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INTRODUCTION
JUSTY ECVT

The Subaru Justy ECVT transmission is a constantly variable transmission. Actually its a transmission with more than 1000 gear ratios. Although this technology dates back to 1909 in motor vehicles its been improved with computer controlled technology. The Justy uses a carbon particle coupling in the place of the standard Torque converter. When the accelerator is depressed the carbon particles in the coupling between the engine and the transmission is energized which solidifies the coupling. The brushes that ride the coupling hub when worn can cause a slipping condition. This booklet contains information on the teardown, assembly and trouble shooting of this unit.

We thank Subaru Motors
for the information and illustrations that
have made this booklet possible.

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PRINCIPALS OF OPERATION

- FWD

The ECVT combines an electronically controlled magnetic clutch with a variable transmission that is driven by steel belt pulleys to provide high running performance, low fuel consumption and ease of control.
Hydraulic line pressure can be changed from "high" to "low" or vice versa, in response to engine load and output. In addition, the ECU and the clutch are optimally controlled by microcomputer to enhance high transmitting efficiency and excellent driveability.

In the data communication between ECU and clutch control, rationalization of the system is accomplished by controling the electromagnetic clutch through coolant temperature and ignition advance signals which are emitted from the ECU while line pressure is regulated through a torque signal.

1 Cross Sectional View

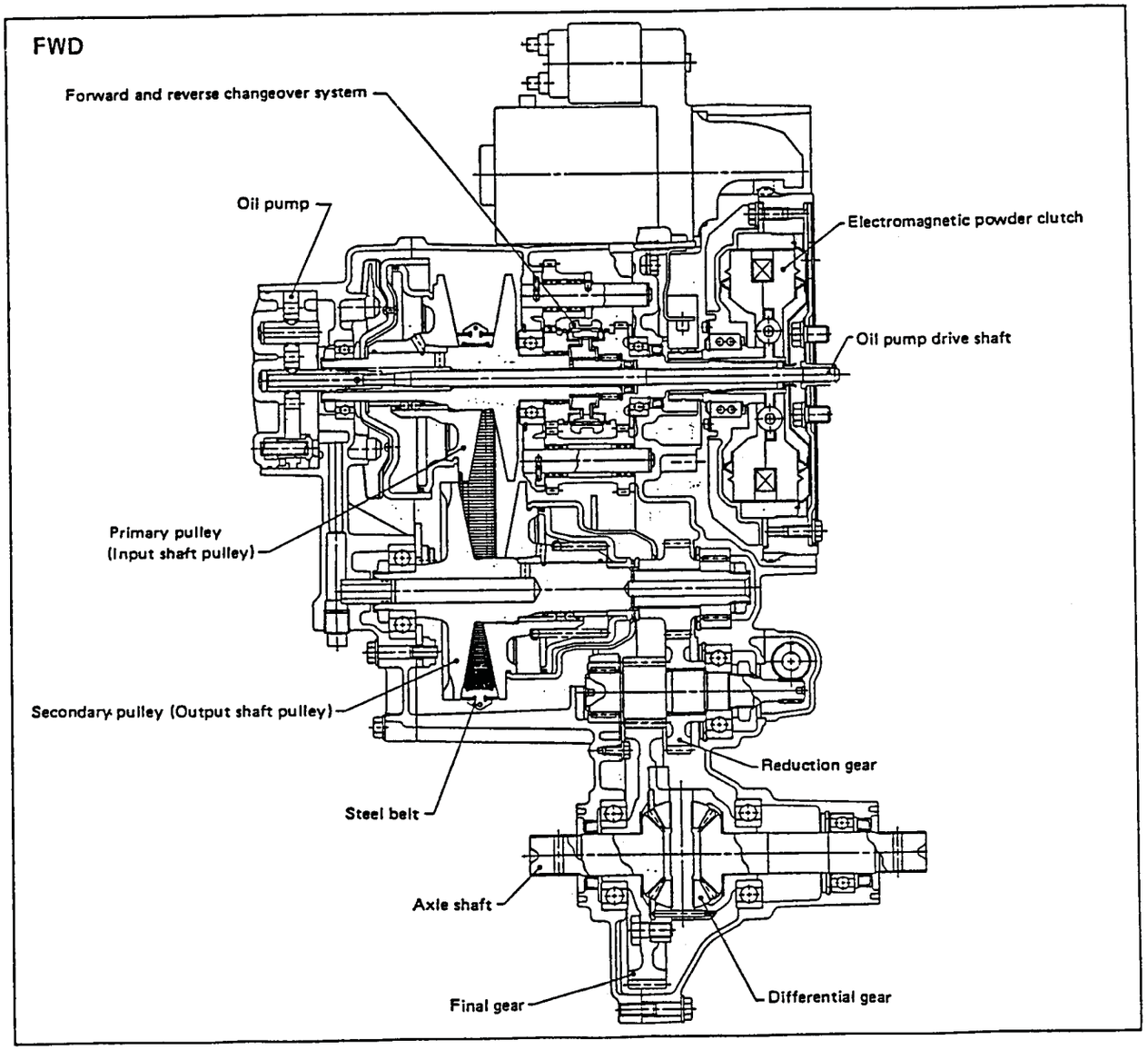


Fig. 1

• 4WD

The 4WD model is equipped with a hydraulically operated selective transfer unit at the rear of the front differential, as well as with the same type of ECVT installed in the FWD model.

The magnetic clutch is designed for exclusive use with the ECVT. It is a "standing-start" clutch that utilizes magnetic powder and is controlled by a microcomputer which constantly evaluates engine-speed, car-speed, and throttle-position signals.

The variable transmission consists of a steel belt and a set of pulleys. Groove width is controlled by hydraulic pressure to provide stepless speed changes from a standing start to maximum speed without a shifting "shock", thus enhancing high running performance.

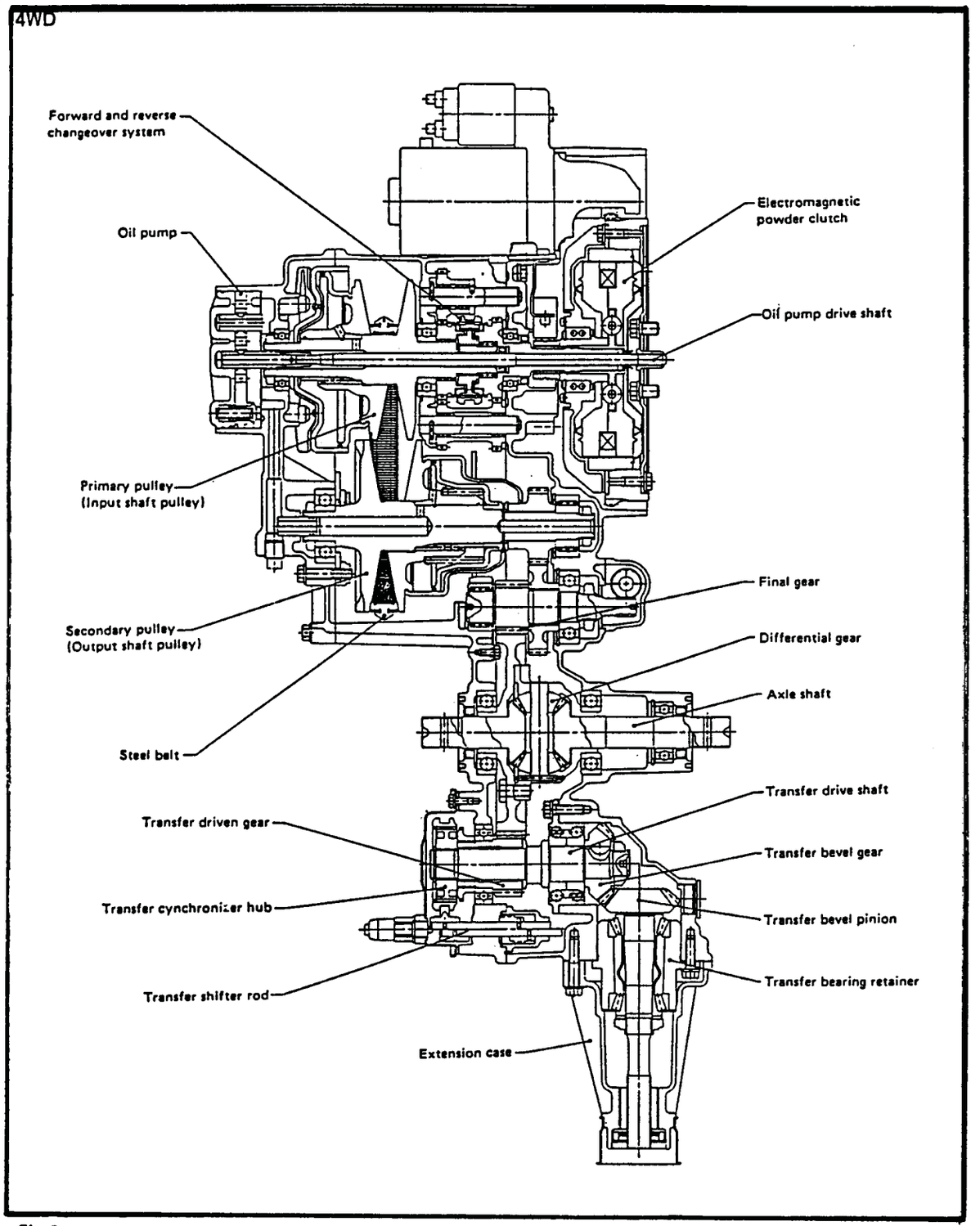


Fig. 2

2 System Construction

The Subaru ECVT consists of the following five systems: electromagnetic powder clutch, forward-and-reverse changeover, belt-and-pulley, hydraulic control, and final reduction systems.

The electromagnetic powder clutch couples the engine to, or uncouples the engine from, the transmission. Its operation is regulated by a control unit (microcomputer) which receives signals corresponding to engine speed, vehicle speed, accelerator pedal depression, etc.

The forward and reverse changeover system utilizes a dog clutch provided with a synchromesh mechanism. It is linked with the selector lever via a push-pull cable.

The belt-and-pulley system provides an automatic and stepless speed change for the final reduction system in response to power transmitted from the electromagnetic powder clutch. Control of oil pressure applied to the input and output shafts of this system is accomplished depending upon engine torque, engine speed, accelerator pedal depression, pulley ratio, etc.

Features

1) Stepless speed changeover from a standing start to high speeds permits ready "high-performance" driving for any driver.

2) Unlike the "L" and "2" ranges of a conventional automatic transmission, the Ds range utilizes the engine's high-speed range which allows driving capabilities such as a standing start to achieve maximum speed.
It is also provided with an engine brake effect, as well as sporty driving pleasure.

3) The electromagnetic powder clutch eliminates the slip loss which is encountered with a conventional torque converter, resulting in low fuel costs.

4) The electromagnetic powder clutch remains off during vehicle stop, eliminating an abrupt movement even when the brakes are released with the selector lever set to the "D", "Ds" or "R" range.

5) Shock-free shifting, combined with frequent use of overdrive, assures quiet operation and smooth driving.

6) Changeover from "FWD" to "4WD" or vice versa is accomplished simply by pressing a pushbutton switch that utilizes low line pressure. (4WD model only)

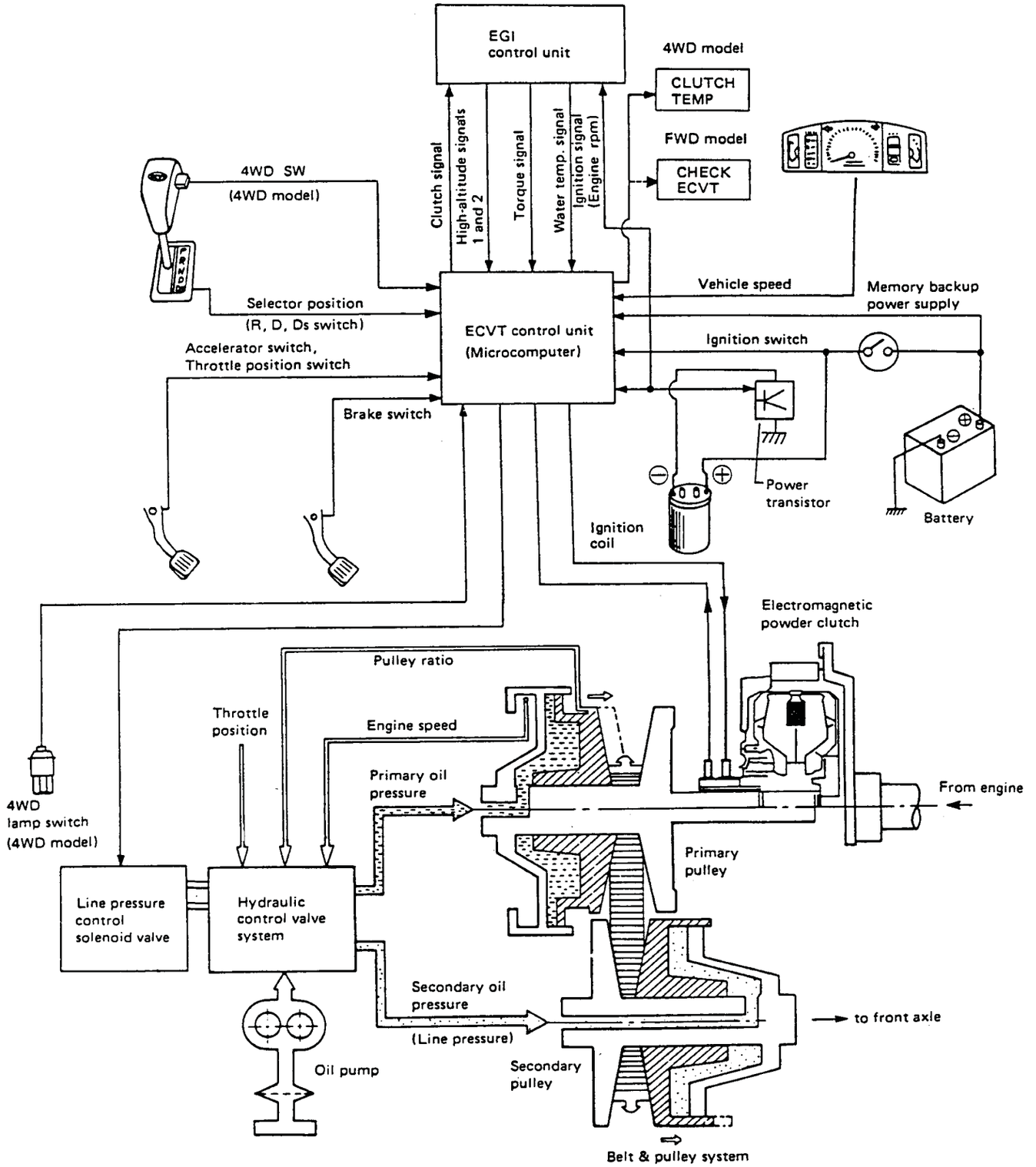

EGI
control unit
4WD model
CLUTCH
TEMP
FWD model
CHECK
ECVT
Clutch signal
High-altitude signals
1 and 2
Torque signal
Water temp. signal
Ignition signal
(Engine rpm)
4WD SW
(4WD model)
Selector position
(R, D, Ds switch)
Accelerator switch,
Throttle position switch
Brake switch
ECVT control unit
(Microcomputer)
Vehicle speed
Memory backup
power supply
Ignition switch
Power
transistor
Battery
Ignition
coil
Electromagnetic
powder clutch
Pulley ratio
Throttle
position
Engine speed
Primary oil
pressure
From engine
4WD
lamp switch
(4WD model)
Primary
pulley
Line pressure
control
solenoid valve
Hydraulic
control valve
system
Secondary oil
pressure
(Line pressure)
to front axle
Oil pump
Secondary
pulley
Belt & pulley system

Fig. 3

3 Construction and Features of Each Component

3-1 Electromagnetic Powder Clutch System

1) SYSTEM CONSTRUCTION

This system consists of an electromagnetic powder clutch, clutch control computer, basic signals, etc., as shown in the figure below.

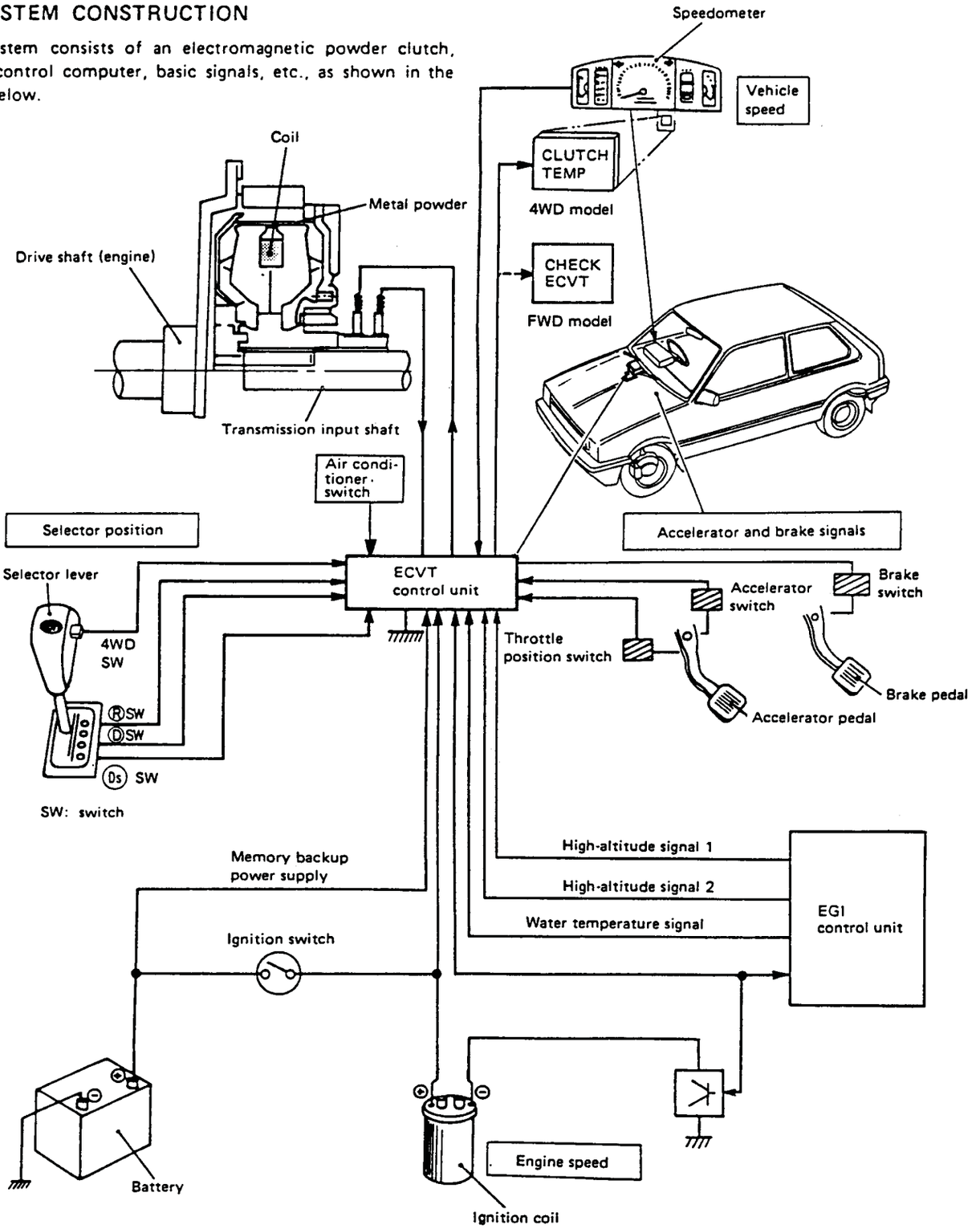


Fig. 4

2) PRINCIPLE OF OPERATION OF ELECTROMAGNETIC POWDER CLUTCH

When metal powder is brought near a magnet, the metal particles are linked in chain fashion and a transmission torque is generated. The electromagnetic powder clutch uses this principle.

A small gap is provided between the inside edge of the drive member and the outside edge of the driven member of the clutch. This gap is filled with a magnetic powder and magnetic force is applied to this powder and the drive member and driven member are coupled together.

A coil provided at the driven member acts as the magnet. If current is passed through this coil, the coil becomes an electromagnet and generates a magnetic force.

The magnetic powder linked in a chain fashion by this magnetic force transmits the power from the drive member to the driven member.

The transmission torque is proportional to the strength of the current.

When the current flow is cut off, the transmission torque disappears.

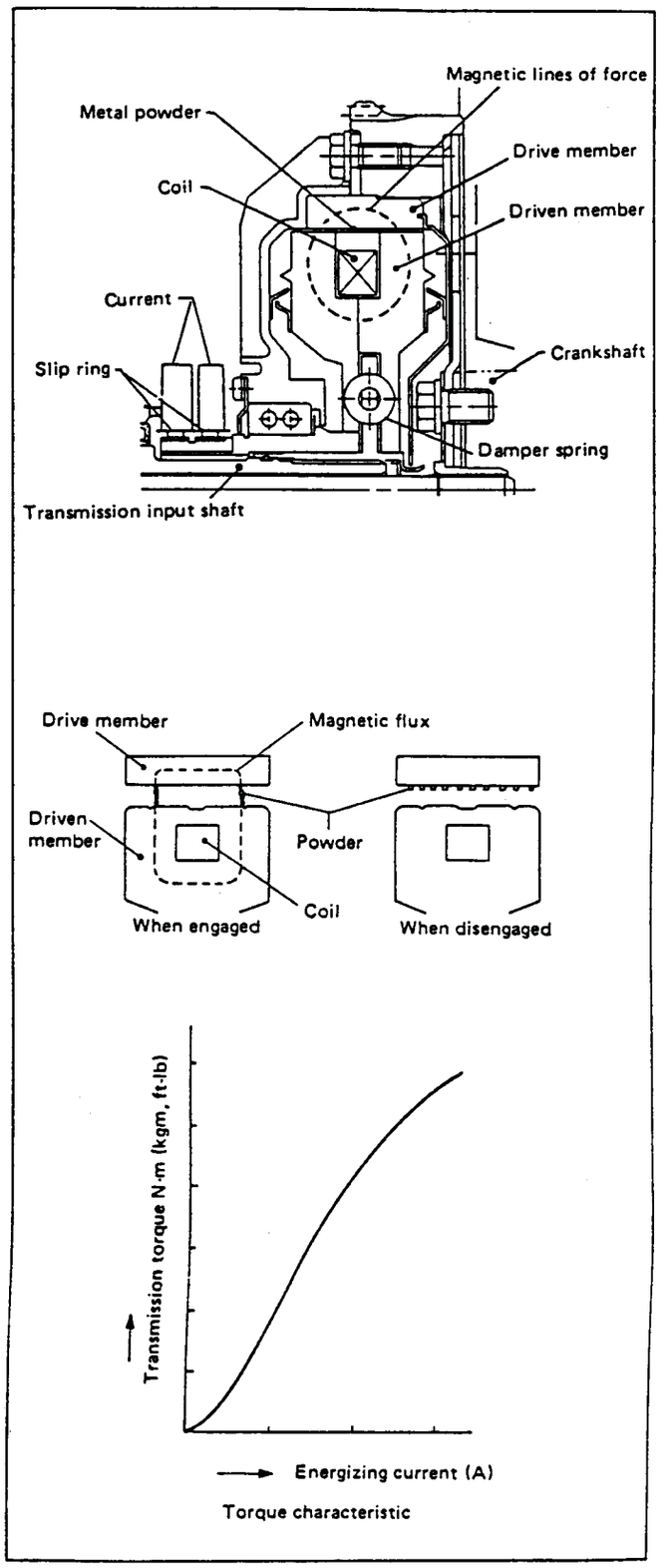


Fig. 5

3) CLUTCH CONTROL

The clutch is applied and released and power is transmitted by controlling the current to the clutch electromagnetic coil.
Signals are input to the clutch control unit and clutch current which controls starting, stopping, and switching is output.
Clutch control also controls damping of the shock when the clutch is directly coupled and recoupled and when the engine brake is applied in the "Ds" position.
Safety is increased by adding a hill holder function when stopping on small grades and a function which prevents sudden starting when the choke is used.
The circuit has a self-diagnosis function and a fail-safe function.

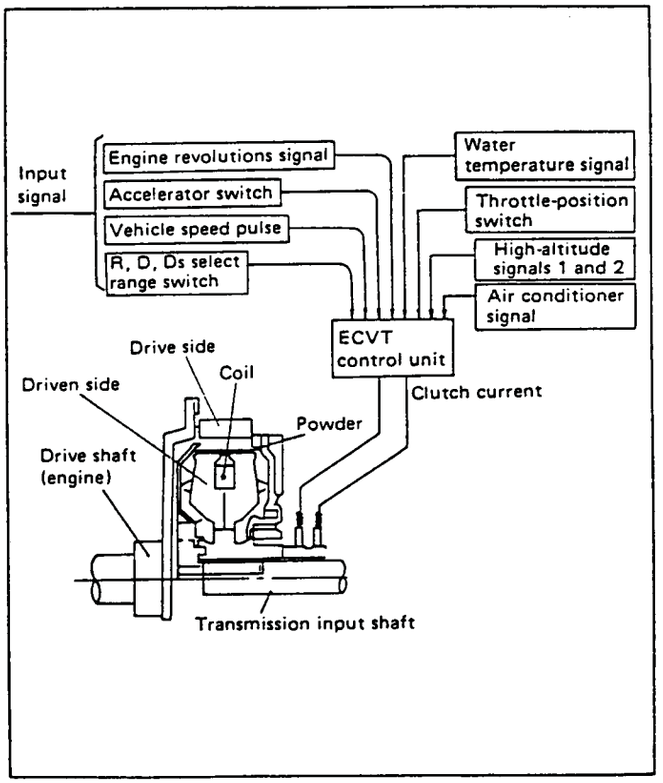


Fig. 6

- **Engine revolutionary signal**
  At starting, the ignition pulse from the minus terminal of the ignition coil is detected and a clutch current proportional to the engine speed is obtained.

- **Accelerator switch**
  Operation of the accelerator pedal is detected by operation of a microswitch attached to the accelerator pedal and, at starting, the clutch current is turned on. At stopping, this signal is used with the vehicle speed pulse to prevent the engine from stalling.

- **Throttle-position switch**
  The amount the accelerator is pressed [approximately 20 mm (0.79 in) stroke] is sensed and the current required to directly couple the clutch is determined.

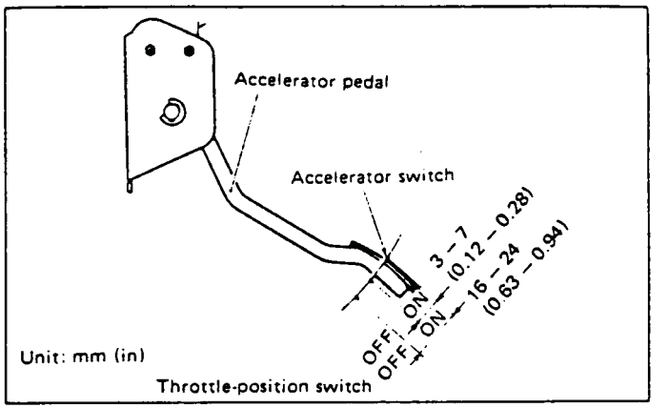


Fig. 7

- **"D", "Ds", and "R" position switches**
  These switches are used to sense the "D", "Ds", and "R" positions.

- **Vehicle speed pulse**
  This pulse is built into the speedometer and is used to sense the vehicle speed and obtains a clutch current proportional to the engine speed.
  This signal also controls the power to the slow cut valve.

- **Water temperature switch**
  When this switch senses a "cold" engine, clutch current "rise" characteristic is changed so that the stall point* is changed to the high side.

  * Stall point
    Point at which the clutch torque curve crosses the engine full speed torque curve.
    Below this point, the clutch slips and above this point, the clutch is directly coupled.

- **High-altitude signals (1 and 2)**
  A signal which varies with atmospheric pressure is emitted by the EFC control unit. This signal changes the clutch current "rise" characteristic to provide a stall point equivalent to that obtained during low-altitude operation so that the starting ability of the engine is improved at high-altitudes.

- **Air conditioner signal**
  This signal senses the air conditioner operation and changes the clutch current "rise" characteristic so that the stall point is changed to the high side.

4) CLUTCH TEMPERATURE WARNING SYSTEM (4WD model only)

Since the 4WD model is often operated on severe road surfaces (such as sandy or snowy roads, etc.), the clutch is subjected to appreciable loads. A clutch warning system, which consists of a "CLUTCH TEMP" lamp and a buzzer, is located on the meter panel of the 4WD model. The "CLUTCH TEMP" lamp also function of the FWD model's "CHECK ECVT".

- **Clutch temperature measuring system**
  The higher the clutch coil temperature, the greater the clutch coil resistance. Based on this principle, the clutch temperature measuring system determines the clutch temperature after the control unit computes the coil resistance from the relationship between current and voltage.

(1) ECVT control unit

The ECVT control unit is an 8-bit 16K byte microcomputer.

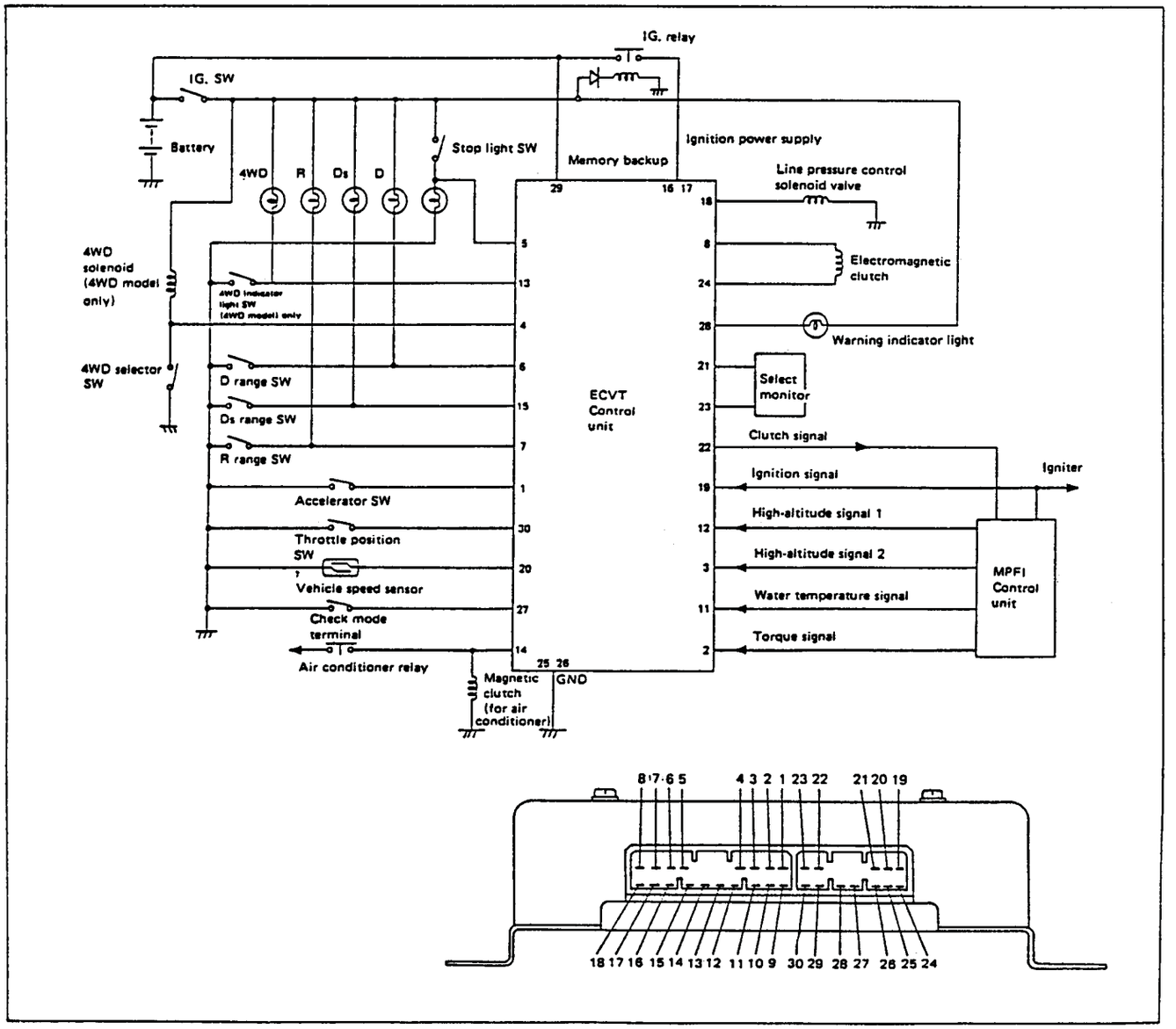


Fig. 8

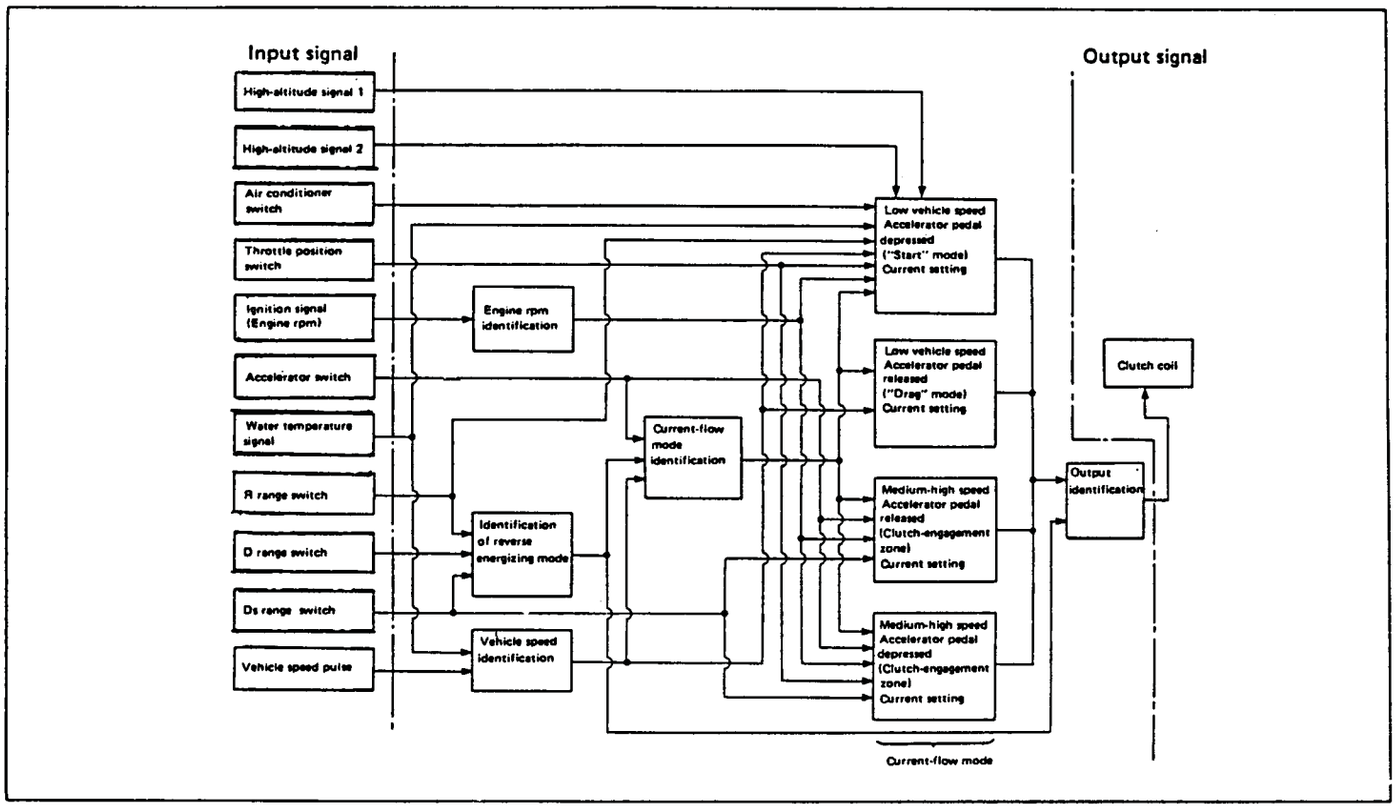


Fig. 9 ECVT clutch current control block diagram

(2) Output modes

The five output modes shown in the table are provided for smooth electromagnetic powder clutch operation:

Engine speed	Shift position	Vehicle speed / Accelerator	← 7 (4)/ 8 (5) →	← 8 (5)/ 12 (7) →	← 16 (10)/ 20 (12) →	← 18.5 (11.5)/ 22.5 (14.0) →	← 30 (19)/ 35 (22) → km/h (MPH)
Under 300 rpm	–	–	❹ Reverse excitation mode				
–	N, P range						
300 rpm or higher	D range	Released	❸ Drag mode	❺ Zero mode			
	Ds, R range				❷ Direct coupling mode		
	D range	Pressed	❶ Starting mode				
	Ds, R range						

❶ Starting mode

This mode controls the clutch torque at starting by increasing the clutch current in proportion to the engine speed and its rate of increase when the accelerator pedal was pressed.

When the vehicle is started by pressing the accelerator pedal lightly at a high idling speed, such as when the choke is used, the engine speed rises at a comparatively low rate and, therefore, the increase of the clutch torque is also small and the vehicle starts slowly and smoothly.

When the stall speed is in the 1,900 to 2,500 rpm range, the starting chracteristic is stable.

Clutch torque characteristic is also modified to compensate for low engine output during high-altitude operation. This enables the engine to start easily at high altitude as it does at low altitude.

When releasing and applying the accelerator pedal at a vehicle speed of 20 km/h (12 MPH) or slower immediately after starting, the shock is absorbed so that the clutch is applied after its output side (pulley input shaft) speed almost coincides with the engine speed.

❷ Direct-coupling mode

This mode directly-couples the clutch by passing the rated current through it when the vehicle has reached a preset speed.

The rated current is divided into three steps, according to how the accelerator pedal is pressed.

Accelerator pedal released	0.4 – 1.8 A
Accelerator pedal pressed lightly	3.0 A *1
Accelerator pedal press heavily	3.51 A *2

*1: Only accelerator switch operated

*2: Accelerator switch and throttle-position switch operated

❸ Drag mode

To maintain good operating characteristics when starting and when driving slowly at a speed of 7 km/h (4 MPH) or less, including stopping, in a running ("D", "Ds", "R") position, a drag torque is applied by passing a small current (approximately 0.2A) through the clutch when the accelerator pedal is released.

To prevent a lowering of the idling speed by dispersion in the drag torque and to prevent the vehicle from creeping, the idling speed (ignition pulse) is fed back to control unit.

❹ Reverse excitation mode

For demagnetization, the clutch enters the reverse excitation mode under the following four conditions:

a. Selector lever in "N" or "P" position

The reverse excitation mode is entered to turn off the clutch. When the selector lever is set to the "D", "Ds", or "R" position, current does not flow in the starter and the engine does not start, even if the ignition key is turned to the "START" position.

b. Engine speed is 300 rpm or less

The reverse excitation mode is entered to prevent starting the engine by pushing the vehicle.

c. For 0.4 to 0.8 seconds after selector lever set to "D" or "P" position

The reverse excitation mode is entered to make selector lever operation easier.

d. For approximately 1 second when accelerator was released at low vehicle speed

The reverse excitation mode is entered to remove the residual magnetism.

❺ Zero mode

This mode de-energizes the clutch while the output mode is being shifted from the direct-coupled mode to the drag mode when the accelerator is released in "D", "Ds", or "R" position.

- Transition response control

This mode controls the clutch torque transition response for smooth coupling of the clutch when the clutch is directly coupled, the selector lever is set to the "Ds" position, and when accelerating and decelerating at a very low speed.

- The control unit also has the control functions described below, besides clutch control.

(3) Self-diagnosis function

The self-diagnosis function includes four modes; a U-check mode, read-memory mode, D-check mode and memory-clear mode. With these control modes, various systems are diagnosed and problems are identified when the "CHECK ECVT" (FWD model) or the "CLUTCH TEMP" (4WD model) warning indicator light is illuminated.

(4) Fail-safe function

When sensor trouble occurs, the following fail-safe functions are performed:

a. When clutch current does not flow because of accelerator switch trouble, throttle-position switch and engine speed 1,000 rpm are sensed and the clutch is energized.

b. When the vehicle speed pulse is not input because of speedometer trouble, engine speed 1,200 rpm or higher is sensed and the clutch is energized with the accelerator released.

c. In the 2-phase line pressure control, when line pressure is not properly shifted due to a faulty torque signal circuit, high line pressure will be maintained.

3-2 Forward and Reverse Changeover System

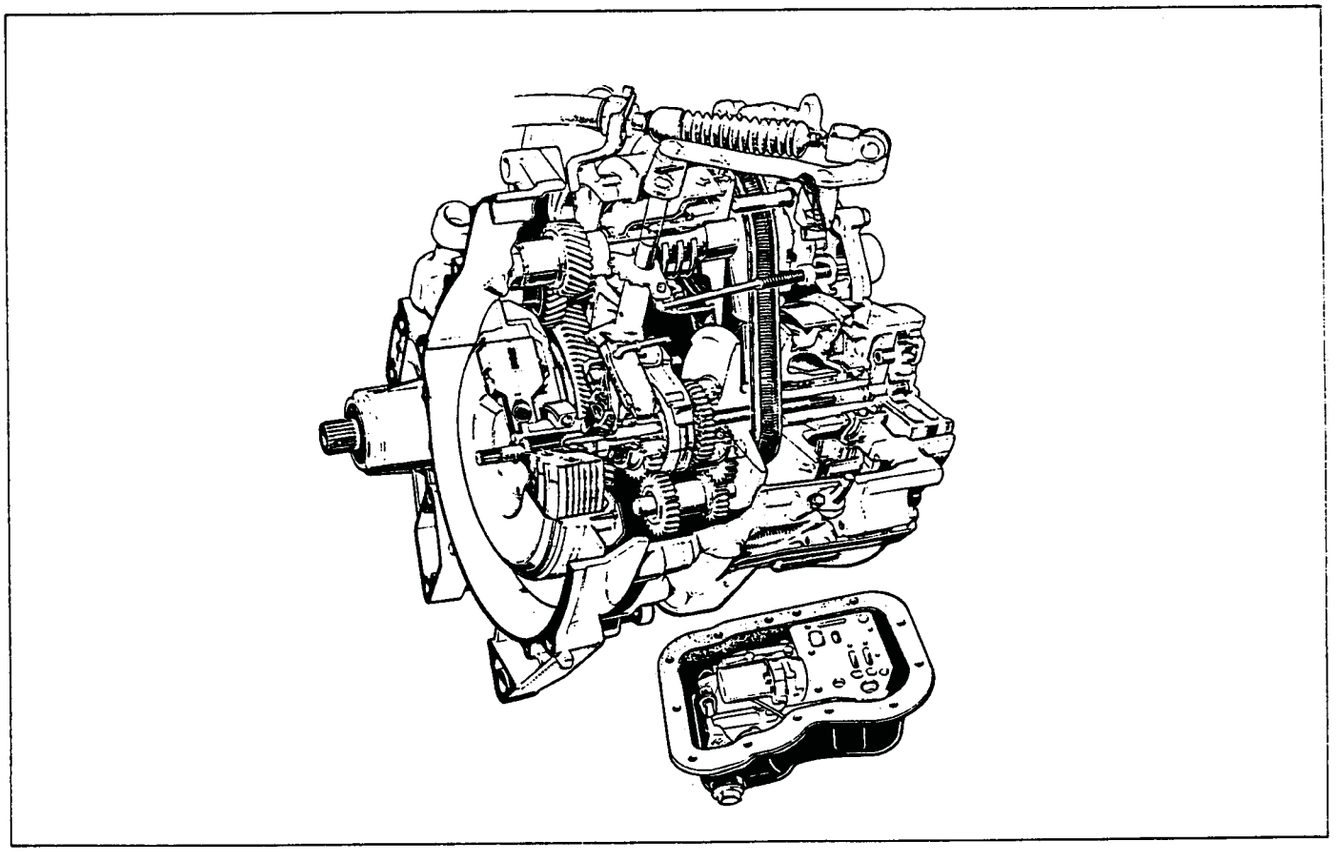


Fig. 10

1) FORWARD AND REVERSE SWITCHING MECHANISM

A synchromesh forward and reverse switching mechanism is installed between the electromagnetic powder clutch and primary pulley.
This mechanism prevents gear squeaks while shifting from the "N" to the "R" position. It also permits gears to be shifted from the "N" to the "D" position or vice versa during operation.

(1) "N" position

This is the neutral state. The sleeve is at the center position and the main drive gear power is not transmitted to the hub.

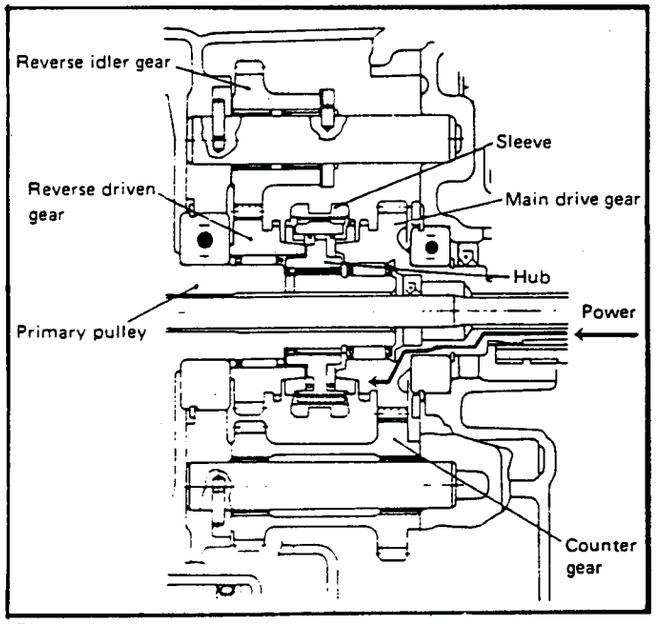


Fig. 11

(2) "D" position

This is the state in which the sleeve is shifted to the right at forward operation. In this state, the main drive gear power is transmitted from the sleeve to the primary pulley through the hub.

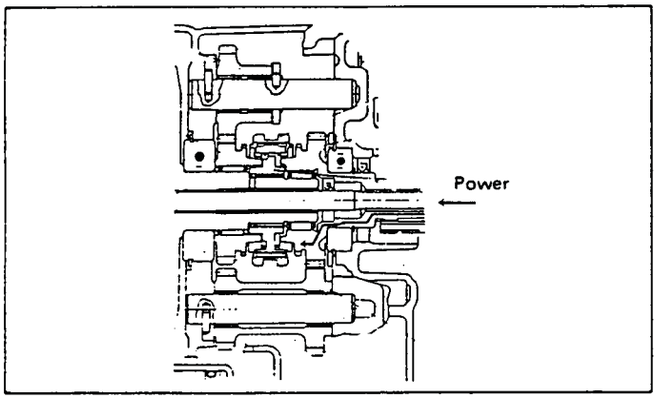


Fig. 12

(3) "R" position

This is the state in which the sleeve is shifted to the left at reverse operation. In this state, the main drive gear power is transmitted from the counter gear to the primary pulley through the reverse idler gear. The direction of rotation is opposite that at forward operation.

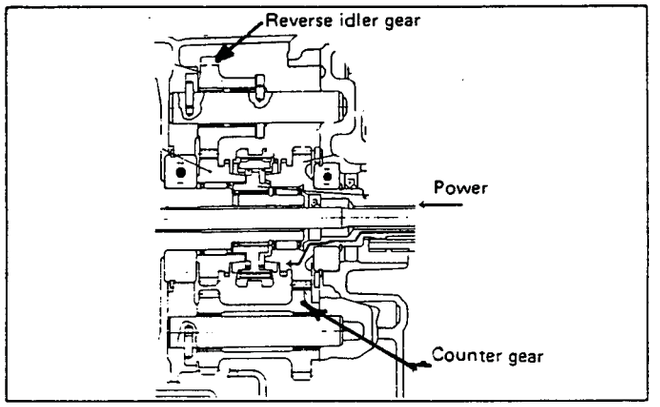


Fig. 13

2) OTHER SELECTOR POSITION MECHANISMS

(1) "Ds" position

In this position, the sleeve position is the same as that of the "D" position. However, when the selector lever is set to the "Ds" position, the engine brake valve inside the hydraulic control valve operates and the shift characteristic changes to the "Ds" position speed change characteristic.

(2) "P" position

In this position the parking rod is moved through the shift arm and selector cam, and the parking rod cam pushes the parking pawl in the arrow direction.
Therefore, the parking pawl meshes with the parking gear at the side of the secondary pulley and the pulley, which is connected to the axle shaft, is mechanically locked. The sleeve remains meshed at the reverse side.

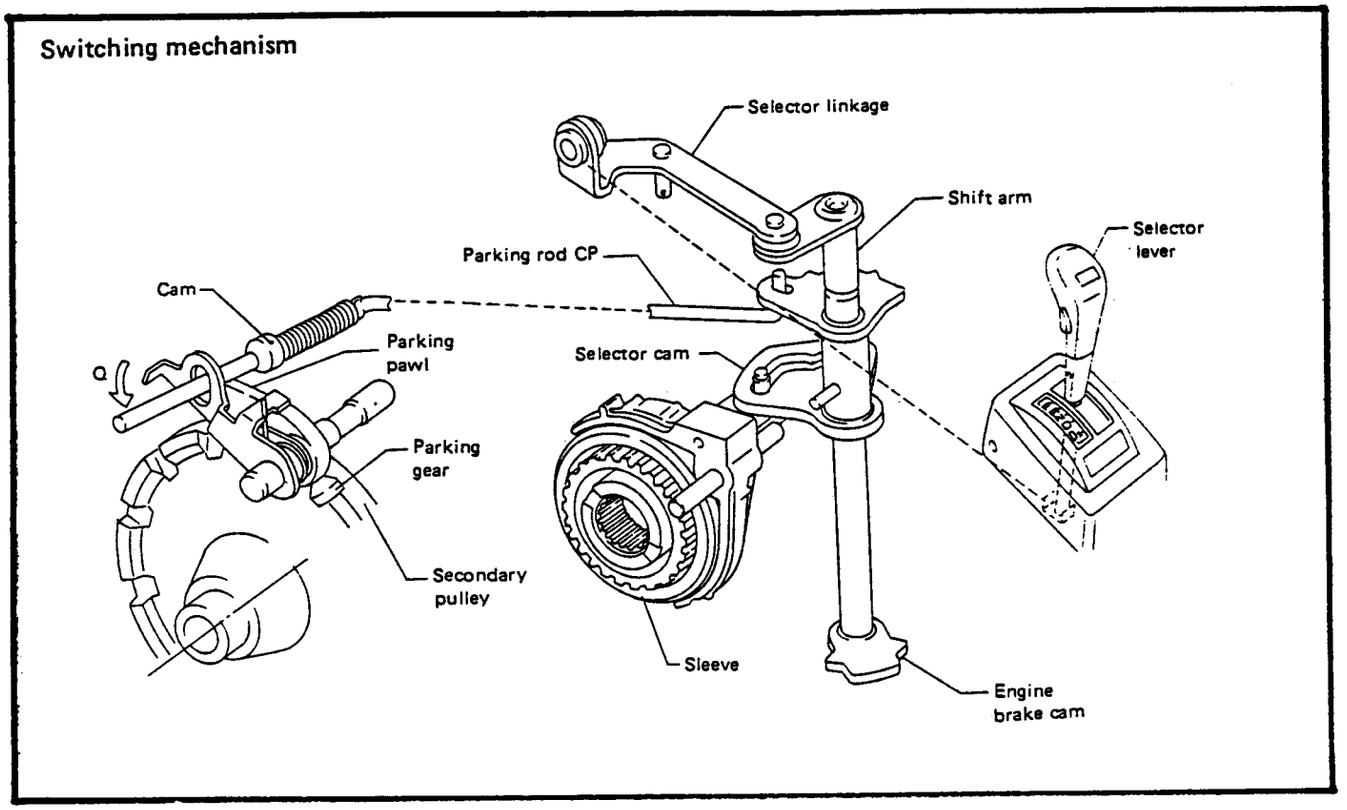


Fig. 14

3-3 Belt and Pulley

BELT AND PULLEY MECHANISM

The belt and pulley mechanism consists of a pair of pulleys whose groove width can be changed freely in the axial direction and a steel belt consisting of steel blocks and a steel band. The speed is changed continuously from low (pulley ratio 2.503) to overdrive (pulley ratio 0.497) according to the steel belt and pulley contact radius.

The pulley groove width is controlled by the hydraulic pressure of the input shaft and output shaft pulleys.

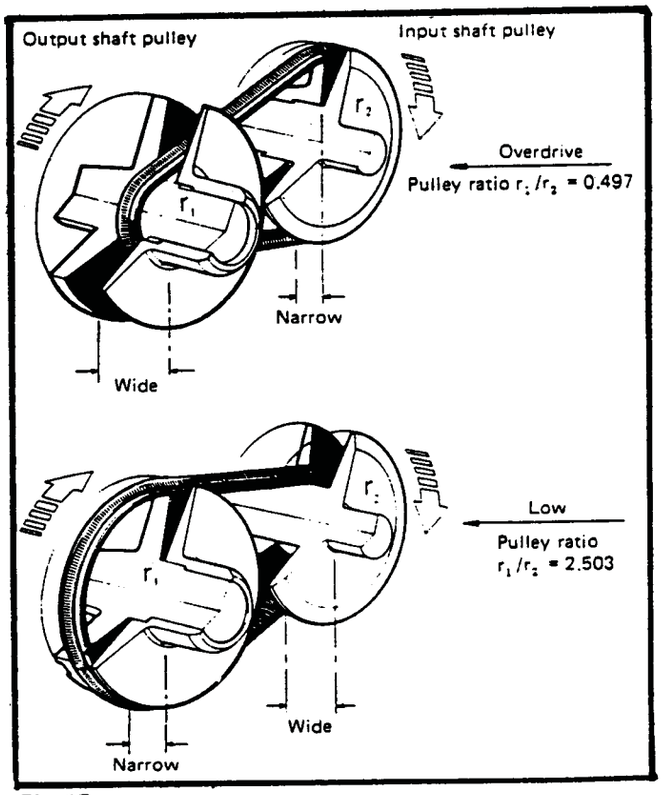


Fig. 15

• Steel belt

The steel belt consists of approximately 280 steel blocks and two steel bands made up of 10 laminated steel strips.
The feature of this steel band is that where the conventional rubber belt, etc. transmit power by tension, the steel belt transmits power by the compression of steel blocks.
The marging steel band consists of 10 laminated steel strips and is divided into thin parts so that it can withstand small bending, thus preventing fatigue breakage caused by bending.
For the steel blocks to transmit power, there must be a friction force between the blocks and the sloped sides of the pulleys.

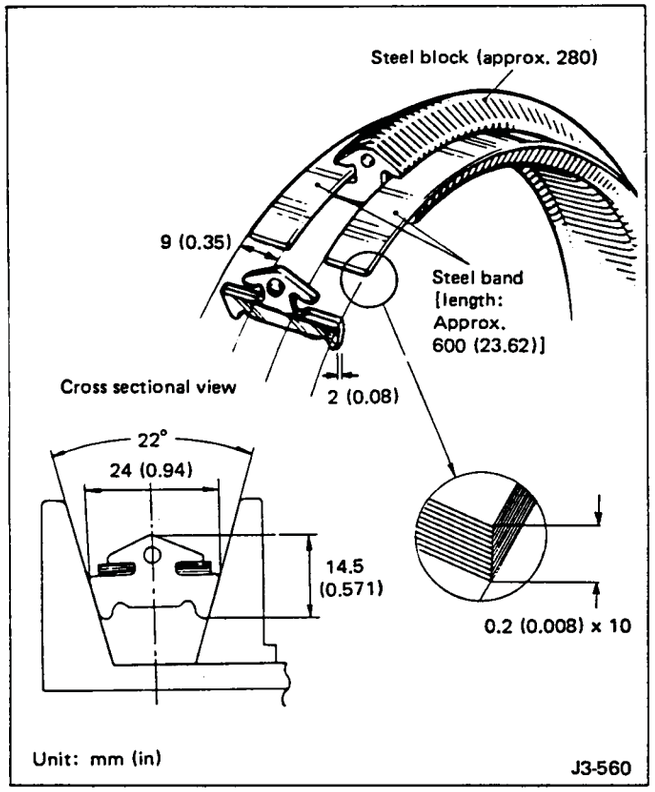


Fig. 16

This friction force is generated by the mechanism described below. When hydraulic pressure is applied to the secondary pulley, the steel blocks are squeezed between the sides of the pulley and forced outward. As a result, tension is generated at the band and friction force is generated between the steel blocks and the primary pulley.
In other words, the steel blocks transmit power by compression, and the steel band maintains the friction force to do this.

• Pulleys

Both the primary pulley and the secondary pulley consist of a moving sheave with 11° sloping sides and a shaft.
A hydraulic pressure chamber is provided for both parts at the back of the moving sheave.
The pulley groove width is changed by sliding the moving sheave on the shaft by a ball spline.

3-4 Hydraulic Control System

HYDRAULIC CONTROL MECHANISM

The hydraulic control system consists of an oil pump driven by the engine, hydraulic pressure control valve which controls the line pressure and speed change, and input signals.
The accelerator opening, engine speed, and speed ratio signals are input to this mechanism, and the action of the belt drive hydraulic pressure on the output shaft and the speed change hydraulic pressure on the input shaft is controlled.

Changeover of line pressure from high to low or vice versa is accomplished through an engine output (torque) signal sent from an electronically controlled carburetor micro-computer. Thus, the optimum clamping force of the belt is obtained under partial engine load (approximately less than 60% of engine output).

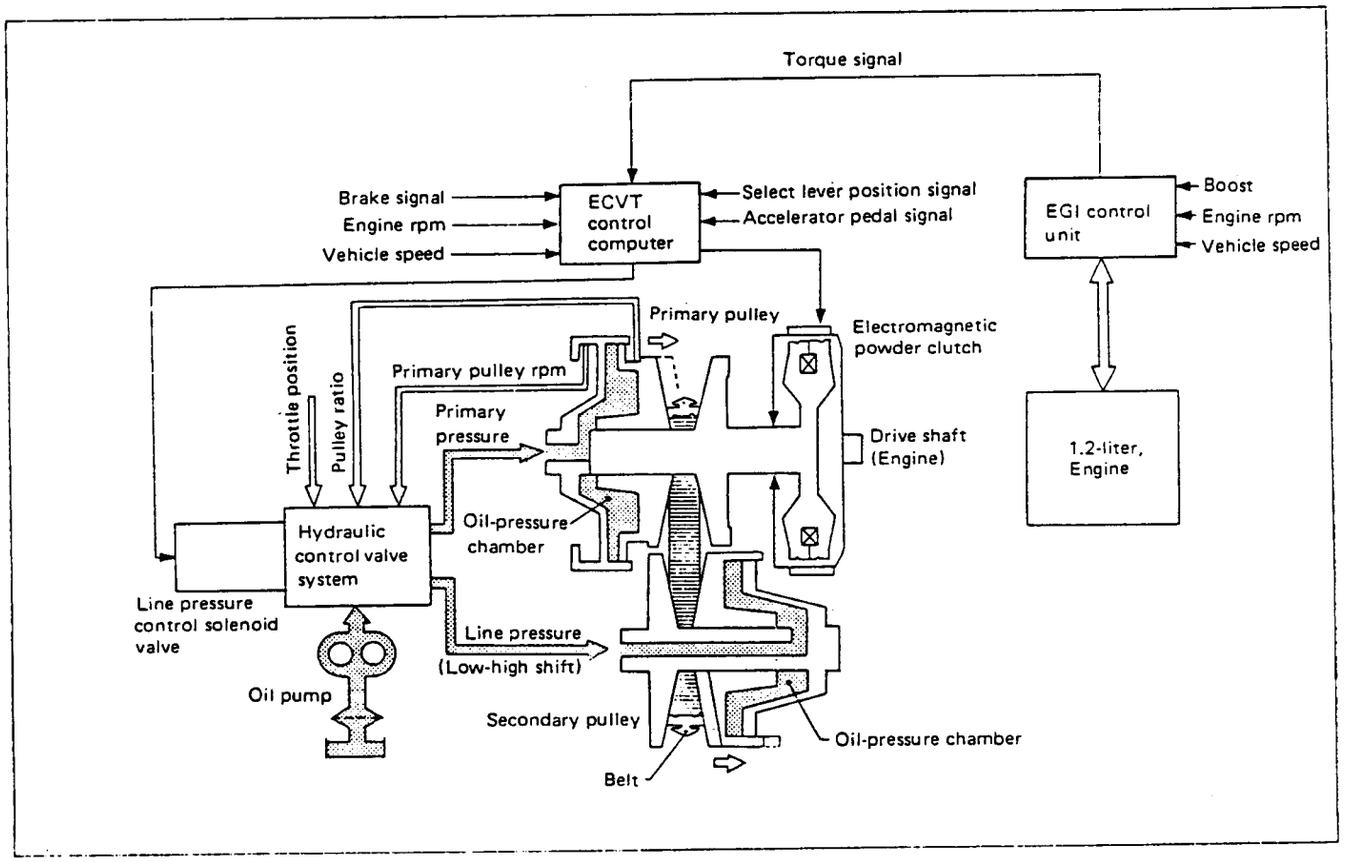


Fig. 17

1) Oil pump

The oil pump is driven by the engine through a drive shaft passing through the primary pulley.
The pump is an external gear pump. The oil discharged from the oil pump is sent to hydraulic control valves, and is used as the primary and secondary pulleys operating oil and the lubricating oil for each parts.

