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# Service Manual

## A30X SERIES PLANETARY POWER SHIFT TRANSMISSION

**Applicable Machine Types：**

**LG956, LG953, LG952, LG936 Series Wheel Loader**

**SHANDONG LINGONG CONSTRUCTION MACHINERY CO.，LTD**

# Driving Axle Service Manual

880×1230 mm 16# 18pieces

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# Service Manual

## Concise Guide

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# PREFACE

This service manual, which shows the mechanism, principle and the maintenance technology of the transmission, will help the maintenance workers understand the disassemble and assemble method of the transmission more deeply and bring the maintenance workers solid technology basis of locating faults and maintaining correctly.

Main content of this Service Manual:

**1. Mechanism and working principle of the transmission**

This chapter shows the mechanisms and functions of each kind of part, which establish the basis of assembling and disassembling transmission. Furthermore, it also could be used as the reference of locating faults.

**2. Disassembling of the transmission**

The steps how to disassembling the parts correctly and the points for attention in disassembling transmission are shown in this chapter.

**3. Assembling of the transmission**

The steps how to assembling the parts correctly and the points for attention in assembling transmission are shown in this chapter.

**4. Standard criterions of the transmission for repairing and replacement of parts**

The identification methods and standards of criterion of vulnerable parts are formulated in this chapter.

**Specially Notes：**

This service manual is described as an example for A301 Transmission. It is similar with other serial productions in our Corp on axle principle, only some small differences in connection types and local structures. Those differences will not describe in here and could be executed referred to the relation chapter in this manual.

**ATTENTION**

Forgiving without further notice about the specification’s changing of the parts, in this manual, which are caused by the transmissions development. The latest information could be get from Shandong Lingong Construction Machinery CD., LTD.

# Table of Contents

# CHAPTER I INTRODUCTION

## 1.1 Safety Notices

**IMPORTANT SAFETY NOTICE**

It's very important for operating the vehicle safely to keep maintenance and repairing. The related technologies about how to assemble and disassemble the transmission correctly are described in this manual.

The safety considerations, marked with as the security label, should be paid more attention when operate it for avoiding hurting persons. Persons should keep themselves safe first and take some necessary measures when the potential dangers coming.

**Security Notice**

On the process of assembling and disassembling, parts wear, life losing, properties failure would be caused by the incorrect operating methods, meanwhile, there are unsafe factors. Please read the manual carefully when assemble and disassemble the transmission's parts.

1. The parameters, graphs and related contents in this manual are suitable to the standard configuration products. As to the deformed products, please consult our company or refer to the related data.

2. In repair workshop, the region for placing the single using or special parts after assembling and disassembling should be marked. Put the corresponding tools on the suitable region. The cleanness of operating region must be kept and make sure there is no oil or pollution in the operating region. Smoke in the specified region and smoking is forbidden in the course of operation. And there are corresponding fire extinguishing equipments.

3. When welding operation is needed, it should be done by expert persons who are trained by professional welding training. Welding gloves, baffles, goggles, hats and other work clothes suitable for welding are essential during welding operation.

4. Before the duplex-transmission assembly is disassembled, the appearance of which must been cleared up to avoid polluting the parts in the course of disassembling.

5. In the progress of operation, safety shoes and safety helmets must been worn. Work clothes not

coincide with requirements are forbidden and the buttons on the work clothes must be attached. Goggles should be worn when persons knock the parts with copper rod.

6. The disassembled parts could be cleaned by petrol, gasoline and water-base oil cleaner.

7. Check the lifting tools whether they were broken before operating the cranes or other hoisting equipments. The lifting amount of the lifting equipments must be big enough. For avoiding collisions between parts, lifting equipments should use the specified lifting position and operated slowly. Make sure no one work under the part lifted.

8. When two or more persons work together, agree the operation procedure which should be implemented by everyone before work to avoid the accidence caused by out of steps.

9. All tools must be kept carefully, and familiar with their using method.

10. When align two holes, don’t put hands and figures in the holes. Pay attention to whether the hands would be extruded when assemble parts by hand directly.

11. The disassembled parts must be checked. The parts which have poor properties should be changed, and the standard of criterion can refer to chapter 5: Standard of criterion for repairing and replacing the parts of the transmission.

12. There should be no interference after assembling each part.

13. When assemble the oil seal and the seal ring, take protection measures if through the keyway, screw holes and steps to protect the oil seal and seal ring.

14. When assemble the parts, all tools must be suitable to the screw fasteners to protect the screw fasteners.

15. When tighten the screws, the tightening tools like the gas trigger are forbidden. Tighten them by hand first, and then tighten them with some specified wrest wrenches to reach the torque demanded.

16. When release the oil in the transmission, loose the releasing-screw slowly to avoid the oil blowout.

## 1.2 Oil and Coating Materials

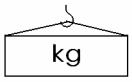
| Domestic oil brands | Kinematic Viscosity（100℃） $mm^2/s$ | The similar foreign oil brands | | | |
|---|---|---|---|---|---|
| | | MOBIL | CALTEX | ESSO | SHELL |
| No.6 Hydraulic transmission oil Q/SH018.44.03-1994 | 5~7 | ATF Vehicle auto-shifting oil (more than -40℃) ATF220 Vehicle auto-shifting oil (-25~40℃) | Torque fluid175; RPM Torque fluid NO.5 | Torque Fluid 47 | Rotella 10w |

| Domestic oil brands | The similar foreign oil brands | | | | | |
|---|---|---|---|---|---|---|
| | MOBIL | CALTEX | CASTROL | ESSO | BP | SHELL |
| 2# or 3# lithium based grease GB7324-1994 | MOBIL grease XHP222 | Marfak multi Purpose | LM grease | Ronex MP; Beacon EP 2 | Energrease L | Retinax A; Alvania |

| Name | Code | Application scope and function |
|---|---|---|
| Sealant | 1545 oxygen-weary type pipe-screw sealant | It's suitable to be used to seal the pipe-screw of hydraulic system, pneumatic system and refrigeration system, also can be used on the surface with little oil. |
| | 1262 pipe-screw fixed sealant | It's used to fix and seal the M10~M20 screws and the ones are endured intense vibration and impact. |
| Grease | 2# or 3# lithium based grease GB 7324-1994 | It is suitable to be used to lubricate the fiction position, rolling bearing and sliding bearing of any kinds of engineering machinery between -20~120 ℃. |
| Cleaning agent | 1755 cleaning agent | It's used to clean the surface of metals, clean the oil pollution on the surface effectively, and enhance the adhesion strength between repair agent, pipe-screw fixed sealant and substrate. |

## 1.3 Marker

For communication and memory, those following marks are used in important safety and quality.

| Marker | Item | Remark |
|---|---|---|
|  | Safety | Specially take care of the safety during the operation. |
|  | Notice | Pay attention to the technical requirements and make sure the operations reach the requirements in operation. |
|  | Heavy | Parts and their heavy and disassembling methods<br>Make sure choose the appropriate spreader and the operating posture |
|  | Tightening Torque | Pay more attention to the parts' Tightening Torque in assembly operation. |
|  | Coating | The location where need to be coated with adhesives and greases. |
|  | Oil and water | Inject required volume of lubricating oil, water or fuel oil. |
|  | Outpour | The place of oil-expulsion and water-draining, or the emission volume |

## 1.4 Hoisting Explanation

1. When it is not easy to take down the parts from duplex-transmission assembly, check the following items:

- Check that whether all of screws of the part have been assembled.
- Check whether the assembly is hindered by some other parts.

2. Wire Rope

1) Wire rope should be hung in the middle of the hook.

If hung in one end of the hook, the wire rope may drop from hook during hoisting and that may cause serious accidence. The strength of the middle of the hook is the biggest, shown in Figure 1-1.

2) One single wire rope is forbidden. Make sure that two or more ropes are used to bundle the heavy.

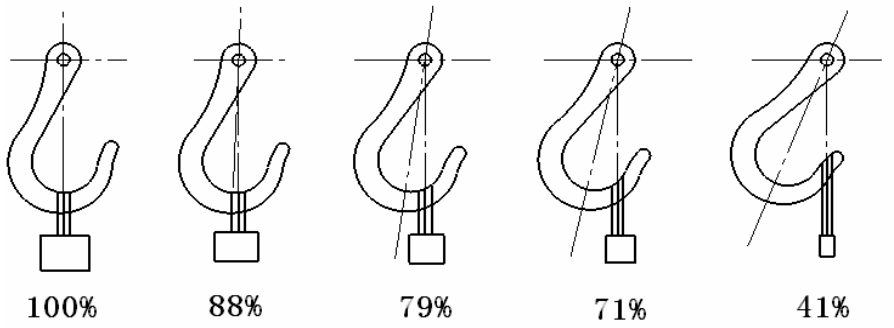
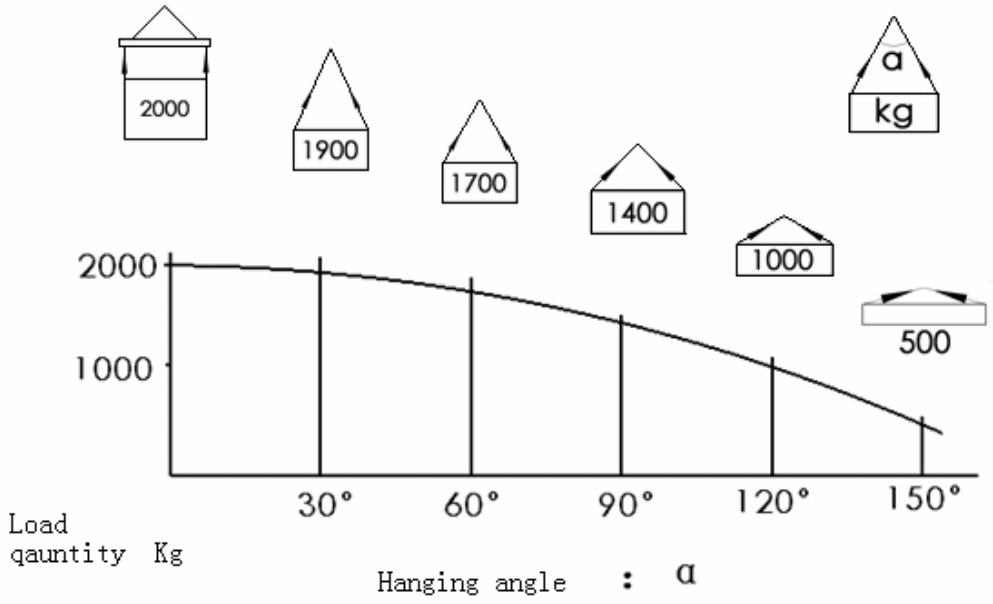



Figure 1-1

Hoisting with one wire rope may cause the heavy rotates, and then the wire rope looses or the heavy slides from the fixed location which will cause serious accidence.

3) The hoisting angle between wire rope and hook should not be oversize when hoist the extremely heavy loading.

When the hook hoists heavy loading with two or more ropes, the bigger of angle between wire rope and hook is, the heavier of each rope loads. The graphic 1-2 shows the changes of allowed loading (kg) in different angles when hoisting with two ropes (The limited vertical hoist loading of each rope is 1000 kg). It can hoist 2000kg when two ropes in the vertical location. But when the angle reaches to 120°, the ropes can only hoist 1000kg. Another hand, the force of the ropes would be 4000kg when the angle reaches 150°, although the loading is only 2000kg.




Figiure.1-2

## 1.5 Table of Tightening Torque for Common Bolts

| Bolt Strength grades | Yield Strength ($N/mm^2$) | Nominal Diameter of Bolts(mm) | | | | |
|---|---|---|---|---|---|---|
| | | 6 | 8 | 10 | 12 | 14 |
| | | Tightening Torque(N·m) | | | | |
| 4.6 | 240 | 4～5 | 10～12 | 20～25 | 36～45 | 55～70 |
| 5.6 | 300 | 5～7 | 12～15 | 25～32 | 45～55 | 70～90 |
| 6.8 | 480 | 7～9 | 17～23 | 33～45 | 58～78 | 93～124 |
| 8.8 | 640 | 9～12 | 22～30 | 45～59 | 78～104 | 124～165 |
| 10.9 | 900 | 13～16 | 30～36 | 65～78 | 110～130 | 180～210 |
| 12.9 | 1080 | 16～21 | 38～51 | 75～100 | 131～175 | 209～278 |
| Bolt Strength grades | Yield Strength ($N/mm^2$) | Nominal Diameter of Bolts (mm) | | | | |
| | | 16 | 18 | 20 | 22 | 24 |
| | | Tightening Torque (N·m) | | | | |
| 4.6 | 240 | 90～110 | 120～150 | 170～210 | 230～290 | 300～377 |
| 5.6 | 300 | 110～140 | 150～190 | 210～270 | 290～350 | 370～450 |
| 6.8 | 480 | 145～193 | 199～264 | 282～376 | 384～512 | 488～650 |
| 8.8 | 640 | 193～257 | 264～354 | 376～502 | 521～683 | 651～868 |
| 10.9 | 900 | 280～330 | 380～450 | 540～650 | 740～880 | 940～1120 |
| 12.9 | 1080 | 326～434 | 448～597 | 635～847 | 864～1152 | 1098～1464 |
| Bolt Strength grades | Yield Strength ($N/mm^2$) | Nominal Diameter of Bolts (mm) | | | | |
| | | 27 | 30 | 33 | 36 | 39 |
| | | Tightening Torque (N·m) | | | | |
| 4.6 | 240 | 450～530 | 540～680 | 670～880 | 900～1100 | 928～1237 |
| 5.6 | 300 | 550～700 | 680～850 | 825～1100 | 1120～1400 | 1160～1546 |
| 6.8 | 480 | 714～952 | 969～1293 | 1319～1759 | 1694～2259 | 1559～2079 |
| 8.8 | 640 | 952～1269 | 1293～1723 | 1759～2345 | 2259～3012 | 2923～3898 |
| 10.9 | 900 | 1400～1650 | 1700～2000 | 2473～3298 | 2800～3350 | 4111～5481 |
| 12.9 | 1080 | 1606～2142 | 2181～2908 | 2968～3958 | 3812～5082 | 4933～6577 |

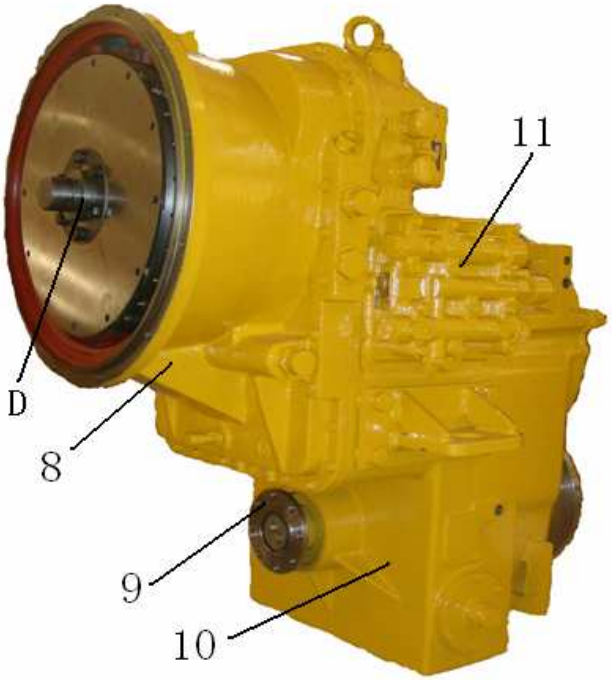
**Remark:** The screws used in the transmission are Grade 8.8. (Bolts connecting the middle cap are Grade 10.9). The following connecting parts should not executive according to the above table and should executive the enumerating data in assembly: 1. Partly assemble the transmission-install the

connecting base bolt M18;  2. Partly assemble the overrunning clutch-install the bolt M10;  3. Partly assemble the reverse gear assembly-install the bolt on the planetary carrier of reverse gear assembly: M8; 4. Partly assemble the first-gear assembly-install the bolt on the direct gear connecting plate M12;  5. Partly assemble the direct gear-install the bolt M12;  6. Install the connecting bolt on the middle cap M14;  7. Install the bolt on the hand brake assembly: M16;  8. Install the bolt on the hand brake assembly: M12.

# CHAPTER II CONSTRUCTION AND WORKING PRINCIPLE OF THE TRANSMISSION

## 2.1 Outside View


1. Eye screw
2. Variable Speed Pump
3. Carrier
4. Hand Brake Assembly
5. Front Flange Assembly
6. Oil-absorbing Assembly
7. Connecting Base




