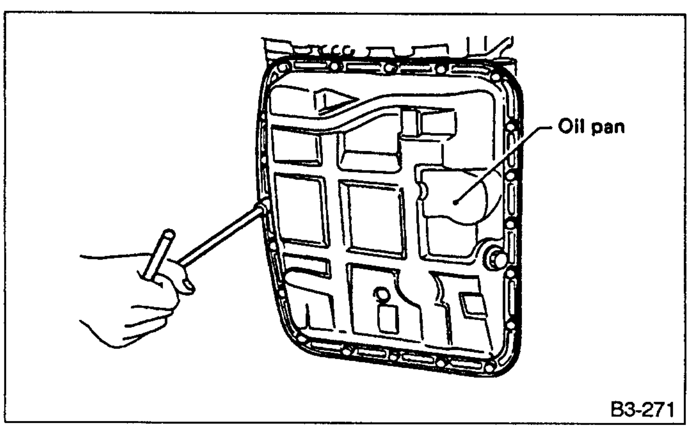



*Fig. 137*

7) Remove the oil cooler outlet pipe.

**Be careful not to twist the pipe.**

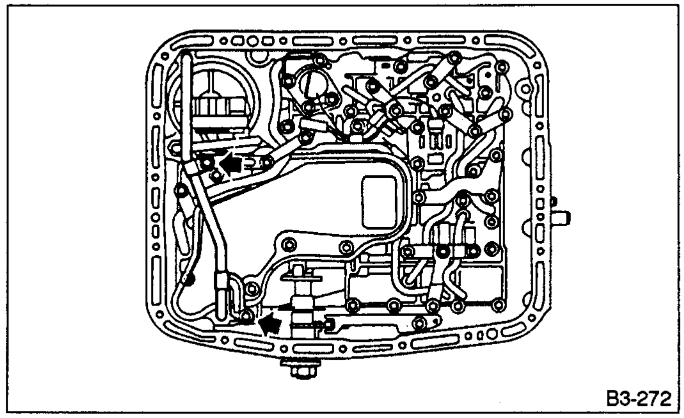



*Fig. 138*

8) Disconnect the harness connectors for the solenoids and duty solenoids and the ground cord.

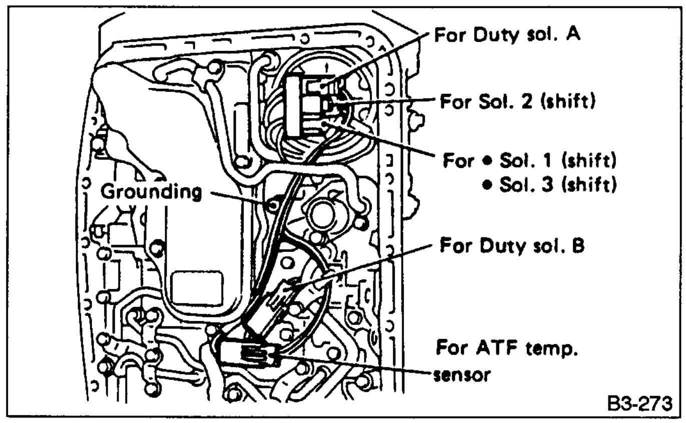



*Fig. 139*

9) Remove the oil strainer.

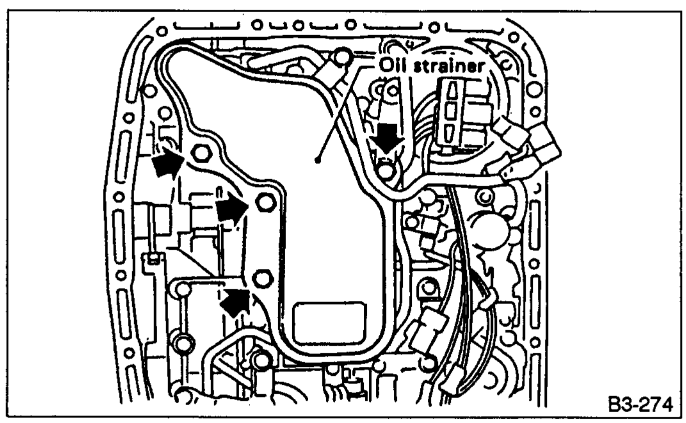



*Fig. 140*

**Be careful not to damage O-ring on oil strainer.**

10) Remove the control valve body.

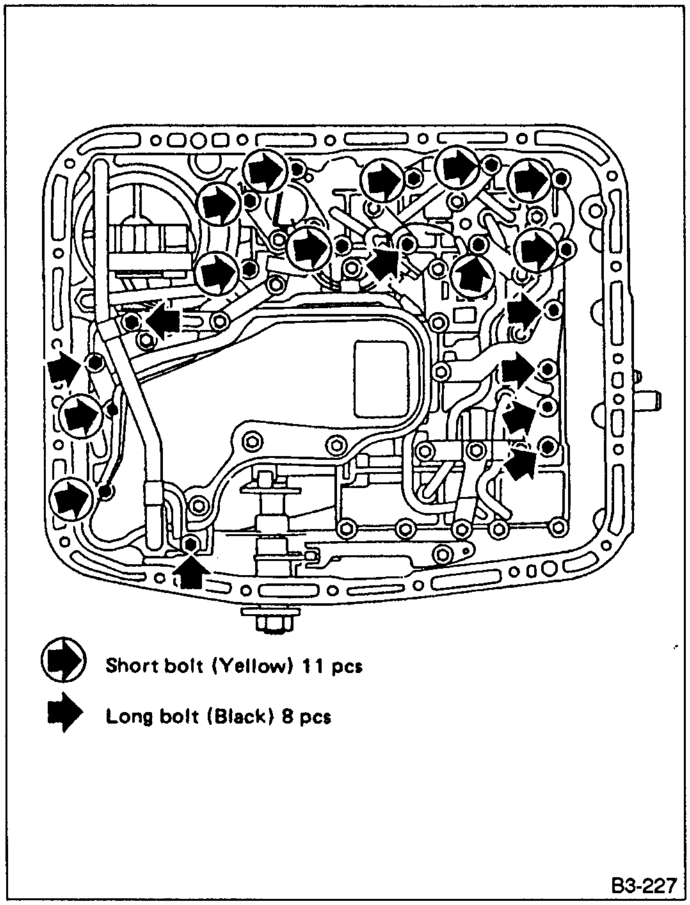



*Fig. 141*

11) Remove three accumulator springs.

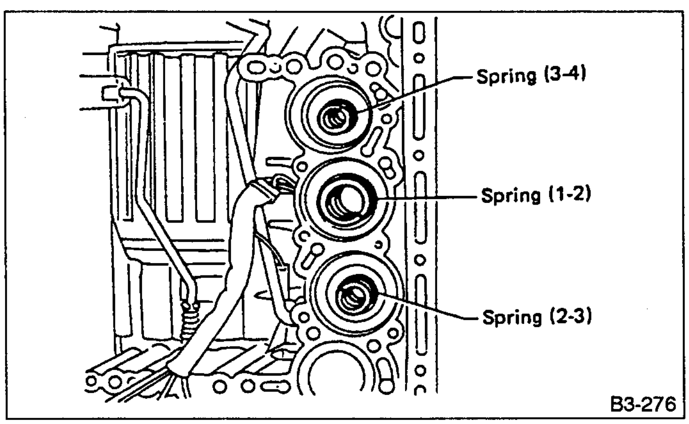



*Fig. 142*

12) Loosen the reverse clutch drum lightly by turning the adjusting screw. Then remove the oil pump housing.
**Be careful not to lose the total end play adjusting thrust washer.**

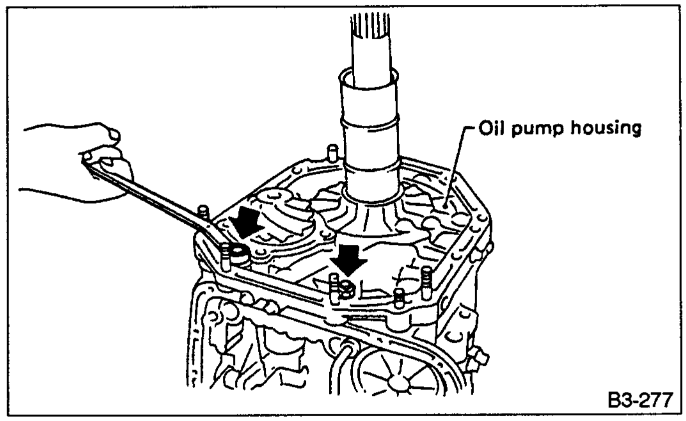



*Fig. 143*

13) Loosen the brake band adjusting screw, and take out the strut.

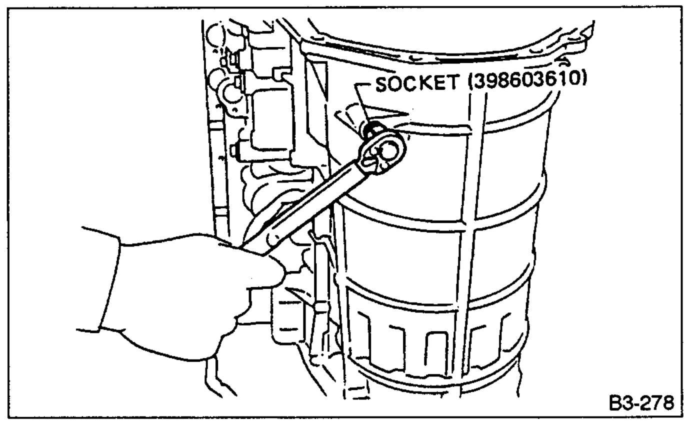



*Fig. 144*

14) Remove the brake band and reverse clutch.
**Contract the brake band with a clip.**

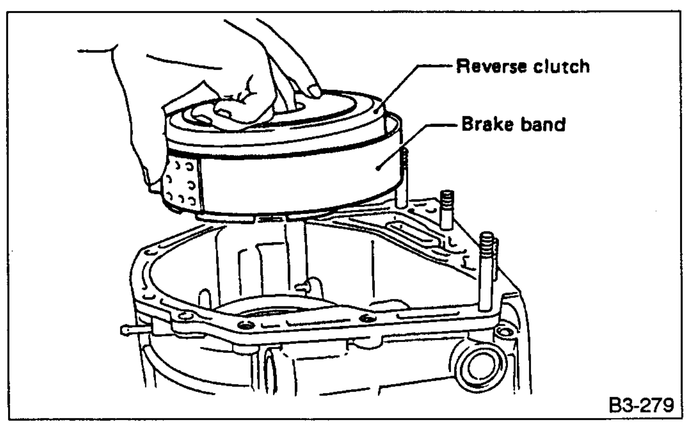



*Fig. 145*

15) Take out the high clutch.

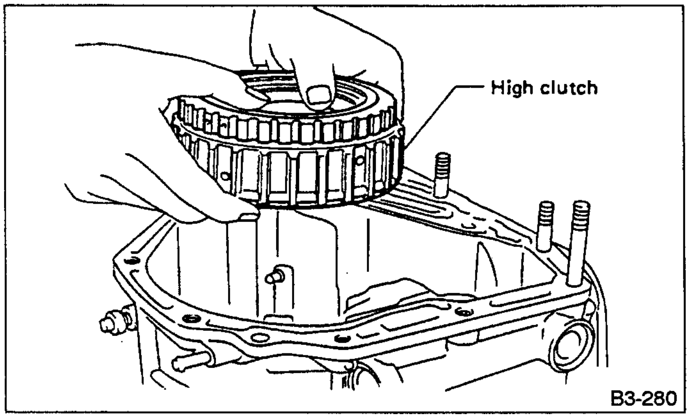



*Fig. 146*

**Needle bearing is removed together with high clutch. Be careful not to lose it.**

16) Take out the high clutch hub.

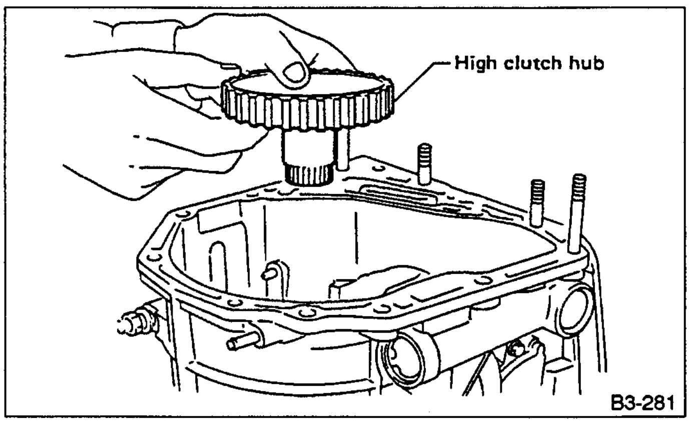



*Fig. 147*

17) Take out the front sun gear.

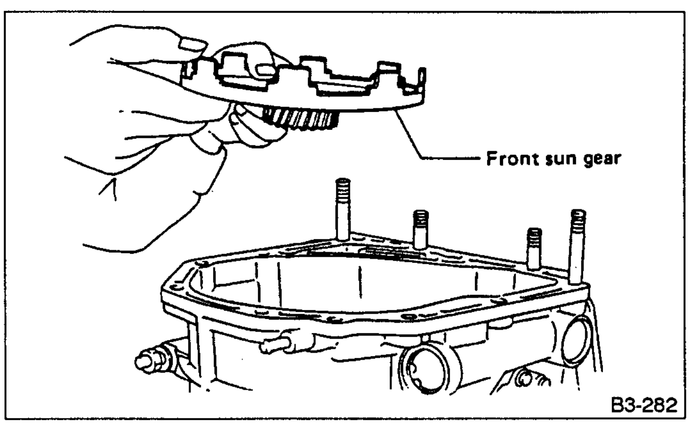



*Fig. 148*

18) Take out the front planetary carrier.

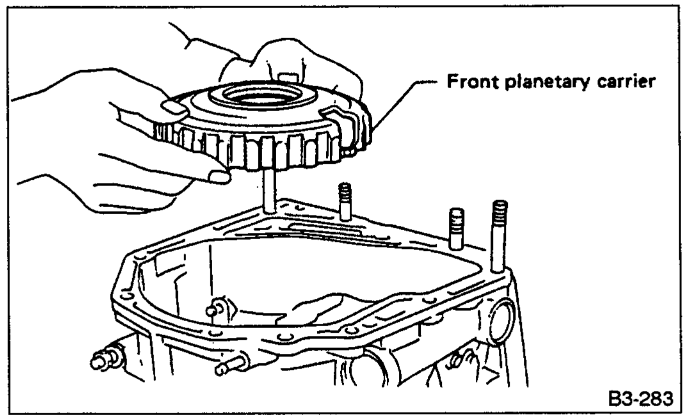



*Fig. 149*

19) Take out the rear planetary carrier and rear sun gear.

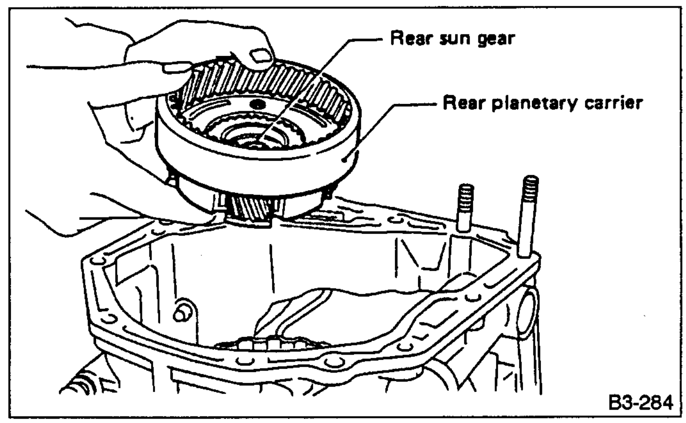



*Fig. 150*

20) Take out the rear internal gear.

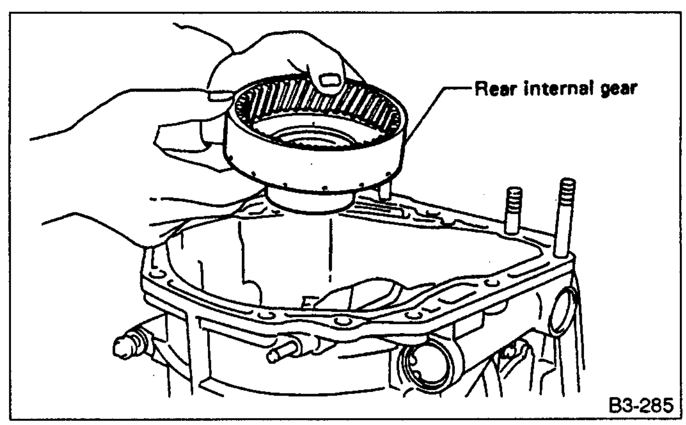



*Fig. 151*

21) Take out the one-way clutch outer race.

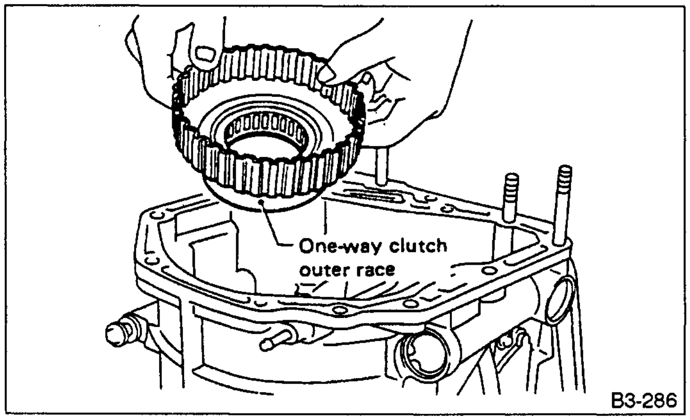



*Fig. 152*

22) Take out the overrunning clutch hub.

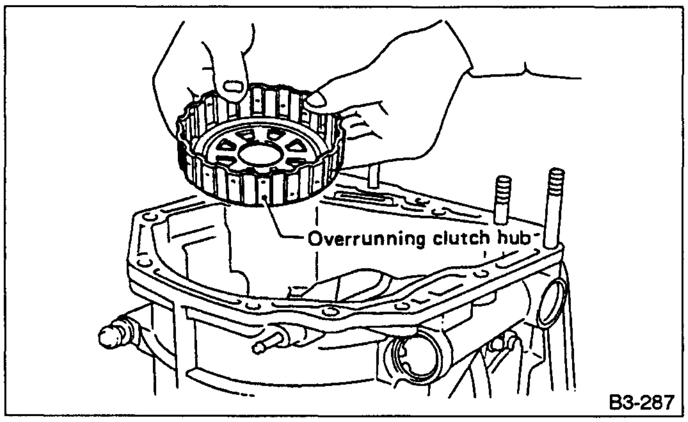



*Fig. 153*

23) Take out the forward clutch drum.

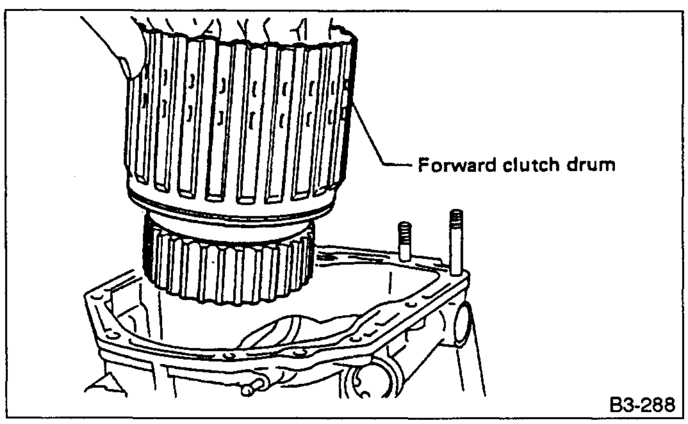



*Fig. 154*

24) Take out the low & reverse brake section.

- Remove the snap ring. Then remove the retaining plate, drive plates, driven plates, and dish plates as a unit.

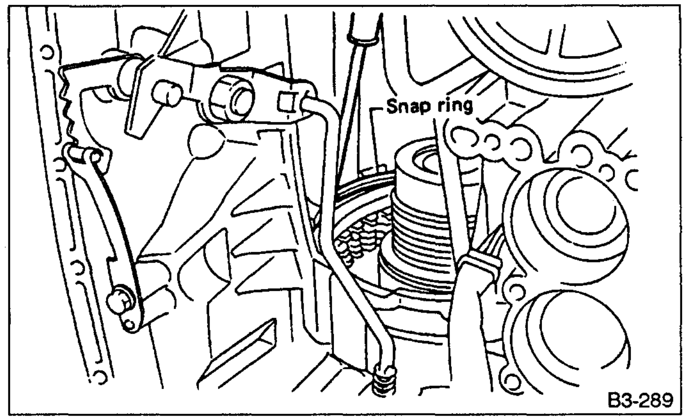



*Fig. 155*

- Turning the case upside down, take out the one-way clutch inner race and spring retainer CP.

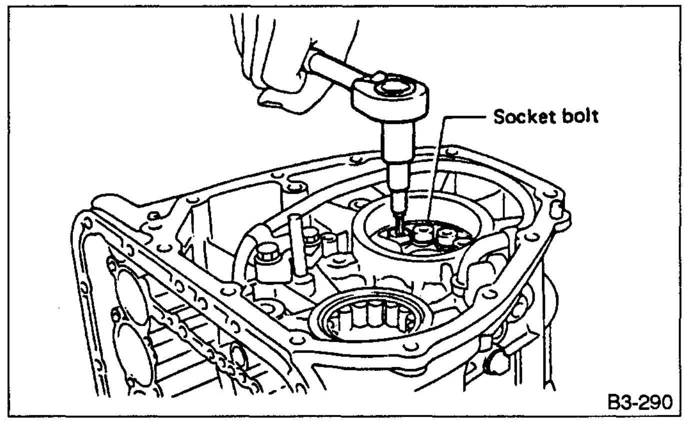



*Fig. 156*

- Take out the low & reverse piston by applying compressed air.

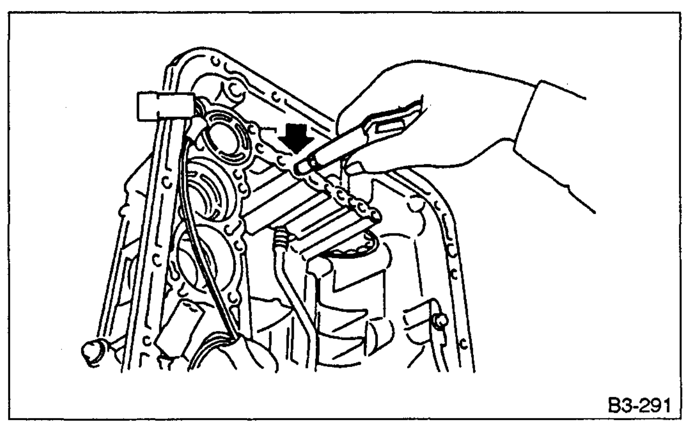



*Fig. 157*

25) After removing the snap ring (inner), take out the servo piston by applying compressed air from the release pressure side.

**Hold the servo piston with a rag so that it will not be ejected with the air pressure. In this case, do not allow your finger to be pinched between the pipe and retainer.**

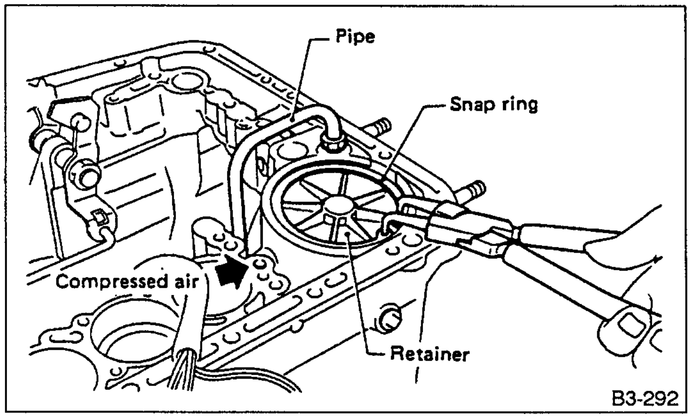



*Fig. 158*

26) Apply compressed air from the operating pressure side, and take out accumulator (3-4), accumulator (1-2), accumulator (2- 3), and accumulator (N-D).

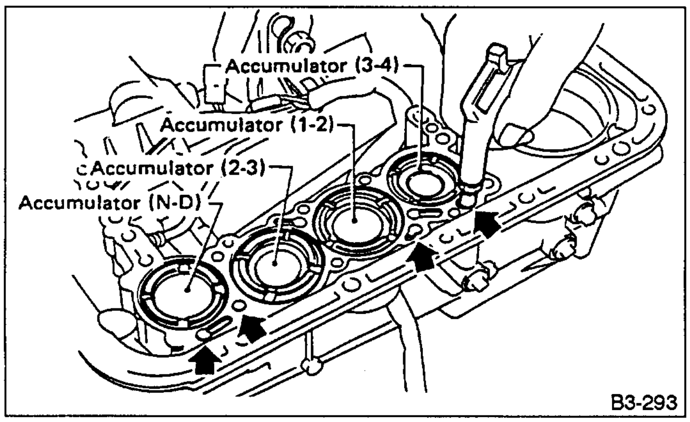



*Fig. 159*

27) Remove the range selector lever.
28) Remove the detent spring.

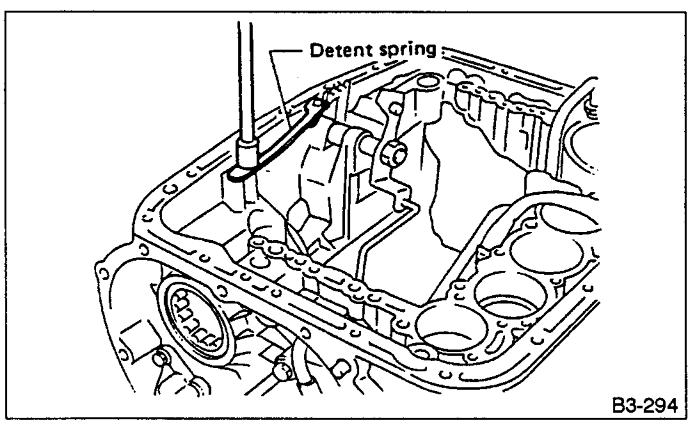



*Fig. 160*

29) Remove the parking rod together with the manual lever. Then remove the manual shaft by pulling off the straight pin.
**Be careful not to damage the lips of the press-fited oil seal in the case.**

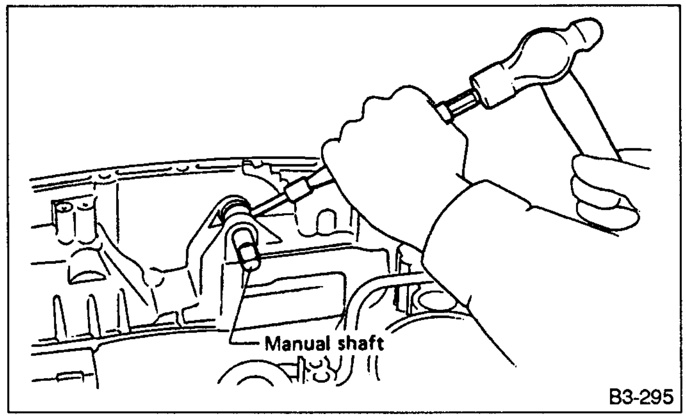



*Fig. 161*

30) Remove the inhibitor switch.

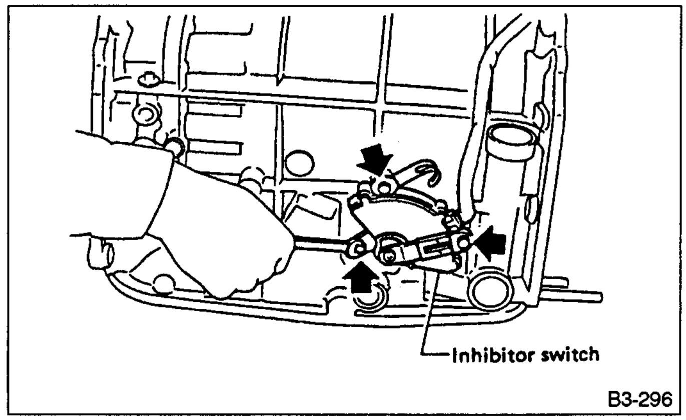



*Fig. 162*

31) Remove the transmission harness.
**Be careful not to damage the cord insulation.**

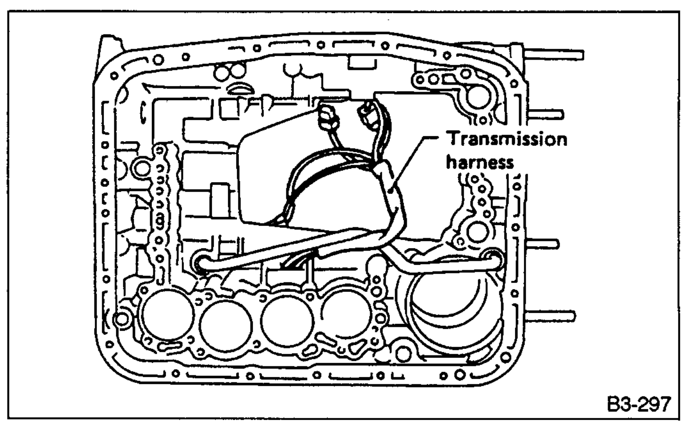



*Fig. 163*

## 4. CONVERTER CASE SECTION

1) Wrap the axle-shaft serration with vinyl tape.

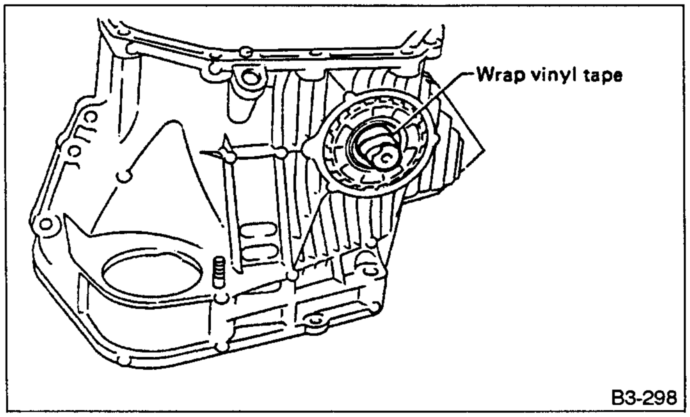



*Fig. 164*

2) Remove the differential side retainer.

**Hold the differential case ASSY by hand to avoid damaging retainer mounting hole of the converter case and speedometer gears.**

3) Extract the axle shaft.

**Do not reuse the circlip.**

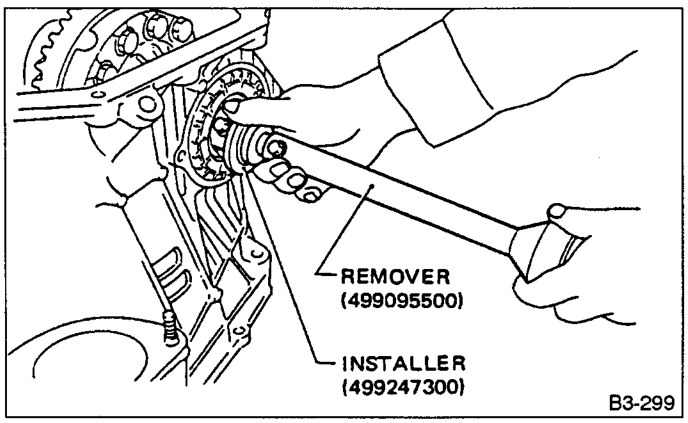



*Fig. 165*

4) Remove the differential case ASSY.

**a. Remove the seal pipe if it is attached. (Reusing is not allowed.)**

**b. Be careful not to damage the retainer mounting hole of the converter case and the speedometer gears.**

5) Remove the vehicle speed sensor 2.

**a. Pay attention so as not to forget to remove the sensor key and packing from the converter case.**

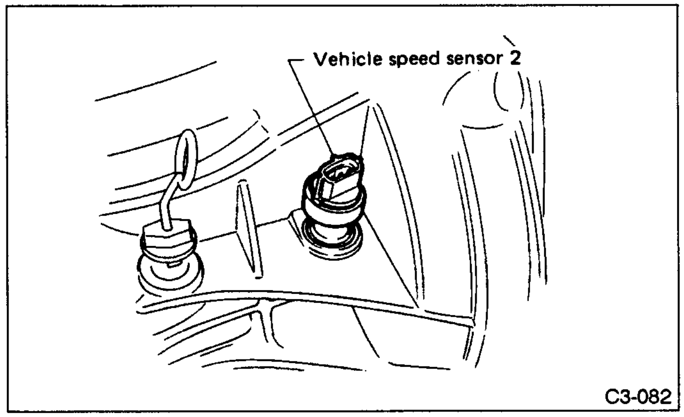



*Fig. 166*

6) Remove the snap ring. Then remove the speedometer driven gear.

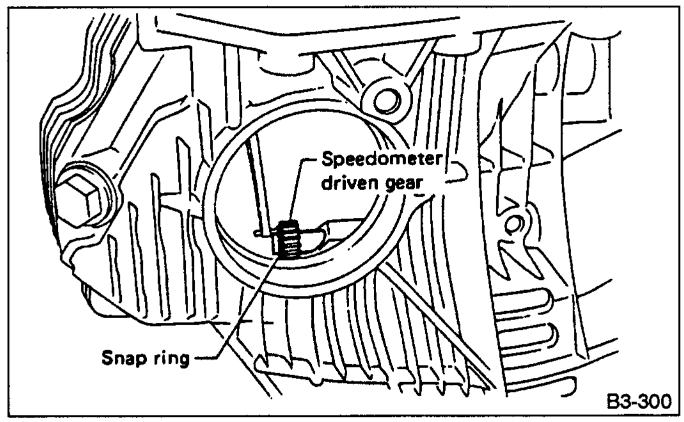



*Fig. 167*

7) Tap out the speedometer shaft to the outside of the case, and remove the oil seal.

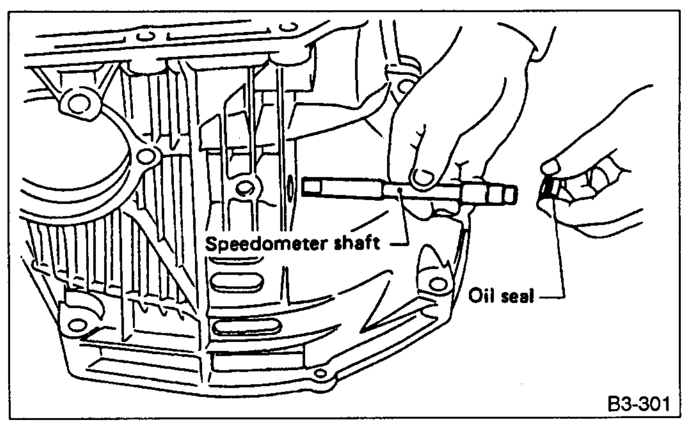



*Fig. 168*

## 5. EXTENSION SECTION

1) Take out the transfer clutch by lightly tapping the end of the rear drive shaft.

**Be careful not to damage the oil seal in the extension.**

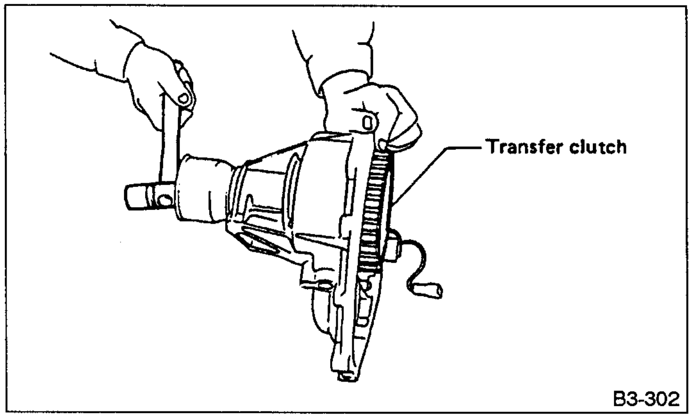



*Fig. 169*

2) Remove the transfer pipe.
**Be careful not to bend the pipe.**

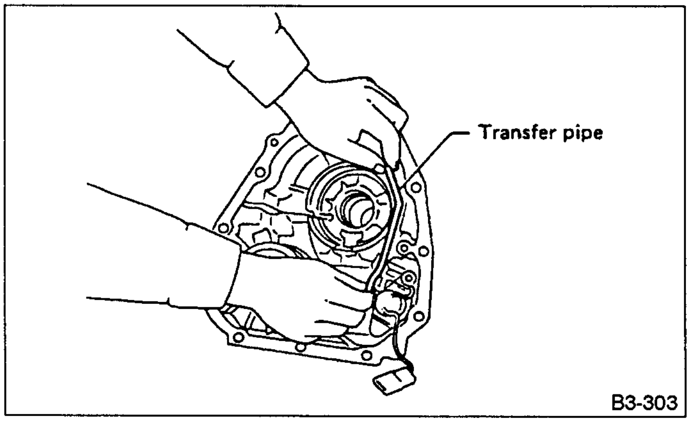



*Fig. 170*

3) Remove duty solenoid C and the transfer valve body.
**a. Take out the inlet filter.**
**b. Do not damage the O-ring.**

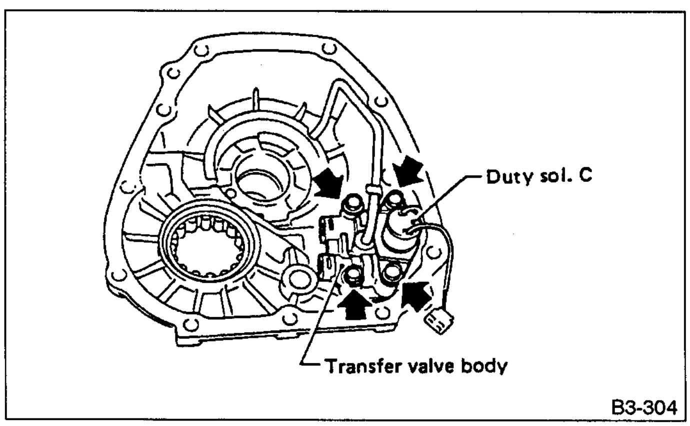



*Fig. 171*

4) Take out the roller bearing.

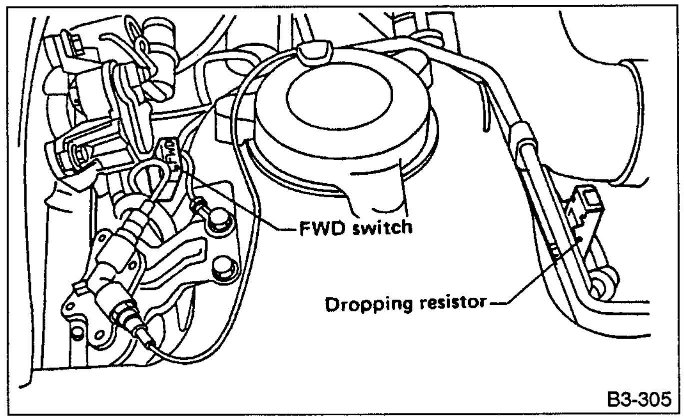



*Fig. 172*

## B: ASSEMBLY OF OVERALL TRANSMISSION

### 1. CONVERTER CASE SECTION

1) Check the appearance of each component and clean.
**Make sure each part is free of harmful cuts, damage and other faults.**
2) Install the washer and snap ring to the speedometer shaft, and set the oil seal. Then force-fit the shaft to the converter case.

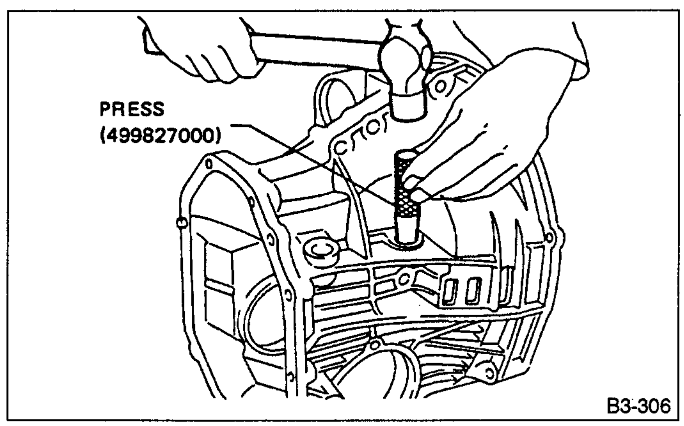



*Fig. 173*

3) Install the speedometer driven gear to the speedometer shaft, and secure with a snap ring.

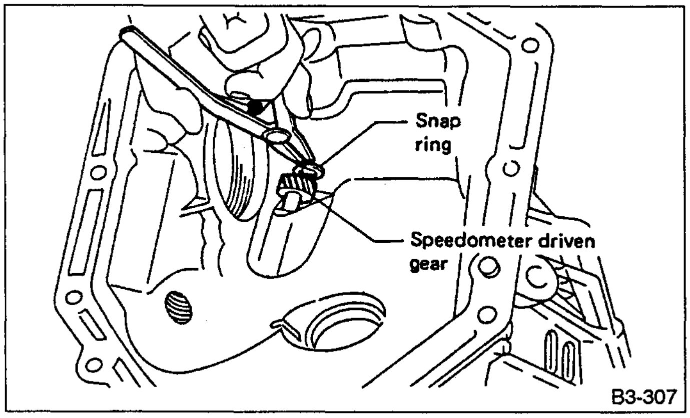



*Fig. 174*

4) Install the vehicle speed sensor 2.

**a. Apply grease to the tip of the sensor key on its sensor side so that the key will not drop when assembling.**

**b. Fit the sensor key tip correctly in the key groove at the tip of the speedometer shaft in the converter case.**

5) Force-fit the oil seal to the converter case.

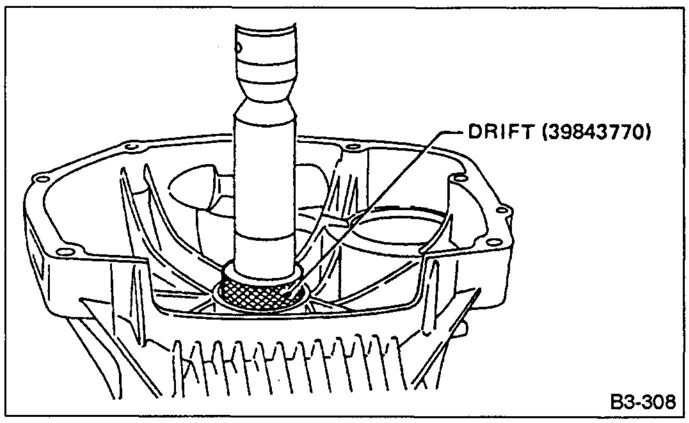



*Fig. 175*

6) Install the differential ASSY to the case, paying special attention not to damage the speedometer gears (drive and driven) and the inside of the case (particularly, the differential side retainer contact surface).

7) Install the circlip to the axle shaft, insert the shaft into the differential assembly, and tap it into position with a plastic hammer.

**Thrust play:**
**Approx. 0.3 — 0.5 mm (0.012 — 0.020 in)**

**a. If no play is felt, check whether the shaft is fully inserted. If shaft insertion is correct, replace the axle shaft.**

**b. Be sure to use a new circlip.**

8) Wrap vinyl tape around the splined portion of the axle shaft.

9) Install the oil seal and outer race (taper roller bearing) to the differential side retainer. Then screw in the retainer after coating the threads with oil.

**a. Pay attention not to damage the oil seal lips.**

**b. Do not confuse the RH and LH oil seals.**

**c. Keep the O-ring removed from the retainer.**

10) Using the HANDLE (499787000), screw in the retainer until light contact is felt.

**Screw in the RH side slightly deeper than the LH side.**

11) Hypoid gear backlash adjustment and tooth contact check

(1) Assemble the drive pinion assembly to the oil pump housing.

**a. Be careful not to bend the shims.**

**b. Be careful not to force the pinion against the housing bore.**

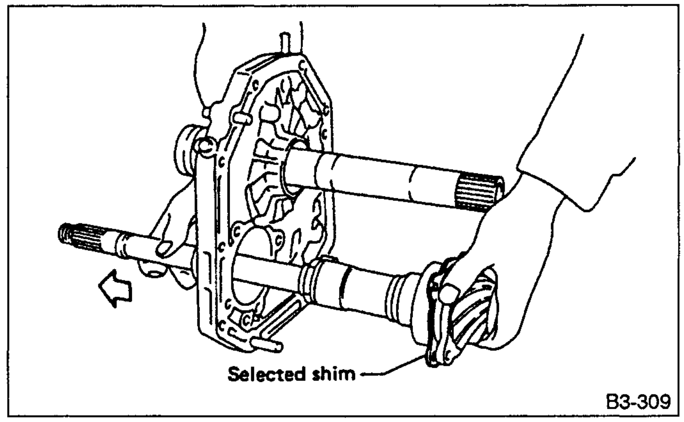



*Fig. 176*

(2) Tighten four bolts to secure the roller bearing.

**Tightening torque:**
**36 — 42 N·m (3.7 — 4.3 kg-m, 27 — 31 ft-lb)**

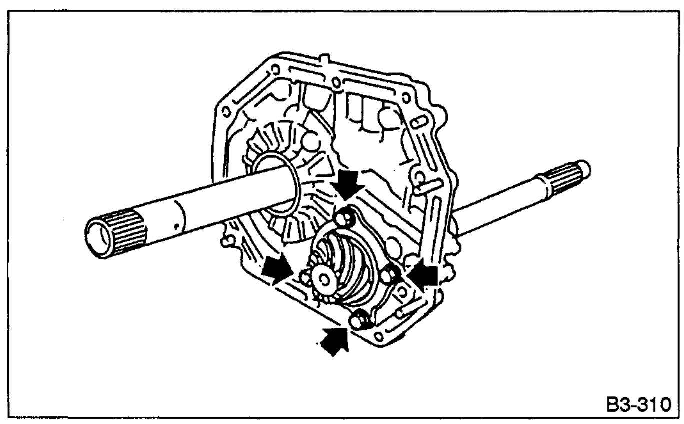



*Fig. 177*

(3) Install the oil pump housing assembly to the converter case, and secure evenly by tightening four bolts.