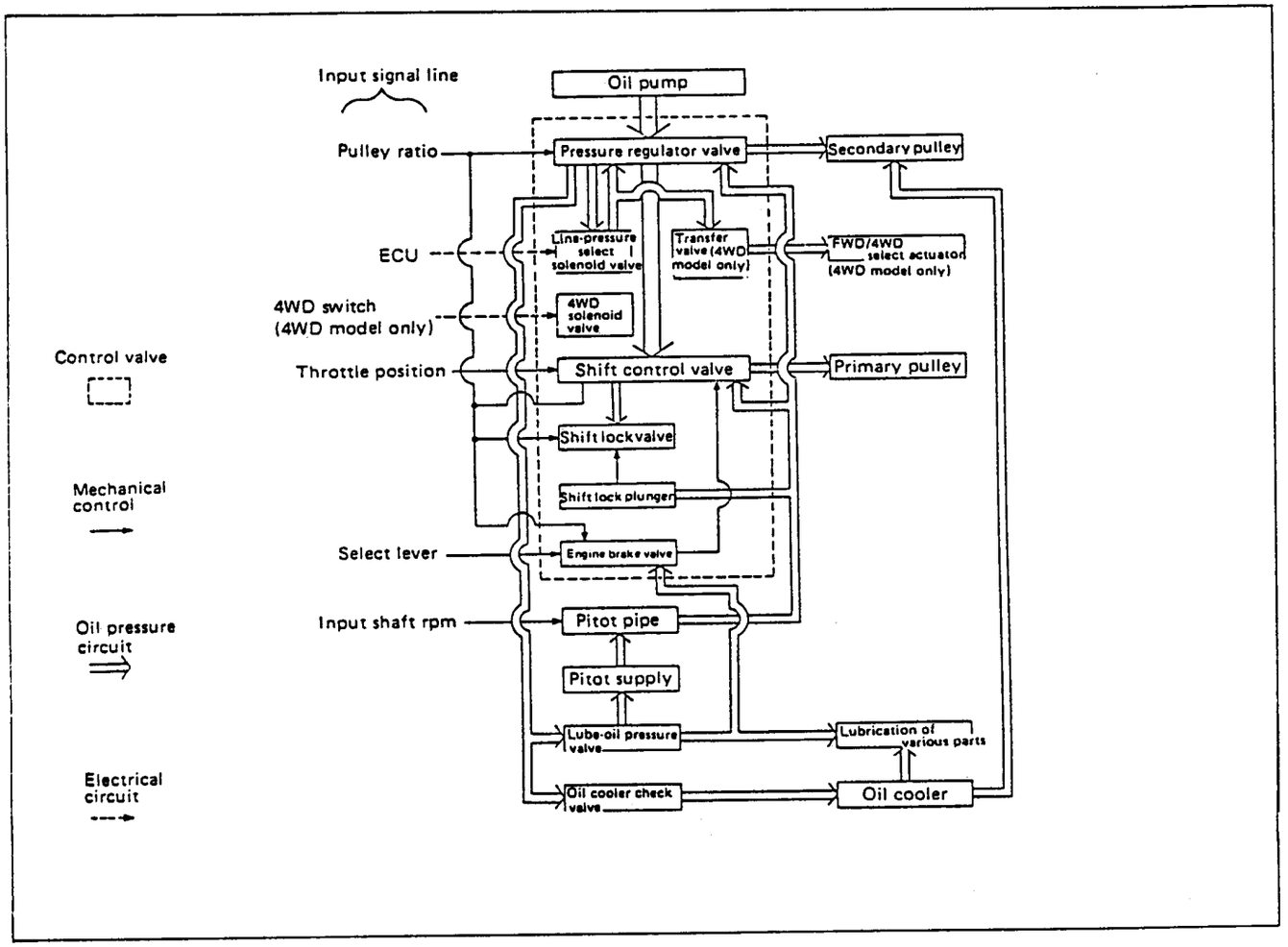


Fig. 18

The belt is lubricated by feeding the lubricating oil through a pipe and spraying it forcefully onto the belt from a nozzle. The side which contacts the pulley of the ratio sensor which senses the pulley ratio is also lubricated forcefully.

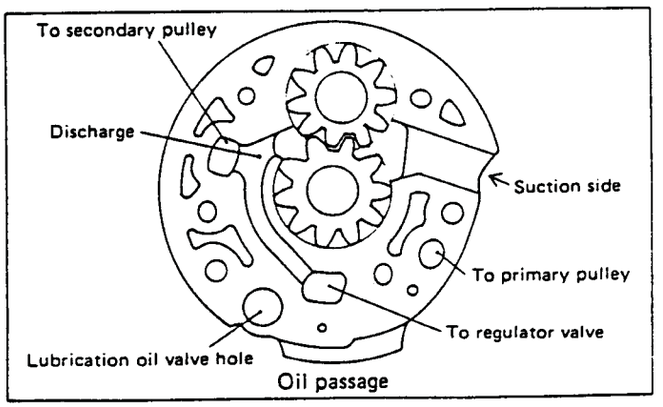


Fig. 19

2) Hydraulic control valves

The hydraulic control valves consist of the following:

- Pressure regulator valve
- Shift control valve
- Engine brake valve

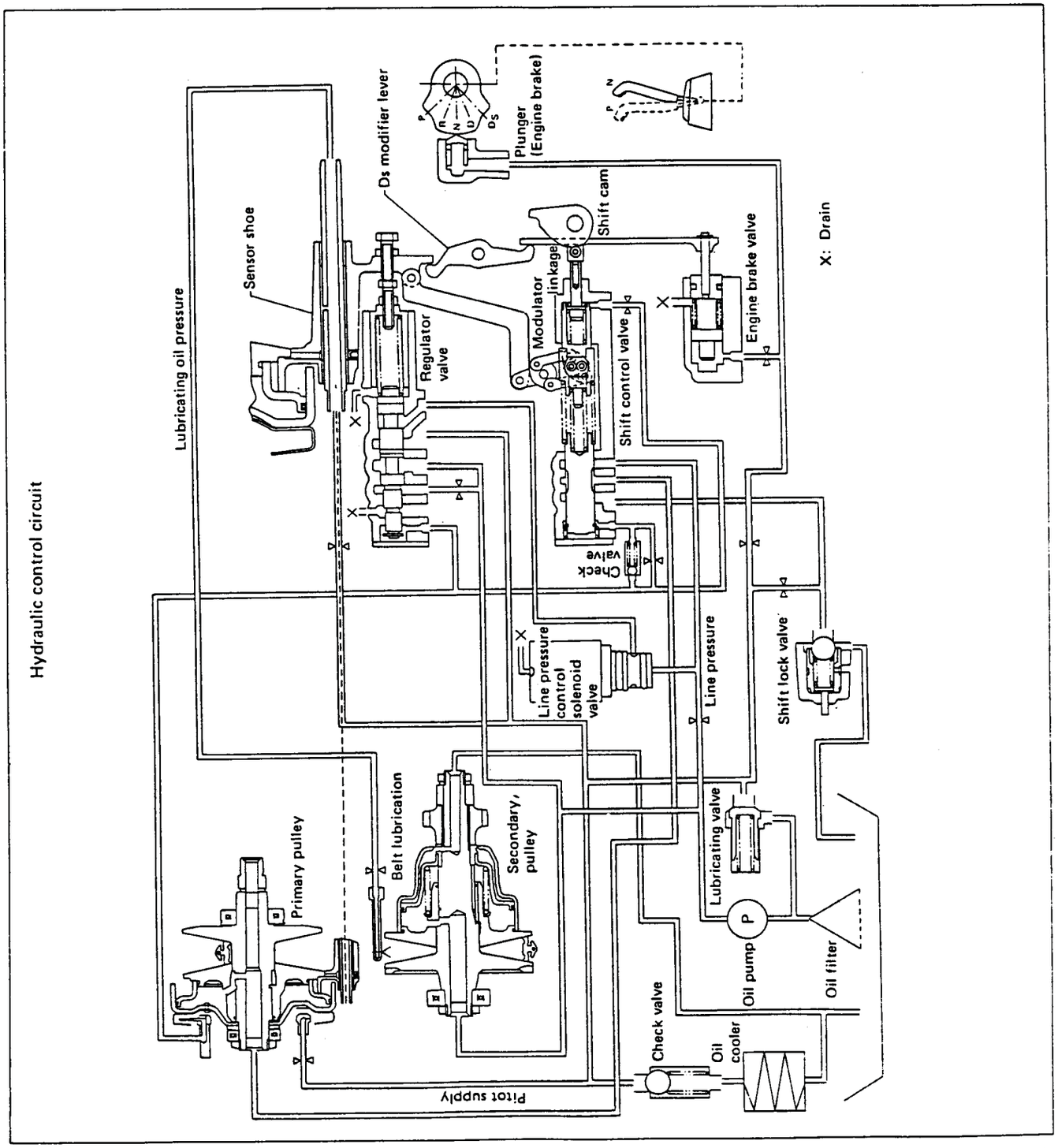


Fig. 20

(1) Pressure regulator valve

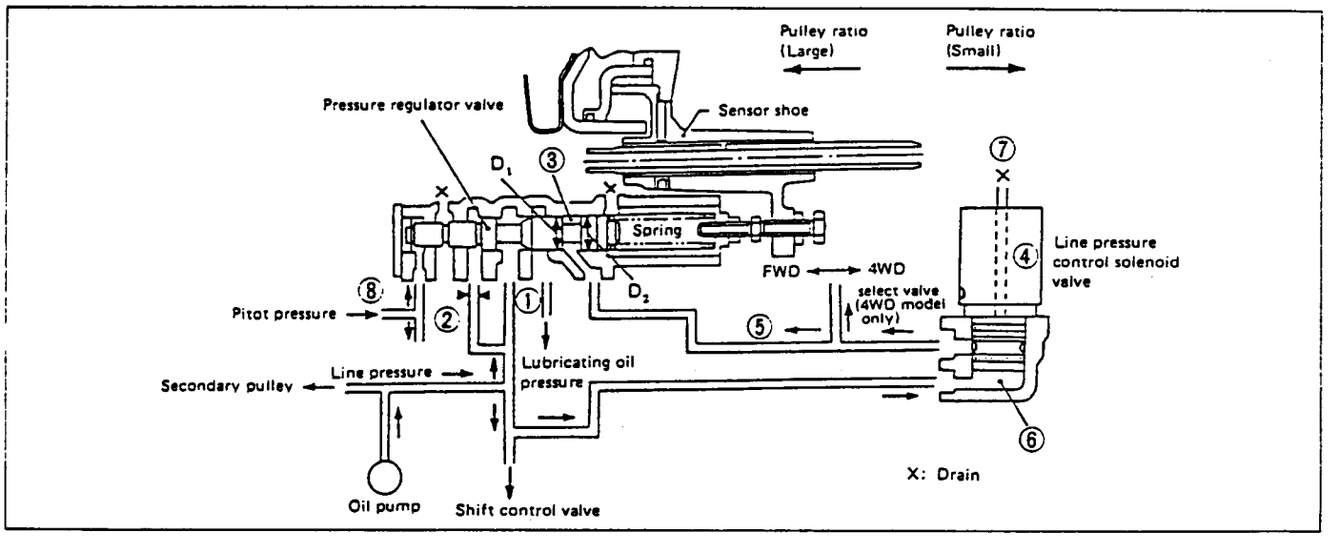


Fig. 21

The pressure regulator valve supplies the optimum hydraulic pressure to the secondary pulley when the pulley transmits power through the steel belt.

Oil discharged from the oil pump acts on circuits ① and ② so that oil pressure in these circuits and spring 1 are maintained in a balanced condition. Line pressure is delivered to the oil-pressure chamber ③ via the circuit ⑤ using the basic control which changes oil pressure from high to low or vice versa according to speed ratio and engine rpm. In addition, the ON-OFF operation of the line pressure control solenoid valve ④ is controlled by a torque signal (sent by the EGI microcomputer).

In operation, the position of the primary pulley's movable sheave is detected to directly change the "set" length of the pressure regulator valve spring. That is, when the speed ratio is high (low range), high line pressure will be maintained and when the speed ratio is low (overdrive), low line pressure is maintained. Oil pressure (or pitot pressure) proportional to primary pulley rpm acts on circuit ⑧ on the opposite side of spring 1. This causes primary pulley rpm (or engine rpm) to increase so that an oil pressure increase caused by increases in oil pressure discharged from the oil pump is prevented.

When the engine is under partial load condition (approximately 60% load), the line pressure control solenoid valve ④ turns ON so that line pressure is delivered from circuit ⑤ to oil-pressure chamber ③ via oil pressure chamber ⑥. At this point, spool diameter D_2 will be greater than D_1. This increases the operating area which moves the pressure regulator valve to the right so that the line pressure is reduced.

When the engine is under heavy loads, the line pressure control solenoid valve ④ turns OFF so that circuit ⑤ and oil-pressure chamber lines are shut off. Drain circuit ⑦ will then be opened to drain oil pressure from circuit ⑤ via the line pressure control solenoid valve ④. This eliminates the force applied to the right side of the pressure regulator valve. The operating area required to move the pressure regulator valve to the right will then be reduced so that the line pressure will increase.

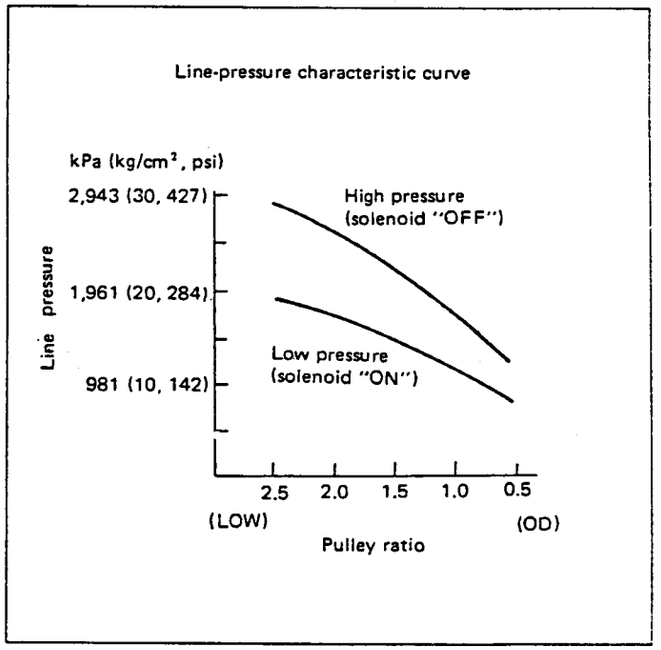


Fig. 22

The hydraulic system is controlled as explained above. Accordingly, the optimum clamping force of the belt will be maintained and, at the same time, drive loss of the oil pump will be reduced to a minimum. As a result, driving performance under medium-low loads as well as fuel economy are improved.

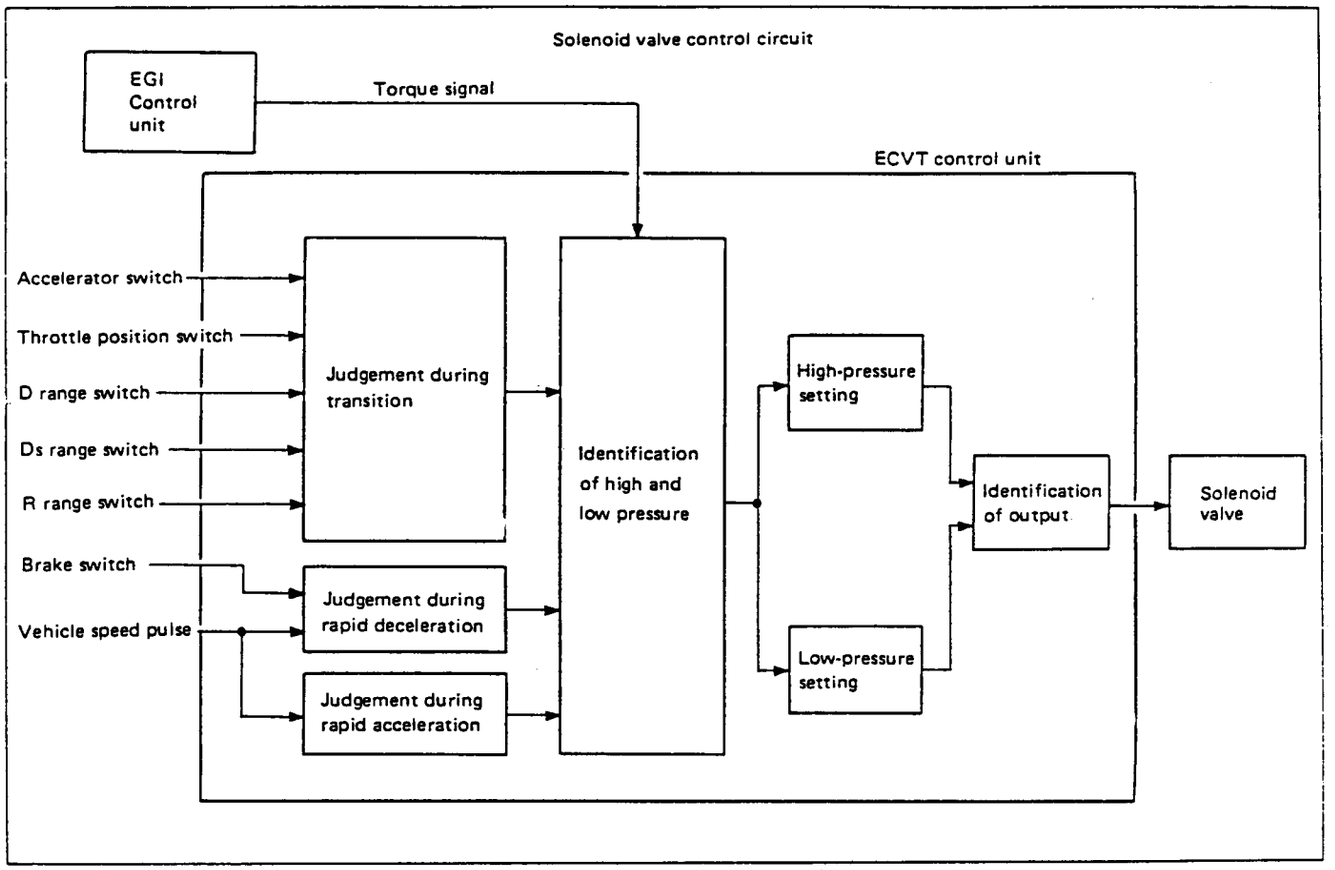


Fig. 23

* Line pressure is temporarily maintained at "high" when throttle position switch and range switch are shifted.
* Torque signal is outputted from engine's EGI control unit.

(2) Shift control valve

The shift control valve controls continuous speed changes from low range to overdrive in the "D" and "Ds" positions. The pulley ratio is controlled by controlling the line pressure (① in the figure) to the primary pulley and selecting the position of the moving sheave of the primary pulley, with the amount the accelerator is depressed and the engine speed as the sensors.

In low range, spring 3 pushes the shift control valve to the left. When the engine speed rises, the pitot pressure ③ becomes high, the shift control valve moves to the right and the line pressure ① flows to circuit ⑦ and is directed to the primary pulley.

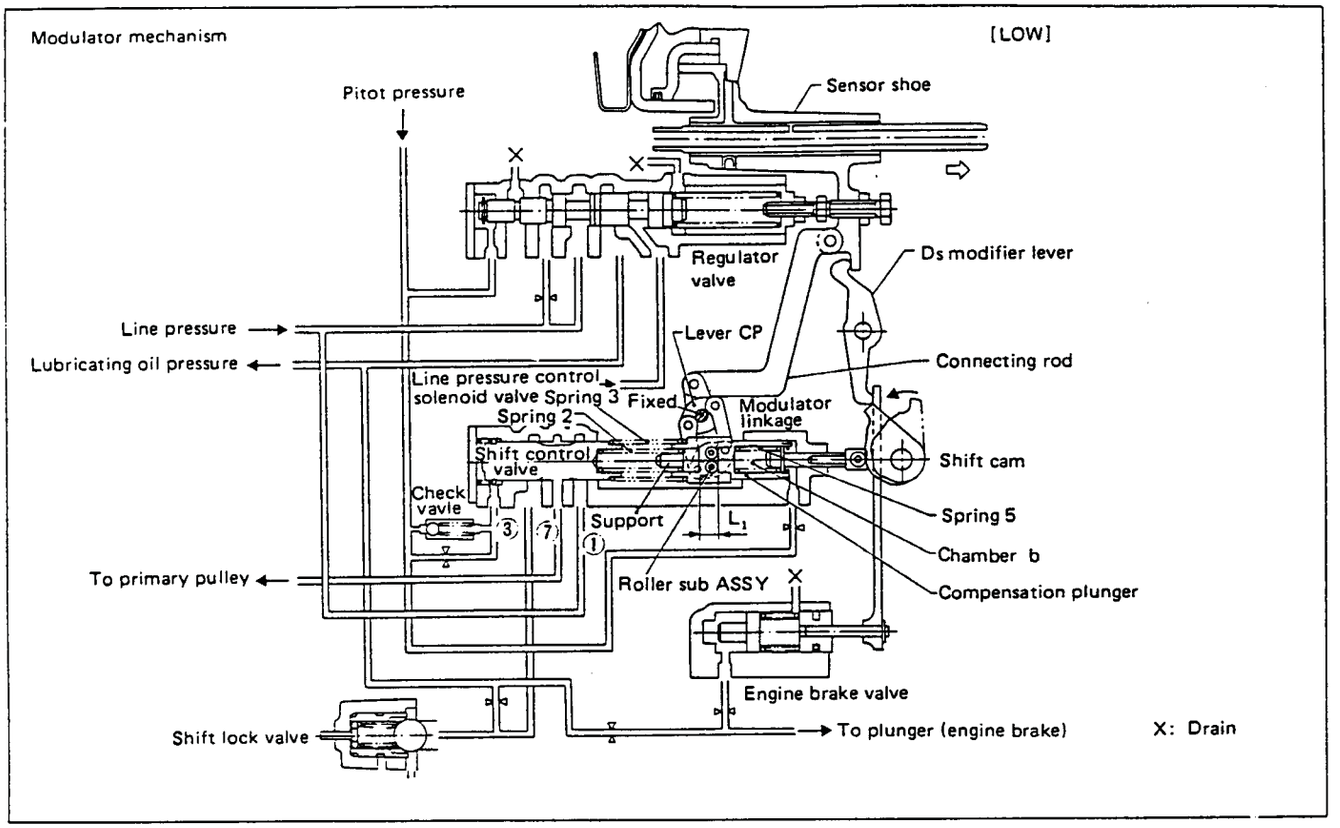

Modulator mechanism
[LOW]
Pitot pressure
Sensor shoe
Regulator valve
Ds modifier lever
Line pressure
Lubricating oil pressure
Lever CP
Connecting rod
Line pressure control solenoid valve
Spring 3
Fixed
Spring 2
Modulator linkage
Shift control valve
Shift cam
Check vavle
Support
L_1
Spring 5
Chamber b
To primary pulley
Roller sub ASSY
Compensation plunger
Engine brake valve
Shift lock valve
To plunger (engine brake)
X: Drain

Fig. 24

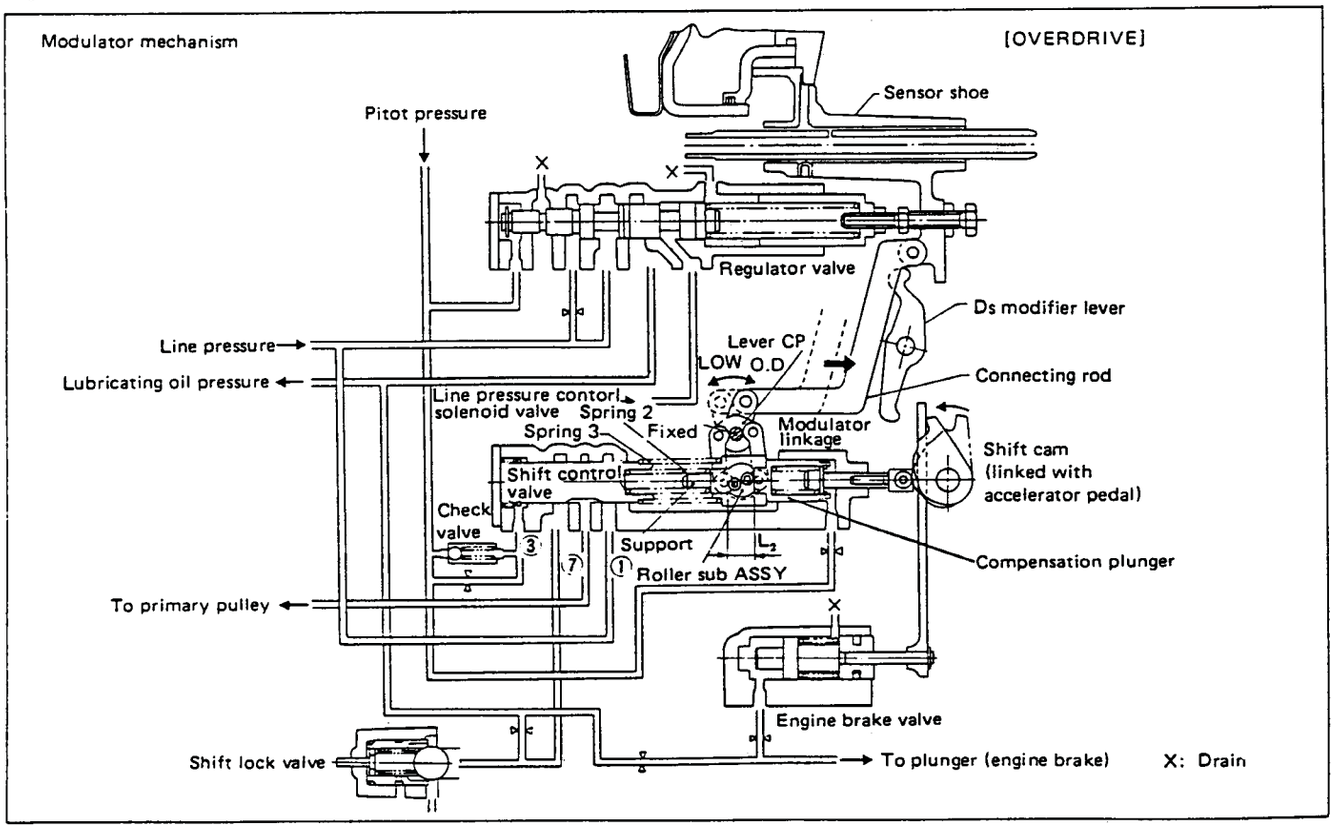

Modulator mechanism
[OVERDRIVE]
Sensor shoe
Pitot pressure
Regulator valve
Ds modifier lever
Line pressure
Lubricating oil pressure
Lever CP
LOW O.D
Connecting rod
Line pressure contorl solenoid valve
Spring 2
Spring 3
Fixed
Modulator linkage
Shift cam (linked with accelerator pedal)
Shift control valve
Check valve
Support
L_2
Compensation plunger
Roller sub ASSY
To primary pulley
Engine brake valve
Shift lock valve
To plunger (engine brake)
X: Drain

Fig. 25

Speed change starts at point "*" in the figure. Speed change starts from the engine speed corresponding to the amount the accelerator pedal was pressed.

On the other hand, if the accelerator pedal is pressed while the vehicle is in overdrive, the force pushing the shift control valve to the left increases, the demanded engine speed rises, the engine speed changes from point B to point C in the speed change characteristics, and the vehicle speed increases. (Kickdown)

Conversely, if the amount of depression of the accelerator pedal is reduced while running at full speed, the demanded engine speed decreases and the engine speed changes from point D to point E of the speed change characteristics. (Upshift)

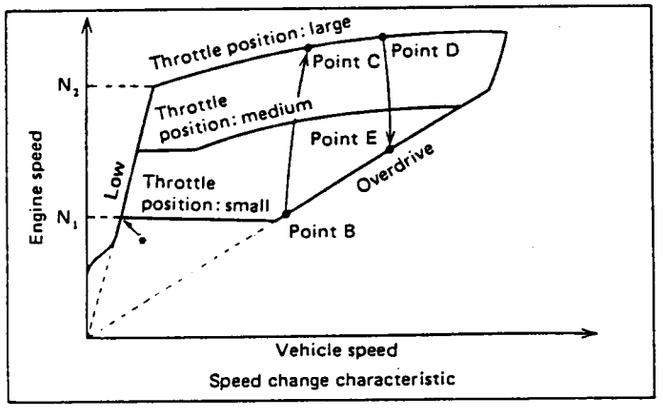


Fig. 26

As the pulley ratio from this valve is changed from "low" to "overdrive", a right-hand "rise" characteristic which increases engine speed to the required rpm occurs. This increase in engine speed is accomplished by the modulator linkage built into the control valve. In operation, as the sensor shoe moves from "low" to "overdrive", the high-speed spring ② is compressed by expanding the gap between the support and compensation plunger ($L_1 \rightarrow L_2$).

Meanwhile, the roller sub-ASSY is turning clockwise via the connecting rod and lever CP which move in response to the movement of the sensor shoe.

A compensation plunger is installed the shift control valve. This plunger is connected to the pin pushed by the shift cam connected to the accelerator pedal through spring 5, and the pitot pressure is directed to chamber ⑤

The compensation plunger prevents sudden draining of the primary pulley hydraulic pressure by movement of the shift control valve to the left when the accelerator pedal is pressed suddenly.

When the primary chamber is not filled with oil in low range, a time lag is produced in the speed change start time so that the lubricating oil pressure is constantly sent to the primary chamber A ball type pressure holding valve is also installed in the shift control circuit so that all of the oil is not drained from the primary pulley circuit ⑦

(3) Engine brake valve

The engine brake valve maintains a comparatively high engine speed when the engine brake is necessary on driving down hills and/or on winding mountain roads.

In the "D" position, since the switching plunger blocks the lubricating oil pressure passage ⑥, the lubricating oil pressure is directed to the engine brake valve ⑤, the force of spring 2 is overcome, and spool 4 is pushed to the right.

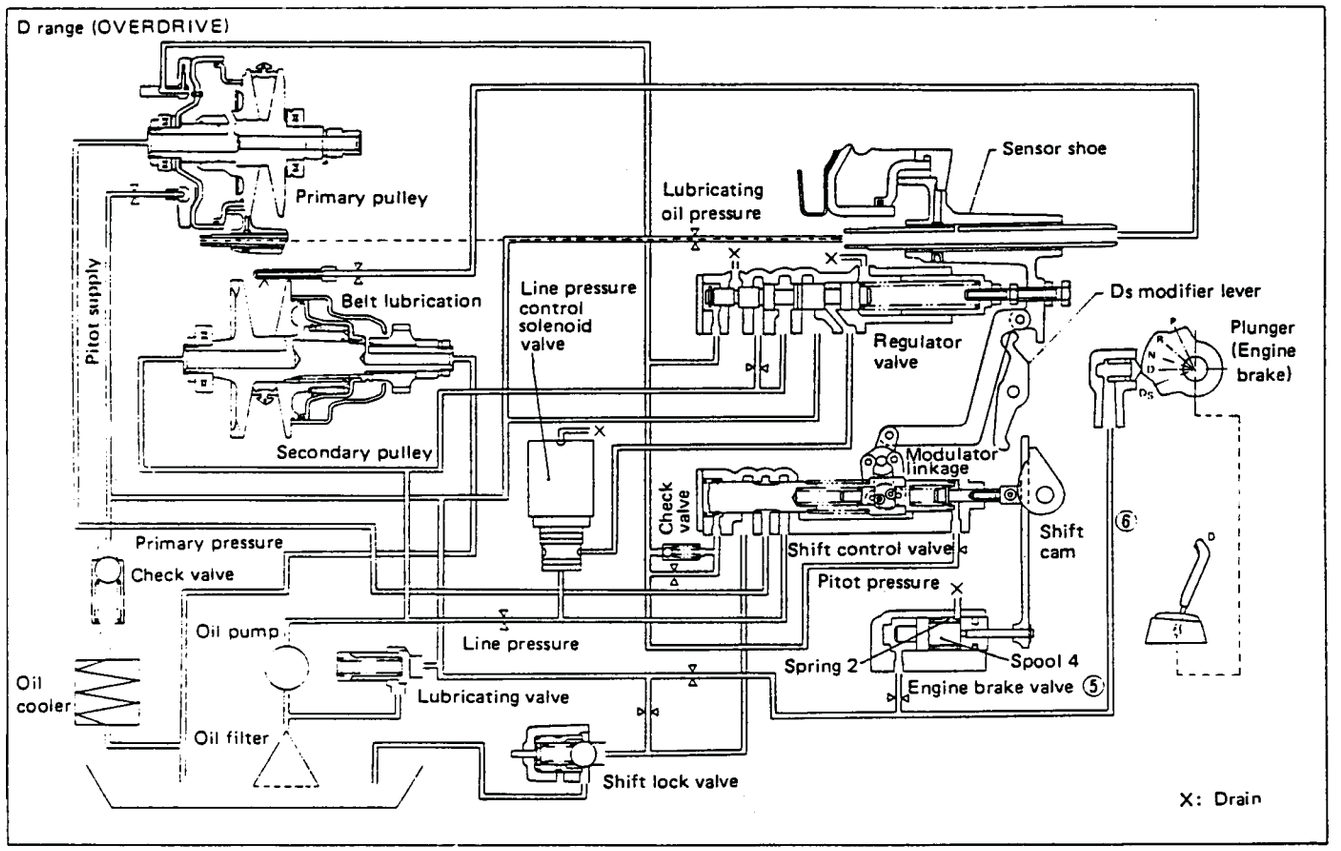


Fig. 27

Conversely, when the selector lever is shifted to the "Ds" position, since the switching plunger moves to the right, the lubricating oil pressure of circuit ⑥ is drained, the spring 2 pushes spool 4 of the engine brake valve to the left. At the same time, the engine brake arm moves to the left and pushes the shift control valve to the left without regard to the movement of the shift cam.

Therefore, in the "Ds" position, a speed change characteristic corresponding to the amount the shift control valve is pushed in by the engine brake valve is obtained even if the accelerator opening is small.

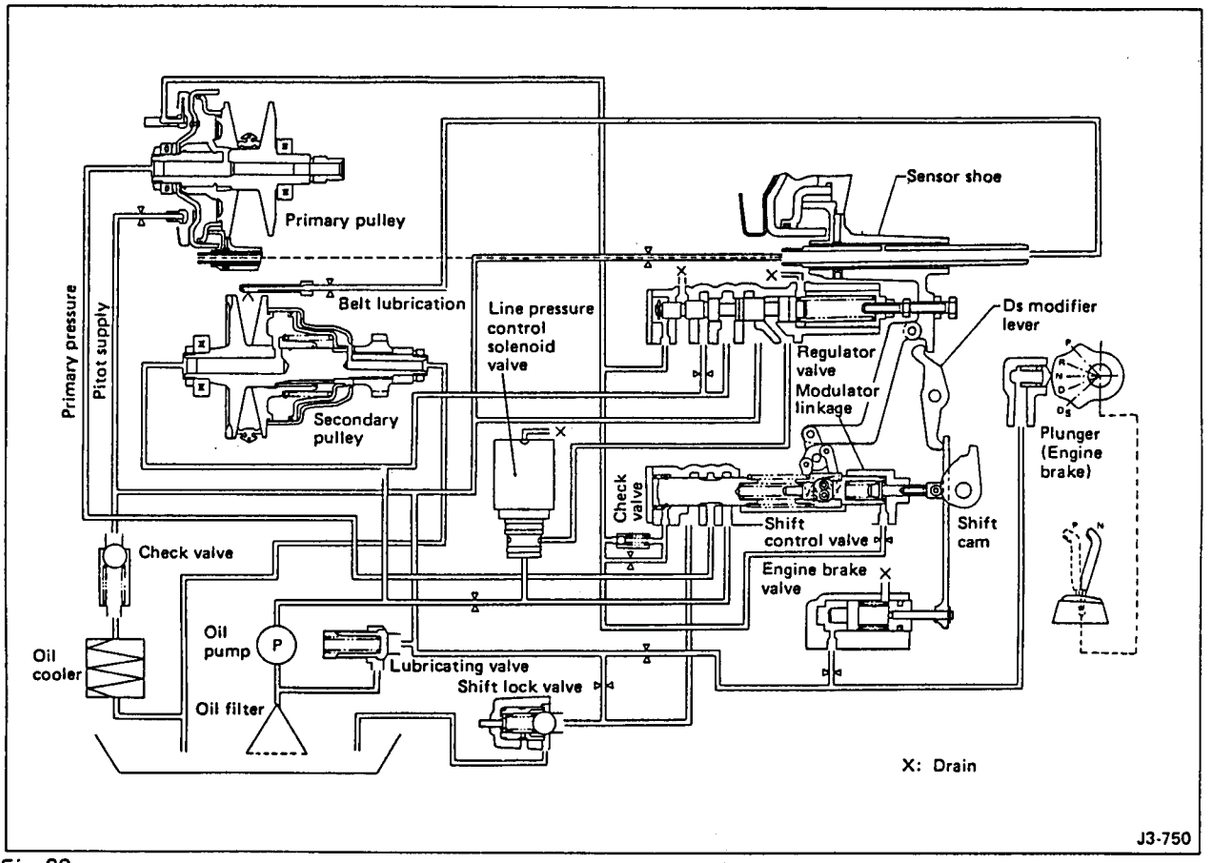


Fig. 28

Moreover, since the position of the moving sheave of the primary pulley is sensed through the engine brake lever, when the vehicle speed is lower than point A in the figure, the engine brake valve acts to reduce the amount spool 4 is pushed in and provides a characteristic which lowers the engine speed as the vehicle speed decreases as shown in the figure at right.

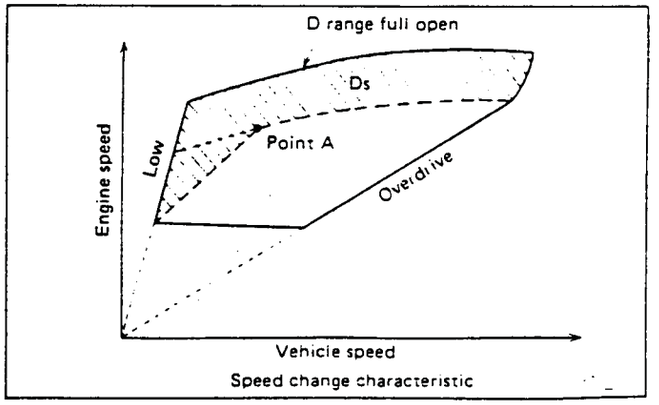


Fig. 29

Therefore, if the shift cam pushes in the shift control valve more than the amount it is pushed in by the engine brake arm, the vehicle can run in the range higher than that shown by the broken lines in the figure. Consequently, in the "Ds" position, the vehicle can run in the range shown by the hatched lines.
As a result, the "Ds" position provides a speed change range not possible with conventional automatic transmissions so that the engine brake is effective and running up to maximum speed is possible.

3) Input signal

Engine speed detection (pitot pressure)

A pitot pipe is inserted into the chamber which rotates with the primary pulley and a hydraulic pressure proportional to the square of the engine speed (primary pulley speed) is detected.

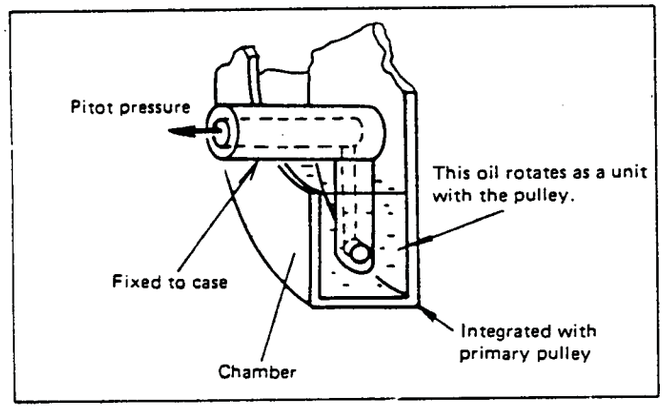


Fig. 30

4) Shift lock valve mechanism

This mechanism activates when the brakes lock the wheels, so that pitot pressure cannot be produced. When this occurs, this mechanism holds the same pulley ratio as that maintained before and after brake release.

3-5 Reduction Mechanism

The reduction mechanism consists of two stages: primary reduction and secondary reduction. Each stage uses a helical gear. A speedometer gear is installed to the end of the drive pinion shaft.
The differential section is the same as that of the manual transmission.

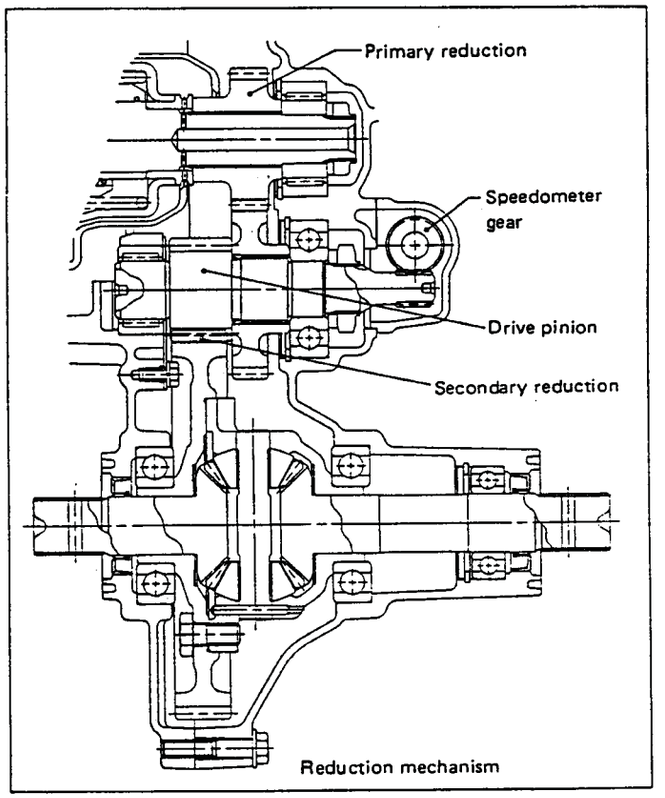


Fig. 31

3-6 Automatic Transmission Fluid Cooling System

This system consists of an oil cooler, which is built into the radiator, pipes and hoses. Heated oil under lubricating oil pressure is delivered to the oil cooler where it is cooled by coolant. In this way, the oil is maintained at the adequate temperature.

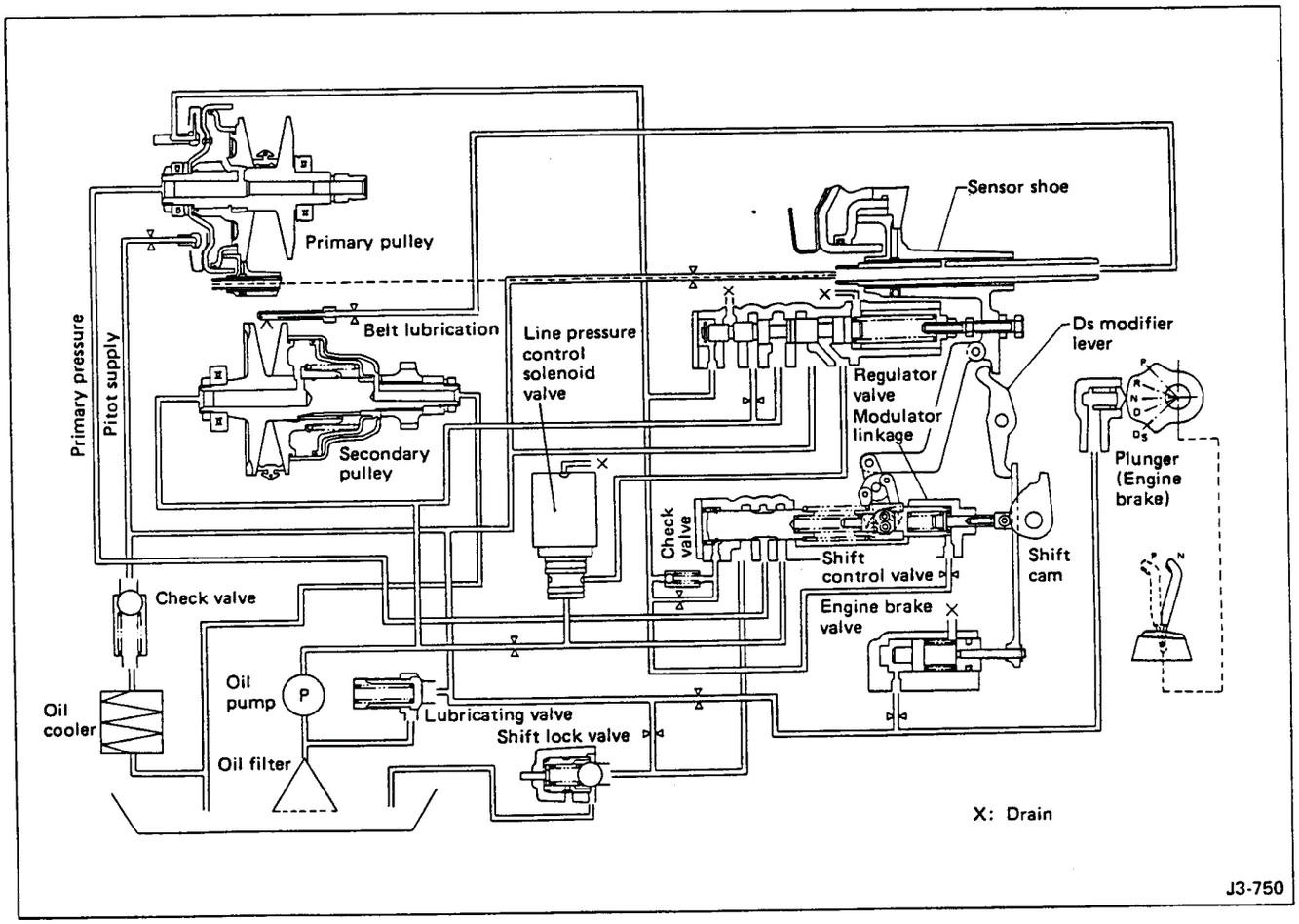


Fig. 32

3-7 FWD-4WD Shift Mechanism (4WD model only)

Shifting from FWD (front-wheel drive) to 4WD (4-wheel drive), or vice versa, is accomplished by a button switch. This switch controls the line pressure to move the fork via the piston and rail.

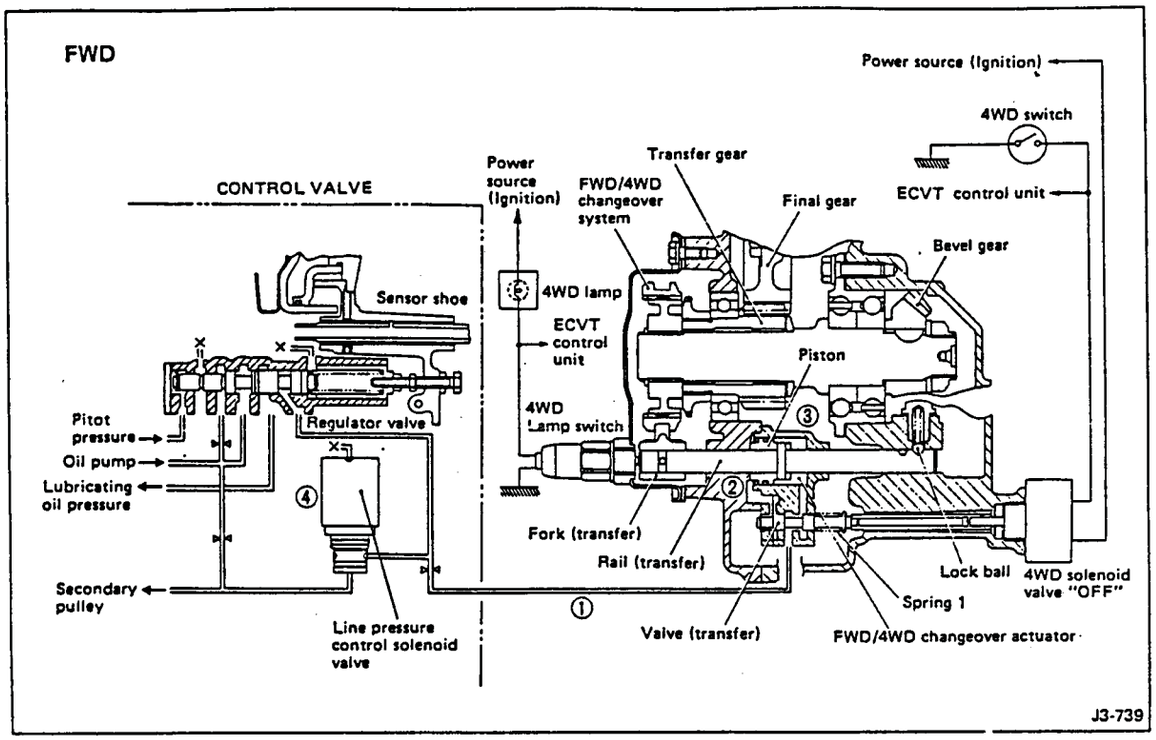


Fig. 33

When current does not flow through the 4WD solenoid valve ("OFF"), the transfer valve moves to the right due to tension from spring 1. This causes line pressure to flow from circuit ① to oil chamber ③ so that the piston moves to the left. Movement of the piston disengages the FWD-4WD clutch to set the circuit in the FWD mode.

When current flows through the 4WD solenoid valve ("ON"), the solenoid valve overcomes the tension of spring 1. This causes the transfer valve to move to the left. Line pressure then flows from circuit ① to oil chamber ② so that the piston moves to the right. Movement of the piston engages the sleeve and coupling to set the circuit in the 4WD mode.

However, when the line pressure control solenoid valve ④ is "OFF" (i.e., current does not flow through it), line pressure in circuit ① is discharged from drain port ⑤ of line-pressure control solenoid valve ④. As a result, shifting between FWD and 4WD cannot be accomplished.

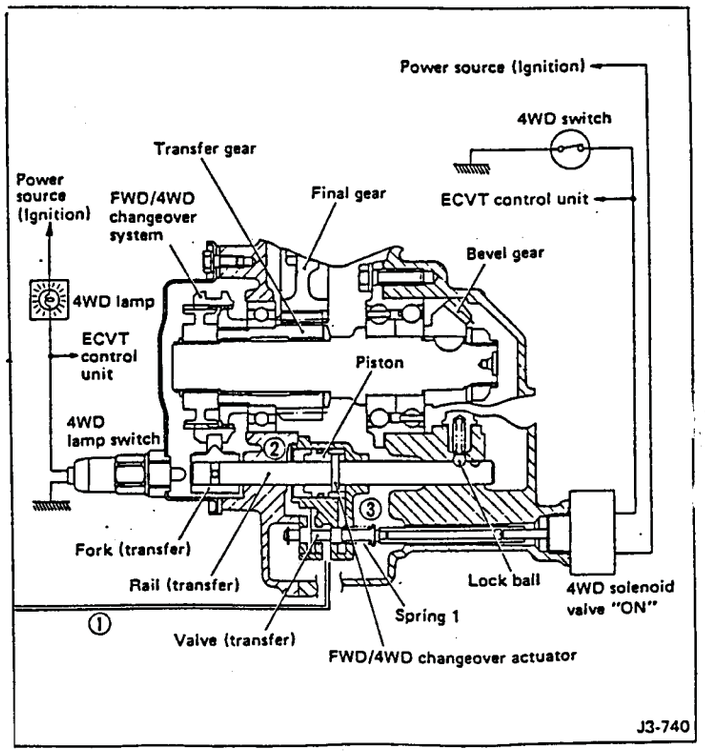


Fig. 34

4 Operating Characteristic and Performance

4-1 Speed Change Characteristic

Speed change characteristic is not linear like that of manual transmission vehicles, but is expressed as the region bounded by the maximum pulley ratio and minimum pulley ratio.
In the graph, the MAX line shows the relationship between vehicle speed and engine speed at full acceleration and the MIN line shows the same relationship when accelerating slowly.
When running on a flat road at a constant speed, the engine speed changes on the MIN line and responds quickly to operation of the accelerator in the region enclosed in the bold lines.
In the full acceleration range, that is, between the speed change start point (A) and speed change end point (B) of the high engine speed range, an engine speed gradual increase versus vehicle speed change characteristic is obtained.

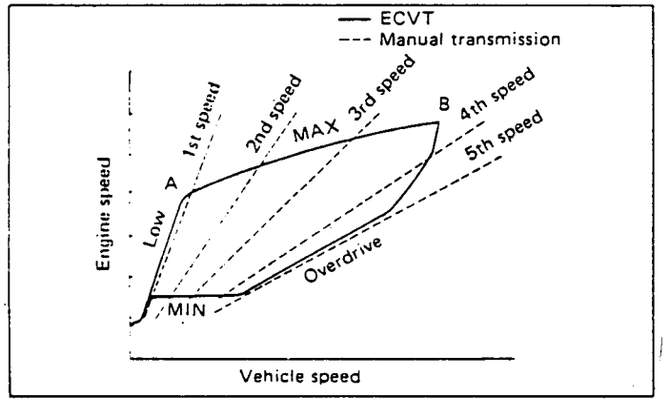


Fig. 35

4-2 Selector Position Function

	Operation	Engine starting
P	Parking	O
R	Reverse	X
N	Neutral	O
D	General running	X
Ds	Hill climbing, engine brake, and sporty range	X

1) "D" position

This is the normal cruising position.

(1) Gradual acceleration

When the accelerator pedal is pressed, the vehicle starts from low range. When the engine speed reaches about 1,600 rpm, speed change begins and the vehicle speed rises on the MIN line.

(2) Fast acceleration

The vehicle remains in low range until the engine speed reaches 4,000 rpm and displays maximum acceleration power.
When the engine speed exceeds 4,000 rpm, speed change begins gradually and maximum speed is reached on the MAX line while displaying maximum engine output.

(3) From rapid acceleration to cruising

When the pressure on the acceleration pedal is reduced after the desired speed is reached by fast acceleration, the pulley ratio that was on the MAX line shifts to normal cruising or. the MIN line. As soon as the engine speed is decreased, the transmission enters overdrive and economy operation begins smoothly.

(4) From cruising to acceleration

When the accelerator pedal is pressed while cruising on the MIN line, the pulley ratio shifts to the low side (MAX line side) automatically and the vehicle speed rises quickly.

2) "Ds" position (Slope and sporty drive use)

The speed change range in the "Ds" position is limited to the high engine speed zone of the overall speed change range in the "D" position. While running, the engine speed remains above 3,000 rpm (over the "Ds" MIN line) and the engine power and torque can be used to the full. As a result, whereas the "L" position of conventional automatic transmission is limited to the low speed range, the "Ds" position can be used over the entire speed range, from starting to maximum speed, and quick response and a strong engine braking effect are obtained.

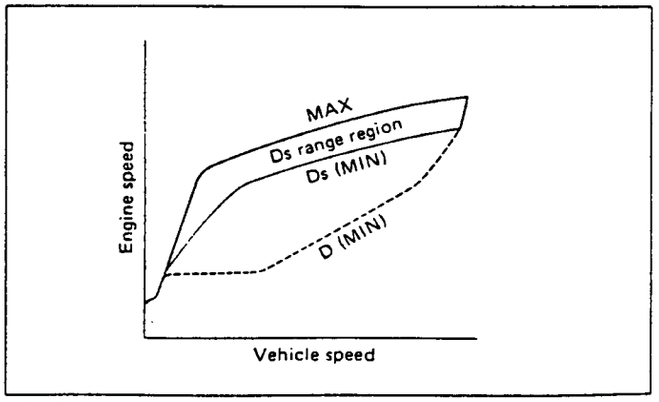


Fig. 36

3) "R" position

In the reverse position, the continuously variable speed mechanism is locked in the highest pulley ratio position (low side) and speed change is not performed.

4) "P" position

In the "P" position, the drive shaft inside the transmission is locked mechanically.

5) "N" position

In the "N" position, the forward and reverse switching mechanism is placed into the neutral state.

4-3 Drive Power Performance

Since the speed is continuously variable from low speed to high speed, the maximum drive power curve is a single continuous curve, and is different from the maximum drive power curve of conventional transmissions.
The maximum drive power curves for an ECVT and a 3-speed automatic transmission installed in J series model are shown in the figure. This figure shows that the ECVT drive power is superior to that of the 3-speed automatic transmission only in the hatched line region.
In the "Ds" position, the high output range (3,000 rpm and above) of the engine can be used continuously up to high speed by accelerator operation only and the surplus drive power of the ECVT is amply displayed.

