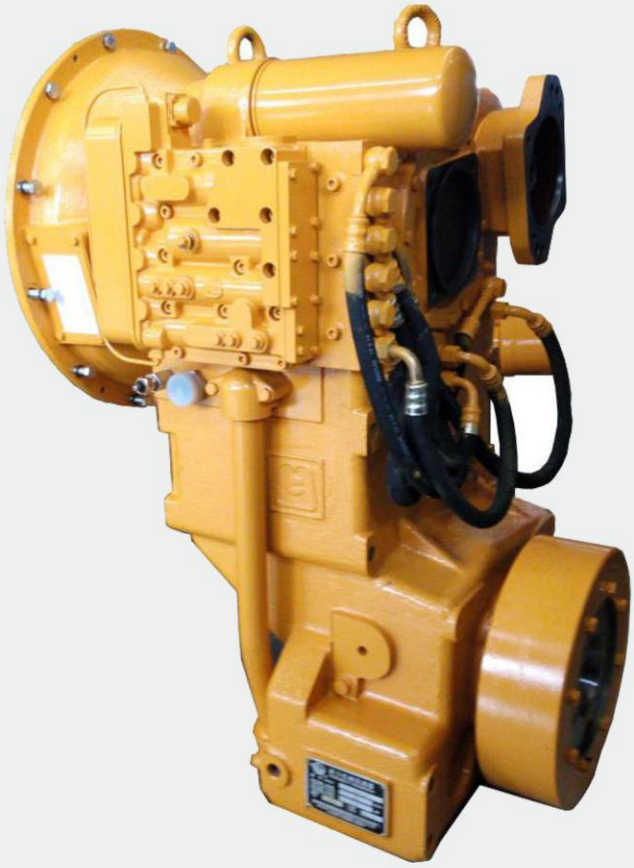
YD13/YD133/YL13 变速箱

YD13/YD133/YL13 Transmission Service Manual



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SDLG

Foreword

This service manual covers the removal and refitting procedures, service technology and standard requirements for YD13 transmission, so as to help service personnel understand the method of removing and refitting it and to lay a solid technical foundation for them concerning the fault determination and proper service. The manual is applicable to YD13/YD133/YL13 transmission as they belong to the same serialized product.

This service manual mainly includes the following:

Chapter 1 Introduction

This chapter mainly describes precautions for servicing transmission, the meaning of all symbols which are included in the following text and the tightening torque for plain bolts.

Chapter 2 Transmission system

This chapter mainly describes the gearshift principle of transmission, electric control system, functional test and the operation and maintenance of transmission.

Chapter 3 Removal of transmission

This chapter describes how to remove each part properly and the relevant precautions in the process.

Chapter 4 Refitting of transmission

This chapter describes how to refit each part properly and the relevant precautions in the process.

Chapter 5 Fault diagnosis and troubleshooting

This chapter introduces common fault diagnosis and troubleshooting for the EST controller and the transmission.

Note

The specifications of parts covered by this Manual may be subject to modification due to the improvement of this product, and no further notice will be given upon such modification, so please contact SDLG for the latest data.

Contents

Chapter 1 Introduction

1.1 Safety precautions

⚠Important safety notice

Service and maintenance is essential to the safe operation of vehicle. This Manual mainly states how to remove and refit transmission assembly.

To prevent relevant from being hurt, this Manual takes ⚠ as a safety sign. With regard to precautions attached with this sign, it is required to do operation carefully. In case of potential hazard, first take into account the safety of yourself, and meanwhile take necessary protective measures.

⚠Safety notice

In the process of removal and refitting, improper operation methods will lead to part damage, service life shortening and operating performance deterioration, and in addition, it may cause personal injury. Therefore, please read related content in this Manual carefully before removing and refitting any part.

1. The parameters, figures and content covered by this Manual apply to products of standard configuration. As regard to variants, please consult SDLG or relevant data.

2. In the repair workshop, a separate or special area shall be provided for removal and refitting of parts or for removed parts, corresponding tools and parts shall be placed at an appropriate area, and the operation area shall be kept clean and free of oil dirt and other contaminant. Do not smoke at any place other than the specified smoking area. Never smoke during operation, and it is required to provide fire extinguishing device.

3. When welding operation is required, it shall be done by a trained and experienced welding worker. During welding operation, it is required to use shield and wear appropriate protective equipment such as welding gloves, blind, work cap and overall.

4. Before removing transmission & torque converter, be sure to clean dirt from the external surface so as to prevent parts from being contaminated during removal.

5. During operation, do wear safety shoes and safety helmet. Do not wear inappropriate overall. The overall must be buttoned. When striking parts with a copper rod, wear goggles.

6. Petrol, kerosene and water-based oil cleaner can be used to clean removed parts.

7. When using a crane or other hoisting equipment, first check the slings for damage. It is required to use hoisting equipment with sufficient lifting capacity. During lifting operation, do lifting operation slowly at appointed position so as to prevent parts from colliding with each other. Do not work under lifted parts.

⚠ CAUTION

As the torque converter can not be positioned axially, avoid torque converter from sliding down during removal and refitting of transmission. See Fig.1-1 as below.

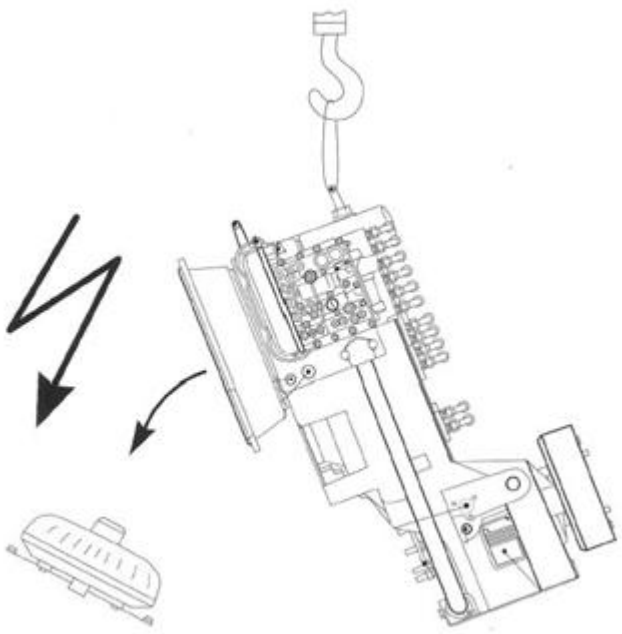


Fig.1-1

8. When two or more persons are required to work simultaneously, they shall be in agreement with the same operation procedure to avoid accident due to out of step.

9. Be sure to keep all tools properly and get familiar with their operating methods.

10. To align one hole with another, do not insert your hand or finger into the holes. As regards to parts requiring assembly with hands, pay attention to the holding position and check it for risk of crushing.

11. Be sure to perform inspection on the removed parts. The part of which the defect has already affected the performance must be replaced.

12. After each part is fitted, no interference is allowed.

13. When passing the oil seal and the seal ring, through key groove, threaded hole and step during installation, take corresponding protective measures so as to avoid damaging them.

14. In the process of assembling parts, the tools used shall match corresponding threaded fasteners so as to prevent the fasteners from being damaged.

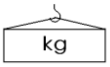
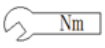
15. To tighten fittings body and plug screw, do not use a pneumatic wrench. Be sure to rotate them to some extent by hand, and then use a torque wrench of corresponding specification to tighten them to required torque.

16. When draining oil from the transmission, be sure to unscrew the drain plug slowly so as to prevent oil from spurting out.

1.2 Description of signs

To make this Manual fully play its roles, the signs in Table 1-1 are used in respect of important safety and quality requirements.

Table 1-1

Sign	Item	Remarks
	Safety	During operation, pay special attention to safety.
		During operation, pay special attention to safety because of inside pressure.
	Note	During operation, pay special attention to technical requirements so as to ensure operation quality.
	Weight	Weight of component or device and removal & refitting modes.
		Pay attention to the selection of sling and the posture during operation.
	Tightening torque	Pay special attention to tightening torque during assembly.
	Application	Points requiring the application of adhesive and grease.
	Oil and water	Add a certain amount of oil, water and fuel.
	Draining	Position for draining oil or water, as well as draining amount.

1.3 Tightening torque table for plain bolts

Table 1-2

Strength class of bolt	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

Strength class of bolt	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
Strength class of bolt	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

2. Transmission system

2.1 Transmission

2.1.1 Description of transmission

The YD13 type powershift transmission (with the maximum input power of 130 KW) consists of a hydraulic torque converter and a rear-mounted fixed shaft transmission with multi-disc friction clutch. Our company provides Loader LG938L equipped with YD13 transmission (4 forward gears and 3 reverse gears), road roller RS8220 equipped with YD133 transmission (3 forward gears and 3 reverse gears, without torque converter) and road roller RP9300 with YL13 transmission (2 forward gears and 2 reverse gears).

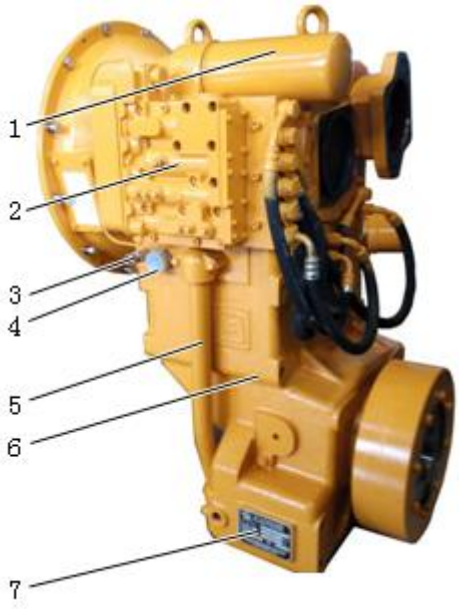
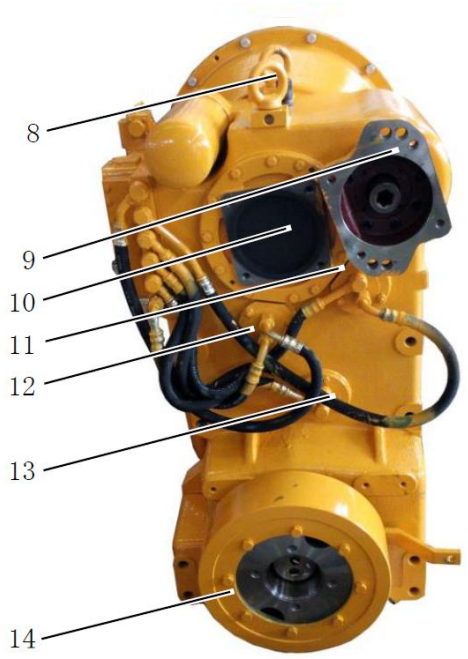


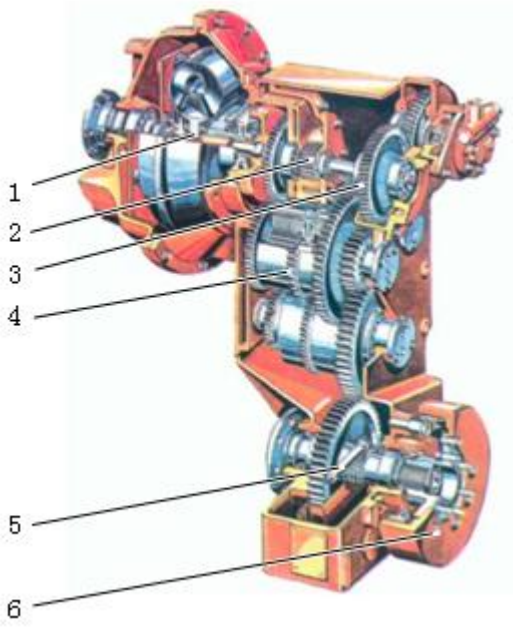
Fig.2-1

1. Transmission control valve
2. Oil filter
3. Torque converter oil temperature measuring port
4. Oil outlet of torque converter to oil cooler
5. Oil suction pipe
6. Transmission body
7. Nameplate



8. Eye screw
9. Auxiliary PTO
10. Main PTO
11. KVK1 clutch shaft
12. KRK2 clutch shaft
13. K3K4 clutch shaft
14. Parking brake

Fig.2-2



1. Hydraulic torque converter
2. Transmission pump
3. PTO gear
4. Clutch (triad)
5. Output shaft
6. Parking brake

Fig.2-3

2.1.2 Basic parameters of torque converter and transmission assembly

Table 2-1

Items		YD13	YD133	YL13
Torque converter	Type	ZFW305	N/A	ZFW320
	Torque ratio	2.3	N/A	2.52
	Working	80~100 ℃, a	N/A	80~100 ℃, a

	temperature		maximum of 120℃		maximum of 120℃
Transmission	Type		Fixed-shaft powershift	Fixed-shaft powershift	Fixed-shaft powershift
	Transmission range		4 forward gears and 3 reverse gears	3 forward gears and 3 reverse gears	2 forward gears and 2 reverse gears
	Drive ratio	Forward I	3.91	8.936	3.7
		Forward II	2.304	4.543	1.603
		Forward III	0.964	1.90	N/A
		Forward IV	0.617	N/A	N/A
		Reverse I	3.91	8.936	3.7
		Reverse II	2.304	4.543	1.603
		Reverse III	0.964	1.90	N/A
	Type of transmission pump		Built-in gear pump	Built-in gear pump	Built-in gear pump
	Pressure (bar)		13~17	13~17	14~17

2.1.3 Gearshift principle of transmission

1. Transmission structure principle

Actuator in YD13 transmission is composed of 6 clutches (i.e. K1, K2, K3, K4, KV (forward gear clutch) and KR (reverse gear clutch)), and different gearshifts can be achieved through the intercombinations among them, and each gearshift requires two clutches working simultaneously; YD13, YD133 and YL13 transmission working principles are respectively shown in Fig.2-4, Fig.2-5 and Fig.2-6.

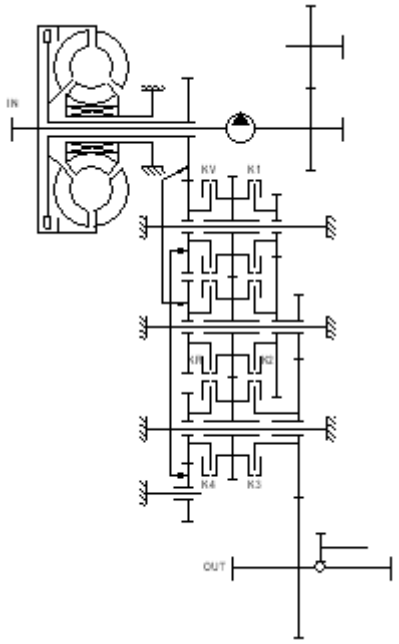


Fig.2-4 (YD13)

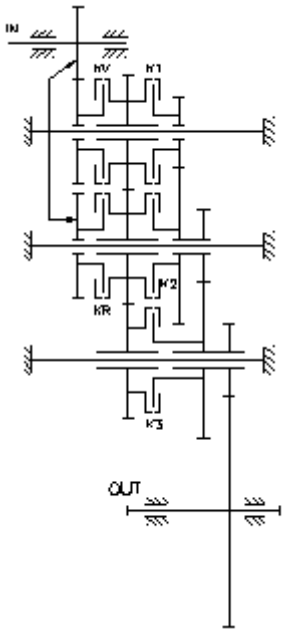


Fig.2-5 YD133

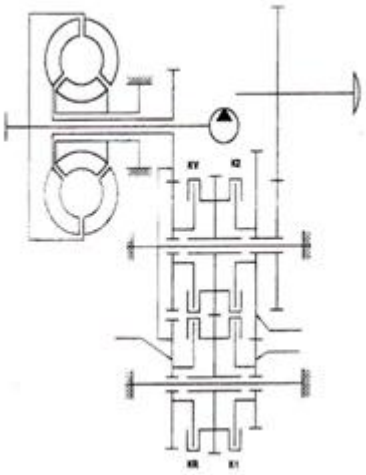


Fig.2-6 (YL13)

2. Principle of transmission hydraulic oil system – take YD13 for example

The gear pump to supply oil for the torque converter and control valve is installed inside the transmission and driven directly by the engine via PTO shaft, with flow of Q=35 L/1000 r/min. The oil pump absorbs oil through the oil suction filter (primary filter) in the oil circuit, pumping the pressurized oil into the spin-on oil filter (fine filter). The oil filteration precision is 0.025 mm, and the filteration area is 5,100 cm^2.

The oil flowing from the filter with the working pressure restricted by the pressure control valve (main pressure regulating valve) passes through the pressure control valve to the control valve. The pressure control valve regulates the boost pressure of the clutch cylinder at the moment of gear shifting, i.e. the oil pressure will drop instantaneously when gearshifting, but after gearshifting (after clutch engagement), it will return to 13~17 bar (the pressure restricted by the pressure control valve). This can reduce the impact of gearshifting and improve gearshifting efficiency; the oil passed through the control valve flows directly to the clutch. The shifter valve is positioned by steel ball, spring and groove.

The oil inlet line of the torque converter is equipped with a by-pass valve (opening pressure of 8 bar) to prevent the element damages due to high internal pressure of the torque converter.

According to the hydraulic transmission working principle, the oil is the medium for energy transfer

inside the torque converter. To avoid oil cavitation, the torque converter cavity should always be full with oil, which is guaranteed by the torque converter pressure control valve (back pressure valve) installed on the torque converter oil outlet line (opening pressure of 2.5 bar). The oil spilled from the torque converter flows directly into the oil cooler.

The oil flowing from the oil cooler enters the transmission lubricating oil circuit, providing all lubricating points with sufficient lubricating cooling oil. An additional pressure cut-off valve can be installed to the transmission upon operational requirements.

The pressure cut-off valve can be easily controlled through a secondary brake pedal regulating the air pressure or oil pressure. The hydraulically controlled pressure should be no less than 40 bar. The pneumatically controlled pressure should be no less than 2.5 bar.The pressure cut-off valve functions to cut off the oil pressure of the clutch oil line, and the clutch can be disengaged when the gearshift valve stops working. So the engine output power can be supplied to the external pump completely. If the pressure cut-off valve is used, there’s no need to put the gearshift valve at the neutral position.

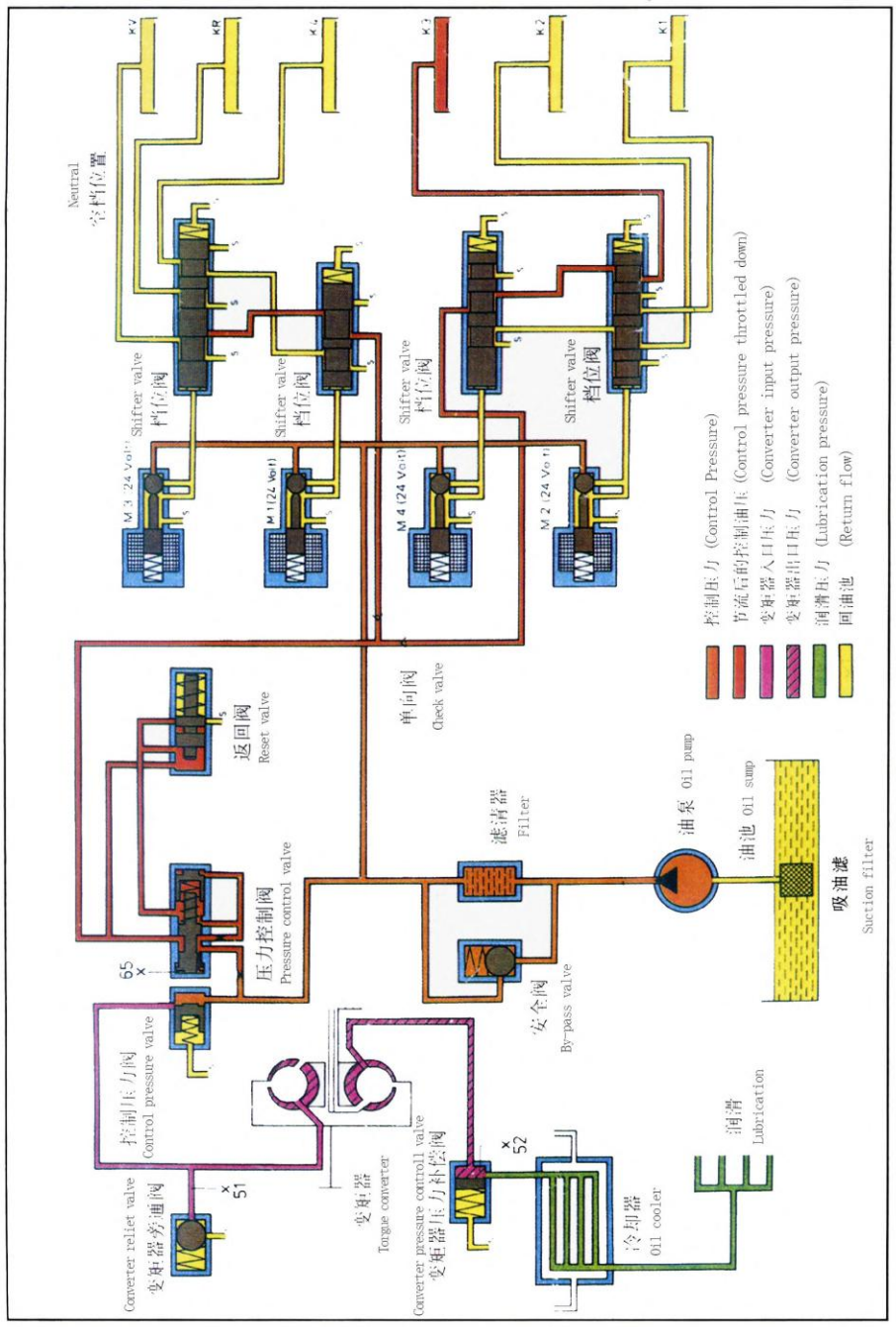


Fig.2-7 Schematic of transmission control hydraulic system

2.1.4 Transmission electrical control system

The gearshifting on the transmission is of electro-hydraulic control, and YD13 transmission with EST semi-automatic gear controller is shown in Fig.2-8. Regulate the hydraulic slide valve through the solenoid valves connected the selector to shift gears in turn without skipping. The gear pump to supply oil for the torque converter and control valve is installed inside the transmission and driven directly by the engine via PTO shaft. The hydraulic transmission oil passed through the oil suction filter and the pressure control valve in the oil circuit flows into the transmission control valve, and

the transmission control pressure is 13~17 bar. The pressure control valve regulates the boost pressure of the clutch cylinder at the moment of gearshifting, reducing the impact of gearshifting and improving the gearshifting efficiency.

