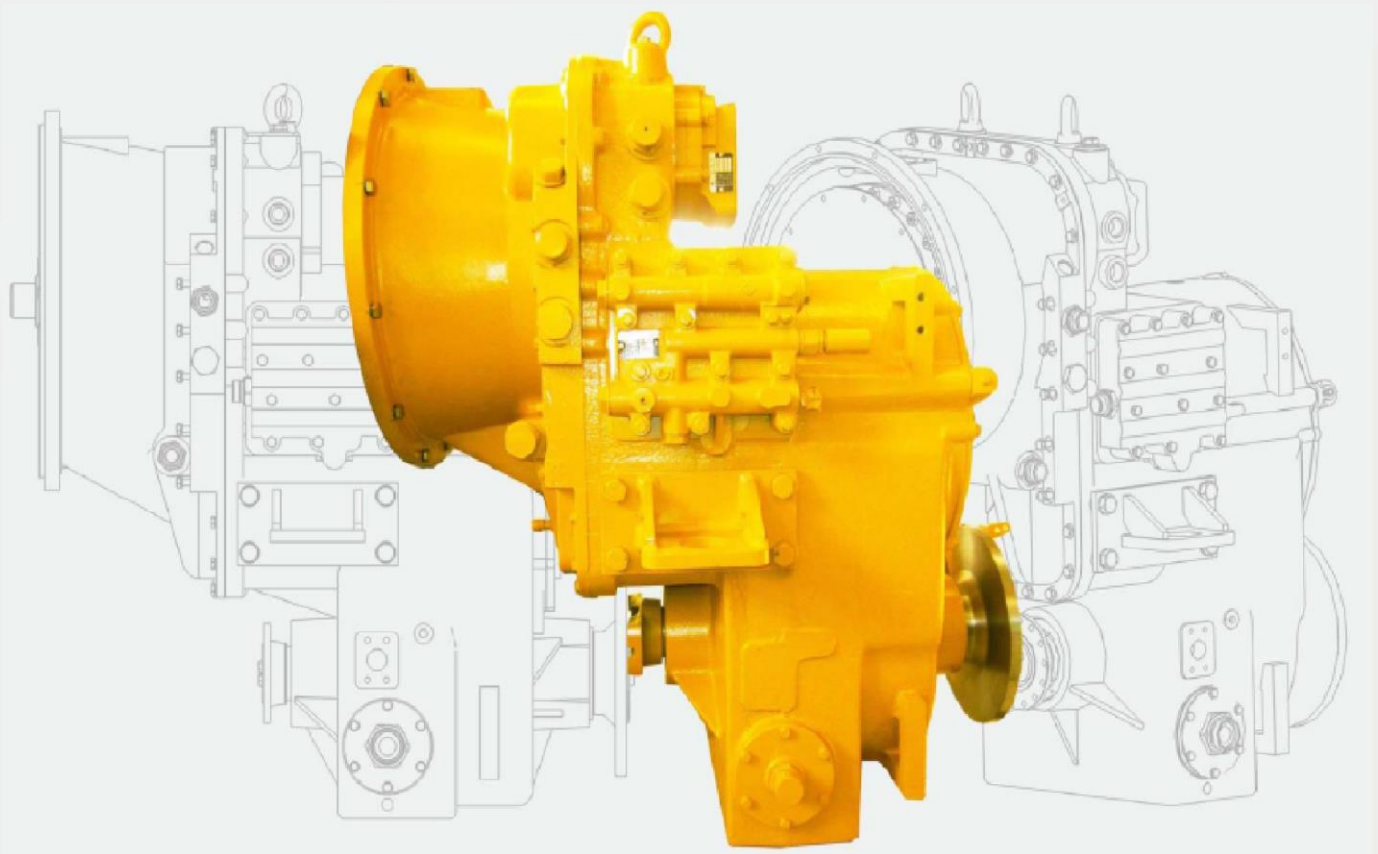
SDLG

SERVICE MANUAL

Planetary Transmission



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Foreword

This in-station service manual describes the disassembling and assembling process of the planetary transmission, and provides repair technologies and standard requirements which can facilitate the maintenance personnel to understand the disassembling and assembling methods of transmission, and lays a solid technical basis for the maintenance personnel to properly determine the fault and perform repair.

This service manual mainly includes the following:

Chapter Ⅰ Introduction

This chapter mainly introduces the precautions for the repair, assembling and disassembling of transmission, lists the specifications and models of the oils and coating materials used and describes the meaning of markings used in the text of the manual, the hoisting instructions and general thread tightening torque values.

Chapter Ⅱ Transmission System

This chapter mainly describes the mechanical principle of each gear, the operation and maintenance of the transmission as well as the structure and function of various parts, which lays the foundation for the assembling and disassembling and also serves as the reference data for troubleshooting.

Chapter Ⅲ Assembling and Disassembling of Transmission

This chapter describes the steps on how to properly disassemble various parts, and the relevant matters which shall be noted in the process of assembling and disassembling.

Chapter Ⅳ Inspection Specifications for Assembling Quality of Typical Transmission

Notice

Specifications of relevant parts referred to in this service manual are subject to change due to product improvement without prior notice. Please consult or ask Shandong Lingong Construction Machinery Co., Ltd. for the latest information.

LG Planetary Transmission
Service Manual

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Contents

1 Introduction

1.1 Safety Precautions

⚠Key Points for Safety

Maintenance and repair are very important for safe operation of the vehicle. This manual mainly explains related techniques on how to properly disassemble and assemble the transmission assembly.

In order to prevent personnel injuries, in this manual ⚠ is used as a safety mark and any precaution with this mark means requiring being very careful when operating. In the case of potential risk, first consider your own safety and take necessary safety measures.

⚠ Safety Instructions

In the process of assembling and disassembling, improper operating methods can cause parts damage, reduced service life, performance deterioration and other unsafe factors. Therefore, for parts assembling and disassembling, please read the related information in this manual carefully.

1. Parameters, graphs and relevant content involved in this manual also apply to other products with standard configuration. For variant products, please consult our company or refer to the relevant documents.

2. In the repair shop there shall be a special area for parts assembling and disassembling and disassembled parts where relevant tools and parts shall be placed appropriately to ensure the tidiness of the work area without oil stain and contaminants. Smoke in the specified smoking area and never smoke in the working process. Besides, provide appropriate fire extinguishing apparatus in the workshop.

3. Welding operations, when necessary, must be undertaken by professionally trained and experienced personnel. During welding operations, the operator must wear welding gloves, baffle plate, goggles, safety helmet and other work clothes suitable for welding operations.

4. Before disassembling the transmission and torque converter assembly, remove the contaminants on the outer surface to avoid contamination of internal parts during disassembling

5. During operation, wear safety boots and safety helmet. Wear work clothes complying with the requirements with all the buttons buttoned. Wear goggles when knocking parts with a copper

bar.

6. Use gasoline, kerosene and water-based oil cleaning agent to clean the removed parts.

7. When using a crane or other hoisting equipment, first check whether there is damage to the sling. Use hoisting equipment with sufficient hoisting capacity and, in the hoisting operation, utilize the designated hoisting position and slowly hoist to avoid collisions between parts. Never work under the hoisted parts.

8. If two or more operators are required to work simultaneously, the operating procedures must be agreed before the job, so as to avoid accidents caused by inconsistent action.

9. Keep all the tools properly and be familiar with their use.

10. When aligning two holes, do not insert your hand and fingers into the holes. For parts needing direct manual assembling, pay attention to whether the holding position will have risk of crush.

11. The disassembled parts must be detected, and those affecting the performance of the transmission must be replaced with new ones.

12. There shall be no interference between the assembled parts.

13. Take protection measures to oil seals and seal rings when passing through keyways, screw holes and steps during assembling to avoid damage to oil seals and seal rings.

14. When assembling parts, the adopted tools must match the threaded fasteners to avoid damage to the latter.

15. When tightening the connector body and the plug, never use such tightening tools as pneumatic spanner, instead, screw the plug by hand to a certain extent, and then use the appropriate torque spanner to tighten to the required torque.

16. When draining the oil inside the transmission, slowly unscrew the drain plug to prevent oil splashing.

1.2 Oils and Coating Materials

Table 1-1

Oil Grade of Domestic Oil	Oil Grade of Similar Foreign Products				
No. 8 hydraulic transmission oil Q/SH 303 064	CALTEX	MOBIL	FUCHS	ESSO	SHELL
	Delo Gold Multigrade 15W-40	Delvac Super 1300 (SAE15W-40)	Titan universal HD15W-40	Standard Torque Fluid G7	Rotella 10W

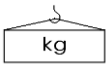
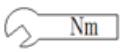
Table 1-2

Name	Code	Scope of Application and Function
Sealant	545 anaerobic pipe thread sealant	Applicable to the sealing of hydraulic system, pneumatic system and cooling equipment pipe threads and the surface with slight oil stain.
	262 thread locking sealant	Applicable to the locking and sealing of M10 ~ M20 threaded fasteners or threaded parts bearing strong vibration and impact.
Lubricating grease	No. 2 or No. 3 lithium base lubricating grease GB 7324-1994	Applicable to the lubrication of roller bearings, sliding bearings and friction parts of various construction equipment used within the temperature of -20 ~ 120℃.
Cleaning agent	755 cleaning agent	Applicable to the cleaning of metal surfaces for effectively eliminating surface oil stain and increasing the bonding strength between the healant, thread locking agent and the matrix.

1.3 Marking Instruction

For the purpose of this manual, the following markings are used for important safety and quality requirements.

Table 1-3

Marking	Item	Remark
	Safety	Be careful in the process of operation.
		Be careful in the process of operation for there is internal pressure.
	Attention	Pay special attention to the technical requirements in the process of operation to ensure the quality requirements are met.
	Weight	Weight of parts or devices as well as assembling and disassembling methods.
		Pay attention to selecting the proper sling and the position adopted during hoisting.
	Tightening torque	Pay special attention to the tightening torque of the subassembly during assembling.
	Coating	Parts needing to be coated with adhesive and lubricating grease.
	Oil, water	Add certain quantity of oil, water or fuel.
	Drain	Place for oil or water discharge, and the discharge amount.

1.4 Hoisting Instructions

1. If it is difficult to remove the components from the transmission and torque converter assembly, carry out the following checks:

- Check whether all the fixing bolts at the component to be removed have been removed.
- Check whether there is any other component at the component to be removed that interferes with the removal operation.

2. Wire rope

1）The wire rope must be hanged in the middle part of the hook.

If it is at one end of the hook, then it may fall off from the hook in hoisting and cause serious accidents, and the middle part of the hook has the maximum strength. See Fig. 1-1.

2）Never use only one wire rope but two or more instead and tie them around the load.

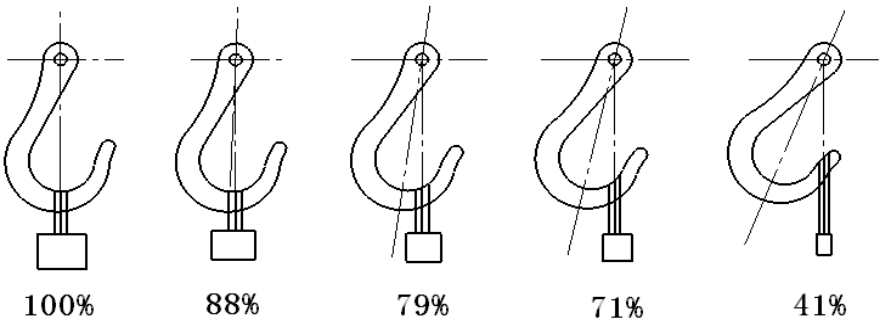


Fig. 1-1

Notice:

Use of only one wire rope may cause spin of load during hoisting, wire rope looseness or sliding from the original bundled position, resulting in accidents.

3） When hoisting heavy load, the hoisting angle of the wire rope with respect to the hook shall not be too large.

When hoisting the load with two or more wire ropes, with the increased hoisting angle, the force borne by each wire rope also increases. Fig. 1-2 shows the variation of permissible load (kg) at various angles when hoisting the load with two wire ropes (maximum permissible vertical hoisting weight of 1000 kg for each one). When using two wire ropes for vertical hoisting, the total permissible hoisting weight can be 2000 kg. But at the hoisting angle of 120 °, the permissible hoisting weight can be only up to 1000 kg. On the other hand, at the hoisting angle of 150 °, the two wire ropes will bear a force of 4000 kg when the load is 2000 kg.

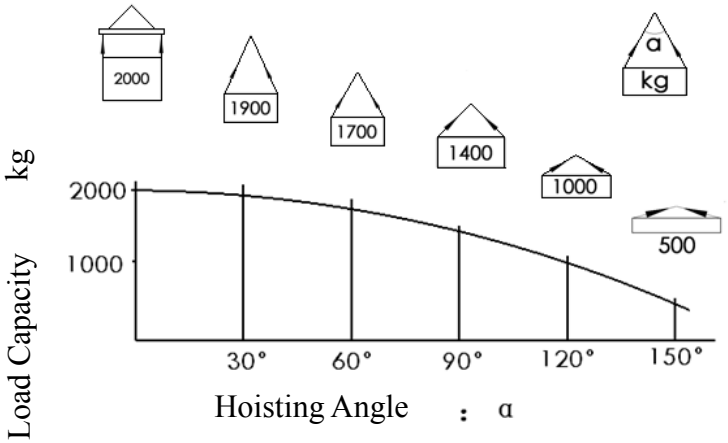


Fig. 1-2

1.5 Table of General Bolt Tightening Torque

Table 1-4

Bolt Strength Grade	Yield StrengthN/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
Bolt Strength Grade	Yield StrengthN/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
Bolt Strength Grade	Yield strengthN/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 Applicable Models and Main Parameters

Table 2-1

Transmission Model		A301	A303	A305	A307A	A307B	BX50-02	BX50-03	TP170
Applicable model		LG936L LG953	LG936L LG944MSK	LG956L	LG946L LG952L LG952H	LG936L LG956L	LG953N	LG955N LG956N LFT20	L955F$_C$ L956F
Type of hydraulic torque converter		Single-stage four-element double-turbine hydraulic torque converter							
Piston stroke in all gears （mm）	1st gear	1.4～2.8					1.7～3.5		1.7～3.5
	2nd gear	1.1～1.8					1.1～1.8		1.1～1.8
	Reverse gear	0.9～2.8					1.0～3.2		1.2～3.4
Transmission working pressure (MPa)		1.1~1.5							
Inlet oil pressure of torque converter （MPa）		0.5～0.6							
Outlet oil pressure of torque converter （MPa）		0.21～0.26							
Transmission type		Planetary power gearshift							
Transmission gear		Two forward gears and one reverse gear							
Quantity of 6# hydraulic transmission oil (L)		44							45

2.2 Transmission Overview

The planetary gear transmission (planetary transmission) consists of basic planetary gear row which accommodates planetary gears rotating axially, making the planetary transmission work with power gearshift only, characterized by force dispersion. Multiple planetary gears in the basic planetary gear row forming the transmission enable the load transmission by pairs of gears and thereby reduce the stress of each pair of meshing gears, permitting the use of small module gears and therefore reducing the gear volume. For this reason, the planetary transmission is compact in radial dimension.

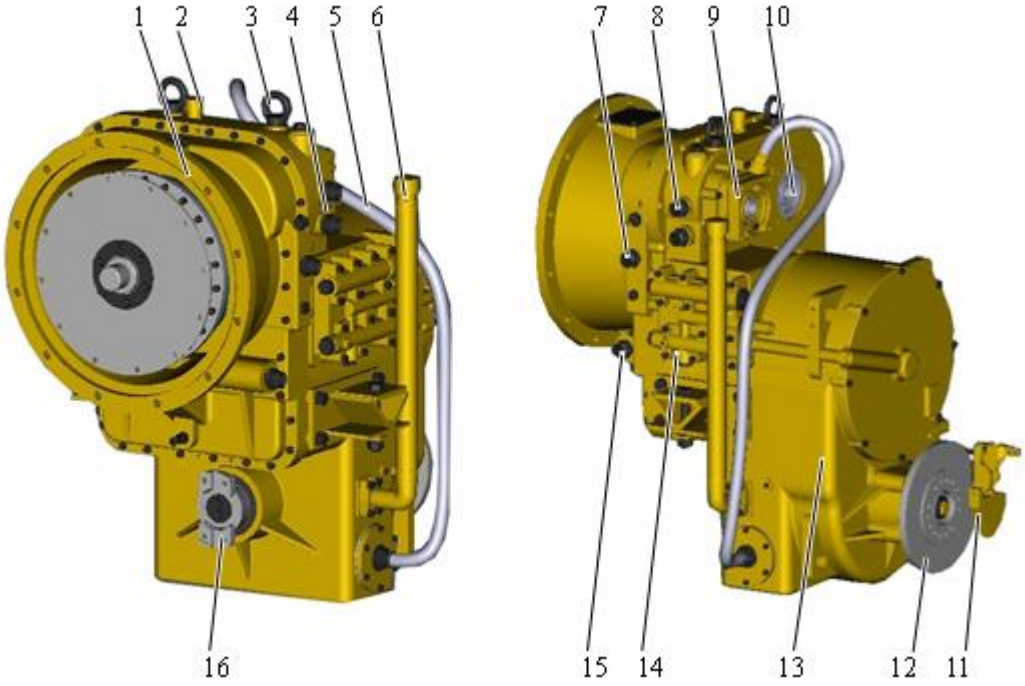


Fig. 2-1

1 Torque converter assembly 2 Ventilation cap 3 Lifting ring screw 4 Transmission return port 5 Oil suction pipe 6 Filler pipe 7 Torque converter outlet port 8 Oil outlet port of transmission 9 Transmission pump 10 Steering pump interface 11 Brake 12 Front output flange 13 Case 14 Transmission control valve 15 Torque converter inlet port 16 Rear output flange

2.3 Structure and Principle of Transmission

2.3.1 Structure

The engine power is transmitted via the hydraulic torque converter to the power gearshift transmission composed of the planetary transmission part and the drive gear part. Its internal main structure is as shown in Fig. 2-2.

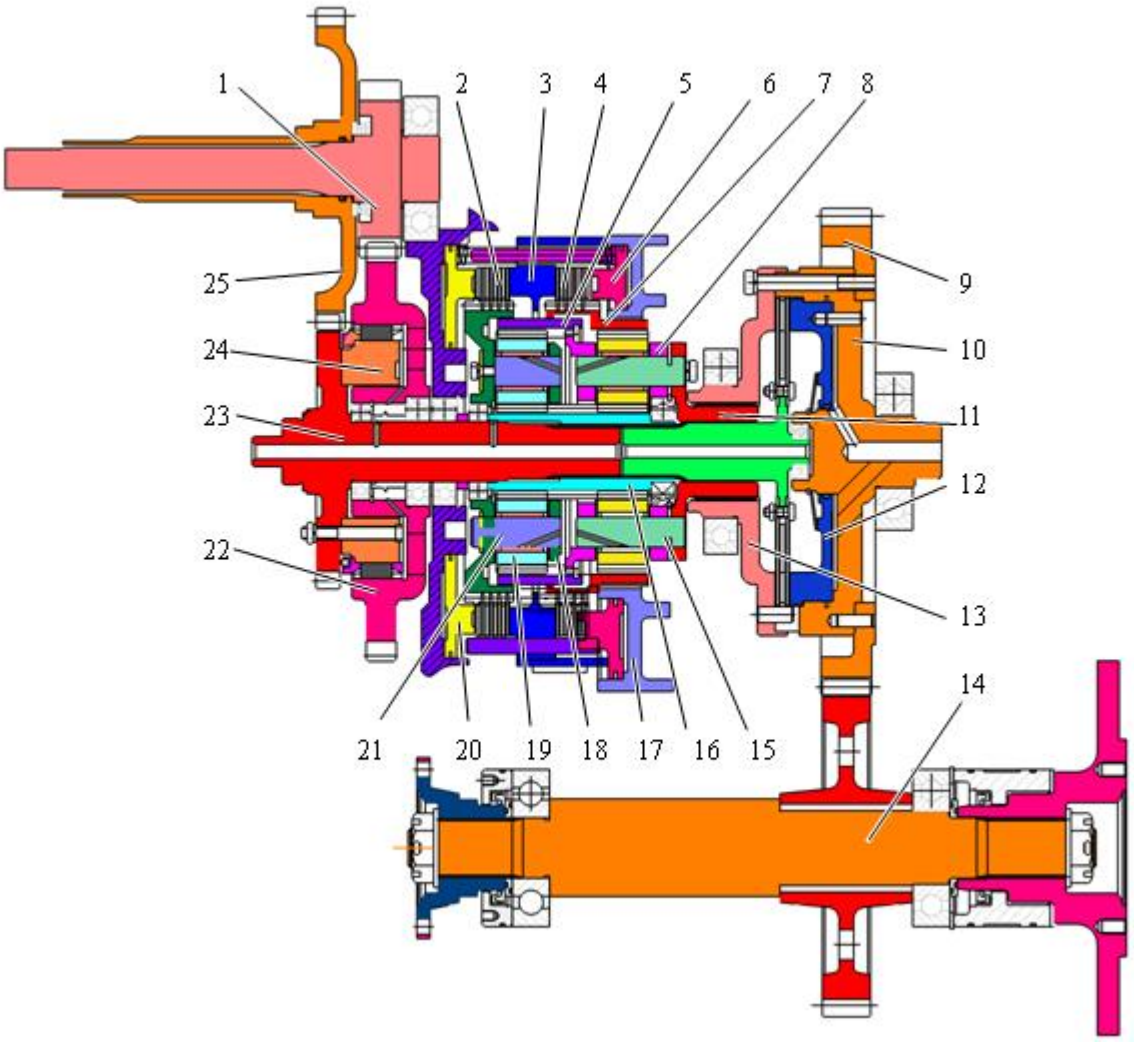


Fig. 2-2 Structure of Planetary Transmission

1 Primary input gear 2 Reverse gear friction lining 3 Isolated bracket assembly 4 1st gear friction lining 5 Reverse gear inner ring gear 6 1st gear piston 7 1st gear inner ring gear 8 1st gear planetary carrier 9 Intermediate output gear 10 Direct gear oil cylinder 11 Direct gear connecting panel 12 Direct gear piston 13 Direct gear pressure plate 14 Output shaft assembly 15 1st gear planetary shaft 16 Sun gear 17 1st gear oil cylinder 18 Reverse gear planetary carrier 19 Planetary gear 20 Reverse gear piston 21 Reverse gear planetary shaft 22 Outer ring gear 23 Intermediate input shaft 24 Inner ring cam 25 Secondary input gear

The planetary transmission part consists of two planetary gear rows including the reverse gear planetary gear row (referred to below as reverse gear assembly) composed of planetary gear, reverse gear planetary carrier, reverse gear planetary shaft, retainer ring, washer, bolt, needle, stop washer and bearing, and the 1st gear planetary gear row (referred to below as 1st gear assembly) comprising the direct gear connecting panel, planetary gear, 1st gear planetary carrier, 1st gear planetary shaft, reverse gear inner ring gear, brake disc, retainer ring, needle, bearing, washer, bolt. Both rows have the same number of sun gears, planetary gears and ring gears. The direct gear assembly (2nd gear the same below) consists of the direct gear pressure plate, direct gear piston, direct gear oil cylinder, intermediate output gear, belleville spring, driving and driven friction linings of direct gear, direct gear shaft, bearing, retainer ring, seal ring, pin, rotary oil seal, washer, nut, etc.

The same sun gear is adopted in both rows for power transmission and splined to the intermediate input shaft and the direct gear input shaft, being the power input part.

The reverse gear inner ring gear, 1st gear planetary gear row, planetary carrier and direct gear pressure plate (fixed together with the intermediate output gear) are connected together through a spline tooth into a whole acting as the power take-off of the planetary transmission part.

The driving and driven friction linings of the reverse gear and the 1st gear are installed on the reverse gear planetary carrier and the inner ring gear respectively, connected to the driving friction lining through teeth. The driven friction lining is guided by the cylindrical pin fixed on the isolated bracket in the case and transfers the stress to the case. The driving and driven friction linings are compressed under the action of oil cylinder piston; when they separate from each other, the piston returns with the help of return spring arranged along the circumference.

There are two driving friction linings and one driven friction lining of the direct gear, and all of them are connected to the direct gear input shaft through bolts and nuts. There is only one direct gear driven friction lining which is guided by the cylindrical pin on the direct gear pressure plate and transfers the stress to the direct gear pressure plate. The clutch pushes and compresses the piston under oil pressure, and the piston returns with the help of belleville spring when the clutch disengages.

2.3.2 Basic Theory of Planetary System

The planetary transmission consists of the planetary gear rows which are structured as shown in Fig. 2-3. The basic planetary gear row is composed of sun gear, planetary gear, planetary carrier and ring gear.

