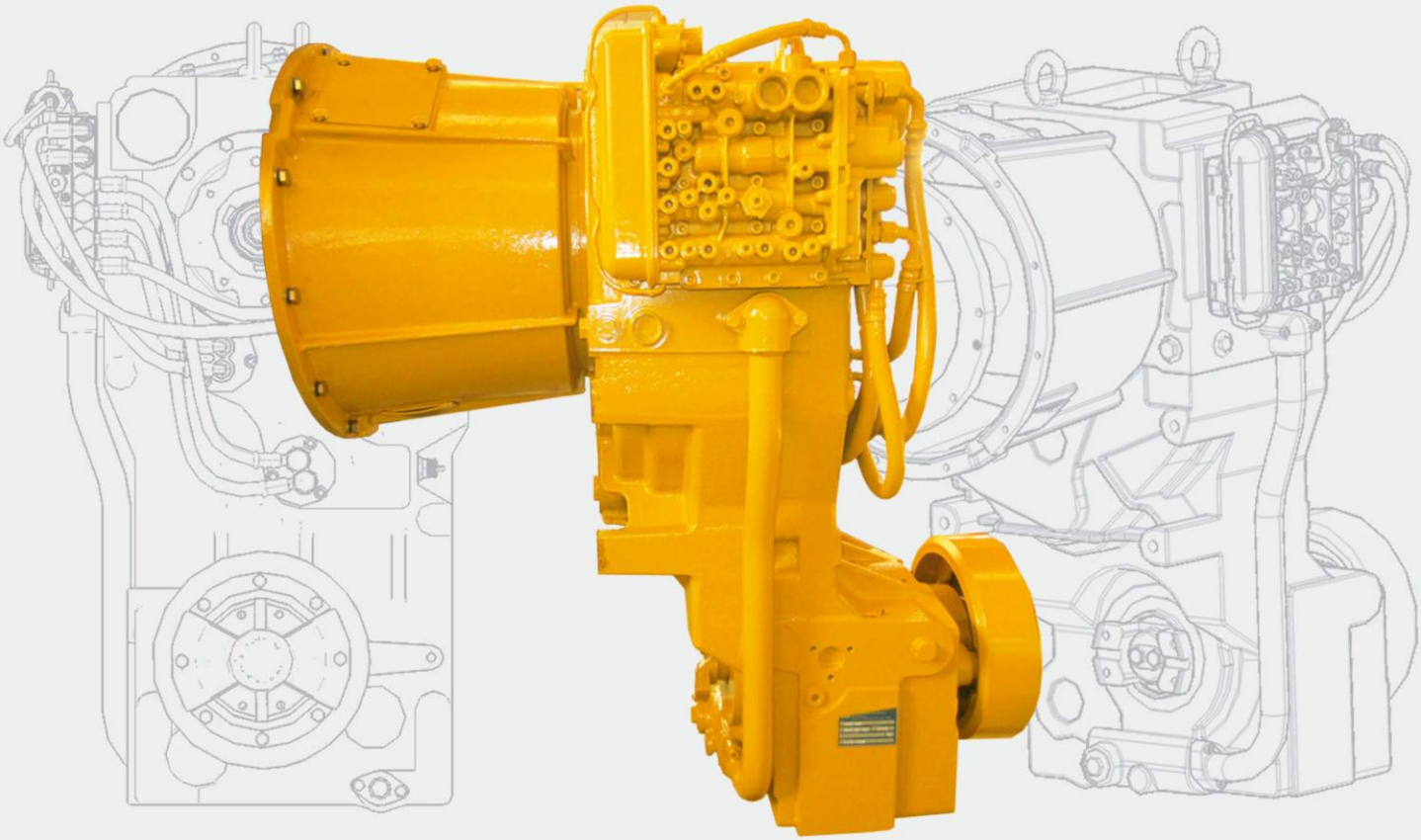
ZF Transmission Service Manual



SDLG

Preface

The Service Manual introduces the ZF 4WG200(4WG158、6WG200 also applied)transmission removal and assembling process and offers the transmission service process technology and standard requirements, which can help the service personnel understand the transmission removal and assembling methods more profoundly as well as lay a solid technical foundation for the service personnel to correctly judge the malfunction and do troubleshooting.

The Service Manual mainly includes following content:

Chapter I. Introduction

The chapter mainly introduces the transmission service precautions as well as symbol meanings and common thread tightening torque value in the text.

Chapter II. Transmission System

The chapter mainly introduces the mechanical principles of different gears of the transmission as well as the transmission operation and maintenance.

Chapter III. Transmission Removal

The chapter introduces the correct parts removal steps as well as precautions during removal.

Chapter IV. Transmission Assembling

The chapter introduces the correct parts assembling steps as well as precautions during assembling.

Chapter V. Malfunction Diagnosis and Troubleshooting

The chapter introduces the malfunction diagnosis and troubleshooting of the transmission system and ZF transmission.

Attention

Due to product improvements, relevant parts in the Service Manual will be subject to change without further notice. For the newest data and information, please consult with or get them from Shandong Lingong Construction Machinery Co., Ltd.

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1 Introduction

1.1 Safety Precautions

⚠Important Safety Precautions

The maintenance and repair is very important for a safe vehicle operation. The Manual mainly describes the correct removal and assembling technology of the transmission assembly.

To avoid personal injuries, ⚠will be made as the safety mark in the Manual. The precautions with shall be paid high attention to. In case of potential dangers, it is recommended to consider the own safety first of all, and then consider taking necessary safety measures.

⚠ Safety Tips

During assembling and removal, wrong operation method will lead to parts damages, service life shortening, service performance deterioration, and other unsafe factors. Accordingly, when assembling and removing the parts, it is recommended to carefully read the Manual.

1. All parameters, figures and relevant content in the Manual are applicable for the standard equipped product. For derivative product, please consult with us or refer to relevant materials.

2. In the repair workshop, the places special for assembling and removal operation and storing removed parts shall be prepared, and the corresponding tools and parts shall be placed in a proper site. In addition, the working area shall be kept clean, which shall be free from oil dirt and pollutants. Smoking is only allowed in the specified place; smoking is not allowed during operation, and corresponding fire extinguishers shall be prepared.

3. The welding operation can only be conducted by the trained personnel with welding experience. During welding, welding gloves, retainer, goggles, work cap and other work clothes applicable for welding operation.

4. Before removing the transmission-torque converter assembly, it is necessary to clean pollutants on the surface of the transmission-torque converter assembly, so as to avoid polluting the parts during removal.

5. During operation, it is necessary to wear safety boots and safety helmet. It is not allowed to wear unqualified work clothes; it is necessary to fasten buttons of the work clothes. When knocking the parts with the copper rod, it is necessary to wear goggles.

6. The gasoline, kerosene and water-based oil stain cleaning agent can be used to clean the removed parts.

7. When applying the traveling crane or other hoisting equipment, check relevant spreader for damages first of all, and such hoisting equipment with sufficient hoisting capacity shall be used. During hoisting, the appointed hoisting position shall be used for slow hoisting, so as to avoid parts collision. It is not allowed to work in the area under the hoisted parts.

Attention

As the torque converter has no axial positioning, it is necessary to prevent its slipping in case of removal and assembling of the transmission, as shown in Figure 1-1

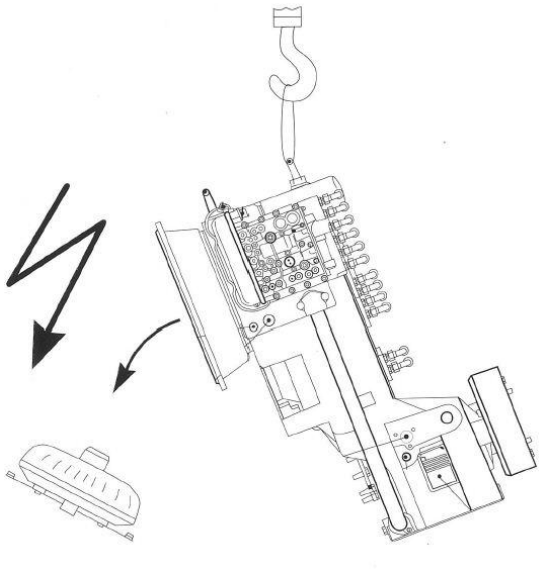


Figure 1-1

8. In case of simultaneous operation with two or more persons, they shall reach an agreement in the operation procedures before operation, so as to avoid accidents due to incompatible pace.

9. It is necessary to properly keep all tools and be familiar with their application methods.

10. In case of alignment of two holes, it is forbidden to insert hands and fingers. For parts to be directly assembled by hand, it is necessary to pay attention that the gripping position is free from squeezing danger.

11. It is necessary to test the removed parts; the parts whose application performance is affected shall be replaced with a new one.

12. After assembling, the parts shall be free from interference.

13. When assembling the oil seal and seal ring through the keyway, screw hole and step, it is necessary to apply relevant protection measures to avoid damages.

14. When assembling the parts, the applied tools shall match with the thread fastener, so as to avoid damages.

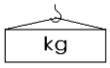
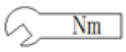
15. When screwing down the connector body and screw plug, it is not allowed to use pneumatic wrench and other similar tightening tools. It is necessary to screw them down by hand and then with the torque wrench with corresponding capacity, so as to reach the corresponding torque value.

16. When draining out fluid in the transmission, it is necessary to slowly screw off the oil drain plug, so as to avoid fluid spraying.

1.2 Instructions of Marks and Symbols

To ensure that the Manual can play a role, it is necessary to use marks specified in Table 1-1 for aspects of the important safety and quality requirements.

Table 1-1

Mark		Remarks
	Safety	Special attention shall be given to the safety in case of operation.
		Special attention shall be given to the safety in case of operation as there is pressure inside.
	Attention	Special attention shall be given to the technical requirements in case of operation to ensure that the operation is qualified.
	Weight	Part or device weight or removal and assembling method.
		Attention shall be given to selection of the spreader and its operation posture.
	Tightening torque	Special attention shall be given to the tightening torque of the component in case of assembling.
	Coating	The place which needs adhesive and lubricating grease coating.
	Oil and water	Fill the engine oil, water and fuel with certain capacity.
	Draining	The place needing oil or water draining and draining capacity.

1.3 Common Bolt Tightening Torque Table

Table 1-2

Bolt strength grade	Yield strength N/mm^2	Nominal diameter of bolt mm				
		6	8	10	12	14
		Tightening torque Nm				
8.8	640	9~12	22~30	45~59	78~104	124~165
10.9	900	13~16	30~36	65~78	110~130	180~210
12.9	1080	16~21	38~51	75~100	131~175	209~278
Bolt strength grade	Yield strength N/mm^2	Nominal diameter of bolt mm				
		16	18	20	22	24
		Tightening torque Nm				
8.8	640	193~257	264~354	376~502	521~683	651~868
10.9	900	280~330	380~450	540~650	740~880	940~1120
12.9	1080	326~434	448~597	635~847	864~1152	1098~1464

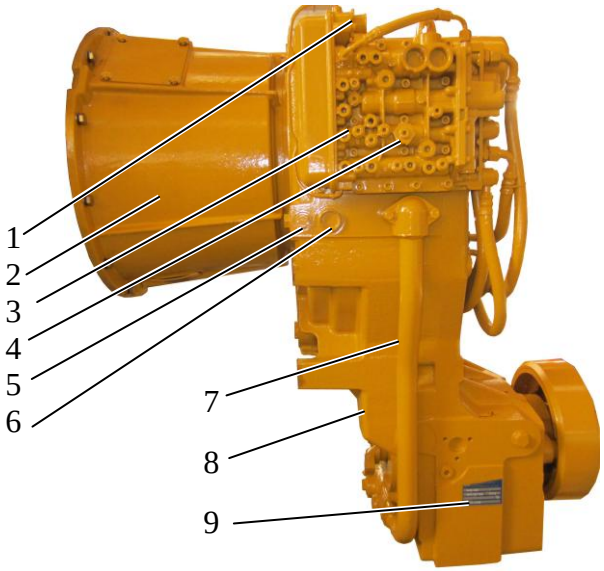
Bolt strength grade	Yield strength N/mm^2	Nominal diameter of bolt mm				
		27	30	33	36	39
		Tightening torque Nm				
8.8	640	952~1269	1293~1723	1759~2345	2259~3012	2923~3898
10.9	900	1400~1650	1700~2000	2473~3298	2800~3350	4111~5481
12.9	1080	1606~2142	2181~2908	2968~3958	3812~5082	4933~6577

2 Transmission System

2.1 Transmission Introduction

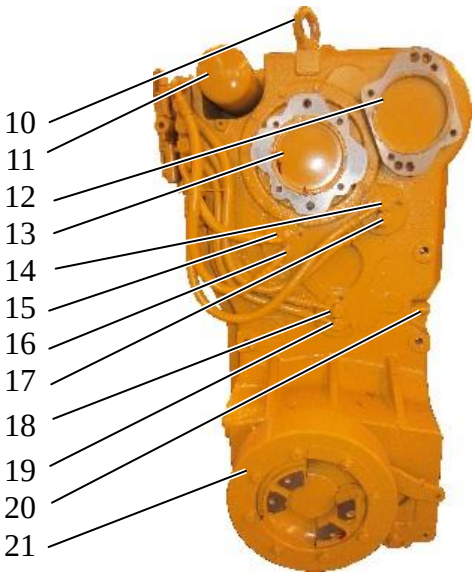
2.1.1 General Overview of the Transmission

The ZF power gearshift transmission is composed of the hydraulic torque converter and rear-mounted countershaft transmission with multi-sheet friction clutch. The SDLG 938L、948L wheel loader adopts the 4WG158 gearbox assembly ，the SDLG 958L、959、968 wheel loader adopts the 4WG200 gearbox assembly which can realize speed switching between 4 forward gears and 3 reverse gears. The SDLG G9190 grader adopts the 6WG200 gearbox assembly which can realize speed switching between 6 forward gears and 3 reverse gears



1. Connecting socket
2. Torque converter shell
3. Transmission control valve
4. Transmission pressure measuring port
5. Torque converter oil temperature measuring port
6. Transmission oil outlet
7. Oil suction pipe
8. Transmission housing
9. Nameplate

Figure 2-1



10. Lifting ring screw
11. Oil filter
12. Auxiliary PTO
13. Main PTO
14. KV
15. KR
16. K2
17. K1
18. K3
19. K4
20. Rotation speed sensor
21. Parking brake

Figure 2-2

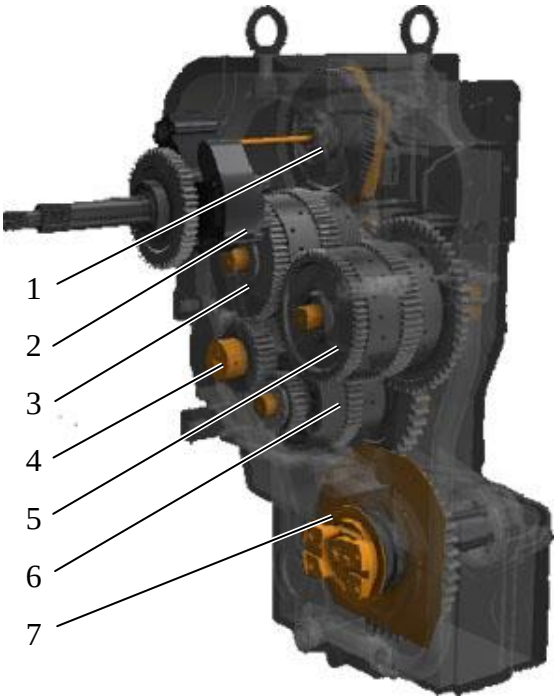


Figure 2-3

1. Auxiliary PTO
2. Variable speed pump
3. KVK1 clutch assembly
4. Intermediate shaft component
5. KRK2 clutch assembly
6. K3K4 clutch assembly
7. Output shaft assembly

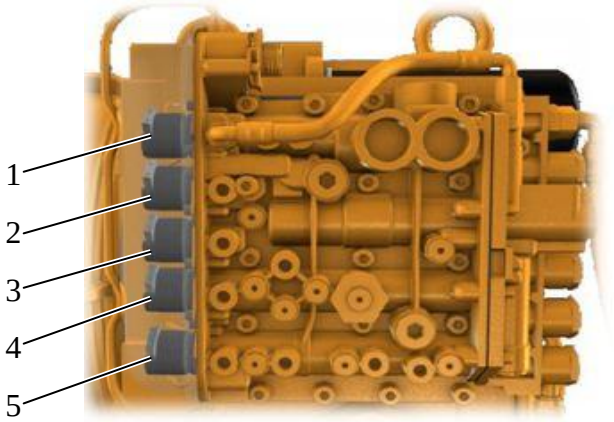


Figure 2-4

1. M4 2. M3 3. M5 4. M2 5. M1

2.1.2 Basic Parameters of the Transmission-torque Converter Assembly

Table 2-1

Item \ Type	4WG158	4WG200	6WG200
Transmission gear	Four forward gears and three reverse gears		Six forward gears and three reverse gears
Torque converter inlet oil pressure (bar)	8.5		
Torque converter outlet oil pressure (bar)	5		
Transmission working pressure (bar)	16&18		
Gearbox oil draining capacity（L）	35		

2.1.3 Mechanical Principles of the Gears of the Transmission (4WG158/200)

1. First forward gear

$Z_0 \rightarrow Z_V \rightarrow Z_{V1} \rightarrow Z_1 \rightarrow Z_2 \rightarrow Z_3 \rightarrow Z_{output}$

The solenoid valves M2, M3, M4 act and the transmission pressure oil flows into KVK1 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear Z_0→ forward gear input gear Z_V→ forward gear clutch KV→ KV1 ring gear assembly Z_{V1}→ first gear clutch K1→ gear Z_1 of the first gear→ second gear combination gear Z_2→ gear Z_3 of the third gear→ output shaft gear Z_{output}→ output shaft, as shown in Figure 2-5

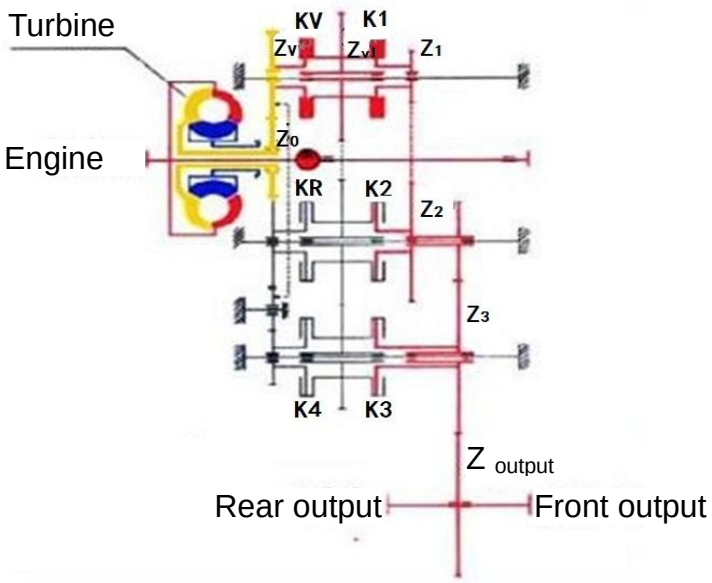


Figure 2-5

2. Second forward gear

The solenoid valves M3 and M4 act and the transmission pressure oil flows into KVK2 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear Z_0→ forward gear input gear Z_V→ forward gear clutch KV→ KV1 ring gear assembly Z_{V1}→ KR2 ring gear assembly Z_{R2}→ second gear clutch K2→ second gear combination gear Z_2→ gear Z_3 of the third gear→ output shaft gear Z_{output}→ output shaft, as shown in Figure 2-6

$Z_0 \rightarrow Z_V \rightarrow Z_{V1} \rightarrow Z_{R2} \rightarrow Z_2 \rightarrow Z_3 \rightarrow Z_{output}$

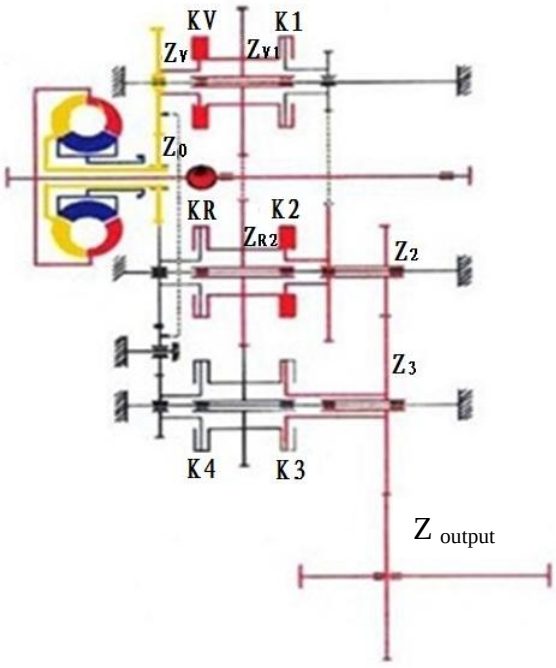


Figure 2-6

3. Third forward gear

The solenoid valve M3 acts and the transmission pressure oil flows into KVK3 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear Z_0→ forward gear input gear Z_V→ forward gear clutch KV→ KV1 ring gear assembly Z_{V1}→ KV2 ring gear assembly Z_{R2}→ K34 ring gear assembly Z_{34}→ third gear clutch K3→ gear Z_3 of the third gear→ output shaft gear Z_{output}→ output shaft, as shown in Figure 2-7

$Z_0 \rightarrow Z_V \rightarrow Z_{V1} \rightarrow Z_{R2} \rightarrow Z_{34} \rightarrow Z_3 \rightarrow Z_{output}$

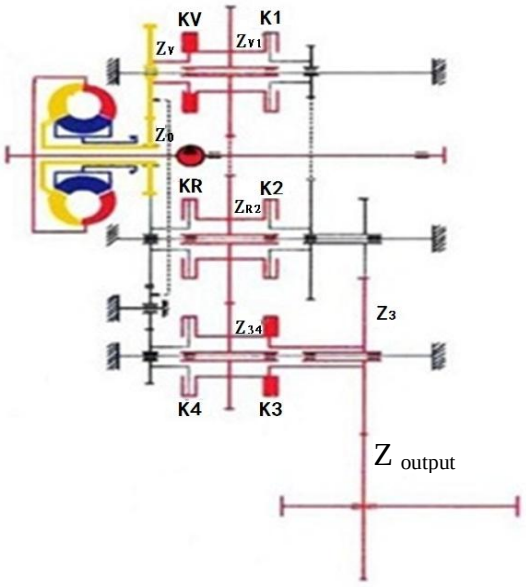


Figure 2-7

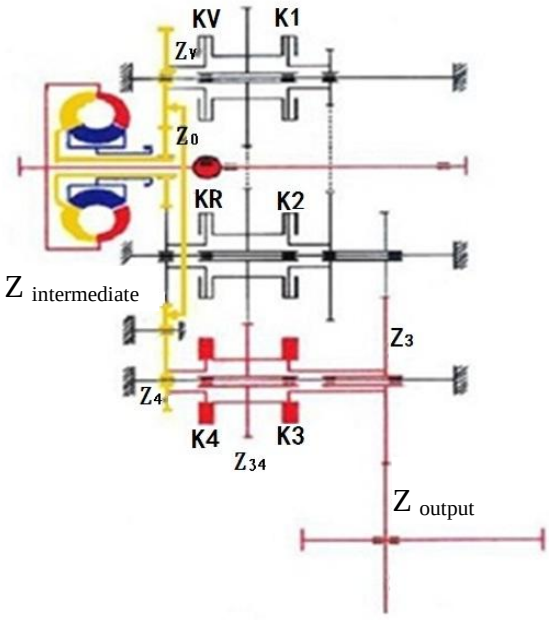


Figure 2-8

4. Fourth forward gear

The solenoid valve M5 acts and the transmission pressure oil flows into K3K4 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear Z_0→ forward gear input gear Z_V→ intermediate gear $Z_{intermediate}$→ gear Z_4 of the fourth gear→ fourth gear clutch K4→ K34 ring gear assembly Z_{34}→ third gear clutch K3→gear Z_3 of the third gear→ output shaft gear Z_{output}→ output shaft, as shown in Figure 2-8

$Z_0 \rightarrow Z_V \rightarrow Z_{intermediate} \rightarrow Z_4 \rightarrow Z_{34} \rightarrow Z_3 \rightarrow Z_{output}$

5. First reverse gear

The solenoid valves M1, M2, M4 act and the transmission pressure oil flows into KRK1 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear Z_0→ reverse gear input gear Z_R→ reverse gear clutch KR→ KR2 ring gear assembly Z_{R2}→ KV1 ring gear assembly Z_{V1}→ first gear clutch K1→ gear Z_1 of the first gear→ second gear combination gear Z_2→ gear Z_3 of the third gear→ output shaft gear Z_{output}→ output shaft, as shown in Figure 2-9

$Z_0 \rightarrow Z_R \rightarrow Z_{R2} \rightarrow Z_{V1} \rightarrow Z_1 \rightarrow Z_2 \rightarrow Z_3 \rightarrow Z_{output}$

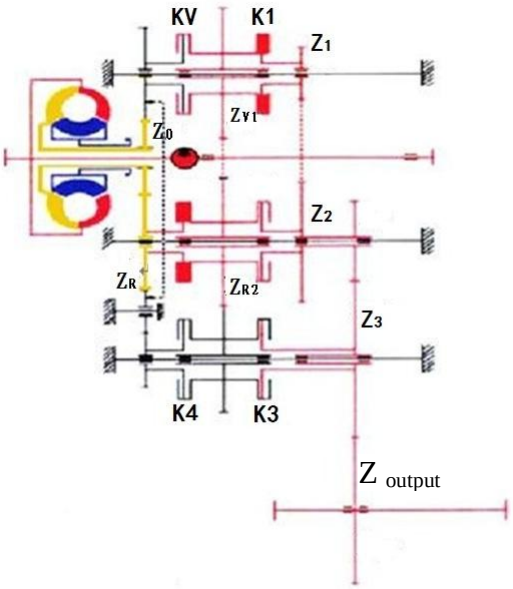


Figure 2-9

6. Second reverse gear

The solenoid valves M1 and M4 act and the transmission pressure oil flows into KRK2 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear Z_0→ reverse gear input gear Z_R→ reverse gear clutch KR→ KR2 ring gear assembly Z_{R2}→ second gear clutch Z_2→second gear combination gear Z_2→ gear Z_3 of the third gear→ output shaft gear Z_{output}→ output shaft, as shown in Figure 2-10

$Z_0 \rightarrow Z_R \rightarrow Z_{R2} \rightarrow Z_2 \rightarrow Z_3 \rightarrow Z_{output}$

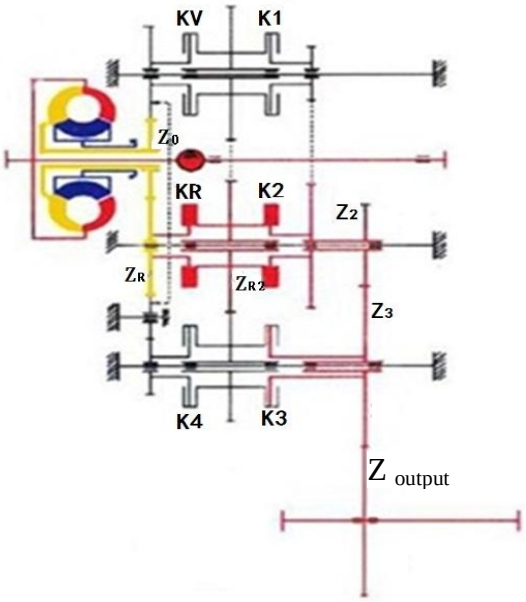


Figure 2-10

7. Third reverse gear

The solenoid valve M1 acts and the transmission pressure oil flows into KRK3 clutch, thus respectively pushing the piston to move; pressing the interior friction lining out of the clutches and forming the transmission subassembly.

The power transmission route: Driving gear Z_0→ reverse gear input gear Z_R→ reverse gear clutch KR→ KR2 ring gear assembly Z_{R2}→ K34 ring gear assembly Z_{34}→ third gear clutch K3→ gear Z_3 of the third gear→ output shaft gear Z_{output}→ output shaft, as shown in Figure 2-11

$Z_0 \rightarrow Z_R \rightarrow Z_{R2} \rightarrow Z_{34} \rightarrow Z_3 \rightarrow Z_{output}$

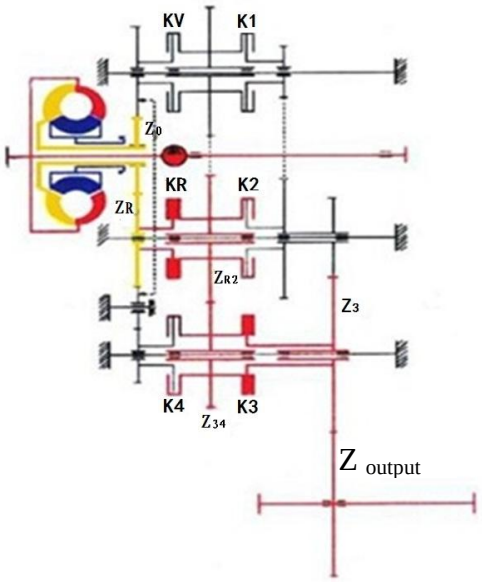


Figure 2-11

The working conditions of the corresponding solenoid valves and clutches are shown in Table 2-2:

Table 2-2

	●Electrified solenoid valve										
	Forward gear				Reverse gear			Neutral gear			
Gear	1	2	3	4	1	2	3	1	2	3	4
M1					●	●	●				
M2	●				●			●			
M3	●	●	●								
M4	●	●			●	●		●	●		
M5				●							
Clutch	KV	KV	KV	K4	KR	KR	KR	K3			
Clutch	K1	K2	K3	K3	K1	K2	K3				

The pressure measuring ports of all gears are shown in Figure 2-12:

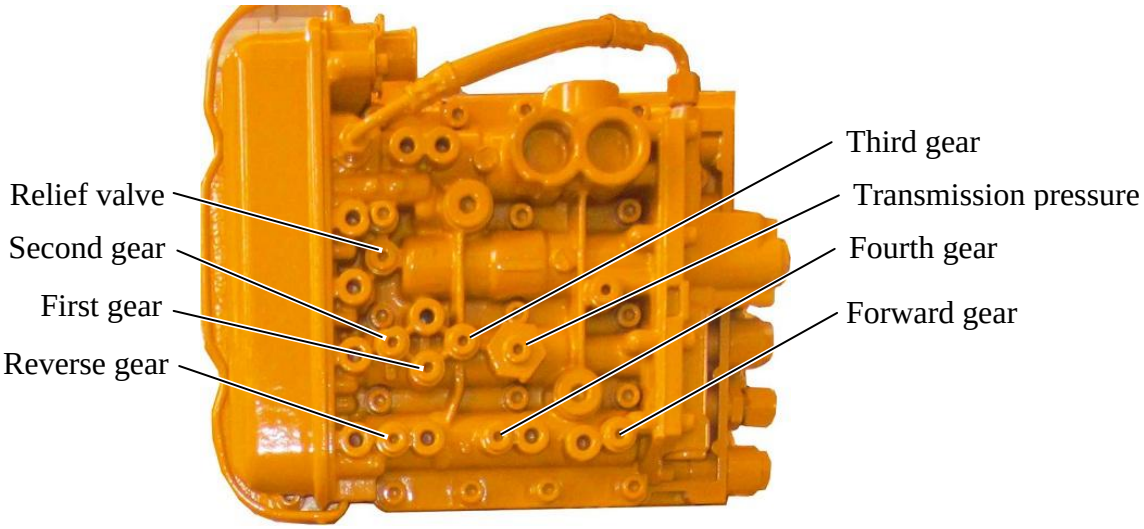


Figure 2-12

Standard pressure of all measuring ports: The pressure of the first gear and the second gear is 16bar; the pressure of the third gear and the fourth gear is 18bar, and the relief valve pressure is 10bar. The KV (forward)/KR (reverse) clutch pressure will change along with gear changes, and the transmission pressure is same as that of the corresponding gear.

