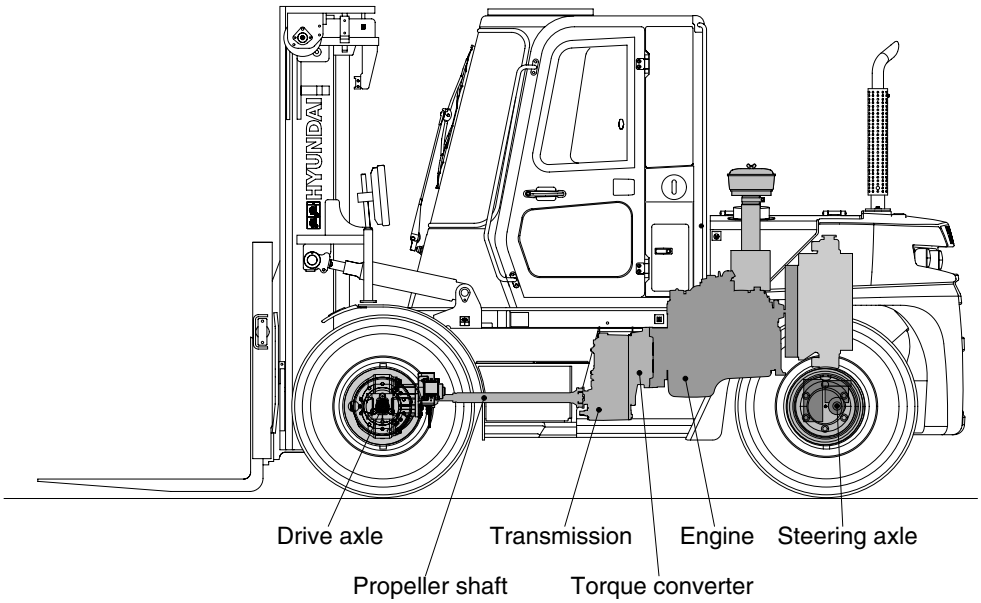
SECTION 3 POWER TRAIN SYSTEM

SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND OPERATION

1. POWER TRAIN COMPONENT OVERVIEW



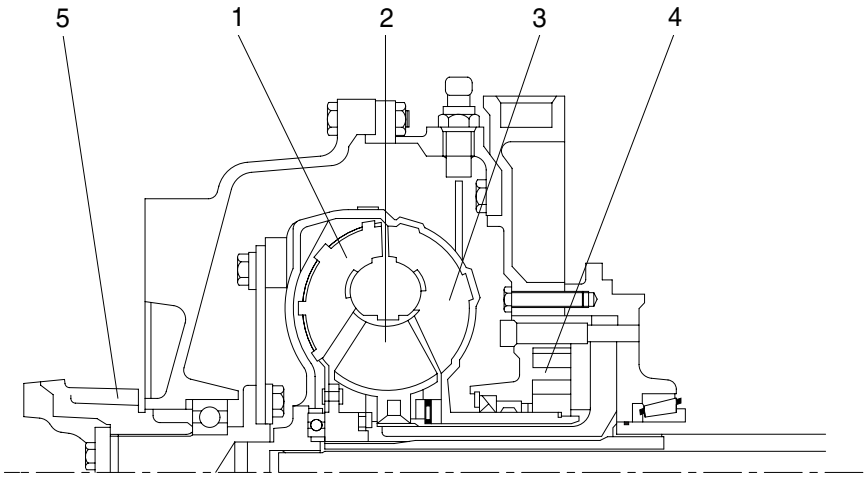
80D9PT01

The power train consists of the following components :

- Torque converter
- Transmission
- Propeller shaft
- Drive axle

Engine power is transmitted to the transmission through the torque converter.
The transmission is a hydraulically engaged three speed forward, three speed reverse power shift type transmission.
The transmission outputs through universal joints to drive axle assembly.
The power transmitted to front axle drives front wheels.

2. TORQUE CONVERTER



D503TM01

1	Turbine	3	Pump	5	Input shaft
2	Stator	4	Transmission pump		

The converter is working according to the Trilok-system, i.e. it assumes at high turbine speed the characteristics, and with it the favorable efficiency of a fluid 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-shape system that the fluid is streaming through the circuit components in the indicated order.

Pressure oil is constantly streaming 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 dissipated through the escaping oil.
The oil, escaping out of the pump wheel, enters the turbine wheel and is there inversed in the direction of flow.

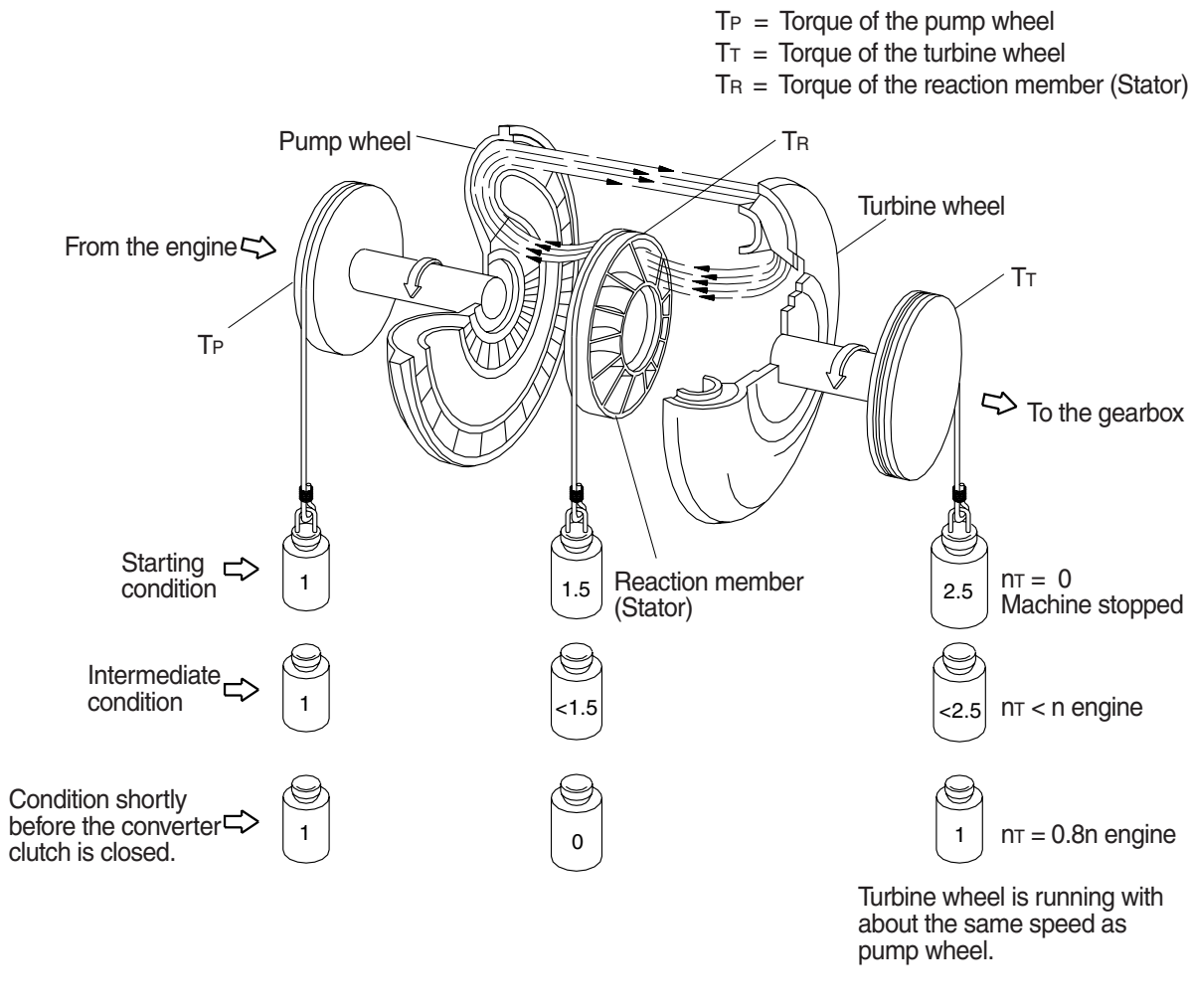
According to the rate of inversion, the turbine wheel and with it also the output shaft, receive a more or less high reaction moment. The stator (Reaction member), following the turbine, has the task to inverse again the oil which is escaping out of the turbine and to delivery it under the suitable discharge direction to the pump wheel.
Due to the inversion, the stator receives a reaction moment.
The relation turbine moment/pump moment is called torque conversion. This is the higher the greater the speed difference of pump wheel and turbine wheel will be.

Therefore, the maximum conversion is created at standing 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.

If the turbine speed is reaching about 80% of the pump speed, the conversion becomes 1.0 i.e. the turbine moment becomes equal to that of the pump moment.
From this point on, the converter is working similar to a fluid clutch.

A stator freewheel serves to improve the efficiency in the upper driving range, it is backing up in the conversion range the moment upon the housing, and is released in the coupling range.
In this way, the stator can rotate freely.

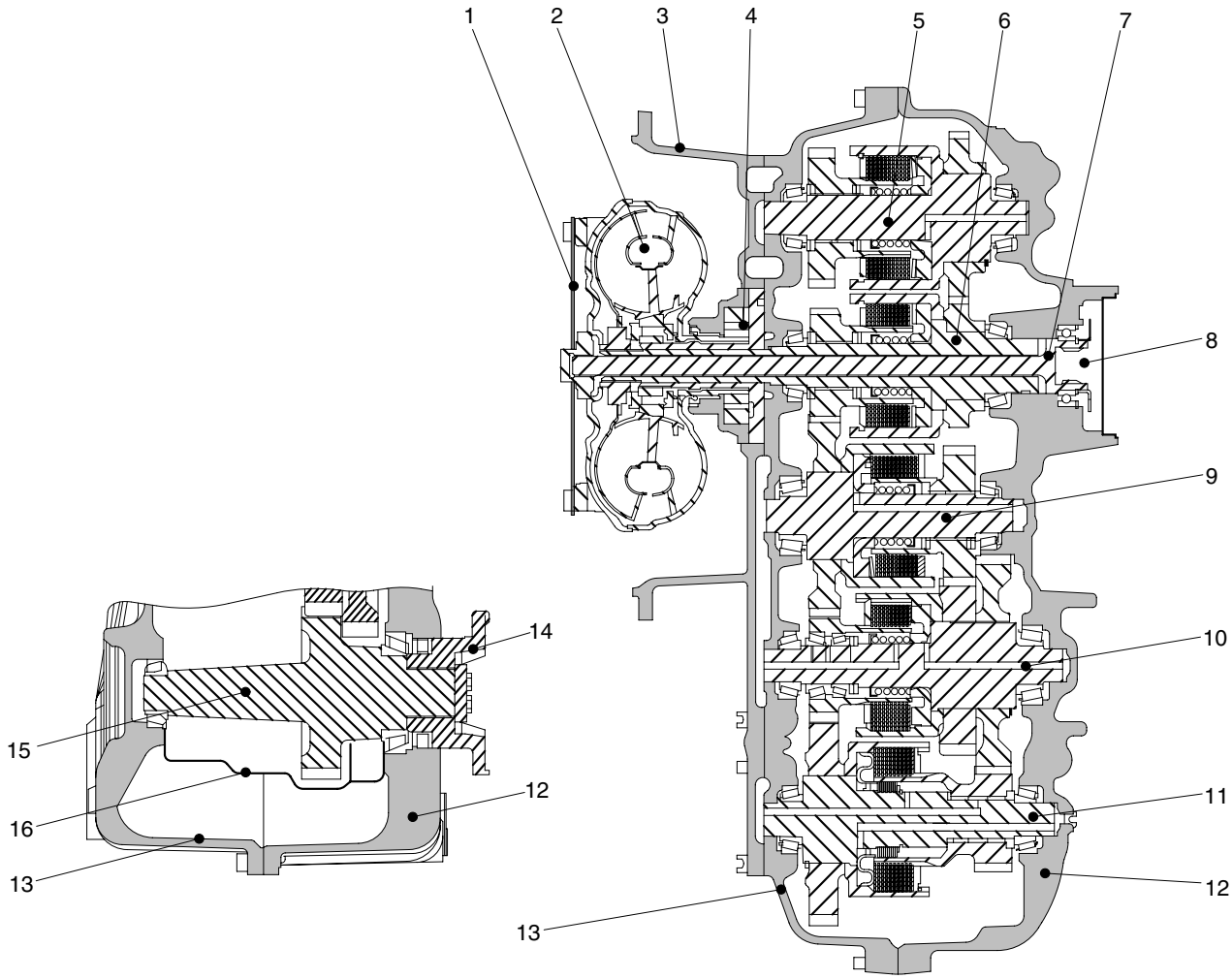
Function of a hydrodynamic torque converter (Schematic view)



D503TM02

3. TRANSMISSION

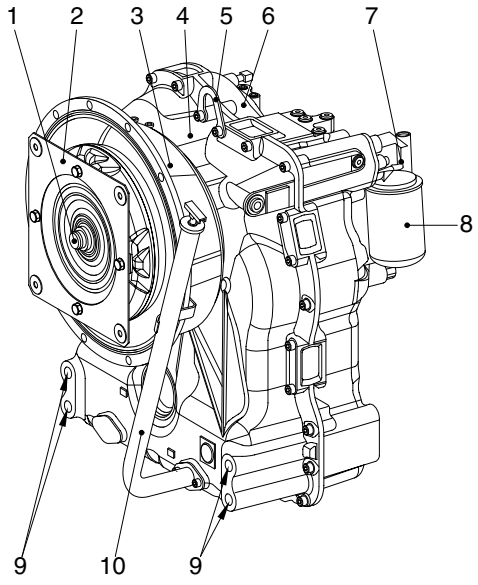
1) LAYOUT



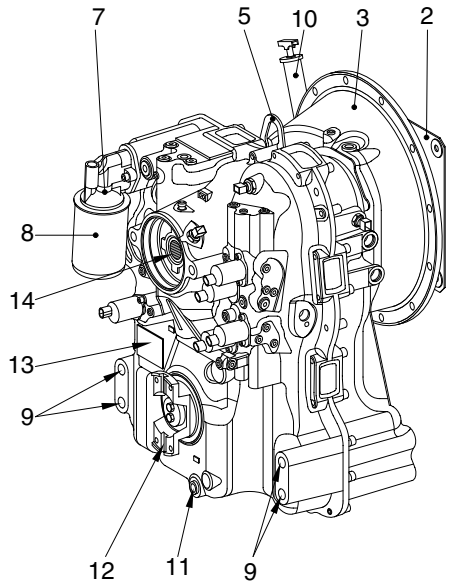
50DS7ETM03

1	Flex plate for direct mount	7	Central shaft/input shaft PTO	12	Transmission housing - rear part
2	Converter	8	Connection, PTO ; coaxial,	13	Transmission housing - front part
3	Converter bell housing		engine-dependent	14	Output flange
4	Transmission pump	9	Clutch shaft (KD)	15	Output shaft
5	Clutch shaft (KV)	10	Clutch shaft (KE)	16	Screen sheet
6	Input shaft/clutch shaft (KR)	11	Clutch shaft (KC)		

2) INSTALLATION VIEW



FRONT VIEW



REAR VIEW

50DS7EPT26

1 Converter
2 Direct mount via flex plate
3 Converter bell housing
4 Transmission housing-front part
5 Transport bracket
6 Transmission housing-rear part
7 Filter head
8 Filter
9 Transmission mounting holes M16 × 1.5
10 Oil filter tube with oil dipstick
11 Oil drain plug 7/8"14 UNF 2B
12 Output flange MECH 6C
13 Identification plate
14 Connection PTO;coaxial, engine-dependent

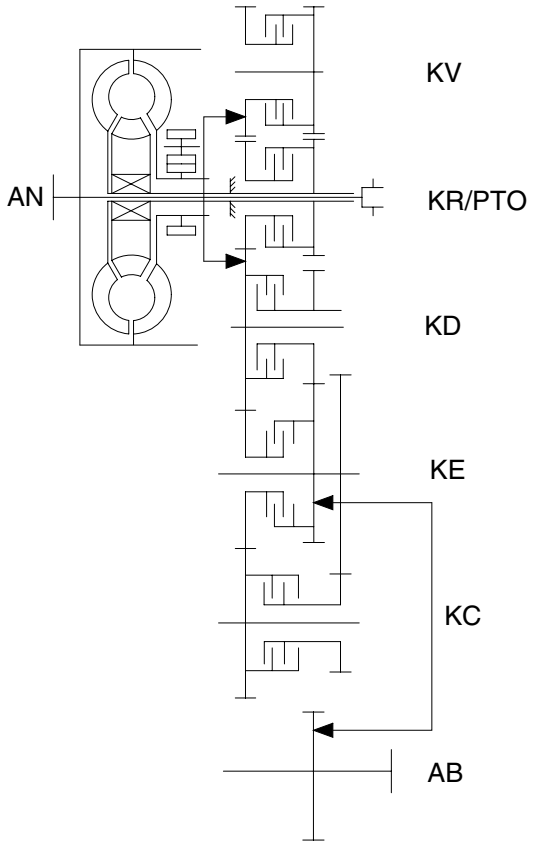
3) OPERATION OF TRANSMISSION

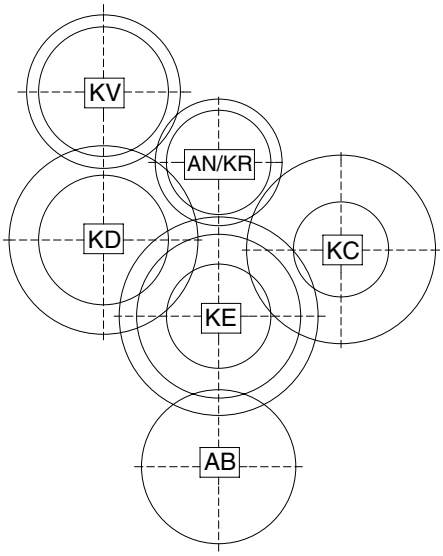
(1) Gearbox diagram

The multi-speed reversing transmission in countershaft design is power shiftable by hydraulically actuated multi-disk clutches.

All gears are constantly meshing and carried on antifriction bearings.
The gear wheels, bearings and clutches are cooled and lubricated with oil.
The 3-speed reversing transmission is equipped with 5 multi-disk clutches.
At the shifting, the actual plate pack is compressed by a piston, movable in axial direction, which is pressurized by pressure oil.

A compression spring takes over the pushing bask of the piston, thus the release of the plate pack. As to the layout of the transmission as well as the specifications of the closed clutches in the single speeds.





Legend:

AN = Input
KV = Clutch forward
KR = Clutch reverse
KC = Clutch 1st speed
KD = Clutch 2nd speed
KE = Clutch 3rd speed
PTO = Power take-off
AB = Output

Diagram Clutches

Driving direction	Speed	Clutch
Forward	1	KV/KC
	2	KV/KD
	3	KV/KE
Reverse	1	KR/KC
	2	KR/KD
	3	KR/KE

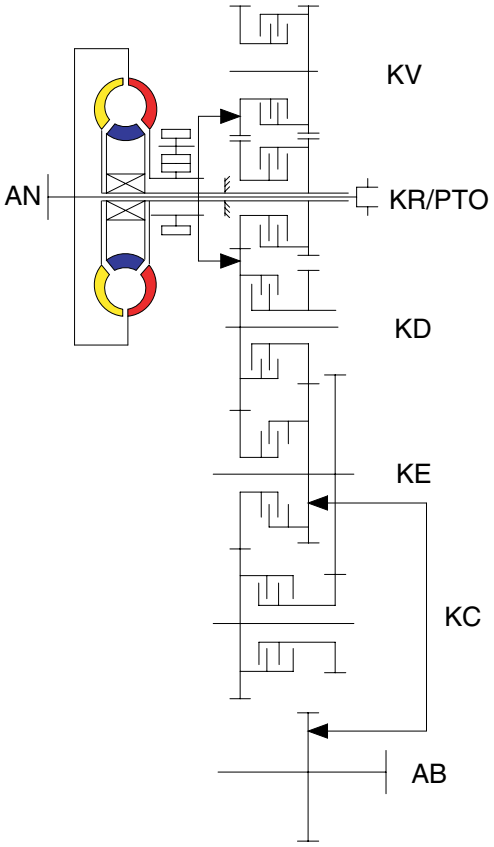
50DS7EPT32

(2) Forward

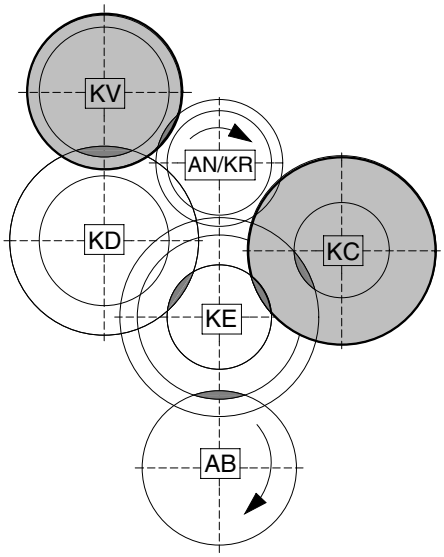
In forward, forward clutch and 1st, 2nd, 3rd clutch are engaged.

Forward clutch and 1st, 2nd, 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.

Transmission diagram



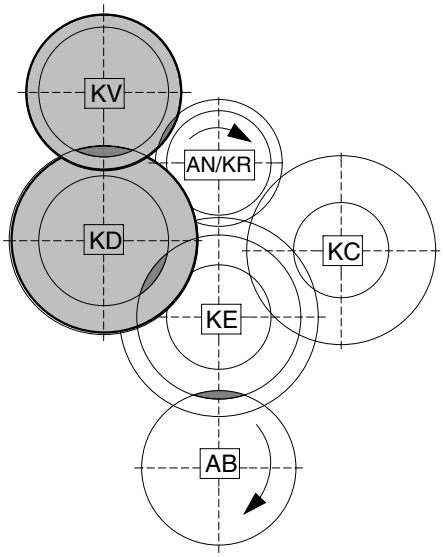
1st gear forward



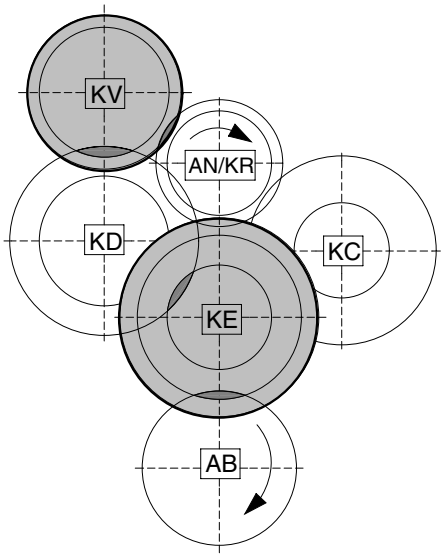
Legend:

AN = Input
KV = Clutch forward
KR = Clutch reverse
KC = Clutch 1st speed
KD = Clutch 2nd speed
KE = Clutch 3rd speed
PTO = Power take-off
AB = Output

2nd gear forward



3rd gear forward



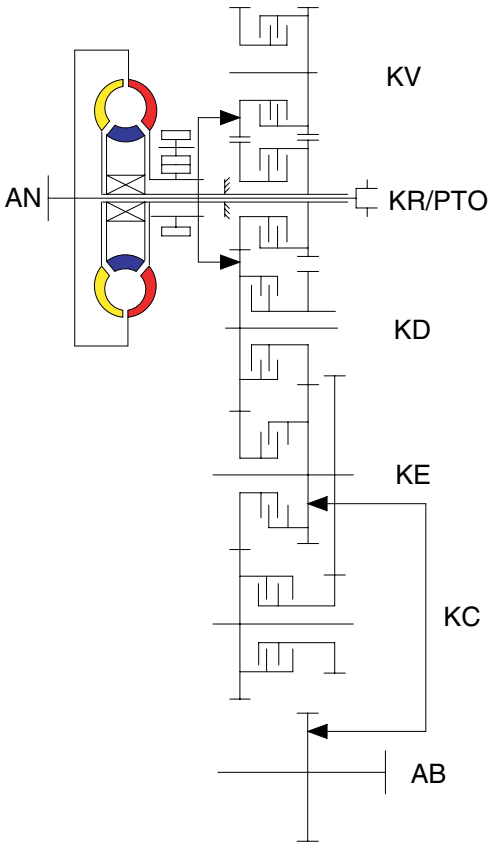
50DS7EPT33

(3) Reverse

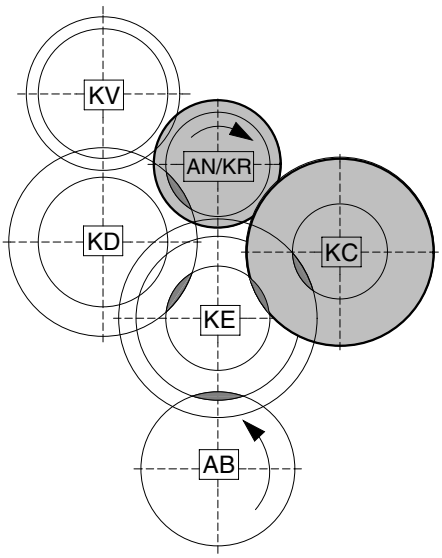
In reserve, reserve clutch and 1st, 2nd, 3rd clutch are engaged.

Reverse clutch and 1st, 2nd, 3rd are actuated by the hydraulic pressure applied to the clutch piston.

Transmission diagram



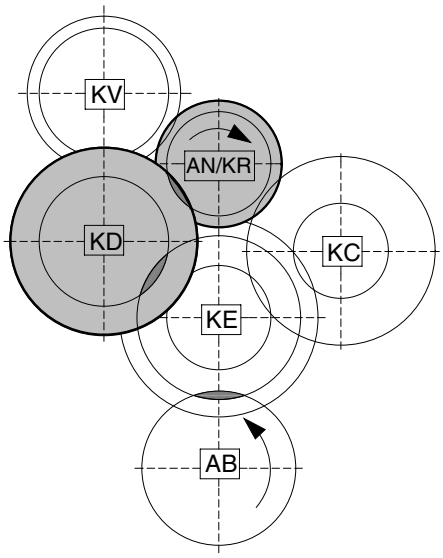
1st gear reverse



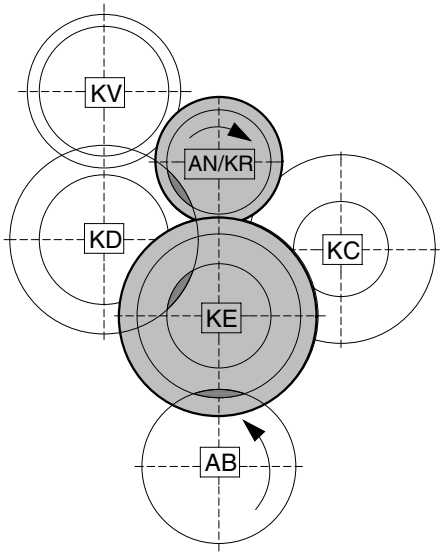
Legend:

AN = Input
KV = Clutch forward
KR = Clutch reverse
KC = Clutch 1st speed
KD = Clutch 2nd speed
KE = Clutch 3rd speed
PTO = Power take-off
AB = Output

2nd gear reverse



3rd gear reverse



50DS7EPT34

4) TRANSMISSION CONTROL

Transmission control see measuring points and oil circuit diagram see page 3-10.
The transmission pump which is necessary for the oil supply of the converter and for the transmission control is located within the transmission on the engine-dependent input shaft.
The pump feed rate is Q=45 ℓ /min, at n_{engine}=1500 min^{-1}
This pump is sucking the oil out of the oil sump via the coarse filter, and delivers it to the main pressure valve via the fine filter.

The 5 clutches of the transmission are controlled via the 5 proportional valves Y1 to Y5.

The direct proportional control with separate pressure modulation for each clutch controls the pressures towards the clutches which are involved in the gear change.
This allows a hydraulic overlapping of the clutches to be engaged and disengaged.
The pressure modulation to the respective clutch is controlled by cup springs and proportional valves in the package.

This creates spontaneous shifting without tractive effort interruption.

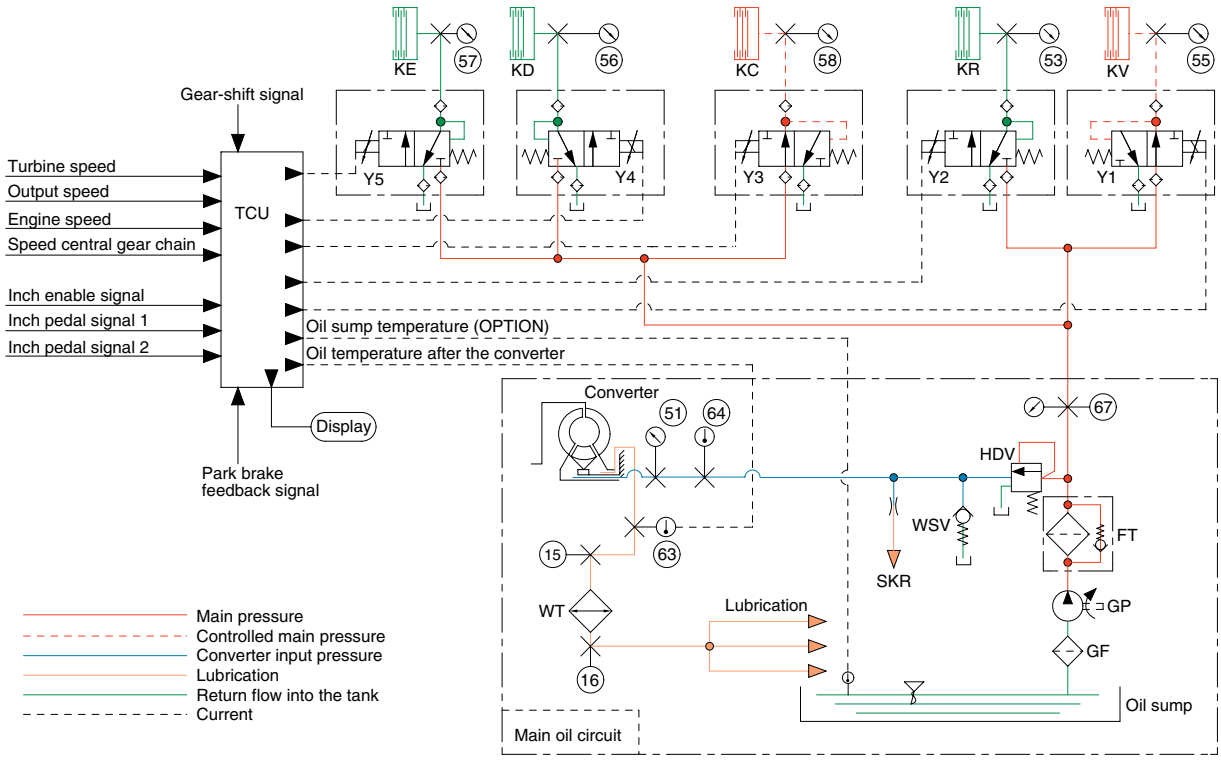
The following criteria are considered during the shifting operation:

- RPM of engine, turbine, gear chain and output
- Transmission temperature
- Shifting mode (upshifting, downshifting, reverse shifting and gear engagement out of neutral)
- Load condition (full and partial load, drive, coast, including consideration of load reversals during shifting)
- Electronic inching

The main pressure valve limits the max, control pressure to 16+3 bar and release the main stream towards the converter-and lubrication circuit.

The converter inlet incorporates a converter safety valve which protects the converter from high internal pressure (opening pressure 11+2 bar).
Within the converter, the oil serves for transmitting the power according to the well-known hydrodynamic principle (see Chapter torque converter page 3-2)
To avoid cavitation, the converter must always be completely filled with oil.

· Hydraulic circuit



50DS7EPT31

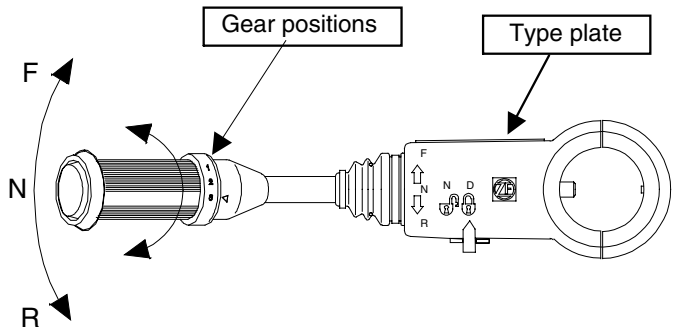
Driving direction	Gear	Proportional valve under current						Engaged clutches	
		Y1	Y2	Y3	Y4	Y5	N		
Forward	1	●		●				KV	KC
	2	●			●			KV	KD
	3	●				●		KV	KE
Reverse	1		●	●				KR	KC
	2		●		●			KR	KD
	3		●			●		KR	KE
Engaged clutch		KV	KR	KC	KD	KE			
Curr. No. of meas. points		55	53	58	56	57			

GF	Coarse filter	Y3	Proportional valve, clutch KC
GP	Transmission pump	Y4	Proportional valve, clutch KD
FT	Filter	Y5	Proportional valve, clutch KE
HVD	Main pressure valve, 16+3 bar	KV	KV clutch, forward
WSV	Converter safety valve, 11+2 bar	KR	KR clutch, reverse
SKR	Lubrication of KR clutch	KC	KC clutch, 1st gear
WT	Heat exchanger	KD	KD clutch, 2nd gear
Y1	Proportional valve, clutch KV	KE	KE clutch, 3rd gear
Y2	Proportional valve, clutch KR	TCU	Transmission control unit

5) GEAR SELECTOR (DW-3)

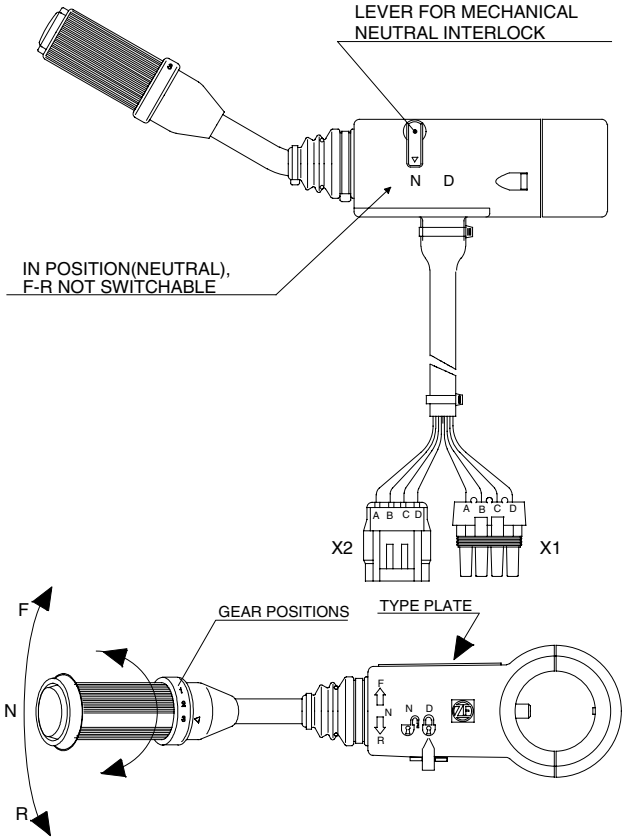
The gear selector is designed for the mounting on the steering column left side. By a rotative motion, the positions(speeds) 1 to 3 are selected by tilting the lever, the driving direction (Forward (F) - Neutral (N) - Reverse (R)).

For the protection from unintended start off, a neutral interlock is installed :
Position "N" - Controller lever blocked in this position
Position "D" - Driving



D507PT12

Gear selector (DW-3)

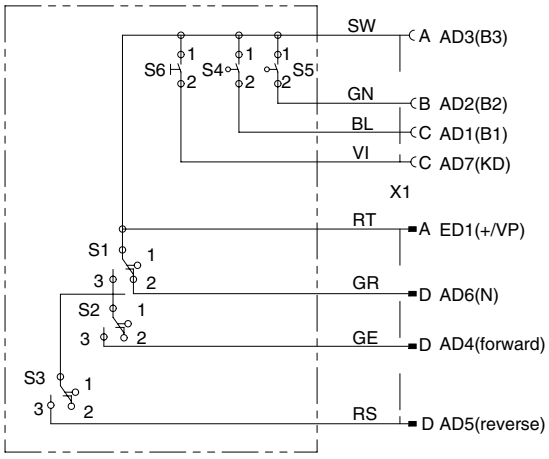


F = Forward
N = Neutral
R = Reverse
D = Mechanical neutral interlock
1 = 1st speed
2 = 2nd speed
3 = 3rd speed

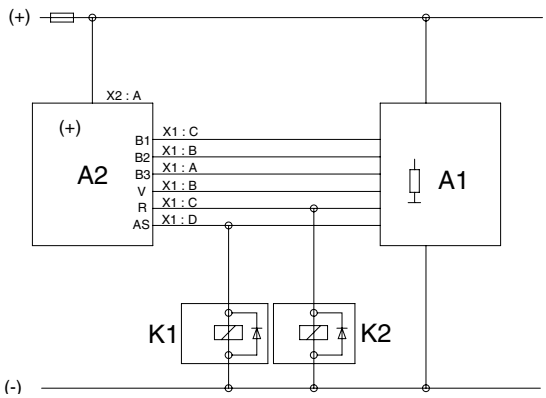
CODING GEAR SELECTOR

		OUTPUT									KD
SPEED		FORWARD			REVERSE			NEUTRAL			
		1	2	3	1	2	3	1	2	3	
AD1	B1	●			●			●			
AD2	B2			●			●			●	
AD3	B3	●	●	●	●	●	●	●	●	●	
AD4	V	●	●	●							
AD5	R				●	●	●				
AD6	AS							●	●	●	
AD7											●

CIRCUIT DIAGRAM SELECTOR



CIRCUIT DIAGRAM SELECTOR



K1 = Relay starter interlock
K2 = Relay reverse lights
A1 = TCU(Transmission Control Unit)
A2 = Gear selector

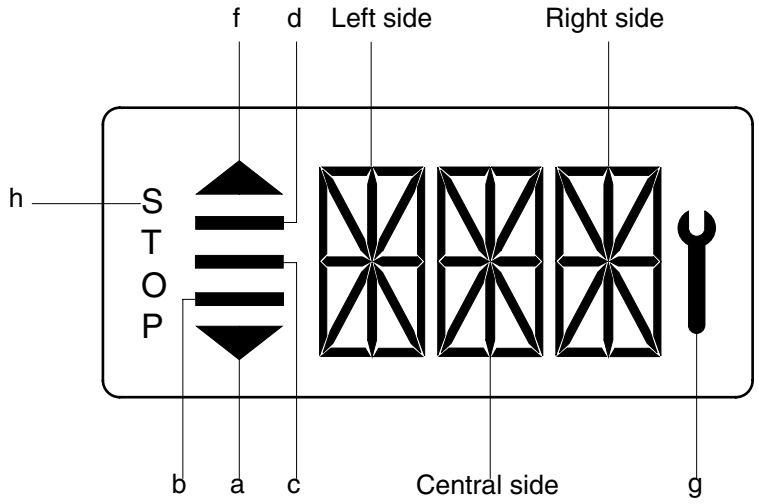
50DS7EPT38

6) TRANSMISSION ERROR DISPLAY

(1) Function

The display can be used with the gear selector. It indicates speed and driving direction as well as the activated inching.

When driving in the automatic mode, a bar indicator gives additionally also information about the selected driving range; The automatic range is symbolized by arrows above and below the bar indicator. In case of possible errors in the system, a wrench appears on the display, combined with indication of the error number. Also sporadically occurring errors can be indicated.



D507CD33

1	Bars	a, f	Automatic range (up and down shifting)
		b, c, d,	Preselected gear
2	Left side		For the moment still without function
3	Central and Right side		On the two alphanumeric 16-segment display, the electric control unit issues the actual state of gear and driving direction. Besides, a two digit error code will be indicated via these two segment
4	Spanner	g	Electronic control unit recognized an error, is flashing
5	Letters STOP	h	Immediate stop is required (At the moment not activated)

(2) Abbreviations

OC : Open circuit
SC : Short circuit
OP mode : Operating mode
TCU : Transmission control unit
EEC : Electronic engine controller
PTO : Power take off

(3) Display during operation

Symbol	Meaning	Remarks
F, N, R 1, 2, 3	Actual gear and direction Central side shows actual gear Right side shows actual direction	
NN (Central and right side)	Not neutral, waiting for neutral after power up or a reverse fault	To engage a gear, first move shift selector to neutral position and again to F to R position
1 bar	Manual mode 1st gear	
2 bar	Manual mode 2nd gear	
3 bar	Manual mode 3nd gear	
3bars and 2 arrows	Automatic mode	a, f
□ □	Transmission neutral	Cold start phase
Spanner flashing	At least on fault active	
WT	Warning torque converter temperature	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WS	Warning sump temperature	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WE	Warning high engine speed	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
PN	Direction F or R selected while parking brake engaged	Transmission in neutral until parking brake is released. ※ Machine starts to move after release of parking brake.
F or R flashing	Direction F or R selected while turbine speed is to high	※ Gear will engage when turbine speed drops
EE flashing (central and right side)	No communication with display	

(4) Display during AEB-Mode

Symbol	Meaning	Remarks
PL	AEB-Starter is plugged at the diagnostic plug	
ST	AEB-Starter-button is pressed	
KA.....KE KV, KR	Calibrating clutch KC..KE, KV or KR resp.	KC, KD for 2 gear transmission KC, KD, KE for 3 gear transmission
_and Kx	Wait for start, initialization of clutch Kx, x : C, D, E, V, R	
≡and Kx	Fast fill time determination of clutch Kx	
=and Kx	Compensating pressure determination of clutch Kx	
OK	Calibration for all clutches finished	Transmission stays in neutral, you have to restart the TCU (ignition off/on) after removing AEB-Starter
STOP	AEB canceled (activation stopped)	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
STOP and Kx	AEB stopped, clutch Kx can't be calibrated	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
Spanner and Kx	Kx couldn't be calibrated, AEB finished	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
△ E	Engine speed too low → raise engine speed	
▽ E	Engine speed too high → lower engine speed	
△ T	Transmission oil temperature too low → heat up transmission	
▽ T	Transmission oil temperature too high → cool down transmission	
FT	Transmission temperature not in defined range during calibration	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FB	Operating mode not NORMAL or transmission temperature sensor defective or storing of Calibrated values to EEPROM-has failed.	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FO	Outputspeed_not_zero	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FN	Shift lever not in Neutral position	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FP	Parkbrake_not_applied	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
STOP	AEB-Starter was used incorrect or is defective. Wrong device or wrong cable used.	Transmission stays in neutral, you have to restart the TCU (ignition off/on)

(5) Definition of the error codes

① Introduction

The error codes consists of two hexadecimal numbers.

The first number shows the type of signal, the second number shows signal and the type of the error.

② Description of error codes

First No.	Meaning of number
1 hex	Digital input signals
2 hex	Analog input signals
3 hex	Speed signals
4 hex	Speed signals
7 hex	Analog current output signals
8 hex	Analog current output signals
9 hex	Digital output signals
A hex	Digital output signals
B hex	Clutch errors
D hex	Power supply
E hex	High speed signals
F hex	General errors

③ List of error codes

Number	Meaning of error code
11 hex	Logical error at gear range signal
12 hex	Logical error at direction select signal
21 hex	Short circuit to battery voltage at clutch cutoff input
22 hex	Short circuit to ground or open circuit at clutch cutoff input
25 hex	Short circuit to battery voltage or open circuit at temperature sensor input
26 hex	Short circuit to ground at temperature sensor input
31 hex	Short circuit to battery voltage at engine speed input
32 hex	Short circuit to ground or open circuit at engine speed input
33 hex	Logical error at engine speed input
34 hex	Short circuit to battery voltage at turbine speed input
35 hex	Short circuit to ground or open circuit at turbine speed input
36 hex	Logical error at turbine speed input
37 hex	Short circuit to battery voltage at internal speed input
38 hex	Short circuit to ground or open circuit at internal speed input
39 hex	Logical error at internal speed input

Number	Meaning of error code
3A hex	Short circuit to battery voltage or open circuit at output speed input
3B hex	Short circuit to ground or open circuit at output speed input
3C hex	Logical error at output speed input
71 hex	Short circuit to battery voltage at clutch KC
72 hex	Short circuit to ground at clutch KC
73 hex	Open circuit at clutch KC
74 hex	Short circuit to battery voltage at clutch KD
75 hex	Short circuit to ground at clutch KD
76 hex	Open circuit at clutch KD
77 hex	Short circuit to battery voltage at clutch KE
78 hex	Short circuit to ground at clutch KE
79 hex	Open circuit at clutch KE
84 hex	Short circuit to battery voltage at clutch KV
85 hex	Short circuit to ground at clutch KV
86 hex	Open circuit at clutch KV
87 hex	Short circuit to battery voltage at clutch KR
88 hex	Short circuit to ground at clutch KR
89 hex	Open circuit at clutch KR
91 hex	Short circuit to ground at relay reverse warning alarm
92 hex	Short circuit to battery voltage at relay reverse warning alarm
93 hex	Open circuit at relay reverse warning alarm
94 hex	Short circuit to ground at relay starter interlock
95 hex	Short circuit to battery voltage at relay starter interlock
96 hex	Open circuit at relay starter interlock
97 hex	Short circuit to ground at park brake solenoid
98 hex	Short circuit to battery voltage at park brake solenoid
99 hex	Open circuit at park brake solenoid

Number	Meaning of error code
B1 hex	Slippage at clutch KC
B2 hex	Slippage at clutch KD
B3 hex	Slippage at clutch KE
B5 hex	Slippage at clutch KV
B6 hex	Slippage at clutch KR
D1 hex	Short circuit to battery voltage at power supply for sensors
D2 hex	Short circuit to ground at power supply for sensors
D3 hex	Low voltage at battery
D4 hex	High voltage at battery
D5 hex	Error at valve power supply 1
D6 hex	Error at valve power supply 2
E5 hex	Communication failure on devicenet
F1 hex	General EEPROM fault
F2 hex	Configuration lost
F3 hex	Application error

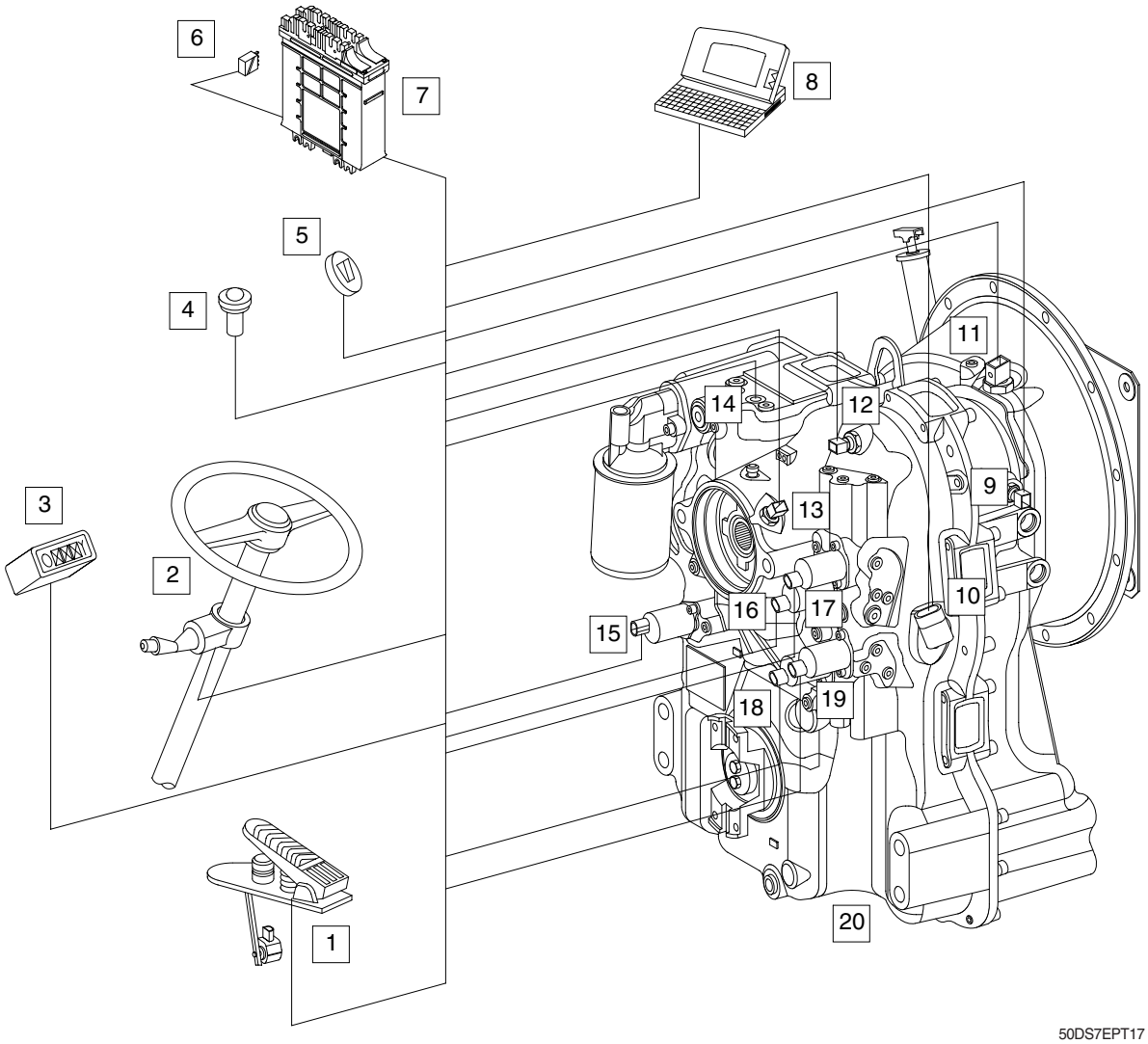
6) ELECTRONIC CONTROL FOR POWER TRANSMISSION

(1) Description of the basic functions

The powershift transmission 3 WG-94 EC of series WG-90 is equipped with the electronic transmission control EST-65 specially developed for this purpose.

The system process the driver command according to the following criteria:

- Gear determination depending on driving speed and load condition.
- If required, protection against operating errors is possible via electronic protection (programming)
- Protection against overspeeding (on the basis of engine and turbine speed)
- Pressure cut-off possible (vehicle-specific, only after coordination with ZF)
- Switch-over possibility for automatic / manual operation
- Downshifting functions possible
- Electronic inching



1 Inching pedal
2 Gear selector
3 Display
4 Optical warning
5 Switch for driving program Manual/Automatic
6 CAN connection
7 TCU
8 Diagnostic Laptop with ZF diagnostic system Testman/Pro
9 Inductive sensor - speed of central gear chain
10 Speed sensor - output
11 Temperature measuring point after the converter (No. 63)
12 Inductive sensor - turbine speed
13 Inductive sensor - engine speed
14 Temperature measuring point for the converter (No. 64)
15 Proportional valve Y3 - KC clutch
16 Proportional valve Y2 - KR clutch
17 Proportional valve Y1 - KV clutch
18 Proportional valve Y5 - KE clutch
19 Proportional valve Y4 - KD clutch
20 Ergopower transmission 3 WG-94 EC

(2) Inching device

This function is especially suitable for lift trucks. Without modifying the engine speed, it allows a continuously variable reduction of the driving speed to such a level that operation at a very low speed is possible. In this way, the driver can move the vehicle to a certain position with high accuracy.
At the same time, a large part of the engine power is available for driving the hydraulic lifting system, due to the high engine speed.

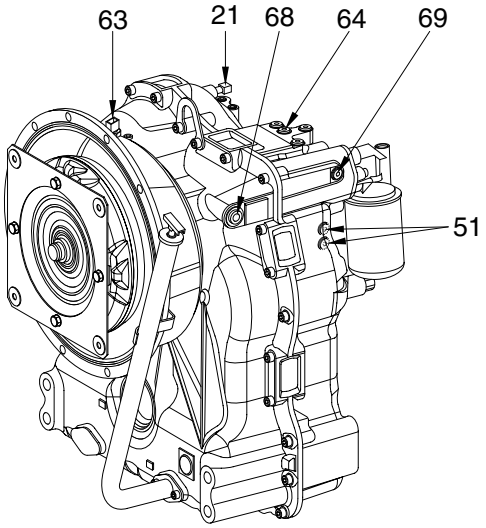
The electrical inching is operated via a separate inching pedal fitted with an angle-of-rotation sensor.
By means of the proportional valve technology, the TCU controls the pressure in the driving direction clutch in such a way that the driving speed is adjusted in accordance with the position of the inching angle-of-rotation sensor. Clutch overloading is prevented by the electronic protection.

