SECTION 3 POWER TRAIN SYSTEM

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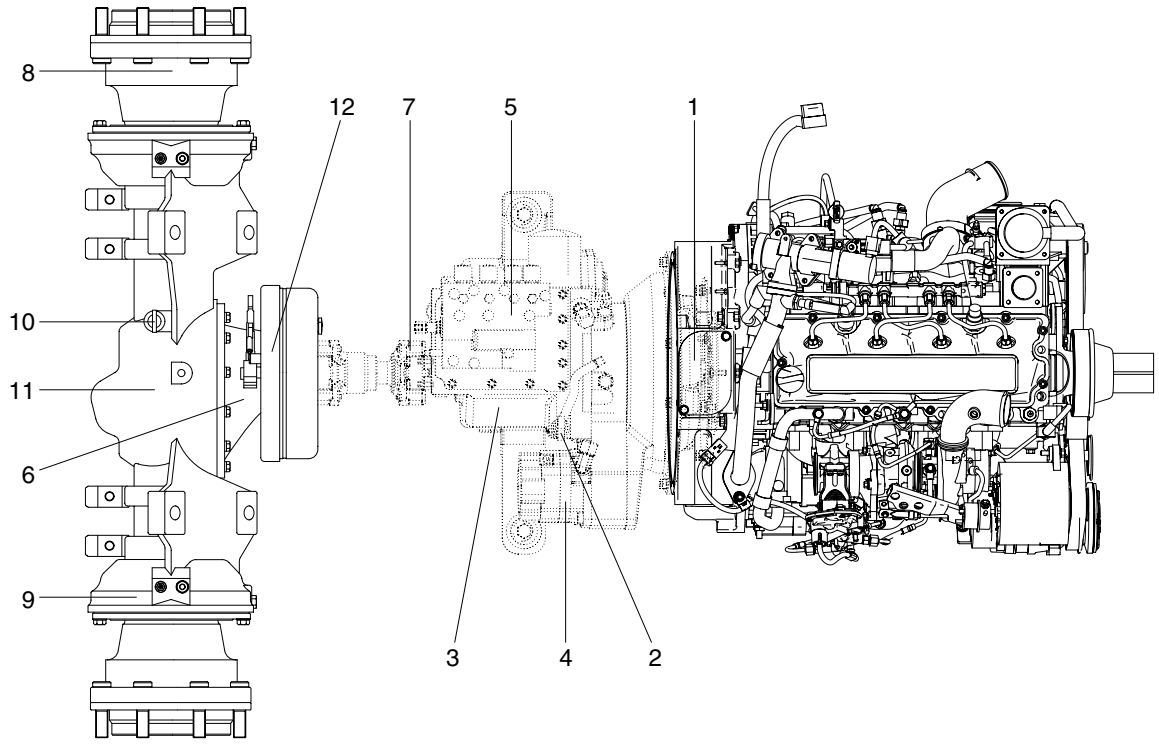
GROUP 1 STRUCTURE AND OPERATION

1. POWER TRAIN COMPONENT OVERVIEW

1) STRUCTURE



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1	Torque converter	5	T/M control valve	9	Disk brake (service)
2	T/M oil level gauge	6	Differential	10	Drive axle oil level gauge
3	Transmission	7	Drive shaft	11	Drive axle
4	T/M oil pump	8	Drive wheel	12	Parking brake

2) OPERATION

Power train system consists of engine, torque converter (1), transmission (3), drive shaft (7), drive axle (11) and drive wheel (8).

Engine power is transmitted to the transmission (3) through the torque converter (1).

Transmission (3) which operates as a type of regularly and continuously engaged counter shaft shifting by 2 stage both forward and reverse consists of 4 hydraulic clutch packs.

Clutch piston is released by tension of spring.

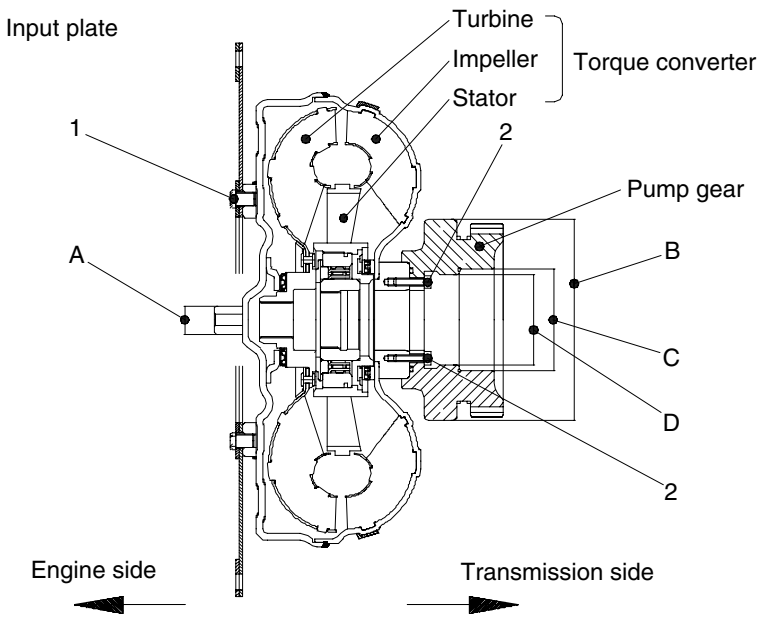
The power is transmitted to spiral gear and bevel gear set of differential through the output gear and then goes to the drive wheel via drive axle.

3) SPECIFICATION

Item			Unit	Specification
Torque converter	Type		-	3 elements 2 phase 1 stage
	Power transmit		-	Torque converter
Transmission	Type/Gear shift		-	Power shift / F2 : R2
	Gear ratio	FR/RR 1 stage	-	2.550
		FR/RR 2 stage	-	1.218
	P.T.O system		-	Included
	T/M oil		-	ATF DEXRON III
	Oil quantity		ℓ	12
T/M valve	Type		-	Electric
Charging pump	Displacement		cc/rev	20.6
Drive axle	Gear ratio	Differential	-	2.923
		Planetary	-	4
		Total	-	11.692
	Axle oil		-	SHELL DONAX TD
	Oil quantity		ℓ	10.5
Brake	Service brake		-	Wet disk brake
	Brake oil		-	AZOLLA ZS32
	Parking brake		-	Seperated drum brake
Differential	Gear type		-	Spiral bevel gear
	Differential type		-	4 pinions

2. TORQUE CONVERTER

1) STRUCTURE



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No	Item	Specification
1	Torque converter input plate	4.5±0.3 kg·m (32.5±2.2 lbf·ft)
2	Torque converter pump gear	2.0±0.3 kg·m (14.5±2.2 lbf·ft)
A	Pilot boss outer diameter	19.959 - 19.980 mm (0.786 - 0.787 in)
B	Oil seal outer diameter	134.9 - 135.0 mm (5.311 - 5.315 in)
C	Needle bearing outer diameter	68.000 - 68.019 mm (2.677 - 2.678 in)
D	Seal ring inner diameter	60.333 - 60.363 mm (2.375 - 2.376 in)

2) OPERATION

The torque converter is working according to the Trilok-system, i.e. it assumes at high turbine speed the characteristics, and therefore the favorable efficiency of a hydraulic clutch.

The converter will be defined according to the engine power so that the most favorable operating conditions for each installation case are given.

The Torque converter is composed of 3 main components :

Pump wheel - turbine wheel - stator (Reaction member)

These 3 impeller wheels are arranged in such a ring-shaped system that the fluid passes through the circulating components in the indicated order.

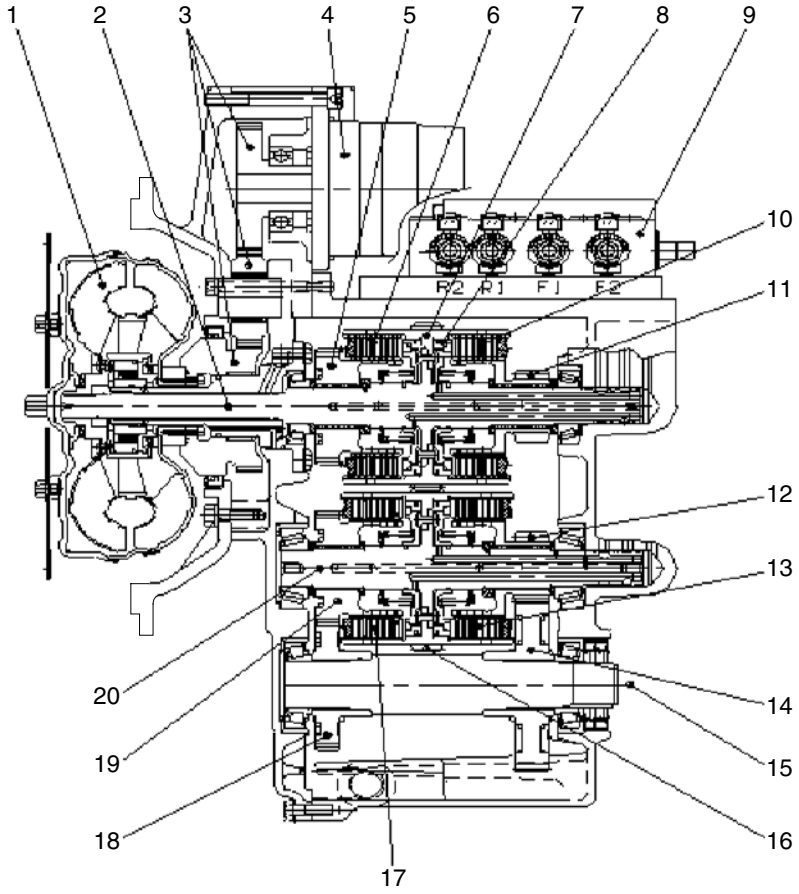
Pressure oil is constantly pressing out of the transmission pump through the converter. In this way, the converter can fulfill its task to multiply the torque of the engine, and at the same time, the heat created in the converter is absorbed through the escaping oil.

The oil, escaping out of the pump wheel, enters the turbine wheel and where the direction of flow is inversed.

According to the rate of inversion, the turbine wheel and with it also the output shaft, receives a more or less high reaction moment. The stator (Reaction member), following the turbine, has the task to inverse again the oil which is escaping out of the turbine and to delivery it under the suitable discharge direction to the pump wheel.
The stator receives a reaction moment, due to the inversion.
The relation between turbine and pump moment is called torque conversion. The conversion is increasing in correspondence with the speed difference of the pump and the turbine wheel.
Finally the maximum conversion will be broken down at turbine wheel.
With increasing output speed, the torque conversion is decreasing. The adoption of the output speed to a certain required output moment is infinitely variable and automatically achieved by the torque converter.

3. TRANSMISSION

1) STRUCTURE



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1	Torque converter	8	Clutch piston	15	Output shaft
2	Input shaft	9	Valve assembly	16	Clutch drum (FR)
3	3 P.T.O gears	10	Clutch (RR, 1 stage)	17	Clutch (FR, 2 stage)
4	Pump assembly	11	Gear (RR, 1 stage)	18	Gear (Output, 2 stage)
5	Gear (RR, 2 stage)	12	Gear (FR, 1 stage)	19	Gear (FR, 2 stage)
6	Clutch (RR, 2 stage)	13	Clutch (FR, 1 stage)	20	Counter shaft
7	Clutch drum(RR)	14	Gear (Output, 1 stage)		

2) OPERATION

Transmission enables to a power transmission and a gearshift by the operation of hydraulic friction clutch pack which is controlled through the torque converter.

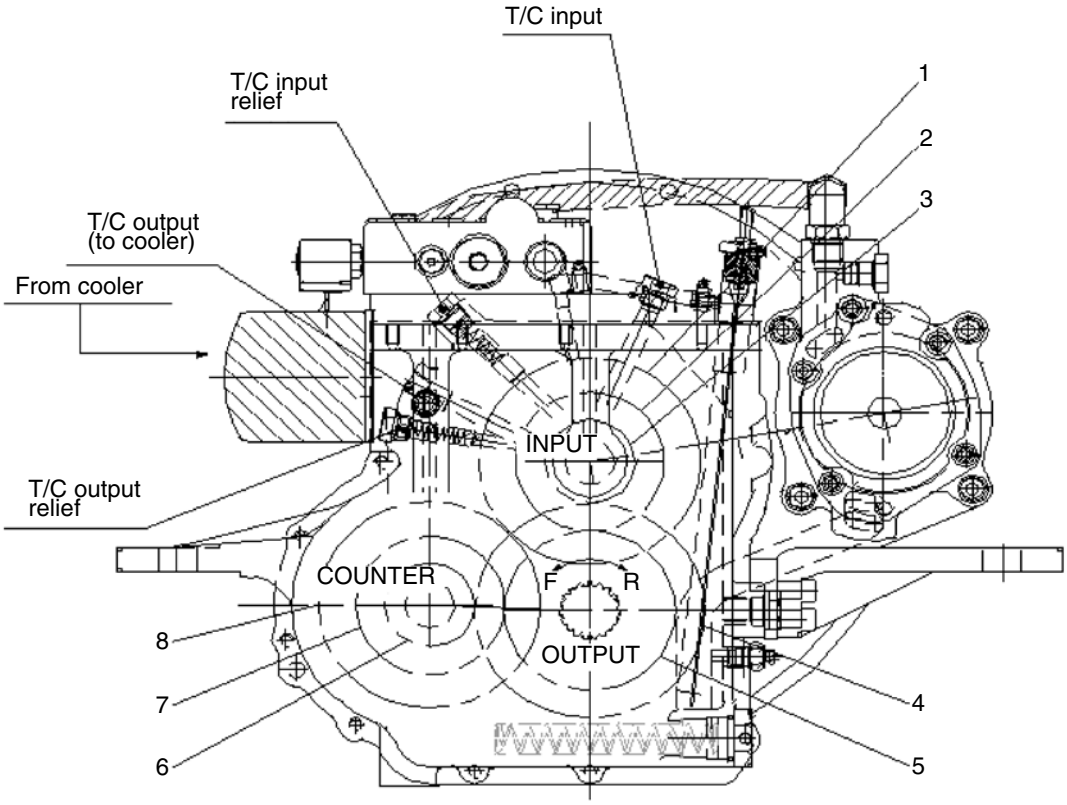
In accordance with the drive speed of vehicle, transmission shifts the gear to the optimal stage for a stable drive.

T/M transmits the power to drive axle by 2 stage each of forward and reverse gear selections.

T/M consists of 4 hydraulic clutches and it is released by spring tension.

Direction and gear stage are electrically changed. The power from the transmission is transmitted to all of the powertrain components.

3) TRANSMISSION GEAR ARRAY



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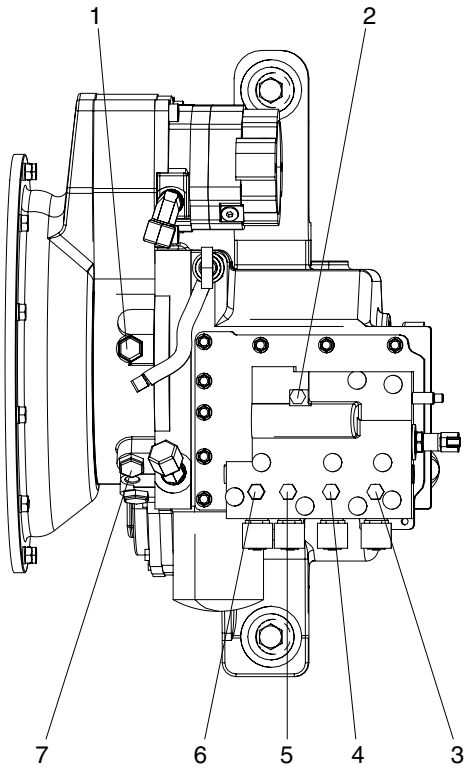
1	Cylinder clutch (RR)	4	Gear (Output, 1st stage)	7	Gear (FR, 2nd stage)
2	Gear (RR, 2nd stage)	5	Gear (Output, 2nd stage)	8	Gear clutch (FR)
3	Gear (RR, 1st stage)	6	Gear (FR, 1st stage)		

※ Selection of either forward or reverse gear makes all of the parts inside the T/M operate.