2.1.4 Introduction to KD Key Functions (4WG158/200)

(1) KD (Kick-Down) function, namely the low gear shift function.

There is one button at the end of DW-2 gearshift handle, which is the KD key, and it can be used to decrease the vehicle speed to the first forward gear from the second forward gear.

(2) Brake power cutoff function of the first gear and the second gear.

In the electric control system, two pressure cutoff switches (one is the service brake pressure switch and one is the emergency/parking brake pressure switch) can be connected. When the driver steps down the foot brake pedal for brake; due to interaction between the brake pressure and the service brake pressure switch, the pressure switch will turn on the power circuit and the computer (namely the electric control box) circuit (equivalent to one electric signal of the computer), and then the computer will command the transmission control valve to act and cut off the pressure oil passage of the transmission clutch, namely the transmission power from the engine. In such case, all power of the engine will be transmitted to the working pump of the loader. Accordingly, when the first and second gears work, the working hydraulic system of the loader will have more sufficient power to perform excavation operation, thus improving the working efficiency of the working device.

In addition, when pressing down the emergency/parking brake button, the emergency/parking brake pressure switch will also act; the pressure switch will turn on the power circuit and the computer circuit, and then the computer will command the transmission control valve to act (namely the transmission power from the engine will be cut off in case of emergency brake), thus improving the brake effect.

(3) Neutral gear locking function and neutral gear start interlock function for vehicle safety improvement.

The gear control handle DW—2 is designed and installed at the lower left part of the steering wheel; if rotating the handle, the speed can be changed to the first, second, third and fourth gears, as shown in Figure 2-13. If pushing the control handle forwards, the vehicle will be driven forwards; if pushing the control handle backwards, the vehicle will be driven backwards; if the control handle stays at the neutral gear, the vehicle will keep still.

Figure 2-13 Gear Control Handle of 4WG200 Transmission

The neutral gear safety lock is used to avoid vehicle movement due to misoperation. When turning the safety lock to position “D”, the vehicle gear will be engaged for traveling; when turning the safety lock to position “N”, the vehicle will be locked at the neutral gear.

If engaging the neutral gear and rotating the locking button of the neutral gear safety lock of the gearshift handle to the locking position (at position “N”), the vehicle will be locked at the neutral gear to avoid gear engagement due to misoperation.

The engine can be started if engaging the neutral gear. When engaging the neutral gear and opening the electric lock, the gearshift handle will send an electric signal to the start interlock relay, and then the start circuit will be connected; or else, the engine can't be started.

(4) Working process of KD key of ZF transmission

With KD function (namely the forced low gear shift function), the loader working efficiency can be greatly enhanced. During operation, the loader will be started at the second gear and then driven at the third gear; when approaching to sand and stone material piles, the second gear will be engaged. In case of material excavation, if pressing down KD key (without rotating the gearshift handle), the vehicle speed will be automatically reduced to the first gear. When the bucket is full, pull the gearshift handle backwards to the reverse gear, and the vehicle can be automatically turned to the second reverse gear from the first forward gear.

When being driven backwards to a proper position, push the gearshift handle forwards to the forward gear and change speed according to following process: 2R → 2F → 3F → 2F. Before being driven to the dump truck and discharging materials onto the dump truck, change speed according to following process: 2F → 2R → 3R → 2R, and then the loader will return to the start point. KD function will be released after rotating the gearshift handle.

In case of material excavation, it is unnecessary to rotate the loader handle to select the speed gear, just perform operation according to steps shown in Figure 2-14:

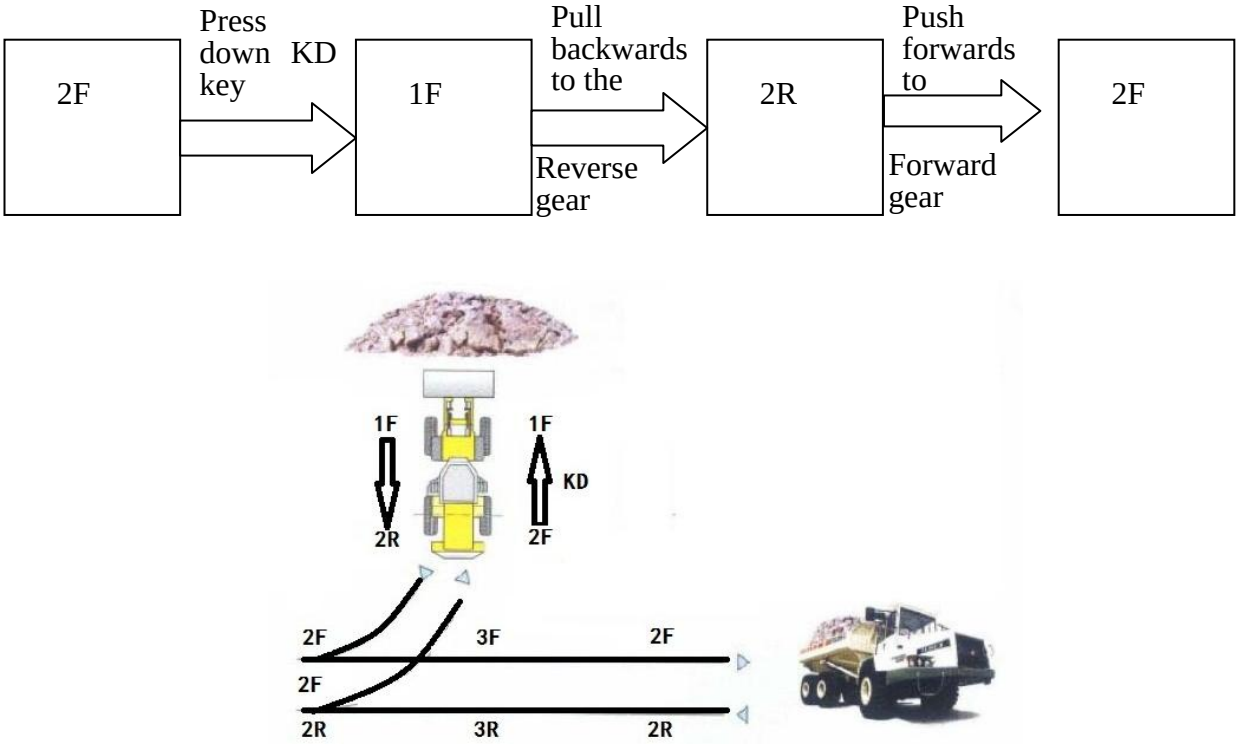


Figure 2-14

2.1.5 Operation and Maintenance of ZF Power Gearshift Transmission

1. Application precautions

(1) When checking the transmission oil level, the engine shall run at idle speed (about 1000 rpm) and the oil temperature shall be kept at the normal working temperature;

(2) When the oil temperature is 40℃, the oil level shall be between the middle and lower scale lines of the oil dipstick.

When the oil temperature is 80℃, the oil level shall be between the middle and upper scale lines of the oil dipstick.

(3) Strictly follow the maintenance requirements and periodically replace the transmission oil and the filter.

(4) Before starting the vehicle engine, ensure that the control handle is at the neutral gear.

(5) Before every traveling, loosen the parking brake (release the brake).

(6) In case of engaging or separating the engine and the transmission and lifting the transmission, try to avoid torque converter detachment.

(7) During parking, the gearshift handle shall be turned to the neutral gear.

(8) The normal working oil temperature shall be kept between 80—110℃; when bearing the heavy load, it can rise to 120℃ in a short time. It is necessary to pay special attention to the control oil pressure of the transmission. If transmission is discovered to be abnormal during use, it is necessary to stop the vehicle for check.

(9) When the vehicle has malfunction and needs electric welding maintenance, it is necessary to remove the cable plug on EST—computer controller (cut off the circuit leading to the computer controller); or else, the computer controller may be burnt due to impact current during electric welding.

2. Operation

(1) Preparations and maintenance before traveling

Before transmission operation, it is recommended to properly fill the lubricating oil with specified specification. In case of initial oil filling of the transmission, it is necessary to consider that the oil radiator, filter and connecting pipe shall be filled with oil. Accordingly, the lubricating oil in the first filling shall be much more than that for the subsequent normal maintenance. As the torque converter oil on the vehicle will flow to the transmission via the oil radiator and oil pipe under a stationary state, the oil level shall be correctly controlled under the thermal equilibrium temperature in case of neutral gear engagement upon parking, idle engine running and normal transmission operation.

The oil level can be tested when the control handle is turned to the neutral gear. When checking the oil level, it is necessary to insert the oil dipstick to the lower limit of the oil pipe. When cleaning the main oil circuit filter, pay attention that no dirt and sediment can enter into the oil circuit. In addition, it is necessary to place a cover plate to prevent the parking brake from oil immersion.

When installing the filter, it shall not be screwed down too tightly.

(2) Traveling and gear shift

In case of engine start, it is necessary to confirm that the gearshift handle is turned to the neutral gear. For the sake of safety, before engine start, the parking brake shall be in a brake

state, so as to ensure that the vehicle will not be started due to engine start. After engine start, release the parking brake; properly select the traveling direction and gear; slowly throttle up the vehicle for start. In case of vehicle traveling, the torque converter will replace the function of the main clutch. When the road conditions are good, the vehicle can be driven with a high gear.

If the vehicle is stopped but the engine still runs and the transmission gear is engaged, the engine will not be stopped. For some traction force may be produced when the engine passes the torque converter at idle speed, the vehicle may crawl on a straight pavement. The rational method is to turn the parking brake to a brake state upon each parking.

To park the vehicle for a long time, the control handle shall be turned to the neutral gear. During traveling, it is recommended to loosen the parking brake of the vehicle. From experience, we draw a conclusion that the operator is hard to immediately find out that: When the torque converter speed changes, due to large output torque ratio of the torque converter, the vehicle can overcome the brake torque and forcedly travel even under the normal operation conditions. The consequence is that the torque converter oil temperature will rise and the brake will become too hot.

Due to impact of the torque converter, when shifting to low speed gear from the high speed gear, the engine rotation speed will increase, specially the gear shift with skipping a grade. Accordingly, if conditions permit, when shifting to low speed gear from the high speed gear, firstly step down the foot brake; perform deceleration slowly and then shift gear. When the vehicle travels at high speed and the traveling direction is changed, it is necessary to reduce the engine rotation speed.

(3) Suspension and parking

As there is no rigid connection between the engine and the torque converter output shaft, when the vehicle is parked on the slope (upslope or downslope) while the driver wants to leave the vehicle, to avoid vehicle sliding, we recommend to apply the parking brake and place stop blocks under wheels.

(4) Dragging

The max. dragging speed is 10km/h and the max. dragging distance is 10km.

When the distance is longer, the vehicle with malfunction shall be placed on other vehicle for transportation.

(5) Oil temperature

The transmission oil temperature shall be monitored with the temperature sensor. The max. oil temperature of the torque converter outlet shall not be higher than 120℃; the normal control component and the transmission with sufficient traveling mileage will not have higher temperature. If the oil temperature is higher than 120℃, the vehicle shall be stopped for oil leakage check. And, the transmission shall be turned to the neutral gear and the engine shall run at 1200~1500rpm. In such case, the oil temperature will quickly reduce to the normal value (within about 2~3 min.). If the oil temperature doesn't fall down, it means that the system has malfunction, and operation can be continued after troubleshooting.

Normal gear shift oil pressure range: 1.6&1.8MPa (16~18bar). To monitor the control pressure, it is necessary to install a pressure gauge or pressure monitoring meter. In case of engaging

some gear and applying the clutch but the pressure drops to the min. pressure lower than the specified pressure (the pressure will quickly drop temporarily in case of gear shift), it is necessary to do troubleshooting. If the control pressure is too low, the clutch will be damaged, for the clutch without sufficient contact pressure will make the friction lining continuously slip and become too hot.

3. Maintenance

(1) Oil level check

—— Park the vehicle in a flat place

—— Turn the transmission gearshift handle to the neutral gear ("N") and the parking brake to the brake position.

—— Idly run the engine with about 1000rpm

—— Counterclockwise loosen the oil dipstick and then take it out and wipe it off

—— Insert the oil dipstick in the oil level pipe and screw it down; keep it for about 3s after reaching the target position, and then take it out (twice measurement at the least)

—— At 40℃, the oil level shall be between the lower scale "cold" and the middle scale

—— At 80℃, the oil level shall be between the upper scale "hot" and the middle scale

The cold vehicle oil level check is only to ensure that the transmission and the torque converter have sufficient circulating flow. The final standard to determine the oil level is to meet the hot vehicle oil level requirements.

★ **Attention**

If the oil level is lower than the min. scale, it is necessary to fill the recommended lubricating oil till the oil level rises to the correct scale range of the corresponding temperature (see Figure 2-15).

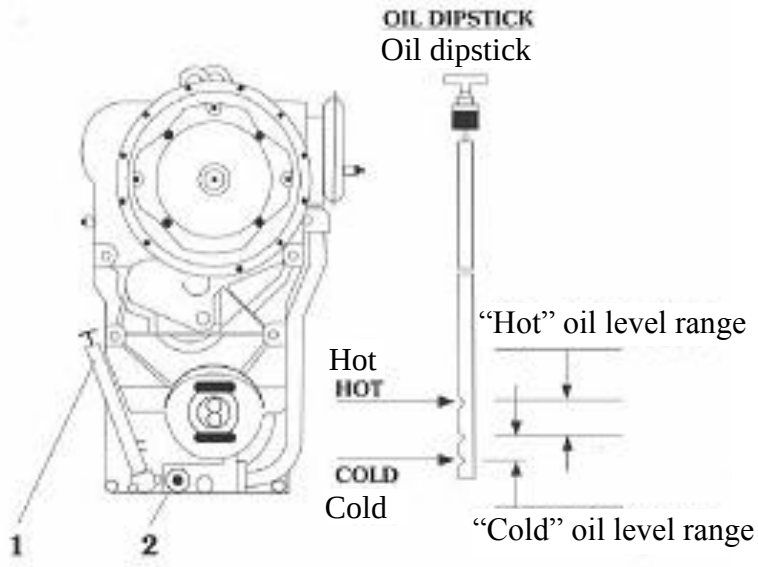
★ **Attention**

According to different types of transmissions, the oil dipstick and filler pipe will have different lengths and shapes. In addition, the filler pipe and transmission have two connection methods: One is to connect the filler pipe at the side of the torque converter and another is to connect the filler pipe at the brake side.

The following Figure shows the connection condition between the filler pipe (and the oil dipstick) and the transmission:

—Torque converter side

—Insert the oil dipstick and clockwise screw it down.



1. Oil filler with oil dipstick

2. Oil drain plug (M38×1.5)

Figure 2-15

(2) Oil replacement

When the vehicle reaches the first 100 working hours, the first oil replacement shall be done. After that, the oil replacement shall be done once every 1000 working hours or every year.

During oil replacement, it is recommended to stop the vehicle in a flat place; keep the transmission at the working temperature; take out the oil drain plug and seal ring, and drain out residual oil.

——Start the engine and run it at idle speed

——Turn the transmission control handle to the neutral gear ("N")

——Fill oil till reaching the upper scale in the "cold" oil area

——Turn the parking brake to the safe position

——Select all gears once

——Check the oil level again

——If necessary, fill oil again

—— At 40℃, the oil level shall be between the lower scale "cold" and the middle scale

——At 80℃, the oil level shall be between the upper scale "hot" and the middle scale

★ **Attention**

When you drain the oil out, the oil in the torque converter cooler should be drained out too.

Oil Replacement Period Table: Table 2-3

Part name	First oil replacement	Normal oil replacement	Oil product standard	Oil level check
Transmission	Upon 100 working hours, the filter shall also be replaced	Upon every 1000 working hours, not longer than one year, and the filter shall also be replaced	SAE15W40 Mobil Delvac Super 1300 or TITAN universal engine oil HD15W—40 (produced by Shanghai Desi Oil Product Company)	Before daily use

Other optional oil product: Table 2-4

Domestic oil grade	Kinematic viscosity (100℃) mm^2/s	Similar foreign oil product grade		
6# hydraulic transmission oil Q/SHO18.44.03-1994	5~7	CALTEX	ESSO	SHELL
		Torque fluid 175; RPM Torque fluid NO.5	Torque Fluid 47	Rotella 10 w

(3) Oil filter replacement

In case of each oil replacement, ZF coarse filter shall also be replaced. The replacement requirements are as follows:

——Coat the seal ring with a thin layer of oil

——Press down the filter till it contacts with the sealing surface of the transmission; after that, screw it down for 1/3 to 1/2 circles by hand

——Fill oil

——Start the engine

——When the engine idly runs (about 1000rpm) and the transmission oil has a working temperature, check the transmission oil level.

——When the oil temperature is 40℃, it shall be within the “cold” oil level range.

——When the oil temperature is 80℃, it shall be within the “hot” oil level range.

——Check if it is screwed down. If necessary, screw it down by hand again.

3 Transmission Removal

3.1 Transmission Assembly Removal

3.1.1 Torque Converter Removal

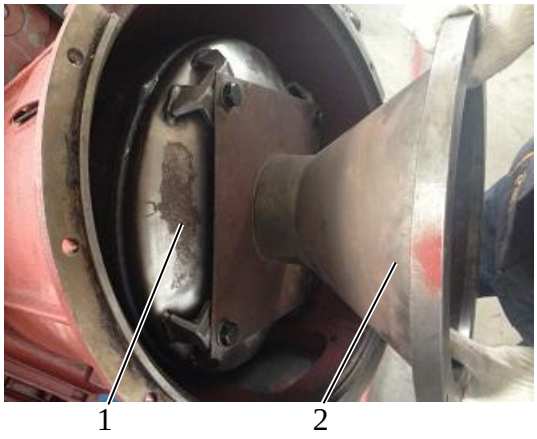


Figure 3-1

1 Torque converter

2 Intermediate ring

1. Pull out the intermediate ring and the torque converter from the transmission; completely drain out residual oil in the torque converter and place it aside.

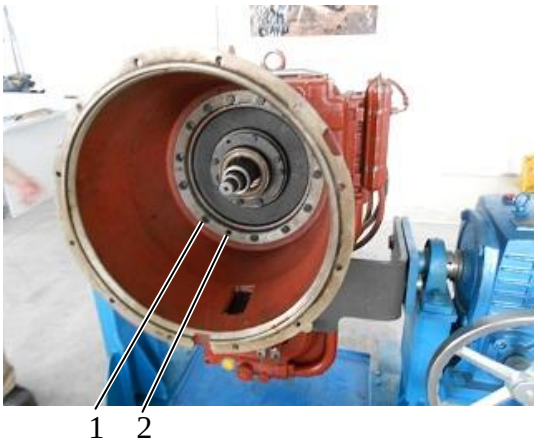


Figure 3-2

1 Hexagon screw (M10*50)×14

2 Tension pin

2. Remove the bolt connecting with the shell and the transmission.

Figure 3-3

1 Connecting shell

3. Adjust the transmission to a proper position; slightly knock the connecting shell periphery with the copper rod, and take down the connecting shell.

kg

★ **Attention**

Upon knocking, ensure that the force which is applied on the connecting shell periphery is uniform.

3.1.2 Transmission Control Valve Removal

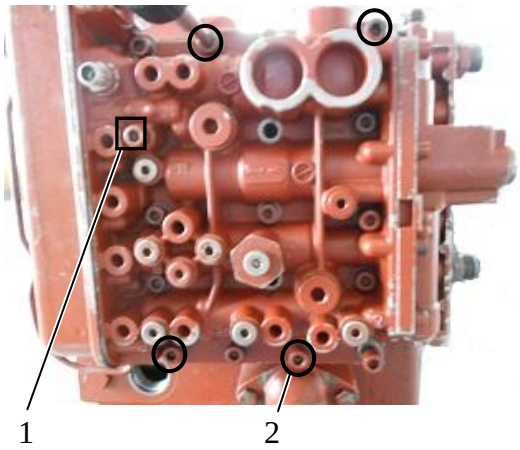


Figure 3-4

1 Head cap screw ×1

2 Head cap screw ×5

1. Take down 6 hexagon socket head cap bolts from the transmission control valve with the hexagon socket spanner.

★ **Attention**

Strictly follow the sequence of "From outside to inside and diagonal removal" to remove bolts.

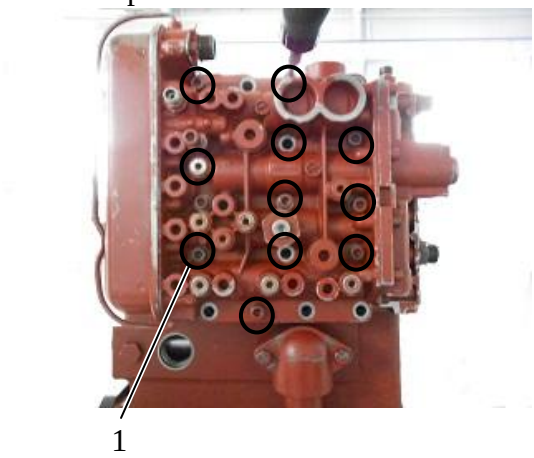


Figure 3-5

1 Head cap screw ×11

2. Respectively take down 11 hexagon socket head cap bolts from the transmission control valve with the hexagon socket spanner.

★ **Attention**

It is recommended to place two screws in the removed thread holes at the top, so as to avoid control valve sliding due to removal of the head cap screws.

Strictly follow the sequence of "From outside to inside and diagonal removal" to remove bolts.

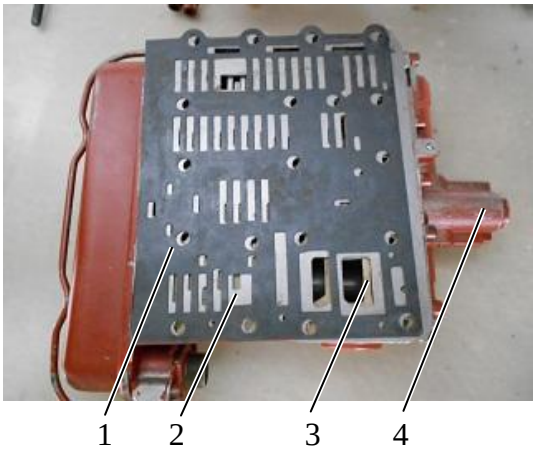


Figure 3-6

1 Valve pad 2 Cover plate

3 Paper pad 4 Transmission control valve

3. Take down the transmission control valve, paper pad, cover plate and valve pad.

★ **Attention**

After removing the transmission control valve, do well in its cleaning and protection.

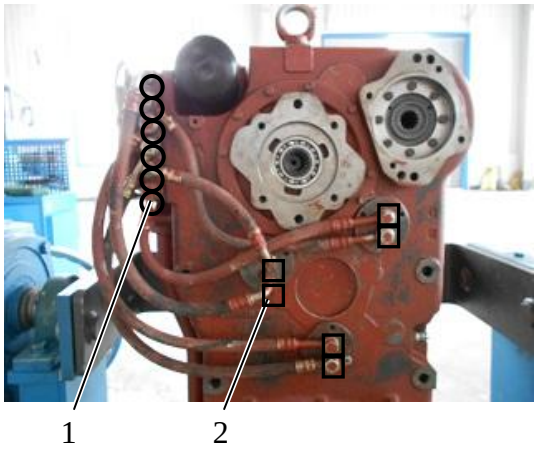


Figure 3-7

1 Oil pipe connector of the oil passage plate

2 Oil passage connector of the clutch shaft

4. Take down six oil pipes from the oil passage plate in turn, which are K2, K1, K3, K4, KR and KV from top to bottom. In addition, remove the oil passage connector on the clutch shafts and take down six oil pipes.

★ **Attention**

Do well in oil pipe connector protection, and mark the oil pipe number with the marker.

After removing the connectors, do well in their cleaning and protection.

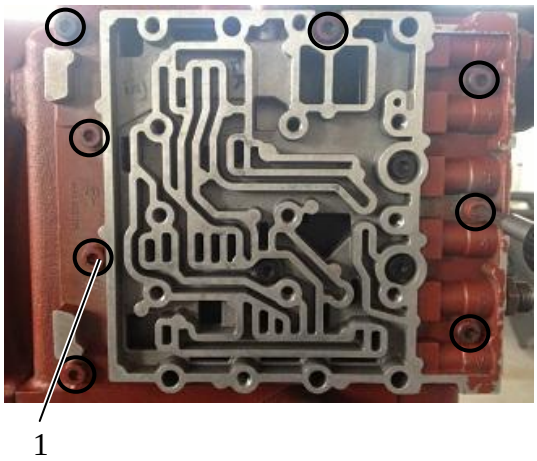


Figure 3-8

1 Head cap screw ×8

5. Take down 8 hexagon socket head cap bolts between the oil passage plate and the transmission.

★ **Attention**

Strictly follow the sequence of "From outside to inside and diagonal removal" to remove bolts.

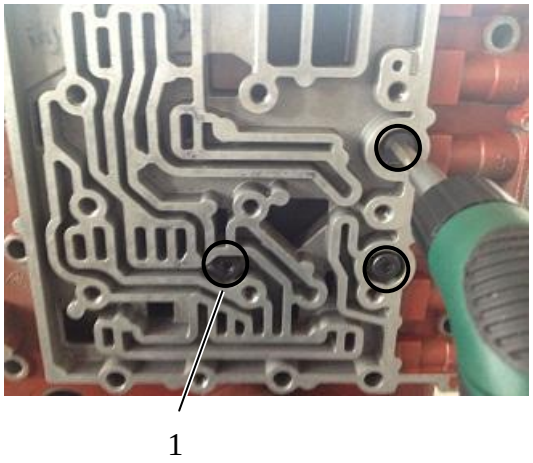


Figure 3-9

1 Head cap screw×3

6. Take down 3 hexagon socket head cap bolts between the oil passage plate and the transmission.

★ **Attention**

It is recommended to place two screws in the removed thread holes at the top, so as to avoid control valve sliding due to removal of the head cap screws.

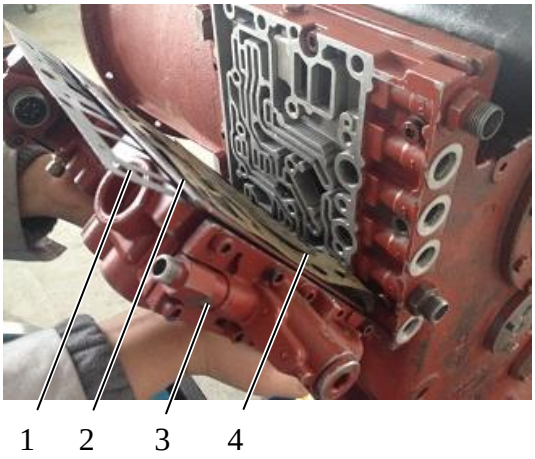


Figure 3-10

1 Packing 2 Cover plate

3 Oil passage plate 4 Paper pad

7. Take down the oil passage plate, packing 1, cover plate and paper pad.

★ **Attention**

After removing the oil passage plate, do well in its cleaning and protection.

Figure 3-11

8. The transmission control valve removal is completed.

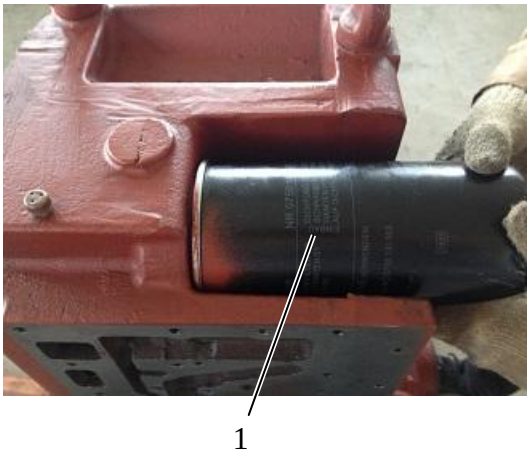


Figure 3-12

1 Oil filter

3.1.3 Oil Filter Removal

1. Rotate the oil filter with the belt spanner for removal.

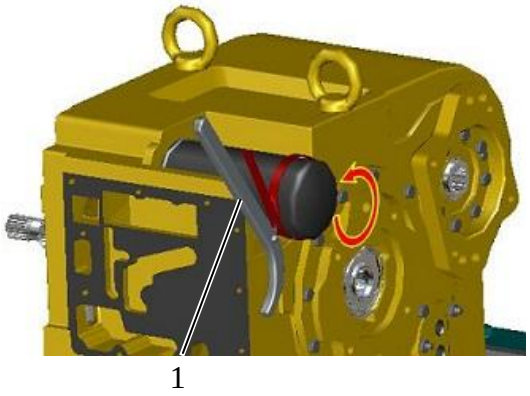


Figure 3-13

1 Belt spanner

2. After taking down the O-ring, the removal is completed.

Figure 3-14

1 O-ring

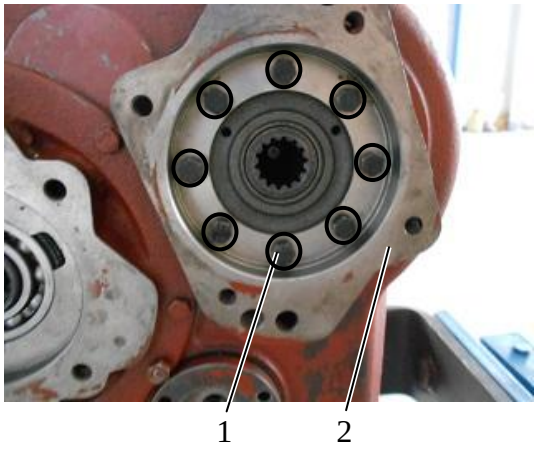


Figure 3-15

1 Hexagon head screw (M8*16)×8

2 Auxiliary PTO wheel hub

3.1.4 Removal of the Auxiliary PTO Wheel Hub

1. Take down the bolt between the auxiliary PTO wheel hub and the transmission body.

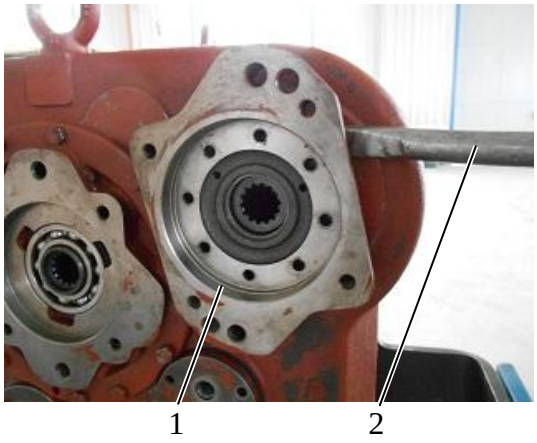


Figure 3-16

1 Auxiliary PTO wheel hub

2 Crowbar

2. After pushing out the wheel hub with the crowbar and taking down the PTO wheel hub and its seal ring, the removal is completed.