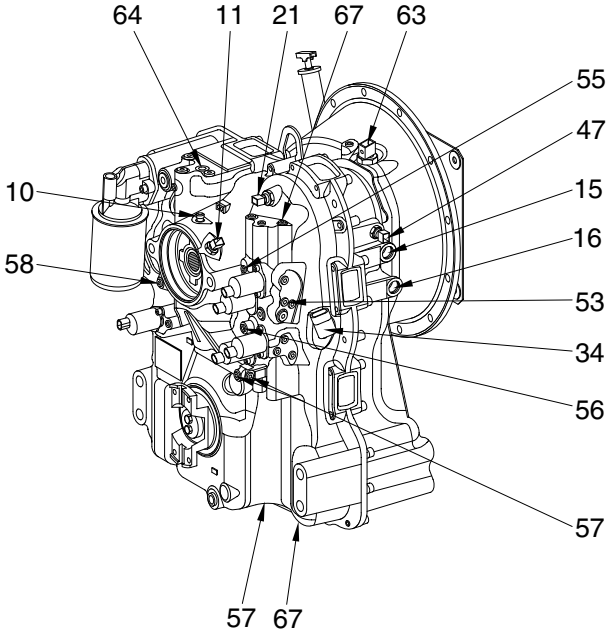
※ After each readjustment of the inching linkage, the IPK (Inch Pedal Calibration-Inch Sensor Calibration) must be carried out.
During the inching calibration mode, the position of the inching pedal in neutral position and at full actuation is determined by the calibration process and stored in theTCU.

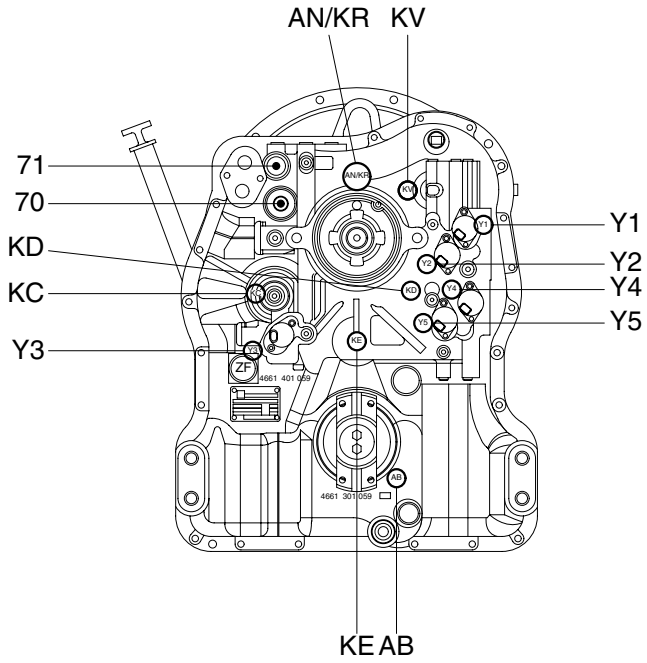
※ The inching function does not become active until successful completion of AEB and IPK start.

4. TRANSMISSION MEASURING POINTS AND CONNECTIONS

The measurement have to be carried out with hot transmission (about 80~95°C)







50DS7ETM04

1) Measuring points for pressure oil and temperature

Port	Description			Size
51	Before the converter - opening pressure		11 + 2 bar	M10×1
53	Reverse clutch	KR	16 + 3 bar	M10×1
55	Forward clutch	KV	16 + 3 bar	M10×1
56	Clutch	KD	16 + 3 bar	M10×1
57	Clutch	KE	16 + 3 bar	M10×1
58	Clutch	KC	16 + 3 bar	M10×1
63	Temperature after the converter 100°C ; short-term 120°C			M14×1.5
64	Temperature sensor			M12×1.5
67	System pressure		16 + 3 bar	M10×1

2) Valves and connections

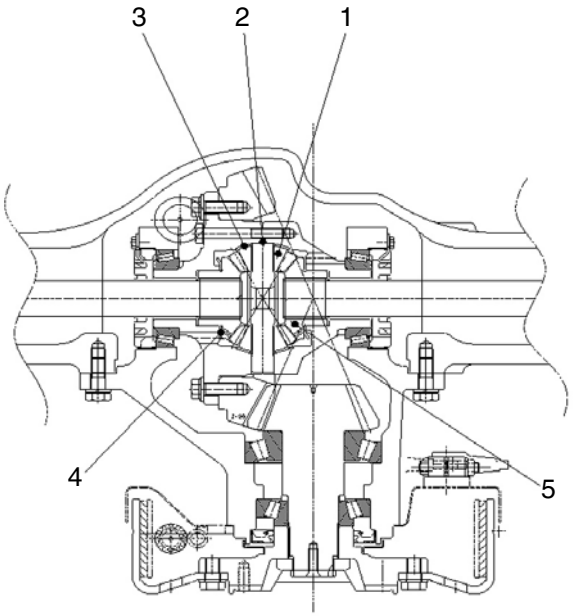
Port	Description	Size
10	Breather	M10×1
15	Connection towards heat exchange	7/8" 14 UNF
16	Connection from heat exchanger	7/8" 14 UNF
68	Connection after fine filter	9/6-18 UNF-2B
69	Connection before fine filter	7/8" 14 UN 2A
70	Converter safety valve (WSV)	
71	Main pressure valve (HDV)	

3) Inductive transmitters and speed sensor

Port	Description		Size
11	Inductive transmitter	n Engine	M18×1.5
21	Inductive transmitter	n Turbine	M18×1.5
34	Speed sensor	n Output	-
47	Inductive transmitter	n Central gear train	M18×1.5

5. DIFFERENTIAL CARRIER ASSEMBLY

1) STRUCTURE



50D7EAX02

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

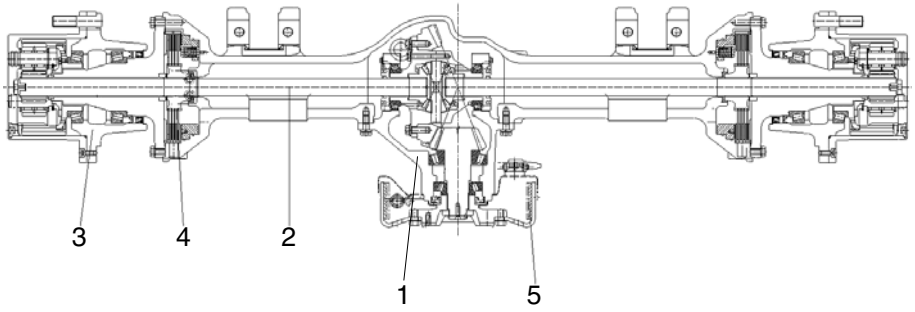
Differential transmits the power from the transmission to drive wheel.

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.

6. DRIVE AXLE

1) STRUCTURE



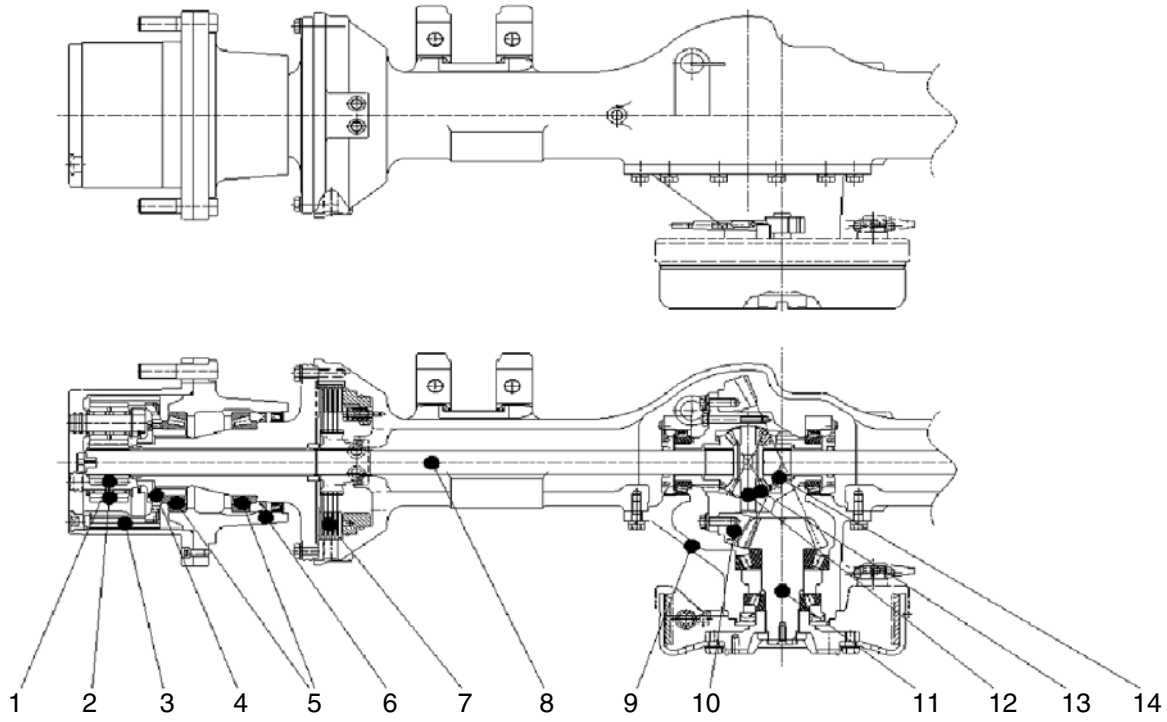
50D7EAX01

1	Differential carrier ass'y	3	Drive wheel	5	Parking brake
2	Drive shaft	4	Disc brake		

OPERATION

The drive axle is composed of differential carrier assy (1), drive shaft (2), and drive wheel (3).
The power is transmitted from the engine fly wheel to the transmission.
The power of transmission is transmitted to the spiral bevel gear through the output gear of the transmission.
Then the power of differential is transmitted to the wheel through the drive shaft.

2) DRIVE AXLE



50D7EAX03

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		

OPERATION

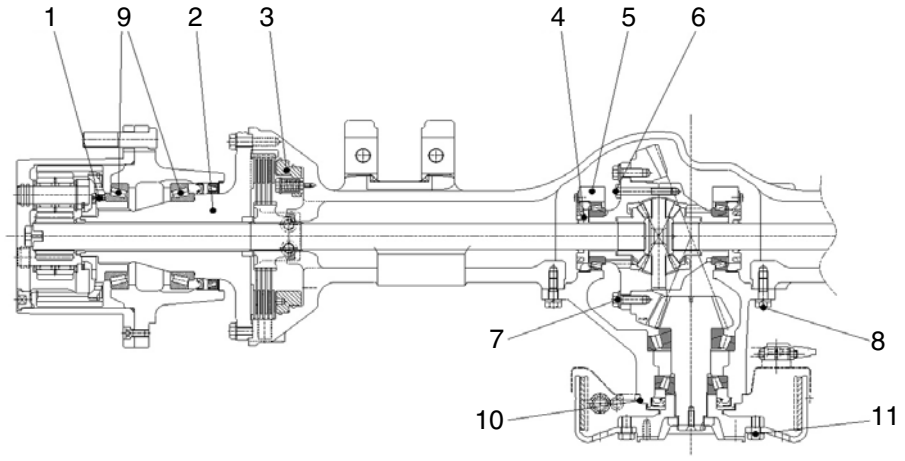
Drive axle which consists of differential carrier assembly (9), drive shaft (8) and hub assembly (6) transmits the drive force from transmission to the wheels.

Pinion shaft (11) is connected to transmission output through universal joint.

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 (8).

Side gear (14) and drive shaft (8) are connected with spline and the drive shaft (8) connect to planetary gear (2), inner hub (6) and finally drive wheels.

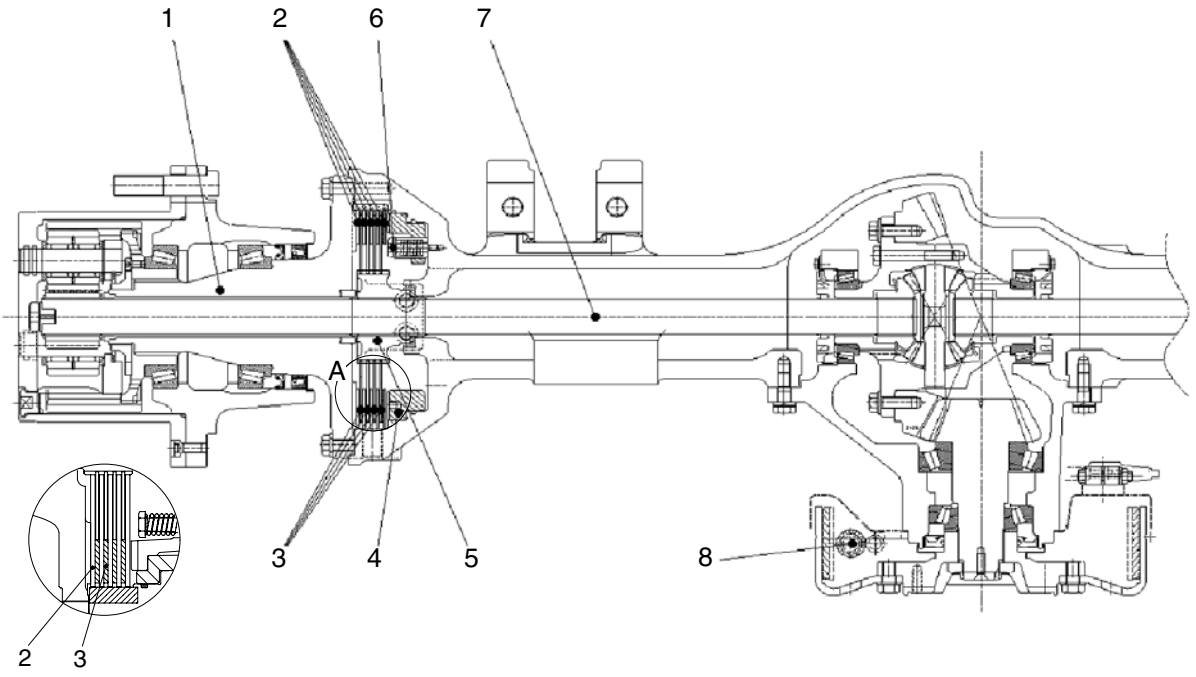
3) DRIVE AXLE TIGHTENING TORQUE



50D7EAX04

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	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 (116±3.6 lbf · ft)
6	Differential case	6.0±0.5 kgf · m (43.4±3.6 lbf · ft)
7	Ring gear	13.5±0.5 kgf · m (97.6±3.6 lbf · ft)
8	Differential carrier assembly	18.0±0.5 kgf · m (130±3.6 lbf · ft)
9	Wheel hub rolling resistant	3.0±0.3 kgf · m (21.7±2.2 lbf · ft)
10	Parking brake	20.0±0.9 kgf · m (144.7±6.5 lbf · ft)
11	Brake drum	12.0±0.5 kgf · m (86.8±3.6 lbf · ft)

4) DISK BRAKE



50D7EAX05

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

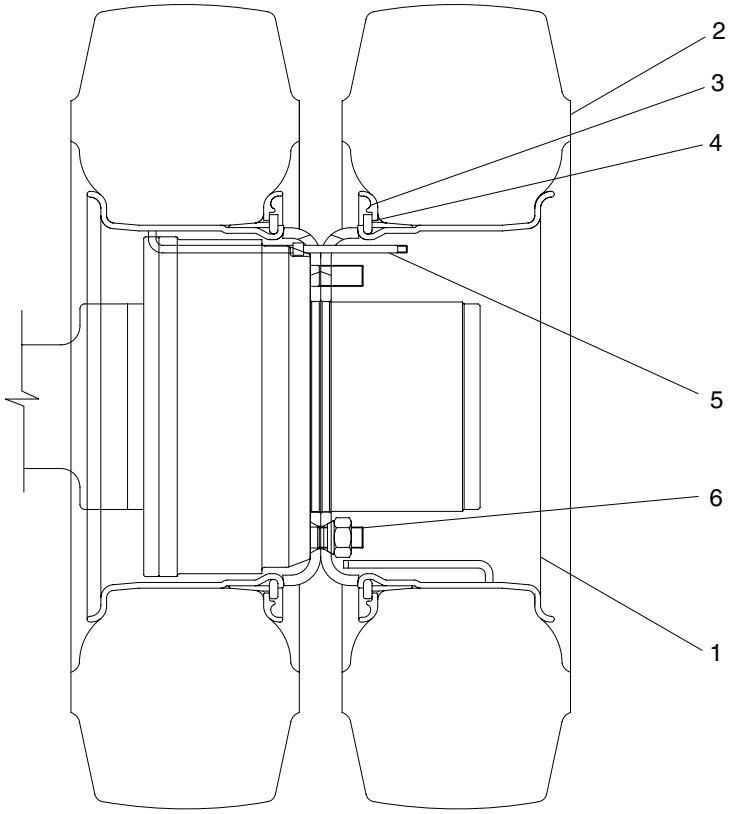
OPERATION

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 maintain its lining as drum type brake do. Also with self-adjust of friction plate clearance, it's easy to prevent the brake 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).

7. TIRE AND WHEEL



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1	Wheel rim	3	Lock ring	5	Valve assembly
2	Tire	4	Side ring	6	Wheel nut

1) The tire acts to absorb the shock from the ground surface to the machine, and at the same time they must rotate in contact with the ground to gain the power which drives the machine.

2) Various types of tires are available to suit the purpose. Therefore it is very important to select the correct tires for the type of work.

GROUP 2 OPERATION AND MAINTENANCE

1. OPERATION

1) DRIVING PREPARATION AND MAINTENANCE

Prior to the commissioning of the transmission, take care that the prescribed oil grade will be filled in with the correct quantity. At the initial filling of the transmission has to be considered that the oil cooler, the pressure filters as well as the pipes must get filled with oil.

According to these cavities, the quantity of oil to be filled in, is greater than at the later oil fillings in the course of the usual maintenance service.

※ Because the converter and the oil cooler, installed in the vehicle, as well as the pipes can empty at standstill into the transmission, the **oil level check must be carried out at engine idling speed and operation temperature of the transmission.**

⚠ **At the oil level check, the vehicle has to be secured against rolling by blocks, articulated vehicles additionally against unintended turning-in.**

2) DRIVING AND SHIFTING

(1) Neutral position

Neutral position will be selected via the gear selector.

After the ignition is switched on, the electronics remains in the waiting state. By the position NEUTRAL of the gear selector, the TCU becomes ready for operation.

A gear can be engaged.

(2) Starting

The starting of the engine has always to be carried out in the NEUTRAL POSITION of the gear selector.

For safety reasons it is to recommend to brake the vehicle securely in position with the parking brake prior to start the engine.

After the starting of the engine and the preselection of the driving direction and the gear, the vehicle can be set in motion by acceleration.

At the start off, the converter takes over the function of a master clutch.

On a level road it is possible to start off also in higher gears.

- **Upshifting under load.**

  Upshifting under load will be then realized if the vehicle can continue to accelerate by it.

- **Downshifting under load.**

Downshifting under load will be then realized if more traction force is needed.

- Upshifting in overrunning condition.

In the overrunning mode, the upshifting will be suppressed by accelerator pedal idling position, if the speed of the vehicle on a downgrade should not be further increased.

- Downshifting in overrunning condition.

Downshifting in overrunning mode will be then carried out if the vehicle should be related.

If the vehicle will be stopped and is standing with running engine and engaged transmission, the engine cannot be stalled. On a level and horizontal roadway it is possible that the vehicle begins to crawl, because the engine is creating at idling speed a slight drag torque via the converter.
It is convenient to brake the vehicle at very stop securely in position with the parking brake. At longer stops, the controller has to be shifted to the NEUTRAL POSITION.

At the start off, the parking brake has to be released. We know from experience that at a converter transmission it might not immediately be noted to have forgotten this quite normal operating step because a converter, due to its high ratio, can easily overcome the braking torque of the parking brake.
Temperature increases in the converter oil as well as overheated brakes will be the consequences to be find out later.
Neutral position of the selector switch at higher vehicle speed(above stepping speed) is not admissible.
Either a suitable gear is to be shifted immediately, or vehicle must be stopped at once.

3) COLD START

At an oil temperature in the shifting circuit <-12 °C, the transmission must be warmed-up for some minutes.
This must be carried out in neutral with an increased engine speed (about 1500 min^{-1}).
Until this oil temperature is reached, the electronics remains in neutral, and the symbol of the cold start phase will be indicated on the display.

Indication on the display: ✻✻

After the indication on the display is extinguished, the full driving program can be utilized out of "NEUTRAL".

4) OIL TEMPERATURE

The oil temperature in the transmission sump is in the electrohydraulic control unit.

The service temperature in the sump of 60~90 °C must not be exceeded.
By overstepping results by 105 °C notice "WS" on the display.

At a trouble-free unit and an adequate driving mode, a higher temperature will not occur.
The notice "WS" results at the display, the vehicle has to be stopped and controlled for external oil loss and the engine must run with a speed of 1200~1500 min^{-1} at NEUTRAL POSITION of the transmission.

Now, the temperature must drop quickly(in about 2~3 minutes) to normal values. If this is not the case, there is a trouble pending, which must be eliminated prior to continue working.

The monitoring of the oil temperature(behind the converter) is additionally on the temperature gauge which is located on the dashboard.

Operating temperature behind the converter at least 65 °C and 100 °C in continuous operation, a short-time increase up to max. 120 °C is permitted.

The temperature is measured on the measuring point "63" (see schedule of measuring points-3-22)

2. MAINTENANCE

1) TRANSMISSION

(1) Oil level check

⚠ At the oil level check, the vehicle has to be secured against rolling with blocks.

The oil level check must be carried out as follows :

- Oil level check (weekly)
- At horizontally standing vehicle
- Transmission in neutral position "N"
- In the cold start phase, the engine must be running about 2-3 minutes at idling speed, and the marking on the oil dipstick must then be lying above the cold start mark "COLD"
- At operating temperature of the transmission (about 80~90 °C)
- At engine idling speed
- Loosen oil dipstick by counterclock rotation, remove and clean it
- Insert oil dipstick slowly into the oil level tube until contact is obtained, and pull it out again.
- On the oil dipstick, the oil level must be lying in the zone "HOT"
- Insert the oil dipstick again, and tighten it by clockwise rotation

If the oil level has dropped in operating temperature condition below the "HOT" zone, it is absolutely necessary to replenish oil.

An oil level above the "HOT" marking, is leading to a too high oil temperature.

(2) Oil change and filter replacement intervals

※ **First oil change after 100 operating hours in service.**
Every further oil change after 1000 operating hours in service, however at least once a year.
At every oil change, the fine filter has to be replaced.

① Oil change and oil filling capacity

The oil change has to be carried out as follows. At operating temperature of the transmission, horizontally standing vehicle open the oil drain plug and drain the used oil.

- Clean oil drain plug with magnetic insert and surface on the housing and install again along with O-ring.
- Fill in oil (about 24 liters).

(Sump capacity, external oil capacities e. g. in the heat exchanger, in the lines etc. are depended on the vehicle).

The indicated value is a guide value.

※ **It is imperative to pay attention to absolute cleanliness of oil and filter.**
Binding is in any case the making on the oil dipstick.

- Start the engine-idling speed
- Transmission in neutral position "N"
- Top up oil up to the marking "COLD"
- Brake the vehicle securely in position and warm up the transmission
- Shift all controller positions through
- Check the oil level once more and top up oil once more if necessary
- On the oil dipstick, the oil level must be lying in the zone "HOT"
- Insert the oil dipstick again and tighten it by clockwise rotation

※ At the initial filling of the transmission has to be considered that the heat exchanger, the pressure filter as well as the pipes must get filled with oil.
According to these cavities, the oil capacity to be filled in is greater than at the later oil fillings in the course of the usual maintenance service.

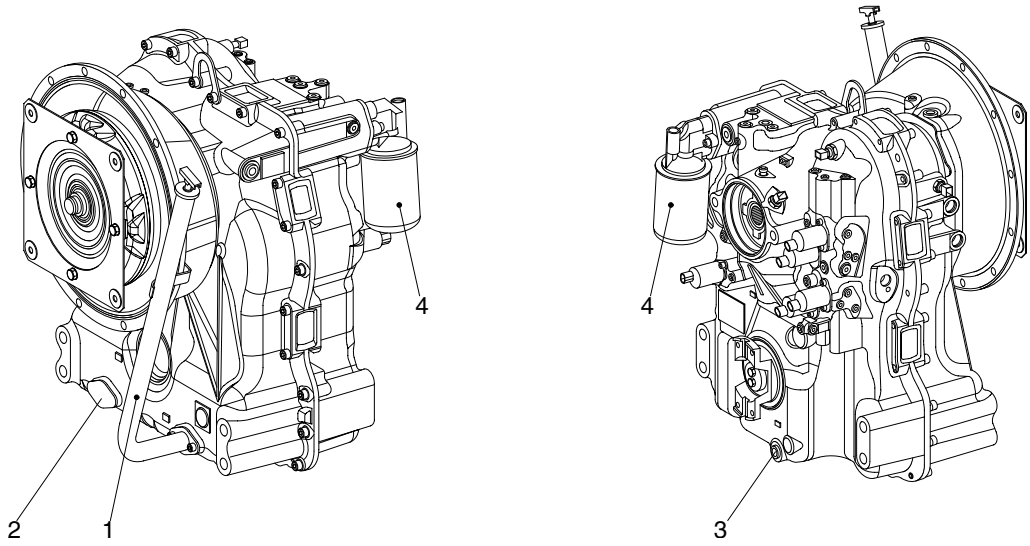
② Filter replacement

At the replacement of the filter in the main oil steam, pay attention that no dirt or oil sludge can penetrate into the circuit.

At the mounting of the filter, any exertion of force has to be avoided.

※ Treat the filter carefully at the installation, the transport and the storage.
Damaged filters must no more be installed.
The mounting of the filter must be carried out as follows:

- Cover the gasket with a small amount of oil.
- Screw the filter in until contact with the sealing surface is obtained and tighten it now by hand about 1/3 to 1/2 turn.



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Legend:

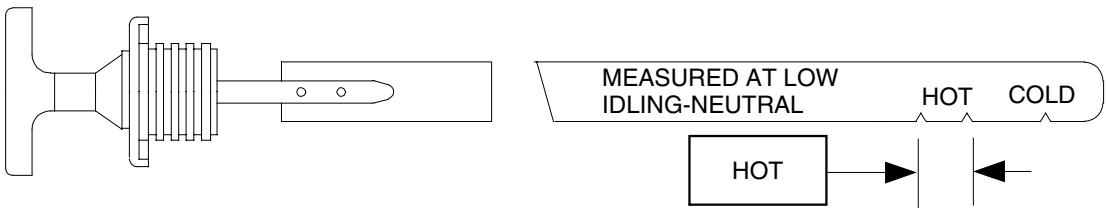
1 = Oil filler tube with oil dipstick

2 = Mounting provision for oil filler tube with oil dipstick (option)

3 = Oil drag plug 7/8" 14 UNF 2B

4 = Fine filter

Oil dipstick



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2) DRIVE AXLE

(1) General information

Drive axles generate small metal wear particles at a fairly steady rate, especially during the break-in period. If these fine, but hard particles are allowed to circulate in the lubricant, along with external moisture and dirt, internal components will wear at a much faster rate than normal.

(2) Magnets and magnetic drain plugs

Planetary axles are equipped with magnetic drain plug that have a minimum pick-up capacity of 0.57 kg (20 ounces) of low carbon steel. The drain plug must be checked for metal particles at every oil change interval.

※ Hyundai recommends replacing the magnetic drain plug each time the oil is changed.
Use the correct part. Pipe plugs will leak if used as a drain plug.
The magnetic drain plug can be reused if, after cleaning, the plug has a minimum pick-up capacity of 0.57 kg (20 ounces) of low carbon steel.

(3) Breather

⚠ Cover the breather when steam cleaning the housing. If the breather is not covered, water can enter the housing and contaminate the oil.

Breathers release pressure and vacuum condensation to minimize premature oil and component failure.

(4) Oil level

⚠ Check and adjust oil

⚠ To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

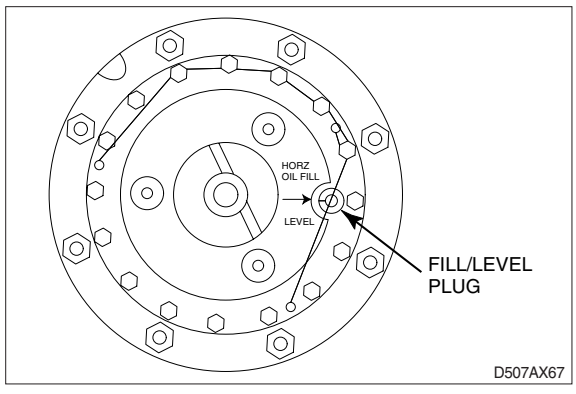
※ Fill and drain plugs are located in both brake housing and the main housing.

① Make sure the vehicle is on a level surface.

※ For axles with a common oil level that have drain and fill plugs only in the axle assembly, proceed to step ③.

② Rotate the wheels so that the "Oil level lines" on the wheel ends are parallel to the ground.

③ Clean the area around the fill/level plug.
Remove the fill/level plug from the wheel ends and the axle housing bowl. The oil level must be even with the bottom of the hole of the fill/level plug.



④ **If oil flows from the hole when you loosen the plug** : The oil level is high. Let the oil drain to the correct level.

※ Do not fill only through the axle housing bowl.

⑤ **If the oil level is below the bottom of the hole of the fill/level plug** : Fill the axle at each wheel end and the axle housing bowl to the bottom of the fill plug hole with the specified oil. Wait and allow the oil to flow through the axle.
Check the oil level again and fill to the specified level if necessary.

⑥ Install the fill/level plugs. Apply thread compound and tighten. Refer to the "Torque table".

(5) Oil change

⚠ Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.

① Make sure the vehicle is on a level surface.
Put large containers under the axle and wheel ends.

② Raise the vehicle so that the wheels are off the ground. Support the vehicle with safety stands.

③ Rotate the wheels so that the "fill/level" plugs in the wheel ends are toward the ground.

④ Remove the drain plugs from both brake housing and the main housing. Drain and discard the oil properly. Clean the plug.

⑤ Install the drain plugs in both brake housings and the main housing. Apply thread compound and tighten. Refer to the "torque table".

⑥ Rotate the wheels so that the " oil level lines" on the wheel ends are parallel to the ground.
Lower the vehicle.

⑦ Clean the area around the fill/level plug.
Remove the fill/level plug from the wheel ends and the axle housing bowl.

※ Do not fill only through the axle housing bowl.

⑧ Fill the axle at each wheel end and the axle housing bowl to the bottom of the fill plugs hole with the specified oil. Wait and allow the oil to flow through the axle. Check the oil level again and fill to the specified level if necessary.

⑨ Install the fill/level plugs. Apply thread compound and tighten. Refer to the "torque table".

(6) Oil change intervals and specifications

Off-highway operation intervals*				Oil specification	Remarks
Recommended initial oil change	Check oil level	Petroleum oil change	Synthetic oil change	Transmission oil	Initial use or refill
100 operating hours	250 operating hours*	1,000 operating hours or twice a year(whichever comes first)	-	Transmission oil	OK to use only for refill

* The checking interval depends on individual operating conditions, speeds and loads, severe operating conditions may require more frequent checks.

3. TROUBLESHOOTING

1) DRIVE AXLE

(1) BRAKE LEAKS ACTUATION FLUID

Condition	Possible cause	Correction
Internal leak : Fluid bypasses seals into axle and fills axle with fluid and blows out breather or empties brake fluid reservoir.	1. Worn or damaged piston seal. 2. Melted or extruded piston seals. 3. Corrosion, pitting, wear or other damage, marks, scratches to piston and/or brake housing bore in area of seal/sealing lips.	1. Replace piston seals. 2. Correct cause of overheating and replace seals. 3. Clean, smooth, rework or replace affected parts.
External leak	1. Loose bleeder screw. 2. Loose inlet fitting or plugs. 3. Damaged inlet fitting or plugs or damaged seats.	1. Tighten bleeder screw to 2.0~2.7 kgf · m (15~20 lb-ft) 2. Tighten inlet fitting to 3.4~4.8 kgf · m (25~35 lb-ft) 3. Replace inlet fitting or plug and O-ring if used.

(2) BRAKE NOISE AND VIBRATION

Condition	Possible cause	Correction
Brakes product noise, chatter, vibration.	Incorrect axle fluid and/or friction material used.	1. Use only approved materials. 2. Drain and flush fluid from axle. Replace with approved fluid. 3. Replace all friction discs. Thoroughly clean or replace stationary discs.

(3) BRAKE OVERHEATS

Condition	Possible cause	Correction
Overheating due to excessive duty cycle.	Inadequate coolant flow or heat exchange.	1. Install brake cooling system if not already installed on vehicle. 2. Re-analyze and re-size brake cooling system if necessary.
Inadequate coolant flow	Low pump output, blocked filter or coolant lines.	Check pump output at different operating modes. Replace filter and check lines.
Low or no coolant.	1. Improper fill or leaks. 2. Leaking face seal. 3. Loose or damaged plugs. 4. Deteriorated or inadequate sealant used at joint.	1. Check for proper fill level. 2. Replace or reinstall face seal assembly. 3. Tighten drain, fill or forced cooling plug. Replace if damaged. 4. Dissemble, clean, re-seal and re-assemble brake housing joint.
Brake drags.	1. More than 1.4 bar (20 psi) pressure applies when brakes released. 2. Damaged piston return spring assembly. 3. Piston not returning. 4. Wrong cooling and/or actuation fluid used. 5. Tight or damaged splines (eg. friction disc-to-hub driver).	1. Repair hydraulic system so pressure is less than 1.4 bar (20 psi) when brakes released and while machine is operating in any mode. 2. Repair or replace piston return spring assembly. 3. Check piston seals and seal separator. 4. Check piston seals and seal separator for swelling or damaged. Replace as necessary. Purge system and use correct fluid. 5. Repair or replace parts.

(4) BRAKE DOES NOT APPLY

Condition	Possible cause	Correction
Low or no pressure to brake	1. Empty fluid reservoir. 2. Damaged hydraulic system. 3. Leaked of brake actuation fluid. 4. Parking brake not adjusted properly.	1. Fill reservoir to correct level with specified fluid. 2. Repair hydraulic system. 3. Refer to "Brake leaks actuation fluid" in this section. 4. Adjust parking brake lever as described in assembly of this manual.

(5) BRAKE DOES NOT RELEASE

Condition	Possible cause	Correction
Vehicle does not move	Damaged hydraulic system.	Repair hydraulic system.
Brakes dragging	1. More than 1.4 bar (20 psi) pressure applied when brakes released.	1. Repair hydraulic system so pressure is less than 1.4 bar (20 psi) when brakes released and while machine is operating in any mode.
	2. Damaged piston return spring assembly.	2. Repair or replace piston return spring assembly.
	3. Piston not returning.	3. Check piston seals for swelling or damage. Replace as necessary.
	4. Wrong cooling and/or actuation fluid used.	4. Check piston seals for swelling or damage. Purge system and use specified fluid.
	5. Parking brake not adjusted properly.	5. Adjust parking brake lever as described in assembly of this manual.

(6) BRAKING PERFORMANCE

Condition	Possible cause	Correction
Noticeable change or decrease in stopping performance.	1. Inadequate actuation fluid supply to brakes.	1. Replenish fluid in brake system. Check for leakage and correct cause.
	2. Inadequate pressure to apply brakes.	2. Check brakes apply system. Check for leakage in brake system or brakes, and correct cause.
	3. Worn or damaged discs.	3. Inspect and replace discs if necessary. ※ As disc wear occurs, make sure brake system can supply adequate fluid to fully apply brakes.
	4. Overheated seals and/or discs.	4. Inspect and replace discs and seals if necessary.
	5. Dirty or contaminated cooling fluid.	5. Drain and flush cooling fluid from brakes and entire brake system. Replace with approved fluid. In some cases, it may necessary to replace discs. Clean or replace filter.
Brake does not fully apply.	1. Empty fluid reservoir.	1. Fill reservoir to correct level with specified fluid.
	2. Damaged hydraulic system.	2. Repair hydraulic system.
	3. Leakage of brake actuation fluid.	3. Refer to "Brake leaks actuation fluid" in this section.
Brakes fell spongy/soft.	Brakes or brake system not properly bled.	Bleed brakes and brake system.

(7) DIFFERENTIAL

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

2) TRANSMISSION

(1) GENERAL INSPECTION WHILE DRIVING

No	Problem	Cause
1	Failure at the specific gear stage	1. Low oil pressure or no pressure. 1) No oil, low level or high oil viscosity. 2) Loose inching control valve connection, incorrect adjustment or damage. 3) Inching valve spool sticked or open. 4) Oil pump damage or defect. 5) T/C pump gear side bolt breakage or gear not meshing with pump. 6) Main regulator valve sticked or open. 7) Oil circuit clogged or strainer contaminated. 8) T/M inside leakage. Control valve gasket damage. - Clutch shaft metal sealing wear or damage. - Clutch piston seal damage or wear. 9) Control valve gasket wear cause oil leakage. 2. Abnormal connection of outer line of cooler. 3. Mechanical defect inside the T/M
2	Gear shift failure	1. Low oil pressure. 2. Main regulator valve does not move. 3. Malfunctioning of solenoid or relative electric components.
3	T/M overheating	1. Clogged cooling line. 2. Oil level is too high or too low. 3. Low pump pressure, pump wear or defect. 4. Partial clutch wear or slip 5. Air mixed with oil, air leakage at the pump input port. 6. Insufficient oil flow through the T/C. 7. Overload on the machine. 8. Too excessive inching operation. 9. Too excessive stall operation of T/C. 10. Cooler bypass valve stick or open. Oil flow insufficient through oil cooler.

No	Problem	Cause
4	Slow clutch meshing or failure	1. Low oil pressure. 2. Low converter oil pressure. 3. Air mixed with oil 1) Air mixed through the pump input port. 2) Low oil level 4. Abnormal adjustment of inching valve linkage.
5	Reverse gear shift failure	1. Excessive wear of disk and plate at reverse clutch. 2. Oil leakage from seal. 3. Reverse clutch components defect. 1) Metal sealing wear or defect. 2) Clutch piston seal wear or defect. 3) Another components damaged. 4. Malfunction of solenoid or related electric parts.
6	Forward gear shift failure	1. Excessive wear of disk and plate at forward clutch. 2. Oil leakage from seal. 3. Forward clutch components defect. 1) Metal sealing wear or defect. 2) Clutch piston seal wear or defect. 3) Another components damaged. 4. Malfunction of solenoid or related electric parts.
7	Low stall speed	1. Incorrect engine performance. 2. Torque converter stator failure.
8	High stall speed at all of gear stage	1. Low oil level. 2. Air mixed with oil. 3. Clutch slip. 4. T/C malfunctioning.
9	High stall speed at partial direction or speed	1. Clutch line leakage. 2. Clutch defect.
10	Slow clutch meshing and rough gear shift	1. Incorrect adjustment of inching valve. 2. Inching valve not closed or clogged orifice. 3. Low main pressure. 4. Low pressure of direction clutch. 5. Oil leakage. 6. Valve spool spring weakened or damaged.
11	Abnormal movement to the specified direction at neutral	1. Clutch defect, clutch disk and plate damaged. 2. Valve spool defect or spool sticked.

(2) ABNORMAL NOISE CHECK LIST

No	Problem	Cause
1	Noise only at neutral	1. Gear or bearing wear inside the pump. 2. Torque converter stator wear. 3. Low oil level. 4. Gear parts of engine and T/M pump's misalignment with that of converter housing and pump.
2	Pump noise	1. Loud noise irregularly repeats if there's contaminants in the T/M hydraulic components. 2. Regular noise means pump defect.
3	T/M noise	1. Converter housing and pump gear misalignment with engine or T/M 2. T/M components wear or damage. 1) Gear damage. 2) Clutch plate and disk slip noise. 3) Thrust washer defect. 4) Another components wear or damage.
4	Control valve noise	1. Air mixed into hydraulic system. 1) Air leakage from the pump input port. 2. Clogged oil passage. 3. Abnormal spool movement.

(3) PRESSURE TEST CHECK LIST

No	Problem	Cause
1	FR/RR clutch low pressure	Incorrect adjustment of inching valve linkage
		Inching spool sticked and open.
		Clutch and piston oil leakage.
		Regulator spring defect.
		Low oil pressure.
		Incorrect connection of cooler external line.
2	High clutch and main pressure	Pressure regulation valve does not move smoothly.
		Clogged hydraulic line.
3	Low clutch pressure	Oil leakage due to incorrect assembly of clutch piston seal.
		Damage or wear of clutch piston seal and shaft seal.
		Valve contact surface not flat or gasket damage.
4	Low main pressure	Low oil quantity
		Pressure regulation valve does not move smoothly.
		Pump wear
		Internal leakage
		Low oil pressure
5	High converter pressure	Main regulation valve sticked and open, oil overflow to converter.
		Clogged internal passage of converter assembly.
		Clogged oil line.
6	Low converter pressure	Clogged main regulator valve.
7	Low converter output pressure, cooler input pressure.	Low oil pressure
		Cooler bypass valve sticked and open.
8	High converter output pressure, cooler input pressure	Clogged or restricted cooler line.

(4) Transmission fault codes

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
11	**Logical error at gear range signal** TCU detected a wrong signal combination for the gear range · Cable from shift lever to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral OP-mode : Transmission shutdown	· Check the cables from TCU to shift lever · Check signal combinations of shift lever positions for gear range ※ Failure cannot be detected in systems with DW2/DW3 shift lever. Fault is taken back if TCU detects a valid signal for the position
12	**Logical error at direction select signal** TCU detected a wrong signal combination for the direction · Cable from shift lever to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral OP-Mode : Transmission shutdown	· Check the cables from TCU to shift lever · Check signal combinations of shift lever positions F-N-R ※ Fault is taken back if TCU detects a valid signal for the direction at the shift leve
25	**S.C. to battery voltage or O.C. at transmission sump temperature sensor input** The measured voltage is too high: · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Temperature sensor has an internal defect · Connector pin is contacted to battery voltage or is broken	No reaction, TCU use default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor
26	**S.C. to ground at transmission sump temperature sensor input** The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Temperature sensor has an internal defect · Connector pin is contacted to vehicle ground	No reaction, TCU uses default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor
27	**S.C. to battery voltage or O.C. at retarder/torque converter temperature sensor input** The measured voltage is too high: · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Temperature sensor has an internal defect · Connector pin is contacted to battery voltage or is broken	No reaction, TCU uses default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
28	**S.C. to ground at retarder/torque converter temperature sensor input** The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Temperature sensor has an internal defect · Connector pin is contacted to vehicle ground	No reaction, TCU uses default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor
2B	**Inch sensor-signal mismatch the measured voltage from CCO and CCO2 signal don't match :** · Cable is defective · Sensor has an internal defect	During inching mode : TCU shifts to neutral While not inching : no change OP-Mode : normal	· Check the cable from TCU to the sensor · Check the connectors · Check the sensor
31	**S.C. to battery voltage or O.C. at engine speed input** TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
32	**S.C. to ground at engine speed input** TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
33	**Logical error at engine speed input** TCU measures a engine speed over a threshold and the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU
34	**S.C. to battery voltage or O.C. at turbine speed input** TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to vehicle battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
35	**S.C. to ground at turbine speed input** TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor ※ This fault is reset after power up of TC
36	**Logical error at turbine speed input** TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap
37	**S.C. to battery voltage or O.C. at internal speed input** TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to vehicle battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
38	**S.C. to ground at internal speed input** TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
39	**Logical error at internal speed input** TCU measures a internal speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU
3A	**S.C. to battery voltage or O.C. at output speed input** TCU measures a voltage higher than 12.5V at speed input pin · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
3B	**S.C. to ground at output speed input** TCU measures a voltage less than 1.00V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
3C	**Logical error at output speed input** TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU
3E	**Output speed zero doesn't fit to other speed signals** If transmission is not neutral and the shifting has finished, TCU measures output speed zero and turbine speed or internal speed not equal to zero. · Speed sensor has an internal defect · Sensor gap has the wrong size	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	· Check the sensor signal of output speed sensor · Check the sensor gap of output speed sensor · Check the cable from TCU to the sensor ※ This fault is reset after power up of TCU
54	**Vehicle1 timeout** Time of CAN-message Vehicle1 from display computer · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage	TCU shifts to neutral NN(because of shifting lever)	· Check vehicle controller · Check wire of CAN-Bus · Check cable to vehicle controller
57	**EEC1 timeout** Timeout of CAN-message EEC1 from EEC controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage	OP mode : Substitute clutch control	· Check EEC controller · Check wire of CAN-Bus · Check cable to EEC controller
71	**S.C. to battery voltage at clutch KC** The measured resistance value of the valve is out of limit, the voltage at KC valve is too high · Cable/connector is defective and has contact to battery voltage · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from TCU to the gearbox · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
72	**S.C. to ground at clutch KC** The measured resistance value of the valve is out of limit, the voltage at KC valve is too low · Cable/connector is defective and has contact to vehicle ground · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
73	**O.C. at clutch KC** The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
74	**S.C. to battery voltage at clutch KD** The measured resistance value of the valve is out of limit, the voltage at KD valve is too high · Cable/connector is defective and has contact to battery voltage · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
75	**S.C. to ground at clutch KD** The measured resistance value of the valve is out of limit, the voltage at KD valve is too low · Cable/connector is defective and has contact to vehicle ground · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
76	**O.C. at clutch KD** The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
77	**S.C. to battery voltage at clutch KE** The measured resistance value of the valve is out of limit, the voltage at KE valve is too high · Cable/connector is defective and has contact to battery voltage · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
78	**S.C. to ground at clutch KE** The measured resistance value of the valve is out of limit, the voltage at KE valve is too low · Cable/connector is defective and has contact to vehicle ground · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
79	**O.C. at clutch KE** The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
84	**S.C. to battery voltage at clutch KV** The measured resistance value of the valve is out of limit, the voltage at KV valve is too high · Cable/connector is defective and has contact to battery voltage · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
85	**S.C. to ground at clutch KV** The measured resistance value of the valve is out of limit, the voltage at KV valve is too low · Cable/connector is defective and has contact to vehicle ground · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
86	**O.C. at clutch KV** The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
87	**S.C. to battery voltage at clutch KR** The measured resistance value of the valve is out of limit, the voltage at KR valve is too high · Cable/connector is defective and has contact to battery voltage · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
88	**S.C. to ground at clutch KR** The measured resistance value of the valve is out of limit, the voltage at KR valve is too low · Cable/connector is defective and has contact to vehicle ground · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
89	**O.C. at clutch KR** The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-56
B1	**Slippage at clutch KC** TCU calculates a differential speed at closed clutch KC. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KC · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch KC · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at output speed sensor · Check signal at internal speed sensor · Check signal at output speed sensor Replace clutch ·
B2	**Slippage at clutch KD** TCU calculates a differential speed at closed clutch KD. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KD · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch KD · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at output speed sensor · Check signal at internal speed sensor · Check signal at output speed sensor Replace clutc ·
B3	**Slippage at clutch KE / KB** TCU calculates a differential speed at closed clutch KE / KB. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KE / KB · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch KE · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at output speed sensor · Check signal at internal speed sensor · Check signal at output speed sensor Replace clutch ·

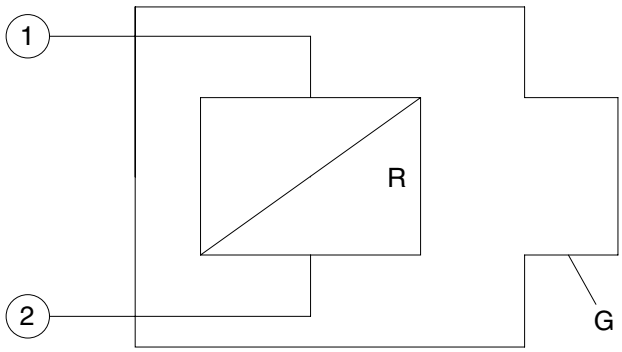
Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
B5	**Slippage at clutch KV** TCU calculates a differential speed at closed clutch KV. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KV · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch KV · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at turbine speed sensor · Check signal at internal speed sensor · Check signal at turbine speed sensor · Replace clutch
B6	**Slippage at clutch KR** TCU calculates a differential speed at closed clutch KR. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KR · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch KR · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at turbine speed sensor · Check signal at internal speed sensor · Check signal at turbine speed sensor · Replace clutch
B7	**Overtemp sump** TCU measured a temperature in the oil sump that is over the allowed threshold.	No reaction OP mode : Normal	· Cool down machine · Check oil level · Check temperature sensor
B8	**Overtemp converter** TCU measured a temperature in the retarder oil that is over the allowed threshold	No reaction OP mode : Normal	· Cool down machine · Check oil level · Check temperature sensor
B9	**Overspend engine**	Retarder applies OP mode : Normal	
BC	**Overtemp converter** TCU measured a transmission output speed above the define threshold	No reaction OP mode : Normal	
C0	**Engine torque or engine power overload** TCU calculates an engine torque or engine power above the defined thresholds	OP mode : Normal	
C1	**Transmission output torque overload** TCU calculates an transmission output torque above the defined threshold	OP mode : Normal	

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
C2	**Transmission input torque overload** TCU calculates an transmission output torque above the defined threshold	programmable : No reaction or shift to neutral OP mode : Normal	
C3	**Overtemp converter output** TCU measured a oil temperature at the converter output that is the allowed threshold	No reaction OP mode : Normal	· Cool down machine · Check oil level · Check temperature sensor
D1	**S.C. to battery voltage at power supply for sensors** TCU measures more than 6V at the pin AU1 (5V sensor supply)	See fault codes No.21 to 2C	· Check cables and connectors to sensors, which are supplied from AU1 · Check the power supply at the pin AU1(Should be appx. 5V) · Fault codes No.21 to No.2C may be reaction of this fault
D2	**S.C. to ground at power supply for sensors** TCU measures less than 4V at the pin AU1 (5V sensor supply)	See fault codes No.21 to 2C	· Check cables and connectors to sensors, which are supplied from AU1 · Check the power supply at the pin AU1(Should be appx. 5V) · Fault codes No.21 to No.2C may be reaction of this fault
D3	**Low voltage at battery** Measured voltage at power supply is lower than 18V(24V device)	Shift to neutral OP mode : TCU shutdown	· Check power supply battery · Check cables from batteries to TCU · Check connectors from batteries to TCU
D4	**High voltage at battery** Measured voltage at power supply is higher than 32.5V(24V device)	Shift to neutral OP mode : TCU shutdown	· Check power supply battery · Check cables from batteries to TCU · Check connectors from batteries to TCU
D5	**Error at valve power supply VPS1** TCU switched on VPS1 and measured VPS1 is off or TCU switched off VPS1 and measured VPS1 is still on · Cable or connectors are defect and are contacted to battery voltage · Cable or connectors are defect and are contacted to vehicle ground · Permanent power supply KL30 missing · TCU has an internal defect	Shift to neutral OP mode : TCU shutdown	· Check fuse · Check cables from gearbox to TCU · Check connectors from gearbox to TCU · Replace TCU
D6	**Error at valve power supply VPS2** TCU switched on VPS2 and measured VPS2 is off or TCU switched off VPS2 and measured VPS2 is still on · Cable or connectors are defect and are contacted to battery voltage · Cable or connectors are defect and are contacted to vehicle ground · Permanent power supply KL30 missing · TCU has an internal defect	Shift to neutral OP mode : TCU shutdown	· Check fuse · Check cables from gearbox to TCU · Check connectors from gearbox to TCU · Replace TCU

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
E3	**S.C. to battery voltage at display output** TCU sends data to the display and measures always a high voltage level on the connector · Cable or connectors are defective and are contacted to battery voltage · Display has an internal defect	No reaction OP mode : Normal	· Check the cable from TCU to the display · Check the connectors at the display · Change display
E4	**S.C. to ground at display output** TCU sends data to the display and measures always a high voltage level on the connector · Cable or connectors are defective and are contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the display · Check the connectors at the display · Change display
F1	**General EEPROM fault** TCU can't read non volatile memory · TCU is defective	No reaction OP mode : Normal	· Replace TCU ※ Often shown together with fault code F2
F2	**Configuration lost** TCU has lost the correct configuration and can't control the transmission · Interference during saving data on non volatile memory · TCU is brand new or from another vehicle	Transmission stay neutral OP mode : TCU shutdown	· Reprogram the correct configurat-ion for the vehicle (e.g. with cluster controller,...)
F3	**Application error** Something of this application is wrong	Transmission stay neutral OP mode : TCU shutdown	· Replace TCU ※ This fault occurs only if an test engineer did something wrong in the application of the vehicle
F5	**Clutch failure** AEB was not able to adjust clutch filling parameters · One of the AEB-Values is out of limit	Transmission stay neutral OP mode : TCU shutdown	· Check clutch ※ TCU shows also the affected clutch on the display
F6	**Clutch adjustment data lost or Inch pedal calibration data lost** TCU was not able to read correct clutch adjustment parameters · Interference during saving data on non volatile memory · TCU is brand new	No reaction, Default values : 0 for AEB Offsets used OP mode : Normal	· Execute AEB

(5) Measuring of resistance at actuator/sensor and cable

① Actuator



76043PT19

Open circuit $R_{12} = R_{1G} = R_{2G} = \infty$

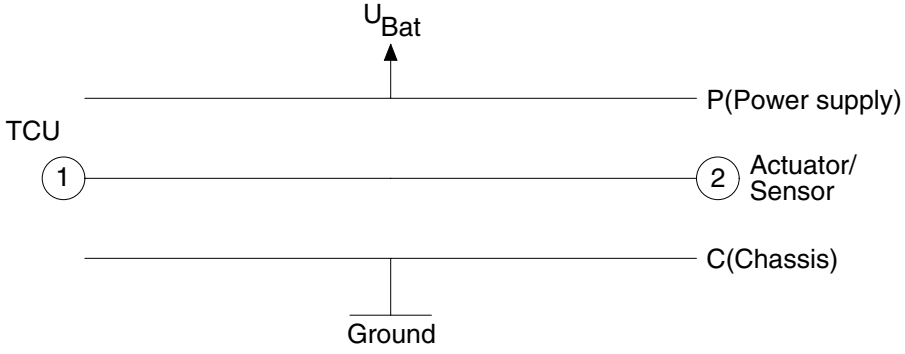
Short cut to ground $R_{12} = R$; $R_{1G} = 0$, $R_{2G} = R$ or $R_{1G} = R$, $R_{2G} = 0$

(For S.C. to ground, G is connected to vehicle ground)

Short cut to battery $R_{12} = R$; $R_{1G} = 0$, $R_{2G} = R$ or $R_{1G} = R$, $R_{2G} = 0$

(For S.C. to battery, G is connected to battery voltage)

② Cable



76043PT20

Open circuit $R_{12} = R_{1P} = R_{1C} = R_{2P} = R_{2C} = \infty$

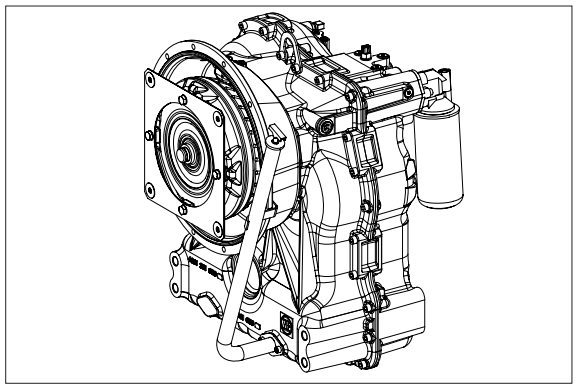
Short cut to ground $R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = \infty$

Short cut to battery $R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = 0$

1. TRANSMISSION DISASSEMBLY

1) DISASSEMBLY

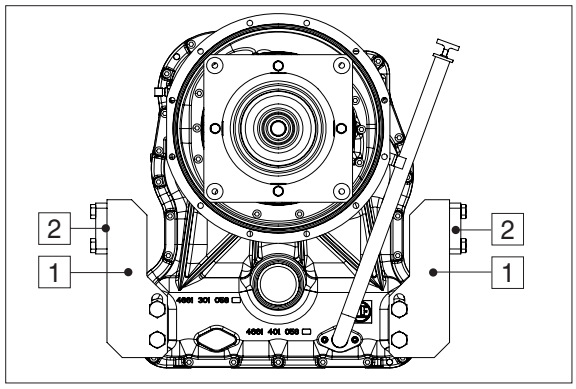
Transmission 3 WG-94 EC



50DS7ETM11

① Attach transmission to the assembly truck by means of clamping angles (1) and holding fixtures (2).