4) TRANSMISSION INPUT PORT



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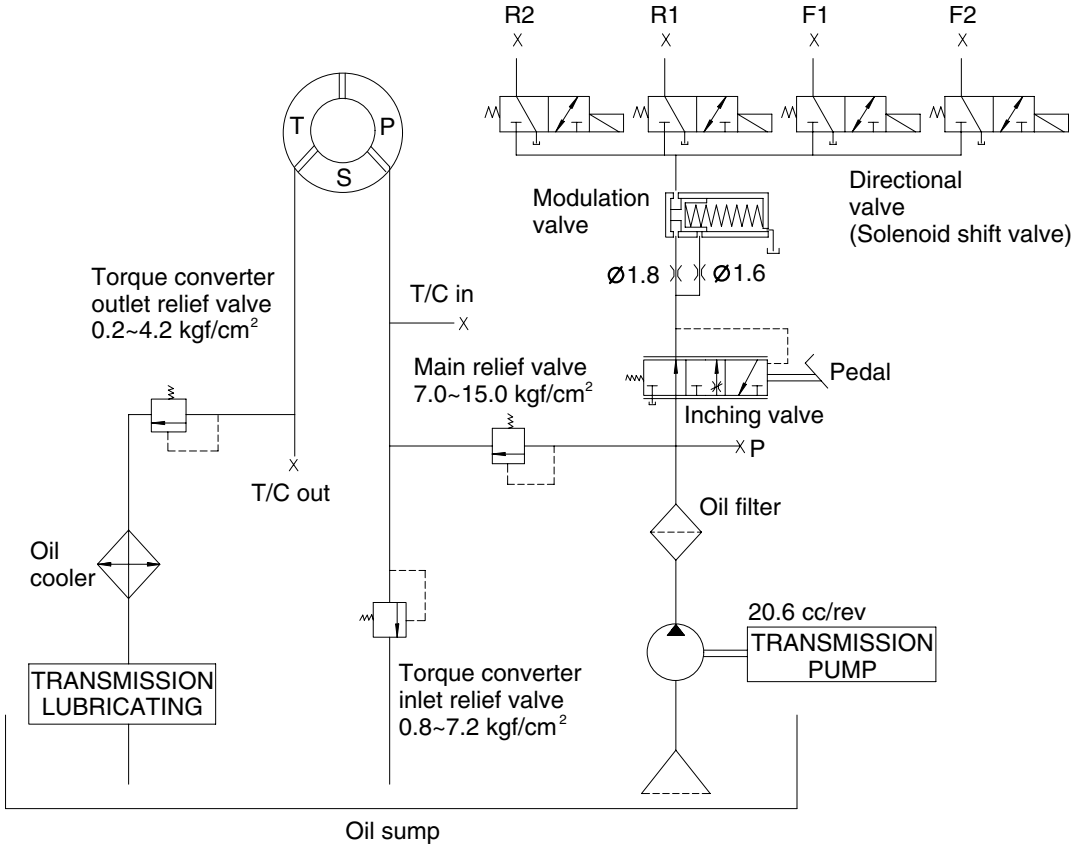
1 T/C input port pressure
2 Main line pressure
3 FR 2nd stage pressure
4 FR 1st stage pressure
5 RR 1st stage pressure
6 RR 2nd stage pressure
7 T/C output port pressure

· Transmission pressure

Engine rpm	Unit	Main line (Neutral)	T/C input port (Neutral)	T/C output port (Neutral)	FR 1,2 stage clutch	RR 1,2 stage clutch
Idle	kgf/cm² (psi)	6.5~13.2 (92.5~187.7)	0.7~4.2 (9.9~59.7)	0.2~1.2 (2.8~17.1)	6.5~13.2 (92.5~187.7)	6.5~13.2 (92.5~187.7)
1300	kgf/cm² (psi)	7.5~14.5 (106.7~206.2)	1.5~9.1 (21.3~129.4)	0.7~2.5 (10.0~35.6)	7.5~14.5 (106.7~206.2)	7.5~14.5 (106.7~206.2)
2200	kgf/cm² (psi)	7.5~15.0 (106.7~213.4)	2.6~11.1 (37.0~157.9)	1.0~4.2 (14.2~59.7)	7.5~15.0 (106.7~213.4)	7.5~15.0 (106.7~213.4)

5) TRANSMISSION INPUT PORT



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(1) Specification

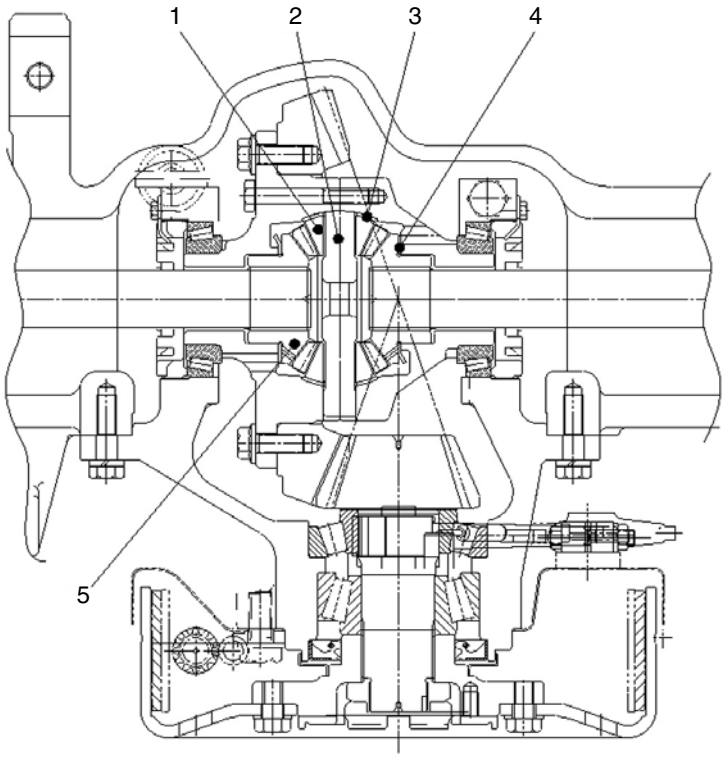
Item	Unit	Specification
Rated flow	ℓ /rpm	37.4 / 2200
Main relief pressure	kgf/cm²(psi)	7.0 ~ 15.0 (99.6~213.4)
T/C relief pressure	kgf/cm²(psi)	0.8 ~ 7.2 (11.4~102.4)
Clutch pressure	kgf/cm²(psi)	7.0 ~ 15.0 (99.6~213.4)
Residual pressure (Clutch release condition)	kgf/cm²(psi)	Max. 0.3(4.3)

(2) Electric input data

Item	Unit	Specification
Initial coil current at 20°C	A / VDC	0.7/24
Resistance at 20°C	Ω	39.3
Shifting time	sec	1.0 ~ 1.6
Connector	-	DR/D Models With Diode

4. DIFFERENTIAL CARRIER ASSEMBLY

1) STRUCTURE



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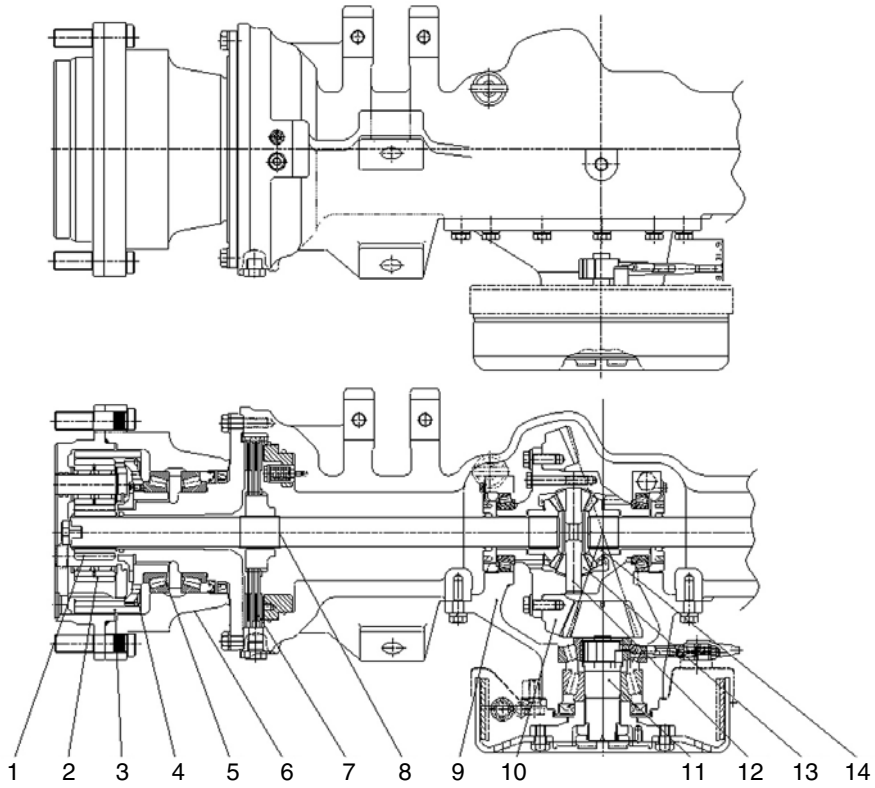
No	Item	Unit	Specification
1	Differential pinion gear inner diameter	mm (in)	20.000 - 20.021 (0.787~0.788)
2	Spider outer diameter	mm (in)	19.959 - 19.980 (0.786~0.787)
3	Pinion gear washer	mm (in)	1.92 - 2.08 (0.076~0.082)
4	Side gear washer	mm (in)	1.95 - 2.05 (0.077~0.081)
5	Side gear	-	-

2) OPERATION

Differential transmits the power from the transmission to drive wheel.
When the vehicle is running one side wheel rotates slower than the other side wheel.
Differential is composed of 4 pinions (1), 2 side gears (5) and 1 spider (2).
The spider is meshed vertically between 4 pinions (1) and 2 side gear (5), so the engagement become a right angle.

5. DRIVE AXLE

1) STRUCTURE



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1	Sun gear	6	Hub assy	11	Pinion shaft
2	Planetary gear	7	Disk brake	12	Spider
3	Inner gear	8	Drive shaft	13	Differential pinion gear
4	Inner gear carrier	9	Differential carrier assy	14	Differential side gear
5	Tapered bearing	10	Ring gear		

2) OPERATION

Drive axle which consists of differential carrier assembly (9), drive shaft (8) and hub assembly (6) transmits the drive force from transmission to drive wheel.

Pinion shaft (11) is connected to transmission output shaft and spline.

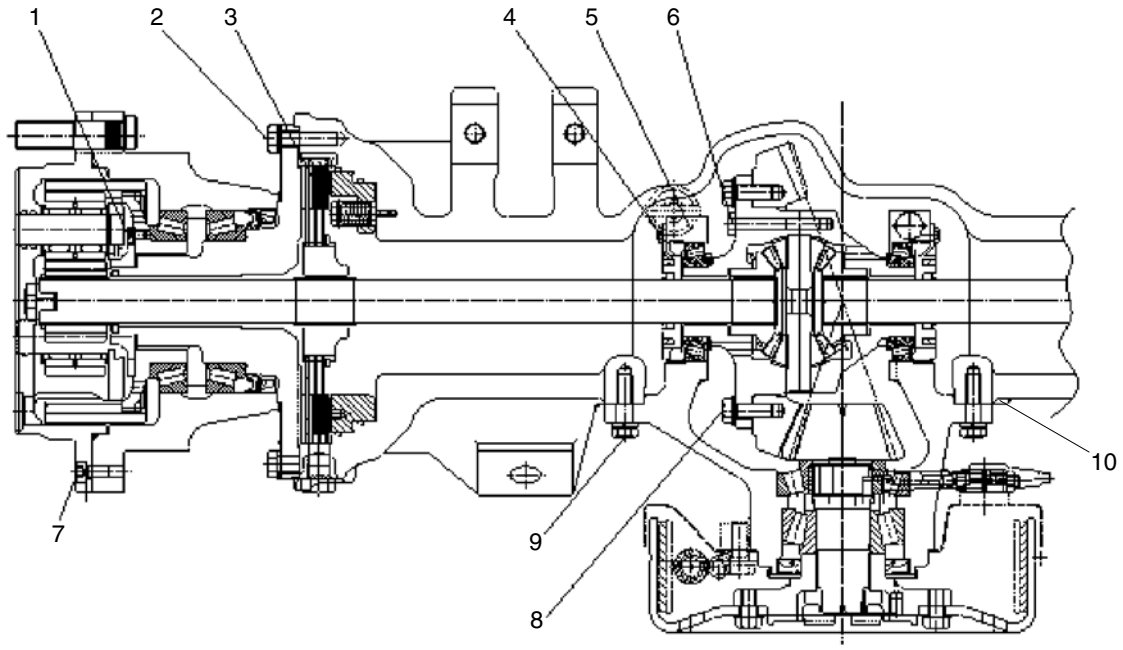
The power of transmission is transmitted to differential which consists of pinion shaft (11) and ring gear (10) and the differential rotates the drive shaft.

The differential transmits the drive force from transmission to wheels and one wheel's rotation speed is differ from the other.

The differential consists of 4 pinions (13) , 2 side gears (14) and spider and the engagement between 4 pinions (13) and side gear (14) makes a right angle.

Side gear (14) and drive shaft (8) are connected with spline and the drive shaft (8) consists of planetary gear (2), inner gear (3), wheel hub (6) and drive wheels.

3) DRIVE AXLE TIGHTENING TORQUE



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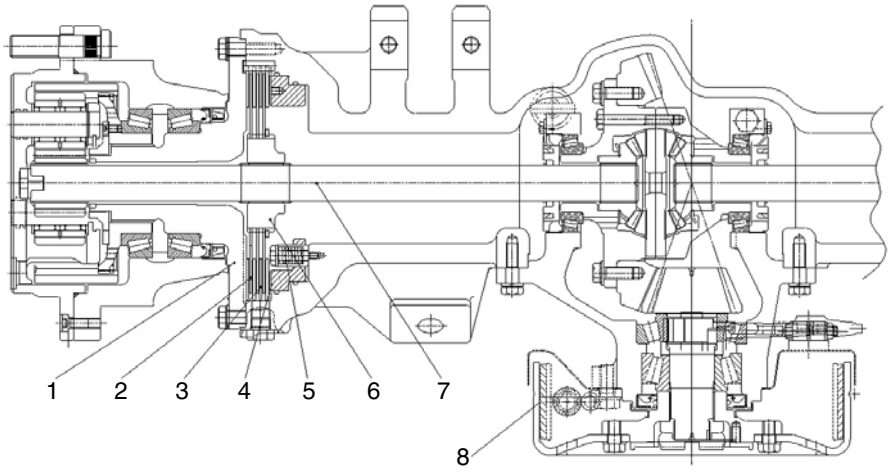
No	Item	Specification
1	Inner carrier	2.2±0.3 kgf·m (15.9±2.2 lbf·ft)
2	Spindle	12±0.5 kgf·m (86.8±3.6 lbf·ft)
3	Adjust bolt for service piston	1.5±0.1 kgf·m (10.8±0.7 lbf·ft)
4	Adjuster nut	1.0±0.2 kgf·m (7.2±1.4 lbf·ft)
5	Differential cap	16±0.5 kgf·m (115.7±3.6 lbf·ft)
6	Differential case	6±0.5 kgf·m (43.4±3.6 lbf·ft)
7	Wheel hub	3.0±0.3 kgf·m (21.7±2.2 lbf·ft)
8	Ring gear	13.5±0.5 kgf·m (97.6±3.6 lbf·ft)
9	Differential carrier assembly	11.5±0.5 kgf·m (83.2±3.6 lbf·ft)
10	Connection between differential carrier and drive axle	LOCTITE #5127

4) DISK BRAKE



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1	Spindle	4	Service piston	7	Drive shaft
2	Steel plate	5	Service piston adjust bolt	8	Parking brake
3	Disk plate	6	Spline collar		

Sealed up structure of hydraulic multi-disk brake system secures good brake performance even in the high humid or dusty area.
Because it is possible to use the brake semi-permanently, there is no need to replace or change the lining as drum type brake do. Also with self-adjust of friction plate clearance, it's easy to prevent the break performance drop due to friction material wear.

Major components are 3 disk plates (3), 4 steel plates (2), service piston (4) and 4 piston adjust bolts (5).
Braking take places when the discs and plates are pressed each other which make rotation resistance to the collar (6) and the drive shaft (7).

GROUP 2 INSPECTION AND TROUBLESHOOTING

1. INSPECTION

To check the problems of transmission, operate the machine and test its performance.
Check and record the abnormal noise and if the machine doesn't operate perfectly, refer to problem and possible cause in the troubleshooting table.

1) VISUAL CHECK

(1) Start engine and check T/M oil level at the neutral gear shift.
(2) Check any kind of damage or leakage on the oil piping, hose, connection, etc.
(3) Operate the Forward/Reverse lever to both of directions.
(4) Check the contamination in the strainer and filter inside the transmission.
① If rubbed paper particles detected, check clutch defects.
② If metal particles detected inside the filter, check metallic friction inside the T/M or mechanical faults.
③ If rubber particles detected, check seal or hose defects.
④ If Aluminum particles detected, check converter or control valve damage.
(5) If metal or rubber particles found, clean all of the T/M hydraulic parts.
(6) Replace damaged parts with the new one.

2) DRIVE CHECK

Fill T/M oil to the proper level before starting the machine.
Improper oil level can cause the damages on the components.

(1) After starting engine, step on the brake pedal and then operate the Forward/Reverse lever to both of directions.
(2) If the machine moves to each of directions, it will operates normally but check noise and cause and then note them.
In case of abnormal operation, refer to troubleshooting table.

2. TROUBLESHOOTING

1) TRANSMISSION

(1) Check list during operation list

No	Condition	Possible causes	Correction
1	Transmission does not operate in any speed or does not engage(slips) in all speeds	(1) Low oil pressure or no oil pressure caused by : a. Low oil, no oil, or thick oil. b. Inching control valve linkage loose, broken or adjustment is not correct. c. Inching valve spool stuck (held) open. d. Failure of the oil pump or a defect in the oil pump. e. Converter drive tangs worn off or not engaged into pump or broken bolt. f. Main regulator valve stuck open. g. Restriction in the oil flow circuit such as dirty oil screen.	(1) Check to oil level. a. Check to mix another oil. b. Check to tightening bolt or changing a control valve ass'y. c. Changing a spool of the control valve ass'y or check it. d. Changing the oil pump or have to check. e. Check to tightening torque of bolt from Torque Converter Gear. f. Check to Control Valve Ass'y. g. Check to suction filter due to a clogged from a mixed foreign materal.
2	Transmission does not shift	(1) Low oil pressure. (2) Main regulator valve will not move (stuck). (3) Solenoids or related electric components are out of order.	(1) Check to oil level. (2) Check Control Valve Ass'y. (3) Check to Solenoids Valve or related electric components.
3	Transmission gets hot.	(1) Restriction in cooling circuit. (2) Oil level too high or too low. (3) Low pump pressure -worn or damaged pump. (4) Converter one way clutch worn and slipping. (5) Air mixed in the oil. Air leaks on the intake side of the pump. (6) Low oil flow through converter. (7) Wrong application for vehicle (loads are too heavy for the lift truck). (8) Too much inching operation (slipping the clutch plates and discs). (9) Too much stalling of torque converter. (10) Cooler bypass valve stuck(held) open, full oil flow does not go through oil cooler.	(1) Check to Restriction in cooling circuit of transmission. (2) Check to oil level or replacement. (5) Check to transmission inside cover. (6) A plugged(restriction) oil flow passage. (7) Check to reliable work place under circumstance. (8) Check to Control Valve Ass'y. (9) Check to Torque Converter Ass'y or replacement.