3.1.5 Input Device Removal

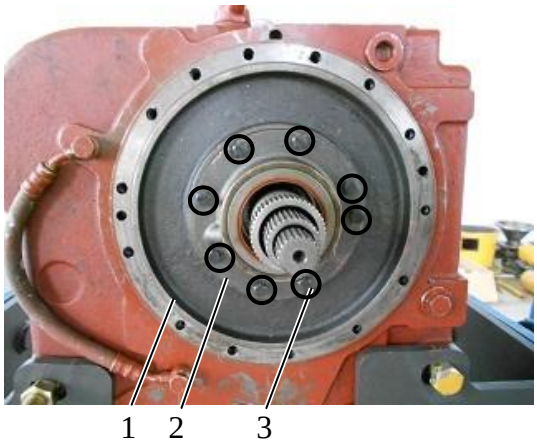


Figure 3-17

1 Oil feed flange 2 Pump impeller bearing seat

3 Hexagon head screw (M8*28)×8

1. Remove the hexagon bolts between the pump impeller bearing seat and the oil feed flange.

Figure 3-18

1 Copper rod

2 Pump impeller bearing seat

2. Slightly knock the bearing seat with the copper rod for loosening.

Figure 3-19

1 Pump impeller bearing seat

2 Packing

3. Take down the bearing seat and the packing.

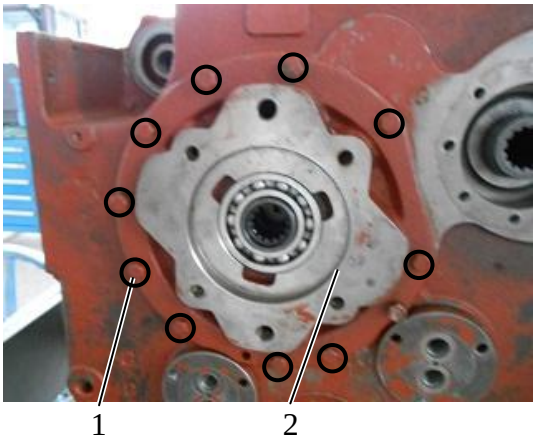


Figure 3-20

1 Hexagon head screw (M8*20)×10

2 Main PTO wheel hub

4. Take down the bolt between the main PTO wheel hub and the transmission body.

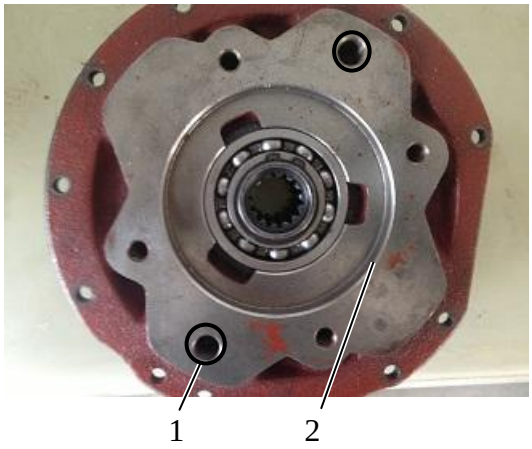


Figure 3-21

1 Shackle bolt mounting hole

2 Main PTO

5. Pull out the main PTO component with two shackle bolts (M20).

kg

★ Attention

During removal, the transmission shall be placed flatly; the PTO port shall face upwards and the force applied on two shackle bolts shall be uniform.

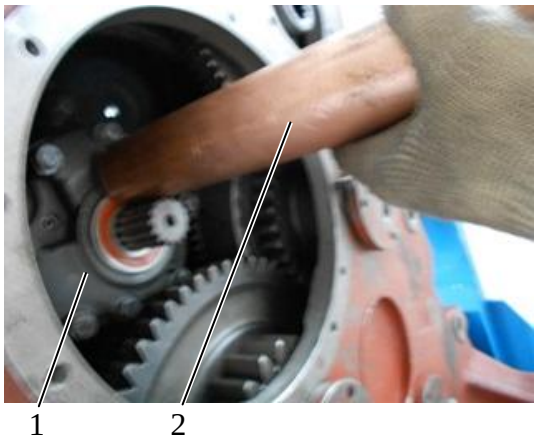


Figure 3-22

1 Variable speed pump component

2 Copper rod

6. Hold one about φ30*400mm copper rod by left hand to jack up the variable speed pump end cover, and hold another copper rod by right hand to knock out the oil feed flange and the variable speed pump component and place them aside.

kg

Attention

The copper rod shall be used to slightly knock the oil feed flange and the variable speed pump component, so as to avoid component slipping.

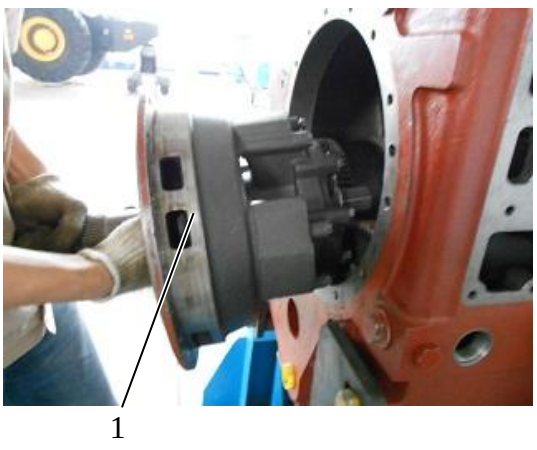


Figure 3-23

1 Input device

7. After taking down the input device, the removal is completed.

Attention

Slowly take down the input device to avoid slipping.

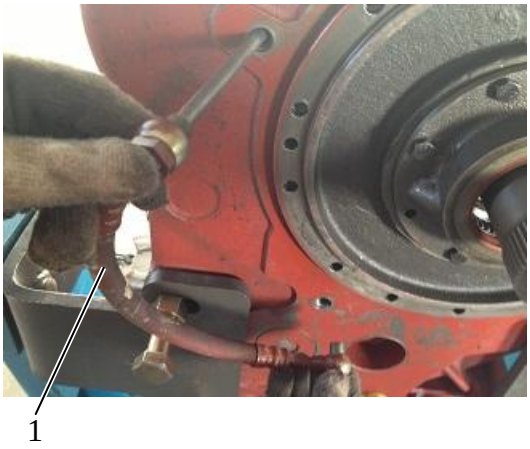


Figure 3-24

1 Lubricating oil pipe component

3.1.6 Removal of the Lubricating Oil Pipe Component and Auxiliary PTO

1. Respectively screw off hollow bolts (M18) at both ends of the transmission lubricating oil pipe and then take out the oil pipe.

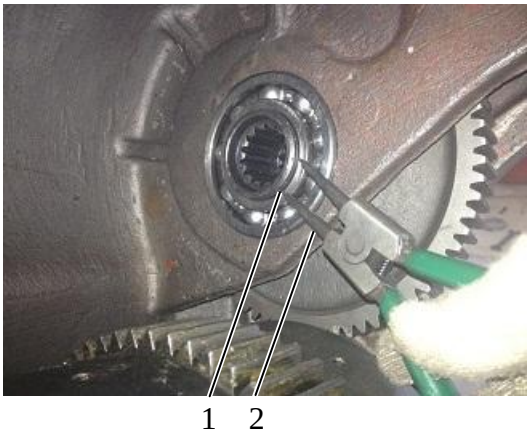


Figure 3-25

1 Snap ring (45*1.75)

2 Snap ring pliers

2. Take down the snap ring from the PTO shaft with the snap ring pliers.

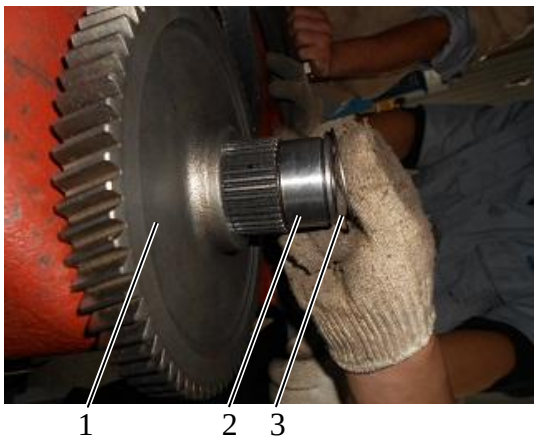


Figure 3-26

1 Driving gear 2 PTO shaft

3 Retainer ring (SW47)

3. Knock out the PTO shaft with the copper rod and take down the PTO driving gear.

Figure 3-27

1 Ball bearing

4. The auxiliary PTO removal is completed.

3.1.7 KVK1 Clutch Assembly Removal

1. Screw off two hexagon nuts on the KVK1 clutch shaft and pull out the clutch shaft with tooling.

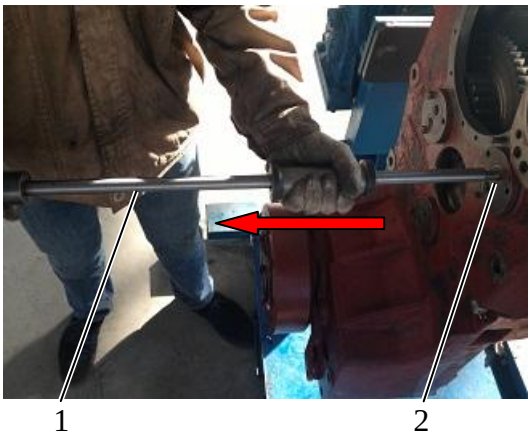


Figure 3-28

1 Clutch shaft removal tooling

2 KVK1 clutch shaft

2. Take down the thrust washer and the compensation washer from the KVK1 clutch shaft.

★ **Attention**

When taking down the thrust washer and the compensation washer, the transmission shall be placed flatly to prevent the washer falling down to the bottom of the transmission body.

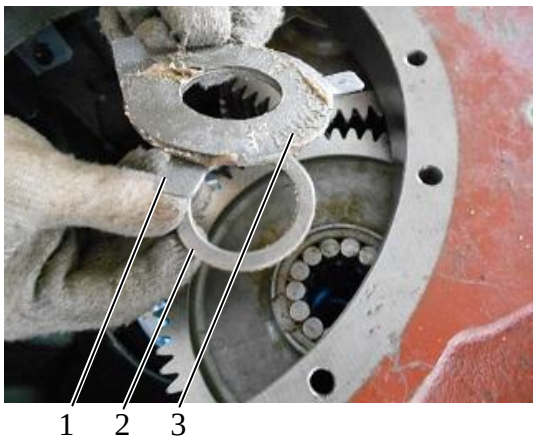


Figure 3-29

1 Thrust washer 2 Thrust washer

3 Compensation washer

Figure 3-30

1 KVK1 clutch assembly

2 Transmission body

3. Take out the KVK1 clutch assembly from the transmission body.

kg

Attention

When taking out the clutch assembly, place the transmission in a proper position, and the operation shall be slow to avoid slipping.

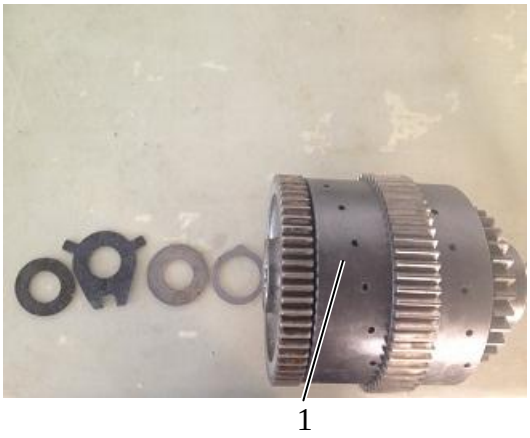


Figure 3-31

1 KVK1 clutch assembly

4. The KVK1 clutch assembly removal is completed.

Attention

Mark the KVK1 clutch with the marker for convenient distinguishing.

3.1.8 KRK2 Clutch Assembly Removal

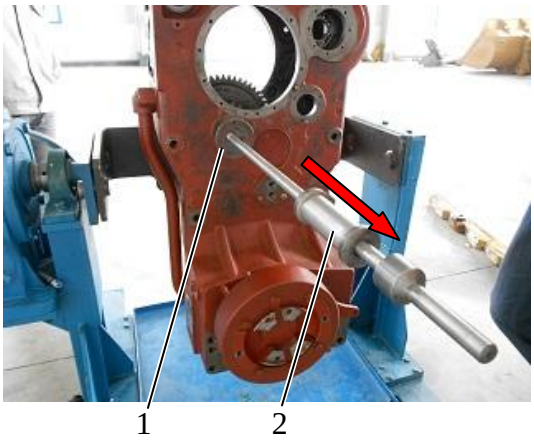


Figure 3-32

1 Hexagon nut (M8)

2 Clutch shaft removal tooling

1. Screw off two hexagon nuts from the KRK2 clutch shaft and pull out the clutch shaft with the tooling.

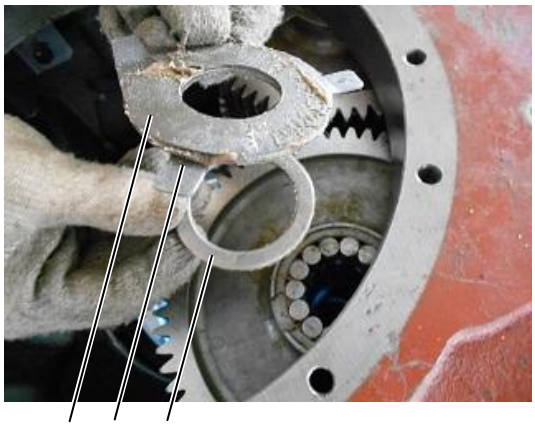


Figure 3-33

1 Compensation washer 2 Thrust washer

3 Thrust washer

2. Take down the thrust washer and the compensation washer from the KRK2 clutch shaft.

★ **Attention**

When taking down the thrust washer and the compensation washer, the transmission shall be placed flatly to prevent the washer falling down to the bottom of the transmission body.

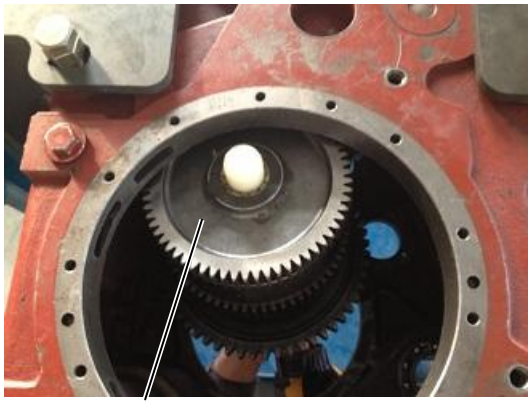


Figure 3-34

1 KRK2 clutch assembly

3. Take out the KRK2 clutch assembly from the transmission body.

★ **Attention**

When taking out the clutch assembly, place the transmission in a proper position, and the operation shall be slow to avoid slipping.

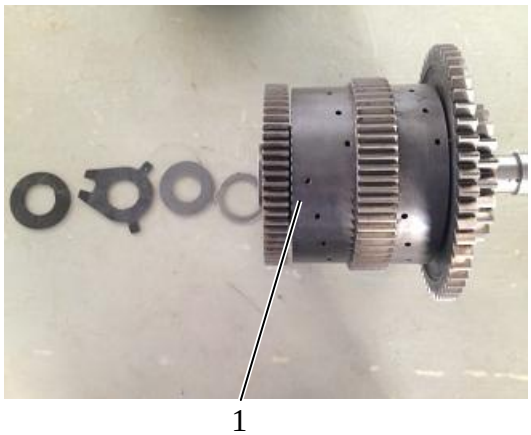


Figure 3-35

1 KRK2 clutch assembly

4. The KRK2 clutch assembly removal is completed.

★ **Attention**

Mark the KRK2 clutch with the marker for convenient distinguishing.

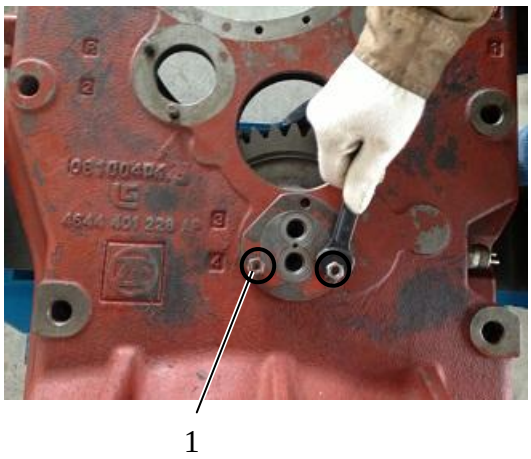


Figure 3-36

1 Hexagonal nut (M8)×2

3.1.9 K3K4 Clutch Assembly Removal

1. Remove two hexagon nuts from the K3K4 clutch shaft.

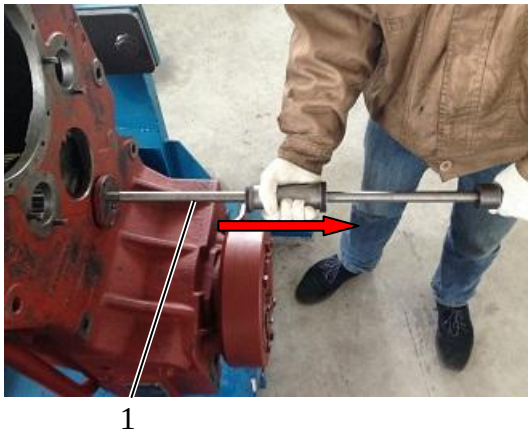


Figure 3-37

1 Clutch shaft removal tooling

2. Pull out the clutch shaft with the tooling.

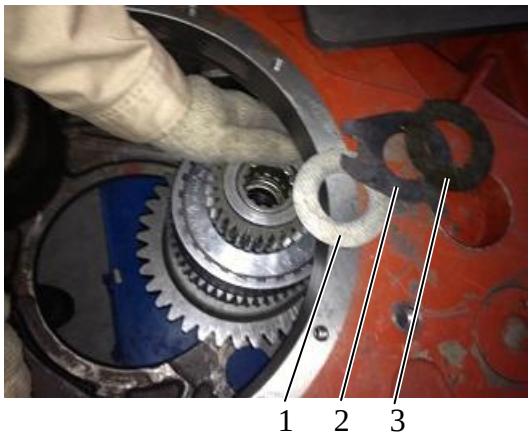


Figure 3-38

1 Thrust washer 2 Thrust washer

3 Compensation washer

3. Take down the thrust washer and the compensation washer from the K3K4 clutch shaft.

★ **Attention**

When taking down the thrust washer and the compensation washer, the transmission shall be placed flatly to prevent the washer falling down to the bottom of the transmission body.

Figure 3-39

1 K3K4 clutch assembly

2 Clutch shaft positioning tooling (29380017611)

4. Take out the K3K4 clutch assembly from the transmission body.

kg

Attention

When taking out the clutch assembly, hold the clutch assembly with the clutch shaft positioning tooling, and the operation shall be slow to avoid slipping.

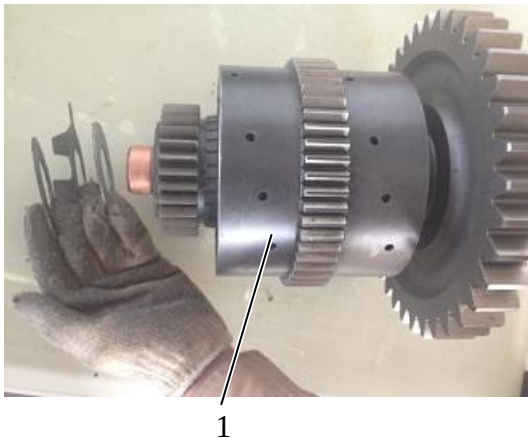


Figure 3-40

1 K3K4 clutch assembly

5. The K3K4 clutch assembly removal is completed.

Attention

Mark the K3K4 clutch with the marker for convenient distinguishing.

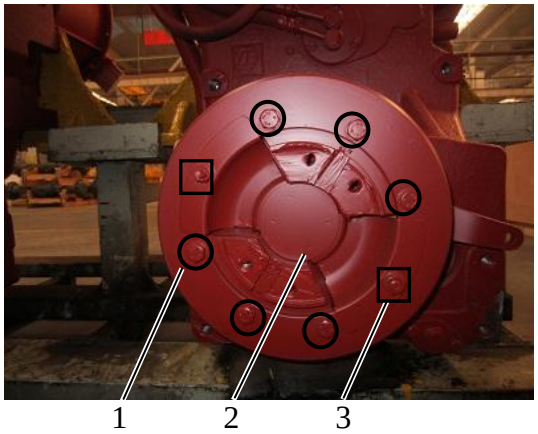


Figure 3-41

1 Hexagon head screw (M10*25)×6

2 butterfly pressure plates

3 Nut (M10)×2

3.1.10 Removal of the Parking Brake and the Output Device

1. Remove the bolt and washer between the brake wheel hub and the brake flange.

Attention

After taking down the wheel hub, connect 2 bolts (M10*25) between the butterfly pressure plate and the brake wheel hub.

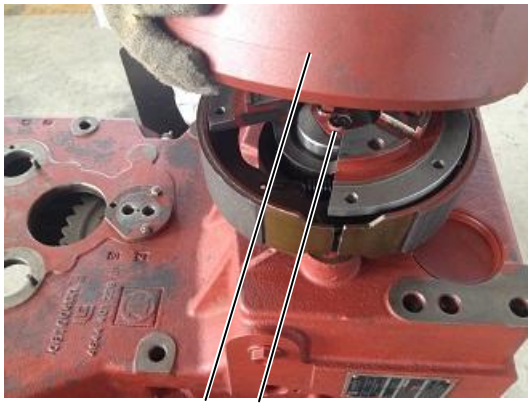


Figure 3-42

1 Brake wheel hub

2 Lock washer

2. Take down the brake wheel hub and remove the lock washer.

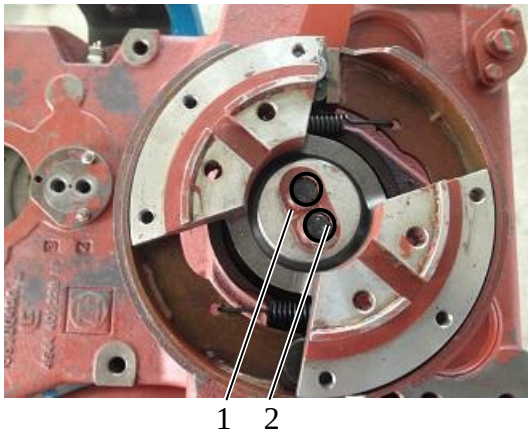


Figure 3-43

1 Lock washer

2 Hexagon head screw (M10*30)×2

3. Remove the bolt between the pressure plate and the output flange.

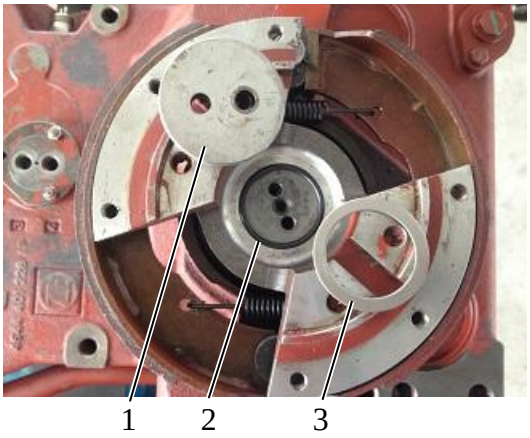


Figure 3-44

1 Pressure plate 2 O-ring

3 Distance washer

4. Take down the pressure plate, distance washer and O-ring.

Figure 3-45

1 Brake flange

2 Fixing plate

5. Remove the brake flange and the fixing plate.

Figure 3-46

1 Brake drum wheel

2 Drum wheel tension spring

6. Remove the brake drum wheel.

Attention

When removing the drum wheel, the force shall be slow and sufficient, and protection measures shall be taken to avoid spring detachment.

Figure 3-47

1 Oil seal

7. Take out the oil seal from the output device.

Attention

When taking out the oil seal, the force shall be uniform and sufficient to avoid damages. And, the special removal tooling can also be used.

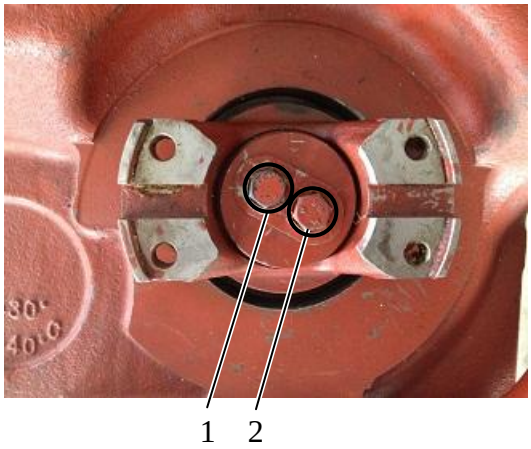


Figure 3-48

1 Lock washer

2 Hexagon head screw (M10*30)×2

8. Take down the lock washer and remove the bolt between the pressure plate and the output flange.

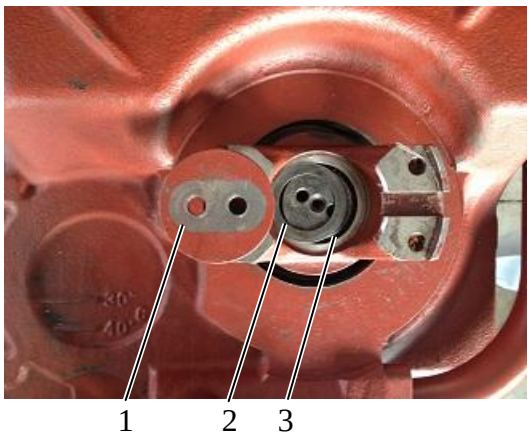


Figure 3-49

1 Pressure plate 2 Distance washer

3 O-ring

9. Take down the pressure plate, distance washer and O-ring in turn.

Figure 3-50

1 Output flange

10. Take down the output flange.

Figure 3-51

1 Oil seal

11. Take down the oil seal.

★ **Attention**

When taking out the oil seal, the force shall be uniform and sufficient to avoid damages. And, the special removal tooling can also be used.

Figure 3-52

1 Snap ring (120*4)

2 Compensation washer

12. Remove the front end bearing snap ring and compensation washer of the output shaft with the snap ring pliers.

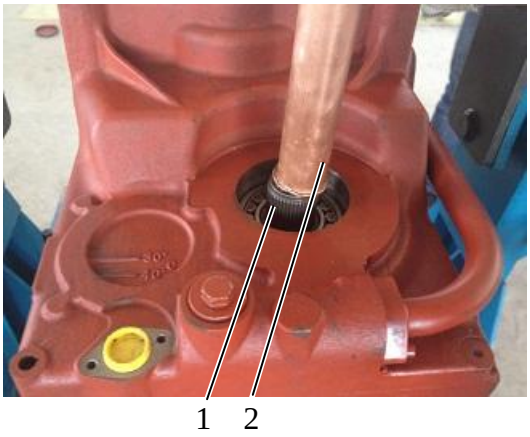


Figure 3-53

1 Rear end of the output shaft

2 Copper rod

13. Knock the rear end of the output shaft with the copper rod.

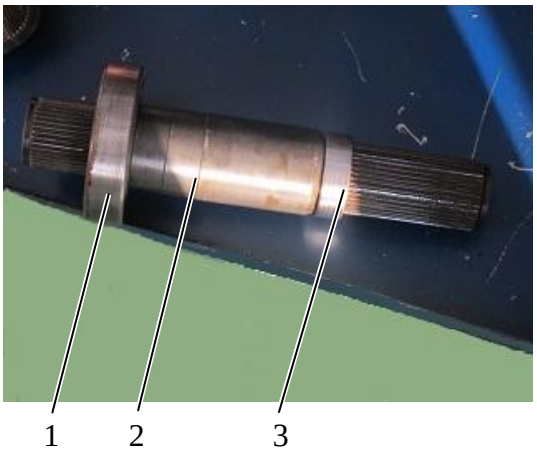


Figure 3-54

1 Bearing 2 Output shaft

3 Shaft sleeve

14. Take down the output shaft, bearing and shaft sleeve.

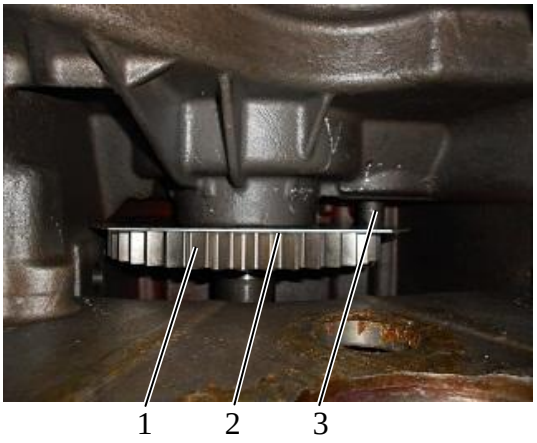


Figure 3-55

1 Output gear 2 Connecting retainer

3 Hexagon head screw (M8*16)×2

15. Take out the output gear and remove the bolt between the retainer, oil shield and transmission body.

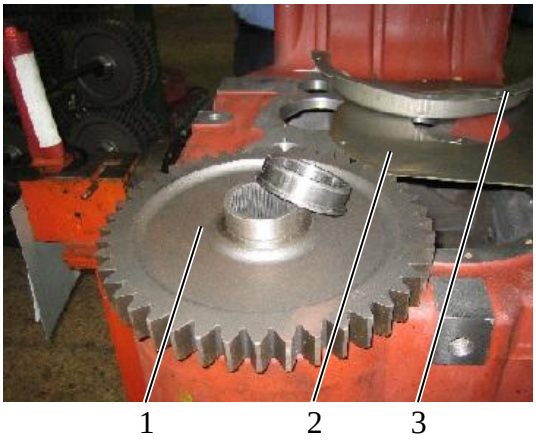


Figure 3-56

1 Output gear 2 Oil shield

3 Retainer

16. Take out the oil shield and the retainer.

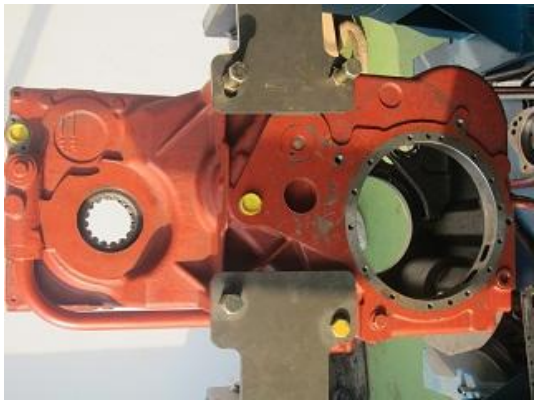


Figure 3-57

17. The removal is completed.

3.1.21 Intermediate Shaft Assembly Removal

Figure 3-58

1 Sealing washer

1. Remove the sealing washer.

Figure 3-59

1 Head cap screw

2. Remove the bolt between the intermediate shaft and the transmission body.

Figure 3-60

1 Intermediate shaft

2 O-ring

3. Take out the intermediate shaft and the O-ring.

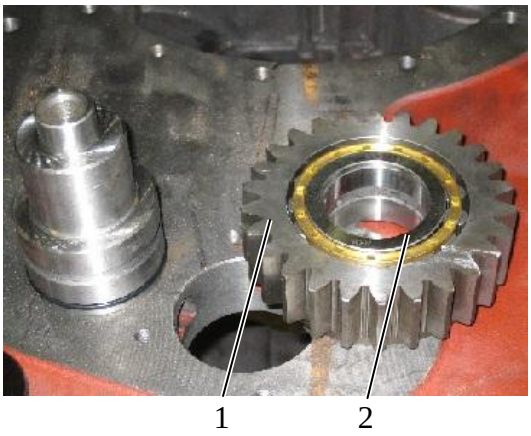


Figure 3-61

1 Intermediate shaft gear

2 Roller bearing

4. After taking out the intermediate shaft and the bearing component, the removal is completed.

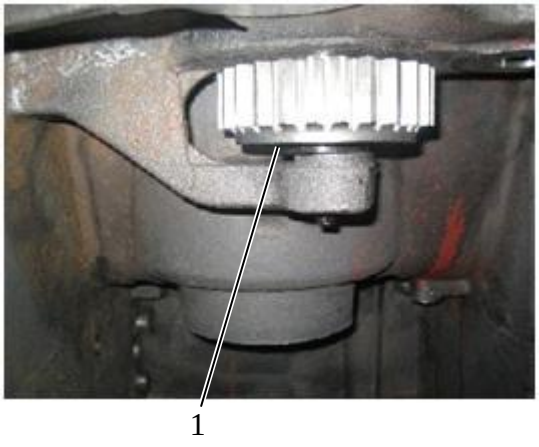


Figure 3-62

1 Thrust washer

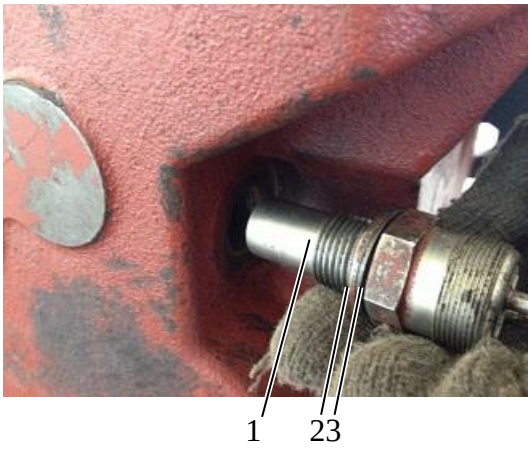


Figure 3-63

1 Rotation speed sensor

2 Adjustable washer 3 Seal ring

3.1.22 Removal of the Output Shaft Rotation Speed Sensor

1. Remove the rotation speed sensor from the transmission body and take down the adjustable washer and the seal ring.

Figure 3-64

1 Seal cover

3.1.23 Removal of the Seal Cover of the Transmission Body

1. Take down the seal cover from the transmission body.

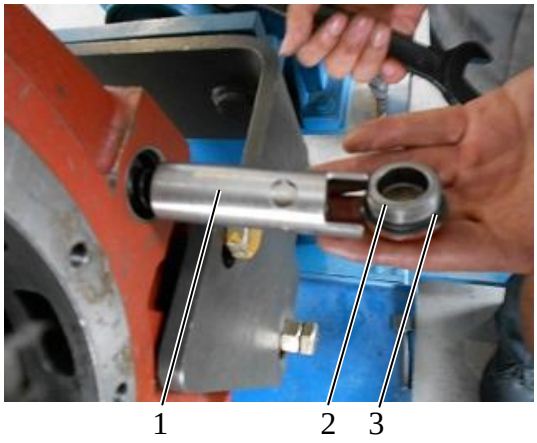


Figure 3-65

1 Valve sleeve component

2 Screw plug (CM30*1.5) 3 O-ring

3.1.24 Removal of the Torque Converter Pressure Regulating Valve

1. Remove the screw plug fixing the valve sleeve component.

Figure 3-66

1 Pressure spring 2 Valve stem

3 Valve sleeve

2. After taking out the valve sleeve components (valve sleeve, valve stem, pressure spring and gasket) from the torque converter pressure valve hole of the transmission body, the removal is completed.

