

SERVICE MANUAL



SUBARU IMPREZA



TRANSMISSION AND DIFFERENTIAL
SECTION

Technical description

• Mechanism and function

1. Outline

A: NON-TURBO MODEL

- The clutch control is of a simple yet reliable design using a cable which directly moves the release fork back and forth. This ensures smooth and reliable clutch control with minimum frictional resistance.
- The clutch itself is a push type clutch. When the clutch pedal is depressed, the self-aligning release bearing is caused to slide on a guide pressing the center of the diaphragm spring. The warped diaphragm spring disengages the pressure plate from the clutch disc.
The clutch using a diaphragm spring has the advantage of little variation in push load even when the clutch disc facing is worn.
The diaphragm spring is located inside the clutch cover.
- The clutch has a clutch disc between the flywheel and the pressure plate.
- Inside the clutch cover, there is a diaphragm spring and a pressure plate combined with each other by means of strap plates, which also serve to prevent the pressure plate from turning.
- The flywheel, whose outer diameter is 314.8 mm (12.394 in), is of flat design for better heat radiation and abrasion powder removal.

B. TURBO MODEL

- The turbo model adopts a hydraulic control due to increased clutch load.
- The clutch control operates the release fork using the hydraulic pressure which the master cylinder generates by converting the pedal depressing force.
- The clutch itself is a pull type clutch. When the clutch pedal is depressed, the self-aligning release bearing is caused to slide on a guide pulling the center of the diaphragm spring. The warped diaphragm spring disengages the pressure plate from the clutch disc.
The clutch using a diaphragm spring has the advantage of little variation in push load even when the clutch disc facing is worn.
The diaphragm spring is located inside the clutch cover.
- The clutch has a clutch disc between the flywheel and the pressure plate.
- Inside the clutch cover, there is a diaphragm spring and a pressure plate combined with each other by means of strap plates, which also serve to prevent the pressure plate from turning with respect to the clutch cover.

2. Operation

A: NON-TURBO MODEL

Applying foot pressure to the clutch pedal moves the release lever. This causes the release bearing to slide on the guide, pressing the diaphragm spring in the center. The spring is warped and the force having pressed the pressure plate is lost. As a result, the flywheel, clutch disc and pressure plate are disengaged, disconnecting the driving power.

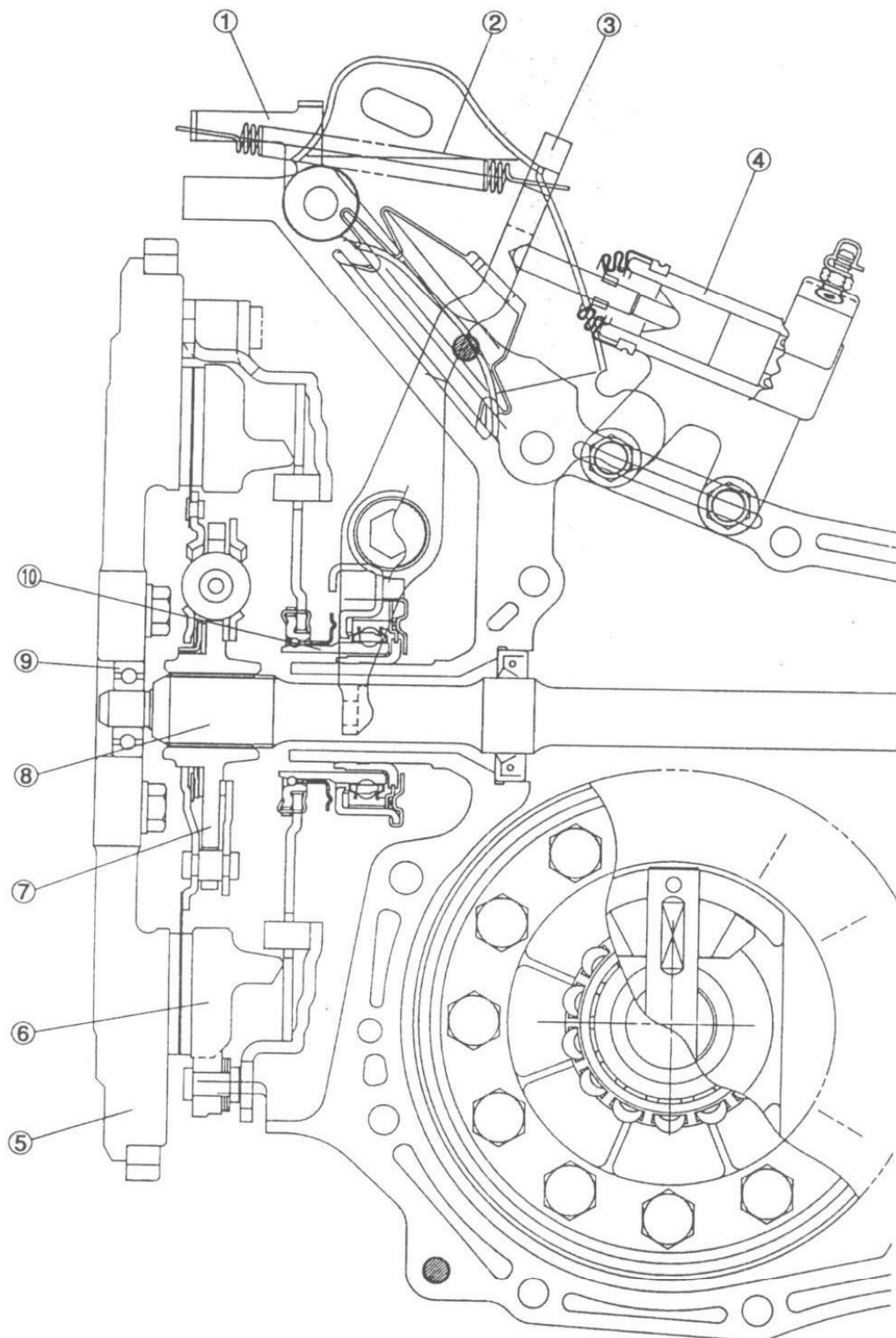
The push type clutch has the point of action at the tips of the diaphragm spring fingers, through which the pressure plate is pressed to the clutch disc. When the power transmission is to be interrupted, the diaphragm spring is forced to warp using the pivots established on the inward side of the spring finger tips (on the principle of the lever and fulcrum) to disengage the pressure plate from the clutch disc.