No	Condition	Possible causes	Correction
4	Clutch engagement is slow or loss of power during engagement.	(1) Low oil pressure. (2) Low converter pressure. (3) Air mixed in the oil. a. Air leaks on suction side of pump. b. Low oil level also causes aeration. (4) Inching valve linkage adjustment is not correct.	(1) Check to oil level. (2) Check touque converter assy. (3) Check to transmission inside cover. a. Air mixed in the oil air on the intake side of the pump. b. Thin oil level.
5	Transmission operates in forward speeds only.	(1) Discs and plates have too much wear in forward direction clutches. (2) Leakage at the seals. (3) Forward clutch components have damage. a. Leakage caused by worn or broken seal around metal sealing rings. b. Leakage caused by worn or broken seal around clutch piston. c. Failure of other components. (4) Solenoids or related electric components are out of order.	(1) Check to disc and plate in clutch assy. (2) Replace to seal. (3) Replace to relate with other component. (4) Check to solenoids valve in control valve.
6	Transmission operates in reverse speeds only.	(1) Discs and plates have too much wear in forward direction clutches. (2) Leakage at the seals. (3) Foward clutch components have damage. a. Leakage caused by worn or broken seal around metal sealing rings. b. Leakage caused by worn or broken seal around clutch piston. c. Failure of other components. (4) Solenoids or related electric components are out of order.	(1) Check to disc and plate in clutch assy. (2) Replace to seal. (3) Replace to relate with other component. (4) Check to solenolds valve in control valve.
7	Low stall speed.	(1) Engine performance is not correct. (2) The one-way clutch of the torque converter does not hold.	(1) Check to engine component. (2) Check to torque converter or replacement.
8	High stall speed in all transmission speeds and directions.	(1) Low oil level. (2) Air in the oil. (3) Clutches slip(clutch plates slide in relation to one another). (4) Torque converter failure.	(1) Check to oil level. (2) Check to mix another oil. (3) Check to inner disc and plate. (4) Replace to torque converter.

No	Condition	Possible causes	Correction
9	High stall speed in one speed or one direction.	(1) There is a leak in that clutch circuit. (2) There is a failure if the clutch in that speed or direction.	(1) Check to clutch assy and then replace to relate with other comonent. (2) Replace the clutch assy.
10	Clutch engagement is slow and makes rough shifts.	(1) Inching valve adjustment is not correct. (2) Inching valve is not completely closed or orifice has dirt(plugged). (3) Low main pressure. (4) Low directional clutch pressure. (5) Internal oil leaks. (6) Valve spool springs are weak or have damage.	(1) Adjust to inching valve (2) Check to orifice has dirt(plugged) and then remove to foregin materal. (3) Check to the oil flow circuit in the transmission. (4) Check to oil flow circuit of clutch. (5) Replace to a leak component. (6) Replace to spring.
11	Vehicle operates in one direction and creeps in that direction in NEUTRAL. Engine stalls when shifted to the other direction.	(1) Failure of clutch in the direction the lift truck moves. Clutch discs or plates are warped(damaged) or held together because of too much heat. (2) Failure of the valve spool in the direction the lift truck moves. The spool stuck(held) in the engaged position possibly caused by metal burrs(particles) or dirt.	(1) Raplace have to relate with other component. (2) Replace have to relate with other component.

(2) Check list from operation noises

No	Condition	Possible causes	Correction
1	Noise in NEUTRAL only.	(1) Worn bushing in pump assembly. (2) Worn one-way clutch in torque (3) converter. (4) Oil level low. Converter housing or converter tangs not in alignment with engine or transmission pump.	(1) Changing is related with other componrent of charging. (2) Charging to Torque Converter Ass'y. (3) Check to oil level. (4) Should be alignment with engine or transmission pump.
2	Pump noise not normal.	(1) A loud sound at short time periods gives an indication that foreign material is in the transmission hydraulic system. (2) A constant loud noise is an indication of pump failure.	(1) Charging to the Oil Pump. (2) Charging to the Oil Pump.
3	Noise in the transmission that is not normal.	(1) Converter housing or converter tangs not in alignment with engine or transmission pump. (2) Transmission components have wear or damage. a. Damaged gears. b. Worn teeth or clutch plates and/ or clutch discs and slipping clutch plates and discs noise. c. Failure of the thrust washers. d. Other component parts have wear or damage.	(1) Should be alignment with engine or transmission pump. (2) Transmission components have wear or damage. a. Charging to Gear. b. Charging to Plate and Disc. c. Charging to Thrust washer. d. Charging to other component.
4	Noise in the control valve.	(1) Air in the hydraulic system. a. Air leakage on suction side of the pump or Low oil level that causes aeration. (2) Restrictions in oil passage. (3) Valve spools movement has restriction.	(1) Charging to Control Valve Ass'y (2) Charging to Control Valve Ass'y (3) Charging to Control Valve Ass'y

(3) Check list from pressure test

No	Condition	Possible causes	Correction
1	Low pressure to FORWARD and REVERSE clutches.	(1) Inching valve linkage adjustment is not correct. (2) Inching valve spool held(stuck) open. (3) Clutch piston seals cause leakages. (4) A defective regulator valve spring. (5) Low oil pressure, see Probable Cause for Low oil pressure. (6) Cooler external lines are not connected correctly.	(1) Adjust to inching valve. (2) Change to inching spool. (3) Change to Clutch and Piston Seal. (4) Change to the spring of the Regulator. (5) Check to oil flow circuit of the transmission. (6) Check to the Cooler external lines.
2	Clutch pressure and main pressure are high.	(1) Pressure regulator valve is not free to move (stuck). (2) A restriction in the hydraulic circuit.	(1) Check to adjusting pressure valve. (2) Check to the hydraulic circuit.
3	Pressure to one clutch is low.	(1) Clutch piston seal alignment is not correct, oil leaks through. (2) Seal rings on shaft or clutch piston seals are broken or worn. (3) Control valve surface not flat or gasket has damage.	(1) Change to clutch piston seal. (2) Change to shaft sealing and clutch piston seal. (3) Change to the control valve gasket.
4	Low main line pressure.	(1) Low oil level. (2) Main regulator valve movement is restricted. (3) Transmission pump is worn. (4) Inner oil leakage. (5) Low oil pressure.	
5	High converter pressure.	(1) Main regulator valve stuck open so most of the flow goes to the converter. (2) A restriction inside the converter assembly. (3) A plugged (restriction) oil flow passage.	(1) Checjk to adjusting main valve. (2) Change to Torque converter ass'y. (3) Check to the oil flow hole of the transmisson.
6	Low converter pressure.	(1) Main regulator valve movement is restricted (plugged).	(1) Check to main regulator valve or change.
7	Converter outlet pressure or cooler inlet pressure is low.	(1) Low oil pressure. (2) Cooler bypass valve stuck open.	(1) Check to the oil level. (2) Cooler bypass valve stuck open.
8	Converter outlet pressure or cooler inlet pressure too high.	(1) Restriction (plugging) in oil cooler lines or a plugged oil cooler.	(1) Check to the oil cooler lines

2) DRIVE AXLE

No	Condition	Possible causes	Correction
1	Constant noise in differential.	(1) Oil is not enough (Replace interval : 50 hrs first, then every 500hrs).	· Refueling lubricating oil
		(2) Wrong kind of oil.	· Exchange lubricating oil
		(3) Wheel bearings out of adjustment or have a defect.	· Exchange bearing
		(4) Drive gear and pinion not in adjustment for correct tooth contact.	· Re-assemble
		(5) Teeth of drive gear and pinion have been damage or worn.	· Exchange dameged gear
		(6) Gear backlash is too much or too little.	· Exchange differential gear set
		(7) Loose or worn on pinion bearings.	· Exchange bearing
		(8) Loose or worn on side bearing.	· Exchange bearing
2	Noise at different intervals.	(1) Ring gear does not run even.	
		a. Bolts on drive gear are not tightened correctly.	· Tighten bolts
		b. Drive gear has a defect (warped)	· Exchange dameged drive gear set
		(2) Loose or broken differential bearings.	· Exchange bearing
3	Noise on turns only.	(1) Differential pinion gears are tight on the spider.	· Exchange differential pinion gear or spider
		(2) Side gears are tight in differential case.	· Exchange differential side gear
		(3) Differential pinion or side gears have a defect.	· Exchange differential gear set
		(4) Thrust washers worn or have a damage.	· Exchange differential washer
		(5) Too much clearance (backlash) between side gears and pinions.	· Exchange differential gear set
4	Leakage of the oil.	(1) Leakage through axle hub carrier	
		a. Too much oi	· Adjust oil level
		b. Wrong kind of oil.	· Exchange lubricating oil
		c. Much restriction on air eather.	· Exchange air breather
		(2) Leakage around pinion shaft.	
		a. Too much oil.	· Adjust oil level
		b. Wrong kind of oil.	· Exchange lubricating oil
		c. Much restriction on air eather.	· Exchange air breather
		d. Oil seal worn or not installed correctly.	· Exchange oil seal

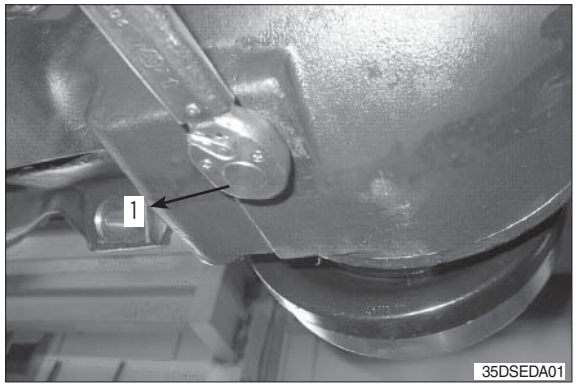
No	Condition	Possible causes	Correction
5	Drive wheels do not rotate	(1) Broken axle shaft. a. Loose wheel bearings. b. Axle shaft too short. c. Loose flange studs or nuts. (2) Drive gear teeth have been damaged. (3) Side gear on differential damaged. (4) Differential pinion shaft or spider broken	 · Re-assemble wheel bearings. · Replace drive shaft · Tighten studs or nuts · Exchange damaged drive gear set · Exchange damaged gear · Exchange damaged gear

GROUP 3 DISASSEMBLY AND ASSEMBLY

1. DISASSEMBLY OF DRIVE AXLE

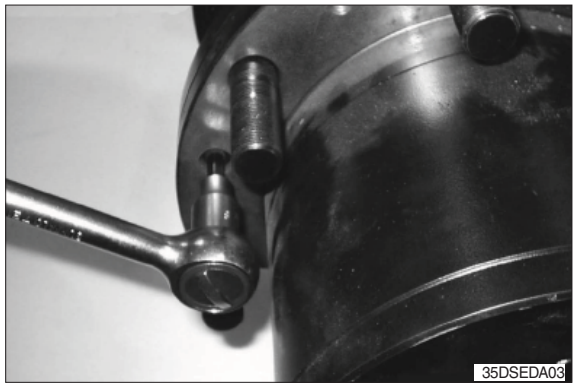
1) DISASSEMBLE WHEEL HUB SUB ASSEMBLY

(1) Loosen oil drain plug using torque wrench (1) in axle housing and drain oil..

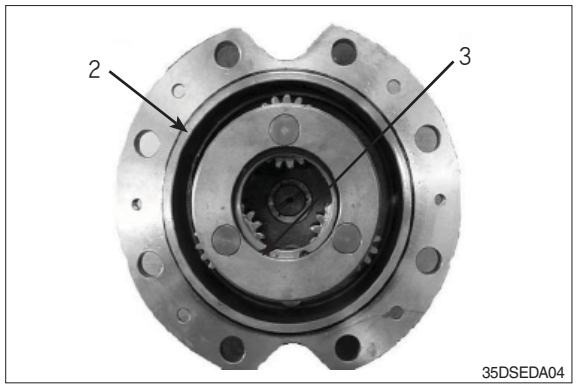


(2) Loosen oil drain plug in planetary housing and drain oil.

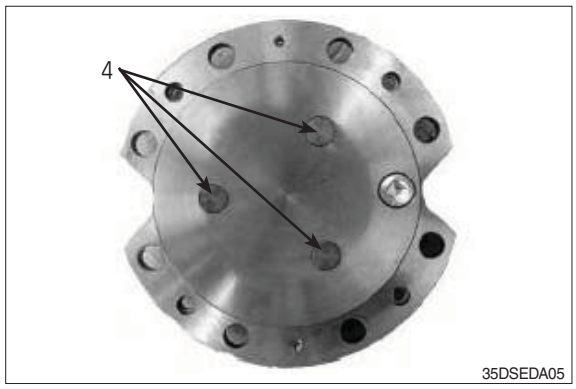
(3) Loosen 4 socket head bolts and remove the planetary carrier.



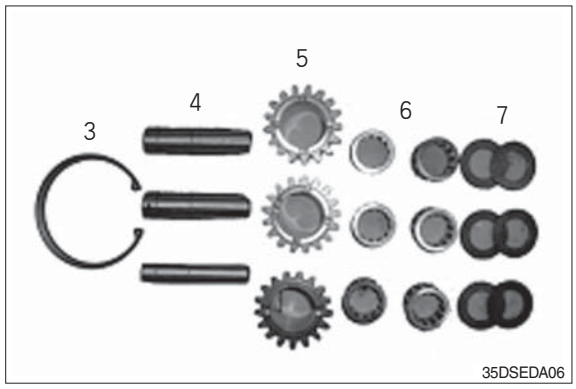
(4) Remove o-ring (2) and snap ring (3) from the housing of planetary.



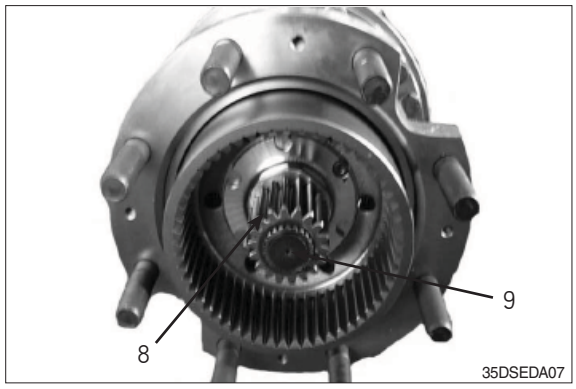
(5) Remove 3 pins (6) with a plastic hammer.



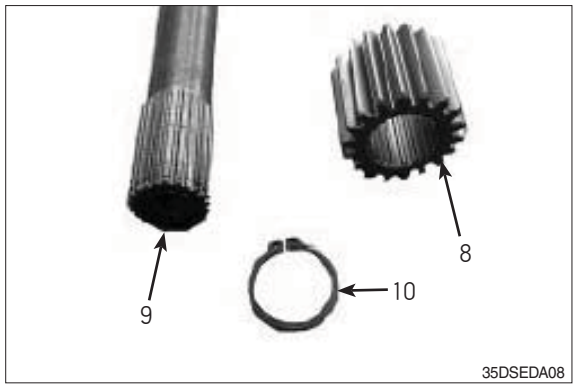
(6) Remove needle bearings (6), planet gears (5) and thrust washers (7).



(7) Remove sun gear (8) and drive shaft (9).

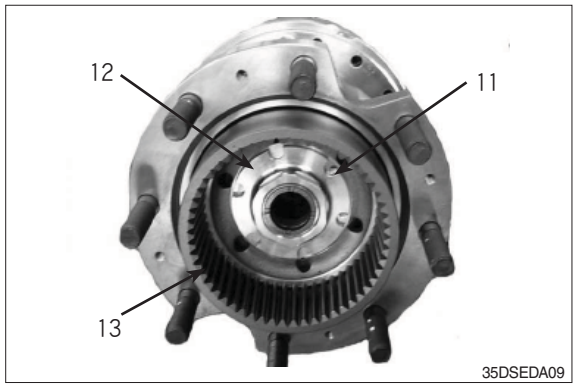


(8) Remove snap ring (10) and then remove sun gear from the shaft (9).

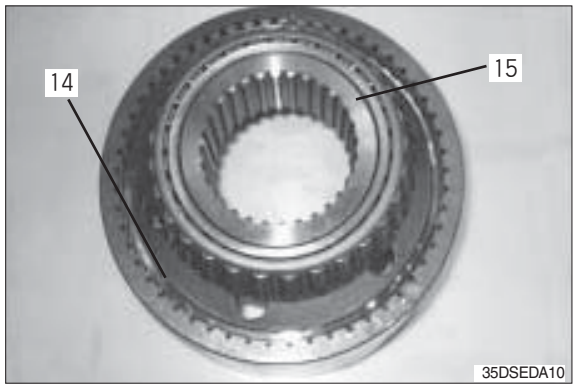


(9) After removing bolt (11), remove ring gear (13) and torque plate assembly (12) from the spindle.

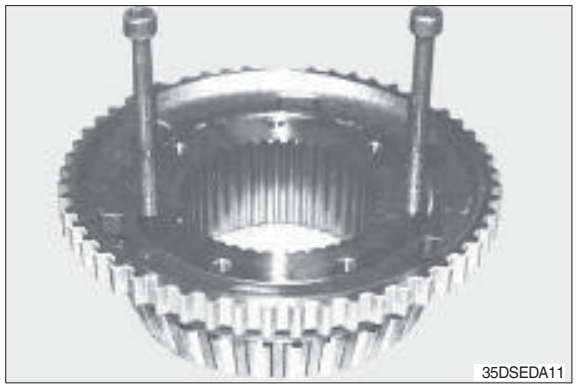
⚠ **Must Measure the rolling resistance of tapered roller bearing.**



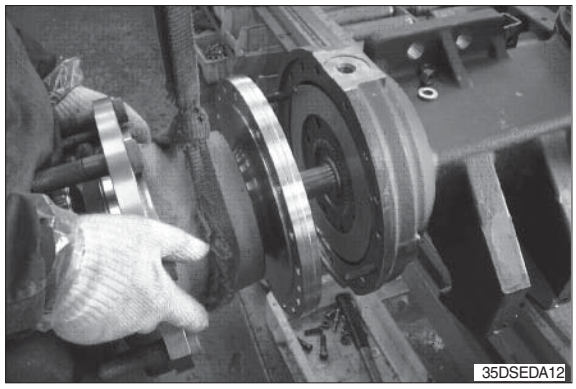
(10) Remove c-ring (14) from the ring gear and pull the spindle (15) out of the ring gear.



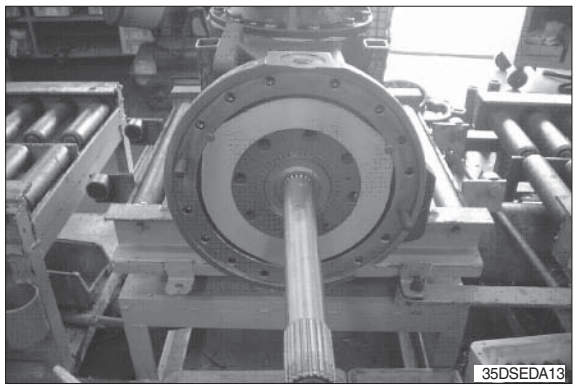
(11) Pull out bearing inner race on flange using 2 × M8 bolts.