(S) Assembly truck	5870 350 000
(S) Holding fixtures	5870 350 063
(S) Clamping angles	5870 350 124



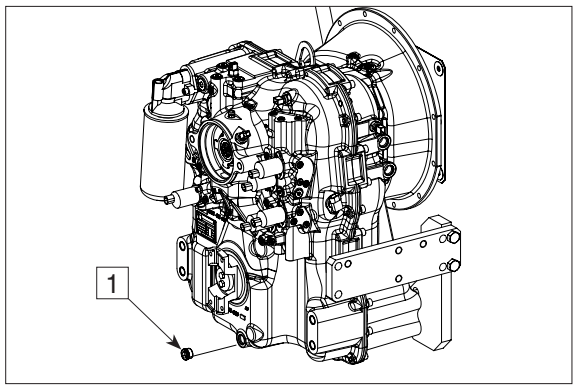
50DS7ETM12

(1) Removal of the filter

※ Drain oil prior to starting disassembly.

① Remove screw plug (1).

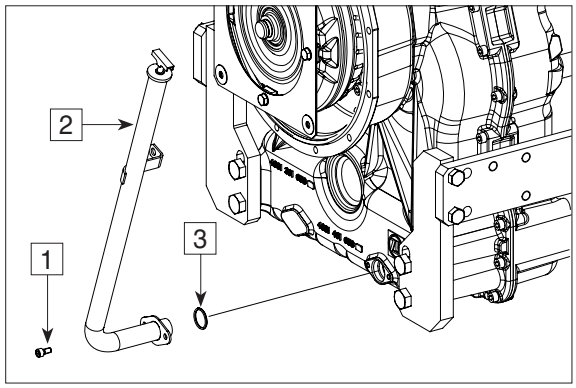
⚠ Disposal of oil according to legal requirements.



50DS7ETM13

② Loosen the cylindrical screws (1) and remove the oil filler tube with the oil dipstick (2).

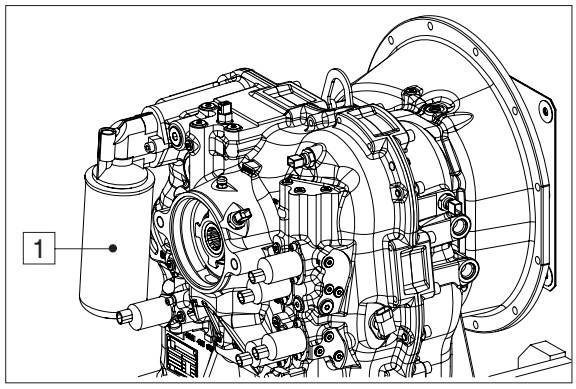
※ Remove the O-ring (3) from the oil filler tube.



50DS7ETM14

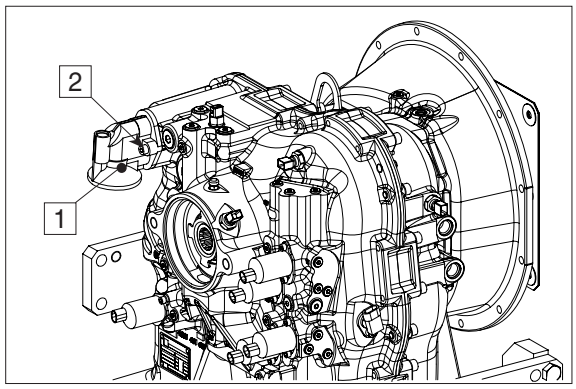
③ Separate the fine filter (1) from the filter head by means of belt wrench.

(S) Belt wrench 5870 105 005



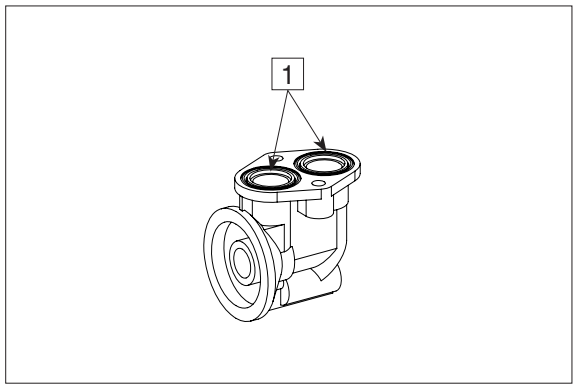
50DS7ETM15

④ Loosen the cylindrical screws (2) and separate the filter head (1) from the transmission housing.



50DS7ETM16

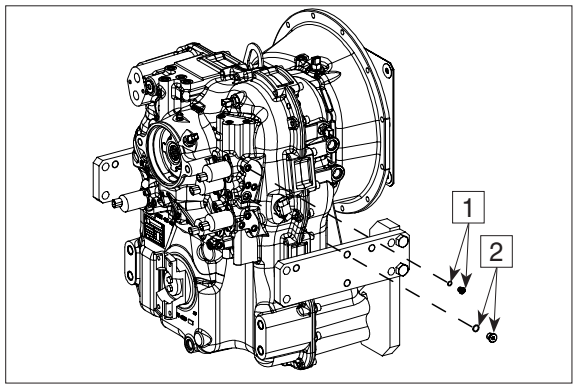
⑤ Remove both O-rings (1) out of the annular groove of the filter head.



50DS7ETM17

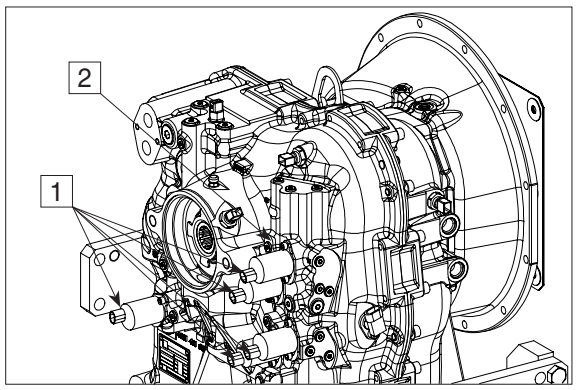
2) DISASSEMBLY PRESSURE CONTROLLER (PROPORTIONAL VALVES), INDUCTIVE SENSOR, SPEED SENSOR (HALL SENSOR), TEMPERATURE SENSOR, BREATHER AND SCREW PLUGS

① Remove all screw plugs with O-ring (1 and 2).



50DS7ETM18

② Loosen cylindrical screws (1) and remove pressure controller (proportional valves, 2).

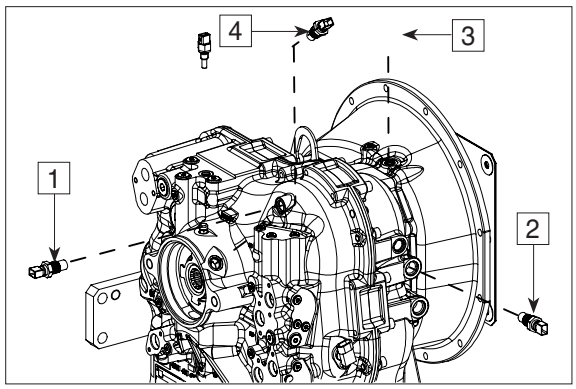


50DS7ETM19

③ Remove positioned parts.

1 = Inductive sensor-n turbine
2 = Inductive sensor-n central gear chain
3 = Temperature sensor, measuring point "63" after converter
4 = Inductive sensor

※ Remove O-rings.

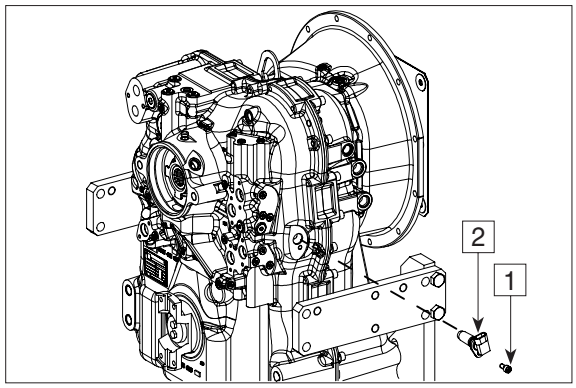


50DS7ETM20

④ Loosen cylindrical screw (1) and remove speed sensor (2).

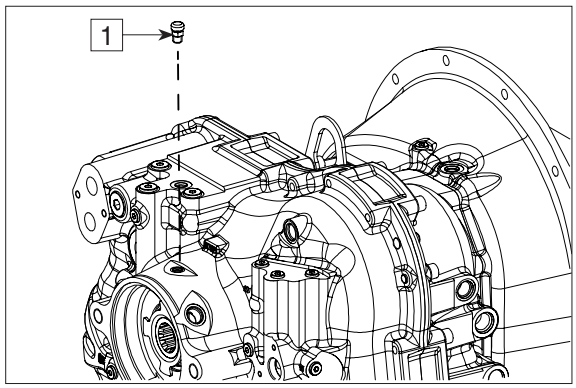
2 = Speed sensor-n output (Hall sensor)

※ Remove O-rings.



50DS7ETM21

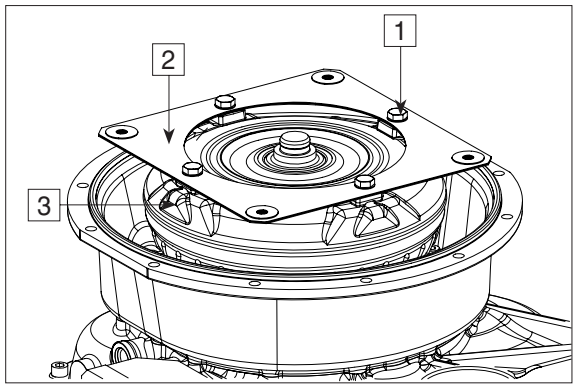
⑤ Remove breather (1).



50DS7ETM22

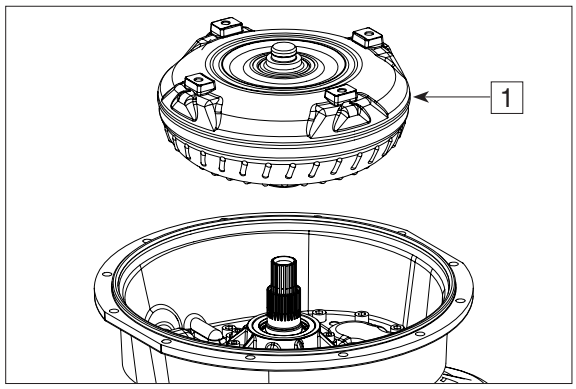
3) DISASSEMBLY CONVERTER AND CENTRAL SHAFT (PTO SHAFT)

① Loosen cylindrical screws (1) and separate the flexplate (2) from the converter (3).



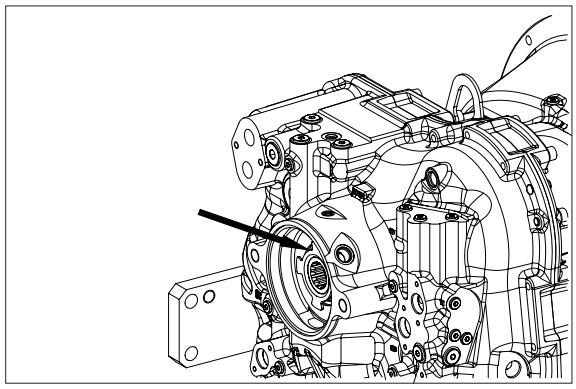
50DS7ETM23

② Pull off converter (1) by hand.



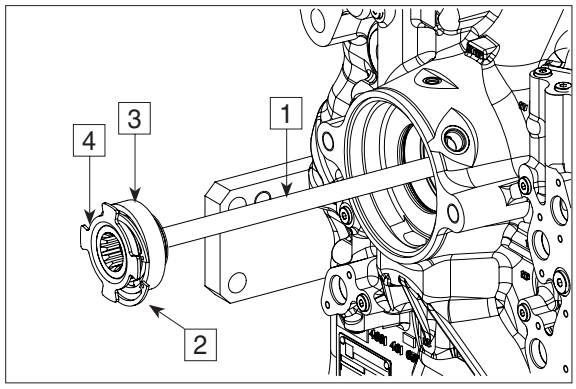
50DS7ETM24

③ Disengage the retaining ring (see arrow).


50DS7ETM25

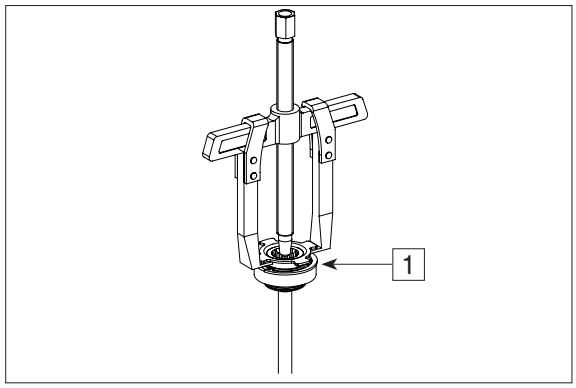
④ Pull the central shaft assy out of the housing hole.

1 = Central shaft
2 = Retaining ring
3 = Ball bearing
4 = Toothed disk



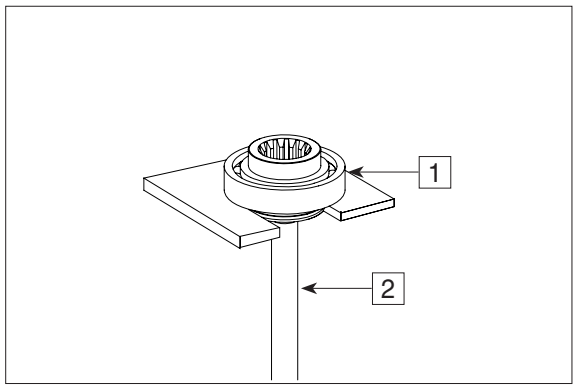
50DS7ETM26

⑤ Pull the toothed disk (1) from the central shaft.



50DS7ETM27

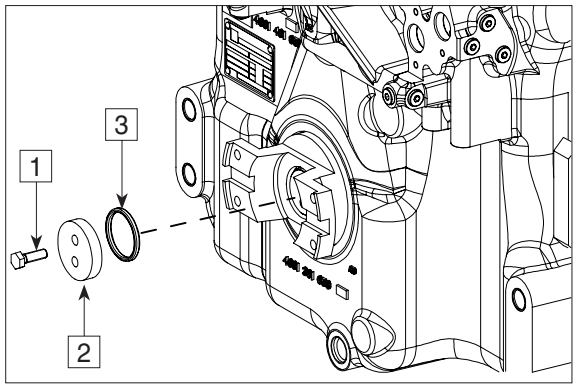
⑥ Press the ball bearing (1) from the central shaft (2).



50DS7ETM28

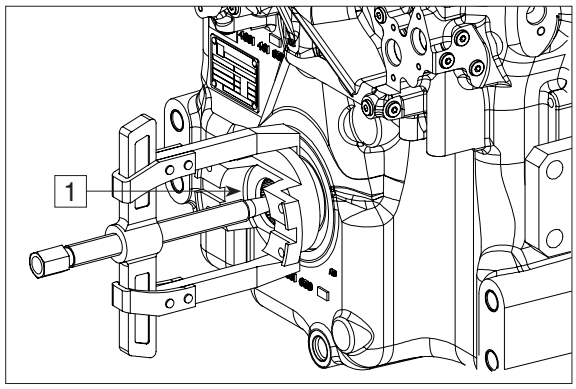
4) DISASSEMBLY OF OUTPUT FLANGE

① Loosen the hexagon screws (1) and remove disk and O-ring (2 and 3).



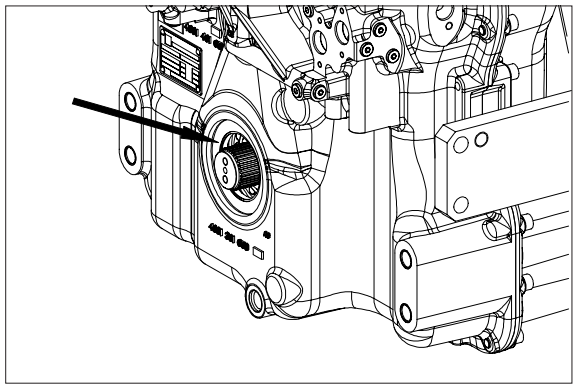
50DS7ETM29

② Pull output flange (1) off the output shaft by means of two-armed puller.



50DS7ETM30

③ Remove shaft seal (see arrow) from the housing hole by means of assembly lever.



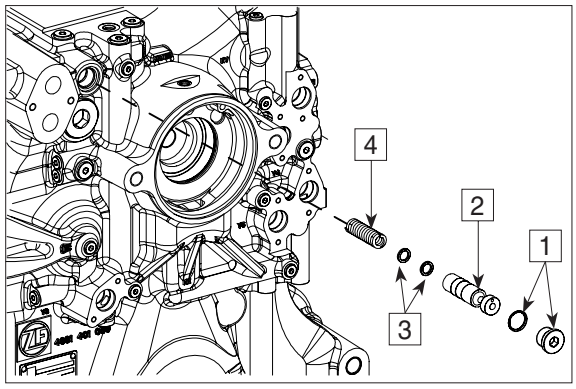
50DS7ETM31

5) DISASSEMBLY OF MAIN PRESSURE VALVE AND CONVERTER SAFETY VALVE

① Loosen screw plug (1) and remove main pressure valve (control pressure valve):

Main pressure valve consists of:

1 = Screw plug with O-ring
2 = Piston
3 = Spacer rings
4 = Compression spring

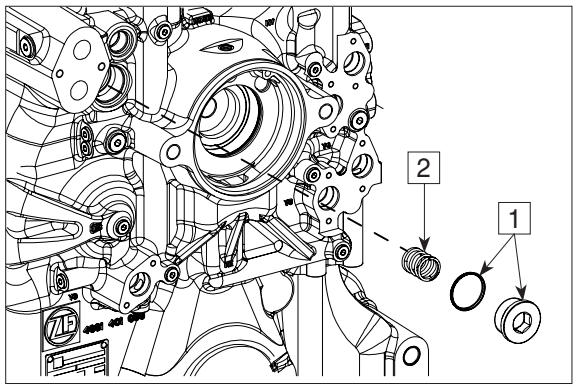


50DS7ETM32

② Loosen screw plug (1) and remove converter safety valve.

Converter safety valve consists of :

1 = Screw plug with O-ring
2 = Pressure valves
- = Valve assy is installed in the housing-not visible-(functional check of valve see below ③).

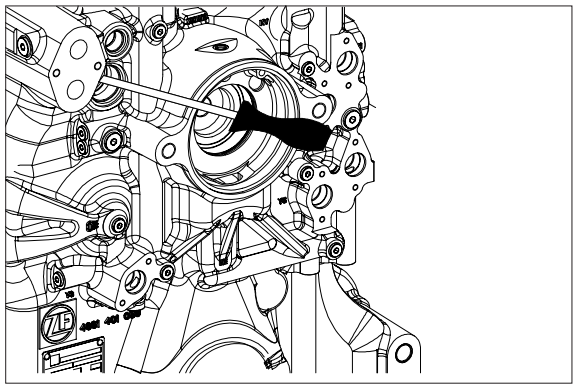


50DS7ETM33

③ **Functional check of valve.**

※ Use a screwdriver to check the movability of the ball in the valve.

If the valve is o.k., it does not need to be removed.

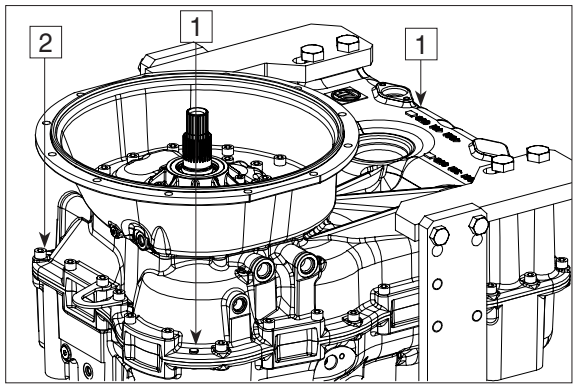

50DS7ETM34

6) REMOVAL OF CLUTCHES AND DISASSEMBLY OF OIL PRESSURE PUMP

① Force out cylindrical pins (1).

② Loosen bolted connection (2) of housing front and rear part.

⚠ Make sure to leave 2 cylindrical screws crosswise in the bolted connection (2). Transmission rear part is not fixed to the clamping angle and could get loose when turning.

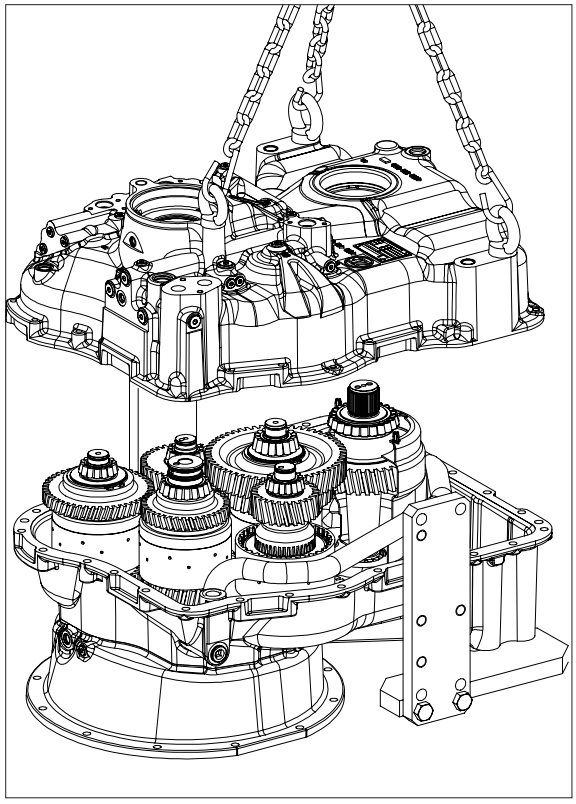


50DS7ETM35

③ Rotate transmission housing 180°, loosen the last 2 cylindrical screws from the bolted connection housing front and rear part and separate housing rear part by means of lifting device.

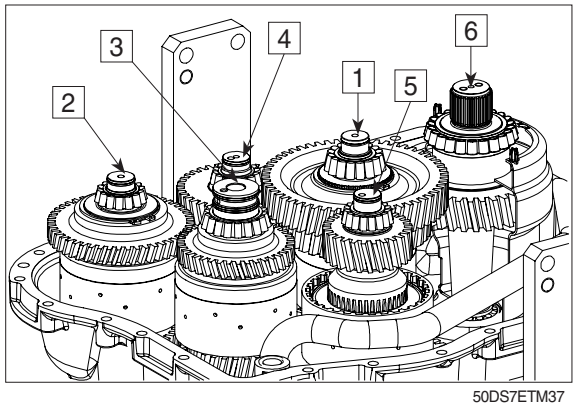
※ Support by means of assembly lever.

(S) Assembly lever 5870 345 036


50DS7ETM36

④ Lift the clutches out of the housing in the following sequence:

1 = Clutch KE (Clutch-3rd gear)
2 = Clutch KV (Clutch-forward)
3 = Clutch KR (Clutch-reverse and input)
4 = Clutch KD (Clutch-2nd gear)
5 = Clutch KC (Clutch-1st gear)
6 = Output with screen sheet

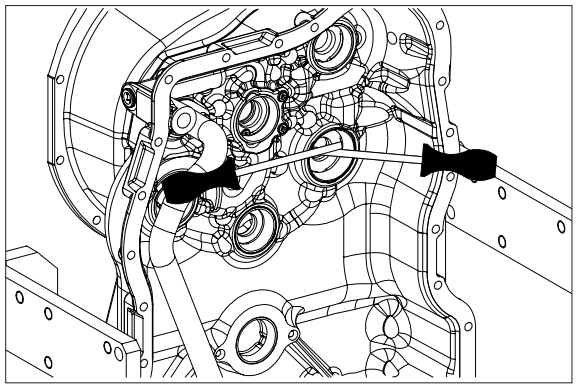


50DS7ETM37

⑤ Use assembly lever to remove all bearing outer rings from the housing front part.

※ If, contrary to the ZF recommendation, the tapered roller bearings of clutches and output are not replaced, it is imperative to ensure the previous pairing (bearing outer ring/bearing inner ring).

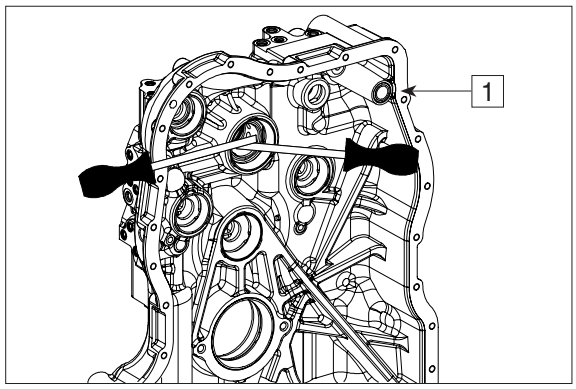
※ Bearing outer ring and bearing inner ring must be marked.


50DS7ETM38

⑥ Use assembly lever to remove all bearing outer rings from the housing rear part.

※ If, contrary to the ZF recommendation, the tapered roller bearings of clutches and output are not replaced, it is imperative to ensure the previous pairing (bearing outer ring/bearing inner ring).

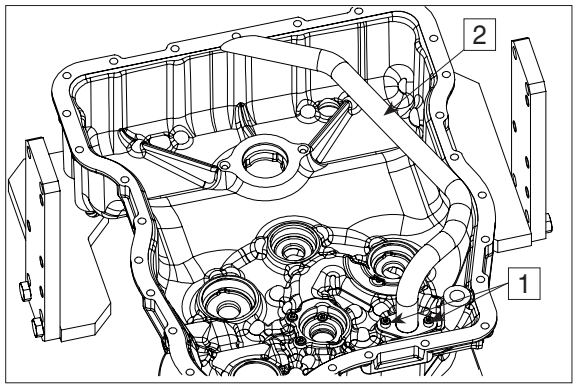
※ Bearing outer ring and bearing inner ring must be marked.



50DS7ETM39

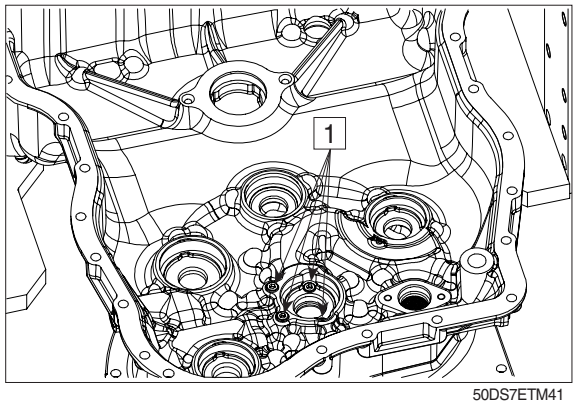
⑦ Remove O-ring (1).

⑧ Loosen cylindrical screws (1) and remove suction tube (2).



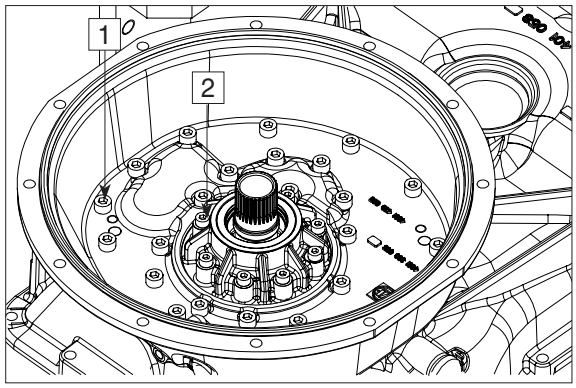
50DS7ETM40

⑨ Loosen cylindrical screws (1).



50DS7ETM41

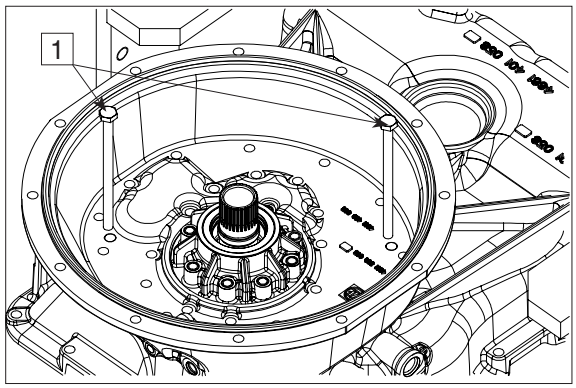
⑩ Loosen bolted connection between converter bellhousing/transmission housing (1) and pressure oil pump/ transmission housing (2).



50DS7ETM42

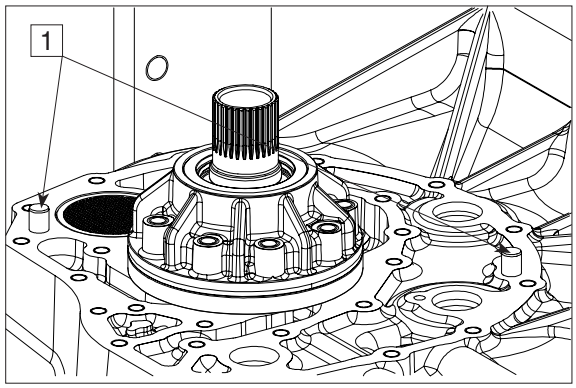
⑪ Press converter bellhousing off the housing equally by means of hexagon screws M10 (1).

※ Difficult disassembly due to fixing by cylindrical pins.



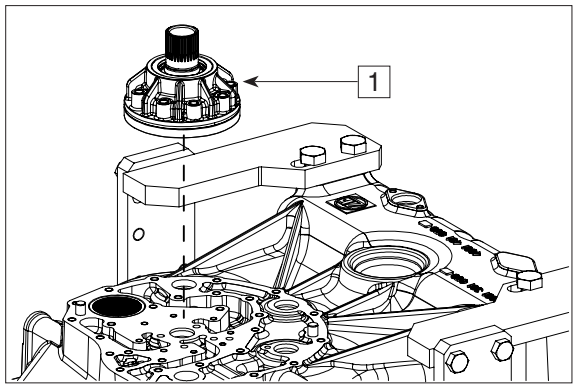
50DS7ETM43

⑫ If required, remove both cylindrical pins (1).



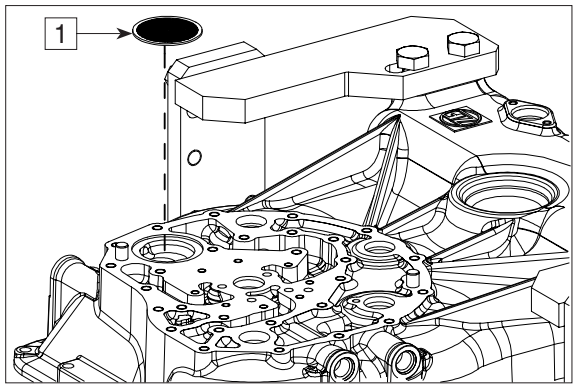
50DS7ETM44

⑬ Remove oil pressure pump (1).



50DS7ETM45

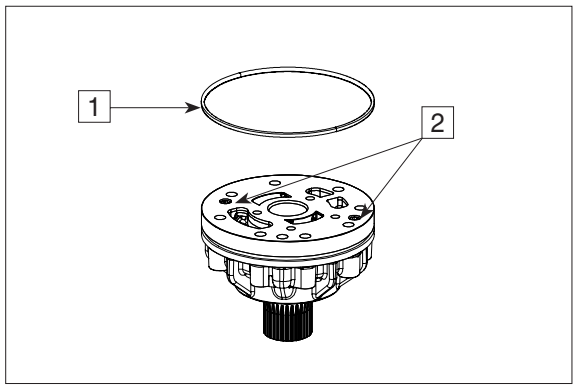
⑭ Remove filter (1).



50DS7ETM46

⑮ Remove O-ring (1).

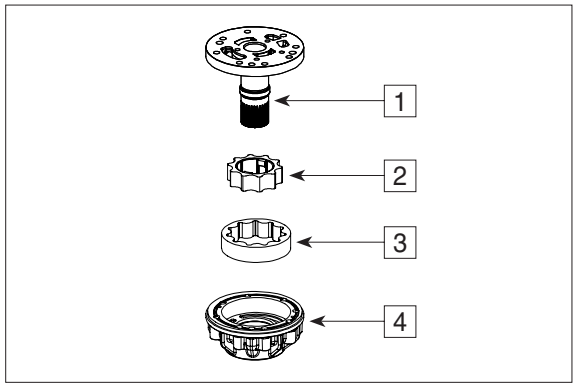
⑯ Loosen cylindrical screws (2).



50DS7ETM47

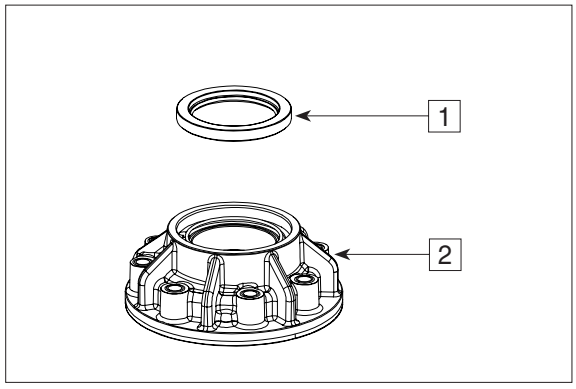
※ Check oil pressure pump :
In case of wear marks in the pump housing, stator hollow shaft or on the inner and outer rotor, the complete oil pressure pump is to be replaced.

1 = Stator hollow shaft
2 = Inner rotor
3 = Outer rotor
4 = Pump housing



50DS7ETM48

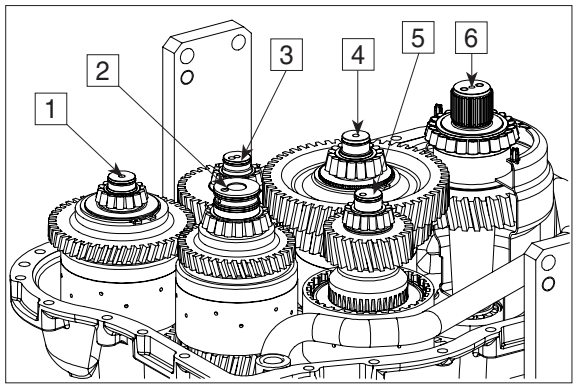
⑰ Remove shaft seal (1) from the pump housing (2).



50DS7ETM49

7) DISASSEMBLY CLUTCHES :

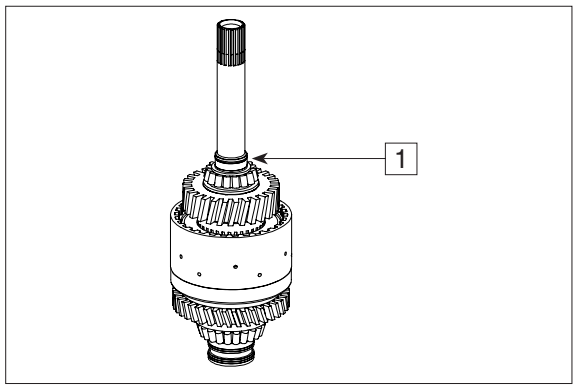
1 = Clutch KV(Clutch-forward)
2 = Clutch KR(Clutch-reverse and input)
3 = Clutch KD(Clutch-2nd gear)
4 = Clutch KE(Clutch-3rd gear)
5 = Clutch KC(Clutch-1st gear)
6 = Output



50DS7ETM50

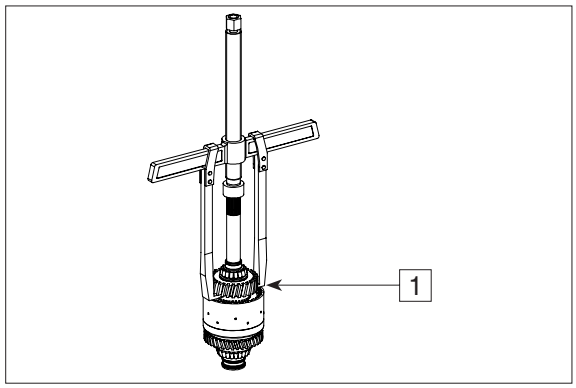
(1) Clutch KR/input

① Disengage rectangular ring (1).



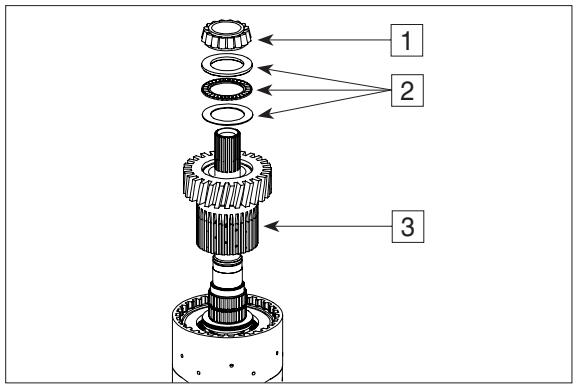
50DS7ETM51

② Pull off bearing inner ring with inner disk carrier (1).



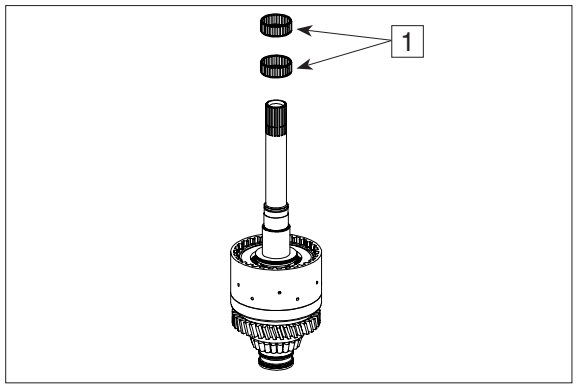
50DS7ETM52

③ Remove bearing inner ring (1), axial bearing assy (2) and inner disk carrier (3).



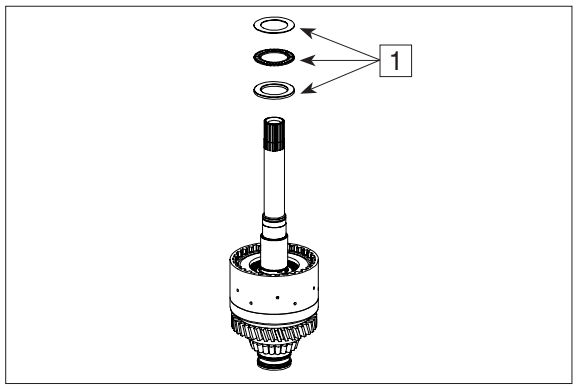
50DS7ETM53

④ Remove needle cage (1).



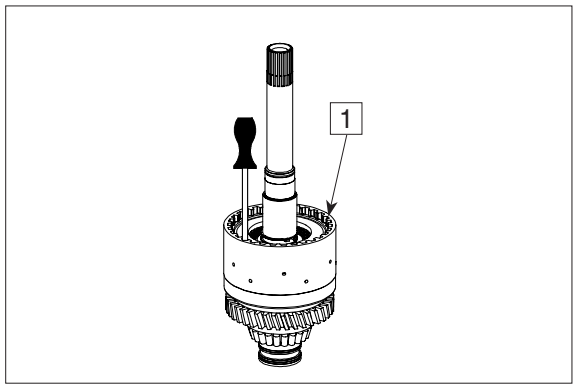
50DS7ETM54

⑤ Remove axial bearing assy (1).



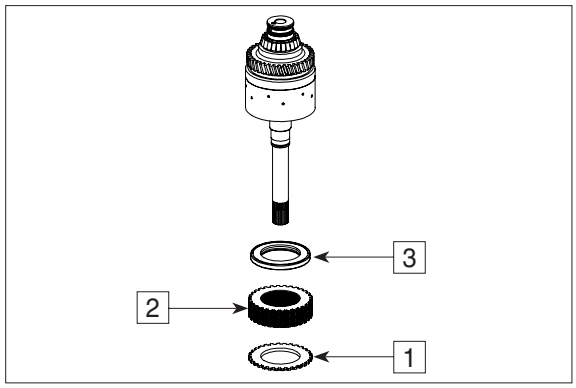
50DS7ETM55

⑥ Disengage snap ring (1).



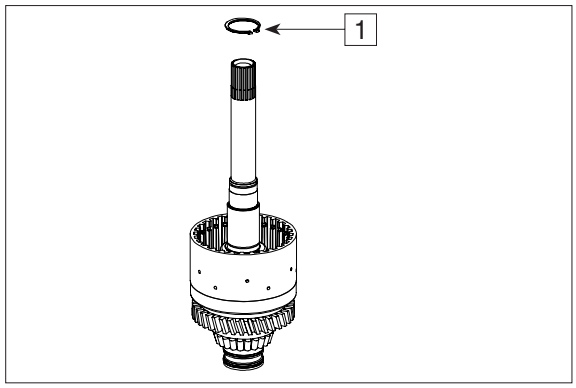
50DS7ETM56

⑦ Remove end plate (1), disk package (2) and plate with cup springs (3) from the disk carrier.



50DS7ETM57

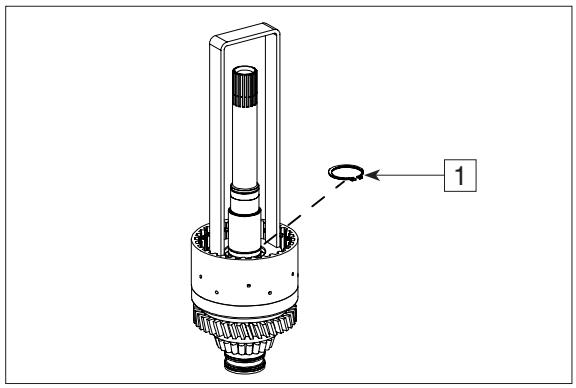
⑧ Remove retaining ring-contact position of axial bearing (1).



50DS7ETM58

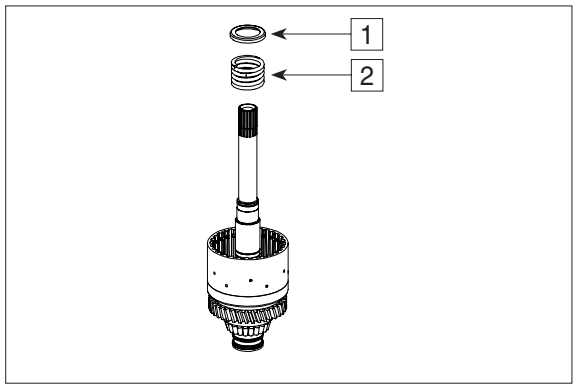
⑨ Preload compression spring and disengage retaining ring (1).

(S) Assembly aid 5870 345 114



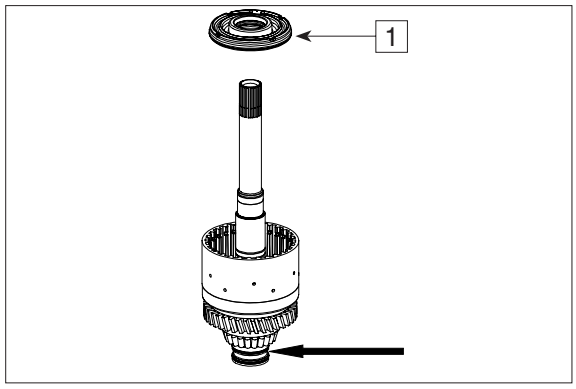
50DS7ETM59

⑩ Remove cup spring (1) and compression spring (2).



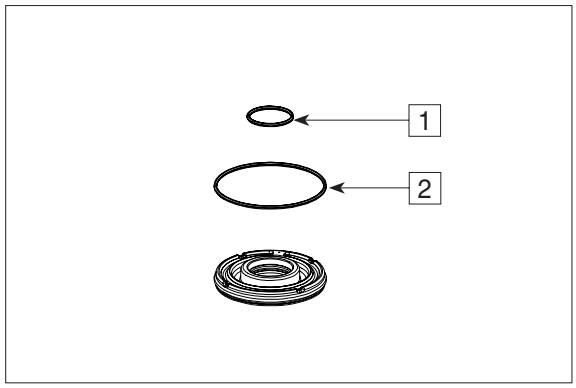
50DS7ETM60

⑪ By means of compressed air (see arrow), press piston (1) off the shaft/disk carrier (see arrow) and remove it.



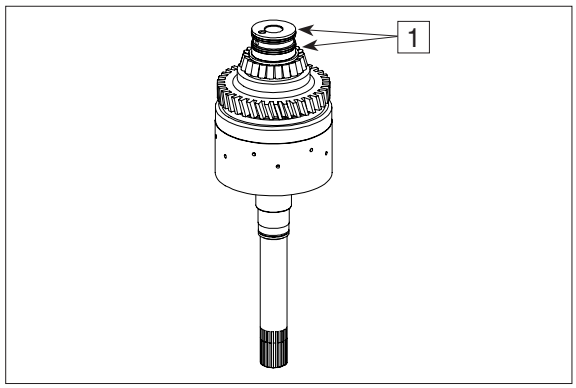
50DS7ETM61

⑫ Remove both O-rings (1 and 2).



50DS7ETM62

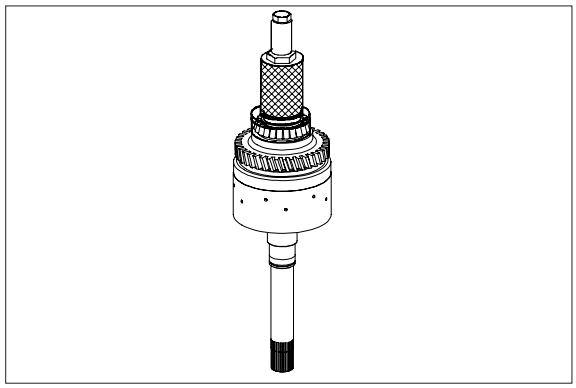
⑬ Disengage rectangular rings (1).



50DS7ETM63

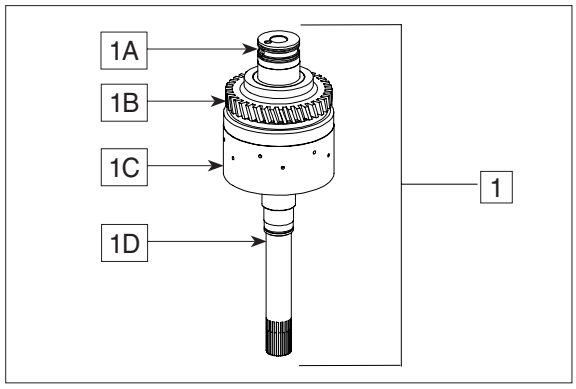
⑭ Pull tapered roller bearing (inner ring) off the shaft.

(S) Grab sleeve	5873 001 026
(S) Basic tool	5873 001 000


50DS7ETM64

※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of :

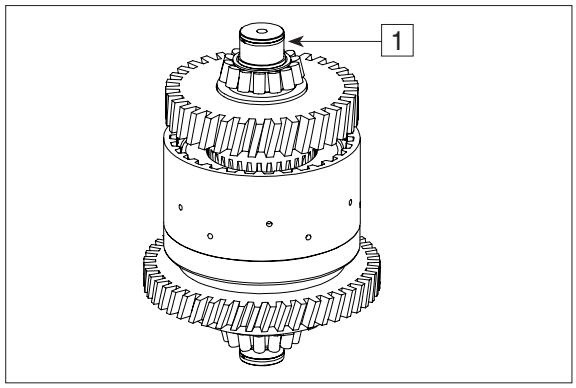
1A = Ball
1B = Helical gear
1C = Disk carrier
1D = Input shaft



50DS7ETM65

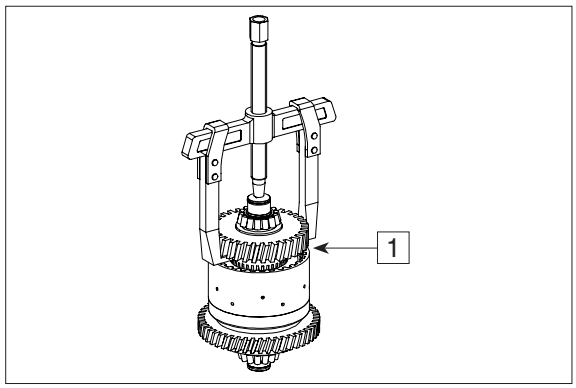
(2) Clutch KV

① Snap out rectangular ring (1).



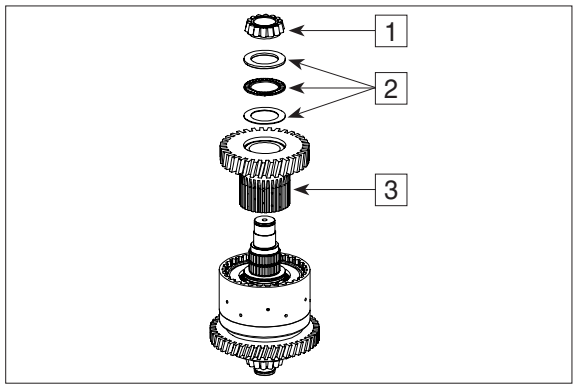
50DS7ETM66

② Pull off bearing inner ring with inner disk carrier (1).



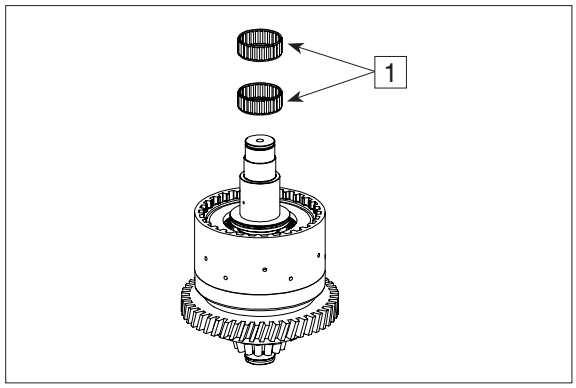
50DS7ETM67

③ Remove bearing inner ring (1), axial bearing assy (2) and inner disk carrier (3).



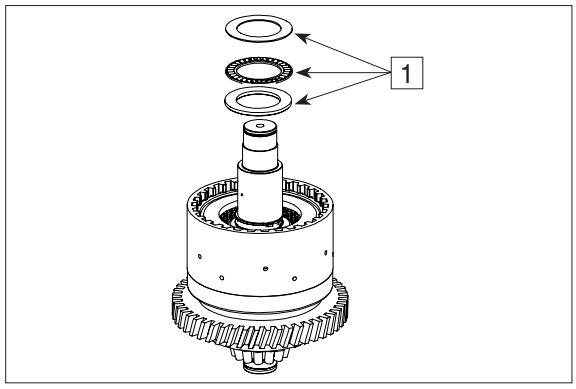
50DS7ETM68

④ Remove needle cage (1).