3.2 Transmission Assembly Component Removal

3.2.1 Main PTO Removal

1. Remove the retainer ring fixing the driving gear on the PTO shaft with the snap ring pliers.

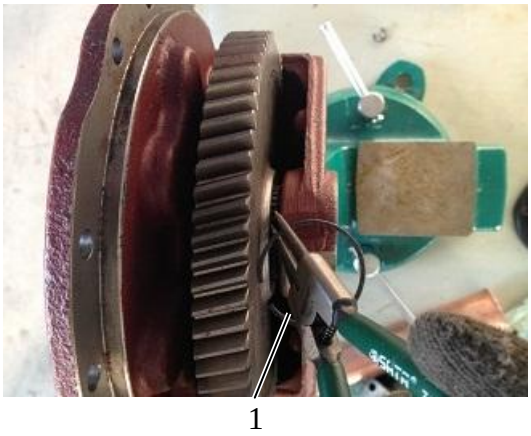


Figure 3-67

1 Retainer ring (SW47)

2. Remove the snap ring fixing the inner ring of the ball bearing on the PTO shaft.

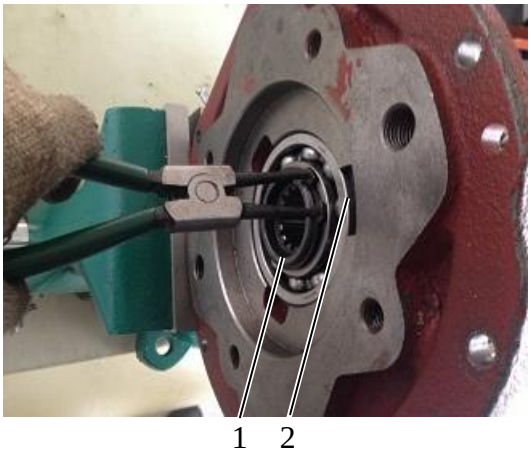


Figure 3-68

1 Snap ring (45*1.75)

2 Ball bearing

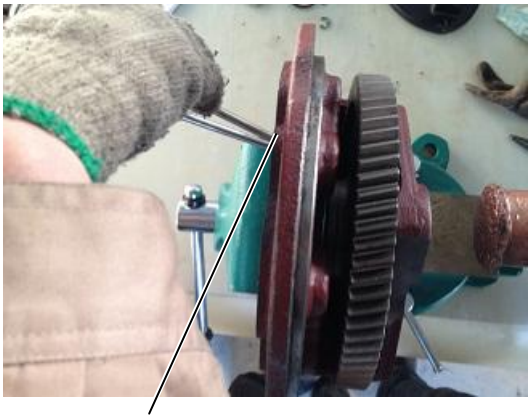


Figure 3-69

1 Elastic retainer ring (SP85)×2

3. Expand and fix the ball bearing elastic retainer ring with the screwdriver and knock the PTO shaft from another side.

Figure 3-70

1 Driving gear 2 PTO shaft

3 Ball bearing

4. Take down the driving gear, PTO shaft and ball bearing.

Figure 3-71

1 Retainer ring (SB52)

2 Needle bearing

5. After taking down two retainer rings fixing the needle bearing on the PTO wheel hub and removing two elastic retainer rings fixing the ball bearing, the removal is completed.

Figure 3-72

1 Input component

3.2.2 Input Component Removal

1. Remove 4 bolts between the variable speed pump and the oil feed flange.

Figure 3-73

1 Hexagon head screw (M8*85)×4

2. Remove 4 bolts between the variable speed pump and the oil feed flange.

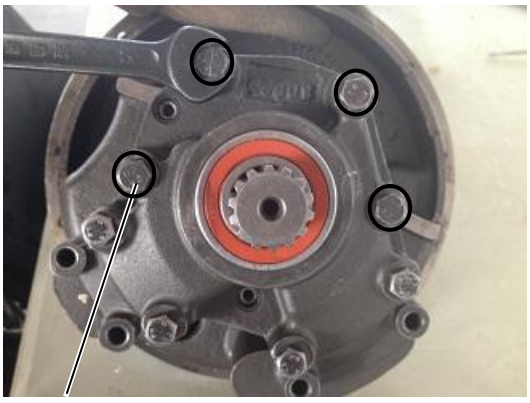
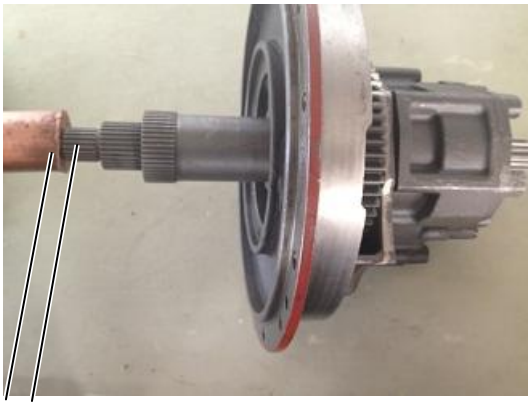


Figure 3-74

1 Hexagon head screw (M8*115)×4



1 2

Figure 3-75

1 Copper rod

2 Output shaft

3. Knock the output shaft with the copper rod to knock out the variable speed pump.

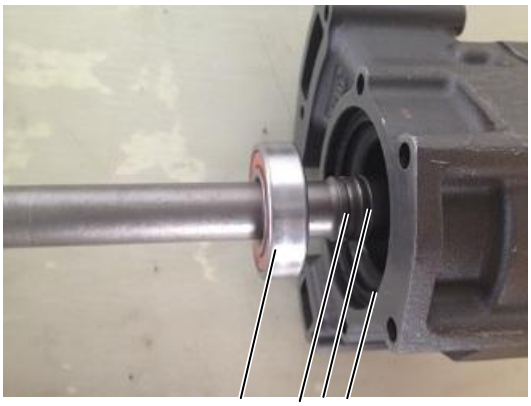
1 2

Figure 3-76

1 Hexagon head screw ×4

2 Output shaft

4. Take down the variable speed pump, packing and output shaft and remove the bolt between the variable speed pump cover and the variable speed pump shell.



1 2 3 4

Figure 3-77

1 Ball bearing 2 Piston ring (30 ×2)

3 Snap ring (30 ×1.5)

4 Compensation washer

5. Take down the bearing snap ring from the output shaft with the snap ring pliers and remove the ball bearing, piston ring and compensation washer.

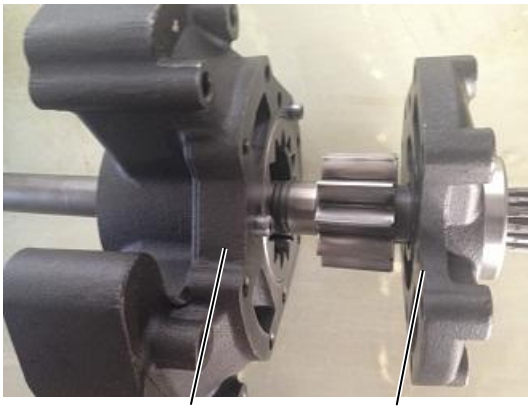


Figure 3-78

1 Variable speed pump shell

2 Variable speed pump cover

6. Knock the output shaft with the copper rod and take down the variable speed pump cover, internal gear and other component.

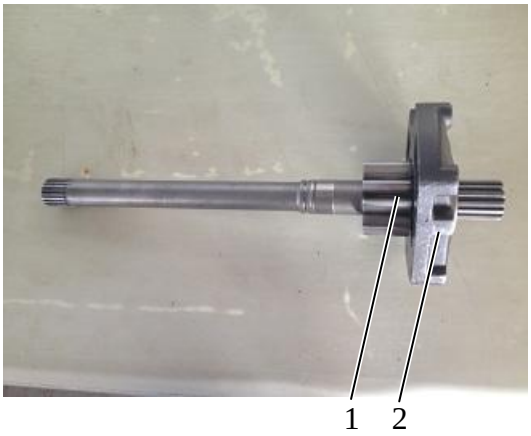


Figure 3-79

1 Internal gear of the variable speed pump

2 Variable speed pump cover

7. Remove the internal gear of the variable speed pump, output shaft, variable speed pump cover and ball bearing.

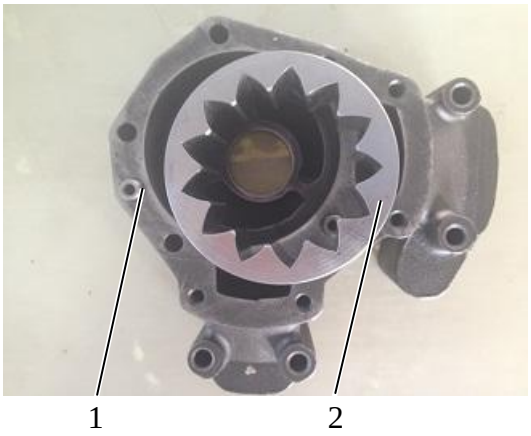


Figure 3-80

1 Variable speed pump shell

2 External ring gear

8. Take out the external ring gear of the variable speed pump.

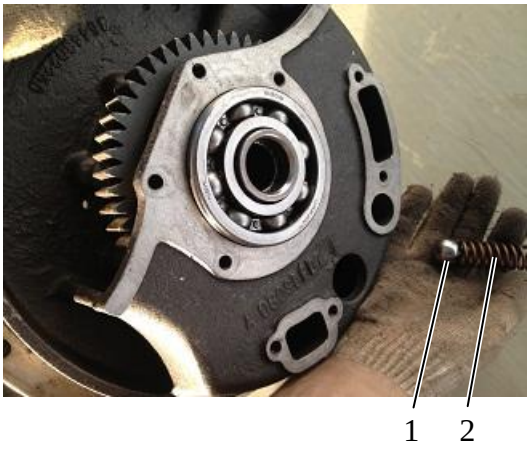


Figure 3-81

1 Steel ball

2 Pressure spring

9. Take down the safety valve of the oil inlet of the torque converter on the oil feed flange, steel ball and pressure spring.

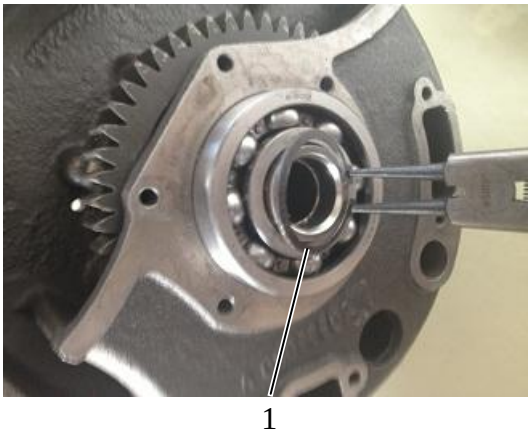


Figure 3-82

1 Snap ring

10. Take down the snap ring fixing the ball bearing on the drive shaft with the snap ring pliers.

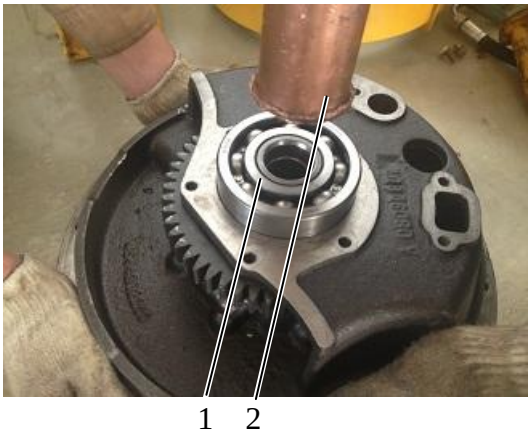


Figure 3-83

1 Drive shaft

2 Copper rod

11. Knock the drive shaft with the copper rod for removal.

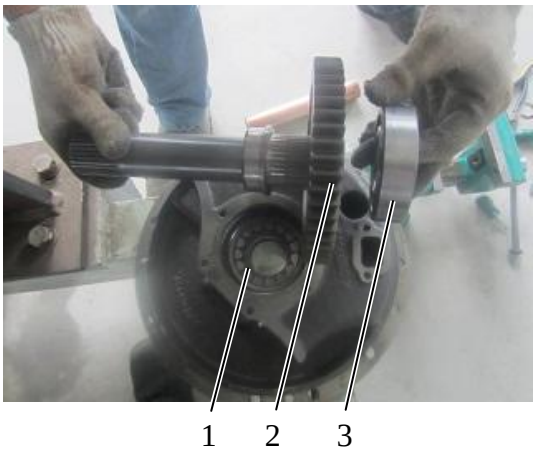


Figure 3-84

1 Roller bearing 2 Driving gear

3 Ball bearing

12. Take down the driving gear, ball bearing and roller bearing.

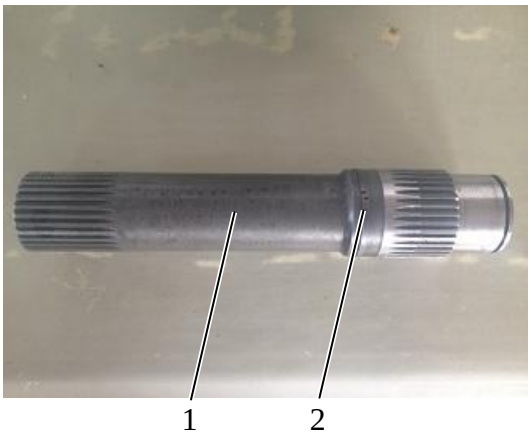


Figure 3-85

1 Drive shaft

2 Plunger ring

13. Remove the plunger ring from the drive shaft.

3.2.3 KVK1 Clutch Removal

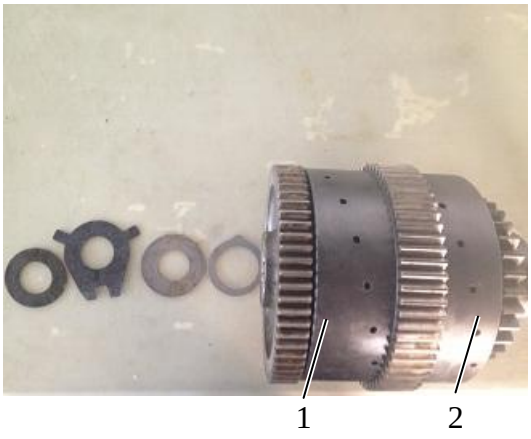


Figure 3-86

1 KV clutch assembly

2 K1 clutch assembly

1. Take down the compensation washer and thrust washer of the KVK1 clutch.

Figure 3-87

1 Compensation washer 2 Thrust washer

3 Thrust washer 4 Thrust washer

2. Take down the roller of the roller bearing on the KV clutch gear.

Figure 3-88

1 Roller×14

3. Take down the washer of the KV clutch gear roller bearing.

Figure 3-89

1 Roller bearing washer

Figure 3-90

1 Roller×14

4. Take down the roller of the roller bearing on the KV clutch gear.

Figure 3-91

1 Thrust washer

2 KV clutch gear

5. Take down the KV clutch gear and bearing thrust washer.

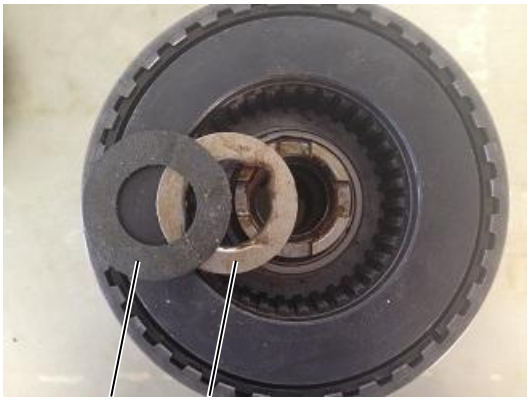
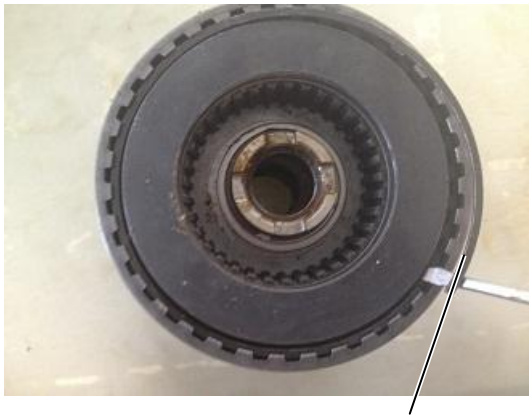


Figure 3-92

1 Thrust washer

2 Thrust washer

6. Take down the thrust washer from the KV clutch.



7. Take down the elastic retainer ring fixing the KV clutch bearing plate.

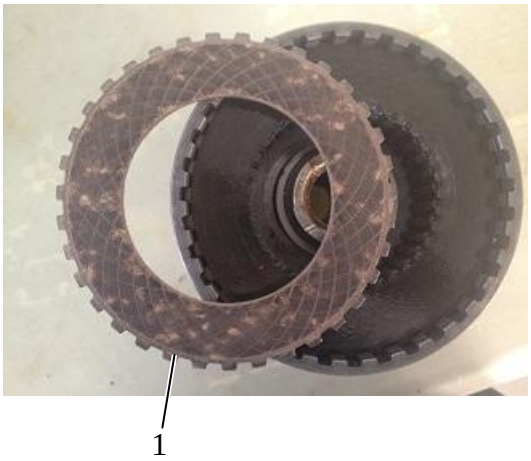
Figure 3-93

1 Elastic retainer ring

8. Take down the bearing plate of the KV clutch friction lining.

Figure 3-94

1 Bearing plate



9. Take out the external friction lining of the KV clutch.

Figure 3-95

1 External friction lining

Figure 3-96

1 Internal friction lining

10. Take out the internal friction lining of the KV clutch.

Figure 3-97

11. Take out the external and internal friction linings and place them aside.

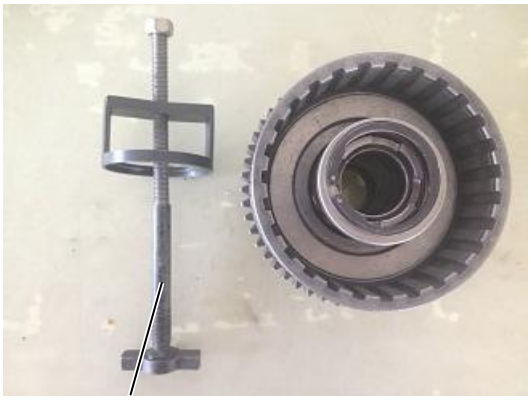


Figure 3-98

1 Clutch spring removal tooling (29380017591) (29380017601)

12. Install the clutch spring removal tooling onto the clutch.

Figure 3-99

1 Pressure spring

13. Screw down the nut on the clutch tooling and press down the clutch spring.

Figure 3-100

1 Retainer ring

14. Take down retainer ring fixing the pressuring spring of the KV clutch with the snap ring pliers.

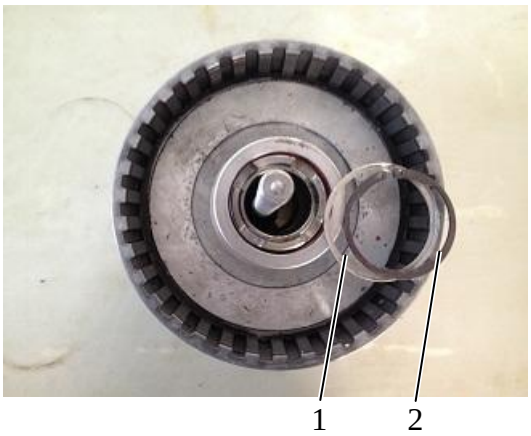


Figure 3-101

1 Guide ring

2 Retainer ring

15. Take down the retainer ring and the guide ring.

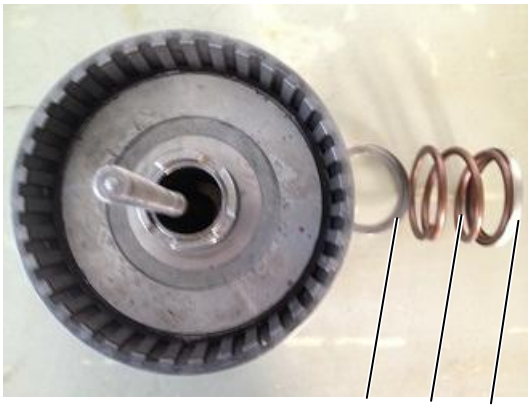


Figure 3-102

1 Lower guide ring 2 Pressure spring

3 Upper guide ring

16. Take out the pressure spring and guide ring of the KV clutch.

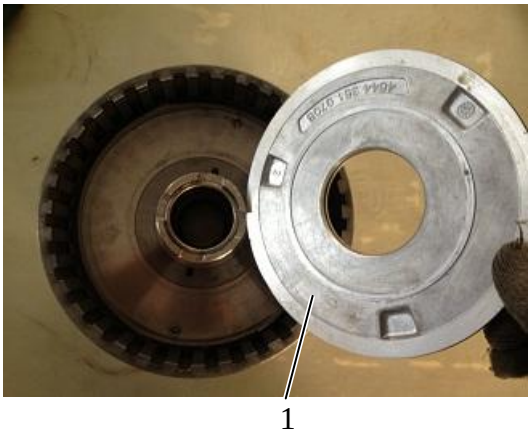


Figure 3-103

1 KV clutch piston

17. Take out the KV clutch piston.

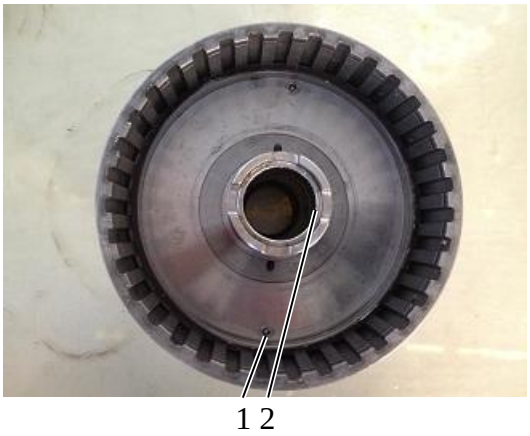


Figure 3-104

1 Check valve

2 Needle bearing

18. Remove the needle bearing of the KV clutch.

Figure 3-105

1 Adjustable washer

2 Snap ring (75*2.5)

19. Take down the snap ring fixing the K1 clutch gear bearing with the snap ring pliers and take down the adjustable washer and the bearing component.

