

C&C Trucks Service Manual

(Volume 1)

C&C TRUCKS CO., LTD.

October 2010

Clutch

C&C TRUCKS CO., LTD.

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Section I Structure and Working Principle of Diaphragm Spring Clutch

C&C Truck is equipped with the optional diaphragm spring clutch generally. The so-called diaphragm spring clutch is a monolithic diaphragm spring instead of coil spring and the release lever (release press claws). The optional clutch of C&C Truck is a diaphragm spring clutch of $\phi 430$ mm diameter, the driven plate (friction plate) diameter is $\phi 430$ mm. Currently, the optional clutch is a pull-type diaphragm spring clutch as 430DTE from French Valeo and 430DTP from Hubei Tri-ring Clutch Co., Ltd.

The diaphragm spring clutch features many advantages: firstly, as a diaphragm spring has nonlinear characteristics, it can be designed in a manner that the spring pressure keeps almost unchanged with the friction plate worn out, furthermore reduces the pedal force of clutch release, then contributes to easy operation; secondly, the installation position of the diaphragm spring is symmetric in clutch shaft centerline, therefore, the pressure of the spring is not affected by the centrifugal force, and it also has stable performance and good balance; thirdly, the diaphragm spring itself works as pressure spring and release lever, so that the structure of the clutch is greatly simplified, and less parts are used, the weight of the clutch is reduced while the axial dimension is shorten significantly; in addition, the diaphragm spring and pressure plate are contacted on the entire circumference, which makes a good pressure distribution and a good contact with the friction plate, and achieve uniform wearing, also it's easy to achieve good heat dissipation and ventilation.

I Structure and Working Principle of Diaphragm Spring Clutch

There are two forms of manipulation for diaphragm spring clutch, one is push-type, and the other is pull-type. The so-called push-type clutch is the clutch with the same operation system as the conventional clutch; the clutch release bearing moves forward to push the diaphragm spring clutch to release the clutch, however, the pull-type clutch is released with the release bearing pulling back the diaphragm spring clutch. Figure 1-1 shows the push-type clutch pressure plate assembly, and Figure 1-2 shows the pull-type clutch pressure plate assembly.



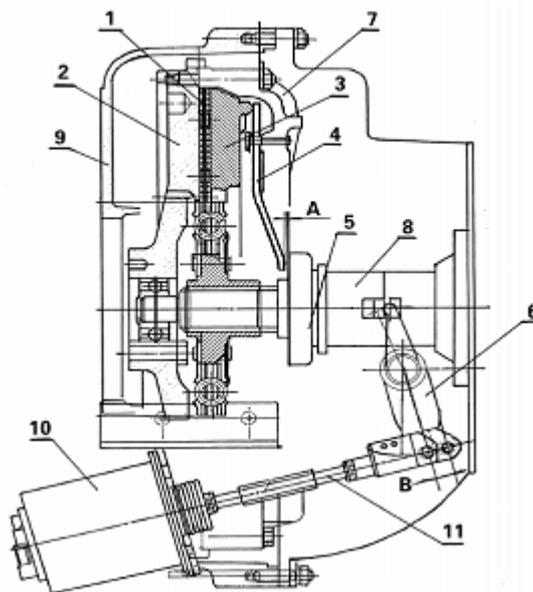
Figure 1-1 Push-type Clutch Pressure Plate Assembly



Figure 1- 2 Pull-type Clutch Pressure Plate Assembly

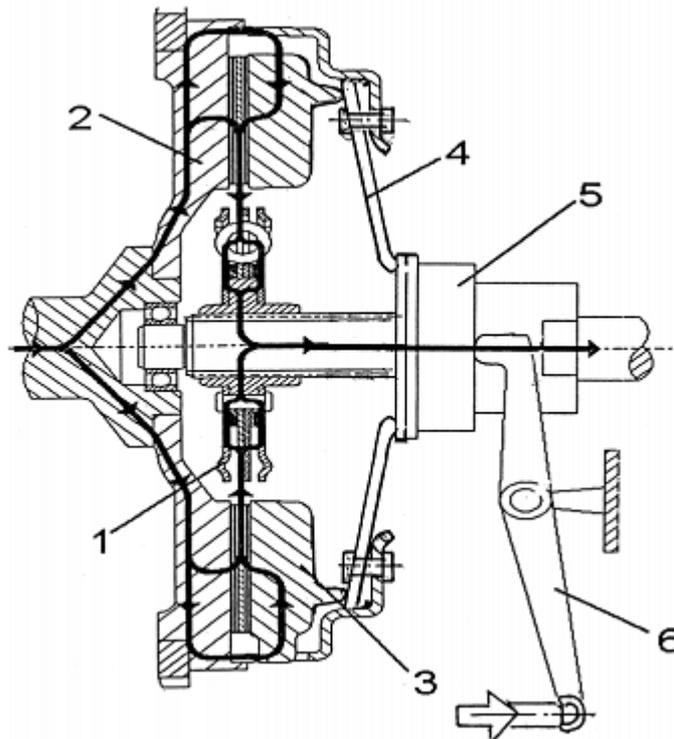
1. Push-type Clutch

Figure 1-3 and Figure 1-4 show the structure and working principle of push-type clutch respectively.



1. Driven disc 2. Flywheel 3. Pressure plate 4. Diaphragm spring 5. Release bearing 6. Separation crankarm 7. Pressure plate housing 8. Release bearing housing 9. Flywheel housing 10. Clutch working cylinder (slave cylinder) 11. Push rod

Figure 1-3 Schematic Diagram of Push-type Clutch Structure



1 Driven disc 2. Flywheel 3. Pressure plate 4. Diaphragm spring 5. Release bearing 6. Separation crankarm 7. Pressure plate housing 8. Release bearing housing 9. Flywheel housing 10. Clutch working cylinder (slave cylinder) 11. Push rod

Figure 1- 4 Schematic Diagram of Push-type Clutch Working Principle

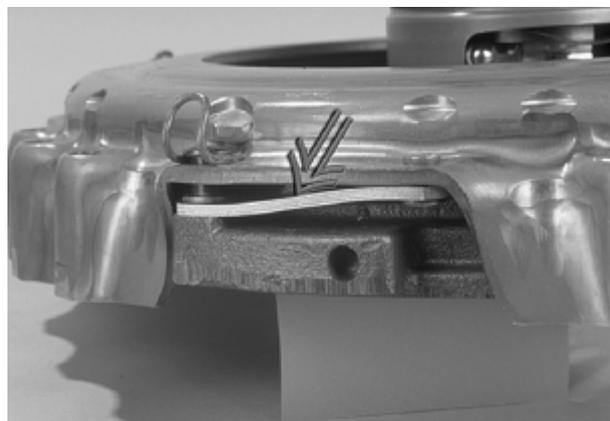


Figure 1-5 Drive Plates between Pressure Plate Housing and Pressure Plate

Figure 1-3, the structure of push-type clutch is very similar to the conventional coil spring clutch, but the coil springs and release lever are replaced with one diaphragm spring (release press claws). Diaphragm spring 4 is a drum-shaped spring, there are several open slots in its inner circle, and the diaphragm spring presses the driven plate 1 against the flywheel 2 through pushing the pressure plate tightly, meanwhile, the diaphragm spring also works as release lever.

Figure 1-5, the difference between diaphragm spring clutch and conventional coil spring clutch is that the clutch diaphragm spring has four drive plates which attach the pressure plate housing with the pressure plate. Each drive plate is composed of four elastic steel sheets. Its function is transmitting the engine rotation power to the pressure plate, so that the compressed pressure plate and flywheel drive and rotate the driven plate friction plate together.

Figures 1-3 and 1-4; when engine is running and the clutch pedal is not depressed, there is a gap A between the release bearing 5 and the release claws of the diaphragm spring, with the elasticity of diaphragm 4, it presses the pressure plate 3 and the driven disc friction plate 1 onto the surface of the flywheel 2 firmly. Then, the engine power is transmitted to the driven plate through the flywheel, pressure plate, thereby driving and rotating the input shaft of the transmission. When driver depresses the clutch pedal, clutch master cylinder controls the clutch power slave cylinder 10 to stretch out the push rod 11, then the crankarm 6 moves the release bearing 5 forward, and pushes the diaphragm spring after passing by the clearance A, the elasticity of the diaphragm spring on the pressure plate is eliminated under the function of supporting points, then the driven plate is released, and the clutch is disengaged completely.

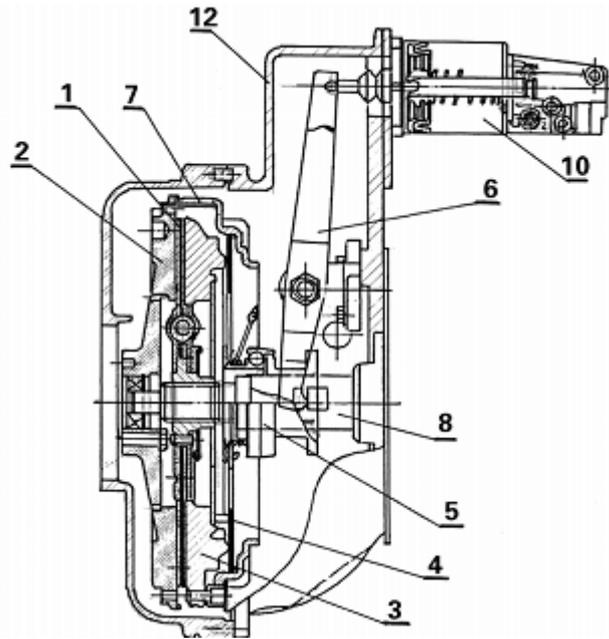
When driver releases the clutch pedal gradually, the release bearing moves back gradually, then the elasticity of diaphragm spring acts on the pressure plate again, and the elasticity increases gradually with the pedal travel reducing until the pedal is released completely. Then, the diaphragm spring presses the pressure plate with full load elasticity, and the clutch is engaged smoothly.

2. Pull-type Clutch

The working of so-called pull-type clutch is just contrary to the working of push-type clutch. Figure 1-6 and 1-7, the encircle of diaphragm spring 4 is supported on the pressure plate housing, the center of diaphragm drum faces front, which presses the pressure plate 3 and the driven plate 1 firmly against the flywheel 2, when driver depresses the clutch pedal, the clutch master cylinder pushes the rod out by the power slave cylinder 10, then pushes the crankarm 6 to swing. The swing of the crankarm moves back the clutch release bearing 5.

Figure 1-8, there is a release ring mounted on the release fingers of the pull-type clutch diaphragm center with the snap ring, there are six ring-clips on the release ring, and there are six wide slots on the corresponding positions of the diaphragm spring, the release ring is mounted on the release finger from the inside of diaphragm spring(flywheel side) out(release bearing side), then fix the release ring with the clips (lower left diagram of Figure 1-8). There is also a spring strip mounted on the release ring, the hook of the spring strip is hung up, the clutch release bearings front (lower right diagram of Figure 1-8) features a cone head, there is a corrugated elastic sleeve on the release bearings sleeve. When installing the release bearing, the spring strip can be disconnected, and the release bearing can be installed, and the hook of the spring strip can be re-connected, then the spring strip is positioned the release bearing on the release fingers of the diaphragm spring, the diaphragm spring causes the release bearing to contact with the diaphragm spring without clearance in place. However, the above operations for connecting the release bearing with the diaphragm spring can only be done in the inspection window of clutch housing after the transmission is fitted. However, the clutch inspection window of general models is too small to carry out the installation work. See "Clutch Installation" section for specific installation methods.

Figure 1-6 and 1-7, when the driver depresses the clutch pedal, clutch master cylinder pushes out the push rod through the power slave cylinder 10, the crankarm sways, crankarm head pulls the release bearing 5 back (transmission side)through the support points, as the spring strip fixes the release fingers of the diaphragm spring on the release bearing, therefore the release fingers are driven back (transmission side) as well, then the diaphragm spring releases the pressure plate, the clutch is released completely. When driver releases the clutch pedal slowly, the release bearing moves forward with the push rod of the slave cylinder returning gradually, and the release fingers move forward to increase the pressure against the pressure plate gradually, then the clutch is engaged smoothly.



1. Driven disc 2. Flywheel 3. Pressure plate 4. Diaphragm spring 5. Release bearing 6. Separation crankarm 7. Pressure plate housing 8. Release bearing housing 9. Flywheel 10. Clutch working cylinder (slave cylinder) 12. Clutch housing

Figure 1-6 Pull-type Clutch Structure Diagram

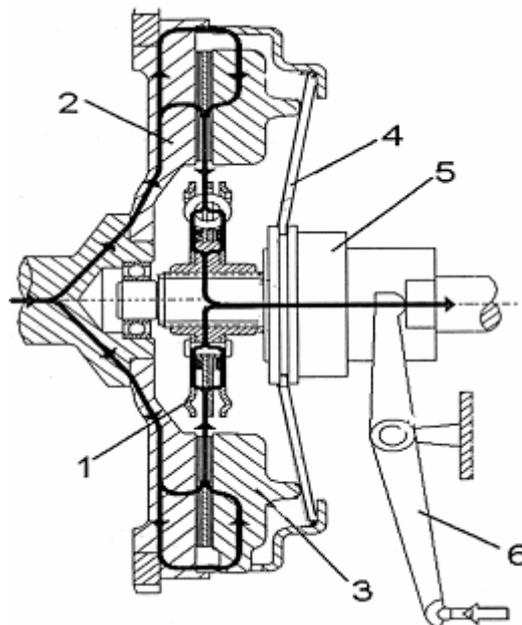


Figure 1- 7 Schematic Diagram of Pull-type Clutch Working Principle

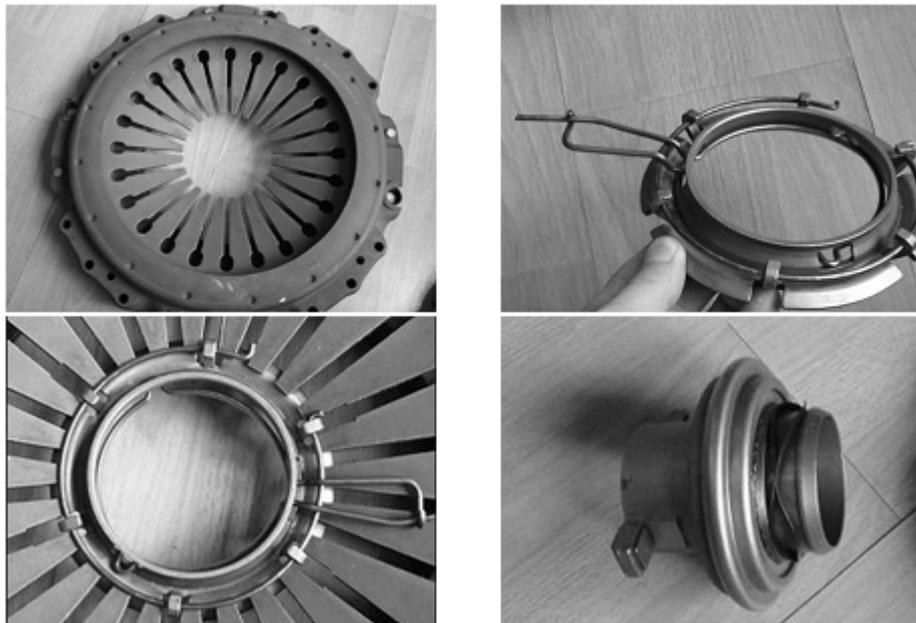


Figure 1-8 Release Ring and Release Bearing

From above analysis we can see: the release bearing of pull-type clutch integrates with the release fingers of the diaphragm spring permanently with no clearance. Therefore, release bearing belongs to constant-mesh type, in other words, as long as the engine rotates; the release bearing and clutch pressure plate assembly will rotate. Generally, the release bearing of pull-type clutch is a long life maintenance-free bearing. For the vehicle models equipped with pull-type clutch, as there is no release bearing clearance, therefore there is no problem related with release bearing adjustment.

It is noteworthy that there are two different specifications of spline hubs for the diaphragm spring clutch driven plate (diameter is $\phi 430\text{mm}$): the spline hub specification for push-type clutch is SAE10C1 (SAE standard 10 tooth C type spline teeth, outer diameter is 1 inches, namely $\phi 44.45\text{ mm}$); and the spline hub specification for pull-type clutch is SAE10C2 (SAE standard 10 tooth C type spline tooth, outer diameter is 2 inches, namely $\phi 50.80\text{ mm}$). Therefore, you should pay attention to driven place replacement.

Compare with the push-type diaphragm clutch, the pull-type clutch has the following advantages:

More compact structure. As the intermediate support parts are cancelled in pull-type diaphragm spring clutch, and only one (or no) support ring is used, the structure is simpler, more compact; fewer parts are used, lighter weight.

Greater torque capacity. As pull-type clutch diaphragm spring presses the pressure plate on the center rather than the big end, bigger diameter diaphragm spring can be used with the same pressure plate size, thereby increasing the pressing force and torque capacity, while not increasing the operation force of release.

Higher release efficiency. To improve the release efficiency, the release travel (free travel) of the release bearing shall be reduced under the condition that there is certain pressure plate lift, as the release fingers of the pull-type clutch must be fitted into special release bearing assembly, there is free travel between the release bearing and the release fingers, and the release efficiency is increased accordingly.

Easier pedal operation. As lever ratio of the pull-type clutch diaphragm is greater than the lever ratio of push-type clutch diaphragm; and there is no central support fitted on pull-type clutch, thus reducing the number of friction sets and friction loss, and then achieve higher transmission efficiency, therefore pedal force of the pull-type clutch is much smaller than the force required by push-type diaphragm clutch.

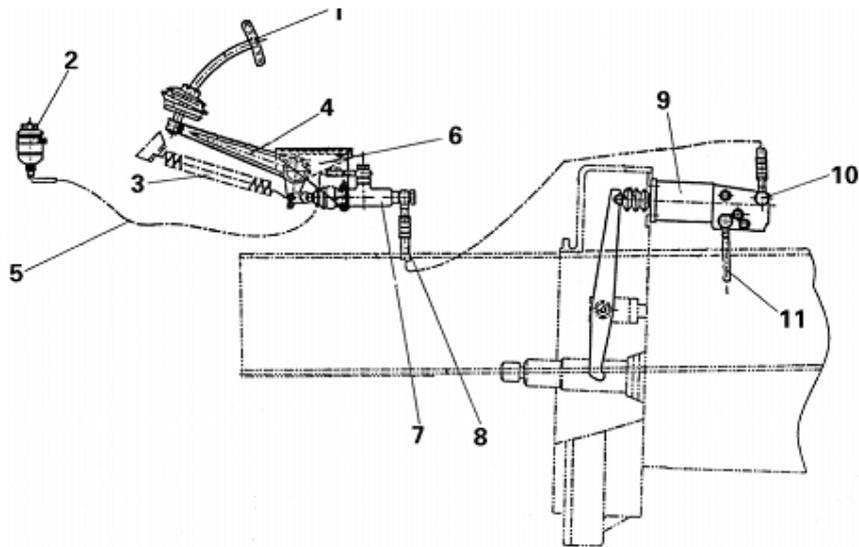
Longer service life. As the central window of pull-type clutch cover gets bigger, heat dissipation is good, therefore its service life is longer.

The disadvantages of the pull-type clutch are that the release fingers' end of the diaphragm spring integrates with the release bearing sleeve assembly, the structure is complex, more difficult in installation and removal, and the release travel is slightly longer than the travel required by push-type clutch.

In recent years, with engine horsepower increasing, the pull-type diaphragm clutch has been used widely, currently, all the C&C Truck models are equipped with pull-type diaphragm clutch.

3 Clutch Operation System

At present, clutch uses the conventional master cylinder-slave cylinder hydraulic control air power operation system as shown in Figure 1-9.



1. Clutch pedal 2. Oil reservoir 3. Pedal return spring 4. Pedal crankarm 5. Pipe 6. Pedal bracket 7. Clutch master cylinder 8. Connection pipe 9. Clutch power slave cylinder 10. Slave cylinder pipe adaptor 11. Slave cylinder gas pipe adaptor

Figure 1-9 Pull-type Clutch Control System

There is no difference between the clutch master cylinder/air power slave cylinder and the conventional master cylinder /slave cylinder control system in structure. There is only a slight difference between the push-type clutch and pull-type clutch in terms of power slave cylinder.

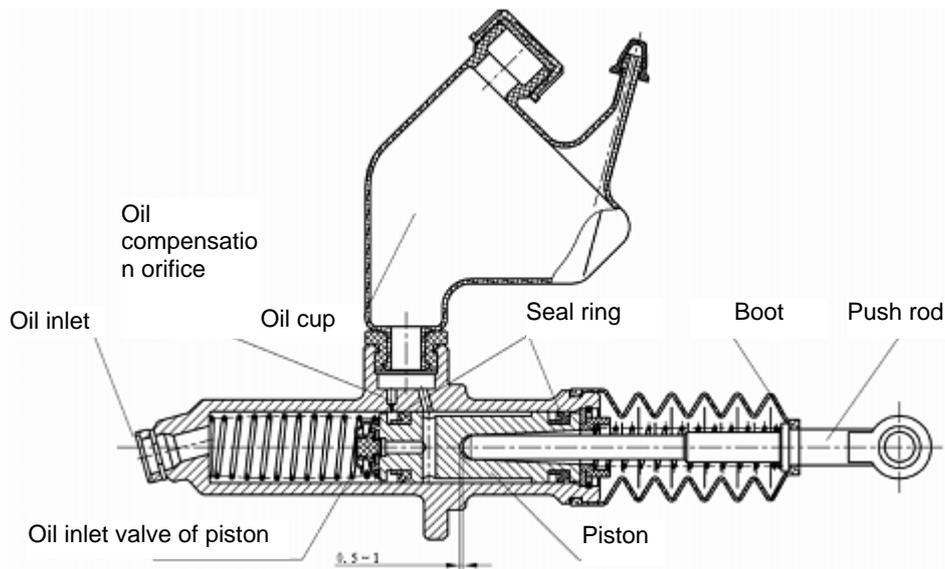
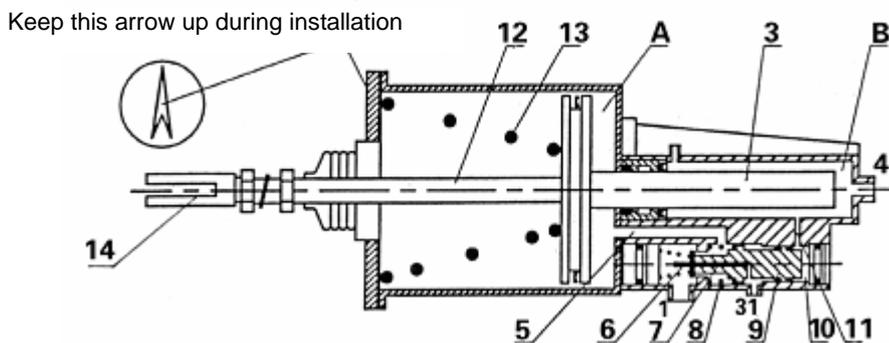


Figure 1-10 Clutch Master Cylinder



1. Air inlet 2. Air outlet 3. Piston push rod 4. Oil inlet 5. Booster cylinder air passage 6. Hydraulic control valve 7. Air outlet passage 8. Return spring 9. Hydraulic control piston 10. Hydraulic chamber 11. Hydraulic oil passage 12. Slave cylinder push rod 13. Return spring 14. Connection rod 31. Air outlet

Figure 1- 11 Schematic Diagram of Push-type Clutch Power Slave Cylinder

The clutch master cylinder used by C&C Truck is the same with conventional clutch in structure, as shown in Figure 1-10, it's basically composed of push rod, piston, master cylinder housing and oil cup. Pay attention in installation process, when the clutch pedal is released completely, there shall be a clearance by 0.5-1.0mm between the push rod and piston.

The power slave cylinder of push-type diaphragm clutch as shown in Figure 1-11 consists of two parts: one is the hydraulic control section, the other one is the air power section.

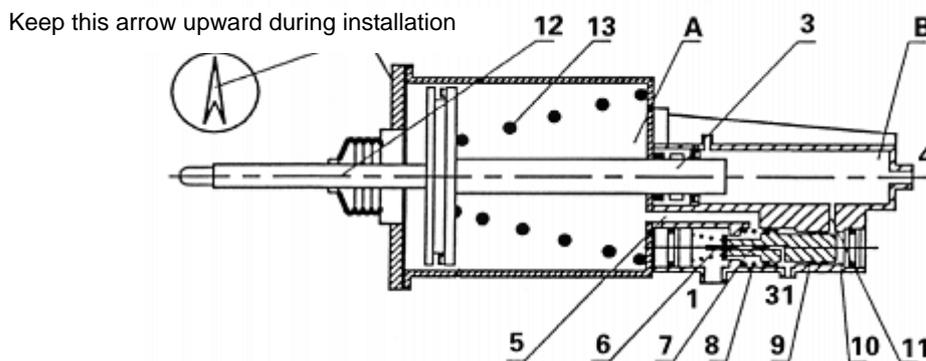
When driver depresses the clutch pedal, the pedal crankarm pushes the piston inside the master cylinder; the fluid inlet of fluid reservoir is closed firstly, and then will push the fluid through pipelines into the power slave cylinder.

Figure 1-11, the fluid goes into the chamber B through inlet 4 of power cylinder, then fluid pushes the piston push rod 3 to the left, while hydraulic fluid is going into chamber 10 through passage 11, and hydraulic controlled piston 9 is moving to the left at the same time. Piston 9 moves to the left, which causes hydraulic controlled air intake valve 6 leave the valve seat, then the air inlet valve is opened, the compressed air from the inlet 1 goes through air inlet passage into chamber A, compressed air from chamber A pushes the power piston which results in power assistance. Hydraulic and air power assistance both act on the push rod 12 of the slave cylinder to push the clutch crankarm, thereby the clutch is disengaged through the operation of release bearing.

When the clutch pedal stops at a certain position, then the fluid from master cylinder stops going into power slave cylinder chamber B, however the compressed air still moves the power piston to left at this time, which leads to a quick pressure decrease inside the hydraulic chamber B, therefore the hydraulic controlled piston 9 starts to move to right under the action of air pressure and return spring, and cause the hydraulic controlled air inlet valve 6 return to seat, thus closing the compressed air channel to chamber A, the slave cylinder push rod 12 will not move outward further, but stop at the balance status. This is the follow-up characteristic of the power assistance, which ensures the nature of completely release and smooth engagement of the clutch.

When driver releases the clutch pedal, the pressure of chamber B is unloaded, the hydraulic controlled piston 9 moves to the end of right side under the action of air pressure and return spring 8, thus opens the channel from chamber A to air outlet 31 A, the compressed air of chamber A is evacuated, the push rod of the slave cylinder moves to right completely under the effect of return spring 13 and the return spring of the release bearing, then clutch is engaged.

There is an adjustable lever 14 in front of the slave cylinder push rod for push-type clutch; the release bearing clearance can be assured through adjusting the length of the lever.



1. Air inlet 2. Air outlet 3. Piston push rod 4. Fluid inlet 5. Booster cylinder air passage 6. Hydraulic controlled valve 7. Air outlet passage 8. Return spring 9. Hydraulic controlled piston 10. Hydraulic chamber 11. Hydraulic oil passage 12. Slave cylinder push rod 13. Return spring 14. Lever 31. Air outlet

Figure 1- 12 Schematic Diagram of Pull-type Clutch Power Slave Cylinder

The structure for both pull-type clutch and push-type clutch is basically the same. Figure 1-12, the difference is the position of the power piston springs 13.

In addition, as there is no release bearing clearance for pull-type clutch, therefore, there is no adjustable linkage for its push rod of the slave cylinder.

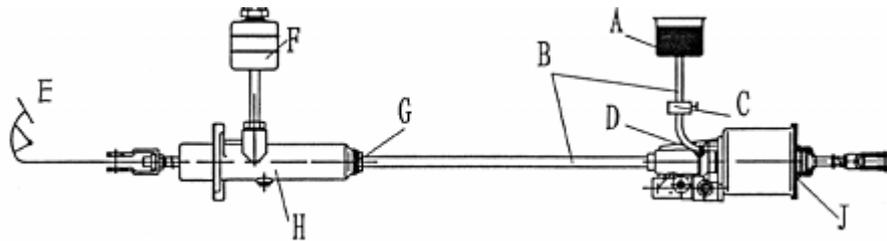
The working process for both pull-type clutch and push-type clutch is completely same.

Pay attention to the following during the clutch operation system installation: the master cylinder and its push rod shall be aligned centrally, the maximum deviation angle should not exceed $\pm 3^\circ$, or the push rod offset will cause early wear and piston failure.

Please note that the oil cup of the master cylinder shall be put upward during installation, so as to prevent oil leakage and air from getting inside.

Please note that the booster pump shall be installed upward according to the arrow on the cover plate, and ensure the air bleeding screw stay at the highest position, which facilitates the air bleeding. Minimize the bending of the pipeline which connects the master cylinder and booster pump; keep the route from high to low, which benefits the air bleeding of the pipeline.

Conduct the air bleeding of the hydraulic system during the initial installation or repair of clutch operation system. There are three methods of air bleeding as shown in Figure 1-13.



E. Clutch pedal F. Fluid reservoir H. clutch master cylinder G. Fluid outlet adaptor of master cylinder A. Tank type power pump

B. Hydraulic pipeline C. Switch D. Air bleeding screw J. Power slave cylinder

Figure 1-13 Operation System Air Bleeding Diagram

The first method: connect one pipe, switch C and power pump A with air bleeding adaptor of power pump, set the pedal E in free state, open the air bleeding screw D and switch C, turn on the power pump to fill power slave cylinder J and master cylinder H with fluid from the air bleeding pipe of the power slave cylinder. You also can use a fluid reservoir with the location higher than fluid reservoir F to fill the master cylinder and slave cylinder with fluid under the gravity till the clean fluid is added up to the rated scale of the fluid reservoir, then screw up the fluid drain screw, and remove the fluid filling devices A and C.

The second method: set pedal E in a free state, loosen the air bleeding screw D, fill the fluid from the fluid reservoir until clean fluid drains out from the air bleeding screw, and then tighten the air bleeding screw. Keep the pedal at its lowest position after several times' depress, loosen the air bleed screw, tighten it immediately after bleeding. Repeat this operation till the clean fluid drains out from the air bleeding screw without air, and then you will have a heavy and strong feeling in pedal depressing, finally tighten the air bleeding screw, and add the fluid to the required level in the fluid reservoir. Please note that you shall always fill the fluid reservoir during this operation.

If the above two methods are still not able to drain out the air, you still have a weak feeling on the pedal in depressing, then turnover the driving cab, pull down the crankarm of the master cylinder pedal with your hand, then loosen the fluid outlet adaptor of the master cylinder to air bleeding, then tighten the adaptor and loose the pedal crankarm. Repeat it several times until the air is drained out and heavy power pedal depress is felt.

During the initial installation or repair of the master cylinder and power slave cylinder, the two methods above can be used for fluid filling.

The clutch operation system uses Great Wall DOT3 brake fluid, pay attention that don't mix the brake fluid with machine oil, and always fill the same type of brake fluid for supplement, otherwise it will cause power slave cylinder failure. Currently, Auman heavy-duty truck generally uses this type of control system, including the coil spring clutch control system.

II. Repair and Installation Notes of Diaphragm Spring Clutch

Based on the structural characteristics of the diaphragm spring clutch, pay special attention to the following during operation, repair and especially in removal and installation process:

(1) Pay special attention to avoid the drive plate (Figure 1-5) getting sudden load during using, repair and removal & installation process; if the drive plate is deformed, it will seriously affect the performance of the clutch.

In order to ensure that the drive plate will not be damaged during shipping and handling, there are four elastic U-clamps (see Figure 1-5) which are fixed on the new clutch pressure plate assembly. After fit the pressure plate on the flywheel, elastic U-clamps will get loose naturally, then the U-clamps must be removed, or they may fall into the running clutch and lead to serious malfunction and consequence. When removing the pressure plate assembly in repair, you should manage to fix the pressure plate and its housing relatively, so as to prevent the drive plate from getting damaged.

(2) When installing the pressure plate assembly, firstly, you can align the pressure plate assembly and flywheel with two positioning bolts. And use the alignment rod to position the driven plate on the central hole of flywheel, then tighten the 12 bolts on the pressure plate housing, finally tighten it with a torque as 50 to 60 N.m in a diagonal sequence.

(3) Check whether the position of the diaphragm spring is correct as shown in Figure 1-14 after installation of pressure plate assembly.



Figure 1-14 Clutch Assembly Installation

(4) Due to smaller inspection window of clutch housing, the spring strip hook on release ring can't be removed by hand or other tools during pull-type clutch release bearing installation, put on the hook after the bearing is fitted. Therefore, fit the pressure plate assembly on the flywheel firstly in the actual installation process. After the installation is completed, move the spring strip with your hand, and see whether the spring strip on the release ring is loose or flexible. If the strip stuck on the release ring, then you should check and re-install it, or the release bearing may not able to be fitted inside. Note: The spring strip hook must engage in place as shown in Figure 1-8.

Then pull out the alignment rod fitted in the pressure plate assembly installation, thus fit the transmission (with the release bearing) on the engine as shown in Figure 1-15, after transmission and flywheel housing are fixed, mount an cable on the crankarm end of the release bearing through the window of the power slave cylinder, then pull the crankarm in a sudden to make the release bearing push the release ring to be caught by the spring strip, then the release bearing is installed in place. Then, move the release bearing through the clutch window, and confirm whether the release bearing and release ring are really in place. Figure 1-16 shows the schematic diagram of the pull-type clutch installation.

(5) There is an upward arrow mark (Figure 1-11 and 1-12) on the slave cylinder housing, which is required to be set upward during installation, so as to facilitate the air bleeding of the slave cylinder, or air bleeding of the slave cylinder will be blocked, which causes improper working of the operation system.



Figure 1-15

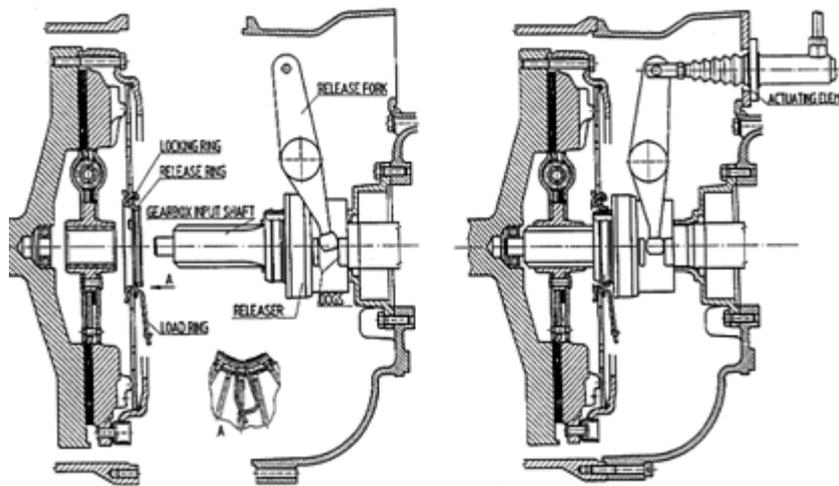


Figure 1-16 Pull-type Clutch Status Before and After Transmission Installation

Section II General Problem Troubleshooting

The clutch shall be released completely, and engaged smoothly. The clutch problems include: improper release, "surging" in engagement, clutch slipping and release bearing burnt etc.

1. Clutch Doesn't Release Properly and Surging in Starting.

The causes of the improper clutch release include: too big clutch pedal free travel (e.g. the free clearance of the master cylinder is too big, which leads to over large release bearing clearance, and results in too small effective travel of the release bearing, and then the clutch can't be released completely. The clutch release lever (press claw) is too low, and the release lever is not pushed to completely release position while release bearing is at its limit, and cause the problem of clutch improper release. If the thickness of the friction plate is above the criteria when replacing the new driven plate, it also will cause improper release problem before the release lever (press claw) height is inspected and re-adjusted. If the friction plate thickness is much greater than the criteria, it will make the release lever (press claw) cannot be adjusted to the standard position (adjustment screw is adjusted in place), then the clutch improper release occurs.

If the clutch driven plate is warped and deformed, clutch pressure plate working surface is deformed and drum deformation occurs, the pressure plate surface is not flat due to warping or uneven wear, even if the release lever height and release bearing clearance comply with the requirements, this will not only lead to incomplete release, also "surging" will happen in starting. The so-called "surging" in starting is the clutch intermittent engagement and lead to shudder in starting due to partial contact between the pressure plate and driven plate friction plate during the clutch engagement process.

II. Clutch Slipping

There are many causes of clutch slipping. Due to improper adjustment of the release bearing, there is no clearance, and release bearing lays on the release lever with certain pressure; the clutch spring is annealed because of overheating, then the elasticity reduces; The clutch spring is not installed according to the required elasticity(color), which causes the pressure plate pressure can't meet the requirement of torque output; clutch driven plate friction plate burnt, complete burnt or rivet exposure; clutch slipping due to oil dirt on the friction plate; the working surface of pressure plate gets deformed and contacts with the friction plate partially, and then lead to weak clutch engagement and "slipping" problem. In addition, clutch slipping also will occur due to no free clearance and non-return master cylinder.

It's easy to identify the clutch slipping phenomenon during vehicle starting, if the starting speed is obviously not synchronized with the engine speed, and vehicle accelerates slowly while sudden engine acceleration is conducted, this indicates the clutch slipping problem happened. Burning odor will be smelt in severe condition.

III. Release Bearing Burnt

The main cause of release bearing burnt is that there is no clearance between the release bearing and the release claw, which causes the release bearing always stand against the release claw, and problem happens with the release bearing rotating constantly. Any part has a certain life, Moreover, release bearing is a one-time lubricated bearing (the grease injected into the clutch mechanism during maintenance is for lubricating the release bearing sleeve rather than the release bearing itself), release bearing only rotates together with the clutch when shifting during starting and normal driving, therefore, if there is no release bearing clearance, the release bearing will soon burn off. Adjusted improperly, friction plate wear and tear can cause the release bearing clearance be eliminated.

As the pull-type clutch release bearing rotates with the clutch, qualified release bearing must be used.

IV. Clutch Noise

If there is no noise during normal running, rattle occurs when the pedal is depressed, it's obvious an indication of release bearing failure, this is the most common noise. If there is other obvious different noise comes from other parts of the clutch, this may be caused by the loose of mounting bolts of the pressure plate, and then you must dismantle the clutch for careful inspection.

Table 1 Clutch Common Problems Troubleshooting

Clutch Common Problems Troubleshooting Table 1.

I. Failure Mode: Clutch Slipping

Symptom: difficulty starting the vehicle, powerless in driving

No.	Cause	Inspection Methods	Solutions for Problems Found in Inspection
1	Improper operation	Whether the driver starts the vehicle at high speed gear or delays in gear shifting (high speed gear at low vehicle speed, doesn't change the low speed gear to high speed gear timely)	Use the correct method of operation (start with 1 st speed gear; don't delay gearshift)
2	Severe overload	Whether the vehicle is used within the rated load range	Avoid serious overloading
3	Free travel is not proper or no free travel	Check whether the free travel of the push-type clutch release bearing complies with the standard as 3-5mm.	If release bearing doesn't have free clearance, it will cause release bearing push against the release fingers hardly and clutch slipping; then adjust the free clearance of release bearing within prescribed range.
4	Release bearing sleeve stuck, no return	Remove the clutch housing bottom cover (or sight hole), and release the clutch pedal after depress, then observe whether the release bearing (seat) return is smooth; release the clutch and check whether the release bearing rotates flexibly.	<ol style="list-style-type: none"> 1. Check whether the release rocker arm (power slave cylinder) has the return spring, slave cylinder returns slowly without return spring, which will cause clutch slippage, therefore, the return spring of the rocker arm should be fitted. 2. Such as release bearing (seat) lacks oil, and then injects grease (fit the grease injection pipe when no grease injection pipe is available). 3. If the problem cannot be resolved by grease injection, then remove the transmission, check whether the release bearing (seat) has return spring, fit the return spring of the bearing seat if the return spring is not available. 4. Check whether the release bearing falls apart or stuck, and then replace the release bearing.
5	The friction place surface is contaminated with oil	Remove the bottom cover of clutch housing (or sight hole); check whether there is oil thrown out from the friction plate edge.	<ol style="list-style-type: none"> 1. Remove the friction plate and clean it with gasoline, blow dry it; If the friction plate is burnt, harden or rivet head is exposed, and then change the driven plate assembly. 2. There is excessive grease filled into the release bearing seat (grease has seeped out at both ends of bearing surface) To clean it up.
6	Pressure plate poor contact	Remove the clutch; there is partial burning (blue) on the pressure plate surface, then check the pressure plate surface	<ol style="list-style-type: none"> 1. It's allowed to proceed to use if the runout is less than 0.2mm. 2. Change the clutch cover and pressure plate if the runout is more

		runout with plane meter, plug gauge.	than 0.2mm.
7	Diaphragm spring becomes soft or is broken, insufficient pressing force	<p>1. Open the clutch sight hole, and check whether there is friction plate wearing debris, whether there is a burning smell;</p> <p>2. Hand brake pulling test (run the engine at neutral gear, pull the hand brake, depress the clutch pedal and shift into 1st speed gear, release the clutch pedal slowly while pushing down the accelerator pedal; if the engine shuts down, it means that the clutch pressing force complies with the requirement, or it means the pressing force is insufficient, then proceed to do further works)</p> <p>3. Remove the clutch, check the wearing of driven plate and measure the thickness of driven piece ;</p> <p>4. Move the release fork with hand, check whether there are following abnormal conditions: stuck, non-returning of release bearing(seat), meshing between the release bearing seat and guide sleeve is loose;</p>	<p>1. Change the clutch cover and pressure plate if the pressure plate surface is obvious blue.</p> <p>2. Firstly, check whether the driven plate wearing excessively (friction plate wears to 0.5mm lower than the rivet head): excessive driven plate wearing, and the pressure plate surface is not blue, then it's only required to change the driven plate assembly;</p>

II Failure Mode: Clutch Does Not Release Properly

Symptom: difficult in gear shifting, gear impact noise in transmission.

No.	Cause	Inspection Methods	Solutions for Problems Found in Inspection
1	Improper adjustment, free travel is too long, and then result in insufficient effective travel.	Check whether the free travel of the clutch release bearing complies with the standard as 3-5mm. Note: for the pull-type clutch, there is no clearance between the release bearing and diaphragm spring.	Adjust the push rod adjustment nut of the clutch slave cylinder to move the release fork forward and push the release sleeve, then reduce the distance between the release bearing and the inner end of release lever. (Adjust by 3-5mm)
2	Slave cylinder component failure, short working travel	1. Set the push rod of the slave cylinder in natural status, and depresses the clutch pedal, then measure the distance of the push rod movement. 2. Check whether the push rod of the slave cylinder gets stuck, slow and or works partially in stretching out and returning process.	Shorten the free travel of the slave cylinder, if the clutch can be released, it means that the slave cylinder travel is not enough, then the following checks shall be performed: 1. Check whether the pipeline between the gas tank and the slave cylinder is unobstructed and sealed, and check whether the pipe diameter is large enough (typically requires 6-8mm). 2. Check whether the hydraulic oil inside the oil reservoir of the master cylinder is sufficient and clean. 3. Check whether there is oil and gas leakage occurred in the slave cylinder, and whether the sealant failed. Replace the slave cylinder if failure occurs.
3	The sleeve of the release bearing stuck, can't move forward	Remove the clutch housing bottom cover (or sight hole), and release the clutch pedal after depress, then observe whether the release bearing (seat) return is smooth; release the clutch and check whether the release bearing rotates flexibly.	1. Check whether the release rocker arm (power slave cylinder) has the return spring, slave cylinder returns slowly without return spring, which will cause clutch slippage, therefore, the return spring of the rocker arm should be fitted. 2. Such as release bearing (seat) lacks oil, injects grease (fit the grease injection pipe when no grease injection pipe is available). 3. If the problem cannot be resolved by grease injection, then remove the transmission, check whether the release bearing (seat) has return spring, fit the return spring of the bearing seat if the return spring is not available. 4. Check whether the release bearing falls apart, stuck, and then replaces the release bearing.
4	Driven plate failure	Remove the clutch for inspection	1. Whether the spline teeth surface of the driven plate/ input shaft of transmission gets damaged, and causing the axial movement of driven plate blocked; replace the driven plate assembly if the driven plate spline wears; change the input shaft of transmission if the input shaft spline wears; 2. Whether the driven plate friction plate is deformed severely(put the driven plate on the pressure plate, then check the

			deformation, if it's above 3mm, then it's defined as driven plate deformation), and the driven plate assembly shall be replaced;
5	Pressure plate failure	Remove the clutch for inspection	<p>1. The serious wear and tear of the release finger/release bearing results in less effective stroke; replace the clutch cover and pressure plate assembly and release bearing;</p> <p>2. The height of the release fingers is not consistent (it's required to measure the difference between the highest and lowest ones); The two adjacent release fingers' height difference (under engagement): if it's lower than 2.5mm, then the pressure plate can be used consecutively; if it's above 2.5mm, then change the clutch cover and pressure plate assembly), and there is no foreign matter block.</p> <p>3. Release fingers broken, change the clutch cover and pressure plate assembly;</p>
6	Fork shaft component failure	Whether the contact area of the fork and bearing seat wears excessively.	Change with new and qualified fork and bearing seat

III Failure Mode: Vehicle Starting Shudder

Symptom: Vehicle doesn't start smoothly, and surging.

No.	Cause	Inspection Methods	Solutions for Problems Found in Inspection
1	Improper operation	To learn from the driver which gear is used in vehicle starting.	If the vehicle is started at the 3 rd speed gear or above, the vehicle will shudder, clutch early wearing and other malfunctions will occur, driver is required to start the vehicle at 1 st or 2 nd speed gear.
2	Connected component failure	Check whether the mounting bolts of the engine, mounting bolts of transmission and flywheel, and the mounting bolts of the clutch over are loose, tighten them accordingly if loose occurs	
3	Master cylinder, slave cylinder and component failures	Check whether the slave cylinder works segmental or returns too fast.	<p>Shorten the free travel of the slave cylinder, if the clutch can release, it means that the slave cylinder travel is not enough, then the following checks shall be performed:</p> <ol style="list-style-type: none"> 1. Check whether the pipeline between the gas tank and the slave cylinder is unobstructed and sealed, and whether the pipe diameter is large enough (typically requires 6-8mm). 2. Check whether the hydraulic oil inside the oil reservoir of the master cylinder is sufficient and clean. 3. Check whether there is oil and air leakage occurred in the slave cylinder, and whether the sealant failed. Replace the slave cylinder if failure occurs. 4. If the above itinerary checking process cannot solve the problem of inadequate travel, then it may be caused by improper selection of the slave cylinder, the bore is too small.
4	The release bearing sleeve stuck, and can't return smoothly	Remove the clutch housing bottom cover (or sight hole), and release the clutch pedal after depress, then observe whether the release bearing (seat) returning is smooth; release the clutch and check whether the release bearing rotates flexibly.	<ol style="list-style-type: none"> 1. Check whether the release rocker arm (power slave cylinder) has the return spring, if slave cylinder returns slowly without return spring, then it will cause clutch slippage, therefore, the return spring of the rocker arm should be fitted. 2. Such as release bearing (seat) lacks oil, then apply grease on the seat (fit the grease injection pipe when no grease injection pipe is available). 3. If the problem cannot be resolved by grease injection, then remove the transmission, and check whether the release bearing (seat) has return spring, fit the return spring of the bearing seat if the return spring is lost. 4. Check whether the release bearing

			falls apart and or stuck, then replace release bearing.
5	The height of release fingers/release ring is inconsistent.	Dismantle the clutch for inspection	The height of the release fingers is not consistent (it's required to measure the difference between the highest and lowest one); The two adjacent release fingers' height difference (under engagement): if it's lower than 2.5mm, then the pressure plate can be used consecutively; if it's above 2.5mm, then change the clutch cover and pressure plate assembly), and there is no foreign matter block.
6	The damping spring of driven plate gets loose, broken	Remove the clutch for inspection	Change the clutch driven plate assembly
7	Pressure plate deformation	Remove the clutch for inspection, check the surface runout of the pressure plate with a ruler and a plug gauge	<ol style="list-style-type: none"> 1. It's allowed to proceed to use pressure plate if the runout is less than 0.2mm. 2. Change the clutch cover and pressure plate if the runout is more than 0.2mm.

IV. Failure Mode: Clutch Noise

Symptom: clutch abnormal sound occurs during vehicle or engine running

No.	Cause	Inspection Methods	Solutions for Problems Found in Inspection
1	The return spring of the clutch pedal is too soft, falls off or is broken	Check the spring	The return spring of the clutch pedal or release bearing is broken, too soft or fall off etc., then cause the release bearing collide with the release lever when moving forward and back, then change the return spring.
2	Release bearing damage	The noise occurs when depressing the clutch pedal a little, but sound disappears after release, it's convinced that the noise comes from the release bearing. 1. If the "swoosh" noise is heard, then it may be due to bearing oil shortage, and or the ball rubs with the race or gets loose. 2. If the "crash" noise is heard, then it's due to the bearing ball broken, and or bearing falls apart or stuck.	1. It's required to lubricate the release bearing with grease. 2. Replace the release bearing.
3	Return spring of release bearing gets loose, broken	If intermittent metallic rattle is heard, it's caused by loose of release bearing (sleeve) and return spring in general.	Replace the return spring
4	The damping spring of driven plate gets loose, broken	Remove the clutch; check the whether the damping spring of the driven plate gets loose or broken, or other problems occur.	Change the clutch driven plate assembly
5	The spline hole of driven plate meshes with shaft loosely	When you just depress or lift the clutch pedal, the clutch generates a "Ko Deng" sound, it's due to the driven plates hub wears too much with the input shaft spline of transmission, and it's the knock sound from the loose coupling parts.	Change the clutch driven plate assembly if the driven plate spline wears; replace the input shaft if the input shaft spline of the transmission wears.
6	The steel plate of the driven plate gets fracture, broken or rivet head is exposed	A sharp noise is heard when the clutch pedal is just released during vehicle starting, then it disappears when the pedal is depressed.	1. The steel plate of driven plate gets fracture, broken; change the driven plate assembly; 2. The exposed rivet head scratches with pressure plate or flywheel; Change the driven plate assembly and relevant damaged parts (clutch cover and pressure plate assembly or flywheel)

V. Failure Mode: Clutch Noise

Symptom: Under normal gas pressure, when depressing the clutch pedal, it feels very heavy

No.	Cause	Inspection Methods	Solutions for Problems Found in Inspection
1	Pedal shaft oil loss, rust, stuck.	Remove the pedal for inspection	Inject the grease
2	Release fork shaft oil loose, rust, stuck.	Remove the push rod of the slave cylinder, push the release fork back and force for checking the flexibility.	Inject the grease
3	The distortion parts of the pedal are disordered	Check for deformation	Replace the pedal
4	Pipe diameter is too small, which causes too much resistance	Check whether the pipeline between the gas tank and the slave cylinder is unobstructed and sealed, and check whether the pipe diameter is large enough (typically requires 6-8mm).	Increase the pipeline diameter

Section III Clutch Repair Special Tools

When replacing the clutch friction plate or dismantling, or assembling the clutch pressure plate assembly, special tools and equipments are needed, or the dismantling and assembling will be very difficult.

During the replacement and assembly of the clutch friction plate, in order to ensure that the transmission input shaft can be inserted into the spline shaft of the clutch friction plate, when fitting the clutch pressure plate and flywheel, as shown in Figure 3-10b, firstly put the clutch center alignment rod through the friction plate into the central bearing hole of flywheel, so that the alignment of friction plate and flywheel is assured, which facilitates the installation of the transmission.

Pull out the clutch center alignment rod after the clutch pressure plate is installed and flywheel is centrally mounted and fastened. Finally, fit the transmission in place.



Figure 3-10a Clutch Center Alignment Rod

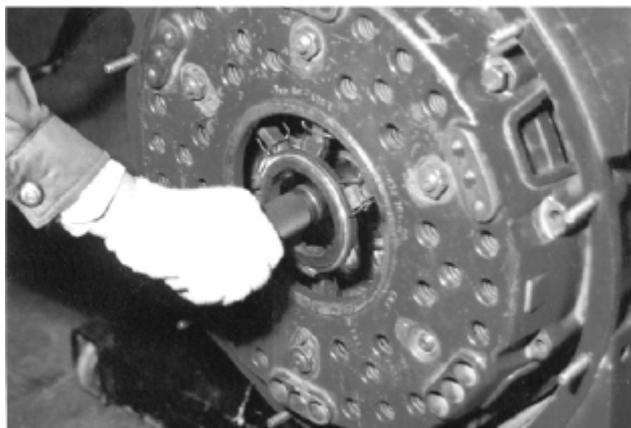


Figure 3-10b Install Friction Plate with Alignment Rod

Transmission

C&C TRUCKS CO., LTD.

October 2010

Foreword

Fuller transmission manufactured by U.S. Eaton is a high-power, multi-speed, double-countershaft, range speed transmission with combined primary transmission and secondary transmission.

Its unique style of double-countershaft structure features a smooth and low noise high torque transmission and compact structure.

It features simple structure with advanced performance, which makes it be widely used in the field of heavy-duty vehicle.