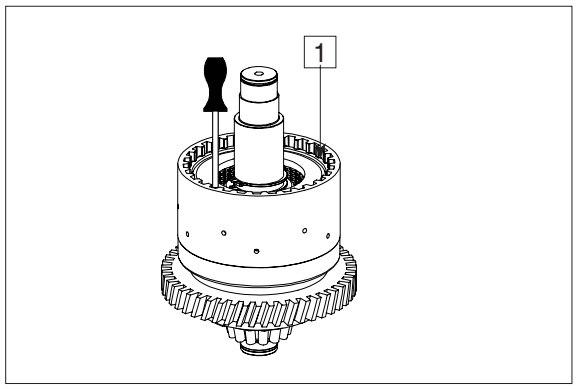
50DS7ETM69

⑤ Remove axial bearing assy (1).



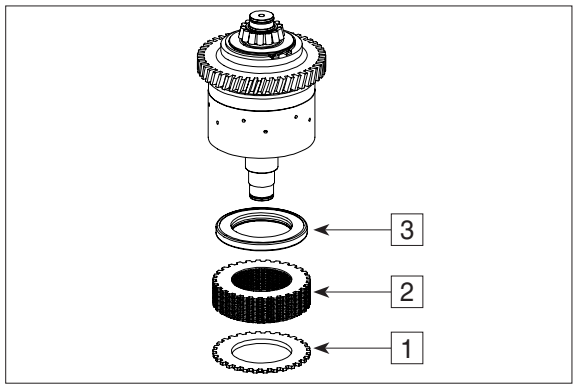
50DS7ETM70

⑥ Remove snap ring (1).



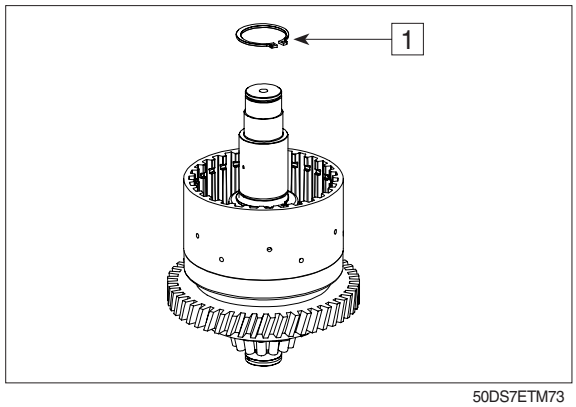
50DS7ETM71

⑦ Remove end plate (1), disk package (2) and plate (3) from the disk carrier.



50DS7ETM72

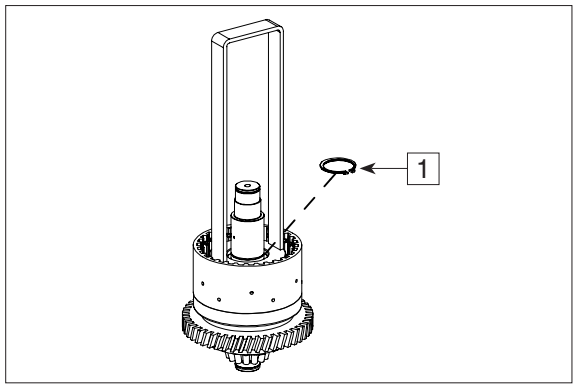
⑧ Remove retaining ring-contact position of axial bearing (1).



50DS7ETM73

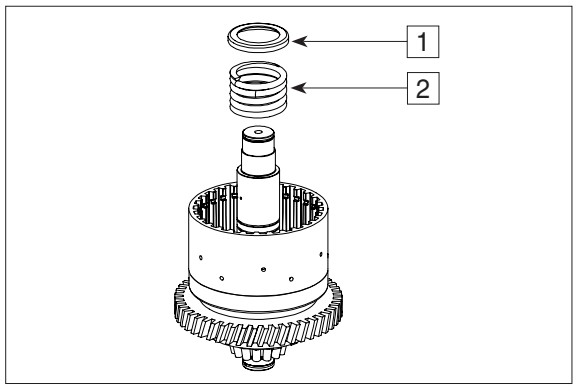
⑨ Preload compression spring and remove retaining ring (1).

(S) Assembly aid 5870 345 114



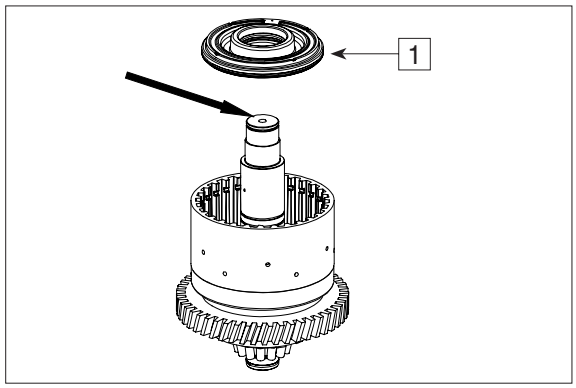
50DS7ETM74

⑩ Remove cup spring (1) and compression spring (2).



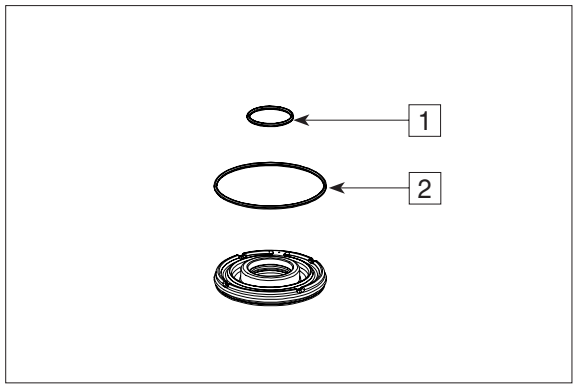
50DS7ETM75

⑪ By means of compressed air (see arrow), press piston (1) off the shaft/disk carrier and remove it.



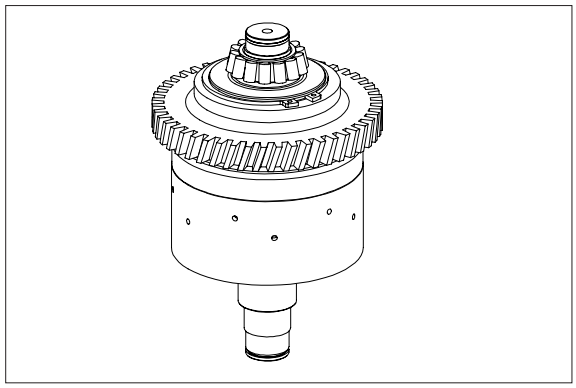
50DS7ETM76

⑫ Remove both O-rings (1 and 2).



50DS7ETM62

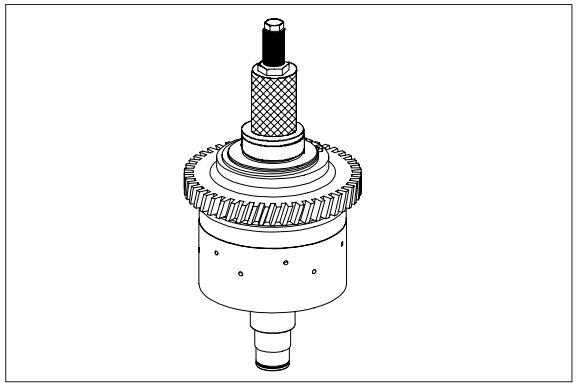
⑬ Snap out rectangular ring (1).



50DS7ETM78

⑭ Pull tapered roller bearing (inner ring) off the shaft.

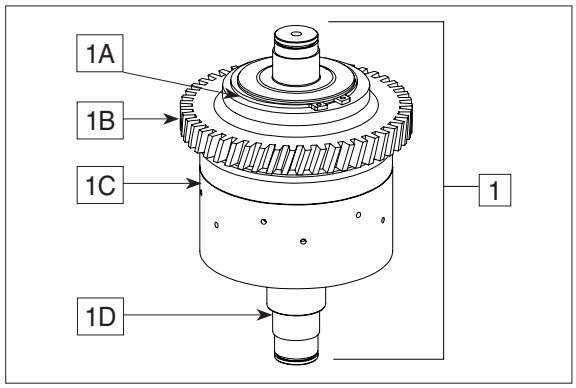
(S) Grab sleeve	5873 000 029
(S) Basic tool	5873 000 000



50DS7ETM79

※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of :

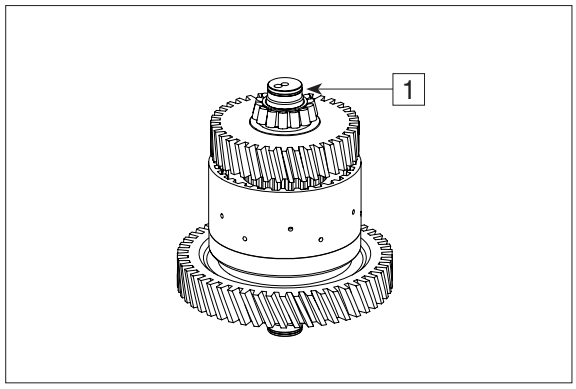
1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM80

(3) Clutch KD

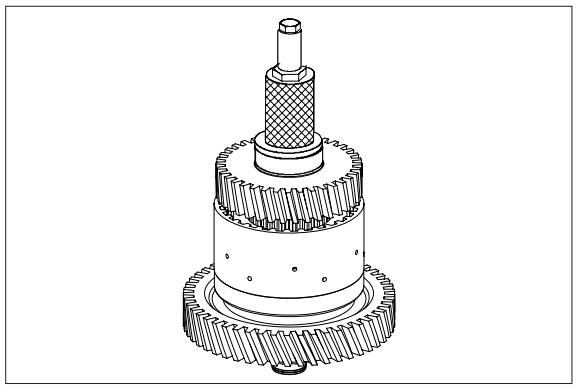
① Snap out rectangular ring (1).



50DS7ETM81

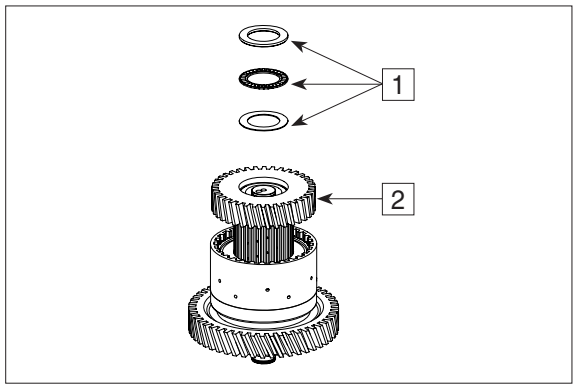
② Pull tapered roller bearing (inner ring) off the shaft.

(S) Grab sleeve	5873 000 029
(S) Basic tool	5873 000 000



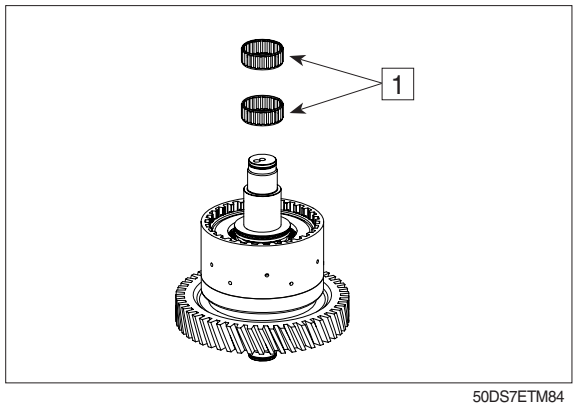
50DS7ETM82

③ Remove axial bearing assy (1) and inner disk carrier.



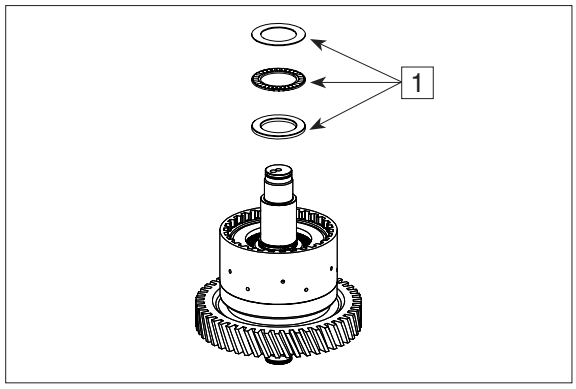
50DS7ETM83

④ Remove needle cage (1).



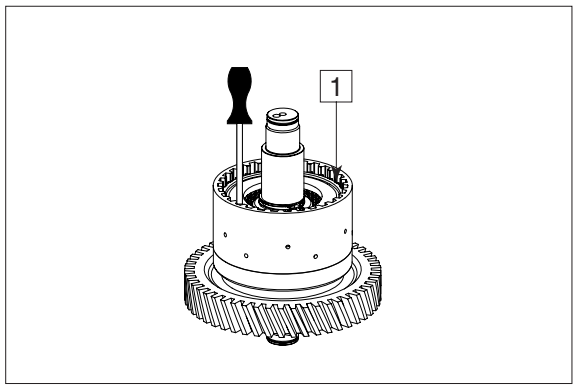
50DS7ETM84

⑤ Remove axial bearing assy (1).



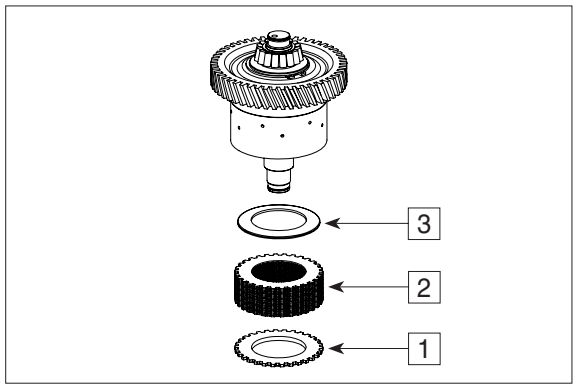
50DS7ETM85

⑥ Remove snap ring (1).



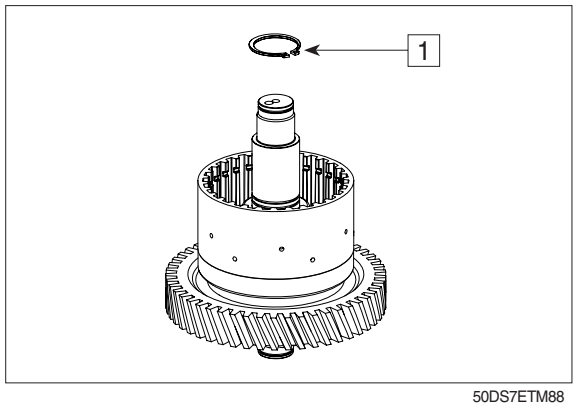
50DS7ETM86

⑦ Remove end plate (1), disk package (2) and cup spring (3) from the disk carrier.



50DS7ETM87

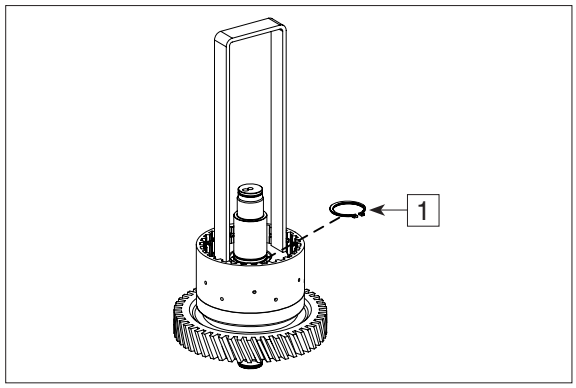
⑧ Remove retaining ring-contact position of axial bearing (1).



50DS7ETM88

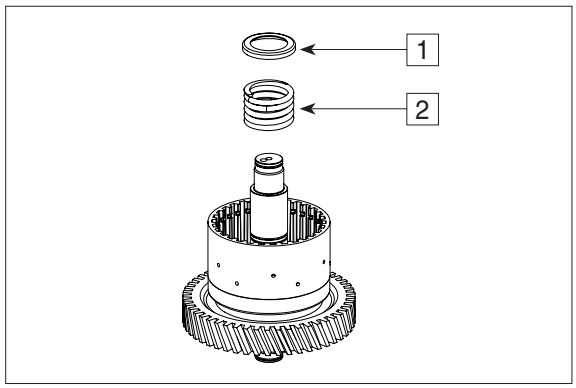
⑨ Preload compression spring and remove snap ring (1).

(S) Assembly aid 5870 345 114



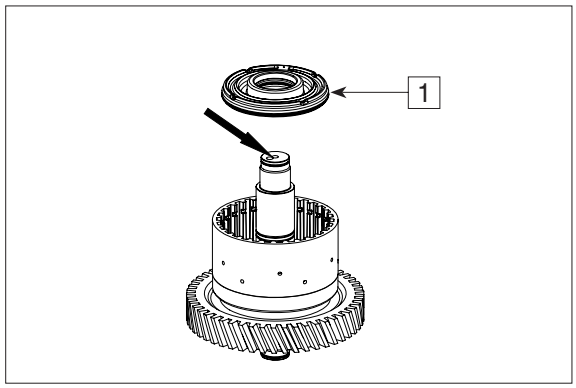
50DS7ETM89

⑩ Remove spring cup (1) and compression spring (2).



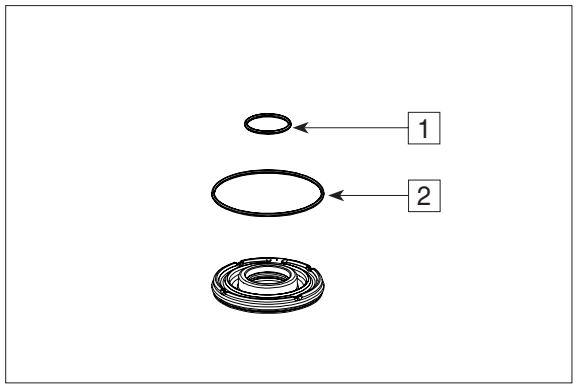
50DS7ETM90

⑪ By means of compressed air (see arrow), press piston (1) off the shaft/disk carrier and remove it.



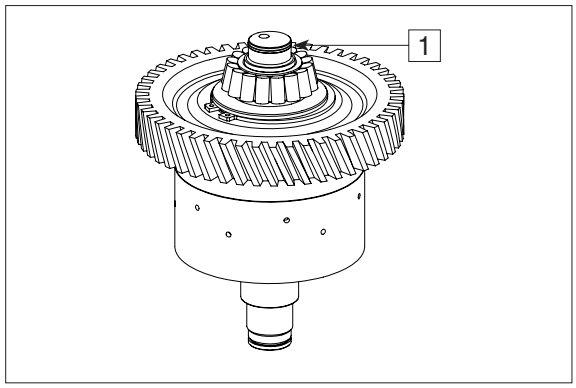
50DS7ETM91

⑫ Remove both O-rings (1 and 2).



50DS7ETM62

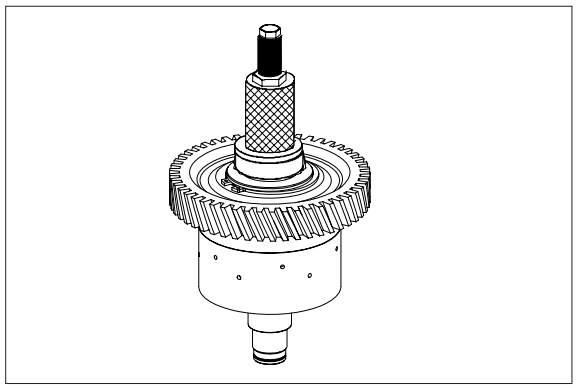
⑬ Snap out rectangular ring (1).



50DS7ETM93

⑭ Pull tapered roller bearing (inner ring) off the shaft.

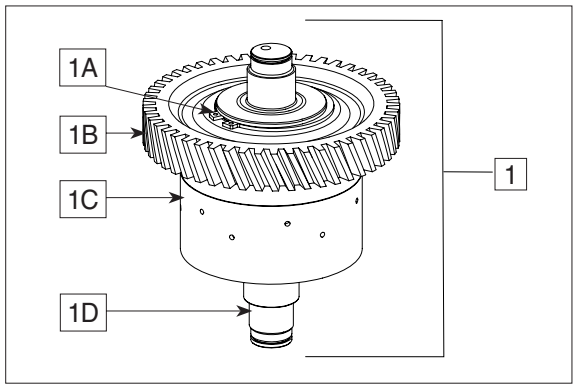
(S) Rapid grip	5873 011 011
(S) Extractor set	5870 026 100



50DS7ETM94

※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of :

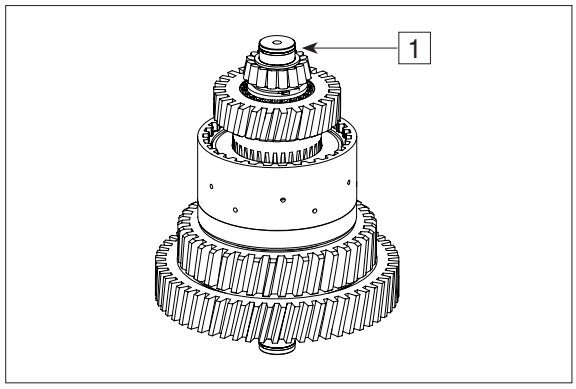
1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM95

(4) Clutch KE

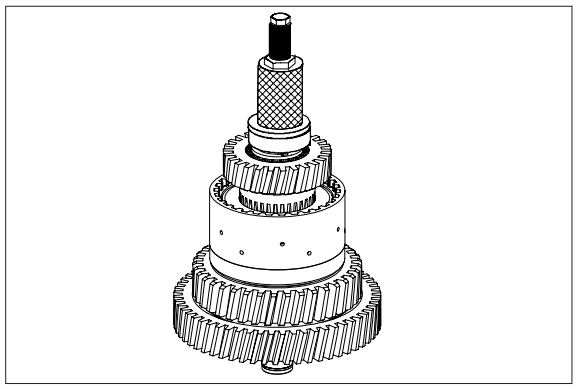
① Snap out rectangular ring (1).



50DS7ETM96

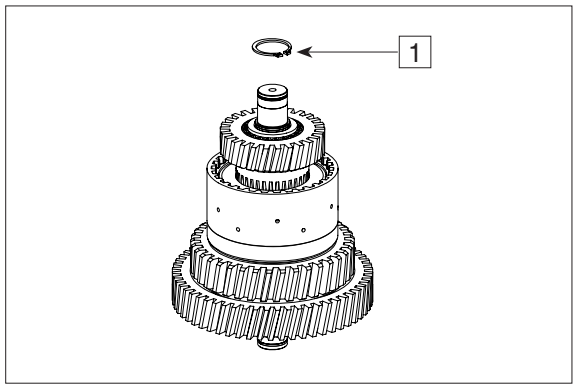
② Pull tapered roller bearing (inner ring) off the shaft.

(S) Grab sleeve	5873 000 029
(S) Basic tool	5873 001 000



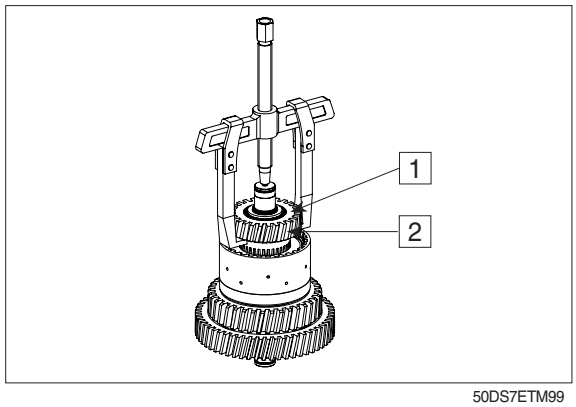
50DS7ETM97

③ Remove retaining ring (1).



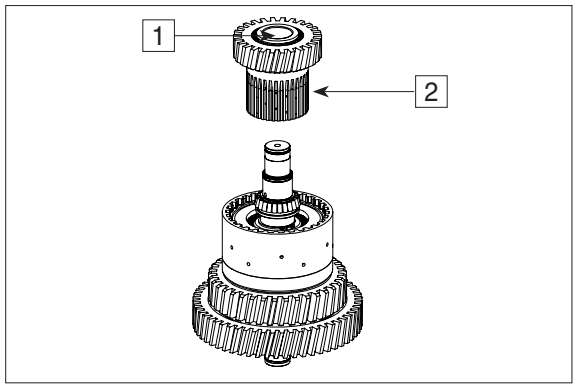
50DS7ETM98

④ Remove bearing inner ring (1) and inner disk carrier (2).



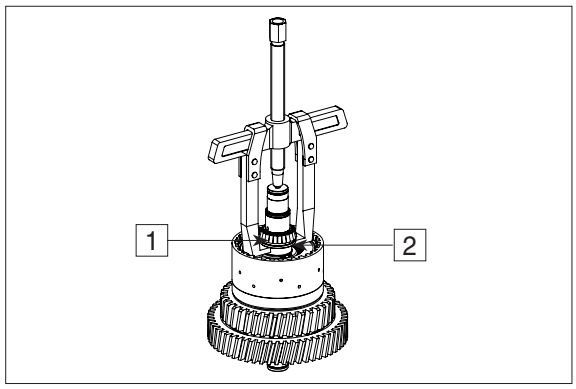
50DS7ETM99

⑤ Remove tapered roller bearing (1) and inner disk carrier (2).



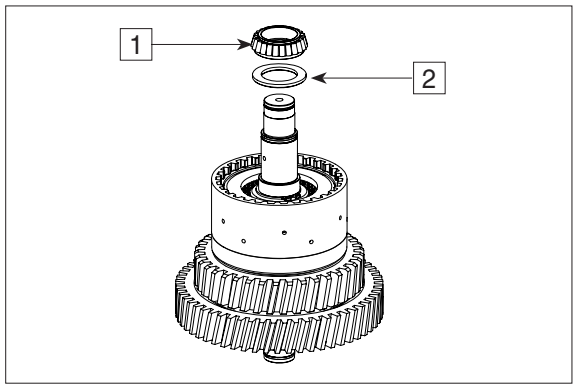
50DS7ETM100

⑥ Pull off bearing inner ring (1) and running disk (2).



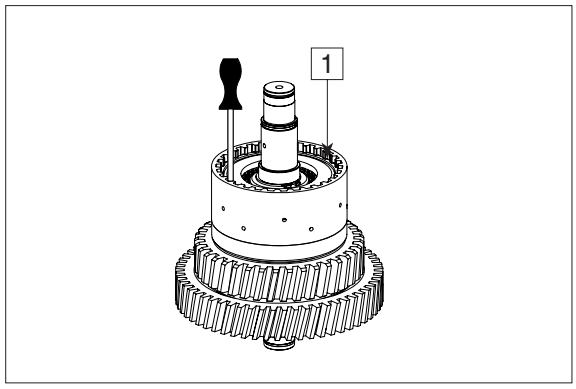
50DS7ETM101

⑦ Remove bearing inner ring (1) and running disk (2).



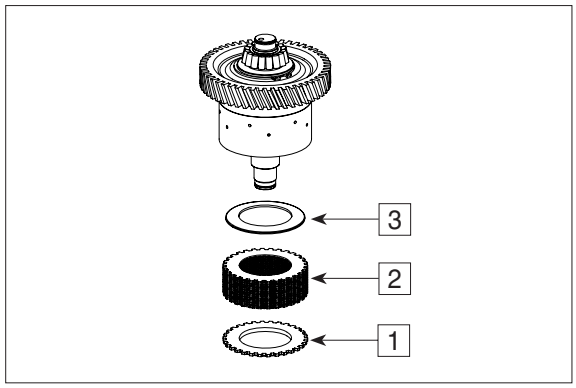
50DS7ETM102

⑧ Disengage snap ring (1).



50DS7ETM103

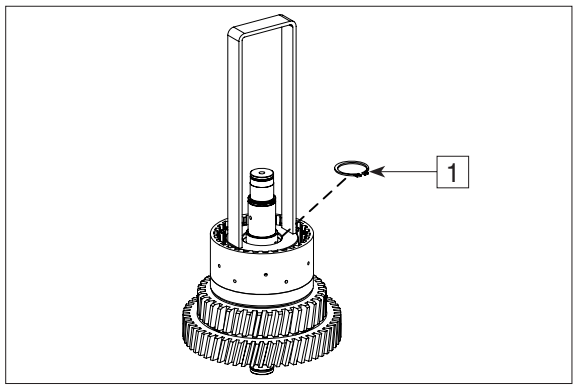
⑨ Remove end plate (1), disk package (2) and cup spring (3) from the disk carrier.



50DS7ETM104

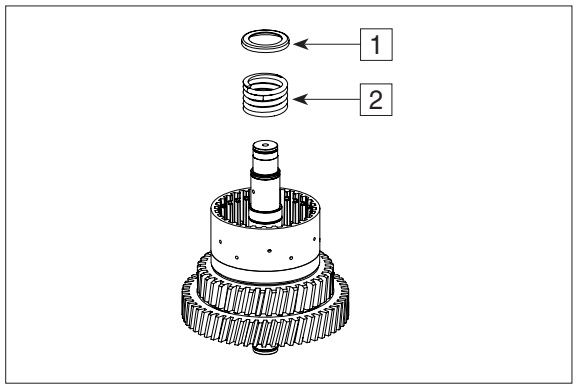
⑩ Preload compression spring and remove snap ring (1).

(S) Assembly aid 5870 345 114



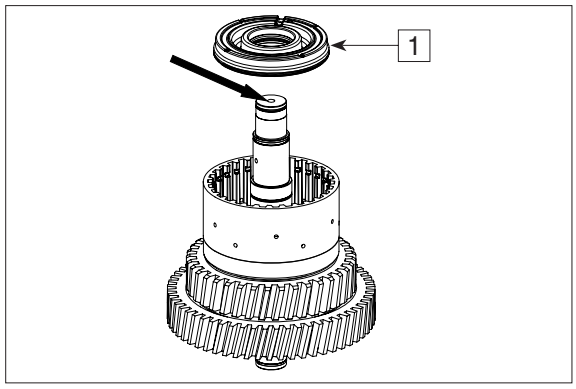
50DS7ETM105

⑪ Remove spring cup (1) and compression spring (2).



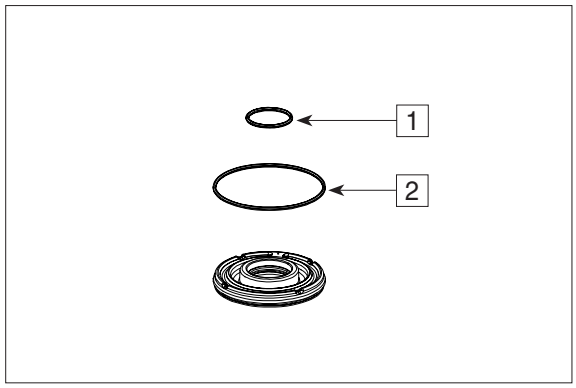
50DS7ETM106

⑫ By means of compressed air (see arrow), press piston (1) off the shaft/disk carrier and remove it.



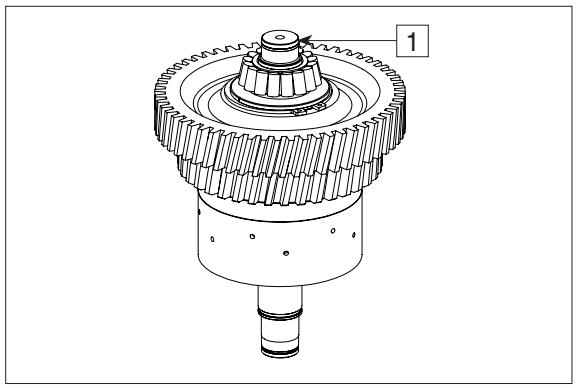
50DS7ETM107

⑬ Remove both O-rings (1 and 2).



50DS7ETM62

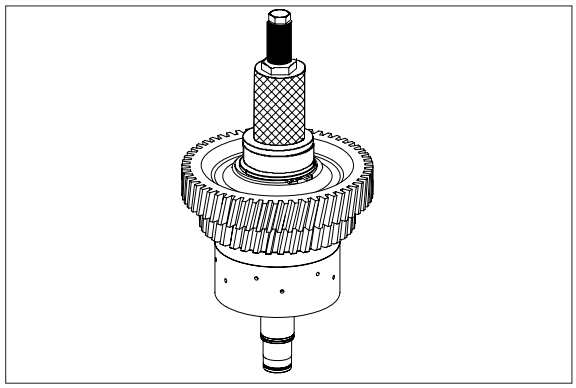
⑭ Snap out rectangular ring (1).



50DS7ETM109

⑮ Pull tapered roller bearing (inner ring) off the shaft.

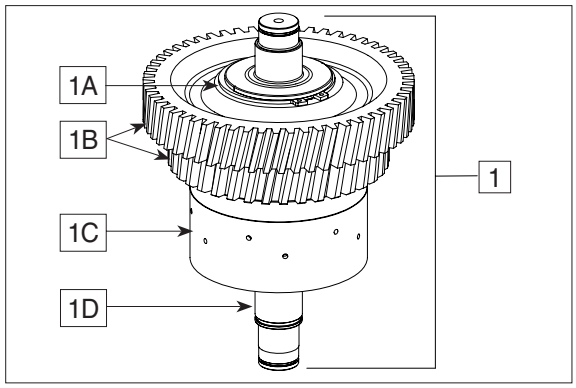
(S) Rapid grip	5873 011 011
(S) Basic tool	5873 001 000



50DS7ETM110

※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of :

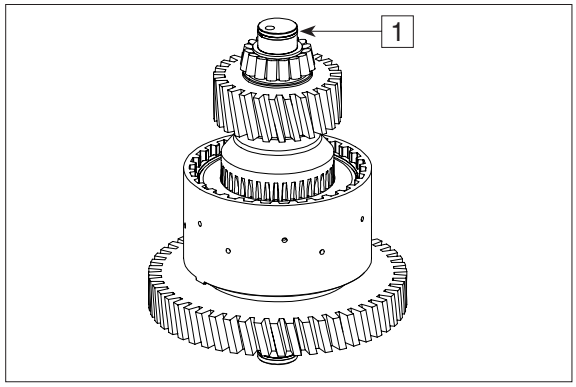
1A = Retaining ring
1B = Helical gears
1C = Disk carrier
1D = Shaft



50DS7ETM111

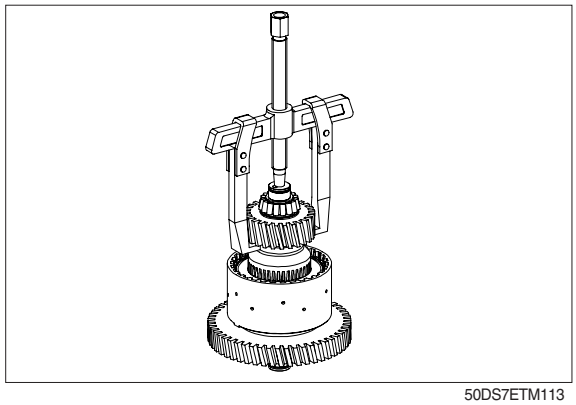
(5) Clutch KC

① Snap out rectangular ring (1).



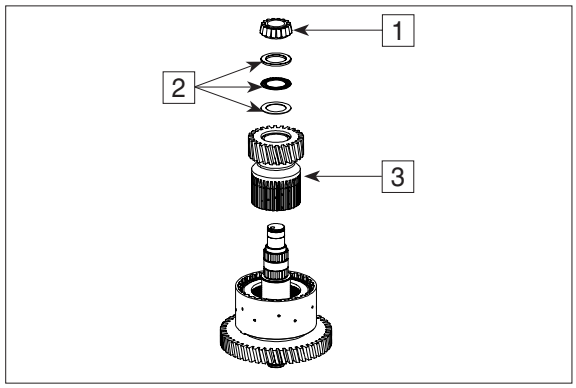
50DS7ETM112

② Pull off bearing inner ring with inner disk carrier (1).



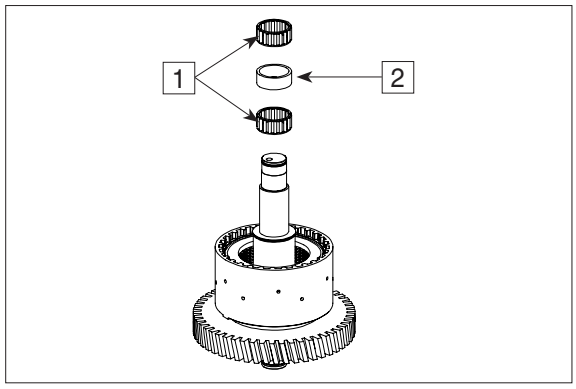
50DS7ETM113

③ Remove bearing inner ring (1), axial bearing assy (2) and inner disk carrier (3).



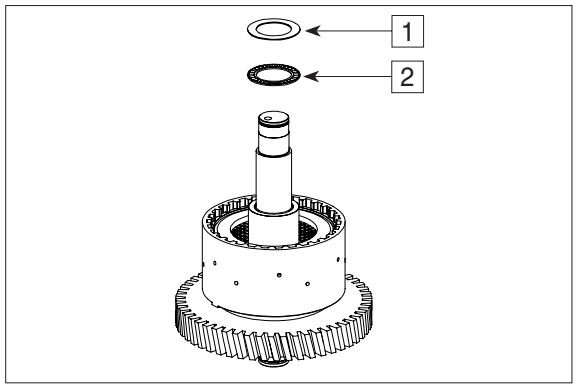
50DS7ETM114

④ Remove needle cage (1) and bush (2).



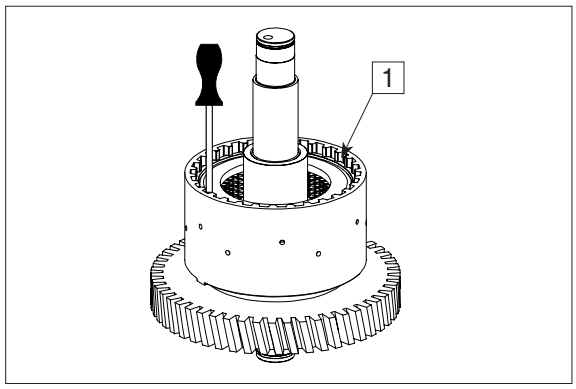
50DS7ETM115

⑤ Remove axial disk (1) and axial needle cage (2).



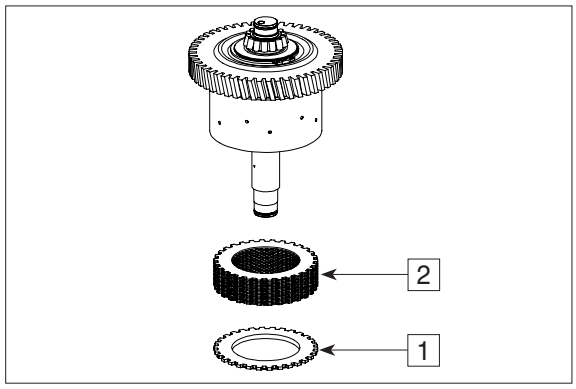
50DS7ETM116

⑥ Disengage snap ring (1).



50DS7ETM117

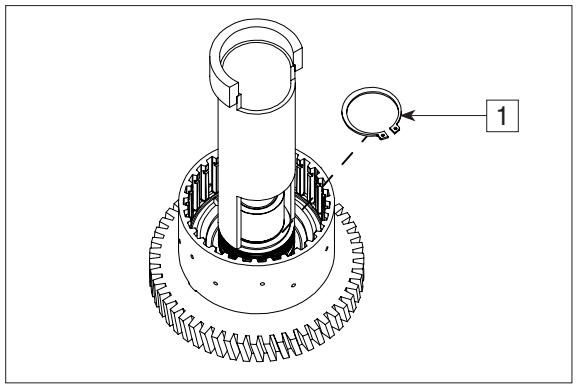
⑦ Remove end plate (1) and disk package (2) from the disk carrier.



50DS7ETM118

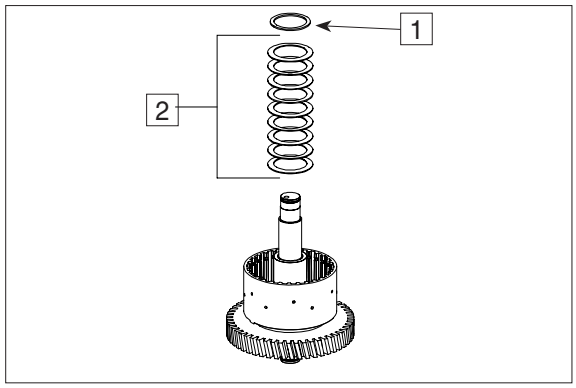
⑧ Preload compression springs and remove snap ring (1).

(S) Assembly aid 5870 506 128



50DS7ETM119

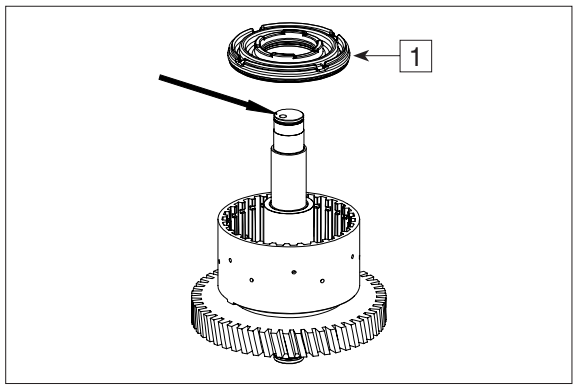
⑨ Remove disk (1) and cup springs (2).



50DS7ETM120

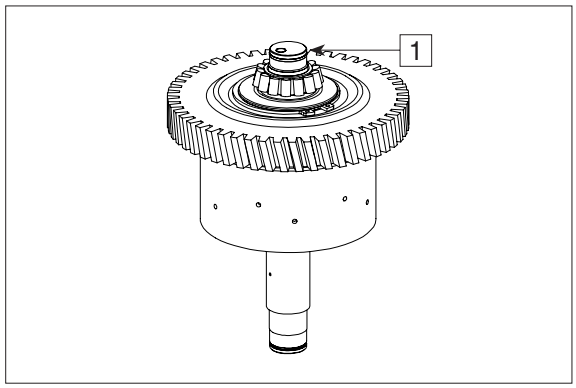
⑩ By means of compressed air (see arrow), press piston (1) off the shaft/disk carrier and remove it.

Remove both O-rings.



50DS7ETM121

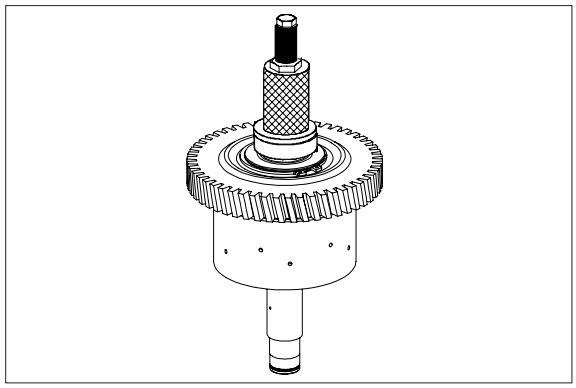
⑪ Snap out rectangular ring (1).



50DS7ETM122

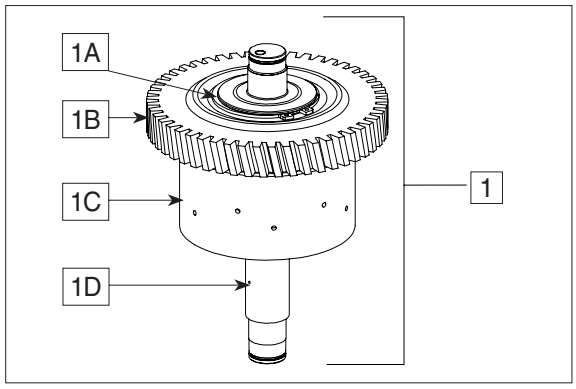
⑫ Pull tapered roller bearing (inner ring) off the shaft.

(S) Grab sleeve	5873 002 029
(S) Basic tool	5873 000 001


50DS7ETM123

※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of:

1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft

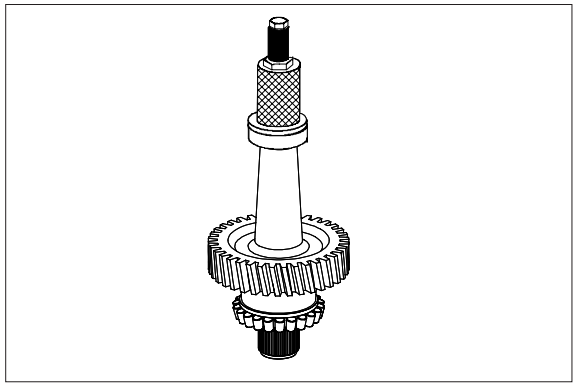


50DS7ETM124

(6) Output shaft

① Pull the bearing inner ring off the output shaft.

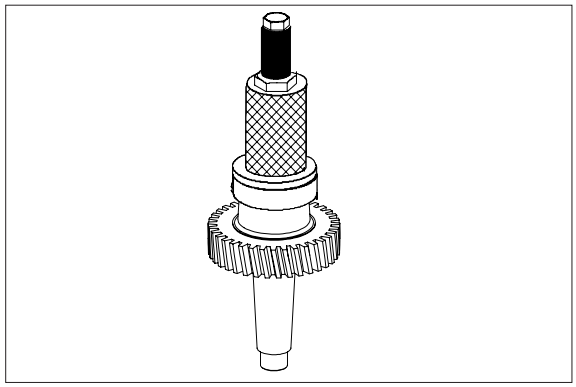
(S) Grab sleeve 5873 000 029
(S) Basic tool 5873 000 001



50DS7ETM125

② Rotate output shaft 180°and pull off bearing inner ring.

(S) Grab sleeve 5873 002 035
or
(S) Rapid grip 5873 012 011
(S) Basic tool 5873 002 000



50DS7ETM126

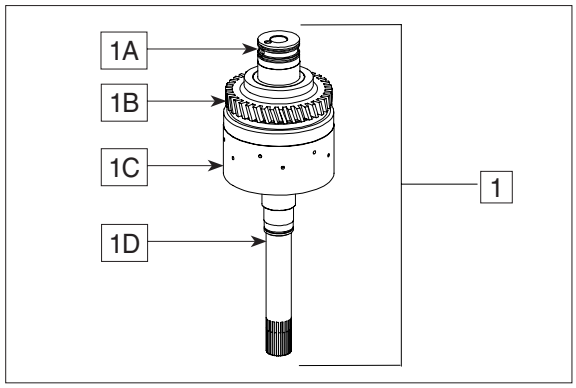
2. TRANSMISSION ASSEMBLY

1) REASSEMBLY OF CLUTCHES :

(1) Clutch KR/input

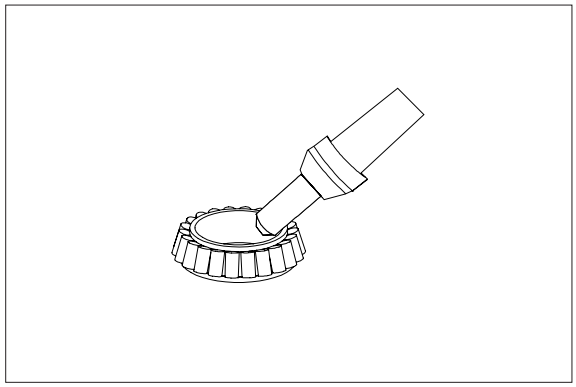
※ The clutch (1) is supplied by the spare parts service only as a complete assy which consists of:

1A = Ball
1B = Helical gear
1C = Disk carrier
1D = Input shaft



50DS7ETM65

① Heat up bearing inner ring (approx. 120°C).

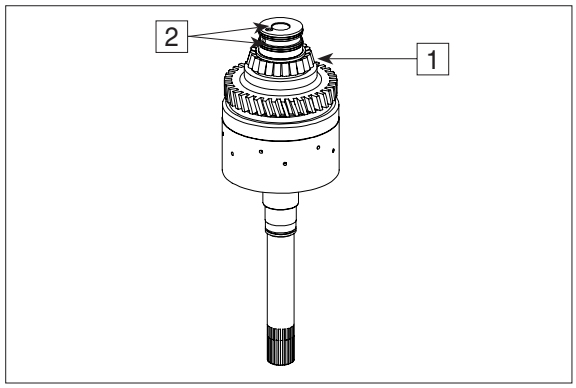

50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular rings 50 × 2.5 (2).

⚠ Wear protective gloves.

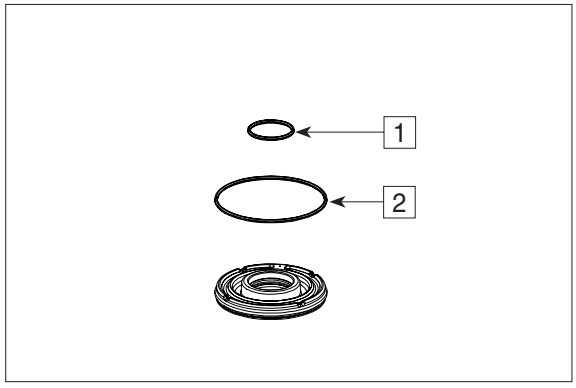
※ Adjust bearing inner ring after cooling-down.



50DS7ETM129

③ Insert both O-rings (1 and 2) into the piston grooves and oil them.

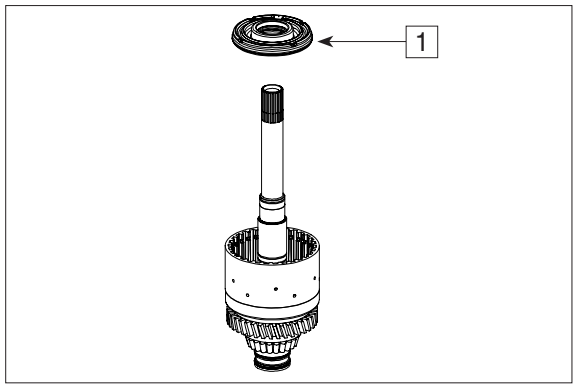
1 = 40 × 3
2 = 104.5 × 3



50DS7ETM62

④ Insert piston (1) into the disk carrier.

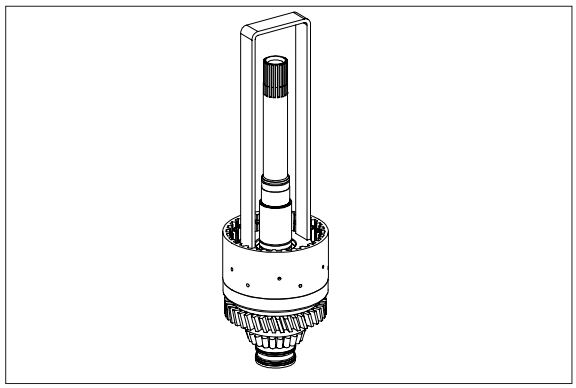
※ Pay attention to the installation position, see Figure.



50DS7ETM131

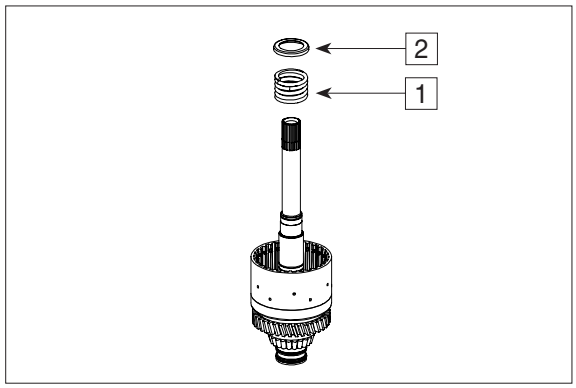
⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

(S) Assembly aid 5870 345 114



50DS7ETM132

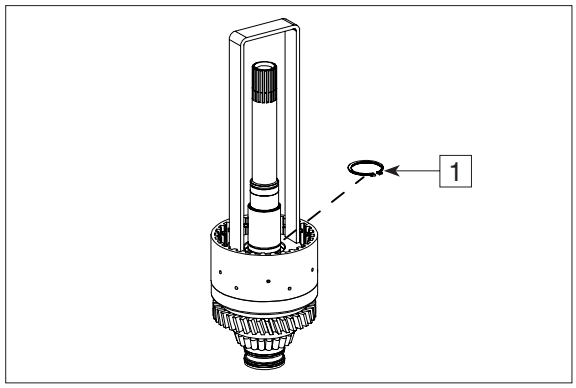
⑥ Mount compression spring (1) and cup spring (2).



50DS7ETM60

⑦ By means of the assembly aid, preload compression spring under a hand-operated press until the retaining ring 40 × 1.75 (1) can be snapped in.

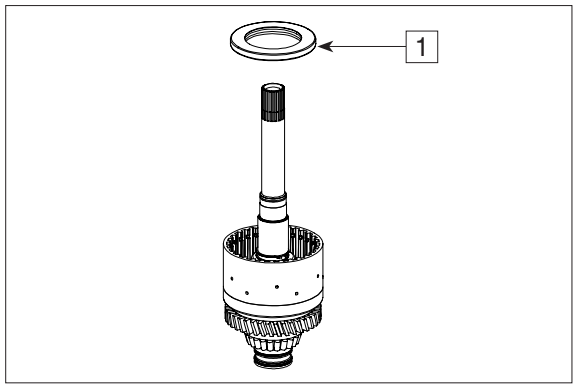
(S) Assembly aid 5870 345 114



50DS7ETM59

⑧ Mount plate assy with cup springs (1), with the open side showing towards the piston (see arrow).

