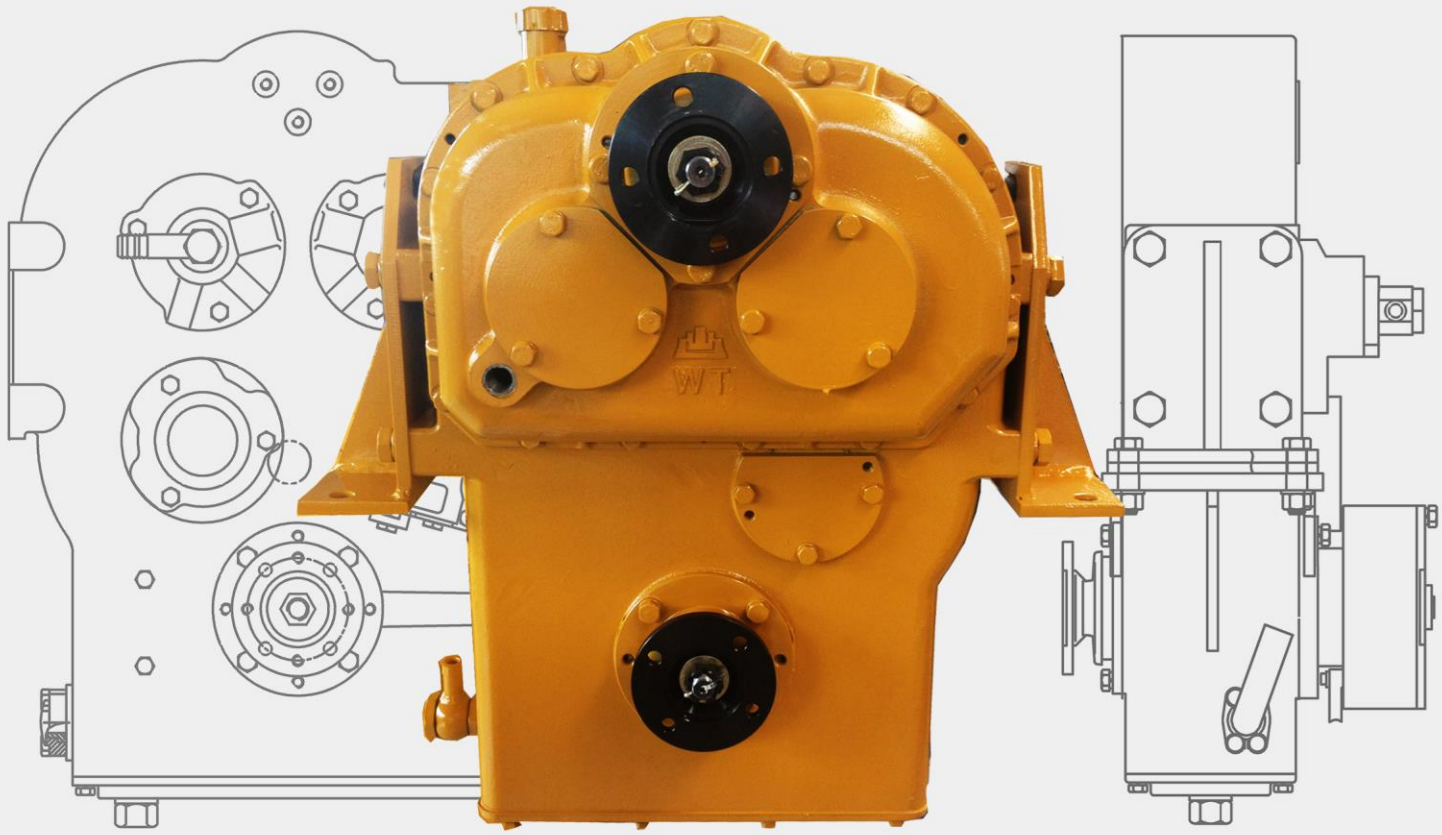
BD05 Transmission Service Manual



SDLG

Foreword

This service manual mainly covers the working principle, service instructions, service technology and standard requirements for BD05 transmission (also applies to ZL15 series 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.

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, the transmission line in each gear, and the operation and maintenance of oil supply line and 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 Service tools for transmission

This chapter describes special tools and conventional tools used in the working process.

Chapter 6 Transmission fault diagnosis and troubleshooting

This chapter describes the troubleshooting of common faults for 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

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 personnel 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, goggles, 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.

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.

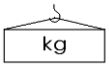
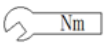
15. To tighten fittings body and plug screw, do not use a pneumatic wrench. Be sure to rotate them to some extent by hand, and then use a torque wrench of corresponding specification to tighten them to required torque.

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

12.9	1080	16~21	38~51	75~100	131~175	209~278
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
12.9	1080	326~434	448~597	635~847	864~1152	1098~1464
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
12.9	1080	1606~2142	2181~2908	2968~3958	3812~5082	4933~6577

2 Transmission system

2.1 Description of transmission

The BD05 transmission is a fixed shaft, constant mesh and power gearshift transmission, which is mainly used for LG918 and LG920 loaders. The ZL15 series transmission is mainly used for the LG916D loader. In the transmission system of LG916D, LG918 or LG920 loader, the engine is directly connected to the torque converter via the spring plate so as to realize output power. The torque converter is connected via the propeller shaft to the front input flange of transmission which changes speed, increases torque and then transmit power to front and rear drive axles via front and rear propeller shafts respectively.

The BD05 transmission mainly consists of input shaft assembly, forward low-gear clutch shaft assembly, reverse high-gear clutch shaft assembly, countershaft assembly and output shaft assembly.

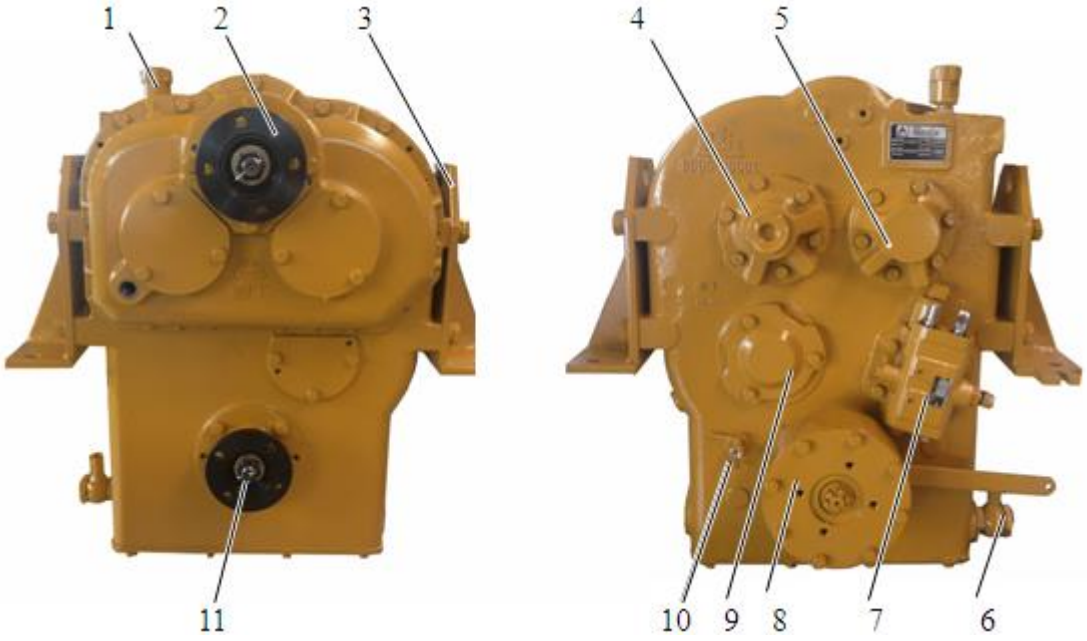


Fig. 2-1

1. Breather 2. Input shaft assembly 3. Transmission mounting bracket 4. Reverse high-gear clutch shaft assembly 5. Forward low-gear clutch shaft assembly 6. Oil suction port 7. Transmission control valve 8. Parking brake 9 Countershaft assembly 10. Oil inspection plug 11. Output shaft assembly

2.2 Basic parameters of transmission & torque converter

Table 2-1

Item		Parameters/description
Torque converter	Type	Single-stage three-element single-turbine torque converter
	Oil pressure at torque converter inlet (MPa)	0.4~0.6
	Oil pressure at torque converter outlet (MPa)	0.15~0.325
Transmission	Type	Fixed-shaft power gearshift
	Gears	Forward II, reverse II
	Transmission working pressure (MPa)	1.2~1.5

2.3 Structure and principle of transmission

2.3.1 Structure of transmission

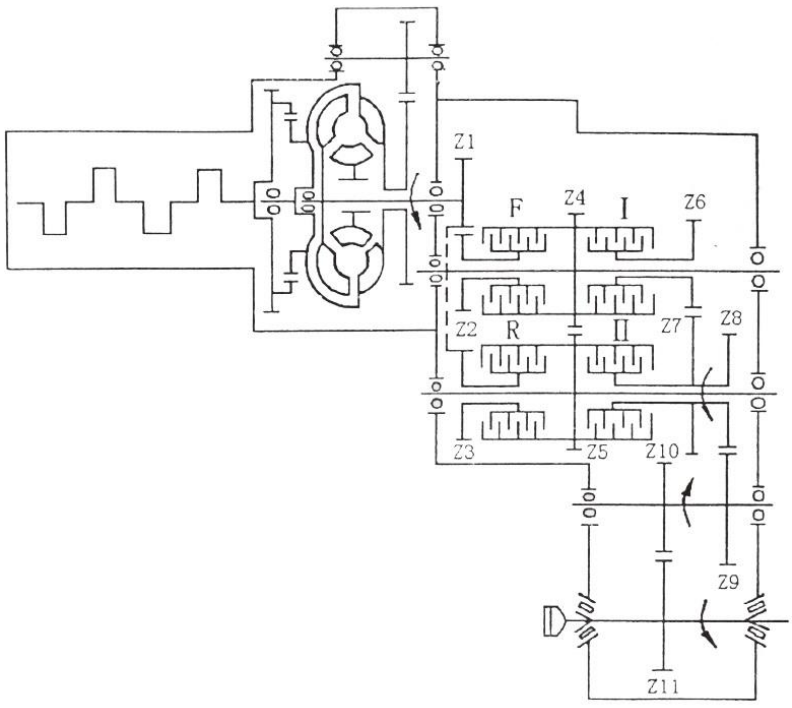


Fig. 2-2 Schematic diagram of transmission structure

2.3.2 Gearshift principle of transmission

The transmission adopts mechanical gearshift. The gearshift mechanism of BD05 transmission is shown in Fig. 2-3. This gearshift mechanism includes two gearshift levers: 1. Direction control lever; 2. High/low speed control lever. They are connected to the transmission control valve stem of the transmission respectively via the flexible shaft, so the working of clutch of each gear is realized by controlling the transmission valve. The working condition of each clutch is shown in Fig. 2-4.