**Tightening torque:**
**30 — 36 N·m (3.1 — 3.7 kg-m, 22 — 27 ft-lb)**

**a. Thoroughly remove the liquid gasket from the case mating surface beforehand.**
**b. Use an old gasket or an aluminium washer so as not to damage the mating surface of the housing.**

(4) Rotate the drive pinion several times.

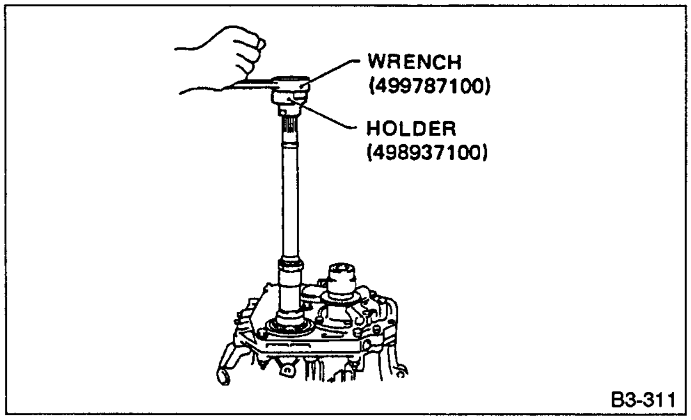



*Fig. 178*

(5) Tighten the LH retainer until contact is felt while rotating the shaft. Then loosen the RH retainer. Keep tightening the LH retainer and loosening the RH retainer until the pinion shaft can no longer be turned. This is the "zero" state.

(6) After the "zero" state is established, back off the LH retainer 3 notches and secure it with the locking tab. Then back off the RH retainer and retighten until it stops. Repeat this procedure several times. Tighten the RH retainer 1-3/4 notches further. This sets the preload. Finally, secure the retainer with its locking tab.

**Turning the retainer by one tooth changes the backlash about 0.05 mm (0.0020 in).**

(7) Turn the drive pinion several rotations and check to see if the backlash is within the standard value.

**Backlash:**
**0.13 — 0.18 mm (0.0051 — 0.0071 in)**

After confirming that the backlash is correct, check the tooth contact.

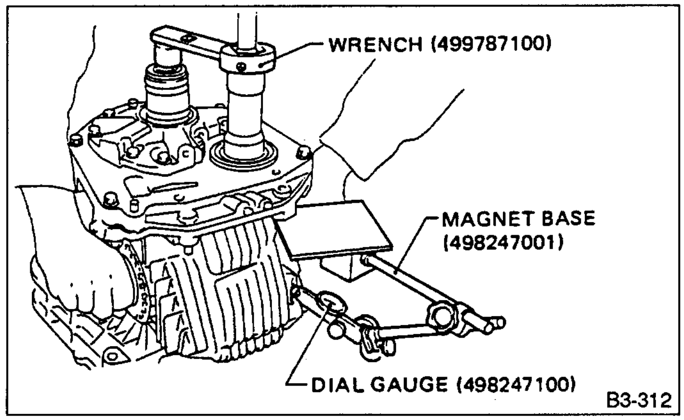
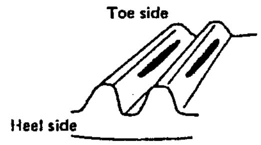
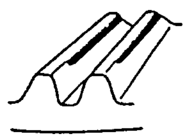
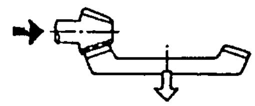
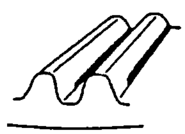
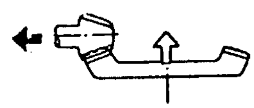
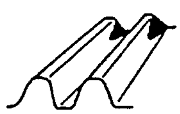
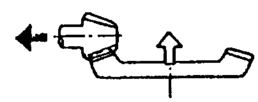
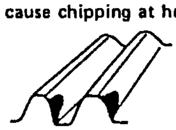
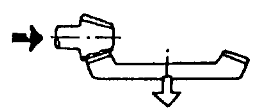



*Fig. 179*

(8) Apply red lead evenly to the surfaces of three or four teeth of the crown gear. Rotate the drive pinion in the forward and reverse directions several times. Then remove the oil pump housing, and check the tooth contact pattern.
If tooth contact is improper, readjust the backlash or shim thickness.

➡ : Adjusting direction of drive pinion ⇨ : Adjusting direction of crown gear

| Checking item | Contact pattern | Corrective action |
|---|---|---|
| Correct tooth contact<br>Tooth contact pattern slightly shifted toward toe under no-load rotation.<br>(When loaded, contact pattern moves toward heel.) |  | |
| Face contact<br>Backlash is too large. | <br>This may cause noise and chipping at tooth ends. | <br>Increase thickness of drive pinion height adjusting shim in order to bring drive pinion close to crown gear. |
| Flank contact<br>Backlash is too small. | <br>This may cause noise and stepped wear on surfaces. | <br>Reduce thickness of drive pinion height adjusting shim in order to move drive pinion away from crown gear. |
| Toe contact<br>(Inside end contact) | <br>Contact area is small. This may cause chipping at toe ends. | Adjust as for flank contact.<br> |
| Heel contact<br>(Outside end contact) | Contact area is small.<br>This may cause chipping at heel ends.<br> | Adjust as for face contact.<br> |

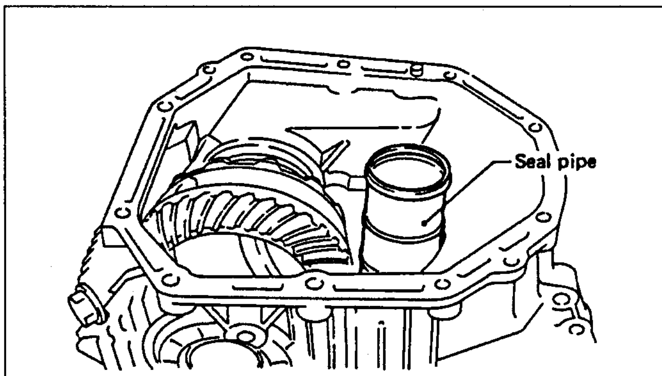
B3-313

*Fig. 180*

(9) If tooth contact is correct, mark the retainer position and loosen it. After fitting the O-ring, screw in the retainer to the marked position. Then tighten the lock plate to the specified torque.

**Tightening torque:**
**23 — 26 N·m (2.3 — 2.7 kg-m, 17 — 20 ft-lb)**

12) Install the seal pipe to the converter case.
**Be sure to use a new seal pipe.**




B3-314

*Fig. 181*

13) Install two oil seals to the oil seal retainer with INSTALLER (499247300).

**a. Pay attention to the orientation of the oil seals.**
**b. Be careful not to damage the seal lips. If any damage is found, replace with a new one.**

14) Attach the O-ring to the oil seal retainer with vaseline. Install the seal to the oil pump housing bore.

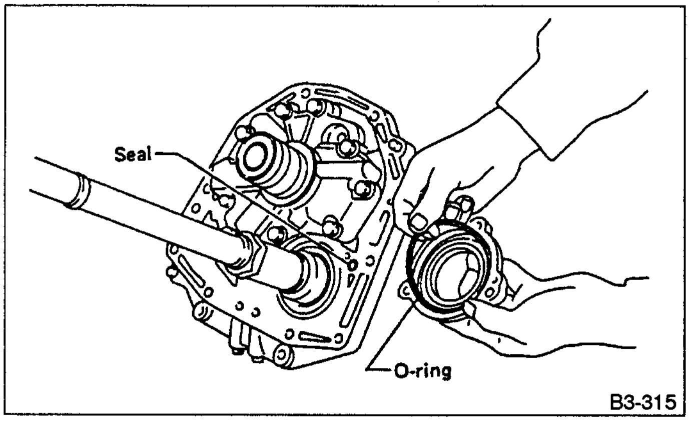



*Fig. 182*

15) Install the oil seal retainer taking care not to damage the oil seal lips. Then secure with three bolts.
**Make sure the O-ring is fitted correctly in position.**

**Tightening torque:**
**6 — 8 N·m (0.6 — 0.8 kg-m, 4.3 — 5.8 ft-lb)**

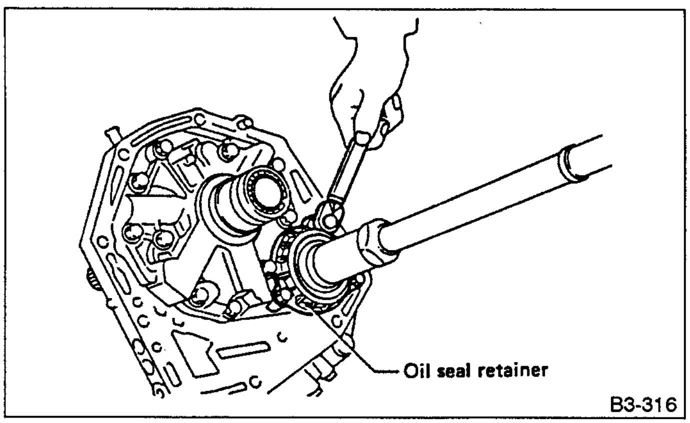



*Fig. 183*

16) Apply vaseline to the groove on the oil pump cover, and install two (R) seal rings and two (H) seal rings.
**a. Fit the seal ring after compressing, and rub vaseline into the seal ring to avoid expansion.**
**b. The "R" seal ring has a large diameter, while "H" has small diameter.**

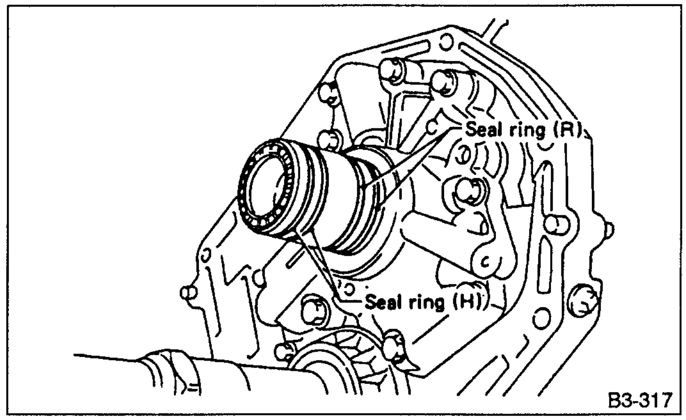



*Fig. 184*

17) Install the rubber seal to the converter case.
**Be careful not to lose the rubber seal.**

## 2. TRANSMISSION CASE SECTION

1) Press-fit the roller bearing to the transmission case.

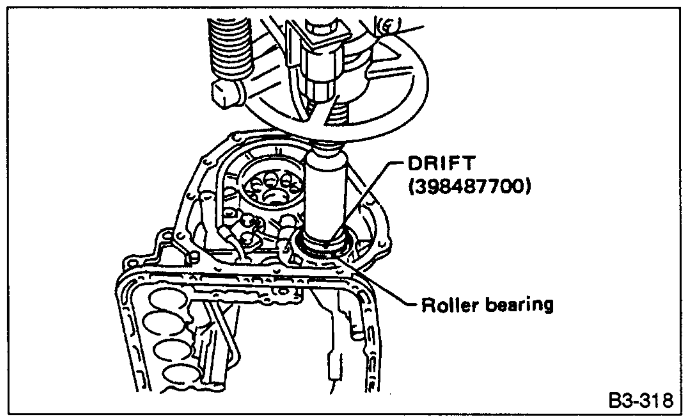



*Fig. 185*

2) Using a plastic hammer, force-fit the oil seal.

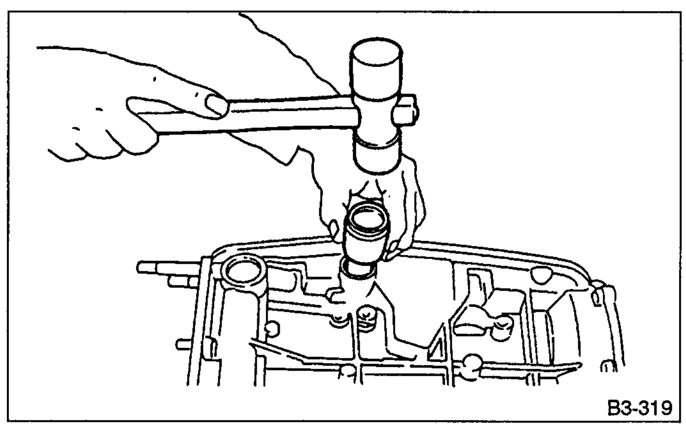



*Fig. 186*

3) Install the manual plate and shaft, and secure with a spring pin.
**a. Be careful not to damage the oil seal lip.**
**b. After installation, make sure of smooth movement.**

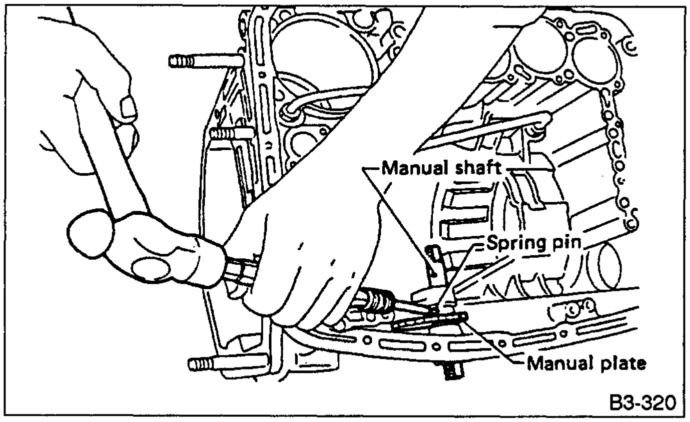



*Fig. 187*

4) Assemble the manual lever and parking rod to the inside shaft, and secure with a nut.

**Tightening torque:**
**36 — 42 N•m (3.7 — 4.3 kg-m, 27 — 31 ft-lb)**

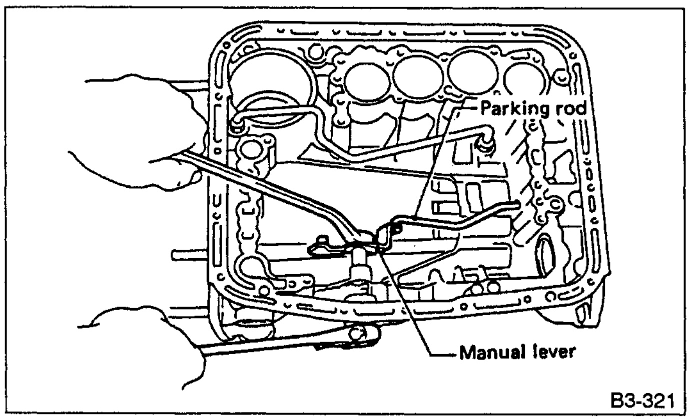



*Fig. 188*

5) Install the detent manual spring.
**Position the spring so that its center is aligned with the center of the manual plate.**

**Tightening torque:**
**5 — 7 N•m (0.5 — 0.7 kg-m, 3.6 — 5.1 ft-lb)**

6) Install the lathe cut seal ring and lip seal to the I.D./O.D. of the low & reverse piston. Then install the piston into the case with a press.
**a. Be careful not to tilt the piston when installing.**
**b. Be careful not to damage the lip seal.**

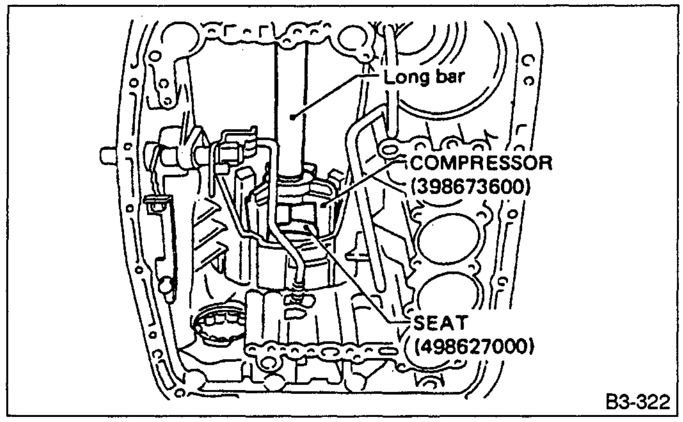



*Fig. 189*

7) Install the one-way clutch inner race.
(1) Using a press, install the thrust needle bearing to the inner race.

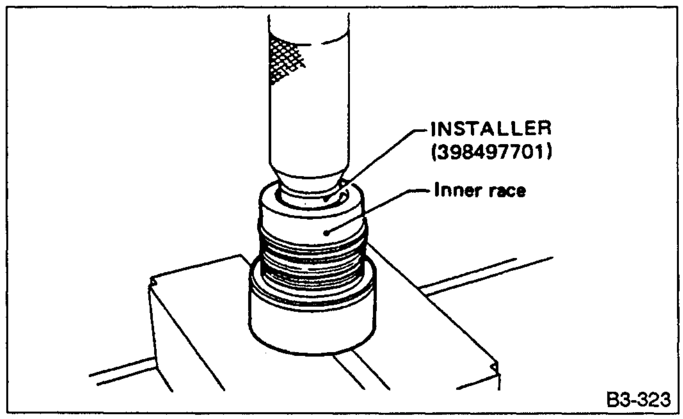



*Fig. 190*

**Use the PULLER ASSY (398527700) when removing.**
(2) Install four seal rings.
**Apply vaseline to the groove of the inner race and to the seal ring after installation, so that the seal ring will not expand.**
(3) Place the spring retainer CP on the inner race. Install the spring to the recessed portion of the piston. Then tighten eight socket head bolts from the rear side of the transmission case.

**Tightening torque:**
**23 — 26 N•m (2.3 — 2.7 kg-m, 17 — 20 ft-lb)**

**Be sure to tighten evenly.**

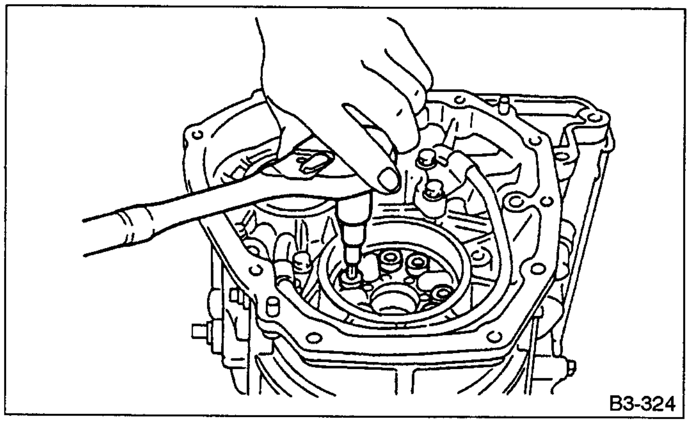



Fig. 191

8) Install the band servo sub ASSY.
9) Press the O.D. servo retainer into position, and secure with a snap ring.

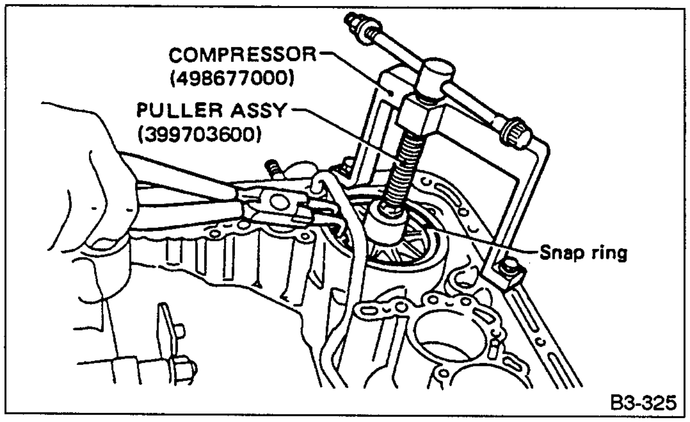



Fig. 192

- **Perform the following operations with the transmission case set vertically on wooden blocks.**

10) Installation of the low & reverse brake:

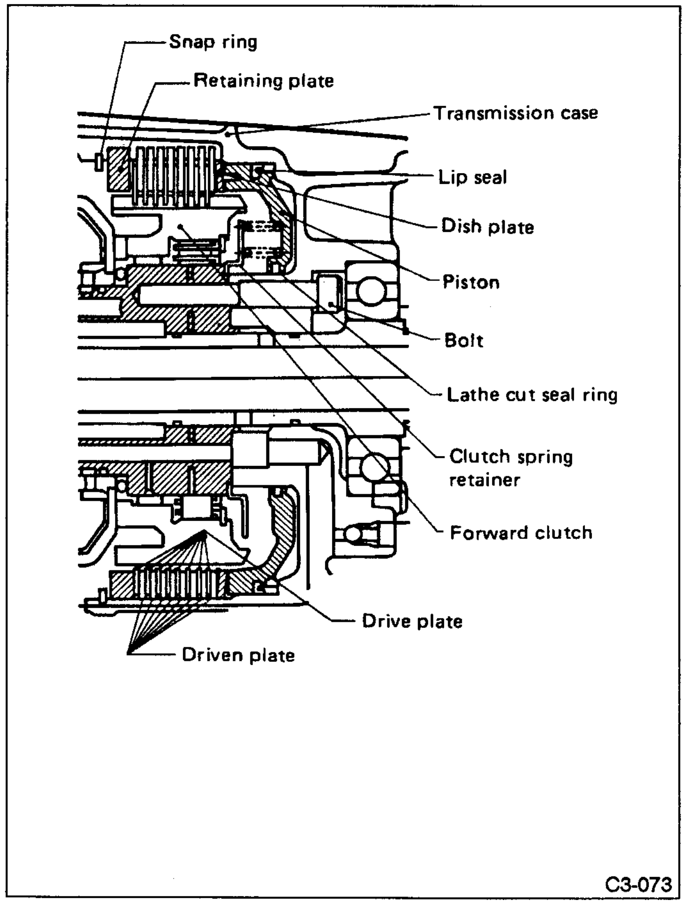



Fig. 193

(1) Install two dish plates, driven plates, drive plates, and a retaining plate, and secure with a snap ring.

**a. Pay attention to the orientation of the dish plate.**
**b. Driven plate : 8**
**Drive plate : 8**
**c. Dish plate : 1**

(2) Apply compressed air intermittently to check for operation.

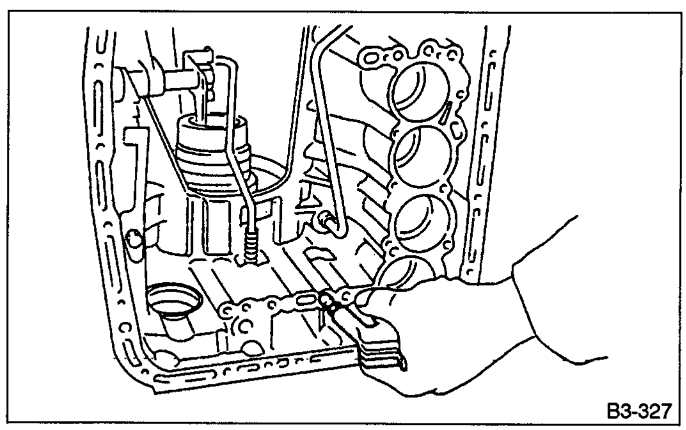



Fig. 194

(3) Check the clearance (Selection of retaining plate)

**Standard value:**
**1.1 — 1.7 mm (0.043 — 0.067 in)**
**Allowable limit: 2.7 mm (0.106 in)**

**Before measuring clearance, place the same thickness of shim on both sides to prevent retaining plate from tilting.**

- **Available retaining plates**

| Part No. | Thickness mm (in) |
|---|---|
| 31667AA180 | 6.5 (0.256) |
| 31667AA190 | 6.8 (0.268) |
| 31667AA200 | 7.1 (0.280) |
| 31667AA210 | 7.4 (0.291) |
| 31667AA220 | 7.7 (0.303) |
| 31667AA230 | 8.0 (0.315) |
| 31667AA240 | 8.2 (0.323) |
| 31667AA250 | 8.4 (0.331) |

11) Install the thrust needle bearing to the inner race.
12) Install the forward clutch drum ASSY.
(1) Install carefully while rotating the drum slowly paying special attention not to damage the seal ring.
(2) Installation is complete when the drum recedes 2.5 mm (0.098 in) from the inner race surface.

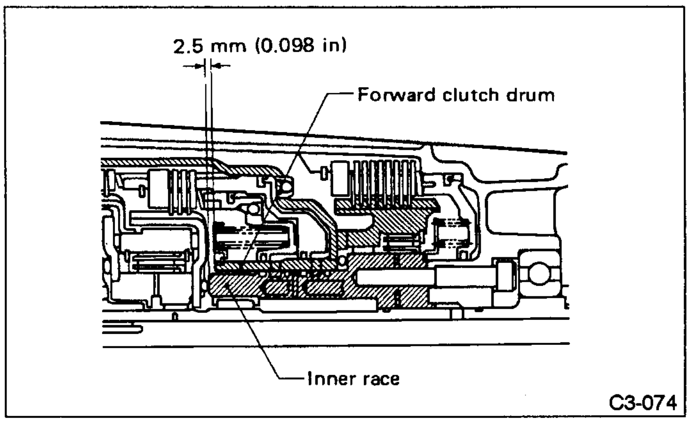



*Fig. 195*

13) Assemble the overrunning clutch hub.
**a. Join the thrust needle bearing and thrust washer with vaseline, and then install them together.**
**b. Make sure that the splines are engaged correctly.**

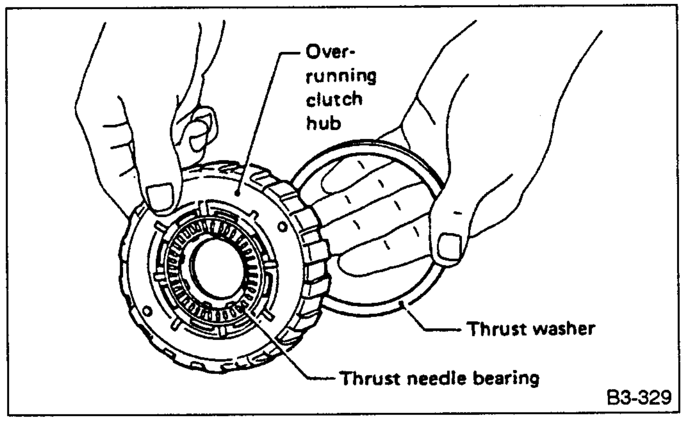



*Fig. 196*

14) Install the one-way clutch outer race ASSY.
**Make sure the forward clutch splines are engaged correctly.**

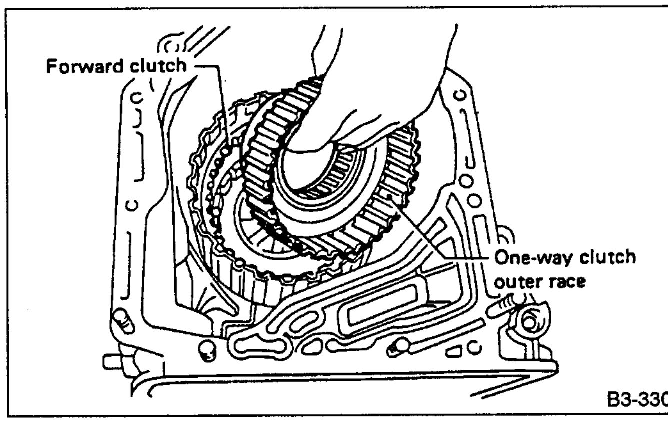



*Fig. 197*

15) Assemble the rear internal gear.
(1) Join the thrust needle bearing and thrust washer to the gear with vaseline, and install the gear while rotating it.
(2) Securely engage the bearing with the dog of the overrunning clutch hub.

**Installation is complete when the snap ring top surface of the forward clutch drum recedes approximately 3.5 mm (0.138 in).**

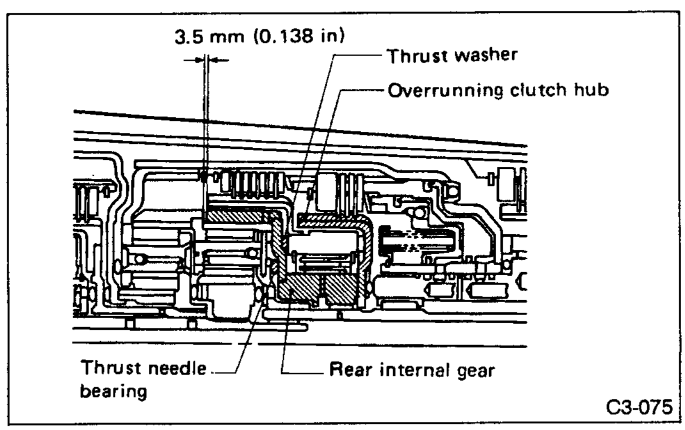



*Fig. 198*

16) Install the rear planetary carrier.
Attach the thrust needle bearing to the inside of the carrier with vaseline. Then install the carrier while rotating slowly.

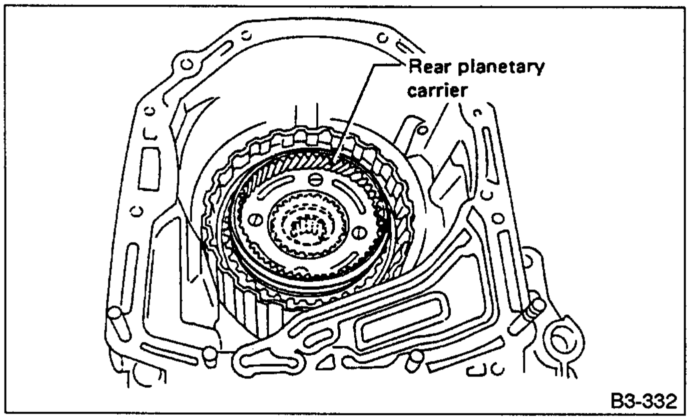



*Fig. 199*

17) Install the rear sun gear.
**Install the gear with the oil hole facing up.**

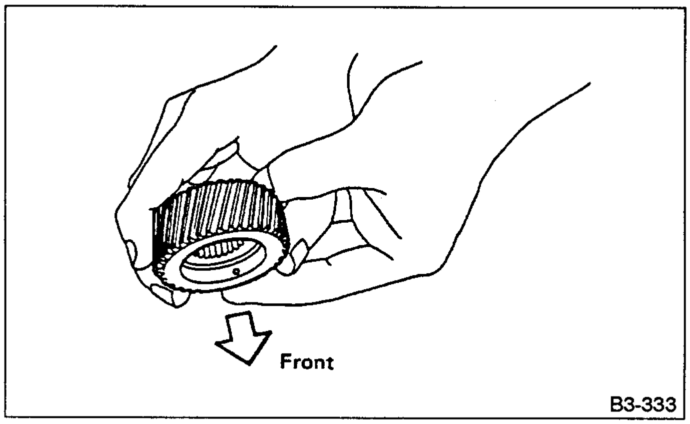



*Fig. 200*

18) Install the front planetary carrier.
Attach the thrust needle bearings to both sides of the carrier with vaseline. Install the carrier carefully, while aligning with the splines of the forward clutch drum, and while rotating the pinion.

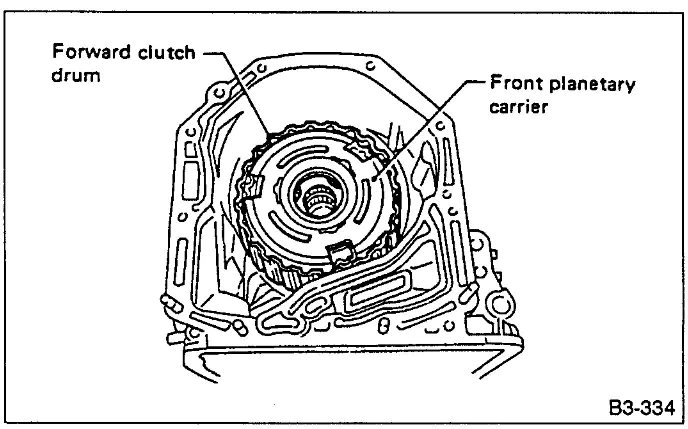



*Fig. 201*

19) Install the front sun gear.
Attach the thrust needle bearing to the gear, and install the gear while turning slowly.

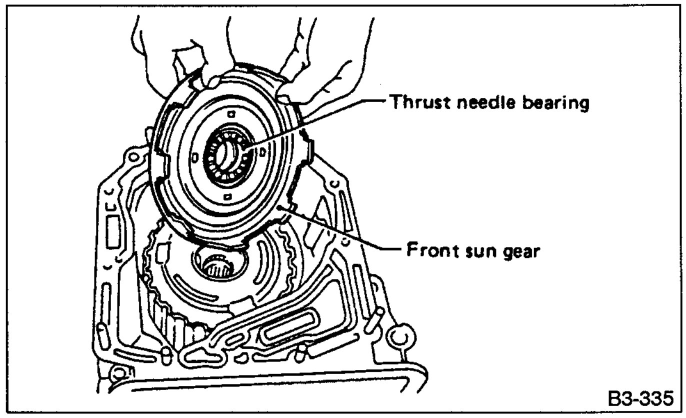



*Fig. 202*

20) Install the high clutch hub.
Attach the thrust needle bearing to the hub with vaseline and install the hub by correctly engaging the splines of the front planetary carrier.

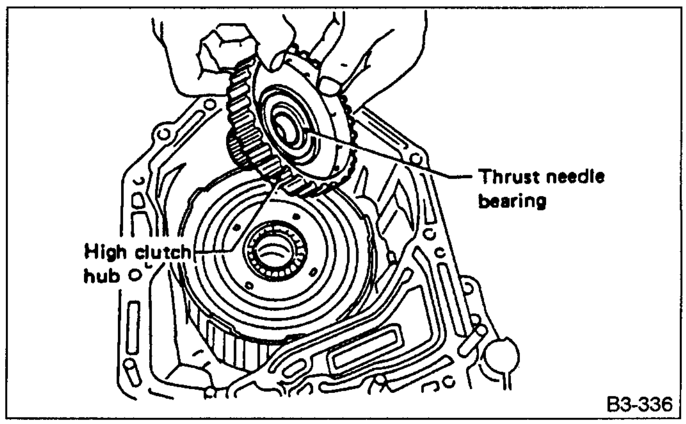



*Fig. 203*

21) Install the high clutch ASSY.
**Correctly engage the high clutch hub and clutch splines.**

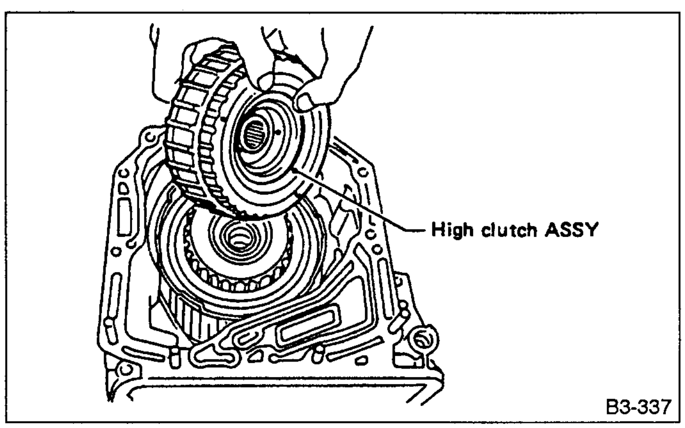



*Fig. 204*

22) Install the reverse clutch ASSY.

**Engage the high clutch outer spline with the reverse clutch spline and the front sun gear with the cut-out portion of the reverse clutch drum correctly when installing.**

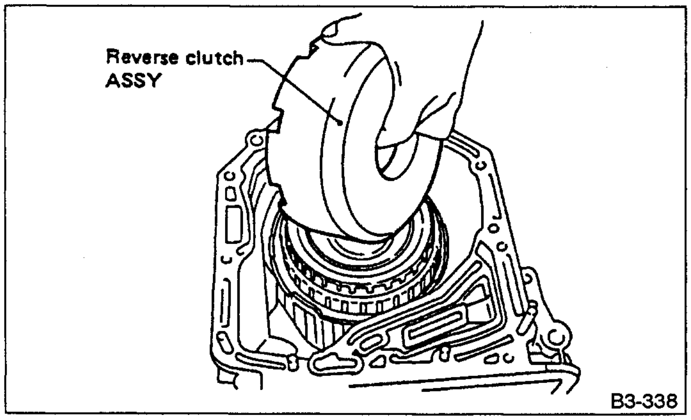



*Fig. 205*

23) Install the brake band ASSY.

**a. Be careful not to damage the brake band when installing.**

**b. Install the strut to the band servo piston stem. Then tighten it temporarily to avoid tilting the band.**

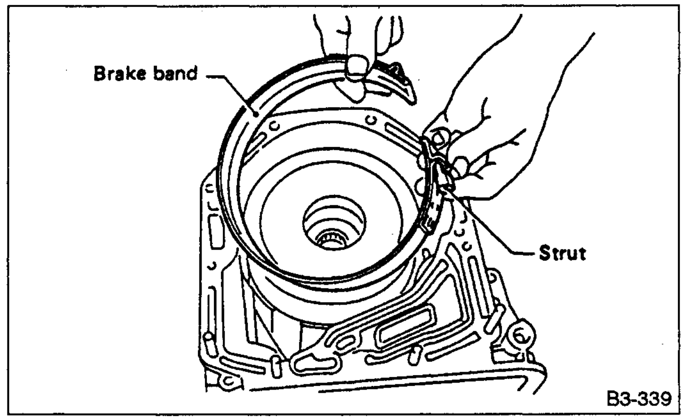



*Fig. 206*

24) Adjustment of total end play and reverse clutch end play

(1) Measure the distance from the transmission case mating surface to the recessed portion of the high clutch drum "L", and the distance to the top surface of the reverse clutch drum "M".

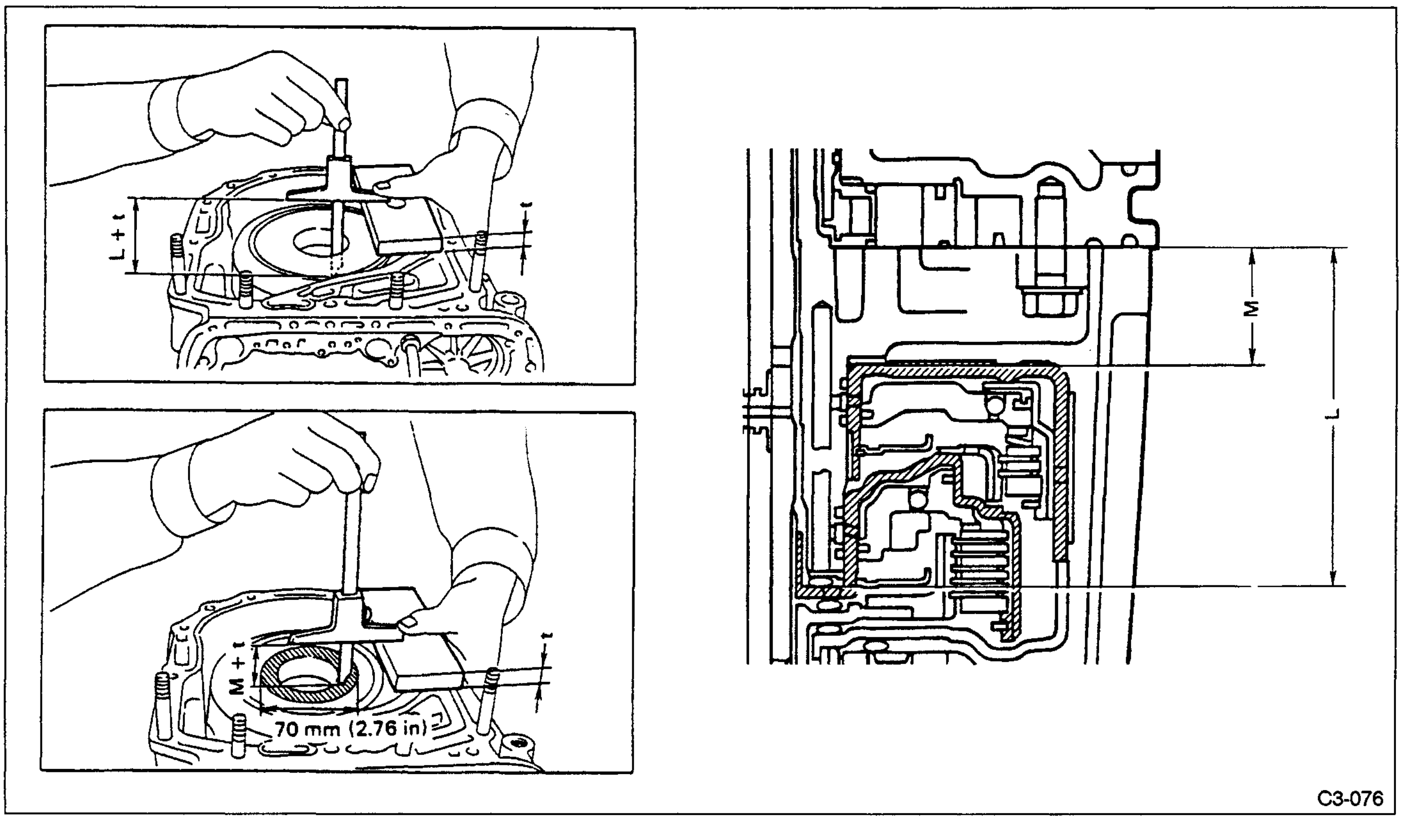



*Fig. 207*

(2) Measure the distance from the oil pump housing mating surface to the top surface of the oil pump cover with needle bearing, and to the thrust surface of the reverse clutch.

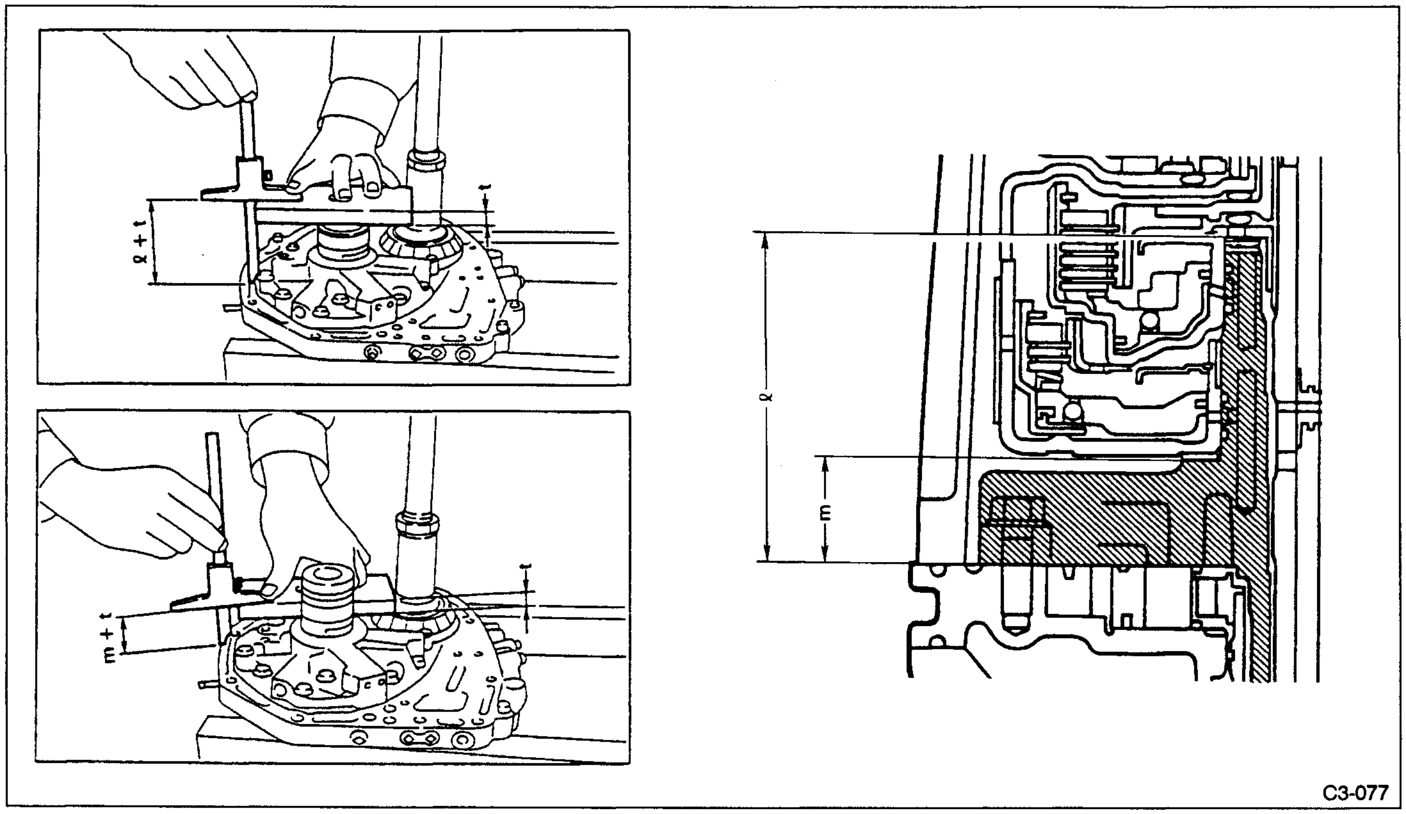



*Fig. 208*

(3) Equation for calculation

- Total end play — Unit: mm

$$C = (L + 0.4) - \ell$$

C : Clearance between concave portion of high clutch and end of clutch drum support
L : Length from case mating surface to concave portion of high clutch
0.4 : Gasket thickness
ℓ : Height from housing mating surface to upper surface of clutch drum support

Select suitable bearing race from among those listed in the following table so that clearance C is in the 0.25 — 0.55 mm (0.0098 — 0.0217 in) range.

| Part No. | Thickness mm (in) |
|---|---|
| 803031021 | 0.8 (0.031) |
| 803031022 | 1.0 (0.039) |
| 803031023 | 1.2 (0.047) |
| 803031024 | 1.4 (0.055) |
| 803031025 | 1.6 (0.063) |
| 803031026 | 1.8 (0.071) |
| 803031027 | 2.0 (0.079) |

- Reverse clutch end play — Unit: mm

$$C = (M + 0.4) - m$$

C : Clearance between oil pump housing hose and end of reverse clutch
M : Distance from case mating surface to upper surface of reverse clutch
0.4 : Gasket thickness
m : Height from housing mating surface to thrust-receiving area of reverse clutch

Select suitable thrust washer from among those listed in the following table so that clearance C is in the 0.55 — 0.9 mm (0.0217 — 0.0354 in) range.

| Part No. | Thickness mm (in) |
|---|---|
| 31299AA000 | 0.7 (0.028) |
| 31299AA010 | 0.9 (0.035) |
| 31299AA020 | 1.1 (0.043) |
| 31299AA030 | 1.3 (0.051) |
| 31299AA040 | 1.5 (0.059) |
| 31299AA050 | 1.7 (0.067) |
| 31299AA060 | 1.9 (0.075) |

25) Install the oil pump housing ASSY.