B. TURBO MODEL

Applying foot pressure to the clutch pedal moves the release lever. This causes the release bearing to slide on the guide, pulling the diaphragm spring at the center. The spring is warped and the force having pressed the pressure plate is lost. As a result, the flywheel, clutch disc and pressure plate are disengaged, disconnecting the driving power.

On the pull type clutch, the diaphragm spring has the point of action at the inward part distant from the tip, through which the pressure plate is pressed against the clutch disc. When the power transmission is to be interrupted, the diaphragm spring is forced to pivot on the tip and warp away from the pressure plate (on the principle of lever and fulcrum).

B. HYDRAULIC APPLICATION TYPE



- ① Spring bracket
- ② Spring
- ③ Release lever
- ④ Operating cylinder
- ⑤ Flywheel

- ⑥ Clutch cover
- ⑦ Clutch disc
- ⑧ Transmission main shaft
- ⑨ Ball bearing
- ⑩ Release bearing

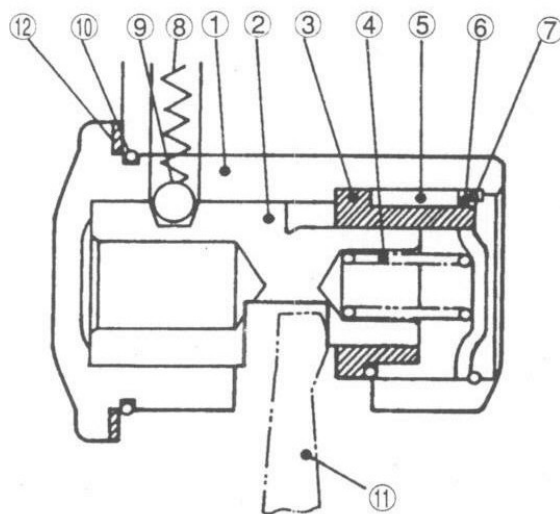
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3. Reverse Check Mechanism

A: CONSTRUCTION

The sleeve ① is bolted to the transmission case. The shaft ② is inserted in the sleeve ①. On the smaller-diameter side of this shaft ②, the cam ③ is loosely mounted so that it can rotate, and the sleeve ① holds the cam in place with its stepped part.

The spring ④, which is inserted in the shaft ② presses the shaft to the left. Further, the spring ⑤ is placed in between the cam ③ and sleeve ①, which forces the cam ③ to the left and in the direction of rotation. Both springs are held down with the plate ⑥ that is attached to the sleeve ① with the snap ring ⑦. The shaft ② has a groove for reverse accent, in which the ball ⑨ and spring ⑧ are put through a hole drilled in the sleeve ①.



- ① Reverse check sleeve
- ② Reverse accent shaft
- ③ Reverse check cam
- ④ Reverse return spring

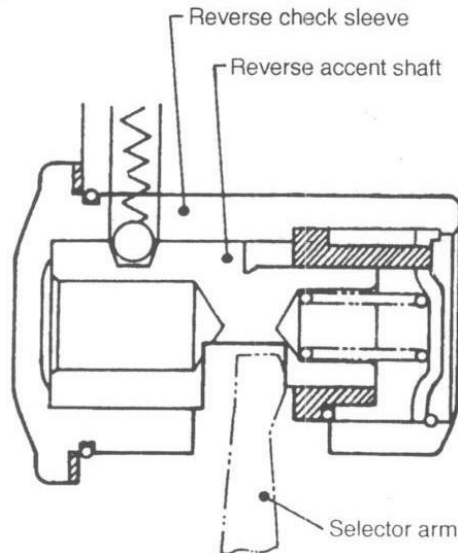
- ⑤ Reverse check spring
- ⑥ Reverse check plate
- ⑦ Snap ring
- ⑧ Reverse accent spring

- ⑨ Ball
- ⑩ O-ring
- ⑪ Selector arm
- ⑫ Select adjust shim

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B: OPERATION

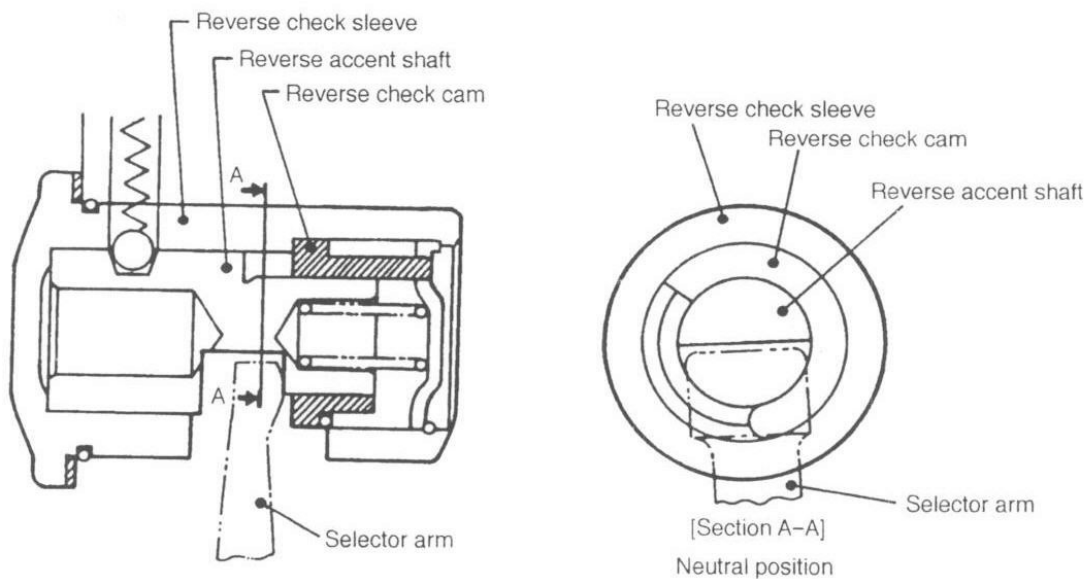
As shown in the previous figure, the sleeve and shaft have a notch, and the arm is placed between the notches. The position of the arm shown is the neutral position (hereafter referred to as (N) position). The point where the arm stops when moved to the left is the 1st and 2nd position. Opposite this, the point where the arm stops when moved to the right is the 5th and reverse position.



