SECTION 3 POWER TRAIN SYSTEM

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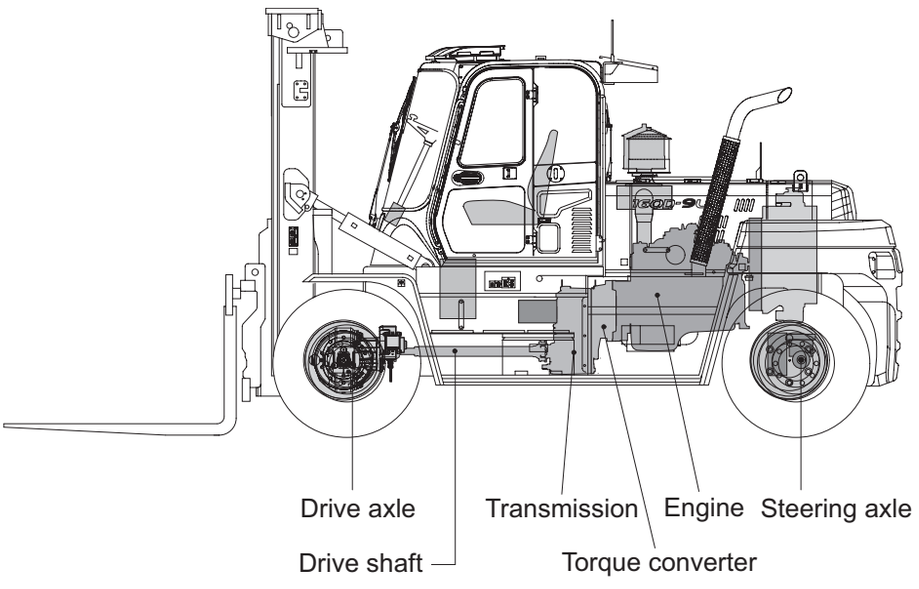
GROUP 1 STRUCTURE AND OPERATION

1. POWER TRAIN COMPONENT OVERVIEW



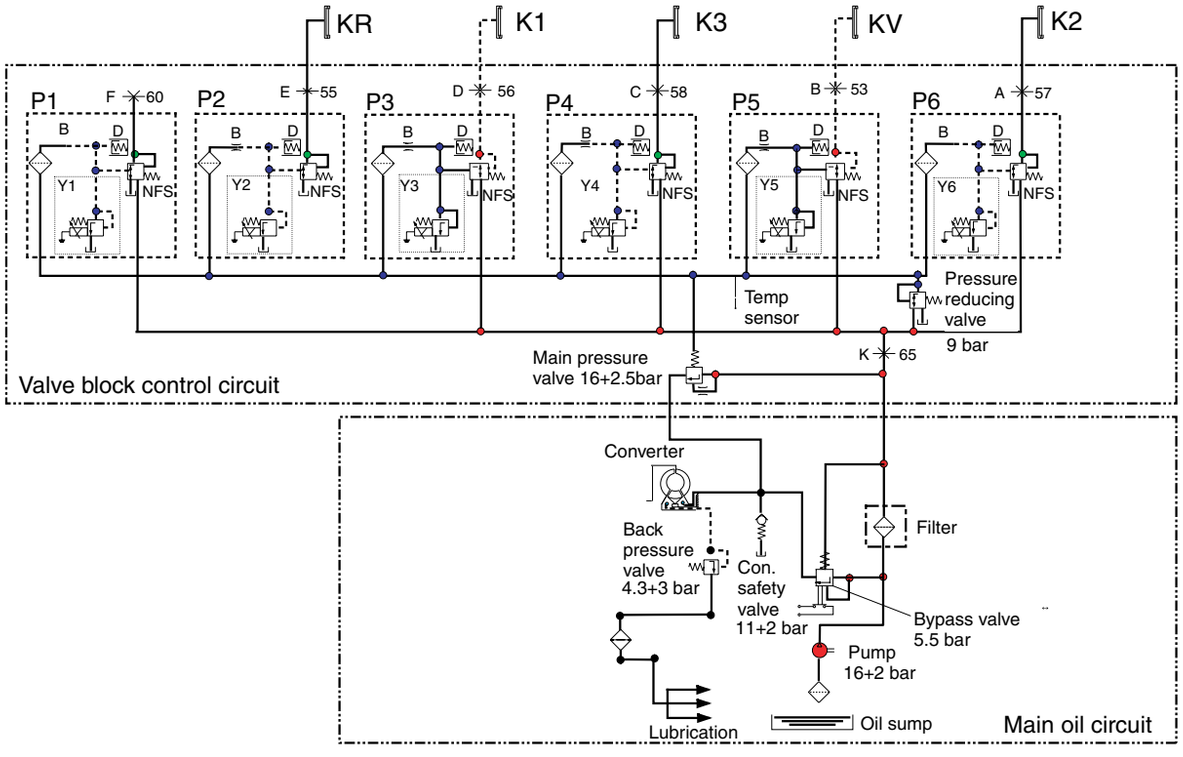
160D9LPT01

The power train consists of the following components :

- Torque converter
- Transmission
- Drive 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 the universal joints of the drive shaft to drive axle assembly.
The power transmitted to front axle drives front wheels.

· Hydraulic circuit

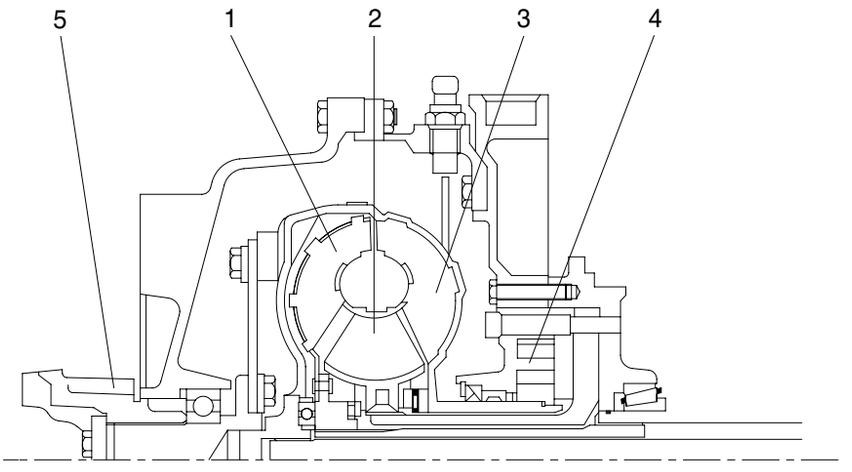


D507PT31

Speed	Forward			Reverse			Neutral	Positions on the valve block	No. of measuring points
	F1	F2	F3	R1	R2	R3			
Y1							-	F	60
Y2				●	●	●	-	E	55
Y3	●			●			-	D	56
Y4			●			●	-	C	58
Y5	●	●	●				-	B	53
Y6		●			●		-	A	57
Clutch engaged	KV, K1	KV, K2	KV, K3	KR, K1	KR, K2	KR, K3	-	-	-

NFS Follow-on slide
D Vibration damper
B Orifice
P1 Not used
P2 Proportional valve KR
P3 Proportional valve K1
P4 Proportional valve K3
P5 Proportional valve KV
P6 Proportional valve K2
Y1~Y6 Pressure regulators

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.

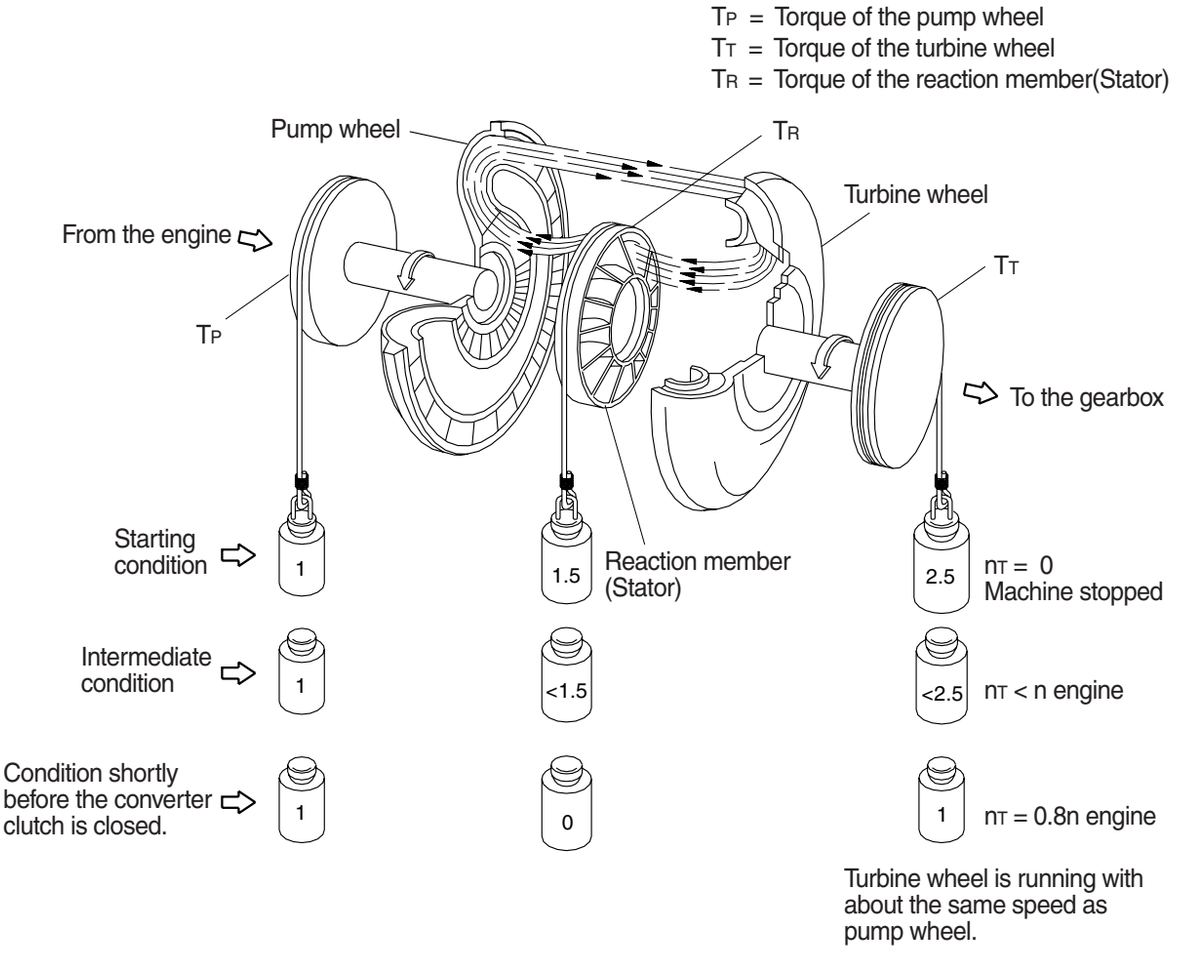
According to the rate of inversion, the turbine wheel and with it also the output shaft, receive a more or less high reaction moment. The stator (Reaction member), following the turbine, has the task to inverse again the oil which is escaping out of the turbine and to delivery it under the suitable discharge 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.

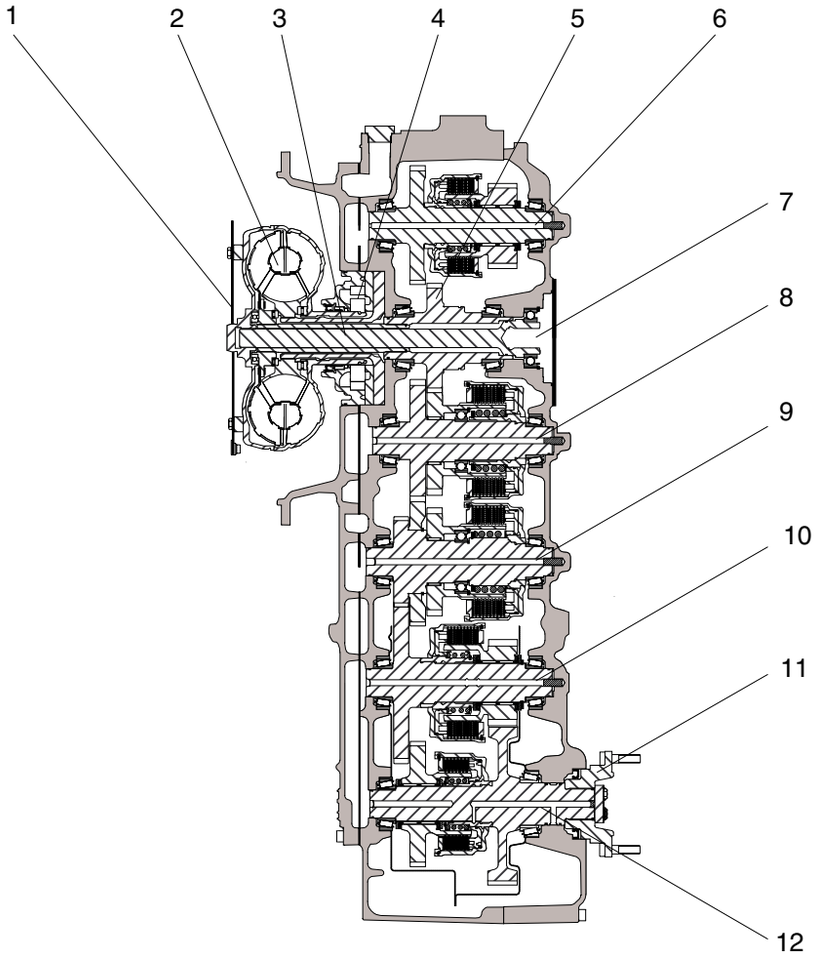
A stator freewheel serves to improve the efficiency in the upper driving range, it is backing up in the conversion range the moment upon the housing, and is released in the coupling range.
In this way, the stator can rotate freely.

Function of a hydrodynamic torque converter (Schematic view)



3. TRANSMISSION

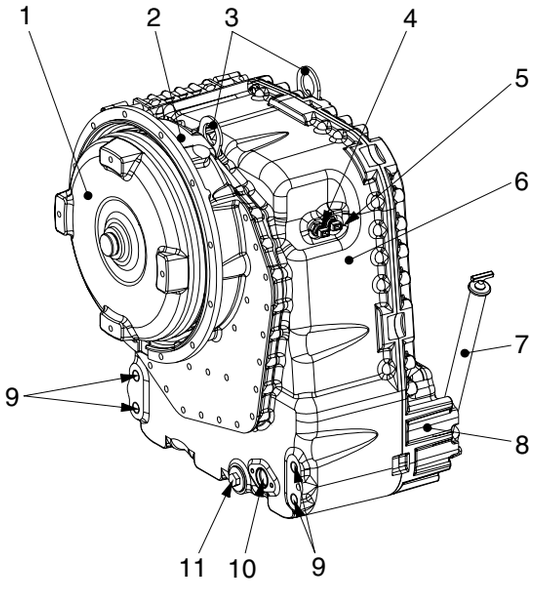
1) LAYOUT



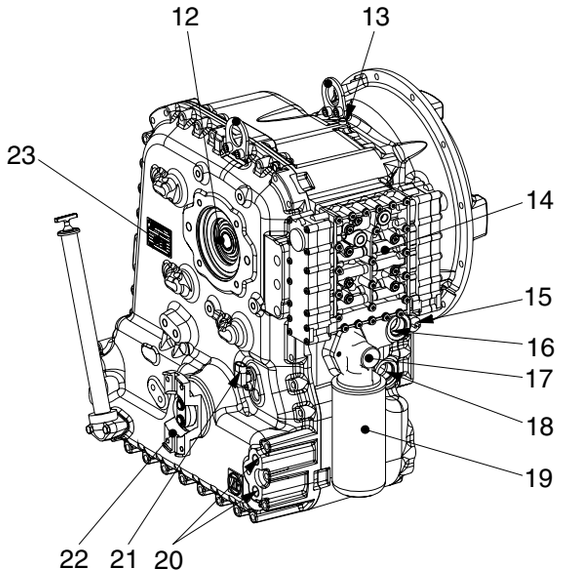
D507TM03

1	Engine connection	5	Input gear	9	Clutch shaft (KR)
2	Converter	6	Clutch shaft	10	Clutch shaft (K1)
3	Input shaft	7	Power take-off	11	Output flange
4	Transmission pump	8	Clutch shaft (KV)	12	Clutch shaft (K3/output)

2) INSTALLATION VIEW



FRONT VIEW



REAR VIEW

110D9PT26

1 Converter
2 Converter bell
3 Lifting lugs
4 Inductive transmitter n central gear train
5 Inductive transmitter n turbine
6 Gearbox housing - Front section
7 Oil level tube with oil dipstick
8 Gearbox housing - Rear section
9 Transmission suspension holes M20
10 Attachment possibility oil level tube with oil dipstick
11 Oil drain plug M38×1.5
12 Power take - off
13 Breather
14 Electro - hydraulic control
15 Temperature sensor behind the converter
16 Connection to the oil cooler
17 Filter head
18 Connection from the oil cooler
19 Exchange filter
20 Transmission suspension holes M20
21 Speed sensor n output
22 Output flange
23 Type plate

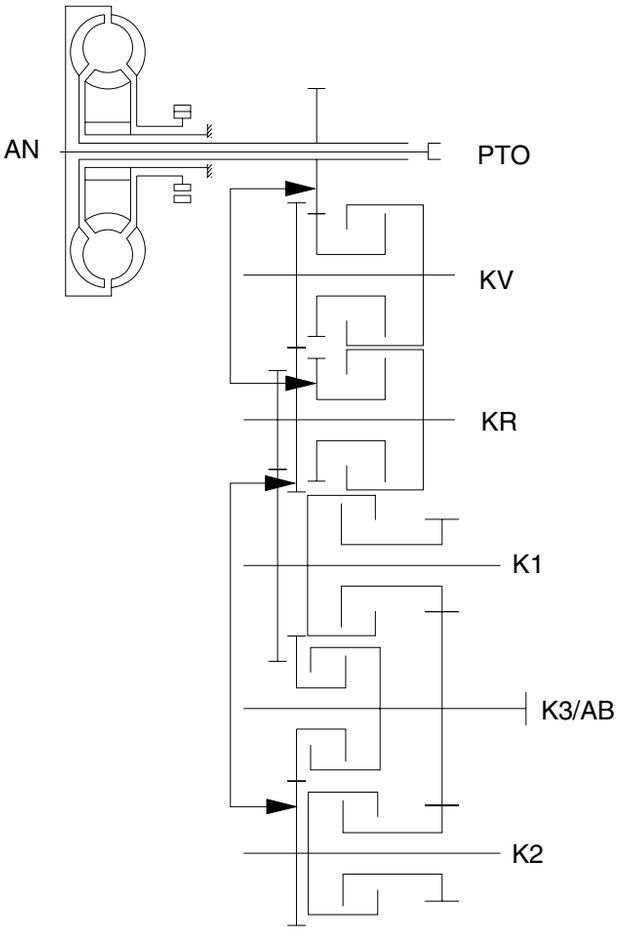
3) OPERATION OF TRANSMISSION

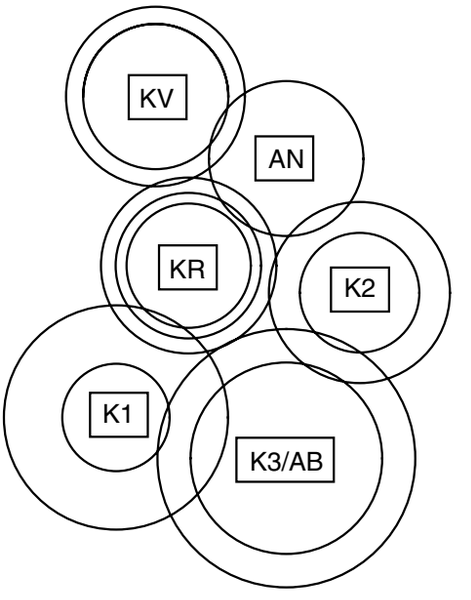
(1) Gearbox diagram

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

All gears are constantly meshing and carried on anti-friction 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
K1 = Clutch 1st speed
K2 = Clutch 2nd speed
K3 = Clutch 3rd speed/output
PTO = Power take-off

Diagram Clutches

Driving direction	Speed	Clutch
Forward	1	KV/K1
	2	KV/K2
	3	KV/K3
Reverse	1	KR/K1
	2	KR/K2
	3	KR/K3

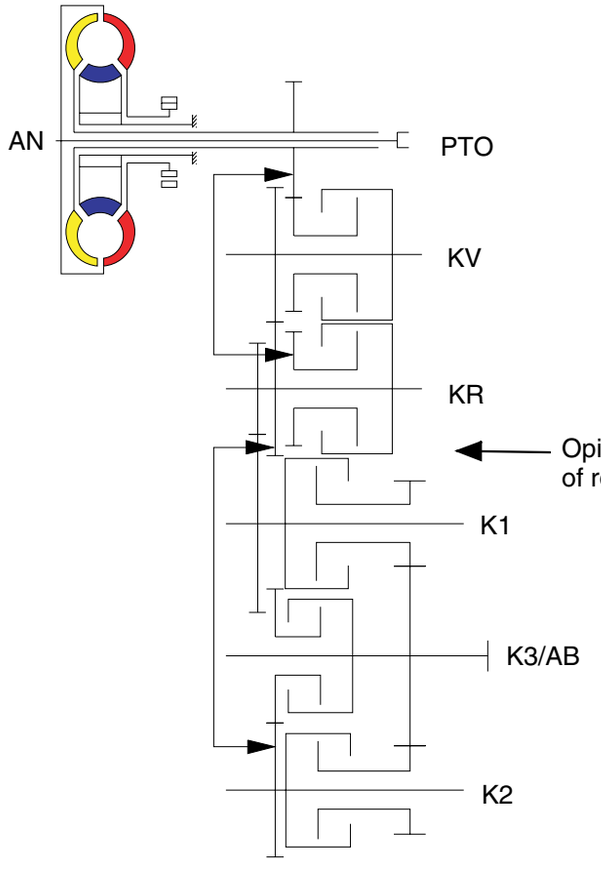
D507PT32

(2) Forward

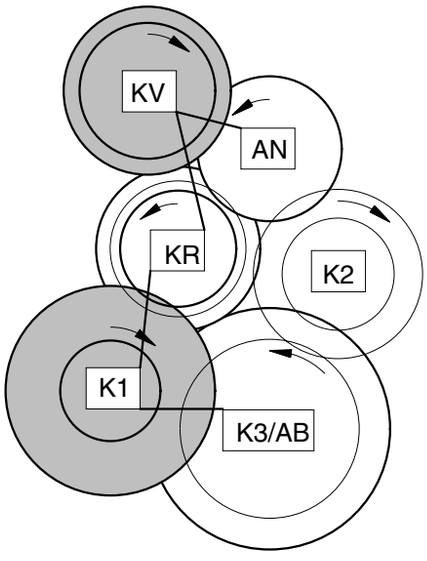
In forward, forward clutch and 1st, 2nd, 3rd clutch are engaged.

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

Transmission diagram



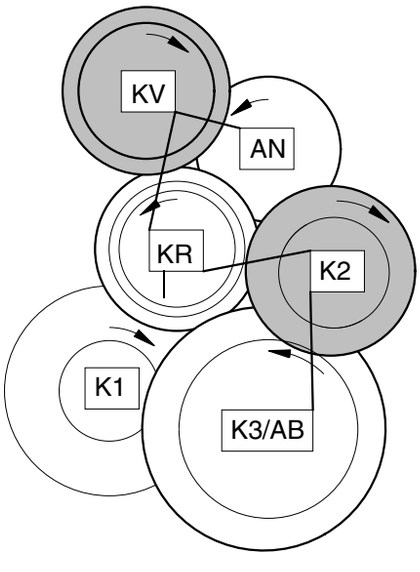
1st speed-forward



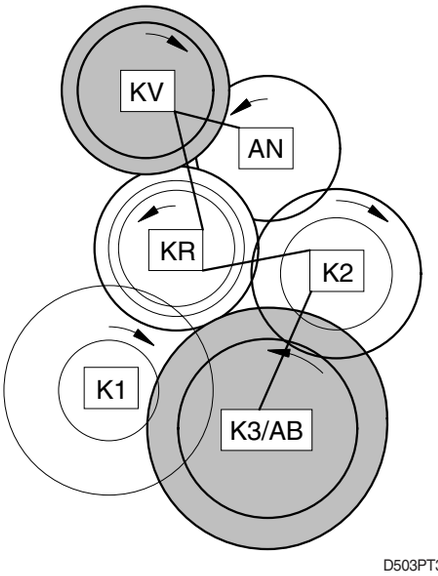
Legend:

AN = Input
KV = Clutch forward
KR = Clutch reverse
K1 = Clutch 1st speed
K2 = Clutch 2nd speed
K3/AB = Clutch 3rd speed/output
PTO = Power take-off

2nd speed-forward



3rd speed-forward



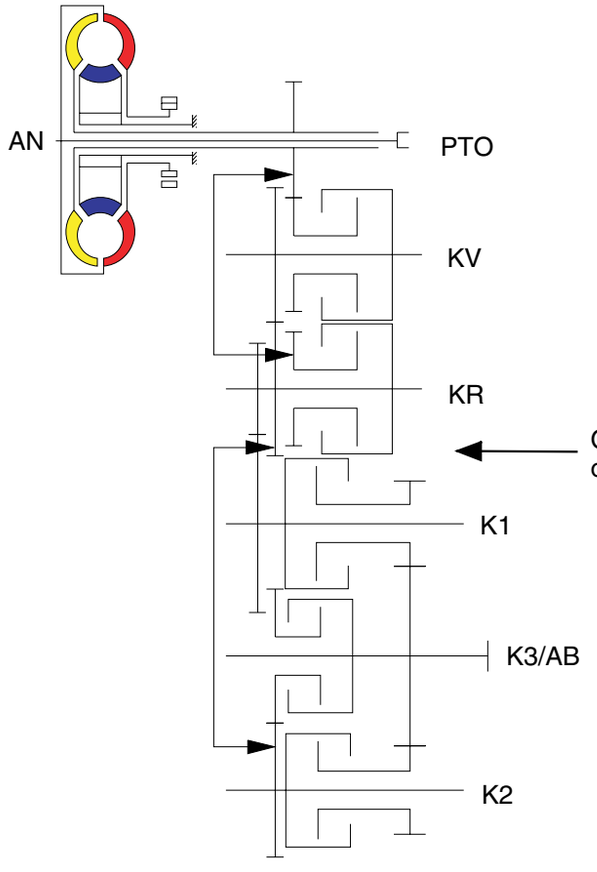
D503PT33

(3) Reverse

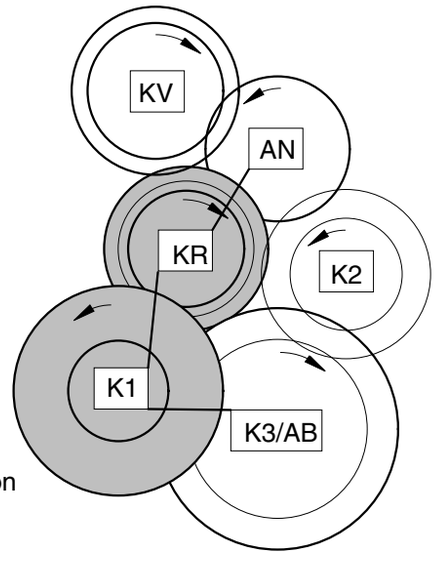
In reserve, reserve clutch and 1st, 2nd, 3rd clutch are engaged.

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

Transmission diagram



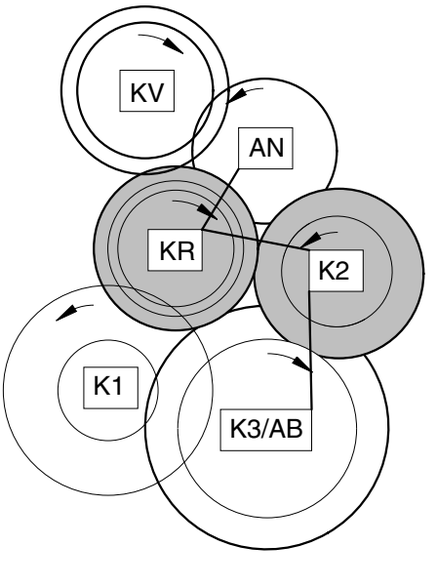
1st speed-reverse



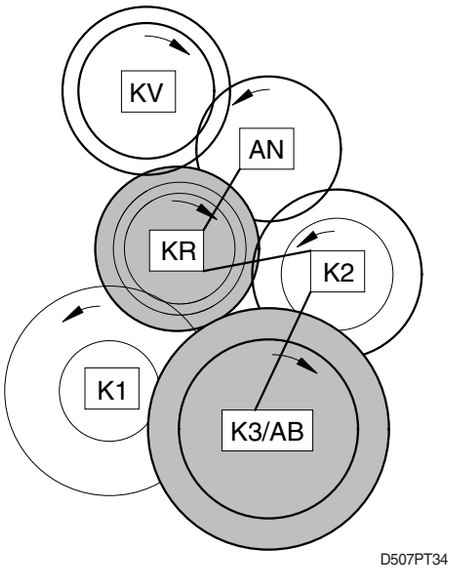
Legend:

AN = Input
KV = Clutch forward
KR = Clutch reverse
K1 = Clutch 1st speed
K2 = Clutch 2nd speed
K3/AB = Clutch 3rd speed/output
PTO = Power take-off

2nd speed-reverse

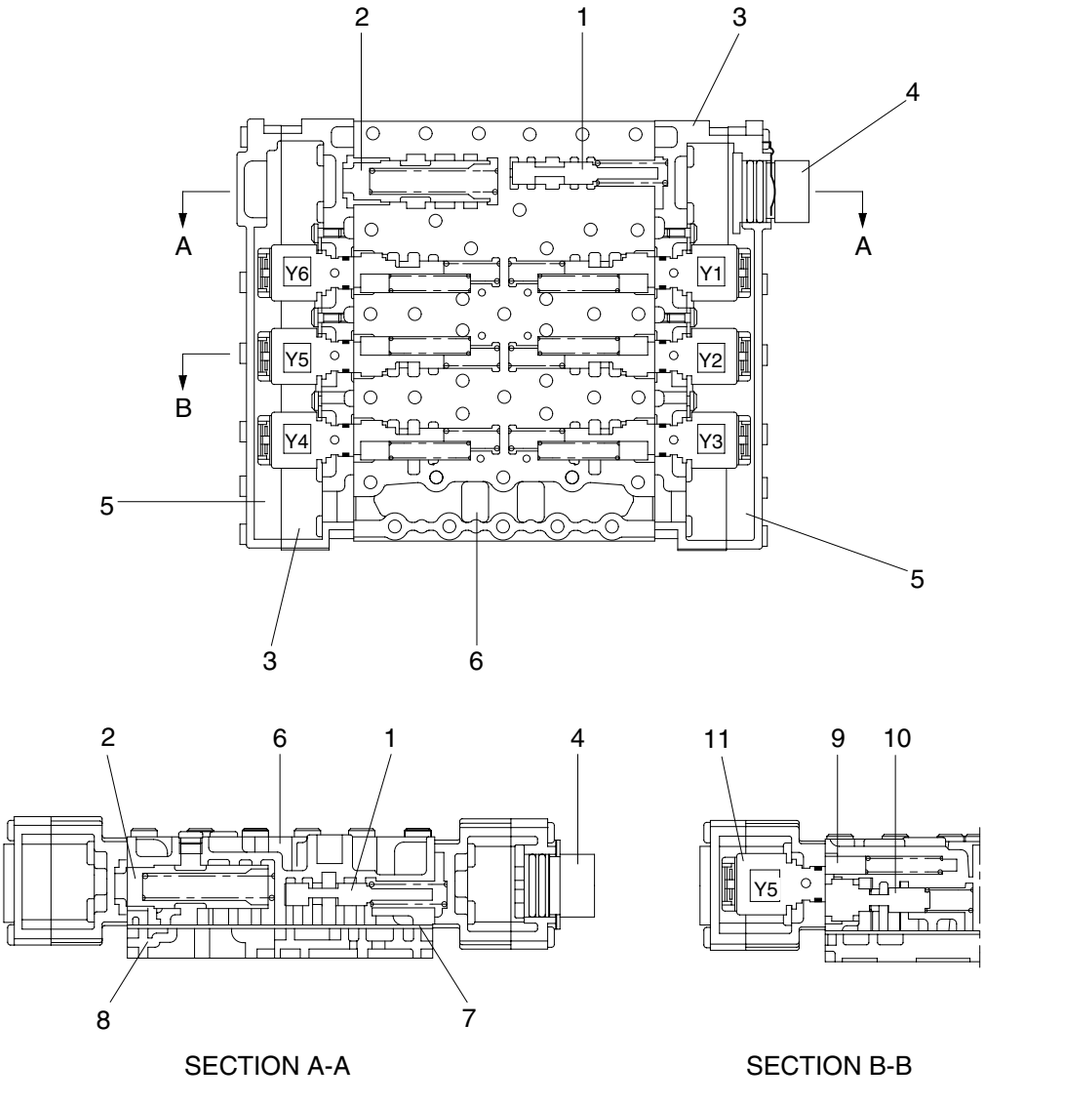


3rd speed-reverse



D507PT34

4) ELECTRO-HYDRAULIC SHIFT CONTROL WITH PROPORTIONAL VALVE



D507PT03

1 Pressure reducing valve (9 bar)
2 Main pressure valve (16 + 2 bar)
3 Housing
4 Plug (cable harness)
5 Cover
6 Valve block
7 Intermediate plate
8 Duct plate
9 Vibration damper
10 Follow - on slide
11 Pressure regulator

Transmission control, see schedule of measuring points, Oil circuit diagram and Electro-hydraulic control unit see page 3-2, 3-10.

The transmission pump, necessary for the oil supply of the converter, and for the transmission control, is sitting in the transmission on the engine-dependent input shaft.

The feed rate of the pump is
Q = 85 ℓ /min, at n_{Motor} = 2000 min^{-1}
This pump is sucking the oil via the coarse filter out of the oil sump and delivers it via the fine filter - the filter can also be fitted externally from the transmission - to the main pressure valve.

If because of contamination, respective damage, the through-flow through the fine filter is not ensured, the oil will be directly conducted via a filter differential pressure valve (bypass valve △p = 5.5+3 bar) to the lubrication.
In this case, an error indication is shown on the display.

The five clutches of the transmission are selected via the 6 proportional valves P1 to P6 (P1 will not be under current at the 3-speed version, i.e. without function).
The proportional valve (pressure regulator unit) is composed of pressure regulator (e.g. Y6), follow-on slide and vibration damper.

The control pressure of 9 bar for the actuation of the follow-on slides is created by pressure reducing valve. The pressure oil (16+2 bar) is directed via the follow-on slide to the respective clutch.

Due to the direct proportional selection with separated pressure modulation for each clutch, the pressure to the clutches, which are engaged in the gear change, will be controlled. In this way, a hydraulic intersection of the clutches to be engaged and disengaged becomes possible.
This is creating spontaneous shiftings without traction force interruption.

At the shifting, the following criteria will be considered :
- Speed of engine, turbine, central gear train and output.
- Transmission temperature.
- Shifting mode (up-,down-, reverse shifting and speed engagement out of Neutral).
- Load condition (full and part load, traction, overrun inclusive consideration of load cycles during the shifting).

The main pressure valve is limiting the max. control pressure to 16+2.5 bar and releases the main stream to the converter and lubrication circuit.
In the inlet to the converter, a converter safety valve is installed which protects the converter from high internal pressures (opening pressure 11+2 bar).
Within the converter, the oil serves to transmit the power according to the well-known hydrodynamic principle (see Chapter torque converter page 3-3).
To avoid cavitation, the converter must be always completely filled with oil.

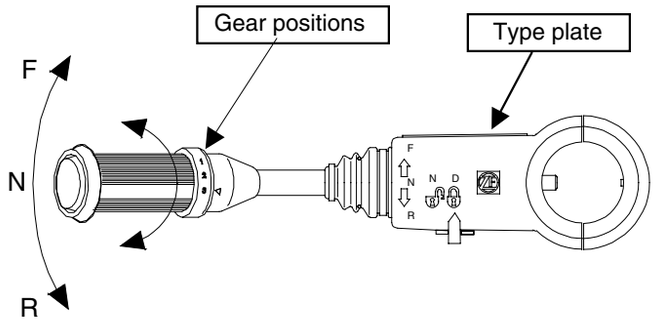
This is achieved by converter pressure back-up valve, rear-mounted to the converter, with an opening pressure of at least 4.3+3 bar.
The oil, escaping out of the converter, is directed to the oil cooler.

From the oil cooler, the oil is directed to the transmission and there to the lubricating oil circuit, so that all lubricating points are supplied with cooled oil.
In the electrohydraulic control unit are 6 pressure regulators installed.

5) GEAR SELECTOR (DW-3)

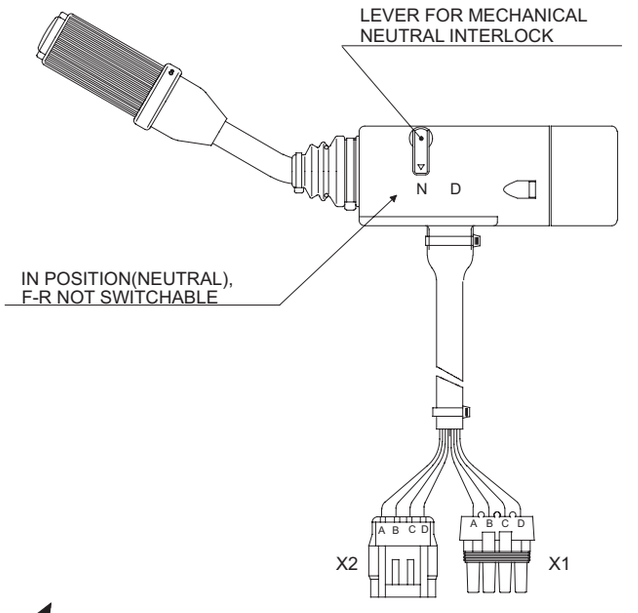
The gear selector is designed for the mounting on the steering column left side. By a rotative motion, the positions (speeds) 1 to 3 are selected by tilting the lever, the driving direction (Forward (F) - Neutral (N) - Reverse (R)).

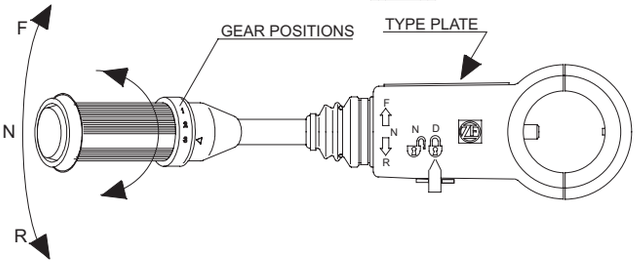
For the protection from unintended start off, a neutral interlock is installed :
Position "N" - Controller lever blocked in this position
Position "D" - Driving



D507PT12

Gear selector (DW-3)



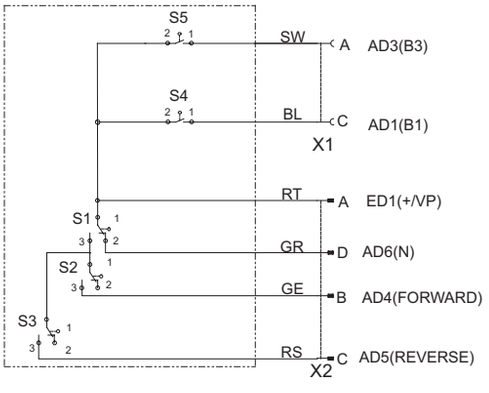


F = FORWARD
N = NEUTRAL
R = REVERSE
D = MECHANICAL NEUTRAL INTERLOCK
1 = 1st SPEED
2 = 2nd SPEED
3 = 3rd SPEED

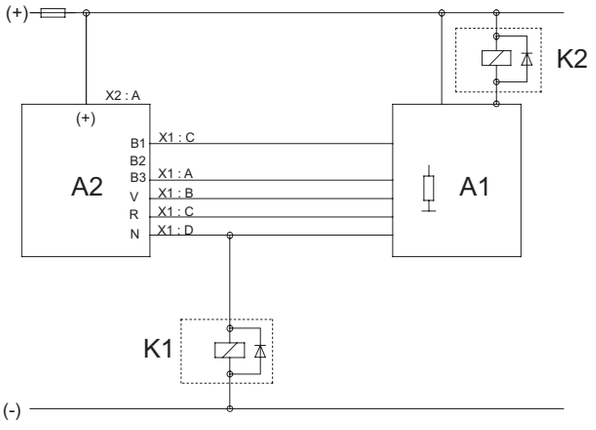
CODING GEAR SELECTOR

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

CIRCUIT DIAGRAM SELECTOR



CONNECTION DIAGRAM SELECTOR



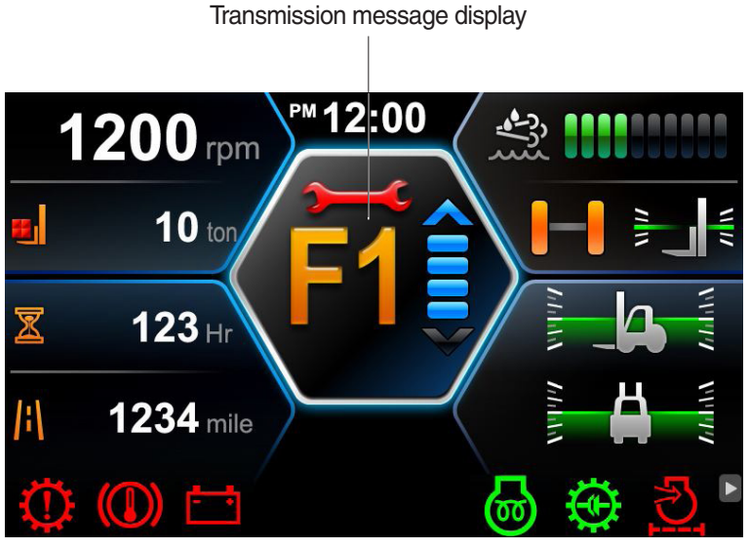
K1 = RELAY STARTER INTERLOCK
K2 = RELAY REVERSE LIGHTS
A1 = TCU(Transmission Control Unit)
A2 = CONTROLLER

160D9LPT38

6) TRANSMISSION ERROR DISPLAY

(1) Function

The display can be used with the gear selector (DW-3). It indicates speed and driving direction. 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.



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※ If it happens error codes, consult with Hyundai service center to repair the fault.

(2) Display during AEB-Mode

Symbol	Meaning	Remarks
K1.....K3 KV, KR	Calibrating clutch K1...K3, KV or KR resp.	
_and Kx	Wait for start, initialization of clutch Kx, x : 1, 2, 3, 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 enging speed	
▽E	Engine speed too high → lower enging 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	Output speed_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	Park brake_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)

(3) INITIALIZING THE INCHING SENSOR

① Start engine after parking the machine on flat floor and blocking wheels.
② Release parking brake and keep neutral gear shift.
③ Adjust the inching sensor linkage so that the regular voltage is supplied to inching sensor when operating the pedal.
※ Regular voltage ; Before pedal operation (1±0.1V), After pedal operation (3.5±0.1V).
④ Stop the engine and then just KEY ON. (Release parking brake, keep neutral gear)
⑤ Connect the AEB STARTER to the T/M controller.
⑥ Push AEB STARTER over 3 seconds.
⑦ If display shows "▼IP", Step on the pedal fully.
⑧ If display shows "▲IP", release "OK"
⑨ After the successful completion, it displays "OK".
⑩ In case of abnormal running, it may display "STOP" with the appropriate error code.
⑪ After troubleshooting, start the machine again to repeat above.
※ Above works are to be done with the parking brake released, so machine's wheels must be blocked for safety.