The planetary gear is installed on the planetary carrier, with its axis rotating in space and thus difficult to connect to the outside, making only three elements (sun gear, planetary carrier, ring gear) in the planetary transmission able to be connected to the outside. During the motion transmission of the planetary gear row, the planetary gear only acts as the idler gear transmitting the motion, in no direct relation to the transmission ratio.

From the principle of mechanics:

The equation of speed of the planetary gear row is given by:

$n_s+Kn_r=(1+K)n_c=0$

Where: n_s —— Speed of sun gear;

n_r —— Speed of ring gear;

n_c —— Speed of planetary carrier;

K —— Characteristic parameter of planetary gear row: K=Zr/Zs;

Zr —— Number of teeth of the ring gear;

Zs —— Number of teeth of the sun gear.

To ensure the possibility of installation between members, K is generally taken $4/3 \leq K \leq 4$.

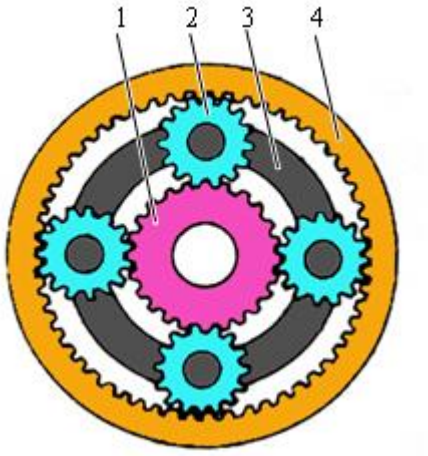


Fig. 2-3

1 Sun gear 2 Planetary gear 3 Planetary carrier 4 Ring gear

According to the equation of speed of the planetary gear row, taking three elements of the basic planetary gear row as the input, the output and the fixed part respectively delivers six transmission schemes for acceleration, deceleration and reversing, two for each case.

For our A301 transmission, the power of planetary gear row is input from the sun gear. Therefore, there are only two transmission schemes, as shown in Fig. 2-4.

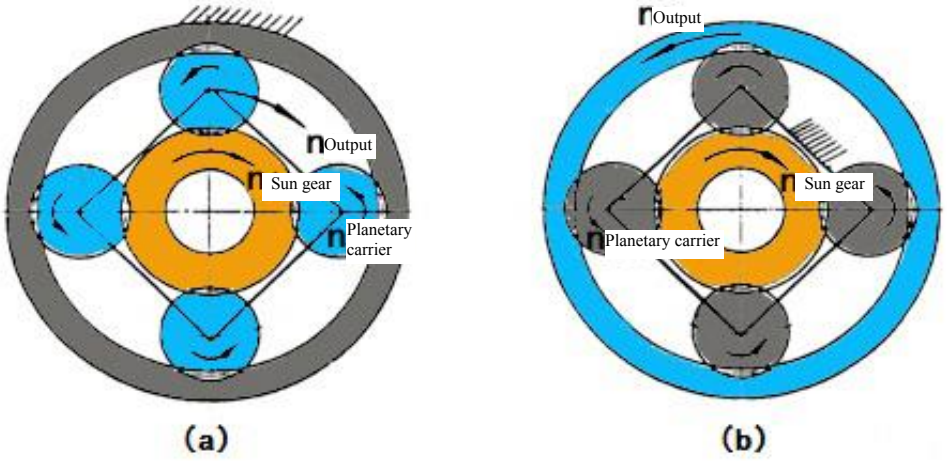


Fig. 2-4

(a) Ring gear fixed, sun gear for input, planetary carrier for output (b) Planetary carrier fixed, sun gear for input, ring gear for output

(1) Sun gear for input, planetary carrier for output, ring gear fixed;

In such case, nf=o, substituting it into the relation of speed of the planetary gear rows yields:

n_s- (1+K)n_c=0

= (1+K)n_c

Transmission ratio: $i=n_s/n_c=1+K$

Because K＞1, so i＞l, it denotes the deceleration, it is the forward 1st gear in actually used transmission;

(2) Sun gear for input, ring gear for output, planetary carrier fixed;

In such case, n_c=0, substituting it into the relation of speed of the planetary gear rows yields:

$n_s+Kn_r=0$

$n_s=-Kn_r$

Transmission ratio: $i+n_s/n_r=-K$

The minus means that n_s is in the opposite direction to n_r, K＞1 denotes the deceleration. In actually used transmission, the same direction as the n_s is the forward direction of the loader, so it is in the reverse gear and performs decelerated motion.

2.4 Transmission Gearshift Principle and Power Transmission Route

2.4.1 Reverse Gear

1. Working Principle

When the transmission control valve stem is in reverse gear, the pressure oil flows from the transmission control valve to the reverse gear oil inlet port on the transmission case into the reverse gear oil cylinder (on the transmission case) to actuate the reverse gear piston and thereby to make the reverse gear driving friction lining match with the driven friction lining on the case (right planetary gear row not working, left planetary gear row working) by means of press fitting-up. Since the driving friction lining slips on and is connected to the planetary carrier, and the driven friction lining is connected with the isolated bracket on the case; according to the principle of reverse gear planetary gearshift mechanism, the reverse gear planetary carrier is fixed and the power from the sun gear is output from the reverse gear inner ring gear through the planetary gear. The reverse inner ring gear is connected with the 1st gear planetary carrier (1st gear planetary carrier connected with the direct gear connecting panel into a whole, and the latter one is splined to the direct gear pressure plate), therefore, the power from the reverse gear inner ring gear is transferred to the direct gear pressure plate through the 1st gear planetary carrier, and then to the intermediate output gear via the direct gear pressure plate (fixed together with the intermediate output gear) and finally transmitted to the output shaft gear (splined with the output shaft) by the intermediate output gear.

2. Transmission Route

The reverse gear transmission route is as follows: Engine torque→ hydraulic torque converter→ primary and secondary input gears→ intermediate input shaft→ sun gear → reverse gear planetary gear → reverse gear inner ring gear →1st gear planetary carrier → direct gear pressure plate → intermediate output gear → output shaft gear → output shaft

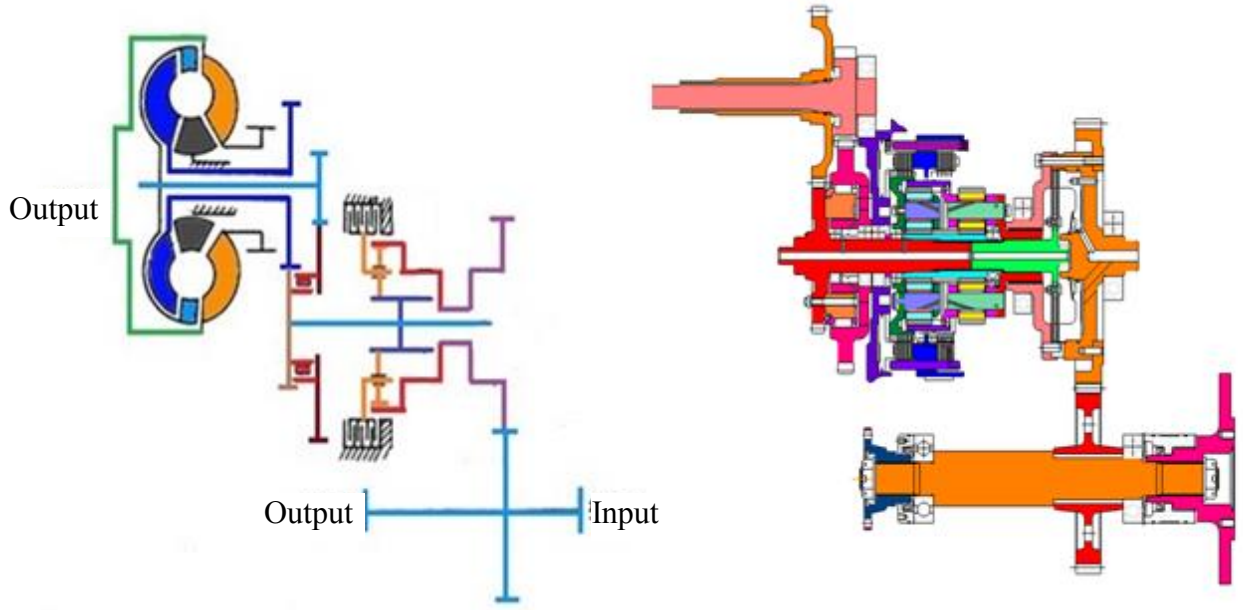


Fig. 2-5 Diagram of Reverse Gear Transmission Route

2.4.2 1st Gear

1. Working Principle

When the transmission control valve stem is in the 1st gear, the pressure oil flows from the transmission control valve into the 1st gear oil cylinder to actuate the 1st gear piston and thereby to make the 1st gear driving friction lining match with the driven friction lining (left planetary gear row not working, right planetary gear row working) by means of press fitting-up. Since the 1st gear inner ring gear meshes with the 1st gear driving friction lining, and the 1st gear driven friction lining is connected to the isolated bracket on the housing through the cylindrical pin; therefore, according to the principle of 1st gear planetary gearshift mechanism, the 1st gear inner ring gear is fixed and the power from the sun gear is output to the 1st gear planetary carrier through the 1st gear planetary gear. Since the 1st gear planetary carrier is connected with the direct gear connecting panel into a whole and the latter is splined to the direct gear pressure plate, so the power from the 1st gear planetary carrier is transferred to the direct gear pressure plate through the direct gear connecting panel, after which it is the same as the reverse gear.

2. Transmission Route

The 1st gear transmission route as follows: Engine torque→ hydraulic torque converter→ primary and secondary input gears→ intermediate input shaft→ sun gear→ 1st gear planetary gear → 1st

gear planetary carrier→ direct gear pressure plate → intermediate output gear→ output shaft gear → output shaft.

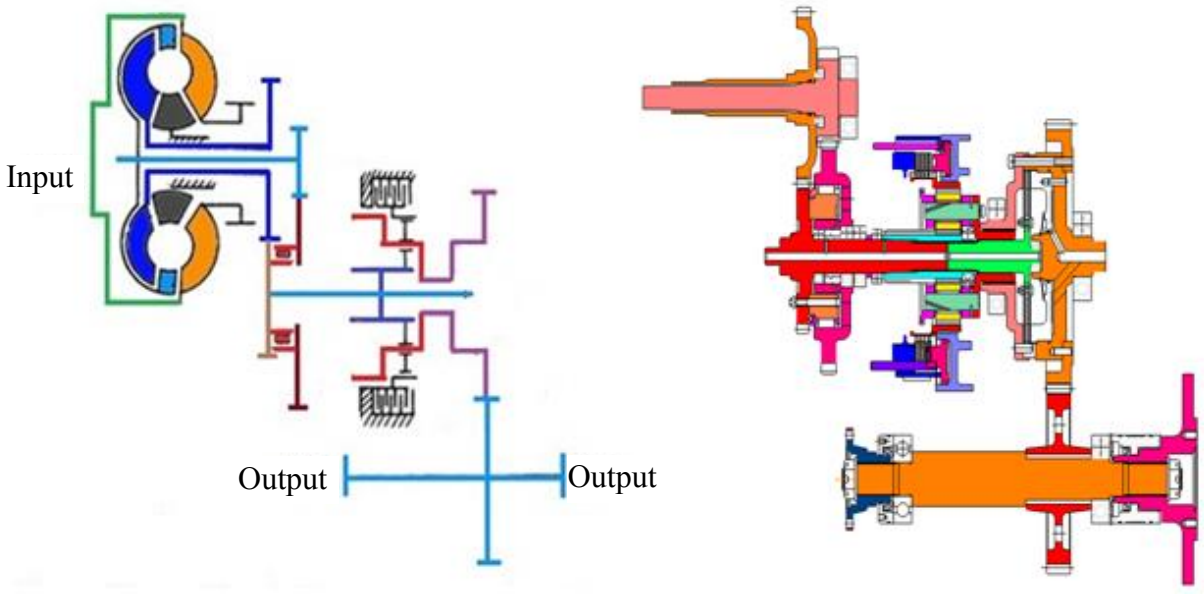


Fig. 2-6 Diagram of 1st Gear Transmission Route

2.4.3 2nd Gear

1. Working Principle

When the transmission control valve stem is in the 2nd gear, the pressure oil flows from the transmission control valve to the direct gear oil inlet port of the case and into the direct gear oil cylinder, so as to actuate the direct gear piston and thereby to make the direct gear driving friction lining match with the driven friction lining by means of press fitting-up. According to the introduction to internal structure of the transmission, the power from the sun gear is transferred through the direct gear shaft to the direct gear pressure plate and finally output by the output shaft gear.

2. Transmission Route

The direct gear transmision route is as follows: Engine torque→ hydraulic torque converter→ primary and secondary input gears→ intermediate input shaft → sun gear → direct gear shaft → direct gear friction lining → intermediate output gear → output shaft gear → output shaft.

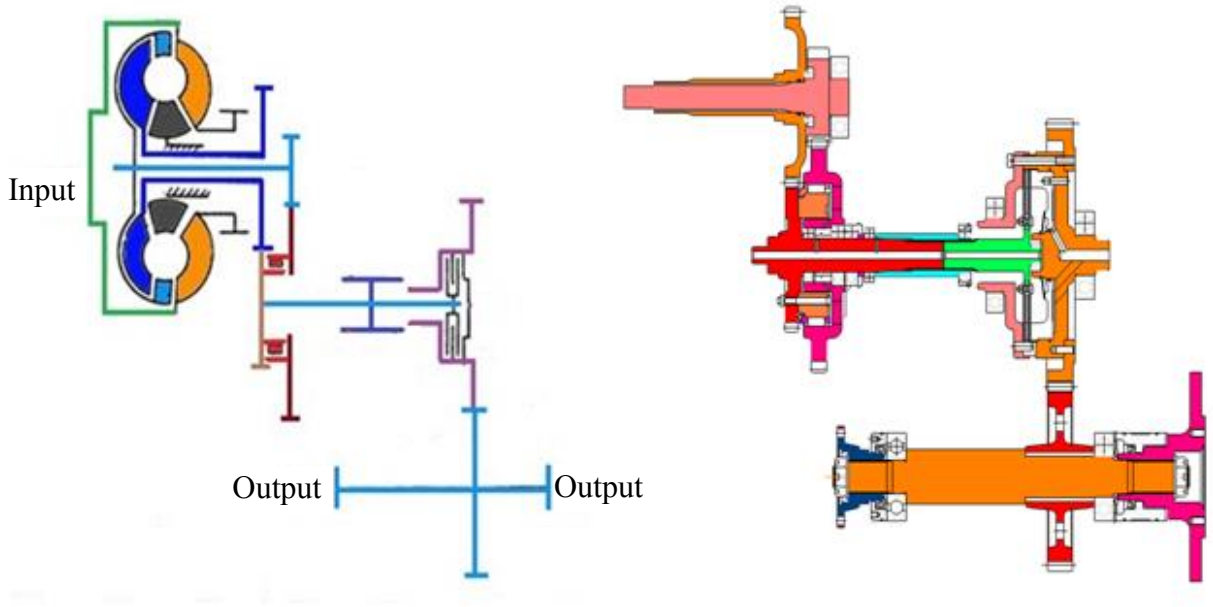


Fig. 2-7 Diagram of 2nd Gear Transmission Route

2.5 Introduction to Main Structure of Transmission

2.5.1 Overrunning Clutch

1. Composition

The overrunning clutch is composed of intermediate input shaft, outer ring gear, bearing, inner ring cam, roller, spacer sleeve, etc.

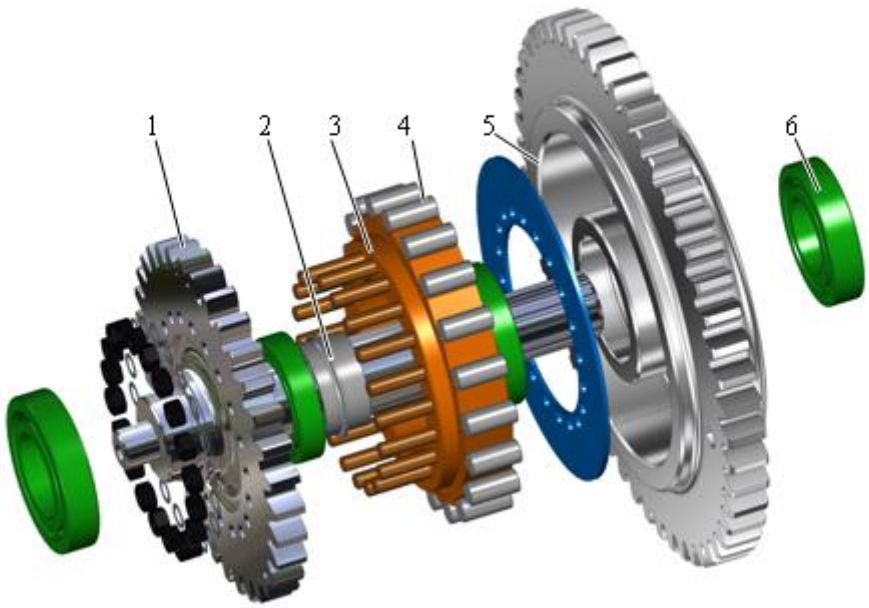


Fig. 2-8 Overrunning Clutch

1 Intermediate input shaft 2 Spacer sleeve 3 Inner ring cam 4 Roller 5 Outer ring gear 6 Bearing

2. Working Principle

When the loader works at low speed and heavy load, the 2nd stage turbine speed is low, and the inner ring cam and the outer ring gear of the overrunning clutch are chocked. In such case, the 1st and the 2nd stage turbines are actually like a whole turbine and work together to improve the capability of the torque converter for overcoming the external resistance. Here, the transmission route of the 1st stage turbine is as follows: 1st stage turbine → primary input gear → transmission overrunning clutch; the transmission route of the 2nd stage turbine is as follows: 2nd stage turbine → secondary input gear → transmission overrunning clutch.

When the loader works at high speed and light load, although the 1st and the 2nd stage turbines have the same power output route, yet the outer ring gear idles because it is slower than the inner ring cam. In such case, only the 2nd stage turbine outputs the power and the 1st stage turbine idles and gives no power output.

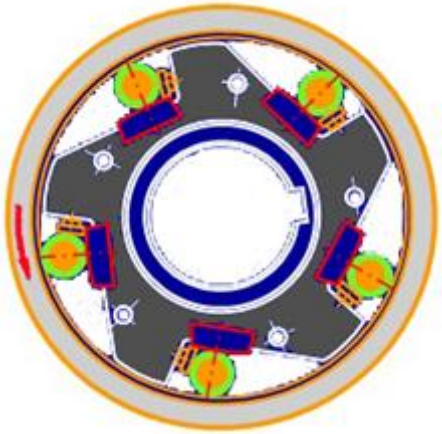


Fig. 2-9 Schematic Diagram of Overrunning Clutch

2.5.2 2nd Gear Assembly

1. Composition

The 2nd gear assembly consists of direct gear pressure plate, direct gear shaft, friction lining, piston, oil cylinder, intermediate output gear, bearing, etc.

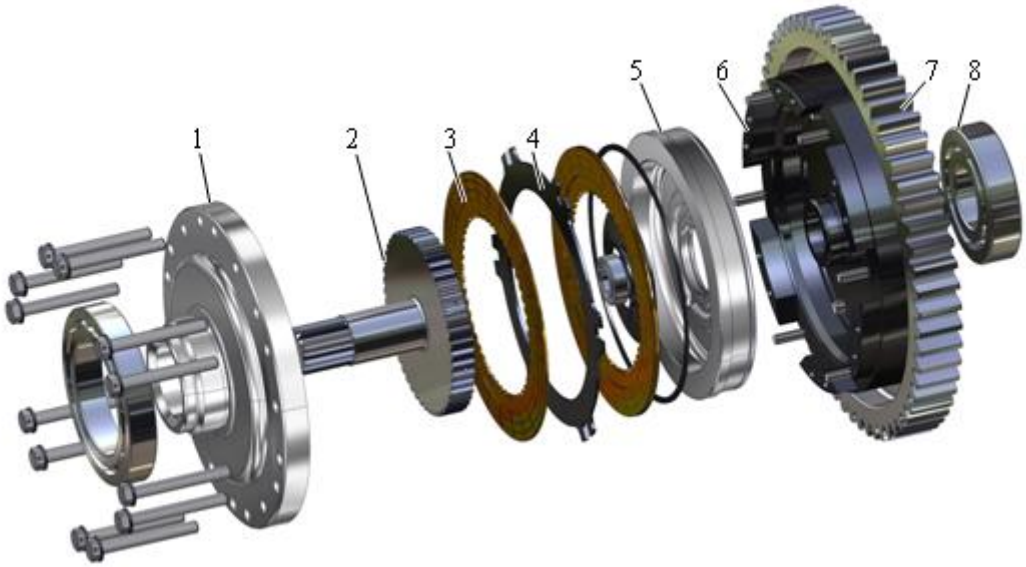


Fig. 2-10 2nd Gear Assembly (BX50 series transmission)

1 Direct gear pressure plate 2 Direct gear shaft 3 Inner friction lining 4 Outer friction lining
5 Piston 6 Oil cylinder 7 Intermediate output gear 8 Bearing

★ **Prompt: The inner and the outer friction linings in the 2nd gear assembly of A30X series transmission are bolted to the direct gear shaft and other structures are as shown in Fig. 2-10.**

2. Working Principle

When the machine is in the 2nd gear, the pressure oil flows from the transmission control valve to the direct gear oil inlet port of the case and into the direct gear oil cylinder, to actuate the direct gear piston and thereby to make the direct gear driving friction lining match with the driven friction lining by means of press fitting-up. The power from the sun gear is transferred to the direct gear pressure plate through the direct gear shaft, and finally output by the output shaft gear for travel in the 2nd gear.

2.6 Composition and Function of Oil Supply System of Transmission and Torque Converter

2.6.1 Composition

The oil supply system is an important part of the hydromechanical transmission system, generally composed of radiator, filter, torque converter, transmission pump (gear pump), transmission control valve, oil pan and pipeline.

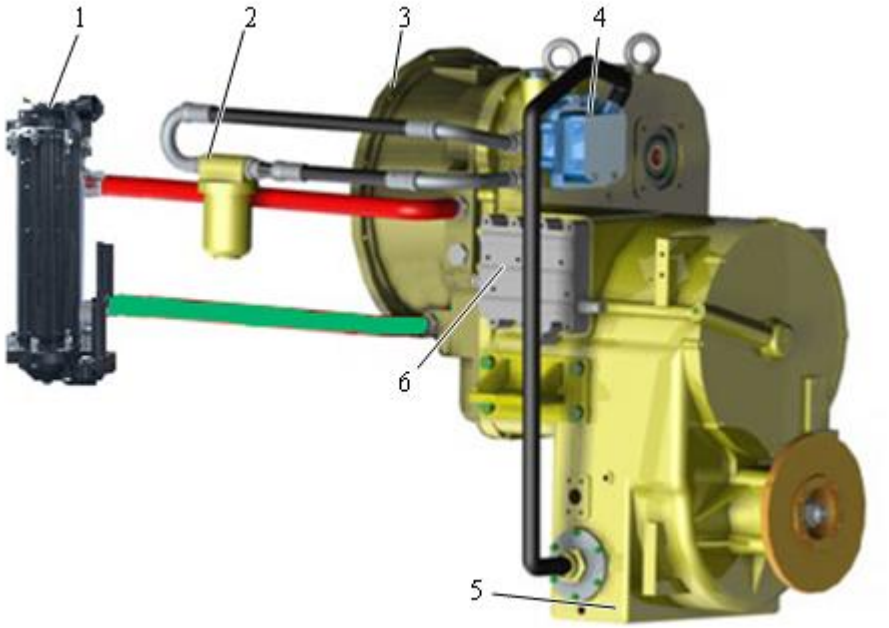


Fig. 2-11 Constitutional Diagram of Oil Supply System
1 Radiator 2 Filter 3 Torque converter 4 Transmission pump 5 Oil pan
6 Transmission control valve

The hydraulic transmission oil is output from the transmission pump, and supplied to the transmission control valve (or reducing valve) after being filtered by the oil filter. The working oil flows to the transmission control oil circuit of the transmission control valve to meet the transmission requirements and then a part of it runs into the torque converter.

To remove metal debris, sediments and other impurities from the oil circuit and prevent them entering the oil supply system, the oil supply system typically features filtration unit and employs two-pass filtration. At the oil suction pipe there is a primary filter for capturing large mechanical impurities such as metal debris to prevent damage to the transmission pump. The primary filter generally features a 0.4~0.7-mm copper mesh, with pressure drop not exceeding 0.01 MPa. The primary filter is generally behind the transmission pump and in front of the transmission control

valve.

The working oil of hydraulic transmission oil supply system shall be at the temperature of 80℃~90℃ preferably and up to 120℃ in a short time, with part of the heat dissipated through the transmission-torque converter case, and most introduced into the radiator and dissipated through forced cooling.