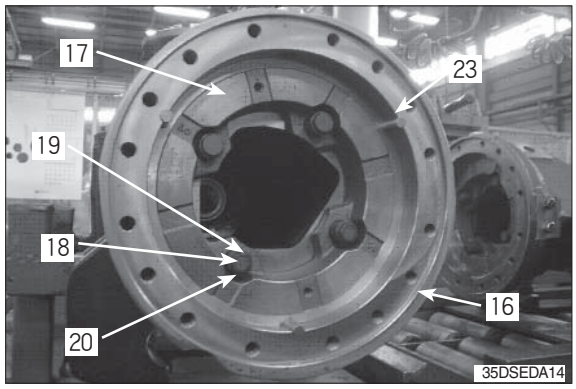


(12) Remove wheel hub from the axle housing after loosen 14 bolts and 2 nuts.



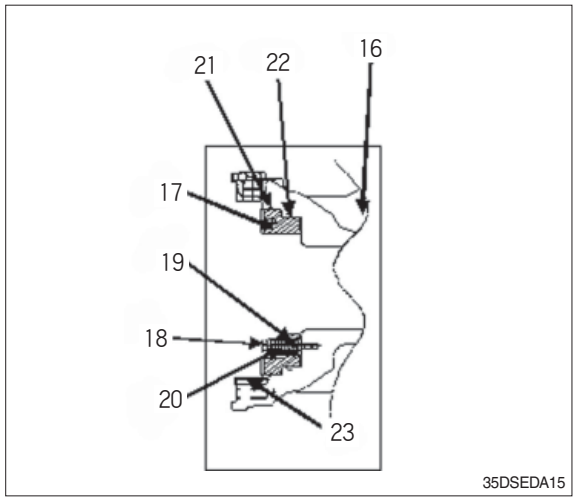
(13) Disassemble drive shaft and disc & plate assembly.



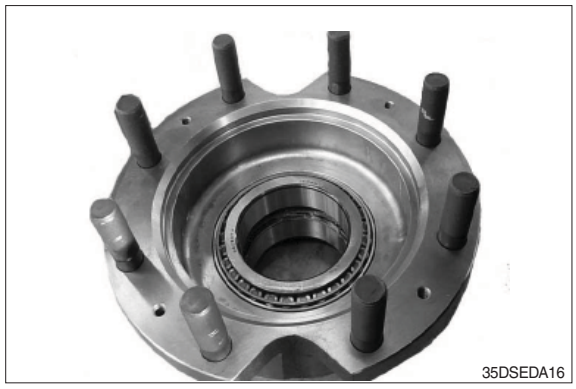


(14) After loosening 4 self adjust bolt (18), disassemble self adjust spring (20) from self adjust bushing (19).
Then disassemble piston (17) from axle housing (16).
After removing 3 pins (23), then finally remove square ring (21), (22)

⚠ **Do not reuse damaged square ring.**

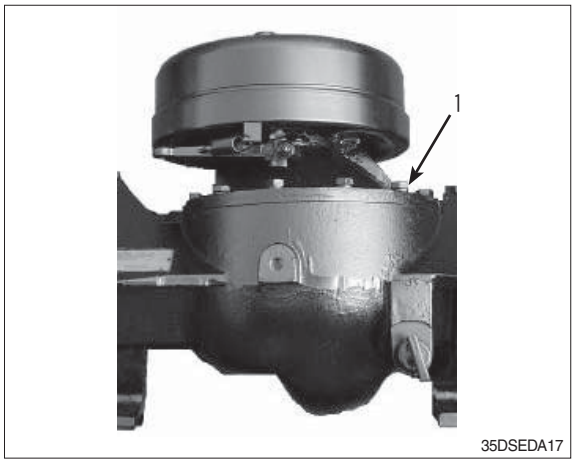


(15) Remove bearing cup from the wheel hub by using jig and hamer. Shaft seal may be damaged.

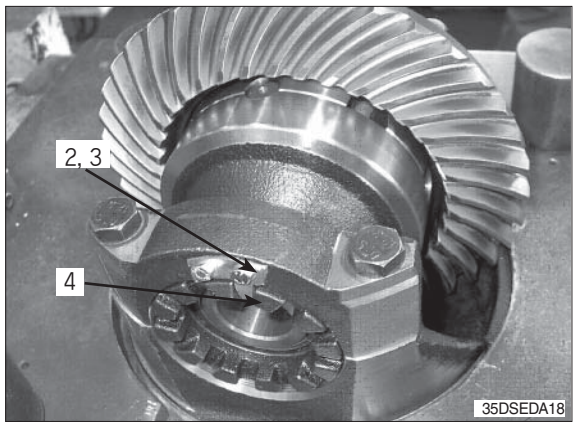


2) DISASSEMBLY OF THE DIFFERENTIAL CARRIER ASSEMBLY

(1) Loosen 12 bolts (1) and then remove carrier from the housing by using a lifting machine.

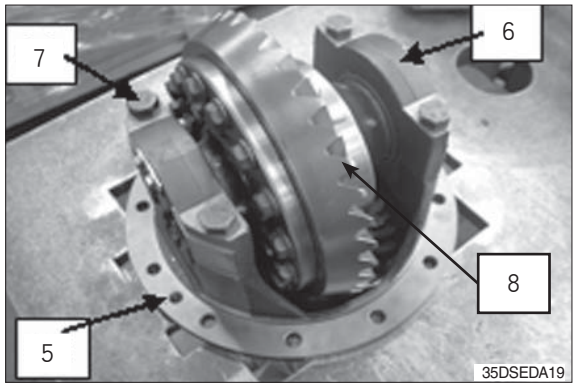


(2) For the reassembly, check rolling resistance and record it.
After loosen 2 bolt (2), washer (3) and then remove backing plate (4).



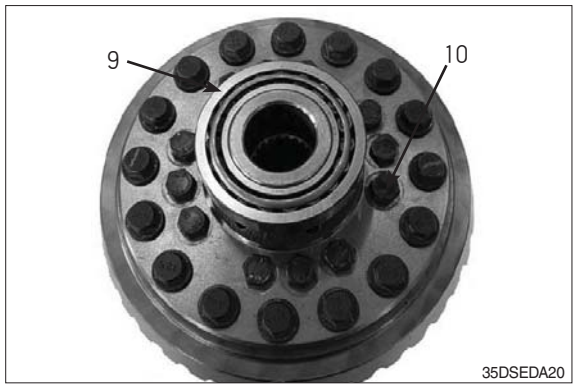
(3) Before removing differential assembly from carrier (5), check the location of cap (6) and mark it for reassembly.

(4) Remove 4 hexagon bolts (7) and cap (6).

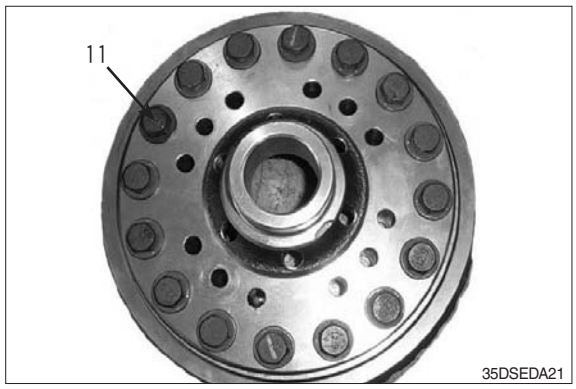


(5) Remove diffrential assembly (8) from the carrier.

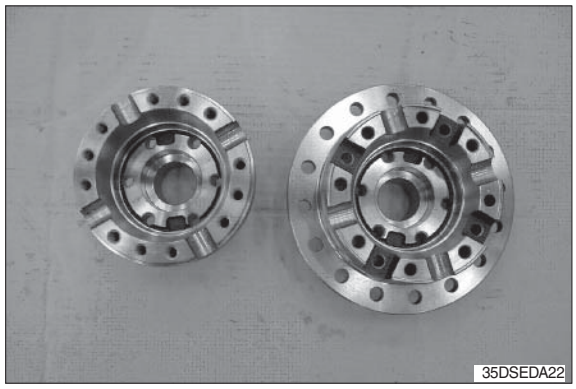
(6) Disassemble bearing (9) from the differential housing and remove 12 bolts (10).



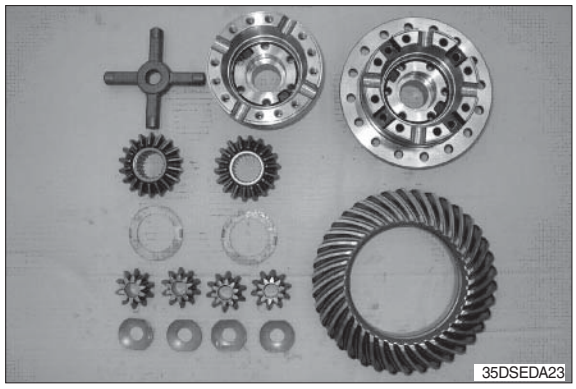
(7) After removing 12 mounting bolts (11) from the housing and then disassemble the ring gear.



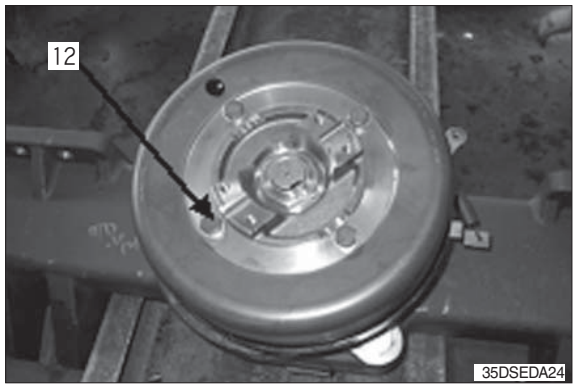
(8) Check the mark on the housing and separate the housing from the differential.
If there is no mark, be sure to mark on the housing.
When reassembling, it must be placed at the same position as before.



(9) Remove thrust washers, side gears, pinion gears and spider and then place them on the clean place.



(10)Loosen 4 bolts (12) and then remove drum from the parking brake.

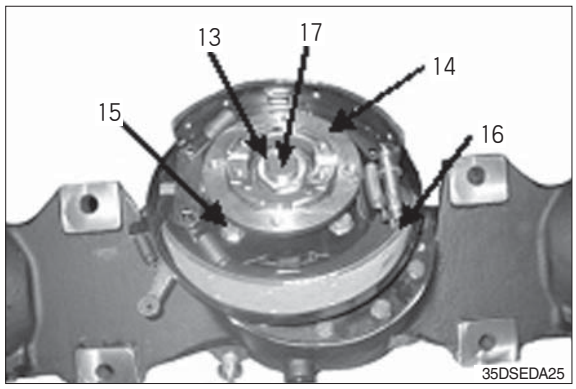


(11)After removing lock nut (13) and then remove the yoke (14).

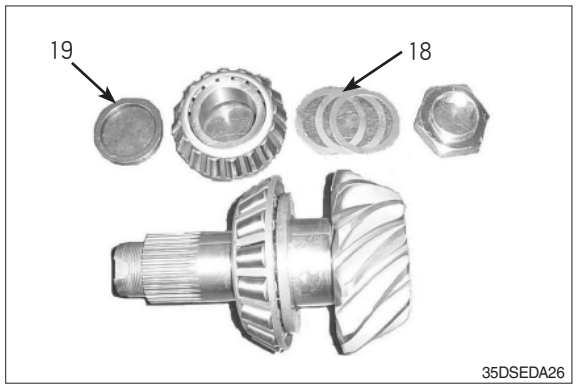
(12)Loosen 4 bolts (15) and then remove parking brake (16) from the carrier housing.

(13)Remove the drive bevel pinion shaft (17) carefully by using a plastic hammer.

⚠ **Be careful not to damage bevel pinion shaft.**



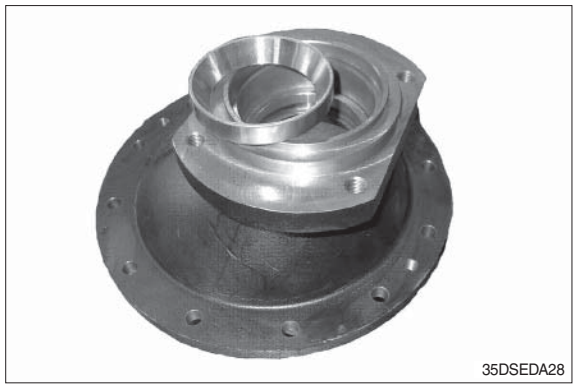
(14)Remove shim (18) and spacer (19) from pinion shaft.
Using a bearing puller, disassemble inner race of taper roller bearing from the pinion shaft.



(15)Remove outer race of taper roller bearing and shim from the housing by using a jig and hammer.

⚠ **Do not reuse damaged shims.**

(16) Remove outer race of taper roller bearing on the opposite side.



2. REASSEMBLY OF DRIVE AXLE

Clean every parts with cleanser and then remove remained loctite.

⚠ Be careful not to spill cleanser on your body.
Avoid drinking cleanser or breathing its fumes.
Wear protective clothing, glasses and gloves.
If spilled on the skin, flush your skin with water immediately.
If swallowed, get medical attention immediately.

- Check wear, damage or crack for all the parts and replace if needed.
- If the teeth of gear are damageed, replace it as a set.
- Replace damaged tapered roller bearing.
- Do not reuse deformed shims or worn thrust washers.
- Polish the surface on which seal contacted if needed.

1) ADJUSTMENT OF BEVEL PINION SHAFT

Adjusting shim of bevel pinion shaft.

(1) Adjust shim thickness and bevel pinion shaft with following method.

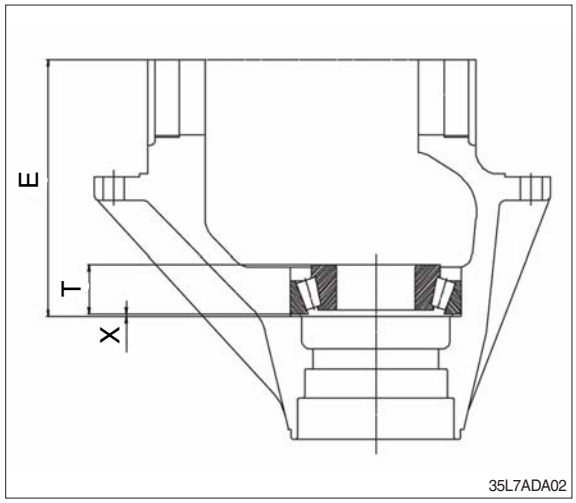
① Measure "**E**" at the housing.

② By the equation " **X = E - B - T ± C** ", define the the shim thickness(1).

B : Mounting dimension of bevel pinion shaft , 133.20mm (5.2 in)

T : Height of bearing.

C : Dimension of carved seal on the pinion. If there's no carved seal **C**=0.



EX) : From the housing
"**E**" = 162.85 mm
B is factory dimension
"**B**" = 131.20 mm
From the bearing
"**T**" = 31.5 mm
Mark on the pinion
"**C**" = 0.05 mm
Shim thickness :
"**X**" = 162.85 -131.20 - 31.5 - 0.05
= 0.10 mm

※ **If teeth are damaged, replace it as a set (Bevel gear and shaft). Do not reuse damaged shims and bearing.**

(2) Using different kinds of shims, adjust shim thickness as measured by previous equation.
Place shims at the bearing place.
Using a jig, assemble drive bearing so that the outer race contact with the bearing place.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(3) Heat the inner race of bearing to max 100°C and then assemble it to the pinion shaft.
Also inner race should contact with bearing place.


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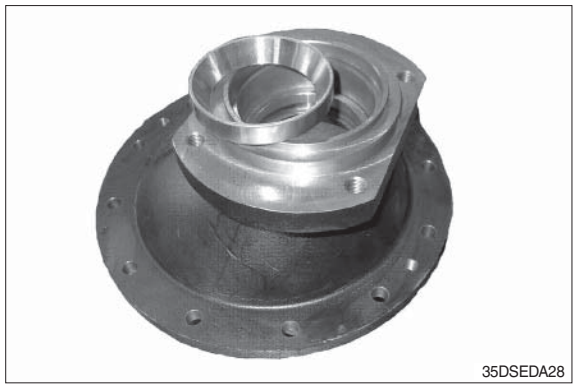
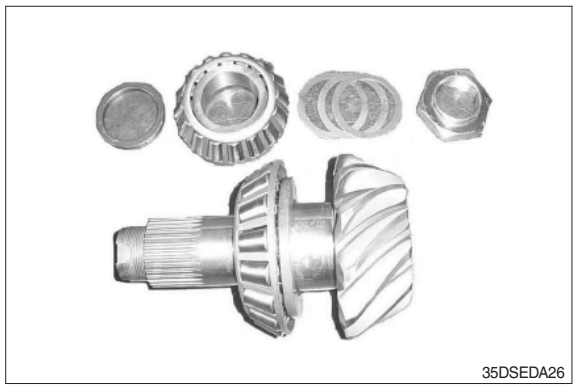
2) ADJUSTMENT OF PINION SHAFT

(1) Assemle bearing cup.

Assemble spacer to the pinion shaft and then install measured shims onto the spacer.





(2) Insert pinion shaft into the carrier.

After assemble bearing cone and lock nut.
Apply grease on the outer bearing.
Apply loctite #271 or #277 on the thread of pinion and then tighten lock nut.

· Tightening torque : 45~51 kg·m

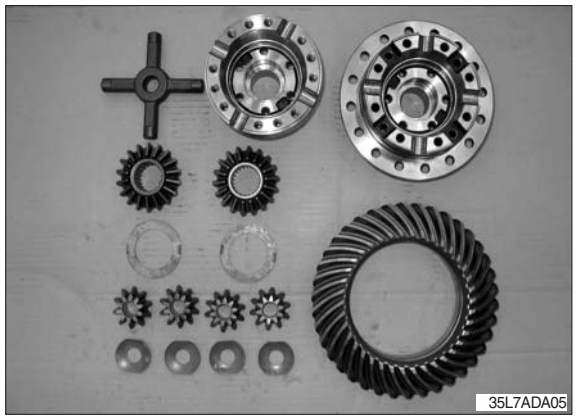
Measure rolling resistance of pinion shaft.