8. Torque-transmission Parts
9. Post Flange
10. Box of Transmission
11. Shift Valve Assembly

A. Interface of working pump

B. Interface of turning pump

C. Port of checking oil

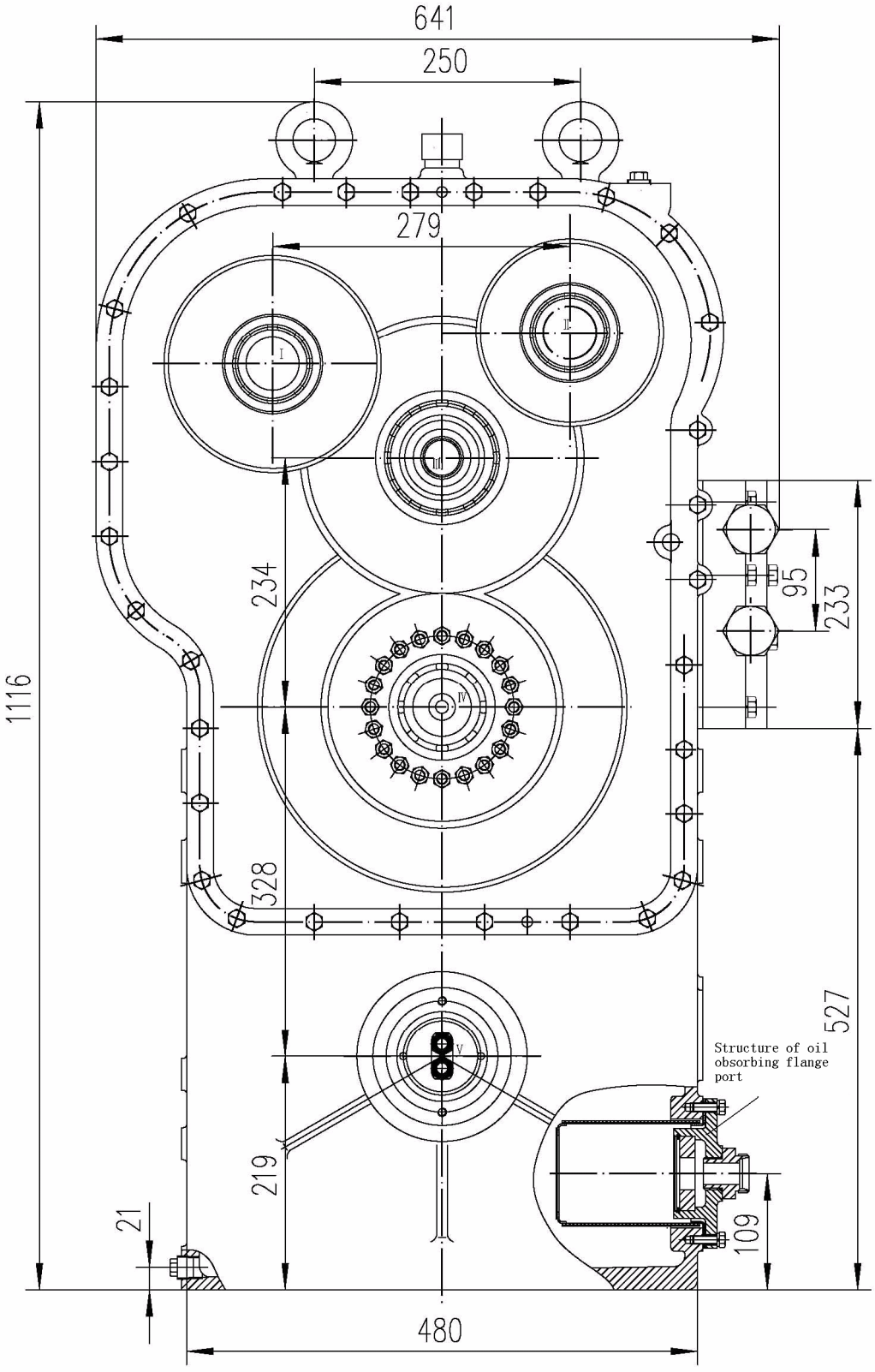
D. Engine Power Input Port

**Table of Duplex-Transmission Assembly Base Diameter**

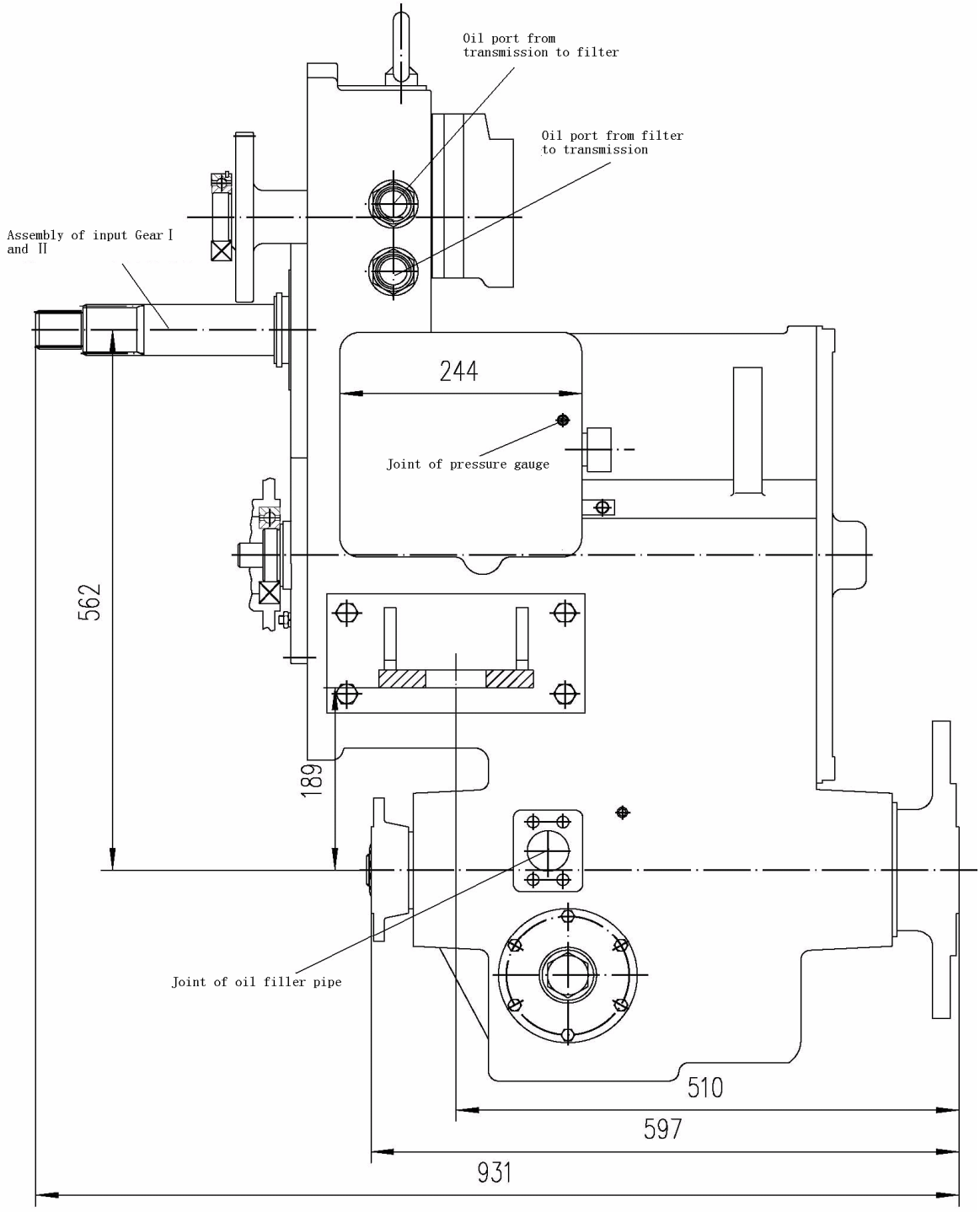
| | |
|---|---|
| Type of Duplex-Transmission Assembly | A301 Transmission |
| Suitable Types | LG953、LG936 Wheel Loaders |
| Type of Hydraulic Torque Converter | Single-grade Four-unit Double-turbine Hydraulic Torque Converter |
| Coefficient of Torque Converter | 4. 14 |
| The Way of Cooling Oil | Circulating Water cooling |
| Torque Converter Input Oil Press (MPa） | 0.549 |
| Torque Converter Output Oil Press （MPa） | 0.275~0.343 |
| Type of Transmission | Planetary Power Shift |
| Shift Gears | Two Forward Gears and One Reverse Gear |
| Variable Ratio of First gear | 2.155 |
| Variable Ratio of Second gear | 0.578 |
| Variable Ratio of Reverse Gear | 1.577 |
| Type of Shift Pump | LG03-BSB |
| Volume of No.6 Hydraulic Transmission Oil （L） | 44 |

## 2.2 General View

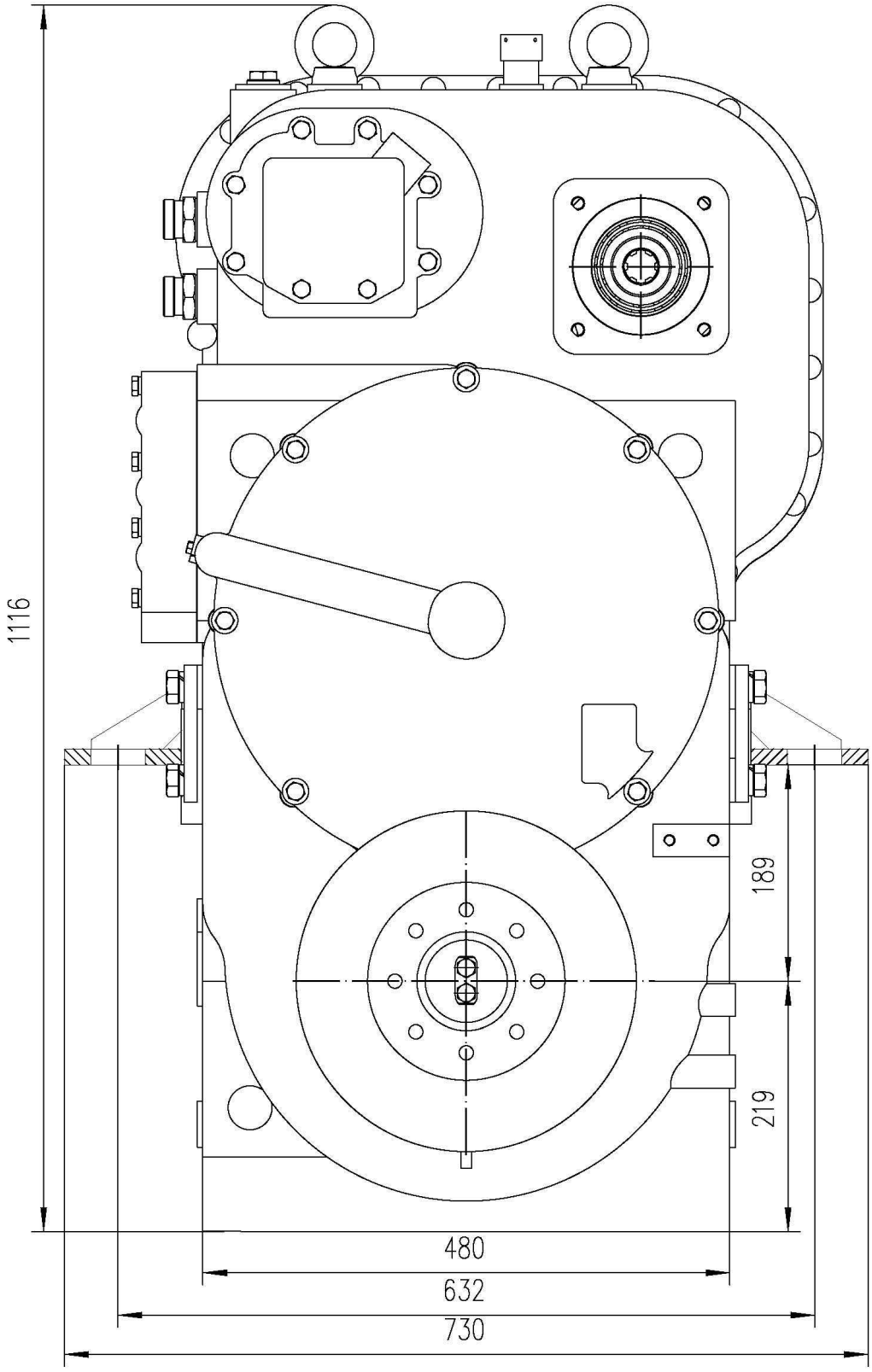
**Front View**



## Left View


Oil port from transmission to filter
Oil port from filter to transmission
Assembly of input Gear I and II
244
Joint of pressure gauge
562
189
Joint of oil filler pipe
510
597
931

**Back View**



## 2.3 The Internal Construction of Transmission

The power from engine is transmitted to the power-shift–transmission by hydraulic torque converter. The transmission is made up of planetary shift part and transmission gear part. The internal construction of which is shown in figure 2-1. Planetary shift part has two planetary systems: Reverse gear planetary system (named Reverse gear assembly followed) is made up of these parts as followed: planetary gears, planetary reverse gear carrier, planetary reverse gear axis, shield rings, washers, bolts, needle rollers, lock washers and 6010 bearings; First gear planetary system (named First gear assembly followed) is made up of these parts as follow: connecting plate of direct gear, planetary wheels, planetary first gear carrier, planetary first gear axis, annular gear of reverse gear, arresting disks, shield rings, needle rollers, 6210 bearings, No.12 washers, and bolts. The solar wheel, planetary wheel and tooth of ring gear of the two systems are the same. The direct gear parts (as Second gear) is made up of direct gear pressed plate, direct gear piston, direct gear cylinder, middle output gears, disc spring, driving and driven plate of direct gear, direct gear axis, 6204 bearings, shield rings, seal rings, pins, rotary oil seal, washers, screws and low carbon steel wires.

The power from two planetary systems will be transmitted by the same solar gear. Then the solar gear is connected with the middle input axis and direct gear input axis by spline, and all of them make up of the power input unit.

Reverse gear internal ring gear, planetary carrier of first gear planetary system, and pressed plate of direct gear (which is fixed with middle output gear) are connected by splines, and all of which are the power export equipment of planetary shift unit.

The driving and driven friction disc are fixed on the reverse gear planetary carrier and the internal gear ring respectively, both of which are connected with driving and driven friction disc by gear teeth. The driven friction disc transmits power to the shell and be guided by the isolating tray cylindrical pin fixed on the shell. The hold-down between driving and driven friction is operated by the piston of oil cylinder. On contrast, the separation is operated by the return spring arranged along circle to the initial position.

The direct gear has two driving friction plates and one driven friction plate. They are connected with direct gear input axis with screws. The only driven friction plate transmits power to direct gear pressed plate and be guided by the cylindrical pin on the direct gear pressed plate.

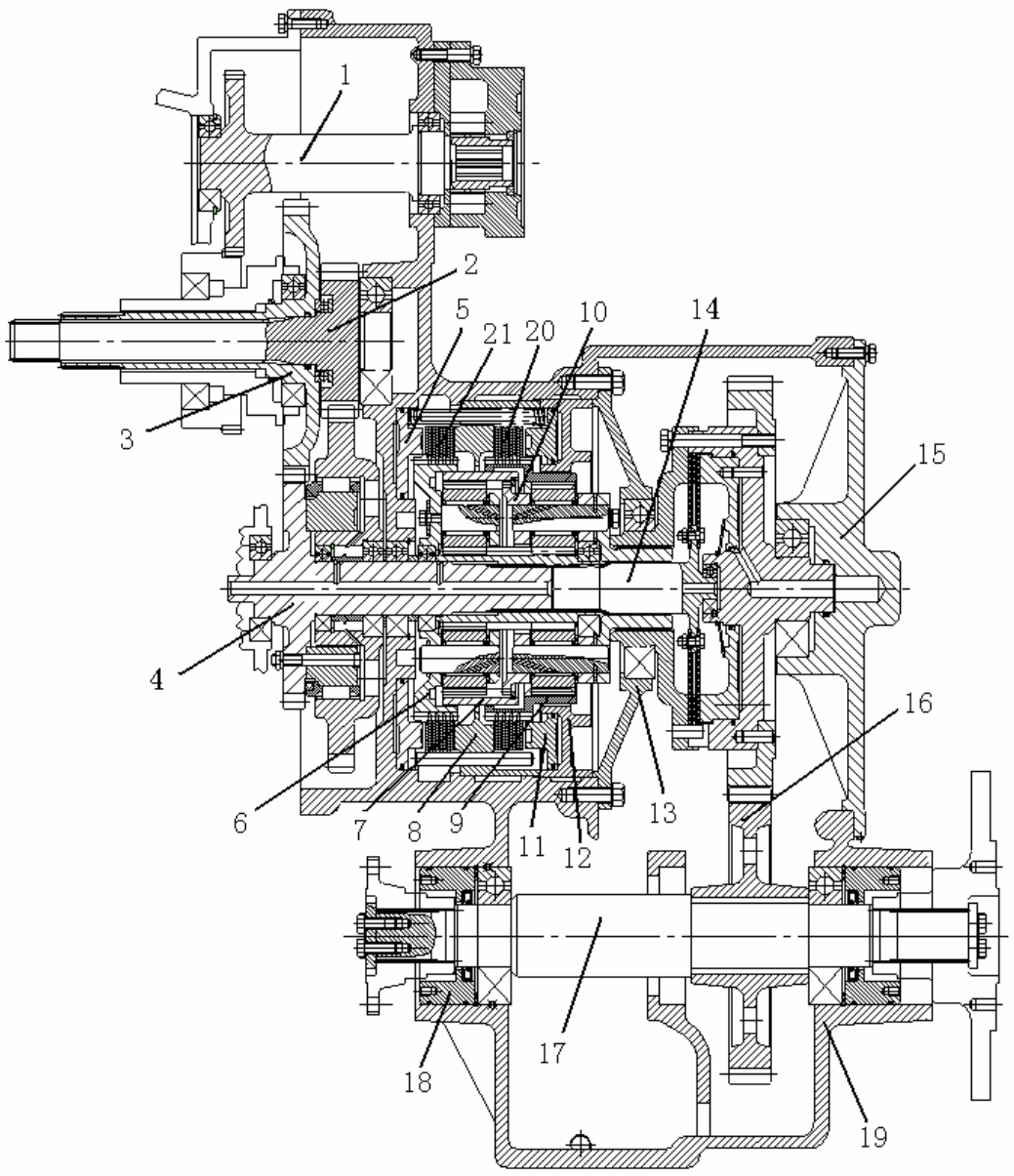



**Figure. 2-1**

1. Axis gear parts 2. Primary input gear assembly 3.Secondary input gear assembly 4.Overrunning clutch assembly 5.Reverse gear piston assembly 6.Reverse gear assembly 7.Reverse internal gear ring 8.Friction plate isolating carrier assembly 9.Internal gear ring 10. First gear assembly 11. First gear piston assembly 12. First Gear oil cylinder assembly 13.Middle cap 14.Direct gear assembly 15.End cap 16.Gear of export axis 17.Export axis 18.Oil seal seat assembly 19.Box 20.Driving and driven plate of first gear

21. Driving and driven plate of reverse gear

## 2.4 Working Principle of the Transmission

### 1. The construction of our company's A301 transmission is planetary power shift transmission.

Planetary transmission is made up of planetary systems. The base construction of planetary system is shown in figure 2-2. The base planetary system contents contain solar gear 1, planetary gears 2, planetary carrier 3, and gear ring 4.

Planetary gears are installed on the planetary carrier. In the planetary transmission, these are only three parts would connect with outside because of the axis of planetary system rotating in the space which causes the internal parts to connect outside difficultly. On the process of transmission, the planetary gear takes no direct relationship with transmission ratio and just is the idle gear transmitting motion.

As known by mechanical principle:

Equation of planetary system rotating speed:

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

$n_s$ —— Rotating speed of solar gear

$n_r$ —— Rotating speed of gear ring

$n_c$ —— Rotating speed of planetary carrier

K —— Characteristic diameter of planetary system：K＝Zr／Zs；

Zr —— Teeth number of gear ring；

Zs —— Teeth number of solar gear.

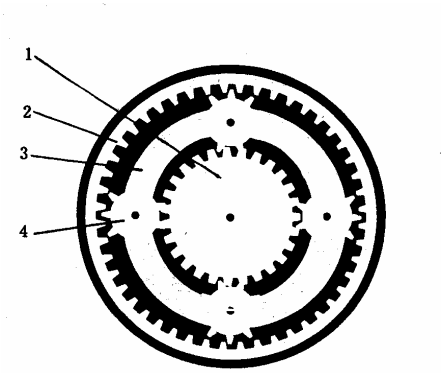



**Figure 2-2 Construction of base planetary system**

1.Solar gear 2.Gear ring

3.Planetary carrier 4.Planetary gear

To ensure the possibility of assembling parts, the value of K often in the followed range：4／3≤K≤4.

As known from equation of planetary system rotating speed, when making the three base parts of planetary system as input, export and fixed parts, we can get six kinds of transmission plans: two deceleration gears, two increasing gears and two reverse gears.

As to the A301 transmission from our company, the power of planetary system is input from solar gear. So, these are only two kinds of transmission scheme. They are shown in figure 2-3.

(1) When the gear ring is fixed, solar gear is input end and planetary carrier is export end.

At this time, nf＝o, put it into the relation equation of planetary system rotating speed and we will

get the next equations:

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

$$= (1 + K)n_c$$

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

It is deceleration transmission because i>1, which caused by K>1. This is the forward First gear of transmission in actual application.

(2) When the planetary carrier is fixed, solar gear is export end and gear ring is input end. At this time, $n_c = 0$, put it into the relation equation of planetary system rotating speed and we will get the next equations:

$$n_s + Kn_r = 0$$

$$n_s = -Kn_r$$

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

The minus sign means the rotating steering of $n_s$ and $n_r$ is opposite. In actual transmission, the direction of loader is forward when it has the same direction with $n_s$. Therefore, the $n_r$ is reverse deceleration motion.

