

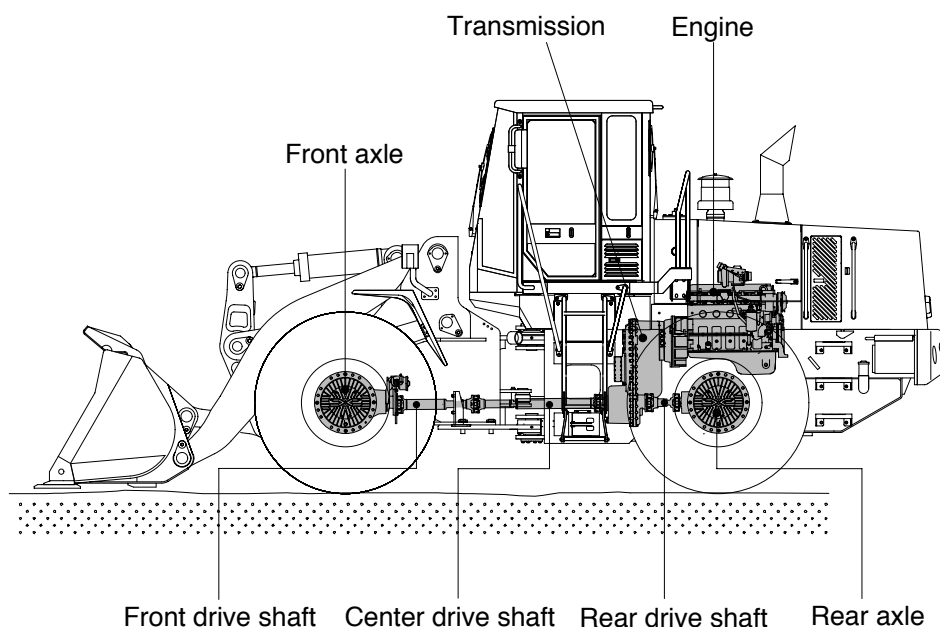
SECTION 3 POWER TRAIN SYSTEM

Group 1	Structure and Function	3-1
Group 2	Operational Checks and Troubleshooting	3-66
Group 3	Tests and Adjustments	3-77
Group 4	Disassembly and Assembly	3-80

SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. POWER TRAIN COMPONENT OVERVIEW



7607PT01

The power train consists of the following components:

- Transmission
- Front, center and rear drive shafts
- Front and rear axles

Engine power is transmitted to the transmission through the torque converter.

The transmission is a hydraulically engaged four speed forward, three speed reverse countershaft type power shift transmission. A calliper-disc type parking brake is located on the front axle.

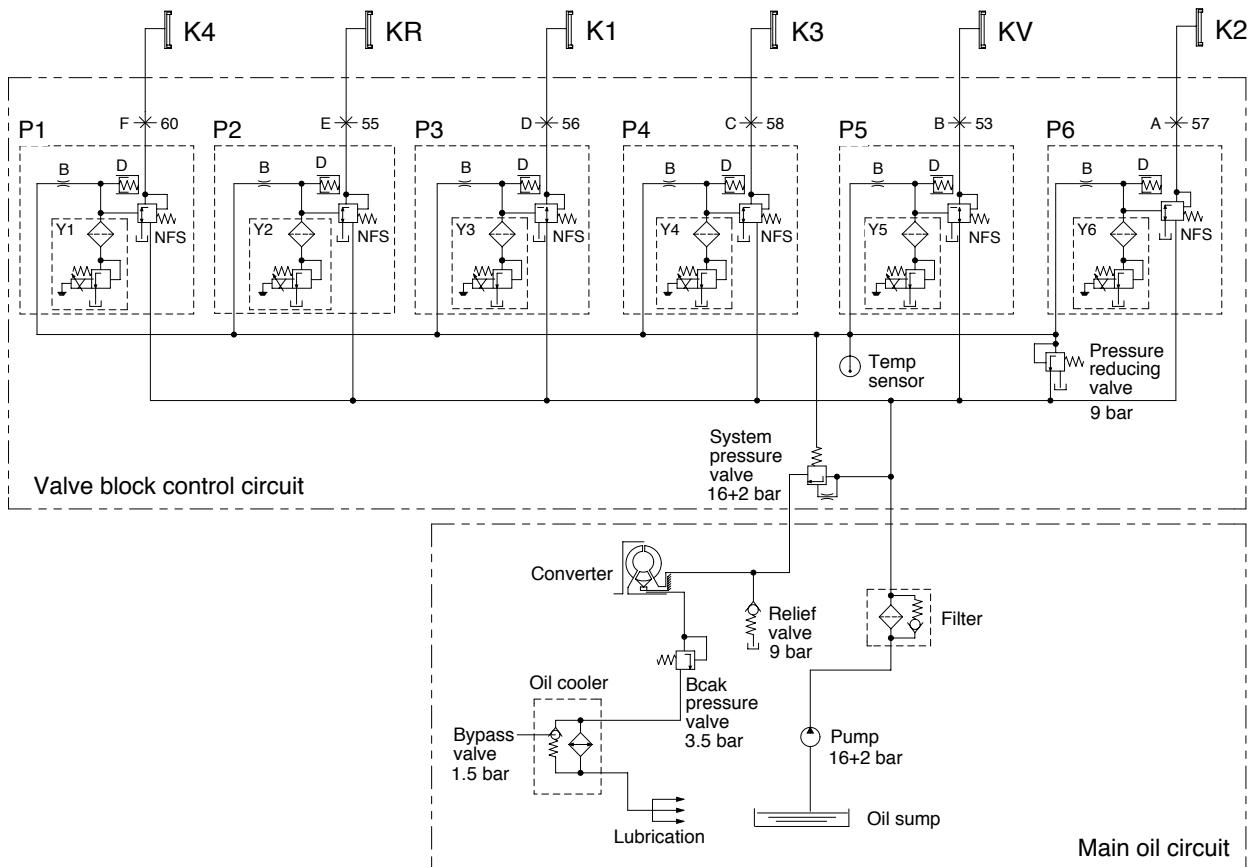
The transmission outputs through universal joints to three drive shaft assemblies. The front drive shaft is a telescoping shaft which drives the front axle. The front axle is mounted directly to the loader frame. The front and rear axle is equipped with torque proportioning differential.(Limited slip differential : option)

The rear axle is mounted on an oscillating pivot.

The power transmitted to front axle and rear axle is reduced by the pinion gear and ring gear of differential. It then passes from the differential to the sun gear shaft(Axle shaft) of final drive.

The power of the sun gear is reduced by a planetary mechanism and is transmitted through the planetary hub to the wheel.

HYDRAULIC CIRCUIT



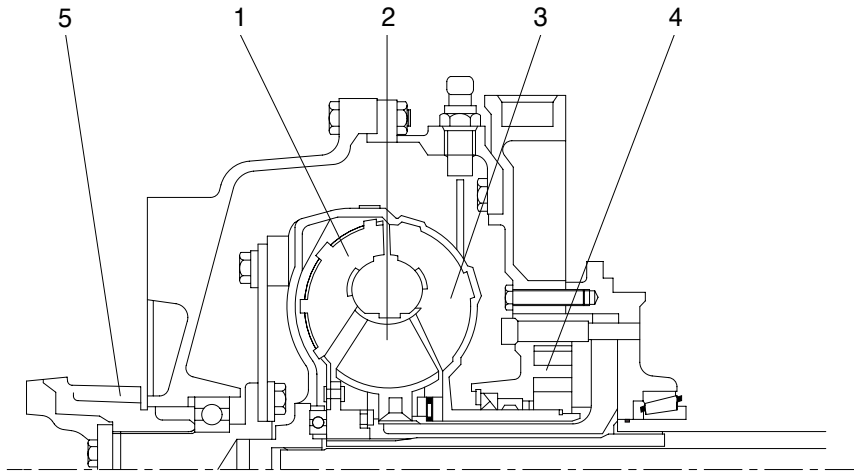
76043PT18

- | | | | |
|-----|------------------------------|-------|------------------------------|
| NFS | Follow-on slide | P3 | Proportional valve clutch K1 |
| D | Oscillation damper | P4 | Proportional valve clutch K3 |
| B | Orifice | P5 | Proportional valve clutch KV |
| P1 | Proportional valve clutch K4 | P6 | Proportional valve clutch K2 |
| P2 | Proportional valve clutch KR | Y1~Y6 | Pressure regulator |

Speed	Forward				Reverse			Neutral	Engaged clutch	Positions on the valve block	Current No. of the measuring points
	1	2	3	4	1	2	3				
Y1				X					K4	F	60
Y2					X	X	X		KR	E	55
Y3	X				X				K1	D	56
Y4			X	X					K3	C	58
Y5	X	X	X						KV	B	53
Y6		X							K2	A	57
Engaged clutch	K1,KV	KV,K2	K3,KV	K4,K3	KR,K1	KR,K2	KR, K3		-	-	-

X : Pressure regulator under voltage

2. TORQUE CONVERTER



73033TM00

- | | | | | | |
|---|--------|---|-------------------|---|--------------|
| 1 | Pump | 3 | Turbine | 5 | Input flange |
| 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 adaption of the output speed to a certain required output moment is infinitely variable and automatically achieved by the torque converter.

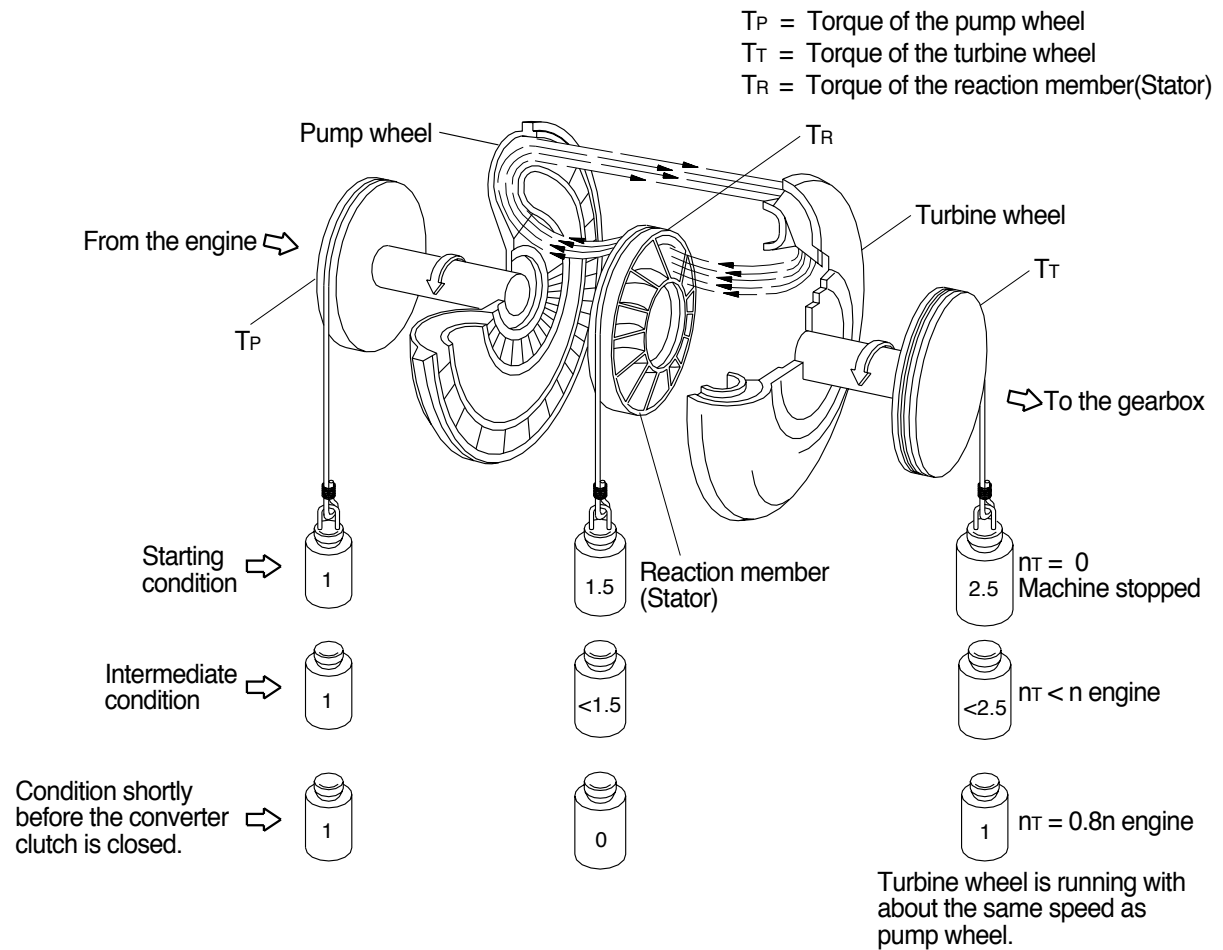
If the turbine speed is reaching about 80% of the pump speed, the conversion becomes 1.0 i.e. the turbine moment becomes equal to that of the pump moment.

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.

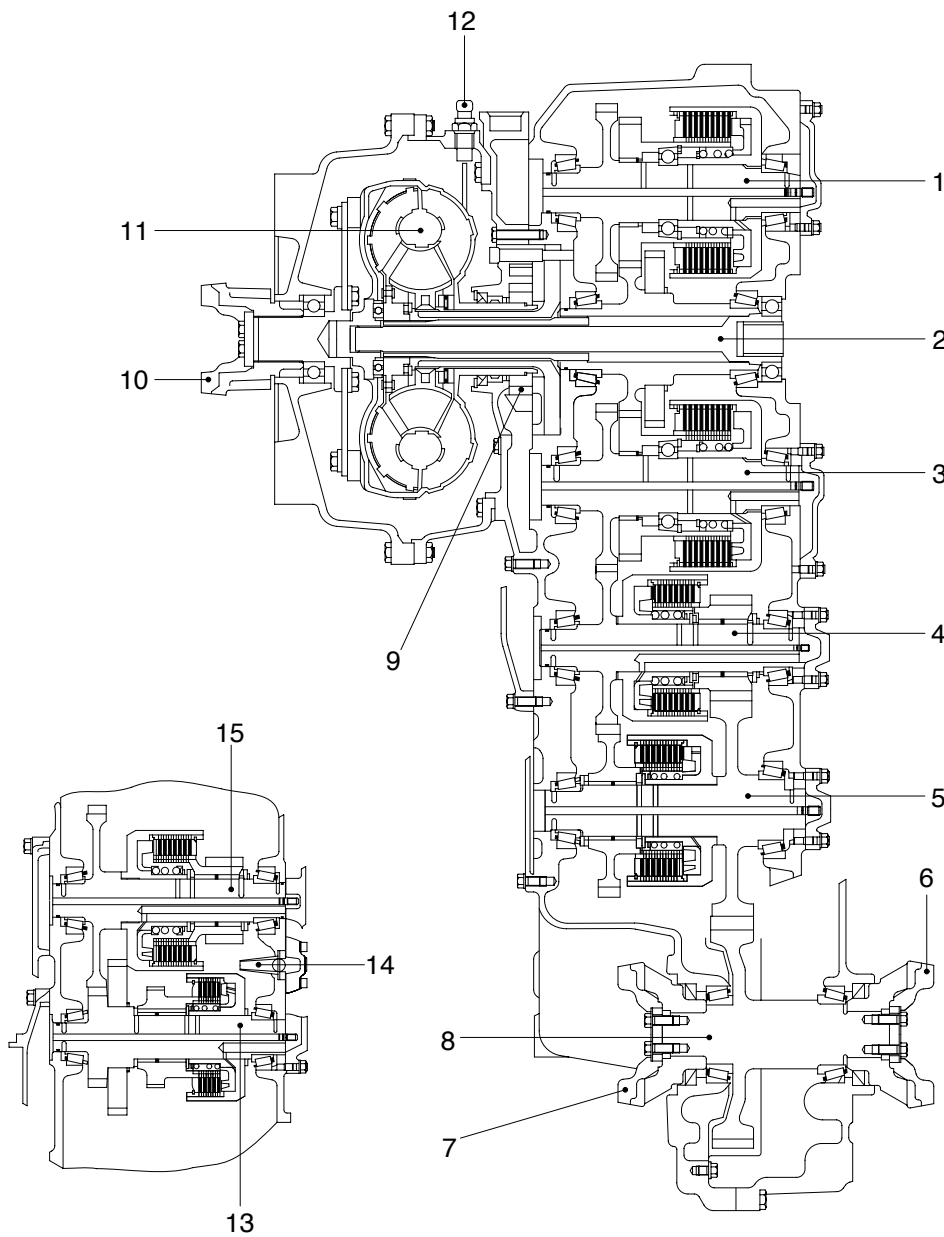
In this way, the stator can rotate freely.

Function of a hydrodynamic torque converter(Schematic view)



3. TRANSMISSION

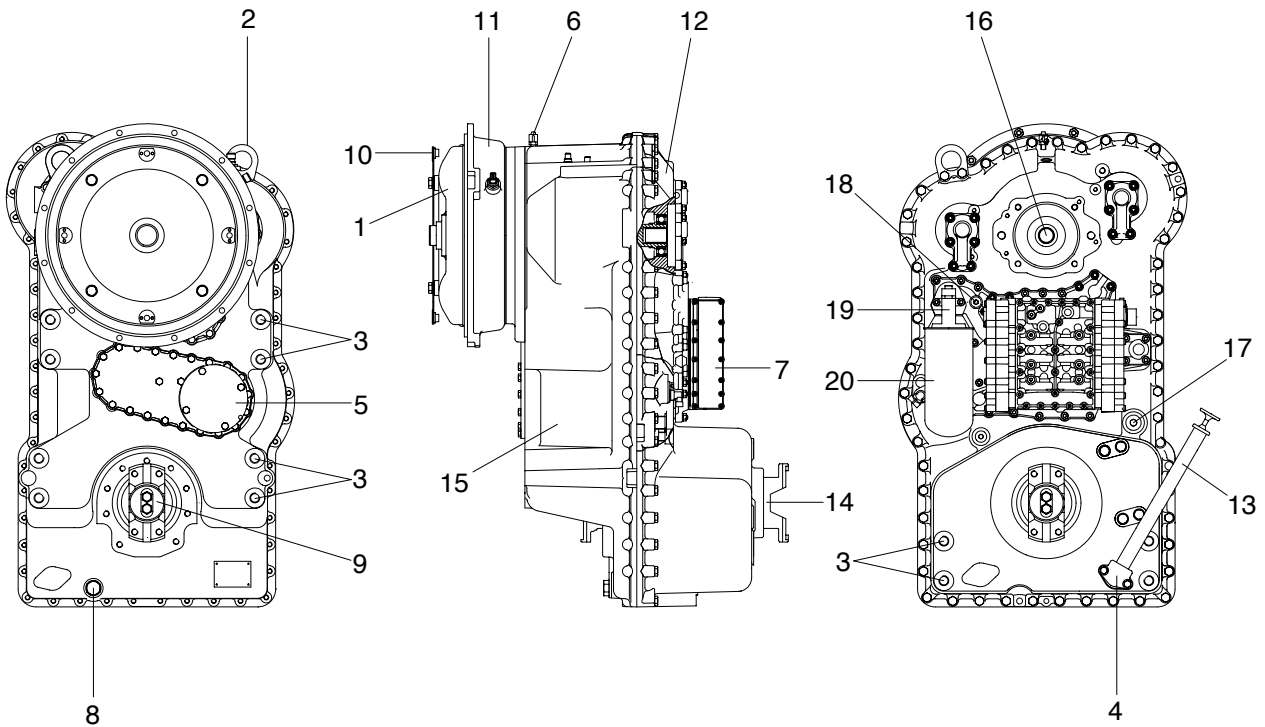
1) LAYOUT



7607PT03

- | | | | | | |
|---|---------------------------------|----|------------------------------|----|--|
| 1 | Reverse clutch(KR) | 6 | Rear output flange | 11 | Converter |
| 2 | Engine-dependent power take-off | 7 | Converter side output flange | 12 | Inductive transmitter for engine speed |
| 3 | Forward clutch(KV) | 8 | Output shaft | 13 | 4th clutch(K4) |
| 4 | 2nd clutch(K2) | 9 | Transmission pump | 14 | Converter relief valve |
| 5 | 3rd clutch(K3) | 10 | Input flange | 15 | 1st clutch(K1) |

2) INSTALLATION VIEW



7607PT02

- | | | | |
|---|---|----|---|
| 1 | Converter | 10 | Connection to engine |
| 2 | Lifting lugs | 11 | Converter bell housing |
| 3 | Transmission suspension bores M20 | 12 | Transmission case cover |
| 4 | Attachment possibility for oil level tube with oil dipstick(Converter side) | 13 | Oil filter pipe with oil dipstick |
| 5 | Attachment possibility for emergency steering pump | 14 | Output flange-Rear |
| 6 | Breather | 15 | Transmission case |
| 7 | Electro hydraulic control | 16 | Power take-off; Coaxial; Engine dependent |
| 8 | Oil drain plug with magnetic insert M38 x 1.5 | 17 | Port return line M26 x 1.5(From brake) |
| 9 | Output flange-Converter side | 18 | Port system pressure M16 x 1.5 |
| | | 19 | Filter head |
| | | 20 | Filter |

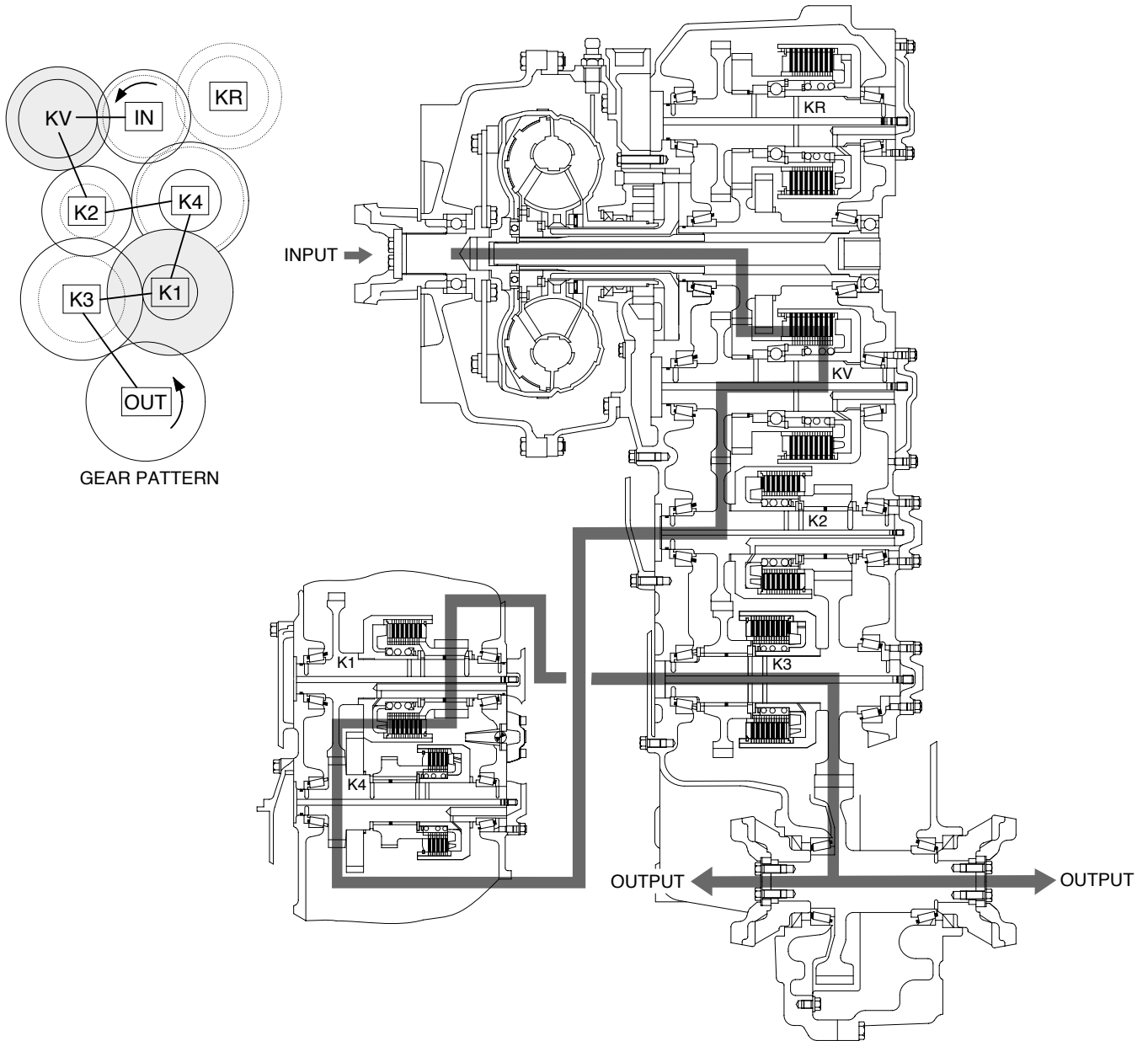
3) OPERATION OF TRANSMISSION

(1) Forward

Forward 1st

In 1st forward, forward clutch and 1st clutch are engaged.

Forward clutch and 1st clutch are actuated by the hydraulic pressure applied to the clutch piston.

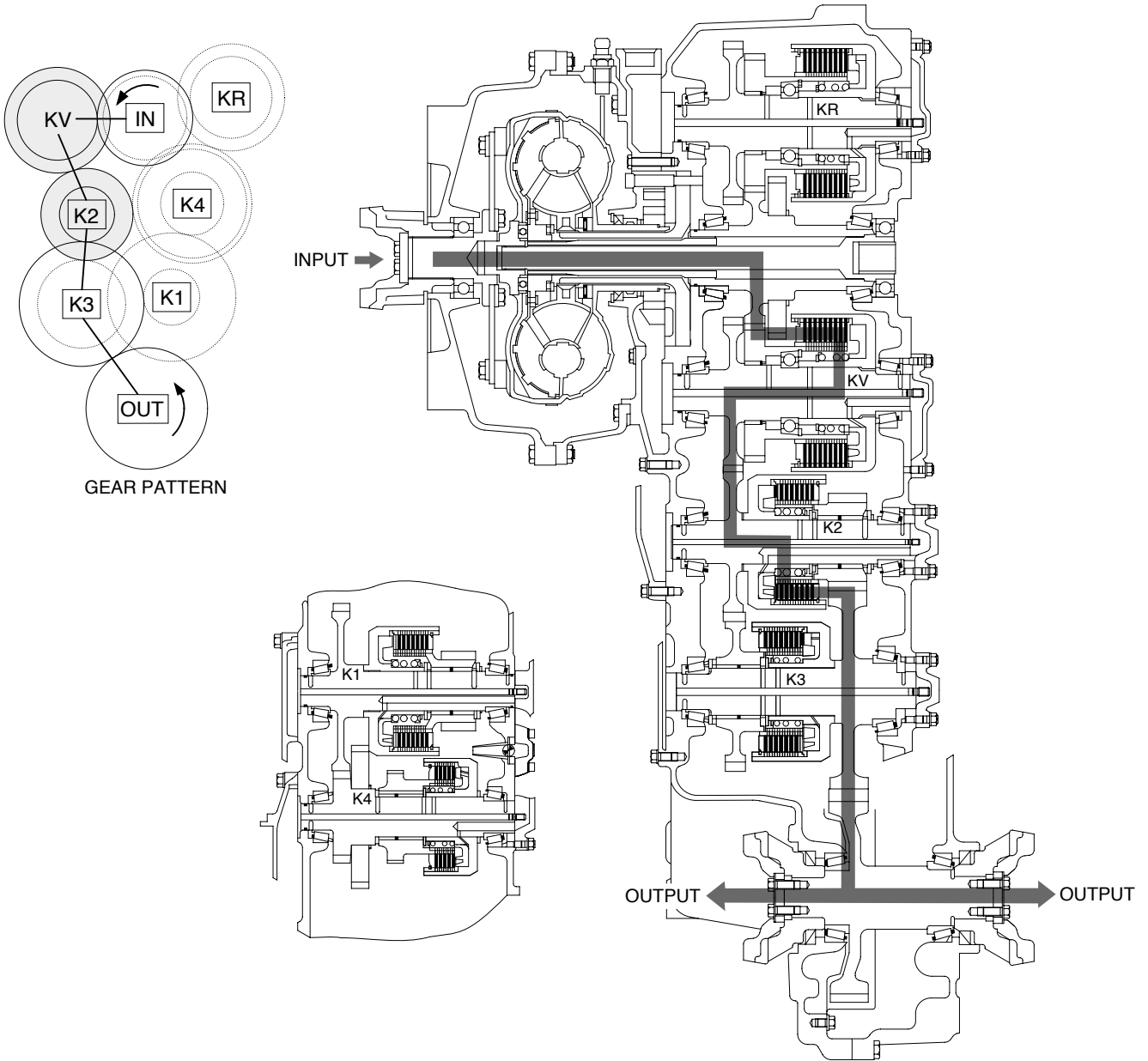


7607PT04

Forward 2nd

In 2nd forward, forward clutch and 2nd clutch are engaged.

Forward clutch and 2nd clutch are actuated by the hydraulic pressure applied to the clutch piston.

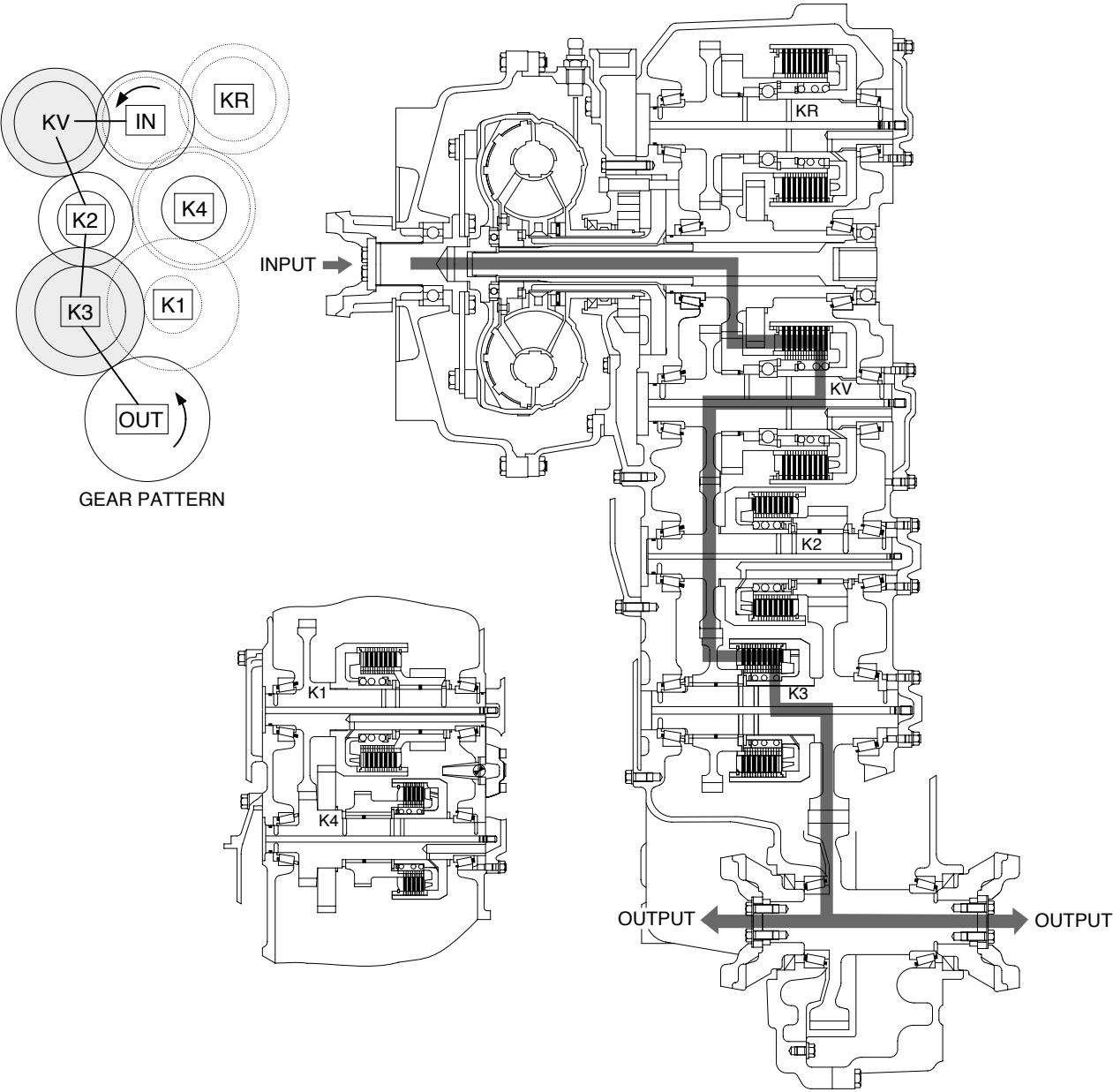


7607PT05

Forward 3rd

In 3rd forward, forward clutch and 3rd clutch are engaged.

Forward clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.

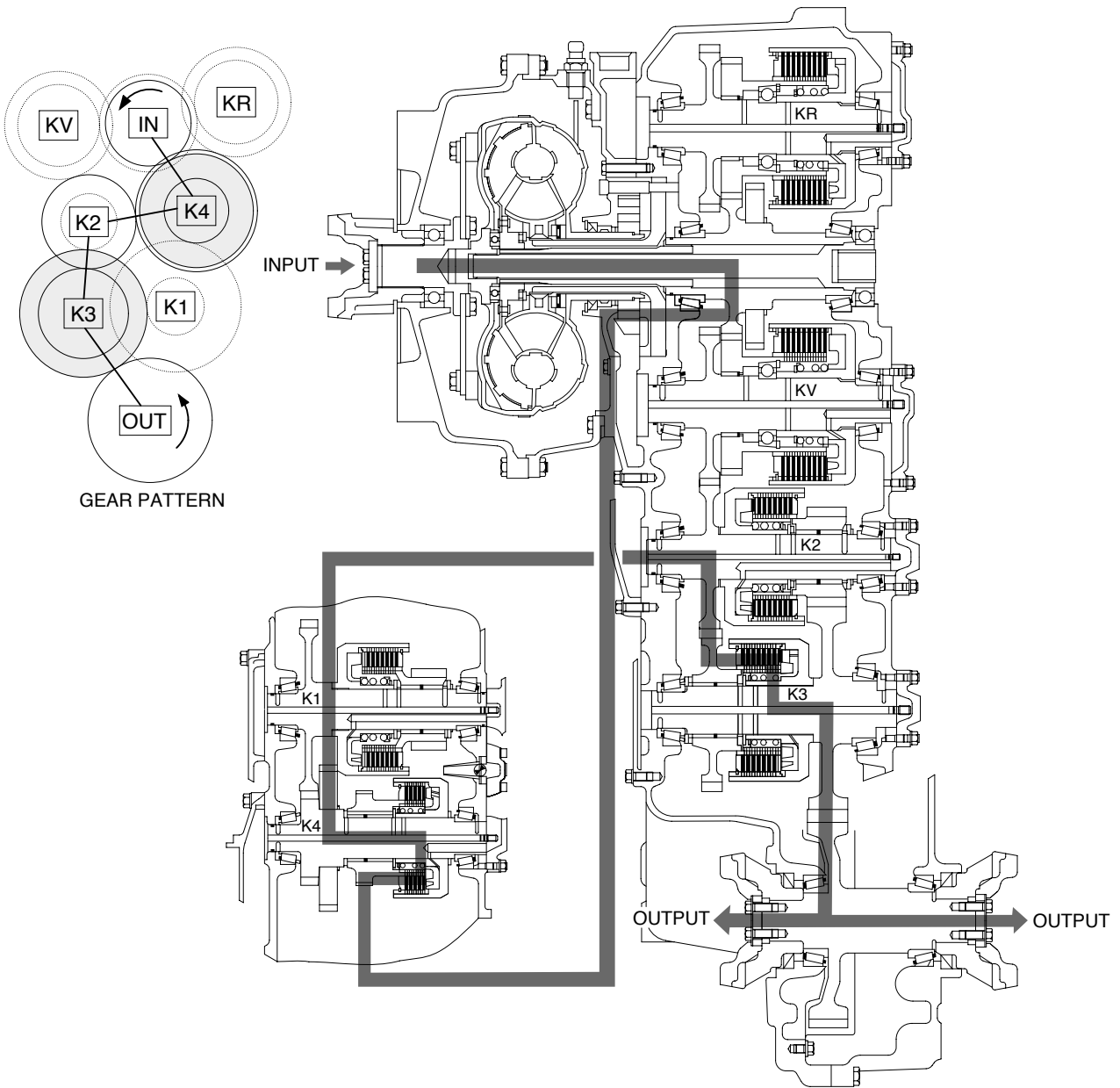


7607PT06

Forward 4th

In 4th forward, 4th clutch and 3rd clutch are engaged.

4th clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.



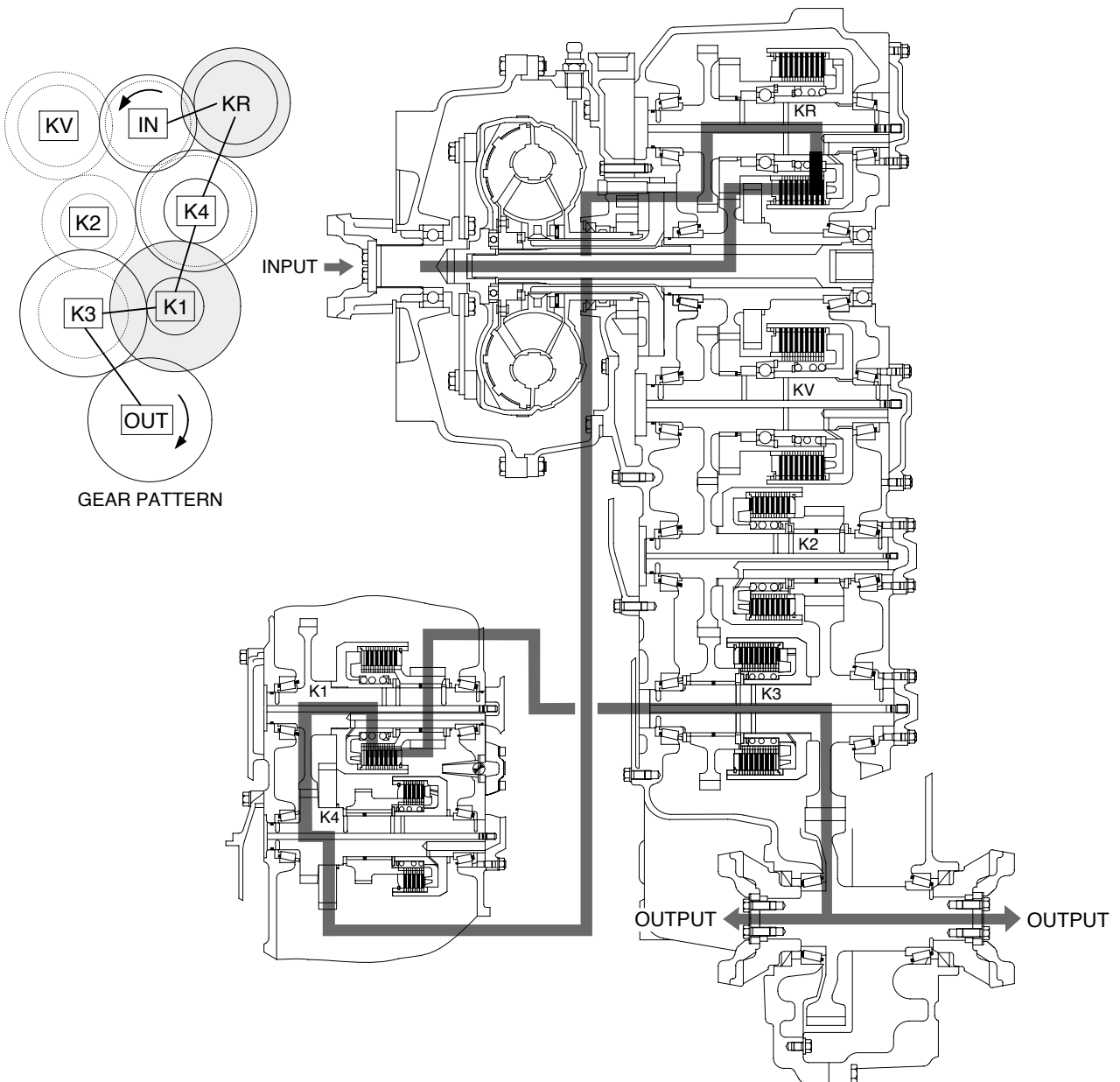
7607PT07

(2) Reverse

Reverse 1st

In 1st reverse, reverse clutch and 1st clutch are engaged.

Reverse clutch and 1st clutch are actuated by the hydraulic pressure applied to the clutch piston.

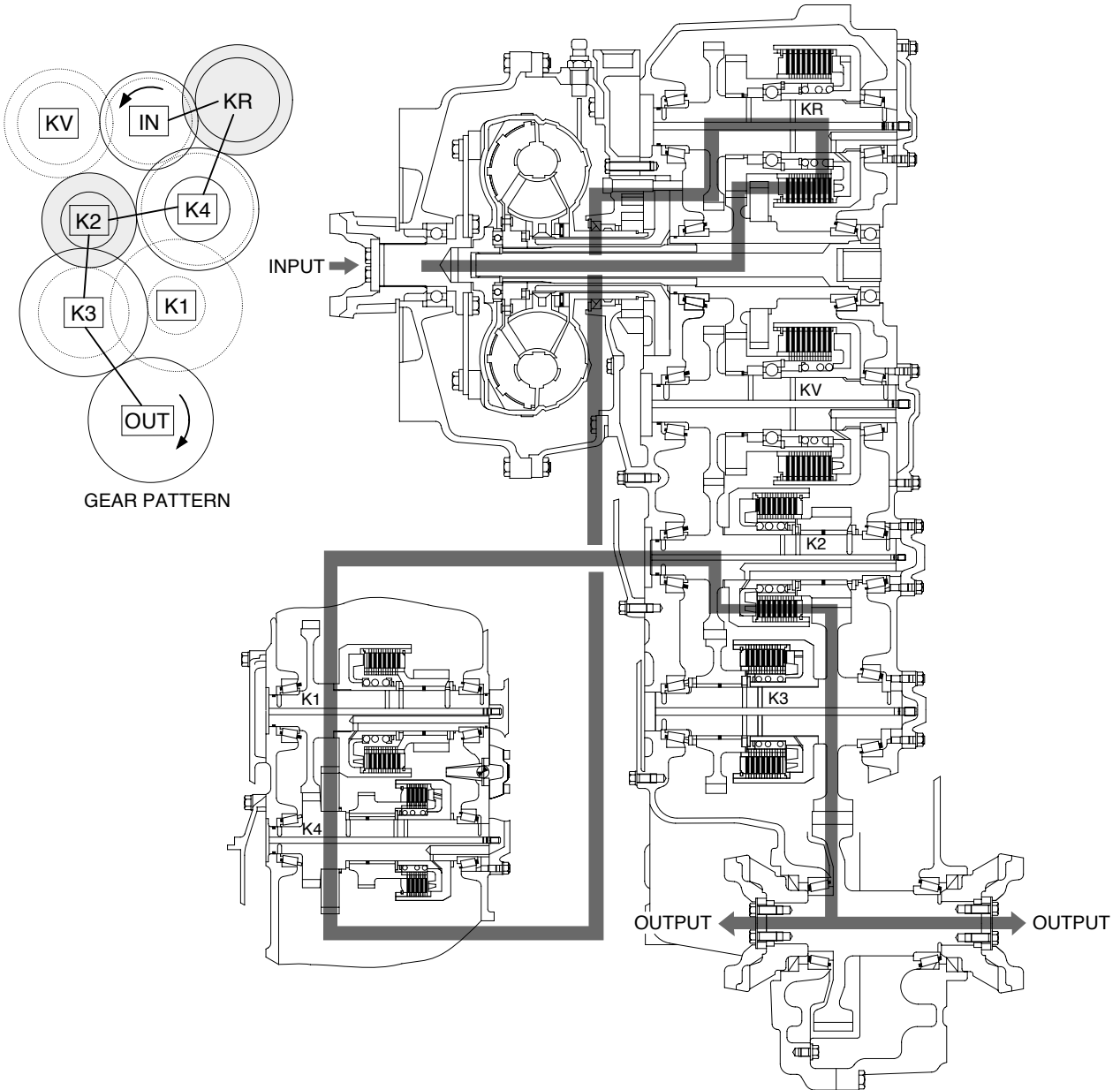


7607PT08

Reverse 2nd

In 2nd reverse, reverse clutch and 2nd clutch are engaged.

Reverse clutch and 2nd clutch are actuated by the hydraulic pressure applied to the clutch piston.

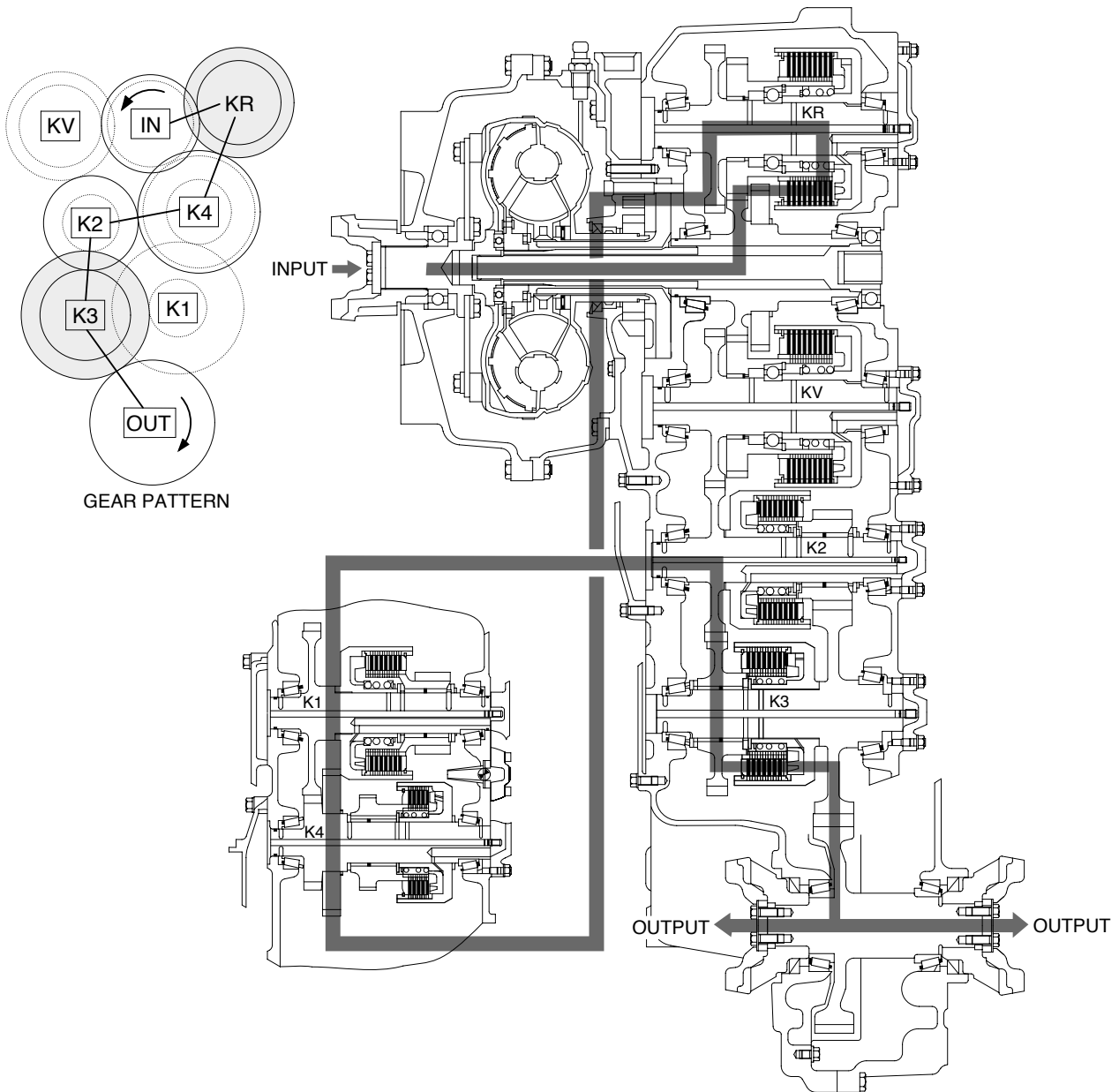


7607PT09

Reverse 3rd

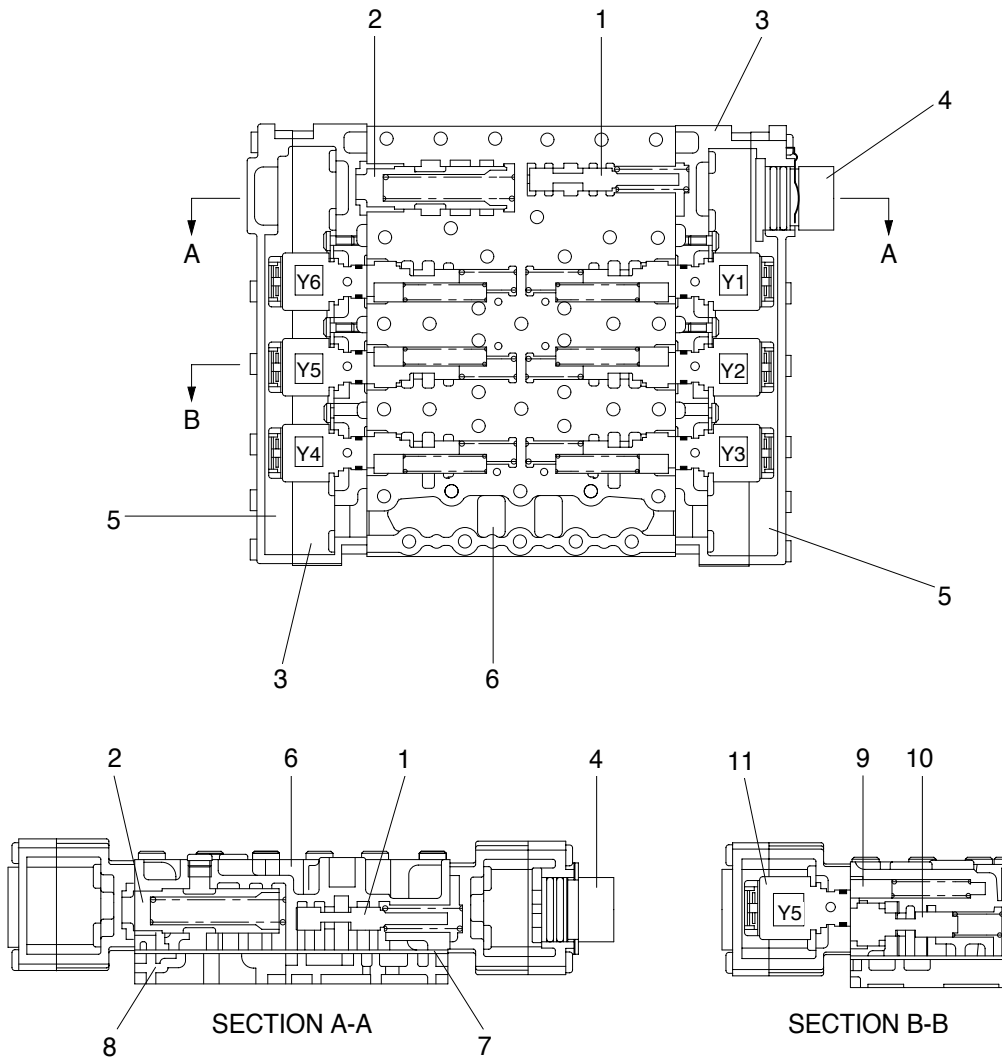
In 3rd reverse, reverse clutch and 3rd clutch are engaged.

Reverse clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.



7607PT10

4) ELECTRO-HYDRAULIC SHIFT CONTROL WITH PROPORTIONAL VALVE



73033CV01

- | | | | |
|---|--------------------------------|----|--------------------|
| 1 | Pressure reducing valve(9bar) | 7 | Intermediate sheet |
| 2 | System pressure valve(16+2bar) | 8 | Duct plate |
| 3 | Housing | 9 | Oscillation damper |
| 4 | Cable harness | 10 | Follow-on slide |
| 5 | Cover | 11 | Pressure regulator |
| 6 | Valve block | | |

Transmission control see schedule of measuring points, hydraulic schematic and electro-hydraulic control unit at page 3-2, 3-14 and 3-78.

The six clutches of the transmission are selected through the 6 proportional valves P1 to P6. The proportional valve(Pressure regulator-unit) consists of pressure regulator(e.g. Y1), booster valve oscillation damper.

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

By the direct proportional selection with separate pressure modulation for each clutch, the pressures to the clutches, taking part in the gear change, are controlled. In this way, a hydraulic overlap of the clutches to be engaged and disengaged is achieved.

This is leading to fast shiftings without traction force interruption.

At the shifting, the following criteria are considered:

- Speed of engine, turbine, central gear train and output.
- Transmission temperature.
- Shifting mode(Up-, down-, reverse shifting and gear engaging from neutral).
- Load level(Full- and partial load, traction, coasting inclusive consideration of load cycles during the shifting).

The system pressure valve is limiting the maximum control pressure to 16+2 bar and releases the main stream to the converter and lubricating circuit.

A converter relief valve is installed in the converter inlet, which protects the converter against high internal pressures(Opening pressure 9bar).