· Rolling resistance : 0.20~0.41 kg·m

Coke lock nut into the pinion shaft slot.

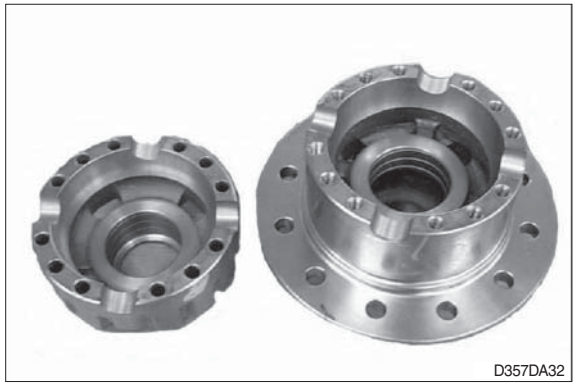
3) ASSEMBLY OF DIFFERENTIAL ASSY

(1) Assemble thrust washer, side gear and spider with gears and then install them to the differential housing.
Apply grease on the bevel gear and thrust washer.



(2) Assemble differential housing.

※ **Check marks on the housing.**
Match two marks at the same position.



(3) Tighten 12 bolts (1) to the differential housing.
Apply loctite #271 or #277 on the thread of bolt.

· Tightening torque : 5.0~7.5 kg·m

(4) Assemble ring gear by tightening 12 bolts (2).
Apply loctite #271 or #277 on the thread of bolt.

· Tightening torque : 12.5~14.5 kg·m

(5) Install differential assembly into the carrier.
Place the bearing cup and screw into the housing.
At that moment, using a screw adjust rotation backlash.
Install the dial gauge on the gear tooth and measure the backlash while rotating bevel gear.

※ Rotation backlash : 0.18~0.23 mm

(6) Assemble bearing cap.

※ **Fix bearing cap with hexagon bolt.**
· Tightening torque : 15~17 kg·m

Measure rolling resistance of tapered roller bearing.
The following table shows the relation between preload (P) of bevel pinion shaft and rollring resistance (Z).
(Calculated at ADJUSTMENT OF PINION SHAFT ②)

Unit : kgf·m

P	Z
0.20 (1.45)	0.44~0.47
0.25 (1.81)	0.49~0.52
0.30 (2.17)	0.55~0.58
0.35 (2.53)	0.59~0.62

(7) Confirm that the screw contacts with bearing.

(8) After complete assembly of bearing, measure rotation backlash once more and readjust with a screw if needed.

(9) Apply loctite #271 to the thread of bearing cap bolt and then assemble it with tightening torque of 15~17 kgf·m.

(10) Assemble plate with hexagon bolts. Apply loctite #271 or #277 to the tapped side of bolt and then assemble at the tightening torque of 0.80~1.20 kg·m.

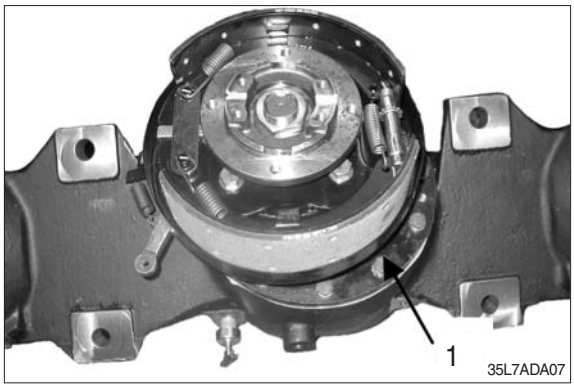
※ **Assemble opposite side with the same methods.**

(11) Apply marking liquid on 3~4 teeth of the ring gear and then rotate pinion gear to check gear contact.
Check out the contacted shape.

4) ASSEMBLY OF CARRIER

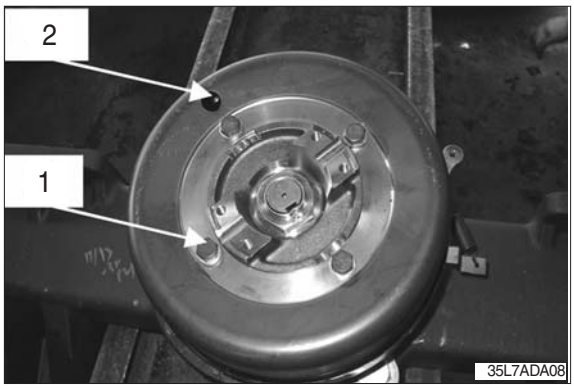
(1) Assemble carrier assembly into the axle housing.

(2) Fix the carrier assembly with hexagon bolt (1).
Apply loctite #271 or #277 to thread of bolt and then assemble it with tightening torque of 11~13 kgf·m.



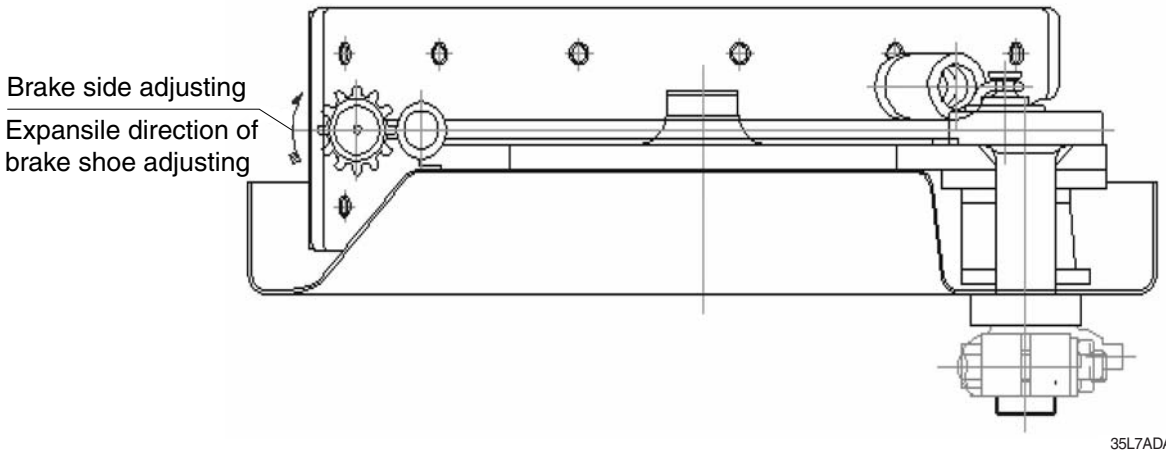
(3) Assemble BRAKE DRUM to YOKE with tighting 4 bolts (1).
Apply loctite #271 or #277 to thread of bolt and then assemble it with tightening torque of 11~13 kgf·m.

(4) Close hole (2) with rubber plug.



5) ADJUSTMENT OF PARKING BRAKE

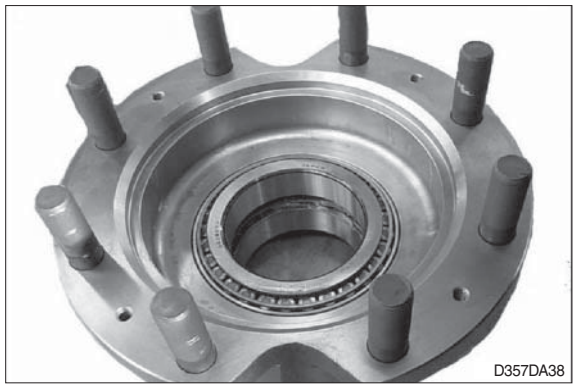
(1) The following procedures should be applied for brake shoe adjustment
① Open rubber plug on (2).
② Adjuster should be turned accoring to arrow direction until occuring drum drug.
③ Adjuster should be turned to opposite direction of the arrow sign by four click.
At that case, lining clearance is 0.1~0.25 mm.
④ Check drum drag after operating lever several times.
(Repeat from begining if drag is occured)



6) ASSEMBLY OF WHEEL HUB ASSY

(1) Insert bearing into wheel hub.
Confirm that the bearing and wheel hub contact completely.

※ **Apply grease or oil to shaft seal and then assemble it with proper direction (Out side of wheel hub).**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(2) Install wheel hub assembly to the spindle completely.


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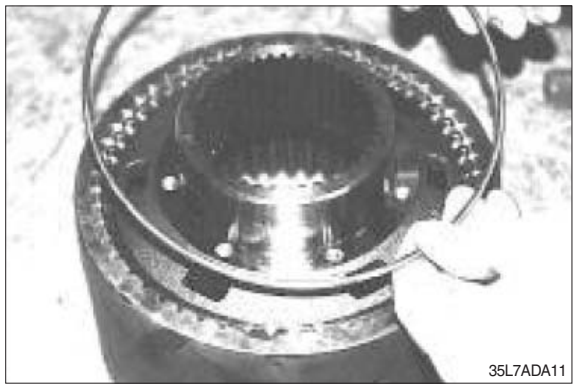
(3) Insert the spindle into ring gear and secure with circlip.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(4) Place heated tapered roller bearing inner race onto the spindle until contact take places.
Install it on the wheel hub after cooling down.


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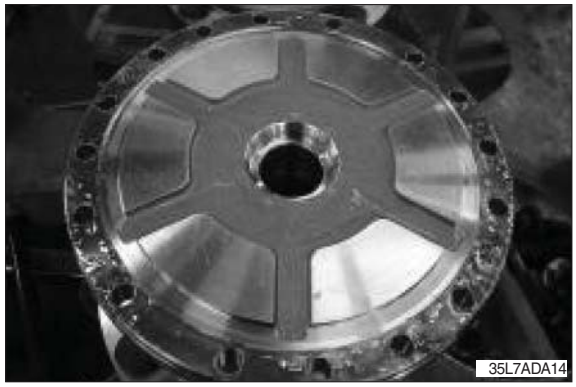
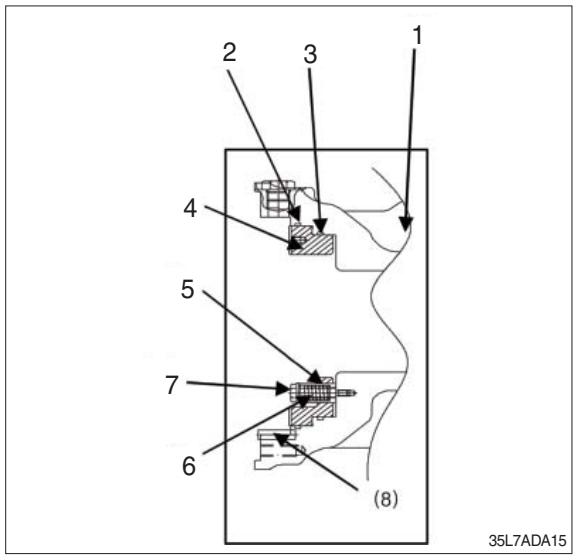
(5) Install the torque plate to fix the spindle.
Apply loctite #5127 to axle housing surface which contact to the spindle.



(6) Assemble square ring (2), (3) to the Axle housing (1) then apply the oil (MOBILFLUID #424).
Assemble bushing (5) to piston (2) and then assemble piston (2) to axle housing after applying oil sufficiently and then assemble the spring (6) to the bushing (5).
Also, apply loctite #271 to 4 bolts (7) then assemble them with tightening torque : 1.4~1.6 kg·m.
Assemble 3 brake pins (8) to axle housing

⚠ Check the status of square ring and replace if damaged.

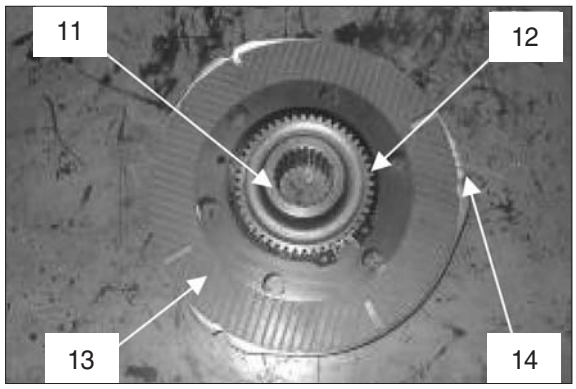


Assembly of plate and inspection

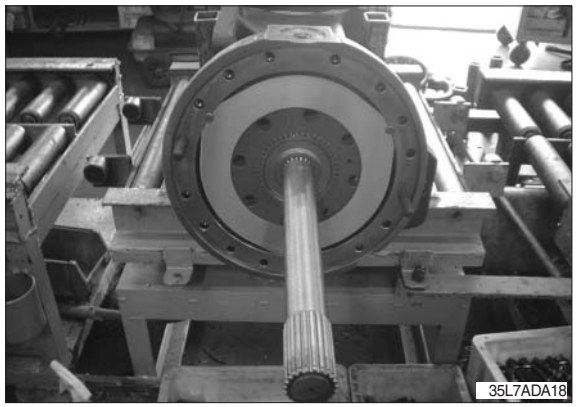
① Assemble 4 plates (9) and 3 disks (10) with spline collar (11) and then lock with snap ring (12).
Disc must be assembled after the oil immersion during 12 hours (MOBILFLUID #424)

② Install assembled the spline collar to the axle housing with the drive shaft.
Before assembling, clean all of the parts completely and remove burrs.

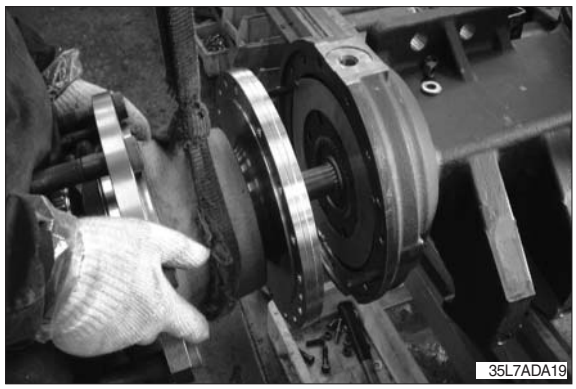
③ After assembling, confirm that the clearance between the outer plate and and the axle housing surface is 2.1~2.6 mm.



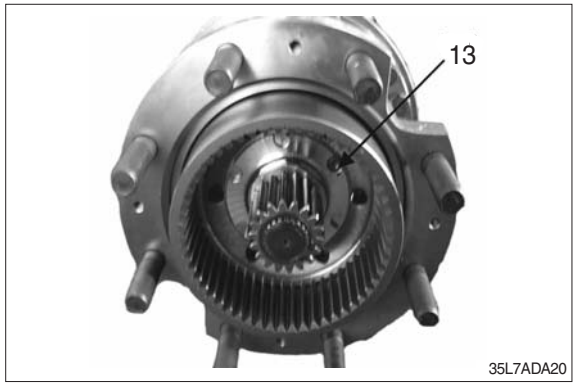
35L7ADA17


35L7ADA18

(7) Push pre-assembled wheel hub to the axle housing until contact take places.

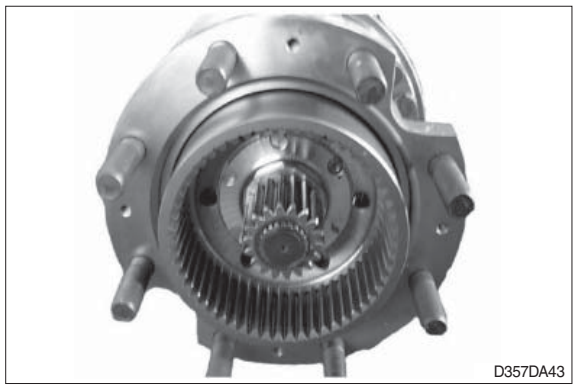

35L7ADA19

(8) Tighen the torque plate until the wheel hub assembly has the same rolling resistance as before.
Apply loctite #271 or #277 to thread of bolt (13) and then assemble it with tightening torque of 1.8~2.2 kg·m.

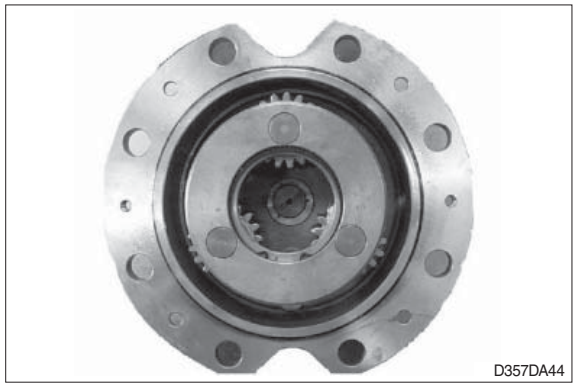


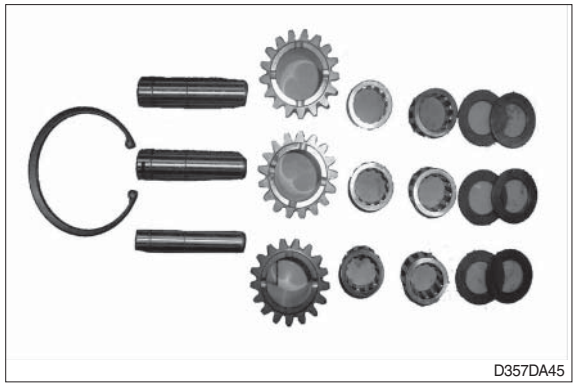
35L7ADA20

(9) After assemble sun gear to axle shaft and fix it with a snap ring.
Apply grease on the shaft where bushing contacts.
Apply grease on teeth of the planetary gear.


D357DA43

(10) Assemble internal components of planetary carrier with the reverse order of disassembly.


D357DA44

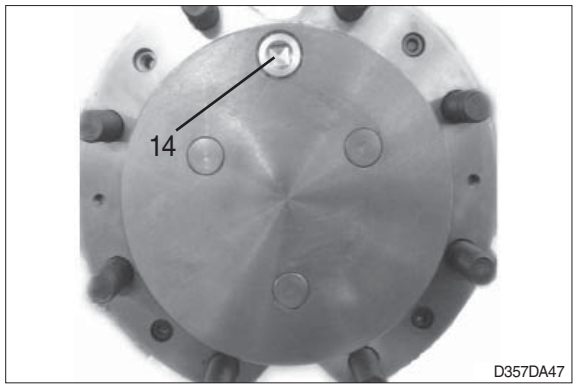

D357DA45

(11) Install planetary carrier assembly to wheel hub and tighten bolt (2)
· Tightening torque : 2.5~4.0 kg·m


35L7ADA21

(12)Assemble the wheel hub and tighten the plug (14).