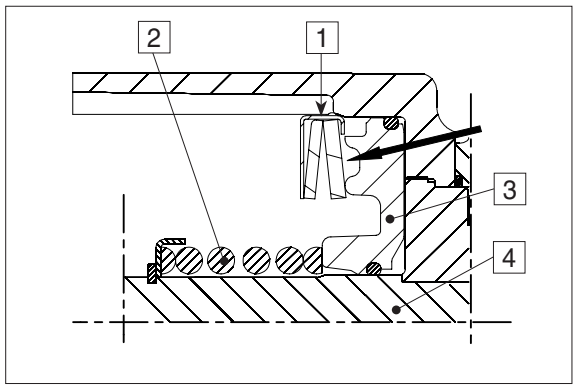
※ Installation position plate-see below figure.



50DS7ETM135

⑨ Fit plate (1) according to sketch (see arrow).

1 = Plate with cup springs
2 = Compression spring with spring cup and retaining ring
3 = Piston with O-rings
4 = Clutch assy

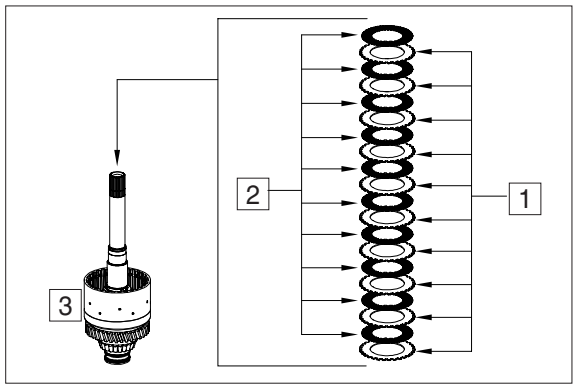


50DS7ETM136

⑩ Install outer and inner disks alternately into the disk carrier (3) as shown in figure.

Starting with an outer disk and ending with an inner disk.

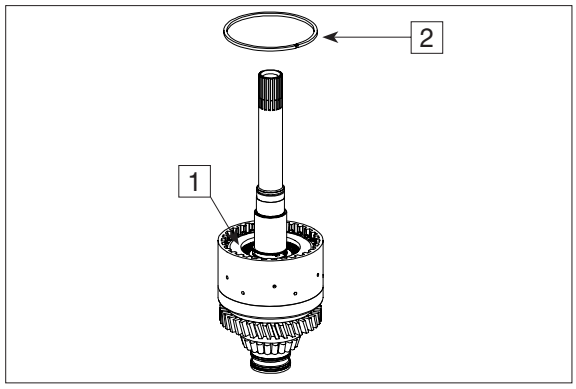
1 = Outer disks (10 pcs)
2 = Inner disks (10 pcs)
3 = Clutch assy



50DS7ETM137

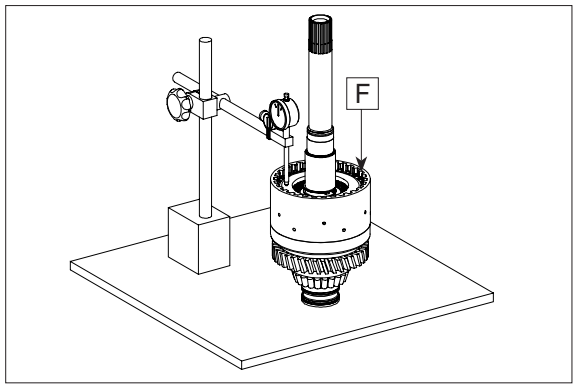
⑪ Mount end plate (1) with the flat side showing towards the disk package and fix it by means of snap ring (2) (e.g. thickness=2.5 mm/recommended value).

※ Pay attention to the installation position of the end plate.



50DS7ETM138

⑫ Equally press on end plate with F (approx. 100N = 10kg) and set dial indicator to "zero".

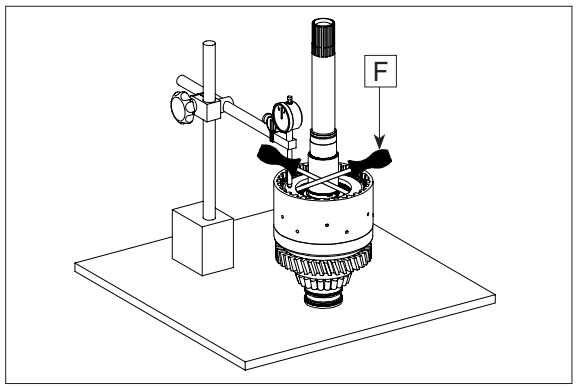


50DS7ETM139

⑬ Then press end plate against the snap ring (upwards) and read the disk clearance.

※ Disk clearance : 2.2 to 2.6 mm

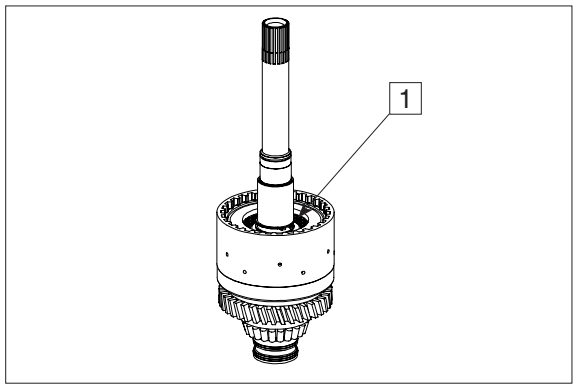
※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thickness = 2.0 ..... 3.5 mm/available in steps of 0.25 mm).



50DS7ETM140

⑭ Snap retaining ring 40×1.75 (1) into the groove.

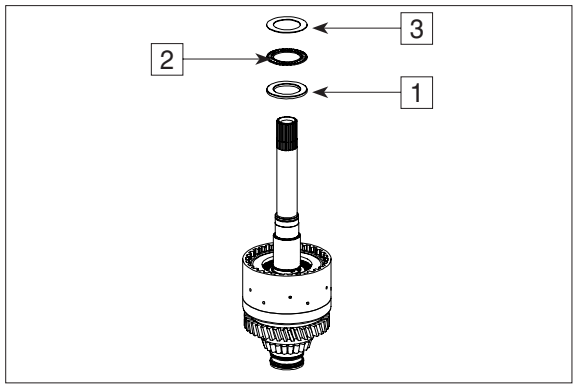
※ Contact for axial bearing - see below figure.



50DS7ETM141

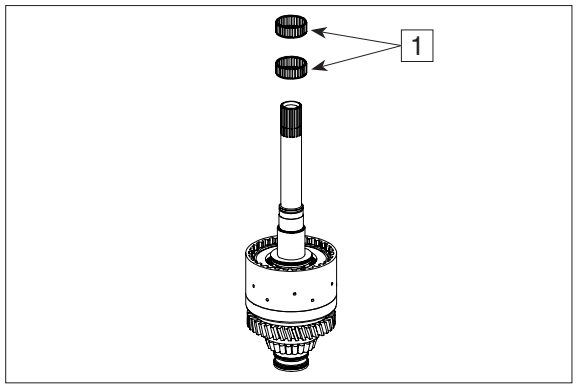
⑮ Mount running disk 40×60×3.5 (1), axial needle cage 40×60×3 (2) and axial washer 40×60×1 (3) and oil them.

※ Fit running disk (1), with the chamfer showing towards the retaining ring.



50DS7ETM142

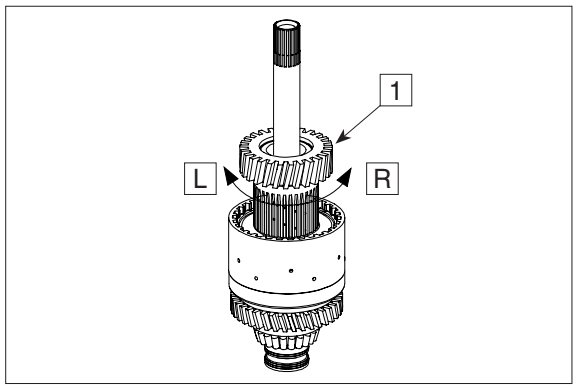
⑯ Mount needle cage 40×45×17 (1) and oil it.



50DS7ETM143

⑰ Mount inner disk carrier until contact is obtained.

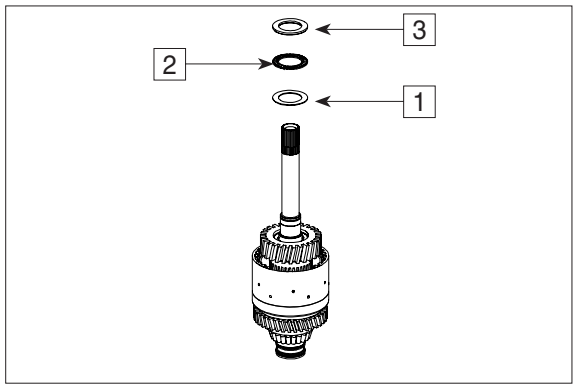
Install inner disks by short ccw/cw rotations of the inner disk carrier (1).



50DS7ETM144

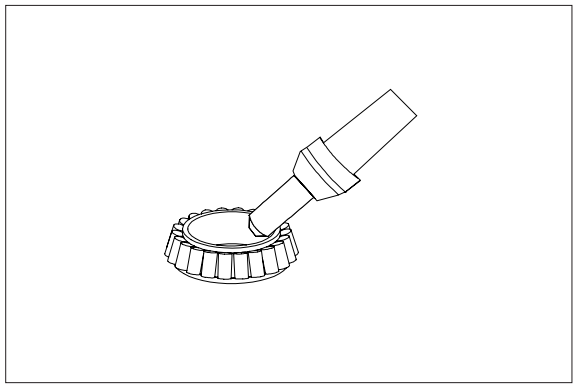
⑱ Mount axial washer 40×60×1 (1), axial needle cage 40×60×3 (2) and running disk (3) 40×60×3.5 and oil them.

※ Fit running disk (3), with the chamfer showing towards the tapered roller bearing.



50DS7ETM145

⑲ Heat up bearing inner ring (approx. 120°C).



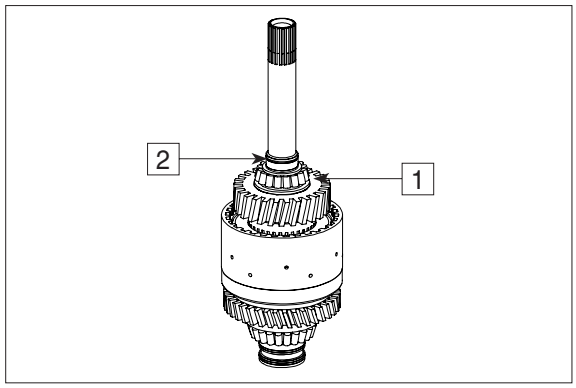
50DS7ETM128

⑳ Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 30 × 2 (2).

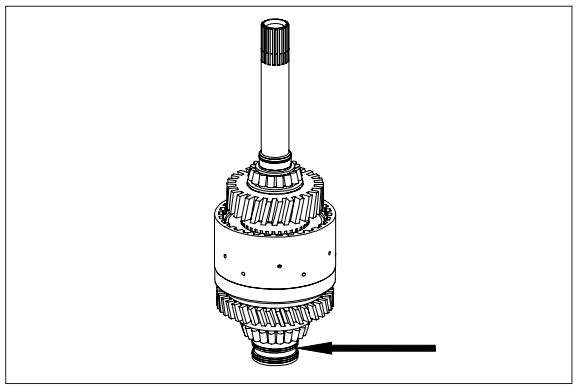
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM147

※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.

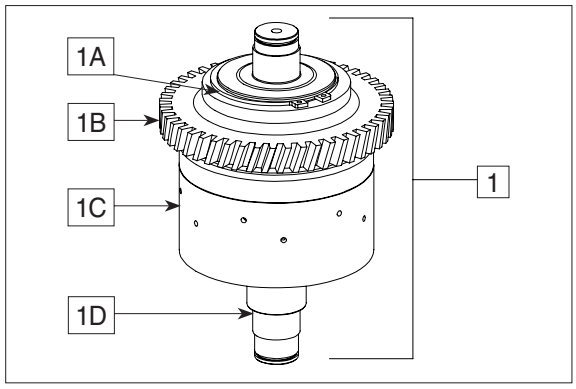


50DS7ETM148

(2) Clutch KV

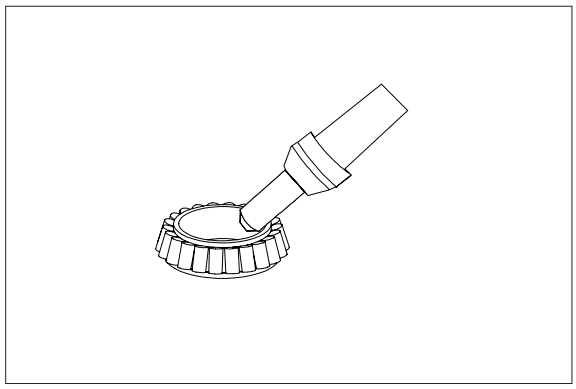
The clutch (1) is supplied by the spare parts service only as a complete assy which consists of :

1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM149

① Heat up bearing inner ring (approx. 120°C).

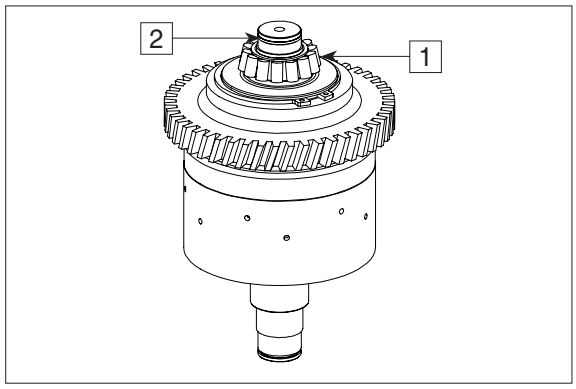

50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular rings 30 × 2 (2).

⚠ Wear protective gloves.

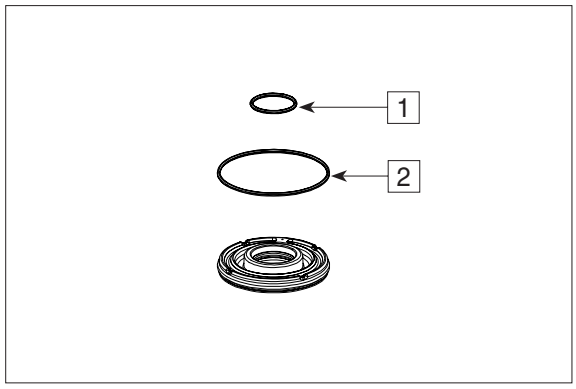
※ Adjust bearing inner ring after cooling-down.



50DS7ETM151

③ Insert both O-rings (1 and 2) into the piston grooves and oil them.

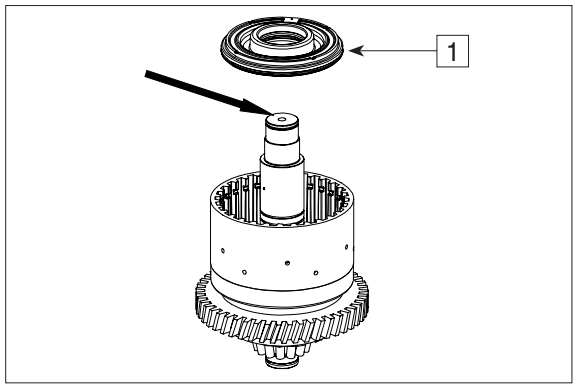
1 = 40 × 3
2 = 104.5 × 3



50DS7ETM62

④ Insert piston (1) into the disk carrier.

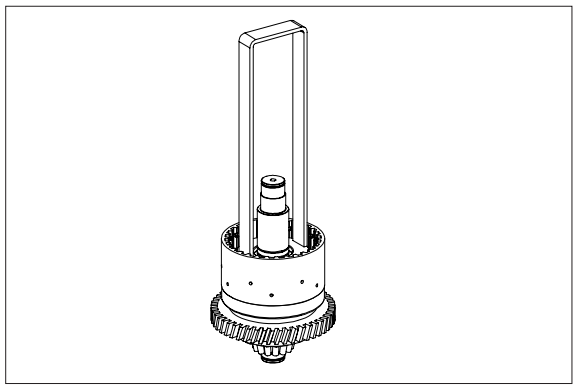
※ Pay attention to the installation position, see figure.



50DS7ETM76

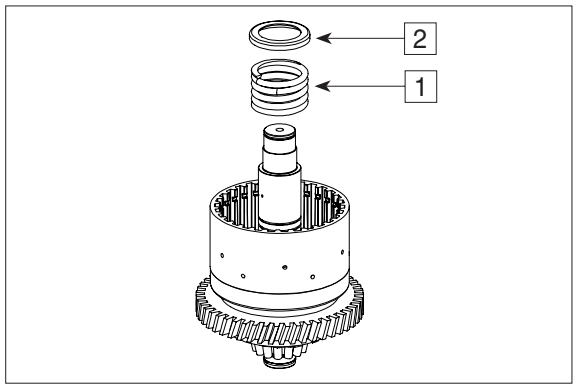
⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

(S) Assembly aid 5870 345 114



50DS7ETM154

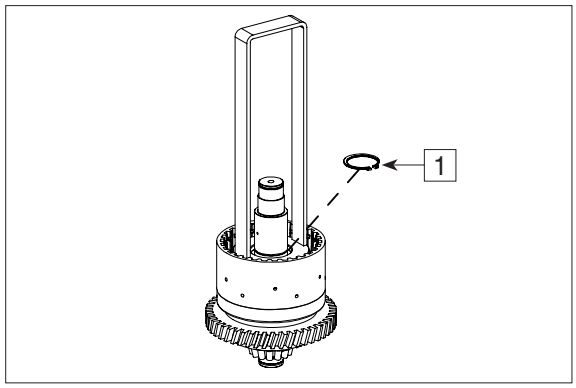
⑥ Mount compression spring (1) and spring cup (2).



50DS7ETM75

⑦ By means of the assembly aid, preload compression spring under a hand-operated press until the retaining ring 40 × 1.75 (1) can be snapped in.

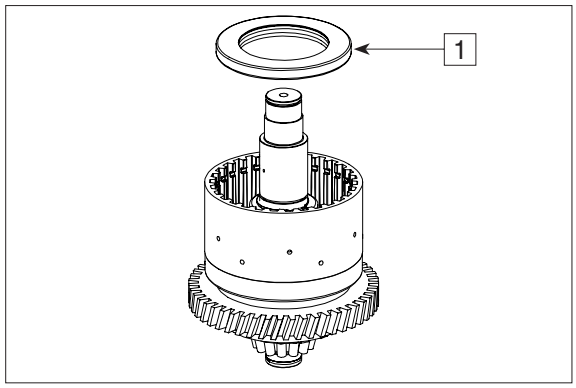
(S) Assembly aid 5870 345 114



50DS7ETM74

⑧ Mount plate assy with cup springs (1), with the open side showing towards the piston (see arrow).

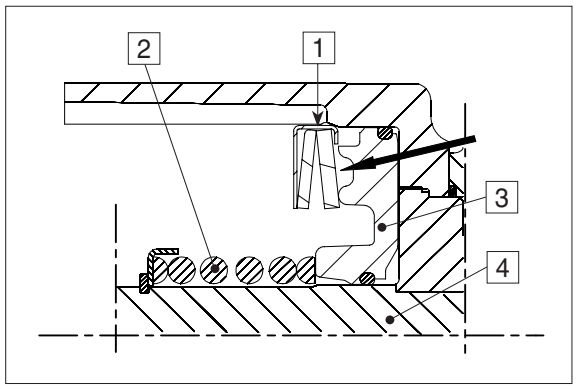
※ Installation position plate-see below figure.



50DS7ETM157

⑨ Fit plate (1) according to sketch (see arrow).

1 = Plate with cup springs
2 = Compression spring with cup spring and retaining ring
3 = Piston with O-rings
4 = Clutch assy

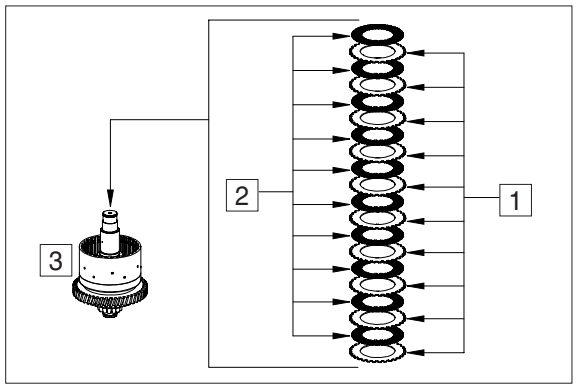


50DS7ETM158

⑩ Install outer and inner disks alternately into the disk carrier (3) as shown in figure.

Starting with an outer disk and ending with an inner disk.

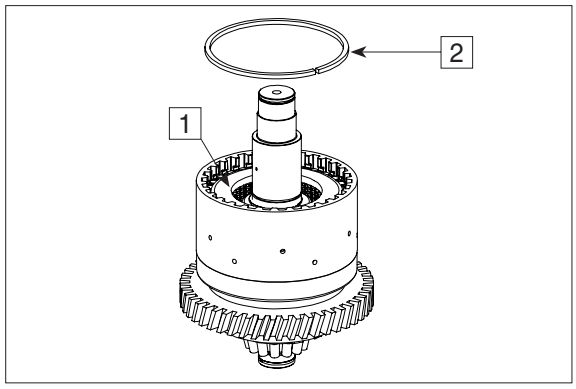
1 = Outer disks (10 pcs)
2 = Inner disks (10 pcs)
3 = Clutch assy



50DS7ETM159

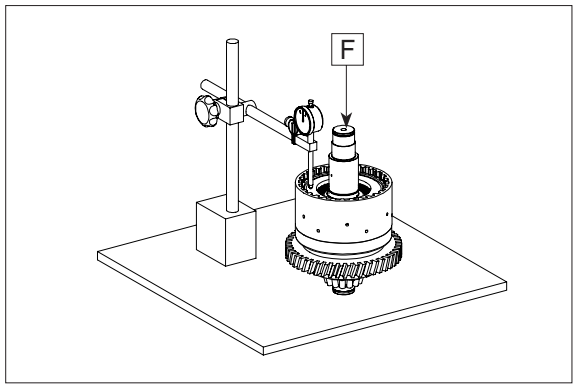
⑪ Mount end plate (1) with the flat side showing towards the disk package and fix it by means of snap ring (2) (e.g. thickness=2.5 mm/recommended value).

※ Pay attention to the installation position of the end plate.



50DS7ETM160

⑫ Equally press on end plate with F (approx. 100N = 10kg) and set dial indicator to "zero".

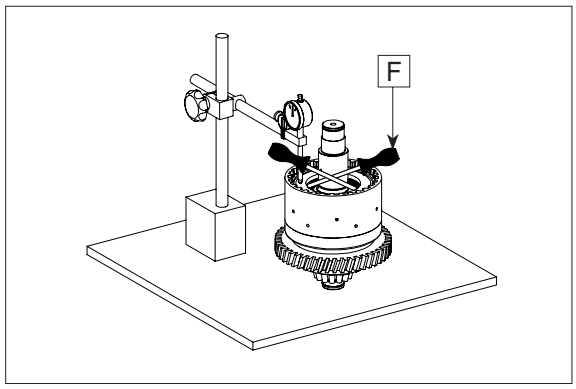


50DS7ETM161

⑬ Then press end plate against the snap ring (upwards) and read the disk clearance.

※ Disk clearance : 2.2 to 2.6 mm

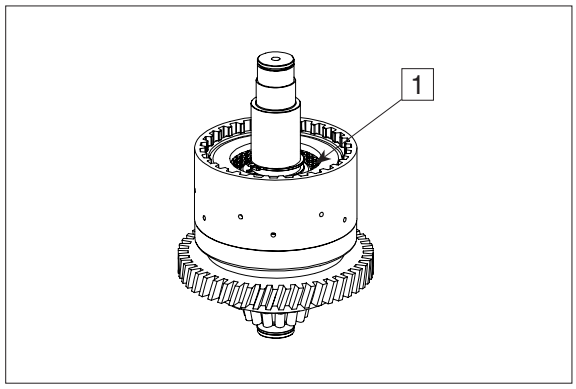
※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring(optional thickness = 2.0~3.5 mm/available in steps of 0.25 mm).



50DS7ETM162

⑭ Snap retaining ring 40×1.75 (1) into the groove.

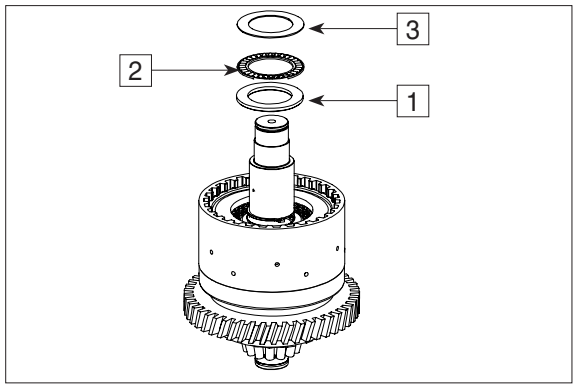
※ Contact for axial bearing-see below figure.



50DS7ETM163

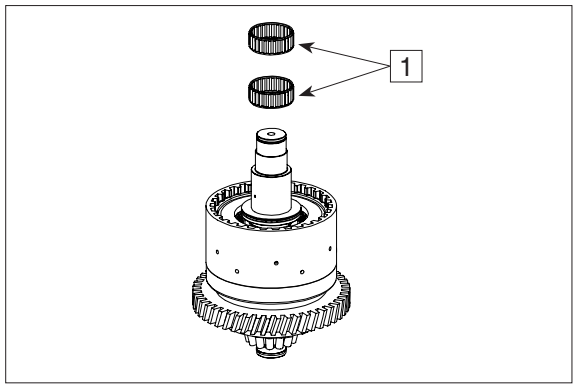
⑮ Mount running disk 40×60×3.5 (1), axial needle cage 40×60×3 (2) and axial washer 40×60×1 (3) and oil them.

※ Fit running disk (1), with the chamfer showing towards the retaining ring.



50DS7ETM164

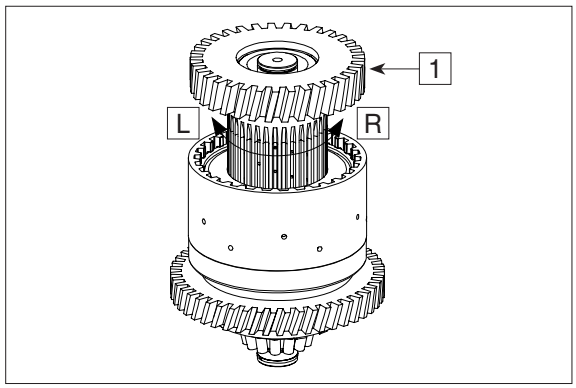
⑯ Mount needle cage 40×45×17 (1) and oil it.



50DS7ETM69

⑰ Mount inner disk carrier until contact is obtained.

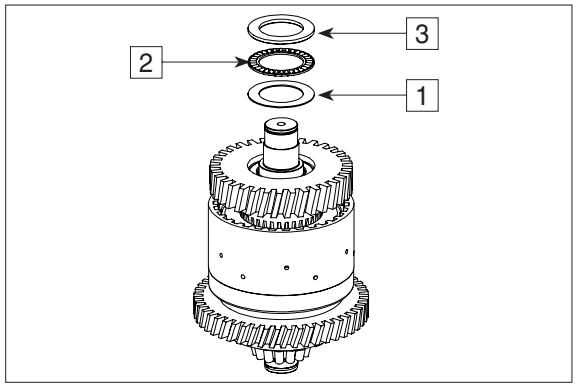
Install inner disks by short ccw/cw rotations of the inner disk carrier (1).



50DS7ETM166

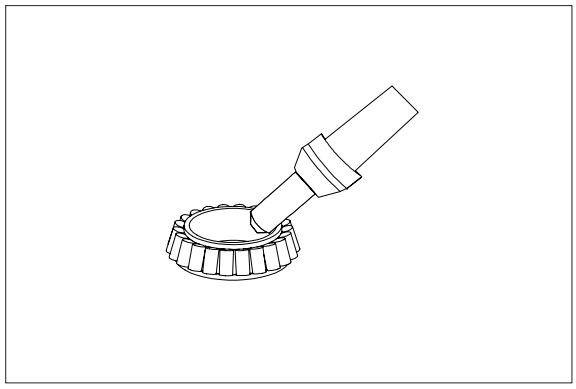
⑱ Mount axial washer 40×60×1 (1), axial needle cage 40×60×3 (2) and running disk (3) 40×60×3.5 and oil them.

※ Fit running disk (3), with the chamfer showing towards the tapered roller bearing.



50DS7ETM167

⑲ Heat up bearing inner ring (approx. 120°C).



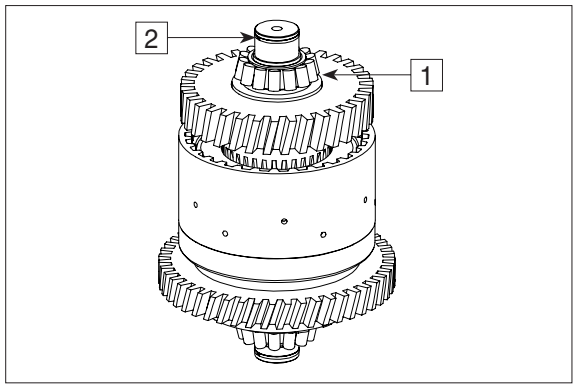
50DS7ETM128

⑳ Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 30 × 2 (2).

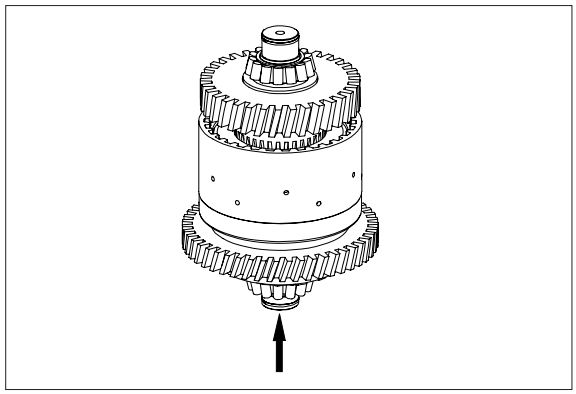
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM169

※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.

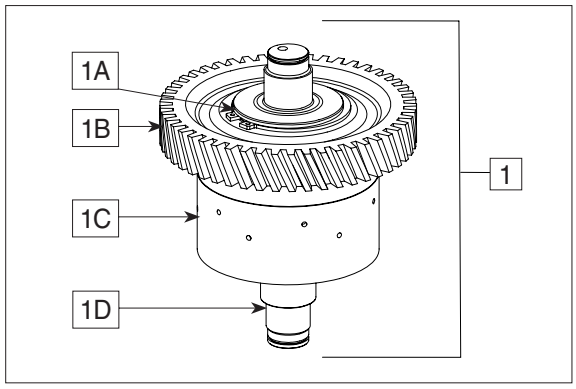


50DS7ETM170

(3) Clutch KD

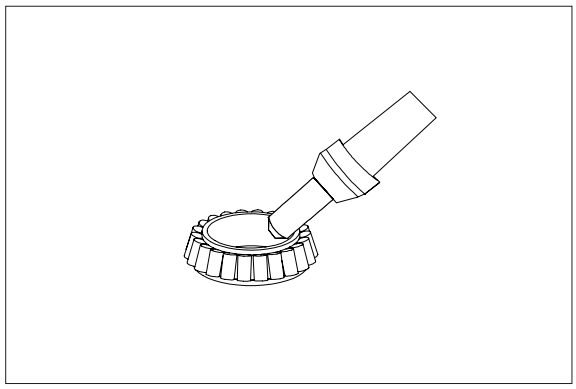
※ The clutch (1) is supplied by the spare parts service only as a complete assy which consists of :

1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM95

① Heat up bearing inner ring(approx. 120°C).

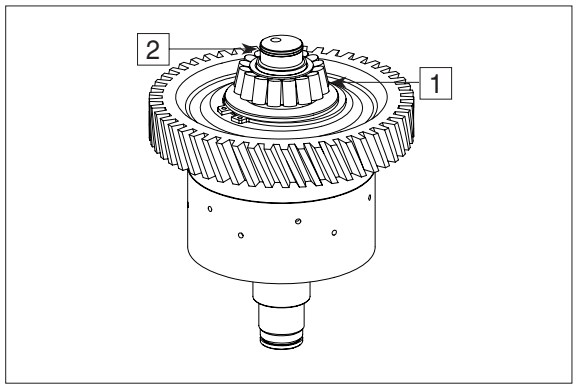

50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular rings 30 × 2 (2).

⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

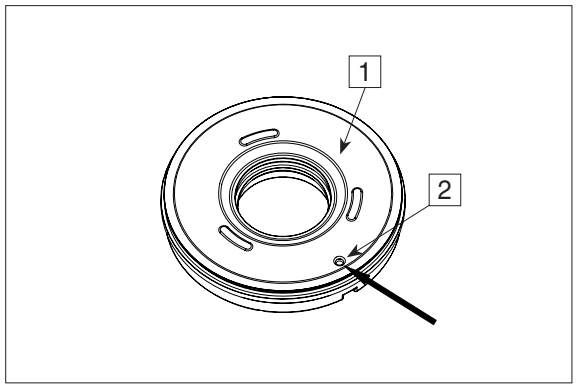


50DS7ETM171

③ Piston (1) with drain valve.

※ Check function of the drain valve (2). There must be no jamming of the ball(see arrow).

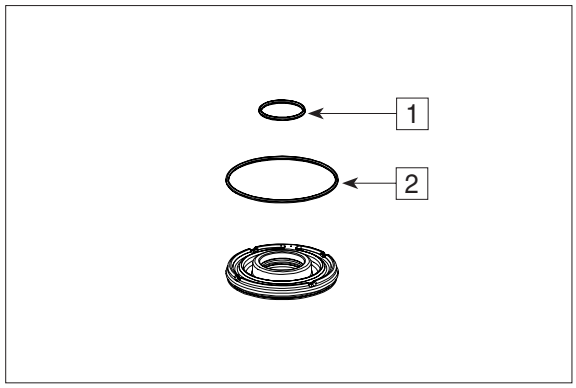
※ The piston (1) is supplied by the spare parts service only as a complete assy.



50DS7ETM172

④ Insert both O-rings (1 and 2) into the piston grooves and oil them.

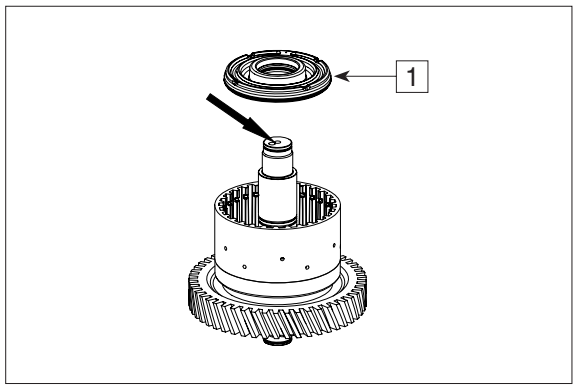
1 = 40×3
2 = 104.5×3



50DS7ETM62

⑤ Insert piston (1) into the disk carrier.

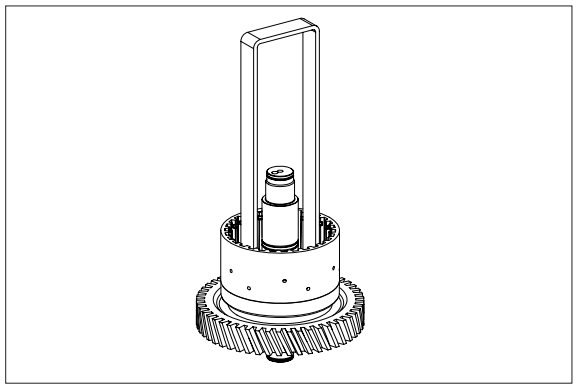
※ Pay attention to the installation position, see figure.



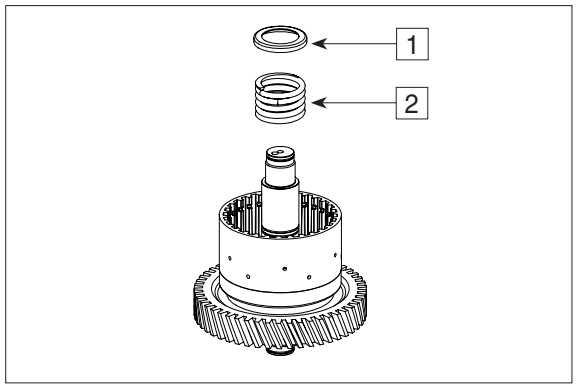
50DS7ETM91

⑥ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

(S) Assembly aid 5870 345 114


50DS7ETM173

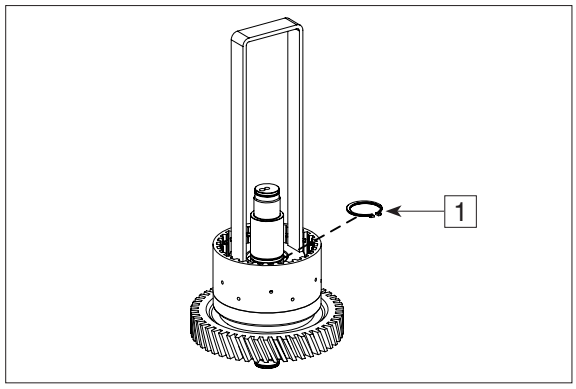
⑦ Mount compression spring (1) and spring cup (2).



50DS7ETM90

⑧ By means of the assembly aid, preload compression spring under a hand-operated press until the retaining ring 40 × 1.75 (1) can be snapped in.

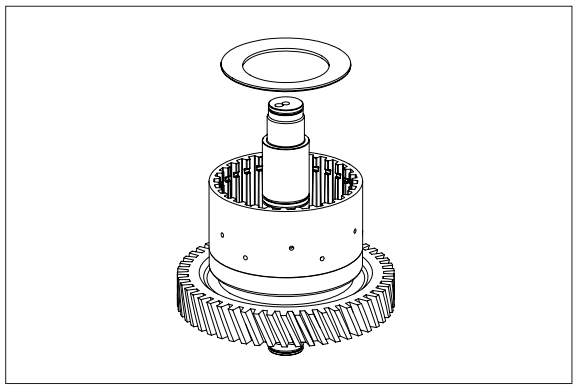
(S) Assembly aid 5870 345 114



50DS7ETM89

⑨ Cup spring (1) into the disk carrier.

※ Pay attention to the installation position, see next page TM177.

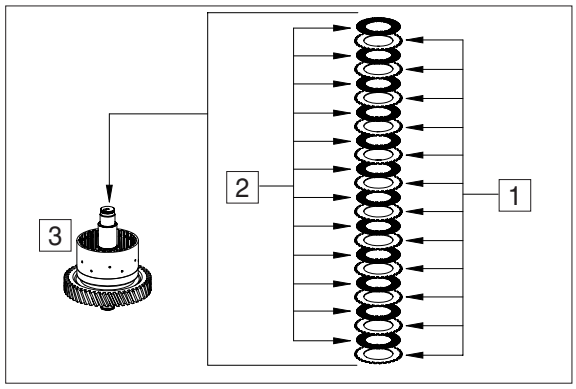


50DS7ETM174

⑩ Install outer and inner disks alternately into the disk carrier (3) as shown in figure.

Starting with an outer disk and ending with an inner disk.

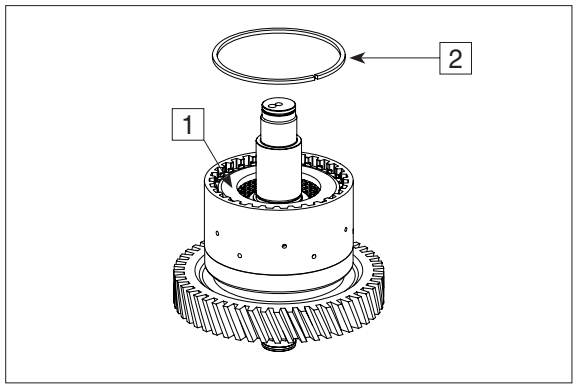
1 = Outer disks (12 pcs)
2 = Inner disks (12 pcs)
3 = Clutch assy



50DS7ETM175

⑪ Mount end plate (1) with the flat side showing towards the disk package and fix it by means of snap ring (2) (e.g. thickness = 2.5 mm/recommended value).

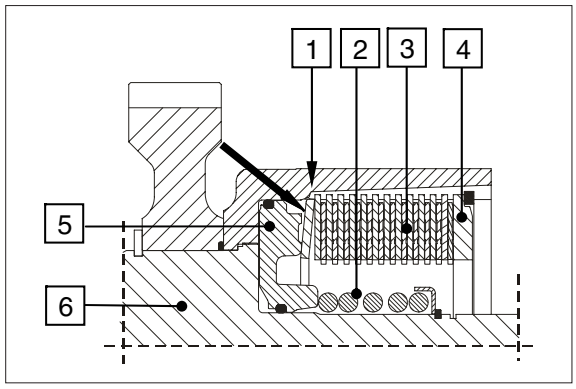
※ Pay attention to the installation position of the end plate, see next page TM177.



50DS7ETM176

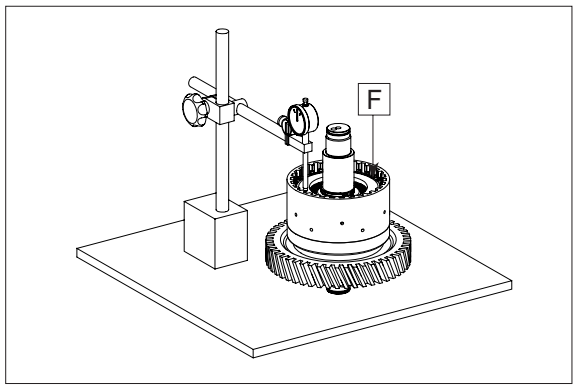
⑫ Cap spring (1) according to sketch (see arrow).

1 = Cup spring
2 = Compression spring with spring cup and retaining ring
3 = Inner clutch- and outer clutch disc
4 = End shim
5 = Piston with O-rings
6 = Clutch assy.



50DS7ETM177

⑬ Equally press on end plate with F (approx. 100N = 10kg) and set dial indicator to "zero".

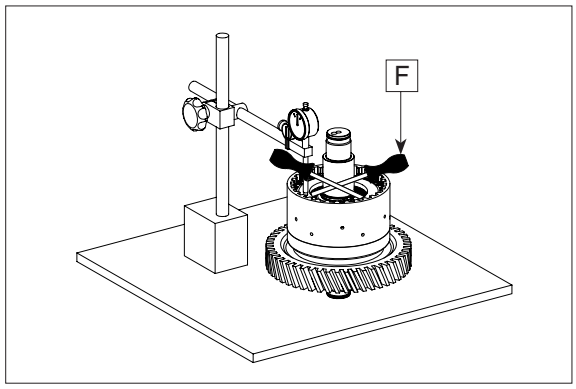


50DS7ETM178

⑭ Then press end plate against the snap ring (upwards) and read the disk clearance.

※ Disk clearance : 2.6 to 3.1 mm.

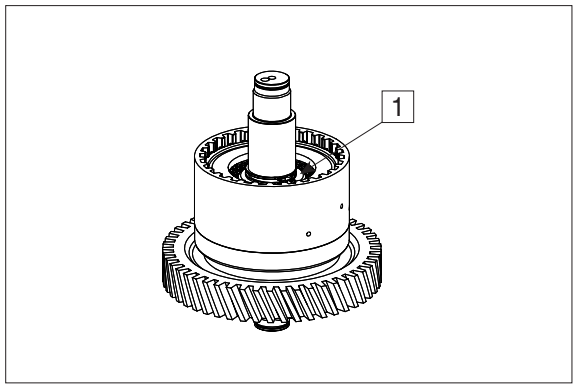
※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring(optional thickness = 2.0~3.5 mm/available in steps of 0.25 mm).



50DS7ETM179

⑮ Snap retaining ring 40×1.75 (1) into the groove.

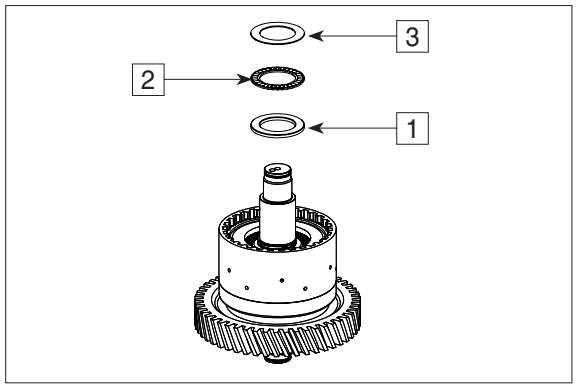
※ Contact for axial bearing - see next page TM181.



50DS7ETM180

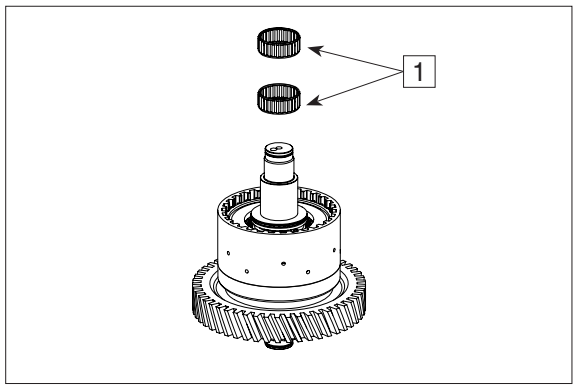
⑯ Mount running disk 40×60×3.5 (1), axial needle cage 40×60×3 (2) and axial washer 40×60×1 (3) and oil them.

※ Fit running disk (1), with the chamfer showing towards the retaining ring.



50DS7ETM181

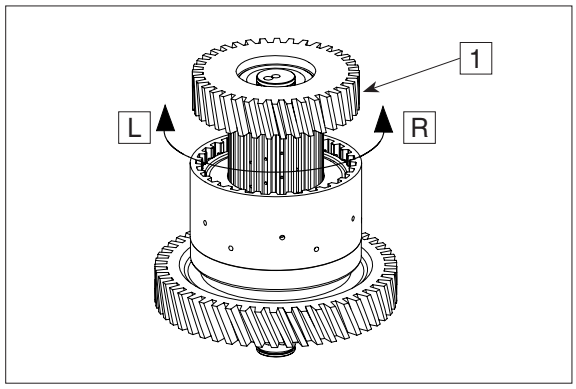
⑰ Mount needle cage 40×45×17 (1) and oil it.



50DS7ETM84

⑱ Mount inner disk carrier until contact is obtained.

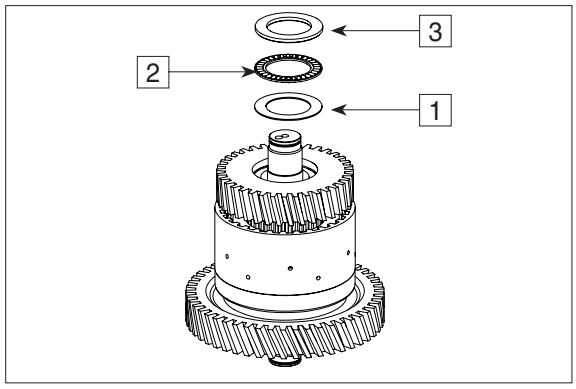
Install inner disks by short ccw/cw rotations of the inner disk carrier (1).



50DS7ETM182

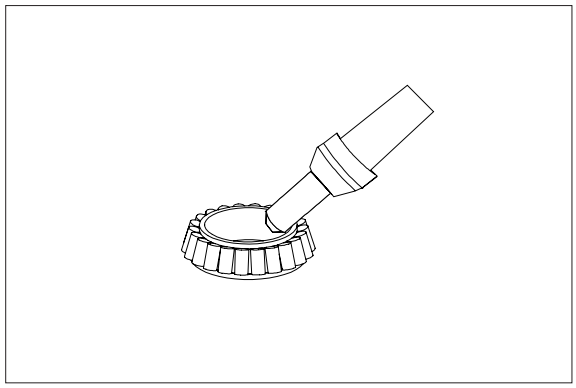
⑲ Mount axial washer 40×60×1 (1), axial needle cage 40×60×3 (2) and running disk (3) 40×60×3.5 and oil them.

※ Fit running disk (3), with the chamfer showing towards the tapered roller bearing.



50DS7ETM183

⑳ Heat up bearing inner ring (approx. 120°C).



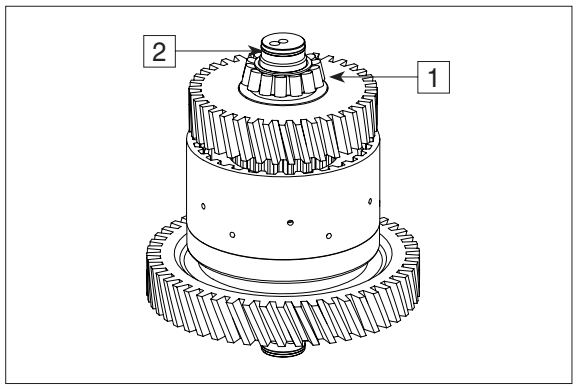
50DS7ETM128

㉑ Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 30 × 2 (2).

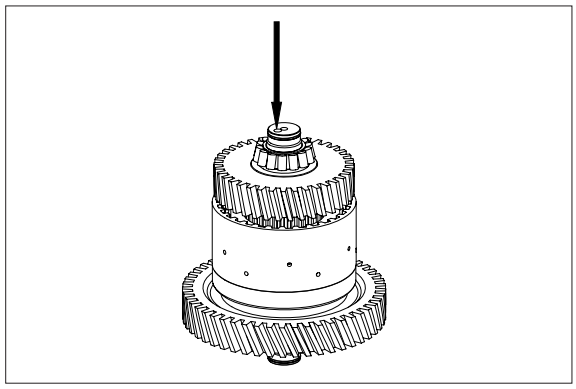
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM184

※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.

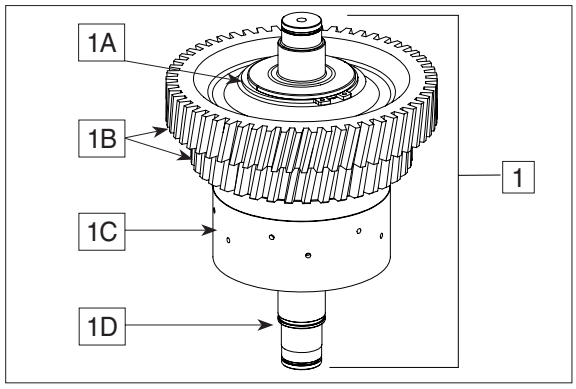


50DS7ETM185

(4) Clutch KE

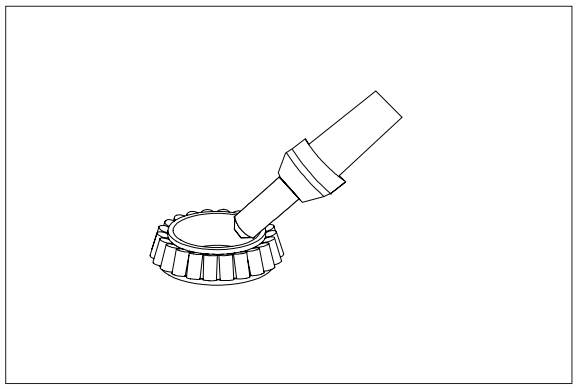
※ The clutch (1) is supplied by the spare parts service only as a complete assy which consists of :

1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM111

① Heat up bearing inner ring (approx. 120°C).

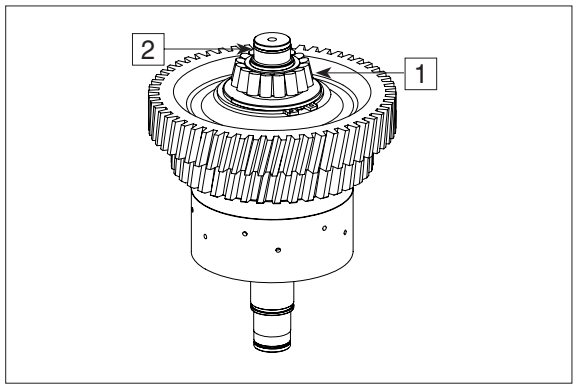

50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 30 × 2 (2).

⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

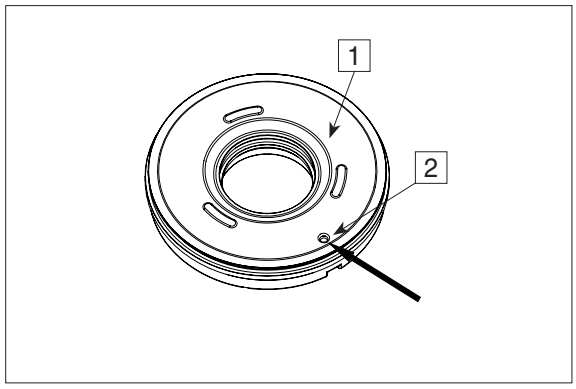


50DS7ETM186

③ Piston (1) with drain valve.