Within the converter, the oil transfers the power transmission according to the well-known hydrodynamic principle(See torque converter, page 3-3).

In order to avoid cavitation, the converter must be always completely filled with oil.

This is achieved by a converter back pressure valve, following the converter, with an opening pressure of about 3.5bar.

The oil, escaping from the converter, is directed to a oil cooler.

The oil is directed from the oil cooler to the transmission and from there to the lubricating-oil circuit so that all lubricating points are supplied with cooled oil.

In the electro-hydraulic control unit there are 6 pressure regulators installed.

5) GEAR SELECTOR(DW-3)

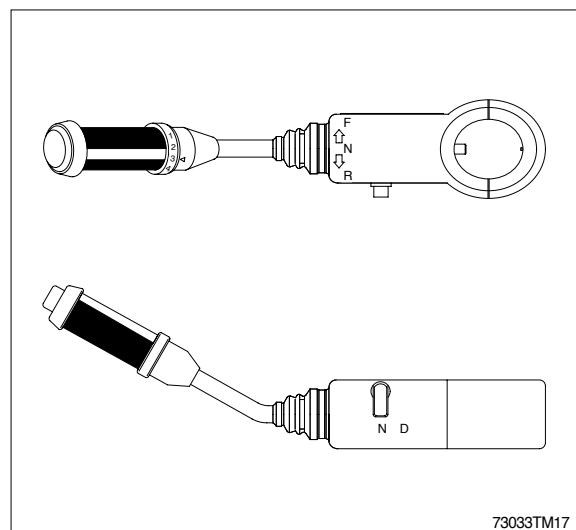
The gear selector is designed for the mounting on the left side of the steering column. The positions(Speeds) 1 to 4 are selected by a rotary motion, the driving direction Forward(F)-Neutral(N)-Reverse(R) by tilting the gear selector lever.

The gear selector is also available with integrated kickdown control knob.

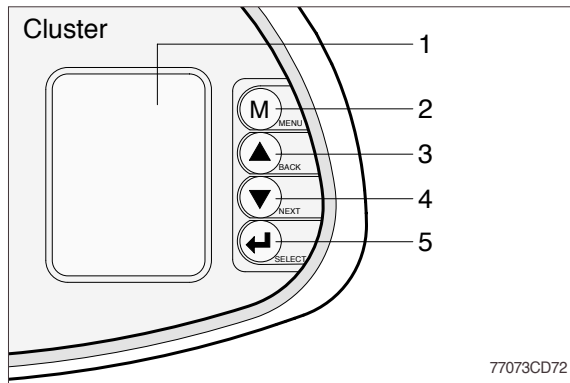
A neutral lock is installed as protection against inadvertent drive off.

Position **N** - Gear selector lever blocked in this position.

Position **D** - Driving.

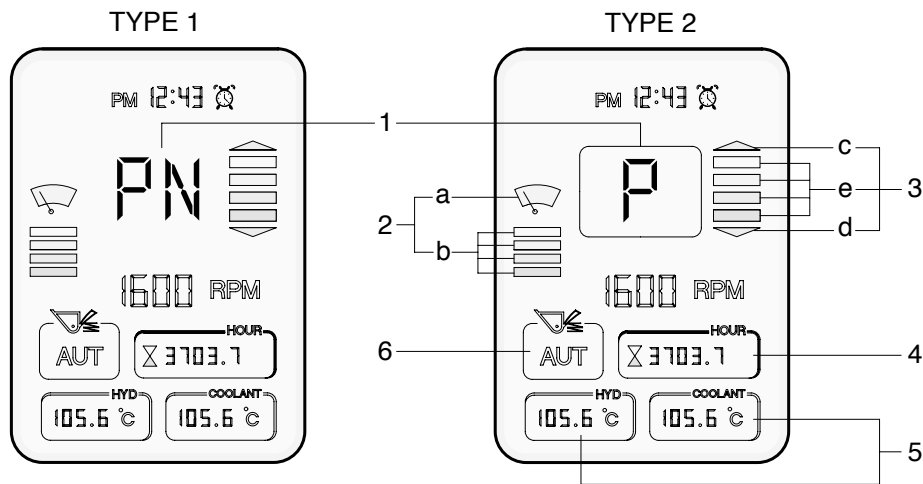


6) LCD



- 1 (□) LCD
- 2 (M) MENU
 - Display main menu
 - Return to the normal display
- 3 (▲) BACK
 - Return to the previous menu
- 4 (▼) NEXT
 - Move to the next selection
- 5 (↵) SELECT
 - Activate the currently chosen item

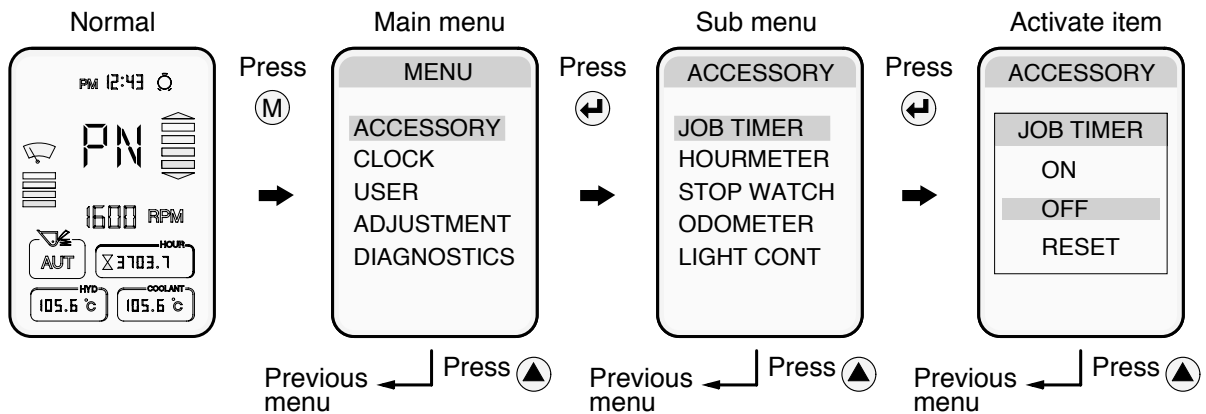
(1) Normal display



No	Symbol	Meaning	Remark
1	△·▽·□	Forward, reverse, neutral	LCD type 1, Display during AEB mode
	F, R, N	Forward, reverse, neutral	LCD type 2, Display during AEB mode
	1, 2, 3, 4	Actual gear	Selected gear in semi-automatic mode
	P	Parking brake mode active	-
2	a	Wiper motor intermittently operating	-
	b	When operating intermittently, it shows an operating time interval.	-
3	c, d	Up and down shifting	c : Forward, d : Reverse
	e	Pre-selected gear	-
4		Hour meter	Display the total operation hours of the machine
5		Engine coolant temperature	Display in accordance with selected items
6 (Option)	AUT	Ride control mode active	Ride control switch AUTO position, see page 7-35
	ON	Ride control mode active	Ride control switch ON position, see page 7-35
	OFF	Ride control mode turn off	Ride control switch MIDDLE position, see page 7-35

Both type1 and type2 are LCD modes and they can be changed each other by operator's selection.

(2) Display map



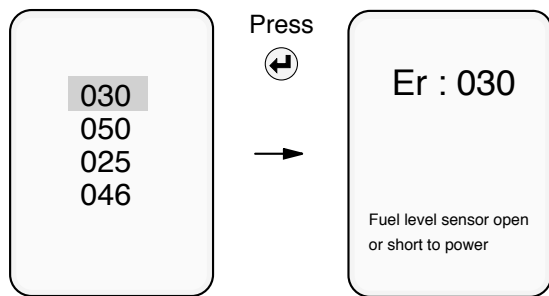
77073CD74

Main group	Sub group	Meaning	Display on LCD	
Accessory	Job timer	<ul style="list-style-type: none"> Measure the various job time. Press Left Arrow : Display ON or OFF. 		
	Stop watch	<ul style="list-style-type: none"> Measures time in seconds. Press Left Arrow : Start. Press Left Arrow again : Stop. 	-	
	Odometer	Latest	Distance until recent times.	
		Total	Total distance.	
	Light control	<ul style="list-style-type: none"> Control of LCD display luminosity. Brightness control : Up Arrow , Down Arrow . 	-	
Clock	Time set	<ul style="list-style-type: none"> When 12H or 24H is selected, the current hour appears. Up Arrow , Down Arrow : input, Left Arrow : setting. 	PM 12:43	
	Clock ON/OFF	<ul style="list-style-type: none"> Left Arrow : Clock display ON or OFF. 		
	Alarm	1	<ul style="list-style-type: none"> Alarm setting. It is possible to set 3 alarms. Stop alarming : Left Arrow or buzzer stop switch. 	
		2		
3				
User	Alternate idle	<ul style="list-style-type: none"> Raise the idle rpm to 1200rpm automatically to warm up the engine. 	-	
	Auto 1/2	Mode 1 (1st-4th)	Automatic travelling speed is applied from 1st to 4th gear.	-
		Mode 2 (2nd-4th)	Automatic travelling speed is applied from 2nd to 4th gear.	-
	Quick shift	Mode 1 (Down/Up)	Press button once : Shift down, press button again ; shift up.	-
		Mode 2 (Down)	Press button every time : Shift to lower gear respectively.	-
	Aux-sw	Auto Select	<ul style="list-style-type: none"> ON : Transmission auto condition. OFF : Transmission semi-auto condition. 	
Clutch Cut-off		<ul style="list-style-type: none"> ON : Clutch cut-off is activated. OFF : Clutch cut-off is cancelled. 	-	

Main group	Sub group	Meaning	Display on LCD display	
Adjustment	Unit	· Choose between metric and inch unit display.		
	Wiper Intermittence	· When using the intermittent function of wiper motor, it regulates operation time.		
	Alternate RPM	· Regulate idle rpm. · Press , : Adjust idle rpm increments (or decrement) by 25rpm.	-	
	Pulse	· Press : Modification.	-	
	AEB	· It controls the disk interval of the transmission.	-	
	ENG/KOR	· English : Display in English. · Korean : Display in Korean.	-	
	Display 1/2	· Type 1 : Indicate with the symbol. · Type 2 : Indicate with a letter.		
Diagnostics	Machine	Fault Code	· Error code display. · Refer to page 3-19.	-
		Monitor	· Hydraulic temperature and battery voltage display. · Press : Display ON or OFF.	
	Engine	Fault Code	· Error code display. · Refer to page 3-20~24.	-
		Monitor	· Engine coolant temperature and oil pressure display · Press : Display ON or OFF.	
	Transmission	Fault Code	· Error code display. · Refer to page 3-25~53.	-
		Monitor	Transmission oil temperature display. · Press : Display ON or OFF.	

(3) Fault code

When selecting the fault code menu, it shows all of the fault codes which mean abnormal conditions of present time.



77073CD60

To go out from fault explanation window, press button.

(Press , to go out to first menu.)

No error will be indicated in case that there's no fault.

Description	Code	Meaning	Remark
Electrical system	010	Power input voltage low	Below 18V
	011	Power input voltage high	Above 38V
	012	Alternator voltage low	Below 5V
	013	Alternator voltage high	Above 36V
	014	Buzzer circuit open or short to ground	
	015	Buzzer circuit short to power	
	016	Wiper relay open or short to ground	
	017	Wiper relay short to power	
Hydraulic system	020	Hydraulic oil temperature sensor open or short to power	
	021	Hydraulic oil temperature sensor short to ground	
Engine system	030	Fuel level sensor open or short to power	
	031	Fuel level sensor short to ground	
	032	Safety relay open or short to ground	Restarting prevention
	033	Safety relay short to power	Restarting prevention
	034	Cooling fan driving valve open or short to ground	
	035	Cooling fan driving valve short to power	
T/M system	050	Auto select switch supply power open or short to power	
	051	Auto select switch supply power short to ground	
	052	Clutch cutoff supply power open or short to power	
	053	Clutch cutoff supply power short to ground	
Steering system	060	Emergency steering relay open or short to ground	Option
	061	Emergency steering relay short to power	Option
Communication	070	MCU communication error	
	071	TCU communication error	
	072	ECM communication error	
Others	080	Speedometer output signal(from TCU) bad	
	081	MCU memory error	
	082	MCU clock error	
	083	MCU clock battery error	
	084	Monitor memory error	

MCU : Machine control unit

TCU : Transmission control unit

ECM : Engine control module

(4) Engine fault code information

Fault code No.	Reason	Effect(only when fault code is active)
111	ECM internal hardware error.	Possible no effect or engine may run rough or not start.
115	No engine speed or position signal detected at pin 17 of the engine harness.	Engine power derate. Possible white smoke.
121	No engine speed or position signal detected at pin 9 of the engine harness	No engine speed and position backup for main speed/position sensor.
122	High voltage detected at the boost pressure sensor signal pin 45 of the engine harness.	Engine will derate to no-boost fueling.
123	Low voltage detected at boost pressure sensor signal pin 45 of the engine harness.	Engine will derate to no-boost fueling.
131	High voltage detected at throttle position signal pin 30 of the machine harness.	Engine idles when idle validation switch indicates idle and ramps up to a default set speed when the idle validation switch indicates off-idle.
132	Low voltage detected at throttle position signal pin 30 of the machine harness.	Engine idles when idle validation switch indicates idle and ramps up to a default set speed when the idle validation switch indicates off-idle.
133	High voltage detected at remote throttle position signal pin 9 of the machine harness.	Engine will not respond to remote throttle input.
134	Low voltage detected at remote throttle position signal pin 9 of the machine harness.	Engine will not respond to remote throttle input.
135	High voltage detected at oil pressure signal pin 33 of the engine harness.	Default value used for oil pressure. No engine protection for oil pressure.
141	Low voltage detected at oil pressure signal pin 33 of the engine harness.	Default value used for oil pressure. No engine protection for oil pressure.
143	Oil pressure signal indicates oil pressure below the low engine protection limit.	Power and/or speed derate and possible engine shutdown if engine protection shutdown feature is enabled.
144	High voltage detected at coolant temperature signal pin 23 of the engine harness.	Default value used for coolant temperature. No engine protection for coolant temperature.
145	Low voltage detected at coolant temperature signal pin 23 of the engine harness.	Default value used for coolant temperature. No engine protection for coolant temperature.
146	Coolant temperature signal indicates coolant temperature has exceeded the minimum engine protection limit.	Power derate and possible engine shutdown if engine protection shutdown feature is enabled.
151	Coolant temperature signal indicates coolant temperature has exceeded the maximum engine protection limit.	Speed derate and possible engine shutdown if engine protection shutdown feature is enabled.
153	High voltage detected at intake manifold temperature signal pin 34 of the engine harness.	Default value used for intake manifold temperature. No engine protection for intake manifold temperature.
154	Low voltage detected at intake manifold temperature signal pin 34 of the engine harness.	Default value used for intake manifold temperature. No engine protection for intake manifold temperature.
155	Intake manifold air temperature signal indicates intake manifold air temperature is above the maximum engine protection limit.	Speed derate and possible engine shutdown if engine protection shutdown feature is enabled.
191	Air conditioner clutch driver signal indicates a short to ground when commanded on.	Air conditioner clutch will not operate.
211	Machine specific fault code has occurred.	No effect on engine performance.
221	High voltage detected at ambient air pressure signal pin 32 of the engine harness.	Engine power derate.
234	Engine speed signal indicates engine speed has exceeded the overspeed limit.	Fuel to injectors disabled until engine speed falls below the overspeed limit.
235	Coolant level signal at pin 37 of the engine harness indicates coolant level is low.	Power and/or speed derate and possible engine shutdown if engine protection shutdown feature is enabled.

Fault code No.	Reason	Effect(only when fault code is active)
241	Vehicle speed signal on pins 8 and 18 of the machine harness has been lost.	EEngine speed limited to "Max. Engine Speed without VSS". Cruise control, gear-down protection and the road speed governor will not work. Trip information data that is based on mileage will be incorrect.
242	Possible tampering has been detected on the vehicle speed circuit pins 8 and 18 of the machine harness	Engine speed limited to " Max. Engine Speed without VSS". Cruise control, gear-down protection and the road speed governor will not work. Trip information data that is based on mileage will be incorrect.
243	Error detected in the exhaust brake relay enable circuit at pin 42 of the engine harness.	Exhaust brake will not work.
245	Error detected in fan clutch relay enable circuit at pin 41 of the engine harness.	Electronic control; module(ECM) can not control the engine cooling fan. Fan will remain on or off.
263	High voltage detected at the fuel temperature sensor signal pin 35 of the engine harness.	Default value used for fuel temperature. Possible low power.
261	Fuel pump control module indicates the fuel temperature has exceeded the pump protection limit.	Power derate.
264	High or low voltage detected at the fuel temperature sensor signal circuit inside the pump controller.	Default value used for fuel temperature. Possible low power.
283	High voltage detected at main engine speed/position sensor voltage supply pin 8 of the engine harness.	ECM will use the engine position signal as a backup. Possible white smoke and power loss.
284	Low voltage detected at main engine speed/ position sensor voltage supply pin 8 of the engine harness.	ECM will use the engine position signal as a backup. Possible white smoke and power loss.
285	The ECM expected information from a multiplexed device but did not receive it soon enough or did not receive it at all.	At least one multiplexed device will not operate properly.
286	The ECM expected info from a multiplexed device but only received a portion of the necessary information	At least on multiplexed device will not operate properly.
287	The machine vehicle electronic control unit (VECU) detected a fault with its throttle pedal.	The engine will only idle.
288	The machine vehicle electronic control unit (VECU) detected a fault with its remote throttle.	The engine will not respond to the remote throttle.
297	High voltage detected at machine pressure signal pin 48 of the machine harness.	Default value used for machine pressure. Lose ability to control machine pressure.
298	Low voltage detected at machine pressure signal pin 48 of the machine harness.	Default value used for machine pressure. Lose ability to control machine pressure.
299	Engine shutdown by device other than key switch before proper engine cool down resulting in filtered load factor above maximum shutdown threshold.	No action taken by the ECM.
319	Power to the real time clock has been interrupted and its setting is no longer valid	Time stamp in ECM powerdown data will be incorrect.
349	Auxiliary speed signal frequency indicates the frequency is above a calibrated threshold value.	Engine will go to idle and lose ability to control speed of the auxiliary device.
352	Low voltage detected at engine position sensor +5 VDC supply, pin 10 of the engine harness.	Default value used for sensors connected to this +5 VDC supply. Engine will derate to no-boost fueling and loss of engine protection for oil pressure, intake manifold pressure, and ambient air pressure.

Fault code No.	Reason	Effect(only when fault code is active)
361	High current detected at the fuel pump control valve.	Fueling to the injectors disabled and engine is shut down.
362	Low or no voltage detected at the fuel pump control valve.	Engine will lose power and may shut down.
363	No fuel control valve movement detected by the fuel pump controller.	Engine power loss.
364	No communications or invalid data transfer rate detected on data link between ECM and fuel pump controller at pins 4 and 13 of the engine harness.	Engine will run at a backup mode set speed when throttle is off-idle.
365	Low voltage detected at fuel pump controller supply voltage circuit.	Engine may lose power and may shut down.
366	Fuel pump controller battery voltage measurement is outside the range between 6 and 24 VDC.	Engine will lose power and may shut down.
367	Fuel pump speed/position sensor signal lost.	Fueling to injectors disabled and engine will shut down.
368	The fuel pump controller can not achieve the timing value being commanded by the engine ECM.	Significant engine power loss.
369	Fuel pump controller does not detect engine position pulse at pin 7 of the engine harness.	Significant engine power loss. Possible white smoke.
372	Fuel pump controller detects continuous voltage at idle select pin 16 of the engine harness or fuel pump controller detects and open circuit or short circuit to ground at idle select pin 16 of the engine harness.	If communication is lost between the ECM and fuel pump controller, engine will only operate at a speed slightly higher than idle, regardless of throttle position.
373	High voltage detected at fuel shut off signal pin 6 of the engine harness.	Fueling to injectors is disabled and engine will shut down.
374	Fuel pump controller has detected an internal error.	Response will vary from some power loss to the engine shutting down.
375	Engine ECM is commanding a fueling or timing value that the pump can not achieve.	Possible no effect or engine may exhibit some power loss.
376	No calibration in the fuel pump controller.	Fueling to injectors disabled and engine will shut down.
377	Fuel pump controller is not powering down when key switch power is removed from the ECM.	Equipment batteries may be drained low during long shutdown periods.
381	Error detected in cold start aid relay 1 enable circuit at pin 41 of the machine harness.	Intake air heater can not be fully energized by the ECM. Possible white smoke and/or hard starting.
382	Error detected in cold start aid relay 2 enable circuit at pin 31 of the machine harness.	Intake air heater can not be fully energized by the ECM. Possible white smoke and/or hard starting.
385	High voltage detected at machine harness sensor +5 VDC supply pin 10 of the machine harness.	Sensors connected to this +5 VDC supply(i.e. remote throttle position sensor) will not function.
386	High voltage detected at the engine harness sensor +5 VDC supply pin 10 of the engine harness.	Default value used for sensors connected to this +5 volts supply. Engine will derate to no-boost fueling and loss of engine protection for oil pressure, intake manifold temperature, and coolant temperature.
387	High voltage detected at the throttle position sensor +5 VDC supply pin 29 of the machine harness.	Engine idles when idle validation switch indicates idle and ramps up to a default set speed when idle validation switch indicates off-idle.
391	Error detected in power supply relay enable circuit at pin 43 of the engine harness.	Possible no effect on performance or engine may not run.

Fault code No.	Reason	Effect(only when fault code is active)
415	Oil pressure signal indicates oil pressure elow the very low engine protection limit.	Speed derate and possible engine shutdown if engine protection shutdown feature is enagled.
418	Water-in-fuel signal indicates the water in the fuel filter needs to be drained.	Excessive water in the fuel can lead to severe fuel sysm damage.
422	Voltage detected simultaneously on both the coolant level high and low signal pins 27 and 37 of the engine harness or no voltage detected on either pin.(Fault is active for switch type coolant level sensors only)	No engine protection for coolant level.
429	Low voltage detected at water-in-fuel signal pin 40 of the machine harness.	No water-in-fuel protection.
431	Idle validation signals on pins 25 and 26 of the machine harness indicate voltage detected simultaneously on both pins or no voltage detected on either pin.	No effect on performance, but loss of idle validation.
432	Idle validation signal at pin 26 of the machine harness indicates the throttle is at the idle position when the throttle position signal at pin 30 of the machine harness indicates the throttle is not at the idle position...OR...idle validation signal at pin 26 of the machine harness indicates the throttle is not at the idle position when the throttle position signal at pin 30 of the machine harness indicates the throttle is at the idle position.	Engine will only idle.
433	Boost pressure signal indicates boost pressure is high when other engine parameters(i.e. speed and load) indicate boost pressure should be low...OR...boost pressure is low when other engine parameters indicate it should be high.	Possible overfueling during acceleration. Increase in black smoke.
434	All data gathered by the ECM since the last key on(i.e.faults, trip information data. etc.)was not stored to permanent memory at the last key off.	None on performance. Fault code table, trip information data, maintenance monitor data, trending data and user activated datalogger data may be inaccurate.
441	Voltage detected at ECM power supply pins 38, 39, 40 and 50 of the engine harness indicates the ECM supply voltage fell below 6 VDC.	Engine will die or run rough.
442	Voltage detected at ECM power supply pins 38, 39, 40 and 50 of the engine harness indicates the ECM supply voltage is above the maximum system voltage level.	None on performance.
443	Low voltage detected at throttle position sensor +5 VDC supply pin 29 of the machine harness.	Engine idles when idle validation switch indicates idle and ramps up to a default set speed when idle validation switch indicates off-idle.
444	Low voltage detected at machine harness sensor +5 VDC supply pin 10 of the machine harness.	Sensors connected to this +5 VDC supply (i.e. remote throttle position sensor) will not function.
488	Intake manifold temperature signal indicates intake manifold temperature is above the minimum engine protection limit.	Power derate and possible engine shutdown if engine protection shutdown feature is enabled.
489	Auxiliary device speed signal on pins 8 and 18 of the OEM harness is out of range of the ECM threshold.	Lose ability to control the speed of the auxiliary device.
515	High voltage detected at the auxiliary +5 VDC sensor supply voltage pin 49 of the engine harness.	Auxiliary device will not function.
516	Low voltage detected at the auxiliary +5 VDC sensor supply voltage pin 49 of the engine harness.	Auxiliary device will not function.

Fault code No.	Reason	Effect(only when fault code is active)
517	A mechanically stuck fuel control valve has been detected by the fuel pump controller.	Engine may shut down.
524	Error detected on the high speed governor droop selection switch in put pin 24 of the engine harness.	Operator can not select alternate high speed governor droop. Normal droop is used.
527	Error detected in the dual output driver "A" circuit pin 5 of the machine harness.	The device being controlled by the dual output driver "A" signal will not function properly.
528	Error detected on the torque curve selection switch input pin 39 of the machine harness.	Operator can not select alternate torque curves. Normal torque curve is used.
529	Error detected in the dual output driver "B" circuit pin 1 of the engine harness.	The device being controlled by the dual output driver "B" signal will not function properly.
551	Idle validation signals on pins 25 and 26 of the machine harness indicate voltage detected simultaneously on both pins.	Engine will only idle.
599	Software has initiated an engine shutdown based on machine sensor inputs	Engine will shutdown.
611	ECM detected the engine has initiated a protection shutdown or has been keyed off while above a specified load limit.	No effect.
768	Error detected in the output device driver(VGT or transmission shift modulation signal) signal pin 21 of the machine harness.	Can not control the VGT or transmission, depending on application.

Some fault codes are not applied to this machine.

(5) Display during AEB mode

Symbol	Meaning	Remarks
K1~K4, KV, KR	Calibrating clutch K1~K4, KV or KR respectively	
- And Kx	Wait for start, initialization of clutch Kx, x : 1, 2, 3, 4, V, R	
And Kx	Fast fill time determination of clutch Kx	
= And Kx	Compensating pressure determination of clutch Kx	
OK	Calibration for all clutches finished	Transmission stays in neutral, you have to restart the TCU(Ignition off/on) after removing AEB-Starter
STOP	AEB canceled(Activation stopped)	Transmission stays in neutral, you have to restart the TCU(Ignition off/on)
STOP and Kx	AEB stopped, clutch Kx can't be calibrated	Transmission stays in neutral, you have to restart the TCU(Ignition off/on)
Spanner and Kx	Kx couldn't be calibrated, AEB finished	Transmission stays in neutral, you have to restart the TCU(Ignition off/on)
E	Engine speed too low, - Raise engine speed	
E	Engine speed too high, - Lower engine speed	
T	Transmission oil temperature too low, - Heat up transmission	
T	Transmission oil temperature too high, - Cool down transmission	
FT	Transmission temperature not in defined range during calibration	Transmission stays in neutral, you have to restart the TCU(Ignition off/on)
FB	Operating mode not NORMAL or transmission temperature sensor defective or storing of calibrated values to EEPROM has failed	Transmission stays in neutral, you have to restart the TCU(Ignition off/on)
FO	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)

※ **AEB mode** : It controls the disk internal of the transmission, automatically.

Refer to page 7-28, 29.

(6) Definition of operating modes

Normal

There's no failure detected in the transmission system or the failure has no or slight effects on transmission control. TCU will work without or in special cases with little limitations.(See following table)

Substitute clutch control

TCU can't change the gears or the direction under the control of the normal clutch modulation. TCU uses the substitute strategy for clutch control. All modulations are only time controlled. (Comparable with EST 25)

Limp-home

The detected failure in the system has strong limitations to transmission control. TCU can engage only one gear in each direction. In some cases only one direction will be possible.

TCU will shift the transmission into neutral at the first occurrence of the failure. First, the operator must shift the gear selector into neutral position.

If output speed is less than a threshold for neutral to gear and the operator shifts the gear selector into forward or reverse, the TCU will select the limp-home gear.

If output speed is less than a threshold for reversal speed and TCU has changed into the limp-home gear and the operator selects a shuttle shift, TCU will shift immediately into the limp-home gear of the selected direction.

If output speed is greater than the threshold, TCU will shift the transmission into neutral. The operator has to slow down the vehicle and must shift the gear selector into neutral position.

Transmission-shutdown

TCU has detected a severe failure that disables control of the transmission.

TCU will shut off the solenoid valves for the clutches and also the common power supply(VPS1).

Transmission shifts to neutral. The park brake will operate normally, also the other functions which use ADM1 to ADM8.

The operator has to slow down the vehicle. The transmission will stay in neutral.

TCU-shutdown

TCU has detected a severe failure that disables control of system.

TCU will shut off all solenoid valves and also both common power supplies(VPS1, VPS2). The park brake will engage, also functions are disabled which use ADM 1 to ADM 8.

The transmission will stay in neutral.

(7) Abbreviations

OC : Open circuit

SC : Short circuit

OP mode : Operating mode

TCU : Transmission control unit

EEC : Electronic engine controller

PTO : Power take off

(8) Table of fault codes

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
11	48	<p>Logical error at gear range signal TCU detected a wrong signal combination for the gear range</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	46	<p>Logical error at direction select signal TCU detected a wrong signal combination for the direction</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	95	<p>Logical error at engine derating device TCU detected no reaction of engine while derating device active</p>	After selecting neutral, TCU change to OP mode limp home	<ul style="list-style-type: none"> • Check engine derating device 	This fault is reset after power up of TCU
15	176	<p>Logical error at direction select signal 2 shift lever TCU detected a wrong signal combination for the direction</p> <ul style="list-style-type: none"> • 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 selector active	<ul style="list-style-type: none"> • 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	178	<p>Logical error at axle connection Feedback axle connection measured by TCU and output signal axle connection don't fit</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cables from TCU to feedback axle connection switch • Check signals of the feedback axle connection switch 	

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
21	32	S.C. to battery voltage at clutch cut off input The measured voltage is too high: <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the clutch cut off sensor 	
22	29	S.C. to ground or O.C. at clutch cut off input The measured voltage is too low: <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the clutch cut off sensor 	
23		S.C. to battery voltage at load sensor input The measured voltage is too high: <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
25	33	<p>S.C. to battery voltage or O.C. at transmission sump temperature sensor input The measured voltage is too high:</p> <ul style="list-style-type: none"> • 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 	<p>No reaction, TCU use default temperature OP mode : Normal</p>	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the temperature sensor 	
26	30	<p>S.C. to battery voltage or O.C. at transmission sump temperature sensor input The measured voltage is too low:</p> <ul style="list-style-type: none"> • Cable is defective and is contacted to vehicle ground • Temperature sensor has an internal defect • Connector pin is contacted to vehicle ground 	<p>No reaction, TCU uses default temperature OP mode : Normal</p>	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the temperature sensor 	
27	76	<p>S.C. to battery voltage or O.C. at retarder temperature sensor input The measured voltage is too high:</p> <ul style="list-style-type: none"> • 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 	<p>No reaction, TCU uses default temperature OP mode : Normal</p>	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the temperature sensor 	
28	74	<p>S.C. to ground at retarder temperature sensor input The measured voltage is too low:</p> <ul style="list-style-type: none"> • Cable is defective and is contacted to vehicle ground • Temperature sensor has an internal defect • Connector pin is contacted to vehicle ground 	<p>No reaction, TCU uses default temperature OP mode : Normal</p>	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the temperature sensor 	

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
27	76	<p>S.C. to battery voltage or O.C. at converter output temperature sensor input The measured voltage is too high:</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the temperature sensor 	
28	74	<p>S.C. to ground at converter output temperature sensor input The measured voltage is too low:</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the temperature sensor 	
31	38	<p>S.C. to battery voltage or O.C. at engine speed input TCU measures a voltage higher than 7.00V at speed input pin</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the speed sensor 	
32	34	<p>S.C. to ground at engine speed input TCU measures a voltage less than 0.45V at speed input pin</p> <ul style="list-style-type: none"> • Cable/connector is defective and is contacted to vehicle ground • Speed sensor has an internal defect 	OP mode : Substitute clutch control	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the speed sensor 	

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
33	42	<p>Logical error at engine speed input TCU measures a engine speed over a threshold and the next moment the measured speed is zero</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	39	<p>S.C. to battery voltage or O.C. at turbine speed input TCU measures a voltage higher than 7.00V at speed input pin</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the speed sensor 	
35	35	<p>S.C. to ground at turbine speed input TCU measures a voltage less than 0.45V at speed input pin</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	43	<p>Logical error at turbine speed input TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the speed sensor • Check the sensor gap 	

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
37	40	<p>S.C. to battery voltage or O.C. at internal speed input TCU measures a voltage higher than 7.00V at speed input pin</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the speed sensor 	
38	36	<p>S.C. to ground at turbine speed input TCU measures a voltage less than 0.45V at speed input pin</p> <ul style="list-style-type: none"> • Cable/connector is defective and is contacted to vehicle ground • Speed sensor has an internal defect 	OP mode : Substitute clutch control	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the speed sensor 	
39	44	<p>Logical error at internal speed input TCU measures a internal speed over a threshold and at the next moment the measured speed is zero</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	41	<p>S.C. to battery voltage or O.C. at output speed input TCU measures a voltage higher than 12.5V at speed input pin</p> <ul style="list-style-type: none"> • 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 	<p>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</p>	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the speed sensor 	

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
3B	37	<p>S.C. to ground at output speed input TCU measures a voltage less than 1.00V at speed input pin</p> <ul style="list-style-type: none"> • Cable/connector is defective and is contacted to vehicle ground • Speed sensor has an internal defect 	<p>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</p>	<ul style="list-style-type: none"> • Check the cable from TCU to the sensor • Check the connectors • Check the speed sensor 	
3C	45	<p>Logical error at output speed input TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero</p> <ul style="list-style-type: none"> • Cable/connector is defective and has bad contact • Speed sensor has an internal defect • Sensor gap has the wrong size 	<p>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</p>	<ul style="list-style-type: none"> • 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	71	<p>Turbine speed zero doesn't fit to other speed signals</p>	-	-	Not used
3E	72	<p>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.</p> <ul style="list-style-type: none"> • Speed sensor has an internal defect • Sensor gap has the wrong size 	<p>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</p>	<ul style="list-style-type: none"> • 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)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
71	22	<p>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</p> <ul style="list-style-type: none"> • 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 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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 Chapter (9)
72	10	<p>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</p> <ul style="list-style-type: none"> • Cable/connector is defective and has contact to vehicle ground • Regulator has an internal defect 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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 Chapter (9)
73	16	<p>O.C. at clutch K1 The measured resistance value of the valve is out of limit</p> <ul style="list-style-type: none"> • Cable/connector is defective and has no contact to TCU • Regulator has an internal defect 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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 Chapter (9)
74	23	<p>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</p> <ul style="list-style-type: none"> • 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 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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 Chapter (9)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
75	11	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)
76	17	O.C. at clutch K2 The measured resistance value of the valve is out of limit <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)
77	24	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)
78	12	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
79	18	O.C. at clutch K2 The measured resistance value of the valve is out of limit <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)
7A	78	S.C. to battery voltage at converter clutch	-	-	
7B	79	S.C. to ground at converter clutch	-	-	
7C	80	O.C. at converter clutch	-	-	Not used
7D	166	S.C. ground at engine derating device <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Not used * See Chapter (9)
7E	168	S.C. battery voltage at engine derating device <ul style="list-style-type: none"> • Cable/connector is defective and is contacted to battery voltage • Engine derating device has an internal defect 	No reaction OP mode : Normal	<ul style="list-style-type: none"> • 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 Chapter (9)
7F	167	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
81	25	<p>S.C. to battery voltage at clutch K4 The measured resistance value of the valve is out of limit, the voltage at K4 valve is too high</p> <ul style="list-style-type: none"> • 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 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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 Chapter (9)
82	13	<p>S.C. to ground at clutch K4 The measured resistance value of the valve is out of limit, the voltage at K4 valve is too low</p> <ul style="list-style-type: none"> • Cable/connector is defective and has contact to vehicle ground • Regulator has an internal defect 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • Check the cable from TCU to the engine derating device • Check the connectors from gearbox to TCU • Check the regulator resistance* • Check internal wire harness of the gearbox 	* See Chapter (9)
83	19	<p>O.C. at clutch K4 The measured resistance value of the valve is out of limit</p> <ul style="list-style-type: none"> • Cable/connector is defective and has contact to TCU • Regulator has an internal defect 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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 Chapter (9)
84	26	<p>S.C. to battery voltage at clutch K4 The measured resistance value of the valve is out of limit, the voltage at K4 valve is too high</p> <ul style="list-style-type: none"> • 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 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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 Chapter (9)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
85	14	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)
86	20	O.C. at clutch KV The measured resistance value of the valve is out of limit <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)
87	27	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)
88	15	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)
89	21	O.C. at clutch KR The measured resistance value of the valve is out of limit <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
91	1	<p>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</p> <ul style="list-style-type: none"> • Cable is defective and is contact to vehicle ground • Backup alarm device has an internal defect • Connector pin is contacted to vehicle ground 	<p>Backup alarm will be on until TCU power down even if fault vanishes(Loose connection) OP mode : Normal</p>	<ul style="list-style-type: none"> • 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 Chapter (9)
92	3	<p>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</p> <ul style="list-style-type: none"> • Cable is defective and is contacted to battery voltage • Backup alarm device has an internal defect • Connector pin is contacted to battery voltage 	<p>No reaction OP mode : Normal</p>	<ul style="list-style-type: none"> • 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 Chapter (9)
93	2	<p>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</p> <ul style="list-style-type: none"> • Cable is defective and has no connection to TCU • Backup alarm device has an internal defect • Connector has no connection to TCU 	<p>No reaction OP mode : Normal</p>	<ul style="list-style-type: none"> • 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 Chapter (9)
94	4	<p>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</p> <ul style="list-style-type: none"> • Cable is defective and is connection to vehicle ground • Starter interlock relay has an internal defect • Connector pin is contacted to vehicle ground 	<p>No reaction OP mode : Normal</p>	<ul style="list-style-type: none"> • 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 Chapter (9)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
95	6	<p>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</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)
96	5	<p>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</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)
97	7	<p>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</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)
98	9	<p>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</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (9)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
99	8	<p>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</p> <ul style="list-style-type: none"> • Cable is defective and has no connection to TCU • Park brake solenoid has an internal defect • Connector has no connection to TCU 	<p>No reaction Optional : Some customers TCU shifts to neutral caused by park brake feed back OP mode : Normal</p>	<ul style="list-style-type: none"> • 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 Chapter (9)
9A	66	<p>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</p> <ul style="list-style-type: none"> • Cable is defective and is contacted to vehicle ground • Converter clutch solenoid has an internal defect • Connector pin is contacted to vehicle ground 	<p>No reaction OP mode : Normal</p>	<ul style="list-style-type: none"> • 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 Chapter (9)
9B	67	<p>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</p> <ul style="list-style-type: none"> • Cable is defective and has no connection to TCU • Converter clutch solenoid has an internal defect • Connector has no connection to TCU 	<p>Converter clutch always open, retarder not available OP mode : Normal</p>	<ul style="list-style-type: none"> • 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 Chapter (9)
9C	68	<p>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</p> <ul style="list-style-type: none"> • Cable is defective and has no contacted to battery voltage • Converter clutch solenoid has an internal defect • Connector pin is contacted to battery voltage 	<p>No reaction OP mode : Normal</p>	<ul style="list-style-type: none"> • 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 Chapter (9)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
9D	81	<p>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</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the retarder solenoid • Check the connectors from retarder solenoid to TCU • Check the resistance* of retarder solenoid 	* See Chapter (9)
9E	82	<p>O.C. at retarder solenoid TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the retarder solenoid • Check the connectors from retarder solenoid to TCU • Check the resistance* of retarder solenoid 	* See Chapter (9)
9F	83	<p>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</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the retarder solenoid • Check the connectors from retarder solenoid to TCU • Check the resistance* of retarder solenoid 	* See Chapter (9)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
A1	84	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the difflock solenoid • Check the connectors from difflock solenoid to TCU • Check the resistance* of difflock solenoid 	* See Chapter (9)
A2	85	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the difflock solenoid • Check the connectors from difflock solenoid to TCU • Check the resistance* of difflock solenoid 	* See Chapter (9)
A3	86	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the difflock solenoid • Check the connectors from difflock solenoid to TCU • Check the resistance* of difflock solenoid 	* See Chapter (9)
A4	96	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check the cable from TCU to the warning device • Check the connectors from warning device to TCU • Check the resistance* of warning device 	* See Chapter (9)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
A5	97	<p>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</p> <ul style="list-style-type: none"> • Cable is defective and has no connection to TCU • Warning device has an internal defect • Connector has no connection to TCU 	<p>No reaction OP mode : Normal</p>	<ul style="list-style-type: none"> • Check the cable from TCU to the warning device • Check the connectors from warning device to TCU • Check the resistance* of warning device 	* See Chapter (9)
A6	98	<p>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</p> <ul style="list-style-type: none"> • Cable is defective and has is contacted to battery voltage • Warning device has an internal defect • Connector pin is contacted to battery voltage 	<p>No reaction OP mode : Normal</p>	<ul style="list-style-type: none"> • Check the cable from TCU to the warning device • Check the connectors from warning device to TCU • Check the resistance* of warning device 	* See Chapter (9)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
B1	60	<p>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</p> <ul style="list-style-type: none"> • 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 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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	61	<p>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</p> <ul style="list-style-type: none"> • 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 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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	62	<p>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</p> <ul style="list-style-type: none"> • 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 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
B4	63	<p>Slippage at clutch K4 TCU calculates a differential speed at closed clutch K4. If this calculated value is out of range, TCU interprets this as slipping clutch</p> <ul style="list-style-type: none"> • Low pressure at clutch K4 • Low main pressure • Wrong signal at internal speed sensor • Wrong signal at turbine speed sensor • Wrong size of the sensor gap • Clutch is defective 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • Check pressure at clutch K4 • 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 	
B5	64	<p>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</p> <ul style="list-style-type: none"> • 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 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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	65	<p>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</p> <ul style="list-style-type: none"> • 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 	<p>TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • 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 	

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
B7	87	Overtemp sump TCU measured a temperature in the oil sump that is over the allowed threshold.	No reaction OP mode : Normal	<ul style="list-style-type: none"> • Cool down machine • Check oil level • Check temperature sensor 	
B8	88	Overtemp retarder TCU measured a temperature in the retarder oil that is over the allowed threshold	TCU disables retarder OP mode : Normal	<ul style="list-style-type: none"> • Cool down machine • Check oil level • Check temperature sensor 	
B9	89	Overspend engine	Retarder applies OP mode : Normal	-	
BA	90	Differential pressure oil filter TCU measured a voltage at differential pressure switch out of the allowed range <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check oil filter • Check wiring from TCU to differential pressure switch • Check differential pressure switch(Measure resistance) 	
BB	172	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 <ul style="list-style-type: none"> • 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 		<ul style="list-style-type: none"> • 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 	

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
BD	169	<p>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</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (7)
BE	171	<p>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</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (7)
BF	170	<p>O.C. at engine brake TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Chapter (7)

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
C3	91	Overtemp converter output TCU measured a oil temperature at the converter output that is the allowed threshold	No reaction OP mode : Normal	<ul style="list-style-type: none"> • Cool down machine • Check oil level • Check temperature sensor 	
C4	129	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 chapter (9)
C5	131	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 chapter (9)
C6	130	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 chapter (9)

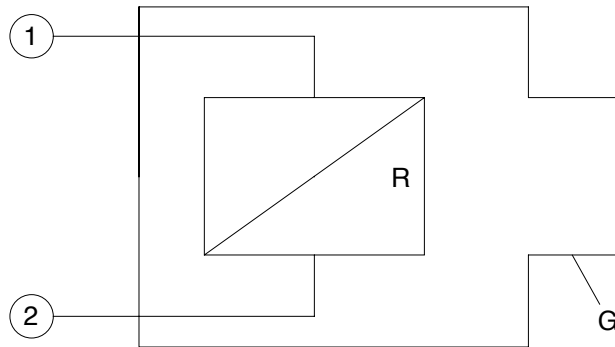
Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
D1	54	S.C. to battery voltage at power supply for sensors TCU measures more than 6V at the pin AU1 (5V sensor supply)	See fault codes No.21 to 2C	<ul style="list-style-type: none"> • 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	55	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	<ul style="list-style-type: none"> • 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	53	Low voltage at battery Measured voltage at power supply is lower than 18V(24V device)	Shift to neutral OP mode : TCU shutdown	<ul style="list-style-type: none"> • Check power supply battery • Check cables from batteries to TCU • Check connectors from batteries to TCU 	
D4	52	High voltage at battery Measured voltage at power supply is higher than 32.5V(24V device)	Shift to neutral OP mode : TCU shutdown	<ul style="list-style-type: none"> • Check power supply battery • Check cables from batteries to TCU • Check connectors from batteries to TCU 	
D5	57	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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check fuse • Check cables from gearbox to TCU • Check connectors from gearbox to TCU • Replace TCU 	

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
D6	58	<p>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</p> <ul style="list-style-type: none"> • 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 	<p>Shift to neutral OP mode : TCU shutdown</p>	<ul style="list-style-type: none"> • Check fuse • Check cables from gearbox to TCU • Check connectors from gearbox to TCU • Replace TCU 	

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
E1	91	S.C. battery voltage at speedometer output	-	-	Not used
E2	92	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 <ul style="list-style-type: none"> • Cable or connectors are defective and are contacted to battery voltage • Display has an internal defect 	No reaction OP mode : Normal	<ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Cable or connectors are defective and are contacted to battery voltage • Display has an internal defect 	No reaction OP mode : Normal	<ul style="list-style-type: none"> • Check the cable from TCU to the display • Check the connectors at the display • Change display 	
E5	93, 104	Communication failure on DeviceNet	Shift to neutral OP mode : TCU shutdown	<ul style="list-style-type: none"> • Check Omron master • Check wire of DeviceNet-Bus • Check cable to Omron master 	
E5	104	DISPID1 timeout Timeout of CAN-message DISPID1 from display controller <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Check display controller • Check wire of CAN-Bus • Check cable display controller 	

Fault code (Hex)	Int. code (Dec)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
F1	51	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	56	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	59	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	173	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	174	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	

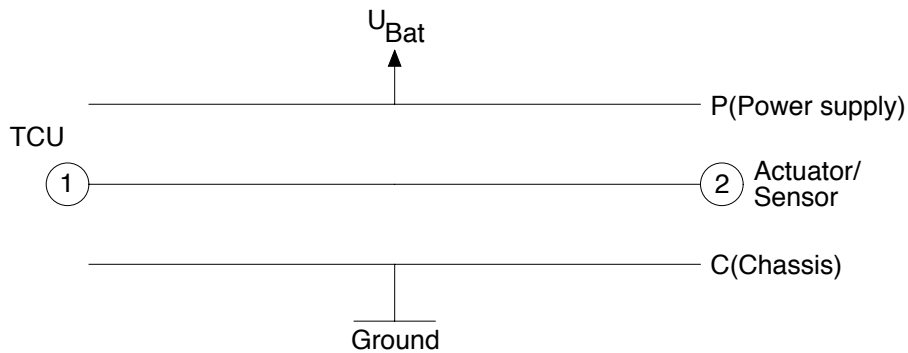
(9) Measuring of resistance at actuator/sensor and cable
Actuator



76043PT19

Open circuit	$R_{12} = R_{1G} = R_{2G} =$
Short cut to ground	$R_{12} = R; \quad R_{1G} = 0, R_{2G} = R$ or $R_{1G} = R, R_{2G} = 0$ (For S.C. to ground, G is connected to vehicle ground)
Short cut to battery	$R_{12} = R; \quad R_{1G} = 0, R_{2G} = R$ or $R_{1G} = R, R_{2G} = 0$ (For S.C. to battery, G is connected to battery voltage)

Cable

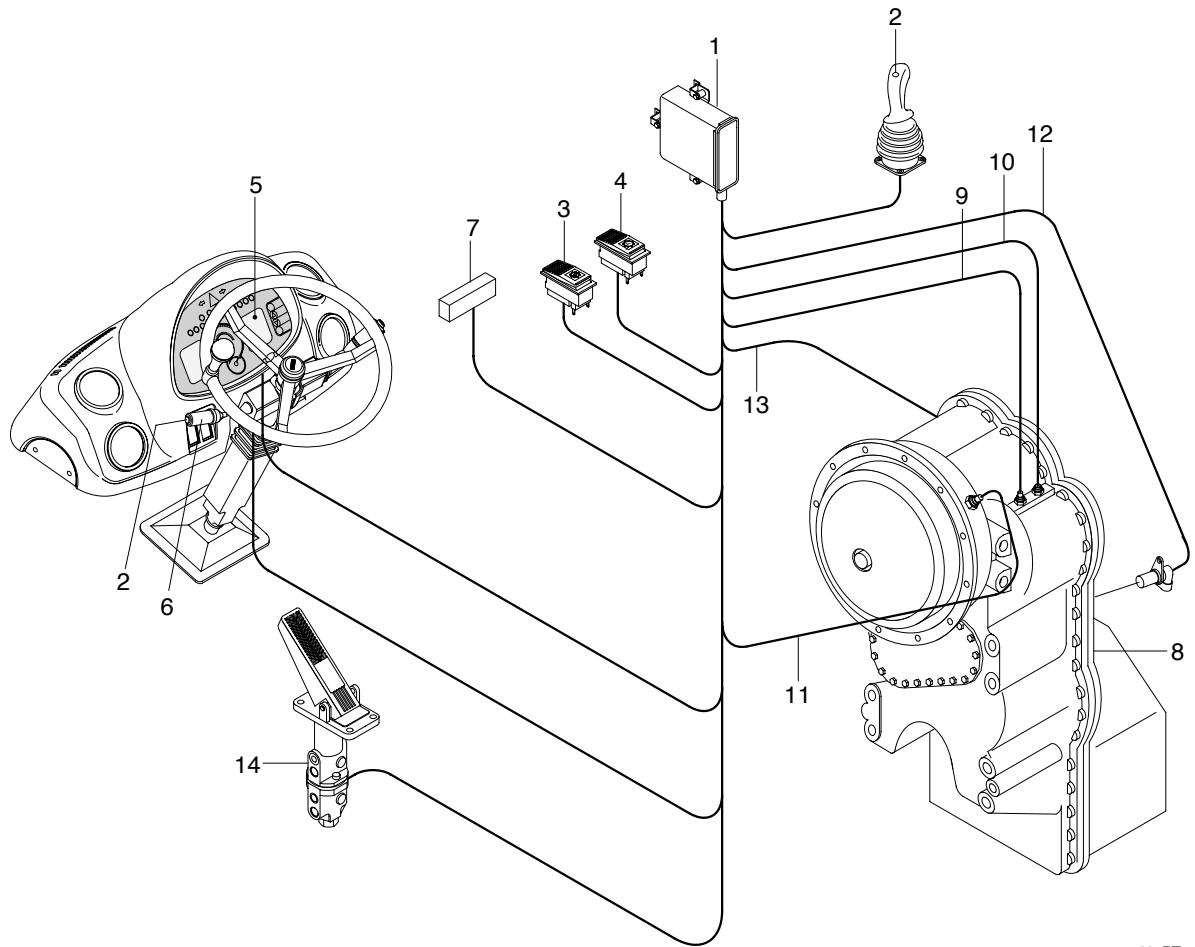


76043PT20

Open circuit	$R_{12} = R_{1P} = R_{1C} = R_{2P} = R_{2C} =$
Short cut to ground	$R_{12} = 0; \quad R_{1C} = R_{2C} = 0, \quad R_{1P} = R_{2P} =$
Short cut to battery	$R_{12} = 0; \quad R_{1C} = R_{2C} = 0, \quad R_{1P} = R_{2P} = 0$

7) ELECTRIC CONTROL UNIT

(1) Complete system



7607PT11

- 1 Control unit(EST-37A)
- 2 Kickdown switch
- 3 Clutch cut off switch
- 4 Full automatic switch
- 5 LCD
- 6 Gear selector(DW-3) with integrated kickdown switch
- 7 Supply-system connection
- 8 Transmission
- 9 Cable to inductive transmitter - speed central gear train
- 10 Cable to inductive transmitter - speed turbine
- 11 Cable to inductive transmitter - speed engine
- 12 Cable to speed sensor output and speedometer
- 13 Cable to plug connection on the electro - hydraulic control unit
- 14 Brake pressure sensor/load sensor

(2) Description of the basic functions

The powershift-reversing transmissions will be equipped with the electronic transmission control unit(EST-37A), developed for them.

The system is processing the wishes of the driver according to the following criteria.

- Speed definition as a function of gear selector position, driving speed and load level.

- Protection against operating errors, as far as possible and practical.
- Protection against overspeeds(On the basis of engine and turbine speed).
- Reversing-automatic system(Driving speed-dependent).
- Pressure cut off(Disconnecting of the drive train for maximum power on the power take-off).
- Switch for manual or automatic operation.
- Reversing function button, respectively kickdown function.

(3) Gearshifts

The control unit(EST-37A) shifts the required speeds fully-automatically under consideration of the following criteria.

- Gear selector position
- Driving speed
- Load level

At the same time, the following speeds are picked up by the control unit(EST-37A).

- n Engine
- n Turbine
- n Central gear train
- n Output

- Neutral position

Neutral position is selected through the gear selector.

After the ignition is turned on, the electronics remains in the waiting state; By the position **neutral** of the gear selector, respectively by pressing on the key **neutral**, the control unit(EST-37A) becomes ready for operation.

Now, a speed can be engaged.

- Speed engagement

In principle, the speed, adapted to the driving speed(At standing, or rolling machine), will be engaged. The engagement is realized in dependence on load and rotational speed.

- Upshifting under load

Upshifting under load will be then realized if the machine can still accelerate by it.