China introduced U.S. Fuller RT11509C model transmission; Shaanxi Fast Gear Co., Ltd. has done the RT11509C localization and additionally extended the product to RT11609 series as well.

In recent years, with the Fuller transmission double-countershaft technology, they have developed a 7 DS; 7 JS; 8 JS; 9 JS and 12J S as well as 16JS series transmissions consecutively, and established a whole series of new "Fast double-Intermediate shaft" Transmissions, C&C Truck generally is fitted with this type of double-countershaft transmission. C&C Truck is also equipped with some Germany ZF's automatic transmission.

This manual focuses on the structure, operation and repair specifications of Fast double-countershaft transmission.

It only explains the ZF transmission generally.

Editor

October 2010

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Chapter I Fast Double-countershaft Transmission

Section I Overview

The main features of Fast double-countershaft transmission is that one additional countershaft is fitted on the symmetric axis of a conventional transmission, then it becomes into a double-countershaft transmission, because of the additional countershaft, the power is transmitted symmetrically, and contribute to the advantages of smooth transmission and low noise.

Its structure is simple, and performance is advanced.

China introduced RT11509C basic model from U.S., and Shaanxi Fast Gear Co., Ltd has done the localization for this model, at the same time extended to RT11609C and RTO11609 series.

With the development of domestic heavy-duty vehicles, with the countershaft technology, Shaanxi Fast Gear Co., Ltd. has developed 7DS; 7JS; 8JS; 9JS; 10JS; 12JS and 16JS Fast transmissions with 7-speed, 8-speed, 9-speed, 10-speed even 12-speed and 16-speed, the ruling meaning of the two kinds of Fast transmission model are as follows:

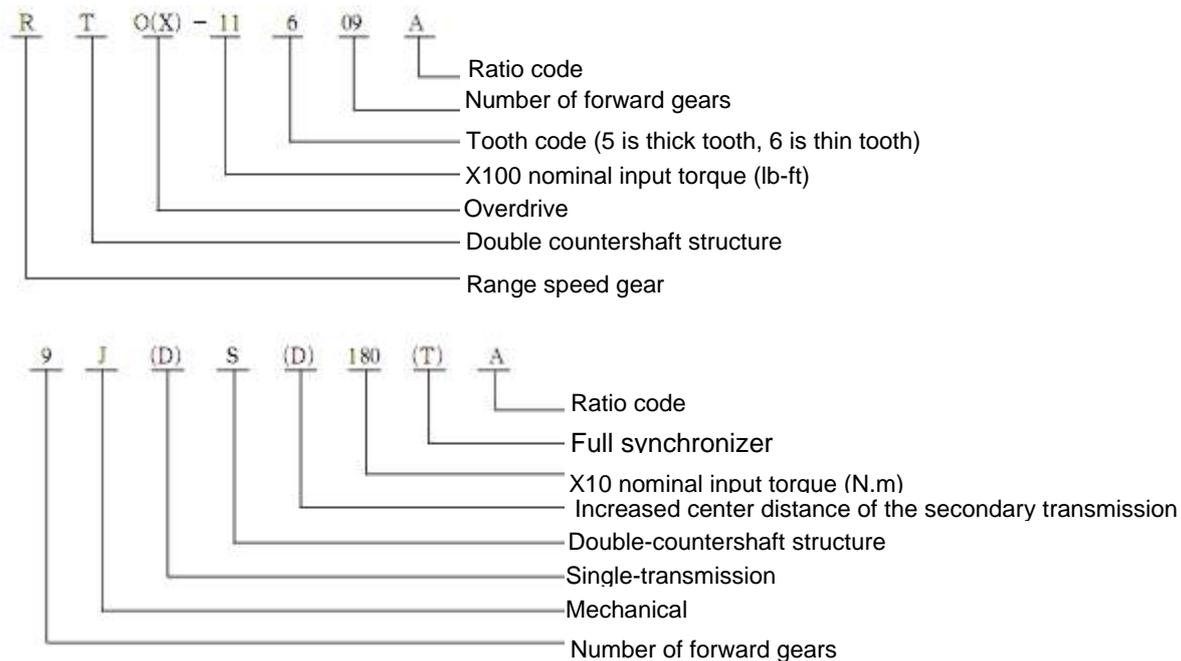


Table 1-1 shows the basic performance and gear ratio of each transmission model.

Figure 1-1 is the outline of RT11509C model Fast transmission, Figure 1-2 is the structure schematic diagram.

At present, 9JS; 10JS and 12JS series Fast transmissions are widely used for C&C Truck.

For RT11509, RT11609 series and 7DS, 7JS, 8JS, 9JS, 12JS and 16JS series transmissions, only 7DS series transmissions are the so-called "single gearbox" transmission equipped with primary transmission only.

Table 1-1 The Main Performance Parameters of Fast Double-countershaft Series Transmission

Number of gears	Model	Torque	Input power (Kw)	Rated speed (rpm)	Gear ratio										Weight (kg)	Oil filling quantity	Structural features
					1	2	3	4	5	6	7	8	9	R			
7	7DS90	900	191	2600	9.20	5.43	3.54	2.53	1.82	1.33	1.00			8.49	255	12	Double-Intermediate shaft, integral model There is only primary transmission without secondary transmission
7	7DS90B	900	191	2600	8.17	4.82	3.14	2.09	1.44	1.00	0.82			7.54	255	12	
7	7DS100	1000	199	2600	9.20	5.43	3.54	2.53	1.82	1.33	1.00			8.49	255	12	
7	7DS100A	1000	199	2600	6.93	4.09	2.67	1.91	1.37	1.00	0.75			6.40	255	12	
7	7DS100B	1000	199	2600	8.17	4.82	3.14	2.09	1.44	1.00	0.82			7.54	255	12	
7	7DS118	1180	220	2600	10.22	5.43	3.54	2.53	1.82	1.33	1.00			9.04	255	12	
7	7DS118B	1180	220	2600	9.08	4.82	3.14	2.09	1.44	1.00	0.82			8.03	255	12	
7	7JS100	1000	199	2600	10.63	7.04	4.63	3.36	2.09	1.38	1.00			10.58	255	12	
7	7JS100A	1000	199	2600	8.03	5.32	3.36	2.54	1.58	1.00	0.76			8.00	255	12	
8	8JS100	1000	199	2600	10.63	7.04	4.63	3.36	3.16	2.09	1.38	1.00		10.58	255	13	
8	8JS100A	1000	199	2600	8.03	5.32	3.36	2.54	2.39	1.58	1.00	0.76		8.00	255	13	
8	8JS100B	1000	199	2600	11.40	7.94	5.63	4.06	2.81	1.96	1.39	1.00		11.35	255	13	
8	8JS100C	1000	199	2600	9.32	6.09	4.06	3.10	2.30	1.50	1.00	0.76		9.28	255	13	Double-intermediate shafts, full synchronizer
8	8JS100T	1000	199	2600	10.31	7.33	5.09	3.77	2.73	1.94	1.35	1.00		10.26	255	13	
8	8JS100TA	1000	199	2600	8.12	5.77	3.77	2.98	2.15	1.53	1.00	0.79		8.08	255	13	
8	8JS115T	1150		2600	10.31	7.33	5.09	3.77	2.73	1.94	1.35	1.00		10.26	255	13	Double- intermediate shafts, secondary transmission synchronizer
8	8JS118	1180	220	2600	11.40	7.94	5.63	4.06	2.81	1.96	1.39	1.00		11.35	255	13	
8	8JS118A	1180	220	2600	9.32	6.09	4.06	3.10	2.30	1.50	1.00	0.76		9.28	255	13	
8	8JS118B	1180	220	2600	10.63	7.04	4.63	3.36	3.16	2.09	1.38	1.00		10.58	255	13	
8	8JS118C	1180	220	2600	8.03	5.32	3.36	2.54	2.39	1.58	1.00	0.76		8.00	255	13	

Table 1-1 Continued

Number of gears	Model	Torque	Input power (Kw)	Rated speed (rpm)	Gear ratio										Weight (kg)	Oil filling quantity	Structural features
					1	2	3	4	5	6	7	8	9	R			
8	8JS118T	1180	220	2600	10.31	7.33	5.09	3.77	2.73	1.94	1.35	1.00		10.26	267	13	Double-intermediate shafts, full synchronizer
8	8JS118TA	1180	220	2600	8.12	5.77	3.77	2.98	2.15	1.53	1.00	0.79		8.08	267	13	
8	8JS118TB	1180	220	2600	11.40	7.94	5.63	4.06	2.81	1.96	1.39	1.00		11.35	267	13	
8	8JS118TC	1180	220	2600	9.32	6.09	4.06	3.10	2.30	1.50	1.00	0.76		9.28	267	13	
8	8JS100T	1000	199	2600	10.31	7.33	5.09	3.77	2.73	1.94	1.35	1.00		10.26	255	13	
8	8JS100TA	1000	199	2600	8.12	5.77	3.77	2.98	2.15	1.53	1.00	0.79		8.08	255	13	
8	8JS130T	1300	243	2600	10.31	7.33	5.09	3.77	2.73	1.94	1.35	1.00		10.26	255	13	
8	8JS130TA	1300	243	2600	8.12	5.77	3.77	2.98	2.15	1.53	1.00	0.79		8.08	255	13	
8	8JS180T	1800	331	2600	10.31	7.33	5.09	3.77	2.73	1.94	1.35	1.00		10.26	300	13	
8	8JS180TA	1800	331	2600	8.12	5.77	3.77	2.98	2.15	1.53	1.00	0.79		8.08	300	13	
9	RT-11609A	1490	265	2600	12.65	8.38	6.22	4.57	3.40	2.46	1.83	1.34	1.00	13.22	267	13	Double-intermediate shafts, secondary transmission synchronizer
9	RTO-11609B	1490	265	2600	12.57	7.47	5.28	3.82	2.79	1.95	1.38	1.00	0.73	13.14	267	13	
9	RT-11509C	1490	265	2600	12.42	8.29	6.08	4.53	3.36	2.47	1.81	1.35	1.00	12.99	270	12	
9	RTO-11609E	1490	265	2600	10.69	7.08	5.25	3.40	2.68	2.08	1.55	1.00	0.79	11.17	267	12	
9	RTO-11509F	1490	265	2600	10.06	6.71	4.92	3.36	2.65	2.00	1.47	1.00	0.79	10.51	267	12	
9	9JS119	1190	220	2600	12.11	8.08	5.93	4.42	3.36	2.41	1.76	1.32	1.00	12.66	255	13	Double -intermediate shafts, secondary transmission synchronizer
9	9JS119A	1190	220	2600	11.02	6.55	4.64	3.36	2.46	1.95	1.38	1.00	0.73	11.52	255	13	
9	9JS119T	1190	220	2600	12.11	8.08	5.96	4.42	3.36	2.41	1.77	1.32	1.00	12.66	267	13	Double intermediate shafts, full synchronizer
9	9JS135	1350	243	2600	12.11	8.08	5.93	4.42	3.36	2.41	1.76	1.32	1.00	12.66	255	13	Double- intermediate shafts, secondary transmission
9	9JS135A	1350	243	2600	11.02	6.55	4.64	3.36	2.46	1.95	1.38	1.00	0.73	11.52	255	13	
9	9JS135T	1350	243	2600	12.11	8.08	5.96	4.42	3.36	2.41	1.77	1.32	1.00	12.66	267	13	Double- intermediate shafts, full synchronizer
9	9JS150	1500	265	2600	12.36	7.35	5.93	3.77	2.76	1.95	1.38	1.00	0.73	12.93	255	13	Double-intermediate shafts, secondary transmission synchronizer
9	9JS150T	1500	265	2600	12.42	8.29	6.11	4.53	3.36	2.47	1.82	1.35	1.00	12.99	267	13	Double- intermediate shafts, full synchronizer
9	9JS180	1800	331	2600	12.65	8.38	6.22	4.57	3.40	2.46	1.83	1.34	1.00	13.22	300	12	Double- intermediate shafts, secondary transmission synchronizer
9	9JS180A	1800	331	2600	10.69	7.08	5.25	3.40	2.68	2.08	1.55	1.00	0.79	11.17	300	12	
9	9JS220	2200	380	2600	12.42	8.29	6.08	4.53	3.36	2.47	1.81	1.35	1.00	12.99	322	12	
9	9JS220A	2200	380	2600	12.78	8.52	6.25	4.27	3.37	2.54	1.87	1.27	1.00	13.35	350	15	Double-intermediate shaft, with lower distance transmission

Table 1-1 Continued

9	9JS180T 9JS200T 9JS240T	1800 2000 2400	331 355 400	2600	14.05	8.38	6.22	4.57	3.40	2.46	1.83	1.34	1.00	14.05	330	14	Double-intermediate shafts, full synchronizer
9	9JS180TA 9JS200TA 9JS240TA	1800 2000 2400	331 355 400	2600	13.96	7.47	5.28	3.82	2.79	1.95	1.38	1.00	0.73	13.96	330	14	Double-intermediate shafts, full synchronizer
9	9JSS180 9JSS220 9JSS260	1800 2200 2600	331 380 430	2600	14.05	8.38	6.22	4.57	3.40	2.46	1.83	1.34	1.00	14.05	350	15.5	Primary transmission double-intermediate shaft Secondary transmission triple-intermediate shaft Secondary transmission synchronizer

Table 1-2 Continued

Number of gears	Model	Torque	Input power (Kw)	Rated speed (rpm)	Gear ratio												Weight (kg)	Oil filling quantity
					1	2	3	4	5	6	7	8	9	10	R1	R2		
12	10JSD120	1200	220	2600	14.86	11.02	8.07	6.02	4.46	3.33	2.47	1.81	1.35	1.00	14.32	3.19	285	12.5
12	10JSD140	1400	250														315	13.5
12	10JSD160	1600	285														325	14.5
12	10JSD180	1800	331															
12	10JSD200	2000	355															
12	10JSD220	2200	380															
12	10JSD120A	1200	220	2600	11.03	8.12	5.98	4.46	3.30	2.47	1.83	1.34	1.00	0.74	10.55	2.37	285	12.5
12	10JSD140A	1400	250														315	13.5
12	10JSD160A	1600	285														325	14.5
12	10JSD180A	1800	331															
12	10JSD200A	2000	355															
12	10JSD220A	2200	380															
12	10JSD120B	1200	220	2600	12.74	9.43	6.67	4.83	3.53	2.64	1.95	1.38	1.00	0.73	13.73	2.84	285	12.5
12	10JSD140B	1400	250														315	13.5
12	10JSD160B	1600	285														325	14.5
12	10JSD180B	1800	331															
12	10JSD200B	2000	355															
12	10JSD220B	2200	380															
12	10JSD120T	1200	220	2600	14.96	11.16	8.28	6.09	4.46	3.35	2.5	1.86	1.36	1.00	15.07	3.38	330	12.0
12	10JSD140T	1400	250															

Number of gears	Model	Torque	Input power (Kw)	Rated speed (rpm)	Gear ratio												Weight (kg)	Oil filling quantity
					1	2	3	4	5	6	7	8	9	10	R1	R2		
12	10JSD160T	1600	285	2600	14.96	11.16	8.28	6.09	4.46	3.35	2.5	1.86	1.36	1.00	15.07	3.38	330	14.5
12	10JSD180T	1800	331														345	15.0
12	10JSD200T	2000	355														300	12.0
12	10JSD220T	2200	380														330	14.5
12	10JSD120TA	1200	220	2600	10.93	8.17	6.07	4.46	3.27	2.45	1.83	1.36	1.00	0.73	11.05	2.48	345	15.0
12	10JSD140TA	1400	250														300	12.0
12	10JSD160TA	1600	285														330	14.5
12	10JSD180TA	1800	331														345	15.0
12	10JSD200TA	2000	355														300	12.0
12	10JSD220TA	2200	380														330	14.5

Number of gears	Model	Torque	Input power (Kw)	Rated speed (rpm)	Gear ratio																Weight (kg)	Oil filling quantity	Structural features		
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16				R1	R2
12	12JS160T	1600	280	2600	14.26	9.78	6.70	4.58	3.77	3.11	2.58	2.13	1.77	1.46	1.21	1.00					13.66		360	16	Double-intermediate shafts, full synchronizer With front mounted gearshift mechanism
12	12JS160TA	1600	280		14.26	9.78	6.70	4.58	3.11	2.57	2.13	1.76	1.46	1.21	1.00	0.83					13.66		360	16	
12	12JS190T	1900	350		14.26	9.78	6.70	4.58	3.77	3.11	2.58	2.13	1.77	1.46	1.21	1.00					13.66		360	16	
12	12JS190TA	1900	350		14.26	9.78	6.70	4.58	3.11	2.57	2.13	1.76	1.46	1.21	1.00	0.83					13.66		360	16	
12	12JS240T	2400	400		14.26	9.78	6.70	4.58	3.77	3.11	2.58	2.13	1.77	1.46	1.21	1.00					13.66		360	16	
12	12JS240TA	2400	400		14.26	9.78	6.70	4.58	3.11	2.57	2.13	1.76	1.46	1.21	1.00	0.83					13.66		360	16	
16	16JS160T	1600	280	2600	17.28	14.26	11.85	9.78	8.12	6.70	5.55	4.58	3.77	3.11	2.58	2.13	1.77	1.46	1.21	1.00	16.55	13.66	360	16	Double-intermediate shafts Full synchronizer
16	16JS160TA	1600	280		14.26	11.76	9.78	8.07	6.70	5.53	4.58	3.78	3.11	2.57	2.13	1.76	1.46	1.21	1.00	0.83	13.66	11.27	360	16	
16	16JS190T	1900	350		17.28	14.26	11.85	9.78	8.12	6.70	5.55	4.58	3.77	3.11	2.58	2.13	1.77	1.46	1.21	1.00	16.55	13.66	360	16	
16	16JS190TA	1900	350		14.26	11.76	9.78	8.07	6.70	5.53	4.58	3.78	3.11	2.57	2.13	1.76	1.46	1.21	1.00	0.83	13.66	11.27	360	16	
16	16JS180T	1800	331		17.04	14.03	11.66	9.60	8.04	6.62	5.53	4.55	3.74	3.08	2.56	2.11	1.77	1.45	1.21	1.00	16.30	13.42	342	19	
16	16JS220T	2200	355		17.04	14.03	11.66	9.60	8.04	6.62	5.53	4.55	3.74	3.08	2.56	2.11	1.77	1.45	1.21	1.00	16.30	13.42	342	19	
16	16JS240T	2400	400		14.03	11.64	9.60	7.97	6.62	5.49	4.55	3.78	3.08	2.56	2.11	1.75	1.45	1.21	1.00	0.83	13.42	11.13	342	19	
16	16JS180TA	1800	331		14.03	11.64	9.60	7.97	6.62	5.49	4.55	3.78	3.08	2.56	2.11	1.75	1.45	1.21	1.00	0.83	13.42	11.13	342	19	
16	16JS220TA	2200	355	14.03	11.64	9.60	7.97	6.62	5.49	4.55	3.78	3.08	2.56	2.11	1.75	1.45	1.21	1.00	0.83	13.42	11.13	342	19		
16	16JS240TA	2400	400	14.03	11.64	9.60	7.97	6.62	5.49	4.55	3.78	3.08	2.56	2.11	1.75	1.45	1.21	1.00	0.83	13.42	11.13	342	19		

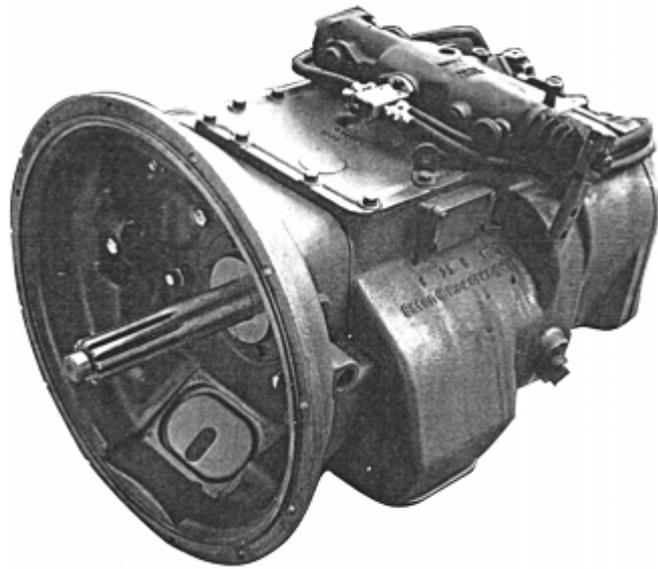


Figure 1-1 RT11509 Model Transmission Outline

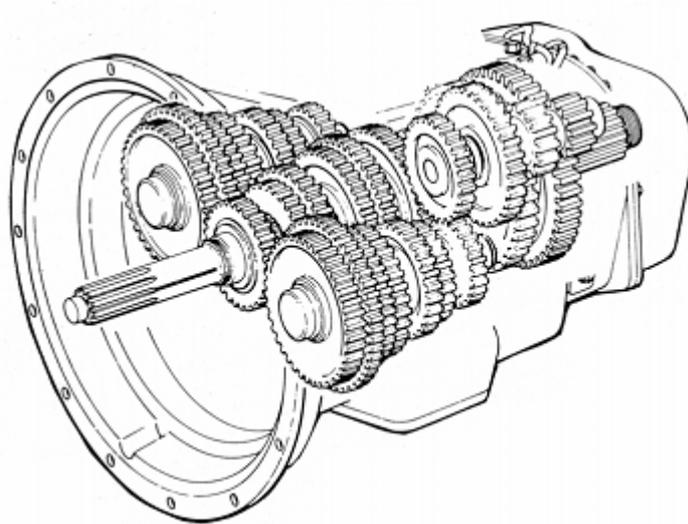
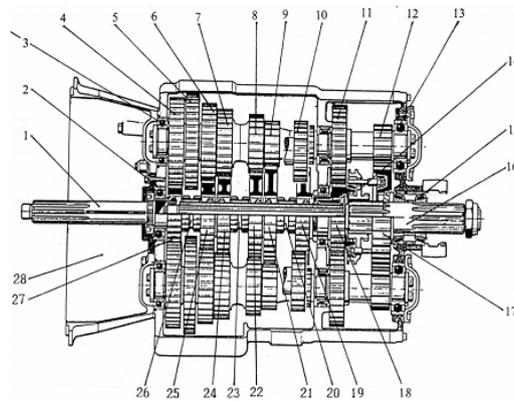


Figure 1- 2 RT11509 Model Transmission Structure Section View

In addition, all the other Fast transmissions are composed of a double-countershaft primary transmission and a double-countershaft secondary transmission. Their basic model is RT11509C model transmission. Figure 1-4 is the structure of this type of transmission.



1. Primary transmission input shaft 2. Input shaft bearing 3. Countershaft head 4. Driven gear of right countershaft 5. Right countershaft PTO gear 6. Primary transmission countershaft 3rd speed gear 7. Primary transmission countershaft 2nd speed gear 8. Primary transmission countershaft 1st speed gear 9. Creeping speed gear, primary transmission countershaft 10. Reverse intermediate gear, primary transmission 11. Secondary transmission driven gear 12. Secondary transmission output gear 13. Secondary transmission input gear 14. High/low gear synchronizer 15. output shaft duplex bearing 16. Secondary transmission output shaft 17. Secondary transmission output gear 18. Secondary transmission input gear 19. Reverse gear of the primary transmission output shaft 20. Gear shift sliding sleeve of creeping gear (reverse I) 21. Creeping speed gear, primary transmission output shaft 22. 1st speed gear, primary transmission output shaft 23. 1st/2nd speed gear sliding sleeve, primary transmission 24. The 2nd speed gear, primary transmission output shaft 25. 3rd speed gear, primary transmission output shaft 26. 3rd/4th speed gear sliding sleeve, primary transmission 27. Input shaft driving gear 28. Clutch housing

Figure 1-4 Fast RT11509C Model Transmission Structure Diagram

Since the structure of all Fast transmissions are basically the same, the disassembly procedures and maintenance standards are basically the same, herein we will take RT11509C model transmission as an example to explain the Fast transmission structure and working, disassembly procedures, repair standard and common problems' troubleshooting.

Section II Structure and Working Principle of Fast RT11509C Model Transmission

Figure 1-4, RT11509C model transmission is composed of one primary transmission with 5 forward gears, a reverse gear and one secondary transmission with high/low speed gear, then it becomes into the integral transmission with 9 forward gears (1-8 speed gears and a creeping gear) and a reverse gear (the primary transmission has 5 forward gears and 1 reverse gear, and one secondary transmission has high/low speed gear, and then combine into 10 forward gears and 2 reverse gears, however because that high-speed creeping gear and high-speed reverse gear do not make sense, then the two gears are removed from control mechanism and form into 9 forward gears and one reverse gear). The primary transmission and secondary transmission are double-countershaft structure, they share transmission housing, there is an intermediate baffle in the housing which separates the front and rear box into the primary transmission and secondary transmission. The two countershafts of the primary transmission are supported between the front housing of transmission and intermediate baffle, the front end of the primary transmission output shaft is mounted inside the input shaft hole, the back-end is supported on the baffle. There is an integral end cover on the transmission output end, which connects with the transmission housing; there are two positioning pins on the rear cover of transmission housing, which ensure the concentricity of rear cover and housing. The two countershafts of the secondary transmission are mounted between the baffle and rear cover, secondary transmission output shaft is mounted on the end cover with two cone bearings (cantilever support).

The conventional structure transmission only has one countershaft, as shown in Figure 2-1.

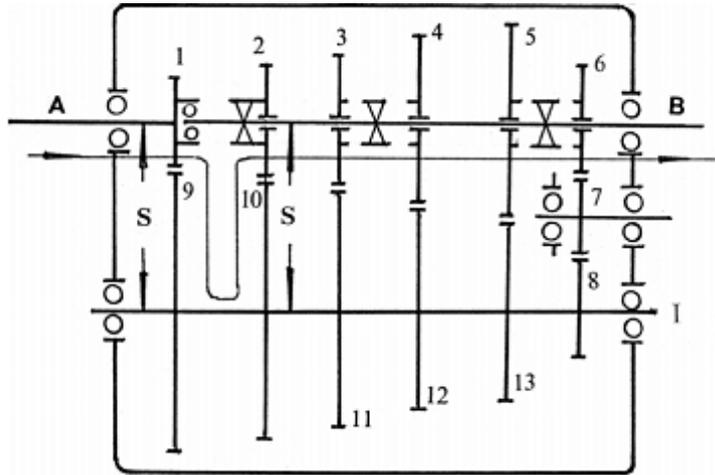


Figure 2-1 Conventional Transmission Driving Diagram

Figure 2-1 is the driving diagram of a conventional structure 5-speed transmission (5 forward gears and one reverse gear). This kind of transmission is generally composed of input shaft, intermediate shaft and output shaft. The power is from the input shaft, and gets out from the output shaft. Since there is only one countershaft, the three shafts bear the radial force in gear meshing while transmitting torque. Figure 2-1, assuming transmission is at the 3rd speed gear, namely the sliding sleeve of the output shaft and the 3rd speed gear is meshing, the power is transmitted from input shaft "A" through driving gear 1 and driven gear 9 of countershaft to the countershaft, and then the power reaches the output shaft and gets out through the 3rd speed gear of countershaft 10 and the 3rd speed gear of output shaft 2. During the gears meshing and torque transferring, the input shaft and countershaft will bear a radial force "S" as well, and the countershaft and the output shaft are also subject to a radial force "S" while the 3rd speed gear 10 of the countershaft is meshing with the 3rd speed gear 2 of the output shaft in torque transmission. Obviously, this radial force acts on the supporting bearings of these shafts. Therefore, not only the torque in transmission shall be taken into account during designing, the impact of radial force against the shaft shall also be taken into consideration. Thus, these three shafts for the general structure transmission must be thick, so that the shaft will not deform under the radial force, the bearing capacity of all the supporting bearings in each shaft must be larger. Moreover, during the gears engagement and power transmission of conventional structure transmission, only the teeth of engaged gears are subject to the force, while the rest teeth which haven't engaged are all "free". In other words, all power is transmitted through one pair of teeth meshing, so the gear must be very big.

The most important feature of Fast transmission structure is the double-countershaft structure, namely add one additional countershaft on completely symmetrical side of the conventional transmission countershaft.

Figure 2-2 is the driving diagram of a double-countershaft transmission with 5 forward gears and one reverse gear.

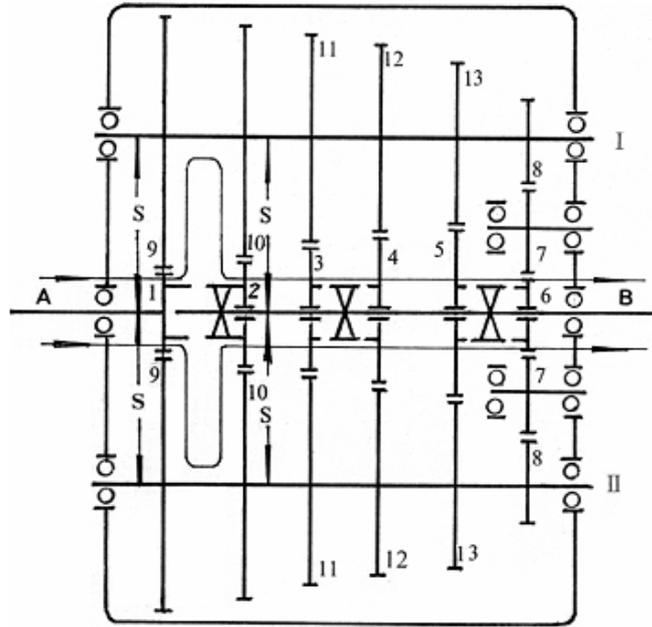


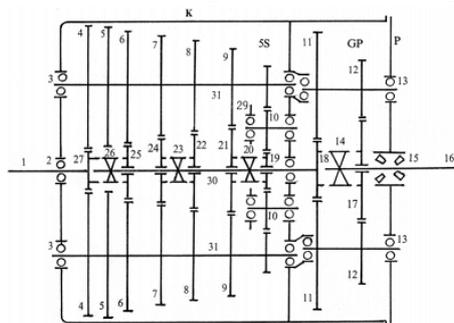
Figure 2- 2 Double-countershaft Transmission Driving Diagram

From Figure 2-2, assuming the transmission is at 3rd gear, the input power from input shaft "A" is divided into two routes, which connect with the two countershafts as "I" and "II" respectively through the driving gear 1 and the driven gear 9 of the two countershafts. And then by the 3rd speed gear 10 of two countershafts and the 3rd speed gear 2 of output shaft and sliding sleeve, the power is "combined from two routes into one route" and output from output shaft "B". Obviously, when the driving gear 1 is meshing with the driving gear 9, the two countershaft gears generate a radial force "S" against input shaft, then the input shaft is only subject to the transmission torque without radial force impact, therefore, the input shaft diameter can be designed only based on the maximum input torque and regardless of bending deformation caused by radial force, so that the shaft can be designed thinner, also smaller support bearings can be used. Also, the two radial force "S" against the output shaft which are generated by the two 3rd speed gears on the countershaft through the 3rd speed gear of the output shaft are same in value, but opposite in direction, then they are balanced with each other, the output shaft is not subject to radial force. The shaft diameter can be decided according to the maximum output torque in transmission and regardless of bending deformation caused by radial force. Therefore, the output shaft can also be smaller, supporting bearing can also be chosen a smaller specification (the radial force still exists on the two countershafts, so the countershaft can still keep the design of thick diameter to ensure the bigger bending resistance, and also the countershaft bearing is bigger). At the same time, due to the two countershafts and two sets of countershaft gears, each pair of teeth meshed only bear half of the power during gears engagement power transmission. In other words: in terms of the input shaft and the output shaft, power is shared by two symmetrical meshed gears on both sides, the meshing teeth on each side only bear half of the power, so the thickness of all speed gears for Fast transmission is much less than the thickness of conventional transmission gears under the same power transmission (in theory, it's half of the conventional transmission gears thickness, in fact, it's about one-third in thickness reduction).

Therefore, Fast transmission looks short and thick. Thanks to the double-countershaft, the transmission driving is very smooth, and noise is low as well. For example: the general structure transmission is like that people pick two buckets of water on one end of the shoulder pole, which is very difficult. Fast transmission is like that the people pick two buckets of water on the two ends of the shoulder pole, which is apparently very easy and smooth.

With smooth transmission, spur gears fully meet the requirements without using of helical gears, there is no need of synchronizer in the gearshift mechanism, except the synchronizers used in assistance of "clutch and brake" during gear shifting in vehicle starting and in high / low gearshift mechanism of the secondary transmission, Fast primary transmission still uses the simplest sliding sleeve gearshift mechanism rather than synchronizer, which meets the operation requirements and reduces the production cost significantly.

Figure 2-3 shows driving diagram of RT11509C transmission, it can be seen from the figure that both the primary transmission and secondary transmission of the Fast transmission are double-countershaft structure. The primary transmission is a double-countershaft transmission which features 5 forward gears (1st-4th speed gear and creeping gear) and a reverse gear. The gearshift mechanism is a traditional sliding sleeve without synchronizer. The secondary transmission also features double-countershaft structure; high/low speed gearshift mechanism is composed of inertia lockpin synchronizer which is controlled by the high/low gearshift cylinder. When the shift lever is at low speed (1st to 4th speed gear) range, the double-H gearshift valve (high/low gearshift air valve) pushes the synchronizer sliding sleeve backward to engage with the output gear of secondary transmission by the cylinder, then the power inputs from the primary transmission is transmitted to two countershafts by driving gear 18 (Figure 2-3) and countershaft driven gear 11, and then the power is transmitted to the output gear 17 of the secondary transmission by the driving gear 12, then the power is transmitted through the synchronizer sliding sleeve 14 and the output shaft 16 of secondary transmission, finally it's output. When the gearshift lever is at high speed gear (5th-8th speed gear) range, the double-H gearshift valve pushes synchronizer forward to engage with the input shaft of the secondary transmission by the cylinder, then the power input from the primary transmission is transmitted to the output shaft of secondary transmission 16 through the synchronizer sliding sleeve directly, then it's direct speed gear, namely high speed gear. The so-called double-H gearshift valve is high/low gearshift valve.



1. Primary transmission input shaft
2. Input shaft bearing
3. Primary transmission countershaft bearing
4. Countershaft driven gear
5. Primary transmission countershaft PTO gear
6. Primary transmission countershaft 3rd speed gear
7. Primary transmission countershaft 2nd speed gear
8. Primary transmission countershaft 1st speed gear
9. Primary transmission countershaft creeping speed gear
10. Intermediate gear and shaft, primary transmission reverse gear
11. Secondary transmission countershaft driven gear
12. Secondary transmission countershaft output gear
13. Secondary transmission countershaft bearings
14. High/low gear synchronizer type gearshift mechanism, secondary transmission
15. Duplex cone bearing, secondary transmission output shaft
18. Secondary transmission input shaft driving gear
19. Primary transmission output shaft reverse gear
20. Creeping speed gear sliding sleeve, reverse gear
21. Creeping speed gear, primary transmission output shaft
22. 1st speed gear, primary transmission output shaft
23. 1st-2nd (5th-6th) speed gear sliding sleeve
24. 2nd speed gear, primary transmission output shaft
25. 3rd speed gear, primary transmission output shaft
26. 3rd-4th (7th-8th) speed gear sliding sleeve
27. Primary transmission input shaft driving gear
28. Intermediate shaft bearing, primary transmission reverse gear
29. Primary transmission output shaft
30. Primary transmission countershafts (two symmetric shafts)
- K. Transmission housing
- P. Secondary transmission rear cover

Figure 2-3 Fast RT11509 Model Transmission Driving Diagram

It can be seen from Figure 2-3: the front end of the output shaft of primary transmission is inserted into shaft hole of input shaft driving gear (note: there is no support bearing here, which is a little different from the conventional transmission), while the other end is supported by bearings in the transmission housing. And the output shaft 16 of secondary transmission is supported on the rear cover of the secondary transmission through duplex cone bearings 15(cantilever support).

Figure 2-4 shows power driving diagram of Fast RT11509C model transmission. It can be seen from the diagram: power is separated into two routes, and then integrated into one route in the primary transmission, so does the power transmission of the secondary transmission.

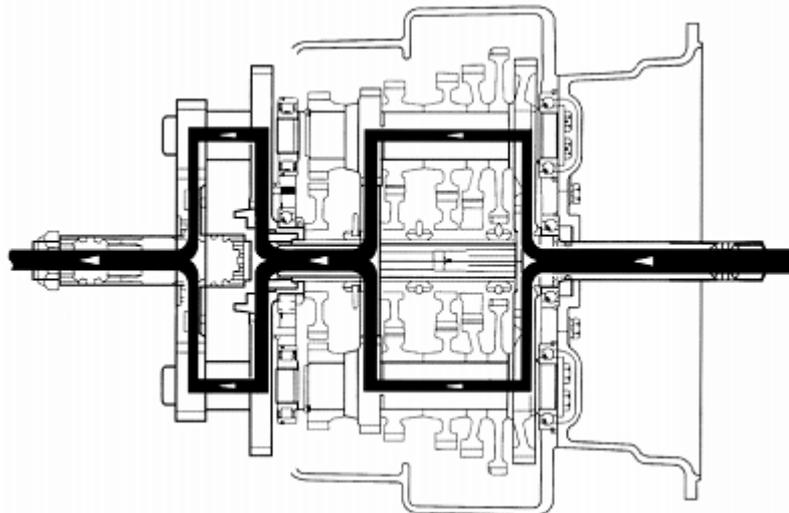


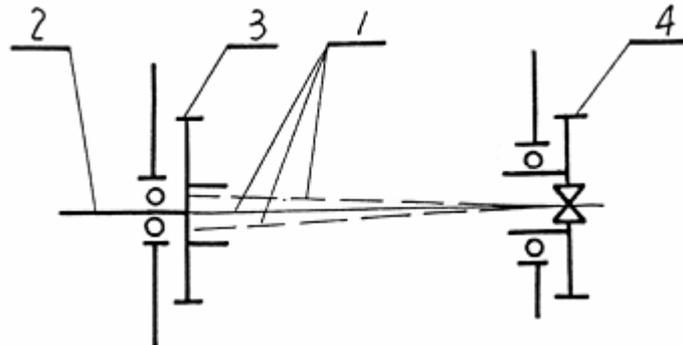
Figure 2-4 Power Driving Diagram of RT11509C Model Transmission

Fast transmission adopts double-countershaft driving, and it also brings a number of structural characteristics and notes for operation and repair.

Firstly, in order to ensure full use of the advantages of double-countershaft driving, all speed gears are fitted on the output shaft in a free status; also there shall be radial clearance of several millimeters between the gear shaft hole and the radial direction of output shaft. In other words: all speed gears are fitted on the output shaft in a very loose status. This is completely different from the conventional transmission in structure.

It is required to ensure simultaneous power transmission of double-countershaft. This is because that dimensional machining tolerance of all the gears in production can't be assured to be exactly the same. Figure 2-3, although in theory, at anytime the power will be divided into routes by the input shaft, and transmitted to two countershafts 3, then the two countershafts integrate the two power routes and transmit to the output shaft for outputting. However, due to different machining tolerance of gears, the accumulated backlash tolerance transmitted by the 1st countershaft gear is different from the accumulated backlash transmitted by the 2nd countershaft gear, if there is no radial clearance between output shaft and the gears on it, namely, it's concentric, it will lead to the engaged power transmission from the 1st countershaft gear to the 2nd countershaft gear in a certain moment, then the 2nd countershaft gear may not able to mesh with the output shaft gear due to the existent backlash. In another moment, while the 2nd countershaft gear is meshing with the output shaft gear, the 1st countershaft gear doesn't mesh with the output shaft gear. Then, the power is transmitted sometimes from the 1st countershaft, and sometimes from the 2nd countershaft, actually each countershaft also delivers the full power, which can't make full use of the characteristic of double-countershaft. In order to ensure that the output shaft gear is engaged with the two countershafts gears at all times for power transmission, in other words: in order to ensure that the power is divided into two routes and transmitted to the output shaft through the two countershafts at anytime, there must be a certain radial clearance between the output shaft gear and the output shaft, and align the output shaft gear automatically, then set the output shaft gear between the two countershaft gears, then cause the two countershaft gears and the output shaft gear engage anytime. The sliding sleeve of the output shaft connects and aligns with the output shaft through the spline during the meshing and power driving process between the sliding sleeve and the gear after gearshift, the gear is at plane motion status against the sliding sleeve, and therefore it's required to ensure the lubrication strictly.

To ensure all speed gears of the output shaft mesh with the corresponding gears of two countershafts 3 at anytime simultaneously, there is a certain radial clearance between all the output shaft gears and the output shaft, also both the output shaft and the input shaft adopt float structure. Figure 2-5, the output shaft is inserted into the input shaft hole, then the supporting bearing is canceled, additionally there is enough radial clearance for the output shaft floating. This is also the main structure difference between the double-countershaft transmission and conventional transmission.



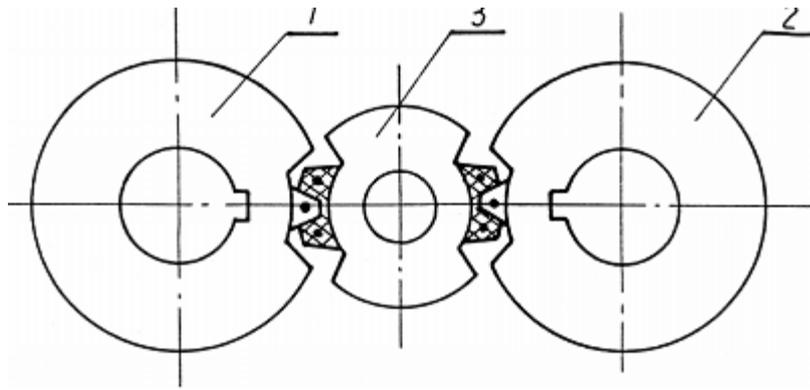
1. Main shaft 2. Input shaft 3. Input shaft gear 4. Secondary transmission driving gear

Figure 2-5 Floating Structure of Transmission Output Shaft

For the same reason, the needle roller bearing between the output shaft driving gear of the secondary transmission and output shaft is also canceled, and there is enough radial clearance for the shaft hole and the journal. Secondary transmission output shaft adopts cantilever structure of duplex cone bearing supporting.

With adopting double-countershaft driving operation, there is a bigger difference with the conventional transmission in repair. Especially during installation after removal, all speed gears of the output shaft and the corresponding speed gears of the two countershafts are all engaged simultaneously only at a fixed position, they can't be meshed in place in the other positions. Therefore, "Teeth matching installation" shall be conducted when re-assembling after the primary transmission and the secondary transmission are dismantled.

Figure 2-6, make installation marks on the corresponding gear face of connection spline of the two countershaft driven gears (1st and 2nd) before primary transmission installation, then make alignment marks on two adjacent teeth of driving gear and two countershafts (with the installation mark) after meshing with the input shaft driving gear 3 symmetrically (make the connected key of the two countershafts at one axis), it's required to align the marks when installing input shaft, countershaft and the output shaft, then all the gears can engage in place, or they can't be fitted in place. There are teeth alignment marks engraved on the two countershaft driving gears and output shaft gear of the secondary transmission, it's only required to mesh the teeth with the alignment mark, then it can be fitted in place (see section I for transmission removal details). If there are no original teeth alignment marks on the secondary transmission gears, make the teeth alignment marks on the output shaft gears and two countershaft gears in the same way before assembling.



1. 1st countershaft driven gear 2. 2nd countershaft driven gear 3. Input shaft driving gear

Figure 2-6 Schematic Diagram of Teeth Matching Installation

In practice, such case often happens in repair: all shafts and gear sets are installed in place without noticing of the teeth alignment marks; however the transmission can't be turned, the symptom is similar as gears in disorder. This is due to gear wearing and bearing loose in long-term use, and then although the transmission is not installed as "teeth matching" procedure, the gears can be fitted even with one wrong teeth alignment mark sometimes, but the all speed gears of the transmission can't be rotated due to wrong engagement force.

As double-countershaft features smooth driving, multi-speed gears, and small gear ratio difference between each gear, the primary transmission doesn't need to use synchronizer gearshift mechanism, the conventional sliding sleeve gearshift mechanism is fully able to meet the demand. Figure 2-7, there is a same size taper angle α (35°) at the sliding sleeve and each speed gear end, the cone plays a certain role of automatically alignment and synchronization.

All above discussions are under the vehicle's normal driving, which is very convenient for gearshift, but vehicle starting is not the same case.



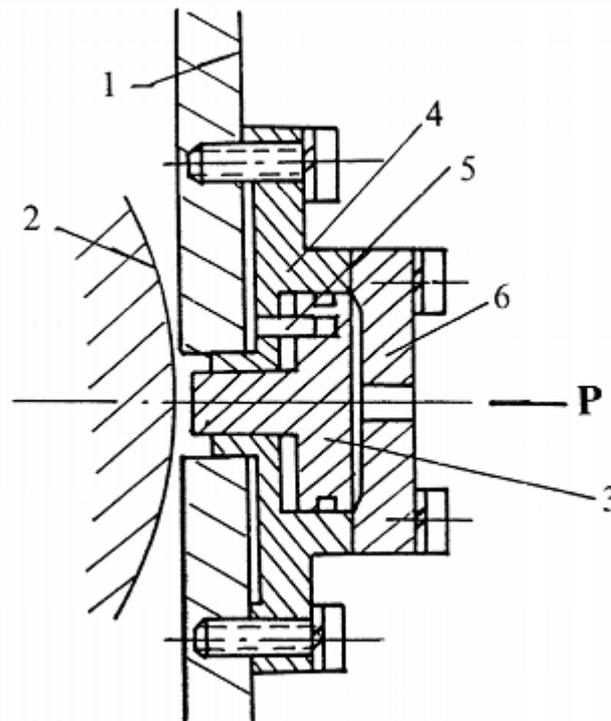
1. Gearshift sliding sleeve 2. Output shaft gear 3. Output shaft

Figure 2-7 Primary Transmission Gearshift Sliding Sleeve

Engine, clutch, transmission input shaft are rotating continuous before vehicle starting. As the input shaft rotation drives the countershaft, obviously, all speed gears on the countershaft drive all the corresponding gears on the output shaft. Then, the vehicle is stopped; the output shaft is stationary. When shifting the gear in starting, although the power is cut off between the engine and transmission by clutch. However, due to the inertia of moving parts, all speed gears are still running, it's obviously more difficult to engage one static part with one running part. Therefore, Fast transmission itself is difficult to be shifted gears in vehicle starting. Then, we will need to use a so called "clutch brake" mechanism for gearshift synchronization.

Clutch brake is composed of clutch brake switch valve and clutch brake cylinder.

There is a two-position 3-way valve fitted under the clutch pedal, which is the clutch brake switch valve. When the clutch pedal is depressed to a obvious obstruction position during gearshift in starting, this means that the pedal arm has already pushed against the brake switch valve, then the pedal arm depresses the pedal and opens the switch valve, through the open valve, the compressed air from the gas reservoir leads to brake cylinder which is mounted on the side window of the primary transmission PTO gear as shown in Figure 2-8. The compressed air goes into the brake cylinder and pushes the brake cylinder piston 3, there is concave side in the front end of the piston 3 with the same radian as the outer circle of the PTO gear 2, the piston 3 presses the outer circle of the PTO gear 2 under the gas pressure, then PTO gear and the countershaft overcome the moment of inertia and brake quickly, all the gears on the output shaft stop rotating, then the starting speed gear is shifted easily. When the clutch pedal is released, the brake switch valve plug returns completely under the action of spring, the gas in brake cylinder is discharged through the switch valve, then the brake is released, transmission returns to normal operation.

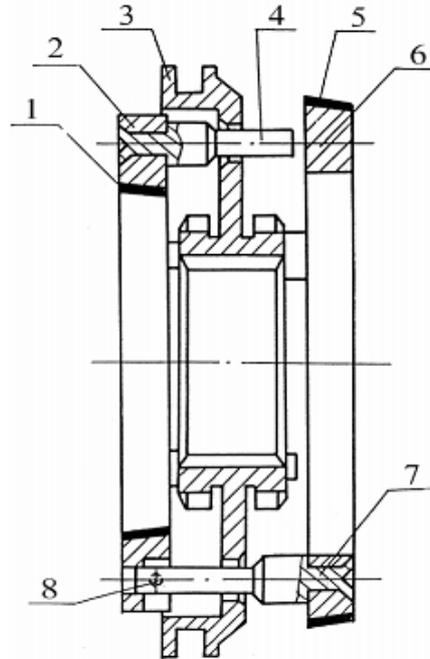


1. Transmission housing 2. Countershaft PTO gear 3. Clutch brake cylinder piston 4. Clutch brake cylinder 5. Guide pin 6. End cover

Figure 2-8 Clutch Brake Cylinder

In fact, clutch brake works as a starting synchronizer; however, the synchronization is different from the general synchronizer. Please note: clutch brake only works during gear shifting in starting; there is no need to conduct such operation of the clutch brake in normal driving. As shown in Figure 2-8, the stroke of piston 3 is limited, obviously, the clutch brake works poorly or fails when the end surface of piston 3 wears seriously, then there will be a poor gearshift in starting.

As the high/low gearshift mechanism of the secondary transmission is gas-controlled, the inertial lockpin synchronizer is used. Synchronizer structure is shown as Figure 2-9.



1. Galen material on synchronization cone ring of high speed gear
2. Synchronization cone of high speed gear
3. Sliding sleeve
4. Lockpin
5. Galen material on synchronization cone ring of low speed gear
6. Synchronization cone of low speed gear
7. Lockpin
8. Lockpin

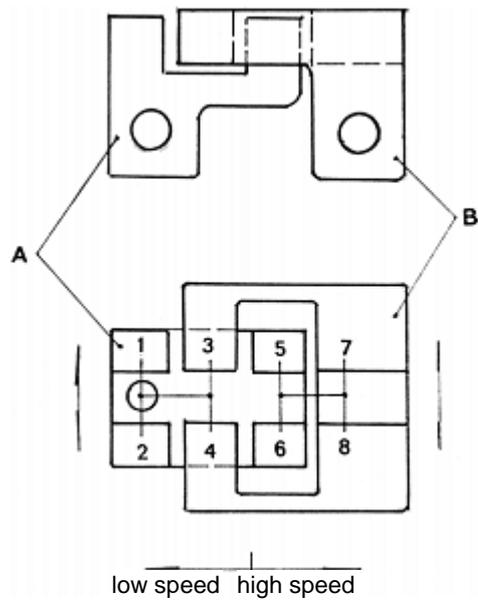
Figure 2-9 High/Low Speed Synchronizer of Secondary Transmission

The high/low speed synchronization cone gears integrate with the secondary transmission input shaft gear and output shaft gear.

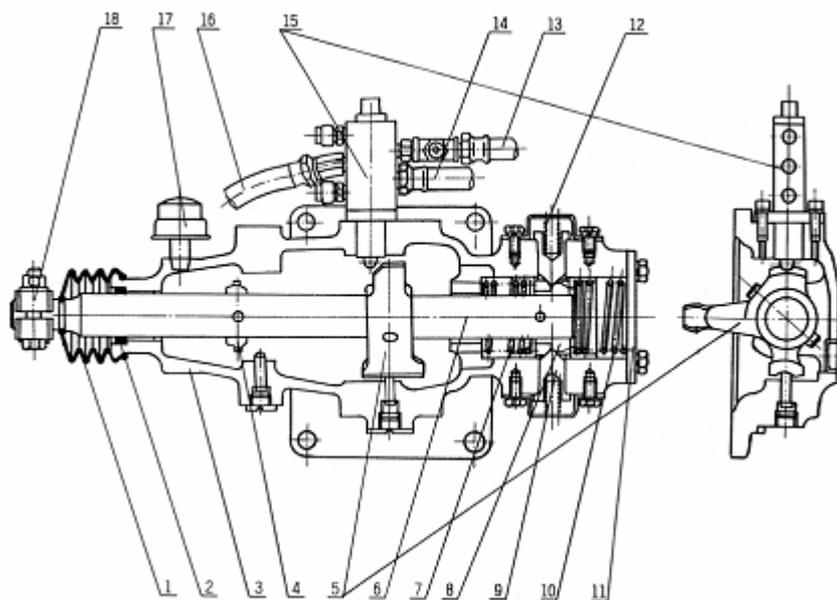
Primary transmission uses "double-H" gearshift mechanism, with the high/low gas controlled gearshift mechanism of secondary transmission; the transmission is integrated into a range speed transmission with 9 forward gears and one reverse gear.

As shown in Figure 2-10, for the so-called double-H gearshift mechanism, the gearshift fork blocks for 1st/2nd speed gear (low speed) and 5th/6th speed gear (high speed) of primary transmission gearshift mechanism are integrated, the gearshift blocks for 3rd/4th speed gear (low speed) and 7th/8th speed gear (high speed) are integrated, but the arrangements of 1st-2nd speed gear, 3rd-4th speed gear and 5th-6th speed gear, 7th-8th speed gear are staggered as "H" which is shown in Figure 2-10 .