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1. WHEN 5TH AND REVERSE SIDE IS SELECTED

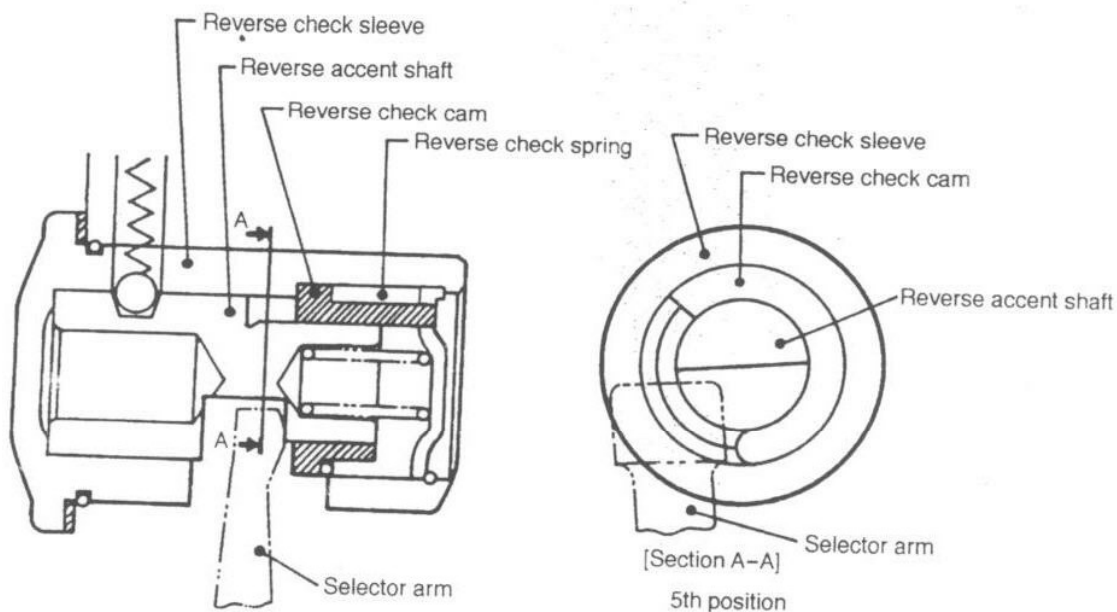
The arm pushes the shaft and cam simultaneously and moves to the 5th and reverse side.



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2. WHEN SHIFT IS MADE TO 5TH

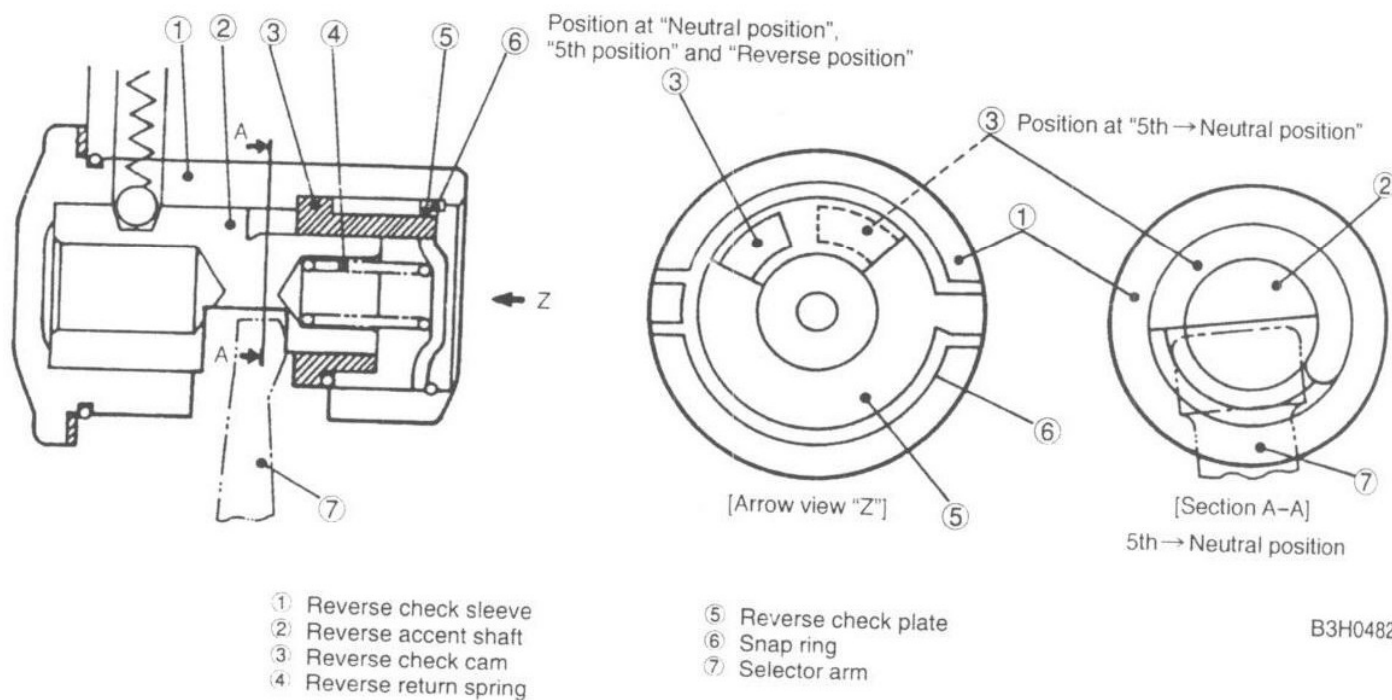
The arm moves to the 5th side pushing the shaft. When the arm pulls out of the cam, the cam is returned to the original position by the spring.