2.6.2 Function

(1) Provide proper pressure and flow for the hydraulic gearshift mechanism and the hydraulic torque converter.

In the hydraulic transmission system, the torque converter and the transmission share the same oil supply system; to ensure the reliable control of transmission control system, the oil supply of transmission control system shall be guaranteed first to prevent the failure of transmission control system and the vehicle being out of control.

(2) Remove the heat generated from working and cool the working fluid

When the loader functions properly, about 20%-25% of power loss in the transmission and torque converter is converted into the heat energy which, if not dissipates timely, will make the transmission and torque converter gain a sharp rise in temperature and fail to work or even damaged. For this reason, a hydraulic transmission oil radiator is provided in the oil supply system of transmission and torque converter.

(3) Prevent cavitation in the hydraulic torque converter.

For this, a back pressure valve is furnished at the oil outlet of the torque converter to keep the fluid pressure in the working chamber of the torque converter higher than the external atmospheric pressure, so as to effectively prevent cavitation in the torque converter.

(4) Compensate for leakage of working fluid in the torque converter to ensure a torque converter always full of operating fluid.

2.7 Oil Supply Route and Principle of Transmission and Torque Converter

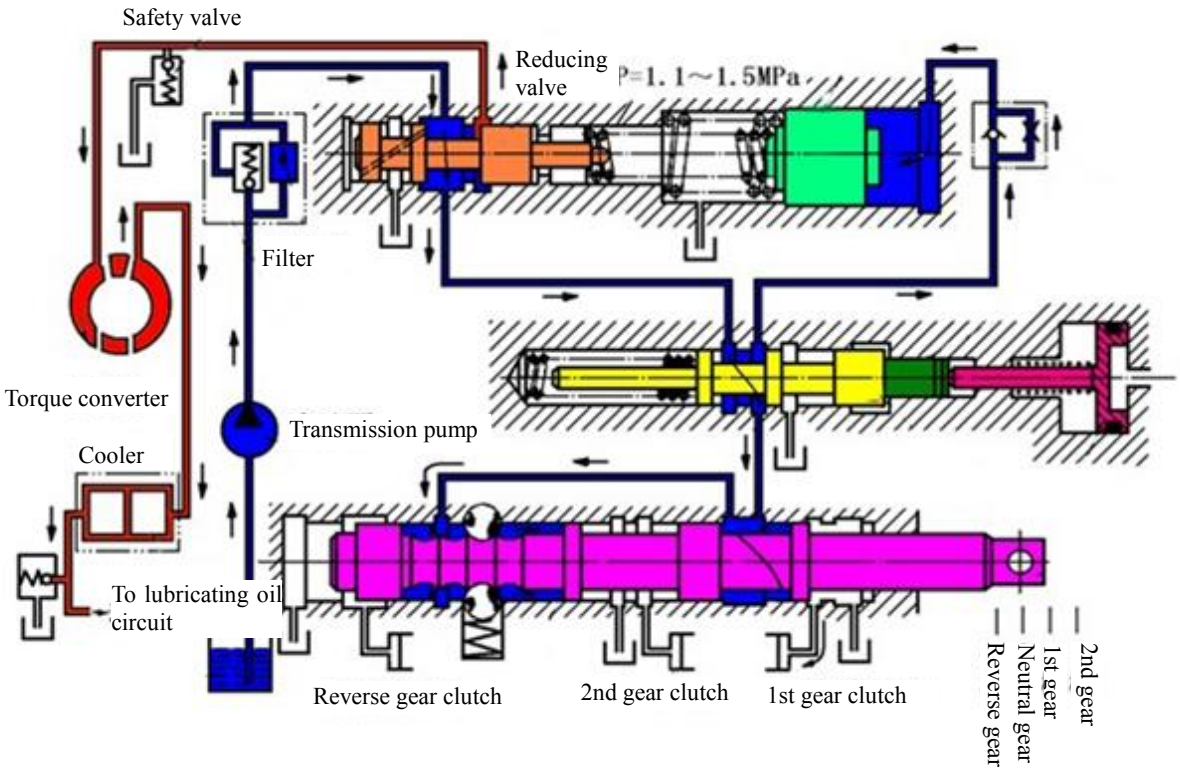


Fig. 2-12 Oil Supply Route Diagram

Torque converter impeller is driven by the diesel engine→ transfer gear on the impeller, transmission pump shaft gear → drive the transmission pump to absorb oil from the oil pan→ pumped pressure oil→ filtered by the oil filter (bypass valve opened for oil passing when the filter core is blocked)→ into the transmission control valve

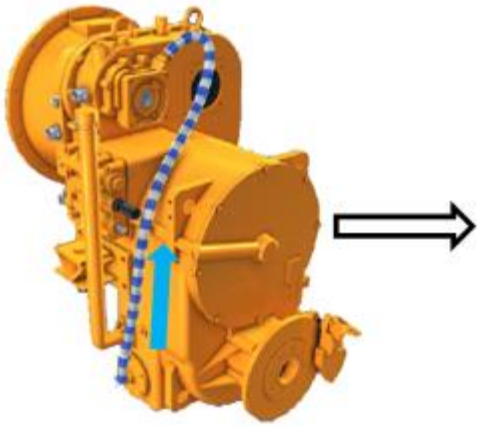


Fig. 2-13 Oil Absorption of Transmission Pump

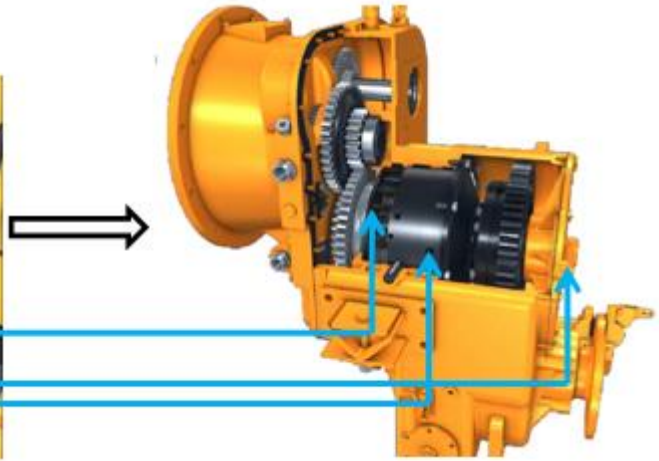
Fig. 2-14 Filtered Oil to Transmission Control Valve

From here, the pressure oil is split into two routes:

1. Working Oil Circuit

One circuit leads to the reducing valve (P=1.1~1.5 MPa)→transmission control oil circuit→ oil cylinders in all gears depending on different positions of the transmission control valve stem → to complete operations in different gears.

Fig. 2-15 Working oil Circuit in Transmission Control Valve Fig.



2-16 Working Oil Circuit to Oil Cylinders in All Gears

The other circuit leads to the working chamber of the torque converter:

2. Lubricating Oil Circuit

The working oil flows into the torque converter through the safety valve (0.3~0.45 MPa) at the inlet of the torque converter → a part circulates among the impeller, 1st and 2nd stage turbines, and the stator.

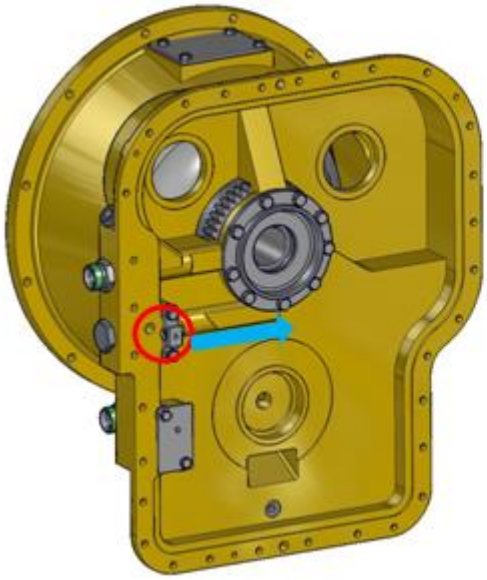


Fig. 2-17 To Oil Circuit of Torque Converter

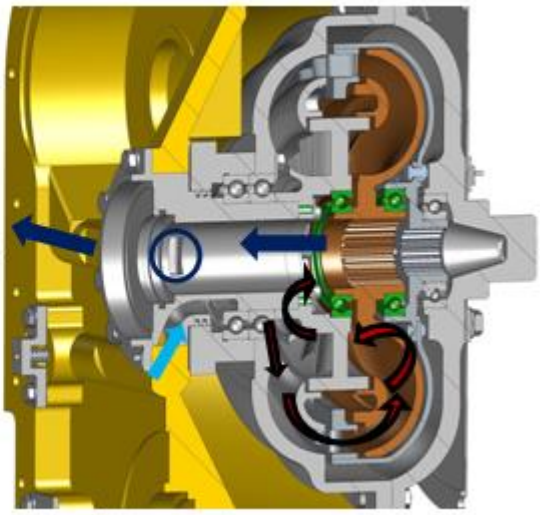


Fig.2-18 Circulating Oil Circuit in Torque Converter

The other part runs through gaps between running wheels→ oil outlet channel of the stator seat→ hose to radiator for heat dissipation→ cooled low pressure oil back to the torque converter (back pressure valve provided at the oil return port)→through the hole on the case to lubricate the overrunning clutch and all planetary gear rows.

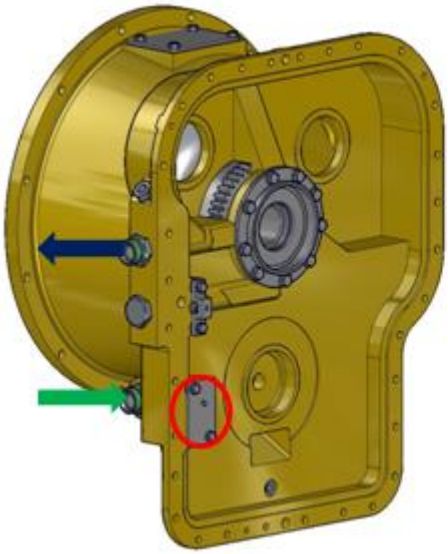


Fig. 2-19 Oil Circuit from Torque Converter to Radiator

Fig. 2-20 Lubricating Oil Circuit in Transmission

2.8 Introduction to Components of Oil Supply System

2.8.1 Hydraulic Torque Converter

1. Function of Hydraulic Torque Converter

The hydraulic torque converter is located between the engine and the transmission, and functions to change the engine torque, make the output torque of the turbine exceed the torque provided by the engine through the impeller, to improve the power performance of the loader and ensure smooth transmission.

A PTO interface is provided on the torque converter for transmitting a part of engine power to the hydraulic oil pump, to actuate the loader, hydraulic system and steering system.

2. Working Principle of Hydraulic Torque Converter

The working principle of hydraulic torque converter is as shown in Fig. 2-21 (single-stage three-element hydraulic torque converter, for instance).

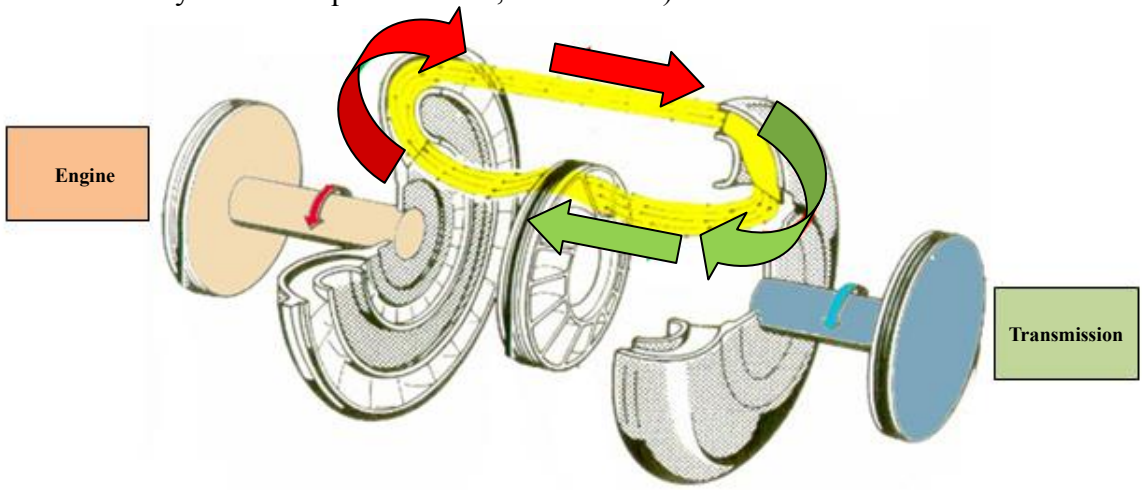


Fig. 2-21 Schematic Diagram of Torque Converter

1 Impeller 2 Turbine 3 Stator

The basic hydraulic torque converter consists of impeller, stator and turbine which together constitute the closed annular working chamber acting as the channel where the working fluid circulates. The shape that the working chamber presents when passing through the section (i.e. axial surface) cut by the rotation axis is called the circulating circle. The circulating circle of the torque converter is split into two symmetrical parts with the rotation axis as the center line. In the circulating circle, the maximum diameter of the part where the working fluid flows is called the

effective diameter of the circulating circle and characterizes the torque converter because it is representative of its size. Therefore, the model of torque converter is typically expressed by the diameter of its circulating circle. For instance, our LG946L, LG952L, LG953N, LG956L loaders employ the YJSW315 hydraulic torque converter in which “315” is the diameter Φ315 mm of the circulating circle.

The working principle of the hydraulic torque converter is as shown in Fig. 2-22. When the torque converter is operating, the impeller is driven by the engine and applied with the engine torque at the same time. When the impeller rotates, the working fluid rotates with the blade. The fluid not only circles (transport motion) around the impeller axis but also performs relative motion by moving along the passageway between blades from the inner edge to the outer edge of the blade under the centrifugal force.

Both motions are combined into the absolute motion. In such case, pressure difference exists between the outer edge (higher) and the inner edge (lower) of the blade and depends on the impeller radius and speed.

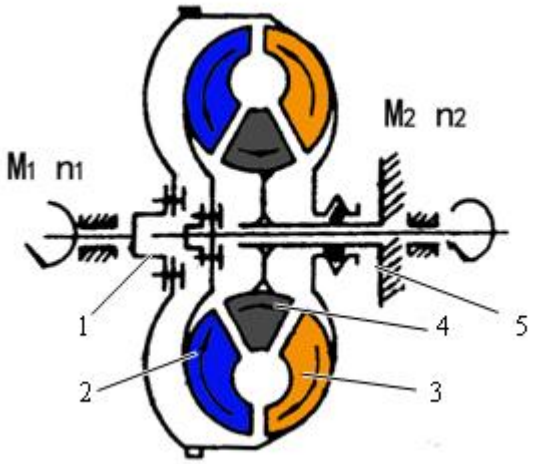


Fig. 2-22 Schematic Diagram of Torque Converter

1 Engine crankshaft 2 Turbine 3 Impeller 4 Stator 5 Stator seat

The working fluid is under the action of the impeller blade and gains certain kinetic energy and pressure energy when leaving the impeller, to convert the mechanical energy of the engine into the energy (kinetic energy and pressure energy) of the working fluid.

The high-speed oil flow from the impeller runs into the turbine through a section of area without blade formed by the wheel shell and impacts the turbine blade to actuate the turbine and make the

turbine shaft obtain certain torque to overcome the external resistance for acting. In such case, the liquid flow still performs two types of motions in the turbine, i.e. the transport motion together with the rotating turbine and the relative motion in the passageway of the turbine blade.

Since the fluid impacts the blade, some of its energy is converted into the mechanical energy, and the kinetic energy of a few of the fluid is consumed in the high speed flow due to heat generation because of friction with the passageway. Therefore, both the kinetic energy and the pressure energy of the working fluid from the turbine are reduced.

The fluid from the turbine flows into the stator which is fixed on the stator seat, i.e. the speed nD=0, thus the power on the stator is always zero, whether there is torque on the stator or not. For this reason, the fluid gives no energy input and output when flowing in the stator.

When flowing through the stator, the fluid can only perform relative motion along the passageway limited by the stator blade. Because there is no rotary transport motion, the relative motion of the fluid is its absolute motion.

The fluid through the stator may have two types of changes in the velocity of the relative (or absolute) motion: change in the velocity of movement: according to the fluid mechanics, this change only occurs when the section of the passageway (or the stator passageway) between blades is changed; when sections at the inlet and the outlet of the stator blade are the same, the absolute velocities are equal; change in the velocity direction: the motion directions of the fluid after entering the blade and before leaving the blade are determined by the blade shape and the setting angle of the inlet and the outlet. The change in the size and direction of the fluid velocity will lead to the change in the moment of momentum of the fluid, and the stator will come under the action of the fluid moment. So the stator in the hydraulic torque converter is mainly to change the moment of momentum of the fluid.

The stator also changes the form of fluid energy while changing the moment of momentum of the fluid, that is, it converts the fluid pressure energy into the kinetic energy, or vice versa. The former case is generally more common.

After flowing from the stator, the fluid reenters the impeller and again obtains the energy from it. The fluid runs in cycles like this throughout the working process of the torque converter, for energy conversion and transfer between the impeller and the turbine.

In the hydraulic torque converter, the impeller, the turbine and the stator interrelate with one another in respect of the working process, and the state of the fluid at the outlet of the previous working wheel determines that of the fluid at the inlet of the next one.

From the above, the interaction between the fluid and the blade of the working wheels during the working process of the hydraulic torque converter, including the velocity change, change and transfer of energy and torque), is a complicated process. The principle of torque change of the torque converter is presented below.

With the torque converter running steadily, all working wheels shall have equal torque on the working fluid, i.e.:

$$-M_{turbine} = M_{impeller} + M_{stator}$$

The above equation indicates that moment on the turbine is equal to the vector sum of moment of the impeller and the stator. The minus before M turbine could mean that the moment is the moment of resistance the external load acts on the turbine shaft. So, the hydraulic torque converter changes the torque as follows: the fixed stator generates the reaction moment to the fluid which (M impeller, M stator) are transferred to the turbine. Where the turbine speed is low or zero, M stator and M impeller have the same direction (M stator＞0), then –M turbine＞M impeller; When the moment on the turbine is greater than its moment of resistance, the vehicle gets started and the turbine speed gradually increases from zero. The turbine rotates and thereby changes the direction of the fluid impacting the stator from the turbine. When the turbine speed increases to a value, i.e. when the velocity of the fluid impacting the stator coincides with the mean camberline of the stator blade, then M stator=0, in such case, M impeller=-M turbine; where the turbine speed keeps increasing, and the fluid at the turbine outlet is about to impact the back of the stator, M stator and M impellor have opposite direction, M stator＜0, then –M turbine＜M impeller; when the turbine speed is equal to the impeller speed, there is no liquid flow in the circulating circle, so no power transmission takes place, -M turbine=0.

3. Type of Hydraulic Torque Converter

According to the structure and performance, the torque converter can be classified into:

(1) Type B (impeller)—T(turbine)— D(stator) and type B－D－T as per the arrangement sequence of working wheels in the circulating circle.

For B－T－D hydraulic torque converter, the turbine rotates in the same direction as the impeller, which is called the forward hydraulic torque converter. For B－D－T hydraulic torque converter, the turbine rotates in the same direction as the impeller, which is called the forward hydraulic torque converter, alternatively, the turbine rotates in the opposite direction to the impeller, which is called the reversal torque converter.

The B－D－T hydraulic torque converter is currently the most widely used in the loader.

(2) Single-stage, two-stage and multistage hydraulic torque converter as per the number of columns of the turbine blades or the number of rigidly connected blades in the torque converter circulating circle.

The torque converter with only one turbine in the circulating circle is called the single-stage torque converter. The double-turbine hydraulic torque converter used in ZL40, ZL50 loaders is of single stage due to no rigid connection between turbines.

Currently, most of hydraulic torque converters used in domestic loaders are of single stage.

(3) Single-phase, two-phase or multiphase torque converter as per the possible working condition (which comes in independent hydraulic torque converter or coupler)

The “phase” refers to one or more functions the torque converter features due to the change in the function of working elements caused by the action of one-way clutch or brake or other mechanisms.

A hydraulic torque converter may have the function provided in single phase, two phases or multiple phases depending on different combinations of working wheels and the working condition (e.g. stator idling or stopped) of each working wheel. YJSW315 hydraulic torque converter is a typical single-stage two-phase torque converter.

Some torque converters have one-way clutch between the stator and the housing, with the one-way clutch chocked or freely rotating depending on the direction of fluid into the stator. Automatic transfer is possible between the functions of the coupler and the torque converter based on the working condition. These torque converters are called the integrated torque converter (converter function enabled with the stator fixed), which provide the functions of the coupler and the torque converter and are commonly used.

(4) Axial-flow, centrifugal and centripetal-turbine torque converter as per the turbine type

The working fluid in the centripetal-turbine torque converter flows to the center from around, with its direction guaranteed by the fact that the entrance radius of the turbine is greater than the exit radius.

The axial-flow-turbine torque converter has working fluid axially flowing, which is enabled by similar entrance radius and exit radius of the turbine.

The working fluid in the centripetal-turbine torque converter runs to the periphery from the center, which is enabled by the fact that the entrance radius is less than the exit radius of the turbine.

The centripetal-turbine torque converter has outstanding merits, making it the most commonly used in the loader.

(5) Non-transmissible, positively transmissible, negatively transmissible and mixed types as per the transmissivity.

The transmissivity of the hydraulic torque converter refers to the capability that torque and speed of the impeller shaft vary with that of the turbine shaft accordingly.

If the torque of turbine shaft changes, but the impeller torque and speed stay the same, the torque converter is considered non-transmissible. When the engine works with such torque converter, it will be always under the same working condition with the throttle opening fixed, regardless of the change in external load.

If the change in the torque of turbine shaft leads to the change in the torque and speed of the impeller, the torque converter is considered transmissible. When the engine works with this torque converter, with throttle opening unchanged and external load changed, the working condition of engine will be changed. The transmissible torque converter can be classified into positively transmissible, negatively transmissible and mixed types as per the degree of transmissivity. The torque converter in which the increase of turbine load leads to increase of impeller load is considered positively transmissible; the one in contrast to this is considered to negatively transmissible (or reversely transmissible); and the one in which the latter case comes before the former case, starting from the braking condition is considered to be mixed type.

4. Structure Features of Hydraulic Torque Converter

YJSW315 single-stage four-element hydraulic torque converter

Currently, YJSW315 hydraulic torque converter has been widely used in loaders, which is

double-turbine, four-element, single-stage, two-phase and centripetal-turbine torque converter, adopted by our LG953N, LG956L, LG936L products, structured as shown in Fig. 2-23.

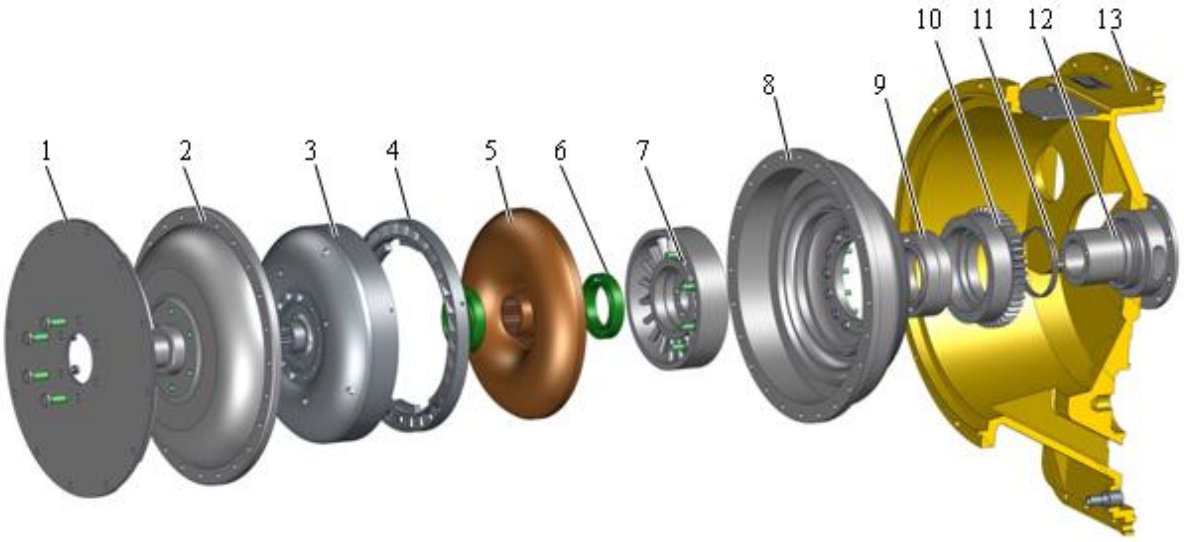


Fig. 2-23 YJSW315 Hydraulic Torque Converter

1 Elastic plate 2 Wheel shell 3 1st stage turbine shroud 4 1st stage turbine 5 2nd stage turbine 6 Bearing 7 Stator 8 Impeller 9 Bearing 10 Transfer gear 11 Seal ring 12 Stator seat 13 Torque converter housing

(1) Power input part

The engine power is input to the impeller as follows: Engine flywheel → elastic plate→ wheel shell → impeller.