Fig. 2-3 Gear selector

Gear \ Clutch	F	R	I	II
F-I	√		√	
F-II	√			√
R-I		√	√	
R-II		√		√
Neutral				

Fig. 2-4 Working condition of clutch for each gear

2.3.3 Transmission line of each gear

1. Transmission line of forward I

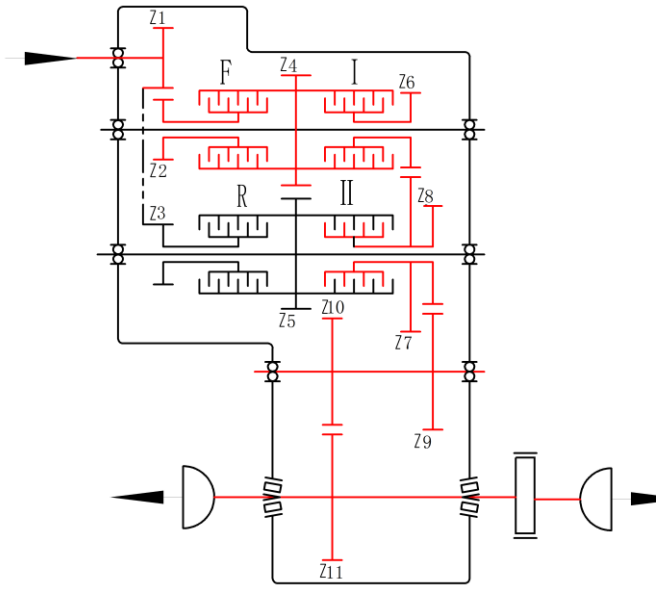


Fig. 2-5

Z1→Z2→Z4→Z6→Z7→Z8→Z9→Z10→Z11

2. Transmission line of forward II

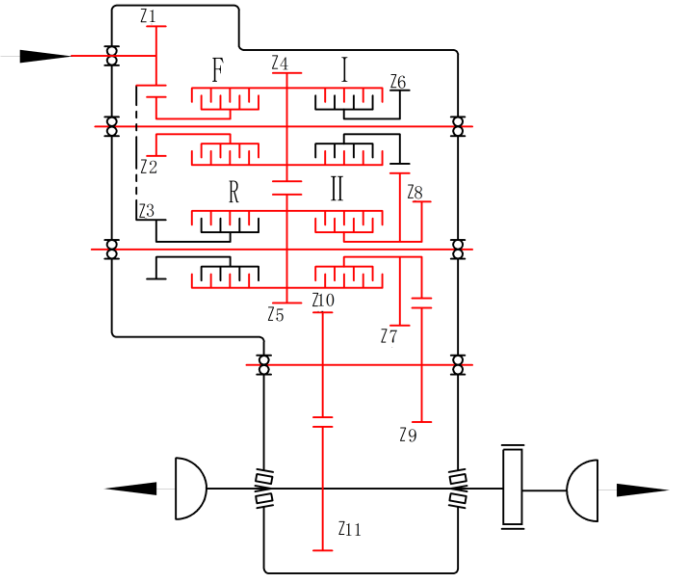


Fig. 2-6

Z1→Z2→Z4→Z5→Z7→Z8→Z9→Z10→Z11

3. Transmission line of reverse I

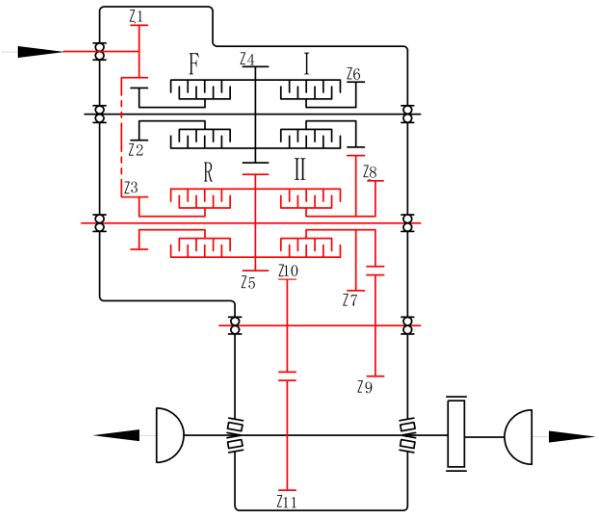


Fig. 2-7

Z1→Z3→Z5→Z4→Z6→Z7→Z8→Z9→Z10→Z11

4. Transmission line of reverse II

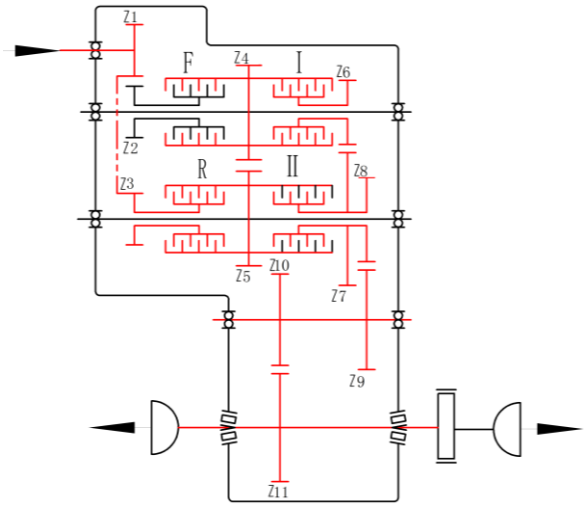


Fig. 2-8

Z1→Z3→Z5→Z7→Z8→Z9→Z10→Z11

2.3.4 Structure and principle of gearshift clutch

(1) Composition and structure

The BD05 transmission is equipped with four groups of normally-released clutches, which are engaged by means of transmission oil so as to fulfill the functions of two forward and two reverse gears. Two groups therein are directional clutches for forward and reverse traveling. The input gear meshes with forward and reverse clutch gears at the same time. For each gear, one direction clutch and one speed clutch work together. The power from the clutch shaft assembly is transmitted to the countershaft assembly, then to the output shaft via the gear of the former, and finally is output by means of forward and rear output flanges.

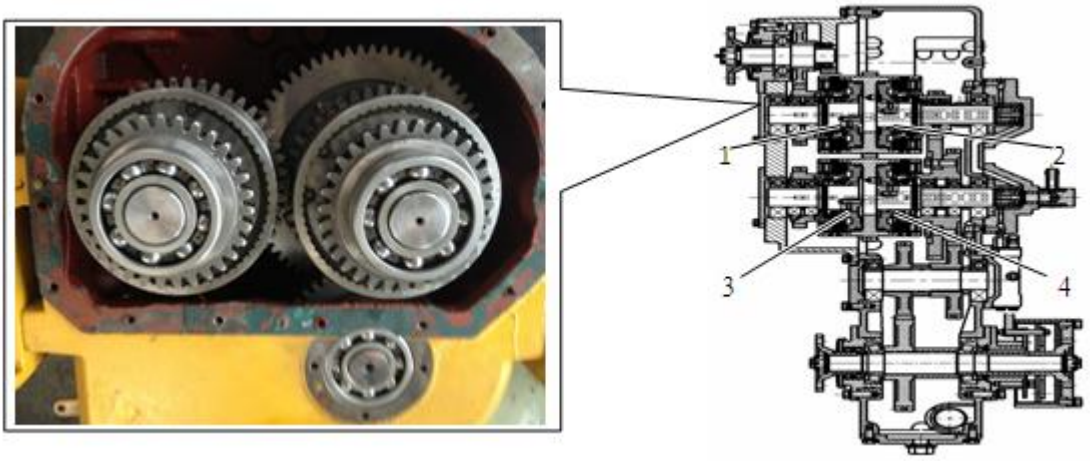


Fig. 2-9

1 Forward gear clutch 2. Low speed gear clutch 3. Reverse gear clutch 4. High speed gear clutch

(2) Working principle

The structures of these four clutches are similar. There are four pieces of drive plates and driven plates for each clutch. The external spline of gear is connected to the internal spline of drive plate, and the internal spline of clutch housing is connected to the external spline of driven plate. One end of return spring is against the piston, and the other end supports the shaft via the spring seat and the retainer ring. Two clutches share one shaft. The oil supply to the two cylinders and the lubrication of clutches and gears are all provided by the oil path of the shaft.

When operating: when gearshift is performed, pressurized oil enters piston chamber via internal oil path, forces piston to overcome spring force and move, and the piston pushes drive plate to press against driven plate. Thus the clutch is engaged.

When operation is stopped: pressurized oil is cut off, so the transmission oil in the cylinder returns via oil return port, and the piston returns under the effect of return spring, in this case, the internal and outer friction linings detach. Thus the gear idles.

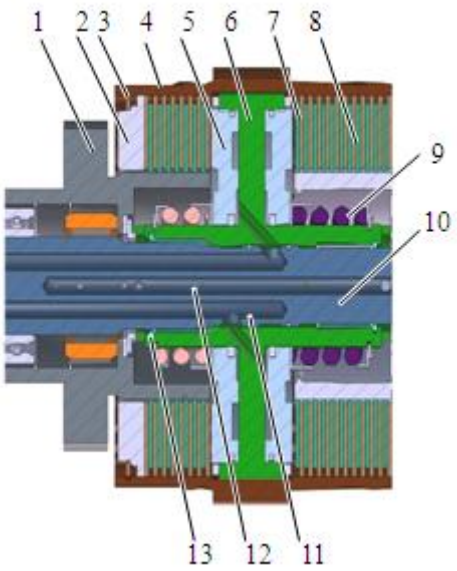


Fig. 2-10 Structure of clutch

1. Constant-mesh gear 2. Bearing plate 3. Snap ring 4. Clutch housing 5. Piston

6. Separation bracket 7. Outer friction lining 8. Inner friction lining 9. Spring

10. Clutch shaft 11. Working oil path 12. Lubrication oil path 13. Snap ring

(3) Working principle of automatic drain valve

After oil supply to the clutch cylinder is stopped, the clutch housing continues to rotate with the shaft under the effect of inertia force, the transmission oil in the cylinder is thrown outward under the centrifugal force, pressure forms around the circumferential edge of cylinder, force is generated to push the piston to return, and thus prevent the clutch from being released rapidly. To unload the centrifugal pressure of oil in the rotary cylinder, an automatic drain valve is installed on the clutch housing.

When clutch is engaged:

Pressurized oil enters the cylinder, and flows out from the drain port via the path between the steel ball and the port. At this moment, pressure difference is generated between the front and the rear sides of the steel ball. Under the effect of this pressure difference, the steel ball is forced to move towards the drain port till the port is closed. The draining is stopped, and the oil pressure in the cylinder rises.

When clutch is released:

The cylinder and the oil return path are connected to unload pressure. At this moment, without the

effect of pressurized oil, steel ball is thrown outward under the centrifugal force, and then the drain port is opened. The oil in the cylinder flows out from the drain port via the path between the steel ball and the port and pushes the piston to return rapidly.