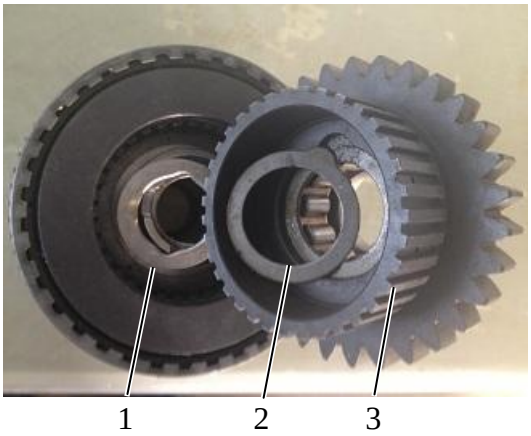


Figure 3-106

1 Thrust washer 2 Thrust washer

3 K1 clutch gear

20. Take down the gear and thrust washer of the K1 clutch.

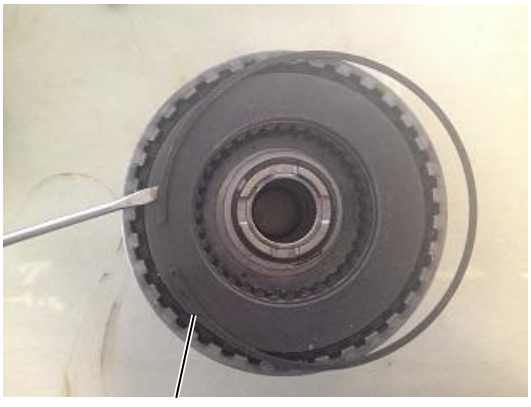


Figure 3-107

1 Elastic retainer ring

21. Take down the elastic retainer ring fixing the K1 clutch bearing plate.

Figure 3-108

1 K1 clutch bearing plate

22. Take down the bearing plate of the K1 clutch friction lining.

Figure 3-109

1 External friction lining

23. Take out the external friction lining of the K1 clutch.

Figure 3-110

1 Internal friction lining

24. Take out the internal friction lining of the K1 clutch.

Figure 3-111

25. Take out the external and internal friction linings and place them aside.

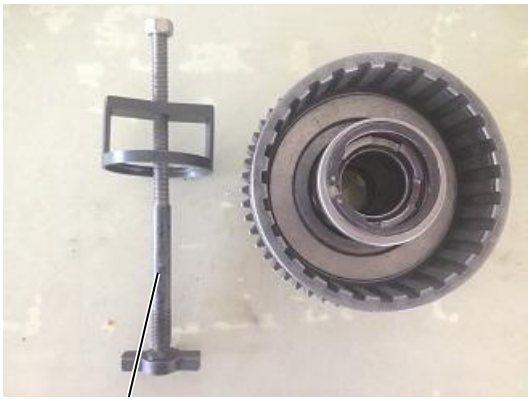


Figure 3-112

1 Clutch spring removal tooling (29380017591) (29380017601)

26. Install the clutch spring removal tooling onto the clutch.

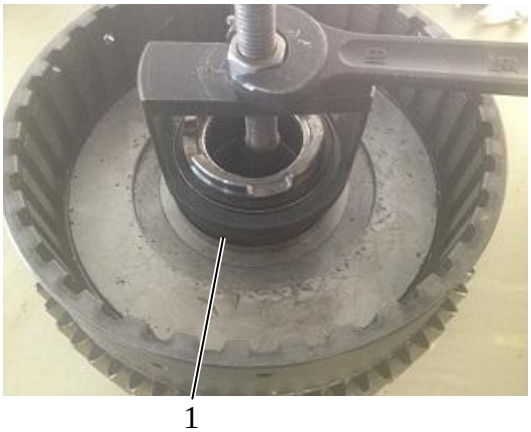


Figure 3-113

1 Pressure spring

27. Screw down the nuts on the clutch tooling and press down the clutch spring.

Figure 3-114

1 Retainer ring

28. Take down the retainer ring fixing the K1 clutch pressure spring with the snap ring pliers.

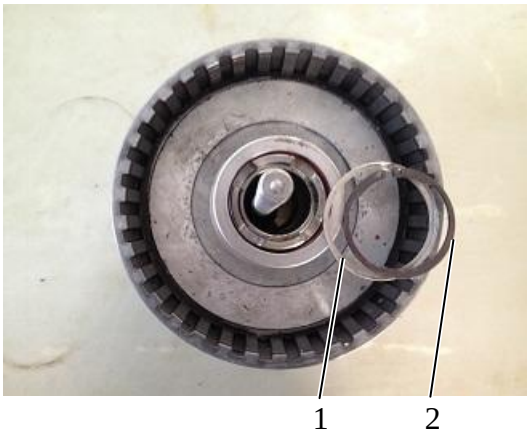


Figure 3-115

1 Guide ring

2 Retainer ring

29. Take out the retainer ring and the guide ring.

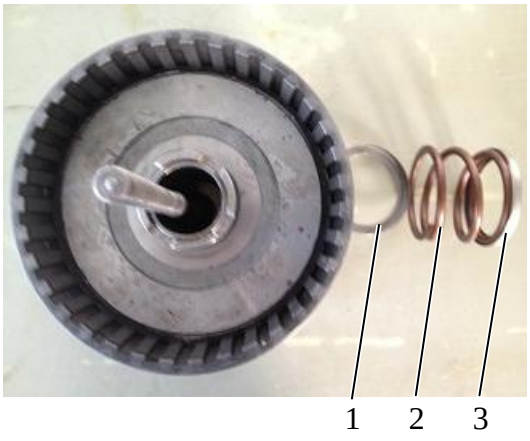


Figure 3-116

1 Lower guide ring 2 Pressure spring

3 Upper guide ring

30. Take out the pressure spring and guide ring of the K1 clutch.

Figure 3-117

1 K1 clutch piston

31. Take out the K1 clutch piston.

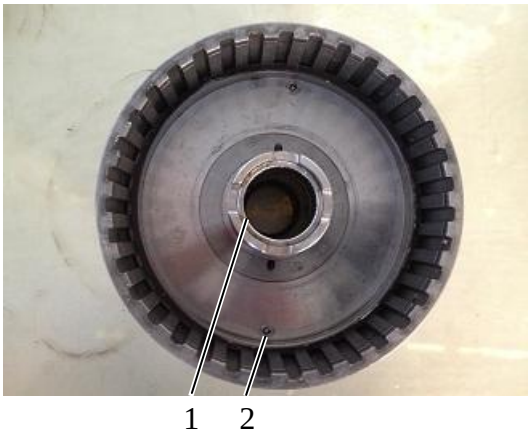


Figure 3-118

1 Needle bearing

2 Check valve

32. After removing the K1 clutch needle bearing, the removal is completed.

3.2.4 KRK2 Clutch Removal

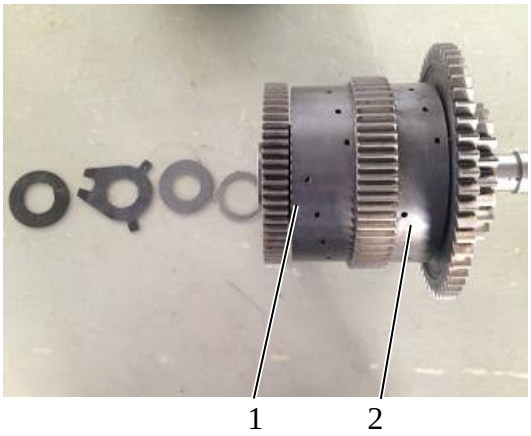


Figure 3-119

1 KR clutch assembly

2 K2 clutch assembly

1. Take down the roller of the KR clutch roller bearing.

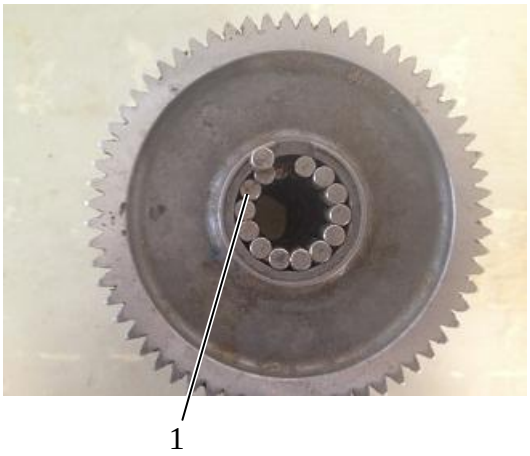


Figure 3-120

1 Roller×14

2. Take out 14 rollers in the external layer.

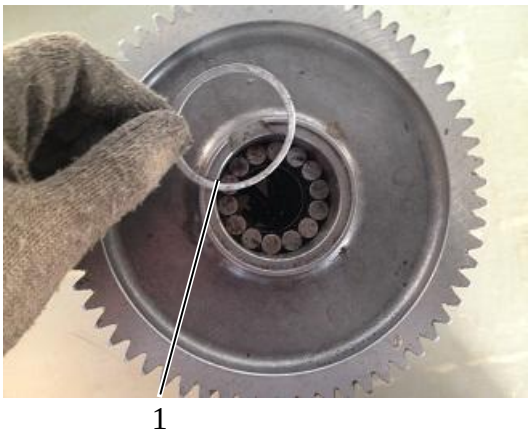


Figure 3-121

1 Roller bearing washer

3. Take out the washer of the KR clutch roller bearing.

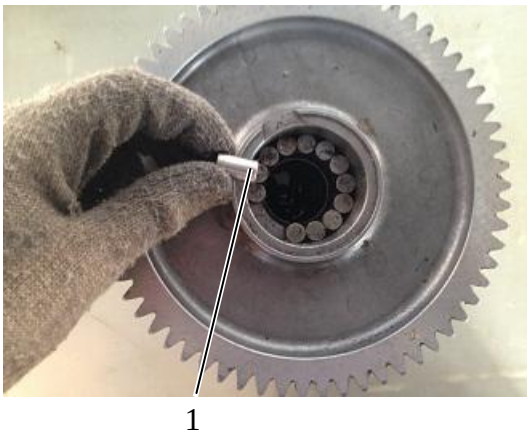


Figure 3-122

1 Roller×14

4. Take out the roller of the KR clutch roller bearing.

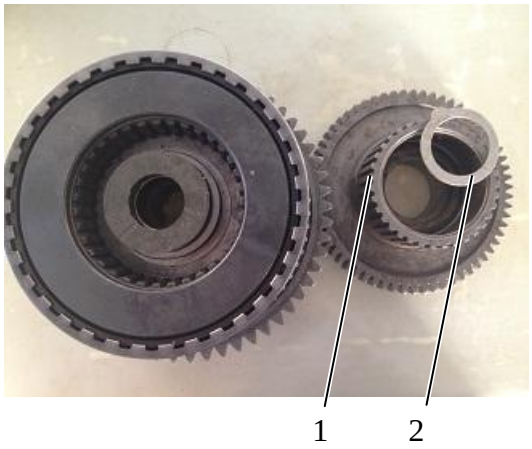


Figure 3-123

1 KR clutch gear

2 Thrust washer

5. Remove the KR clutch gear and take out the thrust washer from the bearing.

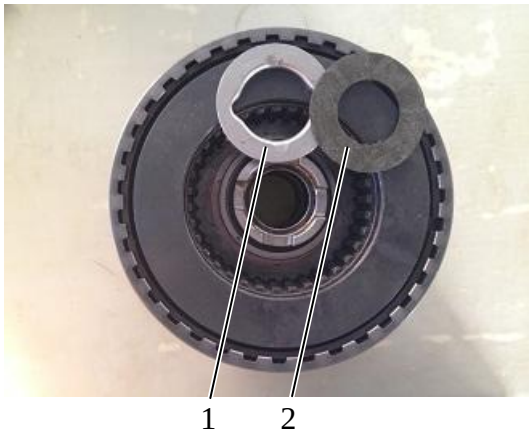


Figure 3-124

1 Thrust washer

2 Thrust washer

6. Take out the thrust washer from the KR clutch.

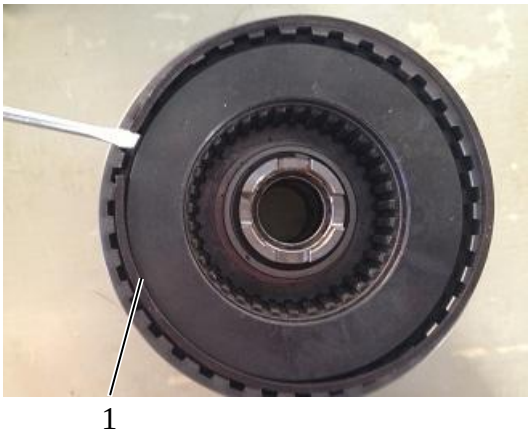


Figure 3-125

1 Elastic retainer ring

7. Take down the elastic retainer ring fixing the KR clutch bearing plate.

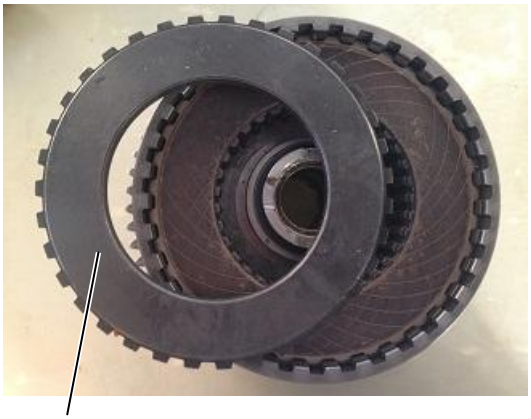


Figure 3-126

1 Bearing plate

8. Take out the bearing plate of the KR clutch friction lining.

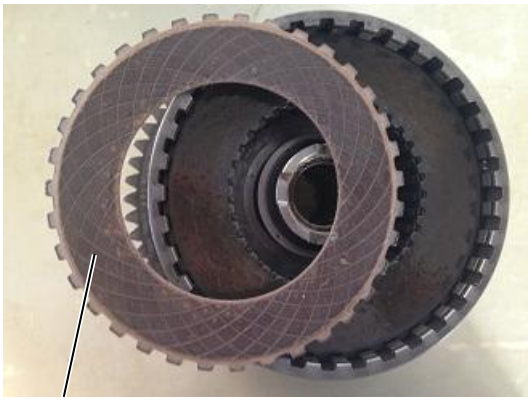


Figure 3-127

1 External friction lining

9. Take out the external friction lining from the KR clutch.

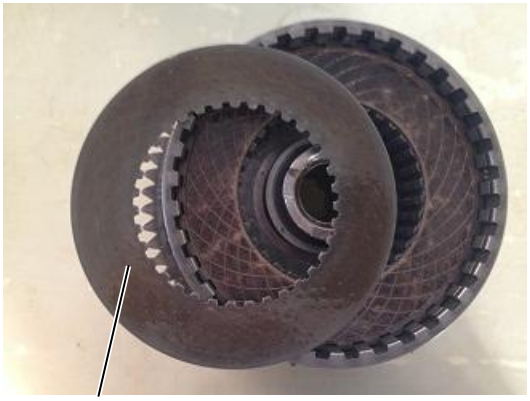


Figure 3-128

1 Internal friction lining

10. Take out the internal friction lining from the KR clutch.

Figure 3-129

11. Take out the external and internal friction linings and place them aside.

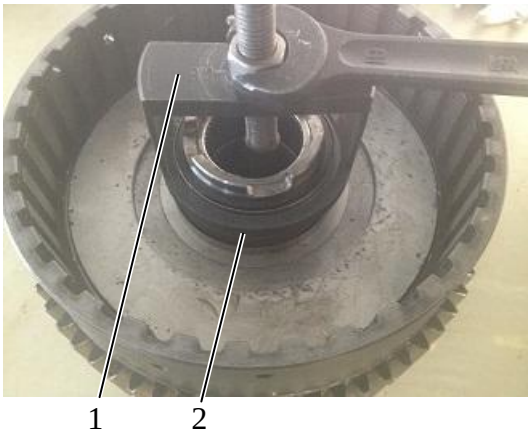


Figure 3-130

12. Install the clutch spring removal tooling and press down the KR clutch pressure spring.

1 Clutch spring removal tooling

2 Pressure spring

Figure 3-131

13. Take down the retainer ring of the KR clutch pressure spring with the snap ring pliers.

1 Retainer ring

Figure 3-132

1 Guide ring

2 Retainer ring

14. Take out the retainer ring and guide ring of the KR clutch.

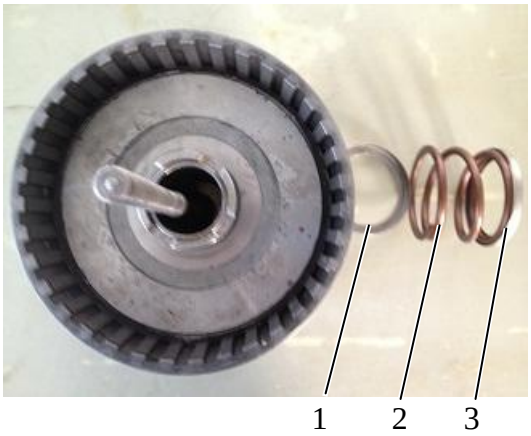


Figure 3-133

1 Lower guide ring 2 Pressure spring

3 Upper guide ring

15. Take out the guide ring and pressure spring of the KR clutch.

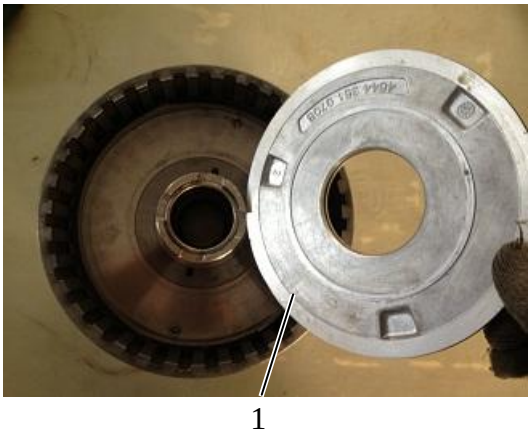


Figure 3-134

1 KR clutch piston

16. Take out the KR clutch piston.

Figure 3-135

1 Needle bearing

2 Check valve

17. Remove the needle bearing on the KR clutch.

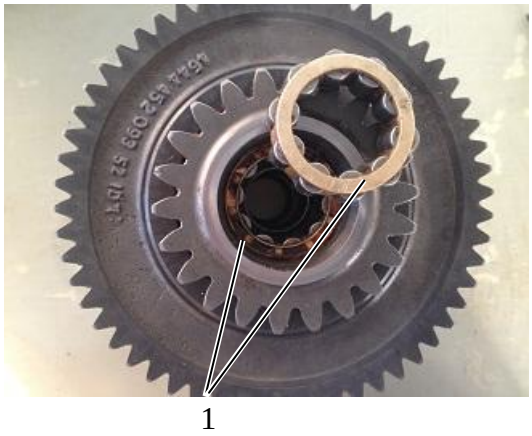


Figure 3-136

1 Roller bearing ×2

18. Take out the roller bearing of the K2 clutch gear.

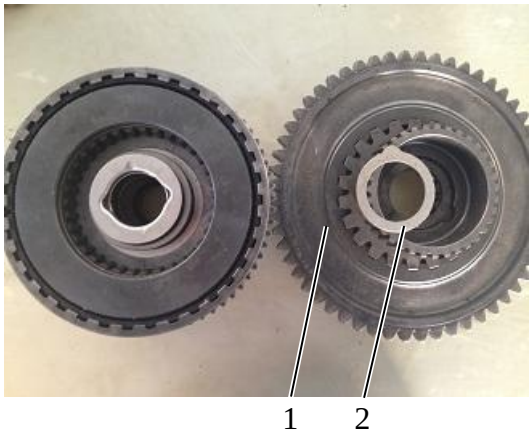
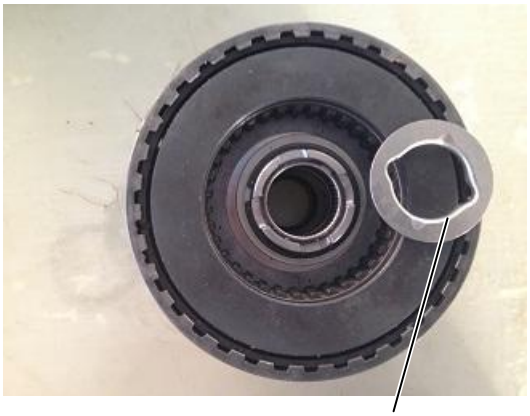


Figure 3-137

1 K2 clutch gear

2 Thrust washer

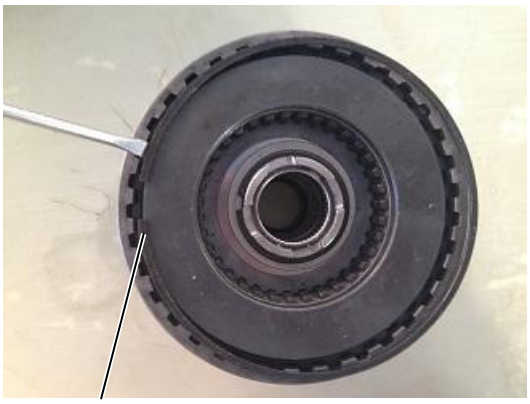
19. Take down the gear and thrust washer of the K2 clutch.



20. Take out the thrust washer on the KR clutch pressure spring.

Figure 3-138

1 Thrust washer



21. Take down the elastic retainer ring fixing the K2 clutch bearing plate.

Figure 3-139

1 Elastic retainer ring

22. Take out the bearing plate on the K2 clutch friction lining.

Figure 3-140

1 Bearing plate

Figure 3-141

1 External friction lining

23. Take out the external friction lining of the K2 clutch.

Figure 3-142

1 Internal friction lining

24. Take out the internal friction lining of the K2 clutch.

Figure 3-143

25. Take out the external and internal friction linings and place them aside.

Figure 3-144

1 Piston

26. Take out the K2 clutch piston.

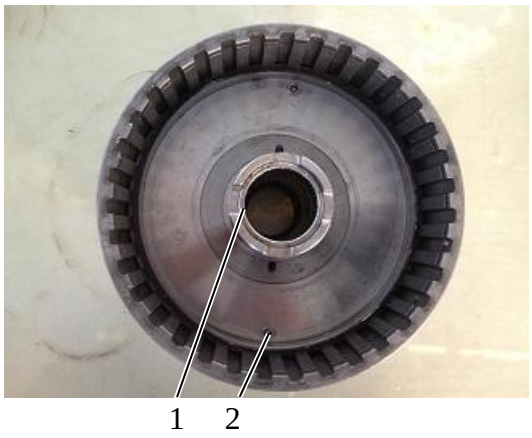


Figure 3-145

1 Needle bearing

2 Check valve

27. After removing the roller bearing of the K2 clutch, the removal is completed.

3.2.5 K3K4 Clutch Removal

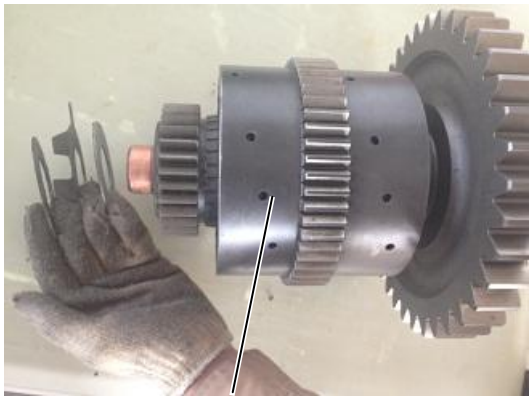


Figure 3-146

1 K3K4 clutch assembly

1. Take down the K4 clutch gear bearing.

Figure 3-147

1 Needle bearing

2. Place the bearing aside.

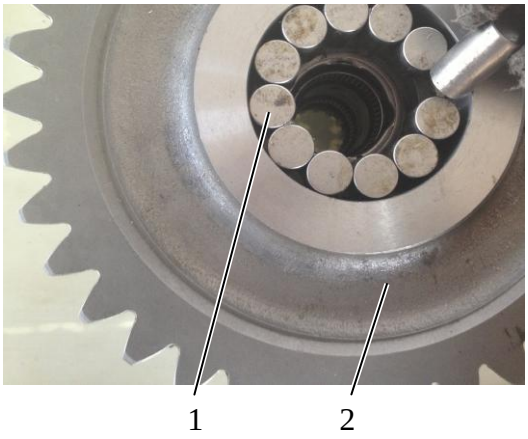


Figure 3-148

1 Roller×12

2 K3 clutch gear

3. Take down the lining seal ring component and roller of the needle bearing of the K3 clutch gear.

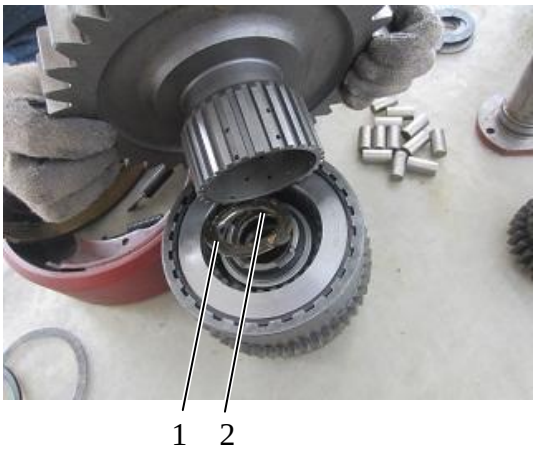


Figure 3-149

1 Washer

2 Thrust washer

4. Take down the gear, washer and thrust washer of the K3 clutch.

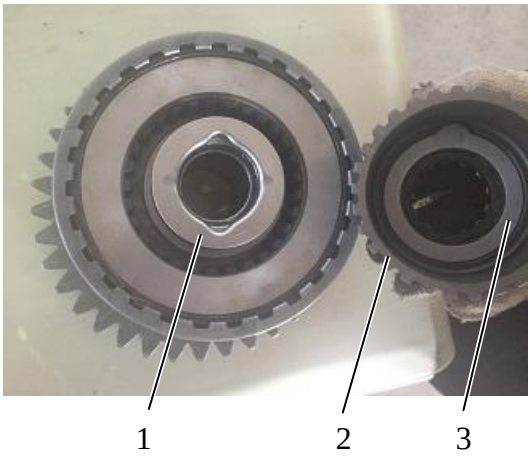


Figure 3-150

1 Thrust washer 2 K4 clutch gear

3 Thrust washer

5. Take down the gear and thrust washer of the K4 clutch.

Figure 3-151

1 Elastic retainer ring

6. Take down the elastic retainer ring of the K4 clutch.

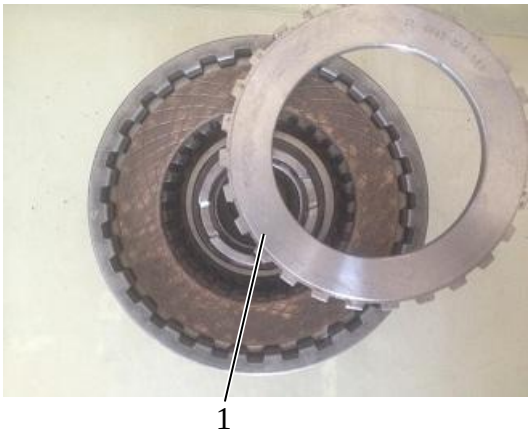


Figure 3-152

1 Bearing plate

7. Take out the bearing plate of the K4 clutch.

Figure 3-153

1 Internal friction lining

2 External friction lining

8. Take out the external and internal friction linings of the K4 clutch.

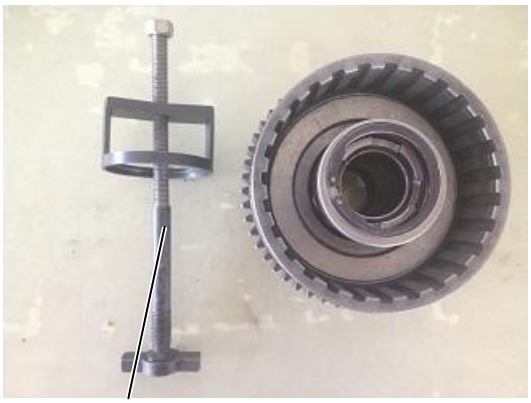


Figure 3-154

1 Clutch spring removal tooling

9. Install the clutch tooling onto the clutch.

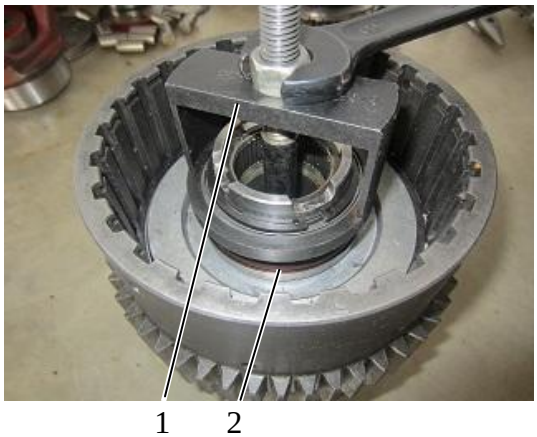


Figure 3-155

1 Clutch spring removal tooling

2 Pressure spring

10. Screw down the tooling nut and press down the clutch spring.

Figure 3-156

1 Retainer ring

11. Take down the retainer ring fixing the pressure spring with the snap ring pliers.

Figure 3-157

1 Retainer ring

2 Guide ring

12. Take out the retainer ring and the guide ring of the K4 clutch in turn.

Figure 3-158

1 Guide ring

2 Pressure spring

13. Take out the upper guide ring, pressure spring and lower guide ring on the K4 clutch in turn.

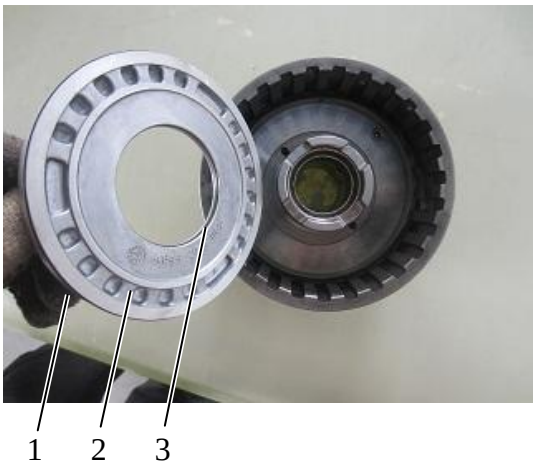


Figure 3-159

1 Seal ring 2 K3 clutch piston

3 Seal ring

14. Take out the piston and seal ring of the K4 clutch.

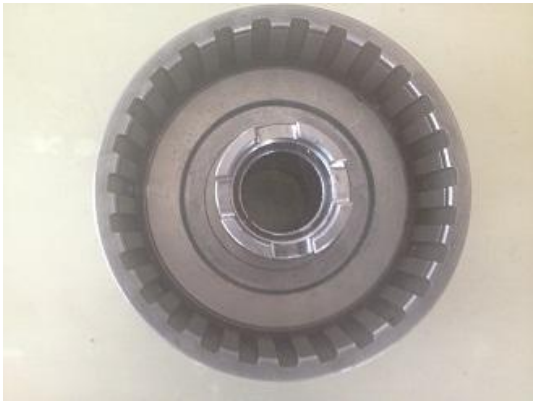


Figure 3-160

15. The removal of the K4 clutch is completed.

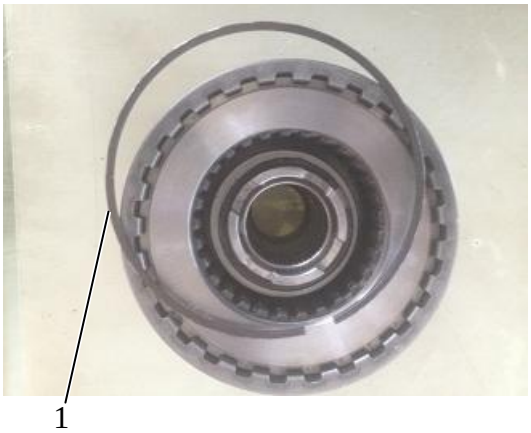


Figure 3-161

1 Elastic retainer ring

16. Take out the elastic retainer ring of the K3 clutch bearing plate.

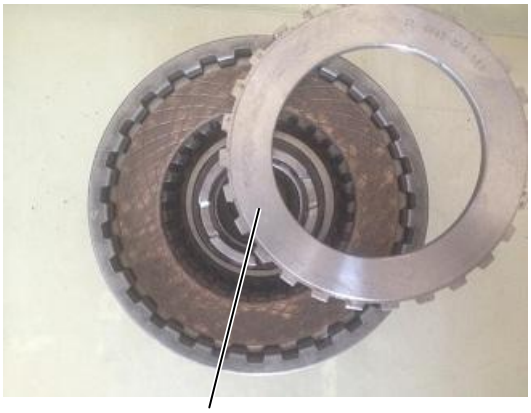


Figure 3-162

1 Bearing plate

17. Take out the K3 clutch bearing plate.

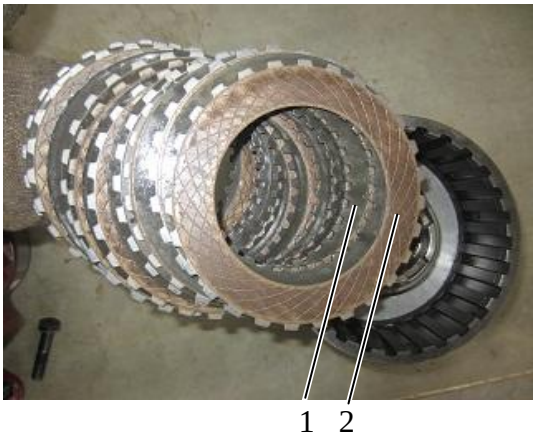


Figure 3-163

1 Internal friction lining

2 External friction lining

18. Take out the external and internal friction linings of the K3 clutch.

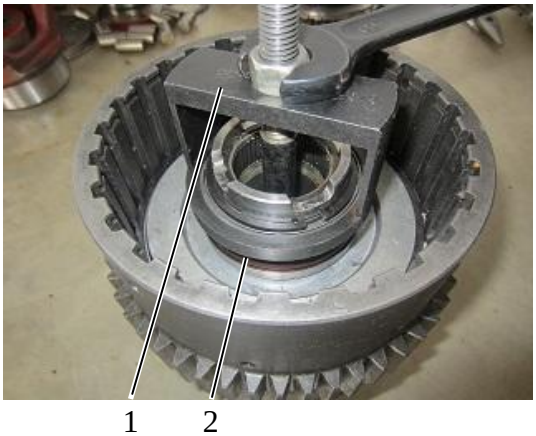


Figure 3-164

1 Clutch spring removal tooling

2 Pressure spring

19. Press down the K3 clutch pressure spring with the clutch spring removal tooling.

Figure 3-165

1 Retainer ring

20. Take down the retainer ring fixing the pressure spring with the snap ring pliers.

Figure 3-166

1 Retainer ring

2 Guide ring

21. Take out the retainer ring and guide ring of the K3 clutch in turn.

Figure 3-167

1 Guide ring

2 Pressure spring

22. Take out the upper guide ring, pressure spring and lower guide ring of the K3 clutch in turn.

Figure 3-168

1 Seal ring 2 K4 clutch piston

3 Seal ring

23. Take out the piston and seal ring of the K3 clutch.

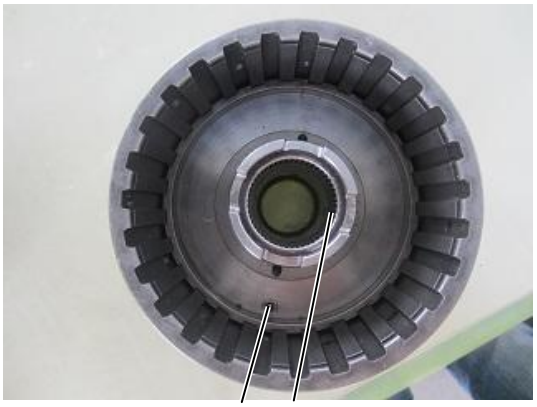


Figure 3-169

1 Check valve

2 Needle bearing

24. Remove the needle bearing and check valve of the K3K4 clutch.

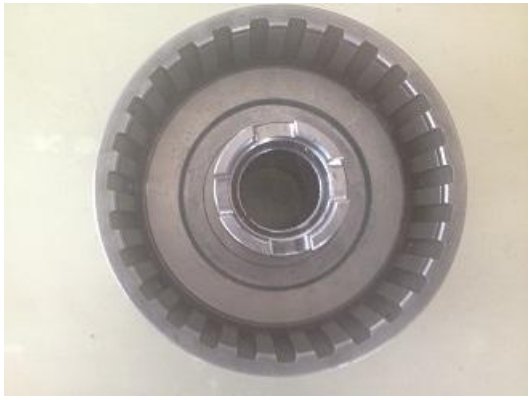


Figure 3-170

25. The K4 clutch removal is completed.

4 Transmission Assembly

4.1 Assembling of the Transmission Assembly

4.1.1 K3K4 Clutch Assembly

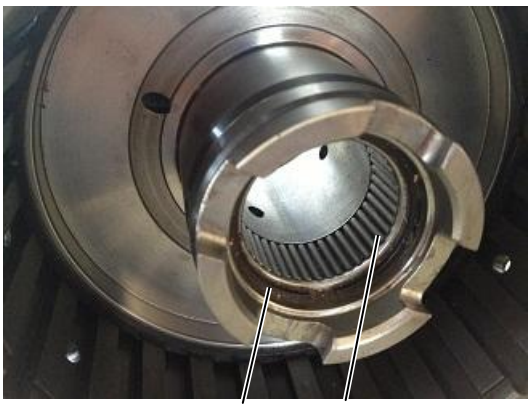


Figure 4-1

1 Retainer ring

2 Needle bearing

1. Knock the needle bearing into the clutch bearing hole and install the retainer ring.

★ **Attention**

Before assembling, clean all parts.

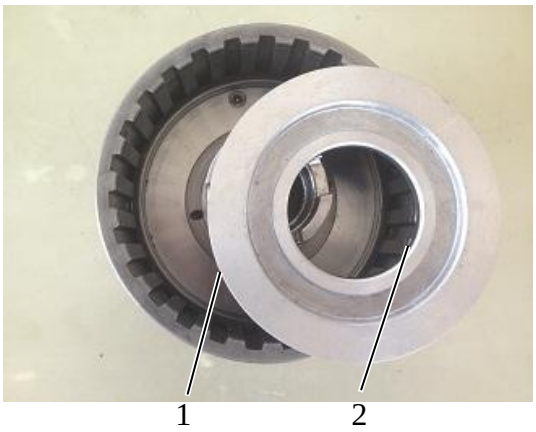


Figure 4-2

1 Seal ring

2 Seal ring

2. Install the seal ring into the piston groove and install the piston component into the clutch cylinder.

★ **Attention**

When installing the seal ring, the sealing surface of the seal ring shall face towards the pressure oil surface.