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3. WHEN SHIFT IS MADE FROM 5TH TO REVERSE

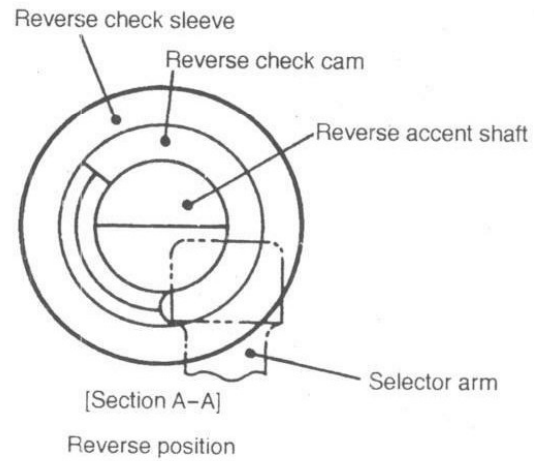
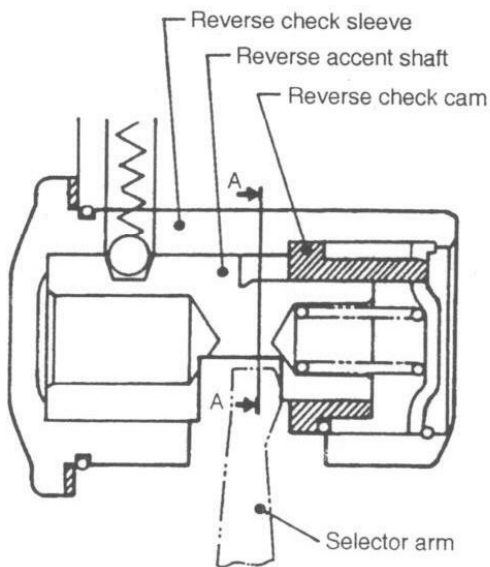
The arm moves to the reverse side pushing the shaft and runs against the cam that has already returned. The cam has, as shown in figure [Arrow view "Z"], a stopper, which hits against the plate. Thus, the cam cannot rotate further. Accordingly, the arm comes to a stop at a point where it has turned the cam to a certain degree (i.e., (N) position), and the cam is pushed back to the (N) position by the shaft (i.e., the spring).



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I. WHEN SHIFT IS MADE TO REVERSE

The arm again moves to the 5th and reverse side. When the shift is made to reverse, the arm moves to the reverse position while pushing the shaft and cam together.



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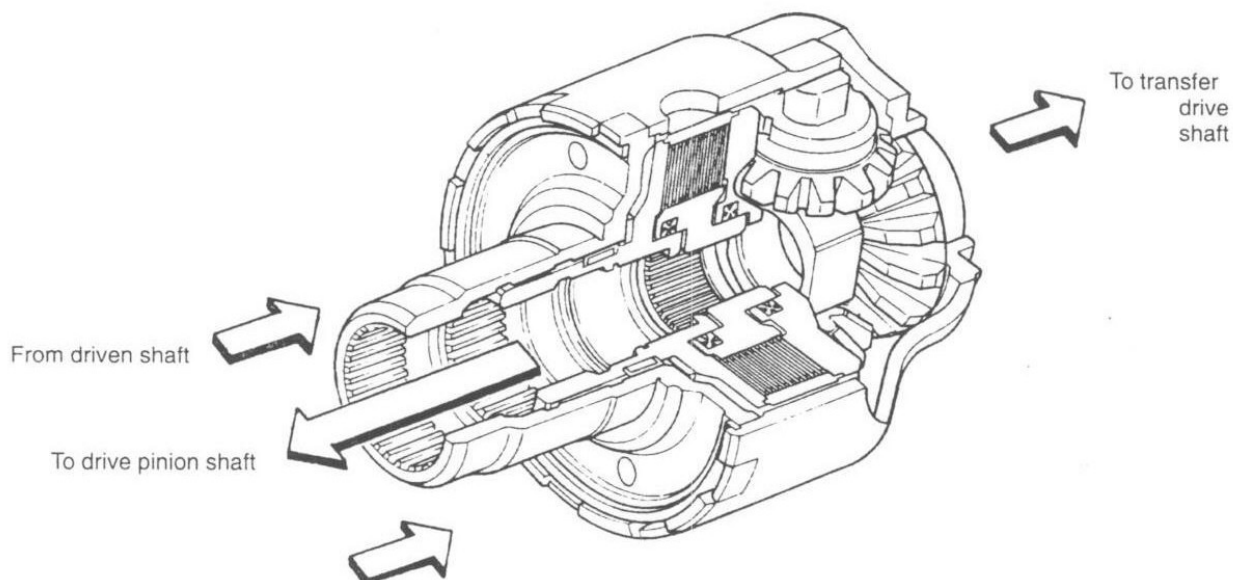
4. Center Differential

A: CONSTRUCTION

The center differential utilizes a "shaft-to-shaft" design which connects the front-wheel drive pinion shaft and the rear-wheel drive transfer drive gear shaft via viscous coupling to achieve compact construction. With this arrangement, viscous torque is generated by a difference in rotating speed between the two shafts so that both differential action and drive torque distribution are properly controlled.

The center differential provides a means of distributing engine torque (transmitted to the tubular driven shafts by way of the clutch, mainshaft and various gears) to the front- and rear-wheel drive shafts equally, as well as absorbing the difference in rotating speed between the front and rear wheels during turns.