As shown in Figure 2-11, there is a two-position 3-way valve (commonly known as double-H gearshift valve 15) fitted on the transmission cover, when the gearshift lever is at low speed gear range (1st-2nd speed gear, 3rd-4th speed gear), the lever is at the position shown in the Figure, the double-H gearshift valve is at low speed gear range position, and supplies gas to the working cylinder joint of the low speed gear of secondary transmission gearshift cylinder, while the working cylinder joint 2 of high speed gear discharges (see Figure 2-12), the compressed air of the low speed gear working cylinder pushes the piston 3 backward, the secondary transmission gearshift shaft 5 controls the synchronizer sliding sleeve to move backward to shift in low speed gear.

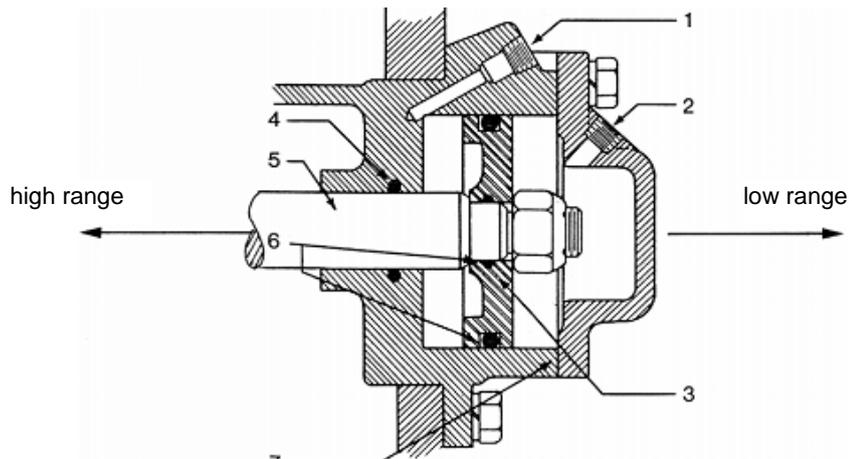


A. Gearshift blocks of the 1st -2nd (5th -6th) speed gear B. Gearshift blocks of the 3rd -4th (7th -8th) speed gear
 Figure 2-10 Double-H Gearshift Mechanism



1. Boot 2. Oil seal 3. Double-H control device housing 4. Reverse gear switch control module 5. Gearshift lever 6. Gearshift shaft 7.10. Balance spring 8. Retaining ring 9. Positioning plunger 11. Side plate 12. Compression spring 13.14.16. Air pipe 15. Double-H gearshift valve 17. Breather plug 18. Gearshift crankarm

Figure 2-11 Single-pole Double-H Gearshift Mechanism



1. Pneumatic joint of low speed gear working cylinder 2. Working cylinder joint of high speed gear 3. Gearshift Piston 4. "O" ring 5. Gearshift shaft 6. "O" ring 7. Gearshift cylinder

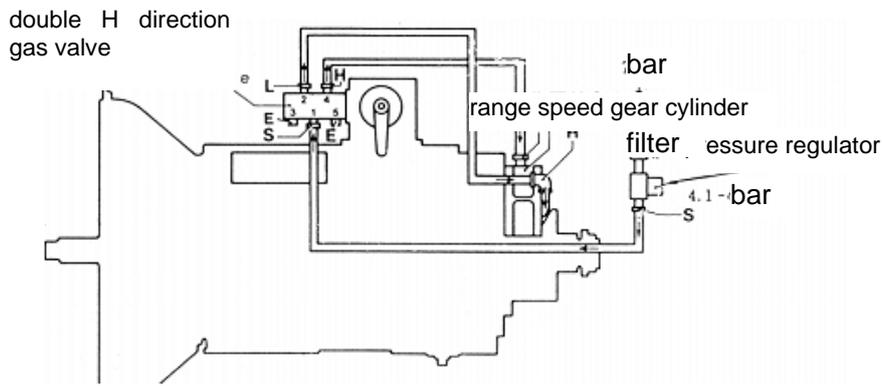
Figure 2-12 High/Low Gearshift Cylinder of Secondary Transmission

When the gearshift shaft on the transmission cover is pushed to left (Figure 2-11) into high speed gear position, the convex plate of the lever will press the valve plug of the double-H gearshift valve inside, which changes the gas route of the valve, as shown in Figure 2-12, the double-H gearshift valve supplies the compressed air to the working cylinder joint of high speed gear 2, and the working cylinder joint of low speed gear 1 is discharged, the piston 3 is pushed forward together with the gearshift 5 at this moment, then the sliding sleeve moves into the high speed gear (direct speed gear).

As shown in Figure 2-10 and Figure 2-12, when the transmission shifts into the 1st-2nd speed gear, the shift lever pushes the 1st-2nd speed gear block, and secondary transmission is at low speed gear. When the transmission is shifted into the 3rd-4th speed gear, the shift lever pushes the 3rd-4th speed gear block, and secondary transmission is still at low speed gear. When the transmission is shifted into the 5th-6th speed gear, the secondary transmission is shifted into high speed gear under the action of double-H gearshift valve and gearshift cylinder, however, the primary transmission lever still moves the 1st-2nd gearshift block when it's at 5th-6th speed gear. In other words: transmission is shifted from the 4th speed gear into the 5th speed gear, the secondary transmission is changed from low speed gear to high speed gear, and the primary transmission is changed from the 4th speed gear into the 1st speed gear. For the same reason, transmission is shifted to the 6th speed gear, the secondary transmission is shifted to high speed gear, the primary transmission is shifted to the 2nd gear and so forth. As the Figure 2-10, the speed gears arrangement of the gearshift block forms into two "H" shaped high/low speed gear as 1st-2nd speed gear, 3rd-4th speed gear and 5th-6th speed gear, 7th-8th speed gear, this is the so-called double "H" gearshift mechanism.

Figure 2-13 shows the gearshift gas control diagram of the secondary transmission high/low speed gear. Because the whole car normal pressure is 7.5 to 8.0 bar, and the high/ low speed gear doesn't need such a high gas pressure, so the gas pressure from reservoir is reduced to 4.1 to 4.4 bar through a filter pressure relief valve, and then is supplied to double-H gearshift valve as shown in Figure 2-13.

For the general transport vehicles (trucks, tractors, etc.) installed with Fast transmission, there is no neutral position for its secondary transmission. For the construction vehicles (tipper) with PTO installed with Fast transmission, as the power take off is through the countershaft of secondary transmission, PTO will work normally only when the primary transmission is at a forward gear. Therefore, the secondary transmission of Fast transmission must be set in neutral when the vehicle stops to take power off.



S. The compressed air from pressure relief valve E. Gas outlet of double-H gearshift valve
 L. Connect with the pipeline of low speed gear working cylinder H. Connect with the pipeline of high speed gear working cylinder

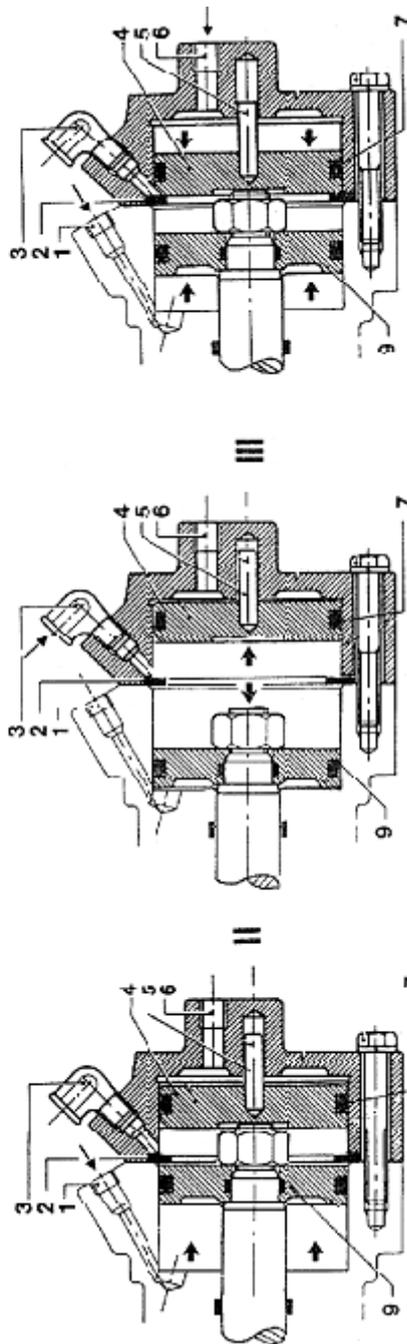
Figure 2- 13 Gas Route Diagram of High/Low Gearshift of Secondary Transmission

The high/low gearshift cylinder structure of construction vehicle fitted with Fast transmission is shown in Figure 2-14. This type of gearshift cylinder must work together with the "neutral gear gas valve", neutral gear gas valve is a two-position 3-way valve installed in the dashboard.

As shown in Figure 2-14 (I), when the shift lever is set at low speed gear (1st-2nd, 3rd-4th speed gear), double-H gearshift valve supplies the compressed air to low speed gear working cylinder joint 1, then if the neutral switch valve is set at "normal working" position, the neutral gear working cylinder joint 6 leads to atmosphere through the neutral gear valve. At this time, the piston 9 of high/low speed gear is pushed to right end by the compressed air of the low speed working cylinder, and pulls the synchronizer sleeve of gearshift shaft to shift into low speed gear. As shown in Figure 2-14 (II), when the shift lever is set at high speed gear (5th-6th, 7th-8th speed gear), the double-H gearshift valve supplies the compressed air to high speed gear working cylinder joint 3, then if the neutral switch valve is set at "normal working" position (the neutral gear working cylinder joint 6 leads to the atmosphere), the piston 9 of high/low speed gear is pushed to left end by the compressed air of the high speed working cylinder, pull the synchronizer sleeve of gearshift shaft to shift into high speed gear. As shown in Figure 2-14 (III), when the neutral gear valve is switched to "neutral gear" position, the compressed air leads to working cylinder joint 6 of neutral gear through the opened neutral gear valve, the compressed air of the neutral gear working cylinder pushes the neutral piston 4 to middle (stopped by the retainer ring) position, then if the transmission is shifted into low speed gear (set the transmission at 2nd speed gear for PTO condition in general), the double-H gearshift valve supplies the compressed air to the low speed working cylinder, which moves the piston 9 to right, but it's stopped by the neutral piston 4 in the middle position, and then the synchronizer sliding sleeve of secondary transmission is at neutral position.

Generally, there are two conditions for construction vehicle power takeoff: one is that the working of the PTO is depending on the working of the vehicle, such as lift up and down the hopper while the tipper is standing still. The operating procedures under this condition are: depress the clutch; press the PTO power switch, the PTO is engaged in place when the indicator light inside the PTO switch is ON. At this time, turn the "neutral switch valve" to "neutral" position, move the gearshift lever into 2nd speed gear, lift the clutch, then manipulate the hopper up and down handle to complete the tasks as hopper up and down while the vehicle is standing still.

Another condition is to take the power in vehicle driving, such as discharging the soil while vehicle is driving. Operating procedure under condition is relatively simple: depress the clutch pedal, then press the PTO power switch, the PTO is engaged in place when the indicator light is ON, keep the neutral gear switch valve at the original "normal working" position, shift into the forward gear, lift clutch pedal, the vehicle moves forward as the speed of this gear when the clutch pedal is released, at the same time, operate the hopper up and down handle.



1. Working cylinder gas joint of low speed gear 2. Retainer ring 3. Working cylinder gas joint of low speed gear 4. Neutral gear piston 5. Neutral gear piston guide 6. Working cylinder gas joint of neutral gear 7. Seal ring of neutral gear piston 9. Gearshift piston

Figure 2-14 High/Low Gearshift Cylinder with Neutral Position

There is a special power takeoff gear on the countershaft of primary transmission of Fast transmission, therefore, the PTO can be installed on the power takeoff window of primary transmission, and then the power takeoff operation is not much different from the operation of conventional transmission. Generally, heavy construction vehicle often adopts the way of power takeoff from the countershaft of secondary transmission, when the PTO is working in this way, primary transmission must shift into low speed forward gear, and this is different from conventional transmission operation.

Section III Fast RT11509C Model Transmission Removal

(I) Removal Notes

Although Fast double-countershaft transmission structure is simple, the following points should be noted during the removal process:

1. Before start the transmission removal, clean the outside of the transmission at first to avoid the foreign body getting into the components during removal process, if it's not cleaned during assembly process, it will result in impurities and foreign matter getting into the body.
2. Before dismantling the sub-assembly, all parts should be put on a clean work table by order as the removal sequence, so as to avoid parts missing in re-assembly.
3. Special tools must be used in removal process to ensure that all the parts will not be damaged.
4. All the parts shall be cleaned accordingly after removal.
5. All the parts should be carefully checked after removal. Check whether there are pockmarks and peel off on the ball bearings, roller and inner/outer race; check fitting of the bearing inner/outer race and the fitting of shaft, bearing outer race and the hole, if the outer race can be rotated freely inside the bearing hole of the housing, then change the housing or bearing.

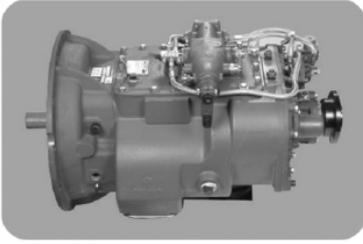
Check whether there is injury or pitting on the gear tooth surface, and check the wearing of tooth surface, replace the gear with tooth surface damage, pitting and obvious wearing. Check the axial clearance of the gear, the axial clearance for the forward gear shaft of the output shaft should be 0.13 to 0.30 mm, it is 0.30 to 0.90 mm for reverse gear. Change the axial washer and gear according to the actual condition if the axial clearance is above the standard, re-adjust the thickness of the axial adjustment washer when the gear wearing is within normal range, and ensure correct gear axial clearance.

Check the wearing of the output shaft spline; change the spline shaft if there is obvious eccentric wearing or spline deformation.

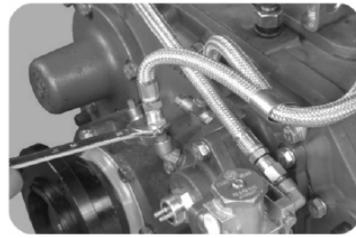
Check whether there is wearing, deformation and axial loose on the spline hole, meshing gear and fork groove of all speed gears' sliding sleeve of the primary transmission.

Check whether there is excessive wearing, partial wearing and overheating discoloration on the cone surface of the secondary transmission synchronizer, check whether the lockpin wears excessively, and then change the synchronizer assembly if the above conditions happen.

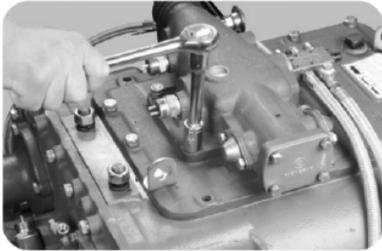
(II) Removal of Double-H Gearshift Mechanism



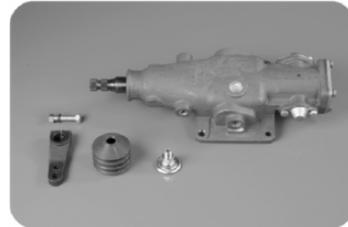
1. Single-pole left-controlled double-H assembly.



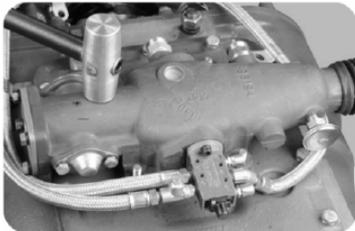
2. Remove the mounting bolts of the three air pipes and two air filters.



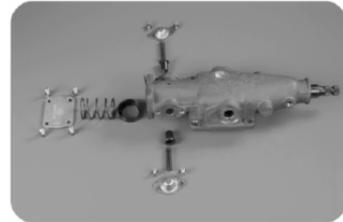
3. Remove the four mounting bolts from the gearshift shaft assembly.



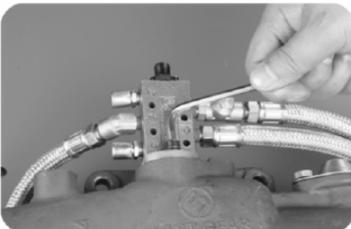
7. Remove the gearshift arm, boot and breather plug.



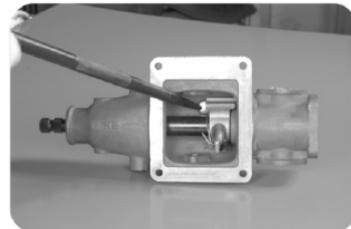
4. Tap the gearshift shaft assembly housing with the copper rod, and make it loose.



8. Remove the side plate and spring seats of both sides, and pull out the spring, positioning plunger and other parts.



5. Remove the double-H gas valve and pipe with hex socket wrench.



9. Removed the locking wire of bowl plug and shifting block.



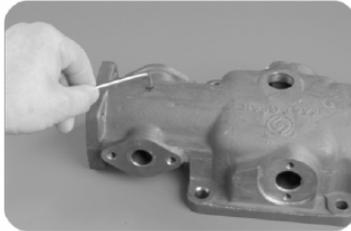
6. Remove reverse gear, neutral switch and the dowel pin.



10. Tap with a tool and then remove the cylindrical pin



11. Remove the elastic pin on the control block of reverse gear.



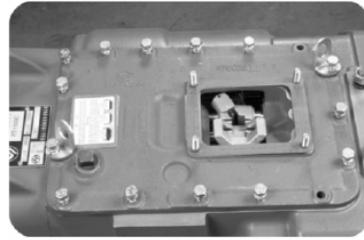
12. Removed the stop screw, take out another set of spring and spring seat from the inside of gearshift shaft housing, and prevent the spring from popping out.



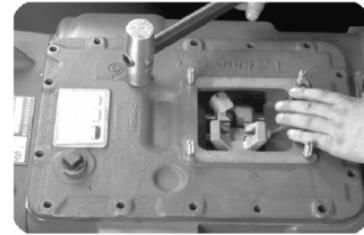
13. The main components inside the double-H control assembly: shifting block, reverse gear control block, spring, spring seat, spacer and lateral shift lever.

Note: for the two springs, the one closes to housing inside is slightly shorter.

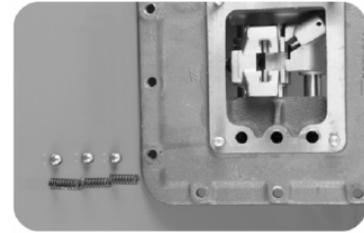
(III) Upper Cover Assembly Removal



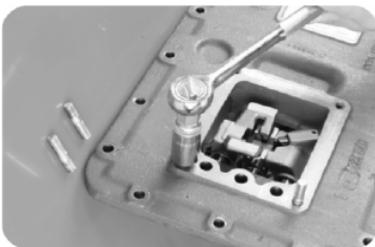
1. Remove the bolts of upper cover assembly.



2. Tap the upper cover with a copper rod to separate it from the washer. Note: plug in the spring with hand and prevent it from falling into the transmission.

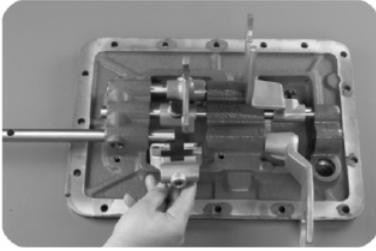


3. Remove the upper cover from the transmission assembly, and then take out gearshift self-lock ball and spring.

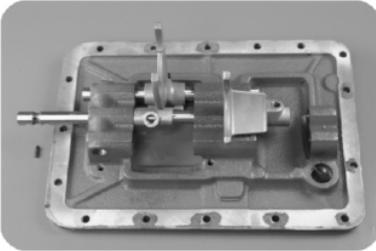


4. Remove the four stud bolts.

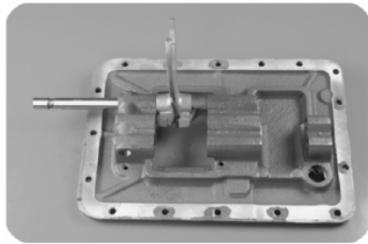
(IV) Secondary Transmission Assembly Removal



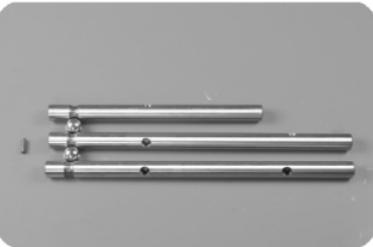
5. Turn over the upper cover assembly; remove 3rd/4th speed gear fork shaft, guide blocks and 3rd/4th gearshift fork.



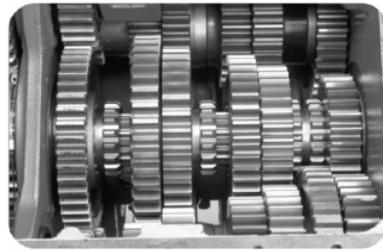
6. Remove the fork guide block, fork and interlocking pins of the 1st/2nd speed gear.



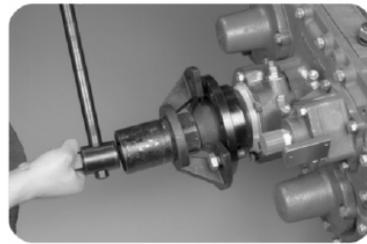
7. Remove the gearshift fork and fork of the low speed gear.



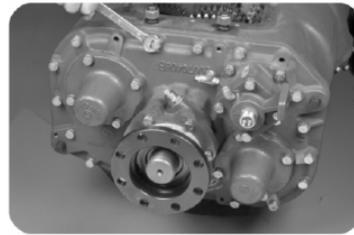
8. Fork shaft, interlocking ball and interlock pin.



1. Mesh any two sliding sleeves with the gears of primary transmission respectively.



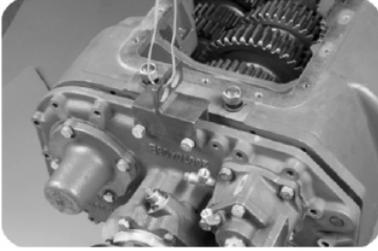
2. Remove the flange nut of flange plate with special labor-saving wrench.



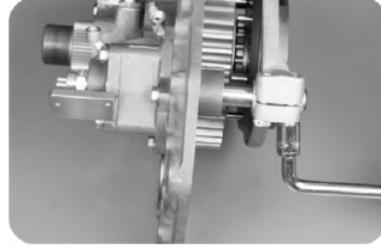
3. Remove the bolts on the rear cover housing.



4. Push out of the secondary transmission by about 10mm with three bolts.



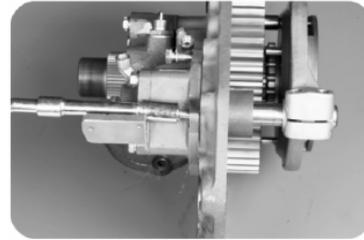
5. Lift the secondary transmission assembly and move it backward with hanger, then separate it from the primary transmission.



9. Cut off the iron wire, and remove the bolts on the secondary transmission fork.



6. Remove the flange plate and the odometer driving gear.



10. Remove the bolt which connects with the gearshift cylinder and rear end cover, and then remove the gearshift cylinder assembly.



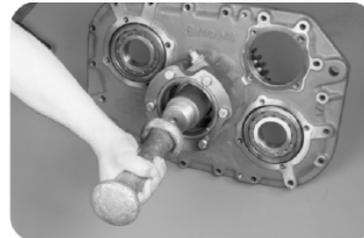
7. Remove the extended countershaft end cover, and then remove the snap ring of the extended intermediate shaft with the tool.



11. Remove the secondary transmission synchronizer.



8. Tap the extended countershaft with a copper rod to separate it from the bearing.



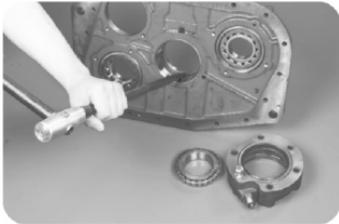
12. Tap the output shaft, and get it out from the rear cover housing.



13. Tap the output shaft to separate it from the bearing.



16. Remove the four cylinder head bolts, and then take down the cylinder head.



14. Remove the output bearing cap, then tap and remove the bearing outer race from the hole of the rear cover housing.



17. Pay attention to set the piston plane outward before removal.



15. Dismantle the secondary transmission synchronizer.

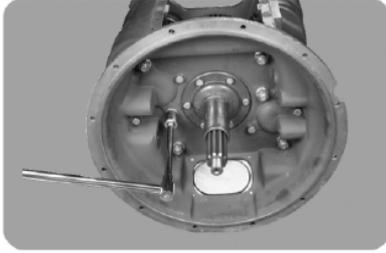


18. Remove the self-lock nut on the piston.

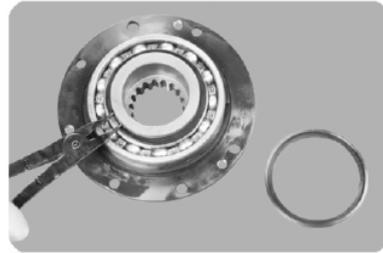


19. The piston of the gearshift cylinder and three O-rings.

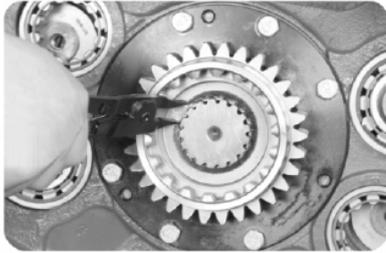
(V) Primary Transmission Removal



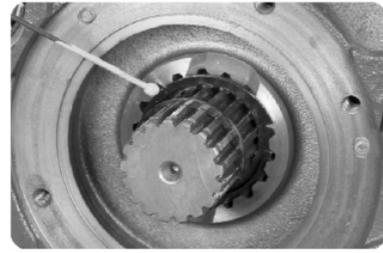
1. Remove the clutch housing assembly.



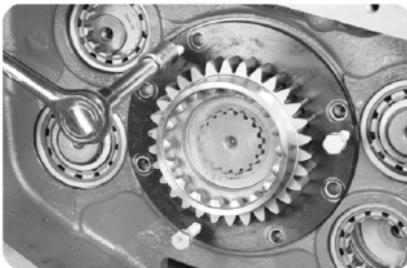
4. Remove the fixed ring and snap ring of the retainer ring on the secondary transmission driving gear, tap the gear and separate it from the bearing.



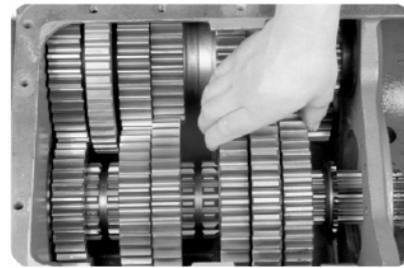
2. Remove the stop ring at the rear of secondary transmission driving gear, cut off the wire that locks the six bolts, and then remove the six bolts of the positioning plate.



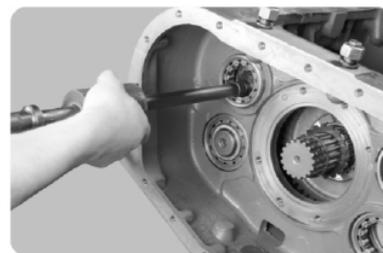
5. Remove the stop ring inside the reverse gear of the output shaft.



3. Push out of the driving gear assembly with three bolts.



6. Put the reverse gear and the low speed gear of the output shaft together.



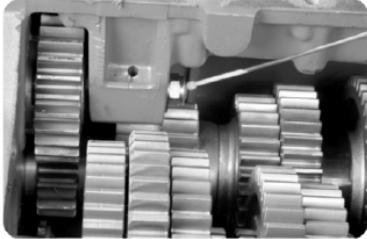
7. Remove the front bearing of secondary transmission countershaft with special tool.



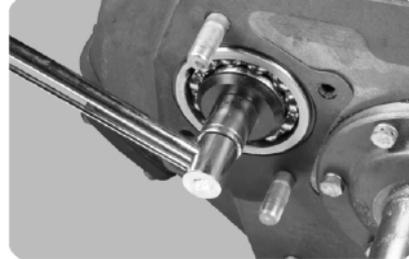
8. Remove the screw plug inside the reverse gear idle shaft.



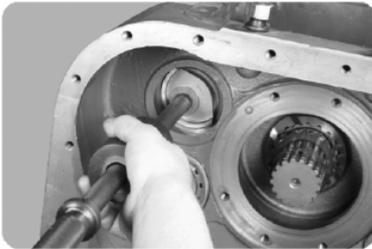
12. Remove the countershaft brake assembly of primary transmission.



9. Remove the self-lock nut on the idle gear shaft of reverse gear.



13. Remove the bearing retaining plate in the front of the primary transmission countershaft.



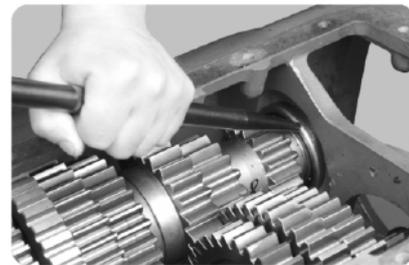
10. Pull out the idle gear shaft of reverse gear and eccentric supporting plate with special tool.



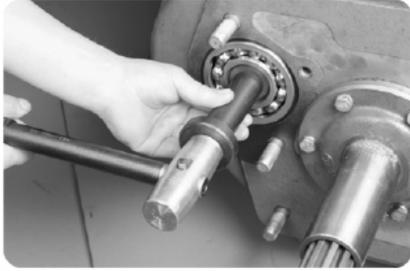
14. Remove the stop ring at the rear of bearing from primary transmission countershaft.



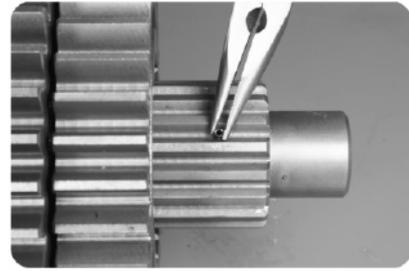
11. Idle gear assembly of reverse gear.



15. Remove the rear bearing on the countershaft with a special punch rod.



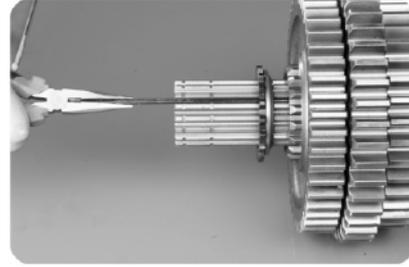
16. Tap the countershaft, and make it move backward about 10 mm.



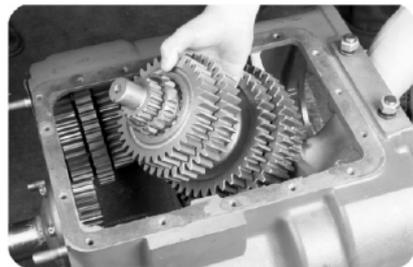
20. Pull out the elastic pins on the output shaft.



17. Tap the countershaft from front the rear, and make the stop ring of the bearing exposed from the housing by at least 5mm, then remove the front bearing of the countershaft with special tool.



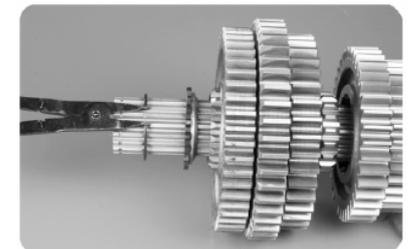
21. Pull out the long key.



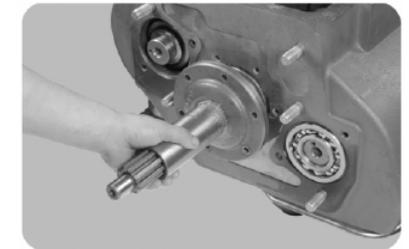
18. Remove the upper section of countershaft assembly and the output shaft assembly from the primary transmission housing.



22. Take out all speed gears from the output shaft in order.



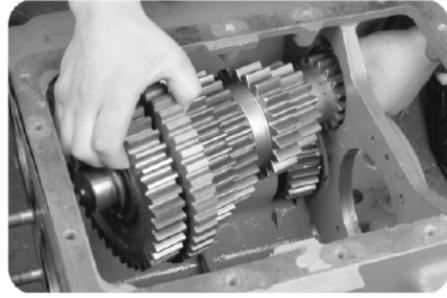
19. Remove the stop ring at the end of the output shaft.



23. Loosen the six bolts on the bearing end cap of the input shaft; remove the bearing end cap of the input shaft.



24. Remove the stop ring on the input shaft bearing, then tap the shaft end, take the input shaft assembly out of the housing.



26. Remove the lower section of countershaft assembly from the primary transmission housing.



25. Remove the input shaft nut with special tool.

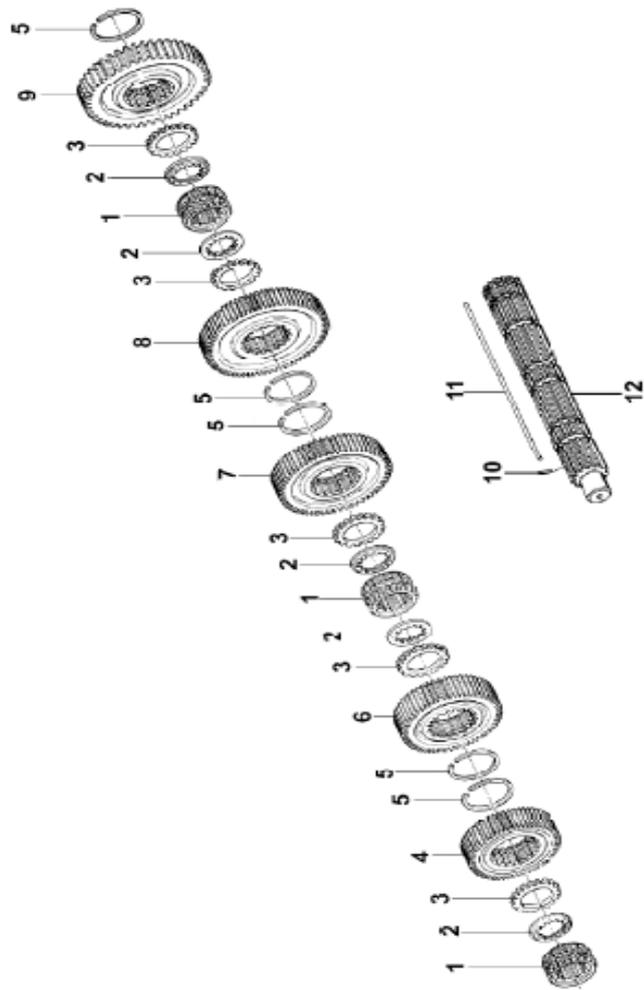
Section IV Assembly of Fast RT11509C Model Transmission

(I) Notes of Assembly

1. All new washers should be used when re-assembling the transmission.
2. All bolts and screws thread should be coated with sealing glue in assembly.
3. All O-rings should be coated with silicone grease in assembly.
4. All thrust washers should be coated with grease for original lubrication purpose.
5. During assembly, the adjustment washers with relative thickness should be chosen to guarantee the axial clearance for each forward gear on the output shaft as 0.13~0.30mm, and 0.30~0.90mm for reverse gear.
6. Tighten each bolt according to the stipulated torque. The nuts of output shaft flange must be tightened by 610~680N/M finally, otherwise, it will lead to serious problem.

(II) Assembly of Output Shaft in Primary Transmission

Exploded view of output shaft assembly components, Figure 3-1



1. Sliding sleeve of output shaft 2. Adjustment washer of gears on output shaft 3. Spline washer of gears on output shaft 4. 3rd speed gear of output shaft 5. Snap ring 6. 2nd speed gear of output shaft 7. 1st speed gear of output shaft 8. Low speed gear of output shaft 9. Reverse gear of output shaft 10. Elastic cylindrical pin 11. Hexagonal connected key of output shaft 12. Spline shaft of output shaft

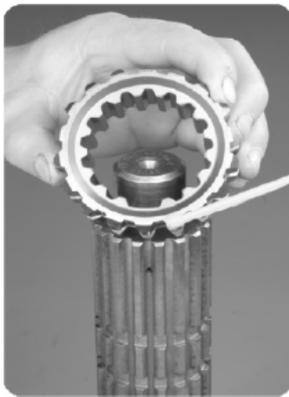
Figure 3-1 Exploded View of Output Shaft Assembly Components



1. Assembly: erect output shaft, put the adjustment washer onto output shaft with convexity up, turn for a pitch and then install the long key.



4. Put the meshing teeth of low speed gear down onto the output shaft



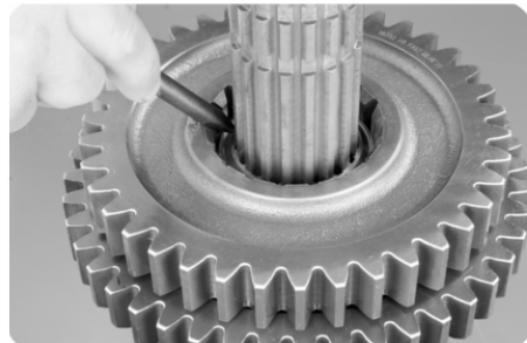
2. Install the sliding sleeve of low/reverse speed gear onto output shaft; make the teeth missing side toward the slot on output shaft.
Note: three sliding sleeves on output shaft are exchangeable.



5. Put the meshing teeth of 1st speed gear up onto output shaft and install a spline washer.



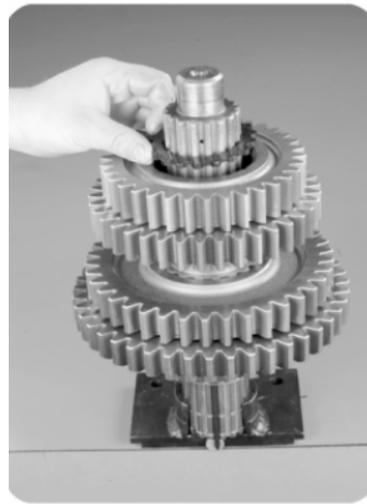
3. Put on an adjustment washer with convexity down, turn for a pitch and then fit the long key and a spline washer.



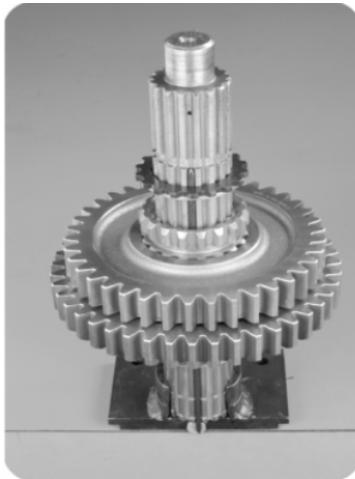
6. Put the meshing teeth of 1st speed gear up onto output shaft and install a spline washer.



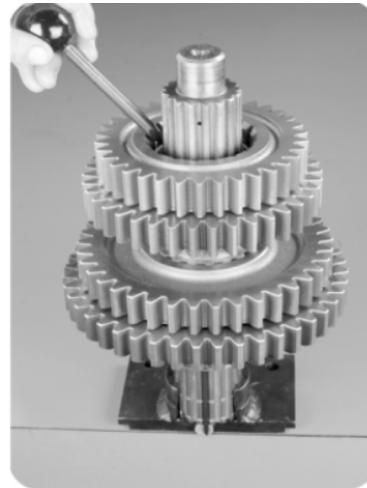
7. Install 1st/2nd speed gear sliding sleeve, make sure the tooth missing side towards the slot on output shaft



10. Install the 3rd speed gear with meshing teeth up onto output shaft, and install a spline washer.



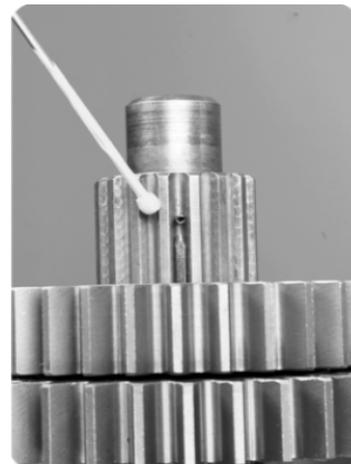
8. Install an adjustment washer with convexity down, turn for a pitch and then push up the long key, install a spline washer.



11. Install an adjustment washer with convexity up, turn for a pitch and then push the long key upward in place.



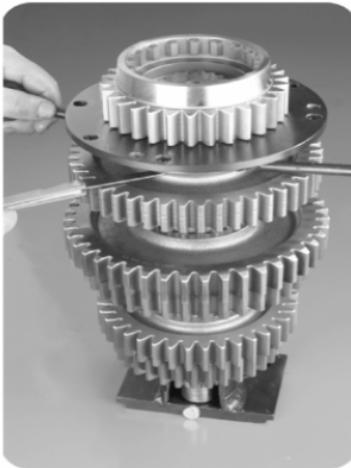
9. Put the meshing teeth of 2nd speed gear down onto output shaft



12. Tap elastic pin into the small hole of output shaft, and install 3rd/4th speed gear sliding sleeve onto output shaft.

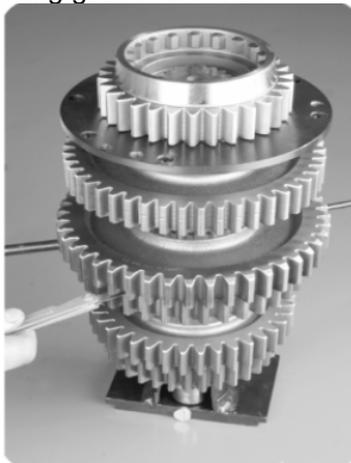


13. Set output shaft horizontally, install reverse gear spline washer, and then install a snap ring on the back end of output shaft, the opening of snap ring should stagger from the slot of long key.



14. Check axial clearance of output shaft: erect up output shaft, install snap ring of reverse gear, and assemble secondary transmission driving gear and snap ring.

Check the clearance (0.3-0.9mm) between reverse gear and driving gear with feeler



15. Check the gear axial clearance of low/reverse speed gear and 2nd /3rd speed gear of output shaft.

6. There are Sorts of thickness of adjustment shims available to be chosen for the correct clearance.

Thickness and Color of Adjustment Shims

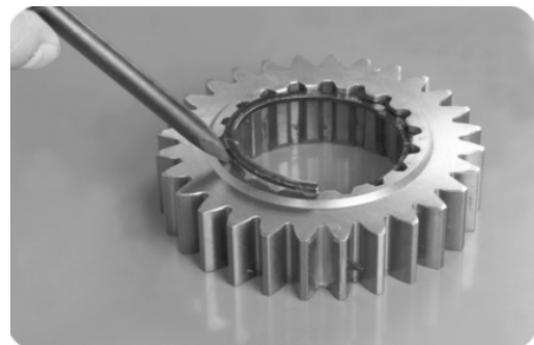
Thickness	Color
6.30-6.35	White
6.45-6.48	Green
6.55-6.60	Orange
6.68-6.73	Red purple
6.80-6.86	Yellow
6.93-6.99	Black

(III) Assembly of Primary Transmission and Shaft

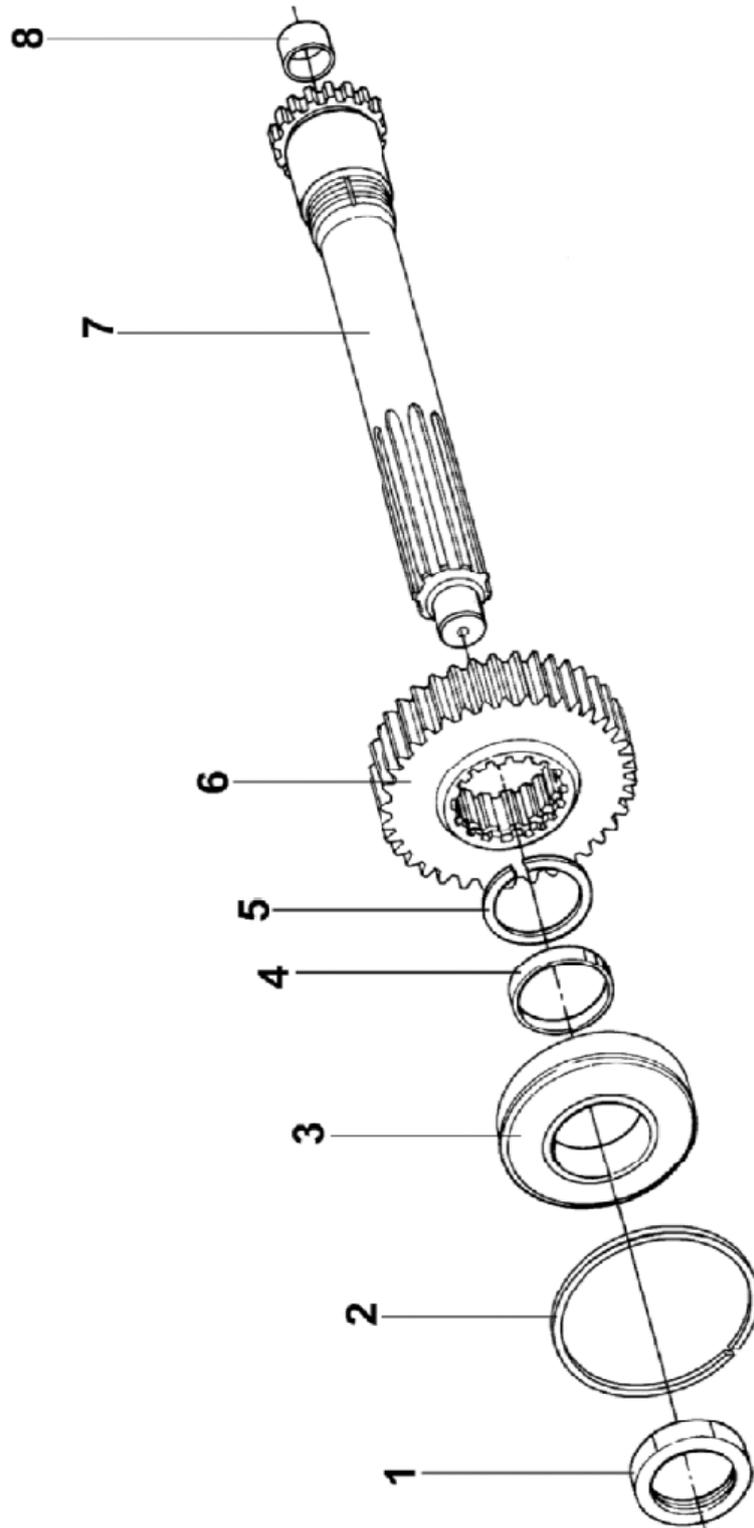
Exploded view of input shaft assembly components Figure 3-2



1. Install the guiding sleeve of output shaft into the internal hole of input shaft.



2. Install snap ring of input shaft gear



1. Input shaft nut 2. Snap ring. 3. Input shaft bearing 4. Gear spacer 5. Stop ring. 6. Input shaft gear 7. Input shaft. 8. Guiding sleeve of output shaft.

Figure 3-2 Exploded View of Input Shaft Assembly Components



3. Put input shaft gear onto input shaft, and install spacer of input shaft gear.



6. Choose 2 groups of teeth in 180° direction of input shaft randomly as the mark to match with teeth.

(IV) Assembly of Countershaft in Primary Transmission

Exploded view of countershaft assembly components Figure 3-3

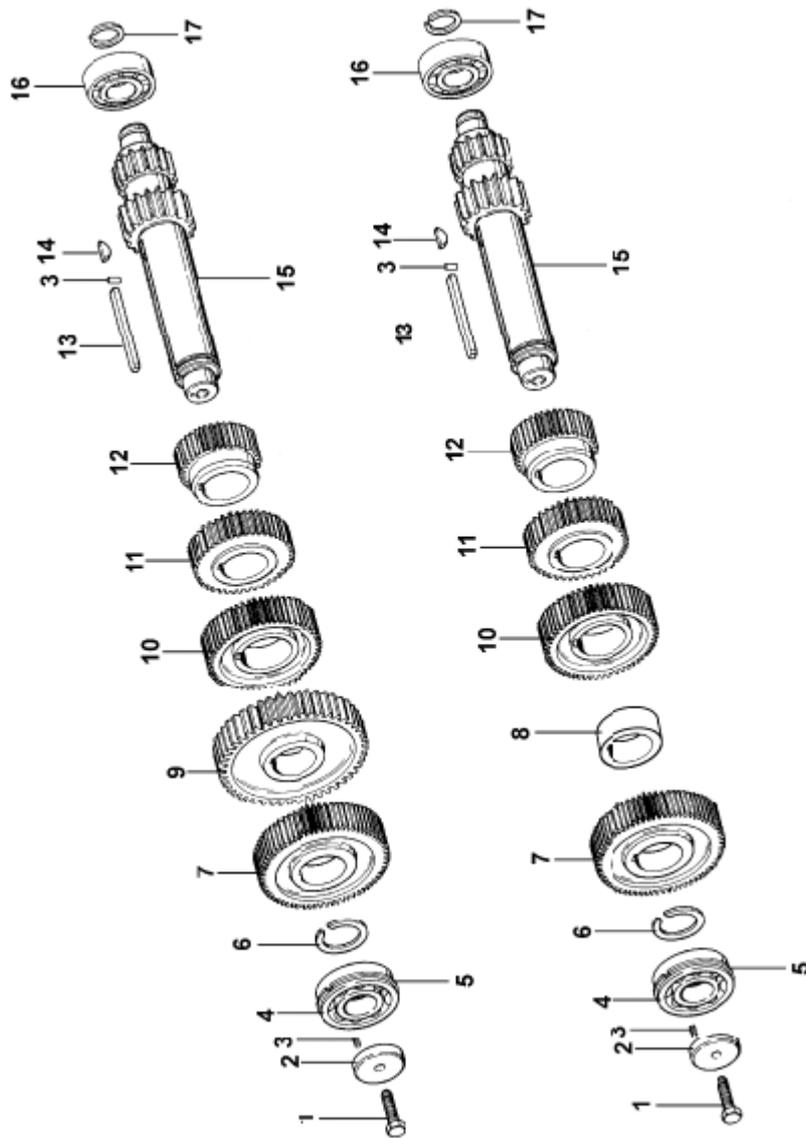


4. Put bearing onto input shaft with oil baffle up.



5. Coat nut thread of input shaft with anaerobic glue, and tighten with 340~410N/M to avoid loosening.

The creeping speed gear (super-low speed gear) and reverse gear are integrated with countershaft, and the other gears are connected with countershaft by semi-circular key or connected key in RT1509C transmission. Press each speed gear and driven gears onto countershaft in assembly sequence in case of changing gear in disassembly. Make a teeth matching mark on the driven gear tooth of countershaft assembly over against the key slot.

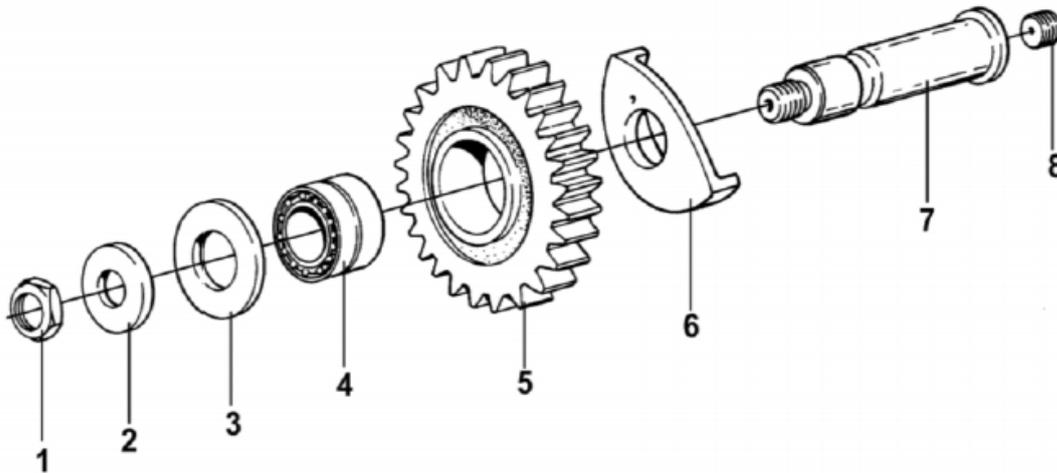


1. Bolt. 2. Bearing guard. 3. Elastic cylindrical pin. 4. Front bearing of countershaft. 5. Snap ring of countershaft. 6. Bearing snap ring. 7. Driven ring of countershaft. 8. Spacer (left countershaft) 9. Braking gear of right countershaft. 10. 3rd speed gear of countershaft. 11. 2nd speed gear of countershaft. 12. 1st speed gear of countershaft. 13. Connected key of countershaft. 14. Semi-circular key. 15. Countershaft. 16. Back bearing of countershaft. 17. Snap ring of shaft.