(4) DISPLAY DURING INCHPEDAL CALIBRATION

Symbol	Meaning	Remarks
▼IP	Push down the pedal slowly until endposition is reached and hold this position	
▲IP	Release the pedal slowly until endposition is reached	
IP blinkt	A problem occurred, release the pedal slowly until endposition is reached	If the expected endposition could not be reached, release the pedal and try again
OK	Finished inchpedal calibration successful	
FN and Stop	Shift lever not in Neutral position	Calibrations is aborted
FS and Stop	Sensor supply voltage AU1 is out of the specified range	Calibrations is aborted
FO and Stop	Outputspeed_not_zero	Calibrations is aborted
SL and Stop	Sensor voltage below specified range	Calibrations is aborted
SU and Stop	Sensor voltage below specified range	Calibrations is aborted
IL and Stop	Sensor position for released pedal out of specified range	Calibrations is aborted
IU and Stop	Sensor position for released pedal out of specified range	Calibrations is aborted
TO and Stop	Time-out calibration, pedal not moved after calibration start	Calibrations is aborted
DL and Stop	Angle between pedal positions released and pressed to small	Calibrations is aborted
DU and Stop	Angle between pedal positions released and pressed to small	Calibrations is aborted
FI and Stop	Sensor signal 1 and 2 don't match together	Calibrations is aborted

(5) Transmission error 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 lever
13	**Logical error at engine derating device** TCU detected no reaction of engine while derating device active	After selecting neutral, TCU change to OP mode limp home	· Check engine derating device ※ This fault is reset after power up of TCU
15	**Logical error at direction select signal 2 shift lever** TCU detected a wrong signal combination for the direction · Cable from shift lever 2 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 if selector active OP mode : Transmission shutdown if elector active	· Check the cables from TCU to shift lever 2 · Check signal combinations of shift lever positions F-N-R ※ Fault is taken back if TCU detects a valid neutral signal for the direction at the shift lever
16	**Logical error at axle connection** Feedback axle connection measured by TCU and output signal axle connection don't fit · Axle can't be connected or disconnected due to mechanical problem · One of the cables from feedback axle connection switch to TCU is broken	OP mode : Normal	· Check the cables from TCU to feedback axle connection switch · Check signals of the feedback axle connection switch
21	**S.C. to battery voltage at clutch cut off input** The measured voltage is too high: · Cable is defective and is contacted to battery voltage · Clutch cut off sensor has an internal defect · Connector pin is contacted to battery voltage	Clutch cut off function is disabled OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the clutch cut off sensor
22	**S.C. to ground or O.C. at clutch cut off input** The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Cable has no connection to TCU · Clutch cut off sensor has an internal defect · Connector pin is contacted to vehicle ground or is broken	Clutch cut off function is disabled OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the clutch cut off sensor

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
23	**S.C. to battery voltage at load sensor input** The measured voltage is too high: · Cable is defective and is contacted to battery voltage · Load sensor has an internal defect · Connector pin is contacted to battery voltage	Retarder function is affected TCU uses default load OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the load sensor · Check the assembly tolerances of load sensor ※ Availability of retarder depends on default load
24	**S.C. to ground or O.C. at load sensor input** The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Cable has no connection to TCU · Load sensor has as internal defect · Connector pin is contacted to vehicle ground or is broken	Retarder function is affected TCU use default load OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the load sensor · Check the assembly tolerances of load sensor ※ Availability of retarder depends on default load
25	**S.C. to battery voltage or O.C. at transmi-ssion 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 battery voltage or O.C. at transmi-ssion 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 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 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
29	**S.C. to battery voltage or O.C. at converter output 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
30	**S.C. to ground at converter output 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
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

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
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
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 TCU
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 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	· 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
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
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
3D	**Turbine speed zero doesn't fit to other speed signals**	-	※ Not used
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

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
71	**S.C. to battery voltage at clutch K1** The measured resistance value of the valve is out of limit, the voltage at K1 valve is too high · Cable/connector is defective and has contact to battery voltage · 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 TCU to the gearbox · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-37
72	**S.C. to ground at clutch K1** The measured resistance value of the valve is out of limit, the voltage at K1 valve is too low · Cable/connector is defective and has contact to vehicle ground · 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 3-37
73	**O.C. at clutch K1** 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 3-37
74	**S.C. to battery voltage at clutch K2** The measured resistance value of the valve is out of limit, the voltage at K2 valve is too high · Cable/connector is defective and has contact to battery voltage · 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 3-37
75	**S.C. to ground at clutch K2** The measured resistance value of the valve is out of limit, the voltage at K2 valve is too low · Cable/connector is defective and has contact to vehicle ground · 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 3-37
76	**O.C. at clutch K2** 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 3-37

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
77	**S.C. to battery voltage at clutch K3** The measured resistance value of the valve is out of limit, the voltage at K3 valve is too high · Cable/connector is defective and has contact to battery voltage · 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 3-37
78	**S.C. to ground at clutch K3** The measured resistance value of the valve is out of limit, the voltage at K3 valve is too low · Cable/connector is defective and has contact to vehicle ground · 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 3-37
79	**O.C. at clutch K2** 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 3-37
7A	**S.C. to battery voltage at converter clutch**	-	-
7B	**S.C. to ground at converter clutch**	-	-
7C	**O.C. at converter clutch**	-	※ Not used
7D	**S.C. ground at engine derating device** · Cable is defective and is contacted to vehicle ground · Engine derating device has an internal defect · Connector pin is contacted to vehicle ground	Engine derating will be on until TCU power down even if fault vanishes(Loose connection) OP mode : Normal	· Check the cable from TCU to the engine derating device · Check the connectors from engine derating device to TCU · Check the resistance* of engine derating device ※ Not used * See page 3-37
7E	**S.C. battery voltage at engine derating device** · Cable/connector is defective and is contacted to battery voltage · Engine derating device has an internal defect	No reaction OP mode : Normal	· Check the cable from TCU to the engine derating device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-37

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
7F	**O.C. at engine derating device** TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Engine derating device has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the engine derating device · Check the connectors from engine derating device to TCU · Check the resistance* of engine derating device * See page 3-37
85	**S.C. to ground at clutch KV** The measured resistance value of the valve is out of limit, the voltage at K4 valve is too low · Cable/connector is defective and has contact to vehicle ground · 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 3-37
86	**O.C. at clutch KV** The measured resistance value of the valve is out of limit · Cable/connector is defective and has 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 3-37
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 · 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 3-37

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 · 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 3-37
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 3-37
91	**S.C. to ground at relay reverse warning alarm** TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contact to vehicle ground · Backup alarm device has an internal defect · Connector pin is contacted to vehicle ground	Backup alarm will be on until TCU power down even if fault vanishes(Loose connection) OP mode : Normal	· Check the cable from TCU to the backup alarm device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-37
92	**S.C. to battery voltage at relay reverse warning alarm** TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and is contacted to battery voltage · Backup alarm device has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the backup alarm device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-37

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
93	**O.C. at relay reverse warning alarm** TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Backup alarm device has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the backup alarm device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-37
94	**S.C. to ground at relay starter interlock** TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is connection to vehicle ground · Starter interlock relay has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to the stater interlock relay · Check the connectors from starter interlock relay to TCU · Check the resistance* of starter interlock relay * See page 3-37
95	**S.C. to battery voltage at relay starter interlock** TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no connection to battery voltage · Starter interlock relay has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the starter interlock relay · Check the connectors from starter interlock relay to TCU · Check the resistance* of starter interlock relay * See page 3-37
96	**O.C. at relay starter interlock** TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Starter interlock relay has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the starter interlock relay · Check the connectors from starter interlock relay to TCU · Check the resistance* of starter interlock relay * See page 3-37

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
97	**S.C. to ground at park brake solenoid** TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is connection to vehicle ground · Park brake solenoid has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to the park brake solenoid · Check the connectors from park brake solenoid to TCU · Check the resistance* of park brake solenoid * See page 3-37
98	**S.C. to battery voltage at park brake solenoid** TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and is connection to battery voltage · Park brake solenoid has an internal defect · Connector pin is contacted to battery voltage	No reaction Optional : (Some customers) TCU shifts to neutral caused by park brake feed back OP mode : Normal	· Check the cable from TCU to the park brake solenoid · Check the connectors from park brake solenoid to TCU · Check the resistance* of park brake solenoid * See page 3-37
99	**O.C. at park brake solenoid** TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Park brake solenoid has an internal defect · Connector has no connection to TCU	No reaction Optional : Some customers TCU shifts to neutral caused by park brake feed back OP mode : Normal	· Check the cable from TCU to the park brake solenoid · Check the connectors from park brake solenoid to TCU · Check the resistance* of park brake solenoid * See page 3-37
9A	**S.C. to ground at converter lock up clutch solenoid** TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Converter clutch solenoid has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to the converter clutch solenoid · Check the connectors from converter clutch solenoid to TCU · Check the resistance* of park brake solenoid * See page 3-37
9B	**O.C. at converter lock up clutch solenoid** TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Converter clutch solenoid has an internal defect · Connector has no connection to TCU	Converter clutch always open, retarder not available OP mode : Normal	· Check the cable from TCU to the converter clutch solenoid · Check the connectors from converter clutch solenoid to TCU · Check the resistance* of park brake solenoid * See page 3-37

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
9C	**S.C. to battery voltage at converter lock up clutch solenoid** TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no contacted to battery voltage · Converter clutch solenoid has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the converter clutch solenoid · Check the connectors from converter clutch solenoid to TCU · Check the resistance* of converter clutch solenoid * See page 3-37
9D	**S.C. to ground at retarder solenoid** TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Retarder solenoid has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to the retarder solenoid · Check the connectors from retarder solenoid to TCU · Check the resistance* of retarder solenoid * See page 3-37
9E	**O.C. at retarder solenoid** TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Retarder solenoid has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the retarder solenoid · Check the connectors from retarder solenoid to TCU · Check the resistance* of retarder solenoid * See page 3-37
9F	**S.C. to battery voltage at retarder solenoid** TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no connection to battery voltage · Retarder solenoid has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the retarder solenoid · Check the connectors from retarder solenoid to TCU · Check the resistance* of retarder solenoid * See page 3-37

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
A1	**S.C. to ground at difflock or axle connection solenoid** TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Difflock solenoid has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to the difflock solenoid · Check the connectors from difflock solenoid to TCU · Check the resistance* of difflock solenoid * See page 3-37
A2	**S.C. to battery voltage at difflock or axle connection solenoid** TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no connection to battery voltage · Difflock solenoid has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the difflock solenoid · Check the connectors from difflock solenoid to TCU · Check the resistance* of difflock solenoid * See page 3-37
A3	**O.C. at difflock or axle connection solenoid** TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Difflock solenoid has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the difflock solenoid · Check the connectors from difflock solenoid to TCU · Check the resistance* of difflock solenoid * See page 3-37
A4	**S.C. to ground at warning signal output** TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Warning device has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to the warning device · Check the connectors from warning device to TCU · Check the resistance* of warning device * See page 3-37
A5	**O.C. voltage at warning signal output** TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Warning device has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the warning device · Check the connectors from warning device to TCU · Check the resistance* of warning device * See page 3-37
A6	**S.C. to battery voltage at warning signal output** TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has is contacted to battery voltage · Warning device has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the warning device · Check the connectors from warning device to TCU · Check the resistance* of warning device * See page 3-37

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
B1	**Slippage at clutch K1** TCU calculates a differential speed at closed clutch K1. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch K1 · 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 K1 · 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 K2** TCU calculates a differential speed at closed clutch K2. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch K2 · 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 K2 · 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
B3	**Slippage at clutch K3** TCU calculates a differential speed at closed clutch K3. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch K3 · 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 K3 · 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 retarder** TCU measured a temperature in the retarder oil that is over the allowed threshold	TCU disables retarder OP mode : Normal	· Cool down machine · Check oil level · Check temperature sensor
B9	**Overspend engine**	Retarder applies OP mode : Normal	-
BA	**Differential pressure oil filter** TCU measured a voltage at differential pressure switch out of the allowed range · Oil filter is polluted · Cable/connector is broken or cable/ connector is contacted to battery voltage or vehicle ground · Differential pressure switch is defective	No reaction OP mode : Normal	· Check oil filter · Check wiring from TCU to differential pressure switch · Check differential pressure switch (Measure resistance)

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
BB	**Slippage at converter lockup clutch** TCU calculates a differential speed at closed converter lockup clutch. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at converter lockup clutch · Low main pressure · Wrong signal at engine speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective	-	· Check pressure at converter lockup clutch · Check main pressure in the system · Check sensor gap at engine speed sensor · Check sensor gap at turbine speed sensor · Check signal at engine speed sensor · Check signal at turbine speed sensor · Replace clutch
BD	**S.C. to ground at engine brake solenoid** TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Engine brake solenoid has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to engine brake solenoid · Check the connectors from engine brake solenoid to TCU · Check the resistance* of engine brake solenoid * See page 3-37
BE	**S.C. to battery voltage at engine brake** TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and is contacted to battery voltage · Engine brake solenoid has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the engine brake solenoid · Check the connectors from engine brake solenoid to TCU · Check the resistance* of engine brake solenoid * See page 3-37
BF	**O.C. at engine brake** TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Engine brake solenoid has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the engine brake solenoid · Check the connectors from engine brake solenoid to TCU · Check the resistance* of engine brake solenoid * See page 3-37

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
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
C4	**S.C. to ground at joystick status indicator** TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Joystick status indicator has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to joystick status indicator · Check the connectors from joystick status indicator to TCU · Check the resistance* of joystick status indicator * See page 3-37
C5	**S.C. to battery voltage at joystick status indicator** TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and is contacted to battery voltage · Joystick status indicator has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to joystick status indicator · Check the connectors from joystick status indicator to TCU · Check the resistance* of joystick status indicator * See page 3-37
C6	**O.C. at joystick status indicator** TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Joystick status indicator has an internal defect · Connector pin has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to joystick status indicator · Check the connectors from joystick status indicator to TCU · Check the resistance* of joystick status indicator * See page 3-37

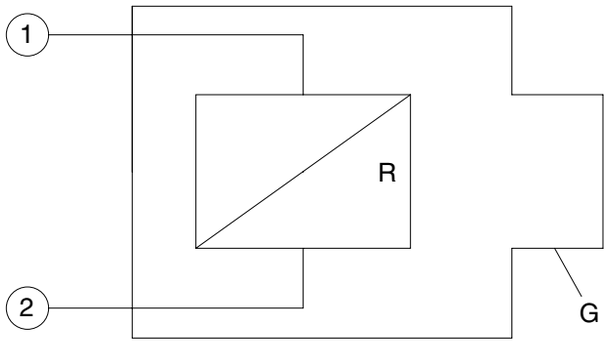
Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
D1	**S.C. to battery voltage at power supply for sensors** TCU measures more than 6V at the pin AU1 (5V sensor supply)	See fault codes No.21 to 2C	· Check cables and connectors 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
E1	**S.C. battery voltage at speedometer output**	-	※ Not used
E2	**S.C. to ground or O.C at speedometer output**	-	※ Not used
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 · 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
E5	**Communication failure on DeviceNet**	Shift to neutral OP mode : TCU shutdown	· Check Omron master · Check wire of DeviceNet-Bus · Check cable to Omron master
E6	**DISPID1 timeout** Timeout of CAN-massage DISPID1 from display controller · Interference on CAN-Bus · CAN wire/connector is defective · Can wire/connector is defective and has contact to vehicle ground or battery voltage	TCU select parameter set with ID0 OP mode : Limp home	· Check display controller · Check wire of CAN-Bus · Check cable display controller

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
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 configuration 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** 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

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

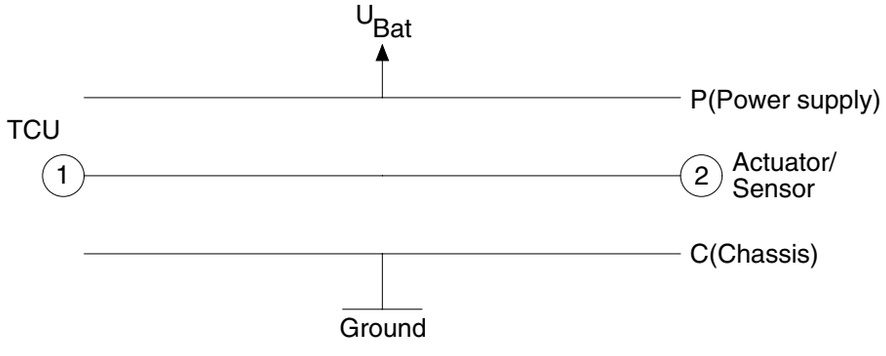
① Actuator



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	$R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = 0$

7) ELECTRONIC CONTROL FOR POWER TRANSMISSION

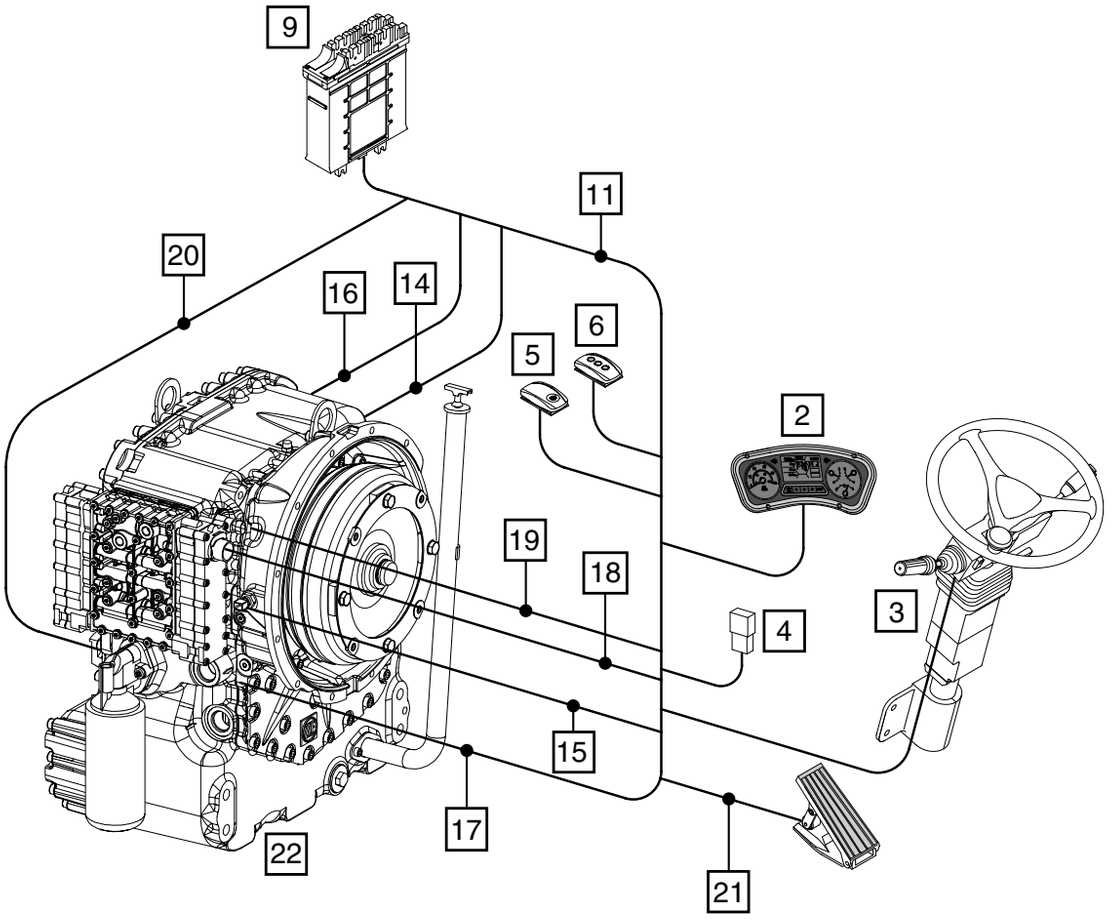
(1) Description of the basic functions

The powershift transmission is equipped with TCU.

- The system is processing the desire of the driver according to the following criteria :
- Gear determination depending on gear selector position, driving speed and load condition.
- Protection from operating error as far as necessary, is possible via electronic protecttion (programming).
- Protection from over-speeds (on the base of engine and turbine speed).
- Electronic inching.

Legend

2 = Display
3 = Gear selector DW - 3
4 = Power supply connection
5 = Switch for enable inched (Option)
6 = Switch for driving program manual/Auto 1/Auto 2
9 = TCU (EST-37A)
11 = Wiring
14 = Cable to inductive transmitter speed central gear train
15 = Cable to inductive speed engine
16 = Cable to inductive transmitter speed turbine
17 = Cable to temperature measuring point behind the converter
18 = Cable to plug connection on the electrohydraulic control unit
19 = Cable to filter contamination switch
20 = Cable to speed sensor output
21 = Cable from angle sensor/inch-sensor
22 = Transmission



110D9PT17

(2) Inching device

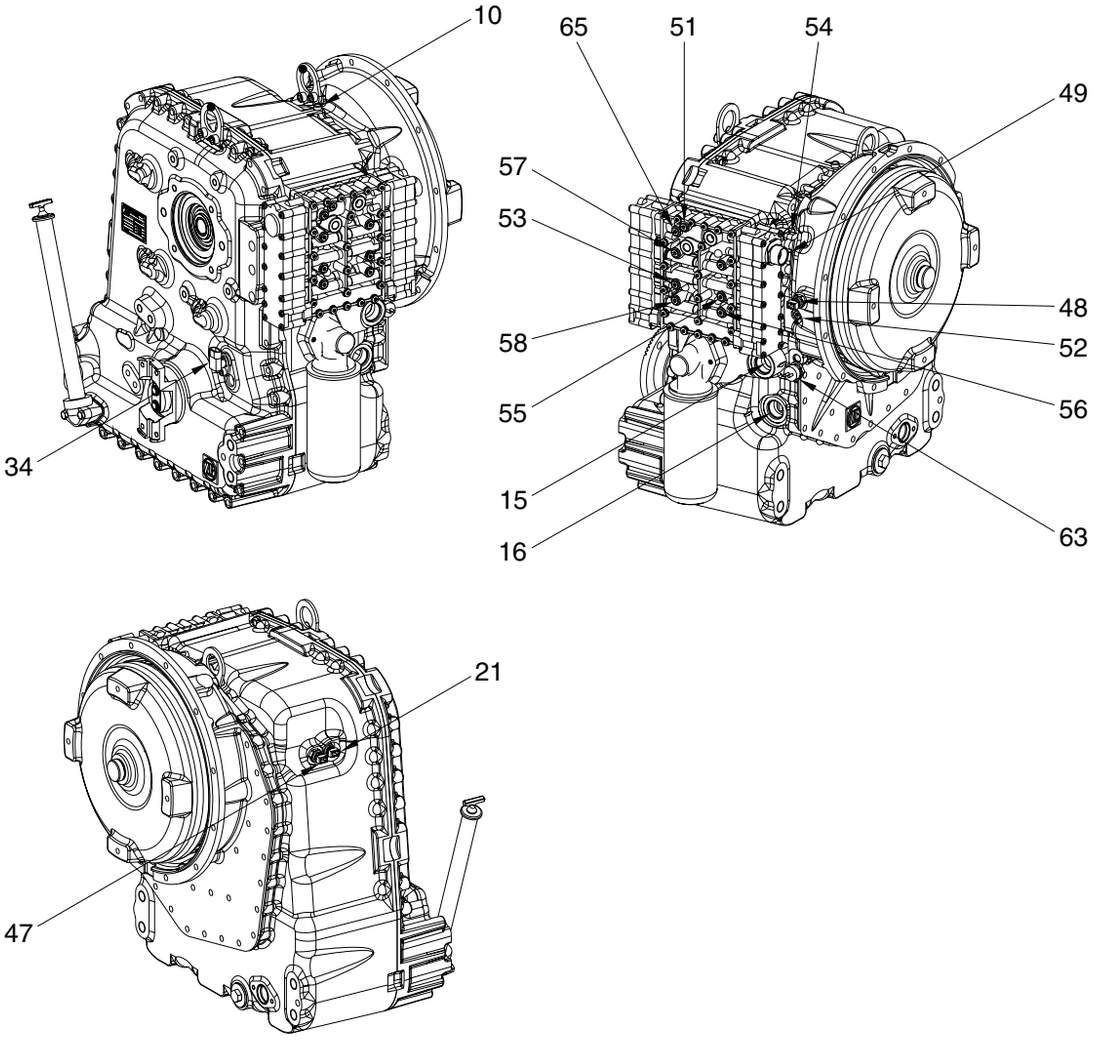
This function is especially suitable for lift trucks. It allows to reduce the driving speed infinitely variable without modification of the engine speed in such a way that driving with a very low speed will be possible. In his way, the driver can move the vehicle very exactly to a determined position. At the same time and important part of the engine power for the output of the hydraulic system is at disposal by the high engine speed.

Operation is carried out by a separate inching pedal, where an angle of rotation sensor is mounted.

By means of the proportional valve technology the TCU regulates the pressure in the driving direction clutch in such a way that the driving speed is adjusted in accordance with the inch rotating angle sensor position. Clutch overloading is avoided thanks to the electronic protection.

4. TRANSMISSION MEASURING POINTS AND CONNECTIONS

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



110D9TM04

1) OIL PRESSURE AND TEMPERATURE

Port	Description			Size
51	In front of converter - Opening pressure 11+2 bar			M10×1
52	Behind converter - Opening pressure 4.3 + 3 bar			M14×1.5
53	Clutch Forward	16 + 2 bar	KV	M10×1
55	Clutch reverse	16 + 2 bar	KR	M10×1
56	Clutch	16 + 2 bar	K1	M10×1
57	Clutch	16 + 2 bar	K2	M10×1
58	Clutch	16 + 2 bar	K3	M10×1
63	Temperature sensor behind the converter			M14×1.5
65	System pressure	16 + 2.5 bar		M10×1

2) FLOW RATES

Port	Description	Size
15	Connection from oil cooler	1 5/16" - 12UN-2B
16	Connection to oil cooler	1 5/16" - 12UN-2B

3) TRANSMITTERS AND SWITCHES

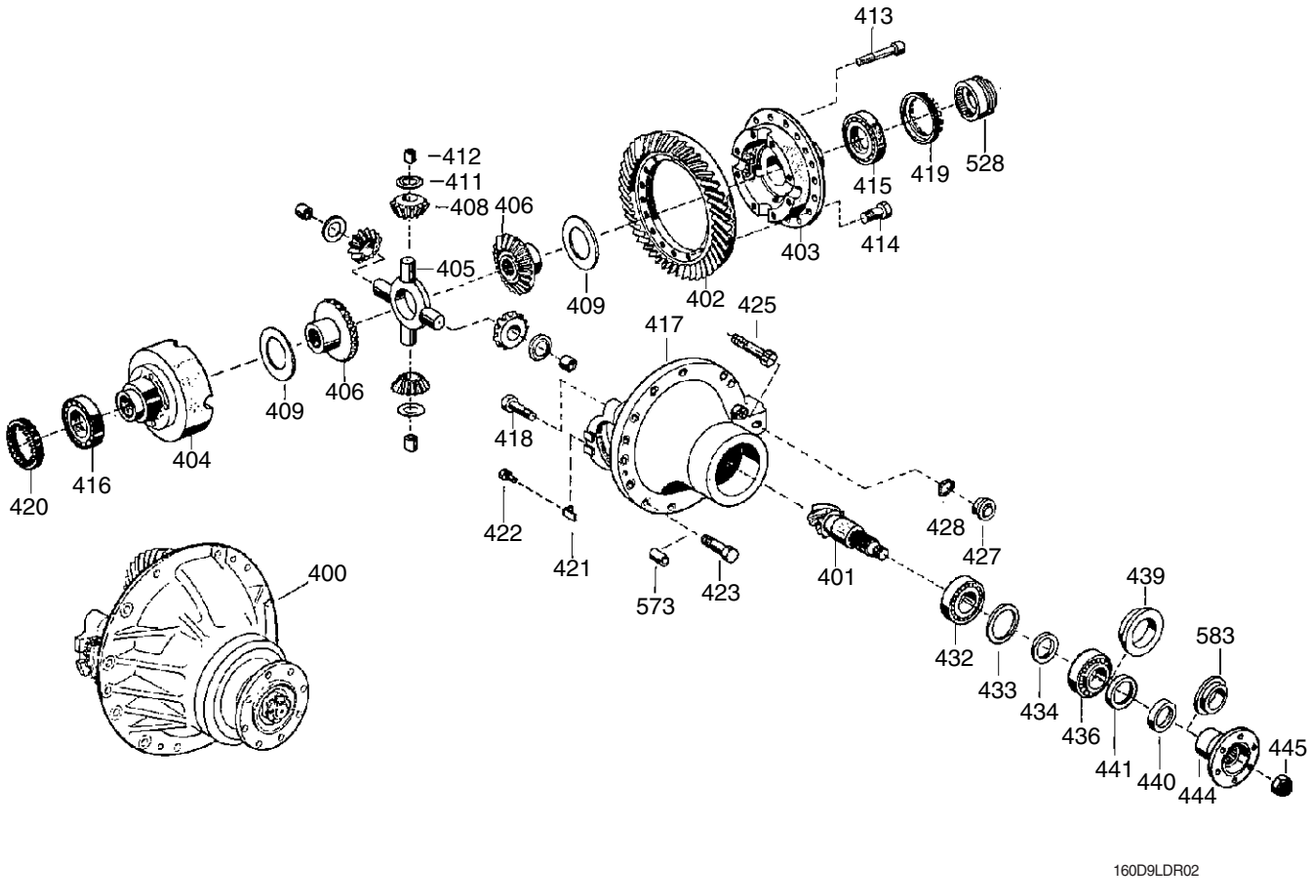
Port	Description		Size
21	Inductive transmitter	n Turbine	M18×1.5
34	Speed transmitter	n Output	-
47	Inductive transmitter	n Internal speed input	M18×1.5
48	Inductive transmitter	n Engine	M18×1.5
54	Differential pressure switch for pressure filter		M14x1.5

4) CONNECTIONS

Port	Description	Size
10	Breather	M10×1
49	Plug connection on electro-hydraulic control unit	

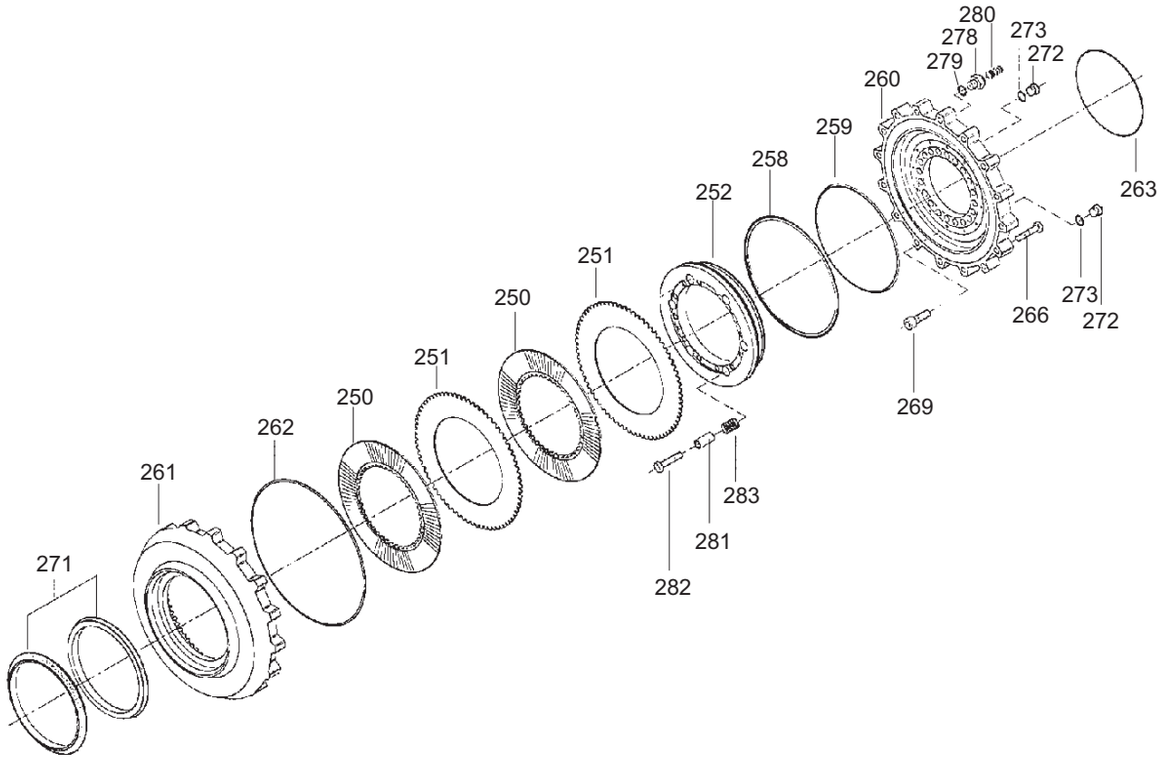
5. DRIVE AXLE (KESSLER)

1) STRUCTURE 1



400	Differential & carrier assy	413	Hexagon screw	425	Hexagon screw
401	Drive pinion	414	Hexagon screw	427	Screw plug
402	Ring gear	415	Tapered roller bearing	428	Sealing ring
403	Differential housing	416	Tapered roller bearing	432	Tapered roller bearing
404	Differential housing	417	Differential carrier	433	Thrust washer
405	Differential spider	418	Hexagon screw	434	Ring
406	Differential side gear	419	Setting ring	436	Tapered roller bearing
408	Differential pinion	420	Setting ring	440	Radial seal ring
409	Disk	421	Lock plate	444	Drive flange
411	Thrust washer	422	Hexagon screw	445	Adjusting nut
412	Bearing bushing	423	Hexagon screw	583	Disk

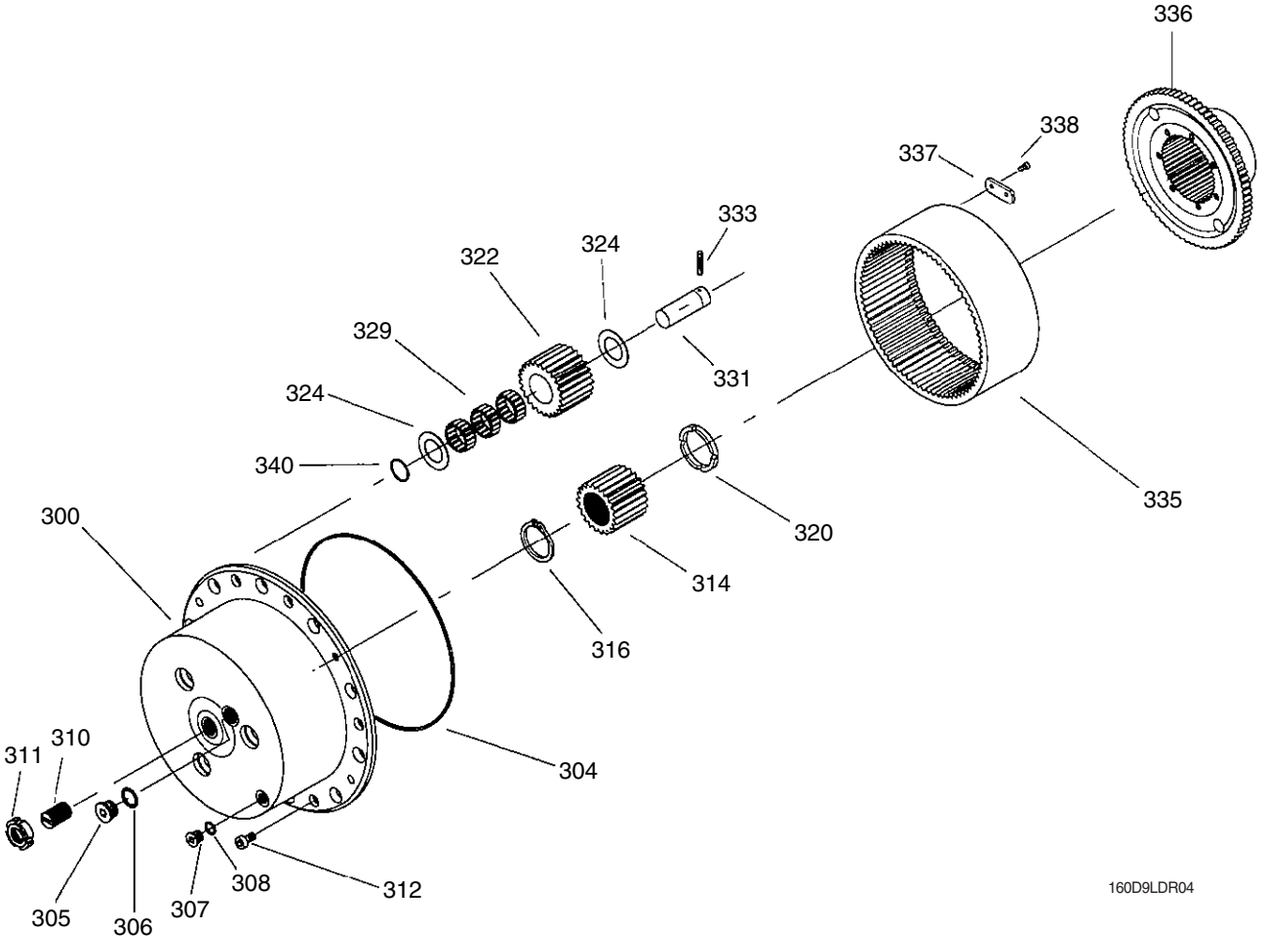
2) STRUCTURE 2



160D9LDR03

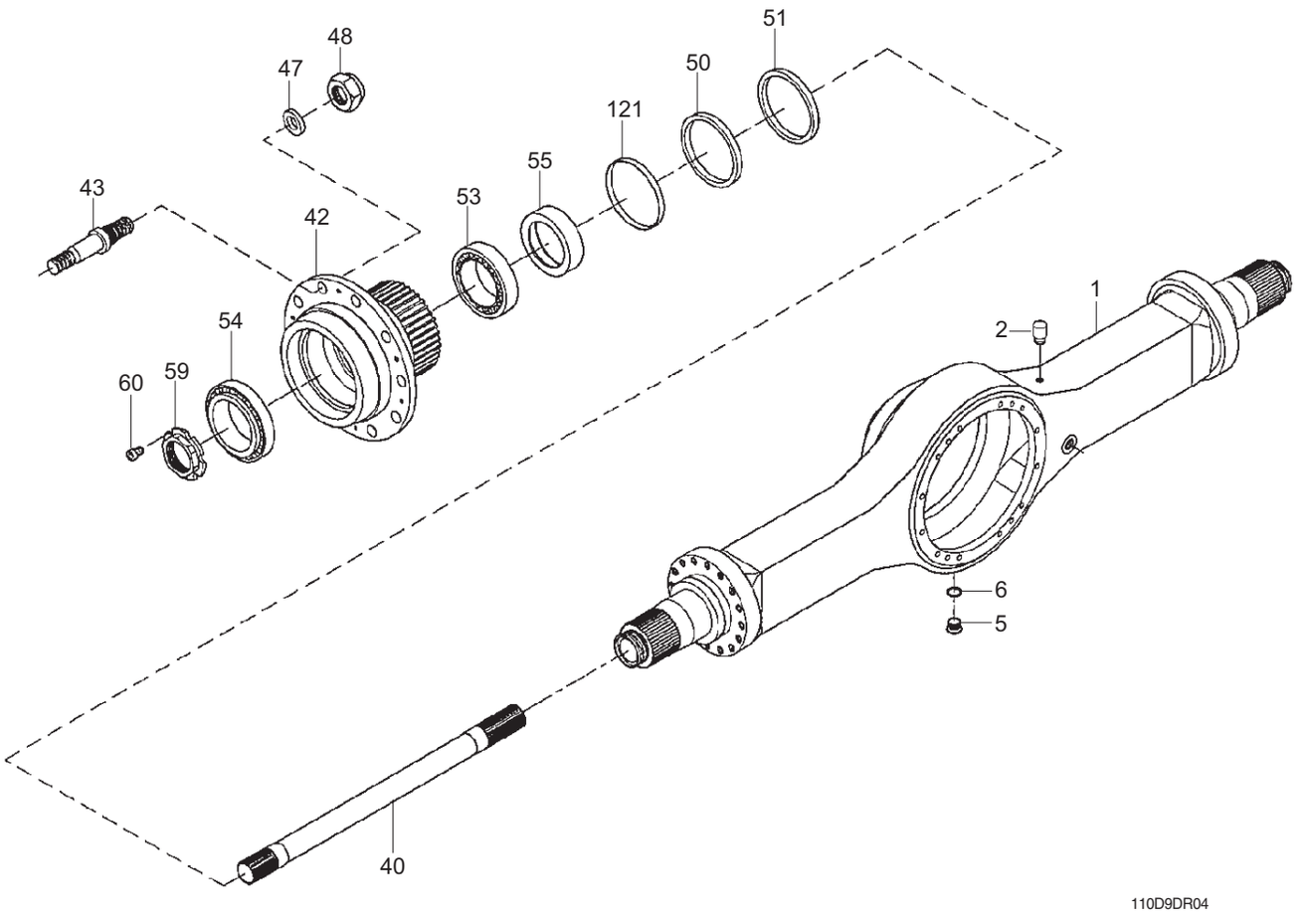
250	Inner disk	262	O-ring	278	Bleeding socket
251	Outer disk	263	O-ring	279	Sealing ring
252	Piston	266	Hexagon screw	280	Bleeder valve
258	Gasket	269	Hex socket screw	281	Pipe
259	Gasket	271	Face seal	282	Hexagon screw with flange
260	Brake carrier	272	Screw plug	283	Compression spring
261	Brake housing	273	Sealing ring		

3) STRUCTURE 3



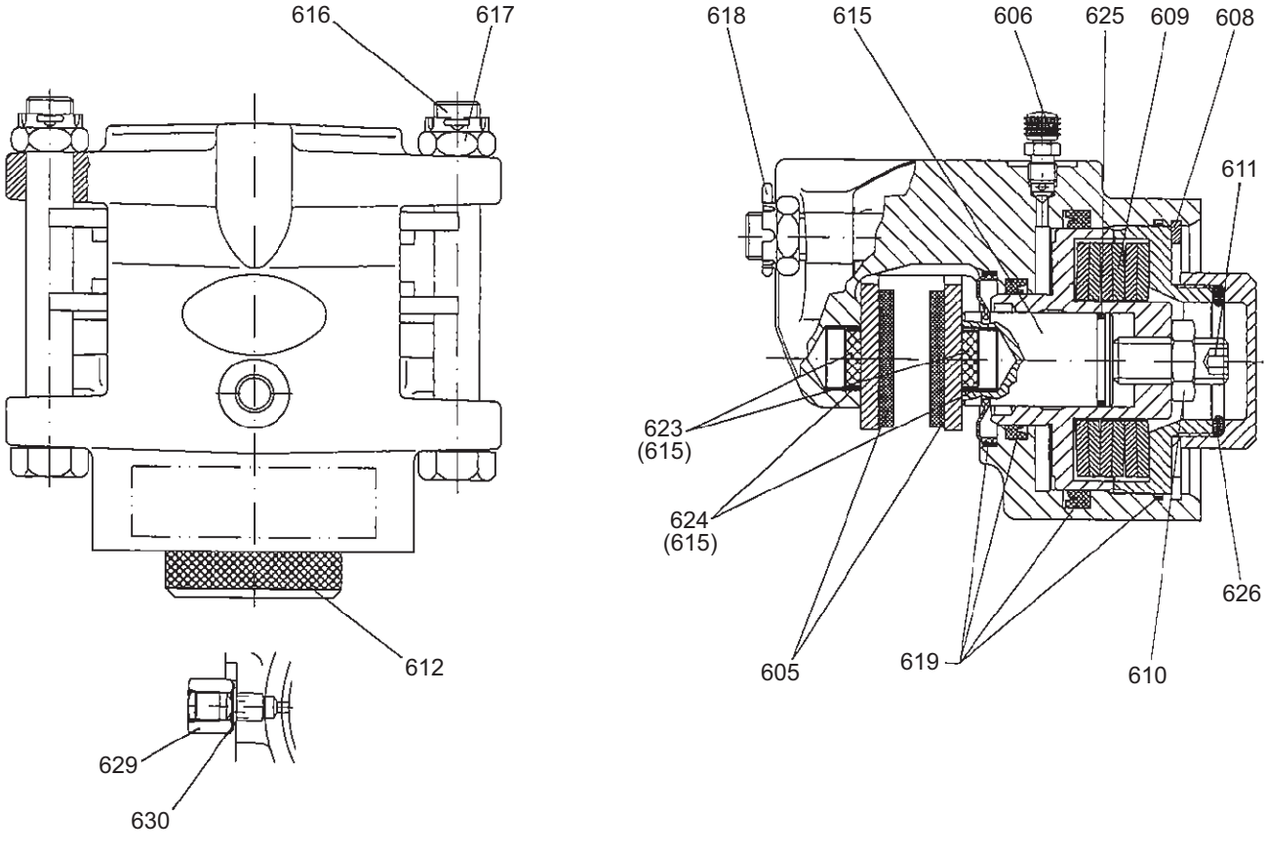
300	Planetary housing	312	Hexagon socket screw	333	Locking pin
304	O-ring	314	Sun gear	335	Ring gear
305	Screw plug	316	Circlip	336	Ring gear carrier
306	Sealing ring	320	Thrust ring	337	Retainer
307	Screw plug	322	Planetary gear	338	Hexagon socket screw
308	Sealing ring	324	Thrust washer	340	O-ring
310	Adjusting screw	329	Needle bearing		
311	Slotted nut	331	Planetary pin		

4) STRUCTURE 4



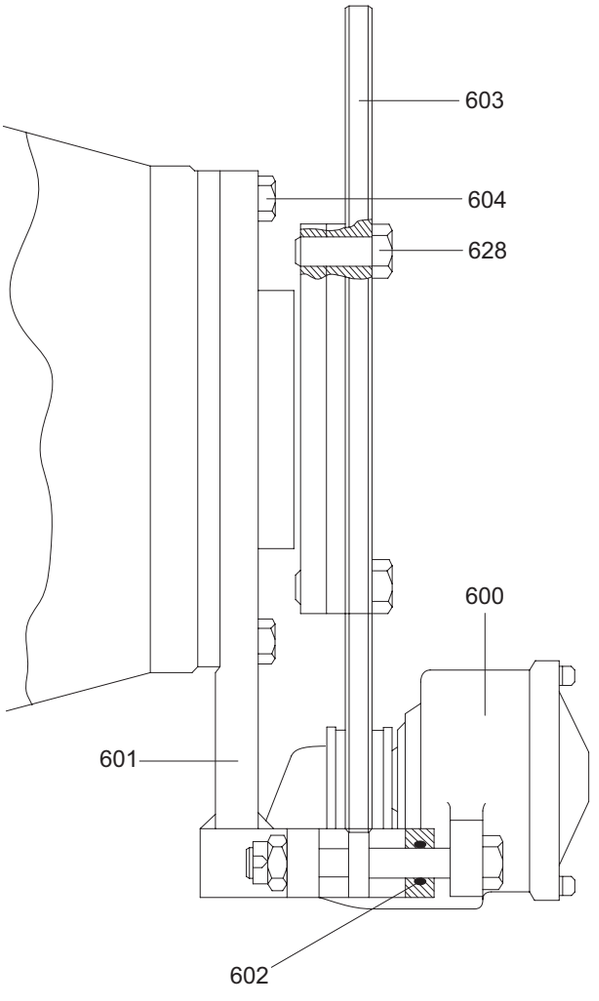
1	Axle housing	43	Stud bolt	54	Taper roller bearing
2	Breather	47	Disk	55	Spacer ring
5	Screw plug	48	Hex nut	59	Nut
6	Sealing ring	50	Radial seal ring	60	Hexagon socket screw
40	Axle shaft	51	Radial seal ring	121	Ring
42	Wheel hub	53	Taper roller bearing		

5) STRUCTURE 5



605	Lining set	615	Pressure bolt	624	Tolerance ring
606	Bleeder valve	616	Hex screw	625	O-ring
608	Circlip	617	Castle nut	626	O-ring
609	Dished plate spring	618	Split pin	629	Socket screw
610	Hex nut	619	Gasket	630	Sealing ring
611	Set screw	623	Magetic		
612	Cap				

6) STRUCTURE 6



110D9DR06

600	Parking brake	602	O-ring	604	Hex screw
601	Brake carrier	603	Brake disk	628	Hex screw

7) OPERATION

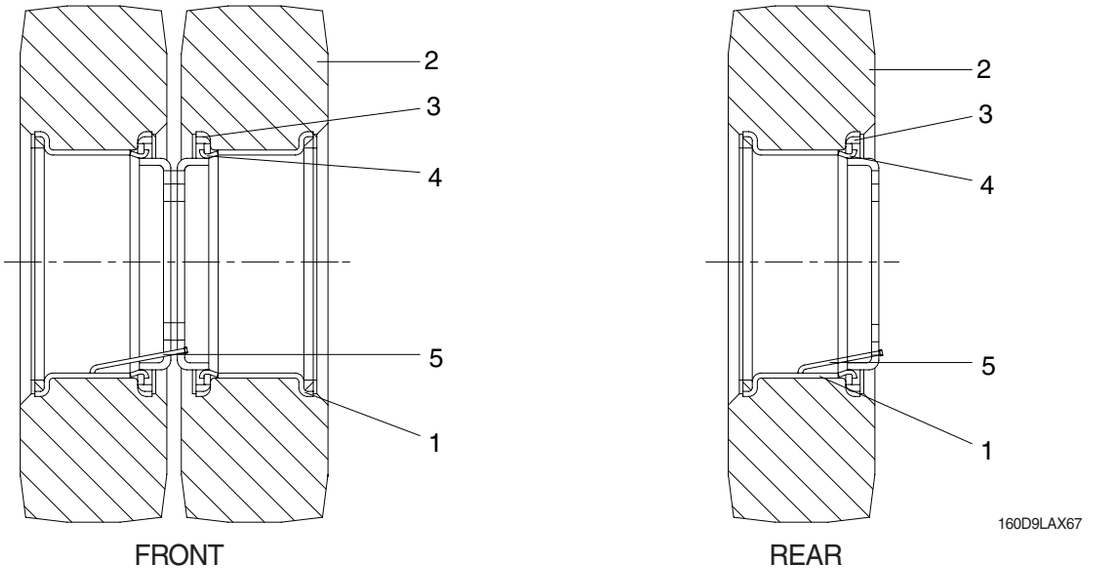
Both sides of the housing are supported by the frame and the center is mounted on the transmission case through drive shaft.

The final deceleration and differential device built in the housing guarantee accurate rotation and smooth operation.

The power from the transmission in transferred through the hypoid pinion, hypoid gear, differential case, the pinion of the differential device and the side gear to the drive axle shaft by the side gear spline and to the hub and wheel mounted on the shaft by high tension bolts.

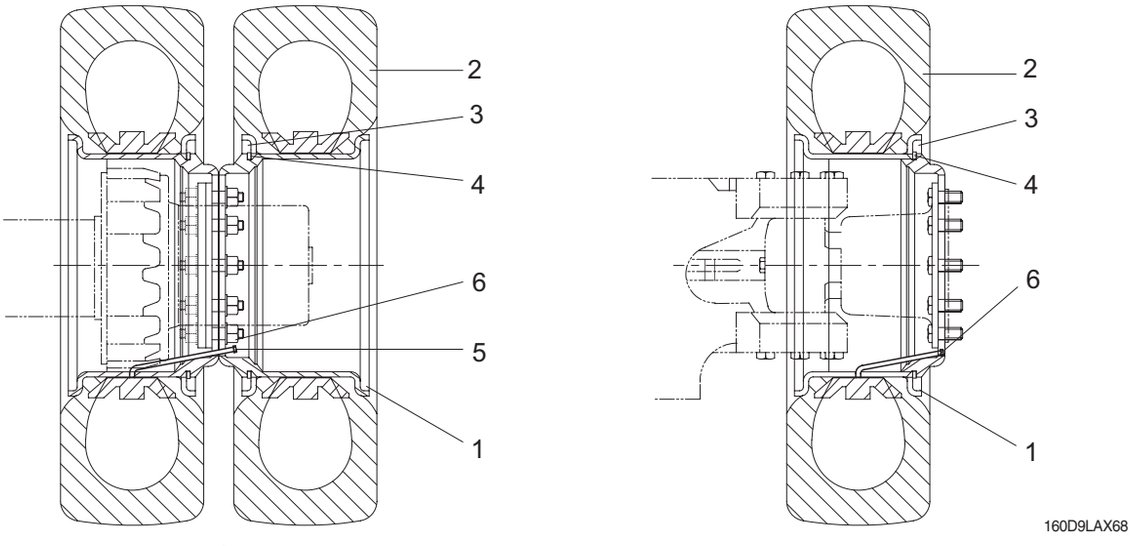
6. TIRE AND WHEEL

· Bias type



FRONT REAR

· Radial type



FRONT REAR

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 vehicle.

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-3-41)

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 counter-clock 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 20 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

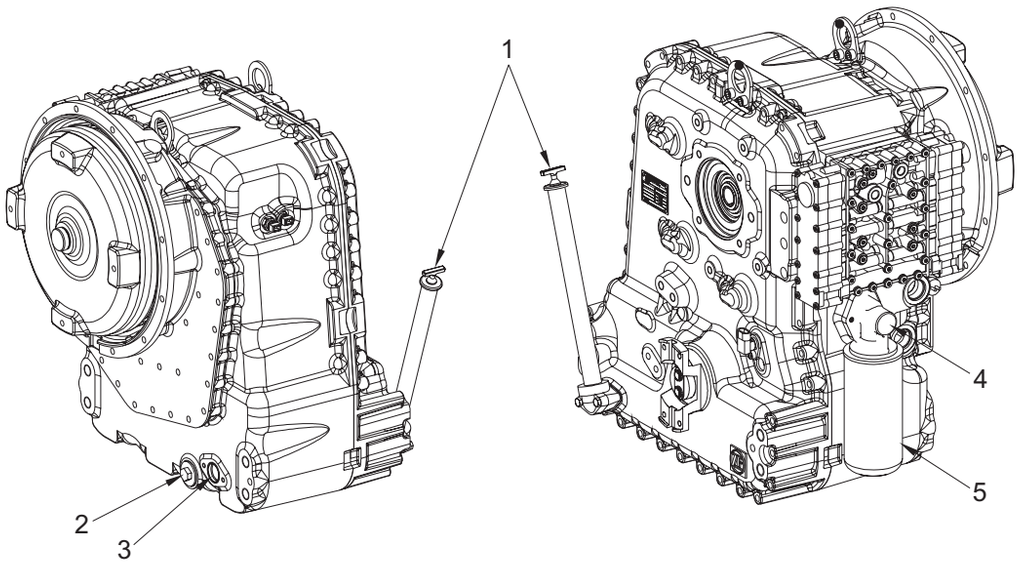
※ At the initial filling of the transmission has to be considered that the heat exchanger, the pressure filter as well as the pipes must get filled with oil.
According to these cavities, the oil capacity to be filled in is greater than at the later oil fillings in the course of the usual maintenance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

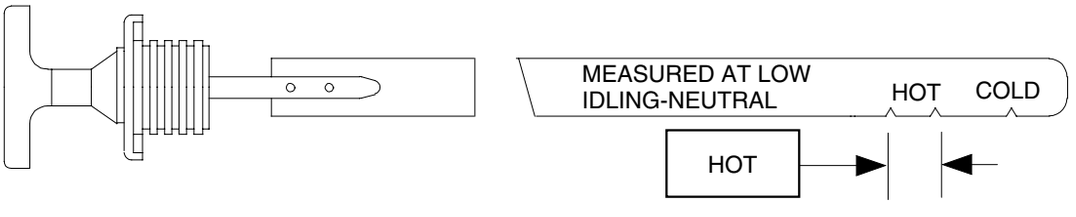


110D9PT19

Legend:

1 = Oil filler tube with oil dipstick
2 = Oil drain plug M38×1.5
3 = Attachment possibility oil level tube with oil dipstick(converter side)
4 = Filter head
5 = Fine filter

Oil dipstick



D507PT20

2) DRIVE AXLE

(1) Important remarks

① For safety reasons, the operator should verify and service at regular intervals all of the bolted assemblies and all of the important safety locks such as :

- Wheel nuts
- Nuts of axle mounting bolts
- Bolts on the steering components and the brake system parts : if the screws are tightable, the loctite contact breaks loose and remounting is necessary.
- Corrosion on the carrier elements (such as the axle spindle) is not acceptable for operational safety reasons.
- Verify seals, oil levels and lubrication at regular intervals.