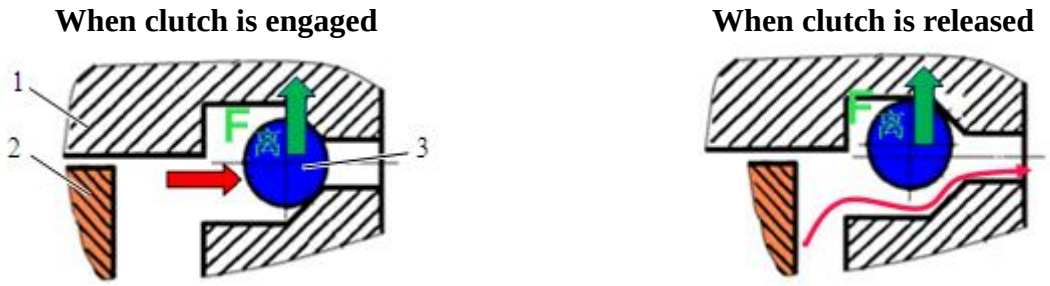


Fig. 2-11 Working schematic of drain valve

1. Piston 2. Clutch cylinder 3. Steel ball

2.4 Oil supply system

2.4.1 Oil supply line and principle of transmission & torque converter oil supply system

(1) Oil supply line of oil supply system

The oil supply system is an important component of hydromechanical transmission system. It mainly consists of radiator, secondary filter, oil filter, transmission pump, relief valve, transmission control valve and each pipeline.

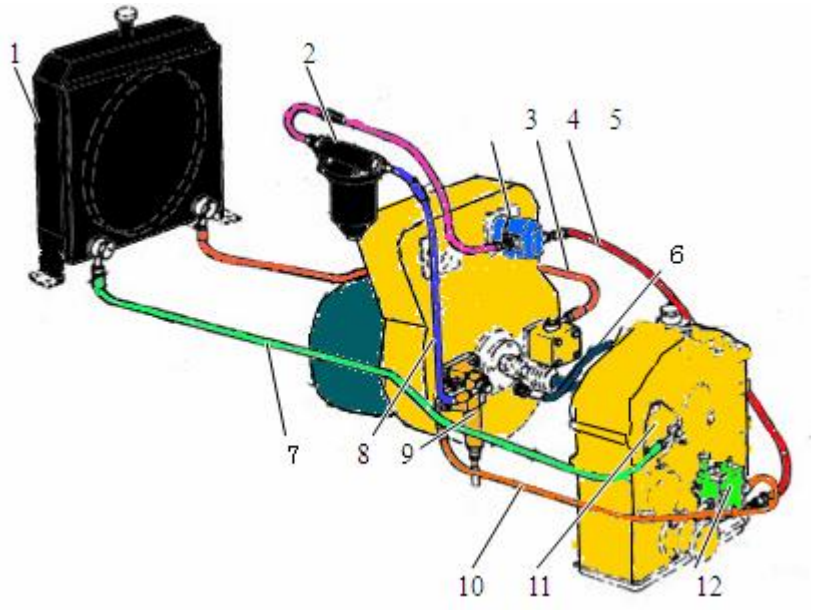


Fig. 2-12 Oil supply line diagram

1. Radiator 2. Secondary filter 3. Transmission pump 4. Radiator oil inlet pipe 5. Oil suction pipe

6. Torque converter oil return pipe 7. Radiator oil outlet pipe 8. Relief valve oil inlet pipe

9. Relief valve 10. Transmission control valve oil inlet pipe 11. Oil distributor

12. Transmission control valve

(2) Oil supply principle

The transmission pump sucks transmission oil from the oil sump via strainer and delivers it to the oil filter, after being purified, the oil enters relief valve. The relief valve has four oil ports of which one directly is connected to the torque converter via valve body and the other three to the transmission valve, transmission pressure gauge and transmission oil filler (oil return pipe) respectively.

At the port connected to the transmission valve, the pressurized oil enters the oil inlet end cap via the connecting pipe (steel pipe in diameter equal to 6 mm) inside the housing, and then flows to each clutch cylinder. The oil outlet of torque converter is equipped with one tee union (equipped with oil temperature sensor) through which the used oil enters oil cooler for cooling and then flows to the common oil inlet port of transmission end cap for the lubrication and cooling of inside parts (such as clutch) of transmission.

2.4.2 Description of main parts of oil supply system

(1) Transmission control valve

Constitution and structure:

The transmission control valve consists of speed valve, directional valve, shut-off valve and valve body (see Fig. 2-13). The speed valve consists of speed valve stem, spring and steel ball. Pull the speed valve stem to engage the transmission in the 1st gear, neutral gear and 2nd gear respectively.

The directional valve consists of directional valve stem, spring and steel ball. Pull the directional valve stem to engage the transmission in the forward gear, neutral gear and reverse gear respectively.

Shut-off valve: the shut-off valve consists of control valve assembly, valve core and spring.

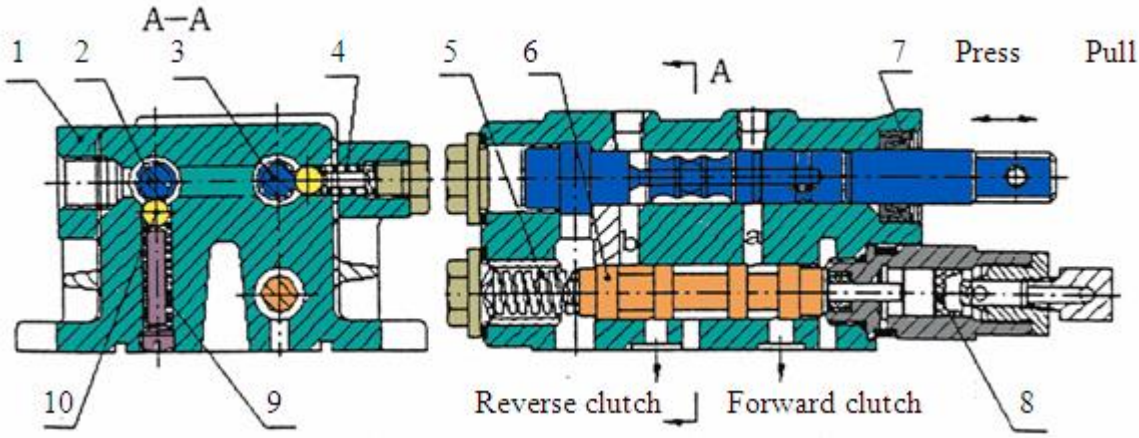


Fig. 2-13 Schematic diagram of transmission control valve structure

1. Valve body 2. Speed valve stem 3. Directional valve stem 4. Spring 5. Spring

6. Shut-off valve core 7. Oil seal 8. Shut-off piston 9. Steel ball

Working principle:

The combination of directional valve and speed valve can realize the function of forward I & II and reverse I & II. For example, when the directional valve stem is pulled out, the pressurized oil from the main regulator valve enters the directional valve and then flows to transmission forward clutch via port a. The pressurized oil pushes the piston to make the drive plate of the clutch press against the driven plate, and thus the transmission engages in the forward gear. When the speed valve is in 1st gear or 2nd gear, the forward I or II is realized. Similarly, when the directional valve stem is pressed down, the pressurized oil enters transmission reverse clutch via port b. The pressurized oil pushes piston to make the drive plate of the clutch press against the driven plate, and thus transmission engages with reverse I or II.

When the loader is traveling and the brake pedal is free, the shut-off valve is in the middle position. When the brake pedal is depressed, the pressurized oil from the brake system enters the oil control chamber and pushes the piston, the piston pushes the valve stem to move the valve core, and thus the spring is compressed. At this moment, the shut-off valve core will cut the path (port a and port b) from selector valve to transmission clutch, the forward or reverse clutch is released, and no power is transmitted. This is not only helpful for loader braking, but also can make loader apply all force on working device during shovel operation.

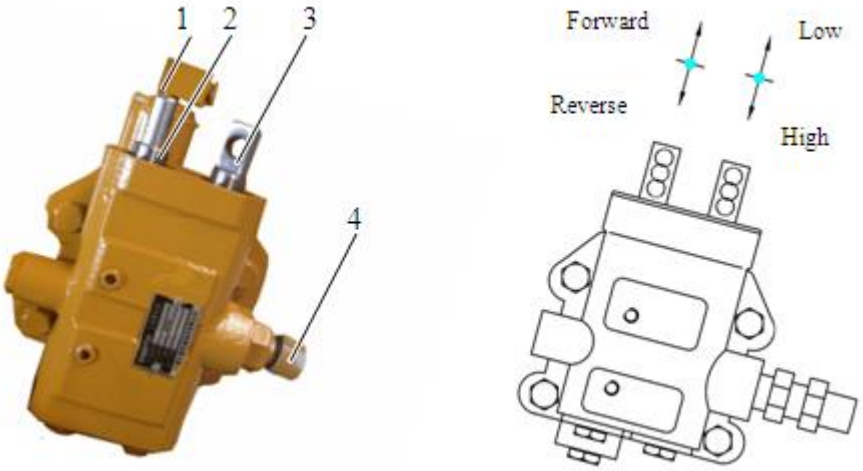


Fig. 2-14

1. Power shut-off valve 2. Main pressure test port 3. Transmission valve oil inlet

4. Transmission valve stem

(2) Relief valve

The relief valve mainly consists of transmission pressure valve and torque converter inlet pressure valve. The transmission pressure valve can regulate the transmission operation pressure (1.2~1.5 MPa), and the torque converter inlet pressure valve can regulate the inlet oil pressure of torque converter (0.4~0.6 MPa). There is an oil path on the relief valve for the lubrication of torque converter internal gears. When the oil supply pressure in the system is too high, the overflow valve inside of the relief valve opens to release pressure via the release port.

Fig. 2-15 Relief valve

1. Transmission pressure sensor 2. To transmission control valve pipe

3. Relief valve oil inlet pipe 4. Oil return pipe 5. Pressure regulating bolt

2.5 Operation and maintenance of transmission

2.5.1 Precautions for installing transmission

(1) When installing transmission, ensure the input of it is coaxial with the output of torque and the output of transmission is coaxial with the input of front/rear axle.

(2) After transmission is fitted, add about 24 L 6# hydraulic transmission oil into it via the oil filler, and check the oil level which shall reach the required position of dipstick after the engine runs for 5 min. Before and after each operation, check the oil level in the transmission.

(3) The shift between forward gear and reverse gear as well as between low gear and high gear shall be done only after the loader is stopped. The shift between forward I and forward II or between forward III and forward IV can be done when the loader is traveling.

(4) When the transmission is running, pay attention to the operation oil pressure, it shall be kept in the range of 1.2~1.5 MPa. Normally, the temperature of oil at outlet of torque converter shall not exceed 105℃, and in a short term, it shall not exceed 115℃. The temperature of oil in the transmission oil sump shall not exceed 100℃.

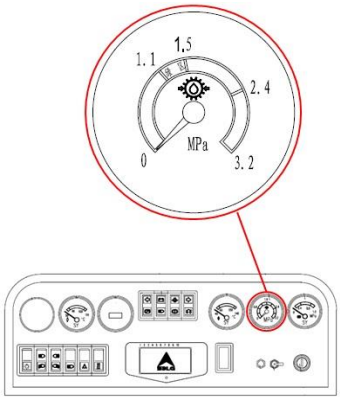


Fig. 2-16

(5) Each control lever and mechanism shall be flexible, and no seizure is allowed. The gear shift must be correct, and the hand feeling should be obvious.