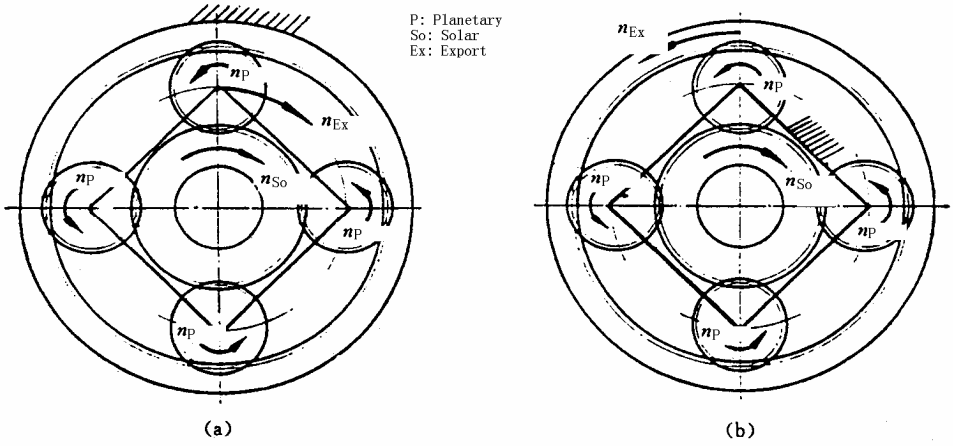



**Figure 2-3 Principle of planetary speed shifting mechanism**

（a）Gear ring is fixed. Solar gear is input end. Planetary carrier is export end

（b）Planetary carrier is fixed. Solar gear is input end. Gear ring is export end

**Notice**: The forward Gear II is named direct gear too. Because it transmits the power, which is from solar gear, to export gear directly by second gear clutch. (We will name it direct gear in the following articles).

## 2. Transmission Principle of the Loader Shifting Mechanism

The transmission principle of A301 transmission torque converter is shown in Figure 2-4. The power from engine transmits to the primary input gear 7 and the secondary gear 6 by the grade one and two turbines of the hydraulic torque converter. Torque is transmitted to the overrunning clutch 15 of the transmission by gears 6 and 7. Furthermore, it is transmitted to the solar gear 14 which in the transmission by the input axis 16. So, the power could be transmitted into the transmission.

When the shift operation valve is located in reverse gear location, press oil flows from shift operation valve into the reverse gear oil inlet of transmission box. The oil flows into reverse gear cylinder and pushes reverse piston, which makes it possible for the driving friction plate to contact with driven friction II plate fixed on the box (The right planetary system works and the left one do not work). Because driving friction plate is fixed on the planetary carrier and connects with it, and driven friction plate connects with isolating carrier which is fixed on the box, when reverse gear planetary carrier is fixed, the power from solar gear exports to outside by the internal gear ring of reverse gear on the way of planetary gears according to the principle of reverse planetary transmission mechanism. The reverse internal gear ring connects with first gear planetary carrier (First gear planetary carrier connects with connecting plate of direct gear, and connecting plate connects with press plate of direct gear by spline). So power from reverse internal gear ring is transmitted to press plate of direct gear by First gear planetary carrier, and then transmitted to middle export gears (Press plate of top is fixed with middle export gears). At last, power is transmitted to the export axis gears by middle export gears (Export axis gears are fixed with export axis by spline).

When the shift operation valve is located in First gear location, press oil flows from shift operation valve into the First gear oil inlet of transmission box. The oil flows into First gear cylinder and pushes reverse piston, which makes it possible for the driving friction plate to contact with driven friction plate fixed on the box (The right planetary system do not work and the left one works). The First gear internal gear ring meshes with driving friction plate, and First gear driven friction plate connect with isolating carrier fixed on the box by cylindrical pin. According to the principle of reverse planetary transmission mechanism, when the internal gear ring of First gear is fixed, the power from solar gear is transmitted outside to the planetary carrier by planetary gear of First gear (First gear planetary carrier connects with connecting plate of direct gear, and connecting plate connects with pressed plate of direct gear by spline). So, the power from First gear planetary carrier is transmitted to pressed plate by connecting plate of direct gear. The following steps are the same as reverse gear.

When the shift operation valve rod is located in direct gear location, press oil flows from shift operation valve into the direct gear oil inlet of transmission box. The oil flows into direct gear cylinder and pushes reverse piston, which makes it possible for the driving friction plate to contact with driven friction plate. According to the principle of reverse planetary transmission mechanism, the power from solar gear is transmitted to direct gear pressed plate by direct gear axis. At last, power is transmitted out from export gear axis.

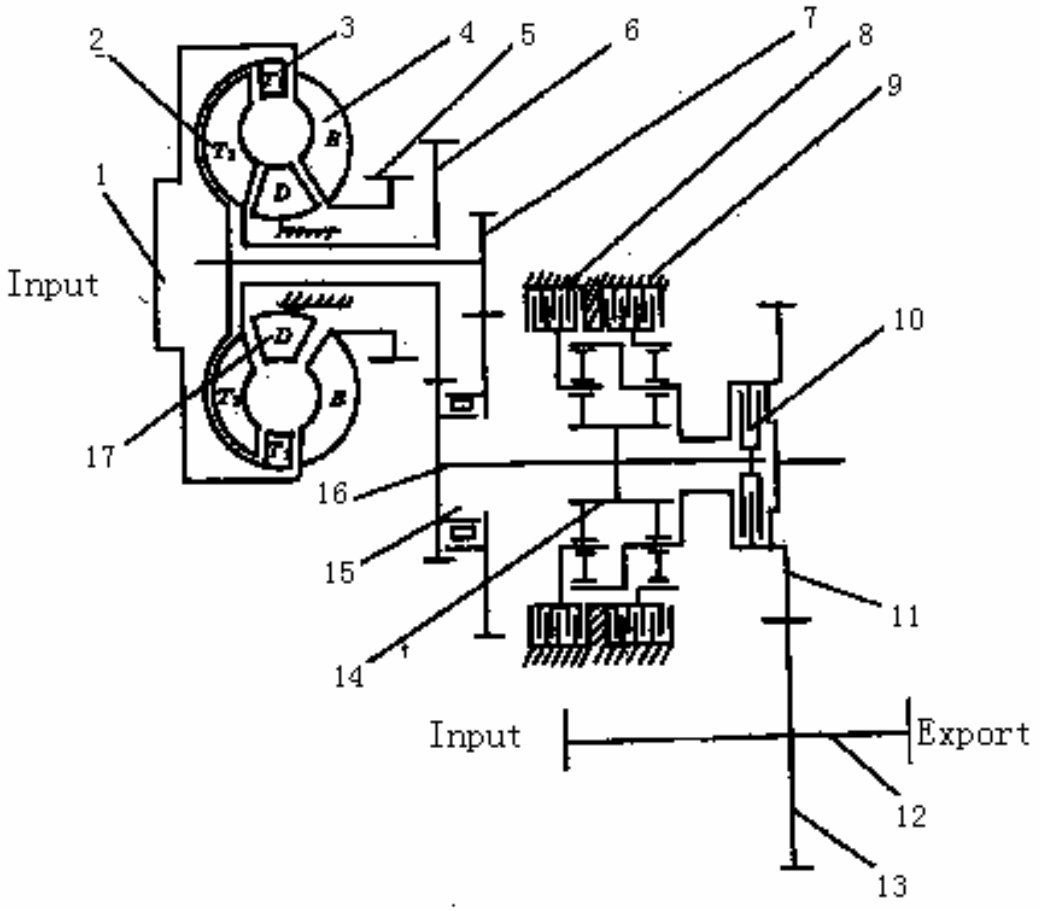
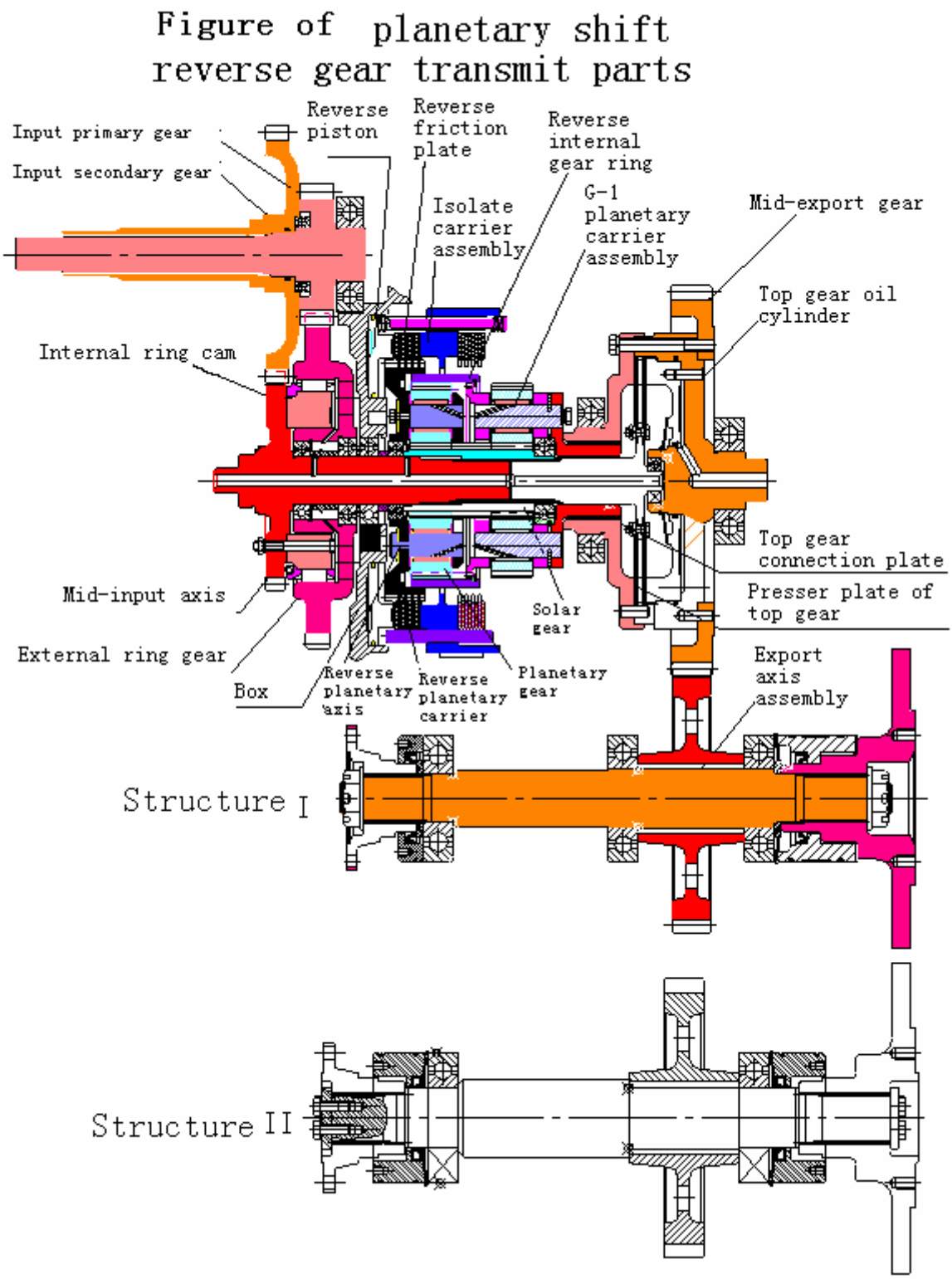



**Figure2-4 Transmission principle of transmission and torque converter**

1.Elastic plate 2.Secondary turbine 3.Primary turbine 4.Pump wheel 5.Diffluence power wheel 6.Input Secondary gear 7.Primary input gear 8.Reverse gear clutch 9.First gear clutch 10.Second gear clutch 11.Export gear ring 12.Export axis 13.Export gear 14.Solar gear 15.Overrunning clutch 16.Middle input axis 17.Guide wheel

### 3. Brief description of transmission ways of each gear in the transmission.

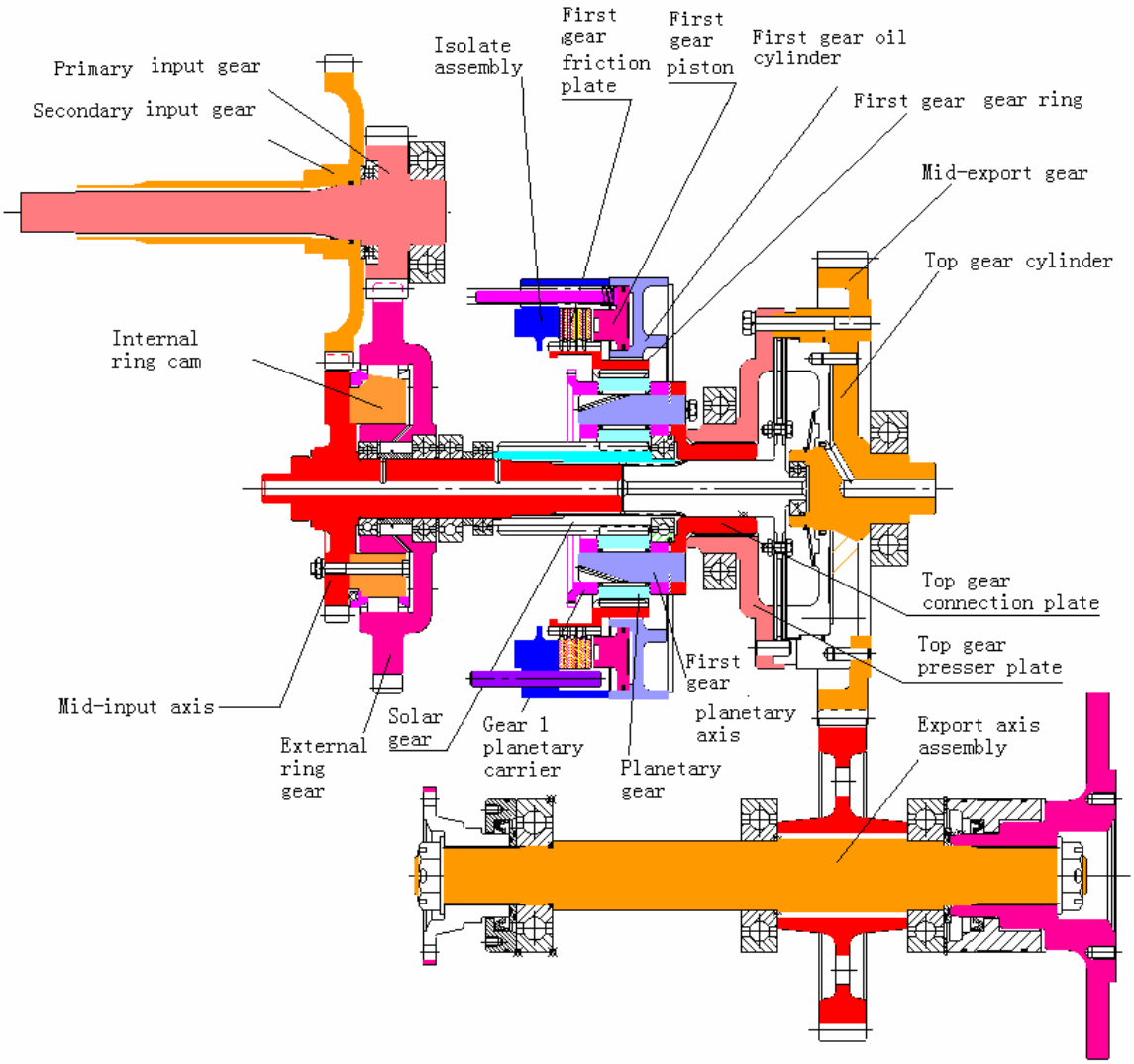



**Notice**: these are two kinds of export axis mechanism as shown in above figure. Partial transmissions apply the mechanism Ⅱ. This manual will introduce the assembly and disassembly

of mechanism Ⅰ. The assembly and disassembly of mechanism Ⅱ won't be introduced here and could be found in other informations. (The mechanism Ⅱ won't be marked in the followed figures of First gear and direct gear.)

The transmitting way of reverse gear as this: Torque from engine—Hydraulic torque converter—Primary and secondary input gear—Middle input axis—Solar gear—Reverse planetary gear—Reverse internal gear ring—First gear planetary carrier—Pressed plate of direct gear—Middle export gear—Gear of export axis—Export axis.

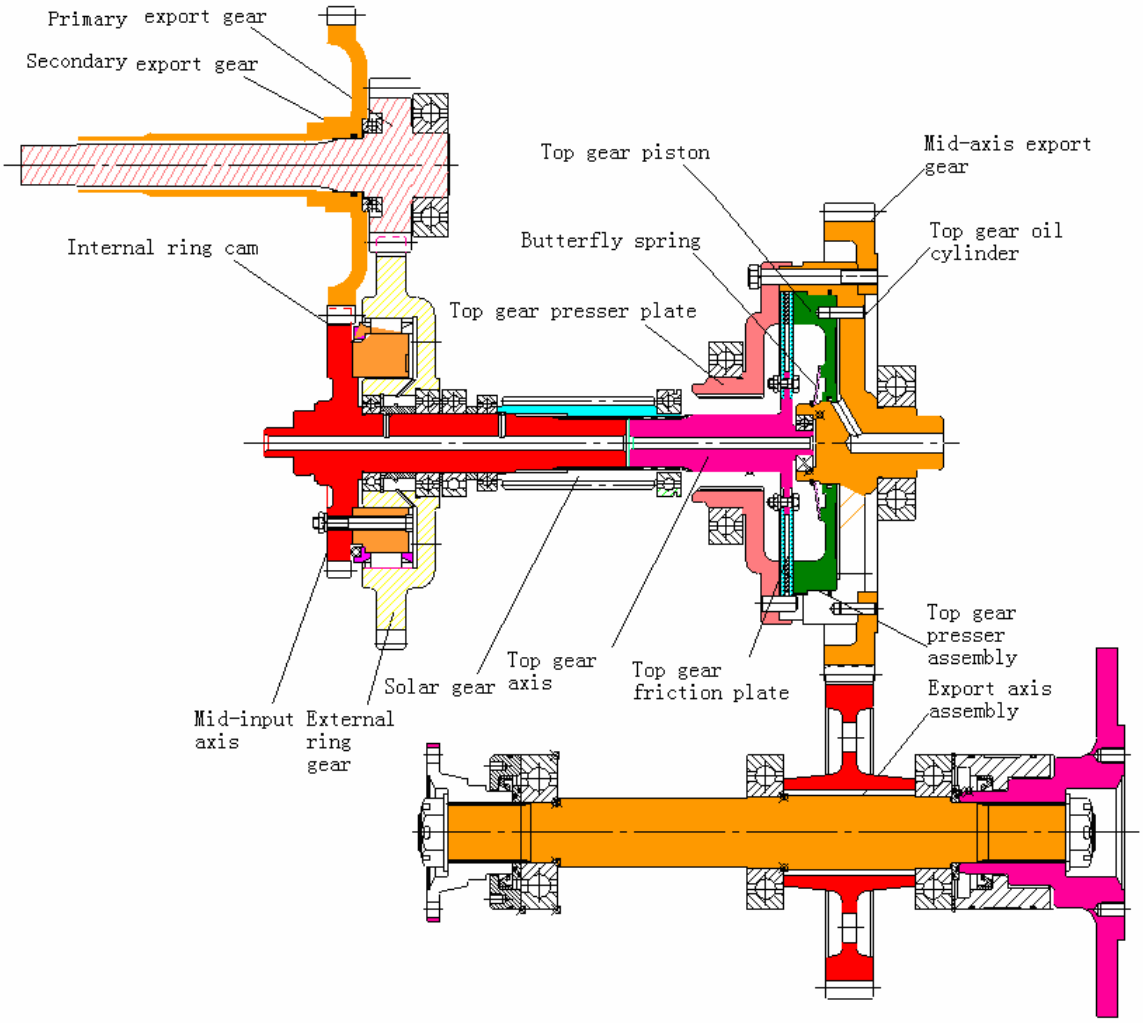
Figure of planetary shift first gear transmit part




The transmitting way of first gear as this:

Torque from engine—Hydraulic torque converter—Primary and secondary input gear—Middle input axis—Solar gear—First gear planetary gear—First gear planetary carrier—Pressed plate of direct gear—Middle export gear—Gear of export axis—Export axis.