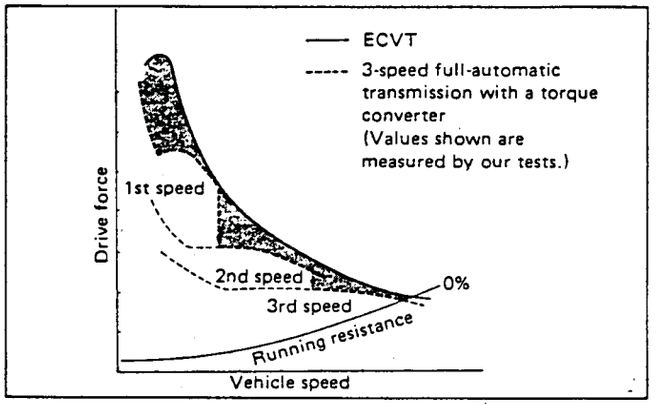


Fig. 37

SPECIFICATIONS AND SERVICE DATA

Specifications

ELECTROMAGNETIC POWDER CLUTCH

Type	Internal damper rotating coil type
Rated torque	142 N·m (14.5 kg-m, 105 ft-lb)/3.5 A
Power consumption	34.4 W
Metal powder	65 g (2.29 oz)
Weight	8.5 kg (18.7 lb)
Control system	Electronic control

Service Data

Item	Specification
Idle speed	800±50 rpm
Stall speed	2,200 rpm
Line pressure (Engine idles in "N" range under high-pressure conditions)	2,354 kPa (24 kg/cm^2, 341 psi) or more

Electromagnetic Powder Clutch

Coil resistance [at 20°C (68°F)]	1.64 Ω (between slip rings)
Service limit of brush	4 mm (0.16 in) (wear limit)

AUTOMATIC TRANSMISSION (ECVT)

Vehicle model		FWD model	4WD model
Type		Continuously variable	
Speed ratic	Forward	2.503 – 0.497	
	Reverse	2.475	
Front reduction ratio	1st	1.275	1.35
	2nd	4.666	
Rear reduction ratio	1st	—	1.266
	2nd	—	0.947
	Final (rear differential)	—	3.900
Oil pump	Type	External gear pump	
	Drive system	Direct drive by engine	
Lubricating oil	Quality	Genuine SUBARU ECVT fluid or DXRON II	
	Approximate lubricating oil quantity (incl. oil cooler)	Approx. 3.35 ℓ (3.5 US qt, 2.9 Imp qt)	Approx. 4.15 ℓ (4.4 US qt, 3.7 Imp qt)
Rear differential gear oil	Quality	—	GL-4 or GL-5
	Amount	—	0.8 ℓ (0.8 US qt, 0.7 Imp qt)
Selector system	Operating system	Direct shift by cable	
	Forward and reverse switching mechanism	Synchromesh dog clutch	
	Selector positions	P : Output shaft locked, engine starting possible R : Reverse N : Neutral, engine starting possible D : Forward, automatic stepless Ds : Forward, automatic stepless (engine brake & sporty range)	

Maintenance Standards

Pulley alignment (All models)	803054021 803054022 803054023 803054024 803054025 803054026	0.1 mm (0.004 in) 0.2 mm (0.008 in) 0.3 mm (0.012 in) 0.4 mm (0.016 in) 0.5 mm (0.020 in) 0.6 mm (0.024 in)
Primary pulley end play (All models)	805062022 805062023 805062024 805062025 805062026 805062027 805062028	1.35 mm (0.0531 in) 1.43 mm (0.0563 in) 1.51 mm (0.0594 in) 1.59 mm (0.0626 in) 1.67 mm (0.0657 in) 1.75 mm (0.0689 in) 1.83 mm (0.0720 in)
Differential side gear backlash Washer (27.1 x 42 x t mm) thickness (All models)	 803027041 803027042 803027043	0.05 – 0.15 mm (0.0020 – 0.0059 in) 1.000 mm (0.0394 in) 1.050 mm (0.0413 in) 1.100 mm (0.0433 in)
Driven hypoid gear bearing preload (4WD model only)	Adjusting method Preload value	Adjusted by collapsible spacer At bearing case hole: 9.32 – 19.61 N (0.95 – 2.0 kg, 2.09 – 4.41 lb) Torque: 0.39 – 0.83 N·m (4.0 – 8.5 kg-cm, 3.5 – 7.4 in-lb)
Hypoind gear height Hypoind gear height adjusting shim (Bevel gear height shim) thickness (4WD model only)	Adjusting method 33189KA000 33189KA010 33189KA020 33189KA030 33189KA040 33189KA050 33189KA060 33189KA070	Adjusted by shim 0.150 mm (0.0059 in) 0.175 mm (0.0069 in) 0.200 mm (0.0079 in) 0.225 mm (0.0089 in) 0.250 mm (0.0098 in) 0.275 mm (0.0108 in) 0.300 mm (0.0118 in) 0.500 mm (0.0197 in)
Hypoid gear backlash Drive pinion shim thickness (4WD model only)	 841968601 841968602 841968603 841968604 841968605 841968606 841968607 841968608	0.1 – 0.15 mm (0.0039 – 0.0059 in) 0.150 mm (0.0059 in) 0.200 mm (0.0079 in) 0.250 mm (0.0098 in) 0.300 mm (0.0118 in) 0.500 mm (0.0197 in) 0.175 mm (0.0069 in) 9.225 mm (0.0089 in) 0.275 mm (0.0108 in)
Transfer driven gear side clearance Snap ring thickness (4WD model only)	 805026031 805026032 805026033	0.05 – 0.30 mm (0.0020 – 0.0118 in) 1.4 mm (0.0550 in) 1.65 mm (0.0650 in) 1.9 mm (0.0748 in)

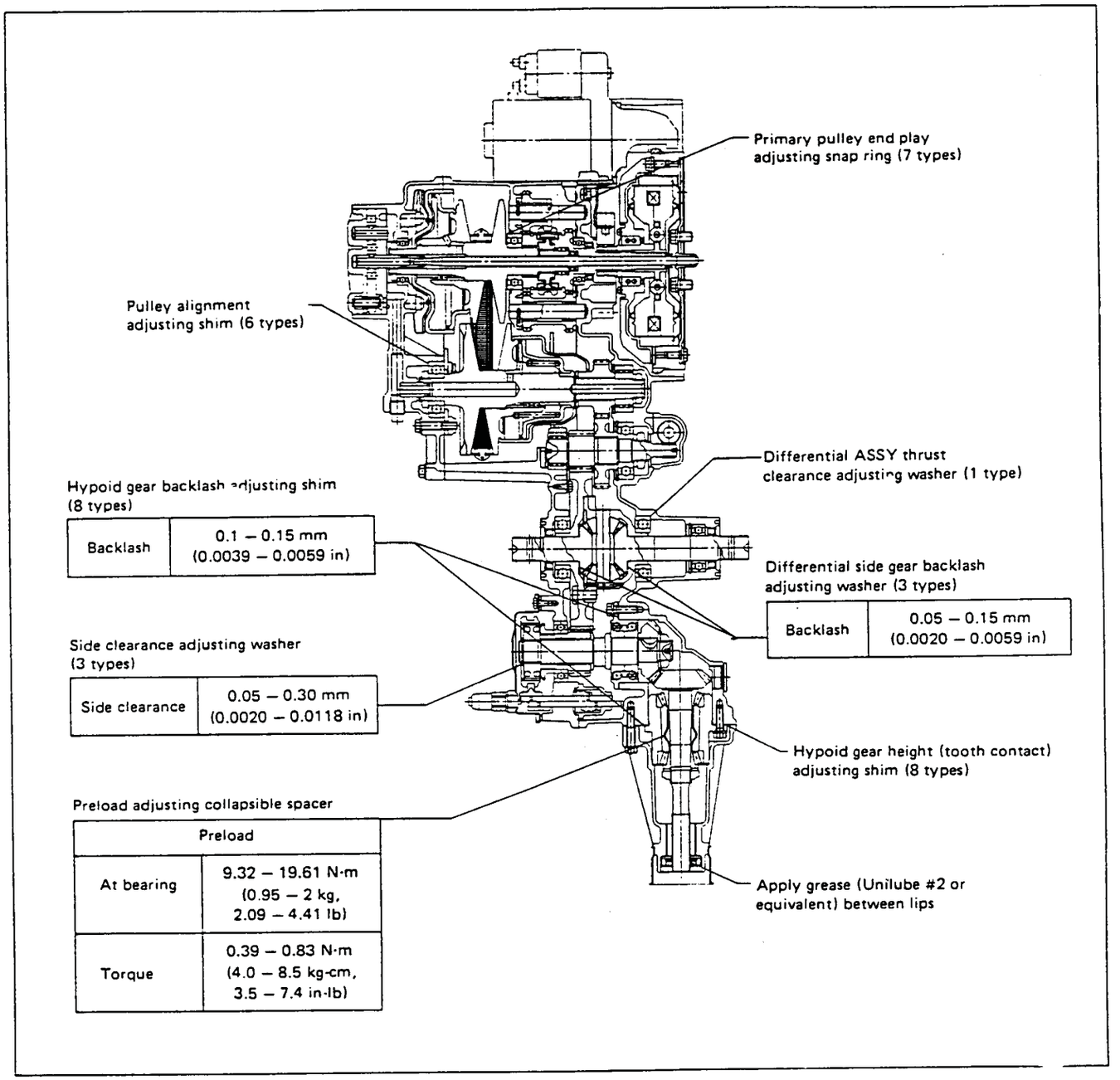
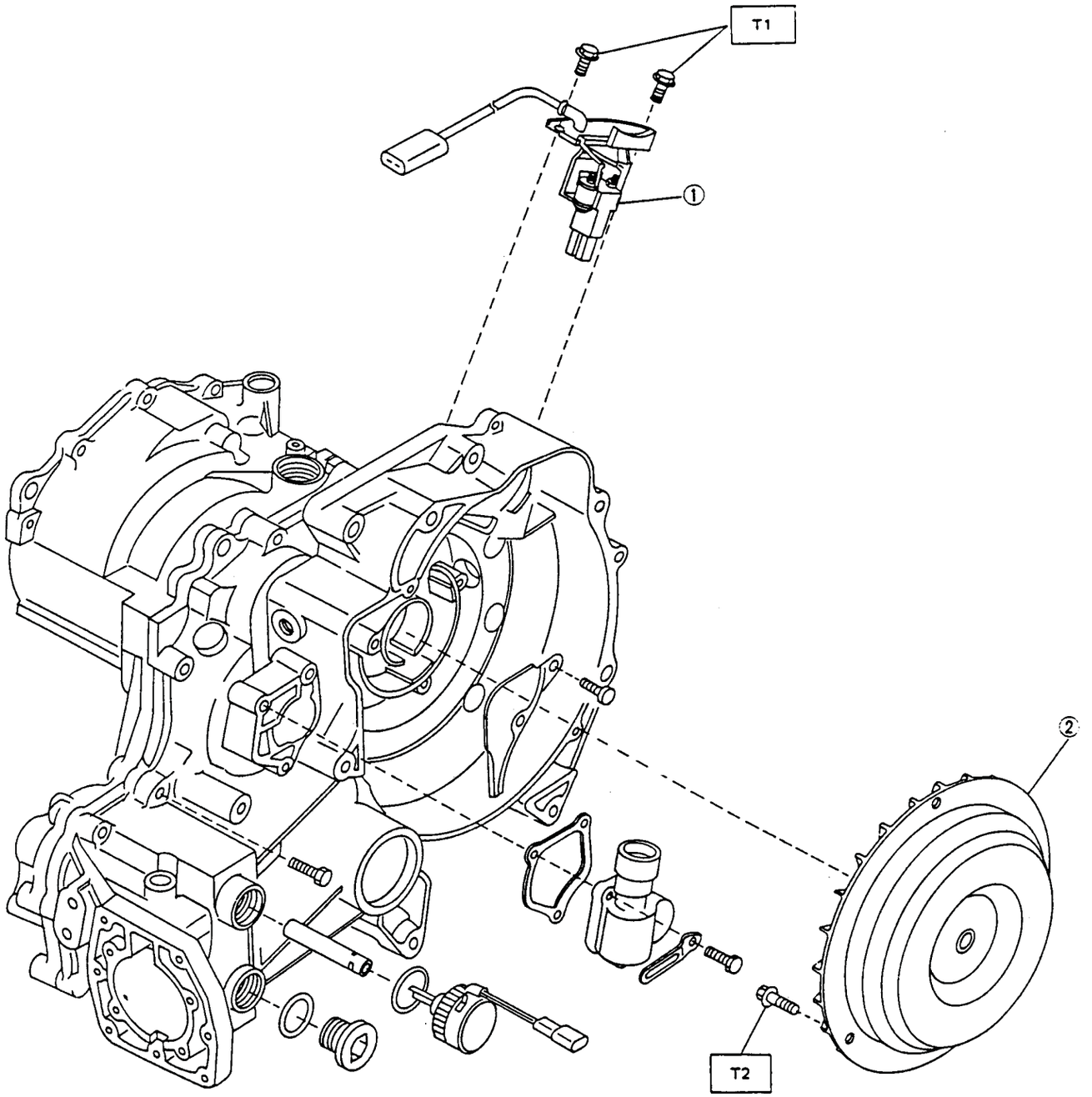

Primary pulley end play adjusting snap ring (7 types)
Pulley alignment adjusting shim (6 types)
Differential ASSY thrust clearance adjusting washer (1 type)
Hypoid gear backlash adjusting shim (8 types)
Backlash
0.1 – 0.15 mm (0.0039 – 0.0059 in)
Differential side gear backlash adjusting washer (3 types)
Backlash
0.05 – 0.15 mm (0.0020 – 0.0059 in)
Side clearance adjusting washer (3 types)
Side clearance
0.05 – 0.30 mm (0.0020 – 0.0118 in)
Hypoid gear height (tooth contact) adjusting shim (8 types)
Preload adjusting collapsible spacer
Preload
At bearing
9.32 – 19.61 N·m (0.95 – 2 kg, 2.09 – 4.41 lb)
Torque
0.39 – 0.83 N·m (4.0 – 8.5 kg-cm, 3.5 – 7.4 in-lb)
Apply grease (Unilube #2 or equivalent) between lips

Fig. 43

COMPONENT PARTS

Electromagnetic Powder Clutch and Brush Holder

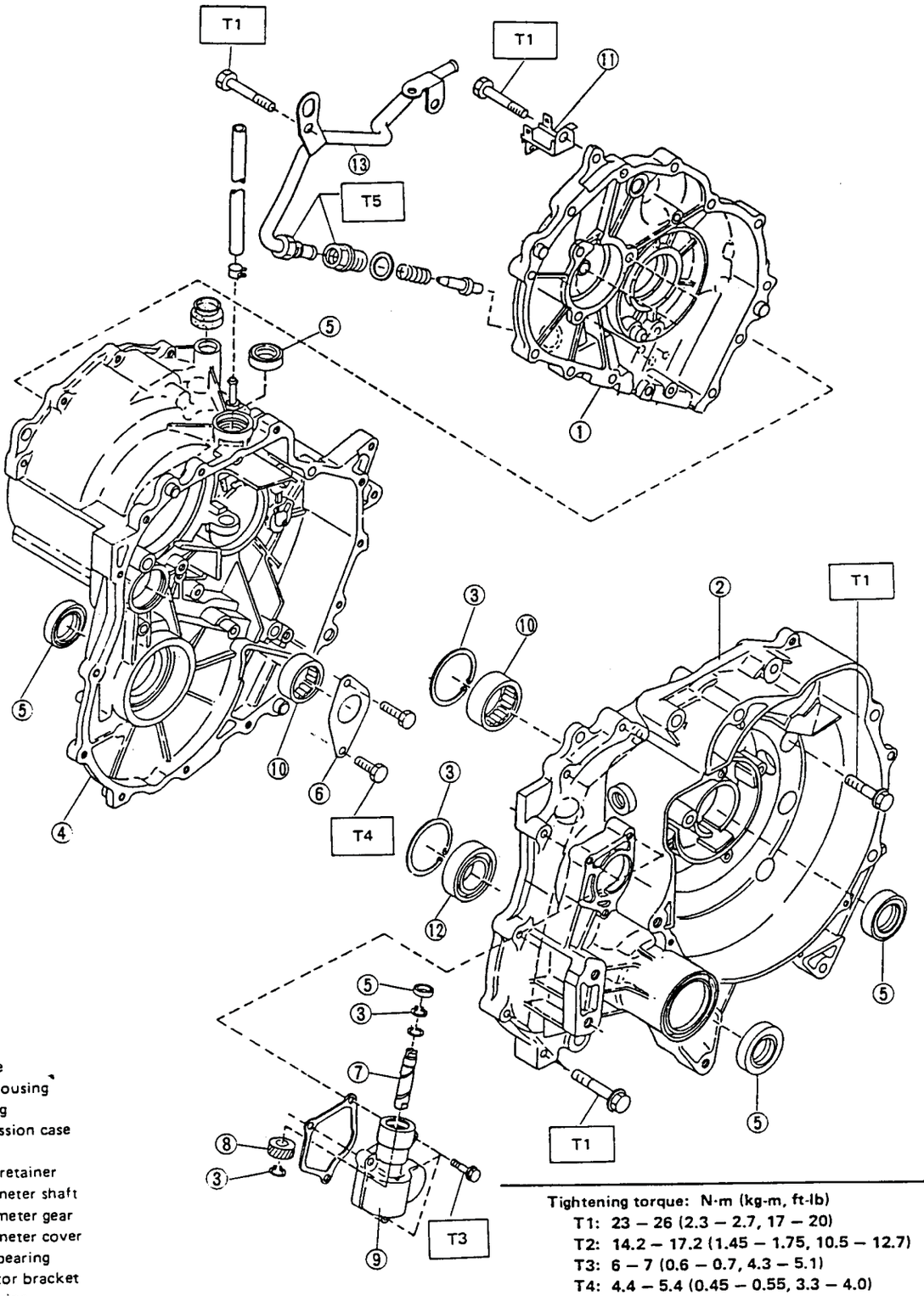


1. Brush holder
2. Electromagnetic powder clutch

Tightening torque: N·m (kg-m, ft-lb)
T1: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)
T2: 31 – 37 (3.2 – 3.8, 23 – 27)

Fig. 44

Clutch Housing, Transmission Case and Side Case (FWD)

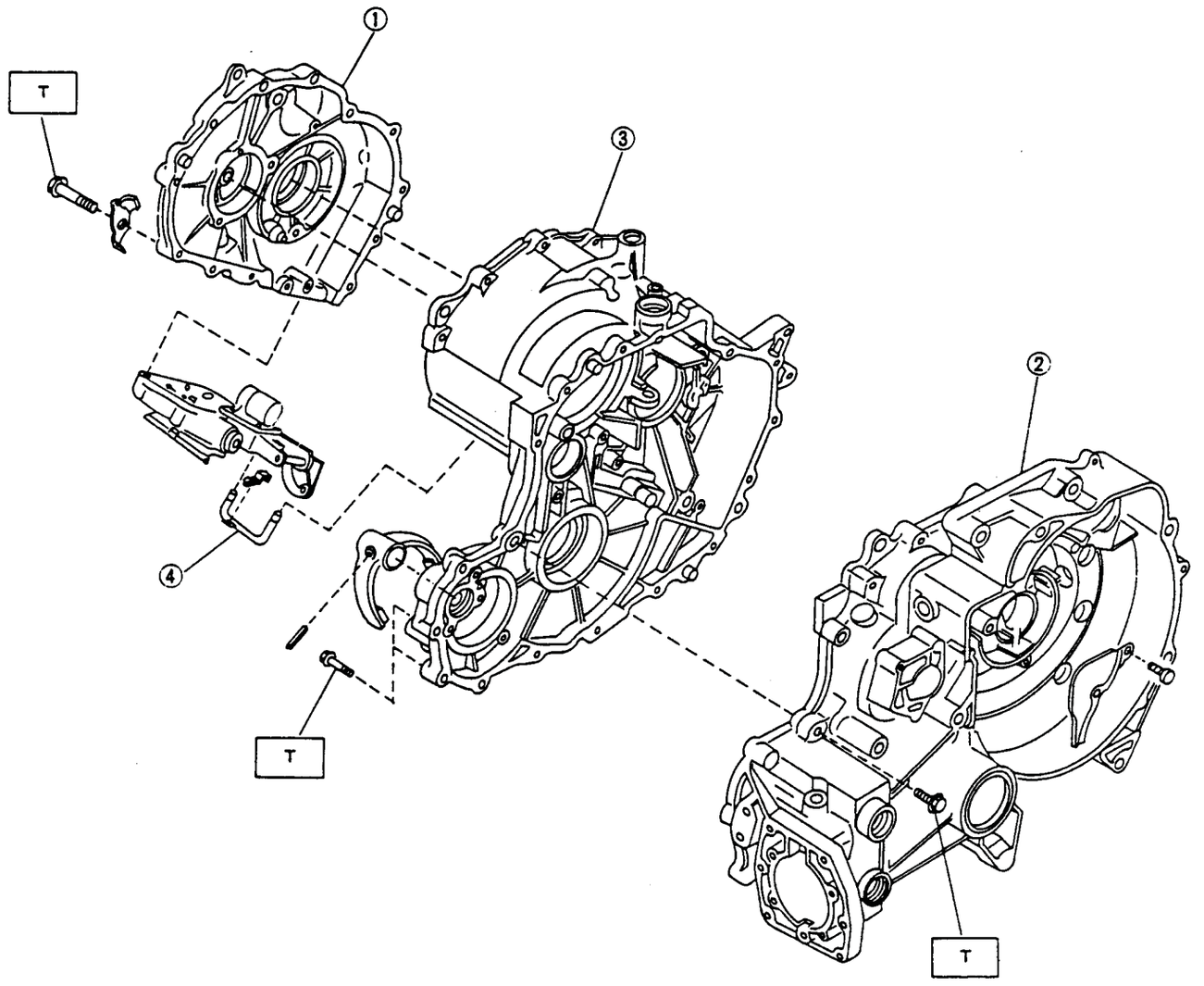


1. Side case
2. Clutch housing
3. Snap ring
4. Transmission case
5. Oil seal
6. Bearing retainer
7. Speedometer shaft
8. Speedometer gear
9. Speedometer cover
10. Needle bearing
11. Connector bracket
12. Ball bearing
13. Oil cooler pipe

Tightening torque: N·m (kg-m, ft-lb)
- T1: 23 – 26 (2.3 – 2.7, 17 – 20)
- T2: 14.2 – 17.2 (1.45 – 1.75, 10.5 – 12.7)
- T3: 6 – 7 (0.6 – 0.7, 4.3 – 5.1)
- T4: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)
- T5: 35 – 43 (3.6 – 4.4, 26 – 32)

Fig. 45

Clutch Housing, Transmission Case and Side Case (4WD)

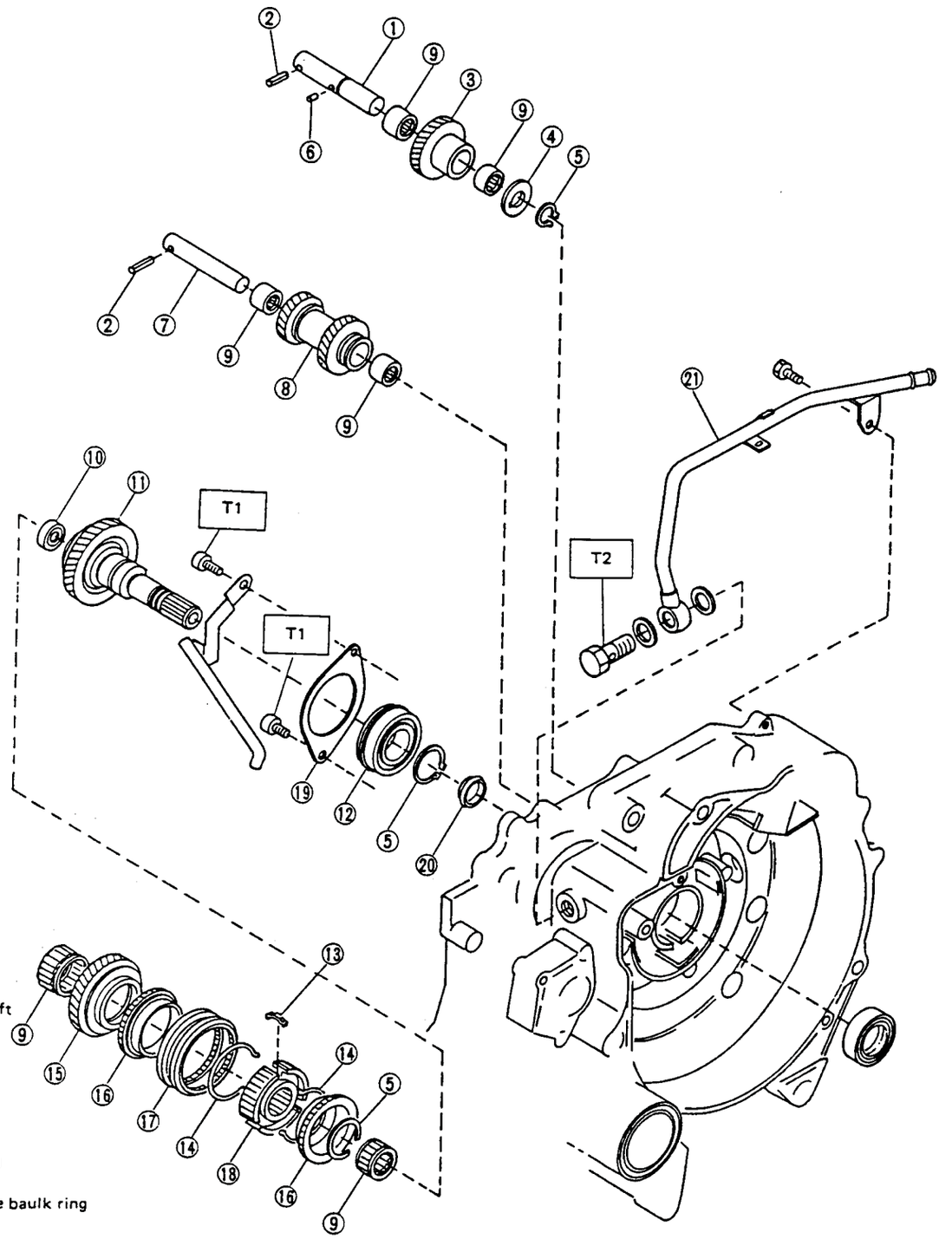


1 Side case
2 Clutch housing
3 Transmission case
4 Transfer control pipe

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

Fig. 46

Forward and Reverse Gear

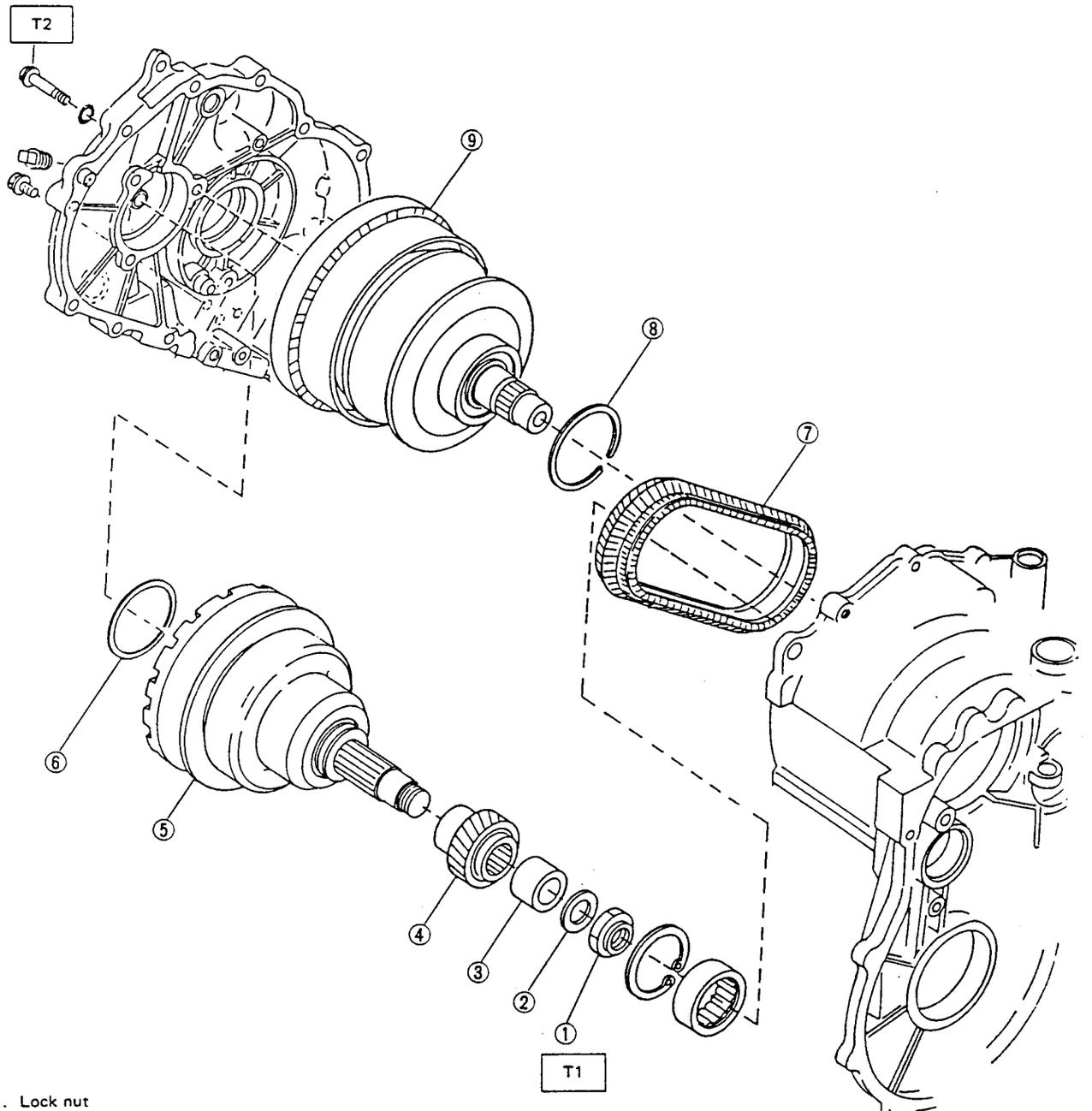


1. Reverse idler shaft
2. Spring pin
3. Reverse idler gear
4. Washer
5. Snap pin
6. Knock pin
7. Counter reverse shaft
8. Counter gear
9. Needle bearing
10. Oil seal
11. Main drive shaft
12. Ball bearing
13. Shifting insert
14. Synchronizer spring
15. Reverse driven gear
16. Forward and reverse baulk ring
17. Coupling sleeve
18. Synchronizer hub
19. Bearing retainer
20. Seal ring
21. Oil cooler pipe

Tightening torque: N·m (kg-m, ft-lb)
T1: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)
T2: 23 – 26 (2.3 – 2.7, 17 – 20)

Fig. 47

Steel Belt and Pulleys

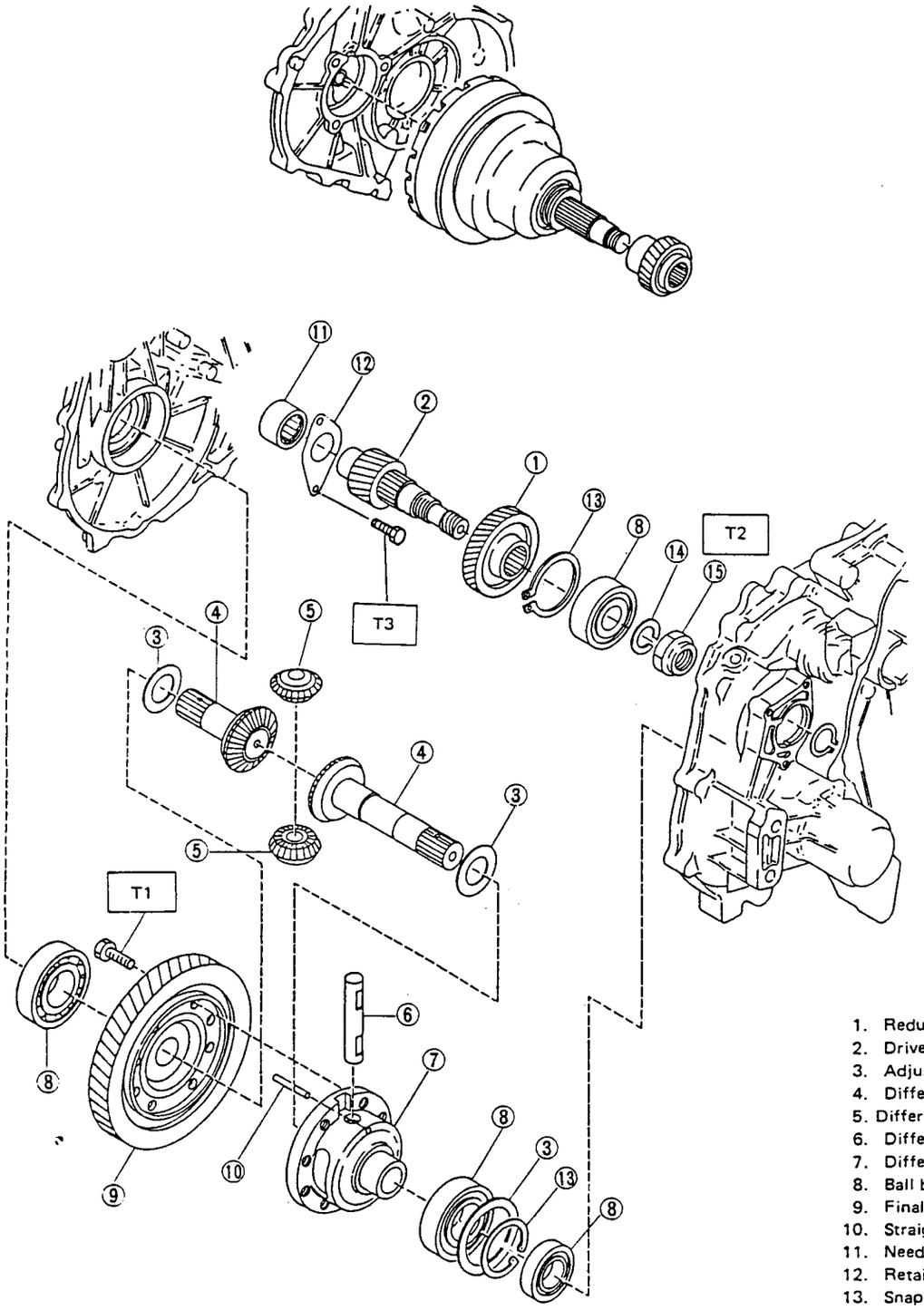


1. Lock nut
2. Lock washer
3. Needle bearing race
4. Reduction drive gear
5. Secondary pulley
6. Adjusting washer
7. Steel belt
8. Adjusting snap ring
9. Primary pulley

Tightening torque: N·m (kg-m, ft-lb)
T1: 123 – 132 (12.5 – 13.5, 90 – 98)
T2: 14.2 – 17.2 (1.45 – 1.75, 10.5 – 12.7)

Fig. 48

Reduction Gear and Differential Gear

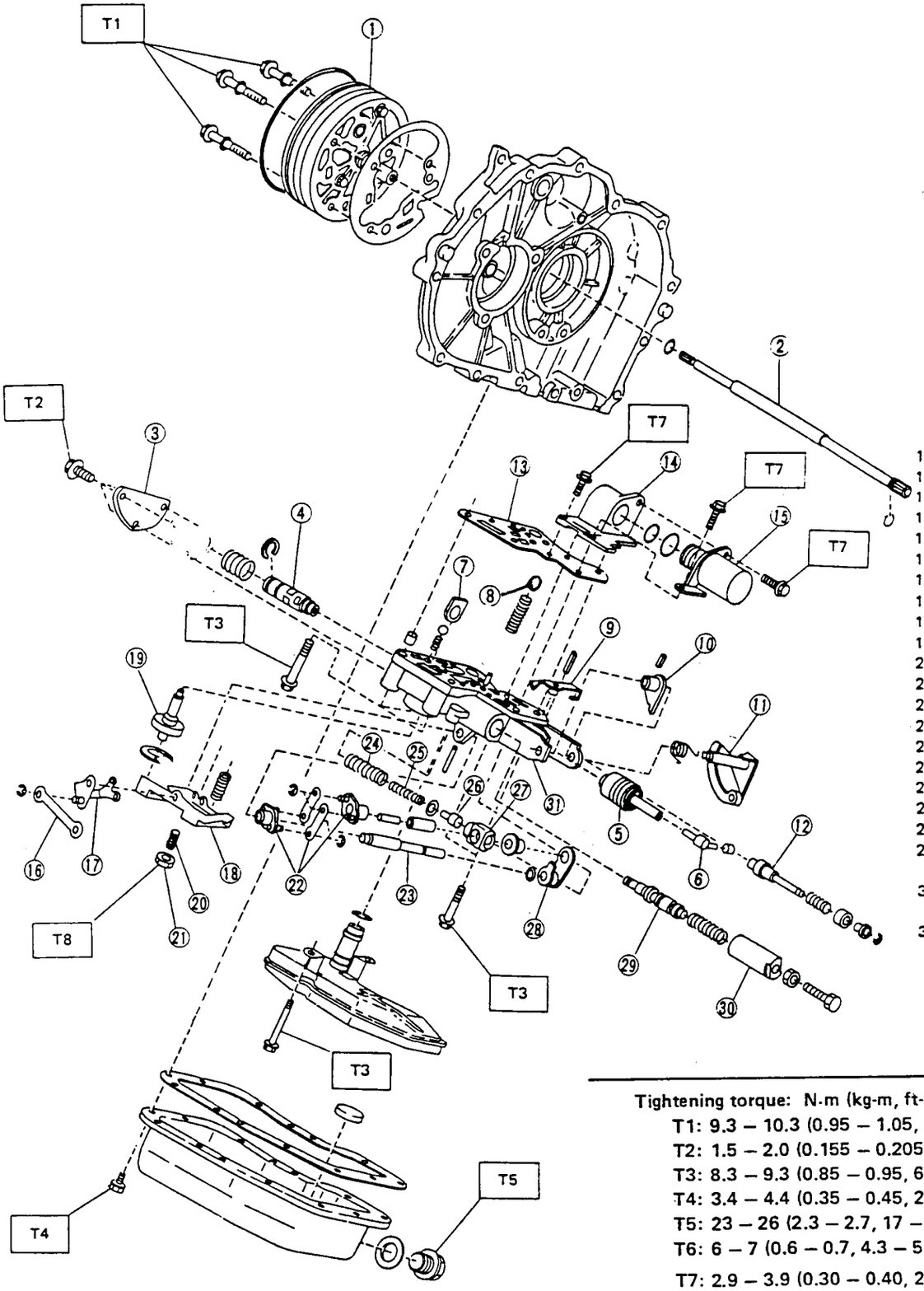


1. Reduction driven gear
2. Drive pinion shaft
3. Adjusting washer
4. Differential side gear
5. Differential pinion gear
6. Differential pinion shaft
7. Differential case
8. Ball bearing
9. Final gear
10. Straight pin
11. Needl bearing
12. Retainer
13. Snap ring
14. Washer
15. Lock nut

Tightening torque: N·m (kg-m, ft-lb)
T1: 57 – 67 (5.8 – 6.8, 42 – 49)
T2: 92 – 104 (9.4 – 10.6, 68 – 77)
T3: 6 – 7 (0.6 – 0.7, 4.3 – 5.1)

Fig. 49

Oil Pump and Control Valve



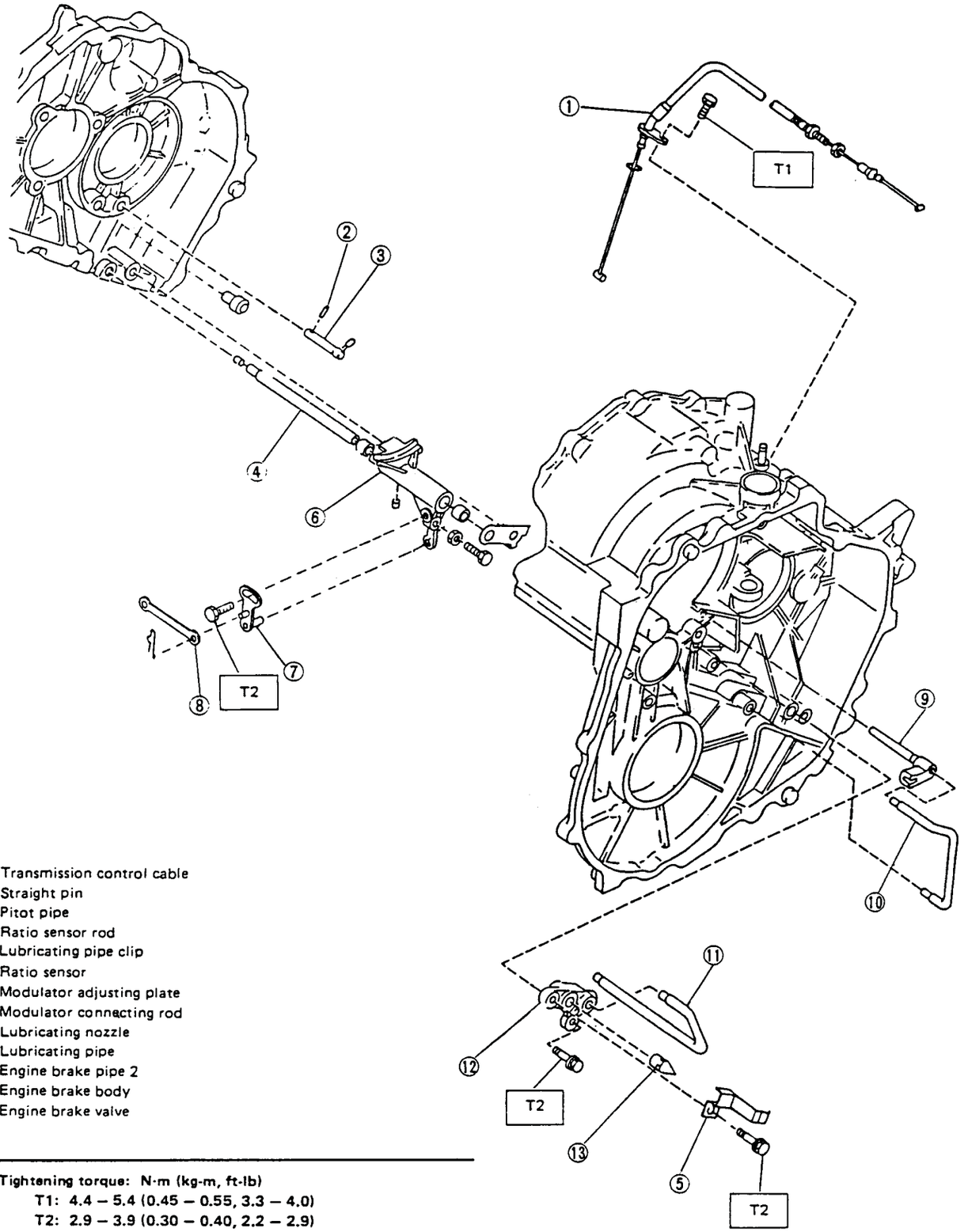
1 Oil pump ASSY
2 Oil pump shaft
3 Side plate
4 Shift control valve
5 Plunger
6 Shift control pin
7 Spacer
8 Shift lock valve
9 Ds modifier lever
10 Shift cam
11 Shift control lever
12 Engine brake valve
13 Separator plate
14 Solenoid body
15 Solenoid
16 Connecting rod
17 Lever
18 Shift lock lever
19 Shift lock piston
20 Stud
21 Adjusting screw
22 Roller ASSY
23 Shaft
24 Low-speed spring
25 High-speed spring
26 High-speed support
27 Low-speed support
28 Linkage guide
29 Pressure regulator valve
30 Pressure regulator spring guide
31 Control valve body

Tightening torque: N·m (kg-m, ft-lb)

T1: 9.3 – 10.3 (0.95 – 1.05, 6.9 – 7.6)
T2: 1.5 – 2.0 (0.155 – 0.205, 1.1 – 1.5)
T3: 8.3 – 9.3 (0.85 – 0.95, 6.1 – 6.9)
T4: 3.4 – 4.4 (0.35 – 0.45, 2.5 – 3.3)
T5: 23 – 26 (2.3 – 2.7, 17 – 20)
T6: 6 – 7 (0.6 – 0.7, 4.3 – 5.1)
T7: 2.9 – 3.9 (0.30 – 0.40, 2.2 – 2.9)
T8: 1.6 – 2.1 (0.16 – 0.21, 1.2 – 1.5)

Fig. 50

Cable and Piping

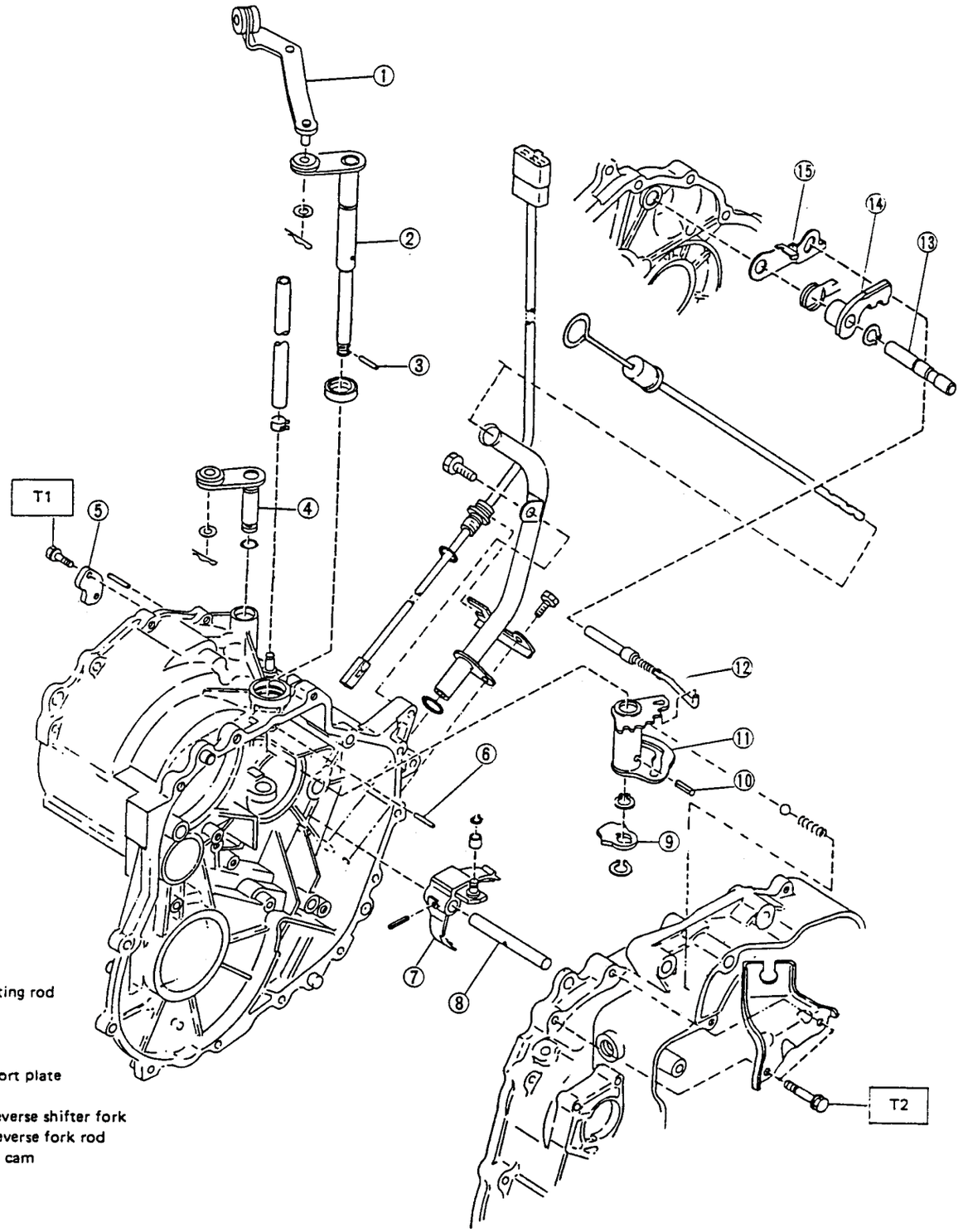


1. Transmission control cable
2. Straight pin
3. Pitot pipe
4. Ratio sensor rod
5. Lubricating pipe clip
6. Ratio sensor
7. Modulator adjusting plate
8. Modulator connecting rod
9. Lubricating nozzle
10. Lubricating pipe
11. Engine brake pipe 2
12. Engine brake body
13. Engine brake valve

Tightening torque: N·m (kg-m, ft-lb)
T1: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)
T2: 2.9 – 3.9 (0.30 – 0.40, 2.2 – 2.9)

Fig. 51

Shifter Fork and Parking Rod

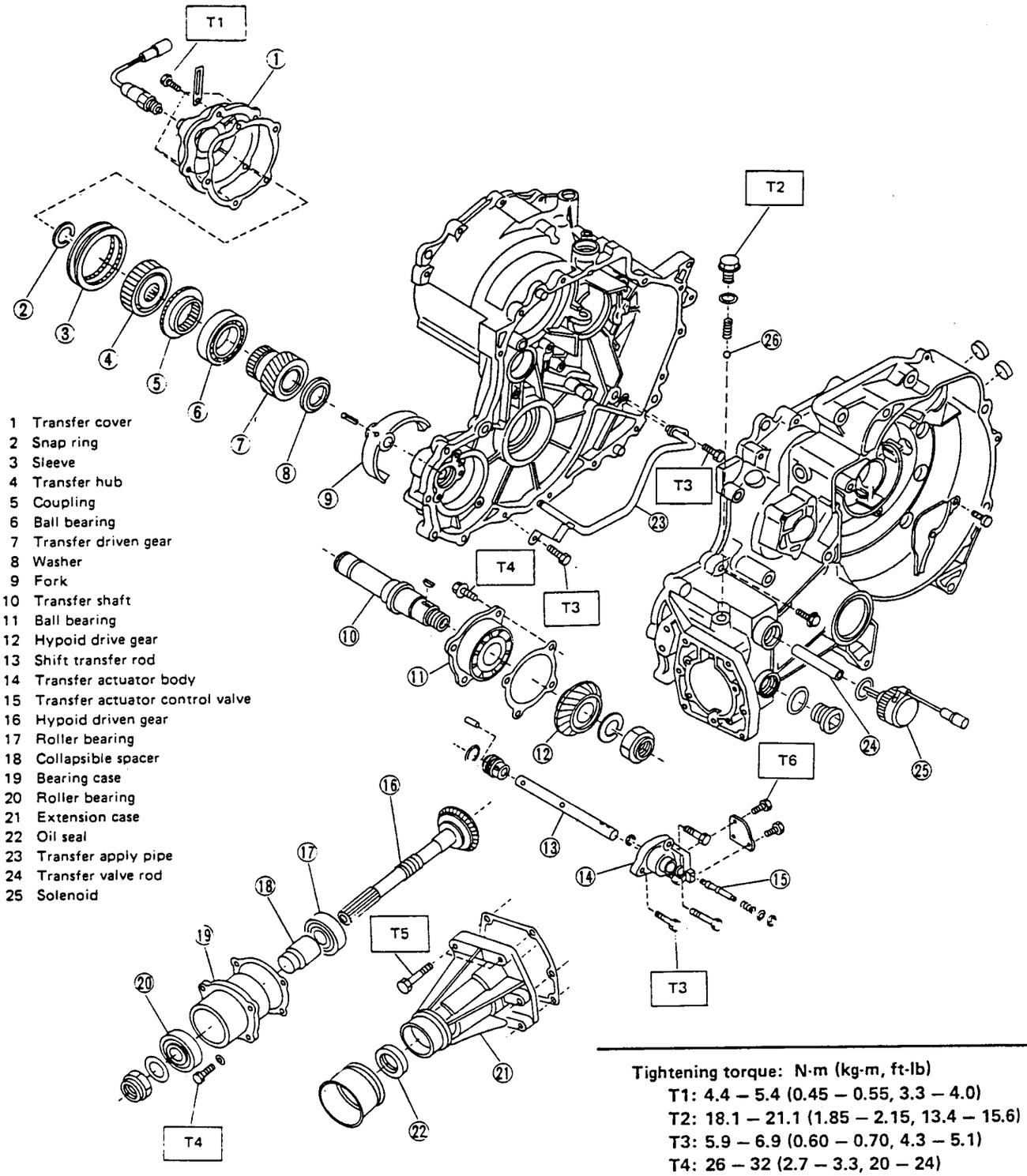


1. Shift connecting rod
2. Shift arm
3. Straight pin
4. Shift lever
5. Parking support plate
6. Straight pin
7. Forward – reverse shifter fork
8. Forward – reverse fork rod
9. Engine brake cam
10. Spring pin
11. Shift cam
12. Parking rod
13. Parking rod
13. Parking pawl shaft
14. Parking pawl
15. Parking pawl guide

Fig. 52

Tightening torque: N·m (kg-m, ft-lb)
T1: 9.1 – 10.5 (0.93 – 1.07, 6.7 – 7.7)
T2: 23 – 26 (2.3 – 2.7, 17 - 20)

4WD Transfer System (4WD)



1 Transfer cover
2 Snap ring
3 Sleeve
4 Transfer hub
5 Coupling
6 Ball bearing
7 Transfer driven gear
8 Washer
9 Fork
10 Transfer shaft
11 Ball bearing
12 Hypoid drive gear
13 Shift transfer rod
14 Transfer actuator body
15 Transfer actuator control valve
16 Hypoid driven gear
17 Roller bearing
18 Collapsible spacer
19 Bearing case
20 Roller bearing
21 Extension case
22 Oil seal
23 Transfer apply pipe
24 Transfer valve rod
25 Solenoid

Tightening torque: N·m (kg-m, ft-lb)
T1: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)
T2: 18.1 – 21.1 (1.85 – 2.15, 13.4 – 15.6)
T3: 5.9 – 6.9 (0.60 – 0.70, 4.3 – 5.1)
T4: 26 – 32 (2.7 – 3.3, 20 – 24)
T5: 23 – 26 (2.3 – 2.7, 17 – 20)
T6: 1.5 – 2.0 (0.155 – 0.205, 1.1 – 1.5)

Fig. 53

SERVICE PROCEDURE

1 General 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).

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

4) Disassembly, assembly and cleaning

(1) Disassemble and assemble the transmission while inspecting the parts in accordance with the Trouble-shooting.

(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.

(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) Apply a coat of ATF or grease to the lip of oil seals.

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

(10) Do not support axle drive shaft, oil pump 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, snap ring, spring pins, etc.

Install new ones.

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

SECTIONS THAT CAN BE DETACHED/ASSEMBLED

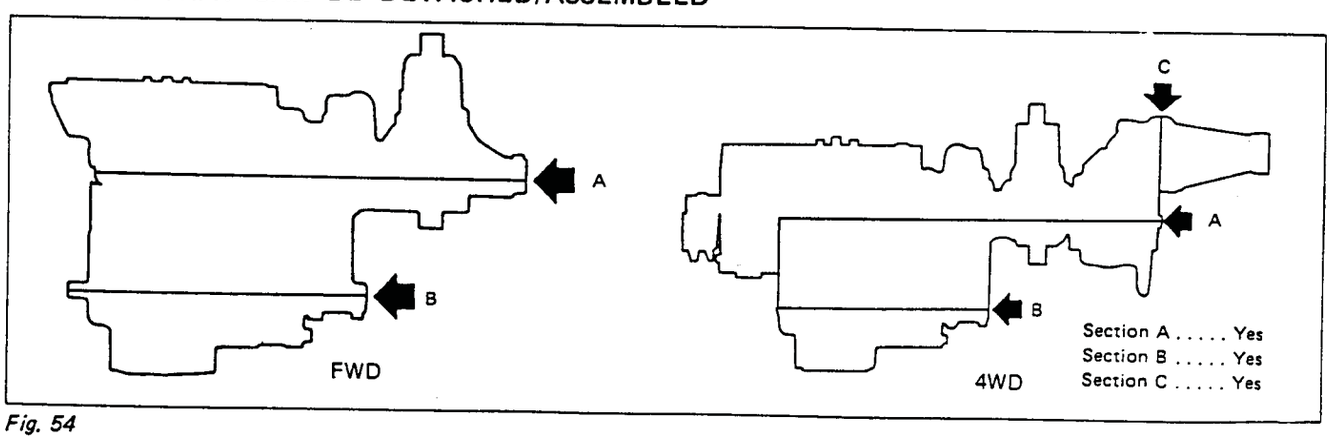


Fig. 54

2 Disassembly of Overall Transmission

2-1 Removal of Engine from Transmission

1) Remove the starter motor from the transmission.

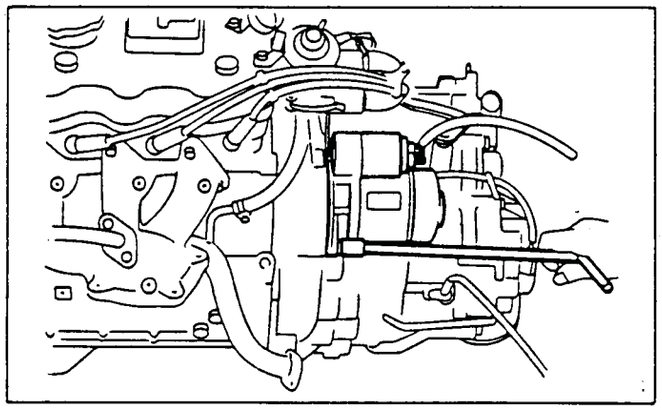


Fig. 55

2) Remove the brush holder.

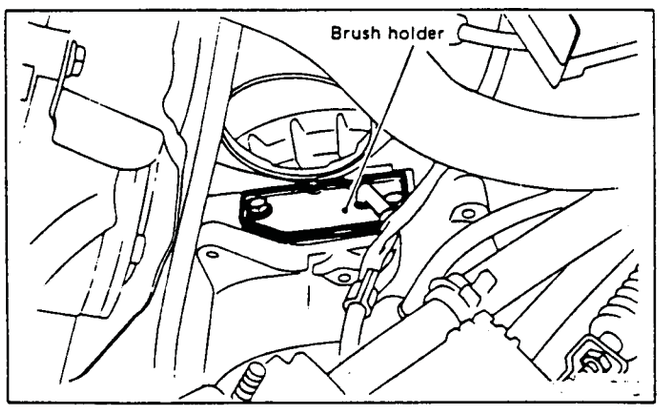


Fig. 56

3) Disconnect the shift control cable from bracket on the carburetor side.

4) Separate the engine and transmission.

a. Be careful not to damage the slip rings of the electromagnetic powder clutch.

b. Be careful not to bend the oil pump shaft.

c. One of the three docking bolts can be removed from the engine side in step 4).

d. Ensure the main drive gear oil seal is not dropped on the clutch side.

e. Ensure the main drive gear oil seal is not hardened or damaged. Discard the oil seal after removal; replace with a new one.

5) Remove the electromagnetic powder clutch from the flywheel.

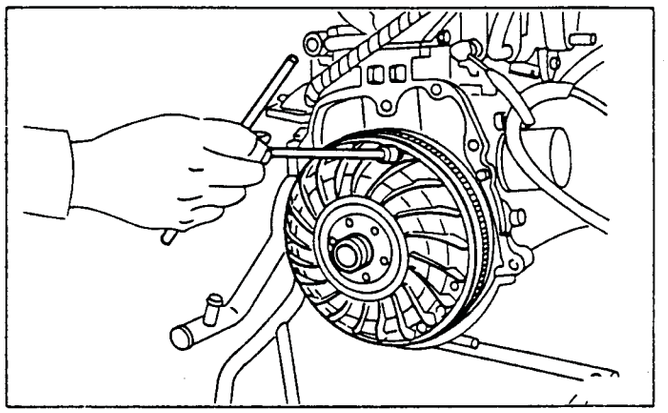


Fig. 57

a. Do not remove the drive plate since it is properly balanced with flywheel.

b. Do not hold the slip ring with bare hands or a cloth stained with oil or grease. If stained with oil, etc., wipe clean using volatile oil (such as thinner or trichloroethylene).

c. Be careful not to dent the slip ring.

d. Be careful not to turn over the removed electromagnetic powder clutch, apply an impact to it or handle it improperly. Otherwise, powder may flow out through the powder gap. Always handle or store it with the slip ring facing up.

e. Do not steam-clean the electromagnetic powder clutch.

6) Place the transmission unit on a workbench, with the oil pan facing down.

Be careful not to bend or damage external parts.

7) Remove the pitching stopper bracket.

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

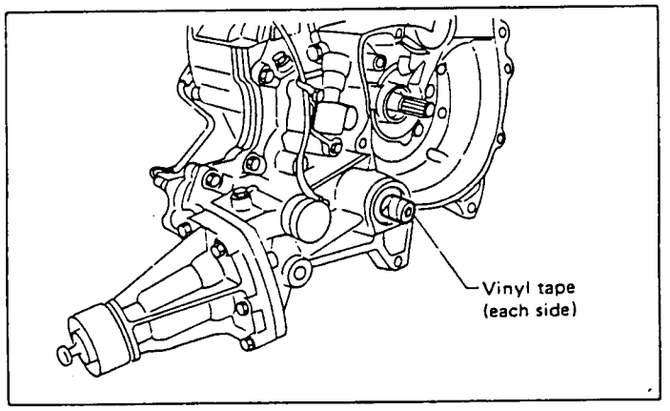


Fig. 58

9) Remove the oil cooler outlet pipe and attach the transmission to TRANSMISSION STAND (499935600).

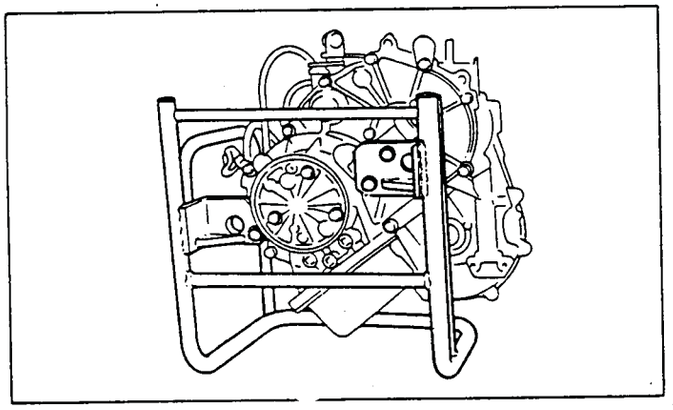


Fig. 59

10) Remove the drain plug, and drain ECVT fluid. Tighten the plug temporarily after draining.
Remove the cap, and drain oil from the propeller shaft joint.

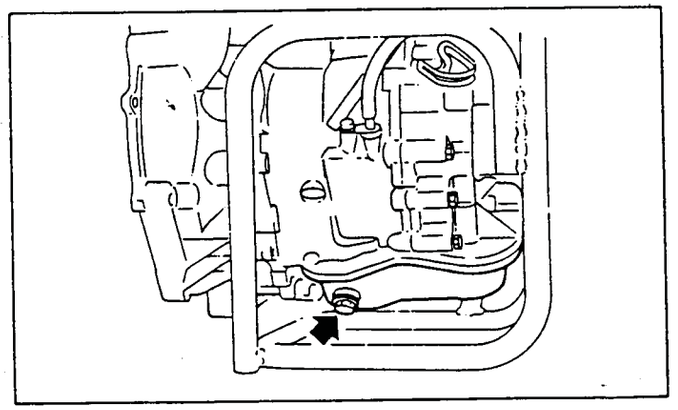


Fig. 60

2-2 Removal of Oil Pump Shaft

REMOVAL

Carefully pull the oil pump shaft by hand pulling it straight out.

If the oil pump shaft is hard to remove by hand, wrap the splined end with vinyl tape or a cloth and remove the shaft using plier.

INSPECTION

1) Check the clip on the end of the oil pump shaft for damage. Discard the clip after removal; replace with a new one.
2) Check the frictional surface of the primary pulley bushing for wear. If it is excessively worn, replace with a new one.