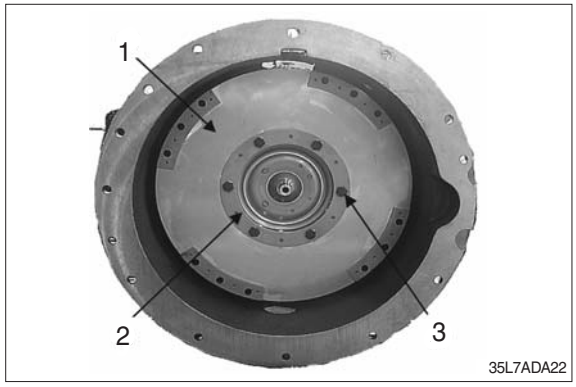
· Tightening torque : 3.5~6.0kg·m



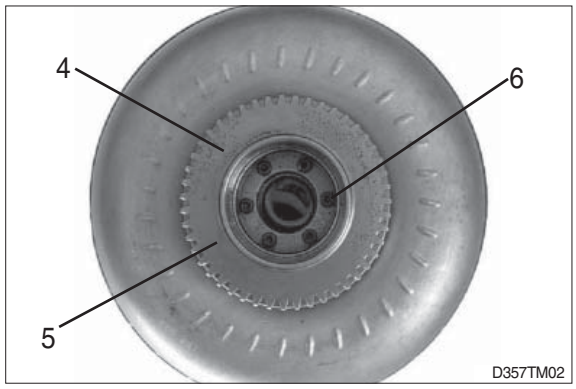
3. DISASSEMBLY OF TRANSMISSION

1) Pull torque converter (1) straight forward and remove from the converter housing.

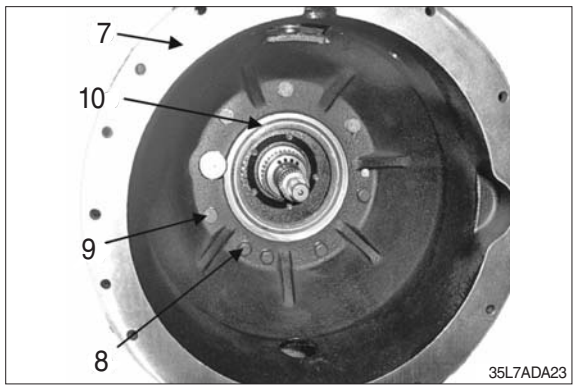
   Remove six bolts (3) and flexible plate (1), plate (2) from the torque converter.



2) Remove six socket bolts (3) and then gear P.T.O input from the the torque converter.



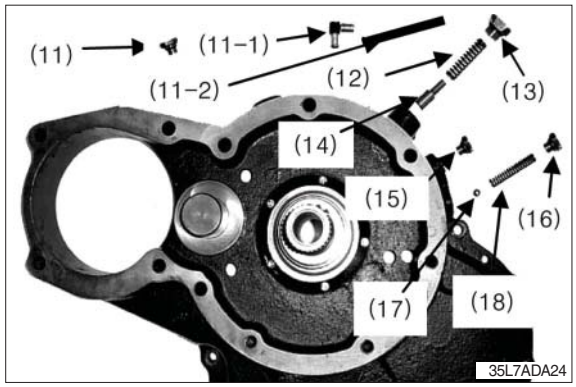
3) Remove four bolts (9) and bolts (8), washes, oil seal (10) from the housing converter (7).



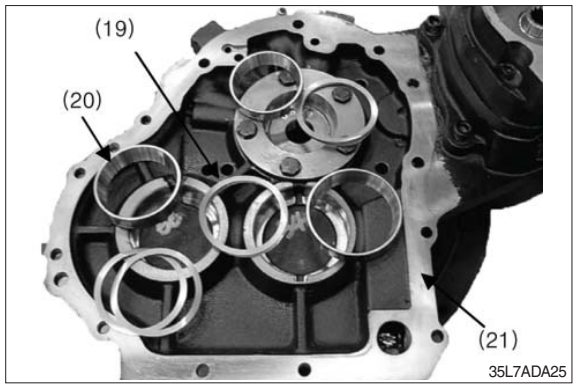
4) Remove plug (16) and o-ring, spring (18) and ball (17) from the bearing plate.

5) Remove plug (13) and spring (12), valve (14).

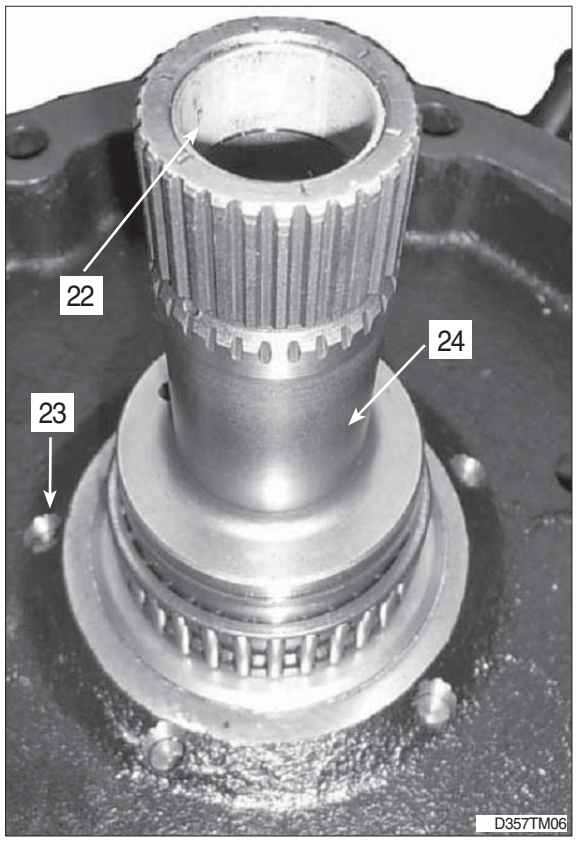
6) Remove plug (11).



※ Bearing cups and their shims will be in cover or on the shafts in transmission case. Put identification on each of bearing cups and shims as to their location on transmission cover or shaft in transmission case.



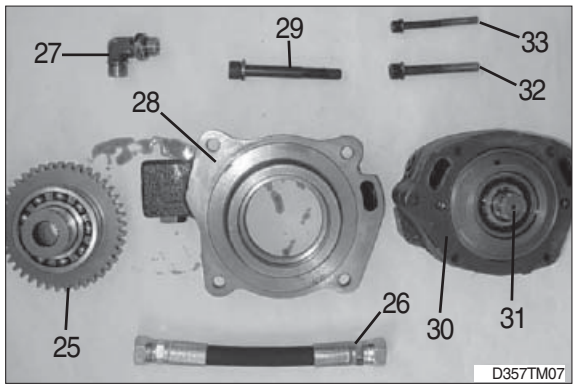
7) Remove fasten five bolts (23) from fixed stator hub (24) and bearing plate. In this time, use the plastic hammer.



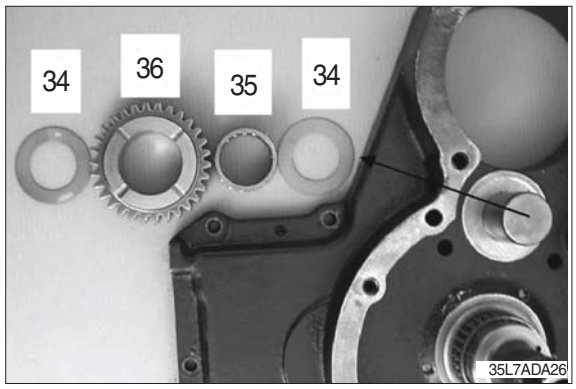
8) Remove four socket bolts (21), flange pump (28) from bearing plate (21).

Remove a socket bolt (32) and four socket bolt (33) from flange pump.

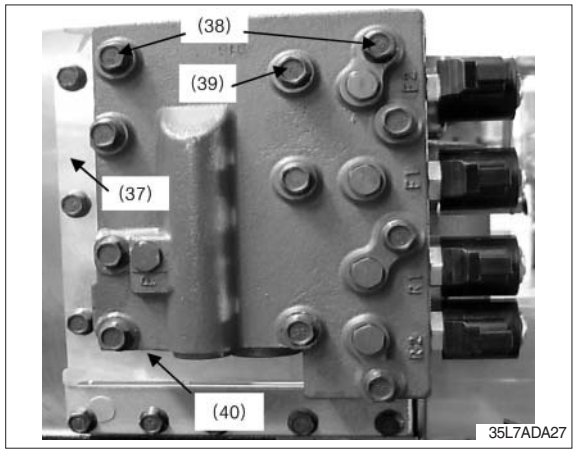
Remove charging pump (31) and pump gasket, then seperate to gear-P.T.O output (23) and ball bearing, 90° elbow (27).



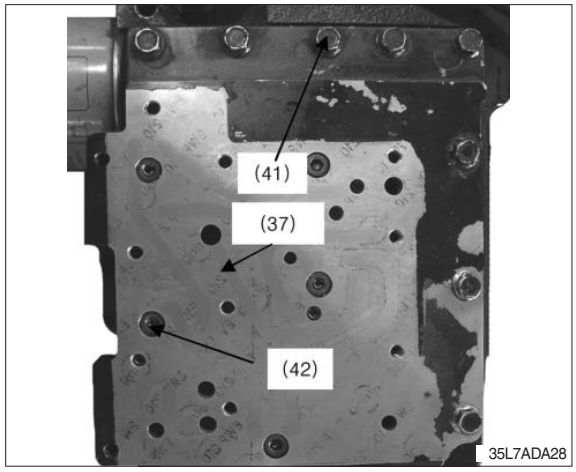
9) Separate to two thrust washer's (34), needle Bearing (35), gear- P.T.O Idle (36) from bearing plate.



10) Remove two bolt's (38), nine bolt's (39), valve gasket (40).

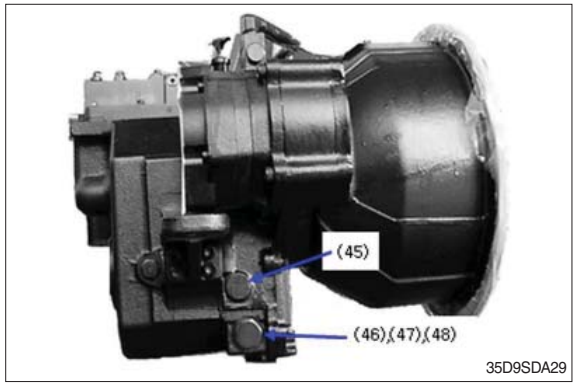


11) Remove eight bolt's (41), five socket bolt (42), then separate valve plate from transmission case.

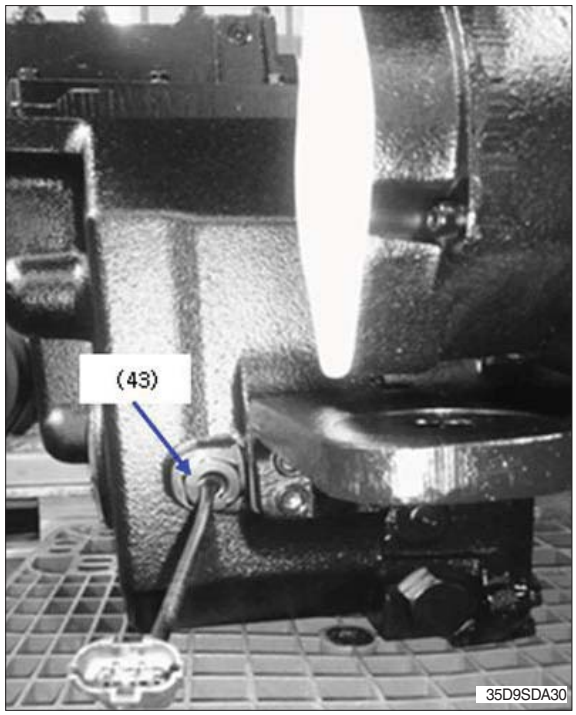


12) Remove O-ring, plug (46) then spring (47), Oil screen (48) from transmisson case.

13) Remove temperature sensor (45) from transmisson case.

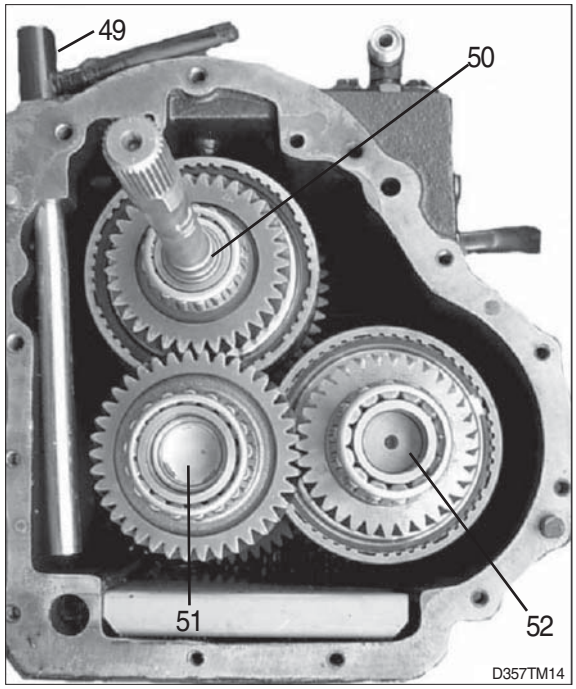


14) Remove the speed sensor (43) from the transmission case.

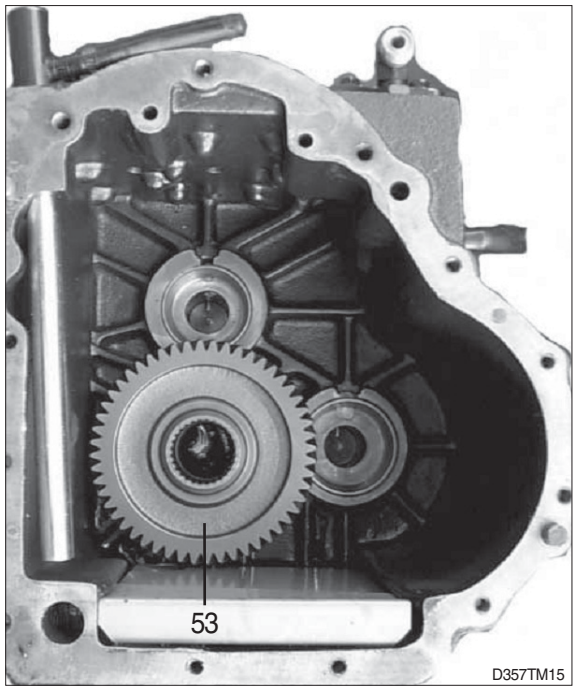


15) Use the plastic hammer to push tube (49) out of the transmission case. Remove the tube.

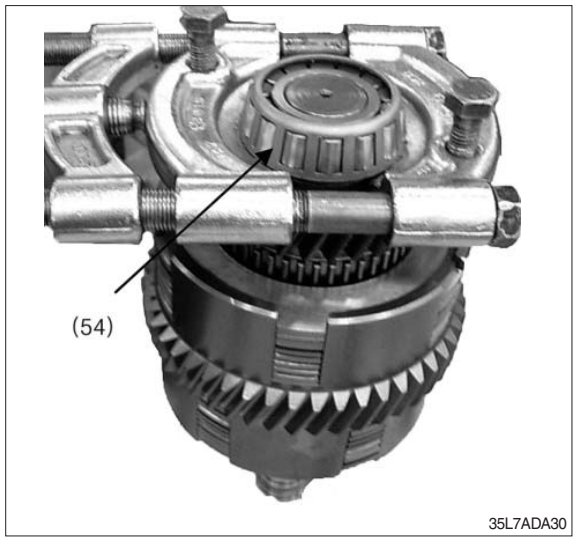
16) Remove output shaft assembly (51), input shaft assembly (50), and counter shaft assembly (52).



17) Remove the output gear (53) from the transmission case.

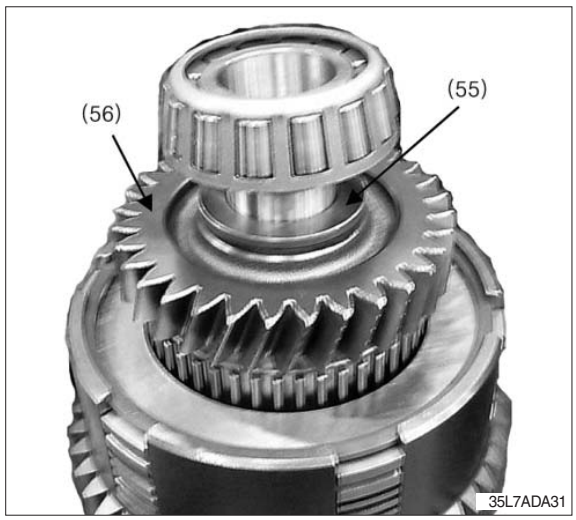


18) For high speed forward clutch assembly, remove bearing cone (54) with gear pulley.

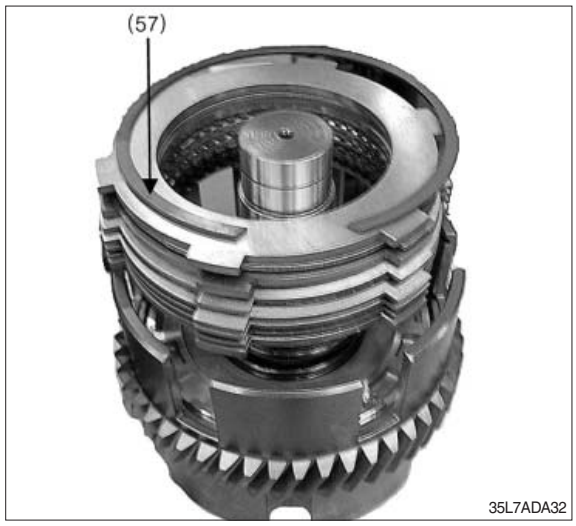


19) Remove two thrust washes (55) and gear (56).