Figure of planetary shift second gear transmit part




The transmission way of direct gear as this:

Torque from engine—Hydraulic torque converter—Primary and secondary input gear—Middle input axis—Solar gear—Axis of direct gear—Pressed plate of direct gear—Middle export gear—Gear of export axis—Export axis.

## 2.5 Oil Supply Principle of Transmission

Oil supply system principle of transmission and torque converter is shown in Figure.2-2.

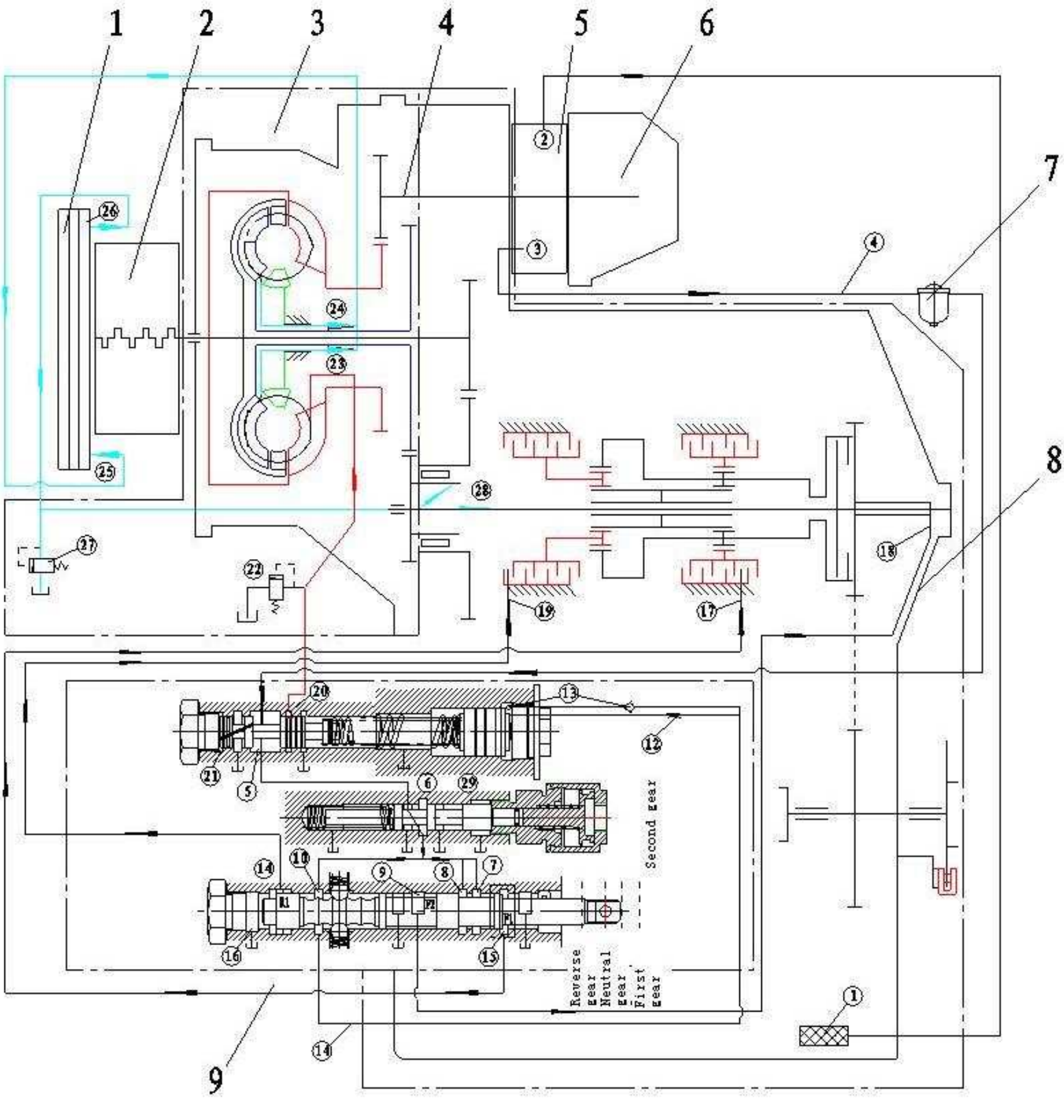



**Figure 2-5 Oil supply system principle figure of transmission and torque converter**

1. Radiator 2.Diesel engine 3.Torque converter 4.Axis gear 5.Speed shifting pump

6.Work pump 7.Oil filter 8.Transmission 9.Shift operating valve

Oil supply system is made up of shift pump 5, oil filter 7, radiator (cooler 1), oil box (made up of oil base shell and box body) and oil cylinder.

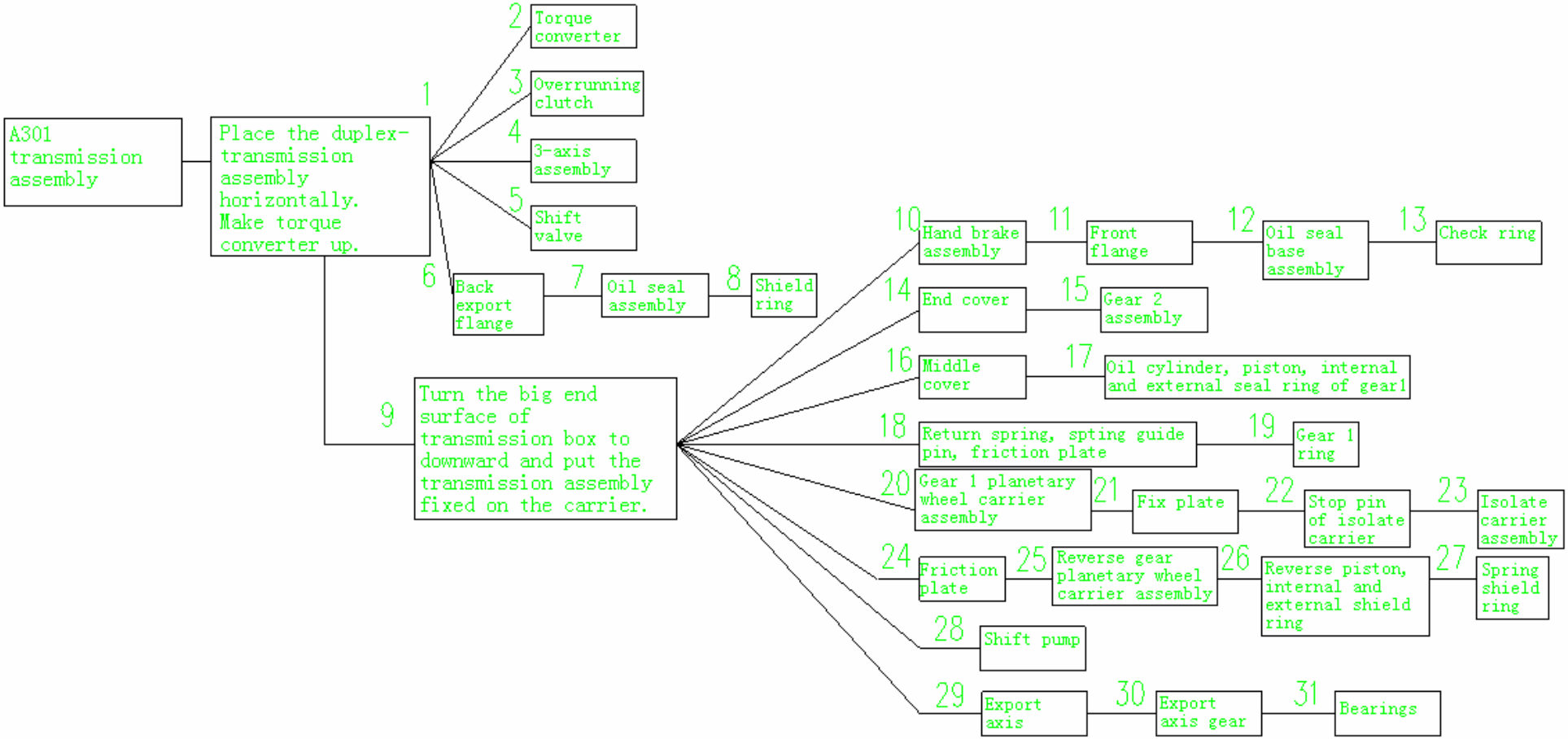
When diesel drives torque converter, the shift pump, which is driven by partial-move gear installed on the pump wheel and shift oil pump gear 4, absorbs oil from the oil base shell. The press oil, which is pressed by oil pump and filtered by oil filter (when the filter element is blocking, oil fluent from bypass valve), flows into operating valve. Now, press oil is separated into two ways: One way is that the oil flows into shift operating oil ways by relief valve. Then oil flows into different gear cylinders by the different location of shift pump bar and does the works of different gear locations. In this shift oil way, cut-off valve could cut off the way to shift valve bar by requirements; another way is that the oil flows into the working cylinder of torque converter.

When the transmission gear is full of oil, working oil flows into the left end of valve bar by the inclined hole in the relief valve bar 21. Push the valve bar to the right, then the hole 5 can connect with the hole 10. Oil will be supplied to torque converter, and the cylinder of torque converter will have some press. A part working-oil which has flown into torque converter incessantly, stay in the pomp wheel, and another flows into the oil-out groove by the gap between the working wheels. Oil from out-groove flows into radiator (cooler) or lubrication oil way by hole 24, 25, 26, 27 to lubricate the bearings and overrunning clutch. The oil from torque converter flows into heat dissipation equipment by flexible pipe to keep the normal temperature of oil supply system. The oil temperature is better to be kept at the range of 80℃～90℃ or 120℃ in a short time when works. If the temperature is too high, which will cause the loader’s power down significantly, the machine must be shutdown. The low-press oil which has been cooled flows back to torque converter and lubricates overrunning clutch and planetary systems by the hole on shell.

When gears should be shifted, shift requirement of first gear, second gear and reverse gear would be achieved by the shift location shown in figures. Oil supply way of the forward first gear: Pressure regulating valve—Cutoff valve—Hole 7—Hole 5—Hole of first gear clutch. Oil supply way of forward second gear: Pressure regulating valve—Cutoff valve—Hole 8—Hole 9—Hole of direct gear clutch. Oil supply way of forward reverse gear: Pressure regulating valve—Cutoff valve—Hole 10—Hole 14—Hole of reverse gear clutch.

# CHAPTER III DISASSEMBLY OF TRANSMISSION

## 3.1 Network Figure of General Disassembly (corresponding to disassembly of transmission)



**Disassembly Tools and Equipments**

| Name of general tools | Specification | Number | Application position (corresponding to the No. of Network Figure or assembly name) |
|---|---|---|---|
| Gas trigger | LB10,LB16,LB20 | 1group | Choose different specification by size of bolts |
| Sleeve | 10,13,16,18,24 | 1group | Choose different specification by size of bolts |
| Flat screwdriver | | 1 | 22, Disassembling the shield ring of First gear assembly |
| Solid wrench | 13×16,18×21,22×24 | 1group | Choose different specification by size of bolts |
| Copper bar | | 1 | During hanging, flick the firm parts by it; Flick bearings when disassembly them |
| **Name of special tools** | **Specification** | **Number** | **Application position (corresponding to the No. of Network Figure or assembly name)** |
| Assembly carrier of transmission | Prepare to provide your own assembly platform when without it | 1 | 1 |
| Shield ring pliers for axis (hole) | 200,300 | one for each | 8,13,27 When disassembling the internal shield ring of assembly |
| Disassembly tools of oil seal base | Prepare it by yourself as shown in figures | 1 | 7,12 |
| Screw pusher | Replace it by common bolts according to size of screw holes | | 2,3,14,16 |
| Hanging bolts  | M10,M14,M16,M18 | | 1,2,3,9,14,15 |
| Platform carrier | Prepare it by yourself as shown in figures | 1 | 3.3.1,3.3.2,3.3.3,3.3.4 |

**Explanation about Disassembled Parts**

1. Never reuse the disassembled sealing elements, and Make sure replace them with the new;
2. Magnitude of references for partial bearings are relatively bigger because they were assembled by heated and pressed assembling in their corporations, which will bring injury to bearings when disassembling. Those bearings, whose surfaces are damaged in disassembling, could be reused when repaired and satisfied the using standard, otherwise, are dealt as scrap bearings.

**Preparative work**

(1) Clean the soil and fouling on the duplex-transmission assembly completely.

(2) Loosen off oil drain plug and release transmission oil.

Hydraulic transmission oil: about 45 liters.

(3) Prepare firmly transmission assembling carrier.

kg Duplex-transmission assembly: about 640 Kg.

## 3.2 Disassembly of Transmission

1. Place the duplex-transmission assembly horizontally and fix it.

Make torque converter up. Fix duplex-transmission assembly on the carrier and loosen off the bolts on the torque converter and transmission.

2. Hanging and disassembling the torque converter assembly.

kg Torque converter: about 150Kg

First, you should separate torque converter and transmission by screw pusher. Then hang the torque converter away from transmission and put it on the working platform.

Screw pusher: M10

When hang the torque converter, make sure that hanging tools on the right top of it. For avoiding hurting hands, do not touch the joint surface of torque converter which is hanged away transmission in the progress of hanging.

3. Screw two corresponding specification sizes of pusher screws into the screw holes on the overrunning clutch. The clutch will be pushed away from shell, and then it will be hung away. Top screw: M 14.

Overrunning clutch assembly

4. Disassemble the third-axis assembly from box body.

5. Loose the bolts which fix the shift valve by corresponding specification tools. And then dismount the shift valve and take down the gasket.

★ Put the shift valve on the clean place and cover the face of oil channel entrance for avoiding the dust and miscellany entering the valve.

6. Loose the bolts by corresponding specification tools. Take down the stop-pushing gasket and back export flange.

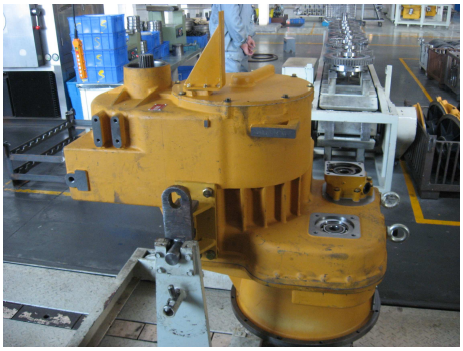
7. Disassemble the oil seal assembly with professional tools.

★ Make sure that the corrosion, which on the joint surface between shell and oil seal assembly, is removed first to avoid destroying the surfaces of shell and oil seal assembly. Make sure your power is average to keep the oil seal assembly to be horizontal if the professional tools are not be used.

8. Take down the shield ring by axis-shield ring pliers.

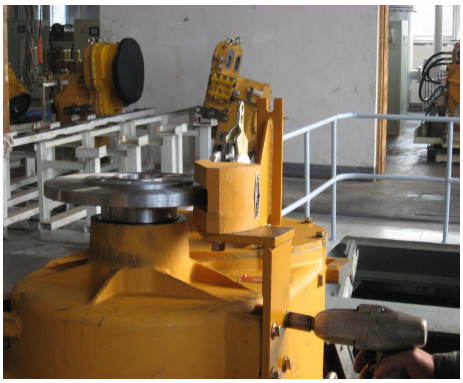
⚠ Make sure that the pliers be clamped firmly to avoid pliers bounce off to form hidden danger.

9. Turn the big end surface of transmission box to downward and put the transmission assembly fixed on the carrier.



⚠ Please keep the part be settled stably and safely without carrier.

10. Disassemble the hand-brake assembly.



11. Disassemble the front flange.

12. Disassemble the oil seal assembly with professional tools.

★ Make sure that the corrosion, which is on the joint surface between shell and oil seal assembly, is removed first to avoid destroying the surfaces of shell and oil seal assembly.

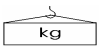
13. Take down the shield ring by axis-shield ring pliers.

⚠ Make sure that the pliers be clamped firmly to avoid pliers bounce off to form hidden danger.

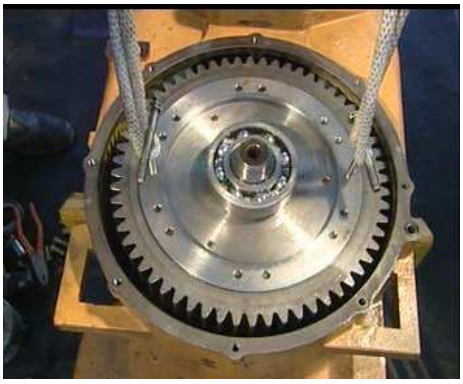
14. Loose the end cover bolts with corresponding specification tools and push end cover away from box with two pusher screws. Top screw: M10.

kg End cover. Take down the seal gasket and take out the rotating seal.

15. Hang the direct gear assembly down.




Direct gear assembly.



16. Push the middle cover with pusher screws and take it down. Top screw: M10.

★ There are 15 return springs distributing around the box. In the disassembly process, the following steps should be abided for avoiding hurting people by the ejecting middle cover caused by the big spring power. Fix two M14×50 bolts in the screw holes on the middle cover first. When loose the bolts choose two diagonal bolts and loose them out from hole about 15mm. And then, loose the other 6 bolts and the two diagonal bolts carefully. At last, extract the middle cover with the two M14×50 bolts.

17. Disassemble First gear oil cylinder by hand. Take out the piston, the internal and external seal ring.

18. Take out the return spring and spring guide pin by hand. And take out friction plate.

19. Take out the first gear ring and separate the friction plate on it.

20. Take out the first gear planetary carrier assembly.

21. Take out the fixed plate.

22. Warped the stop pin of isolate plate with screwdriver.

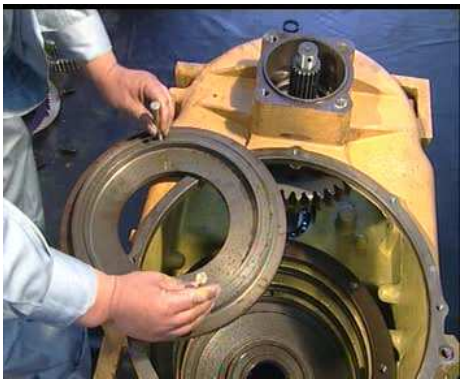
★ Don’t hurt the box shell in the warped process.

23. Take out the isolate assembly by hand.

24. Take out the friction plate by hand.

25. Take out the reverse gear planetary carrier assembly by hand.

26. Take out the reverse gear piston, internal and external seal ring.



27. Detach the spring seal ring on the box four-axis with circlip pliers.

⚠ Make sure that the pliers be clamped firmly to avoid spring bouncing off to form hidden danger.

28. Loose the connection screws that fixed the shift pump. Disassemble the shift pump and take out seal ring.

★ Put the shift pump on the clean place and cover the face of oil channel entrance for avoiding the dust and miscellany entering the pump.

29. Detach the export axis by hand.

★ Keep the power balance to protect box surface in the progress of detaching axis.