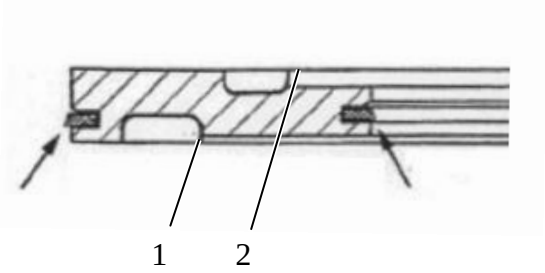


Figure 4-3

1 Pressure oil surface

2 Friction lining

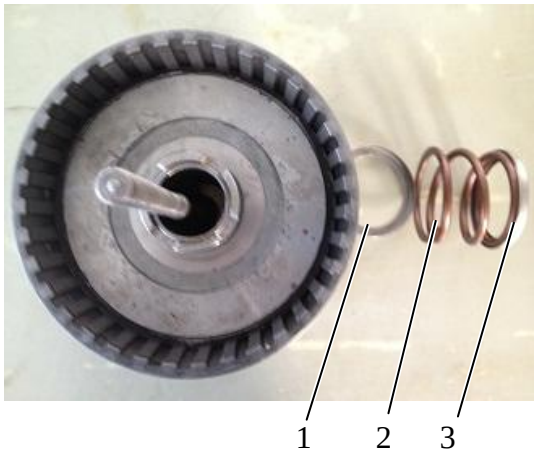


Figure 4-4

1 Guide ring 2 Pressure spring

3 Guide ring

3. Place the guide ring and the pressure spring into the clutch cylinder.

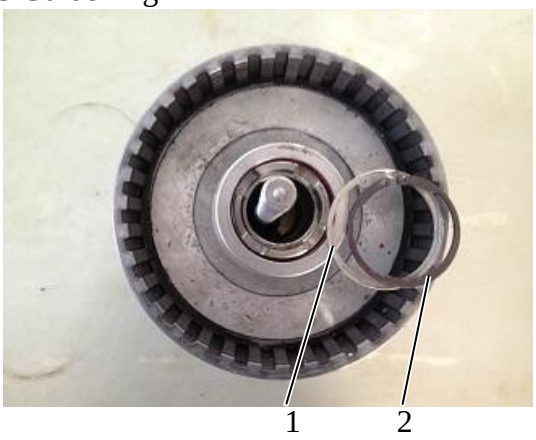


Figure 4-5

1 Guide ring

2 Retainer ring

4. Place the guide ring and the retainer ring into the clutch cylinder.

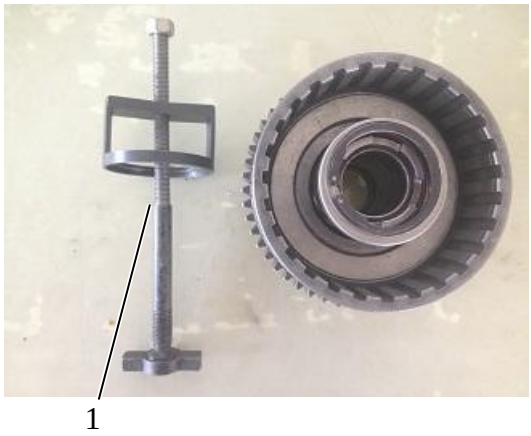


Figure 4-6

1 Clutch spring removal and assembly tooling (29380017591) (29380017601)

5. Install the spring removal and assembling tooling onto the clutch.

Figure 4-7

6. Screw down the nuts on the tooling and press down the clutch spring.

Figure 4-8

1 Retainer ring

2 Snap ring pliers

7. Install the retainer ring into the clutch cylinder clip groove with the snap ring pliers.

Figure 4-9

8. Take down the clutch spring removal and assembling tooling.

Figure 4-10

1 External friction lining

9. Firstly, place the external friction lining into the K3 clutch.

★ **Attention**

During use, if the external friction lining of the clutch is worn out and more than 2/3 parts of the pattern groove of the friction lining are worn out, timely replacement shall be done.

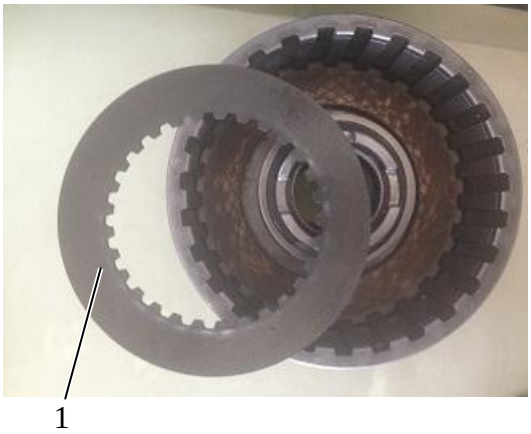


Figure 4-11

1 Internal friction lining

10. Place the internal friction lining into the K3 clutch.

★ **Attention**

Firstly, place the external friction lining into the K3 clutch and then place the external and internal friction linings in turn, including 10 external friction linings and 9 internal friction linings.

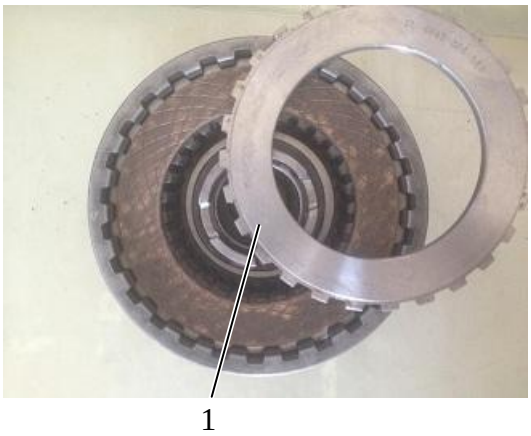


Figure 4-12

1 Bearing plate

11. Place the bearing plate into the K3 clutch.

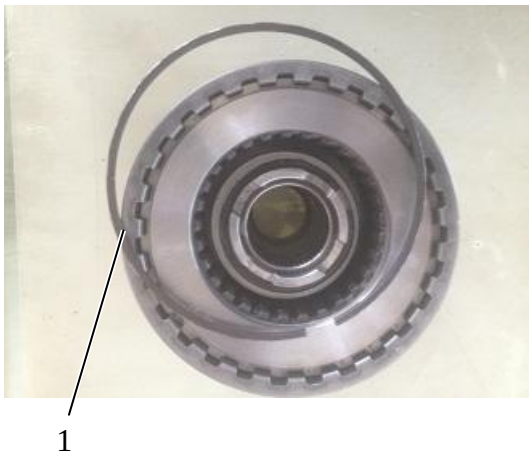


Figure 4-13

1 Elastic retainer ring

12. Install the elastic retainer ring into the K3 clutch.

Figure 4-14

1 Dial indicator

13. Slightly push the K3 clutch friction lining upwards to the upper limit position with the screwdriver; record the clutch piston stroke which is measured by the dial indicator, and the K3 clutch assembling is completed.

★ **Attention**

Press the dial indicator contact onto the bearing plate and select different positions for three measurements at the least. The dial indicator reading is the K3 clutch piston stroke. Select the internal friction lining with different thickness to ensure that the piston stroke is 1.8mm~2.2mm.

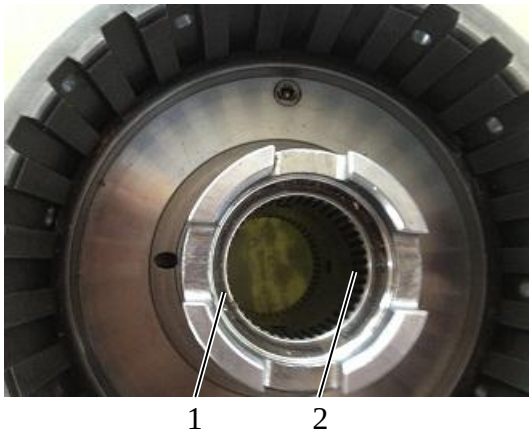


Figure 4-15

1 Retainer ring

2 Needle bearing

14. Knock the K4 clutch needle bearing into the clutch bearing hole and install the retainer ring.

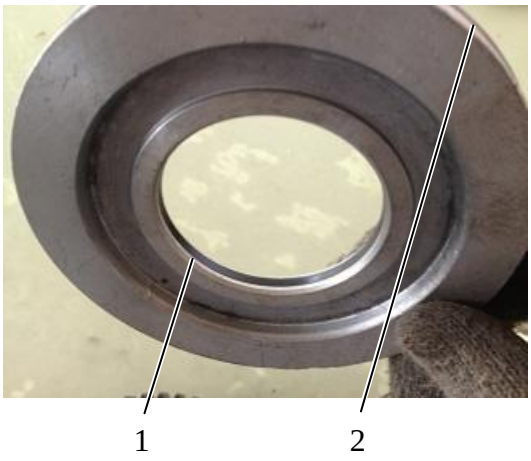


Figure 4-16

1 Seal ring

2 Seal ring

15. Install the seal ring into the K4 clutch piston groove.

★ **Attention**

When installing the seal ring, the sealing surface of the seal ring shall face towards the pressure oil surface. (Refer to Figure 4-3)

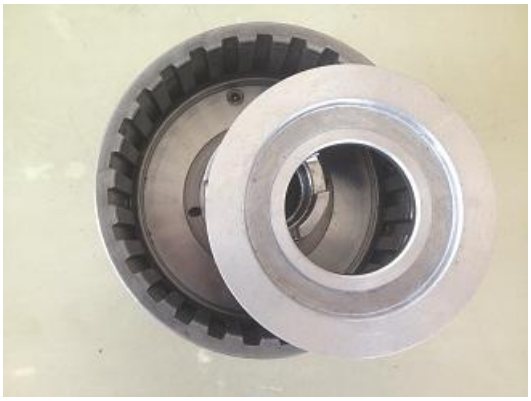


Figure 4-17

16. Install the K4 clutch piston into the clutch.

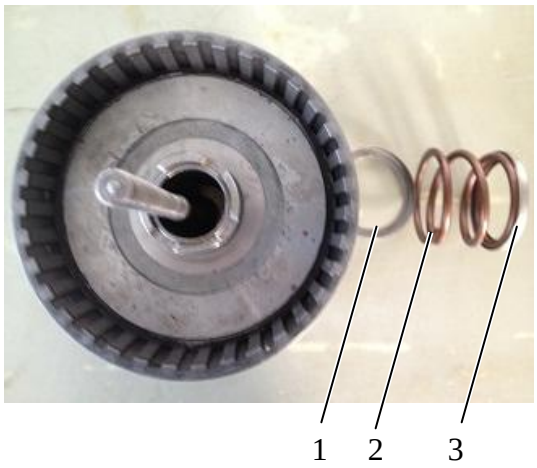


Figure 4-18

1 Guide ring 2 Pressure spring

3 Guide ring

17. Install the guide ring and the pressure spring into the clutch cylinder.

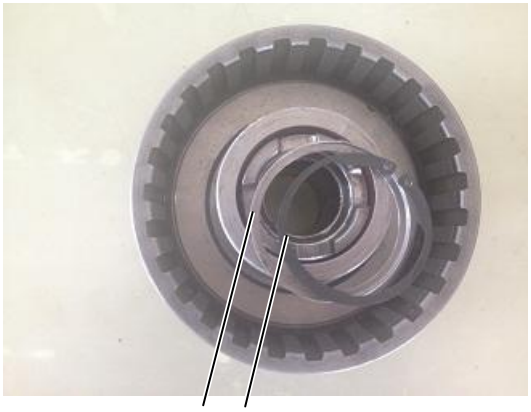


Figure 4-19

1 Guide ring

2 Retainer ring

18. Install the guide ring and the retainer ring.

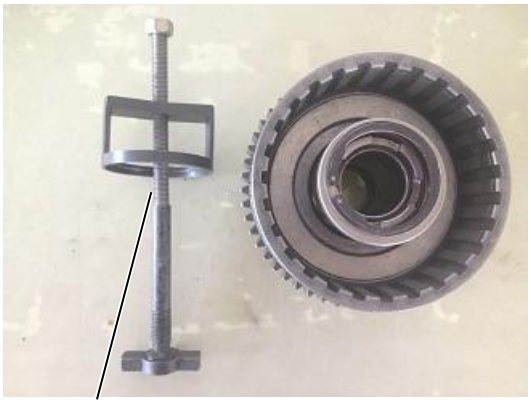


Figure 4-20

1 Clutch spring removal and assembling tooling (29380017591) (29380017601)

19. Install the clutch spring removal and assembling tooling onto the clutch.

Figure 4-21

20. Screw down the nuts on the clutch removal tooling and press down the clutch spring.

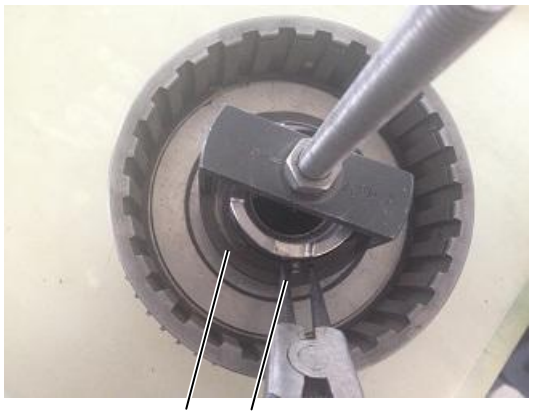


Figure 4-22

1 Retainer ring

2 Snap ring pliers

21. Install the retainer ring into the cylinder clip groove of K4 clutch with the snap ring pliers.

Figure 4-23

22. Take down the clutch spring removal and assembling tooling.

Figure 4-24

1 External friction lining

23. Firstly, place the external friction lining into the K4 clutch.

★ **Attention**

During use, if the external friction lining of the clutch is worn out and more than 2/3 parts of the pattern groove of the friction lining are worn out, timely replacement shall be done.

Figure 4-25

1 Internal friction lining

24. Install the internal friction lining into the K4 clutch.

★ **Attention**

Firstly, place the external friction lining into the clutch and then place the external and internal friction linings in turn, including 9 external friction linings and 8 internal friction linings.

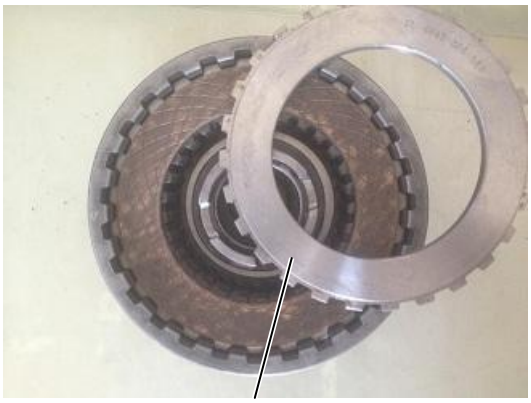


Figure 4-26

1 Bearing plate

25. Place the bearing plate into the K4 clutch.

Figure 4-27

1 Elastic retainer ring

26. Install the elastic retainer ring into the K4 clutch.

Figure 4-28

1 Dial indicator

27. Slightly push the K4 clutch friction lining upwards with the screwdriver and record the clutch piston stroke which is measured by the dial indicator.

★ **Attention**

Press the dial indicator contact onto the bearing plate and select different positions for three measurements at the least. The dial indicator reading is the K4 clutch piston stroke. Select the internal friction lining with different thickness to ensure that the piston stroke is stroke: 1.8mm~2.2mm.

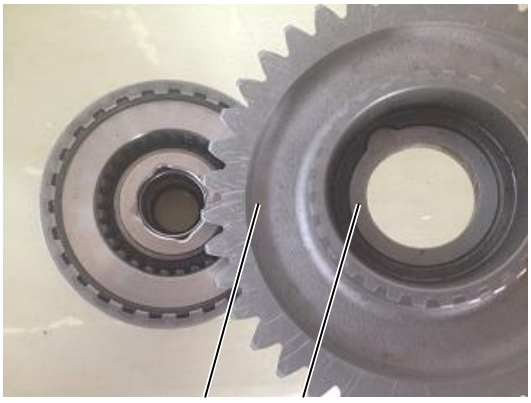


Figure 4-29

1 K3 clutch gear

2 Thrust washer

28. Install the thrust washer into the K3 clutch gear.

★ **Attention**

The thrust washer shall be coated with grease.

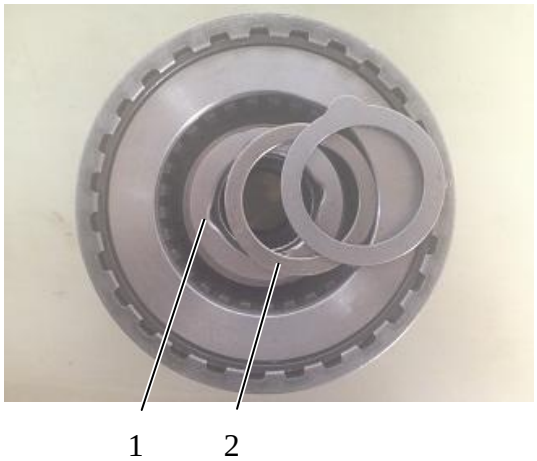


Figure 4-30

1 Thrust washer

2 Washer

29. Install the gasket and the thrust washer into the K3 clutch.

Figure 4-31

1 K3 clutch gear

30. Install the K3 clutch gear.

★ **Attention**

Before installing the gear, it is necessary to perform alignment to the internal friction lining splines of the clutch.

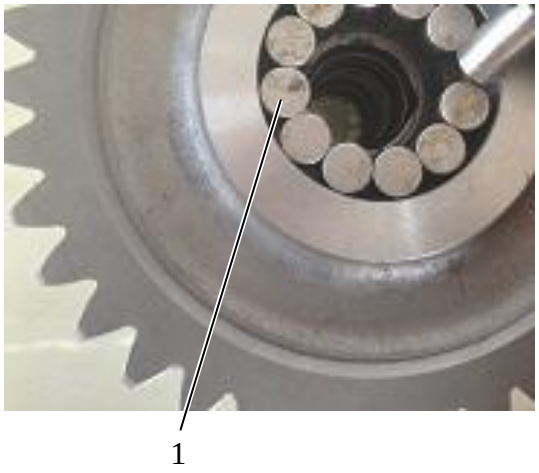


Figure 4-32

1 Roller×12

31. Install the lining seal ring component and roller of the internal needle bearing of the K3 clutch gear.

★ **Attention**

The roller shall be coated with grease to prevent the clutch assembly dropping when being installed into the transmission body.

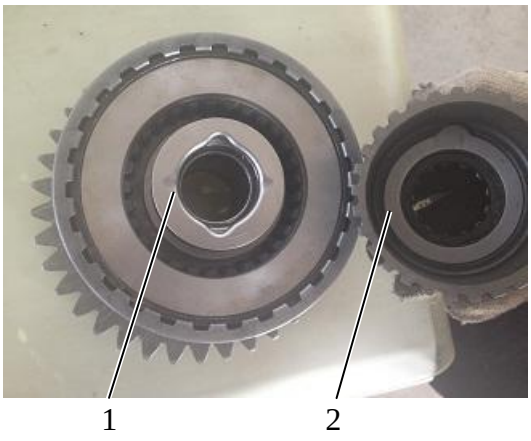


Figure 4-33

1 Thrust washer

2 Thrust washer

32. Install the thrust washer into the K4 clutch cylinder clip and gear.

★ **Attention**

The thrust washer shall be coated with grease.

Figure 4-34

1 Needle bearing

33. Install the needle bearing into the K4 clutch gear.

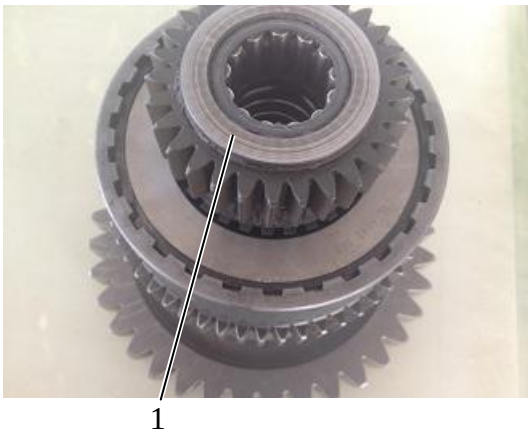


Figure 4-35

1 K4 clutch gear

34. Install the K4 clutch gear.

★ **Attention**

Before installing the gear, it is necessary to perform alignment to the internal friction lining splines of the clutch.

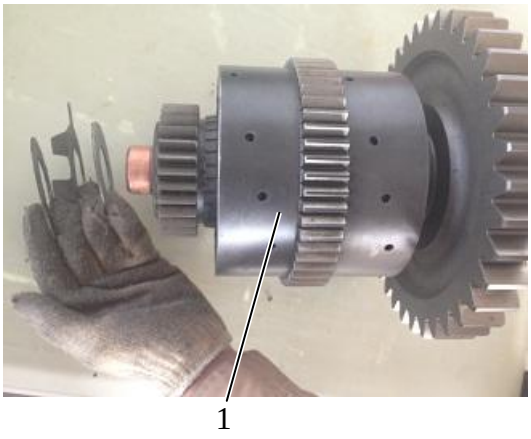


Figure 4-36

1 K3K4 clutch assembly

35. The K3K4 clutch assembling is completed.

★ **Attention**

The KVK1 and KRK2 clutch assembling process can follow the K3K4 clutch assembling process, which is omitted here.

Figure 4-37

1 KVK1 clutch assembly

36. The KVK1 clutch assembling is completed.

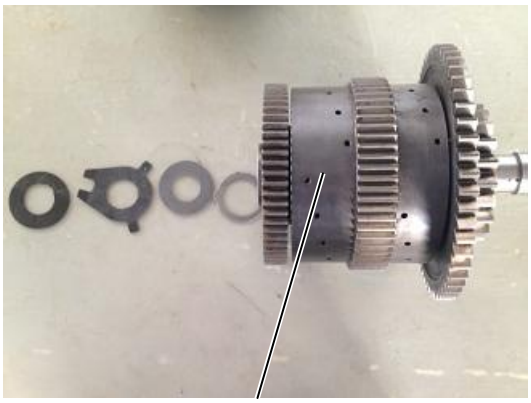


Figure 4-38

1 KRK2 clutch assembly

37. The KRK2 clutch assembling is completed.

4.1.2 Main PTO Assembly

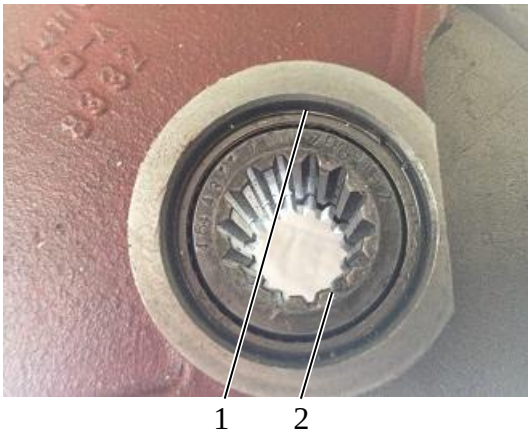


Figure 4-39

1 Retainer ring ×2

2 Needle bearing

1. Install the needle bearing into the wheel hub of the output transmission body and then install the retainer ring.

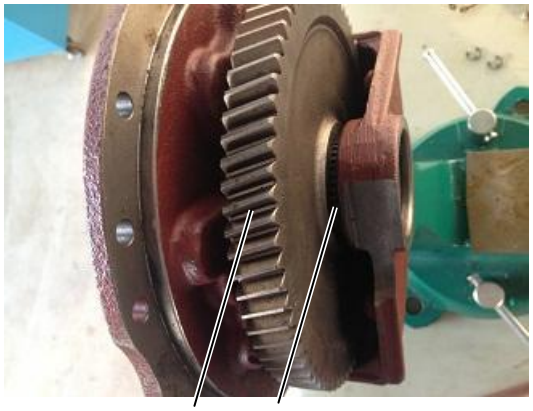


Figure 4-40

1 Transmission gear

2 Retainer ring

2. Install the retainer ring into the transmission gear hole and then install the gear into the wheel hub of the output transmission body.

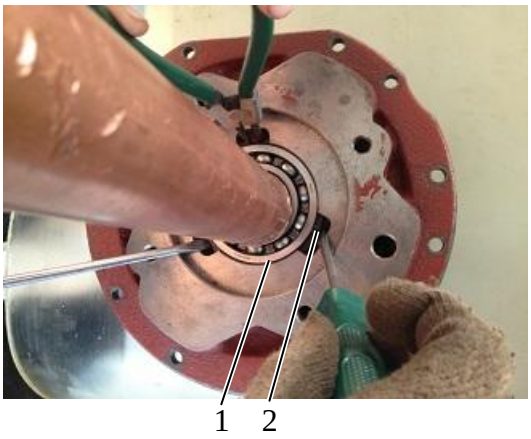


Figure 4-41

1 Ball bearing

2 Elastic retainer ring×2

3. Insert the PTO shaft into the gear hole; knock in the ball bearing, and insert 2 elastic retainer rings and 1 retainer ring.

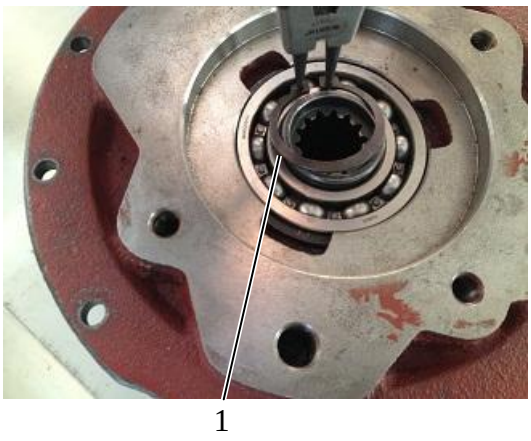


Figure 4-42

1 Retainer ring (45×1.75)

4. The PTO assembling is completed.

Figure 4-43

1 Ball bearing

2 Auxiliary driving shaft

4.1.3 Input Part Assembly

1. Knock the ball bearing onto the auxiliary driving shaft.

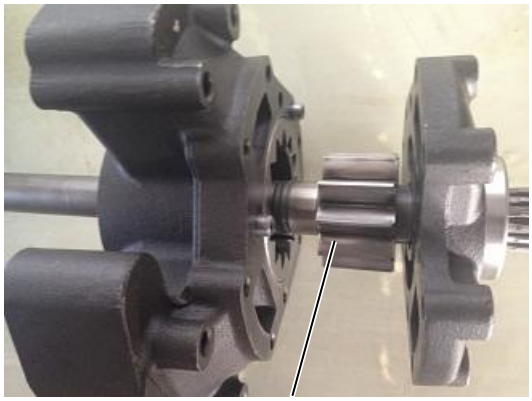


Figure 4-44

1 Internal gear of the gear pump

2. Install the flat key of the internal gear of the gear pump on the shaft and cover it with the oil pump.

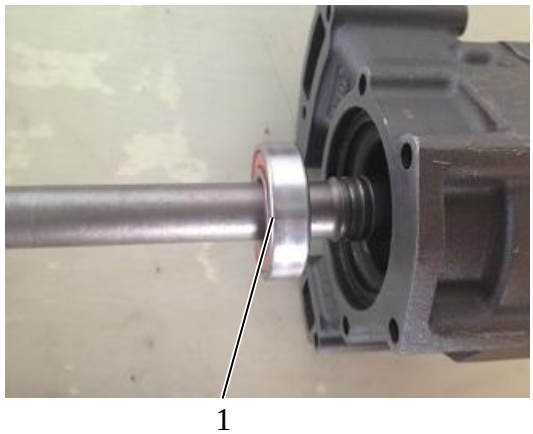


Figure 4-45

1 Ball bearing

3. Knock another ball bearing into the oil pump bearing hole.

★ **Attention**

Ensure that the auxiliary driving shaft can flexibly rotate.

1 2

Figure 4-46

1 Clip (30×1.5)

2 Seal ring

4. Install the clip for shaft and buckle seal ring.

1 2

Figure 4-47

1 Oil seal Φ75

2 Needle bearing

5. Knock the needle bearing into the bearing hole of the pump impeller bearing seat and then install the oil seal.

★ **Attention**

Replace the old oil seal with a new one.

1 2

Figure 4-48

1 Roller bearing

2 Oil feed flange

6. Install the roller bearing into the bearing hole of the oil feed flange.

★ **Attention**

Before assembling, it is necessary to clean the oil feed flange.

Figure 4-49

1 Input gear

7. Install the input gear into the oil feed flange and adjust the gear clearance.

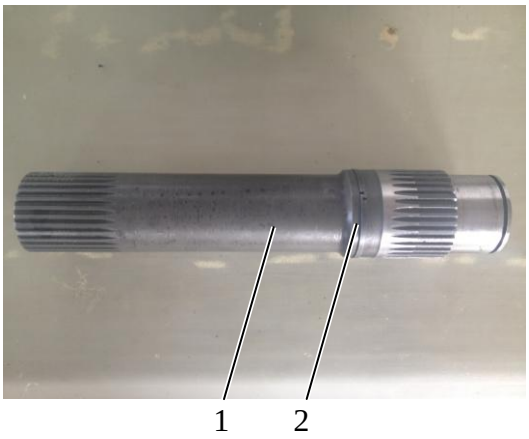


Figure 4-50

1 Drive shaft

2 Seal ring

8. Install the seal ring onto the drive shaft.

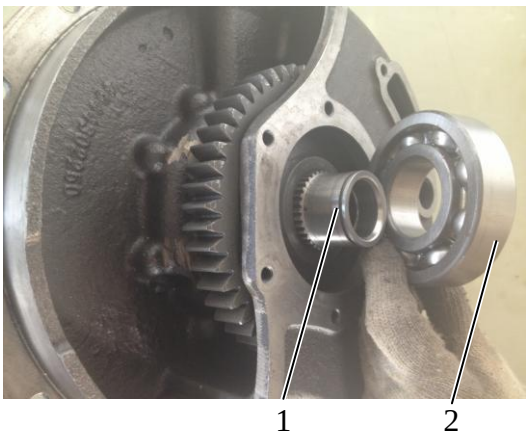


Figure 4-51

1 Drive shaft

2 Ball bearing

9. Insert the drive shaft and install the ball bearing.

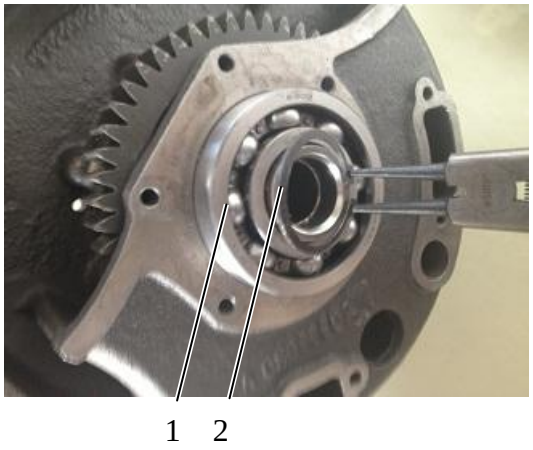


Figure 4-52

1 Output shaft ball bearing

2 Elastic retainer ring 40×1.75

10. Install the elastic retainer ring.

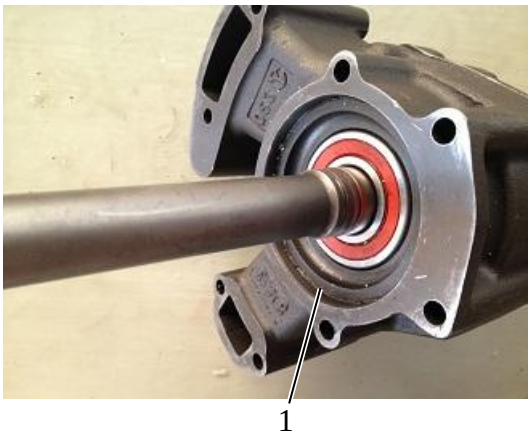


Figure 4-53

1 Adjustable washer

11. Install the adjustable washer into the gear pump hole.

★ **Attention**

Ensure that the axial run-out clearance of the output shaft bearing is 0.2mm~0.4mm.