※ Check function of the drain valve (2). There must be no jamming of the ball (see arrow).

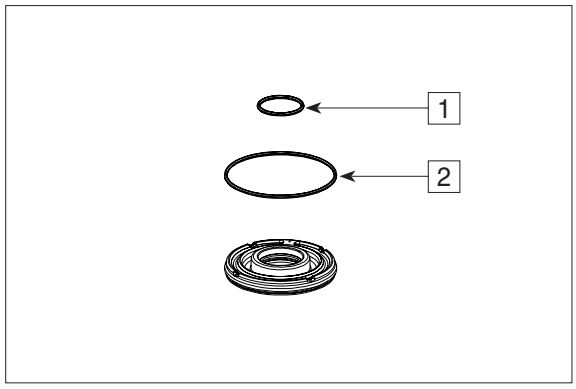
※ The piston (1) is supplied by the spare parts service only as a complete assy.



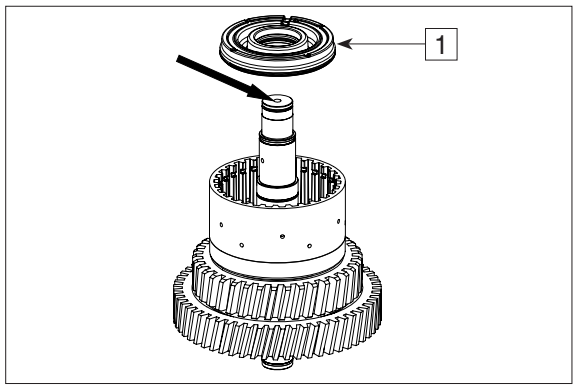
50DS7ETM187

④ Insert both O-rings (1 and 2) into the piston grooves and oil them.

1 = 40 × 3
2 = 104.5 × 3



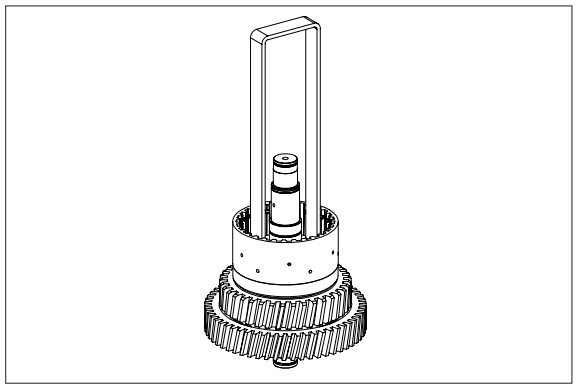
50DS7ETM62



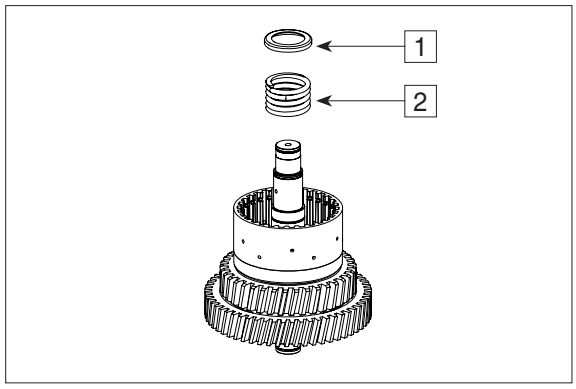
50DS7ETM107

⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

(S) Assembly aid 5870 345 114


50DS7ETM188

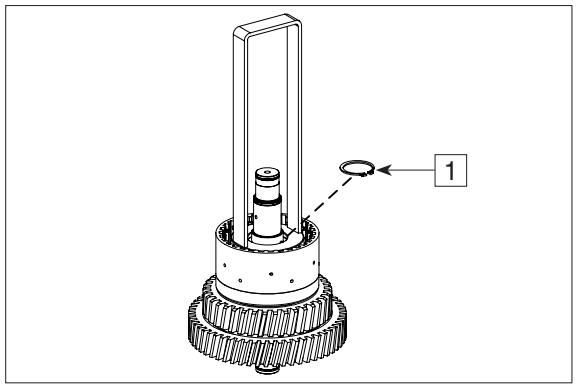
⑥ Mount compression spring (1) and spring cup (2).



50DS7ETM106

⑦ By means of the assembly aid, preload compression spring under a hand-operated press until the retaining ring 40 × 1.75 (1) can be snapped in.

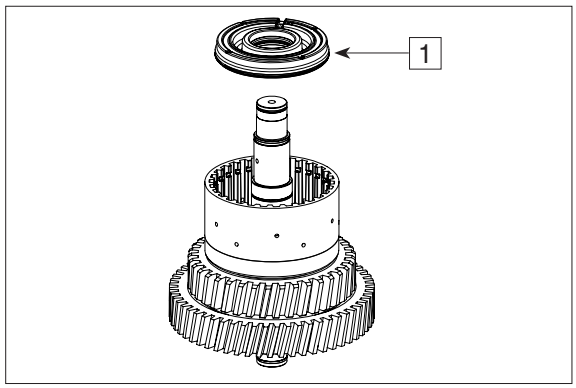
(S) Assembly aid 5870 345 114



50DS7ETM105

⑧ Cup spring (1) into the disk carrier.

※ Pay attention to the installation position, see next page TM192.

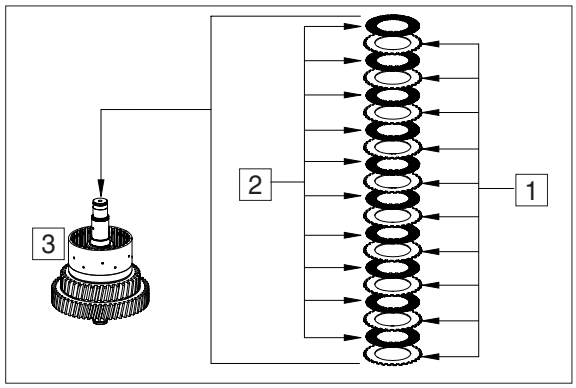


50DS7ETM189

⑨ Install outer and inner disks alternately into the disk carrier (3) as shown in figure.

Starting with an outer disk and ending with an inner disk.

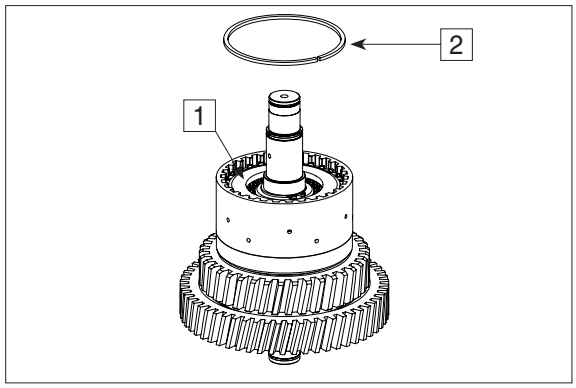
1 = Outer disks (10 pcs)
2 = Inner disks (10 pcs)
3 = Clutch assy



50DS7ETM190

⑩ Mount end plate (1) with the flat side showing towards the disk package and fix it by means of snap ring (2) (e.g. thickness=2.5 mm/recommended value).

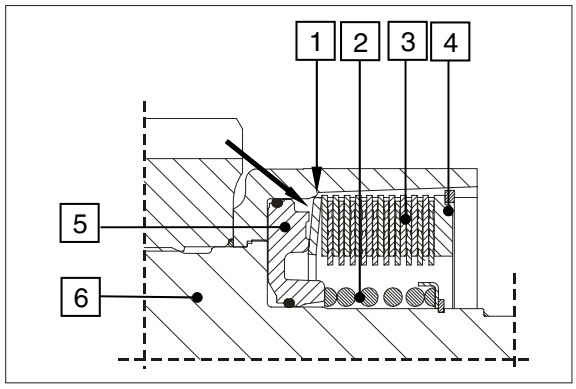
※ Pay attention to the installation position of the end plate, see next page TM192.



50DS7ETM191

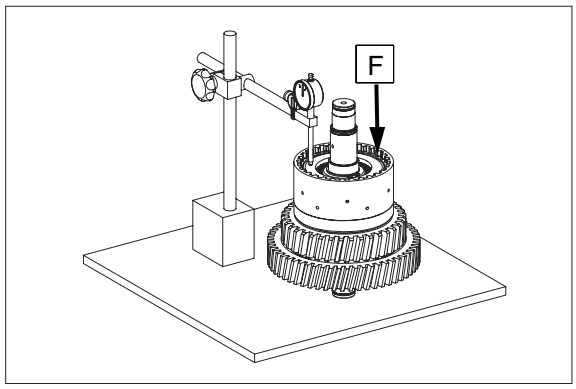
⑪ Cap spring (1) according to sketch(see arrow).

1 = Cup spring
2 = Compression spring with spring cup and retaining ring
3 = Inner clutch-and outer clutch disc
4 = End shim
5 = Piston with O-rings
6 = Clutch assy



50DS7ETM192

⑫ Equally press on end plate with F (approx. 100 N = 10㎏) and set dial indicator to "zero".

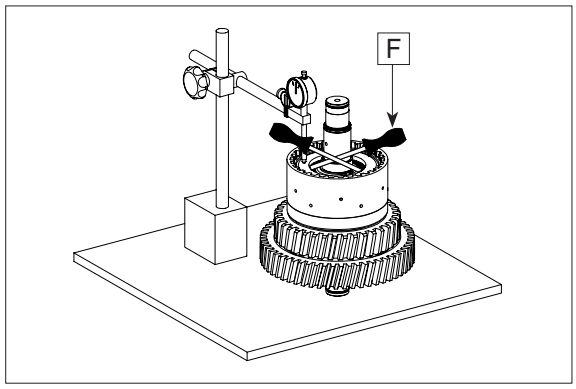


50DS7ETM193

⑬ Then press end plate against the snap ring (upwards) and read the disk clearance.

※ Disk clearance : 2.2 to 2.6 ㎜.

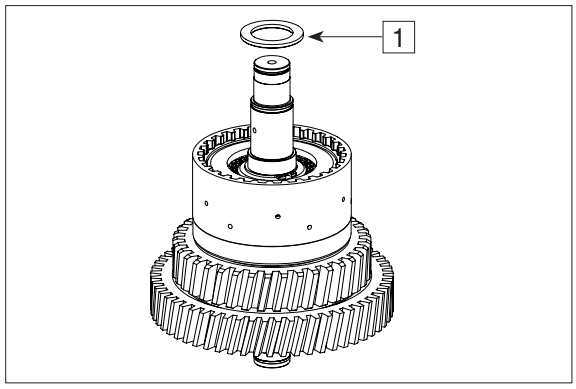
※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring(optional thickness=2.0~3.5 ㎜/available in steps of 0.25 ㎜).



50DS7ETM194

⑭ Mount running disk 35 × 52 × 3.5 (1).

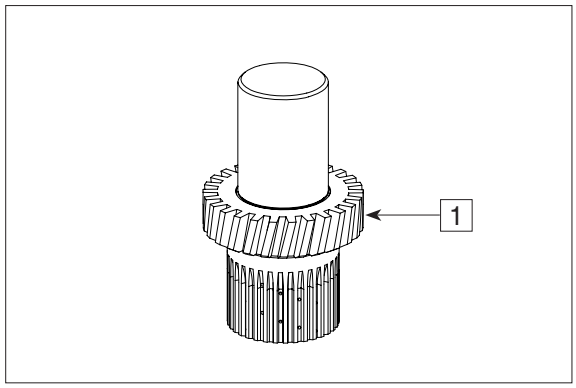
※ Fit running disk (1), with the chamfer showing towards the retaining ring.



50DS7ETM195

⑮ Press in both bearing outer rings into the inner disk carrier (1) until contact is obtained.

Then mount the bearing inner rings.



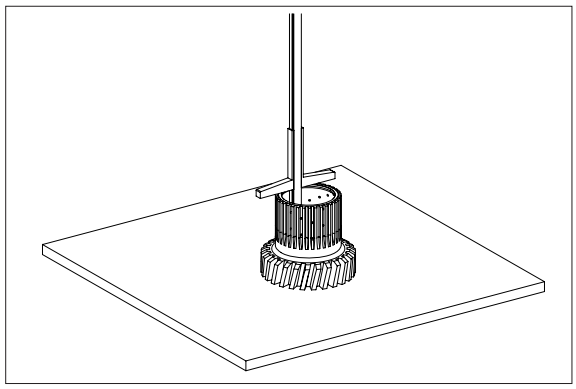
50DS7ETM196

※ Setting of axial play of the inner disk carrier bearing ± 0.05 mm (see TM197 to TM202) :

⑯ Determine dimension "X2" of the inner disk carrier → see below figure.

Calculation example :

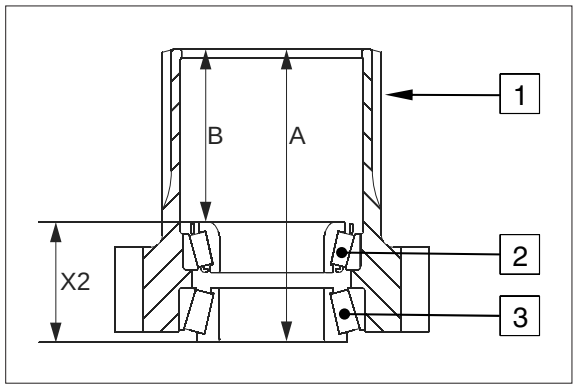
Dimension A ----------	97.00 mm
Dimension B ----------	- 57.00 mm
Dimension X2 ----------	= 40.00 mm



50DS7ETM197

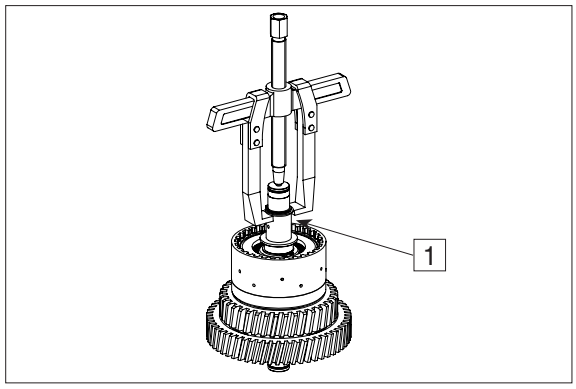
⑰ Legend :

1 = Inner disk carrier
2 = Tapered roller bearing 59 × 35 × 16
3 = Tapered roller bearing 62 × 35 × 18



50DS7ETM198

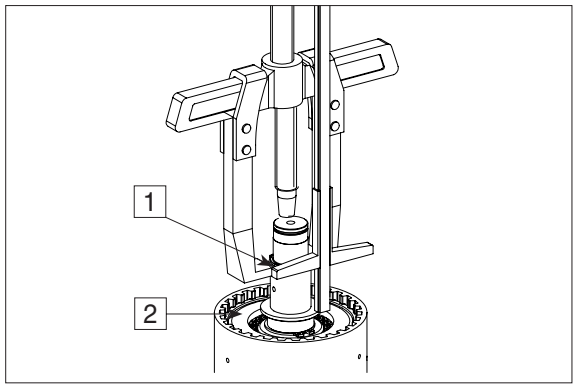
⑱ Mount the retaining ring e.g. 35 × 2.0 (1) and bring it into contact position by means of a two-armed puller.



50DS7ETM199

⑲ Determine dimension "X1" from retaining ring (1) to running disk (2).
→ see below figure.

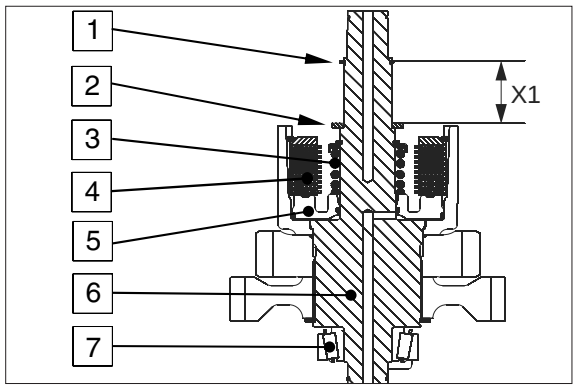
Dimension X1 = 42.1 mm



50DS7ETM200

⑳ Legend :

1 = Retaining ring 35 × 2.0
2 = Running disk 35 × 52 × 3.5
3 = Compression spring with cup spring and retaining ring
4 = Disk package with end plate and snap ring
5 = Piston with O-rings
6 = Clutch assy
7 = Tapered roller bearing



50DS7ETM201

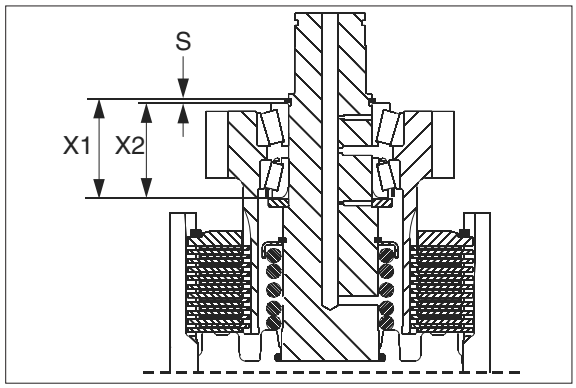
㉑ **Axial play of inner disk carrier bearing ±0.05**

Calculation example :

Dimension X1 ----------	42.10 mm
Dimension X2 ----------	- 40.00 mm
Dimension S (retaining ring) ---	= 2.10 mm

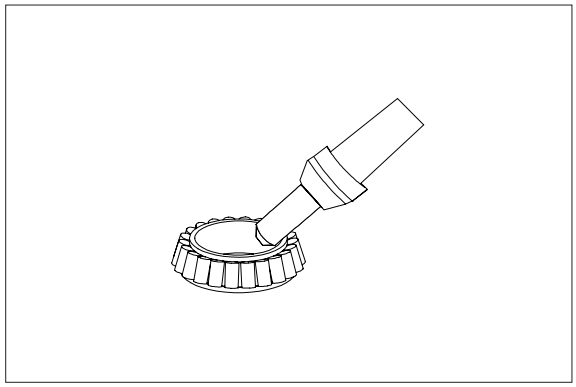
※ Determined retaining ring S = 2.10 mm

※ Axial play must be set with the retaining ring(optional thickness = 1.8~2.7 mm/ available in steps of 0.10 mm).



50DS7ETM202

㉒ Heat up bearing inner ring (approx. 120°C).



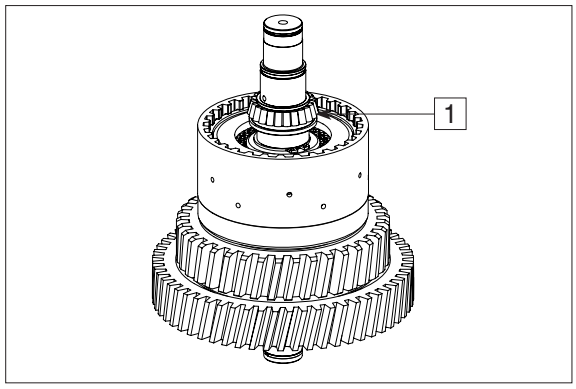
50DS7ETM128

㉓ Mount bearing inner ring (1) until contact is obtained.

※ Different bearing sizes → see page 3-124 TM198.

⚠ Wear protective gloves.

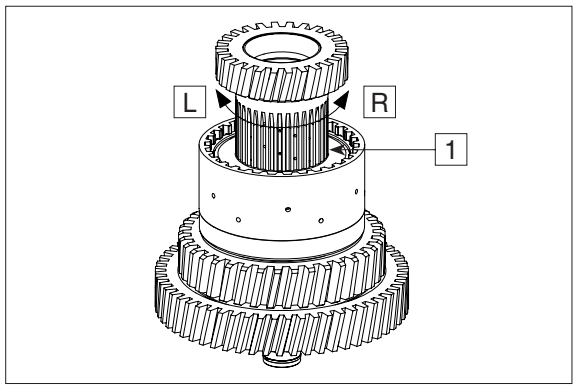
※ Adjust bearing inner ring after cooling-down.



50DS7ETM203

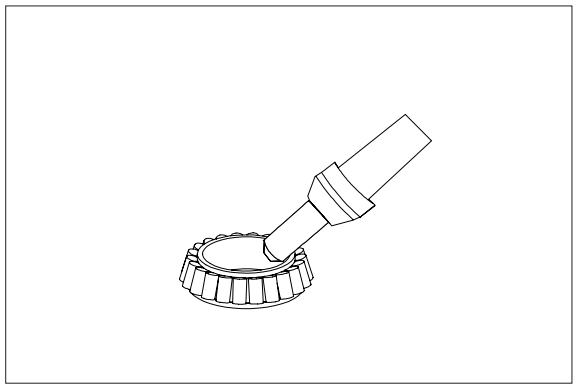
㉔ Mount inner disk carrier until contact is obtained.

Install inner disks by short ccw/cw rotations of the inner disk carrier (1).



50DS7ETM204

㉕ Heat up bearing inner ring (approx. 120°C).



50DS7ETM128

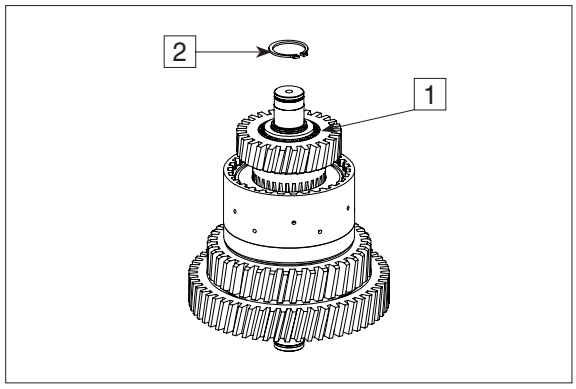
㉖ Mount bearing inner ring (1) until contact is obtained.

⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

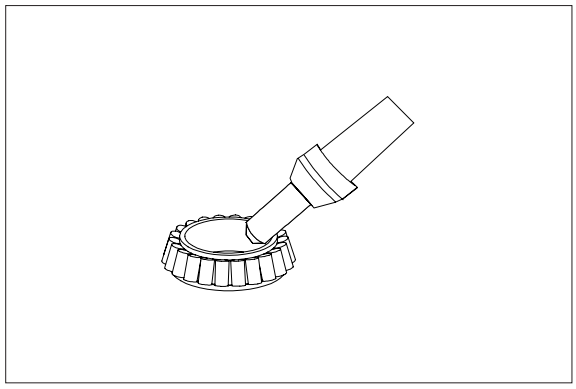
Snap in retaining ring 35 × 2.1 (2).

※ Pay attention to an exact contact of the retaining ring in the groove.



50DS7ETM205

㉗ Heat up bearing inner ring (approx. 120°C).

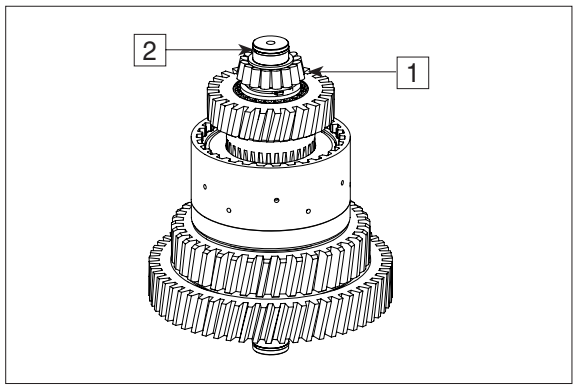


50DS7ETM128

㉘ Mount bearing inner ring (1) until contact is obtained.
Fit rectangular ring 30 × 2 (2).

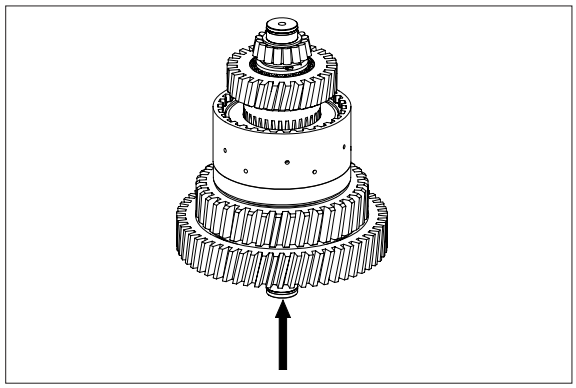
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM206

※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.

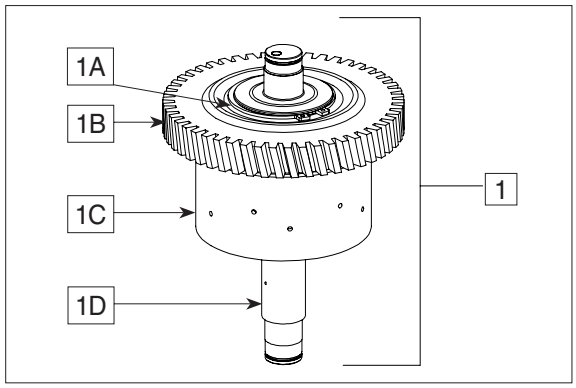


50DS7ETM207

(5) Clutch KC

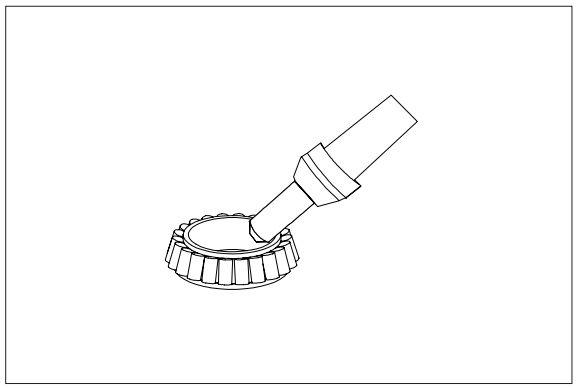
※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of :

1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM124

① Heat up bearing inner ring (approx. 120°C).

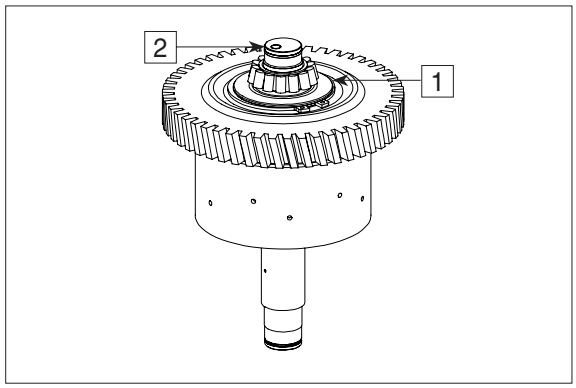

50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular rings 30 × 2 (2).

⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM208

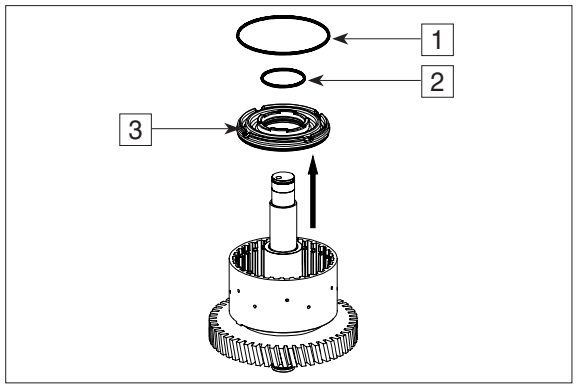
③ Insert both O-rings (1 and 2) into the piston (3) grooves and oil them.

1 = 115 × 3
2 = 52 × 3

Insert piston (3) into the disk carrier.

※ Pay attention to the installation position, see next page TM211.

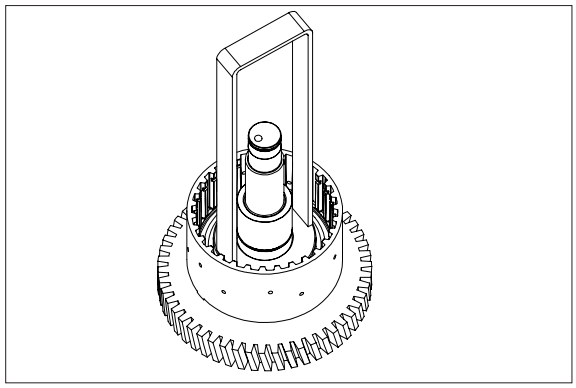
※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



50DS7ETM209

④ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

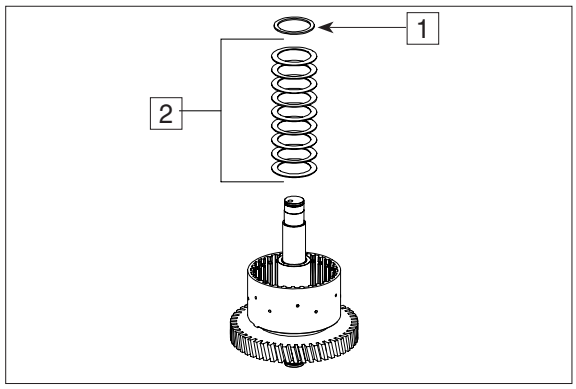
(S) Assembly aid 5870 345 114



50DS7ETM210

⑤ Mount cup spring package (1) and disk (2).

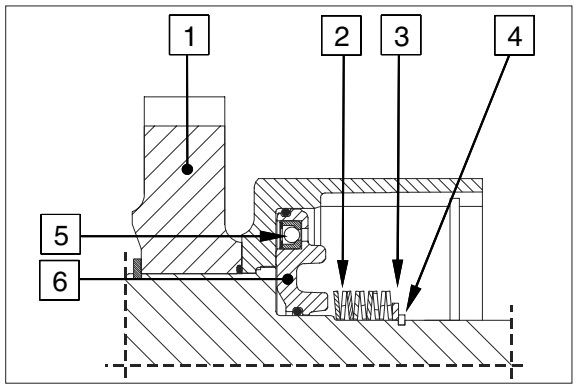
※ Installation position of the cup springs, see below figure.



50DS7ETM120

⑥ Install cup springs according to the sketch.

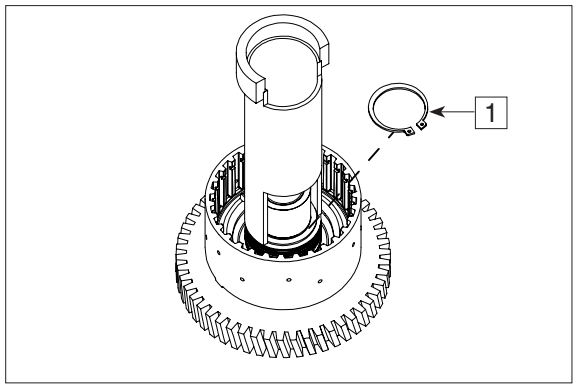
1 = Clutch
2 = Cup springs (9 pcs)
3 = Disk
4 = Retaining ring (50×2)
5 = Drain valve (piston)
6 = Piston with O-Rings



50DS7ETM211

⑦ By means of the assembly aid, preload cup springs under a handoperated press until the retaining ring 50×2 (1) can be snapped in.

(S) Assembly aid 5870 506 128

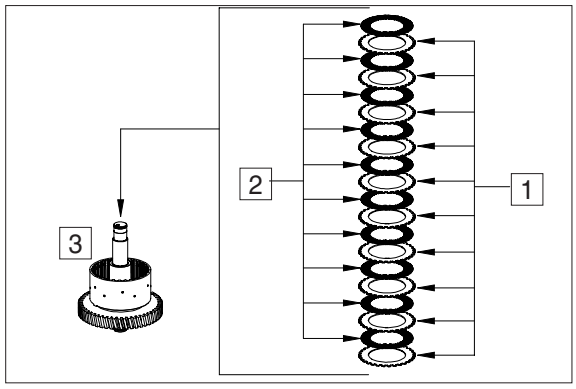


50DS7ETM119

⑧ Install outer and inner disks alternately into the disk carrier (3) as shown in figure.

Starting with an outer disk and ending with an inner disk.

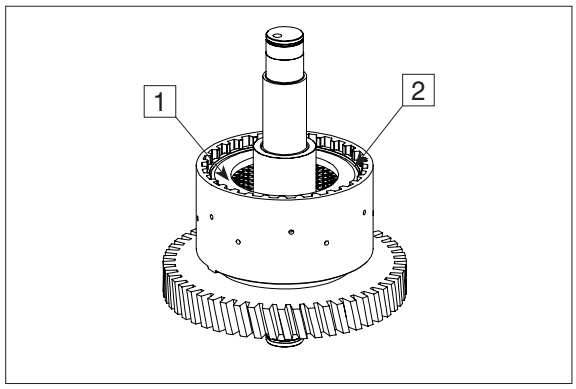
1 = Outer disks (10 pcs)
2 = Inner disks (10 pcs)
3 = Clutch assy



50DS7ETM212

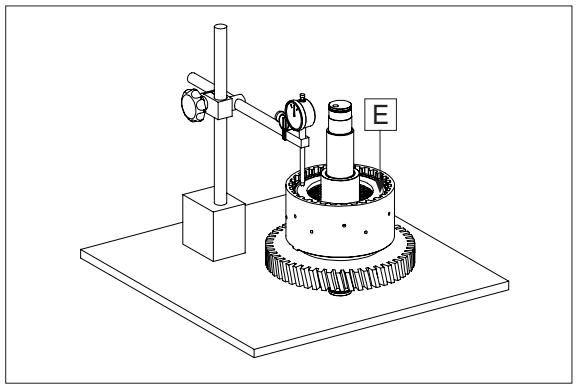
⑨ Mount end plate (1) with the flat side showing towards the disk package and fix it by means of snap ring (2) (e.g. thickness=2.5 mm/recommended value).

※ Pay attention to the installation position of the end plate.



50DS7ETM213

⑩ Equally press on end plate with F (approx. 18 N to 20 N = 1.8 to 2.0 kg) and set dial indicator to "zero".

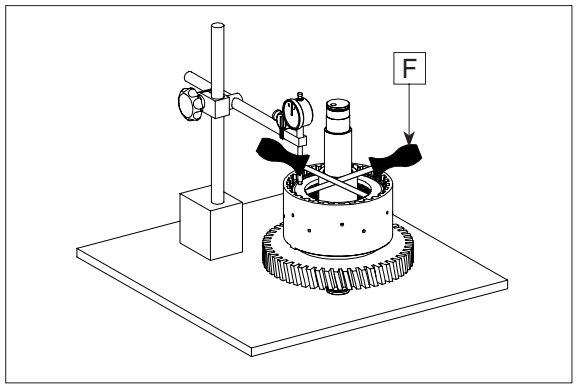


50DS7ETM214

⑪ Then press end plate against the snap ring (upwards) and read the disk clearance.

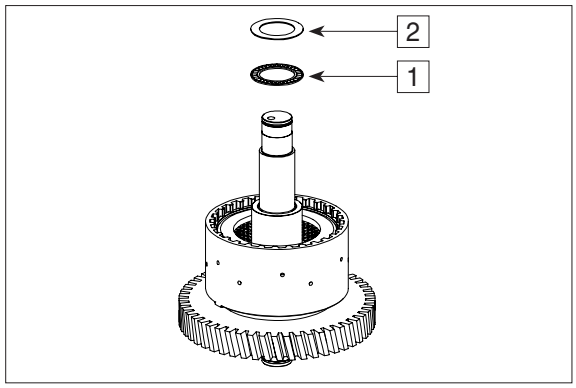
※ Disk clearance : 2.0 to 3.0 mm.

※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thickness s=2.0~4.0 mm/available in steps 0.25 mm).



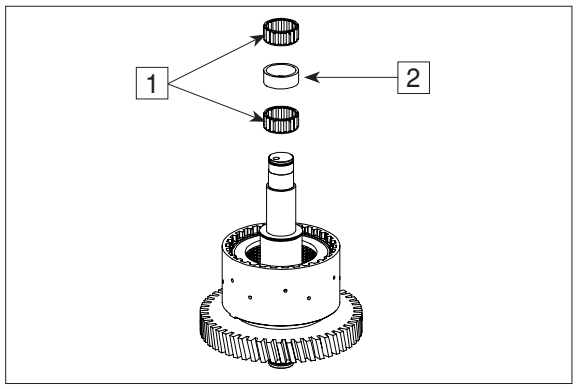
50DS7ETM215

⑫ Mount axial needle cage 35×52×2 (1) and axial disk 35×52×1 (1) and oil them.



50DS7ETM116

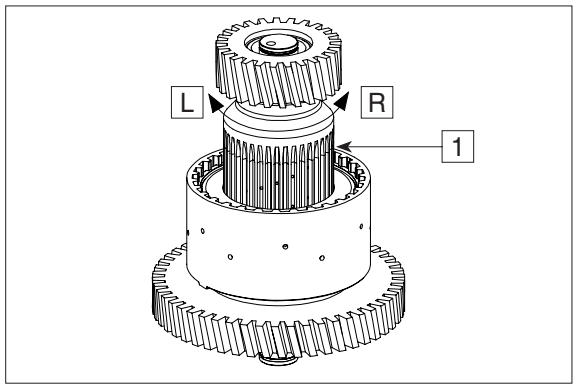
⑬ Mount needle cage 35×42×18 (1) and bush (2) and oil it.



50DS7ETM115

⑭ Mount inner disk carrier until contact is obtained.

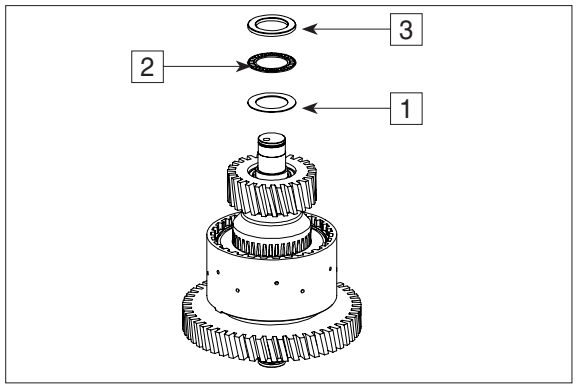
Install inner disks by short ccw/cw rotations of the inner disk carrier (1).



50DS7ETM216

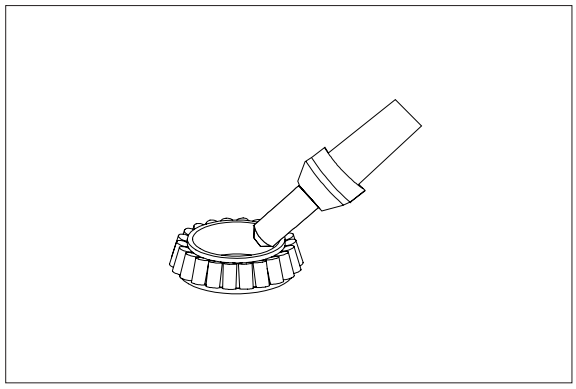
⑮ Mount axial washer 35×60×1 (1), axial needle cage 40×60×3 (2) and running disk (3) 40×60×3.5 and oil them.

※ Fit running disk (3), with the chamfer showing towards the tapered roller bearing.



50DS7ETM217

⑯ Heat up bearing inner ring (approx. 120°C).



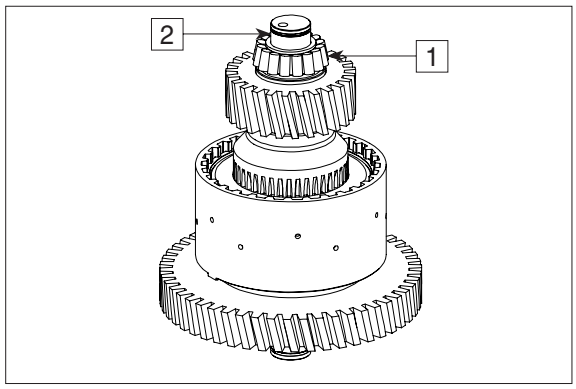
50DS7ETM128

⑰ Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 30 × 2 (2).

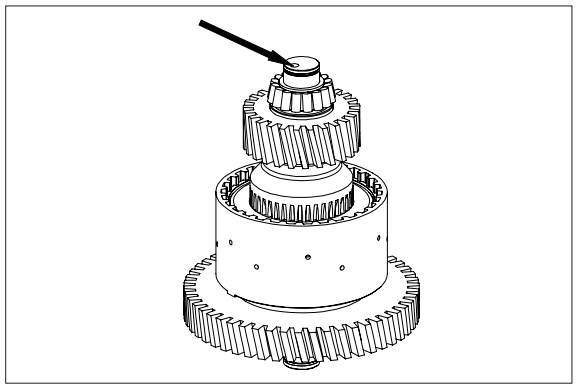
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM218

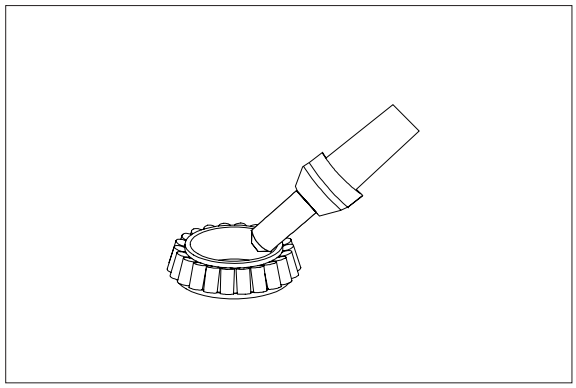
※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.



50DS7ETM219

(6) Output

① Heat up bearing inner ring (approx. 120°C).

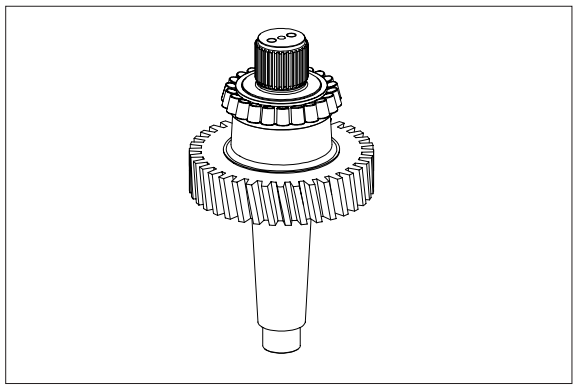


50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

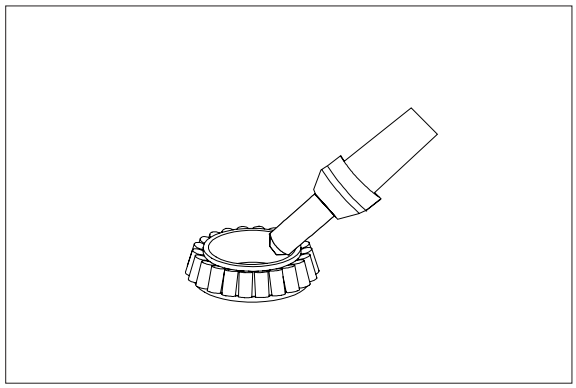
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM220

③ Heat up bearing inner ring (approx. 120°C).

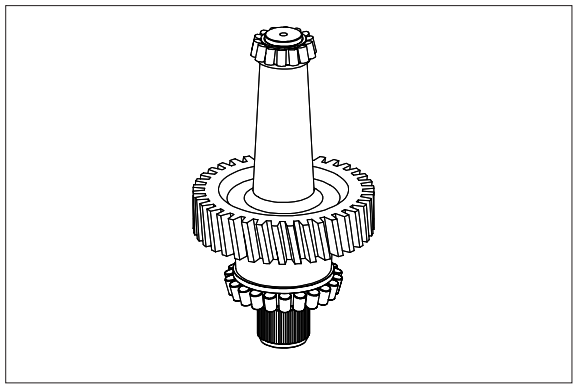


50DS7ETM128

④ Mount bearing inner ring (1) until contact is obtained.

⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



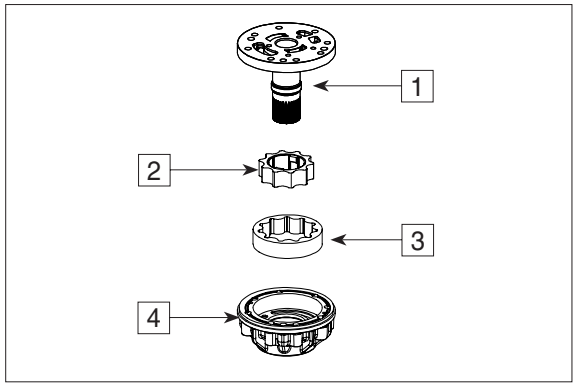
50DS7ETM221

2) REASSEMBLY OF OIL PRESSURE PUMP AND REINSTALLATION OF CLUTCHES

(1) Reassembly of oil pressure pump

※ In case of wear marks in the pump housing, stator hollow shaft, inner rotor, outer rotor and on the sliding bearing, the pump assy must be replaced.

1 = Stator hollow shaft
2 = Inner rotor
3 = Outer rotor
4 = Pump housing with sliding bearing

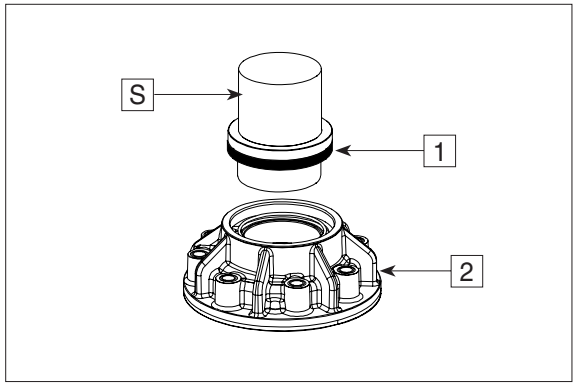


50DS7ETM48

① With the sealing lip showing downwards, carefully insert the shaft seal 55×75×8 (1) into the pump housing (2) until contact is obtained.

※ Apply sealing agent (Loctite no. 574) to the outer diameter.

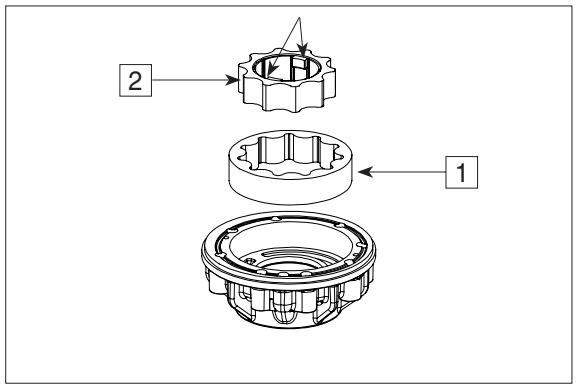
(S) Driver tool 5870 048 219



50DS7ETM222

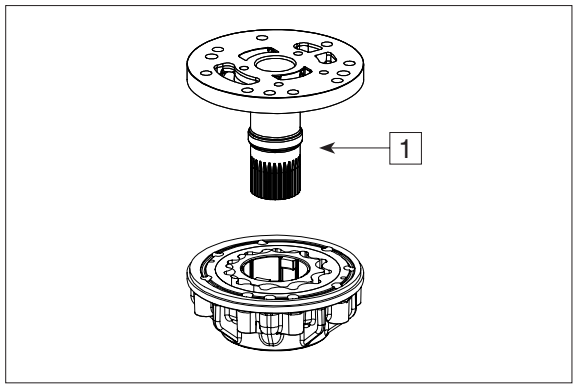
② Mount outer rotor (1) and inner rotor (2).

※ The driver pins of the inner rotor (see arrows) are to be fitted in upward direction.



50DS7ETM223

③ Fit stator hollow shaft (1).

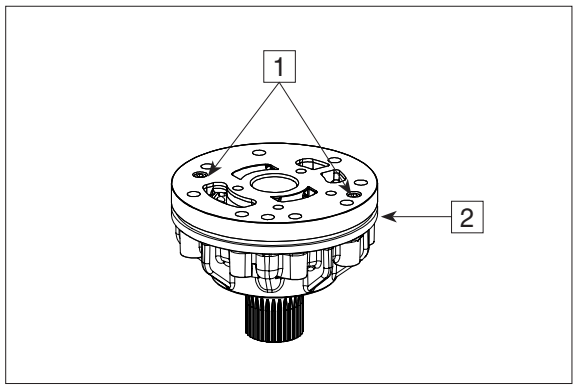


50DS7ETM224

④ Fix stator hollow shaft radially with two cylindrical screws (1).

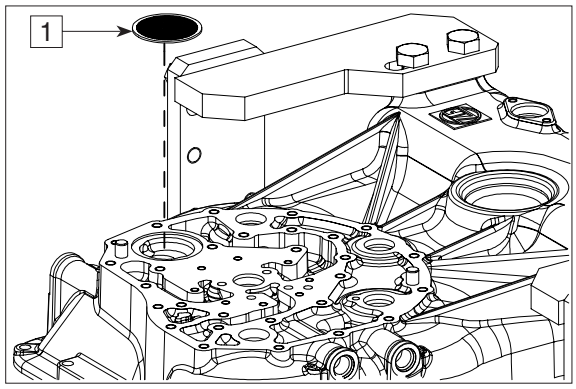
※ Do not tighten the cylindrical screws - just turn them in until contact is obtained and then turn them back by approx. 1/2 rotation.

Place O-ring (2) 135×3 into the annular groove and grease it.



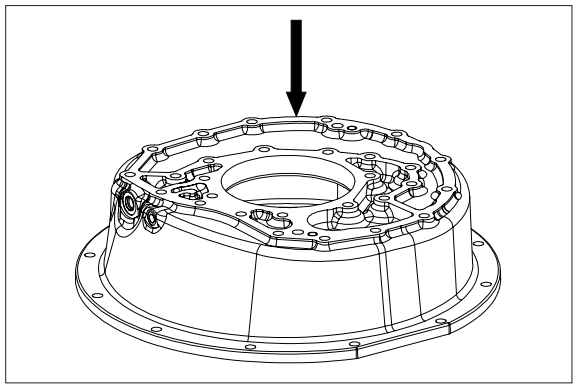
50DS7ETM225

⑤ Insert filter (1).



50DS7ETM226

⑥ Wet mounting face bell housing with Loctite (type no. 574).

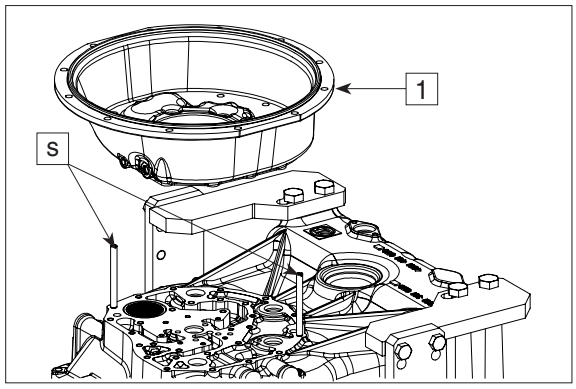


50DS7ETM227

⑦ Fit two adjusting screws (S) and position converter bellhousing (1) equally until contact is obtained.

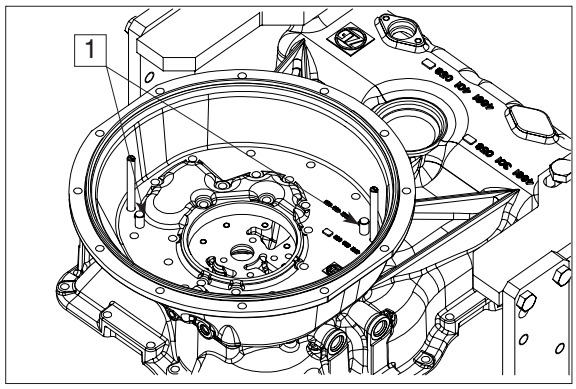
※ Pay attention to the hole pattern.

(S) Adjusting screws (M10) 5870 204 007



50DS7ETM228

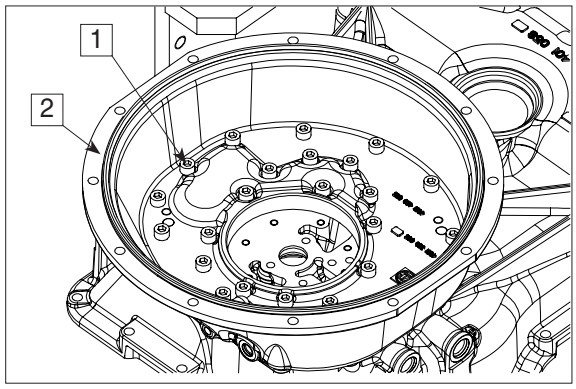
⑧ Force the cylindrical pins 12×24 (1) into the holes (blind holes) until contact is obtained.



50DS7ETM229

⑨ Fix converter bell housing (1) with cylindrical screws M10×30 (2).

Tightening torque (M10/8.8×30) ····· ····· M_A = 46 Nm

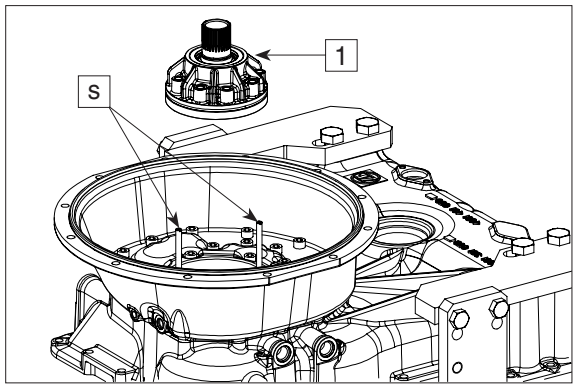


50DS7ETM230

⑩ Fit two adjusting screws (S) and mount preassembled pump (1).