30. Take out the gear of export axis by hand.

31. Detach the bearings.

## 3.3 Disassemble of the Assembly

### 3.3.1 Disassemble the direct gear assembly

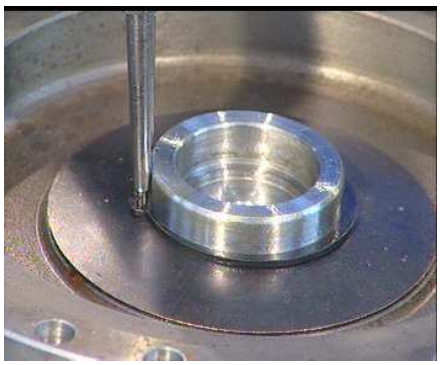
1. Place direct gear assembly on the bench horizontally.

2. Disassemble the locking steal wire of the connecting bolt on the direct gear pressure plate with pincers.
3. Disassemble the connecting bolt.

4. Take down the direct gear pressure plate by hand.

5. Take down the direct gear and three fiction plates together.

6. Take down the shield ring with external circlip pliers.



Make sure the circlip pliers are clamped firmly during using to avoid bouncing off the box body, otherwise form hidden danger.

7. Take down the disc spring by hand.

8. Take down the direct gear piston by hand.

9. Take down the seal ring and rotary oil seal on the direct gear piston by hand.

10. Take down the intermediate output gear by hand, separate the direct gear cylinder from the intermediate output gear, then take down the intermediate output gear.

### 3.3.2 Disassemble the first gear assembly

1. Place first gear assembly on the bench horizontally.
2. Disassemble the attaching bolts in the direct gear coupling flange.

3. Take down the direct gear coupling flange by hand.

4. Take down the stop disk by hand.

5. Take out the shield ring in reverse ring gear with screwdriver.

**Never** take out too hard to avoid bouncing out the shield ring and causing accident happen.

6. Separate the inner ring gear from planet gear frame, and take down the inner ring gear.

7. Lightly beat the first gear planet axis out.

.

8. Take down the planet gear and the gasket by hand.

9. Take out the shield ring and needle roller in the planet gear.

10. Lightly beat the bearing out.

11. Take out the shield ring on the bearing with external circlip pliers.

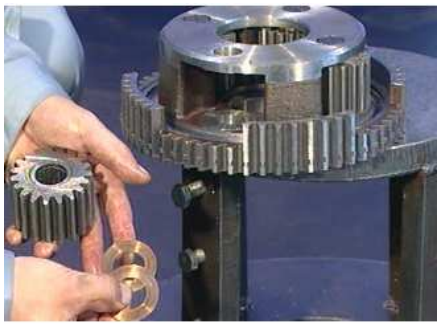
Make sure the circlip plier is clamped firmly during using to avoid bouncing off the box body and forming hidden danger.

### 3.3.3 Disassemble the reverse gear assembly

1. Place reverse gear assembly on the bench horizontally.
2. Disassemble the bolts and stop washer on the reverse gear planet axis.

3. Lightly beat the reverse gear planet axis out.

4. Take down the planet gear and gasket by hand.

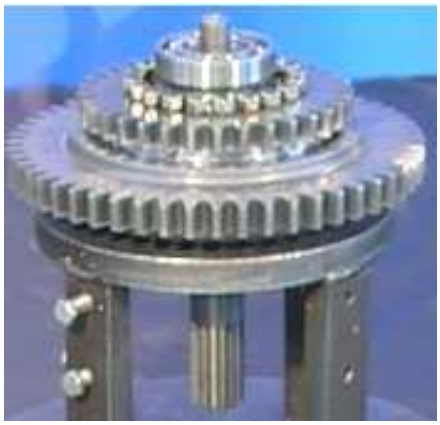


5. Take down the shield ring and needle roller in the planet gear by hand.

6. Lightly beat the bearing out.

### 3.3.4 Disassemble the overrunning clutch

1. Place overrunning clutch on the bench horizontally.



2. Dismount the intermediate input axis and connecting nuts of inner loop cam.

3. Beat the intermediate input axis out lightly.

4. Take down the bearing and washer in order.

5. Bind the bolts with rubber band, and then take out the isolating ring, inner loop cam and 24 balls and bolts simultaneously.

★ **Notice**: Some machine type structure is different from the picture, please adjust working contents according to the actual structure when disassembly.

6. Take down the return spring by hand.

★ **Notice**: Some machine type structure is different from the picture, please adjust working contents according to the actual structure when disassembly.

7. Take down the isolating ring and rubber band by hand.

★ **Notice**: Some machine type structure is different from the picture, please adjust working contents according to the actual structure when disassembly.

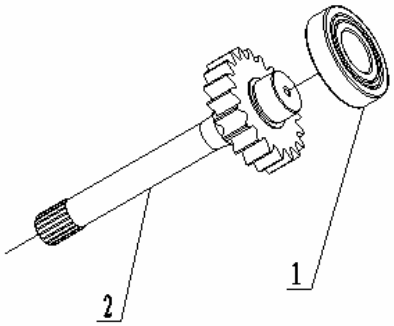
8. Take out the shield ring with circlip pliers.

⚠ Make sure the circlip plier is clamped firmly during using to avoid bouncing off the box body, otherwise form hidden danger.

9. Beat the bearing in outer loop gear out with copper rod lightly.

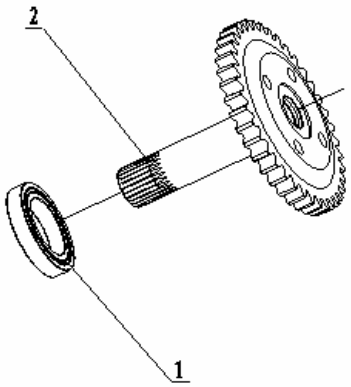
### 3.3.5 Disassemble the primary input gear assembly

Dismount the bearing 1.



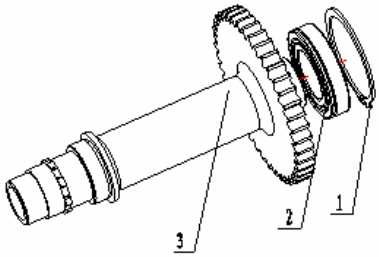

### 3.3.6 Disassemble the secondary input gear assembly

Dismount the bearing 1.



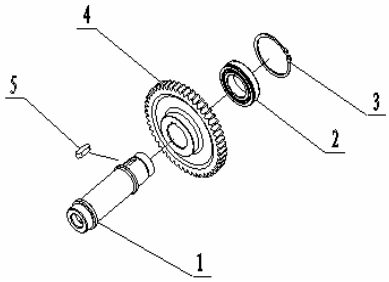

### 3.3.7 Disassemble the shaft gear assembly

Take down the shield ring 1 with external circlip pliers, and then take down bearing 2 from the shaft gear.



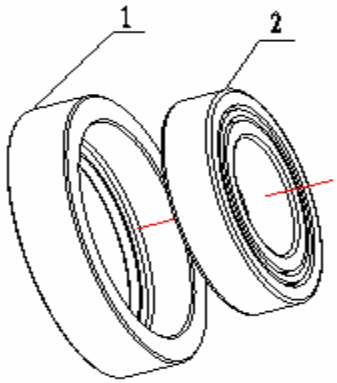
### 3.3.8 Disassemble the steering pump driving gear assembly

Take down the shield ring 3 with external circlip pliers, then take down bearing 2 from the shaft gear, finally take down the steering pump driving gear 4 and bond 5 from the steering pump driving axis in order.



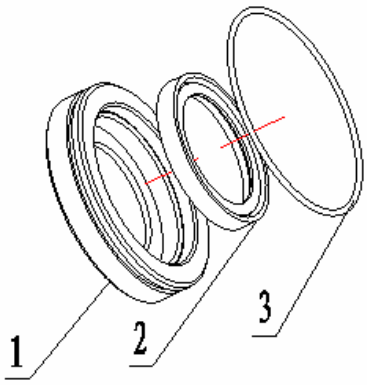

### 3.3.9 Disassemble the bearing chock assembly

Beat the bearing 2 out of the bearing chock 1.



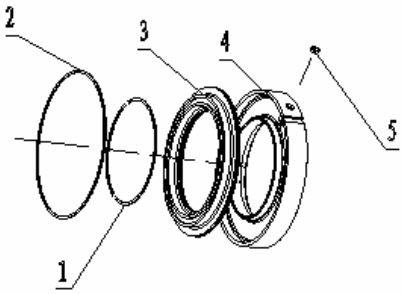

### 3.3.10 Disassemble the oil seal seat assembly

Take down o-ring 3 and framework oil seal from the oil seal seat in order.



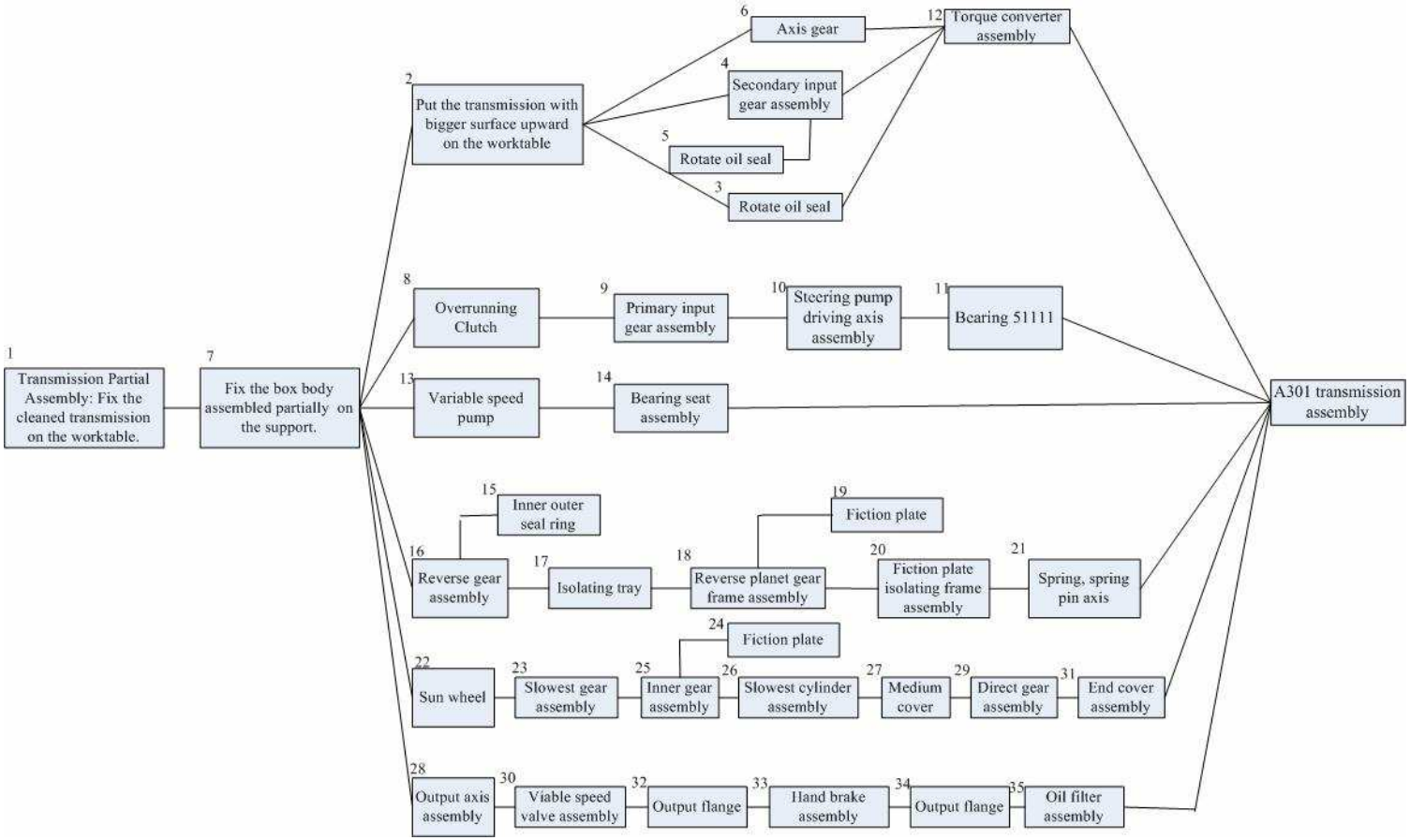

### 3.3.11 Disassemble the first gear cylinder assembly

Take down rectangular seal ring 5 with screwdriver, then take down the seal ring 1, outer seal ring 2 and first gear piston 3 by hand simultaneously, finally take out the seal ring 1, outer seal ring 2 from the first gear piston 3.



# Chapter IV the Assembly of Transmission

## 4.1 The Network Figure of the General Assembly (corresponding to the assembly of transmission)



Assembly Tools and Equipments

| **General Tools Name** | **Specification** | **Number** | **Application position (corresponding to the No. of Network Figure or assembly name)** |
|---|---|---|---|
| Gas Trigger | LB10, LB16, LB20 | 1 group | Select different specification according to the size of the assembly bolts |
| Sleeve | 10, 13, 14, 15, 16, 18, 21, 24, 41 | 1 group | Select different specification according to the size of the assembly bolts |
| Dial Indicator | 0.01/0~3, 0.01/0~5 | 2 | 12 |
| Solid Wrench | 13*16, 18*21, 22*24 | 1 group | Select different specification according to the size of the assembly bolts |
| Copper Rod | | 1 | Lightly beat the parts with Assembly Magnitude of Interference |
| Heating Machine | Please use other methods without it | 1 | Assembly parts of general assembly |
| Cleaning Machine | Please use other methods without it | 1 | Clean every parts |
| Frozen Cabinet | Please use other methods without it | 1 | 28 |
| Press | Please use other methods without it | 1 | Assembly parts of general assembly |
| Depth Vernier Caliper | 0.02/0~200 | 1 | Assembly parts of orque converter, General assembly of input first gear gear, Assemble the friction disk, medium cover, variable speed pump, end cover |
| Leveling Rule | | 1 | Assembly parts of orque converter, variable speed pump |
| **Special Tools Name** | **Specification** | **Number** | **Application position (corresponding to the No. of Network Figure or assembly name)** |
| Variable Speed Pump Assembly Support | Prepare to provide your own assembly platform when without it | 1 | 7 |
| Circlip Pliers for Axis (Hole) | 200, 300 | 1 | Assemble the circlip |
|  Hoisting Bolts | M10, M14, M16, M18 | 1 | 8, 29, 31 |

# 4.2 Specification of Assembly of the Transmission and Notices

### 4.2.1 Classifications and tightening methods of screw fasteners of box

The screw fastener for box can be classified Grade A, B, C according to the analysis of assembly performance, assembly process, assembly operation and assembly quality of box series products, and the prevention factors of oil leakage, and the importance of assembly goods' quality characteristics.

Table of importance Grade A for the transmission screw fastener

| No. | Position |
|---|---|
| 1 | The bolts and nuts connecting input axis and inner loop cam in the overrunning clutch |
| 2 | The bolts connecting direct gear coupling flange and first gear planet gear |
| 3 | Variable speed pump connecting bolts |
| 4 | Medium cover connecting bolts |
| 5 | Speed-changing valve connecting bolts |
| 6 | The bolts connecting end cover and box |
| 7 | Divariant connecting bolts |

Table of importance Grade B for the transmission screw fastener

| No. | Position |
|---|---|
| 1 | Thrust washer connecting bolts of reverse planet carrier |
| 2 | Direct driving disk connecting bolts |
| 3 | Direct gear compression plate, cylinder, medium output gear connecting bolts |
| 4 | Upper joint body of variable speed pump |
| 5 | Brake support connecting bolts |
| 6 | The bolts connecting coupling flange and frontal flange |
| 7 | Fluted nuts of output axis |

Table of importance Grade C for the transmission screw fastener

| No. | Position |
|---|---|
| 1 | Upper bolts of box |
| 2 | The bolts of connecting seat |
| 3 | The plug of end cover |
| 4 | Fixed mount bolts of brake |
| 5 | The bolts connecting handbrake assembly and transmission |
| 6 | Filter assembly connecting bolts |
| 7 | Oil discharge plug at the bottom of box |

The assembly methods of Grade A of the screw fastener

1.1.1 First, wring in more than 2~3 pitches by hand.

1.1.2 Then preload with gas trigger of low velocity and torque in the symmetry and cross method.

1.1.3 In the end, using proper torsion wrenches, turn 30° at least to reach the median of regular moment.

1.1.4 Step 1.1.3 could be substituted by using an intelligent tightening machine, so long as the median of regular moment is reached and the accuracy of the machine is ensured.

Tightening principle for B/C-Grade screw fastener:

1.2.1 Firstly, insert the screws by more than 2-3 pitches manually.

1.2.2 Secondly, preload diagonally using gas trigger of the appropriate or one-Grade smaller size.

1.2.3 At last, tighten the screw to reach the median of regular moment with appropriate gas trigger.

**4.2.2 Notices in assembly of transmission**

1. Before assembly, the scrap iron, burrs, oil contaminant, sediment on the part must be cleaned out. There must be no corrosion, scratch or damage on the mating surface and friction surface. The oil holes and groove should be cleaned and unobstructed.

2. In assembly, do not damage the screw on the bolts.

3. The end face of bolt and nut should be in uniform contact with the fastener; neither inclination nor hammering the faces into contact is allowed. No bending deformation to the screws.

4. The fastener should be under uniform compression, closely jointed and connected firmly.

5. It is forbidden to use inappropriate wrench or sleeve when tightening the bolts and nuts.

6. Assemble strictly using the fastener of the right Grade according to the drawings or process documents. It's not allow to use low performance fastener instead of high performance ones or on the contrary in principle.

7. Coat sealant for locking screws of appreciate on the external screw cycle by cycle, don't coat onto the first two pitches of the screw, the width of sealant coated would be 3 to 5 pitches, then screw into internal screw to the regular moment. In case of a blind hole, coat some sealant onto the bottom, and then tighten.

8. In the assembly of screws and bolts, insert them by more than 2-3 pitches, then preload with tools, and finally tighten to regular moment with the torque wrench of appropriate size.

9. In the assembly of screws bolts and nuts, pay attention to the paint film, coating and etc of the components to be connected, as while as the end of screws and bolts, and grooving of the screws, no damage is allowed.

10. Use appropriate tap when screwed holes need rescrewed, and keep vertical between the axis of screwed hole and the surface of connectors.

11. After being tightened, the bolts and screws should protrusion out of the end face of the nuts by 2-3 pitches.

12. When group of screws and bolts being preloaded, preload in order according to the shape of parts to be connected and the distribution of bolts.

12.1 In case of group of screws and bolts in a rectangle-distribution, tighten them from the middle to the both sides symmetrically. The order is showed in Figure (1).

12.2 In case of screws and bolts in a square-distribution or cycle-distribution, tighten symmetrically. The order is showed in Figure (2).

12.3 If a locating pin is existed, tighten from the screws near the pin. The order is showed in Figure (3).

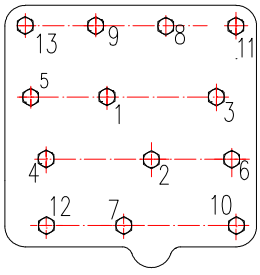



Figure (1)

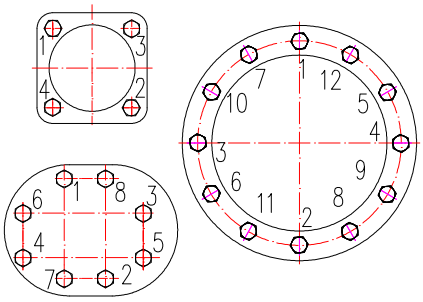



Figure (2)

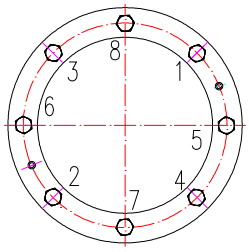



Figure (3)

13. When fixing heated bearings, heat insulating gloves must be used in order not to be hurt.

# 4.3 Assembling of the Transmission

1. Transmission partial assembly (refer to Figure 1)

kg Fix the box which is cleaned on the worktable, not to swing it around.