② **Brakes**

- Inspect brake lining and brake drum/brake disk regularly as well as wear of brake system parts.
- Inspect the free movement of brake system rode.
- In case of signs of excessive heating, consult a brake specialist or the manufacturer.

(2) General lubrication instructions

① **Lubrication points**

See page 3-57 installation drawing.

② **Fill levels**

Are checked at the level control plugs.

③ **Oil change**

Place the vehicle in a horizontal position. Draining of the oil is to be accomplished only in warm condition. Clean all lubrication points before opening them. On the hub assemblies, the drain plug should be turned downward.

Replacement of the oil draining plugs.

Oil draining

Remove the oil filler plug as well as the oil level control plug on the carrier assembly, and on the planetary assembly. Drain the oil.

Oil filling

Supply oil into oil filler hole until it overflows.

Check the oil level at the oil level plug hole (Overflow control). Wait a few minutes. If the oil level falls, add oil until the level remains constant.

Clean the grease nipples before lubrication.

(3) Lubrication points

The binding lubrication points has to be taken from the according installation drawing of the axle.

① Single drive assembly

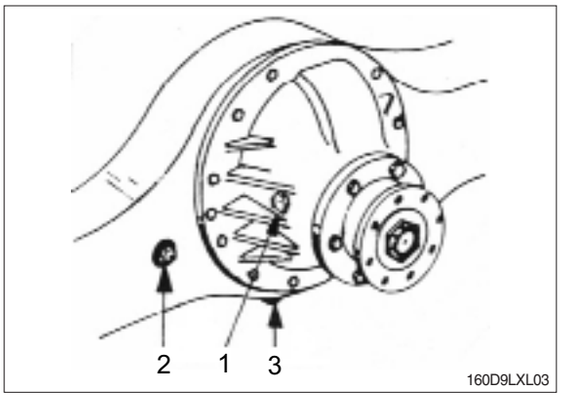
※ The position is dependent from the respective axle version.

※ Legend

1 : Oil fill plug

2 : Oil level control plug

3 : Oil drain plug



3. TROUBLESHOOTING

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 2.04~2.75 kgf · m (15~20 lb · ft) 2. Tighten inlet fitting to 3.47~4.79 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 meritor specified or 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	Condition	Possible causes	Correction
1	Constant noise in differential.	(1) Oil is not enough(Replace interval : 100 hrs first, then every 1000 hrs).	· Refueling lubricating oil
		(2) Wrong kind of oil.	· Exchange lubricating oil
		(3) Wheel bearings out of adjustment or have a defect.	· Exchange bearing
		(4) Drive gear and pinion not in adjustment for correct tooth contact.	· Re-assemble
		(5) Teeth of drive gear and pinion have been damage or worn.	· Exchange dameged gear
		(6) Gear backlash is too much or too little.	· Exchange differential gear set
		(7) Loose or worn on pinion bearings.	· Exchange bearing
		(8) Loose or worn on side bearing.	· Exchange bearing
2	Noise at different intervals.	(1) Ring gear does not run even.	
		a. Bolts on drive gear are not tightened correctly.	· Tighten bolts
		b. Drive gear has a defect (warped)	· Exchange dameged drive gear set
		(2) Loose or broken differential bearings.	· Exchange bearing
3	Noise on turns only.	(1) Differential pinion gears are tight on the spider.	· Exchange differential pinion gear or spider
		(2) Side gears are tight in differential case.	· Exchange differential side gear
		(3) Differential pinion or side gears have a defect.	· Exchange differential gear set
		(4) Thrust washers worn or have a damage.	· Exchange differential washer
		(5) Too much clearance(backlash) between side gears and pinions.	· Exchange differential gear set
4	Leakage of the oil.	(1) Leakage through axle hub carrier	
		a. Too much oi	· Adjust oil level
		b. Wrong kind of oil.	· Exchange lubricating oil
		c. Much restriction on air eather.	· Exchange air breather
		(2) Leakage around pinion shaft.	
		a. Too much oil.	· Adjust oil level
		b. Wrong kind of oil.	· Exchange lubricating oil
		c. Much restriction on air eather.	· Exchange air breather
		d. Oil seal worn or not installed correctly.	· Exchange oil seal

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

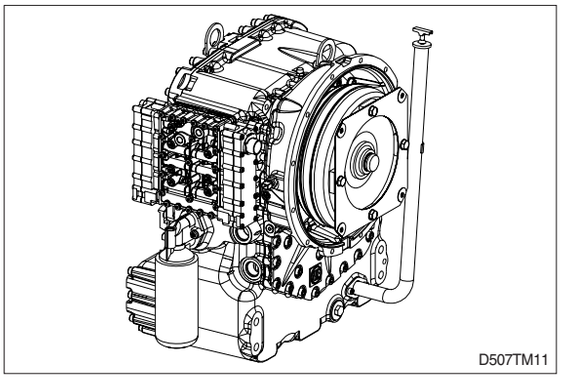
1. TRANSMISSION DISASSEMBLY

1) ELECTRO-HYDRAULIC CONTROL AND FILTER (EXCHANGE FILTER)

① Mount the transmission to the assembly truck.

(S) Assembly truck 5870 350 000
(S) Holding fixture 5870 350 124

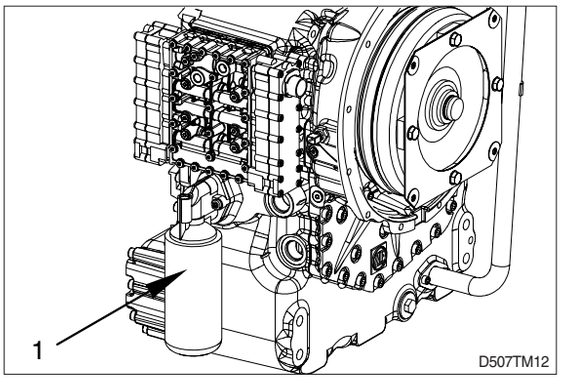
※ Prior to start the disassembly, drain the oil


D507TM11

(1) Removal of the filter

① By means of the strap wrench separate the filter (1) from the filter head.

(S) Strap wrench 5870 105 005

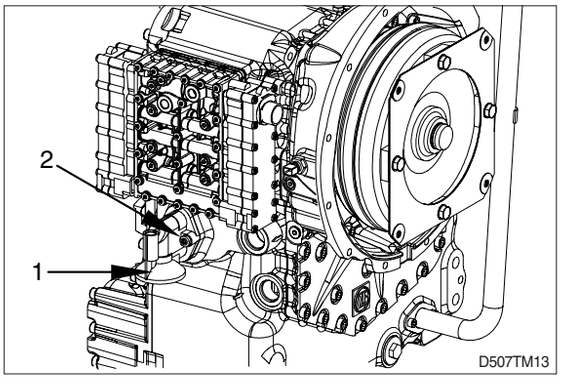


D507TM12

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

※ Remove the O-ring

(S) Socket spanner 5873 042 004

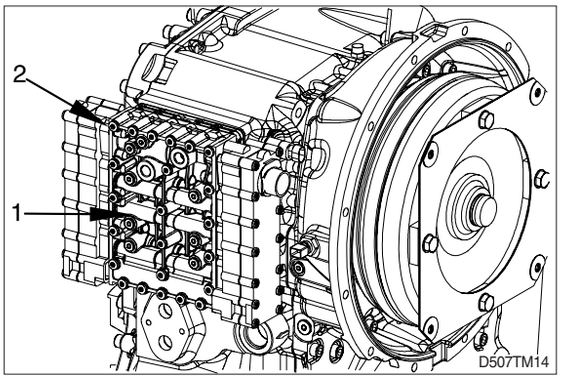


D507TM13

(2) Removal of the electric shift system

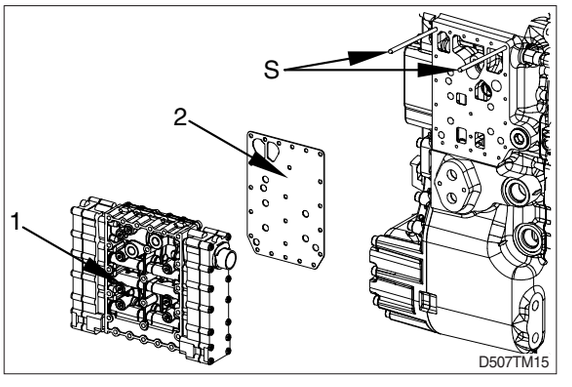
① Remove the shift system (1).
Loosen the Torx screws (2) and separate the gearshift housing from the intermediate sheet.

(S) Socket spanner TX-27 5873 042 002
(S) Adjusting screw M6 5870 204 063

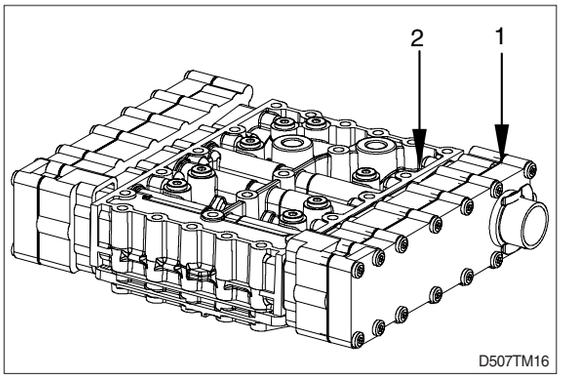


② Remove the complete shift system (1) and the intermediate shaft (2).

(S) Adjusting screw M6 5870 204 063

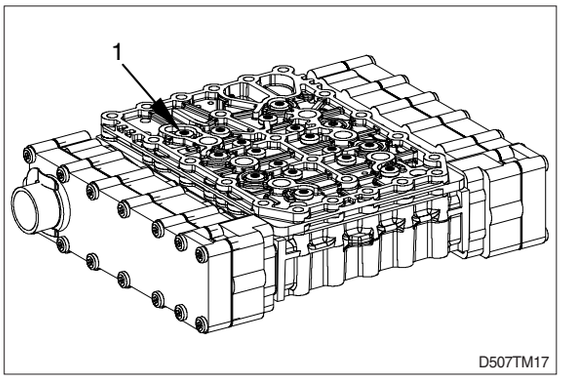


③ Mark the installation position of the cover (1) to the valve block (2).

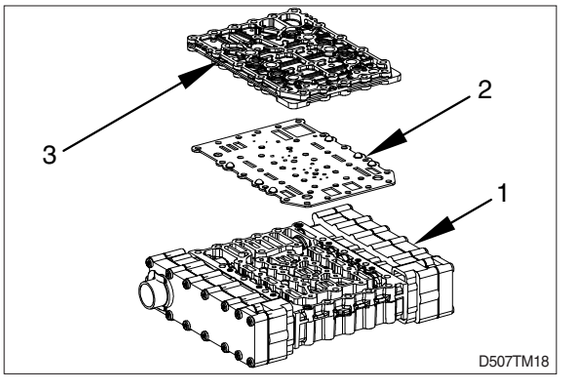


④ Loosen the Torx screws (1).

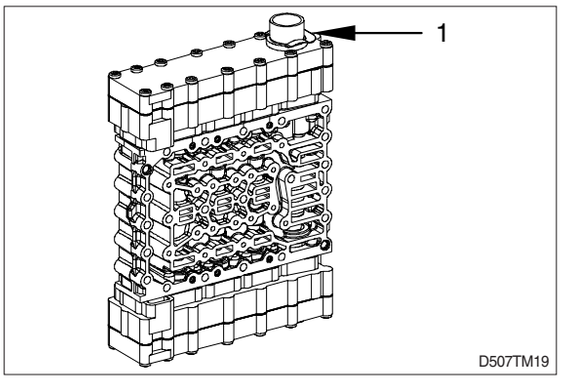
(S) Socket spanner TX-27 5873 042 002



⑤ Separate the duct plate (3), and intermediate sheet (2) from the valve block (1).

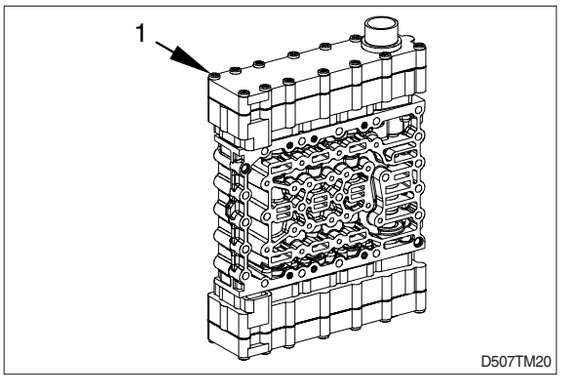


⑥ Remove the retaining clamp (1).



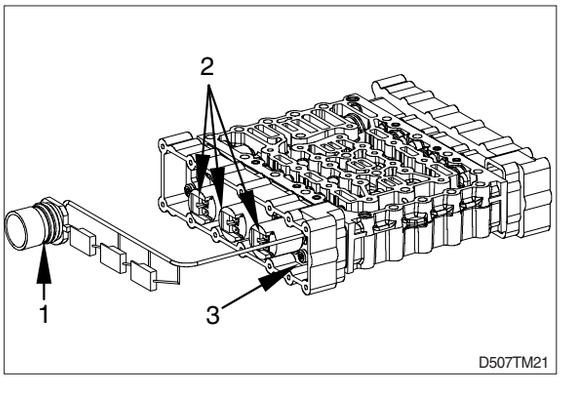
⑦ Loosen the cap screws (1) and remove the cover.
Remove the opposite cover.

(S) Socket spanner TX-27 5873 042 002



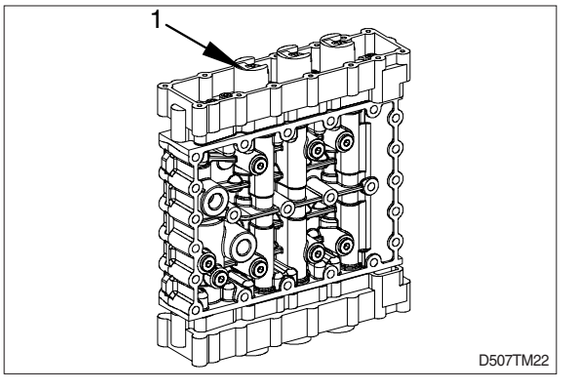
⑧ Remove the wiring harness (1).
Loosen the cap screws (3), remove the fixing plates and the pressure regulators (2).

(S) Socket spanner TX-27 5873 042 002



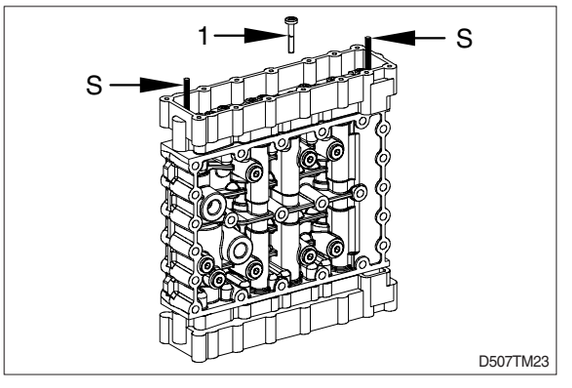
⑨ Loosen the cap screws, remove the fixing plates and the pressure regulators (1).

(S) Socket spanner TX-27 5873 042 002



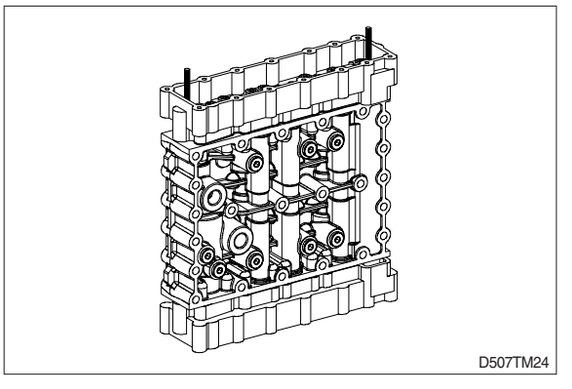
⑩ Loosen two cap screws (1) and fasten the adjusting screws (S) preliminarily (housing is spring-loaded). Following to this loosen the remaining cap screws.

(S) Adjusting screws 5870 204 036
(S) Socket spanner 5873 042 002



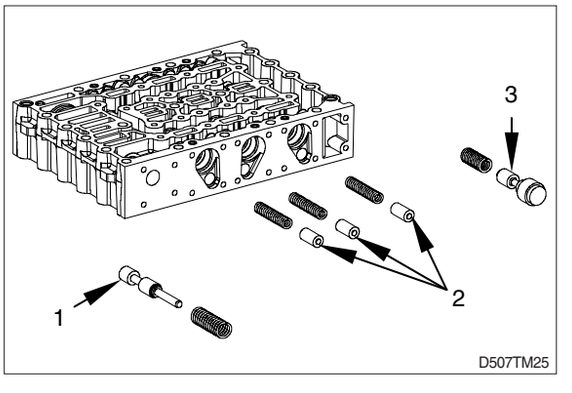
⑪ Separate the housing from the valve housing by loosening the adjusting screws equally.

(S) Adjusting screws 5870 204 036



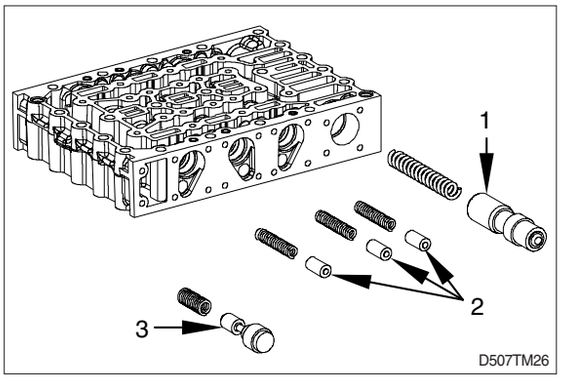
⑫ Remove the single parts:

1 = Pressure reducing valve
2 = Vibration damper
3 = Follow-on slide



⑬ Remove the single parts on the opposite side analogously:

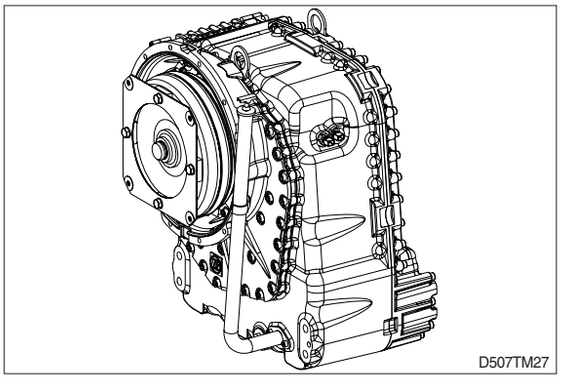
1 = Main pressure valve
2 = Vibration damper
3 = Follow-on slide



2) INDUCTIVE TRANSMITTERS, VALVES, OIL FILTER AND OIL DRAIN PLUG, SCREW PLUGS

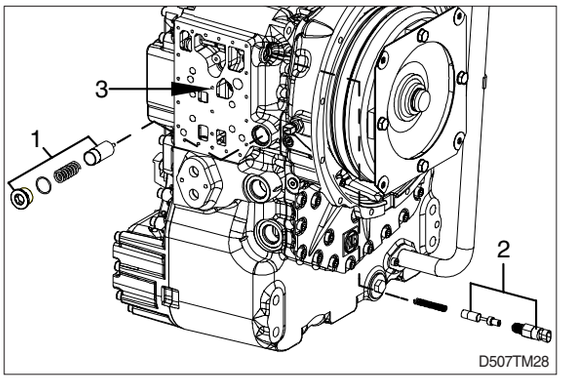
① Mount the transmission to the assembly truck.

(S) Assembly truck	5870 350 000
(S) Holding fixture	5870 350 124



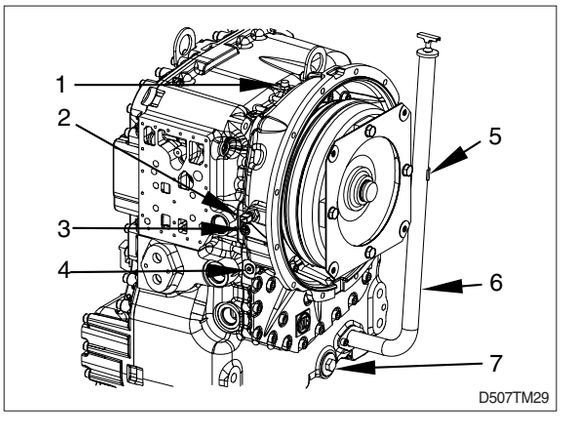
② Remove the converter pressure back-up valve (1) and differential pressure switch (3) for the filter (2).

※ Do not remove the pressure relief valve.



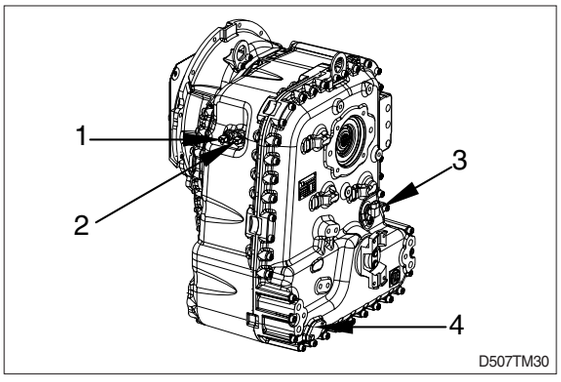
③ Remove the positioned parts.

1 = Breather
2 = Inductive transmitter-n engine
3 =Screw plug (measuring point after converter)
4 =Screw plug (option for temperature sensor)
5 = Fixing strap oil filler tube
6 = Oil filler tube with oil dipstick
7 = Screw plug (Oil drain bore)



④ Remove the positioned parts.

1 = Inductive transmitter n - Internal speed input
2 = Inductive transmitter n - Turbine
3 = Speed transmitter n - Output
4 = Cover (mounting possibility for oil filler tube)

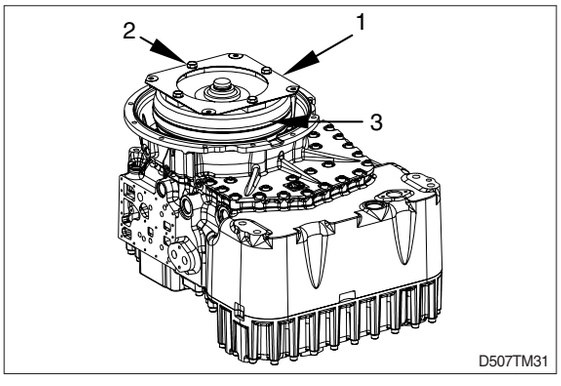


3) ENGINE CONNECTION, PRESSURE OIL PUMP AND REMOVAL OF THE CLUTCHES

① Mount the transmission to the assembly truck.

(S) Assembly truck 5870 350 000
(S) Holding fixture 5870 350 124

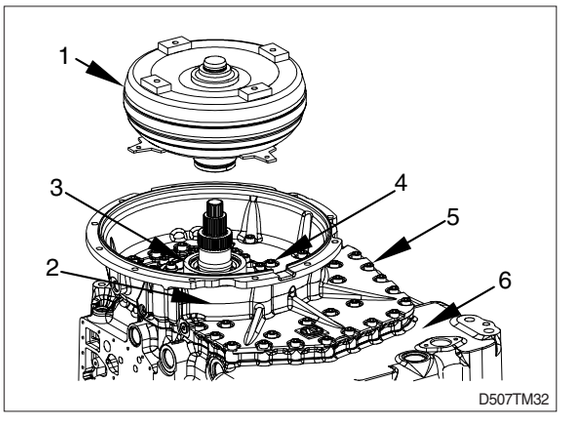
Loosen the hexagon screw (2) and separate the flexplate (1) from the converter (3).



② By means of the lifting equipment separate the converter (1) from the transmission. Loosen the bolted connection (4) and (5).

1 = Converter
2 = Converter bell
3 = Pressure oil pump
4 = Bolted connection converter bell/transmission housing rear section
5 = Bolted connect. pressure oil pump/transmission housing rear section
6 = Transmission housing rear section

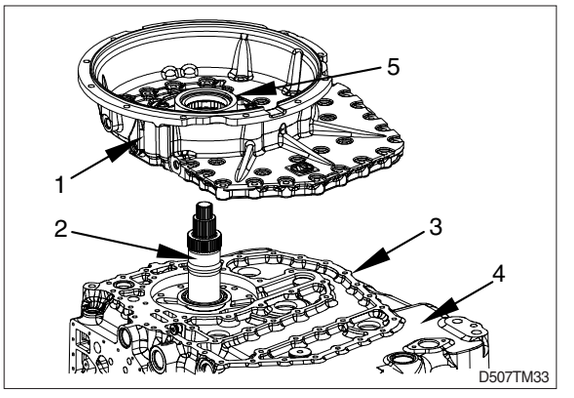
(S) Eyebolts assortment 5870 204 002
(S) Lifting chain 5870 281 047



③ By means of the lifting equipment the converter bell (1) with pressure oil pump (5) are commonly to be separated from the transmission housing rear section (4).

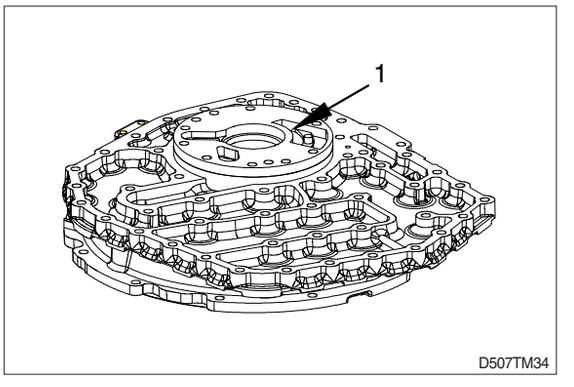
Remove the intermediate sheet (3) and the stator hollow shaft (2).

(S) Eyebolts assortment 5870 204 002
(S) Lifting chain 5870 281 047



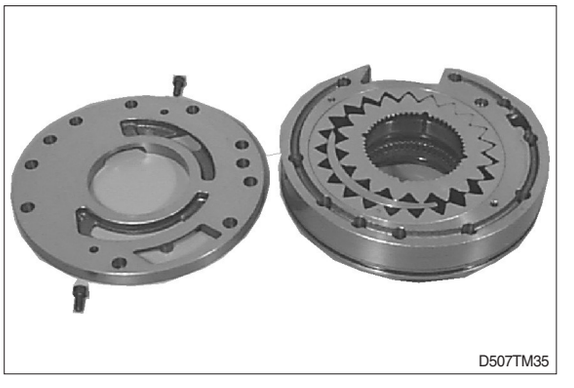
④ Separate the pressure oil pump (1) from the converter bell.

(S) Hammer 5870 280 004



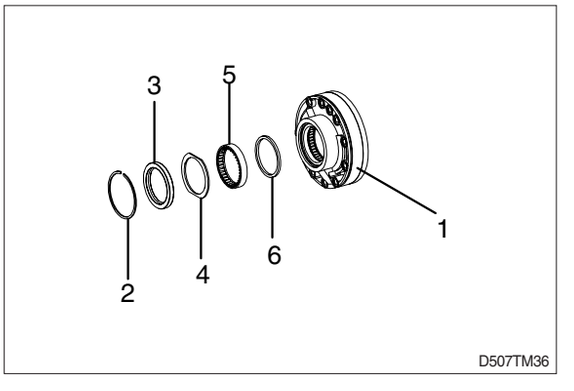
⑤ Loosen both cap screws and remove the cam disc.

※ If running-in marks should be found in the pump housing or on the cam disc, the complete pump has to be replaced.

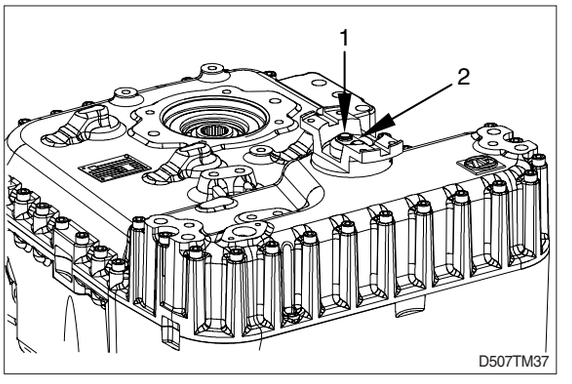


⑥ Squeeze out the snap ring (1) and remove the single parts.

1 = Pump housing with rotor
2 = Snap ring
3 = Shaft seal
4 = Support shim
5 = Needle bearing
6 = Ring



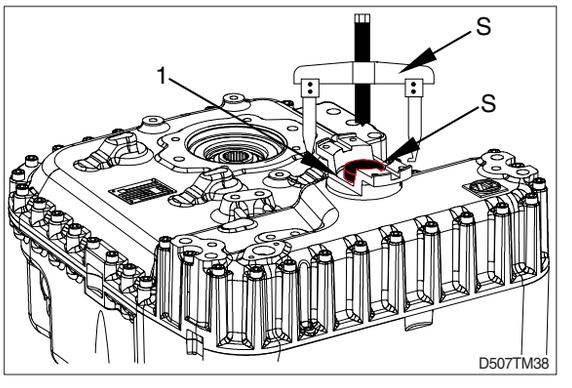
⑦ Remove the tab washer (2) and loosen the hexagon screws (1).



⑧ Pull off the input shaft (1).

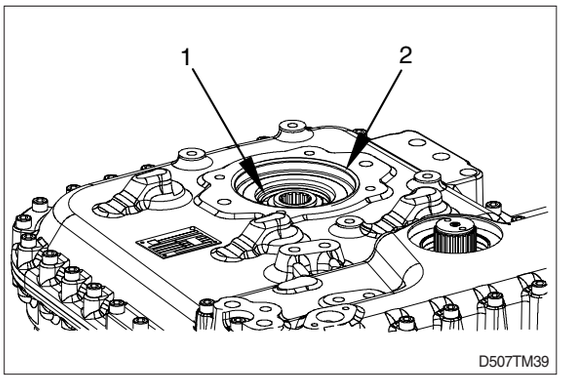
Remove the shaft seal.

(S) Two-armed puller 5870 970 003



⑨ Unsnap the retaining ring (1) from the power take-off and remove the O-ring (2).

(S) Set of internal pliers 5870 900 013

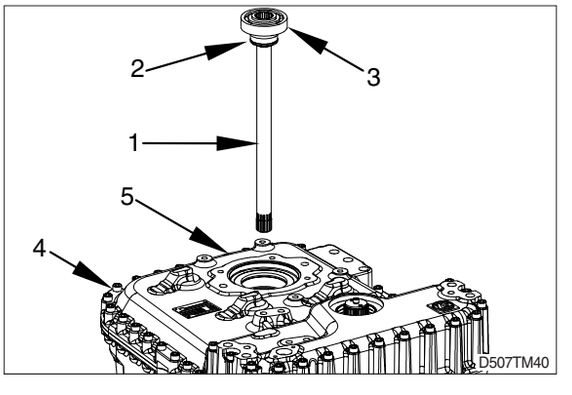


⑩ Pull the pump shaft (1) out of the housing bore.

Unsnap the rectangular ring (2).

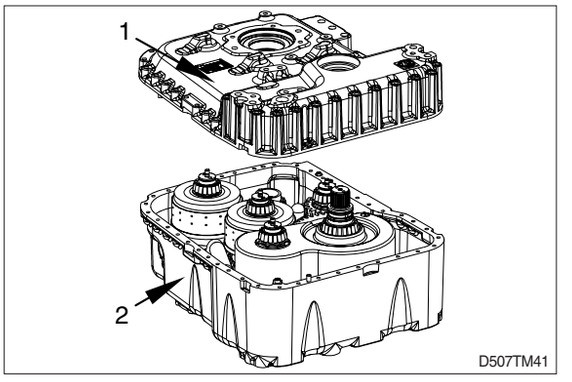
Press off the ball bearing (3) from the shaft.

Loosen the bolted connection (4) transmission housing rear section/transmission housing front section.

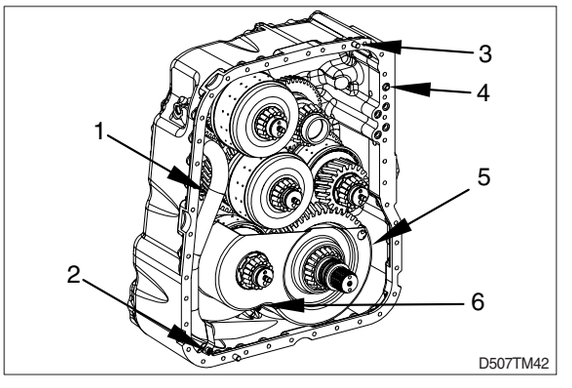


⑪ By means of the lifting equipment separate the transmission housing rear section (1) from the transmission housing front section (2).

(S) Eyebolts 2 × (M20) 0636 804 003
(S) Ring nut (M12) 0664 462 774
(S) Lifting chain 5870 281 047



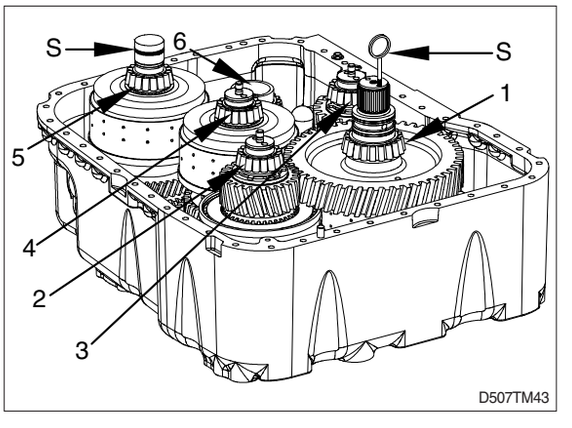
⑫ Loosen the cap screws (2) and remove the suction tube (1).
Remove the O-ring from the suction tube.
Loosen the cap screws (6) and remove the screen sheet (5).
Remove the pipes (4) with O-rings.



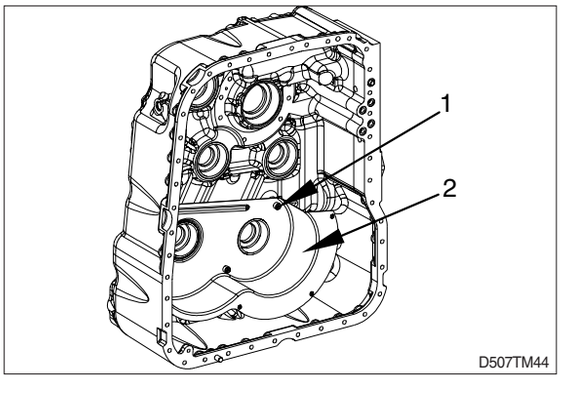
⑬ The clutch is to be removed from the transmission housing according to the sequence of numbers as described in the legend.

1 = Clutch K3
2 = Clutch K1
3 = Clutch K2
4 = Clutch KR
5 = Clutch KV
6 = Input shaft

(S) Handle 5870 260 014 (K1/K2/KV/KR)
(S) Eyebolt 5870 204 002 (K3)

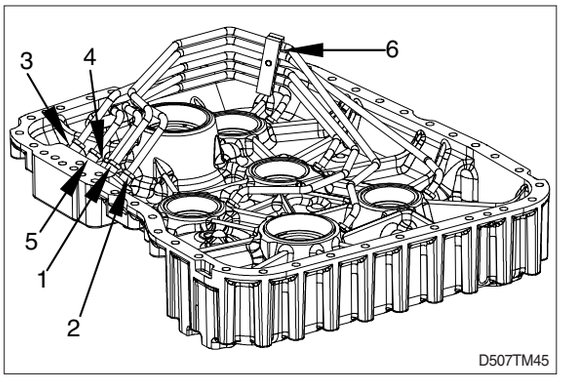


⑭ Loosen the cap screws (1) and remove the screen sheet (2).



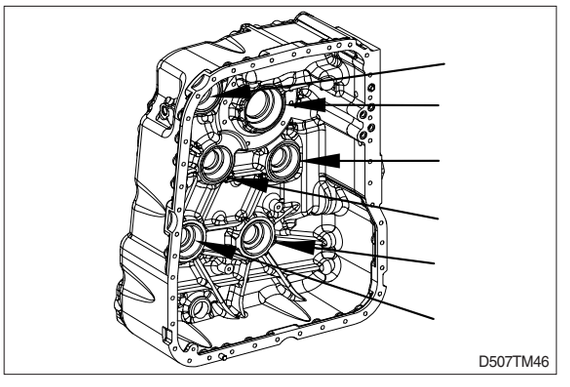
⑮ Remove the pipes (system pressure from the electro-hydraulic control to the respective clutch).
Remove the holding segment (6).
The pipes are to disassembled in the following sequence:

1 = Pipe	k3
2 = Pipe	k1
3 = Pipe	k2
4 = Pipe	kR
5 = Pipe	kV



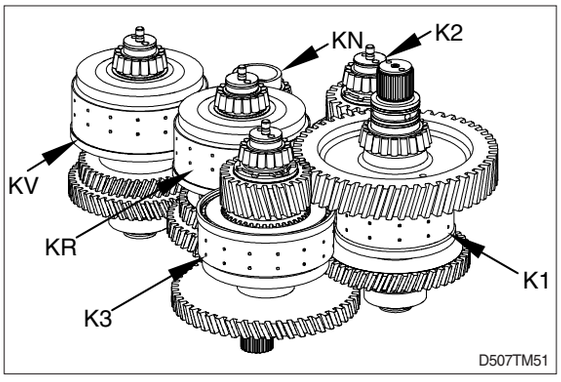
⑯ Remove all bearing outer rings (see arrows).

※ Should contrary to the recommendations the taper roller bearings of the clutches as well as of the input not be replaced the assignment (bearing inner and outer ring) has to be kept at least.
Mark the bearing inner and bearing outer rings to each other accordingly.



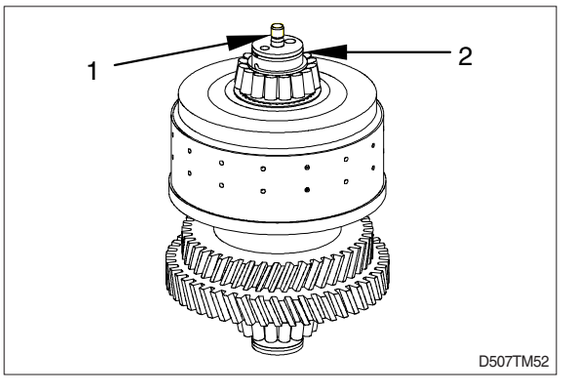
4) CLUTCHES KV/KR/K1/K2/K3 AND INPUT

See figure on the right.



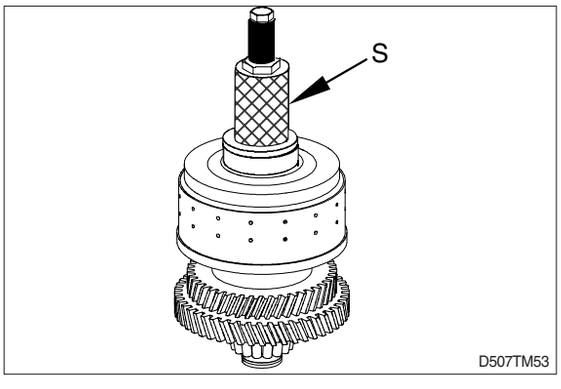
(1) Clutch KV

① Remove the stud (1) and unsnap the piston ring (2).



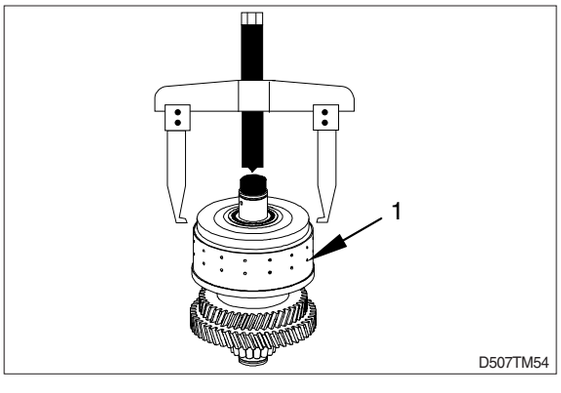
② Pull the taper roller bearing (inner ring) from the shaft.

(S)Gripping insert	5873 001 057
(S)Back-off insert	5870 026 100
or	
(S)Rapid grip	5873 001 011



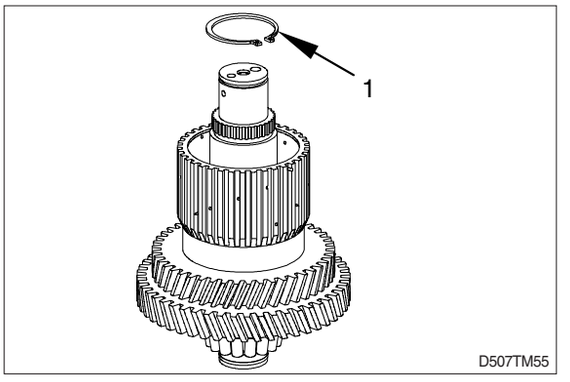
③ Pull the clutch (1) from the shaft.

(S) Two-armed puller	5870 970 003



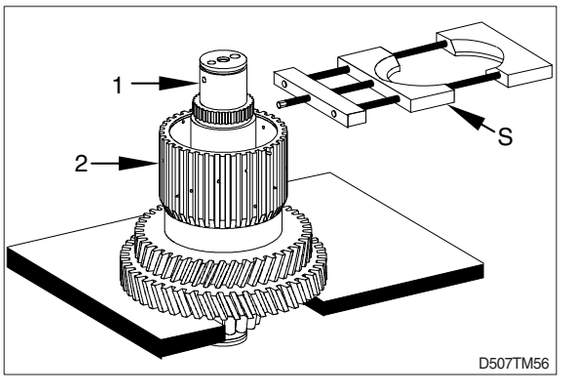
④ Unsnap the retaining ring (1).

(S) Set of external pliers 5870 900 015



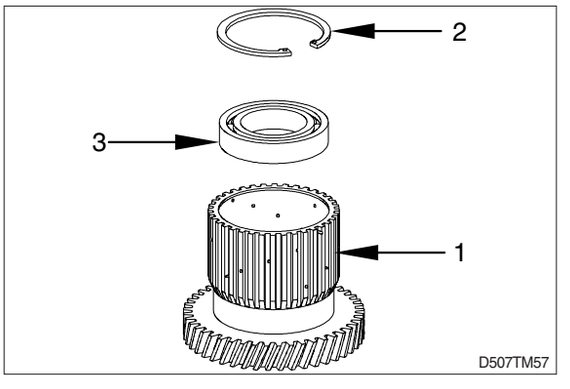
⑤ Press the clutch shaft (1) out of the idler (2).

(S) Parting tool 5870 300 028

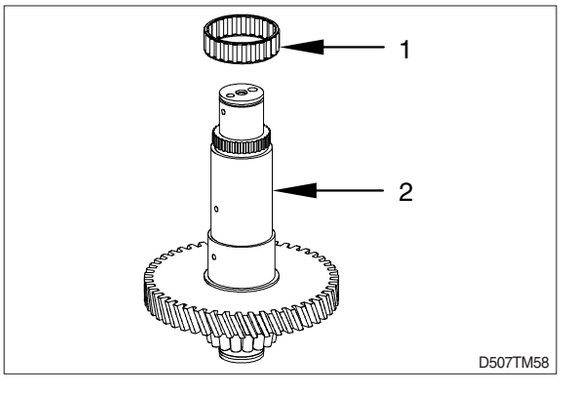


⑥ Unsnap the retaining ring (2) from the idler (1) and remove the ball bearing (3).

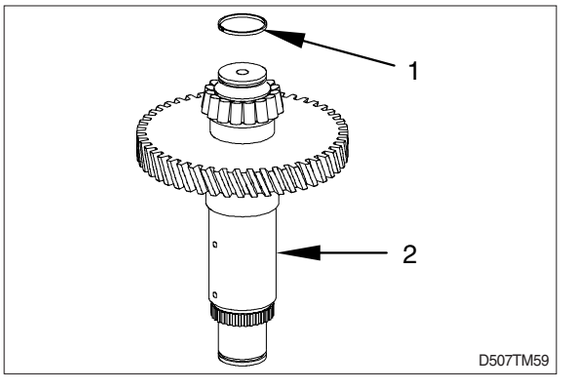
(S) Set of internal pliers 5870 900 013



⑦ Remove the needle cage (1) from the shaft (2).

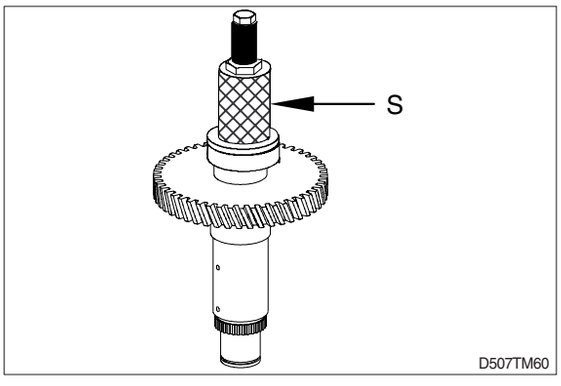


⑧ Rotate the shaft (2) by 180° and unsnap the piston ring (1).



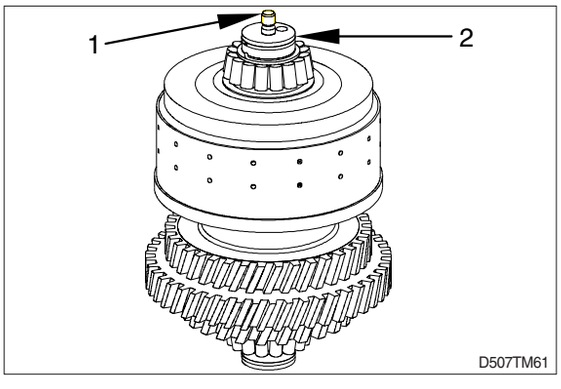
⑨ Pull the taper roller bearing (inner ring) from the shaft.

(S) Gripping insert	5873 001 057
(S) Back-off insert	5870 026 100
or	
(S) Rapid grip	5873 011 011



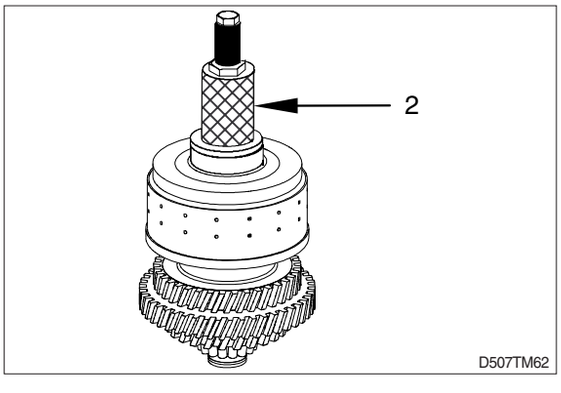
(2) Clutch KR

① Remove the stud (1) and unsnap the piston ring (2).



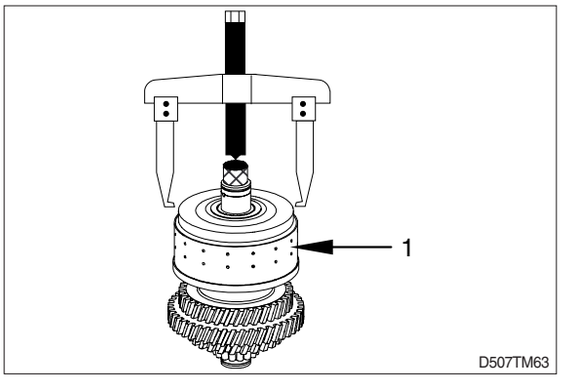
② Pull the taper roller bearing (inner ring) (2) from the shaft.

(S) Gripping insert	5873 001 057
(S) Bush	5870 026 016



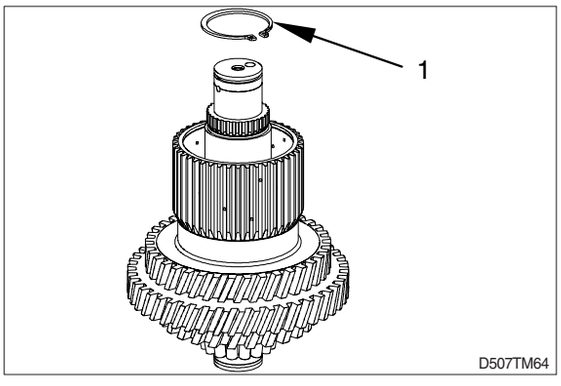
③ Pull the clutch (1) from the shaft.