Fig.2-8

1. EST semi-automatic gear controller

(1) Principle

The EST series gear controller is an electric control system mainly composed of EST-4 (4-valve) electric control unit as shown in Fig.2-8, with the semi-automatic control function for gearshifting. This system mainly consists of the five components below:

(a) Gearshift lever DW-4 (four-gear selector), installed under the steering wheel and operated by left hand;

(b) Electric control unit EST-4;

(c) Special purpose wire harness and connector;

(d) Solenoid valve on the control valve;

This control system is currently used to control the YD13 type transmission for the loader. Both the signals of DW-4 selector and the other signals of the whole vehicle circuit are transferred to EST-4 electric control unit. After analysis and determination through combining all the signals and according to the transmission control requirement, the electric control unit outputs the corresponding voltage to the solenoid valve on the transmission control valve. The solenoid valve assembly controls the corresponding oil circuit, and the hydraulic oil drives the appropriate clutch,

thus achieving the direction and gear control. The EST-4 electric control unit not only controls the direction and the gearshifting on the transmission, but also provides four lines of output signals for the whole vehicle circuit, including neutral gear signal AS (for interlock start), reverse gear signal RF (for reverse indication), kickdown indication (H1) and alarm indication (H2). See “EST-4 output signal function table” below for output signal status. These output signals are all positive outputs, i.e. the voltage is +24 V when signal is available.

The EST-4 electric control unit has detection and protection functions, and all the outlet cable plugs should be connected before powering it for operation. As for “Vehicle electrical system”, the power positive and negative cables must be connected, the signal AS for interlock start should be also applied, and others are connected as needed. If one of the solenoid valves on the transmission control valve fails to be connected, or short circuit occurs or the power voltage appears abnormal, the electric control unit will lock all outputs but only send out the alarm signal (signal lamp H2 will flash, or the unit will click). In this case, switch off the power to clear the fault, and then switch on the power again for normal operation.

For the operation of the control system, in addition to pulling the DW-4 selector lever to shift gears and control directions, the brake signal BR and emergency braking BR2 in the vehicle electrical system will also affect the output of the controller. Under forward I and II gears or reverse I and II gears, if one of the two signals is connected to +24V, EST-4 output will remain the same as the neutral of the corresponding gear on the DW-4.

Technical parameters:

Table 2-2

Rated voltage	DC 24 V
Working voltage range	DC 20~32 V
Input current	A maximum of 5 A
Output signal current	A maximum of 0.5 A for each line
Working temperature	-20~+70 ℃
Storage temperature	-40~+80 ℃

(2). Operation

Before starting the engine, put the DW-4 gear selector lever at “N” position, or the engine cannot be started. After switching on the power, put the DW-4 selector at neutral when using it for the first time, then shift to another gear as required, or the electric control unit EST-4 has no output;

(a) Push or pull the control lever of the gear selector horizontally to change the driving directions, including F (Forward), N (Neutral) and R (Reverse); rotate the control lever to shift gears, counterclockwise for upshift and clockwise for downshift, but never apply too much operating force. Marks “1”, “2”, “3” and “4” on the lever refers to four gears among which “1” is the lowest speed and “4” is the highest speed;

(b) As the controller has kickdown (KD) function, when DW-4 selector is put at “Forward” II gear, pressing the lever forward can shift to I gear, and meanwhile the indicator lamp H1 comes on. This function does not work at other gears other than II gear. Any method of the followings can cancel the “kickdown”: (1) press the lever again; (2) rotate the lever to shift gear; (3) change directions; (4) shift to neutral.

(c) When the vehicle runs at I or II gear, if the service brake or emergency brake is applied, the gear signal from the electric control unit remains the same as the corresponding neutral, and the previous gear will be recovered immediately after releasing the brake switch. But at III and IV gears, the brake has no this function.

(d) When stopping the vehicle, the DW-4 gear selector should be put at “N”.

(e) In case the vehicle sends out an alarm when running (the vehicle stops running, the indicator lamp H2 is flashing and the electric control unit is clicking), first pull the gear selector lever to neutral (N), and if the alarm stops at this moment, continue the normal operation. If not, the line may be faulty, and in this case, switch off the power, inspect carefully, clear the fault and lastly switch on the power again to continue the operation.

★ Test methods for main components

(a) Measurement of solenoid valve: The resistance valve of the solenoid valve is about 60-70 Ohm, and when measuring with a universal meter, switch off the power firstly and remove the round plug connecting the control valve. The resistance value out of the range above indicates that the solenoid valve is faulty and thus replacement is required.

(b) Test of speed sensor: In order to measure the resistance value of the speed sensor with a universal meter, remove the power plug firstly, then measure between the two plug terminals, and the resistance value within 1.02 K~1.2 K is normal. The resistance value of 0 or infinity indicates that the sensor is damaged and thus replacement is required. Besides, inspect for its proper installation position: the clearance between the sensor top surface and inspected gear peak should be within 0.5~0.8 mm. Screw the sensor forward completely, then loosen half turn, and now the clearance should be basically appropriate.

(c) Test of brake switch: The service brake and emergency brake pressure switches should apply normally open contact, and the measured resistance should be infinite. With the brake switch depressed, the resistance value should be 0.

(d) Test of DW-4 gear selector: A special purpose test box is required for testing DW selector: fit the 8-core socket of the test box with the DW-4 plug, and connect two power lines to DC 24 V power (with the red line to +24 and the yellow line to ground). The eight indicator lamps on the test box correspondingly display the eight position statuses of DW-4. Rotate the selector lever, and four lamps for I to IV gears come on accordingly; pull the lever, and “Forward”, “Neutral” and “Reverse” lamps come on accordingly; press the lever, and the “KD” lamp comes on accordingly. The selector has no any fault if all the above are correct. And the selector is faulty and should be replaced if one of the above is failed.

(e) Test of EST-4 electric control unit:

A special purpose test box is required for testing EST: Connect the 35-pin plug of the outlet cable on the test box to the outlet line socket on the EST unit. Allow the hook at one end of the plug to catch the pin on the unit end cap, align the plug and press hard till the other end of the plug is clamped by the leaf spring. Connect a DW-4 selector on the 8-core square plug of the outlet cable. Connect the two power lines of the test box to DC 24 V power (with the red line to +24 and the yellow line to negative pole). Put the DW-4 at neutral II gear, and at the moment of powering, the four indicator lamps of M1-M4 on the test box flash once simultaneously, and then only the indicator lamp M2 remains on. Rotate or pull the selector lever, and the eight indicator lamps on the test box should change in accordance with the function table below.

EST-4 Output signal function table

Table 2-3

Gear / Output	Forward				Reverse				Neutral			
	1	2	3	4	1	2	3	4	01	02	03	04
M1				●	●	●	●	●				
M2	●				●				●			
M3	●	●	●		●	●	●	●				
M4	●	●			●	●			●	●		
AS									●	●	●	●
RF					●	●	●	●				
H1	It comes on under KD status.											
H2	It flashes when an alarm occurs. For the model with speed sensor, it comes on before connecting the speed sensor.											

"●": Indicates that there is signal output, and the lamp comes on.

电控系统电缆及插头连接图

Electric control system electric cable and pluy connection diagram

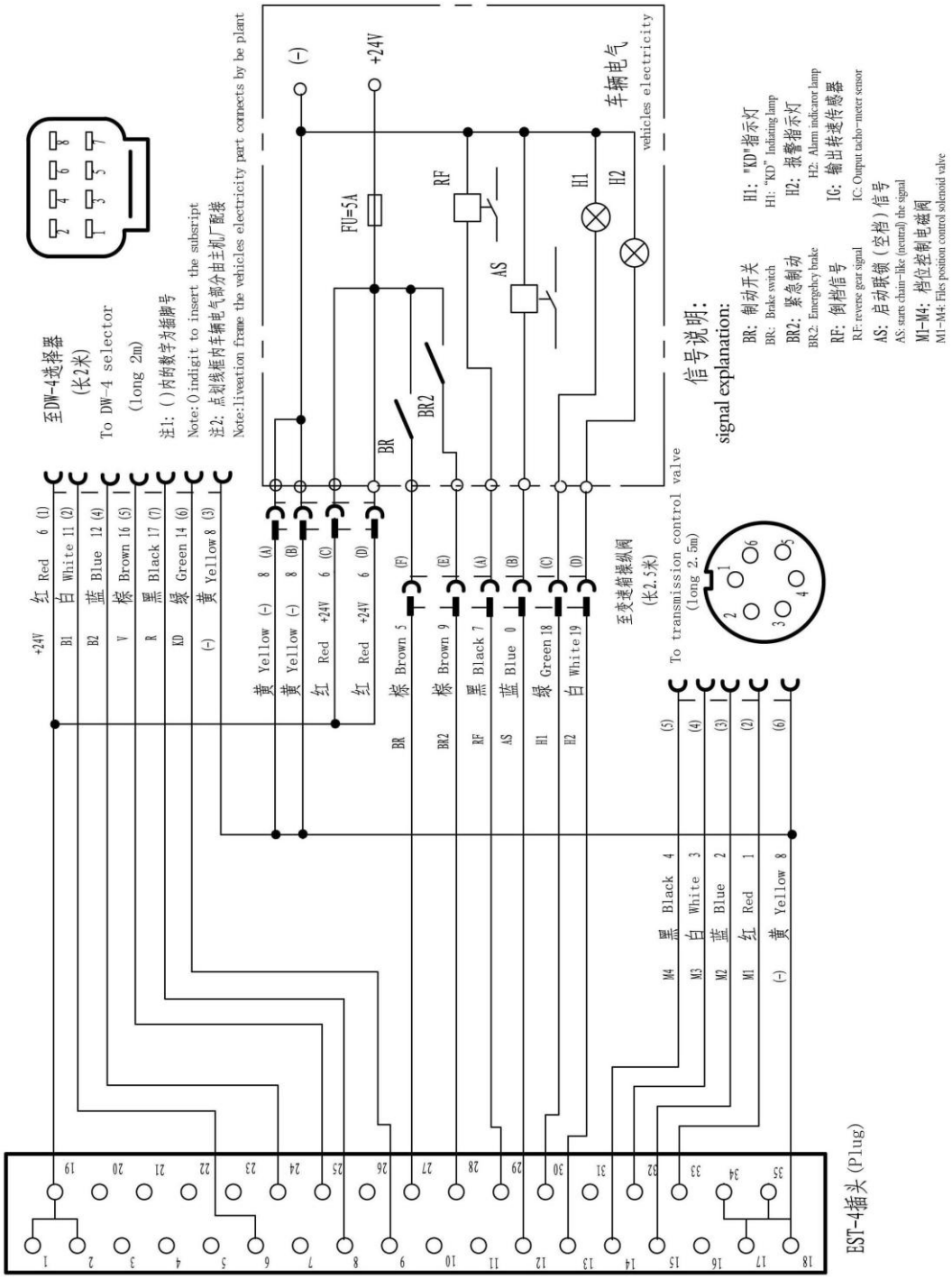


Fig.2-9

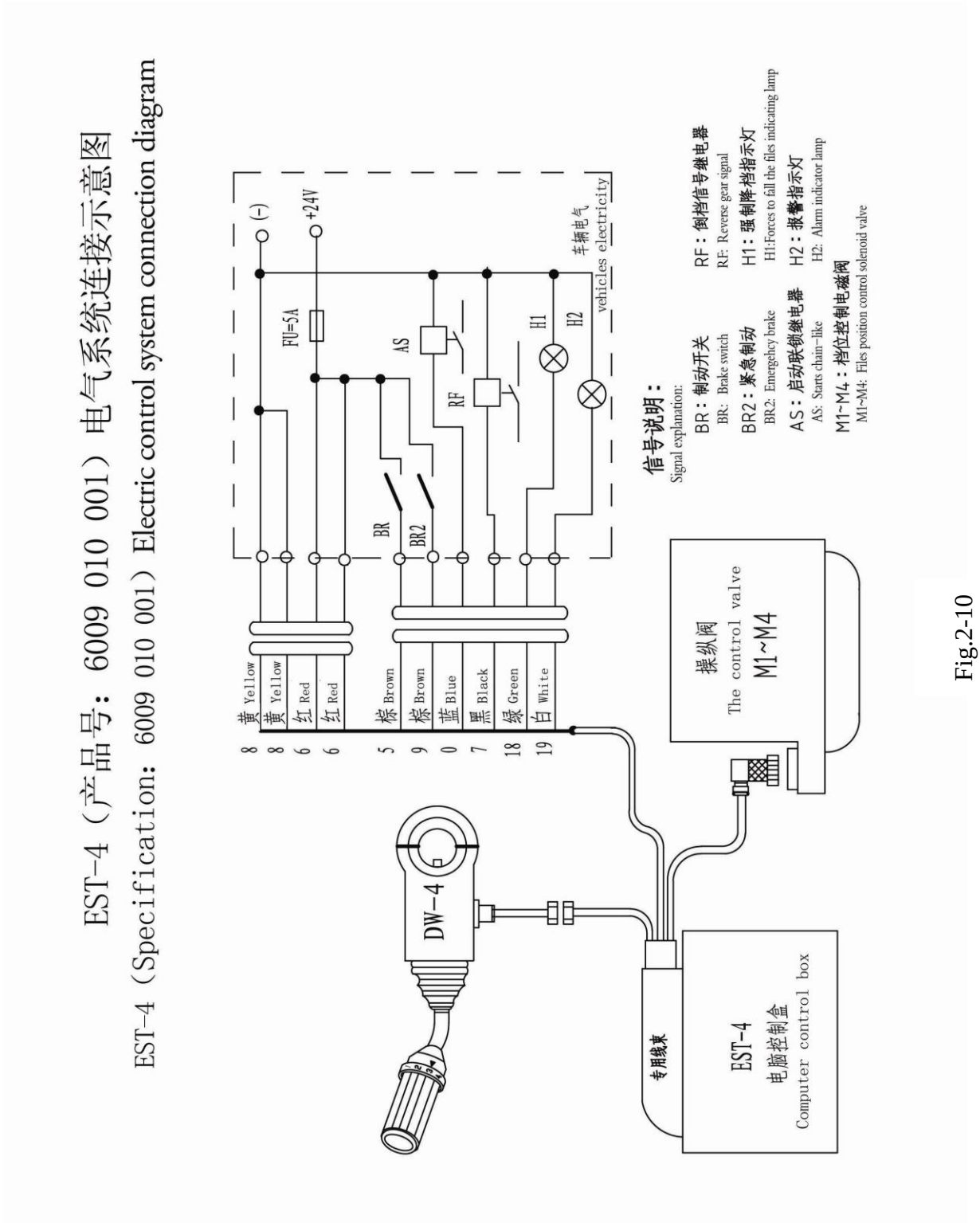

EST-4（产品号：6009 010 001）电气系统连接示意图
EST-4（Specification：6009 010 001）Electric control system connection diagram
(-)
+24V
FU=5A
AS
BR
BR2
RF
H1
H2
车辆电气
vehicles electricity
黄 Yellow
黄 Yellow
红 Red
红 Red
棕 Brown
棕 Brown
蓝 Blue
黑 Black
绿 Green
白 White
8
8
6
6
5
9
0
7
18
19
DW-4
专用线束
EST-4
电脑控制盒
Computer control box
操纵阀
The control valve
M1~M4
信号说明：
Signal explanation:
BR：制动开关
BR: Brake switch
BR2：紧急制动
BR2: Emergency brake
AS：启动联锁继电器
AS: Starts chain-like
M1~M4：档位控制电磁阀
M1~M4: Files position control solenoid valve
RF：倒档信号继电器
RF: Reverse gear signal
H1：强制降档指示灯
H1:Forces to fall the files indicating lamp
H2：报警指示灯
H2: Alarm indicator lamp

Fig.2-10

2.1.5 Functional test of transmission

1. Test of electro-hydraulic control transmission

★**CAUTION:**

The test shall be carried out only when the transmission temperature is within 80~95℃， and when the engine runs at full throttle.

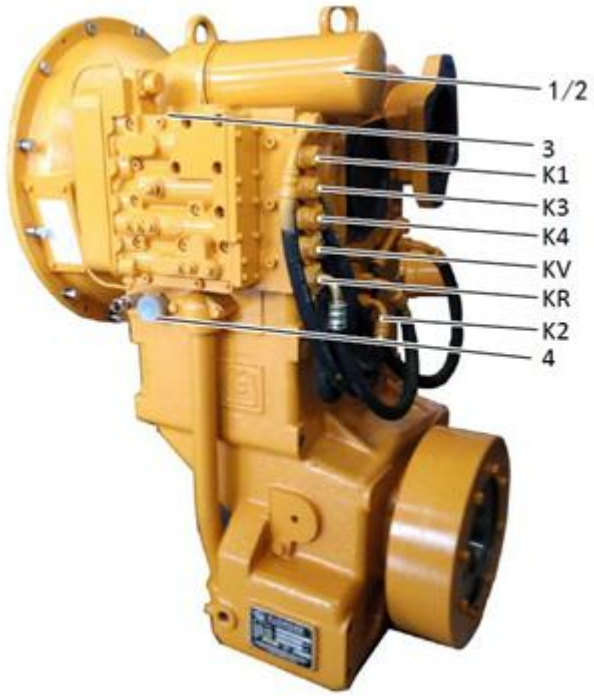


Fig.2-11

Fig.2-12

(1) **Oil pressure test points:**

3=Torque converter inlet oil pressure 4=Torque converter outlet oil pressure 8=Control oil pressure 11=KV clutch pressure

10=KR clutch pressure 6=K1 clutch pressure 5=K2 clutch pressure 7=K3 clutch pressure

9=K4 clutch pressure

(2) **Temperature measuring point:**

4=Torque converter outlet

(3) **Flow test points:**

1=Filter inlet 2=Filter outlet (a minimum flow of 50 L/min);

Connecting threads for all points

No.	Spec.
3, 5, 6, 7, 8, 9, 10, 11	M10×1;
1, 2	M26×1.5

Table 2-5

Control valve

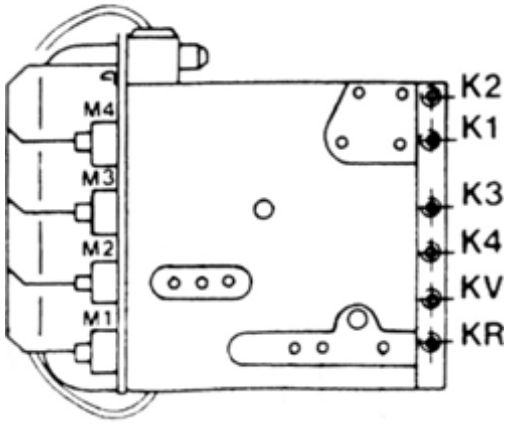


Fig.2-13

Gear	Solenoid valve				Clutch	
	M1	M2	M3	M4		
Forward I		●	●	●	V	1
Forward II			●	●	V	2
Forward III			●		V	3
Forward IV	●				4	3
Reverse I	●	●	●	●	R	1
Reverse II	●		●	●	R	2
Reverse III	●		●		R	3

2.1.6 YD13 Operation and maintenance of powershift transmission

1. Precautions for use

(1) Regularly change transmission oil and replace the filter in strict accordance with the maintenance requirements.