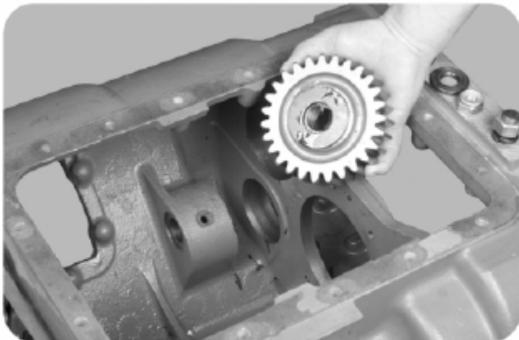
Figure 3-3 Exploded View of Countershaft Assembly Components

(V). Assembly of Reverse Intermediate Shaft

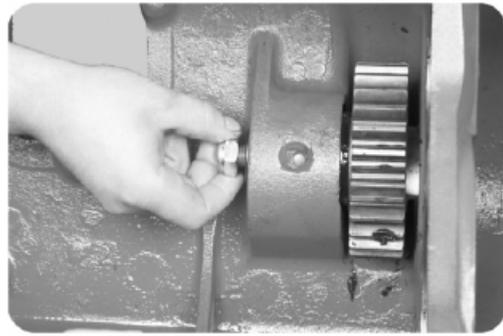
Figure 3-4 Exploded View of Reverse Intermediate Shaft Assembly Components



1. Self-lock nut 2. Washer 3. Thrust washer 4. Needle roller bearing 5. Reverse intermediate gear 6. Eccentric supporting washer of reverse shaft 7. Reverse intermediate shaft 8. Screw plug
Figure 3-4 Component Exploded View of Intermediate shaft of Reverse Gear



1. Assemble intermediate gear of lower reverse gear into the housing with convexity up



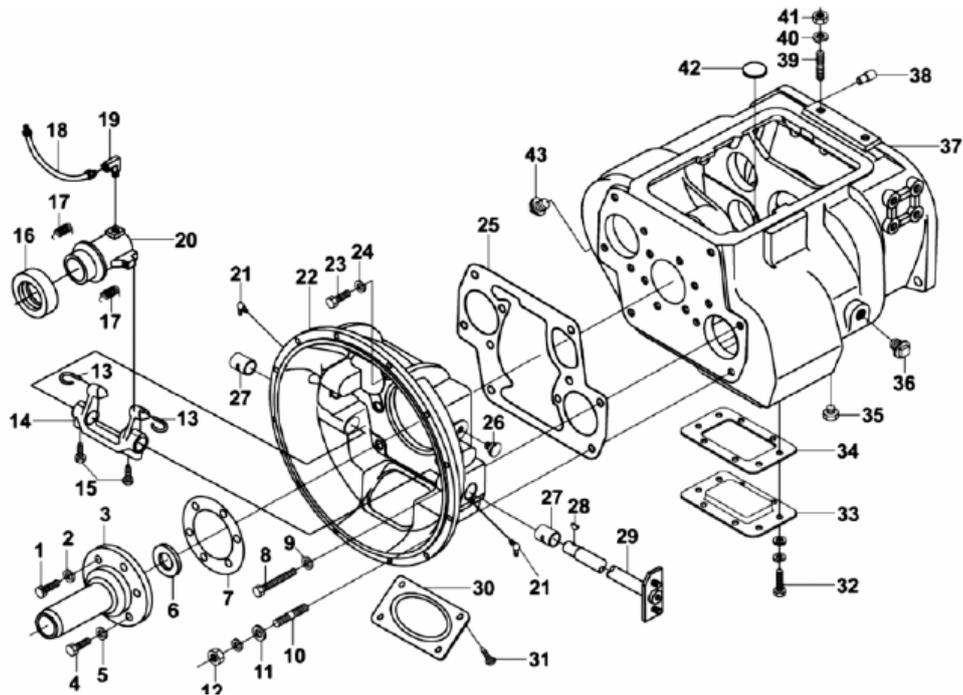
3. Washer assembly, tighten self-lock nut at the front of reverse gear intermediate shaft.



2. Assemble intermediate shaft of reverse gear
Note: the direction to assemble reverse eccentric supporting washer is unique, prohibit from taping

(VI). Assembly of Primary Transmission

Exploded view of transmission housing assembly components Figure 3-5



1. Bolt 2. Spring washer 3. Input shaft bearing cover 4. Bolt 5. Spring washer 6. Oil seal of input shaft bearing cover 7. Bearing cover gasket 8. Bolt 9. Spring washer 10. Stud bolt 11. Washer 12. Tightening nut 13. Return spring of releasing bearing 14. Release bearing fork 15. Bolt 16. Release bearing 17. Pulling spring 18. Oil pipe assembly 19. Elbow pipe joint 20. Holder of clutch release bearing 21. Grease nipper of elbow pipe 22. Clutch housing 23. Bolt 24. Spring washer 25. Clutch housing gasket 26. Cover style oil cup 27. Release shaft bush 28. Semi-circular key 29. Release fork shaft assembly 30. Sight glass cover 31. Bolt 32. Bolt 33. Bottom power takeoff (PTO) cover 34. Liner 35. Oil drain plug 36. Oil filling plug 37. Transmission housing 38. Positioning pin of back cover 39. Stud bolt 40. Spring washer 41. Nut 42. Circular magnet 43. Oil drain plug of primary transmission

Figure 3-5 Exploded View of Transmission Housing Components

Assemble transmission housing firstly according to Figure 3-5 in case that some of transmission housing components are necessary to be changed and the housing is disassembled. Note: do not assemble clutch housing and the relative parts at first.



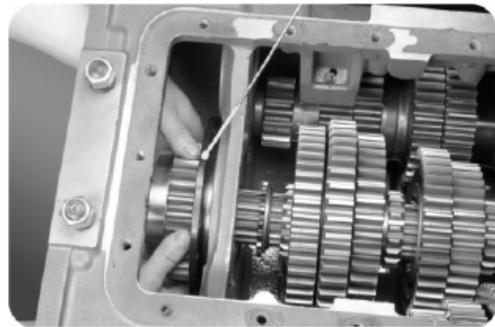
1. Put 2 countershafts housing into the primary transmission housing. Note: the size of power takeoff gears on 2 countershafts are different, the smaller one is assembled at upright of the housing



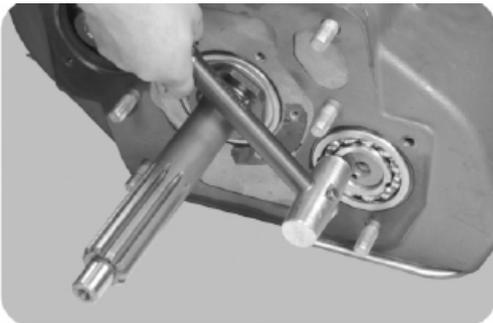
2. Put input shaft assembly in the primary transmission housing



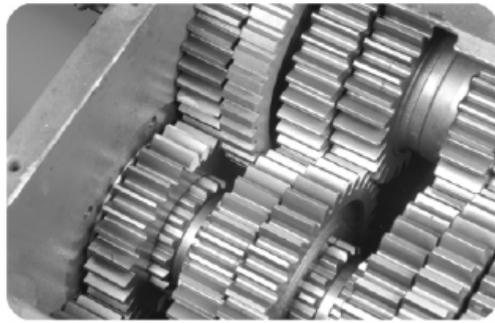
3. Insert the teeth with the mark at of the bottom of countershaft into slot marked at input shaft gear, assemble countershaft rear bearing and position it by snap ring.



7. Push the upper countershaft into the housing, put output shaft assembly into the primary transmission, and position the backside by driving gear initially.



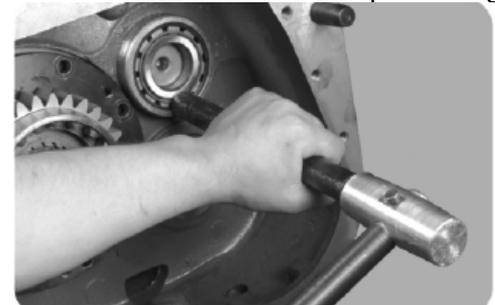
4. Assemble the front bearing of lower countershaft.



8. Insert the teeth marked on upper of countershaft into the slot with the mark on the input shaft gear.



5. Assemble the snap ring of input shaft bearing.



9. Put back the bearing on upper of countershaft, and position it by snap ring.



6. Apply grease into the internal hole of input shaft (original lubrication)

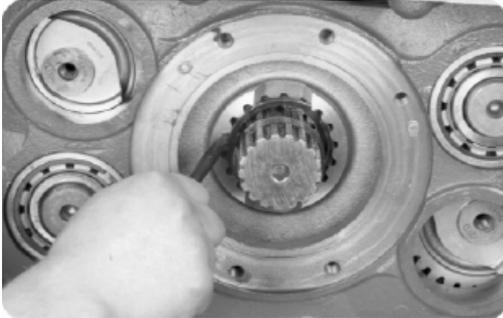


10. Assemble upper right bearing and pressing plate of countershaft.

Note: pressing plate should be coated with anaerobic glue.



11. Assemble another intermediate gear assembly and self-lock nut.



12. Pull the reverse gear of output shaft back, and then engage it with the reverse idling gear, then install the stop ring of reverse gear.



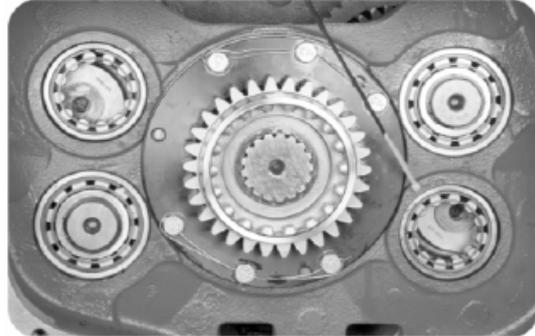
13. Assembly of driving gear assembly: put the driving gear on a flat surface, and then install the positioning plate and bearing.



14. Assemble the stop ring of driving gear



15. Assemble the retainer snap ring of driving gear



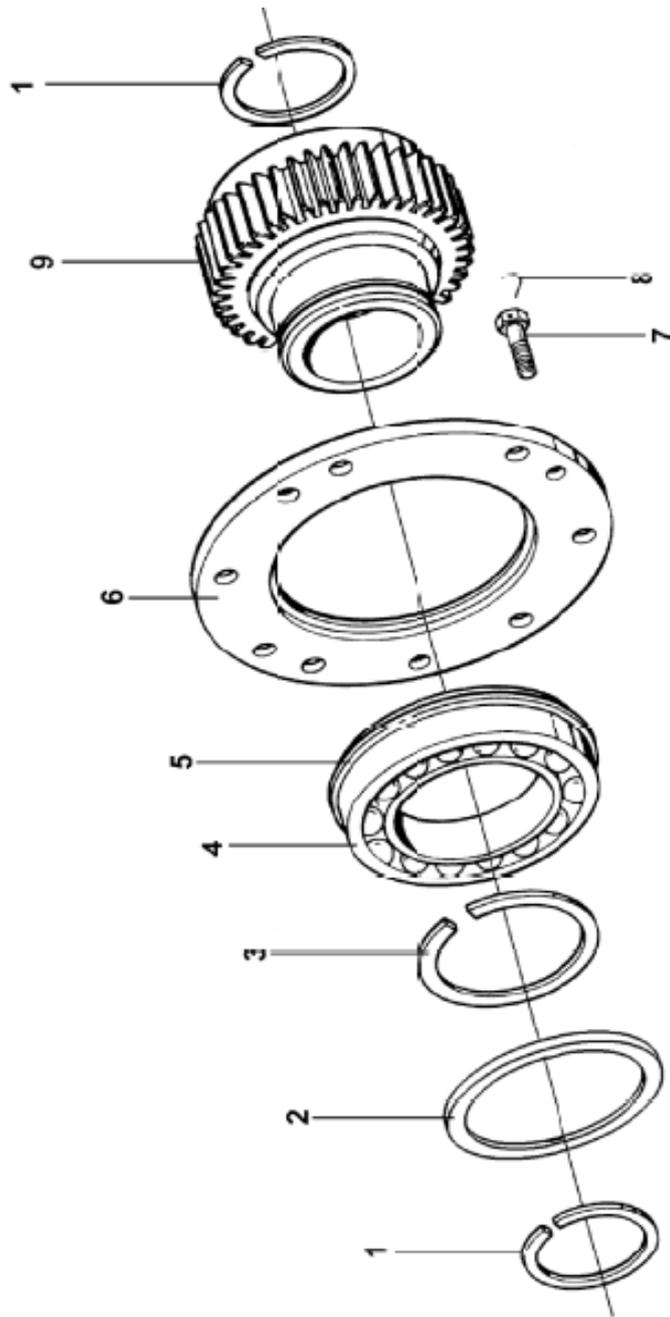
16. Assemble driving gear assembly and 2 front bearings of secondary transmission countershafts.



17. Assemble countershaft brake assembly.

(VII). Assembly of Secondary Transmission

See Figure 3-6 for exploded view of driving gear assembly components of secondary transmission
See Figure 3-7 for exploded view of main shaft assembly components of secondary transmission
See Figure 3-8 for exploded view of countershaft assembly components of secondary transmission
See Figure 3-9 for exploded view of back cover assembly components of secondary transmission



1. Snap ring 2. Washer 3. Snap ring 4. Output shaft bearing of primary transmission 5. Bearing snap ring 6. Bearing positioning gear 7. Bolt 8. Iron wire 9. Driving gear of secondary transmission

Figure 3-6 Exploded View of Driving Gear Assembly Components of Secondary Transmission

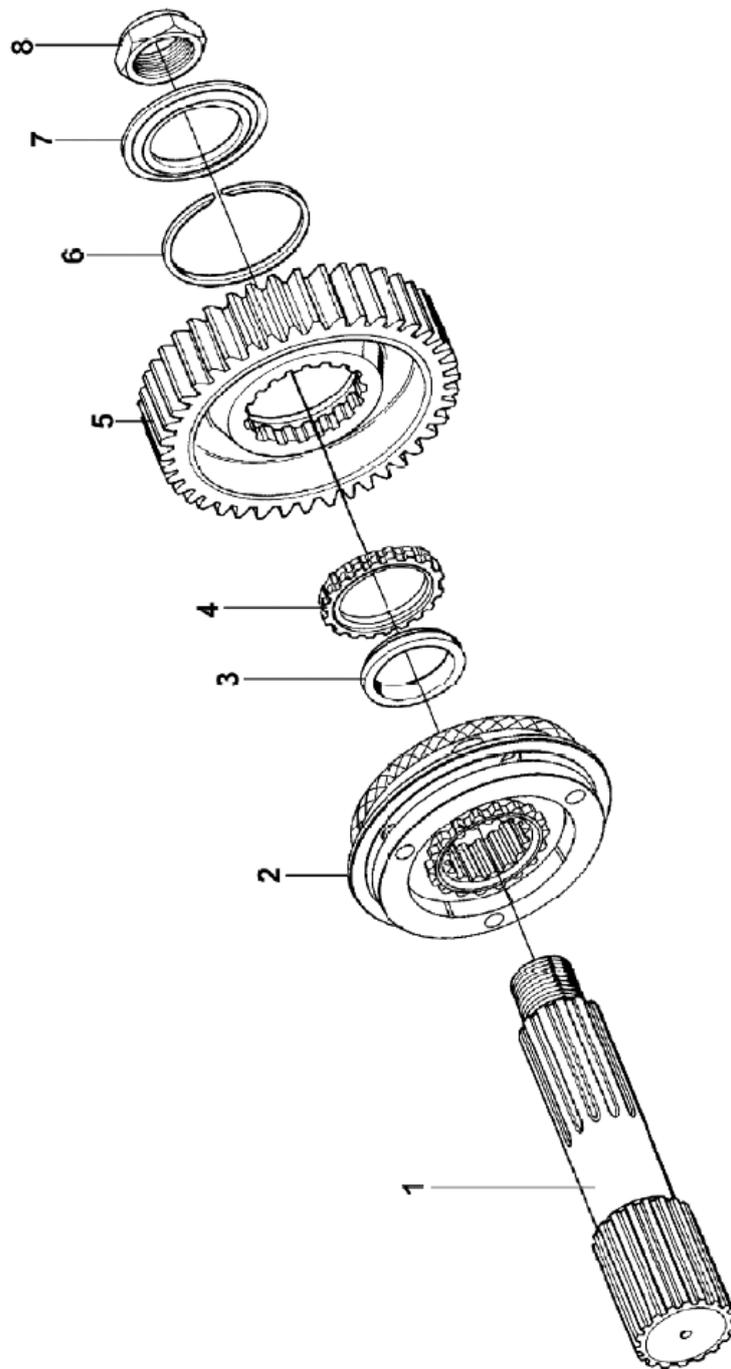
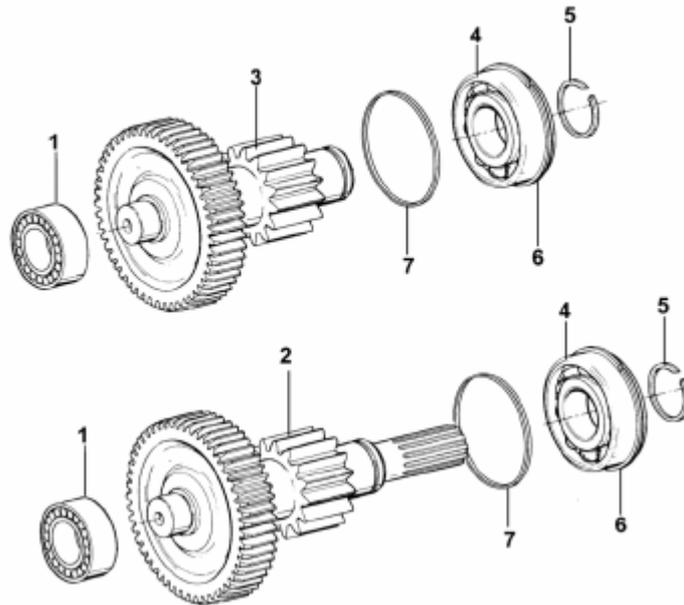


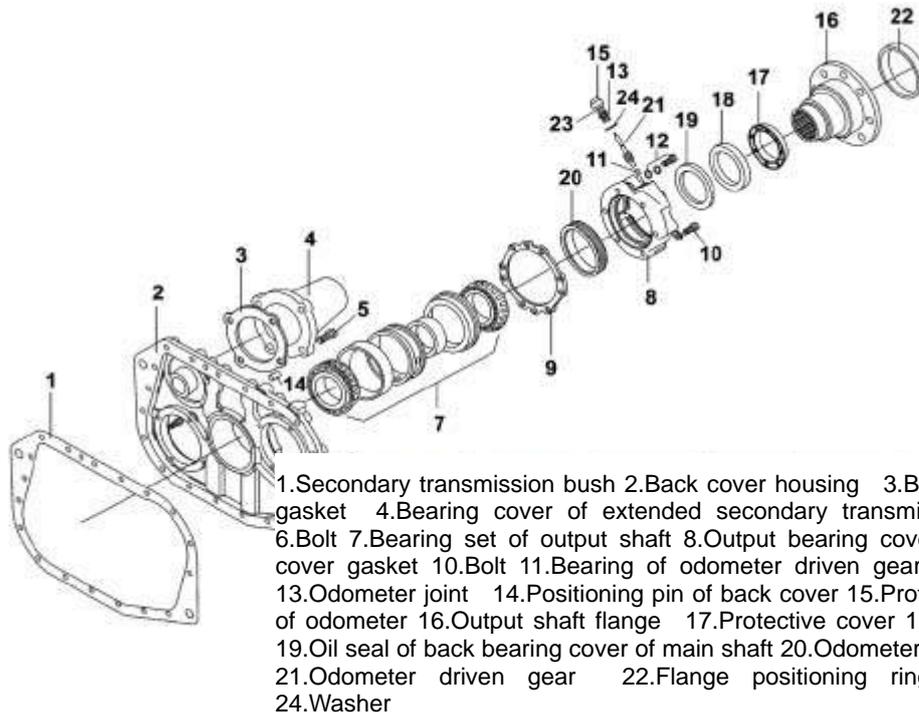
Figure 3-7 Exploded View of Main Shaft Assembly Components of Secondary Transmission

1. Main shaft of secondary transmission 2. Synchronizer 3. Main shaft washer 4. Spline washer of main shaft gear 5. Reducing gear of main shaft in secondary transmission 6. Snap ring 7. Main shaft gear washer 8. Flange nut



1. Short cylindrical roller bearing
2. Extended countershaft welding assembly of secondary transmission
3. Countershaft assembly of secondary transmission
4. Short cylindrical roller bearing
5. Snap ring
6. Bearing snap ring

Figure 3-8 Exploded View of Countershaft Assembly Components of Secondary Transmission



1. Secondary transmission bush
2. Back cover housing
3. Bearing cover gasket
4. Bearing cover of extended secondary transmission
5. Bolt
6. Bolt
7. Bearing set of output shaft
8. Output bearing cover
9. Bearing cover gasket
10. Bolt
11. Bearing of odometer driven gear
12. Bolt set
13. Odometer joint
14. Positioning pin of back cover
15. Protective cover of odometer
16. Output shaft flange
17. Protective cover
18. Oil sealing
19. Oil seal of back bearing cover of main shaft
20. Odometer driving gear
21. Odometer driven gear
22. Flange positioning ring
23. O-ring
24. Washer

Figure 3-9 Exploded View of Back Cover Assembly Components of Secondary Transmission



1. Put the cone ring of low speed gear of secondary transmission synchronizer on the plane, and then fit the synchronizer sliding sleeve.



4. Install the main shaft gear gasket and washer of secondary transmission.



2. Put three springs into the cone ring hole of high speed gear, and then make a revolving force to mesh it with the other parts of synchronizer.



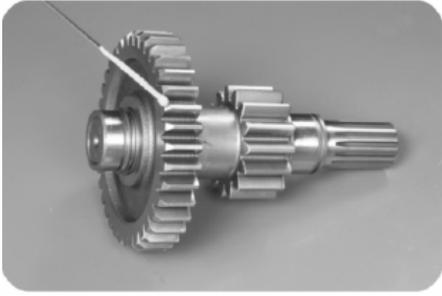
5. Install gear washer onto output shaft with convexity downward, apply initial lubrication to the washer.



3. Put a wooden block (50mm in height) on the cone ring of low speed gear of synchronizer, and then insert the input shaft.



6. Fit the bearing inner race into extended countershaft of secondary transmission.



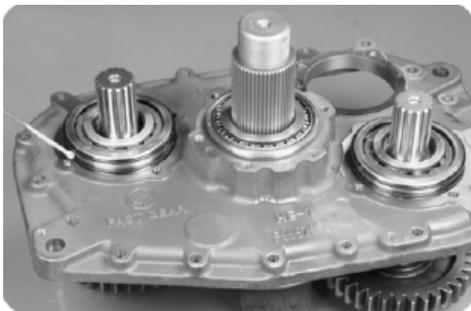
7. Make a teeth matching mark on the extended countershaft of secondary transmission



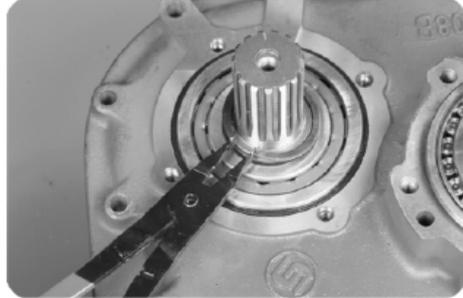
8. Make marks on two couples of teeth in adjacent 180° direction of the secondary transmission reducing gear as shown in the Figure.



9. Assemble back cover housing
Note: the shaft is assembled at the lower right of back cover housing if there is only one spline key on the extended countershaft.



10. Assemble bearing set and roller bearing of two countershafts
Note: there is a stop ring on the bearing, and also a bearing washer.



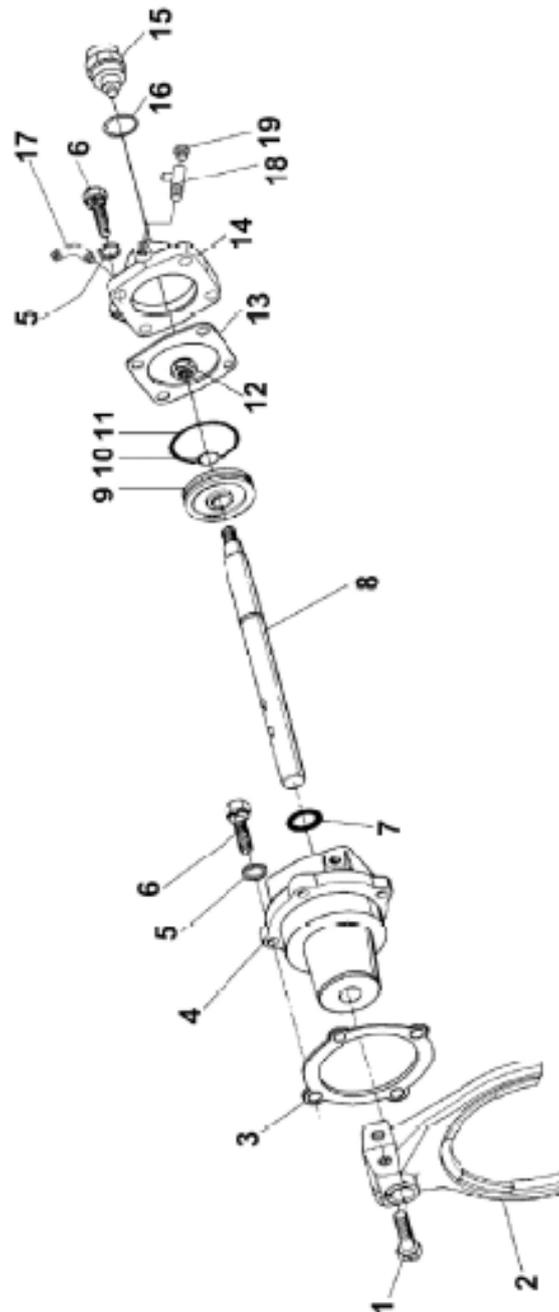
11. Assemble snap rings onto two countershafts.



12. Assemble output bearing cover, odometer driven gear and odometer joint.



13. Assemble end covers on two countershafts

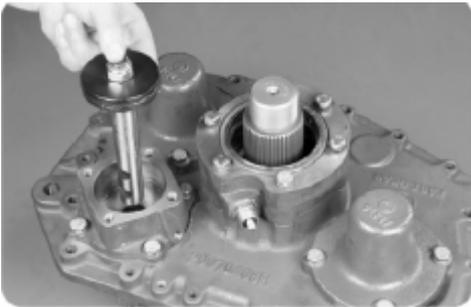


- 1 .Eye bolt 2. Synchronizer fork of secondary transmission 3. Gasket 4. High/low speed gear cylinder of secondary transmission 5. Spring washer 6. Bolt 7. O-ring 8. Fork shaft 9. Gearshift piston 10. O-ring of piston shaft 11. Piston O-ring 12. Self-lock nut
13. Gasket of gearshift cylinder cover 14. Gearshift cylinder cover. 15. High/low speed gear indicator switch. 16. O-ring 17. Elbow joint of gas tube 18. 3-way joint of gas tube 19. Screw plug

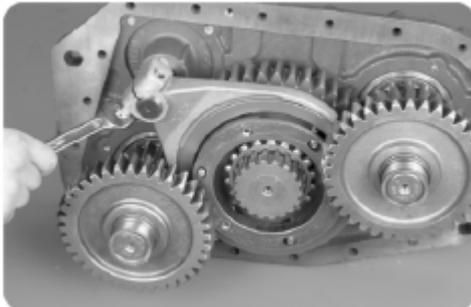
Figure 3-10 Exploded View of High/ Low Speed Gear Cylinder of Secondary Transmission



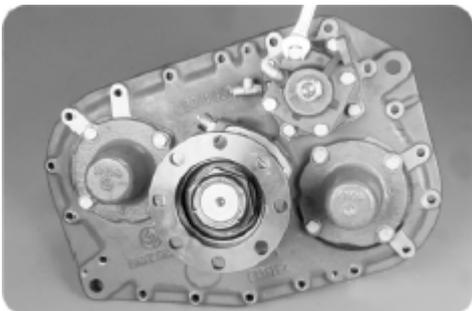
14. Assemble cylinder housing



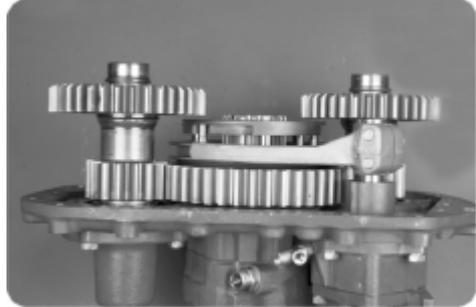
15. Assemble cylinder piston
Note: keep piston surface up.



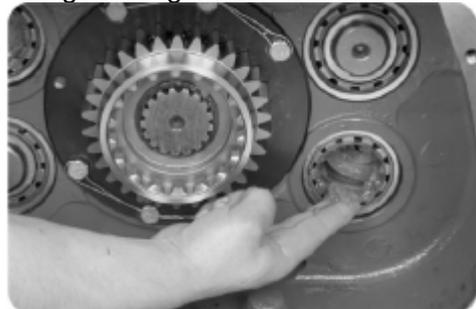
16. Insert gearshift fork of secondary transmission into synchronizer sliding sleeve and fork shaft, fit the bolts of fork shaft, and then lock it with iron wire.



17. Assemble gearshift cylinder cover



18. Set synchronizer of secondary transmission in low speed gear range.



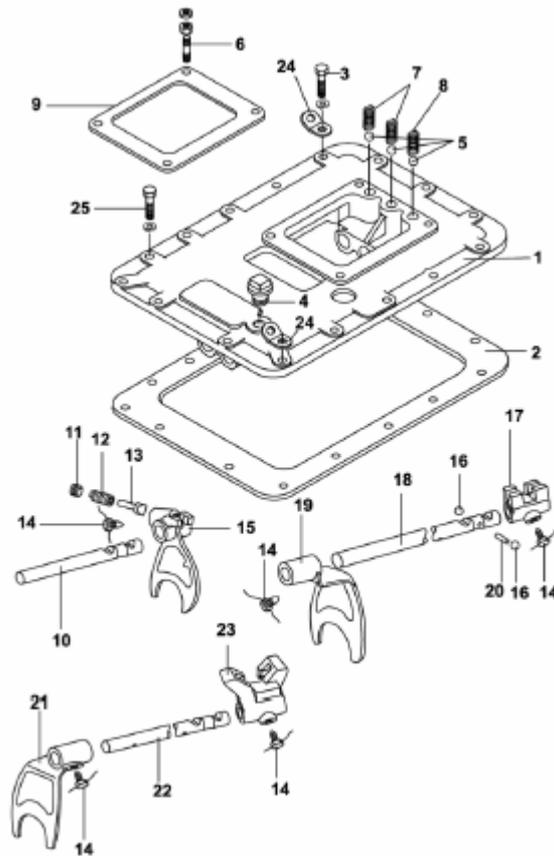
19. Coat two countershaft front holes with grease. This step is very important in secondary transmission assembly process.



20. Lift and move the secondary transmission assembly with secondary transmission hanger to the back of primary transmission, turn the flange, push secondary transmission forward to install the secondary transmission in place, and then tighten back cover bolts, also tighten output flange nut by 610~680 N/M.

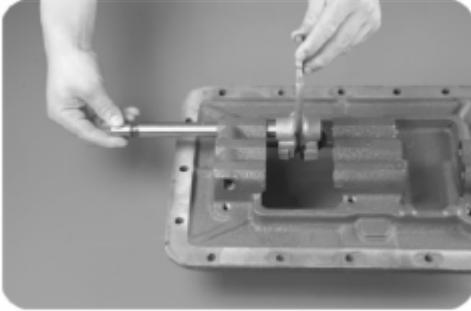
(VIII). Assemble Transmission Upper Cover

Exploded view of upper cover assembly components Figure 3-11

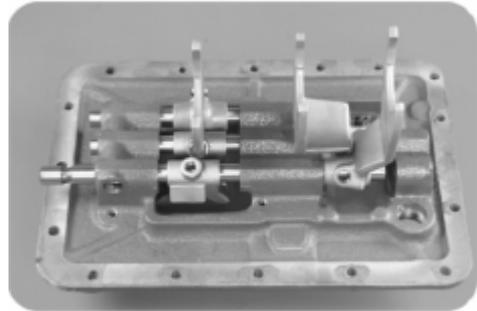


1. Upper cover of transmission 2. Upper cover gasket 3. Bolt 4. Screw plug 5. Interlock steel ball 6. Stud bolt 7. 8. Interlock spring 9. Gasket 10. Low speed / reverse gear fork shaft 11. Reverse lock screw plug 12. Reverse lock spring 13. Reverse lock pin 14. Lock screw of gearshift fork 15. Low speed / reverse gear fork 16. Interlock steel ball 17. 1st/2nd, 5th/6th speed gearshift block 18. 1st/2nd speed gear fork shaft 19. 1st/2nd speed gear fork 20. Fork shaft interlock pin 21. 3rd/4th speed gearshift fork 22. 3rd/4th speed gearshift fork shaft 23. 3rd/4th, 7th/8th speed gearshift block 24. Lifting bent board 25. Bolt

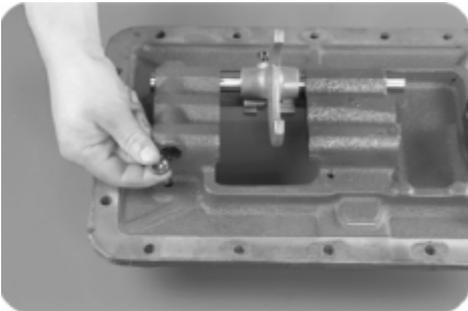
Figure 3-11 Exploded View of Upper Cover Assembly Components



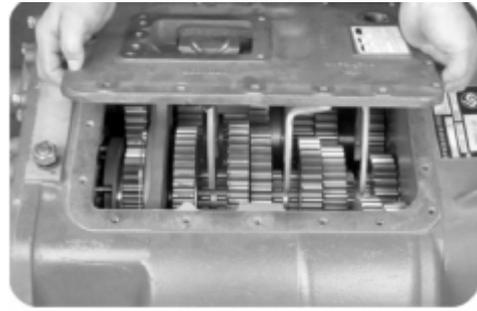
1. Assemble low speed, reverse gearshift fork and fork shaft, tighten the bolts and lock the bolts with iron wire.



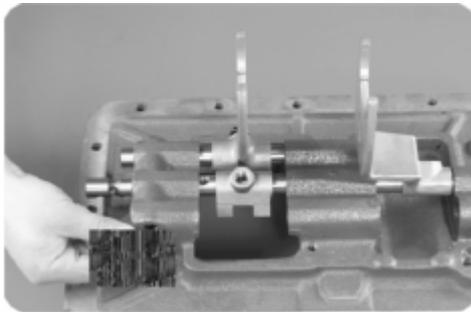
4. Fit the 3rd /4th speed gear fork, block and fork, tighten the bolts and lock the bolts with iron wire..



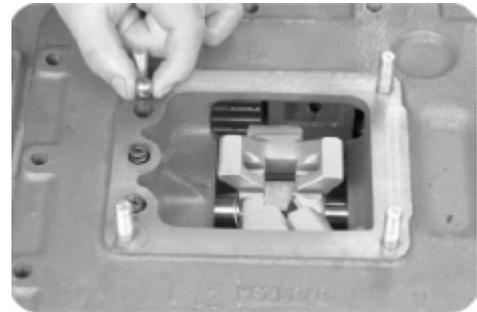
2. Install an interlock steel ball.



5. Set fork at neutral position and assemble upper cover assembly.



3. Install the fork shaft of 1st /2nd speed gear, guiding block and 1st /2nd speed fork, tighten the bolts and lock the bolts with iron wire. Install interlock pin and interlock steel ball.

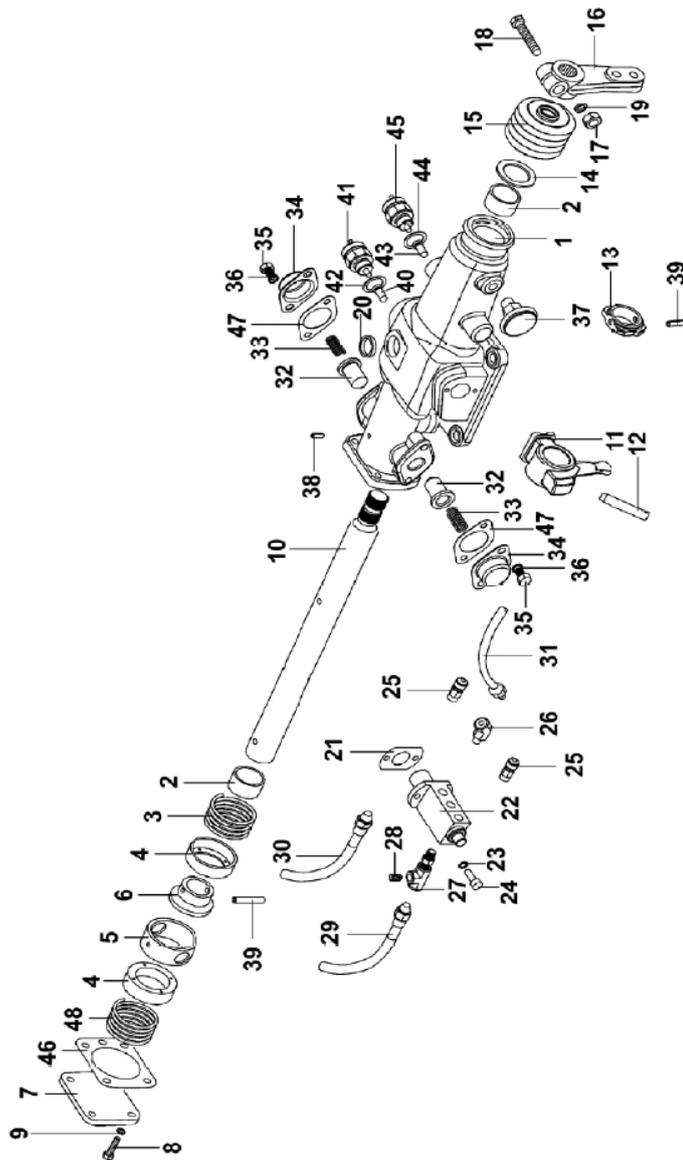


6. Assemble four stud bolts, interlock steel ball and spring.

Note: the springs in the holes of 3rd/4th gear fork shaft are thicker.

(IX).Assembly of Gearshift Mechanism Assembly

Exploded view of components of gearshift mechanism assembly Figure 3-12

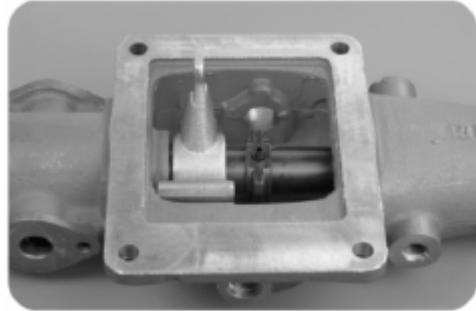


1. Double-H gearshift mechanism housing 2. Gearshift shaft bush 3. Compression spring 4. Spring seat 5. Spring spacer 6. Positioning ring 7. End cover 8. Bolt 9. Spring washer 10. Gearshift lever 11. Gearshift block 12. Cylindrical pin 13. Control module of low speed / reverse gear switch 14. Oil sealing 15. Boot 16. Gearshift crankarm 17. Nut 18. Bolt 19. Washer 20. Bowl plug 21. Gasket 22. Double-H air valve 23. Spring washer 24. Bolt 25. Breather plug 26. Elbow joint of gas tube 27. 3-way joint of gas tube 28. Plug Screw 29. 30. 31. Gas tube assembly 32. Positioning pin 33. Spring 34. Spring pressing cover 35. Bolt 36. Washer 37. Breather plug 38. Stop screw 39. Positioning ring pin 40. Neutral switch pin 41. Neutral switch 42. Washer 43. Reverse switch pin 44. Washer 45. Reverse switch 46. Gasket 47. Gasket 48. Compression spring

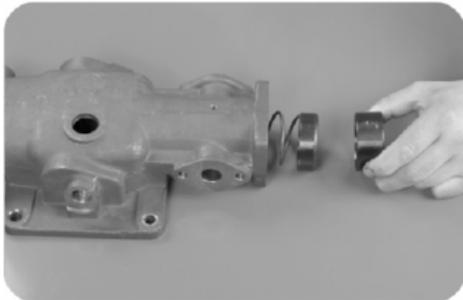
Figure 3-12 Exploded View of Gearshift Mechanism Assembly Components



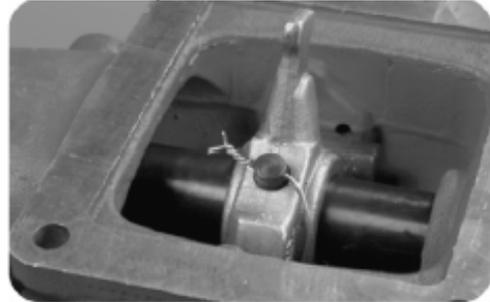
1. Install oil sealing, and apply grease at the cutting edge.



4. Insert lateral gearshift lever into the housing, and fit the elastic pin of reverse control block.



2. Fit the spring, spring holder and spacer in the double-H housing, and then lock them with stop screw.



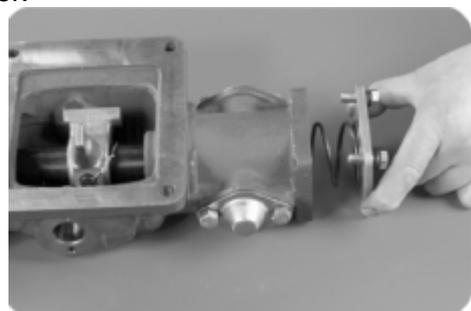
5. Assemble cylindrical pin of gearshift block, and lock it with iron wire.



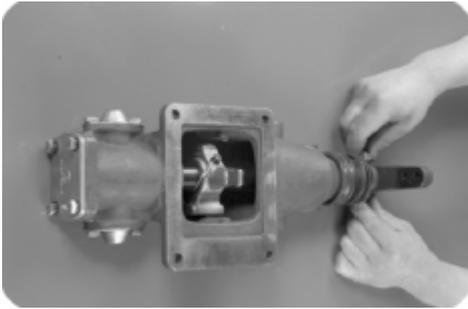
3. Put the elastic pin on the positioning ring, pay attention to the direction of positioning ring



6. Install the pistons on two sides, and fit spring and spring seat, and make initial lubrication for plunger.



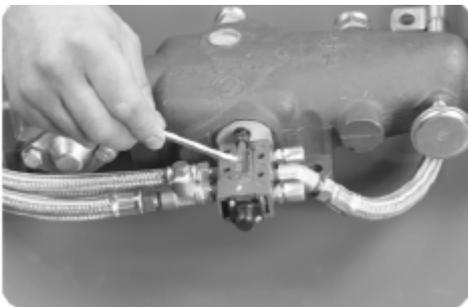
7. Assemble spring, spring seat, and install side plates.



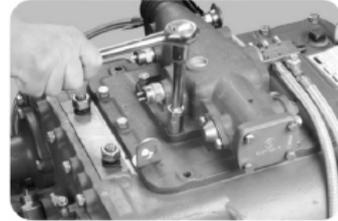
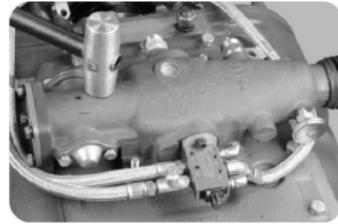
8. Assemble boot and gearshift rocker.
Note: make sure the rocker and gearshift block are in the same line.



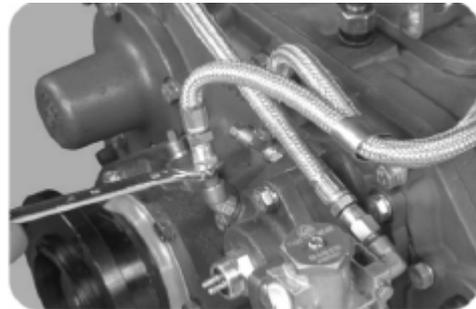
9. Assemble reverse gear, neutral switch and plunger.



10. Assemble two positioning screws of double-H valve with hex wrench.



11. Assemble double-H gearshift mechanism assembly on upper cover of transmission and tighten the four fastening bolts.



12. Connect double-H valve gas tube with filtering pressure regulation valve. Assemble clutch housing and its accessories, and then the transmission assembly is completed.

Tightening Torque

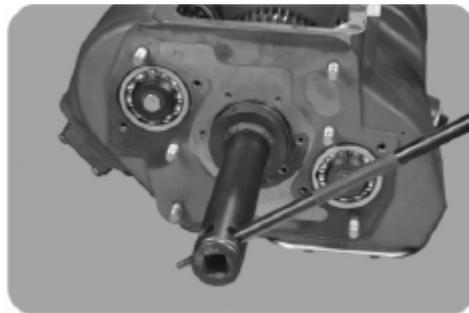
No.	Applicable Components or Parts	Bolts (Nuts)	Suggested Tightening Torque
1	Clutch housing	6 — M16 × 1.5	244~271N.m
2	Clutch housing	4 — M12	108~135N.m
3	Bearing cover of input shaft	6 — M10	47.5~61N.m
4	Input shaft gear	M54 × 1.5 turn left	338~406N.m
5	Double-H control mechanism	8 — M10 × 1	47.5~61N.m
6	Upper cover	16 — M10	47.5~61N.m
7	Fork lock screw	5 — M12 × 1.25	67.5~88N.m
8	Secondary transmission fork	2 — M12 × 1.5	67.5~88N.m
9	Air filter holder	2 — M6	13.5~20.3N.m
10	Output shaft	M50 × 1.5	609~677N.m
11	Back cover of secondary transmission	19 — M10	47.5~61N.m
12	Oil drain hole	3/4'	61~74.5N.m
13	Oil filling hole	1/4'	81~101.5N.m
14	Positioning plate of secondary transmission driven gear	6 — M10	47.5~61N.m
15	Reverse idling gear shaft	2 — M16 × 1.5	67.5~81N.m
16	Back cover of secondary transmission intermediate shaft	8 — M10	47.5~61N.m
17	Bottom power takeoff cover	8 — M12	67.5~88N.m
18	Intermediate shaft brake	8 — M10	47.5~61N.m
18a	Side glass cover of transmission	6 — M10	24.5~31N.m
19	Rear bearing cover of main shaft	6 — M10	47.5~61N.m
20	Gearshift cylinder housing	4 — M10	47.5~61N.m
21	Cylinder cover	4 — M10	47.5~61N.m
22	Bottom cover of clutch housing	4 — M8	20~27N.m
23	Intermediate shaft	2 — M16 × 1.5	122~162N.m

Section V Remove Input Shaft from Transmission Directly

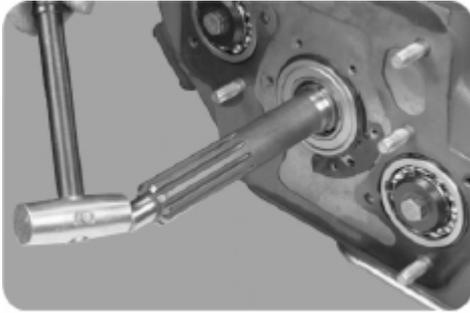
During repair, it is necessary to remove and install the input shaft sometimes. See the detailed operations as followings.



1. Mesh two couples of gears with sliding sleeve in transmission.



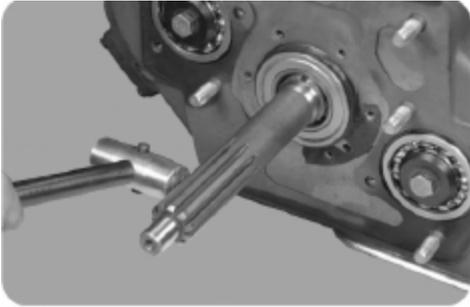
2. Remove the input shaft nut (left turning) with special tool.



3. Tap the input shaft inside with a copper rod.



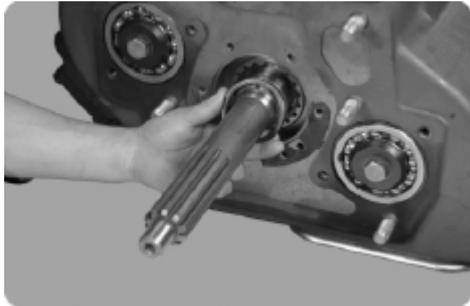
7. Take out the input shaft and make corresponding inspection of it.



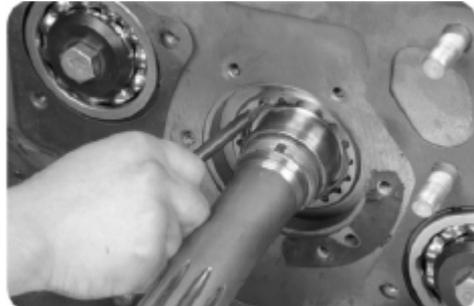
4. Tap the input shaft with copper rod from left and right and separate the input shaft bearing from the input shaft.



8. Assembly: take a new input shaft and insert it into output shaft guide sleeve. Apply grease in the hole.



5. Take out the input shaft gear spacer.



9. Put the input shaft into the input shaft gear hole and assemble the snap ring



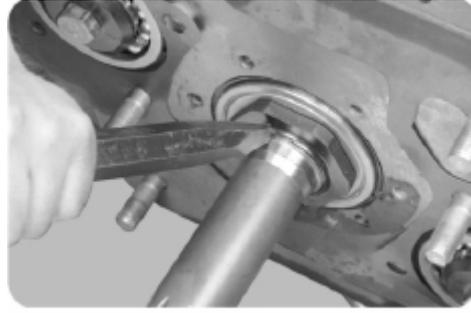
6. Move out the snap ring inside the input shaft gear with a screwdriver.



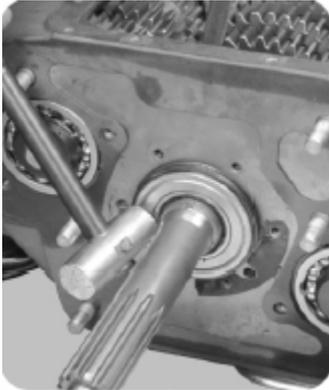
10. Assemble the spacer of input shaft gear .



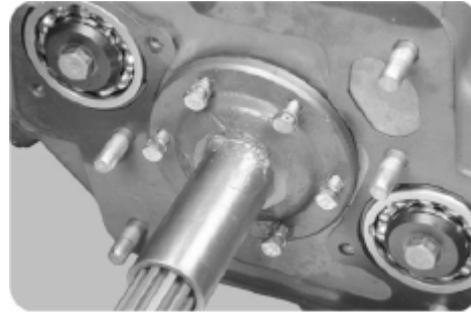
11. Mesh the 3rd /4th speed gear sliding sleeve of output shaft with the internal teeth of input shaft gear, and support it with soft rod.



15. Rivet the input shaft nut at the slot of input shaft thread.



12. Assemble the input shaft bearing in place.

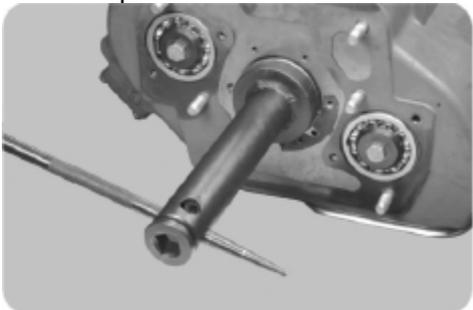


16. Assemble the end cover of input shaft and tighten it with six bolts.



13. Apply anaerobic glue on the nut thread of input shaft

Refer to above process on removal and assembly of double-countershaft 9-speed series (such as 9JS series) transmission. For 8-speed series (such as 8JS series) transmission, the removal process for output shaft assembly is a little bit different because of low gear cancellation, and the rest operations can refer to above process. The content in the section is applicable for transmission models as following RT11509C, RTO11509F, 9JS180, 9JS180A, 9TS150, 9TS150 A, 9JS135, 9JS135A, 9JS119, 9JS119A, 9JS119B, 8JS100B, 8JS100C, 8JS118 and 8JS118A.



14. Use special tool to tighten the input shaft nut (left turning).

Section VI Fast JS Series Transmission

As the introduction above, RT11509C transmission is a basic transmission model introduced from U.S. Fuller by Fast. At the same time, partial variant models have also been introduced, for example, RT11609A is thin tooth design (RT11509C is thick tooth design); RT011609B is designed with over-speed gear etc. The basic structure, working principle, removal and assembly procedures of these variant models are the same as RT11509C.

In recent years, in order to meet market demand, Shaanxi Fast Gears Co., Ltd has developed series of double-intermediate shaft transmission on the basis of double-countershaft design principle independently, such as 7DS,7JS,8JS,9JS,10JS,12JS and 16JS etc. Among these series, 7DS series is single box structure only with primary transmission (without secondary transmission), and the others are double-countershaft transmission with combination of primary transmission and secondary transmission.

Figure 6-1 is the structure diagram of 7DS series transmission, Figure 6-2 is the transmission diagram of 7DS series.