(6) Do not start the loader when the brake pedal is depressed and the opening of engine throttle reaches the maximum.

(7) The hand brake must be adjusted properly so that it can work reliably.

2.5.2 Maintenance of transmission

(1) Change transmission oil for a new loader after 100 h for the first time and once every 500 h thereafter. Add about 24 L 6# (8#) hydraulic transmission oil into it via the oil filler, and check the oil level which shall reach the required position of dipstick after engine runs for 5 min. Before and after each operation, check the oil level in the transmission.

(2) When transmission is running, pay attention to the operation oil pressure, it shall be kept in the

range of 1.2~1.5 MPa. Normally, the temperature of oil at outlet of torque converter shall not exceed 105℃, and in a short term it shall not exceed 115℃.

(3) When a new transmission is fitted, a 12 h running-in period is required. Run it for two hours when it is in one of six gears. During the running-in period, the load shall not exceed 70% of the rated load, and the oil temperature, oil level and the tightening conditions of bolts shall be noted. After the running-in period, clean the transmission oil sump and the oil strainer.

(4) The shift between forward gear and reverse gear as well as between low gear and high gear shall be done only after the loader is stopped. The shift between forward I and forward II or between forward III and forward IV can be done when the loader is traveling.

3 Removal of transmission

3.1 Removal of assembly

★**Preparation before removal:**

(1) Clean mud and dirt from the transmission and the torque converter completely.

(2) Remove the drain plug, and discharge transmission oil.

Hydraulic transmission oil: about 24 L

(3) Prepare a firm transmission assembly support.

kg **Transmission & torque converter assembly: about 200 kg.**

Fig. 3-1

1. Transmission bracket

1. Place the transmission on the maintenance support.

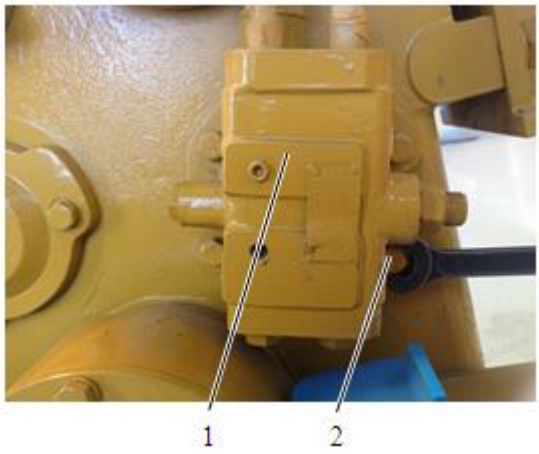


Fig. 3-2

1. Transmission operation valve

2. Bolt

2. Remove the fixed bolt of transmission operation valve, and take off the transmission control valve and gasket.

★**NOTE:**

Protect the sealing face and gasket.

Fig. 3-3

1. Tightening nut
2. Pressure plate

3. Remove the cotter pin from the tightening nut of input flange with a pair of pliers. Remove the tightening nut of input flange, and take off the pressure plate.

★**NOTE:**

Protect the cotter pin.

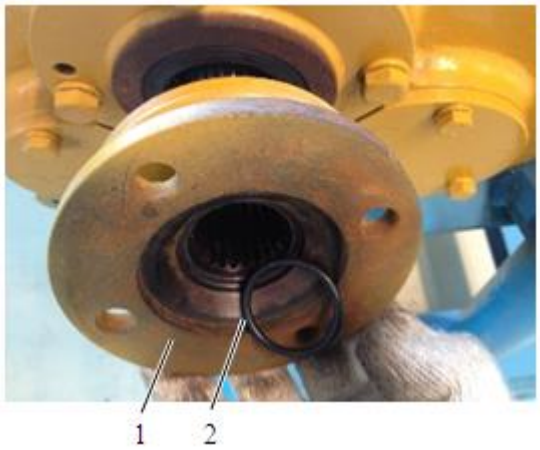


Fig. 3-4

1. Input flange 2. O-ring

4. Remove the O-ring and the input flange by hand.

★**NOTE:**

Protect the O-ring.

Fig. 3-5

1. Oil distributor cap

5. Remove the bolts from the oil distributor cap of reverse high-speed gear clutch.

★**NOTE:**

If it is not easy to remove them, use a recoilless hammer to strike the oil distributor cap slightly.

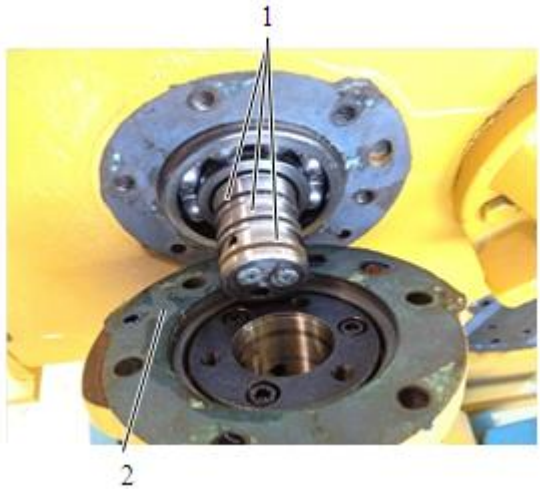


Fig. 3-6
1. Seal ring
2. Gasket

6. Remove the oil distributor cap and the seal ring.

★**NOTE:**

Protect the sealing face and the gasket. Keep the seal ring properly.

Fig. 3-7

1. Oil distributor cap

7. Remove the bolts from the oil distributor cap of forward low-speed gear clutch assembly.

Fig. 3-8

1. Seal ring 2. Gasket

8. Remove the oil distributor cap.

★**NOTE:**

Protect the sealing face and the gasket.

Keep the seal ring properly.

Fig. 3-9

1. Jackscrew

9. Remove the mounting bolt of transmission big end cap. Install the jackscrew into the mounting hole of housing end cap to eject the big end cap out.

Jackscrew: M10

Fig. 3-10

10. Remove the transmission big end cap and paper gasket.

★**NOTE:**

Protect the sealing face and the gasket.

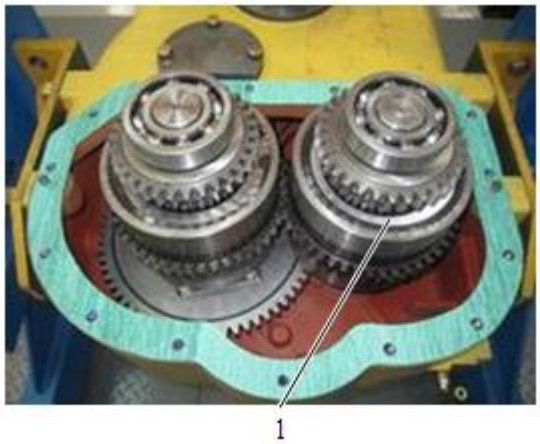


Fig. 3-11

1. Forward low-gear clutch assembly

11. Vertically remove the forward low-gear clutch assembly with a crowbar.

★**NOTE:**

When using a crowbar, protect the sealing face.

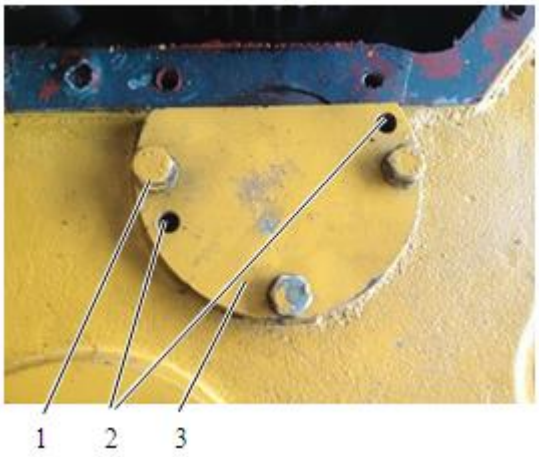


Fig. 3-12

1. Bolt 2. Jackscrew hole
3. End cap

12. Remove the bolt from the intermediate end cap, and eject the end cap out with two jackscrews.

Jackscrew: M10

Fig. 3-13

1. Gasket 2. Pressure cap

13. Remove the bolts from the countershaft pressure cap, slightly strike the pressure cap with a recoilless hammer, remove it and the gasket, and place them aside.

★**NOTE:**

Protect the sealing face and the gasket.

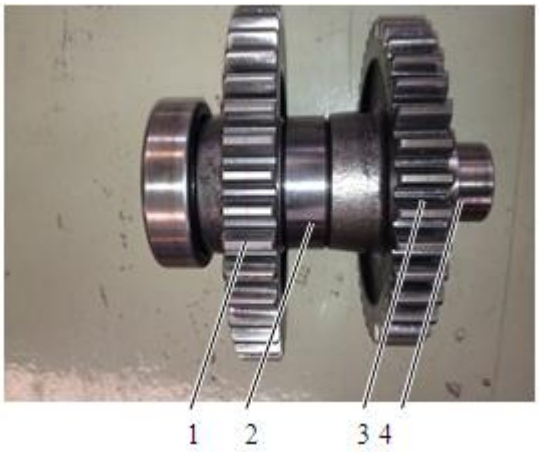
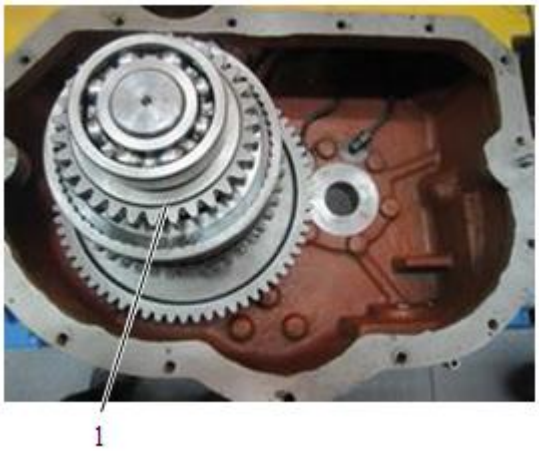


Fig. 3-14
1. Countershaft bull gear
2. Spacer ring 3. Countershaft pinion
4. Retainer ring

14. Slightly strike the countershaft on the back with a copper rod, and remove the countershaft assembly from the front.

★**NOTE:**

Record the installation sequence and direction of each part.



15. Remove the reverse high-speed gear clutch assembly.

★**NOTE:**

When using a crowbar, protect the sealing face.

Fig. 3-15

1. Forward low-gear clutch assembly

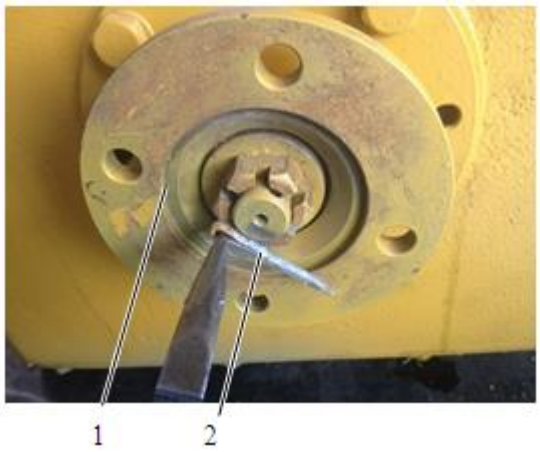
16. Remove bolts, and take off the oil sump and the gasket.