(S)Two-armed puller 5870 970 003



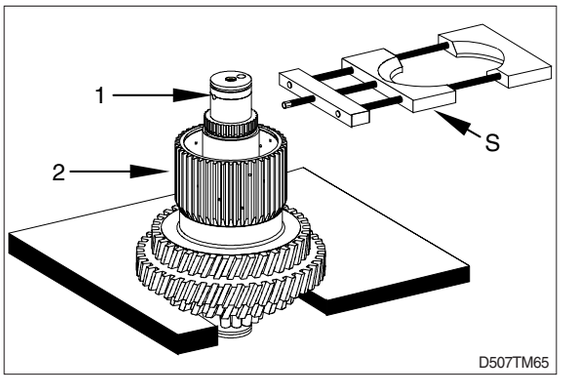
④ Unsnap the retaining ring (1).

(S)Set of external pliers 5870 900 015

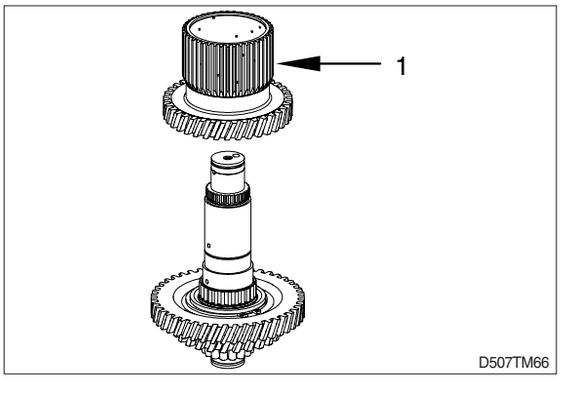


⑤ Press the clutch shaft (1) out of the idler (2).

(S)Parting tool 5870 300 028

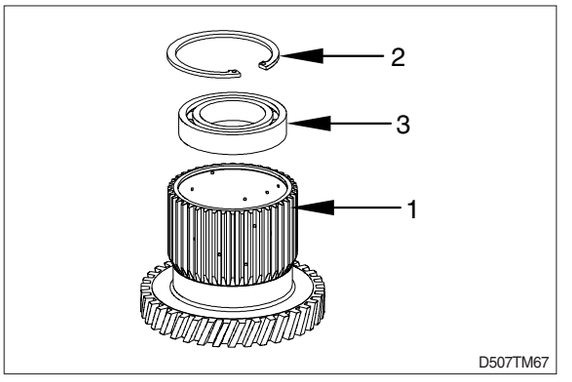


⑥ Disassemble the idler (1).

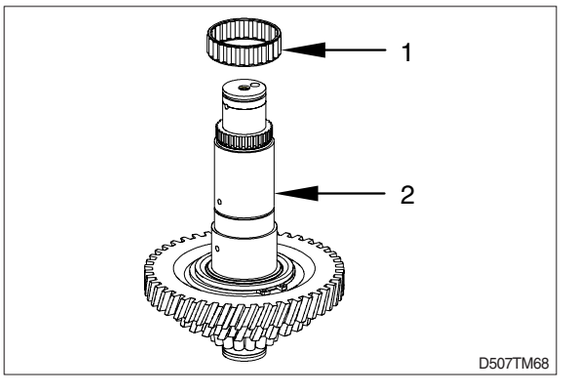


⑦ Unsnap the retaining ring (2) from the idler (1) and remove the ball bearing.

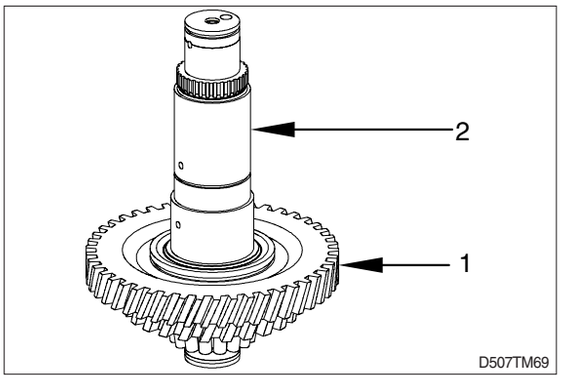
(S) Set of internal pliers 5870 900 013



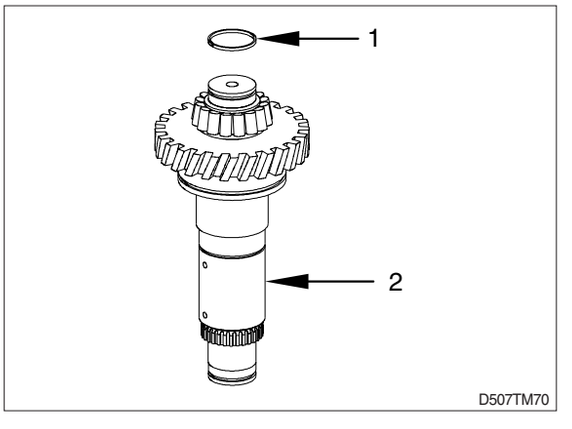
⑧ Remove the needle cage (1) from the shaft (2).



Shaft (2) and gear (1) cannot be separated (shrink fit).

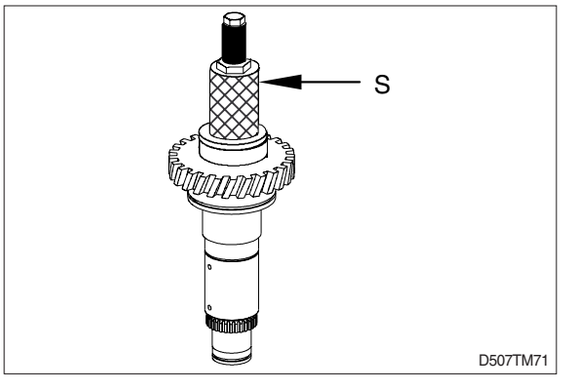


⑨ Rotated the shaft (2) by 180° and unsnap the piston ring (1).



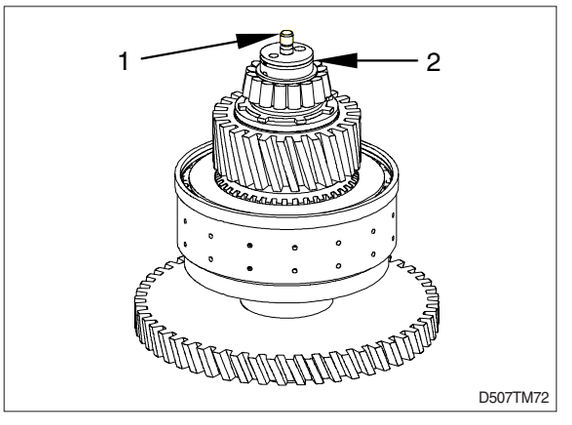
⑩ Pull the taper roller bearing (inner ring) from the shaft.

(S) Gripping insert 5873 001 057
(S) Back-off insert 5870 026 100
or
(S) Rapid grip 5873 011 011



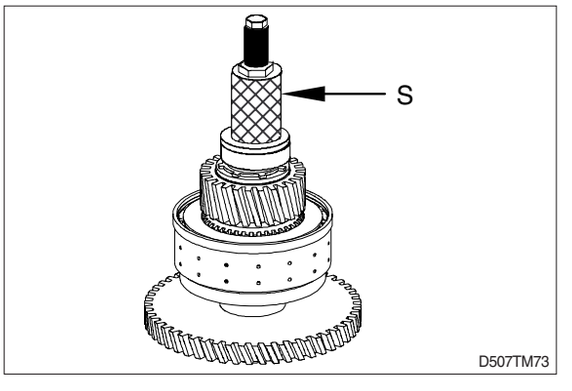
(3) Clutch K1

① Remove the stud (1) and unsnap the piston ring (2).



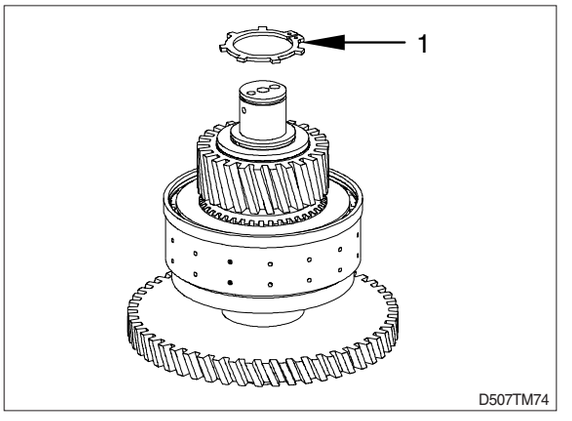
② Pull the taper roller bearing (inner ring) from the shaft.

(S) Gripping insert 5873 001 057
(S) Back-off insert 5870 026 100
or
(S) Rapid grip 5873 011 011

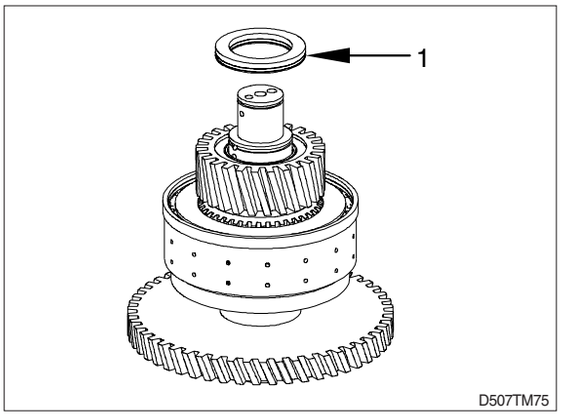


③ Unsnap the retaining ring (1).

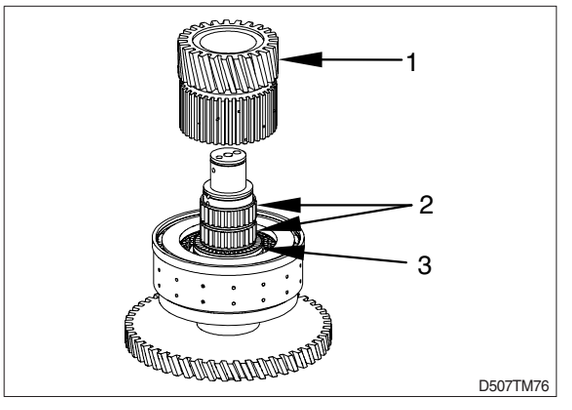
(S) Set of internal pliers 5870 900 013



④ Remove the complete axial bearing (1).

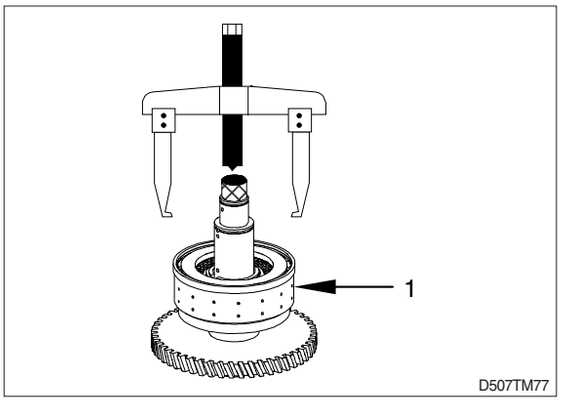


⑤ Take off idler (1), remove the needle cage (2) and the complete axial bearing (3).

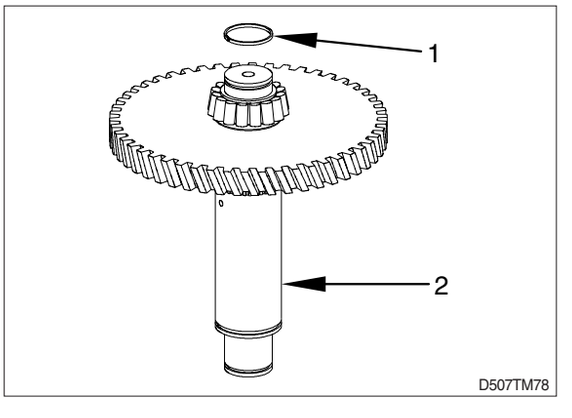


⑥ Pull the clutch (1) from the shaft.

(S)Two-armed puller 5870 970 003

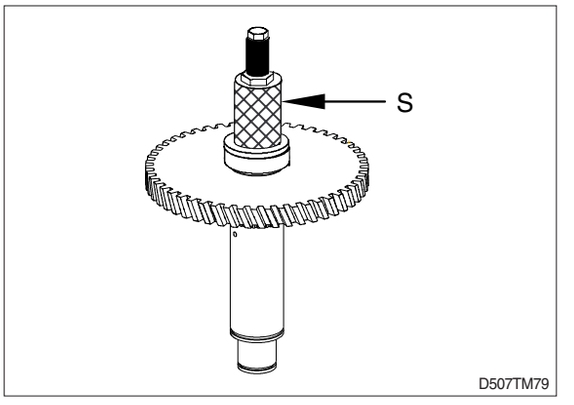


⑦ Rotated the shaft (2) by 180° and unsnap the piston ring (1).



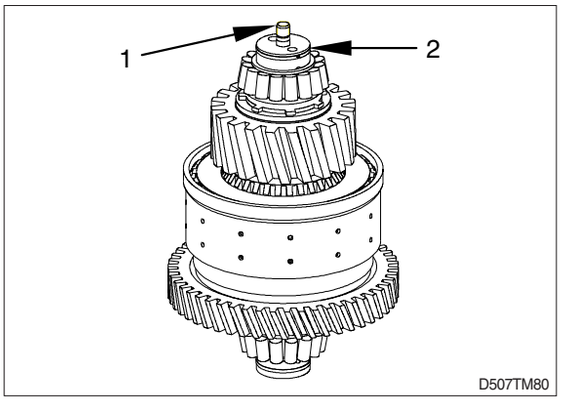
⑧ Pull the taper roller bearing (inner ring) from the shaft.

(S) Gripping insert 5873 001 057
(S) Back-off insert 5870 026 100
or
(S) Rapid grip 5873 011 011



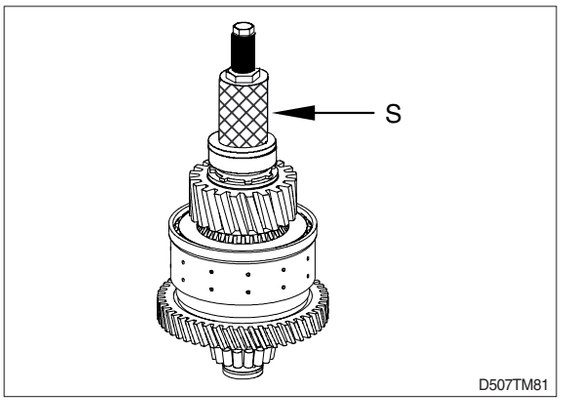
(4) Clutch K1

① Remove the stud (1) and unsnap the piston ring (2).



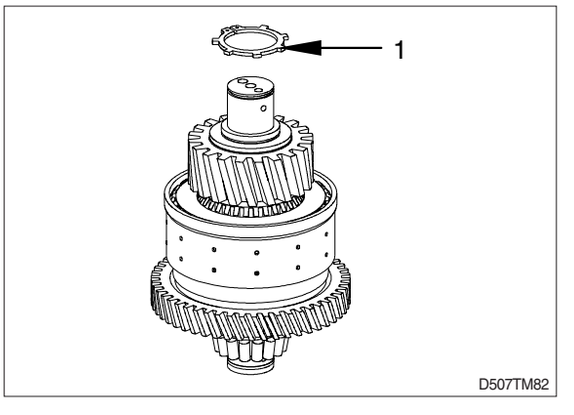
② Pull the taper roller bearing (inner ring) from the shaft.

(S) Gripping insert 5873 001 057
(S) Back-off insert 5870 026 100
or
(S) Rapid grip 5873 011 011

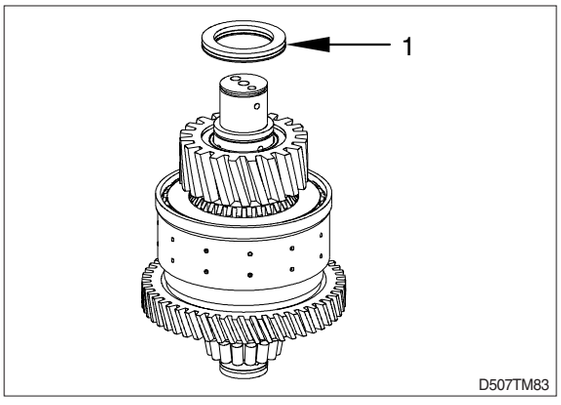


③ Unsnap the retaining ring (1).

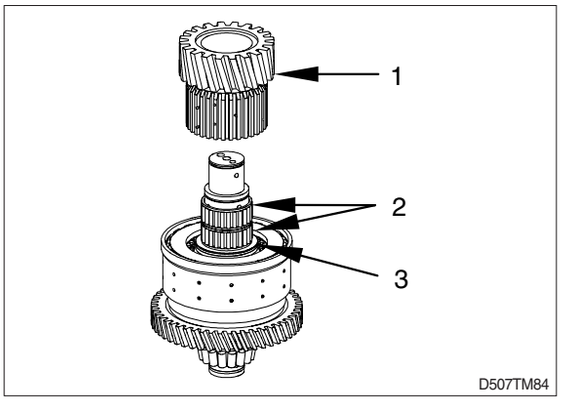
(S) Set of internal pliers 5870 900 015



④ Remove the complete axial bearing (1).

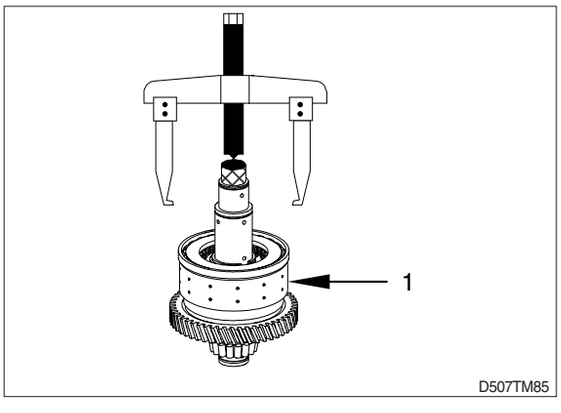


⑤ Take off idler (1), remove the needle cage (2) and the complete axial bearing (3).

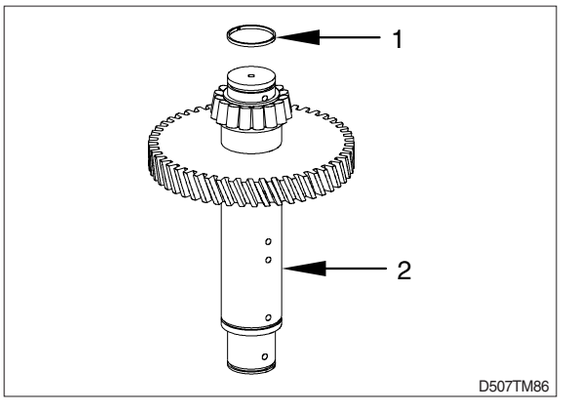


⑥ Pull the clutch (1), front the shaft.

(S) Two-armed puller 5870 970 003

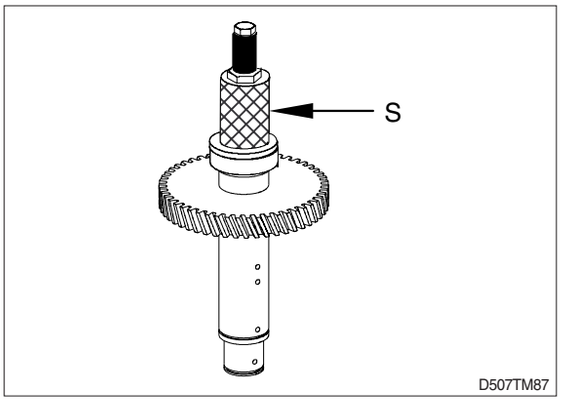


⑦ Rotated the shaft (2) by 180° and unsnap the piston ring (1).



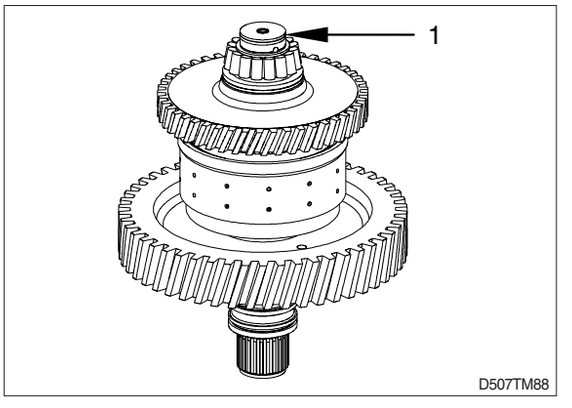
⑧ Pull the taper roller bearing (inner ring) from the shaft.

(S)Gripping insert	5873 001 057
(S)Back-off insert	5870 026 100
or	
(S)Rapid grip	5873 011 011



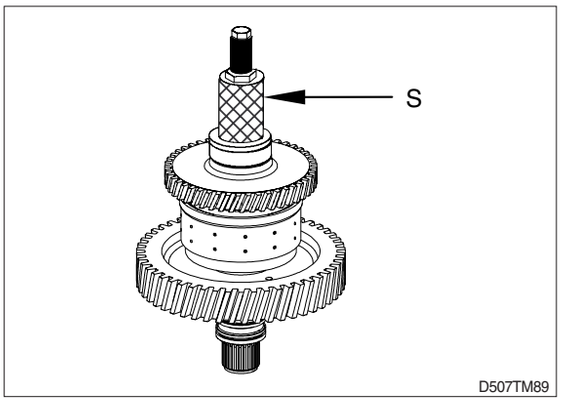
(5) Clutch K3

① Unsnap the piston ring (1).

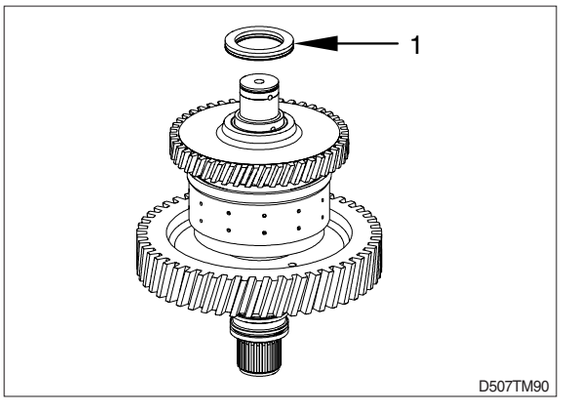


② Pull the taper roller bearing (inner ring) from the shaft.

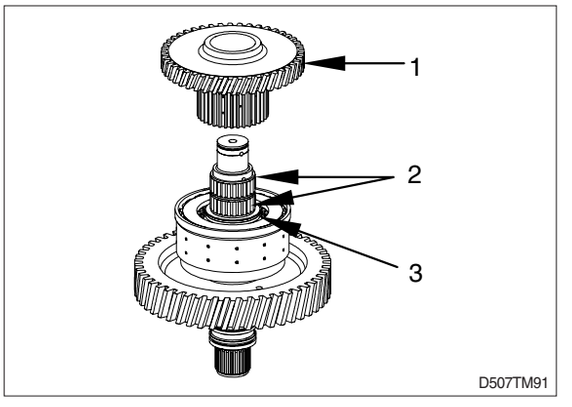
(S)Gripping insert	5873 001 057
(S)Back-off insert	5870 026 100
or	
(S)Rapid grip	5873 011 011



③ Remove the complete axial bearing (1).

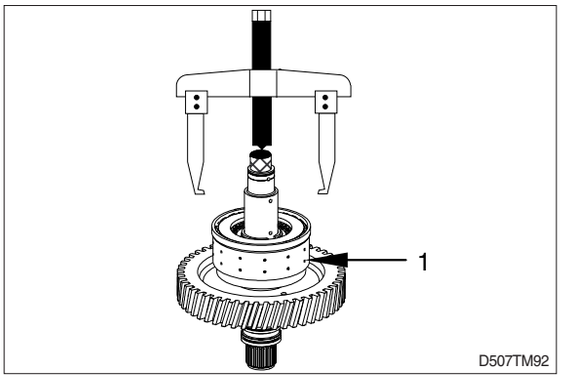


④ Take off idler (1), remove the needle cage (2) and the complete axial bearing (3).

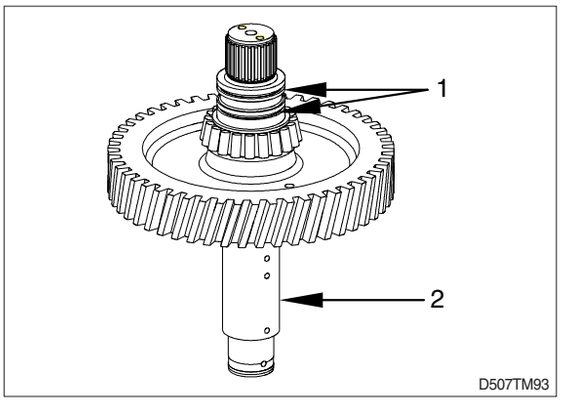


⑤ Pull the clutch (1) from the shaft.

(S) Two-armed puller 5870 970 003

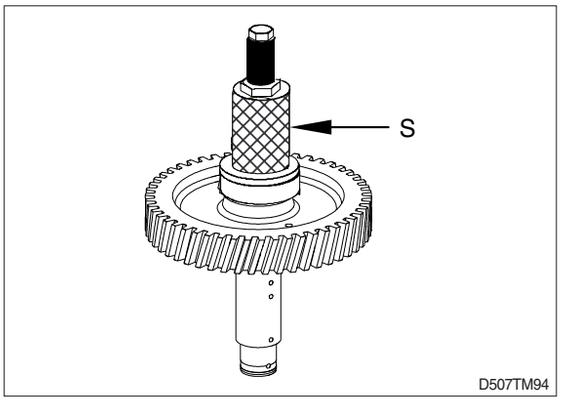


⑥ Rotated the shaft (2) by 180° and unsnap the piston ring (1).



⑦ Pull the taper roller bearing (inner ring) from the shaft.

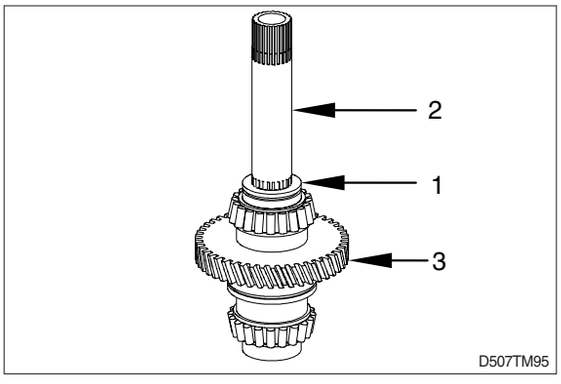
(S) Gripping insert 5873 001 058
(S) Back-off insert 5870 026 100
or
(S) Rapid grip 5873 011 014



(6) Input

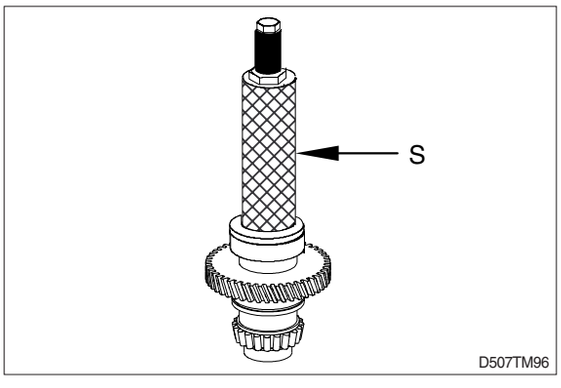
① Unsnap the piston ring (1).
The turbine wheel shaft (2) and the input gear (3) are attached with a snap ring.

※ The components are destroyed at separation



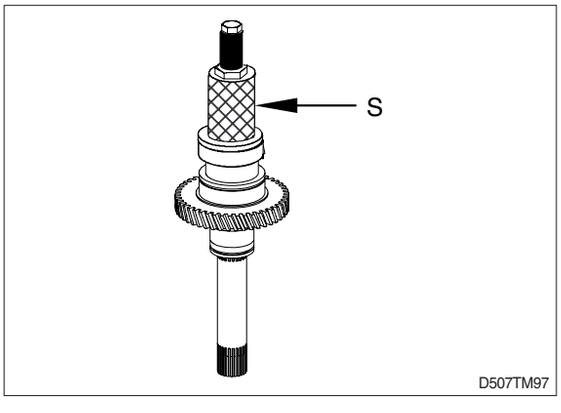
② Pull the taper roller bearing (inner ring) from the input gear.

(S) Gripping insert	5873 001 058
(S) Back-off insert	5870 026 100
or	
(S) Rapid grip	5873 011 014



③ Pull the taper roller bearing (inner ring) from the input gear.

(S) Gripping insert	5873 001 058
(S) Back-off insert	5870 026 100
or	
(S) Rapid grip	5873 011 011



2. TRANSMISSION ASSEMBLY

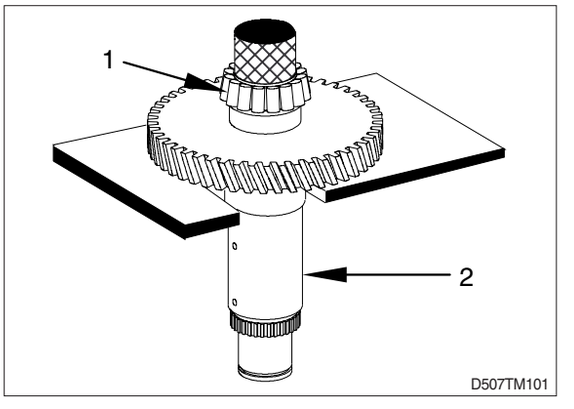
1) CLUTCHES KV/KR/K1/K2/K3 AND INPUT

※ In the EST-37A (electronic transmission control) the gear change (filling times and pressure level) are controlled via the drive program of the transmission electronics. Additionally, the EST-37A monitors the disc clearance (clearance) of the clutches and if exceeded, a fault message is given in the transmission error display.

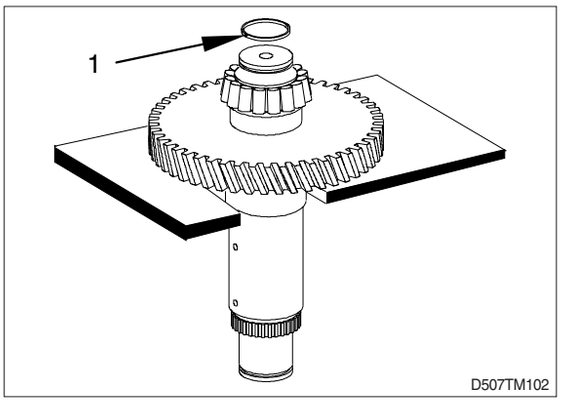
To ensure the shifting quality continuously, no repairs are allowed to be made on the clutches KV/KR/K1/K2/K3, which means that only the complete clutch is allowed to be replaced.

(1) Clutch KV

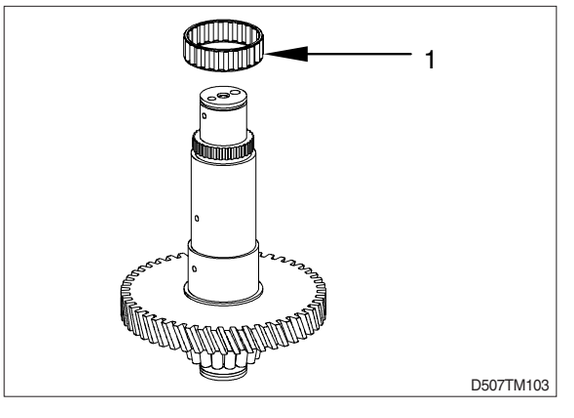
① Press the taper roller bearing (inner ring) (1) onto the shaft (2) until contact is obtained.



② Install the piston ring (1).

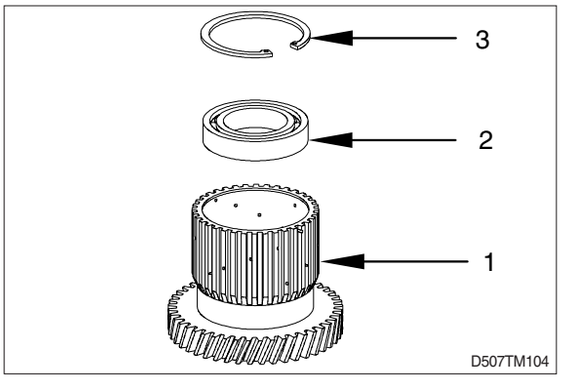


③ Mount the needle bearing (1) onto the shaft.

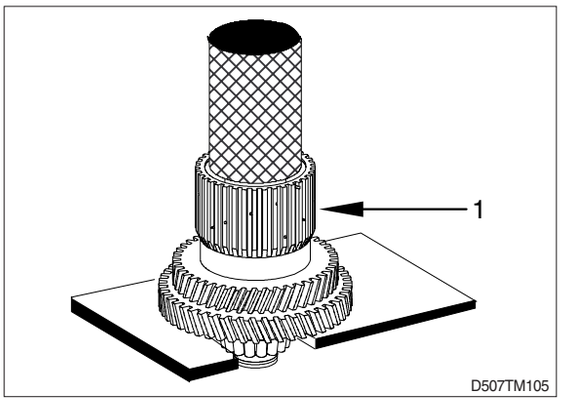


④ Put the ball bearing (2) into the idler (1) until contact is obtained and fasten it by means of retaining ring (3).

(S) Set of internal pliers

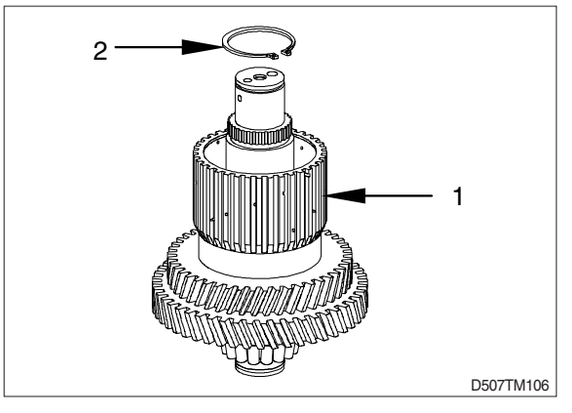


⑤ Press in preassembled idler (1) until contact.



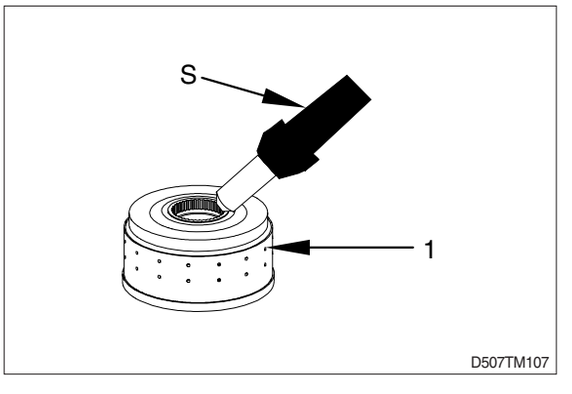
⑥ Fasten the idler (1) by means of retaining ring (2).

(S) Set of external pliers 5870 900 015



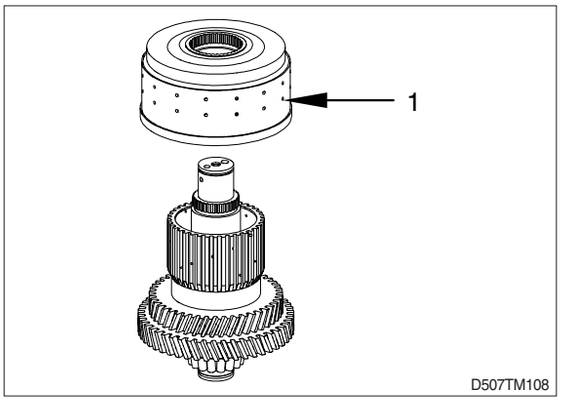
⑦ Heat up the inner diameter of the clutch (1) (approx. 120 ˚C).

(S) Hot- air blower 220V 5870 221 500
(S) Hot- air blower 110V 5870 221 501

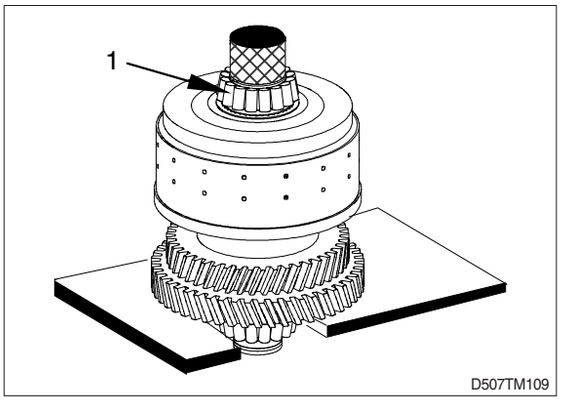


⑧ Mount the clutch (1) until contact is obtained.

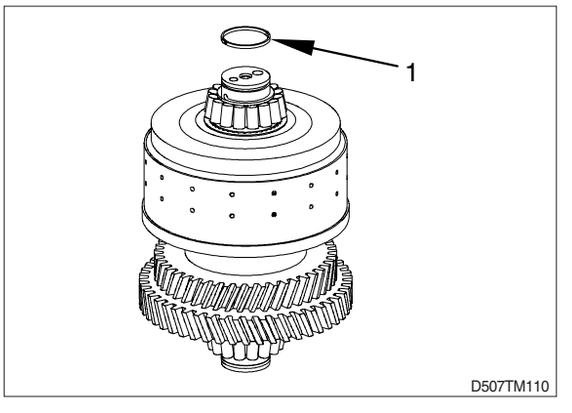
⚠ Wear safety gloves.



⑨ Press the taper roller bearing (inner ring) (1) until contact is obtained.



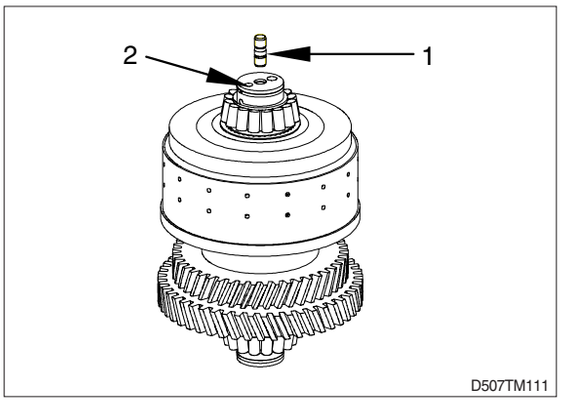
⑩ Install the piston ring (1).



⑪ Install the stud (1).

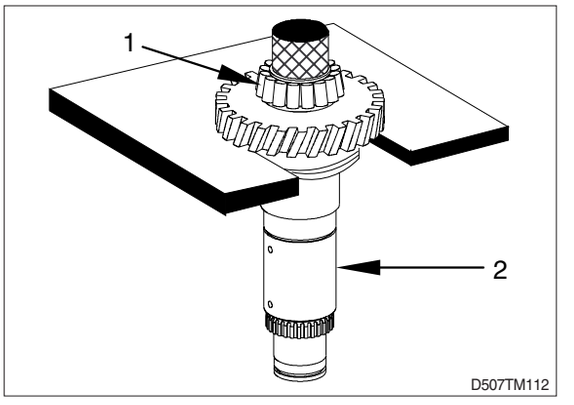
Tightening torque ····· M_A=1.7 kg·m

※ Check closing respective opening of the clutch by means of compressed air at the bore (2).
Closing respective opening of the clutch must be clearly audible.

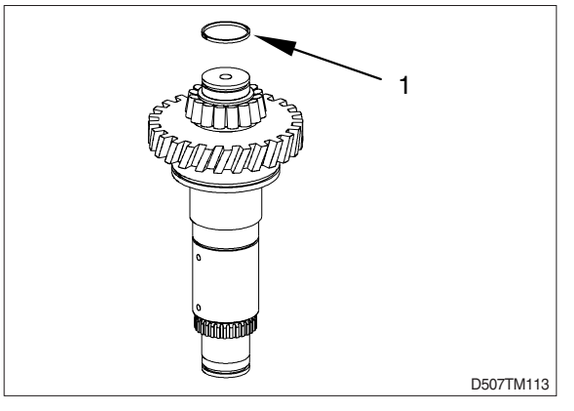


(2) Clutch KR

① Press the taper roller bearing (inner ring) (1) onto the shaft (2) until contact is obtained.



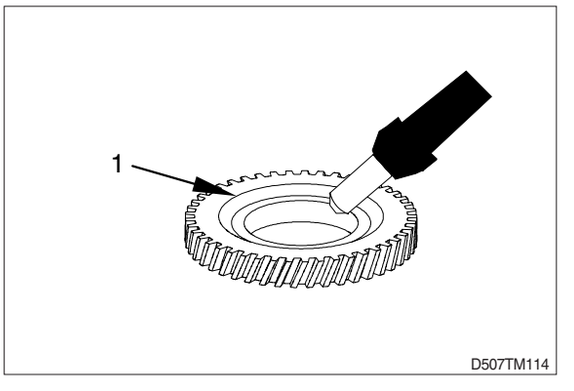
② Install the piston ring (1).



③ Heat up the inner diameter of the gear (1) (approx. 120 ˚C).

(S)Hot- air blower 220V 5870 221 500
(S)Hot- air blower 110V 5870 221 501

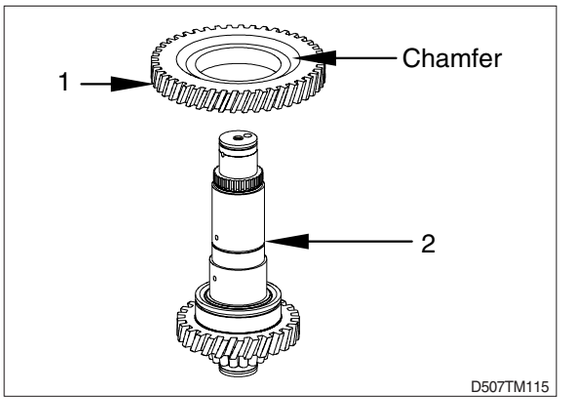
⚠ Wear safety gloves.



④ Undercool the shaft (2) (approx. 80 ˚C). Mount the gear until contact is obtained.

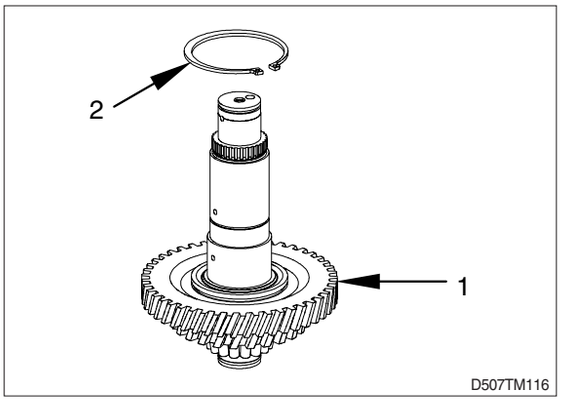
※ Install the chamfer of the gear (see arrow) showing upwards.
※ Observe the radial installation position.

⚠ Wear safety gloves.

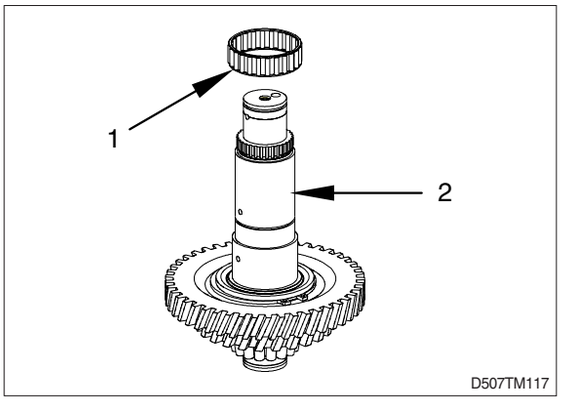


⑤ Fasten the gear (1) by means of retaining ring (2).

(S) Set of internal pliers 5870 900 015

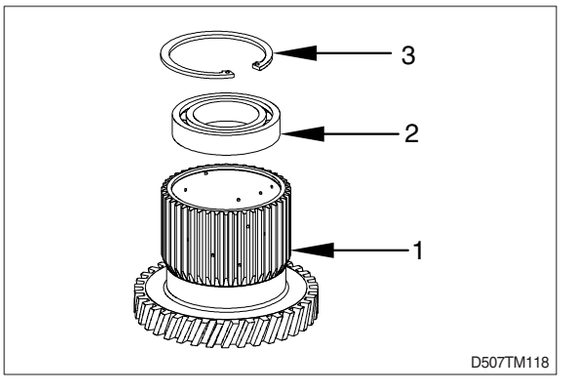


⑥ Mount the needle bearing (1) onto the shaft (2).

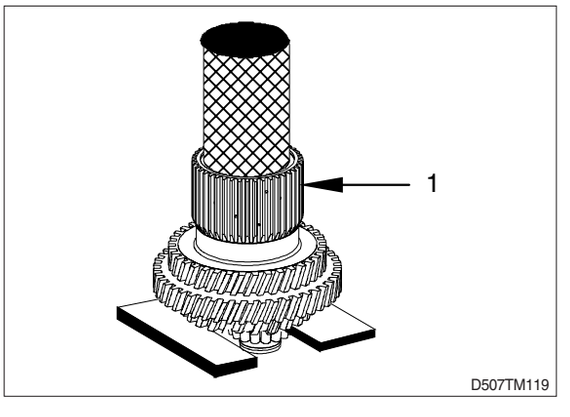


⑦ Put the ball bearing (2) into the idler (1) until contact is obtained and fasten it by means of retaining ring (3).

(S) Set of internal pliers 5870 900 013

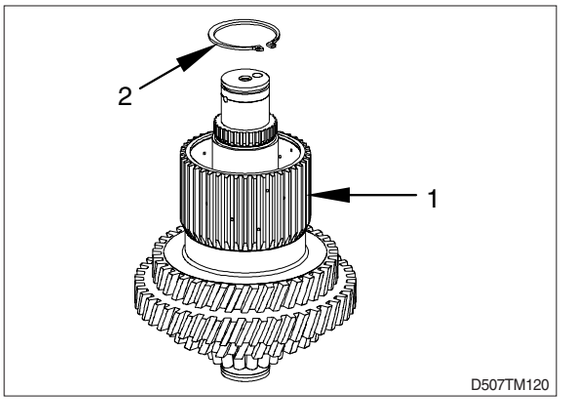


⑧ Press in the preassembled idler (1) until contact.



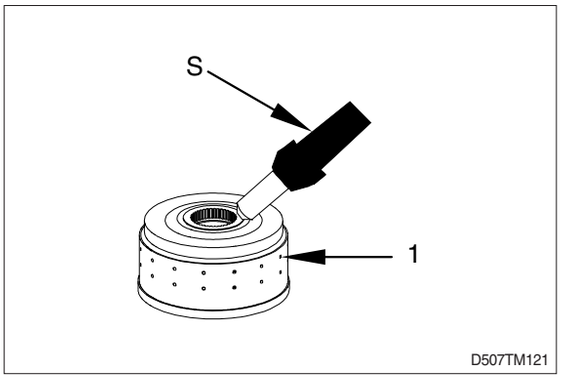
⑨ Fasten the idler (1) by means of retaining ring (2).

(S) Set of internal pliers 5870 900 015



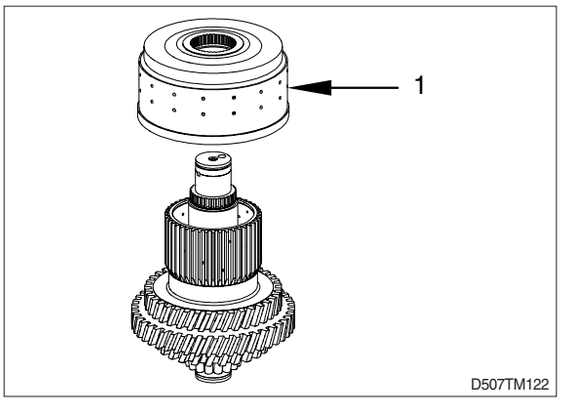
⑩ Heat up the inner diameter of the clutch (1) (approx. 120 ˚C).

(S) Hot- air blower 220V 5870 221 500
(S) Hot- air blower 110V 5870 221 501

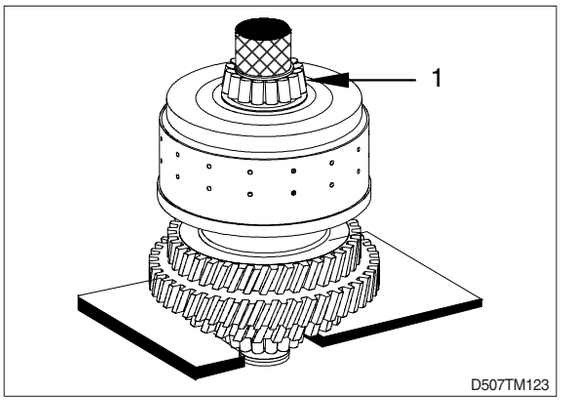


⑪ Mount the clutch (1) and press it until contact is obtained.