- Downshifting under load

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

- Upshifting in coasting condition

In the coasting condition, the upshifting will be suppressed if the speed of the machine on a slope shall not be further increased.

- Downshifting in coasting condition

Downshiftings in the coasting condition will be realized if the machine shall be retarded.

- Reversing

At speeds below the reversing limit, direct reversing can be carried out at any time in the speeds 1F 1R and 2F 2R(As a rule, this is the maximum driving speed of the 2nd speed).

Reversings in the speeds 3 and 4 are realized dependent on the driving speed.

- Above the programmed reversing limit, the machine is braked down by downshifts of the electronic control unit(EST-37A) to the permitted driving speed, and only then, the reversing into the correspondingly preselected speed will be carried out.
- Below the permitted driving speed, the reversing is carried out immediately.

(4) Specific kickdown function

By means of the kickdown-button, integrated in the gear selector, it is at any time possible to select in the speeds 2F and 2R(i.e. position 2 of the gear selector, at automatic mode also in the 2nd speed of the automatic range) the 1st speed by a short touch. This kickdown state can be cancelled by :

1. Pressing the kickdown-button again
2. Realization of a reversal operation
3. Change of the gear selector position by the following modification
Gear selector(DW-3) - (Rotation) of the driving position 1...4.

The kickdown function will be always terminated by shifting to neutral.

(5) Clutch cut off

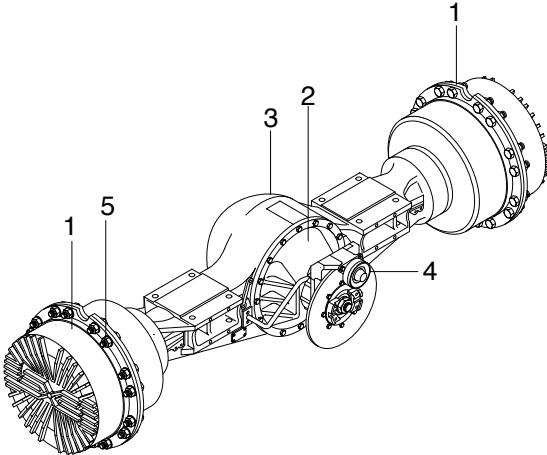
Especially at wheel loaders, the clutch cut off can be activated through a switch signal. It is interrupting the power flow in the transmission as long as this signal is active. Besides, this function can be used for the transmission-neutral shifting at applied hand brake or as **emergency-stop**(In this case, a restarting is only possible through the gear selector-neutral position).

5. AXLE

1) OPERATION

- The power from the engine passes through torque converter, transmission and drive shafts, and is then sent to the front and rear axles.
- Inside the axles, the power passes from the bevel pinion to the bevel gear and is sent at right angles. At the same time, the speed is reduced and passes through the both differentials to the axle shafts. The power of the axle shafts is further reduced by planetary-gear-type final drives and is sent to the wheels.

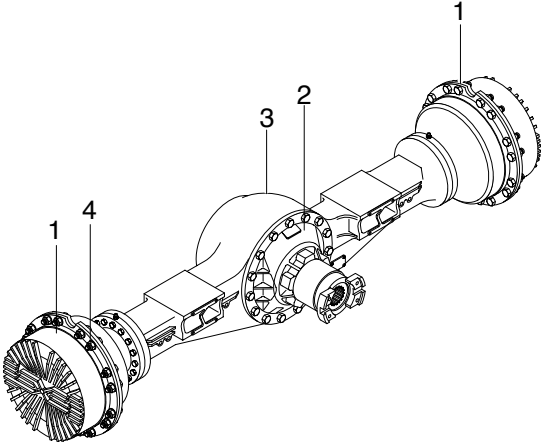
(1) Front axle



7607PT12

- | | | | | | |
|---|--------------|---|---------------|---|-----------|
| 1 | Final drive | 3 | Housing | 5 | Wheel nut |
| 2 | Differential | 4 | Parking brake | | |

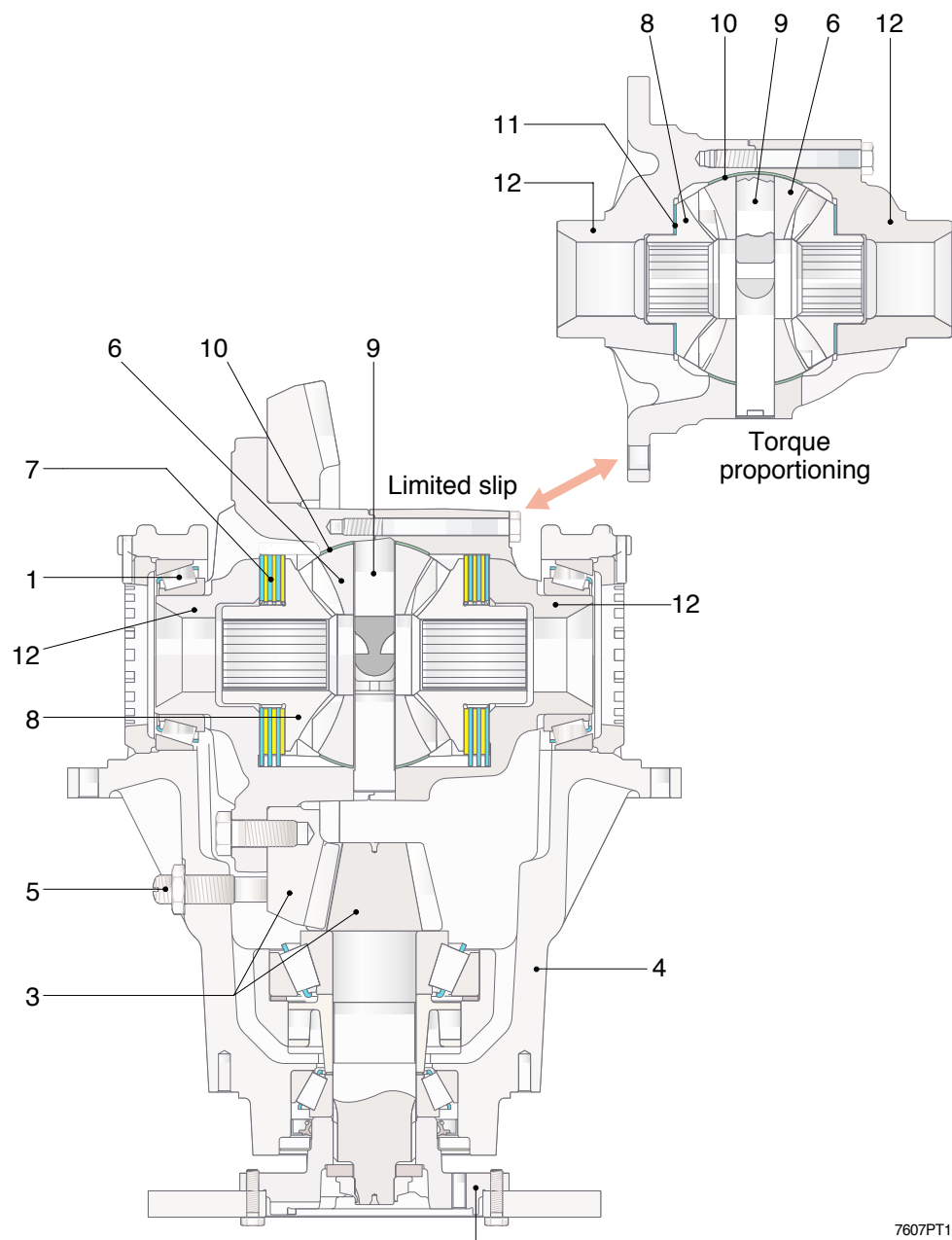
(2) Rear axle



7607PT13

- | | | | | | | | |
|---|-------------|---|--------------|---|---------|---|-----------|
| 1 | Final drive | 2 | Differential | 3 | Housing | 4 | Wheel nut |
|---|-------------|---|--------------|---|---------|---|-----------|

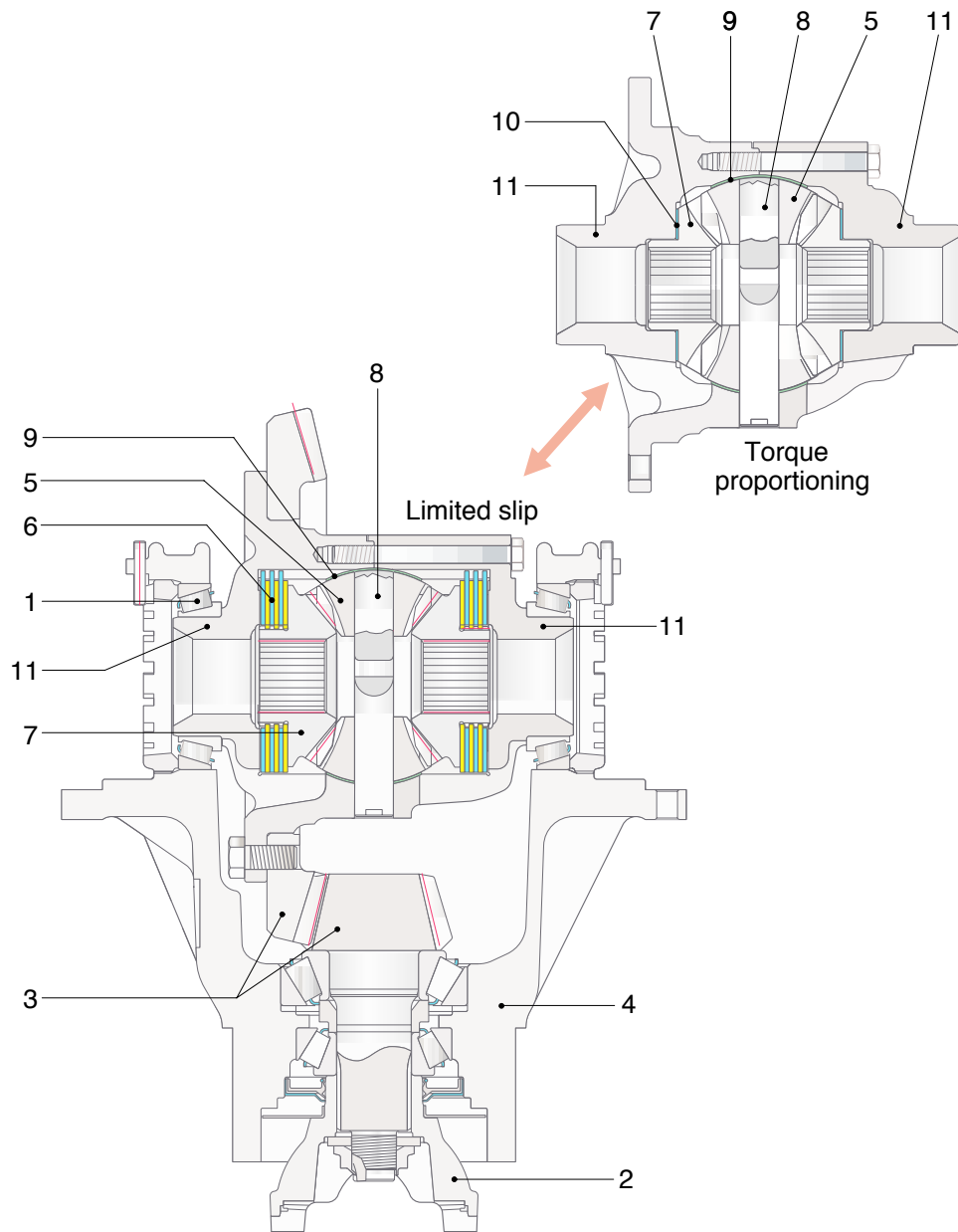
2) FRONT AXLE DIFFERENTIAL SECTION



- | | | | |
|---|----------------------|----|----------------------------------|
| 1 | Roller bearing | 7 | Clutch |
| 2 | Input flange | 8 | Planetary gear |
| 3 | Bevel gear set | 9 | Spider |
| 4 | Differential housing | 10 | Bevel thrust washer of side gear |
| 5 | Adjusting screw | 11 | Thrust washer of planetary gear |
| 6 | Side gear | 12 | Half case |

7607PT16

3) REAR AXLE DIFFERENTIAL SECTION



- | | | | |
|---|----------------------|----|----------------------------------|
| 1 | Roller bearing | 7 | Planetary gear |
| 2 | Input flange | 8 | Spider |
| 3 | Bevel gear set | 9 | Bevel thrust washer of side gear |
| 4 | Differential housing | 10 | Thrust washer of planetary gear |
| 5 | Side gear | 11 | Half case |
| 6 | Clutch | | |

7607PT17

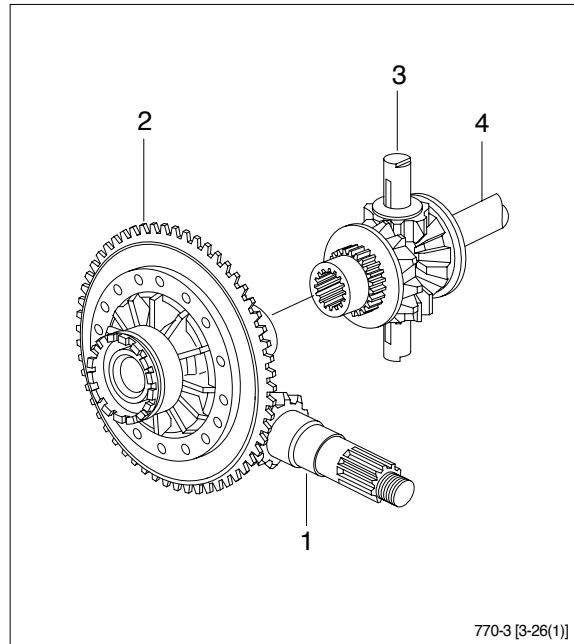
4) DIFFERENTIAL

(1) Description

When the machine makes a turn, the outside wheel must rotate faster than the inside wheel. A differential is a device which continuously transmits power to the right and left wheels while allowing them to turn at different speeds, during a turn.

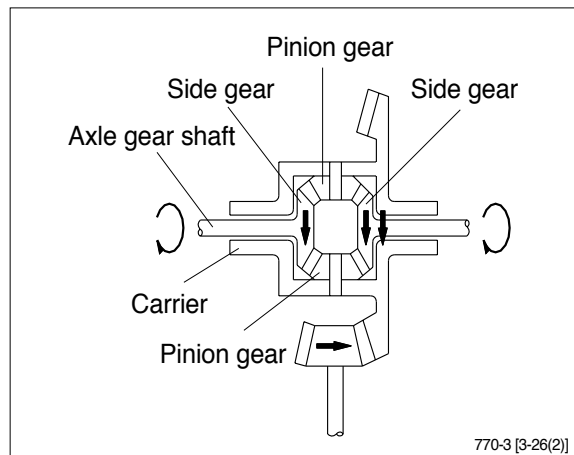
The power from the drive shaft passes through bevel pinion(1) and is transmitted to the bevel gear(2). The bevel gear changes the direction of the motive force by 90 degree, and at the same time reduces the speed.

It then transmits the motive force through the differential(3) to the axle gear shaft(4).



(2) When driving straight forward

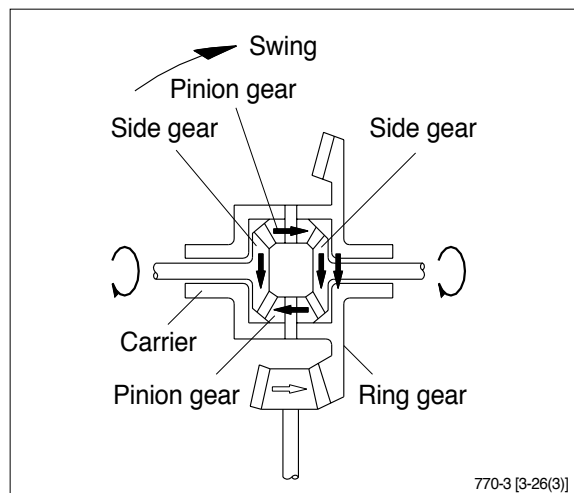
When the machine is being driven straight forward and the right and left wheels are rotating at the same speed, so the pinion gear inside the differential assembly do not rotate. The motive force of the carrier is sent through the pinion gear and the side gear, therefore the power is equally transmitted to the left and right axle gear shaft.



(3) When turning

When turning, the rotating speed of the left and right wheels is different, so the pinion gear and side gear inside the differential assembly rotate in accordance with the difference between the rotating speed of the left and right wheels.

The power of the carrier is then transmitted to the axle gear shafts.



5) TORQUE PROPORTIONING DIFFERENTIAL

(1) Function

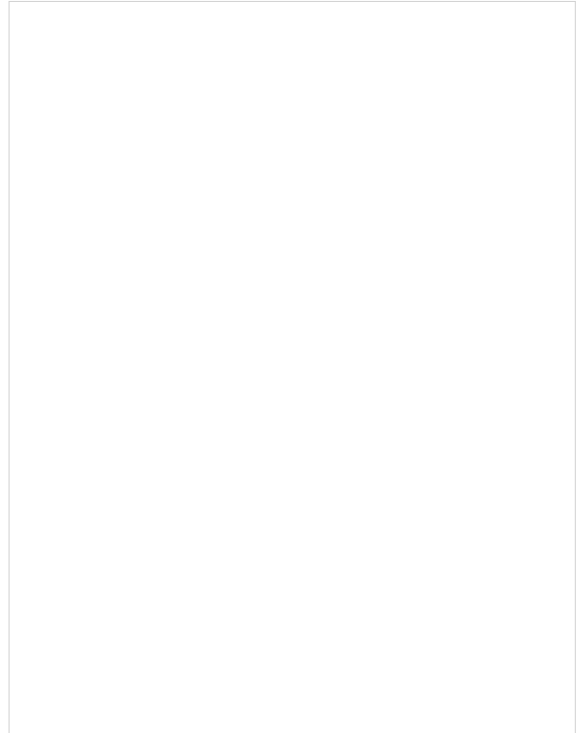
Because of the nature of their work, 4-wheel-drive loaders have to work in places where the road surface is bad.

In such places, if the tires slip, the ability to work as a loader is reduced, and also the life of the tire is reduced.

The torque proportioning differential is installed to overcome this problem.

In structure it resembles the differential of an automobile, but the differential pinion gear has an odd number of teeth.

Because of the difference in the resistance from the road surface, the position of meshing of the pinion gear and side gear changes, and this changes the traction of the left and right tires.

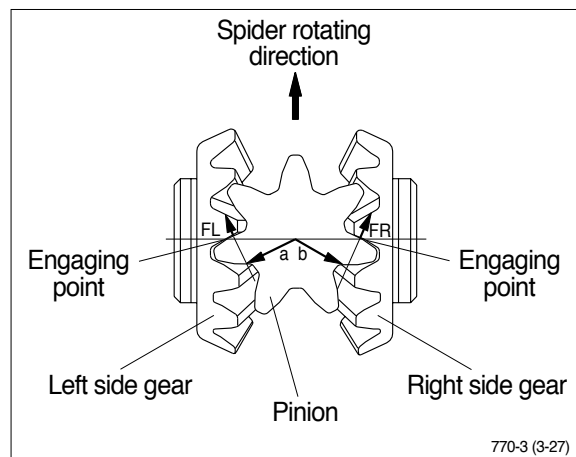


(2) Operation

When traveling straight

(Equal resistance from road surface to left and right tires)

Under this condition, the distances involving the engaging points between right and left side gears and pinion-a and b-are equal and the pinion is balanced as $FL \times a = FR \times b$. Thus, $FL = FR$, and the right and left side gears are driven with the same force.

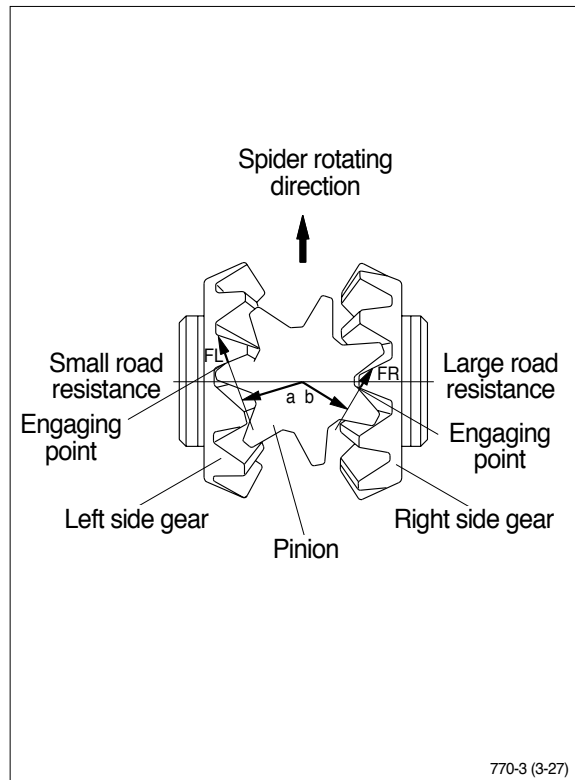


When traveling on soft ground

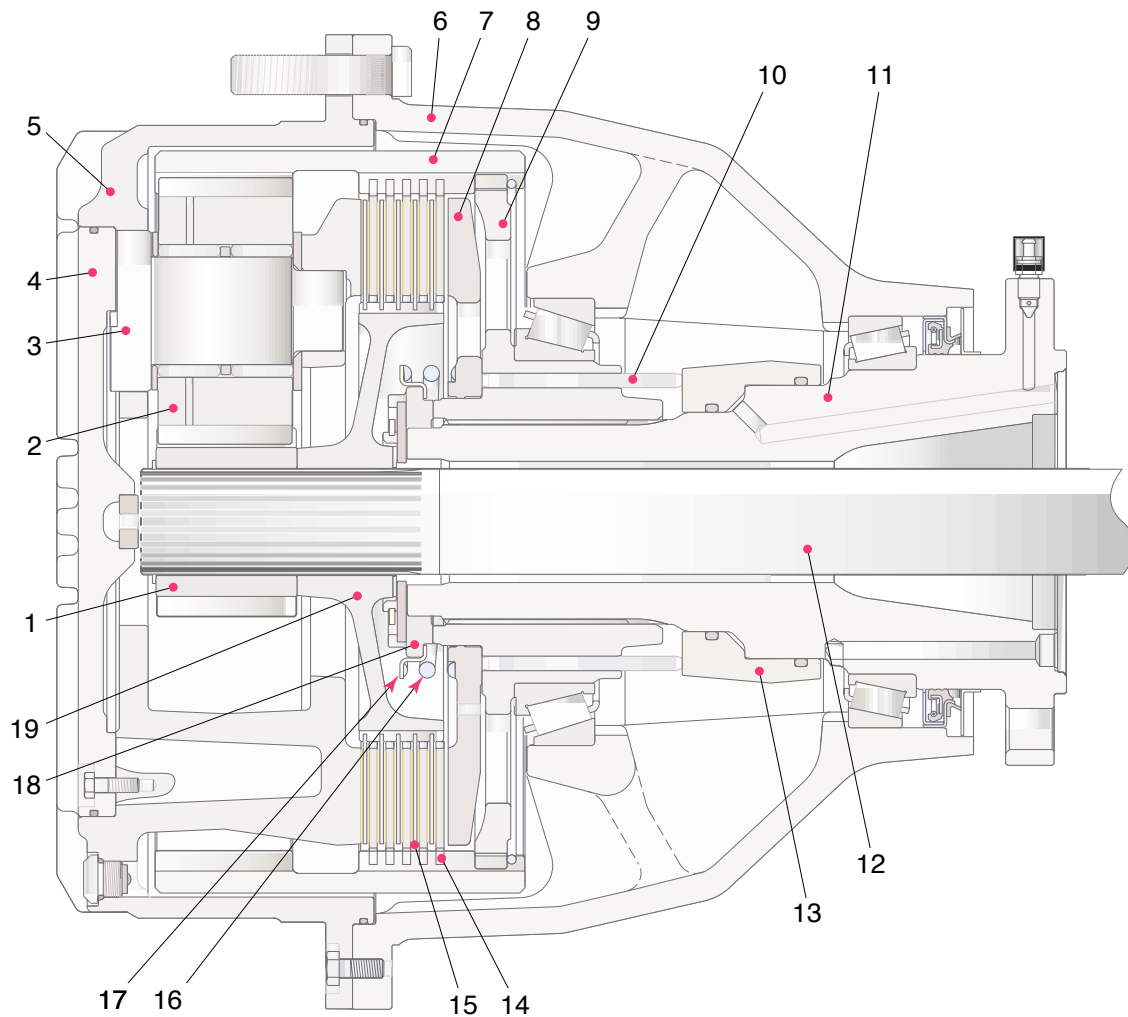
(Resistance from road surface to left and right tires is different)

If the road resistance to the left wheel is smaller, the left side gear tends to rotate forward, and this rotation changes the engaging points between the side gears and pinion. As a result, the distances involving the engaging points becomes $a > b$. The pinion now is balanced as $FL \times a = FR \times b$, where $FL > FR$. The right side gear is driven with a greater force than the left side gear. The torque can be increased by up to about 30% for either side gear.

The pinion therefore does not run idle and driving power is transmitted to both side gears until the difference between road resistance to the right and left wheels reaches about 30%.



6) FINAL DRIVE SECTION(Front & rear)



7707PT16

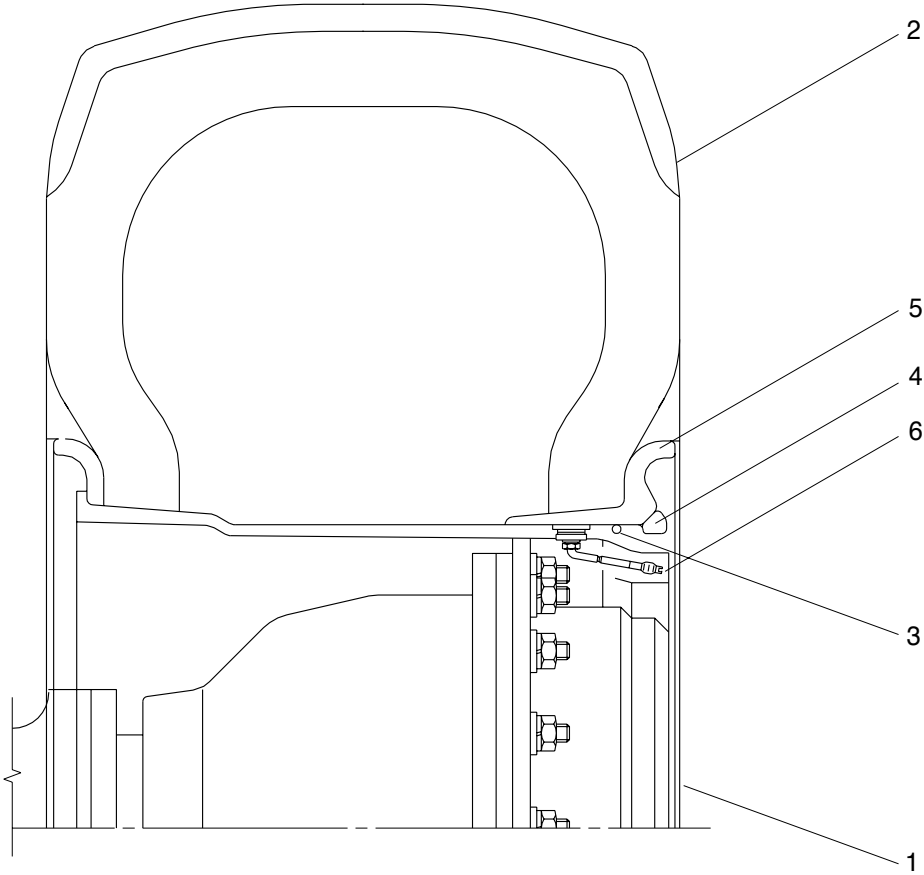
1	Sun gear	8	Pressure plate	14	Lug disc
2	Side gear(Planetary gear)	9	Bevel gear support	15	Brake disc(Friction plate)
3	Side gear carrier pin	10	Pin(Push rod)	16	Piston return spring
4	Final drive cover	11	Spindle	17	Retaining spring ring
5	Side gear carrier support(Hub drum)	12	Half shaft	18	Ring nut
6	Wheel hub	13	Brake drive piston	19	Disc carrier hub
7	Bevel gear(Ring gear)				

(1) To gain a large drive force, the final drive uses a planetary gear system to reduce the speed and send drive force to the tires.

(2) The power transmitted from the differential through axle shaft(12) to sun gear(1) is transmitted to planetary gear(2). The planetary gear rotates around the inside of a fixed ring gear(7) and in this way transmits rotation at a reduced speed to the planetary carrier.

This power is then sent to the wheels which are installed to the planetary carriers.

6. TIRE AND WHEEL



770-3 (3-30)

- | | | | | | |
|---|-----------|---|-----------|---|----------------|
| 1 | Wheel rim | 3 | O-ring | 5 | Side ring |
| 2 | Tire | 4 | Lock ring | 6 | Valve assembly |

- 1) The tire acts to absorb the shock from the ground surface to the machine, and at the same time they must rotate in contact with the ground to gain the power which drives the machine.
- 2) Various types of tires are available to suit the purpose. Therefore it is very important to select the correct tires for the type of work and bucket capacity.

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. POWER TRAIN OPERATIONAL CHECKS

This procedure is designed so that the mechanic can make a quick check of the system using a minimum amount of diagnostic equipment. If you need additional information, read **Structure and function**, Group 1.

A location will be required which is level and has adequate space to complete the checks.

The engine and all other major components must be at operating temperature for some checks.

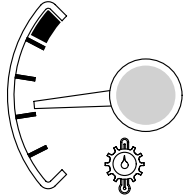
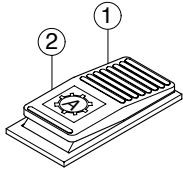


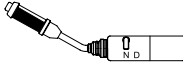
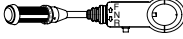
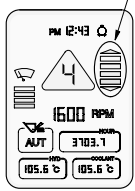
Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.

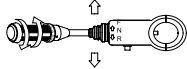
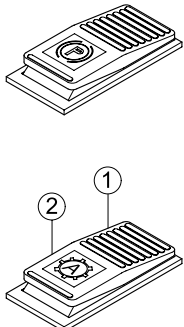

At the end of each check, if no problem is found(OK), that check is complete or an additional check is needed. If problem is indicated(NOT OK), you will be given repair required and group location. If verification is needed, you will be given next best source of information :


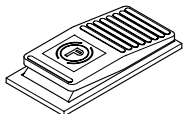
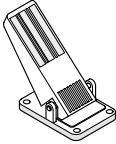
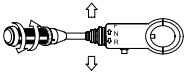
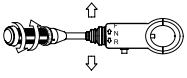
Chapter 2 : Troubleshooting

Group 3 : Tests and adjustments

Transmission oil must be at operating temperature for these checks.

Item	Description	Service action
<p>Transmission oil warm-up procedure</p>	 <p>Start engine. Apply service brakes and release parking brake.</p> <p>Select full automatic switch to manual mode .</p> <p>Move gear selector lever to 3rd speed.</p> <p>Move gear selector lever to forward "F" position.</p>  <p>Increase engine speed to high idle for 30 seconds.</p> <p>Move gear selector lever to neutral "N" position and run for 15 seconds.</p>  <p>Repeat procedure until transmission temperature gauge arrow points to bar above dial.</p>	<p>OK Check completed.</p>
<p>Gear selector lever and neutral lock latch checks Engine OFF.</p>	 <p>Move gear selector lever to each position.</p> <p>NOTE : Gear selector lever position changes slightly as steering column is tilted.</p> <p>FEEL : Lever must move freely through all positions.</p> <p>Engage neutral lock.</p>  <p>Apply slight effort to move lever into forward(F) and reverse(R).</p> <p>LOOK : Neutral lock must stay engaged.</p>	<p>OK Check completed.</p> <p>NOT OK Repair lock or replace switch.</p>
<p>Automatic shifting check</p>	 <p>Start engine.</p> <p>Move gear selector lever to 4th speed.</p> <p>Turn full automatic switch ON.</p> <p>LOOK : Automatic sign on display.</p>  <p>Automatic sign</p> <p>Move gear selector lever to forward or reverse position.</p> <p>Increase engine rpm.</p> <p>LOOK : Speed(2nd~4th) on display must vary with machine speed.</p>	<p>OK Check completed.</p> <p>NOT OK Go to transmission error code group at page 3-25~3-53. Repair or replace the display or harness.</p>

Item	Description	Service action
<p>Transmission noise check Engine running.</p>	 <p>Run engine at approximately 1600rpm.</p> <p>Drive unit with transmission in each forward and reverse speed.</p> <p>LISTEN : Transmission must not make excessive noise in any range.</p> <p>Engine rpm must not "lug down" as unit is shifted between gears.</p>	<p>OK Check completed.</p> <p>NOT OK Go to transmission makes excessive noise group 3.</p>
<p>Transmission "quick shift" check Engine running.</p>	  <p>Release parking brake and select full automatic switch to manual mode ①.</p> <p>Shift to 2nd forward.</p> <p>Drive machine at approximately 5km/h and press gear selector lever kick down switch or RCV lever switch once.</p> <p>LOOK/FEEL : Transmission must shift to and remain in 1st gear.</p> <p>Press gear selector lever kick down switch once.</p> <p>LOOK/FEEL : Transmission must shift back to 2nd gear.</p> <p>Shift to (3rd or 4th) gear and press gear selector lever kick down switch once.</p> <p>LOOK/FEEL : Transmission must not shift down.</p> <p>Select full automatic switch to automatic mode .</p> <p>Drive machine at approximately 90% speed of max speed in each gear(2nd or 3rd or 4th).</p> <p>Shift to(2nd or 3rd or 4th) gear in each forward and reverse speed and press gear selector kick down lever switch or RCV lever switch once.</p> <p>LOOK/FEEL : Transmission must shift to lower(1st or 2nd or 3rd) gear respectively.</p> <p>Press gear selector lever kick down switch or RCV lever switch once again.</p>	<p>OK Check completed.</p> <p>NOT OK Check connector at base of control valve.</p> <p>IF OK Go to transmission controller circuit in group 1.</p>

Item	Description	Service action
	<p>LOOK/FEEL : Transmission must shift to former(2nd or 3rd or 4th) gear.</p> <p>NOTE : If gear selector lever kick down switch or RCV lever switch is pressed twice, transmission will shift down the immediately back to former gear.</p>	
<p>Forward, reverse and 4th speed clutch pack drag check Transmission must be warmed up for this check. Engine running.</p>	 <p>Park unit on level surface.</p> <p>Apply service brakes.</p>  <p>Move gear selector lever to neutral.</p> <p>Move gear selector lever to 1st.</p>  <p>Release parking brake and service brakes.</p> <p>Run engine at low idle.</p> <p>LOOK : Unit must not move in either direction.</p> <p>NOTE : If unit moves forward, either the forward pack or the 4th speed pack is dragging.</p>	<p>OK Check completed.</p> <p>NOT OK If unit moves, repair transmission.</p>
<p>Transmission shift modulation check Engine running.</p>	 <p>Run engine at approximately 1300rpm.</p> <p>Put transmission in 1st forward, shift several times from forward to reverse and reverse to forward. Repeat check in 2nd gear.</p> <p>LOOK : Unit must slow down and change direction smoothly.</p>	<p>OK Check completed.</p> <p>NOT OK Go to unit shifts too fast, chapter 2 in this group.</p>
<p>Torque converter check</p>	 <p>Start engine. Apply service brakes and release parking brake.</p> <p>Move gear selector lever to 3rd speed.</p> <p>Move gear selector control lever to forward "F" position.</p> <p>Increase engine speed to high idle.</p> <p>LOOK : Torque converter stall rpm must be within the following range. Stall rpm : 2240 ± 70rpm</p> <p>Move gear selector control lever to neutral "N" position and run for 15 seconds.</p>	<p>OK Check completed.</p> <p>NOT OK If stall rpm are too low or too high, problem may be engine power or torque converter.</p> <p>IF OK Replace transmission torque converter.</p>

2. TROUBLESHOOTING

1) TRANSMISSION

Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely, more difficult to verify. Remember the following steps when troubleshooting a problem :

Step 1. Operational check out procedure(See group 3 in section 1.)

Step 2. Operational checks(In this group.)

Step 3. Troubleshooting

Step 4. Tests and/or adjustments(See group 3.)

Problem	Cause	Remedy
Transmission slippage	<p>Low oil level.</p> <p>Wrong oil grade.</p> <p>Restricted transmission pump suction screen.</p> <p>Leak in transmission control valve or gasket.</p> <p>Low transmission pump flow due to worn pump.</p> <p>Weak or broken pressure regulating valve spring.</p>	<p>Add oil.</p> <p>Change oil.</p> <p>Remove and clean screen.</p> <p>Remove valve and inspect gaskets.</p> <p>Do transmission pump flow test.</p> <p>Do transmission system pressure test.</p>
Error code on display	<p>Something wrong in transmission.</p>	<p>Go to transmission error code group at page 3-25~3-53.</p>

Problem	Cause	Remedy
Machine will not move	<p>Low oil level.</p> <p>Applied park brake.</p> <p>No power to transmission controller.</p> <p>Malfunctioning parking brake solenoid valve.</p> <p>Restricted orifice of PPC valve.</p> <p>Excessive leakage in transmission element.</p> <p>Worn clutch disks.</p> <p>Low or no transmission pressure.</p> <p>Service brake will not release.</p> <p>Failed torque converter.</p> <p>Broken shafts or gears.</p> <p>Broken drive shafts.</p> <p>Broken ring or pinion gear.</p>	<p>Add oil.</p> <p>Check parking brake fuse. Check continuity to parking brake switch.</p> <p>Check transmission controller fuse.</p> <p>Remove and inspect parking brake solenoid valve. Check for power to solenoid valve.</p> <p>Remove orifice and check for contamination and/or plugging. (Do not remove valve housing for this purpose.)</p> <p>Do transmission element leakage test using system pressure.</p> <p>Repair transmission.</p> <p>See transmission pressure is low in this group.</p> <p>Do brake pedal operational check. Do service and park system drag checks.</p> <p>Do torque converter stall test. If engine pulldown in normal, torque converter is good.</p> <p>Drain transmission to determine if large pieces of metal contamination are present.</p> <p>Inspect drive shafts and universal joints for external damage. Repair.</p> <p>If drive shaft rotate with transmission in gear but machine does not move, a differential failure is indicated. Repair.</p>
Machine does not engage in low gear	<p>Malfunctioning transmission control solenoid valve.</p> <p>Stuck spool in transmission control valve.</p> <p>Stuck PPC valve.</p> <p>Malfunctioning transmission speed sensor.</p>	<p>Check solenoid valve.</p> <p>Remove and inspect transmission control valve spools.</p> <p>Remove end cover to inspect PPC valve. Replace if necessary.</p> <p>Check speed sensor.</p>

Problem	Cause	Remedy
Transmission pressure is low (All gears)	<p>Low oil level.</p> <p>Failed transmission pressure switch.</p> <p>Plugged suction strainer.</p> <p>Stuck transmission pressure regulating valve or broken spring.</p> <p>Failed control valve gasket.</p> <p>Stuck PPC valve.</p>	<p>Check transmission oil level and refill if necessary.</p> <p>Verify transmission system pressure. Do transmission system pressure test.</p> <p>Transmission pump may be noisy if transmission suction screen is clogged. Drain transmission. Remove and clean suction screen. Also, check condition of transmission filter.</p> <p>Remove transmission pressure regulating valve. Inspect for damage(See transmission control valve).</p> <p>Inspect transmission control valve for external leakage. Remove control valve. Inspect or replace gasket.</p> <p>Remove end cover to inspect modulation spool and check torque on cap screws retaining control valve to transmission.</p>
Transmission system pressure is low (One or two gears)	<p>Failed transmission pump.</p> <p>Failed transmission control valve gasket.</p> <p>Leakage in clutch piston or seal ring.</p>	<p>Do pump flow test.</p> <p>Inspect transmission control valve for external leakage. Remove control valve. Inspect or replace gasket.</p> <p>Disassemble and repair.</p>
Transmission shifts too low	<p>Low oil level(Aeration of oil).</p> <p>Low transmission pressure.</p> <p>Restricted transmission pump suction screen.</p> <p>Low transmission pump flow.</p> <p>Excessive transmission element leakage.</p> <p>Stuck PPC valve.</p> <p>Restricted PPC valve orifice.</p> <p>Restricted oil passages between control valve and transmission elements.</p> <p>Incorrect transmission oil.</p>	<p>Add oil.</p> <p>Do transmission system pressure test.</p> <p>Remove and clean screen.</p> <p>Do transmission pump flow test.</p> <p>Do transmission element leakage test using system pressure.</p> <p>Remove end cover to inspect modulation spool. Replace if necessary.</p> <p>Remove orifice and inspect for contamination and /or plugging.</p> <p>Remove control valve and inspect oil passage.</p> <p>Change oil(SAE 10W-30/15W-40)</p>

Problem	Cause	Remedy
Transmission shifts too fast	<p>Wrong transmission controller.</p> <p>System pressure too high.</p> <p>Stuck PPC valve.</p> <p>Stuck or missing check valves.</p> <p>Missing O-ring from end of modulation orifice.</p> <p>Broken piston return spring.</p> <p>Incorrect transmission oil.</p>	<p>Check if transmission controller has been changed</p> <p>Do transmission system pressure test.</p> <p>Remove and inspect PPC valve. Replace if necessary. Also remove end cover to inspect PPC valve and control valve housing. Replace if necessary.</p> <p>Inspect transmission control valve.</p> <p>Remove orifice and inspect port for O-ring.</p> <p>Disassemble and inspect clutch.</p> <p>Change oil(SAE 10W-30/15W-40)</p>
Machine "creeps" in neutral	<p>Warped disks and plates in transmission.</p>	<p>Check transmission.</p>
Transmission hydraulic system overheats	<p>High oil level.</p> <p>Low oil level.</p> <p>Wrong oil grade.</p> <p>Park brake dragging.</p> <p>Pinched, restricted or leaking lube lines.</p> <p>Machine operated in too high gear range.</p> <p>Malfunction in temperature gauge or sensor.</p> <p>Restricted air flow through oil cooler or radiator.</p> <p>Failed oil cooler bypass valve(In thermal bypass valve).</p> <p>Failed thermal bypass valve.</p> <p>Internally restricted oil cooler.</p> <p>Leakage in transmission hydraulic system.</p> <p>Malfunction in converter relief valve.</p> <p>Low transmission pump output.</p>	<p>Transmission overfilled or hydraulic pump seal leaking.</p> <p>Add oil.</p> <p>Change oil.</p> <p>Check for heat in park brake area.</p> <p>Check cooler lines.</p> <p>Operate machine in correct gear range.</p> <p>Install temperature sensor the verify temperature. Do tachometer/temperature reader installation procedure.</p> <p>Do radiator air flow test.</p> <p>Disassemble and inspect.</p> <p>Remove thermal bypass valve and check to see if machine still overheats. Do transmission oil cooler thermal bypass valve test.</p> <p>Do oil cooler restriction test.</p> <p>Do transmission system pressure, element leakage test.</p> <p>Do converter out pressure test.</p> <p>Do transmission pump flow test.</p>

Problem	Cause	Remedy
Excessive transmission noise (Under load or no load)	<p>Too low engine low idle.</p> <p>Worn parts or damaged in transmission.</p> <p>Warped drive line between engine and torque converter.</p> <p>Low or no lube.</p>	<p>Check engine low idle speed.</p> <p>Remove transmission suction screen. Inspect for metal particles. Repair as necessary.</p> <p>Inspect drive line.</p> <p>Do converter-out and lube pressure test. Do transmission pump flow test.</p>
Foaming oil	<p>Incorrect type of oil.</p> <p>High oil level.</p> <p>Low oil level.</p> <p>Air leak on suction side of pump.</p>	<p>Change oil.</p> <p>Transmission overfilled or hydraulic pump seal leaking.</p> <p>Add oil.</p> <p>Check oil pickup tube on side of transmission.</p>
Oil ejected from dipstick	<p>Plugged breather.</p>	<p>Inspect breather on top of transmission. Replace.</p>
Machine vibrates	<p>Aerated oil.</p> <p>Low engine speed.</p> <p>Failed universal joints on transmission drive shaft or differential drive shafts.</p>	<p>Add oil.</p> <p>Check engine speed.</p> <p>Check universal joints.</p>
Machine lacks power and acceleration	<p>Engine high idle speed set too low.</p> <p>Incorrect transmission oil.</p> <p>Aerated oil.</p> <p>Low transmission pressure.</p> <p>Warped transmission clutch.</p> <p>Torn transmission control valve gasket.</p> <p>Brake drag.</p> <p>Failed torque converter.</p> <p>Low engine power.</p>	<p>Check high idle adjustment.</p> <p>Change oil.</p> <p>Add oil.</p> <p>Do transmission system pressure test.</p> <p>Do transmission clutch drag checks.</p> <p>Inspect gasket.</p> <p>Do brake drag check.</p> <p>Do torque converter stall speed test.</p> <p>Do engine power test.</p>
Torque converter stall RPM too high	<p>Aerated oil.</p> <p>Stuck open converter relief valve.</p> <p>Leakage in torque converter seal.</p> <p>Torque converter not transferring power(Bent fins, broken starter).</p>	<p>Put clear hose on thermal bypass outlet port. Run machine to check for bubbles in oil.</p> <p>Do converter-out pressure test.</p> <p>Do converter-out pressure test.</p> <p>Replace torque converter.</p>

Problem	Cause	Remedy
Torque converter stall RPM too low	Low engine power. Mechanical malfunction.	Do engine power test. Remove and inspect torque converter.
Transmission pressure light comes ON when shifting from forward to reverse (All other gears OK)	Low oil level. Cold oil. Leak in reverse pack.	Add oil. Warm oil to specification. Do transmission pressure, pump flow, and leakage check.
Transmission pressure light comes ON for each shift	Cold oil. No time delay in monitor. Restriction in modulation orifice. Stuck PPC valve. Low transmission pressure circuit. Leak in transmission pressure circuit. Failed transmission pump. Clogged filter.	Warm oil to specification. Do monitor check. Remove orifice and inspect for restriction and/or plugging. Remove and inspect. Do transmission system pressure test. Do converter out pressure test. Do transmission pump flow test. Inspect filter. Replace.

2) DIFFERENTIAL / AXLE

Problem	Cause	Remedy
Differential low on oil	External leakage.	Inspect axle and differential for leaks.
Excessive differential and/or axle noise	Low oil level in differential. Incorrect type of oil. Dragging brakes. Failed pinion bearing. Incorrect gear mesh pattern between ring and pinion gear. Failed differential pinion gears and/or cross shafts. Failed axle bearing. Mechanical failure in axle planetary.	Check oil. Remove drain plug and inspect for metal particles in differential case. Disassemble and determine cause. Change oil Do brake check. Remove and inspect pinion. Check to ensure pinion housing was indexed. Remove pinion gear housing and inspect ring and pinion gear. Remove differential housing drain plug and inspect for metal particles. Disassemble and inspect. Do axle bearing adjustment check. Remove differential. Inspect, repair.
Oil seeping from outer axle seal	Excessive end play in axle. Worn outer bearing and/or cup. Overfilled differential.	Do axle bearing adjustment check. Disassemble and inspect outer axle bearing, cup, spacer, and seal. Replace, if necessary. Check differential oil return system for excessive internal restriction.
Axle overheats	Low differential oil. Overfilled differential. Brake drag.	Add oil. See differential overfills with oil in this group. See brakes drag in this group.

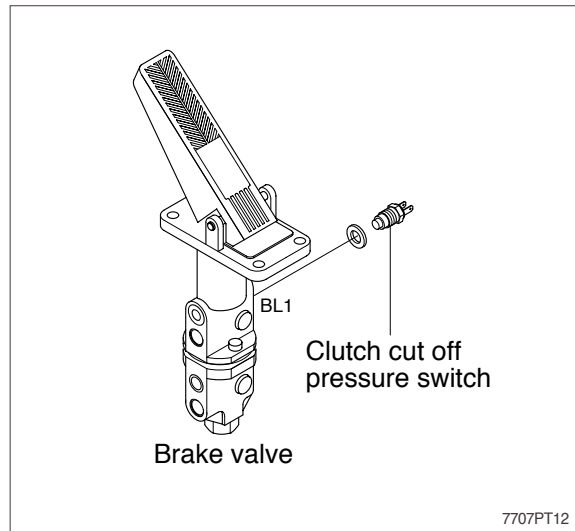
3) DRIVE LINE

Problem	Cause	Remedy
Excessive drive line vibration or noise	Yokes not in line on drive shafts. Worn front drive line support bearing. Bent drive shaft. Loose yoke retaining nuts(Drive shafts wobble at high speed). Rear axle oscillating support. Lack of lubrication.	Inspect. Align drive shaft yokes. Inspect, repair. Inspect all drive shafts. Replace. Inspect. Replace. Inspect, repair. Lubricate with proper grade of grease.

GROUP 3 TESTS AND ADJUSTMENTS

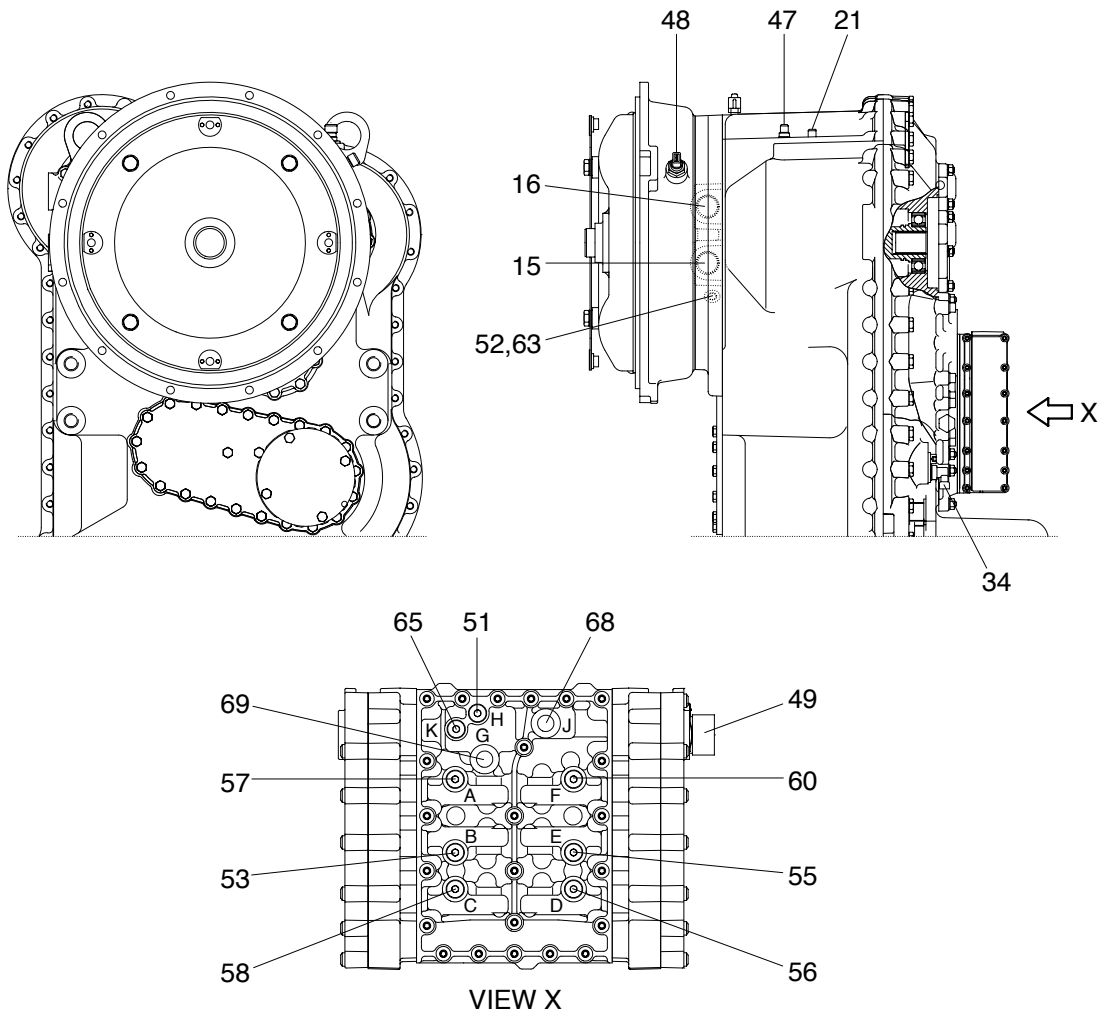
1. CLUTCH CUT-OFF PRESSURE SWITCH TEST

The setting pressure of the clutch cut-off pressure switch should be suited with the specification. The rated pressure is 25kgf/cm². For the detailed method for pressure adjusting, refer to page 4-22.



2. TRANSMISSION MEASURING POINTS AND CONNECTIONS

The measurements have to be carried out at hot transmission (About 80-95, C).