When the front and/or rear wheels spin on muddy roads, etc., viscous coupling controls the differential action so that the optimum drive torque is automatically distributed to these wheels.

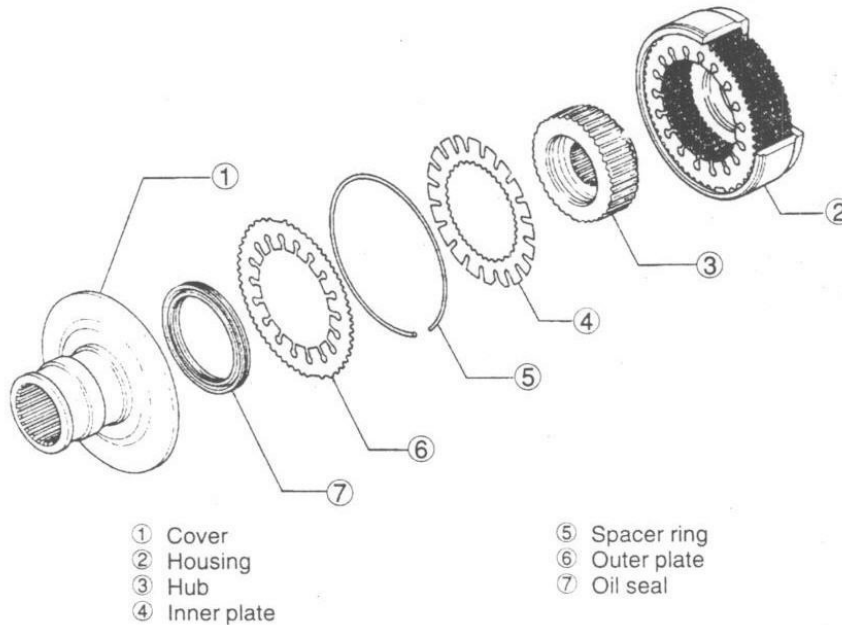


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B: MECHANISM OF VISCOUS COUPLING

The viscous coupling housing contains a number of inner and outer plates which are arranged alternately. The inner plate has its internal perimeter fitted to the external hub splines while the outer plate has its external perimeter fitted to the internal housing splines. A spacer ring is provided to position the perimeter of the outer plate. The inner plate has no spacer ring and moves slightly between the adjacent outer plates, along the hub splined in the axial direction.

A mixture of silicone oil and air is sealed in the space inside the viscous coupling housing. An "X" seal ring prevents silicone oil from entering the transmission. This could occur when silicone oil is highly pressurized due to an increase in rotating speed difference between the front and rear wheels.

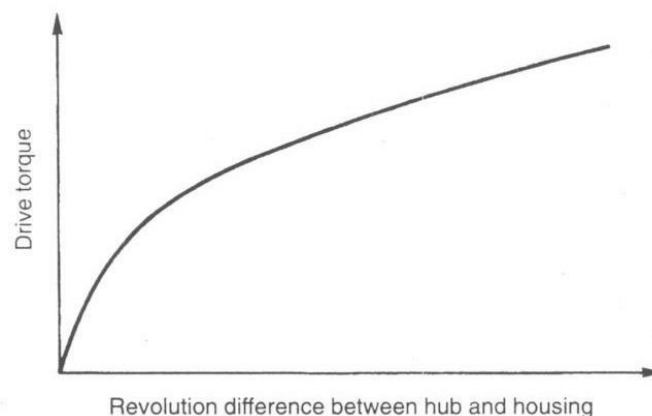


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1. TORQUE CHARACTERISTICS

When a difference in rotating speed between the viscous coupling housing and the hub occurs, a viscous shearing force is generated in the silicone oil placed between the outer and inner plates. The torque is then transmitted by the silicone oil between the housing and the hub.

The greater the difference in rotating speed between the viscous coupling housing and the hub, the greater the shearing force of the silicone oil. The relationship between the torque transmission and rotation speed difference is shown in the figure. As can be seen from the figure, the smaller the rotating speed difference, the lesser the torque transmission and the differential-action.



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1. "HUMP" PHENOMENON

Silicone oil is heated and expands as differential action continues. This crushes air inside the viscous coupling so that the silicone oil "charging rate" will increase. As differential action continues, internal pressure will abruptly increase so that inner and outer plates (alternately arranged) come in contact. This causes quick torque transmission to occur, which is called a "hump" phenomenon.

The "hump" phenomenon eliminates the rotating speed difference between the housing and hub (which results in a state similar to "direct coupling"). This in turn decrease internal pressure and temperature. The viscous coupling returns to the normal operation. (The "hump" phenomenon does not occur under normal operating conditions.)

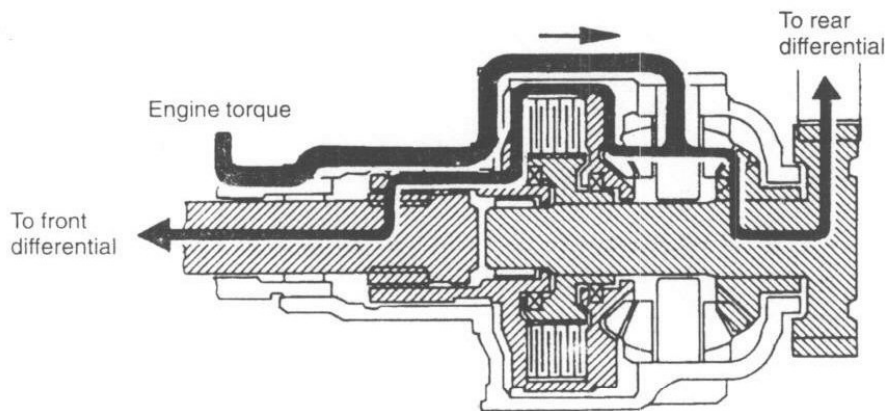
2. FUNCTION

During normal driving (when there is no speed difference between the front and rear wheels), the center differential delivers drive power to the front and rear wheels at a torque ratio of 50:50.