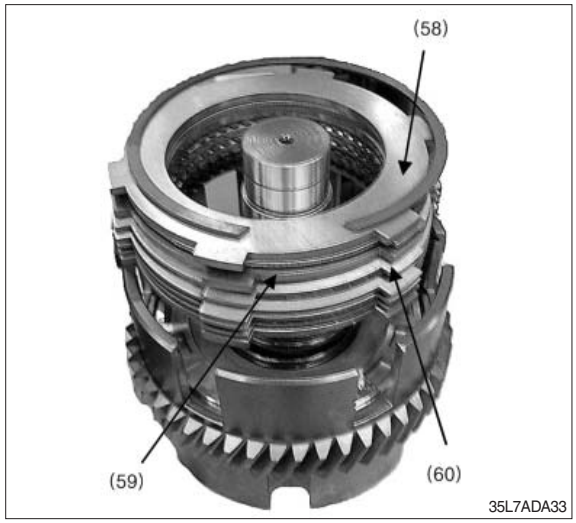
20) Remove needle bearings and thrust washer from the forward shaft of high speed clutch side.



21) Use a screwdriver and remove snap ring (57) from the cylinder.



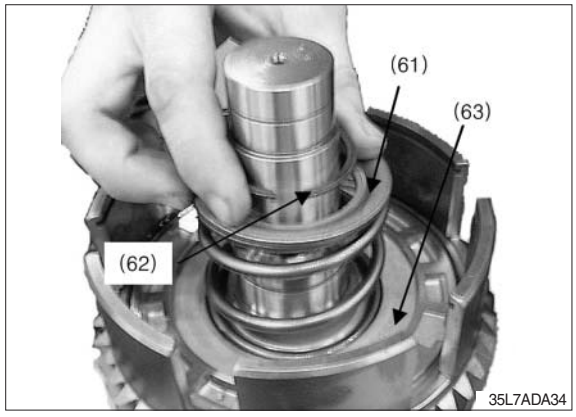
22) Remove a five clutch discs and three 4T clutch plates (58), four 2T clutch plates (60), one bending plate (59) from the cylinder.



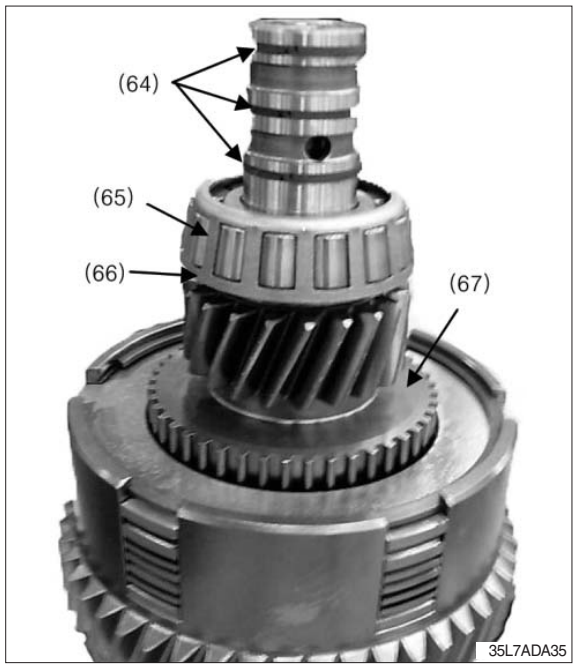
23) Push down on the retainer (61) by a press and remove snap ring (62) with a screwdriver. Slowly release the tension on the spring assembly.

24) Remove retainer (61) and spring assembly from cylinder.

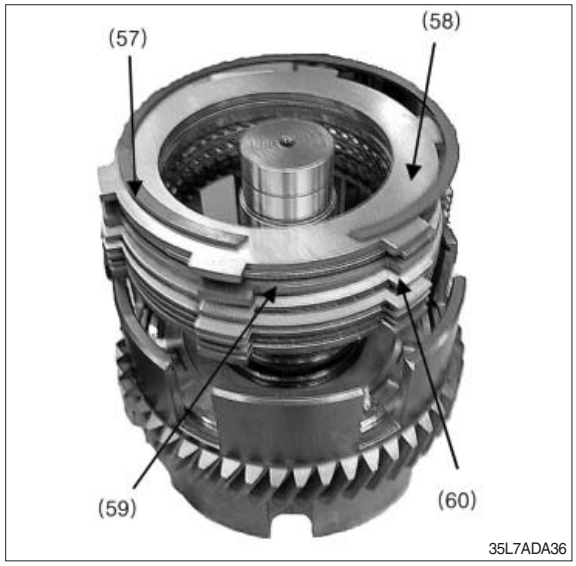
25) Remove piston (63) by using compressed air, then remove O-ring from the shaft.



26) For low speed forward clutch assembly, remove seal rings (64) from shaft.
Remove bearing (65), thrust washer (66), gear (67), needle bearing, spacer and sealing (64).



27) Remove snap ring (57), then remove a five clutch discs and three 4T clutch plates (58) and four 2T clutch plates (60), one bending plate (59) from the cylinder.

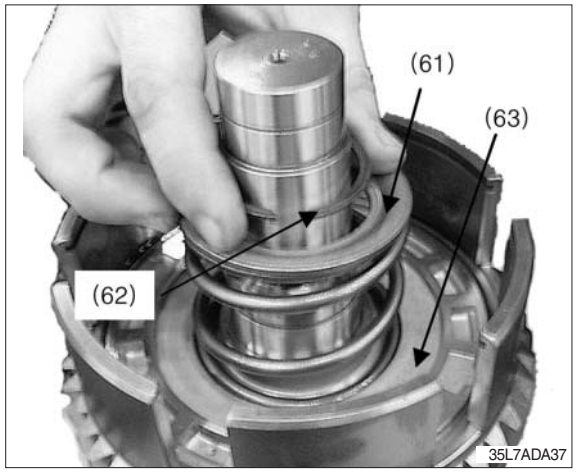


28) Remove two thrust washes and pin.

29) Push down on the retainer (61) by a press and remove snap ring (62).
Slowly release the tension on the spring assembly, then remove retainer and spring assembly.

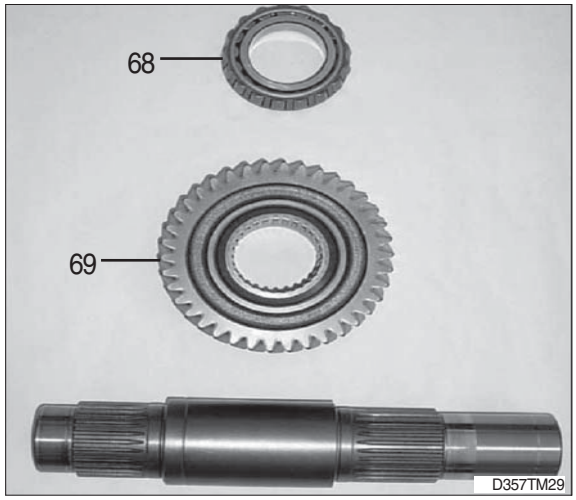
30) Remove piston (60) by using compressed air, then remove O-ring from the shaft.

※ Disassembling procedure of input shaft assembly is the same as counter shaft assembly.



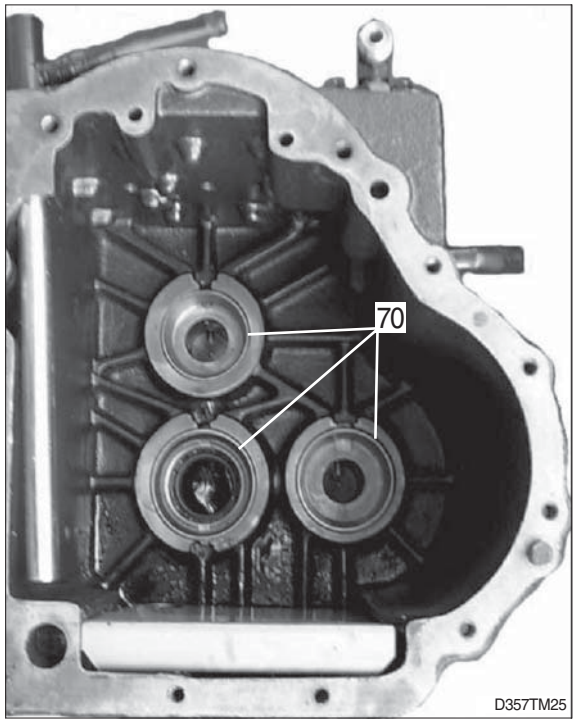
31) Disassemble input shaft assembly.

32) For output shaft assembly (51), remove the bearing (68) and gear (69).

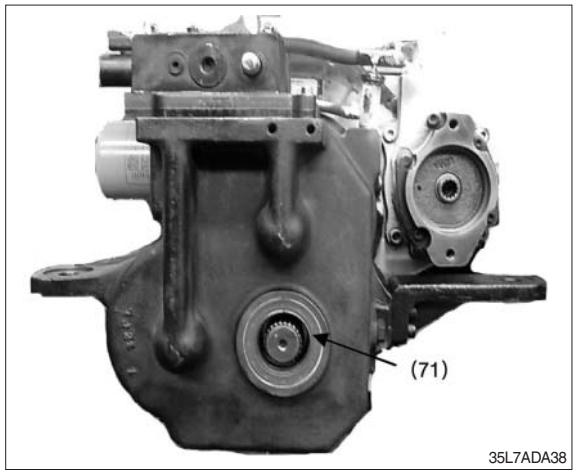


33) Remove bearing cups (70) from the transmission case.

※ Put identification on bearing cups to use at assembly.



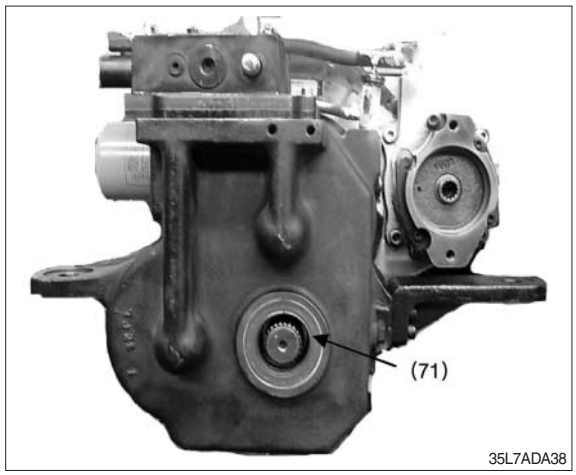
34) Remove two lip type oil seals (71) from the transmission case.



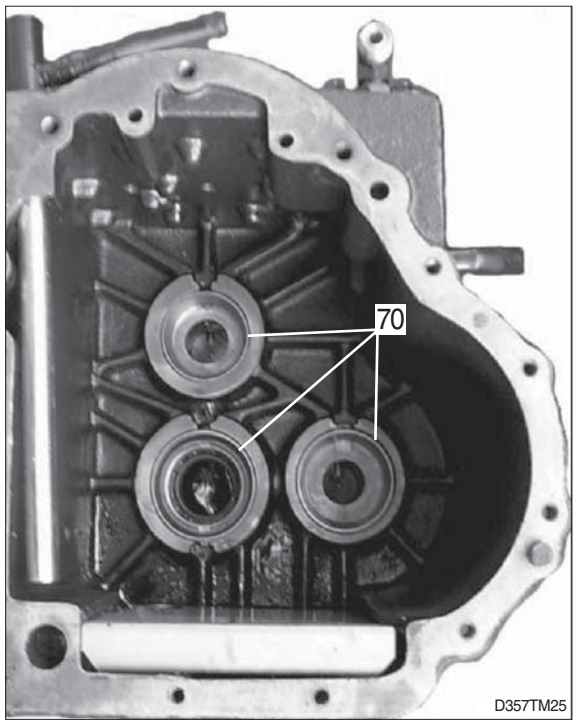
4. ASSEMBLY OF TRANSMISSION

1) Thoroughly clean all the parts of the transmission.
   Put clean transmission oil on all of the inner parts.

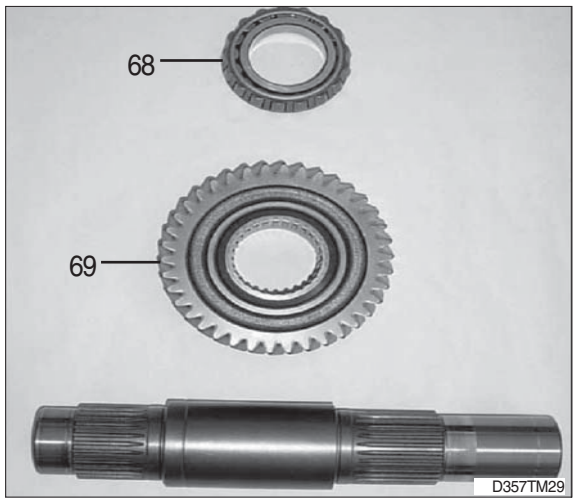
2) Put lip type oil seal (71) in position on the case with the spring loaded lip of the inside seal toward the inside of the transmission case and with the lip of the outside seal (71) toward the outside of the transmission case.



3) Install bearing cups (70) in position on the transmission case.



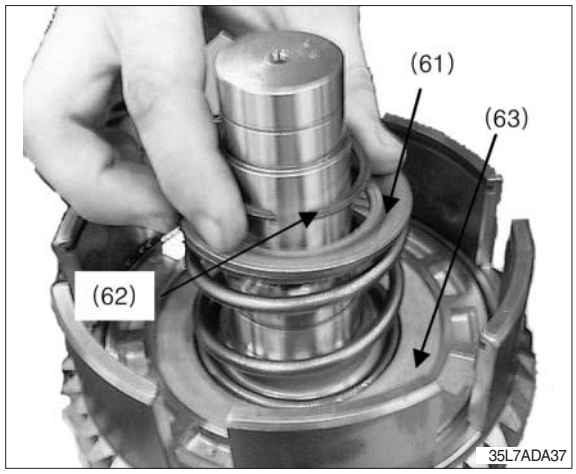
4) Install gear (69) and bearing (68) on the output shaft assembly (51).



5) Install seal ring on the piston (60).
Put clean transmission oil on the seal ring.

6) Install piston with seal ring in cylinder.

※ Be extra careful during installation of the piston.
Broken seal rings can be the result.

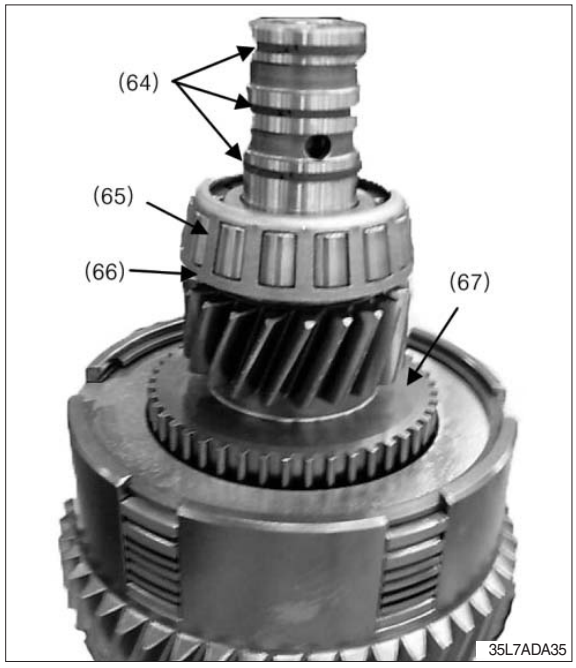


7) Put spring assembly and retainer (61) in position in the cylinder.

8) Put the shaft assembly in a press. Push down on the retainer and install snap ring (62) with a screwdriver.

9) Install pin and two thrust washes in the counter shaft of low speed clutch side.

10) Install needle bearing, spacer, needle bearing gear (67), thrust washer (66) and bearing (65) and seal ring (64).



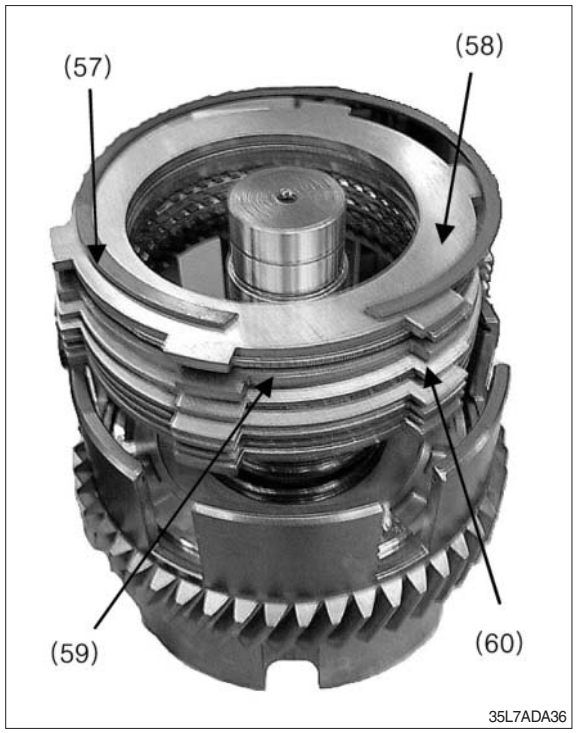
11) Put clean transmission oil on each side of the clutch plates and clutch discs. Install four 2T clutch plates, three 4T clutch plates, five clutch discs and one bending plate in the cylinder with the following procedure.
   (1) Install a clutch plate first, that has guide shape on its outside diameter.
   (2) Next, install a clutch disc that has teeth on its inside diameter.
   (3) Follow steps a and b again until all of four the 2T clutch plates and discs are installed in the cylinder.
   (4) Install a 4T clutch plate, then install a bending plate. In following procedure, bending plate shape will be downward.
   (5) Finaly, install a 4T cluch plate.

12) Use a screwdriver and install snap ring (57) that check all of them in position in the cylinder.

13) Install a three seal rings on the shaft.
※ Be carefully, Do not damage to the seal rings on the counter shaft.

14) For the other side of the counter shaft assembly, follow the procedure in steps 5 through 8.