(1) After completing end play adjustment, insert the bearing race* in the recess of the high clutch. Attach the thrust washer and thrust needle bearing to the oil pump cover with vaseline.

(2) After correctly installing the gasket to the case mating surface, carefully install the oil pump housing ASSY. Be careful to avoid hitting the drive pinion against the inside of the case.

**a. Be careful not to damage the seal ring.**
**b. Be sure to use a new gasket.**

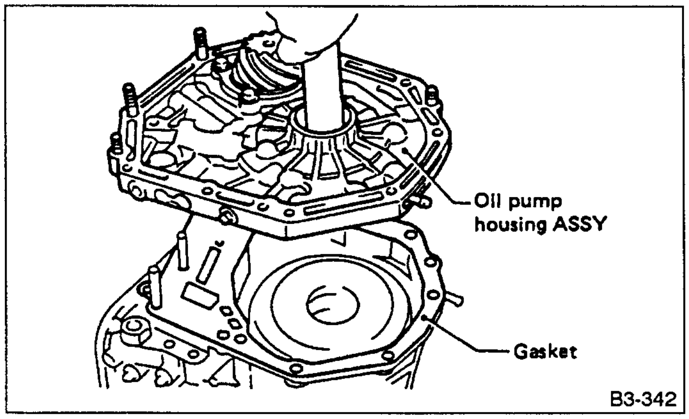



*Fig. 209*

(3) Install both parts with dowel pins aligned. Make sure no clearance exists at the mating surface.

**Any clearance suggests a damaged seal ring.**

(4) Secure the housing with two nuts.

**Tightening torque:**
**38 — 44 N•m (3.9 — 4.5 kg-m, 28 — 33 ft-lb)**

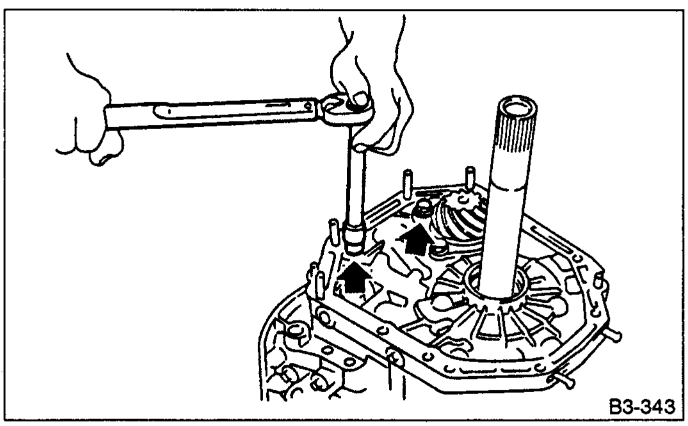



*Fig. 210*

## 3. CONVERTER CASE AND TRANSMISSION CASE

1) Apply proper amount of liquid gasket (Three-bond #1215) to the entire converter case mating surface.

**Make sure that the rubber seal and seal pipe are fitted in position.**

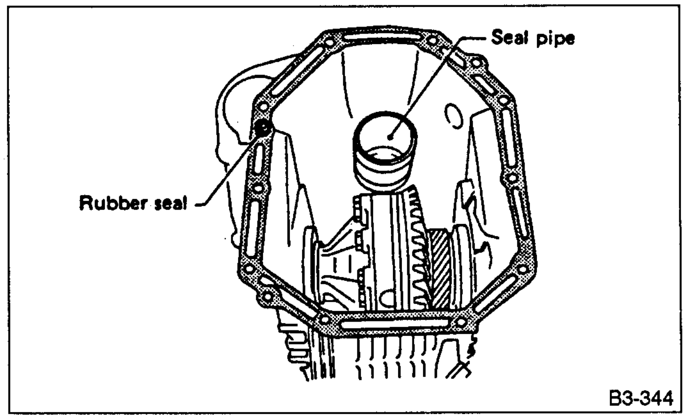



*Fig. 211*

2) Install the converter case ASSY to the transmission case ASSY, and secure with six bolts and four nuts.

**Tightening torque:**
**34 — 40 N•m (3.5 — 4.1 kg-m, 25 — 30 ft-lb)**

**When installing, be careful not to damage the converter case bushing and oil seal.**

## 4. CONTROL VALVE AND OIL PAN

1) Install four accumulators with oil pans facing upward.

**Be careful not to confuse the springs and installation positions.**

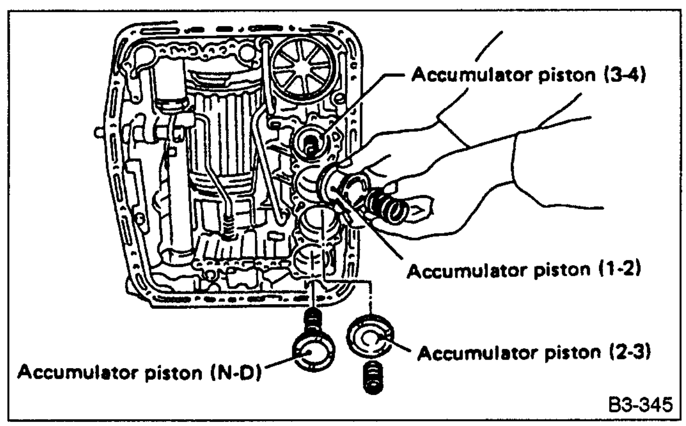



*Fig. 212*

- Spring spec.

Unit: mm (in)

| Accumulator spring | Outer diameter | Free length |
|---|---|---|
| 1 — 2 | 28.5 (1.122) | 44.5 (1.752) |
| 2 — 3 | 20.5 (0.807) | 31.0 (1.220) |
| 3 — 4 | 17.3 (0.681) | 43.7 (1.720) |
| N — D | 17.8 (0.701) | 36.5 (1.437) |

2) Install and route the transmission harness.

**Be careful not to damage the harness.**

3) Install the control valve ASSY.

(1) Set the selector lever in range "2".

(2) Install the control valve by engaging the manual valve and manual lever, then tighten the 19 bolts.

**Tighting torque:**
**7 — 9 N•m (0.7 — 0.9 kg-m, 5.1 — 6.5 ft-lb)**

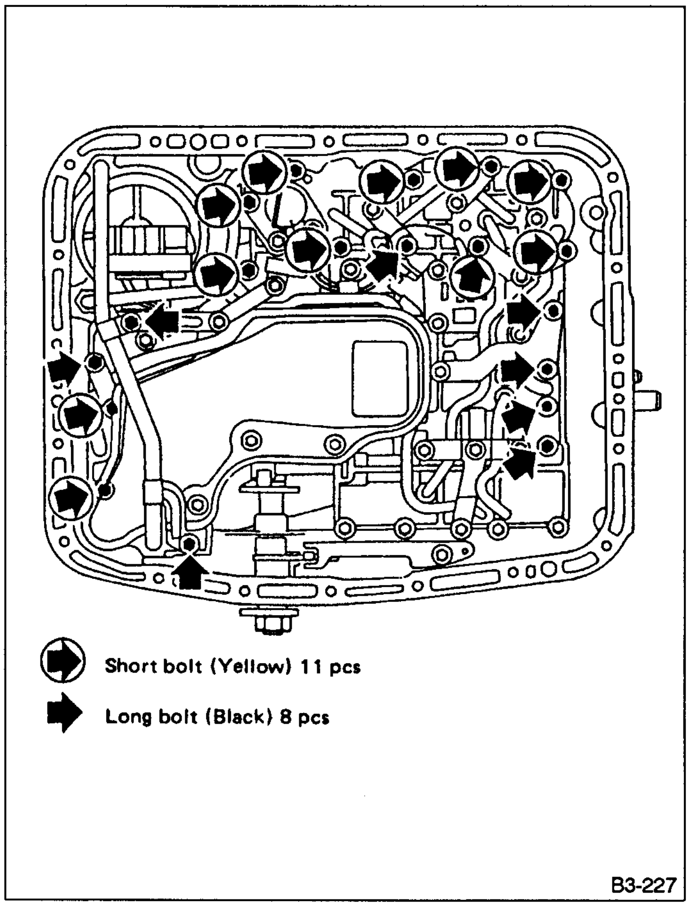



*Fig. 213*

**a. Be careful not to pinch the harness roll the gasket.**
**b. Tighten the control valve mounting bolts evenly.**

4) Install the oil strainer to the control valve. Be careful not to cut or break the O-ring. Then tighten bolts.

**Tightening torque:**
**7 — 9 N•m (0.7 — 0.9 kg-m, 5.1 — 6.5 ft-lb)**

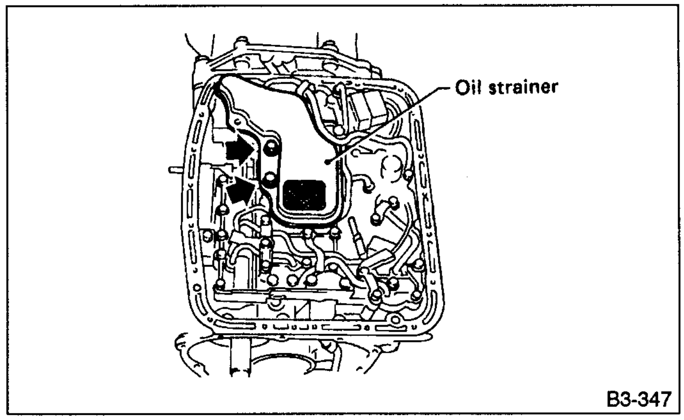



*Fig. 214*

5) Secure five connectors.

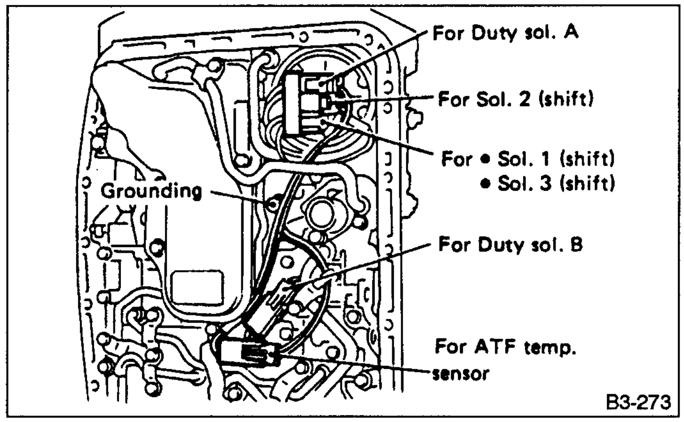



*Fig. 215*

6) Install the oil cooler outlet pipe, and secure with two bolts.

**Tightening torque:**
**7 — 9 N•m (0.7 — 0.9 kg-m, 5.1 — 6.5 ft-lb)**

**Fit the pipe into position. Be careful to avoid twisting.**

7) Install the oil pan.
(1) Attach the magnet at the specified position.

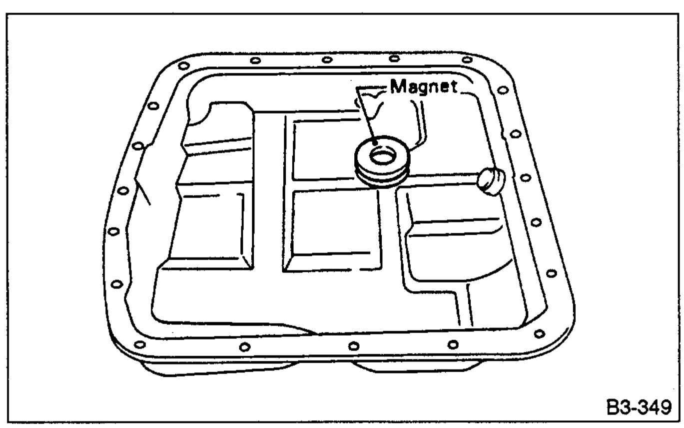



*Fig. 216*

**Tightening torque:**
**3.4 — 4.4 N·m (0.35 — 0.45 kg-m, 2.5 — 3.3 ft-lb)**

**Tighten the bolts evenly.**

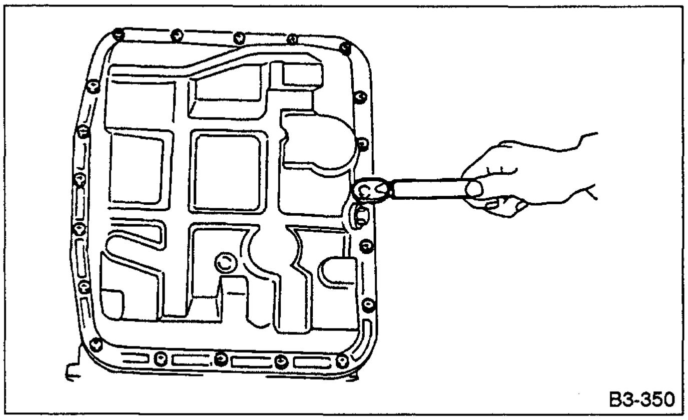



*Fig. 217*

## 5. EXTENSION SECTION

**When installing new oil seal into extension case, press it with INSTALLER (498057300).**

1) Install the filter in the extension case.

**Pay attention to the orientation of the filter.**

2) Install the transfer clutch valve ASSY, and secure with four bolts.

**Tightening torque:**
**7 — 9 N·m (0.7 — 0.9 kg-m, 5.1 — 6.5 ft-lb)**

**a. Be sure to tighten the going lead with one of these bolts.**
**b. Be sure to use a new gasket.**

3) Install the pipe, and clamp securely.
4) Install the transfer clutch assembly to the case.

**a. Be careful not to damage the seal rings.**
**b. Insert the clutch assembly fully into position until the bearing shoulder bottoms.**

## 6. CONNECTION OF EACH SECTION

1) Install the reduction driven gear.
2) Install the parking pawl and shaft, set the selector lever in the "P" range and tighten the drive pinion lock nut.

**Tightening torque:**
**93 — 103 N·m (9.5 — 10.5 kg-m, 69 — 76 ft-lb)**

**After tightening, stake the lock nut securely.**

3) Install the reduction drive gear ASSY.

**Insert it fully into position until the bearing shoulder bottoms.**

4) Measurement and adjustment of extension end play
(1) Measure distance L from end of extension case and rear drive shaft.

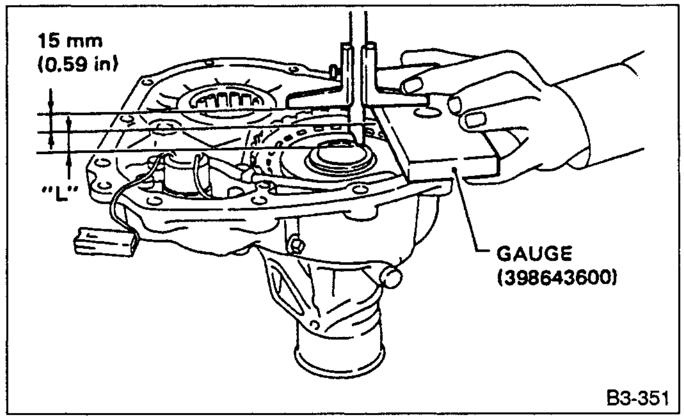



*Fig. 218*

| L = Measured value — 15 |
|---|

(2) Measure the distance "$\ell$" from the transmission case mating surface to the reduction drive gear end surface.

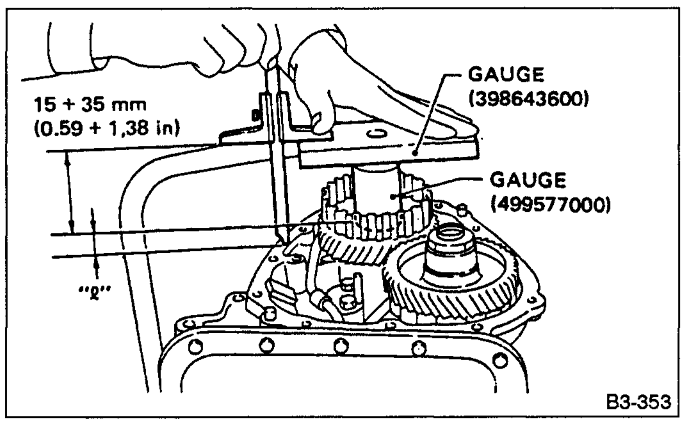



*Fig. 219*

| $\ell$ = Measured value — 50 |
|---|

(3) Calculation equation: Unit: mm

| T = (L + 0.4) — $\ell$ |
|---|

T : Clearance between end of reduction drive gear and end of rear drive shaft.

L : Distance from end of extension case to end of rear drive shaft.
0.4 : Gasket thickness
$\ell$ : Height from end of transmission case to end of reduction drive gear.

Select suitable thrust needle bearing from among those listed in the following table to adjust clearance in the 0.50 — 0.2 mm (0.0197 — 0.0079 in) range.

- AWD: Thrust needle bearing

| Part No. | Thickness mm (in) |
|---|---|
| 806535020 | 3.8 (0.150) |
| 806535030 | 4.0 (0.157) |
| 806535040 | 4.2 (0.165) |
| 806535050 | 4.4 (0.173) |
| 806535060 | 4.6 (0.181) |
| 806535070 | 4.8 (0.189) |
| 806535090 | 5.0 (0.197) |

Select from one to five shims so that clearance is within specifications.

5) Installation of extension case and transmission case.
AWD model:
(1) Attach the selected thrust needle bearing to the end- surface of reduction drive gear with vaseline.
(2) Set the parking return spring.
(3) Remove the transfer clutch from the extension case.
Set the needle bearing on the reduction drive shaft and then install transfer clutch to the transfer clutch hub. **Be sure to engage the spline teeth correctly.**
(4) With gasket inserted between them, install the extension case to the transmission case. (Be sure to use a new gasket.)

**a. After inserting the extension case halfway, connect the connector for duty sol. C. Be careful not to jam the cord in the case.**

**b. Be careful not to damage the rear drive shaft seal ring.**

(5) Tighten bolts to secure the case.

**Tightening torque:**
**23 — 26 N•m (2.3 — 2.7 kg-m, 17 — 20 ft-lb)**

## 7. EXTERNAL PARTS

1) Install the vehicle speed sensor 1.

**Tightening torque:**
**6 — 8 N•m (0.6 — 0.8 kg-m, 4.3 — 5.8 ft-lb)**

2) Installation and adjustment of inhibitor switch:
(1) Install the inhibitor switch to the transmission case. Fit the projecting portion of the switch in the recessed portion of the case, and tighten three bolts temporarily.
(2) Insert the range selector lever into the shaft, and tighten the nut.

**Tightening torque:**
**36 — 42 N•m (3.7 — 4.3 kg-m, 27 — 31 ft-lb)**

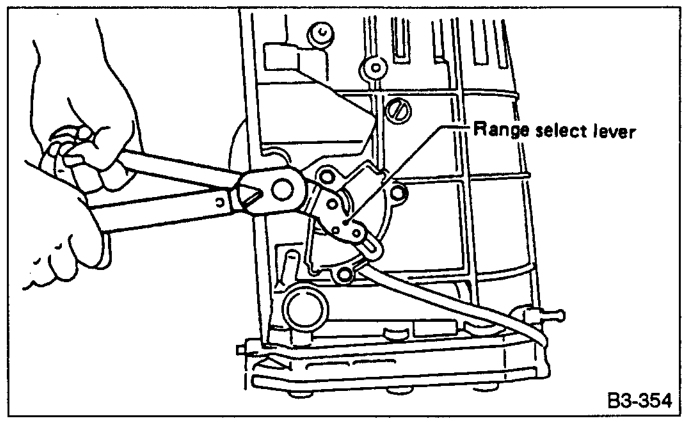



*Fig. 220*

(3) With the selector lever set to "N" adjust the inhibitor switch so that the hole of range selector lever is aligned with the inhibitor switch hole.

**Ensure that gauge moves properly.**

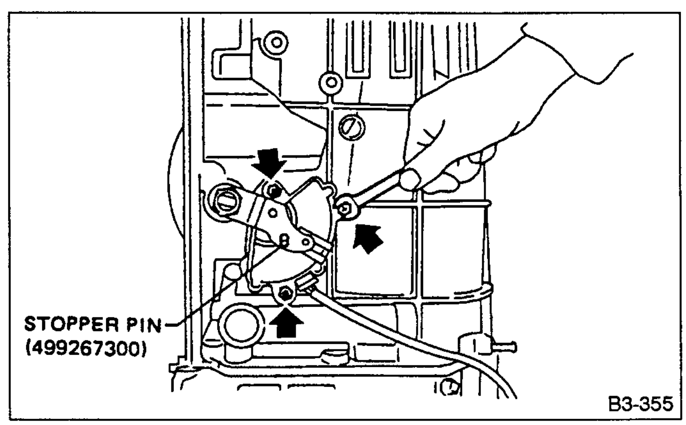



*Fig. 221*

(4) With hole aligned, tighten three bolts to secure the inhibitor switch.

**Tightening torque:**
**2.9 — 3.9 N•m (0.30 — 0.40 kg-m, 2.2 — 2.9 ft-lb)**

3) Connect the following cords and harness to bracket.
(1) Transmission harness
(2) Inhibitor switch cord
(3) Vehicle speed sensor 1 cord
4) Install the oil cooler outlet pipe.

**Tightening torque:**
**27.5 — 34.3 N•m (2.80 — 3.50 kg-m, 20.3 — 25.3 ft-lb)**

5) Install the oil cooler inlet pipe.

**Tightening torque:**
**23 — 26 N•m (2.3 — 2.7 kg-m, 17 — 20 ft-lb)**

**Be sure to use a new aluminum washer.**
6) Install the oil charge pipe.

**Tightening torque: N•m (kg-m, ft-lb)**
**UPPER**
**34 — 40 (3.5 — 4.1, 25 — 30)**
**LOWER**
**5.9 — 6.9 (0.60 — 0.70, 4.3 — 5.1)**

**Be careful not to damage the O-ring.**
7) Adjustment of brake band:
(1) After tightening the brake band adjusting screw to 9 N•m (0.9 kg-m, 6.5 ft-lb) torque, back it off three turns. Then secure with a lock nut.

**Tightening torque:**
**25 — 28 N•m (2.5 — 2.9 kg-m, 18 — 21 ft-lb)**

**When tightening the lock nut, be careful not to turn the adjusting screw.**
8) Install the pitching stopper bracket.

**Tightening torque:**
**36 — 42 N•m (3.7 — 4.3 kg-m, 27 — 31 ft-lb)**

9) Tighten the drain plugs.

**Tightening torque: N•m (kg-m, ft-lb)**
**Diff.**
**41 — 47 (4.2 — 4.8, 30 — 35)**
**ATF**
**23 — 26 (2.3 — 2.7, 17 — 20)**

10) Install the air breather hose.
11) Insert the input shaft while turning lightly by hand.
**Be careful not to damage the bushing.**

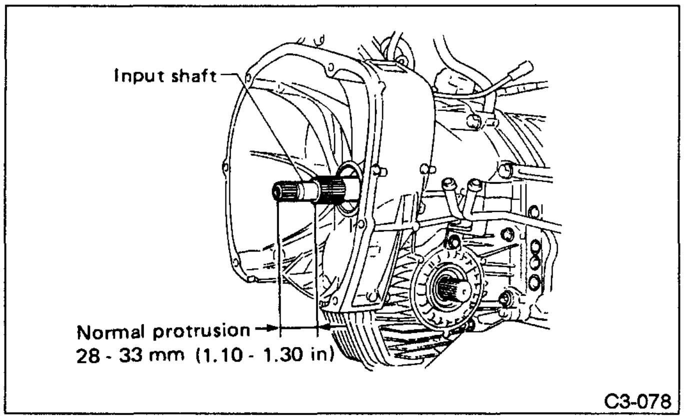



*Fig. 222*

12) Install the torque converter assembly.
(1) Install the oil pump shaft to the torque converter.
**Make sure the clip fits securely in its groove.**
(2) Holding the torque converter assembly by hand, carefully install it to the converter case. Be careful not to damage the bushing. Also, to avoid undue contact between the oil pump shaft bushing and stator shaft portion of the oil pump cover.
(3) Rotate the shaft lightly by hand to engage the splines securely.
13) Add oil:

**Specified quantity ℓ (US qt, Imp qt)**
**Diff.**
**1.3 — 1.5 (1.4 — 1.6, 1.1 — 1.3)**
**ATF**
**9.5 — 9.8 (10.0 — 10.4, 8.4 — 8.6)**

**After adding oil, insert the oil level gauge into the oil inlet.**

# 5. Reduction Drive Gear Assembly

## A: DISASSEMBLY

1) Take out the seal rings.

**Be careful not to damage the seal rings.**

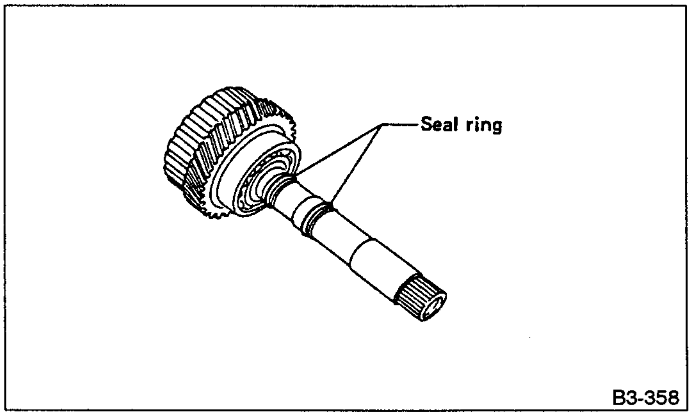



*Fig. 223*

2) Take out the snap ring (out).

**Be careful not to damage the splines.**

3) Using a press, remove the reduction drive gear.

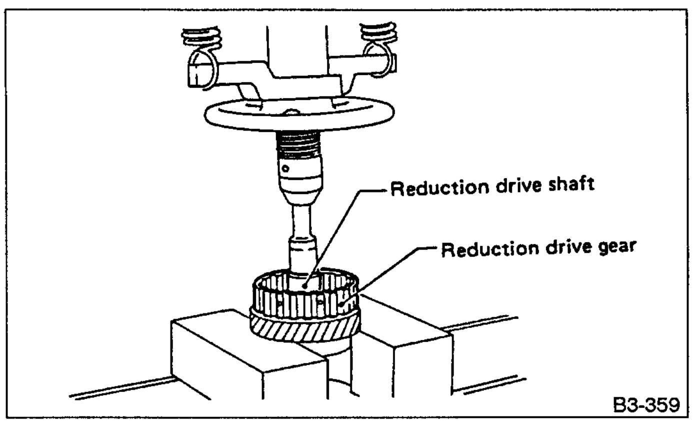



*Fig. 224*

4) Using a press, remove the ball bearing.

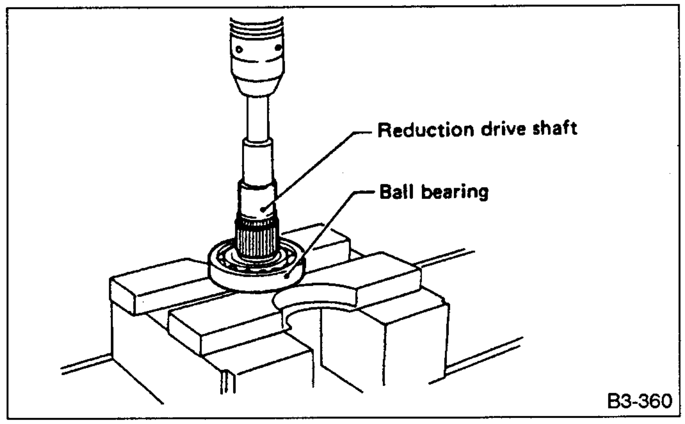



*Fig. 225*

## B: INSPECTION

Make sure that each component is free of harmful gouges, cuts, or dust.

## C: ASSEMBLY

1) Press-fit the ball bearing and reduction drive gear to the shaft.

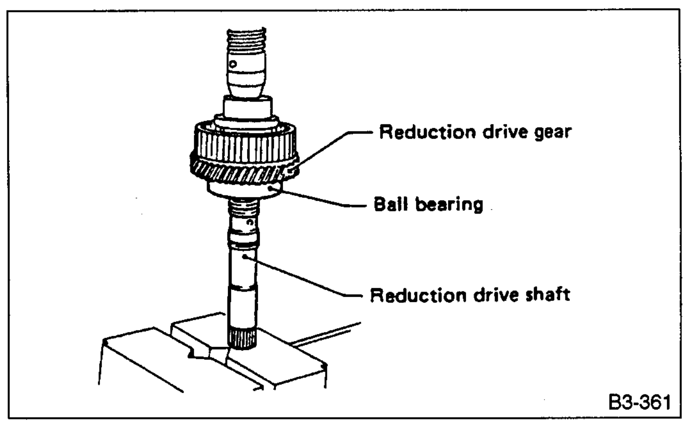



*Fig. 226*

2) Fit the snap ring securely in the snap ring grove on the shaft.

3) Attach two seal rings.

**To make subsequent assembly easier, apply vaseline to the grooves of the shaft and to the exterior of the seal ring.**

# 6. Control Valve Body

## A: DISASSEMBLY

1) Remove the following parts from the upper valve body.
   (1) Solenoid ASSY (shift 1-2-3)
   (2) Duty solenoid A (line pressure)

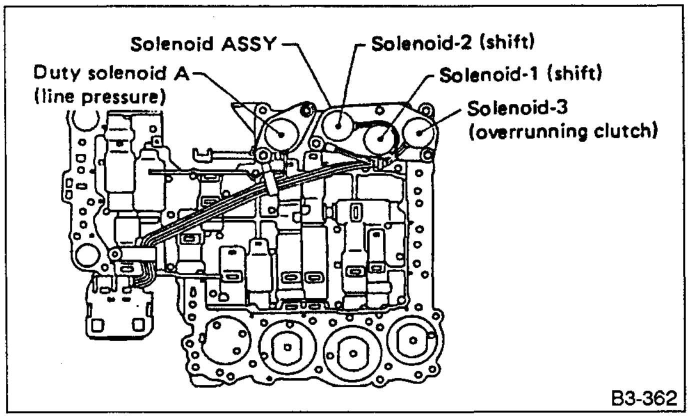



*Fig. 227*

2) Remove the following parts from the lower valve body.
   (1) Duty solenoid B (lock-up)
   (2) ATF temperature sensor

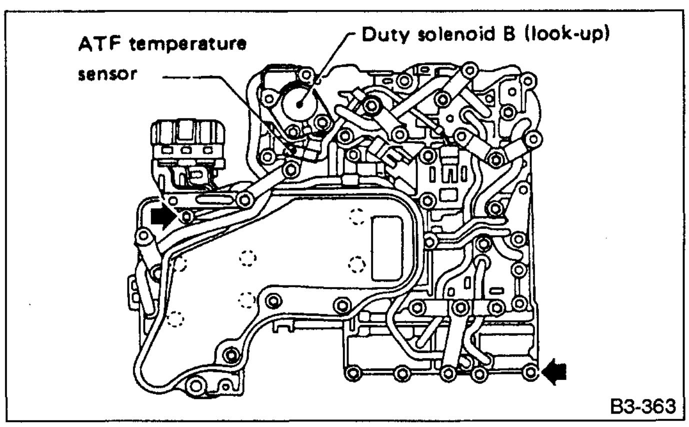



*Fig. 228*

3) Separate the upper valve body and lower valve body.
**a. Do not lose the nine (9) steel balls contained in the upper valve body.**
**b. Do not lose an orifice and a strainer contained in the lower valve body.**
**c. Remove the upper-lower valve body tightening bolts. Then remove two locating bolts. ( XX )**
**During ordinary servicing, clean the control valve bodies in this condition, without further disassembly.**
**In the event of a seized clutch or other problem, disassemble the control valve bodies further, and clean the component parts.**

## B: INSPECTION

Make sure that each component is free of harmful gouges, cuts, or dust.

## C: ASSEMBLY

Reverse the disassembly sequence, paying attention to the following points:
**a. Be sure to properly position the steel balls, orifice and strainer.**

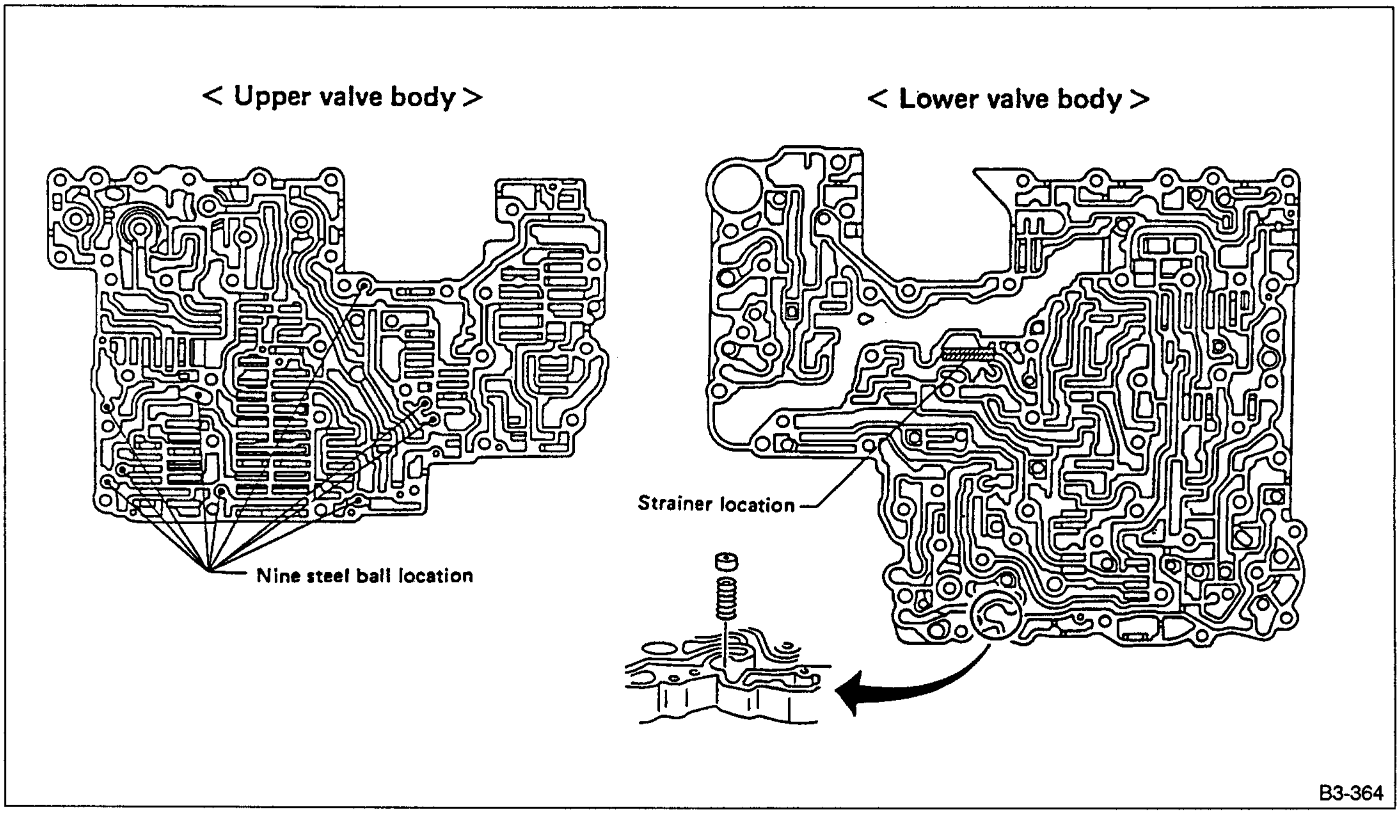



*Fig. 229*

**b. Tighten two locating bolts. Then tighten the upper-lower valve body tightening bolts.**

**Tightening torque:**
**7 — 9 N·m (0.7 — 0.9 kg-m, 5.1 — 6.5 ft-lb)**

# 7. Oil Pump Assembly

## A: DISASSEMBLY

1) Remove the oil seal retainer.
Also remove the O-ring and oil seal (air breather).

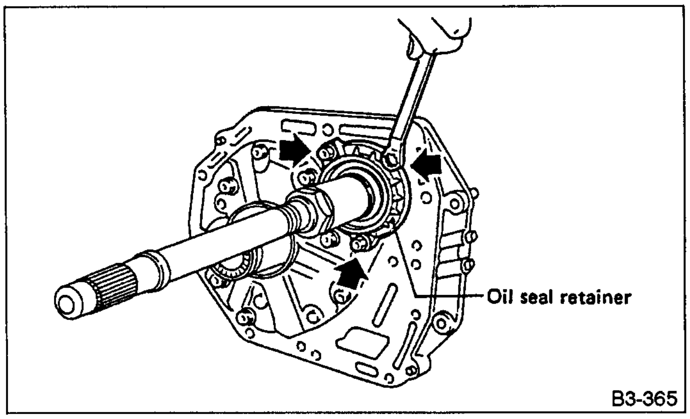



*Fig. 230*

2) Remove the oil pump cover.
**Lightly tap the end of the stator shaft to remove the cover.**

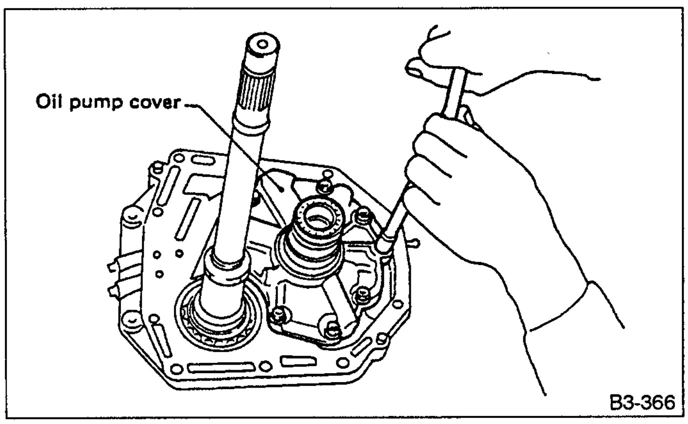



*Fig. 231*

3) Remove the retainer and return spring. Then remove the rotor, two vane rings and nine vanes.

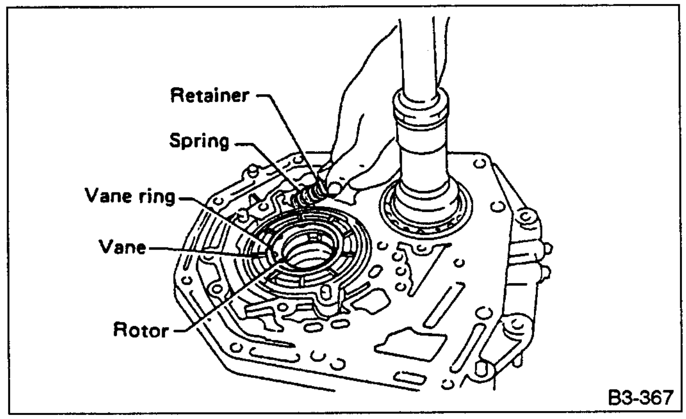



*Fig. 232*

4) Remove the cam ring and control piston.
Also remove the O-ring, friction ring, two side seals, and plain seal.

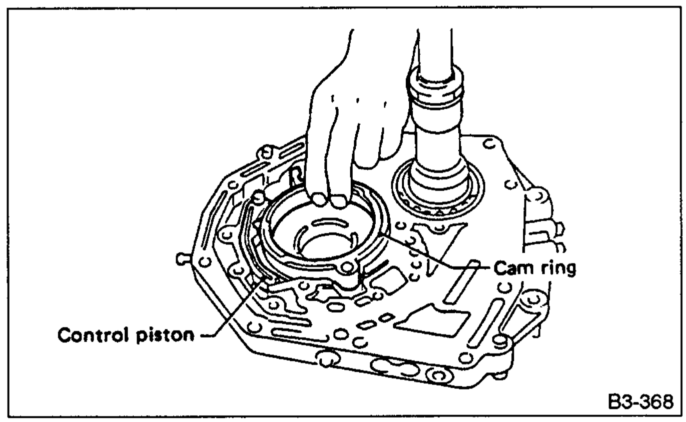



*Fig. 233*

5) Remove two seal rings (R) and two seal rings (H).

## B: INSPECTION

1) Make sure that each component is free of harmful gouges, cuts, and dust.
2) Selection of oil pump components (rotor, vanes, control piston and cam ring):
   (1) Using a micrometer, measure the height of the rotor, vanes, control piston and cam ring in at least four positions. (Measure the height at one place for each of the nine vanes.)

**a. Remove the control piston seals when measuring.**
**b. Remove the friction ring from the cam ring when measuring.**

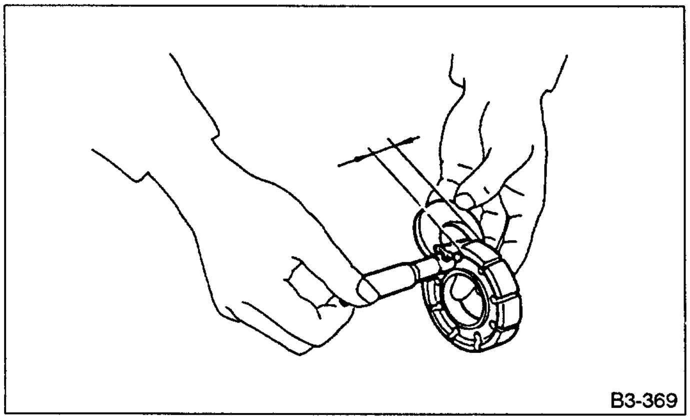



*Fig. 234*

(2) Using a depth gauge, measure the depth of the oil pump housing from the contact/sliding surface of the above-mentioned component parts in the same manner as above.

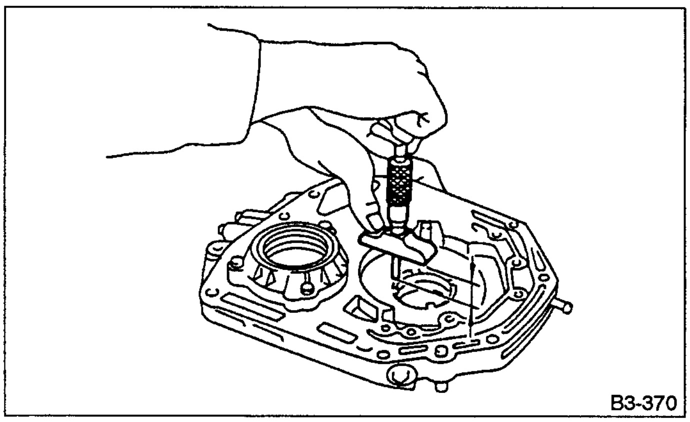



*Fig. 235*

(3) Make sure that the clearances are within the specified wear limits. If the wear limit is exceeded, select pump components so that the standard clearance can be obtained.

| Part name | Wear limit | Standard value |
|---|---|---|
| Rotor, control piston, vanes | 0.054 mm (0.0021 in) | 0.030 — 0.044 mm (0.0012 — 0.0017 in) |
| Cam ring | 0.034 mm (0.0013 in) | 0.010 — 0.024 mm (0.0004 — 0.0009 in) |

**Select vanes which are the same height as the rotor.**

## C: ASSEMBLY

1) Coat both the O-ring and friction ring with vaseline and attach to the cam ring. Then fit them into the oil pump housing.

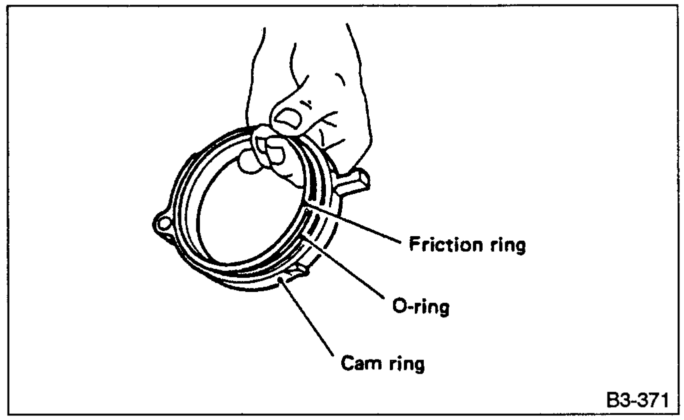



*Fig. 236*

2) Install the vane ring, rotor, vanes, and vane ring into the housing in this sequence.