(2) Before starting the engine, ensure that the control lever is at neutral position.

(3) Before each driving, release the parking brake (to relieve braking).

(4) In the case of combining or separating the engine with or from the transmission and the transmission needs to be lifted, always avoid the torque converter from falling off.

(5) When stopping the vehicle, always keep the gear lever at neutral position.

(6) The working temperature, normally within 80-120℃, is permissible to rise to 120℃ in short time, especially note the control oil pressure of the transmission. When the transmission works abnormally in service, stop the vehicle immediately for inspection.

(7) If a faulty vehicle needs to be repaired by electric welding, remove the cable plug from the EST-computer controller (to cut off the circuit to the computer controller), which, otherwise, will be burnt out due to impulse current during electric welding.

2. Operation

(1) Preparation and maintenance before driving

Prior to transmission operation, always add appropriate lubricating oil according to the specified lubricating oil specification. For the transmission initial filling, the oil cooler, filter and connecting lines must be full with the oil. So the initial filling amount is more than that of the later normal maintenance. Since the installed torque converter oil flows through the oil cooler and pipe and returns to the transmission in a stationary state, the correct oil level should be kept when stopping the vehicle at the neutral gear, the engine running at idle speed and the transmission in a normally thermal equilibrium temperature.

Check the oil level only when the control lever is put at neutral. Inset the oil dipstick to the oil tube bottom when checking the oil level. When cleaning the filter of the main oil passage, be cautious not to allow dirt and deposits into the oil circuit. Moreover, put a cover plate so as not to wet the parking brake by the oil.

Note not to tighten the filter too tightly in the course of its installation.

(2) Driving and gearshifting

To start the engine, confirm the gear lever is at neutral position. For safety reasons, the parking brake should be kept in the applied state before starting the engine, so as to prevent the vehicle moving in the case of an engine start. After the engine is started, release the parking brake, select the driving direction and gear, and then depress the accelerator slowly to move the vehicle. Until the vehicle travels, the torque converter functions instead of a main clutch. Driving with a high gear is possible under good road condition.

If the engine still runs and the transmission engages gear while the vehicle has been stopped, in which case surely the engine is not shut down, the vehicle will creep on a straight road, for that certain traction is generated through the torque converter during the engine idling. Therefore, it is reasonable to keep the parking brake in the applied state when stopping the vehicle each time.

To stop the vehicle for a long time, the control lever must be put at neutral position. When the vehicle is running, always remember to release the parking brake. Because as far as we know, it is hard for the operator to realize this immediately, and due to large output torque ratio when the

torque converter changes speed, the vehicle itself can overcome the braking torque to run forcefully even in the case of a rather normal operation. Consequently, the torque converter oil temperature will rise and the brake will be overheated.

The torque converter influence may result in the engine speed increase when shifting from high gear to low gear, especially the skipping gear. Therefore, if possible, depress the service brake first to reduce the speed slowly, and then shift gear when shifting from high gear to low gear. First to reduce the engine speed when the vehicle runs at high speed and driving direction is required.

(3) Temporary stop and stop

There is no rigid coupling between the engine and the torque converter output shaft, so when the vehicle is to be stopped on a slope (either uphill or downhill) and the driver intends to leave, it is recommended to apply the parking brake and put wedges under the wheels to prevent the vehicle sliding.

(4) Towing

The maximum towing speed is 10 km/h, and the maximum towing distance is 10 km.

For a long distance, the broken-down vehicle should be loaded on another vehicle for transport.

(5) Oil temperature

The transmission oil temperature must be monitored by a temperature sensor. The maximum oil temperature at the torque converter outlet should not exceed 120℃, and for the faultless control assembly and the transmission with sufficient operating range, the temperature will not be higher. If the oil temperature is higher than 120℃, stop the vehicle to check if there is oil leakage, and the transmission should be at neutral and the engine run at a speed of 1200~1500 rpm, in which case the oil temperature will drop soon to a normal valve (within approx. 2~3 min.). If the oil temperature still keeps high, somewhere in the system is faulty, so clear the fault before the operation.

The oil pressure during gear shifting is normally within 13~17 bar, and to monitor the control pressure, a pressure gauge or pressure monitor must be installed. If some gear is engaged, and after applying the clutch, the pressure drops to a value lower than the specified minimum pressure (the pressure drops temporarily right at the moment the gear is shifted), eliminate the cause of the

pressure drop. A low control pressure will result in the clutch damage as the clutch lacks the sufficient contact pressure, resulting in the friction plate keeping slipping and therefore being overheated.

3. Maintenance

(2) Oil level check

—— Stop the vehicle at flat place.

—— Put the transmission gear lever at “N” position and the parking brake at applied position.

—— Run the engine at an idle speed of 1000 rpm.

—— Loosen the oil dipstick counterclockwise, and take it out for wiping.

—— Insert the oil dipstick into the oil pipe and screw it into place tightly, then take it out after 3 s (at least two measurements).

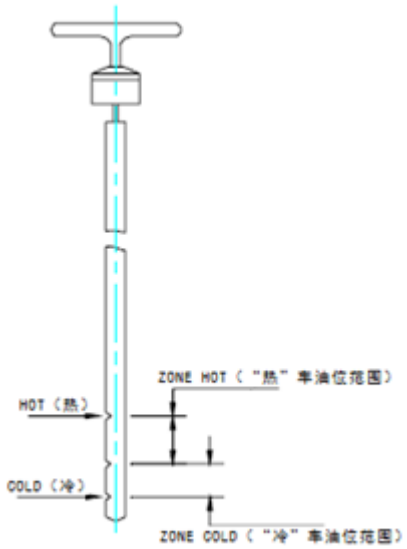


Fig.2-14

—— For the oil temperature of 40℃, the oil level should be between the lower mark “Cold” and the center mark.

—— For the oil temperature of 80℃, the oil level should be between the upper mark “Hot” and the center mark.

Oil level check in cold state can ensure the transmission and the torque converter with sufficient circulating flow, but the final criteria to determine the oil level is to reach the oil level in hot state.

★**CAUTION:**

If the oil level is below the minimum mark, add the recommended lubricating oil as specified, until the oil level is within the correct range for the corresponding temperature (See Fig.2-16).

(2) Oil change

Change oil for the first time when the vehicle runs for 100 hours initially. After that, change oil every 1,000 hours or at least once every year.

In order to change oil, stop the vehicle at flat place with the transmission at the working temperature, take out the oil drain plug and seal ring to drain off the used oil.

——Start the engine and run it at idle speed.

—— Put the transmission control lever at “N” position.

—— Add oil to the upper mark of the “Zone Cold”.

—— Keep the parking brake at a safe position.

—— Select all gears one by one.

—— Check the oil level again, and add oil if necessary.

—— For the oil temperature of 40°C, the oil level should be between the lower mark “Cold” and the center mark.

—— For the oil temperature of 80 ℃, the oil level should be between the upper mark “Hot” and the center mark.

★**CAUTION:**

The oil of the torque converter and cooler shall be drained off along with the used oil.

Oil change schedule: Table 2-6

Part name	Initial change	Regular change	Standard	Oil level check
Transmission (YD13)	After running for 100 h, and replace the oil filter.	After running for 1,000 h but no longer than 1 year, and replace the oil filter.	Delvac Super 1300 CF-4/SAE (15W-40)	Before daily use

Other optional oil: Table 2-7

Acceptable oil specifications and standards (when HC-WG01 special oil is not available in your region).
American Petroleum Institute (API) CF-4/CG-4/CH-4 (15W-40); European Automobile Manufacturers Association (ACEA) E2-96 SAE (15W-40); ZF TE-ML03 SAE (15W-40); Society of Automotive Engineers (SAE) 306 SAE (15W-40); Caterpillar T0-4 SAE (15W-40); FUCHS TITAN SPECIAL HD CF-4/ SAE (15W-40);

(3) Filter replacement

Replace the oil filter while changing oil each time. The requirements are as follows:

—— Apply the seal ring with a thin layer of oil.

—— Push the oil filter inward till it contacts the sealing surface of the transmission, and then tighten by 1/3~1/2 turn with hand.

—— Add oil and start the engine.

—— When the engine runs at an idle speed (about 1,000 rpm) and the transmission oil temperature is just the working temperature, check the transmission oil level.

—— For the oil temperature of 40°C, the oil level should be within the “Zone Cold”.

—— For the oil temperature of 80℃, the oil level should be within the “Zone Hot”.

—— Check for tightening. Tighten with hand again when necessary.

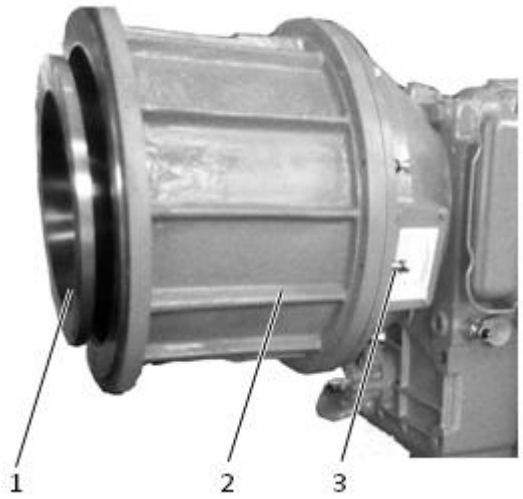


Fig. 3-1
1 Transition plate 2 Transition tube
3 Bolt

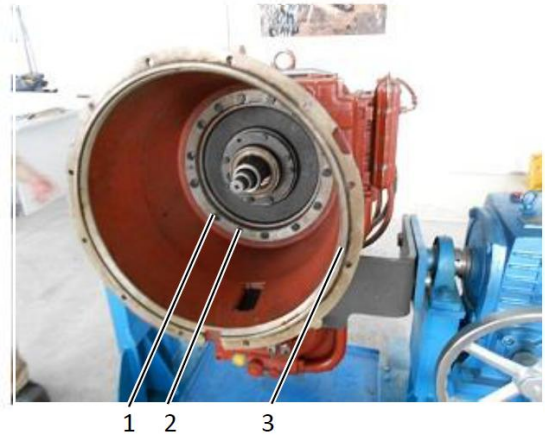


Fig. 3-2
1 Hexagon screw 2 Tensioning pin
3 Connecting casing

3 Removal of Transmission

NOTE: The removal and Refitting of YD13 transmission is described here as an example, which can be served as reference for YD133 and YL13 transmissions.

3.1 Removal of transmission assembly

3.1.1 Removal of torque converter

1. Remove transition plate and torque converter from the transmission, drain off the oil in the torque converter and put them aside.

kg About 20 kg

2. Remove the bolt 3 for connecting transition tube and transmission.
3. Remove the bolt for connecting casing and the transmission, and adjust the transmission to the appropriate position; then use two bolts to push the casing out and remove it.

Fig. 3-3
1 Control valve

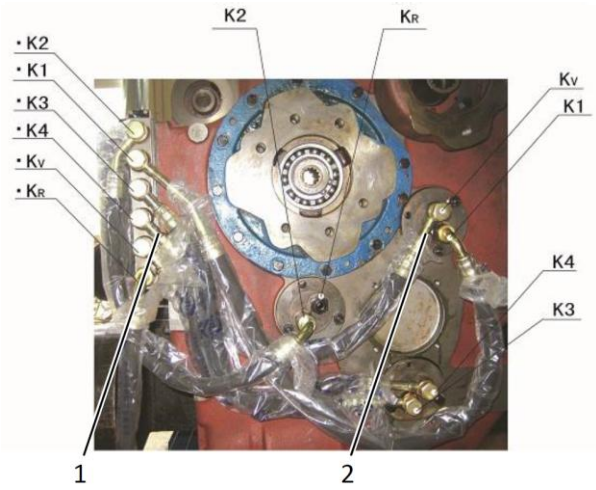


Fig. 3-4
1 Oil duct plate pipe joint
2 Clutch shaft oil duct joint

3.1.2 Removal of transmission control valve

1. Use M8 hexagon socket wrench to remove ten M8×45 and six M8×75 hexagon socket bolts respectively.

★**NOTE**

Bolts must be removed from outside to inside diagonally.

The valve pad should be in good condition during the removal of the control valve.

2. Remove the six oil pipes (from top to bottom are K2, K1, K3, K4, KV and KR) from the oil duct plate in turn (**NOTE: KV and KR are subject to change according to different rear axle steering of OEMs**). Meanwhile, remove the oil duct joint on each clutch shaft to remove six oil pipes.

★**NOTE**

Oil pipe joints should be protected properly, and serial number of each pipe should be marked with a marker.

Removed joints should be cleaned and protected properly.

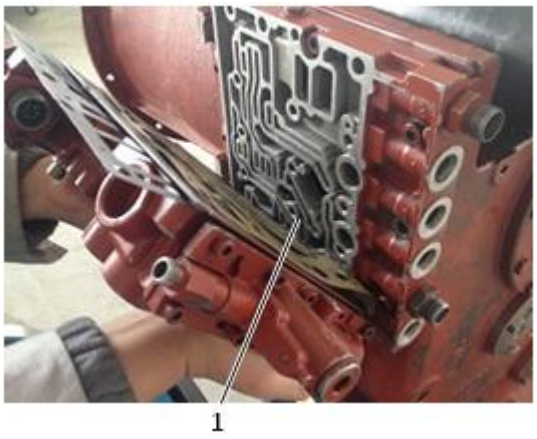


Fig. 3-5
1 Oil duct plate

3. Take off three M8×45 and six M8×35 hexagon socket bolts for connecting oil feed plate and housing, then remove the oil feed plate and partition, and put them aside.

★**NOTE**

Bolts must be removed from outside to inside diagonally.

Removed oil duct plate should be cleaned and protected properly.

3.1.3 Removal of oil filter

1. Use the strap wrench to remove the oil filter, and take off the O-ring.

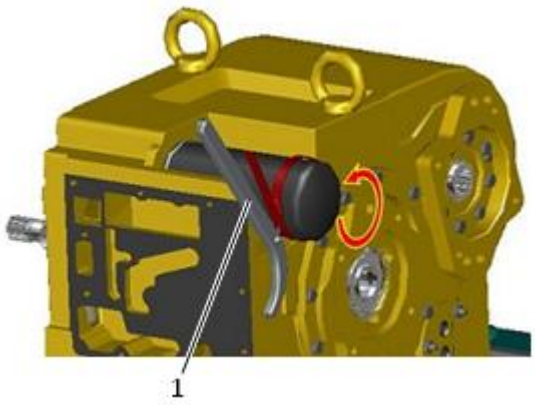


Fig. 3-6
1 Strap wrench

3.1.4 Removal of auxiliary PTO hub

1. Remove the bolt for connecting auxiliary PTO hub and housing.
2. Use crowbar to push out the hub, and take off the PTO hub and seal ring. At this time, the PTO hub has been removed completely.

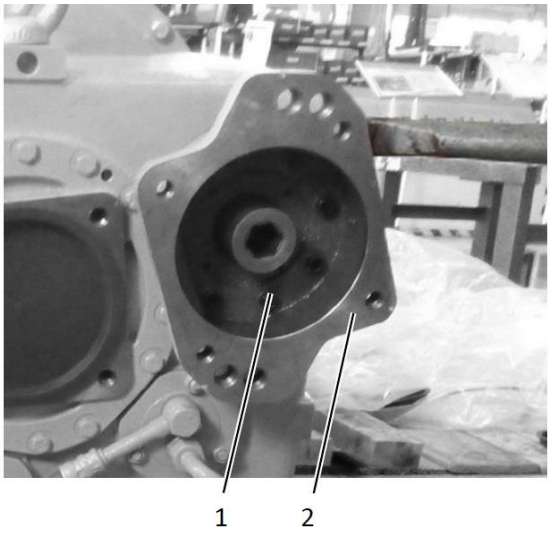


Fig. 3-7
1 Hexagon socket screw
2 Auxiliary PTO hub

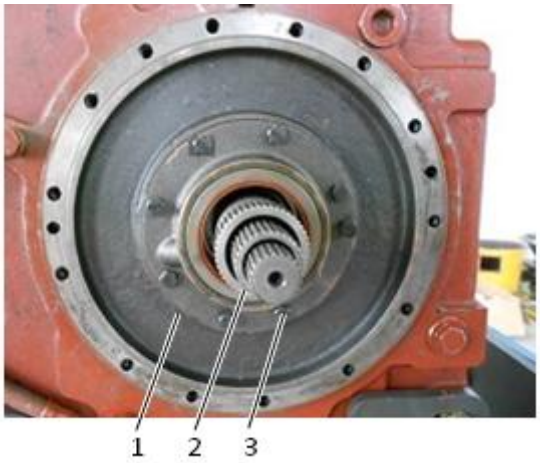


Fig. 3-8
1 Oil distributor flange
2 Pump impeller bearing seat
3 Hexagon screw

3.1.5 Removal of input device

1. Remove the hexagon bolt for connecting pump impeller bearing seat and oil distributor flange.

Fig. 3-9
1 Pump impeller bearing seat 2 Gasket

2. Use two jackscrews to push out the input device, and then use the copper bar to tap and loosen the bearing seat. Afterwards, take off the bearing seat and gasket.

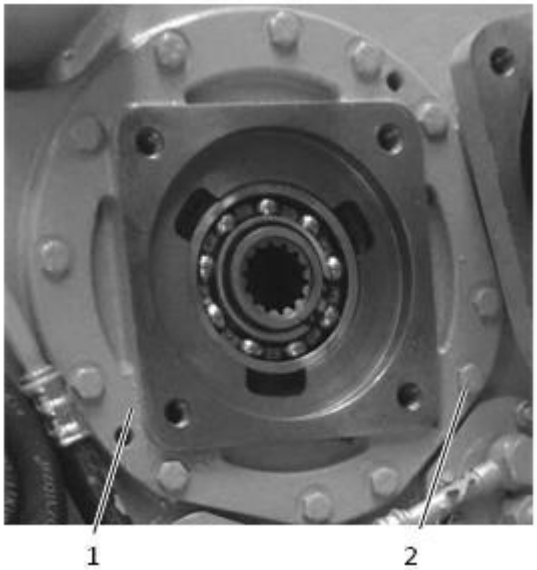


Fig. 3-10
1 Main PTO hub 2 Hexagon screw

3. Remove the bolt for connecting main PTO and housing, and use two M8×20 bolts to push out the PTO assembly.

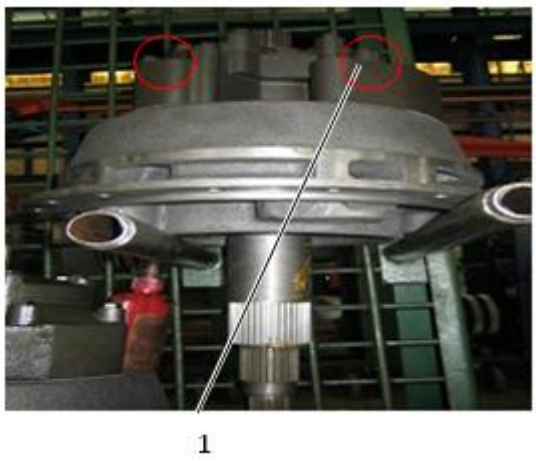


Fig. 3-11
1 Position to be supported by copper bar

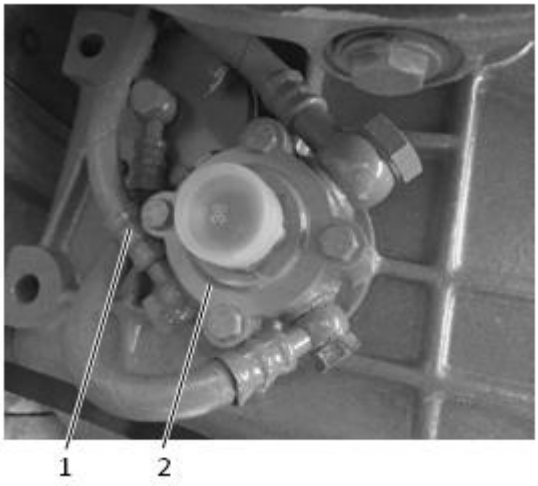


Fig. 3-12
1 Transmission oil pipe
2 Transmission oil inlet cover

4. Support the transmission pump end cover with a piece of φ30*400mm copper bar by the left hand, and tap out the oil distributor flange and transmission pump assembly with another piece of copper bar by the right hand, and put them aside.

★**NOTE**

Appropriate position should be tapped by the copper bar, and the oil distributor flange and transmission pump assembly should be tapped in order to prevent against dropping.