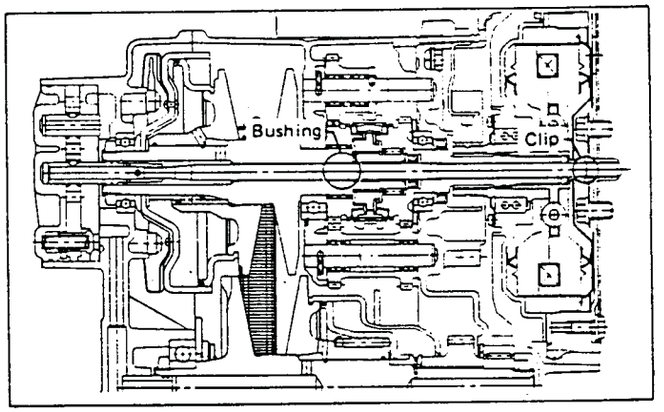


Fig. 61

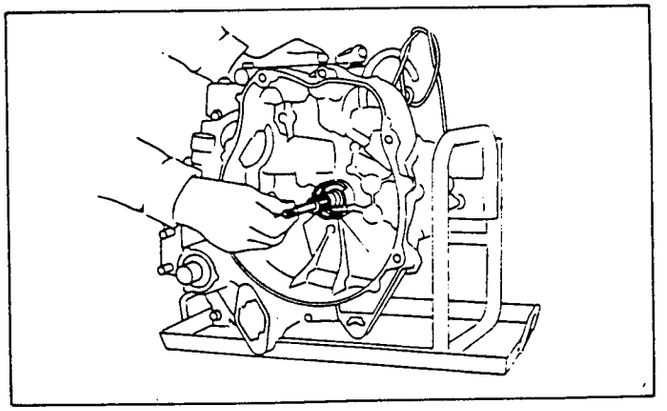


Fig. 62

2-3 Separation of Clutch Housing and Transmission Case Sections (FWD)

Remove the fourteen bolts which secure the clutch housing to the transmission, and separate the two units by lightly tapping the protruded portions located near the mating surfaces with a plastic hammer.

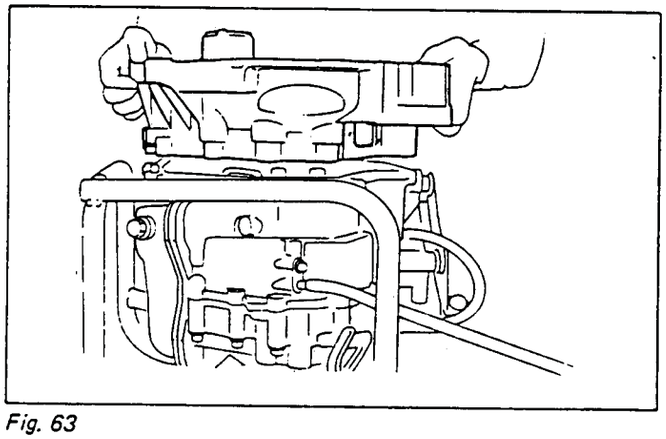


Fig. 63

2-4 Removal of Transfer Fork & Hub Assembly and Transfer Gear (4WD)

1) Disconnect the solenoid connector and remove the solenoid.

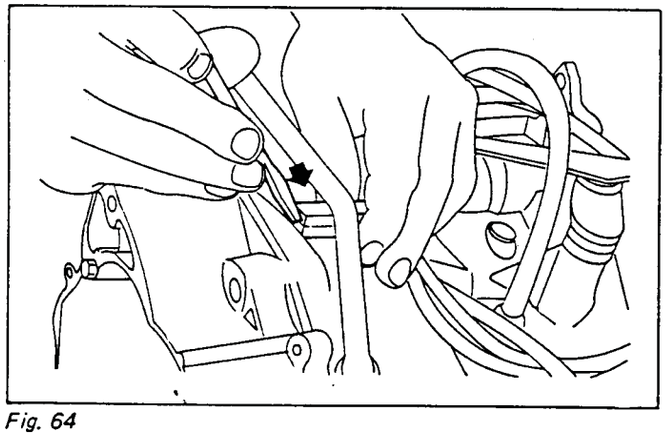


Fig. 64

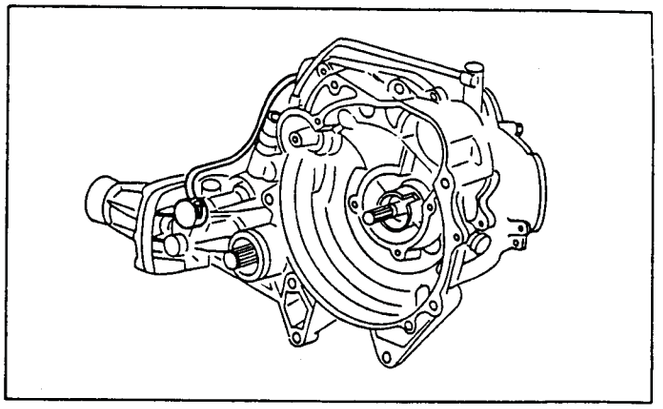


Fig. 65

2) Remove the transfer valve rod.

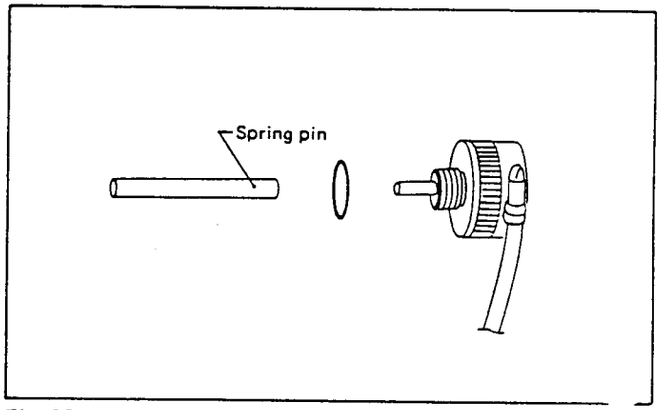


Fig. 66

3) Remove plug and aluminum gasket, and take out spring and ball from plug mounting hole.

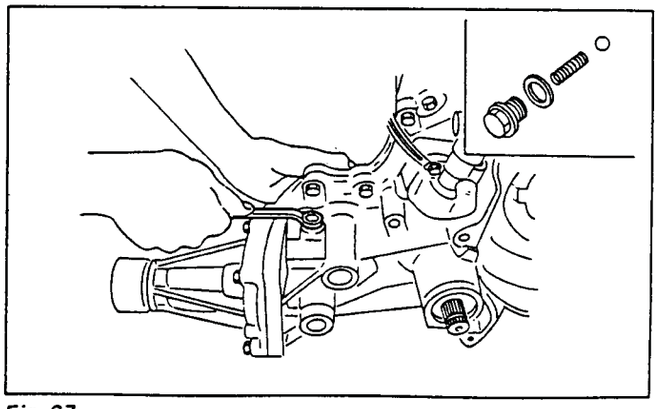


Fig. 67

4) Remove the transfer cover and 4WD indicator light switch connector.
Place a container to catch ATF.

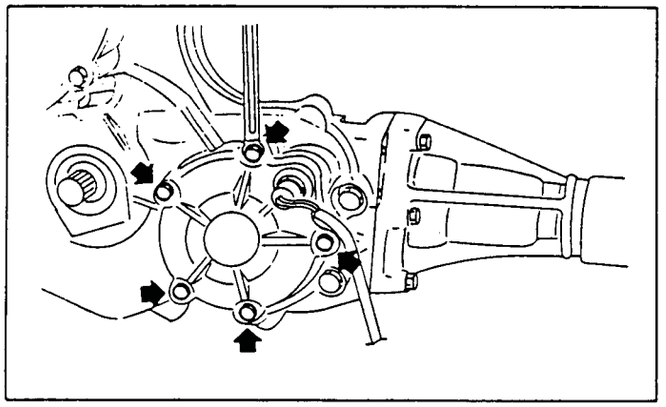


Fig. 68

5) Drive the spring pin out, and remove the fork and sleeve.

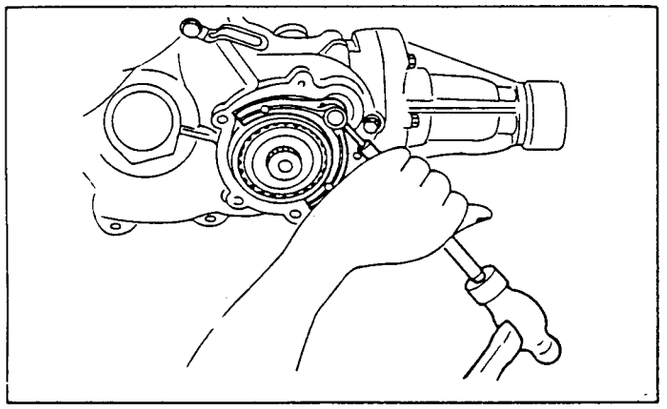


Fig. 69

6) Using the PLIER (499895400), remove the snap ring. Remove the synchro transfer hub and coupling.

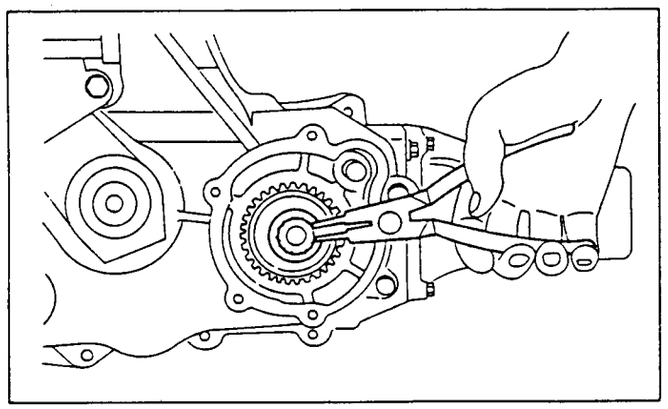


Fig. 70

7) Remove the transfer driven gear by hand. Also remove the washer.

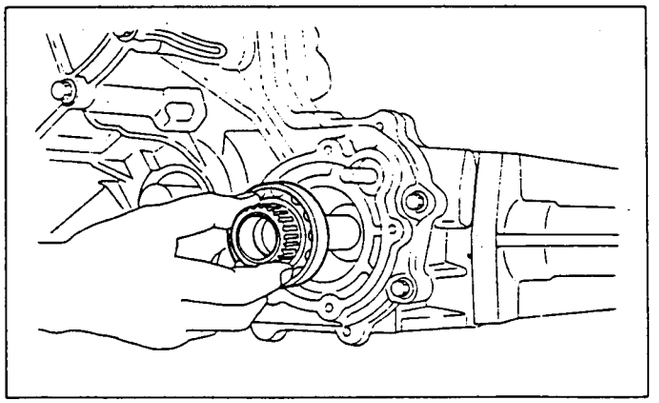


Fig. 71

8) Remove the seventeen bolts which secure the clutch housing to transmission, and separate the two units by lightly tapping the protruded portions located near the mating surfaces with a plastic hammer.

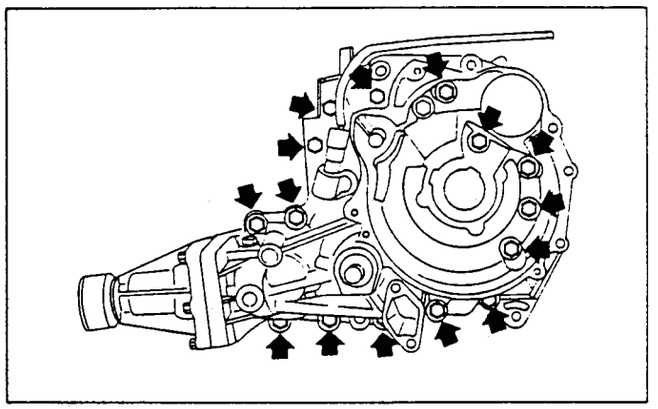


Fig. 72

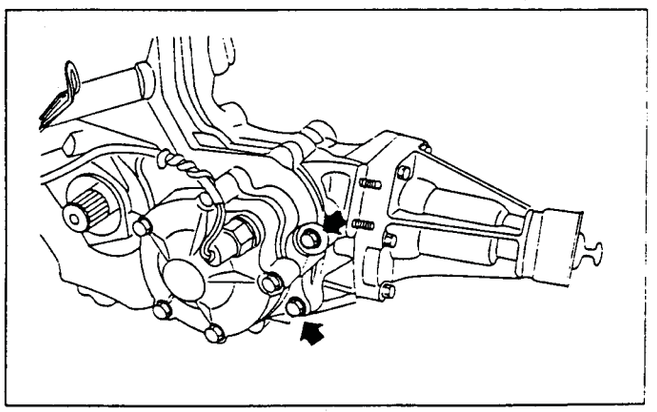


Fig. 73

2-5 Transmission Case Section

1) Remove the transfer "apply" pipe and actuator body ASSY. (4WD)

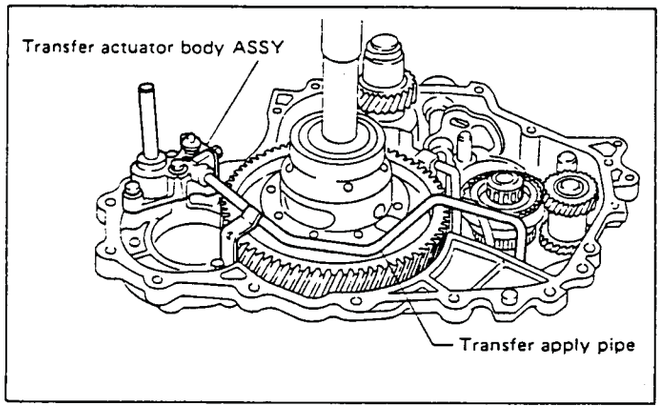


Fig. 74

2) Pull out the differential ASSY.

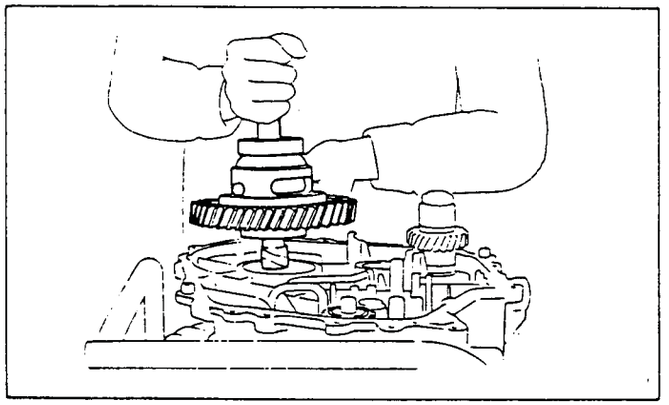


Fig. 75

3) Remove the shift connecting rod.

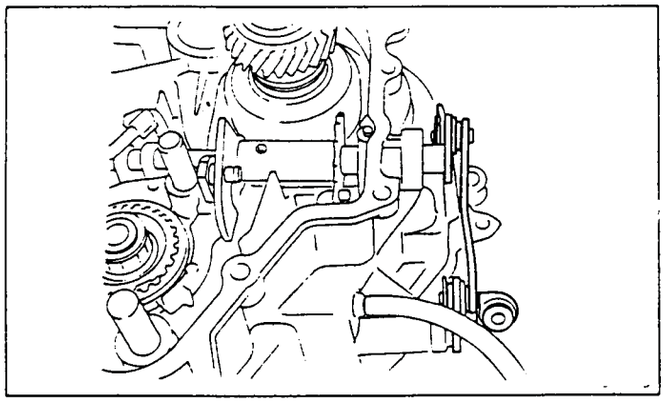


Fig. 76

4) Remove the shift arm and shift cam.
(1) Face the straight pin straight downward, as shown in the figure. Using the STRAIGHT PIN REMOVER 2 (398791700), gradually tap the straight pin out until the shift arm rotates smoothly.

a. Do not allow the spring pin to hit the secondary pulley.
b. Do not reuse the spring pin.

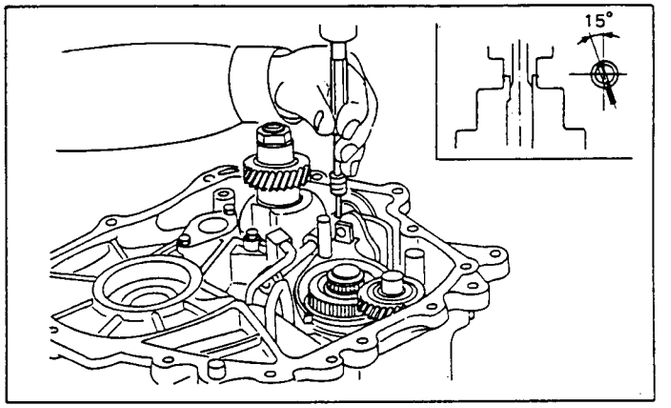


Fig. 77

(2) Remove the engine brake cam.
Remove the snap ring using the SNAP RING EXPANDER (899471410). Set the cam to the position shown in the figure and remove the cam and straight pin. Remove the snap ring.

Always remove the cam and straight pin while positioning the straight pin horizontally. Otherwise, the straight pin may drop.

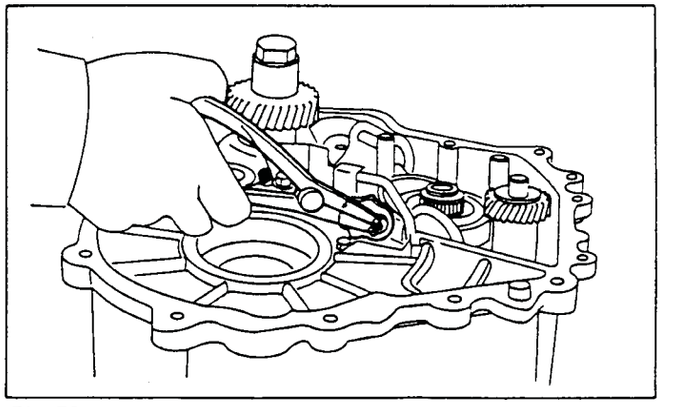


Fig. 78

(3) After removing the straight pin, remove the shift arm from the transmission case.

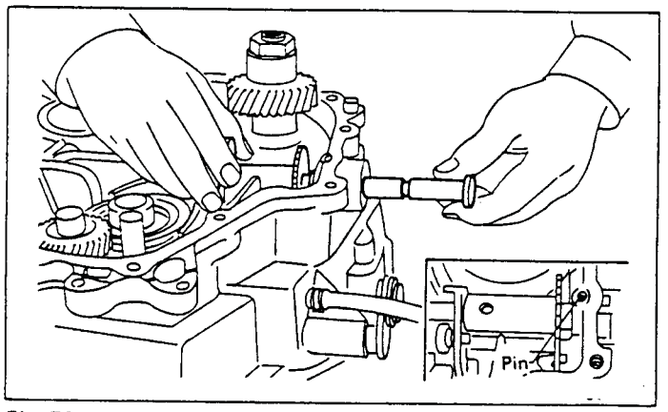


Fig. 79

(4) Set the sleeve to the "D" position so that the shift cam and fork are located as shown in the figure. Then remove the shift cam.

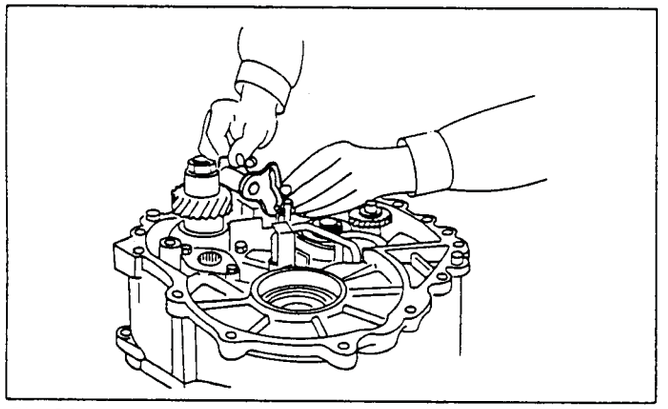


Fig. 80

5) Remove the needle bearing.

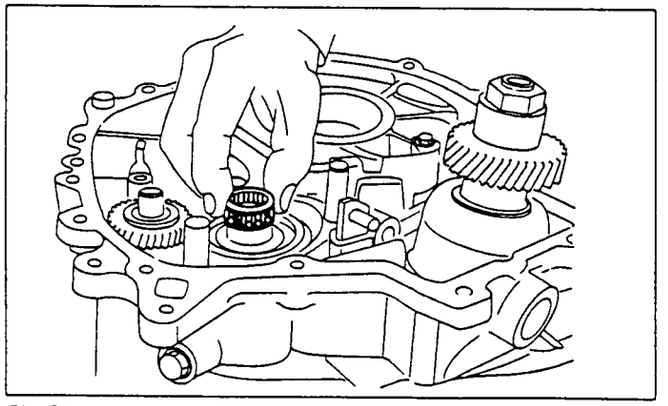


Fig. 81

6) Remove the outer snap ring using the SNAP RING PLIER (499895400).

Be careful not to scratch the needle bearing rolling surface when removing the snap ring.

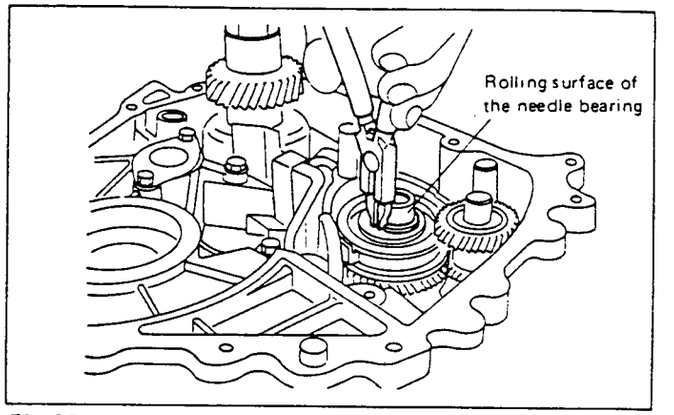


Fig. 82

7) While slightly lifting the sleeve and hub ASSY, pull out the counter gear and counter gear shaft.

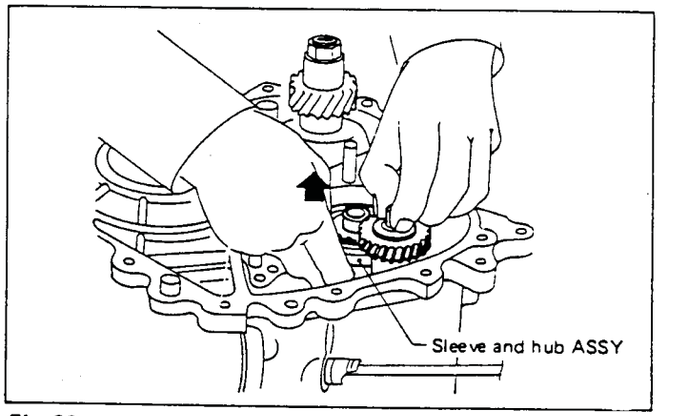


Fig. 83

8) Remove the sleeve and hub ASSY and reverse driven gear as a unit.

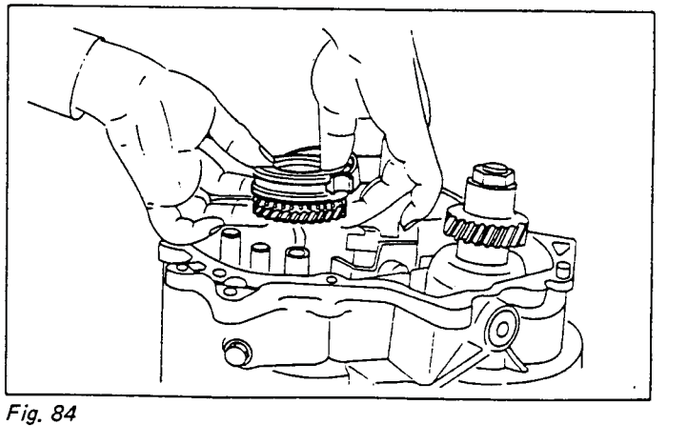


Fig. 84

9) Remove the needle bearing.

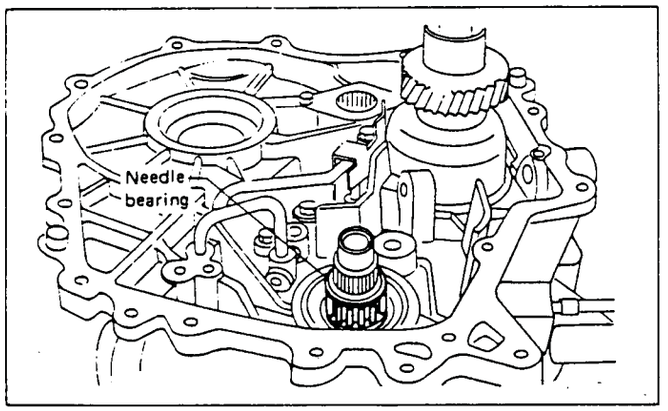


Fig. 85

10) Remove the reverse idler gear and shaft.

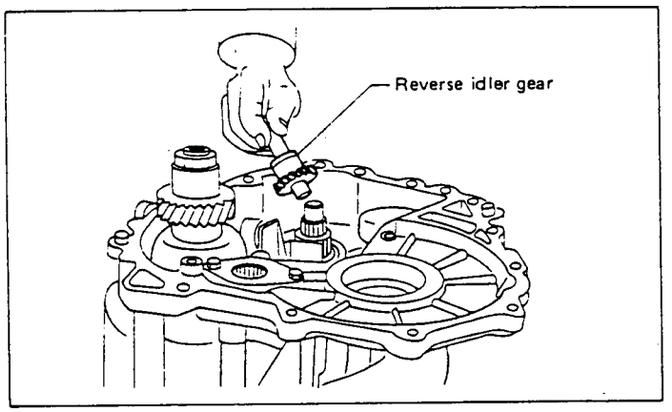


Fig. 86

11) Remove the lubricating pipe and engine brake pipe 2. Then, remove the engine brake body and lubricating nozzle.

Always install new pipes after disconnecting old pipes.

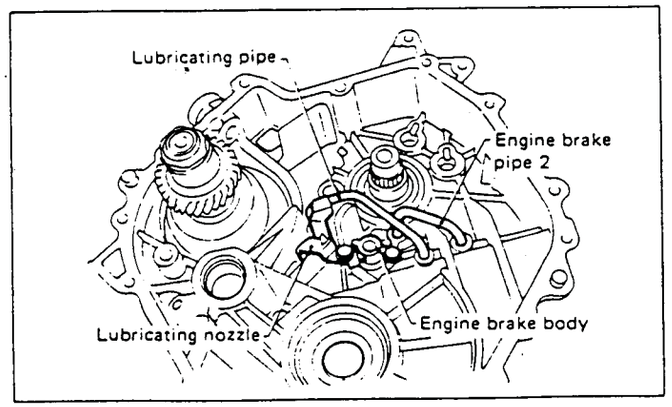


Fig. 87

12) Remove the oil pan and gasket.

Place a container to catch ATF.

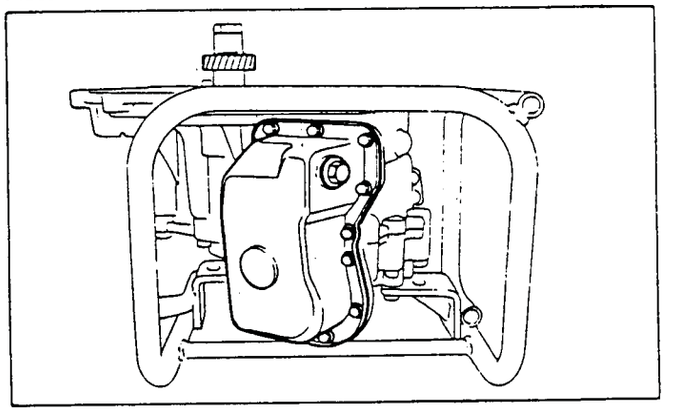


Fig. 88

13) Disconnect the transmission control cable end from the pulley of the control valve body.

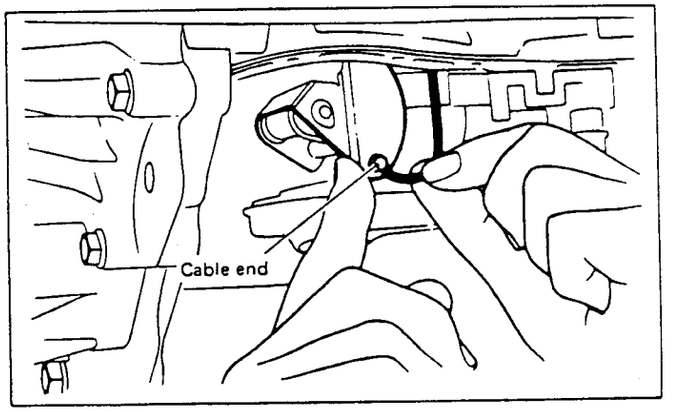


Fig. 89

14) Remove the oil strainer.

a. Be careful because a large amount of ATF will flow out of the inlet port.

b. If the O-ring is left in the inlet hole of the body ASSY, remove and attach it to the strainer.

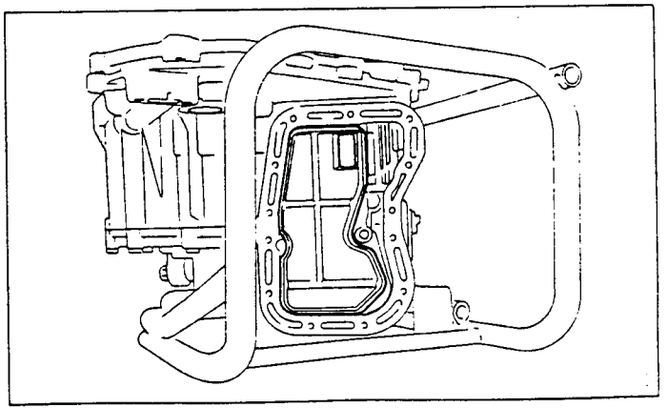


Fig. 90

15) Remove the connector from the bracket and disconnect the connector.

16) Remove the snap pin and E-ring, and disconnect the modulator connecting rod. Loosen the bolt. While turning the plate in the direction shown by the arrow, remove the plate and modulator connecting rod as a unit.

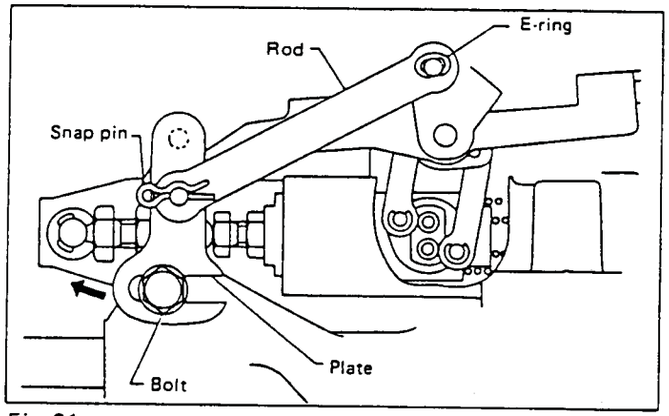


Fig. 91

17) Remove the transfer control pipe. (4WD)

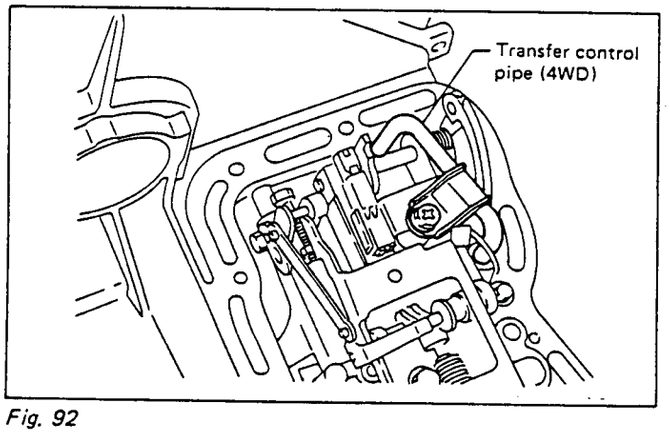


Fig. 92

18) Attach the CONTROL VALVE HOLDER (499205600) to the control valve body to prevent the pressure regulator valve spring from popping out.

While hooking the small end of the holder across the terminal nut of the pressure regulator spring guide and pushing on it, insert the big end into place by aligning it with the center bolt on the side of the control valve.

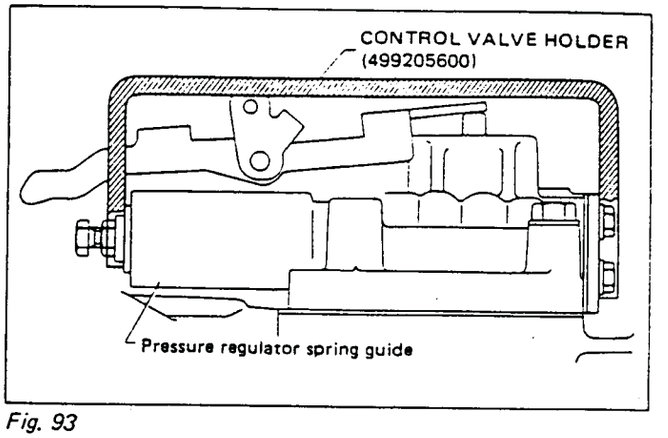


Fig. 93

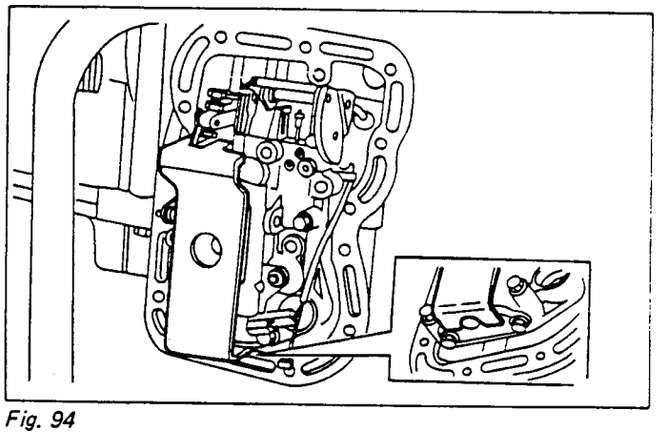


Fig. 94

19) Remove the control valve body and holder as a unit.

a. Be careful not to lose the control valve pin (which may have been left on the case side).

b. Be careful because a large amount of ATF will flow out.

c. Do not remove the holder from the control valve body.

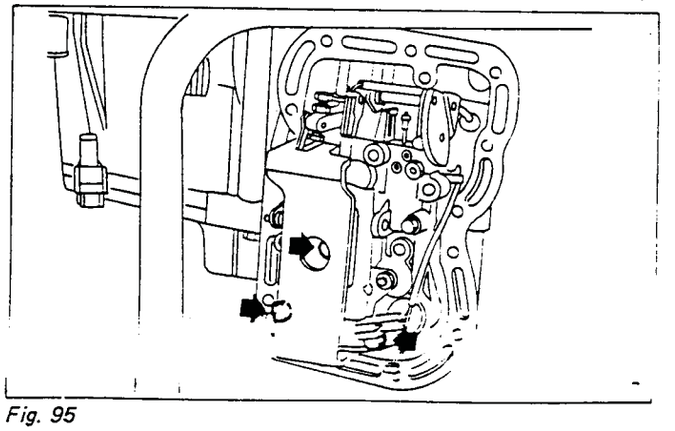


Fig. 95

20) Remove the bolts. Using the OIL PUMP REMOVER (499715600), remove the oil pump ASSY.

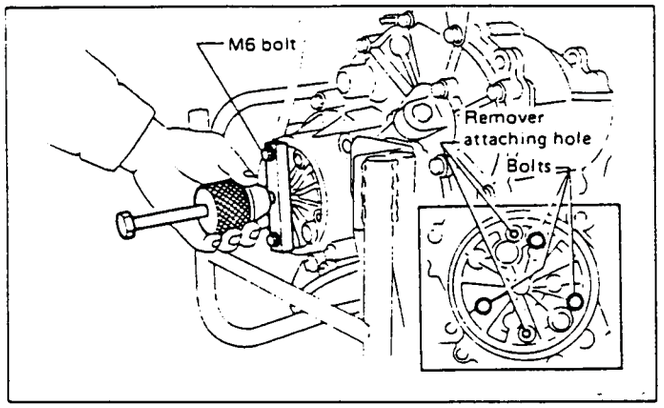


Fig. 96

21) Remove the twelve bolts which secure the side case to the transmission.

Do not remove the three retainer bolts.

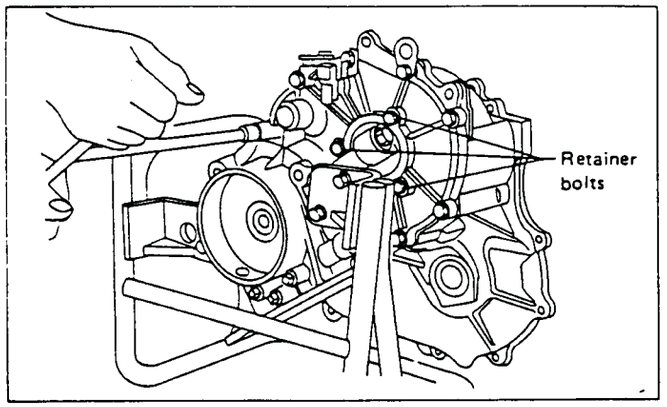


Fig. 97

22) Separate the side case from the transmission case by lightly tapping the latter.

a. Do not tap the mating surface of the oil pan as it is easily deformed.
b. Do not place the transmission case upside down as this may cause the engine brake valve (if equipped) to fall off.
c. Do not remove the three retainer bolts.

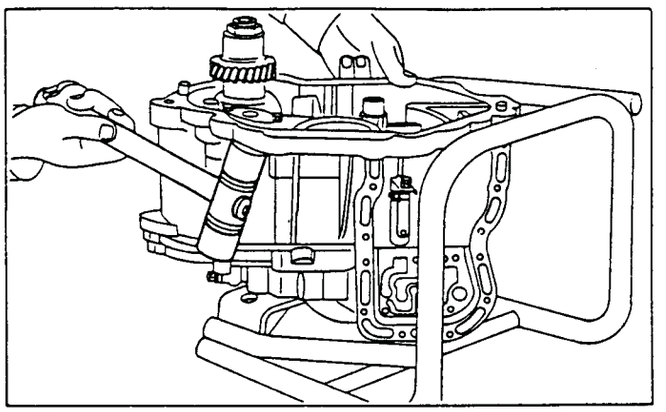


Fig. 98

23) Pull out the ratio sensor and parking pawl.

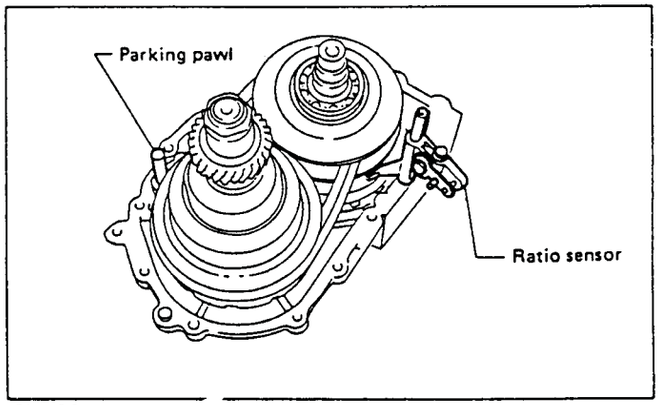


Fig. 99

24) Remove the secondary pulley.
(1) Remove the retainer bolts.

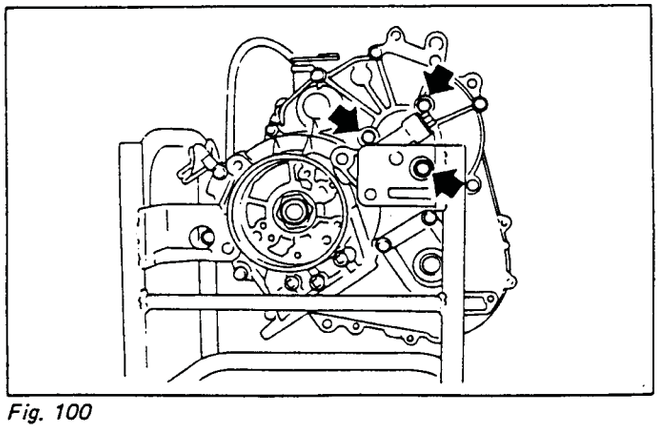


Fig. 100

(2) Install the clip band at two places to prevent the separation of the steel block and steel band.

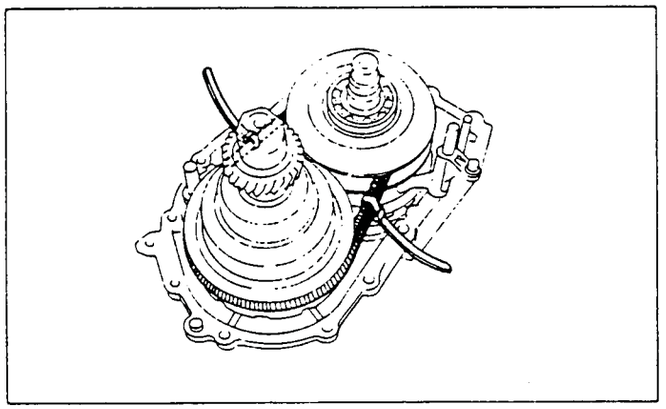


Fig. 101

(3) Attach the SECONDARY PULLEY PULLER (49919 5400) and SEAT (899524105) to the secondary pulley, and push the pulley so that the groove width is 52 to 53 mm (2.05 to 2.09 in). The arrow mark is helpful in roughly determining the groove width.

Do not expand the groove width more than 52 to 53 mm (2.05 to 2.09 in). Otherwise, the pulley interior may be damaged.

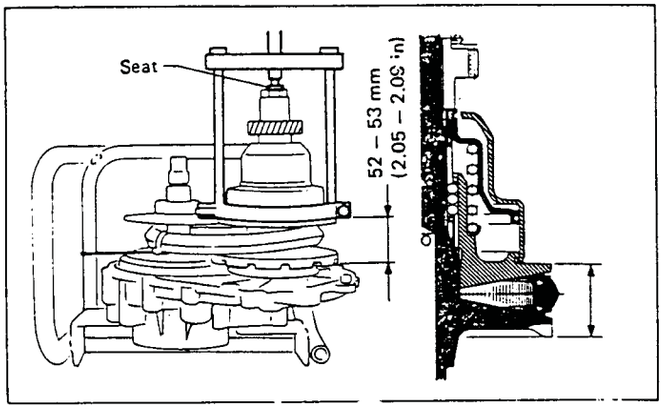


Fig. 102

(4) Carefully remove the secondary pulley from the side case.

(5) Engage the V grooves of the primary and secondary pulleys with each other and remove the belt from the primary pulley together with the secondary pulley.

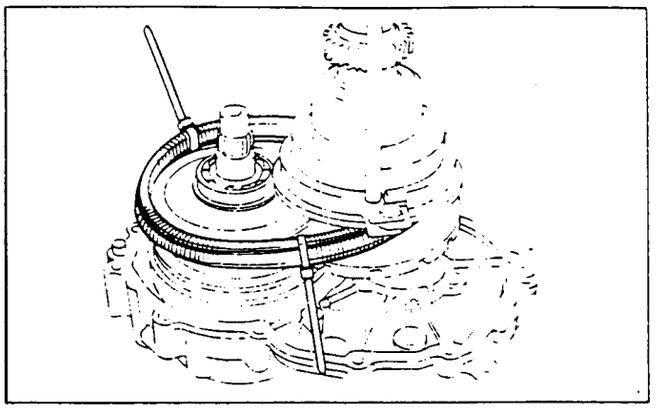


Fig. 103

To avoid scratching the cone surface, two workers are required. While one worker is lifting the secondary pulley and engaging the V grooves of the pulleys with each other, as shown in the figure, the other worker removes the belt from the primary pulley.

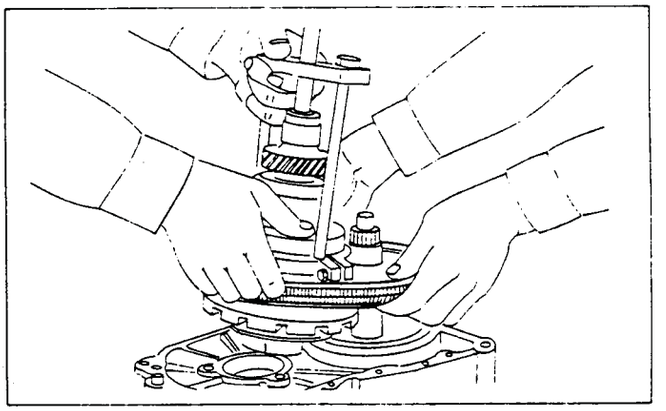


Fig. 104

a. Do not force the secondary pulley out as this may damage the belt.

b. Be careful not to strike the cone while crossing in the pulleys.

25) Remove the belt from the secondary pulley and wrap it with chamois or a nylon cloth.

Keep the secondary pulley in storage after attaching it to the HOLDER (498935400).

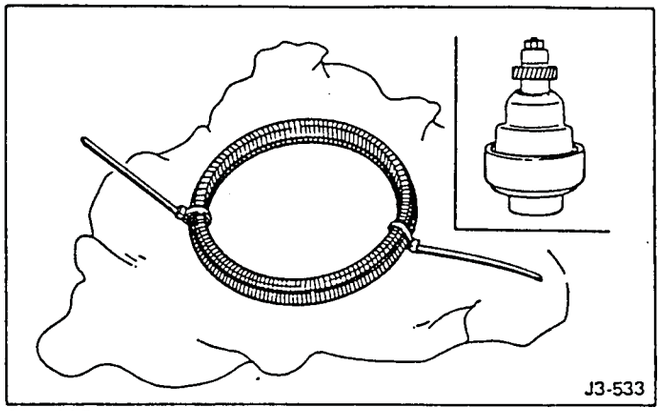


Fig. 105

26) Position the straight pin of the pilot pipe in the center of the primary pulley.

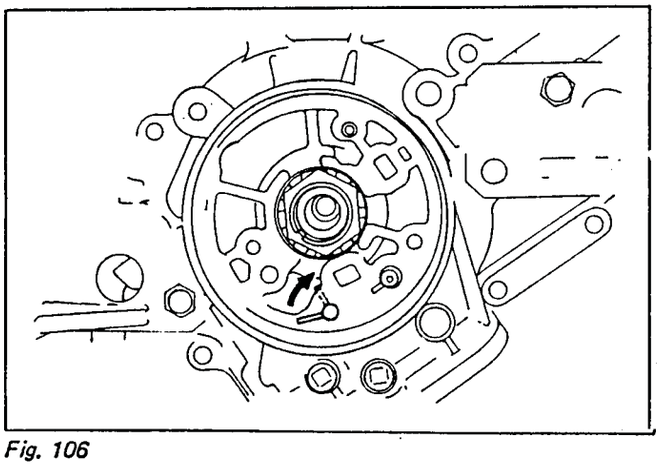


Fig. 106

27) Remove the primary pulley and place it on chamois or a nylon clo

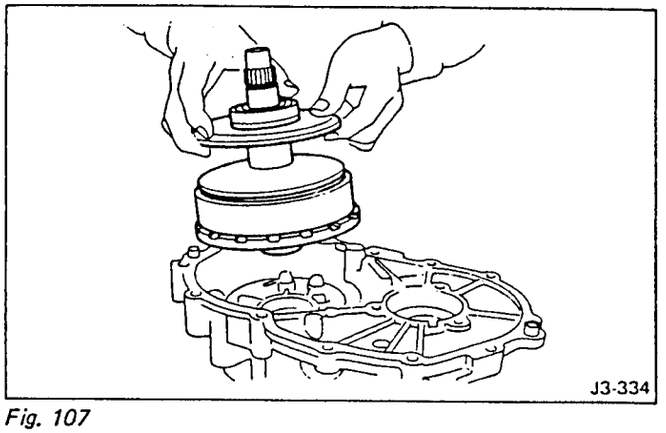


Fig. 107

-SPECIAL ASSEMBLY HINT-

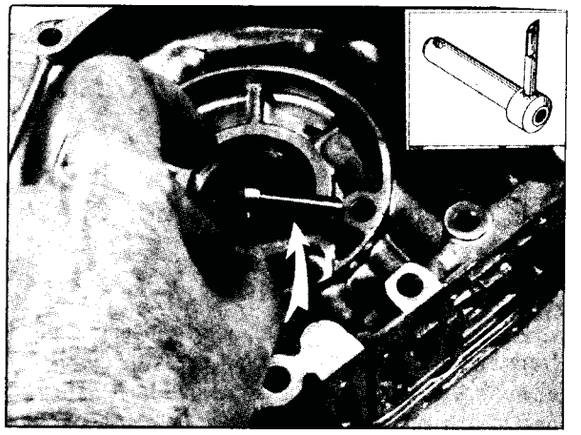


Fig.107A Install Pitot tube in bore on pulley side of housing.

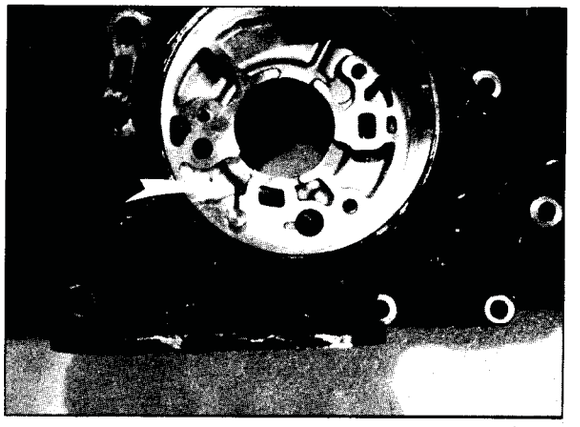


Fig.107B Have retaining pin face up (12 O'clock position, when installing pulley(fig.107).Pump side of housing.

Fig.107C Pump shown on left with arrow pointing to groove for retain-pin,which is now in the 9 O'clock position.

3 Disassembly, Inspection and Assembly of Each Component

3-1 Electromagnetic Powder Clutch

HANDLING PRECAUTIONS

a. When storing or moving the electromagnetic pouder clutch from one place to another, handle it with the slip rings facing upward. Otherwise, powder contained in the clutch may flow out of the powder gap. However, because of the labyrinth structural design, powder will return to the powder gap. During the clutch rotation, powder is collected at the powder gap by centrifugal force and will not flow out of the powder gap.

b. Do not apply an impact to the clutch as this may cause the powder to flow out of the powder gap.

c. Do not allow oil, grease, water, etc. tb come in contact with the powder clutch.

Keep the service tools, workbench, and workers' hands clean and dry.

d. Be extremely careful not to scratch or deform the labyrinth plate, as well as the operating surface located opposite the powder gap.

e. Avoid rolling the powder clutch as this may cause powder to flow out of the gap indicated by arrow in the figure.

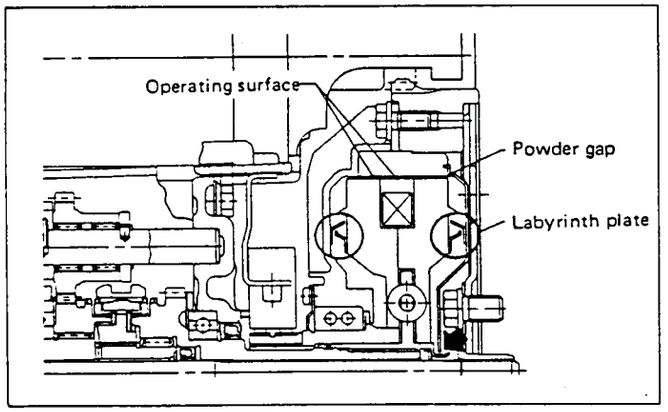


Fig. 108

INSPECTION

BEARINGS

Check the bearing for seizure, wear, noise or improper rotation.

Before checking the bearing for noise or improper rotation, apply ATF to it and spin.

SLIP RINGS

Wipe foreign particles (such as sand, dust, oil, etc.) off the slip ring using a volatile oil (thinner, trichloroethylene, etc.) and check the slip ring for damage.

Continuity check

Measure resistance between the slip rings using a circuit tester. If it is in the 2 to 4 Ω range, the slip rings are functioning properly.

If continuity does not exist or resistance is extremely low, replace the driven member.

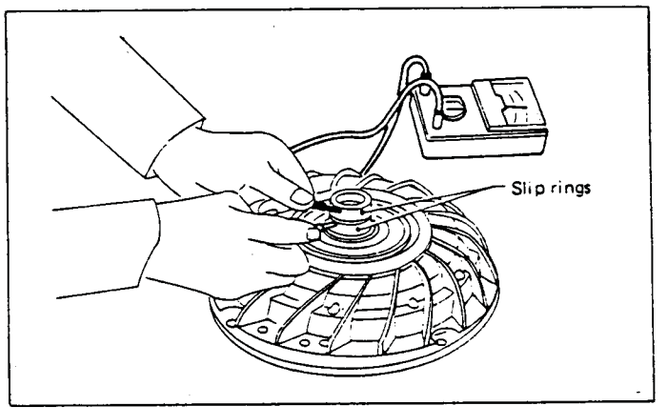


Fig. 109

Insulation check

Check insulation resistance between each slip ring and aluminum bracket of the electromagnetic powder clutch using a circuit tester (set in the max. ohm range). If continuity exists, replace the electromagnetic powder clutch.

Do not attach the test probes to the slip ring as this may scratch it.

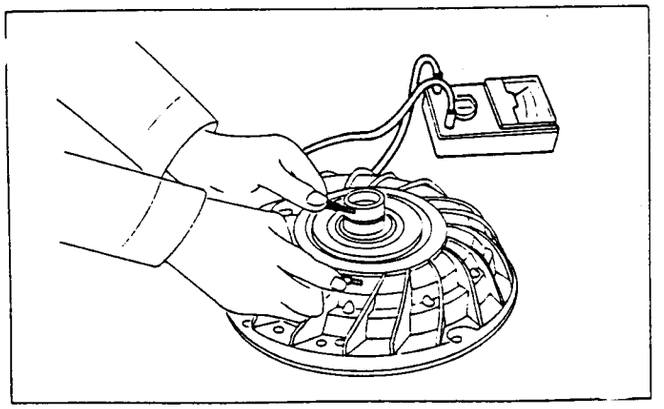


Fig. 110

3-2 Control Valve Body Assembly

DISASSEMBLY

1) Remove the CONTROL VALVE HOLDER (499205600) in the order indicated in the figure below. Remove the pressure guide and spring.

Do not adjust the pressure regulator guide nut and bolt.

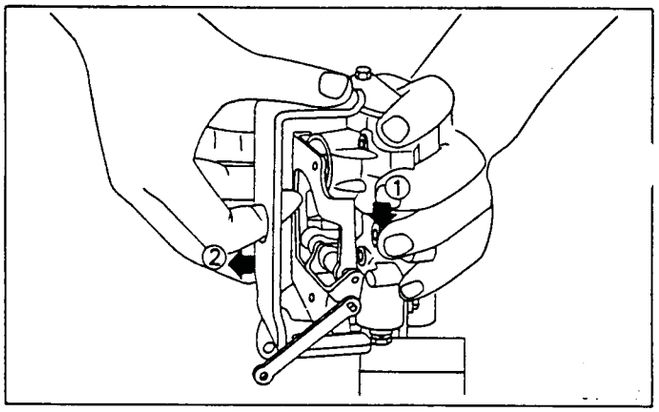


Fig. 111

2) Remove the line pressure control solenoid valve.

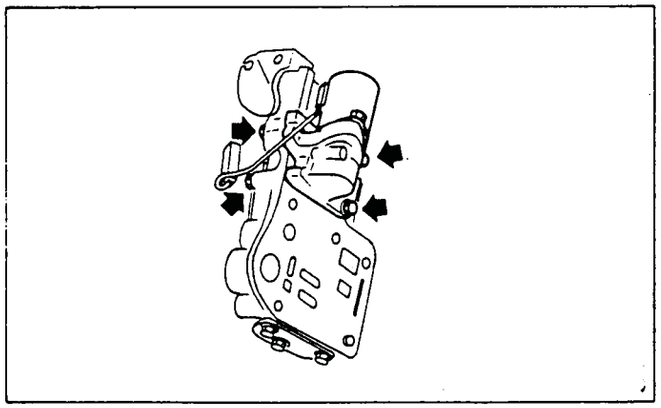


Fig. 112

3) Remove the separator plate; remove the steel balls, springs, shift lock valve and straight pin.

Carefully remove the two steel balls and two springs. Be careful not to lose or miss them.

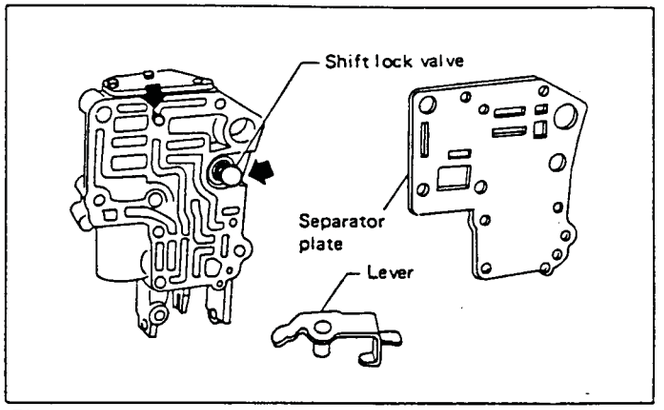


Fig 113

4) Being careful not to remove the straight pin from the engine brake valve, remove the spring pin from the shift cam using the STRAIGHT PIN REMOVER (499905400). Then, remove the shift cam and shift control lever.

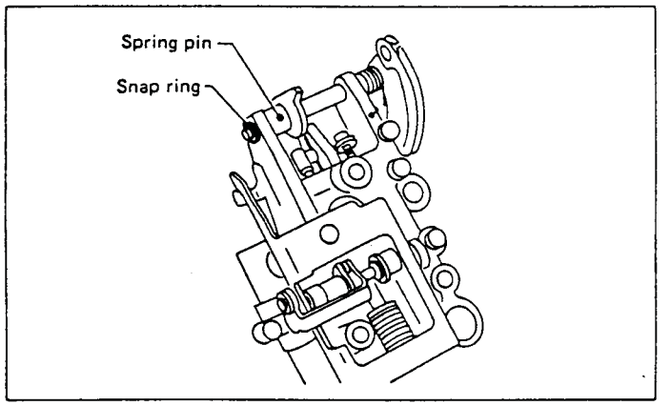


Fig. 114

5) Remove the snap ring and engine brake support from the engine brake valve. Remove the straight pin using the STRAIGHT PIN REMOVER (499905500); remove the engine brake valve. Then, remove the engine brake lever and shift control pin.

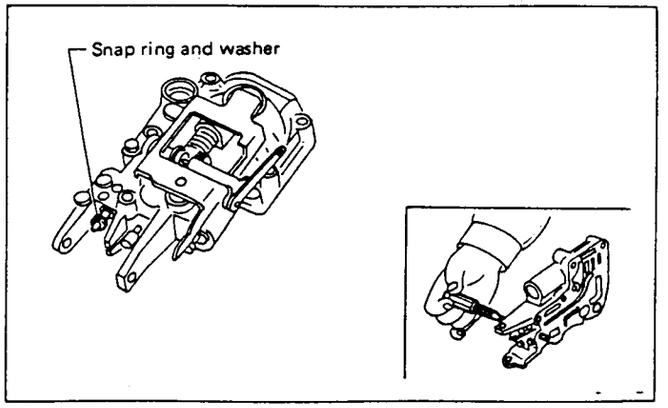


Fig. 115

6) Remove the pin using a pair of pliers and remove the snap ring.

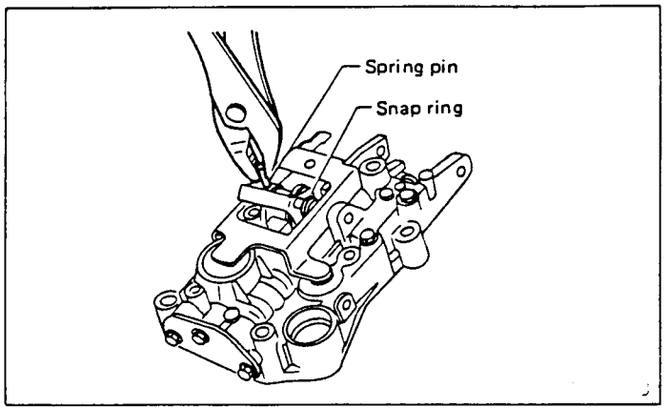


Fig. 116

7) Move the shaft in the direction of arrow ① and remove one end of the lever from the shaft. Move the shaft in the direction of arrow ② and remove the shaft from the roll ASSY.

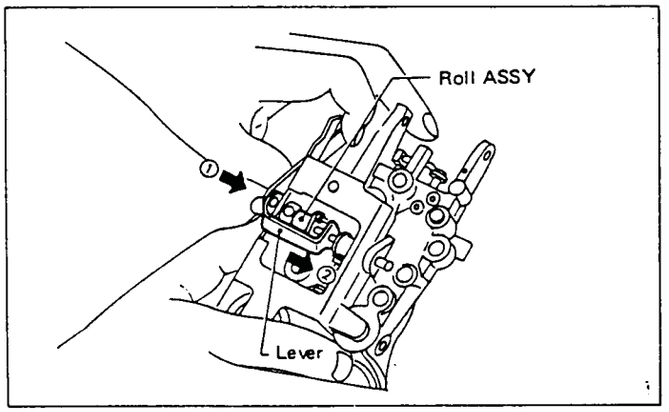


Fig. 117

8) While pressing the shift lock lever, remove the shaft and shift lock lever.