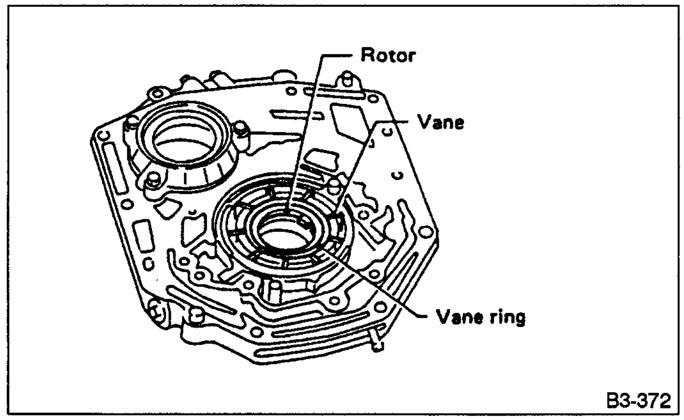



*Fig. 237*

3) Install the return spring and retainer between the housing and cam ring.

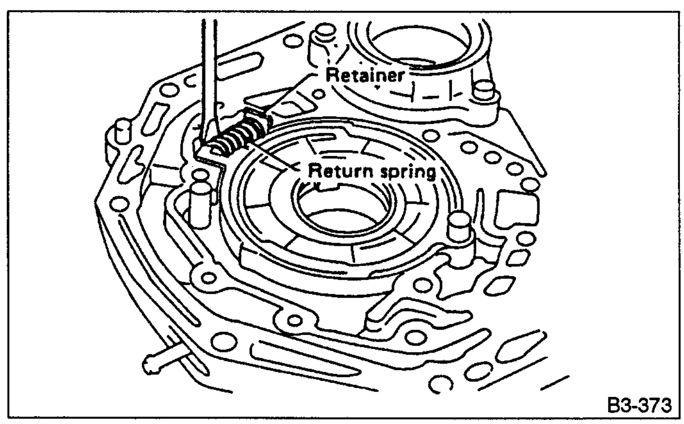



*Fig. 238*

4) Install the control piston to the oil pump housing.
**Fit the seal in the piston groove, with the red seals facing the top side. (Two side seals and one plain seal are attached.)**

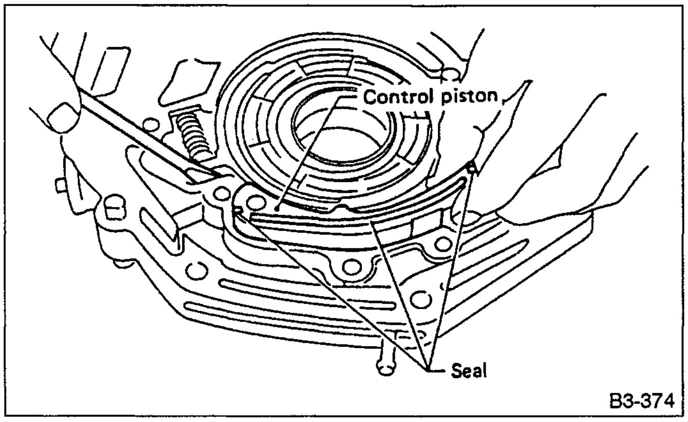



*Fig. 239*

5) Set the rotor at the center of the housing bore. Apply ATF abundantly to each rotary portion.
6) Install the oil pump cover.

**Tightening torque:**
**23 — 26 N·m (2.3 — 2.7 kg-m, 17 — 20 ft-lb)**

**a. Align both pivots with the pivot holes of the cover, and install the cover being careful not to apply undue force to the pivots.**
**b. After assembling, turn the oil pump shaft to check for smooth rotation of the rotor.**

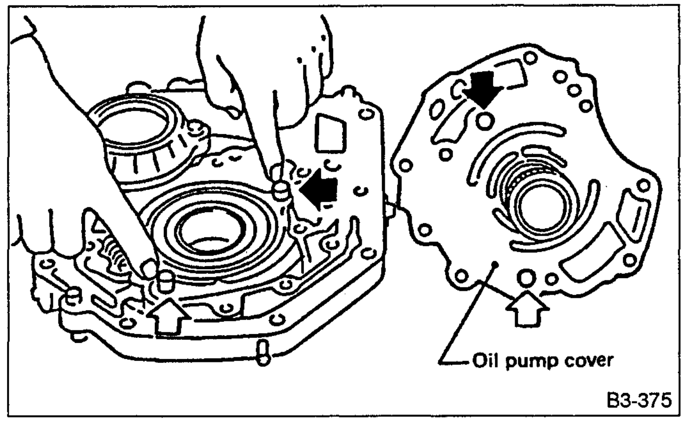



*Fig. 240*

**Install the oil seal retainer and seal rings (R) and (H) after adjusting the drive pinion backlash and tooth contact.**

# 8. Drive Pinion Shaft

## A: DISASSEMBLY

1) Straighten the staked portion of the lock nut, and remove the lock nut while locking the rear spline portion of the shaft. Then pull off the drive pinion collar.
**Remove the O-ring**

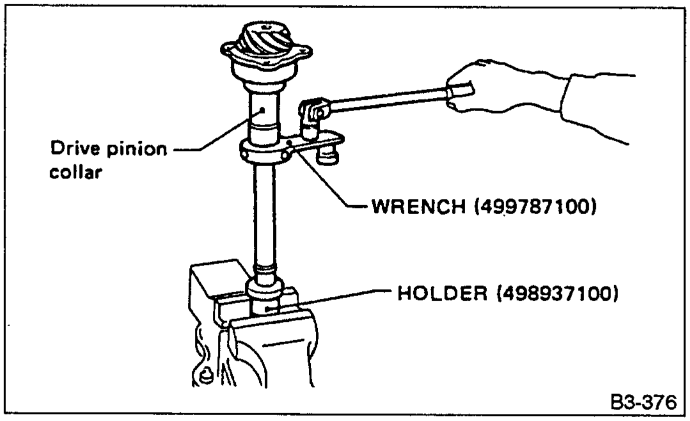



*Fig. 241*

2) Using a press, separate the rear roller bearing and outer race from the shaft.

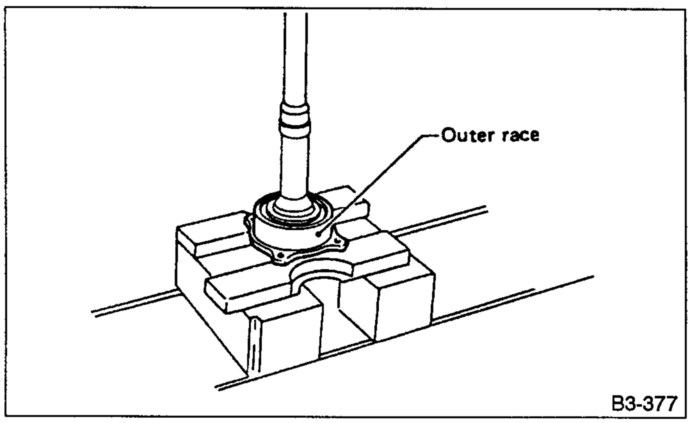



*Fig. 242*

3) Using a press, separate the front roller bearing from the shaft.

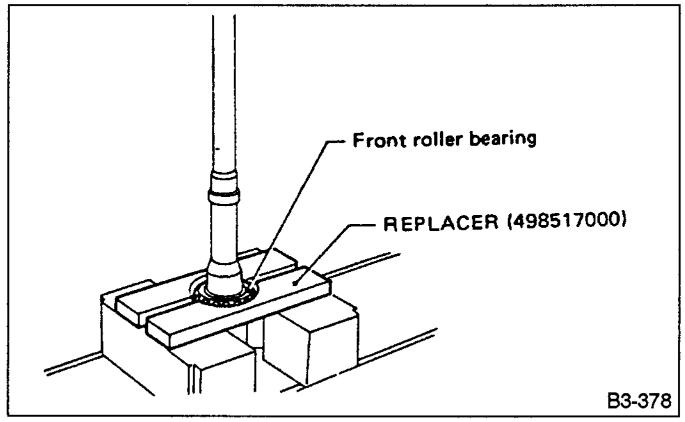



*Fig. 243*

## B: INSPECTION

Make sure that all component parts are free of harmful cuts, gouges, and other faults.

## C: ASSEMBLY

1) Measure dimension "A" of the drive pinion shaft.

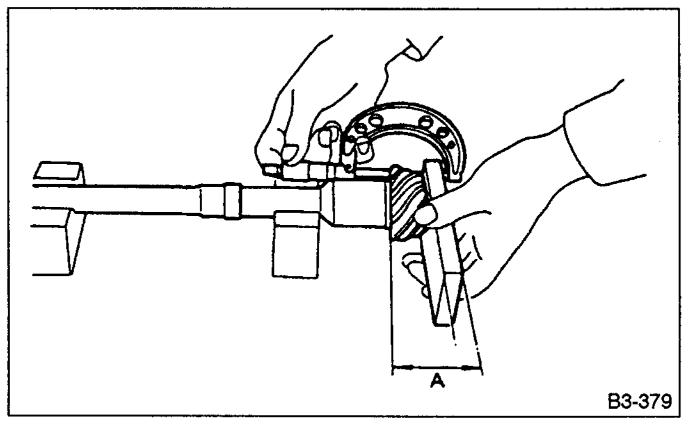



*Fig. 244*

2) Using a press, force-fit the roller bearing in position.
**Do not change the relative positions of the outer race and bearing cone.**

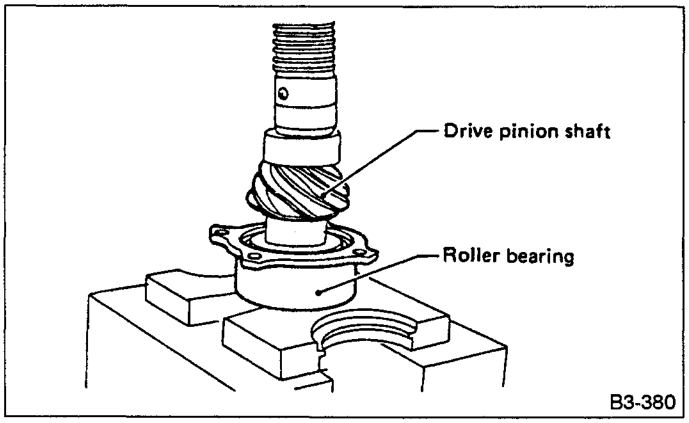



*Fig. 245*

3) After fitting the O-ring to the shaft, attach the drive pinion collar to the shaft. Be careful not to damage the O-ring.
4) Tighten the lock washer and lock nut.

**Actual tightening torque:**
**108 — 118 N•m (11.0 — 12.0 kg-m, 80 — 87 ft-lb)**

**a. Pay attention to the orientation of lock washer.**
**b. When using special tool WRENCH (499787100) and torque wrench, tighten it to 88 N•m (9 kg-m, 65 ft-lb).**

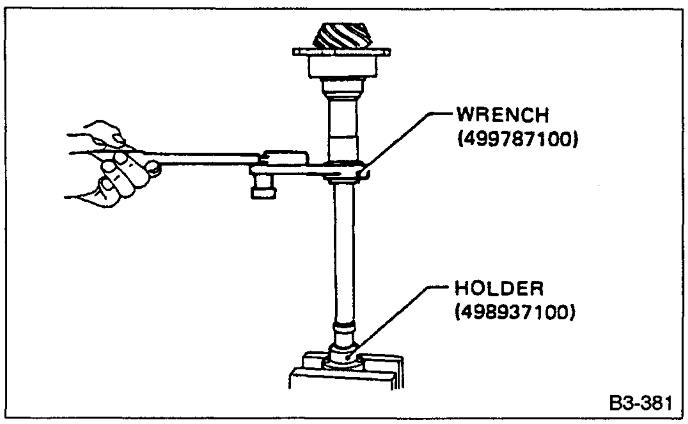



*Fig. 246*

5) Measure the starting torque of the bearing.
Make sure the starting torque is within the specified range. If out of the allowable range, replace the roller bearing.

**Starting torque:**
**0.3 — 2.0 N•m (3 — 20 kg-m, 2.6 — 17.4 ft-lb)**

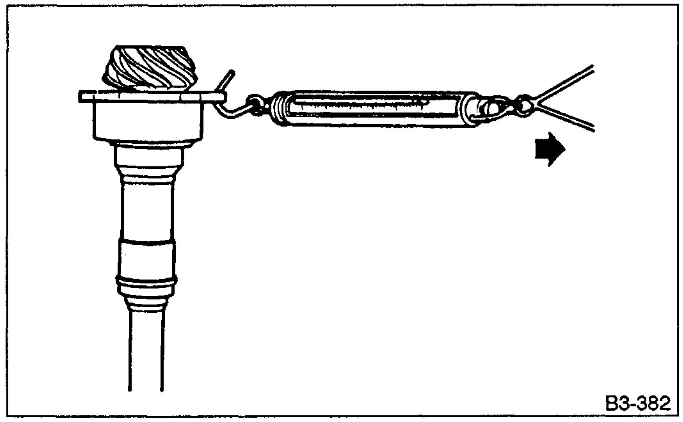



*Fig. 247*

6) Stake the lock nut securely at two places.
7) Measure dimension "B" of the drive pinion shaft.

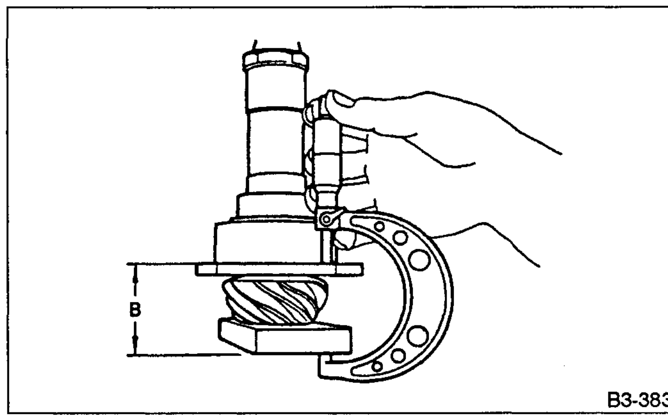



*Fig. 248*

8) Determine the thickness t (mm) of the drive pinion shim.

**t = 6.5 — (B — A)**

**The number of shims must be three or less.**
- **Available drive pinion shims**

| Part No. | Thickness mm (in) | |
|---|---|---|
| 31451AA050 | 0.15 | (0.0059) |
| 31451AA060 | 0.175 | (0.0069) |
| 31451AA070 | 0.2 | (0.008) |
| 31451AA080 | 0.225 | (0.0089) |
| 31451AA090 | 0.25 | (0.0098) |
| 31451AA100 | 0.275 | (0.0108) |

# 9. Reverse Clutch

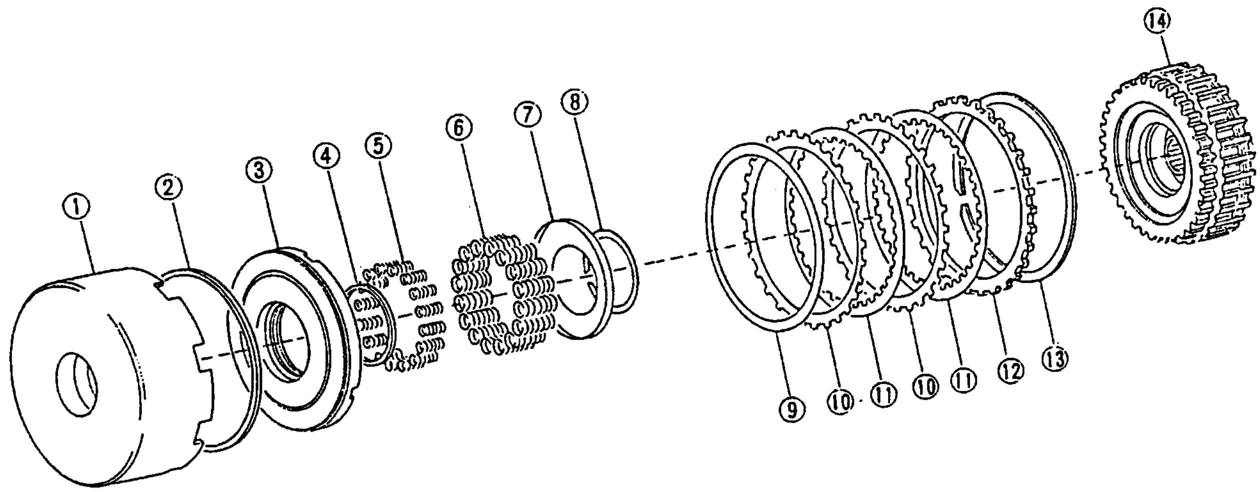



*Fig. 249*

## A: DISASSEMBLY

1) Remove the snap ring, and take out the retaining plate, drive plates, driven plates, and dish plate.
2) Using the COMPRESSOR (398673600), INSTALLER (398177700) and PLIER (399893600), remove the snap ring and take out the spring retainer and springs.
3) Take out the piston by applying compressed air.

## B: INSPECTION

1) Drive plate facing for wear and damage
2) Snap ring for wear, return spring for breakage or setting, and spring retainer for deformation
3) Lip seal and lathe cut seal ring for damage
4) Piston check ball for operation

## C: ASSEMBLY

1) Using the same special tools as those used in disassembling, assemble piston the return springs, spring retainer and snap ring.
2) Assemble the dish plate, driven plates, drive plates and retaining plate in that order and attach the snap ring.

**Pay attention to the orientation of the dish plate.**

3) Checking operation:
Apply compressed air intermittently to the oil hole, and check the reverse clutch for smooth operation.
4) Measuring clearance (Retaining plate selection).

**Standard value:**
**0.5 — 0.8 mm (0.020 — 0.031 in)**
**Allowable limit: 1.2 mm (0.047 in)**

**Before measuring clearance, place the same thickness of shim on both sides to prevent retaining plate from tilting.**

- **Available retaining plates**

| Part No. | Thickness mm (in) |
|---|---|
| 31567AA000 | 4.6 (0.181) |
| 31567AA020 | 4.8 (0.189) |
| 31567AA030 | 5.0 (0.197) |
| 31567AA040 | 5.2 (0.205) |
| 31567AA050 | 5.4 (0.213) |

# 10. High Clutch

## A: DISASSEMBLY

1) Remove the snap ring, and take out the retaining plate, drive plates, and driven plates.
2) Using the COMPRESSOR (398673600), INSTALLER (398177700), and PLIERS (399893600), remove the snap ring and take out the spring retainer CP.
3) Apply compressed air to the clutch drum to remove the piston.

## B: INSPECTION

1) Drive plate facing for wear and damage
2) Snap ring for wear, return spring for setting and breakage, and spring retainer for deformation
3) Lathe cut rings (large) (small) for damage
4) Piston check ball for smooth operation

## C: ASSEMBLY

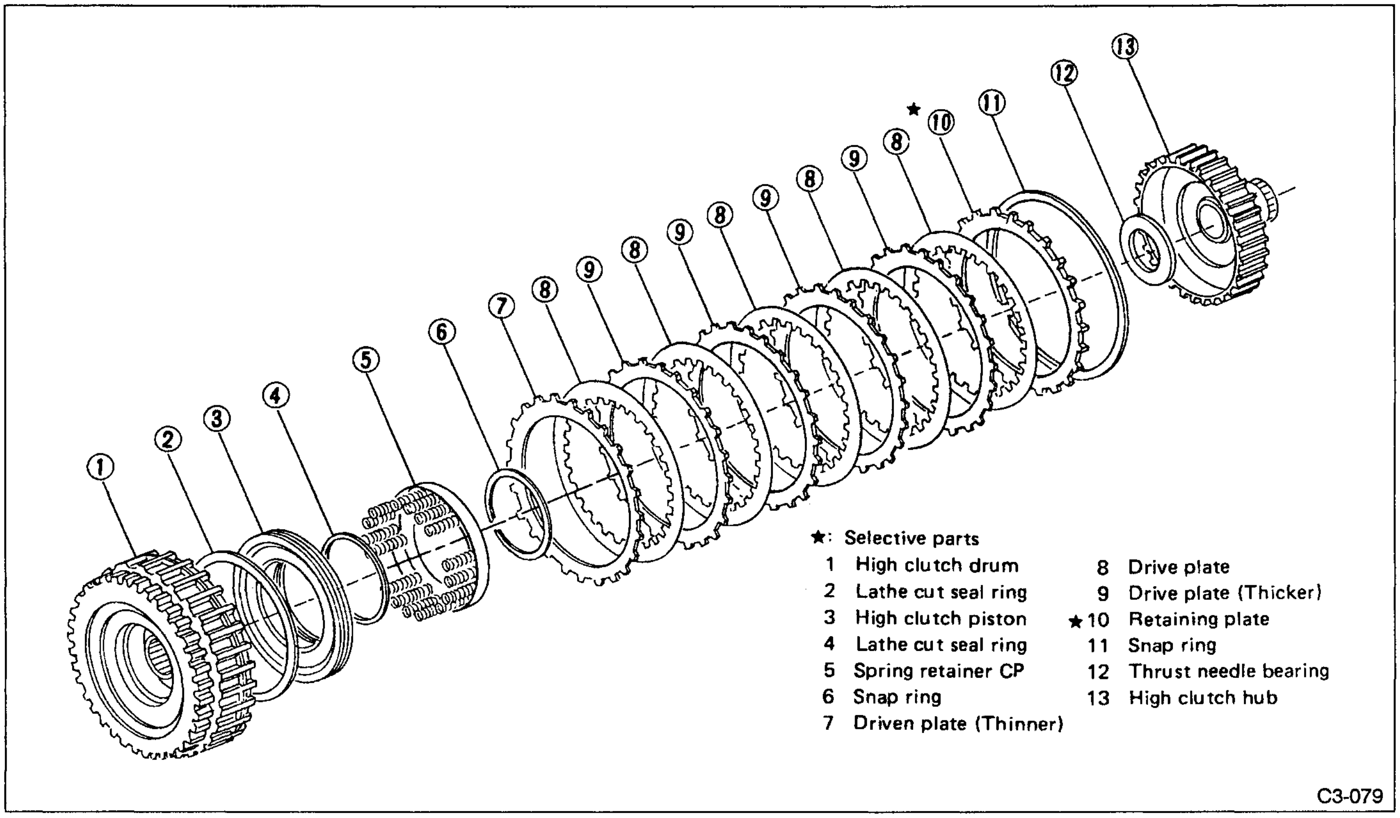



*Fig. 250*

1) Using the same special tools as those used in disassembling, assemble the piston, spring retainer CP, and snap ring.
2) Install the driven plate (thin), drive plates, driven plates, and retaining plate in that order. Then attach the snap ring.
3) Checking operation:
Apply compressed air intermittently to the oil hole, and check the high clutch for smooth operation.
4) Measuring clearance (Retaining plate selection).

**Standard value:**
**1.8 — 2.2 mm (0.071 — 0.087 in)**
**Allowable limit: 2.6 mm (0.102 in)**

**Before measuring clearance, place the same thickness of shim on both sides to prevent retaining plate from tilting.**

- **Available retaining plates**

| Part No. | Thickness mm (in) |
|---|---|
| 31567AA190 | 3.6 (0.142) |
| 31567AA200 | 3.8 (0.150) |
| 31567AA210 | 4.0 (0.157) |
| 31567AA220 | 4.2 (0.165) |
| 31567AA230 | 4.4 (0.173) |
| 31567AA240 | 4.6 (0.181) |
| 31567AA250 | 4.8 (0.189) |
| 31567AA260 | 5.0 (0.197) |

# 11. Forward Clutch Drum

## A: DISASSEMBLY

1) Remove two snap rings from the forward clutch drum.

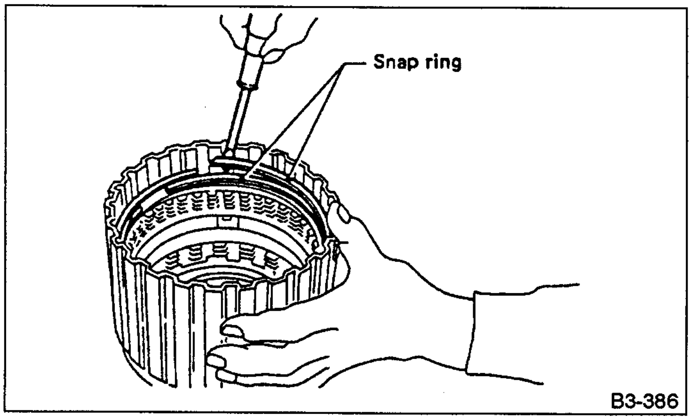



*Fig. 251*

2) Remove the retaining plate, drive plates, driven plates and dish plate. (Forward clutch)
3) Remove the snap ring from the forward clutch drum.

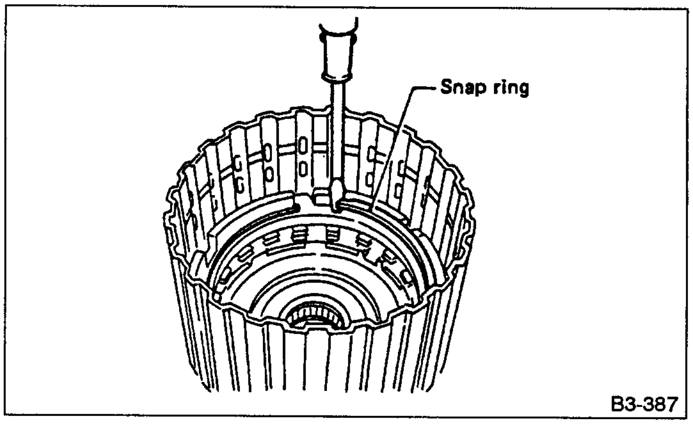



*Fig. 252*

4) Remove the retaining plate, drive plates, driven plates and dish plate. (Overrunning clutch)
5) Compress the spring retainer, and remove the snap ring from the forward clutch, by using SEAT (498627100) and COMPRESSOR (398673600).
6) Install the one-way clutch inner race to the forward clutch drum, and apply compressed air to remove the overrunning piston and forward piston.

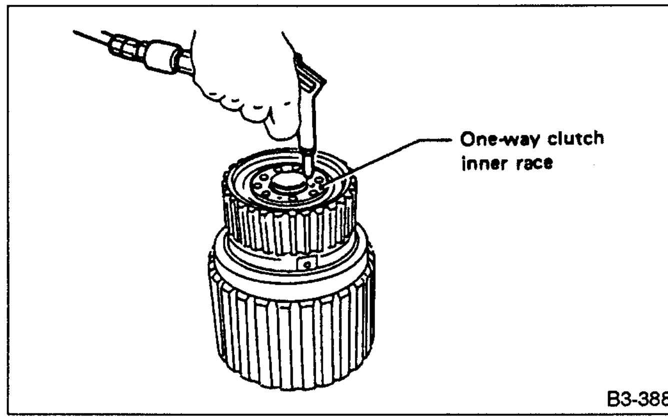



*Fig. 253*

7) Remove the one-way clutch after taking out the snap ring.
8) Remove the needle bearing after taking out the snap ring.

## B: INSPECTION

1) Drive plate facing for wear and damage
2) Snap ring for wear, return spring for setting and breakage, and snap ring retainer for deformation
3) Lip seal and lathe cut ring for damage
4) Piston and drum check ball for operation

## C: ASSEMBLY

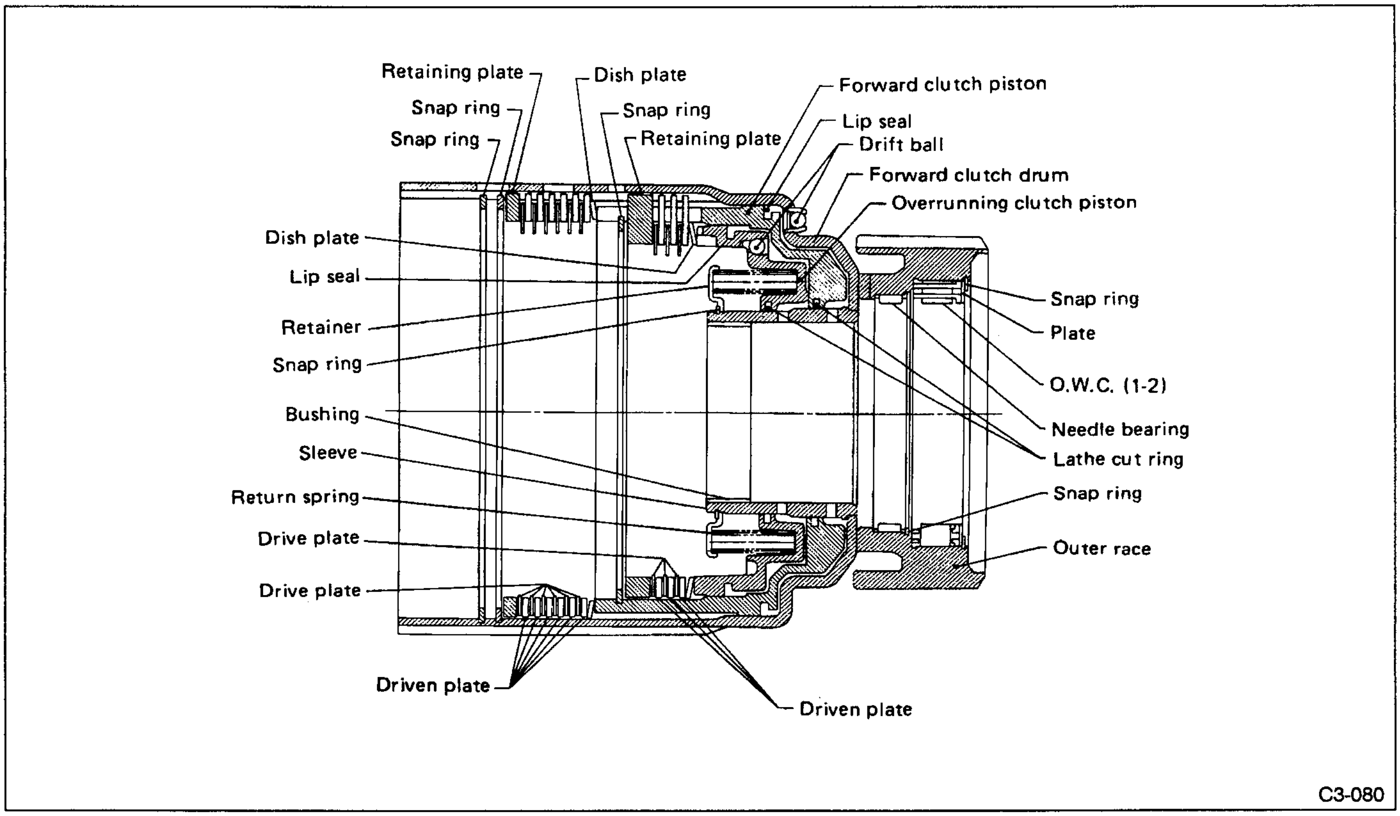



*Fig. 254*

1) Fit the forward piston and overrunning piston to the forward clutch drum.
**Align the forward piston cut-out portion with the spline of the drum.**

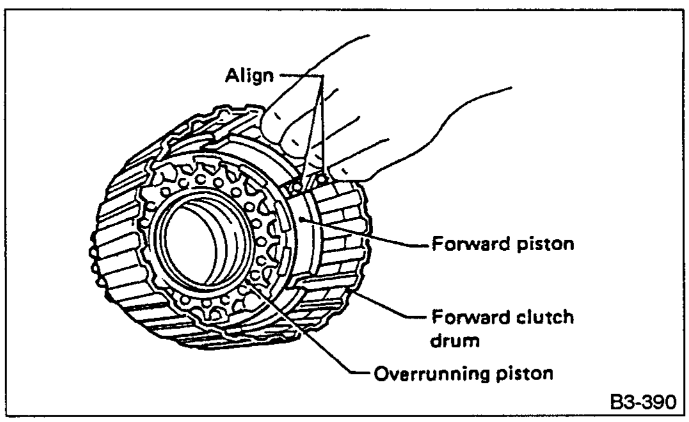



*Fig. 255*

2) Set the springs and retainer on the piston with a press and attach the snap ring.

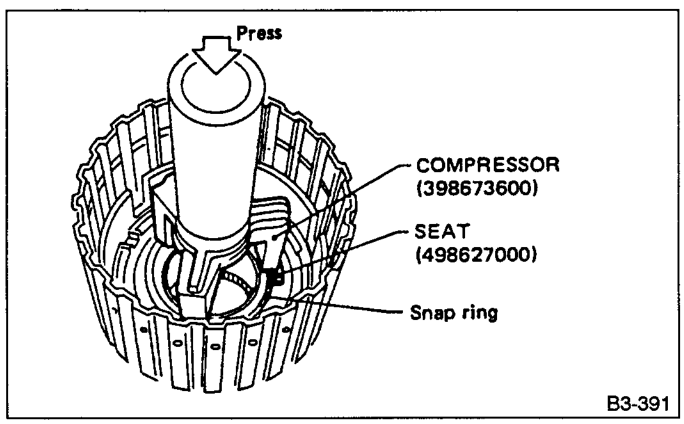



*Fig. 256*

3) Install the dish plate, driven plates, drive plates, and retaining plate, and secure with the snap ring. (Overrunning clutch)
**Pay attention to the orientation of the dish plate.**

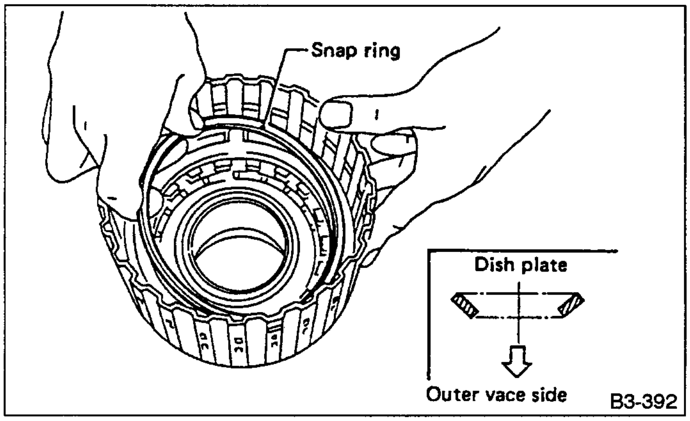



Fig. 257

4) Install the dish plates, driven plates, drive plates, and retaining plate, and secure with the snap ring. (Forward clutch)

**Pay attention to the orientation of the dish plate.**

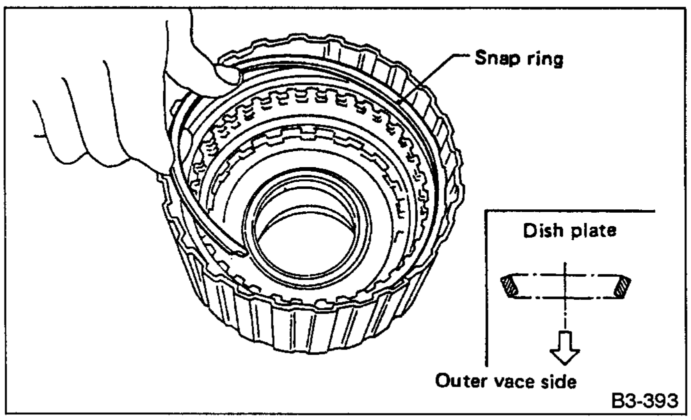



Fig. 258

5) Install the snap ring (for front planetary carrier).
6) Check the forward clutch and overrunning clutch for operation.
Set the one-way clutch inner race, and apply compressed air for checking.
7) Checking clearance:

| | Standard value mm (in) | Allowable limit mm (in) |
|---|---|---|
| Forward clutch | 0.45 — 0.85 (0.0177 — 0.0335) | 1.6 (0.063) |
| Overrunning clutch | 1.0 — 1.4 (0.039 — 0.055) | 2.0 (0.079) |

**Before measuring clearance, place the same thickness of shim on both sides to prevent retaining plate from tilting.**

If the clearance is out of the specified range, select a proper retaining plate so that the standard clearance can be obtained.
(Forward clutch)

| Part No. | Thickness mm (in) |
|---|---|
| 31567AA010 | 8.0 (0.315) |
| 31567AA060 | 8.2 (0.323) |
| 31567AA070 | 8.4 (0.331) |
| 31567AA080 | 8.6 (0.339) |
| 31567AA090 | 8.8 (0.346) |
| 31567AA100 | 9.0 (0.354) |

(Overrunning clutch)

| Part No. | Thickness mm (in) |
|---|---|
| 31567AA120 | 8.0 (0.315) |
| 31567AA130 | 8.2 (0.323) |
| 31567AA140 | 8.4 (0.331) |
| 31567AA150 | 8.6 (0.339) |
| 31567AA160 | 8.8 (0.346) |
| 31567AA170 | 9.0 (0.354) |
| 31567AA180 | 9.2 (0.362) |

8) Install the needle bearing, and secure with the snap ring.

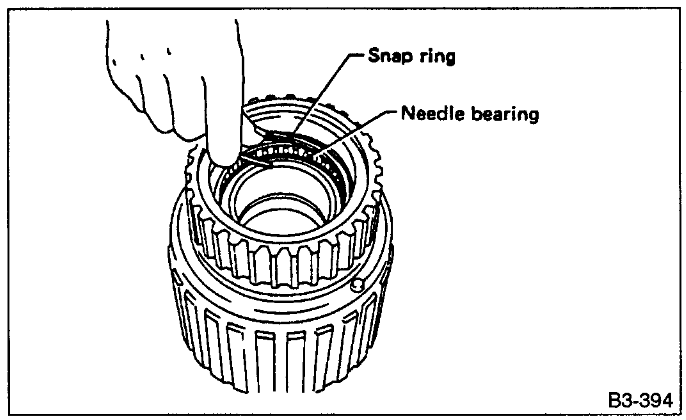



Fig. 259

9) Install the one-way clutch (1-2) and plate, and secure with the snap ring.

**Set the inner race. Make sure that the forward clutch is free in the clockwise direction and locked in the counterclockwise direction, as viewed from the front of the vehicle.**

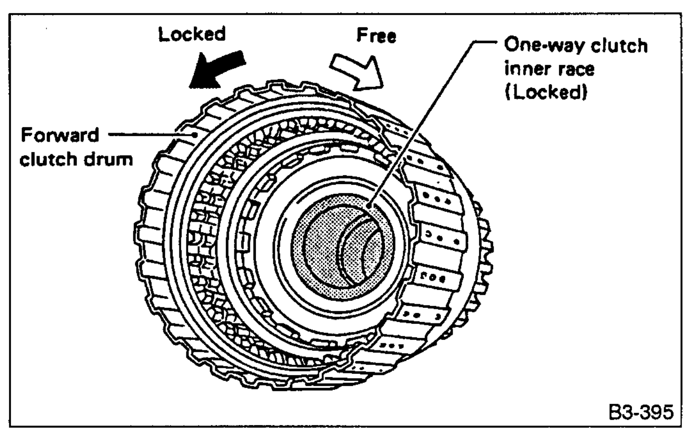



Fig. 260

# 12. One-way Clutch Outer Race

## A: DISASSEMBLY

Remove the snap ring. Then remove the one-way clutch (3-4).

## B: INSPECTION

Check the sliding surface and one-way clutch (3-4) for any harmful cuts, damage, or other faults.

## C: ASSEMBLY

Assemble the one-way clutch (3-4), and secure with the snap ring.

**Pay attention to the orientation of the one-way clutch (3-4).**

**Confirm:**

**Assemble the rear internal gear, and secure the outer race. Make sure that the internal gear is locked in the clockwise direction, and free to rotate in the counter-clockwise direction.**

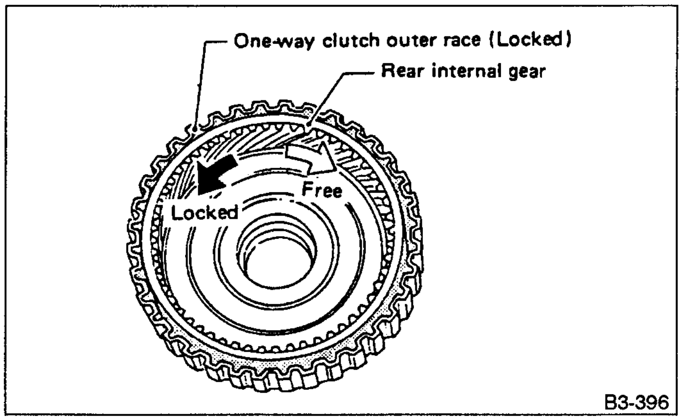



*Fig. 261*

# 13. Servo Piston

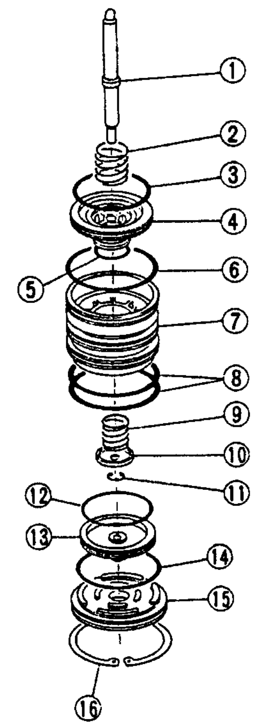
## A: DISASSEMBLY

1) Remove the spring.
2) Remove the band servo piston O.D.
3) While compressing the retainer from above, remove the snap ring. Then remove the retainer, spring and stem.
4) Take out the band servo piston.

## B: INSPECTION

1) Check each component for harmful cuts, damage, or other faults.
2) Check the O-ring and lathe cut ring for damage.

## C: ASSEMBLY




1 Band servo piston stem
2 Spring
3 Lathe cut seal ring
4 Band servo piston
5 Lathe cut seal ring
6 O-ring
7 Band servo retainer
8 O-ring
9 Spring
10 Retainer
11 Snap ring
12 Lathe cut seal ring
13 Band servo piston O.D.
14 O-ring
15 O.D. servo retainer
16 Snap ring

B3-397

*Fig. 262*

1) Install the band servo piston to the retainer, and insert the stem.
2) Put the spring and retainer on the piston. Fit the snap ring securely while compressing the spring.
3) Install the band servo piston O.D.
4) Install the spring securely to the band servo piston.

**a. Many different O-rings and lathe cut rings are used. Be careful not to confuse them when installing.**
**b. Be careful not to damage O-rings and lathe cut rings.**

# 14. Differential Case Assembly

## A: DISASSEMBLY

1) Using a press, remove the taper roller bearing.
**Be careful not to damage the speedometer drive gear.**

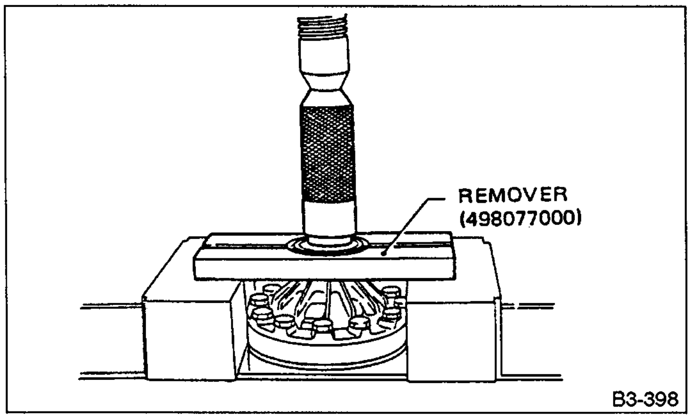



*Fig. 263*

2) Secure the case in a vise and remove the crown gear tightening bolts, then separate the crown gear, case (RH) and case (LH).

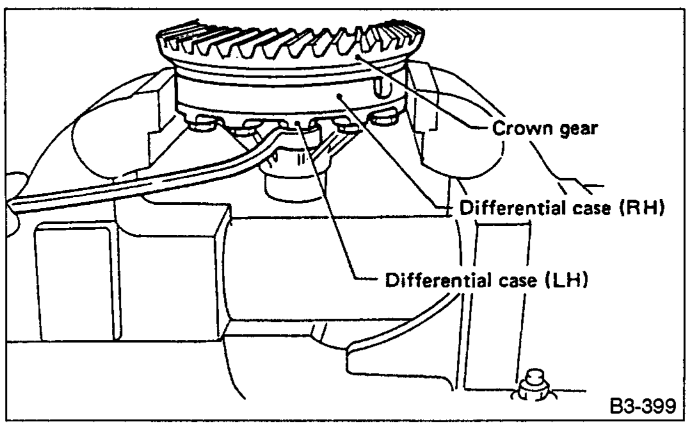



*Fig. 264*

3) Pull out the straight pin and shaft, and remove the differential bevel gear, washer, and differential bevel pinion.

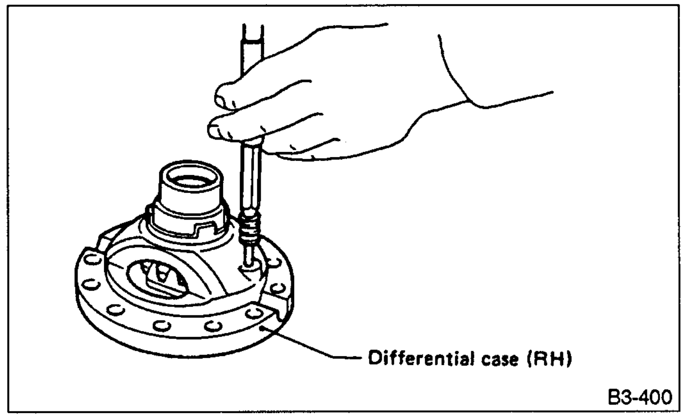



*Fig. 265*

## B: INSPECTION

Check each component for harmful cuts, damage and other faults.

## C: ASSEMBLY

1) Install the washer, differential bevel gear and differential bevel pinion in the differential case (RH). Insert the pinion shaft, and fit the straight pin.
**Make sure that the case (RH) is staked in order to lock the straight pin.**
2) Install the washer and differential bevel gear to the differential case (LH). Then put the case over the differential case (RH), and connect both cases.
3) Install the crown gear and secure by tightening the bolt.

**Standard tightening torque:**
**59 — 65 N·m (6.0 — 6.6 kg-m, 43 — 48 ft-lb)**

4) Measurement of backlash (Selection of washer).
Measure the gear backlash by inserting a dial gauge through the access window of the case.