The diesel engine flywheel is connected with the outer ring of the elastic plate through stud, and the inner edge of the elastic plate bolted to the wheel shell. Between the wheel shell and the impeller an O-ring is used for sealing and many bolts are used for connection. The fitting surface is adopted at the junction of wheel shell and impeller for positioning to ensure the concentricity of the impeller with the engine crankshaft.

To ensure normal operation of the hydraulic system and the steering system, the engine is required to have a part of power directly output to the working oil pump. For this purpose, a PTO interface is arranged on the torque converter, and a certain amount of power from the diesel engine is transferred to the transfer gear 13 by the wheel shell and the impeller, and then to the gear pump by the working pump spindle and the steering pump spindle meshing with the transfer gear to actuate the oil pump.

There are three bearing points for power input of the torque converter; the first one is the fixed

support which is inserted into the center hole of the engine flywheel through the shaft end of the wheel shell to support the torque converter on the engine, so as to provide a solution to the concentricity of the torque converter with the engine crankshaft, and also to prevent radial movement of working wheels and provide the resistance to the radial load of the system.

The second one is to support the impeller on the stator seat through two rows of ball bearings by supporting the transfer gear on two rows of bearings of the stator seat and then connecting the impeller to the transfer gear through bolts.

The third one is to make the wheel shell and 1st stage turbine hub carry each other through a ball bearing, which is needless for the impeller system but essential for the 1st and the 2nd stage turbines.

The balance test is generally not required for all parts of the power input system, except the impeller and the wheel shell. Since the wheel shell is an iron casting, its all surfaces, though machined, shall be subject to the balance test. The impeller is an aluminum casting and has many unmachined surfaces, and there may be errors in the blade distribution, thus the balance test is also needed.

In the power input system, the elastic plate can also buffer and reduce the additional load due to eccentricity and thermal expansion in addition to the torque transfer. And the wheel shell constitutes part of the circulating circle together with the impeller, etc. in addition to acting as the intermediate part for power transmission.

(2) Power output part

There are two turbines in YJSW315 torque converter, i.e. the 1st and the 2nd stage turbine. The power output is complicated, with structure and working principle as illustrated in Fig. 2-24.

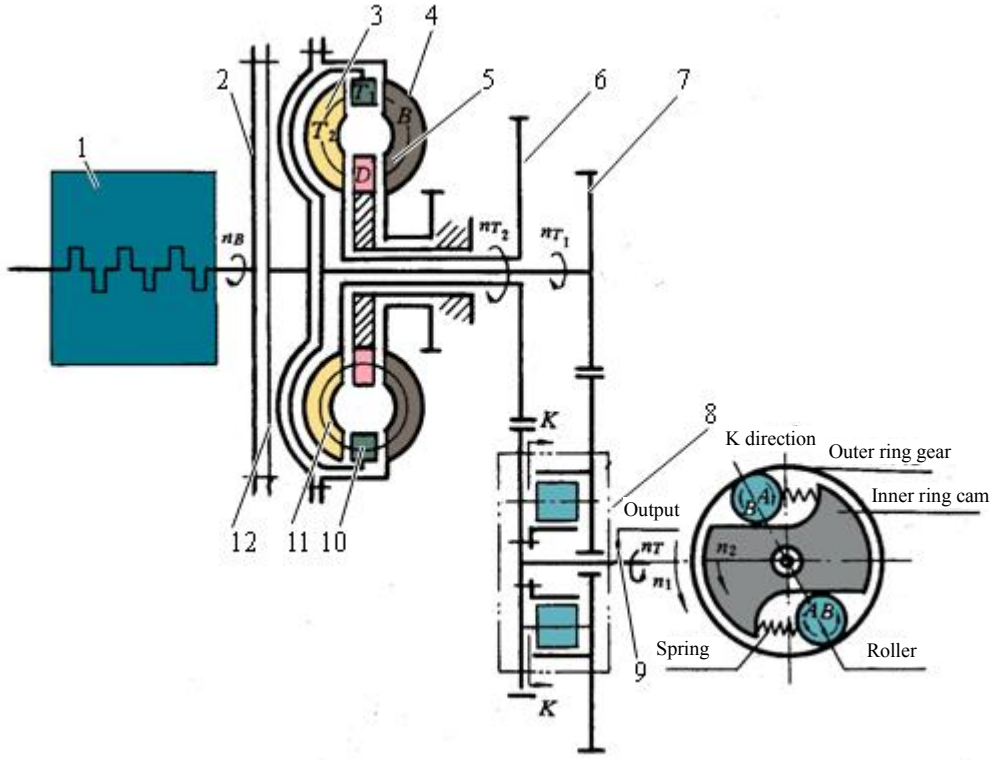


Fig. 2-24 Schematic Diagram of Double-turbine Hydraulic Torque Converter

1 Engine 2 Engine flywheel 3 Wheel shell 4 Impeller 5 Stator 6 Secondary output gear 7 Primary output gear 8 Overrunning clutch 9 Transmission input shaft 10 1st stage turbine 11 2nd stage turbine 12 Elastic plate

It fits with the turbine of double-turbine hydraulic torque converter, with power output by two output shafts including 1st stage turbine output shaft and 2nd stage turbine output shaft, of which the output gears mesh with two gears on the overrunning clutch in the transmission respectively, so as to extend the speed variation.

The hubs and the output shafts of the 1st and the 2nd stage turbines are splined. To axially fix the turbine on the turbine shaft, at the left side of the 2nd stage turbine hub there is a shaft retainer ring, provided with clearance adjustment sheet which is also arranged on the bearing seat at the right side of the output shaft of the 1st stage turbine, to ensure appropriate clearance. Special care shall be taken to the clearance adjustment during the reassembling.

The output shaft of the 1st stage turbine is supported by two ball bearings in which the left one is located in the bearing seat hole on the wheel shell and the right one is in the bearing seat hole on the transmission; the output shaft of the 2nd stage turbine is also supported by two ball bearings in which the left one is press-fitted in the 2nd stage turbine hub and supported on the 1st stage turbine hub, and the right one is supported in the bearing seat hole of the housing.

The balancing of the power output system is mainly for the turbine, while the concentricity of the turbine with the turbine shaft is guaranteed by the spline centering. The turbine is formed by aluminum-alloy casting, with blades evenly distributed in its passageway. The shape of circulating circle and the location of the contour line of the axial surfaces of blade entrance and exit are roughly symmetrical with those of the impeller.

(3) Fixed bearing part of stator

The stator is a fixed working wheel in the hydraulic torque converter, connected with the housing of torque converter as follows: stator → stator seat → housing of hydraulic torque converter

The stator is splined to its seat. To prevent the axial movement of the turbine, a retainer ring is used at the left side of the stator. The stator seat is bolted to the housing of torque converter, which accommodates oil duct.

(4) Sealing of circulating circle

When the hydraulic torque converter is working, the circulating circle is filled with pressure and high-speed liquid flow. To prevent the liquid leaking from the circulating circle, sealing measures must be taken at related connection of the circulating circle.

Additionally, in the oil supply system of the hydraulic torque converter, the influent low temperature working fluid shall be isolated from the effluent high temperature working fluid, that is, both shall have their own independent passageway, so sealing measures are also needed.

There are generally three sealing types for the hydraulic torque converter:

- For sealing two connecting parts without relative motion between each other, O-ring shall be used. For instance, O-ring seal is adopted at the junction of the wheel shell and the impeller, to prevent liquid leaks at the junction in the circulating circle.
- For sealing the junction of two parts with relative motion between each other, the seal ring of alloy cast iron shall be used. For instance, such sealing is adopted between the transfer gear and the stator seat, to prevent liquid leaks at the bearing seat.
- Lip type seal ring (also known as the rotary oil seal) is a kind of contact seal, and commonly used between the output shaft and the housing of the hydrodynamic unit. For instance, it is used between the secondary output shaft and the stator seat, between the primary output shaft and the secondary output shaft. During the assembling, observe the followings:

★**Notice: The lip of the lip type seal ring shall be toward the incoming flow.**

The double-turbine torque converter is characterized by high efficiency within a large transmission ratio range, i.e. wide high efficiency area. That's why the loader can employ the transmission with fewer gears to simplify the mechanism. For instance, ZL40, ZL50 loaders employ the double-turbine torque converter, with the transmission providing only two forward gears and one reverse gear.

2.8.2 Transmission Control Valve

1. Composition

The transmission control valve consists of reducing valve (adjusting the system pressure P=1.1~1.5 MPa), servo piston, power cut-off valve, transmission control valve stem, one-way valve, etc.

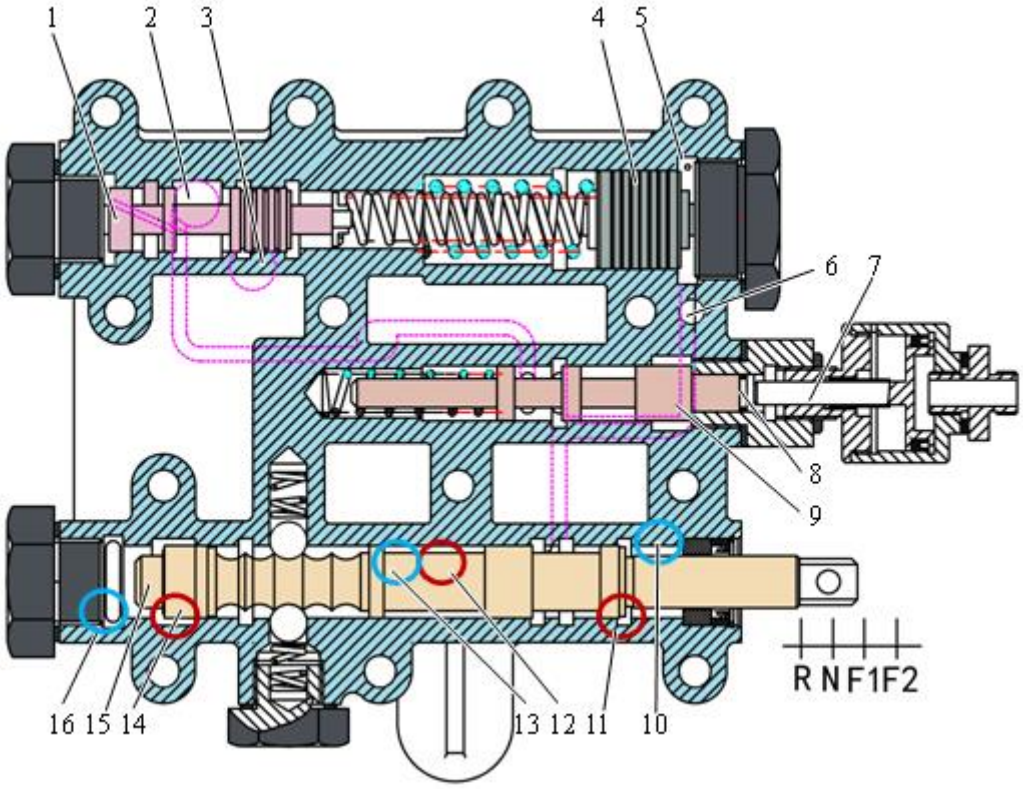


Fig. 2-25 Transmission Control Valve

1 Reducing valve stem 2 Oil inlet port of transmission control valve 3 Oil inlet port of torque converter 4 Servo piston 5 One-way valve 6 Main pressure tap 7 Air valve stem 8 Cylindrical plug 9 Cut-off valve stem 10 1st gear oil return port 11 1st gear oil inlet port 12 2nd gear oil inlet port 13 2nd gear oil return port 14 Reverse gear oil inlet port 15 Transmission control valve stem 16 Reverse gear oil return port

2. Oil Supply Route of Transmission Control Valve

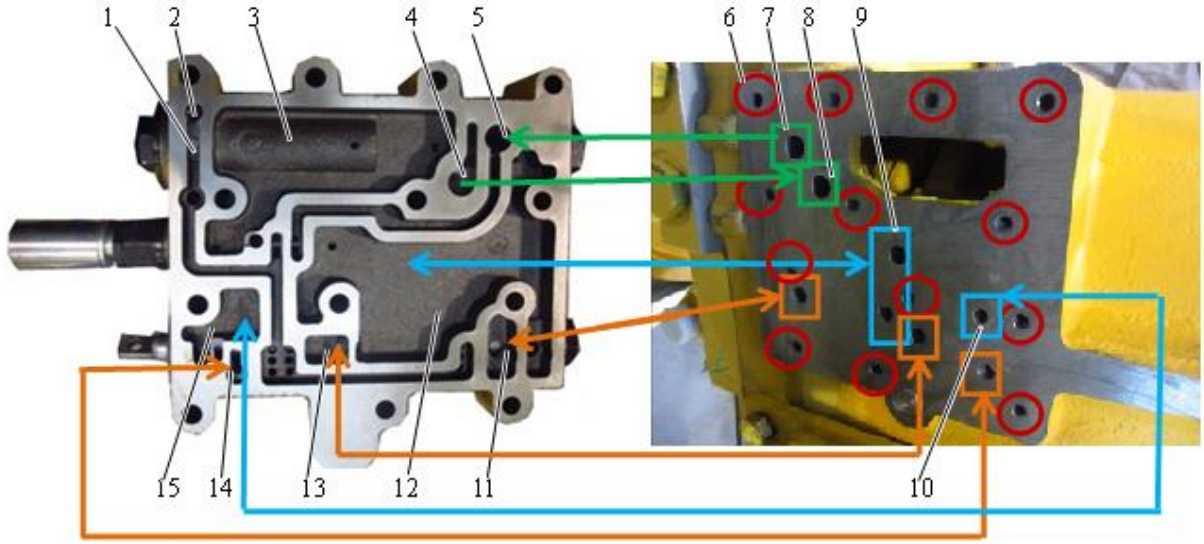


Fig. 2-26 Oil Supply Route of Transmission Control Valve

1 Orifice 2 One-way valve 3 Oil return chamber 4 Oil inlet port of torque converter 5 Oil inlet port of transmission control valve 6 Threaded hole (×13) 7 Oil inlet port of transmission control valve 8 Oil inlet port of torque converter 9 Reverse gear oil return hole, 2nd gear oil return hole 10 1st gear oil return hole 11 Reverse gear oil inlet chamber 12 Oil return chambers of reverse gear and 2nd gear 13 2nd gear oil inlet chamber 14 1st gear oil inlet port 15 1st gear oil return chamber

3. Working Principle of Transmission Control Valve

(1) Principle of transmission pressure adjustment

The oil supply pressure of the transmission is adjusted by the pressure regulating valve in the transmission control valve. The structure and working principle of the pressure regulating valve is illustrated in Fig. 2-27. According to the oil supply process of the torque converter-transmission, the press of the pressure adjusting spring 5 is in direct proportion to the gear pressure.

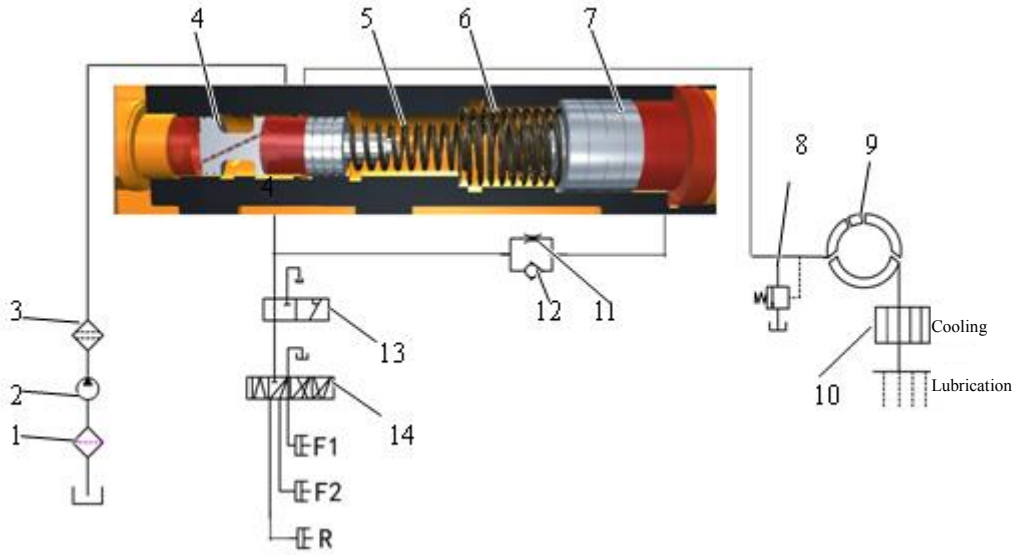


Fig. 2-27 Working Principle of Pressure Adjustment

1 Primary strainer 2 Transmission pump 3 Filter 4 Pressure regulating valve steam 5 Pressure adjusting spring 6 Spring (or fixing sleeve) 7 Servo piston 8 Oil outlet back pressure valve of torque converter 9 Torque converter 10 Radiator 11 Orifice 12 One-way valve 13 Cut-off valve stem 14 Gearshift valve stem

There are two types of pressure regulating valves: One type is a combination of single spring and fixing sleeve, and the other features double springs. In the former case, the fixing sleeve can be extended as appropriate when the gear pressure exceeds 1.5 MPa, and conversely shortened. In general, 1 mm increase in the length of fixing sleeve reduces the pressure by 0.16 MPa; while 1 mm reduction in the length increases the pressure by 0.16 MPa. For dual-spring pressure regulating valve, reference can be made to the above method for adjusting the gear pressure by changing the length of coarse spring.

During the gearshift, the previous gear clutch disengages and the next gear clutch engages. When the next gear clutch is connected with the oil pressure pipeline, the oil is added to the next gear oil cylinder first, the clutch oil pressure is reduced and the pressure oil in the servo oil chamber actuates the one-way valve (not through the orifice) to immediately discharge oil to the oil circuit of the next gear clutch, in such case, the servo piston again moves to the right limiting position under the spring force. The process in which the servo piston moves to the right is the process whereby the previous gear clutch disengages, and the moment at which the servo piston reaches the right limiting position is just the time when the oil circuit of the next gear clutch starts to be filled.

When the previous gear clutch disengages and the next gear clutch engages, resistance exists along the oil circuit from the servo oil chamber of the pressure regulating valve to the oil cylinders in all gears, which also manifests as oil pressure resistance at the servo oil chamber. Despite the provision of one-way valve, there's not enough time to drain out the oil from the servo oil chamber at the gearshift moment, making the servo piston unable to fully move back to the left limiting position, which degrades the valve's buffering the activation of next gear. To enable the servo piston to timely discharge the pressure oil at the gearshift moment under no back pressure, depress the brake pedal to fully release pressure from the clutch oil circuit by the automatic cut-off valve before gearshift. The servo piston is allowed to move to the right limiting position before gearshift, to ensure that next gear is smooth during the gearshift.

(2) Principle of cut-off valve

Since the clutches of all gears are connected to the oil circuit and the oil pan of the cut-off valve, so when the foot brake is applied, the compressed air drives the staring valve stem (Fig. 2-25) to the right, to cut off and prevent the oil source (from the oil duct of pressure regulating valve) entering the gearshift valve, so as to connect to the oil pan. At the end of the braking, the compressed air is exhausted and the return spring actuates the cut-off valve stem to return to cut off the oil source to the oil pan and to connect it to the gearshift valve. In such case, the clutch can be reengaged.

(3) Principle of gearshift valve

The gearshift valve is to control the oil charge and discharge of clutches of all gears, that is, to achieve gearshift by controlling the engagement or disengagement of clutches of all gears.

The gearshift valve stem has four positions (Fig. 2-25) including reverse gear, neutral gear, 1st gear and 2nd gear which are positioned by the steel ball. The clutch of a gear which the valve stem is in will be connected to the pressure oil pipeline and engaged, while other clutches are connected to the oil return circuit and disengaged.

When the valve stem is in neutral gear, the pressure oil into the gearshift valve is cut off and all clutches are disengaged, with oil discharged.

It has been found that a correct stem location is important, or else, disordered or incorrect gears will occur.

2.8.3 Filter

1. Filter Structure and Technical Parameters

The filter is composed of housing, bypass valve, filter core, etc.

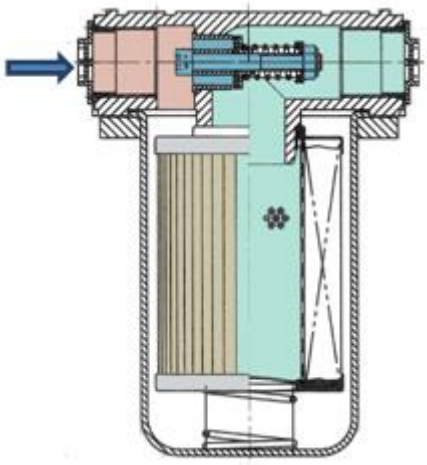


Fig. 2-28 Filter

Table 2-2

Item	Parameter/Index
Filter precision	20 um
Effective filtration area of filter core	≥0.3 m^2
Working pressure	1.6 MPa (oil of filter core flows from outside to the inside)
Bypass valve opening pressure	0.35±0.05 MPa
Rated flow	150 L/min
Initial resistance	≤0.04 MPa

2. Working Principle of Bypass Valve

The high pressure oil of transmission pump flows from the inlet into the cavity (as shown in Fig. 2-28) in the filter housing through the pipeline. The oil is filtered by the glass fiber filter core and then flows from the outlet to the working chamber of the torque converter and the transmission control valve through pipeline. After filtration, the pollutants in the oil are blocked out of the filter core; once the filter core surface is stained with many pollutants, the oil through the filter core will be greatly reduced and the system back pressure will be increased. To ensure no failure occurs due to the increased pressure, a bypass valve is furnished on the filter. When the back pressure exceeds the spring opening pressure, the piston moves to the right to make the front and rear chambers of the filter core directly connected to each other, and the unfiltered oil directly flows into the system. Although the system damage due to increased back pressure is avoided, yet this causes oil pollution of the system and does great harm to the hydraulic elements of the drive system. For this reason, the oil filter of torque converters shall be cleaned and inspected.

Proper functioning

Blocked filter core

Fig. 2-29 Working Principle of Bypass Valve

2.8.4 Requirements for Hydraulic Transmission Oil

The hydraulic transmission works with the liquid as the working medium for energy transfer. In the hydraulic transmission system, the pressure, temperature and flow of the working medium have large variation range. The hydraulic transmission oil provides the lubrication, extreme pressure anti-wear and cooling, and energy transfer. Therefore, it shall:

(1) Have appropriate viscosity and good viscosity-temperature characteristics. Under the premise of less leakage and good lubricating property, to improve the efficiency of hydraulic transmission, use working medium with low viscosity wherever possible. Moreover, the working medium shall have viscosity hardly changing with temperature, that is, good viscosity-temperature characteristics.

(2) Good chemical stability. During the use, the working medium shall not deteriorate, get thickened or exhibit noticeable change in the viscosity and the sedimentation. This requires the working medium to have high stability and antioxidant capacity.

(3) High flashing point and low condensation point. Higher flashing point provides less oil gas dissolved and higher safety. When the hydraulic torque converter is working, the oil temperature changes greatly, and the upper limit of allowable oil temperature at the outlet of elements of the hydraulic torque converter is generally 120℃, and transient temperature up to 130℃. Therefore, the working medium shall have flashing point not less than 160℃. Lower condensation point provides better flowing property at low temperature, so the condensation point shall not exceed -30℃~-40℃.