※ Pay attention to the hole pattern.

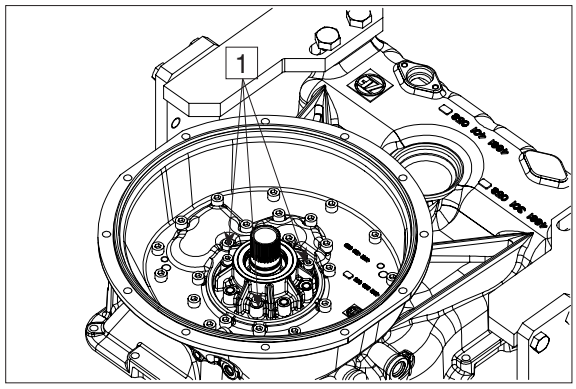
(S) Adjusting screws (M8) 5870 204 011



50DS7ETM231

⑪ Position transmission pump with 3 cylindrical screws (1) M8 × 60 (3 × 120° offset position) equally until contact is obtained.

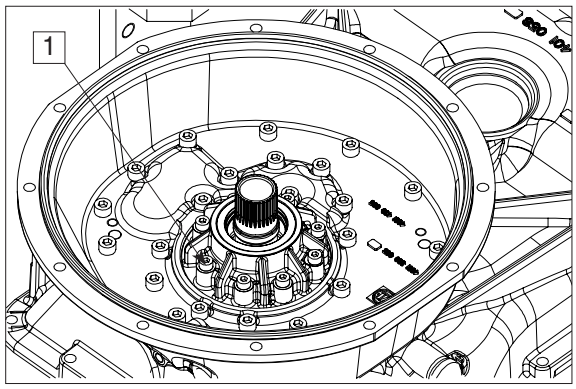
※ Do not damage (shear off) the O-ring.



50DS7ETM232

⑫ Fix transmission pump with cylindrical screws M8 × 60 (1).

Tightening torque (M8/8.8 × 60) ..... M_A = 23 Nm



50DS7ETM233

⑬ Fix pump with cylindrical screws (1 and 2).

1 = M8 × 16

2 = M8 × 35

Tightening torque M8/8.8 × 16 ---- M_A = 23 Nm

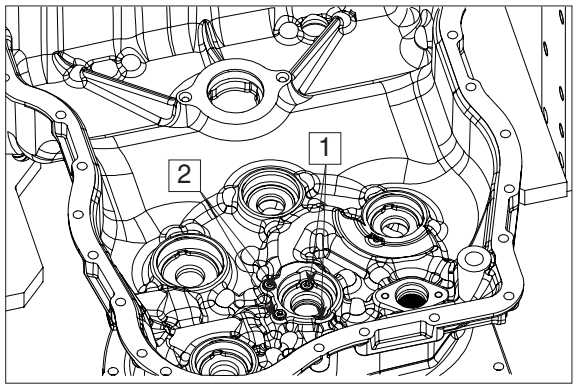
Tightening torque M8/8.8 × 35 ---- M_A = 23 Nm

※ New cylindrical screws are to be fitted on a general basis.

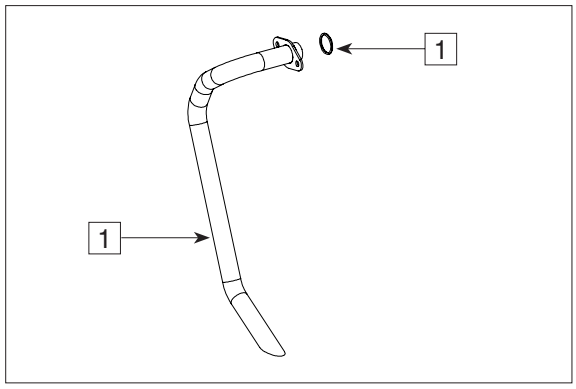
※ These cylindrical screws are already provided with adhesive (microcapsule).

The microcapsule bursts when the screw is turned in, wets screw and nut thread and hardens.

Mount O-ring 30 × 3 (1) onto the suction tube (2) and grease it.



50DS7ETM234



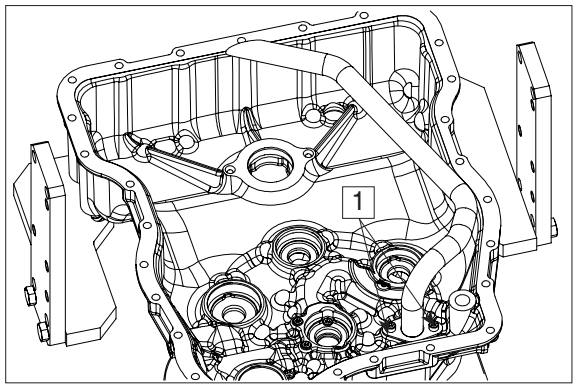
50DS7ETM235

⑭ Fix suction tube (1) with cylindrical screws M8 × 16 (2).

Tightening torque M8/8.8 × 16 ---- M_A = 23 Nm

※ When reusing the cylindrical screws, they must be secured with Loctite no. 243.

※ New cylindrical screws are already provided with adhesive (microcapsule). The microcapsule bursts when the screw is turned in, wets screw and nut thread and hardens.

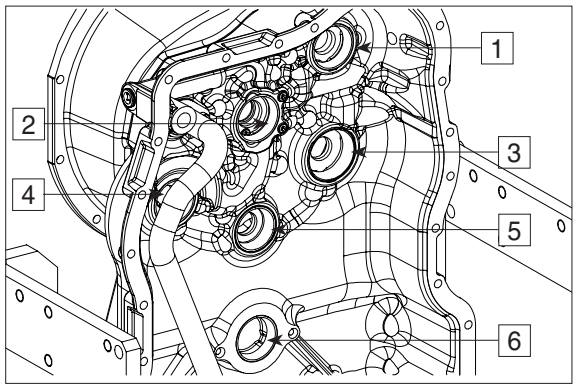


50DS7ETM236

⑮ Insert all bearing outer rings into the bearing holes of both housing parts (see figure TM236 and TM237).

1 = KV clutch - forward
2 = KR clutch - reverse and input
3 = KD clutch - 2nd gear
4 = KC clutch - 1st gear
5 = KE clutch - 3rd gear
6 = Output

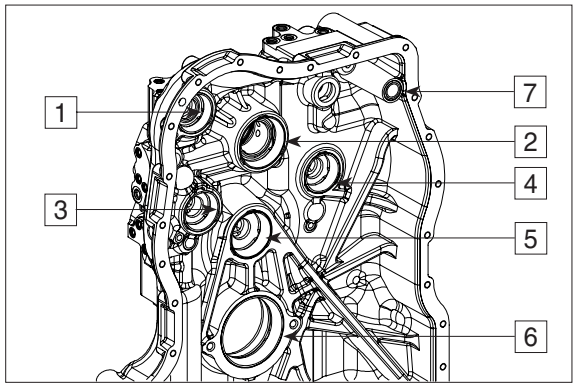
※ Place bearing outer rings into the bearing holes using assembly grease.



50DS7ETM237

※ If, contrary to the ZF recommendation, the tapered roller bearings of clutches and input are not replaced, it is imperative to ensure the previous pairing (bearing inner ring/bearing outer ring) - see page 3-78 TM40 and TM41.

⑯ Insert O-ring 24 × 2.5 (7) into the hole and grease it.

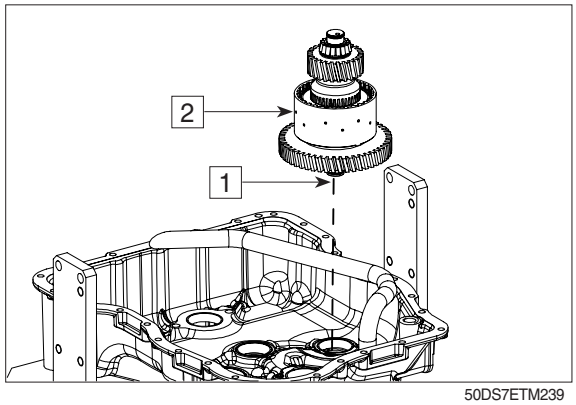


50DS7ETM238

(2) Reinstallation of clutches

① Align and grease rectangular ring 30 × 2 (1).

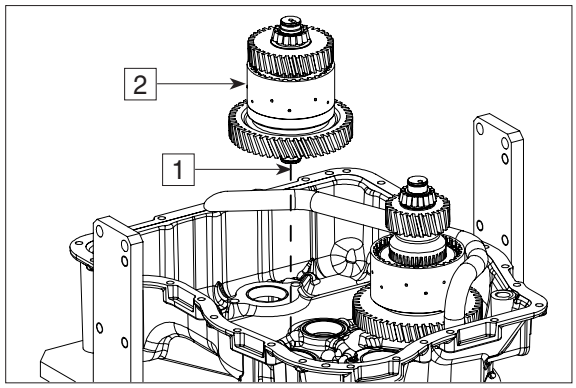
Position clutch KC (2).



50DS7ETM239

② Align and grease rectangular ring 30×2 (1).

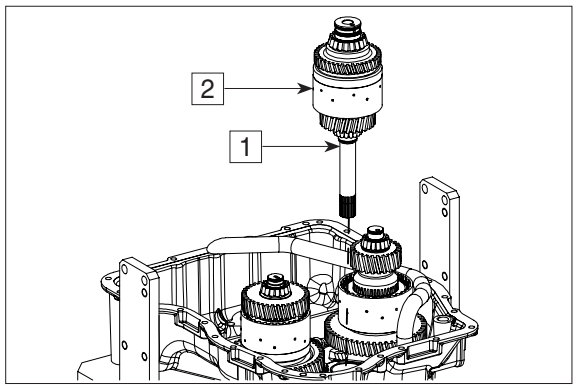
Position clutch KD (2).



50DS7ETM240

③ Align and grease rectangular rings 50×2.5 (1).

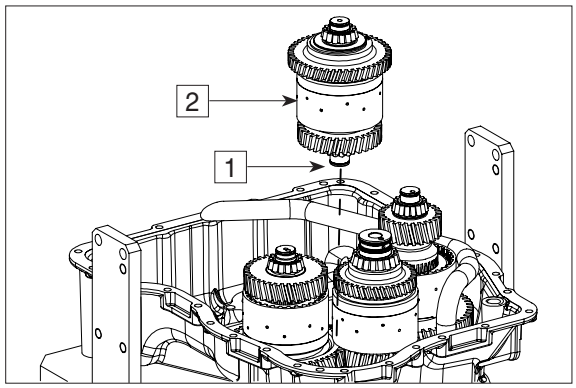
Position clutch KR- input (2).



50DS7ETM241

④ Align and grease rectangular ring 30×2 (1).

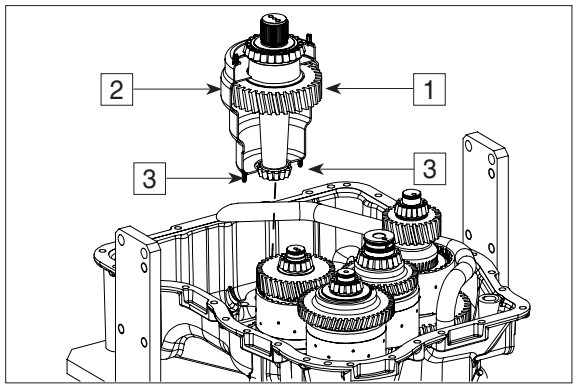
Position clutch KV (2).



50DS7ETM242

⑤ Position output shaft (1) together with screen sheet (2).

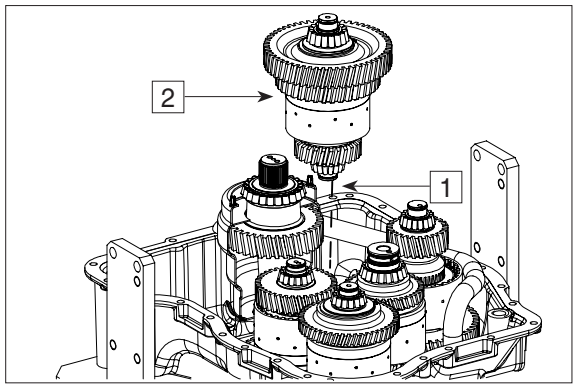
※ Bolts (3) of screen sheet must be fixed into the pilot holes.



50DS7ETM243

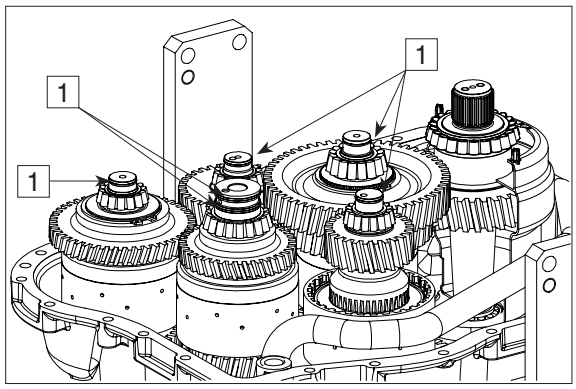
⑥ Align and grease rectangular ring 30×2 (1).

Position clutch KE (2).



50DS7ETM244

⑦ Align and grease rectangular rings (1).

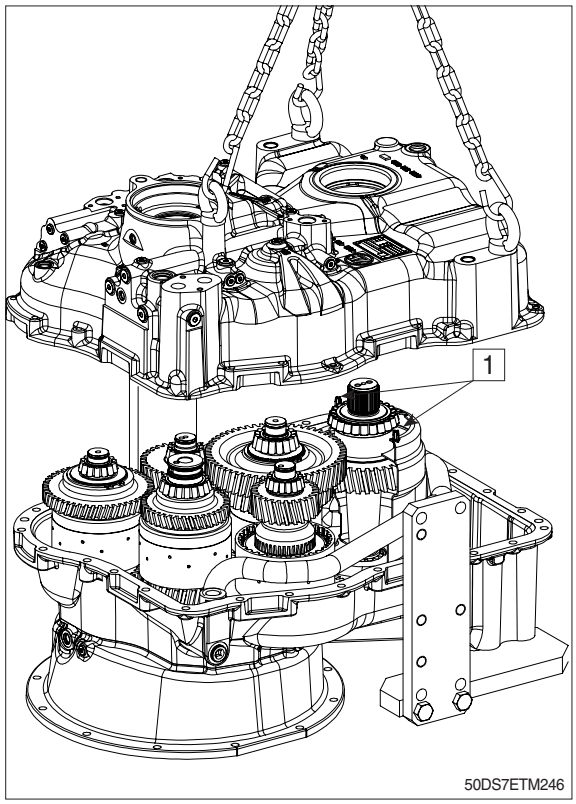


50DS7ETM245

⑧ Use the lifting device to carefully bring the transmission housing rear part into contact position.

※ Bolts (1) of screen sheet must be fixed into the pilot holes.

※ Wet mounting face with Loctite (type no. 574).



50DS7ETM246

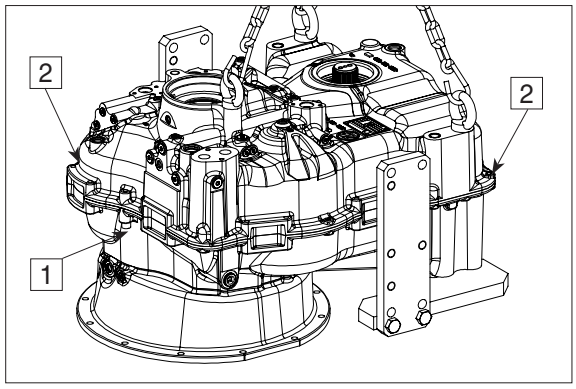
⑨ Hand-tighten the transmission housings crosswise with 2 cylindrical screws (1).

Fit cylindrical pins 12 × 24 (2) centrically to the mounting face.

Tighten the transmission housing front and rear part crosswise with 4 cylindrical screws M10 (1).

Tightening torque ---------- M_A = 46 Nm

⚠ Transmission rear part is not fixed to the holding fixture and could get loose after turning.
Secure the connection with cylindrical screws.



50DS7ETM247

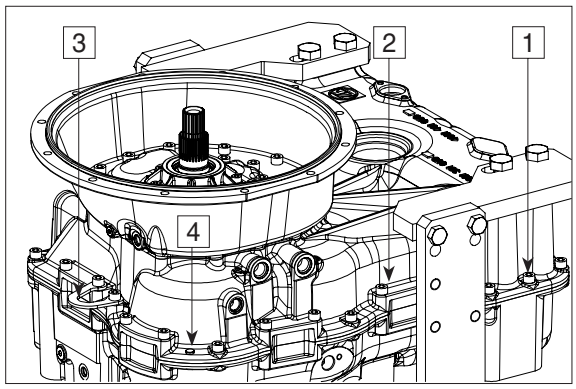
⑩ Fix transmission housing front and rear part by means of cylindrical screws (1 and 2).

Fit bracket (3).

Cylindrical screws (1) M10 × 30 (11EA)
Cylindrical screws (1) M10 × 50 (17EA)

Tightening torque (M10/8.8 × 30) ····· M_A = 46 Nm
Tightening torque (M10/8.8 × 50) ···· M_A = 46 Nm

4 = cylindrical pin 12 × 24



50DS7ETM248

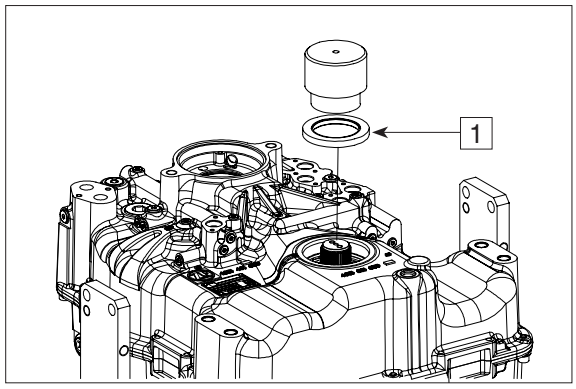
3) REASSEMBLY OF OUTPUT FLANGE

① Use driver tool to fit the shaft seal 70×100 ×10 (1) until contact position, with the sealing lip showing towards the oil sump.

(S) Driver tool 5870 048 057

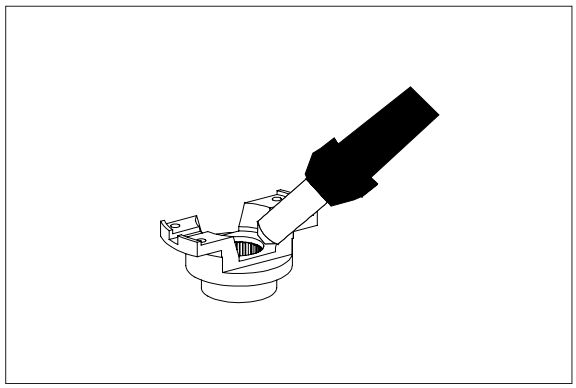
※ Fill space between sealing lip and dust lip with grease.

※ Wet outer diameter with spirit.



50DS7ETM249

② Heat up output flange(approx. 120°C).

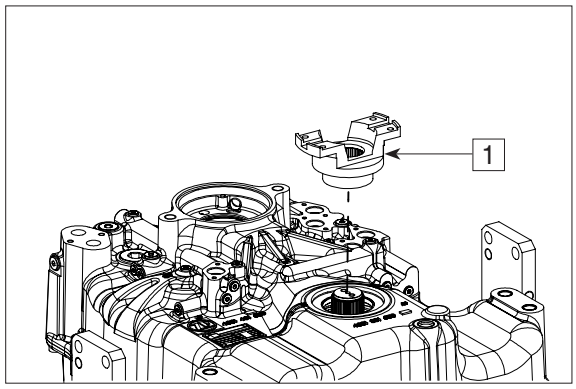


50DS7ETM250

③ Mount output flange (1) until contact is obtained.

⚠ Wear protective gloves.

※ Adjust output flange after cooling down.

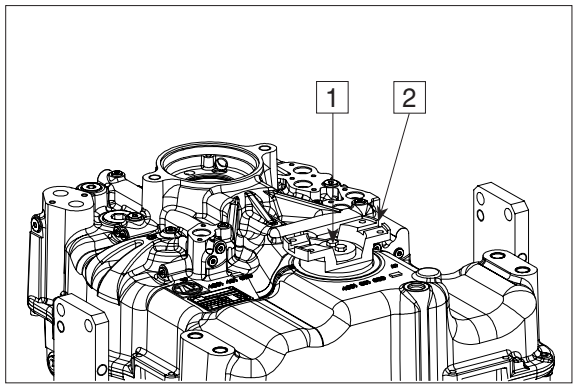


50DS7ETM251

④ Insert O-ring 38×4 into the space between output flange and shaft.

Fix output flange by means of washer (1) and hexagon screws 10×25 (2).

Tightening torque (M8/10.9×25) ···· M_A = 34 Nm



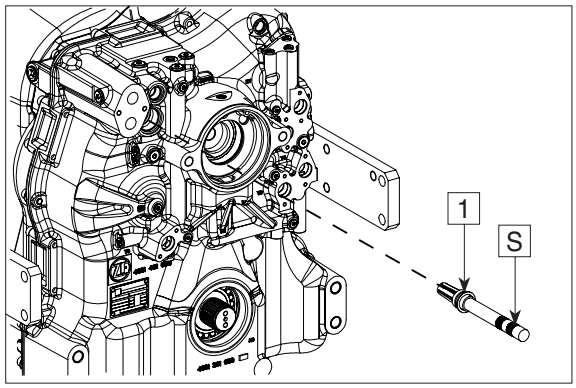
50DS7ETM252

4) REASSEMBLY OF CONVERTER SAFETY VALVE AND MAIN PRESSURE VALVE

(1) Reassembly of converter safety valve

① Insert valve(1) with drift(S) into the housing until contact is obtained.

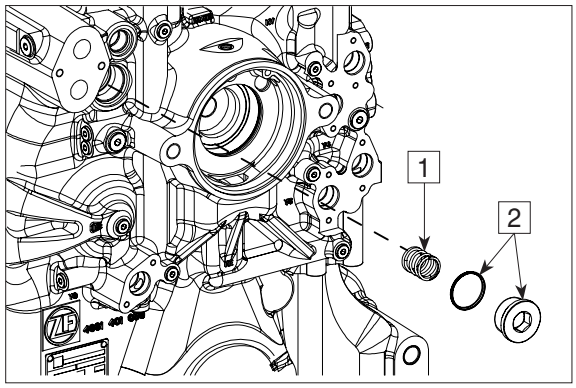
(S) Drift 5870 705 012



50DS7ETM253

② Place compression spring (1) into the transmission hole and fit screw plug M38 × 1.5 (2) with O-ring 35 × 2 (3).

Tightening torque ····· M_A = 46 Nm



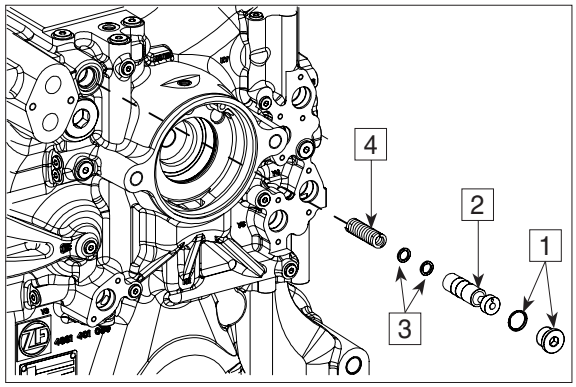
50DS7ETM33

(2) Reassembly of main pressure valve (control pressure valve)

① Main pressure valve consists of :
1 = Screw plug M22 × 1.5 with O-ring 19 × 2
2 = Piston
3 = Spacer ring (2 pcs)
Recommended value 5 mm
4 = Compression spring

※ The main pressure 16+3 bar is determined by means of the spacer rings.
Gradation of available spacer rings see parts manual.

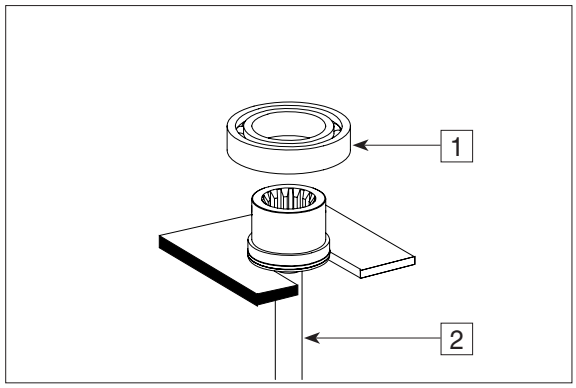
Tightening torque ····· M_A = 60 Nm



50DS7ETM32

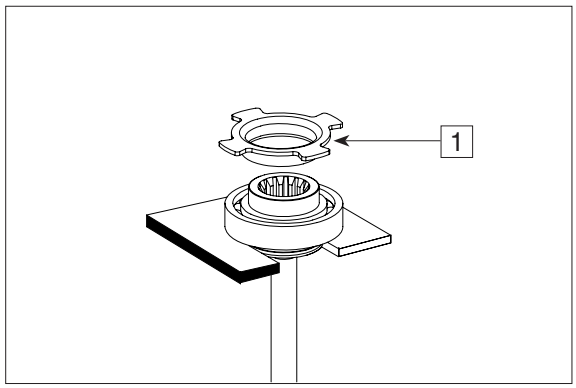
5) REASSEMBLY OF CENTRAL SHAFT (PTO) AND CONVERTER

① Press tapered bearing (1) onto the central shaft (2) until contact is obtained.



50DS7ETM254

② Press the toothed disk (1) onto the pump shaft until contact is obtained.



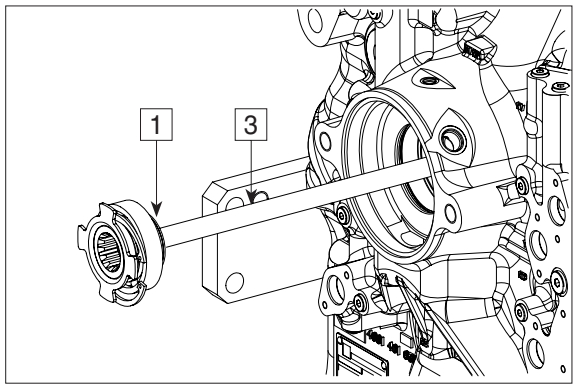
50DS7ETM255

③ Mount rectangular ring 50×2.5 (1).

Grease and centrically align rectangular ring.

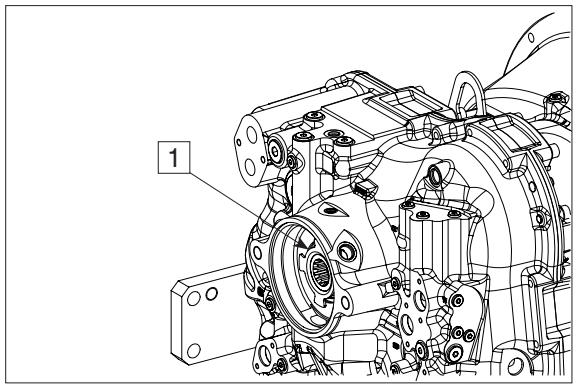
Mount retaining ring 75×2.5 (2).

Mount central shaft (3) until contact is obtained.



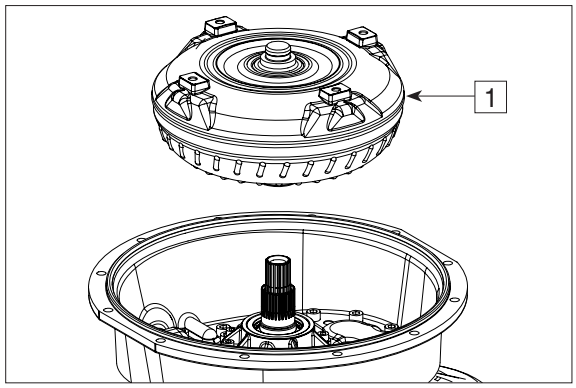
50DS7ETM256

④ Fix central shaft with retaining ring 75×2.5 (1).



50DS7ETM257

⑤ Mount converter (1) until contact is obtained.



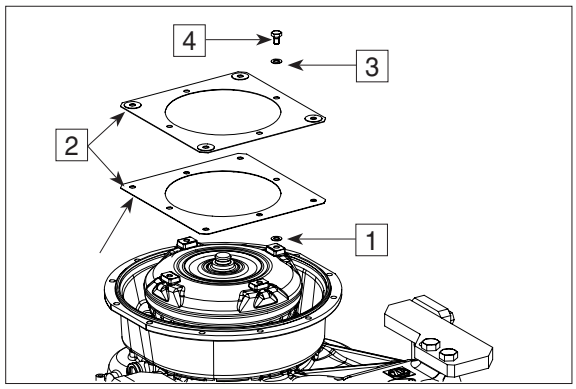
50DS7ETM24

⑥ Position 1 washer/each/thickness= 1.0mm (4EA) (1) onto the flexplate mounting webs (4EA).

Place flexplates (2).

※ Pay attention to the installation position. Spot-welded reinforcing disks of the flexplate to be arranged towards the outside-see arrows.

Mount washer (3) to the hexagon screw M10 × 16 (4) and fix the flexplates.



50DS7ETM258

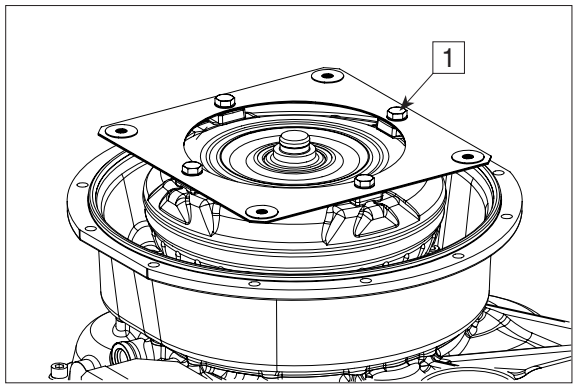
⑦ Tighten hexagon screws M10 × 16 (1).

Tightening torque (M10/8.8 × 16) ···· M_A = 46 Nm

※ When reusing the hexagon screws they must be secured with Loctite 243.

※ New hexagon screws are already provided with adhesive (microcapsule). The microcapsule bursts when the screw is turned in, wets screw and nut thread and hardens.

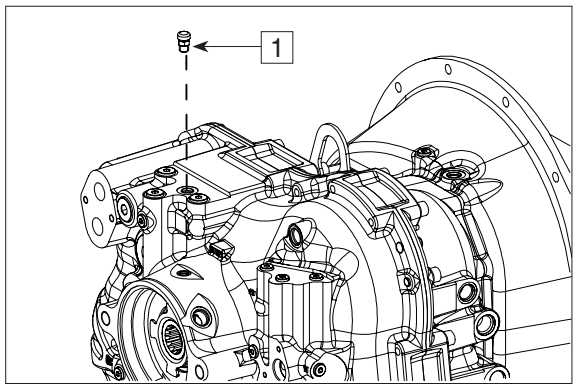
⚠ Fix converter axially.
Risk of injury.



50DS7ETM259

6) REASSEMBLY OF PRESSURE CONTROLLER (PROPORTIONAL VALVES), INDUCTIVE SENSOR, SPEED SENSOR (HALL SENSOR), TEMPERATURE SENSOR, BREATHER AND SCREW PLUGS

① Mount breather (1).



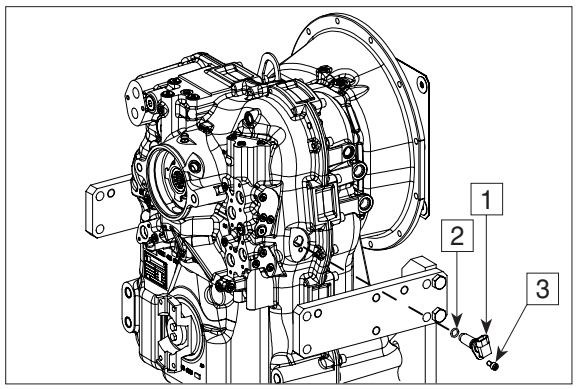
50DS7ETM260

② Mount output Hall sensor- (1) onto the speed sensor, install O-ring 15.5×2.6 (2) and fix it with cylindrical screws M8×16 (3).

Tightening torque (M8/8.8x16) ····· M_A = 23 Nm

※ When reusing the cylindrical screw, it must be secured with Loctite no. 243.

※ New cylindrical screw is already provided with adhesive (microcapsule). The microcapsule bursts when the screw is turned in, wets screw and nut thread and hardens.



50DS7ETM261

③ Fit positioned parts.

1 = Inductive sensor with O-ring 15×2
- n turbine

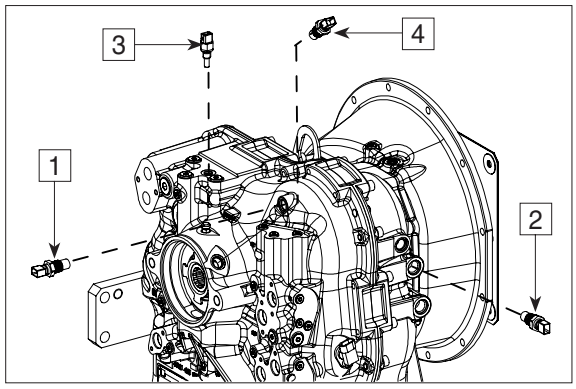
2 = Inductive sensor with O-ring 15×2
- n central gear chain

3 = Inductive sensor with O-ring 15×2
- n engine

Tightening torque ····· M_A = 30 Nm

4 = Temperature sensor with O-ring 11×2
Measuring point "63" after the converter

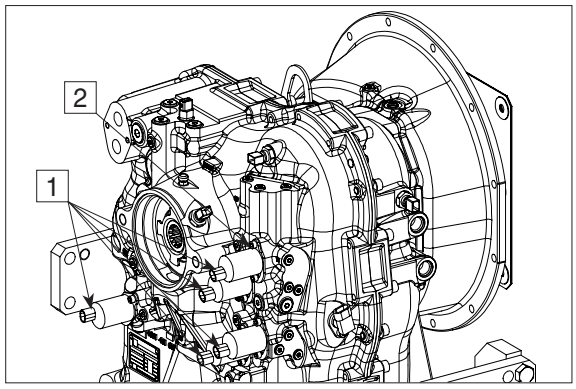
Tightening torque ····· M_A = 25 Nm



50DS7ETM262

④ Fix pressure controller-proportional valves-(1) with the cylindrical screws M6 × 12 (2).

Tightening torque (M6/8.8 × 12) ····· M_A = 9.5 Nm



50DS7ETM263

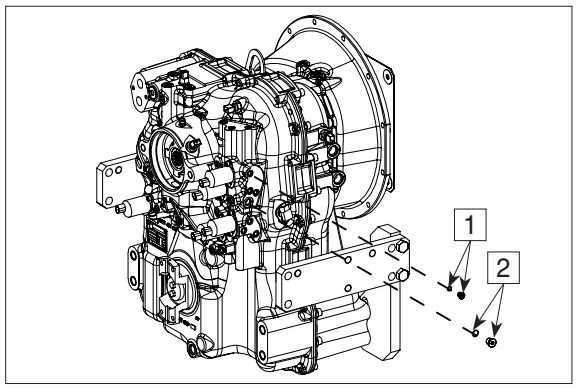
⑤ Mount all screw plugs (1 and 2) with O-rings.

1 = Screw plug M10x1 with O-ring 8 × 1.5 (24EA)

Tightening torque (M10 × 1) ····· M_A = 6 Nm

2 = Screw plug 9/16-18 UNF with O-ring 11.9 × 2 (7EA)

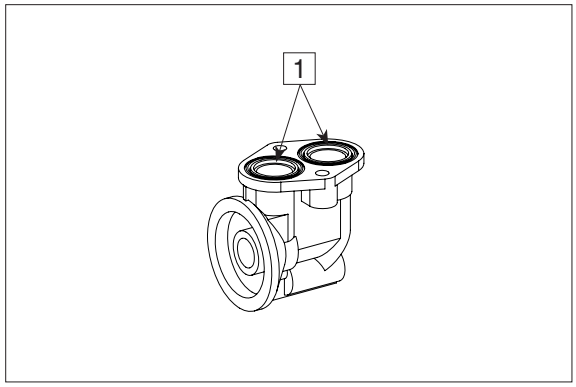
Tightening torque (9/16-18 UNF) ·· M_A = 15 Nm



50DS7ETM264

7) REASSEMBLY OF FILTER, CLOSING COMPONENTS, OIL FILLER TUBE WITH OIL DIPSTICK AND OIL DRAIN PLUG

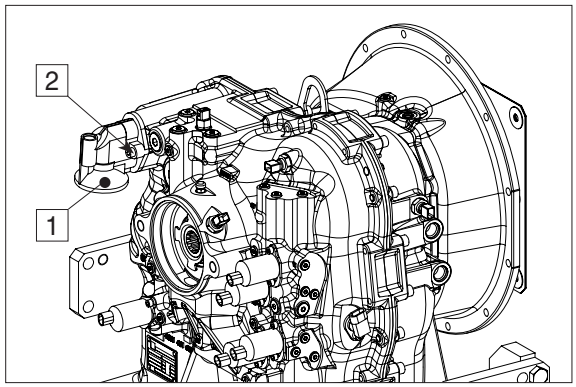
① Place O-rings 34.2×3 (1) into the holes and grease them.



50DS7ETM265

② Attach filter head (1) with cylindrical screws M8×30 (2).

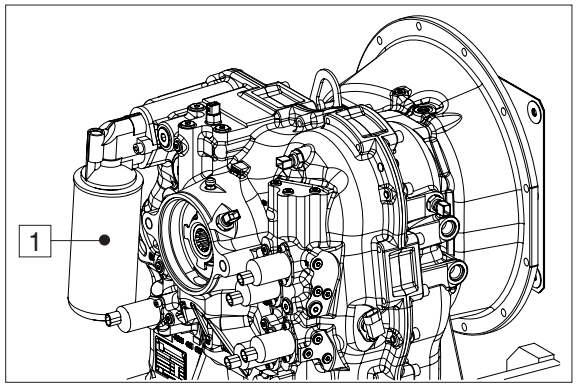
Tightening torque (M8/8.8×30) ····· M_A = 23 Nm



50DS7ETM266

※ The fine filter (1) has to be fitted as follows :

- Slightly oil the seal
- Turn in the filter until contact with the sealing surface is obtained, and then tighten it by hand with approx. 1/3 to 1/2 rotation.

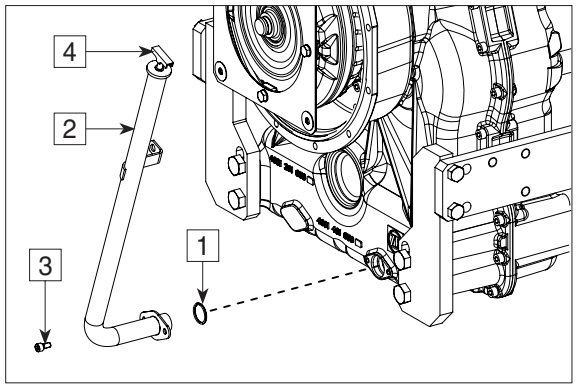


50DS7ETM267

③ Install O-ring 30×3 (1) onto the oil suction tube (2), grease it and fix it with cylindrical screws M8×16 (3) to the transmission housing.

Mount oil dipstick (4).

Tightening torque (M8/8.8×16) ····· M_A = 23 Nm

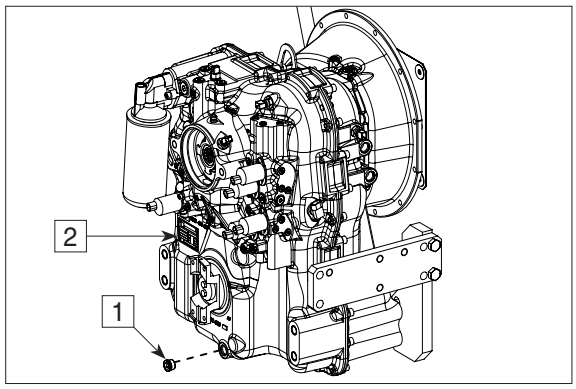


50DS7ETM268

④ Fit oil drain plug 7/8-14 UN 2A (1).

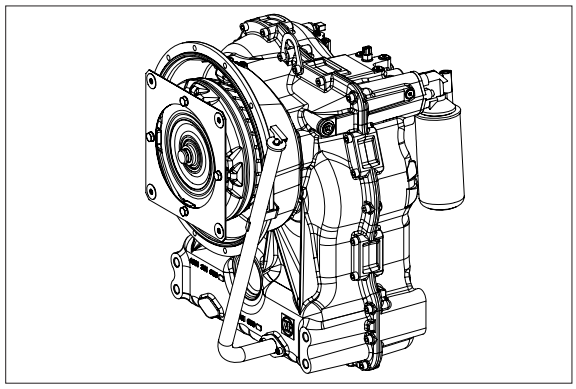
Tightening torque (7/8-14 UN 2A) ··· M_A = 30 Nm

Fix identification plate (2) by means of grooved pins 3×5.



50DS7ETM269

※ Before putting the transmission into operation, fill it with oil according to Operator's Manual.

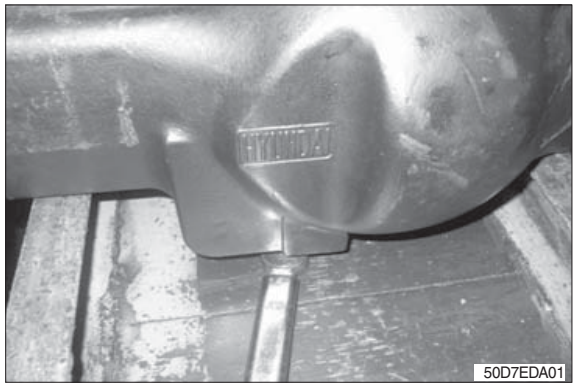


50DS7ETM270

3. DISASSEMBLY OF DRIVE AXLE

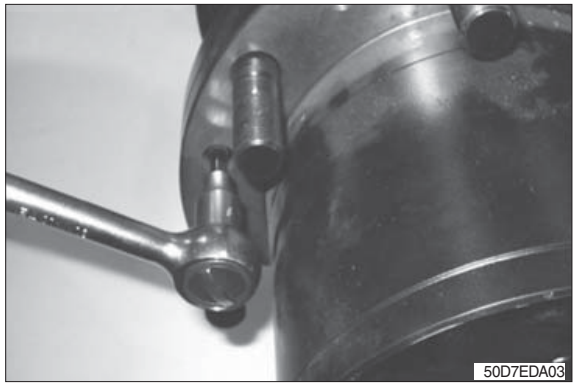
1) REMOVAL AND DISASSEMBLY OF WHEEL HUB

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

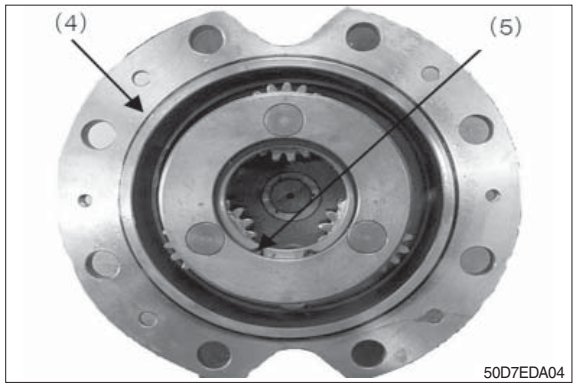


(2) Loosen oil drain plug in planetary housing and drain oil.

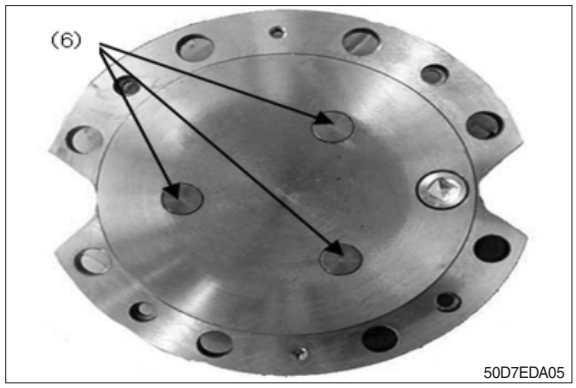
(3) Loosen 4 socket head bolts and remove the planetary carrier.



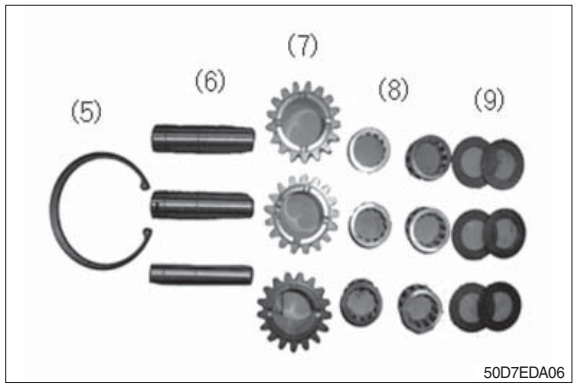
(4) Remove O-ring (4) and snap ring (5) from the housing of planetary.



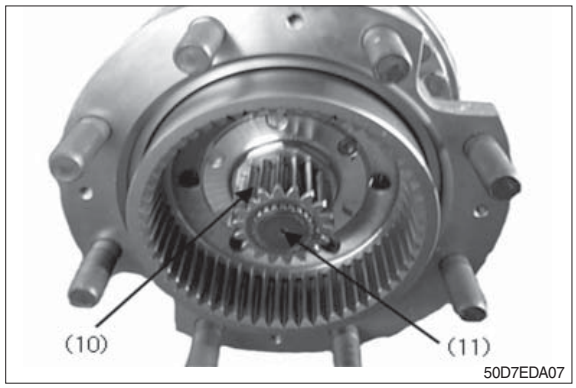
(5) Remove 3 pins (6) with a plastic hammer.



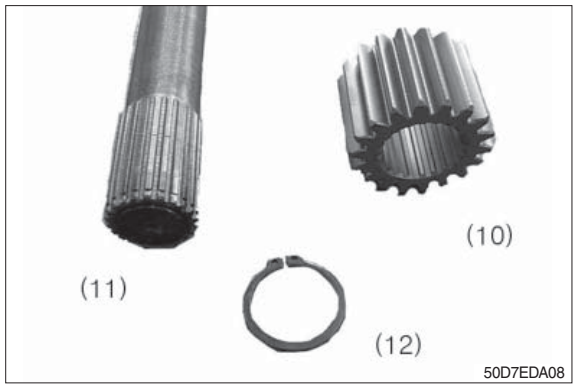
(6) Remove needle bearing (8), planet gear (7) and thrust washer (9).



(7) Remove sun gear (10) and drive shaft (11).

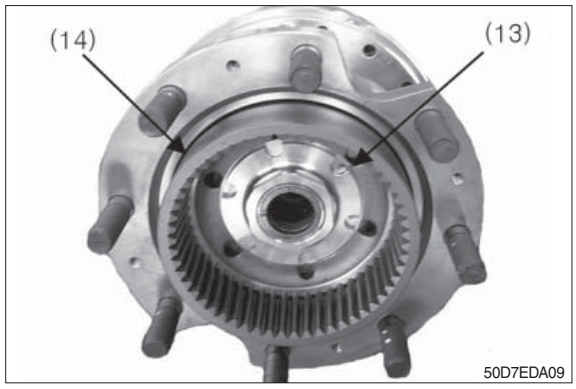


(8) Remove snap ring (12) and then remove sun gear (10) from the shaft (11).

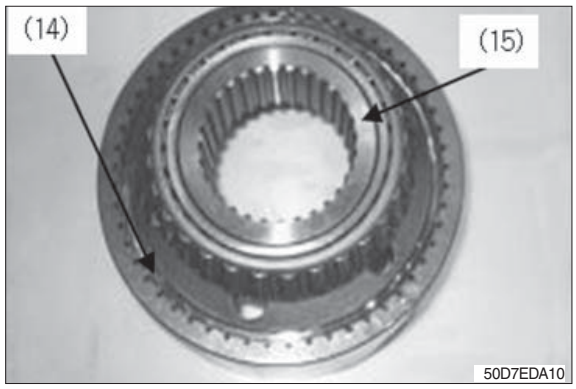


(9) After removing bolt (13), remove ring gear (14) and torque plate assembly (14) from the spindle.

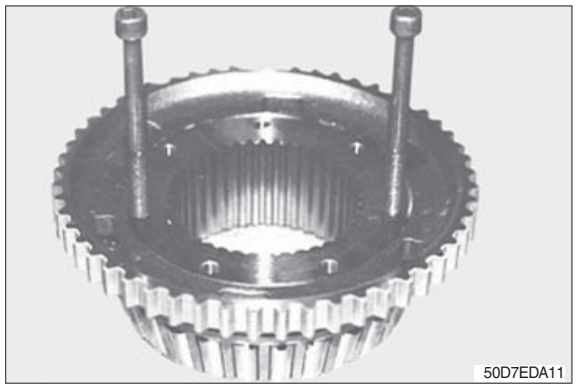
※ **Must measure the rolling resistance of tapered roller bearing.**



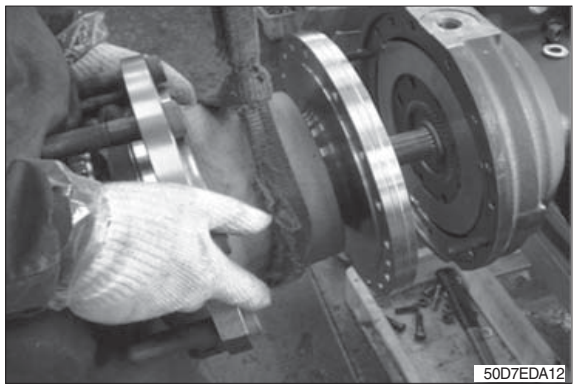
(10) Remove C-ring (14) from the ring gear and pull the spindle (15) out of the ring gear.



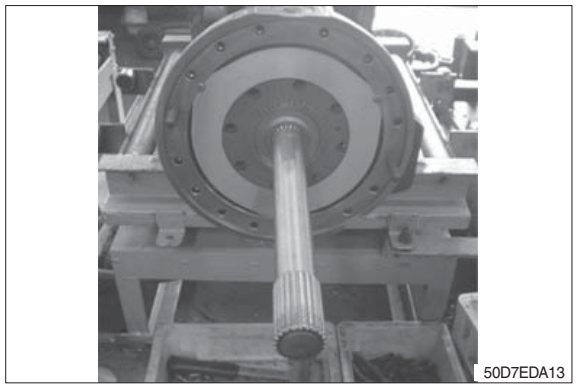
(11) Pull out bearing inner race on flange using 2 × M8 bolts.

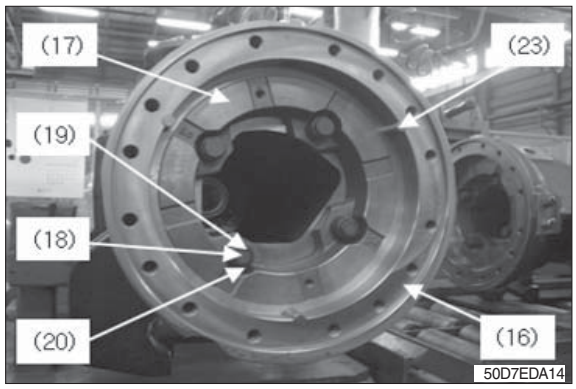


(12) Remove wheel hub from the axle housing after loosen 14 bolt and 2 nut.



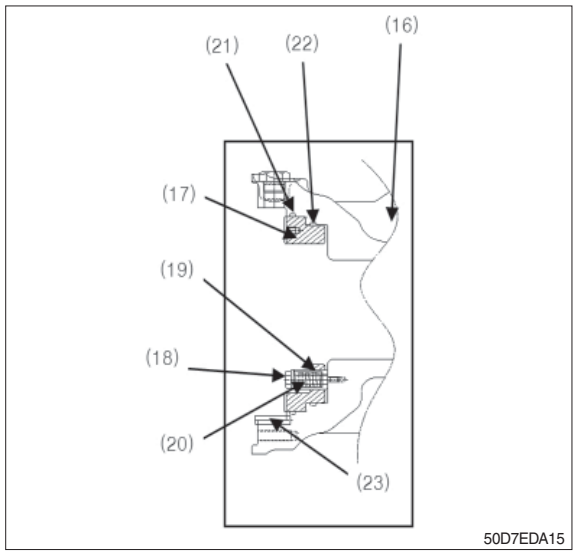
(13) Disassemble drive shaft and disc & plate assembly.



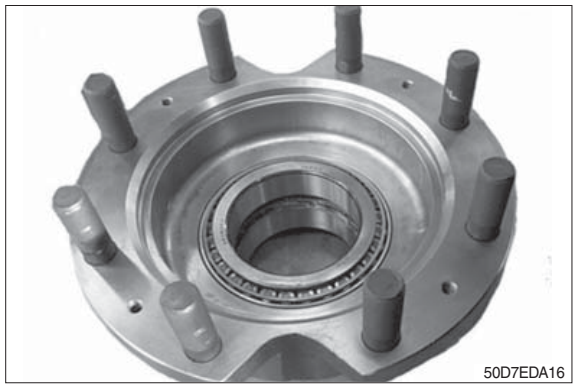


(14) After loosing 4 bolt-self adjust (18), disassemble spring-self adjust (20) form bushing-self adjust (19).
Then disassemble piston (17) from axle housing (16).
After checking 3 pins (23), then finally remove square ring (21, 22).