**Standard value:**
**0.13 — 0.18 mm (0.0051 — 0.0071 in)**

**Measure the backlash by applying a pinion tooth between two bevel gear teeth.**

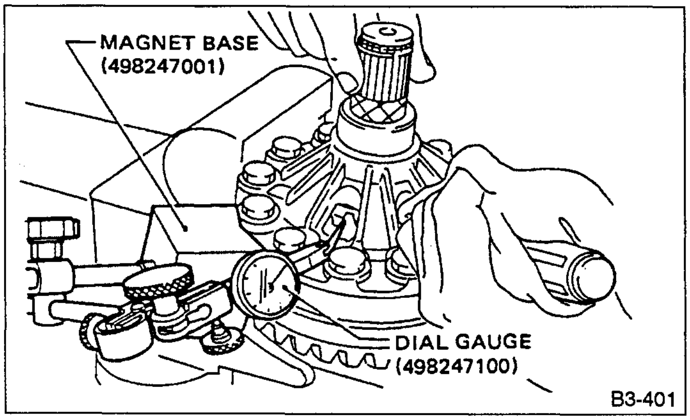



*Fig. 266*

5) Install the speedometer drive gear. Then force-fit the taper roller bearing with a press.

**Be sure to position correctly the locking end of the speedometer drive gear.**

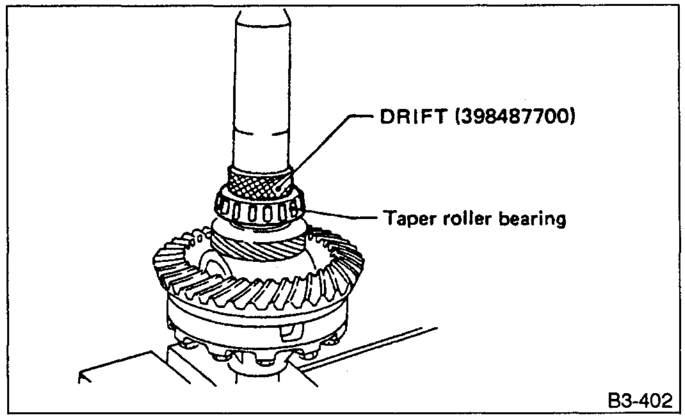



*Fig. 267*

# 15. Transfer Clutch

## A: DISASSEMBLY

1) Remove the seal ring.
**Be careful not to damage the seal ring.**

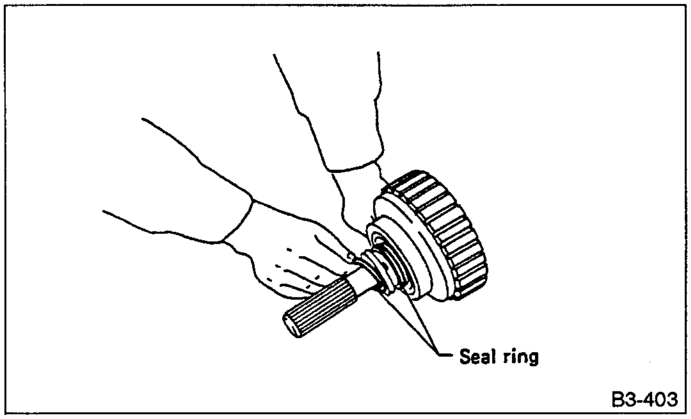



*Fig. 268*

2) Using a press, remove the ball bearing.
**Do not reuse the bearing.**

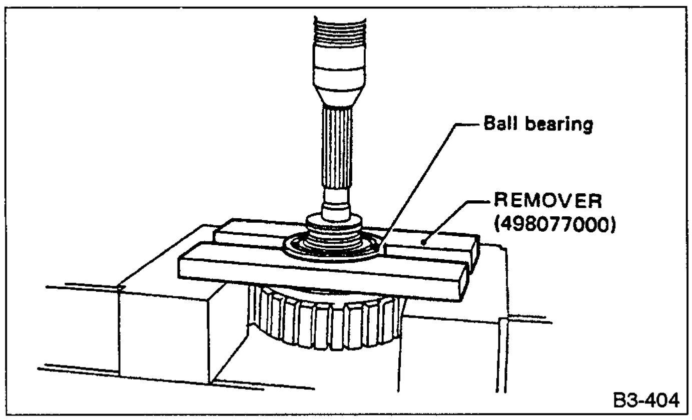



*Fig. 269*

3) Remove the snap ring, and take out the pressure plate, drive plates, and driven plates.

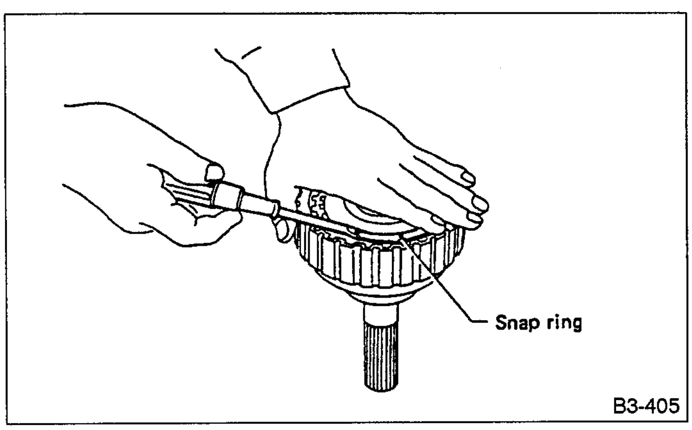



*Fig. 270*

4) Remove the snap ring, and take out the spring retainer CP.

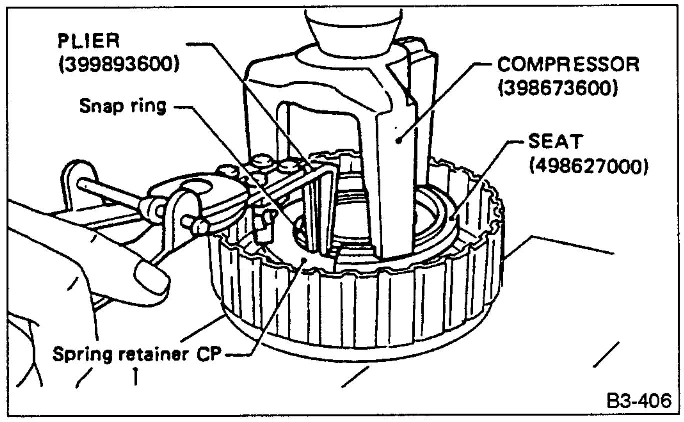



*Fig. 271*

5) Apply compressed air to the rear drive shaft to remove the piston.

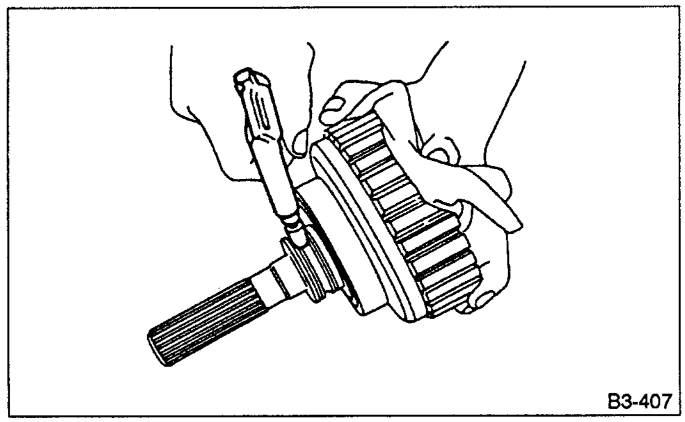



*Fig. 272*

## B: INSPECTION

1) Check the drive plate facing for wear and damage.
2) Check the snap ring for wear, return spring for permanent set and breakage, and spring retainer for deformation.
3) Check the lathe cut ring for damage.

## C: ASSEMBLY

1) Install the lathe cut seal ring to the I.D./O.D. of the transfer clutch piston.
2) Install piston.
   (1) Connect piston to rear drive shaft (until it reaches hole in valve body).
   (2) Install spring retainer to piston.
   (3) Using SPECIAL TOOL, attach transfer piston seal to transfer piston seal guide.

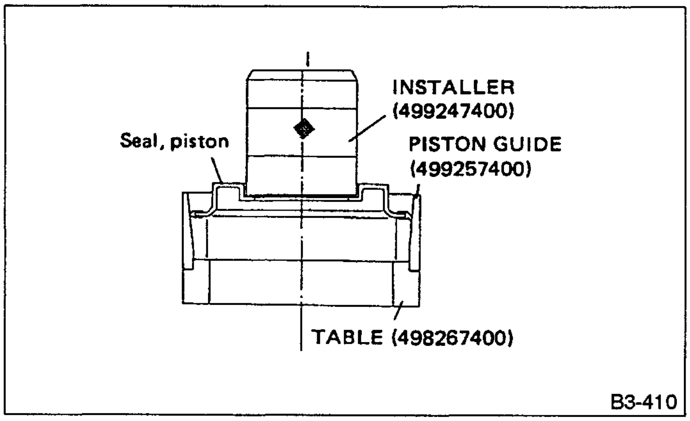



*Fig. 273*

**Be careful not to tilt transfer piston seal.**

(4) Place transfer piston seal guide onto rear drive shaft so that spring can be inserted into hole in transfer piston seal.

(5) Attach outer snap ring guide to rear drive shaft. Using an outer snap ring installer, press into place.

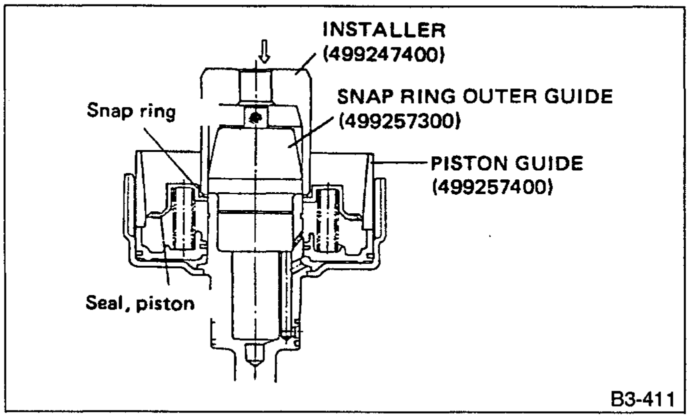



*Fig. 274*

**Do not allow lip of transfer piston seal to fold back.**

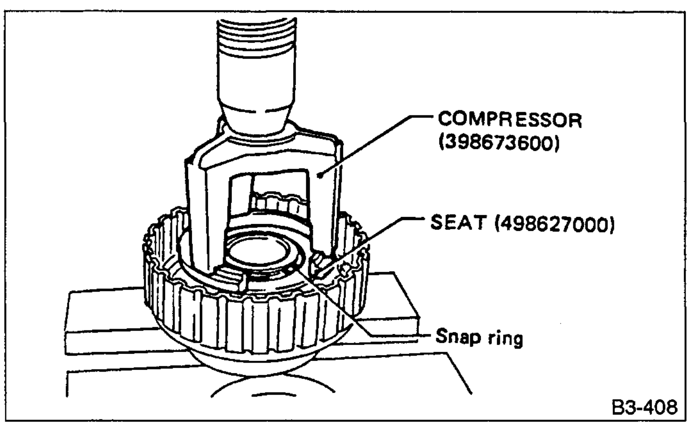



*Fig. 275*

3) Install the driven plates, drive plates, and pressure plate, and secure with a snap ring.

4) Apply compressed air to see if the assembled parts move smoothly.

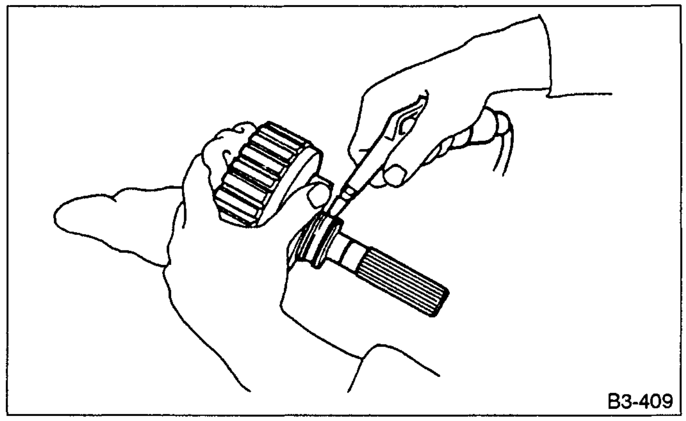



*Fig. 276*

5) Check the clearance:

**Standard value:**
**0.2 — 0.6 mm (0.008 — 0.024 in)**
**Allowable limit: 1.6 mm (0.063 in)**

If the clearance is not within the specified range, select a proper pressure plate.

**Before measuring clearance, place the same thickness of shim on both sides to prevent pressure plate from tilting.**

- **Available pressure plates**

| Part No. | Thickness mm (in) |
|---|---|
| 31593AA150 | 3.3 (0.130) |
| 31593AA160 | 3.7 (0.146) |
| 31593AA170 | 4.1 (0.161) |
| 31593AA180 | 4.5 (0.177) |

6) Press-fit the ball bearing.

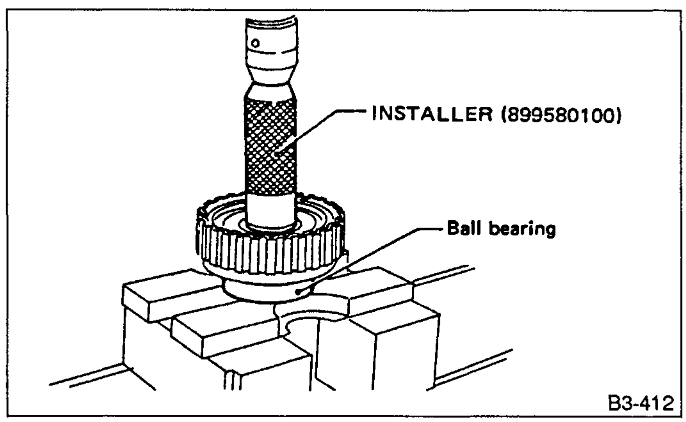



*Fig. 277*

7) Coat the seal ring with vaseline, and install it in the seal ring groove of the shaft.

**Do not expand the seal ring excessively when installing.**

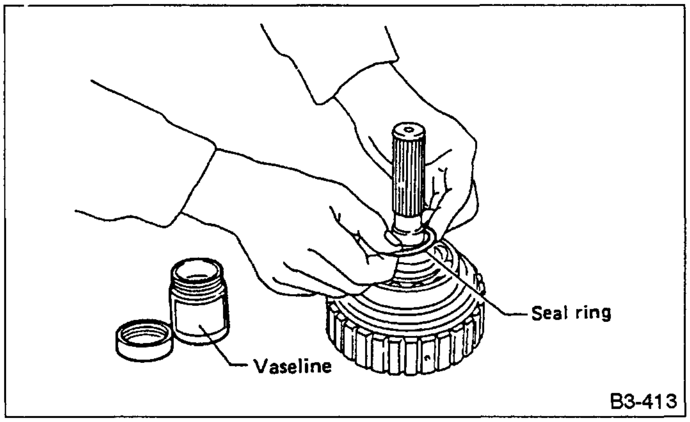



*Fig. 278*

# 16. Transfer Valve Body

## A: DISASSEMBLY

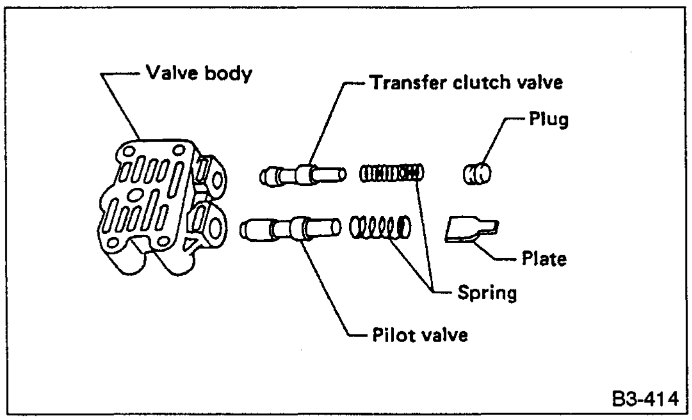



*Fig. 279*

1) Remove the plate. Then remove the spring and pilot valve together.
2) Remove the straight pin and pry out the plug with a screwdriver. Then extract the spring and transfer clutch valve together.
**Be careful not to damage the valve and valve body.**

## B: INSPECTION

Check each component for harmful cuts, damage, or other faults.

## C: ASSEMBLY

To assemble, reverse the removal sequence.
**Make sure the valve slides smoothly after assembling.**

# T TROUBLESHOOTING AIRBAG

## 1. Supplemental Restraint System "Airbag"

Airbag system wiring harness is routed near the transmission control unit (TCU).

**1. All Airbag system wiring harness and connectors are colored yellow. Do not use electrical test equipment on these circuit.**

**2. Be careful not to damage Airbag system wiring harness when troubleshooting and servicing the TCU.**

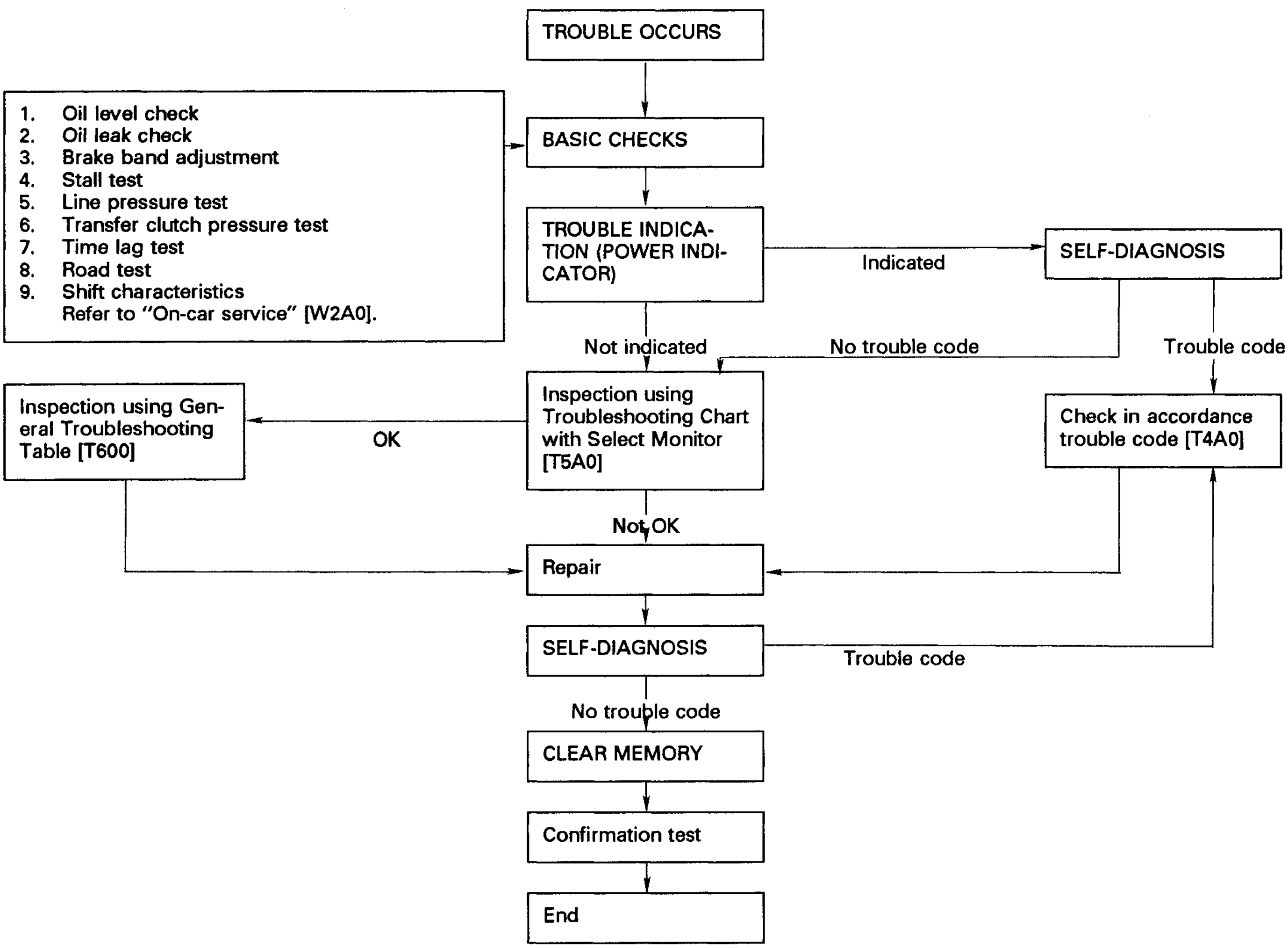
## 2. Precaution

1) Problems in the electronic-controlled automatic transmission may be caused by failure of the engine, the electronic control system, the transmission proper, or by a combination of these. These three causes must be distinguished clearly when troubleshooting.

2) Troubleshooting should be conducted by rotating with simple, easy operations and proceeding to complicated, difficult operations. The most important thing in troubleshooting is to understand the customer's complaint, and distinguish between the three causes.

## 3. Troubleshooting Chart for Self-diagnosis System

### A: BASIC TROUBLESHOOTING PROCEDURE



## B: ABNORMAL DISPLAY ON POWER INDICATOR

When any self-diagnostic item is malfunctioning, the display on the power indicator blinks immediately after the engine starts.
The malfunctioning part or unit can be determined by a trouble code during self-diagnosis operation. Problems which occurred previously can also be identified through the memory function.
If the power indicator does not show a problem (although a problem is occurring), the problem can be determined by checking the performance characteristics of each sensor using the select monitor.
Indicator signal is as follows:

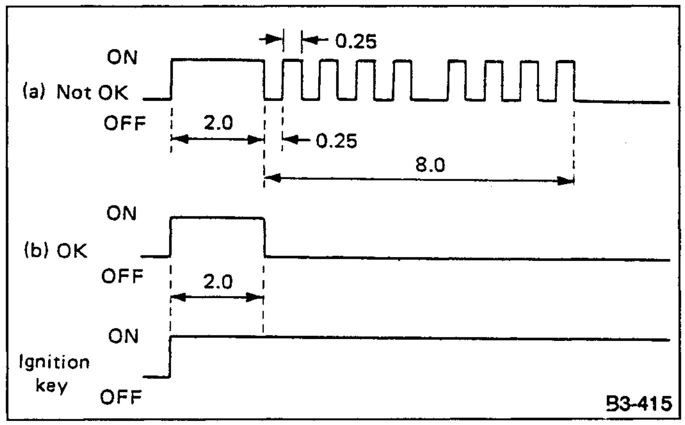
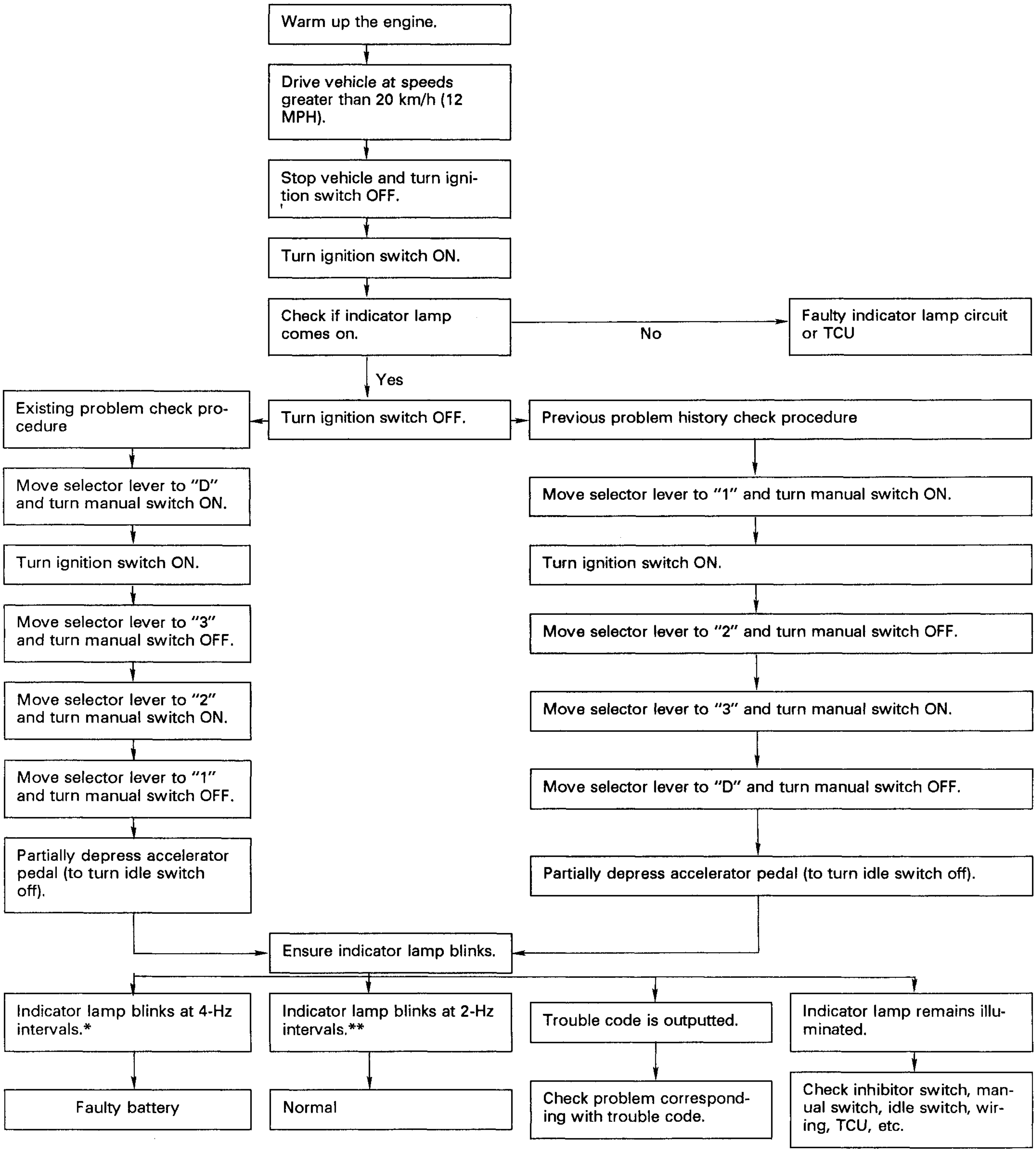


*Fig. 280*

**Warning can be noticed only when the ignition switch is initially turned to ON.**

## C: SELF-DIAGNOSIS




*: Blinks every 0.125 (1/8) seconds (with ignition switch OFF).
**: Blinks every 0.25 (1/4) seconds (until ignition switch is turned OFF).

## D: SELF-DIAGNOSIS WITH SELECT MONITOR

### 1. CONNECT SELECT MONITOR.

1) Connect select monitor to select monitor connector located under instrument panel (on driver's side).
**Applicable cartridge : Type "R" (No. 498348500)**
2) Turn ignition switch and select monitor switch ON.
3) After display is shown, press slash "/" key.
4) After AT mode is displayed, press function "[0]". (Display returns to AT mode when slash "/" is pressed during self-diagnosis operation.)

### 2. READ TROUBLE CODE SHOWN ON DISPLAY.

1) Connect select monitor.
2) Designate mode using function key.
Press [F] [B] [0] [ENT] in that order.
3) Ensure trouble code(s) is shown.

### 3. PREVIOUS TROUBLE CODE READING

1) Connect select monitor.
2) Designate mode using function key.
Press [F] [B] [1] [ENT] in that order.
3) Ensure displayed trouble code(s).

## E: LIST OF TROUBLE CODE

### 1. TROUBLE CODE

| Trouble code | Item | Content of diagnosis | Abbr. (Select monitor) |
|---|---|---|---|
| 11 | Duty solenoid A | Detects open or shorted drive circuit, as well as valve seizure. | PL |
| 12 | Duty solenoid B | Detects open or shorted drive circuit, as well as valve seizure. | L/U |
| 13 | Shift solenoid 3 | Detects open or shorted drive circuit, as well as valve seizure. | OVR |
| 14 | Shift solenoid 2 | Detects open or shorted drive circuit, as well as valve seizure. | SFT2 |
| 15 | Shift solenoid 1 | Detects open or shorted drive circuit, as well as valve seizure. | SFT1 |
| 21 | ATF temperature sensor | Detects open or shorted input signal circuit. | ATFT |
| 22 | Atmospheric sensor | Detects a faulty atmospheric sensor built into ECU (MPFI). | BARO.P |
| 23 | Engine revolution signal | Detects open or shorted input signal circuit. | EREV |
| 24 | Duty solenoid C | Detects open or shorted drive circuit, as well as valve seizure. | 4WD |
| 25 | Engine torque control signal | Detects open or shorted output signal circuit. | TRQ |
| 31 | Throttle sensor | Detects open or shorted input signal circuit. | THV |
| 32 | Vehicle speed sensor 1 | Detects open or shorted input signal circuit. | VSP1 |
| 33 | Vehicle speed sensor 2 | Detects open or shorted input signal circuit. | VSP2 |

## 2. HOW TO READ TROUBLE CODE OF INDICATOR LIGHT

The power indicator light flashes the code corresponding to the faulty part.

The long segment (1.2 sec on) indicates a "ten", and the short segment (0.2 sec on) signifies a "one".

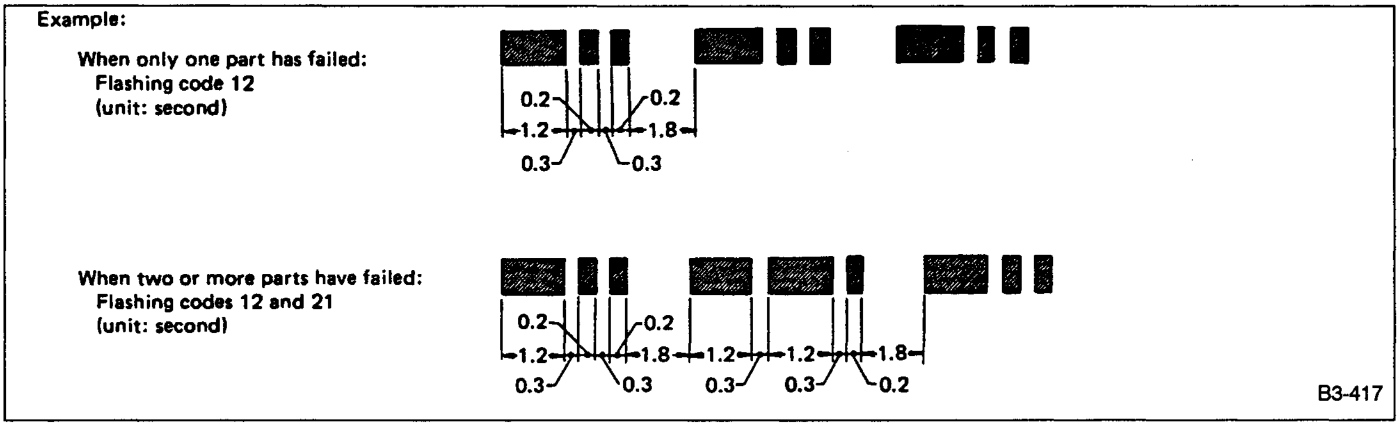



*Fig. 281*

## F: CLEAR MEMORY

Current trouble codes shown on the display are cleared by turning the ignition switch OFF after conducting self-diagnosis operation. Previous trouble codes, however, cannot be cleared since they are stored in the ECU memory which is operating on the back-up power supply. These trouble codes can be cleared by removing the specified fuse (located under the right lower portion of the instrument panel), as shown in the following table.

**CLEAR MEMORY:**
**Removal of No. 14 fuse (for at least one minute)**

- The No. 14 fuse is located in the line to the memory back-up power supply of the TCU and ECU (MPFI). Removal of this fuse clears the previous trouble codes stored in the TCU and ECU (MPFI) memory.
- Be sure to remove the No. 14 fuse for at least the specified length of time. Otherwise, trouble codes may not be cleared.

# 4. Transmission Control Module (TCM) I/O Signal

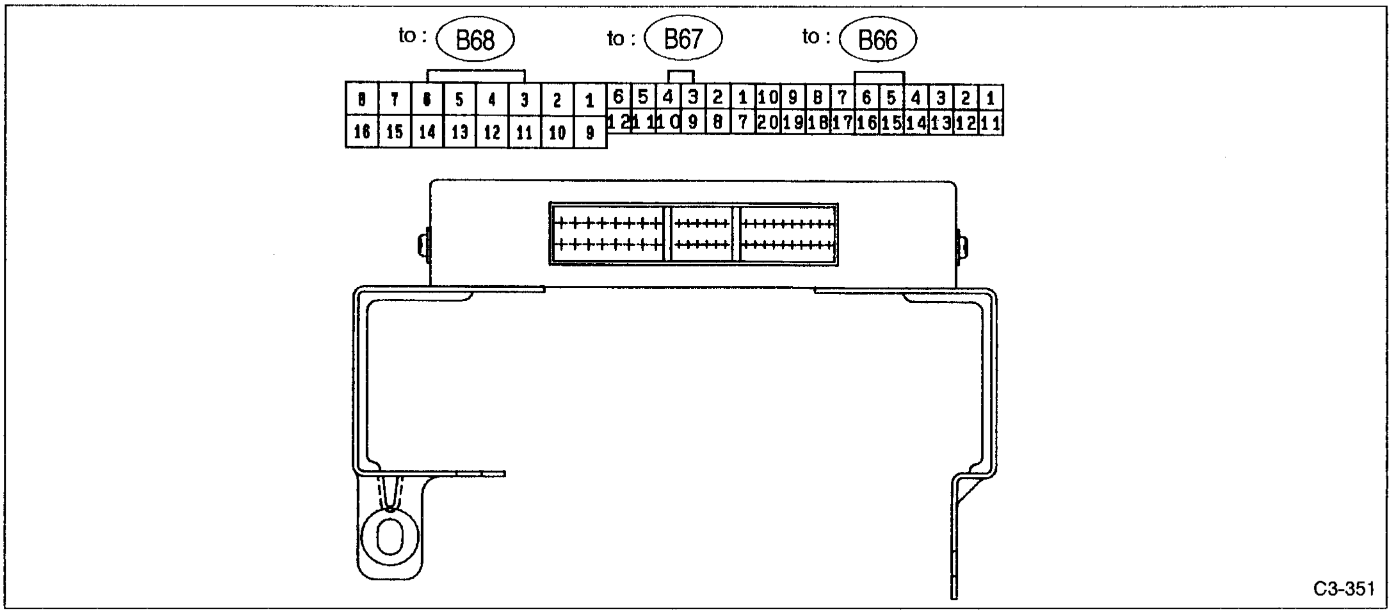



*Fig. 7*

**Check with ignition switch ON.**

| Content | | Connector No. | Terminal No. | Measuring conditions | Voltage (V) |
|---|---|---|---|---|---|
| Back-up power supply | | B66 | 14 | Ignition switch OFF | 10 — 16 |
| Ignition power supply | | B67 | 6 | Ignition switch ON (with engine OFF) | 10 — 16 |
| | | B68 | 1 | | |
| Inhibitor switch | "P" range switch | B66 | 9 | Select lever in "P" range | Less than 1 |
| | | | | Select lever in any other than "P" range | More than 8 |
| | "N" range switch | B66 | 8 | Select lever in "N" range | Less than 1 |
| | | | | Select lever in any other than "N" range | More than 8 |
| | "R" range switch | B66 | 10 | Select lever in "R" range | Less than 1 |
| | | | | Select lever in any other than "R" range | More than 6 |
| | "D" range switch | B67 | 1 | Select lever in "D" range | Less than 1 |
| | | | | Select lever in any other than "D" range | More than 6 |
| | "3" range switch | B67 | 2 | Select lever in "3" range | Less than 1 |
| | | | | Select lever in any other than "3" range | More than 6 |
| | "2" range switch | B67 | 3 | Select lever in "2" range | Less than 1 |
| | | | | Select lever in any other than "2" range | More than 6 |
| | "1" range switch | B67 | 4 | Select lever in "1" range | Less than 1 |
| | | | | Select lever in any other than "1" range | More than 6 |
| Manual switch | | B66 | 6 | Manual switch ON | Less than 1 |
| | | | | Manual switch OFF | More than 6 |
| Brake switch | | B66 | 7 | Brake pedal depressed. | More than 10.5 |
| | | | | Brake pedal released. | Less than 1 |
| ABS signal | | B66 | 5 | ABS switch ON | Less than 1 |
| | | | | ABS switch OFF | More than 6.5 |
| AT diagnostic signal | | B68 | 12 | Ignition switch ON (With engine OFF) | Less than 1 |
| | | | | Ignition switch ON (With engine ON) | More than 10 |

| Content | Connector No. | Terminal No. | Measuring conditions | Voltage (V) | Resistance to body (ohms) |
|---|---|---|---|---|---|
| Throttle position sensor | B67 | 8 | Throttle fully closed. | 0.3 — 0.7 | — |
| | | | Throttle fully open. | 4.3 — 4.9 | |
| Throttle position sensor power supply | B66 | 19 | Ignition switch ON (With engine OFF) | 5.12±0.1 | — |
| ATF temperature sensor | B67 | 10 | ATF temperature 20°C (68°F) | 2.9 — 4.0 | 2.1 — 2.9 k |
| | | | ATF temperature 80°C (176°F) | 1.0 — 1.4 | 275 — 375 |
| Vehicle speed sensor 1 | B67 | 12 | Vehicle stopped. | 0 | 450 — 720 |
| | | | Vehicle speed at least 20 km/h (12 MPH) | More than 1 (AC range) | |
| Vehicle speed sensor 2 | B66 | 11 | When vehicle is slowly moved at least 2 meters (7ft). | Less than 1↔More than 9 | — |
| Engine speed signal | B67 | 5 | Ignition switch ON (with engine OFF). | More than 10.5 | — |
| | | | Ignition switch ON (with engine ON). | 8 — 11 | |
| Cruise set signal | B66 | 3 | When cruise control is set (SET lamp ON). | Less than 1 | — |
| | | | When cruise control is not set (SET lamp OFF). | More than 6.5 | |
| Torque control signal | B68 | 16 | Ignition switch ON | 5±1 | — |
| Mass air flow signal | B67 | 9 | Engine idling after warm-up | 0.5 — 1.22 | — |
| Shift solenoid 1 | B68 | 14 | 1st or 4th gear | More than 9 | 20 — 32 |
| | | | 2nd or 3rd gear | Less than 1 | |
| Shift solenoid 2 | B68 | 13 | 1st or 2nd gear | More than 9 | 20 — 32 |
| | | | 3rd or 4th gear | Less than 1 | |
| Shift solenoid 3 | B68 | 15 | Select lever in "N" range (with throttle fully closed). | Less than 1 | 20 — 32 |
| | | | Select lever in "D" range (with throttle fully closed). | More than 9 | |
| Duty solenoid A | B68 | 8 | Throttle fully closed (with engine OFF) after warm-up. | 1.5 — 4.0 | 2.0 — 4.5 |
| | | | Throttle fully open (with engine OFF) after warm-up. | Less than 1 | |
| Dropping resistor | B68 | 7 | Throttle fully closed (with engine OFF) after warm-up. | More than 8.5 | 12 — 18 |
| | | | Throttle fully open (with engine OFF) after warm-up. | Less than 1 | |
| Duty solenoid B | B68 | 5 | When lock up occurs. | More than 8.5 | 9 — 17 |
| | | | When lock up is released. | Less than 0.5 | |
| Duty solenoid C | B68 | 3 | Fuse on FWD switch | More than 8.5 | 9 — 17 |
| | | | Fuse removed from FWD switch (with throttle fully open and with select lever in 1st gear). | Less than 0.5 | |
| Sensor ground line 1 | B67 | 7 | — | 0 | Less than 1 |
| Sensor ground line 2 | B66 | 20 | — | 0 | Less than 1 |
| System ground line | B66 | 1 | — | 0 | Less than 1 |
| Power system ground line | B68 | 10 | — | 0 | Less than 1 |
| FWD switch | B66 | 2 | Fuse removed. | 6 — 9.1 | — |
| | | | Fuse installed. | Less than 1 | |

# 5. Troubleshooting Chart with Trouble Code

## A: TROUBLE CODE (11) — DUTY SOLENOID A —

**CONTENT OF DIAGNOSIS:**
**Output signal circuit of duty solenoid A or resistor is open or shorted.**

**TROUBLE SYMPTOM:**
**Excessive shift shock**

| Step | Check | OK | Not OK |
|---|---|---|---|
| 1 | Measure signal voltage output emitted from TCU. | Go to 2 | Repair TCU terminal poor contact. (Replace TCU.) |
| 2 | Check harnesses between TCU and duty solenoid A and TCU and resistor. | Go to 3 | Repair harness/connector. |
| 3 | Check duty solenoid A's ground line. | Go to 4 | Repair ground line. |
| 4 | Check resistor. | Go to 5 | Check and replace resistor if necessary. |
| 5 | Check duty solenoid A. | OK ↓ | Replace duty solenoid A. |
| | Check contact of TCU connector terminal. | OK ↓ | Repair TCU connector and terminal. |
| | Repair TCU terminal poor contact. (Replace TCU.) | | |

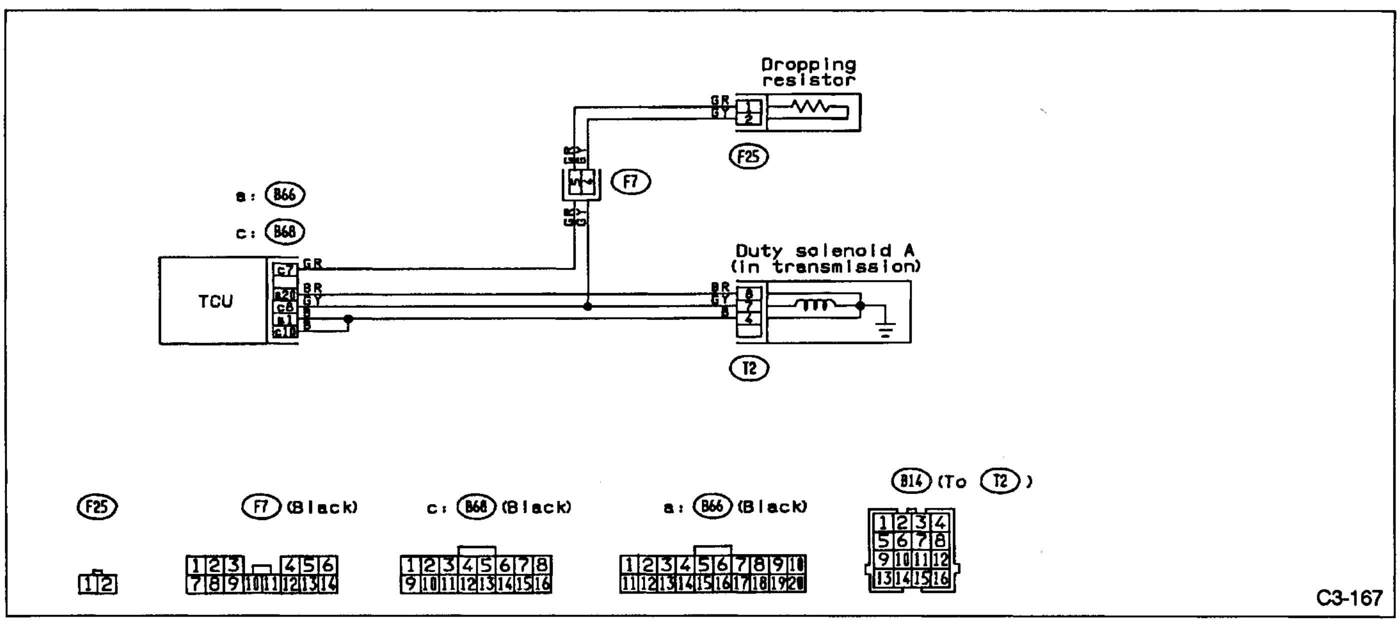



*Fig. 283*

**1. MEASURE SIGNAL VOLTAGE OUTPUT EMITTED FROM TCU.**

1) Warm up the engine and transmission.
2) Ignition switch ON (Engine OFF).
3) Move selector lever to "N".
4) While opening and closing throttle valve, measure voltage between TCU connector and body.

**Connector & terminal / Specified resistance:**
**(B68) No. 8 — No. 10 /**
**1.5 — 3.0 V (Throttle is fully closed.)**
**0.5 V, max. (Throttle is fully open.)**
**(B68) No. 7 — No.10 /**
**5 — 14 V (Throttle is fully closed.)**
**0.5 V, max.(Throttle is fully open.)**

- **SELECT MONITOR FUNCTION MODE**

| Mode: 11 | |
|---|---|
| Condition: Ignition switch ON (Engine OFF) N range | |
| Specified data: PLDTY F11 | |
| 10% | (Throttle is fully open.) |
| 100% | (Throttle is fully closed.) |

**2. CHECK HARNESSES BETWEEN TCU AND DUTY SOLENOID A AND BETWEEN TCU AND RESISTOR.**

1) Disconnect connector from TCU.