★**NOTE:**

Protect gasket.

Record the installation sequence and direction of each gear and sleeve of the output shaft.

Fig. 3-16



17. Remove the cotter pin from the tightening nut of rear output flange with a pair of pliers.

★**NOTE:**

Protect the cotter pin.

Fig. 3-17

1. Rear output flange
2. Cotter pin

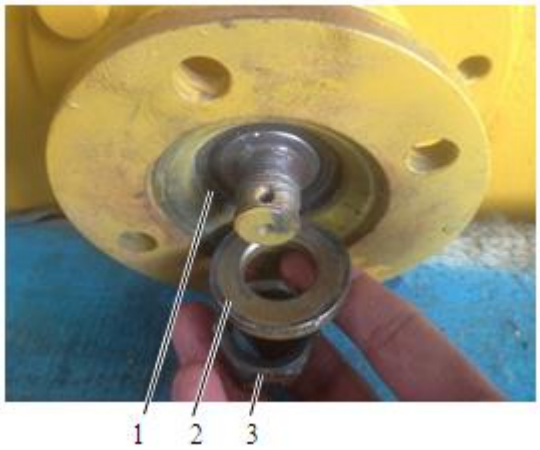


Fig. 3-18

1. O-ring 2. Pressure plate

3. Tightening nut

18. Remove the tightening nut from the rear output flange, and take off the pressure plate and the O-ring.

★**NOTE:**

When removing the nut, apply the brake.

Fig. 3-19

1. Jackscrew hole 2. Bolt

3. Rear end cap 4. Rear output flange

19. Take off the rear output flange, remove the bolts from the rear end cap, and eject the rear end cap out with two jackscrews.

Jackscrew: M10

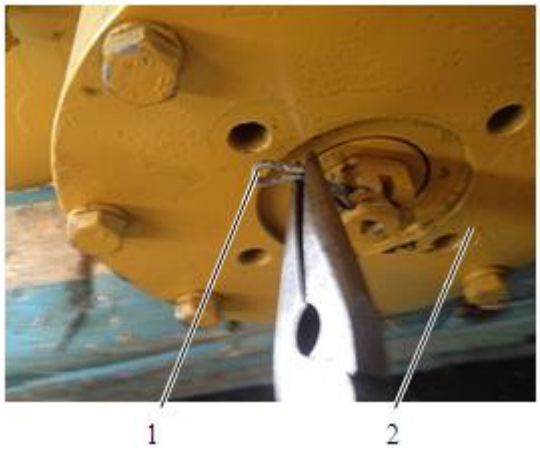


Fig. 3-20

1. Cotter pin

2. Parking brake

20. Remove the cotter pin from the tightening nut of output shaft front output flange.

Fig. 3-21

1. O-ring 2. Pressure plate

3. Tightening nut 4. Front output flange

21. Remove the tightening nut from the front output flange, and take off the pressure plate, the O-ring and the front output flange.

★**NOTE:**

When removing the nut, apply the brake.

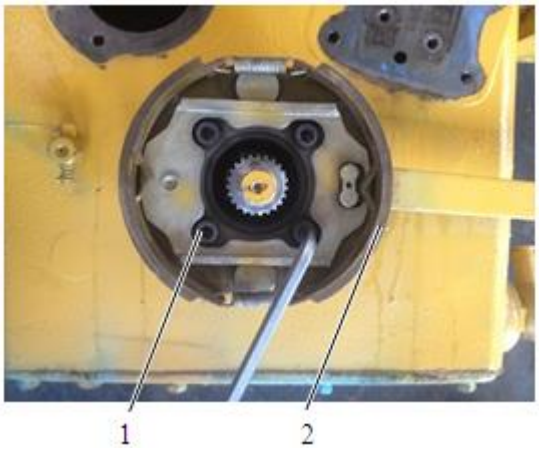


Fig. 3-22

1. Bolt 2. Parking brake

22. Unscrew the mounting bolts of parking brake, and remove the parking brake.

Fig. 3-23

1. Bolt

2. Output shaft front end cap

23. Remove the mounting bolts of output shaft front end cap, take off the front end cap, and place it aside.

★**NOTE:**

If it is not easy to remove the end cap, use a recoilless hammer or copper rod to strike it.

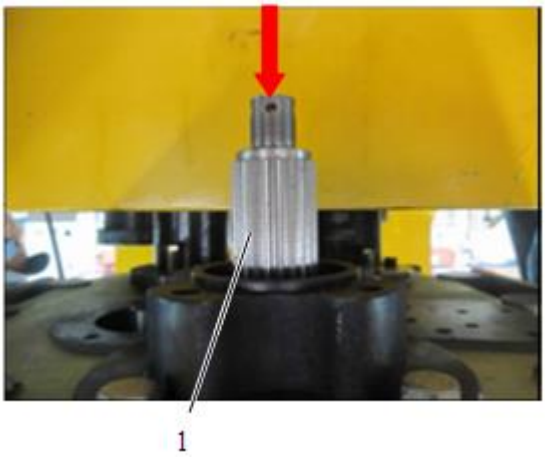


Fig. 3-24

1. Output shaft

24. Use a copper rod to strike the output shaft on the rear output flange side, and remove the output shaft assembly, i.e., output shaft gear, spacer and bearing.

Fig. 3-25

1. Output shaft assembly

25. Remove the output shaft assembly from the front side of transmission.

★**NOTE:**

The gear and sleeve of the shaft and the bearing cone on the side of brake may fall down, so pay attention to keeping it.

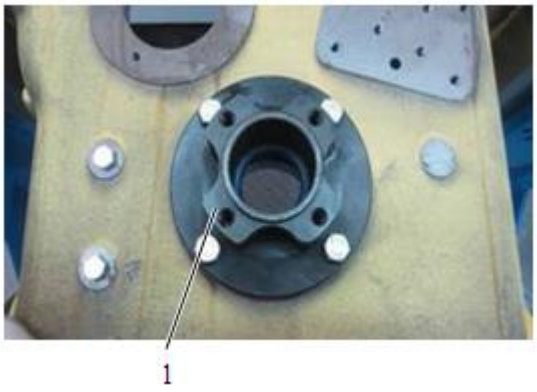


Fig. 3-26

1. Brake support

26. Remove the bolts, and eject the brake support out with a jackscrew.

3.2 Removal of assembly

3.2.1 Removal of clutch assembly

Fig. 3-27

1. Forward low-gear clutch assembly

★**NOTE:**

Because the structures of clutches are similar, take the removal of forward gear clutch as an example, and no details relating to others is given.

Fig. 3-28

1. Bearing

1. Remove the bearing with a crowbar.

Fig. 3-29

1. Retainer ring

2. Remove the retainer ring from the shaft.

3. Use a crowbar to separate gear from the clutch.

Fig. 3-30

1. Gear

4. Remove the bearing with a crowbar.

Fig. 3-31

1. Bearing

5. Press the spring shield with a crowbar, and remove the retainer ring with a pair of snap ring pliers. Remove the spring shield and the spring.

Fig. 3-32

1. Retainer ring
2. Spring shield

Fig. 3-33

1. Retainer ring
2. Bearing plate

6. Remove the retainer ring with a pair of snap ring pliers. Remove the bearing plate of clutch friction lining.

Fig. 3-34

1. Friction lining

7. Successively remove the outer friction lining, and then the inner friction lining.

Fig. 3-35

1. Piston

8. Remove the piston.

3.2.2 Removal of transmission control valve

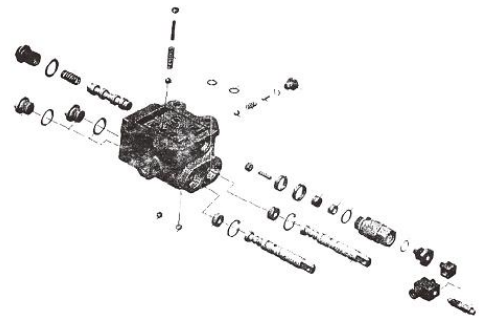


Fig. 3-36

1. Unscrew the plug and washer from the locating lock pin of valve stem, and remove spring and steel ball.

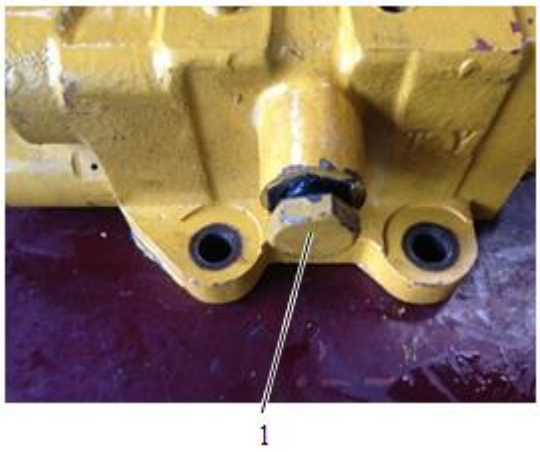


Fig. 3-37

1. Plug screw

2. Remove the locating screw plug of forward & reverse valve core.

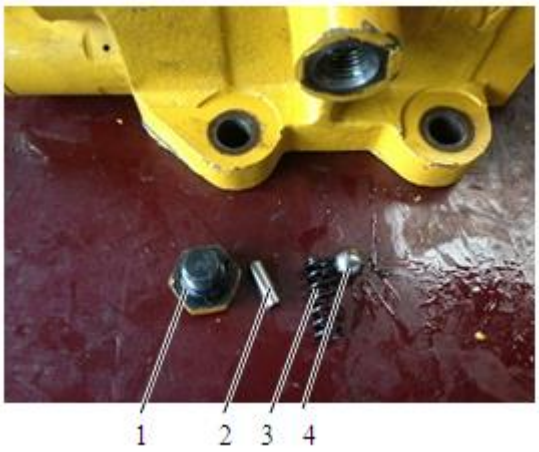


Fig. 3-38

1. O-ring 2. Locating guide
3. Spring 4. Steel ball

3. Successively remove O-ring, locating guide rod, spring and steel ball.

Fig. 3-39

1. Forward & reverse valve cores

4. Take out the forward & reverse control valve core.

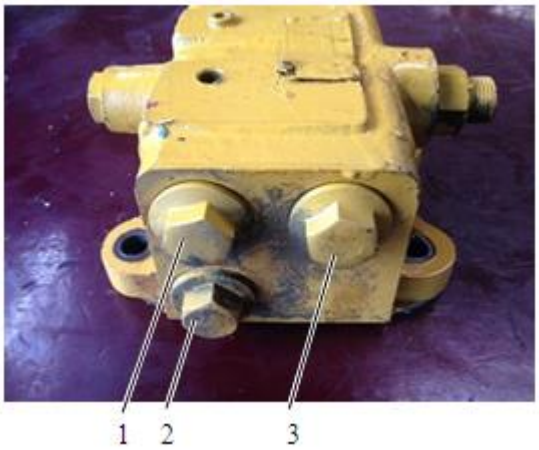


Fig. 3-40

1. Forward & reverse control valve plug screw

2. Shut-off valve screw plug

3. High & low speed control valve screw plug

5. Remove the plug screws of the three valve cores, and take off the O-rings.

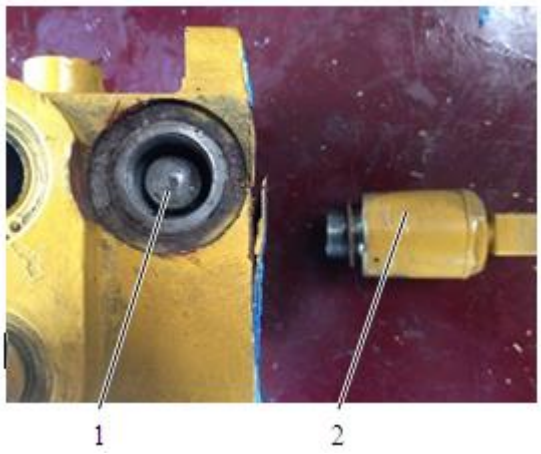


Fig. 3-41

1. Shut-off valve core
2. Shut-off valve control valve body

6. Unscrew the shut-off control valve body and the joint on it.

Fig. 3-42

1. Spring

7. Take out the shut-off valve spring and the valve core.

4 Refitting of Transmission

4.1 Refitting of assembly components

★ **NOTE:**

Clean each component before refitting.