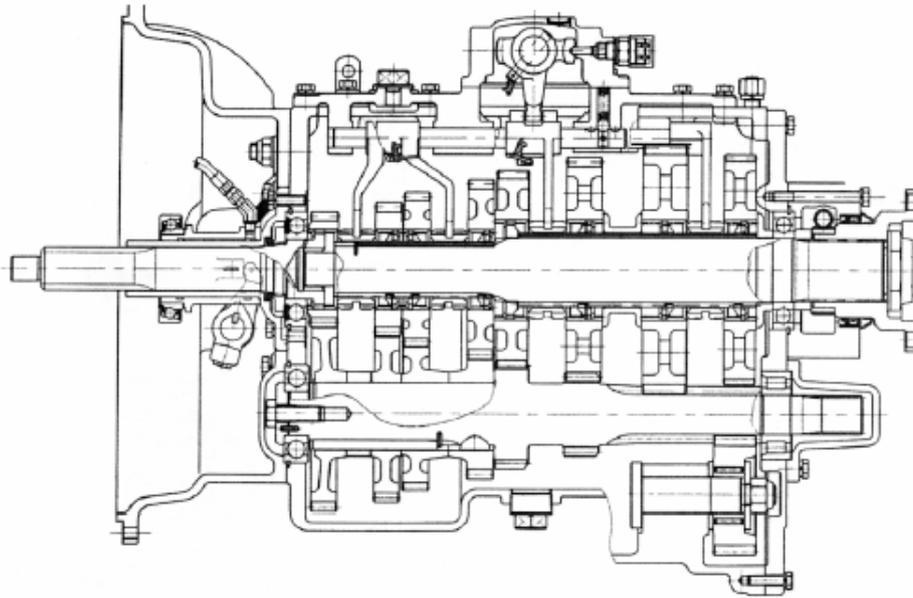


Figure 6-1 Structure Diagram of 7DS Series Transmission

Figure 6-3 is the primary transmission structure diagram of 7JS and 8JS series transmissions. Figure 6-4 is the transmission diagram of 7JS series transmission. Figure 6-5 is the transmission diagram of 8JS series.

From the structure diagram and transmission diagram above, 7DS series transmission is a single box gearbox with double-countershaft primary transmission only (without secondary transmission). While 7JS and 8JS series transmissions have the same basic structures, and the difference is that 7JS transmission is at high speed gear range, As in Figure 6-4 and Figure 6-5, for 8JS series transmission, when the secondary transmission is at low speed gear, 1st and 2nd speed gear synchronizer will move back to mesh with 1st speed gear and the transmission is at 1st speed gear, when it is pushed forward to mesh with 2nd speed gear, the transmission is at 2nd speed gear. When 3rd and 4th speed gear synchronizer moves back to mesh with 3rd gear, the transmission is at 3rd speed gear. When it is pushed forward to mesh with input shaft, the transmission is in direct gear, i.e. 4th speed gear. When the secondary transmission is at high speed gear, the primary transmission will repeat the above gear engaging process, i.e. 5th, 6th, 7th and 8th gears are realized. From Figure 6-4, we can see 1st, 2nd, 3rd, 4th speed gears' engaging process is as the same as 8JS transmission series completely when 7JS series transmission is at low speed gear.

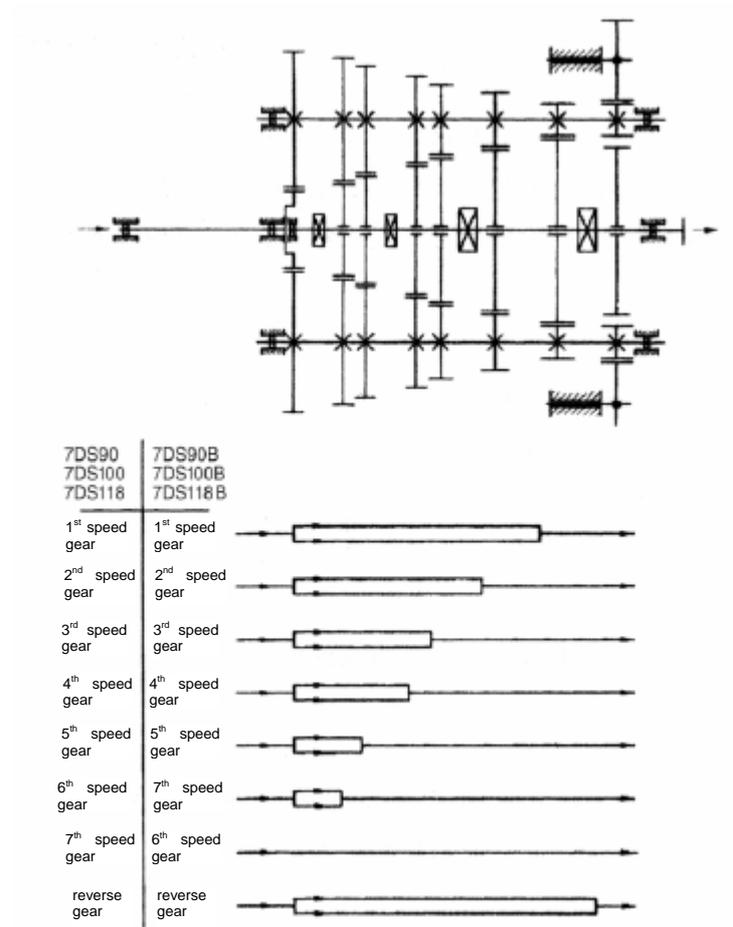
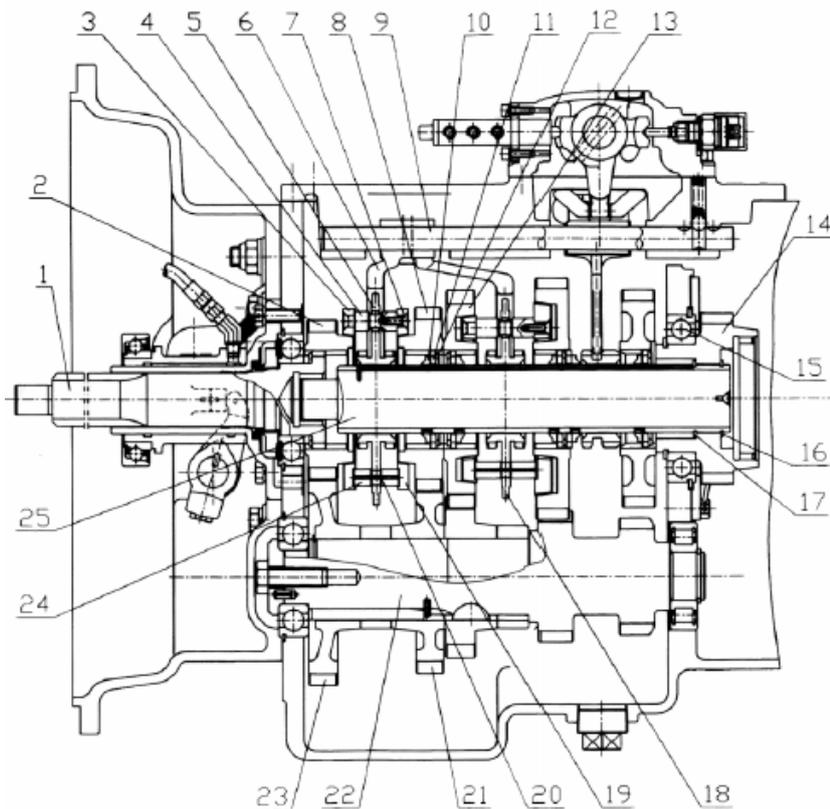


Figure 6-2 Driving Diagram of 7DS Series Transmission

When the secondary transmission is at high speed gear position, 1st and 2nd speed gear synchronizer of primary transmission will be pushed forward directly to mesh with 2nd speed gear, then 5th speed gear is achieved. When 3rd and 4th speed gear synchronizer is pushed backward to mesh with 3rd speed gear, 6th speed gear is achieved. When 3rd and 4th speed gear synchronizer is pushed forward to mesh with input shaft, 7th speed gear is achieved. Obviously, 7JS transmission is the combination operation of 1st and 2nd gear synchronizer backward with input shaft gear. This is the difference between 7JS transmission and 8JS transmission, i.e. the operating device is cancelled, and in other words, 7JS transmission is formed on the basis of 8JS transmission with one gear removed only.

From Figure 6-4 and Figure 6-5, we can see the difference between transmission with direct gear (7JS100, 8JS100, 8JS100T, 8JS115T, 8JS118, 8JS118T, 8JS130, 8JS180) and transmission with over-speed gear (7JS100A, 8JS100A, 8JS100TA, 8JS115TA, 8JS118A, 8JS118TA, 8JS130A, 8JS180A), they are only different in terms of gear speed, and there is slight difference on its power transmission routes, as shown in transmission driving diagram, for transmission with direct gear, the transmission is at 3rd speed gear when the secondary transmission is at low speed gear and 3rd/4th gear synchronizer is extracted to mesh with 3rd speed gear, and transmission is at 4th speed gear when it is pushed to mesh with input shaft gear. When the secondary transmission is at high speed gear position, the transmission is at 7th speed gear when 3rd and 4th gear synchronizer is extracted to mesh with 3rd speed gear, and the transmission is at 8th speed gear when it is pushed to mesh with input shaft gear.



1. Input shaft 2. Input shaft gear 3. Synchronizer ring of 3rd/4th speed gear 4. Lock pin 5. Synchronizer sliding sleeve 6. 3rd/4th gear fork 7. Sunk screw 8. 3rd speed gear of output shaft 9. Fork shaft of 3rd and 4th speed gear 10. Gear spacer of output shaft 2 11. Gear spline spacer of output shaft 12. Snap ring 13. 2nd speed gear of output shaft 14. Driving gear of secondary transmission 15. Bearing 16. Snap ring 17. Snap ring 18. Synchronizer of 1st and 2nd gear 19. Synchronizer ring 20. Synchronizer spring 21. 3rd speed gear of intermediate shaft 22. Intermediate shaft 23. Transmission gear of intermediate shaft 24. Positioning pin 25. output shaft

Figure 6-3 Primary Transmission Structure Diagram of 7JS and 8JS Series Transmissions

For transmission with over-speed, the condition of secondary transmission at low speed gear is the same as the transmission equipped with direct gear. When the secondary transmission is at high speed gear, its gear engaging methods for 7th/8th speed gear is just contrary to the transmission equipped with direct gear, i.e. when the synchronizer is extracted to mesh with 3rd speed gear, the transmission is at 8th speed gear, when it is pushed to mesh with input shaft gear, it is 7th speed gear. Figure 6-6 is the gear position diagram of 7JS series transmission gearshift lever.

Figure 6-7 is gear position diagram of 8JS series transmission gearshift lever. 7JS series and 8JS series transmissions with over-speed produced recently have the same gearshift lever operation as the transmission equipped with direct gear.

Transmissions of 7JS and 8JS series with direct gear or over-speed are all equipped with remote control double-H gearshift mechanism. As Figure 2-11, "Double-H gearshift mechanism" is transmission gearshift shaft 6, it does not only move gearshift lever 5 and double-H gearshift block backward and forward to engage into a gear position, but also move and control double-H gearshift air valve laterally to decide low/high speed gear of secondary transmission. It means that two gearshift tasks of primary transmission and secondary transmission are completed by one gearshift shaft at the same time; the gearshift gas route is shown in Figure 2-13.

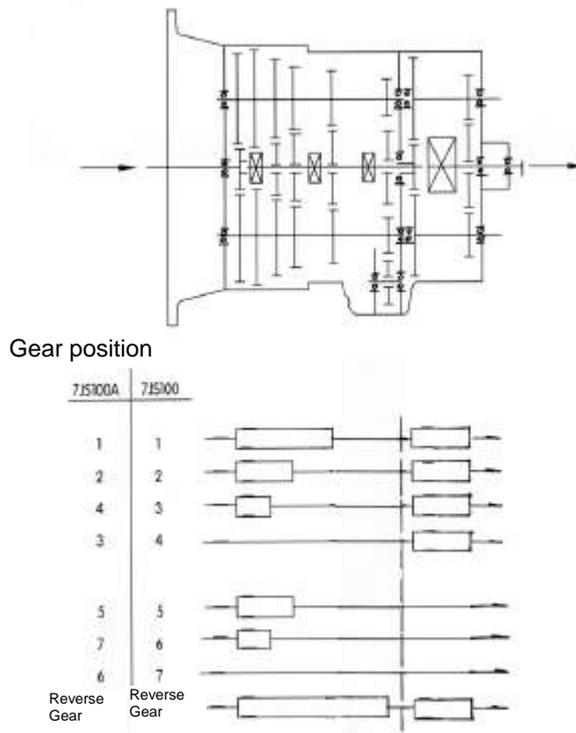
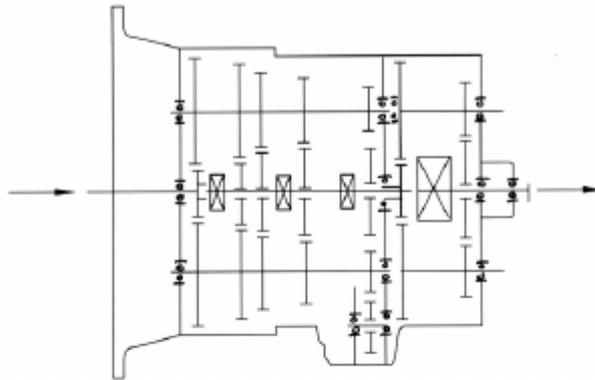


Figure 6-4 Driving Diagram of 7JS Series Transmission

9JS series transmission is a product based on RT11509C basic transmission with upgrading output torque. The structure is same as RT11509C basically, which also has double-countershafts of primary transmission and secondary transmission with 9 forward gears and one reverse gear, Figure 6-8 is the structure of 9JS transmission without synchronizer, Figure 6-9 is its driving diagram.

All of 9JS series transmissions' route is the same as Figure 6-9, although it has been indicated as the driving routes of 9JS180 and 9JS180A models.



Gear position

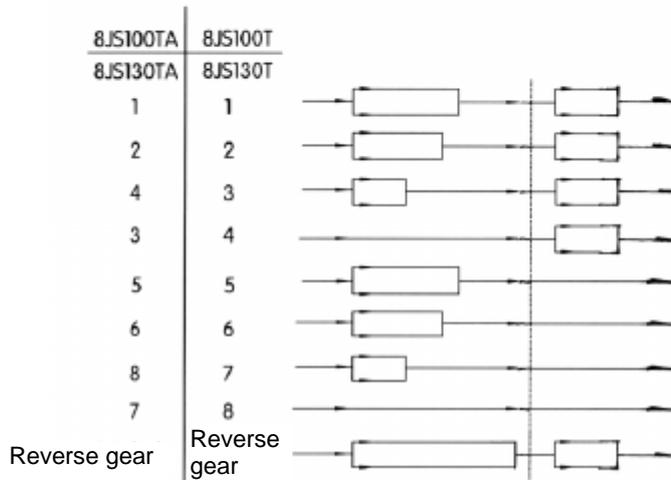


Figure 6-5 Driving Diagram of 8JS Series Transmission

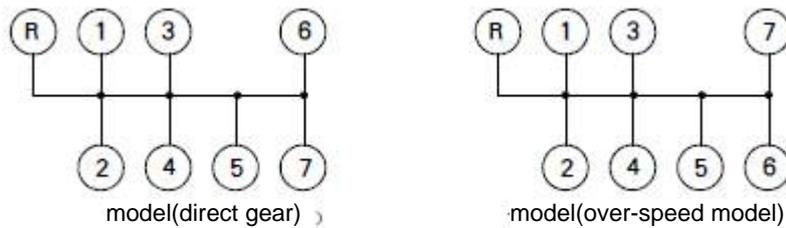


Figure 6-6 Gear Position Diagram of 7JS Series Transmission

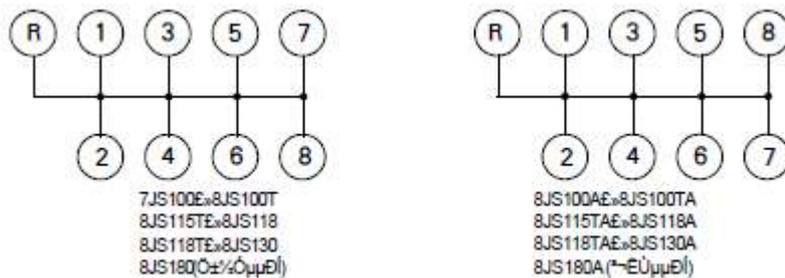


Figure 6-7 Gear Position Diagram of 8JS Series Transmission

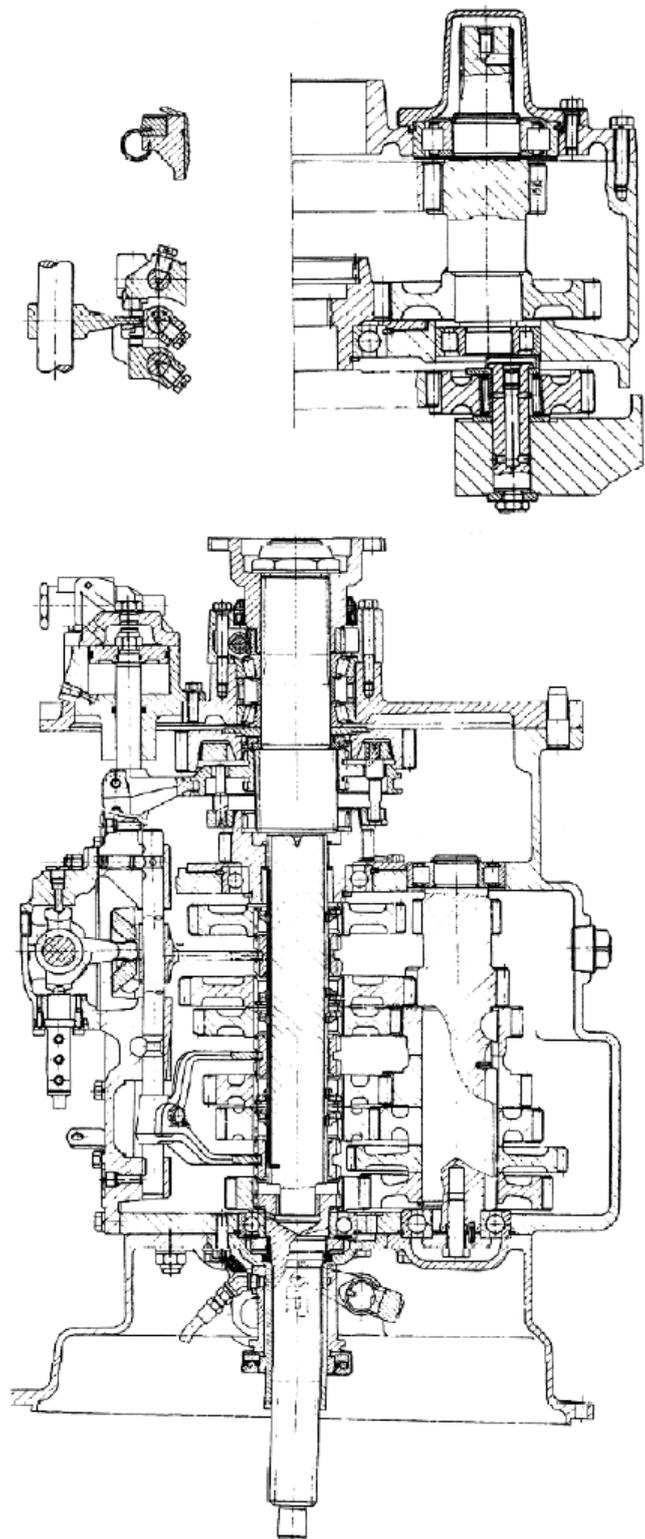


Figure 6-8 Schematic of 9JS Series Transmission Structure without Synchronizer

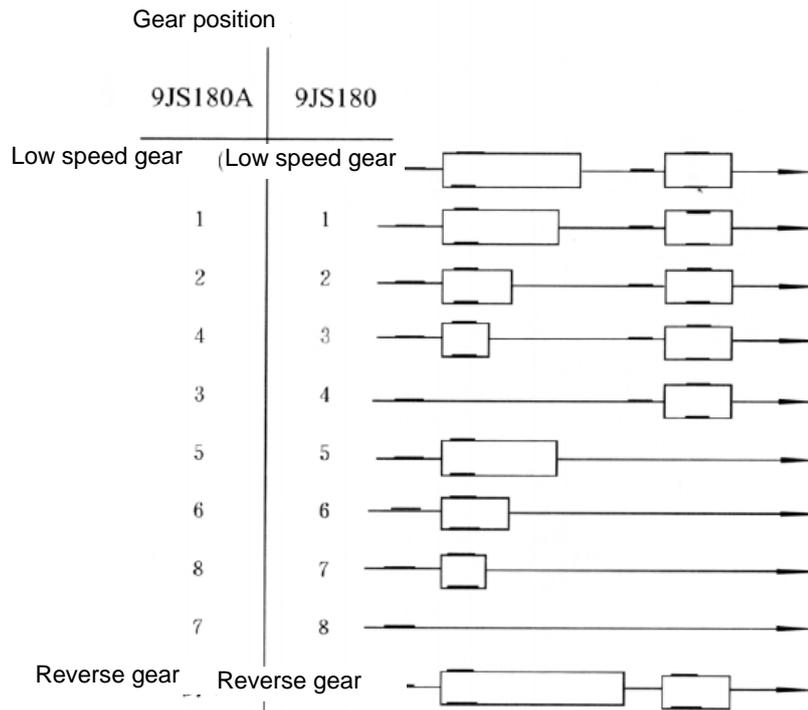
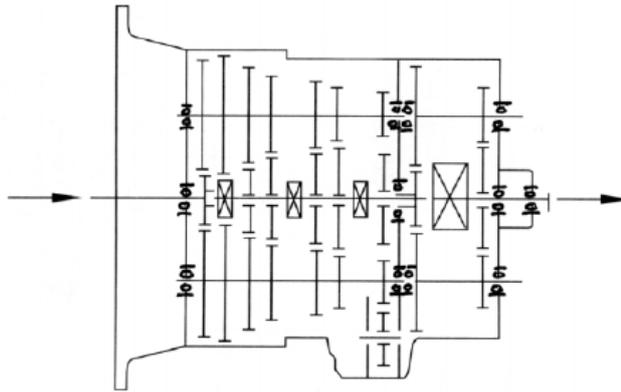
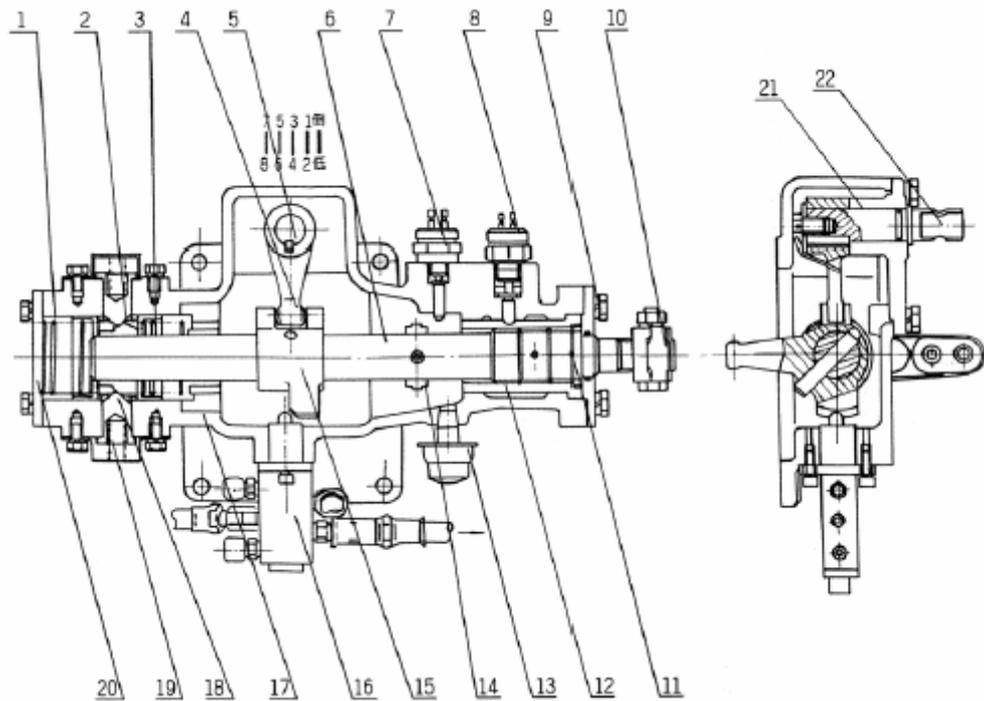


Figure 6-9 Transmission Diagram of 9JS Series Transmission

There are 3 gearshift control mechanisms for 9JS series transmission: single lever double-H remote controlled gearshift mechanism, double-lever double-H remote controlled gearshift mechanism and direct gas valve controlled single H gearshift mechanism.

The so-called "single lever double-H remote controlled gearshift mechanism" is mentioned above, the gear shifting of primary transmission and the control of double-H gearshift valve of secondary transmission are completed by one gearshift shaft. Its structure is as Figure 2-10. RT (RT0) series and 7JS and 8JS series transmissions all adopt this kind of gearshift mechanism basically.

The gearshift shaft action of the so-called “double-lever double-H remote controlled gearshift mechanism” is controlled by two sets of levers or soft shafts. The structure is as in Figure 6-10. The difference between the double-lever double-H gearshift mechanism and single lever double-H gearshift mechanism is a gearshift lever 4 added in gearshift mechanism. In this way, the transmission of gearshift shaft 6 is controlled by a gearshift lever out of transmission through gearshift crankarm 10 only; shift on/off the gear of primary transmission is realized by the swing the gearshift lever forward and backward. And the other lever (or soft shaft) controls the gearshift lever 4 to move the gearshift lever 15 left and right through the selector shaft 22 to realize the gear shifting. Obviously, the high/low speed gearshift operation of secondary transmission is realized by the lever (or soft shaft) to move right and left of gearshift lever 15 and control double-H gearshift valve 16. Obviously, it has certain linkage between the two levers of transmissions, and link mechanism is mounted outside the transmission.

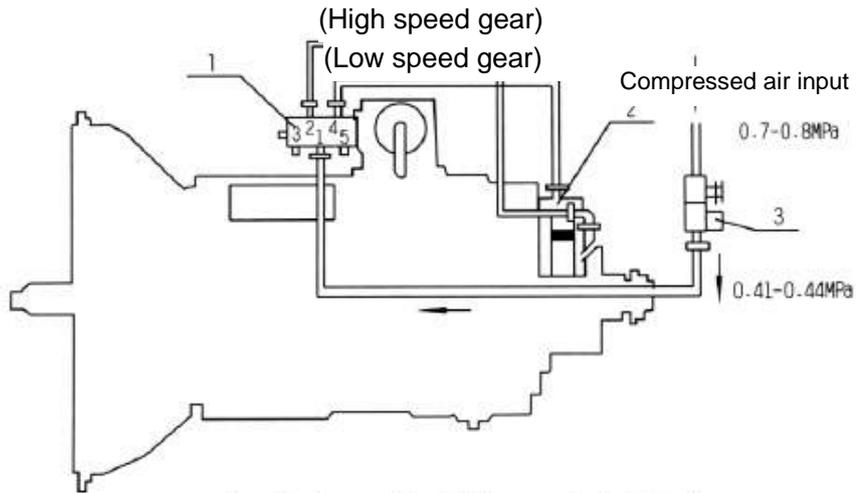


1.3. Balance spring 2. Positioning ring 4. Gearshift lever 5. Plane key 6. Gearshift shaft 7. Reverse gear indicator 8. Neutral switch indicator 9. Baffle 10. Gearshift crankarm 11. Gearshift connector 12. Spline housing 13. Breather plug 14. Reverse gear switch control block 15. Gearshift lever 16. Double-H air valve 17. Double-H control mechanism housing 18. Positioning plunger 19. Compression spring 20. Side plate 21. Window cover 22. Gear selector shaft

Figure 6-10 Double-lever Double-H Remote Controlled Gearshift Mechanism

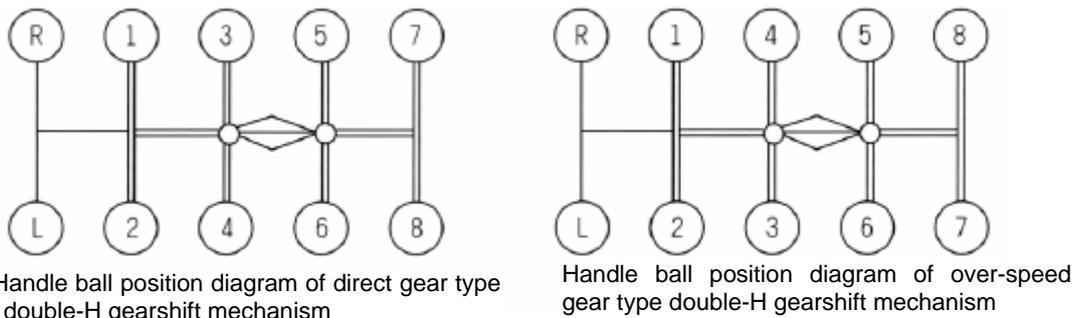
Figure 6-11 is the air route diagram of “single lever” or “double-lever” double-H gearshift mechanism. The structure of double-H gearshift valve and gearshift cylinder (including neutral gearshift cylinder used in engineer truck) is the same as “RT11509C transmission” introduced in Section I .

Figure 6-12 is the operation handle gear position diagram of (single lever or double levers) double-H gearshift mechanism for 9JS series transmission.



1. Double-H air valve 2. Range speed gear cylinder 3. Air filter regulator

Figure 6-11: Gas Route Diagram of Double-H Gearshift Mechanism



Handle ball position diagram of direct gear type double-H gearshift mechanism

Handle ball position diagram of over-speed gear type double-H gearshift mechanism

Figure 6-12 Gear Position Diagram of Double-H Gearshift Mechanism Lever Ball of 9JS Series Transmission.

From the Figures, the unique difference between direct gear model transmissions (9JS119; 9JS119T; 9JS135; 9JS135T; 9JS150; 9JS150T; 9JS180; 9JS220; 9JS180T; 9JS220T; 9JS240T; 9JSS180; 9JSS220; 9JSS260 etc) and over-speed model transmissions (9JS119A, 9JS135A, 9JS180A, 9JS220A, 9JS180TA, 9JS200TA, 9JS240TA etc) is the different position of high speed gear on 7th/8th speed gear. 9JS series with over-speed transmission produced recently has been added a direction turning mechanism on 7th/8th speed gear in order that the gear position for over-speed transmission control lever is the same as direct gear position completely, which is convenient for driver's operation.

There is an insert gearshift mechanism "air controlled valve single H" for 9JS series transmission as well.

As Figure 6-13, a pre-selective valve 1 is assembled on gearshift lever ball in the gearshift mechanism; two-position 3-way directional control air valve 4 is controlled by the air valve. Single H gearshift block is controlled by gearshift lever directly to determine the gear position of primary transmission, secondary transmission high/low speed gear is controlled by pre-selective valve through directional control air valve 4. Concretely, transmission gearshift lever is available for 1st/2nd/3rd/4th speed gear when pre-selective valve switch is at "low speed gear" position, transmission gearshift lever is available for 5th/6th/7th/8th speed gear, when pre-selective valve switch is at "high speed gear" position. 7th/8th speed gear is just contrary to the transmission equipped with both the "direct gear" and "over-speed gear".

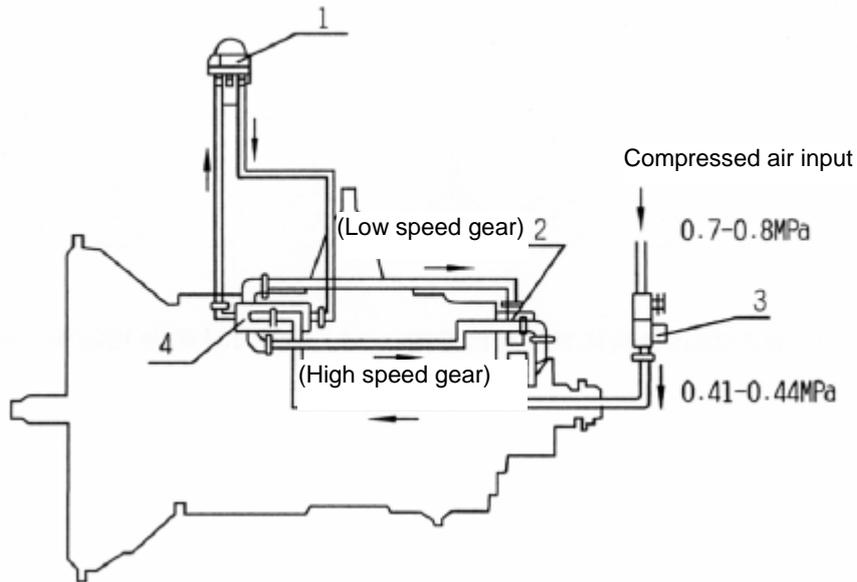
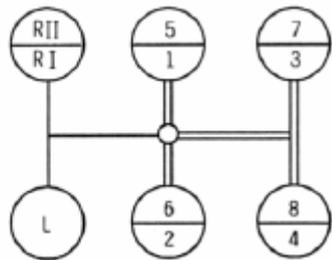
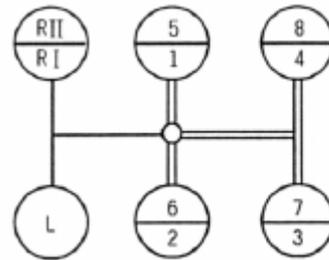


Figure 6-13 Gear Position Diagram of Air Valve Controlled Single H Gearshift Mechanism



Gear position diagram of direct gear type single H gearshift mechanism



Gear position diagram of over-speed gear type single H gearshift mechanism

Figure 6-14 Air Route of Air Valve Controlled Single H Gearshift Mechanism

On the basis of 9JS series transmission, 10JS series transmission which has 10 forward speeds and high/low two reverse gears will be formed in case that structure of so-called “high speed gear creeping gear” and “high speed reverse gear” are reserved, it means that the combination of primary transmission which has 5 forward gears and a reverse and secondary transmission which has high /low speeds are reserved. Therefore, the main structure of 10JS series transmission and 9JS series transmission are same completely.

On the basis of 9JS series transmission, a set of transmission gears are added in the primary transmission to form into 12-speed transmission, it is 12JS series transmission.

As Figure 6-15, 12JS series transmission is combined with a primary transmission which has 6 forward gears and one reverse and a secondary transmission which has high/low speed gear, 12 forward gears and 2 reverse gears. Certainly, primary transmission and secondary transmission are double-countershaft structure. 12JS series transmission is equipped with full synchronizer, double-cone inertia lock ring synchronizer is used for primary transmission, strengthened lock ring synchronizer is used for secondary transmission, synchronous property is good and it is easy to shift with good feeling.

Remote controlled single gearshift mechanism is used for 12JS series transmission

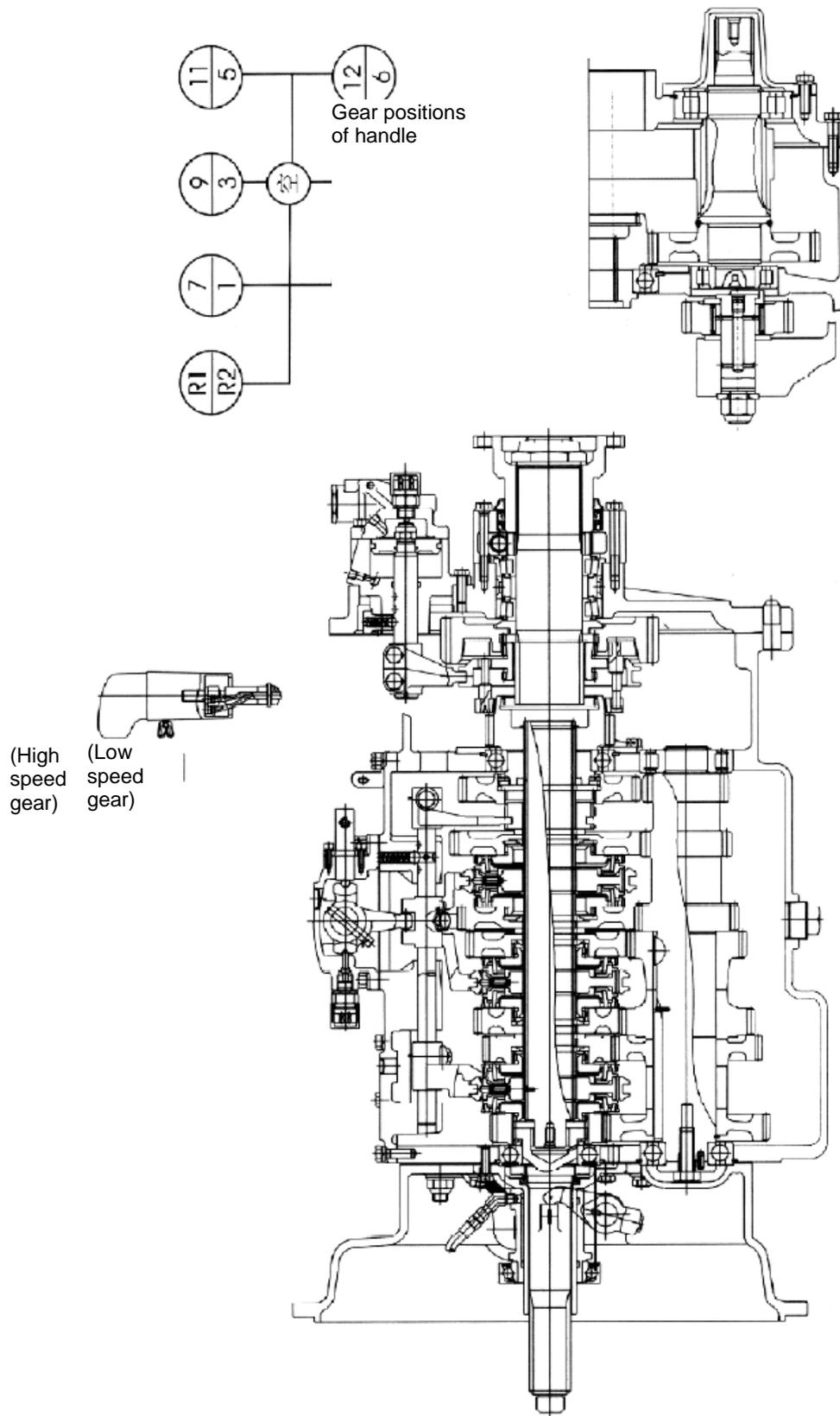


Figure 6-15 Structure Diagram of 12JS Series Transmission

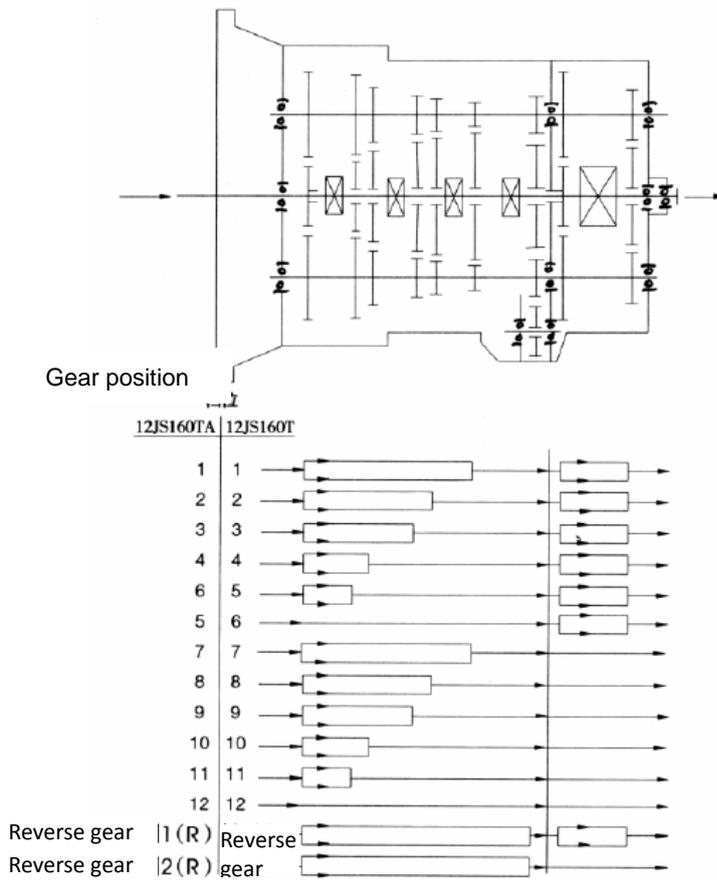
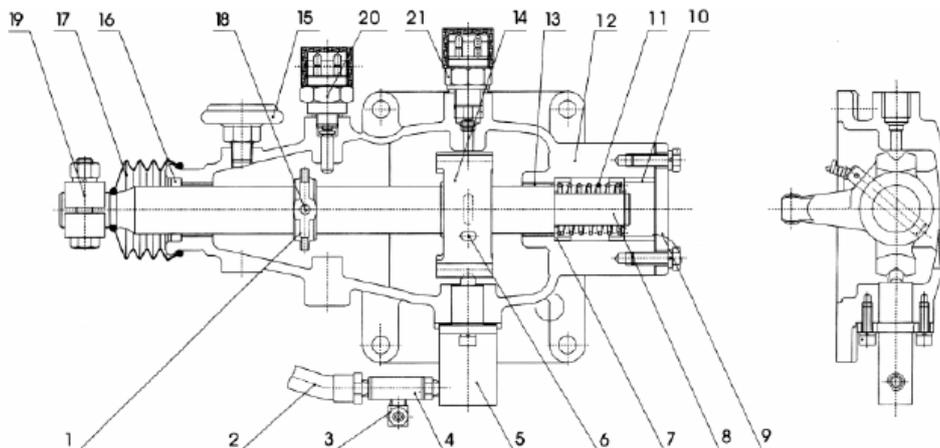
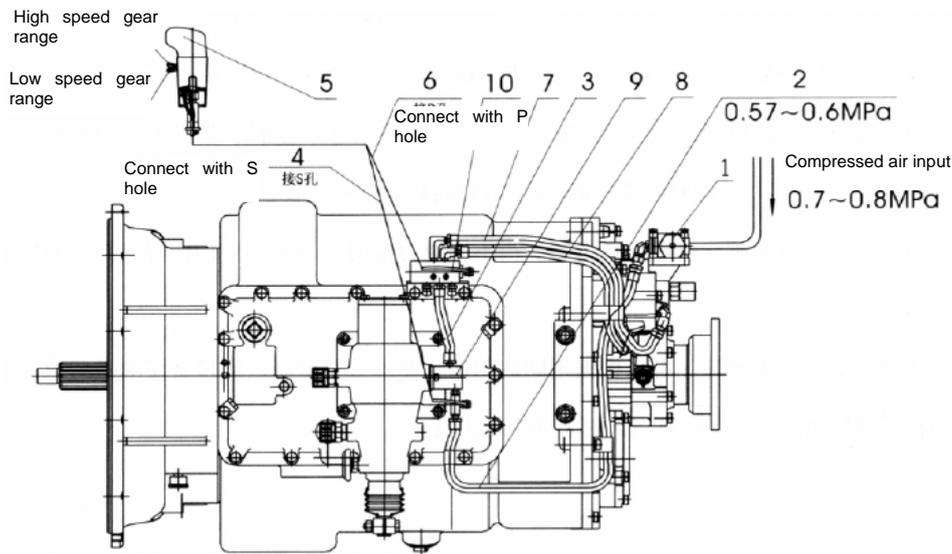


Figure 6-15-1 Driving Diagram of 12JS Series Transmission



1. Low speed /reverse switch control module
2. Air tube assembly
3. 90°fast-change connector
4. 3-way connector
5. Air route control valve
6. Cylindrical pin
7. Spring seat
8. Gearshift shaft
9. Lateral plate
10. Stop sleeve
11. Compression spring
12. Control mechanism housing
13. Gearshift shaft gasket
14. Gearshift lever
15. Breather plug
16. Oil seal
17. Housing
18. Elastic cylindrical pin
19. Gearshift crankarm
20. Reverse switch
21. Neutral switch.

Figure 6-16 Structure Diagram of Single H Gearshift Mechanism



1. Air filter regulator 2. Main air tube 3. Internal air tube 4. Control air input tube 5. gearshift handle
 6. Control air output tube 7. High speed gear air tube 8. Low speed gear air tube 9. Air route control valve 10. Air directional gearshift valve.

Figure 6-17 Air Route Diagram of Single H Gearshift Mechanism

The so-called "Single H" gearshift mechanism is the gearshift mechanism with three lines of gearshift blocks. As Figure 6-16, control lever of transmission makes gearshift shaft 8 swing backward and forward and move from right to left laterally through a series of linkages to operate gearshift crankarm 19, gear shifting is achieved by traverse movement of gearshift shaft, the gear is shifted ON/OFF by swinging the gearshift lever 14 forward and backward.

There are three lines of parallel gearshift blocks excluding reverse block in gearshift mechanism, respectively, 1st -2nd speed (7th -8th speed gear) gear block, 3rd -4th speed gear (9th -10th speed gear) block, 5th -6th speed gear (11th -12th speed gear) block. So, it is called as single gearshift mechanism.

Transmission gearshift procedure, as shown in Figure 6-17, pre-selective switch of gearshift handle 5 should be set down to low speed range before starting, air way control valve 9 opens when transmission is at neutral position, compressed air comes into the air input connector of gearshift cylinder low speed gear via air route directional control valve 10, gearshift cylinder makes secondary transmission at low speed gear. And then, as the vehicle is running normally, transmission gearshift lever can be set at 1st -2nd -3rd -4th -5th -6th speed gear. Press down clutch pedal from 6th to 7th speed gear, move the lever to neutral position from 6th speed gear at first, and then move the pre-selective switch of handle up to "high speed gear", at this time, pre-selective switch changes the direction of gearshift valve 10, air supplies into the high speed gear connector of gearshift cylinder, air returns from low speed gear connector, and secondary transmission is shifted into high speed gear by gearshift cylinder, at last, move gearshift lever to 7th speed gear. Hereafter, 7th -8th -9th -10th -11th -12th speed gear is available by shifting the gearshift lever only during acceleration.

Similar as double-H gearshift mechanism, do not operate too rapidly and frequently when single gearshift mechanism moves from 6th speed gear to 7th speed gear or from 7th speed gear to 6th speed gear, namely from 6th speed gear to neutral position, set pre-selective valve switch at high speed gear position at first, one moment later, move gearshift lever to 7th speed gear after secondary transmission at high speed gear. The same time interval is necessary for changing from 7th speed gear to 6th speed gear in order to avoid gear shifting happening on main and secondary transmissions at the same time, secondary transmission will be damaged if clutch release operation is too fast.

Special attention shall be taken as follows: the single gearshift mechanism is still range speed transmission although it changes high/low speed gear by pre-selective switch, it means that gear increase or decreasing must perform by sequence as 1st-2nd-3rd-4th-5th-6th-7th-8th-9th-10th-11th-12th speed gear, and it is different from insert transmission which is allowed to shift from 1st speed gear to 7th speed gear directly.

Specially note: although the assembly position is the same, the function of air route control valve 9 for single gearshift mechanism (Figure 6-17) and double-H gearshift mechanism are not the same at all. Double-H gearshift valve is a two-position 4-way valve which controls the gearshift cylinder to shift the high/low speed gear directly. And air route control valve 9 of single gearshift mechanism is a two-position 2-way valve; compressed air can be supplied to air route directional valve 10 by this valve, then realize the secondary transmission high /low speed gear when the primary transmission is at neutral position. Therefore, it is a protection device only.

There is another difference from double-H gearshift mechanism, 0.7~0.8Mpa air pressure is filtered and adjusted to 0.57~0.6Mpa for gearshift air route by air filter regulator 1 of single H gearshift mechanism (Figure 6-17)

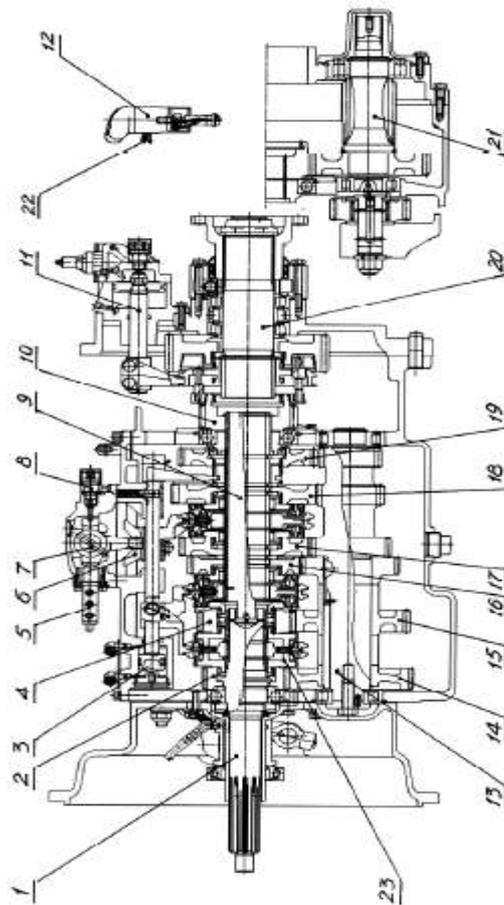
Secondary transmission gearshift cylinder structure of 12JS series transmission is the same as the models above completely.

Fast Gears Co., Ltd has developed 16JS series transmission in succession to improve truck starting performance and operation.

As Figure 6-18 and Figure 6-19, 16JS series transmission is built by adding a front semi-gear mechanism on the basis of structure of 8JS series transmission. For front semi-gear mechanism, there are two driving gears fitted on the input shaft, there are two driven gears fitted on the secondary transmission, then form into two sets of driving and driven gears for power transmission. There is a synchronizer gearshift mechanism in the middle of two input shaft driving gears, different gear ratios are realized by the combination of synchronizer sliding sleeve and different driving gears, and original transmission gears have been extended one time because the gear ratio difference between the two sets of driven and driving gears of input shaft and output shaft is smaller. Therefore, forward gears can be operated among all gears. In details, 16JS series transmission which has 16 forward gears and two reverse gears is an insert transmission combined by a primary transmission that has 4 forward gears and one reverse gear, a secondary transmission that has high /low speed gears and a front secondary transmission that has a high semi-gear and a low semi-gear. The primary transmission, front semi-gear secondary transmission and back secondary transmission all adopt double-countershaft in structure.

As Figure 6-18, input shaft of 16JS series transmission has been assembled with two main driving gears, driving gear 4 of high semi-gear of input shaft and driving gear 2 of low semi-gear, correspondently, there are a high semi-gear driven gear 15 and a low semi-gear driven gear 14 on the two countershafts. The synchronizer 23 which connects with input shaft spline is assembled between two driving gears of input shaft to form into the front secondary transmission which has high/low semi-gear. "Semi-gear" means the difference of two gears' ratio is smaller, front secondary transmission is shifted by pre-selective switch on the gearshift handle 12 to control front secondary transmission gearshift cylinder 3. Apart from this, the other structure is the same as 8JS series transmission.

As there is a large gear range for 16JS series transmission, the gear ratio difference is smaller (about 1.21), therefore, the speed difference between two adjacent gears is smaller in operation, it is easy to shift the gear, the loading of synchronizer is also smaller and service life is longer. While the initial gear ratio can be bigger for improving starting and climbing performance (1st speed gear ratio is up to 17.04), more stable to start the vehicle.



1. Input shaft 2. Driving gear of input shaft semi-gear 3. Gearshift cylinder of front secondary transmission 4. Whole input shift driving gears 5. Double-H gearshift valve 6. Double-H gearshift mechanism 7. Gearshift shaft 8. Neutral switch 9. Output shaft 10. Primary transmission output gear 11. Secondary transmission gearshift cylinder 12. Gearshift handle 13. output shaft (intermediate shaft) 14. Driven gear of secondary transmission semi-gear 15. Driven gears of whole secondary transmission 16. 3rd speed gear of primary transmission output shaft 17. 2nd speed gear of primary transmission output shaft 18. 1st speed gear of primary transmission output shaft 19. Output shaft reverse gear 20. Secondary transmission output shaft 21. Secondary transmission output shaft 22. Semi-gear pre-selective switch 23. Semi-gear synchronizer of input shaft

Figure 6-18 Structure Diagram of 16JSSeries Transmission

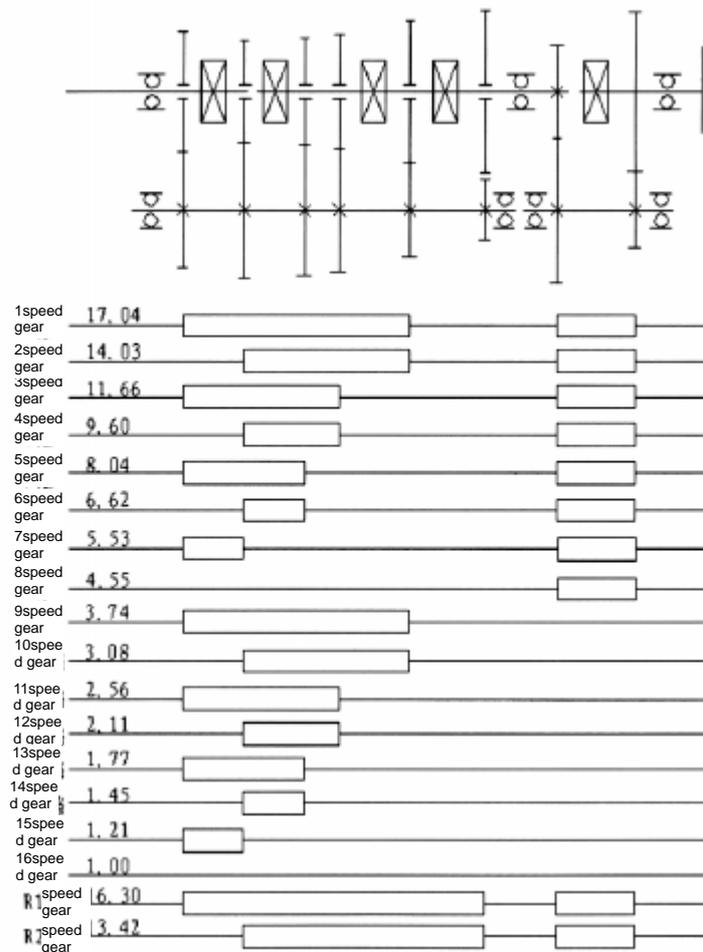


Figure 6-19 Driving Diagram of 16JS Series Transmission

Pay special attention to “alignment teeth” in assembly because 16JS series transmission is thin tooth design and the gear ratio difference between adjacent gears is small. Make the mark of “alignment teeth” carefully and assemble the parts according to the mark strictly. It is easy to make a mistake if you are careless. Occasionally, assembly is possible when the teeth is not aligned exactly, and input shaft can be rotated after assembly, however, serious damage will happen after the transmission is assembled in the vehicle and driven by engine. It means that there is problem in “teeth alignment” in case that it is very difficult to align intermediate shaft with bearing internal hole in primary transmission secondary shaft. Check carefully if the operation is smooth after the transmission assembly.