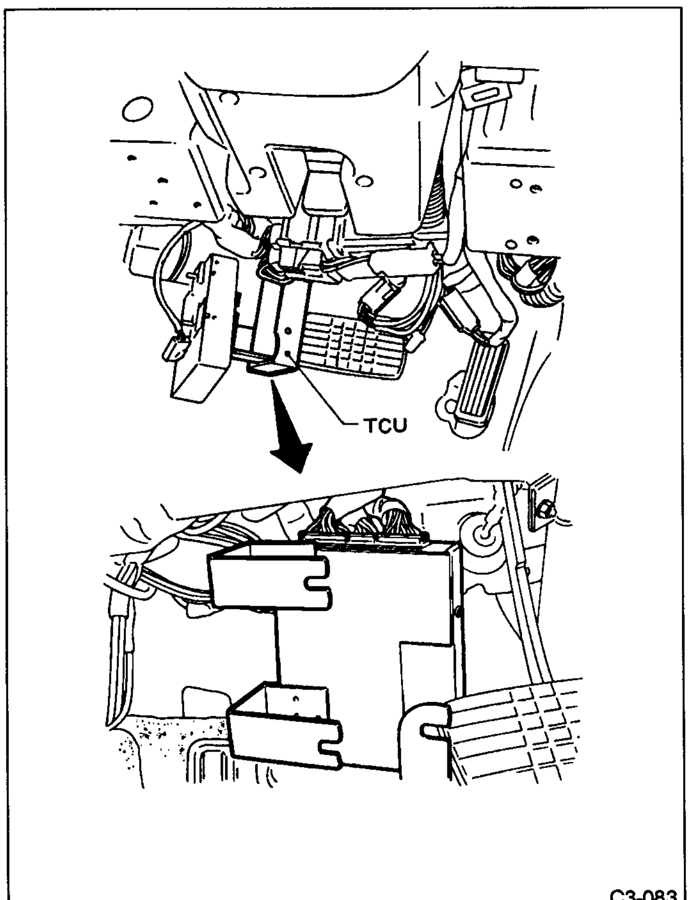



*Fig. 284*

2) Disconnect connector from transmission.
3) Disconnect connector from resistor.
4) Measure resistance between TCU connector and transmission and between TCU connector and body.

**Connector & terminal / Specified resistance:**
**(B68) No. 8— (B14) No. 7 / 0 Ω**
**(B68) No. 8 — Body / 1 MΩ min.**

5) Measure resistance between TCU connector and resistor connector and between TCU connector and body.

**Connector & terminal / Specified resistance:**
**(B68) No. 7 — (F25) No. 1 / 0 Ω**
**(B68) No. 7 — Body / 1 MΩ min.**

**3. CHECK DUTY SOLENOID A'S GROUND LINE.**

1) Disconnect connector from transmission.
2) Measure resistance between transmission connector receptacle (on transmission) and transmission case.

**Connector & terminal / Specified resistance:**
**(T2) No. 4 — Transmission / 1 Ω max.**

**4. CHECK RESISTOR.**

1) Disconnect connector from resistor.
2) Measure resistance between resistor terminals.

**Specified resistance:**
**9 — 15 Ω**

**5. CHECK DUTY SOLENOID A.**

1) Disconnect connector from transmission.
2) Measure resistance between transmission connector receptacle (on transmission) terminals.

**Connector & terminal / Specified resistance:**
**(T2) No. 7 — No. 4 / 1.5 — 4.5 Ω**

## B: TROUBLE CODE 12 — DUTY SOLENOID B —

**CONTENT OF DIAGNOSIS:**
**Output signal circuit of duty solenoid B is open or shorted.**

**TROUBLE SYMPTOM:**
**No "locking-up" (after engine warm-up)**

| | Step | Result | Action |
|---|---|---|---|
| 1 | Measure signal voltage output emitted from TCU. | Not OK | Repair TCU terminal poor contact. (Replace TCU.) |
| 2 | Check harness between TCU and duty solenoid B. | Not OK | Repair harness. |
| 3 | Check duty solenoid B's ground line. | Not OK | Repair ground line. |
| 4 | Check duty solenoid B. | Not OK | Replace duty solenoid B. |

Each step: OK → next step.

After step 4, OK: Repair TCU terminal poor contact. (Replace TCU.)

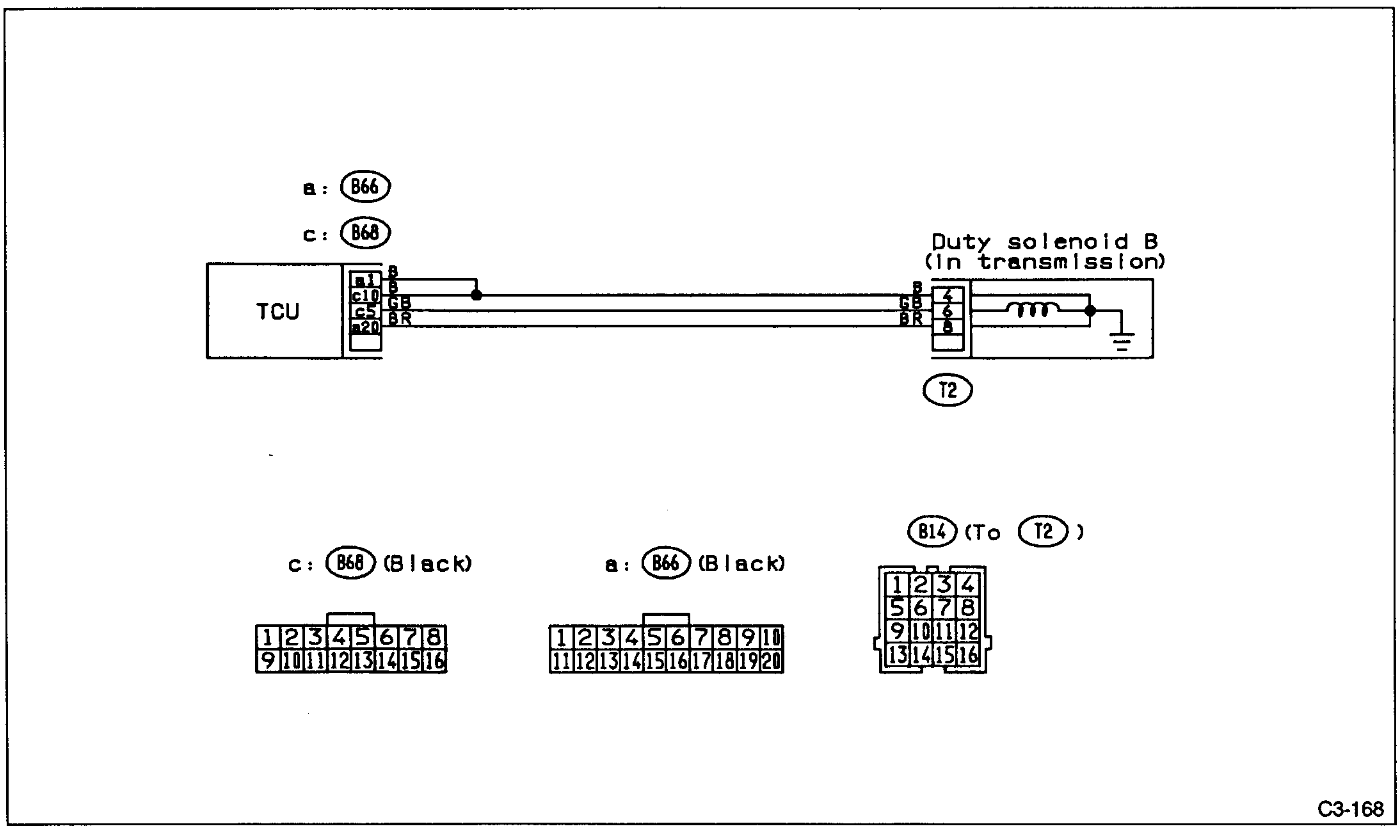



*Fig. 285*

## 1. MEASURE SIGNAL VOLTAGE OUTPUT EMITTED FROM TCU.

1) Raise vehicle and support with safety stands.
**On 4-wheel drive models, raise all wheels off ground.**
2) Warm up the engine and transmission.
3) Move selector lever to "D" and slowly increase vehicle speed to 60 km/h (37 MPH). Measure voltage output emitted from TCU.

**Connector & terminal / Specified voltage:**
**(B68) No. 5 — No. 10 / 8 — 14 V (when wheels are locked up)**

4) Return the engine to idling speed. Move selector lever to "N" and measure voltage output emitted from TCU.

**Connector & terminal / Specified voltage:**
**(B68) No. 5 — No. 10 / 0.5 V, max.**

- SELECT MONITOR FUNCTION MODE

| Mode: 12 | |
|---|---|
| Condition: Start the engine and increase vehicle speed to 60 km/h (37 MPH). When wheels are locked up: | |
| Specified data: LUDTY F12 | |
| 95%<br>5% | (wheel locked up)<br>(release) |

## 2. CHECK HARNESS BETWEEN TCU AND DUTY SOLENOID B.

1) Disconnect connector from TCU.
2) Disconnect connector from transmission.
3) Measure resistance between TCU connector and transmission connector, and between TCU connector and body.

**Connector & terminal / Specified resistance:**
**(B68) No. 5— (B14) No. 6 /0 Ω**
**(B68) No. 5— Body / 1 MΩ min.**

## 3. CHECK DUTY SOLENOID B'S GROUND LINE.

1) Disconnect connector from transmission.
2) Measure resistance between transmission connector receptacle and transmission case.

**Connector & terminal / Specified resistance:**
**(T2) No. 4 — Transmission / 1 Ω max.**

## 4. CHECK DUTY SOLENOID B.

1) Disconnect connector from transmission.
2) Measure resistance between transmission connector receptacle's terminals.

**Connector & terminal / Specified resistance:**
**(T2) No. 6 — No. 4 / 9 — 15 Ω**

## C: TROUBLE CODE 13 — SHIFT SOLENOID 3 —

**CONTENT OF DIAGNOSIS:**
**Output signal circuit of shift solenoid 3 is open or shorted.**

**TROUBLE SYMPTOM:**
**Ineffective engine brake with shift lever in "3"**

| Step | Check | Not OK |
|---|---|---|
| 1 | Measure signal voltage output emitted from TCU. | Repair TCU terminal poor contact. |
| | ↓ OK | |
| 2 | Check harness between TCU and shift solenoid 3. | Repair harness. |
| | ↓ OK | |
| 3 | Check shift solenoid 3's ground line. | Repair ground line. |
| | ↓ OK | |
| 4 | Check shift solenoid 3. | Replace shift solenoid 3. |
| | ↓ OK | |
| | Repair TCU terminal poor contact. (Replace TCU.) | |

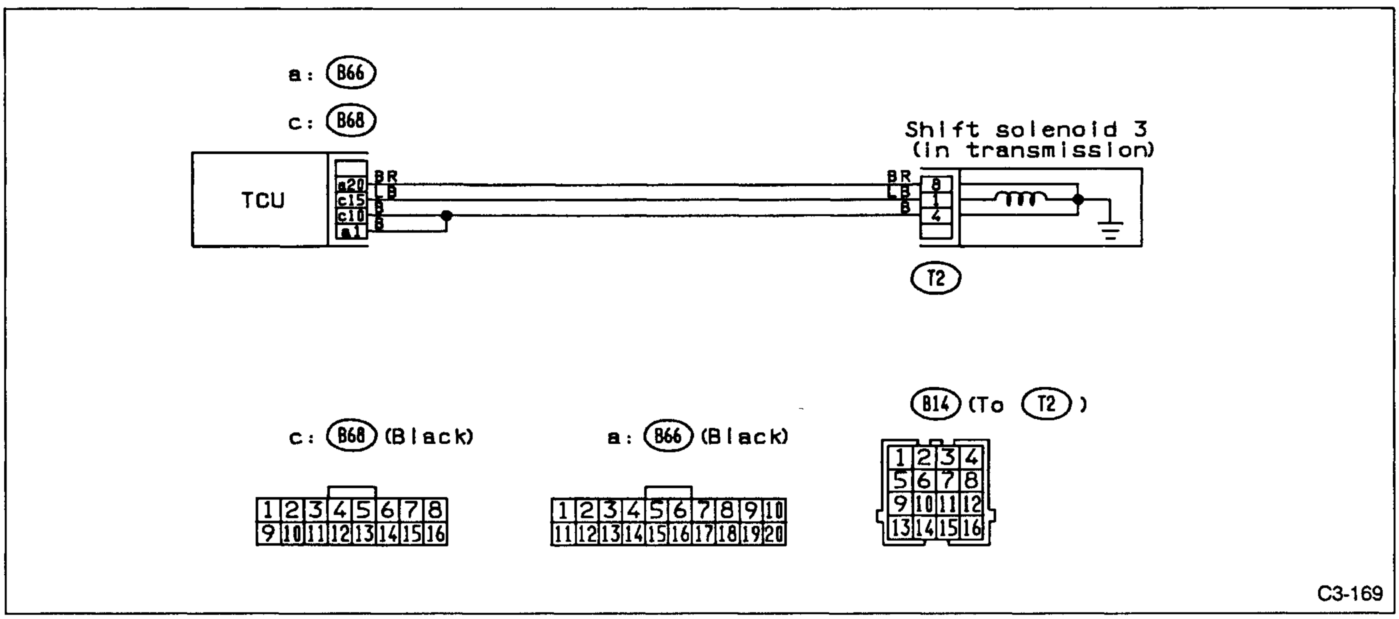



Fig. 286

**1. MEASURE SIGNAL VOLTAGE OUTPUT EMITTED FROM TCU.**

1) Raise vehicle and support with safety stands.

**On 4-wheel drive models, raise all wheels off ground.**

2) Warm up the engine and transmission.

3) Move selector lever to "D."

4) Measure signal voltage output emitted from TCU while idling the engine.

---

**Connector & terminal / Specified voltage:**
**(B68) No. 15 — No. 10 / 10 — 14 V**

---

**2. Check harness between TCU and shift solenoid 3.**

1) Disconnect connector from TCU.

2) Disconnect connector from transmission.

3) Measure resistance between TCU connector and transmission connector, and between TCU connector and body.

---

**Connector & terminal / Specified resistance:**
**(B68) No. 15 — (B14) No. 1 / 0 Ω**
**(B68) No. 15 — Body/ 1 MΩ, min.**
**(B68) No. 10 — (B14) No. 4 / 0 Ω**
**(B68) No. 10— Body / 1 MΩ, min.**

---

**3. Check shift solenoid's grounding line.**

1) Disconnect connector from transmission.

2) Measure resistance between transmission connector receptacle and transmission case.

---

**Connector & terminal / Specified resistance:**
**(T2) No. 4 — Transmission / 0 Ω**

---

**4. Check shift solenoid.**

1) Disconnect connector from transmission.

2) Measure resistance between transmission connector receptacle's terminals.

---

**Connector & terminal / Specified resistance:**
**(T2) No. 1 — No. 4 / 20 — 30 Ω**

---

## D: TROUBLE CODE 14 — SHIFT SOLENOID 2 —

**CONTENT OF DIAGNOSIS:**
**Output signal circuit of shift solenoid 2 is open or shorted.**

**TROUBLE SYMPTOM:**
**No shift**

| Step | Check | Not OK |
|---|---|---|
| 1 | Measure output signal voltage emitted from TCU. | Repair TCU terminal poor contact. (Replace TCU.) |
| ↓ OK | | |
| 2 | Check harness between TCU and shift solenoid 2. | Repair harness. |
| ↓ OK | | |
| 3 | Check shift solenoid 2's grounding line. | Repair grounding line. |
| ↓ OK | | |
| 4 | Check shift solenoid 2. | Replace shift solenoid 2. |
| ↓ OK | | |
| | Repair TCU terminal poor contact. (Replace TCU.) | |

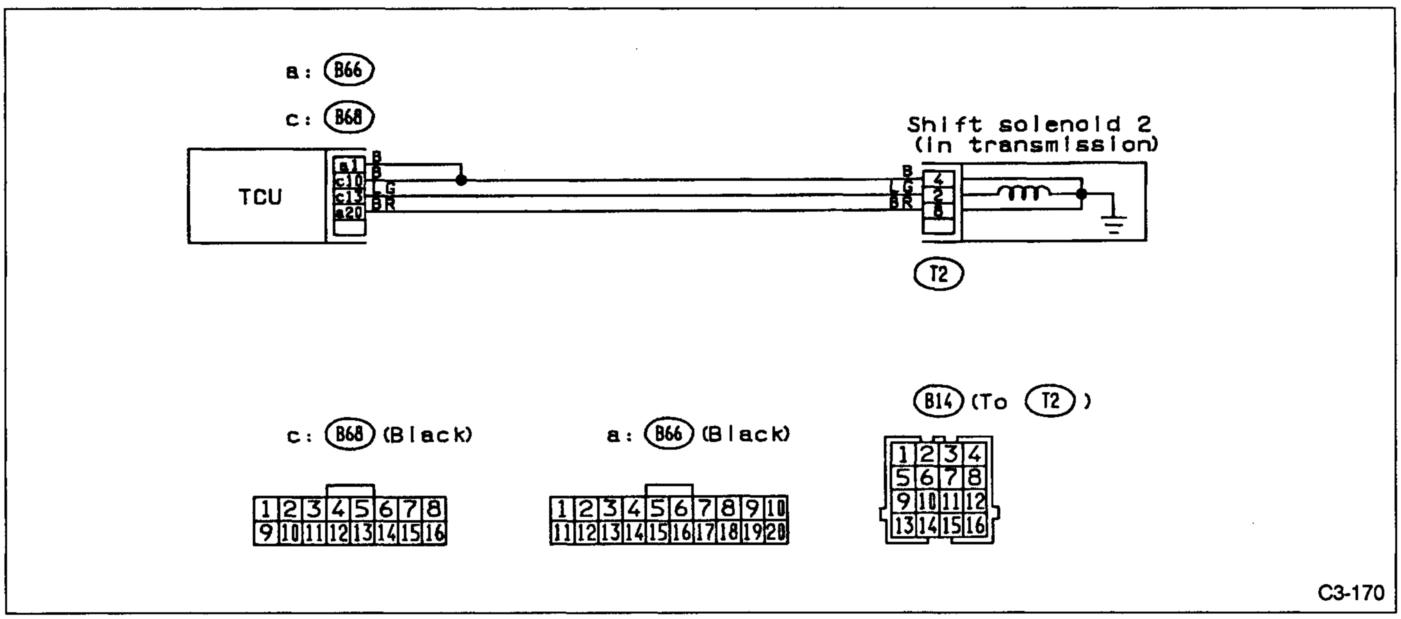



*Fig. 287*

## 1. MEASURE SIGNAL VOLTAGE OUTPUT EMITTED FROM TCU.

1) Raise vehicle and support with safety stands.
**On 4-wheel drive models, raise all wheels off ground.**
2) Warm up the engine and transmission.
3) Move selector lever to "D."
4) Measure signal voltage output emitted from TCU while idling the engine.

---

**Connector & terminal / Specified voltage:**
**(B68) No. 13 — No. 10 / 10 — 14 V**

---

## 2. CHECK HARNESS BETWEEN TCU AND SHIFT SOLENOID 2.

1) Disconnect connector from TCU.
2) Disconnect connector from transmission.
3) Measure resistance between TCU connector and transmission connector, and between TCU connector and body.

---

**Connector & terminal / Specified resistance:**
**(B68) No. 13— (B14) No. 2 / 0 Ω**
**(B68) No. 13 — Body / 1 MΩ, min.**
**(B68) No. 10— (B14) No. 4 / 0 Ω**
**(B68) No. 10— Body / 1 MΩ, min.**

---

## 3.CHECK SHIFT SOLENOID 2'S GROUNDING LINE.

1) Disconnect connector from transmission.
2) Measure resistance between transmission connector receptacle and transmission case.

---

**Connector & terminal / Specified resistance:**
**(T2) No. 4 — Transmission / 0 Ω**

---

## 4. Check shift solenoid 2.

1) Disconnect connector from transmission.
2) Measure resistance between transmission connector receptacle's terminals.

---

**Connector & terminal / Specified resistance:**
**(T2) No. 2 — No. 4 / 20 — 30 Ω**

---

## E: TROUBLE CODE 15 — SHIFT SOLENOID 1 —

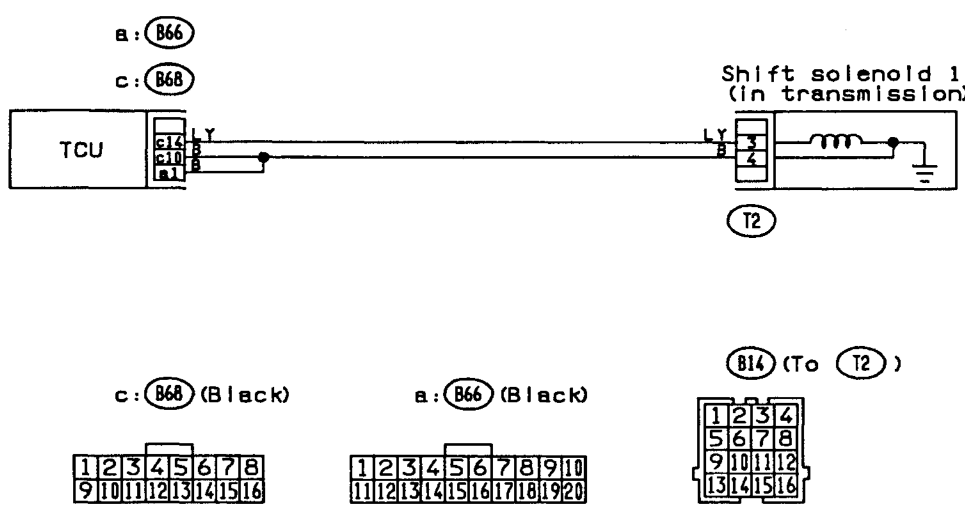
**CONTENT OF DIAGNOSIS:**
**Output signal circuit of shift solenoid 1 is open or shorted.**

**TROUBLE SYMPTOM:**
**No shift**

| | Check | Not OK |
|---|---|---|
| 1 | Measure signal voltage output emitted from TCU. | Repair TCU terminal poor contact. (Replace TCU.) |
| 2 | Check harness between TCU and shift solenoid 1. | Repair harness. |
| 3 | Check shift solenoid 1's ground line. | Repair ground line. |
| 4 | Check shift solenoid 1. | Replace shift solenoid 1. |

↓ OK

Repair TCU terminal poor contact. (Replace TCU.)




C3-171

*Fig. 288*

## 1. MEASURE SIGNAL VOLTAGE OUTPUT EMITTED FROM TCU.

1) Raise vehicle and support with safety stands.
**On 4-wheel drive models, raise all wheels off ground.**
2) Warm up the engine and transmission.
3) Move selector lever to "D."
4) Measure signal voltage output emitted from TCU while idling the engine.

---

**Connector & terminal / Specified voltage:**
**(B68) No. 14 — No. 10 / 10 — 14 V**

---

## 2. CHECK HARNESS BETWEEN TCU AND SHIFT SOLENOID 1.

1) Disconnect connector from TCU.
2) Disconnect connector from transmission.
3) Measure resistance between TCU connector and transmission connector, and between TCU connector and body.

---

**Connector & terminal/Specified resistance:**
**(B68) No. 14 — (B14) No. 3/0 Ω**
**(B68) No. 14 — Body/1 MΩ, min.**
**(B68) No. 10 — (B14) No. 4/0 Ω**
**(B68) No. 10 — Body/1 MΩ, min.**

---

## 3. CHECK SHIFT SOLENOID 1'S GROUND LINE.

1) Disconnect connector from transmission.
2) Measure resistance between transmission connector receptacle and transmission case.

---

**Connector & terminal / Specified resistance:**
**(T2) No. 4 — Transmission / 0 Ω**

---

## 4. CHECK SHIFT SOLENOID 1.

1) Disconnect connector from transmission.
2) Measure resistance between transmission connector receptacle's terminals.

---

**Connector & terminal / Specified resistance:**
**(T2) No. 3 — No. 4 / 20 — 30 Ω**

---

## F: TROUBLE CODE 21 — ATF TEMPERATURE SENSOR —

**CONTENT OF DIAGNOSIS:**
**Input signal circuit of TCU to ATF temperature sensor is open or shorted.**

**TROUBLE SYMPTOM:**
- **ATF indicator full time ON**

| Step | Check | Result | Action |
|---|---|---|---|
| 1 | Measure signal voltage input of TCU. | OK | Repair TCU terminal poor contact. (Replace TCU.) |
| | | Not OK | Go to step 2. |
| 2 | Check harness between TCU and ATF temperature sensor. | Not OK | Repair harness. |
| | | OK | Go to step 3. |
| 3 | Check ATF temperature sensor. | Not OK | Replace ATF temperature sensor. |
| | | OK | Repair TCU terminal poor contact. (Replace TCU.) |

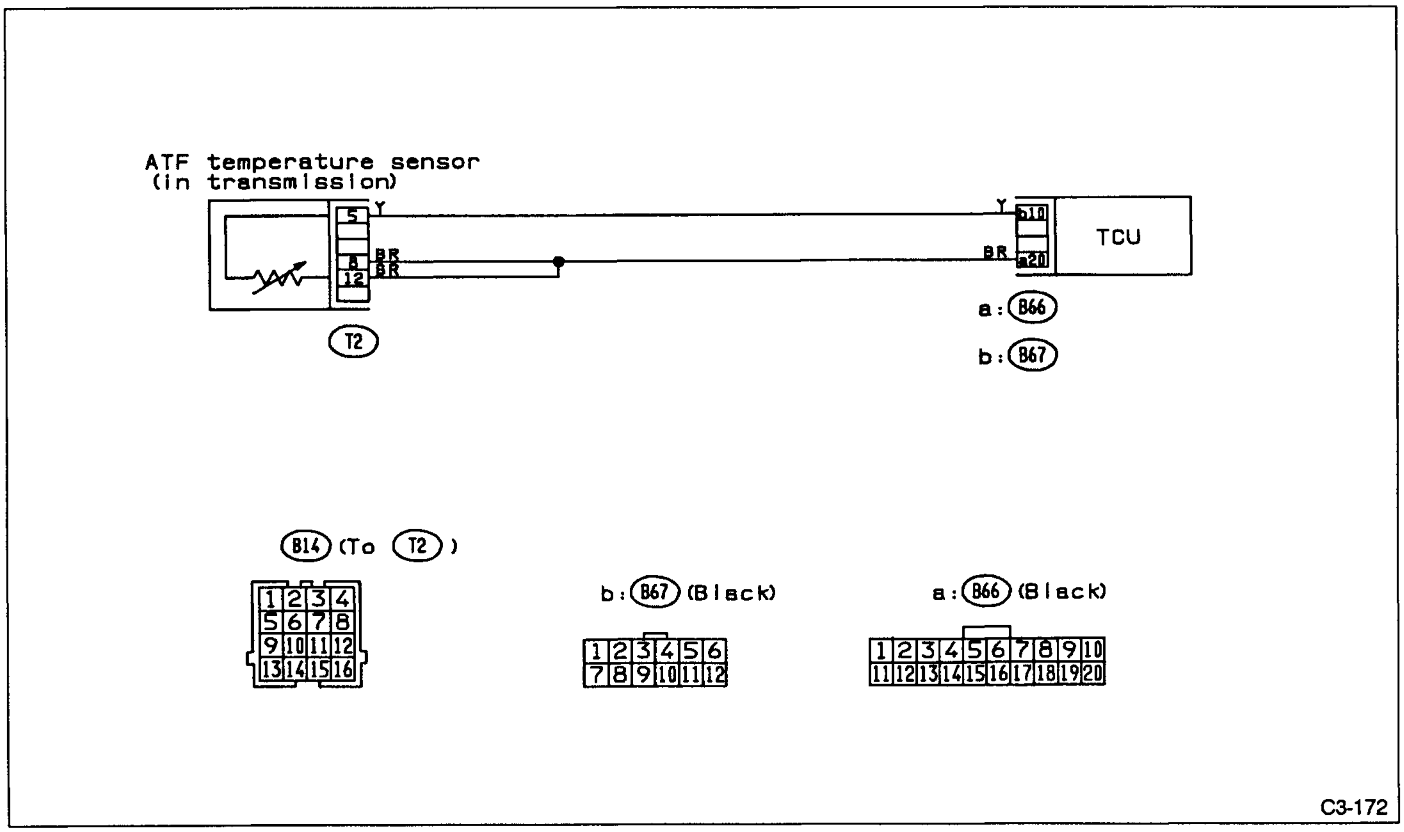



*Fig. 289*

## 1. MEASURE SIGNAL VOLTAGE INPUT OF TCU.

1) Turn ignition switch ON (with engine OFF) and measure signal voltage input of TCU.
2) Start and warm up the engine. Measure signal voltage input of TCU.

**Connector & terminal / Specified voltage:**
**(B67) No. 10 — (B66) No. 20 /**
**1.4 — 1.7 V [ATF temperature: 20°C (68°F)]**
**0.3 — 0.6 V [ATF temperature: 80°C (176°F)]**

- **SELECT MONITOR FUNCTION MODE**

**Mode: 07 or 08**
**Condition:**
**Warm up the engine to increase ATF temperature.**
**Specified data:**
**ATFT F07 or 08**
**(Temperature shown on display increases)**

## 2. CHECK HARNESS BETWEEN TCU AND ATF TEMPERATURE SENSOR.

1) Disconnect connector from TCU.
2) Disconnect connector from transmission.
3) Measure resistance between TCU connector and transmission connector, and between TCU connector and body.

**Connector & terminal / Specified voltage:**
**(B67) No. 10— (B14) No. 5 / 0 Ω**
**(B67) No. 10— Body / 1 MΩ min.**
**(B66) No. 20— (B14) No. 12 / 0 Ω**

## 3. CHECK ATF TEMPERATURE SENSOR.

1) Disconnect connector from transmission.
2) Measure resistance between transmission connector receptacle's terminals.

**Connector & terminal / Specified resistance:**
**(T2) No. 5 — No. 12 /**
**2.3 — 2.7 kΩ [ATF temperature: 20°C (68°F)]**

3) Connect connector to transmission, and warm up the engine to increase ATF temperature.
4) Stop the engine and disconnect connector from transmission.
5) Measure resistance between transmission connector receptacle's terminals.

**Connector & terminal / Specified resistance:**
**(T2) No. 5 — No. 12 /**
**280 — 360 Ω [ATF temperature: 80°C (176°F)]**

# 5. Diagnostic Chart with Trouble Code

## G: TROUBLE CODE 23 — ENGINE SPEED SIGNAL —

**DIAGNOSIS:**
**Engine speed input signal circuit is open or shorted.**

**TROUBLE SYMPTOM:**
- **No lock-up (after engine warm-up)**
- **AT OIL TEMP indicator remains on when vehicle speed is "0".**

| Step | Result | Action |
|---|---|---|
| 1. Check harness and connector between TCM and ECM. | Not OK | Repair or replace harness connectors. |
| | OK | Go to step 2. |
| 2. Check input signal for TCM. | OK | • Repair TCM connector terminal poor contact. • Replace TCM. |
| | Not OK | Conduct diagnostics for ECM's ignition system. |

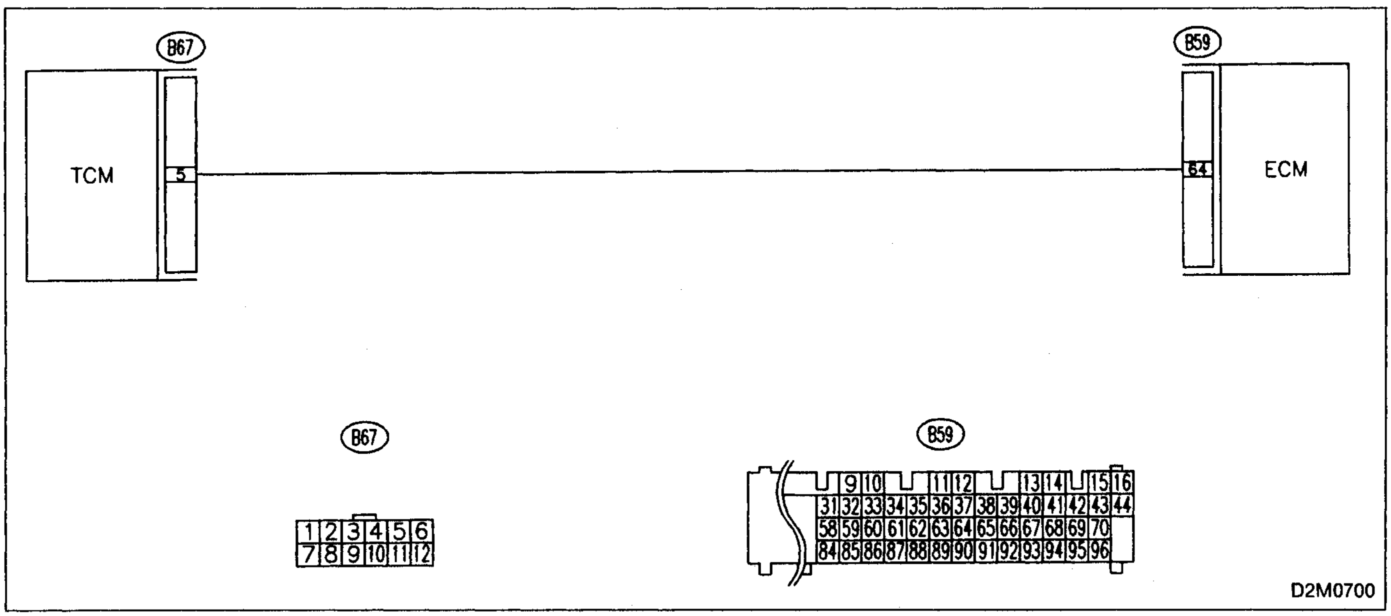



*Fig. 8*

## 1. CHECK HARNESS AND CONNECTOR BETWEEN TCM AND ECM.

1) Turn ignition switch to OFF.
2) Disconnect connectors from TCM and ECM.
3) Measure resistance of harness connector between TCM and ECM.

**Connector & terminal / Specified resistance:**
**(B67) No. 5 — (B59) No. 64 / 1 Ω, or less**

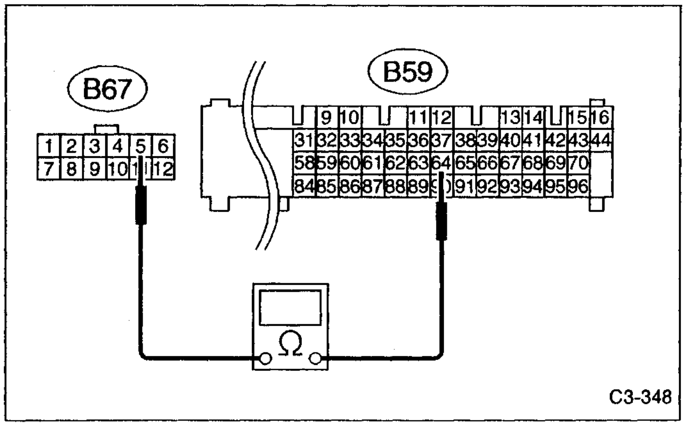



*Fig. 9*

4) Measure resistance of harness connector between TCM and body to make sure that circuit does not short.

**Connector & terminal / Specified resistance:**
**(B67) No. 5 — Body / 1 MΩ, or more**

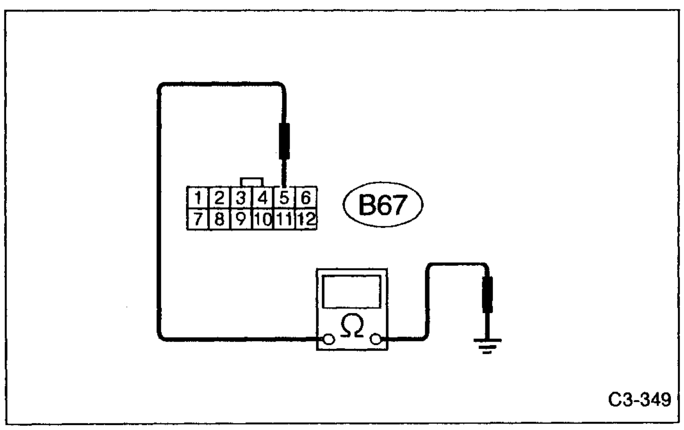



*Fig. 10*

## 2. CHECK INPUT SIGNAL FOR TCM.

1) Connect connectors to ECM and TCM.
2) Turn ignition switch ON (with engine OFF).
3) Measure signal voltage for TCM.

**Connector & terminal / Specified voltage:**
**(B67) No. 5 — Body / 10.5 V, or more**

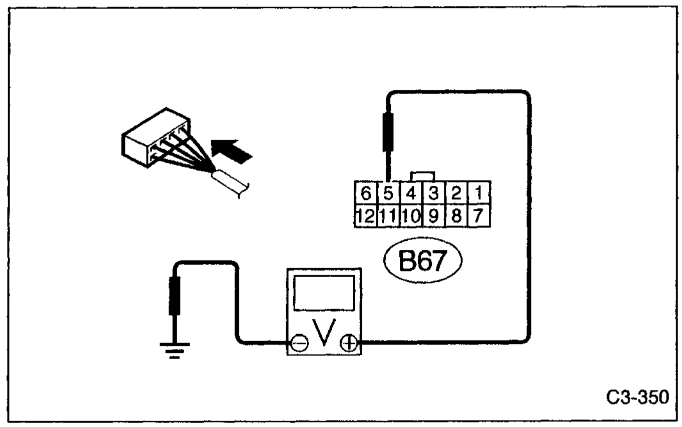



*Fig. 11*

- Using Subaru select monitor:
  (1) Connect connectors to ECM and TCM.
  (2) Turn ignition switch to OFF.
  (3) Connect the Subaru select monitor to data link connector.
  (4) Turn ignition switch to ON (with engine OFF) and Subaru select monitor switch to ON.

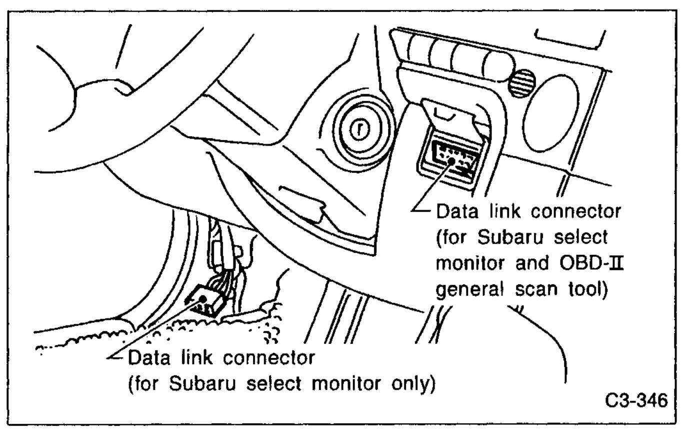



*Fig. 12*

(5) Start and warm-up the engine.
(6) Operate at constant engine speed.
(7) Read data on Subaru select monitor.
(8) Designate mode using function key.

**Function mode: F06**
**SPECIFIED DATA:**
**Same as tachometer reading (in combination meter)**

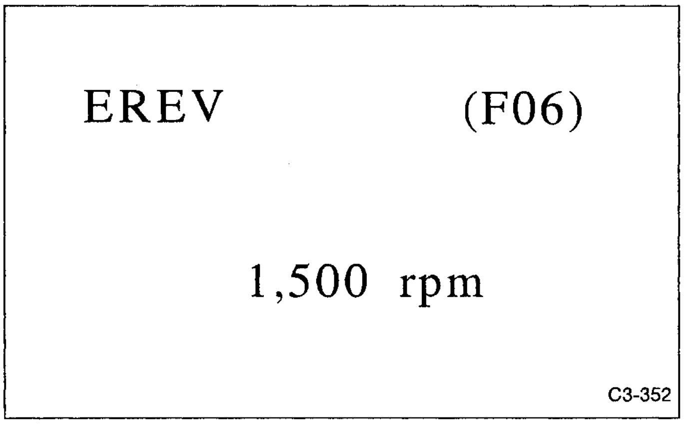



*Fig. 13*

## H: TROUBLE CODE 24 — DUTY SOLENOID C —

**CONTENT OF DIAGNOSIS:**
**Output signal circuit of duty solenoid C is open or shorted.**

**TROUBLE SYMPTOM:**
**Excessive "braking" in tight corners**

| Step | Check | Not OK → |
|---|---|---|
| 1 | Measure signal voltage output emitted from TCU. | Repair TCU terminal poor contact. (Replace TCU.) |
| ↓ OK | | |
| 2 | Check harness between TCU and duty solenoid. | Repair harness. |
| ↓ OK | | |
| 3 | Check duty solenoid C's ground line. | Repair ground line. |
| ↓ OK | | |
| 4 | Check duty solenoid C. | Replace duty solenoid C. |
| ↓ OK | | |
| | Repair TCU terminal poor contact. (Replace TCU.) | |

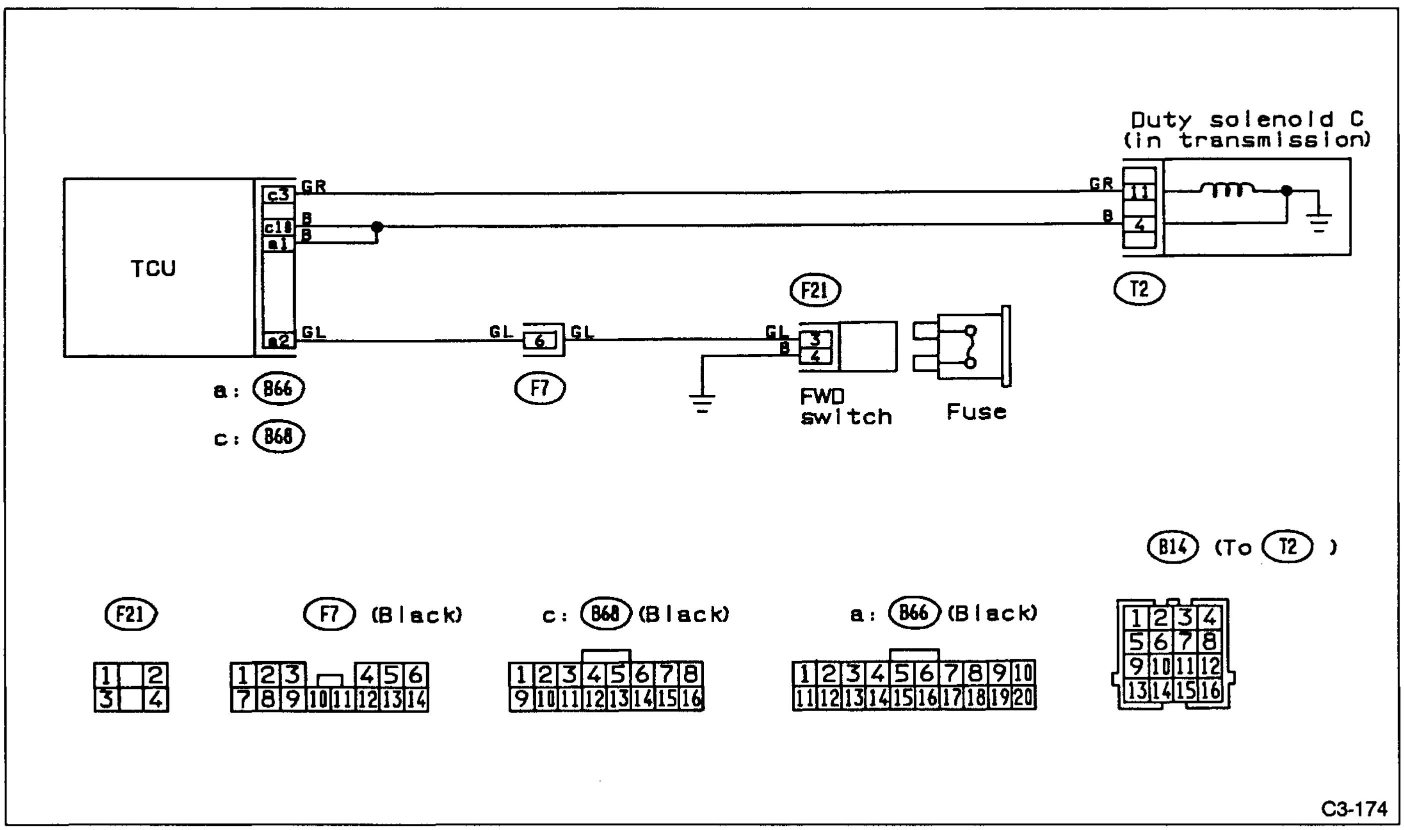



*Fig. 291*

**1. CHECK SIGNAL VOLTAGE OUTPUT EMITTED FROM TCU.**

1) Install spare fuse on FWD connector and set in FWD mode.

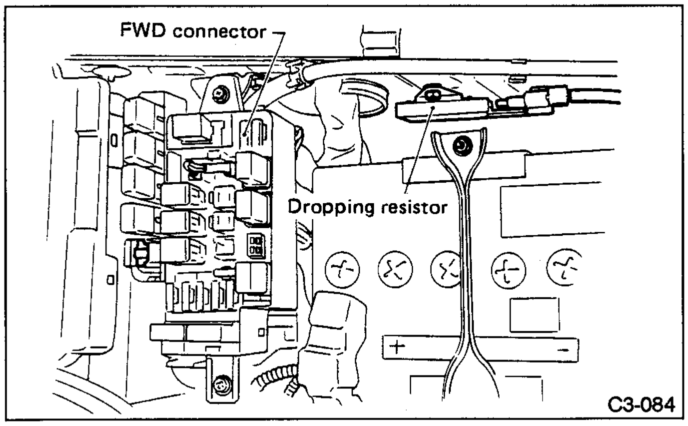



*Fig. 292*

2) Turn ignition switch ON (with engine OFF).
3) Move selector lever to "D".
4) Measure voltage output emitted from TCU (with accelerator pedal released).

**Connector & terminal / Specified voltage:**
**(B68) No. 3 — No. 10 / 8 — 14 V**

5) Turn ignition switch OFF.
6) Remove spare fuse from FWD switch.
7) Turn ignition switch ON (with engine OFF).
8) Move selector lever to "D."
9) Measure voltage output emitted from TCU (with accelerator pedal fully depressed).

**Connector & terminal / Specified voltage:**
**(B68) No. 3 — No. 10 / 0.5 V, max.**

**• SELECT MONITOR FUNCTION MODE**

**Mode: 13**
**Condition:**
**Ignition switch ON (Engine OFF)**
**Specified data:**
**4WDTY F13**
**95% (FWD mode)**
**25%, max. (AWD mode, D-range, Full throttle)**

**2. CHECK HARNESS BETWEEN TCU AND DUTY SOLENOID C.**

1) Disconnect connector from TCU.
2) Disconnect connector from transmission.
3) Measure resistance between TCU connector and transmission connector.