When a rotating speed difference occurs between the front and rear wheels, the center differential action is controlled by viscous coupling so that optimum drive forces are automatically distributed to the two.

1. DURING NORMAL DRIVING

During normal straight driving (on flat roads at constant speed), all four wheels rotate at the same speed. The center differential delivers engine torque to the front and rear drive axles. The viscous coupling does not perform the differential-action control because there is no rotating speed difference between the front and rear drive shafts.

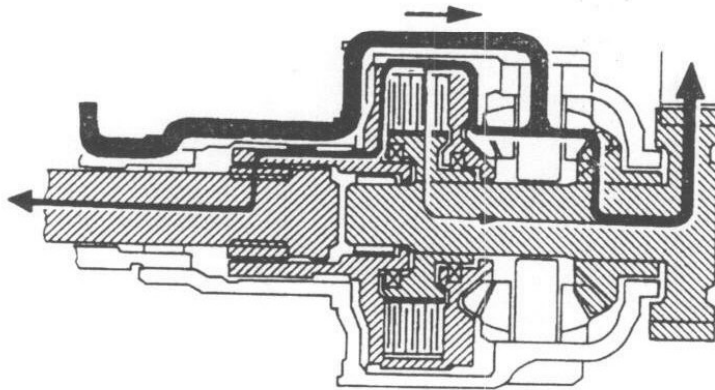


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2. DURING TURNS AT LOW SPEEDS

During turns at low speeds, a rotating speed difference occurs between the front and rear wheels, as well as the left and right wheels. In other words, the front wheels rotate faster than the rear wheels. When there is a small rotating speed difference (when vehicle speed is low), the center differential acts to absorb the rotating speed difference, making it possible to drive smoothly.

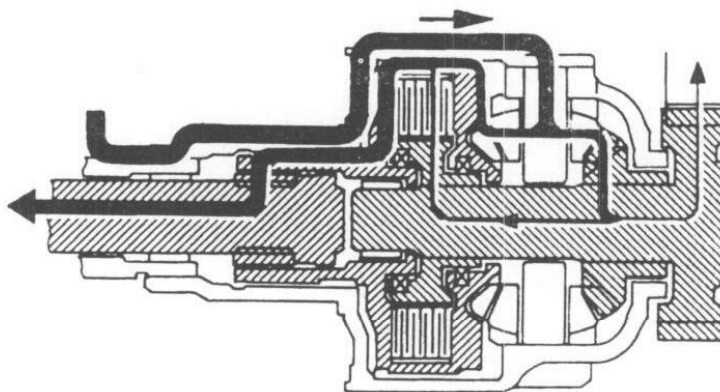
Although a slight rotating speed difference is transmitted to the viscous coupling, less torque transmission occurs because of the small rotating speed difference.



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3. ACCELERATION DURING STANDING STARTS ON A LOW “ μ ” ROAD

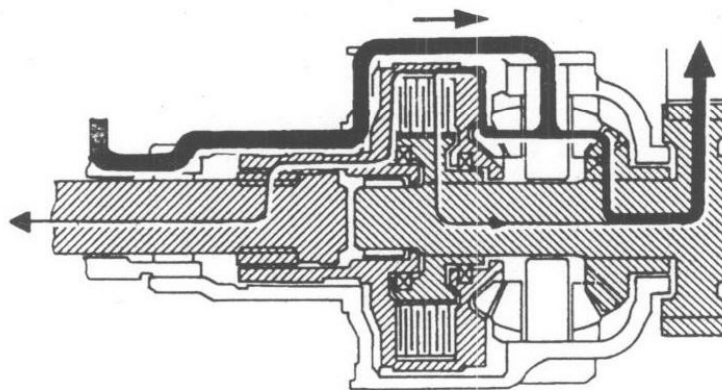
During rapid acceleration from standing starts on a slippery (low “ μ ”) road, front and rear wheel weight distribution changes. When the rear wheels begin to spin, the rotating speed difference between the two shafts increase simultaneously. This causes the viscous coupling to activate to that more torque is transmitted to the front wheels than to the rear. In addition, the center-differential's action is also restricted. In this way, acceleration performance during standing starts on low “ μ ” roads is greatly enhanced.