3 Disassembling and Assembling of Transmission

3.1 Key Points in Disassembling and Assembling of Transmission and Torque Converter Systems

3.1.1 Disassembling and Assembling Tools and Instruments

Table 3-1

Special Tool	Tool Name	Part Used	Remarks
	Transmission bracket	Support and turn-over the transmission	If unavailable, equip the disassembling/assembling bench
	Rack	1st gear, 2nd gear, reverse gear and overrunning clutch	If unavailable, equip the disassembling/assembling bench
	Hoisting tool	Overrunning clutch, 2nd gear, wheel shell, end cover, transmission piston hoisting	M10, M12, M14
	Oil seal seat of output shaft extractor	Oil seal seat of output shaft	Including the stud, pressure plate and jackscrew
	Torque converter impeller（transfer gear）extractor	Torque converter impeller（transfer gear）	Including the stud and pressure plate
	Output oil seal pressing sleeve	Output oil seal	Including the positioning sleeve and movable pressure sleeve
	Oil seal seat of output shaft pressing sleeve sleeve	Oil sealing seat of output shaft	
	Transmission pump bearing pressing sleeve sleeve	Transmission pump bearing	
	Steering pump bearing pressing sleeve	Steering pump bearing	
	Straight edge	Subassembling of torque converter and transmission pump	

	I-beam straight edge	Primary and secondary input gear and overrunning clutch	
	Feeler gauge	Parking brake	
	Depth gauge	Subassembling of torque converter, install the primary input gear assembly, friction lining, middle cover, transmission pump and end cover	Specification: 0.02/0 ～ 200
	Torque spanner	Tightening torque of key parts	
	Dial indicator	Jump of transmission pump driving shaft and assembling plane of pump	Specification: 0.01/0～3 0.01/0～5
	Magnetometer stand	Used together with dial indicator	

3.1.2 Important Torque in the Assembling of Transmission and Torque Converter

Table 3-2

No.	Position	Tightening Torque
1	The bolts and nuts connecting the input shaft and inner ring cam in the overrunning clutch	52±7 Nm
2	Connecting bolt between the direct gear connecting panel and 1st gear planetary carrier	130±15 Nm
3	Connecting bolt of transmission pump	52±7 Nm
4	Connecting bolt of middle cover	145±20Nm
5	Connecting bolt of transmission control valve	52±7Nm
6	Connecting bolt between the end cover and case	52±7Nm
7	Connecting bolt of transmission and torque converter	52±7Nm

3.1.3 Fitting Clearance at the Key Positions of Transmission and Torque Converter Assembly

Table 3-3

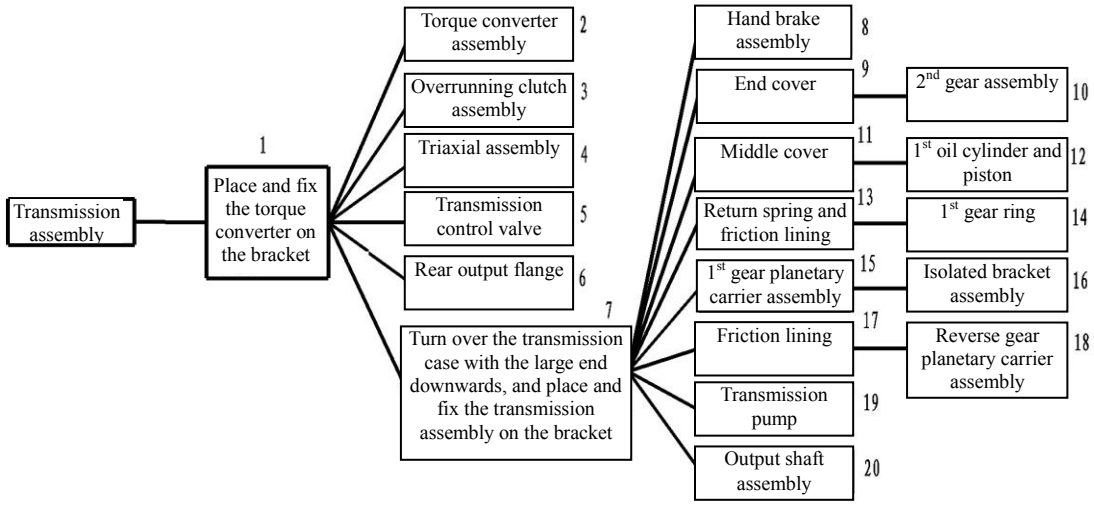
NO.	Position	Fitting Clearance	Adjusting Method	
			Too large clearance	Too small clearance
1	Clearance between the secondary input gear shaft end and the torque converter 2nd stage turbine retainer ring (in the stator seat hole)	0.2～0.5mm	Add the adjusting gasket	Replace the secondary input gear
2	Bearing axial clearance between the primary and secondary input gears of transmission	0.2～0.5 mm	Add the metal adjusting gasket	Replace the primary input gear
3	Perpenicularity of shaft gear assembly against the junction surface of transmission pump	Less than 0.08mm	Knock the torque converter housing and adjust it to the requirements	
4	Clearance between the reverse gear friction lining and isolated bracket	0.9～2.8 mm	Select the isolated bracket, friction lining	Select the isolated bracket, friction lining
5	Clearance between the 1st gear friction lining and 1st gear oil cylinder piston	1.4～2.8 mm	Select the 1st gear oil cylinder assembly or friction lining	Select the 1st gear oil cylinder assembly or friction lining
6	Clearance between the 1st gear oil cylinder assembly and middle cover	-0.05～0.1 mm	Select middle cover, oil cylinder and isolated bracket	Select middle cover, oil cylinder and isolated bracket
7	Fitting clearance between the end cover bearing hole and upper bearing of 2nd gear	0.35～0.55 mm	Add the metal adjusting gasket	Select the end cover or 2nd gear assembly

3.1.4 List of Tolerances of Key Parts for Failure Judgment

Table 3-4

Type of Part	Inspection Item	Criteria		Solution to Out-of-tolerance
		Size (Tolerance)	Allowable Limit	
Direct gear driven plate	Thickness	3±0.05	Micrometer(0-25)	Replace it
Direct gear driving plate	Thickness	3.85±0.05	Micrometer(0-25)	Replace it
Reverse gear 1st gear driven plate	Thickness	3±0.05	Micrometer(0-25)	Replace it
Reverse gear 1st gear driving plate	Thickness	3.85±0.05	Micrometer(0-25)	Replace it
	Bar spacing	232.777 ～ 232.975	Vernier caliper(0-300)	
	Length bar		φ7.22	
Direct gear piston	Thickness	$36^{0}_{-0.20}$	Vernier caliper(0-150)	Replace it
	Fitting internal diameter	$\varphi 70(^{+0.174}_{+0.100})$	Vernier caliper(0-150)	
	Fitting external diameter	$\varphi 248(^{-0.20}_{-0.32})$	Vernier caliper(0-300)	
	Fitting diameter with pin	φ11±0.1	Dial indicator(10-18)	
Reverse gear piston	Thickness	24.8±0.1	Vernier caliper(0-300)	Replace it
	Fitting internal diameter	$\varphi 170(^{+.0.208}_{+0.145})$	Vernier caliper(0-300)	
	Fitting external diameter	$\varphi 342^{-0.08}_{-0.18}$	Vernier caliper(0-500)	
1st gear piston	Thickness	30.2±0.1	Vernier caliper(0-300)	Replace it
	Fitting internal diameter	$\varphi 235(^{+0242}_{+0.170})$	Vernier caliper(0-300)	
	Fitting external diameter	$\varphi 342^{-0.2}_{-0.3}$	Vernier caliper(0-500)	

3.2 Transmission Disassembling Process



★**Disassembling preparation:**

(1)Sufficiently clean the soil and dirt on the transmission and torque converter assembly.

(2)Take off the oil-drain plug and discharge the transmission oil.

Hydraulic transmission oil: about 44 L

(3) Prepare the firm transmission and assembling jig.

kg **Transmission and torque converter assembly: about 640Kg**

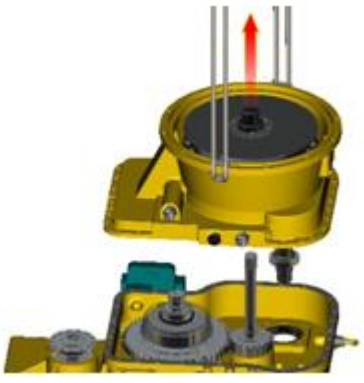


Fig.3-1

1. Hoist and disassemble the torque converter assembly.

★**Notice:**

First separate the torque converter and transmission with jackscrew, and then hoist the torque converter assembly from the transmission, and place the torque converter assembly on the workbench.

Jackscrew: M10

Fig.3-2

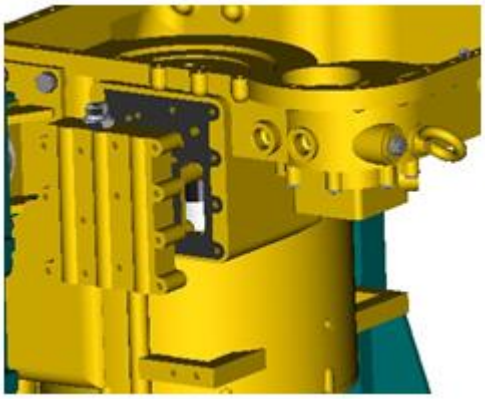


Fig.3-3

Fig.3-4

Fig.3-5

Fig.3-6

2. Screw down 2 jackscrews of specification into the corresponding thread hole in the overrunning clutch to push the case, and then hoist it; remove the triaxial assembly from the case.

Jackscrew: M14

3. Loosen the connecting bolt for fixing the transmission control valve, remove the transmission control valve and take off the packing.

★**Notice:**

Place the transmission control valve at the clean place, and cover the oil duct surface to prevent the dust and

debris into the valve body.

4. Use the corresponding specification tool to loosen the bolt, take off the thrust gasket, rear output flange, and use the special tool to remove the oil seal seat assembly.

5. Remove the parking brake assembly, and take off the front flange.

6. Use the corresponding specification tool to loosen the end cover bolt, push the end cover from the case with 2 jackscrews, take off the packing; remove the rotary seal; lift off the

direct gear assembly.

Jackscrew：M10

Fig.3-7

7. Push and take off the middle cover with jackscrew.

Jackscrew：M10

★ **Notice:**

When removing the middle cover, to prevent the injury caused by the ejected middle cover due to the too much elastic force, fix 2 M14×50 bolts at two holes of middle cover. When loosening the connecting bolt, screw off 2 bolts at opposite angles by about 15 mm, and after removing remaining 6 bolts, and then slowly loosen the remaining 2 bolts at opposite angles, and lift the middle cover.

Fig.3-8

8. As shown in Fig.3-8, remove the 1st gear cylinder, take out of the piston, inner and outer seal rings; return spring and spring guide pin, friction lining and 1st gear ring gear, and separate the friction lining.
9. Take out of the 1st gear planetary carrier assembly and isolated bracket assembly.

Fig.3-9

10. Take out of the friction lining, the reverse gear planetary carrier assembly and reverse gear piston.

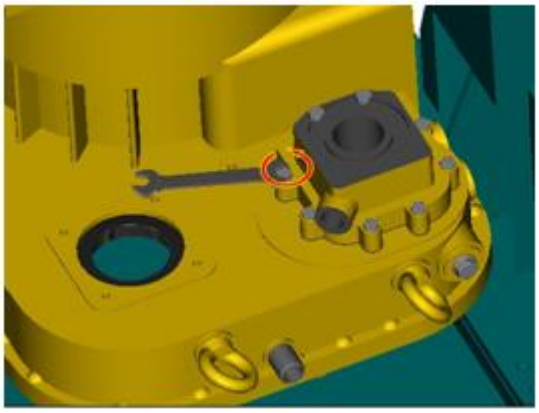


Fig.3-10

11. Loosen the connecting bolt for fixing the transmission pump, remove the transmission pump and take off the packing.

Fig.3-11

12. Remove the output shaft, and take out of the output shaft gear.

3.3 Disassembling Process of Assembly Parts

Disassembling of 1st Gear Assembly

Fig.3-12

1. Place the 1st gear assembly on the rack, remove the fixing bolt of direct gear connecting panel, take off the direct gear connecting panel; take off the lock plate.

Fig.3-13

2. Pry out the retainer ring in the inner ring gear of reverse gear with screwdriver.

Notice:

During the operation, do not exert too much force to prevent the retainer ring popup causing the safety accidents.

3. Separate the inner gear ring and planetary carrier, and take off the inner ring gear.
4. Slightly knock out the 1st gear planetary shaft; take off the planetary gear and gasket.

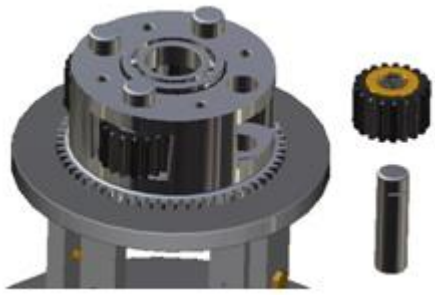


Fig.3-14

Fig.3-15

5. Take out of the needle in the retainer ring and planetary gear.

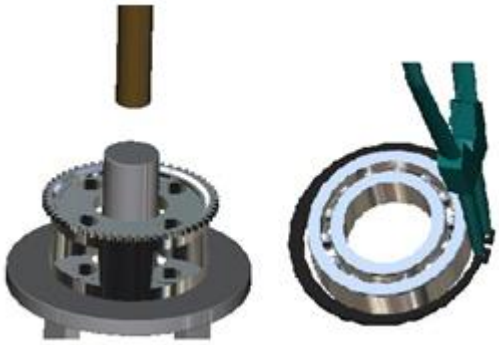


Fig.3-16

6. Slightly knock out the bearing with copper bar.
7. Take off the retainer ring on the bearing with the shaft retainer ring pliers.

Notice:

Clamp the retainer pliers firmly to prevent it from poping out when leaving the case, resulting in the safety accidents.

Disassembling of 2nd Gear Assembly

1. Remove the connecting bolt, take off the direct gear pressure plate, and remove 3 friction linings together.

Fig.3-17

Notice:

Currently, A307A, BX50-02 and BX50-03 are of this structure: structures of A301, A303 and

A305：3 friction linings are fixed on the direct gear shaft through bolts and the detailed description is no longer necessary.

2. Take out of the direct gear shaft.

★Notice:

Currently, A307A, BX50-02 and BX50-03 are of this structure;

Fig.3-18

Fig.3-19

Structures of A301, A303 and A305: 3 friction linings are fixed on the direct gear shaft through bolts, and the disassembling process is as follow:

3. Take off the direct gear shaft and 3 friction linings.

Fig.3-20

4. Remove the retainer ring and belleville spring with the shaft retainer ring pliers.

⚠Notice:

Clamp the retainer pliers tightly to prevent it from poping out when leaving the case, resulting in the safety accidents.

5. Take out of the direct gear piston and the upper seal ring and rotary oil seal and remove the intermediate output gear.

Fig.3-21

Fig.3-22

Fig.3-23

Fig.3-24

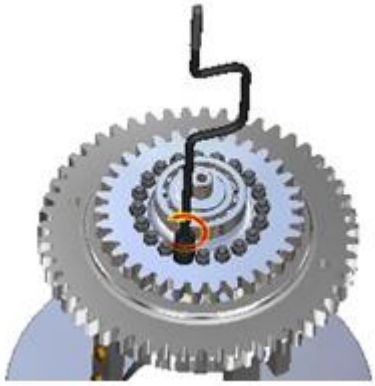


Fig.3-25

Disassembling of Reverse Gear Assembly

1. Place the reverse gear assembly on the rack, remove the bolt and reverse gear planetary shaft stop washer; slightly knock out the reverse gear planetary shaft.

2. Take off the planetary gear and gasket, remove the needle in the retainer ring and planetary gear.

3. Slightly knock out the bearing.

Disassembling of Overrunning Clutch

1. Place the overrunning clutch on the rack, remove the connecting nut of intermediate input shaft and inner ring cam.

Fig.3-26

2. Knock out the intermediate input shaft, and take off the bearing and washer.

Fig.3-27

3. Tighten the bolt with rubber band, take out the retainer ring, inner ring cam, 20 pin rollers and bolts, and take off 40 sets of return springs and pins.

★**Notice:**

The structures of some models are different with the figure, and adjust the working contents during the disassembling according to the actual structure.

Fig.3-28

4. Take off the retainer ring and rubber band, 20 bolts and a baffle plate.

★**Notice:**

The structures of some models are different with the figure, and adjust the working contents during the disassembling according to the actual structure.

Fig.3-29

5. Take out of the retainer ring, knock out the bearing in the outer ring gear with the copper bar.

Fig.3-30

Disassembling of Torque Converter

1. Place the torque converter on the workbench with the big head downwards, remove the shaft gear and steering pump driving shaft; remove the secondary input gear assembly and remove the rotary oil seal.

Fig.3-31

2. Remove the pressure regulating valve of oil inlet port and the back pressure valve of oil outlet port.
3. Loosen the bolts and washers for fixing the stator seat, and remove the stator seat rotary oil seal.

Fig.3-32

4. Place the junction surface between the torque converter and transmission on the workbench, and loosen the bolt fixing the elastic plate.
5. Take off the round nail plate and elastic plate.

Fig.3-33

6. Take off the observation window and gasket.
7. Loosen the wheel shell and connecting bolt of impeller.

Fig.3-34

8. Take off the wheel shell and 1st and 2nd stage turbine assemblies.

★**Notice:**

Do not knock it with metal bar.

9. Remove the elastic retainer ring of stator seat and remove the stator.

★**Notice:**

Shantui torque converter **YJSW315-2A/2D/6C/6G/8A/8B/8C are all of this structure.**

SDLG YJSW315-8A and Dexin YJSW315-8A/6C stator are fixed on the stator seat through the bolts with the disassembling process as follows:

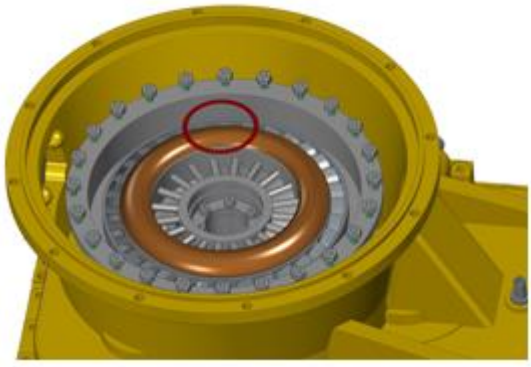


Fig.3-35

10. Take out of the adjusting gasket and remove the bolt for fixing the stator, take off the bolt and washer. Take out of the stator pressure plate and stator.

Fig.3-36

11. Loosen the connecting bolt between the impeller and transfer gear. To take off the impeller, first knock the locking gasket, and then loosen the bolt to separate the impeller and transfer gear, and remove the impeller and bearing together with the pressure plate tool.

Fig.3-37

Fig.3-38

Fig.3-39

Fig.3-40

Fig.3-41

12. Take off the transfer gear, and check the inner hole of transfer gear for wear.
13. Knock out the stator seat with tool and take out of the stator seat, and check the seal ring on the stator seat for damage and wear.
14. Knock out the spring pin of connecting 1st stage turbine and 1st stage turbine housing to separate the 1st stage turbine and 1st stage turbine housing.
15. Knock out the 2nd stage turbine and bearing from the 1st stage turbine housing, and check the bearing seat and bearing for damage.
16. Take out of the 2nd stage turbine.
17. Remove the retainer ring in the inner hole of 2nd stage turbine.

Disassembling of Transmission Pump

1. Remove the fastening bolt of transmission pump cover, take off the pump cover; remove the main gear.
2. Take out of the pinion.
3. Remove the retainer ring and framework oil seal.

Fig.3-42

Disassembling of Transmission Control Valve

1. Remove the plug, O-ring and the slide block, and take out of the spring.

Fig.3-43

2. Take off the sleeve and spring seat; remove the plug and O-ring on the other side.

Fig.3-44

3. Take off the reducing valve stem.
4. Remove the brake cut-off valve block and gas valve body.

Fig.3-45

5. Remove the power cut-off valve stem and return spring.
6. Remove the plug, O-ring, spring and steel ball.

Fig.3-46

7. Remove the plug, O-ring and remove the transmission control valve stem.

Fig.3-47

8. Take out of the steel ball and spring.
9. Remove the retainer ring and take off the framework oil seal.

3.4 Assembling Process of Assembly Parts

Assembling of Torque Converter

Fig.3-48

1. Clean the parts of torque converter and dry it with compressed air.
2. Add the lubricating oil at the 2nd stage turbine bearing seat, drive the bearing into the 2nd stage turbine with tool, check the turbine rotation and install the retainer ring.

Fig.3-49

3. As shown in Fig.3-49, add the lubricating oil at the bearing hole of 1st stage turbine housing, install the 2nd stage turbine into the 1st stage turbine housing, stir the turbine to check if it is rotating freely.
4. After aligning the 1st stage turbine pin hole with the turbine housing pin hole, install the 1st stage turbine into the 1st stage turbine housing.

Fig.3-50

5. Install 9 connecting spring pins from inside out with the copper bar.
6. After cleaning the torque converter housing, place the larger plane on the workbench. Install the sealing ring on the stator seat.

★ **Notice:**

Check the quality of seal ring, and check the oil seal slot on the stator seat for burr.

Fig.3-51

7. After aligning the oil inlet and oil outlet ports of stator seat with those of torque converter housing, and install the stator seat into the housing.
8. Install the bolt and washer.

Nm 45～59 Nm

★**Notice:**

Tighten it on the principle of symmetrical crossing.

Fig.3-52

9. Install the rotary seal into the stator seat.

★**Notice:**

Put the lip of rotary seal downwards.

Fig.3-53

10. First install the oil outlet valve on the seat board and install the spring seat. Install the oil outlet valve components on the torque converter housing, and fix it with bolts and washers.

★**Notice:**

Check the quality of oil outlet valve spring.

Fig.3-54

11. Install the oil inlet valve components on the torque converter housing and fix it with bolts.

★**Notice:**

Check the quality of oil inlet valve spring.

12. Turn over the torque converter housing for 180°, and protect the oil inlet and oil outlet

valves and the junction surface of torque converter.

Fig.3-55

13. Install the rotary seal ring into the transfer gear, check the quality of sealing ring spring and coat it with the lubricating grease.
14. Install the spring into the seal ring and install the stop pin into the seal ring.

★ **Notice:**

Check the quality of spring.

Fig.3-56

15. Install the seal ring into the stator seat.

Fig.3-57

16. Slightly knock the transfer gear into the stator seat and check if the transfer gear rotates freely.
17. Add the lubricating oil at the stator bearing seat and transfer gear.

Fig.3-58

18. Knock the bearing into the transfer gear.
19. Knock the bearing into the transfer gear and stator seat.

Fig.3-59

20. Coat the transfer gear end face with the sealant.

Fig.3-60

Fig.3-61

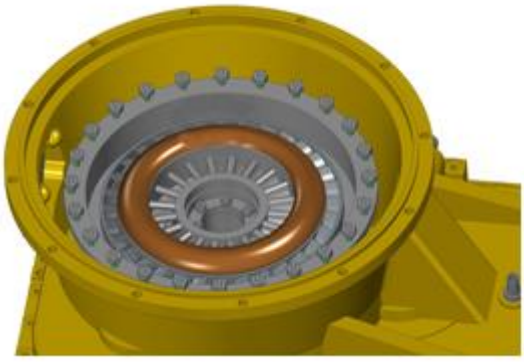


Fig.3-62

21. Place the gasket into the impeller, install the impeller into the transfer gear and tighten it with bolts.

Nm 22～30 Nm

★**Notice:**

Tighten it on the principle of symmetrical crossing.

22. Repair the burrs on the outer spline of stator seat and the inner spline of stator, and install the stator into the stator seat.

★**Notice:**

Shantui torque converter YJSW315-2A/2D/6C/6G/8A/8B/8C are all of this structure.

SDLG YJSW315-8A and DexinYJSW315-8A/6C torque converter stators are fixed on the stator seat through the bolts with the assembling process as follows：

23. Place the stator and pressure plate, and align them with the bolt hole. Install the bolt and washer, and coat them with the sealant 2271.

Nm 25 Nm

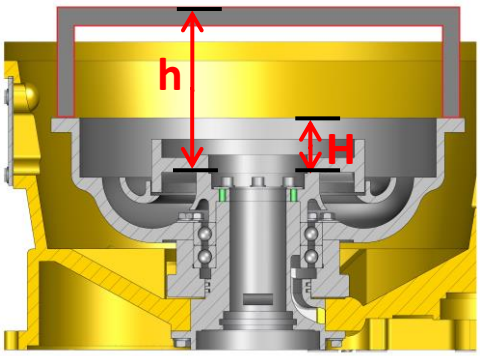


Fig.3-63

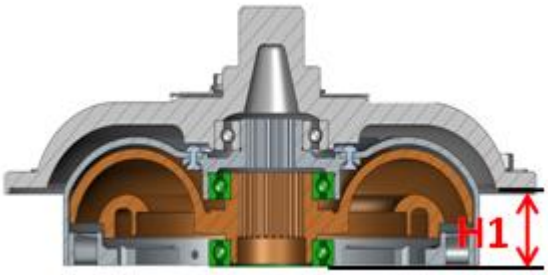


Fig.3-64

Fig.3-65

Fig.3-66

24. Stably place the special I-beam straight edge on the impeller end face, and measure the distance h between the upper surface of I-beam straight edge and the mounting hole of stator bearing with the digital micrometer. Calculate the value of H, H=h-100, and record the H value on the end face of impeller with the Mark pen.
25. Based on the H value, select the turbine set and cover assembly with the suitable H1 （distance between the outer ring of 6013 bearing and the junction surface of wheel cover and impeller）.