15) Put clean transmission oil on each side of the clutch plates and clutch discs. Install four 2T clutch plates, three 4T clutch plates, five clutch discs and one bending plate in the cylinder with the following procedure.
   (1) First, install a 4T cluch plate.
   (2) Install a 4T clutch plate, then install a bending plate. In following procedure, bending plate shape will be downward.
   (3) Follow steps a and b again until all of four the 2T clutch plates and discs are installed in the cylinder.
   (4) Next, install a clutch disc that has teeth on its inside diameter.
   (5) Finally, Install a clutch plate first, that has guide shape on its outside diameter.



16) Use a screwdriver and install snap ring (57) that check all of them in position in the cylinder.

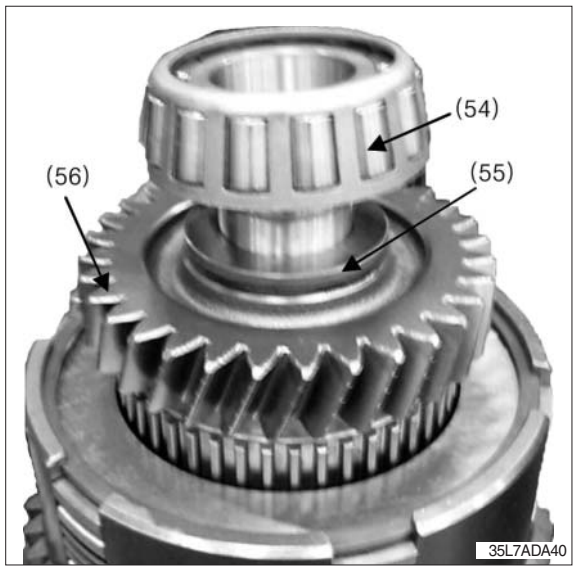
17) Install three seal rings on the shaft.

※ Be careful not to cause damage to the seal rings.

18) Install thrust washer and needle bearings on the counter shaft of high speed clutch side.

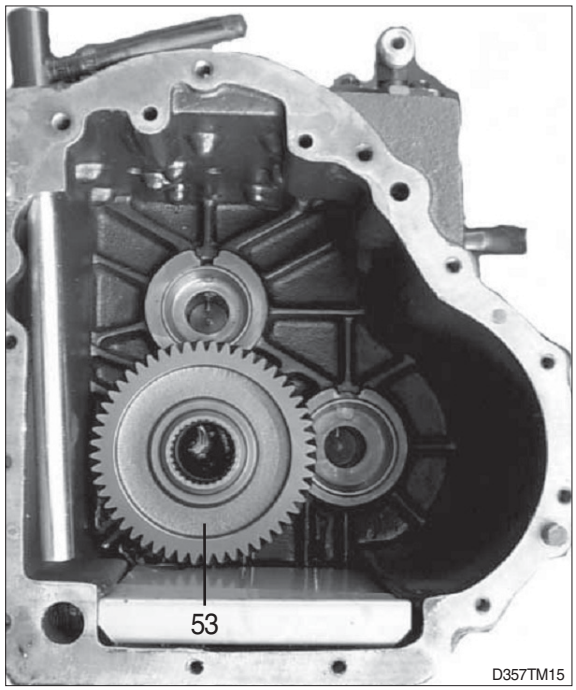
19) Install gear (56), thrust washes (55) and bearing cone (54) with tool.

※ Do not use force to install the gear.
Move the gear backward and forward while the gear is pushed into the clutch assembly until the teeth on the clutch discs are in alignment with the splines on the gear.



20) Assemble input shaft assembly with the same procedure as counter shaft assembly.

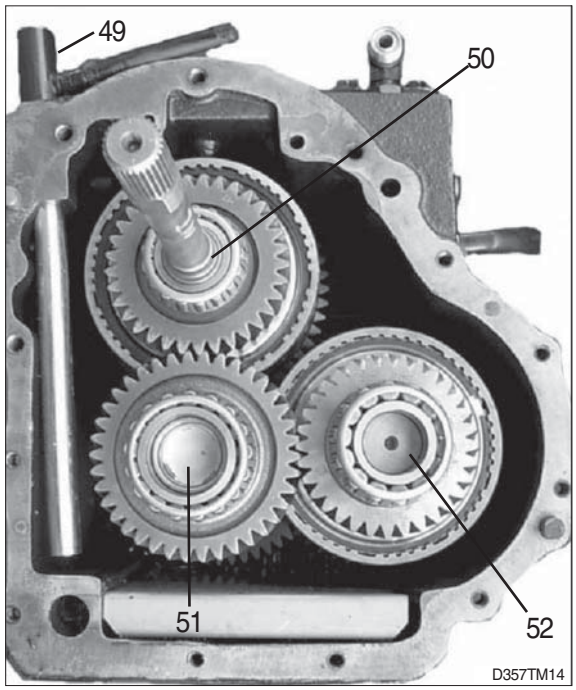
21) Install the gear assembly (53) into transmission case.



22) Carefully put the counter shaft assembly (52) in position in the transmission case.

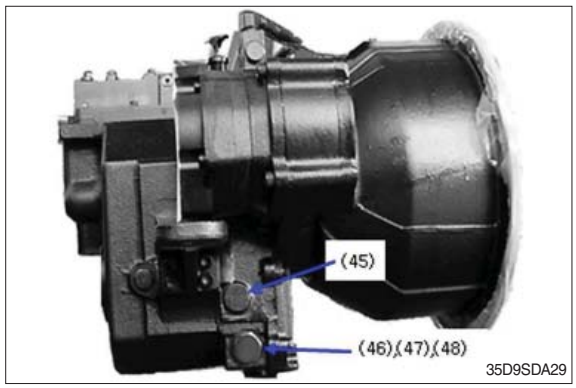
23) Carefully put the input shaft assembly (50) in position in the transmission case.
Install output shaft assembly (51) into output gear assembly.
Turn the gear until the teeth are in alignment with gears of another shaft assembly.

24) Use the plastic hammer and install tube (49) in the transmission case.

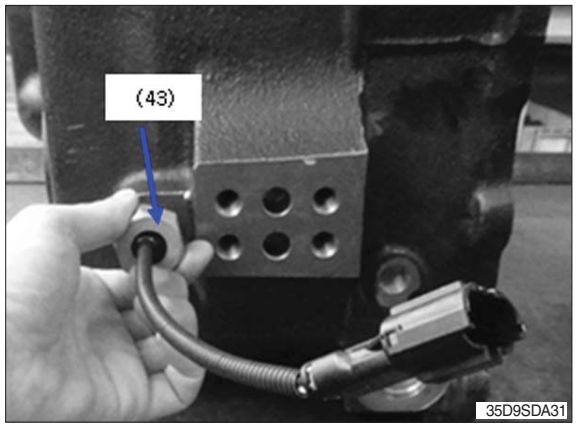


25) Install screen (48), spring (47) and plug, (46), o-ring in the transmission case.

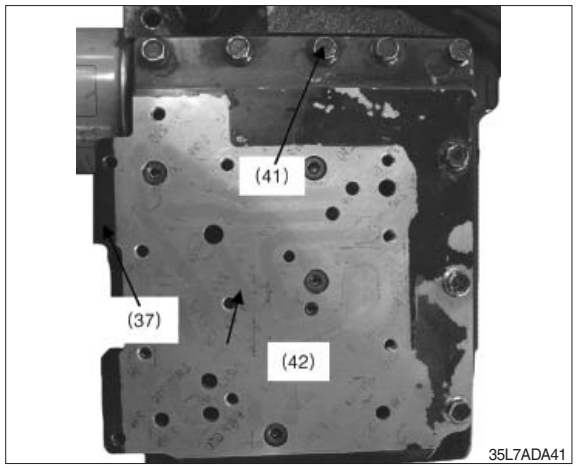
26) Install temperature sensor (45) in the transmission case.



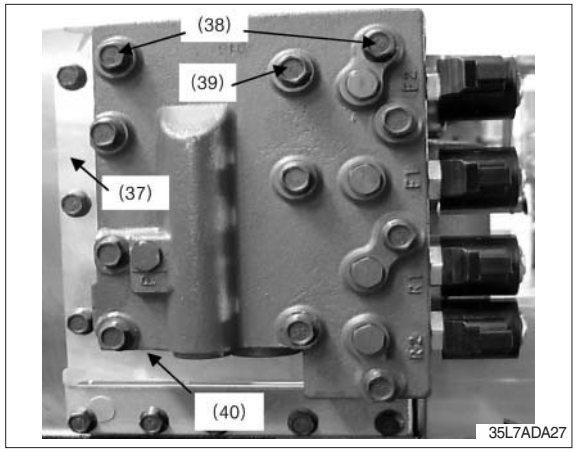
27) Install speed sensor (43) in the transmission case.



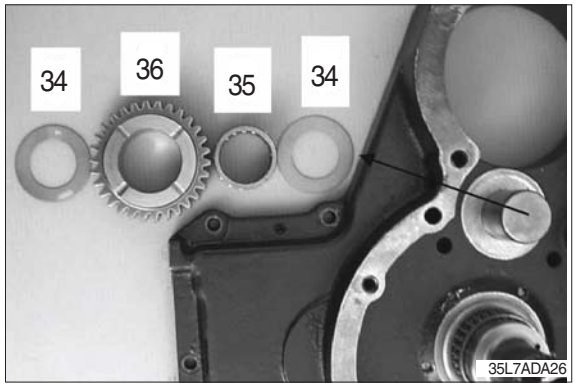
28) First, apply to Loctite 5172 on the transmiss case then, fixed.
Install valve plate by using a eight bolts and an five socket bolt



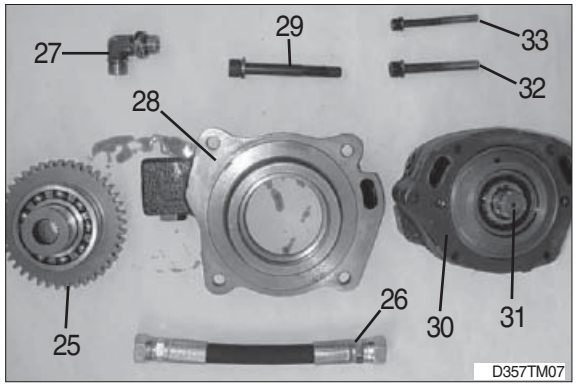
29) Install sticks to gasket on the transmisson case and then install two bolt (38), nine bolt (39) on the control valve.



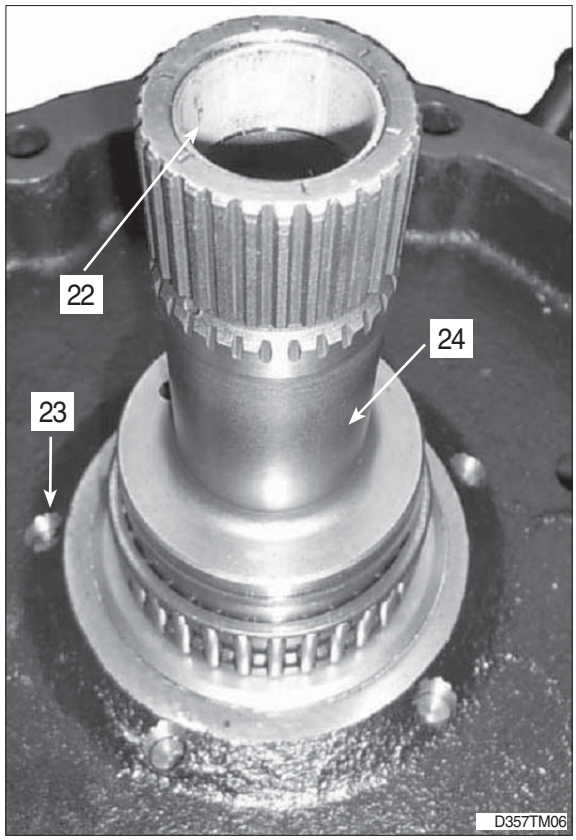
30) Install a two thrust washer (34), a needle bearing (35), gear-P.T.O Idle (36) in the bearing plate (21).



31) Install a gear-P.T.O output (25), two ball bearings on the flange pump (28) by using the jig then, install four bolts on the bearing plate.
Then, charging pump (31) and gasket (30) on the flange Pump by install a bolt (32) and four bBolt's (33). Install a 90 degree Elbow.



32) Install the sator hub assembly (24) due to Bearing plate assy (21).
- Install bush (22), piston ring, bolt (23) which assembling by each six's.
  Then install Bearing plate



33) Install plug (11) and o-ring in the bearing plate.

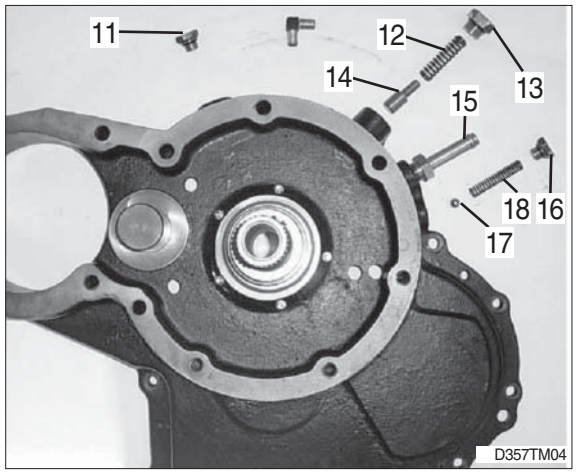
34) Install valve (14), spring (12), plug (13) and o-ring in the bearing plate.

35) Install plug (15) in the bearing plate.

36) Install ball (17), spring (18), plug (16) and o-ring in the bearing plate.

37) Put bearing cups and their shims in the bearing plate.

※ Bearing cups and their shims should be put into their location on transmission cover so as to fit on their shafts in transmission case.

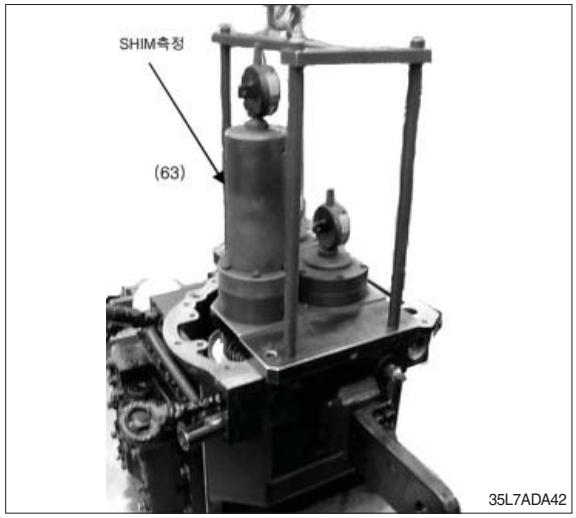


38) When new parts are used, required shim thickness should be calculated as follows .

(1) Assemble shaft assembly (including taper bearing cone and cup).

(2) Insert shaft assembly into transmission case.

※ Use depth gage and block gage because the height of bearing cup is higher than surface of transmission case.



· Method of the shaft shim measure

: Measure the dimension "depth" from surface of bearing plate to bottom of bore where bearing cup is installed.

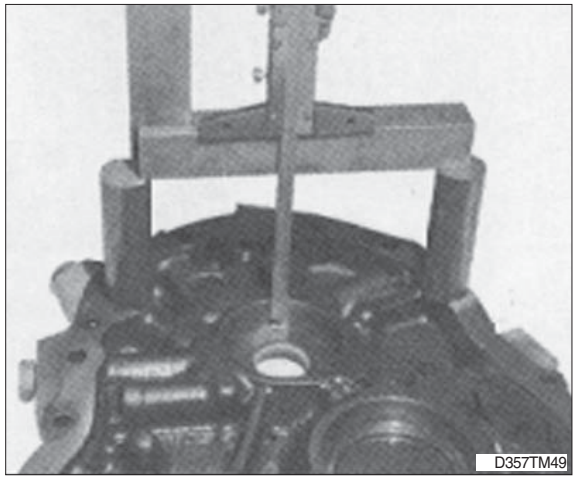
Item	Shim thickness
Input shaft	**Y-X**-0.01
Counter shaft	**Y-X**-0.05
Output shaft	**Y-X**-0.05

(3) Select shims to have 0 to 0.05 mm (0 to 0.002 inch) of axial tightness.

(4) Assemble transmission case, cover and gasket.

(5) Set up transmission assembly vertically.

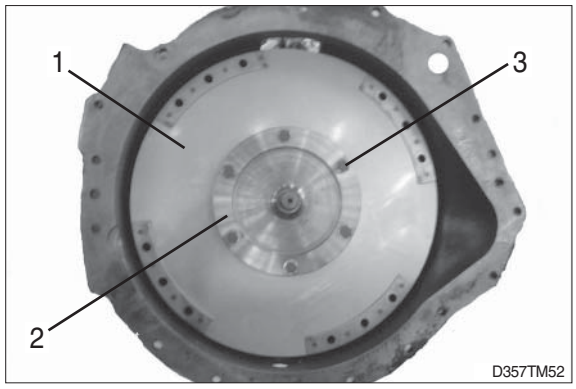
(6) If you reshim input shaft or counter shaft, turn transmission input shaft by hand. It should be turned smoothly. If you reshim output shaft, turn output shaft by hand. It should be turned smoothly.



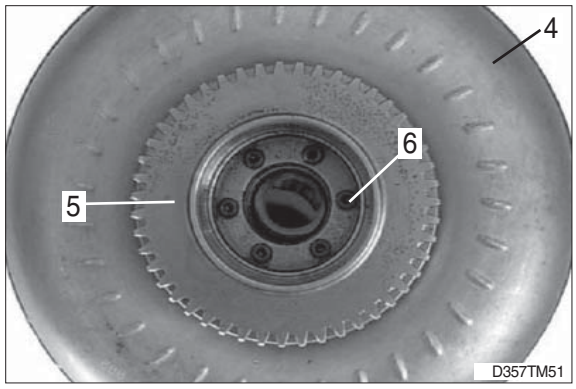
(7) If the input shaft or output shaft does not turn smoothly, remove shims about 0.025 - 0.05 mm.

※ Be extra careful during installation of the cover.Do not tilt the cover during installation, damage to the seal rings on the input shaft can be result.

39) Install torque converter housing in position. Install four bolts (9) and washes, oil seal (10), four bolts (8) that hold torque converter housing to the transmission.



40) Install gear P.T.O input(5) to torque converter, then tighten six socket bolts (6) in postion.



41) Install torque converter in postion. Install flexible plate (1) with six bolts (3) and plate (2).

Then, Install torque converter housing in position.