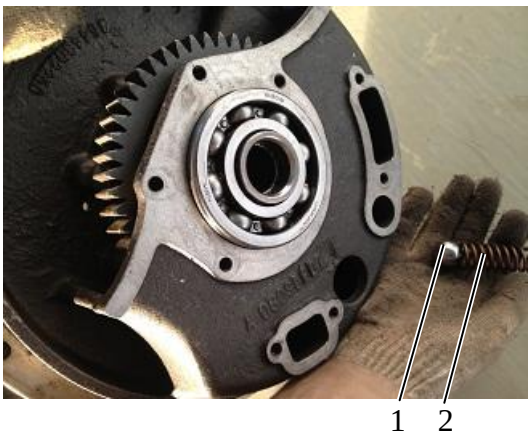
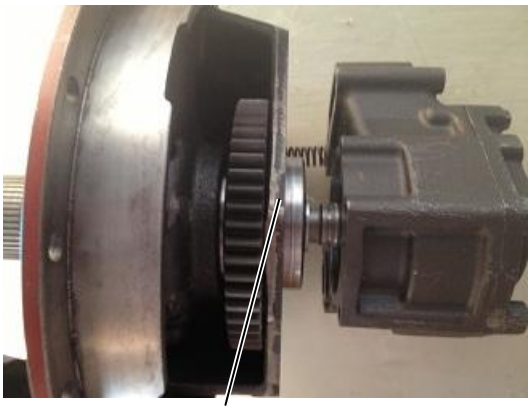


Figure 4-54

1 Steel ball Φ20mm

2 Pressure spring (2.5×16.95×57.2)

12. Install the steel ball and the pressure spring into the safety valve hole of the torque converter on the oil feed flange.

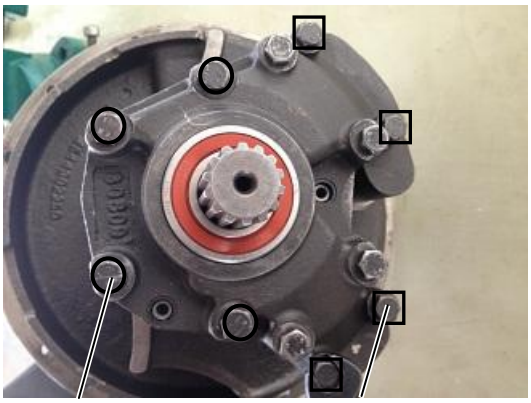


1

Figure 4-55

1 Oil pump packing

13. Place the oil pump packing on the oil feed flange oil pump surface; coat it with grease, and insert the oil pump component into the oil feed flange component hole.



1 2

Figure 4-56

1 Hexagon head screw (M8*115)×4

1 Hexagon head screw (M8*85)×4

14. Screw down the bolt between the oil pump component and the oil feed flange component.

Nm : 23N.m

1

Figure 4-57

1 Packing

15. Place the packing of the pump impeller bearing seat on the oil feed flange surface.

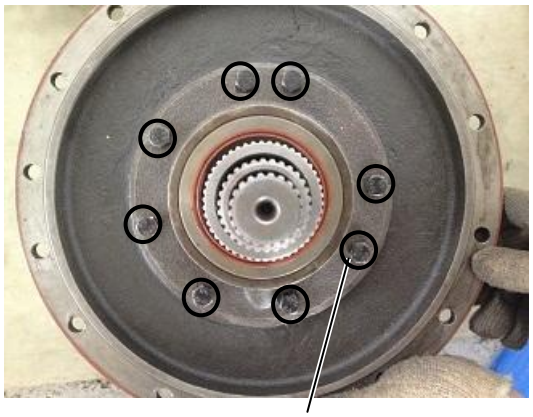


Figure 4-58

1 Hexagon head screw (M8*28)×8

16. After knocking in the pump impeller bearing seat and screwing down the bolt between the pump impeller bearing seat and the oil feed flange, the assembling is completed.

Nm : 23N.m

4.2 Transmission Assembly

4.2.1 Output Part Assembly

1. Place the output shaft gear; install the baffle plate and the oil shield into the transmission body, and then fix them with two bolts (M8*16) and the washer.

Figure 4-59

1 Output shaft gear 2 Baffle plate

3 Oil shield

2. Knock out the roller bearing and place it at the output gear shaft end, and then place it into the oil shield; install the spacer sleeve and insert the output shaft.

Figure 4-60

Figure 4-61

1 Output shaft

3. Adjust the washer in turn.

★ **Attention**

Select the adjustable washer with different thickness, so as to ensure that the axial clearance of the bearing is 0.1mm~0.3mm.

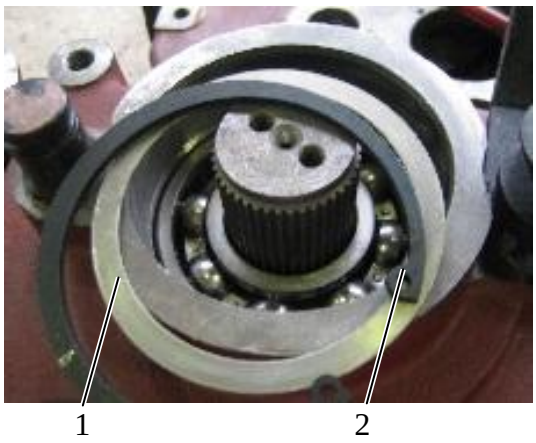


Figure 4-62

1 Adjustable gasket

2 Snap ring (120*4)

4. Install the snap ring.

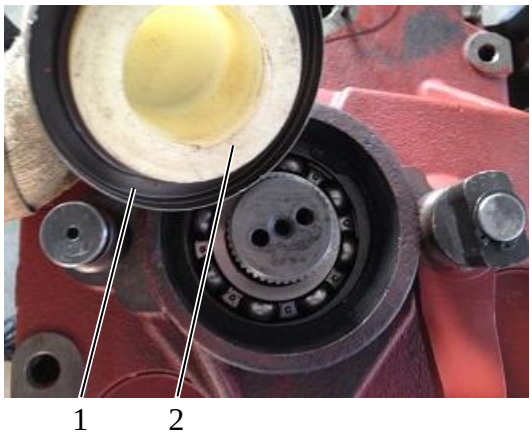


Figure 4-63

1 Oil seal

2 Oil seal assembling tooling (29380017071)

5. Install the oil seal into the transmission body with the tooling.

★ **Attention**

Replace the removed oil seal with a new one.

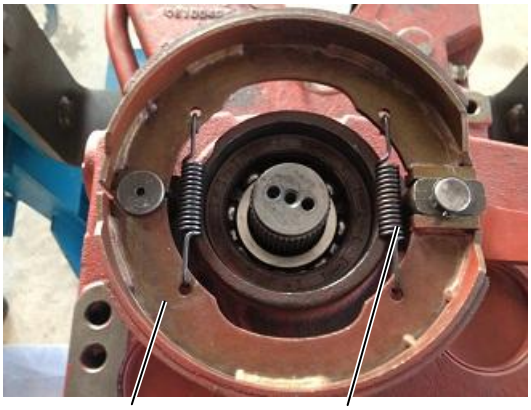


Figure 4-64

1 Brake drum wheel

2 Contact roller tension spring

6. Install the parking brake drum wheel.

Attention

During installation, take protection measures to avoid tension spring detachment.

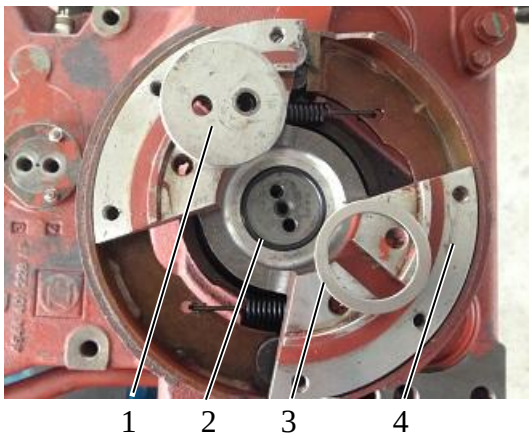


Figure 4-65

1 Pressure plate 2 O-ring

3 Distance washer (A=0.6) 4 Output flange

7. Install the output flange, O-ring, distance washer and pressure plate in turn.

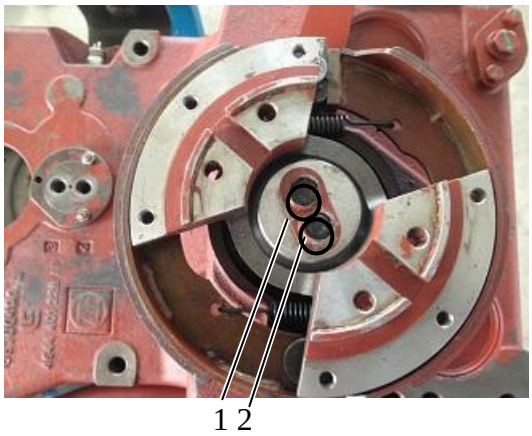


Figure 4-66

1 Lock washer

2 Hexagon head screw (M10*30)×2

8. Screw down the bolt between the pressure plate and the output shaft.

Nm : 46N.m

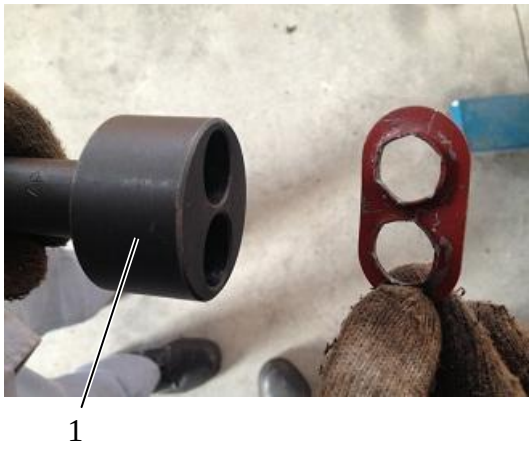


Figure 4-67

1 Lock washer assembling tooling (29380017101)

9. Install the lock washer with the lock washer assembling tooling.

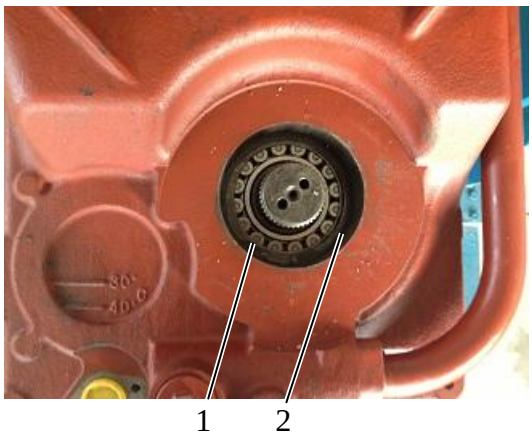


Figure 4-68

1 Roller bearing

2 Snap ring (120*4)×2

10. Install the snap ring, bearing, adjustable washer and snap ring at the front end of the output shaft in turn.

★ **Attention**

Select the adjustable gasket with different thickness, so as to ensure that the axial clearance of the bearing is: 0.1mm~0.3mm.

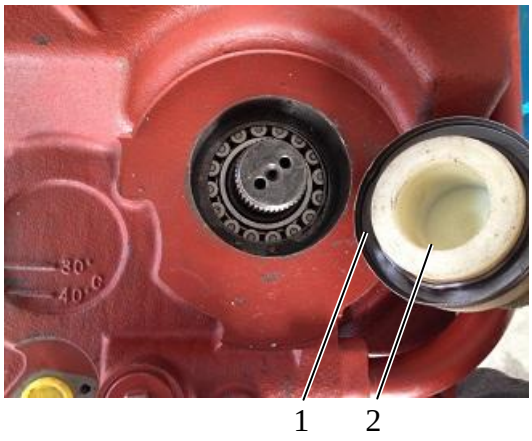


Figure 4-69

1 Oil seal

2 Oil seal assembling tooling (29380017071)

11. Install the oil seal into the transmission body with the tooling.

★ **Attention**

Replace the removed oil seal with a new one.

Figure 4-70

1 Output flange

12. Install the output flange onto the output shaft.

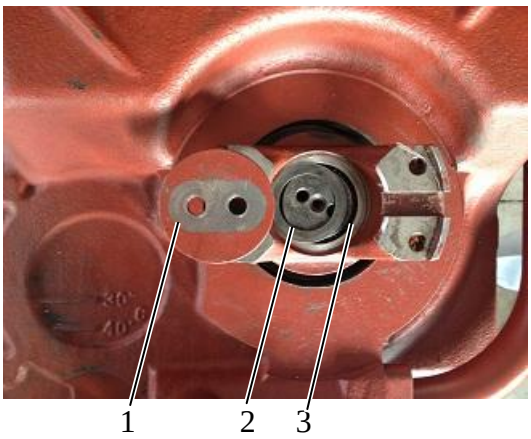


Figure 4-71

1 Pressure plate 2 Distance washer (A=0.6)

3 O-ring

13. Place the O-ring, distance washer and pressure plate in turn.

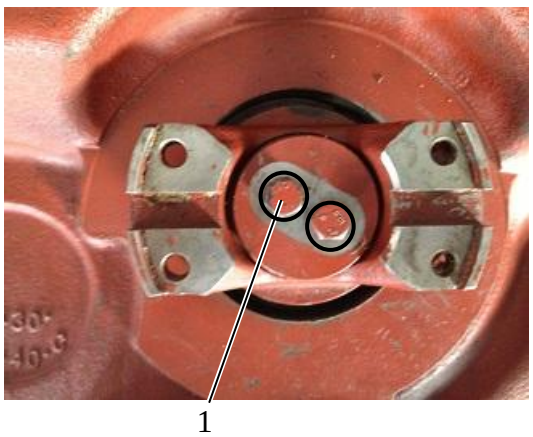


Figure 4-72

1 Hexagon head screw (M10*30)×2

14. Screw down the bolt between the pressure plate and the output shaft.

Nm : 46N.m

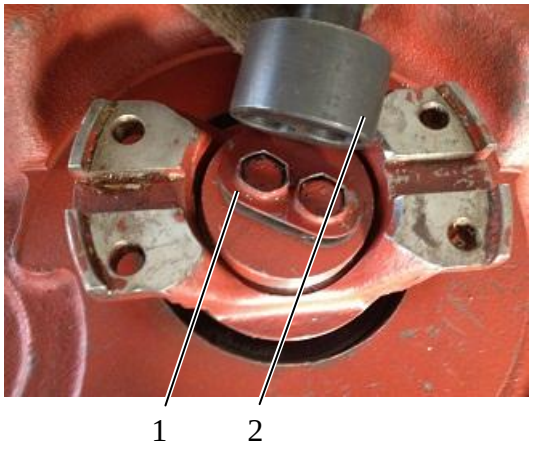


Figure 4-73

1 Lock washer

2 Lock washer assembling tooling (29380017101)

15. Lock the lock washer with the tooling.

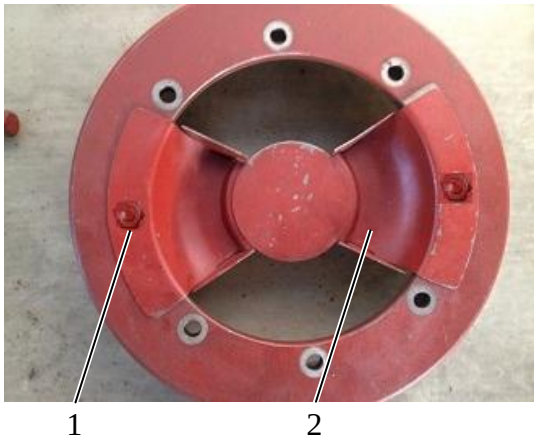


Figure 4-74

1 Nut (M10)×2

2 Butterfly pressure plate

16. Screw down 2 bolts (M10*25) between the butterfly pressure plate and the pressure plate and then install the additional washer and nut.

: 68N.m

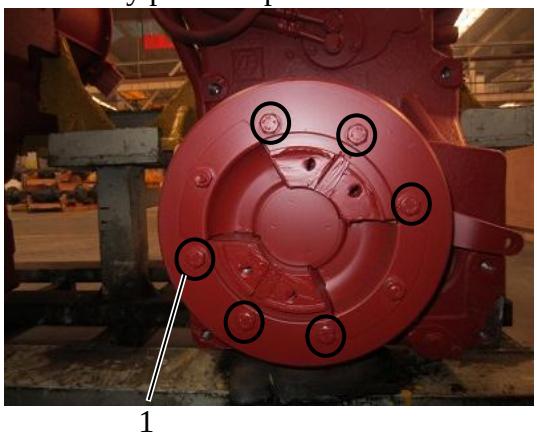


Figure 4-75

1 Hexagon head screw (M10*25)×6

17. After installing the bolt and washer between the pressure plate and the output flange, the assembling is completed.

Nm : 68N.m

Figure 4-76

1 O-ring 2 Intermediate shaft

3 Roller bearing 4 Intermediate shaft gear

4.2.2 Intermediate Shaft Component Assembly

1. Install the roller bearing into the bearing hole of the intermediate shaft gear and fix it with grease for standby.

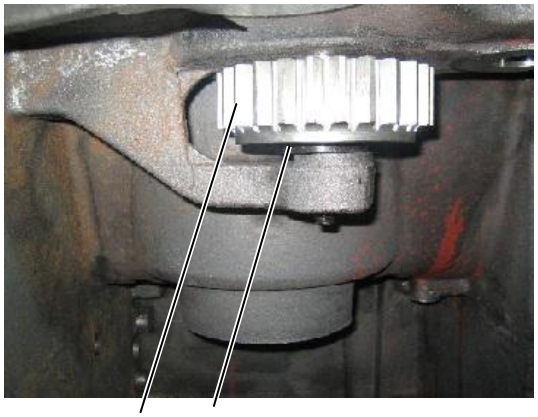


Figure 4-77

1 Intermediate shaft gear

2 Gasket

2. Place the intermediate shaft gear component into the gear groove of the transmission body; insert the intermediate shaft and install the gasket.

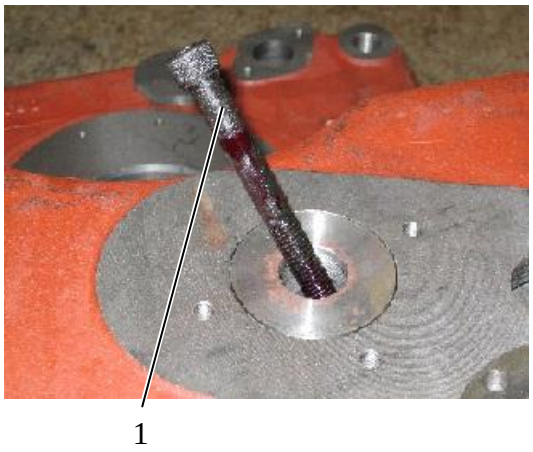


Figure 4-78

1 Head cap screw ×1

3. Install the screw and then install the sealing washer.

Nm : 80N.m

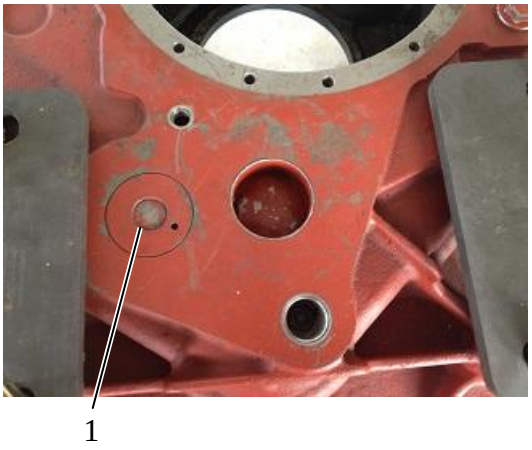


Figure 4-79

1 Sealing washer

4. The intermediate shaft assembling is completed.

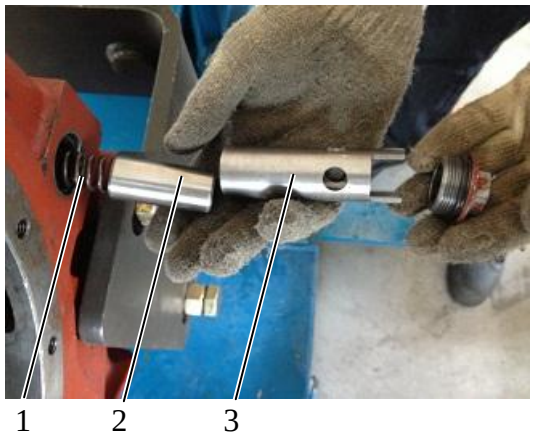


Figure 4-80

1 Pressure spring 2 Valve core

3 Valve sleeve

4.2.3 Torque Converter Pressure Control Valve Assembly

1. Install the pressure spring and the valve core into the valve sleeve hole.

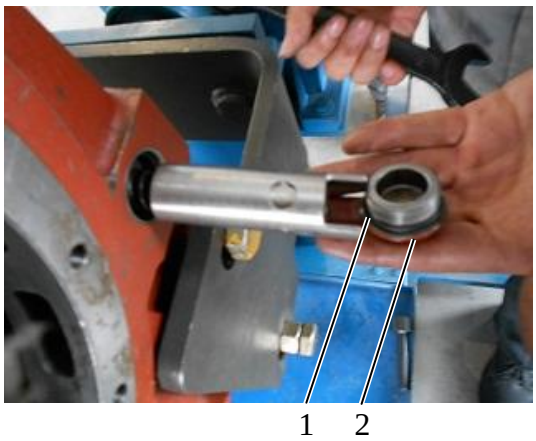


Figure 4-81

1 O-ring

2 Screw plug (CM30*1.5)

2. Firstly, install the O-ring onto the screw plug, and then install the valve sleeve component into the pressure maintaining valve hole of the torque converter of the transmission body and screw down the screw plug; after that, the assembling is completed.

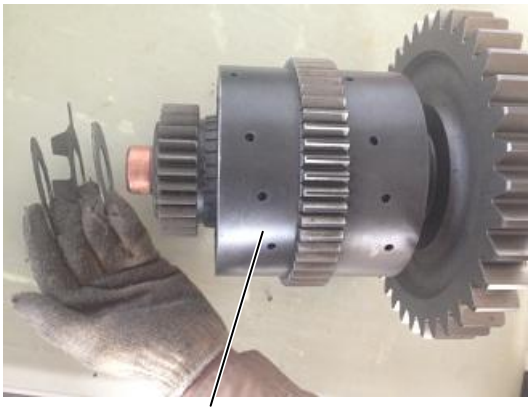


Figure 4-82

1 K3K4 clutch assembly

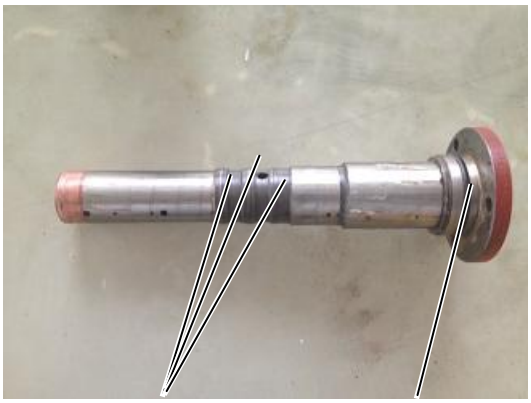


Figure 4-83

1 Piston ring×3

2 O-ring (49*3)

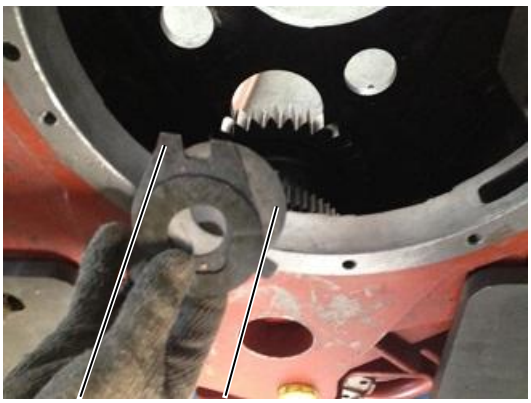


Figure 4-84

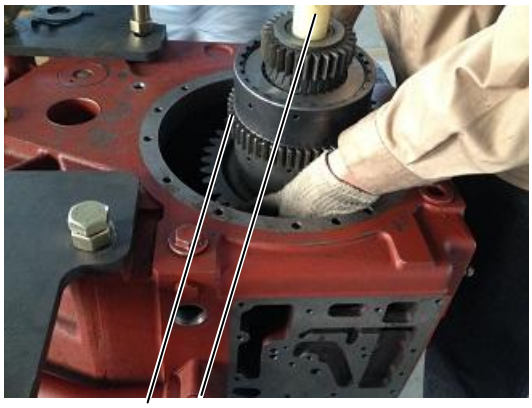
1 Thrust washer

2 Thrust washer

4.2.4 Assembling of the K3K4 Clutch Assembly

1. Install the O-ring and piston ring on the K3K4 clutch shaft.

2. Coat the thrust washer with grease and fix it onto the inner wall of the transmission body.



1 2

Figure 4-85

1 K3K4 clutch assembly

2 Clutch assembling tooling (29380017611)

3. Place the clutch assembly into the transmission body.

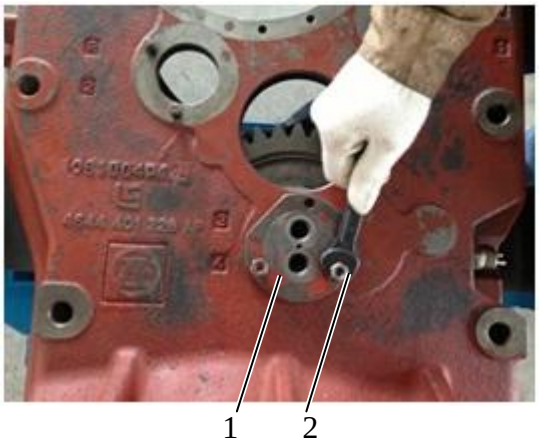
kg

Attention

When placing the clutch, use the tooling and jack up the bottom of the clutch to avoid its falling.

Figure 4-86

4. Overturn the transmission to make it be in a horizontal position, and then install the clutch assembling tooling.



1 2

Figure 4-87

1 K3K4 clutch assembly

2 Hexagon nut (M8)×2

5. Take out the tooling; install the K4K3 clutch shaft and screw down the nut fixing the clutch assembly.

★ **Attention**

The K3K4 clutch gear can flexibly rotate.

Nm : 23N.m

Figure 4-88

1 Magnetic meter seat 2 Dial indicator

3 Crowbar

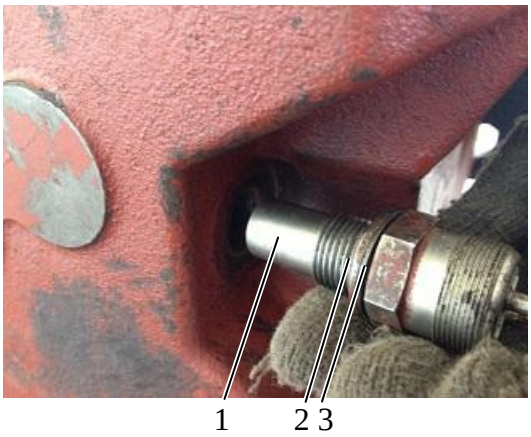


Figure 4-89

1 Rotation speed sensor

2 Adjustable washer

3 Packing washer

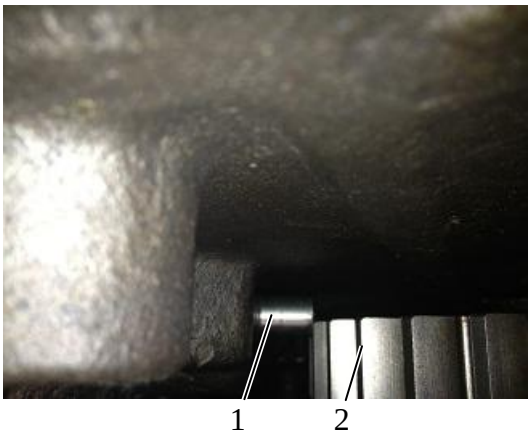


Figure 4-90

1 Rotation speed sensor

2 K3 gear

6. Slowly jack up the clutch assembly with the crowbar to make it have axial runout, and then record the dial indicator reading.

★ **Attention**

Select the adjustable washer with different thickness, so as to ensure that the axial clearance of the clutch assembly is: 0.1mm~0.3mm; after that, the assembling is completed.

4.2.5 Rotation Speed Sensor Assembly

1. Screw the rotation speed sensor into the mounting hole.

★ **Attention**

Before screw in, observe the mounting hole and rotate the clutch to align the K3 gear top at the hole center; after that, slowly screw in the sensor to make it contact with the gear top.

Figure 4-91

1 Rotation speed sensor

2. Screw out the rotation speed sensor by 120°~192° and measure the clearance between the sensor and the transmission body with the feeler gauge.

★ **Attention**

Ensure that the distance between the sensor and the K3 gear top is 0.5mm~0.8mm. Specifications of the rotation speed sensor: M18×1.5.

Figure 4-92

3. Select the proper adjustable washer and assemble it onto the sensor, and then screw down the sensor and coat it with the sealant; after that, the assembling is completed.

AT262 sealant

4.2.6 KRK2 Clutch Assembly

1. Coat the thrust washer of the clutch assembly with grease.

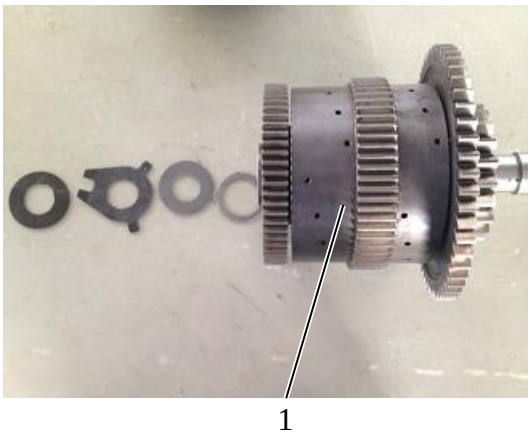


Figure 4-93

1 KRK2 clutch assembly

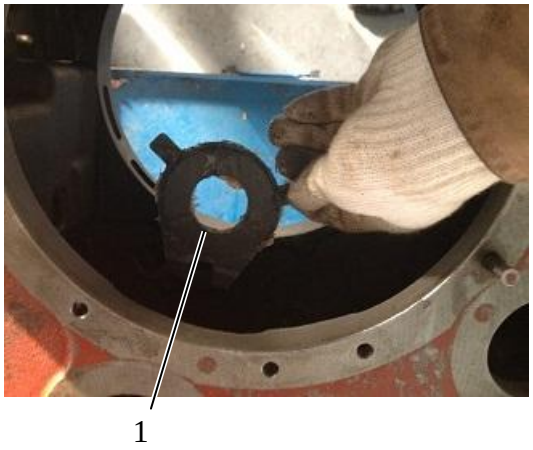


Figure 4-94

1 Washer

2. Place the washers onto the transmission body wall.

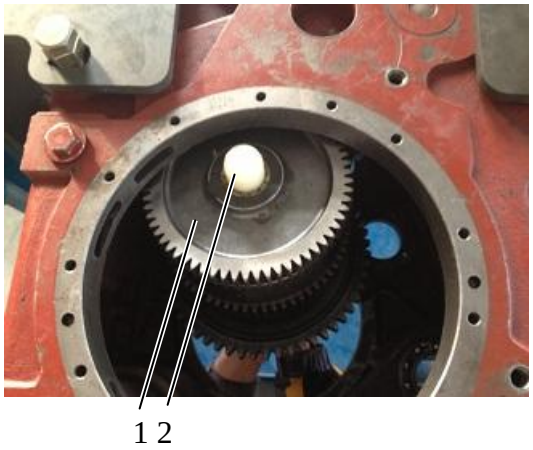


Figure 4-95

1 KRK2 clutch

2 Clutch shaft positioning tooling (29380017611)

3. Install the clutch tooling onto the KRK2 clutch and place it into the transmission body.

kg

Attention

When placing the clutch, jack up the clutch bottom with the tooling to avoid clutch falling.