4.1.1 Refitting of transmission control valve

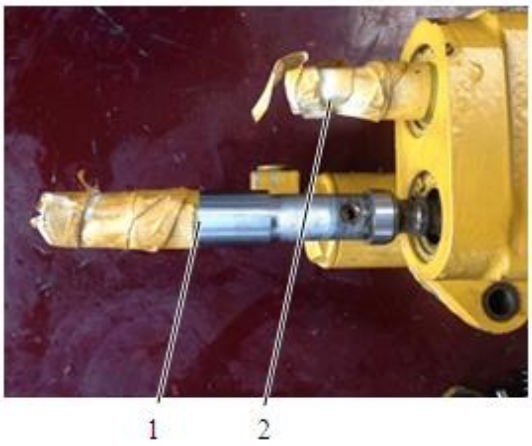


Fig. 4-1

1. Forward & reverse control valve core

2. High & low speed control valve core

1. Insert all the control valve cores.

Fig. 4-2

2. Tighten the plug screw of all valve cores.

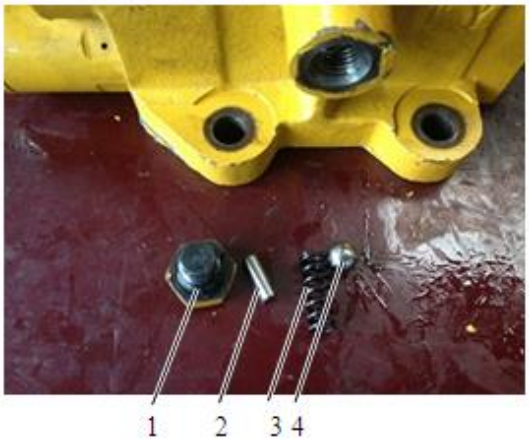


Fig. 4-3

1. O-ring 2. Locating guide
3. Spring 4. Steel ball

3. Successively insert the locating assembly of forward & reverse control valve core and tighten the plug screw.

★**NOTE:**

Install the locating assembly of high & low speed control valve core in the same sequence as above.

4.1.2 Refitting of clutch

★**NOTE:**

The structures of the two clutch shaft assemblies are similar, here take the refitting of forward clutch of input shaft assembly as an example, and no details relating to the other is given.

1. Install the internal and external seal rings onto the piston.

★**NOTE:**

The big end of seal ring should face towards the pressurized oil surface.

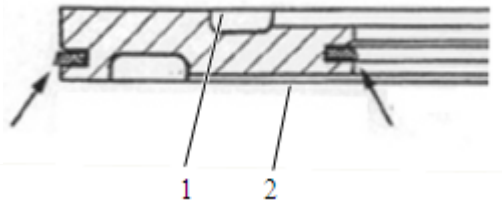


Fig. 4-4

1. Pressurized oil surface
2. Friction lining surface

Fig. 4-5

1. Piston

2. Put the piston into the clutch.

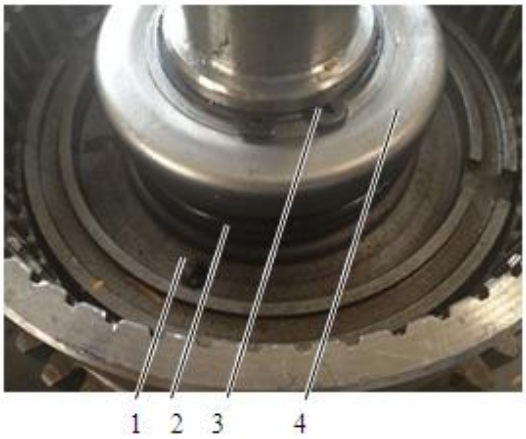


Fig. 4-6
1. Piston
2. Return spring
3. Snap ring
4. Spring retainer

3. Successively install the return spring and the spring shield onto the clutch shaft. Press the return spring with a crowbar and then install the snap ring.

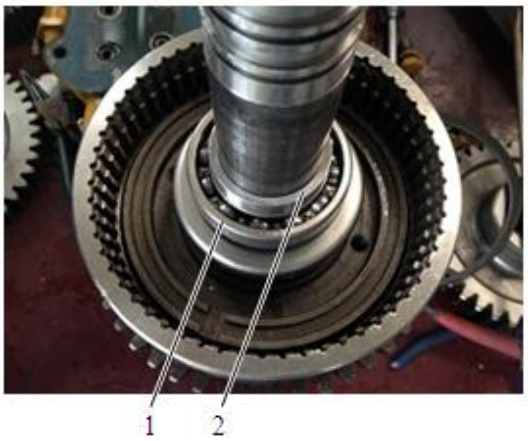


Fig. 4-7

1. Bearing

2. Retainer ring

4. Successively install the bearing and the retainer ring onto the clutch shaft.

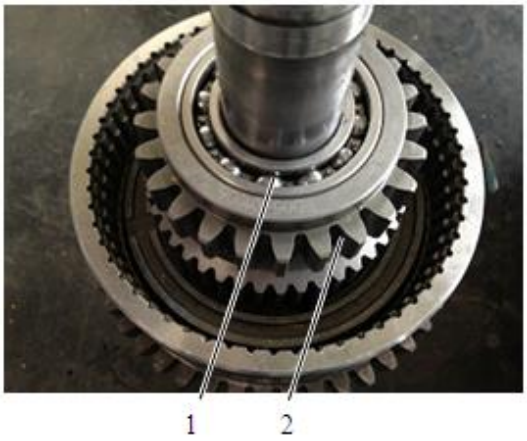


Fig. 4-8

1. Bearing

2. Low speed gear

5. Install the low speed gear and the bearing onto the clutch shaft.

Fig. 4-9

1. Outer friction lining

6. Place the outer friction lining into the clutch.

Fig. 4-10

1. Inner friction lining

7. Alternatively place internal and outer friction linings into the clutch.

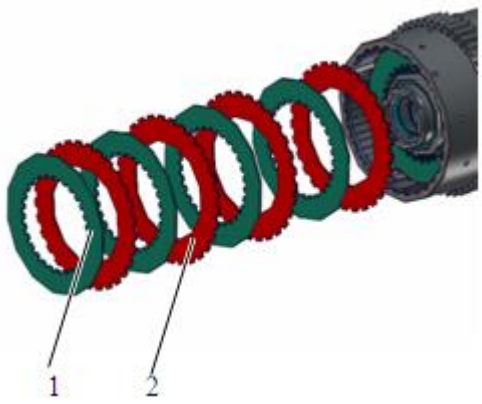


Fig. 4-11

1. Inner friction lining

2. Outer friction lining

8. After the installation of internal and outer friction linings, install the bearing plate into the clutch.

★**NOTE:**

In the four groups of clutches, there are 4 internal friction lings and 4 outer friction linings.

The specifications of all inner friction linings are the same, so are those outer friction linings. During replacement, it is required to replace the friction ling involved, and ensure the number of the friction linings and the fitting sequence are correct.

Fig. 4-12

1. Retainer ring
2. Bearing plate

9. Install the bearing plate, and use a circlip plier to install the retainer ring of clutch bearing plate.

Fig. 4-13

1. Retainer ring

10. Install the retainer ring onto the clutch shaft.

Fig. 4-14

1. Bearing

11. Install the bearing onto the clutch shaft in position.

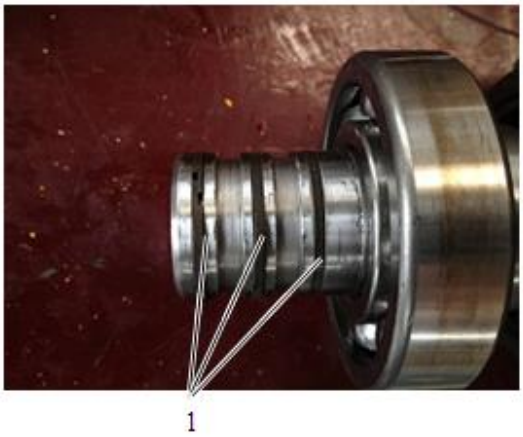


Fig. 4-15

1. Seal ring

12. Install three seal rings onto the clutch shaft.

★**NOTE:**

● The piston ring is made of cast iron which is very brittle, thus the force applied during installation should be uniform to avoid damage.

● The openings of the two seal rings should stagger 120° against each other and also in relation to the oil inlet path.

4.2 Refitting of assembly

4.2.1 Refitting of output shaft assembly and parking brake

Fig. 4-16

1. Bolt
2. Front output end cap

1. With the oil inlet cap of transmission housing upwards, install the output shaft front end cap onto the housing, apply 515 sealant evenly to the sealing surface, and tighten the bolts.

★**NOTE:**

Check and replace oil seals in the end cap.

Nm: 78~104Nm

: 515 sealant

Fig. 4-17
1. Bearing
2. Output shaft
3. Output shaft gear

2. With the section connecting to torque converter upwards, place the spacer on the bearing and then the output gear on the spacer; after this, install the output shaft onto the output gear, the spacer and the bearing.