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



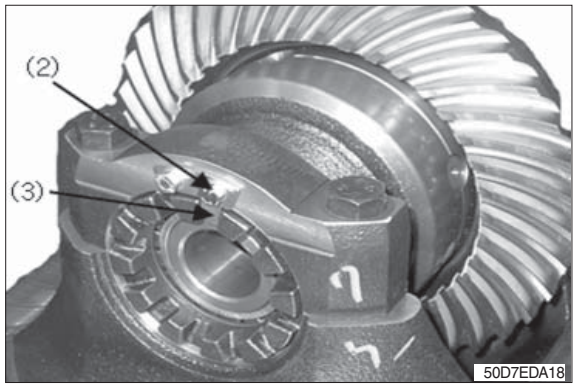
(15) Remove bearing cup from the wheel hub by using jig and hammer. Shaft seal may be damaged.



2) DISASSEMBLY OF THE DIFFERENTIAL CARRIER ASSEMBLY

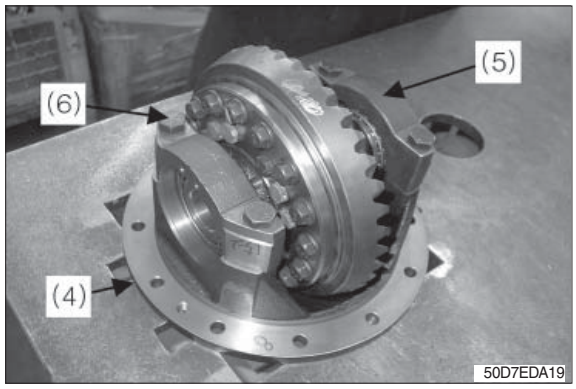
(1) Loosen 12 bolts (1) and then remove carrier from the housing by using a lifting machine.

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



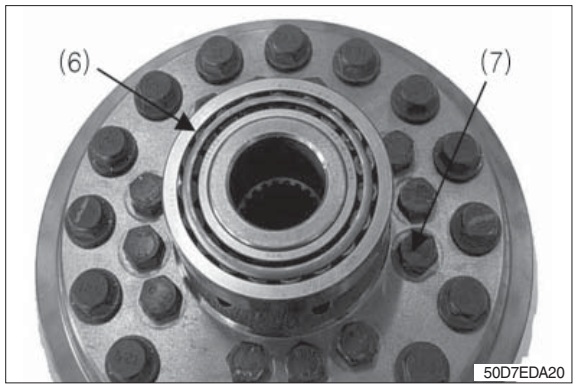
(3) Before removing differential assembly from carrier (4), check the location of cap (5) and mark it for reassembly.

(4) Remove 4 hexagon bolts (6) and cap (5).

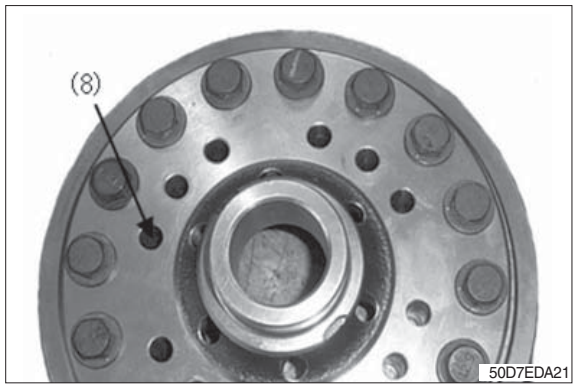


(5) Remove differential assembly from the carrier.

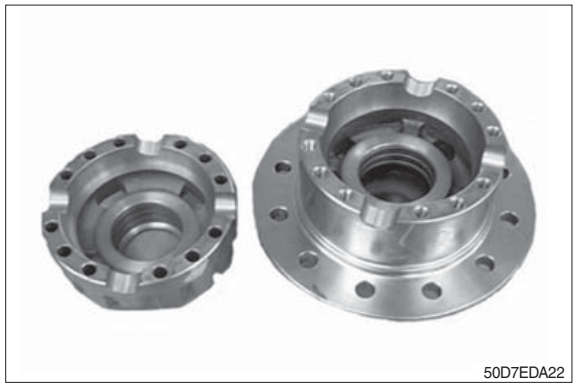
(6) Disassemble bearing (6) from the differential housing and remove 12 bolts (7).



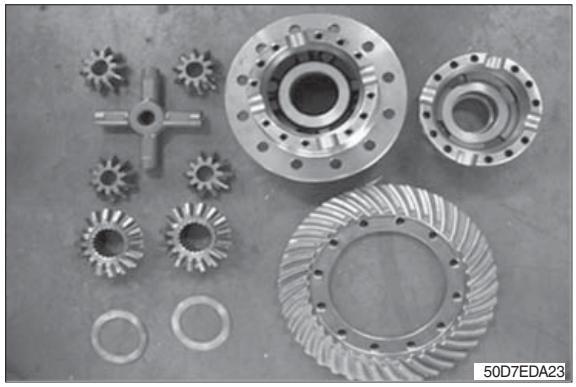
(7) After removing 12 mounting bolts (8) from the housing and then disassemble the ring gear.



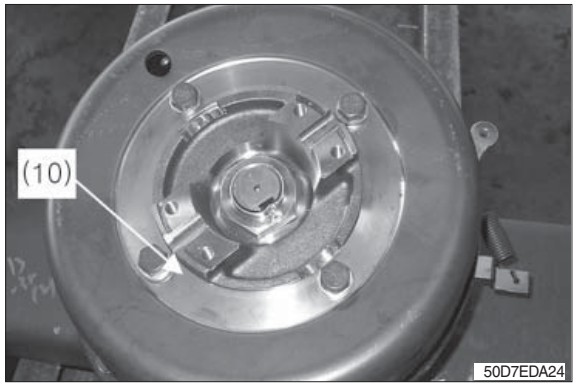
(8) Check the mark on the housing and separate the housing from the differential.
If there is no mark, be sure to mark on the housing.
When reassembling, it must be placed at the same position as before.



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



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

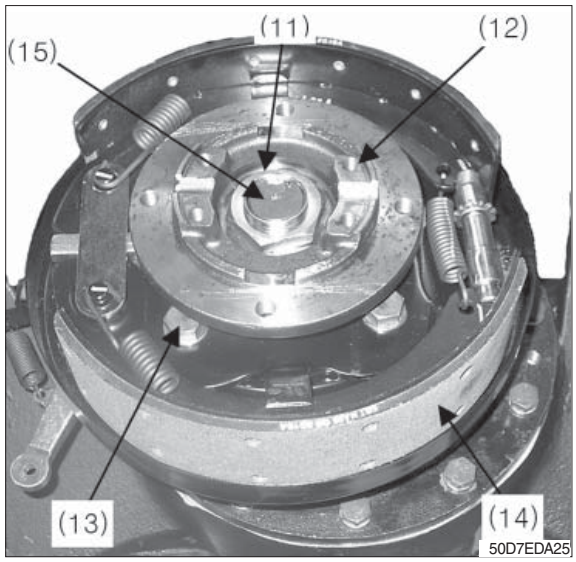


(11) After removing lock nut (11) and then remove the yoke (12).

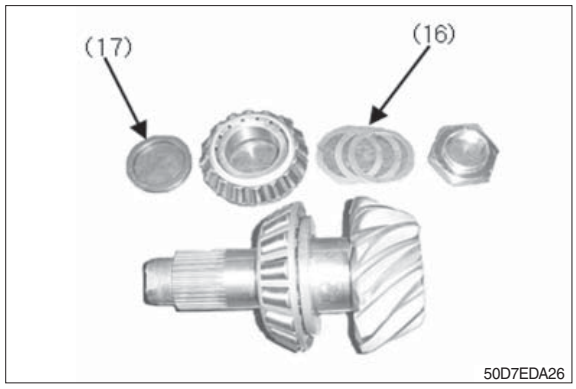
(12) Loosen 4 bolts (13) and then remove parking brake (14) from the carrier housing.

(13) Remove the drive bevel pinion shaft (15) carefully busing a plastic hammer.

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

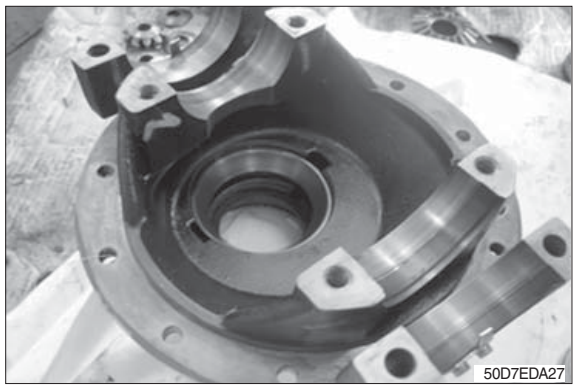


(12) Remove shim (16) and spacer (17) from pinion shaft.
Using a bearing puller, disassemble inner race of taper roller bearing from the pinion shaft.

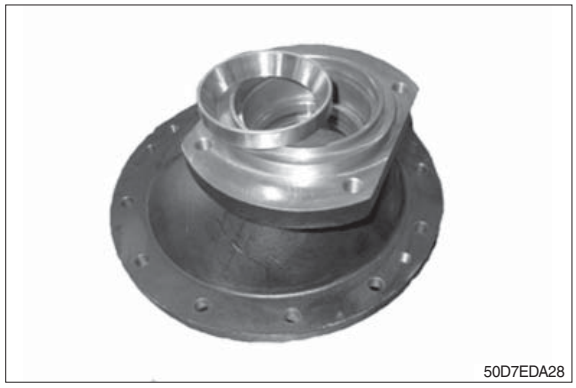


(13) Remove outer race of taper roller bearing and shim from the housing by using a jig and hammer.

※ **Do not reuse damaged shims.**



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



4. REASSEMBLY OF DRIVE AXLE

Clean every parts with cleaner and then remove remained loctite.

※ **Be careful not to spill cleaner on your body.**
Avoid drinking cleaner 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 damaged, 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 shims of bevel pinion shaft.

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

① Measure "**E**" distance on the housing.

② By the equation "**X = E - B - T ± C + 0.25**", define the shim thickness (1).

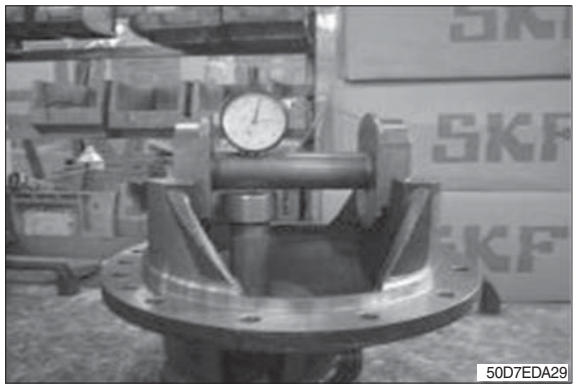
B : Mounting dimension of bevel pinion shaft , 131.10 mm (5.2 in)

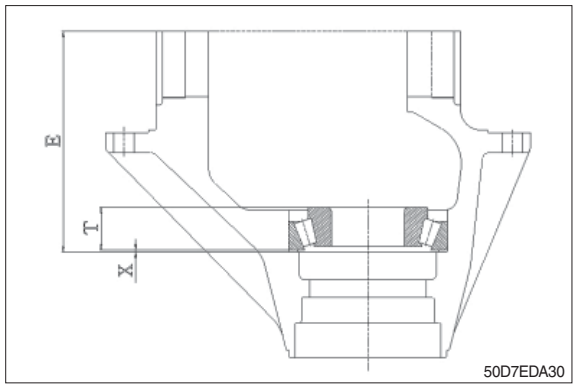
T : Height of bearing.

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

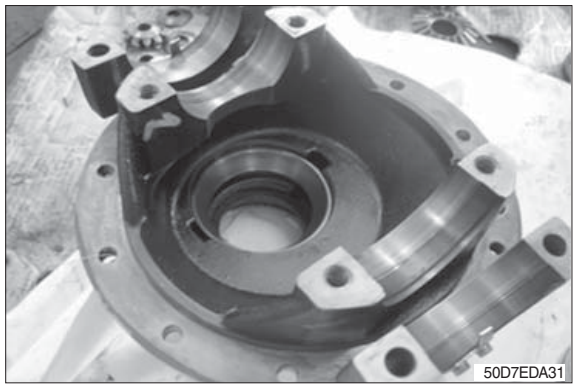
EX) : From the housing
"**E**" = 162.85 mm (6.4 in)
B is factory dimension
"**B**" = 131.10 mm (5.2 in)
Front the bearing
"**T**" = 31.75 mm (1.5 in)
Carved seal on the pinion
"**C**"= 0.05 mm (0.002 in)
Shim thickness :
"**X**" = 162.85 -131.10 - 31.75 + 0.05
= 0.45 mm (0.022 in)

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





(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 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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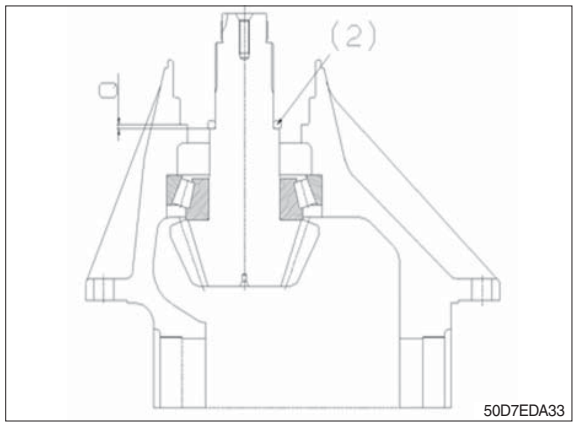
· **Measuring play of bevel pinion shaft end**
Measure shim thickness by following method.
Dimension "**Q**" : Distance from bearing outer race surface to spacer surface.
Dimension "**S**" : Distance from bearing outer race surface to inner race surface.
From the below equation, define required shim thickness **Z**.

" **Z** = **S** + **Q** "

EX) : From the bearing
S = 2.25 mm (0.09 in)
From the housing
Q = 3.15 mm (0.12 in)
Needed shim thickness **Z** :

Z = 2.25 + 3.15 = 5.40 mm (0.21 in)



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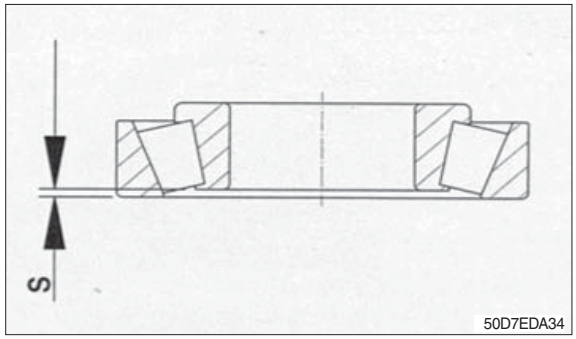
Unit : mm (in)

P	Q	Z
2.25 (0.089)	3.15 (0.124)	5.40 (0.213)
2.30 (0.091)	3.15 (0.124)	5.45 (0.215)
2.35 (0.093)	3.15 (0.124)	5.50 (0.217)
2.40 (0.094)	3.15 (0.124)	5.55 (0.219)
2.45 (0.096)	3.15 (0.124)	5.60 (0.220)



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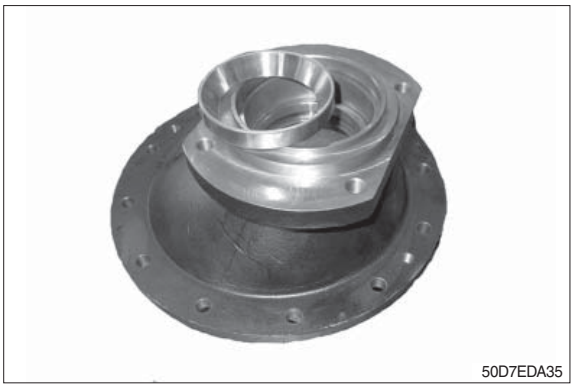
2) ADJUSTMENT OF PINION SHAFT

(1) Assemble bearing cup.
Assemble spacer to the pinion shaft and then install measured shims onto the spacer.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(2) Insert pinion shaft into the carrier.
Assemble bearing cone and lock nut.
Apply grease on the outer bearing.

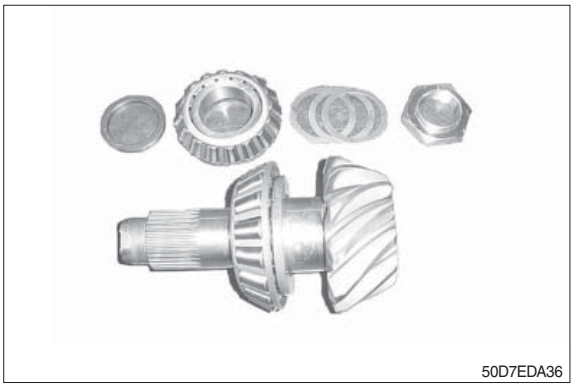
Apply loctite #271 or #277 on the thread of pinion and then tighten lock nut.

· Tightening torque : 45~51 kgf · m
(325~369 lbf · ft).

Measure rolling resistance of pinion shaft.

· Rolling resistance : 0.20~0.41 kgf · m
(1.4~2.9 lbf · ft).

Coke lock nut into the pinion shaft slot.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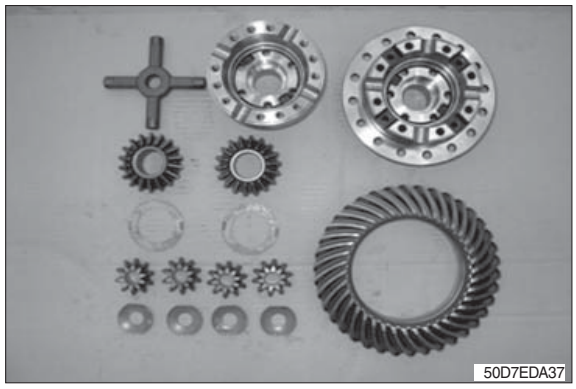
3) ASSEMBLY OF DIFFERENTIAL ASSEMBLY

(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.

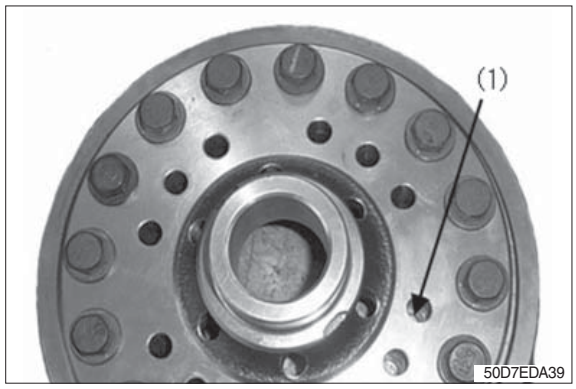


(2) Assemble differential housing.

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

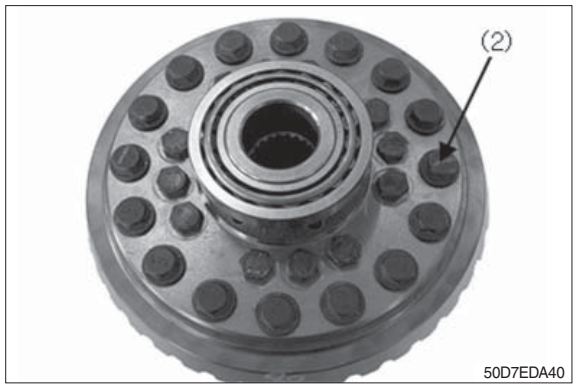
(3) Tighten 12 bolts (1) to the differential housing.
Apply loctite #271 or #277 on the thread of bolt.

· Tightening torque : 5.0~7.5 kgf · m
(36~54 lbf · ft)



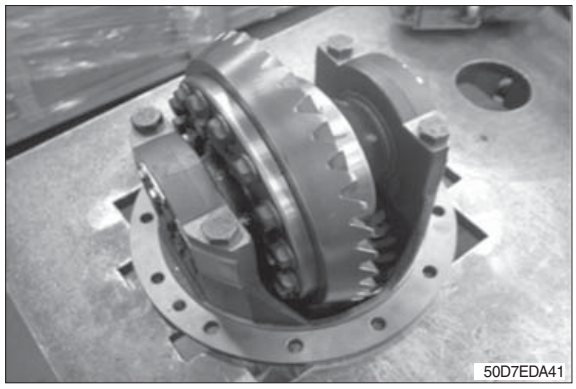
(4) Assemble ring gear by tightening 12 bolts (2).
Apply loctite #271 or #277 on the thread of bolt.

· Tightening torque : 12.5~14.5 kgf · m
(90~105 lbf · ft)



(5) Install differential assembly into the carrier. Place the bearing cup and screw into the housing. At this 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 (0.007~0.009 in)



(6) Assemble bearing cap.

※ **Fix bearing cap with hexagon bolt.**
·Tightening torque : 15.0~17.0 kgf·m (108~123 lbf·ft)
Measure rolling resistance of tapered roller bearing.
The following table shows the relation between preload (P) of bevel pinion shaft and rolling resistance (Z).
(calculated at adjustment of pinion shaft ②).

Unit : kgf · m (lbf · ft)

P	Z
0.20 (1.45)	0.30~0.36 (2.17~2.60)
0.25 (1.81)	0.35~0.41 (2.53~2.97)
0.30 (2.17)	0.40~0.46 (2.89~3.33)
0.35 (2.53)	0.45~0.49 (3.25~3.54)

(7) Confirm that the screw contacts to the 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 15.0~17.0 kgf · m (108~123 lbf · ft).

(10) Assemble plate with hexagon bolts. Apply loctite #271 or #277 to the tapped side of bolt and then assemble it with tightening torque of 0.80~1.20 kgf · m (5.8~8.7 lbf · ft).

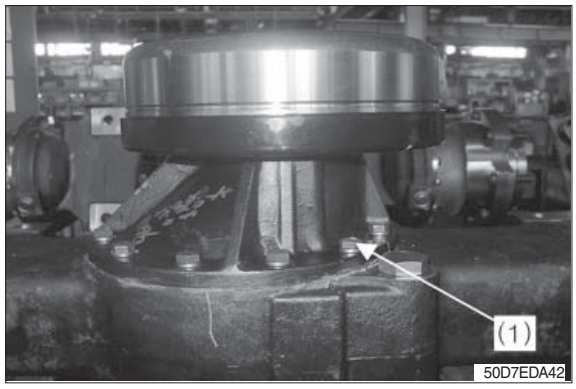
※ **Assemble opposite side with the same methods.**

(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) ASSEMBLING CARRIER

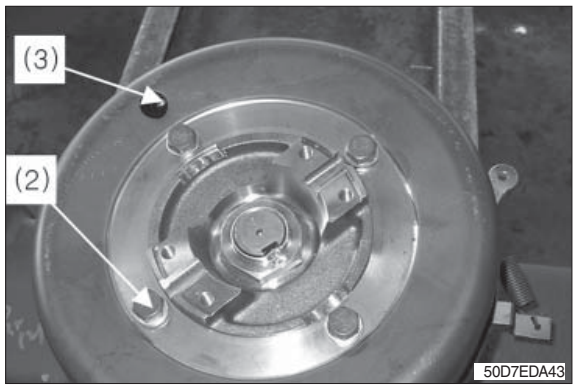
(1) Assemble carrier assembly into the axle housing.

(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 (79.6~94.0 lbf · ft).



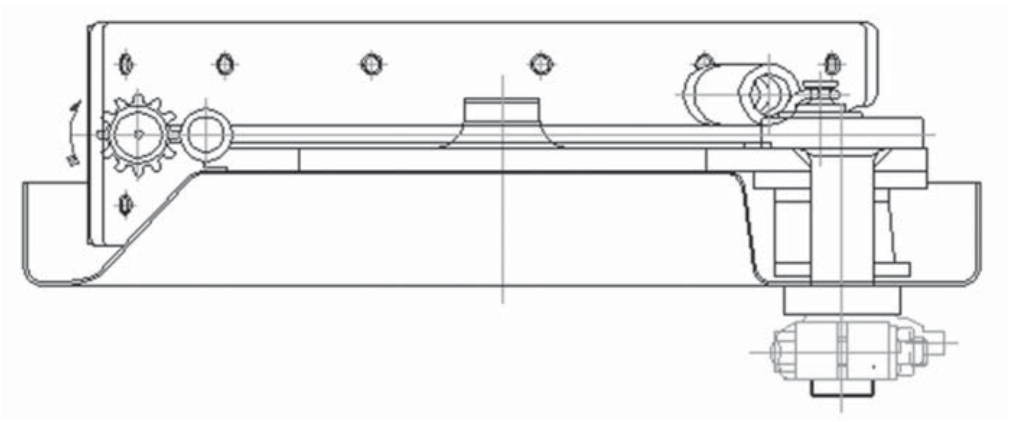
(3) Assemble brake drum to yoke with tighting 4 bolts (2).
Apply loctite #271 or #277 to thread of bolt and then assemble it with tightening torque of 11~13 kgf · m (79.6~94.0 lbf · ft).

(4) Close hole (3) with rubber plug.



5) ADJUSTMENT OF PARKING BRAKE

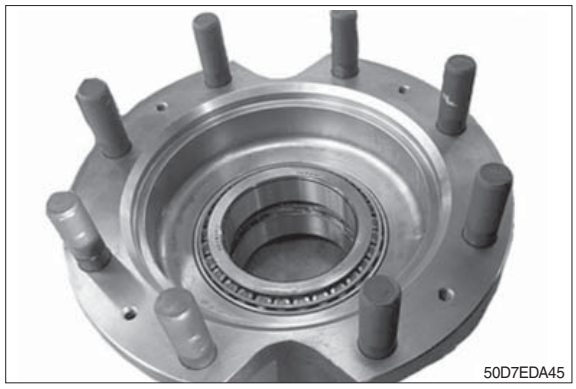
(1) The following procedures should be applied for brake shoe adjustment.
① Open rubber plug on (2).
② Adjuster should be turned according to arrow direction until occurring drum drug.
③ Adjuster should be turned opposite direction of the arrow sign by four click.
At that case, lining clearance is 0.1~0.25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



6) ASSEMBLING WHEEL HUB ASS'Y

(1) Insert bearing into wheel hub.

※ Apply grease or oil to shaft seal and then assemble it with proper direction (outer side of wheel hub).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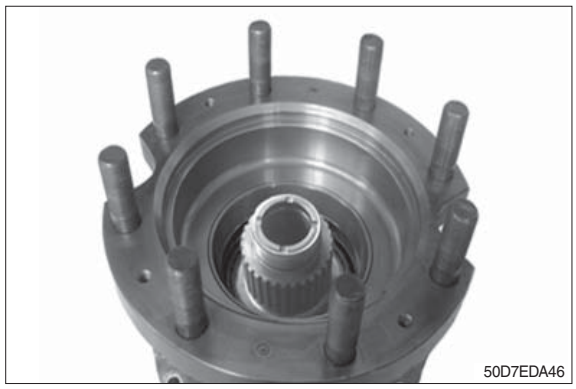
(2) Install wheel hub assembly to the spindle completely.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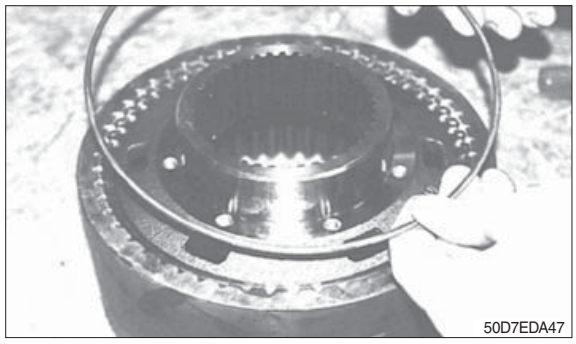
(3) Insert the spindle into ring gear and secure with circlip.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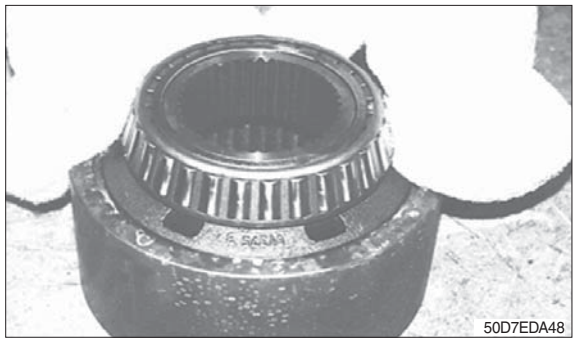
(4) Place heated tapered roller bearing inner race into the spindle until contact take places. Install it on the wheel hub after cooling down.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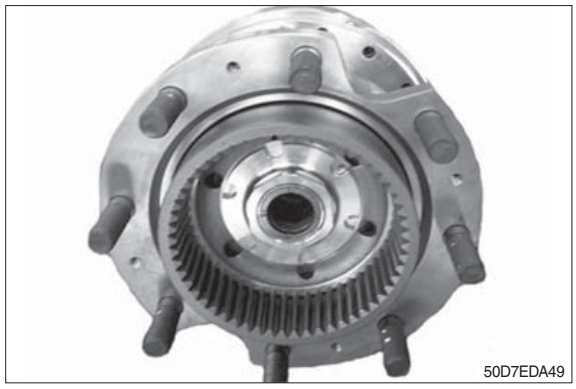
(5) Install the torque plate to fix the spindle.
Apply loctite #5127 to axle housing surface which contact to the spindle.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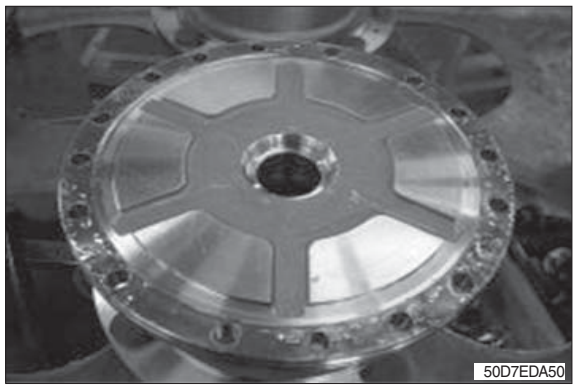
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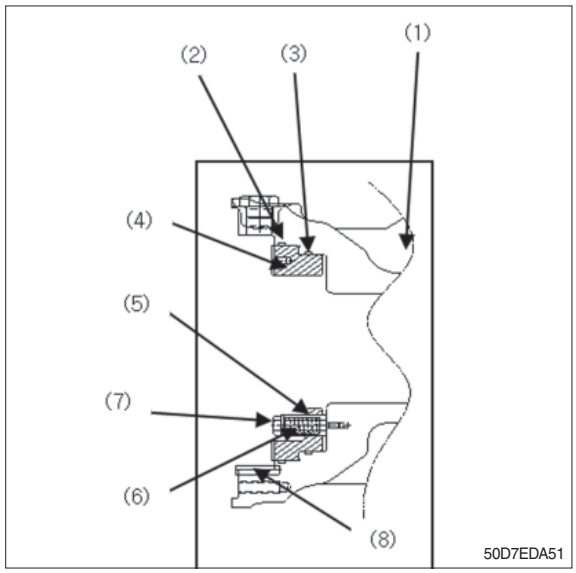
(6) Assemble square ring (2), (3) to the axle housing (1) then apply the oil (Mobilfluid #424). Assemble bushing(5) to piston (2) and then assemble piston (2) to axle housing after applying oil sufficiently and then assemble the spring (6) to the bushing (5).
Also, apply loctite #271 to 4 bolts (7) then assemble them with tightening torque 14~16 kgf · m (101.3~115.7 lbf · ft).
Assemble 3 brake pins (8) to axle housing.

※ **Check the status of square ring and replace if damaged.**



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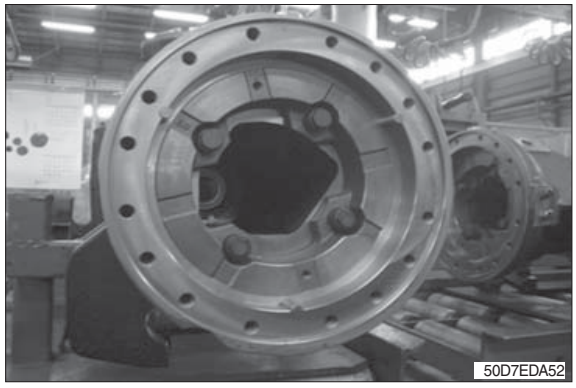
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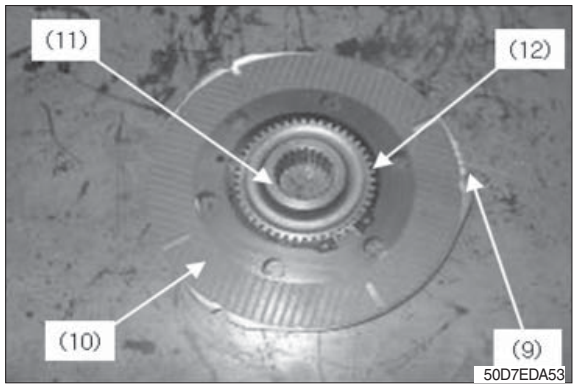
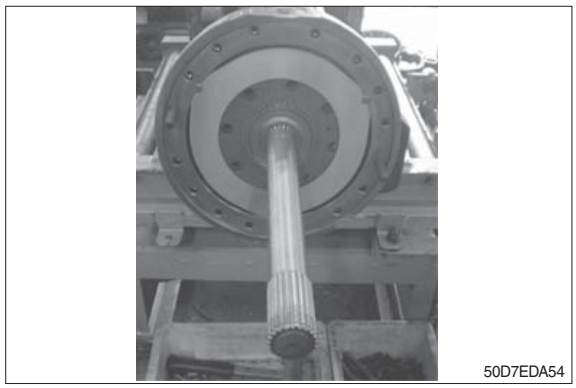
Assembling plate and inspection

① Assemble 5 plates (9) and 4 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)

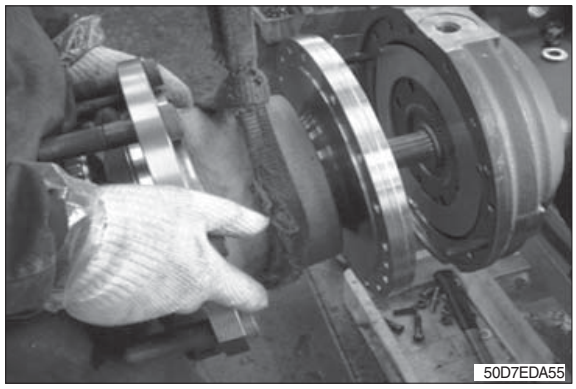
② Install assembled spline collar to the axle housing with the drive shaft.
- Before assembling, clean all of the parts completely and remove burrs.

③ After assembling, confirm that the clearance between the outer plate and the axle housing surface is 2.1~2.6 mm (0.08~0.10 in).

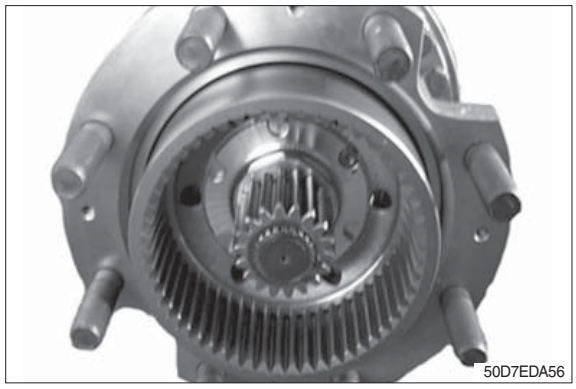




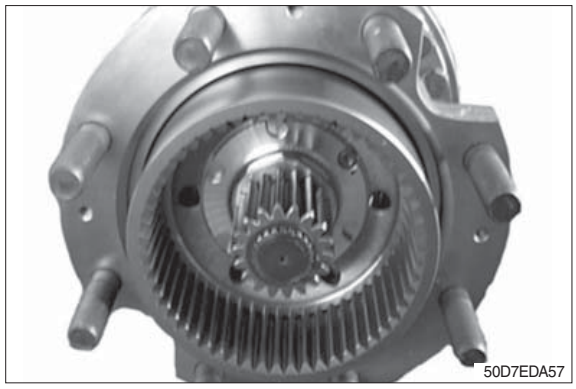
(7) Push pre-assembled wheel hub to the axle housing until contact take places.



(8) Tighten 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 18~22 kgf · m (130.2~159.1 lbf · ft).



(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.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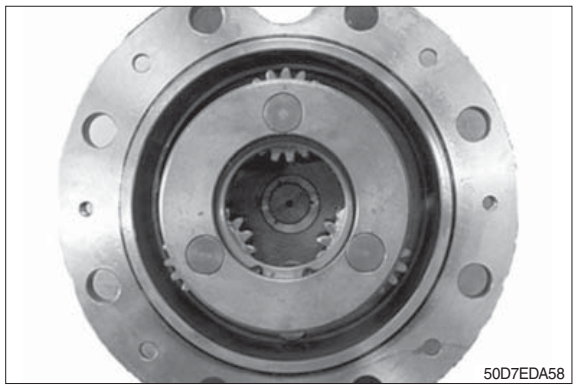
(10) Assemble internal components of planetary carrier with the reverse order of disassembly.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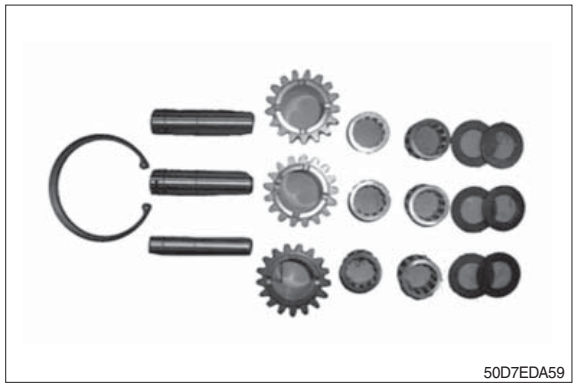
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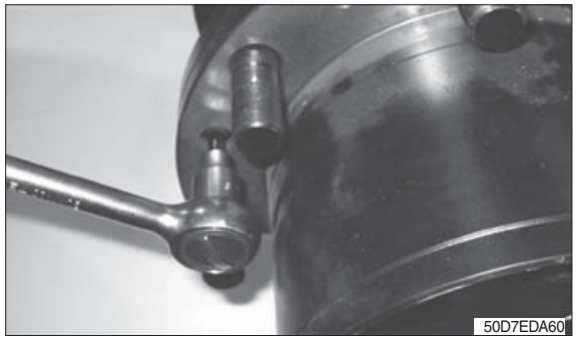
(11) Install planetary carrier assembly to wheel hub and tighten bolt (2).
· Tightening torque : 25~40kgf · m (180.9~289.3lbf · ft).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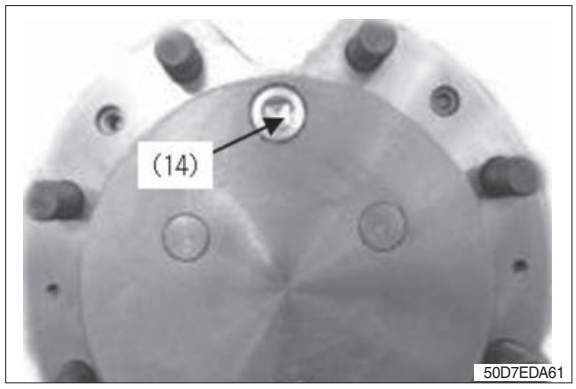
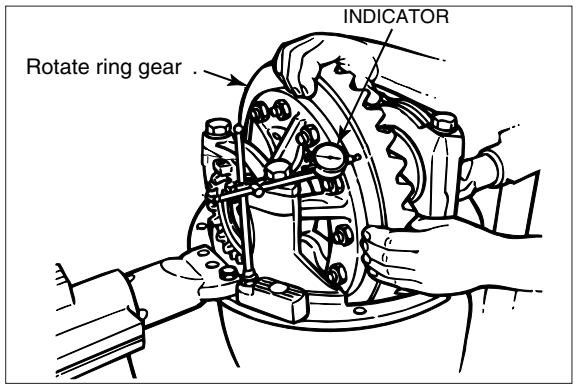
(12)Assemble wheel hub and tighten plug (14).

· Tightening torque : 35~60 kgf · m (253.2~434.0 lbf · ft).



1.CHECKING THE RING GEAR BACKFACE RUNOUT

Runout specification : 0.20 mm (0.008 inch) maximum



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1) Attach a dial indicator on the mounting flange of the carrier.
2) Adjust the dial indicator so that the plunger or pointer is against the back surface of the ring gear.
3) Set the dial indicator to zero (0).
4) Rotate the ring gear and read the dial indicator. The runout must not exceed 0.20 mm (0.008 inch).

   If runout exceeds specification, remove the differential and ring gear assembly from the carrier. Refer to "Disassembling the differential carrier assembly".
5) Check the differential parts, including the carrier, for problems that may cause the ring gear runout to exceed specifications. Repair or replace parts.
6) Re-install the differential and ring gear into the carrier. Refer to "Assembling the differential case".
7) Repeat the preload adjustment of the differential bearings.

2. ADJUSTING THE GEARSET BACKLASH

Backlash specification : 0.13~0.18 mm
(0.005-0.007 inch)

If the old gearset is installed, adjust the backlash to the setting that was measured before the carrier was disassembled.

If a new gearset is installed, adjust the backlash to the correct specification for new gear sets.

1) Attach a dial indicator on the mounting flange of the carrier.

2) Adjust the dial indicator so that the plunger or pointer is against the tooth surface, near the heel end of the gear tooth. Set the indicator dial to zero (0).

3) Hold the drive pinion in position.

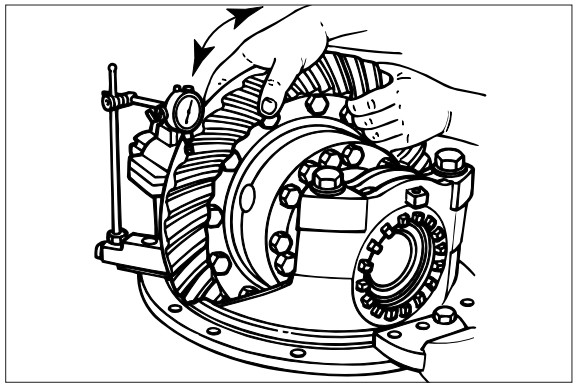
4) Read the dial indicator, while rotating the ring gear a small amount in both directions, against the drive pinion teeth.

※ When you adjust backlash, move the ring gear ONLY. DO NOT move the drive pinion.

5) If the backlash reading is within specification, continue checking tooth contact patterns.
Otherwise, adjust backlash. Refer to step 6), and check, following steps 1) - 4).

※ Backlash is increased by moving the ring gear away from the drive pinion. Backlash is decreased by moving the ring gear toward the drive pinion.

6) Loosen one bearing adjusting ring one notch, then tighten the opposite ring the same amount.



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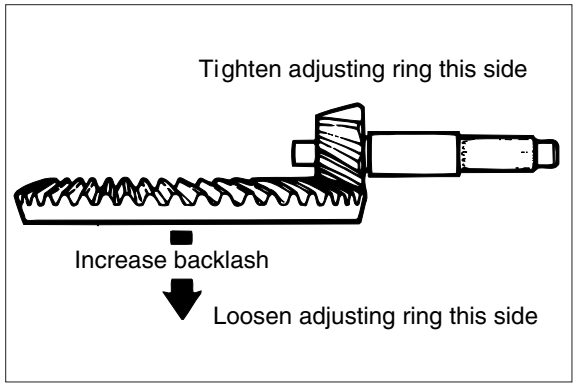

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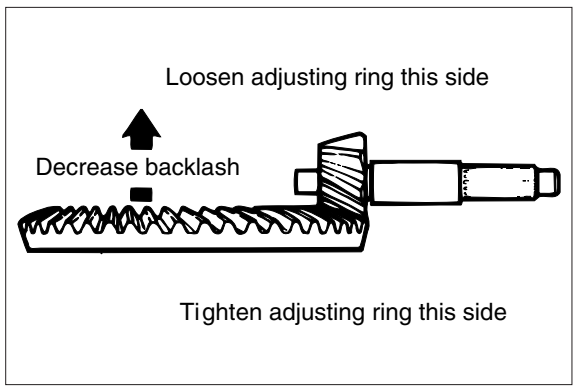

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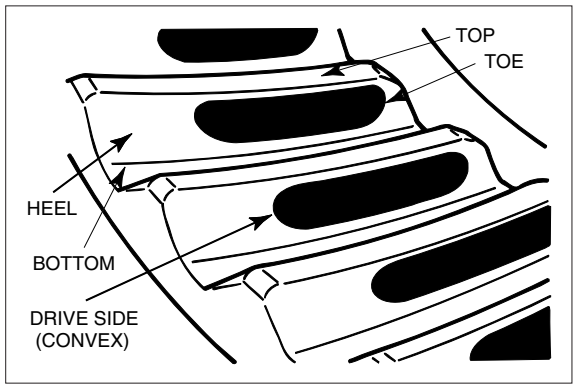
3. ADJUSTING TOOTH CONTACT PATTERN OF THE GEARSET

Always check tooth contact pattern on the drive side of the gear teeth.

1) Apply marking compound to approximately 12 teeth of the ring gear.



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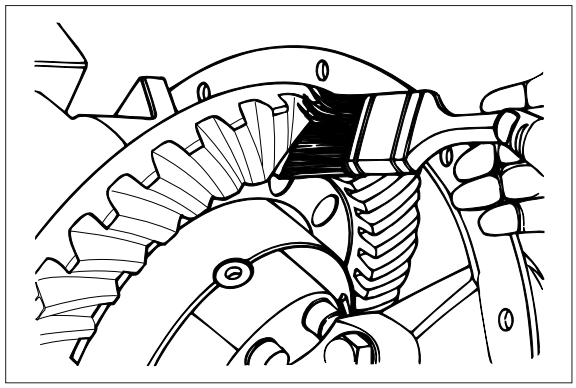

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2) Rotate ring gear forward and backward so that the 12 marked teeth go past the drive pinion six times to get a good contact pattern.

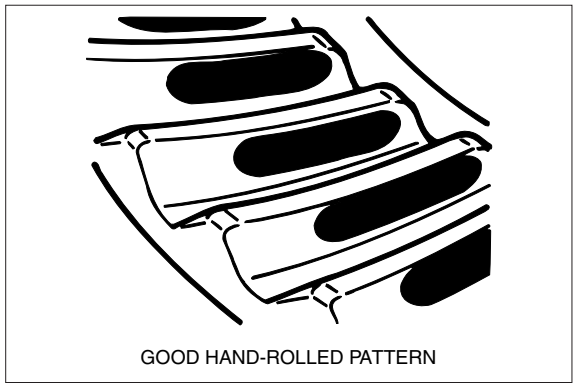
3) Compare the contact patterns.

In new gearsets, a good contact pattern is toward the toe of the tooth, and centered between the top and bottom of the tooth.

In used gearsets, a good contact pattern fills approximately the full length of the tooth. The top of the pattern is near the top of the tooth. The location should match the wear pattern on the tooth.

If the contact patterns require adjustment along the width of tooth (top/bottom), follow steps 4) - 5).

If the contact patterns requires adjustment along the length of tooth (toe/heel), follow step 6) - 7).



GOOD HAND-ROLLED PATTERN

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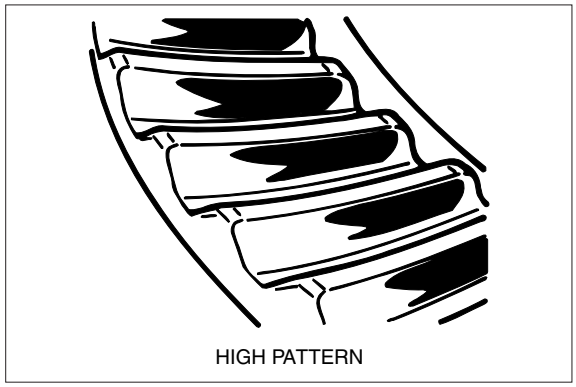

HIGH PATTERN

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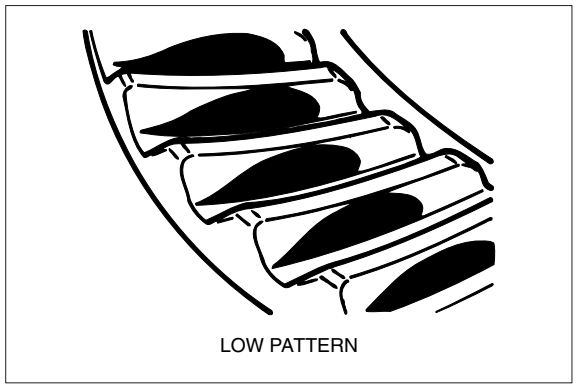

LOW PATTERN

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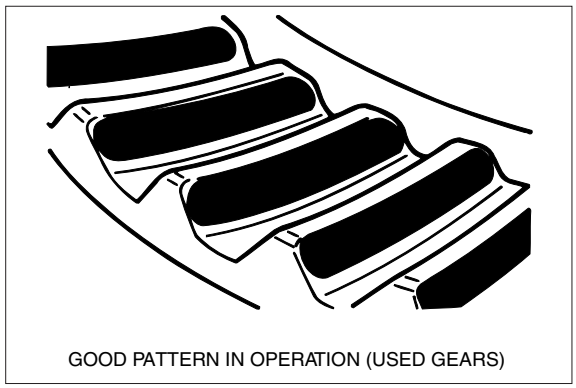

GOOD PATTERN IN OPERATION (USED GEARS)

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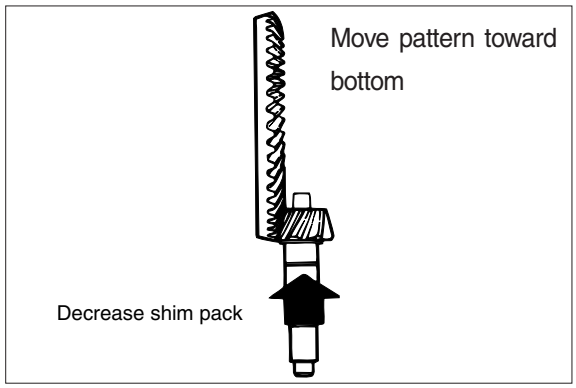
4) **High pattern :** A high contact pattern indicates that the pinion was installed too shallow into the carrier.

To correct, move the pinion toward the ring gear by decreasing the shim pack between pinion spigot and inner bearing cone. Refer to "Assembling the pinion bearing cage".



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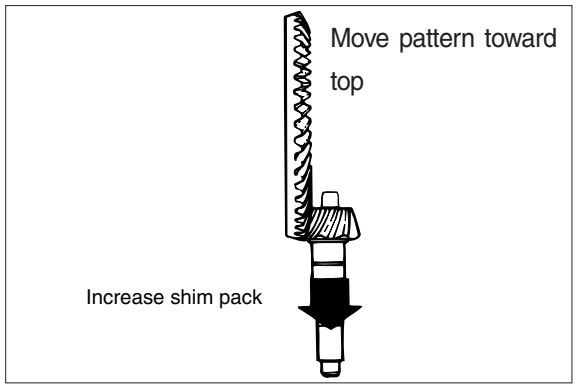
5) **Low pattern :** A low contact pattern indicates that the pinion was installed too deep into the carrier.

To correct, move the pinion away from the ring gear by increasing the shim pack between pinion spigot and inner bearing cone. Refer to "Assembling the pinion bearing cage".



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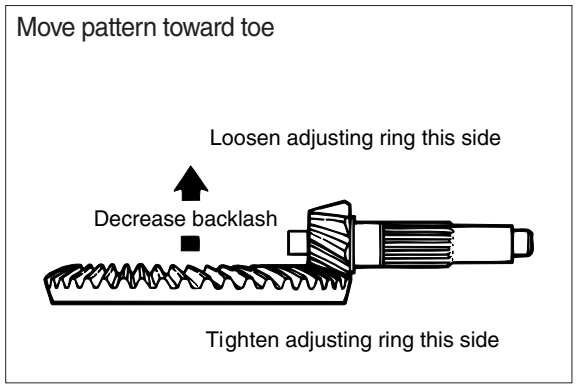
6) **Heel pattern :** Decrease the gearset backlash (within specified range) to move contact pattern toward toe and away from heel.
Refer to "Adjusting the gearset backlash".



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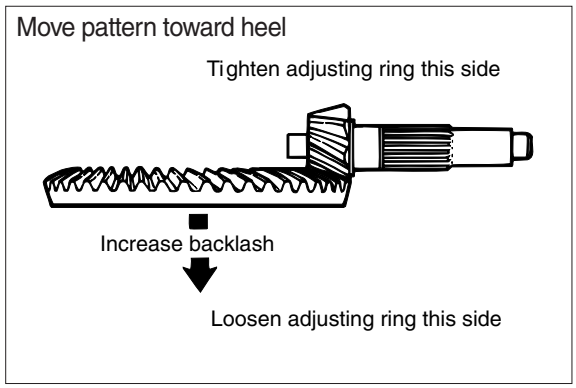
7) **Toe pattern :** Increase the gearset backlash (within specified range) to move contact pattern toward heel and away from toe.
Refer to "Adjusting the gearset backlash".



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