★**Notice:**

H1 is provided by the supplier of turbine assembly.

26. Select the adjusting gasket to ensure the axial play of 6013 bearing at +0.3 ~ +0.5 mm.
27. Install the large O-ring in the oil seal slot of stator. Install the 1st stage and 2nd stage turbine assemblies into the wheel shell.
28. Hoist the assembled assembly into the torque converter housing.
29. Install the connecting bolt and washer of wheel shell and impeller with the upper and window clearance of housing, and tighten it

on the principle of symmetrical crossing.

Nm 22～30 Nm

Fig.3-67

30. Fix the elastic plate and circular backup plate on the wheel shell with the bolts and washers, and tighten it n the principle of symmetrical crossing.

Nm 78～104 Nm

31. Install the observation window backup plate.

Assembling of Transmission Pump

Fig.3-68

1. Clean all the parts for installation preparation.

Fig.3-69

2. Coat the pinion with a little lubricating grease, and assemble the pinion needle bearing and washer.

Fig.3-70

3. Place the bump body and framework oil seal levelly, and coat the pump body with a little hydraulic oil.

Fig.3-71

4. Install the retainer ring.

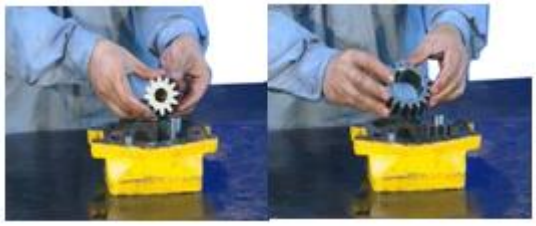


Fig.3-72

5. Turn over the pump body and install the pinion.
6. Install the main gear.

Fig.3-73

7. Coat the pump cover with a proper amount of sealant, and install the pump cover by aligning to the dowel pin hole.

Fig.3-74

8. Tighten the fixing bolt.

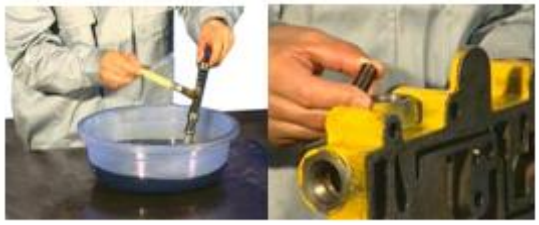


Fig.3-75

Assembling of Transmission Control Valve

1. Clean the parts of transmission control valve for installation preparation.
2. Install the spring and steel ball with the transmission control valve raising and the positioning hole of valve stem upwards.

Fig.3-76

3. Install the sliding sleeve and transmission control valve stem.
4. Install the steel ball, spring, O-ring and tighten the plug.

Fig.3-77

5. Install and tighten the plug and O-ring.
6. Install the framework oil seal and retainer ring.

★ **Notice:**

Pull the transmission control valve stem to

check if it moves freely and is positioned accurately.

Fig.3-78

7. Install the spring and cut-off valve stem.

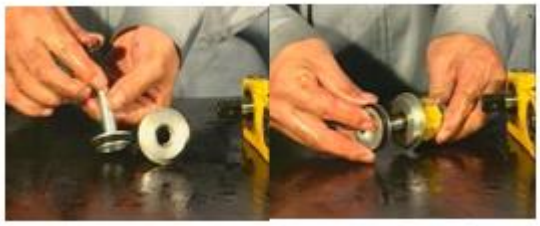


Fig.3-79

8. Install the seal ring and spring on the valve stem, and then install them together on the gas valve seat.

Fig.3-80

9. Install the gas valve body on the seat, clamp it with vice and then tighten it.
10. Install the O-ring on the gas valve body.

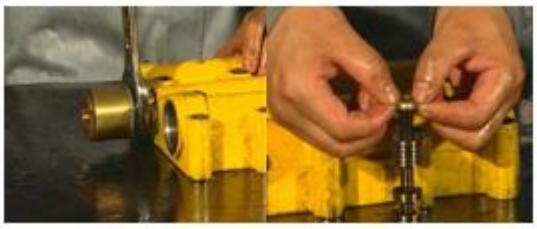


Fig.3-81

11. Install the gas valve body.
12. Install the spring seat on the reducing valve stem.

Fig.3-82

13. Install the reducing valve stem.
14. Install the plug and O-ring seal ring.

Fig.3-83

15. Install the spring and sleeve.

Fig.3-84

16. Install the valve block.
17. Install and tighten the plug and O-ring.
18. Install the one-way valve seat, spring and steel ball.

Fig.3-85

Assembling of 1st Gear Assembly

1. Place the retainer ring into one end in the planetary gear hole and level it.
2. Paste and align the needle with lubricating grease on the internal wall of planetary gear. Install the retainer ring into the needle assembled in place and hammer it down.

★ **Notice:**

Place the needle in a clean plastic box, coat it with lubricating grease, and stick each needle with lubricating grease, and cover the box with the clean plastic cloth to prevent the needle with lubricating grease from being contaminated.

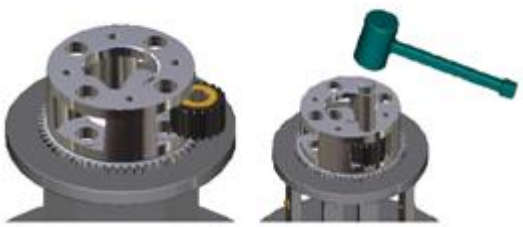


Fig.3-86

3. Place a gasket at each end of planetary gear component, and then put them together into the seat hole of 1st gear planetary carrier. The hole of planetary gear component is aligned with the hole of 1st gear planetary

carrier.

4. Install the 1st gear planetary shaft into the planetary gear, and align the center of 1st gear planetary shaft slot with the excircle tangent line of 1st gear planetary carrier.

Fig.3-87

5. Install the lock plate with the notch aligning with the 1st gear planetary shaft slot, adjust the lock plate and align 4 threaded holes. Adjust the mounting height of 1st gear planetary shaft to make the lock plate flush with the end face of 1st gear planetary carrier; install the retainer ring into the rolling bearing slot.

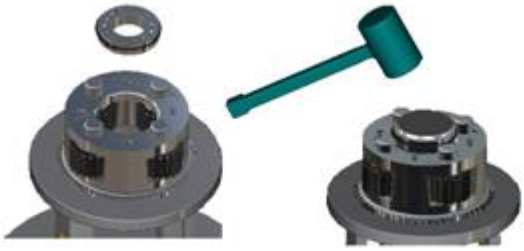


Fig.3-88

6. As shown in Fig.3-88, place the bearing into the 1st gear planetary carrier with the end for installing the retainer ring upwards; place the special tool into the inner ring of bearing with the small end downwards, and install the bearing into the 1st gear planetary carrier with hammer.

★**Notice:**

The bearing end face close to the retainer ring shall keep upwards.

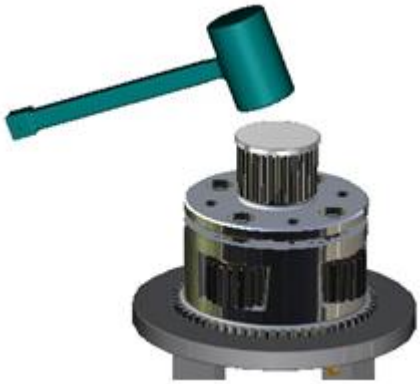


Fig.3-89

7. Install the direct gear connecting panel to 1st gear planetary carrier with 4 holes aligning with the 4 1st gear planetary shafts; install the direct gear connecting panel in place with special tool (same with installation of bearing special tool).

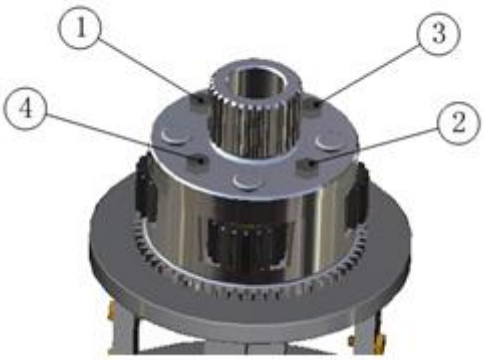


Fig.3-90

8. Coat the 1st gear planetary carrier threaded hole with 262 thread locking sealant, install the bolts into 4 threaded holes of connecting panel and then manually tighten 2 ~ 3 pitches as well as the bolts at diagonal lines.

★ **Notice:**

Evenly coat 5 ~ 6 threads of the threaded hole with 262 thread locking sealant for 1/3 circle along the circumference from the second thread, and then install the bolts.

Nm 130±15 Nm

Fig.3-91

9. Place the assembled 1st gear rack into the inner ring gear of reverse gear, and insert the teeth of 1st gear planetary carrier into the socket of inner ring gear of reverse gear; and place one end of retainer ring into the socket of inner ring gear of reverse gear, and slightly knock another end of retainer ring with special tool, install the retainer ring into the inner ring gear of reverse gear, and lock the 1st gear planetary carrier component.

Fig.3-92

Assembling of 2nd Gear Assembly

1. Place the direct gear oil cylinder on the intermediate output gear and align 12 holes on the direct gear oil cylinder with 12 threaded holes of intermediate output gear.
2. Align the assembled direct gear piston with 3 dowel pins on the direct gear oil cylinder, and install it into the direct gear oil cylinder.

★**Notice:**

The opening of rotary oil seal shall face the oil side.

Fig.3-93

3. Install the retainer ring in the intermediate shaft slot of direct gear oil cylinder and lock the belleville spring.

Fig.3-94

4. Install the direct gear shaft of assembled bearing into the bearing hole of direct gear oil cylinder.
5. Place them into the driving and driven friction linings of direct gear.

★**Notice:**

Currently, A307A, BX50-02 and BX50-03 are of this structure;

The structure of A301, A303 and A305：3 friction linings are fixed on the direct gear

shaft with bolts with assembling process as follows:

Fig.3-95

6. Install the rolling bearing on the direct gear shaft by means of press fitting-up.
7. Arrange 12 bolts on the special tooling.

Fig.3-96

8. Cover the direct gear driving friction lining on 12 M8 bolts.
9. Place the direct gear driven friction lining on the direct gear driving friction lining.

Fig.3-97

10. Get the direct gear shaft component with bearing through 12 bolts and place it on the direct gear driving friction lining.
11. Get the direct gear driving friction lining through 12 bolts and place it on the end face of direct gear shaft.
12. Slip 12 washers on 12 bolts.
13. Evenly coat 12 bolts with 262 thread locking sealant for 3 ~ 5 threads from the last 2nd or 3rd thread along the circumference.

Fig.3-98

Fig.3-99

14. Respectively install 12 nuts on 12 bolts, and manually screw it down for more than 2 ~ 3 pitches.
15. Pretighten the nuts on the principle of symmetrical crossing. Tighten the M8 nut,

Fig.3-100

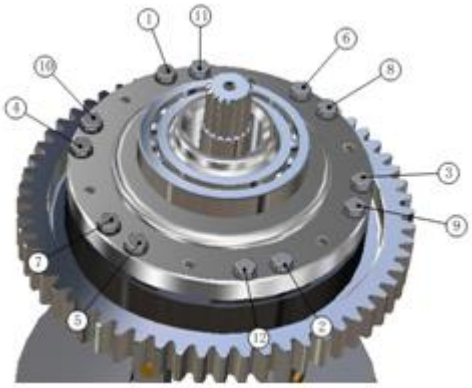


Fig.3-101

Fig.3-102

and rotate the torque spanner for at least 30° to reach the specified tightening torque.

Nm 26±4 Nm

16. Install the direct gear pressure plate assembly on the direct gear oil cylinder and fit 12 washers on 12 bolts, and coat it with the thread locking sealant and then install it into the hole of direct gear pressure plate, and manually screw it down for more than 2 ~ 3 pitches.
17. Coat the pressure plate journal with the proper amount of 6# hydraulic transmission oil, install the rolling bearing on the shaft end of direct gear pressure plate, and install it in place with special pressing sleeve.
18. Tighten 12 bolts on the principle of symmetrical crossing.

Nm 90±10 Nm

19. Turn over the direct gear assembly for 180° on the workbench bracket, coat the direct gear oil cylinder journal with proper amount of 6# hydraulic transmission oil, install the roller bearing on the shaft end of direct gear oil cylinder and install it in place with the special pressing sleeve.

★ **Notice:**

The assembling shall ensure that the lower end face of bearing is fitted with the shaft shoulder of direct gear oil cylinder.

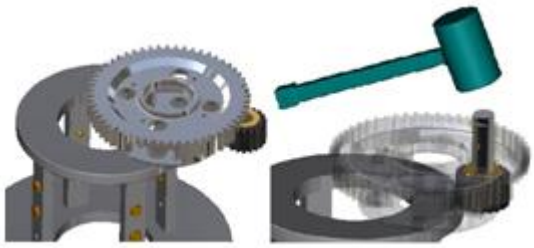


Fig.3-103

Assembling of Reverse Gear Assembly

1. Place the reverse gear planet carrier with the large end face upwards, put a gasket on the upper and lower surfaces each of planetary gear component, and then place it into the reverse gear planetary carrier; adjust it and align it with the axle hole with guide bar.
2. Install the reverse gear planetary shaft into the shaft hole of reverse gear carrier, and slightly knock the reverse gear planetary shaft in place with the dead-blow hammer.

★**Notice:**

The pressing shall ensure that the notch at the shaft end is flush with the shaft hole end face and the slot center at the shaft end is aligned with the threaded hole center: reverse gear planetary shaft shall be free of the traces left by hard objects.

Fig.3-104

3. Place the stop washer into the slot of reverse gear planetary shaft aligned with the threaded hole, and fit the washer on the bolt, and install them all into the threaded hole.

★**Notice:**

Screw it down for more than 2 ~ 3 pitches.

4. Install the roller bearing into the bearing hole of reverse gear planetary carrier and install the special tool in place by means of press fitting-up.

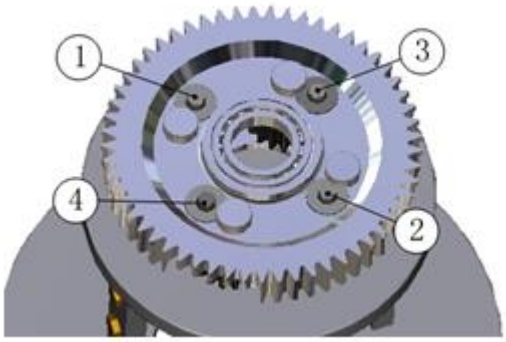


Fig.3-105

Fig.3-106

5. Tighten 4 bolts at diagonal line.

Nm 26±4 Nm

★**Notice:**

Manually rotate the 4 planetary gears, Requirement：It shall rotate freely without the stagnation.

Assembling of Overrunning Clutch Assembly

1. Place the inner ring cam on the workbench, install the baffle plate on the inner ring cam, align it with screw hole, get 20 bolts through the screw hole, raise the inner ring cam, and band the bolts with rubber band; install the spring into the pin, and then insert the exposed end of spring into the inner ring cam φ4.5 hole.

★**Notice:**

Adjust the bolt head to ensure the completely fitting between the inner end face and baffle plate.

Manually squeeze the pin, check and ensure that the pin comes and goes freely, deterimine if the length of spring is as required by the extended length of pin.

Fig.3-107

Fig.3-108

Fig.3-109

2. Place the intermediate input shaft on the workbench vertically, and install the bearing in place with the special pressing sleeve.

★**Notice:**

Ensure that the lower end face of bearing is flush with the step surface of intermediate input shaft.

3. Place the outer ring gear on the workbench levelly with the notch end upwards, and place the slot of outer ring gear of retainer ring with the hole retainer pilers for hole.

★**Notice:**

Coat the internal wall of outer ring gear evenly with 6# hydraulic transmission oil.

4. Place the inner ring cam components into the outer ring gear and install 20 rollers.
5. Install the retainer ring into the inner ring cam with the flat end downwards, and take off the rubber band.
6. Install the intermediate input shaft components into the outer ring gear, and adjust the screw hole to be flush with bolt head, and install the intermediate input shaft components in place with the special pressing sleeve and dead-blow hammer.

★**Notice:**

Ensure the fitting between the intermediate input shaft and upper end face of inner ring cam.

Fig.3-110

7. Install the washer and nut, manually screw down the nuts for 2 ~ 3 pitches. There are 20 sets of bolts and gaskets.
8. As shown in Fig.3-110, raise the outer ring gear, and pretighten the bolts on the principle of symmetrical crossing. Two persons cooperate to rotate the intermediate input shaft, adjust the bolt head to be fitted with baffle plate through the process hole on the side of outer ring gear, and then tighten the bolts with pneumatic spanner.

Nm 52±7 Nm

★**Notice:**

Tighten the nuts on the principle of symmetrical crossing with the Click spanner.

Fig.3-111

9. Coat the intermediate input shaft journal with proper amount of 6# hydraulic transmission oil with hairbrush, and install the bearing in place with the special pressing sleeve.

Fig.3-112

10. Turn over the outer ring gear for 180°, and then place it on the workbench and install the isolation sleeve.

★**Notice:**

The end of isolation sleeve with R5 arc shall keep downwards and fitted with the bearing 6010E inner ring end face.

Fig.3-113

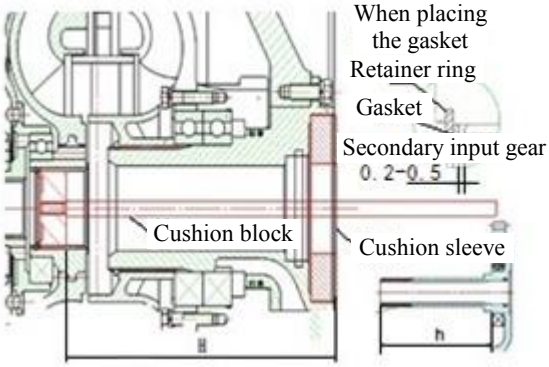


Fig.3-114

11. Install the bearing in place with the special pressing sleeve; install the spacer ring, and install another bearing in place.

Subassembling of Torque Converter

1. Measure the height h between the end face of secondary input gear assembly bearing and the end face of spline shaft; place the cushion block into the hole of torque converter to be fitted with the 2nd stage turbine retainer ring, place the cushion cover into the bearing socket of stator seat, and measure the height difference H between the cushion cover and the upper surface of block.

★**Notice:**

H：Height difference between the cushion sleeve and the upper surface of block

h：Height between the end face of secondary input gear bearing and end face of spline shaft

Calculate the clearance t=H-h, select the adjusting gasket with the combination thickness of t1, t-t1 shall be within 0.2～0.5 mm.

The clearance control only aims at the torque converter of the 2nd stage turbine with the retainer ring （ Shantui torque converter YJSW315-2A/2D/6C/6G/8A/8B/8C）, and the torque converter of other structures （SDLG YJSW315-8A, Dexin YJSW315-8A/6C） shall

not be measured.

Fig.3-115

2. Install the rotary oil seal into the hole slot of stator seat.

★**Notice:**

The notch of rotary oil seal shall face downwards.

3. Install the shaft gear assembly on the torque converter; and install the steering pump driving shaft gear assembly on the torque converter.

★**Notice:**

The assembling shall ensure the free rotation of steering pump driving shaft gear.

Fig.3-116

4. Install the secondary input gear assembly on the torque converter.

★**Notice:**

The assembling shall ensure the free rotation of secondary input gear.

5. Install the rotary oil seal on the midde hole slot of secondary input gear.

★**Notice:**

The notch of rotary oil seal shall face downwards.

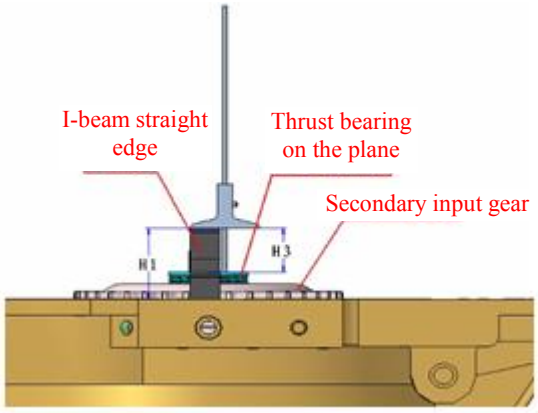


Fig.3-117

6. Install the roller bearing into the bearing socket of secondary input gear, place the I-beam straight edge on the large plane on the torque converter housing, measure the distance H3 between the upper surface of I-beam straight edge and the upper surface of thrust bearing, calculate h1=H3-50, and record the value into the upper surface of secondary input gear.

★ **Notice:**

Measure the H3 at both sides and take mean value, with the difference between the Max. value and Min.value is less than 0.4 mm, if the out-of-tolerance is 0.4 mm, re-adjust it untill it meets the requirements.

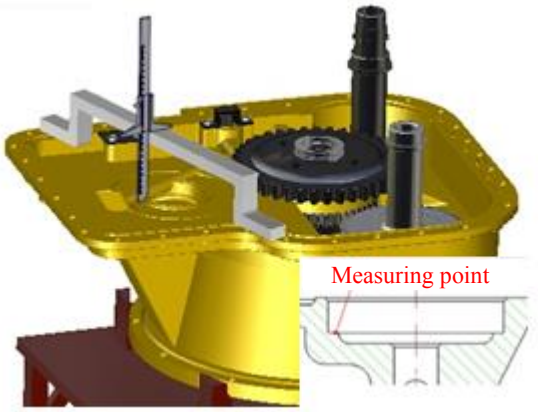


Fig.3-118

7. Place the I-beam straight edge on the large end face of torque converter, measure the distance D2 between the upper end face of I-beam straight edge and the step surface of bearing socket, calculate d2=D2-130, and record the d2 value on the side of torque converter housing.

★ **Notice:**

Measure D2 at least 2 points at 180° direction and take the mean value.

3.5 Transmission Assembly Process

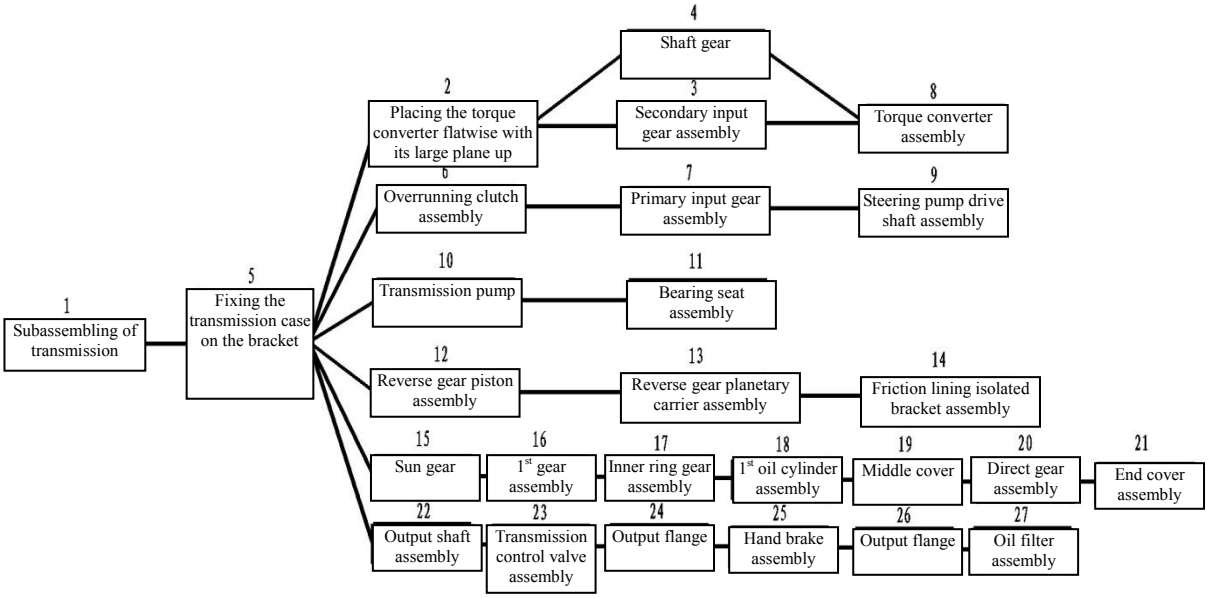


Fig. 3-119

Fig. 3-120

Assembling of Output Shaft and Output Shaft Gear

1. Place the output shaft gear in the transmission case on the assembling jig; place the transmission case on the assembling jig and install the output shaft, meanwhile install it in the output gear.

2. Apply with a hairbrush an appropriate amount of lubricating oil on the rear output end where the bearing is installed; insert the bearing and place the pressing sleeve; assemble the shaft in place with a dead-blow hammer.