Gearshift system of 16JS series transmission is composed of two sets of mechanisms. One of them is to shift main and secondary transmissions, single lever or double-lever remote controlled double-H gearshift device which is same as RT11509C, 8JS series transmission gearshift device, transmission gearshift shaft is controlled by shift lever through connecting rod, gearshift shaft swings forward and backward, and primary transmission is shifted directly by moving the double-H gearshift block through the gearshift lever. Shift selection is operated by moving the gearshift shaft left and right, then control the double-H gearshift valve 1 (as Figure 6-20) and shift high/low speed gear of secondary transmission by secondary transmission gearshift cylinder 2. Operational air pressure of the device is 0.67~0.71Mpa.

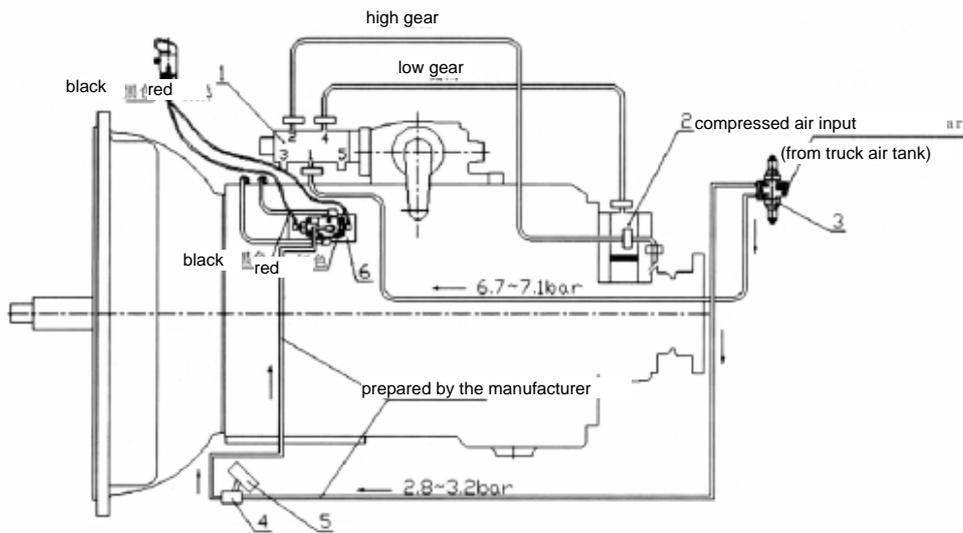


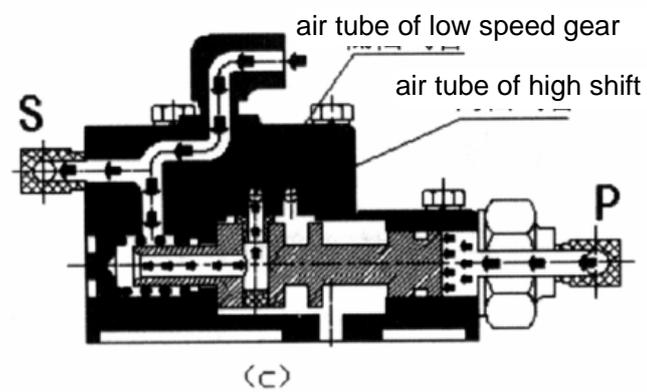
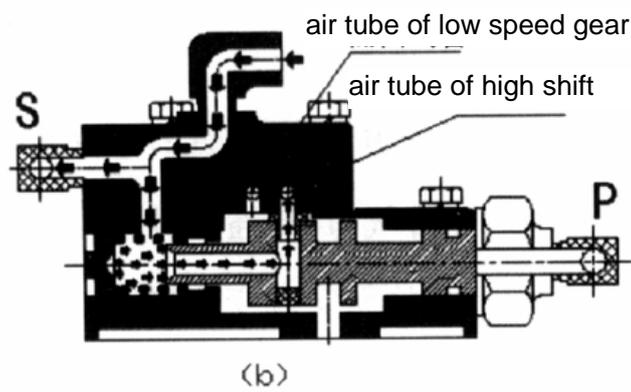
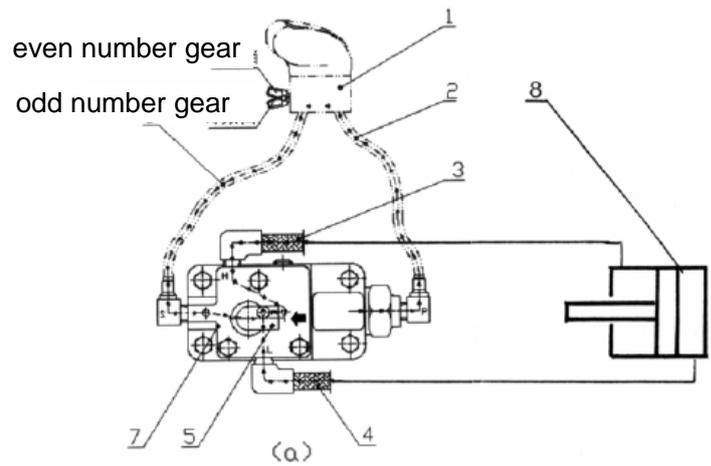
Figure 6-20 Air Route of 16JS Series Transmission Operation System

1. Double-H gearshift valve 2. Sub- gearshift cylinder 3. Air filter regulation valve 4. Clutch switch valve 5. Clutch pedal 6. Front sub- gearshift valve

Another one is front secondary transmission gearshift device controlled by shifts selecting switch. As Figure 6-20, the device is composed of pre-selective valve, front secondary transmission gearshift valve 6, clutch switch valve 4 and front secondary transmission gearshift cylinder. Figure 6-20 shows the operation principle of front secondary transmission gearshift valve. Air pressure has been reduced to 0.28~0.32Mpa by air filter regulation valve 3, and then connects with front secondary transmission gearshift valve 6 through clutch switch valve 4. Gearshift valve 6 which connects with front sub- gearshift cylinder by two output pipes is controlled by pre-selective valve on the lever.

Clutch switch valve 4 opens; compressed air goes to gearshift valve 6 and then to pre-selective valve when driver presses down clutch pedal. At this time, pre-selective switch shuts off when pre-selecting valve is set up to "even number shift", as Figure 6-21, gearshift valve core is moved right to the place as shown in Figure 6-21(b), compressed air goes to high gear air pipe 3 under the action of gearshift valve, and front gearshift cylinder 8 piston is moved right to combine synchronizer sliding sleeve of input shaft with high semi-gear gear, in this way, the vehicle is running at variable speed gears at high speed gear range. In case of pressing down clutch pedal, pre-selecting valve opens as shown in Figure 6-21 when pre-selective switch is set down to "even number gear", compressed air goes to gearshift valve "P" joint by "P" air tube, as Figure 6-21(C), gearshift valve core is moved to the left end because of pressure difference. At the moment, valve core moves compressed air to low shift air pipe 4, and compressed air of high speed gear air pipe is evacuated by gearshift valve. The piston of gearshift cylinder 8 is pushed out forward (left), input synchronizer meshes with low semi-gear of input shaft, vehicle is running at variable speeds at low semi-gear range.

The function of clutch switch valve is to ensure gear shifting of front secondary transmission, and avoid driver's wrong operation and damage result from gears' shifting under full load when clutch pedal is pressed down and separated completely.



1. Pre-selective valve 2. P air pipe 3. Air tube of high speed gear 4. Air tube of low speed gear 5. Air input tube 6. S air pipe 7. Front secondary transmission gearshift valve 8. Front secondary transmission gearshift cylinder

Figure 6-21 Working Principle of Gearshift Valve of Front Secondary Transmission

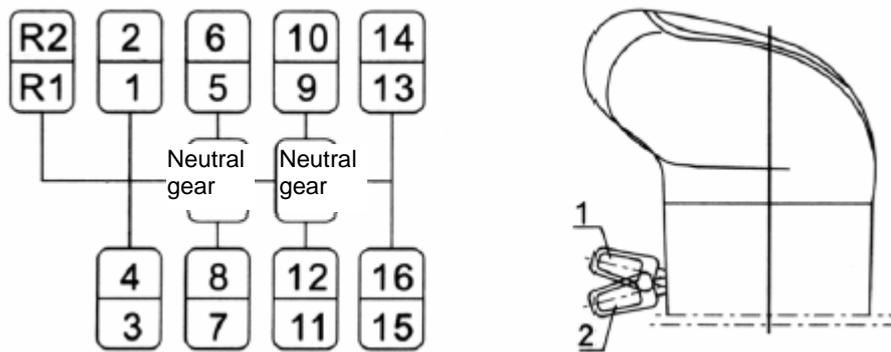


Figure 6-22 Gear Position Diagram of 16JS Series Transmission

From Figure 6-22, transmission shows even number gear range as “2nd-4th-6th-8th-10th-12th-14th-16th” gear when pre-selective switch valve is set up to position “1”, and transmission shows odd number gear range as “1st-3rd-5th-7th-9th-11th-13th-15th” gear when pre-selective switch valve is set up to position “2”. Generally, vehicle runs in even number gear range or in odd number range, while driver can operate the pre-selective valve from odd number shift to even number gear or from even number gear shift to odd number gear according to the loading variation at any gear, in another words, odd number gear and even number gear can be changed across any gear. Therefore, primary transmission and rear secondary transmission of 16JS series adopt range gear transmission design, and front secondary transmission adopts insert gear transmission design.

Attention: clutch must be released completely when primary transmission and back secondary double H gearshift mechanism of 16JS series are shifted, otherwise, synchronizer will be worn early, and this is common knowledge.

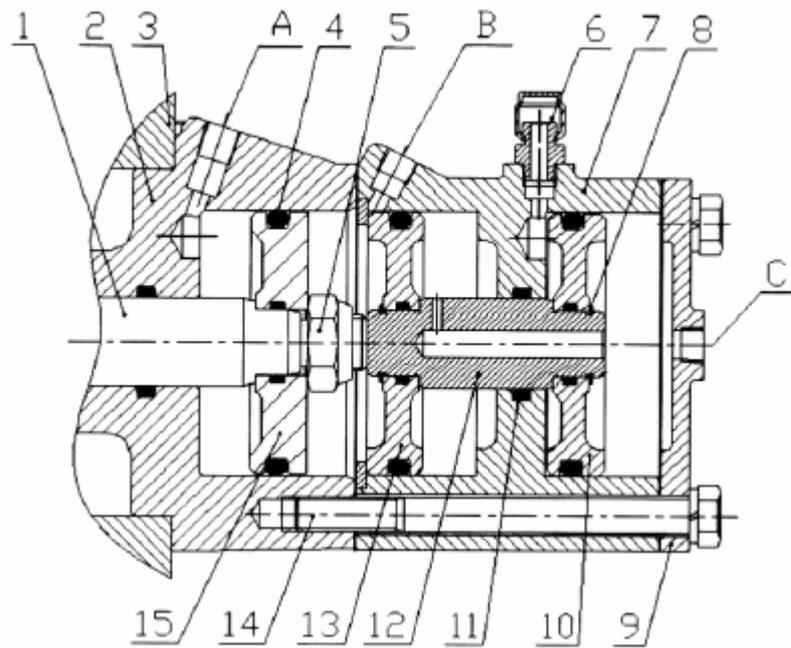
As the same reason, when front sub- pre-selective valve is shifting by air, it does not only result in synchronizer problem happening in early stage, but also cause gearshift failure because of no clutch switch valve connection when clutch pedal is not pressed completely and clutch is not released completely during gear shifting. Obviously, check the pre-selective valve, gearshift valve, and especially check clutch switch valve at first in case of front secondary transmission gearshift failure.

Public road vehicles rear secondary transmission gearshift cylinder of 16JS series and the other double-secondary transmission have no difference, and rear secondary transmission gearshift cylinder of 16JS series transmission for construction truck is different from general transmission, two middle pistons 13 and 10 are added to realize the neutral position operation, as Figure 6-23.

A three-countershaft transmission has been developed again by Fast Gear Co., Ltd in order to improve transmission output power and further reduce noise, currently, 9-speed transmissions such as 9JSS180, 9JSS220, and 9JSS260 series are launched. 120°symmetrical three –countershaft structure is used for rear secondary transmission of this series, accordingly, the structure of secondary transmission is more compact and transmission is more stable. And we believe the three or more-countershaft transmission variation will be applied to the other gear series transmission.

Fast double secondary transmission is divided into two kinds according to gearshift mechanism models, one of them is full sliding sleeve gearshift mechanism and the other one is full synchronizer structure.

Sliding sleeve gearshift is applied for all full sliding sleeve gearshift Fast transmissions. Inertia lock pin synchronizer is used for all series of Fast secondary transmissions due to air controlled gearshift of secondary transmission double-H valve, as Figure 6-24 (c)



1. Range speed gear fork
2. Range speed gear cylinder
3. Rear cover housing
4. O-ring
5. Hexagonal nylon tight nut
6. Breather plug
7. Middle cylinder
8. Shaft retainer
9. Cylinder cover
10. Middle cylinder piston
11. O-ring
12. Neutral shaft
13. Middle cylinder piston
14. Bolt
15. Range speed gear cylinder piston

Figure 6-23 Gearshift Cylinder Structure of 16JS Transmission with Neutral Gear

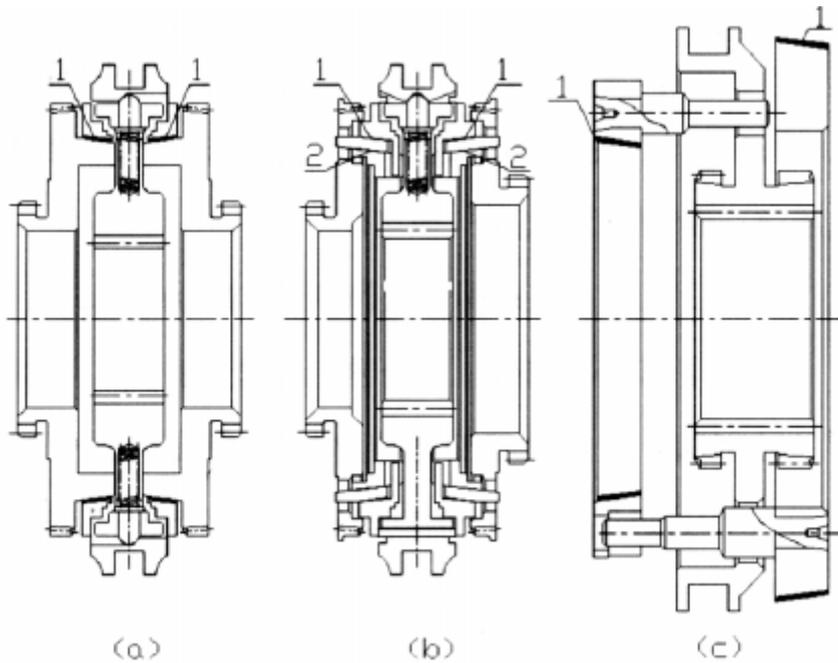
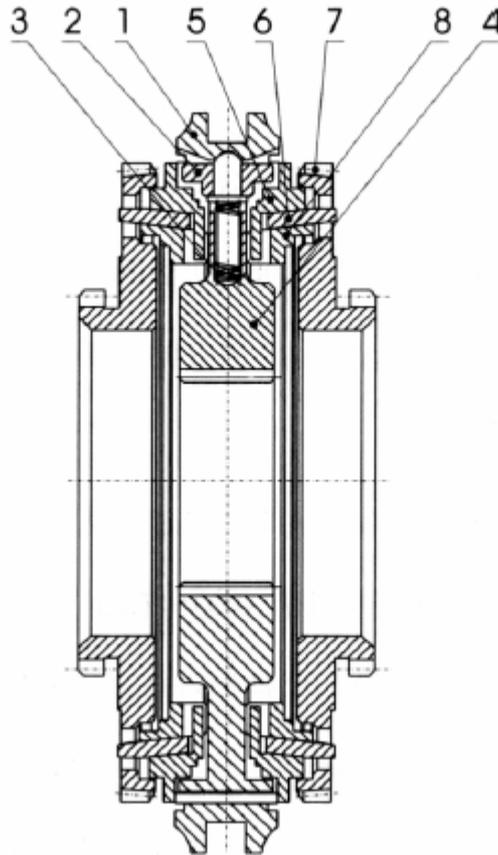


Figure 6-24 Schematic of Synchronizer Classification

Sliding sleeve gearshift is generally mainly used for 1st speed gear and reverse gear in full synchronizer gearshift transmission, the normal single face inertia lock ring synchronizer is used for 7JS-T, 8JS-T AND 9JS-T series full synchronizer transmission as shown in Figure 6-24 (a). For 12JS-T series transmission, the strengthened lock ring synchronizer is used in secondary transmission; double cone inertia lock ring synchronizer is used in the primary transmission as shown in Figure 6-24 (b). For 16JS-T series, double cone inertia lock ring synchronizer is used in the primary transmission as shown in Figure 6-24 (b); single cone face inertia lock ring synchronizer is used in front secondary transmission, as Figure 6-24 (a) the intensified lock ring synchronizer is used in the rear secondary transmission.

As Figure 6-25, the unique difference between double cone inertia lock ring synchronizer and normal lock ring synchronizer is an additional dual-face cone ring between synchronous cone and synchronous ring. The abrasive area is increased by one time during the synchronizer synchronous operation, so the synchronous function is increased by one time; it is smoother in gear shifting.



1. Sleeve 2. Tooth ring 3. Spring 4. Tooth holder 5. External cone ring 6. Dual-face cone ring 7. Cone 8. Internal cone ring

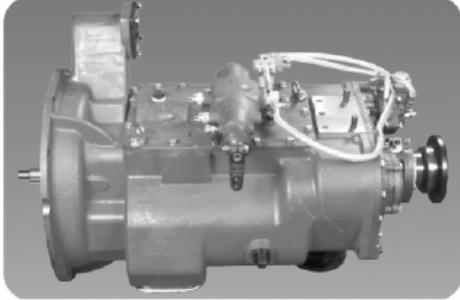
Figure 6-25 Structure of Double Cone Inertia Lock Ring Synchronizer

To match with different clutches, the specifications of JS series transmission input shafts are different. Be careful in repair when parts change is required.

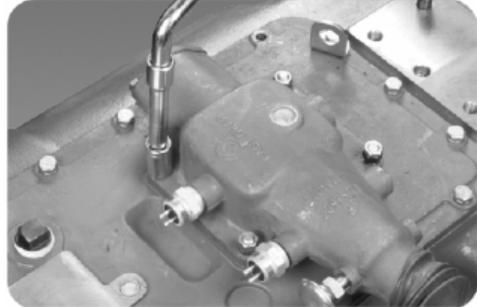
Section VII Removal and Installation of Fast 12JS Series Transmission

As there is a little difference in the structure between the 12JS series transmission and 9 gear series transmission, the removal and installation procedures are different from each other. The removal and installation procedures of 12JS series transmission will be stated in details by using the following example of 12JS200T series transmission.

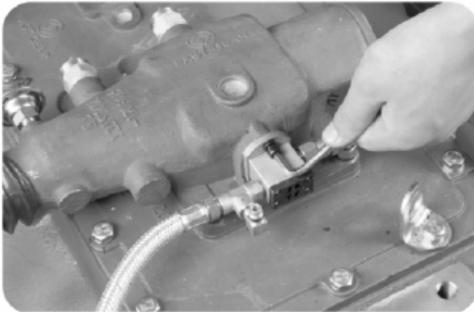
1. Removal of 12JS Series Transmission Housing



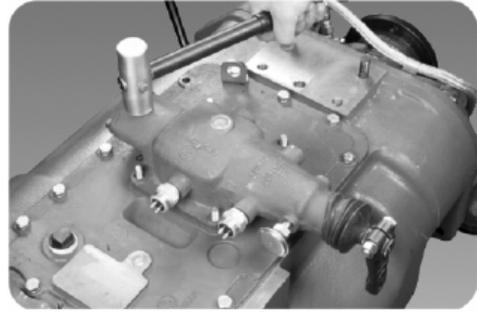
1. 12-speed transmission with single lever used for left handling.



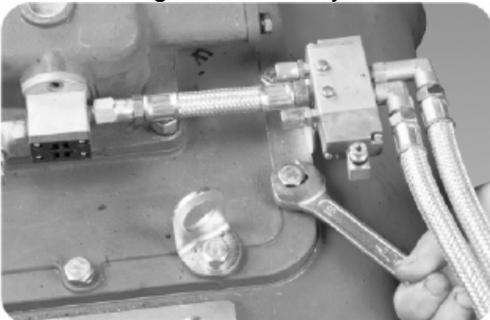
4. Remove 4 positioning nuts from the gearshift mechanism assembly



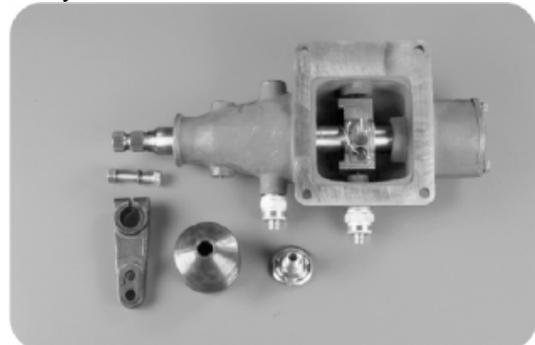
2. Remove the set screws of upper gas line control valve from the single H assembly.



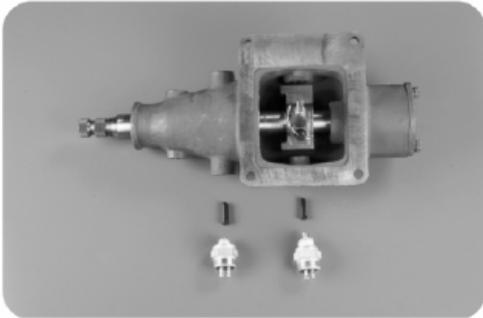
5. Tap and remove the gearshift mechanism assembly.



3. Remove the frame bolts of single H valve on the right side of upper cover.



6. Remove the rocker arm, boot and breather plug.



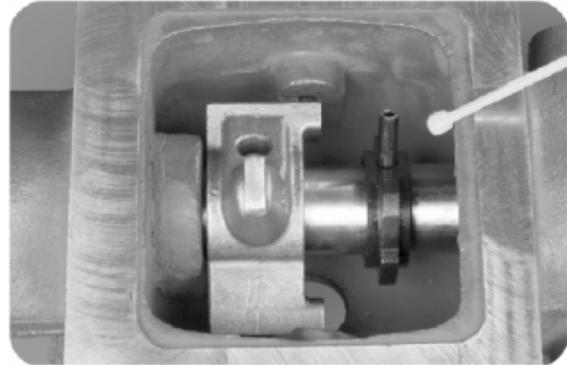
7. Remove the reverse switch, neutral switch and plug



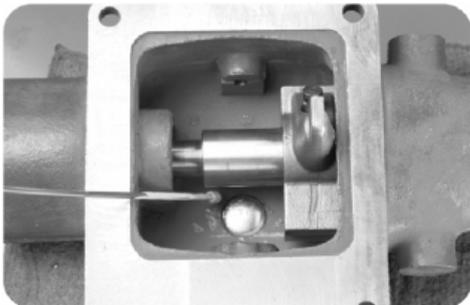
10. Remove the cylindrical pin of gearshift shifting block.



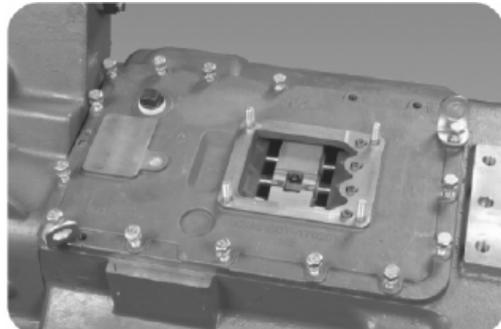
8. Remove 2 bolts on the side panel of gearshift mechanism assembly, pull out the stopping sleeve and remove the stop ring on lateral gearshift axis.



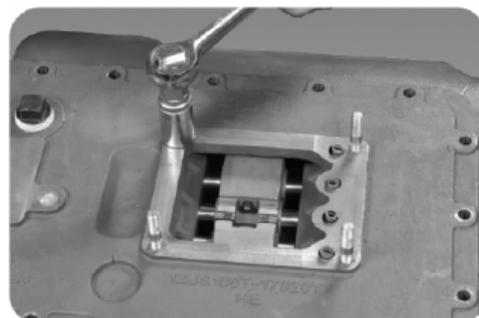
11. Remove the elastic cylindrical pin from reverse control block, and pull out lateral gearshift axis (II) **Removal of Transmission Upper Cover**



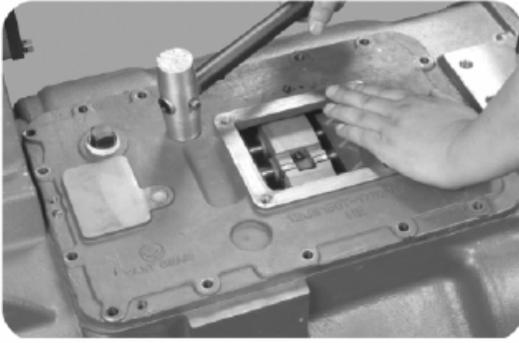
9 Turn over the gearshift mechanism housing, and remove the iron wire from bowl plug piece and gearshift shifting block.



1. Remove the bolts on the upper cover housing.

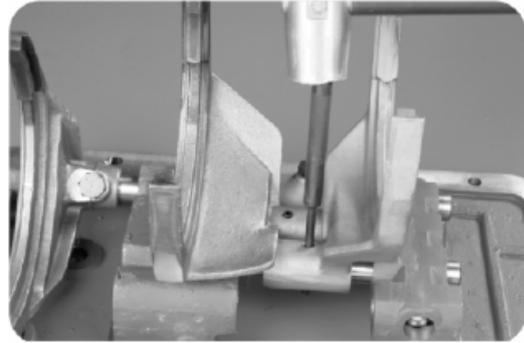


2. Remove 4 stud bolts on the upper cover housing by using special tool.

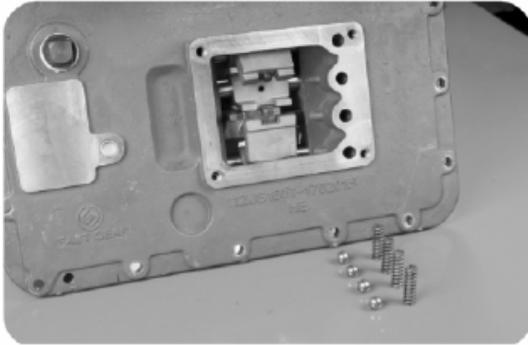


3. Tap the upper cover by copper rod to separate it from gasket.

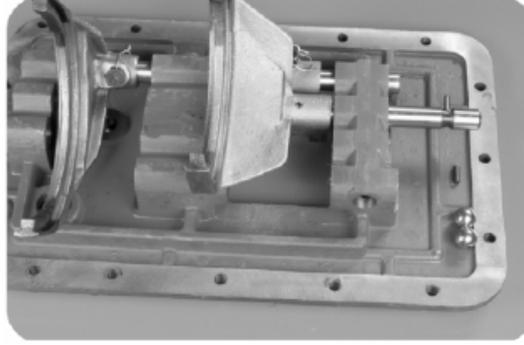
Note: Cover the spring hole by your hand while tapping to prevent the spring dropping into primary transmission.



6. Remove the elastic cylindrical pin of 1st /2nd speed gear fork, take down 1st/2nd speed gear fork and fork shaft, and take off the interlock pin on axis and the interlock steel ball in the hole



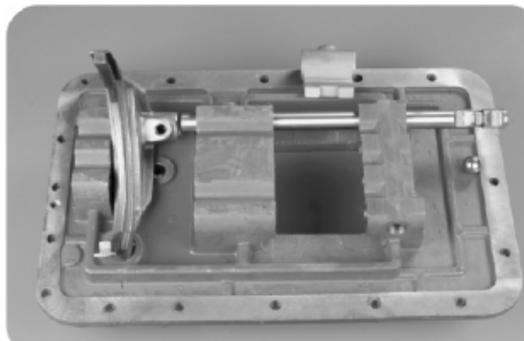
4. Take off the upper cover assembly, and remove the spring and steel ball from the upper cover hole.



7. Remove the elastic cylindrical pin on 3rd/4th speed gear fork, take down 3rd/4th speed gear fork and fork shaft, and take off the interlock pin on shaft and the interlock steel ball in the hole.

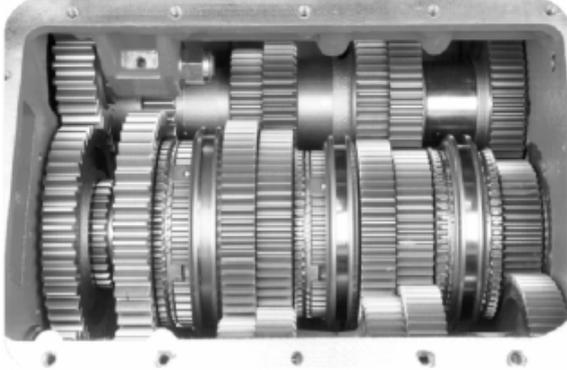


5. Turn over the upper cover assembly, and remove the reverse fork, reverse fork shaft and guide block.

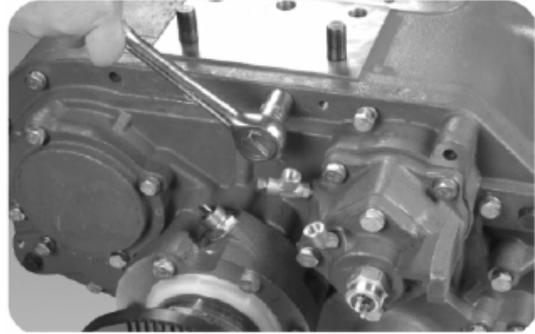


8. Remove the set screws of 5th/6th speed gear fork axis, take out the fork axis, and take off 5th/6th speed gear fork and guide block.

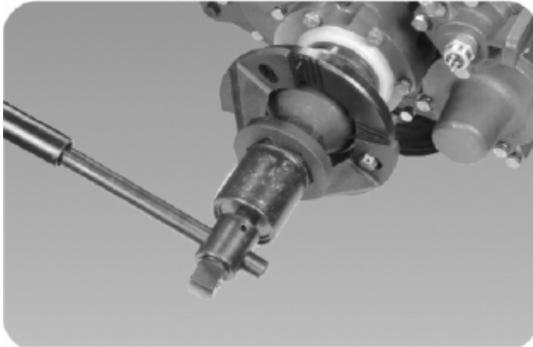
(III) Removal of Secondary Transmission Assembly



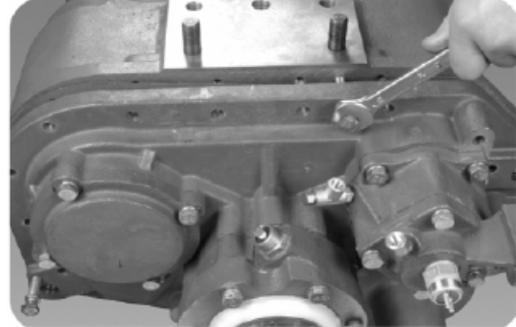
1. 2 synchronizers in the primary transmission are engaged separately with the gear.



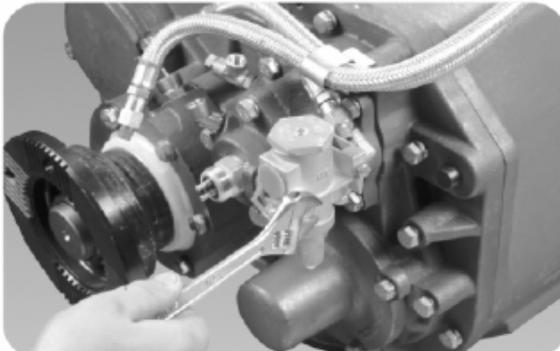
4. Remove the joint bolt connecting rear cover housing and primary transmission.



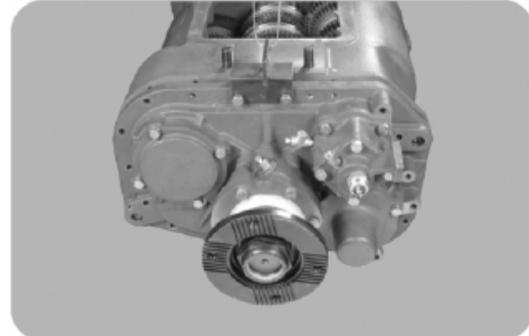
2. Screw off the flange nut on output shaft by using special wrench.



5. Push the secondary transmission assembly backwards about 10 mm by using 3 bolts.



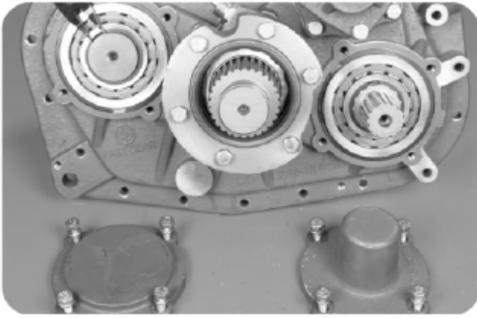
3. Remove 3 air tubes on the cylinder of secondary transmission and 2 bolts of air filter



6. Lift the lower secondary transmission assembly by using secondary transmission hanger



7. Remove the flange nuts and flange



8. Remove 2 bearing covers of output shafts, and remove the stop ring from the countershaft of secondary transmission by using snap ring pliers.



12. Remove 4 bolts on the gearshift cylinder of secondary transmission, and take off the cylinder assembly.



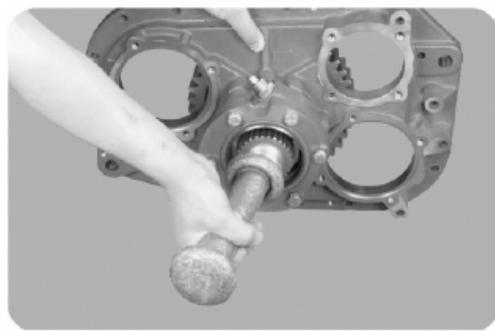
9. Tap the output shaft backwards to separate it from bearing, and take off the bearing of countershaft.



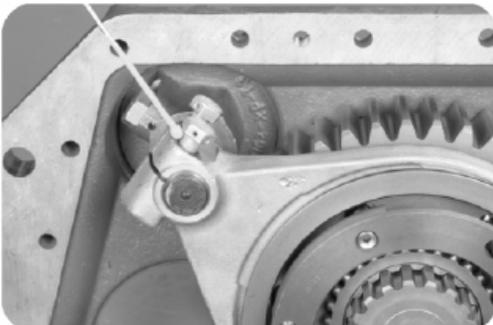
13. Take off the synchronizer assembly from the output shaft.



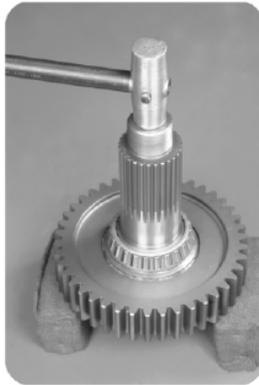
10. 2 countershafts and bearings of secondary transmission



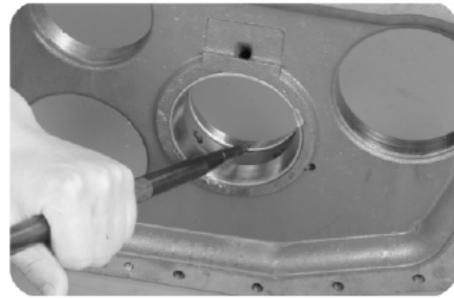
14. Tap the output shaft backwards to detach it from bearing hole.



11. Remove the joint bolt connecting the gearshift cylinder and gearshift fork in the secondary transmission.



15. Put the supporting stuff under the output shaft assembly, and remove the bearing by tapping.

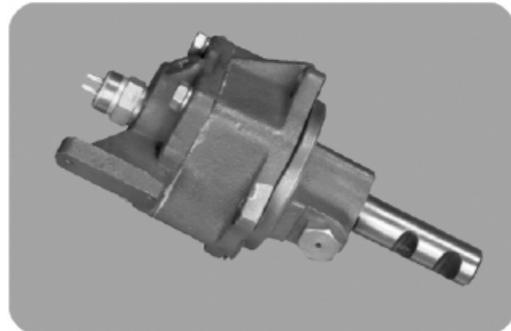


18. Take out the outer ring of combination bearing from the rear cover housing.

(IV) Disassembly of Gearshift Cylinder of Secondary Transmission



16. Components of output shaft assembly.



1. Gearshift cylinder of secondary transmission.



17. Remove the bolts on the output shaft bearing cover, take off the bearing cover, and remove the odometer joint and the drive and driven gear of odometer



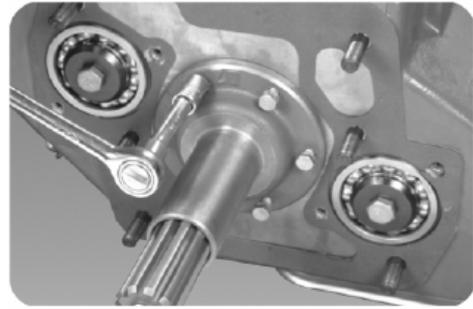
2. Remove the bolt on the side of cylinder housing, and take out the positioning spring and steel ball.



3. Remove self-locking nut on the cylinder piston, and take off the seal ring from the piston.



4. Piston of gearshift cylinder and seal ring.



2. Remove the bolt from input shaft cover, and take off input shaft cover by tapping slightly.

(V) Disassembly of Secondary Transmission Synchronizer

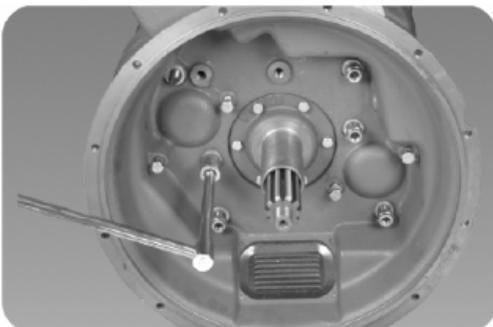


1. High/low gear tapered ring, 3 springs and sliding bush of synchronizer for secondary transmission

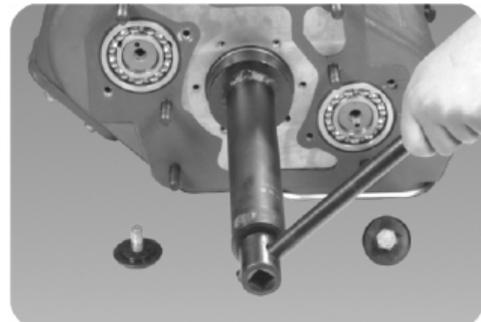


3. Engage the synchronizer of primary transmission to 2 sets of bearings individually.

(VI) Removal of Input Shaft (Input Shaft Can Be Replaced by This Way without Removing Primary Transmission)



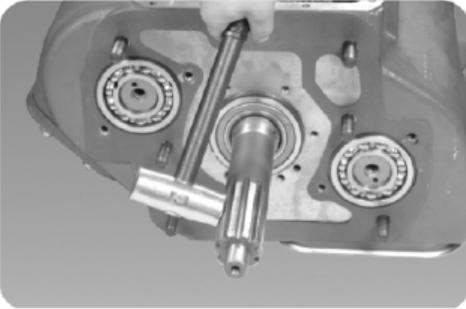
1. Remove bolts in the clutch housing, and take off the clutch housing assembly



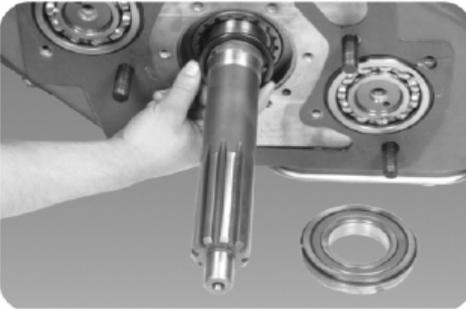
4. Remove 2 bearing baffles in the front side of countershaft for primary transmission, and remove the nut of input shaft by using special



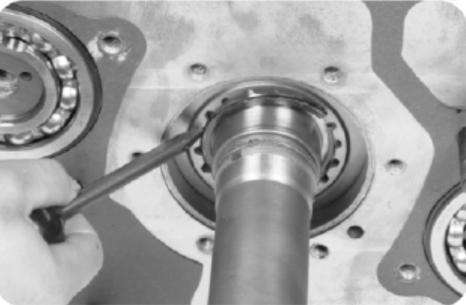
5. Tap the input shaft inwards.



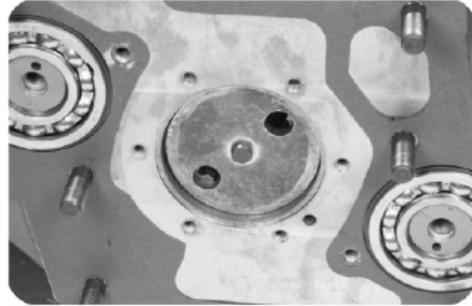
6. Tap the input shaft in left and right direction to separate the bearing from housing hole.



7. Take off the spacer of input shaft bearing.



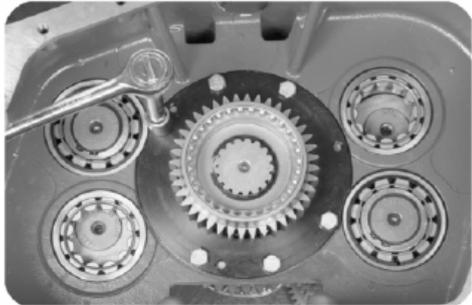
8. Remove the stop ring in the input shaft gear. Take out the input shaft.



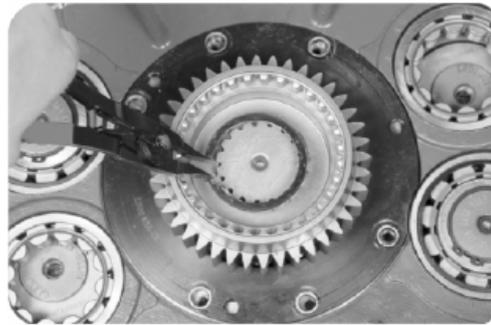
9. Hold down the input shaft gear by the baffle and one bolt (M10×1).

To prevent 5th/6th speed gear synchronize from being damaged while removing and installing, the input shaft gear should be attached to the output shaft assembly by using baffle and bolt when the output shaft assembly is removed or installed.1. This baffle can be made according to the current situation.

(VII)Removal of Drive Gear Assembly of Secondary Transmission



1. Cut off the lock iron wire of drive gear assembly, and remove 6 bolts with hole



2. Remove the snap ring inside the hole of drive gear, and take off the drive gear and positioning plate

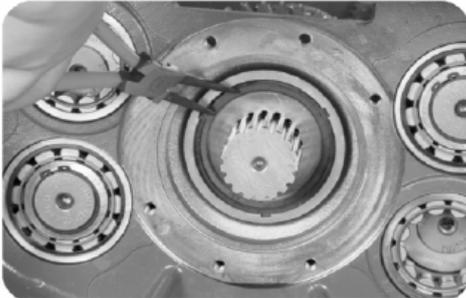


3. Take off the bearing of drive gear by tapping the bearing mount from the inside of primary transmission.

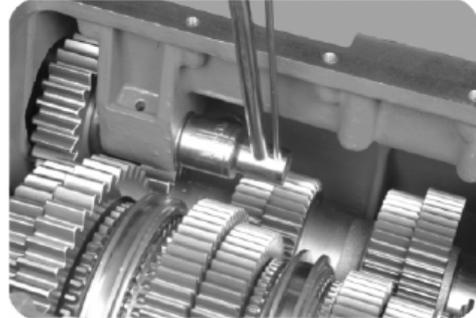
(VIII) Removal of Reverse Intermediate Gear on The Upper Side



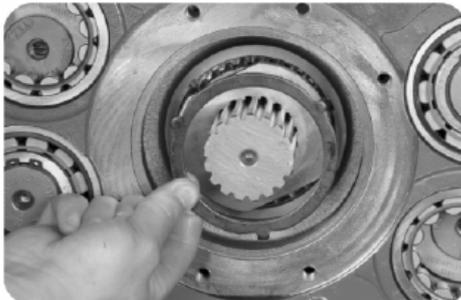
4. Take out the screw plug inside the reverse intermediate gear shaft by using screwdriver



1. Remove the snap ring inside the reverse gear of output shaft.



5. Loosen the self-locking nut on the reverse intermediate gear shaft



2. Take out shaft bearing spacer inside the reverse gear of output shaft.



6. Remove the reverse intermediate gear shaft by using the shaft pulling device.



3. Remove the front bearing of countershaft of secondary transmission by using special too

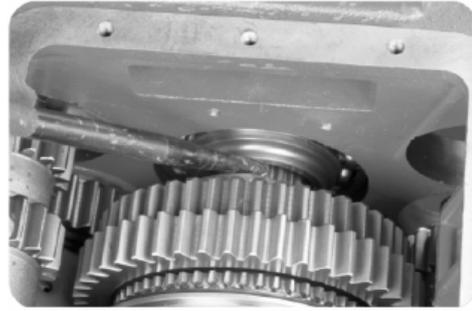


7. Components of reverse intermediate gear assembly.

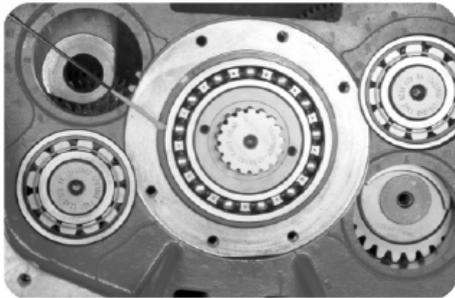
(IX) Removal of Primary Transmission



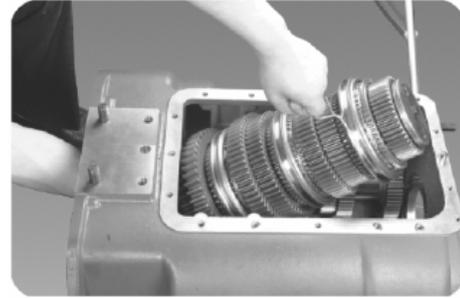
1. Remove the rear bearing snap ring of countershaft of primary transmission.



5. Remove the drive gear bearing again.



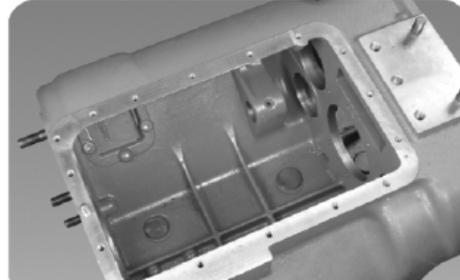
2. Install the drive gear bearing to position the rear end of output shaft.



6. Take out the output shaft assembly from primary transmission.



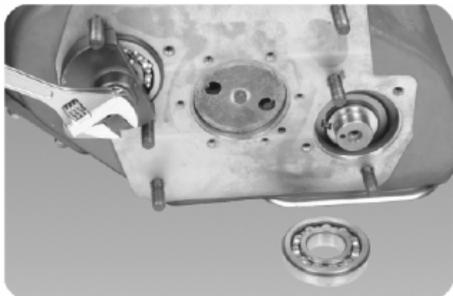
3. Remove rear bearings of 2 countershafts.



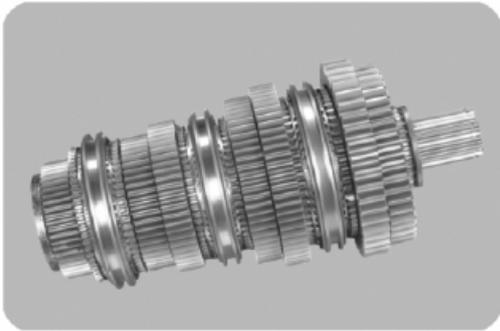
7. Take out 2 countershafts assembly from the primary transmission, and remove the reverse intermediate gear assembly.

(X) Disassembly of Output Shaft Assembly

Note: there is no thrust clearance adjusting shim as the machining accuracy can assure each gear thrust clearance for output shaft of 12 speed transmission



4. Tap the secondary transmission by using copper rod to move it back by about 10 mm, and remove the front bearings of 2 countershafts by using special tool.



II. Installation of 12JS Series Transmission

1) Installation of output shaft assembly

For the component exploded view of output shaft sub-assembly of 12JS series transmission, see the Figure 7-1.

1. Remove the baffle in the front end of output shaft assembly, and take off the input shaft gear and components in one side of 5th/6th speed gear synchronizer.



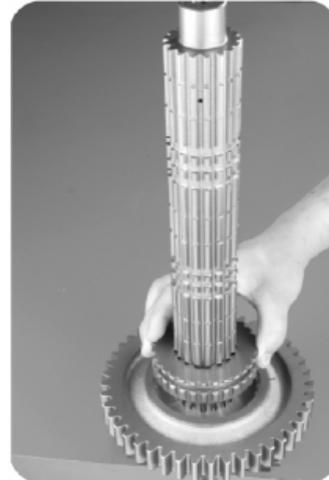
2. Remove the snap ring fixing 5th/6th gear synchronizer from the output shaft, and take off 5th/6th gear synchronizer.



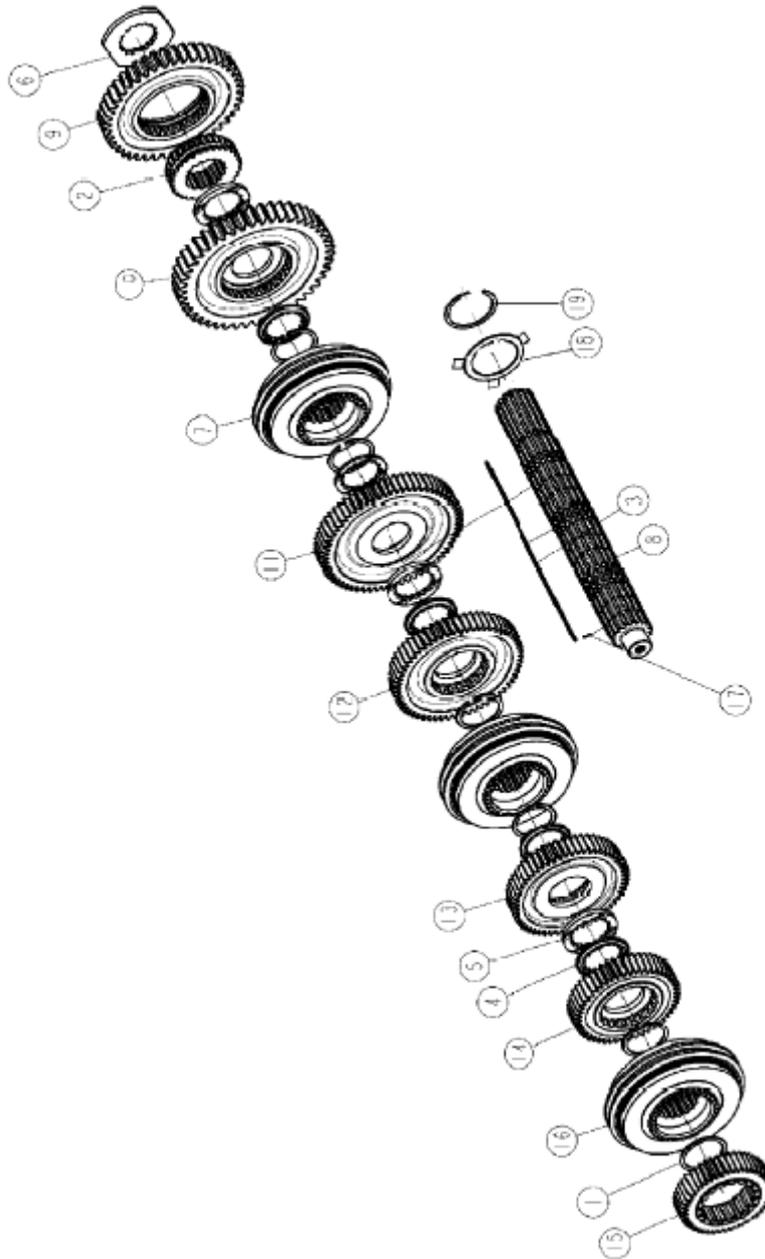
3. Pull out the elastic spring from the output shaft, take out the long key, and remove the gear and shim from output shaft in sequence.