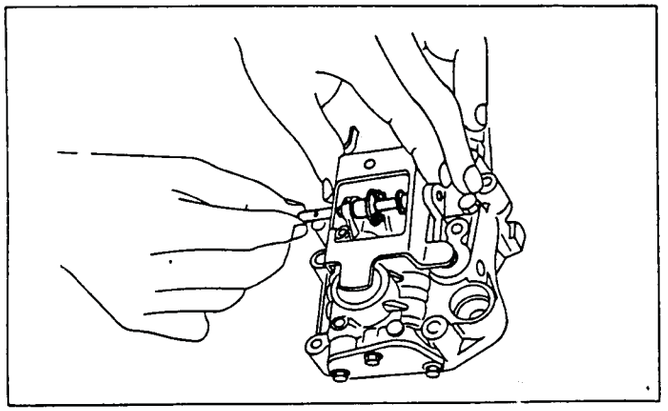


Fig. 118

9) Remove the side plate, then the shift control valve, high-speed spring and high-speed support. To facilitate this operation, face the side plate downward.

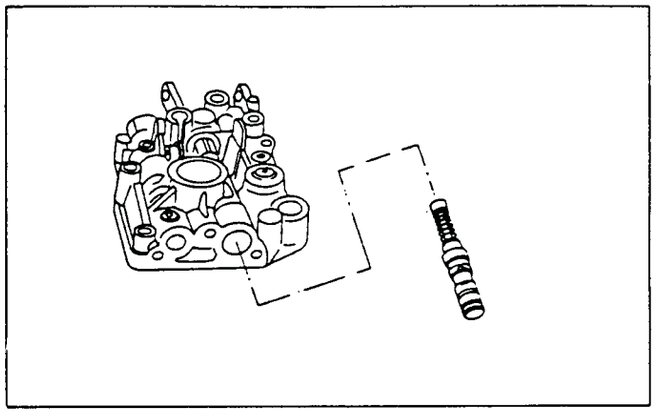


Fig. 119

10) Remove the low-speed spring.

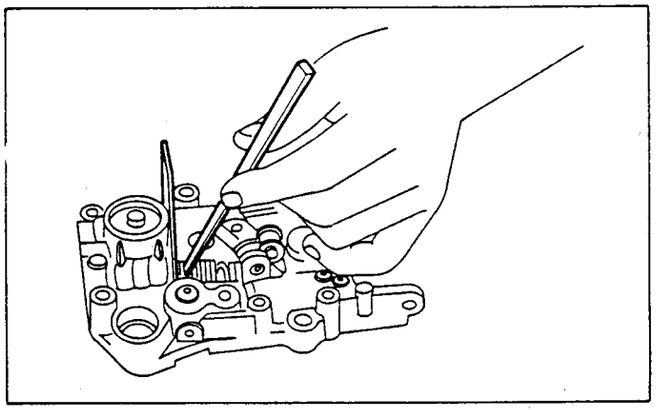


Fig. 120

11) Remove the spacer, linkage guide, roller ASSY and low-speed support.

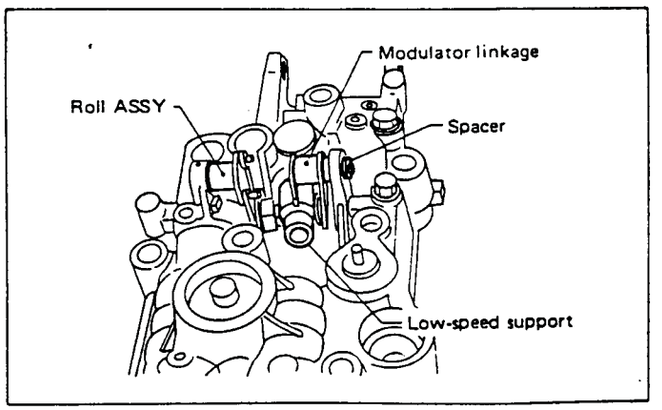


Fig. 121

12) Remove the plunger ASSY.
13) Remove the snap ring, then the pressure regulator valve.

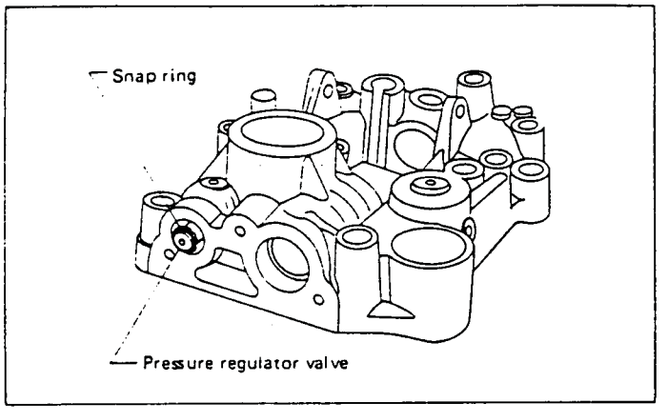


Fig. 122

14) Remove the spacer and shift lock piston.

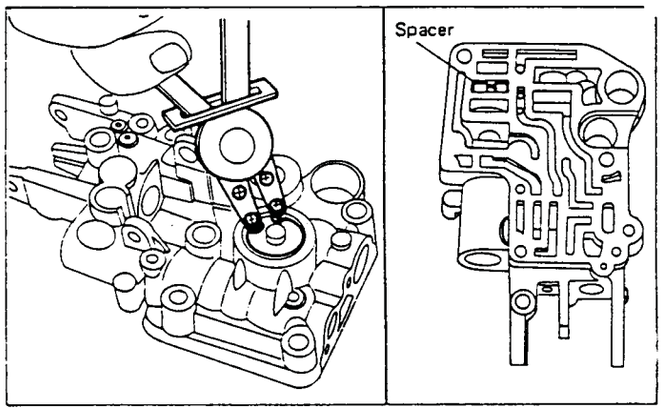


Fig. 123

INSPECTION

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

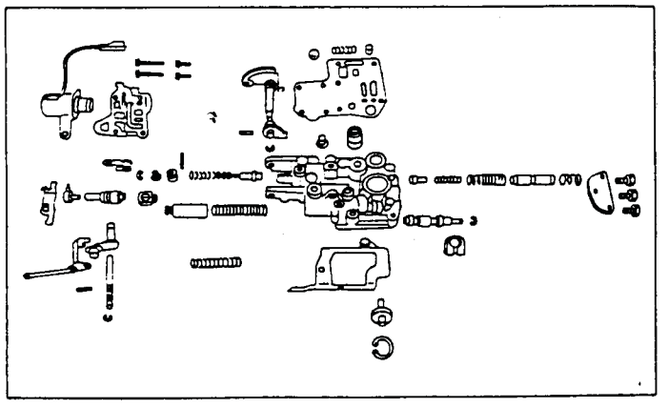


Fig. 124

ASSEMBLY

To assemble the control valve body ASSY, reverse the order of disassembly. Observe the following instructions.
When assembling minor parts, such as valve springs, and valves, refer to the general exploded view and detailed description of valve springs, in figure before. Apply the ATF to all valves when installing.
When tightening parts, be sure to observe the specified torques. Do not force valves into place, but lightly push them into place with hand.
1) Install the shift lock piston.
2) Install the spacer, and install the pressure regulator valve.
3) Position the plunger.
4) Assemble the linkage guide, roller Assy and low speed support and install them on control valve body.
Also install the spacer.

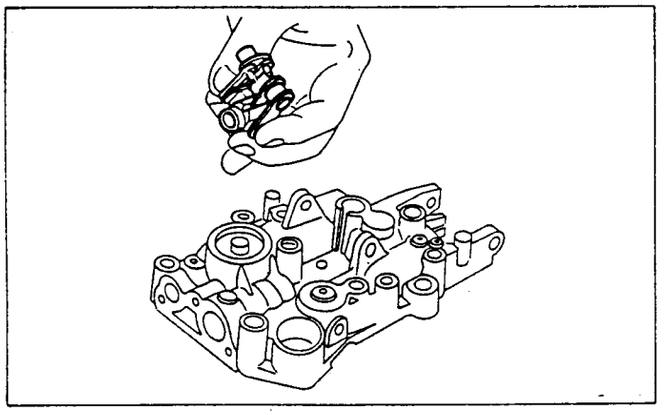


Fig. 125

5) Install the low-spring using a thin plate as shown.

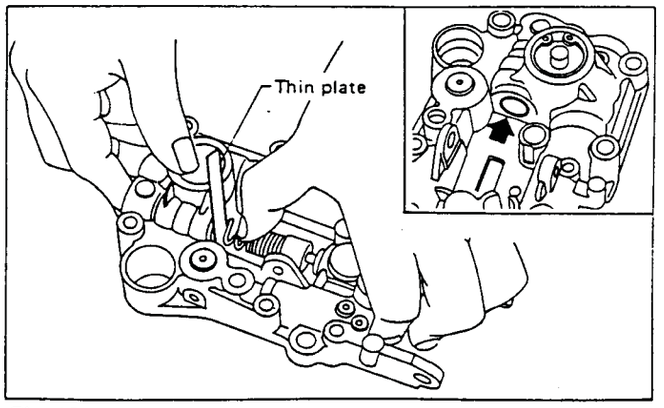


Fig. 126

- **Install the spring with its small pitched end facing the plunger.**
- **Assemble the shift control valve temporarily, and adjust the centering of the low-speed spring.**
- **Be careful not to scratch the body when installing the spring (shown by an arrow in the figure). Failure to follow this instruction may obstruct smooth movement of the shift control valve.**

6) Position the shift control valve, high-speed spring, high-speed support and spring and install the side plate.

Ensure the valve and plunger operate smoothly

Tightening torque:
1.5 – 2.0 N·m (0.155 – 0.205 kg-m, 1.1 – 1.5 ft-lb)

7) Position the spring and install the shift lock lever and shaft.

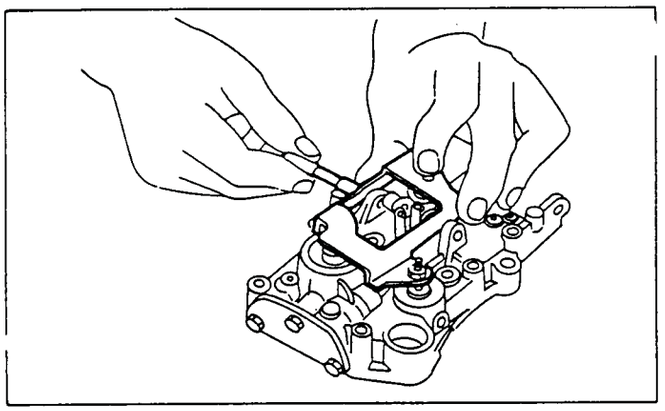


Fig. 127

8) Install the lever, spring pin and snap ring.

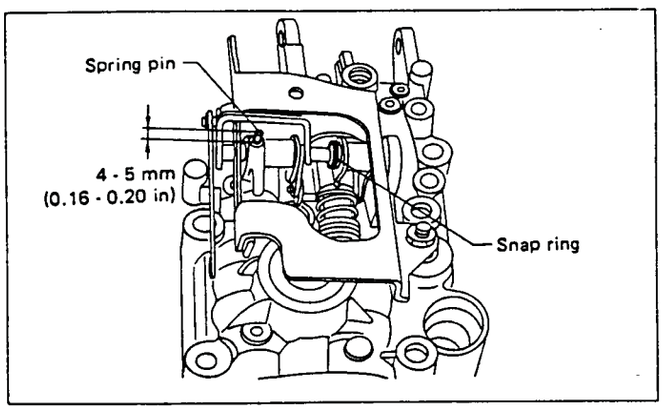


Fig. 128

9) Install the engine brake valve, spring and engine brake sleeve.

Be sure to insert the straight pin while pushing the aluminum portion of the engine brake valve.

10) Install the shift control pin and position the lever properly.

11) While manually pressing the engine brake lever down, position engine brake support in the engine brake valve, and lock with the snap ring.

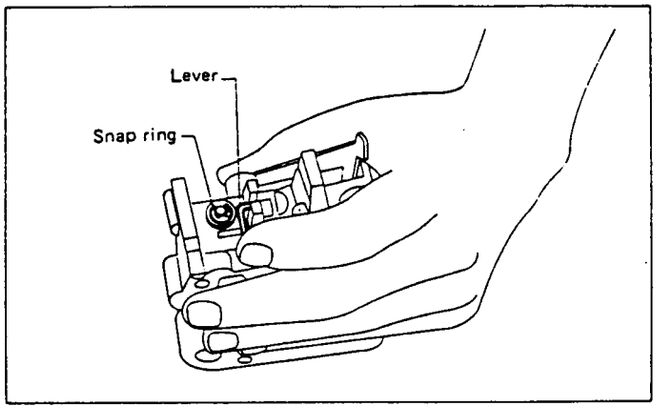


Fig. 129

12) Install the shift control lever and shift cam.

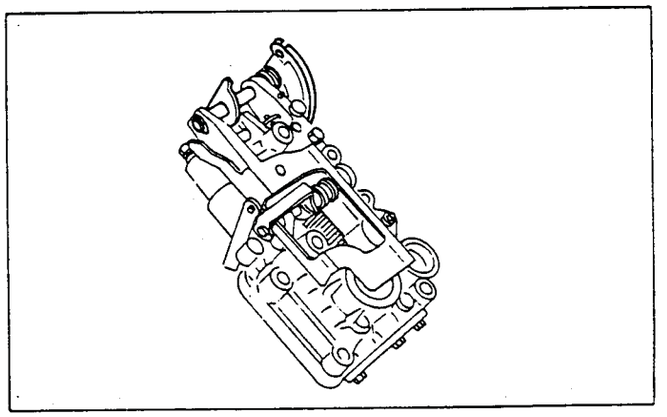


Fig. 130

13) Install the steel balls, springs, shift lock valve and straight pin. Set the spring guide in position and install the solenoid valve.

Tightening torque:
2.9 – 3.9 N·m (0.30 – 0.40 kg-m, 2.2 – 2.9 ft-lb)

14) Shift lock valve adjustment
(1) Screw the stud in until the shift lock valve comes in light contact with the separator plate.

a. Do not tighten the stud excessively as this moves the separator plate.
b. While screwing the stud, hold the separator plate and shift control lever against the control valve body.

(2) Turn the stud a further 1/8 to 1/4 rotations (45° to 90°), and then tighten the nut to the specified torque.

Tightening torque:
1.6 – 2.1 N·m (0.16 – 0.21 kg-m, 1.2 – 1.5 ft-lb)

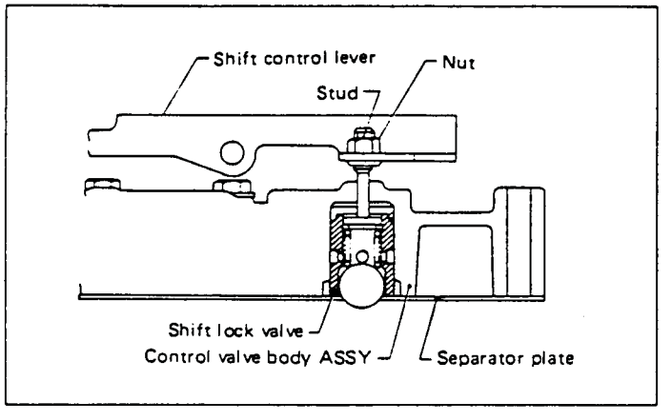


Fig. 131

15) Install the pressure regulator spring and guide. Attach the CONTROL VALVE HOLDER (499205600) to the control valve body. If the pressure regulator valve guide is replaced with a new one, check the line pressure. (Refer to "ON-CAR-SERVICE" under the topic "Troubleshooting.")

3-3 Transfer Actuator Body Assembly (4WD)

DISASSEMBLY

1) Remove the shift transfer rod.
2) Remove the snap ring and transfer actuator control valve.
3) Remove the cover plate.

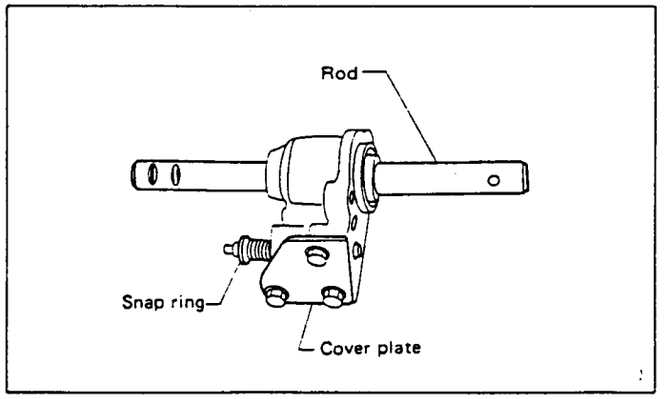


Fig. 132

INSPECTION

Make sure that each component is free of harm full gauges, scratches or dust.

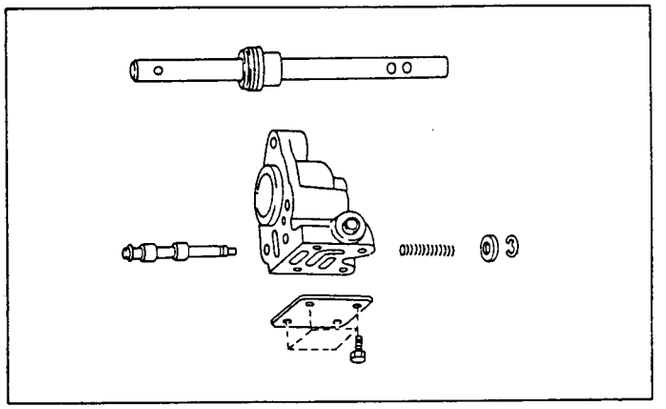


Fig. 133

ASSEMBLY

To assemble the control valve body ASSY, reverse the order of disassembly. Observe the following instructions.
When assembling minor parts, such as valve springs, and valves, refer to the general exploded view and detailed description of valve springs, in figure before. Apply the ATF to all valves when installing.
When tightening parts, be sure to observe the specified torques. Do not force valves into place, but lightly push them into place with hand.
1) Install the control valve.
2) Install the plate cover.

Tightening torque:
1.5 – 2.0 N·m (0.155 – 0.205 kg-m, 1.1 – 1.5 ft-lb)

3) Install the shift transfer rod on the transfer actuator body.

3-4 Secondary Pulley Assembly

DISASSEMBLY

1) Straighten the lock nut at staked portion. Remove the lock nut using the HOLDER (498935400).

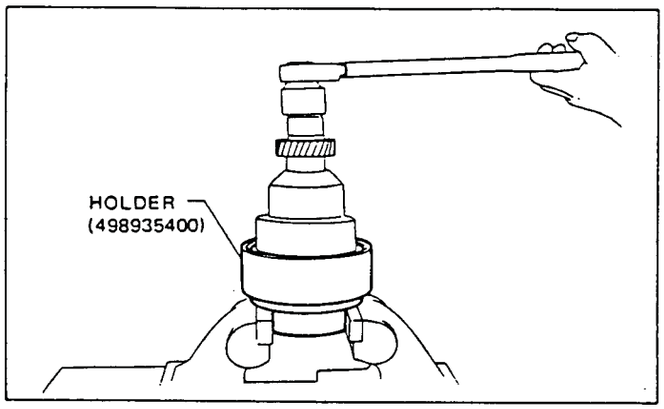


Fig. 134

Do not use an air tool when loosening the lock nut or the ball splined end of the pulley may be damaged.

2) Remove the needle bearing race using the REMOVER (899714110) and OIL SEAL DRIFT (498475500).

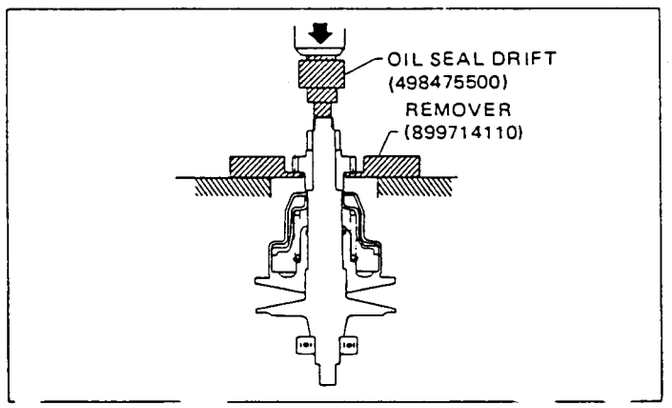


Fig. 135

INSPECTION

1) Replace if the tooth surface is broke damaged or excessively worn.
2) Replace if the perimeter (at the bearing location) or the inner wall is damaged or excessively worn.
3) Check the bearing for seizure, wear, noise or unsmooth rotation.

When checking the bearing for noise or unsmooth rotation, apply ATF to it and spin.

ASSEMBLY

1) Press the reduction drive gear onto the pulley.

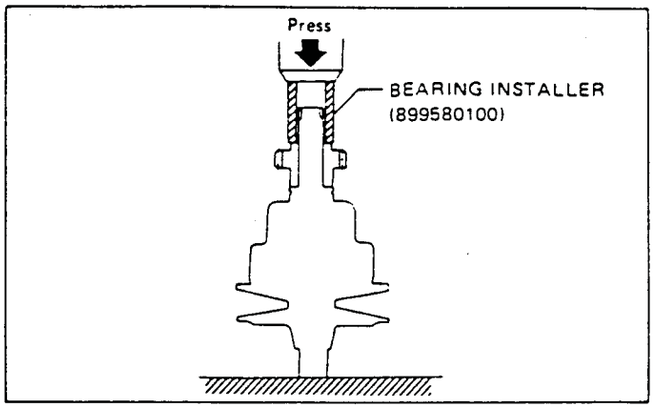


Fig. 136

2) Press the needle bearing race onto the pulley.

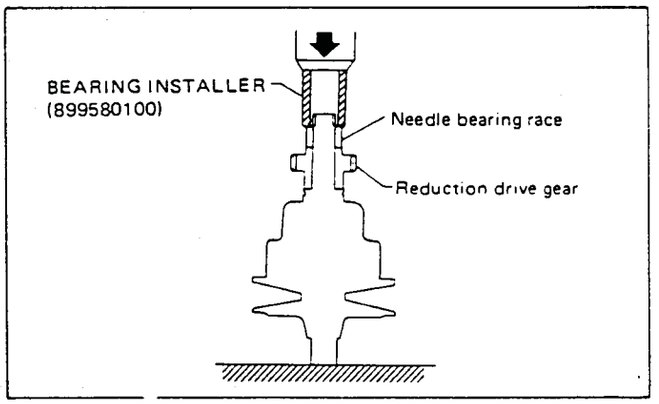


Fig. 137

3) Install the pulley to the HOLDER (498935400) with the convex side of the washer facing the lock nut, and tighten the lock nut to the specified torque.

Tightening torque:
123 – 132 N·m (12.5 – 13.5 kg·m, 90 – 98 ft·lb)

4) Stake the lock nut after tightening.

3-5 Oil Pump Assembly

DISASSEMBLY

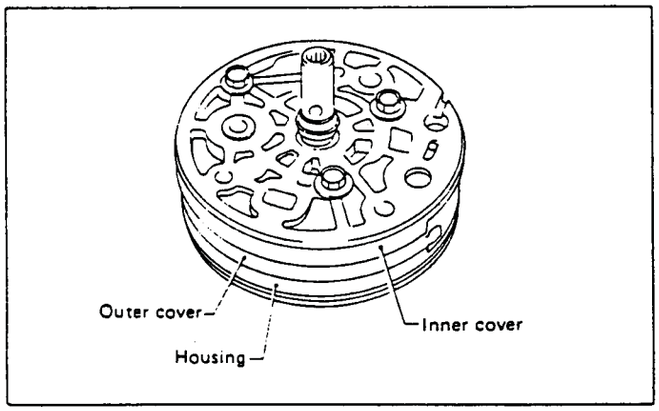


Fig. 138

1) Remove the three boits.
2) Install two bolts from the inner cover side. While tapping the bolt heads with a plastic hammer, separate the housing and outer cover.

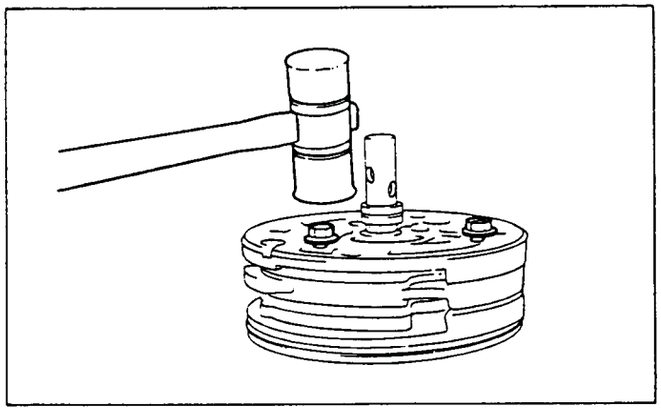


Fig. 139

3) Separate the housing from the inner cover by tapping the housing with a plastic hammer.

Be careful not to damage adjacent parts.

INSPECTION

Check all parts for abnormal wear, breakage or damage.

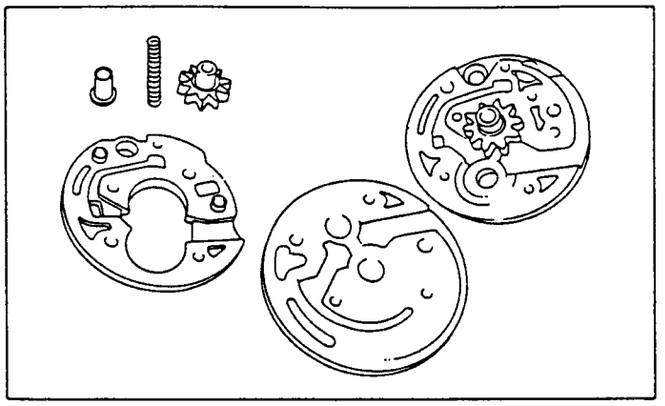


Fig. 140

ASSEMBLY

To assemble the oil pump ASSY, reverse the order of disassembly.
1) Attach the lubricating valve on the housing, and install the inner cover on the housing.
2) Set the driven gear and spring in place, and install the outer cover.

a. The driven gear can be installed with either side facing the front.
b. Apply a coat of ATF to the contact surfaces of the gears and parts.

3) Tighten the bolts.

Tightening torque:
5 – 15 N·m (0.5 – 1.5 kg-m, 3.6 – 10.8 ft-lb)

4) After tightening the bolts, check by hand to ensure the shaft rotates smoothly.
5) Using the SEAL RING GUIDE 2 (499305600), install seal ring on oil pump shaft.

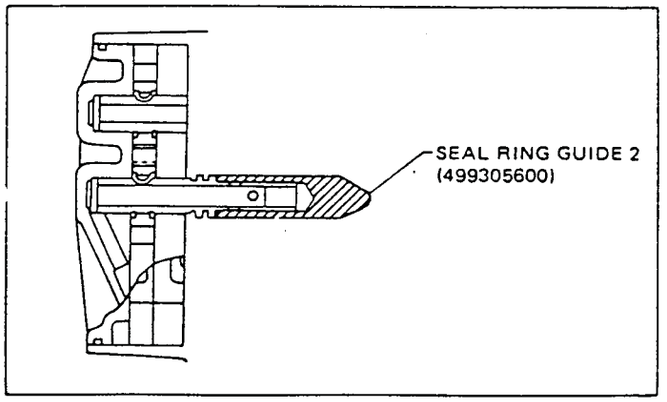


Fig. 141

3-6 Main Drive Shaft Assembly

DISASSEMBLY

1) Remove the bolts.

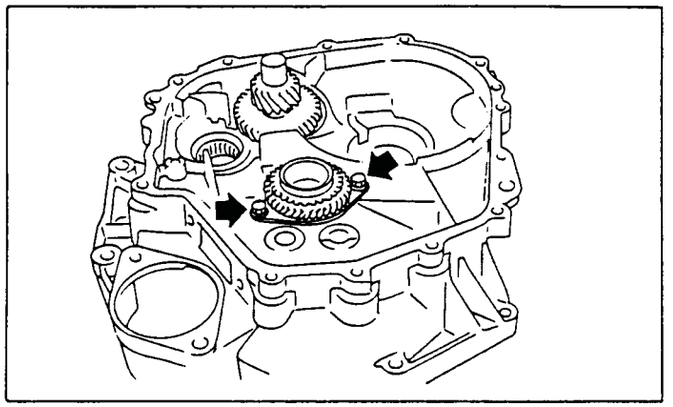


Fig. 142

2) Remove the main drive shaft ASSY from the clutch housing by tapping the end of the shaft with a plastic hammer.

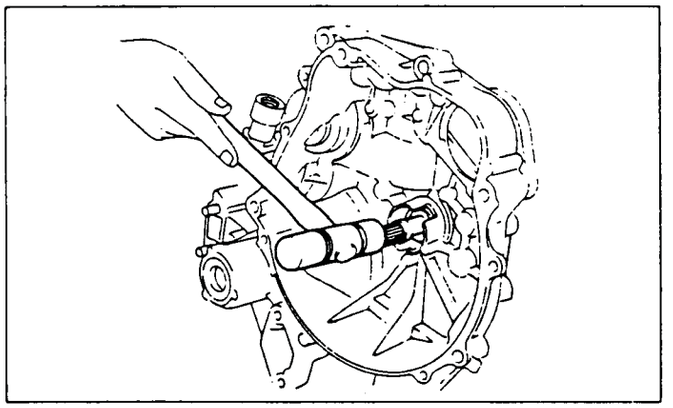


Fig. 143

3) Remove the snap ring. While supporting the retainer, press the ball bearing out.

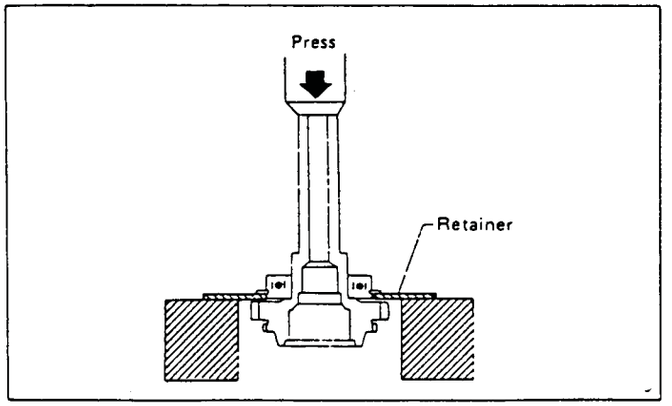


Fig. 144

Do not reuse the retainer.

INSPECTION

GEARS

1) Replace the gear if the tooth face is broken, damaged or excessively worn.
2) Replace the gear if the cone surface is seized or damaged.
3) Replace the gear if the perimeter (at the bearing location) or the inner wall is damaged or excessively worn.

BALL BEARINGS

Replace the bearing if it is noisy or rolls unsmoothly.

Before checking the bearing, apply ATF to it and spin.

SYNCHRONIZER RING

1) Check inside surface, tooth surface and synchronizer hub insert contacting surface of synchronizer ring for damage or abnormal wear, and replace if defective.
2) Clearance between synchronizer ring and cone

Press ring against cone and measure clearance C between interfacial surfaces of ring and cone.

Standard value of C:
1.2 mm (0.047 in)
Limit of C:
0.4 mm (0.016 in)

SYNCHRONIZER HUB INSERT

Check synchronizer hub insert for excessive wear and other defects and replace if defective.

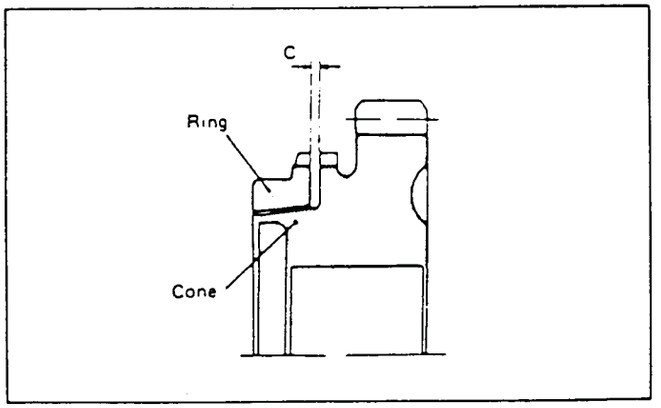


Fig. 145

ASSEMBLY

1) Install the oil seal on the main drive shaft.

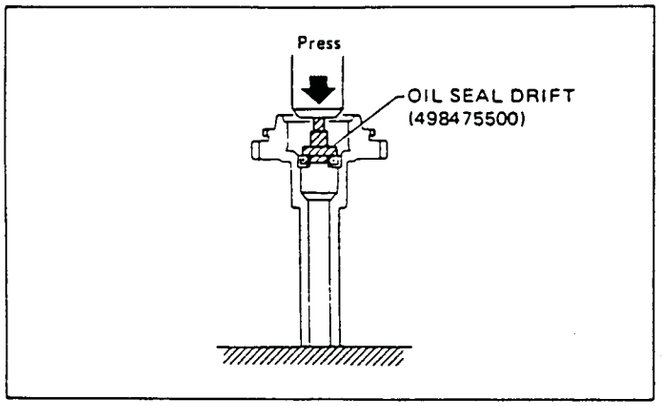


Fig. 146

2) Install the retainer. Press the ball bearing into place.

a. Ensure the mark on the ball bearing faces up during installation.
b. Do not re-use the ball bearing after removal.

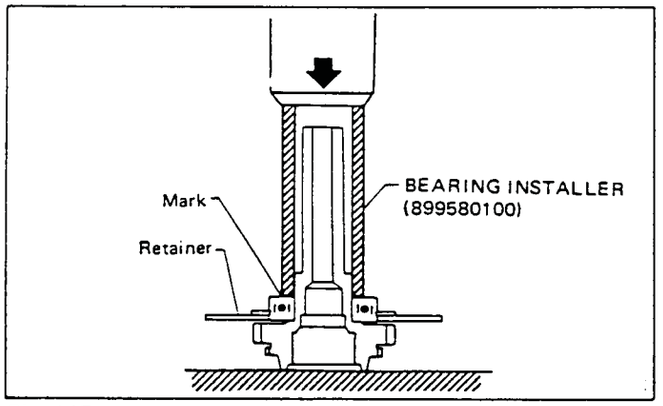


Fig. 147

3) Press the oil seal into the bore in the clutch housing using the OIL SEAL DRIFT (498415600).

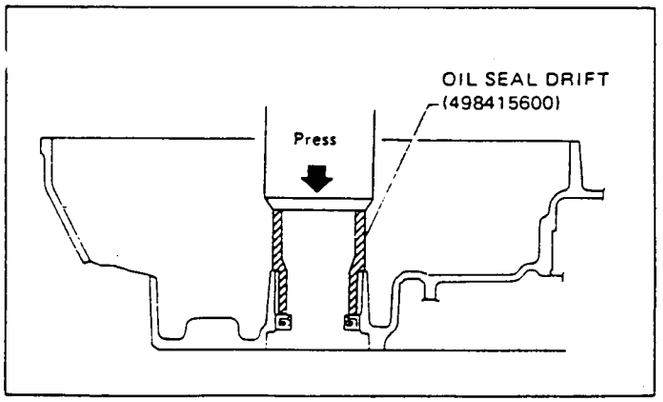


Fig. 148

4) Press the shaft ASSY into the clutch housing.

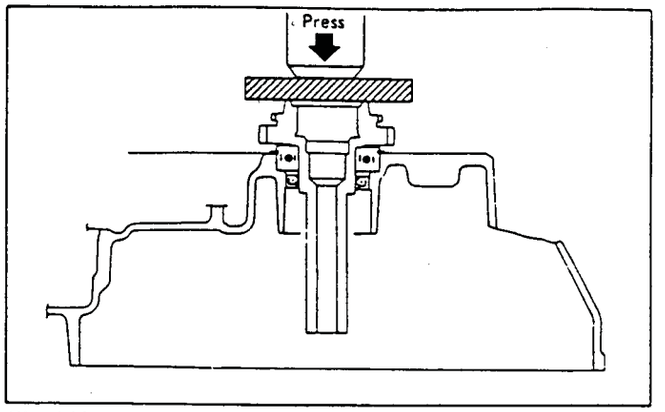


Fig. 149

5) Tighten the retainer bolts.

Tightening torque:
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

3-7 Speedometer Cover

DISASSEMBLY

1) Remove the bolts which secure the speedometer cover; remove the cover.

Be careful not to damage the nylon speedometer gear when removing the cover.

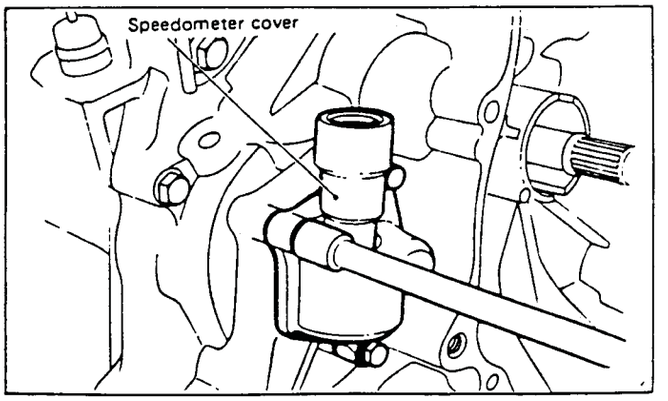


Fig. 150

2) Remove the outer snap ring from the inside of the cover using the SNAP RING EXPANDER (899471410). Remove the speedometer driven gear.
3) Place the speedometer cover in a vise. Drive the oil seal and speedometer shaft out by lightly tapping the end of the shaft on the gear side.

a. Remove the outer snap ring in the direction opposite the oil seal. Otherwise, the contact surface of the oil seal may be damaged.
b. Discard the old oil seal after removing. Replace with a new one.

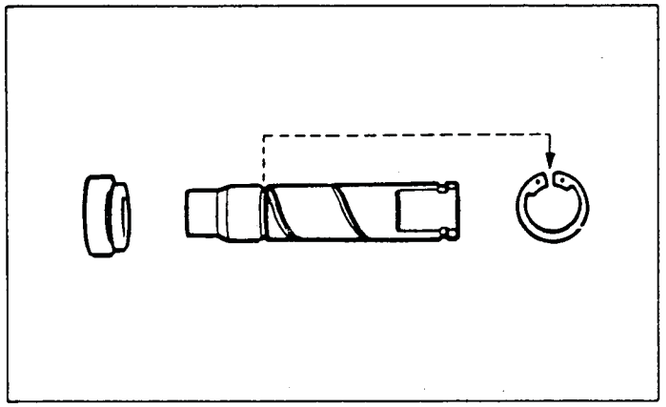


Fig. 151

INSPECTION

1) Check the speedometer driven gear for wear.
2) Check for oil leakage on the installed portion of the speedometer cable.
3) Ensure that the shaft rotates smoothly.

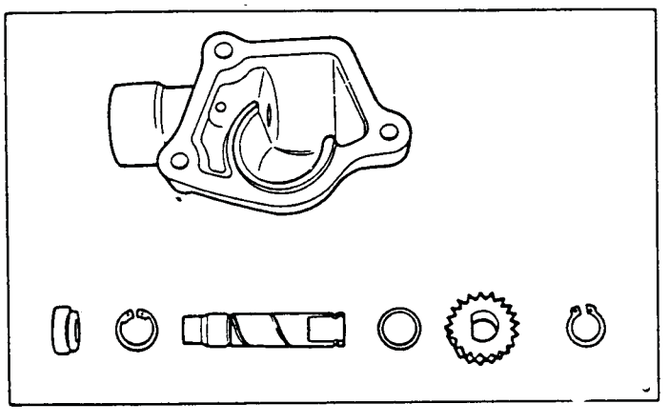


Fig. 152

ASSEMBLY

1) Install the outer snap ring on the end of the speedometer shaft on the speedometer.

Discard the old snap ring. Replace with a new one. Be careful not to expand the snap ring excessively during installation. Do not install the snap ring from the frictional side of the oil seal.

2) Place a washer under the speedometer shaft and position the speedometer shaft in the speedometer cover.
3) Install the speedometer gear onto the shaft and secure with the outer snap ring.

Discard the old snap ring. Replace with a new one. Be careful not to expand the snap ring excessively during installation.

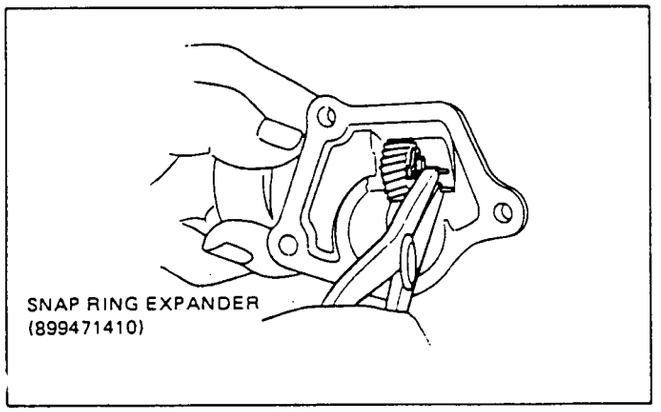


Fig. 153

4) Using the SPEEDOMETER OIL SEAL PRESS (499827000), press the oil seal into place.

Discard the old oil seal. Replace with a new one. Apply a coat of ATF to the sealing lip of the oil seal.

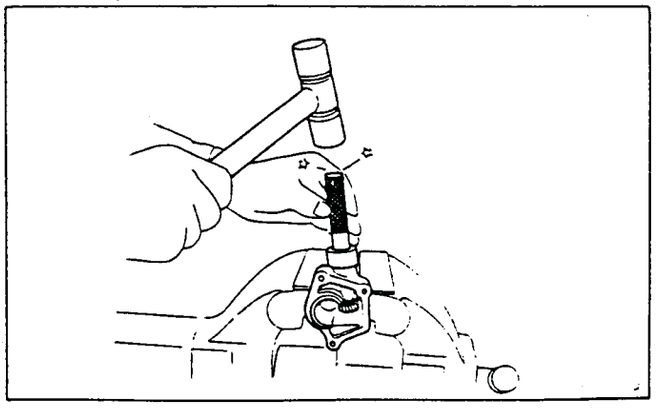


Fig. 154

5) Remove all traces of grease from the mating surfaces of the speedometer cover and clutch housing, and install the cover with a gasket.
6) Tighten the bolts with the washers in place.

Tightening torque:
6 – 7 N·m (0.6 – 0.7 kg-m, 4.3 – 5.1 ft-lb)

Discard the old gasket; replace with a new one.

3-8 Drive Pinion Shaft Assembly

REMOVAL

1) Remove the speedometer cover.
2) Remove the snap ring using the PLIER (398663600).

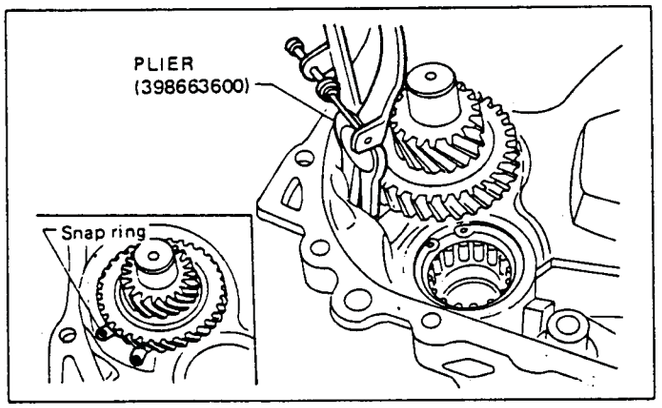


Fig. 155

3) Remove the drive pinion shaft ASSY from the clutch housing by tapping the end of the shaft with a plastic hammer.

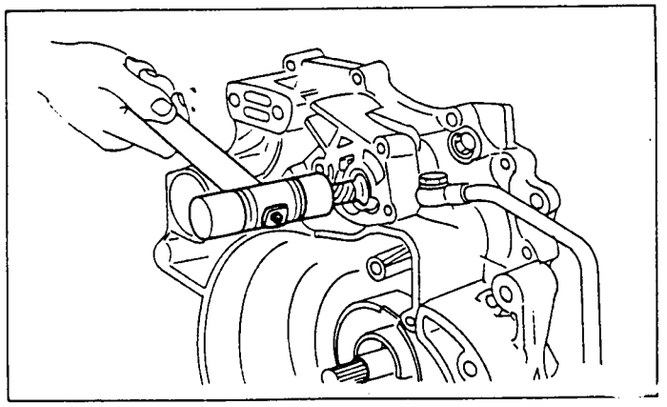


Fig. 156

DISASSEMBLY

1) Straighten the lock nut at staked portion.
2) Place the small-dia gear in a vise using HOLDER (499165500) and remove the lock nut using SOCKET WRENCH (35) (499987100).

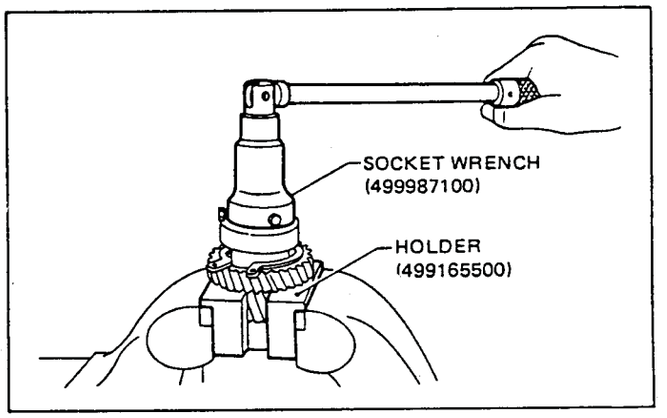


Fig. 157

3) Press the ball bearing and gear from the shaft, using the REMOVER (899714110) and OIL SEAL DRIFT (498475500).

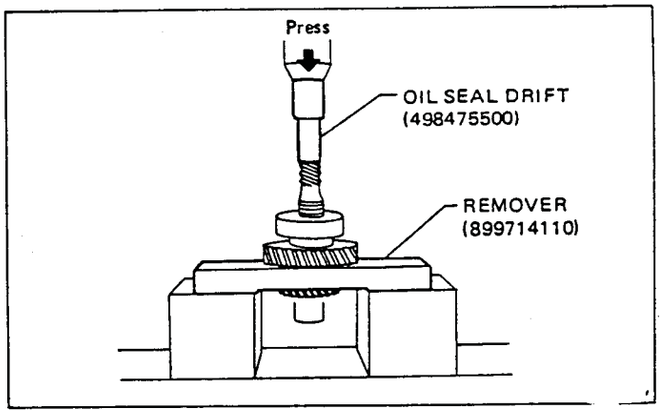


Fig. 158

INSPECTION

GEAR

1) Replace the gear if the tooth face is damaged or excessively worn.
2) Replace the gear if the cone surface is seized or damaged.
3) Replace the gear if the perimeter or inner wall is damaged or excessively worn.

Ball and needle bearings

Replace the bearing if it is seized or excessively worn.

Apply ATF to a noisy bearing and spin the bearing. If it is still noisy or spins unsmoothly, replace.

ASSEMBLY

1) Press the reduction driven gear onto the shaft.

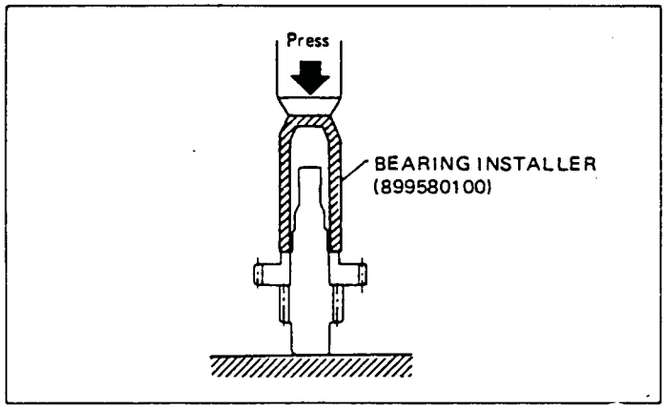


Fig. 159

2) Install the snap ring. Press the ball bearing into place.

a. Ensure the mark on the bearing faces upward.
b. Do not re-use the ball bearing after removal.

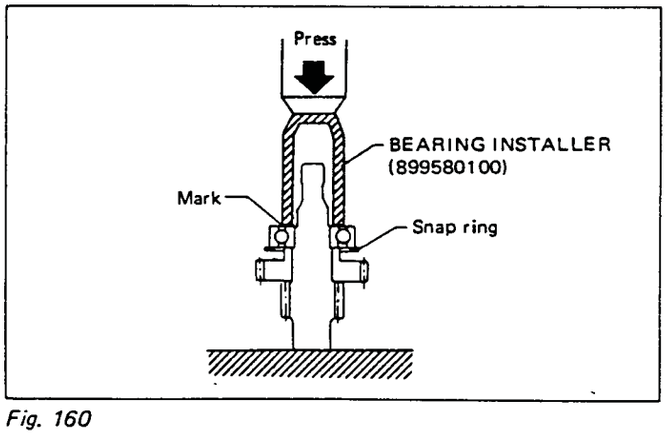


Fig. 160

3) Place the small-dia. gear in a vise with the washer protrusion facing the lock nut, and tighten the lock nut to the specified torque. Use aluminum blocks as soft jaws when placing the gear in a vise.

Tightening torque:
92 – 104 N·m (9.4 – 10.6 kg-m, 68 – 77 ft-lb)

4) Stake the lock nut after tightening.

INSTALLATION

1) Install the drive pinion shaft ASSY in the clutch housing.

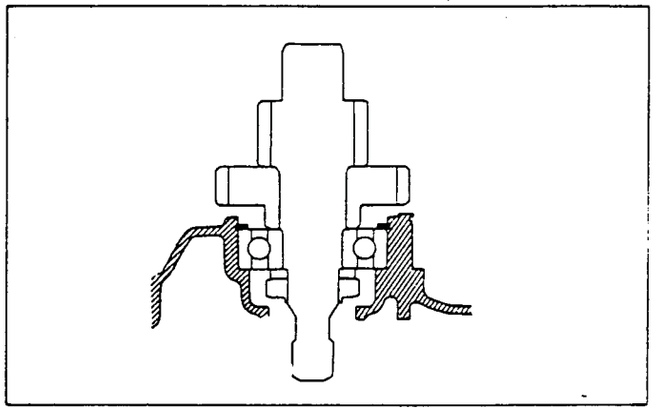


Fig. 161

2) Secure with the snap ring. The snap ring can be easily installed by pushing it down with a screwdriver inserted into the gear service hole.

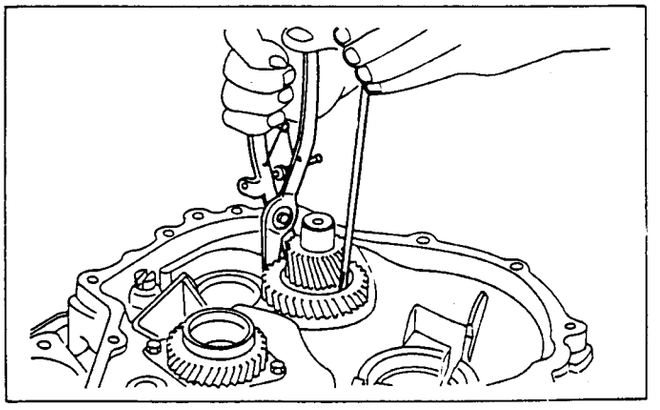


Fig. 162

3-9 Differential Assembly

DISASSEMBLY

1) Remove bolts, and take out final gear.

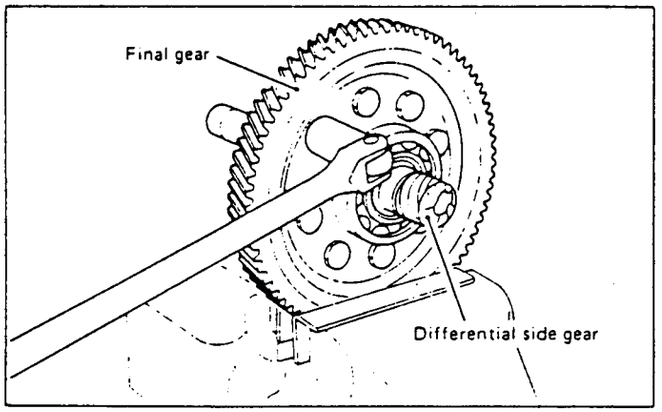


Fig. 163

2) Remove differential side gear adjusting washer from final gear side.
3) Remove straight pin from differential case, and take out differential pinion shaft. Then, remove differential pinions, differential side gears, and adjusting washer.

a. Be careful not to damage differential side gear ground portion which is a sliding surface for oil seal.
b. Place removed adjusting washer for final gear side separately from those for differential case side.

4) Using PULLER ASSY (399703600) and SEAT (39952015), pull out left and right ball bearings from differential case.

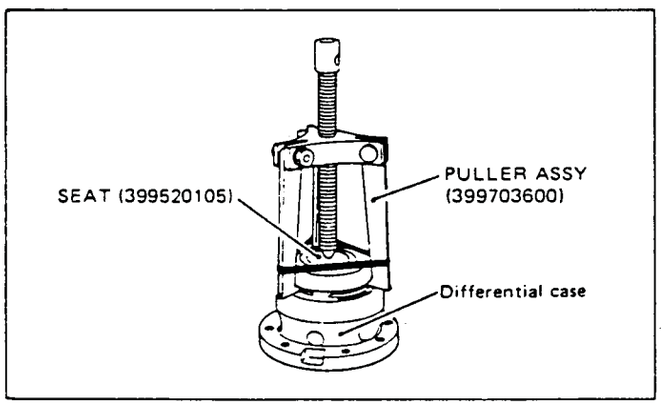


Fig. 164

5) Remove the snap ring and drive the ball bearing out of the clutch housing.

INSPECTION

1) Check final gear of differential, drive pinion, differential pinion, differential side gear, washer, differential pinion shaft, etc. for damage, wear, burns, etc. and replace if defective.
2) Check differential case for cracks and other defects and replace if defective.

ASSEMBLY

a. Ensure the mark on the ball bearing faces upward during installation.
b. Do not re-use the ball bearing after removal.

1) Assemble ball bearing onto final gear, using BEARING INSTALLER (899580100).

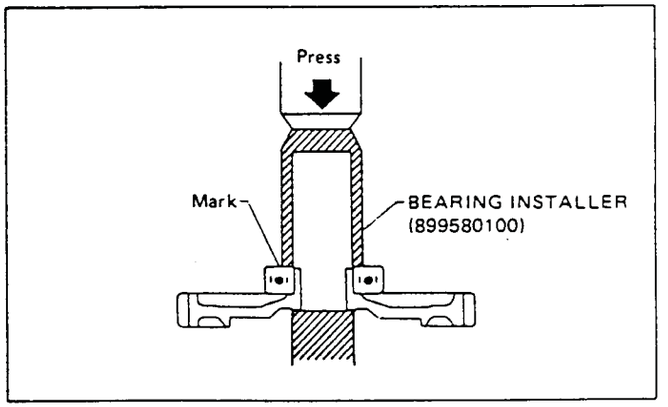


Fig. 165

2) Assemble ball bearing onto differential case, using BEARING INSTALLER (899580100).

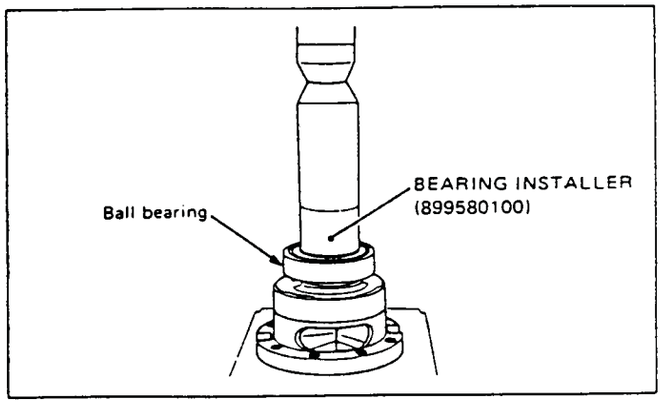


Fig. 166

3) Assemble pinion, washer (27.1 x 42 x t mm), side gear, pinion shaft, and straight pin (4 x 35 mm) on differential case side and washer (27.1 x 42 x t mm) and side gear on final gear side. Then, install differential case to final gear with tightening torque specified below, and measure backlash. Vary washer to obtain backlash in the range between 0.05 mm (0.0020 in) and 0.15 mm (0.0059 in). After assembling check to ensure that gears turn smoothly.
Install adjusting washers with chamfered side of inside diameter toward differential side gear.

Tightening torque:
57 – 67 N·m (5.8 – 6.8 kg-m, 42 – 49 ft-lb)

Adjusting washers 27.1 x 42 x t mm	
Part No.	Standard thickness mm (in)
803027041	1.000 (0.0394)
803027042	1.050 (0.0413)
803027043	1.100 (0.0433)

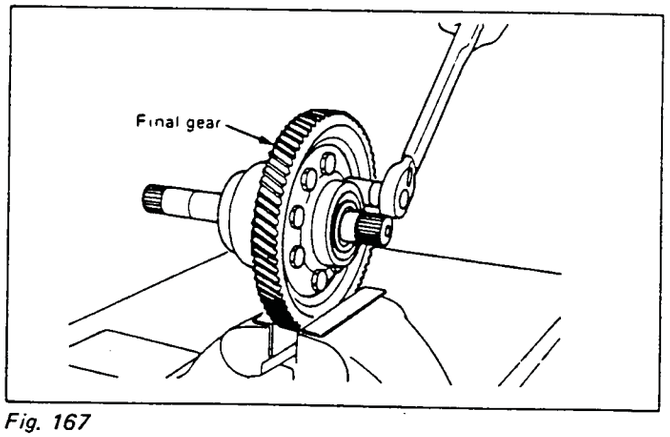


Fig. 167

Ensure the chamfered bore side of the washer (27.1 x 42 x t) faces the differential side gear during installation.

4) Press the ball bearing into the bore in the clutch housing.

Ensure the mark on the bearing faces upward during installation.

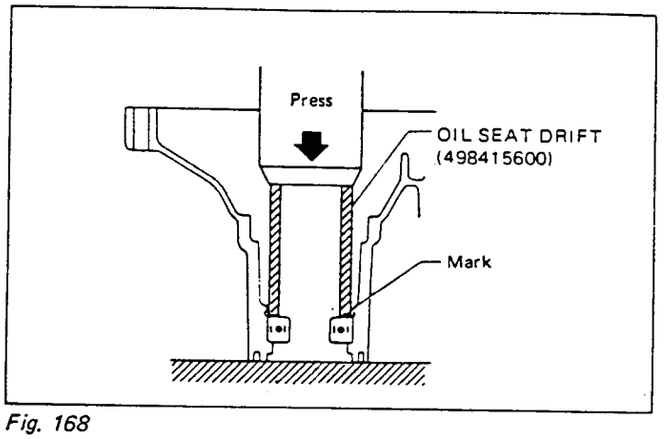


Fig. 168

5) Install the snap ring.
6) Install differential gear oil seal L [27 x 45 x 9 mm (1.06 x 1.77 x 0.35 in)] into main case using the OIL SEAL INSTALLER (498175600).

- **Oil seal with mark L must be used, and gear oil must be applied to lips. If oil seal for case (oil seal R) is used, oil leakage will result.**
- **Press oil seal into place until installer rests evenly against main case.**

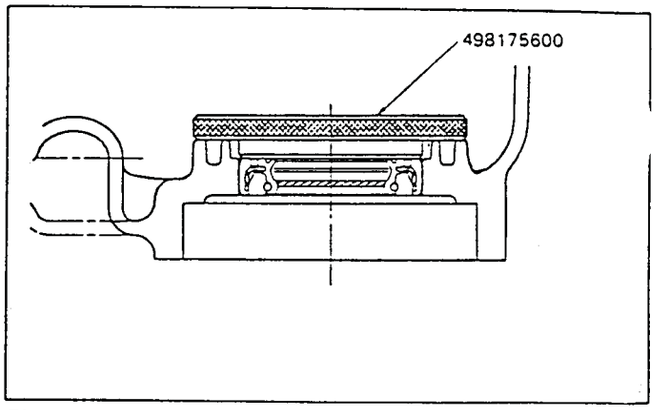


Fig. 169

7) Install differential gear oil seal R [27 x 45 x 9 mm (1.06 x 1.77 x 0.35 in)] into main case using the OIL SEAL INSTALLER (498175600).

- **When oil seal R of differential assembly is installed, check to ensure that it has mark R. If oil seal for case (oil seal L) is used, oil leakage will result. Use care not to install wrong oil seal.**
- **Check to ensure that gear oil has been applied to lips and install oil seal with mark up.**

- **Press oil seal into place until installer rests evenly against clutch housing.**

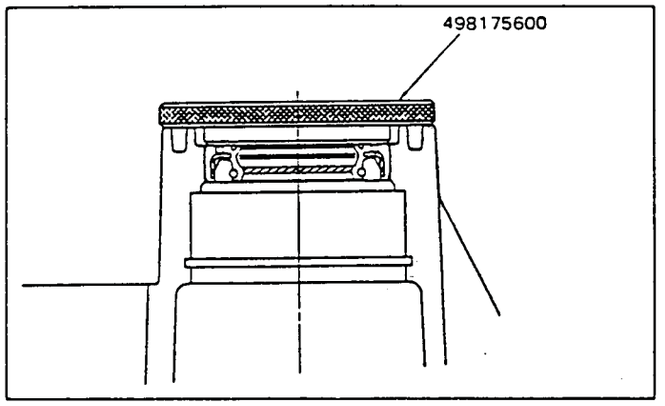


Fig. 170

3-10 Pitot Pipe -Refer to Page 55 for assembly information.