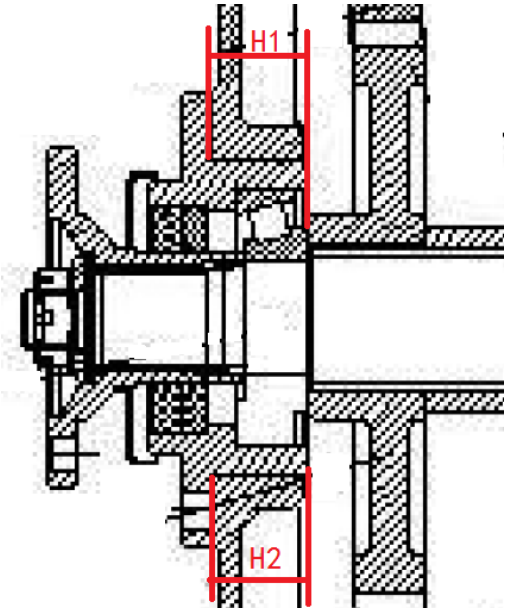


Fig. 4-18

★**Adjusting method**

Measure the distance H1 between the output gear plane and the housing plane, and distance H2 between the bearing cone plane and bearing pedestal connecting section, and if H2-H1-δ=0.1~0.13, install adjusting shims with a thickness of δ onto the gear end face.

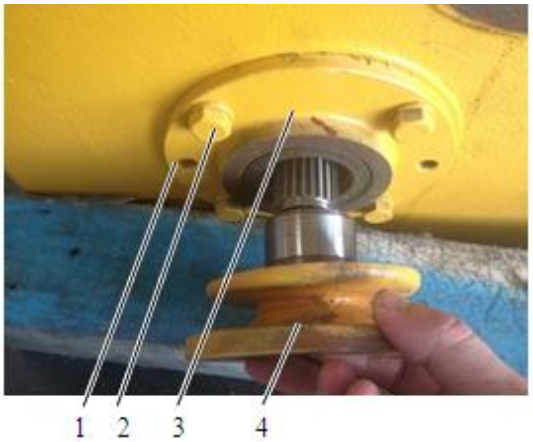


Fig. 4-19
1. Jackscrew hole 2. Bolt
3. Bearing pedestal 4. Front output flange

3. Install the bearing pedestal assembly onto the housing, the front output flange, the O-ring and pressure plate successively, and tighten the fixing nut of output flange.

Nm: 78~104Nm

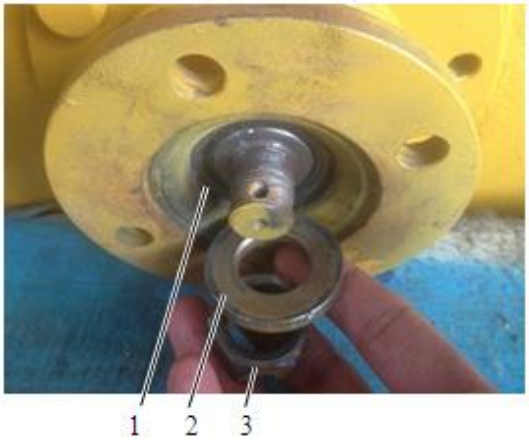


Fig. 4-20
1. O ring 2. Pressure plate
3. Fixing nut

4. Fit the cotter pin to the fixing nut onto the output shaft front output flange.

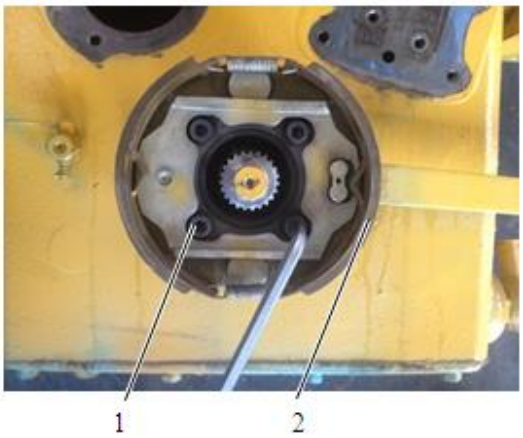


Fig. 4-21
1. Bolt
2. Parking brake

5. Install the output shaft rear end cap, and tighten the fixing bolts. Install the rear output flange.

★**NOTE:**

Check and replace the oil seal in the end cap.

Fig. 4-22
1. O-ring 2. Pressure plate
3. Fixing nut 4. Front output flange

6. After installing the O-ring and pressure plate, tighten the fixing nut of rear output flange.

★**NOTE:**

When tightening nuts, apply the parking brake.

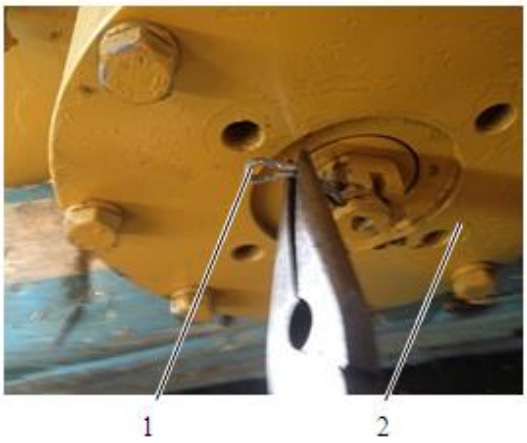


Fig. 4-23

1. Cotter pin

2. Parking brake

7. Install the parking brake, and tighten the fixing bolts.

Nm: 78~104Nm

4.2.2 Refitting of two clutch shafts and countershaft assembly

Fig. 4-24

1. Reverse gear shaft assembly

2. Countershaft assembly

1. With the face connecting the housing with the torque converter upwards, install the high-speed reverse clutch assembly into the housing.

★**NOTE:**

Screw in the clutch.

Fig. 4-25

1. Gasket 2. Pressure cap

2. Install the countershaft pressure cap and gaskets, and tighten the fixing bolts. Apply 515 sealant evenly to the sealing surface.

★**NOTE:**

Check and replace the gasket.

Nm :78~104Nm

: 515 sealant

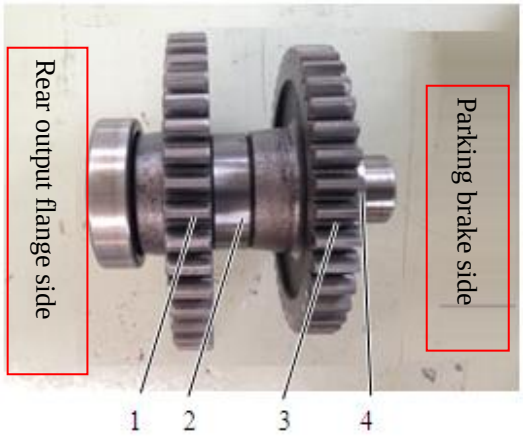


Fig. 4-26

1. Countershaft bull gear

2. Spacer ring 3. Countershaft pinion

4. Retainer ring

3. Put the countershaft assembly into the housing in the sequence as shown left, then insert the countershaft, and finally install the bearing on the countershaft.

★**NOTE:**

Ensure that each pair of gears mesh properly.

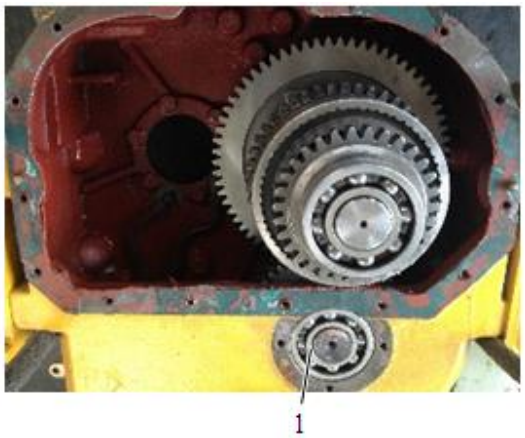


Fig. 4-27

1. Countershaft assembly

4. Install the countershaft assembly in position.

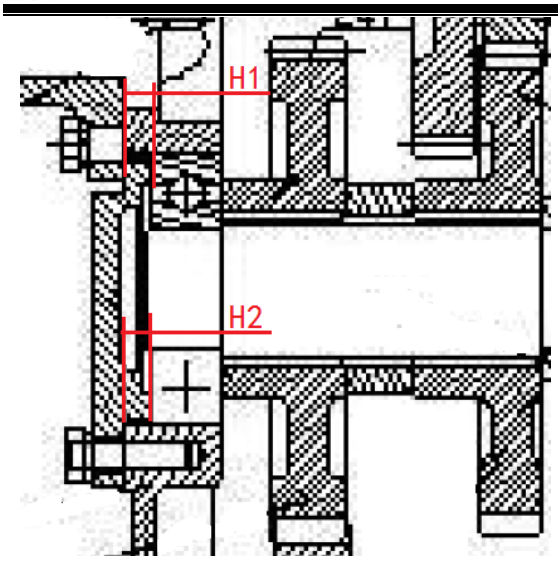


Fig. 4-28

★**Adjusting method**

After bearing is fitted in place, measure the distance H1 between the bearing end face and the housing end face, and the height H2 of countershaft rear end cap stop, and if H1-H2-δ=0.1~0.15., install adjusting shims with a thickness of δ onto the bearing.

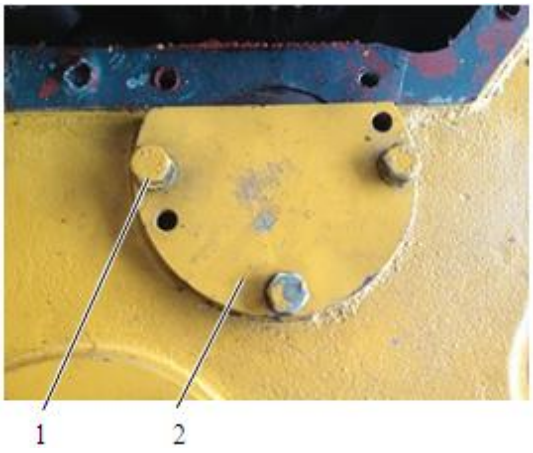


Fig. 4-29

1. Bolt

2. End cap

5. Install O-ring onto the countershaft rear end cap, and then install the countershaft end cap; after that, tighten the bolts.

Nm :45~59Nm

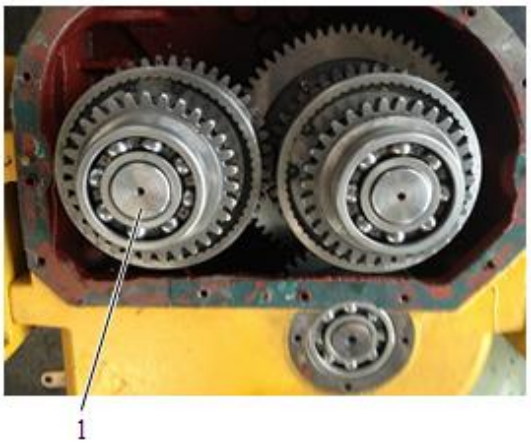


Fig. 4-30

1. Low-speed forward clutch assembly

6. Install the low speed forward clutch into the housing.

★**NOTE:**

Screw in the clutch by rotating, always with the two clutch gears and the countershaft gear meshed properly.

Fig. 4-31

1. Big end cap

7. Install the housing big end cap and the gasket.

★**NOTE:**

Check and replace the gasket.