3.1.6 Removal of transmission oil pipe and auxiliary PTO

1. Screw off the fixing bolts of transmission oil pipe in turn, and then take out the pipe.
2. Remove the transmission oil inlet cover.

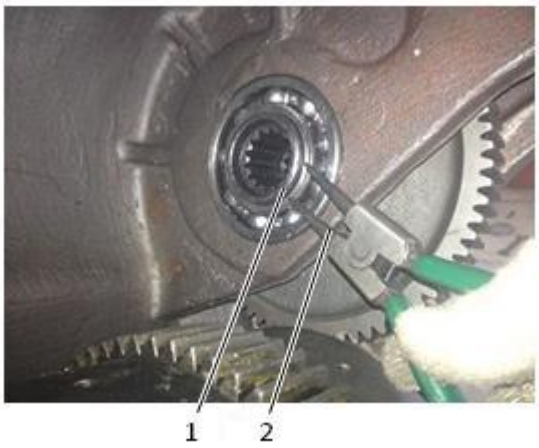


Fig. 3-13
1 Snap ring (45*1.75)
2 Circlip pliers

3. Use circlip pliers to take off the snap ring from the PTO shaft.

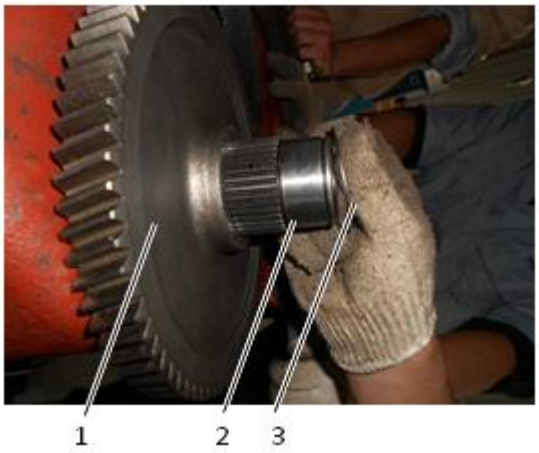


Fig. 3-14
1 Driving gear 2 PTO shaft
3 Retainer ring

4. Use copper bar to tap out the PTO shaft, and then take off the PTO driving gear.

Fig. 3-15
1 Ball bearing

5. At this time, the PTO has been removed completely.

3.1.7 Removal of three sets of clutch components

1. Remove the bolts for connecting the three pieces of clutch shaft and the housing in turn.

Fig. 3-16
1 K3&K4 clutch shaft 2 KR&K2 clutch shaft
3 KV&K1 clutch shaft

2. Use the removal tool for clutch shaft to take off K1, K2 and K3 clutch shafts in turn, and take out three clutch assemblies simultaneously.

Fig. 3-17
1 Removal tool for clutch shaft (2938001828) (2938001829)

kg About 15kg

★**NOTE**

After the removal of every set of clutch, the clutch adjusting shim should be placed on the shaft end for subsequent final assembly.

During the removal of clutch assembly, the transmission should be put at proper position and taken out slowly to prevent against dropping.

Fig. 3-18
1 Parking brake

Fig. 3-19
1 Oil seal

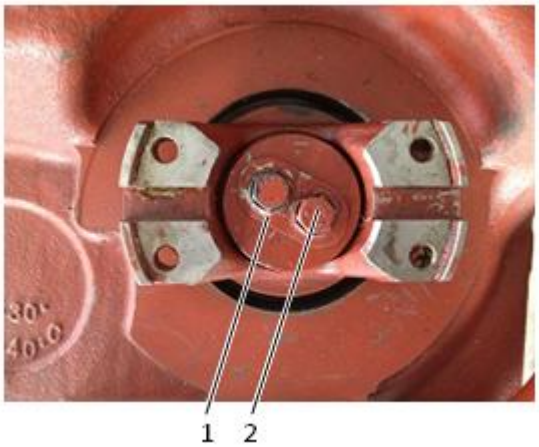


Fig. 3-20
1 Lock plate 2 Hexagon screw (M10*30)

3.1.8 Removal of parking brake and output device

1. Remove the two M10×30 lock plates from the output shaft at the end of parking brake, unscrew the bolts, and use two crowbars to remove the parking brake together with the parking brake flange assembly.

NOTE

During the removal, force should be applied slowly and protective measures should be taken.

2. Remove the oil seal from the output device.

3. Take off the lock plate, and remove the bolt for connecting pressure plate and output flange.

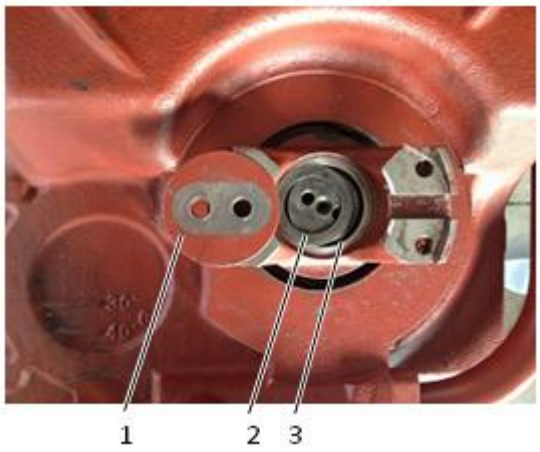


Fig. 3-21
1 Pressure plate 2 Distance washer
3 O-ring

4. Remove the pressure plate, distance washer and O-ring in turn.

Fig. 3-22
1 Output flange

5. Remove the output flange.

Fig. 3-23
1 Oil seal

6. Remove the oil seal.

★**NOTE**

The oil seal should be removed with even force in order to prevent against damage, or by the use of special removal tool.

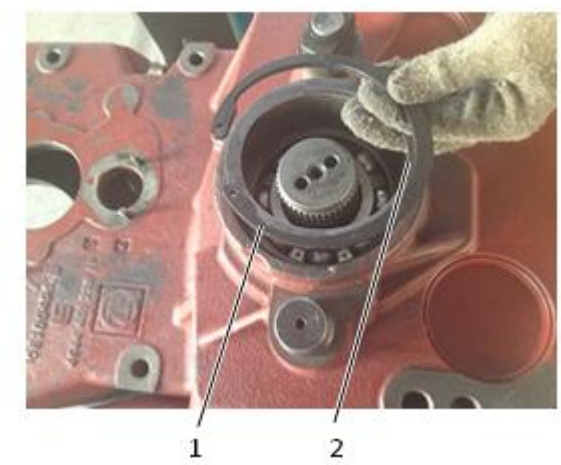


Fig. 3-24
1 Snap ring (120*4)
2 Compensation washer

7. Use circlip pliers to remove the bearing snap ring and compensation washer at the front end of output shaft.

Fig. 3-25
1 Rear end of output shaft
2 Copper bar

8. Use copper bar to tap the rear end of output shaft.

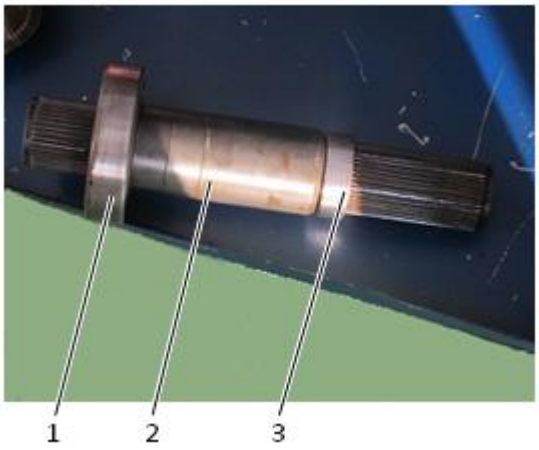


Fig. 3-26
1 Bearing 2 Output shaft
3 Shaft sleeve

9. Remove the output shaft, bearing and shaft sleeve.

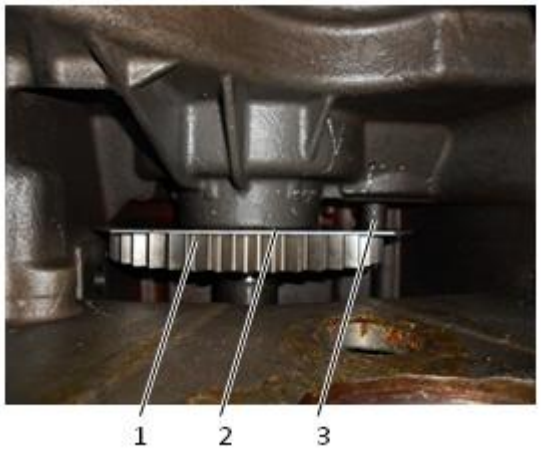


Fig. 3-27
1 Output gear 2 Connecting baffle
3 Hexagon screw (M8*16)

10. Take out the output gear, and remove the bolt for connecting baffle, oil baffle disc and housing.

Fig. 3-28
1 Output gear 2 Oil baffle disc
3 Baffle

11. Remove the oil baffle disc and baffle.

3.1.9 Removal of torque converter pressure regulating valve

1. Remove the screw plug for fixing valve housing assembly.

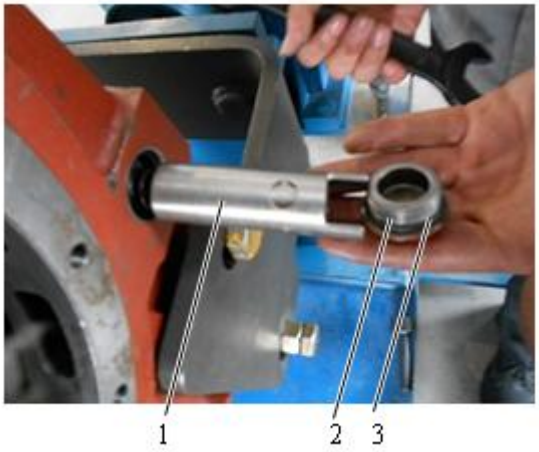


Fig. 3-29
1 Valve housing assembly 2 Screw plug (CM30*1.5)
3 O-ring

2. Remove valve housing assembly from the torque converter pressure valve port on the housing, namely the valve housing, valve stem, pressure spring and washer.

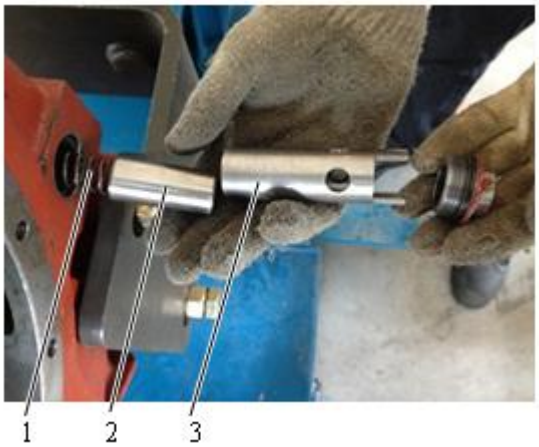


Fig. 3-30
1 Pressure spring 2 Valve stem
3 Valve housing

3.2 Removal of transmission assembly

3.2.1 Removal of main PTO

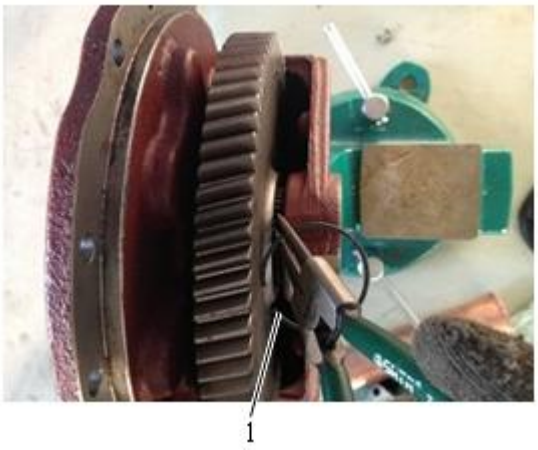


Fig. 3-31
1 Retainer ring

1. Use circlip pliers to remove the retainer ring for fixing driving gear on the PTO shaft.
2. Remove the snap ring for fixing ball bearing cone on the PTO shaft.

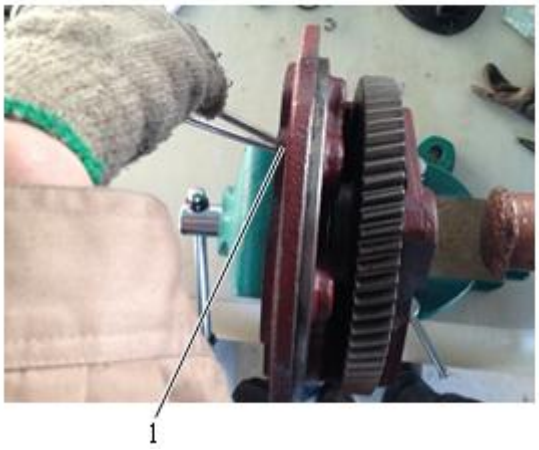


Fig. 3-33
1 Elastic damping ring

3. Use screwdriver to expand the elastic damping ring for fixing ball bearing, and tap PTO shaft from the other side.

Fig. 3-34
1 Driving gear 2 PTO shaft
3 Ball bearing

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

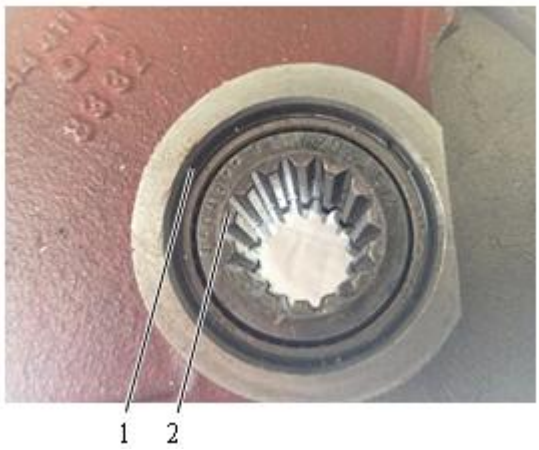


Fig. 3-35
1 Retainer ring
2 Needle roller bearing

5. Take off the two retainer rings for fixing needle roller bearing on the PTO hub, and remove the two retainer rings for fixing ball bearing.

3.2.2 Removal of input assembly

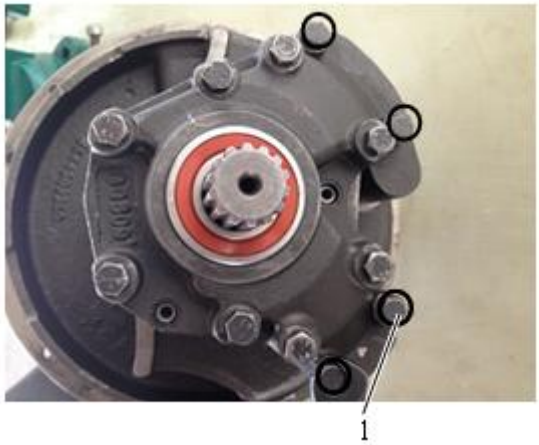


Fig. 3-36
1 Hexagon screw (M8*85)

1. Remove the four bolts for connecting transmission pump and oil distributor flange.

Fig. 3-37
1 Hexagon screw (M8*115)

2. Remove the four bolts for connecting transmission pump and oil distributor flange.

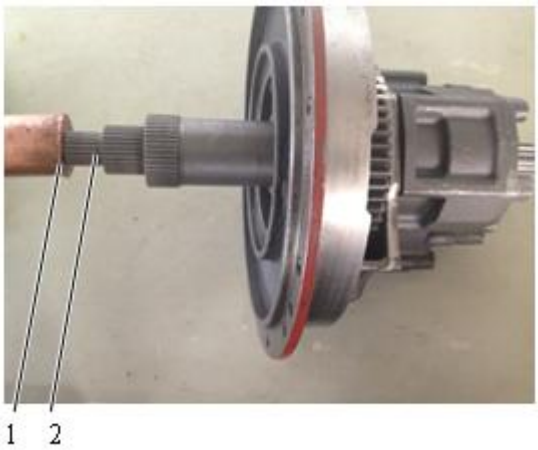


Fig. 3-38
1 Copper bar
2 Output shaft

3. Use copper bar to tap the output shaft to tap out the transmission pump.

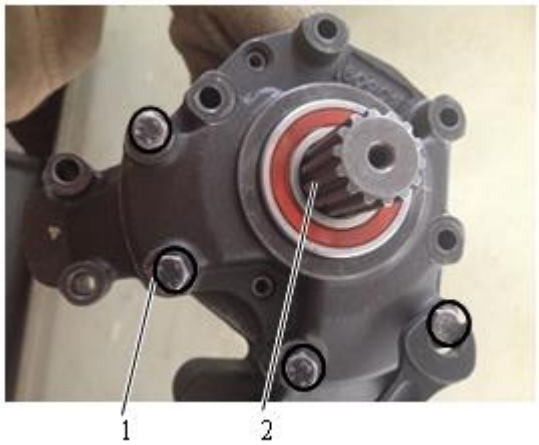


Fig. 3-39
1 Hexagon screw
2 Output shaft

4. Take off the transmission pump, gasket and output shaft, and remove the bolt for connecting transmission pump cover and pump housing.

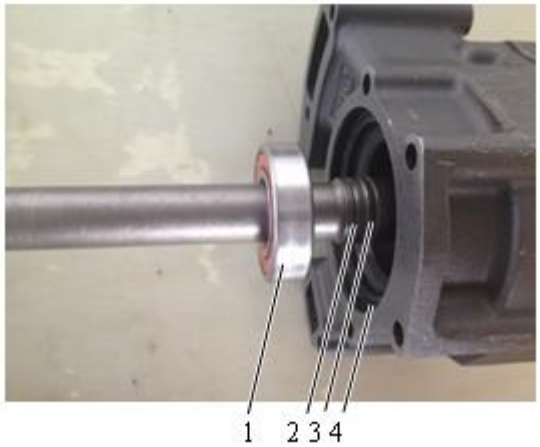


Fig. 3-40
1 Ball bearing 2 Piston ring (30×2)
3 Snap ring (30×1.5) 4 Compensation washer

5. Use circlip pliers to take off the bearing snap ring from the output shaft, and remove the ball bearing, piston ring and compensation washer.

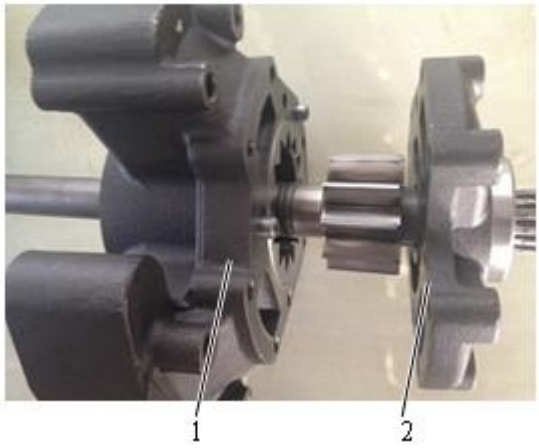


Fig. 3-41
1 Transmission pump housing
2 Transmission pump cover

6. Use copper bar to tap the output shaft, and take off the transmission pump cover, inner gear and other assemblies.

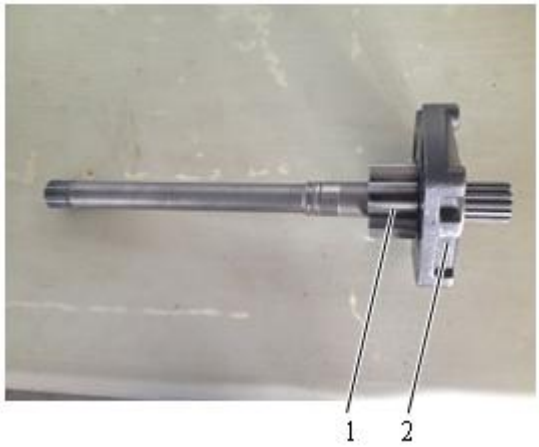


Fig. 3-42
1 Transmission pump inner gear
2 Transmission pump cover

7. Remove the transmission pump inner gear, output shaft, transmission pump cover and ball bearing.

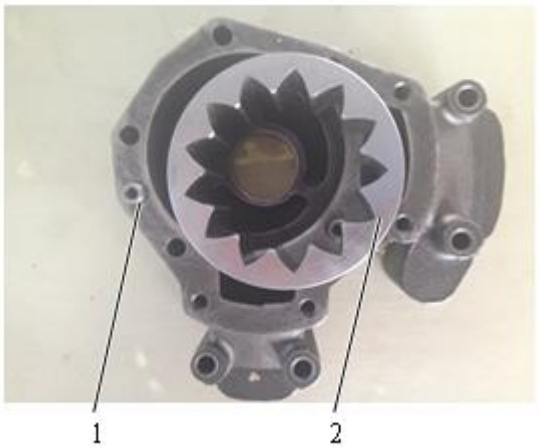


Fig. 3-43
1 Transmission pump housing
2 Outer ring gear

8. Take out the transmission pump outer ring gear.

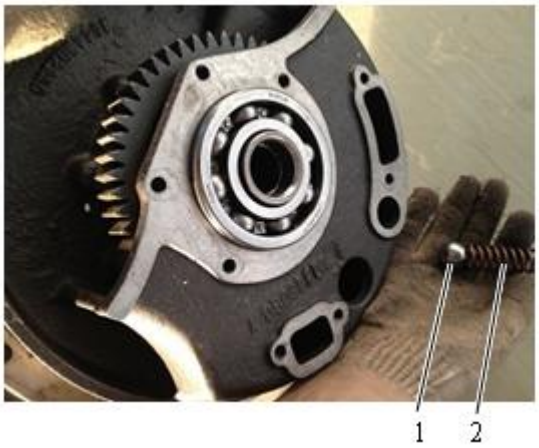


Fig. 3-44
1 Steel ball
2 Pressure spring

9. Take off the safety valve at the torque converter oil inlet on the oil distributor flange: steel ball, pressure spring.