REMOVAL AND INSTALLATION

Remove the straight pin, then the pitot pipe.

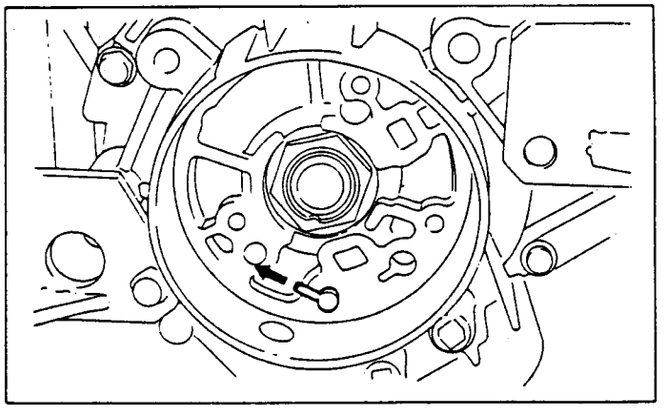


Fig. 171

3-11 Shifter Fork and Parking Assembly

INSPECTION

1) Replace the shifter fork if the pawl is excessively worn.
2) Replace the shifter cam if the "detent" portion or cam groove is excessively worn.
3) Replace the parking pawl, parking support plate and/or parking rod if excessively worn.

3-12 Transfer Shaft Assembly and Bearing Case Assembly (4WD)

REMOVAL

EXTENSION ASSY

Remove bolts, and separate extension and gasket from clutch housing.

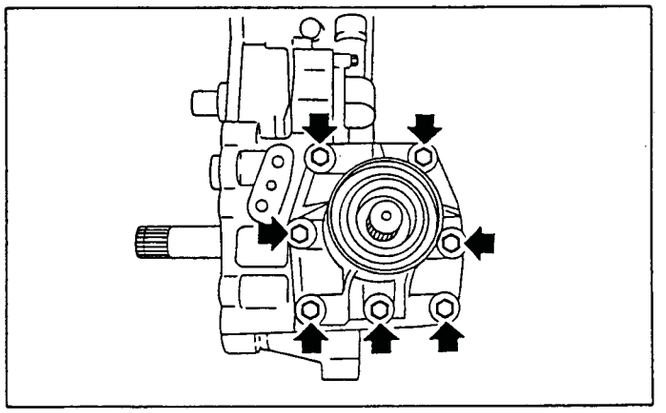


Fig. 172

TRANSFER SHAFT ASSY

Remove the bolts. Remove the transfer shaft and height adjusting shim(s) from the clutch housing.

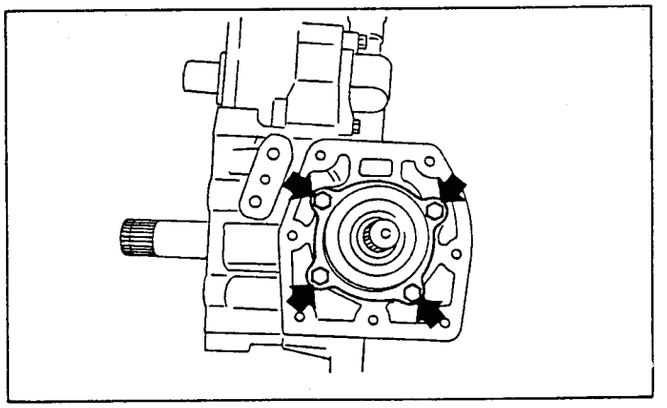


Fig. 173

BEARING CASE ASSY

Remove bolts, and separate bearing case ASSY and height adjusting shim from clutch housing.

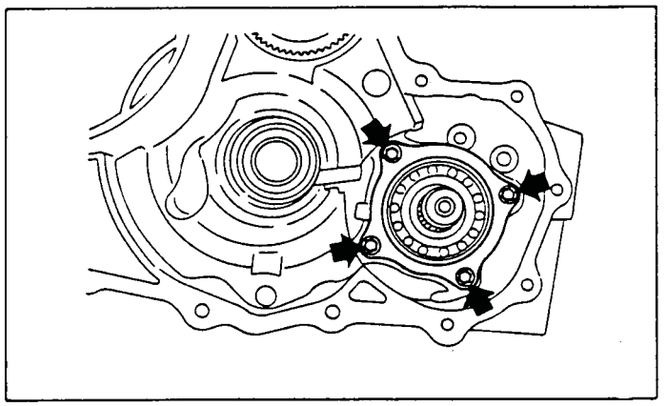


Fig. 174

DISASSEMBLY

TRANSFER SHAFT ASSY

1) Straighten the lock nut at staked portion.
2) Place the transfer shaft in a vise, and loosen the lock nut using the SOCKET WRENCH (499987100).

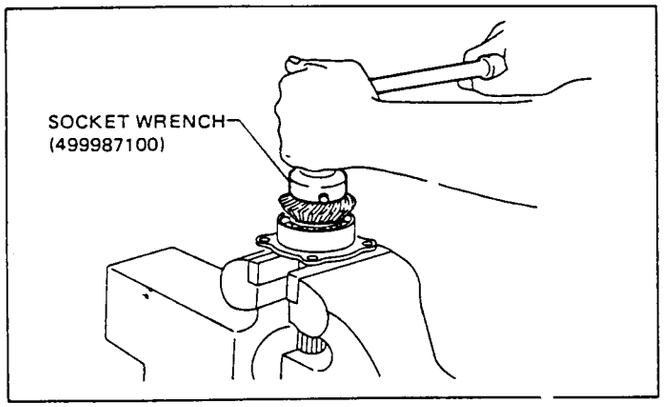


Fig. 175

3) Press the hypoid drive gear from the transfer shaft, using the REPLACER (498517000).

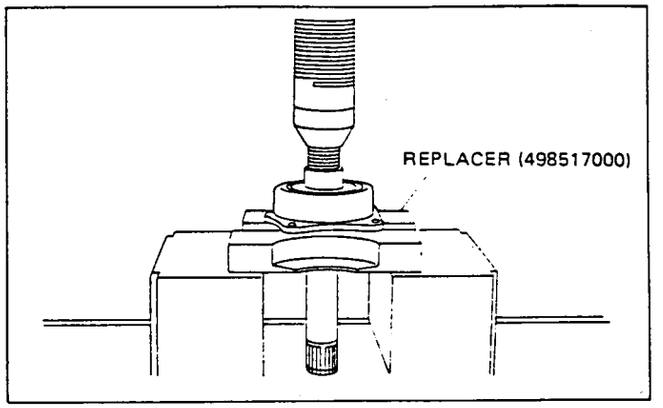


Fig. 176

4) Press the transfer shaft from ball bearing.

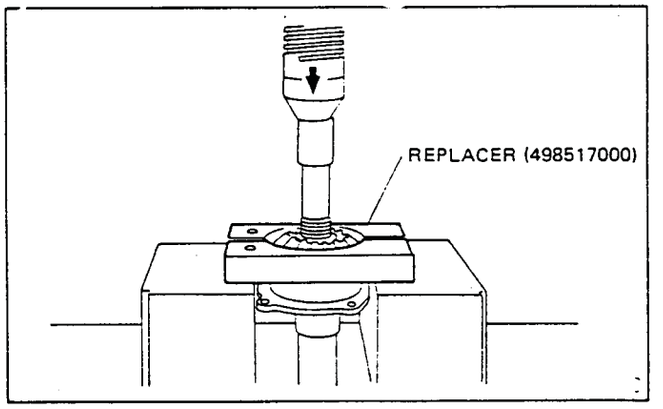


Fig. 177

5) Using the REPLACER (498517000), press the bearing out of the transfer driven gear.

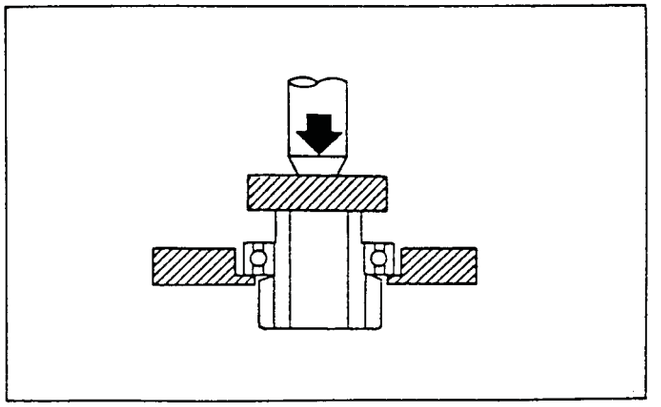


Fig. 178

BEARING CASE ASSY

1) Remove the extension case.
2) Remove the bolts which secure the bearing holder, and remove the bearing case ASSY from the clutch housing.
3) Straighten the lock nut at staked portion. Remove the lock nut using the BEVEL GEAR STAND (498405400).

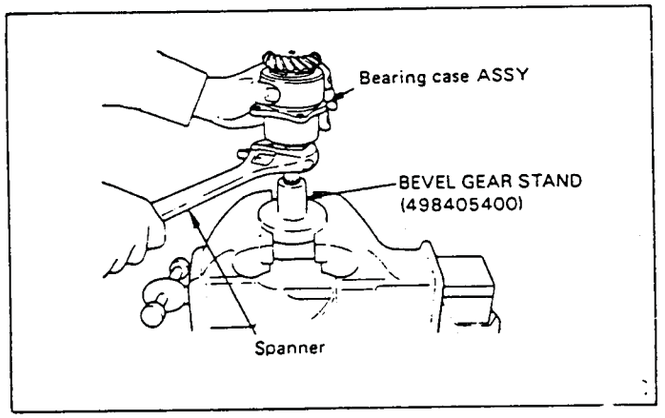


Fig. 179

4) Remove bevel driven gear using MAIN SHAFT REMOVER (899864100), REMOVER (899714110).

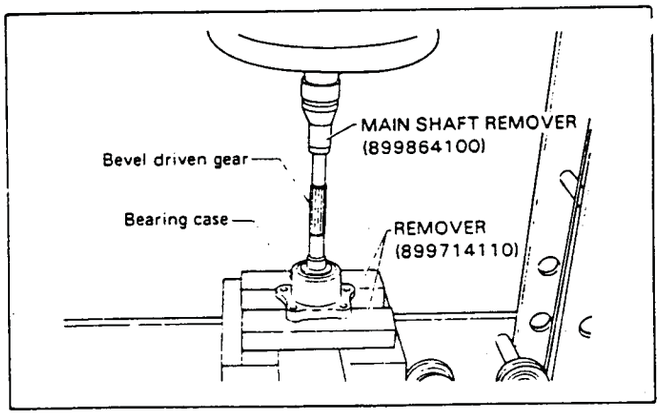


Fig. 180

5) Remove front bearing cone.
6) Remove rear bearing cone from bevel driven gear, using BEVEL GEAR REPLACER (498515400), MAIN SHAFT REMOVER (899864100).

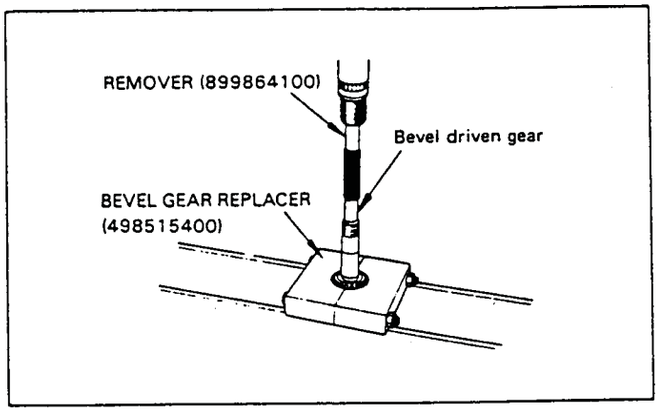


Fig. 181

7) Press out bearing races from bearing case, using OIL SEAL OUTER RACE PULLER ASSY (398527700).

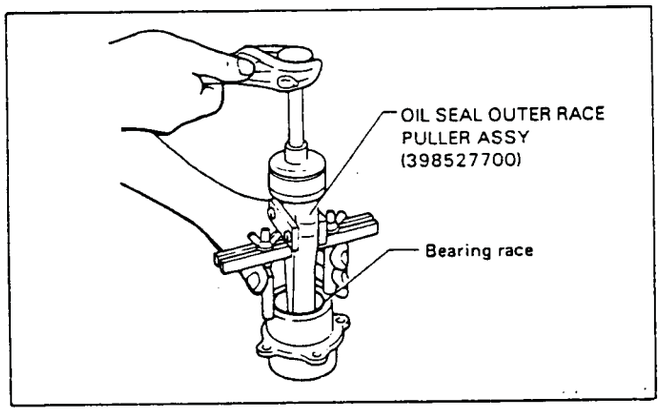


Fig. 182

INSPECTION

GEAR

1) Replace the gear if the tooth face is damaged or excessively worn.
2) Replace the gear if the cone surface is seized or damaged.
3) Replace the gear if the perimeter or inner wall is damaged or excessively worn.

Drive gear and driven gear should be replaced as a set.

Ball bearing

Replace the bearing if it is seized or excessively worn.

Apply ATF to a noisy bearing and spin the bearing. If it is still noisy or spins unsmoothly, replace.

ASSEMBLY

Reassemble all parts by reversing order of disassembly, while paying attention to the following points.

- The removed oil seal, snap ring, spring pin, lock nut and gasket must not be reused.
- Apply ATF to all sliding surfaces of the bearing, gears, etc.

TRANSFER SHAFT ASSEMBLY

1) Handle drive and driven gears of hypoid gears as a set.

The bevel driven gear used with the 4WD ECVT model is provided with a groove for identification purposes.

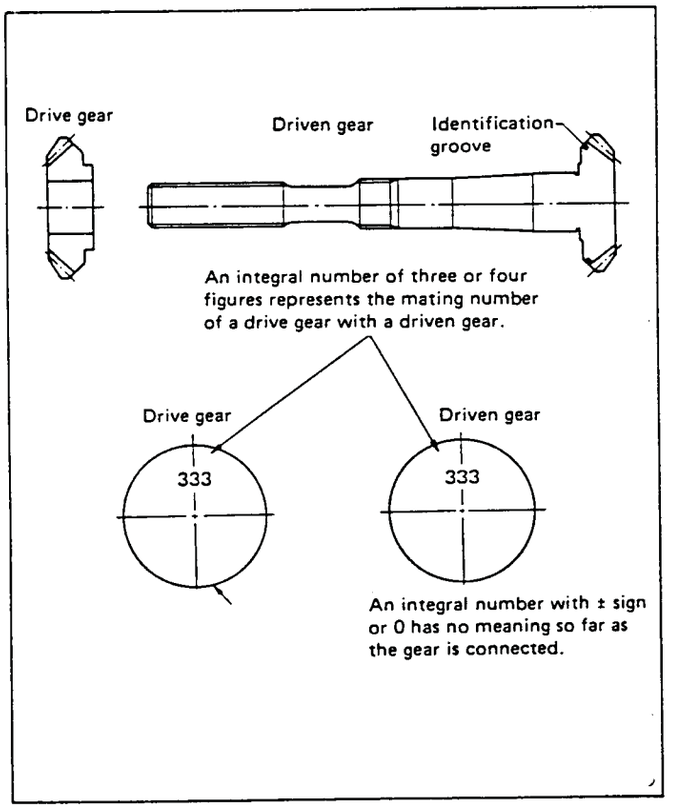


Fig. 183

2) Press the ball bearing onto the transfer shaft.

The drive gear and driven gear should be replaced as a unit.

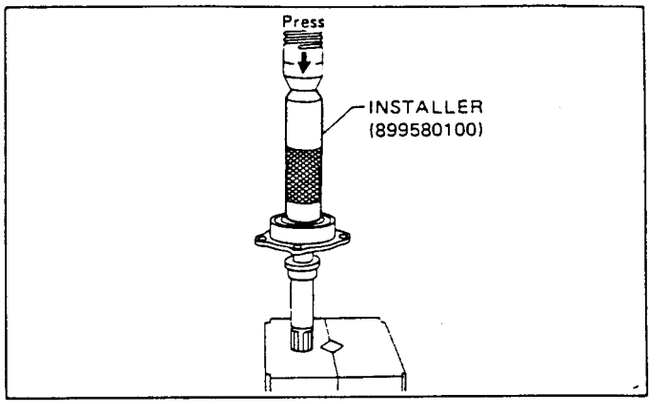


Fig. 184

3) Install the woodruff key in the shaft groove and press the drive gear onto the shaft.

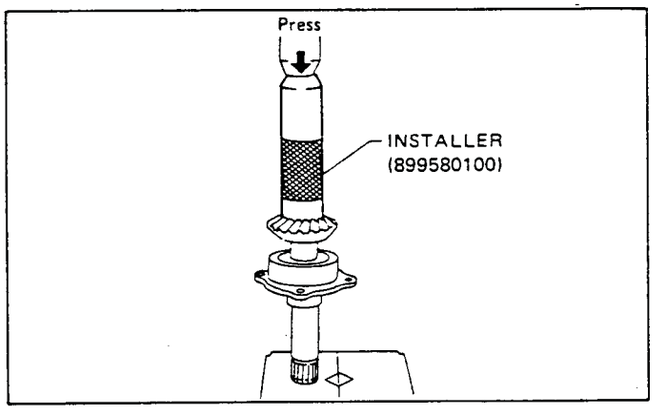


Fig. 185

4) Install the lock washer. Place the shaft in a vise and tighten the lock nut to specifications.

Tightening torque:
73 – 84 N·m (7.4 – 8.6 kg-m, 54 – 62 ft-lb)

5) Press the bearing into the bore in the transfer driven gear.

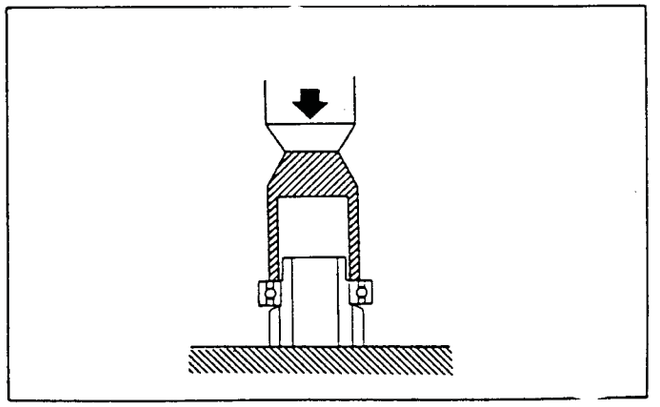


Fig. 186

BEARING CASE ASSEMBLY

1) Install front and rear bearing races into bearing case, case, using DRIVE PINION OUTER RACE DRIFT HANDLE (398477701), BEARING OUTER RACE DRIFT (398477702), DIFFERENTIAL CARRIER STAND (498215402).

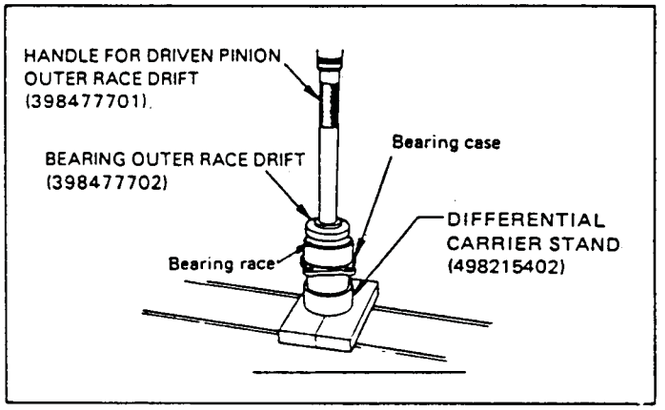


Fig. 187

2) Press-fit rear bearing cone onto bevel driven gear, using BEVEL GEAR, BEARING INSTALLER (498175400) and MAIN SHAFT REMOVER (899864100).

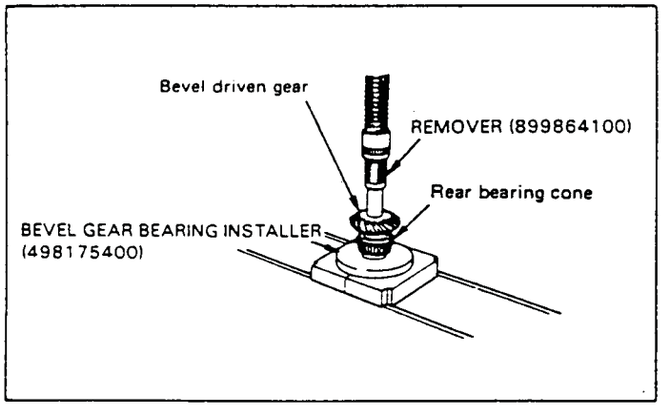


Fig. 188

3) Install bevel driven gear, with collapsible spacer attached on it, into bearin gcase.
Before installing, apply gear oil to bearing.

4) Press-fit front bearing cone into bearing case, using BEVEL GEAR BEARING INSTALLER (498175400) and MAIN SHAFT REMOVER (899864100). At that time, apply gear oil to bearing.

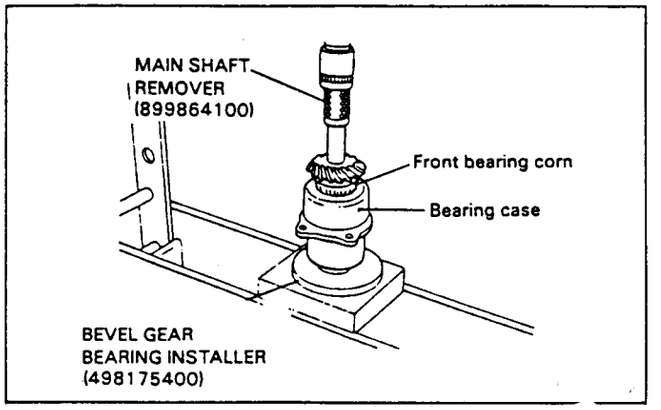


Fig. 189

5) Install lock washer and nut. Using BEVEL GEAR STAND (498405400), tighten lock nut until there is no play in bearing case and bevel driven gear, then hook a spring balance into bolt hole of bearing case to measure starting torque. If preload is insufficient, retighten lock nut another 5° to 10°. Do not perform caulking until tooth contact pattern check is completed.
If preload is excessive, replace spacer.

Load:
9.32 – 18.63 N (0.95 – 1.9 kg, 2.09 – 4.19 lb)
Starting torque:
0.39 – 0.78 N·m (4.0 – 8.0 kg-cm, 3.5 – 6.9 in-lb)

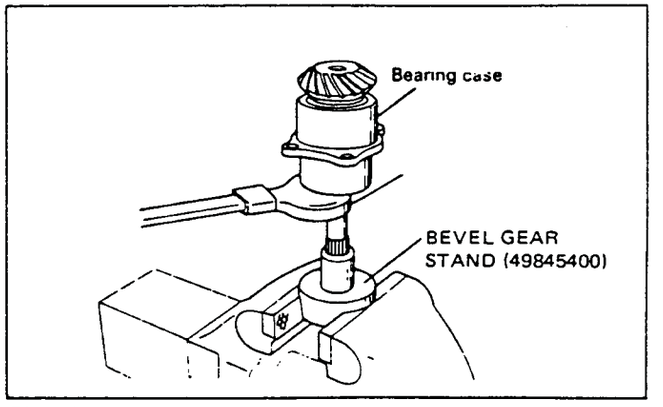


Fig. 190

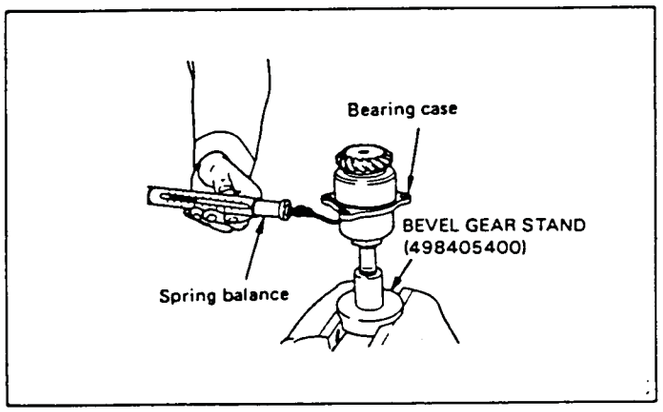
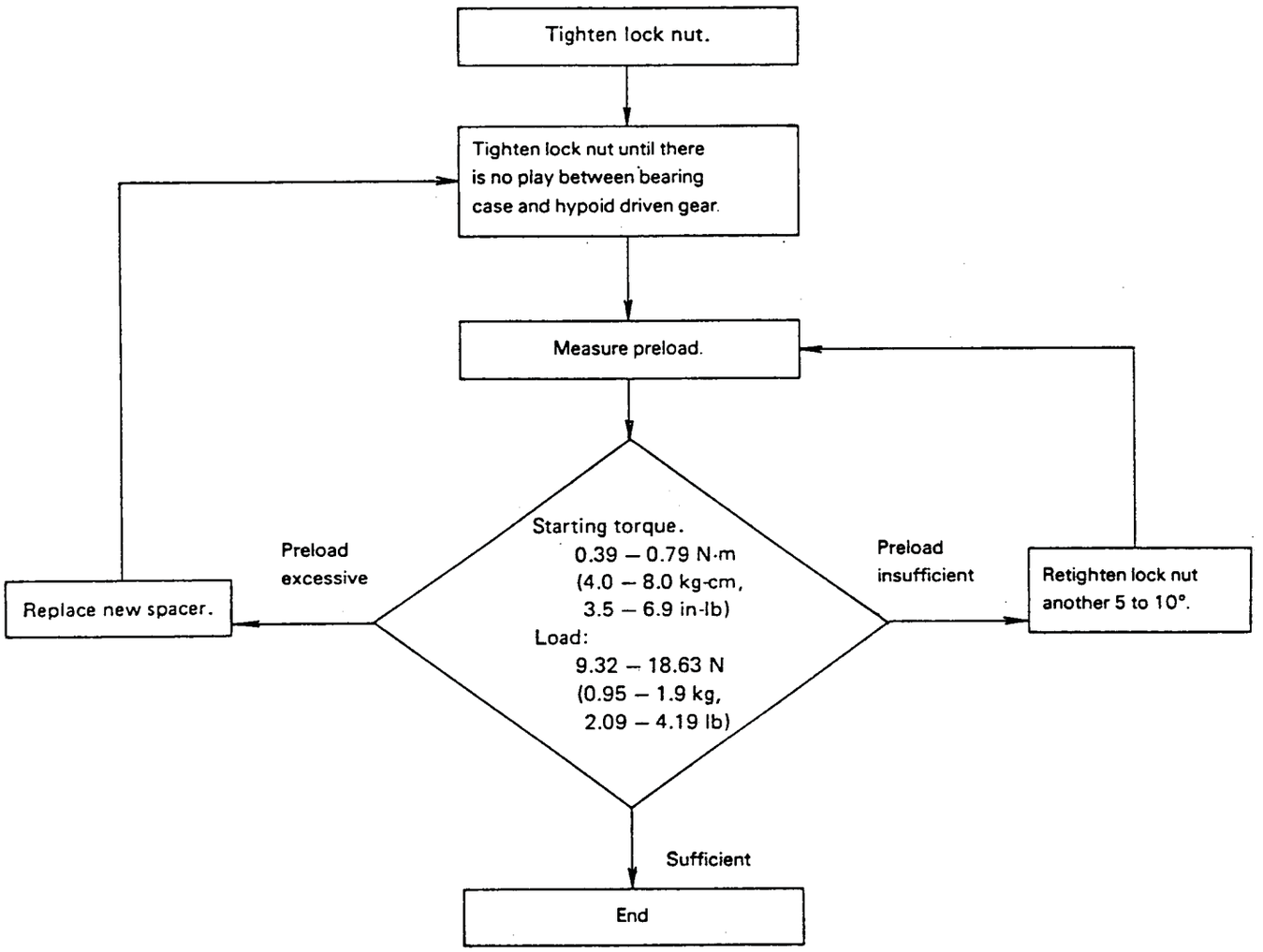

Bearing case
BEVEL GEAR STAND
(498405400)
Spring balance

Fig. 191


Tighten lock nut.
Tighten lock nut until there is no play between bearing case and hypoid driven gear.
Measure preload.
Starting torque.
0.39 – 0.79 N·m
(4.0 – 8.0 kg-cm,
3.5 – 6.9 in-lb)
Load:
9.32 – 18.63 N
(0.95 – 1.9 kg,
2.09 – 4.19 lb)
Preload excessive
Replace new spacer.
Preload insufficient
Retighten lock nut another 5 to 10°.
Sufficient
End

INSTALLATION

Selection of bevel gear backlash adjusting shims

1) Temporarily install the transfer shaft ASSY on clutch housing with old shim(s) in place.
2) Temporarily install the bearing case ASSY on the clutch housing without using shim(s).
3) Fasten MAGNET BASE PLATE (498255400) to clutch housing with bolt (8 x 20 mm), and mount MAGNET BASE (498247001) and DIAL GAUGE (498247100).
4) Insert dial gauge probe through backlash adjusting hole and set it on bevel driven gear.

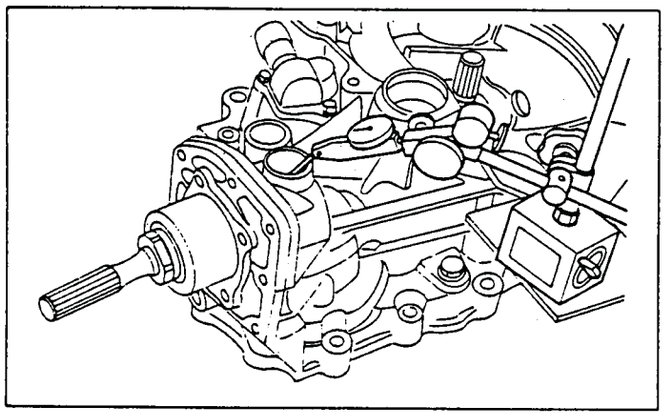


Fig. 192

5) Slowly force the bevel driven gear shaft in, hold in at the point where the bevel gear backlash is "0", and measure clearance between clutch housing end face and bearing flange with THICKNESS GAUGE (49966700).

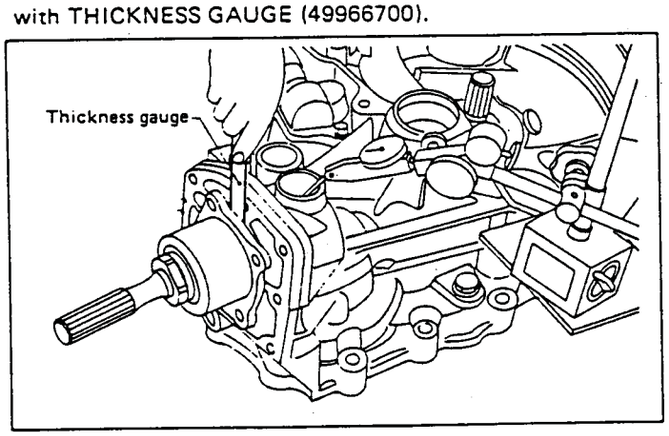


Fig. 193

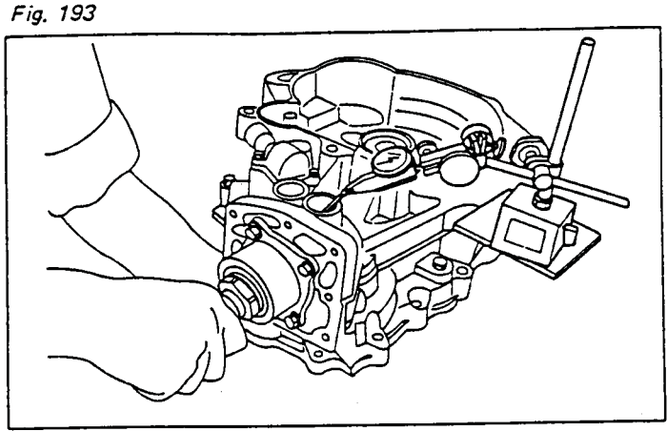


Fig. 194

6) Pull out bearing case ASSY.
7) Attach to bearing case ASSY shim with a thickness of clearance measured in 8) plus 0.15 mm (0.0059 in).

Part No.	t mm (in)
33286KA000	0.150 (0.0059)
33286KA010	0.175 (0.0069)
33286KA020	0.200 (0.0079)
33286KA030	0.225 (0.0089)
33286KA040	0.250 (0.0098)
33286KA050	0.275 (0.0108)
33286KA060	0.300 (0.0118)
33286KA070	0.500 (0.0197)

8) Add shim(s) to the bearing case ASSY, and temporarily install the bearing case ASSY on the clutch housing.
9) To measure the backlash, turn the bevel driven gear while firmly holding the transfer shaft with hand.

Backlash specification:
0.10 – 0.15 mm (0.0039 – 0.0059 in)

10) If the specified backlash is not obtained, vary transfer shaft ASSY shim and/or bearing case ASSY shim.
- To increase the backlash, equally increase shim thickness for both the transfer shaft and bearing case.
- To decrease the backlash, equally decrease shim thickness for both the transfer shaft and bearing case.

11) Pull out transfer shaft ASSY and bearing case ASSY.

Installing transfer shaft ASSY and bearing case ASSY

1) Insert transfer shaft ASSY into clutch housing with shim, tighten bolts to the specification to secure transfer shaft ASSY.

Tightening torque:
26 – 32 N·m (2.7 – 3.3 kg-m, 20 – 24 ft-lb)

2) Apply a thin even coat of red-lead to bevel driven gear teeth surface.
Then tighten bolts to the specified torque to fasten bearing case ASSY together with shim.

Tightening torque:
26 – 32 N·m (2.7 – 3.3 kg-m, 20 – 24 ft-lb)

3) Check backlash.

Backlash specification:
0.10 – 0.15 mm (0.0039 – 0.0059 in)

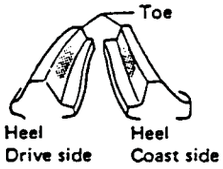
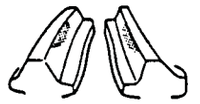
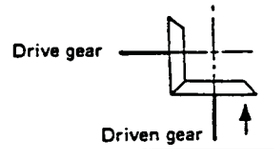
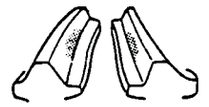
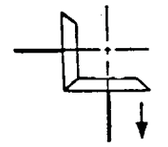
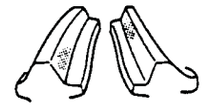
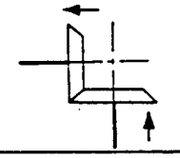
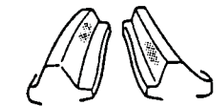
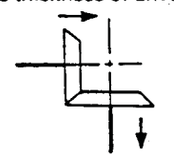
Tooth contact between drive and driven hypoid gear		
Condition	Contact pattern	Adjustment
Proper contact		
Backlash is too large.		Reduce the backlash. 
Backlash is too small.		Increase the backlash. 
Adjusting shim (drive gear shim) thickness is too large.		Reduce the thickness of drive gear shim. 
Adjusting shim (drive gear shim) thickness is too small.		Increase the thickness of drive gear shim. 

Fig. 195

hecking hypoid gear tooth contact

Hold the transfer shaft down and turn the bevel driven shaft several times. If the tooth contact is incorrect, readjust.

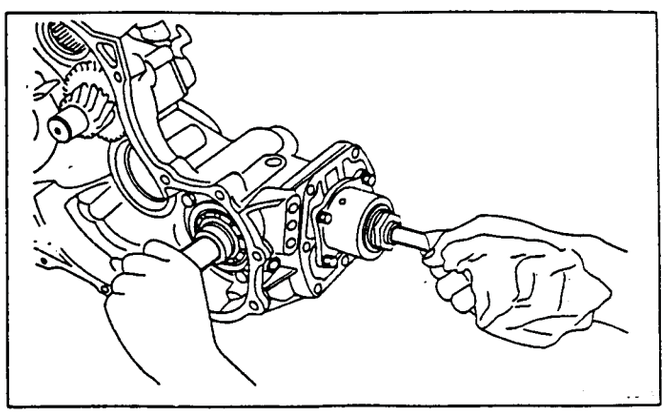


Fig. 196

1) Press oil seal into extension case, using OIL SEAL DRIFT (498415500).

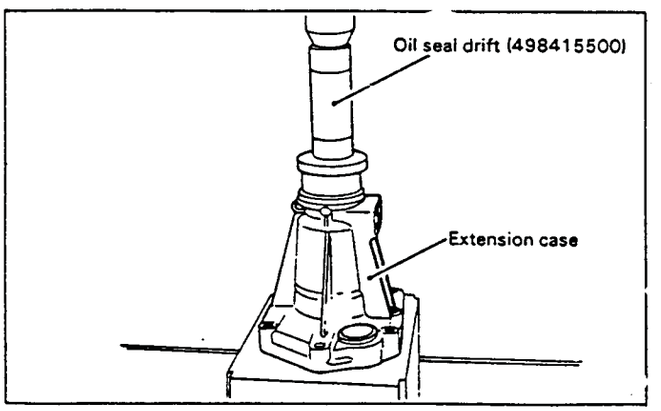


Fig. 197

2) Install extension CP together with extension gasket to clutch housing by tightening bolts. (No plain washer involved)

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

4 Assembly of Overall Transmission

- Before assembling the transmission case and clutch housing, drain ATF completely and then wipe remaining ATF off the interiors to prevent it from coming in contact with the mating surfaces of the case and housing where liquid gasket (004403007) is to be applied.
- If either the primary pulley or the secondary pulley is damaged, replace both pulleys as a unit. (The side case can be re-used if not damaged.)
- When slip marks on the steel belt are noticed, replace the steel belt, primary pulley and secondary pulley.

1) Attach the STAND (499935600) to the side case.

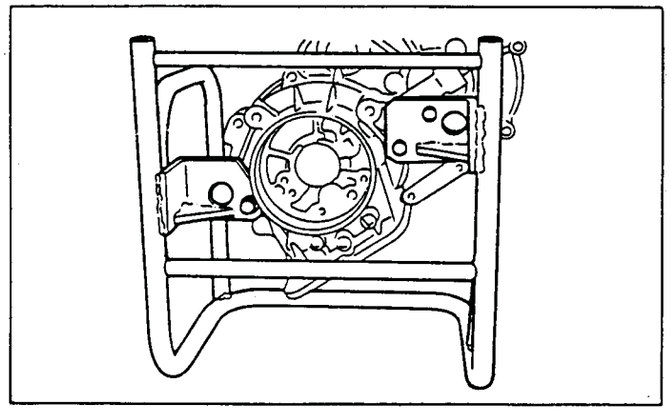


Fig. 198

2) Connect the pitot pipe.
Face the straight pin toward the center of the pulleys. Then, install the seal ring on the secondary guide using the SEAL RING GUIDE (499305500).

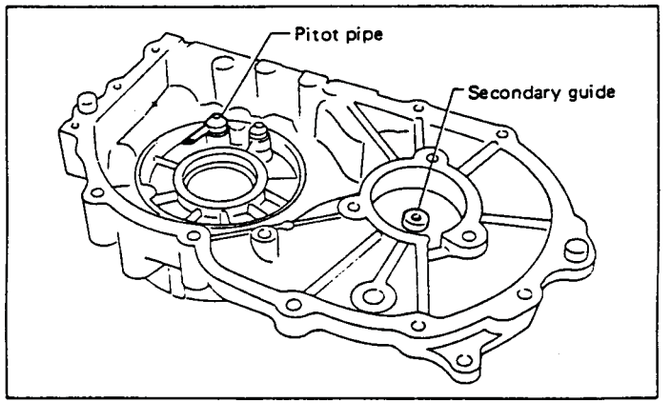


Fig. 199

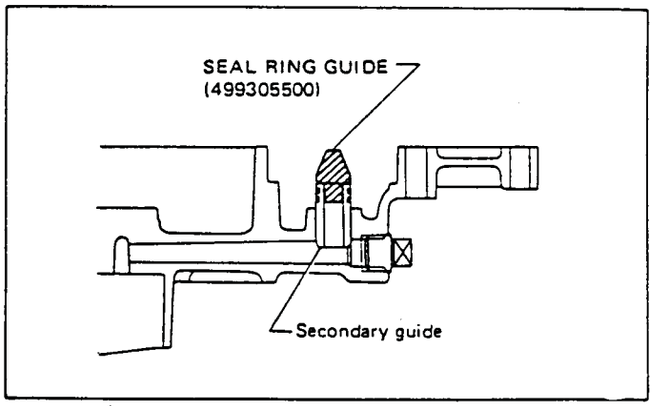


Fig. 200

3) Adjusting the pulley alignment and the primary pulley end play.

Replacement of pulleys and/or side case

- Adjusting the pulley alignment

(1) Remove all traces of old liquid gasket from the mating surface of the side case and clean, as required.
(2) Dress the mating surface of the side case to remove burrs.
(3) Wash clean the side case to remove all traces of grease.
(4) Secure the GAUGE (499575700) to the side case using bolts.
(5) Measure the depth between the mating surface of the side case and the mounting portion of the primary pulley ball bearing and between the mating surface of the side case and the mounting portion of the secondary pulley ball bearing, using the DEPTH GAUGE (498145400).
(6) The depths must be respectively measured at four points. Determine the average values of the measurements.

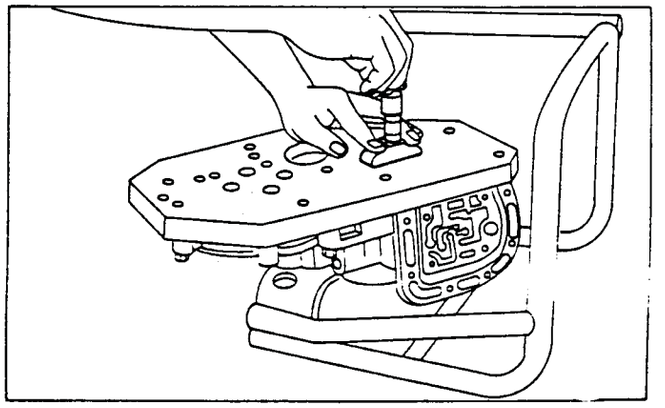


Fig. 201

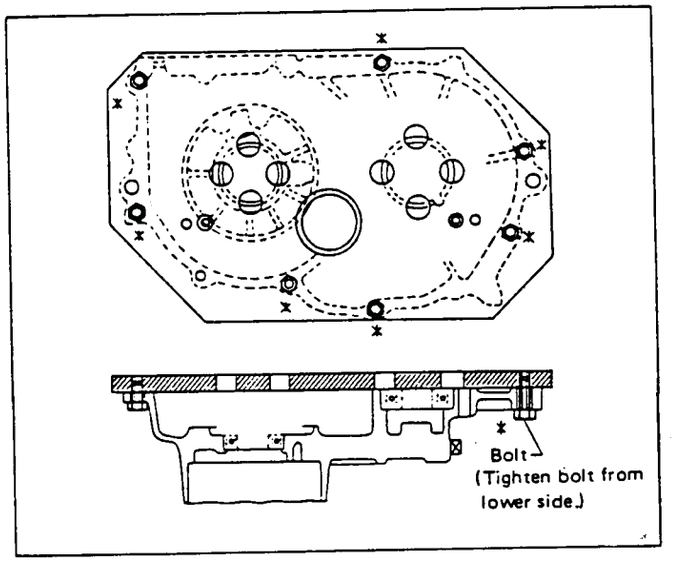


Fig. 202

x mm (Calculated value)	Part No.	t mm (in) (Shim thickness)
0 – 0.050	–	0 (0)
0.050 – 0.150	803054021	0.1 (0.004)
0.150 – 0.250	803054022	0.2 (0.008)
0.250 – 0.350	803054023	0.3 (0.012)
0.350 – 0.450	803054024	0.4 (0.016)
0.450 – 0.550	803054025	0.5 (0.020)
0.550 – 0.650	803054026	0.6 (0.024)

If the shim thickness determined by calculation overlaps the value in the next range, use a shim in either range. For example, if the calculated shim thickness is 0.250 mm, either a 0.2 or 0.3 mm (0.008 or 0.012 in) shim can be used.

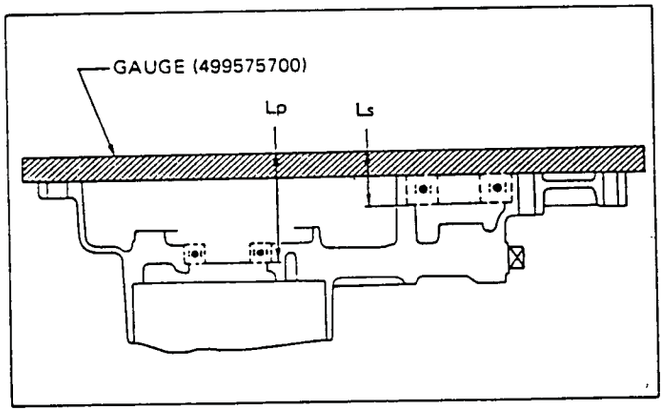


Fig. 203

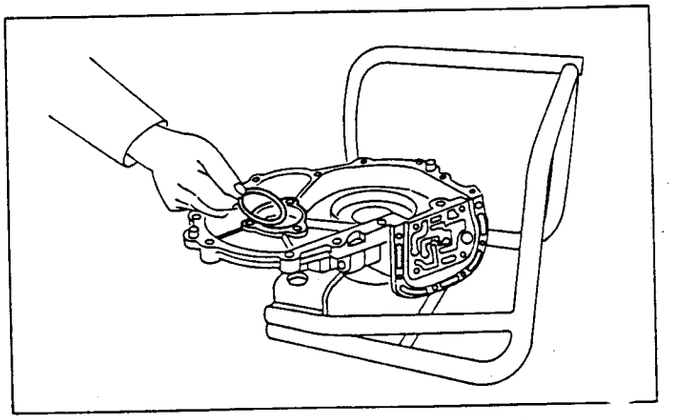


Fig. 204

(7) Equation for calculation Unit: mm

$$x = A - (B + Lp - Ls) + 0.054 - 24.45$$

where: t = Shim thickness (As a result of the calculation of the above equation. Select a suitable shim from among those listed in the following table)

A : Indicated primary pulley dimension

B : Indicated secondary pulley dimension

L_p : Depth between upper surface of gauge (499575700) and mounting portion of primary pulley bearing (average value of four-point measurements)

L_s : Depth between upper surface of gauge (499575700) and mounting portion of secondary pulley bearing (average value of four-point measurements)

24.45 : Constant

■ Adjusting the primary pulley end play.

(1) Remove all traces of old liquid gasket from the mating surface of the transmission case and clean, as required.

(2) Dress the mating surface of the side case to remove burrs.

(3) Wash clean the side case to remove all traces of grease.

(4) Secure the GAUGE (499575700) to the transmission case using bolts.

(5) Using the GAUGE (499575700) and the DEPTH GAUGE (498145400), measure the "depth" (distance) between the mating surface of the transmission case and the stepped portion at the 70 mm (2.76 in) dia. hole.

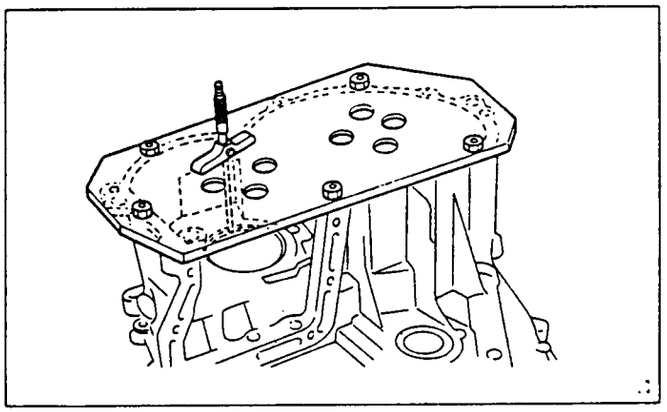


Fig. 205

(5) Equation for calculation Unit: mm

$$X = C + L_p - D - 2t$$

where: T : Snap ring thickness (Select a suitable shim whose thickness is determined by the above calculation from among those listed in the table below.)

C : Depth or distance between upper surface of gauge and the recess for the snap ring at the 70 mm (2.76 in) hole (Average value of four-point measurements)

L_p : Dimension measured under "Adjusting the pulley alignment"

D : Indicated primary pulley dimension

t : Gauge thickness (stamped on the side of gauge)

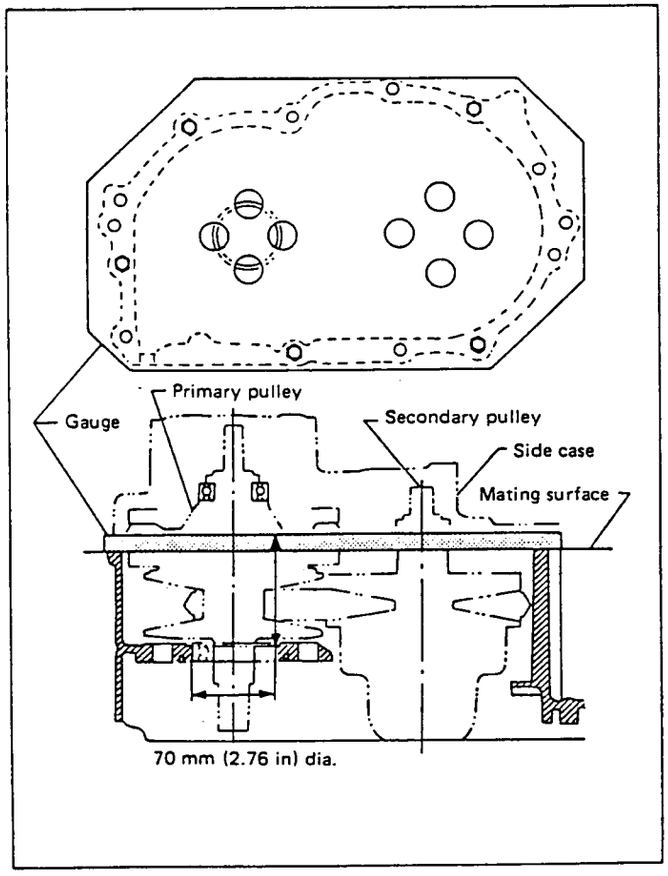


Fig. 206

x mm (Calculated value)	Part No.	T mm (in) (Snap ring thickness)
1.2 – 1.28	805062022	1.35 (0.0531)
1.28 – 1.36	805062023	1.43 (0.0563)
1.36 – 1.44	805062024	1.51 (0.0594)
1.44 – 1.52	805062025	1.59 (0.0626)
1.52 – 1.60	805062026	1.67 (0.0657)
1.60 – 1.68	805062027	1.75 (0.0689)
1.68 – 1.76	805062028	1.83 (0.0720)

If the shim thickness determined by calculation overlaps the value in the next range, use a shim in either range. For example, if the calculated shim thickness is 1.36 mm, either a 1.43 or 1.51 mm (0.0563 or 0.0594 in) shim can be used.

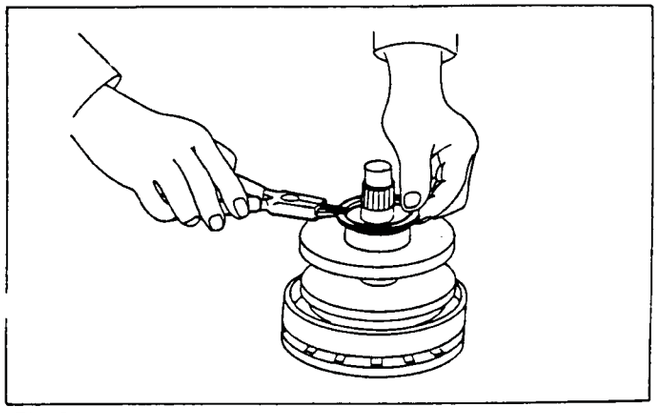


Fig. 207

Side case replacement

- Adjusting the pulley alignment

(1) Remove all traces of old liquid gasket from the mating surface of side case and clean, as reguired.
(2) Dress the mating surface of the side case to remove burrs.
(3) Wash clean the side case to remove all traces of grease.
(4) Secure the GAUGE (499575700) to the side case using bolts.
(5) Measure the depth between the mating surface of the side case and the mounting portion of the primary pulley ball bearing and between the mating surface of the side case and the mounting portion of the secondary pulley ball bearing, using the DEPTH GAUGE (498145400).
(6) The depths must be respectively measured at four points. Determine the average values of the measurements.

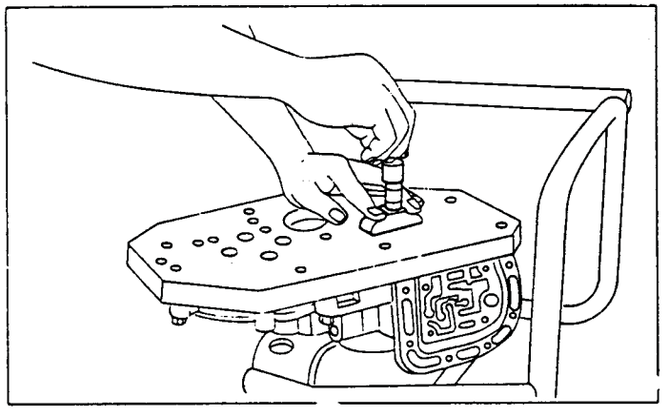


Fig. 208

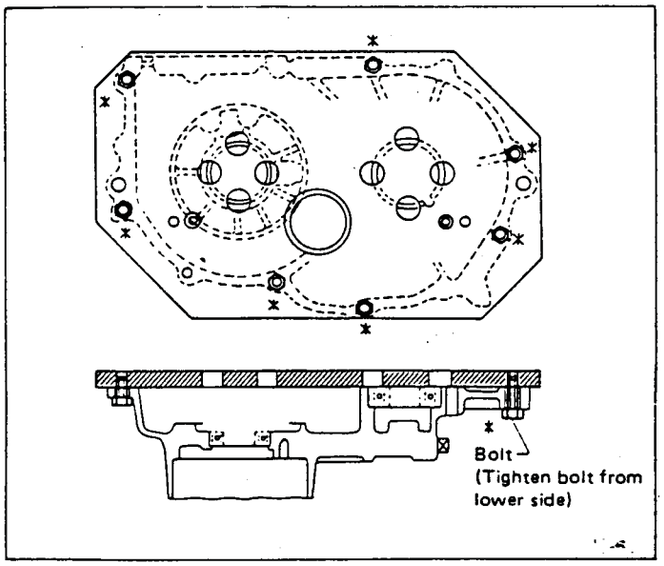


Fig. 209

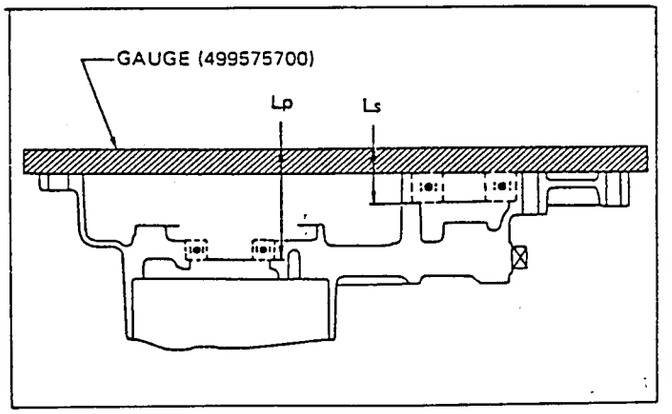


Fig. 210

(7) Equation for calculation

$$L_D = L_p - L_s$$

Where: L_D : Calculated value

(8) Measurements must be made on the new and old side cases.
L_{D1} : Calculated value of the old side case
L_{D2} : Calculated value of the new side case
(9) Shim selection
Select shim(s) determined by Equation "$L_{D2} - L_{D1}$" or "$L_{D1} - L_{D2}$", as applicable.

Case 1	If $L_{D2} - L_{D1}$ is less than 0.05, use a new shim whose thickness is the same as that (hereinafter called " old shim") used on the secondary side of the old side case.
Case 2	If $L_{D2} - L_{D1}$ is equal to or greater than 0.05, but less than 0.15, use a new shim 0.1mm (0.004in) thinner than the old shim. If the old shim is 0.1mm (0.004in) thick, a shim need not be used.
Case 3	If $L_{D2} - L_{D1}$ is equal to or greater than 0.15, but less than 0.25, use a new shim 0.2mm (0.008in) thinner than the old shim.
Case 4	$L_{D1} - L_{D2}$ is less than 0.05. Same as Case 1 above.
Case 5	If $L_{D1} - L_{D2}$ is equal to or greater than 0.05, but less than 0.15, use a new shim 0.1mm (0.004in) thicker than the old shim.
Case 6	If $L_{D1} - L_{D2}$ is equal to or greater than 0.15, but less than 0.25, use a new shim 0.2mm (0.008in) thicker than the old shim.

Part No.	t mm (in) (Shim thickness)
803054021	0.1 (0.004)
803054022	0.2 (0.008)
803054023	0.3 (0.012)
803054024	0.4 (0.016)
803054025	0.5 (0.020)
803054026	0.6 (0.024)

■ Adjusting the primary pulley end play

(1) Select a shim measured as "L_p"under "Pulley Alignment Adjustment".

L_{p1} : Dimension of the old side case

L_{p2} : Dimension of the new side case

(2) Snap ring selection

Select a snap ring determined by Equation "$L_{p2} - L_{p1}$" or "$L_{p1} - L_{p2}$", as applicable.

Unit: mm

Case 1	If $L_{P2} - L_{P1}$ is less than 0.05, use a new snap ring whose thickness is the same as that(hereinafter called the "old snap ring") used on the old primary pulley side.
Case 2	If $L_{P2} - L_{P1}$ is equal to or greater than 0.05, but less than 0.13, use a new snap ring one rank higher in thickness than the old snap ring.
Case 3	If $L_{P2} - L_{P1}$ is equal to or greater than 0.13, but less than 0.21, use a new snap ring two ranks higher in thickness than the old snap ring.
Case 4	If $L_{P2} - L_{P1}$ is equal to or greater than 0.21, but less than 0.29, use a new snap ring three ranks higher in thickness than the old snap ring.
Case 5	If $L_{P2} - L_{P1}$ is equal to or greater than 0.29, but less than 0.37, use a new snap ring four ranks higher in thickness than the old snap ring.
Case 6	If $L_{P2} - L_{P1}$ is equal to or greater than 0.37, but less than 0.45, use a new snap ring five ranks higher in thickness than the old snap ring.
Case 7	$L_{P1} - L_{P2}$ is less than 0.01. Same as Case 1 above.
Case 8	If $L_{P1} - L_{P2}$ is equal to or greater than 0.01, but less than 0.09, use a snap ring one rank lower in thickness than the old snap ring.
Case 9	If $L_{P1} - L_{P2}$ is equal to or greater than 0.09, but less than 0.17, use a new snap ring two ranks lower in thickness than the old snap ring.
Case 10	If $L_{P1} - L_{P2}$ is equal to or greater than 0.17, but less than 0.25, use a new snap ring three ranks lower in thickness than the old snap ring.
Case 11	If $L_{P1} - L_{P2}$ is equal to or greater than 0.25, but less than 0.33, use a new snap ring four ranks lower in thickness than the old snap ring.
Case 12	If $L_{P1} - L_{P2}$ is equal to or greater than 0.33, but less than 0.41, use a new snap ring five ranks lower in thickness than the old snap ring.

Part No.	T mm (in) (Snap ring thickness
805062022	1.35 (0.0531)
805062023	1.43 (0.0563)
805062024	1.51 (0.0594)
805062025	1.59 (0.0626)
805062026	1.67 (0.0657)
805062027	1.75 (0.0689)
805062028	1.83 (0.0720)

4) Set the SECONDARY PULLEY PULLER (499195400) on the secondary pulley, and expand the groove width to 52 to 53 mm (2.05 to 2.09 in).

Do not expand the groove width beyond 52 to 53 mm (2.05 to 2.09 in).

5) Place the belt on the secondary pulley and engage the V grooves of the primary and secondary pulleys with each other. While placing the belt on the primary pulley, position the primary and secondary pulleys in the side case.

To avoid scratching the cone surface, two workers are required to perform this work.