7607PT14

1) OIL PRESSURE AND TEMPERATURE

Port	Description		Size
51	Converter inlet-opening pressure(9bar)	H	M10 × 1.0
52	Converter outlet-opening pressure(3.5bar)		M14 × 1.5
53	Forward clutch(16+2bar)	KV B	M10 × 1.0
55	Reverse clutch(16+2bar)	KR F	M10 × 1.0
56	1st clutch(16+2bar)	K1 D	M10 × 1.0
57	2nd clutch(16+2bar)	K2 A	M10 × 1.0
58	3rd clutch(16+2bar)	K3 C	M10 × 1.0
60	4th clutch(16+2bar)	K4 E	M10 × 1.0
63	Converter outlet temperature 100,C, short-time 120,C		M14 × 1.5
65	System pressure(16+2bar)	K	M10 × 1.0

2) DELIVERY RATES

Port	Description	Size
15	Connection to the oil cooler	1 5/6 -12UNF-2B
16	Connection from the oil cooler	1 5/6 -12UNF-2B

3) INDUCTIVE TRANSMITTER AND SPEED SENSOR

Port	Description	Size
21	Inductive transmitter n turbine	M18 x 1.5
34	Speed sensor n output and speedometer	-
47	Inductive transmitter n central gear train	M18 x 1.5
48	Inductive transmitter n engine	M18 x 1.5

4) CONNECTIONS

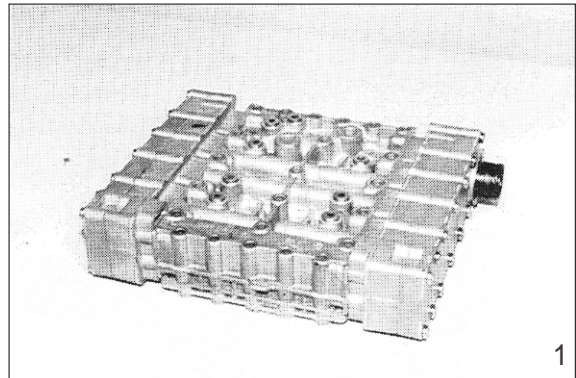
Port	Description	Size
49	Plug connection on the hydraulic control unit	-
68	Pilot pressure(Optional) J	M16 x 1.5
69	System pressure(Optional) G	M16 x 1.5

GROUP 4 DISASSEMBLY AND ASSEMBLY

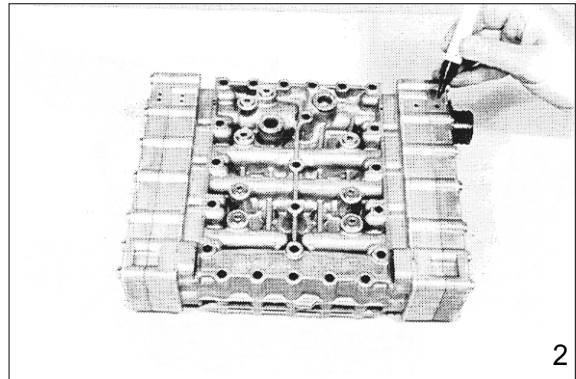
1. CONTROL VALVE

1) DISASSEMBLY

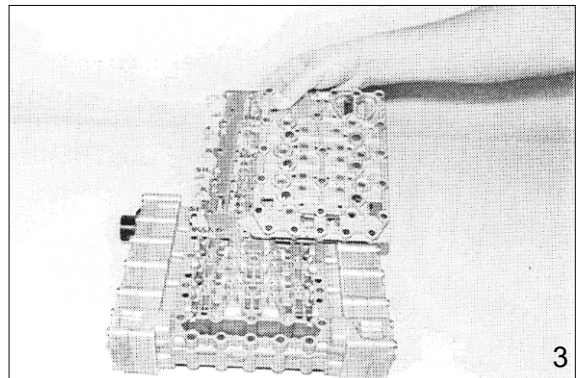
(1) Illustration on the right shows the complete control unit.



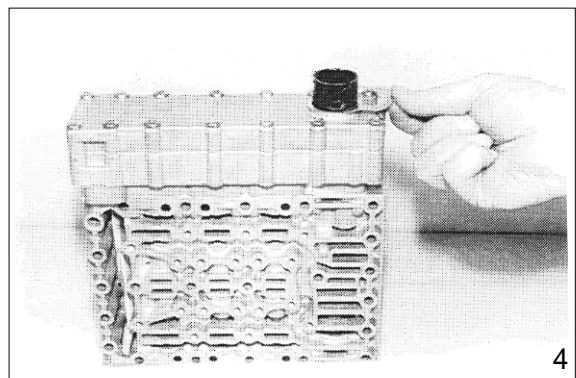
(2) Mark the installation position of the different covers, the housing and cable harness with the valve housing.



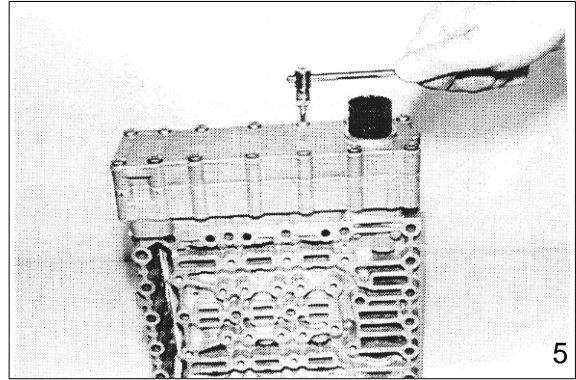
(3) Loosen socket head screws.
Separate duct plate, 1st gasket, intermediate plate and 2nd gasket from the valve housing.
Box spanner 5873 042 002



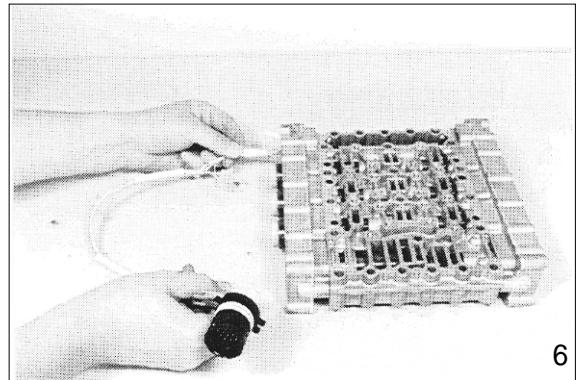
(4) Remove retaining clip.



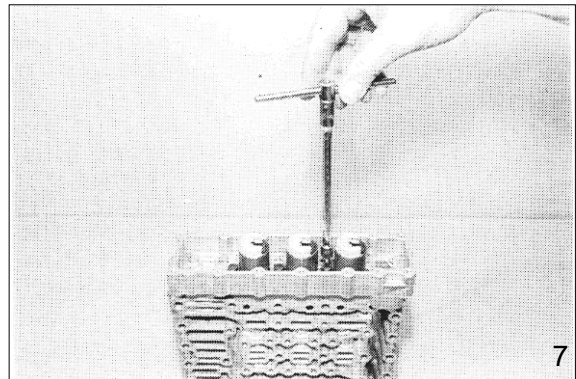
- (5) Loosen socket head screws.
Separate cover from housing and cable harness.
Box spanner 5873 042 002



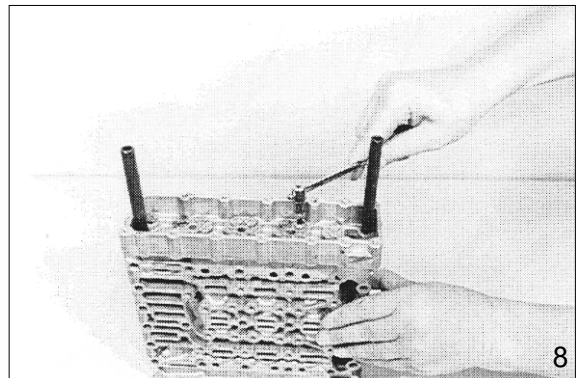
- (6) Disassemble opposite cover.
Disconnect pressure regulator and remove cable harness.



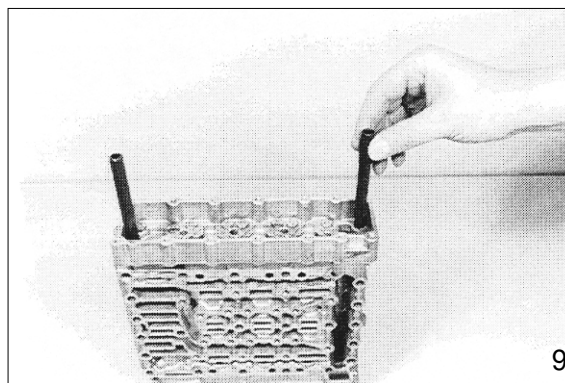
- (7) Loosen socket head screws, remove fixing plate and pressure regulators(3EA).
Box spanner 5873 042 002



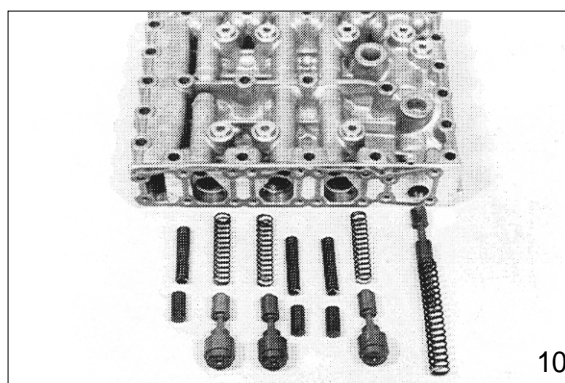
- (8) Loosen two socket head screws and locate housing provisionally, using adjusting screws(Housing is under spring preload).
Now, loosen remaining socket head screws.
Box spanner 5873 042 002
Adjusting screws 5870 204 036



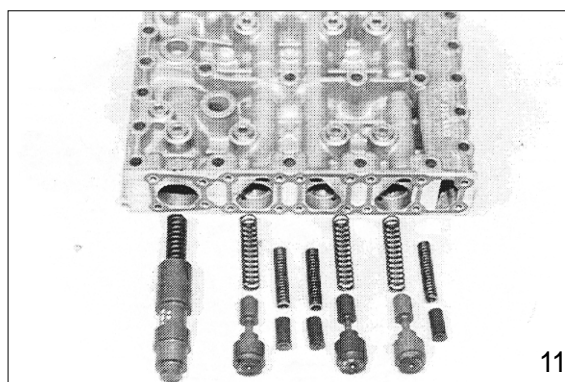
- (9) Separate housing from valve housing by loosening the adjusting screws uniformly.
Adjusting screws 5870 204 036



- (10) Remove components.



- (11) Remove opposite pressure regulators, housing as well as components accordingly.



2) ASSEMBLY

Check all components for damage and renew if necessary.

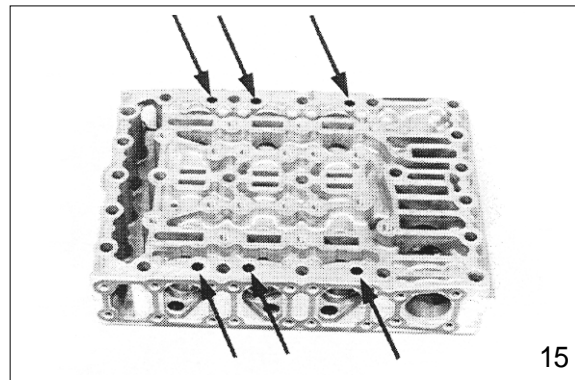
Prior to the installation, check free travel of all moving parts in the housing.

Spools can be exchanged individually.

Oil the components prior to the assembly.

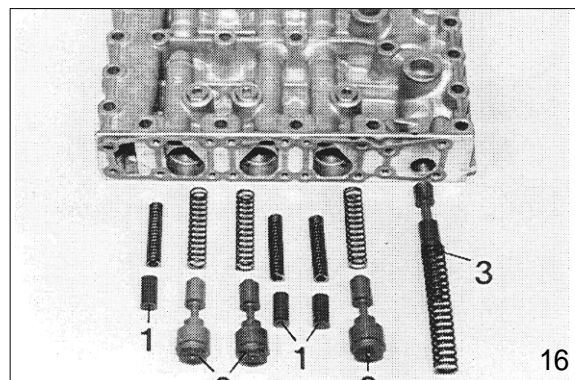
Insert diaphragms with the concave side showing upward until contact is obtained.

Installation position, see arrows.

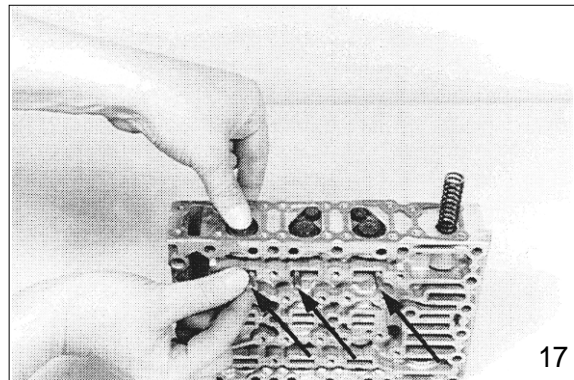


(1) Illustration on the right shows the following components.

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



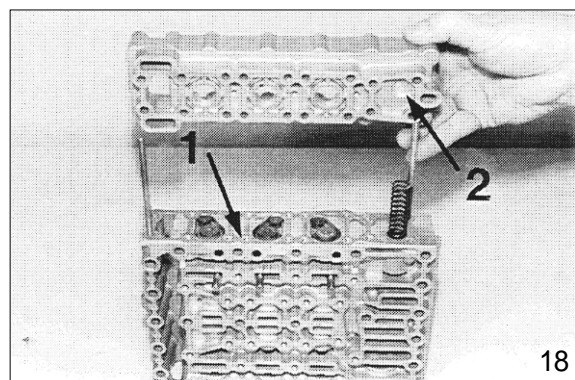
(2) Install components according to figure (1). Preload compression spring of the follow-on slides and locate spool provisionally by means of cylindrical pins $\varnothing 5.0\text{mm}$ (Assembly aid), see arrows.

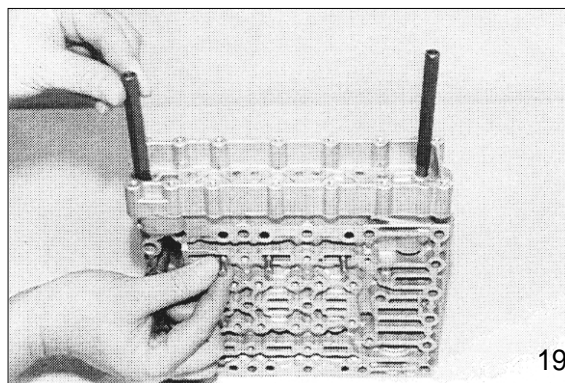


(3) Install two adjusting screws. Assemble gasket (Arrow 1) and housing cover. Now, position the housing cover uniformly, using adjusting screws, until contact is obtained and remove cylindrical pins (Assembly aid) again (See the next figure).

Pay attention to the different housing covers. Install recess $\varnothing 15\text{mm}$ (Arrow 2), facing the spring of the pressure reducing valve.

Adjusting screws 5870 204 036

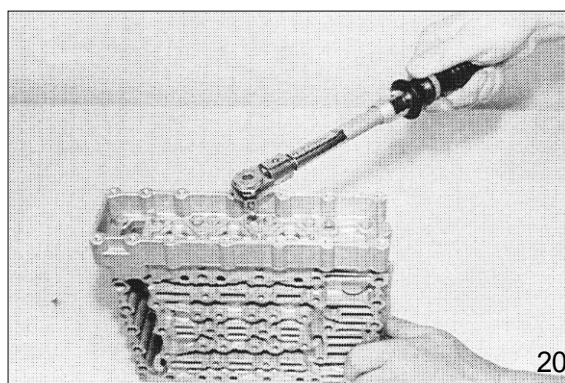




(4) Fasten housing cover by means of socket head screws.

· Torque limit : 0.56kgf · m(4.06lbf · ft)

Box spanner 5873 042 002



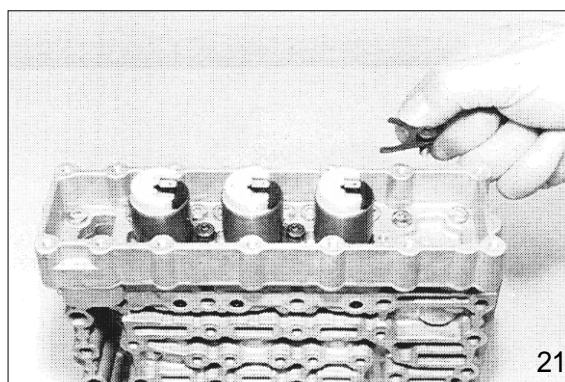
(5) Introduce pressure regulators and fix by means of fixing plates and socket head screws.

Install fixing plate, with the claw showing downward.

Pay attention to the radial installation position of the pressure regulators, see figure.

· Torque limit : 0.56kgf · m(4.06lbf · ft)

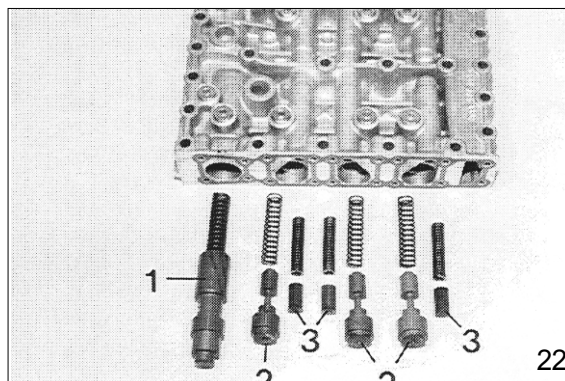
Box spanner 5873 042 002



Pre assemble opposite side

(6) Illustration on the right shows the following components.

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



- (7) Install components according to figure (6).
Preload compression springs of the follow-on slides and locate spool provisionally by means of cylindrical pins $\varnothing 5.0\text{mm}$ (Assembly aid), see arrows.

Install two adjusting screws.

Assemble gasket (Arrow 1) and housing cover, and position them uniformly against shoulder, using adjusting screws.

Pay attention to the different housing covers—install the recess $\varnothing 19\text{mm}$ (Arrow 2), facing the main pressure valve.

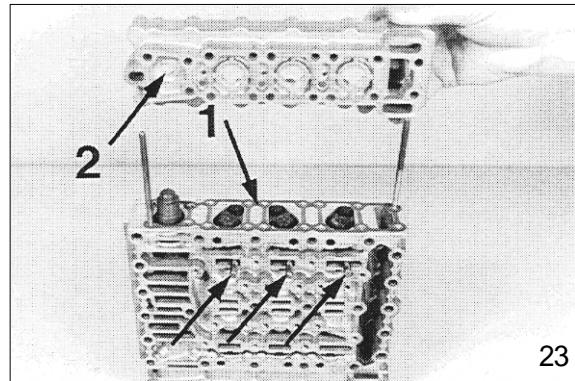
Now, fasten housing cover by means of socket head screws.

· Torque limit : $0.56\text{kgf} \cdot \text{m}$ ($4.06\text{lbf} \cdot \text{ft}$)

Remove cylindrical pins (Assembly aid) again.

Adjusting screws 5870 204 036

Box spanner 5873 042 002



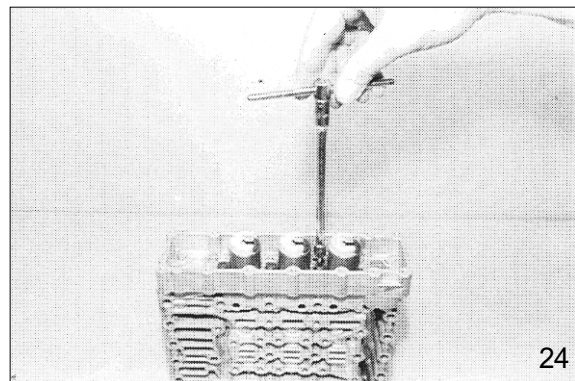
- (8) Introduce pressure regulators and fix by means of fixing plates and socket head screws.

Install fixing plates, with the claw showing downward.

Pay attention to the radial installation position of the pressure regulators, see figure.

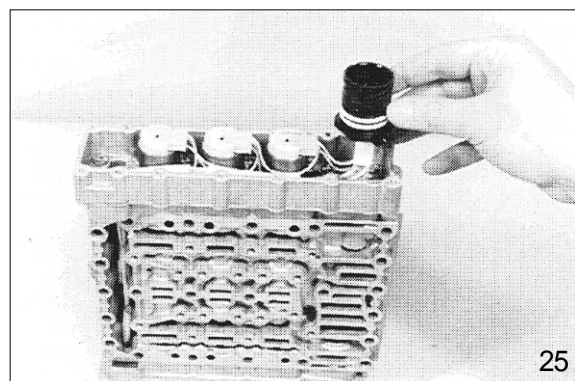
· Torque limit : $0.56\text{kgf} \cdot \text{m}$ ($4.06\text{lbf} \cdot \text{ft}$)

Box spanner 5873 042 002



- (9) Introduce cable harness and connect pressure regulators (6EA).

Pay attention to the installation position of the cable harness, also markings (See figure(2), page 3-74).

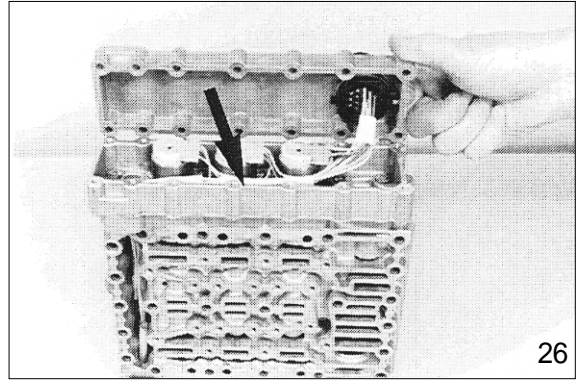


(10) Introduce female connector against shoulder, with the groove facing the guide nose of the cover.

Install gasket (Arrow) and fasten cover by means of socket head screws.

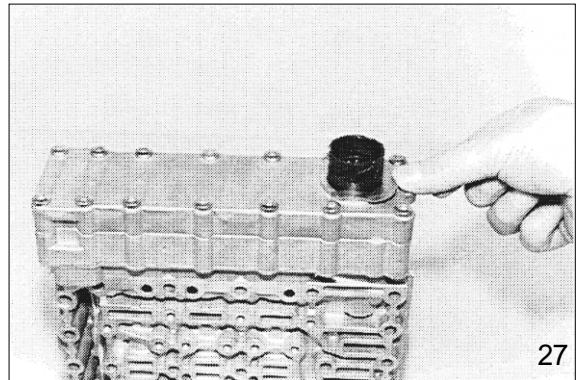
· Torque limit : 0.56kgf · m(4.06lbf · ft)

Box spanner 5873 042 002



(11) Fix female connector by means of retaining clamp, see figure.

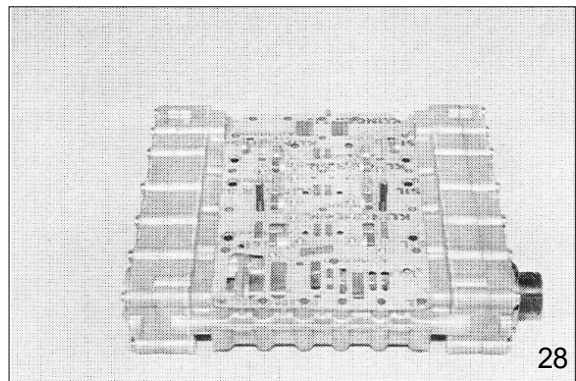
Install opposite cover.



(12) Install two adjusting screws and mount gasket .

Pay attention to the different gaskets, see on the right figure and (15).

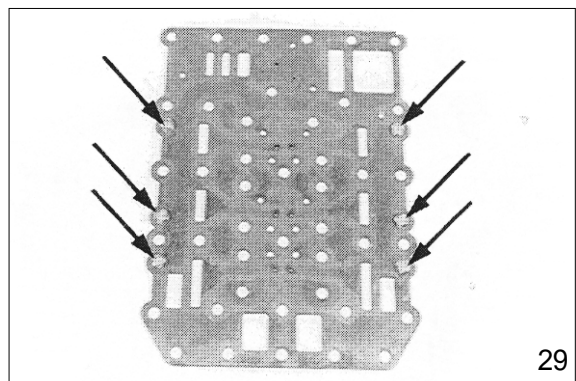
Adjusting screws 5870 204 063



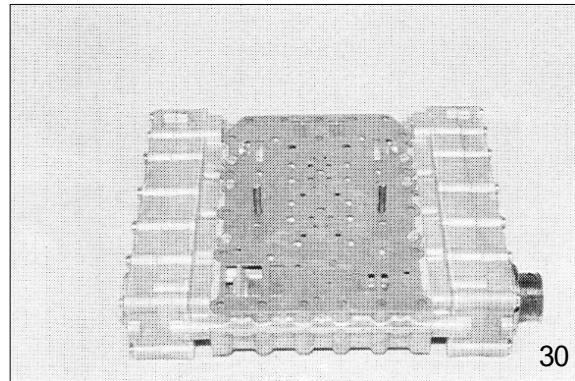
Intermediate plate-Version with screens

(13) Insert screws(6EA) flush mounted into the bore of the intermediate plate, see arrow.

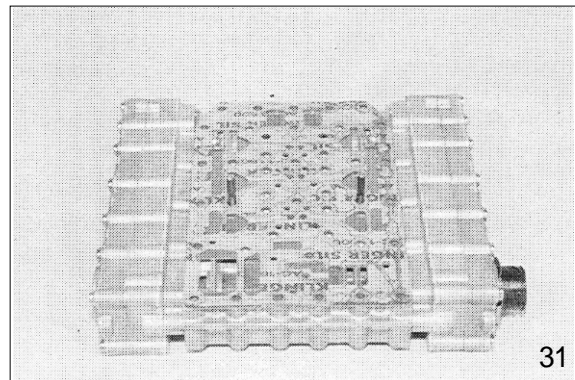
Pay attention to the installation position-screws are showing upward(Facing the duct plate).



(14) Mount intermediate plate, with the screens showing upward.



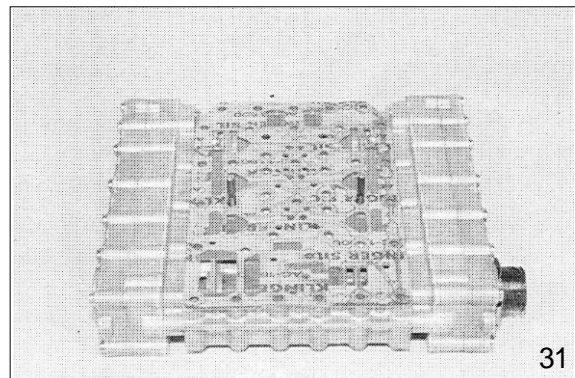
(15) Mount gasket



(16) Mount duct plate and fasten it uniformly by means of socket head screws.

· Torque limit : 0.97kgf · m(7.0lbf · ft)

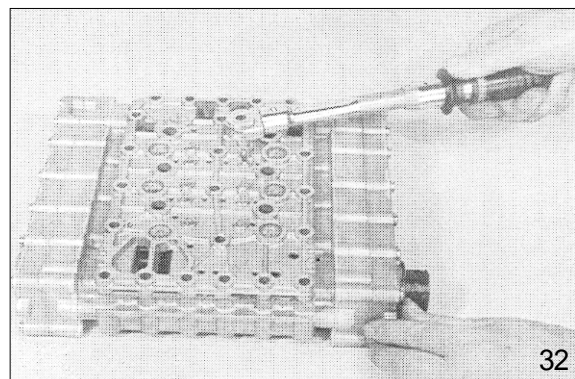
Box spanner 5873 042 002



(17) Equip screw plug(8EA) with new O-rings and install them.

· Torque limit : 0.56kgf · m(4.06lbf · ft)

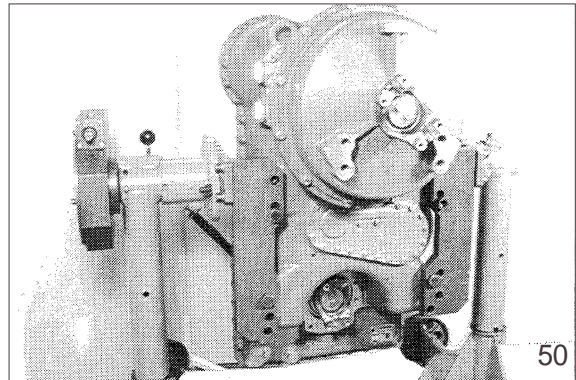
The installation of the hydraulic control unit is described, starting from page 3-131.



2. POWERSHIFT TRANSMISSION

Fasten transmission of the assembly car.

Assembly car	5870 350 000
Strips	5870 350 063
Support	5870 350 090



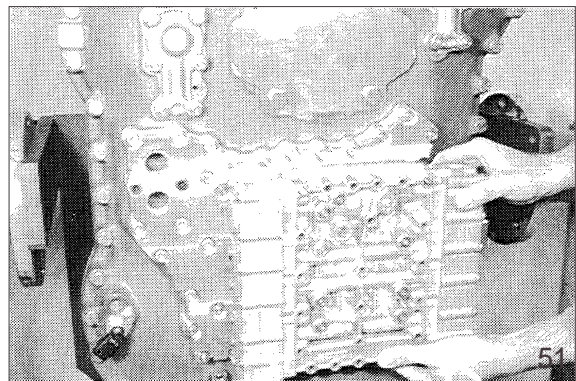
1) DISASSEMBLY

(1) Separate hydraulic control unit and duct plate from gearbox housing

Loosen two socket head screws and install adjusting screws.

Now, loosen remaining socket head screws and separate valve housing from duct plate.

Adjusting screws(M6)	5870 204 063
Box spanner	5873 042 002

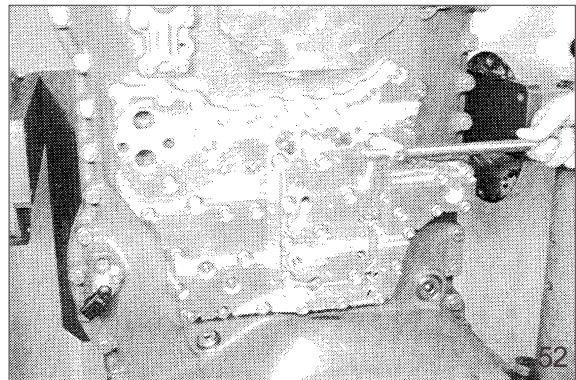


Remove both gaskets and intermediate plate.

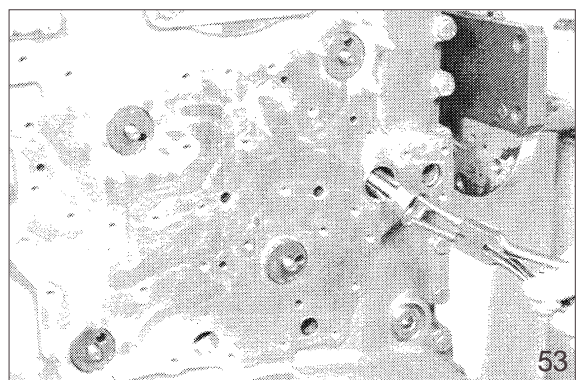
Loosen socket head screws as well as hexagon nuts and separate duct plate from gearbox housing.

Now, remove gasket.

Box spanner	5873 042 004
-------------	--------------

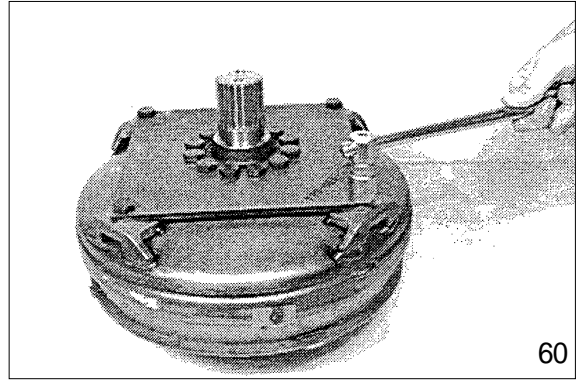


Pull converter safety valve out of the housing bore.

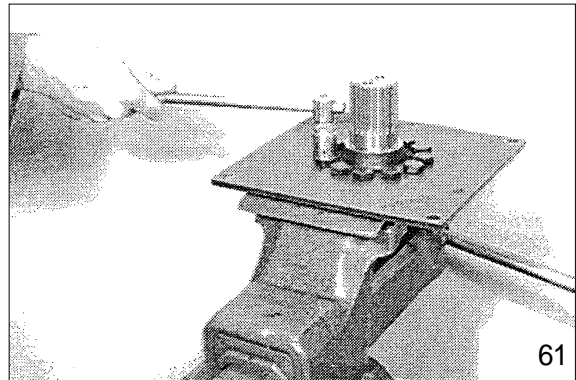


(2) Converter

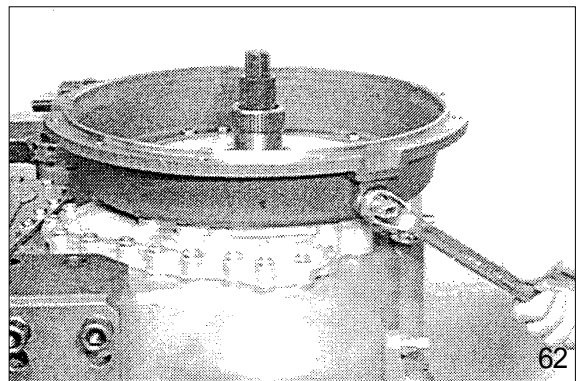
Loosen hexagon head screws and separate diaphragm from the converter.



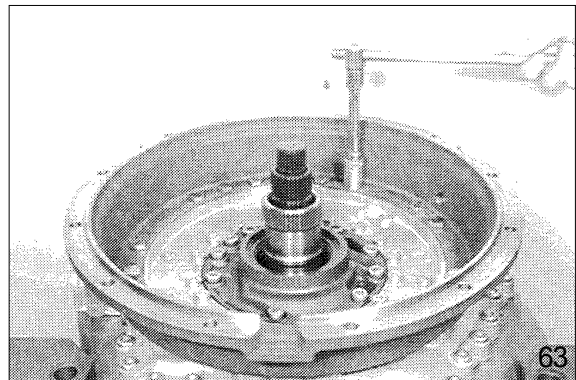
Loosen hexagon head screws and separate drive shaft from the diaphragm.



Remove inductive transmitter(Engine).

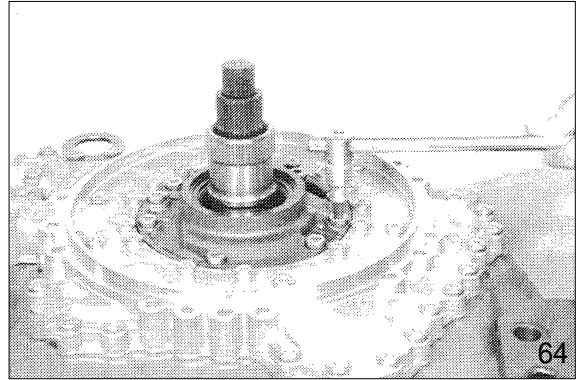


Loosen hexagon head screws and remove converter bell.



(3) Hydraulic pump

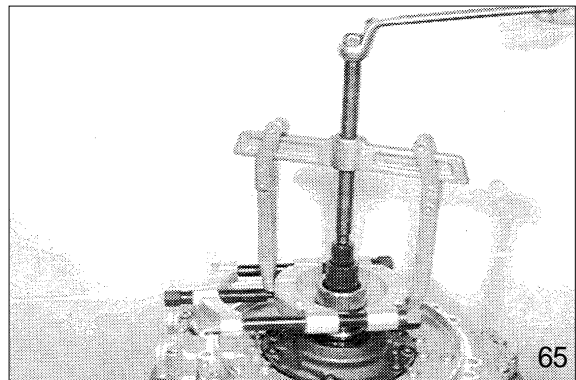
Loosen socket head screws.



Apply separating device on the gear teeth runout of the stator shaft and pull pump(Compl.) by means of two leg puller carefully out of the housing bores.

Separating device 5870 300 024

Two leg puller 5870 970 004

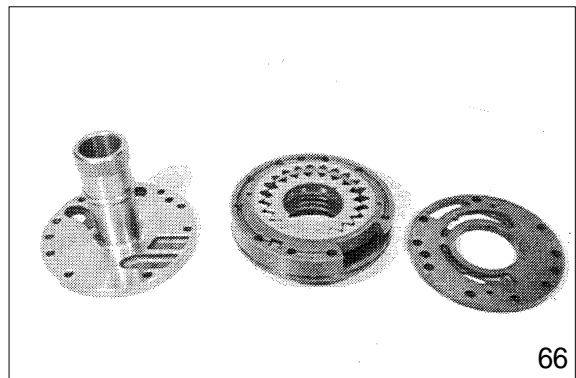


Separate hydraulic pump from stator shaft.

Separate control disk from pump.

If traces due to running in should be encountered in the pump housing or on the control disk, the complete pump has to be renewed.

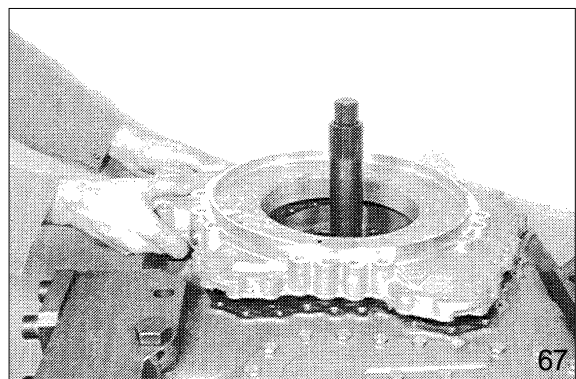
Now, lay on control disk again and fix it by means of grooved pins(2EA).



Loosen socket head screws as well as two hexagon head screws and remove oil feed housing.

Now, remove gasket.

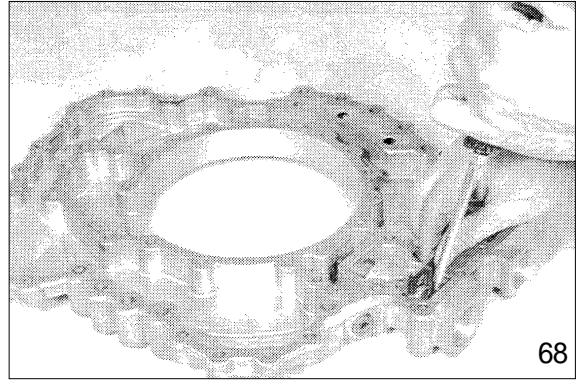
Box spanner 5873 024 004



(4) Converter back pressure valve

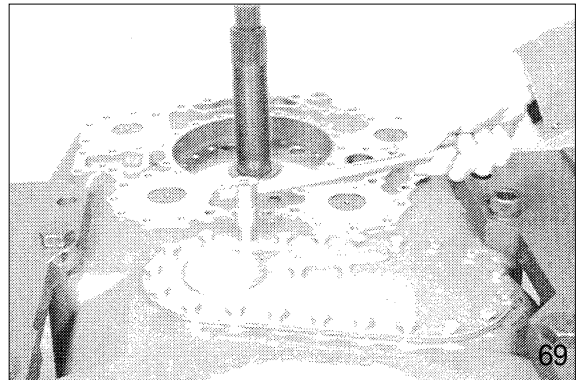
Preload compression spring and remove lock plate.

Remove released components.



Loosen hexagon head screws.

Remove cover and gasket.



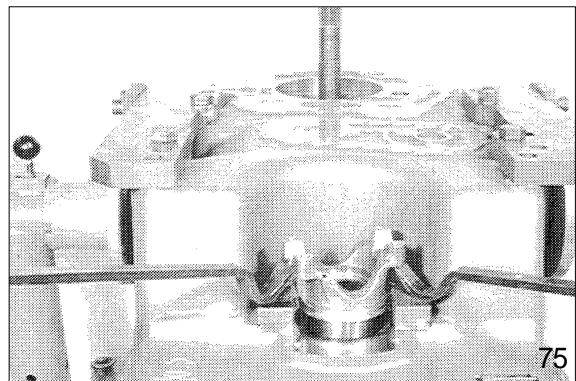
(5) Remove output, input and clutches

Remove lock plate, loosen hexagon head screws and pry converter side output flange off the shaft.

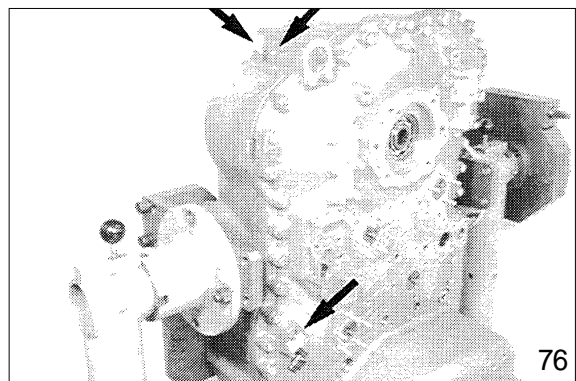
Now, pry shaft seal out of the housing bore.

Tilt transmission 180. and remove rear side output flange accordingly.

Pry bar 5870 345 065

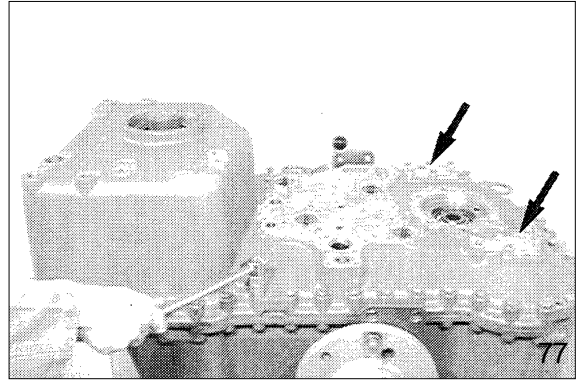


Remove speed sensor as well as both inductive transmitters(Arrows).

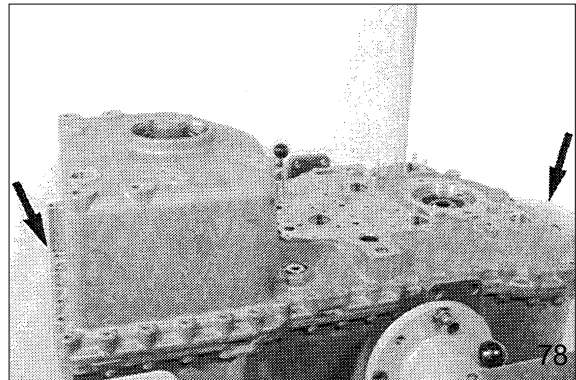


Loosen hexagon nuts and remove both covers(Arrows).

Loosen screw connection(Housing/
Housing cover).



Drive both cylindrical pins out(Arrows).



The following figures show the common removal of all clutches.

The removal of single clutches without use of the special tool(Handle 5870 260 010) is due to the installation conditions extremely difficult.

Besides there is the danger of injuries.

Locate all clutches by means of handles in the housing cover.

Install eye bolts and hang in the lifting device.

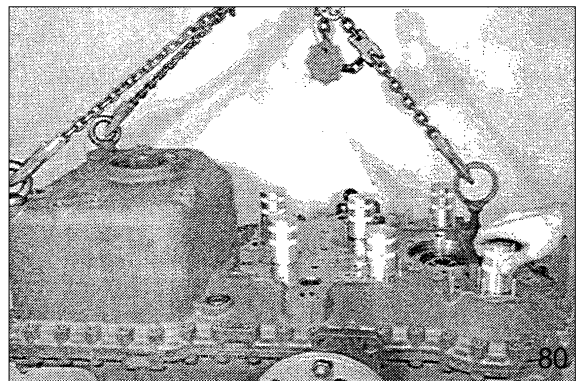
Handle(6 pieces needed) 5870 260 010

Eye bolt(M20, 2EA) 0636 804 003

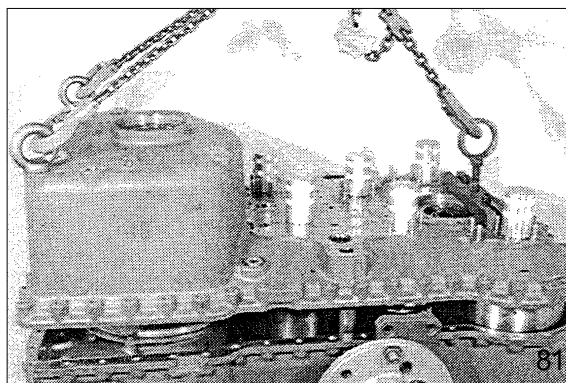
Eye bolt(M16, 1EA) 0636 804 001

Puller device 5870 000 017

Lifting chain 5870 281 047

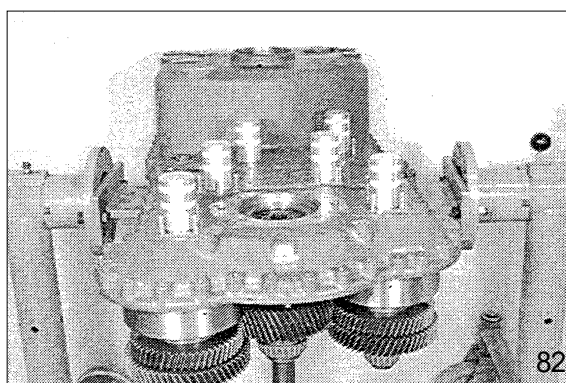


Separate housing cover along with clutches from the gearbox housing, using lifting device.

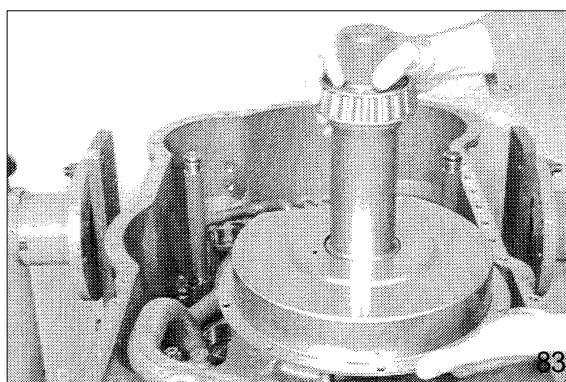


Fasten housing cover on the assembly car.

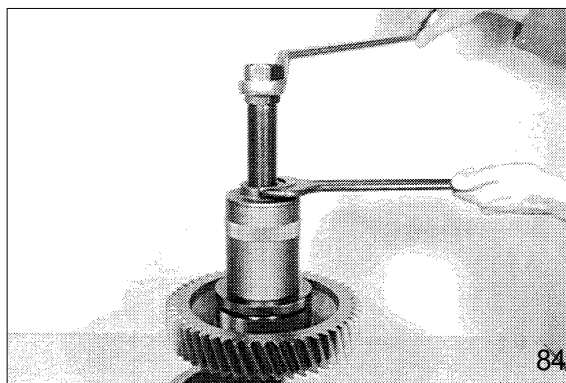
Assembly car 5870 350 000
Clamping bracket 5870 350 089



Loosen socket head screws and remove output shaft as well as the two oil collecting plate.



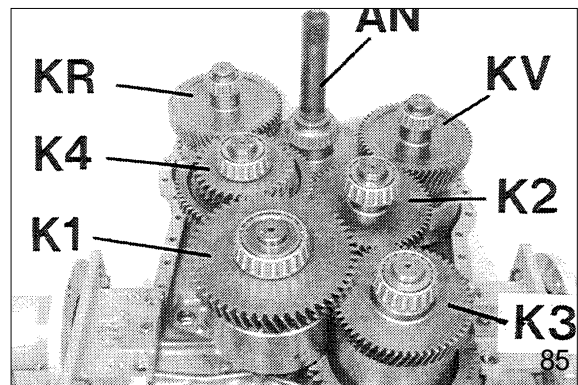
Pull off tapered roller bearing.
Remove opposite tapered roller bearing accordingly.
Grab sleeve 5873 002 038
Basic set 5873 002 001



Tilt housing cover 180°.

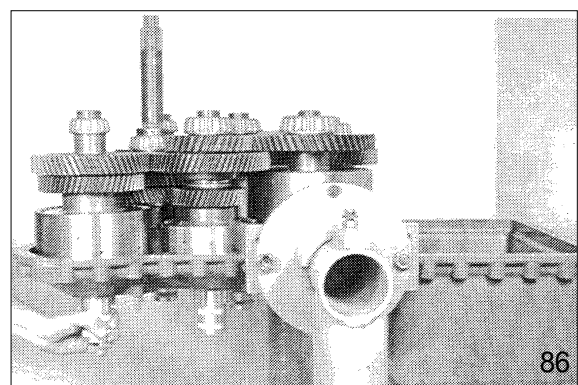
Illustration on the right shows the arrangement of the single clutches and the input in the housing cover.

- AN Input
- KV Clutch-Forward
- KR Clutch-Reverse
- K1 Clutch-1st speed
- K2 Clutch-2nd speed
- K3 Clutch-3rd speed
- K4 Clutch-4th speed

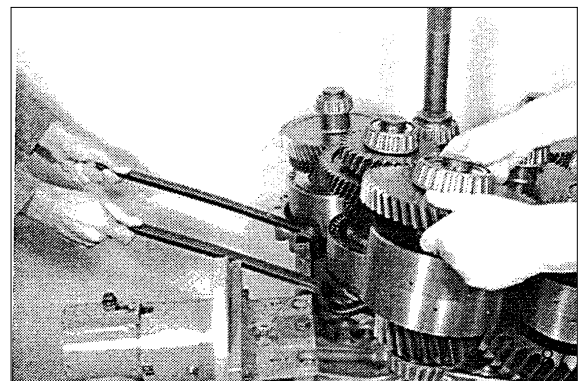


.Remove handles(See figure).

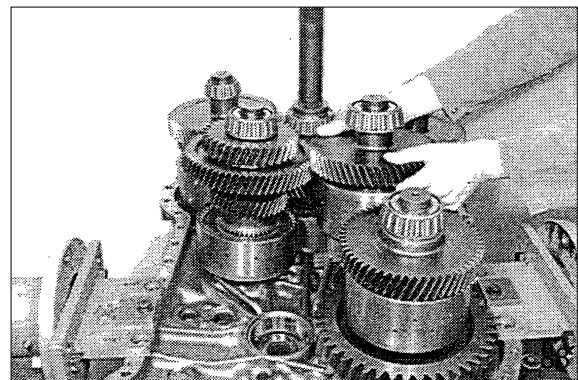
Handles 5870 260 010



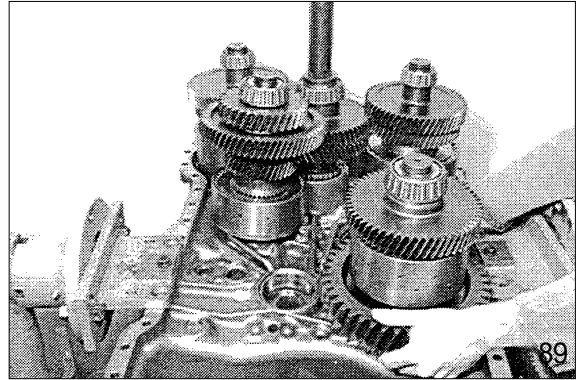
Lift clutch K4 a bit by means of pry bars and remove clutch K1.



Remove clutch K2.

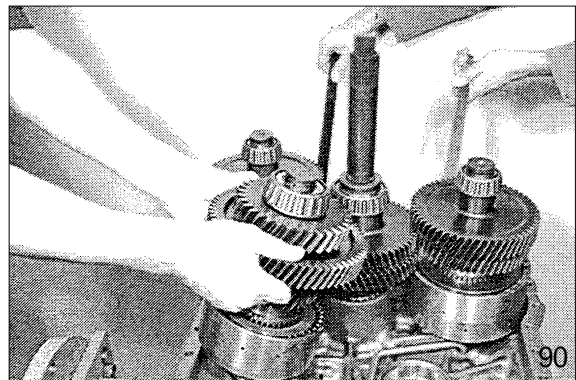


Remove clutch K3.



Lift clutch KV and KR by means of pry bars and remove clutch K4.

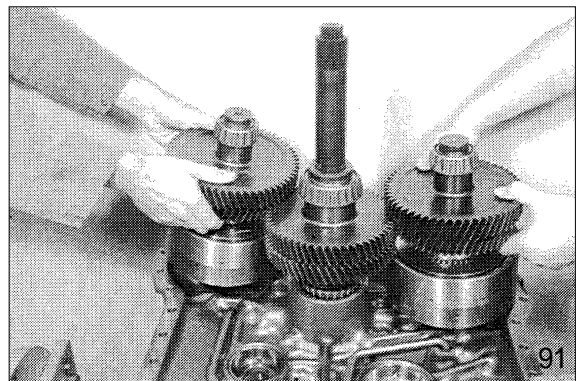
Pry bar 5870 345 065



Lift clutch KV and clutch KR as well as input together out of the housing cover.
Remove bearing outer races out of the housing bores.

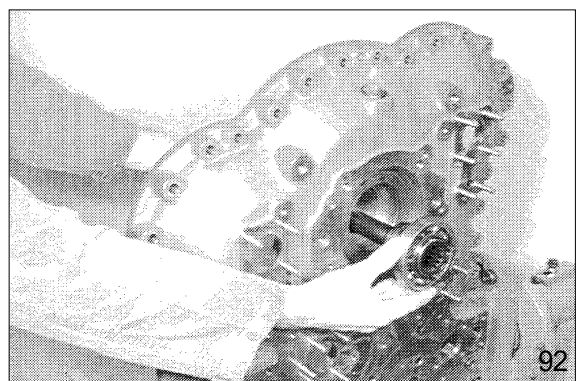
If contrary to the recommendation the tapered roller bearings of the clutches as well as of the input and output will not be renewed, the allocation (Bearing inner races to bearing outer races) must at least be maintained.

Mark bearing inner race and bearing outer race accordingly to each other.