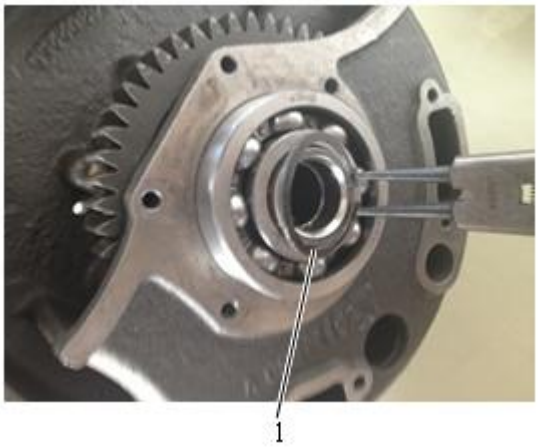


Fig. 3-45
1 Snap ring

10. Use circlip pliers to take off the snap ring for fixing the ball bearing on the driving shaft.

Fig. 3-46
1 Driving shaft
2 Copper bar

11. Use copper bar to tap and remove the driving shaft.

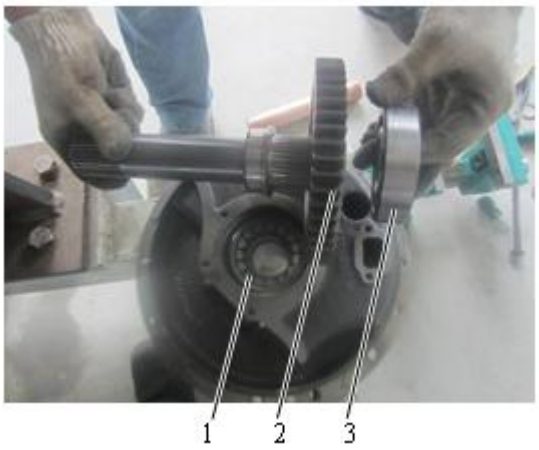


Fig. 3-47
1 Roller bearing 2 Driving gear
3 Ball bearing

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

Fig. 3-48
1 Driving shaft
2 Plunger ring

13. Remove the plunger ring from the driving shaft.

3.2.3 Removal of three sets of clutch assemblies

★ **NOTE**

The three sets of clutch assemblies are similar in structure, and the removal process of K3 and K4 clutch assemblies is here described as an example.

Fig. 3-49
1 Needle roller bearing

1. Take off K4 cutch gear bearing, and put it aside.

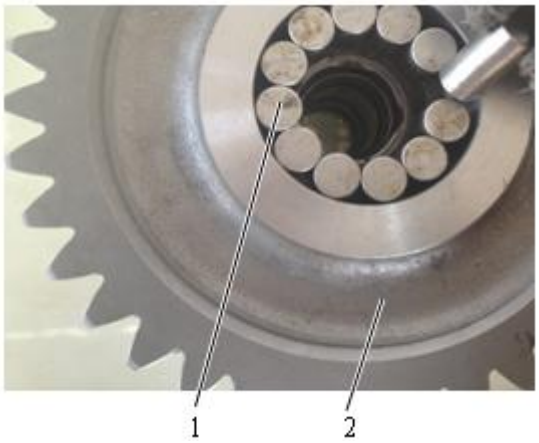


Fig. 3-50
1 Roller (12 pcs) 2 K3 clutch gear

2. Remove the face seal assembly and roller from K3 clutch gear inner needle roller bearing.

Fig. 3-51
1 Washer 2 Thrust washer

3. Remove the gear, washer and thrust washer from K3 clutch.

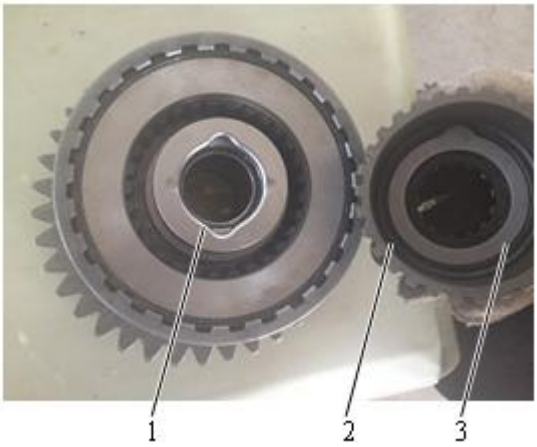


Fig. 3-52
1 Thrust washer 2 K4 clutch gear
3 Thrust washer

4. Remove the gear and thrust washer from K4 clutch.

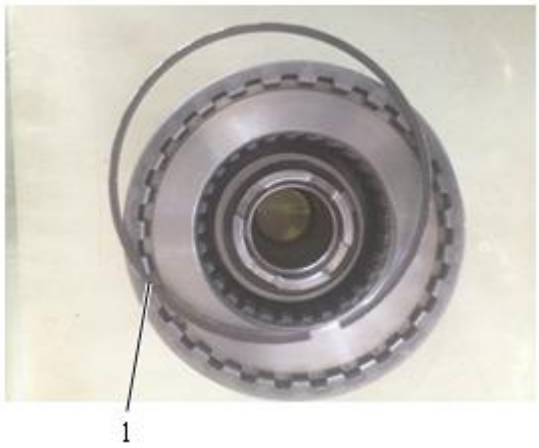


Fig. 3-53
1 Elastic damping ring

5. Remove the elastic damping ring from K4 clutch.

Fig. 3-54
1 Bearing plate

6. Remove the bearing plate from K4 clutch.

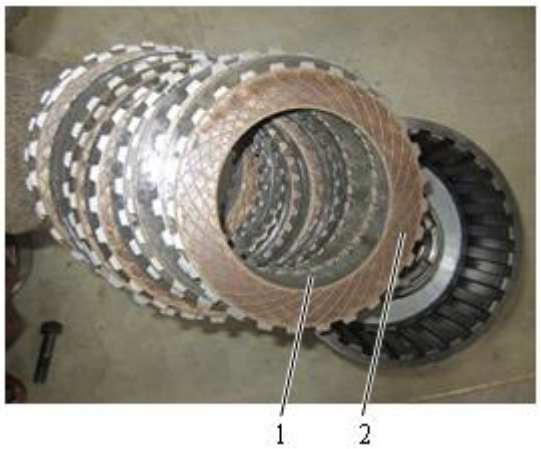


Fig. 3-55
1 Inner friction lining
2 Outer friction lining

7. Remove the outer and inner friction linings from K4 clutch.

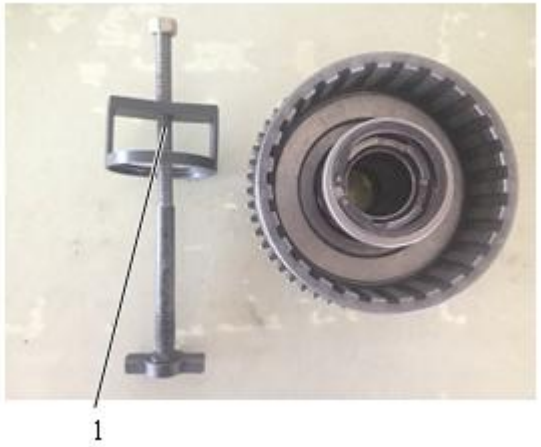


Fig. 3-56
1 Removal tool for clutch spring (2938001826) (2938001827)

8. Install the clutch tool onto the clutch.

Fig. 3-57
1 Removal tool for clutch spring
2 Pressure spring

9. Tighten the tool nut and press the clutch spring.

Fig. 3-58
1 Retainer ring

10. Use circlip pliers to remove the retainer ring for fixing pressure spring.

Fig. 3-59
1 Retainer ring
2 Guide ring

11. Remove the retainer ring and guide ring from K4 clutch in turn.

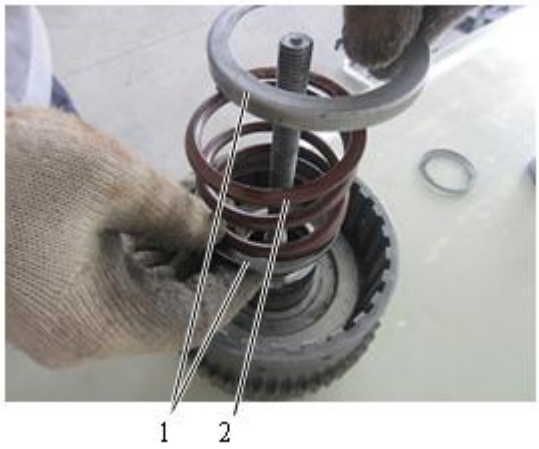


Fig. 3-60
1 Guide ring
2 Pressure spring

12. Remove the upper guide ring, pressure spring and lower guide ring from K4 clutch in turn.

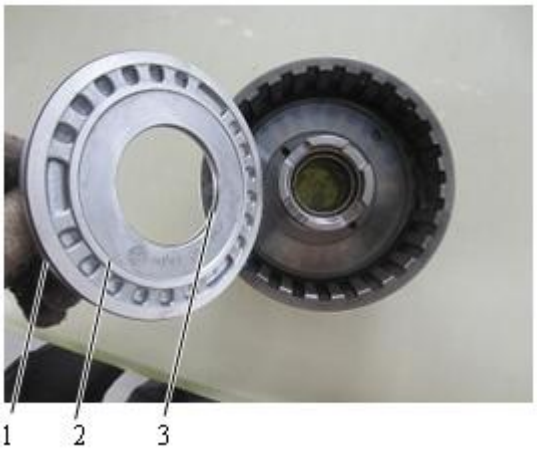


Fig. 3-61
1 Seal ring 2 K3 clutch piston
3 Seal ring

13. Remove the piston and seal ring from K4 clutch. Then K4 clutch has been removed completely.

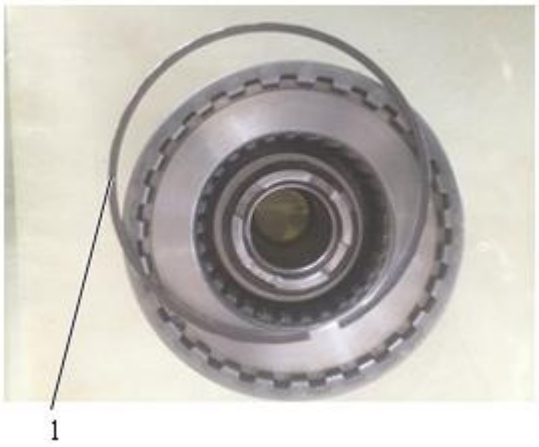


Fig. 3-62
1 Elastic damping ring

14. Remove the elastic damping from K3 clutch bearing plate.

Fig. 3-63
1 Bearing plate

15. Remove the bearing plate from K3 clutch.

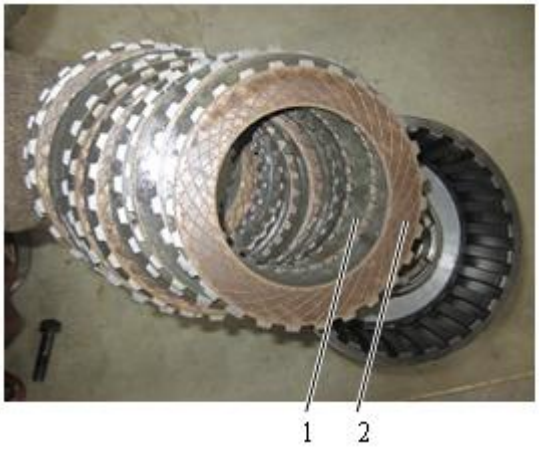


Fig. 3-64
1 Inner friction lining
2 Outer friction lining

16. Remove the outer and inner friction linings from K3 clutch.

Fig. 3-65
1 Removal tool for clutch spring
(2938001826)
(2938001827)
2 Pressure spring

17. Use the removal tool for clutch spring to press the pressure spring of K3 clutch.

Fig. 3-66
1 Retainer ring

18. Use circlip pliers to remove the retainer ring for fixing pressure spring.

Fig. 3-67
1 Retainer ring
2 Guide ring

19. Remove the retainer ring and guide ring from K3 clutch in turn.

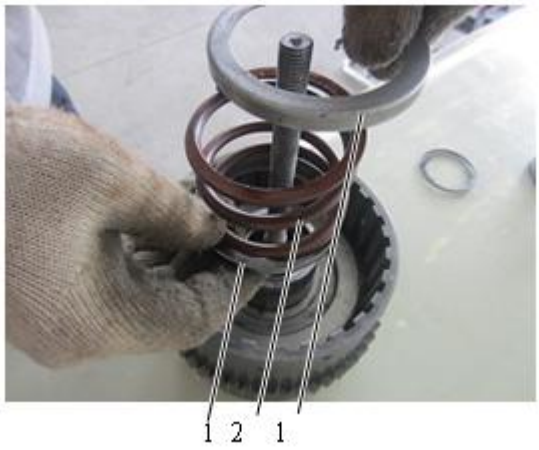


Fig. 3-68
1 Guide ring
2 Pressure spring

20. Remove the upper guide ring, pressure spring and lower guide ring from K3 clutch in turn.

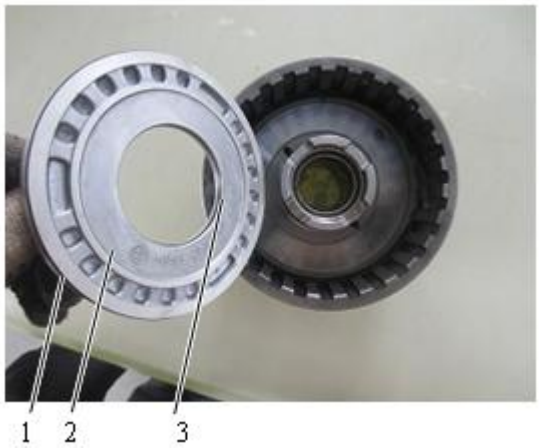


Fig. 3-69
1 Seal ring 2 K4 clutch piston
3 Seal ring

21. Remove the piston and seal ring from K3 clutch.

Fig. 3-70
1 One-way valve
2 Needle roller bearing

22. Remove the needle roller bearing and one-way valve from K3 & K4 clutches. Then K3 clutch has been removed completely.

4 Refitting of Transmission

4.1 Refitting of transmission assembly

4.1.1 Refitting of three sets of clutches

★ **NOTE**

The three sets of clutch assemblies are similar in structure, and the assembling process of K3 and K4 clutch assemblies is here described as an example.

1. Tap needle roller bearing into clutch bearing hole, and install retainer ring.

★ **NOTE**

Each component should be cleaned before the assembling.

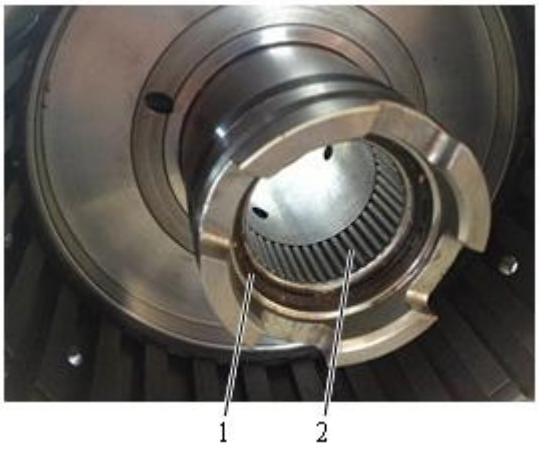


Fig. 4-1
1 Retainer ring
2 Needle roller bearing

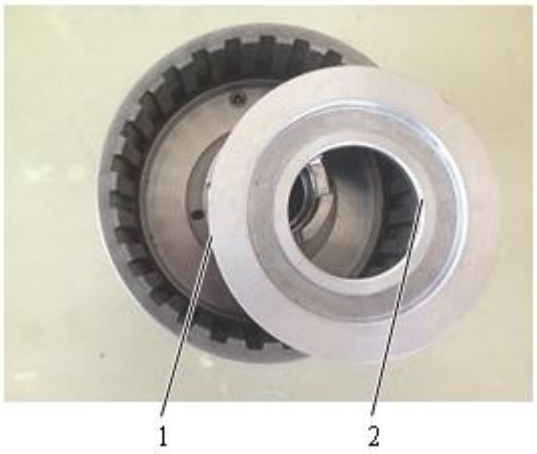


Fig. 4-2
1 Seal ring
2 Seal ring

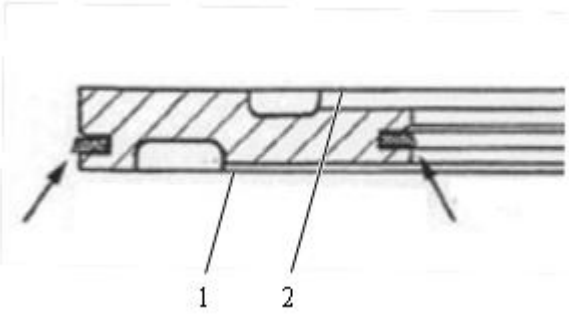


Fig. 4-3
1 Pressure oil face
2 Friction lining surface

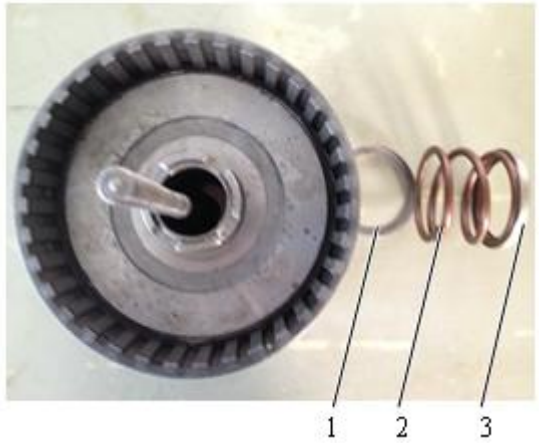


Fig. 4-4
1 Guide ring 2 Pressure spring
3 Guide ring

2. Install seal ring into the piston groove, and then install piston assembly into the clutch cylinder.

★**NOTE**

The seal ring should be installed with the sealing surface facing towards the pressure oil face.

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

Fig. 4-5
1 Guide ring
2 Retainer ring

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

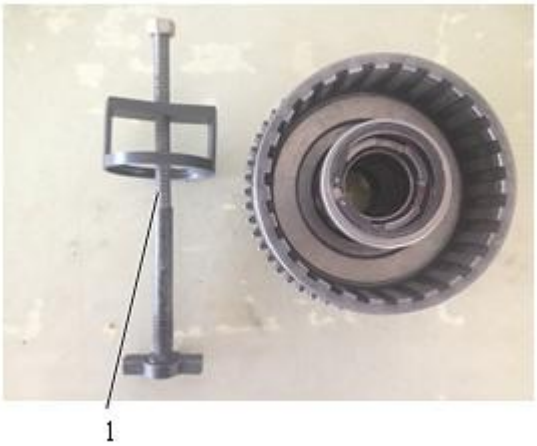


Fig. 4-6
1 Removal tool for clutch spring (2938001826)
(2938001827)

5. Install the removal tool for spring onto the clutch.

Fig. 4-7

6. Tighten the tool nut and press the clutch spring.

Fig. 4-8
1 Retainer ring
2 Circlip pliers

7. Use circlip pliers to install the retainer ring into the clutch cylinder snap spring groove, and remove the removal tool for clutch spring.

★**NOTE**

In normal use, the outer friction lining of clutch with the depth of grained groove worn more than 2/3 should be replaced in time.