Fig. 4-32

1. Bolt

8. Tighten the fixing bolts of the big end cap.

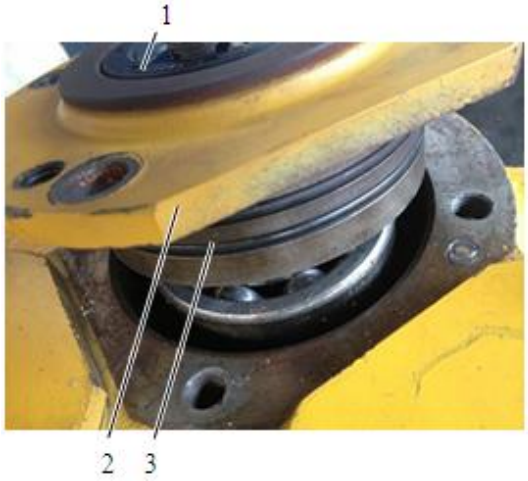


Fig. 4-33

1. Skelton oil seal
2. Input bearing support
3. O-ring

9. Install the O-ring and the skeleton oil seal into the input bearing pedestal, and then install the input bearing pedestal into the big end cap.

★**NOTE:**

Check and replace the gasket.

Fig. 4-34

1. Bolt

10. Tighten the fixing bolts of input bearing pedestal.

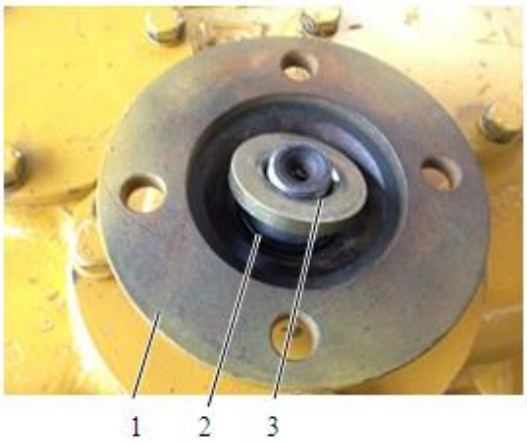


Fig. 4-35

1. Input flange 2. O-ring 3. Pressure plate

11. Install the input flange with the O-ring and the pressure plate.

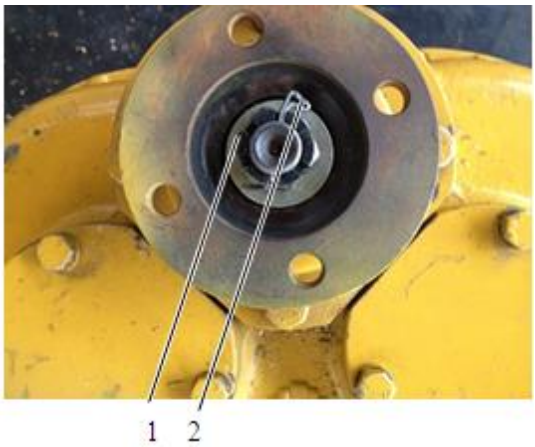


Fig. 4-36

1. Fixing nut

2. Cotter pin

12. Tighten the fixing nut of output flange, and install the cotter pin.

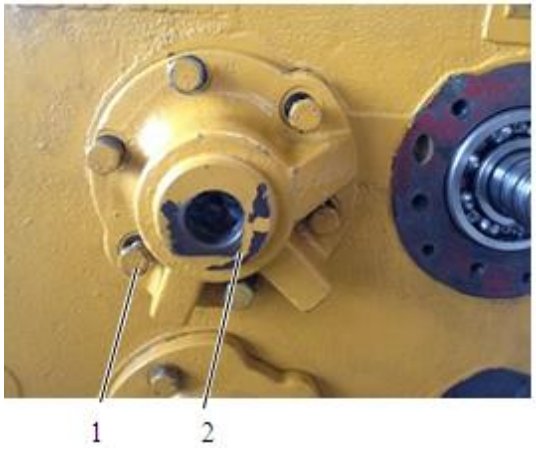


Fig. 4-37

1. Bolt

2. Oil distributor cap

13. Apply 515 sealant evenly to the oil inlet cap surface, install the oil distributor cap of reverse high speed reverse clutch assembly and the gasket, and tighten the bolts.

★**NOTE:**

Do not apply sealant to the O -ring. Prevent damaging any seal ring when installing oil inlet cap.

Nm: 45~59Nm

: 515 sealant

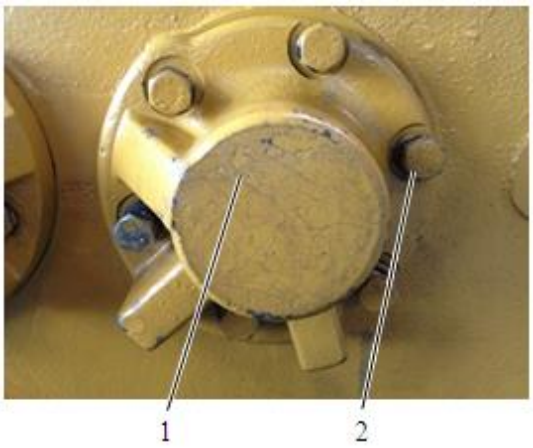


Fig. 4-38

1. Oil distributor cap

2. Bolt

14. As described above, install the oil distributor cap of low speed forward clutch and the gasket, and tighten the bolts.

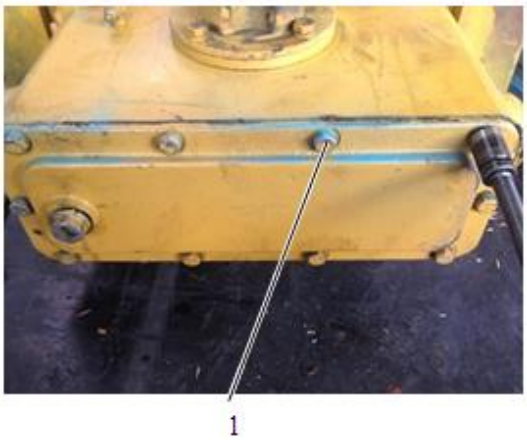


Fig. 4-39

1. Bolt

15. Tighten the bolts connecting the oil sump and the housing, and install the gasket.

★**NOTE:**

Check and replace the gasket.

The bolts should be tightened diagonally and repeatedly.

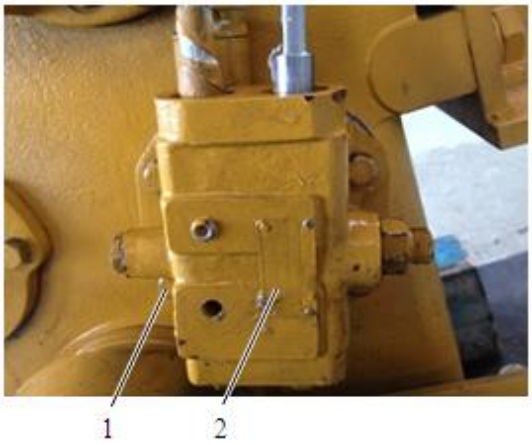


Fig. 4-40

1. Bolt

2. Transmission control valve

16. Install the transmission control valve and the gasket, and tighten the fixing bolts.

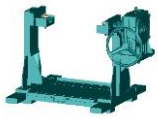
★**NOTE:**

Check and replace the gasket.

Nm: 45~59Nm

5 Service tools for transmission

Table 5-1

Special tool	Designation	Applicable position	Remarks
	Transmission support	To support and tilt the transmission	If not available, a removal platform can be set up.
	Depth meter	Countershaft and output shaft	Specification: 0.02/0~200
	Transmission pressure joint	Relief valve pressure joint	6410006223
	Pressure testing hose	Used with the pressure test joint and pressure gauge	4030000368
	Pressure gauge with a range of 25 bar		6430000943

6 Fault Diagnosis and Troubleshooting of Transmission

Table 6-1

Symptoms	Probable causes	Solution
1. Gear engaging failure	1. The gear engaged is incorrect.	1. Engage it again or check the transmission control valve.
	2. The clutch piston leaks oil.	2. Disassemble, check, or replace the rectangle ring.
	3. The transmission pressure is low.	3. Do troubleshooting as described below.
	4. The housing oil passage is blocked.	4. Disassemble, clean and unblock it.
2. Low transmission pressure	1. The main regulator valve is improperly adjusted or the spring is in failure.	1. Readjust it or replace the spring.
	2. The transmission oil level is too low.	2. Add oil up to the oil mark.
	3. The strainer or oil path is clogged up.	3. Clean or unclog it.
	4. The clutch leaks oil.	4. Replace the rectangle ring.
	5. The transmission pump is in failure.	5. Check and replace.
3. High oil temperature	1. The operation time is too long.	1. Stop the vehicle or run it at idle speed for a while.
	2. The oil in the transmission is insufficient or excessive.	2. Add oil up to the overflow hole.
	3. The clutch plate skids.	3. Check oil pressure and seal ring.
	4. The clutch cannot be	4. Check the clutch control oil

Symptoms	Probable causes	Solution
	released.	line or the position of control lever.
4. Low transmission oil pressure at certain gear	1. The rectangle ring of this gear is damaged.	1. Replace the rectangle ring of piston.
	2. The seal ring of this oil path is damaged.	2. Replace the seal ring.
	3. This oil path leaks or is clogged up.	3. Check and eliminate the fault.
5. Gears in disorder	1. The seal ring at the shaft end leaks.	1. Replace the seal ring.
6. Oil leakage from the system	1. The joint is loose.	1. Tighten the joint.
	2. The seal ring is damaged.	2. Replace the seal ring.
7. Low oil pressure	The oil level is low, and the pump inhales air.	Check oil level and add oil.
	Oil suction filter element is dislodged or clogged up.	Check, clean or replace.
	Air enters the oil suction pipe or the internal surface of the pipe is peeling.	Check and replace.
	The shaft ring or sleeve of transmission wears out.	Replace the seal ring or sleeve.
	The oil seal of piston is worn out or damaged.	Replace.
	The relief valve spring is broken.	Check and replace the valve.
	The pump wears and leaks.	Replace the pump.
	The adjusting value of pressure valve is too low.	Readjust it.
	The oil path from pressure	Check the pipeline.

Symptoms	Probable causes	Solution
	reduction valve to control valve is blocked.	
8. Unusual noises	The propeller shaft is in reverse connection.	Reinstall it as per the direction indicated by the arrow.
	Eddy is formed when the relief valve opens.	Replace the relief valve.
	The internal parts are damaged or the precision of gear is poor.	Disassemble and check.
9. High/low gear skipping	The fork locating steel ball groove is worn flat, and thus the steel ball cannot be positioned.	Check and replace.
	The steel ball is excessively worn.	Check and replace.
	The spring is damaged.	Check and replace.
	The locating hole of lock screw is so shallow that the fork cannot be locked.	Check and replace.
	The thread of lock screw is slipping, etc.	Check and replace.
10. Only the pressure at one gear is normal, and pressure at other gears is low.	The oil inlet end cap is installed improperly.	Reverse.
	The oil seals or piston rings of the other two gears are damaged.	Check and replace.
11. Only one gear functions, and the vehicle travels even in neutral position.	The clutch of one gear is burnt out, and the friction lining cannot be separated.	Check and repair.

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