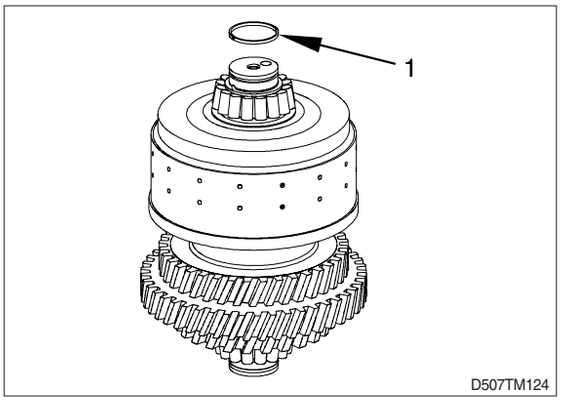
⚠ Wear safety gloves.



⑫ Press the taper roller bearing (inner ring) (1) until contact is obtained.

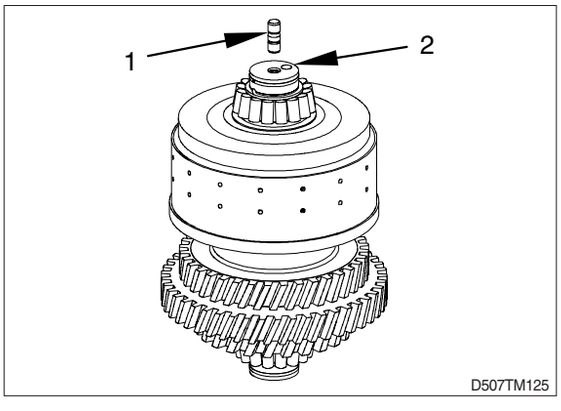


⑬ Install the piston ring (1).



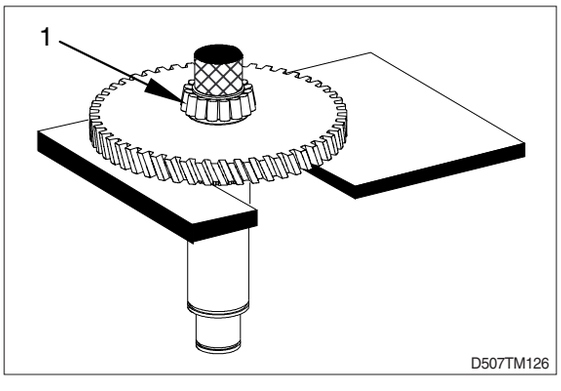
⑭ Install the stud (1).
Tightening torque ····· M_A=1.7 kg·m

※ Check closing respective opening of the clutch by means of compressed air at the bore (2).
Closing respective opening of the clutch must be clearly audible.

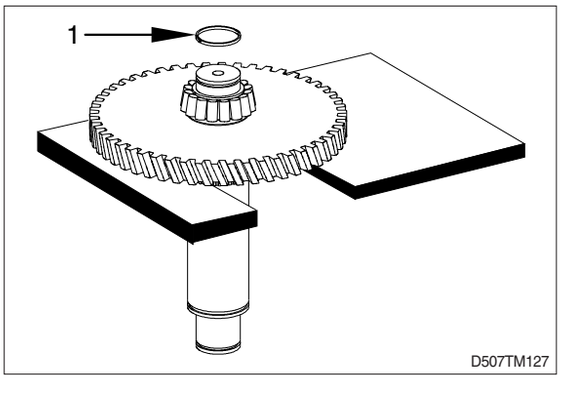


(3) Clutch K1

① Press the taper roller bearing (inner ring) (1) onto the shaft until contact.

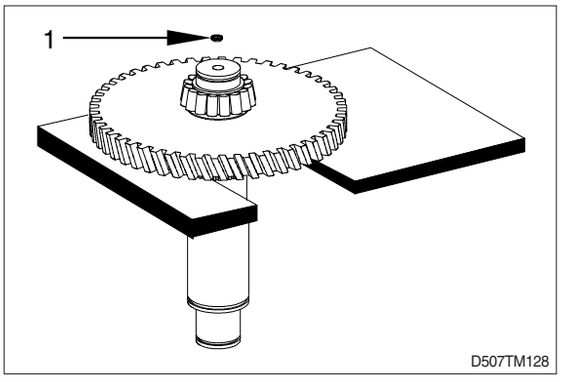


② Install the piston ring (1).



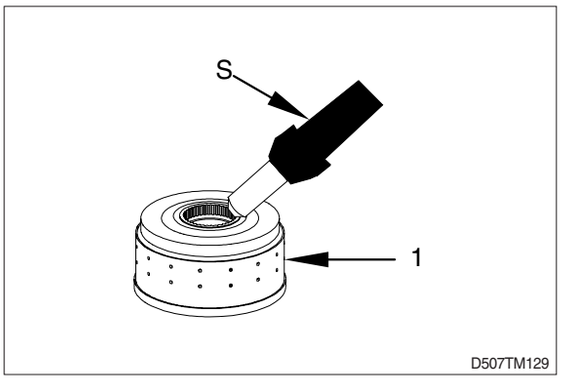
③ Install the sealing cap (1).

※ Wet the contact surface with (Loctite Type No. 262).



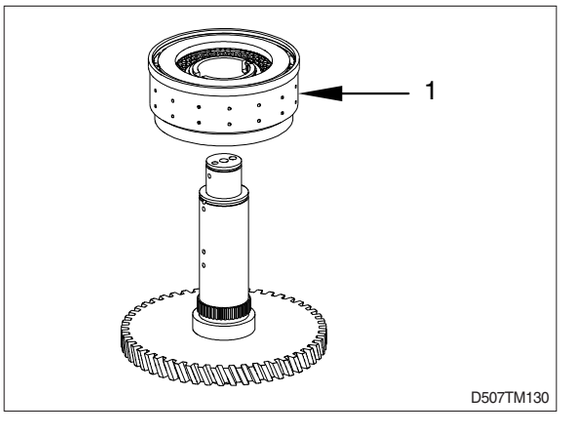
④ Heat up the inner diameter of the clutch (1) (approx. 120 ˚C).

(S) Hot- air blower 220V 5870 221 500
(S) Hot- air blower 110V 5870 221 501



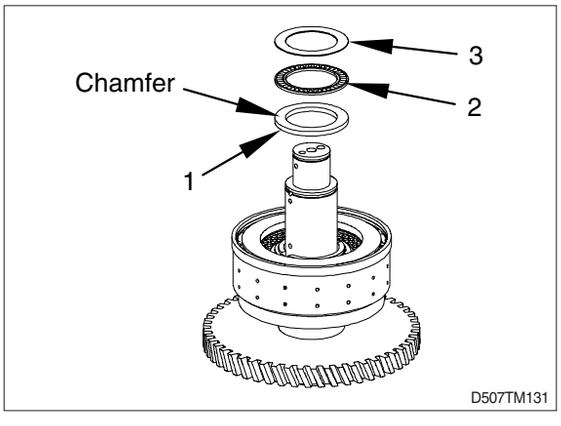
⑤ Mount the clutch (1) and press it until contact is obtained.

⚠ Wear safety gloves.

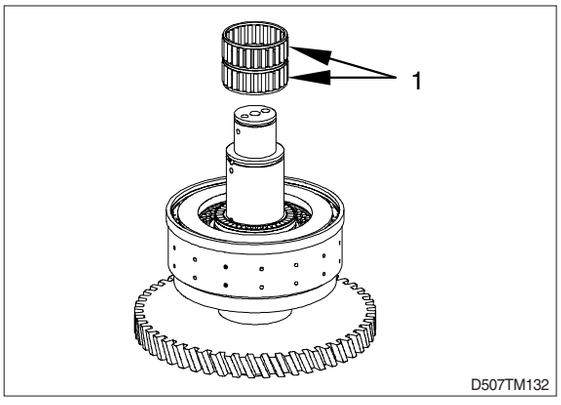


⑥ Mount the running disc (1), axial cage (2) and axial washer (3).

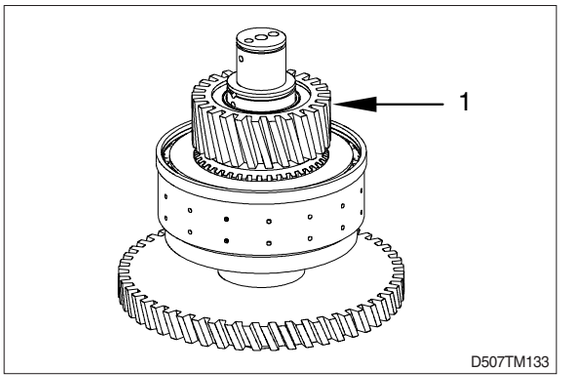
※ Install chamfer (see arrow) of the running disc (2) showing towards the axial cage.



⑦ Mount the needle cage (1).

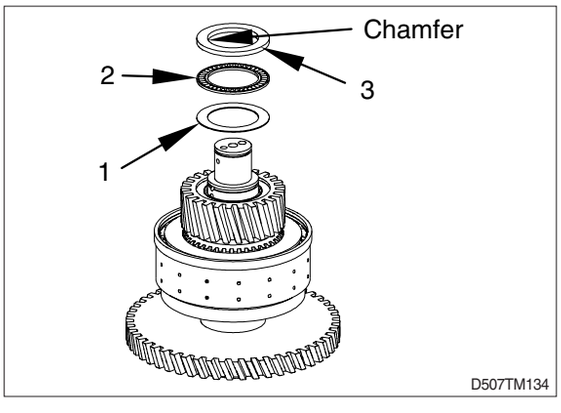


⑧ Install the idler (1).



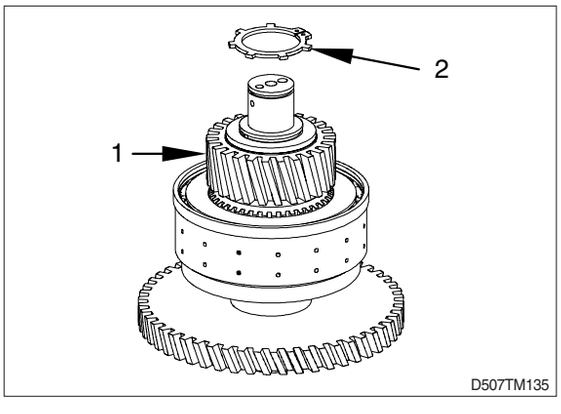
⑨ Mount the axial washer (1), axial cage (2) and running disc (3).

※ Install chamfer (see arrow) of the running disc (3) showing towards the axial cage

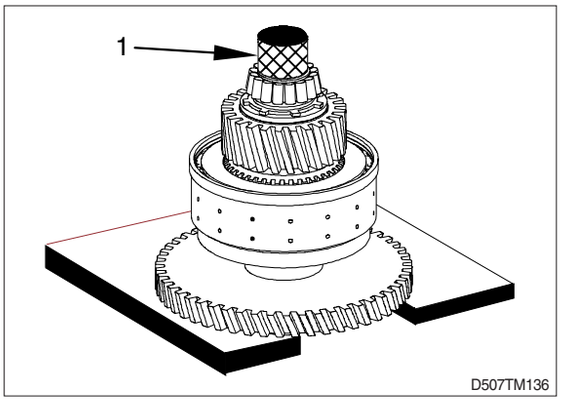


⑩ Fasten the idler (1) and the single parts by means of the retaining ring (2).

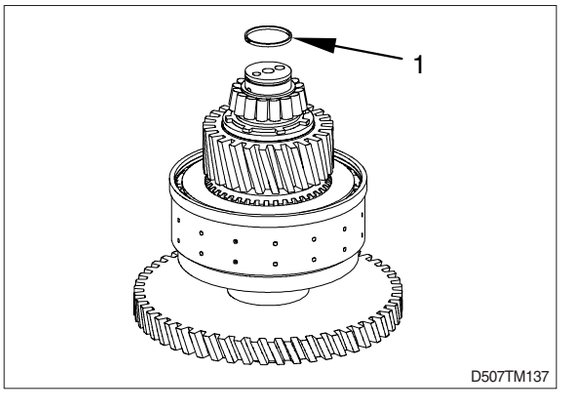
(S) Set of external pliers 5870 900 015



⑪ Press the taper roller bearing (inner ring) (1) until contact is obtained.

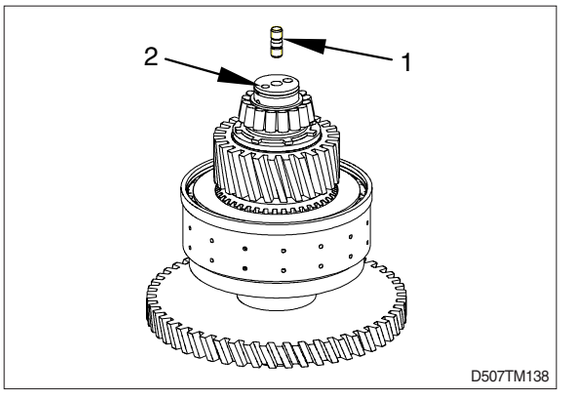


⑫ Install the piston ring (1).



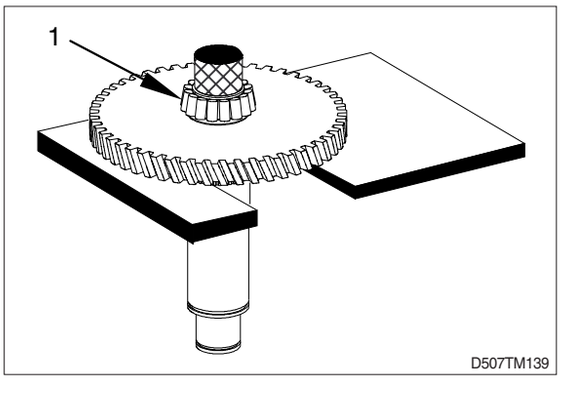
⑬ Install the stud (1).
Tightening torque ····· M_A=1.7 kg·m

※ Check closing respective opening of the clutch by means of compressed air at the bore (2).
Closing respective opening of the clutch must be clearly audible.

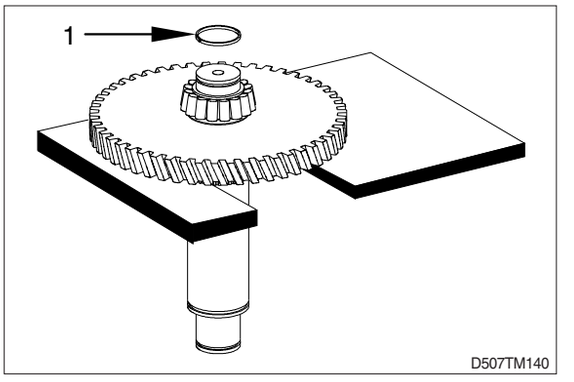


(4) Clutch K2

① Press the taper roller bearing (inner ring) (1) onto the shaft until contact.

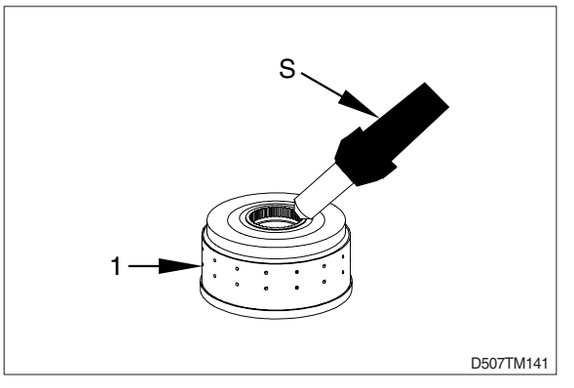


② Install the piston ring (1).



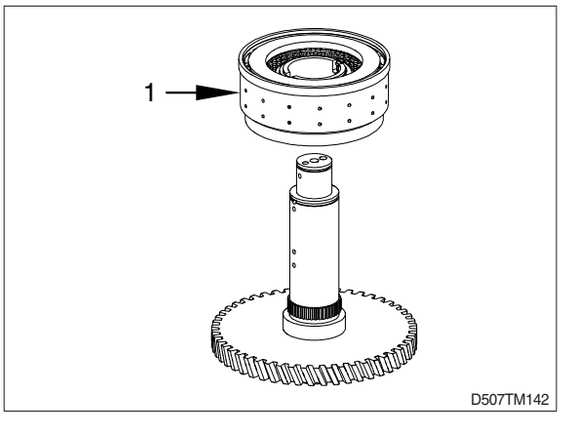
③ Heat up the inner diameter of the clutch (1) (approx. 120 ˚C).

(S) Hot- air blower 220V 5870 221 500
(S) Hot- air blower 110V 5870 221 501



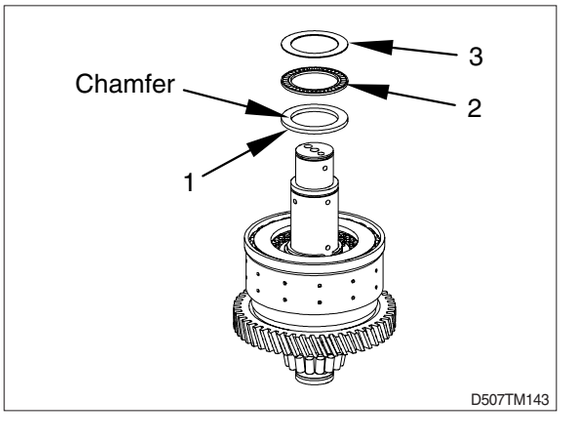
④ Mount the clutch (1) until contact is obtained.

⚠ Wear safety gloves.

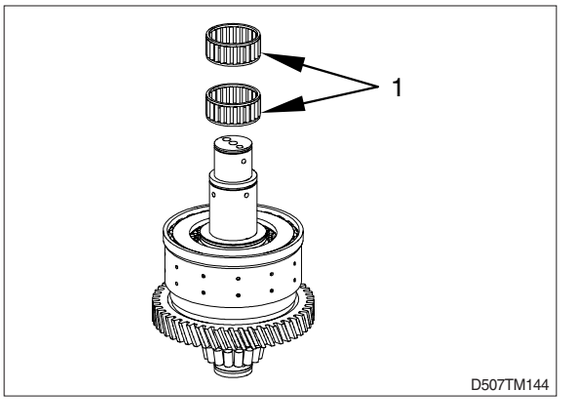


⑤ Mount the running disc (1), axial cage (2) and axial washer (3).

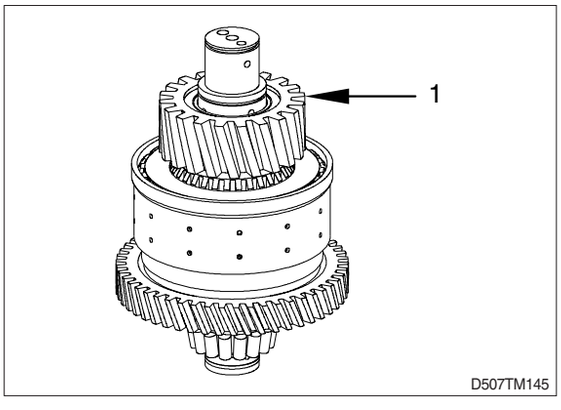
※ Install chamfer (see arrow) of the running disc (2) showing towards the axial cage.



⑥ Mount the needle cage (1).

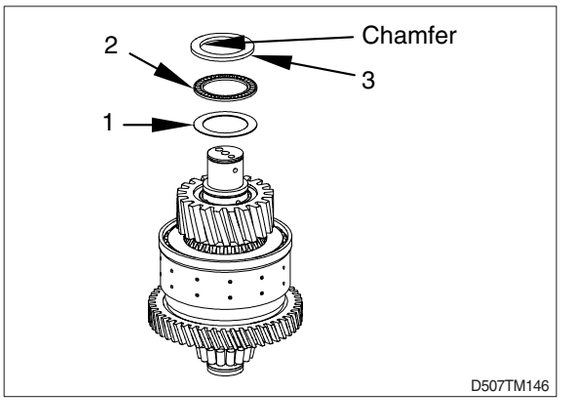


⑦ Install the idler (1).



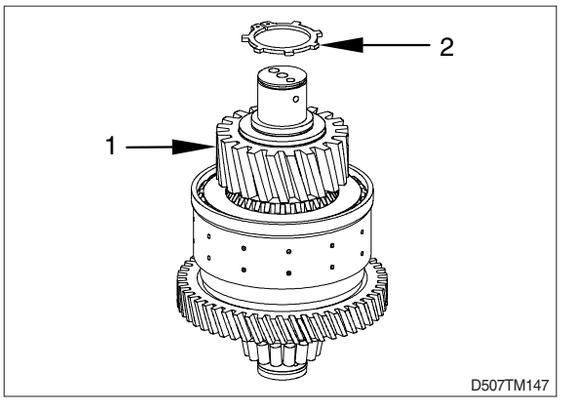
⑧ Mount the axial washer (1), axial cage (2) and running disc (3).

※ Install chamfer (see arrow) of the running disc (3) showing towards the axial cage.

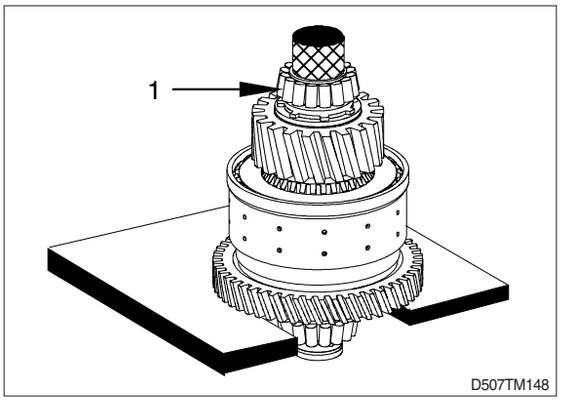


⑨ Fasten the idler (1) and the single parts by means of the retaining ring (2).

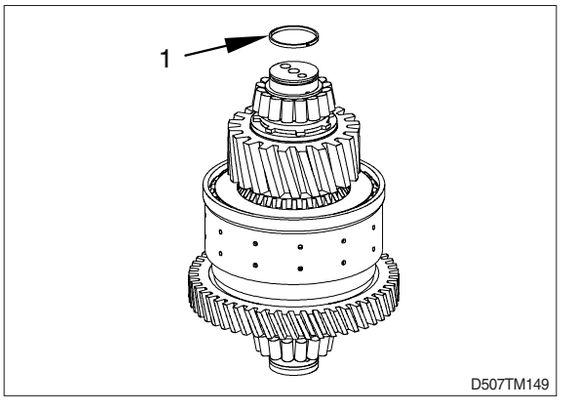
(S) Set of external pliers 5870 900 015



⑩ Press the taper roller bearing (inner ring) (1) until contact is obtained.

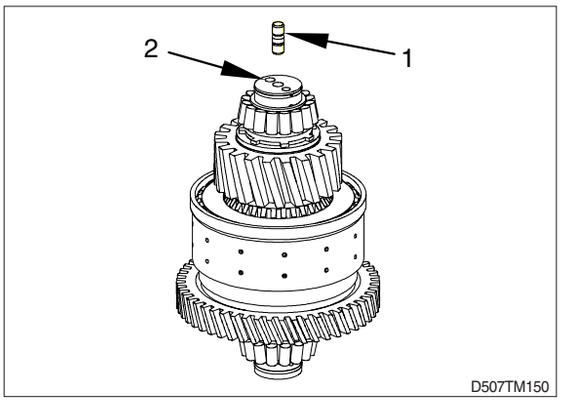


⑪ Install the piston ring (1).



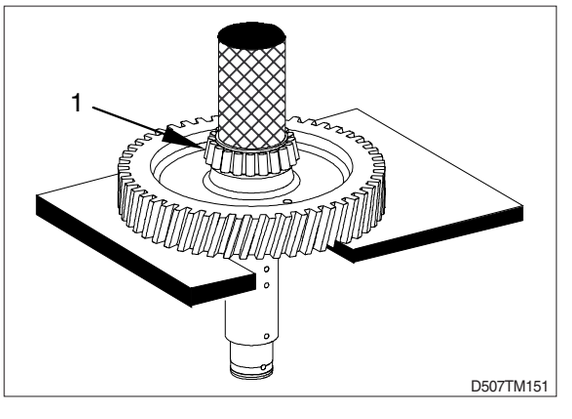
⑫ Install the stud (1).
Tightening torque ····· M_A=1.7 kg·m

※ Check closing respective opening of the clutch by means of compressed air the bore (2).
Closing respective opening of the clutch must be clearly audible.

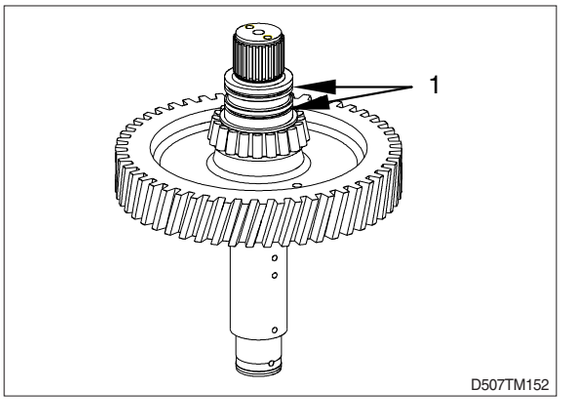


(5) Clutch K3

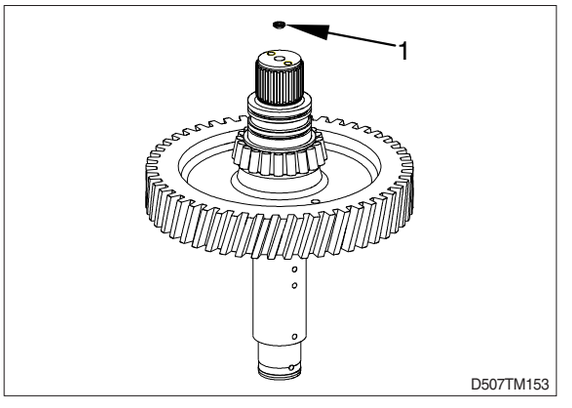
① Press the taper roller bearing (inner ring) (1) onto the shaft until contact.



② Install the piston ring (1).

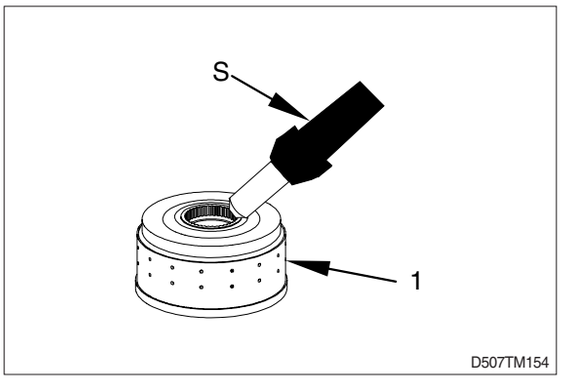


③ Install the sealing cap (1).
Wet the contact surface with loctite type No.262.



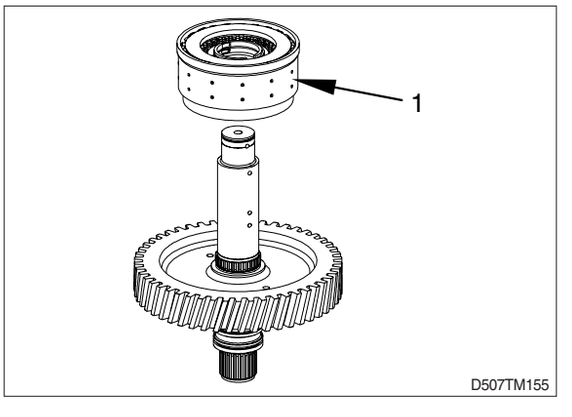
④ Heat up the inner diameter of the clutch (1) (approx. 120 ˚C).

(S) Hot- air blower 220V 5870 221 500
(S) Hot- air blower 110V 5870 221 501



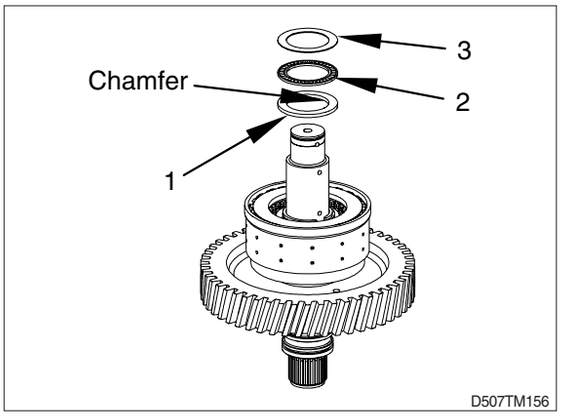
⑤ Mount the clutch (1) until contact is obtained.

⚠ Wear safety gloves.

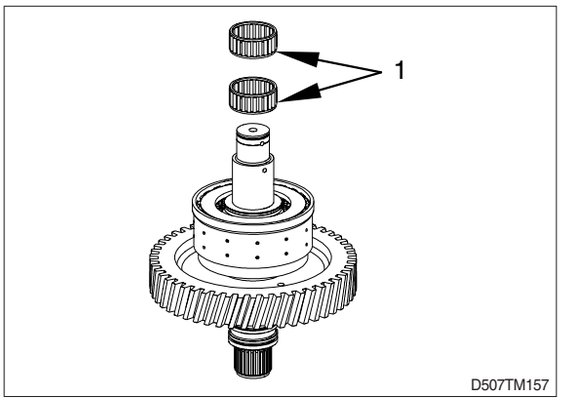


⑥ Mount the running disc (1), axial cage (2) and axial washer (3).

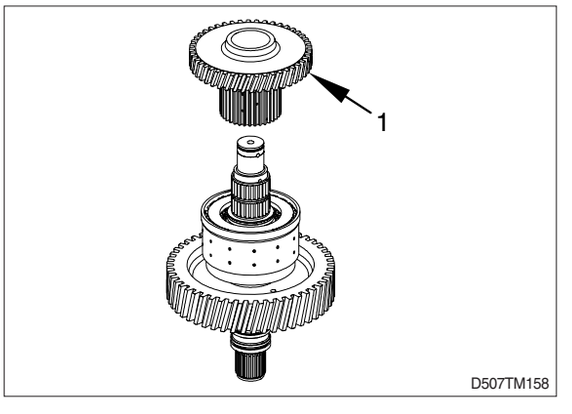
※ Install chamfer (see arrow) of the running disc (3) showing toward the axial cage.



⑦ Mount the needle cage (1).

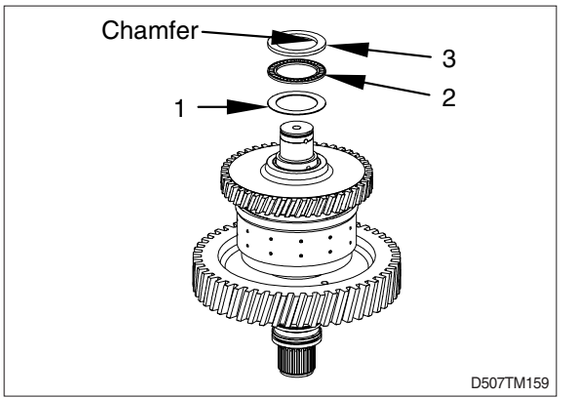


⑧ Install the idler (1).

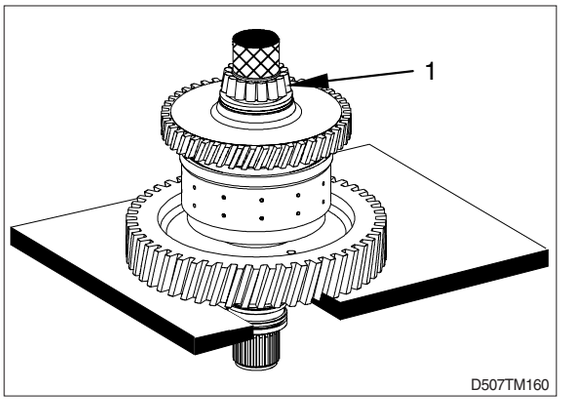


⑨ Mount the axial washer (1), axial cage (2) and running disc (3).

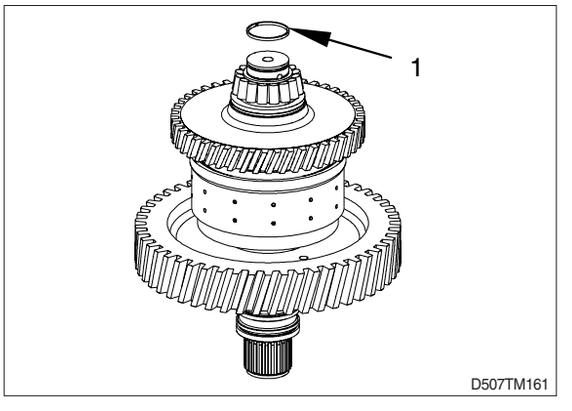
※ Install chamfer (see arrow) of the running disc (3) showing towards the axial cage.



⑩ Press the taper roller bearing (inner ring) (1) until contact is obtained.

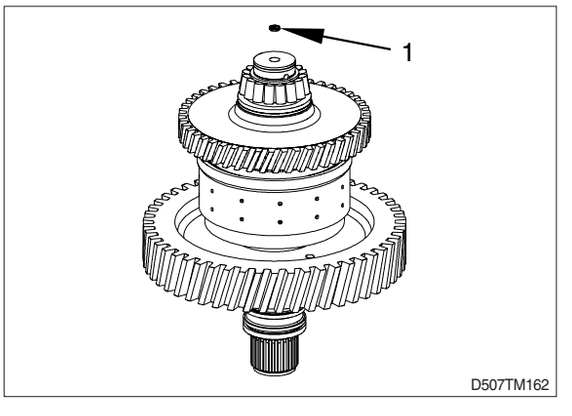


⑪ Install the piston ring (1).

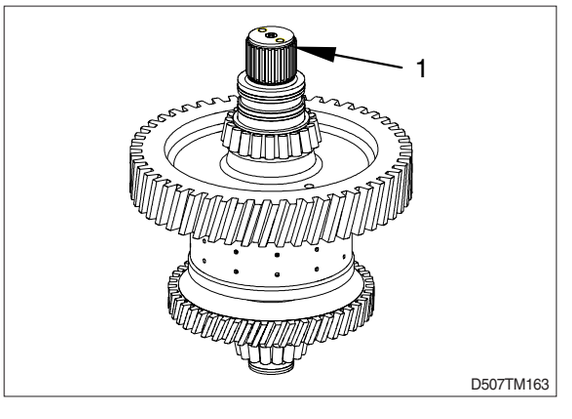


⑫ Install the screw plug (1).

(S) Lever riveting tongs 5870 320 016

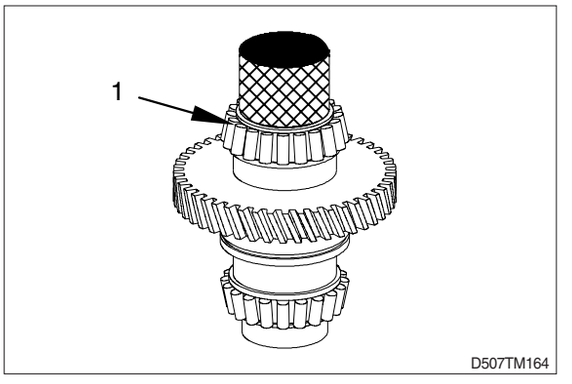


※ Check closing respective opening of the clutch by means of compressed air at the bore (1).
Closing respective opening of the clutch must be clearly audible.

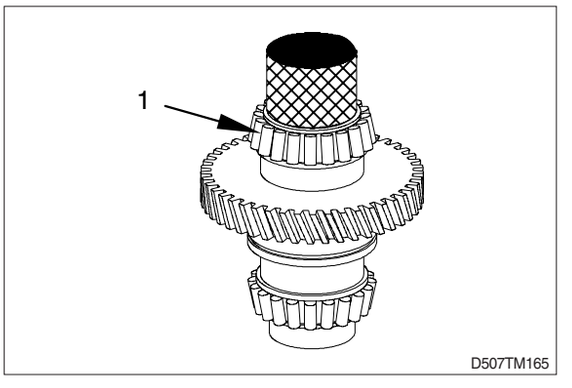


(6) Input

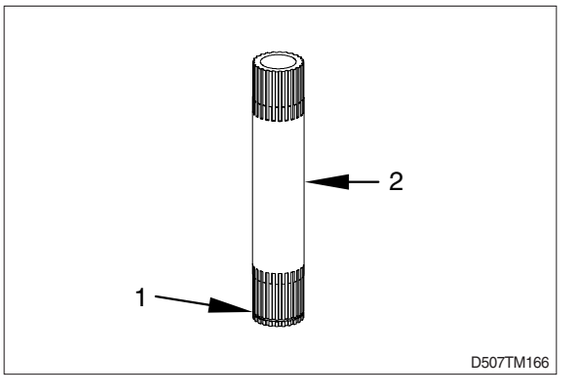
① Press the taper roller bearing (inner ring) (1) until contact is obtained.



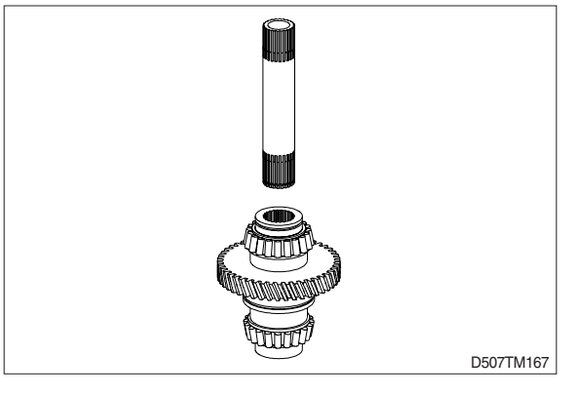
② Press the taper roller bearing (inner ring) (1) until contact is obtained.



③ Have the snap ring (1) engaged into the annular groove of the turbine wheel shaft (2).



④ Mount the turbine wheel shaft until the snap ring engages into the recess of the input gear-turbine wheel shaft is axially fixed.



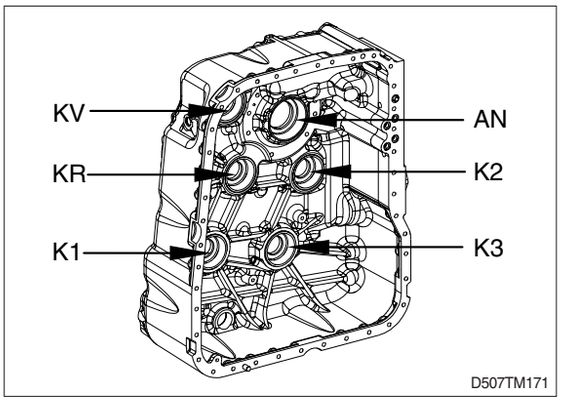
2) ENGINE CONNECTION, PRESSURE OIL PUMP AND INSTALLATION OF THE CLUTCHES

Install all bearing outer rings into the bearing bores of both transmission housing sections.

※ Should contrary to the recommendations the taper roller bearing of the clutches as well as of the input not be replaced, the assignment (bearing inner and outer rings) has to be kept at least . Mark the bearing inner and bearing outer rings to each other accordingly.

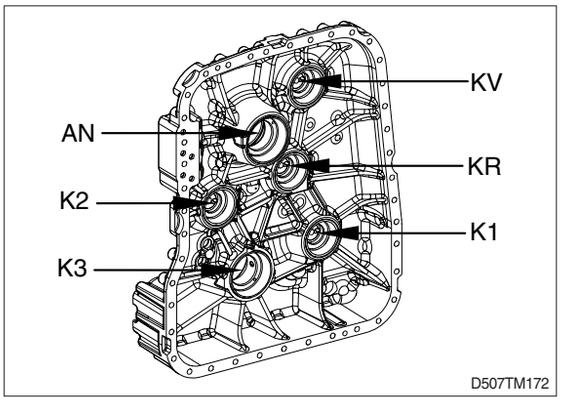
(1) Transmission housing front section

AN = Input
KV = Clutch - Forward
KR = Clutch - Reverse
K1 = Clutch - 1st gear
K2 = Clutch - 2nd gear
K3 = Clutch - 3rd gear



(2) Transmission housing rear section

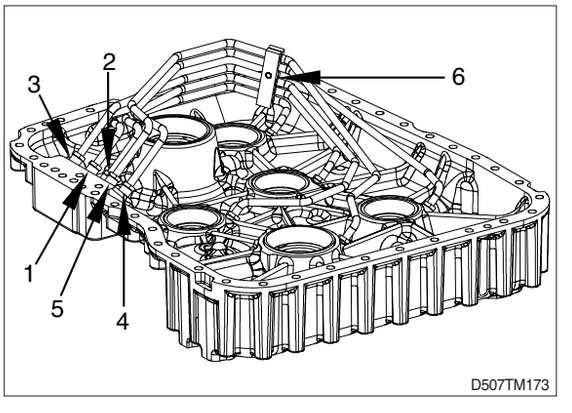
※ Put the bearing outer rings with assembly grease into the bearing bores



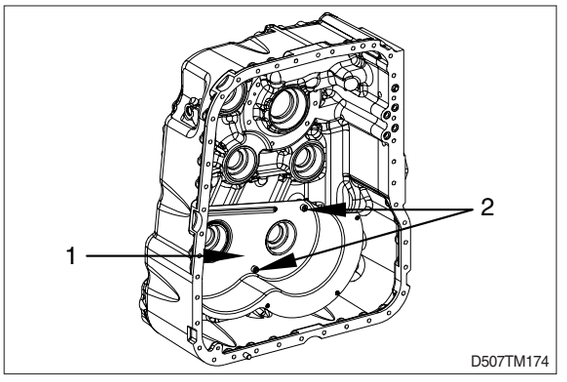
① Install the pipe (system pressure from the electro-hydraulic control to the respective clutch).
The pipes are to be installed in the following sequence:

1 = Pipe	KV
2 = Pipe	KR
3 = Pipe	K2
4 = Pipe	K1
5 = Pipe	K3

Tightening torque ····· M_A =4.3 kg · m
Install the holding segment (6)
Tightening torque (M8/8.8) ·· M_A =2.3 kg · m



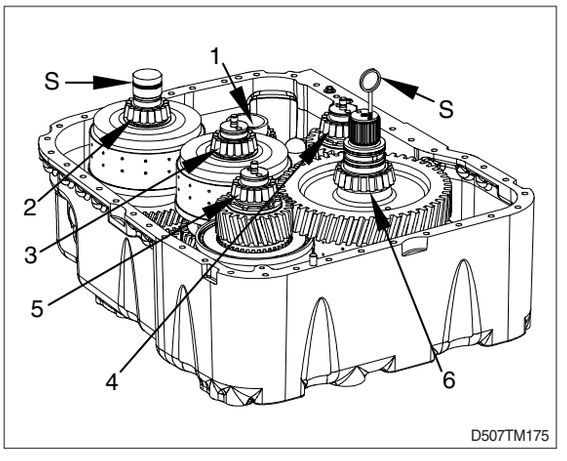
② Fasten the screen sheet (1) by means of cap screws (2).
Tightening torque (M8/8.8) ·· M_A =2.3 kg · m



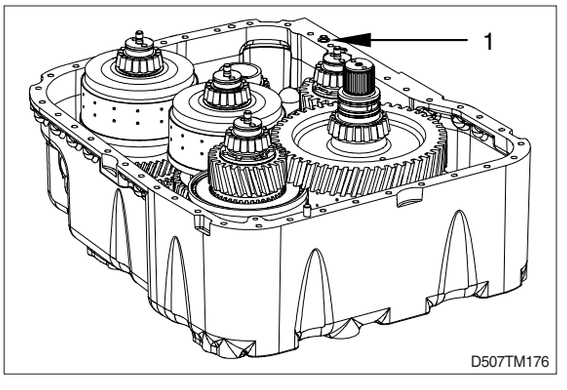
③ The clutch is to be put into the transmission housing front section as described in the legend.

1 = Input shaft
2 = Clutch KV
3 = Clutch KR
4 = Clutch K2
5 = Clutch K1
6 = Clutch K3

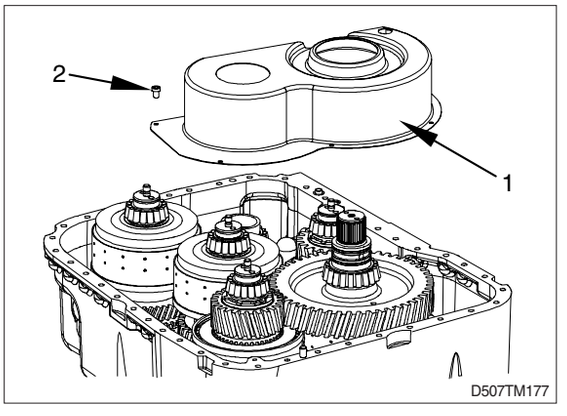
(S) Handle 5870 260 010 (K1/K2/KV/KR)
(S) Eyebolt 5870 204 002



④ Put the pipes and O-rings into the bores and grease them.

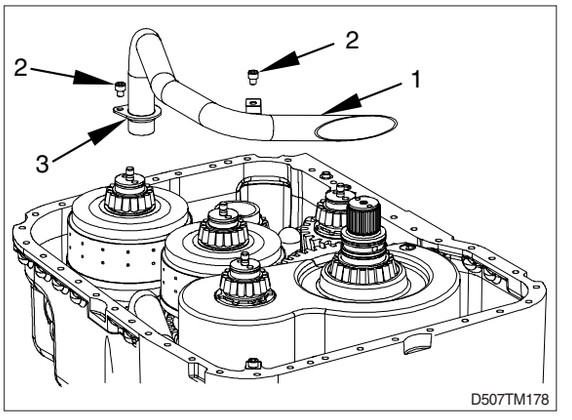


⑤ Fasten the screen sheet (1) by means of cap screws (2).
Tightening torque (M6/8.8) ·····
····· M_A =0.97 kg · m



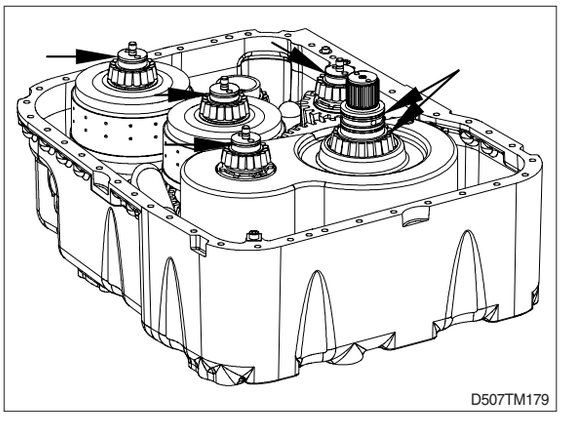
⑥ Install the O-rings (3) and fasten the suction pipe (1) by means of cap screws (2).

Tightening torque (M8/8.8) ·· M_A =2.3 kg·m



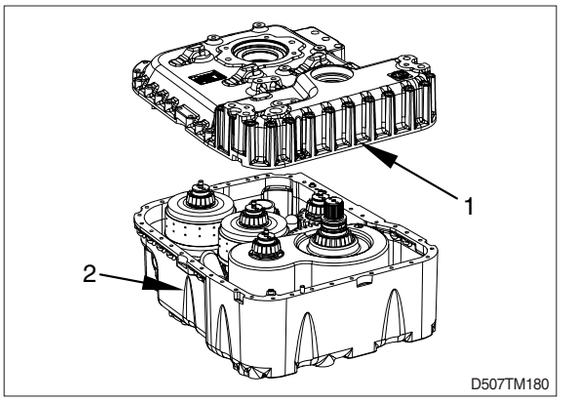
⑦ Grease the rectangular rings (see arrows) and align them, centrically.

※ Wet the mounting face with sealing compound loctite (Type No.574)



⑧ Cautiously place the transmission housing rear section (1) by means of the lifting equipment to the transmission housing front section (2) until contact is obtained.

(S) Eyebolts 2×(M20)	0636 804 003
(S) Ring nut(M12)	0664 462 774
(S) Lifting chain	5870 281 047

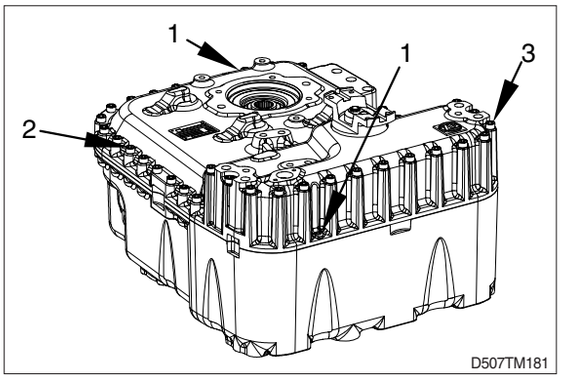


⑨ Install both cyl. pins (1) centrally to the mounting face.

By means of cap screws (2 and 3) fasten the transmission housing rear section to the transmission housing front section.

※ Cap screws with different lengths.

Tightening torque (M8/8) ···· M_A =4.7 kg·m

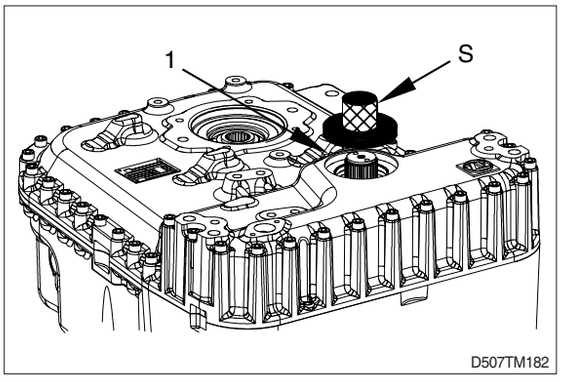


⑩ Install the shaft seal (1) with the sealing lip showing to the oil sump.