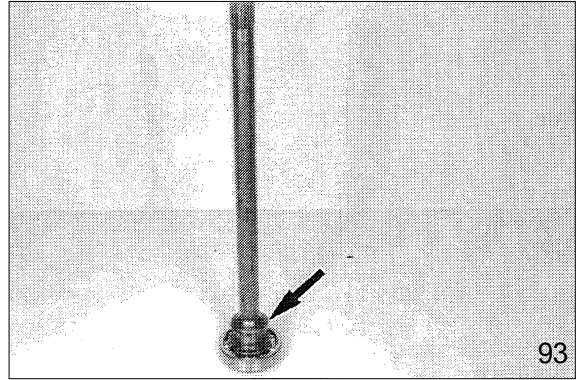


Tilt housing cover 90°.

Squeeze circlip out and separate pump shaft from housing cover.



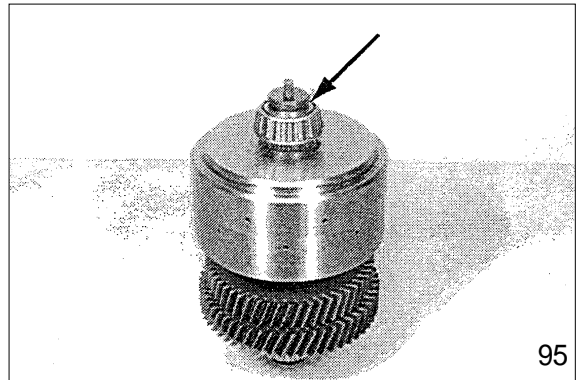
Squeeze rectangular ring out(Arrow) and press ball bearing from the shaft.



(6) Disassemble clutch KV and KR

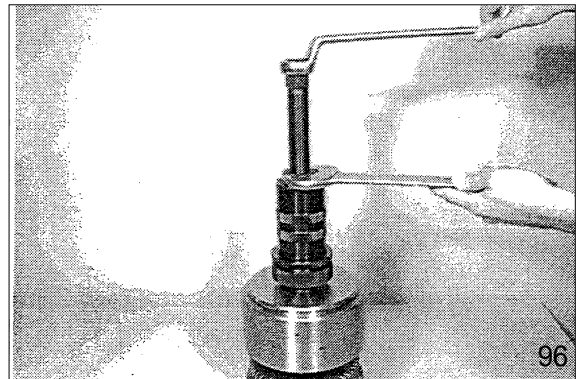
The following figures show the disassembly of clutch KV.

The disassembly of clutch KR is similar. Squeeze rectangular ring out(Arrow).

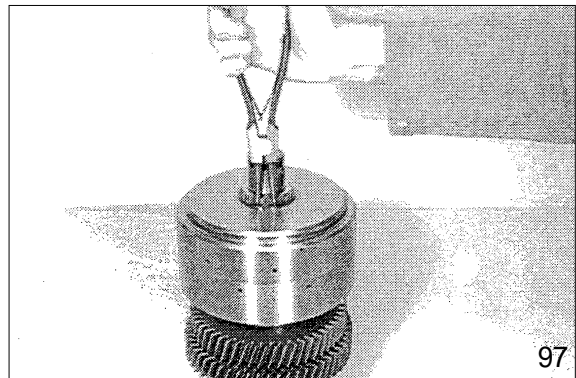


Pull tapered roller bearing from the shaft. Remove opposite tapered roller bearing accordingly.

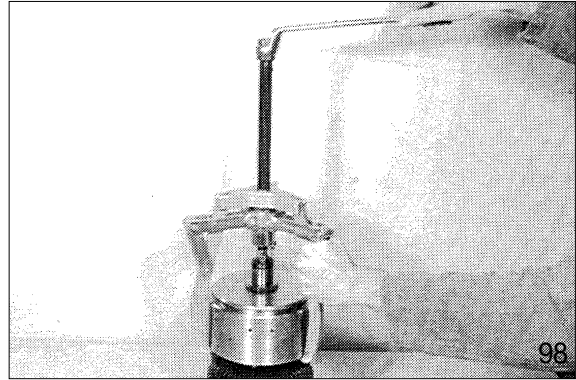
Grab sleeve	5873 001 057
Grab sleeve	5873 001 059
Basic set	5873 001 000



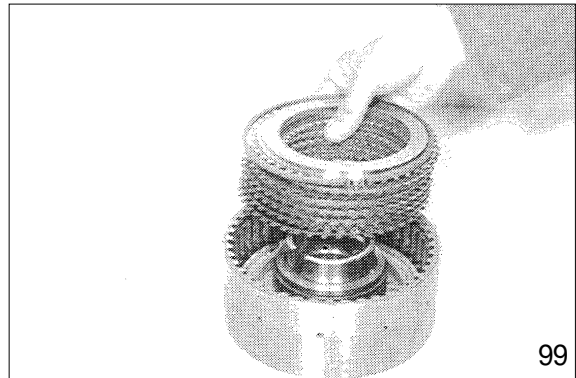
Squeeze circlip out.



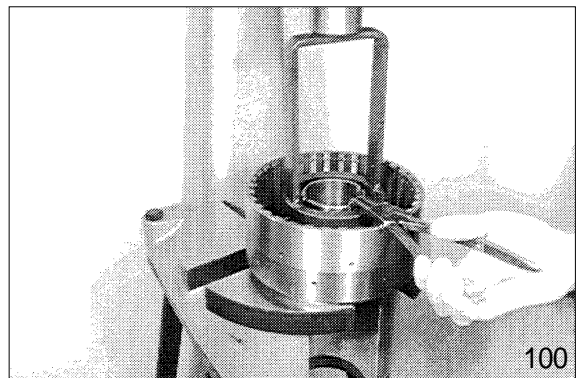
Separate plate carrier from the shaft.
Three leg puller 5870 971 003



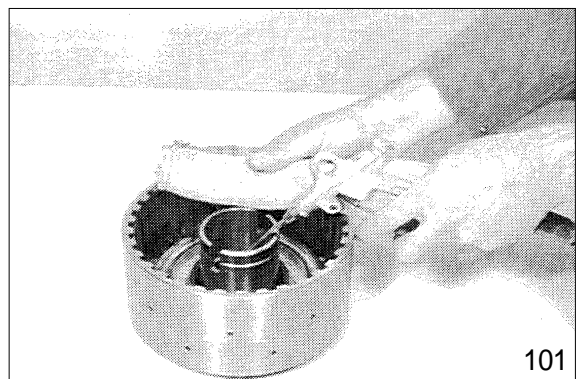
Squeeze snap ring out and remove plate pack.



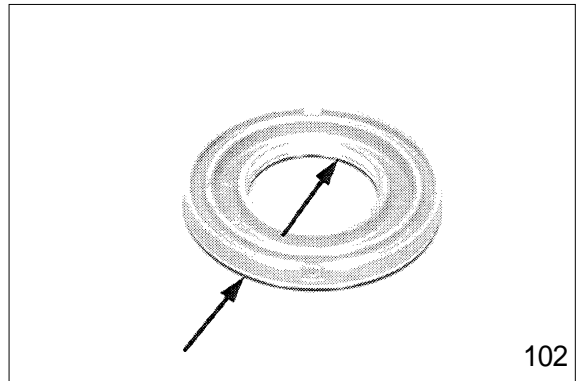
Preload compression spring, squeeze
snap ring out and remove components.
Assembly aid 5870 345 088



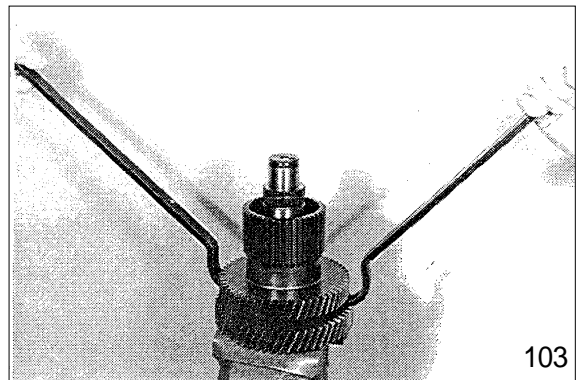
Lift piston by means of compressed air
out of the cylinder bore and remove it.



Remove both O-rings(Arrows).



Lift idler gear a bit by means of pry bare.



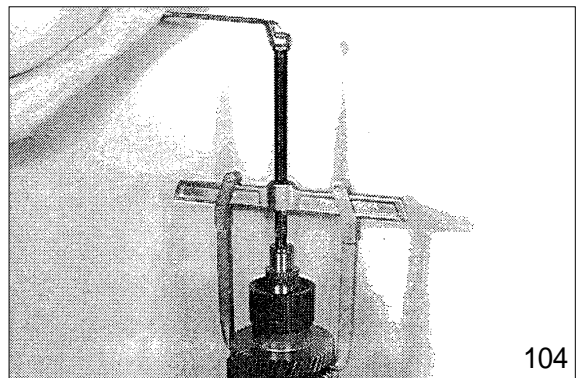
Apply puller and separate idler gear from the clutch shaft.

Pry bar

5870 345 065

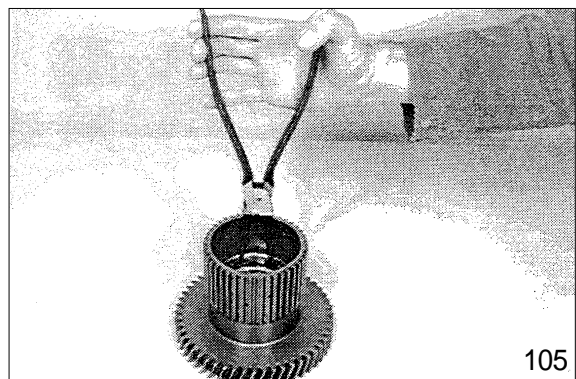
Puller

5870 971 003



Squeeze circlip out and remove ball bearing.

The disassembly of clutch KR has to be carried out accordingly.



(7) Disassemble clutch K1, K2 and K3

The following figures show the disassembly of clutch K3.

The disassembly of the clutches K1 and K2 is similar.

Squeeze rectangular ring out.

Pull tapered roller bearing from the shaft.

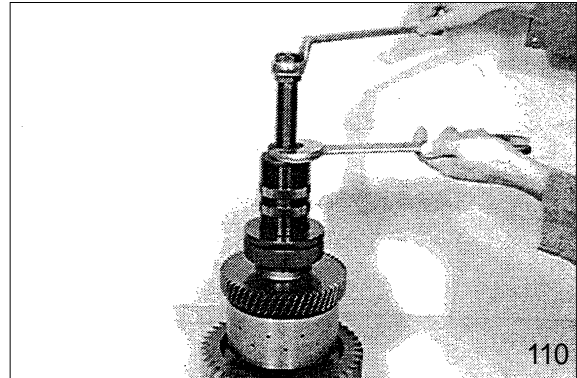
Remove the opposite tapered roller bearing accordingly.

Grab sleeve(Bearing 33800) 5873 001 059

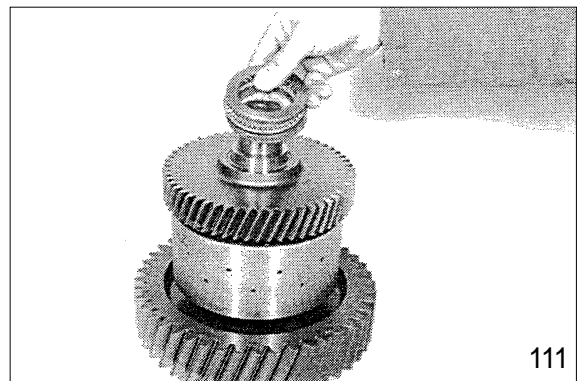
Grab sleeve(Bearing 39500) 5873 002 038

Basic set 5873 001 000

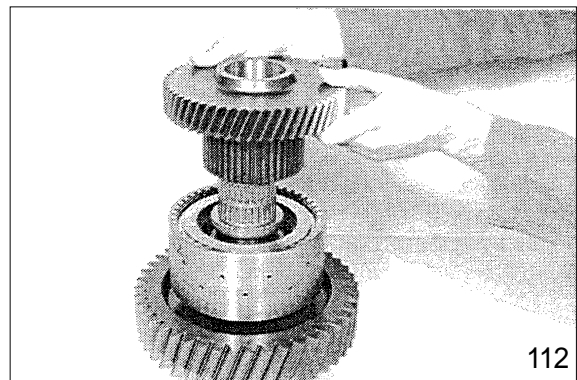
Basic set 5873 002 001



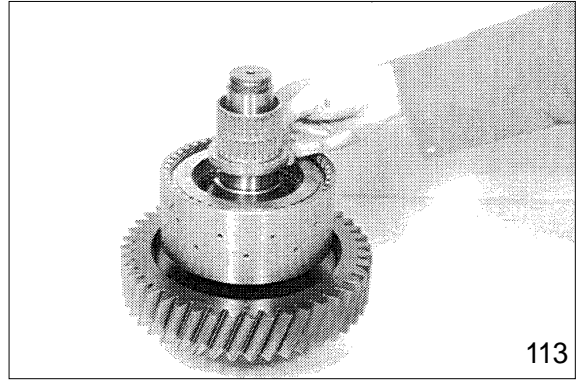
Remove running disk, axial needle cage and axial washer.



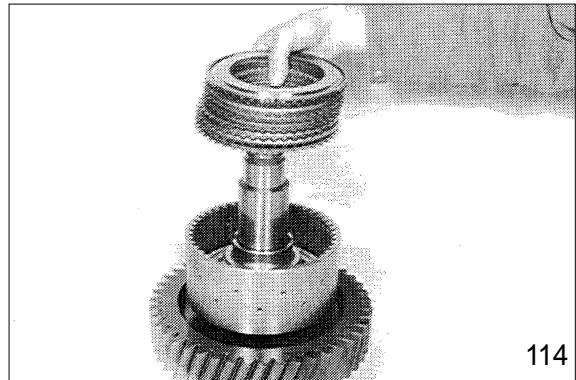
Remove idler gear.



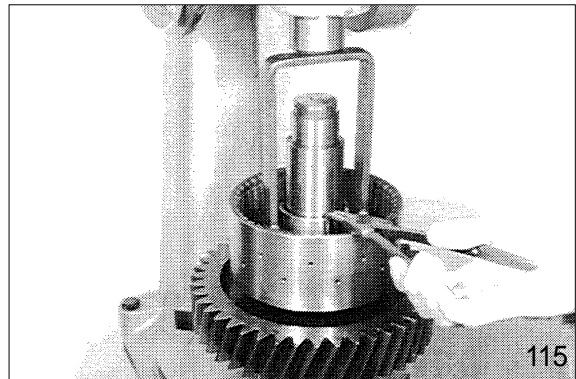
Remove both needle bearings as well as the axial bearing(Complete).



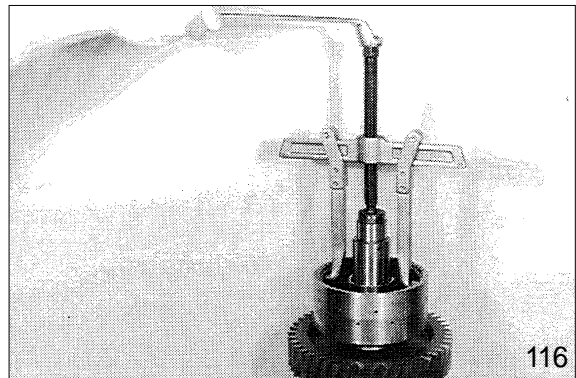
Squeeze snap ring out and remove plate pack.



Preload cup-spring pack and squeeze snap ring out.
Remove released components.
Assembly aid 5870 345 088

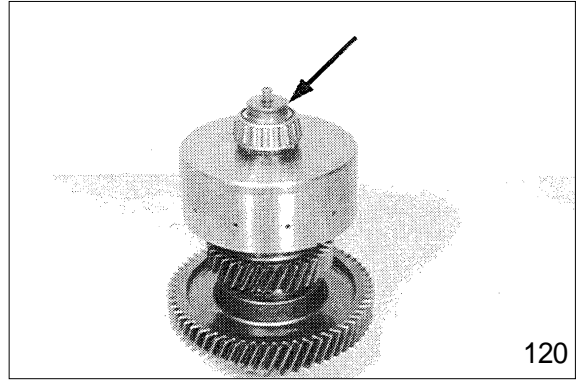


Squeeze circlip into the groove of the plate carrier.
Apply puller on the circlip and pull plate carrier from the clutch shaft.
Puller 5870 970 004
Circlip 0630 502 053



(8) Disassemble clutch K4

Squeeze rectangular ring out(Arrow).

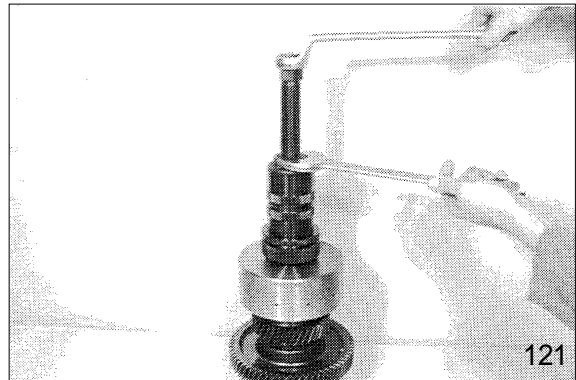


Pull tapered roller bearing from the shaft.
Remove opposite tapered roller bearing accordingly.

Grab sleeve 5873 001 057

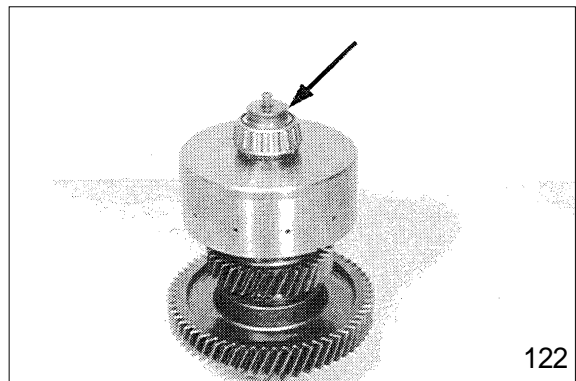
Grab sleeve 5873 001 059

Basic set 5873 001 000

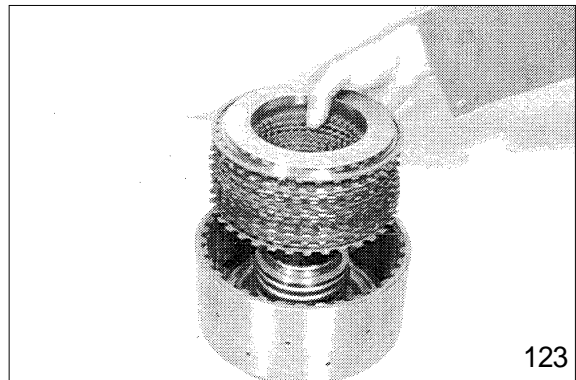


Squeeze circlip out and separate plate carrier from the shaft.

Three leg puller 5870 971 003



Squeeze snap ring out and remove plate pack.



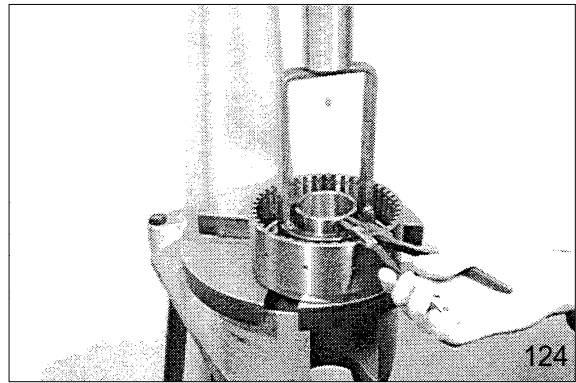
Preload cup-spring pack and squeeze snap ring out.

Remove released components.

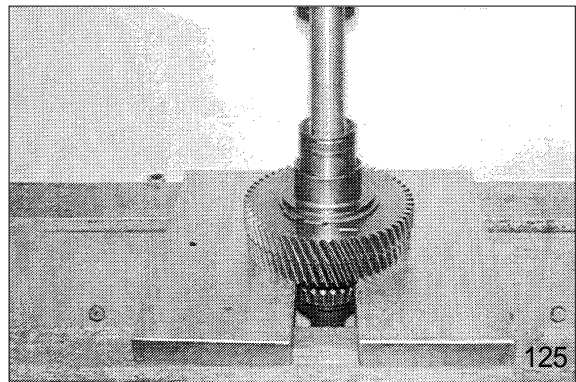
Remove piston.

Assembly aid

5870 345 008

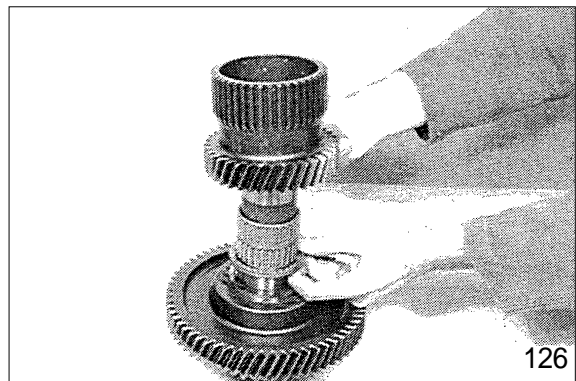


Lift piston by means of compressed air out of the cylinder bore and remove it.



Take off the idler gear and remove release components.

The separation of shaft and gear is not possible(Shrink fit).



(9) Disassemble drive shaft

Squeeze rectangular ring out.

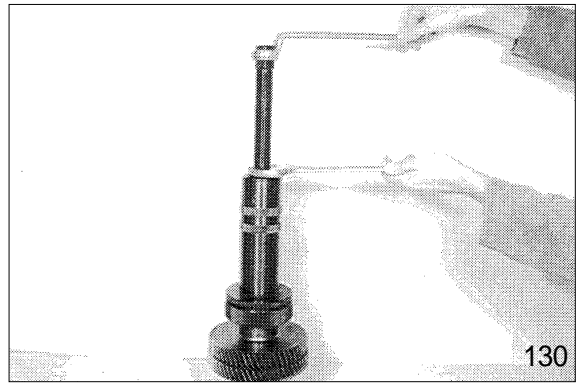
Pull off tapered roller bearing.

Remove opposite tapered roller bearing accordingly.

Grab sleeve 5873 002 045

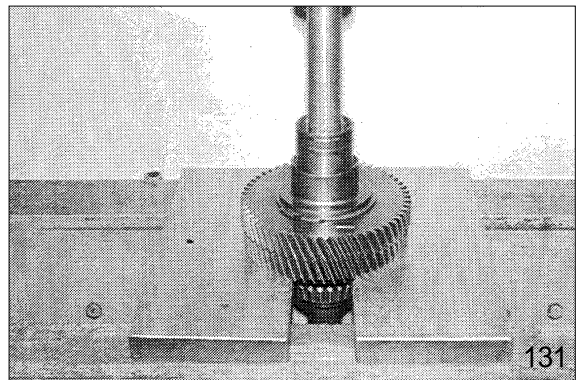
Basic set 5873 002 001

Basic set 5873 002 006



If necessary, press turbine shaft out of the drive shaft.

The turbine shaft is axially fixed with a snap ring which will be destroyed at the pressing out.



2) REASSEMBLY

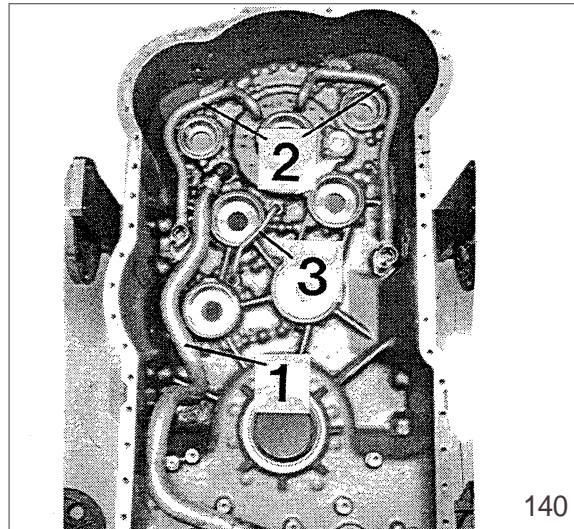
(1) Install oil tubes

To ensure the correct installation of the oil tubes, the use of the indicated special tool is imperative.

Insert suction pipe(1), pressure pipes(2) and pressure pipelubrication(3) into the housing bores.

Fasten suction and pressure pipes by means of socket head screws.

- Torque limit : 2.3kgf · m(17.0lbf · ft)



140

Tilt housing 180°.

Roll suction as well as pressure pipes(Arrows) into the housing bores, using special tool.

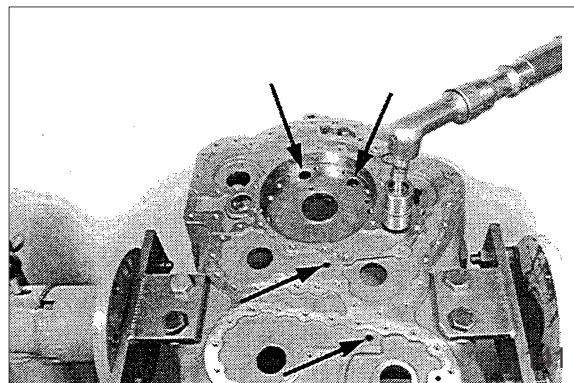
The pipe end must be maximally plane with the housing face.

If necessary, equalize projection of pipe.

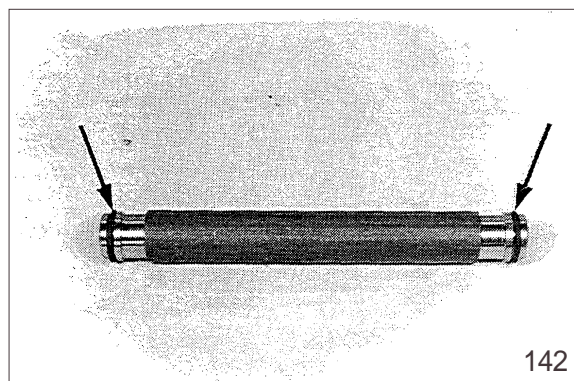
Rolling tool 5870 600 003

Rolling tool 5870 600 005

Rolling tool 5870 600 007



Insert O-rings(2EA/pipe) into the annular grooves of the two oil tubes and oil them.

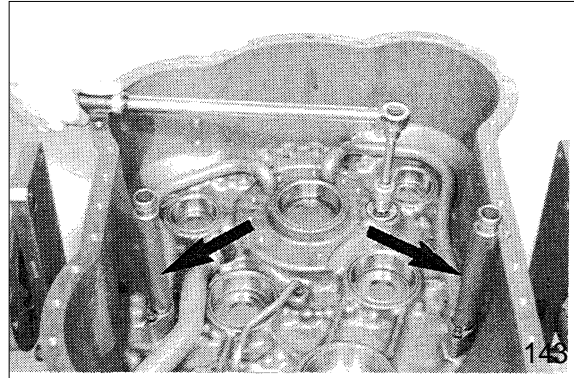


142

Assemble both oil tubes(Arrows) until contact is obtained.

Equip screw plug with new O-ring and install it.

- Torque limit : 14.3kgf · m(103lbf · ft)

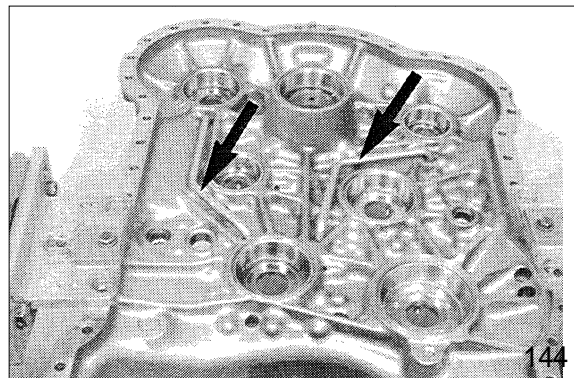


Insert both oil tubes(Arrows) into the housing cover, tilt housing cover 180, and roll oil tubes into the housing bores.

The tube end must be maximally plane with the housing face.

If necessary, equalize projection of the tube.

Rolling tool 5870 600 008



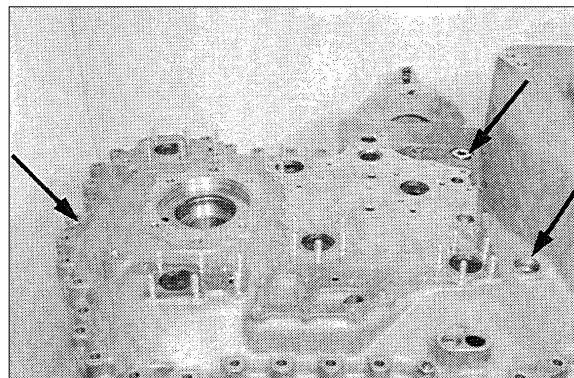
Mount studs(M8 x 25).

- Torque limit : 0.92kgf · m(6.64lbf · ft)

Wet screw in thread with loctite(Type No. 262).

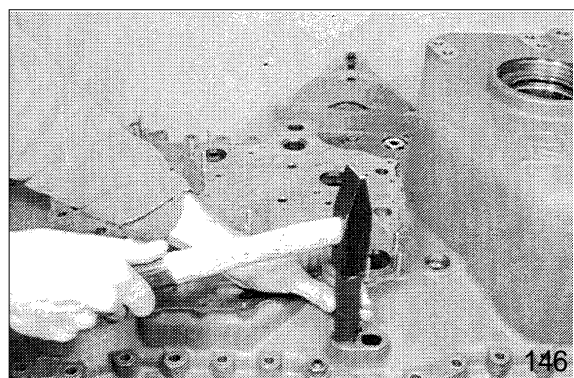
Equip plugs(Arrows) with new O-rings and install them

- Torque limit(M16 x 1.5) : 4.1kgf · m
(29.5lbf · ft)
- Torque limit(M18 x 1.5) : 5.1kgf · m
(36.9lbf · ft)
- Torque limit(M26 x 1.5) : 8.2kgf · m
(59.0lbf · ft)



Insert sealing cover, with the recess showing upward.

Wet contact face with loctite(Type No. 262).



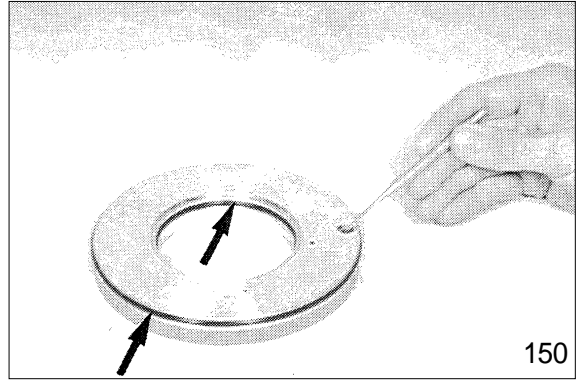
(2) Reassemble clutch KV and KR

The following figure show the reassembly of the clutch KV. The reassembly of the clutch KR has to be carried out accordingly.

Preassemble plate carrier

Check function of the purge valve.

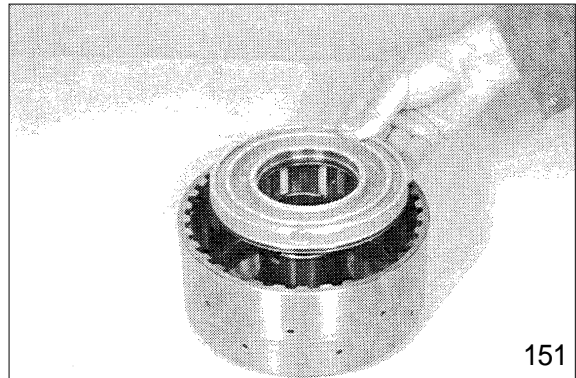
Ball must not stick, if necessary, clean with compressed air.



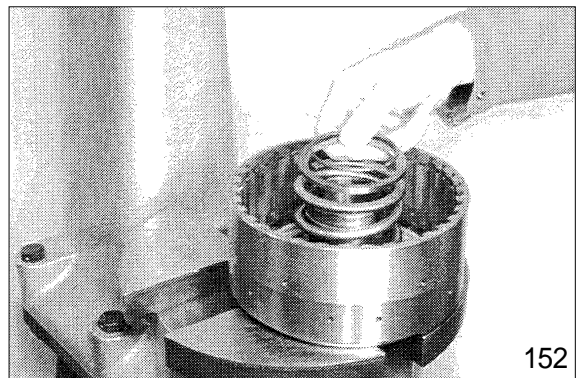
Insert both O-ring(Arrows) scrollfree into the grooves of the piston and oil.

Introduce piston until contact is obtained.

Pay attention to the installation position, see figure.



Install disk, compression spring and guide ring.



Preload compression spring and fix it by means of snap ring.

Assembly aid

5870 345 088

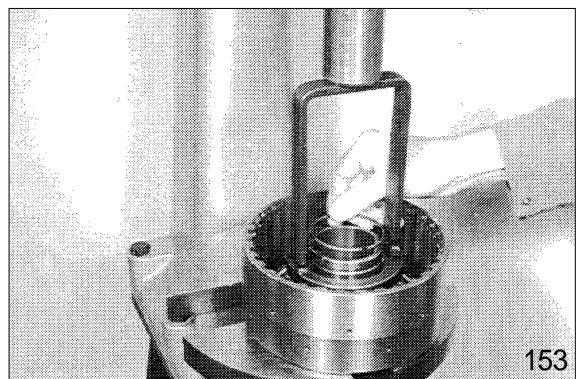


Plate pack KV, KR

The plate arrangement respectively stacking of clutch KV and KR is identical.

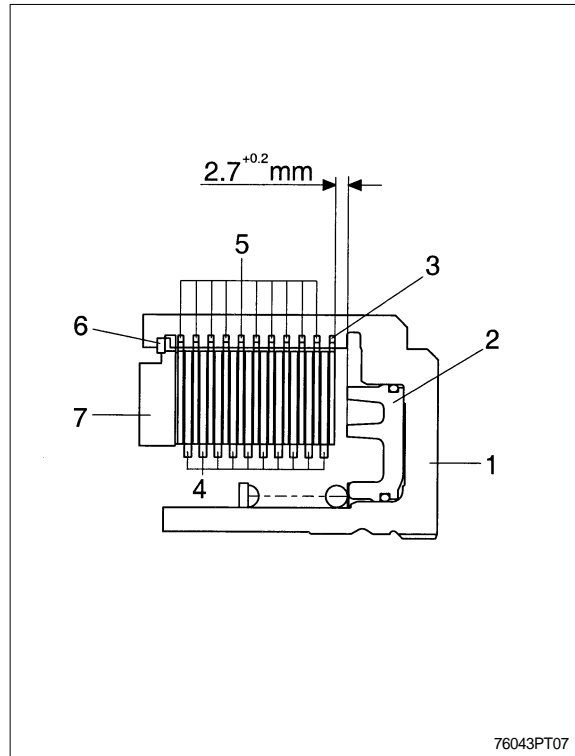
The following draft shows the installation position of the components.

- 1 Plate carrier
- 2 Piston
- 3 Outer plate-one sided coated(1 piece)
- 4 Inner plates(10 pieces)
- 5 Outer plates-coated on both sides (10 pieces)
- 6 Snap ring(Optional s= 2.1~4.2mm)
- 7 End shim

Effective number of friction surfaces = 20

Install outer plate 3 with the uncoated side facing the piston.

Install on the end-shim side two outer and inner plates each.

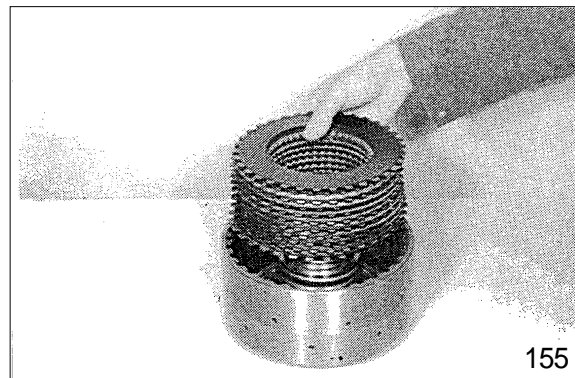


Adjust plate clearance : $2.7+0.2$ mm

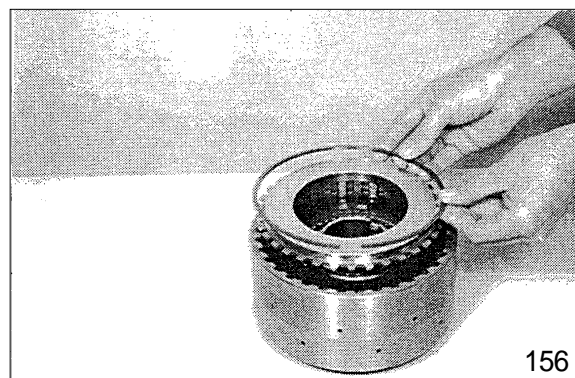
For the adjustment of the plate clearance are snap rings of different thickness available.

To ensure a faultless measuring result, install plates for the moment without oil.

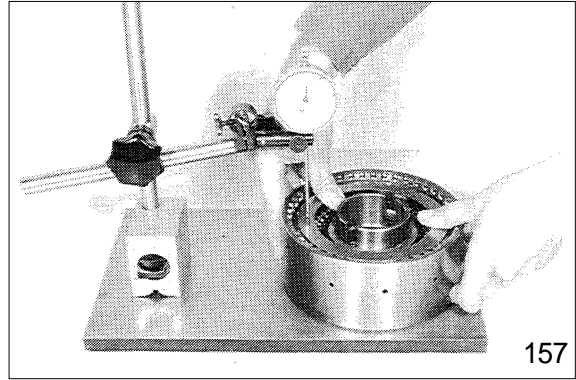
Introduce plate pack according to the upper draft.



Lay on the end shim and squeeze the snap ring in(e.g. s=2.55mm)



Press on end shim with about 100N (10kg), apply dial indicator and set it at zero.



Now, push the end shim by means of screw driver against snap ring until contact is obtained(Upward) and read plate clearance on the dial indicator.

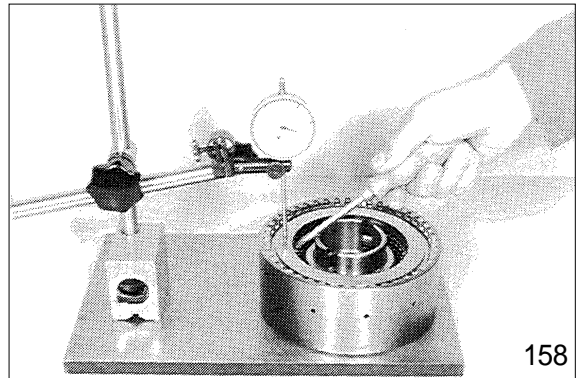
In case of a deviation from the required plate clearance, correct with corresponding snap ring(s=2.1~4.2mm).

After the adjustment of the plate clearance has been carried out, remove the plate pack, oil plates and install it again.

Use oil Dexron- D, /Mercon-M.

Magnetic stand 5870 200 055

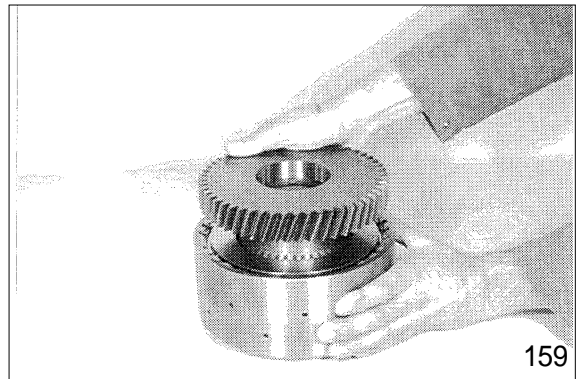
Dial indicator 5870 200 057



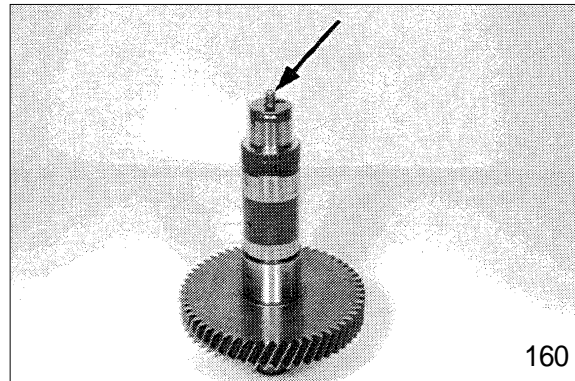
Introduce idler gear until all inner plates are accommodated.

This step makes the later assembly of the idler gear easier.

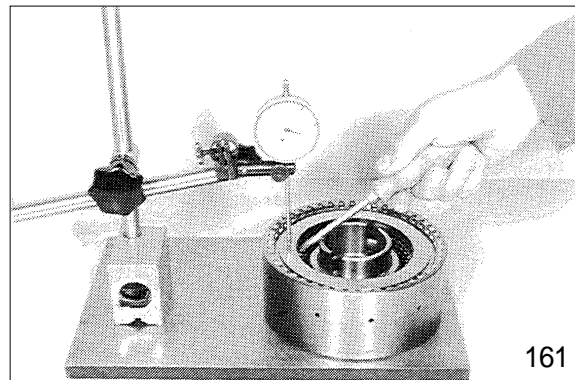
Now, remove the idler gear again.



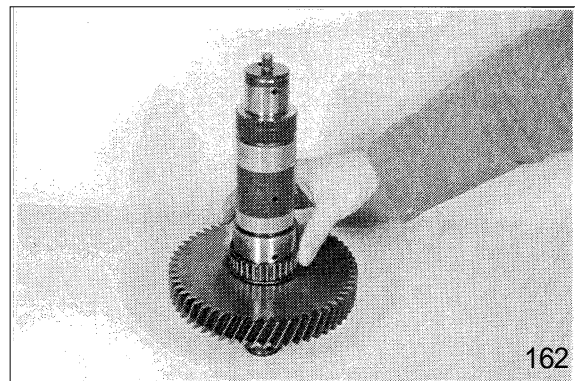
Mount stud(Arrow).
Wet screw-in thread with loctite(Type No.241).
· Torque limit(M10) : 1.7kgf · m(12.5lbf · ft)



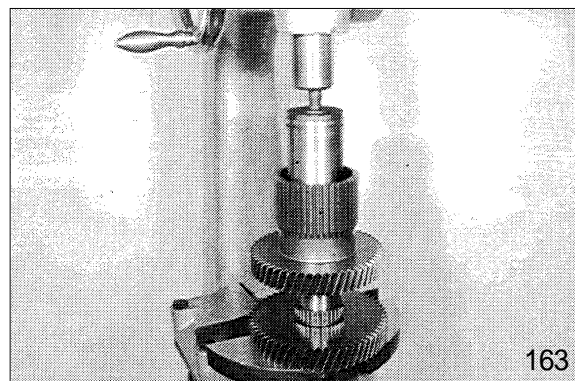
Insert ball bearing until contact is obtained and fix by means of circlip.



Assemble needle bearing.



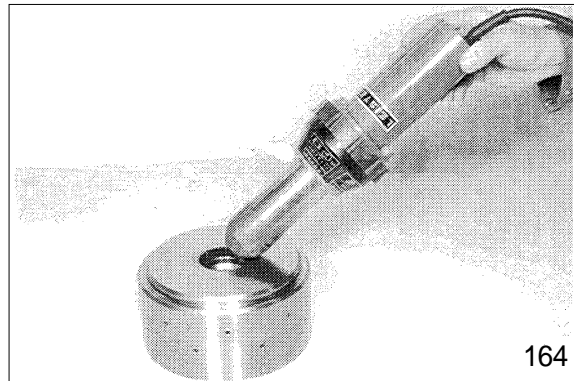
Press idler gear against shoulder.
Support it on the bearing inner race.



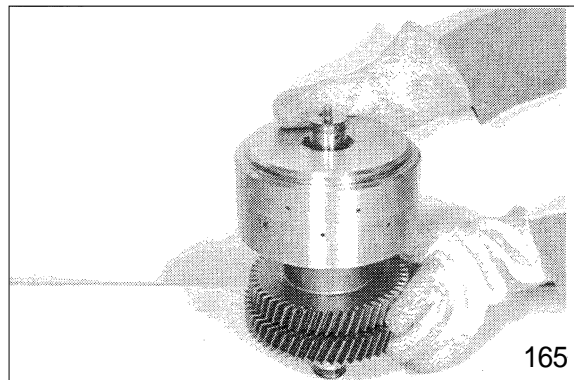
Heat inner diameter of plate carrier (About 120°C).

Hot air blower 220V 5870 221 500

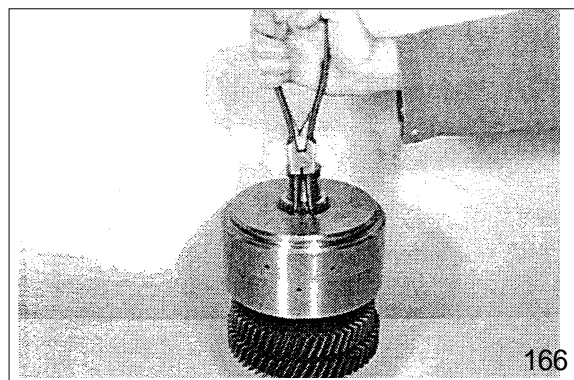
Hot air blower 110V 5870 221 501



Assemble preassembled plate carrier until contact is obtained.

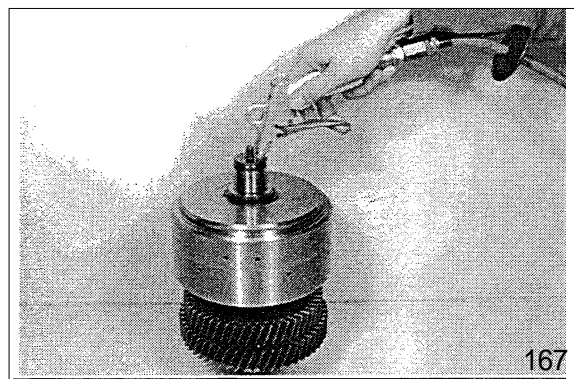


Locate plate carrier axially by means of circlip.

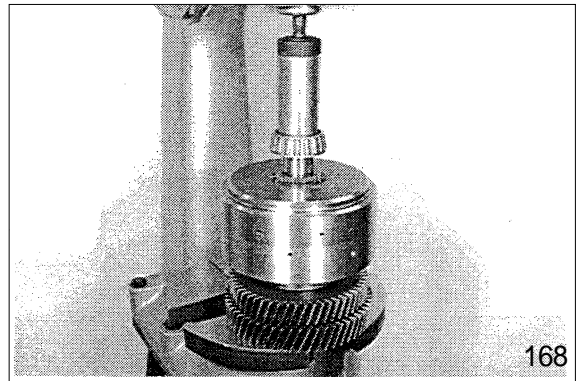


Check function of clutch by means of compressed air.

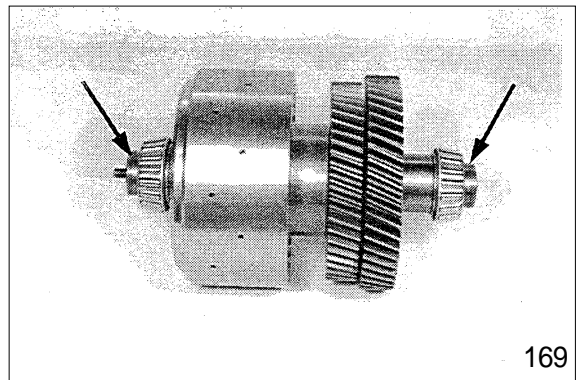
At correctly installed components, the closing resp. opening of the clutch is clear audible.



Press tapered roller bearing against shoulder.
Install opposite tapered roller bearing accordingly.



Squeeze rectangular rings in (Arrow) and let them snap in.



(3) Reassemble clutch K1, K2 and K3

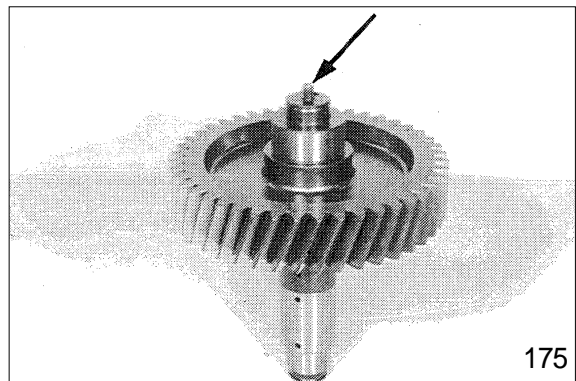
The following figures show the reassembly of clutch K3.

The reassembly of the clutches K1 and K2 has to be carried out accordingly.

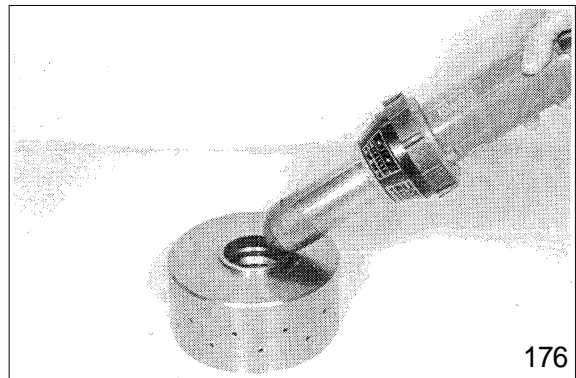
Install stud (Arrow).

Wet screw in thread with loctite (Type No. 241).

- Torque limit (M10) : 1.7kgf · m (12.5lbf · ft)



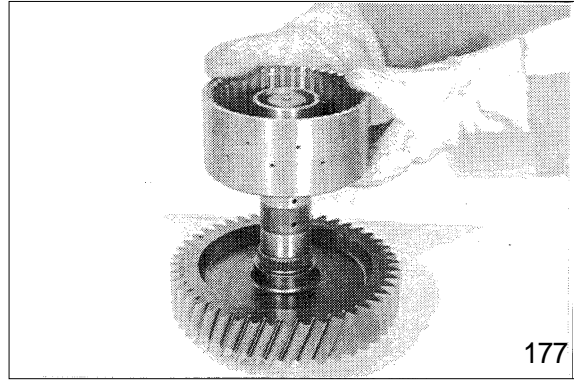
Heat inner diameter of plate carrier.



Assemble plate carrier until contact is obtained.

Hot air blower 220V 5870 221 500

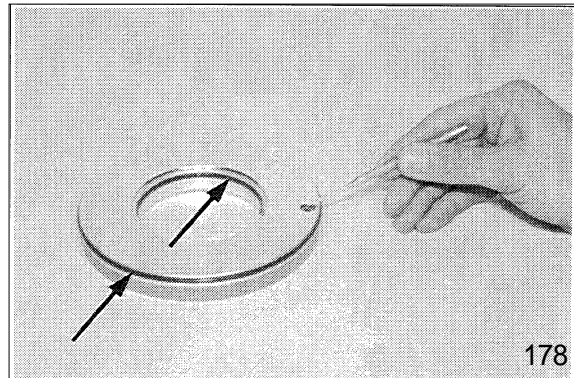
Hot air blower 110V 5870 221 501



.Check function of the purge valve

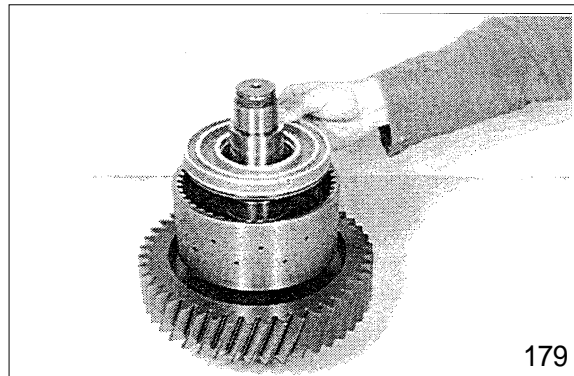
Ball must not stick, if necessary clean with compressed air.

Insert both O-rings(Arrows) scrollfree into the grooves of the piston and oil.



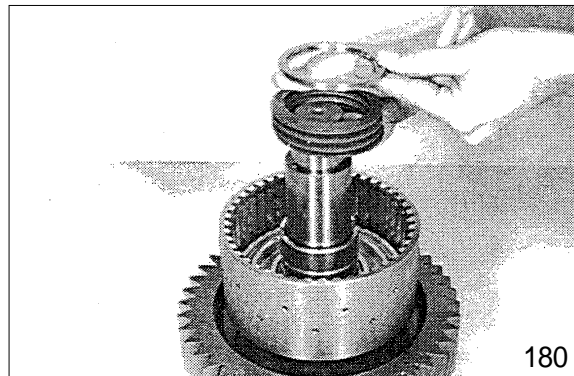
Introduce piston until contact is obtained.

Pay attention to the installation position, see figure.

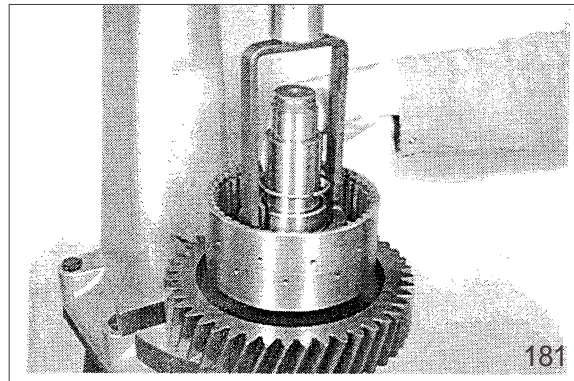


Lay on cup spring pack and guide ring.