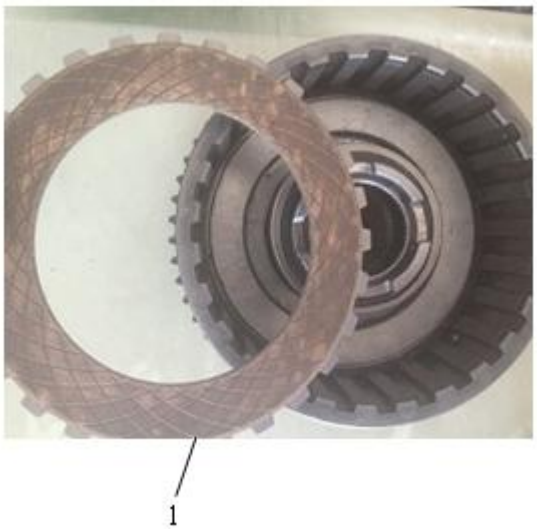


Fig. 4-9
1 Outer friction lining

8. Place the outer friction lining into K3 clutch firstly.

★**NOTE**

Outer friction lining should be placed into the clutch firstly, and then outer and inner friction linings placed into the clutch alternately.

Fig. 4-10
1 Inner friction lining

9. Place the outer friction lining into K3 clutch.

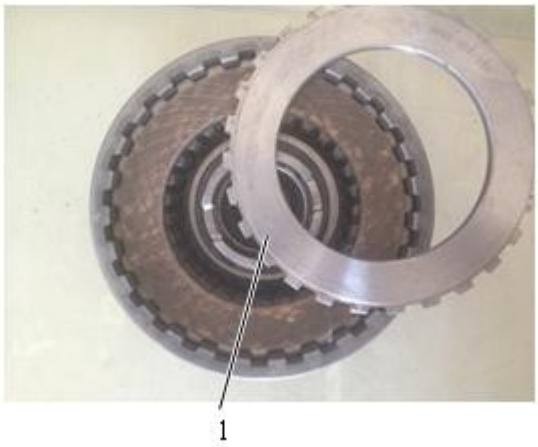


Fig. 4-11
1 Bearing plate

10. Place the bearing plate into K3 clutch.

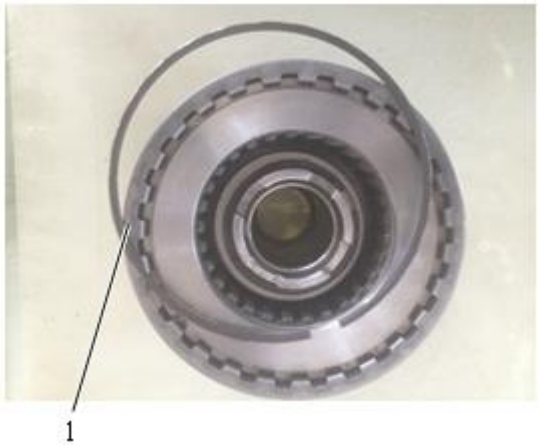


Fig. 4-12
1 Elastic damping ring

11. Install the elastic damping ring into K3 clutch.

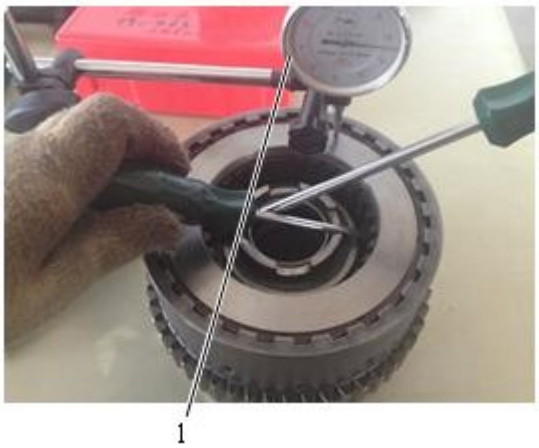


Fig. 4-13
1 Dial gauge

12. Use screwdriver to set the friction lining of K3 clutch to the uppermost position, and record the stroke of clutch piston measured by the dial gauge. At this time, K3 clutch has been assembled completely.

★ **NOTE**

The stroke should be measured several times (more than 3 times) at different positions by the use of dial gauge with the contact pressed against the bearing plate. The reading of dial gauge is the stroke of K3 clutch piston. Inner

friction linings with different thickness (number of inner friction linings is fixed) should be selected such that the piston stroke (the same for three sets of clutches) is between 1.8-2.2 mm.

13. Tap the needle roller bearing of K4 clutch into the clutch bearing hole, and install retainer ring.

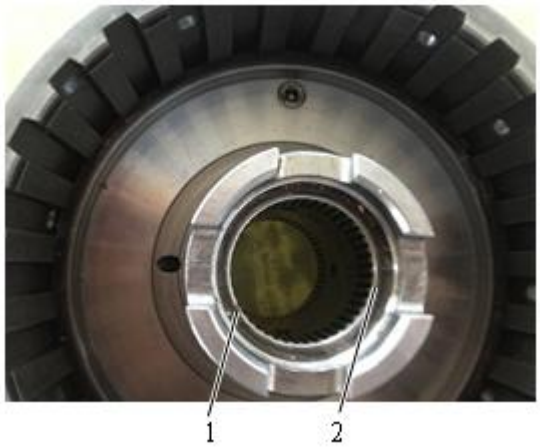


Fig. 4-14
1 Retainer ring
2 Needle roller bearing

14. Install seal rings into piston groove of K4 clutch.

NOTE

Seal ring should be installed with the sealing surface facing towards the pressure oil face. (See Fig. 4-3)

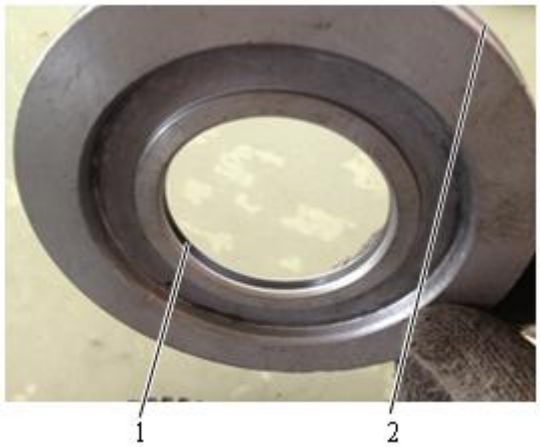


Fig. 4-15
1 Seal ring
2 Seal ring

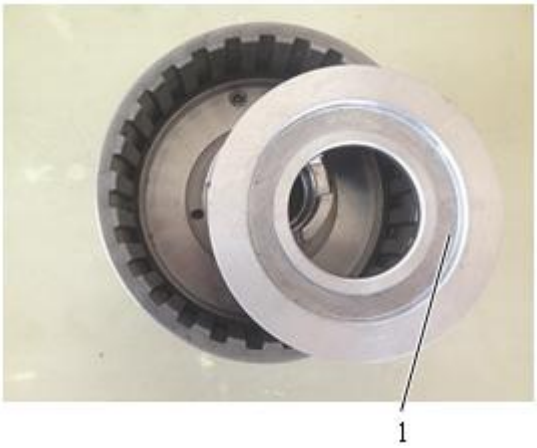


Fig. 4-16
1 Piston

15. Install K4 clutch piston into the clutch.

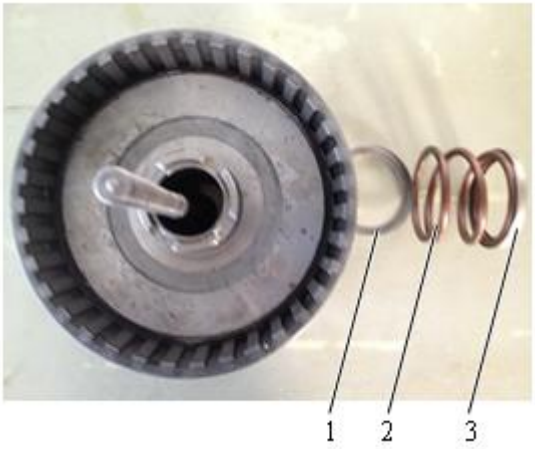


Fig. 4-17
1 Guide ring 2 Pressure spring
3 Guide ring

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

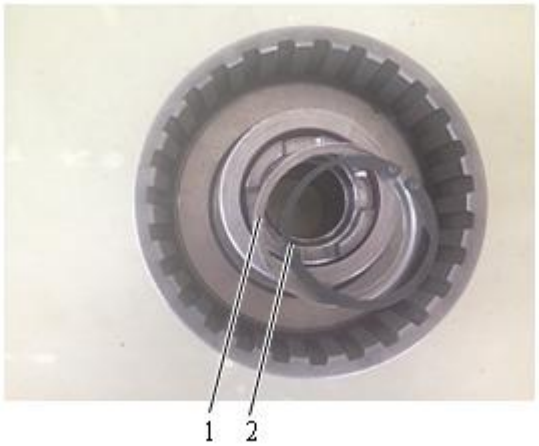


Fig. 4-18
1 Guide ring
2 Retainer ring

17. Install guide ring and retainer ring.

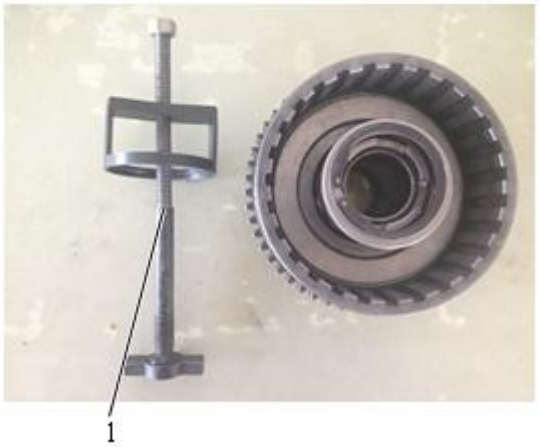


Fig. 4-19
1 Removal tool for clutch spring (2938001826)
(2938001827)

18. Install the removal tool for clutch spring onto the clutch, tighten the tool nut and press the clutch spring.

Fig. 4-20
1 Retainer ring
2 Circlip pliers

19. Use circlip pliers to install retainer ring into K4 clutch cylinder snap spring groove, and remove the removal tool for clutch spring.

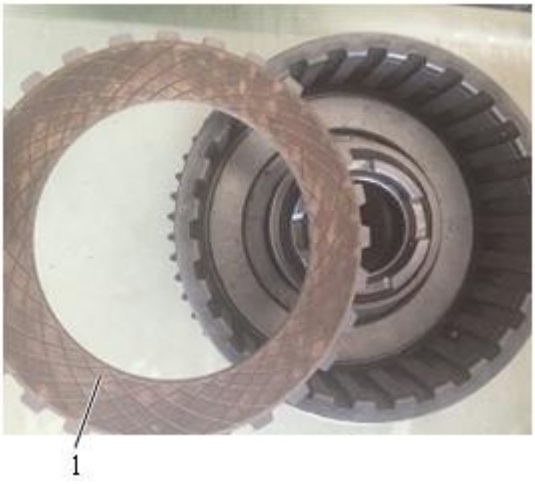


Fig. 4-21
1 Outer friction lining

20. Place the outer friction lining into K4 clutch firstly.

★**NOTE**

In normal use, the outer friction lining of clutch with the depth of grained groove worn more than 2/3 should be replaced in time.

Fig. 4-22
1 Inner friction lining

21. Place the inner friction lining into K4 clutch.

Fig. 4-23
1 Bearing plate

22. Place the bearing plate into K4 clutch.

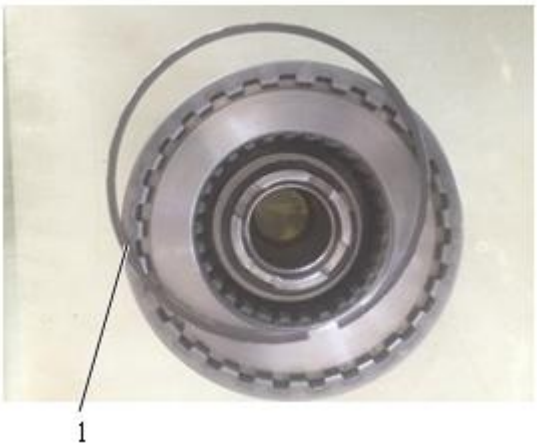


Fig. 4-24
1 Elastic damping ring

23. Install the elastic damping ring into K4 clutch.

Fig. 4-25
1 Dial gauge

24. Use screwdriver to pick up the friction lining of K4 clutch lightly, and record the stroke of clutch piston measured by the dial gauge.

★**NOTE**

The stroke should be measured several times (more than 3 times) at different positions by the use of dial gauge with the contact pressed against the bearing plate. The reading of dial gauge is the stroke of K4 clutch piston. Inner friction linings with different thickness should be selected such that the piston stroke is between 1.8-2.2 mm.

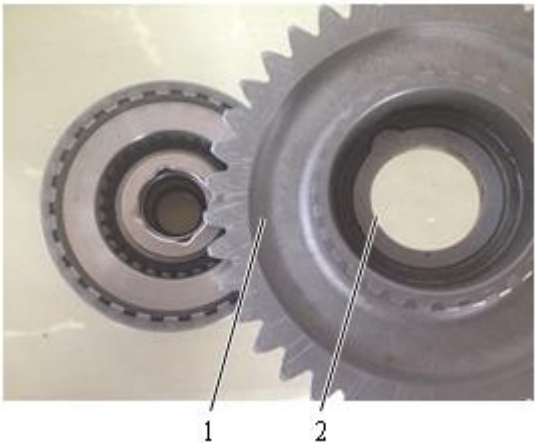


Fig. 4-26
1 K3 clutch gear
2 Thrust washer

25. Install the thrust washer into K3 clutch gear.

★**NOTE**

The thrust washer should be greased.

26. Install the washer and thrust washer into K3

clutch.

Fig. 4-27
1 Thrust washer
2 Washer

Fig. 4-28
1 K3 clutch gear

27. Install K3 clutch gear.

★**NOTE**

Splines of inner friction lining in the clutch should be aligned before the gear installation.

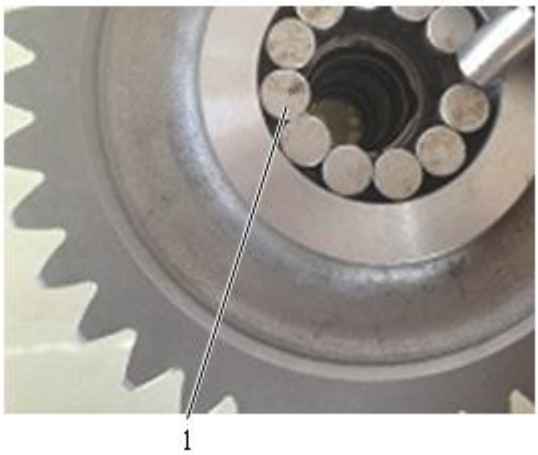


Fig. 4-29
1 Roller

28. Install the face seal assembly and roller to K3 clutch gear inner needle roller bearing.

★**NOTE**

The roller should be greased in order to prevent against dropping during installation of clutch assembly to the housing.

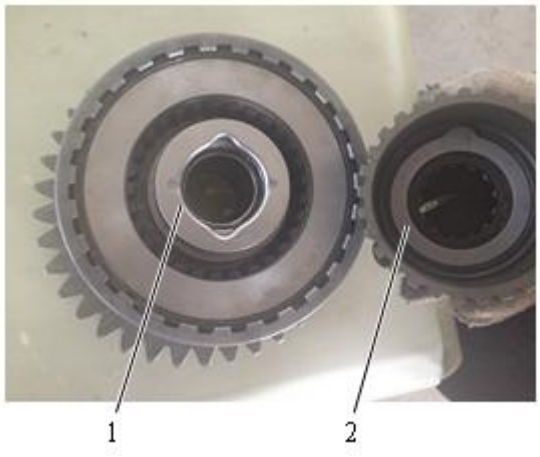


Fig. 4-30
1 Thrust washer
2 Thrust washer

29. Install the thrust washers into snap spring and gear of K4 clutch cylinder.

★**NOTE**

Thrust washers should be greased.

Fig. 4-31
1 Needle roller bearing

30. Install needle roller bearing into K4 clutch gear.

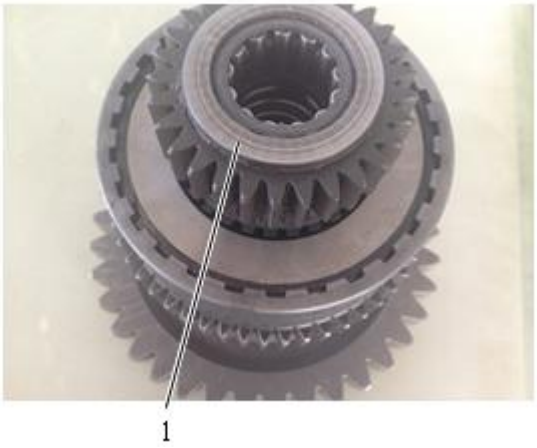


Fig. 4-32
1 K4 clutch gear

31. Install K4 clutch gear. At this time, K3 and K4 clutches have been assembled completely.

★**NOTE**

Splines of inner friction lining in the clutch should be aligned before the gear installation.

4.1.2 Refitting of main PTO

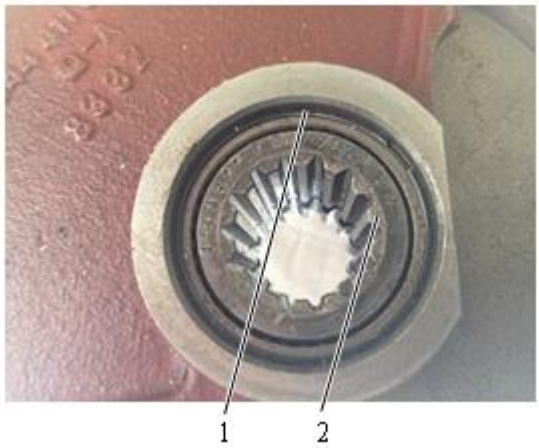


Fig. 4-33
1 Retainer ring (2 pcs)
2 Needle roller bearing

1. Install needle roller bearing into output housing hub, and then install retainer ring.

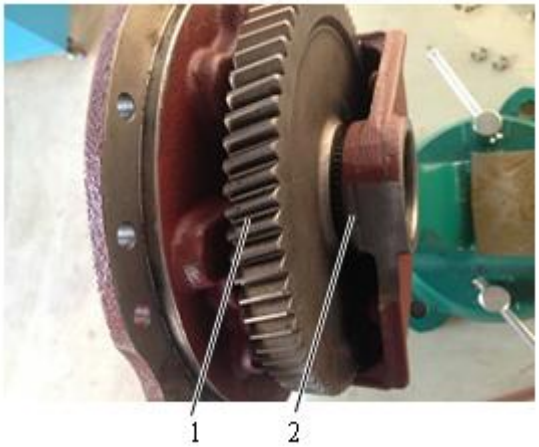


Fig. 4-34
1 Driving gear
2 Retainer ring

2. Install retainer ring into driving gear hole, and install gear into output housing hub.
3. Insert PTO shaft into gear hole, tap in the ball bearing, and install 2 elastic damping rings and 1 retainer ring.

4.1.3 Refitting of input components

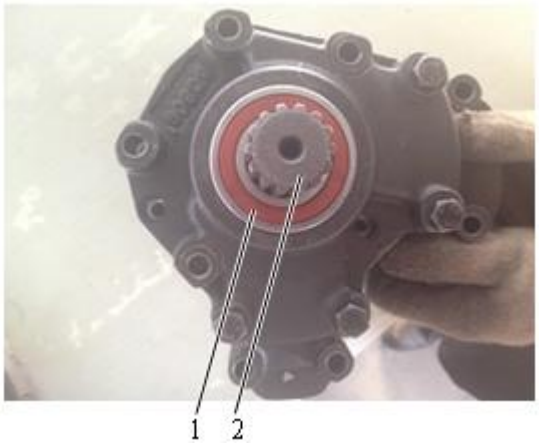


Fig. 4-35
1 Ball bearing
2 Auxiliary drive shaft

1. Tap ball bearing onto auxiliary drive shaft.

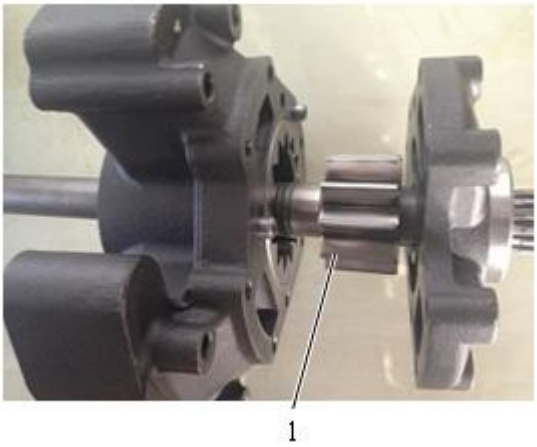


Fig. 4-36
1 Gear pump inner gear

2. Install flat key of gear pump inner gear onto the shaft, and install the oil pump.

Fig. 4-37
1 Ball bearing

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

★**NOTE**

The auxiliary drive shaft must be able to rotate flexibly.