3. Put in the retainer ring, hold the ring with one hand and install it into its groove with an hole retainer plier.

Fig. 3-121

Fig. 3-122

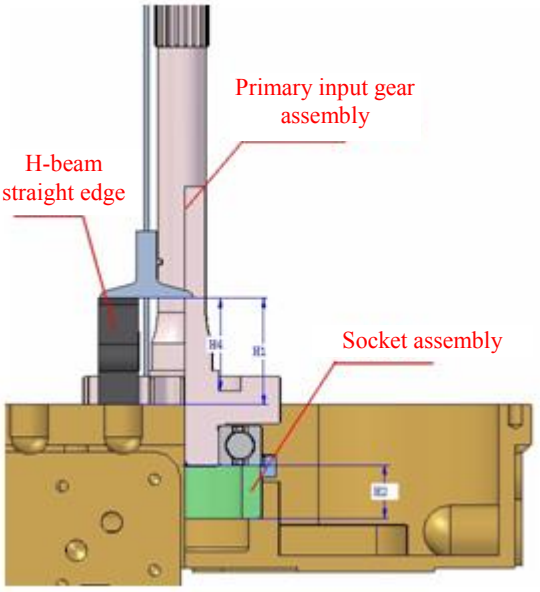


Fig 3-123

Assembling of Overrunning Clutch

1. Put the retainer ring into the center hole of the case.
2. Place the cushion cover in the bearing socket of the primary input gear.
3. Place the primary input gear on the cushion cover and the I-beam straight edge on the transmission housing's large plane to measure the distance H4 between the upper plane of the I-beam straight edge and the inner end face of the upper bearing socket of the primary gear.
4. Calculation: h2=H4-70, then the bearing clearance of the pre-assembly transmission is given by h=h1+h2+0.8, (h1 refers to the measurement feedback data of the torque converter subassembly, and 0.8 refers to the size after the packing is compressed).

★**Notice:**

In order to keep the thrust bearing clearance δ between 0.25 mm and 0.45 mm, the required thickness of gasket shall be t=h-δ. Select the adjusting gasket combination (three thicknesses: 0.1 mm, 0.2 mm,0.5 mm) based on the t value.

Fig. 3-124

5. Take out of the socket, and apply an appropriate amount of 6# hydraulic transmission oil on the primary input gear assembly pilot hole inner wall and the overrunning clutch assembly pilot hole inner wall.
6. Hoist the overrunning clutch assembly and install it in the case; install the overrunning clutch assembly in place with a dead-blow hammer and pressing sleeve.

Fig. 3-125

7. Put the selected adjusting gasket combination into the bearing socket.
8. Put the primary input gear assembly into the bearing socket and press it properly with a dead-blow hammer.

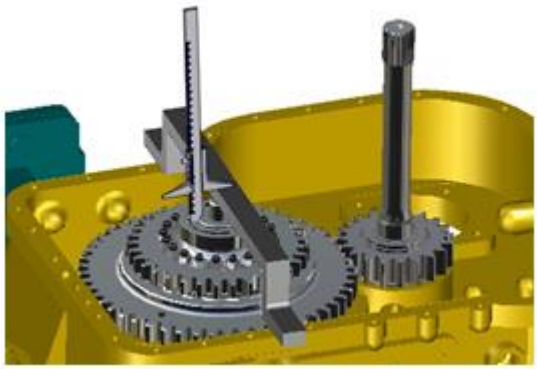


Fig. 3-126

9. Place the I-beam straight edge on the T1 face of the case and measure the distance D1 between the upper end face of the I-beam straight edge and the upper end face of the second shaft assembly bearing.

Fig. 3-127

10. Place the packing with t=0.9 on the end face of the case, and align it. Calculate d1=D1-30 and record the d1 value on the packing.

Fig. 3-128

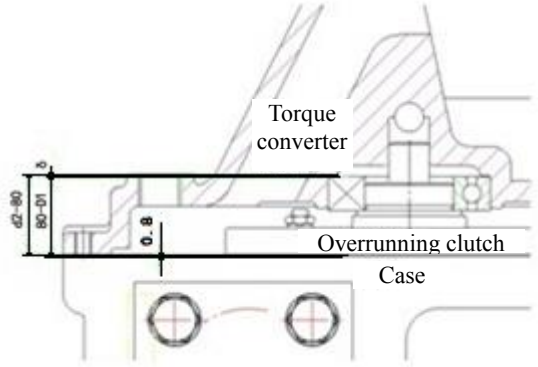


Fig. 3-129

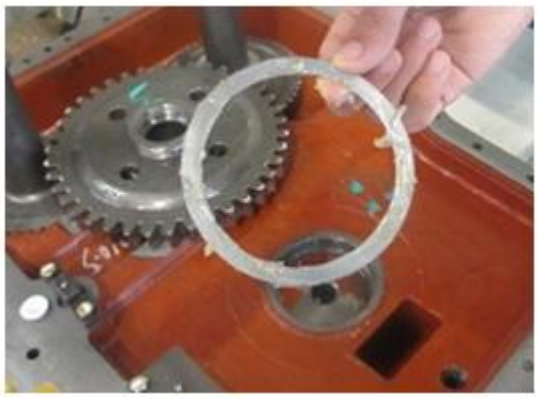


Fig. 3-130

Assembling of Torque Converter

1. Remove the roller bearing from the torque converter and install it on the associated transmission primary input gear.

2. Calculate the clearance by d=d1+d2+0.8-t, and keep the clearance d within the range of 0.35～0.55 mm.

★**Notice:**

d1=D1-30，i.e., the value recorded on the packing.

d2=D2-130，i.e., the value recorded on the torque converter.

t refers to the thickness of required adjusting gasket combination.

3. Select the suitable adjusting gasket combination according to the calculation and apply an appropriate amount of lubricating grease on the adjusting gaskets so that the adjusting gasket combination will adhere to the torque converter bearing socket.

★**Notice:**

After the adjusting gaskets are assembled, make sure the combination of adjustng gaskets won't fall off when the torque

Fig. 3-131

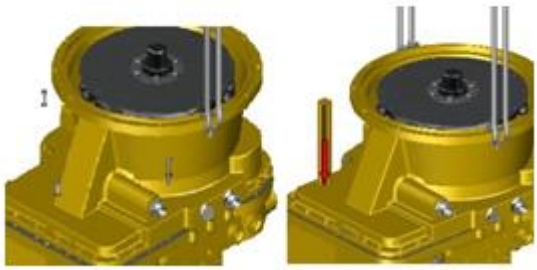


Fig. 3-132

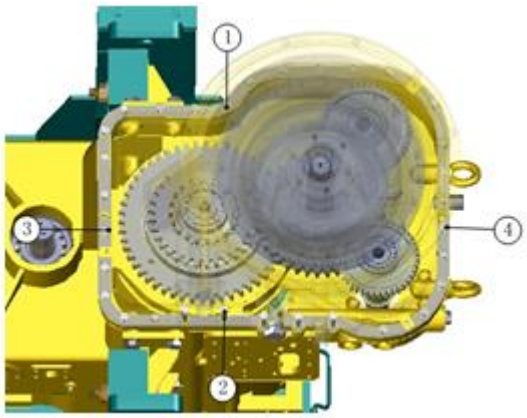


Fig. 3-133

converted is hoisted.

4. Hoist and turn over the torque converter; hoist it again and open the plastic plug on the bottom of the torque converter with a right-angled screwdriver to empty the torque converter.
5. Hoist the empty torque converter assembly over the transmission and adjust the gear engagement with a right-angled screwdriver to integrate the torque converter assembly with the transmission.
6. Install three bolt washers at the juncture of the torque converter and the transmission to locate the packing and then install the torque converter in place with a copper bar. Install the remaining bolts and washers at the joint surface of the torque converter and the transmission and screw in the bolts for 2～3 pitches with hands.
7. Pretighten all bolts with a pneumatic spanner in such a way that the washers won't be covered and the bolt washers won't fall off when case is turned over, and then tighten the four bolts with a torque spanner in the order of ①②③④ as shown in the figure. Make sure the torque converter keeps stable during the overturning process and convenient for adjusting the run-out.

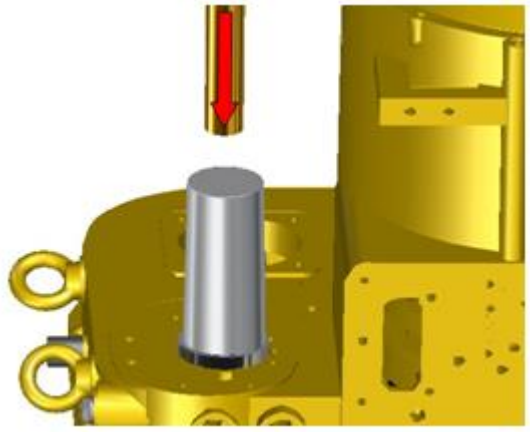


Fig. 3-134

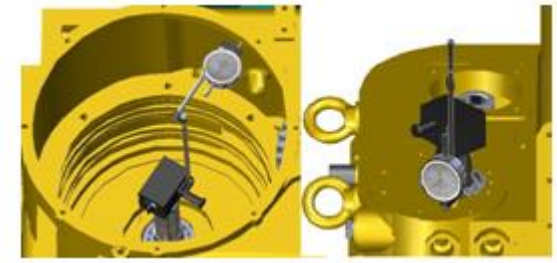


Fig. 3-135

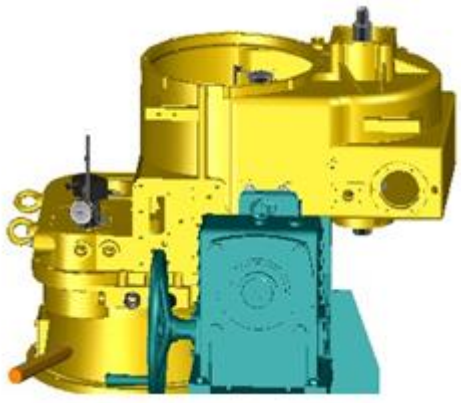


Fig. 3-136

Nm 10±3 Nm

Run-out Adjustment after Case Assembling

1. Apply an appropriate amount of lubricating oil inside the hole for installing the transmission pump bearing with a hairbrush; put the bearing in the hole and then the pressing sleeve; install the bearing in place with a copper bar and remove the pressing sleeve.
2. Fix the dial indicator on the end face of the intermediate input shaft, with its head pointing at the end cover hole and compressed to 1～1.5 mm.
3. Fix the dial indicator on the end face of the shaft gear assembly, with its head pointing at the pump body and compressed to 1～1.5 mm, and make sure the center line from the head to the shaft gear assembly is 75 mm.
4. Rotate the intermediate input shaft and the shaft gear assembly; knock on the torque converter housing according to the dial indicator reading until the reading meets the specified requirements.

★**Notice:**

When the intermediate input shaft is rotated for one circle, the run-out on the dial indicator shall be less than 0.3 mm; when the shaft gear assembly is rotated for

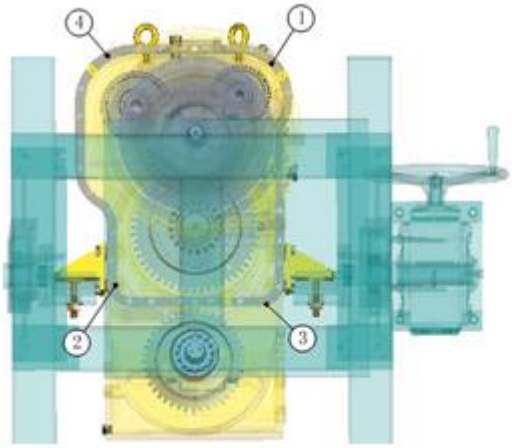


Fig. 3-137

Fig. 3-138

one circle, the jeck value on the dial indicator shall be less than 0.08 mm.

5. Pretighten the bolts at the four corners of the torque converter with a pneumatic spanner in the order of ①②③④.

★**Notice:**

In order to keep the run-out from being affected by the overturning of the transmission, the four bolts shall be pretightened before the transmission is turned over.

6. Turn over the case to make the torque converter face up, tighten symmetrically all bolts with a pneumatic spanner and tighten all bolts on the principle of symmetrical crossing with a Click spanner; install the pin in two aligned holes of the torque converter housing and the transmission housing.

Nm 52±7 Nm

★**Notice:**

In order to ensure the tightening quality, the bolts shall be pretightened by two persons cooperatively and simultaneously.

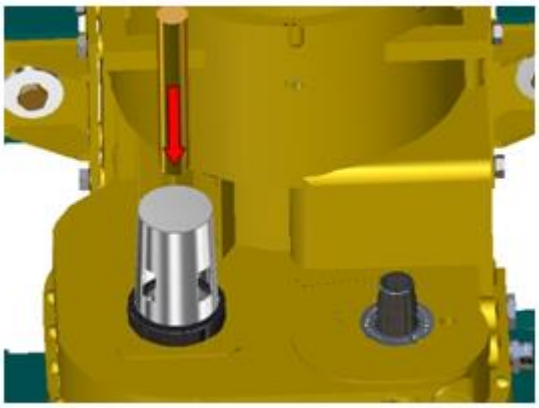


Fig. 3-139

Assembling of Bearing Seat Assembly and Reverse Gear Piston Assembly

1. Install the bearing seat assembly in the case assembly.

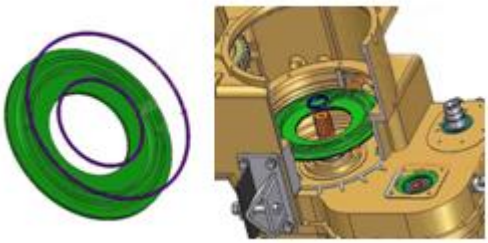


Fig. 3-140

2. Install the external and internal seal rings in the reverse gear piston groove.

★**Notice:**

Before assembling the seal rings, drag the external ring rather than the internal ring.

3. Install the reverse gear piston assembly in the case and then install the spacer sleeve on the overrunning clutch journal.

Fig. 3-141

Assembling of Reverse Gear Bracket and Isolated Bracket Assembly

1. Install the reverse gear bracket assembly on the overrunning clutch journal and knock it in place with the assembling tool.
2. First install the reverse gear driven friction lining and then the reverse gear driving friction lining and the reverse gear driven friction lining alternately.

Fig. 3-142

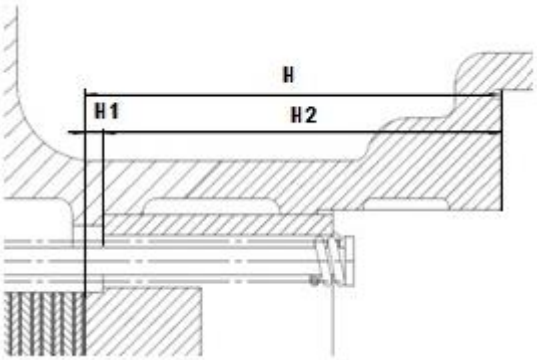


Fig. 3-143

Fig. 3-144

3. The distance from middle transmission case cover surface to the last friction lining is H, the spigot depth of the isolated bracket is H1, and the distance from the middle transmission case cover surface to the case isolated bracket surface is H2. Make sure the clearance between the last friction lining and the isolated bracket given byδ=H-H1-H2 is within 0.9～2.8 mm.
4. The distance from middle transmission case cover surface to the last friction lining is H. Measure at least two location points in the 180° direction during the measurement to measure the the spigot depth H1 of the isolated bracket and the distance from the middle transmission case cover surface to the case isolated bracket surface H2.
5. Install the friction lining isolated bracket assembly in the case, and insert the pin into the hole of the driven fiction lining so as to keep the isolated spigot bottom surface fitting to the case isolated bracket surface.
6. Rotate the friction lining isolated bracket assembly to keep its retaining notch to be aligned with the Φ25 hole on the valve surface and then push the cylindrical pin

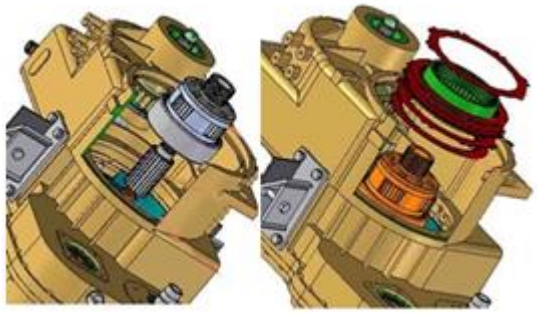


Fig. 3-145

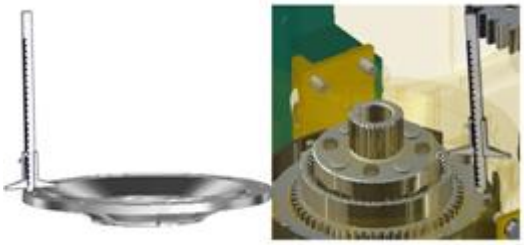


Fig. 3-146

into the pin hole.

Assembling of 1st Gear Planetary Carrier Assembly

1. Install the sun gear on the intermediate input shaft and then the 1st gear planetary carrier assembly on part 1.
2. Install the 1st gear driving friction linings and driven friction linings (install three driving linings and two driven linings alternatively, starting from the driving one) on the inner ring gear, and then install the part in the case and install two driven friction linings and one driving friction lining alternatively, starting from the driven one.
3. Measure the distance H1 from the middle transmission case cover surface to the last friction lining, the height H2 of the 1st gear oil cylinder assembly and the depth H3 of the middle cover spigot, and make sure the clearance between the last friction lining and the 1st gear piston given by δ=H1-H2-H3 is within 1.4～2.8 mm.

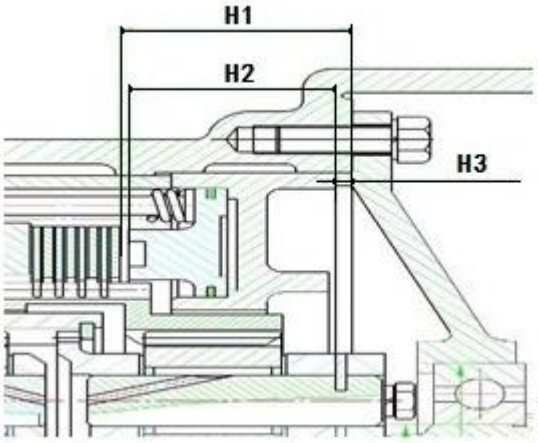


Fig. 3-147

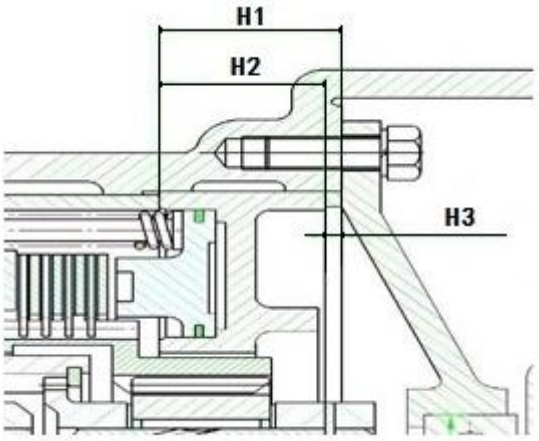


Fig. 3-148

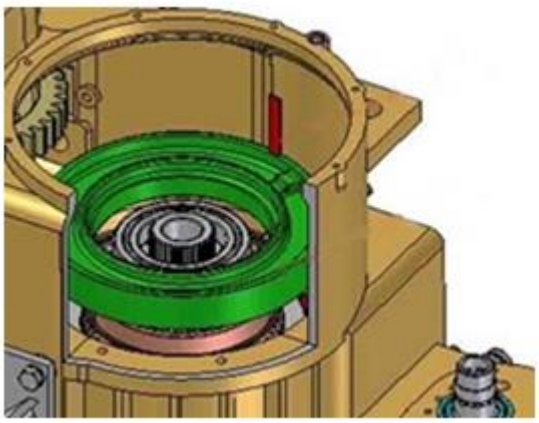


Fig. 3-149

★**Notice:**

Measure at least two location points in the 180° direction during the measurement.

4. Fit together the spring and the spring pin and then install them in each hole of the friction lining isolated bracket assembly.
5. Measure the distance H1 from the upper surface of the isolated bracket to the middle transmission case cover surface, the thickness H2 of 1st gear oil cylinder, and depth H3 of the middle cover spigot; calculate the clearance between the 1st gear oil cylinder and the middle cover by δ=H1-H2-H3 and make sure it is within -0.05～0.1 mm.
6. Install the 1st gear oil cylinder in the case and adjust the angle so that the notch of the oil cylinder will be aligned at the notch of the friction lining isolated bracket; then install the dead plate.

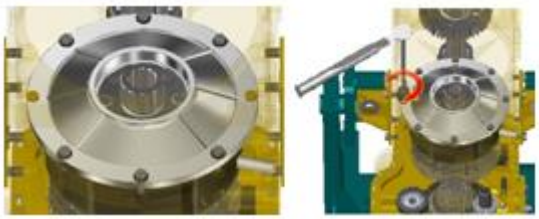


Fig. 3-150

Assembling of Middle Cover

1. Put the middle cover in the case, screw two M14×45 bolts symmetrically into the bolt holes and pretighten them with a pneumatic spanner; install 6 middle cover bolts and washers into the middle cover holes and screw them by 2～3 pitches with hands; tighten the bolts successively on the principle of symmetrical crossing with a pneumatic spanner; remove two M14×45 bolts and install the remaining two middle cover bolts and washers into the bolt holes; tighten them successively on the principle of symmetrical crossing with a Click spanner.

Nm 145±20 Nm

Fig. 3-151

Assembling of Transmission Control Valve

1. Clean the junction surface of the transmission control valve and the case with 755 high-efficient detergent in such a way that the surface will be free from grease. Install the bolts and washers into the transmission control valve bolt holes and the packing in the transmission control valve surface.

Fig. 3-152

2. Install the transmission control valve on the case valve surface and tighten the above two bolts with hands; screw in other bolts for 2～3 pitches and pretighten the bolts successively on the principle of symmetrical crossing outwards from the center with a pneumatic spanner.
3. Tighten the bolts successively on the principle of symmetrical crossing outwards from the center with a Click spanner.

Nm 52±7 Nm

★**Notice:**

After the assembly, the gear shift lever shall be pulled flexibly with a pulling force not more than 150 N.

Assembling of Transmission Pump

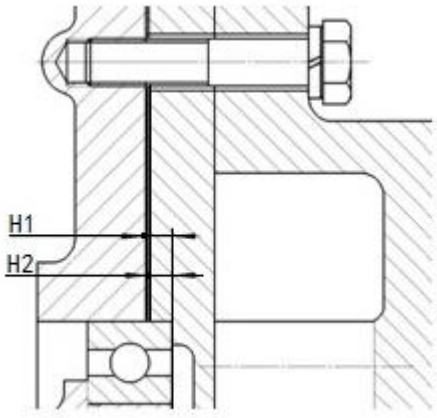


Fig. 3-153

1. H2: the depth of transmission pump cover spigot; H1: the height of bearing 6012 in the case higher than the case hole end face; t1: the thickness of the combined adjusting gaskets. Calcualte t=H2-H1+0.8 and make sure the value of compression clearance &=t-t1 is within 0.35～0.55 mm. Select the suitable adjusting gasket combination based on it.

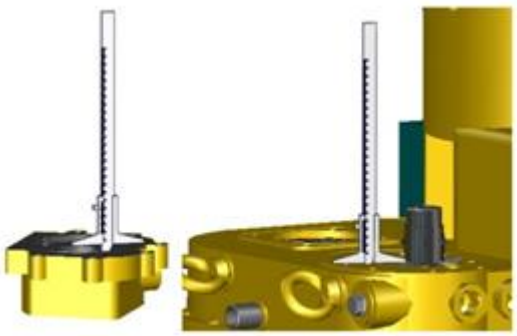


Fig. 3-154

2. Measure the depth H2 of transmission pump cover spigot.
3. Measure the height H1 of bearing in the case higher than the case hole end face.

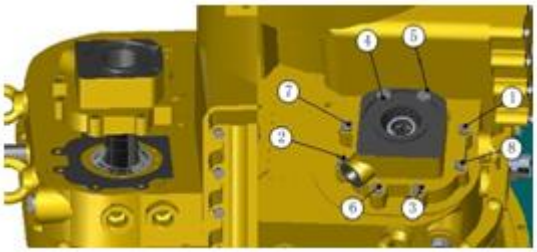


Fig. 3-155

4. Place the packing (t=0.8 mm) on the case pump surface and align it at the case bolt hole; attach the selected adjusting gasket combination to the transmission pump bearing socket with lubricating grease.
5. Fix the packing and transmission pump on the case with bolts, gaskets and bolts, and tighten the bolts on the principle of symmetrical crossing with a Click spanner.