Pay attention to the stacking of the cup springs, see the next draft.



Preload cup spring pack and fix it by means of snap ring.
 Assembly aid 5870 345 088



The plate arrangement of clutch K1 is identical with clutch K2 and K3.
 In this connection see the following drafts.

Plate pack K1

- 1 Plate carrier
- 2 Piston
- 3 Outer plate-one side coated(1 piece)
- 4 Inner plates(9 pieces)
- 5 Outer plates-on both sides coated (9 pieces)
- 6 Snap ring(Optional s=2.1~4.2mm)
- 7 End shim

Effective number of friction surfaces = 18

Install outer plate 3 with the uncoated side facing the piston.

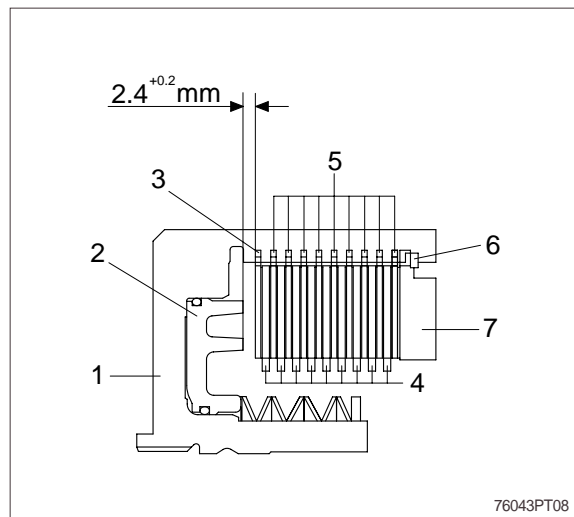


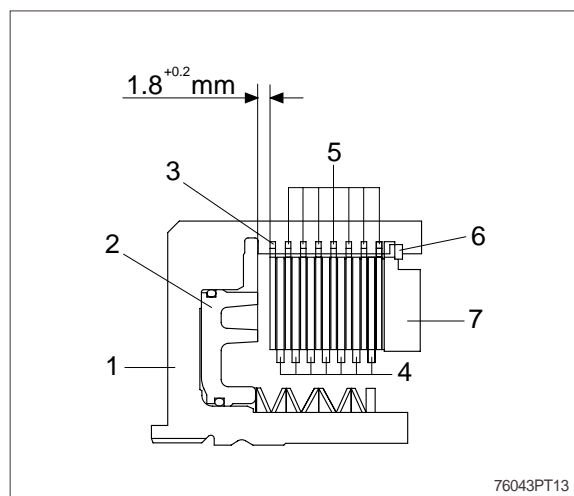
Plate pack K2 and K3

- 1 Plate carrier
- 2 Piston
- 3 Outer plate-one side coated(1 piece)
- 4 Inner plates(7 pieces)
- 5 Outer plates-on both side coated (7 pieces)
- 6 Snap ring(Optional s= 2.1~4.2mm)
- 7 End shim

Effective number of friction surfaces = 14

Install outer plate 3 with the uncoated side facing the piston.

Install on the end-shim two outer and inner plates each.



Adjust plate clearance

Plate clearance clutch K1 $2.4^{+0.2}\text{mm}$

Plate clearance clutch K2 and K3
 $1.8^{+0.2}\text{mm}$

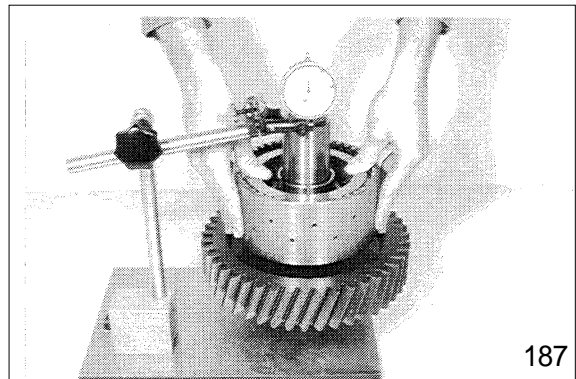
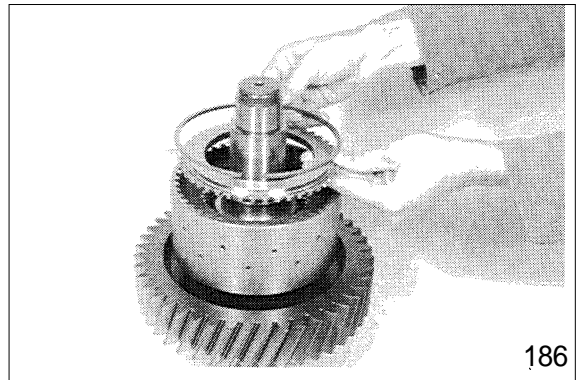
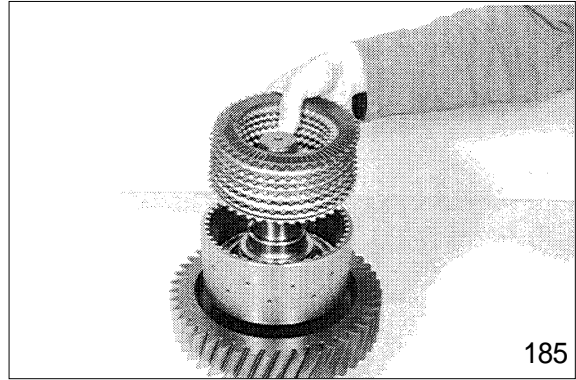
For the adjustment of the plate clearance are snap rings with different thickness available.

To ensure a faultless measuring result, install the plates for the moment without oil.

Introduce plate pack according to drafts / page 3-107.

Lay on the end shim and squeeze circlip in (e.g. $s=3.1\text{mm}$).

Press on the end shim with about 100N (10kg), apply dial indicator and set it at zero.

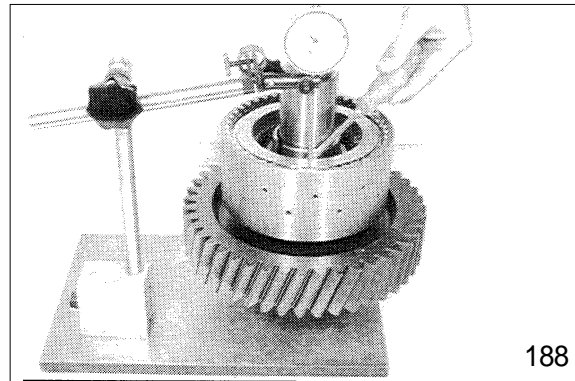


Now, push the end shim by means of screw driver against snap ring until contacts is obtained(Upward) and read plate clearance on the dial indicator.
 In case of a deviation from the required plate clearance, correct with corresponding snap ring(s=2.1~4.2mm).
 After the adjustment of the plate clearance has been carried out, remove the plate pack, oil plates and install it again.

Use oil Dexron- D, /Mercon-M.

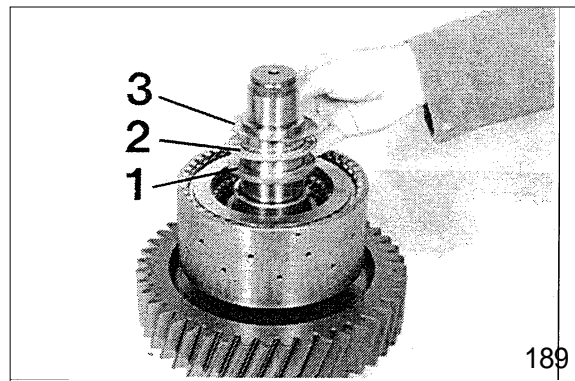
Magnetic stand 5870 200 055

Dial indicator 5870 200 057

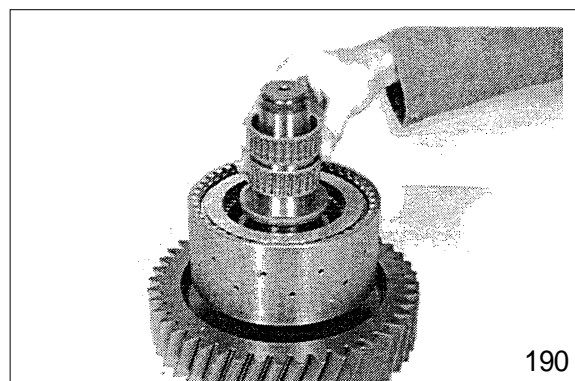


Assemble running disk 1(55 x 78 x 5), axial needle cage 2 and axial washer 3 (55 x 78 x 1).

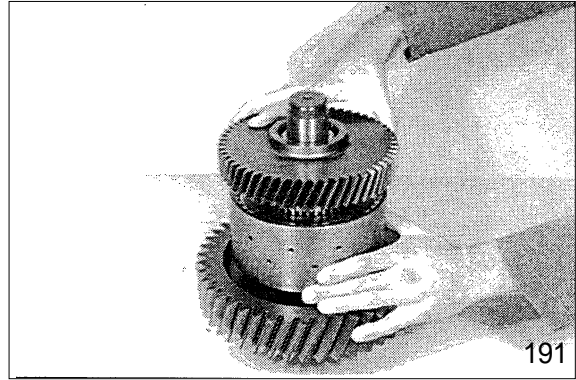
Install running disk 1, with the chamber facing the axial needle cage.



Assemble both needle bearings.



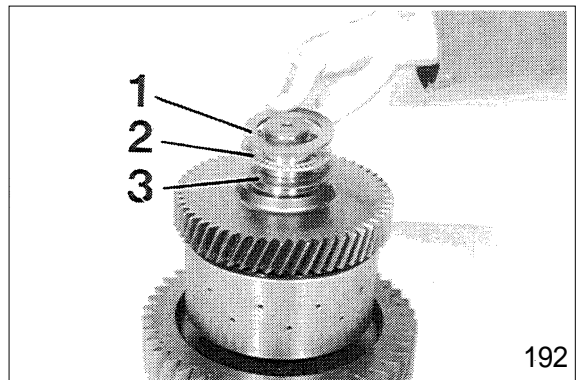
Introduce idler gear until all inner plates are accommodated.



Assemble axial washer 3(55 × 78 × 1), axial needle cage 2 and running disk 1 (55 × 78 × 5).

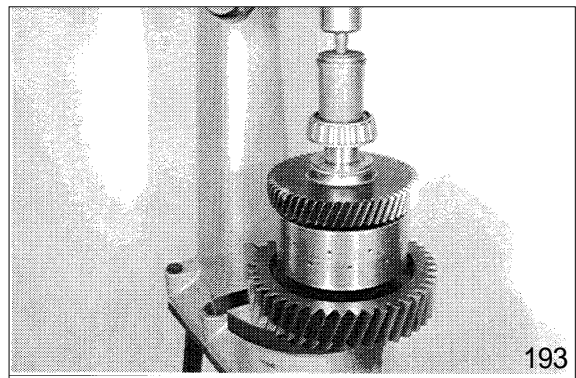
Install running disk 1, with the chamfer facing the axle needle cage.

Only if the running disk is overlapping with the shaft collar is ensured that all inner plates are accommodated.



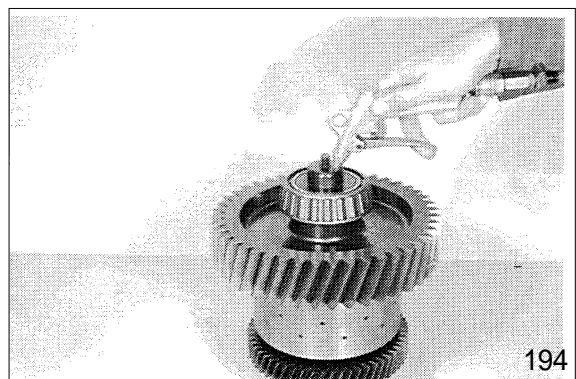
Press tapered roller bearing against shoulder.

Press opposite tapered roller bearing against shoulder.

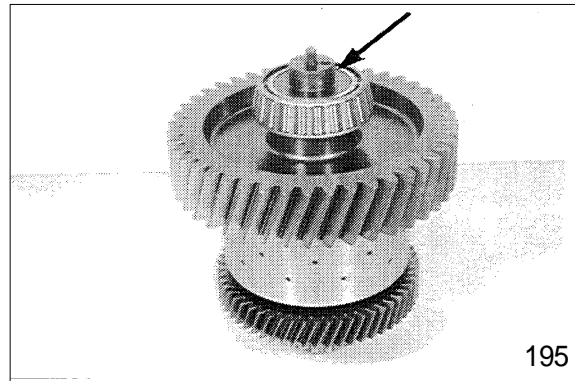


Check function of the clutch by means of compressed air.

At correctly installed components, the closing respectively opening of the clutch is clearly audible.

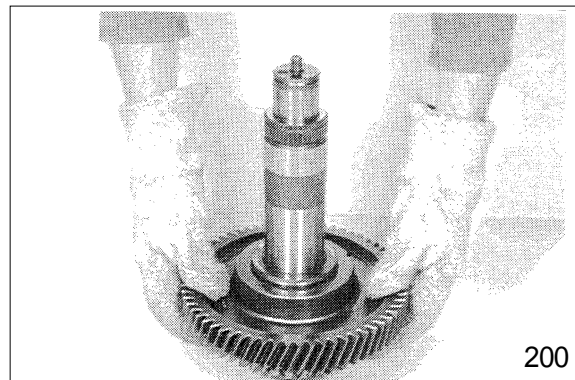


Squeeze rectangular ring in(Arrow) and let it snap in.
Install opposite rectangular ring accordingly.

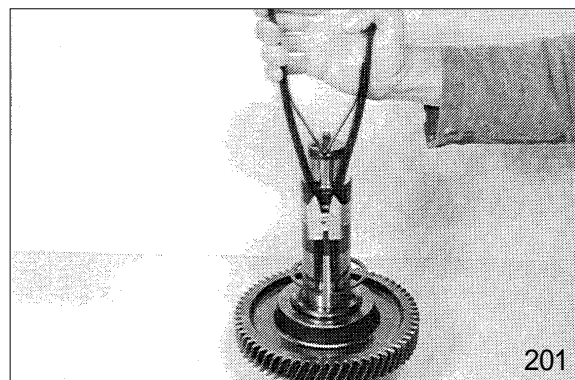


(4) Reassemble clutch K4

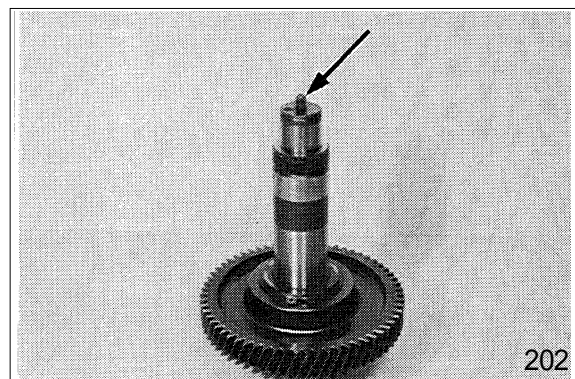
Undercool shaft(About -80°C), heat gear (About $+120^{\circ}\text{C}$) and assemble it until contact is obtained.



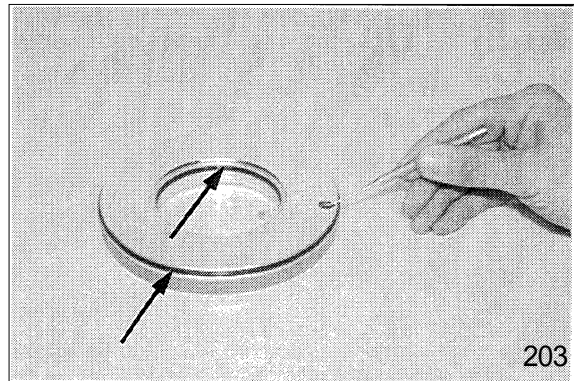
Fix gear axially by means of circlip.
Set of external pliers 5870 900 015



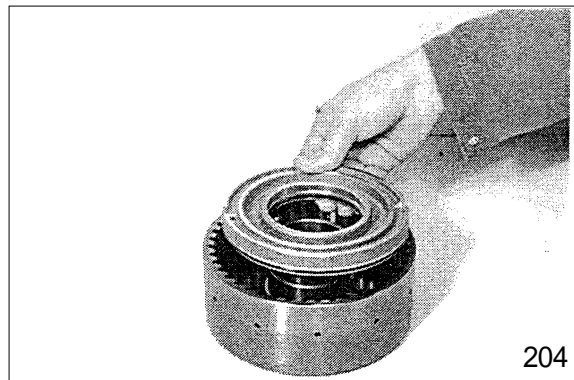
Install stud(Arrow).
Wet screw-in thread with loctite(Type No. 241).
• Torque limit(M10) : $1.7\text{kgf} \cdot \text{m}$ ($12.5\text{bf} \cdot \text{ft}$)



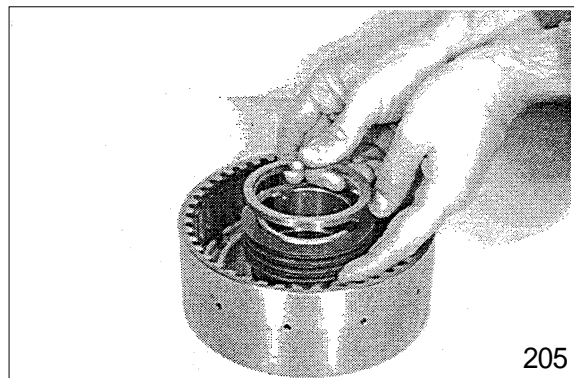
Check function of the purge valve.
Ball must not stick, if necessary clean
with compressed air.
Insert both O-ring(Arrow) scrollfree into
the grooves of the piston and oil them.



Introduce piston until contact is obtained.
Pay attention to the installation position,
see figure.



Install cup-spring pack and guide ring.
Pay attention to the stacking of the cup
springs, see the next draft.



Preload cup-spring pack and fix it by
means of snap ring.
Assembly aid 5870 345 088

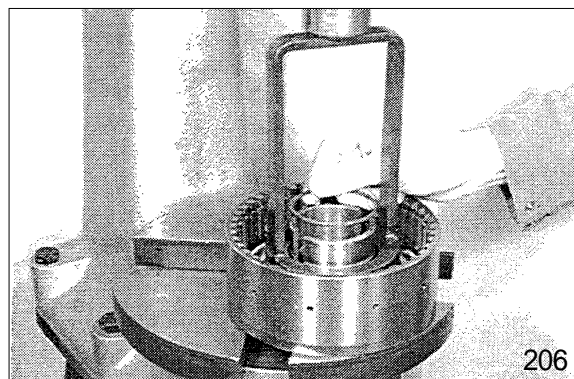


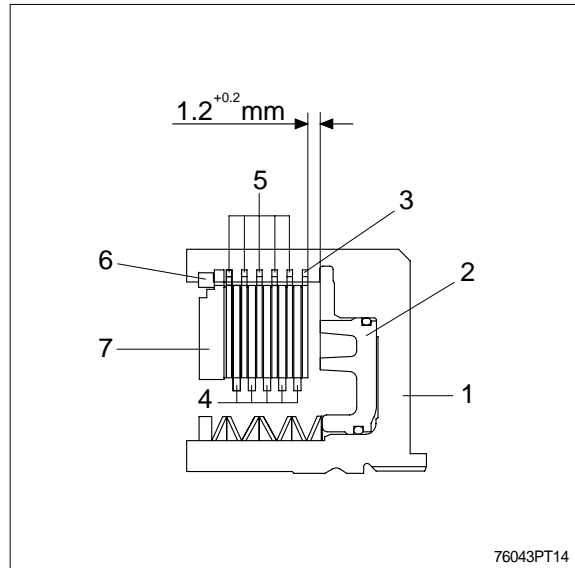
Plate pack K4

The following draft shows the installation position of the components.

- 1 Plate carrier
- 2 Piston
- 3 Outer plate-one side coated(1 piece)
- 4 Inner plates(5 pieces)
- 5 Outer plates-coated on both sides (5 pieces)
- 6 Snap ring(Optional s= 2.1~4.2mm)
- 7 End shim

Effective number of friction surfaces = 10

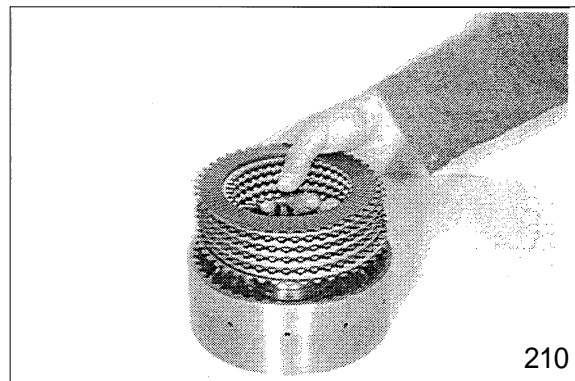
Install outer plate 3 with the uncoated side facing the piston.



Adjust plate clearance = $1.2^{+0.2}$ mm

For the adjustment of the plate clearance are snap rings of different thickness available.

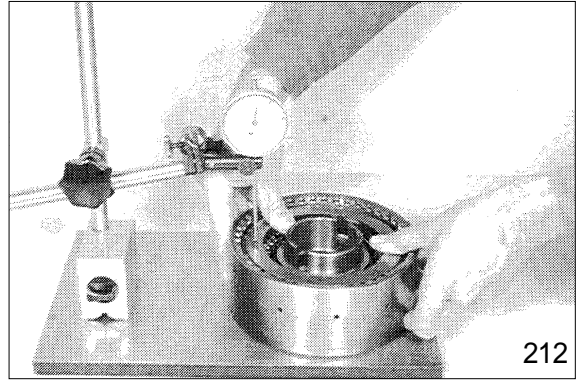
To ensure a faultless measuring result, install plates for the moment without oil. Introduce plate pack according to the draft.



Lay on end shim and squeeze snap ring in(e.g. s= 3.4mm).



Press on the end shim with about 100N (10kg), apply dial indicator and set it at zero.



Now, push the end shim by means of screw driver against snap ring until contacts is obtained(Upward) and read plate clearance on the dial indicator.

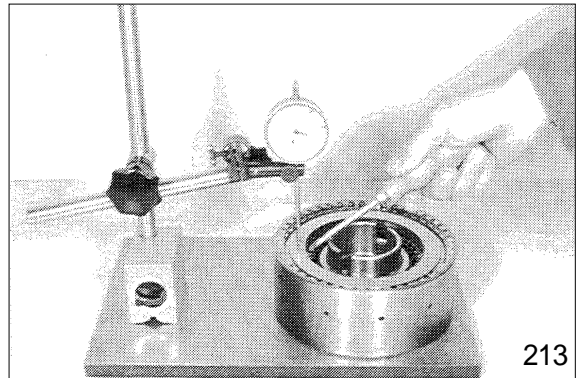
In case of a deviation from the required plate clearance, correct with corresponding snap ring(s=2.1~4.2mm).

After the adjustment of the plate clearance has been carried out, remove the plate pack, oil plates and install it again.

Use oil Dexron- D, /Mercon-M.

Magnetic stand 5870 200 055

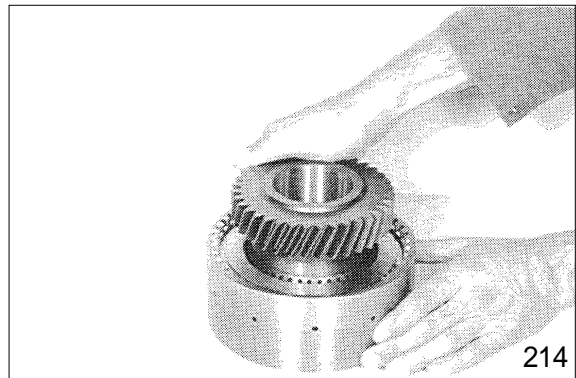
Dial indicator 5870 200 057



Introduce idler gear until all inner plates are accommodated.

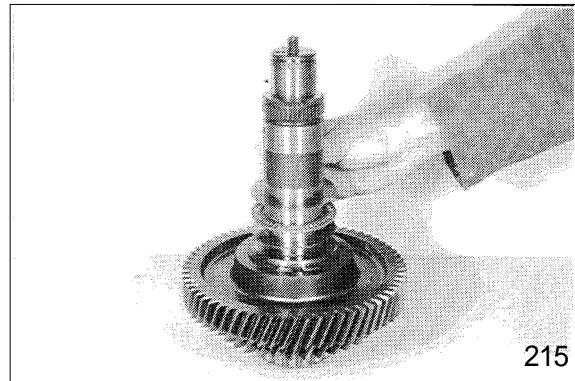
This step makes the later assembling of the idler gear easier.

Now, remove idler gear again.

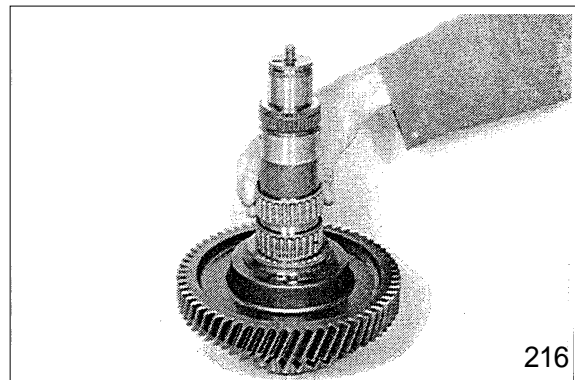


Assemble both axial washers as well as needle case.

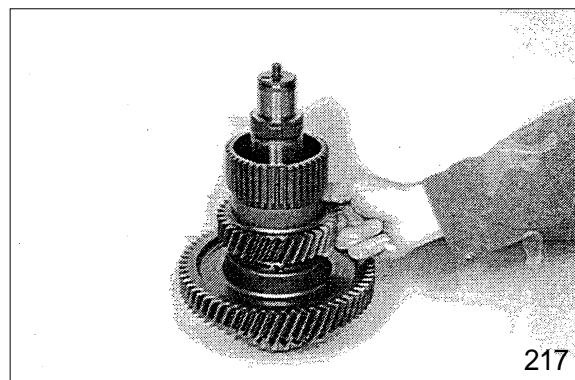
Upper and lower axial washer have the same thickness(55 x 78 x 1).



Assemble both needle bearings.

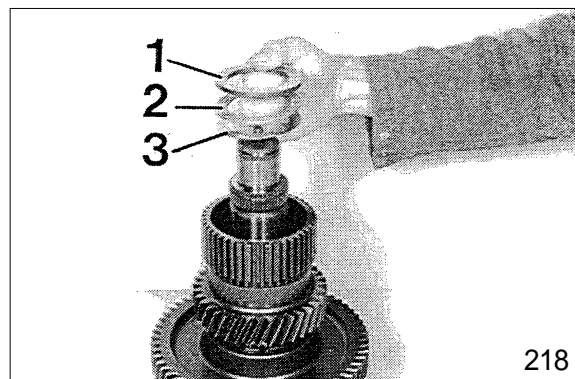


Assemble idler gear.



Assemble axial washer 3(55 x 78 x 1), needle cage 2 and running disk 1(55 x 78 x 5).

Install running disk 1, with the chamfer facing the needle cage.



Heat inner diameter of the plate carrier
(About 120°C).

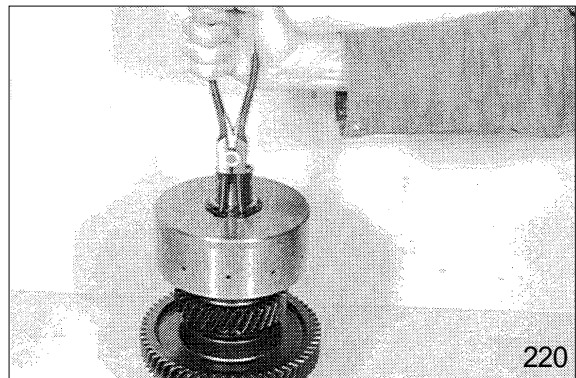
Assemble preassembled plate carrier
until all inner plates are accommodated.

Use safety gloves.



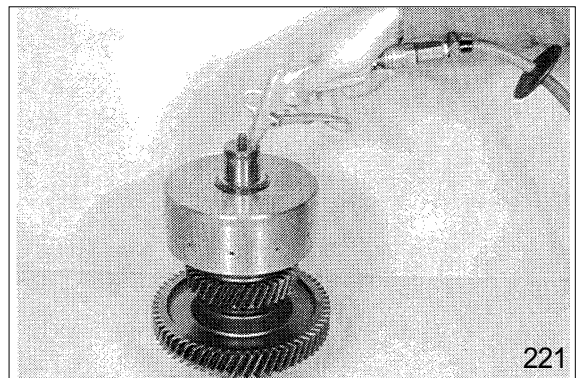
Fix plate carrier axially by means of
circlip.

Set of external pliers 5870 900 015



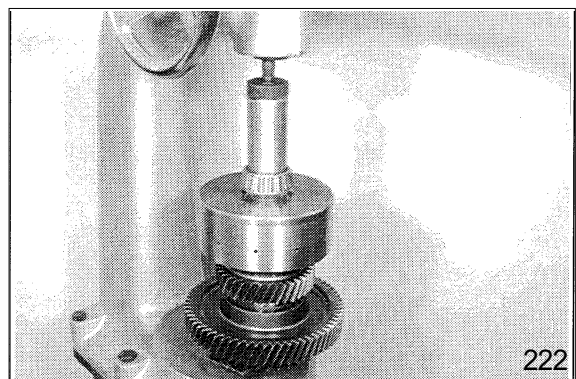
Check function of the clutch by means of
compressed air.

At correctly installed components, the
closing respectively opening of the clutch
is clearly audible.

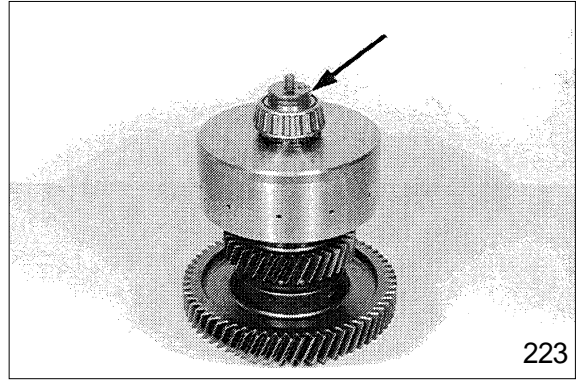


Press tapered roller bearing against
shoulder.

Install opposite tapered roller bearing.

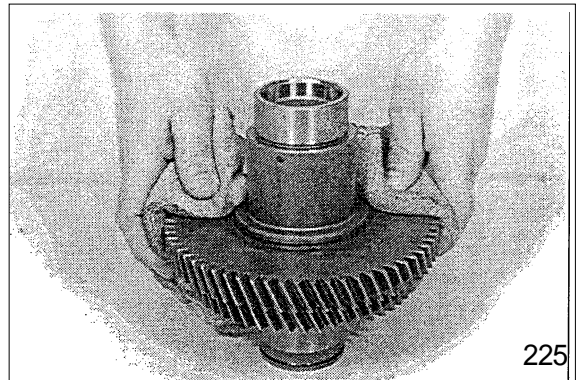


-) Squeeze rectangular ring in(Arrow) and let it snap in.
Install opposite rectangular ring.

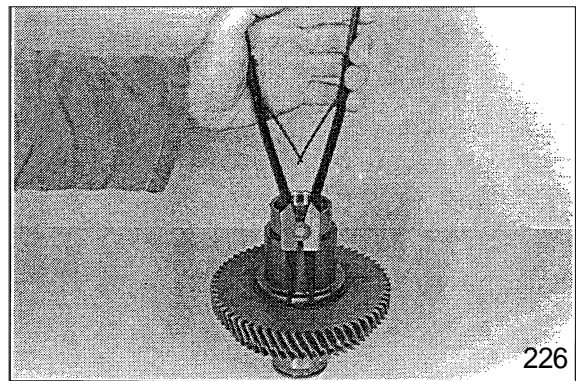


(5) Preassemble drive shaft

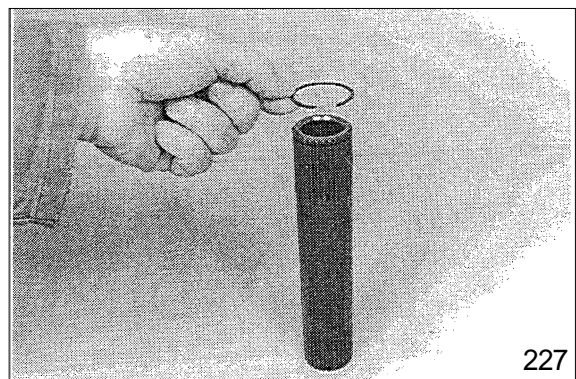
Undercool the drive shaft(About -80°C),
heat the gear(About $+120^{\circ}\text{C}$) and
assemble it until contact is obtained.



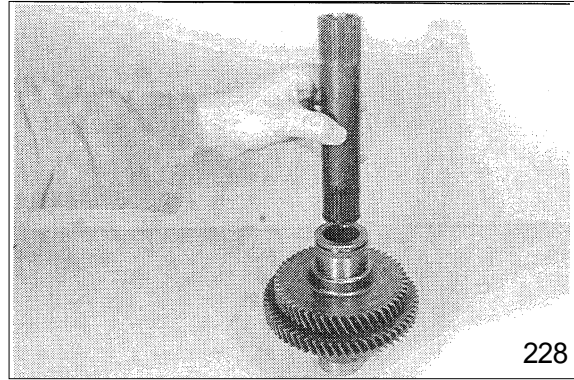
Fix gear axially by means of circlip.



Squeeze snap ring into groove of the
turbine shaft.



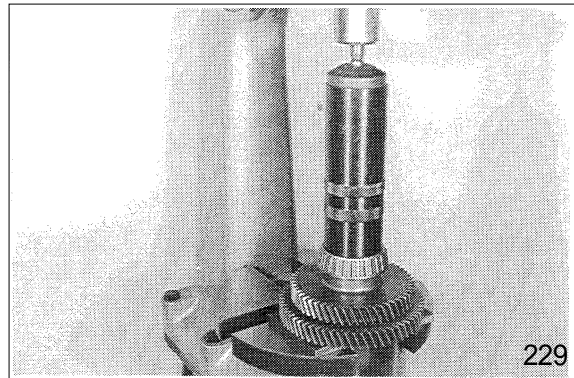
Introduce turbine shaft until the snap ring snaps into the groove of the drive shaft
turbine shaft is axially fixed.



Press tapered roller bearing against shoulder.

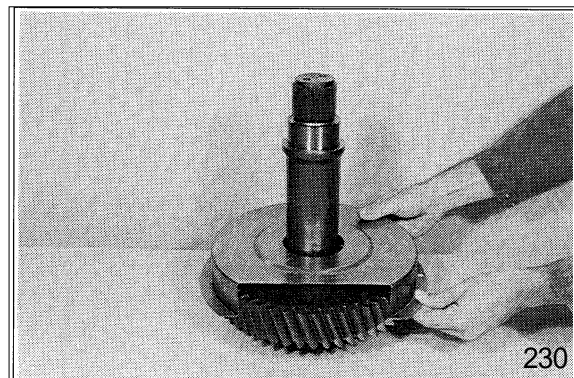
Now, squeeze rectangular ring into the groove of the drive shaft and let it snap in.

Install opposite tapered roller bearing.



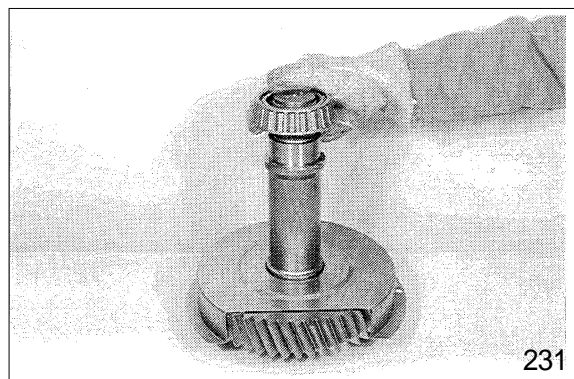
(6) Preassemble and install output

Lay on screening plate



Heat tapered roller bearing and assemble it until contact is obtained.

Install opposite tapered roller bearing accordingly.

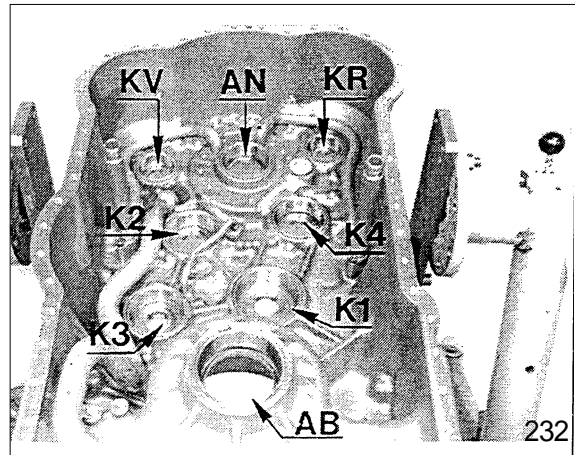


Insert all bearing outer races into the bearing bores of the housing.

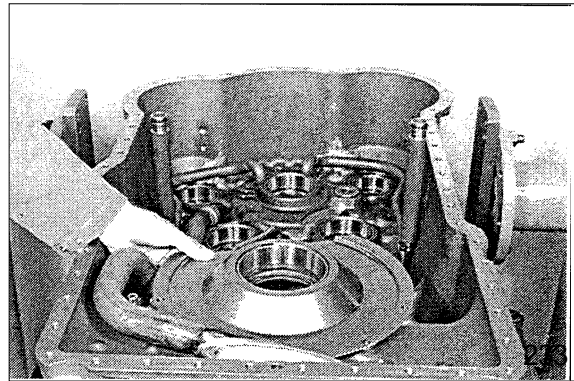
Install O-ring(Arrows).

At the use of already run bearings, pay attention to the allocation of the bearing outer races, see also note/page 3-89.

- AN Input
- KV Clutch-Forward
- KR Clutch-Reverse
- K1 Clutch-1st speed
- K2 Clutch-2nd speed
- K3 Clutch-3rd speed
- K4 Clutch-4th speed
- AB Output



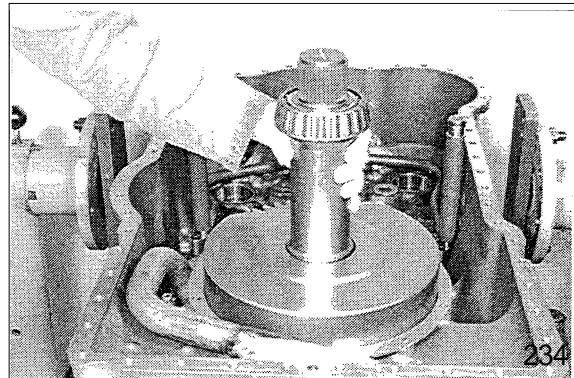
Lay on screening plate.



Insert preassembled output shaft.

Fix screening plates by means of socket head screws.

- Torque limit(M8/8.8) : 2.3kgf · m
(17.0lbf · ft)

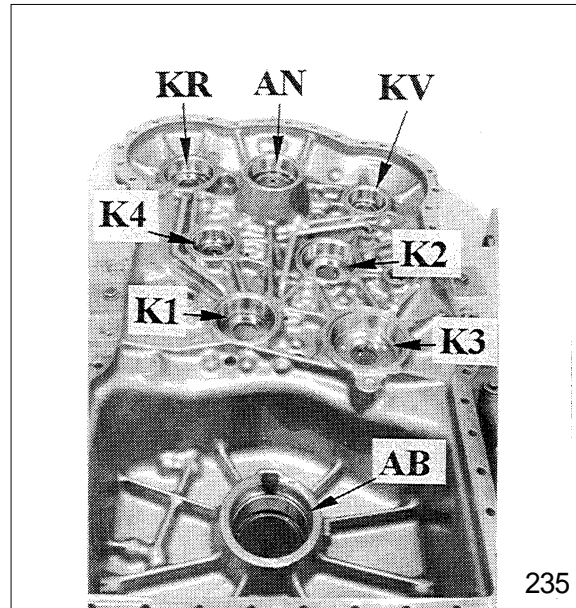


(7) Install preassembled drive shaft and clutches

Insert all bearing outer races into the bearing bores of the housing cover.

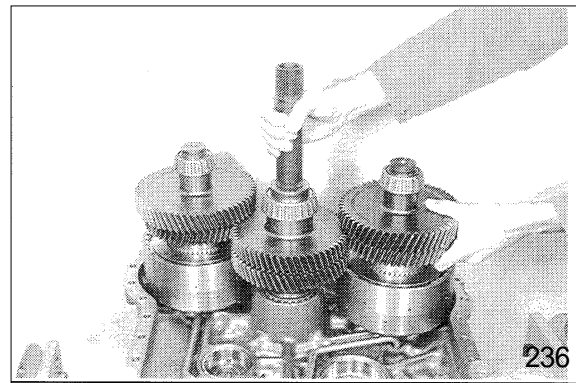
At the use of already run bearings, pay attention to the allocation of the bearing outer races, see also note/page 3-89.

- AN Input
- KV Clutch-Forward
- KR Clutch-Reverse
- K1 Clutch-1st speed
- K2 Clutch-2nd speed
- K3 Clutch-3rd speed
- K4 Clutch-4th speed
- AB Output

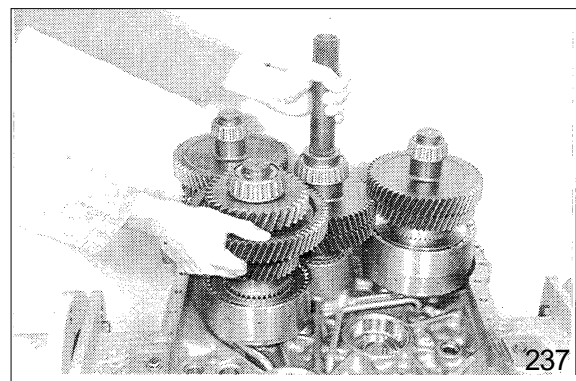


Prior to the installation of the clutches and the drive shaft, grease rectangular rings and align them centrally.

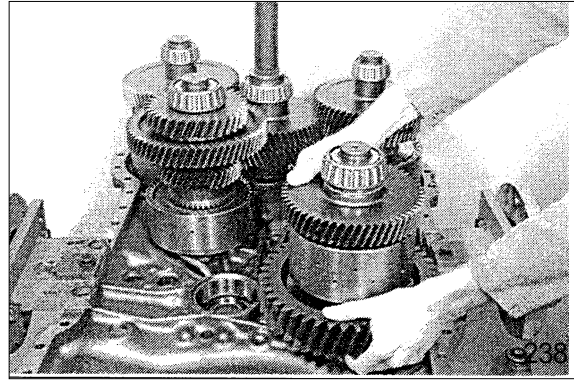
Insert clutch KR, drive shaft and clutch KV together into the housing cover.



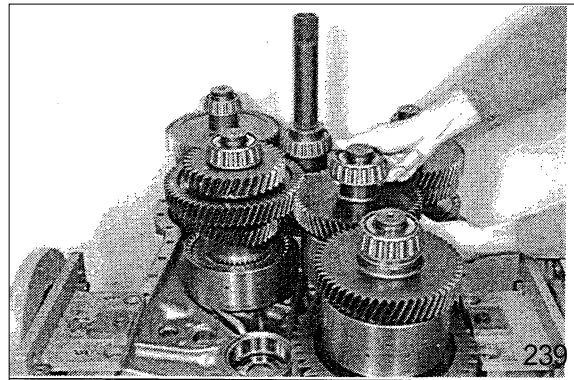
Lift drive gear and position clutch K4.



Install clutch K3.



Position clutch K2.



Lift clutch K4 and position clutch K1.

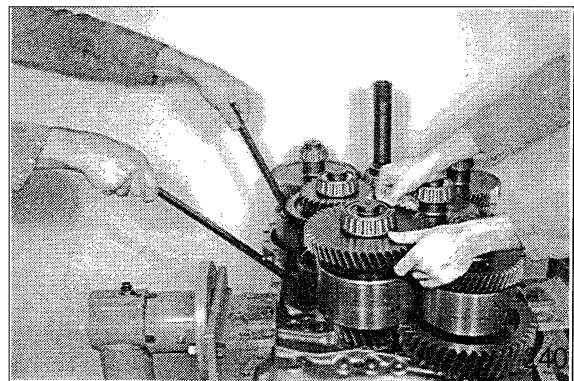
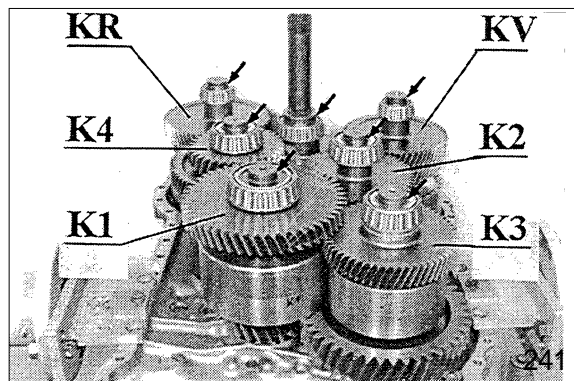
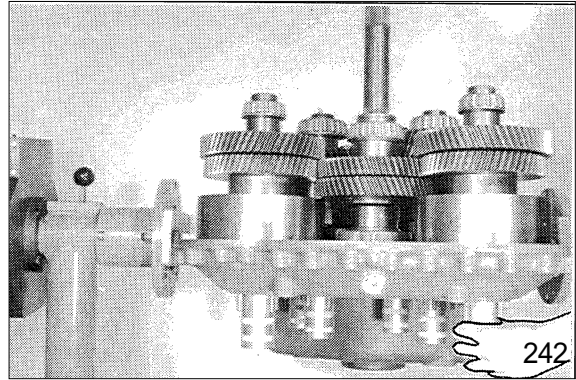


Illustration on the right shows the installation position of the single clutches in the housing cover. Grease rectangular rings (Arrows) and align them centrally.

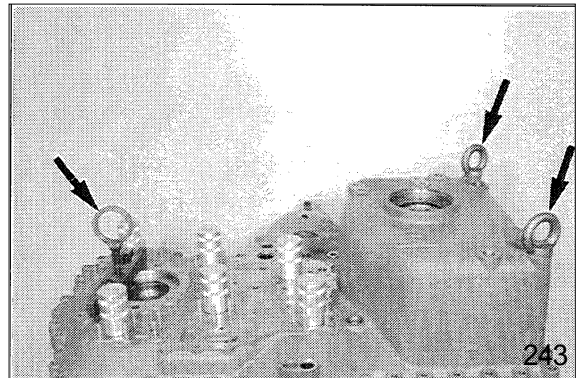


Fix all clutches by means of handles.
Handle(6 pieces needed) 5870 260 010

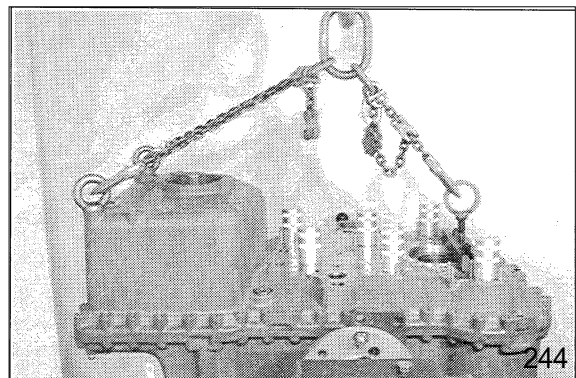


Tilt housing cover 180°.
Install eye bolts(Arrows).

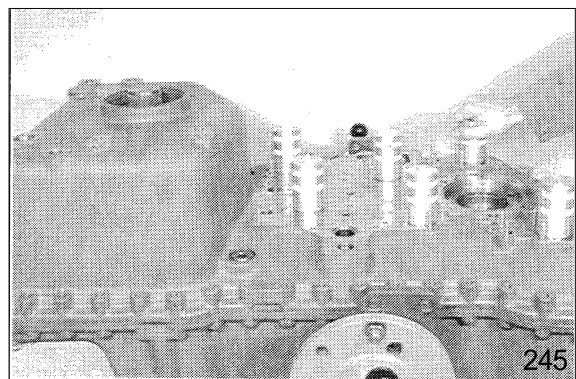
Eye bolt(M20, 2EA) 0636 804 003
Eye bolt(M16, 1EA) 0636 804 001
Puller device 5870 000 017



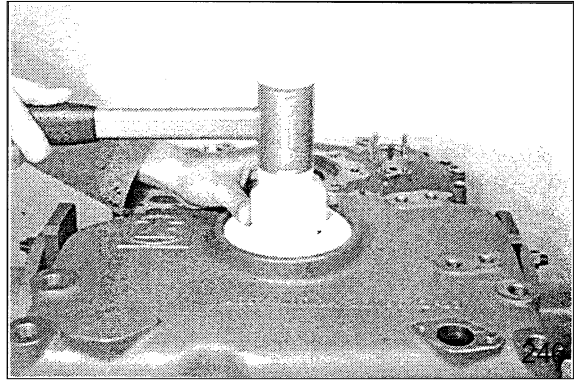
Grease O-rings of the two oil tubes.
Wet mounting face with sealing compound loctite(Type No.574).
Position preassembled housing cover by means of lifting device carefully on the gearbox housing until contact is obtained.
Pay attention to the overlapping of the oil tubes with the bores in the housing cover.
Lifting chain 5870 281 047



Remove handles again.



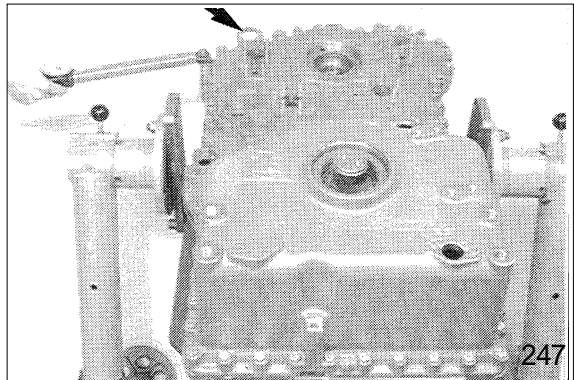
Install both cylindrical pins centrally to the housing face.



Fasten housing cover by means of hexagon head screws.

- Torque limit(M10/8.8) : 4.7kgf · m
(33.9lbf · ft)

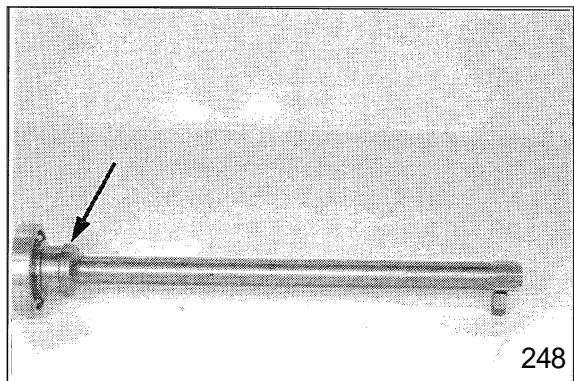
Pay attention to position of the fixing plate, see Arrow.



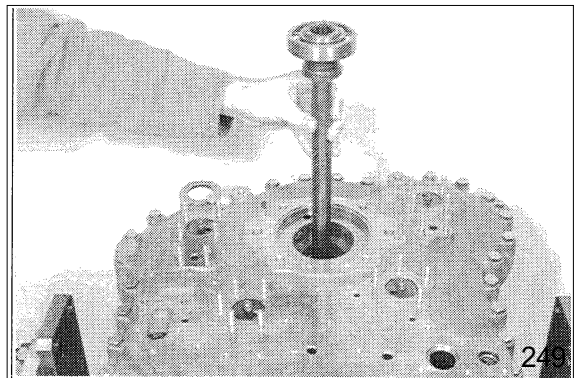
(8) Install pump shaft(Power take off)

Install ball bearing.

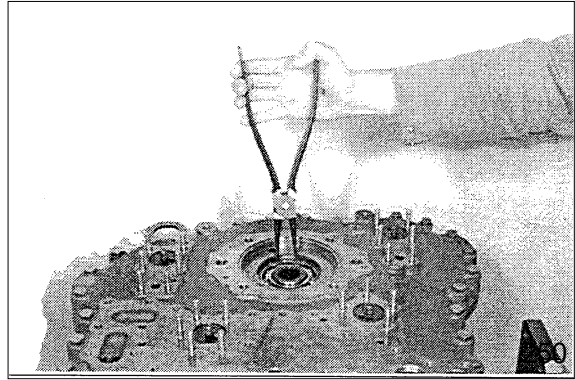
Squeeze rectangular ring in(Arrow) and let it snap in.



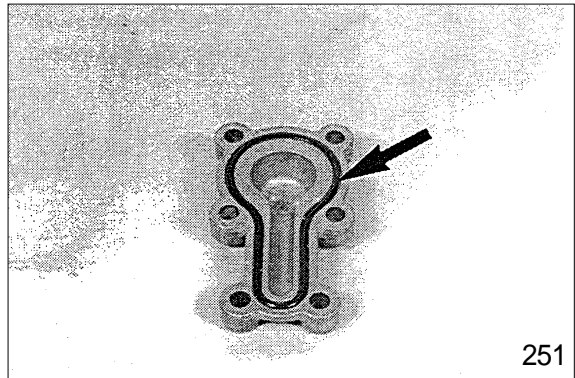
Grease rectangular ring, align it centrally and introduce pump shaft until contact is obtained.