※ The exact installation position is obtained by using the specified mounting tool (S).

※ Fill the shaft seal between dust lip and sealing lip with grease.
Wet the outer diameter with spirit.

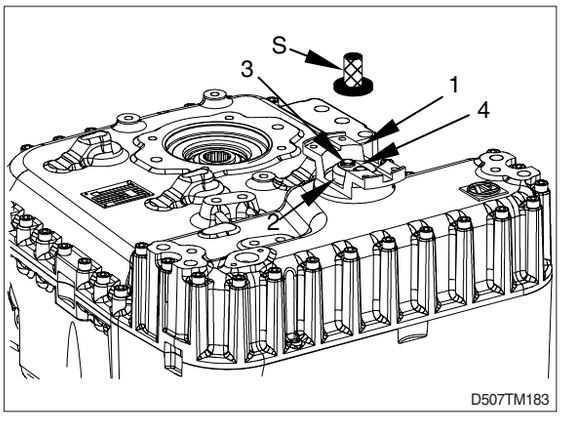
(S) Mounting tool 5870 048 057



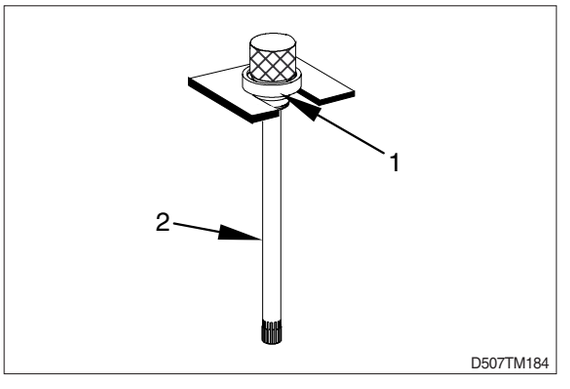
⑪ Insert the input flange (1) until contact and put in the O-ring. Fix the input flange (1) by means of washer (2) and hexagon screws (3).
Then fix the hexagon screws (3) with the tab washer (4) by means of the mounting tool (S).

Tightening torque (M8/8.8) ·· M_A =3.5 kg · m

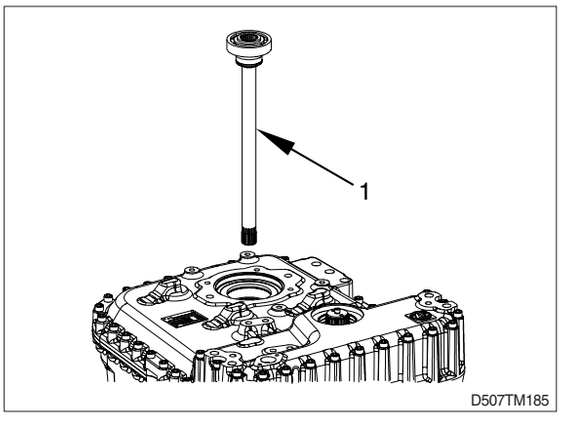
(S) Mounting tool 5870 057 011
(S) Handle 5870 260 002



⑫ Press the ball bearing (1) onto the pump shaft (2) until contact is obtained.

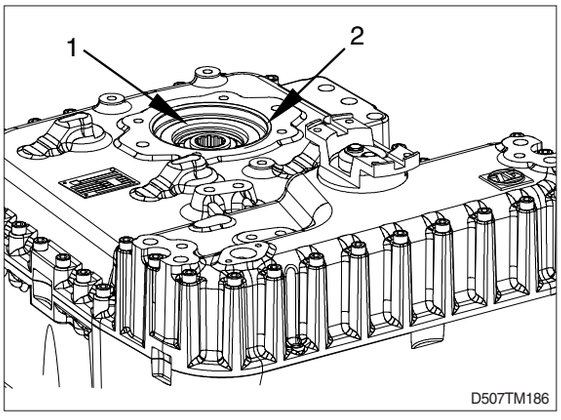


⑬ Install the pump shaft (1) until contact is obtained.



⑭ Install the retaining ring (1) and the O-ring (2).

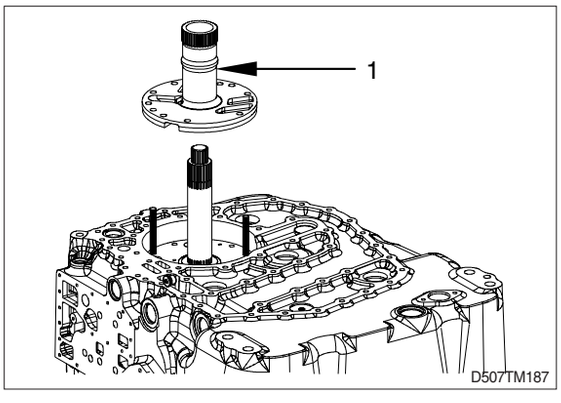
※ Grease the O-ring



⑮ Install two adjusting screws and mount the stator hollow shaft (1).

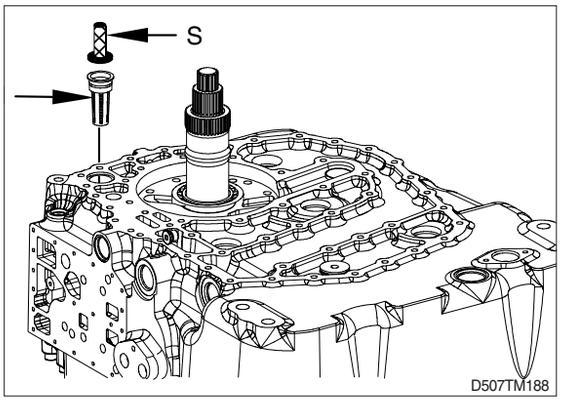
※ Observe the radial installation position.

(S) Adjusting screws 5870 204 007



⑯ Install the converter safety valve (1) until contact.

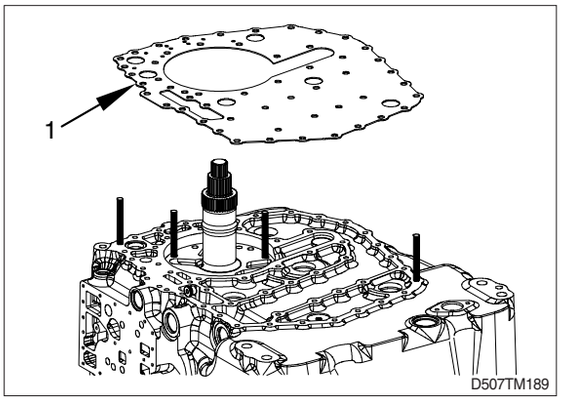
(S) Drive mandrel 5870 705 012



⑰ Install two adjusting screws and mount the intermediate sheet (1).

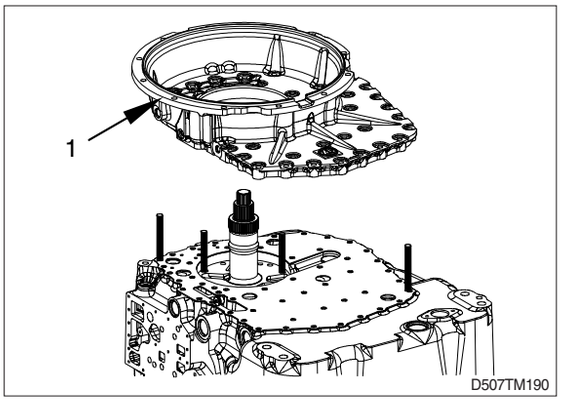
※ The intermediate sheet has always to be replaced.

(S) Adjusting screws 5870 204 007



⑱ Cautiously place the converter bell (1) by means of the lifting equipment to the transmission until contact is obtained.

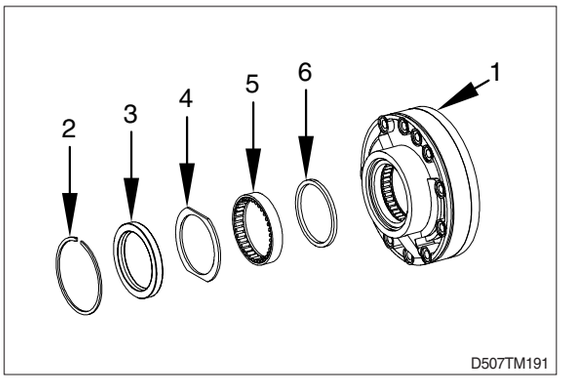
(S) Eyebolts assortment 5870 204 002
(S) Lifting chain 5870 281 047



(3) Pressure oil pump

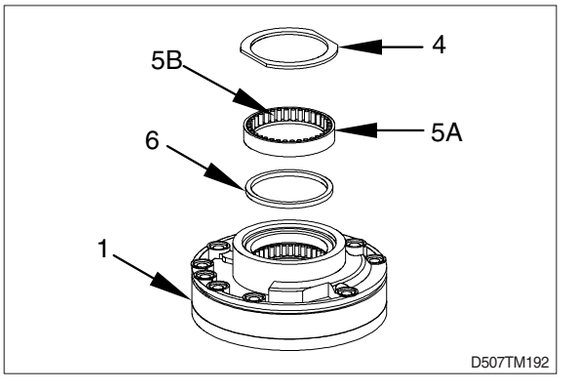
※ If running-in marks should be found in the pump housing or on the cam disc, the complete pump has to be replaced.
※ Item 1-6 are allowed to be replaced.

1 = Pump housing with rotor
2 = Snap ring
3 = Shaft seal
4 = Support shim
5 = Needle bearing cpl.(bearing outer ring and needle bearing)
6 = Ring



① Install the following parts into the pump housing (1).

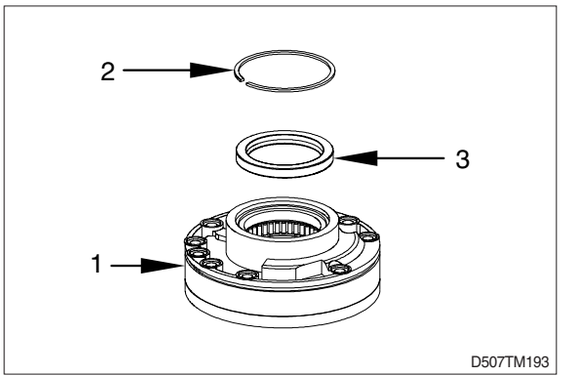
6 = Ring
5A = Bearing outer ring
5B = Needle cage
4 = Support shim



② Cautiously put the shaft seal (3) with the sealing lip showing downwards into the pump housing (1) until contact and fasten it by means of the snap spring (2).

※ Wet the outer diameter of the shaft seal with spirit.

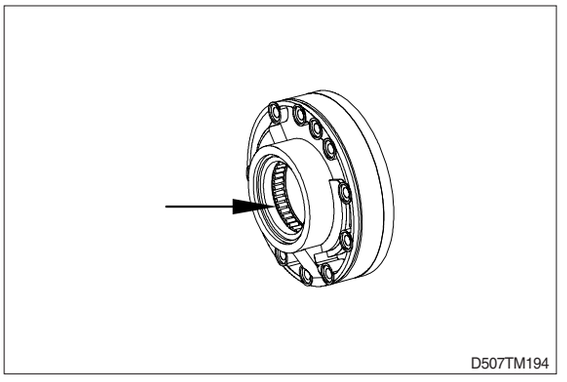
(S) Mounting tool 5870 055 070
(S) Handle 5870 260 002



(4) Installation of the external and internal rotor

※ Install the external rotor.
Chamfer shows to the pump base (cannot be seen in the picture).

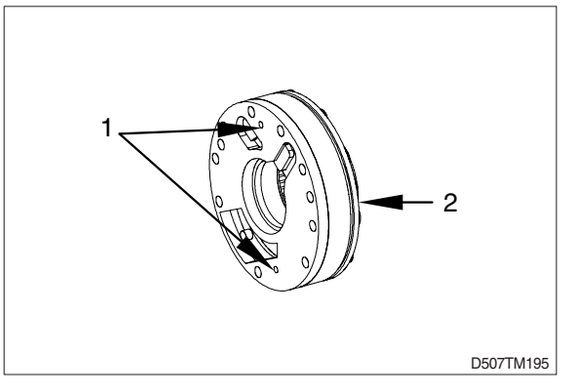
※ Install the internal rotor.
Gearing (arrow) shows downwards.



① Put on the cam disc and by means of two cap screws (1) fasten it radially.

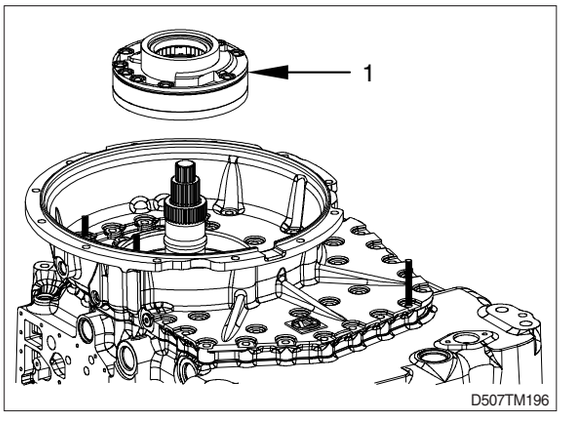
※ Do not tighten the cap screws - just turn then in until contact is obtained and then make approx. 1/2 rotation back.
Observe the installation position of the cam disc.

Put the O-ring (2) into the annular groove and oil it.



② Mount the preassembled pressure oil pump (1) and with the cap screws (3pcs.) first place it equally until contact is obtained.

※ Observe the radial installation position.
Then remove the cap screws again.



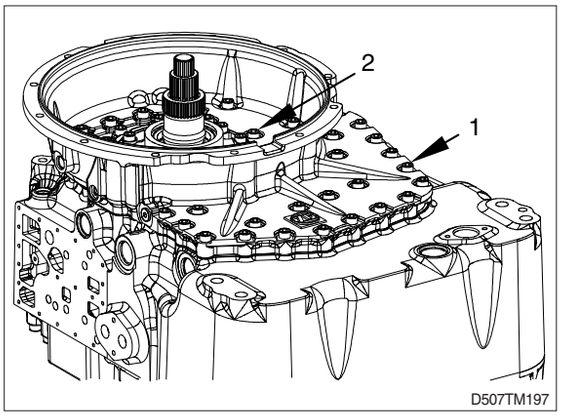
③ Fasten the converter bell, pressure oil pump and stator hollow shaft together by means of cap screws.

※ Different bolted connections.

1 = Bolted connection converter bell/transmission housing rear section.

Tightening torque (M10/8.8) ..... M_A=4.7 kg·m

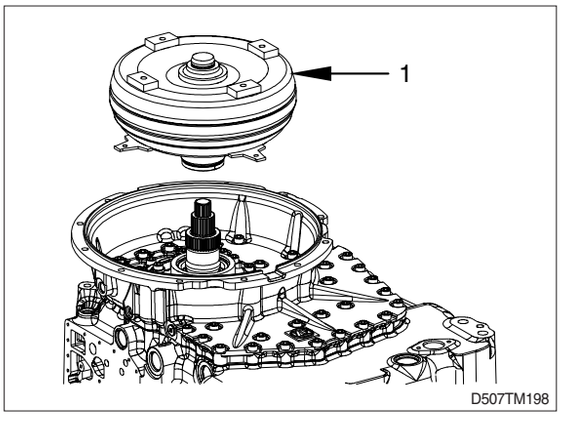
2 = Bolted connect. pressure oil pump/ stator hollow shaft transmission housing rear section.



※ Cap screws with O-rings.
Grease the O-rings.

④ Mount the converter (1) by means of lifting equipment until contact is obtained.

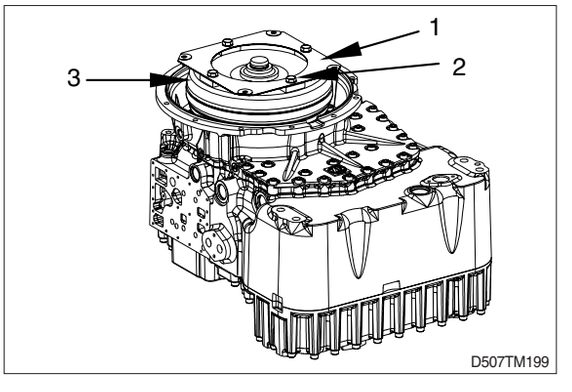
(S) Eyebolts assortment 5870 204 002
(S) Lifting chain 5870 281 047



⑤ Fasten the flexplate (1) by means of hexagon screws (2).

※ Install washers between converter (3) and flexplate (1) under the hexagon
※ screws.
Lock the hexagon screws with loctite (Type No.262).

Tightening torque (M12/10.9) ..... M_A=11.7 kg·m

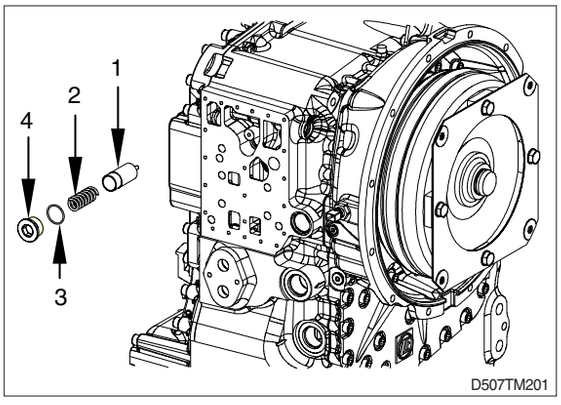


3) INDUCTIVE TRANSMITTERS, VALVES, OIL FILTERS AND OIL DRAIN PLUG, SCREW PLUGS

① Install the converter pressure back-up valve.

1 = Piston
2 = Compression spring
3 = O-ring (27×2)
4 = Screw plug (30×1.5)

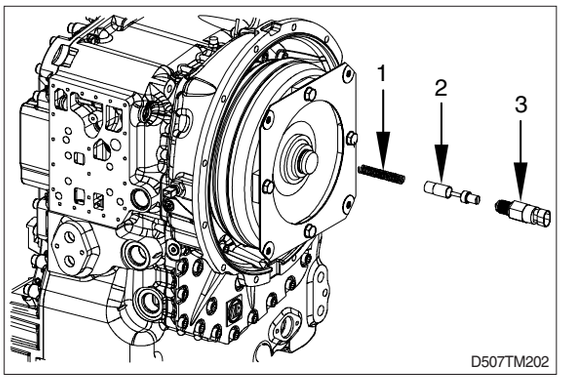
※ Tightening torque ····· M_A=10.2 kg·m



② Install the differential pressure switch for the pressure filter.

1 = Compression spring
2 = Piston
3 = Tappet switch

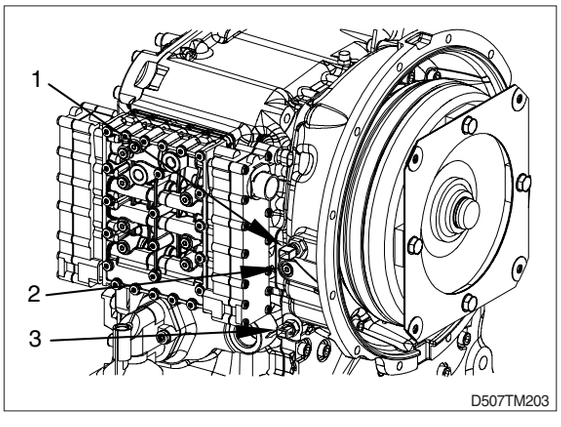
※ Tightening torque ····· M_A=3.1 kg·m



③ Installation of:

1 = Inductive transmitter - n Engine
2 = Screw plug M10×1.0
(measuring point pressure after converter)
3 = Temperature transmitter M14×1.5
(measuring point temperature after converter)

※ Tightening torque (1) ····· M_A=3.1 kg·m
Tightening torque (2) ····· M_A=0.97 kg·m
Tightening torque (3) ····· M_A=2.6 kg·m



④ Installation of:

1 = Inductive transmitter - n Internal speed input

2 = Inductive transmitter - n Turbine

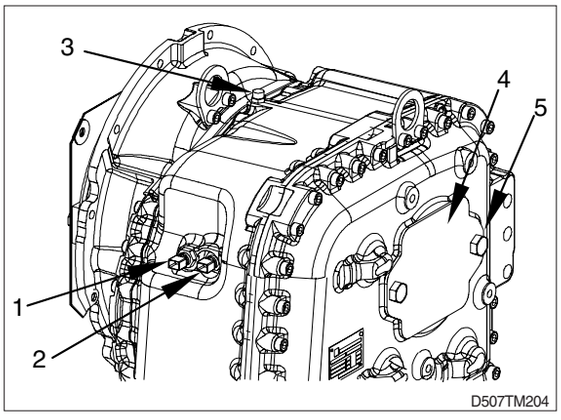
3 = Breather

※ Tightening torque (1 and 2) · M_A =3.1 kg · m

Tightening torque (3) ····· M_A =1.2 kg · m

Fasten the cove replate (4) by means of hexagon screws (5).

Tightening torque (M16/8.8) ····· M_A =2.6 kg · m



⑤ Installation of :

1 = Speed transmitter

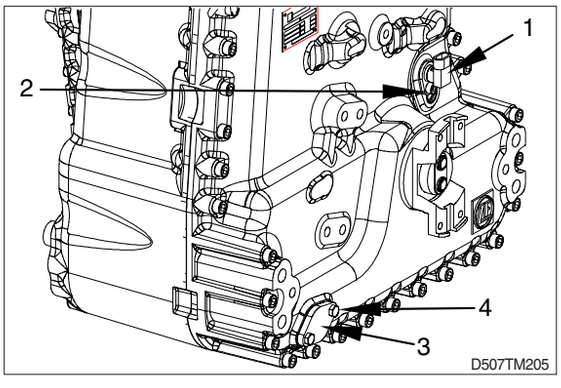
2 = Cap screw

※ Tightening torque(2)(M8/8.8) ·· M_A =2.4 kg · m

3 = Install the cove replate (3) with gasket.

4 = Hexagon screw

※ Tightening torque (2) (M8/8.8) ····· M_A =2.4 kg · m



⑥ Fasten the oil filler tube (1) with O-ring (2) to the transmission housing by means of the hexagon screws (3).

Turn the oil dipstick (4) into the oil filler tube.

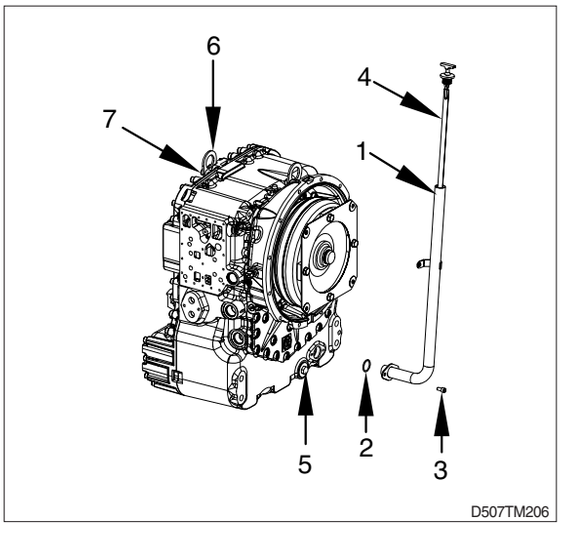
※ Tightening torque (2) (M8/8.8) ····· M_A =2.4 kg · m

Install the oil drain plug (5) with the O-ring.

※ Tightening torque ····· M_A =14.3 kg · m

Fasten the fixing plate (6) by means of cap screws (7)

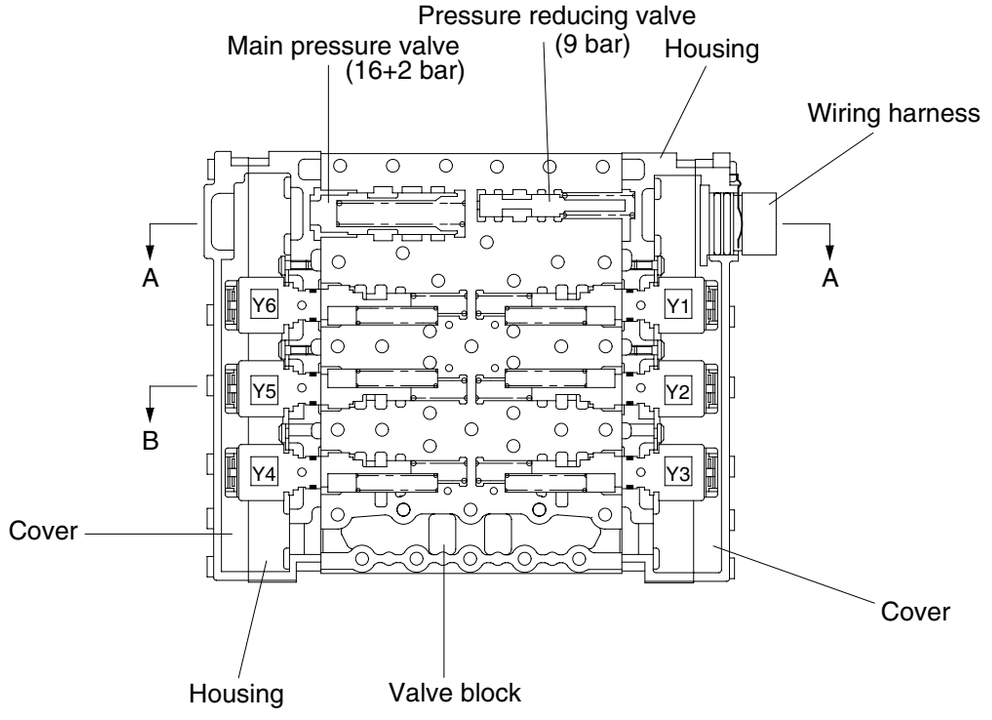
※ Tightening torque (M10/8.8) · M_A =4.7 kg · m

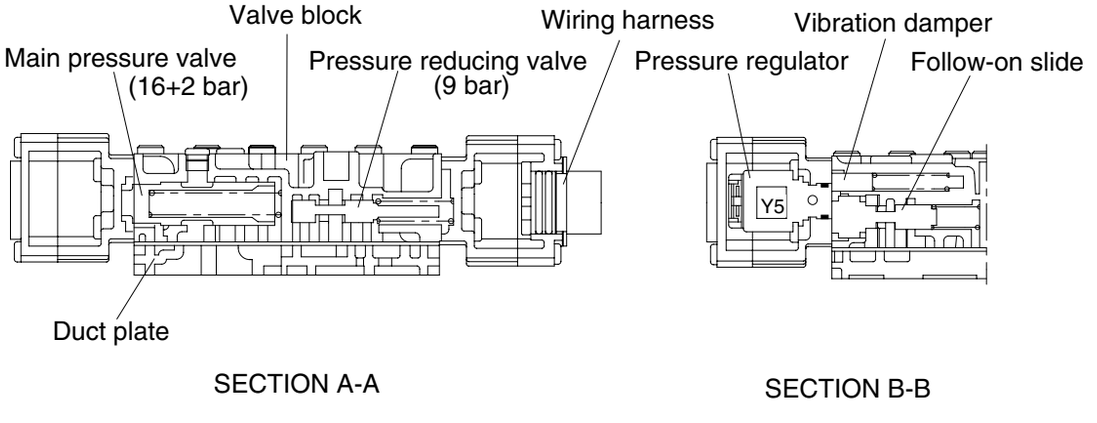


4) ELECTRO-HYDRAULIC CONTROL UNIT WITH PROPORTIONAL VALVES

※ Different versions as to the positions of the wiring harness are possible.

· The following sketches shows the sections of the electro-hydraulic control unit.





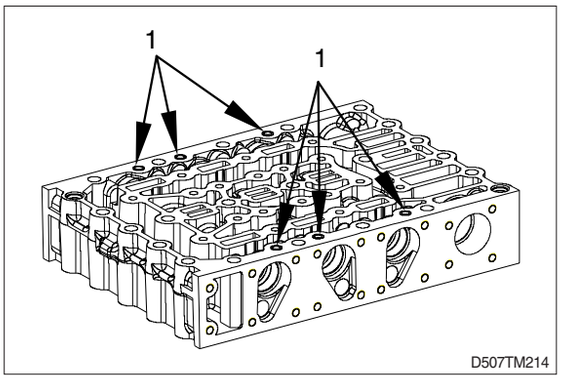
D507TM211

(1) Mounting of the electric control unit

※ All single parts are to be checked for damaged and replaced, if required.
Prior to installation check the mobile parts in the housing for functionality. Piston can be replaced individually.
Oil the single parts prior to installation acc. to the list of lubricants.

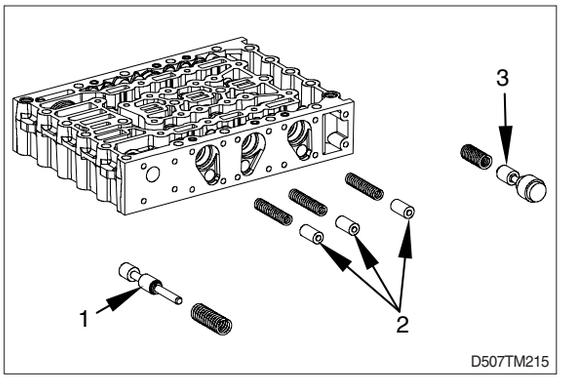
① Place the orifices (1) with the concave side showing upwards, until contact.

※ Installation position, see arrows.



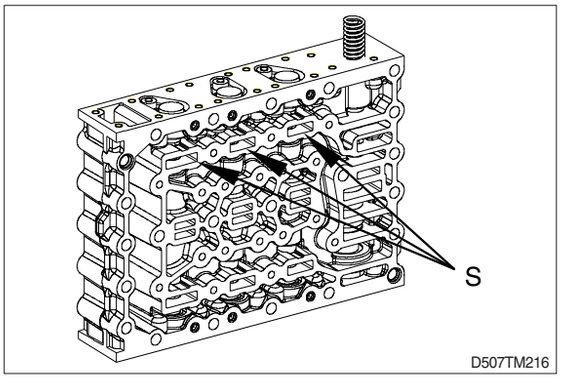
② The figure on the left shows the following single parts:

1 = Pressure reducing valve
(1×, piston a. compr. spring)
2 = Vibration damper
(3×, piston a. compr. spring)
3 = Follow-on slide
(3×, piston a. compr. spring)



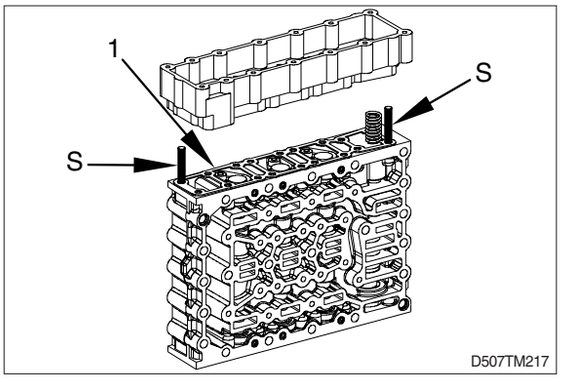
③ Install the single parts acc to right figure.

※ Preload the compression springs of the follow-on slides and fasten the piston preliminarily by means of cylindrical pins Ø5.0 mm (assembly aid), see arrows (s)

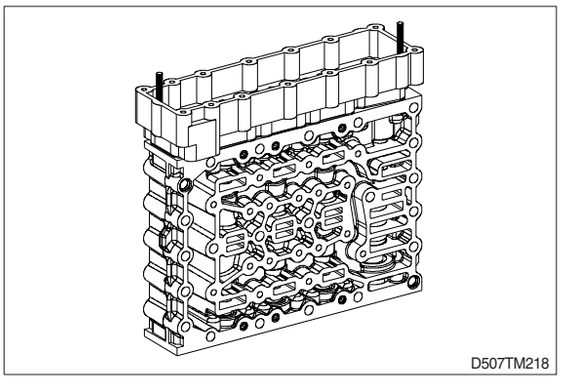


④ Install two adjusting screws.
Assembly flat gasket (1) and housing cover.
Then place the housing cover by means of adjusting screws equally until contact.

(S) Adjusting screws 5870 204 036



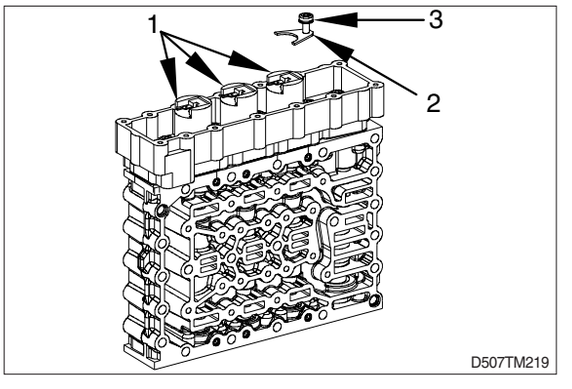
⑤ Preload the pistons with cap screws and remove the cyl. pins (assembly aid)again.



⑥ Fasten the housing cover by means of cap screws (1).

※ Tightening torque ····· M_A=0.56 kg·m

(S) Torque spanner 5870 203 031
(S) Reducer 5870 656 056
(S) Socket spanner TX-27 5873 042 002

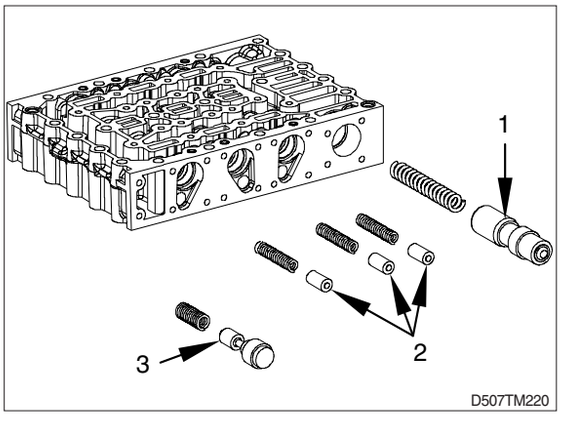


⑦ Mount the pressure regulators (1) and fasten them by means of fixing plates (2) and cap screws (3).

※ Install the fixing plate with the neck showing downwards
Observe radial installation position of the pressure regulators.

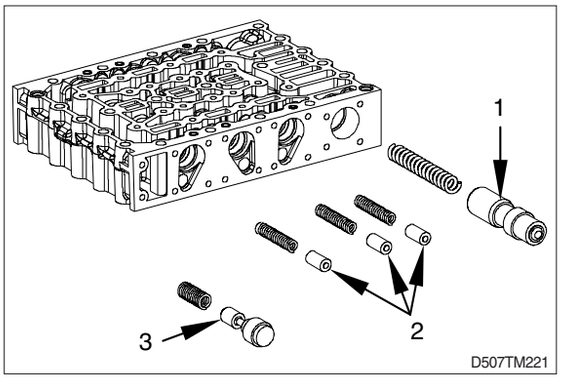
Tightening torque ····· M_A=0.56 kg·m

(S) Torque spanner 5870 203 031
(S) Reducer 5870 656 056
(S) Socket spanner TX-27 5873 042 002



· **Preassemble the opposite side**

⑧ The figure on the right shows the following single parts:
1 = Main pressure valve
(1×, piston a. compr. spring)
2 = Vibration damper
(3×, piston a. compr. spring)
3 = Follow-on slide
(3×, piston a. compr. spring)



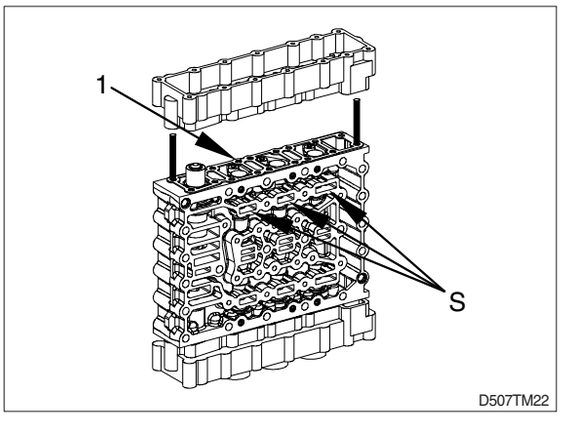
⑨ Install the single parts acc to right figure.

※ Preload the compression springs of the follow-on slides and fasten the pistons preliminarily by means of cylindrical pins (S) Ø5.0 mm (assembly aid), see arrows (S).

Install two adjusting screws.

(S) Adjusting screws M5 5870 204 036

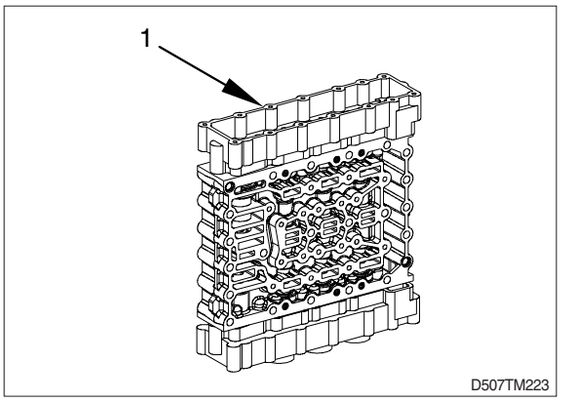
Assemble flat gasket (1) and housing cover. Then place the housing cover by means of adjusting screws equally until contact.



⑩ Preload the pistons with cap screws and remove the cyl. pins (assembly aid) again.
Then fasten the housing cover by means of cap screws (1).

Tightening torque ····· M_A =0.56 kg·m

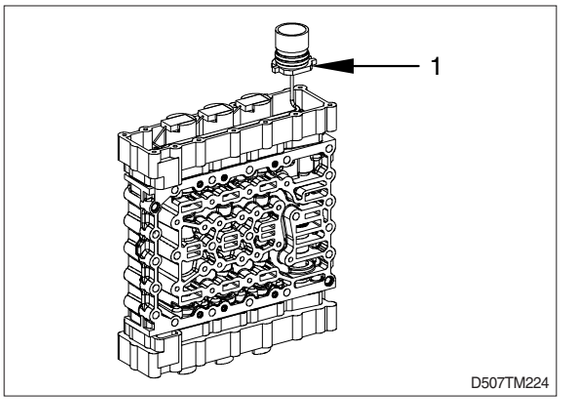
(S) Adjusting screws 5870 204 036
(S) Torque spanner 5870 203 031
(S) Reducer 5870 656 056
(S) Socket spanner TX-27 5873 042 002



⑪ Mount the pressure regulators (1) and fasten them by means of fixing plates and cap screws.

※ Install the fixing plate with the neck showing downwards
Observe radial installation position of the pressure regulators.

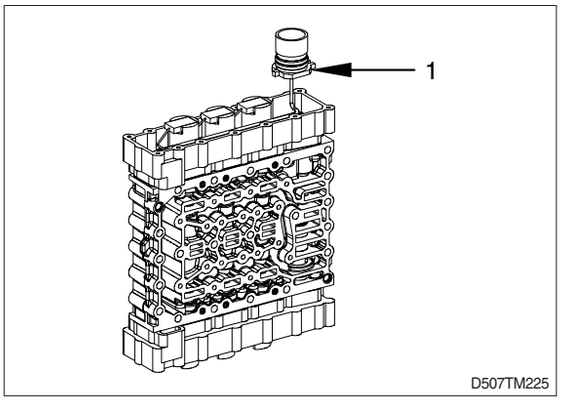
Tightening torque ····· M_A =0.56 kg·m



⑫ Assemble the wiring harness(1) and connect the pressure regulators (6×).

※ Installation position of pressure regulators.

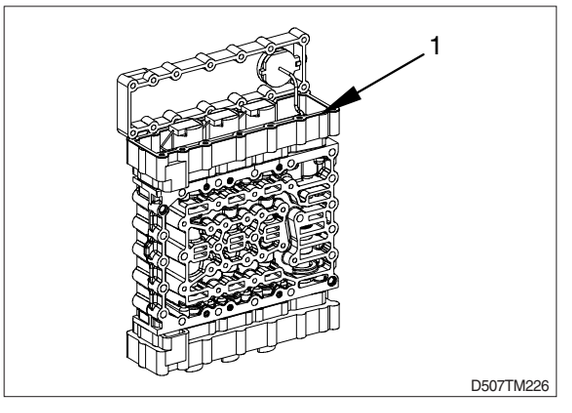
※ Pay attention to the installation position of the wiring harness, also see markings ③ page 3-74.



⑬ Put on the plate gasket (1).
Assemble the plug socket with the slot showing to the lug of the cover until contact.
Fasten the cover by means of cap screws.

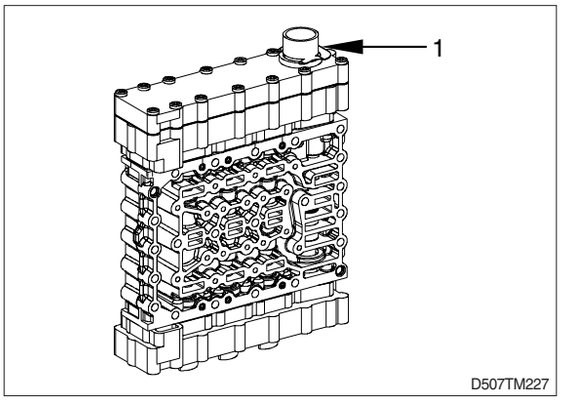
Tightening torque ····· M_A =0.56 kg·m

(S) Torque spanner 5870 203 031
(S) Socket spanner TX-27 5873 042 002



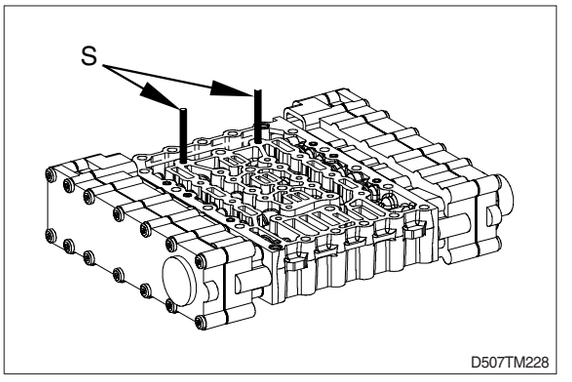
⑭ Fix the wiring harness by means of retaining clamp (1).

※ Install the opposite cover



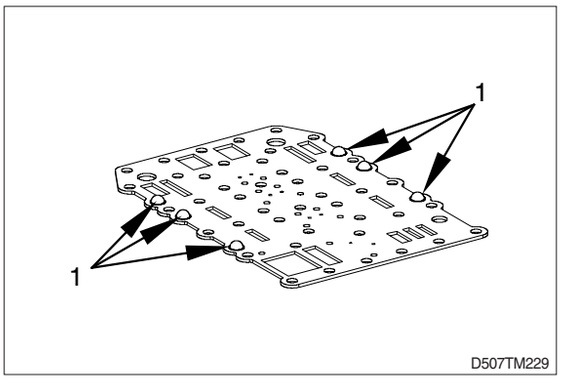
⑮ Install two adjusting screws.

(S) Adjusting screws 5870 204 063



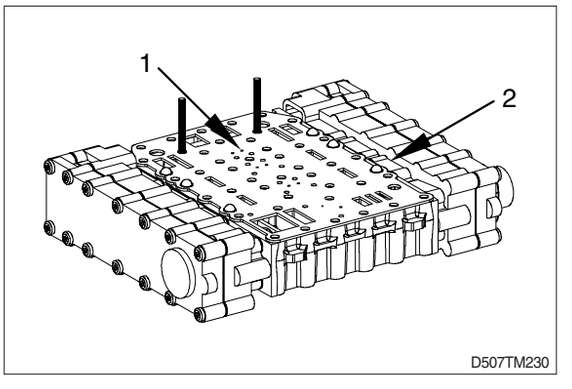
⑯ Screens (1) are to be flush mounted into the bores of the intermediate sheet, see arrows.

Observe the installation position-the screens are showing upwards (to the duct plate).



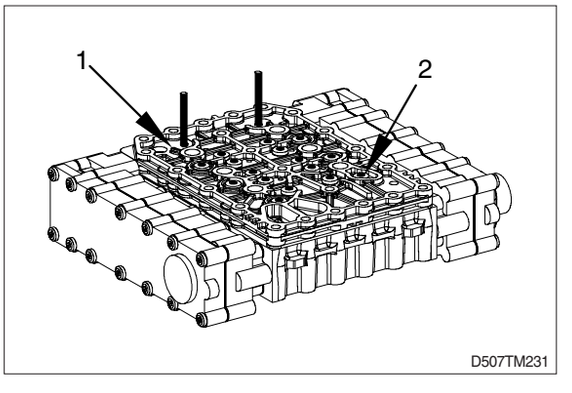
⑰ Put on the intermediate sheet (1)

※ Screens (2) must show upwards.



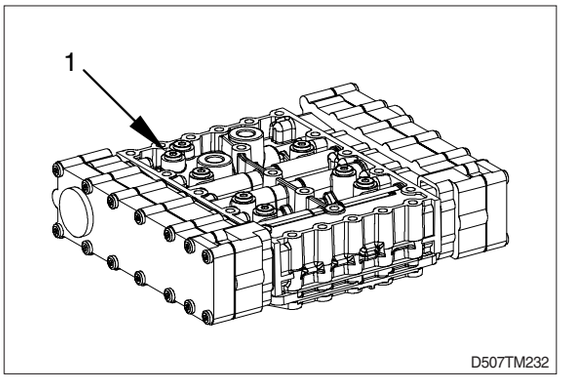
⑱ Put on the duct plate (1) and tighten it equally with torx screw (2).

※ Tightening torque ····· M_A=0.97 kg·m
(S) Socket spanner TX-27 5873 042 002



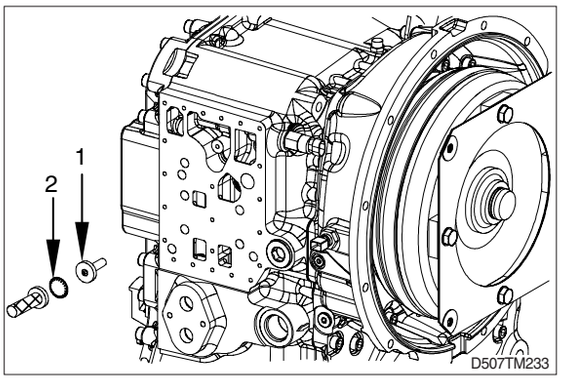
⑲ Provide the screw plugs (1) with new O-rings and install them.

※ Tightening torque ····· M_A=0.61 kg·m



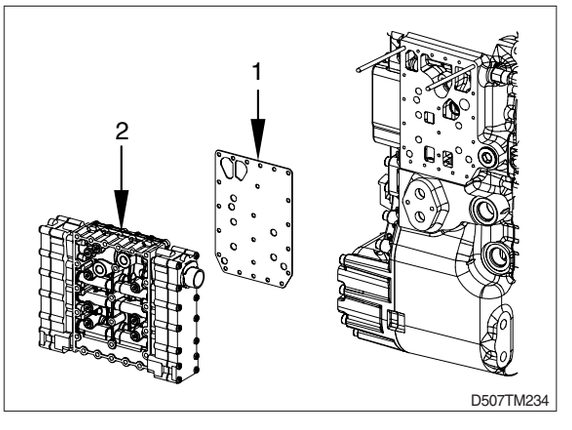
⑳ Insert the pressure relief valve (1) and lock it with the indented ring (2).

(S) Drive mandrel 5870 705 012



㉑ Mount the gasket (1) and the cpl. shift system (2).

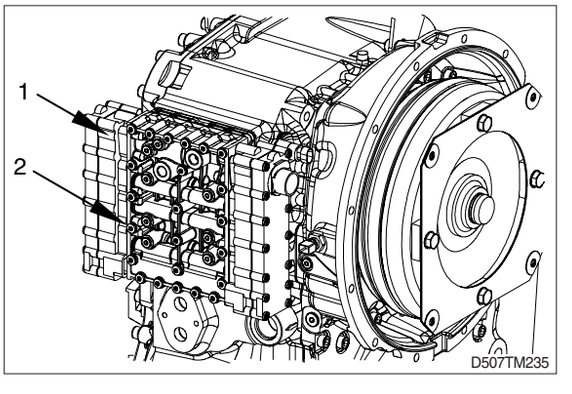
(S) Adjusting screws M6 5870 204 063



㉒ Fasten the electro-hydraulic control unit (1) equally by means of Torx screws (2).

※ Tightening torque ····· M_A=0.56 kg·m

(S) Torque spanner 5870 203 031
(S) Reducer 5870 656 056
(S) Socket spanner TX-27 5873 042 002

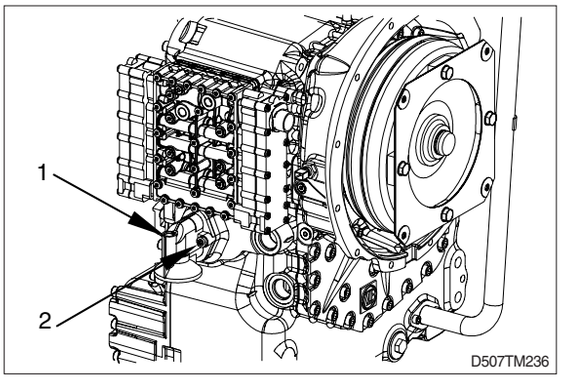


(2) Mounting of the filter (pressure filter)

① Fasten the filter head (1) with new O-rings by means of cap screws (2) to the trans-mission housing.