Fig. 4-38
1 Snap spring (30×1.5)
2 Seal ring

4. Install shaft snap spring and snap-in seal ring.

Fig. 4-39
1 Oil seal Φ75
2 Needle roller bearing

5. Tap needle roller bearing into bearing hole on pump impeller bearing seat, and then install the oil seal.

★**NOTE**

The oil seal should be replaced with new one.

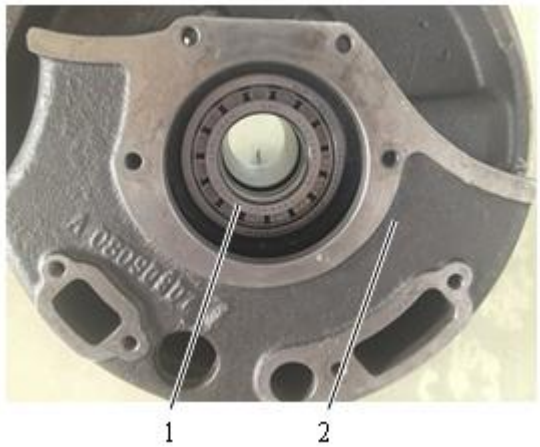


Fig. 4-40
1 Roller bearing
2 Oil distributor flange

6. Install roller bearing into bearing hole on oil distributor flange.

★**NOTE**

The oil distributor flange should be cleaned before the assembly.

Fig. 4-41
1 Input gear

7. Install input gear into oil distributor flange, and adjust the gear clearance properly.

Fig. 4-42
1 Driving shaft
2 Seal ring

8. Install gear ring onto driving shaft.

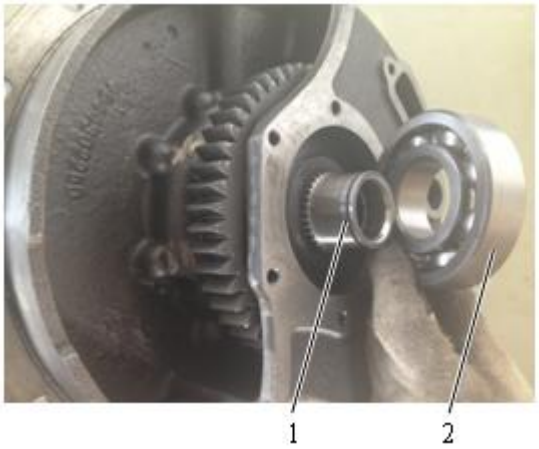


Fig. 4-43
1 Driving shaft
2 Ball bearing

9. Insert driving shaft and install ball bearing.

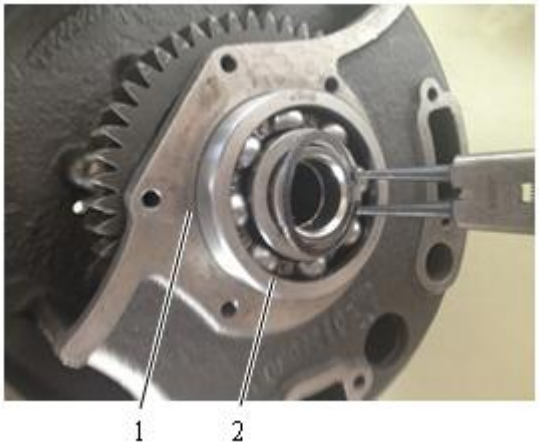


Fig. 4-44
1 End face of oil distributor flange
2 End face of bearing cup

10. Install elastic damping ring, and use depthometer to measure the distance between two end faces *h*.

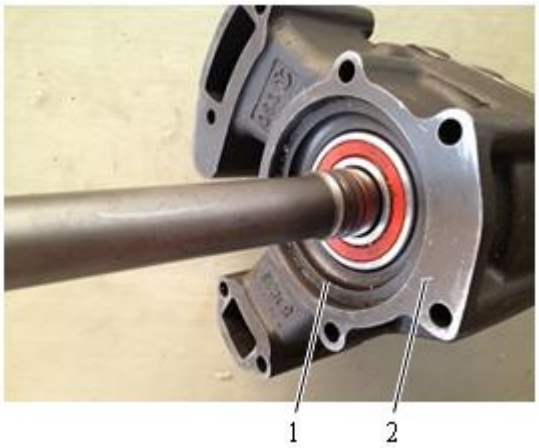


Fig. 4-45
1 Step surface of transmission pump bearing
2 Joint surface of transmission pump

11. Use depthometer to measure the distance between two end faces *H*.

★**NOTE**

Axial run-out of output shaft bearing: D=H-h

Adjusting washers with different thickness should be selected such that *D* is 0.2-0.4 mm.

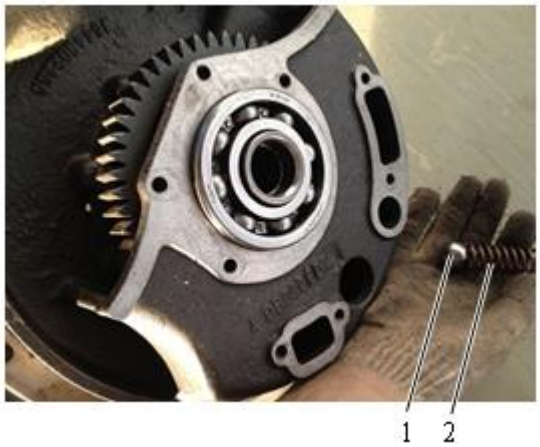


Fig. 4-46
1 Steel ball Φ20mm
2 Pressure spring

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

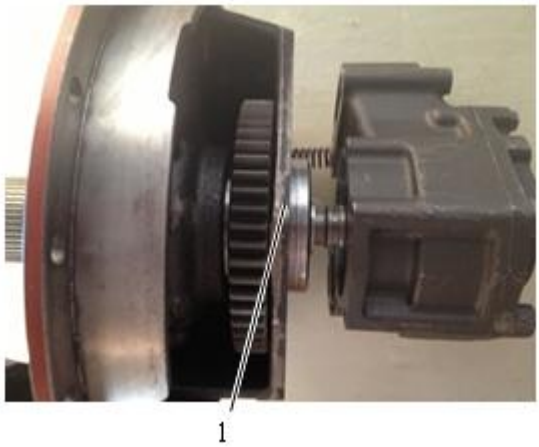


Fig. 4-47
1 Oil pump gasket

13. Place oil pump gasket onto the pump surface of oil distributor flange, grease it, and insert the pump assembly into the hole of oil distributor flange assembly.

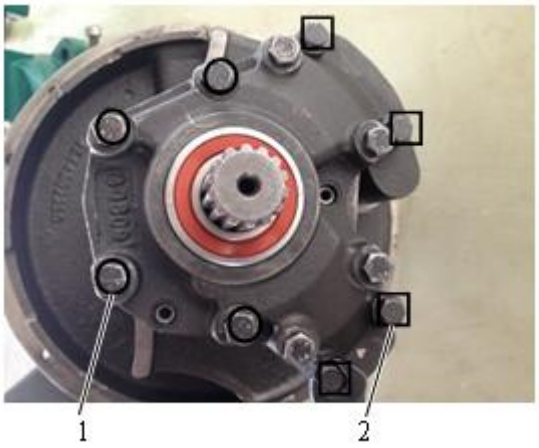


Fig. 4-48
1 Hexagon screw (M8*115) (4 pcs)
1 Hexagon screw (M8*85) (4 pcs)

14. Tighten the bolt for connecting oil pump assembly and oil distributor flange assembly.

Nm 23 Nm

Fig. 4-49
1 Gasket

15. Place the gasket of pump impeller bearing seat onto the oil distributor flange face.

Fig. 4-50
1 Hexagon screw (M8*28)

16. Tap in the pump impeller bearing seat, and tighten the bolt for connecting pump impeller bearing seat and oil distributor flange.

Nm 23 Nm

4.2 Refitting of transmission assembly

4.2.1 Refitting of output components

Fig. 4-51
1 Output shaft gear 2 Partition
3 Oil baffle disc

1. Place output shaft gear, install partition and oil baffle disc into the housing, and use two bolts (M8*16) and washers to fix them.

Fig. 4-52

2. Tap roller bearing to output gear shaft end, and place it into oil baffle disc. Then install spacer sleeve and insert output shaft.

Fig. 4-53
1 Output shaft

3. Place adjusting washers in turn.

★**NOTE**

Adjusting washers with different thickness should be selected for replacement such that the axial clearance of bearing is 0.1-0.3 mm.

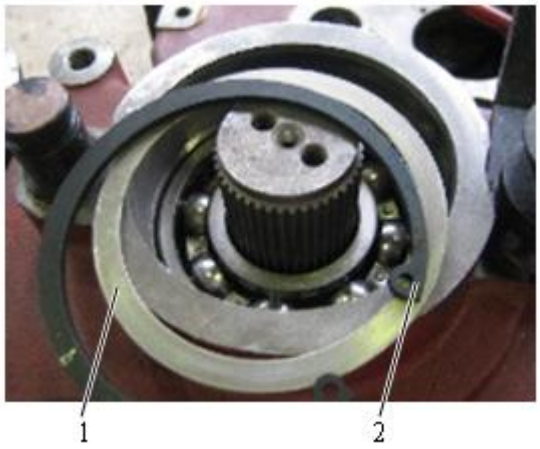


Fig. 4-54
1 Adjusting washer
2 Snap ring (120*4)

4. Install snap ring.

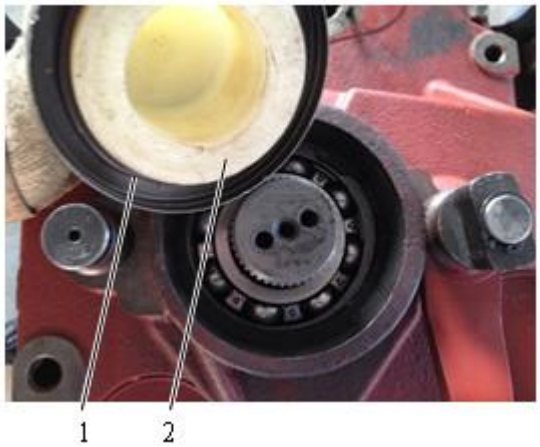


Fig. 4-55
1 Oil seal
2 Assembling tool for oil seal (2938001833)

5. Use tool to install oil seal into housing.

★**NOTE**

New oil seal should be installed after the removal.

Fig. 4-56
1 Output flange

6. Install output flange and pressure plate, and tighten two M10×30 bolts.

Nm 46 Nm

Fig. 4-57
1 Assembling tool for lock plate (2938001838)

7. Use special assembling tool to install lock plate.

Fig. 4-58
1 Brake flange

8. Install parking brake flange.

Fig. 4-591
1 Parking brake

9. Install brake drum wheel and pressure plate, tighten bolt and lock the lock plate.

4.2.2 Refitting of countershaft assembly

Fig. 4-60
1 O-ring 2 Countershaft
3 Roller bearing 4 Countershaft gear

1. Install roller bearing into bearing hole of countershaft gear, and fix it with grease for subsequent use.

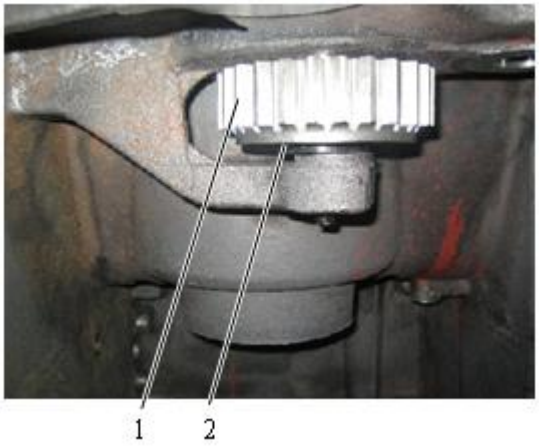


Fig. 4-61
1 Countershaft gear 2 Shim

2. Place countershaft gear assembly into gear groove on housing, insert countershaft and install shim.
3. Install and tighten fixing bolt, and install sealing washer.

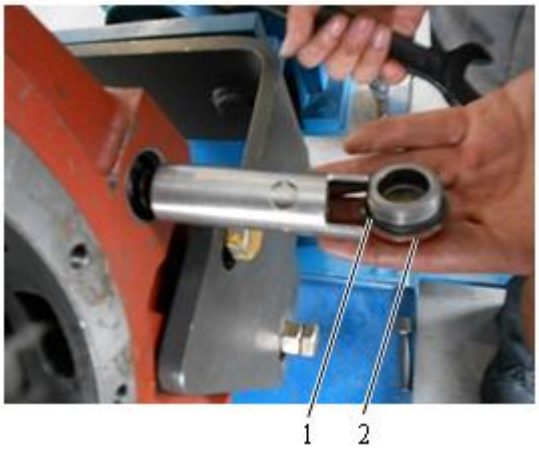


Fig. 4-62
1 O-ring
2 Screw plug (CM30*1.5)

4.2.3 Refitting of torque converter pressure control valve

1. Install pressure spring and valve core into hole on valve housing, then install O-ring onto screw plug, and the valve housing assembly into the pressure retaining valve port of torque converter on the housing. Afterwards, tighten the screw plug.

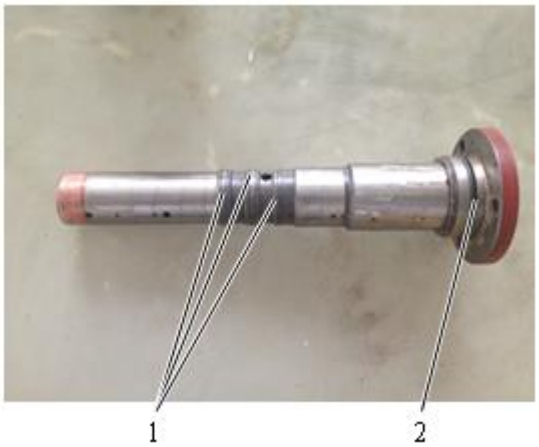


Fig. 4-63
1 Piston ring (3 pcs)
2 O-ring (49*3)

Fig. 4-64
1 K3 and K4 clutch assemblies
2 Assembling tool for clutch (29380017611)

Fig. 4-65

4.2.4 Refitting of K3 and K4 clutch assemblies

1. Install O-rings and piston rings onto K3 and K4 clutch shafts.

2. Place clutch assembly into the housing, and move the clutch to 3# shaft position; then install nylon bar and thrust washer to clutch assembly.

kg About 15 kg

NOTE

The clutch should be supported under the lower part by the tool to prevent against its dropping.

3. Tilt transmission to make it horizontal, and install assembling tool for clutch.

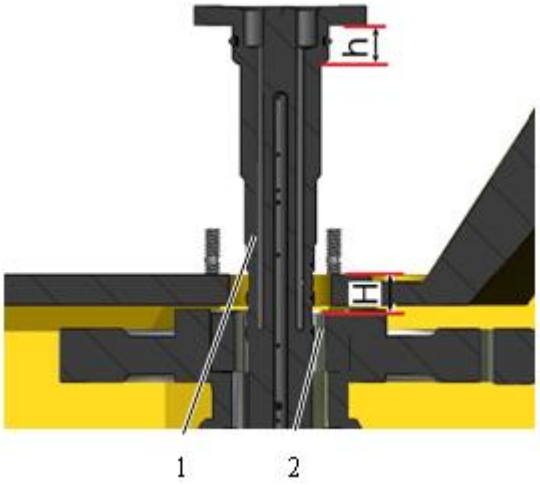


Fig. 4-66
1 K3&K4 clutch shaft
2 K3 clutch bearing roller

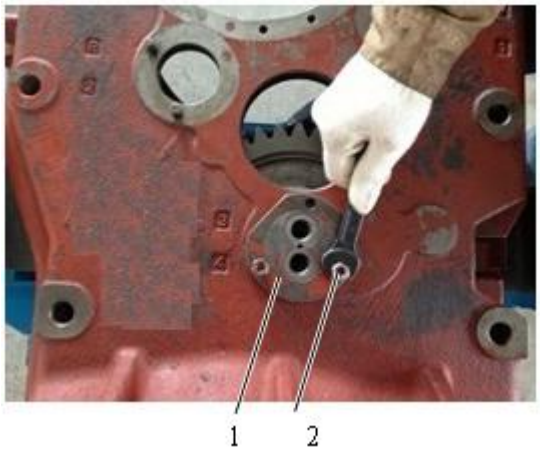


Fig. 4-67
1 K3&K4 clutch assembly
2 Hexagon nut (M8) (2 pcs)

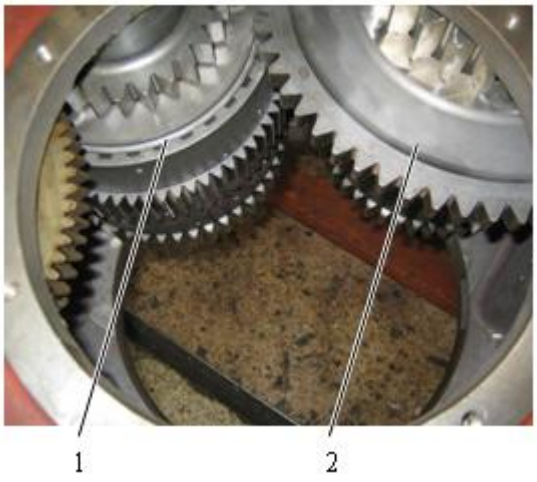


Fig. 4-68
1 KV&K1 clutch assembly
2 KR&K2 clutch assembly

4. Use depthometer to measure the height of bearing step on clutch shaft *h*, and the height of K3 clutch bearing roller from the housing surface *H*.

★**NOTE**

Axial clearance of clutch assembly A=H-h

Adjusting washer with appropriate thickness should be assembled such that *A* is 0.1-0.3 mm.

5. Take out the tool, install K4&K3 clutch shaft, and tighten the nut for fixing clutch assembly.

★**NOTE**

K3&K4 clutch gear should be able to rotate flexibly.

Nm 23Nm

4.2.5 Refitting of KR&K2 and KV&K1 clutches

1. Install K2&KR and K1&KV clutch components into respective shaft holes on the housing, and adjust the bearing clearance. Then insert K2 and K1 shafts, and use three M8×18 bolts to fix them.

★**NOTE**

Adjusting washer with appropriate thickness should be assembled such that *A* is 0.1-0.3

mm.

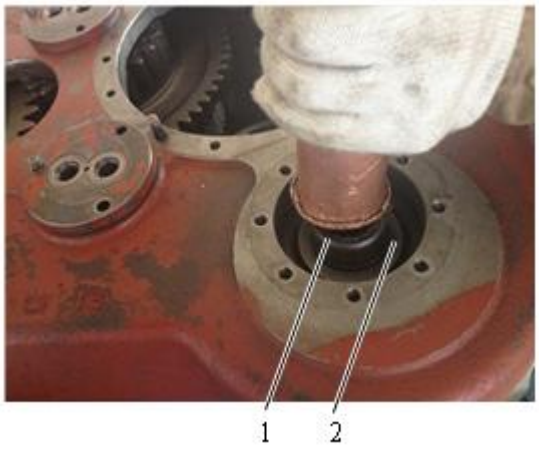


Fig. 4-69
1 PTO shaft
2 Retainer ring

4.2.6 Refitting of auxiliary PTO

1. Place transfer gear into the housing.
2. Tap in PTO shaft to make the shaft retainer ring fit the gear.

Fig. 4-70
1 Snap ring (45*1.75)

3. Use circlip pliers to install bearing snap ring onto PTO shaft.
4. Assembly PTO end cover, install gasket and tighten the bolt for connecting PTO end cover and housing.

★**NOTE**

New gasket should be installed after the removal.

Nm 16 Nm

4.2.7 Refitting of input assembly

1. Place input device onto the housing, install gasket, and use copper bar to tap it in.

★**NOTE**

During the assembling, two bolts should be screwed into the fixing screw holes, and new gasket installed after the removal.

Fig. 4-71
1 Input assembly

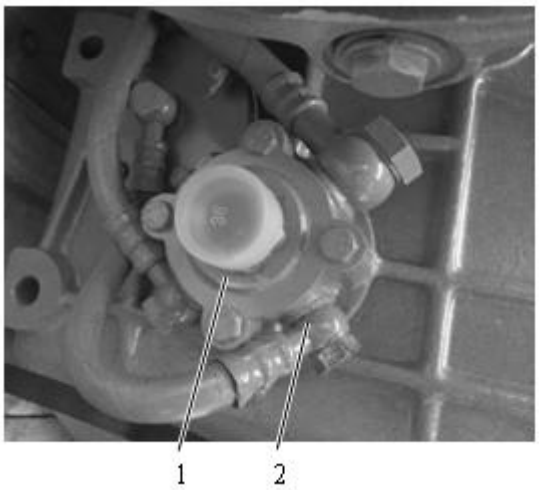


Fig. 4-72
1 Transmission oil inlet cover
2 Transmission oil pipe

2. Assemble transmission oil inlet pipe assembly and transmission oil pipe, and tighten the hollow screw of transmission oil pipe and housing.