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4. DRIVING ON ROUGH ROADS

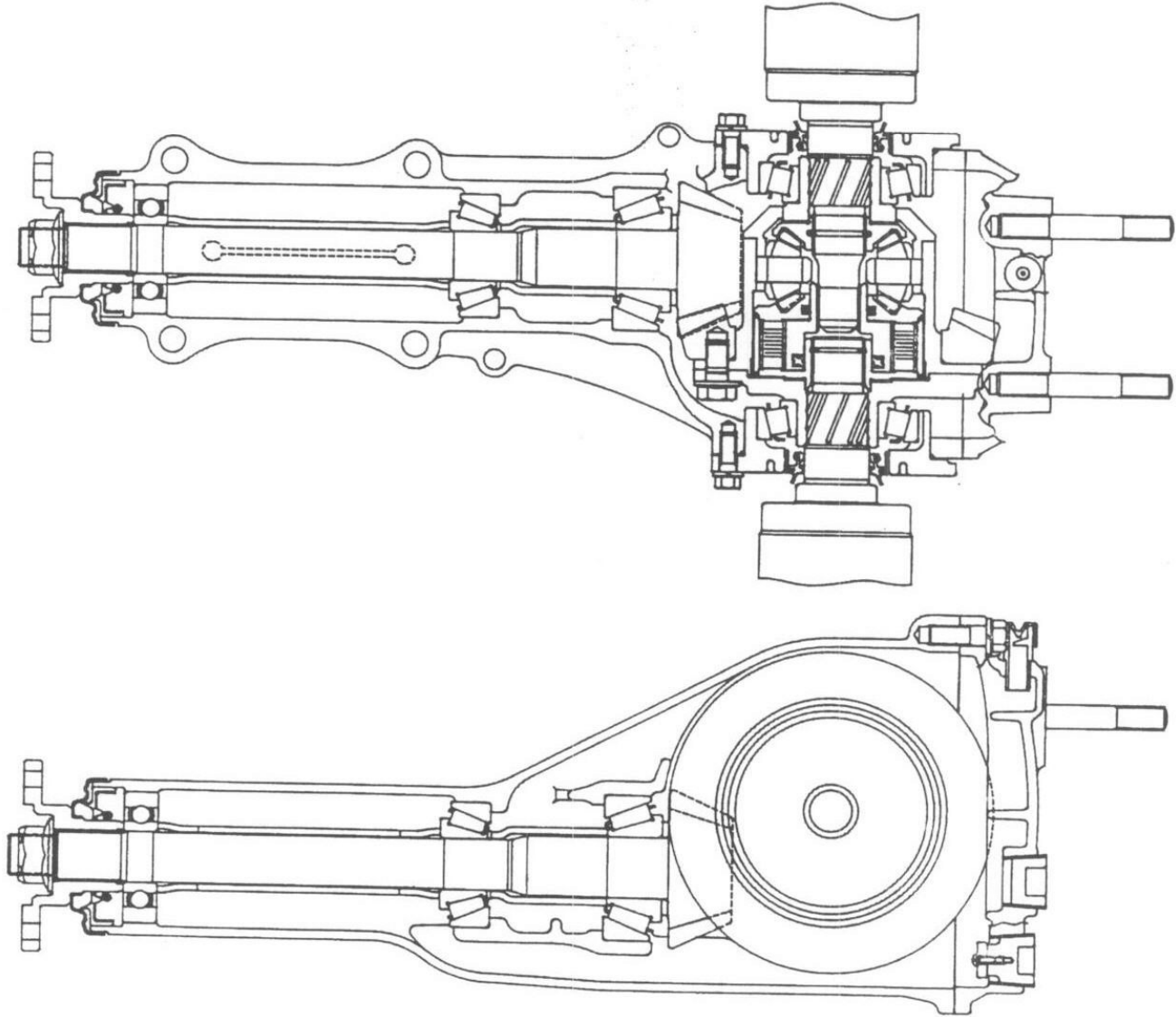
When one of the wheels begins to spin during rough-road driving, the rotating speed difference between the shafts is increased by the differential's action. At this point, the viscous coupling delivers large torque to the differential on the side which is not spin ring. In this way, driving stability on rough roads is increased. (The figure below shows an example of front wheel slip.)



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C: T-TYPE (TURBO MODEL)

The rear differential is a limited slip differential (LSD) incorporating outer plates, inner plates, and viscous coupling with silicon oil.



H3H1409

3. Limited Slip Differential (LSD)

A viscous coupling (VC) type LSD has been adopted so as to ensure safe and smooth transfer of increased power under various driving conditions. This VC type LSD features ease of turning while maintaining excellent stability when driving over slippery roads or when using engine brake, thus enabling engine power to be utilized efficiently. Smooth restriction of differential operation of the left and right wheels results in improved running stability on bad roads, snowy roads, and also on muddy roads.

A: STRUCTURE

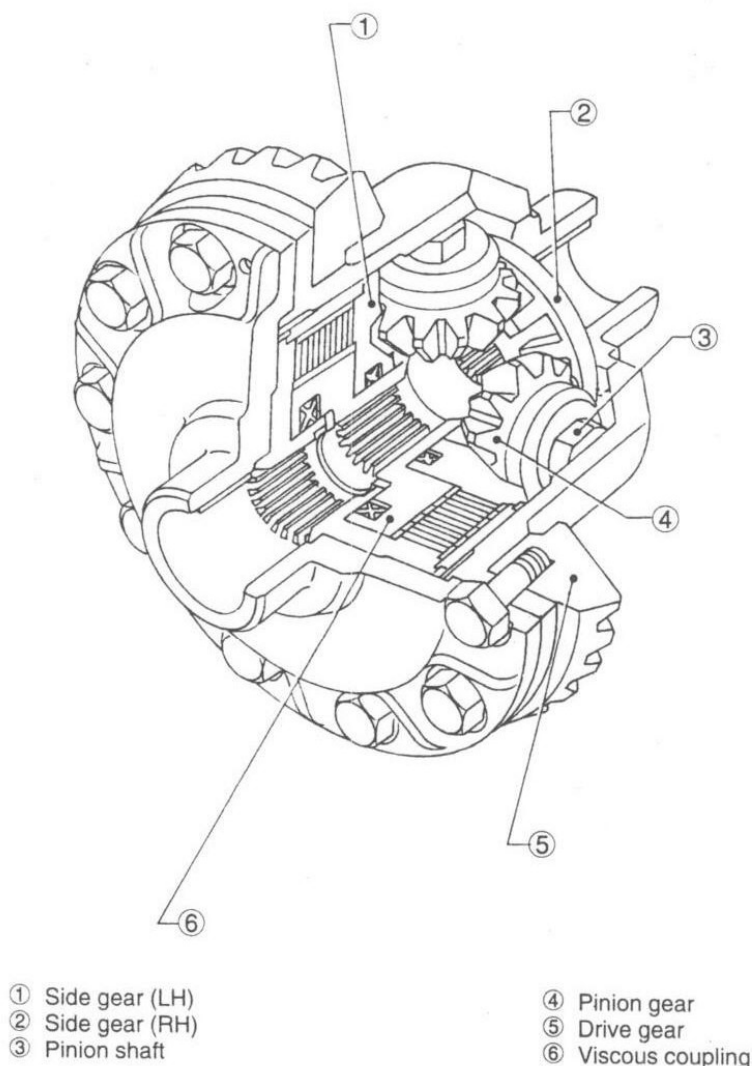
The VC type LSD adopts a "shaft to shaft system" in which the RH and LH rear drive shafts are coupled by a VC.

This results in a compact structure with high performance.

The inside of the VC housing is formed by alternately combining the outer plates (the outer periphery of each plate engages with the internal spline of the housing) and inner plates (the inner periphery of each plate engages with the outer spline of the hub).