**Connector & terminal / Specified resistance:**
**(B68) No. 3 — (B14) No. 11 / 0 Ω**
**(B68) No. 3 — Body / 1 MΩ, min.**
**(B68) No. 10 — (B14) No. 4 / 0 Ω**
**(B68) No. 10 — Body / 1 MΩ, min.**

**3. CHECK DUTY SOLENOID C'S GROUND LINE.**

1) Disconnect connector from transmission.
2) Measure resistance between transmission connector receptacle and transmission case.

**Connector & terminal / Specified resistance:**
**(T2) No. 4 — Transmission / 1 Ω, max.**

**4. CHECK DUTY SOLENOID C.**

1) Disconnect connector from transmission.
2) Measure resistance between transmission connector receptacle's terminals.

**Connector & terminal / Specified resistance:**
**(T2) No. 11 — No. 4 / 9 — 15 Ω**

## I: TROUBLE CODE 25 — TORQUE CONTROL SIGNAL —

**DIAGNOSIS:**
- **Torque control signal is not emitted from TCM.**
- **The signal circuit is open or shorted.**

**TROUBLE SYMPTOM:**
**Excessive shift shock**

1. Check harness connector between TCM and ECM. — Not OK → Repair or replace harness connectors.
   - OK ↓
2. Check output signal for TCM. — OK → Repair TCM connector terminal poor contact.
   - Not OK ↓
- Repair ECM connector terminal poor contact.
- Replace ECM.

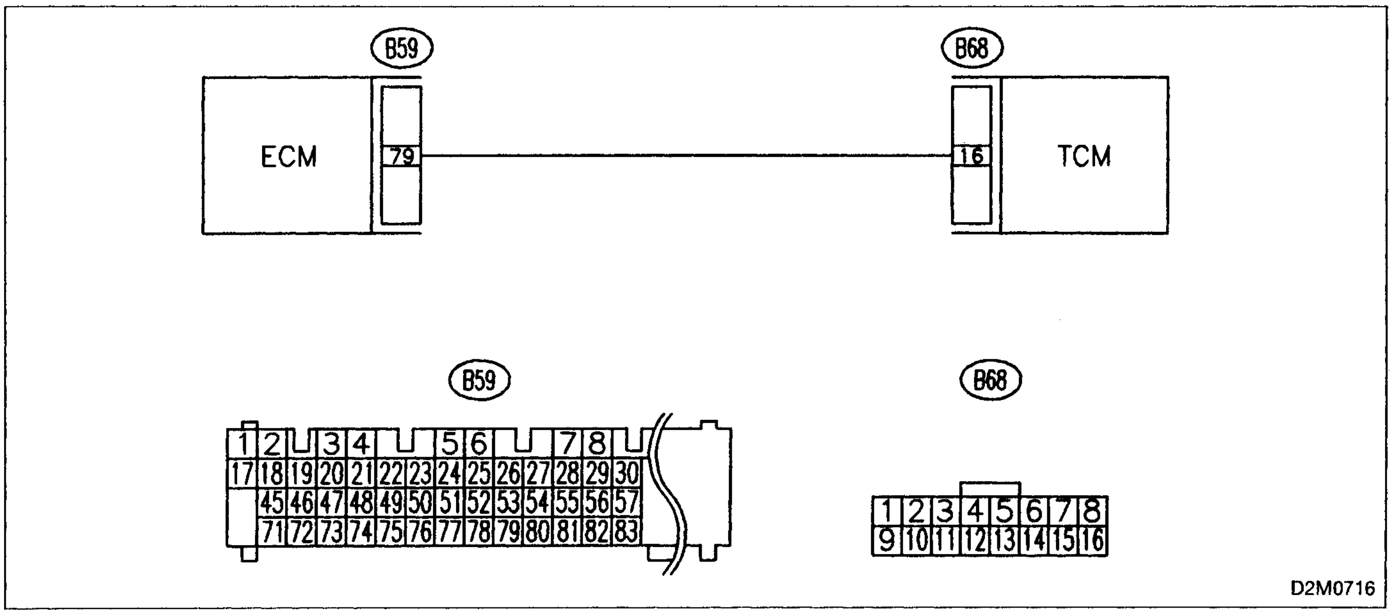



*Fig. 14*

## 1. CHECK HARNESS CONNECTOR BETWEEN TCM AND ECM.

1) Turn ignition switch to OFF.
2) Disconnect connectors from TCM and ECM.
3) Measure resistance of harness connector between TCM and ECM.

**Connector & terminal / Specified resistance:**
**(B68) No. 16 — (B59) No. 79 / 1 Ω, or less**

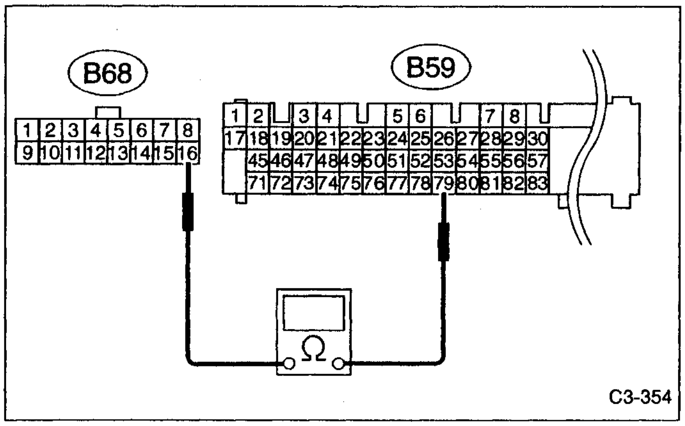



*Fig. 15*

4) Measure resistance of harness connector between TCM and body to make sure that circuit does not short.

**Connector & terminal / Specified resistance:**
**(B68) No. 16 — Body / 1 MΩ, or more**

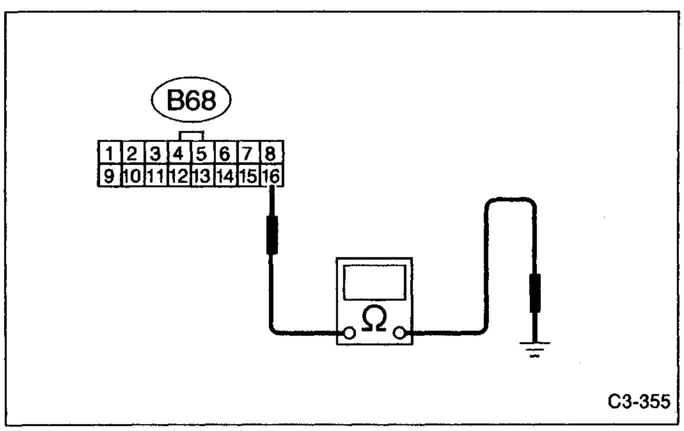



*Fig. 16*

## 2. CHECK INPUT SIGNAL FOR TCM.

1) Connect connectors to TCM and ECM.
2) Turn ignition switch to ON.
3) Measure signal voltage between TCM connector terminal and body.

**Connector & terminal / Specified voltage:**
**(B68) No. 16 — Body / 5±1 V**

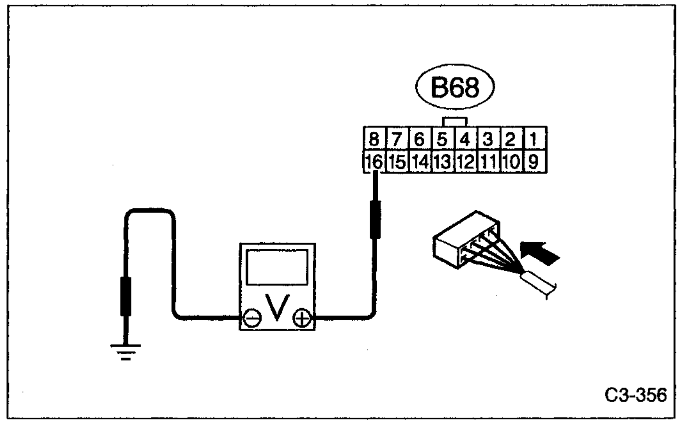



*Fig. 17*

## J: TROUBLE CODE 31 — THROTTLE POSITION SENSOR —

**DIAGNOSIS:**

**Input signal circuit of throttle position sensor is open or shorted.**

**TROUBLE SYMPTOM:**

**Shift point too high or too low; engine brake not effected in "3" range; excessive shift shock; excessive tight corner "braking"**

1. Check harness connector between TCM and throttle position sensor.
   - Not OK → Repair or replace harness connectors.
   - OK ↓
2. Check throttle position sensor.
   - Not OK → Replace throttle position sensor.
   - OK ↓
3. Check input signal for TCM.
   - OK → • Repair TCM connector terminal poor contact. • Replace TCM.
   - Not OK ↓
4. Check power supply to throttle position sensor.
   - Not OK → Repair or replace harness connectors.
   - OK ↓

- Repair TCM connector terminal poor contact.
- Replace TCM.

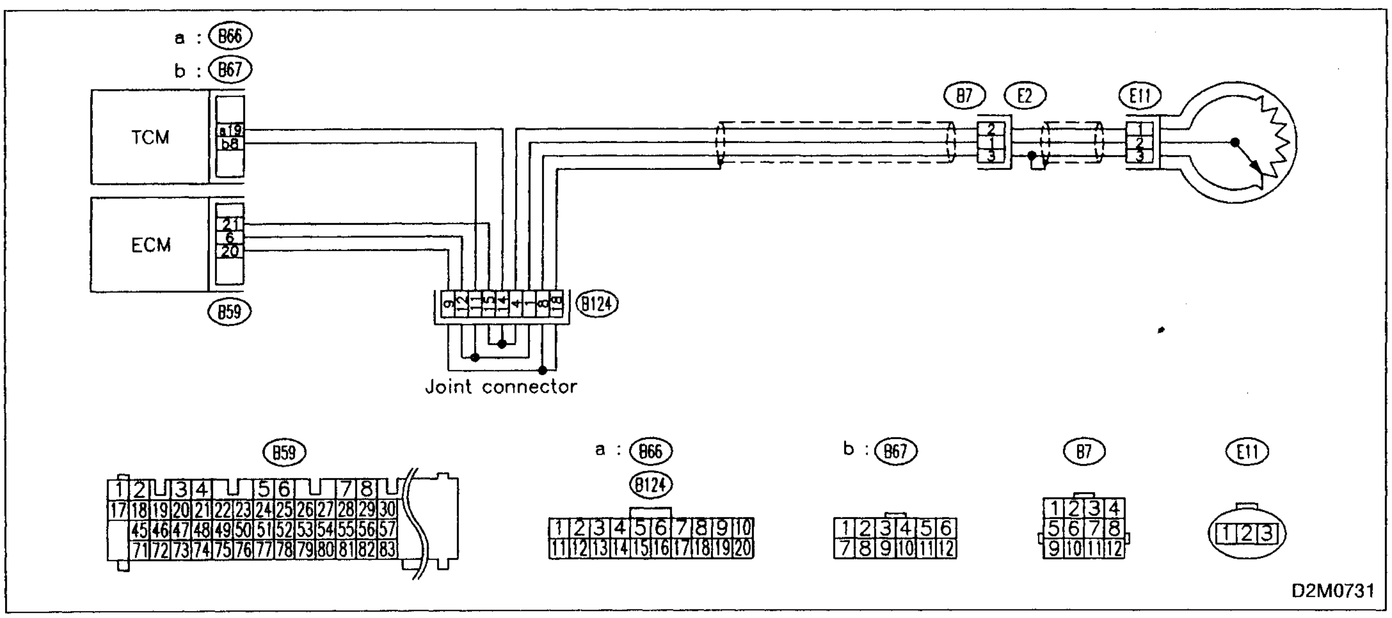



*Fig. 18*

**1. CHECK HARNESS CONNECTOR BETWEEN TCM AND THROTTLE POSITION SENSOR.**

1) Turn ignition switch to OFF.
2) Disconnect connector from TCM and throttle position sensor.
3) Measure resistance of harness connector between TCM and throttle position sensor.

**Connector & terminal / Specified resistance:**
**(B67) No. 8 — (E11) No. 2 / 1 Ω, or less**
**(B66) No. 19 — (E11) No. 3 / 1 Ω, or less**

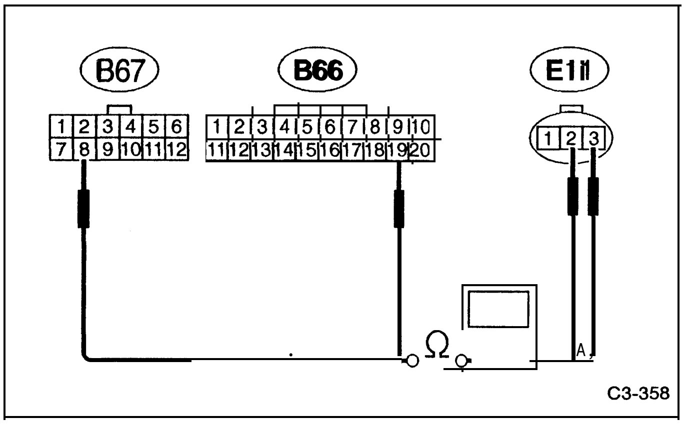



*Fig. 79*

4) Measure resistance of harness connector between TCM and body to make sure that circuit does not short.

**Connector & terminal / Specified resistance:**
**(B67) No. 8 — Body / 1 MΩ, or more**
**(B66) No. 19 — Body / 1 MR, or more**

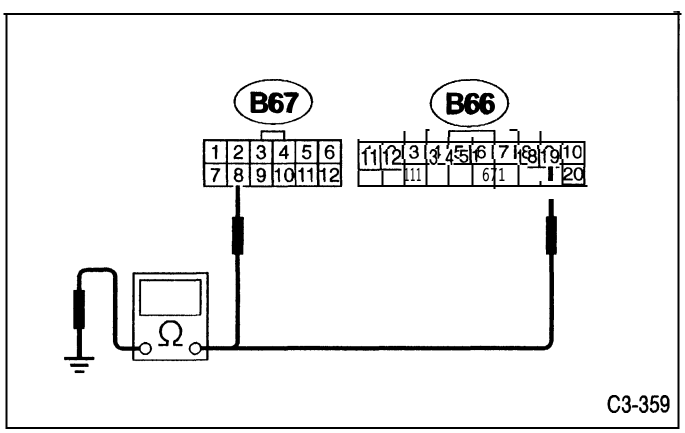



*Fig. 20*

**2. CHECK THROTTLE POSITION SENSOR.**

Measure resistance between throttle position sensor terminals.

**Terminals / Specified resistance:**
**(E11) No. 1 — No. 2 / 0.3 — 0.7 kΩ**
**(Throttle fully closed.)**
**3 - 6 kΩ**
**(Throttle fully open.)**
**(E11) No. 1 — No. 3 / 3.5 — 6.5 kΩ**

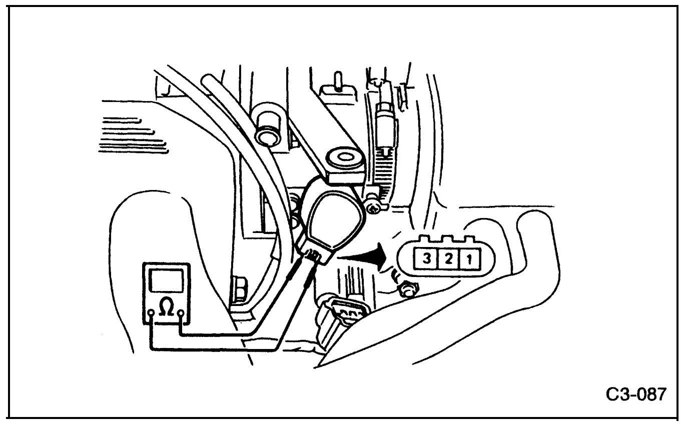



*Fig. 27*

**3. CHECK INPUT SIGNAL FOR TCM.**

1) Connect connectors to TCM and throttle position sensor.
2) Turn ignition switch ON (with engine OFF).
3) Measure signal voltage input emitted from throttle position sensor with accelerator pedal fully depressed.

**Connector & terminal / Specified voltage:**
**(B67) No. 8 — No. 7 /**
**0.3 — 0.7 V (Throttle fully closed.)**
**4.3 — 4.9 V (Throttle fully open.)**

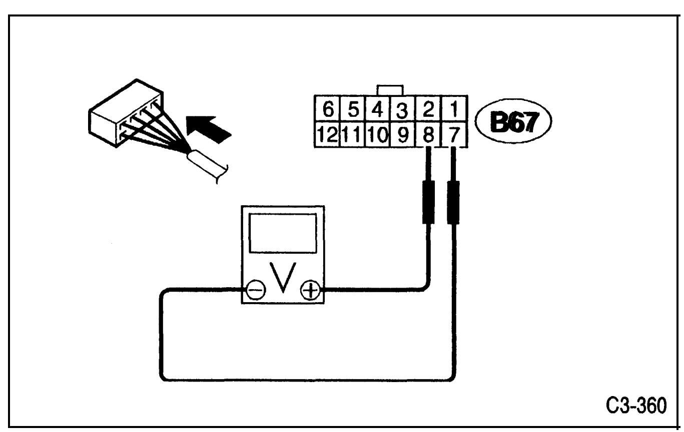



*Fig. 22*

- Using Subaru select monitor:

(1) Connect connectors to TCM and throttle position sensor.
(2) Turn ignition switch to OFF.
(3) Connect the Subaru select monitor to data link connector.
(4) Turn ignition switch to ON (with engine OFF) and Subaru select monitor switch to ON.

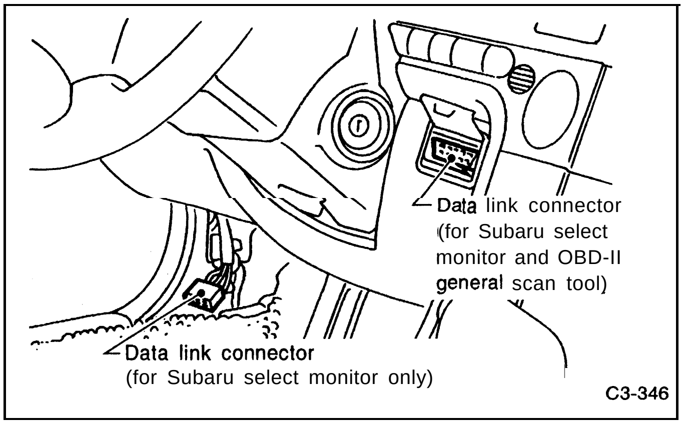



*Fig. 23*

(5) Designate mode using function key.
(6) Read data on Subaru select monitor.

---

**Function mode: F09**
**SPECIFIED DATA:**
*0.3* **— 0.7 V (Throttle fully closed.)**
*4.3* **— 4.9 V (Throttle fully open.)**
[Must **be changed correspondingly with accelerator pedal operation (from "released" to "depressed" position).]**

---

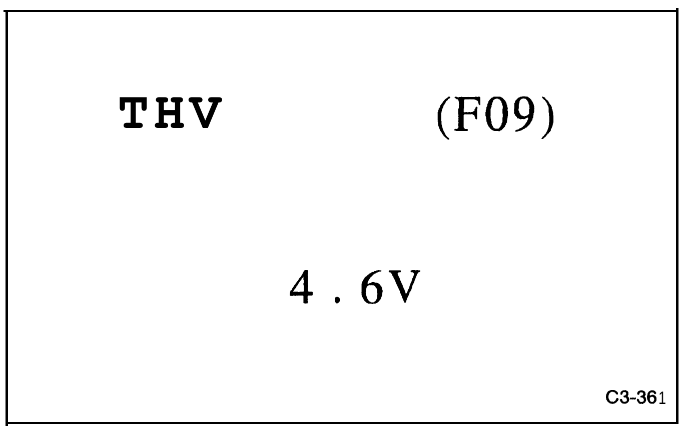



*Fig. 24*

**4. CHECK POWER SUPPLY TO THROTTLE POSITION SENSOR.**

1) Turn ignition switch to ON (with engine OFF).
2) Measure power supply voltage to throttle position sensor.

---

**Connector & terminal / Specified voltage:**
**(Ell) No. 1 — Body / 5.12 ± 0.1 V**

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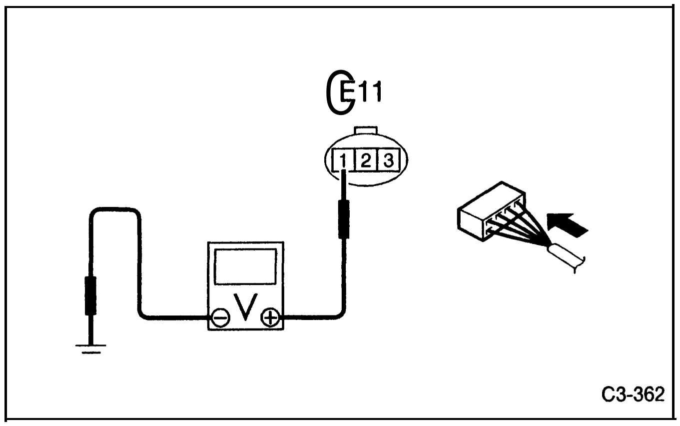


*Fig. 25*

- Using Subaru select monitor:

(1) Turn ignition switch to OFF.
(2) Connect the Subaru select monitor to data link connector.
(3) Turn ignition switch to ON (with engine OFF) and Subaru select monitor switch to ON.

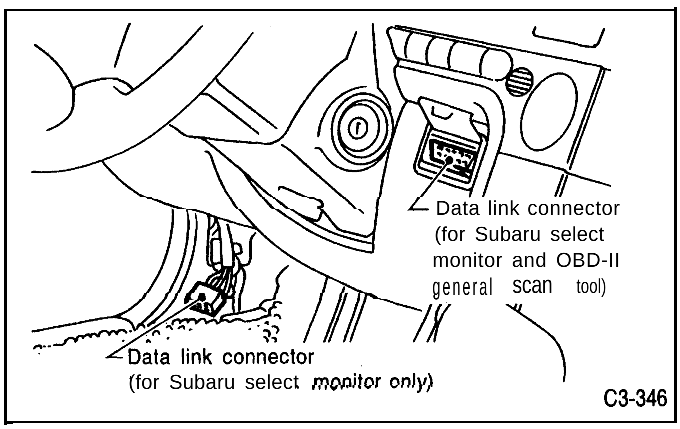


*Fig. 26*

(4) Designate mode using function key.
(5) Read data on Subaru select monitor.

**Function mode: F14**
**SPECIFIED DATA:**
**5.12 ± 0.1 v**

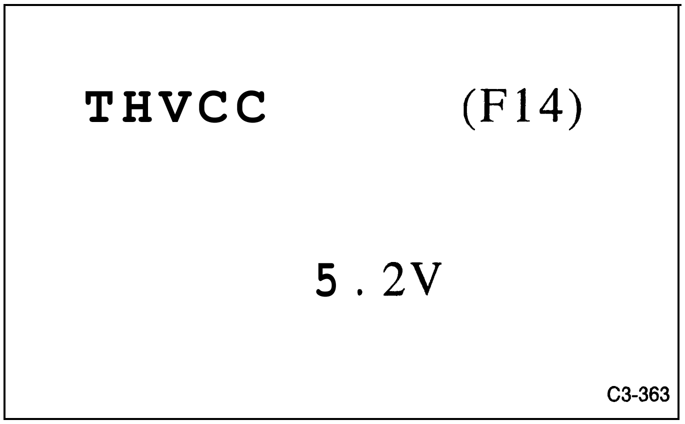

Fig. 27

## K: TROUBLE CODE 32 — VEHICLE SPEED SENSOR 1 —

**CONTENT OF DIAGNOSIS:**
**Input signal circuit of TCU is open or shorted.**

**TROUBLE SYMPTOM:**
**No shift or excessive tight corner "braking"**

1 Measure signal voltage input of TCU. — OK → Repair TCU terminal poor contact. (Replace TCU.)

↓ Not OK

2 Check harness between TCU and vehicle speed sensor 1. — Not OK → Repair harness/connector.

↓ OK

3 Check vehicle speed sensor 1. — Not OK → Replace vehicle speed sensor 1.

↓ OK

Replace TCU terminal poor contact. (Replace TCU.)

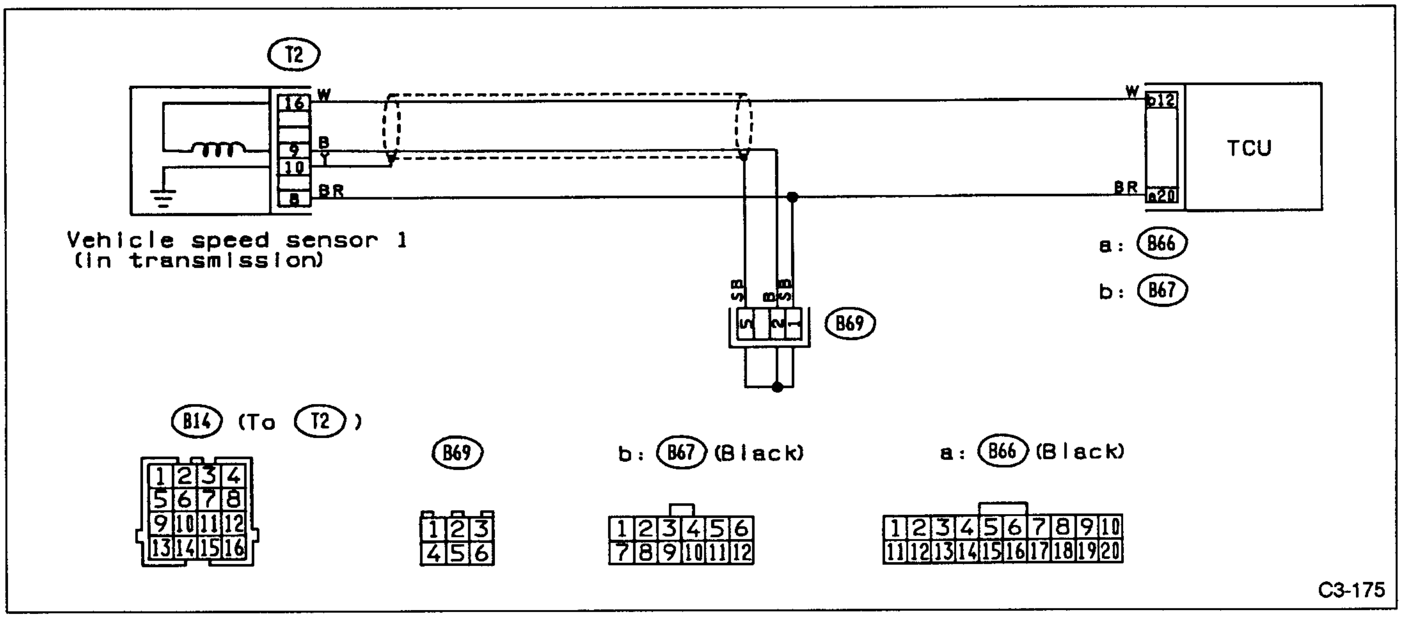


Fig. 296

## 1. MEASURE SIGNAL VOLTAGE INPUT OF TCU.

1) Raise vehicle and place safety stands.

**On AWD models, raise all wheels off floor.**

2) Start the engine. Set vehicle in 12 miles/h condition.

3) Measure signal voltage input of TCU.

**Connector & terminal / Specified voltage:**
**(B67) No. 12 — (B66) No. 20 / AC 1 V, min.**

- **SELECT MONITOR FUNCTION MODE**

| Mode: 02 | |
|---|---|
| Condition: Simulated driving | |
| Specified data: | VSP1 F02<br>(Vehicle speed) miles/h |

**Mode 03: "km/h" indication**

## 2.CHECK HARNESS/CONNECTOR BETWEEN TCU AND VEHICLE SPEED SENSOR 1.

1) Disconnect connector from TCU.

2) Disconnect connector from transmission.

3) Measure resistance between TCU connector and transmission connector.

**Connector & terminal / Specified resistance:**
**(B67) No. 12 — (B14) No. 16 / 0 Ω**
**(B67) No. 12 — Body / 1 MΩ min.**
**(B66) No. 20 — (B14) No. 9 / 0 Ω**
**(B66) No. 20 — Body / 1 MΩ min.**

## 3. CHECK VEHICLE SPEED SENSOR 1.

1) Disconnect connector from transmission.

2) Measure resistance between transmission connector receptacle's terminals.

**Connector & terminal / Specified resistance:**
**(T2) No. 16 — No. 9 / 450 — 650 Ω**

## L: TROUBLE CODE 33 — VEHICLE SPEED SENSOR 2 —

**CONTENT OF DIAGNOSIS:**
**Input signal circuit of vehicle speed sensor 2 is open or shorted.**

**TROUBLE SYMPTOM:**
**Improper shift points**

| Step | Check | Result | Action |
|---|---|---|---|
| 1 | Measure signal voltage input of TCU. | OK | Repair TCU terminal poor contact. (Replace TCU.) |
| | ↓ Not OK | | |
| 2 | Check harness/connector between TCU and vehicle speed sensor 2. | Not OK | Repair harness/connector. |
| | ↓ OK | | |
| 3 | Check voltage of power supply line. | Not OK | Repair or replace power supply circuit. |
| | ↓ OK | | |
| 4 | Check vehicle speed sensor 2. | Not OK | Replace vehicle speed sensor 2. |
| | ↓ OK | | |
| | Mechanical trouble in transmission. | | |

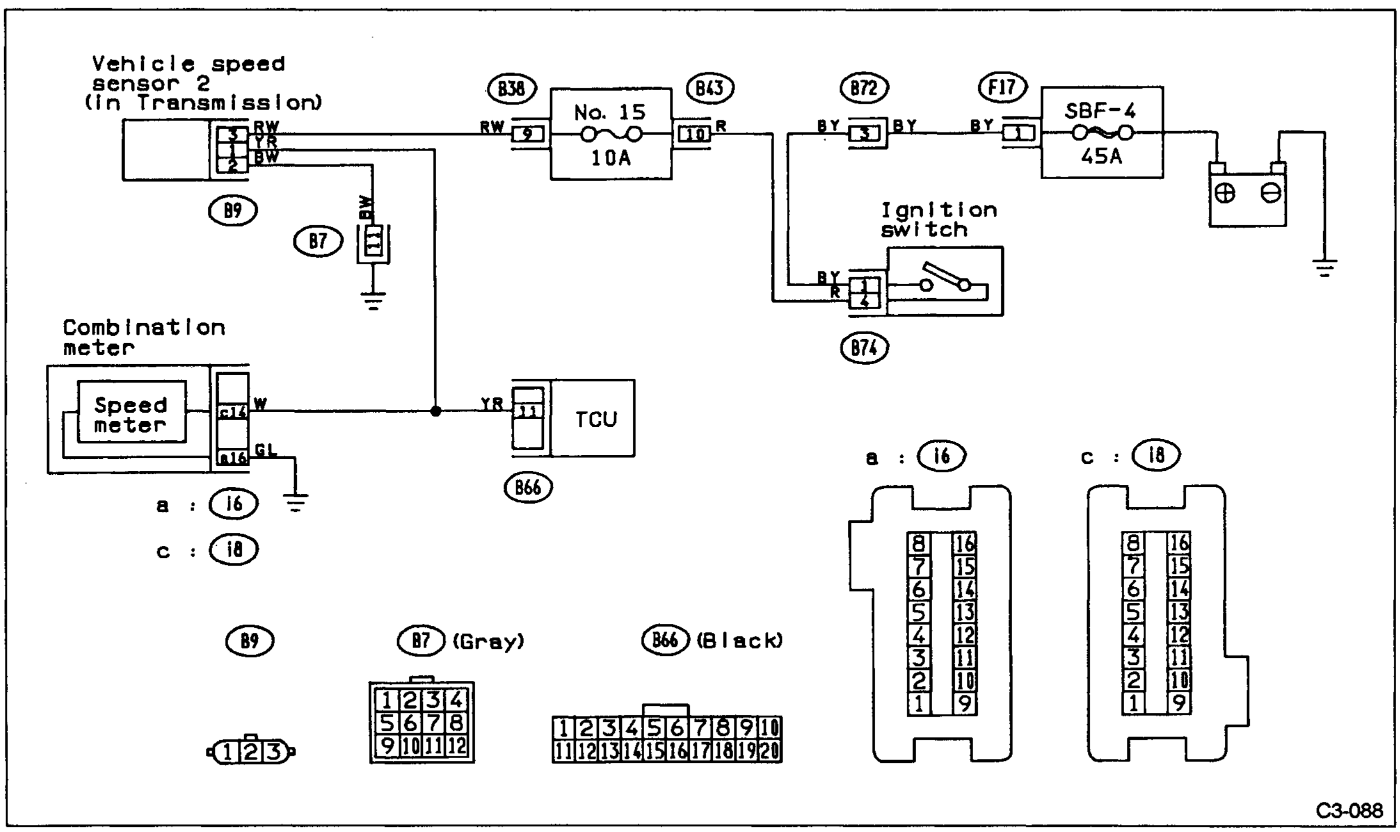


*Fig. 297*

## 1.MEASURE SIGNAL VOLTAGE INPUT OF TCU.

1) Turn ignition switch ON (with engine OFF).
2) Move select lever to "N" and slowly move vehicle by pushing it.
3) While vehicle is slowly moving, measure signal voltage input of TCU.

**Connector & terminal / Specified voltage:**
**(B66) No. 11 — (B66) No. 20 / 0 ⇄ 5V**

- **SELECT MONITOR FUNCTION MODE**

| Mode: 04 | |
|---|---|
| Condition: Simulated driving | |
| Specified data: | VSP2 04<br>(vehicle speed) miles/h* |

***: "km/h" indication in mode 05.**

## 2. CHECK HARNESS/CONNECTOR BETWEEN TCU AND VEHICLE SPEED SENSOR 2.

1) Disconnect connector from TCU.
2) Disconnect connector from vehicle speed sensor 2.
3) Measure resistance between TCU connector and vehicle speed sensor 2 connector, and vehicle speed sensor 2 connector and body.

**Connector & terminal / Specified resistance:**
**(B66) No. 11 — (B9) No. 1 / 0 Ω**
**(B66) No. 11 — Body / 1 MΩ min.**
**(B9) No. 2 — Body / 0 Ω**

## 3. CHECK VOLTAGE OF POWER SUPPLY LINE.

1) Turn ignition switch ON (with engine OFF).
2) Measure voltage between vehicle speed sensor 2 connector and body.

**Connector & terminal / Specified voltage:**
**(B9) No. 3 — Body / 10V, min.**

## 4. CHECK VEHICLE SPEED SENSOR 2.

1) Remove vehicle speed sensor 2 from transmission, connect body harness connector (B9) to vehicle speed sensor 2 and turn ignition switch ON.
2) Rotate vehicle speed sensor 2.
3) Check that voltage across vehicle speed sensor 2's connector terminals change (from 0 to 5) volts four times per rotation.

**Connector & terminal / Specified voltage:**
**(B9) No. 1 — (B9) No. 2 / 0 ⇄ 5 V**

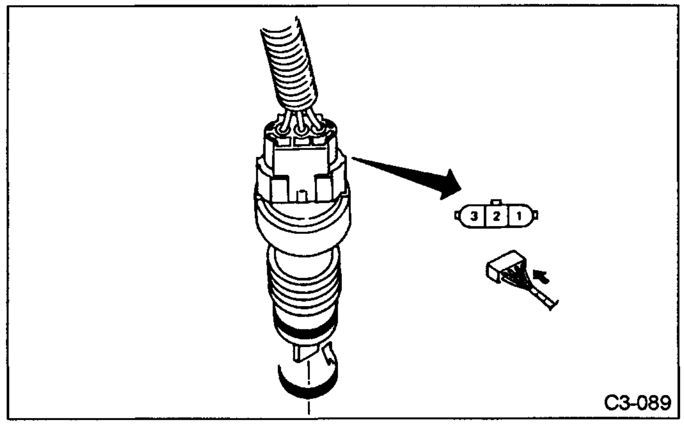


*Fig. 298*

## M: TROUBLE CODE 22 — MASS AIR FLOW SIGNAL —

**DIAGNOSIS:**
**Input signal circuit of TCM from ECM is open or shorted.**

**TROUBLE SYMPTOM:**
**Excessive shift shock**

1. Check trouble code on engine side.
   <Ref. to 2-7 On-Board Diagnostics II System [T10B0].☆5>
   - Not OK → Check for cause of trouble in engine.
   - OK ↓
2. Check harness connector between TCM and ECM.
   - Not OK → Repair TCM connector terminal poor contact.
   - OK ↓
3. Check input signal for TCM.
   - Not OK → Replace TCM.
   - OK ↓

Clear memory → Confirmation test → Not OK → Repair TCM connector terminal poor contact.

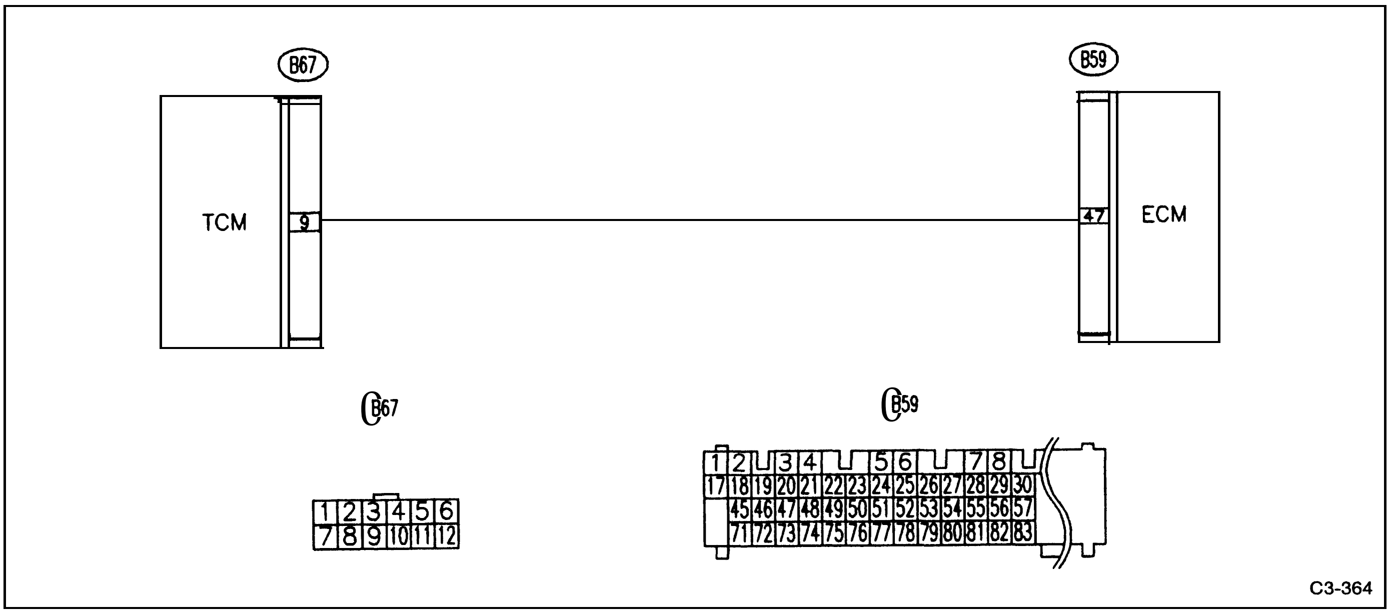


Fig. 28

### 1. CHECK TROUBLE CODE ON ENGINE SIDE.

Using Subaru select monitor or OBD-II general scan tool, check trouble code of mass air flow sensor on engine side.

### 2. CHECK HARNESS CONNECTOR BETWEEN TCM AND ECM.

1) Turn ignition switch to OFF.
2) Disconnect connectors from TCM and ECM.
3) Measure resistance of harness connector between TCM and ECM.

**Connector & terminal / Specified resistance:**
**(867) No. 9 — (859) No. 47 / 1 Ω, or less**

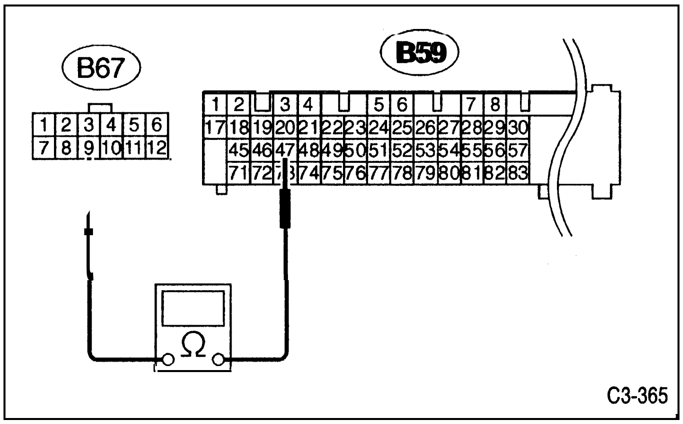


*Fig. 29*

4) Measure resistance of harness connector between TCM and body to make sure that circuit does not short.

**Connector & terminal / Specified resistance:**
**(B67) No. 9 — Body / 1 MΩ, or more**

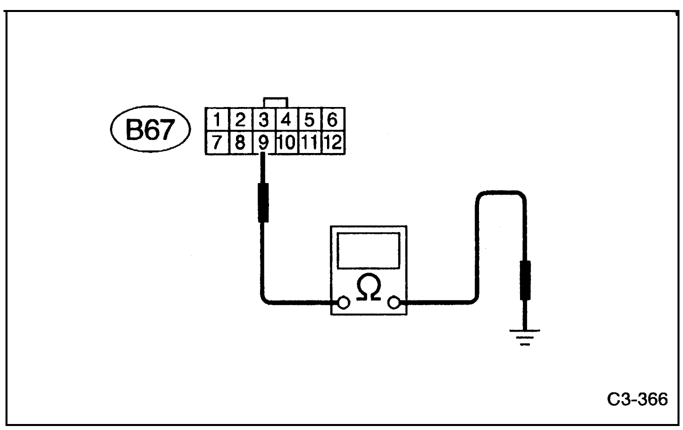


*Fig. 30*

### 3. CHECK INPUT SIGNAL FOR TCM.

1) Connect connectors to TCM and ECM.
2) Start the engine. (engine idling after warm-up)
3) Measure signal voltage between TCM connector terminal and body.

**Connector & terminal / Specified voltage:**
**Engine warm-up;**
**(B67) No. 9 — Body / 0.5 — 1.22 V**

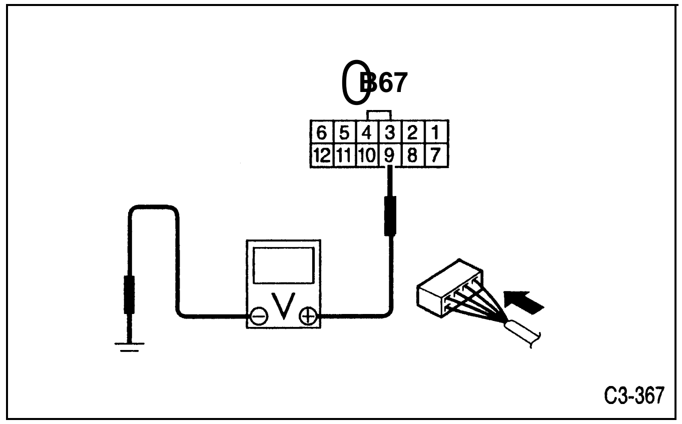


*Fig. 37*

- Using Subaru select monitor:
  (1) Connect connectors to TCM and ECM.
  (2) Turn ignition switch to OFF.
  (3) Connect the Subaru select monitor to data link connector.
  (4) Turn ignition switch to ON and Subaru select monitor switch to ON.
  (5) Start the engine (engine idling after warm-up).

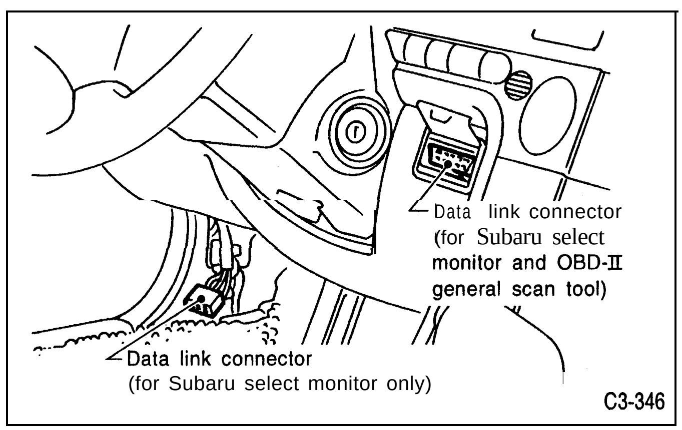


*Fig. 32*

(6) Read data on Subaru select monitor.
(7) Designate mode using function key.

---

**Function mode: F15**
**SPECIFIED DATA:**
**0.5 — 1.22 V (Engine warm-up)**

---

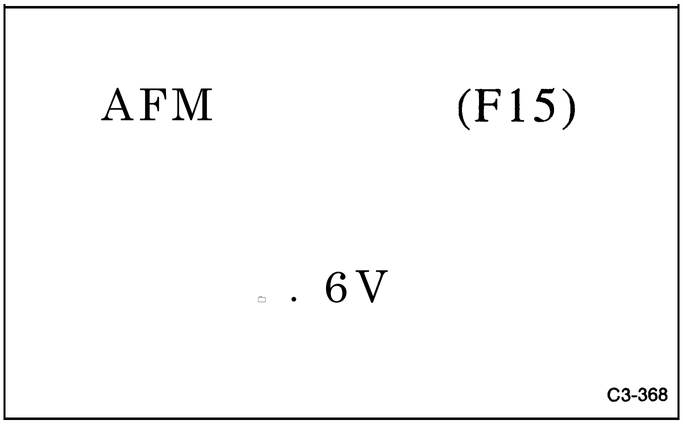


*Fig. 33*

# 6. Troubleshooting Chart with Select Monitor

## A: BASIC TROUBLESHOOTING CHART

If no trouble codes appear in the self diagnosis function (although problems have occurred or are occurring), measure performance characteristics of sensors, actuators, etc., in the "F" mode (select-monitor function), and compare with the "basic data" to determine the cause of problems.