1) Put the cylindrical blocking (7) in transmission body (1), and install in place.

Coating evenly the 1545 screw sealant on plug screw, then install it in the box body and tighten it.

kgm: 75±10Nm.

2) Install O-shape seal ring (6) and joint body G28 (5) [two for each] and tighten them.

kgm: 280±30Nm.

3) Install the swinging rings screw M20 (9) in transmission body (1) and tighten it.

4) Install the shield ring 90 (12) in the medium hole of the box body.

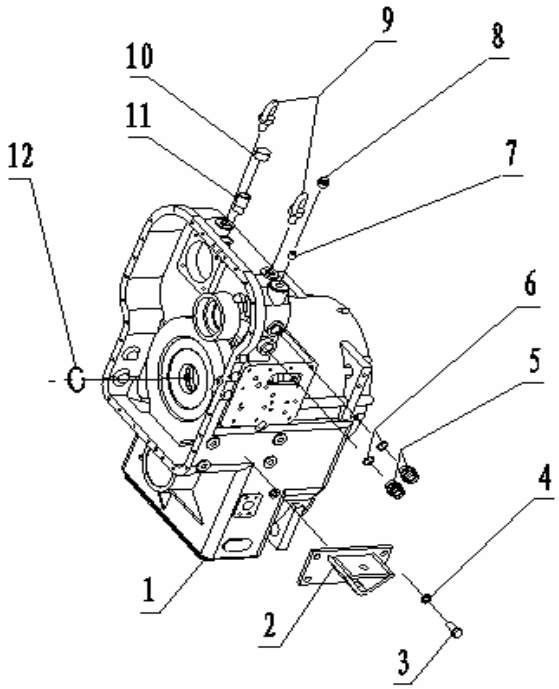



Figure 1

5) Install the breathable cover assembly (10) on the breathable pipe (11), and then press in transmission body (1).

6) Connect and tighten the coupling seat and transmission body with bolt (3) and washer 18 (4).

kgm: 260±20Nm.

★ a. When install every axis, copper rod or hand hammer can not be used directly, and special sleeve must be used. As to other stationary fit can use copper rod, but must not use hard matters or hand directly.

★ b. Tighten every bolt fastener must be in the symmetrical chiasma and tightening successive method.

**Torque converter partial assembly** (refer to Figure 2)

2. kg Place the torque converter with the bigger surface upward on the worktable horizontally.

3. Install the rotary oil seal (1) in groove of torque converter guide wheel seat.

4. Install the secondary input gear assembly (2) in torque converter (5).
5. Install the rotary oil seal (3) in secondary input gear assembly (2).
6. Install the shaft gear (4) in torque converter (5).

★ Measure the torque converter, then calculate the thickness of adjusting shim according to the measurement result. Measure the distance h between the left end of secondary input gear and the left end of bearing, and measure the depth H=H1-H2 (H1 is the hole depth between the bigger end of torque converter and shield ring, H2 is the dimension between the bigger end of torque converter and guide wheel seat bearing fosse) between the hole of torque converter and shield ring, then H-h is the clearance should be adjusted. After adding the adjusting gasket, the dimension should be in the range of 0.3~0.6. Install the selected adjusting gasket in the secondary turbine shield ring. (Refer to the Figure 3)

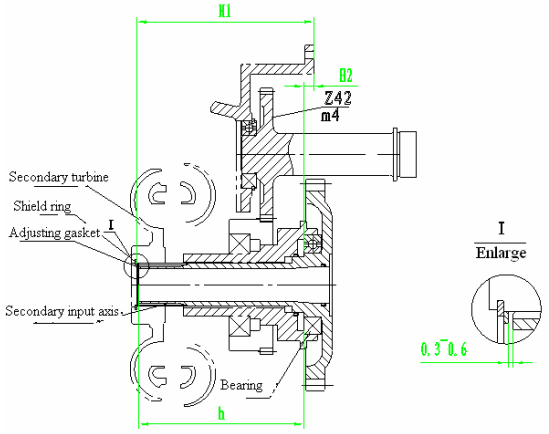



Figure 2

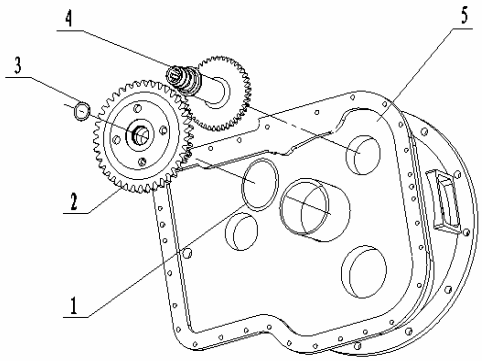



Figure 3

**Assemble the torque converter, four-axis assembly (1)** (refer to the Figure 4)

7. kg Hang the partial assembled box body on the assembly fixture and adjust the position of the box body (the end which combines with the torque converter assembly is upward).
8. kg Install the overrunning clutch assembly (2).
9. Install the primary input gear assembly (4) in the axis hole of the transmission body (1).
10. Install the steering pump driving axis assembly (10) in the axis hole of the transmission body (1).
11. Install the bearing 5111 (9) in the bearing fosse of the primary gear assembly (4).

★ Measure the distance H1 between the bigger end of transmission (1) and the bearing seat end of primary input gear assembly (4). Measure the distance H2 between the bigger end of torque converter assembly (7) and the right end of bearing 5111 (9), then select the thickness of primary input gear assembly (4) based on H=H1-H2. Select the seal gasket (3) according to the joint surface

between the transmission body (1) and the torque converter assembly (7) to make sure the axial clearance of bearing 5111 is 0.3~0.7. (Refer to Figure 5)

12. kg Assemble the torque converter assembly

1) Clean the joint surface with high efficient detergent (the cleaned surface can't have oil-water).

2) Place the seal gasket (3) on the end surface of the box body horizontally.

3) Combine the joint surface between the torque converter assembly (7) and the transmission assembly (1), then install the bearing 6012 (11) in the bearing hole of transmission. Adjust the input axis acting on the flop of hole of end cover and the verticality between the axis gear assembly (8) and the joint surface of variable speed pump. Finally, link and tighten the torque converter assembly (7) and box body (1) with washer 10 (5) and bolt (6).

kgm 52±7Nm.

After tightening the bolts, make sure the part (8) flopping on the surface of pump body is less than 0.08 and the input axis flopping on the hole of end cover is less than 0.40, and record the measured value. Please re-adjust if the measured value exceeds the regular value.

★ Adjusting method: preload the bolt, reverse the box body.

1) Fix the dial indicator whose head points to the hole of end cover and presses to 1~1.5 on the end surface of medium input axis. The flop of dial indicator should be less than 0.40 after rotating the medium input axis for a circle.

2) Fix the dial indicator whose head points to the hole of end cover and presses to 1~1.5 on the end surface of axis gear assembly. The distance between the head and the center line of the axis gear assembly. The flop of dial indicator should be less than 0.08 after rotating the axis gear assembly. Tighten the four bolts around the corner, then turnover the box body to tighten all the other bolts.

★ Notice: Some machine type have taper pin between the torque converter and the transmission, so don't adjust according to the above steps and assemble directly.

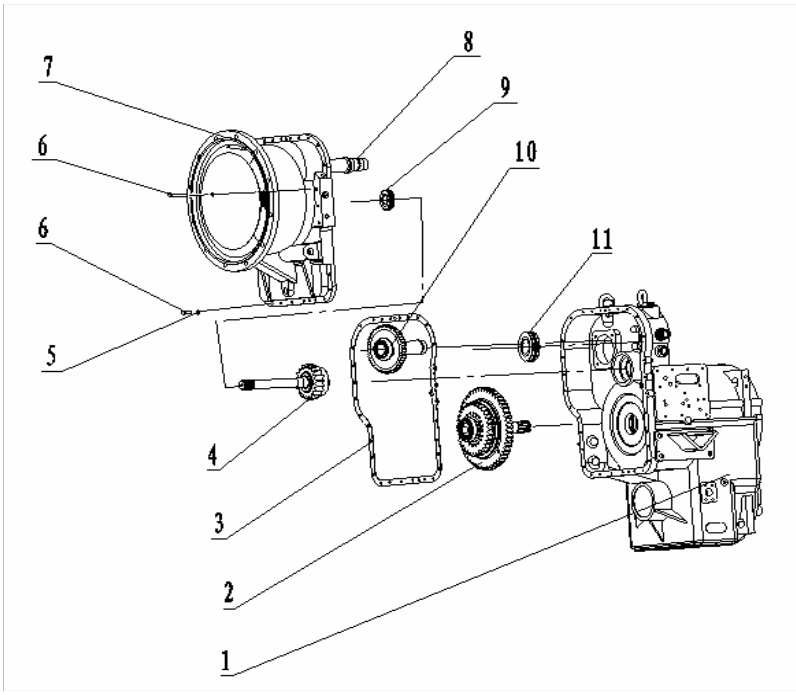



Figure 4

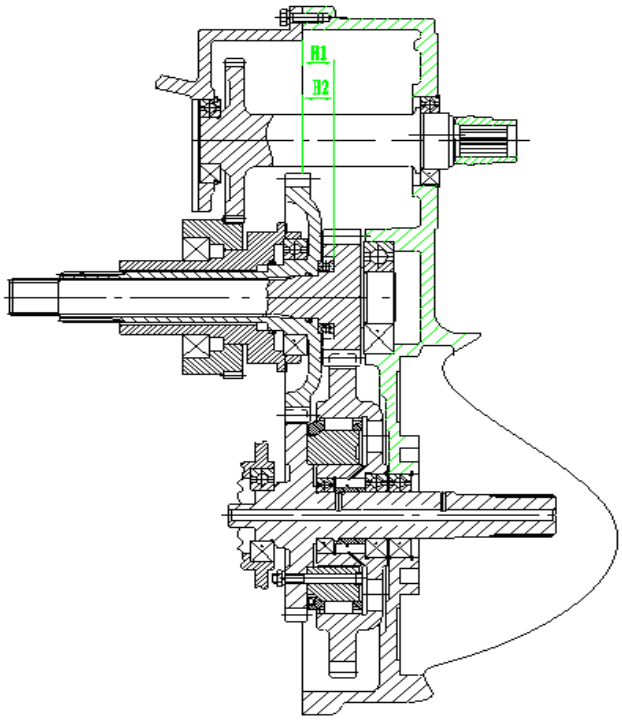



Figure 5

**Assemble the axis and reverse planet carrier** (refer to the Figure 6)

13. Fix the seal gasket (1) and variable speed pump (2) on the box body with the bolt (3), the washer 10 (4) and the bolt (5). kgm 52±7Nm.

★ Measure the dimension of bearing higher than the hole end and the depth difference of the gland spigot. Select the gasket on the basis of the dimension to ensure the axial clearance between the end surface of bearing and the gland spigot is 0.4~1.5 after tight compression.

14. Install the bearing seat assembly (6) in the box assembly, meanwhile adjust the driving axis assembly in the torque converter shell.

15. Install the inner seal ring (7), outer seal ring (10) on the reverse drive piston (11).

16. Install the reverse drive piston assembly in the box assembly.

17. Install the distance sleeve (9) in the journal of the overrunning clutch assembly.

18. Install the reverse carrier assembly (8) in the journal of the overrunning clutch assembly.

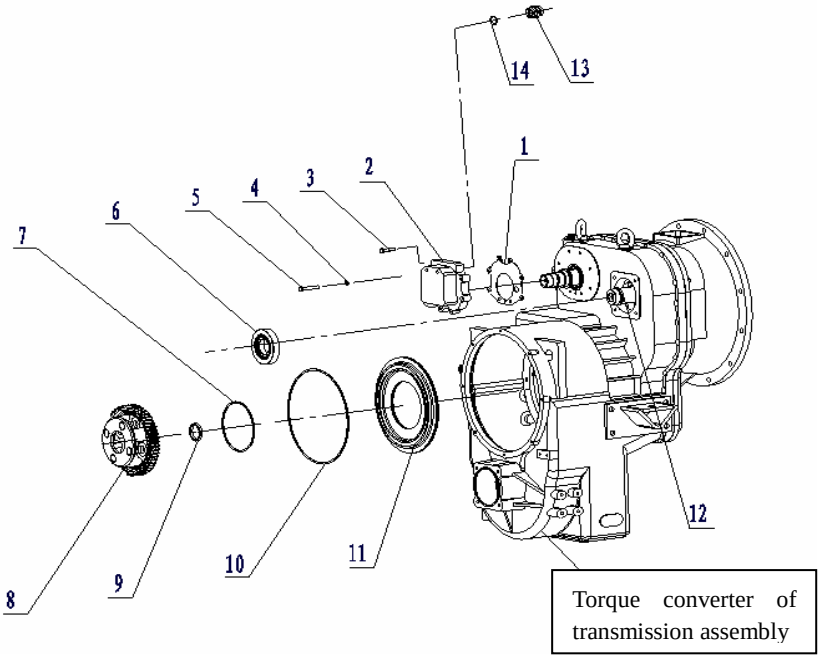



Figure 6

**Partially assemble the first gear planet carrier assembly** (refer to the Figure 7)

19. Install the driven fictional tablet (5) and the active fictional tablet (6) on the reverse planet carrier at interval.

★ Each of the driven and the active fictional tablet is four, and install the driven fictional tablet (5) firstly. Make sure the clearance between the last tablet and the fictional tablet isolating tray is 0.9~2.8.

20. Install the fictional tablet isolating tray (8) in the box body. The retainer notches of fictional tablet isolating tray (8) aligns to the Φ25 hole on the valve surface, and then install the cylindrical pin (9) to tighten.

21. Install the spring on the spring pin, and then install in the every hole of the fictional tablet isolating tray.

22. Install the sun gear on the medium input axis.

23. Install the first gear assembly on the sun gear.

24. Install the driven fictional tablet (5) and the driving fictional tablet (6) on the annular gear at interval.

★ When install the driven fictional tablet (5) and the driving fictional tablet (6) at interval, install the driving fictional tablet (6) firstly until install five tablets on the part 3. After installing part 3 with fictional tablets in the box body, install one tablet for part 6 and two tablets for part 5 at interval again to ensure the clearance between the fictional tablet and piston is 1.8~4.6.

25. Install the annular gear with fictional tablets in the first gear assembly.

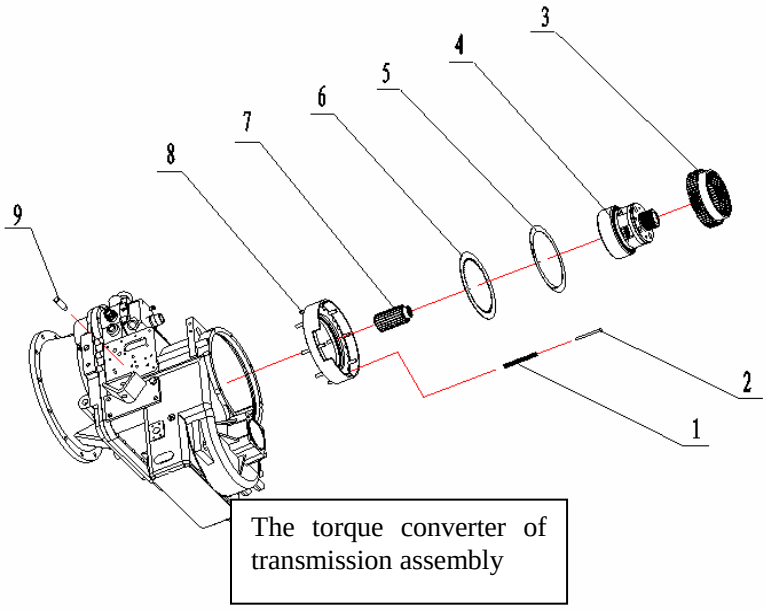



Figure 7

**Assemble the first gear cylinder and medium cover** (refer to the Figure 8)

26. Install the first gear cylinder assembly (1), adjust the angle until the notch on the first gear cylinder assembly (1) aligns to the notch on the isolating tray, and then install the fixed plate (5).

27. Joint and tighten the medium cover (2) on the box assembly with the medium cover bolt (3) and the washer 14 (4).

kgm 145±20Nm.

★ Notice: Measure before installing to ensure the clearance between the first gear cylinder assembly (1) and the medium cover (2) is -0.1~0.3mm.

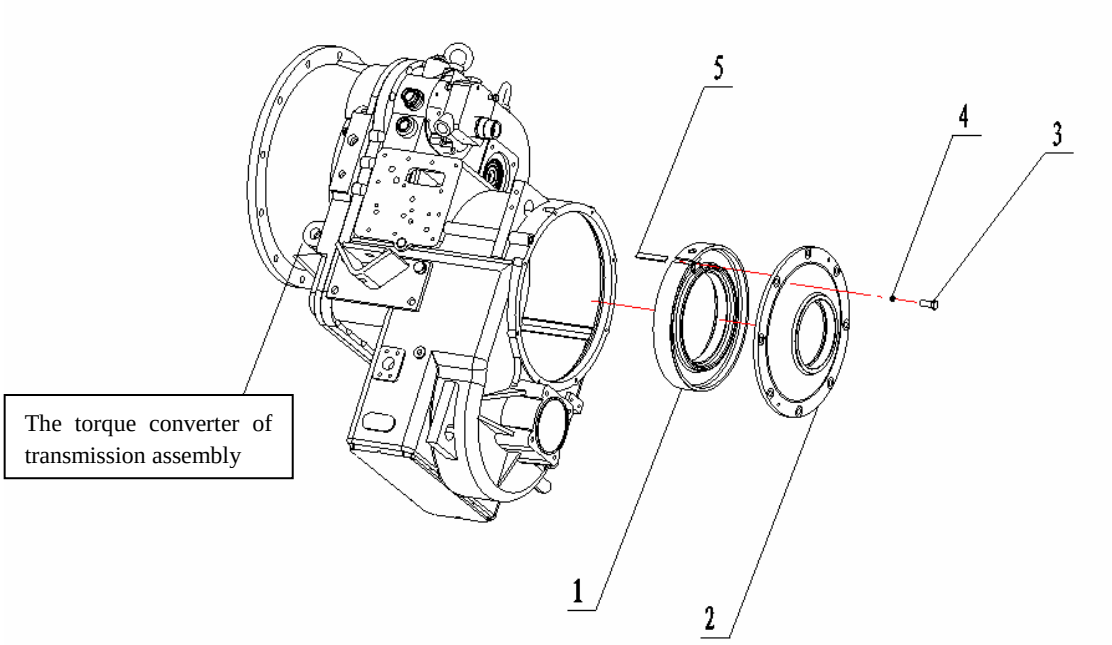



Figure 8

28. Assemble the output axis assembly (refer to the Figure 9)

1) Freeze the output axis to -60~-80℃ in the refrigerated cabinet.

2) Install the rolling bearing (2) in the middle hole of the transmission, then put in the output axis gear (3).