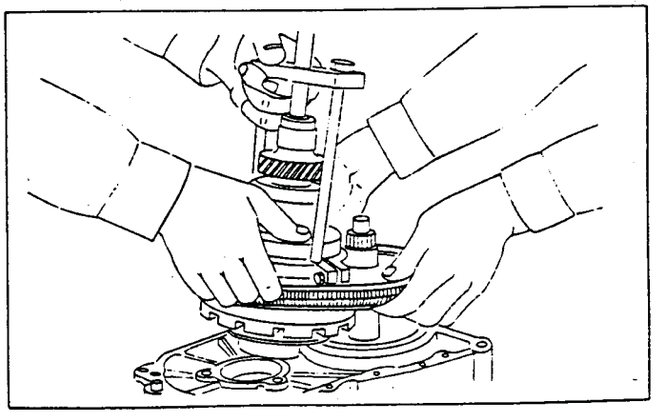


Fig. 211

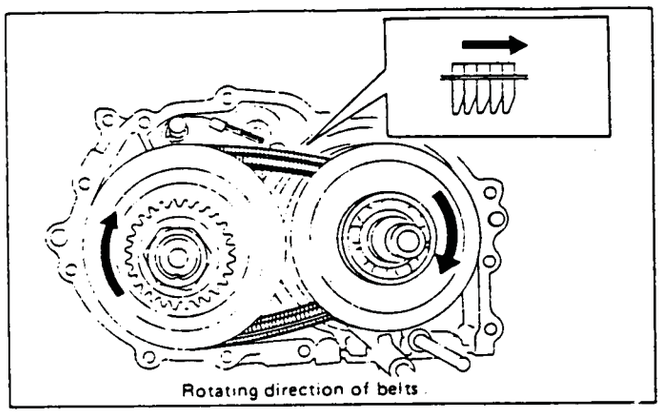


Fig. 212

a. Ensure the belt is installed in the proper direction as indicated by the arrow on it.
b. Be sure to fasten with a clip band before installation.
c. Be careful not to scratch the cone when crossing the pulleys with each other.
d. Ensure shim(s) for the secondary pulley are placed properly.

6) Remove the SECONDARY PULLEY PULLER (499195400) and the clip bend, and install the retainer.

Ensure the bolt and the O-ring are installed as a unit.

Tightening torque:
14.2 – 17.2 N·m
(1.45 – 1.75 kg-m, 10.5 – 12.7 ft-lb)

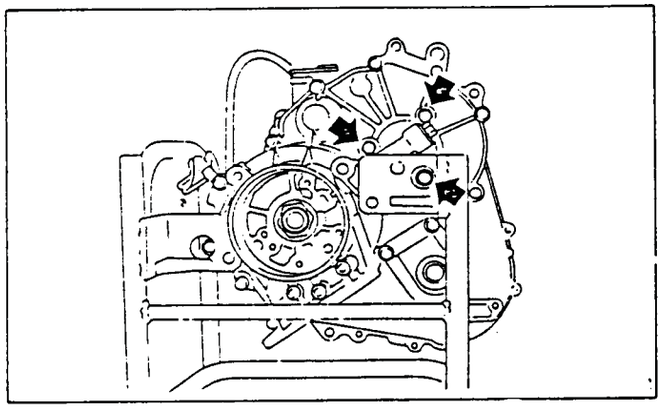


Fig. 213

7) Install the ratio sensor on the side case.

Position ratio sensor in the groove of the primary pulley, pass the rod through the ratio sensor and insert into the side case.

Ensure the stepped side of the rod faces the side case.

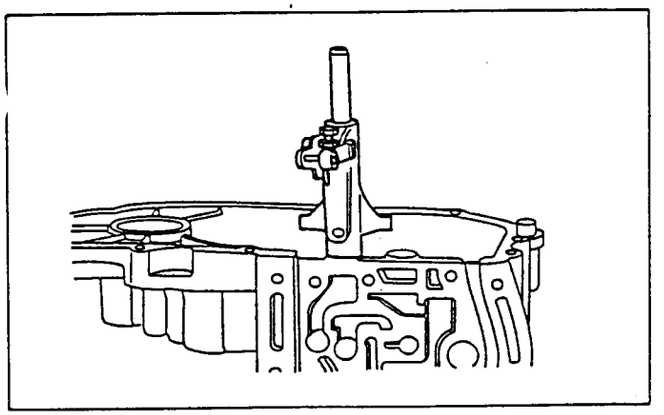


Fig. 214

8) Insert the parking pawl into the side case.

a. Ensure the pawl of the guide end is inserted into the hole in the side case (in area shown by arrow "➡") in Figure 215.
b. Ensure the spring is not caught between the parking pawl and parking cam guide (in area shown by arrow "⇨") in Figure 215.

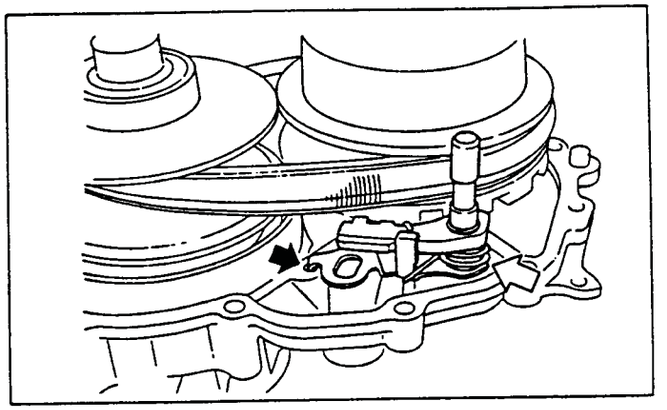


Fig. 215

9) Install the transmission case on the side case.
(1) Remove grease from the mating surfaces of the transmission and side cases and apply a continuous coat of liquid gasket (004403007) to the surfaces. Do not apply an excess amount of the liquid gasket as this causes the liquid to extend over the mating surfaces.

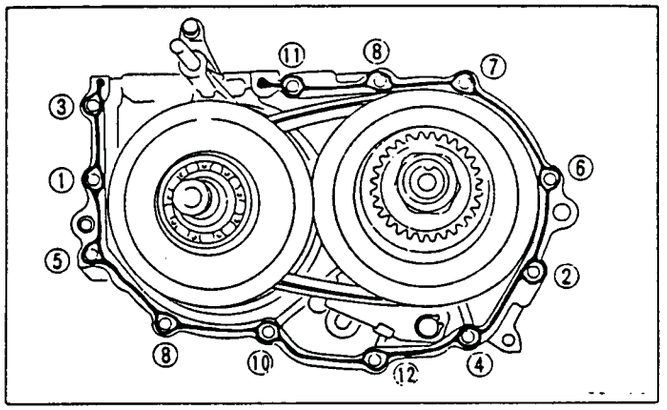


Fig. 216

(2) While inserting the ratio sensor rod, engine brake pipe, and parking pawl into the hole in the transmission case, install the transmission case on the side case.
(3) Tighten bolts in order shown in figure.

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

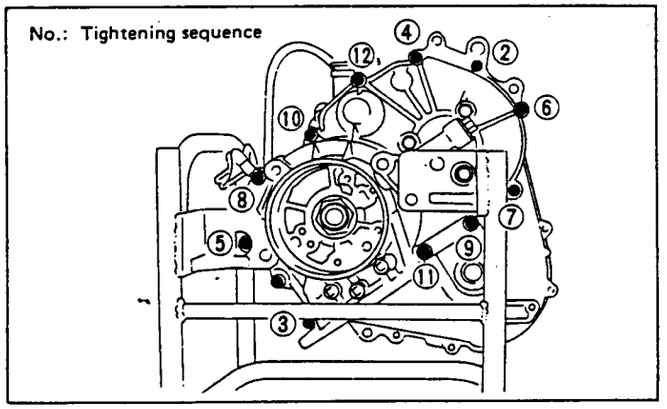


Fig. 217

10) Install the needle bearing.

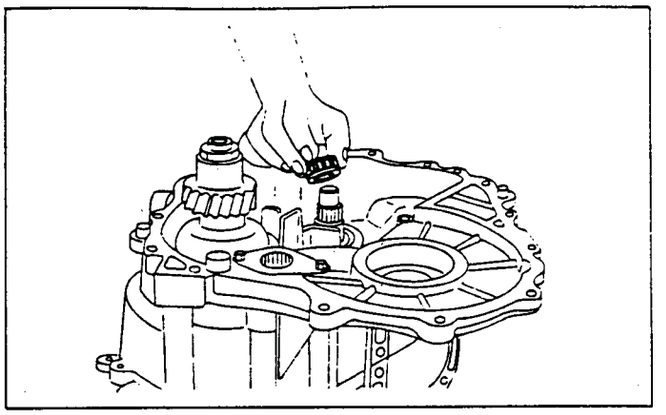


Fig. 218

11) Install the reverse idler gear.

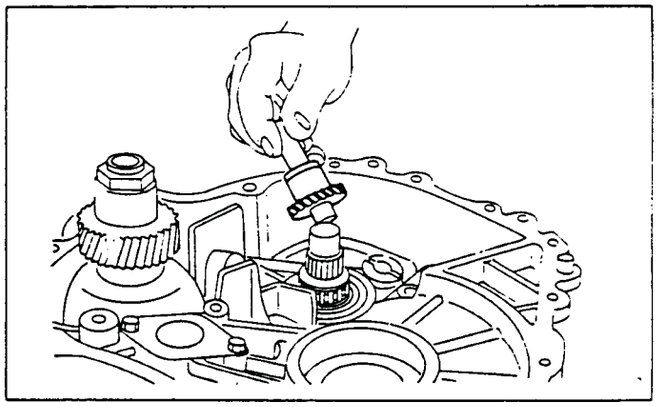


Fig. 219

Ensure the spring pin is positioned in the groove on the transmission case by turning the shaft.

12) Install the sleeve & hub ASSY, fork and reverse driven gear on the primary pulley as units.

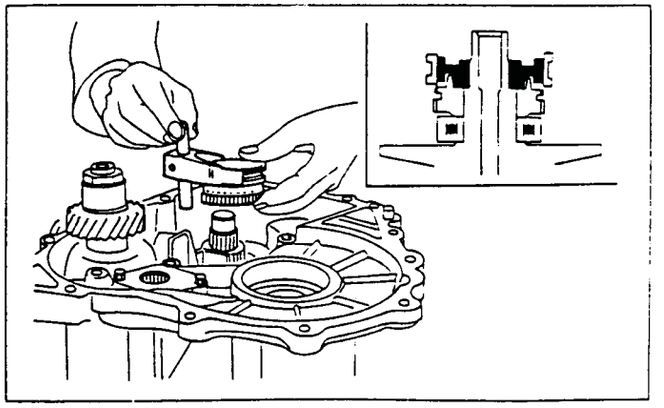


Fig. 220

13) Facing the small dia. end of the counter gear downward (toward the belt), install the counter gear onto the shaft.

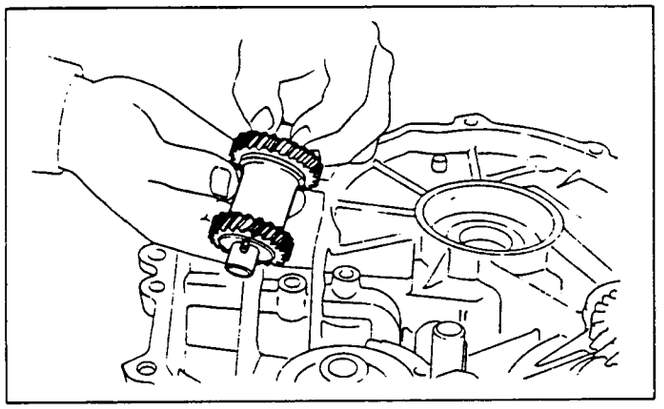


Fig. 221

14) While slightly lifting the sleeve & hub ASSY and reverse driven gear, assemble the counter gear.

Ensure the spring pin is positioned in the groove on the transmission case by turning the shaft.

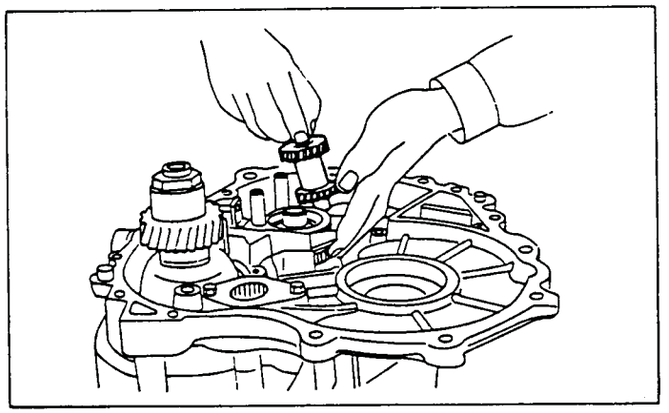


Fig. 222

15) Install the outer snap ring using the SNAP RING PLIER (499895400).

Be careful not to scratch the rolling surface of the needle bearing when installing the snap ring.

16) Install the needle bearing.

17) Install the lubricating pipe, engine brake pipe, engine brake body and lubricating nozzle.

(1) Insert the valve into the engine brake body.

(2) Temporarily tighten the engine brake body with one bolt (shown by the arrow).

(3) Insert the lubricating nozzle into the case, and connect the lubricating pipe. Install the bracket and temporarily tighten with a bolt.

(4) Connect the engine brake pipe.

Be sure to firmly insert the engine brake pipe into the hole in the side case in Figure 225.

(5) Tighten the two bolts to the specified torque.

Tightening torque:
2.9 – 3.9 N·m (0.30 – 0.40 kg-m, 2.2 – 2.9 ft-lb)

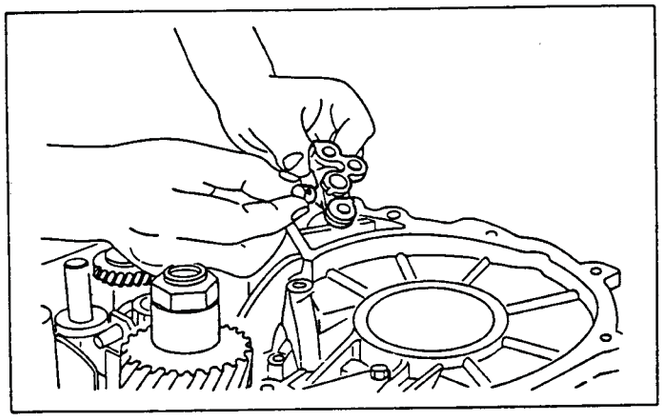


Fig. 223

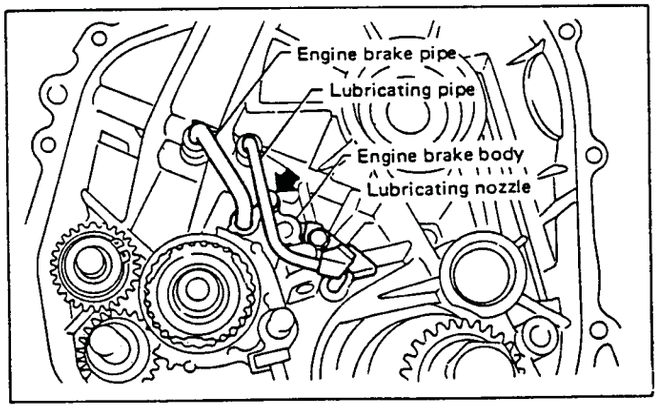


Fig. 224

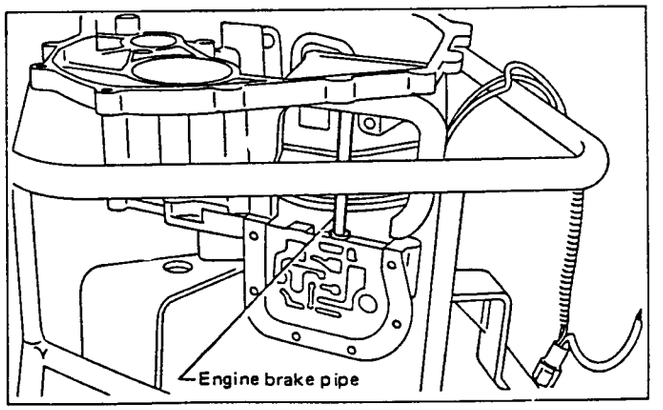


Fig. 225

18) Install the shift connecting rod.
(1) Install the parking rod on the shift cam.

Ensure the parking rod faces in the correct direction during installation.

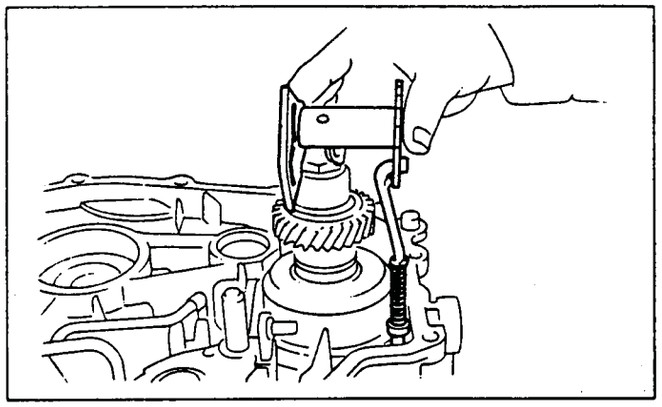


Fig. 226

(2) While inserting the fork pin into the groove in the shift cam, position the parking rod in the hole on the parking cam guide.

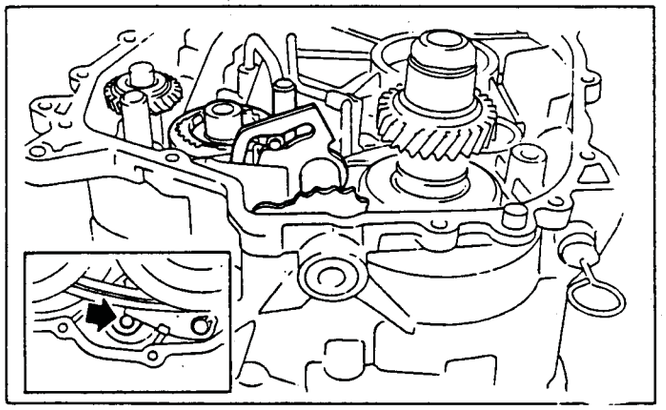


Fig. 227

(3) Pass the shift arm through the transmission case and shift cam, and insert the straight pin into the case.
(4) Install the engine brake cam on the shift arm using the snap ring and straight pin.

a. Ensure the engine brake cam is installed with the shift arm facing the "ECVT" mark side.
b. Position the shift arm so that the straight pin is horizontal.

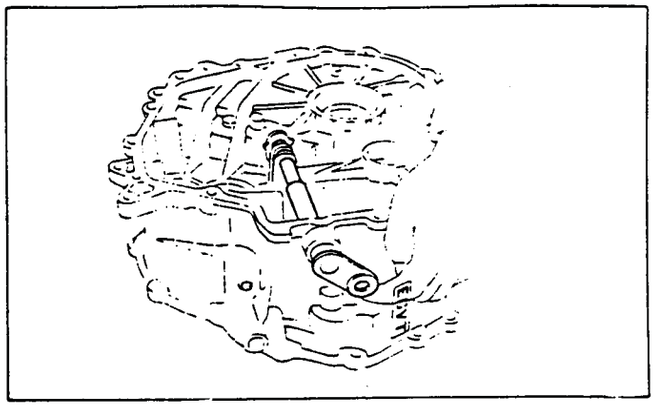


Fig. 228

(5) Secure the shift arm to the shift cam by driving the spring pin into place.
19) Position the differential ASSY in the case.

Wrap the left and right axle shaft ends with vinyl tape.

20) Adjusting thrust clearance of differential ASSY
(1) Measure the distance (h) between the mating surface of the transmission case and the ball bearing using the GAUGE (499575660) and DEPTH GAUGE (498145400).

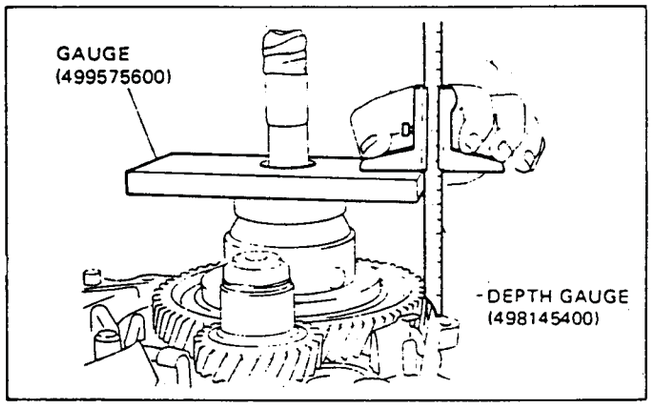


Fig. 229

Be careful not to tilt or incline the differential ASSY from the vertical position.

(2) Measure the distance (H) between the mating surface of the clutch housing and the 72 mm (2.83 in) dia. stepped portion using the GAUGE (499575600) and DEPTH GAUGE (498145400).

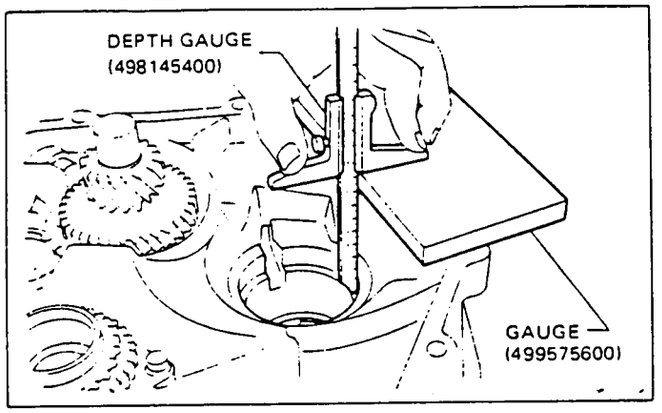


Fig. 230

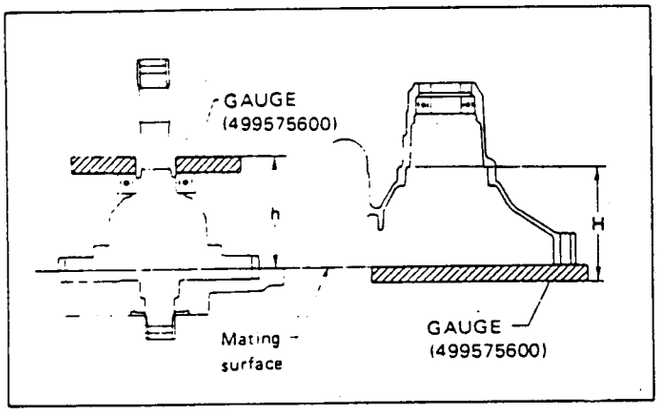


Fig. 231

(3) Equation for calculation Unit: mm

C = H − h

where: C : Thrust clearance
H : Distance between clutch housing mating surface and 72 mm (2.83 in) dia. stepped portion
h : Distance between transmission case mating surface and ball bearing

After determining the thrust clearance by using the above equation, select the number of suitable washers using the following table

C	Washer 61 x 71 x 0.2 mm (803061020)
0.2 mm (0.008 in) or less	None
Over 0.2 mm (0.008 in) and less than 0.4 mm (0.016 in)	Use one
0.4 mm (0.016 in) or more	Use two

21) Install the transfer "apply" pipe and actuator body ASSY. (4WD)

Tightening torque:
5.9 – 6.9 N·m (0.60 – 0.70 kg-m, 4.3 – 5.1 ft-lb)

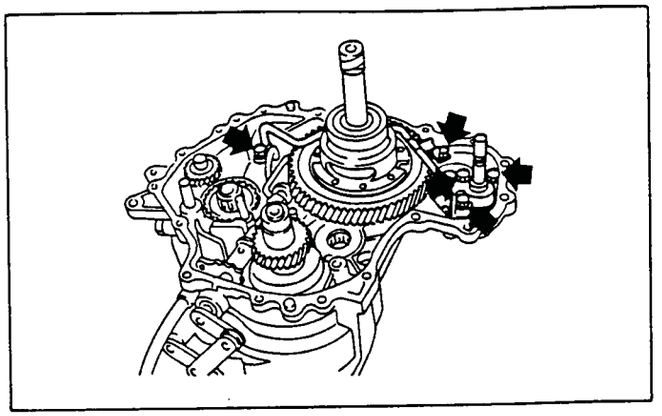


Fig. 232

22) Installing the clutch housing on the transmission case
(1) Remove oil or grease from the mating surfaces of the clutch housing and transmission case.
(2) While installing the clutch housing on the transmission case, apply a coat of vaseline to the needle bearing to protect it from being scratched.

Never apply grease in place of vaseline.

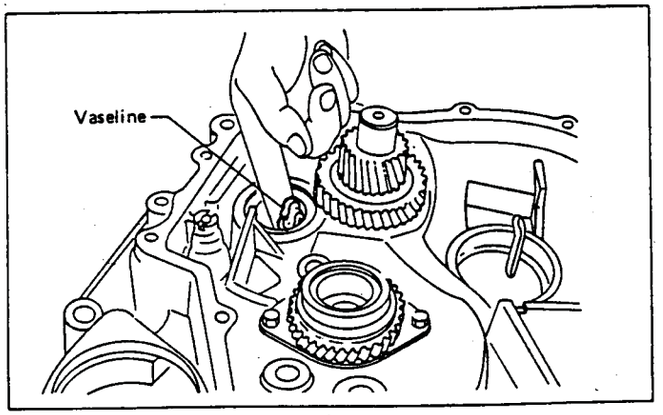


Fig. 233

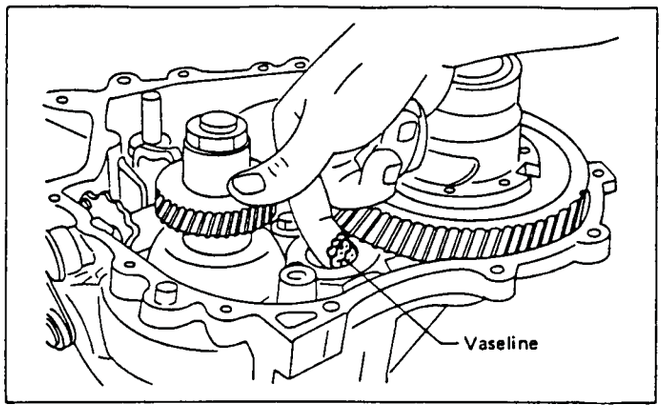


Fig. 234

(3) Apply a continuous coat of liquid gasket (004403007) to the mating surfaces. Be careful not to apply an excess amount of the liquid as this causes the liquid to expand over the mating surfaces.

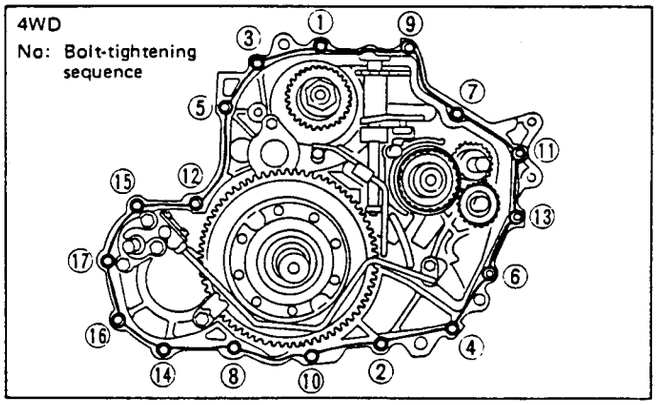


Fig. 235

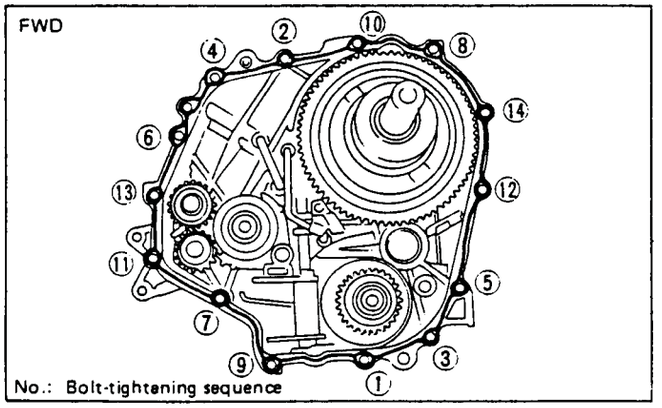


Fig. 236

(4) Attach the washer to the clutch housing using vaseline.

(5) Install the clutch housing on the transmission case and tighten the bolts to the specified torque in the order shown in the figure.

To provide smooth gear engagement, rotate the differential side gear and/or main drive shaft during assembly.

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

23) Set the select lever in "P" Ensure that the main drive shaft locks properly when turned.

24) Installation of transfer driven gear, coupling and hub (4WD).

(1) Install the washer.

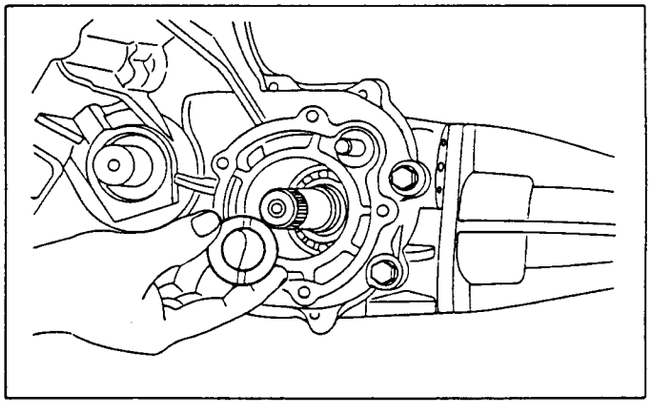


Fig. 237

(2) Install the transfer driven gear

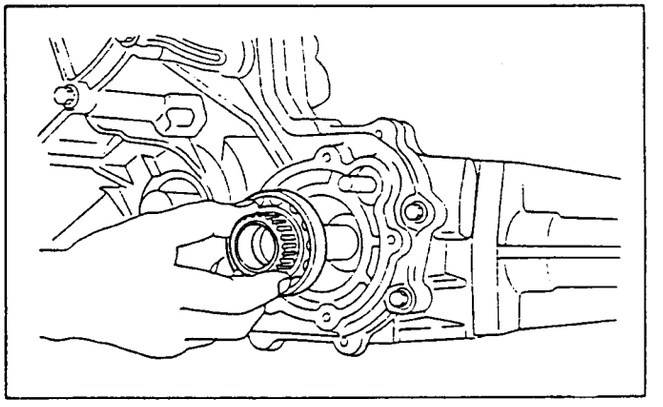


Fig. 238

(3) Install the coupling.

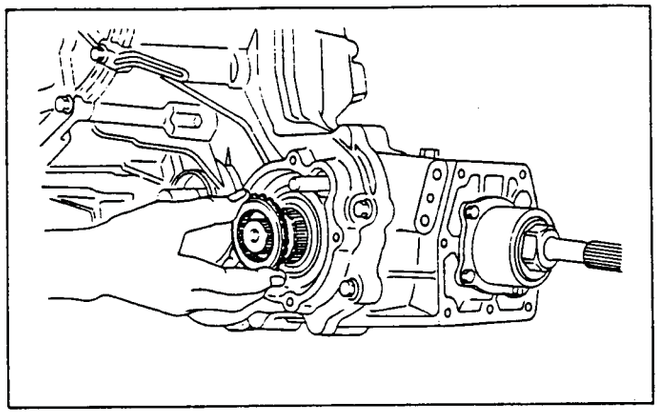


Fig. 239

(4) Install the synchro transfer hub.

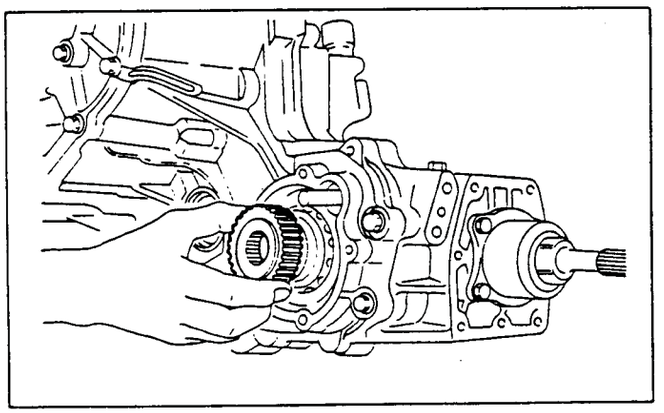


Fig. 240

(5) Install the sleeve and fork ASSY.

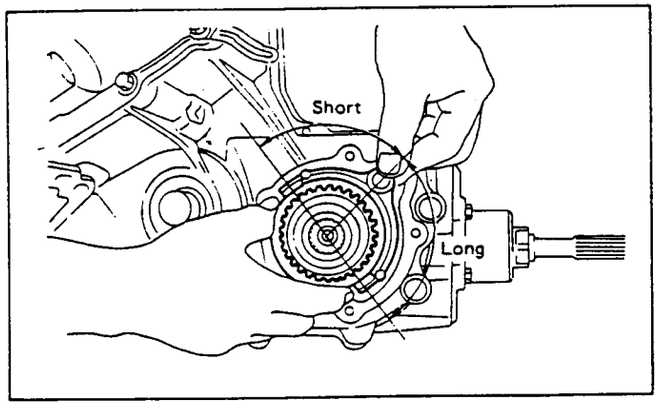


Fig. 241

(6) Side clearance adjustment of transfer driven gear
Install a 1.4 mm (0.055 in) thick snap ring and measure the side clearance.

Side clearance:
0.05 – 0.30 mm (0.0020 – 0.0118 in)

Select a proper snap ring from those listed in the table below so that the specified side clearance is obtained. Then, install the transfer shaft.

Part No.	t mm (in) (Snap ring thickness)
805026031	1.4 (0.055)
805026032	1.65 (0.0650)
805026033	1.9 (0.075)

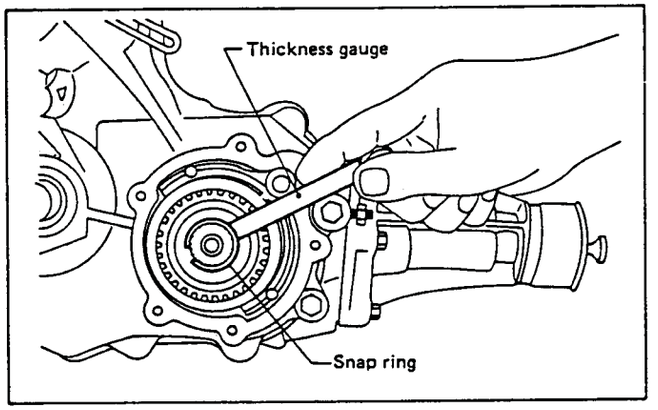


Fig. 242

(7) Drive in the spring pin into place to hold the fork.

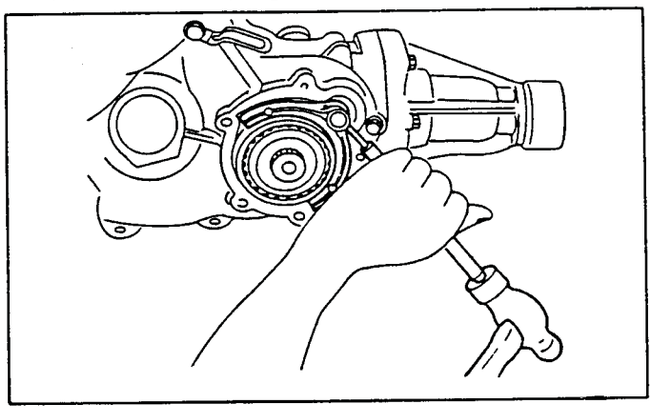


Fig. 243

(8) Insert the spring and ball into the plug mounting hole, and install the plug and aluminum gasket.

Tightening torque:
18.1 – 21.1 N·m
(1.85 – 2.15 kg-m, 13.4 – 15.6 ft-lb)

(9) Install the transfer cover.

Tightening torque:
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

(10) Install the transfer solenoid rod with the spring pin side facing the solenoid valve. Install the solenoid valve.

Tightening torque:
10 – 14 N·m (1.0 – 1.4 kg-m, 7 – 10 ft-lb)

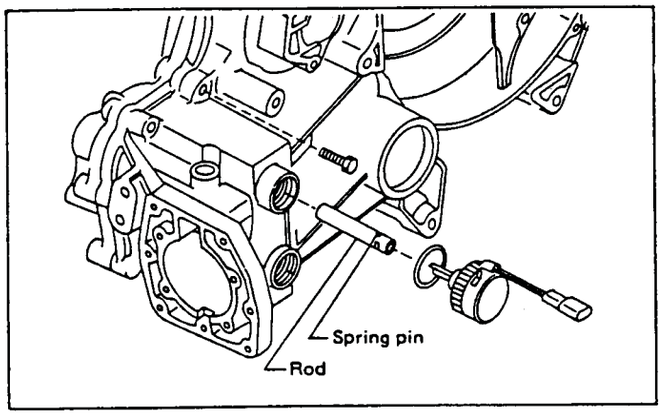


Fig. 244

25) Installing the control valve body ASSY
(1) Install the CONTROL VALVE HOLDER (499205600) on the control valve body.

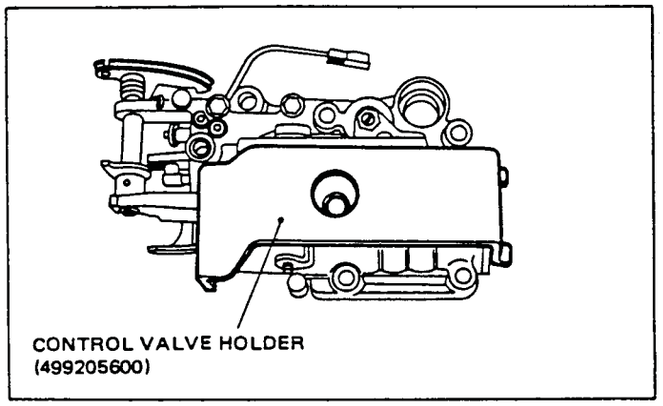


Fig. 245

(2) Installing body ASSY on the transmission ASSY
Ensure the valve body pin is inserted into the dowel hole in the control valve body. While lightly pushing the body ASSY toward the ratio sensor, align the valve body pin with the hole in the side case. Then install the valve body on the side case.

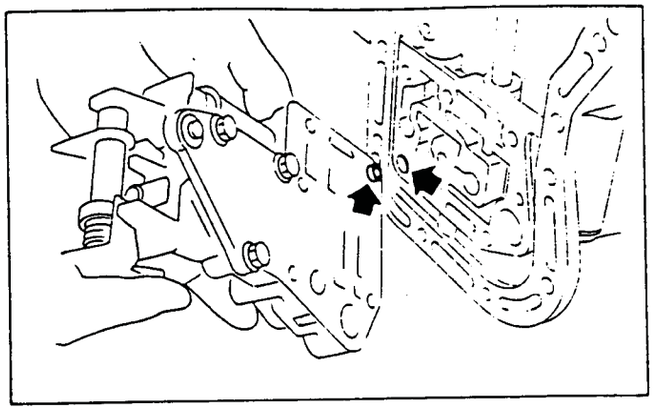


Fig. 246

Ensure the engine brake lever comes in contact with the back of the ratio sensor bolt's seating surface.

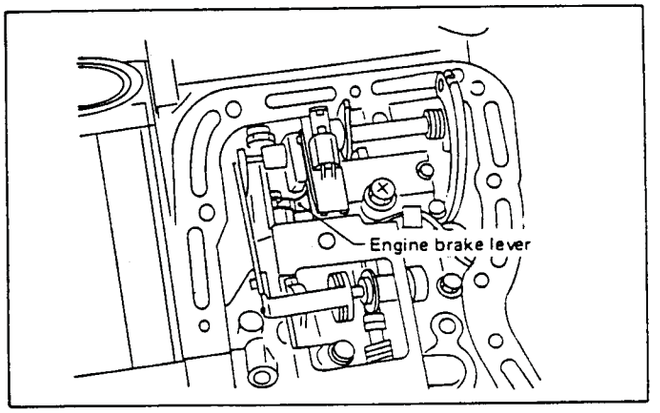


Fig. 247

(3) Temporarily tighten the control valve body mounting bolts, and on 4WD model, install the transfer control pipe. While vertically holding the control valve body by hand, tighten the bolts.
Remove the HOLDER (499205600).

Tightening torque:
Transfer control pipe mounting bolt:
5.9 – 6.9 N·m
(0.60 – 0.70 kg-m, 4.3 – 5.1 ft-lb)
Control valve body mounting bolt:
8.3 – 9.3 N·m
(0.85 – 0.95 kg-m, 6.1 – 6.9 ft-lb)

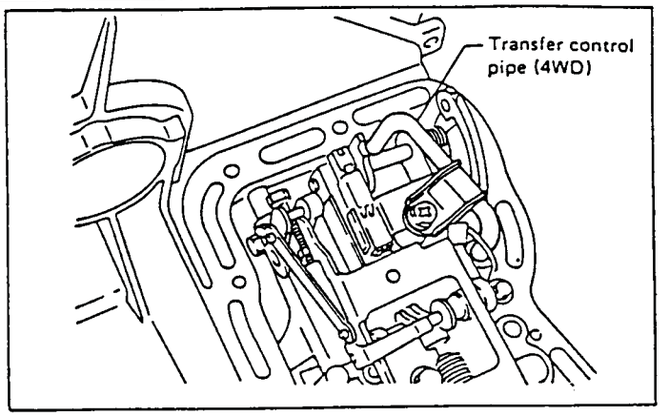


Fig. 248

(4) Connect the modulator connecting rod to the ratio sensor using a snap ring, and temporarily fix the modulator adjust plate with bolts.
(5) Set the MODUALTOR PLATE (498255600) in position as shown in the figure.

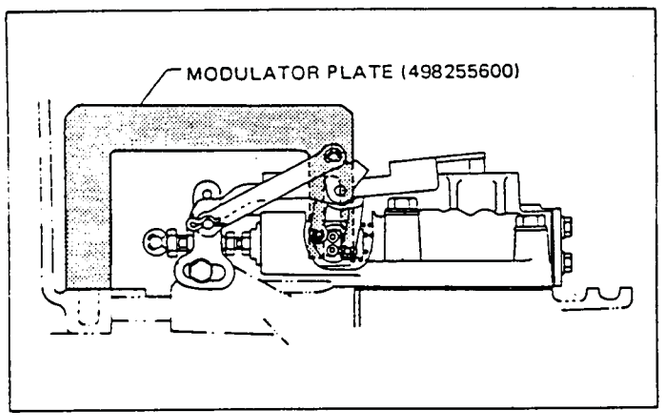


Fig. 249

(6) While pushing the modulator adjusting plate in the direction of the arrow, tighten the bolts. This takes up linkage free play.

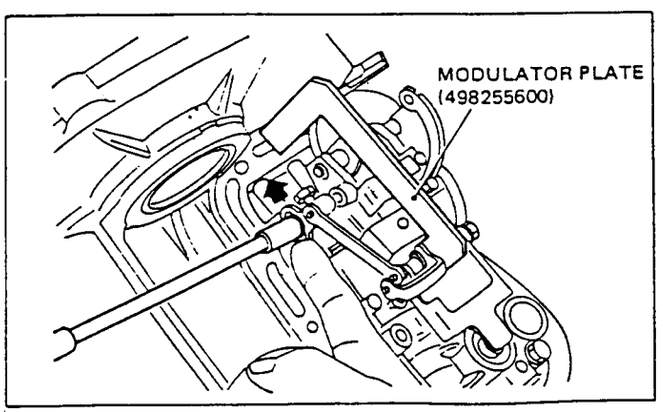


Fig. 250

Tightening torque:
2.9 – 3.9 N·m (0.30 – 0.40 kg-m, 2.2 – 2.9 ft-lb)

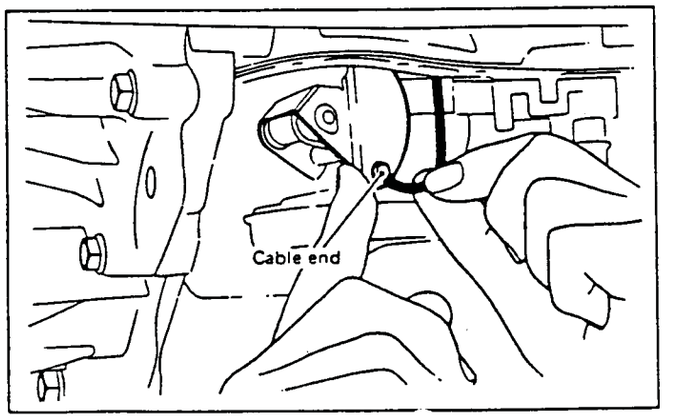


Fig. 251

26) Secure the end of the cable to the hole in the shift control lever and place it along the perimeter of the lever.

a. Ensure that the inner cable is routed through the guide rib as shown in the figure.
b. Pull the inner cable from the outside to ensure it moves smoothly without being interfered with by the inner wall of the case and the control valve body ASSY.

27) Connect the connector and install the connector to the bracket.

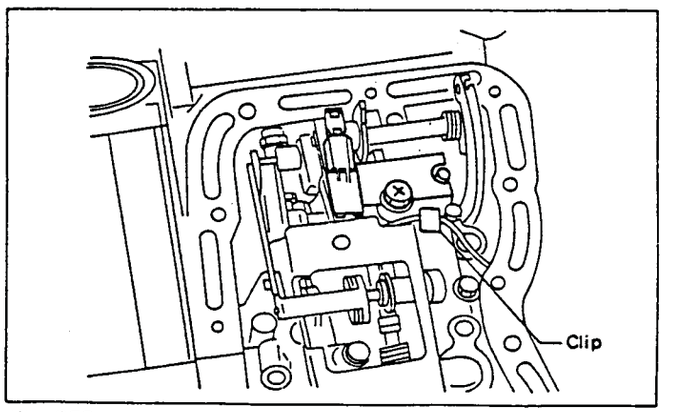


Fig. 252

28) Installing the oil strainer

Tigntening torque:
8.3 – 9.3 N·m (0.85 – 0.95 kg-m, 6.1 – 6.9 ft-lb)

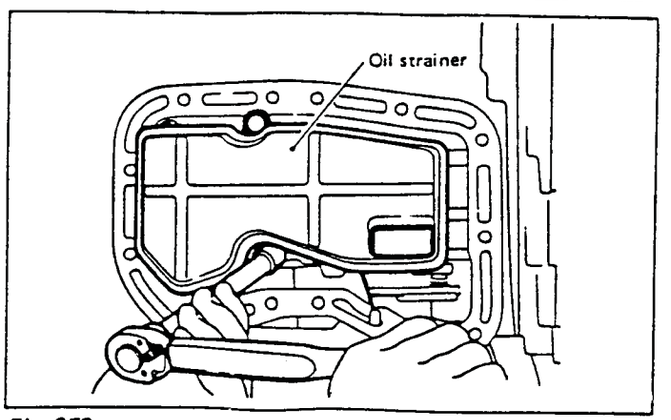


Fig. 253

a. Ensure the O-ring is installed properly.
b. If the O-ring is damaged or hardened, replace with a new one.

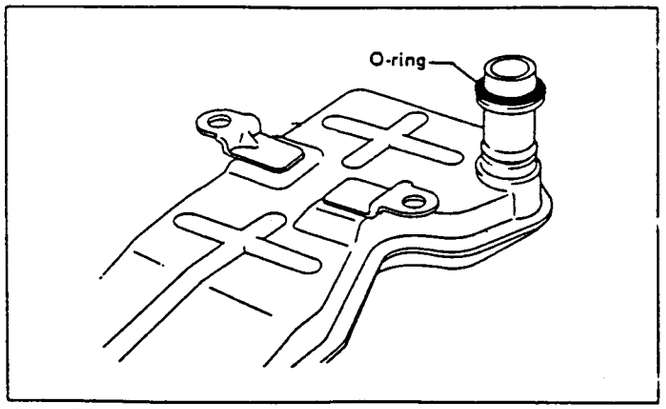


Fig. 254

29) Remove grease from the mating surface of the oil pan and position the magnet in the concave portion. Install the oil pan using a gasket and tighten with bolts and washers.

a. Be sure to remove foreign particles from the magnet before installation.
b. Also remove all traces of gasket from the mating surface of the oil pan before installation.
c. Discard the old gasket; replace with a new one.

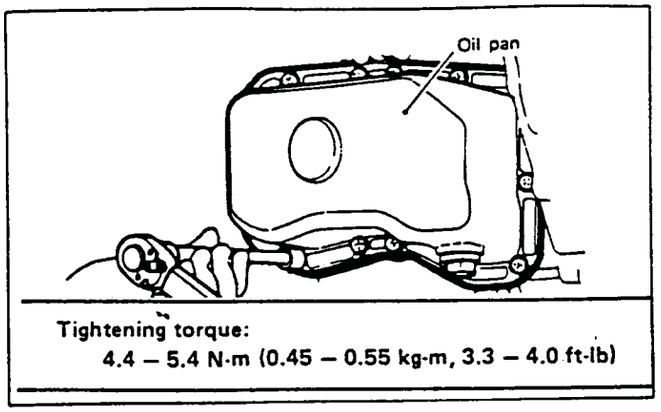


Fig. 255

30) Install the shift connecting rod.
31) Installing the oil pump ASSY
   (1) Temporarily tighten the oil pump ASSY with bolts.
   (2) Evenly tighten the bolts and push the O-ring in the side case.
   (3) Position the oil pump ASSY by lightly tapping it with a plastic hammer.
   (4) Tighten the bolts to the specified torque.

a. Install the O-ring and apply a coat of ATF to it.
b. Turn the straight pin of the pitot pipe counterclockwise until it comes in contact with the wall.

32) Installing the oil pump shaft
Insert the small dia. spline end of the oil pump shaft.

a. Be careful not to damage the seal inside the main drive gear while the oil pump shaft is being inserted.
b. Turn the shaft to ensure that the small spline end engages with the mating part.

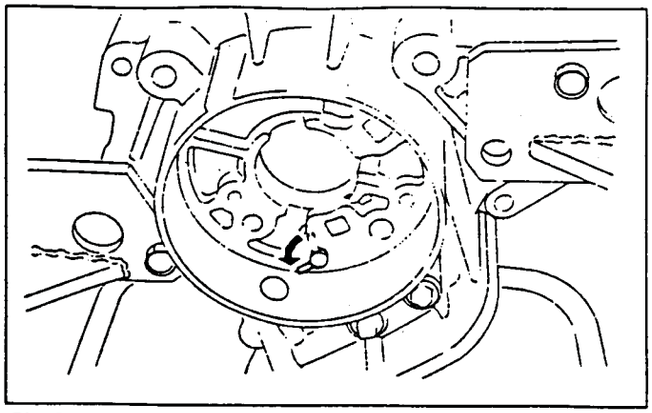


Fig. 256

33) Remove the STAND (499935600).
34) Install the oil cooler inlet and outlet pipes.

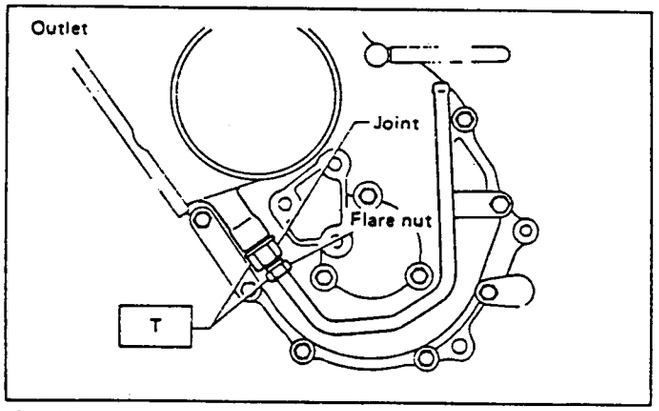


Fig. 257

35) Install the pitching stopper bracket.
36) Install the electromagnetic powder clutch on the flywheel.

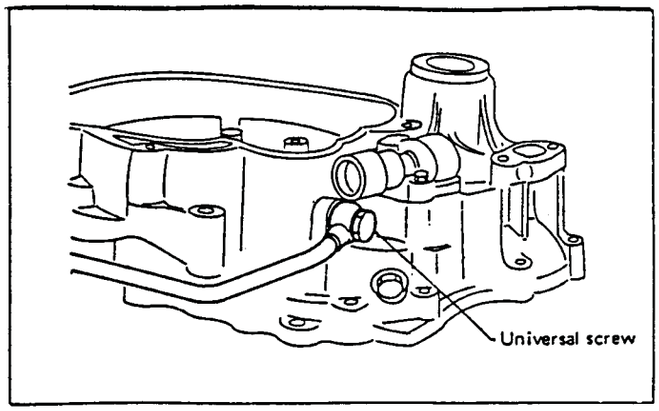


Fig. 258

37) Secure the engine and transmission.
38) Connect the shift control cable to the carburetor.
39) Install the brush holder.

Tightening torque:
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

40) Install the starter.

TROUBLESHOOTING

1 Preliminary Inspection

Problems which occur in the ECVT are often solved by conducting the basic inspection and adjustment procedures. Before troubleshooting the ECVT, always conduct the following preliminary checks to save time and labor.
In diagnosing the problem, it is best to first locate the part, such as (clutch, control unit, switches, hydraulic control valve, transmission, etc.) of the ECVT that is causing the problem.

1) Instruments required for checks
   (1) Engine tachometer
   (2) Circuit tester
   (3) Oil pressure gauge [0 – 3,432 kPa (0 – 35 kg/cm^2, 0 – 498 psi) range]
   (4) Boost meter (used to measure intake manifold vacuum pressure)
   (5) Timing light

It is recommended that the instruments (1) and (2) indicated above be located inside the driver's compartment to facilitate measurements.

2) Preliminary checks

For details regarding inspection and adjustment procedures, refer to the instructions under the "ON-CAR-SERVICE."

(1) Ensure that the necessary engine adjustments are made properly.
- Ensure idle speed, idle boost and ignition timing are all checked.
- Check engine rpm when the dashpot and lever come in contact with each other.
- If the engine operates erratically, check the stall engine speed.

(2) Ensure the accelerator pedal, transmission control cable and carburetor linkages operate properly. (Confirmation of the full-open and full-close functions)
(3) Ensure the accelerator switch and throttle-position switch operate within the specified ranges in relation to the depression of the accelerator pedal.
(4) Ensure the selector cable linkage is adjusted to the specified position and the inhibitor switch operates at the specified position.
(5) Ensure the clutch control unit connector and the brush holder harness connector are connected properly.
(6) Ensure the clutch control unit is self-diagnosed properly.
(7) Ensure no leakage occurs at and around the transmission.
(8) Ensure the ATF level is in the specified range.

2 Self-diagnostic function of ECVT control unit

1) Display of self-diagnostic items

When a problem occurs in the ECVT, the "CHECK ECVT" warning indicator light will illuminate.
(When there is no problem in the ECVT, the "CHECK ECVT" warning indicator light will go out soon after the engine starts.)
When the warning indicator light illuminates, connect the CHECK MODE connector, determine the cause of the problem in accordance with the call-up procedure and repair the faulty part as per the troubleshooting chart. (After repairs, recheck that the problem has been eliminated and then clear the memory.)

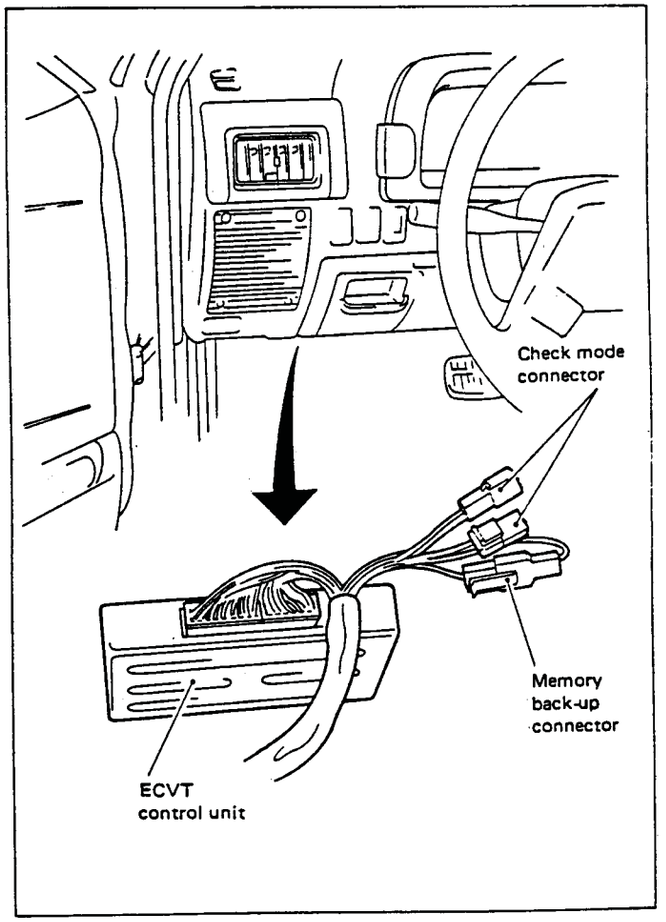


Fig. 259

2) Warning display readout

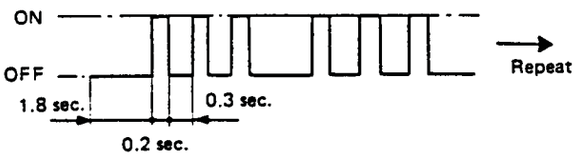
Warning display

Mode	CHECK ECVT warning indicator light				CHECK MODE connector	MEMORY BACK-UP connector
	Normal condition		Abnormal condition			
	Ignition switch "ON"	After engine starts	Ignition switch "ON"	After engine starts		
U-check	Remains "ON"	OFF	Remains "ON"	Remains "ON"	Disconnect at all times	Connect at all times
Read memory	Same as above	Emits vehicle and OK codes	Same as above	*Emits vehicle and trouble codes	Connect	Same as above
D-check	Same as above	Same as above	Same as above		Same as above	Same as above
(Clear memory)	—	—	—	—	Disconnect at all times	Disconnect for at least one minute before reconnecting

*Remains "ON" when ignition signal system is in trouble.