Tightening torque(M8) ····· M_A=2.4 kg·m

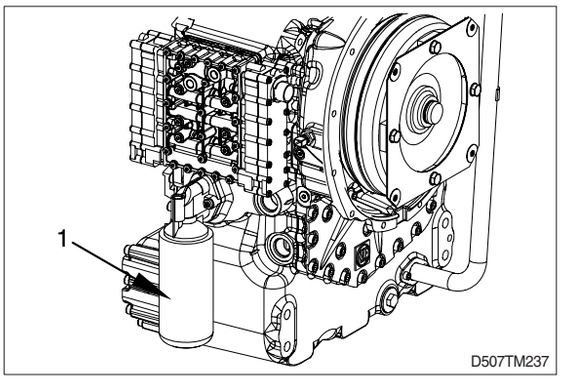
(S) Torque spanner 5870 203 034
(S) Socket spanner TX-40 5870 042 004



⚠ **The filter is to be installed as follows:**

- Oil the gasket slightly
- Turn in the filter until contact with the sealing surface is obtained and then tighten it by hand with an approx. 1/3 to 1/2 rotation.

Prior to initial operation of the transmiss-ion make the oil filling in accordance with the operating instructions.



3. DRIVE AXLE DISASSEMBLY

1) GENERAL INSTRUCTIONS FOR CORRECT ASSEMBLY AND DISASSEMBLY

(1) Disassembly and assembly are to be accomplished only by trained personnel.

(2) The assembly can be made reverse to the respective disassembly instruction.

(3) Drain oil before removing, check for presence of metal particles.

(4) Mark the parts to each other before dismantle.

(5) Never use a hard object to separate tightly fitted assemblies. To remove bearings, drive flanges and similar parts, use the proper pullers.

(6) It is recommended that the special tools according page 3-126 used for disassembly.

(7) Do not place parts on a dirty surface.

(8) Systematically replace used seals, O-rings and, if necessary, bearings on disassembly.

(9) Clean parts before reassembly.

(10) Replace or clean corroded parts.

(11) The cages of bearings rotating in oil are to be coated with oil at reassembly.

(12) Seal ring treads on flanges, shafts etc. must be preserved with SAE 80W-90/API GL-5 before mounting.

(13) Oil seal rings and particularly the anti-dust lip seals must be filled with grease.

(14) The universal joint shafts and the axle shafts must not be force mounted (They must slide).

(15) At mounting of radial seal rings pay attention that there is suffice overlap to the housing bores. Pay attention for a plain alignment of the radial seal ring. The seal lips always must not be contacted with Loctite.

(16) The bolted or keyed assemblies safeties are to be checked according to instructions ; in case of doubt, consult Hyundai dealer.

(17) Refill the oil after assembly.

(18) Repair weldment is only allowed after consultation with Hyundai.

2) USING OF LOCTITE AND OPERATING SUPPLIES

Kind	Type	Color	Application
Loctite	243	Blue	Lightly locked screws
	262	Red	Middle locked screws
	270	Green	Highly locked screws
	270	Green	Increased coefficient of friction in contact surfaces
	510	Orange	Surface gasket
	572	White	Special gasket
	638	Light-green	Glueing with big width of slit
Epple	33	Grey	Surface gasket
Dirko	-	Grey	Elastic gasket

3) REMARKS FOR WORKING UP LOCTITE AND OPERATING SUPPLIES

(1) Threads and surfaces have to be cleaned and free from color, oil and grease before applying loctite.

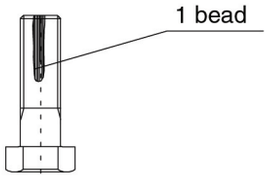
(2) Loctite will harden under following conditions :
① Exclusion of air
② Metal contact
③ Increased temperature

(3) Pre-assembly and control tightening has to be made in a short time (5 to 10 min).

(4) The time between glueing and mounting of the parts should be shorter than 1hour.
Exception : Parts made from nonferrous metal have to be glued within one minute.

(5) Assembled parts must remain unloaded for at least 24 hours.

(6) Loctite quantity :
- At screws :



100D7XL80

- At contact surfaces : Pay attention for a sufficient loctite application.

4) UTILIZATION OF LOCTITE AND OPERATING SUPPLIES

(1) Hub assembly

Safety blocked parts	Joint	Loctite	Operating supplies
Spacer ring	Contact surface	572	-
Axle spindle	Screws	562	-
Axle spindle	Contact surface	270	-
Grommet	In planetary housing	270	-
Disk	In axle spindle	270	-
Adjusting screw with nut	In planetary housing	270	-
Support	Screw	262	-
Ring gear retainer	Screws	270	-
Pol wheel	Contact surface	638	-
Steering lever Track rod lever	Screws	262	- -
Steering lever Track rod lever	Contact surface	270	- -
Wheel hub cover	Thread	572	-
Radial seal rings Rubber casing	Contact surface	572	- -
Radial seal rings Steel casing	Contact surface	270	- -
Wheel safety nut → See page 3-138 → Adjustment of wheel bearings			

(2) Drive assembly

Safety blocked parts	Joint	Loctite	Operating supplies
Drive flange	Nut surface	-	Epple 33
Diff-housing	Screws	262	-
Shifter cylinder(Diff-lock)	Contact surface	572	-
Diff. carrier(Through drive)	Contact surface	510	-
Drop gear housing	Contact surface	510	-
Diff. carrier	Contact surface	-	Epple 33
Through drive cover	Contact surface	510	-
Differential stap	Screws	262	-
Adjustment nut screw	Screw	270	-
Ring gear	Screw	262	-
Ring gear	Contact surface	270	-
Ring gear support	Cap	270	-
Ring gear support	Thread	-	Epple 33

5) TIGHTENING TORQUES

Unit : kgf·m

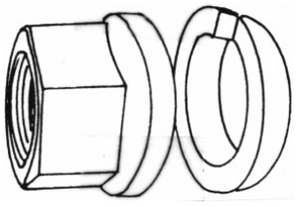
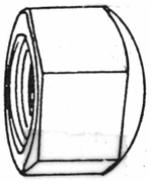
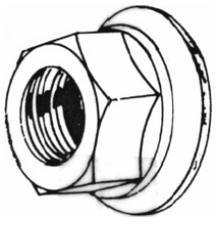
Metric standard thread						
Thread	Screw	Nut	Screw	Nut	Screw	Nut
	8.8	8	10.9	10	12.9	12
M4	0.3		0.4		0.5	
M5	0.6		0.9		1.0	
M6	1.0		1.5		1.8	
M8	2.5		3.7		4.4	
M10	5.0		7.3		8.6	
M12	8.7		12.7		14.8	
M14	13.8		20.4		24.0	
M16	21.4		31.6		37.2	
M8	30.6		43.8		51.0	
M20	43.3		62.2		72.4	
M22	59.1		84.6		98.9	
M24	74.4		107		124	
M27	112		158		184	
M30	148		214		250	

Unit : kgf·m

Metric fine thread						
Thread	Screw	Nut	Screw	Nut	Screw	Nut
	8.8	8	10.9	10	12.9	12
M 8×1	2.8		4.0		4.7	
M10×1	5.6		8.3		9.7	
M10×1.25	5.3		7.7		9.2	
M12×1.25	9.5		13.8		16.3	
M12×1.5	9.1		13.3		15.8	
M14×1.5	14.8		21.9		26.0	
M16×1.5	22.9		33.7		39.8	
M18×1.5	34.7		49.5		58.1	
M20×1.5	48.4		69.3		80.6	
M22×1.5	66.3		93.8		107	
Brake caliper dowel screws (Greased)						
M20×1.5	40.8 + 10.2					
M27×2	91.8 + 10.2					
Nut for steering stop = 30.6 kgf·m						

Regard reduced tightening torque for galvanized bolts and nuts.

(1) Tightening torques of wheel nuts

		
Wheel nut with spring lock washer	Wheel nut with clamp (For clamp fixation)	Wheel nut with thrust collar (For rims with centering)

① Wheel nut with spring lock washer

Dimensions	Phosphorus darkened	Galvanized
M18×1.5	27.5 kgf·m	25.5 kgf·m
M22×1.5	45.9 kgf·m	35.7 kgf·m

② Wheel nut with thrust collar

Dimensions	Phosphorus darkened	
M22×1.5	66.3 kgf·m	

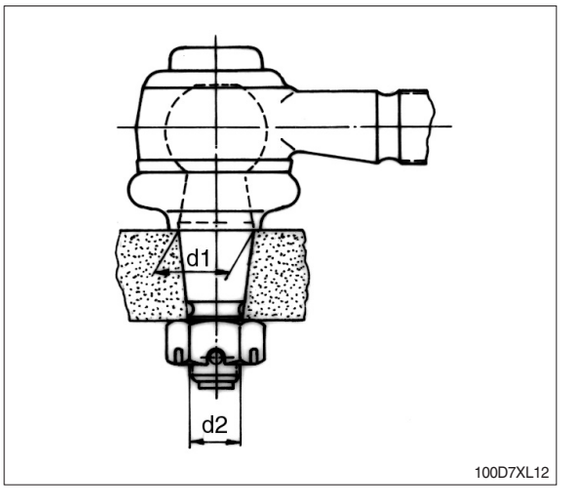
③ Wheel nut with clamp

Dimensions	Galvanized	
M18×2	35.7 kgf·m	

(2) Tightening torques for castle nuts on ball joints for track rods and ram cylinders

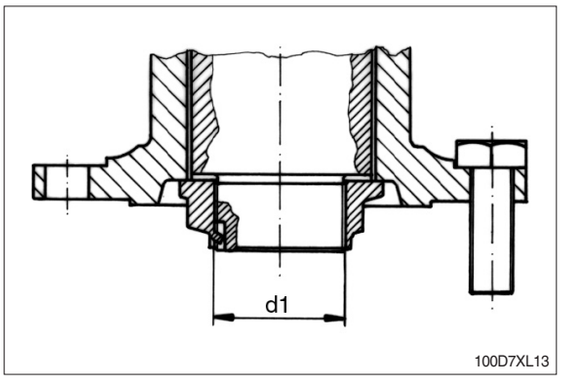
The tightening torques of the different thread dimensions of the joints are applicable for nuts of quality S6.

Cone size d1 (mm)	Thread d2 (mm)	Torque (kgf·m)
26	M20×1.5	20.4~22.4
30	M24×1.5	28.6~30.6
32	M27×1.5	29.6~32.6
38	M30×1.5	34.7~36.7
45	M39×1.5	41.8~43.8



(3) Tightening torque of the adjusting nut respective slotted nut at flanges respective gear wheels ect.

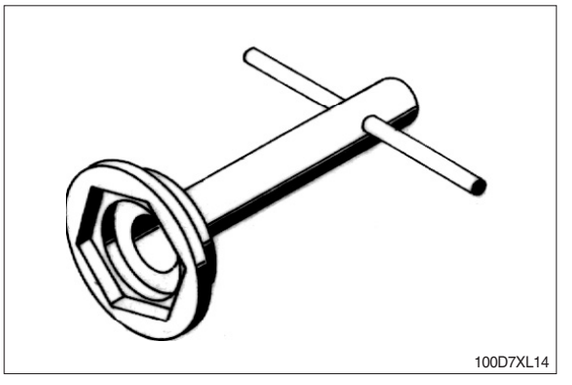
Thread d1 (mm)	Torque (kgf·m)
M20×1.5	36.7
M30×1.5	45.9
M36×1.5	55.1
M42×1.5	86.7
M45×1.5	86.7
M48×1.5	86.7
M52×1.5	96.9
M64×1.5	107~112

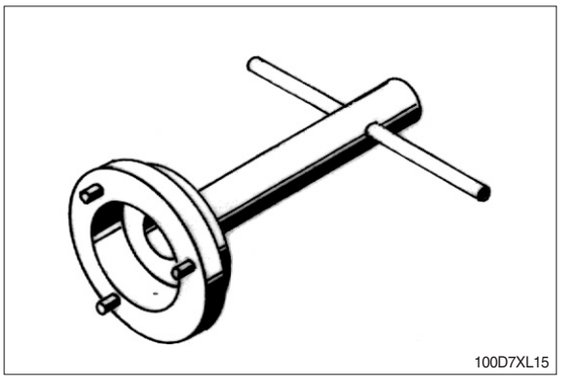


6) SERVICE TOOLS

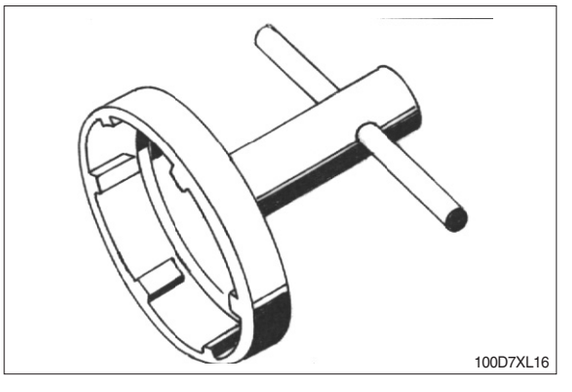
When ordering service tools please provide order number (Installation drawing no), respective fabrication number→see identification plate. (The illustrations are not binding for the design)

(1) Spanner for wheel safety nut

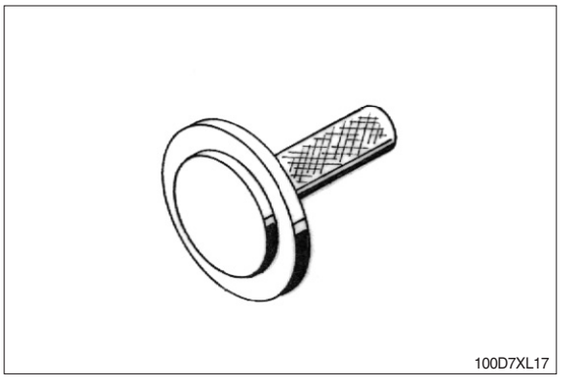




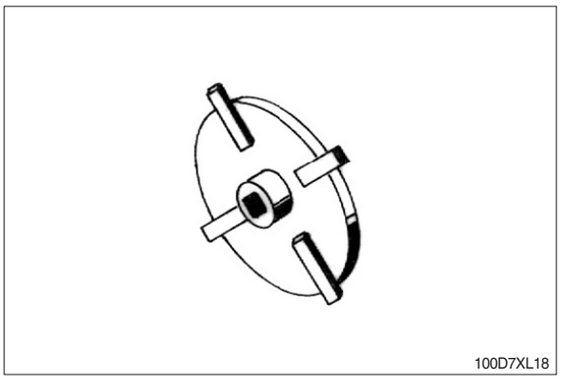
(2) Spanner for splined nut (hub assembly)



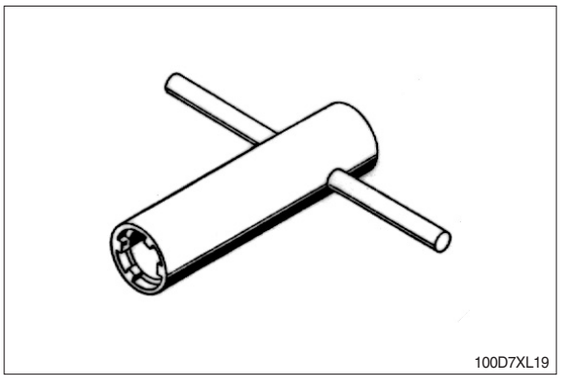
(3) Seal ring sleeve driver.



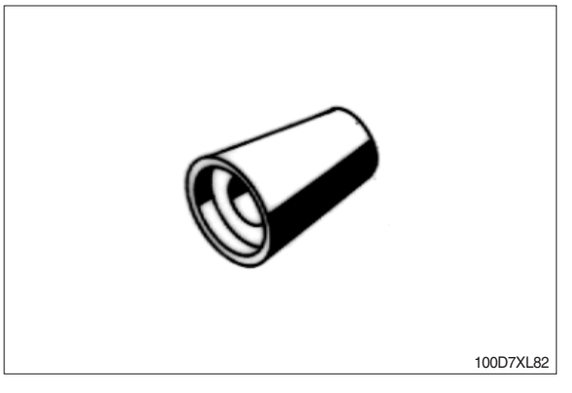
(4) Spanner for thread rings.
(Differential bearing)



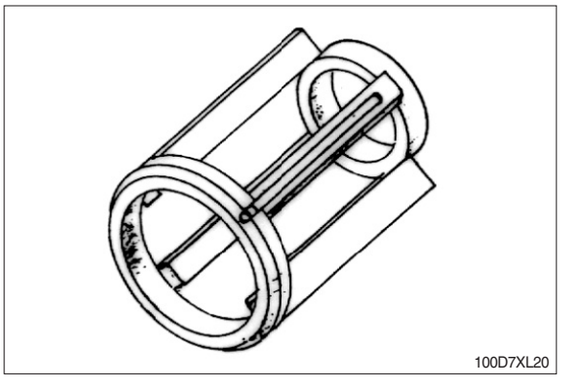
(5) Spanner for counter nut.
(Planetary gear drive)



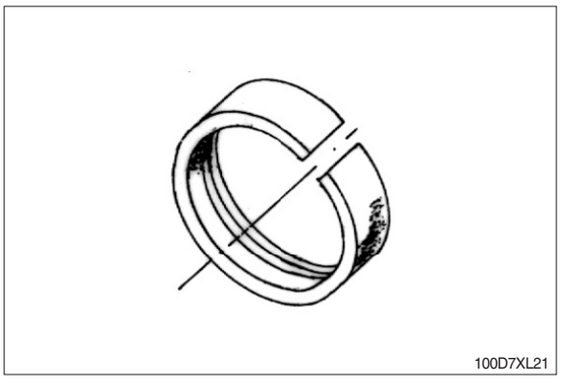
(6) Assembly cone for O-ring.
(Differential lock)



(7) Centering tool for discs.



(8) Installation tool for face seal.

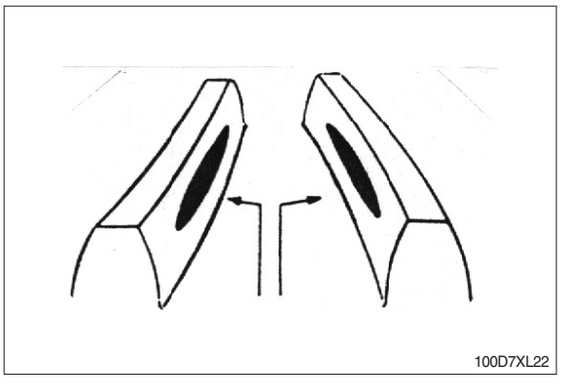


7) ASSEMBLY DRIVE ASSEMBLY

(1) Adjustment of gear meshing of gleason gears

① **Perfect marking**

To become a perfect gear meshing is only possible, if the fabrication number of the drive pinion (marked on the end face) and the ring gear(marked on the circumference) are corresponding.

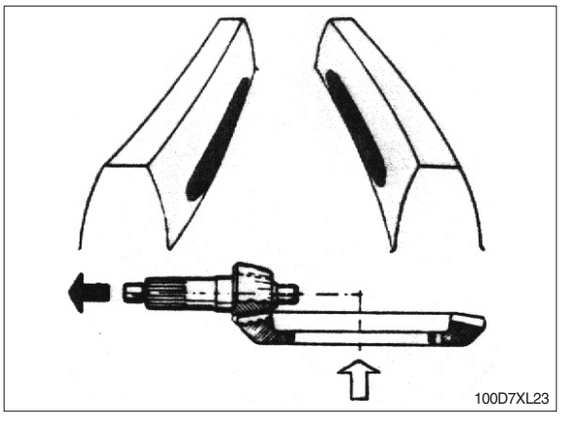


※ **Improper gear meshing marks**

The following figures are showing improper gear meshing marks of the ring gear. The text alongside gives the corrections to obtain correct gear meshing. The dark colored arrows in the sketch of the drive pinion and ring gear are indicating the direction towards which the drive pinion has to be moved. The clear arrows are indicating the direction towards which the ring gear has to be moved, to get further more a correct backlash.

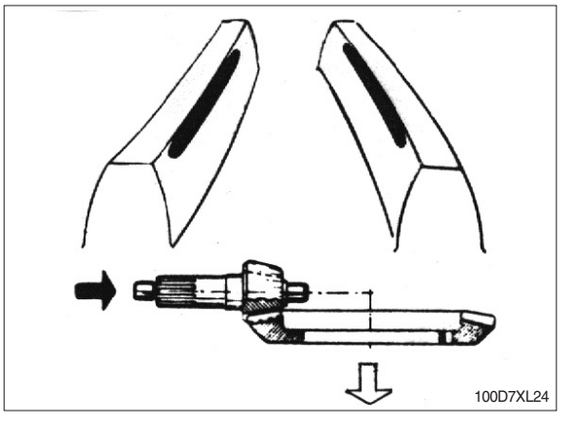
② **Gear meshing to deep**

Increase the drive pinion distance by correction of the adjustment disk thickness. Regulate the backlash by inwards moving of the ring gear.



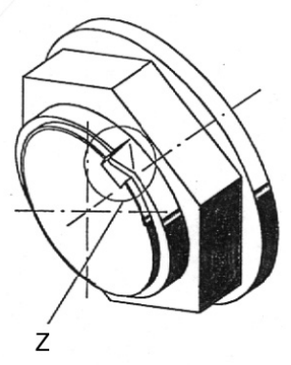
③ **Gear meshing to high**

Decrease the drive pinion distance by correction of the adjustment disk thickness. Regulate the backlash by outwards moving of the ring gear.



(2) Securing of the striking nut

The brim of the striking nut has to be sheared only along the slot flank and the corner has to be bent on the slot ground.



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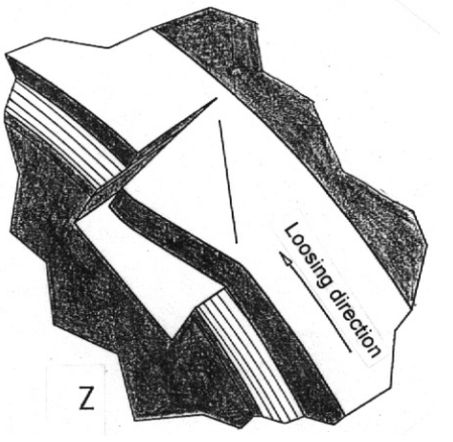


100D7XL25

① **Using of Loctite and other operating supplies**

a. Striking nut at drive flange
   - In thread : Assembly paste with MoS_2 (exception through drive pinion see point Z).
   - Front side contact surface : Sealing compound (Epple 33 or equivalent).

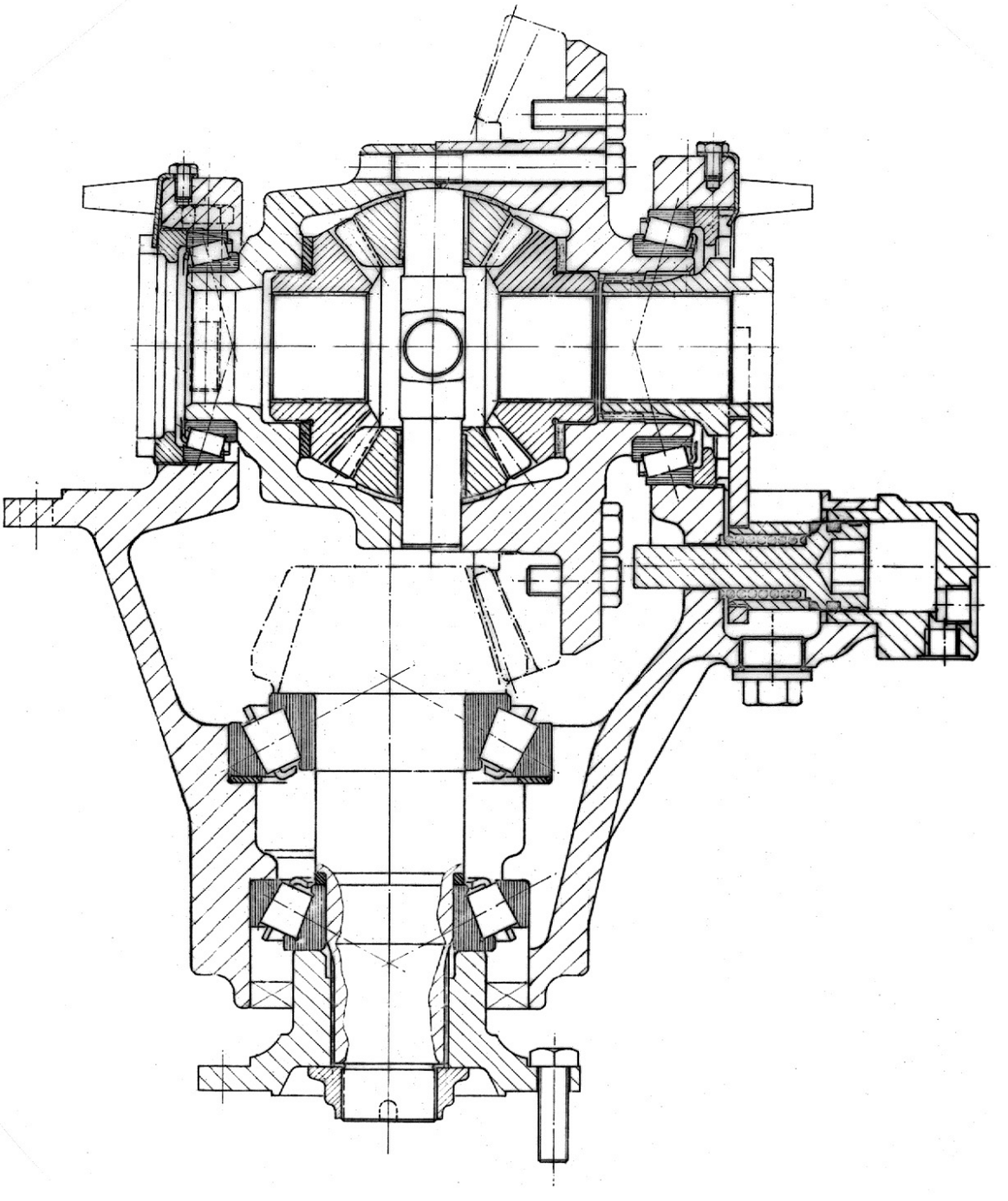
b. Striking nut at through drive pinion
   - In thread : Loctite 262.

   Striking nut at gear wheels, bearings etc.
   - In thread : Assembly paste with MoS_2.

② **Removing of the striking nut**

Bend away the nose and screw off the nut.

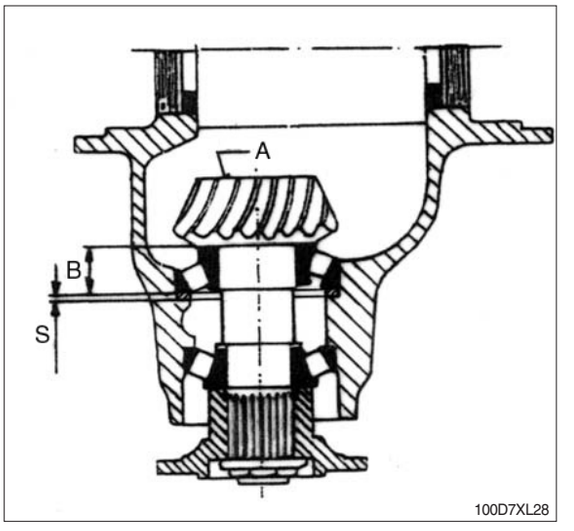
③ Drive assembly D 51



100D7XL27

(3) Adjustment drive pinion distance

To obtain the proper tooth flank contact, adjust the axial position of the drive pinion with the thickness of the adjustment disk.
The necessary thickness of the adjustment disk for first time assembly can be obtained by measurement (see calculation example).
The final thickness of the adjustment disk can be fixed during the checking of gear meshing at the assembled drive assembly (see page 3-129 "Adjustment of gear meshing of gleason gears")



- A = Set value for correct pinion support. This dimension is written on the end face of the pinion in millimeter. It indicates the deviation from the theoretic distance(setpoint dimension).
- B = Measured width of the taper roller bearing.

※ Calculation example to ascertain the thickness S from the adjustment disk :
A = + 0.10 ; B = 37.95
S = 3.00 mm (theorem)
+ 0.05 mm → B = 0.05 mm smaller than B theorem.
= 3.05 mm
- 0.10 mm → Drive pinion value A
= **2.95 mm** → Necessary thickness of the adjustment disk

Fit corresponding disk and outer rings of the taper roller bearings.

※ If value A is positive (f.e. +0.1) the adjustment disk has to be 0.1 mm thinner than theorem.
S. If value A is negative (f.e. -0.1) the adjustment disk has to be 0.1 mm thicker than theorem S.

※ If measure B is positive (f.e. 38.05) the adjustment disk has to be 0.05 mm thinner than theorem S.
If measure B is negative (f.e. 37.95) the adjustment disk has to be 0.05 mm thicker than theorem S.

(4) Assembly of drive pinion bearing

① Insert the two outer rings of the taper roller bearings into the differential carrier.

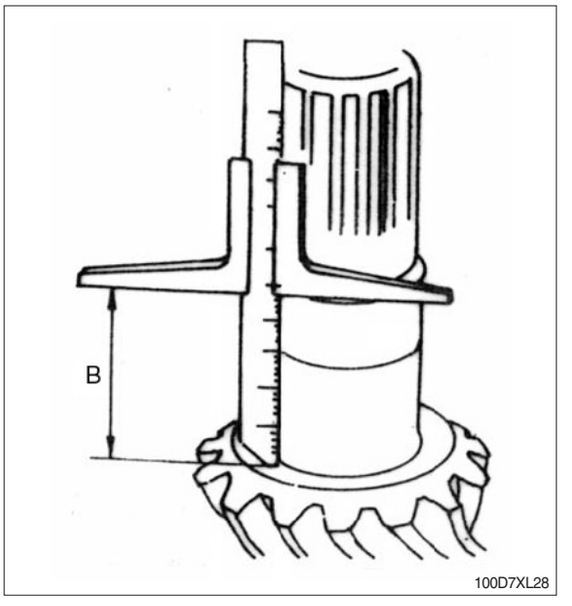
② Calculate the thickness C of the spacer ring.

a. Place the two inner rings of the taper roller bearings in their outer rings. Measure A.

b. Measure the dimension B of the drive pinion.

c. Thickness of the spacer ring C = A-B.

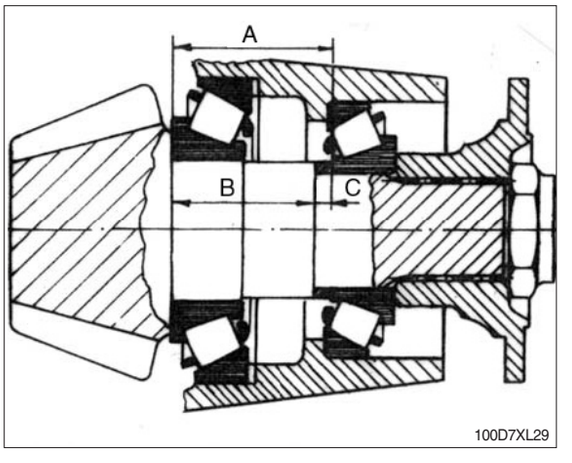
③ Heat the drive pinion side taper roller bearing to about 100 ˚C and install it on the drive pinion shaft.(Drive on completely after it cools)



④ Install the spacer ring on the pinion shaft.

⑤ Install the drive pinion into the differential carrier. Heat the taper roller bearing inner ring at undersize to about 100 ˚C and install it with a tube onto the drive pinion shaft.

⑥ Install the drive flange onto the drive pinion shaft. Tighten the safety nut according page 3-138. For tightening fix the differential carrier and block the drive flange.



⑦ Measure the resistance of the bearings by using a torque wrench. If the measured value is not the prescribed 0.08 to 0.12 kgf·m, adjust the resistance by modification of the thickness of the spacer ring. After arriving at the adjustment of the bearing, back-off the safety nut and draw off the drive flange.

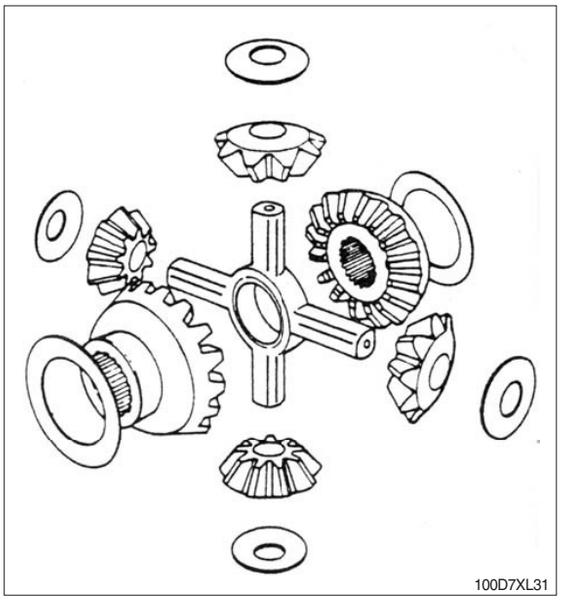
⑧ Install the radial seal ring with Loctite 572 applied. Fill the radial seal ring with bearing grease. Fit the carrier of the parking brake (if present) on the differential carrier and tighten the screws. Slip on the drive flange, screw on the safety nut with sealing compound between the contact surfaces. Tighten the safety nut according page 3-138. Lock the nut by striking the nut brim into the slot of the pinon.

8) ASSEMBLY OF THE DIFFERENTIAL

Before assembly all of the bevel gears and the thrust rings should be well oiled.

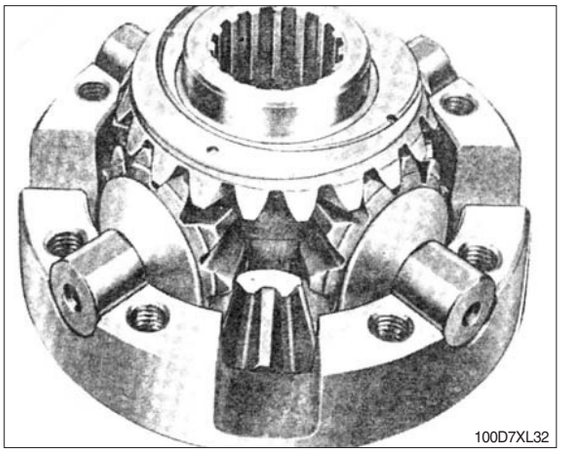
(1) Place one differential side gear with the side gear thrust washer in the differential case.

(2) Install the spider with differential gears and differential pinion thrust washers in the differential case.



(3) Install the other differential side gear and side gear thrust washer. (At variants with nospin differential install the nospin diff. instead of the differential gears)

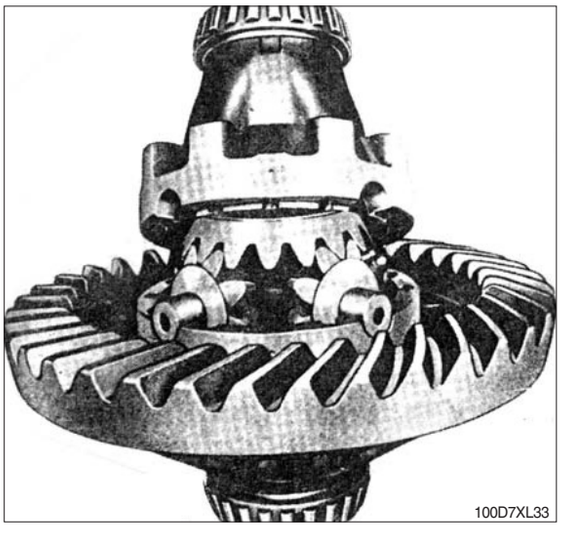
(4) Install the other half of the differential case over the assembly and observe the alignment marks, tighten the differential case bolts. Secure with Loctite 262.



(5) Check that all differential pinions can rotate easily.

(6) Coat the contact surface of the ring gear with Loctite 270 and install the ring gear on the differential case by tapping lightly on the circumference. Tighten the ring gear bolts. Secure with Loctite 262.

(7) Heat the two taper roller bearings to about 100 ˚C and install them by using a sleeve.

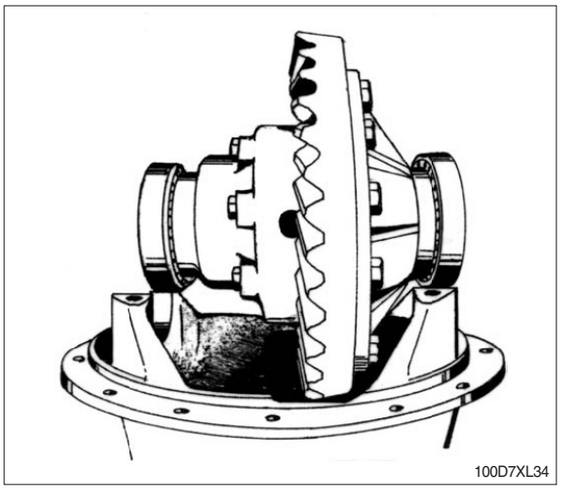


9) ASSEMBLY OF DRIVE ASSEMBLY

(1) Place the differential with the outer rings of the taper roller bearings on the differential carrier which is in a vertical position, with mounted drive pinion.

(2) Mount the differential straps and align them with the thread rings.

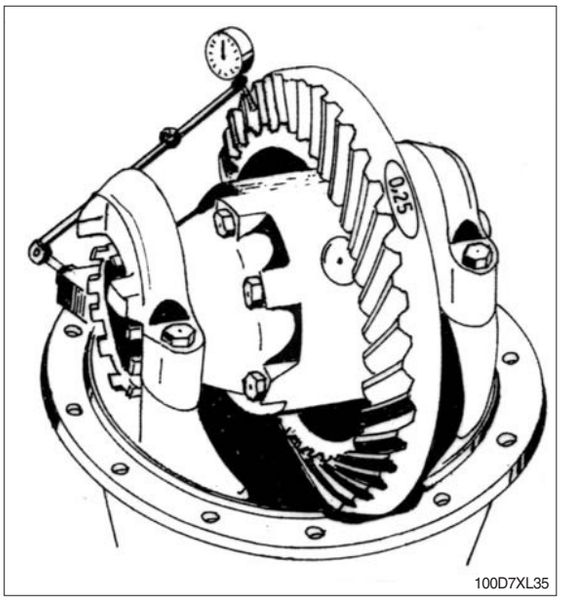
(3) During this operation be careful of the alignment marks on the differential straps with respect to the differential carrier. (Do not interchange the differential straps)


100D7XL34

(4) Hand tighten the differential strap bolts. By a counter rotation of the two thread rings, move the differential until the backlash is correct. (The smallest admissible value at the closest place is marked on the ring gear)

(5) Therefore hold the drive pinion at the drive flange. Check the backlash by careful forwards and rearwards rotating the ring gear. Use a dial indicator.

(6) Measure the backlash during a few times turns of the ring gear and if need correct the backlash, because of the smallest admissible value at the closest place must not be fall short of.



100D7XL35

(7) Adjust gear meshing according to page 3-129 "Adjustment of gear meshing of gleason gears".

(8) Tighten screws of the differential straps and lock them with Loctite 262.

(9) Adjust the bearing roll resistance through tightening of the thread rings. Set value : 0.2 to 0.3 kgf·m. Check the value with a torque wrench. If measuring at the drive pinion/drive flange, take the ratio of the bevel wheel set into account.

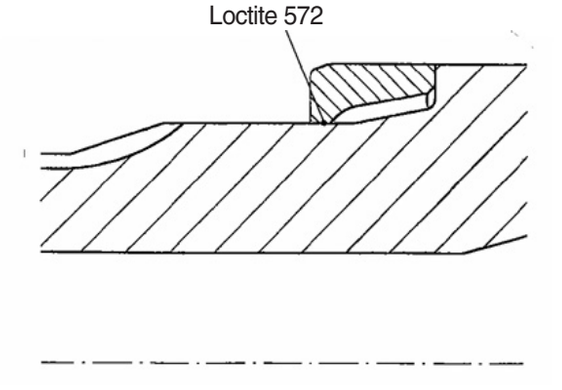
(10) Screw the lock plates for the thread rings and secure with Loctite 270, if need bend the lock plates.


100D7XL36

10) ASSEMBLY OF HUB ASSEMBLY

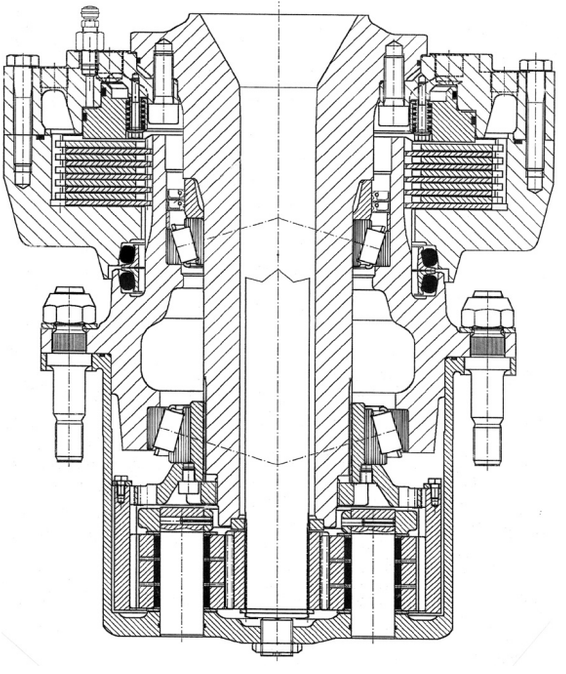
(1) Assembly of the spacer ring

Coat the seat of the spacer ring on the steering knuckle respective axle spindle with Loctite 572. Heat the spacer ring to about 100 ˚C and push it by gently striking onto the steering knuckle respective axle spindle. (The steering knuckle respective axle spindle must be free of corrosion) Oil the seal ring tread onto the spacer ring.



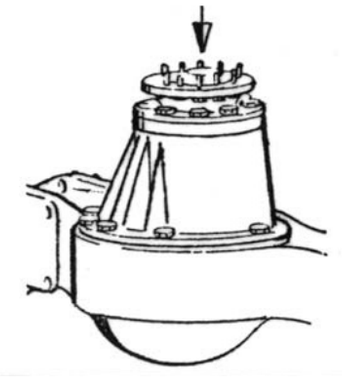
100D7XL37

(2) Drive axle hub assembly

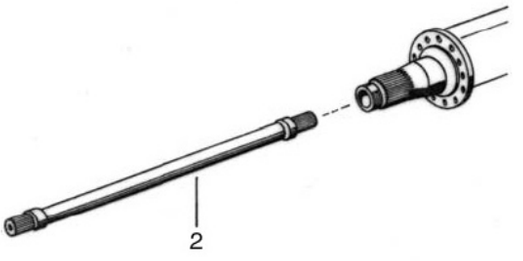


100D7XL38

11) ASSEMBLY OF THE DRIVE ASSEMBLY ONTO THE AXLE HOUSING



100D7XL39



100D7XL40

(1) Coat the contact surface of the axle housing with Epple 33 (at version through drive with Loctite 510), and mount the complete drive assembly. The axle housing being placed in a horizontal position, secure the screws with Loctite 262.

(2) Engage the axle shaft into the axle housing.

(3) The axle shaft should be able to be moved easily (by hand) in the toothing of the differential side gear.

(4) At version with differential lock on the outside (D71/D109) the differential lock must always be actuated when assemble or disassemble the axle shaft.

※ Actuating of the differential lock is necessary to prevent the sliding sleeve to drop out of the shifter fork into the axle housing when pulling out or sliding in the axle shaft. This would entail disassembly of the axle.

(5) Assembly hub assembly

① Assembly of the spacer ring (if present) see page 3-136.
② Install the brake onto the axle spindle, be careful of the brake control position and bolt it.
At version with disk brake install the brake carrier (if present), then mount the wheel hub with the brake disk, and after this operation install the brake.
③ Prepare and mount the wheel hub see page 3-138.
Attention : Hold the wheel hub with a hoist till the outer bearing with ring gear carrier is mounted.
④ Assembly of the planetary gear drive see page 3-144.
⑤ At version with drum brake mount the brake drum.

(6) Prepare wheel hub

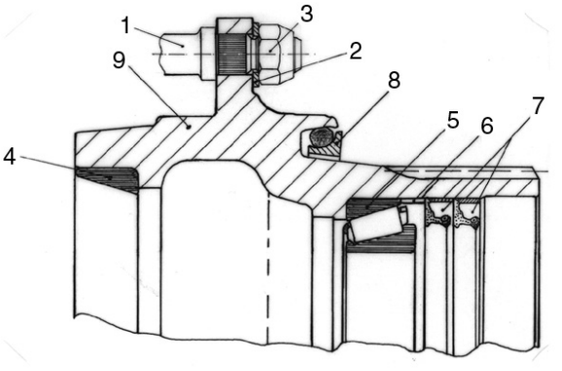
① Install the wheel studs (1), attach the shim (2), screw on the nuts (3) with 800 Nm.
② Press in outer rings of taper roller bearings (4+5), do not hammer them.
③ Install inner ring of taper roller bearing (5).
④ Install the distance ring (6).
⑤ Press the radial seal rings (7) with Loctite 572 (rubber cage) respective Loctite 270 (steel cage) applied into the wheel hub (9). Fill the radial seal rings with bearing grease.
⑥ Install the face seal (8) into the wheel hub (9) (see page 3-139).

(7) Mount wheel hub

① Push the pre-assembled wheel hub (9) parallel onto the axle spindle respective steering knuckle.

Be carefully do not damage the seal rings.

※



100D7XL41

(8) Adjustment of wheel bearings

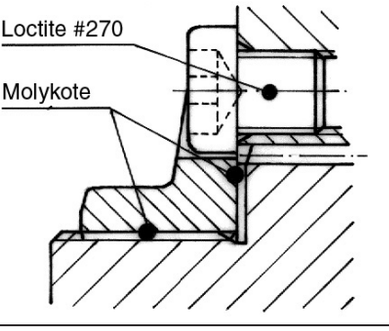
① **Tightening torque of the wheel safety nut.**

Series	kgf·m
81	45.9

② **Adjustment of wheel bearings**

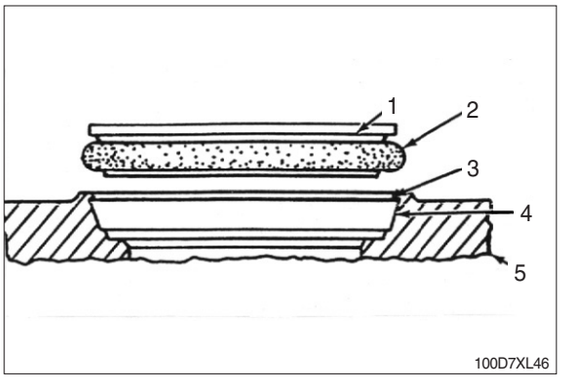
The temperature of the axle parts should be between 0 and +20 ˚C at the bearing adjustment.
Screw on the wheel safety nut (Loctite-respective Molykote-using see below) and adjust and secure as following described :
Screw on the wheel safety nut and tighten it with a 1.5 to 2 times higher tightening torque than the finish tightening torque. During the tightening, turn the wheel hub a few times and knock it with a plastic hammer. Untighten the wheel safety nut (about 180˚ back rotation), then tighten the wheel safety nut to the tightening torque according to the table. At this tightening turn the wheel hub also a few times, if there is no possibility for securing, the wheel safety nut has to be turned back to next securing possibility.

③ **Wheel safety nut**

Designation	Version	Security / Remarks
Shaft nut with cheese head screw		Cheese head screw & Loctite 270

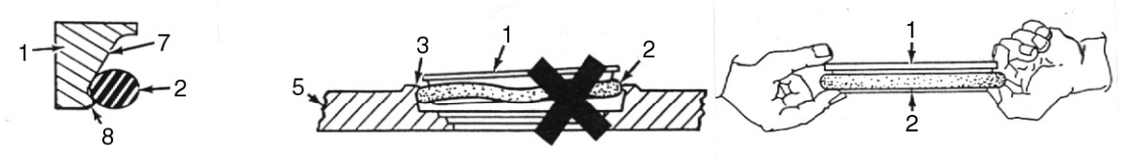
(9) Assembly of the face seal

1 Seal ring
2 Rubber toric ring
3 Housing retaining lip
4 Housing ramp
5 Seal ring housing



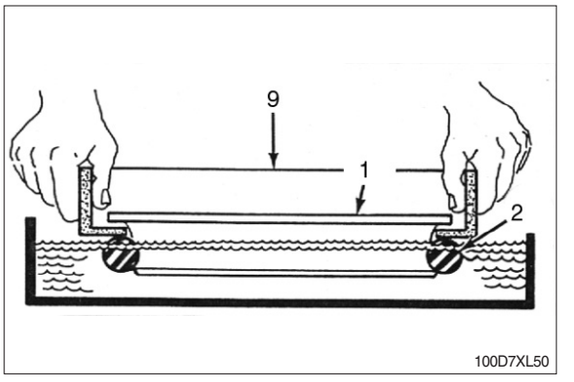
① Seal rings, torics, and housings must be clean and free of any oil film, dust, or other foreign matter. Use a solvent that evaporates quickly, leaves no residue, and is compatible with the rubber toric rings. The recommended solvent is Isopropanol. Ring and housings should be wiped with a solvent-soaked lint free cloth or paper towel.

② After all components have been wiped clean, the torics should be installed on the metal seal rings so that they rest in the radius on the tail of the metal ring. Insure that the torics are not twisted by inspecting the mold flash line on the outside diameter of the toric for true circumferential tracking around the seal. Twisted torics will case nonuniform face load that can result in leakage of lubricant and pumping of debris past the toric. If a twist is apparent, it can be eliminated by gently pulling a section of the toric radially away from the metal seal ring and letting it "snap" back. Repeating this in several places around the ring will eliminate any twist in the toric ring.