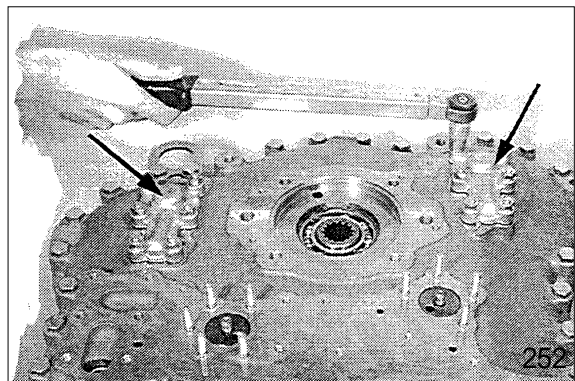
Fix pump shaft by means of circlip.



Insert O-ring(Arrow) into the annular groove of the oil feed covers.



Fasten both covers(Arrows) by means of hexagon nuts(Use plain washers).
· Torque limit : 2.3kgf · m(17.0lbf · ft)



(9) Install output flanges

Install shaft seal with the sealing lip facing the oil chamber.

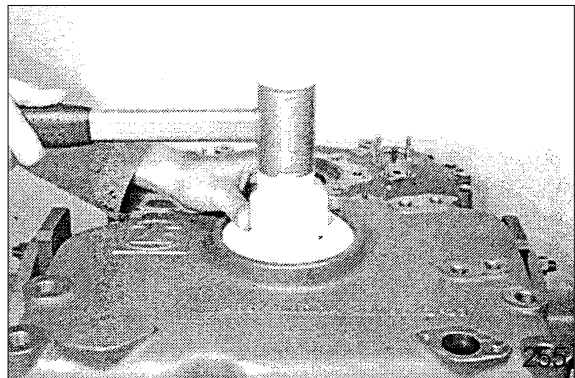
At the use of the prescribed driver, the exact installation position is obtained.

Wet rubber coated outer diameter with spirit.

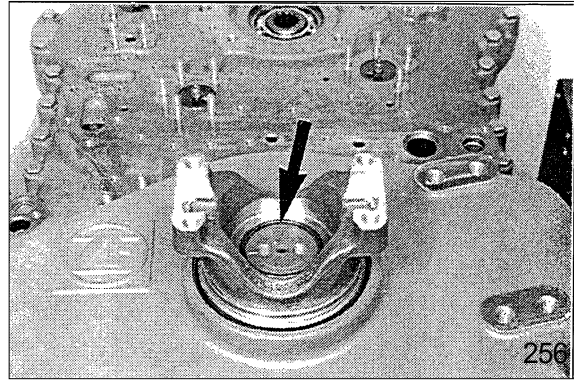
Grease sealing lip.

Driver

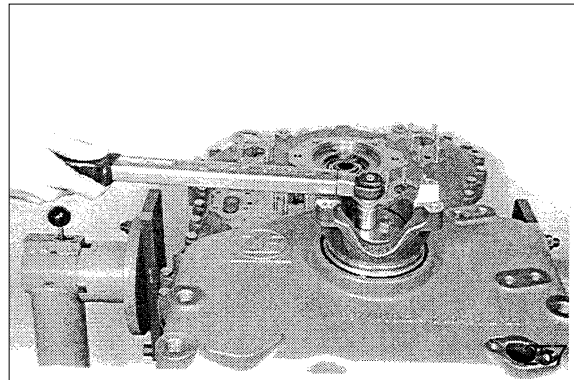
5870 048 213



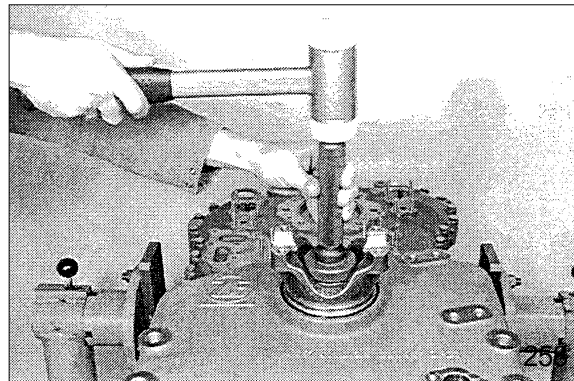
Assemble output flange.
 Insert O-ring(Arrow) into the gap of drive flange and shaft.



Fasten output flange by means of disk and hexagon head screws.
 · Torque limit(M10/8.8) : 4.7kgf · m
 (33.9lbf · ft)



Fix hexagon head screws by means of lock plate.
 Driver 5870 057 009
 Handle 5870 260 002
 Install converter side output flange accordingly.

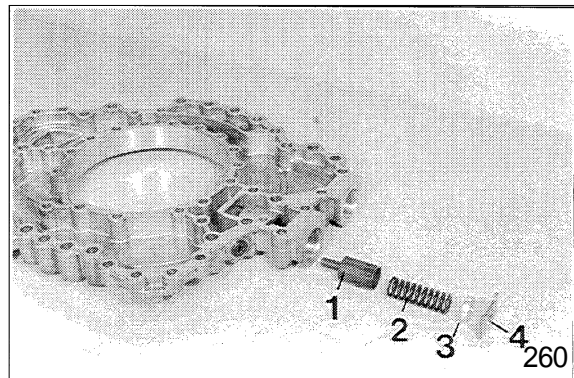


(10) Converter back pressure valve

Illustration on the right shows the components of the converter back pressure valve.

- 1 Piston
- 2 Compression spring
- 3 Pressure plate
- 4 Lock plate

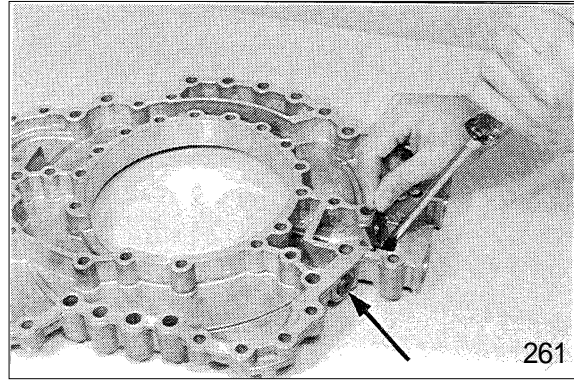
Install pressure plate with the spigot (Ø6mm) facing the lock plate.



Introduce components according to figure (10) ①, preload and fix by means of lock plate.

Equip plug(Arrow) with new O-ring and install it.

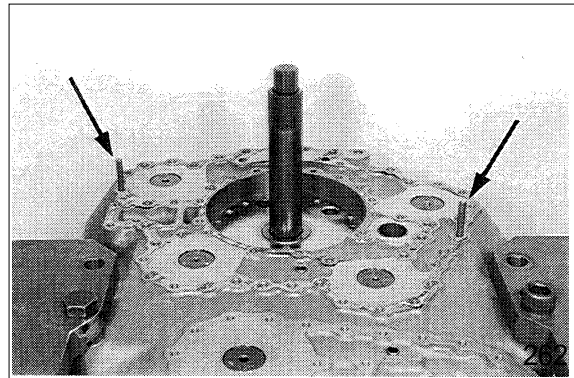
- Torque limit(M14 x 1.5) : 2.5kgf · m
(18.4bf · ft)



(11) Oil feed housing-Transmission pump

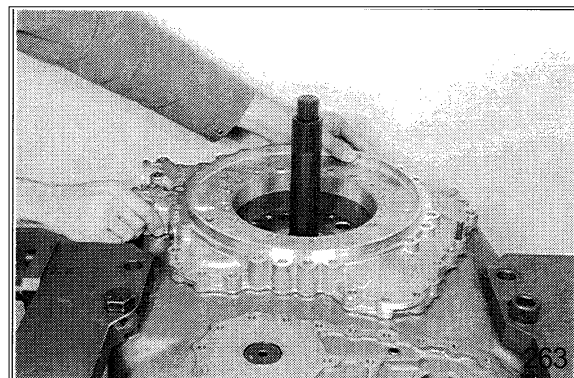
Install two adjusting screws(Arrows) and lay on gasket.

Adjusting screws(M8) 5870 204 011



Lay on oil feed housing and fix it provisionally by means of socket head screws.

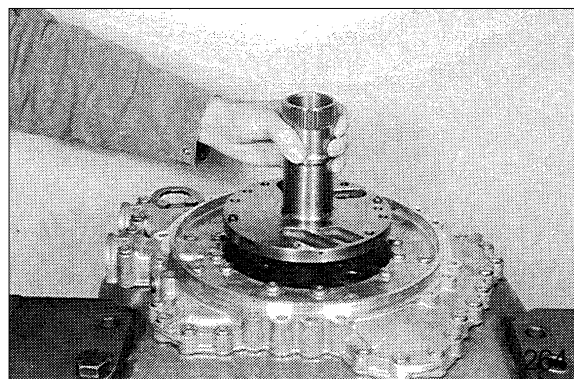
Screw socket head screws only in until contact is obtained **do not tighten.**



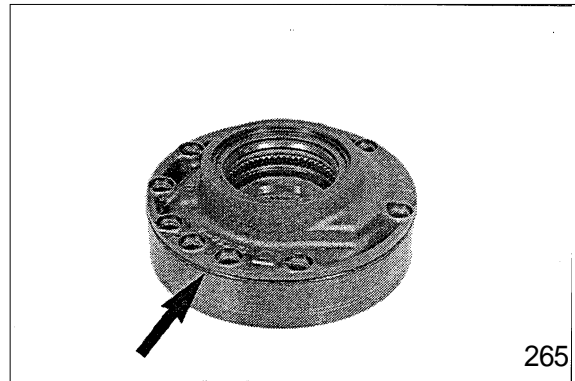
Install two adjusting screws and introduce stator shaft until contact is obtained.

Pay attention to the overlapping of the bores.

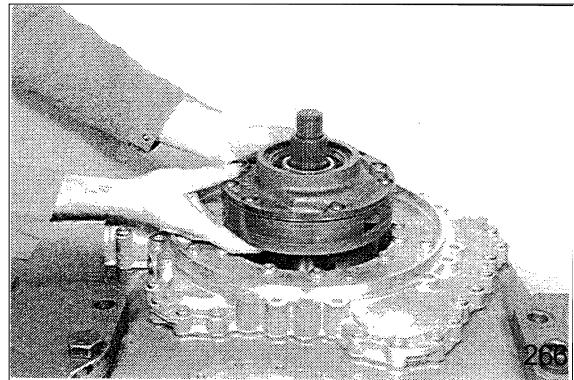
Adjusting screws(M10) 5870 204 007



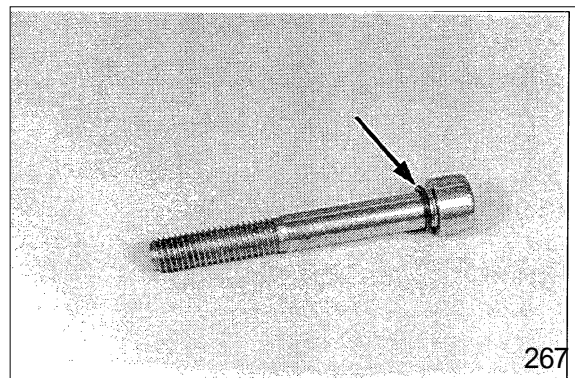
Insert O-ring(Arrow) into the annular groove and oil it.



Introduce transmission pump(Complete) and put it by means of socket head screws(For the moment without O-rings) evenly against shoulder. Now, remove socket head screws again.

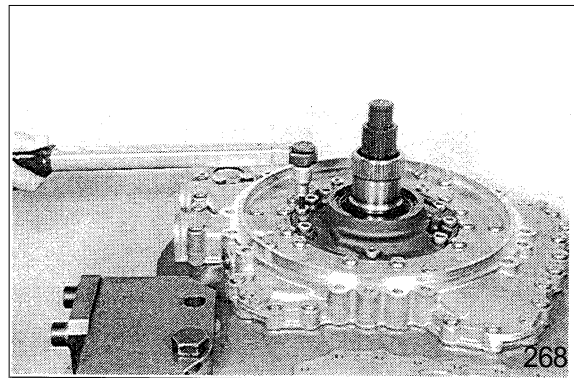


Equip socket head screws with new O-ring(Arrow). Grease O-rings.



Fasten transmission pump by means of socket head screws.

- Torque limit : 4.7kgf · m(33.9lbf · ft)

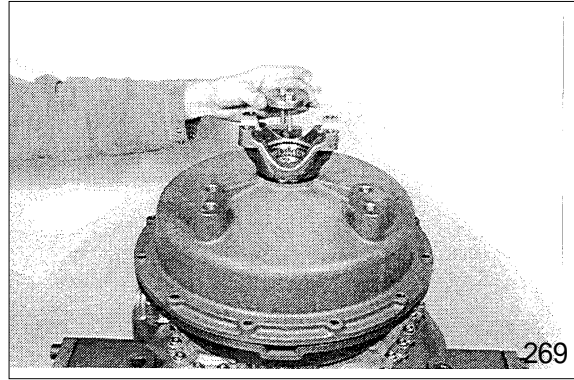


Fasten oil feed housing by means of socket head screws and hexagon head screws(2 pieces).

- Torque limit
 - Socket head screw : 2.3kgf · m
(16.6bf · ft)
 - Hexagon head screw : 4.7kgf · m
(33.9bf · ft)

Pay attention to the position of the fixing plate, see Arrow.

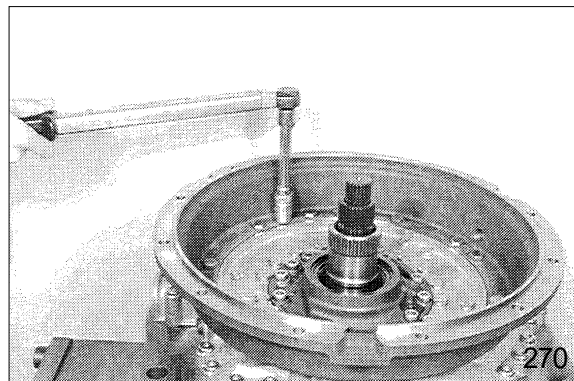
Box spanner(Torx, TX-40) 5873 042 004



(12) Engine connection-Converter

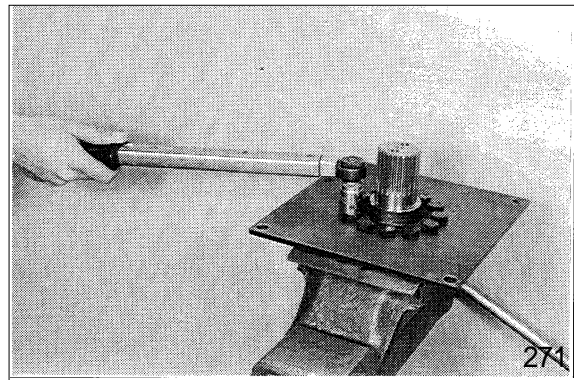
Fasten converter bell by means of hexagon head screws.

- Torque limit(M10/10.9) : 6.9kgf · m
(50.1bf · ft)



Screw drive shaft and diaphragm together.

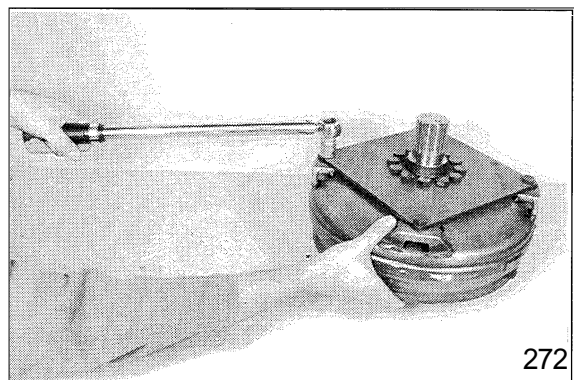
- Torque limit(M12/10.9) : 11.7kgf · m
(84.8bf · ft)



Fasten diaphragm by means of hexagon head screws on the converter.

- Torque limit(M12/10.9) : 11.7kgf · m
(84.8bf · ft)

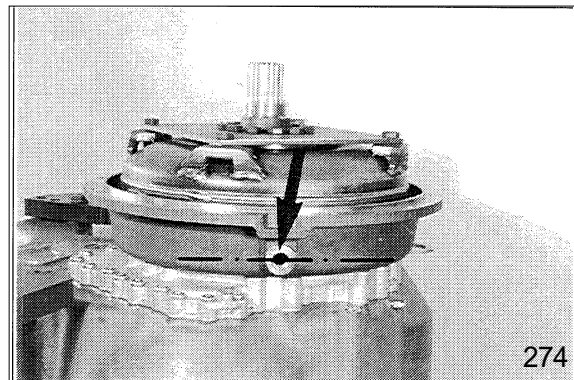
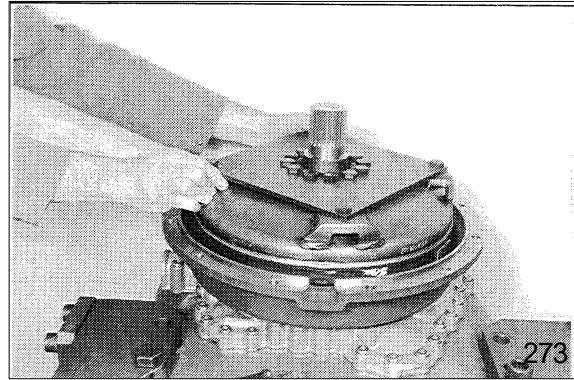
Insert hexagon head screws with loctite (Type No.262).



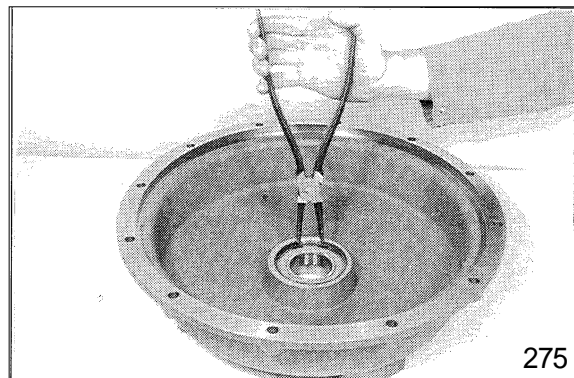
Introduce converter until contact is obtained.

Pulse disk of the converter must be positioned centrally to the bore of the inductive transmitter, see Arrow.

Only in this way will be ensured that the converter is perfectly introduced.



Insert ball bearing until contact is obtained and fix it by means of circlip.



Assemble housing cover.

Install drive flange, lay on disk and pull cover by means of hexagon head screws evenly against shoulder.

- Torque limit(M8/10.9) : 3.5kgf · m
(25.1bf · ft)

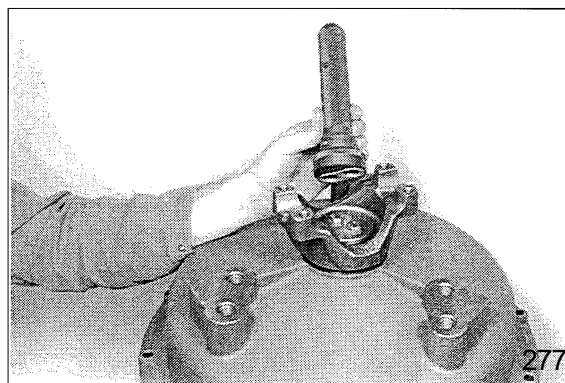
Pay attention to the radial installation position of the cover, see figure.



Fix hexagon head screws by means of lock plate.

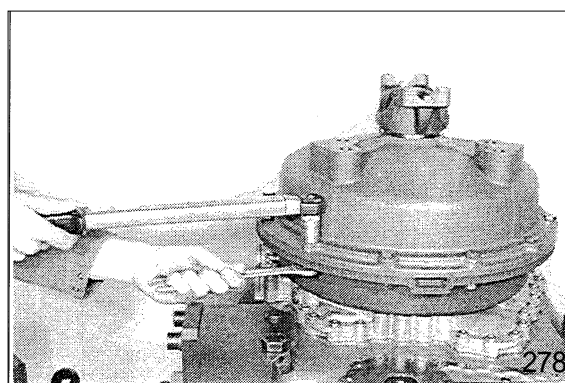
Driver 5870 057 010

Handle 5870 260 002



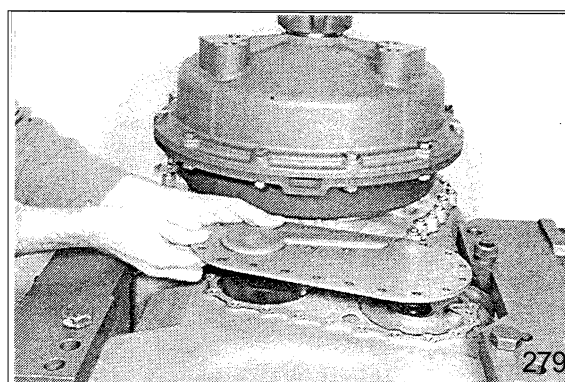
Fasten cover by means of hexagon head screws and nuts on the converter bell.

- Torque limit(M10/838) : 4.7kgf · m
(33.9lbf · ft)



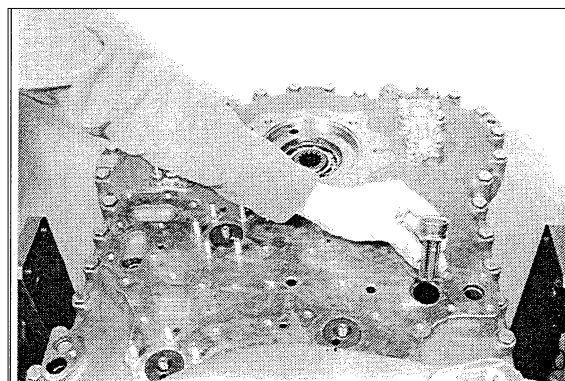
Mount gasket and fasten cover by means of hexagon head screws.

- Torque limit(M8/8.8) : 2.3kgf · m
(17.0lbf · ft)



(13) Converter safety valve

Insert converter safety valve(Complete) into the housing hose.



(14) Mount duct plate and hydraulic control unit

Install components according to the following draft.

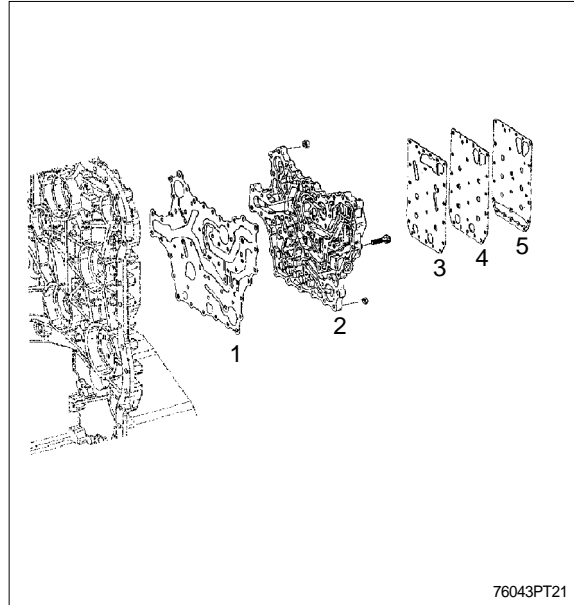
- Torque limit(M8) : 2.3kgf · m(17.0lbf · ft)

Pay attention to the installation position of the different gaskets, see draft.

- 1 Gasket
- 2 Duct plate
- 3 Gasket
- 4 Intermediate plate
- 5 Gasket

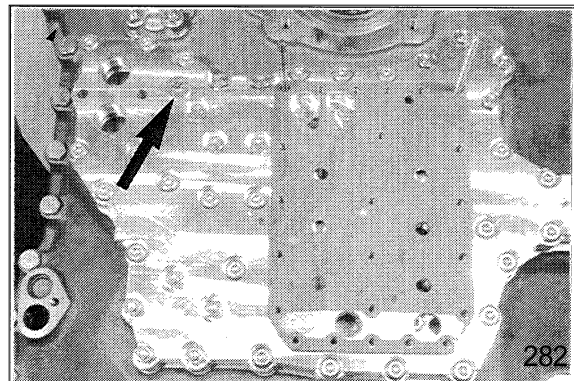
Adjusting screws 5870 204 063

Box spanne 5873 042 004



Equip screw plug(Arrow) with new O-ring and install it.

- Torque limit(M16 × 1.5) : 3.0kgf · m
(21.7lbf · ft)

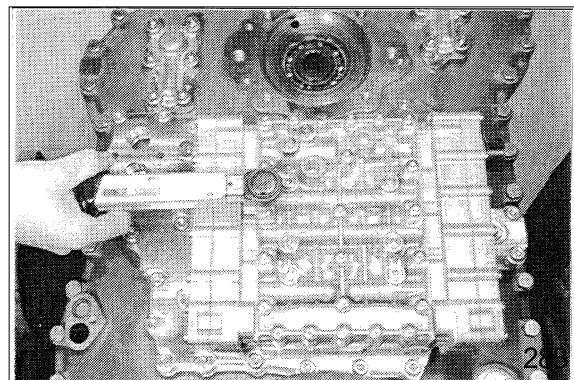


Fasten hydraulic control unit(HSG-94) by means of socket head screws.

- Torque limit(M6) : 0.97kgf · m(7.0lbf · ft)

Adjusting screws 5870 204 063

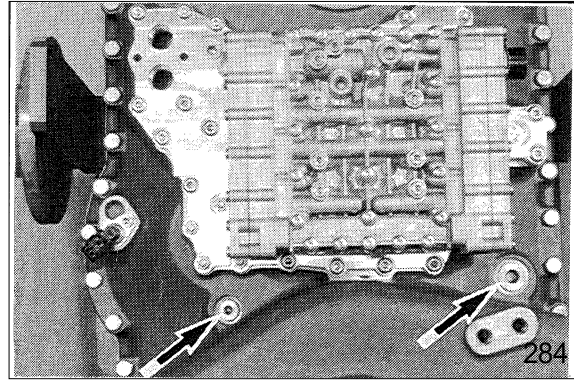
Box spanner(Torx Tx-27) 5873 042 002



(15) Install plugs and oil level tube

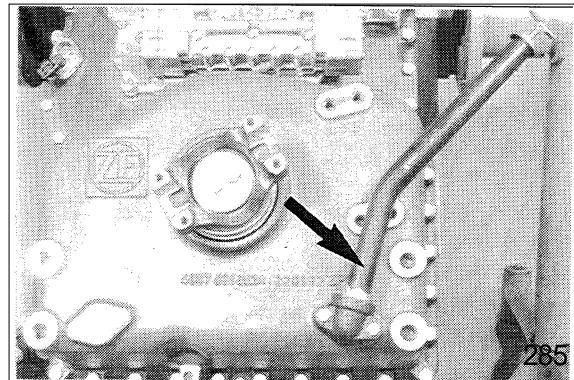
Equip both plugs(Arrows) with new O-rings and install them.

- Torque limit(M18 × 1.5) : 5.1kgf · m
(36.9lbf · ft)
- Torque limit(M26 × 1.5) : 8.2kgf · m
(59.0lbf · ft)



Install oil level tube(Arrow).
Mount new gasket.

- Torque limit(M8/10.9) : 3.5kgf · m
(25.1lbf · ft)

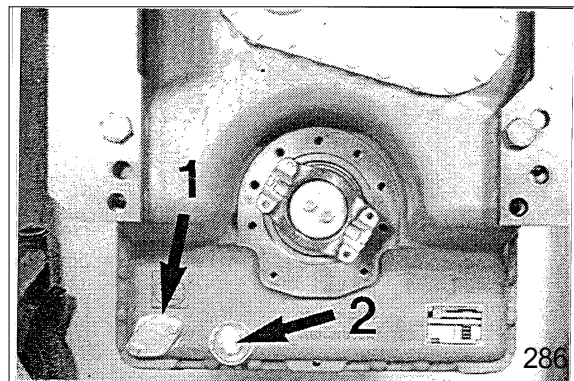


Install cover plate(Arrow 1).
Install new gasket.

- Torque limit(M8/8.8) : 2.3kgf · m
(17.0lbf · ft)

Equip screw plug(Arrow 2) with new O-ring and install it.

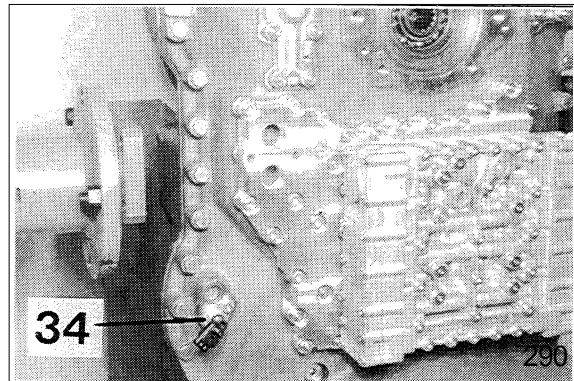
- Torque limit(M38 × 1.5) : 14.3kgf · m
(103lbf · ft)



(16) Speed sensor and inductive transmitters

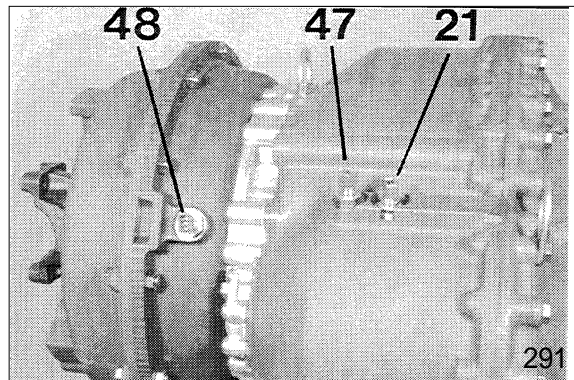
The figures show the installation position of the single inductive transmitters and the speed sensor.

- 34 Speed sensor
n-Output and speedometer
- 21 Inductive transmitter
n-Turbine
- 47 Inductive transmitter
n-Central gear train
- 48 Inductive transmitter
n-Engine



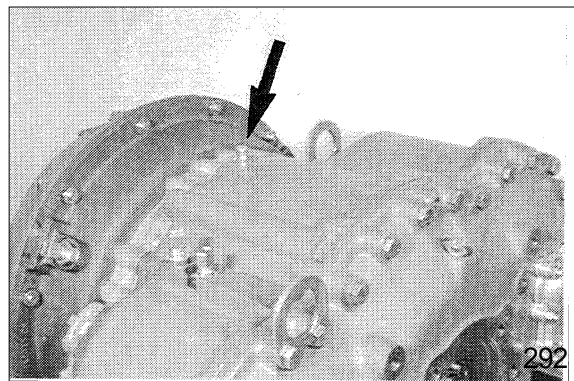
Grease O-rings and install speed sensor as well as inductive transmitters.

- Torque limit : 2.3kgf · m(17.0lbf · ft)
(Socket head screw/Speed sensor)
- Torque limit : 3.1kgf · m(22.1lbf · ft)
(Inductive transmitter)



Install breather(Arrow).

- Torque limit : 1.2kgf · m(8.9lbf · ft)



3. AXLE

1) GENERAL INSTRUCTIONS

(1) SHIMS

All adjustments shall be carried out after all adjustment shims have been selected measuring them one by one with a micrometer gauge and, then, summing up all values measured; don't trust incorrect measurement of pack as a unit or sum of nominal value printed on each shim.

(2) SEALS FOR REVOLVING SHAFTS

Proceed as follows for proper fitting of captioned seals:

Prior assembly, seals should be kept, for at least half an hour, in a bath with the same oil to be sealed;

Clean thoroughly shaft and make that working surface be not damaged;

Position sealing lip against the fluid to be sealed; in case of hydrodynamic lip lines should be oriented so as that, considering direction of revolving shaft, they lead fluid inside of sealing means;

Smear sealing lip with a film of lubricant(oil is better than grease) and fill up with grease the space between sealing lip and dust shield lip, if using double sealing lip type seals;

Press seal in relevant seat or use a proper fitter with flat contact surface; never use hammer or mallet to mount seal;

When press fitting seal make sure that it be correctly driven in relevant seat, i.e., perpendicular with respect to its seat, as fitting is completed make sure, if required, that seal itself be in contact with relevant shoulder;

To prevent damage of seal lip when inserting shaft, duly protect component during assembly.

(3) O-RING SEALS

Lubricate O-RING seals at assembly to prevent twisting that would impair correct sealing.

Clean matching surface as follows prior, smearing compound:

Remove old deposits using a metal brush;

Degrease surfaces by one the following cleaners: trichloroethylene, kerosene or a warm water and soda solution.

(4) BEARINGS

When assembling them it is advisable to proceed as follows:

Heat them with 80 to 90°C before fitting on relevant shafts;

Cool them before inserting in relevant external seats.

(5) SPRING PINS

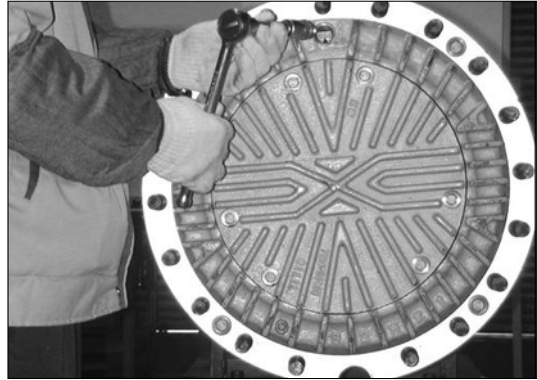
When using split pins be sure that lengthwise cleft be positioned toward stress on pin.

Coil pins don't require specific position.

2) REDUCTION ASSEMBLY

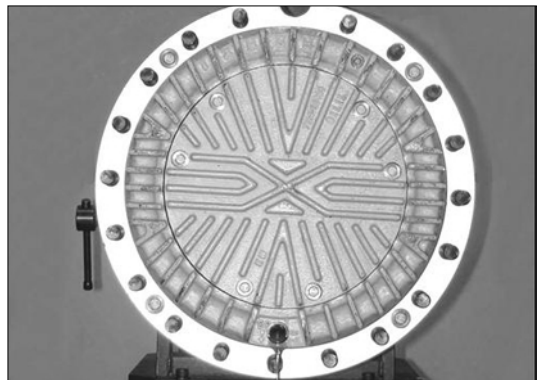
(1) DISASSEMBLY

Turn the plug toward top position and remove the plug for the air vent. Assemble the plug temporarily.



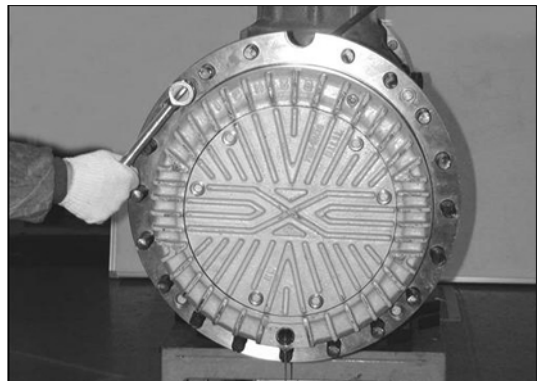
AX001

Drain oil from final drive unit.



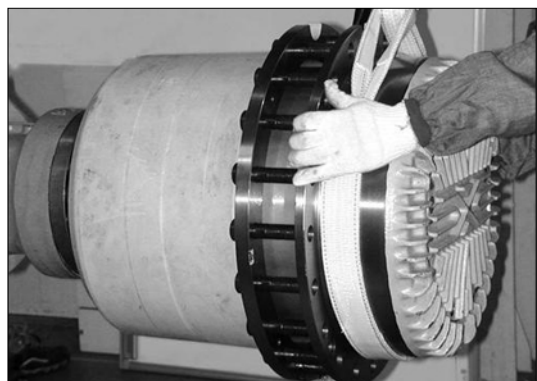
AX002

Loosen screws securing side gear carrier to wheel hub.



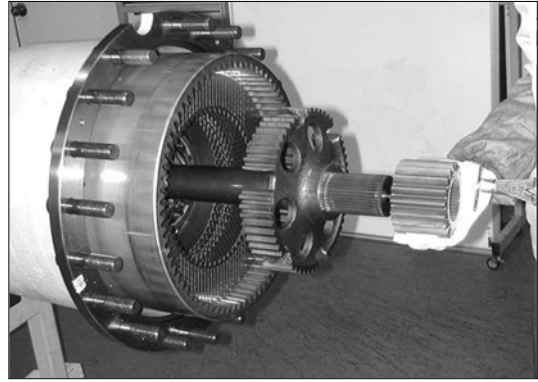
AX003

Pull out complete side gear carrier.



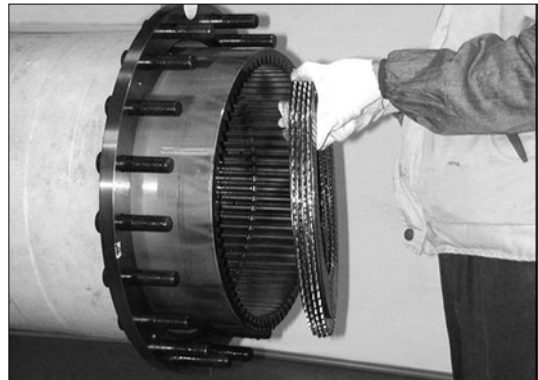
AX004

Pull out wheel shaft with sun gear, discs carrier hub and thrust plate.



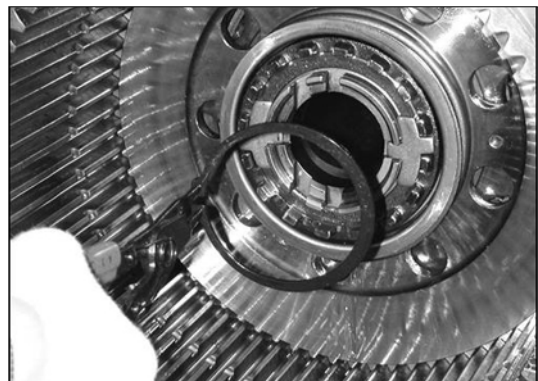
AX005

Remove brake disc pack.



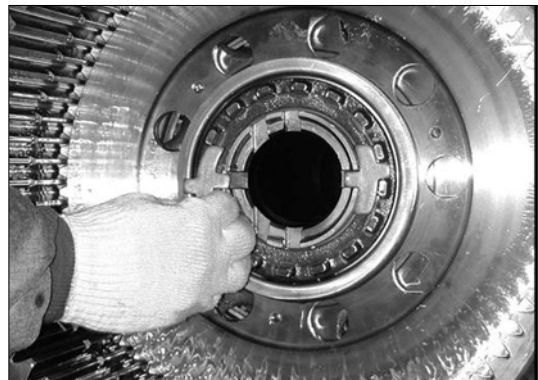
AX006

Remove lock ring nut locks.



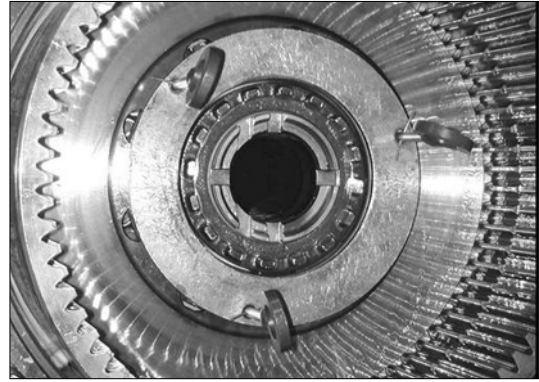
AX007

Remove locks.



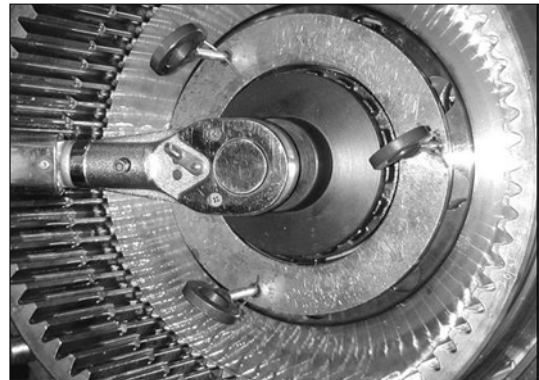
AX008

Install the proper tool on pressure plate and apply the eye bolt(3EA) temporarily. Tighten the eye bolt tool perfectly.



AX009

Remove the adjusting nut by the use of the special tool.



AX0010

Remove the pressure plate, return spring, cover and compression tool.



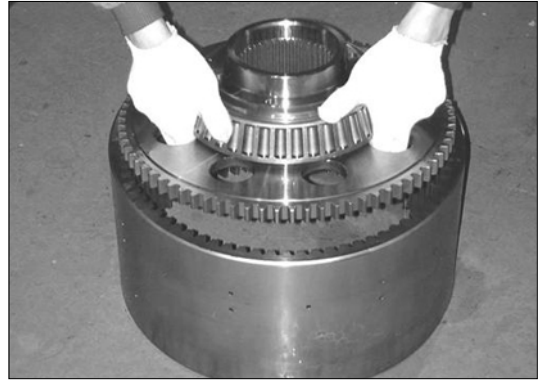
AX0011

Remove the ring gear assembly.
Attention to the weight.



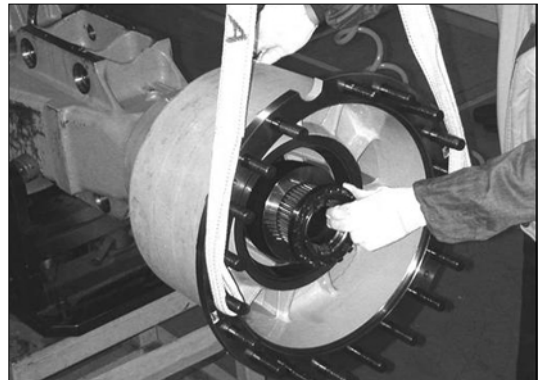
AX0012

Pry off lock ring from ring gear by a screw driver and remove ring gear support.



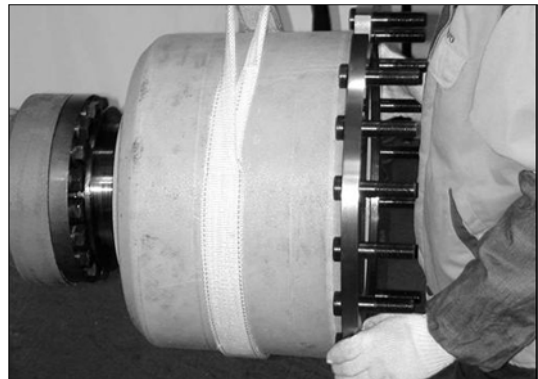
AX0013

Remove piston, it's easier by blowing compressed air in brake oil delivery ducting.



AX0014

Remove wheel hub assembly.



AX0015

Pry off wheel hub seal and remove inner race with roller cage of wheel inside bearing. By using a punch remove from wheel hub outer races of inner and outer bearings.

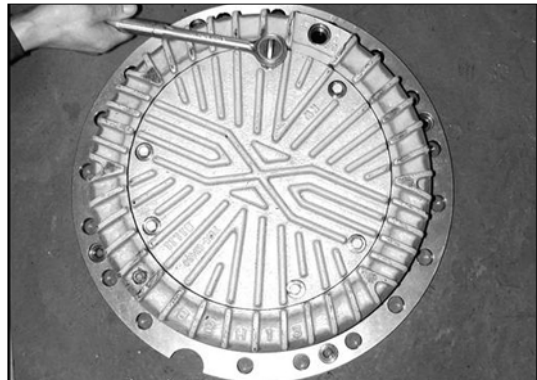


AX0016



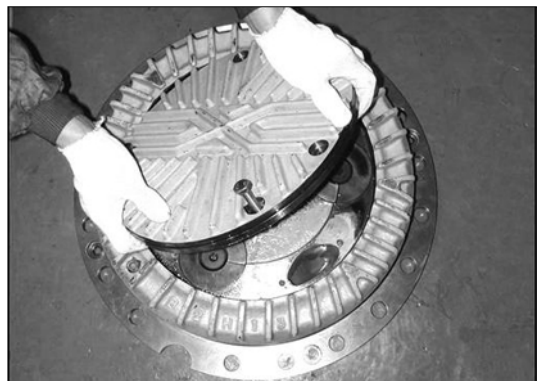
AX0017

Remove final drive cover.



AX0018

It is provided with three threaded holes (M10 x 1.5) to be used for puller screws.



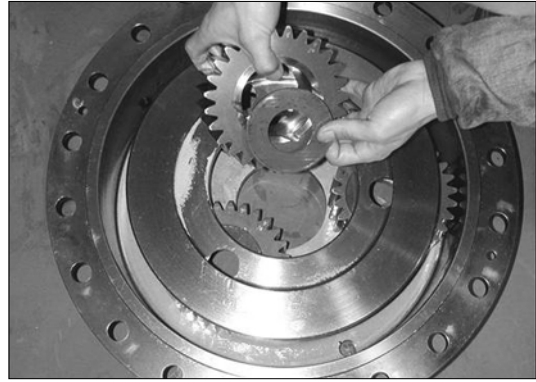
AX0019

Remove the planetary pin(3EA) from hub drum(Side gear carrier support) assembly.



AX0020

Remove the planetary gear and thrust washer step by step.



AX0021

(2) ASSEMBLY

Insert the inner bearing cone.



AX085

Press fitting lip seal.

Smear loctite 573 or equivalent sealant on outer diameter surface.



AX086

Support suitably wheel hub while assembling parts to prevent damage of seal; then go on by fitting wheel bearing on hub spindle.



AX087

Replace O-ring seals on piston.
Cover the oil on O-ring seal enough.



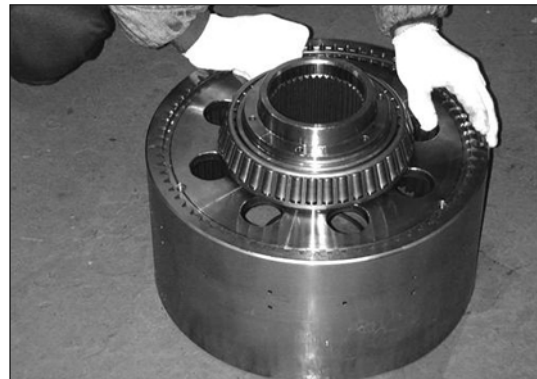
AX088

Insert piston full travel down on hub spindle.



AX089

Insert ring gear support in ring gear, then fit spring ring retaining axle.



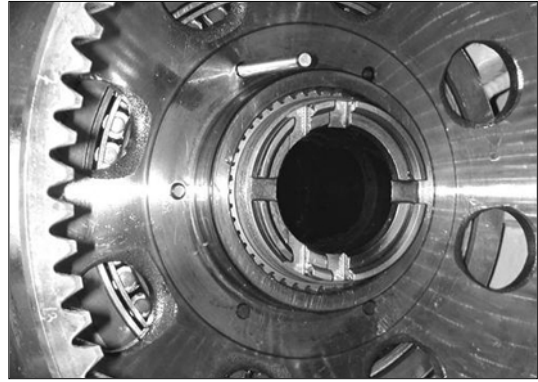
AX090

Mount on hub spindle the complete ring gear unit.
Attention to the weight.



AX091

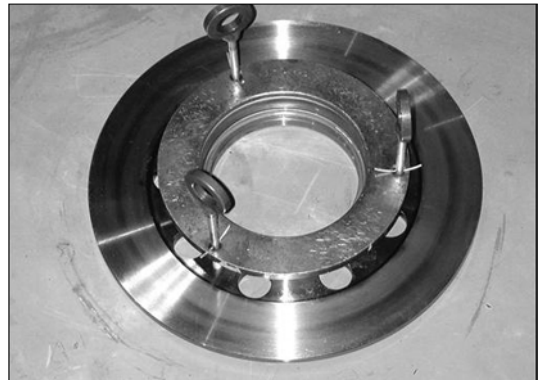
Insert into relevant holes the six pins that, for proper operation of whole system, have to be of the same length and however in accordance with relevant drawing.



AX092

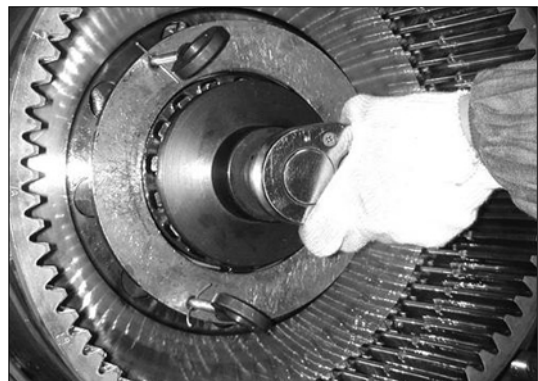
Position return spring, cover and spacer on pressure plate, press compression tool.
(Front axle only)

There is not spacer to the rear axle.



AX093

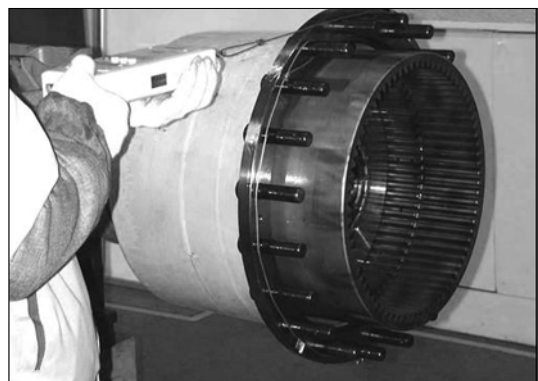
Assemble support assembly with spring compression tool on spindle and tighten adjusting nut.



AX094

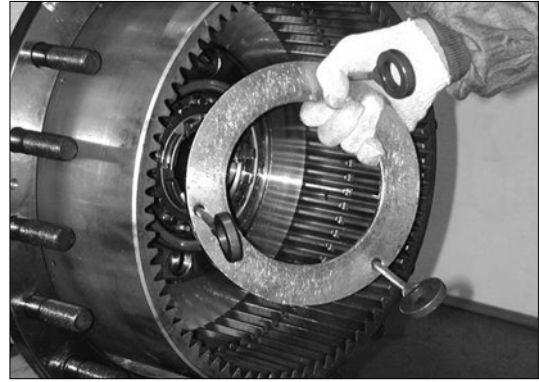
With proper wrench lock ring so to reach the specified wheel bearing pre-load corresponding to a rotation torque and a rope pull strength on studs included into 15~18kg.

To prevent wrong torque recording, it is advisable to set bearings, by various wheel revolutions, prior performing the check.



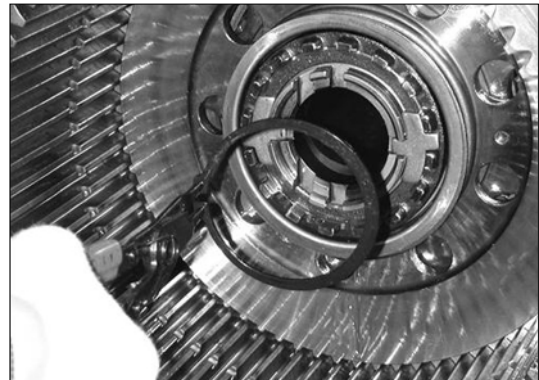
AX095

Remove spring compression tool.



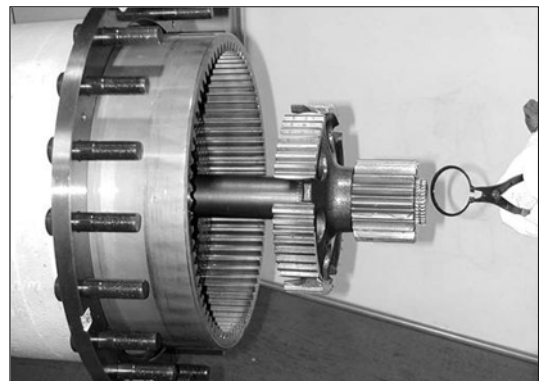
AX096

Fit plate and assemble retain ring.

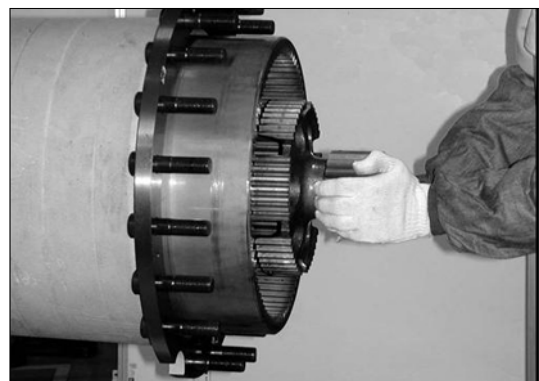


AX097

Insert wheel shaft on which sequentially mount ; the thrust washer, discs carrier hub, sun gear and lock ring ; then push all components fully down against hub spindle.