Trouble occurs

↓

No trouble codes appear in self-diagnosis operation.

↓

Check each item in select mode function.

↓

Compare measured values with basic data.

↓

Determine item which is outside basic data specifications.

↓

Check sensor and actuator affected.

## B: LIST OF OUTPUT MODES

### 1. FUNCTION MODE

| Mode | Contents | Abbr. | Unit | Contents of display |
|---|---|---|---|---|
| 00 | Mode display | — | — | AT or EGI mode (when monitor is connected) |
| 01 | Battery voltage | VB | V | Battery voltage applied to control unit. |
| 02 | Vehicle speed sensor 1 | VSP1 | m/h | Vehicle speed (miles/h) sent from vehicle speed sensor 1. |
| 03 | Vehicle speed sensor 1 | VSP1 | km/h | Vehicle speed (km/h) sent from vehicle speed sensor 1. |
| 04 | Vehicle speed sensor 2 | VSP2 | m/h | Vehicle speed (miles/h) sent from vehicle speed sensor 2. |
| 05 | Vehicle speed sensor 2 | VSP2 | km/h | Vehicle speed (km/h) sent from vehicle speed sensor 2. |
| 06 | Engine RPM | EREV | rpm | Engine speed sent from EGI unit. |
| 07 | ATF temperature sensor | ATFT | °F | ATF temperature (°F) sent from ATF temperature sensor. |
| 08 | ATF temperature sensor | ATFT | °C | ATF temperature (°C) sent from ATF temperature sensor. |
| 09 | Throttle sensor | THV | V | Voltage sent from throttle sensor. |
| 10 | Gear position | GEAR | — | Transmission gear position. |
| 11 | Line pressure duty | PLDTY | % | Duty ratio flowing through duty solenoid A. |
| 12 | Lock-up duty | LUDTY | % | Duty ratio flowing through duty solenoid B. |
| 13 | AWD duty | 4WDTY | % | Duty ratio flowing through duty solenoid C. |
| 14 | Atmospheric sensor | BARO.P | mmHg | — |

## 2. ON ←→ OFF SIGNAL LIST

| Mode | LED No. | Contents | Display | LED "ON" requirements |
|---|---|---|---|---|
| A0 | 5 | ABS switch | AB | When ABS signal is entered |
| | 6 | Cruise control set | CR | When cruise control is set |
| | 7 | OD cut | OD | When OD cut signal is entered |
| | 8 | FWD switch | FF | When fuse is installed in FWD switch |
| A1 | 1 | N/P range switch | NP | When N/P range is selected |
| | 2 | R range switch | RR | When R range is selected |
| | 3 | 2 range switch | R2 | When 2 range is selected |
| | 4 | 3 range switch | R3 | When 3 range is selected |
| | 5 | D range switch | RD | When D range is selected |
| | 6 | 1 range switch | R1 | When 1 range is selected |
| | 7 | Manual switch | MS | When manual switch is turned ON |
| A2 | 2 | Engine torque control signal | TS | When engine torque control signal is entered |
| | 3 | Brake switch | BR | When brake switch is turned ON |

## 3. DIAGNOSIS MODE

| Mode | Contents | Abbr. | Contents of display |
|---|---|---|---|
| B0 | Self-diagnosis | DIAG.U | Current trouble code determined by self-diagnosis |
| B1 | Self-diagnosis | DIAG.M | Previous trouble code stored in memory by self-diagnosis |
| C0 | Back-up clear | — | Function of clearing trouble code stored in memory |

## C: MODE 00 — MODEL YEAR —

**CONDITION:**

**SPECIFIED DATA:**
**Following data should be indicated.**
**⟨Indications⟩**

| | |
|---|---|
| **E-4AT** | **(F00)** |
| **4WD** | **1992** |

**Probable cause (if outside "specified data")**

| | Probable cause | | Check |
|---|---|---|---|
| 1 | Communication failure (No communication method can be confirmed with power ON) | → | (1) Check loose or poor connectors, or shortcircuit.<br>(2) Check type of cartridge. |
| 2 | Vehicle types cannot be identified (due to communication failure). | → | Check improper cartridge. Replace with proper one. |

## D: MODE 01 — BATTERY VOLTAGE (VB) —

**CONDITION:**
**(1) Ignition switch ON**
**(2) Engine idling after warm-up**

**SPECIFIED DATA:**
**VB: 10 — 15 V**
**⟨Indications⟩**

| | |
|---|---|
| **VB** | **(F01)** |
| **12 V** | |

| | Probable cause | | Check |
|---|---|---|---|
| 1 | Battery | → | Check battery voltage and specific gravity of electrolyte. |
| 2 | Charging system | → | (1) Measure regulating voltage under no loads<br>(2) Check alternator (as a single unit). |

## E: MODE 02 — SPEED SENSOR 1 (VSP 1) —

**CONDITION:**
**Raise vehicle off ground and operate at constant speed.**

**SPECIFIED DATA:**
**Compare speedometer with monitor indications.**
**Probable cause (if indications are different)**
**⟨Indications⟩**

| | |
|---|---|
| **VSP1** | **(F02)** |
| **18 m/h** | |

**Probable cause (if outside "specified data")**

| | |
|---|---|
| 1 | Vehicle speed sensor 1 |

→ Check performance characteristics of vehicle speed sensor 1. ⟨Ref. to [T4K0.]⟩

↓ OK

Check TCU and replace if necessary.

## F: MODE 04 — SPEED SENSOR 2 (VSP 2) —

**CONDITION:**
**Raise vehicle off ground and operate at constant speed.**

**SPECIFIED DATA:**
**Compare speedometer with monitor indications.**
**Probable cause (if indications are different)**
**⟨Indications⟩**

| | |
|---|---|
| **VSP2** | **(F04)** |
| **12 m/h** | |

**Probable cause (item outside "specified data")**

| | |
|---|---|
| 1 | Vehicle speed sensor 2 |

→ Check performance characteristics of vehicle speed sensor 2. ⟨Ref. to [T4L0]⟩

↓ OK

Check TCU and replace if necessary.

## G: MODE 06 — ENGINE SPEED (EREV) —

**CONDITION:**
**Measure with engine operating at constant speed.**

**SPECIFIED DATA:**
**Same as tachometer reading (in combination meter)**
**⟨Indications⟩**

| | |
|---|---|
| **EREV** | **(F06)** |
| **1,500 rpm** | |

**Probable cause (if outside "specified data")**

| | |
|---|---|
| 1 | Conduct troubleshooting in relation to EGI system for engine speed. |

↓ OK

Check TCU and replace if necessary.

## H: MODE 08 — ATF TEMPERATURE (ATFT) —

**CONDITION:**
**(1) Low ATF temperature (before engine/vehicle starts)**
**(2) High ATF temperature (after driving vehicle for warm-up)**

**SPECIFIED DATA:**
**(1) Ambient temperature: ± 10°C**
**(2) ATF temperature: 70 — 110°C**
**⟨Indications⟩**

| | | |
|---|---|---|
| **ATFT** | **deg C** | **(F08)** |
| **80 deg C** | | |

**Probable cause (if outside "specified data")**

| | |
|---|---|
| 1 | ATF temperature sensor |

→ Check performance characteristics of ATF temperature sensor.

↓ OK

Check TCU and replace if necessary.

**F07 = ATF temperature (ATFT): to be indicated in "deg F".**

## I: MODE 09 — THROTTLE SENSOR (THV) —

**CONDITION:**
**Ignition switch ON (with engine OFF) Measure voltage while operating throttle valve from a fully closed position to a fully open position.**

**SPECIFIED DATA:**
**Fully closed position: 4.7 V**
**Fully open position: 1.6 V**
**From fully closed to fully open position: Voltage must smoothly decrease.**
**⟨Indications⟩**

| THV | (F09) |
|---|---|
| 4.7V | |

**Probable cause (if outside "specified data")**

| | |
|---|---|
| 1 | Throttle sensor |

1 Throttle sensor → Check performance characteristics of throttle sensor. ⟨Ref. to [T4J0]⟩

↓ OK

Check TCU and replace if necessary.

## J: MODE 10 — GEAR POSITION (GEAR) —

**CONDITION:**
**Check while driving vehicle (after sufficient warm-up).**

**SPECIFIED DATA:**
**Gear position (Ref. shift performance characteristics chart)**
**⟨Indications⟩**

| GEAR | (F10) |
|---|---|
| 1 st | |

**Probable cause (item outside "specified data")**

| | |
|---|---|
| 1 | Shift solenoid 1 |
| 2 | Shift solenoid 2 |
| 3 | Shift solenoid 3 |

1 Shift solenoid 1 → Check performance characteristics of shift solenoid 1. ⟨Ref. to [T4E0.]⟩

↓ OK

2 Shift solenoid 2 → Check performance characteristics of shift solenoid 2. ⟨Ref. to [T4D0.]⟩

↓ OK

3 Shift solenoid 3 → Check performance characteristics of shift solenoid 3. ⟨Ref. to [T4C0.]⟩

↓ OK

Check TCU and replace as necessary.

## K: MODE 11 — LINE PRESSURE DUTY (PLDTY) —

**CONDITION:**
- **After sufficient warm-up**
- **Ignition ON (engine OFF)**
- **N range**

**SPECIFIED DATA:**
**Throttle fully closed: 100%**
**Throttle fully open : 10%**
**⟨Indications⟩**

| | |
|---|---|
| **PLDTY** | **(F11)** |
| **50%** | |

**Probable cause (if outside "specified data")**

| No. | Probable cause | Check |
|---|---|---|
| 1 | Throttle sensor | Check in FO9 mode. ⟨Ref. to [T5I0.]⟩ |
| 2 | Vehicle speed sensor 1 | Check in FO2 mode. ⟨Ref. to [T5E0.]⟩ |
| 3 | Vehicle speed sensor 2 | Check in FO4 mode. ⟨Ref. to [T5F0.]⟩ |
| 4 | Engine speed | Check in FO6 mode. ⟨Ref. to [T5G0.]⟩ |
| 5 | ATF temperature sensor | Check in FO8 mode. ⟨Ref. to [T5H0.]⟩ |
| 6 | Inhibitor switch | Check for operation. |
| 7 | Manual switch | Check for operation. |

Each check → OK → next check.

Check TCU and replace if necessary.

## L: MODE 12 — LOCK-UP DUTY (LUDTY) —

**CONDITION:**
**(1) Idling (after sufficient warm-up) with lock-up system released**
**(2) Driving at 50 km/h (31 MPH) (after sufficient warm-up) with lock-up system applied**

**SPECIFIED DATA:**
**(1) Lock-up system released: 5%**
**(2) Lock-up system applied: 95%**
**⟨Indications⟩**

| | |
|---|---|
| LUDTY 5% | (F12) |

**Probable cause (if outside "specified data")**

| | Probable cause | | Check |
|---|---|---|---|
| 1 | Throttle sensor | → | Check in FO9 mode. ⟨Ref. to [T5I0.]⟩ |
| | | | ↓ OK |
| 2 | Vehicle speed sensor 1 | → | Check in F02 mode. ⟨Ref. to [T5E0.]⟩ |
| | | | ↓ OK |
| 3 | Vehicle speed sensor 2 | → | Check in F04 mode. ⟨Ref. to [T5F0.]⟩ |
| | | | ↓ OK |
| 4 | Engine speed | → | Check in F06 mode. ⟨Ref. to [T5G0.]⟩ |
| | | | ↓ OK |
| 5 | Inhibitor switch | → | Check for operation. |
| | | | ↓ OK |
| | | | Check TCU and replace if necessary. |

## M: MODE 13 — AWD DUTY (4WDTY) —

**CONDITION:**
- **After sufficient warm-up**
- **Ignition switch ON (engine OFF)**

**1) FWD mode**
**2) AWD mode, D-range, Full throttle**

**SPECIFIED DATA:**
**(1) 95%**
**(2) 25%, max. (vehicle speed 0 m/h)**
**⟨Indications⟩**

| | |
|---|---|
| **4WDTY** | **(F13)** |
| **95%** | |

**Probable cause (if outside "specified data")**

| | Probable cause | Check |
|---|---|---|
| 1 | Throttle sensor | Check in F09 mode. ⟨Ref. to [T5I0.]⟩ |
| 2 | Vehicle speed sensor 1 | Check in F02 mode. ⟨Ref. to [T5E0.]⟩ |
| 3 | Vehicle speed sensor 2 | Check in F04 mode. ⟨Ref. to [T5F0.]⟩ |
| 4 | ATF temperature sensor | Check in F08 mode. ⟨Ref. to [T5H0.]⟩ |
| 5 | Inhibitor switch | Check for operation. ⟨Ref. to [W2B2.]⟩ |
| 6 | ABS signal | Check ABS system for operation. . |
| | | Check TCU and replace if necessary. |

## N: MODE 14 — ATMOSPHERIC SENSOR (BARO. P) —

**CONDITION:**
**Ground surface (not high altitude)**

**SPECIFIED DATA:**
***(Atmospheric pressure) mmHg**
***"—9 to 10 mmHg" changes at an altitude of 100 meters.**
**⟨Indications⟩**

| | |
|---|---|
| **BARO.P** | **(F14)** |
| 760 mmHg | |

**Probable cause (if outside "specified data")**

| | Probable cause | Check |
|---|---|---|
| 1 | Atmospheric sensor | Replace ECU (MPFI). |

## O: A0 MODE — SWITCH 1 (SW1) —

### DISPLAY

| LED No. | Signal name | Symbol |
|---|---|---|
| 5 | ABS switch | AB |
| 6 | Cruise control set | CR |
| 8 | FWD switch | FF |

**Reference values**

(1) Lights up when the ABS signal is entered (No. 5).
(2) Lights up when the cruise control is set (No. 6).
(3) Lights up when the fuse is installed in FWD switch (No. 8).

| | | | | |
|---|---|---|---|---|
| — | — | — | — | AB |
| CR | — | FF | — | — |

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |

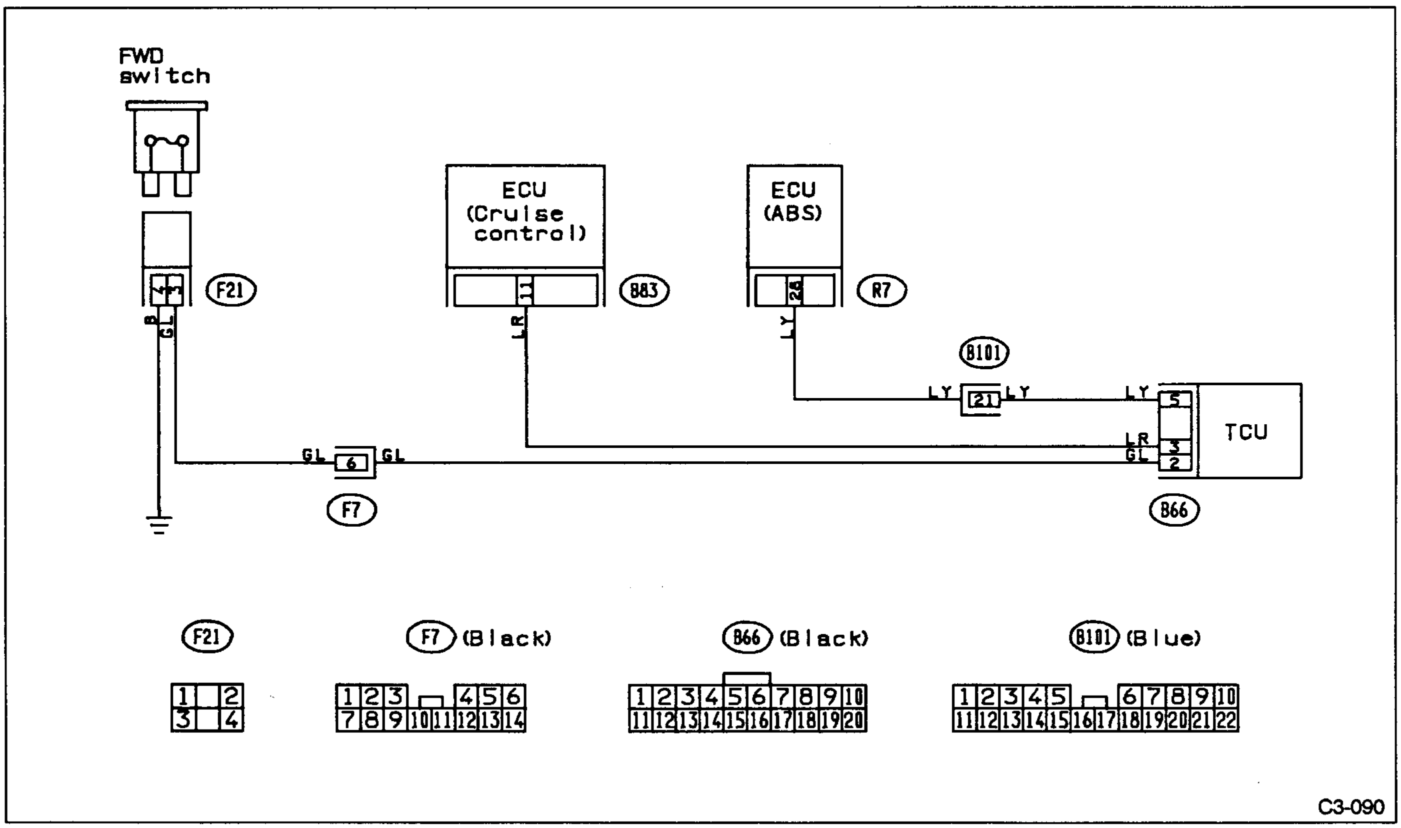


*Fig. 299*

## P: A1 MODE — SWITCH 2 (SW2) —

### DISPLAY

| LED No. | Signal name | Symbol |
|---|---|---|
| 1 | N/P range switch | NP |
| 2 | R range switch | RR |
| 3 | 2 range switch | R2 |
| 4 | 3 range switch | R3 |
| 5 | D range switch | RD |
| 6 | 1 range switch | R1 |
| 7 | Manual switch | MS |

| | | | | |
|---|---|---|---|---|
| NP | RR | R2 | R3 | RD |
| R1 | MS | — | — | — |

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |

**Reference values**

**(1) Lights up when the N or P range is selected (No. 1).**
**(2) Lights up when the R range is selected (No. 2).**
**(3) Lights up when the 2 range is selected (No. 3).**
**(4) Lights up when the 3 range is selected (No. 4).**
**(5) Lights up when the D range is selected (No. 5).**
**(6) Lights up when the 1 range is selected (No. 6).**
**(7) Lights up when the manual switch is turned ON (No. 7).**

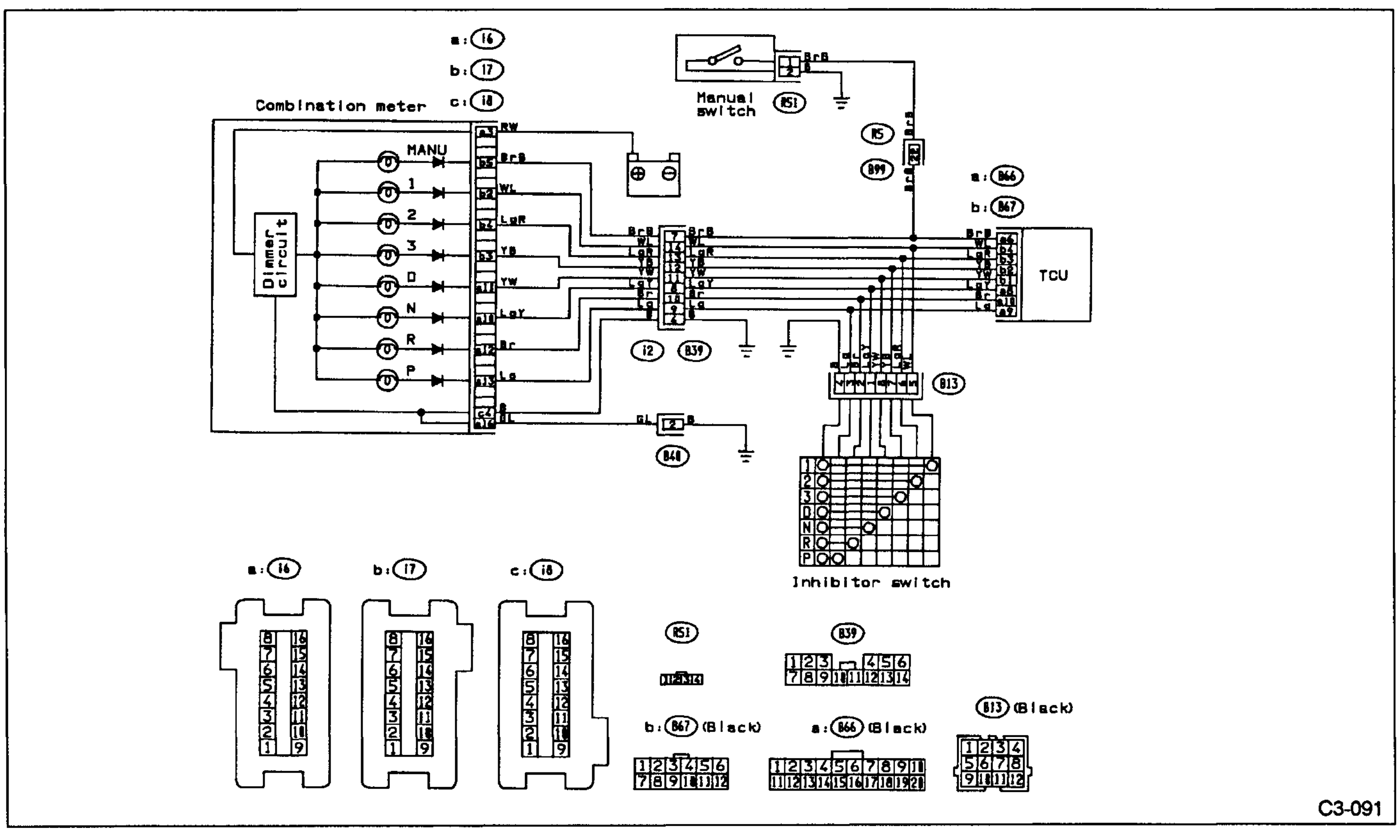


*Fig. 300*

## Q: A1 MODE — LED NO. 7, MANUAL SWITCH —

**CONTENT OF DIAGNOSIS:**

**LED does not come on when manual switch is ON.**
**Manual switch circuit is open or shorted.**

**TROUBLE SYMPTOM:**

- **Tight corner "braking"**
- **2nd and 3rd gears not held**
- **Failure of vehicle to start in 2nd range 2nd gear**

**Probable cause (if outside "specified data")**

| | Check | Result | Action |
|---|---|---|---|
| 1 | Measure signal voltage input of TCU. | OK | Repair TCU terminal poor contact. |
| | ↓ Not OK | | |
| 2 | Check harness/connector between TCU and manual switch. | Not OK | Repair harness/connector. |
| | ↓ OK | | |
| 3 | Check manual switch ground line. | Not OK | Repair ground line. |
| | ↓ OK | | |
| 4 | Check manual switch. | Not OK | Replace manual switch. |
| | ↓ OK | | |
| | Repair TCU terminal poor contact. | | |

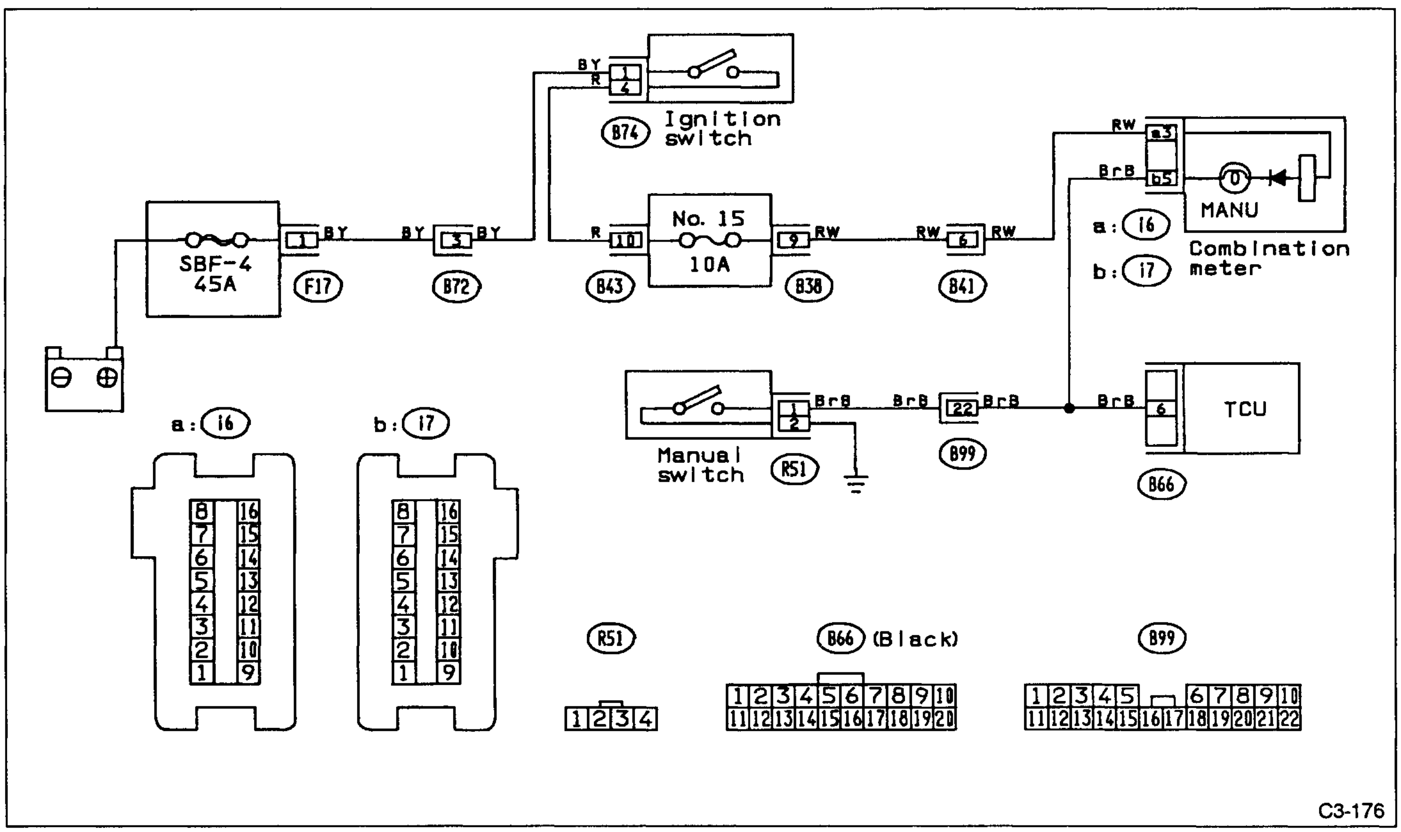


*Fig. 301*

**1. MEASURE SIGNAL VOLTAGE INPUT OF TCU.**

1) Turn ignition switch ON (with engine OFF).
2) Measure difference in voltage inputs of TCU when manual switch is ON and OFF.

**Connector & terminal / Specified voltage:**
**(B66) No. 6 — / Body 1 V (ON)**
**(B66)No. 6 — Body / 10 V (OFF)**

**2. CHECK HARNESS/CONNECTOR BETWEEN TCU AND MANUAL SWITCH.**

1) Disconnect connector from TCU.
2) Disconnect manual switch connector from selector lever connection.

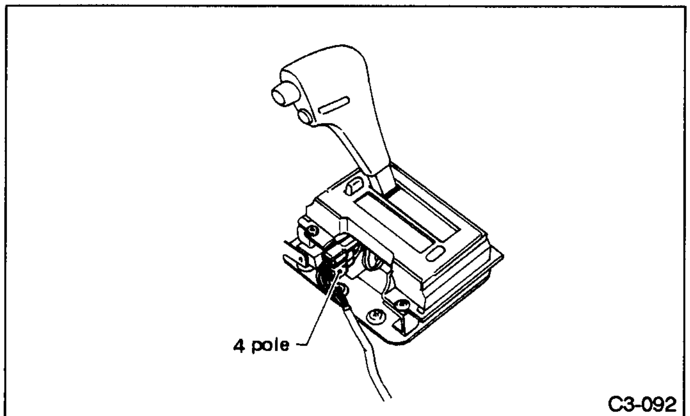


*Fig. 302*

3) Measure resistance between TCU connector and manual switch connector, and between TCU and body.

**Connector & terminal / Specified resistance:**
**(B66) No. 6— (R51) No. 1 / 0 Ω**
**(B66) No. 6— Body/ 1 MΩ min.**

**3. CHECK MANUAL SWITCH GROUND LINE.**

1) Disconnect manual switch connector from selector lever connection.
2) Measure resistance between manual switch connector and body.

**Connector & terminal / Specified resistance:**
**(R51) No. 1 — Body / 1 Ω max.**

**4. CHECK MANUAL SWITCH.**

1) Disconnect manual switch connector from selector lever connection.
2) Measure resistance between manual switch terminals.

**Specified resistance:**
**(Switch ON) 0 Ω**
**(Switch OFF) 1 MΩ min.**

## R: A2 MODE — SWITCH 3 (SW3) —

### DISPLAY

| LED No. | Signal name | Symbol |
|---|---|---|
| 2 | Engine torque control signal | TS |
| 3 | Brake switch | BR |

| | | | | |
|---|---|---|---|---|
| — | TS | BR | — | — |
| — | — | — | — | — |

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |

**Reference values**

**(1) Lights up when the engine torque control signal is entered (No. 2).**

**(2) Lights up when the brake switch is turned ON (No. 3).**

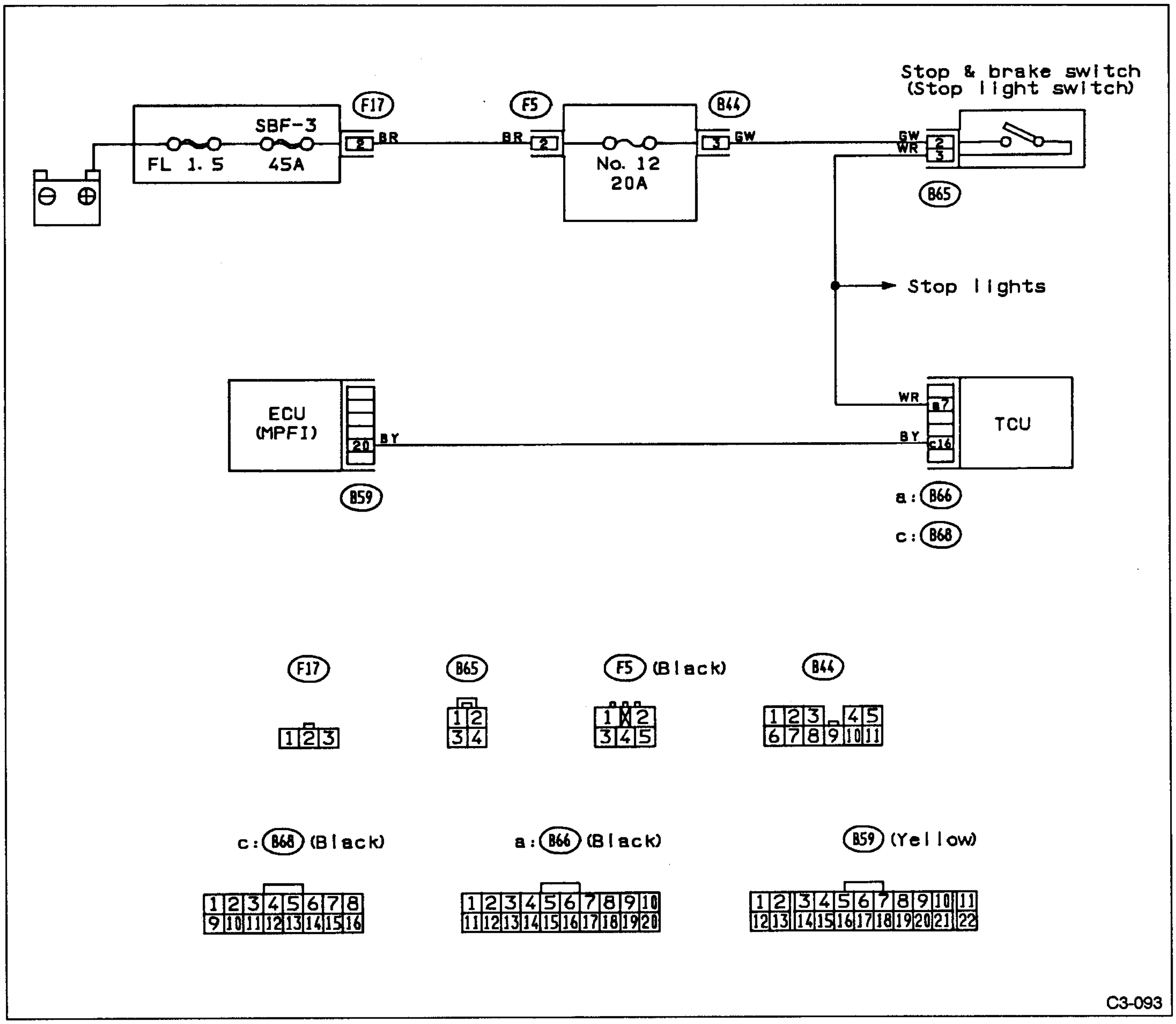


*Fig. 303*

## S: MODE F14 — THROTTLE POSITION SENSOR POWER SUPPLY (THVCC) —

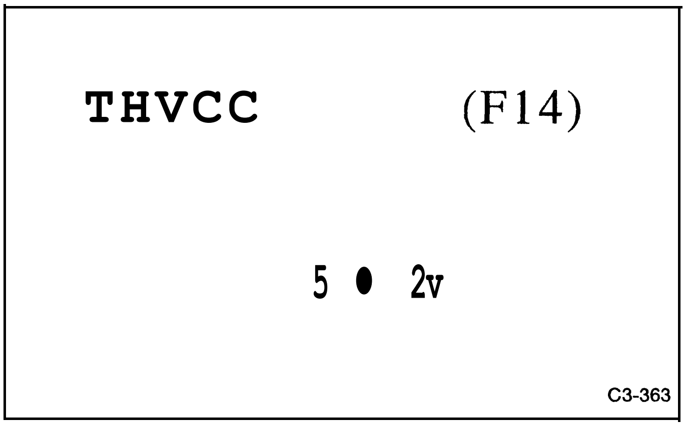


Fig. 35

**CONDITION:**
Ignition switch ON (engine OFF)

**SPECIFIED DATA:**
**5.12±0.1** V

Probable cause (Item outside "specified data")

1. Throttle position sensor power supply → Check throttle sensor line. <Ref. to 3-2 [T5J0].☆5>

↓ OK

Check TCM and replace if necessary.

## T: MODE F15 — MASS AIR FLOW SIGNAL (AFM) —

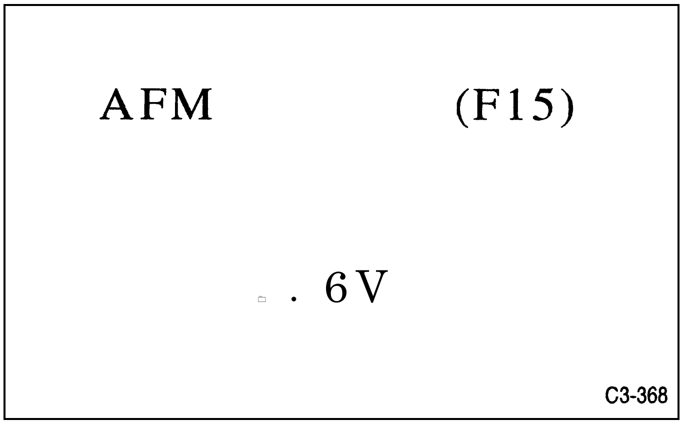


*Fig. 36*

**CONDITION:**
- Ignition switch ON (engine ON)
- N range
- Idling

**SPECIFIED DATA:**
Engine warm-up: 0.5 — 1.22 V

Probable cause (if outside "specified data")

1. Mass air flow signal

→ Check performance characteristics of mass air flow signal. <Ref. to 3-2 **[T5M0].☆5**>

↓ OK

Check TCM and replace if necessary.

## 0: MODE FA0 — SWITCH 1 (SW1) —

**DISPLAY**

| LED No. | Signal name | Symbol. |
|---|---|---|
| 1 | FWD switch | FF |
| 2 | Kick-down switch | KD |
| 3 | | |
| 4 | | |
| 5 | Brake | BR |
| 6 | ABS switch | AB |
| 7 | Cruise control set | CR |
| a | Power switch | PW |
| 9 | | |
| 10 | | |

| | | | | |
|---|---|---|---|---|
| FF | KD | — | — | BR |
| AB | CR | PW | — | — |

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |

**Reference values**

(1) Lights up when the fuse is installed in FWD switch (No. 1).

(2) Light up when the brake pedal is depressed (No. 5).

(3) Light up when the ABS signal is entered (No. 6).

(4) LIghts up when the cruise control is set (No. 7).

**LED Nos. 2 and 8 do not come on.**

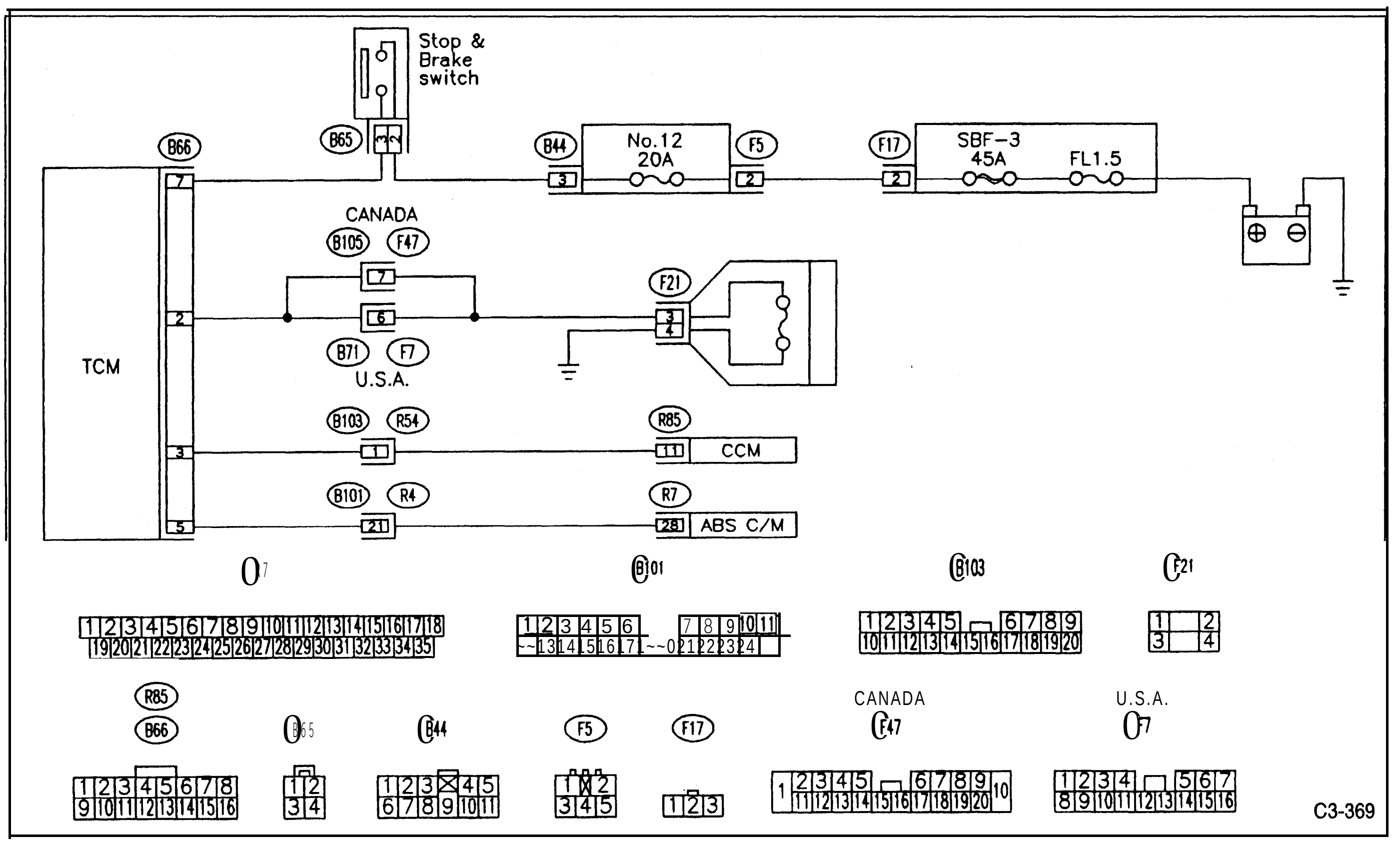


*Fig. 37*

## P: MODE FA1 — SWITCH 2 (SW2) —

**DISPLAY**

| LED No. | Signal name | Symbol |
|---|---|---|
| 1 | N/P range switch | NP |
| 2 | R range switch | RR |
| 3 | D range switch | RD |
| 4 | 3 range switch | R3 |
| 5 | 2 range switch | R2 |
| 6 | 1 range switch | R1 |
| 7 | Manual switch | SS |

| | | | | |
|---|---|---|---|---|
| NP | RR | RD | R3 | R2 |
| R1 | SS | — | — | — |

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |

**Reference values**

(1) Lights up when the N or P range is selected (No. 1).
(2) Lights up when the R range is selected (No. 2).
(3) Lights up when the D range is selected (No. 3).
(4) Lights up when the 3 range is selected (No. 4).
(5) Lights up when the 2 range is selected (No. 5).
(6) Lights up when the 1 range is selected (No. 6).
(7) Lights up when the manual switch is turned ON (No. 7).

**If each LED does not illuminate with the above conditions, inhibitor switch malfunction may occur. Perform diagnostics on inhibitor switch. <Ref. to 2-7 [T10AV0].☆5>**

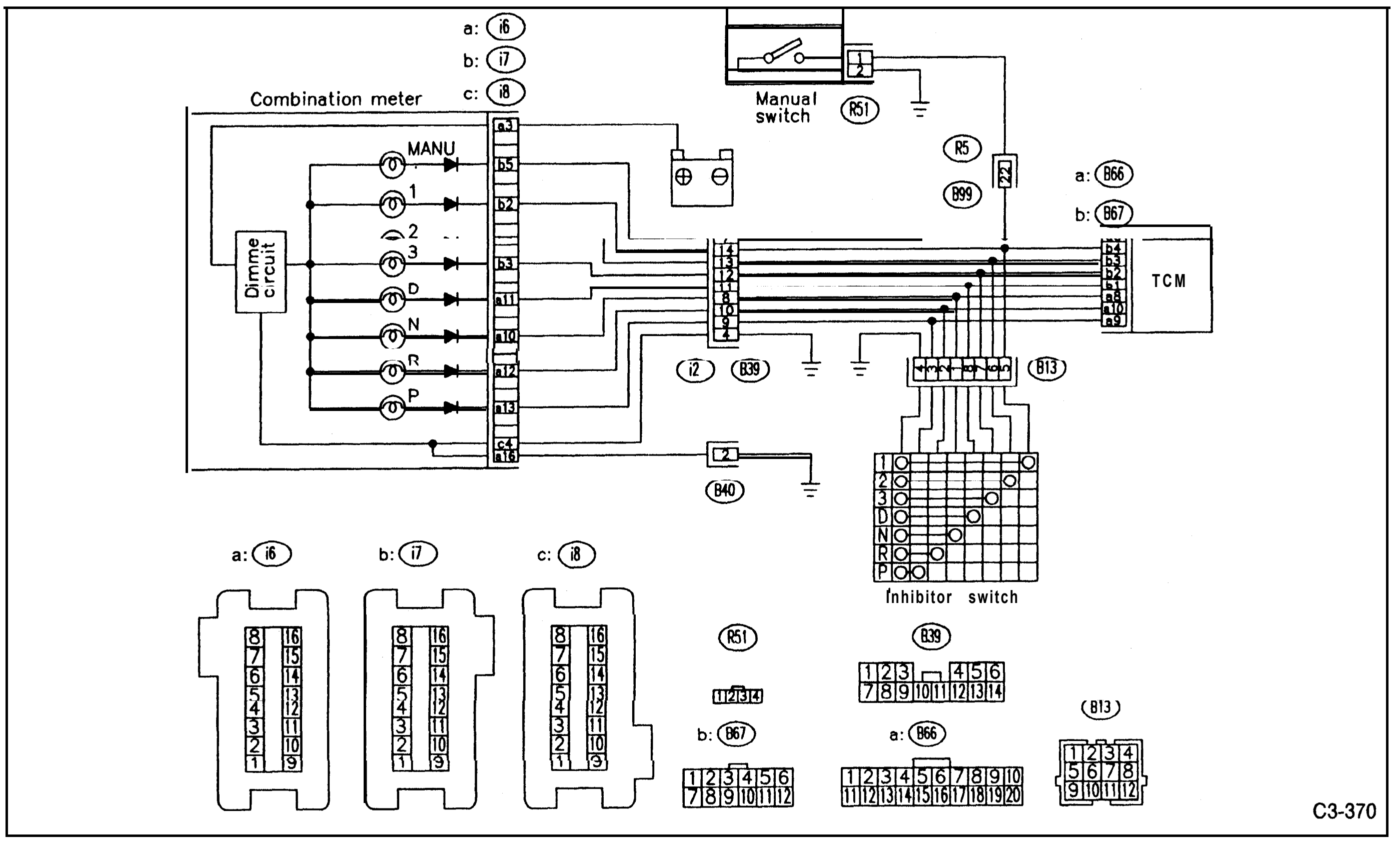


Fig. 38