3) Install the frozen output axis (1) in the spline hole of the output axis gear (3).

4) Install the rolling bearing (2) and shield ring (4) on the front end, and then install the oil seal seat (5) on the output axis (1).

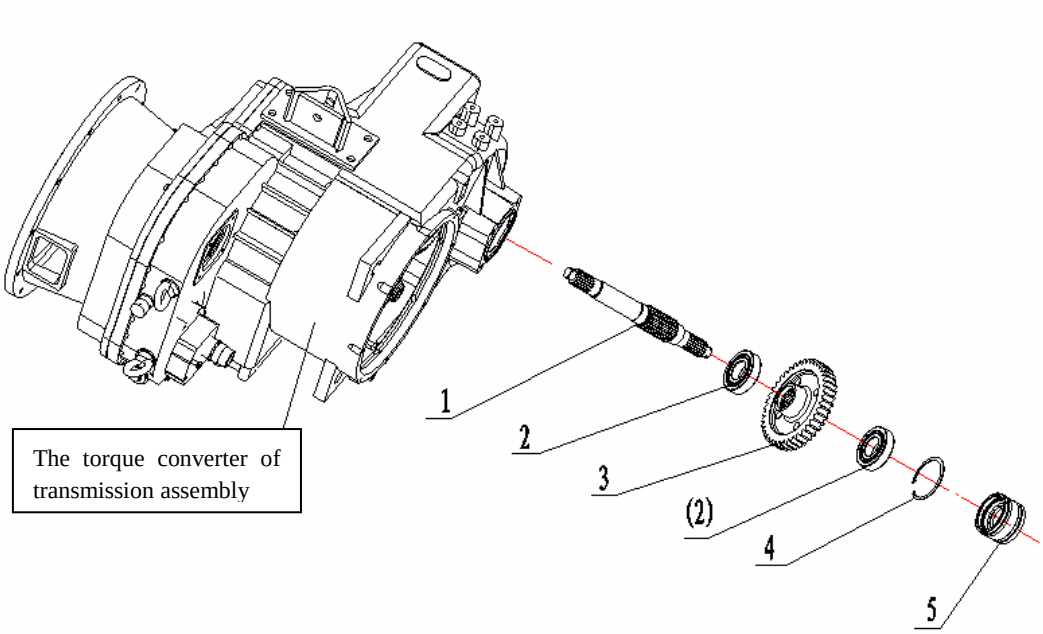



Figure 9

**Assemble the four-axis assembly (2)** (refer to the Figure 10)

29. Coat the lubricating oil on the medium cover bearing fossa and the kg bearing, and install the direct gear assembly (5).

30. Place the seal gasket (4) on the variable speed control valve (1), then install the variable speed control valve (1) and the seal gasket (4) on the box assembly, and tighten with the bolt (2) and the washer (3). kgm 52±7Nm. Tighten after coating rubber on the joint of variable speed pressure gauge. 1545 screw sealant

★ Clean the joint surface with high efficient detergent before assembling (the cleaned surface can't has oil-water).

★ Tighten the bolts from middle to edge in the symmetric cross successive method. Pull the gearlever flexibly so that the pulling force is not more than 150N.

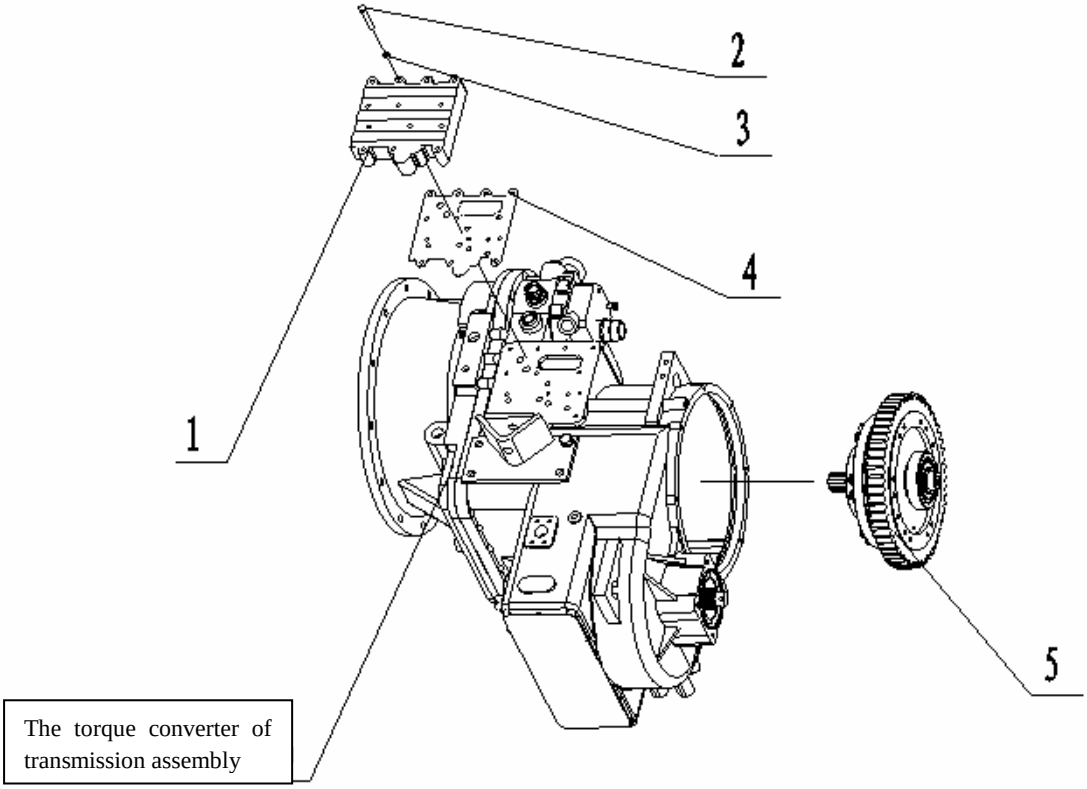



Figure 10

**Assemble the end cover and the hand brake** (refer to the Figure 11)

31. kg Assemble the end cover assembly

1) Install the plug (9) and the seal gasket (2) on the end cover (3). The plug (9) should be tightened not to leak oil. kgm 28±4Nm.

2) Install the o-ring (8) on the joint surface of the box body, and place the seal gasket (1) horizontally, then install and tighten the end cover (3) with the washer (4) and the bolt (5). 52±7Nm.

★ Measure the distance H2 between the right end surface of bearing and the end surface of box body, then measure the same dimension H1 of the end cover. Select the seal gasket (1) on the basis of the above dimension to make sure the clearance between the right end surface of bearing and the end cover is 0.3~1mm after tightening. (refer to the Figure 12)

3) Joint the fixed mount (6) on the box assembly with the bolt (7). kgm 25±3Nm

32. Install the output flange (14) on the front end of the output axis. Install the washer (12) and tighten with the bolt (11), and then lock with the anti-thrust gasket (10). kgm 52±7Nm.

33.

1) Joint and tighten the stent (17) and the hand brake (13) with the bolt (19). kgm 180±20Nm.

2) Install the hand brake assembly on the transmission body assembly, and then tighten with the bolt (18). kgm 80±10Nm.

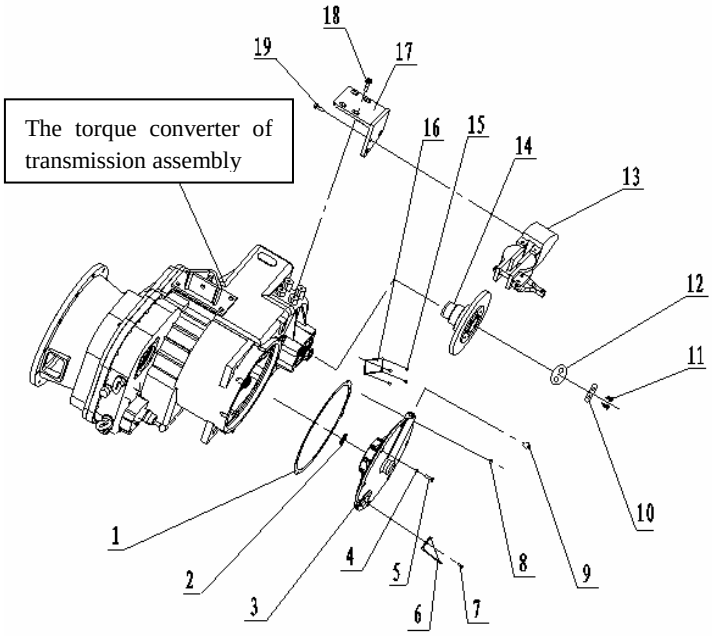



Figure 11

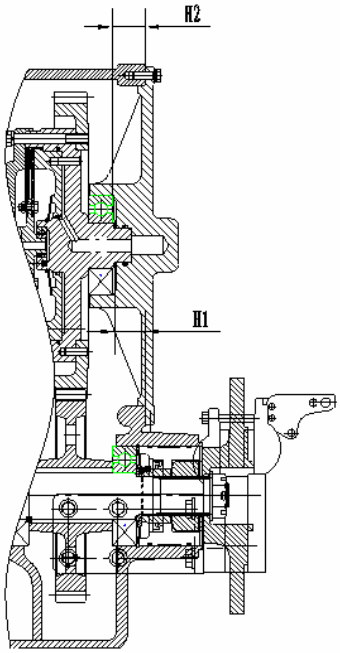



Figure 12

34. **Assemble the output flange assembly** (refer to the Figure 13)

Turnover the box body and fix firmly. Install the septal sleeve (8) on the output axis. Install the bearing 6312 (7) on the rear end of the output, and install the shield ring (6) and the oil seal seat (5), then install the output flange (4) on the output axis; Install the washer (3) and anti-thrust gasket (2) and tighten the bolt (1). Finally lock the bolt (1) with the anti-thrust (2). Install the bearing 6410 (9) on the rear end of the output axis, and install o-rings (6, 8) with septal sleeve (7) on the output axis, then install the oil seal seat assembly (5) in the box body, and then install the rear flange (4) and washer (3) and tighten with the groove nut (2), finally lock with pin (1). kgm 52±7Nm.

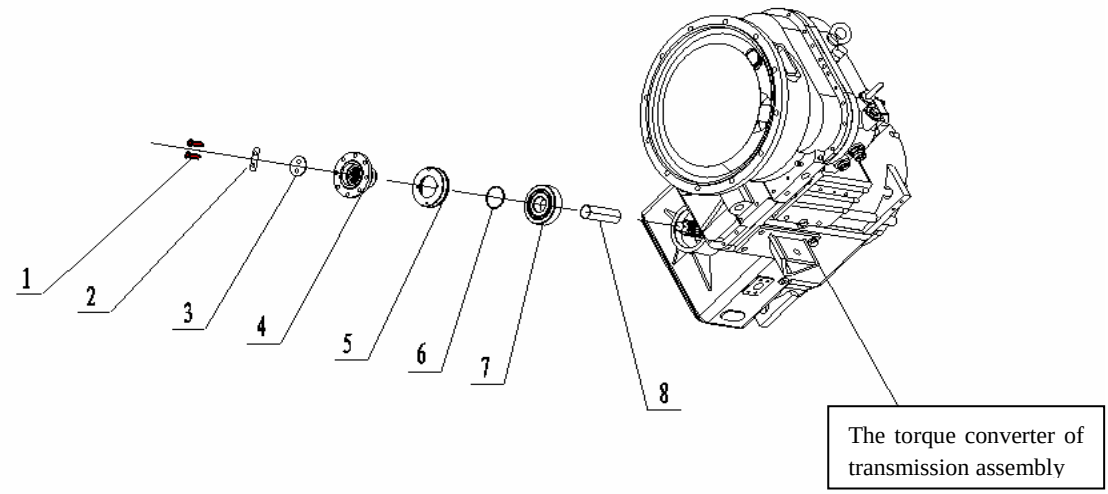



Figure 13

35. **Assemble the oil filter assembly** (refer to the Figure 14)

1) Install the oil filter assembly (1) after putting the gasket (2) between the oil filter assembly (1) and the box body. Put the magnet (3) in the gland (5), and then install the shield ring (4), finally install the whole in the oil filter assembly (1), and put the gasket (2) between the whole and the oil filter assembly (1). After adjusting, tighten the gland (5) and the oil filter assembly (1) with the washer (6) and the bolt (7). kgm 26±4Nm.

Finally, install the o-ring (8) and the joint body (9). kgm 280±30Nm.

2) Install the plug (10) in the oil exit at the bottom end of the box body. kgm 70±5Nm.

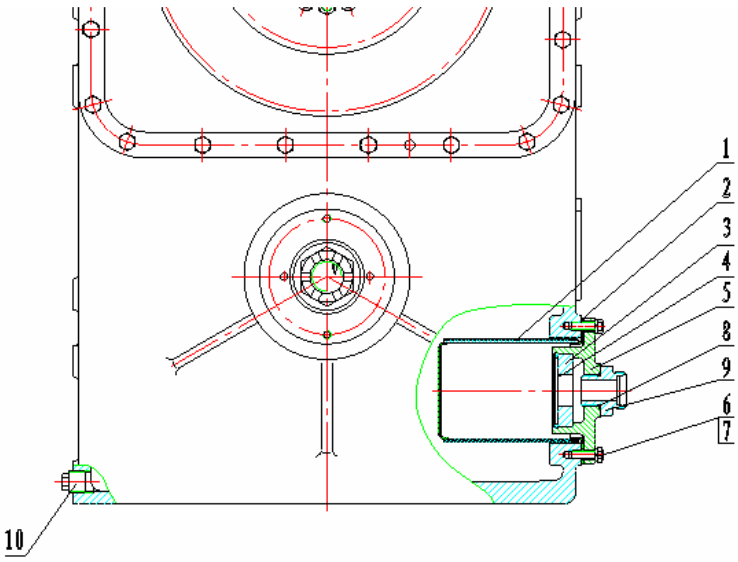
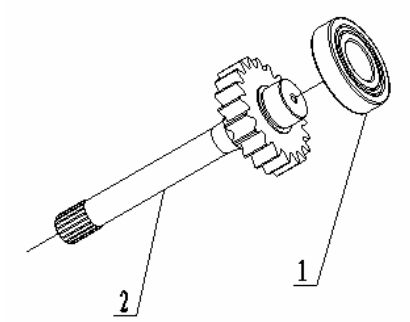


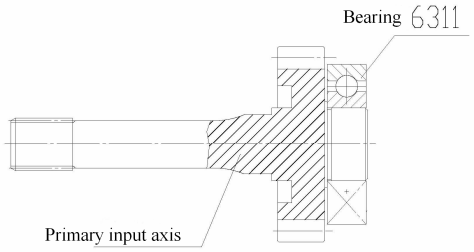

Figure 14

# 4.4 Assembling of the Assembly

### 4.4.1 Partially assemble the primary input gear

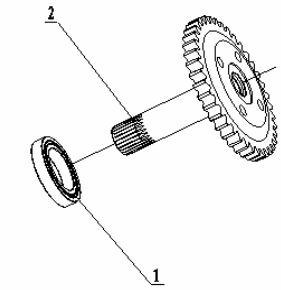
Heat the bearing (1) until the bearing bore is up to 50~80℃, then install it in the axis end of the primary input gear (2).

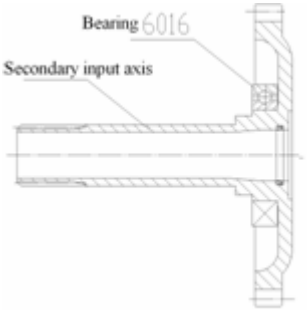



### 4.4.2 Partially assemble the secondary input gear

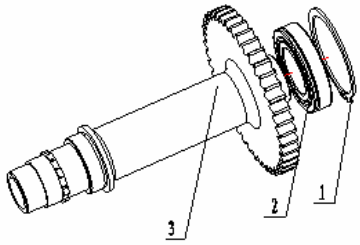
Heat the bearing (1) until the bearing bore is up to 50~80℃, then install it in the journal of the primary input gear (2).

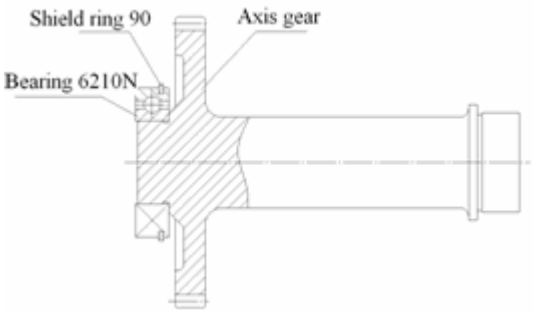



### 4.4.3 Partially assemble the shaft gear

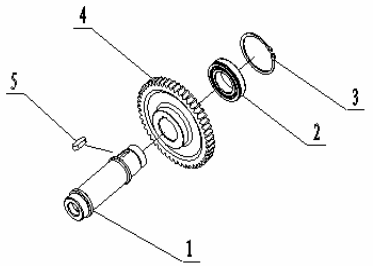
Install the shield ring (1) on the bearing (2), and put both of them in the heater to heat the bearing bore to 50~80℃, then install the whole on the axis end of the shaft gear (3).

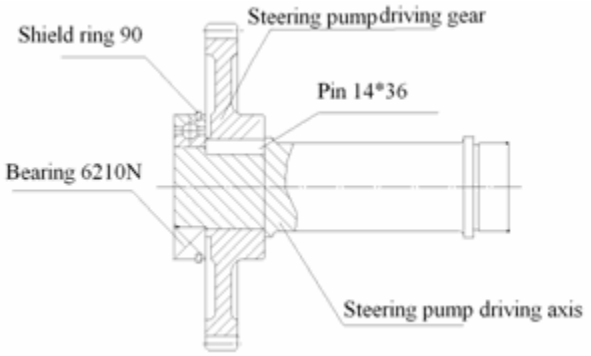


### 4.4.4 Partially assemble the driving gear of steering pump

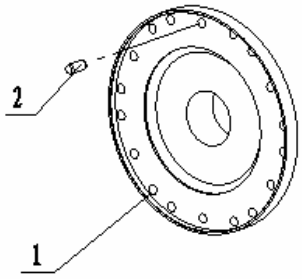
Install the shield ring (3) on the bearing (2), then install them and the driving gear of steering pump (4), pin (5) on the driving axis of the steering pump (1).




### 4.4.5 Partially assemble the direct gear pressure plate

Press the pin (2) in the direct gear pressure plate (1).

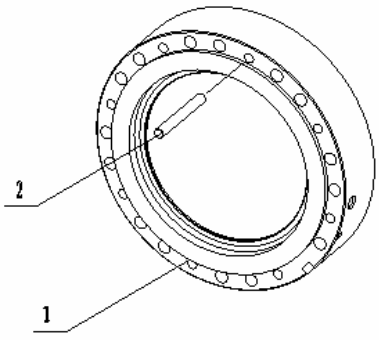


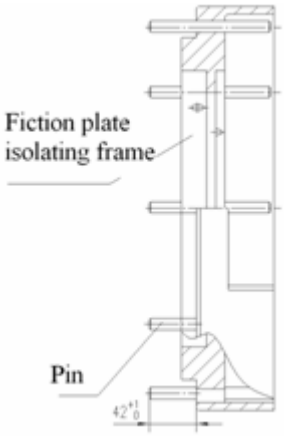

★ Pin should be firm and not be loose, and its right end surface should align to the roller surface.

### 4.4.6 Partially assemble the isolating tray

Press the pin (2) in the friction plate isolating tray.