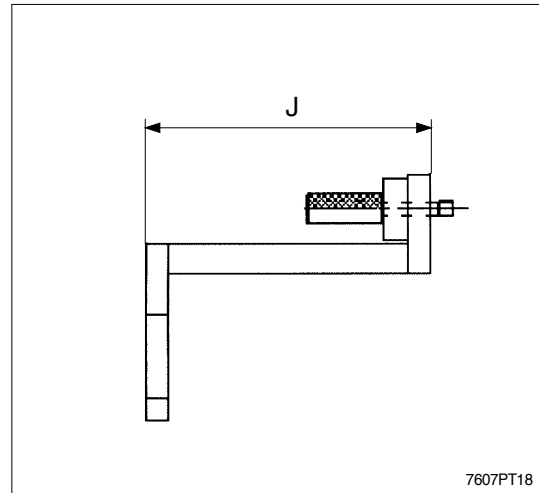
AX098



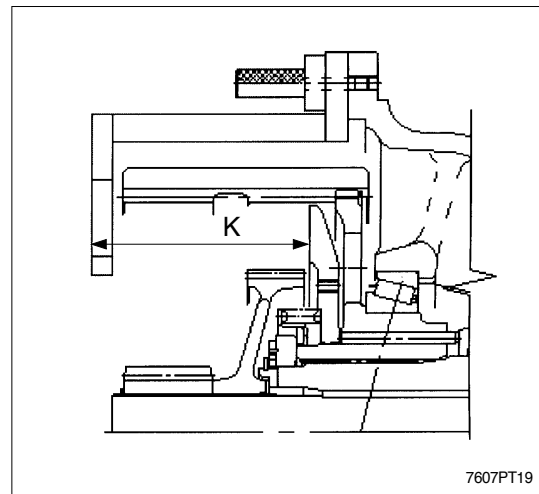
AX099

Install brake measuring tool on wheel hub.

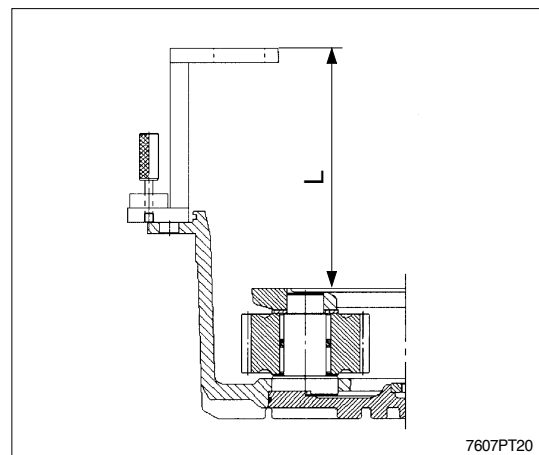
Distance of brake measuring tool **J**



Measure **K** between end of measuring tool and pressure plate.



Install brake measuring tool on hub drum and measure **L**.



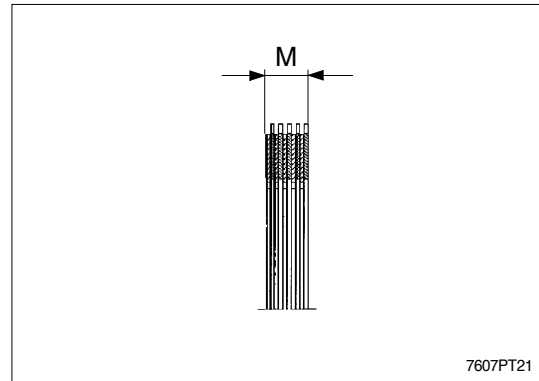
To determine thickness of disc pack from previously computed value **M**.

Assembly procedure of brake disc pack :

To hub drum from pressure plate **C, B, C, B.....C, B.**(C=disc-count, B=disc-brake)

Quantity of brake disc.

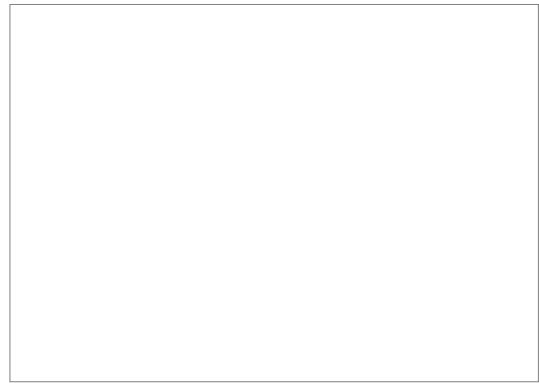
- Front axle : disc-count 5EA
disc-brake 5EA
- Rear axle : disc-count 4EA
disc-brake 4EA



Calculate stroke, and if it is not satisfied with the specification, readjust stroke by means of change the thickness of each disc.

Stroke : $S=(K+L-2J)-M$

- Stroke
Front axle : 3.5~4.0mm
Rear axle : 3.6~4.0mm



Assemble disc pack according to the procedure.



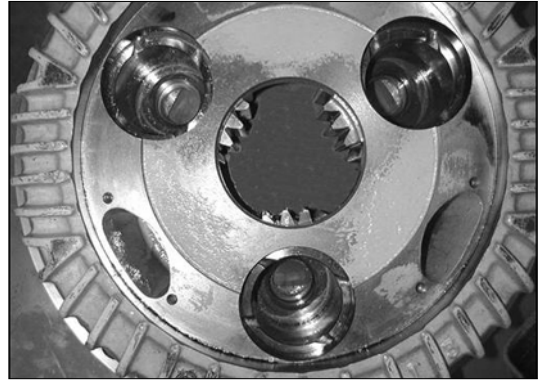
AX104

-) Arrange side gear carrier on blocks made of wood and remove pins.
Save needle rollers of filling bearing casings.
It is important to keep needle rollers joined with relevant pin for allowance question of pins themselves.



AX105

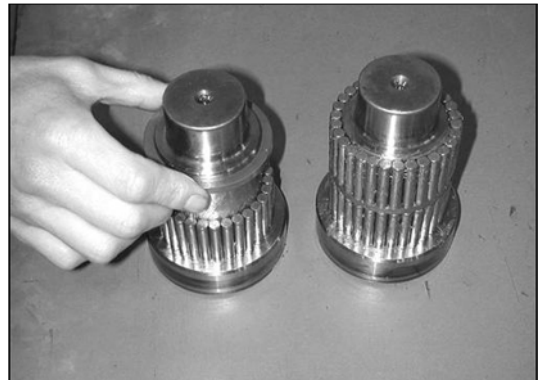
-) Arrange all the three side gears into relevant seats of side gear carrier, position inner thrust washers and align holes.



AX106

-) Mount on pins the two needle roller casings. Insert outer thrust washers, grease lower half of pin(head side) and position the first needle roller casing, insert spacer and position the second casing.

In case of needle roller replacement, use needle roller of the same selection class for the two casings of each side gear.



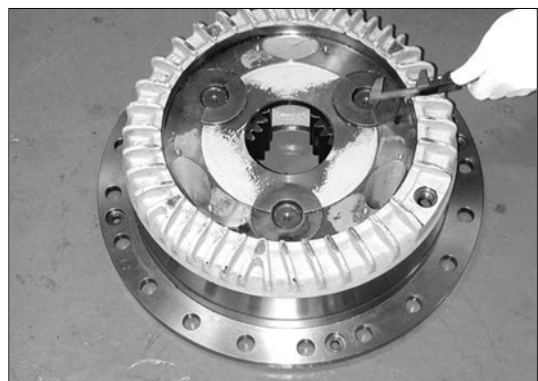
AX107

-) Insert the complete pins, taking care to avoid any bump, cause of needle rollers fall.



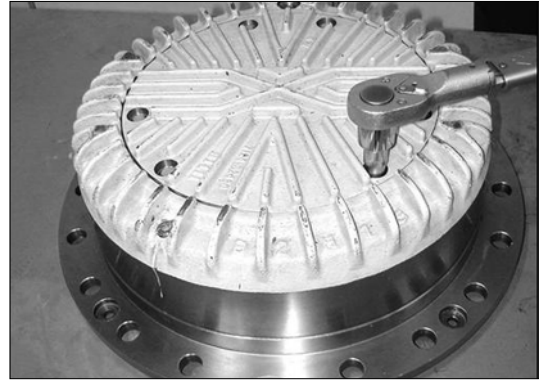
AX108

-) Rotate pins so to align them and allow fitting of cover that also prevent pin rotation.



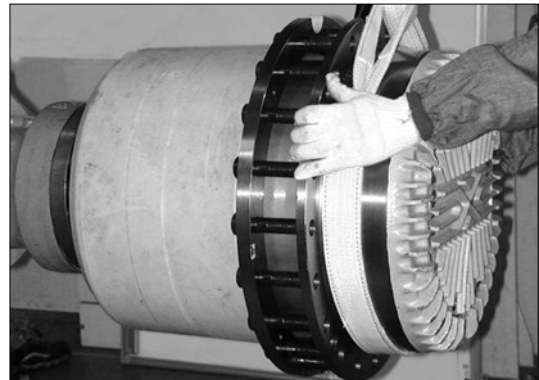
AX109

-) Fit O-ring seal on outer side.
Mount side cover on final drive.
- Tightening torque
Front and rear axle : 2.9~3.6kgf · m
(21.0~26.0lbf · ft)



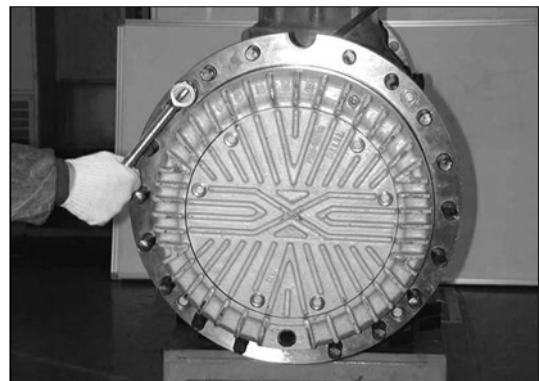
AX110

-) Assemble hub drum on wheel hub.



AX111

-) Tight the fixed bolt of hub drum and assemble plug.
- Tightening torque
Front and rear axle : 6.3~6.9kgf · m
(45.6~50.0lbf · ft)



AX112

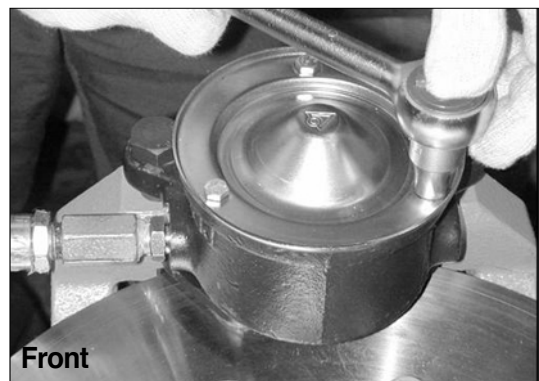
3) PARKING BRAKE(FRONT AXLE ONLY)

(1) DISASSEMBLY

Insert through oil adding hole of gripper the pressure of 100~120bar, in order to obtain calipers release.

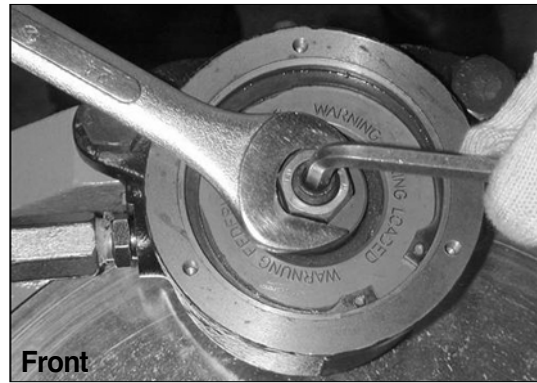
Remove the cover bolts of caliper.

- Brake port size : 7/16 -20UNF O-ring type



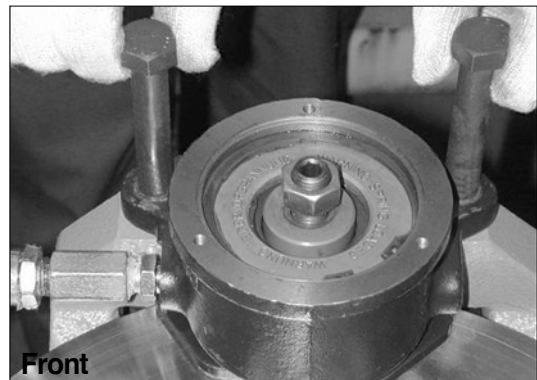
AX022

Release nut and screw.



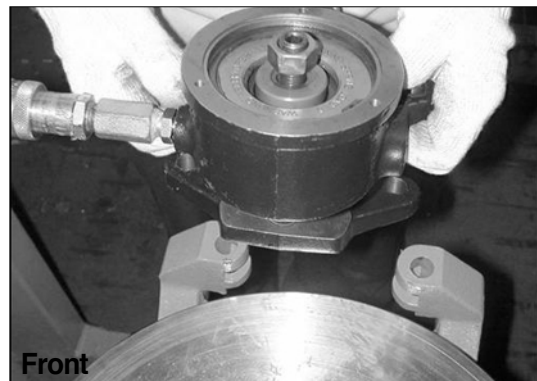
AX023

Remove the split pin and nut of caliper brake. Remove the bolts.



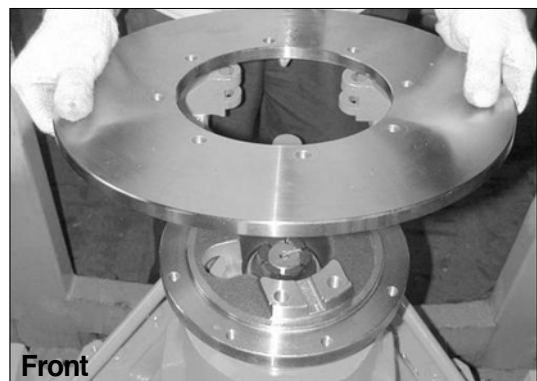
AX024

Remove the caliper brake.



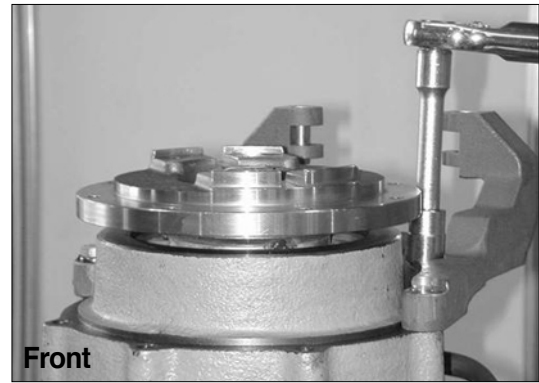
AX025

Remove the disc.



AX026

Remove the fixed bolts of caliper bracket.

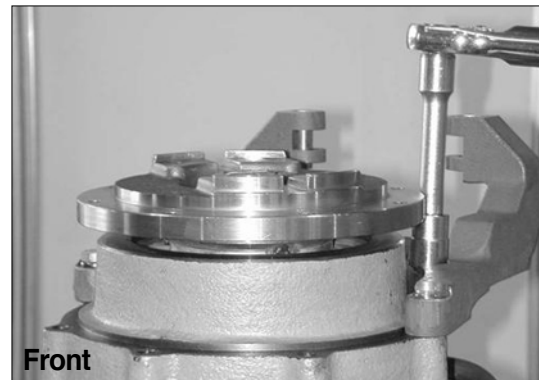


AX027

(2) ASSEMBLY

Install caliper bracket.

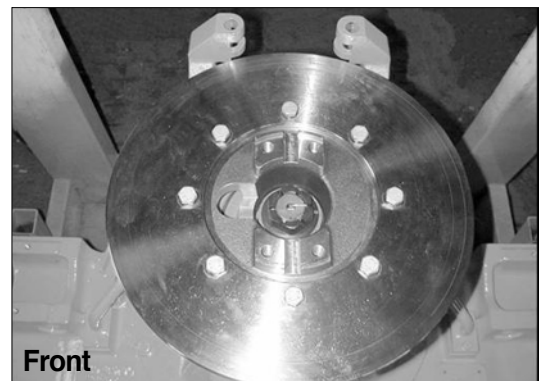
- Tightening torque
14.2~15.7kgf · m(103~114lbf · ft)



AX113

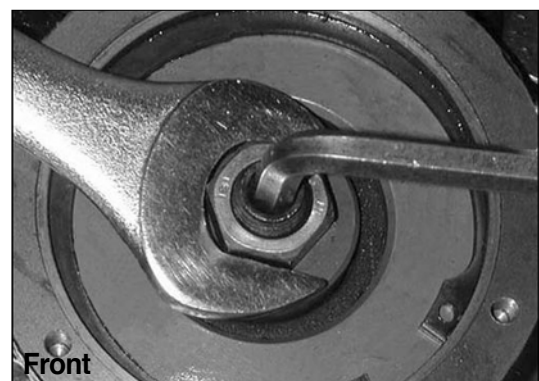
Fit disc on flange, and tighten bolts.

- Tightening torque
6~7kgf · m(43.4~50.6lbf · ft)



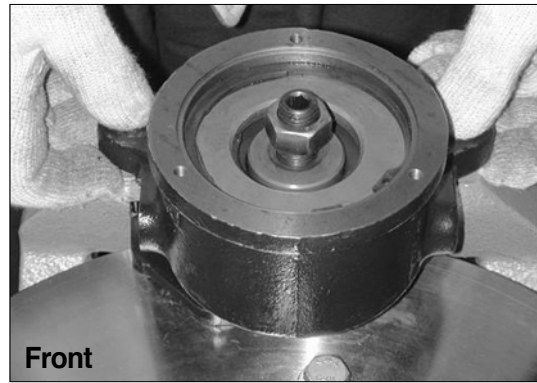
AX114

Remove cover and O-ring of caliper bracket,
and release nut and pin screw.



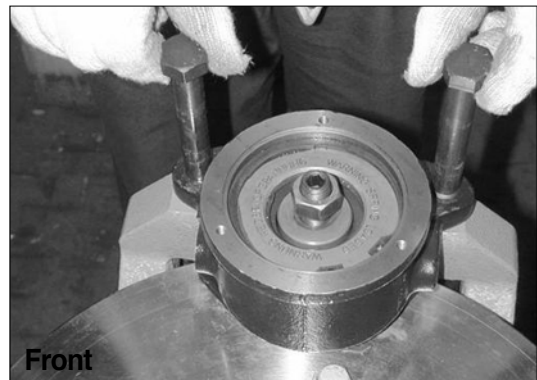
AX115

Release nuts on fixed bolts in order to obtain the maximum opening of gripper.



AX116

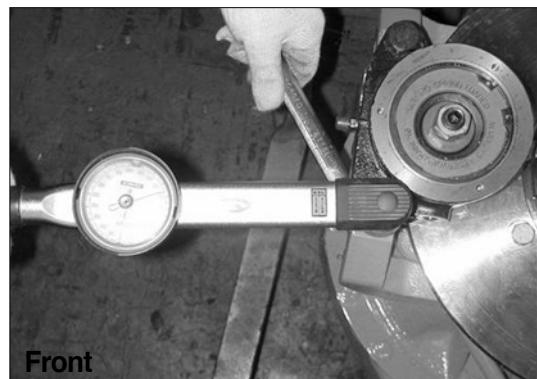
Insert fixed bolts on caliper bracket.



AX117

Tighten nuts and split pins.

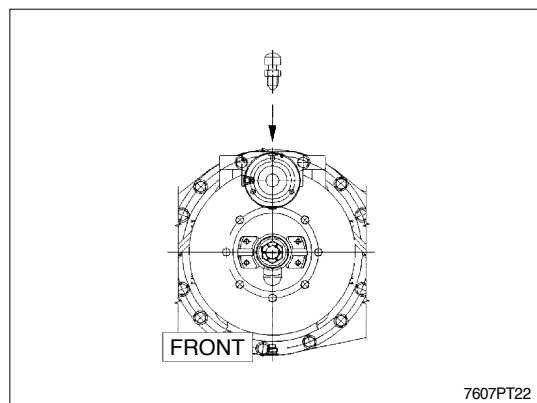
- Tightening torque
1~3kgf · m(7.2~21.7lb · ft)



AX118

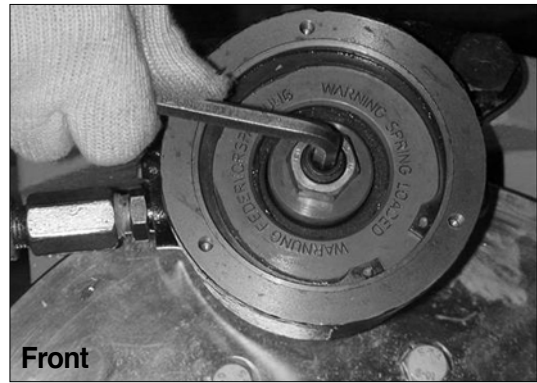
Assemble the bleeder on brake caliper.

- Bleeder tightening torque : 1.4~1.5Kgf · m
(10.1~10.8lb · ft)



7607PT22

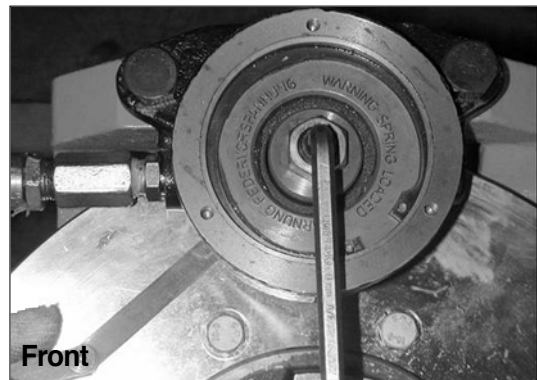
Press 110~120bar in brake port and close
adhesion pad on disc by means of tightening
screw pin.



AX120

Check the gap between discs after unscrew-
ing pin screw 1/8~1/4turn.

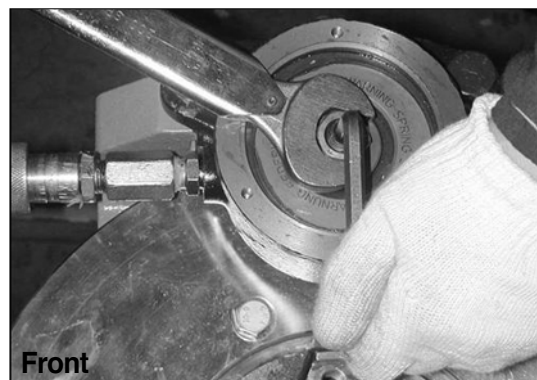
Disc gap : Each 0.125~0.25mm



AX121

Tighten nut.

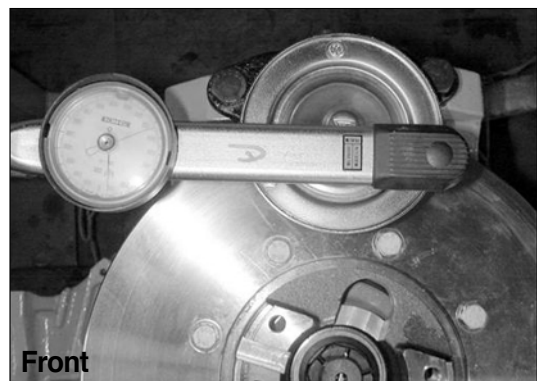
- Tightening torque : 14~16Kgf · m
(101~116lbf · ft)



AX122

Tighten bolts after assembling O-ring on cover.

- Tightening torque : 1.3~1.5Kgf · m
(9.4~10.8lbf · ft)



AX123

4) DIFFERENTIAL ASSEMBLY

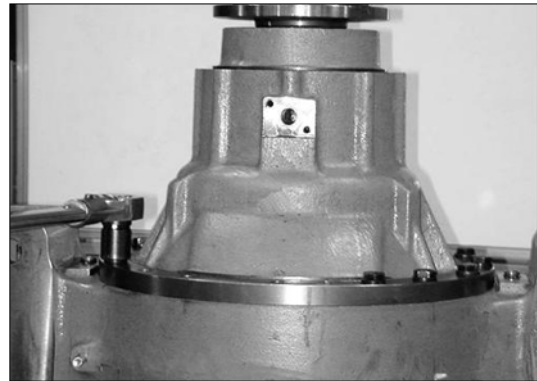
(1) REMOVAL

Remove screws and take away air recirculation duct from differential support and axle case.(Front axle only)

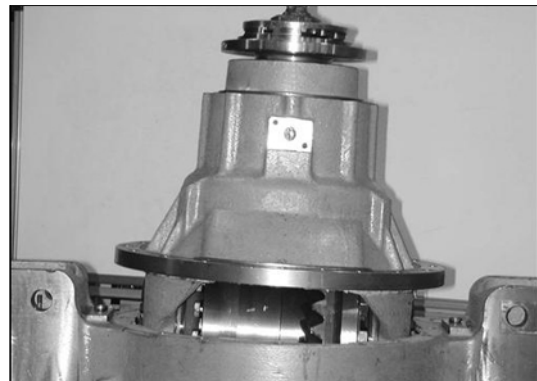


AX0228

Loosen the screws retaining differential group, then remove it from axle case.



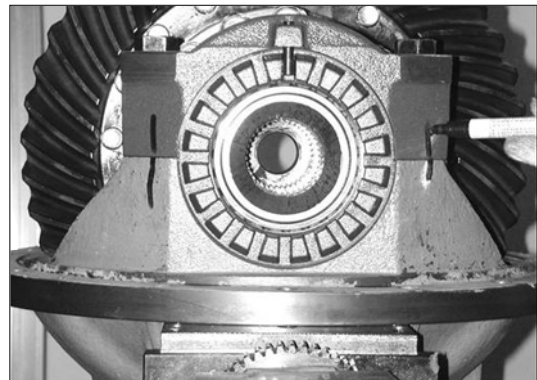
AX029



AX030

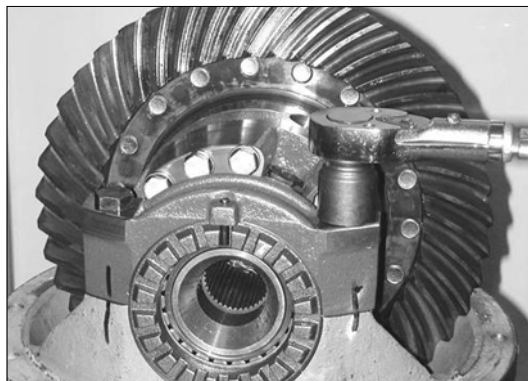
(2) DISASSEMBLY

Place differential unit upside down; mark caps position.



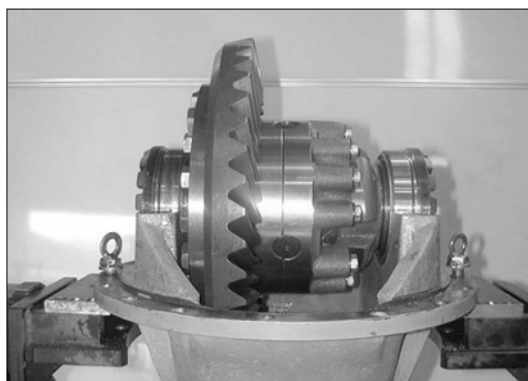
AX031

Unlock and remove caps fixing screws.



AX032

Remove lock pin of ring nut, remove caps.



AX033

Unlock nut and remove screw.
(Rear differential only)



REAR

7607AX130

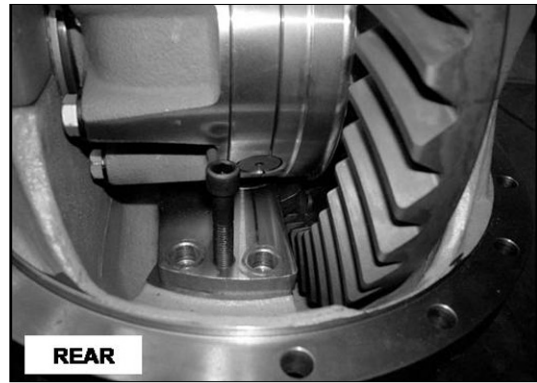
Remove fixing screws(4EA) of cross beam
assembly. (Rear differential only)



REAR

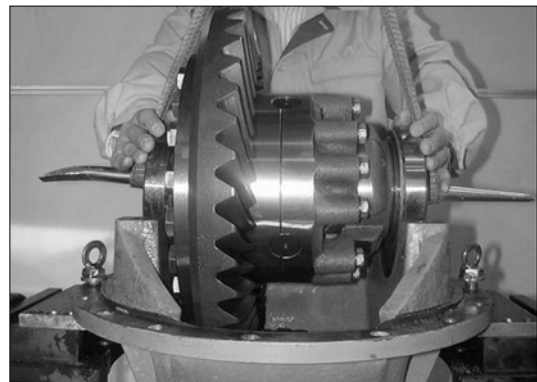
7607AX131

Install the disassembling bolt on tap (M12 x 1.75, 2EA) of cross beam assembly.
(Rear differential only)



7607AX132

Lift up differential, cross beam assembly
(Rear differential only) from support, by a
lifting tool with proper capacity.



AX034

Remove pin, washer from cross beam
assembly. (Rear differential only)



AX133

Remove bearing from cross beam. (Rear
differential only)



AX134

Place on proper support and lock the differential. Straighten notches on pinion nut, then position reaction tool on P.T.O. flange and unlock nut; release pinion nut. Remove drive flange from pinion shank.



AX035



AX036

Pry off seal from P.T.O. flange.



AX037

Drive out bevel pinion from differential support hammering by a proper remover on shank, don't damage thread.



AX038

Remove the bearing cone.



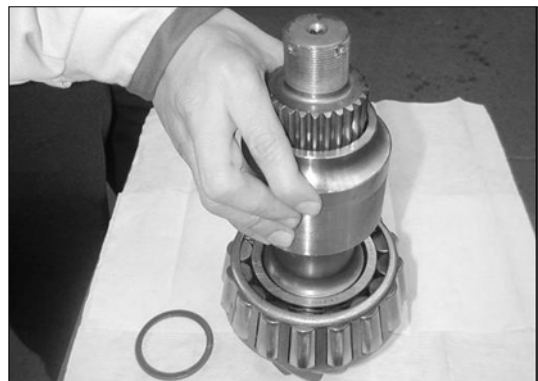
AX039

Remove pump and shim.
(Front differential only)



AX135

Remove the shim and spacer in removed pinion.
(Rear differential only)



AX041

Remove shim and bearing cup from differential support, hammer pinion shank by a proper tool, taking care not to damage thread.

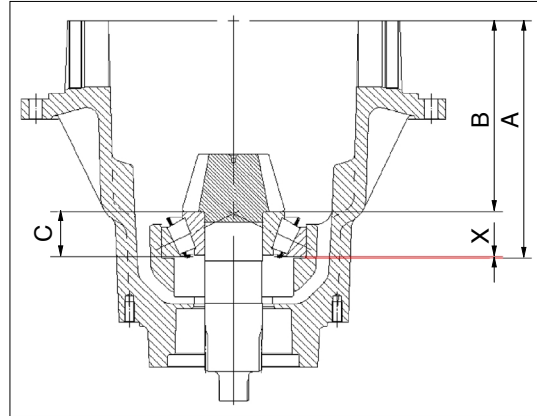


AX137

(3) ASSEMBLY

Measure the dimensions for assembly position of pinion bevel.

Decide the dimension X(shim thickness) by the calculation.



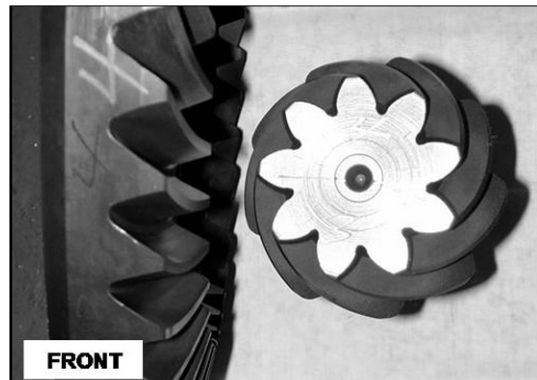
AX043

Both the bevel pinion and the bevel gear are marked with a number. Confirmed the some numbers both the pinion-bevel and gear-bevel.

Number location of bevel set

Bevel pinion : Head surface

Bevel ring : Outer cutting side



AX138

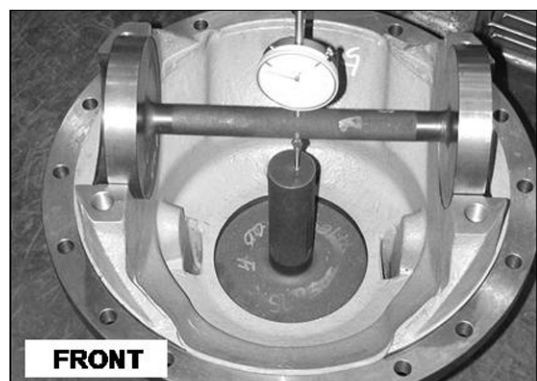


AX139

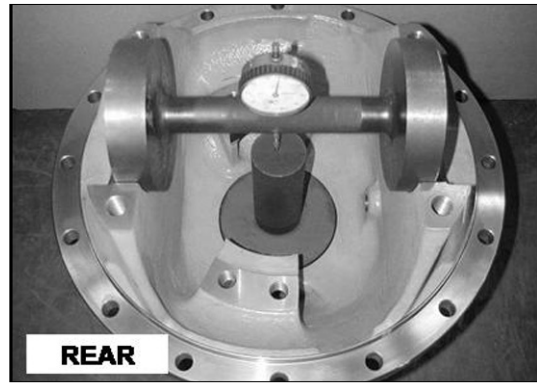
Measure the carrier height **A** by the special tool.

Standard value of **A**

- Front axle : 263.0mm
- Rear axle : 222.0mm



AX140

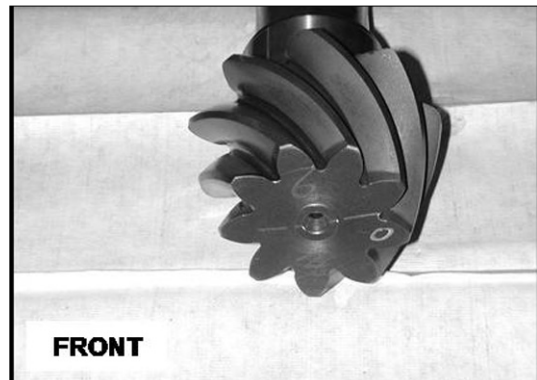


AX141

Decide a value **B** by the carved value of bevel pinion head.

- Front axle : $B = 208.0 \pm \text{carved value}$
- Rear axle : $B = 184.0 \pm \text{carved value}$

In case, the carved value is -10, **B** of Front axle $= 208.0 - 0.1 = 207.9\text{mm}$



AX142

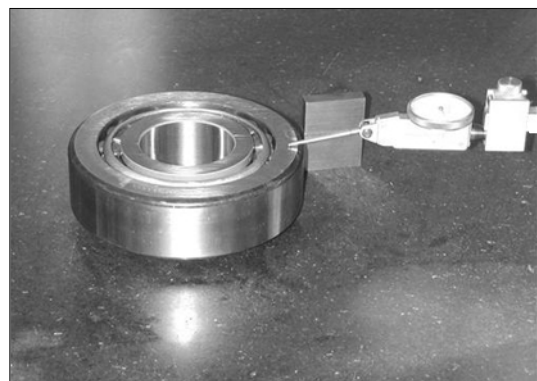


AX143

Measure the width of bearing **C**.

Standard value of **C**

- Front axle : 54.0mm
- Rear axle : 37.0mm



AX047

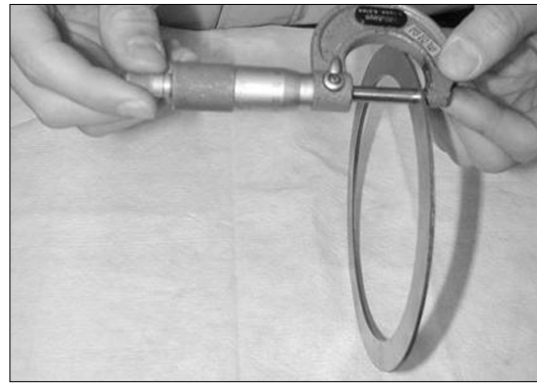
Determine shim X thickness for correct axial position of pinion-bevel.

$$X = A - (B + C)$$

Round up or down to the nearest tenth of millimeter the computed thickness.

2.12 rounded down to = 2.1mm

2.18 rounded up to =2.2mm



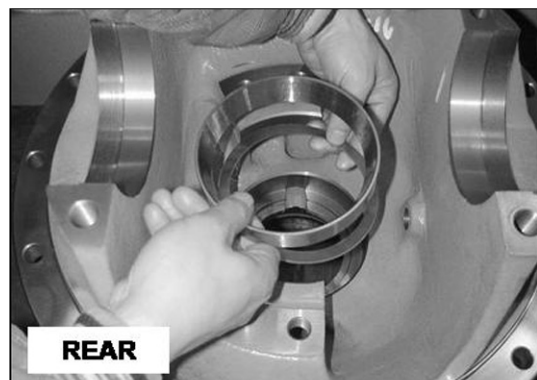
AX144

Insert adjustment shim for axial position of pinion.

Its value was computed previously ; also, fit outer races of pinion under head and shank bearings.



AX145



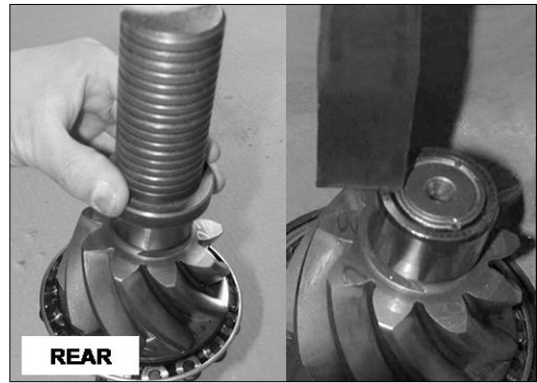
AX146

Fit in pinion shank inner race of under head bearing, heat or press-in part by installer.



AX049

Fit in inner race bearing by pressing.



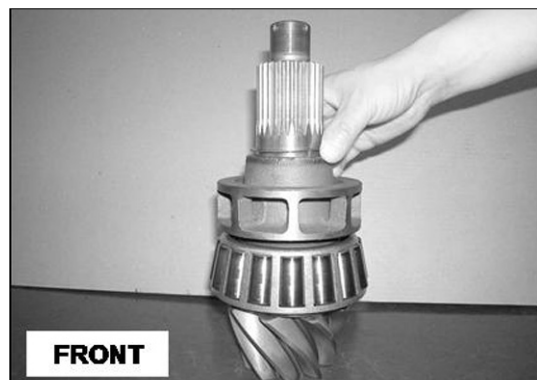
AX147

Fit in bearing by pressing.
Assemble the pin and washer.
(Rear differential only)



AX148

Assemble the pump and shims(3EA).
(Front differential only)
Assemble the spacer and shims(2EA).
(Rear differential only)



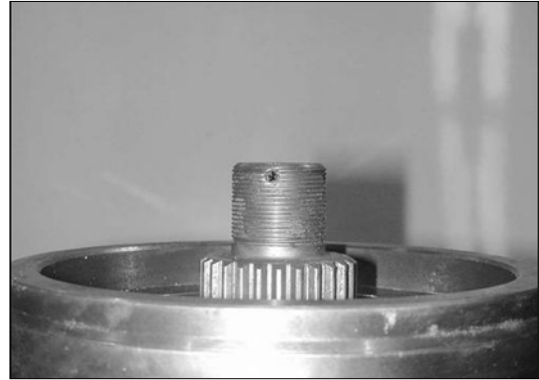
AX149



AX150

Turn the carrier upside down and assemble the bevel pinion assembly.

In order to contact between the bearing cone in pinion bevel and the cup bearing of carrier perfectly, support the bevel pinion by preferable tool.



AX052

Fit in cone bearing by heating or pressing.



AX055

Assemble flange and holder in bevel pinion, and tighten pinion nut.

Don't assemble seal.

- Tightening torque : 64~70kgf · m
(463~506lbf · ft)



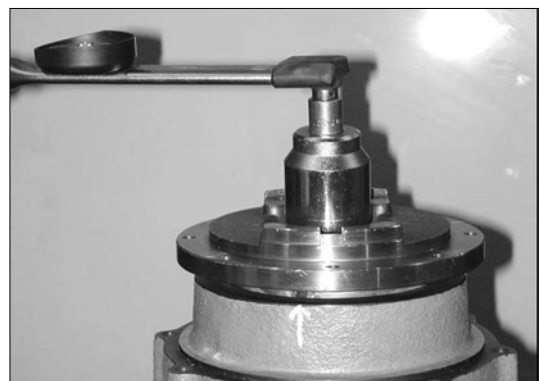
AX056

Measure preload and confirm the follow value.

Bearing preload

- Front axle : 0.2~0.4kgf · m
- Rear axle : 0.2~0.4kgf · m

Before measuring preload, rotate two or three times. Disassemble and change adjustment shims and spacer(Rear axle only) to eliminate all end play up to reach a pre-load.



AX057

As bearing pre-load has been determined, remove drive flange and pinion nut holder.



AX058

Assemble seal.

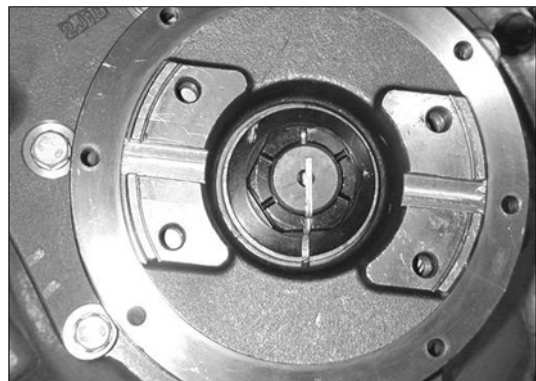
Cover the seal with retaining compound.
Cover the seal lip and the flange with oil.



AX059

Assemble the flange and the holder on the bevel pinion, and tighten the pinion nut and the split pin.

- Tightening torque : 64~70kgf · m
(463~506lbf · ft)



AX060

Install cross beam assembly to the location of bolts fixing bevel ring. And then assemble the bearing inner race before mounting differential to carrier.



AX151

Tighten the fixing bolt of cross beam assembly.

(Rear differential only)

- Tightening torque : 31.3~34.6kgf · m
(226~250lbf · ft)

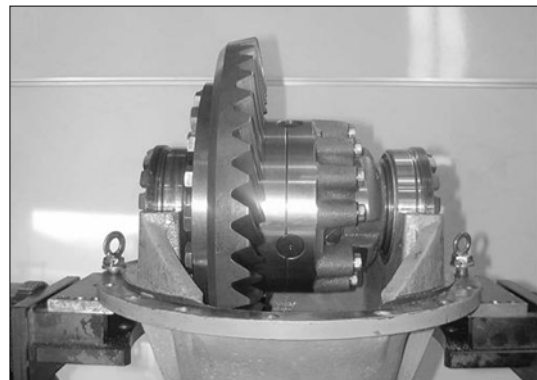


AX152

-) Fit in the differential assembly on the carrier, and assemble adjusting nut temporarily.
(Front differential only)

Assemble adjusting nut temporary.

(Rear differential only)

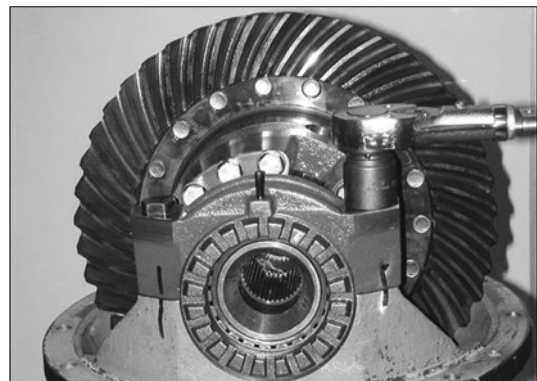


AX061

-) Install caps, care not to reverse position and lock screws fixing to differential support with belows.

Cap tightening torque

- Front axle : 63~69kgf · m(456~499lbf · ft)
- Rear axle : 31.3~34.6kgf · m(226~250lbf · ft)



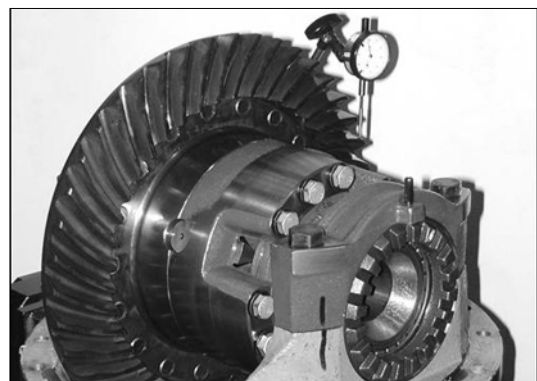
AX062

-) Position a dial gauge perpendicular than ring gear tooth and check, with pinion steady, backlash that has to be of 0.25 ~ 0.33mm (front) and 0.20~0.28mm(rear).

Otherwise rotate both ring nuts by displacing them of the same number of notches and nearing ring gear to pinion if backlash is excessive, by moving away on the contrary.

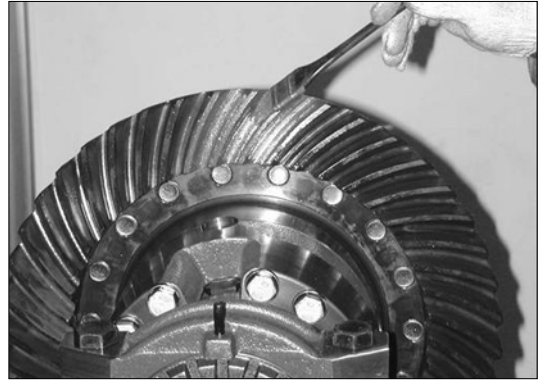
Bevel set backlash

- Front axle : 0.25~0.33mm
- Rear axle : 0.20~0.28mm



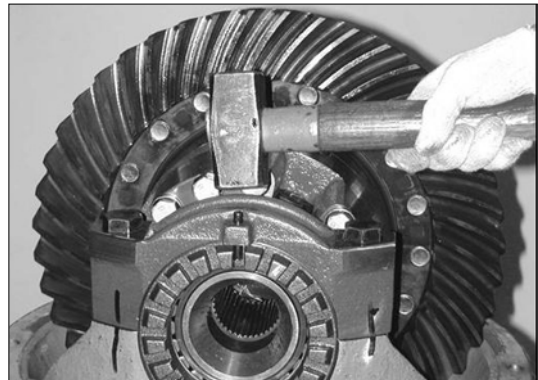
AX063

-) Brush red lead on some ring tooth, rotate to mesh pinion and ring gear repeatedly, so to make evident tooth contact. Proper and correct tooth contact marks are visible on a new bevel gear set as a result of an optimum contact approached on the tester, consequently, a proper axial position of pinion against ring gear will emphasise remarking of previous tester contact markings.



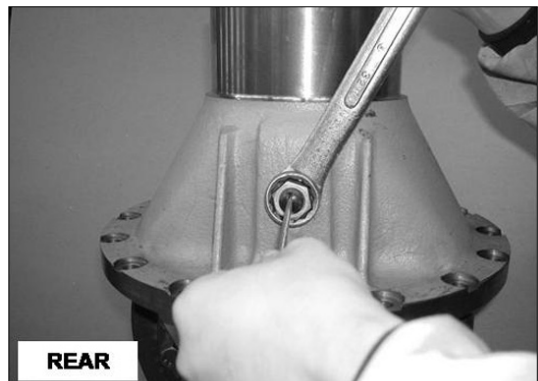
AX064

-) Fit spring pins locking threaded rings of differential unit.



AX065

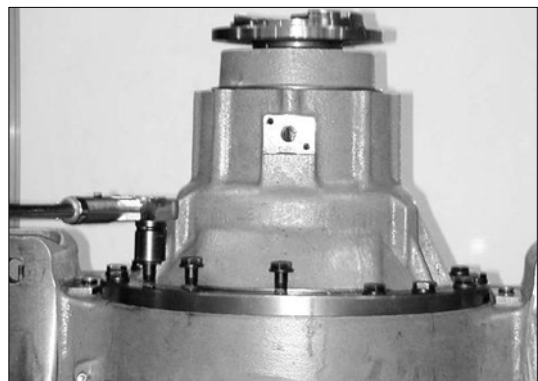
-) Apply flange sealant on the screw.
Tighten the screw until contacting the bevel gear and then loosen about 60°, before tightening nut.



AX153

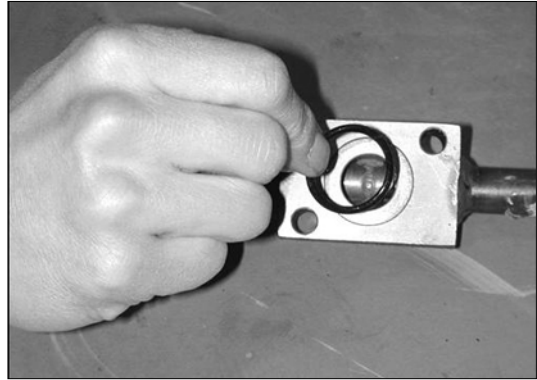
(4) HOUSING AND DIFFERENTIAL MOUNTING

Perform two securing notches on pinion nut.
Clean with care contact surfaces, apply hard locking compound and then install the differential unit on axle case ; lock the connecting screws with a torque of 18.0~20.0Kgf · m(130~145lbf · ft).



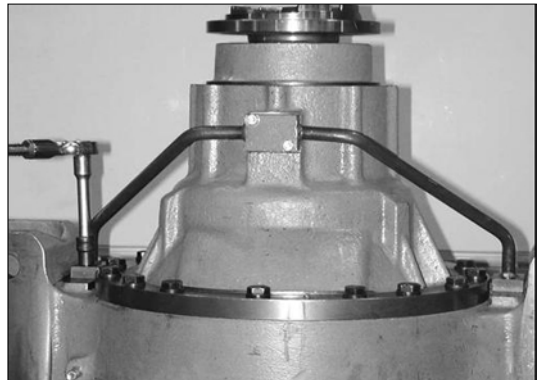
AX065

Assemble O-ring on tube assembly port(3EA).
(Front axle only)



AX083

Position the tube assembly, fit screws and lock
with a torque of 3.0~3.6Kgf · m(21.7~26.0lbf · ft).
(Front axle only)

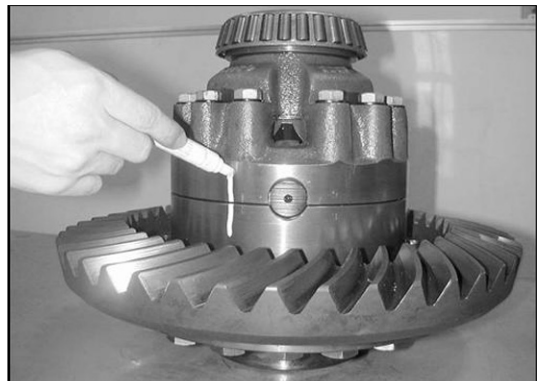


AX084

5) SUPER MAX TRAC

(1) DISASSEMBLY

Mark the two half cases(LH/RH).



AX154

Loosen the bolts of the case(RH) and
remove the case(LH).



AX155

Remove the side gear and the thrust washer.



AX156

Remove spider with the four side gears and relevant bevel thrust washers.



AX157

Remove the planetary gear with relevant intermediate and shim discs and clutch discs, in half case on bevel gear side.



AX158

Loosen bevel gear fixing screws.



AX159

(2) ASSEMBLY

Install gear-bevel on case(LH) by bolts.

Tightening torque

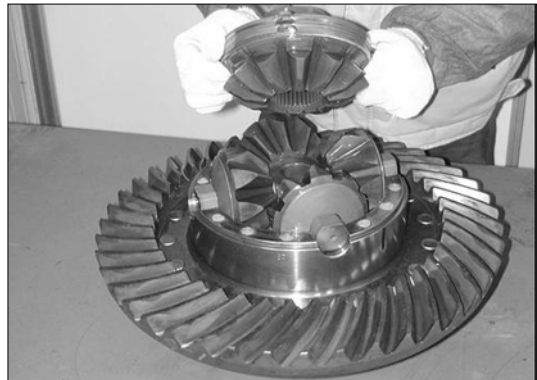
- Front axle : 45.6~50.4kgf · m(330~365lbf · ft)
- Rear axle : 31.3~34.6kgf · m(226~250lbf · ft)



AX160

Insert side gear assembly and thrust washer in case(LH).

Assemble spider and side gear according to procedure.



AX079

Mount the cover, taking care to align the reference marked done before disassembling ; close the two half casings.

Screw in fixing screws and lock a torque of ;

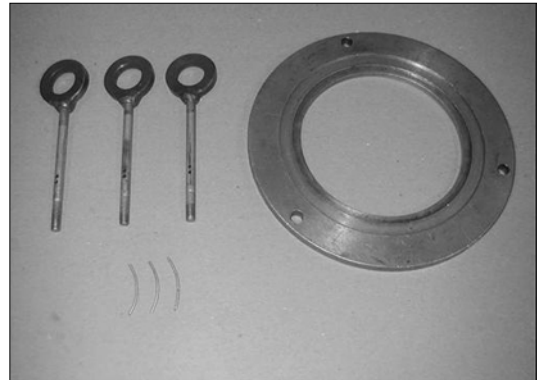
- Front and rear axle : 11.4~12.6kgf · m
(82.5~91.1lbf · ft)



AX162

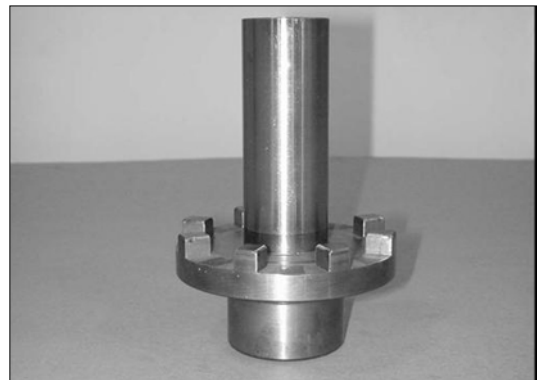
6) TOOLS

Spring compression tool.



AX124

Nut adjusting tool of reduction assembly.



AX125