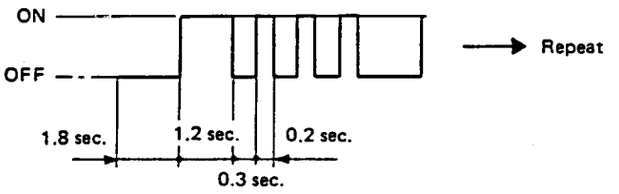
Example of code display

- **Vehicle code (Vehicle type identification code)**

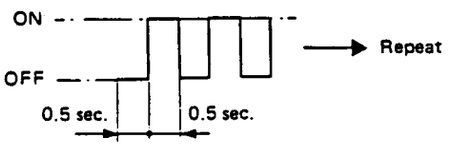


- **Trouble code**

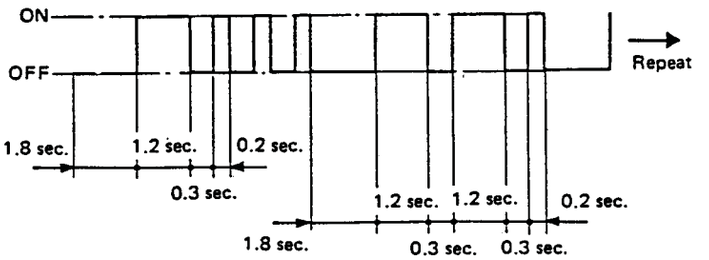
When one part becomes inoperative:
e.g.: Trouble code "13"



- **OK code**

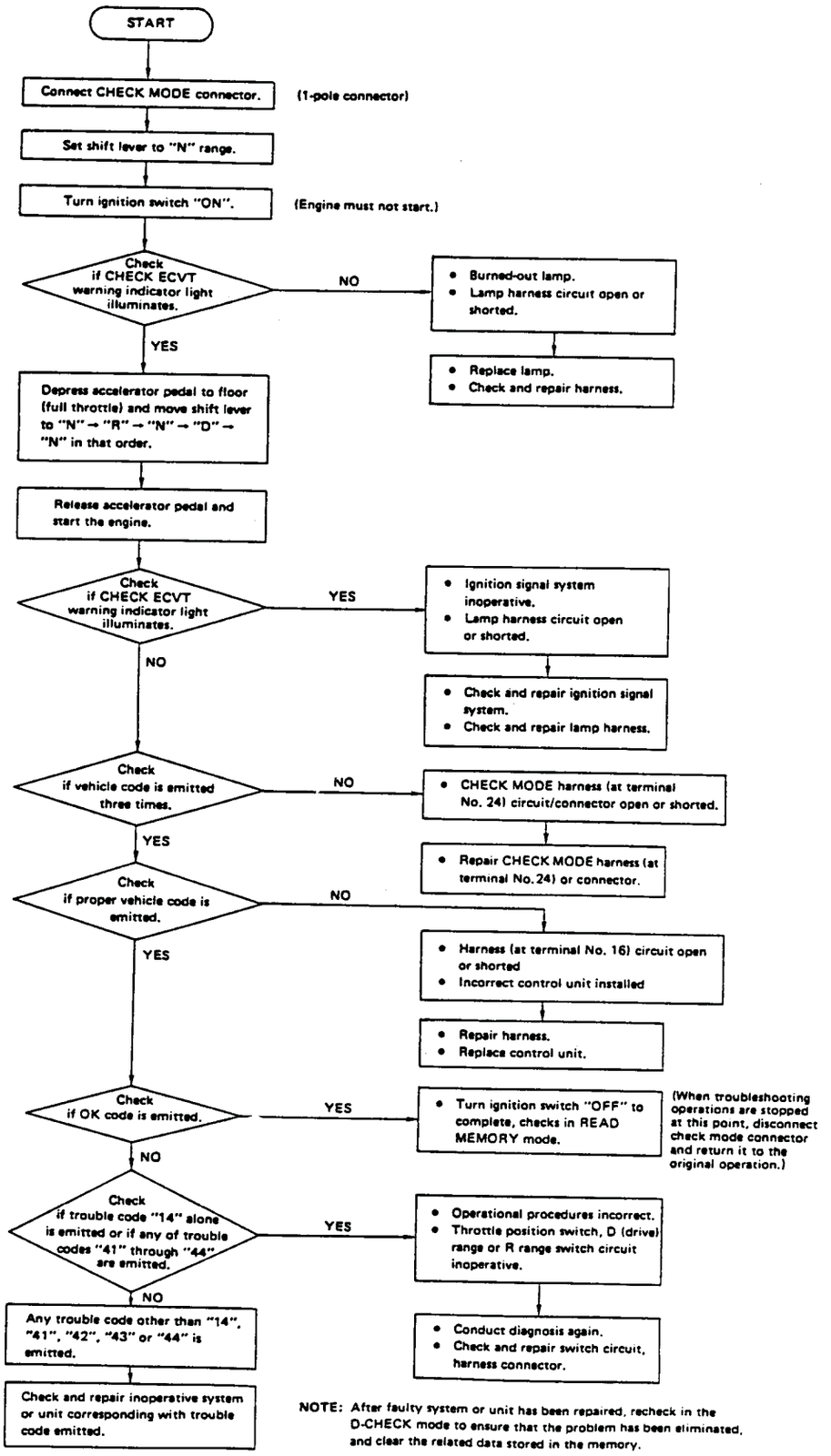


When two or more parts become inoperative:
e.g.: Trouble codes "13" and "21"



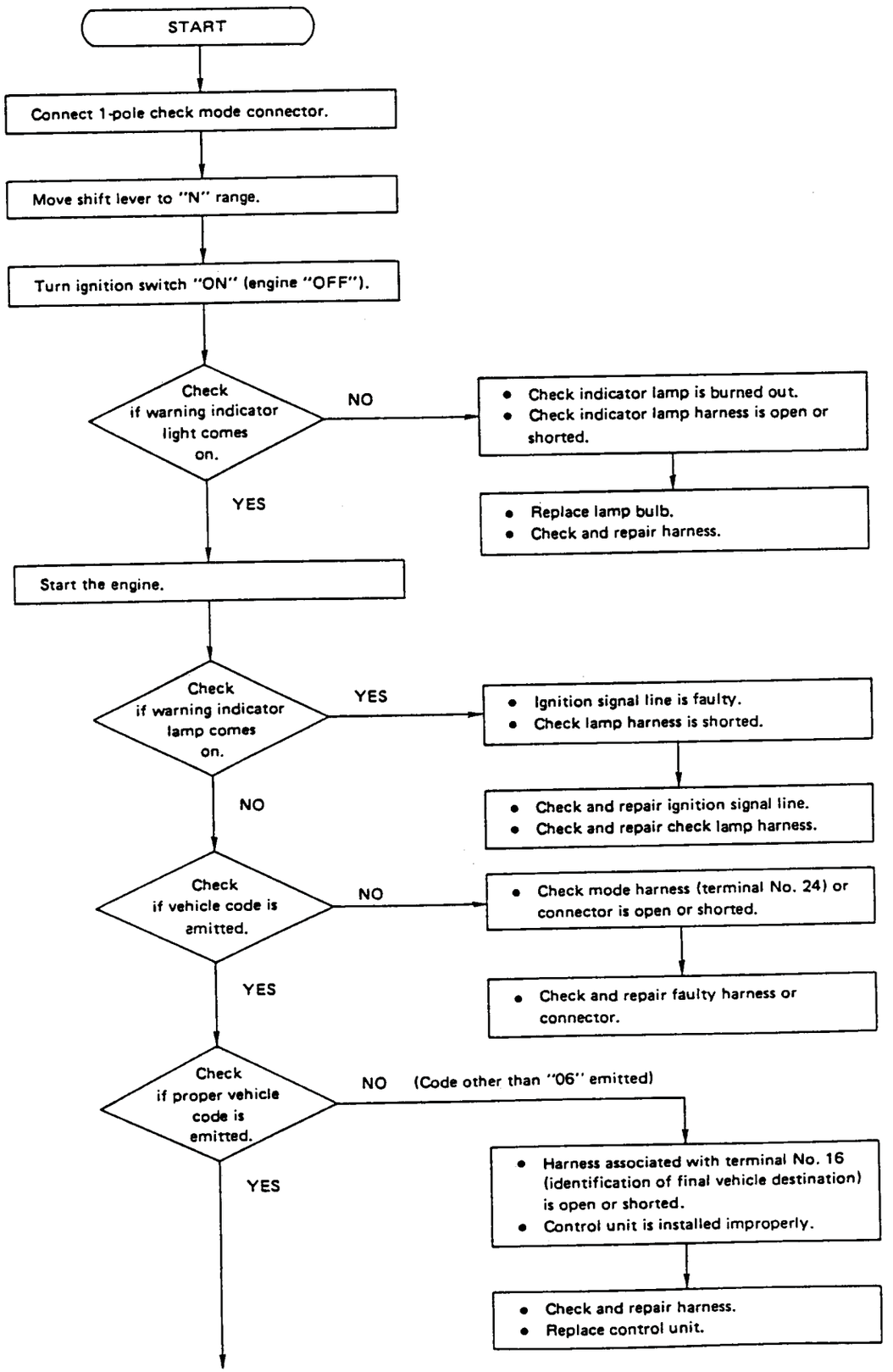
3) Trouble code "call-up" procedure

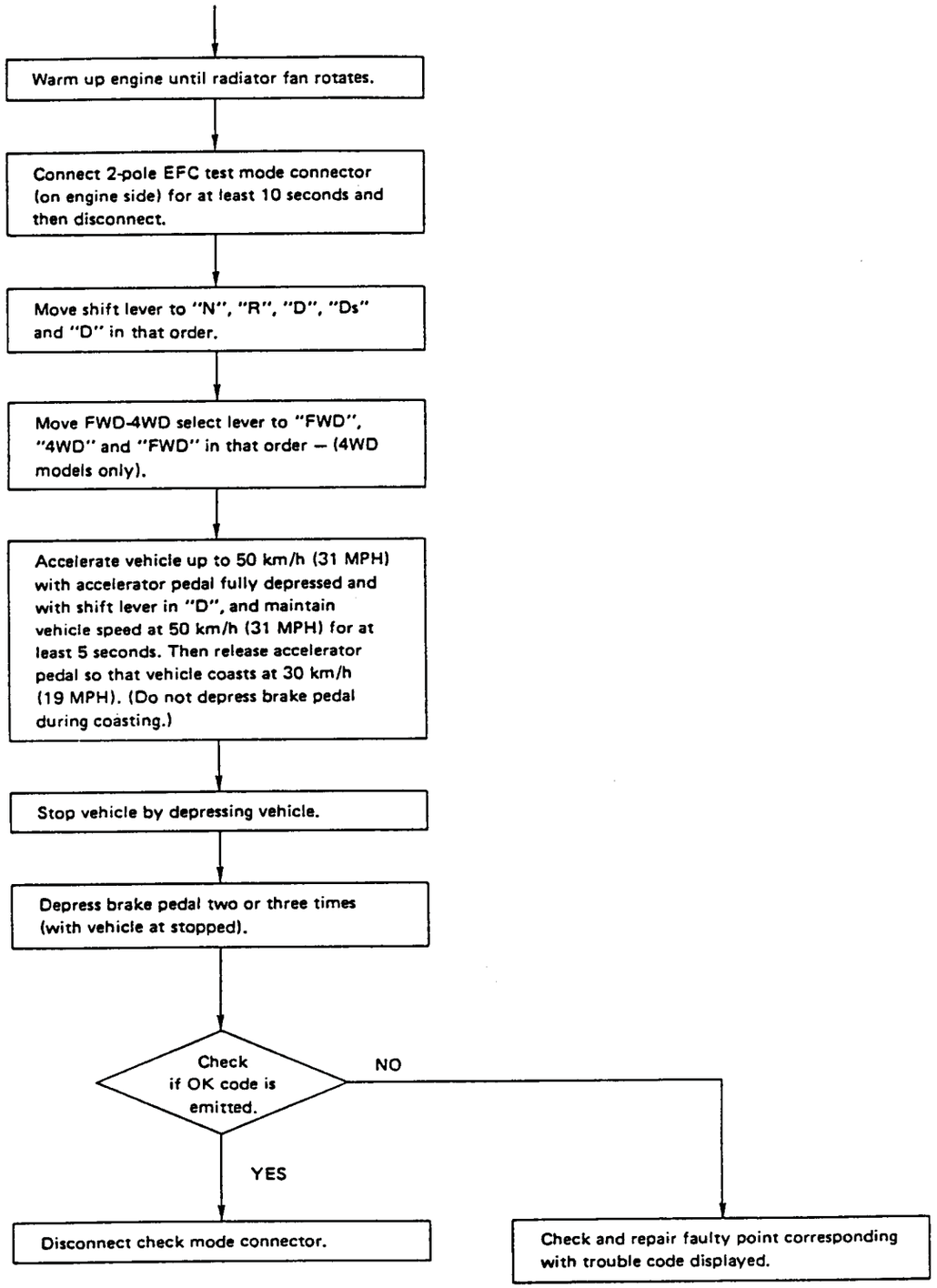
- **"Read memory" mode**



NOTE: After faulty system or unit has been repaired, recheck in the D-CHECK mode to ensure that the problem has been eliminated, and clear the related data stored in the memory.

- **D-CHECK mode (Air conditioning system "OFF")**





• MEMORY CLEAR

To cancel previous trouble codes stored in memory, set the self-diagnostic system in the CLEAR MEMORY mode and disconnect the 2-pole MEMORY BACK-UP connector for at least one minute.

NOTE: After cancelling previous trouble codes, re-connect the MEMORY BACK-UP connector to its position.

4) List of trouble codes

Trouble code (Blinks)	System in trouble	Probable cause	Parts to check
13	D-range switch signal system	D-range switch signal circuit open or shorted.	① Wire harness and connector ② D-range inhibitor switch ③ Control unit
14	Ds-range switch signal system	Ds-range switch signal circuit open or shorted.	① Wire harness and connector ② Ds-range inhibitor switch ③ Control unit
15	R-range switch signal system	R-range switch signal circuit open or shorted.	① Wire harness and connector ② R-range inhibitor switch ③ Control unit
21 (*1)	Torque signal system	Torque signal remains "ON" or "OFF"	① Wire harness and connector ② Control unit ③ EFC control unit
22	Water temperature signal system	Signal remains "ON" or "OFF".	① Wire harness and connector ② Control unit ③ EFC control unit
25	Slow cut solenoid system	Slow cut output circuit open or shorted	① Wire harness and connector ② Slow cut solenoid ③ Control unit
31	Accelerator switch signal system	Accelerator switch signal circuit open or shorted.	① Wire harness and connector ② Accelerator switch ③ Control unit
32	Throttle position signal system	Throttle position signal circuit open or shorted.	① Wire harness and connector ② Throttle position switch ③ Control unit
33	Vehicle speed signal system	Vehicle speed signal not entered.	① Wire harness and connector ② Speedometer cable ③ Vehicle speed switch ④ Control unit
34	Clutch coil system	Current control does not occur for at least 3 seconds during standing start.	① Wire harness and connector ② Brush holder ③ Clutch ④ Control unit
35	Line pressure solenoid system	Line pressure solenoid output circuit open or shorted.	① Wire harness and connector ② Line pressure solenoid ③ Control unit
41	High altitude signal 1	High altitude signal 1 remains "ON" or "OFF".	① Wire harness and connector ② Control unit ③ EFC control unit
42	High altitude signal 2	High altitude signal 2 remains "ON" or "OFF".	① Wire harness and connector ② Control unit ③ EFC control unit

Trouble code (Blinks)	System in trouble	Probable cause	Parts to check
45 (*2)	Brake switch signal system	Brake signal switch circuit open or shorted.	1 Wire harness and connector 2 Brake switch 3 Control unit

*1: When torque signal circuit becomes inoperative, check EFC control unit sensor system (including pressure sensor, vehicle speed sensor, etc.). Also check air conditioner harness and switch signal connector.

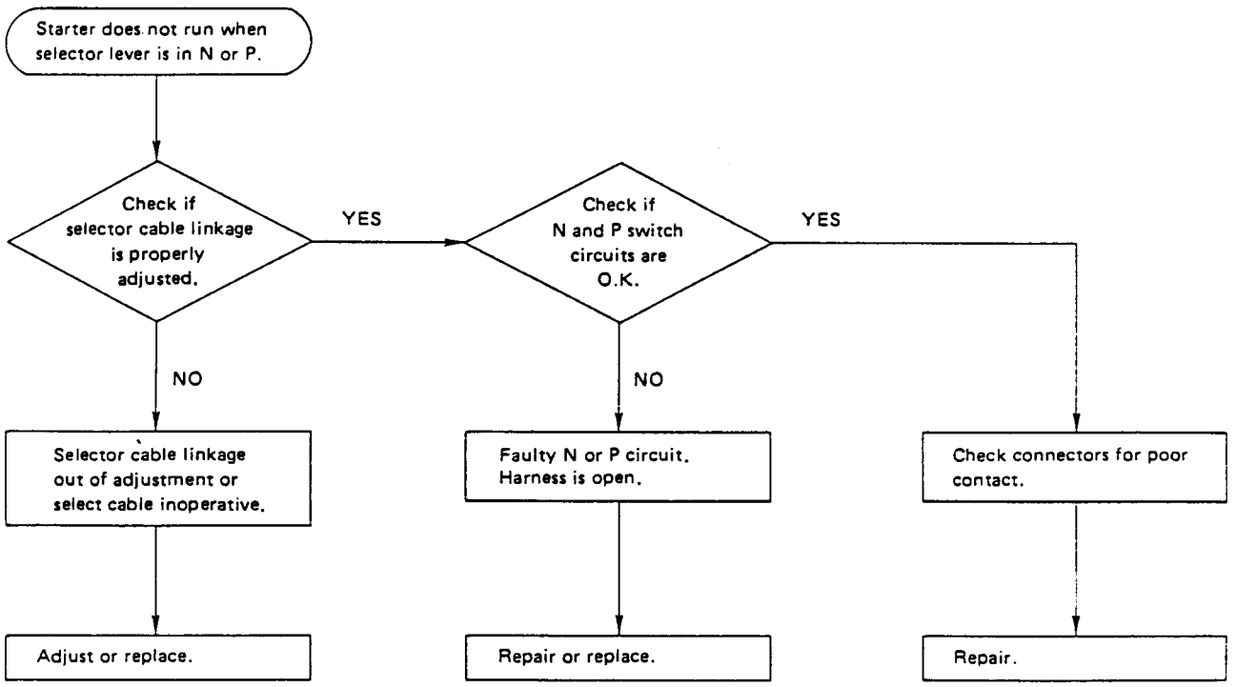
*2: When vehicle-speed pulse circuit becomes inoperative while driving, brake signal circuit problem may also be stored in memory.

3 Troubleshooting Chart

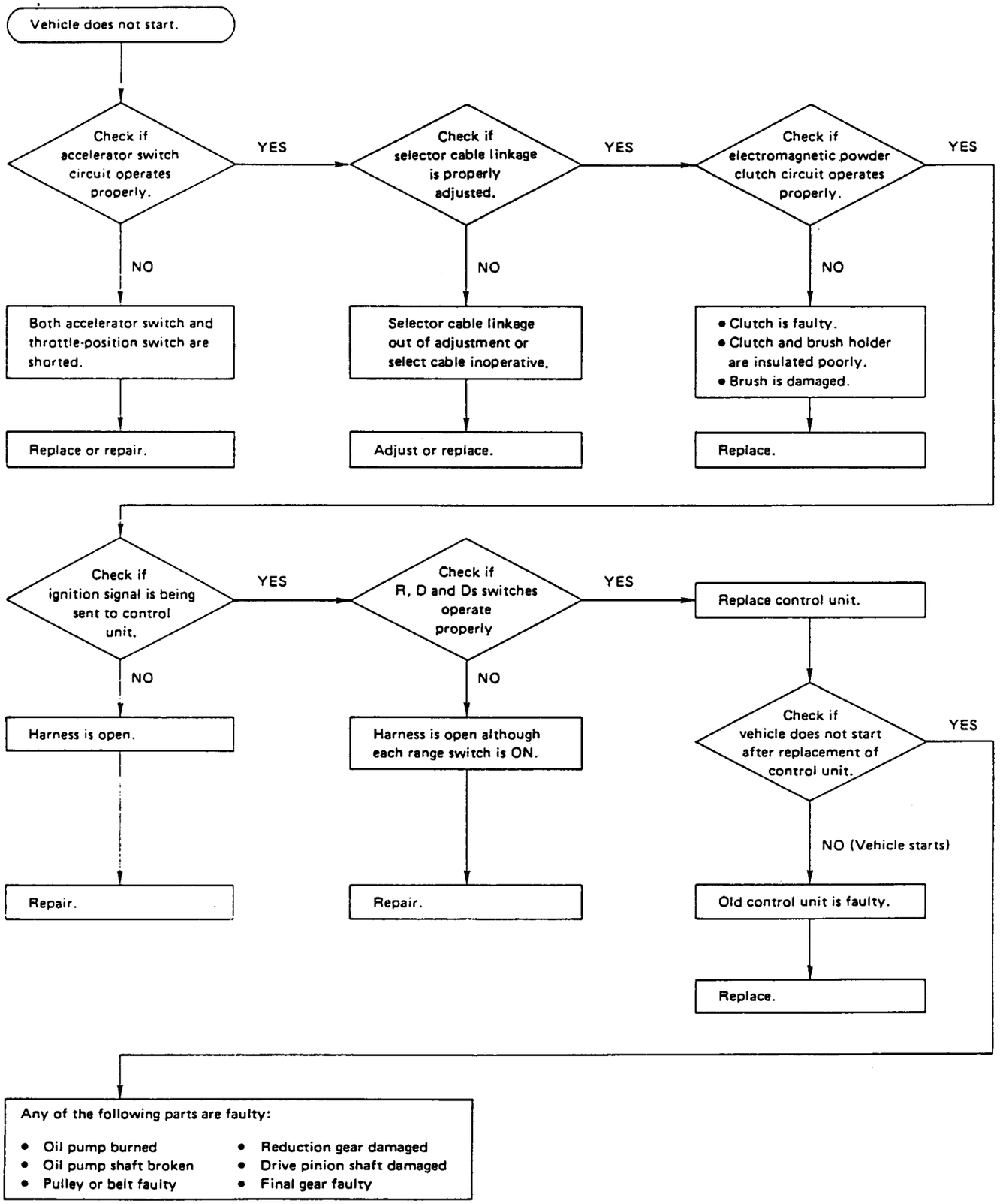
Trouble Diagnosis Flowchart

The charts indicate typical trouble modes. Before troubleshooting, always perform preparatory inspection.

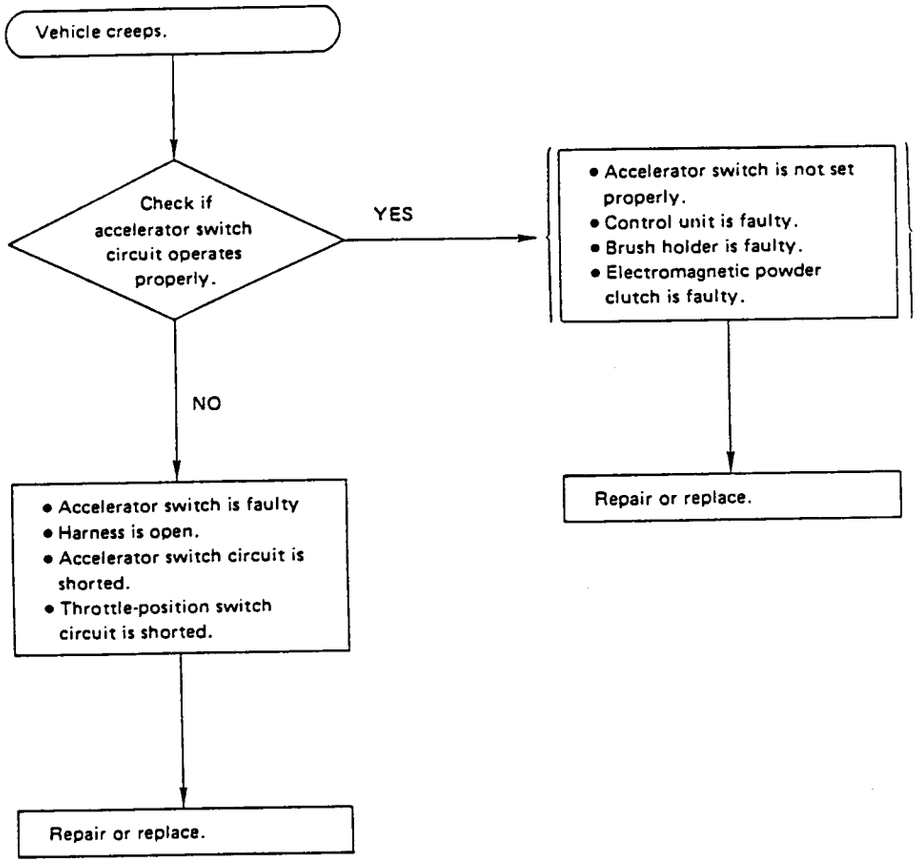
1) Starter does not run when selector lever is in N or P.



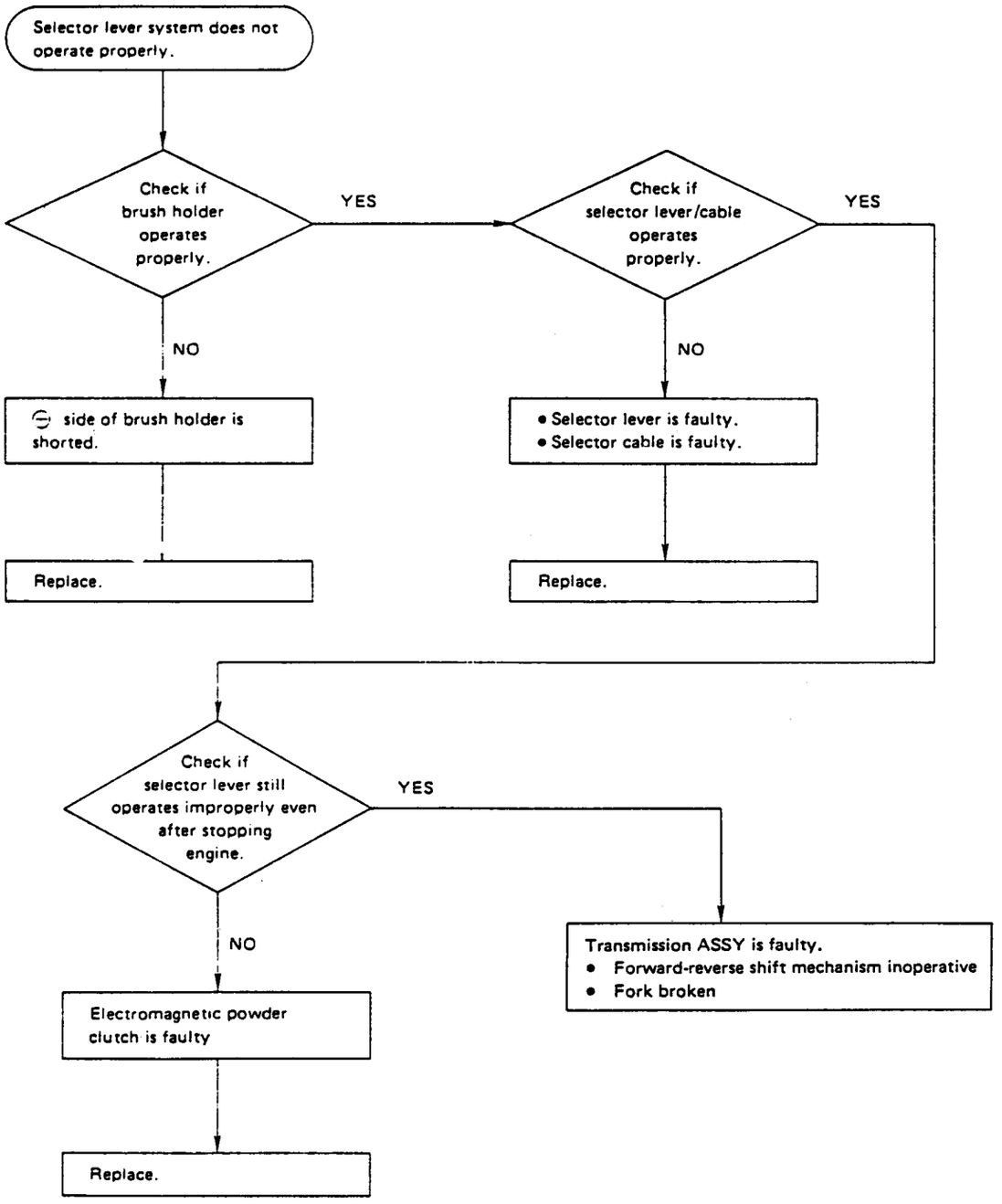
2) Vehicle does not start.



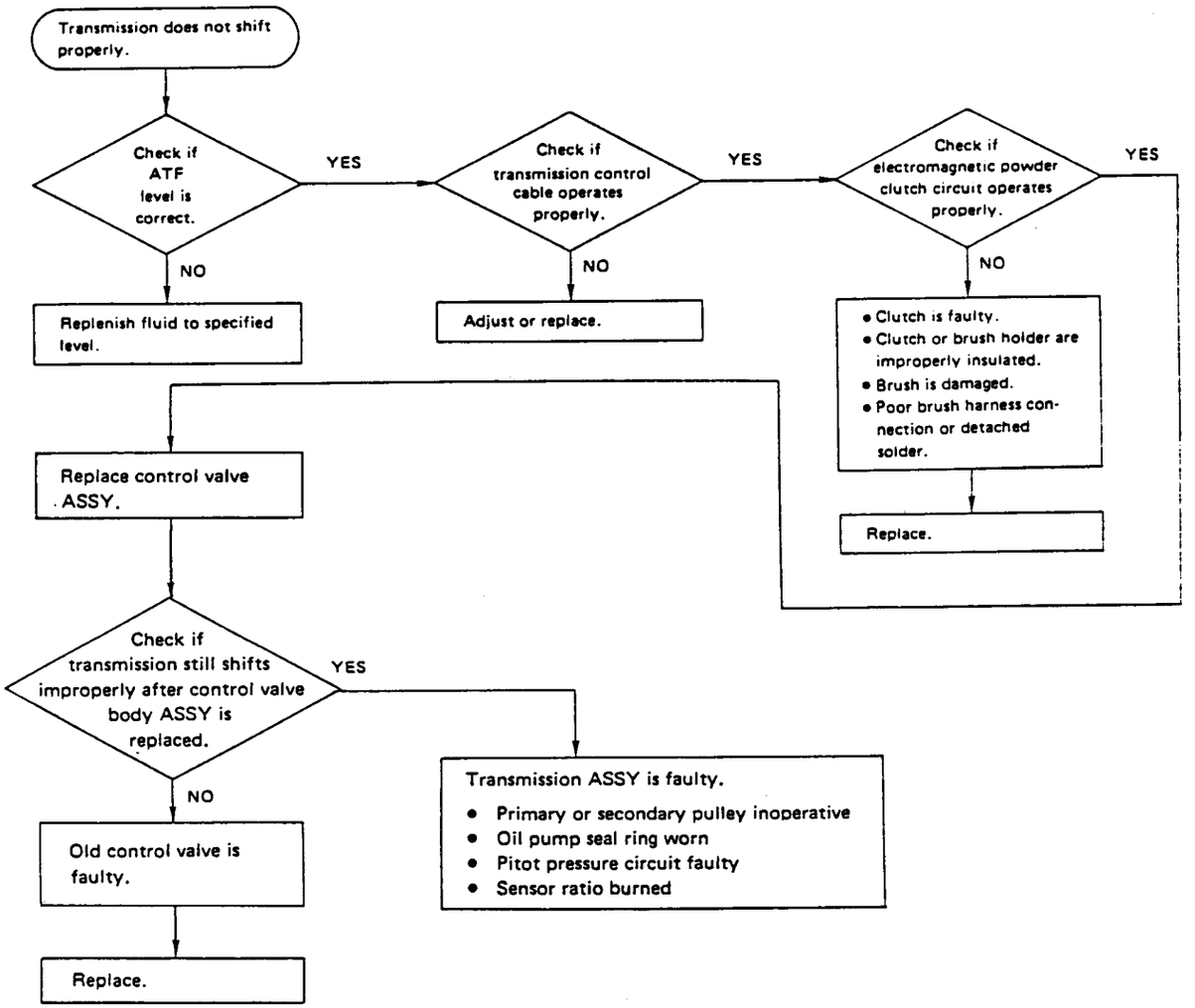
3) Vehicle creeps.



4) Selector lever system does not operate properly.



5) Transmission does not shift properly.*



*** Symptoms of improper shifting and their judgement methods (after engine warm-up)**

1) Pulley ratio remains in "LOW" range and cannot be shifted to overdrive.

(1) Vehicle speed does not increase with an increase engine speed.

(2) Engine reaches 5,000 rpm or greater when vehicle speed is approximately 35 km/h (22 MPH).

(Under normal conditions, engine speed is less than 4,300 rpm when vehicle speed is 35 km/h (22 MPH) with engine at full throttle, when operating at a constant speed in the 10 to 50 km/h (6 to 31 MPH) range, engine speed is approximately 1,500 rpm.)

2) Vehicle speed does not increase in response to depression of accelerator pedal immediately after starting.

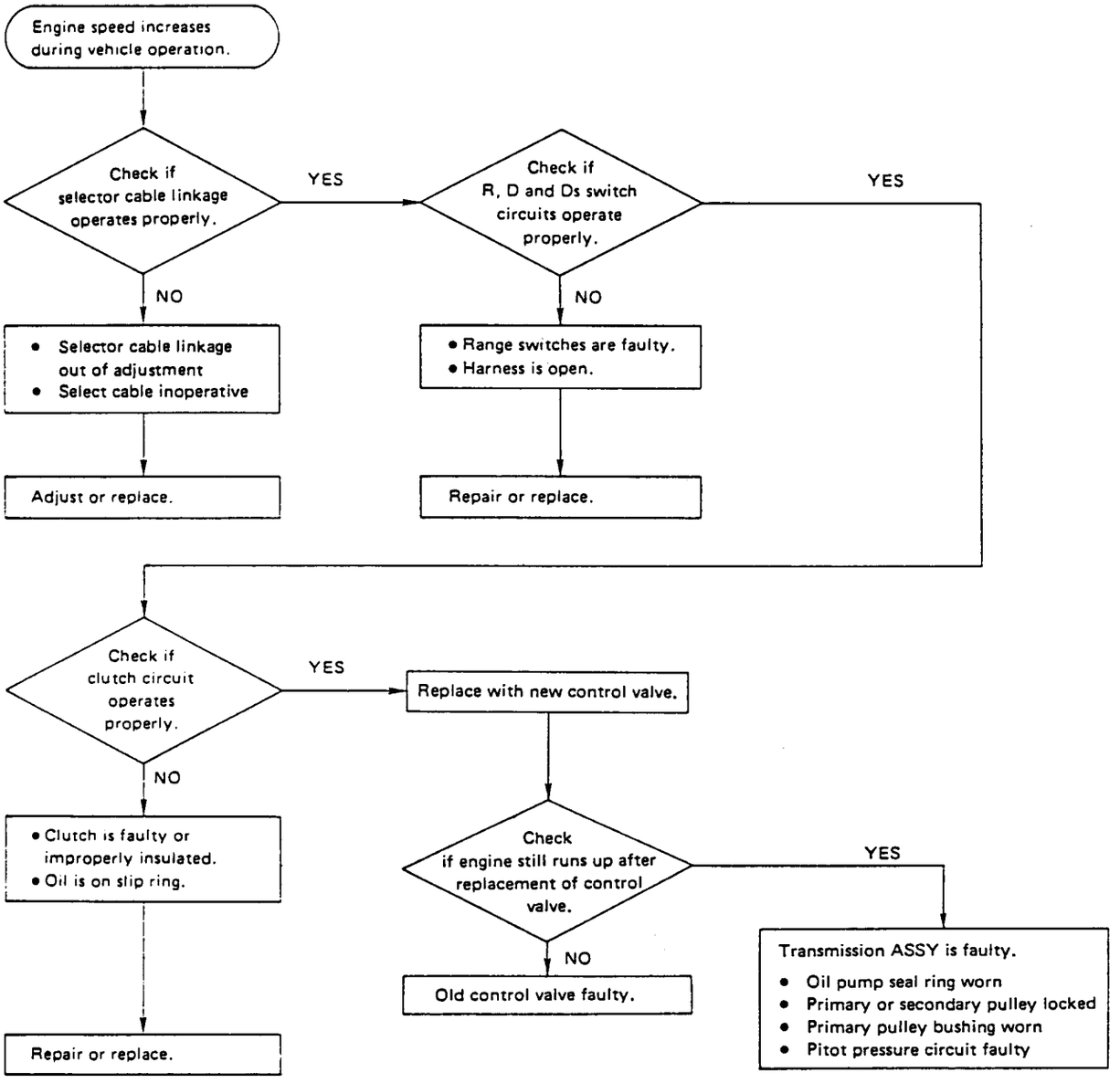
(1) Engine speed is between 2,000 and 3,000 rpm even when accelerator pedal is fully depressed (full-throttle) in the 20 to 60 km/h (12 to 37 MPH) range. Beyond that range, engine speed increases slowly which gives the driver the sansation of driving with the manual transmission lever in 5th gear.

3) Engine speed does not increase even when kicked down.

(1) Engine speed remains unchanged when selector lever is shifted from "D" to "Ds" position. (The Ds function does not activate.)

(2) Engine speed is less than 3,500 rpm even when the accelerator pedal is fully depressed or does not decrease relative to the release of accelerator pedal.

6) Engine races while driving the vehicle.



Trouble Diagnosis Chart

Selector lever position	Symptom / Part considered to be in problem	On-car-check									Off-car-check						
		Selector cable linkage	Transmission control cable	Brush holder	Vehicle speed sensing system	Accelerator switch/ throttle position switch	P, R, N, D and/or Ds range switches	Control unit	ECVT fluid	Line pressure control solenoid valve	Electromagnetic powder clutch	Forward-reverse shift mechanism and parking mechanism	Pulley & steel belt	Oil pump	Control valve	Final & reduction gear	Pitot pressure circuit
	*	A	B	C	D	E	F	—	G	H	K	L	M	N	P	Q	R
D or R	Starter runs.	①					②										
	Vehicle does not start.	②	③	④		①	⑥	⑦			⑤	⑨	⑩	⑧	⑪	⑫	
	Engine stops soon when vehicle starts.							②			①						
	Clutch engages too soon.			②		①		④			③						
	Shock is felt during standing start.					②			①	⑦	③		④	⑥	⑤		
	Vehicle creeps.			②		①		④			③						
	Transmission remains low and does not shift.								①				③		②		
	Engine speed does not increase after kickdown. (Remains in overdrive)		①											③	②		④
	Stall speed is too low.			①							②						
	Stall speed is too high.			①							②						
	Engine races while driving.	②		④		①	③				⑤			⑥	⑧		⑦
	Gear squeaks while shifting from N to R or P.	②		④		①	③				⑤	⑥					
	Shifting from N to D or R cannot be made.										①	②					
	Clutch is not disengaged when vehicle speed is below 20 km/h (12 MPH).				②	①		④			③						
Ds	Starter runs.	①					②										
	Engine brake does not activate when shifting from D to Ds.	①													②		
	Shock is felt when shifting from D to Ds.					①	②						③				
	Engine races when shifting from D to Ds.	①					②										
	Shifting cannot be made from D to Ds.	①										②					
D, Ds	Car speed does not increase.		①					②			③			⑥	④		⑤
P	Starter does not run.	①					②										
	Vehicle does not stop properly.	①										②					
	Cannot shift from P to R or vice versa.	①										②					
	Parking pawl is not disengaged when lever is shifted to any other range.											①					

* : Symbols "A" through "R" refer to probable causes which are indicated on the next page.
○ : Figures in a circle refer to diagnostic procedures.

Symbol	Probable cause
A	1) Selector cable linkage improperly adjusted.
B	1) Improperly adjusted 2) Cable end broken 3) Inner cable broken 4) Liner degraded
C	1) Faulty insulation 2) Brush broken, worn or seized
D	1) Speedometer cable broken or improperly assembled 2) Reed switch faulty 3) Vehicle speed sensing circuit open, shorted or poorly connected
E F	1) Improperly adjusted 2) Circuit open, shorted or poorly connected
G	1) Fluid level too low.
H	1) Solenoid valve faulty 2) Harness open or shorted
K	1) Faulty insulation 2) Bearing locked 3) Oil on slip ring
L	1) Fork broken 2) Baulk ring worn 3) Parking mechanism faulty
M	1) Movable sheave of primary or secondary pulley inoperative 2) O-ring broken
N	1) Excessive tightening torque to side case 2) Gear, oil pump and housing gouged 3) Seal ring worn
P	1) Valve stick (Shift control valve, Compensation plunger, Pressure regulator valve) 2) Oil circuit leakage
Q	1) Drive pinion shaft broken 2) Reduction gear broken 3) Final gear broken 4) Differential gear broken
R	1) Oil circuit leakage 2) Improper pitot pressure

4 On-car Service

ATF Level

INSPECTION

- Idle the hot engine after driving. Note that a true fluid level cannot be checked without driving the vehicle.
- Use a clean cloth when checking the fluid level to prevent dirt or dust from coming in contact with the level gauge.
- Position the vehicle on a flat surface.
- Set the selector lever to the P range and check the fluid level using the level gauge. The engine must be idling.

1) If fluid needs to be added frequently, carefully check for leakage.

2) Recommended fluid

Use only genuine Subaru ECVT fluid or DEXRON II.

Quantity of fluid (incl. oil cooler):
FWD: Approx. 3.35 ℓ (3.5 US qt, 2.9 Imp qt)
4WD: Approx. 4.15 ℓ (4.4 US qt, 3.7 Imp qt)

3) Mixing different brand of fluid with the genuine fluid may malfunction the ECVT.

4) Condition of ATF

If ATF is found to be contaminated during inspection, the problem may be inside the transmission. Immediately check the condition of the transmission. ATF must be red without stickness.

FLUID LEVEL GAUGE

- The center fluid level varies with changes in fluid temperature. Note that if fluid is replenished to the HOT level mark without the engine being warmed up sufficiently, the fluid level will be higher than the specified level under normal operating conditions.
- Pay particular attention to the fluid temperatue which greatly affects the fluid level. The level gauge is marked with "HOT" [60 to 80°C (140 to 176°F)] and "COOL" [20 to 40°C (68 to 104°F)].

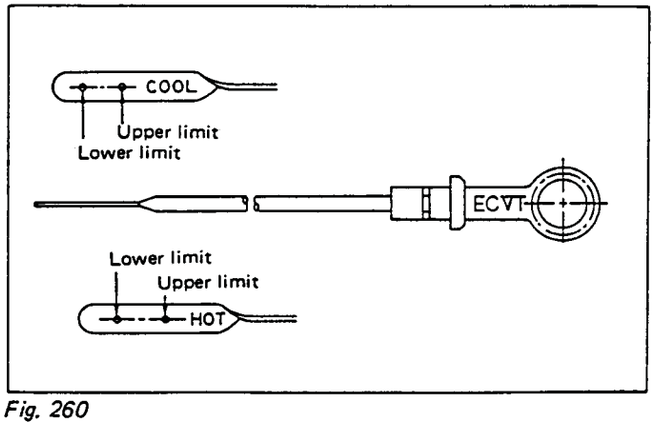


Fig. 260

Control Valve Body ASSY

For removal, installation, disassembly and inspection on the control valve, refer to "SERVICE PROCEDURES".

Transmission Control Cable

ADJUSTMENT

1) Ensure shift control lever on the transmission side turns fully when the throttle valve is fully opened. If the shift control lever on the transmission side is not fully turned, driving performance may be degraded.
2) Ensure the throttle valve fully opens or closes.
3) While fully opening the throttle valve, lightly pull the transmission control cable to ensure free play is within specified range.

Free play:
0.5 — 1.5 mm (0.020 — 0.059 in)

4) If the free play is not within the specified range, adjust length of the transmission control cable.
(1) If free play is less than 0.5 mm (0.020 in), loosen lock nut ①

Adjustment:
One rotation of lock nut changes free play by 1 mm (0.04 in).

(2) While preventing lock nut ① from turning, tighten lock nut ②.
(3) If free play is greater than 1.5 mm (0.059 in), loosen lock nut ②.

Adjustment:
One rotation of lock nut changes free play by 1 mm (0.04 in).

(4) While preventing lock nut ③ from turning, tighten lock nut ①.
(5) Set throttle cable to the fully-open position again, and check inner cable free play.

Be careful not to allow the rubber boot from being caught by the pulley during adjustment.

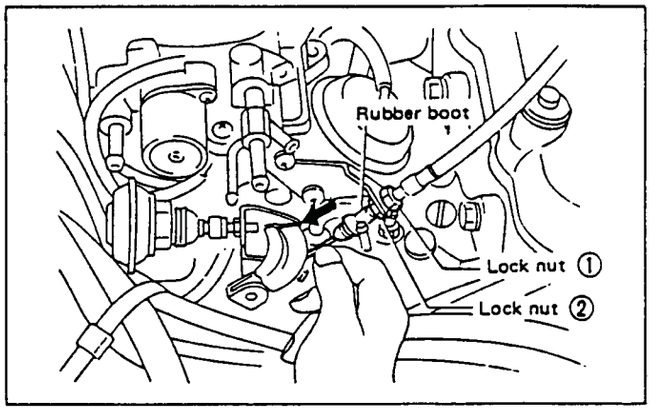


Fig. 261 EFC model

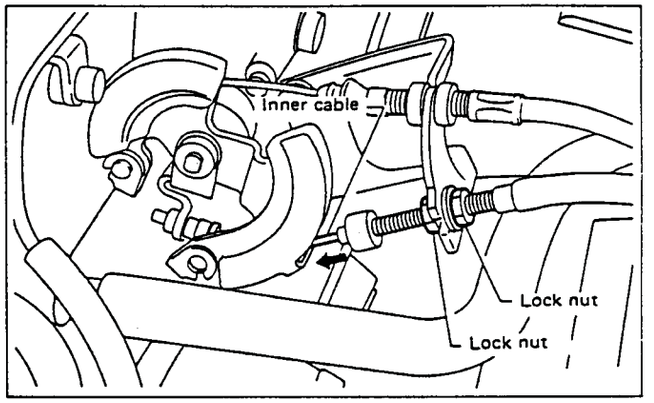


Fig. 262 MPFI model

REMOVAL

1) Completely drain ATF and remove the oil pan.
2) Remove the end of the cable from the pulley; remove the bolt.

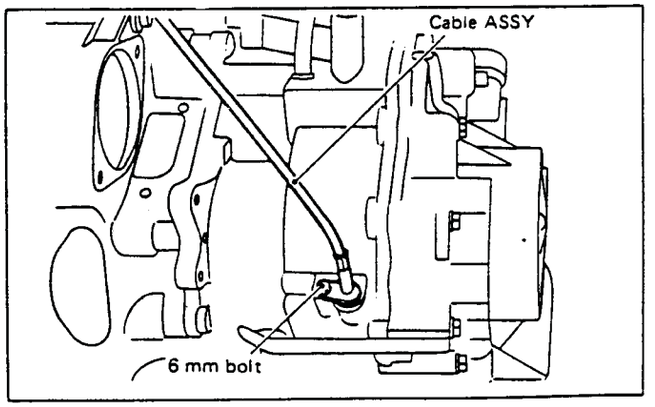


Fig. 263

a. Discard the O-ring; replace with a new one.
b. To facilitate removal of the oil pan, remove the front grille and radiator in advance.

INSPECTION

1) Ensure the inner cable moves smoothly. Also check it for wear or damage.
2) Check the clinched portion of the outer cable for looseness.
3) Also check the outer cable for wear or damage.

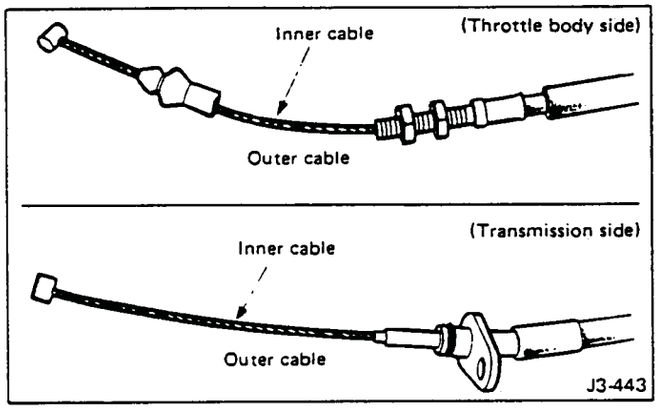


Fig. 264

INSTALLATION

1) Install the O-ring onto the cable, insert the cable into the hole in the transmission case, and tighten with the bolt and washer.

Tightening torque:
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

2) Route the inner cable along the rib on the transmission case, as shown in the figure below. Secure the end of the cable to the hole on the shift control lever and place the cable on the perimeter of the lever.

Ensure the inner cable moves smoothly without disturbing the inner wall of the transmission case and control valve body ASSY when pulled from the outside.

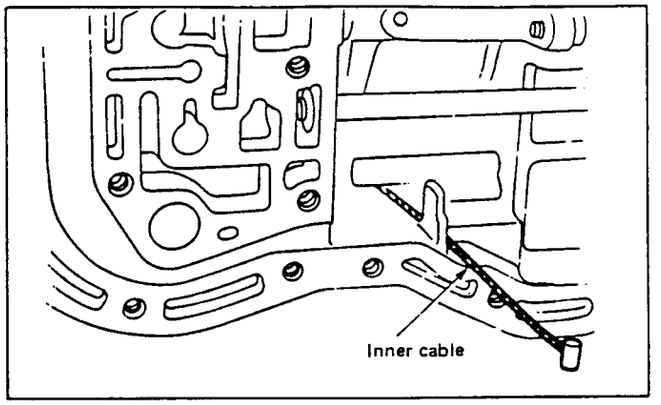


Fig. 265

Adjustment of Selector Cable Neutral Position

Adjustment on the body side

1) Shift the selector lever to "N."
2) Push slightly nut Ⓐ to the lever end and then tighten nut Ⓑ.

Do not move the nut Ⓒ.

3) Shift the selector lever to all positions to ensure it operates properly.

Tightening torque:
13 – 23 N·m (1.3 – 2.3 kg-m, 9.4 - 16.6 ft-lb)

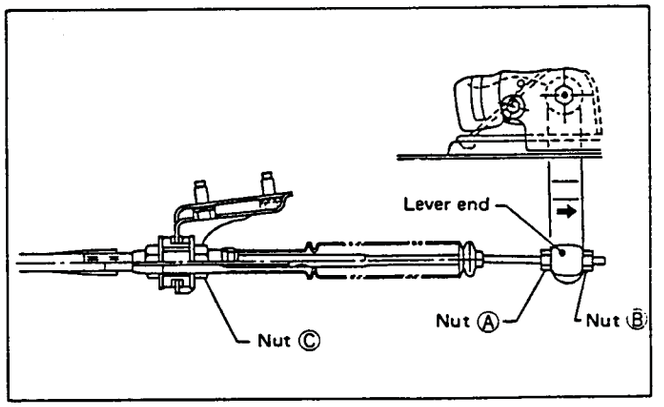


Fig. 266

Inhibitor Switch

1) Ensure that the relative positions of the selector lever and respective inhibitor switches are correct.
Check the relative positions of the selector lever and that shift cams (on the transmission side) are aligned properly.
2) Check to ensure the starter starts when the ignition switch is turned ON with the selector lever set at P or N, and that the back-up lights come on when the selector lever is shifted into R.
3) Continuity test of inhibitor switches

Terminal No.	P	R	N	D	Ds
1	○	○	○	○	○
2	○				
3		○			
4			○		
5				○	
6					○
7	○		○		
8	○		○		
9		○			
10		○			

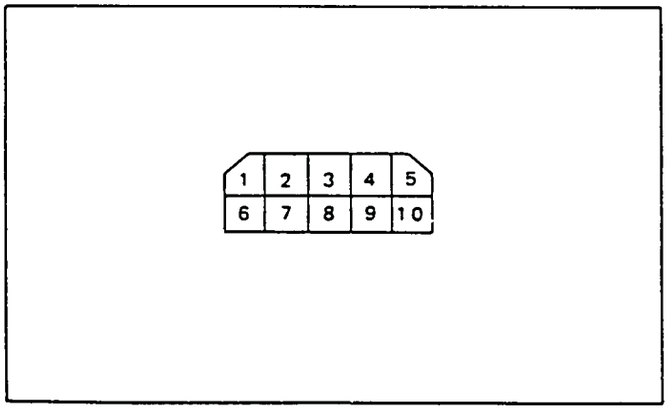


Fig. 267

ADJUSTMENT

1) Loosen the two bolts which secure the inhibitor switch.
2) At the position where the selector lever is shifted in the "N" range and pushed to the "P" side lightly, match the locator to bracket hole, the moving plate pin to arm hole, then tighten the bolts to the specified torque.
3) While lightly pushing the selector lever toward P, tighten the bolts.

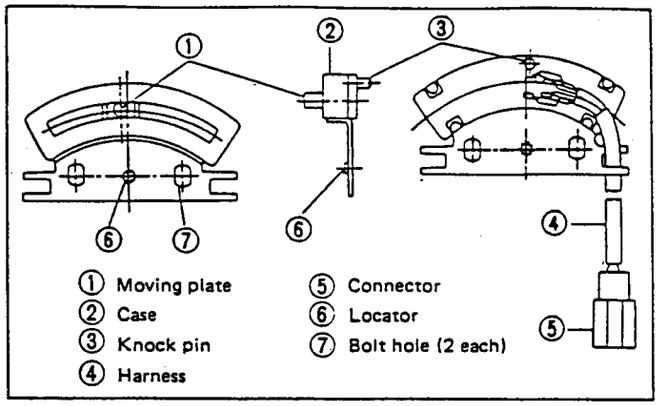


Fig. 268

Brush Holder

REMOVAL

1) Remove the starter.
2) Disconnect the brush holder harness and wiring harness connectors. Remove the bolts which secure the brush holder; remove the brush holder.

Be careful not to break the brush when removing the brush holder from the case.

INSPECTION

1) Check the tip of the brush to see if it is worn close to the wear limit mark. If it is, replace the brush holder.

Also consider whether the brush will still be suitable for use by the time of the next specified inspection.

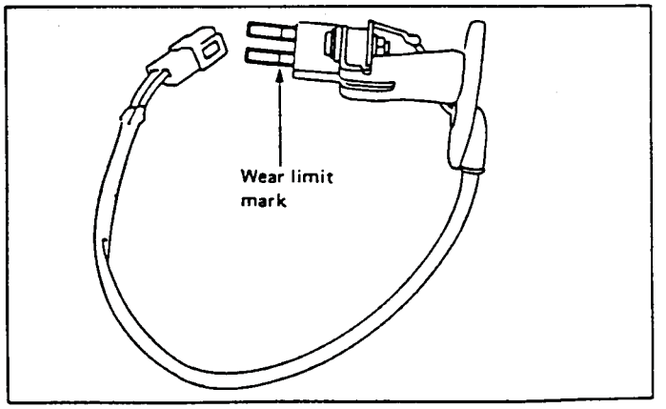


Fig. 269

2) Check the bolts for looseness.
3) Check to ensure the harness is properly insulated of the two 5 mm screws and bracket.
4) Ensure that oil does not come in contact with the tip of the brush.

Do not move the brush up or down unnecessarily as this may break the lead.

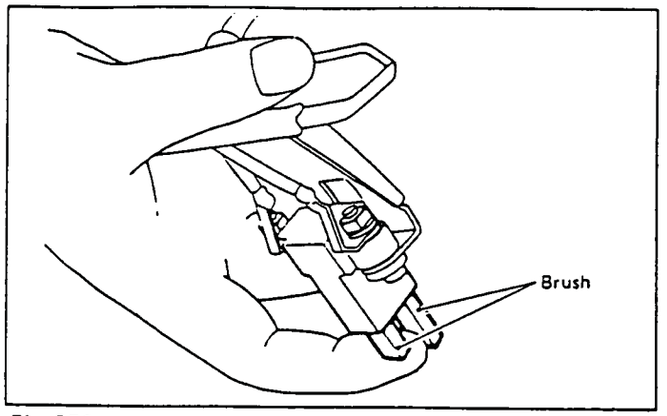


Fig. 270

INSTALLATION

a. Be careful not to bend or scratch the seal plate affixed to the brush holder.
b. Ensure that the brush is fitted into the brush holder's guide groove of the housing when the brush holder is installed on the clutch housing.
c. Do not forcefully install or tighten the brush holder as this may break the brush.

Accelerator Switch and Throttle-position Switch

Check to ensure both the accelerator switch and throttle-position switch operate within the specified ranges in relation to the stroke of the accelerator pedal.

INSPECTION

The accelerator switch must turn ON within a range from 3 to 7 mm (0.12 to 0.28 in) from the released position of the accelerator pedal; and the throttle-position switch must turn ON within a range from 16 to 24 mm (0.63 to 0.94 in). Beyond these specified ranges, both switches must turn OFF.

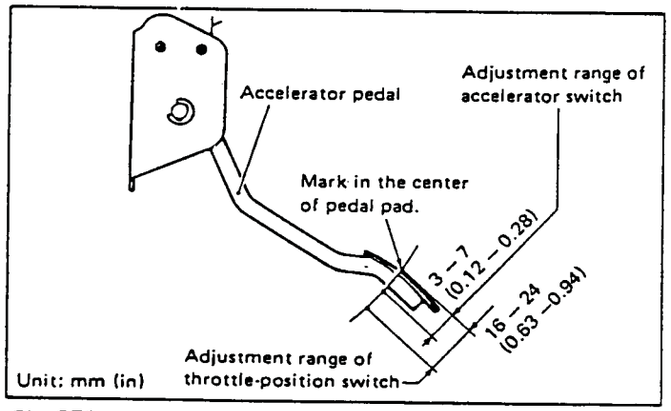


Fig. 271

Clutch Inspection

1) Check if the clutch is noisy during idle. If it is noisy, check the clutch bearing and replace if faulty.
2) Check to ensure the vehicle starts smoothly when the accelerator pedal is lightly depressed.
3) Check to ensure the clutch is directly coupled during rapid acceleration at vehicle speed of greater than 20 km/h (12 MPH). If the stall speed in the D range is at least 2,500 rpm or if the clutch persistently slips at vehicle speed of greater than 20 km/h (12 MPH), the clutch must be replaced.
4) The stall speed in the D range must be less than 2,500 rpm.

5 Performance Test

Stall Test

Measurement of the engine stall speed in the D range determines whether or not the transmission belt and pulley system, electromagnetic powder clutch, engine, etc. function properly.

Stall-test method

Before conducting a stall test, check to ensure the levels of engine oil, coolant and ATF are correct, and warm up the engine completely.
1) Install an engine tachometer in a place visible from the driver's compartment.
2) Chock the front and rear of all wheels and apply the parking brake.
3) Shift the selector lever to the D range.
4) While forcefully depressing the brake pedal with one foot, slowly depress the accelerator pedal to the full-throttle position with the other.
5) When the engine reaches constant speed, immediately read that speed (stall rpm) within five seconds.
6) Shift the selector lever to the N range, and idle the engine for at least one minute to cool down.
7) Record the measured stall speed.

Stall speed:
D range: 2,000 – 2,600 rpm

Stall-speed adjustment

If the stall speed exceeds the specified range, disconnect the jumper lead from terminal 17 of the control unit.

Line-pressure Test

When a slipping belt and pulley system is noted as a result of the road and stall-speed tests or when inadequate vehicle speed is encountered during shift operations, check the line pressure.

Line-pressure measurement

1) Remove the outlet plug (for a pressure gauge) from the side case and connect OIL PRESSURE GAUGE ADAPTER (498895400) instead. Connect the tip of OIL PRESSURE GAUGE (498575400) to the ADAPTER.

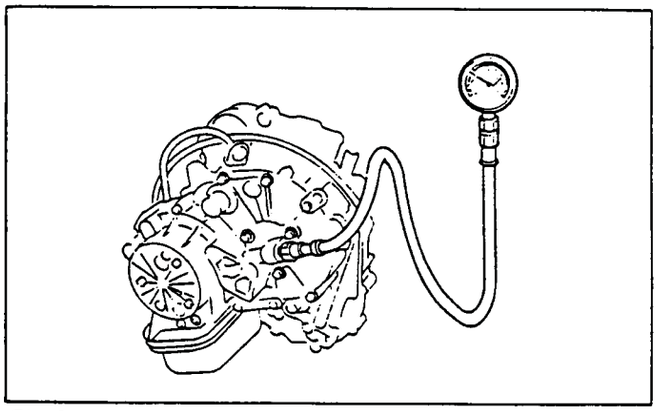


Fig. 272

2) Remove the connector of line pressure control solenoid valve.

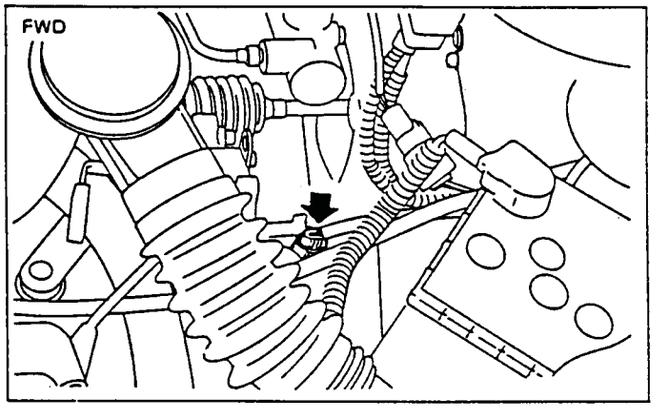


Fig. 273

Low line pressure is produced while idling the engine or when vehicle is stopped. (Solenoid "ON")

3) Shift the selector lever to the N range while idling the engine, and measure the line pressure.

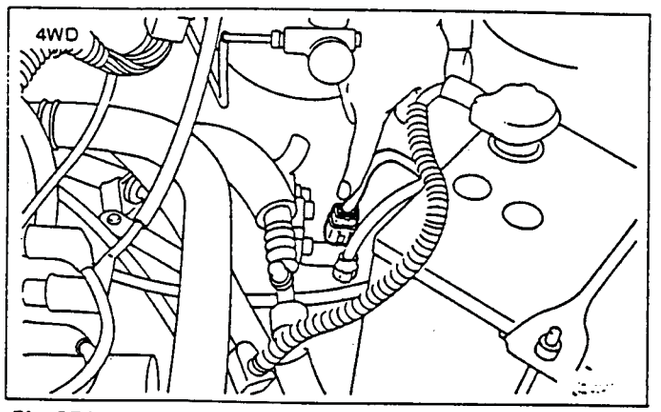


Fig. 274

Line pressure:
N range (with engine idling):
2,305 kPa (23.5 kg/cm^2, 334 psi)

a. Before measuring the line pressure, ensure the engine is warmed up completely.
b. After measuring the line pressure, connect the connector of line pressure control solenoid valve.

ADJUSTMENT PROCEDURE

1) Drain ATF.
2) Remove the oil pan and oil strainer.
3) Loosen the lock nut on the pressure regulator valve guide, and turn the bolt in or out to adjust the line pressure as required.

Adjustment:
One rotation of bolt changes line pressure by 98 kPa (1 kg/cm^2, 14 psi).

Loossening the bolt one complete rotation increases line pressure by 98 kPa (1 kg/cm^2, 14 psi).
Tightening the bolt one complete rotation decreases line pressure by 98 kPa (1 kg/cm^2, 14 psi).

When either of the switches operate beyond the specified range, problems listed in the following chart will occur.

Type of switch	Problem	Cause
Accelerator switch	Vehicle "creeps" during idle.	Switch turns ON before pedal is depressed 3 mm (0.12 in) (There is no free play between switch and pedal.)
	Clutch is engaged abruptly, or clutch is not engaged in low-speed operation.	Switch turns ON when pedal is depressed at least 7 mm (0.28 in).
Throttle-position switch	Shock is felt when clutch is engaged.	Switch turns ON before pedal is depressed 16 mm (0.63 in).
	Clutch tends to slip during acceleration in low-speed range.	Switch turns ON when pedal is depressed at least 24 mm (0.94 in).

Ensure the carburetor throttle valve fully closes when the accelerator switch operates within the specified range.