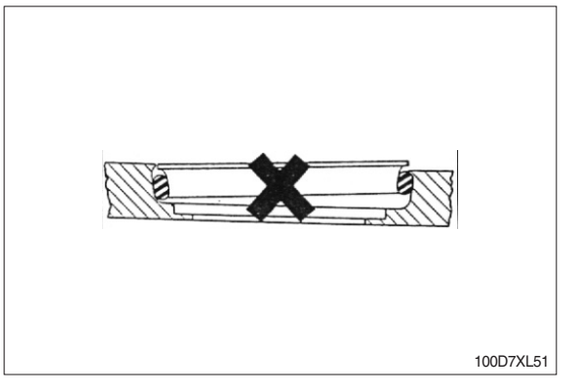


③ Put the toric ring (2) on seal ring (1), at the bottom of the seal ring ramp (7) and against the retaining lip (8).
④ The toric ring (2) can twist if it is not wet all around during installation or if there are burrs or fins on the retaining lip (3) of the housing (5).
⑤ Eliminate toric twist by gently pulling a section of the toric (2) rapidly away from the seal ring (1) and letting it "snap" back.
⑥ Place the installation tool around the seal ring and dip the seal ring into a pan of Isopropanol solvent to lubricate the toric ring. It is essential to lubricate the toric with Isopropanol so that the toric will slip past the housing retaining lip and seal uniformly in the housing nose radius. Insufficient lubrication can cause poor seal performance due to nonuniform loading (twisted torics or cocked seals). Use of solvents other than Isopropanol can leave a residue on the toric or ramps and allow the toric to slide rather than roll in seat. This can also result in poor seal performance due to nonuniform loading.

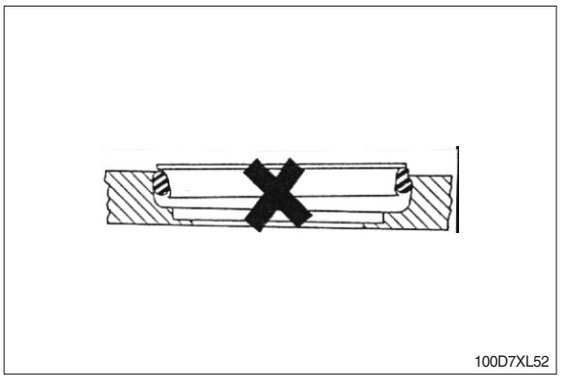
⑦ Put the installation tool (9) onto the seal ring (1) with toric ring (2).
Lower the rings into a container with Isopropanol until all surfaces of the toric (2) are wet.



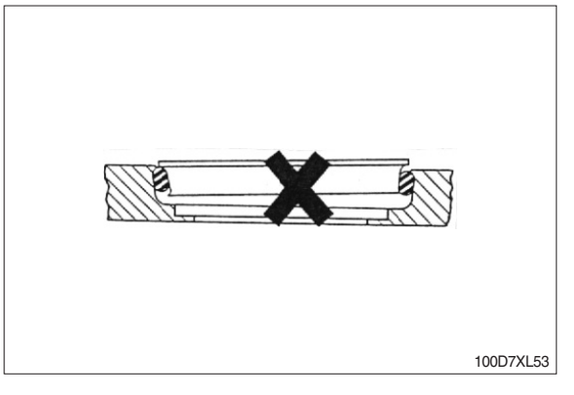
⑧ Toric sliding on retainer ramp.



⑨ Toric caught on housing retainer lip.

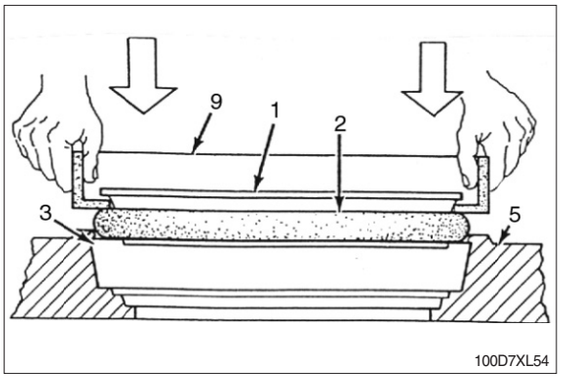


⑩ Toric sliding on seal ramp.



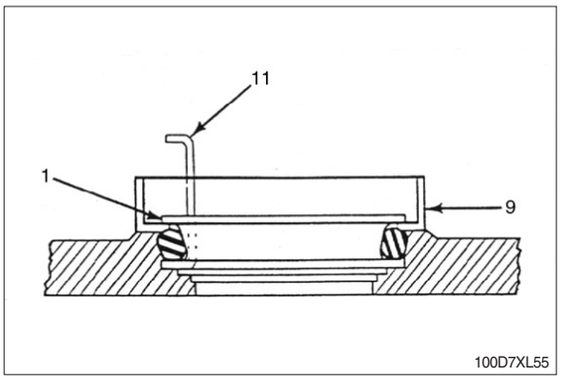
⑪ After dipping the seal assembly in the solvent, shake the excess solvent from the seal assembly and immediately "pop" the seal into the housing with a firm push of the installation tool. Remove the installation tool and check the seal standout height at several places around the circumference of the ring to verify an accurate installation. If the seal does not meet the height specification, inspect the toric for twists or obvious bulges.

⑫ With all surfaces of the toric ring (2) wet with Isopropanol, use the installation tool (9) to position the seal ring (1) and the toric ring (2) squarely against the housing (5) as shown. Use sudden and even pressure to pop (push) the toric ring (2) under the retaining lip (3) of the housing (5).

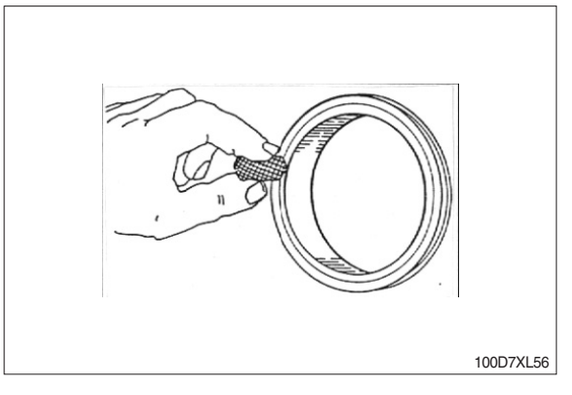


⑬ The seal can be adjusted by gently pushing the toric into position by hand or by using a fabricated adjustment hook.

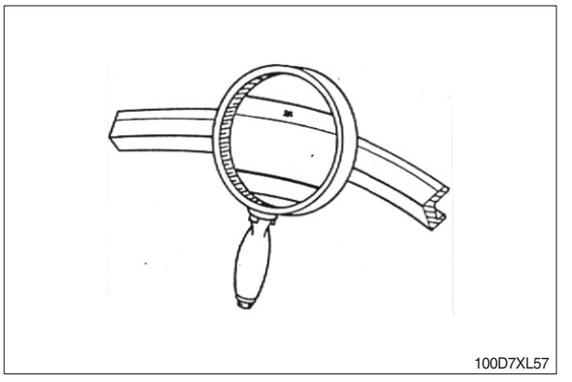
⑭ If small adjustments are necessary, do not push directly on the seal ring (1) ; use the installation tool (9) to push down or the adjustment tool (11) to pull up.



⑮ A thin film of light oil should be applied to the seal faces prior to assembly. Use an applicator, a disposable tissue or a clean finger to distribute the oil evenly. Be careful not to get any oil on the rubber toric rings.

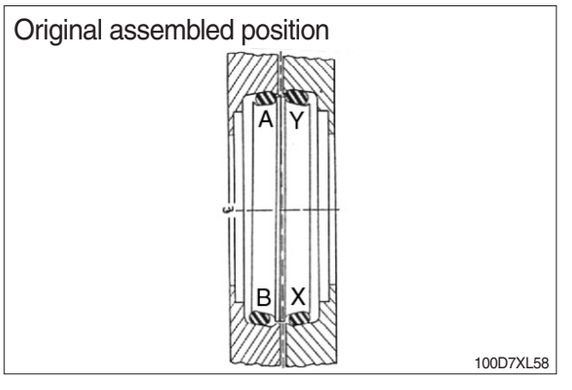


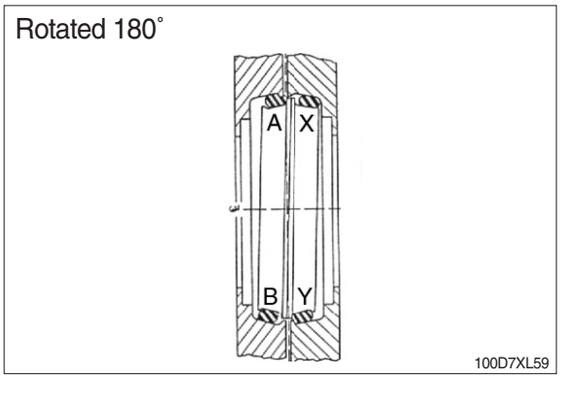
⑯ Be sure there is no visible debris on either of the seal faces even a small piece of lint can hold the seal faces apart and cause leakage.



⑰ After successful installation, wait one minute for the Isopropanol to dry before assembling the two seal halves in the final loaded position. This delay is to allow any excess solvent to dry so that the torics roll, rather than slide, in the housing as the faceload is increased. If the torics slide, this can produce a nonuniform load that can result in poor seal performance.

※ Results of incorrect assembly :
Point "A" and point "B" remain stationary.
Points "X" and "Y" rotate 180˚.
This causes high pressure at "A" and "Y" and possible galling.
When rotated, points "B" and "X" have low pressure and possible leakage.





⑱ After the unit to be sealed is assembled, a post-assembly leakage test can be performed to insure the seal is properly installed. A vacuum check is recommended rather than a pressure check as vacuum checks are more sensitive. Many users find this an easy check to combine with a vacuum fill technique for the lubricant. It is recommended the compartment be filled to the correct level with lubricant and then rotated slowly several revolutions to seat the seals.

A vacuum test will catch big seal damage such as broken seal rings or cut torics that may be caused in the last phases of assembly. The Duo-Cone seal is not designed to seal air, so some leakage can be expect using such a procedure.

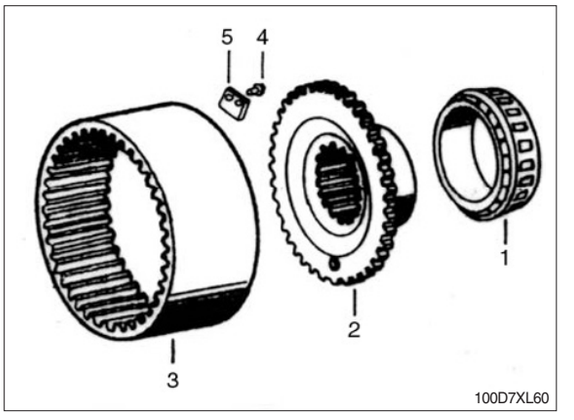
⑲ Following these guidelines and recommendations should insure optimum performance from the Duo-Cone-Seals.

10) ASSEMBLY OF PLANETARY GEAR DRIVE

(1) Prepare the ring gear and the ring gear carrier

Heat the taper roller bearing inner ring with cage (1) to about 100 ˚C and install it onto the ring gear carrier (2). Place the ring gear (3) onto the ring gear carrier.

Bolt the retainer (5) with the screws (4), secure the screws with Loctite 270.



(2) Assembly of the ring gear carrier

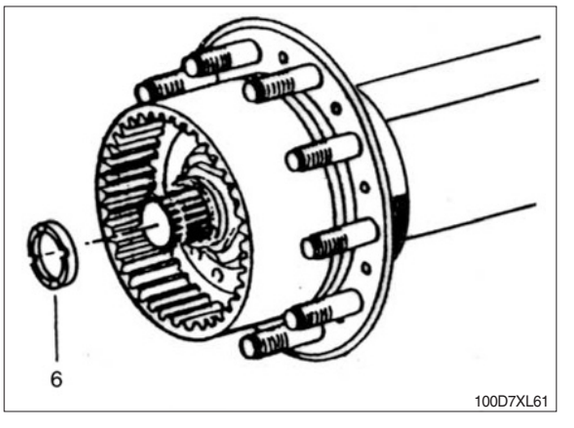
Install the ring gear carrier (2) with ring gear (3) into the wheel hub respective onto the steering knuckle respective axle spindle.

The oil compensating hole in the ring gear carrier must be on the bottom.

Subsequent adjust wheel bearings (see page 3-138).

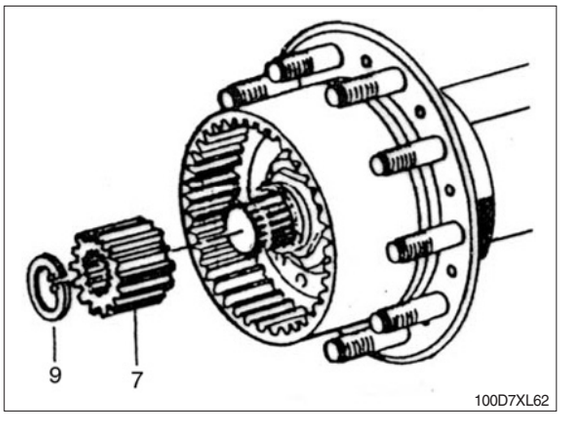
(3) Assembly of the thrust ring

Press the thrust ring (6) into the steering knuckle respective axle spindle. Secure with Loctite 270.



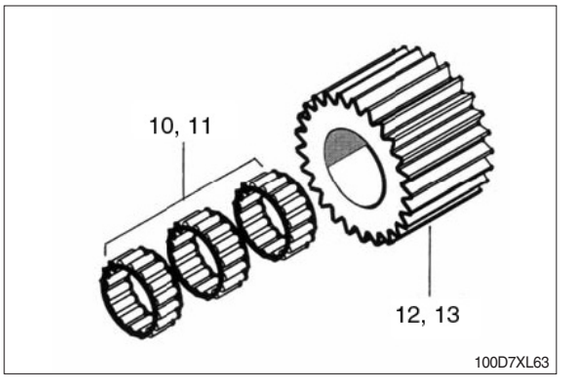
(4) Assembly of the sun gear

Slip the sun gear (7) onto the universal joint respective axle shaft, install the circlip (9) and push the universal joint respective axle shaft towards the inside until the circlip contacts to the sun gear and the sun gear contacts to the thrust ring.

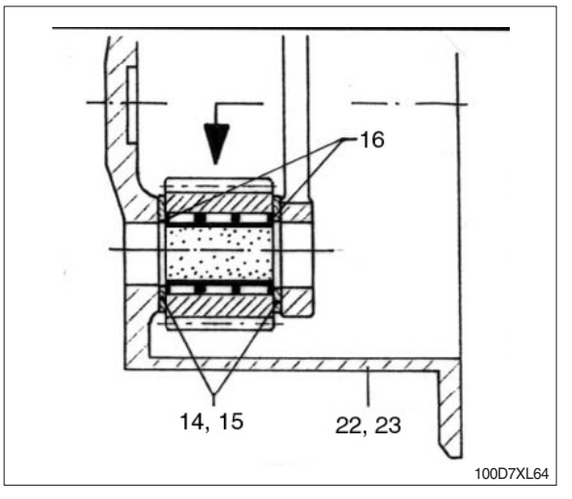


(5) Assembly of planetary gear

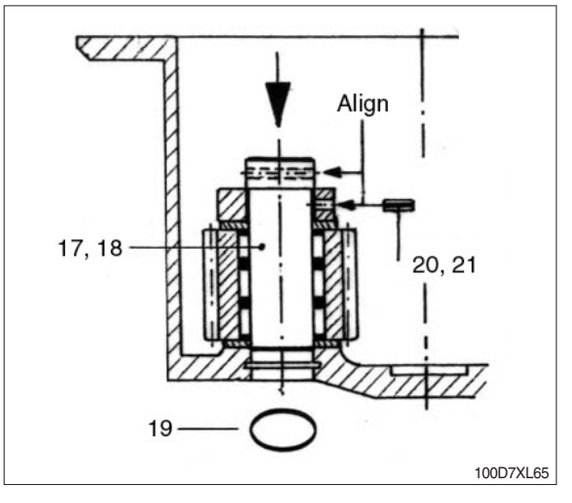
① Prepare planetary gear :
Install the needle bearing (10, 11) into the planetary gear (12, 13).



② Insert the preassembled planetary gears (12, 13) with needle bearings (10, 11), rings(16) (if present) and thrust disks (14 , 15) into the planetary housing (22, 23) (planetary housing in horizontal position).

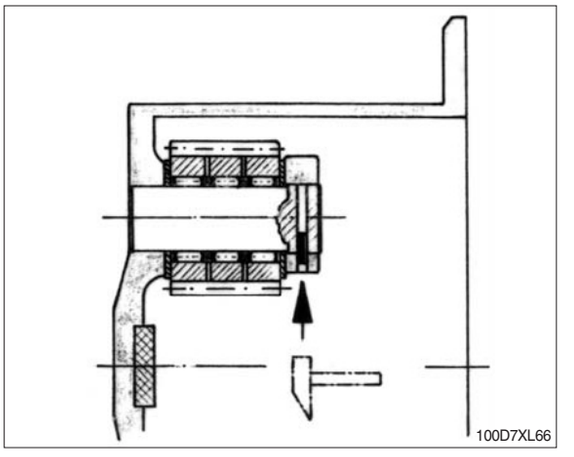


③ Place O-ring (19) into the slot of the planetary housing (22). Because of the difference of diameter of 0.1㎜ press the planetary pin (17, 18) in direction of arrow. Be sure, that the bore hole of the locking pin in the planetary pin and planetary housing are aligned. After inserting, secure the planetary pin with the locking pin (20, 21).



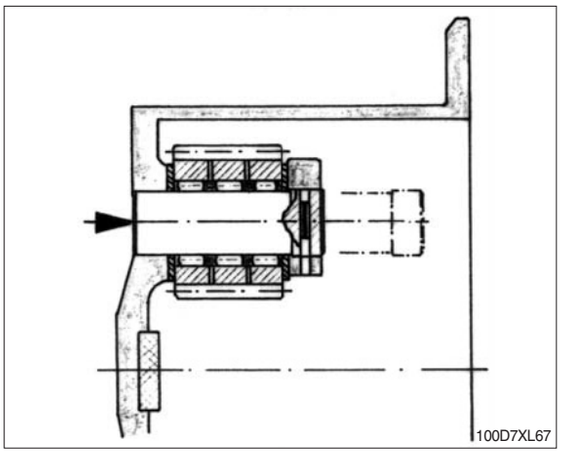
(6) Disassembly of planetary gear

① Knock the locking pin (20, 21) completely to the inner side of the planetary pin.

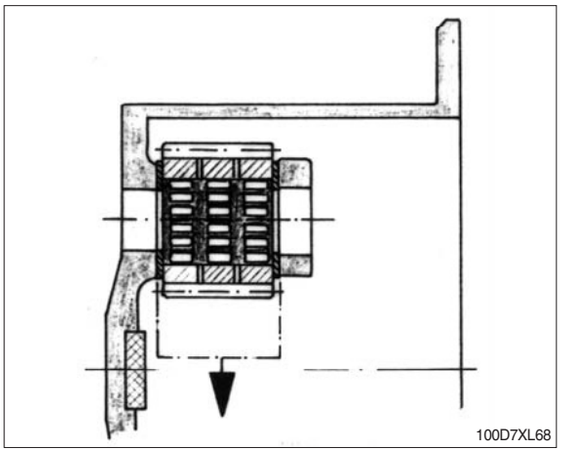


② Press the planetary pin in direction of arrow out of the planetary housing.

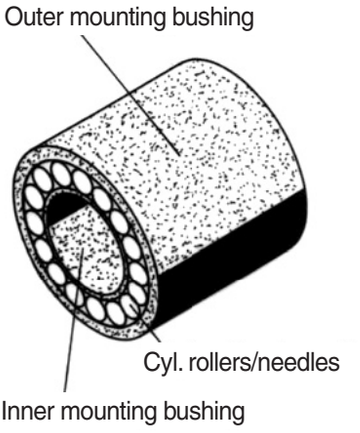
※ Because of the difference of diameter of 0.1 ㎜ do not press the planetary pin against the direction of arrow out of the planetary housing, to prevent damaging the bore.



③ Remove the planetary gears with the thrust disks and needle bearings.

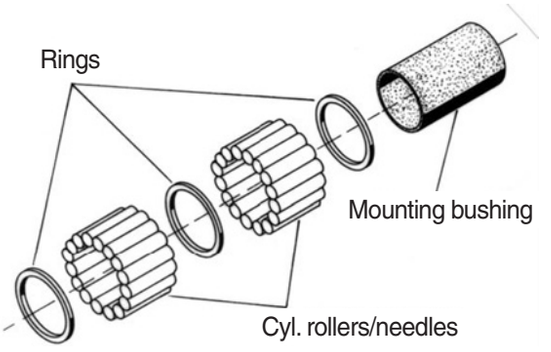


11) Assembly / disassembly cageless needle bearing (planetary gear bearing)



Version 1

100D7XL39



Version 2

100D7XL40

(1) Assembly

① **Version 1**

Install the needle bearing with mounting bushings into the planetary gear, thereby the outer mounting bushing will be stripping. Insert the planetary gear with thrust disks into the planetary housing. Press in the planetary pin, thereby the inner mounting bushing will remove.

② **Version 2**

Place one thrust disk on the work bench, place on the planetary gear and insert the mounting bushing. Insert the cylindrical rollers/needles alternately with the rings (according to the design). Insert the planetary gear with thrust disks into the planetary housing.
Press in the planetary pin, thereby the mounting bushing will remove.

③ **Hint**

Note the passage "Assembly of the planetary gear".

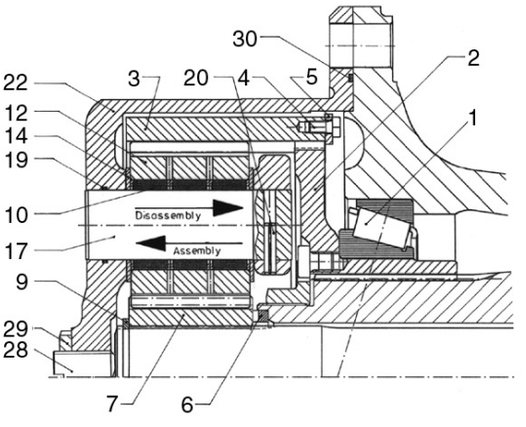
(2) Disassembly

At the disassembly of the planetary pin the cageless needle bearing will fall asunder, if not a mounting bushing will be pushing inwards at planetary pin removing.

① **Hint**

Note the passage "Disassembly of the planetary gear".

(3) Planetary gear drive

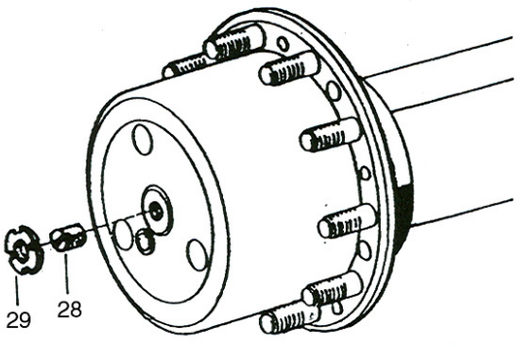


100D7XL71

12) Assembly of the planetary housing

Place O-ring (30) into the slot of the planetary housing. Install the planetary housing and bolt it.

13) Adjustment of the axial clearance

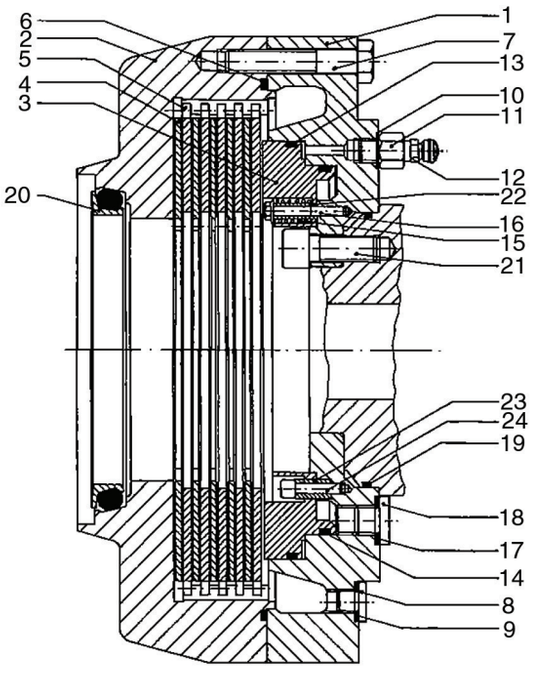


100D7XL72

The axial clearance between axle shaft respective universal joint and adjusting screw must be 0.3~0.7 mm. The adjustment has to be made by screwing in the adjusting screw until it touches the axle shaft respective universal joint. Back-off the adjusting screw 72~170˚ from the tightened position (this corresponds to about 0.3~0.7 mm axial clearance).
Secure the adjusting screw and the counter nut with Loctite 270.

※ When tightening the counter nut (29), hold the adjusting screw unconditional, to prevent turning of the adjusting screw.

14) Assembly of service brake



100D7XL83

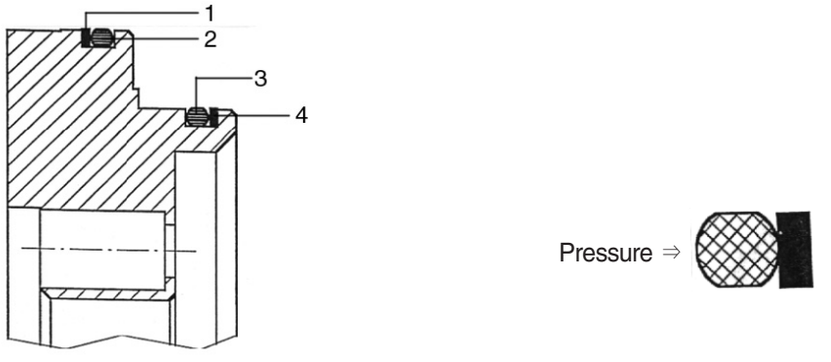
1	Brake carrier	9	Seal ring	17	Seal ring
2	Brake housing	10	Seal ring	18	Screw plug
3	Piston	11	Connection piece	19	O-ring
4	Inner disk	12	Breather	20	Face seal
5	Outer disk	13	Sealing ring	21	Screw
6	O-ring	14	Sealing ring	22	Tube
7	Screw	15	Spring	23	Bushing
8	Screw plug	16	Screw	24	Screw

(2) Assembly of the piston seals

Place piston with the larger diameter downwards. Note succession of the sealing parts at fitting.
Install O-rings free of torsion and loops.

(3) Assembly of O-ring and supporting ring

Install the supporting rings to the averting side of pressure.

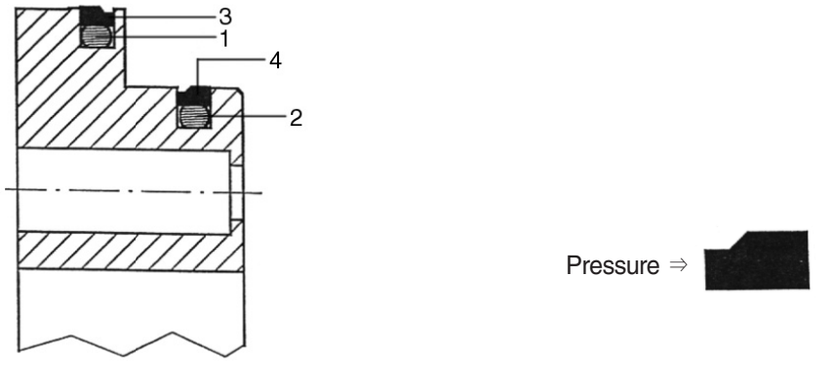


100D7XL73/84

1 Large supporting ring
2 Large O-ring
3 Small O-ring
4 Small supporting ring

(4) Assembly of the Omegat seal kit

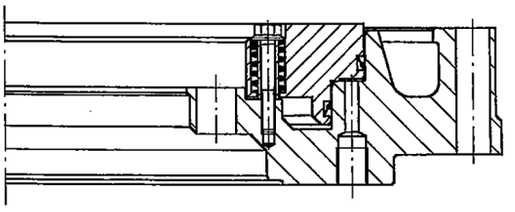
Install the PTFE-profile rings with small diameter to pressure side.
For assembly there can be used mounting tapes from Merkel company.



100D7XL74/85

1 Large O-ring
2 Small O-ring
3 Large supporting ring
4 Small supporting ring

(5) Assembly of the piston



100D7XL86

Lubricate cylinder bore, apply the thread holes at wet disk brakes of dimension X270 and X340 with Loctite 243, at wet disk brakes of dimension X460 and X650 with Loctite 262 and install and screw the bushing (if present). Place the piston onto the brake carrier (do not cant it).

※ Wet disk brakes of dimension X270 and X340

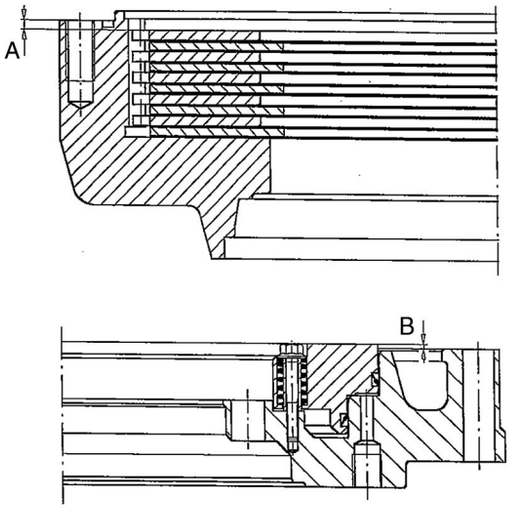
Press the piston equal by hand into the brake carrier (do not cant it).

※ Wet disk brakes of dimension X460 abd X650

Press the piston equal with mounting screws into the brake carrier (do not cant it).

If necessary adjust the piston with easy hammer taps to the thread holes. Install first the spring, then the tubes in the bore holes of the piston. Screw in the hexagon head screws with flange.

① **Prepare housing and check the air gap**



100D7XL87

Lay discs into the housing.

② **Check the air gap**

Air gap = measure A-measure B (measured without pressure)
Rated size about 0.5 ㎜ smaller than the air gap pressurized (see table).

Install O-ring (brake housing / brake carrier) free of torsion and loops.

③ **Air gap and wear dimension**

Brake type	Air gap sL new (Pressurized) (㎜)	Wear dimension (㎜)
5340	2.4±0.9	2.0

(6) Finish assembly

Place the brake carrier onto the brake housing and bolt it. Mount breather with connection piece and seal ring, screw plugs with seal rings.

Check brake hydraulic system for leaks (see tightness checking instruction).

Install O-ring (brake carrier / axle spindle respective steering knuckle) free of torsion and loops.

① Check the air gap (pressurized)

Measure through the check hole the distance from brake carrier to the piston end face, while non actuated brake, actuate the brake and repeat the measure operation-the difference of the measured distances gives the air gap sL (pressurized), rated size sL see table.

Measure through the check hole the distance from brake carrier to the piston end face, while actuating the brake and knock the measured value with marking punches into the brake carrier.

Install the complete brake on the axle (coat the contact surface with Loctite 270).

Mount face seal see page 3-139.

② Alignment of the discs

Wet disk brake dimension X270 and X340 :

The alignment of the discs has to be made at mounting of the wheel hub by itself.

Wet disk brake dimension X460 and X650 :

The alignment of the discs has to be made by a mounting device (see page 3-132). Clamp the discs by actuating the brake (hydraulic or air pressure).

(7) Tightness checking instruction for brake hydraulic system and cooling oil room

① Check brake hydraulic system for leaks

Before conducting the test, bleed the brake hydraulic system.

The pressure drop after applying 120 bar for a period of 15 minutes must not exceed 2% (leaving 117.5 bar).

Test medium : Motor oil SAE 10W corresponding to MIL-L2104.

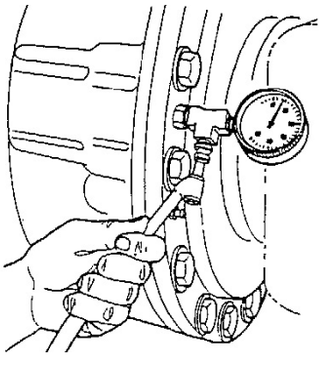
② Check cooling oil room for leaks

Brake with external cooling :

After assembly of the wheel hub with the face seal and adjusting of the wheel bearings check the tightness of the cooling oil room. Install a air pressure gauge with shutoff valve.

Beload the hub assembly with 1.5 bar pressure air. Turn the hub assembly several times.

The pressure drop after a period of 10minutes must not exceed 0.1bar.



100D7XL75

(8) Permissible oil for brake with external cooling

① **Actuation fluid**

Do not use brake fluid any time.

Use a mineral oil base hydraulic oil type fluid only.

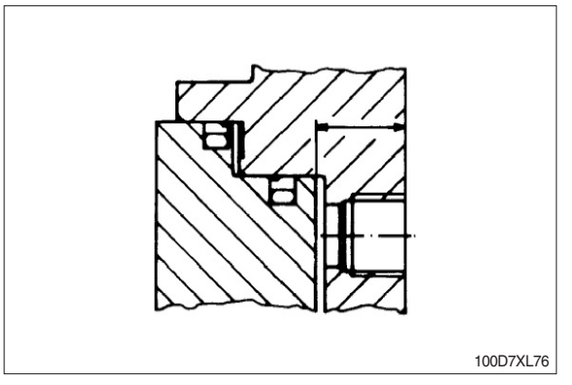
· Motor oil : SAE 80W-90

② **Cooling fluid**

· DONAX TD

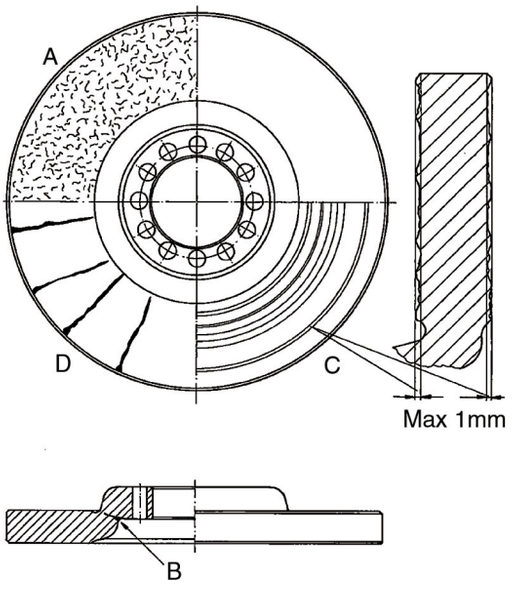
③ **Check measure**

It is measured through the check hole, while actuating the brake. The check measure, new, is marked in the housing below the hole. Is the measured dimension bigger than the marked dimension and max. wear dimension, unconditional consult Hyundai dealer.



After working at the brake, bleed the brake hydraulic system and check for tightness.

(9) Brake disk



100D7XL78

A	Network - like formation of cracks	admissible
B	Radially shaped crack	not admissible
C	Uneven brake surface characteristics below 1.0 mm	admissible
D	Continuous cracks	not admissible

(10) Spring - loaded sliding caliper brakes

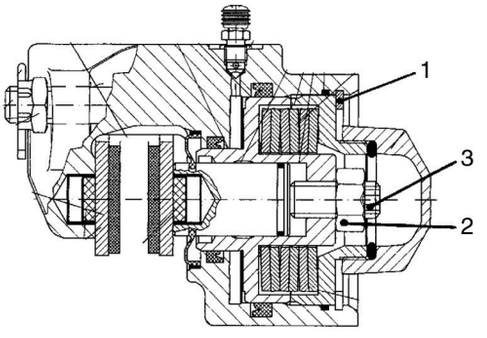
Safety notes :

· **Warning**

Before commencing work on the parking brake, ensure that no unintended machine movement can happen when the braking effect is removed.

· **Danger**

The parking brake is under spring tension. Parts could become loose and fly out suddenly if improper brake opening. Therefore release the lock nut (2) and turn the adjusting screw (3) counter - clockwise until the spring set is released before disassembly of the circlip (1).

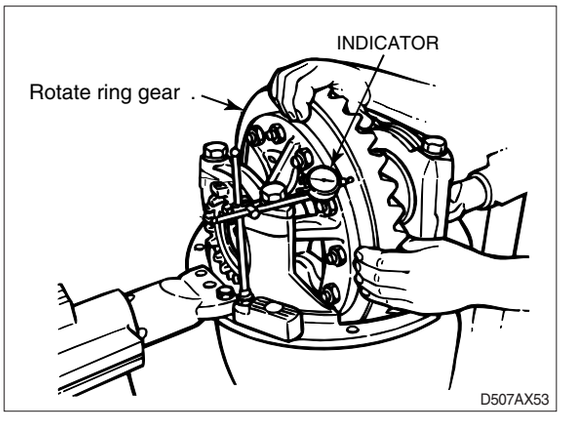


100D7XL79

GROUP 4 ADJUSTMENT

1. CHECKING THE RING GEAR BACKFACE RUNOUT

Runout specification : 0.20 mm (0.008 inch) maximum



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 "Assembly of the differential".
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 ㎜
(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 gearsets.

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.

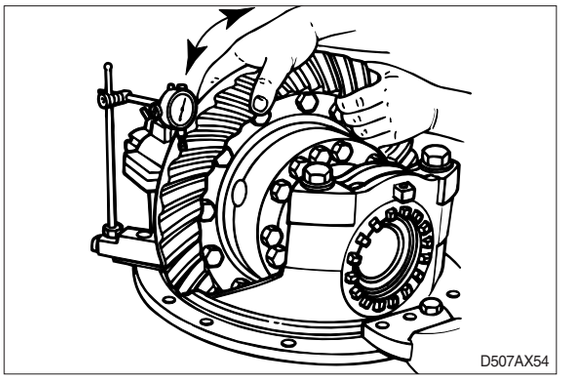
4) Read the dial indicator, while rotating the ring gear a small amount in both directions, against the drive pinion teeth.

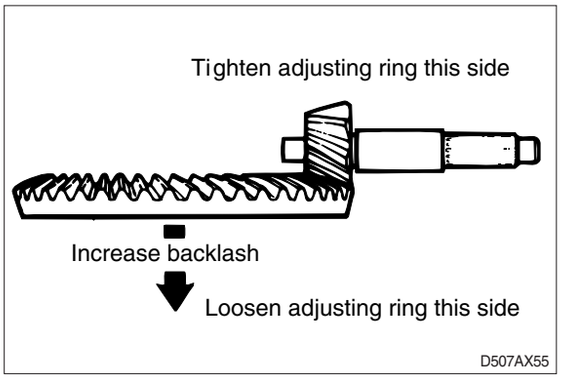
※ When you adjust backlash, move the ring gear only. Do not move the drive pinion.

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).

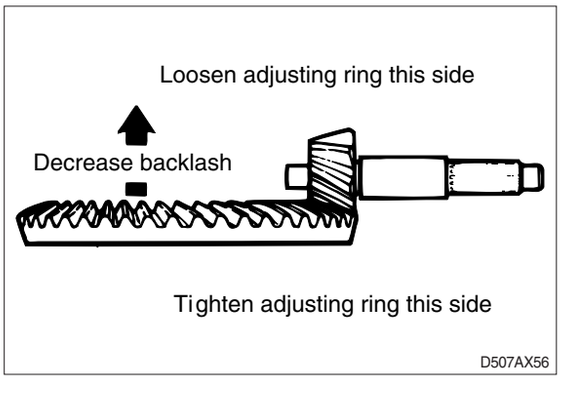
※ Backlash is increased by moving the ring gear away from the drive pinion. Backlash is decreased by moving the ring gear toward the drive pinion.

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


D507AX54



D507AX55

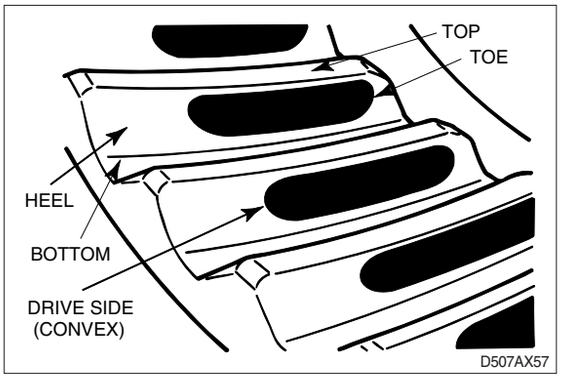


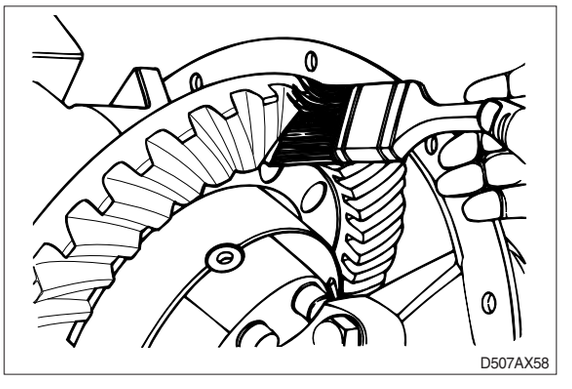
D507AX56

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.





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.

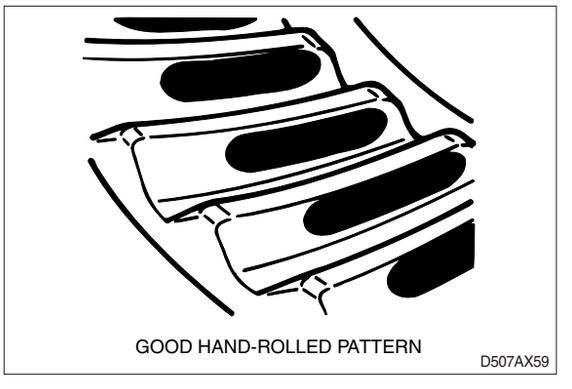
3) Compare the contact patterns.

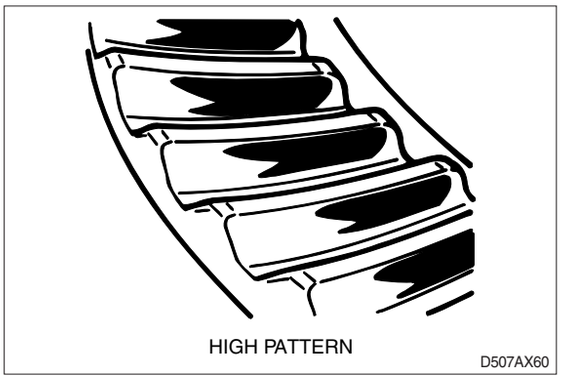
In new gearsets, a good contact pattern is toward the toe of the tooth, and centered between the top and bottom of the tooth.

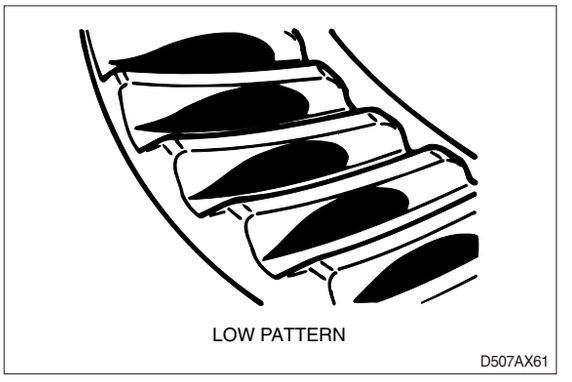
In used gearsets, a good contact pattern fills approximately the full length of the tooth. The top of the pattern is near the top of the tooth. The location should match the wear pattern on the tooth.

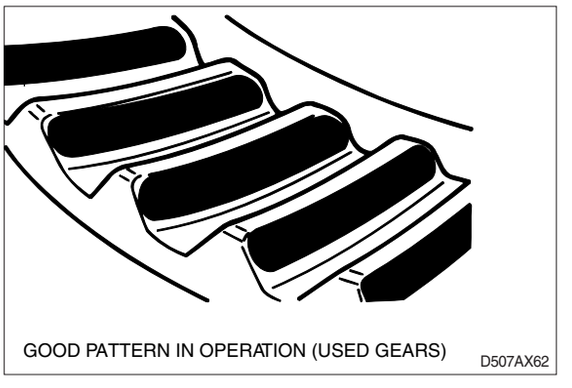
If the contact patterns require adjustment along the width of tooth (top/bottom), follow steps 4)-5).

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



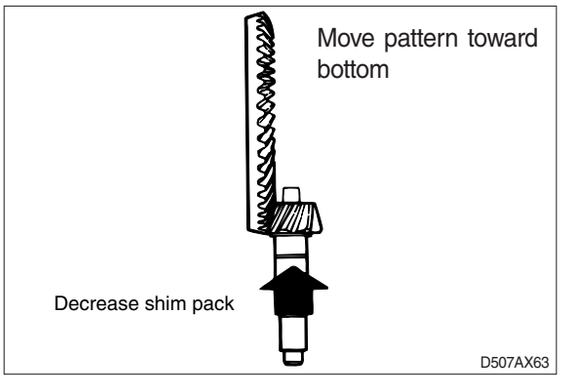






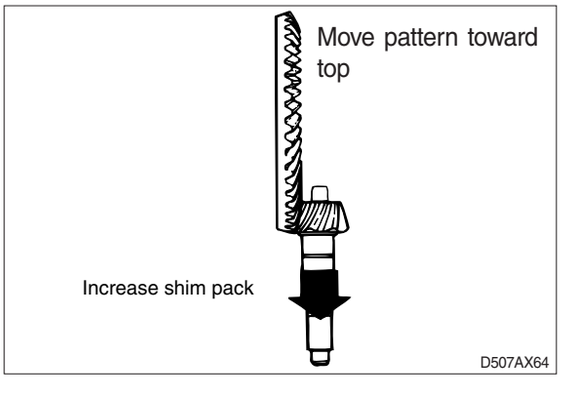
4) High pattern : A high contact pattern indicates that the pinion was installed too shallow into the carrier.

   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".



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".

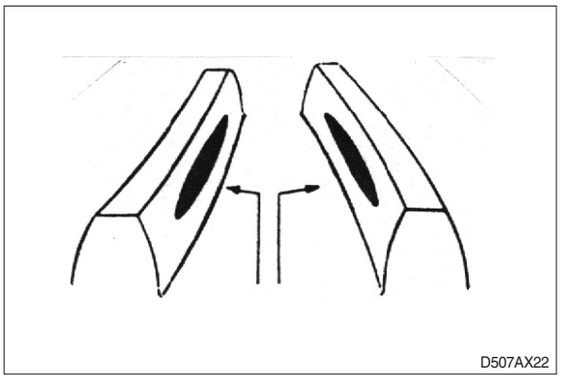


4. ADJUSTMENT OF GEAR MESHING OF GLEASON GEARS

1) Perfect marking

To become a perfect gear meshing is only possible, if the fabrication number of the drive pinion (marked on the end face) and the ring gear (marked on the circumference) are corresponding.

※ The following figures are showing improper gear meshing marks of the ring gear.
The text alongside gives the corrections to obtain correct gear meshing. The dark colored arrows in the sketch of the drive pinion and ring gear are indicating the direction towards which the drive pinion has to be moved. The clear arrows are indicating the direction towards which the ring gear has to be moved, to get further more a correct backlash.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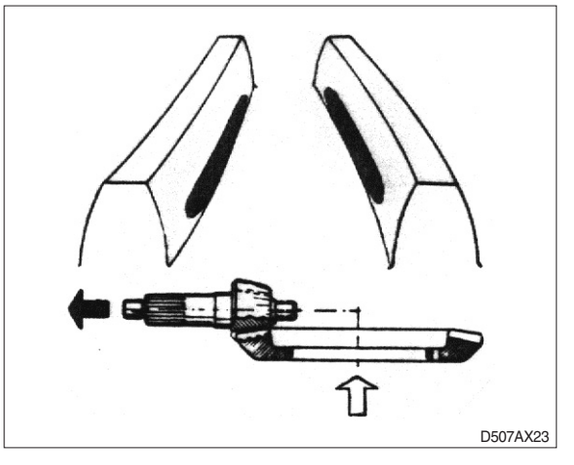
2) Gear meshing to deep

Increase the drive pinion distance by correction of the adjustment disk thickness. Regulate the backlash by inwards moving of the ring gear.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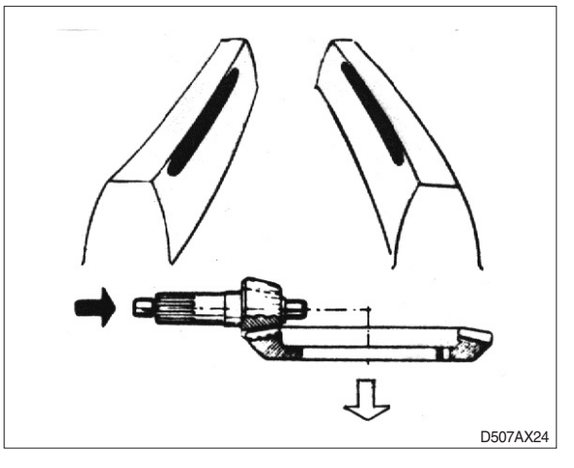
3) Gear meshing to high

Decrease the drive pinion distance by correction of the adjustment disk thickness. Regulate the backlash by outwards moving of the ring gear.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