On the outer periphery of the outer plate, the spacer ring is fitted and set in position. On the inner plate, no positioning ring is used: The plate can be moved a certain amount on the hub spline in the axial direction.

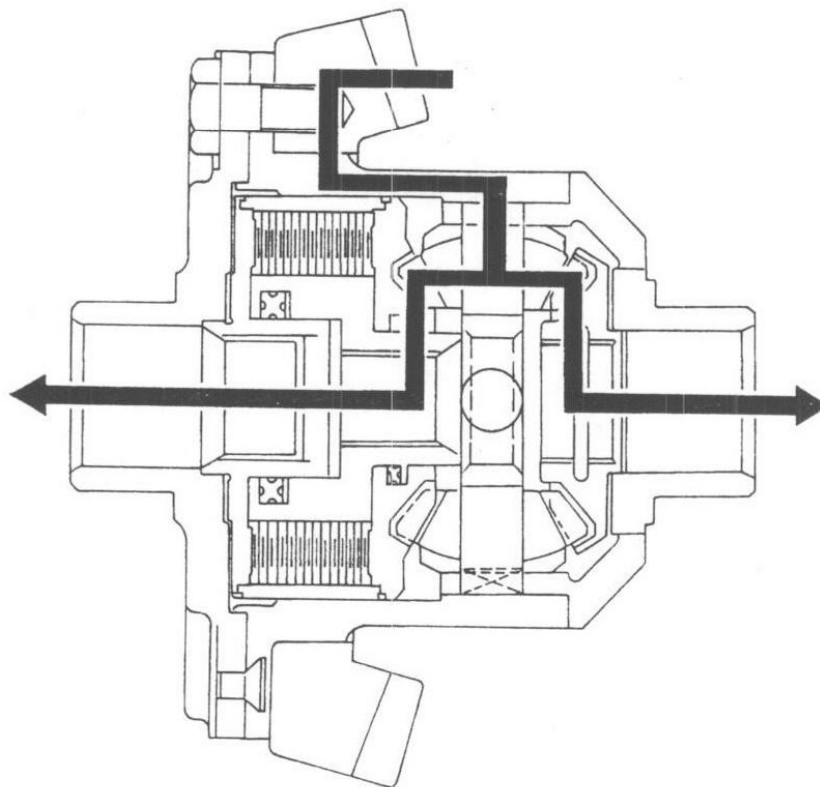
Sealed inside the housing is a mixture of high viscosity silicon oil and air. The housing is sealed by X-rings so that silicon oil will not leak into the rear final drive even when the pressure increases due to a greater difference in the rotation speed between LH and RH wheels.



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B: OPERATION**1. WHEN RIGHT AND LEFT WHEELS TURN AT EQUAL SPEED.**

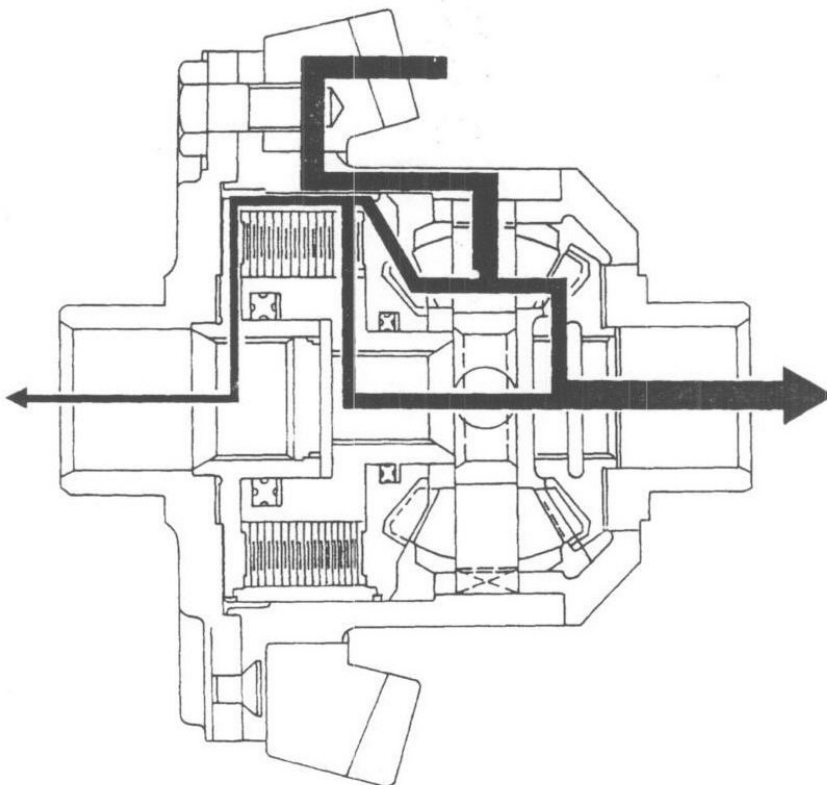
During normal straight-road driving where the right and left wheels run at an equal speed, the differential case and side gears rotate together, just as in conventional differentials. As a result, driving torque is transmitted equally to the right and left side gears.



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2. WHEN RIGHT AND LEFT WHEELS TURN AT DIFFERENT SPEEDS.

When a speed difference occurs between the right and left wheels, the VC housing and VC hub turn relatively at the same speed difference occurs as that of the rear drive shaft. Because of the shearing force caused in the silicon oil, a differential torque is generated, which controls differential operation (idle rotation). For example, if the left wheel turns idle due to a difference in the road resistance, a speed difference occurs between the right and left wheels. Since the VC is installed between the right and left wheels, a differential torque is generated in the VC corresponding to this speed difference, and this differential torque is transferred from the left wheel to the right wheel. Accordingly, a greater driving force is transferred to the right wheel which is rotating at a lower speed.



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C: SERVICE PROCEDURES FOR LSD

The component parts of LSD assembly are not available as piece parts. Therefore, it is recommended to not disassemble LSD assembly.