Nm 34±5 Nm

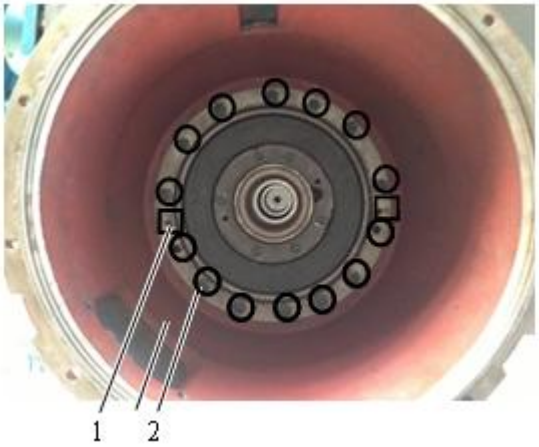


Fig. 4-73
1 Tensioning pin
2 Hexagon screw

3. Assemble connecting housing, and use copper bar to tap it in.

★**NOTE**

During the assembling, the locating pin holes should be aligned, and tapping force distributed evenly on the connecting casing.

4. Tighten the bolts for connecting housing, oil distributor flange and connecting casing.

★**NOTE**

Pin holes should be aligned, and bolts tightened several times diagonally.

Nm 68 Nm

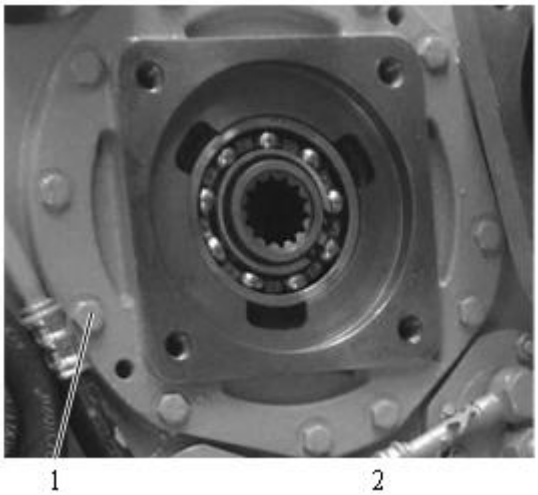


Fig. 4-74
1 Hexagon screw

4.2.8 Refitting of main PTO assembly

1. Install PTO assembly, and tighten the bolts and nuts for connecting PTO and housing.

★**NOTE**

Bolts should be tightened several times diagonally.

Nm 23 Nm

4.2.9 Refitting of oil filter

1. Screw up the oil filter.

Fig. 4-75

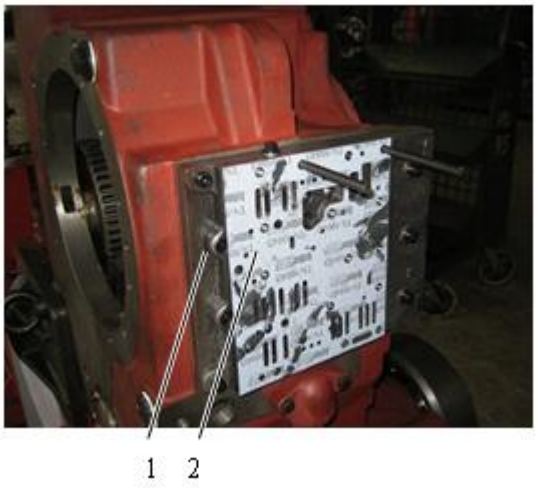


Fig. 4-76
1 Oil feed plate
2 Paper washer

4.2.10 Refitting of transmission control valve

1. Place paper washer, lower partition, paper washer and oil feed plate onto the valve plate plane of housing respectively, and use three M8×30 bolts and three M8×45 and six M8×35 hexagon socket screws to fix them.

★**NOTE**

New paper washers should be installed after the removal.

Fig. 4-77
1 Transmission control valve

Fig. 4-78

Before the assembling, the housing valve plate, oil duct plate and partition should be cleaned.

Nm 20 Nm

2. Place paper washer, upper partition, paper washer and control valve onto the oil feed plate, and use ten M8×45 and six M8×75 hexagon socket screws to fix them.

★**NOTE**

New paper washers should be installed after the removal.

Bolts should be tightened several times diagonally.

Nm 20 Nm

3. From top to bottom, the six oil holes on oil feed plate are for K2, K1, K3, K4, KV and KR (among them, KV and KR pipes are subject to rear axle differential gear steering of each OEM) pipes respectively; connect them with various oil duct holes on K1, K2 and K3 shafts respectively.

★**NOTE**

Bolts should be tightened after the proper adjustment of hose position.

Nm 55±5.5 Nm

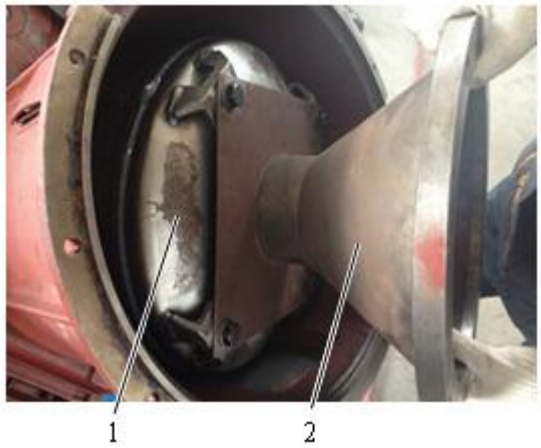


Fig. 4-79
1 Torque converter
2 Intermediate ring

4.2.11 Refitting of torque converter

1. Install intermediate ring and torque converter into connecting casing, and note the positions of splined holes.

kg About 20kg

NOTE

As provision is not made for axial fixing, the installed torque converter should be fixed properly to prevent against dropping.

5 Troubleshooting

5.1 Removal and assembling tools for YD13 transmission:

1	Code	2938001832	
	Name	Clutch nylon bar	
	Qty.	1	
	Purpose	For assembling adjusting shims during the Refitting of clutch assembly	
2	Code	2938001833	
	Name	Output oil seal sleeve	
	Qty.	1	
	Purpose	For assembling output shaft oil seal	
3	Code	2938001838	
	Name	Special tool for lock plate	
	Qty.	1	
	Purpose	Output flange pressure plate lock plate tool for locking assembled output shaft lock plate	
4	Code	2938001835	
	Name	Special tool for bearing	
	Qty.	1	
	Purpose	For assembling needle roller bearing 3526	
5	Code	2938001836	
	Name	Special tool for bearing	
	Qty.	1	
	Purpose	For assembling needle roller bearing 4026	

6.7	Code	2938001829	2938001828	
	Name	Clutch shaft puller - shaft	Clutch shaft puller - sleeve	
	Qty.	1		
	Purpose	For removing clutch shaft		
8	Code	2938001826		
	Name	Clutch pressing tool - shaft		
	Qty.	1		
	Purpose	For removing and assembling clutch piston return spring		
9	Code	2938001827		
	Name	Clutch pressing tool – pressure plate		
	Qty.	1		
	Purpose	For removing and assembling clutch piston return spring		

5.2 Inspection tools for YD13 transmission

Special tool	Tool name	Applicable position	Remarks
	Transmission pressure joint	Relief valve pressure joint	6410006224
	Pressure tesing hose	Used with pressure testing joint and pressure gauge	4030000368
	Pressure gauge with a range of 25 bar		6430000943

5.3 Fit clearance of critical parts of transmission

S/N	Part	Fit clearance
1	Clutch piston stroke and clearance	1.8-2.2 mm
2	Axial clearance of three sets of clutch shaft assemblies	0.1-0.3 mm

6 Fault Diagnosis and Troubleshooting

6.1 Fault diagnosis and troubleshooting for transmission EST controller

Table 5-1

S/N	Fault phenomenon	Analysis	Fault diagnosis and troubleshooting
1	Engine fails to be started.	(1) Power voltage is not correct; (2) Starter relay or other related electric appliances is failed; (3) Gear selector lever DW－4 is not placed in neutral position; (4) EST control unit incus poor-contacted plug or failure.	(1) Check power voltage, and in case of power insufficiency, charge the battery at the very first; (2) Check if the starting circuit of the engine involves poor connection or damaged elements; (3) Place the gear selector lever to the neutral position, when the starter relay on the control unit should pull in; (4) If no AS signal is received (i.e. the voltage on the 0# circuit is not +24V), the output signal of the control unit may involve problems. In this case, disconnect the plug of EST control unit, and connect it again, always clamped forcibly by hand to ensure that both ends are clamped tightly and properly connected. If it does work, replace the EST control unit.
2	The vehicle fails to run regardless of	(1)Open-circuit or short-circuit occurs; (2) The solenoid valve is damaged.	(1) Disconnect the plug, and measure the resistance of solenoid valves on the control valve is within 60Ω~70Ω. If

	the gear engaged	If it can be determined that the fault is thus resulted, the control unit will input a warning signal, i.e. indicator H2 flashes and clicks can be heard from the control unit inside; (3) Gear selector lever DW－4 is damaged or its plug is poorly connected; (4) EST-4 control unit is damaged or its plug is poorly connected; (5) Non-electrical faults such as oil circuit fault or mechanical fault occur.	not, replace the faulty solenoid valve; (2) Check the connecting cable for any wear; and replace the faulty cable when necessary; (3) Check if the incoming cable plug of DW－4 and EST is dislodged; and clamp it when necessary; (4)Replace DW-4 selector or EST control unit; (5) Replace hydraulic control valves.
3	The vehicle runs as normal in $1^{st}/2^{nd}$ gear, but not in $3^{th}/4^{th}$ gear.	(1) Brake switch BR or emergency brake switch BR2 gets seized; (2) Short circuit occurs between signal wire BR and +24V wire; (3) Solenoid valve M4 is damaged.	(1) Check if the two switch can be opened and closed flexibly, and if not, do troubleshooting accordingly; (2) Disconnect the cable between Br and BR2, if the gear is normal, check the relevant wirings and repair the faulty part; (3) Replace the solenoid valve M4.
4	There is no high-speed gear, and the speed in 2^{nd} gear is equal to that in $3^{rd}/4^{th}$ gear.	(1) This fault often occurs to the engine equipped with output speed sensor when the sensor is not or poorly connected or damaged; (2) Selector DW-4 incurs poorly-connected plug or damage.	(1) Check the speed sensor as described above, and if it is damaged, replace; (2) Check the wire to sensor, and if it is damaged, repair; (3) Replace selector DW-4.

5	No $1^{st}/2^{nd}/3^{rd}$ forward gears.	(1) Any of internal elements of selector DW-4 is damaged; (2) Solenoid valve M3 is damaged.	(1) Replace the selector; (2) Replace solenoid valve M3.
6	No reverse gear.	(1) Solenoid valve M1 is damaged; (2) Selector is damaged.	(1) Replace the solenoid valve M1; (2) Replace selector DW-4.
7	Gears disappear sometimes.	(1) The power voltage is not stable; (2) The connector is poorly connected somewhere; (3) The solenoid valve or electric box works in an unstable state.	(1) Check the power supply system of vehicle, and eliminate the factors related with voltage; (2) Check, arrange and clamp all connectors; (3) Replace the electric box.

6.2 Diagnosis and troubleshooting of common transmission faults

Table 5-2

S/N	Fault phenomenon	Analysis	Fault diagnosis and troubleshooting
1	Engine fails to be started.	1、The engine starting circuit (like power supply, starter relay, starter motor etc.) is faulty. 2. The lever is not placed in the neutral position. 3. The fuse to the control circuit on the engine is burnt out; 4. The lever involves poorly-connected plug or faults.	1. Check the engine circuits with reference to the *Instructions to Engine Starting Circuit*. 2. Place the lever to the neutral position. 3. Replace the fuse. 4. Arrange the connectors, and check if the handle circuit is normally energized. 5. Arrange the connectors or eliminate the faults of electric box.

		5. The electric box incurs poorly-connected plug or faults.	
2	Pressure at all gears is low	1. The oil pressure gauge is faulty. 2. Bolt of transmission control valve is not sufficiently tightened. 3. Spring of main pressure valve is broken. 4. Transmission pump wears out. 5. Chips invade into the transmission control valve or the valve gets seized.	1. Replace the oil pressure gauge; 2. Tighten the control valve bolt M8 with a torque of 20Nm; 3. Replace the broken spring; 4. Replace the transmission pump; 5. Replace the filter and clean the control valve.
3	Oil pressure in $1^{st}/2^{nd}/3^{rd}$ forward gears is low but normal in other gears.	1. Forward gear clutch incurs internal leakage.	1. After the engine stops, block the oil passage to the corresponding KV clutch, and then start the engine and engage $1^{st}/2^{nd}/3^{rd}$ forward gears. If the pressure rises to a normal level, it indicates that the clutch incurs internal leakage and should be repaired.
4	Oil pressure in $1^{st}/2^{nd}/3^{rd}$ reverse gears is low but	1. Reverse gear clutch incurs internal leakage.	1. After the engine stops, block the oil passage to the corresponding KR clutch, and then start the engine and

	normal in other gears.		engage 1st/2nd/3rd reverse gears. If the pressure rises to a normal level, it indicates that the clutch incurs internal leakage and should be repaired.
5	Oil pressure in 1st forward and reverse gears is low but normal in other gears.	1. Clutch of 1st gear incurs internal leakage.	1. After the engine stops, block the oil passage to the corresponding K1 clutch, and then start the engine and engage 1st forward/reverse gears. If the pressure rises to a normal level, it indicates that the clutch incurs internal leakage and should be repaired.
6	The engagement time of all gears is too short.	1. O-ring on the throttle plug is damaged. 2. Bolts of pressure control valve are not tightened with the torque specified.	1. Replace O-ring. 2. Tighten the transmission control valve bolt M8 with a torque of 20Nm;
7	The engagement time of all gears is too long.	1. Throttle plug is blocked. 2. Pressure control valve gets seized.	1. Clean and unblock. 2. Clean and check.
8	Torque converter incurs high oil temperature.	1. The oil temperature sensor is faulty. 2. The oil temperature gauge is faulty. 3. The oil level is low.	1. Replace. 2. Replace. 3. Check the oil level correctly and top up when necessary. 4. Bleed off the radiator via the exhaust

		4. Air invades into the radiator of torque converter. 5. Oil passage between the torque converter and the radiator is blocked. 6. The heat dissipating capacity of radiator is low. 7. Back pressure valve of the torque converter gets seized.	outlet on the top (for engines with exhaust outlet); 5. Check if the oil circuits between the radiator to the transmission and the radiator are blocked; 6. Check if the radiator can perform heat dissipation appropriately, and check the tension of engine fan belt, and check the radiator outside for adhered dirt. 7. Check if the hose joint between the transmission and the radiator is inserted deeply into the transmission so that the back pressure valve core is pressed, the valve is seized and thus the oil passage is blocked.
9	The vehicle fails to run regardless of the gear engaged.	1. The oil level is low. 2. The elastic plate connected between the engine and the torque converter is torn off, and the power connection between the torque converter and the transmission input gear is failed (seldom). 3. Power circuits of the	1. Check the oil level correctly and top up when necessary. 2. Replace the elastic plate or the corresponding damaged part. 3. Check if the power supply is damaged, if the cable is worn out, and if the cable connector is dislodged. 4. Do troubleshooting as described above. 5. Check if resistance of solenoid valve is 65+5Ω, and if it is 0 or ∝, it

		vehicle are faulty. 4. Transmission involves low pressure. 5. The solenoid valve is damaged. 6. The gear selector lever is damaged. 7. The electric box is faulty.	indicates that the solenoid valve is damaged and should be replaced. 6. Check the lever as per the corresponding troubleshooting method and replace when necessary. 7. Check the electric box as per the corresponding troubleshooting method or with a PR68 detector.
10	Vehicle fails to run with $1^{st}/2^{nd}$ gear engaged.	1. Pressure switch of emergency brake or parking brake is damaged. 2. (M4)The solenoid valve M4 is in failure.	1. If the $1^{st}/2^{nd}$ gear of the vehicle is recovered after the emergency brake pressure switch or the parking brake pressure switch is disconnected, it indicates that the corresponding pressure switch is damaged. 2. Replace the solenoid valve.
11	The vehicle runs with a speed of 2^{nd} gear when the $3^{rd}/4^{th}$ gear is engaged	1. The speed sensor is damaged.	1. Measure if the sensor resistance is 1020±100Ω, and if it is 0 or ∝, it indicates that the speed sensor is damaged and should be replaced.
12	No $1^{st}/2^{nd}/3^{rd}$ forward gears.	1. The clutch of forward gears involves internal leakage. 2. The circuit in the gear selector lever incurs burnt-out contract or poor connection.	1. Eliminate the clutch internal leakage as described above. 2. Arrange the lever wires or replace the lever. 3. Measure if the resistance of the solenoid valve is 100±10Ω, and if it is 0 or ∝, it indicates that the

		3. The solenoid valve M3 is in failure. 4. The transmission control valve gets seized.	solenoid valve is damaged and should be replaced. 4. Clean the transmission control valve.
13	No reverse gear.	1. The clutch of reverse gear involves internal leakage. 2. The circuit in the gear selector lever incurs burnt-out contract or is not energized. 3. The solenoid valve M1 is in failure. 4. The valve gets seized.	1. Eliminate the clutch internal leakage. 2. Arrange the lever wires or replace the lever. 3. Measure if the resistance of the solenoid valve is 65±5, and if it is 0 or ∝, it indicates that the solenoid valve is damaged and should be replaced. 4. Clean the transmission control valve.
14	Gears disappear sometimes.	1. The power supply provided to ECU is not stable. 2. The power supply circuit to ECU is poorly connected. 3. The gear selector lever works unstably or the connector is poorly connector. 4. The transmission oil level is low. 5. The solenoid valve or	1. Check the power supply system of the vehicle. 2. Do troubleshooting to the circuit of engine. 3. Arrange the lever wires or replace the lever. 4. Top up correctly. 5. Arrange connectors. 6. Clean.

		the electric box works unstably or their connectors are poorly connected. 6. The valve gets seized.	
15	The transmission produces unusual noises.	1. Bolts securing the engine with transmission get loose. 2. The transmission oil level is low. 3. The propeller shaft connecting the transmission is faulty. 4. The elastic plate connected between the engine and the torque converter is torn off. 5. The transmission incurs mechanical fault inside.	1. Check and tighten. 2. Add oil to the normal level. 3. Check the propeller shaft. 4. Replace the elastic plate. 5. Remove the propeller shaft, and check if there is still unusual noise produced; if were, check if the transmission involves mechanical fault.
16	The vehicle reverses with neutral position engaged, remains still with $1^{st}/2^{nd}/3^{rd}$ forward gear engaged, and runs as normal with	1. The clutch of reverse gear is ablated; 2. The valve gets seized. 3. The solenoid valve M1 is in failure. 4. The lever is faulty.	1. After the engine stops, block the oil passage to the KR clutch, and then start the engine and engage the reverse gear. If the vehicle runs as normal, it indicates that the reverse gear clutch is ablated and should be repaired mechanically. 2. Clean.

	reverse gear engaged.		3. Replace the solenoid valve. 4. Replace the lever.
17	The vehicle proceeds with neutral position engaged, remains still with reverse gear engaged and runs as normal with $1^{st}/2^{nd}/3^{rd}$ forward gear engaged.	1. The clutch of forward gear is ablated. 2. The valve gets seized. 3. The solenoid valve M3 is in failure. 4. The lever is faulty.	1. After the engine stops, block the oil passage to the KV clutch, and then start the engine and engage the $1^{st}/2^{nd}/3^{rd}$ forward gear. If the vehicle runs as normal, it indicates that the forward gear clutch 1 is ablated and should be repaired mechanically. 2. Clean. 3. Replace the solenoid valve. 4. Replace the lever.
18	The vehicle can only proceed with 1^{st} forward/reverse gear engaged.	1. K1 clutch is ablated. 2. The valve gets seized. 3. The solenoid valve is in failure.。 4. The lever is faulty.	1. After the engine stops, block the oil passage to the K1 clutch, and then start the engine and engage the 1^{st} forward/reverse gear. If the vehicle runs as normal, it indicates that the clutch of the 1^{st} gear is ablated and should be repaired mechanically. 2. Clean. 3. Replace the solenoid valve. 4. Replace the lever.