Figure 4-96

1 Hexagon nut (M8)×2

4. Take out the clutch shaft installation tooling; install the KRK2 clutch shaft and screw down the nut fixing the KRK2 clutch shaft.

Attention

The KRK2 clutch gear can flexibly rotate.

Nm : 23N.m

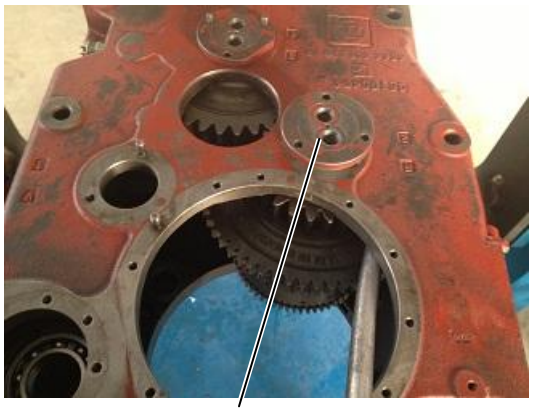


Figure 4-97

1 KRK2 clutch shaft

5. Slowly jack up the clutch assembly with the crowbar to make it have axial runout; measure and record the axial clearance of the clutch (the measurement method can follow that specified in 4.2.4 K3K4 Clutch Assembling). Select the adjustable washer with different thickness, so as to ensure that axial clearance of the KRK2 clutch shaft is 0.1mm~0.3mm; after that, the assembling is completed.

4.2.7 KVK1 Clutch Assembly

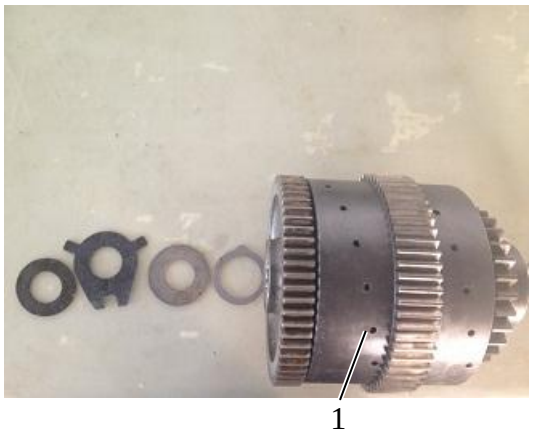


Figure 4-98

1 KVK1 clutch assembly

1. Coat the thrust washer of the clutch assembly with grease.

Figure 4-99

1 Washer

2. Place the washers onto the transmission body wall.

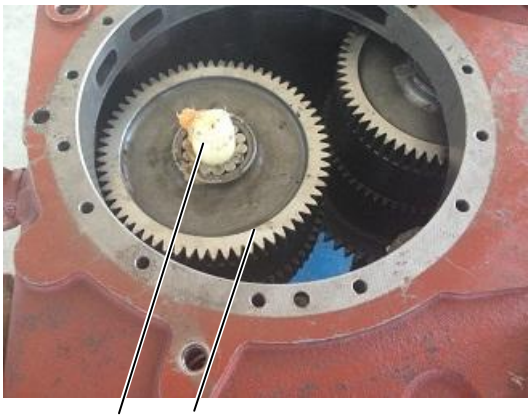


Figure 4-100

1 Clutch assembling tooling

2 KVK1 clutch assembly

3. Install the clutch tooling onto the KVK1 clutch and place it into the transmission body.

kg

Attention

When placing the clutch, jack up the clutch bottom with the tooling to avoid clutch falling.

Figure 4-101

1 Hexagon nut (M8)×2

4. Take out the clutch shaft installation tooling; install the KVK1 clutch shaft and screw down the nut fixing the KVK1 clutch shaft.

Attention

The KVK1 clutch gear can flexibly rotate.

Nm : 23N.m

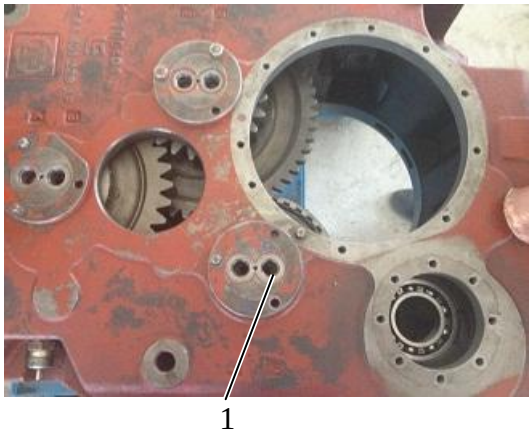


Figure 4-102

1 KVK1 clutch shaft

5. Slowly jack up the clutch assembly with the crowbar to make it have axial runout; measure and record the axial clearance of the clutch (the measurement method can follow that specified in 4.2.4 K3K4 Clutch Assembling). Select the adjustable washer with different thickness, so as to ensure that axial clearance of the KRK2 clutch shaft is 0.1mm~0.3mm; after that, the assembling is completed.

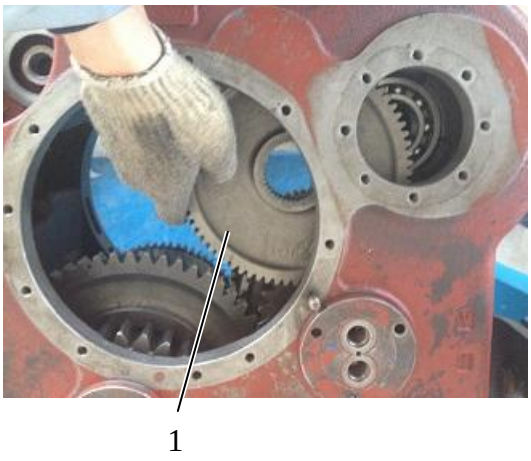


Figure 4-103

1 Transfer gear

4.2.8 Auxiliary PTO Assembly

1. Place the transfer gear into the transmission body.

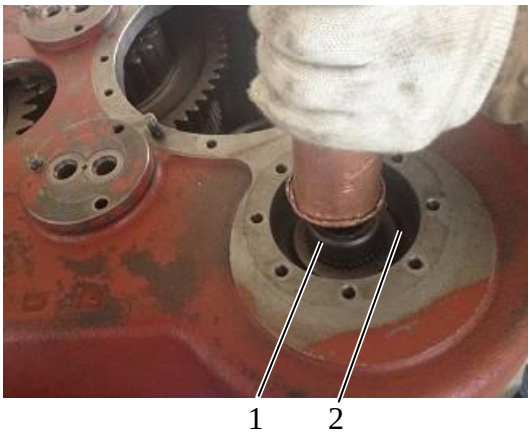


Figure 4-104

1 PTO shaft

2 Retainer ring (SW47)

2. Knock in the PTO shaft to make the retainer ring on the shaft fits with the gear.

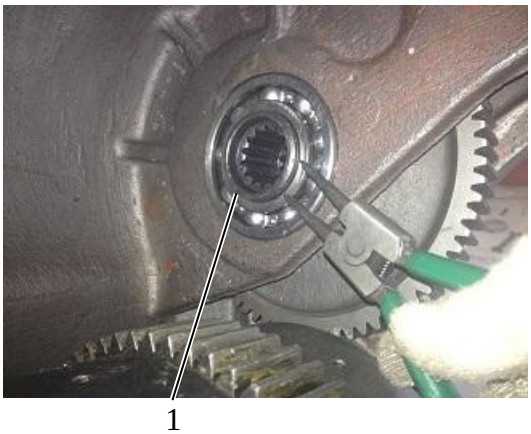


Figure 4-105

1 Snap ring (45*1.75)

3. Install the bearing snap ring on the PTO shaft with the snap ring pliers.

Figure 4-106

1 PTO end cover

4. Assemble the PTO end cover and install the additional packing.

★ **Attention**

Replace the removed packing with a new one.

Figure 4-107

1 Hexagon head screw (M8*16)×8

5. After screwing down the bolt between the PTO end cover and the transmission body, the assembling is completed.

Nm : 16N.m

4.2.9 Input Component Assembly

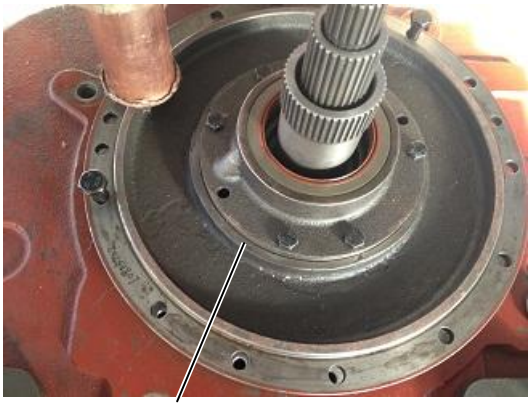


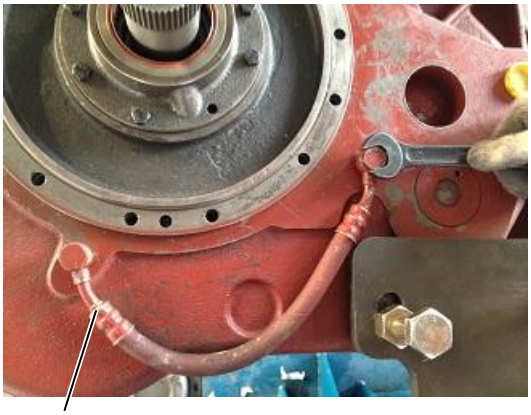
Figure 4-108

1 Input component

1. Install the input device onto the transmission body; install the additional packing and knock it in with the copper rod.

★ **Attention**

Upon installation, screw in two bolt positioning thread holes. Replace the removed packing with a new one.



1

Figure 4-109

1 PTO lubricating oil pipe component

2. Assemble the lubricating oil pipe component and screw down the hollow screw between the oil pipe and the transmission body.

Nm : 34±5N.m

1

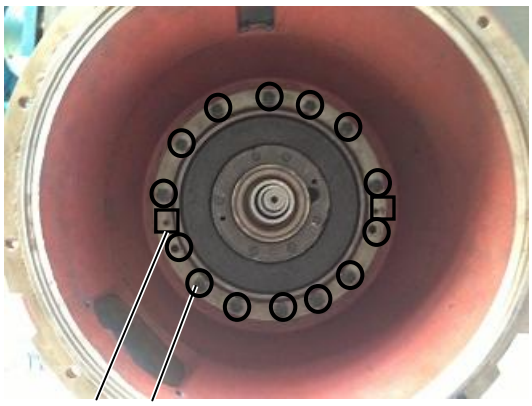
Figure 4-110

1 Torque converter connecting shell

3. Assemble the connecting shell and knock it in with the copper rod.

★ **Attention**

Upon assembling, align it at the positioning pin hole. Upon knock in, ensure that the force which is applied on the connecting shell is uniform.



1 2

Figure 4-111

1 Tension pin×2

2 Hexagon head screw (M10*50)×14

4. After screwing down the bolt between the transmission body, flange and connecting shell, the assembling is completed.

★ **Attention**

Align at the pin position, and repeatedly screw down the bolt in accordance with the diagonal sequence.

Nm : 68N.m

Figure 4-112

1 Hexagon head screw ×10

2 Hexagonal nut (M8) ×1

4.2.10 Main PTO Component Assembly

1. After installing the main PTO component and screwing down the bolt and nut between the PTO and the transmission body, the assembling is completed.

★ **Attention**

Repeatedly screw down the bolt in accordance with the diagonal sequence.

Nm : 23N.m

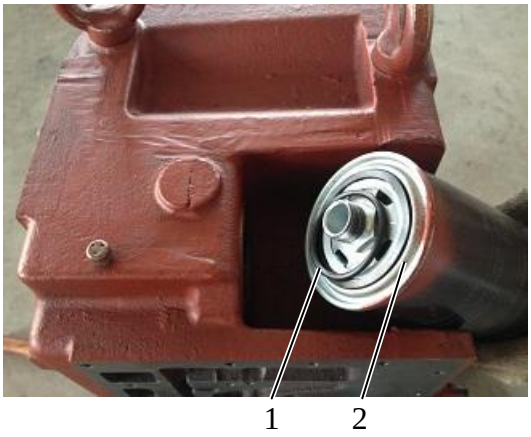


Figure 4-113

1 O-ring

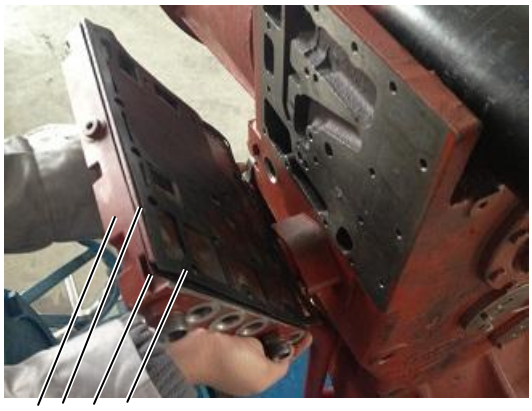
2 Oil filter

4.2.11 Oil Filter Assembly

1. Install additional O-ring onto the oil filter and screw in the transmission body.

Figure 4-114

2. Screw down the oil filter with the belt spanner.



1 2 3 4

Figure 4-115

1 Oil passage plate 2 Baffle plate

3 Paper pad 4 Paper pad

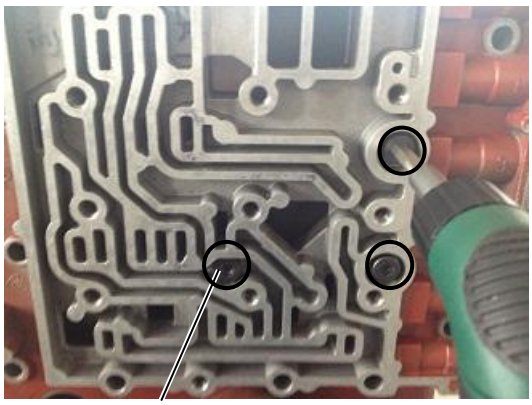
4.2.12 Transmission Control Valve Assembly

1. Respectively place the paper pad, lower partition plate, paper pad and oil passage plate onto the transmission body valve plate plane.

★ **Attention**

Replace the removed paper pad with a new one.

Before assembling, clean the valve plate, oil passage plate and baffle plate of the transmission body.



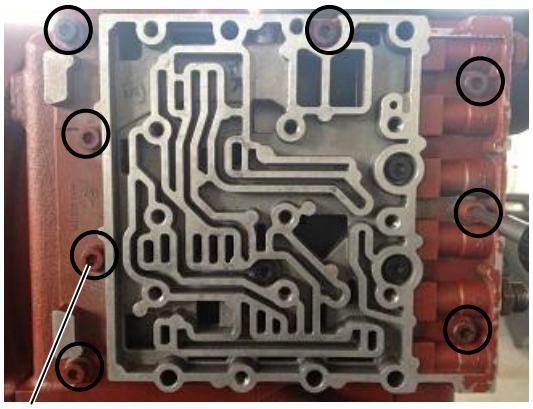
1

Figure 4-116

1 Head cap screw×3

2. Fix 3 bolts between the oil passage plate and the transmission body.

Nm : 20N.m



1

Figure 4-117

1 Head cap screw×8

3. Fix 8 bolts between the oil passage plate and the transmission body.

Nm : 20N.m

★ **Attention**

Repeatedly screw down the bolt in accordance with the diagonal sequence.

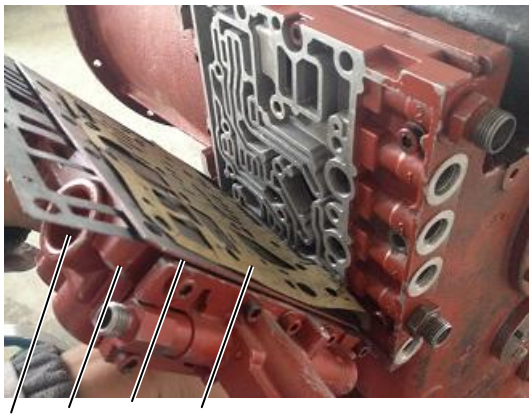


Figure 4-118

1 Paper pad 2 Transmission control valve

3 Baffle plate 4 Paper pad

4. Place the paper pad, upper partition plate, paper pad and control valve onto the oil passage plate.

★ **Attention**

Replace the removed paper pad with a new one.

Before assembling, clean the baffle plate and the variable speed valve.

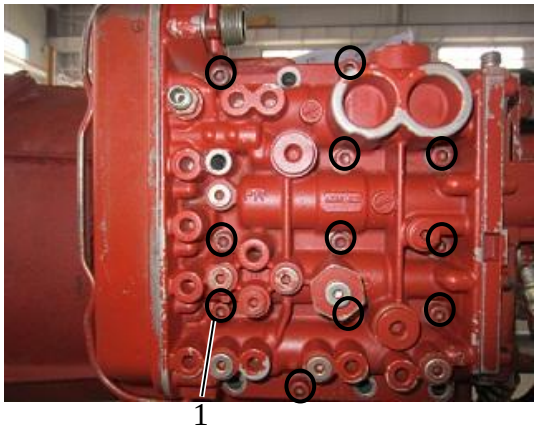


Figure 4-119

1 Head cap screw ×11

5. Screw down 11 bolts between the variable speed valve and the transmission body.

Nm : 20N.m

★ **Attention**

Repeatedly screw down the bolt in accordance with the diagonal sequence.

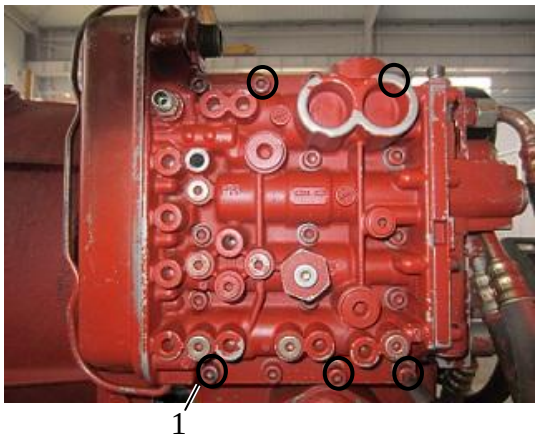


Figure 4-120

1Head cap screw ×5

6. Screw down 5 bolts between the variable speed valve and the transmission body.

Nm : 20N.m

★ **Attention**

Repeatedly screw down the bolt in accordance with the diagonal sequence.

Figure 4-121

1 Head cap screw

7. Screw down 1 bolt between the variable speed valve and the transmission body.

: 20N.m

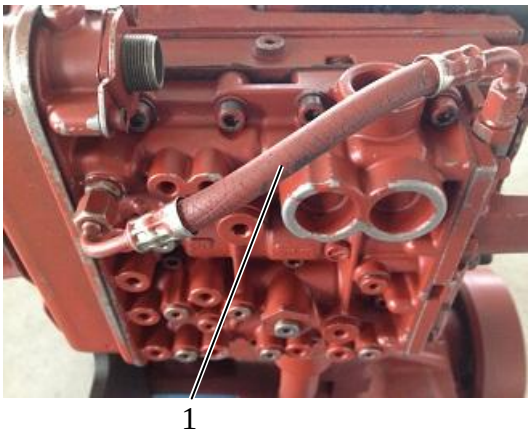


Figure 4-122

1 Oil pipe

8. Install the oil pipe of the variable speed valve.

Nm : 35±3.5N.m

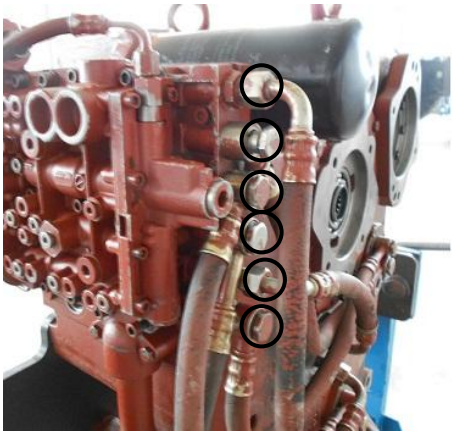


Figure 4 -123

9. From top to bottom, six oil holes on the oil passage plate are K2, K1, K3, K4, KR and KV oil pipes, which are connected with the oil passage holes on the K1, K2 and K3 shafts.

★ **Attention**

After adjusting the hose position, screw down the bolt again.

Nm : 55±5.5N.m

Figure 4-124

10. The assembling of the transmission control valve and the oil pipe component is completed.

4.2.13 Torque Converter Assembly

1. After installing the intermediate ring and the torque converter into the connecting shell, the assembling is completed.

kg

Attention

As there is no axial positioning after installing the torque converter, fixing measures shall be adopted to avoid its falling.

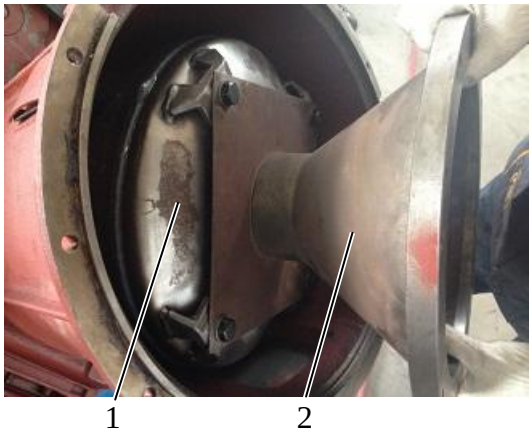


Figure 4-125

1 Torque converter

2 Intermediate ring

Figure 4-126

2. The torque converter assembling is completed.

5 Malfunction Diagnosis and Troubleshooting

5.1 Malfunction Diagnosis and Troubleshooting of the Transmission System

1. Vehicle start failure: Table 5-1

No.	Malfunction Point	Troubleshooting Method
1	Check if engaging the neutral gear of the gearshift handle	Engage the neutral gear
2	Check if the EST electric control box and wire plug are loose	Push and press the plug till there is a “click” sound
3	Check if the battery is fully charged	Charge or replace the battery
4	Check if the starter circuit has malfunction and if the starter fuse is burnt out	Return the circuit to normal

2. Normal vehicle start but traveling failure: Table 5-2

No.	Malfunction Point	Troubleshooting Method
1	Check if the transmission has sufficient oil and check the oil level in case of cold and hot states	Adjust the oil level to normal
2	Check if the wire plug of the transmission control valve is screwed down	Screw down the plug
3	Check if the EST electric control box and wire plug are loose	Push and press the plug till there is a “click” sound
4	Check if the plug connecting with the gearshift selector cable is loose	Firmly insert the plug.
5	Check if the locking switch of the gearshift selector neutral gear is turned on	Turn on the neutral gear locking switch
6	Check if the parking brake is released	Loosen the parking brake
7	Check if the transmission oil pressure on the instrument panel is normal	Check the transmission oil pressure gauge
8	Check if the ventilating valve on the transmission is blocked and if oil flows out	Clean the ventilating valve and check if the oil quantity is proper.
9	Check if the speed sensor plug is loose and if the speed sensor cable wire is worn out.	Screw down the plug and wrap up or replace the worn-out cable wire.

3. Functions of the parts and common malfunction troubleshooting

(1) Electric control box

After turning on the electric lock switch and turning the gearshift handle to the neutral gear, the electric control box is in a ready state. To shift the gear after the vehicle start, rotate the gearshift handle to select certain gear, and the electric control box can, based on the electric signal from the output speed sensor and the gearshift handle, automatically judge if it can turn to the preselected gear at the current speed. If these two have too large speed difference, the computer can command the solenoid valve to engage the transmission with certain applicable min. speed gear and then turn to the preselected speed gear at an interval of 2.5s. For example, if engaging the third gear from the first gear, the computer will identify the speed signal of the speed sensor and judge if the speed is qualified after receiving the electric signal from the gearshift handle; if the speed is unqualified, it will automatically send the electric signal to the solenoid valve and turn to the second gear firstly; after the speed reaches 14km/h, it will turn to the third gear to mitigate impact.

Common malfunction example:

In case of the loader maintenance, clean it with water; after that, it is found out that the vehicle is unavailable for gear shift and can't be started. After check, it is found out that the electric control system of the vehicle has normal circuit connection, which is free from mechanical malfunction. The cause is that the electric control box is affected with damp during cleaning; after being dried, the complete vehicle has a normal traveling. Accordingly, during the vehicle cleaning and maintenance, it is necessary to pay attention to the waterproof protection of the computer box and the handle.

The vehicle has normal traveling originally; however after parking for oil filling, it is found out that the vehicle engine can be started while the vehicle can't be driven. After check, it is found out that both the electric control system circuit and the transmission oil pressure are normal. Later, it is found out that the lower plug of the electric control box is improperly inserted. The cause is that there is a clip fixing the electric control box plug on the electric control box, when there is one "click" sound after inserting both ends of the wire plug into the pin, it means that the clip has firmly fixed the plug; or else, vibration arising from vehicle traveling will loosen the plug.

Figure 5-1

1 Electric control box of the transmission

2 Cable plug

3 Clip

(1) Electric control box of the 4WG200 transmission

The vehicle structural part has malfunction; after welding the vehicle structural parts, it is found out that the vehicle can't be started. After check, it is found out that the electric control box is burnt out.

After starting the vehicle, turn off the electric lock. Several minutes later, the counter on the instrument panel smokes and the vehicle can't be driven. After check, it is found out the cause is violation to the operation regulations: The electric lock is turned off when the engine dosen't stop. In such case, the generator can't charge the storage battery and sometimes it will product higher surge voltage, which will result in dozens of amperes transient current and electric control box damage. However, if connecting the generator with the storage battery circuit, it will stabilize the circuit voltage. Accordingly, it is necessary to turn off the electric lock after the engine stops.

(2) Output speed sensor

The output speed sensor is used to record the rotation frequency of the output gear, so as to help the computer compare the preselected speed with the current speed and make the gearshift decision. The resistance value of the output speed sensor is 1020±100; if the resistance value is 0 or ∞, it means that the sensor has short circuit or open circuit, which shall be replaced.

Common malfunction example:

The vehicle has the first and second gears, while no third and fourth gears. Check steps: After turning off the electric lock, screw off the output speed sensor plug and check it with the universal meter. If the resistance value is 0, it means the speed sensor is damaged.

The complete vehicle is unavailable for any gearshift. After check, it is found out that the oil level is normal and the cable wire between the electric control box and the speed sensor is worn out by metal; after re-wrapping, the vehicle returns to normal.

(3) Gearshift handle

Its inside mainly has two inching switches; by forwards and backwards pulling the handle and rotating the handle sleeve, the direction and speed can be selected.

Common malfunction example:

The user reflects that the loader can't be accelerated to the fourth gear. After check, it is found out that the transmission oil level is normal but the 8# wire of the 12-hole plug connecting with the gearshift handle is loose, and the cause is that the 8# wire has poor contact. When engaging the fourth gear, the computer can only receive the electric signal from the third gear; accordingly, the loader is unavailable for the fourth gear.

(4) Other typical malfunction

After the transmission oil replacement, the vehicle can't be driven after about 20m traveling;

after stop and restart, it can only be driven for 10~20m. After check, it is found out that the electric control system has normal circuit, which is free from mechanical malfunction. And the cause is that, the oil level is not checked as specified after oil replacement, which is seriously insufficient. After filling oil till reaching the normal oil level, the vehicle can be normally driven.

5.2 Malfunction Diagnosis and Troubleshooting of Transmission

1. Cause of the gearshift clutch malfunction

The transmission clutch is a kind of vulnerable part. When engaging the transmission clutch, the hydraulic pressure will pass through the piston; overcome the spring force and press down the friction lining. The friction lining will contact with the metal plate and both of them will be pressed down along with the hydraulic pressure increase.

In case of each gearshift, friction will occur between the friction lining and the steel sheet. Though the friction heat quantity arising from the coolant has been considered in design, the cooling effect is limited. When becoming thinner, the clutch will need more hydraulic oil to bring full engagement between the friction lining and the steel sheet; in such case, the diesel engine shall be further accelerated.

When accelerating the engine to very high idle speed, the friction lining slipping time on the steel sheet will be extended accordingly and the friction heat quantity will be larger as well. When the increase of the hydraulic oil heating time and temperature can change the sealing characteristics of the transmission, there will be internal leakage in the transmission. And, the internal leakage will increase the heat quantity from two aspects:

When the high pressure oil passes through the damaged seal, it will leak and result in friction, thus the oil temperature will continue rising;

As the oil leakage will reduce the oil flow in the system; to fully engage the clutch, the hydraulic pump shall convey much more oil to produce necessary oil pressure, namely, the engine shall be further accelerated to make the oil delivery pump output larger flow. Such vicious circulation will finally result in too hot or damaged clutch and even clutch failure.

2. Common malfunction diagnosis and troubleshooting method of the transmission and its oil circuit system

(1) Gear engagement failure

Malfunction cause: Incorrect gearshift position; oil leakage of the clutch piston; low transmission pressure; blocked oil circuit in the transmission body.

Troubleshooting method: Engage the gear again or check the transmission control valve; remove, check and replace the rectangular ring. The details of the troubleshooting method of the low transmission pressure are shown in (2) Removal, cleaning and dredging.

(2) Low transmission pressure

Malfunction cause: Improper adjustment of the main pressure regulating valve; broken spring and spring failure; low transmission oil level; blocked filter screen or oil passage; oil leakage of the clutch; variable speed oil pump failure.

Troubleshooting method: Re-adjust or replace the spring; fill oil till reaching the specified oil level; clean or dredge it; replace the rectangular ring; do inspection or replacement.

(3) Too high oil temperature

Malfunction cause: Too long operation time; insufficient or excessive oil in the transmission; clutch facing slipping; clutch release failure.

Troubleshooting method: Stop or idly run the vehicle for a certain period; fill oil till reaching the overflow hole; check the oil pressure and seal ring; check the position of the clutch control oil circuit or control lever.

(4) Low transmission oil pressure of certain gear

Malfunction cause: Damaged rectangular ring of the piston; damaged oil circuit seal ring; oil leakage or blockage of the oil passage.

Troubleshooting method: Replace the rectangular ring of the piston; replace the seal ring; do check and troubleshooting.

(5) Disordered gear

Malfunction cause: Leakage of the shaft end seal ring.

Troubleshooting method: Replace the seal ring.

(6) System oil leakage

Malfunction cause: Loose connector; damaged seal ring.

Troubleshooting method: Screw down the connector; replace the seal ring.

(7) Automatic oil level rise of the transmission oil pan

The cause is that the input shaft oil seal of the steering pump or the working pump is damaged; the oil of the hydraulic system flows to the transmission oil pan via the torque converter gear case and increases the oil level. The old oil seal can be replaced with a new one according to the damage conditions.

Shandong Lingong Construction Machinery Co.,Ltd
Address:Lingong Industry Park,Linyi Economic Development Zone,Shandong,China
Tel:0086-531-66590966
Fax:0086-531-66590959
Customer Service Tel:0086-531-66590955
Email:export@sdlg.com.cn
http://www.sdlg.cn