1. Stand the small end of output shaft up on the working table, set the reverse gear shim of output shaft, and install the long key after turning it in one tooth pitch.



2. Install the reverse sliding bush of output shaft, align the tooth lack part and hole notch of output shaft with shot teeth upwards



1. Snap ring 2. Engaged Sliding sleeve 3. Hexagonal connected key of output shaft 4. Spline gasket of output shaft gear 5. Gear spacer of output shaft 6. Shim of reverse gear 7. 1st/2nd speed gear synchronizer 8. Output shaft 9. Reverse gear of output shaft 10. 1st speed gear of output shaft 11. 2nd speed gear of output shaft 12. 3rd speed gear of output shaft 13. 4th speed gear of output shaft 14. 5th speed gear of output shaft 15. Input shaft gear 16. 3rd/4th speed gear synchronizer assembly 17. Elastic cylindrical pin 18. Shaft gear shim 19. Snap ring of reverse gear

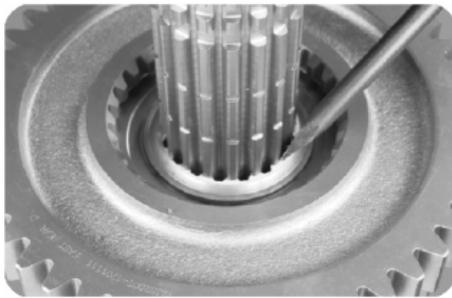
Figure 7-1 Component Exploded View for Output Shaft Assembly of 12JS Series Transmission



3. Install the gear spacer of output shaft, and install the long key up after turning it in one tooth pitch.



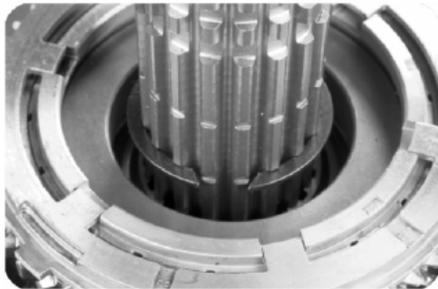
6. Install the gear hub of 1st/2nd gear synchronizer, and attach a snap ring with its opening facing the notch of output shaft.



4. Install 1st gear of output shaft into output shaft with the engaged teeth upwards, place the spline gasket with its protruding part upwards, and install the long key up after turning it in one tooth pitch.



7. Install the components which are on another side of 1st/2nd gear synchronizer, place the spline gasket of output shaft with its protruding part downwards, and install the long key up after turning it in one tooth pitch.



5. Install the components which are on one side of 1st/2nd speed gear synchronizer, attach a snap ring with its opening facing the hole notch of output shaft.



8. Install 2nd speed gear of output shaft into output shaft with the engaged teeth downwards, place the spacer of output shaft gear, and install the long key up after turning it in one tooth pitch.



9. Install 3rd speed gear of output shaft into output shaft with the engaged gears upwards, place the spline gasket with its protruding part upwards, and install the long key up after turning it in one tooth pitch.



12. Install the components which are on another side of 3rd/4th speed gear synchronizer, place the spline gasket of output shaft with its protruding part downwards, and attach the long key upwards after turning it in one tooth pitch.



10. Install the components which are on one side of 3rd/4th speed gear synchronizer, attach a snap ring with its opening facing the hole notch of output shaft.



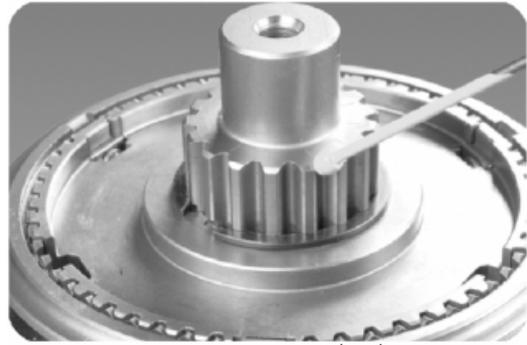
13. Install 4th speed gear of output shaft into output shaft with the engaged teeth downwards, place the spacer of output shaft gear, and install the long key up after turning it in one tooth pitch



11. Install the gear hub of 3rd/4th speed gear synchronizer, and attach a snap ring with its opening facing the notch of output shaft.



14. Install 5th speed gear of output shaft into output shaft with the engaged teeth upwards, place the spline spacer with its protruding part upwards, and install the long key up after turning it in one tooth pitch.



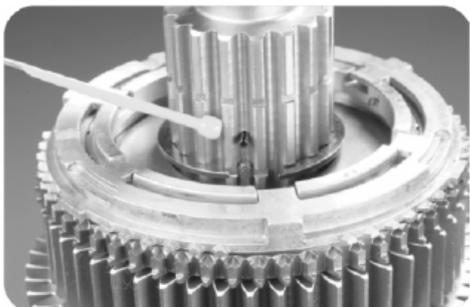
17. Install the gear hub of 5th/6th speed gear synchronizer, and attach a snap ring which is aligned with the notch of output shaft.



15. Install the components which are on one side of 5th/6th speed gear synchronizer, attach a snap ring with its opening facing the notch of 2nd shaft.



18. Install the components which are on another side of 5th/6th speed gear synchronizer, attach the input shaft gear, and place 2 matching marks of alignment toothon the two sets of teeth which are symmetrical to each other in the center axis of input shaft gear.



16. Install the elastic pin which is on the output shaft, and push the long key in position.

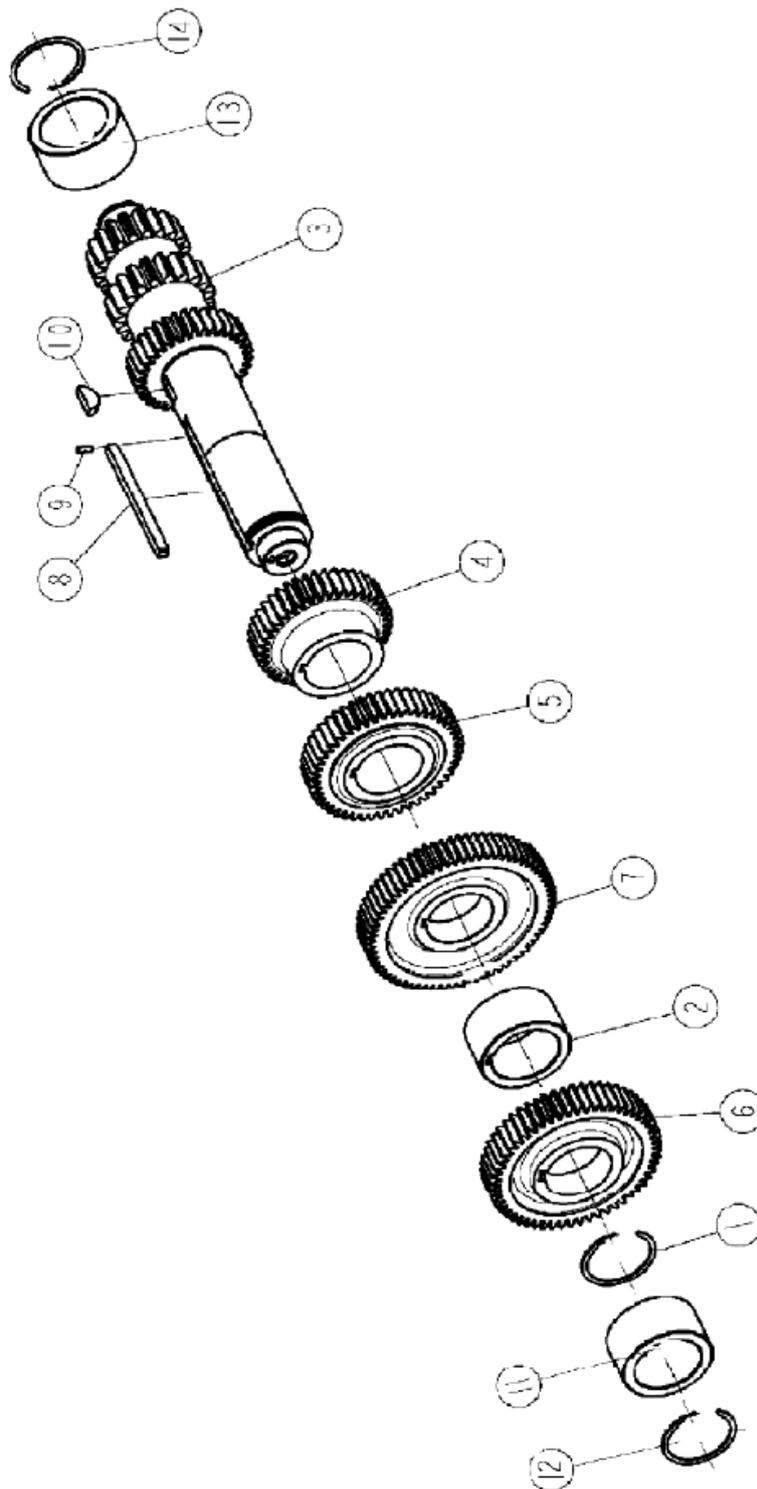


19. Fix the input gear to output shaft by using baffle.

2) Installation of output shaft assembly of primary transmission

If the gear of output shaft needs to be replaced, press down the gears of output shaft separately by using the press, and then the gear to be used should be press into output shaft separately in the installing procedures described in Figure 7-2 by using the press. Place marching marks of alignment toothon the gear facing the keyway of 2 output shafts assembly.

For the component exploded view for output shaft assembly of primary transmission, see the Figure 7-2.

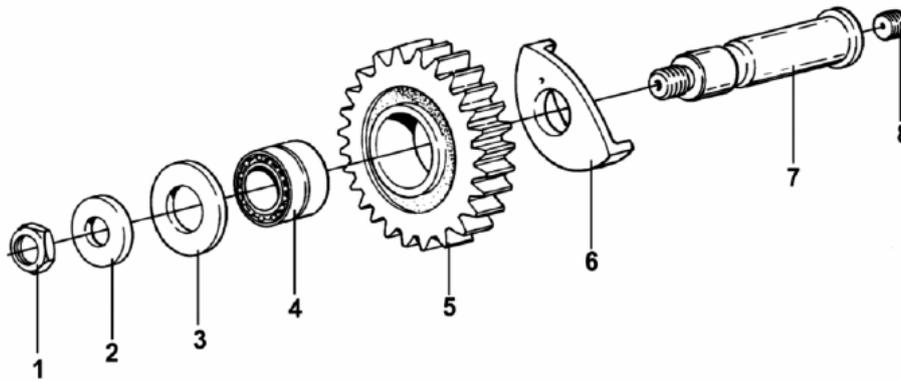


1. Snap ring 2. Spacer 3. Countershaft 4. 3rd speed gear of countershaft (Such gear is overdrive gear for 8JS100TA-B and JS130TA-B) 5. 4th speed gear of countershaft 6. Drive and driven gear of countershaft 7. 5th speed gear of countershaft 8. Squared connected key of countershaft 9. Elastic cylindrical pin 10. Semi-round key 11. Short cylindrical roller bearing 12. Snap ring 13. Short cylindrical roller bearing 14. Snap ring

Figure 7-2 Component Exploded View for Countershaft of Primary Transmission of 12JS Series Transmission

(III) Installation of Lower Reverse Intermediate Gear Assembly

For the component exploded view for reverse intermediate shaft assembly, see the Figure 7-3.



1. Reverse shaft nut 2. Washer 3. Thrust washer of reverse gear 4. Needle roller bearing 5. Reverse gear 6. Reverse shaft eccentric plate 7. Reverse shaft 8. Screw plug

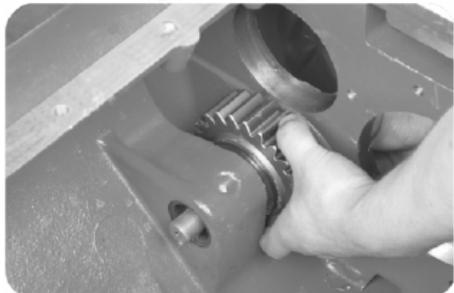
Figure 7-3 Component Exploded View for Reverse Intermediate Gear Assembly



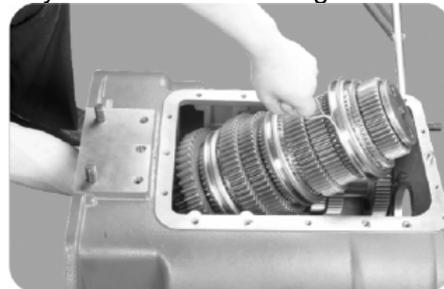
1. Install the reverse intermediate gear with its protruding part facing forward.



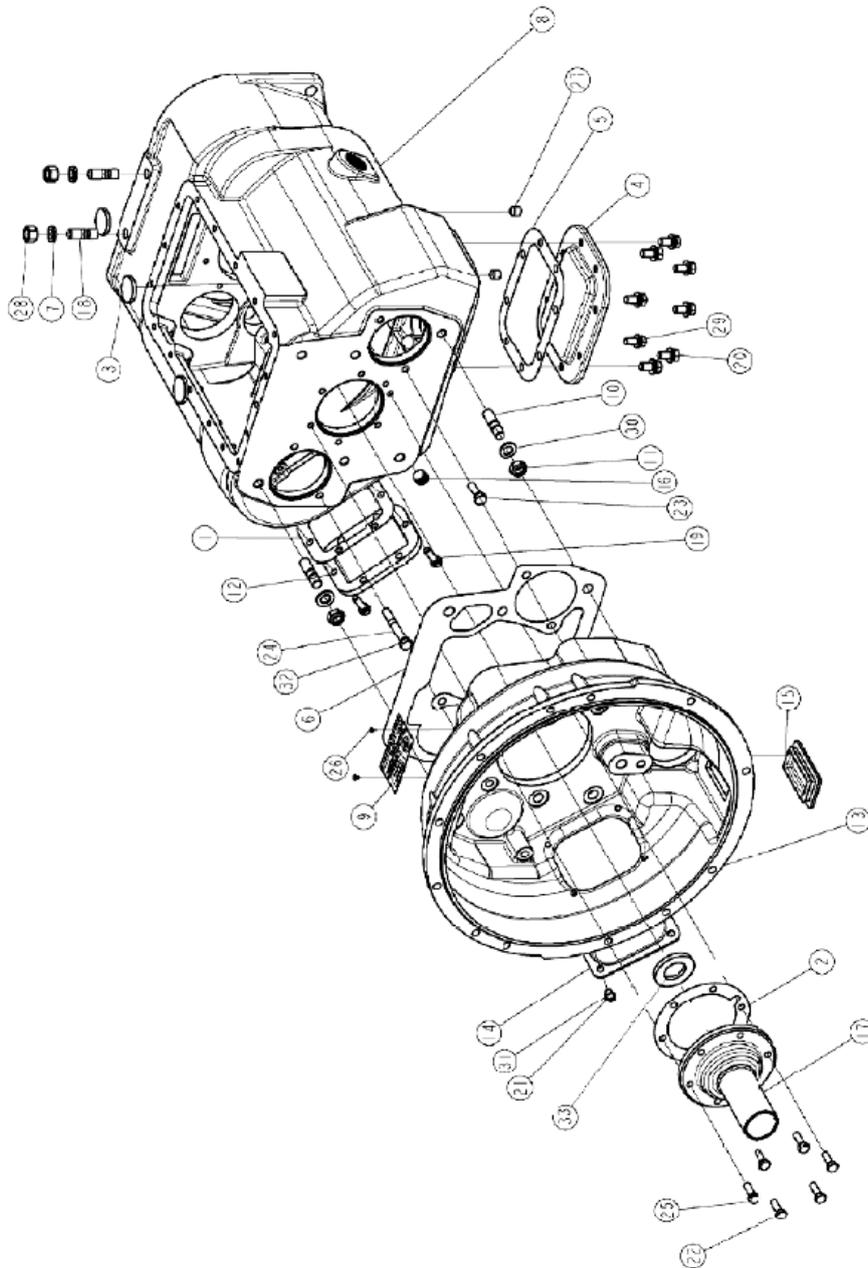
1. Put 2 countershafts of primary transmission into the primary transmission housing.



2. Install the reverse intermediate gear shaft, and tighten the self-locking nut.

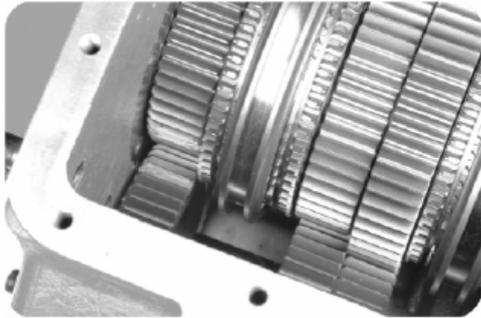


2. After placing matching marks of alignment tooth on each set of symmetrical teeth which are selected in 180° interval on the input shaft gear, install the output shaft assembly into primary transmission, and attach the drive gear bear and position the rear end of output shaft.



1. Side PTO window gasket 2. Bearing cover gasket of input shaft 3. Round magnet 4. Bottom PTO window cover
 5. Gasket 6. Clutch housing gasket 7. Spring washer 8. Transmission housing
 9. Caution plate 10. Stud bolt 11. Lock nut 12. Side PTO window cover 13. Clutch housing
 14.15. Sight glass cover 16. Screw plug 17. Bearing cover of input shaft 18. Stud bolt
 19.20.21.22.23.24. Bolt 25. Hole bolt 26. Tapping screw 27. Screw 28. Nut 29.30. Plate washer
 31.32. Spring washer 33. Oil seal of input shaft

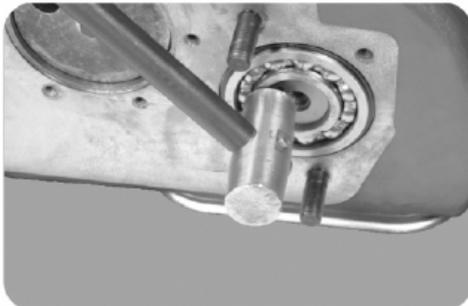
Figure 7-4 Component Exploded View of Transmission Housing



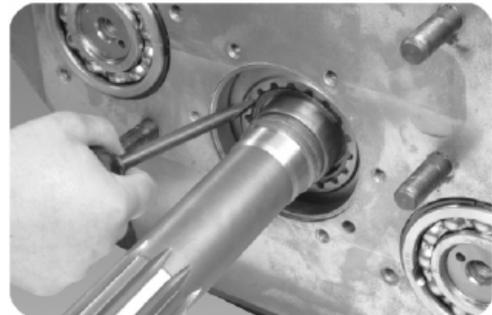
3. Insert the marked teeth which are on the lower countershaft into 2 marked teeth of input gear, and install the rear bearing of lower countershaft.



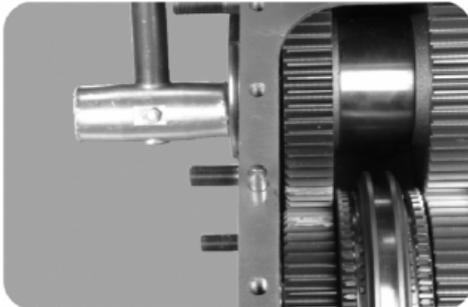
1. Remove the baffle which is on the front side of input shaft gear, apply grease to the inside of the input shaft, and install the input shaft into the spline of input shaft gear



4. Install the front bearing of lower countershaft.



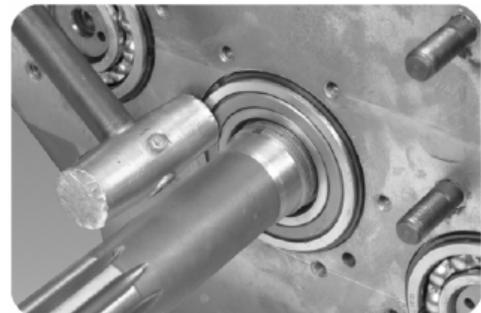
2. Install the snap ring of input shaft gear.



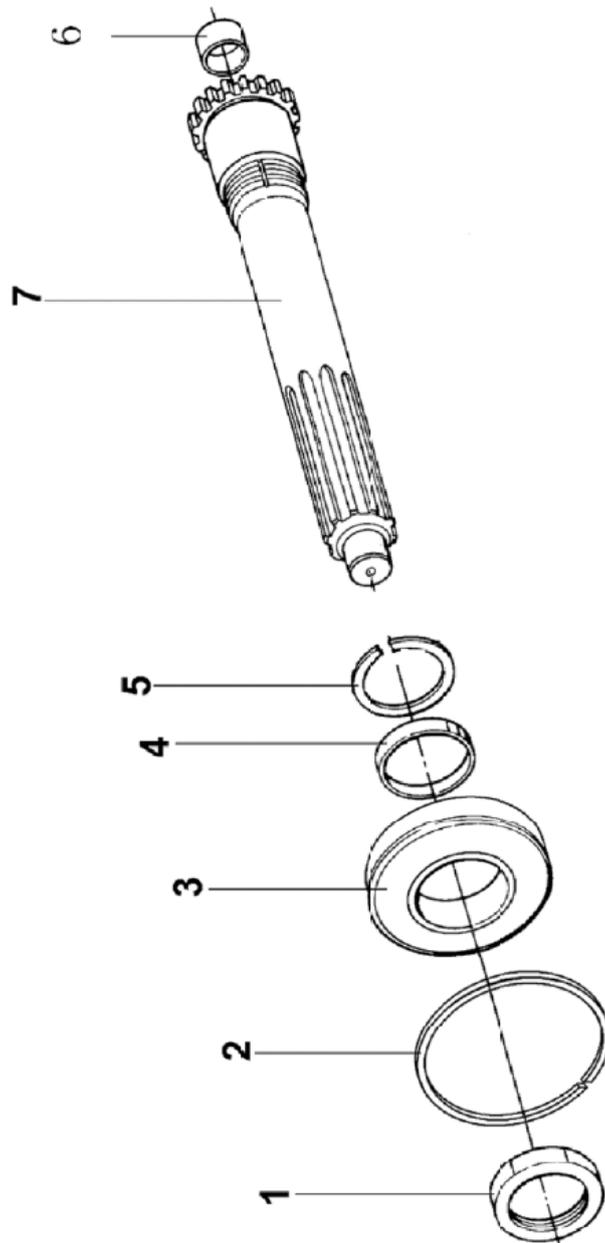
5. Install the front and rear bearing of upper countershaft against tooth in the same way.
(V)Installation of input shaft assembly
For the component exploded view of input shaft assembly, see the Figure 7-5.



3. Install the spacer of input shaft gear.

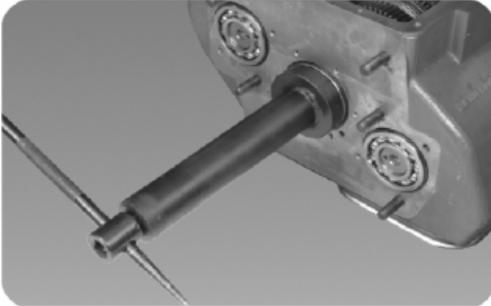


4. Install the input shaft bearing.



1. Input shaft nut 2. Snap ring 3. Input shaft bearing 4. Spacer 5. Snap ring 6. Guide sleeve of output shaft 7. Input shaft

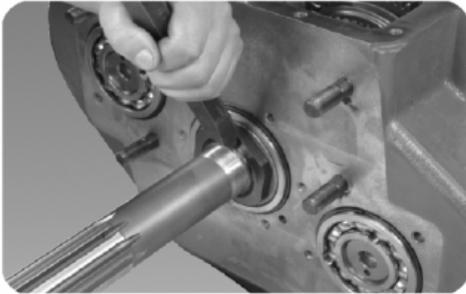
Figure 7-5 Component Exploded View of Input Shaft



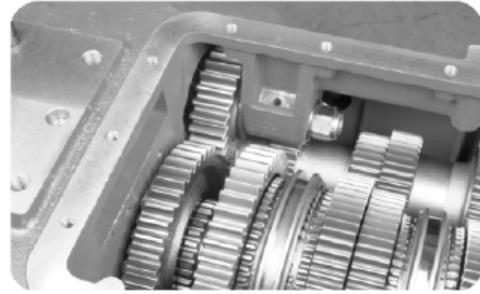
5. Apply seal packing to the input shaft nut, and install the input shaft nut by using special tool.



7. Install the front baffle of 2 countershafts, and install a shaft cover.



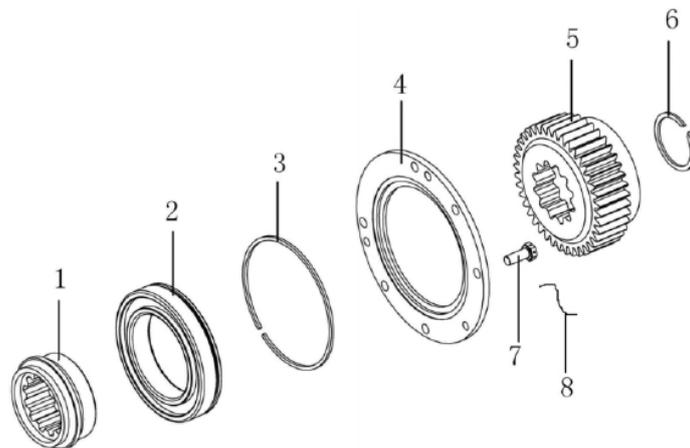
6. Securely rivet the input shaft nut to the threaded and notched part of input shaft



8. Install the upper reverse intermediate gear assembly, remove the drive gear bearing, and pull the reverse gear of output shaft backwards to make it engaged with reverse intermediate gear.

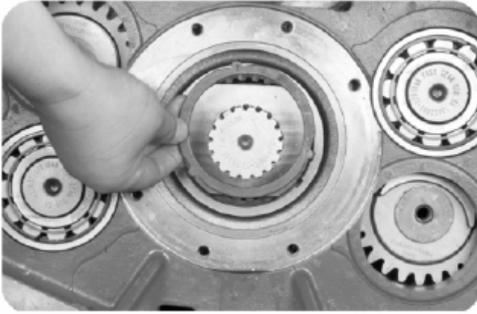
6) Installation of Driving Gear for Primary and Secondary Transmissions

For the component exploded view for drive gear of secondary transmission, see the Figure 7-6.

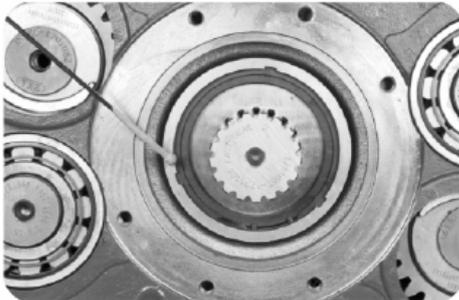


1. Bearing seat 2. Support bearing 3. Snap Ring 4. Positioning plate of secondary transmission bearing 5. Drive gear of secondary transmission 6. Snap ring 7. Bolt 8. Iron wire

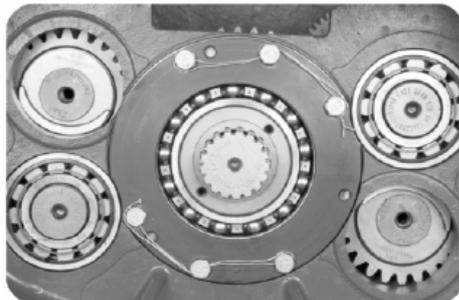
Figure 7-6 Component Exploded View for Drive Gear of Secondary Transmission



1. Install the shaft gear washer which is inside the reverse gear of output shaft



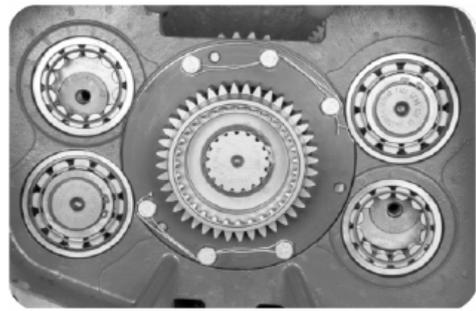
2. Install the snap ring which is inside the reverse gear of output shaft.



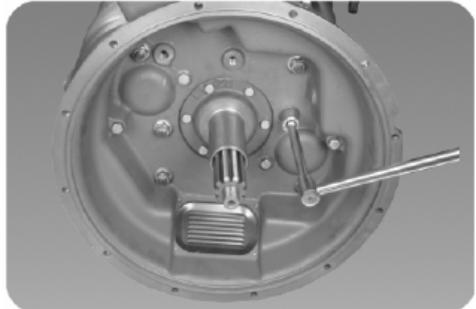
3. Install the bearing and positioning disc of drive gear, fasten them with bolts and attach the iron wire to prevent them losing.



4. Install the drive gear of secondary transmission, and attach the rear snap ring.



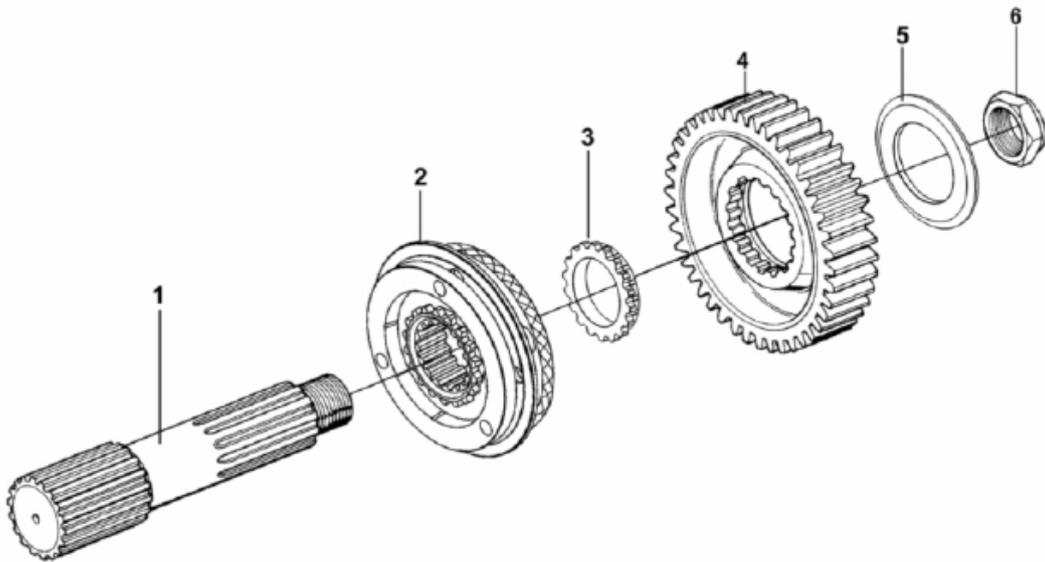
5. Install the front bearing of 2 countershafts, and install 2 snap rings which are on the rear end of countershaft for primary transmission.



6. Installation of clutch housing assembly.

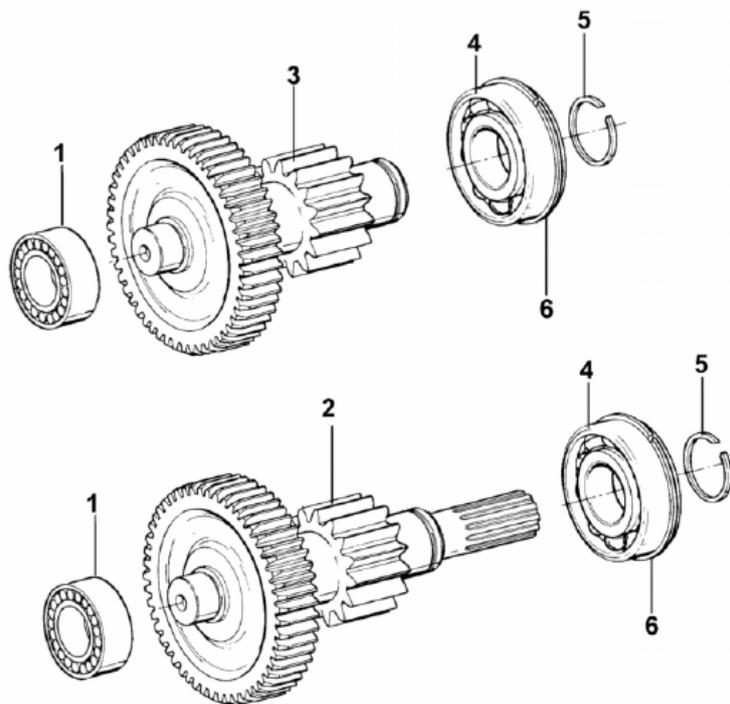
7) Installation of Secondary Transmission Assembly

For the component exploded view for the shaft assembly, countershaft assembly and rear cover assembly of secondary transmission, see the Figure 7-7 to 7-9. For the component exploded view of gearshift cylinder, see the Figure 7-10.



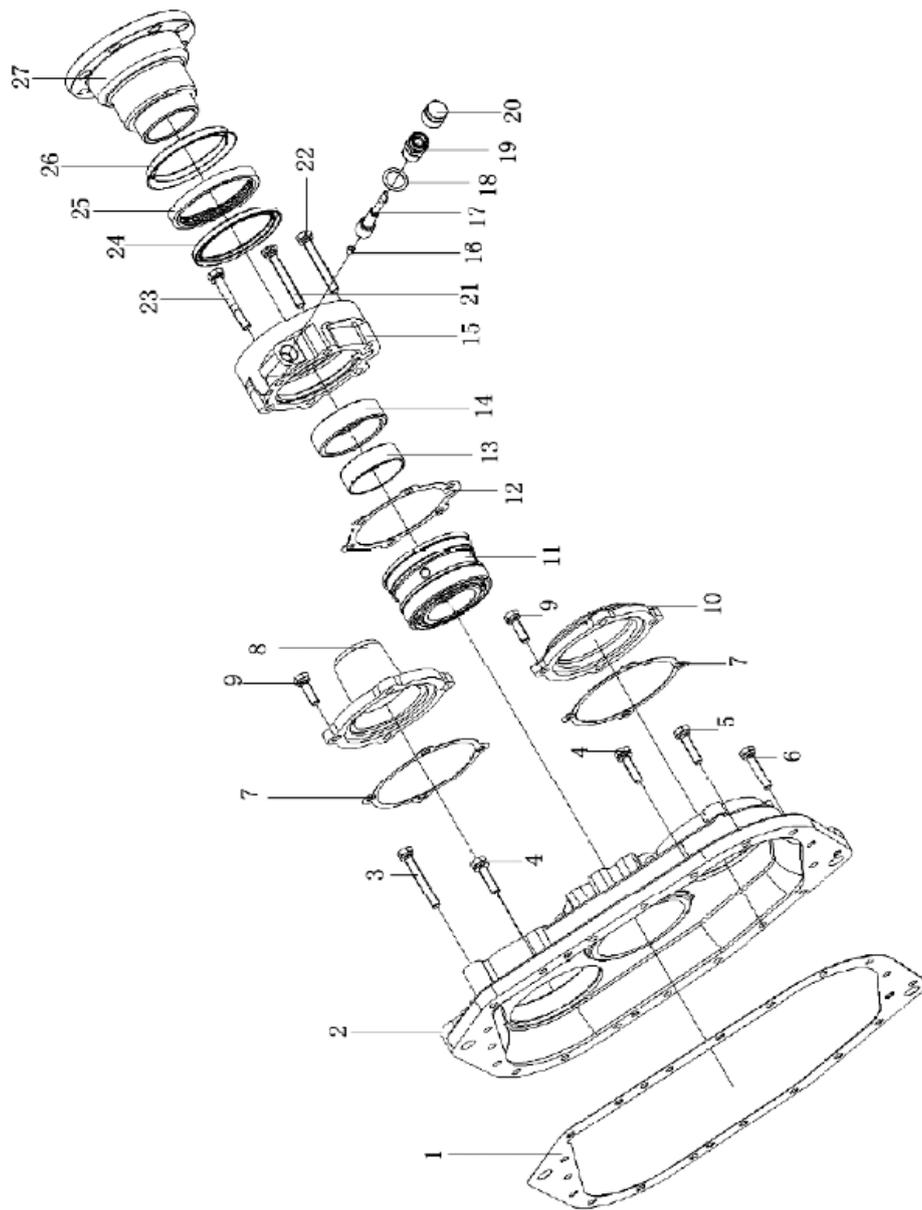
1. Secondary transmission shaft 2. High/low speed gear synchronizer assembly 3. Shaft spline washer 4. Reduction gear of secondary transmission shaft 5. Gear baffle 6. Flange nut

Figure7-7 Component Exploded View of Secondary Transmission Main Shaft



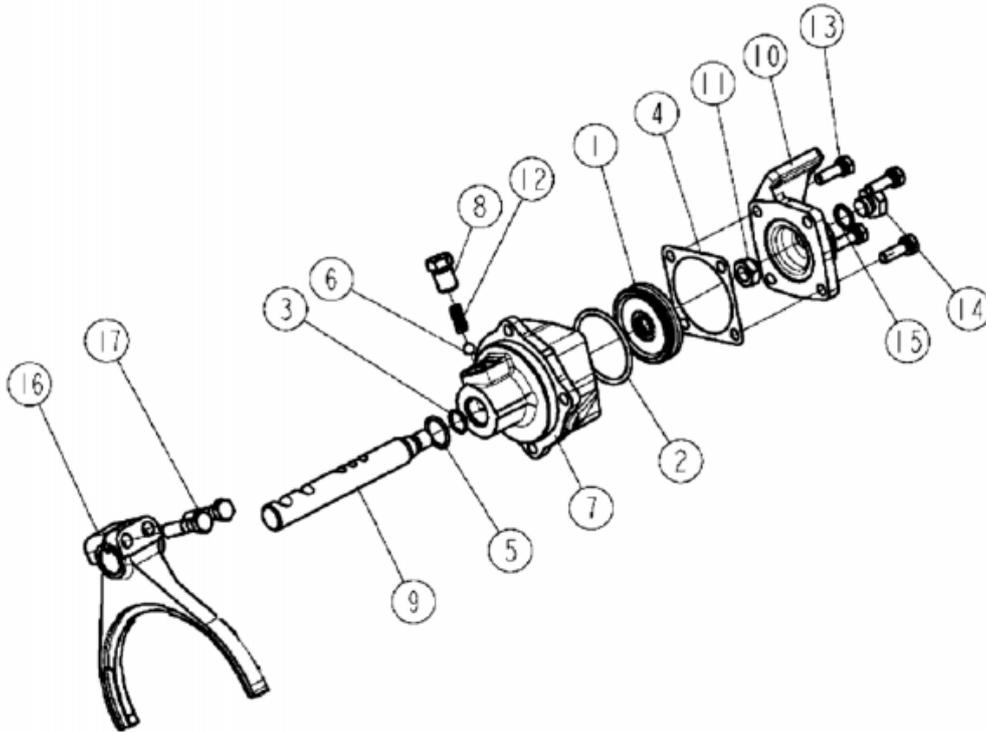
1. Front bearing of countershaft of secondary transmission 2. Extension countershaft welding assembly of secondary transmission 3. Countershaft assembly of secondary transmission 4. Rear bearing of countershaft of secondary transmission 5. Snap ring 6. Bearing snap ring

Figure7-8 Component Exploded View for Countershaft of Secondary Transmission



1. Rear cover Gasket 2. Rear cover of secondary transmission 3.4.5.6. Bolt 7. Countershaft cover gasket 8. Rear end cover of extension countershaft 9. Bolt 10. Rear end cover of countershaft 11. Combination bearing 12. End cover gasket of rear bearing 13. Bush 14. Odometer sliding rod 15. Rear bearing mount 16. Bearing sleeve 17. Odometer sliding wheel 18. Shim 19. Odometer joint 20. Boot 21. Bolt 22.23. Bolt 24. Rear shaft seal of shaft 25. Oil seal 26. Dust cover 27. Output flange

Figure 7-9 Component Exploded View for Rear Cover Assembly of Secondary Transmission



1. Cylinder piston 2.3. O-ring 4. Cylinder bushing 5. O-ring 6. Steel ball 7. High/low gearshift cylinder
 8. Screw plug 9. Fork shaft 10. Cylinder cover 11. Nut 12. Positioning spring
 13. Bolt 14. High/low gear indicator switch 15. Copper washer 16. Gearshift fork 17. Hole bolt

Figure7-10 Component Exploded View for Gearshift Cylinder of Secondary Transmission



1. Place the low gear ring of synchronizer horizontally with its pin upwards, and attach it into the sliding bush of synchronizer



2. Install the high gear of synchronizer, and make it in position by applying turning



3. Place the low gear ring of synchronizer upwards on the wooden block which is 50 mm high, and insert the output shaft.



4. Install the shaft washer of secondary transmission with its notch downwards.



6. Install one side of combination bearing into the output shaft, and place match marks of alignment tooth on the reduction gear of secondary transmission in 180° direction.



5. Install the reduction gear of secondary transmission into the output shaft with its level surface upwards, and install the shaft gear baffle of secondary transmission.

Note: apply grease to the shaft gear baffle of secondary transmission.



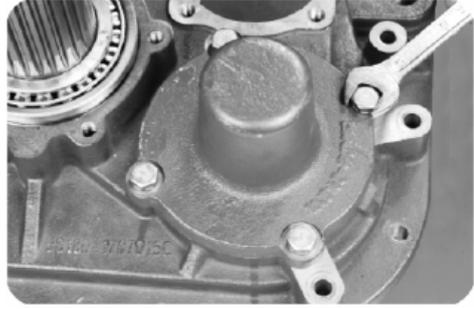
7. If the inner ring of countershaft bearing of secondary transmission is removed, the inner ring of bearing should be installed into 2 countershafts.



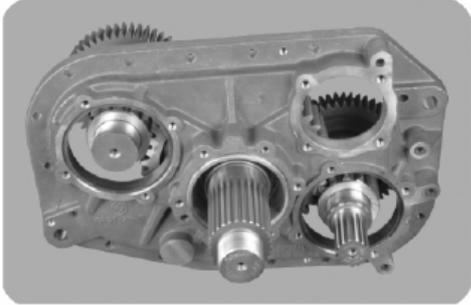
8. Place match marks of alignment tooth on the marked teeth end of countershaft of secondary transmission.



(9) Insert 2 marked gears of countershaft into 2 marked gear slots of shaft.



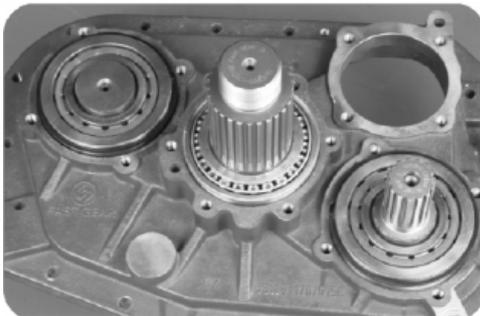
(13) Install the end covers of 2 countershafts.



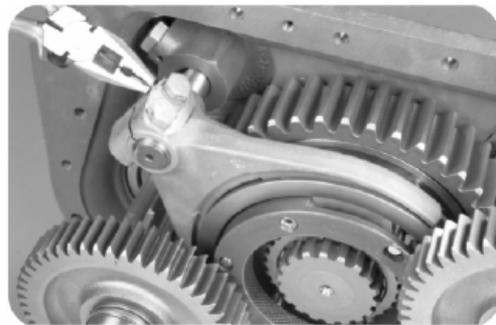
(10) Install the rear cover housing.
Note: Install the extension shaft of PTO under the right side of rear cover housing.



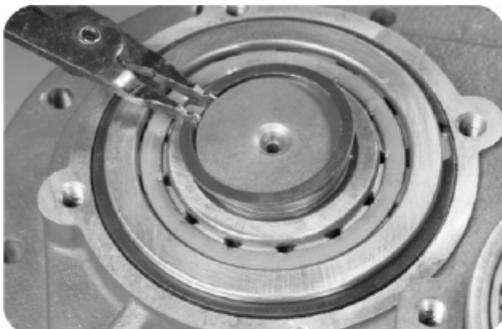
(14) Install the bearing cover of output shaft, and attach the drive/driven gear and joint of odometer.



(11) Install 2 bearings of countershaft and the outer bearings of output shaft for the rear cover.



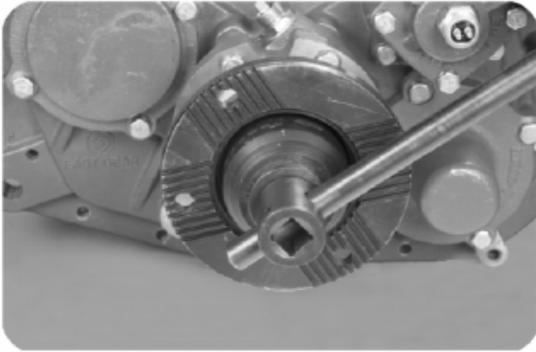
(15) Insert the gearshift fork of secondary transmission into the sliding bush of synchronizer with its level surface outwards, and install the bolt connecting the fork and fork shaft and lock them by using iron wire



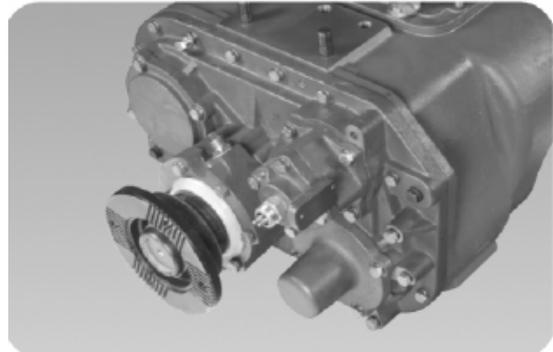
(12) Install the stop ring of countershaft bearing of secondary transmission.



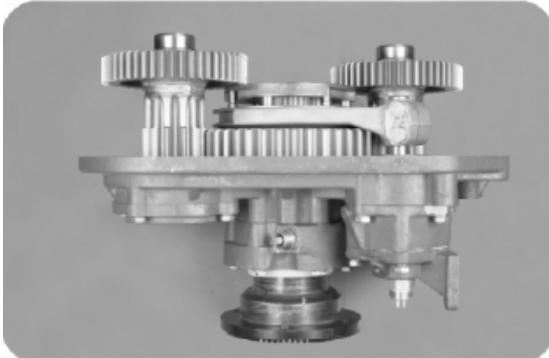
(16) Install the gearshift cylinder of secondary transmission



(17) Tighten the flange nut by using special socket.



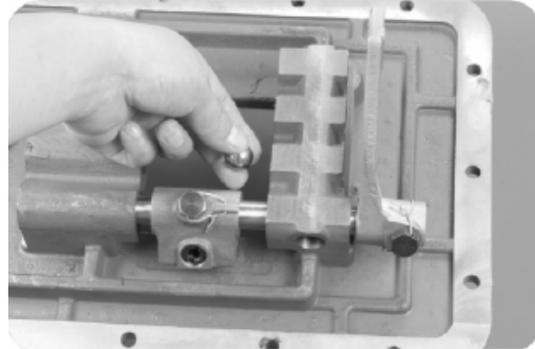
(21) Tighten the joint bolt connecting rear cover and primary transmission housing.



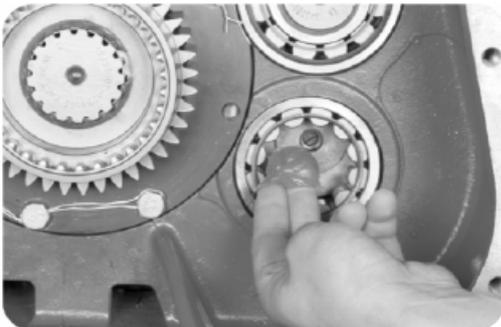
(18) Set the synchronizer of secondary transmission in the low gear position.

(IX) Installation of Transmission Upper Cover

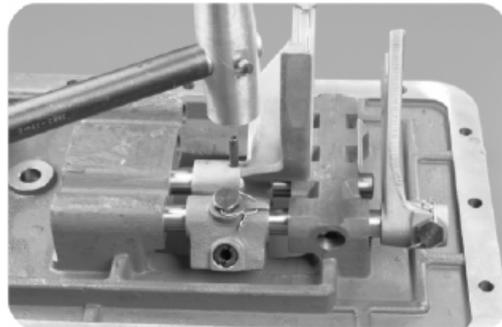
For the component exploded view of transmission upper cover assembly, see the Figure 7-11.



(1) Install the low reverse guide block and fork into reverse fork shaft in sequence, fasten them by using tapered bolt and tighten the iron wire to avoid from getting loose, and attach a interlock steel ball.

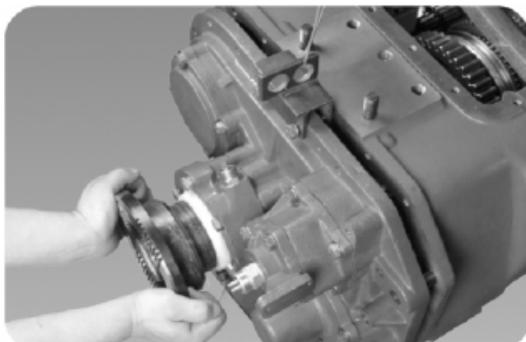


(19) Uniformly apply grease to the front bearing inner hole of 2 countershafts at the rear end of secondary transmission (this procedure is very important).



(2) Install 1st /2nd speed gear fork shaft, and install the elastic cylindrical pin of fork.

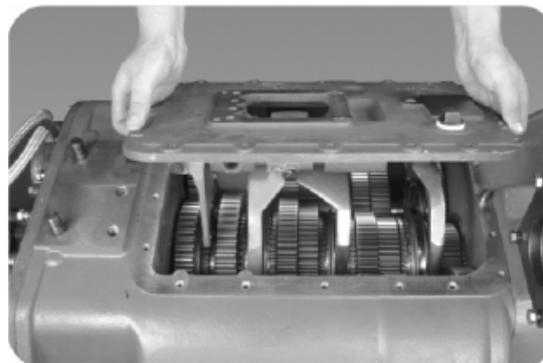
Note: don not miss the interlock pin of 1st /2nd speed gear fork shaft.



(20) Install the secondary transmission assembly by using special hanger.



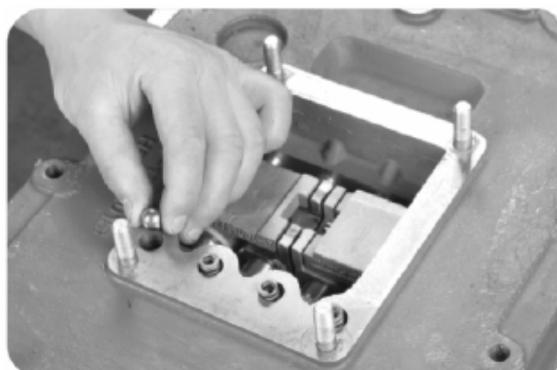
(3) Install one interlock steel ball.



(6) Install the upper cover assembly into the primary transmission.

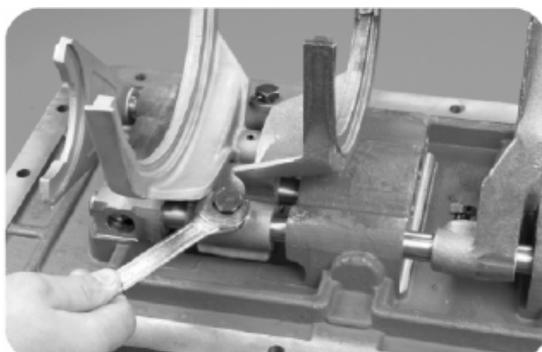


(4) Install 3rd/4th speed gear fork shaft, elastic cylindrical pin of fork, and interlock pin and interlock steel ball.