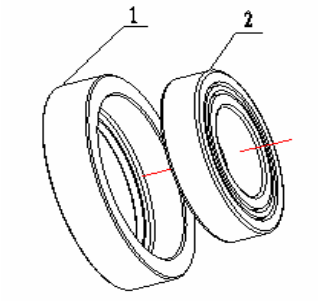
★ Pay attention to the directivity of different coordination of both ends of the isolating tray (1) when assemble. After assembling, it would be firm not be loose.



### 4.4.7 Partially assemble the bearing seat

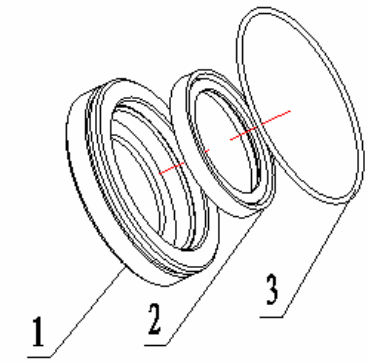
Install the bearing (2) in the bearing sleeve (1).





### 4.4.8 Partially assemble the oil seal seat

Install the oil seal (2), o-ring (3) in the oil seal seat (1).



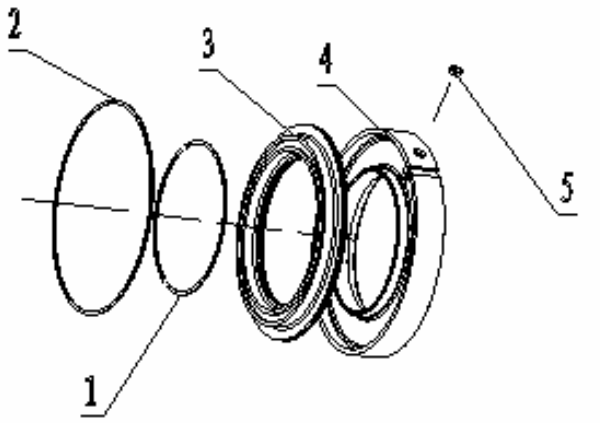

### 4.4.9 Partially assemble the first gear cylinder

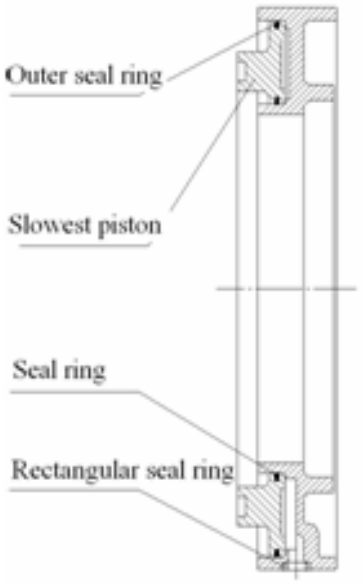
1) Install the rectangular seal ring (5) on the oil duct port of the first gear cylinder (4).

★ The exertion part of the rectangular seal ring (5) is not more than 0.5 and not lower than the external circular surface of the first gear cylinder (4).

2) Install the seal ring (1) and external seal ring (2) on the first gear piston (3).

3) Press the part assembled in the above steps in the first gear cylinder (4).




### 4.4.10 Partially assemble the reverse gear assembly

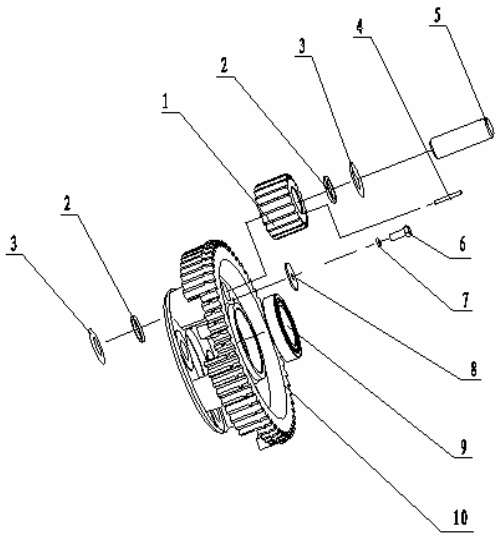
1) Coat the lubrication grease in the holes [four in all] of the planet gear (1). Adhere the needle rollers on the inner holes wall [22 for each] of the planet gear (1) in order, and make sure the needle rollers are arranged in line and install a shield ring (2) in both ends of each hole.

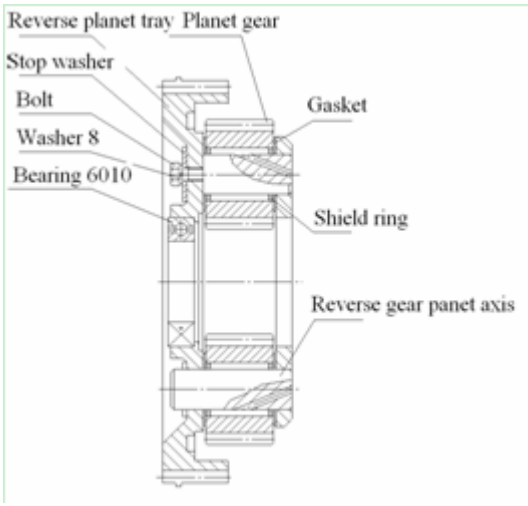
2) Install the four planet gear assemblies assembled in the above step and gasket (3) in the corresponding seat hole of the reverse gear planet carrier (10), and install the reverse gear planet axis (5) [four] and the stop washer (8) [four, align to the gap of the reverse gear planet axis (5)], then install the bolt (6) and washer (7) and tighten. kgm 25±10Nm.

3) Install the bearing 6010 (9) in the reverse gear planet carrier (10).

★**Notice**: After assembling completely, the planet gear can be rotated smoothly by hand and not have the hindering phenomenon, and there is no beating trace on the reverse gear planet axis.

Select the needle rollers when assemble to ensure the deviations of max diameter and min diameter are less than 0.005 in the same group and the possible errors of roundness and cylindricity are less than 0.003.




### 4.4.11 Partially assemble the first gear assembly

1) 1) Coat the lubrication grease in the holes [four in all] of the planet gear (5). Adhere the needle rollers Φ4×35（eleven）on the inner holes wall [22 for each] of the planet gear (5) in order, and make sure the needle rollers are arranged in line and install a shield ring (4) in both ends of each hole.

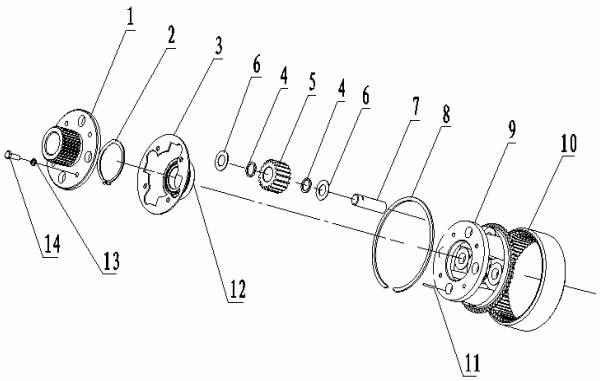
2) Install the four planet gear assemblies assembled in the above step and gaskets (6) [8 in all] in the four seat holes of the first gear planet carrier (9), and install the first gear planet axis (7) [4 in all].

3) Install the shield ring 90 (2) on the bearing 6210N (12), and install the whole in the first gear planet carrier (9). Install the stop plate (3). Rotate the stop plate (3) to the gap of the first gear planet axis. Install the direct gear joint plate, then joint and tighten with the washer (13) and the bolt (14). kgm 75±10Nm.

★Notice: After assembling completely, the planet gear can be rotated smoothly by hand and not have the hindering phenomenon, and there is no beating trace on the reverse gear planet axis.

Select the needle rollers when assemble to ensure the deviations of max diameter and min diameter are less than 0.005 in the same group and the possible errors of roundness and cylindricity are less than 0.003

4) Install the part assembled in the above step in the reverse annular gear (10), and then lock with shield ring (8).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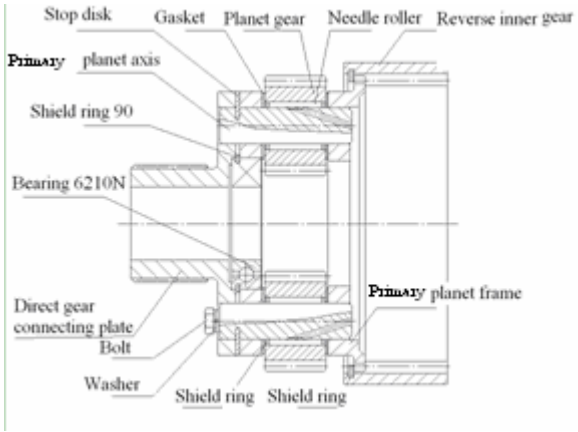

Stop disk
Gasket
Planet gear
Needle roller
Reverse inner gear
Primary planet axis
Shield ring 90
Bearing 6210N
Primary planet frame
Direct gear connecting plate
Bolt
Washer
Shield ring
Shield ring

### 4.4.12 Partially assemble direct gear

1) Press the pin (14) in the direct gear cylinder (13).

2) Install the seal ring (12) in the external gap of direct gear piston, and install the rotary oil seal (17) in the internal gap, then press the part 11 in the direct gear cylinder (13). Install the disk spring (10) in the direct gear cylinder (13) and seize with the shield ring 65.

3) Install the direct gear active tablet (5) and the direct gear driven tablet (6) [part 6 in the middle of part 5] on the direct gear axis, then joint and tighten with the bolt (3), the washer (18) and the nut (19). Install the bearing 6204 (8). Coat proper 1262 screw locking sealant on the 5~10mm screw from the end of the bolt (3). Clean if overflow after tightening. kgm 26±4Nm.

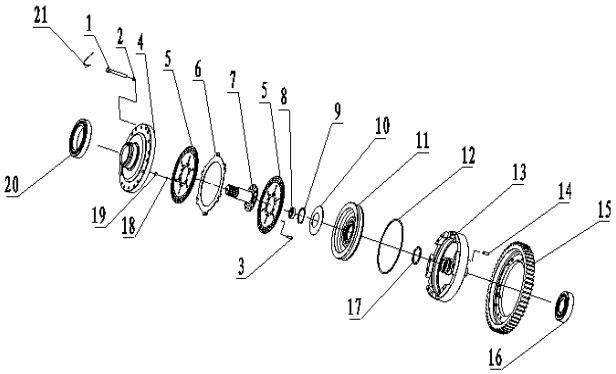
4) a) Install the direct gear cylinder on the medium input axis (15), then install the direct gear fiction tablet assembly and the direct gear pressure plate in order. Lock and tighten with the bolt (1) and washer 12 (2), and lock with low carbon steel wire (21). When wind the part 21, increase the bolt (1) tightening trend. kgm 90±10Nm.

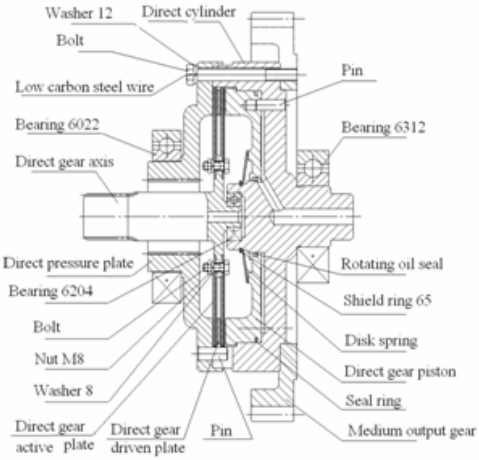
b) Put the bearing 6312 (16) and the bearing 6022 (20) in the heater to heat the bearing bore to 50~80℃, then install them on the end of the direct gear cylinder (13) and the direct gear pressure plate assembly (4) respectively.

★ Notices in assembly

1) After assembling, wrap the oil duct port with plastics cloth to prevent sundries in if necessary.

2) Tighten every bolt in the symmetric cross method.



### 4.4.13 Partially assemble the overrunning clutch

1) a) Place the external ring gear on the worktable horizontally, and then install the shield ring 80 (13).

b) Install the bolt (5) in the bolt hole of the internal ring cam (11).

c) Install the isolating ring (12) on the internal ring cam (11) and both of them should align the Φ2 locating hole. Install the roller Φ13×26 (4) on the isolating ring, then put in the external ring gear (6).

d) Install the spring (14).

2) a) Put the bearing 6010 (3) in the heater to heat the bearing bore to 50~80℃, then install on the journal of the medium input axis (2).

b) Install the pin (15) in the Φ8 hole of the medium input axis (the flat surface of the pin 15 should point to the end surface of the spring 14)

c) Install the medium input axis (2) assembly in the external ring gear, and adjust the spring (14), then tighten the washer (16) and the nut (17). kgm 50±10 Nm.

d) Put the bearing 6211 (1) in the heater to heat the bearing bore to 50~80℃, then install on the end of the medium input axis (2).

★ Tighten every bolt in the symmetric crossing method. In assembling, the Φ4 hole on the medium input axis (2) and inner ring cam (11) should align to the allocating hole of the isolating ring (12).

3) a) Turnover, install the isolation cover on the journal of the medium input axis.

b) Put the bearing 6210 (7), bearing 6210 (8) and interval ring (9) in the heater to heat the bearing bore to 50~80℃, then install on the journal of the medium input axis together.

★ a) The two R5 arc ends on the isolating cover (10) should be downward.

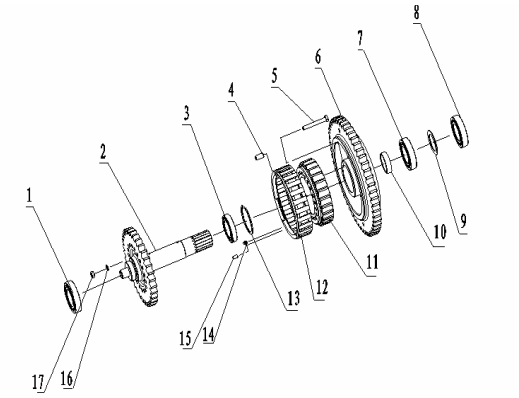
b) Match the spring (14) with the same number of cycles and the same length.

c) Tighten the bolts with uniform exertion in the successive crossing method.

d) After assembling, turn flexibly and not have hindering and inversion.

e) After assembling, wrap the oil duct port with plastics cloth to prevent sundries in.

f) Attach correctly each binding face between which do not have the filth burr, bumping and tappet.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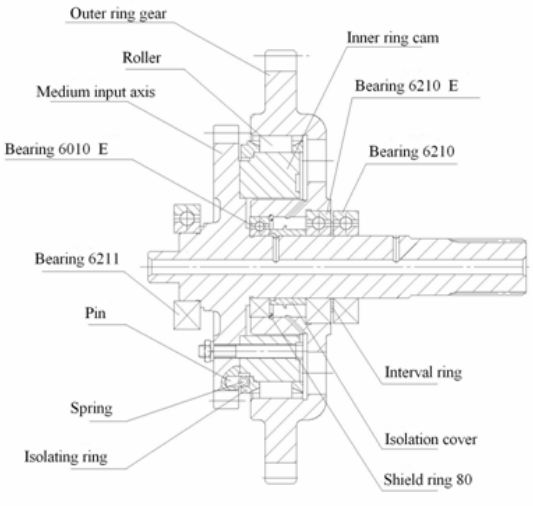
Outer ring gear
Inner ring cam
Roller
Medium input axis
Bearing 6210 E
Bearing 6010 E
Bearing 6210
Bearing 6211
Pin
Interval ring
Spring
Isolation cover
Isolating ring
Shield ring 80

# Chapter V Standard Criterions of Maintenance and Parts Replacement for Transmission

I After disassembly, the standard criterion of the parts scraped: Whether completely lose their function (service performance) and could not be repaired.

II There has two ways to judge the disassembled parts:

1. watch & touch by hand
2. measure the dimension

III Judge the disassembled parts by watching and touching primarily, make sure replace the parts when under the following condition:

1. **Never** further use those parts with seriously knocked, fracture, cracks, or looseness function.
2. **Never** further use the sealing parts after disassembled.
3. Because of low reliability and short service life resulted in repeated reuse, **Never** further use oil seals, dust ring, o-ring and gasket after disassembling by reason of leakage.
4. **Never** further use bolts, nuts, washers, plug screws, pipe joints if there is serious corrosion, and the screw could not wring well in tightening operation, or the screw is damaged, worn out or slipping.
5. **Never** further use those parts such as pumps and valves if they lose function or have serious collision or scratch on the touching surface in assembly to affect the sealing properties.
6. **Never** further use those bearings if they could not be turned smoothly by hand, or the cracks exist, the ball race is seriously worn or the balls are broken.
7. **Never** further use those gears with cracks, sheet exfoliation, collision or over-wearing appears on the teeth.
8. **Never** further use those boxes or shells with cracks, those mounting holes on the bearing shell with crack, serious wear, or sheet exfoliation, and those shell screws damaged result in operating weakly in tightening.
9. **Never** further use those end-covers, cylinders, pistons with cracks, wear, collision or sheet exfoliation on the touching surface or spigot.

10. **Never** further use those friction plates with serious wear, cracks, collision or sheet exfoliation.

11. **Never** further use those springs with corrosion, fracture, cracks, bending deformation or low stiffness.

12. **Never** further use those pins with serious wear, collision or cracks.

13. **Never** further use those shafts and flanges with are collisions, serious wear; cracks on the spline or teeth as while as crack on the surface.

14. **Never** further use those planet carriers with collision, serious wear, cracks on their splines and tooth or cracks on their surfaces.

IV. If it is hard to judge by watching and touching, check it by measurement. The common standard criterions of easily wear parts are listed in the following table.

Unit: mm

| Parts | Checking Items | Standard Criterions | | Oversize Measures |
|---|---|---|---|---|
| | | Dimension (Tolerance) | Allowable Limit | |
| Bearings | Internal diameter tolerance | About 0~ -0.02 | +0.02 | Replace |
| | External diameter tolerance | About 0~ -0.02 | -0.04 | |
| Gears | Wear volume of tooth thickness | About 0~ 0.10 | 12 percent of the reference circle thickness(small module gear is about 0.70;big module gear is about 1.2) | Replace |
| Direct Gear Driven Plates | Thickness | 3±0.05 | 2.5 | Replace |
| Direct Gear Active Plates | Thickness | 3.85±0.05 | 3.2 (single edge wear limit is 0.4) | Replace |
| Reverse Slowest Driven Plate | Thickness | 3±0.05 | 2.5 | Replace |
| Reverse Slowest Active Plate | Thickness | 3.85±0.05 | 3.2(single edge wear limit is 0.4) | Replace |
| Direct Gear Piston | External diameter Φ248 | -0.285~ -0.170 | -0.40 | Replace |

| | | | | |
|---|---|---|---|---|
| | Internal diameter Φ70 | 0.174~0.10 | +0.30 | |
| Reserve Gear Piston | External diameter Φ342 | 0~ -0.089 | -0.20 | Replace |
| | IDφ170 | 0.145~0.208 | +0.30 | |
| Slowest Gear Piston | External diameter Φ342 | -0.24~ -0.15 | -0.35 | Replace |
| | Internal diameter Φ235 | 0.17~0.242 | +0.35 | |
| Common Part | External diameter used in common assembly | Tolerance denoted by T | Recommend: less than lower limit 0.3 T | Replace |
| | Internal diameter used in common assembly | Tolerance denoted by T | Recommend: more than upper limit 0.3 T | |