Nm 52±7 Nm

Assembling of Second Gear Assembly and End Cover

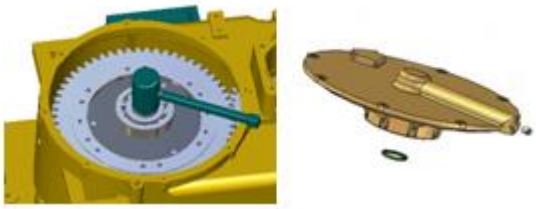


Fig. 3-156

1. Apply the lubricating oil on the middile cover bearing socket and the bearing; hoist the direct gear assembly; install the direct gear assembly in place with a dead-blow hammer by means of press fitting-up.
2. Install the plug and rotary oil seal on the end cover. Make sure the plug is tightened, secured, and oil-tight.

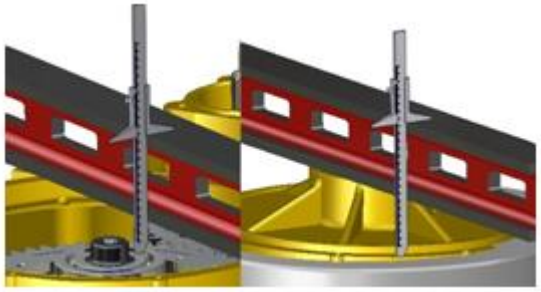


Fig. 3-157

Nm 28±4Nm

★**Notice:**

Apply an appropriate amount of 545 pipe thread sealant at the threaded end of the plug; keep the opening of the rotary oil seal facing the inside of the end cover.

3. Measure the distance H3 from the right bearing end face to the case end face; measure the distance H1 from the small end face of the end cover to the step surface of the end cover; measure the distance H2 from the small end face of the end cover to the right bearing socket of the end cover; calculate the distance from the bearing socket of the end cover to the step surface of the end cover by t=H1-H2; make sure the clearanceδ=H3-t+0.8-t1 between the right end of the bearing and the end cover bearing socket surface is within 0.35～0.55 mm and t1 is the thickness of the adjusting gasket combination after the tightening.

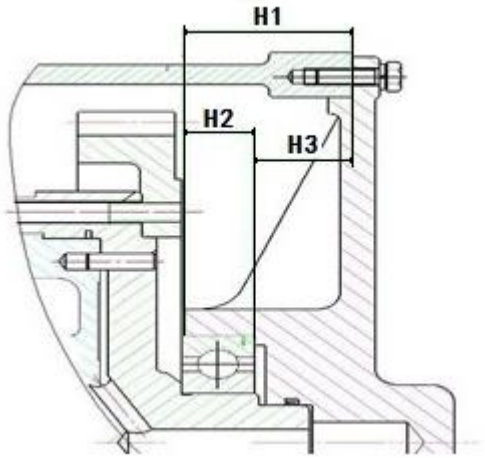


Fig. 3-158

Fig. 3-159

4. Install an O-ring on the case; place the packing (t=0.8) on the case end face.

Fig. 3-160

5. Attach the selected adjusting gasket combination to the end cover bearing socket with an appropriate amount of lubricating grease; apply the 6# hydraulic transmission oil around the end cover bearing socket with a hairbrush.

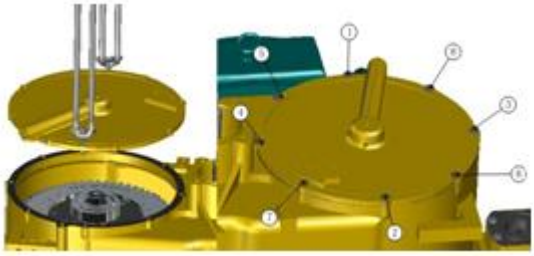


Fig. 3-161

6. Hoist the end cover assembly on the case, adjust the end cover, align the threaded hole and the oil port, insert the positioning bolt into the bolt hole to lock the end cover, knock the end cover surface with a copper bar and install it in place by means of press fitting-up.
7. Slip the washers on the bolts and then install them in the bolt holes; screw in

them for 2~3 pitches with hands, pretighten the bolts in symmetrical crossing with a pneumatic spanner and tighten the bolts on the principle of symmetrical crossing with a Click spanner.

Nm 52±7Nm

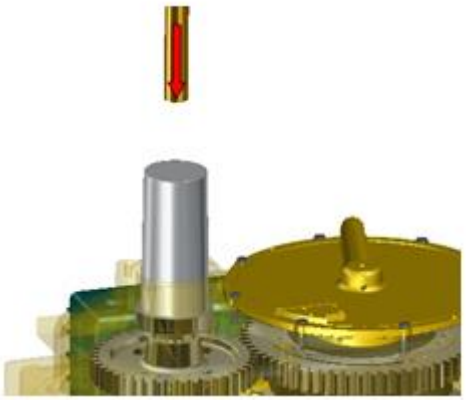


Fig. 3-162

Assembling of Front Output End Parts

1. As shown in Fig. 3-162, align the rear output end bearing and knock the output shaft; install the rear output bearing and the output shaft in place by means of press fitting-up; apply an appropriate amount of lubricating oil on the inner wall of the front output shaft hole.
2. Slip the bearing on the output shaft and align it to the shaft hole; install it in place with a bearing pressing sleeve by means of press fitting-up.
3. As shown in Fig. 3-163, measure h1 and h2 with a vernier caliper with depth gauge measure the thickness t2 of the retainer ring with a vernier caliper with dial indicator; calculate t=h1-h2-t2; select and install the adjusting gaskets as per the calculation result, keeping theδ (=t-t1) within 0.1～0.2 mm.

Fig. 3-163

★**Notice:**

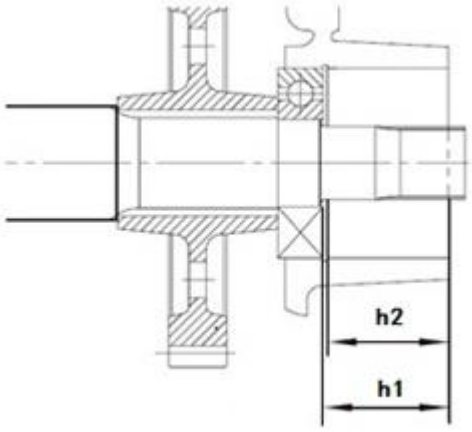


Fig. 3-164

h1: distance from the bearing end face to the output hole end face

h2: distance from the outer end face of the retainer ring groove to the output hole end face

t1: thickness of selected adjusting gaskets

When measuring h1 and h2， the same position of the output hole end face shall be used as the benchmark.

4. Install the selected adjusting gasket combination in the shaft hole and install the retainer ring in the output shaft retainer ring groove with an hole retainer plier.

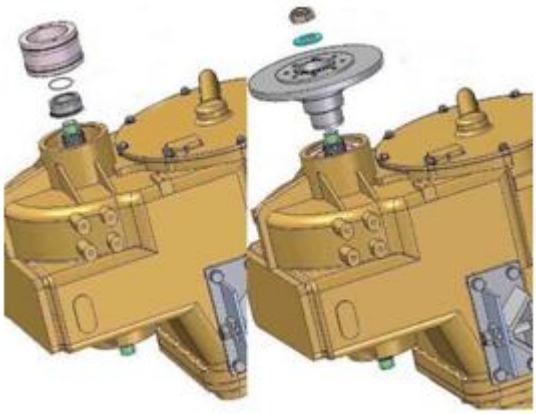


Fig. 3-165

5. As shown in Fig. 3-152, place the O-ring in the groove of the gland cover inner hole, install the gland cover at the output shaft end and install it with a gland cover pressing sleeve by means of press fitting-up. Apply an appropriate amount of lubricating grease at the lip of the seal ring and some lubricating oil on the inner wall of the output shaft hole; install the oil seal seat in place with a pressing sleeve by means of press fitting-up.
6. Install the output flange on the front end of the output shaft and then install the washers and nuts; tighten the nuts.

Nm 360±40Nm

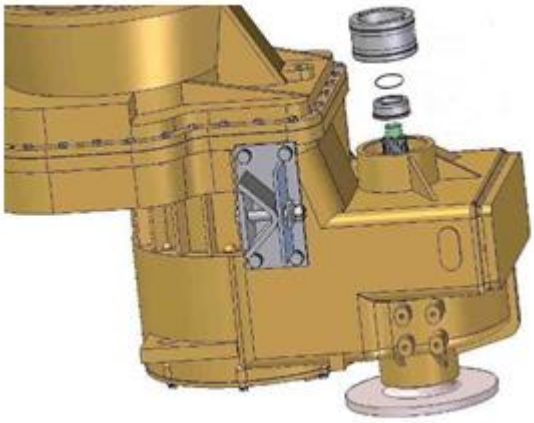


Fig. 3-166

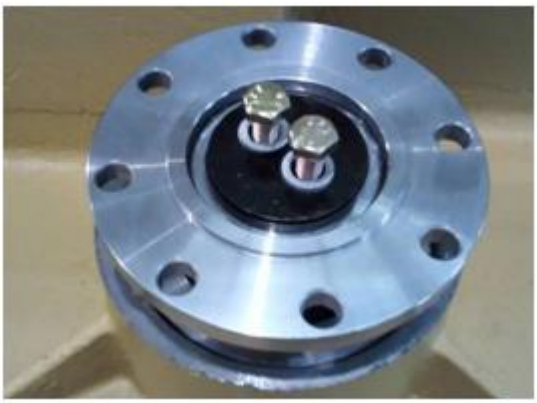


Fig. 3-167

Assembling of Rear Output End Parts

1. Turn over the case 180° and fasten it tightly; place the O-ring in the groove of the gland cover inner hole, install the gland cover at the output shaft end and install it with a gland cover pressing sleeve by means of press fitting-up. Apply an appropriate amount of lubricating grease at the lip of the seal ring and some lubricating oil on the inner wall of the output shaft hole; install the oil seal seat in place with a pressing sleeve by means of press fitting-up.
2. Apply an appropriate amount of 262 thread lock adhesive in the screw hole at the end of the output shaft.
3. As shown in Fig. 3-167, install the rear flange in the end of the output shaft; adjust the spline for perfect fitting; install the washers, lock washers and bolts; screw them in by 2～3 pitches; pretighten the bolts; insert a special spanner into the bolt hole of rear flange, acting as a counter-force lever; tighten the bolts with a torque spanner.

Nm 52±7Nm

Fig. 3-168

Fig. 3-169

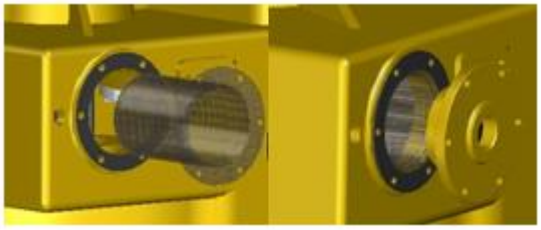


Fig. 3-170

Assembling of Hand Brake Assembly

1. Fix the bracket on the hand brake and tighten it with bolts.

Nm 180±20Nm

2. Connect the hand brake assembly to the transmission assembly with bolts and pretighten the bolts. Adjust the hand brake with a copper bar, tighten the adjusting bolts to make the friction linings at both sides closely fit to the front flange.
3. Adjust the adjusting bolts and the clearance between the friction lining and the front flange.
4. Check the clearance between the friction lining and the front flange with a filler gauge so as to meet the fixing requirements. Tighten the bolts as per the opposite angle principle.

Nm 90±20Nm

★**Notice:**

The unilateral clearance between the friction lining and the front flange is within 0.2～0.3 mm.

Assembling of Oil Filter Assembly

1. Install the oil filter assembly and place a gasket between the oil filter assembly and the case. Put the magnet in the gland and install the retainer ring. Install them as a whole in the oil filter assembly, and place

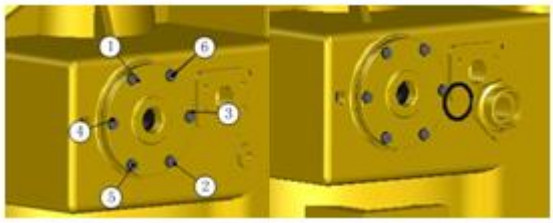


Fig. 3-171

a gasket in between them.

2. Conduct a proper adjustment, and tighten the gland and the oil filter assembly with washers and bolts.
3. At last, install the O-ring and connector bodies, and tighten them to the specified torque.

Nm 280±30 Nm

4 Inspection Specifications for Assembling Quality of Typical Transmission

Table 4-1

Process	Description of Non-conformity	Remarks
Subassembling of transmission	Whether each plane, bearing hole, threaded hole and unthreaded hole of the case has casting pores, blowholes, part missing, cracks, dirt, burrs, rust, water, oil, scrap iron, etc; whether the interior paint is coated in a qualified way; whether there is residual molding sand.	
	Whether the nameplate is unrecognizable and insecure.	
	Whether the nameplate rivet joint is in malposition, inclined too much or uneven.	
	Whether the O-ring of G28 connector is damaged.	
	Whether the roughness of sealing face of the inner cone at the G28 connector end is qualified	
	The tightening torque for G28 connector is 280±30 Nm	
	The tightening torque for the oil duct ZG1/2 plug is 75±10 Nm.	
	The tightening torque for the transmission bearing (connecting base) bolts is 240±30 Nm.	
	Whether the depth and width of the output shaft hole retainer ring groove are qualified.	
Subassembling of Primary Input Gear	Whether the 6311 bearing's mark is clear, the holder is deformed, and there are foreign matters in the rolling element (ball).	
	Whether the spline and the gear teeth of the primary input gear have bruise or part missing, whether there are greasy dirt, oxide skin, flashes, burrs, etc.	
	There is a gap between the inner ring and the primary gear after the assembling of 6311 bearing.	

Subassembling of Secondary Input Gear	Whether the 6016 bearing's mark is clear, the holder is deformed and there are foreign matters in the rolling element (ball).	
	There is a gap between the inner ring and the secondary gear after the assembling of 6016 bearing.	
	Whether the gear teeth of the secondary input gear have bruise, part missing and cracks, the roughness is qualified, and there are greasy dirt, oxide skin, flashes, burrs, etc.	
Subassembling of Shaft Gear Assembly	Whether the gear teeth of the shaft gear have bruise, part missing or cracks, the roughness is qualified, and there are greasy dirt, oxide skin, flashes, burrs, etc.	
	Whether the 6210N bearing's mark is clear, the holder is deformed and there are foreign matters in the rolling element (ball).	
	There is a gap between the ring gear and the shaft gear after the assembling of 6210N bearing.	
Subassembling of Steering Pump Drive Gear Assembly	Whether the gear teeth have bruise, part missing or cracks, the roughness is qualified, and there are greasy dirt, oxide skin, flashes, burrs, etc.	
	Whether there are casting pores, blowholes, part missing, cracks, etc in the bearing socket on the conjunction plane connected to the case's T1 plane; whether there are dirt, burrs, rust, water, oil, scrape iron, etc in the bearing socket on the conjunction plane connected to the case's T1 plane;	
Subassembling of Torque Converter	Whether the 6210N bearing's mark is clear, the holder is deformed and there are foreign matters in the rolling element (ball).	
	Whether the rotary oil seal is damaged or has flashes.	
	Whether the 51111 bearing's mark is clear, the holder is deformed	

	and there are foreign matters in the rolling element (ball).	
	Whether there are residual foreign matters generated during the assembling.	
	The clearance between the secondary input and the secondary turbine retainer ring is within 0.2～0.5 mm.	
	Whether the rotary oil seal is installed correctly (with the notch facing down)	
	The relative (to the torque converter T1) height difference between the 51111 bearing's upper end faces at both sides is less than 0.4 mm.	
Subassembling of 1st Gear Oil Cylinder	Whether there are pores, blowholes and shrinkage in the oil cylinder; whether there are processing burrs, scrape iron, molding sand, oxide skin, etc.	
	Whether the roughness of the oil cylinder rectangular ring fitting surface is qualified; whether there are bruise and scratch; whether the grinding burrs are not cleaned.	
	Whether the inner and outer seal rings are damaged and whether there are flashes.	
	Whether there are pores, blowholes and shrinkage in the piston; whether there are processing burrs, scrape iron, etc.	
	Whether the inner and outer seal rings of the piston are bumped and deformed; whether the oil port is normal.	
	Whether is rectangular seal ring is grinded properly so as to ensure an exposed height within 0.2～0.5 mm.	
Subassembling of Direct Gear Pressure Plate	Whether the splines and bolt holes of the pressure plate have burrs, scrape iron, etc.	
	Whether there are burrs, scrape iron, etc around after the pins are assembled.	

	Whether the pins are abreast with the edge of the pressure plate.	
Subassembling of Friction Lining and Isolated Bracket	Whether the isolated bracket has pores, blowholes, shrinkage, etc; whether there are burrs, scrape iron, etc at the machining surface and excircles.	
	Whether there are cracks at the milling groove in the pin hole of the isolated bracket after the press fitting-up	
	Whether there are burrs, scrape iron, etc around after the pins are assembled.	
	The size is 42（0～＋1） mm after the pins are assembled.	
Subassembling of Bearing Seat	Whether the 6211 bearing's mark is clear, the holder is deformed and there are foreign matters in the rolling element (ball).	
	Whether there are burrs, scrape iron, etc in the machining surface and holes of the bearing seat.	
Assembling of Planetary Gear	Whether the surface, holes and teeth of the gear have bruise, part missing or cracks, the roughness is qualified, and there are greasy dirt, oxide skin, flashes, burrs, etc.	
Subassembling of Reverse Gear Assembly	Whether the teeth, holes, threaded holes and faces of the reverse gear planetary carrier have casting pores, blowholes, part missing, cracks, bruise, scratches, etc; whether there are dirt, burrs, rust, water, oil, scrape iron, etc.	
	Whether the 6010 bearing's mark is clear, the holder is deformed and there are foreign matters in the rolling element (ball).	
	Whether there are residual foreign matters generated during the assembling.	
	The tightening torque for the bolts of the planetary shaft thrust gasket is 26±4 Nm.	
	Whether the planetary gears can rotate flexibly without jamming.	
Subassembling	Whether the teeth, holes, threaded holes and faces of the 1st gear	

of 1st Gear Assembly	planetary carrier have casting pores, blowholes, part missing, cracks, bruise, scratches, etc; whether there are dirt, burrs, rust, water, oil, scrape iron, etc.	
	Whether the 6210N bearing's mark is clear, the holder is deformed and there are foreign matters in the rolling element (ball).	
	Whether the fitting points of connecting panel splines have bruise.	
	Whether the reverse gear inner ring gear has bruise, part missing, cracks, etc; whether the roughness is qualified;	
	The tightening torque of direct gear connecting panel bolts is 130±15 Nm.	
	Whether the planetary gear rotates flexibly without jamming.	
Subassembling of Direct Gear	Whether the direct gear friction lining has bruise and breakage.	
	Whether the direct gear piston has pores, blowholes, shrinkage, etc.	
	Whether the inner and outer seal ring grooves in the piston is bumped or deformed, the oil port is normal and there are machining burrs, scrape iron, etc.	
	Whether the outer seal ring and the rotary oil seal has breakage or flashes.	
	Whether the surface, holes and teeth of the intermediate output gear have bruise, part missing, cracks, etc, the roughness is qualified, and there are oxide skin, sharp corners, burrs, etc.	
	Whether the roughness of oil cylinder seal ring fitting surface is qualified, the surface has bruise or scratches, there are machining burrs, scrape iron, molding sand, oxide skin, etc.	
	Whether the direct gear shaft has oxide skin, sharp corners, burrs, etc.	

	Whether the 6204 bearing's mark is clear, the holder is deformed and there are foreign matters in the rolling element (ball).	
	Whether the 6022 bearing's mark is clear, the holder is deformed and there are foreign matters in the rolling element (ball).	
	Whether the 6312 bearing's mark is clear, the holder is deformed and there are foreign matters in the rolling element (ball).	
	Whether the connecting panel has dirt, burrs, rust, water, oil, scrape iron, etc.	
	Whether the reverse gear ring gear has dirt, burrs, rust, water, oil, scrape iron, etc.	
	Whether the friction lining has machining burrs, scrape iron, etc.	
	The tightening torque for the friction lining connecting bolts is 26±4 Nm.	
	The tightening torque for the pressure plate connecting bolts is 90±10 Nm (relaxed steel winding method).	
Assembling of Output Shaft and Output Shaft Gear	Whether the surface, holes and teeth of the output shaft and the output shaft gear have bruise, part missing, cracks, etc, the roughness is qualified, and there are oxide skin, sharp corners, burrs, etc.	
	Whether the 6312 bearing's mark is clear, the holder is deformed and there are foreign matters in the rolling element (ball).	
Assembling of Plug and Overrunning Clutch Assembly	Whether the ball, spring and bearing of the overrunning clutch are normal; whether there are foreign matters.	
	Whether the length of thread engagement for the ZG1/2 plug of the oil duct is suitable.	
Selection of Torque	Whether the axial clearance of the 51111 bearing is within 0.25～0.45 mm	

Converter	Whether the packing is damaged	
Assembling of Torque Converter Assembly	Whether 31 bolts are tightened in proper sequence.	
	Whether the 6012 bearing's mark is clear and its holder is deformed.	
Assembling of Transmission Pump Bearing and Output Shaft Bearing	Whether the run-out of the intermediate output shaft is less than 0.3 mm.	Key process
	Whether the run-out of the shaft gear is less than 0.08 mm.	Key process
	The tightening torque for the torque converter and transmission connecting bolts is 52±7 Nm.	
	The axial clearance after the assembling of output shaft is 0.1～0.2 mm.	
Assembling of Bearing Seat Assembly and Reverse Gear Piston Assembly	Whether the piston has pores, blowholes, shrinkage, etc; whether there are machining burrs, scrape iron, etc.	
	Whether the outer seal ring groove is bumped and deformed; whether the oil ports are normal.	
	Whether the rectangular seal ring has grinding burrs that are not cleaned.	
	Whether the driving and driven friction linings has deformation, cracks, part missing, dirt, burrs, scrape iron, etc.	
	Whether the inner and outer seal rings have breakage or flashes.	
Assembling of Reverse Gear Bracket Assembly and Isolated Bracket	Whether the assembling clearance between the reverse gear friction linings, i.e., the clearance between the last piece of reverse gear friction lining and the isolated bracket, is 0.9～2.8 mm.	
	Whether the assembling clearance between the 1st gear friction linings, i.e., the clearance between the friction lining and the 1st	

Assembly	gear piston is 1.4～2.8 mm.	
Assembling of 1st Gear Planetary Carrier	The clearance between the 1st gear oil cylinder assembly and the middle cover is -0.1～0.3 mm.	
	Whether the holes, bearing sockets and surfaces of the middle cover have casting pores, blowholes, part missing, cracks, bruise, scratches, dirt, burrs, scrape iron, etc	
Assembling of Middle Cover and Pump Surface Packing	Whether the transmission pump has casting pores, blowholes, part missing, cracks, bruise, scratches, etc; whether the assembling roughness is qualified; whether there are dirt, burrs, scrape iron, etc on the threaded hole, oil duct and fitting surface.	
	The tightening torque for the middle cover connecting bolts is 145±20 Nm.	
	The tightening torque for the variable-speed connecting bolts is 52±7 Nm.	
	The clearance between the shaft gear 6210N bearing and the transmission pump gland spigot is 0.35～0.55 mm.	
	Whether the transmission control valve has casting pores, blowholes, part missing, cracks, bruise, scratches, etc; whether the assembling roughness is qualified; whether there are dirt, burrs, scrape iron, etc on the threaded hole, oil duct and fitting surface.	
Assembling of Transmission Control Valve	The tightening torque for the transmission control valve connecting bolts is 52±7 Nm.	
	The pulling force of the transmission control valve gearshift lever is not more than 150 N.	
Assembling of Direct Gear Assembly and	Whether the end cover has casting pores, blowholes, part missing, cracks, bruise, scratches, etc; whether the assembling roughness is qualified; whether there are dirt, burrs, scrape iron, etc.	

End Cover	The tightening torque for the end cover plug is 28±4 Nm.	
	The tightening torque for the end cover connecting bolts is 52±7 Nm.	
	The axial clearance between the end cover bearing socket and the direct gear 6312 bearing is 0.35～0.55 mm.	
Assembling of Oil Seal Seat Assembly and Front Output Flange	Whether the main lip of the oil seal is deformed or damaged; whether the lubricating grease is applied uniformly; whether there are foreign matters, flashes, etc.	
	The tightening torque for the output shaft flange pressure flat gasket connecting bolts is 52±7 Nm.	
	Whether the friction linings in the hand brake have bruise, scratches, part missing, etc.	
Assembling of Rear Flange and Hand Brake Assembly	Whether the brake calliper in the hand brake has obvious pores and part missing (influencing the strength).	
	The tightening torque for the connecting bolts of the hand brake bracket and the hand brake is 180±20 Nm.	
	The tightening torque for the connecting bolts of the hand brake bracket and the transmission is 90±20 Nm.	
Adjustment of Hand Brake Clearance	The unilateral clearance between the hand brake friction lining and the flange is 0.1～0.3 mm.	

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