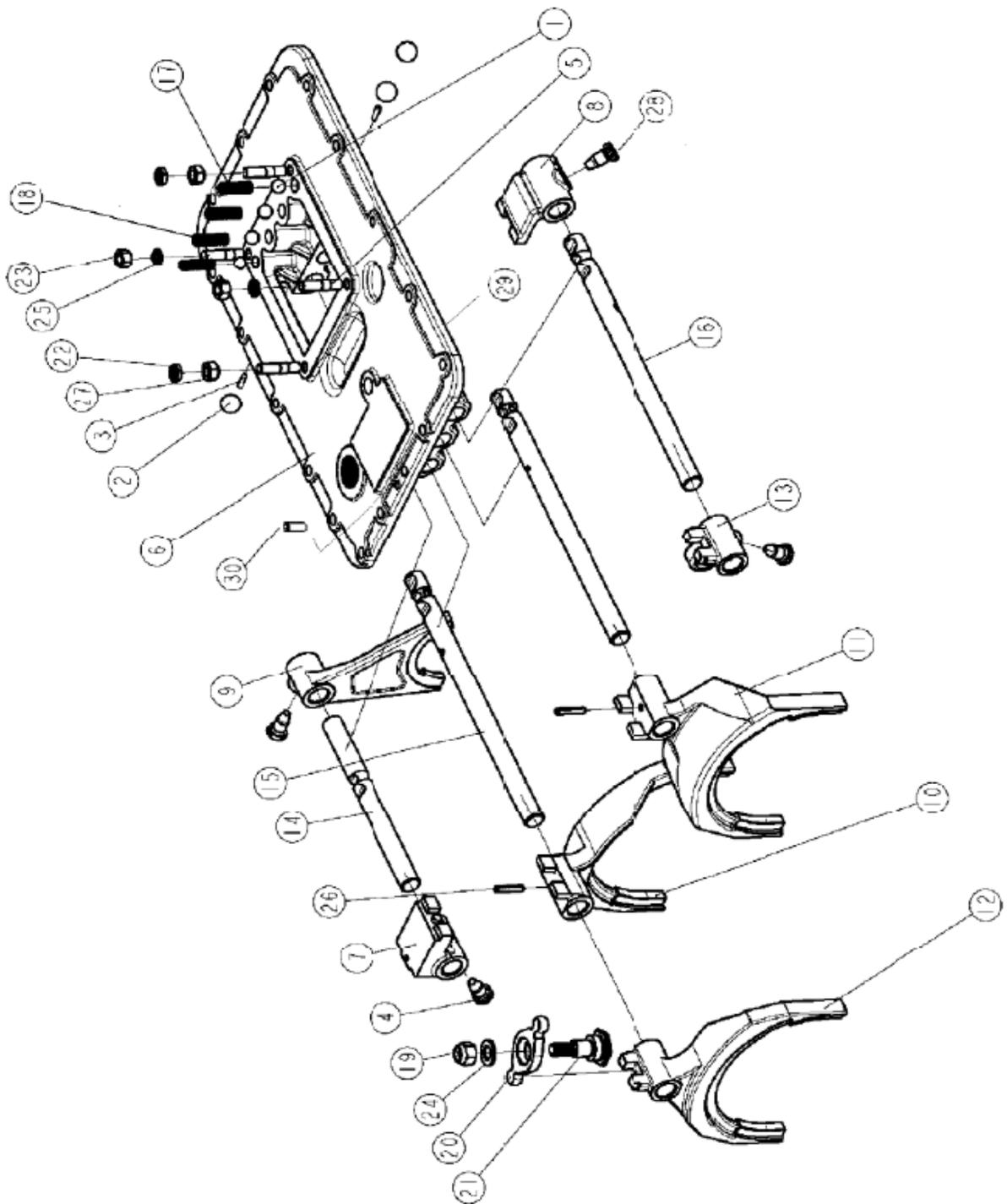


(7) Install the 4 stud bolts, positioning spring and steel ball which are on the upper cover.

Note: the spring inside 5th/6th speed gear fork shaft hole is much thicker.



(5) Install 5th/6th speed gear fork shaft, install 5th/6th speed gear guide block and fork in sequence, and tighten the iron wire to avoid loose by using bolt.

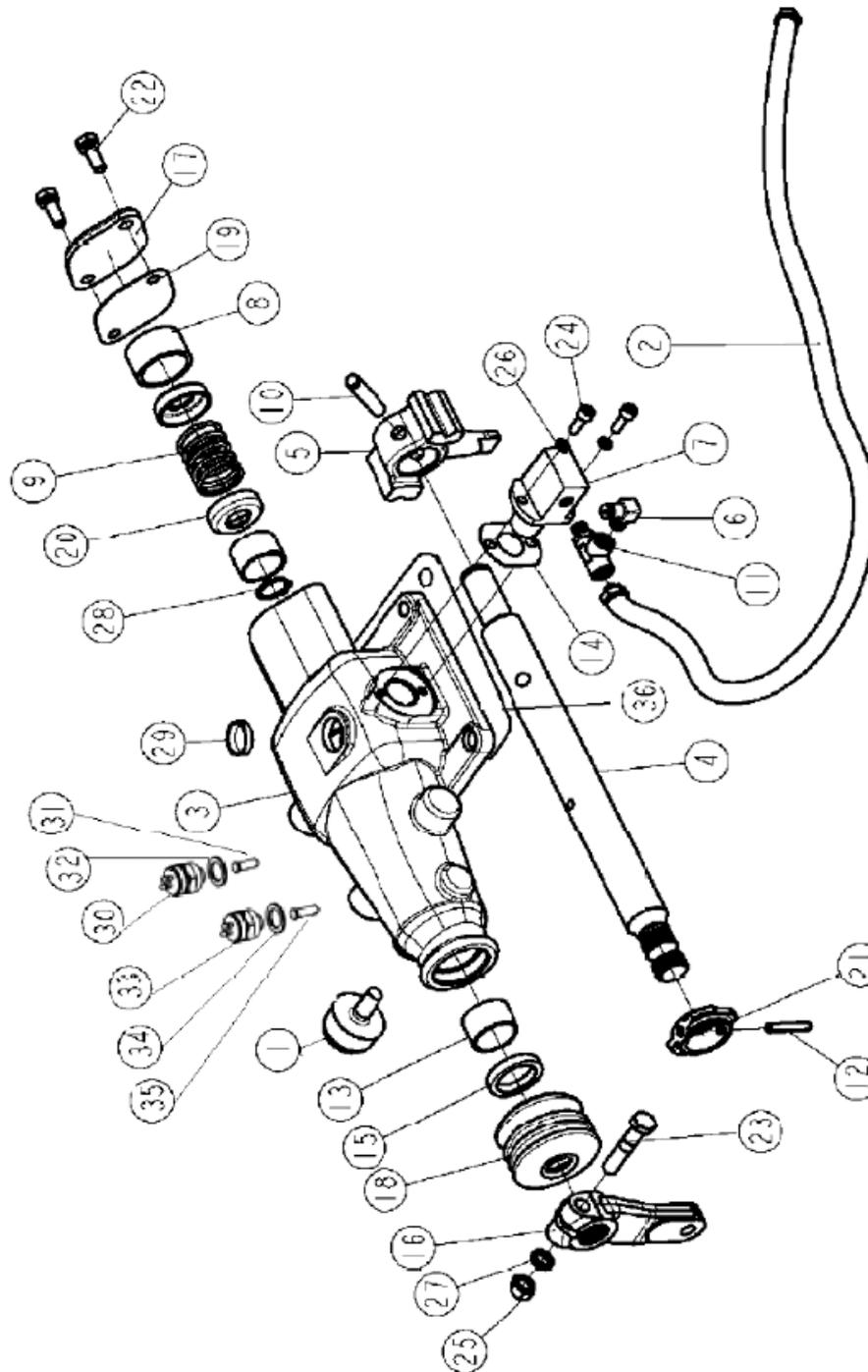


1.2. Steel ball 3 .Interlock pin of fork shaft 4 . Lock screw of fork 5.Stud bolt 6. Upper cover 7. Reverse guide block 8. 5th/6th speed gear guide block 9. Reverse fork 10. 1st/2nd speed gear fork 11. 3rd/4th speed gear fork 12. 5th/6th speed gear fork 13. 5th/6th speed gear gearshift guide block 14. Reverse fork shaft 15. 1st/2nd, 3rd/4th speed gear fork shaft 16. 5th/6th speed gear fork shaft 17. Compression spring 18. Compression spring 19. Nut 20. Swing fork 21. Support bearing pin 22. Nut 23. Nut 24. Plate washer 25. Spring washer 26. Elastic cylindrical pin 27. Nut 28. Lock screw 29. Upper cover gasket 30. Cylindrical pin

Figure 7-11 Component Exploded View of Upper Cover Assembly

9) Installation of Gearshift Mechanism Assembly

For the component exploded view of gearshift mechanism assembly, see the Figure 7-12.

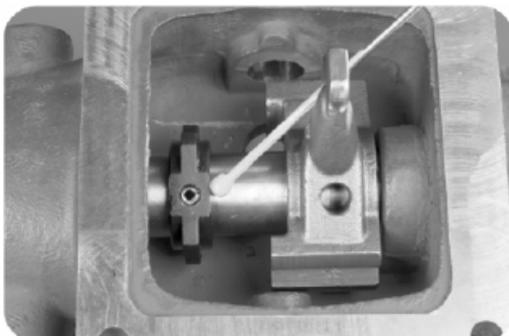


1. Breather plug 2. Air tube assembly 3. Gearshift mechanism housing 4. Gearshift shaft 5. Shifting block 6. Air tube bent 7. Air route control valve 8. Stopping sleeve Stopping sleeve 9. Compression spring 10. Cylindrical pin 11. 3-way joint of air tube 12. Elastic cylindrical pin 13. Gearshift shaft bushing 14. Control valve gasket 15. Oil seal 16. Gearshift crankarm 17. End cover 18. Boot 19. End cover pad 20. Spring seat 21. Low/Reverse gear cam 22. Bolt 23. Bolt 24. Cylindrical screw 25. 1 type nut 26.27. Spring washer 28. Spring washer for shaft 29. Bowl plug 30. Neutral switch 31. Stroke top pin 32. Washer 33. Back up light switch 34. Washer 35. Stroke top pin 36. Window shim

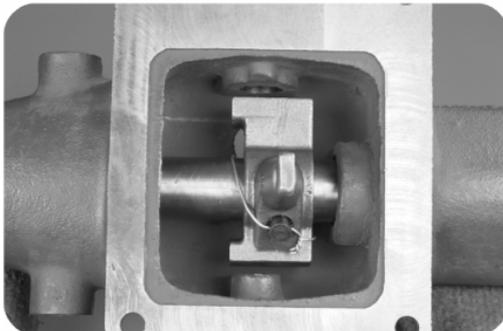
Figure7-12 Component Exploded View of Gearshift Mechanism



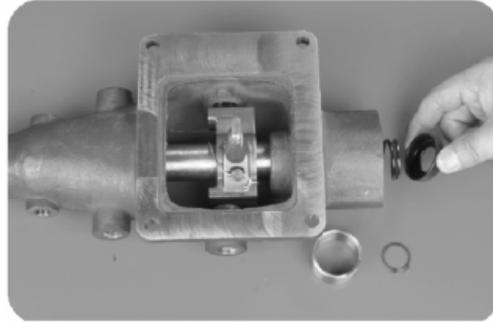
(1) If the oil seal is removed, stand the gearshift mechanism assembly up and install the oil seal



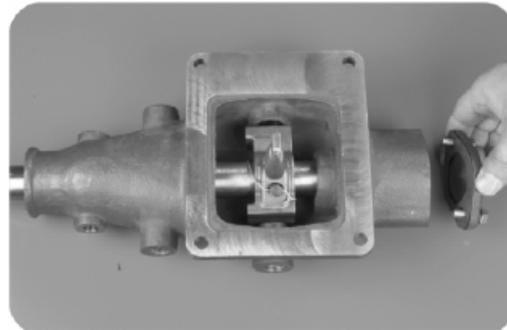
(2) Install the lateral gearshift shaft, and install the elastic cylindrical pin of reverse control block with its small end upwards.



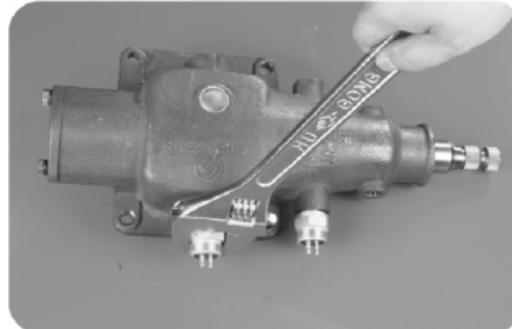
(3) Install the cylindrical pin of gearshift shifting block, and tighten it by using iron



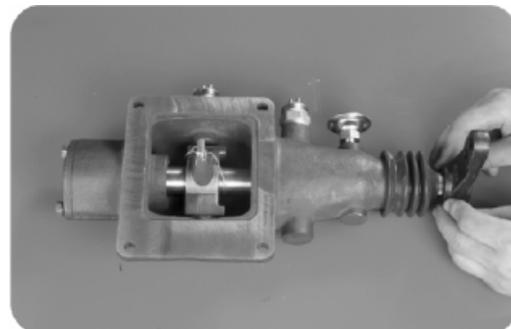
(4) Install the spring, spring mount and stop ring.



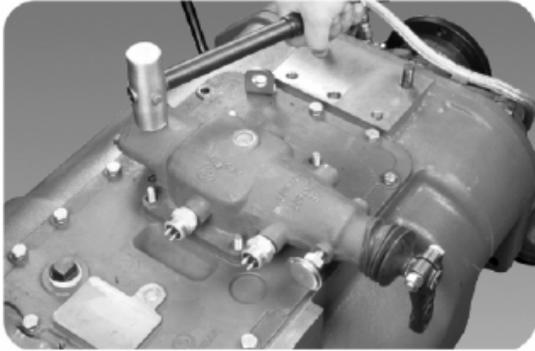
(5) Install the stopping sleeve and attach the side plate.



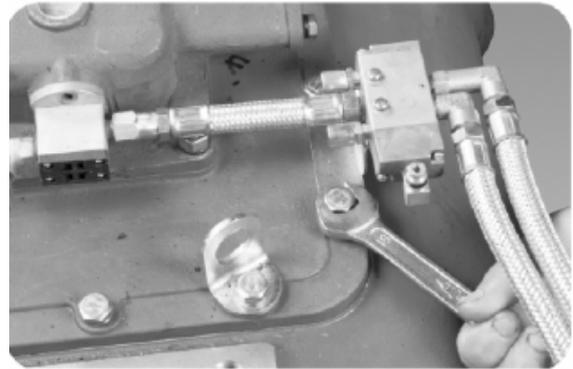
(6) Install the reverse light switch and neutral switch



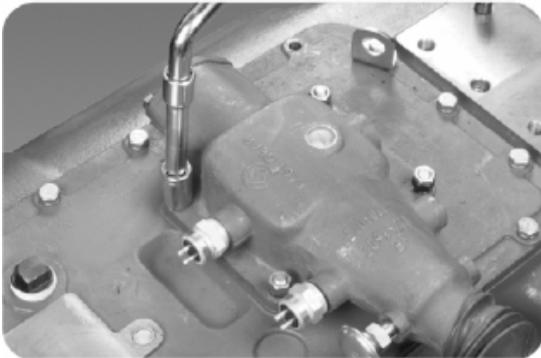
(7) Install the boot and gearshift swing arm to ensure that the swing arm and shifting block are positioned in line.



(8) Install the gearshift mechanism to the upper cover



(10) Installation of air line commutating valve, air line control valve and air tube line.



(9) Tighten the 4 bolts.

The whole assembly of transmission is finished here.

The above procedures of removal and installation also apply for 8JS130TA-B, 8JS130T-B, 8JS100TAB, 8JS100T-B, 9JS119T-B, 9JS135TB, 9JS150T-B model transmission, and the construction is a little different from 12JS series transmission, so the attention should be paid when removing or installing them.

Section 8 Removal and Installation of Fast 16JS Series Transmission

The Fast 16-speed gear transmission consists of a front secondary transmission with the inserted gear, a primary transmission with 4 forward gears and a secondary transmission with the range gear of high/low gear, so that there is a much difference about the removal and installation between this one and Fast transmission stated above. Mainly, the removal and installation of 16 gear transmission which are different from other transmission will be stated below, and please see RT1509C model transmission for the remaining removal and installation.

1. Removal of the Main Parts of 16JS Series Transmission

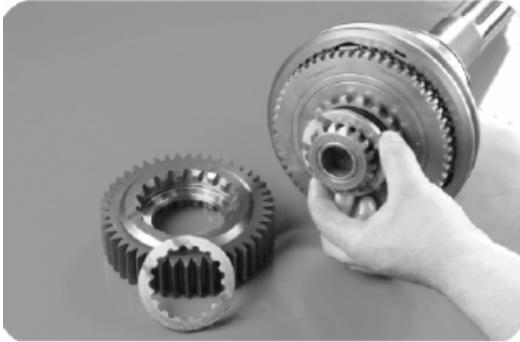
1) Removal of input shaft



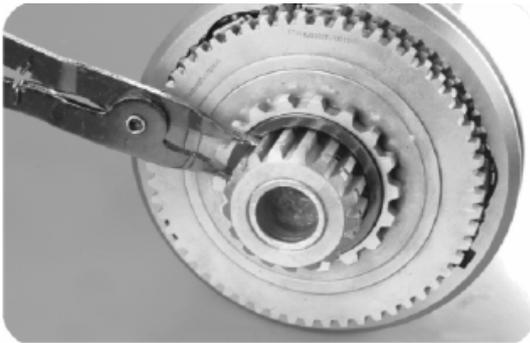
(1) Input shaft gear assembly of 16 gear transmission



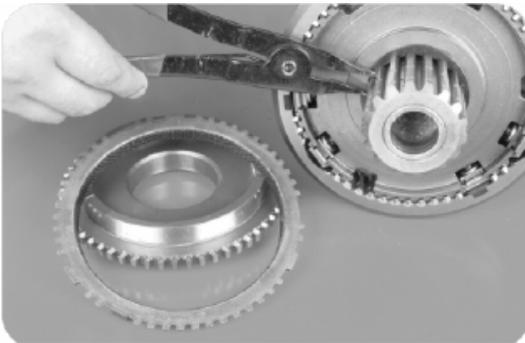
(2) Remove the stop ring of inner hole of input shaft gear.



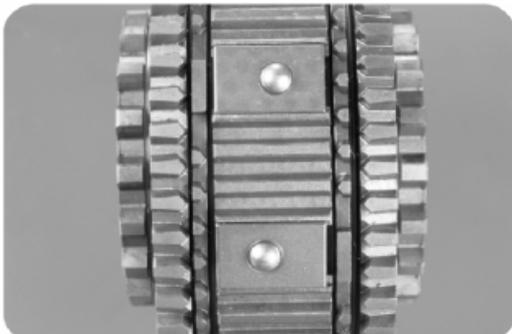
(3) Take off the input shaft gear and spline gasket which is on two sides.



(4) Remove the stop ring which is in the front of engaged teeth of synchronizer.



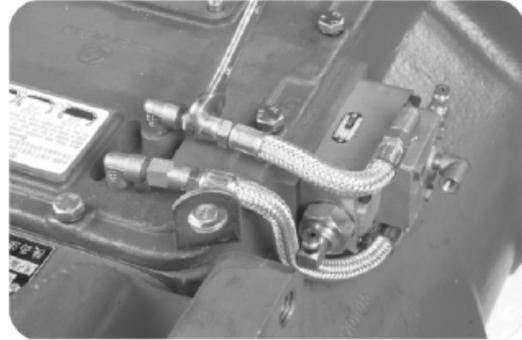
(5) Take off the components which are on one side of even and odd gear synchronizer, and remove the stop ring on one side of synchronizer.



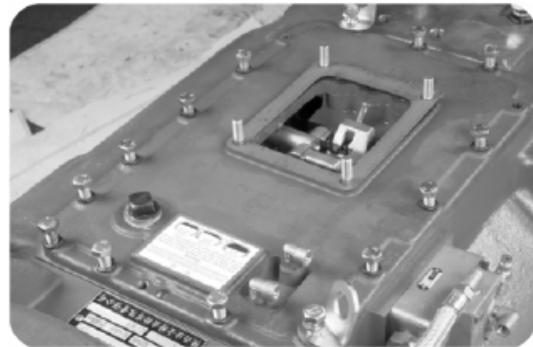
(6) The direction of sliding block and tapered ring of synchronizer.

Note: It is impossible to interchange the tapered ring with the engaged gear on both sides of 16-gear even and odd gear synchronizer.

2) Removal of transmission upper cover



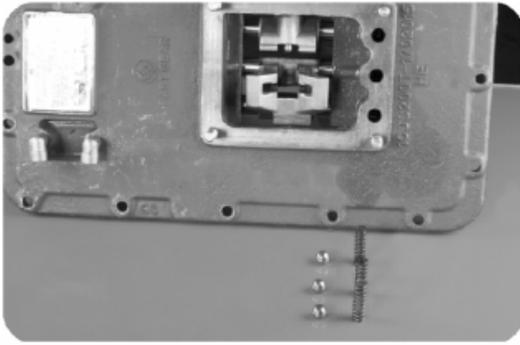
(1) Remove the following valve and the air pipe of even and odd gear cylinder.



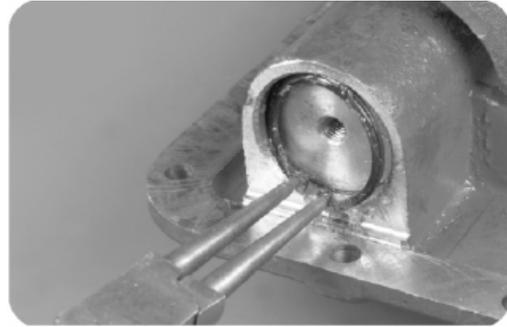
(2) Remove the upper cover bolts.



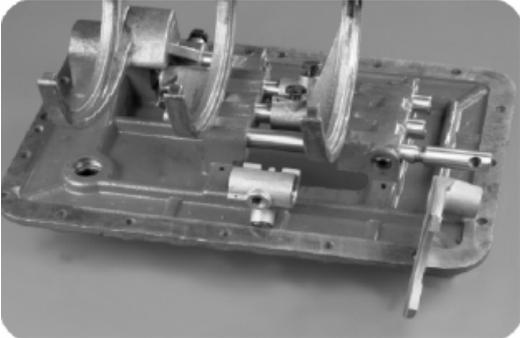
(3) Push out the upper cover by using the bolt, and remove the upper cover assembly.



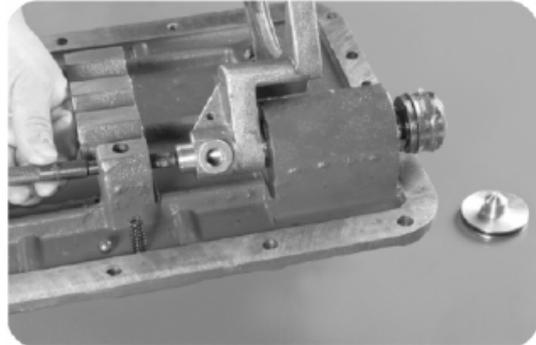
(4) Take out 3 positioning springs and steel ball from the housing hole.



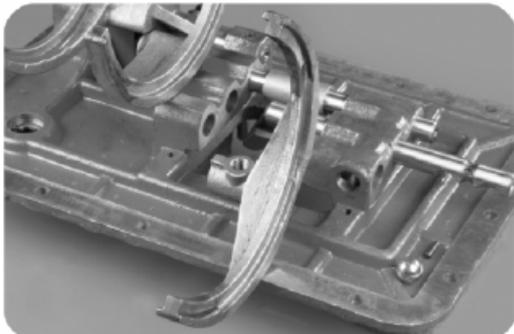
(8) Remove the stop ring inside even and odd gear gearshift cylinder from the upper cover housing



(5) Remove the reverse fork shaft, guide block and reverse fork.



(9) Tap the piston and fork shaft, take out the spring and steel ball from the housing, and take off the piston and fork shaft.

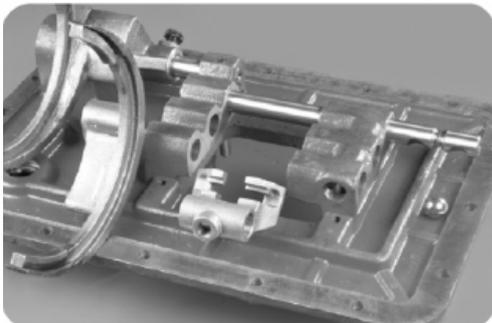


(6) Remove 1/2 gear fork shaft and fork, and take out the interlock steel ball from the housing.

Note: there is interlock pin in the hole of 1/2 gear fork shaft.



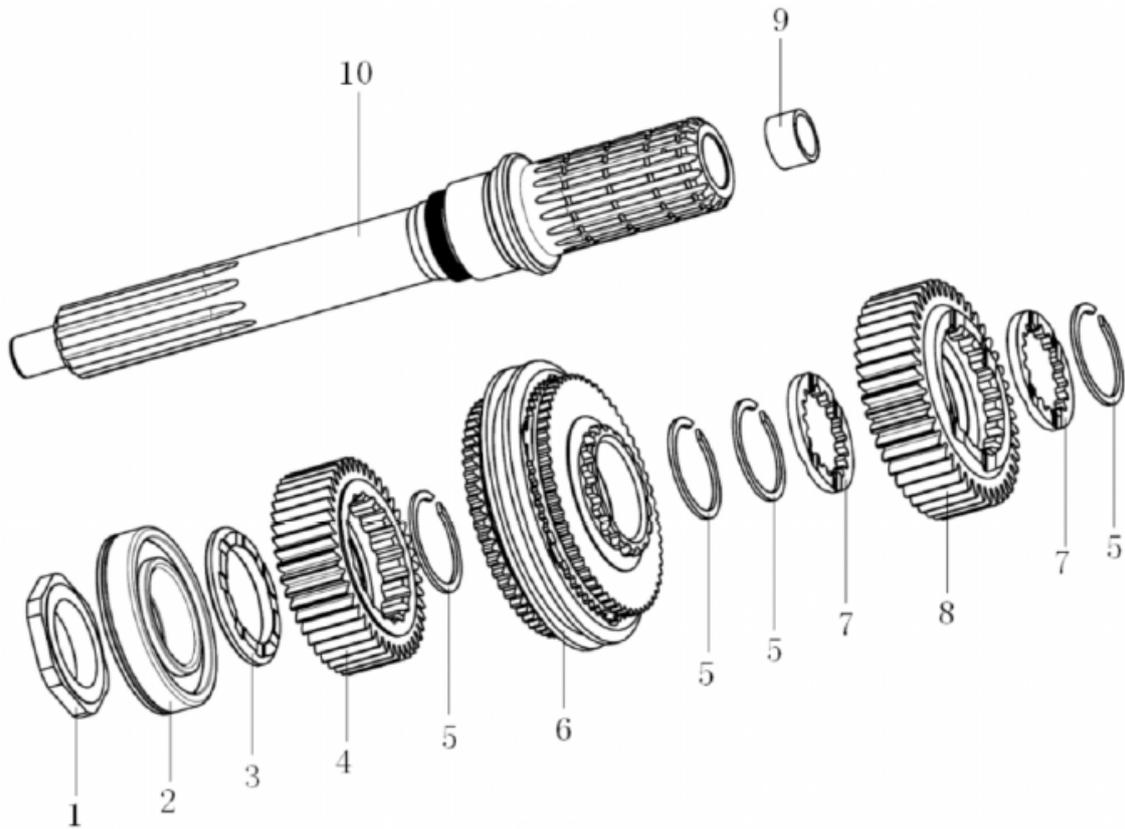
(10) Y-ring of piston fork shaft and O-ring of side cover.



(7) Remove 3rd/4th speed gear fork shaft, fork shaft, guide block and fork, and take out the interlock steel ball from the housing.

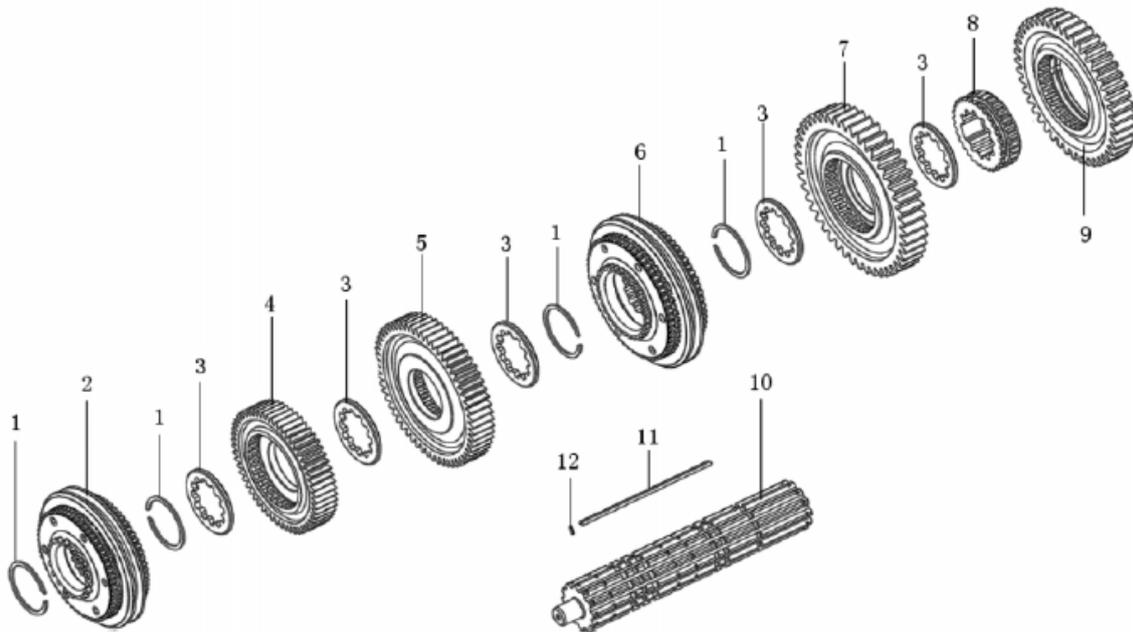
II Installation of 16JS Series Transmission

There is one additional front secondary transmission with the inserted gear in 16JS series transmission; this is the main difference from common transmission with double-countershaft. For the component exploded view of input shaft, countershaft and output shaft, see Figure 8-1, 8-2 and 8-3 respectively. And the remaining parts are exactly the same as common transmission with 2 countershafts.



1. Input shaft nut 2. Input shaft bearing 3. Spacer gasket 4. Low half gear of input shaft 5. Snap ring 6. Synchronizer of front mount secondary transmission 7. Spline gasket of input shaft gear 8. High half gear of input shaft 9. Guide sleeve of output shaft 10. Input shaft

Figure8-1 Component Exploded View of Input Shaft of 16JS Series Transmission



1. Snap ring 2. 3rd/4th speed gear synchronizer assembly 3. Gear spacer of output shaft 4. 3rd speed gear of output shaft 5. 2nd speed gear of output shaft 6. 1st/2nd speed gear synchronizer 7. 1st speed gear of output shaft 8. Sliding sleeve of input shaft reverse gear 9. Reverse gear of output shaft 10. Output shaft 11. Hexagonal long key of output shaft 12. Elastic cylindrical pin

Figure 8-2 Component Exploded View of Output Shaft of 16JS Series Transmission

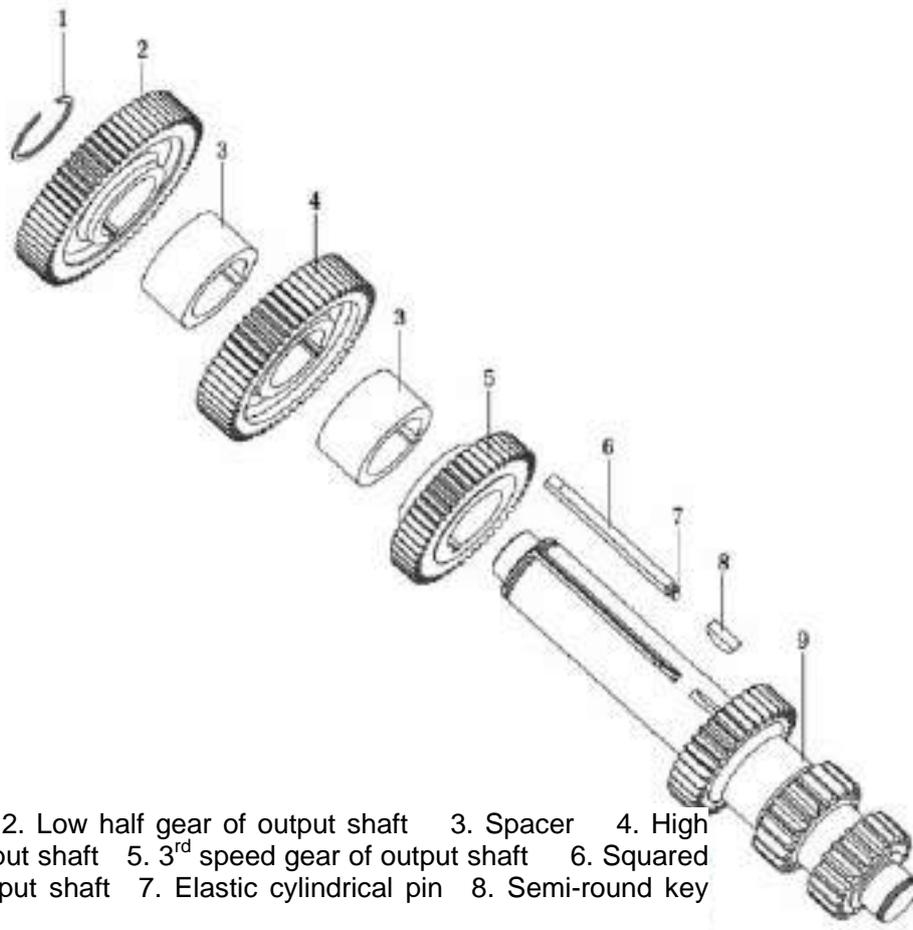


Figure 8-3 Component Exploded View of Output Shaft of Primary

The installation of these parts is stated below respectively

(I) Installation of Primary Shaft Assembly



(1) Stand the primary shaft up, attach the high half gear of primary shaft, and install the gear gasket of primary shaft with its protruding part downwards.



(2) Install the primary shaft bearing.



(3) Place the primary shaft horizontally, install the components which are on one side of even and odd gear synchronizer, and attach one stop ring.



(7) Install the low semi-gear of input shaft and spline gasket, and attach one stop ring.



(4) Install the gear hub of synchronizer and attach one stop ring.



(8) Apply anti-oxygen adhesive to the nut thread of input shaft, install the input shaft nut and rivet it securely. Place matching marks of alignment tooth on any 2 sets of gears in 108° direction of speed changing gear of input shaft.



(5) Install the components which are on another side of synchronizer, and attach one stop ring.

(II) Installation of Output Shaft Assembly



(6) Install the spline gasket of input shaft.



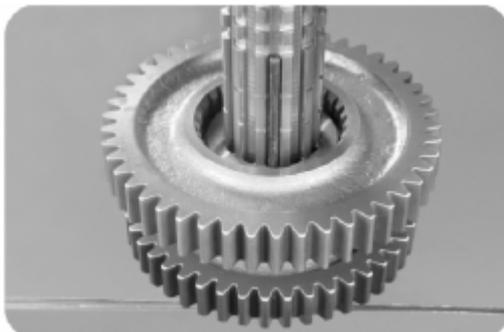
(1) Stand output shaft up on the working table, set the reverse gear shim, and install the long key after turning it in one tooth pitch.



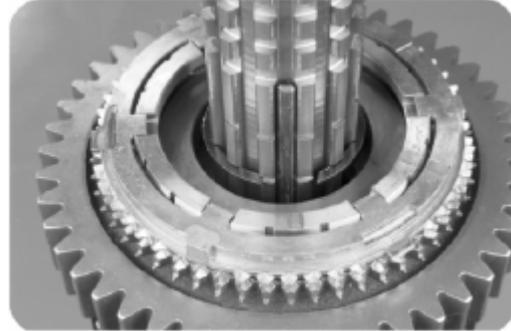
(2) Install the reverse gear of output shaft into output shaft with its engaged teeth upwards, and set the reverse sliding bush with the tooth lack notch facing hole keyway of output shaft.



(3) Install the gear gasket of output shaft, and push the long key up after turning it in one tooth pitch.



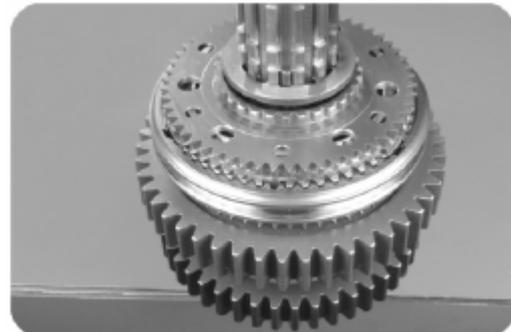
(4) Install the 1st speed gear of output shaft into output shaft with its engaged teeth upwards, attach the gear spline of output shaft, and push the long key up after turning it in one tooth pitch.



(5) Install the components which are on one side of 1st/2nd speed gear synchronizer, and attach a snap



(6) Install the gear hub of 1st/2nd speed gear synchronizer, and attach a snap ring.



(7) Install the components which are on another side of 1st/2nd speed gear synchronizer, place the spline gasket of output shaft, and push the long key up after turning it in one tooth pitch.



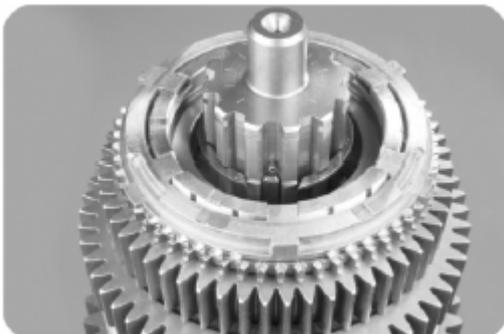
(8) Install 2nd gear of output shaft into output shaft with the engaged teeth downwards, place the spacer of output shaft gear, and push the long key up after turning it in one tooth pitch.



(9) Install 3rd speed gear of output shaft upwards into output shaft with the engaged teeth upwards, place the spline gasket of output shaft gear, and push the long key upwards after turning it in one tooth pitch.



(10) Install the elastic pin of output shaft.



(11) Install the components which are on one side of 3rd/4th speed gear synchronizer, and attach a snap.
Note: the opening of stop ring must face the hole notch of output shaft.



(12) Install the gear hub of 3rd/4th speed gear synchronizer, and attach a snap ring.
Note: the opening of stop ring must not face the hole notch of output shaft.



(13) Install the components which are on another side of 3rd/4th speed gear synchronizer.
(III) The Main Features for Installation of Primary Transmission

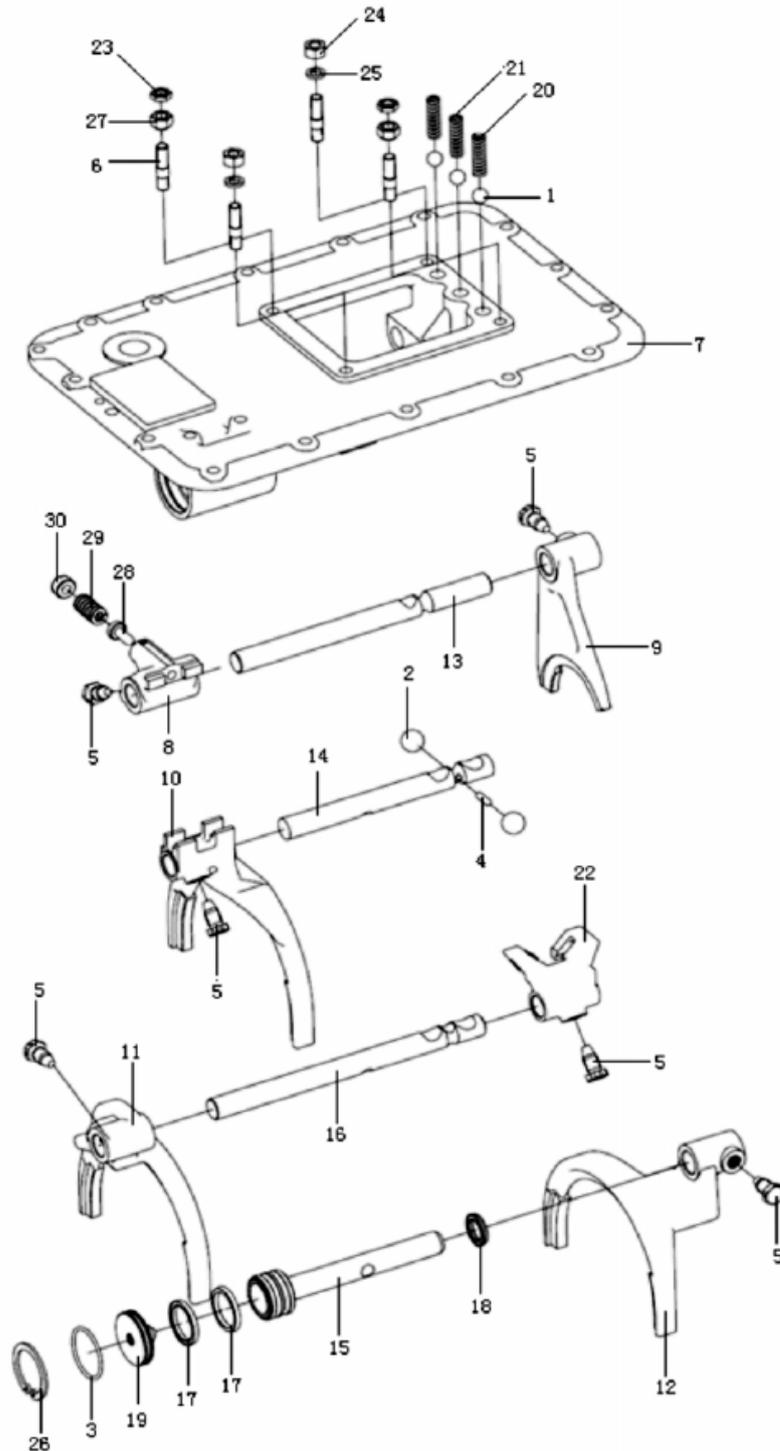


There is no difference in the installation procedures between primary transmission of 16JS series transmission and common transmission with double-countershaft, but both the symmetrical teeth for high half gear of input shaft and the symmetrical teeth for low half gear of input shaft can be used while installing the engaged teeth (as shown in the Figure).

The installation of its secondary transmission assembly and double-H gearshift mechanism is almost the same as the installation of common transmission, and the installation can be performed according to 12JS series transmission.

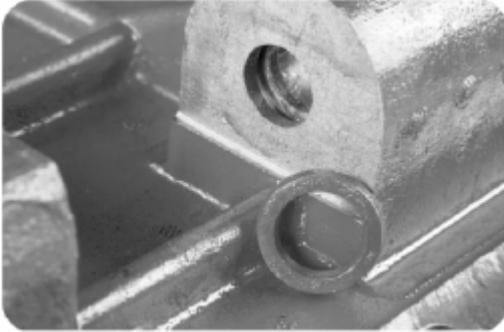
(IV) Installation of Primary Transmission Upper Cover

For the component exploded view of upper cover assembly, see the Figure 8-4.



1.2. Steel ball 3. O-ring 4. Interlock pin of fork shaft 5. Lock screw of fork 6. Stud bolt 7. Upper cover 8. Reverse guide block 9. Reverse fork 10. 1st/2nd speed gear fork 11. 3rd/4th speed gear fork 12. Fork of front secondary transmission 13. Reverse fork shaft 14. 1st/2nd speed gear fork shaft 15. Fork piston-rod of front secondary transmission 16. 3rd/4th speed gear fork shaft 17.18. Y-ring 19. End cover 20. Compression spring 21. Compression spring 22. 3rd/4th, 7th/8th speed gear guide block 23. Thin nut 24. Z nut 25. Spring washer 26. Spring retainer ring for hole 27. Nut 28. Reverse lock plunger 29. Reverse lock spring 30. Reverse lock screw plug

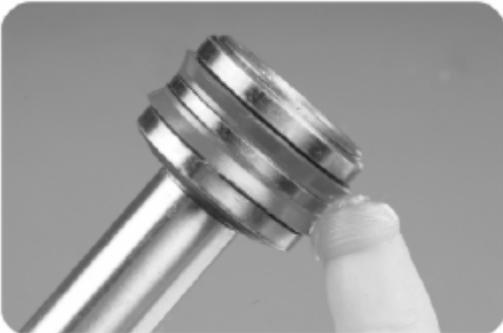
Figure 8-4 Component Exploded View of Upper Cover Assembly



(1) Y-ring inside even and odd gear gearshift cylinder hole on upper cover housing.



(4) Install the side cover with its level surface facing outside.



(2) Apply grease to Y-ring of piston axis, and install the axis into even and odd gear gearshift cylinder of upper cover housing.

Note: Direction of Y-ring.

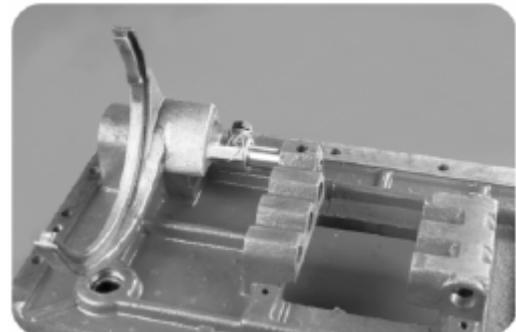


(5) Install the stop ring of gearshift cylinder.

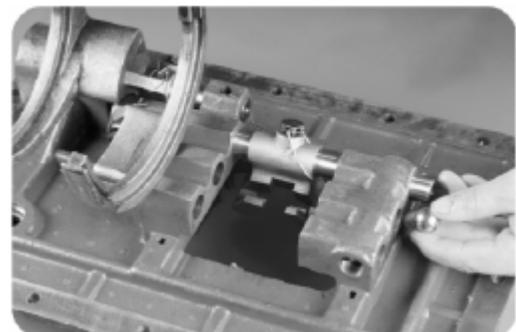


(3) Install the positioning steel ball of even and odd gear gearshift cylinder hole.

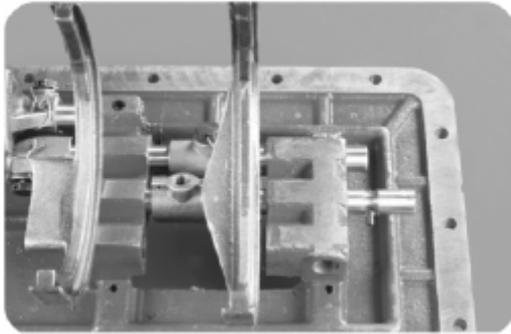
Note: the spring is in the low side, and the steel ball is in the upper side.



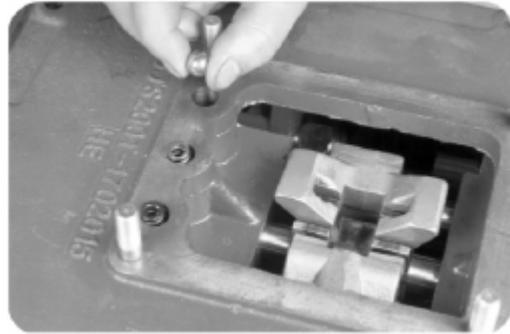
(6) Install the bolts of even and odd gear gearshift cylinder fork, and tighten them by using iron wire.



(7) Install 3th/4th speed gear fork shaft, guide block and fork, tighten the bolt, and attach one interlock steel ball.

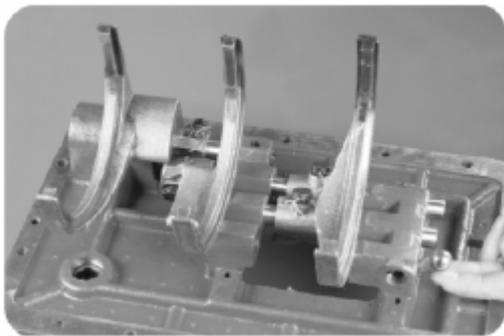


(8) Install 1st/2nd speed gear fork shaft and fork, and attach the interlock pin.

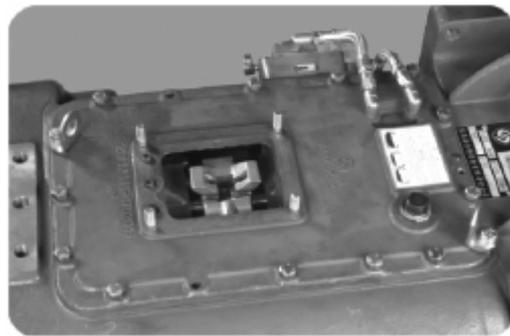


(12) Install 3 positioning steel balls and spring which are inside the upper cover hole.

Note: the spring inside 3th/4th speed gear fork shaft is much thicker.

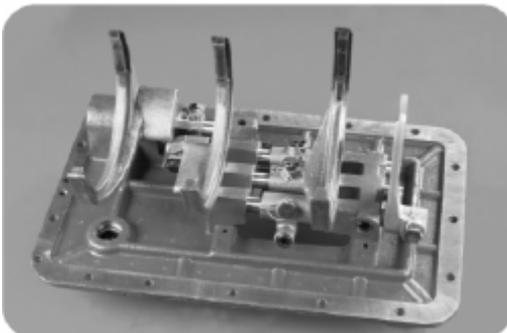


(9) Tighten the bolts of 1st/2nd speed gear fork and guide block, and fasten them by using iron wire. Install one interlock steel ball.

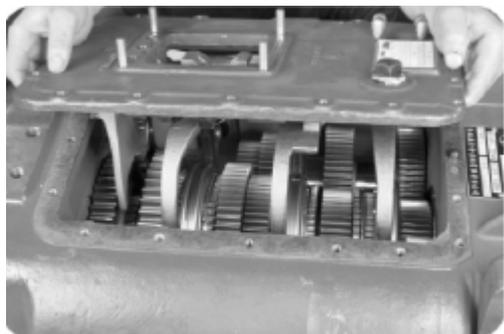


(13) Tighten the bolt of upper cover and air tube connecting the gearshift device and upper cover.

There is no difference between the rear secondary transmission and gearshift mechanism of 16JS series transmission and the common transmission with double output shafts. Therefore, please see the ones of 12JS series transmission for the installation procedures. Comparing with other transmission, there is much difference in the gearshift air line. The attention should be paid when the installation is performed again.



(10) Install the reverse fork shaft, guide block and reverse fork, and tighten the bolt.



(11) Install the upper cover assembly.

Section 9 Troubleshooting of Fast Transmission's Common Problems

The common malfunctions and the troubleshooting methods of Fast transmission are as follows:

1. Hard Shifting

If it is hard to shift during normal driving, first check if it is caused by a malfunction in the remote control shift lever mechanism. For the heavy-duty vehicle, Fast transmission applies the remote control shift mechanism. If the shift lever mechanism is not adjusted properly or the connector and bush are too tight or excessively worn, it will cause the problems of shift resistance increase and hard shifting. Especially with some gears hard engaged, adjust the shift crankarm support adjust screw on the transmission so that the handling lever mechanism is in a proper position.

Because that the lever handling selector lever or flexible shaft is not adjusted correctly, the transmission with double lever and H shift mechanism can not engage the gears on the border (such as the 9th reverse, creeping or 7th and 8th gear). At this time, remove the handling lever or flexible shaft from the selector lever, and then place the selector lever in the border gear positions. Adjust the length of handling lever or the flexible shaft in order to reach the limit gear positions. Link the handling lever or flexible shaft with the selector lever.

Now, all serials of the transmissions are equipped with the synchronizers. It is easy to shift for these transmissions. When it is hard to engage one gear, check if the synchronizer is burn generally. During handling the synchronizer transmission, please shift at a proper speed and so that it can reduce the wears of synchronizer and extend the life of the synchronizer. When shift between high/low speed gear nearby (such as the 4th and 5th gear on the 9th transmission). Shift and engage the high/low speed gear in proper interval. The shift is too quick and it is easy to burn the

If the remote control mechanism and the transmission shift crankarm are separated, operate the shift crankarm directly to shift and still find that it is hard to shift. It indicates that there are errors in the transmission. It is necessary to remove and check it. Generally, it is caused by the distorted shift shaft of the transmission cover, the deformed or excessive worn engagement sleeve and the output shaft or the loose lock pins of the shift shaft and rocker.

2. The Transmission Is in Neutral or Out of Gear

One gear is often out of gear during driving, especially abrupt acceleration or deceleration (the accelerator fails). It is mainly caused by that the long time strikes and wears between engagement sleeve and gear engagement teeth take the teeth into taper and it produces axial thrust against the engagement sleeves. It should replace the severely worn engagement sleeve or the gear. It is easy to cause the transmission out of gear by that the transmission input shaft and the flywheel shaft hole pilot bearing is not concentric. Of course it can also cause the transmission out of gear by the wears of shift rail positioning concave on the transmission cover and shift lock pin and the fails of the spring. Because of the long remote control shift mechanism lever, the driving may make the lever swing and so that the transmission is out of gear occasionally. Obviously the remote control mechanism is adjusted improperly, so that the engagement sleeve of one gear cannot be engaged in position. Even if only half of the gear is engaged that it also may make the transmission out of gear.

The secondary transmission out of gear is also caused by that the engagement sleeve is excessively worn or the engagement teeth are not engaged totally. In addition, please check if the secondary transmission output shaft two disc double cone bearing is loose. If it does, it is not only the secondary transmission out of gear but also the gear is broken.

Sometimes, the shifts are out of gear with the engine mount damaged.

3. There Is Only High Speed Gear without Low Speed Gear or There Is Only Low Speed Gear without High Speed Gear.

There is only the high speed gear without the low speed gear or there is only the low speed gear without the high speed gear during driving. It often occurs. It means that the vehicle drives in low speed gear and shifts to high speed gear, but it still drives in low speed gear. For example, when it drives in 4th gear and then shifts to 5th gear, in a result it drives in a lower gear. In general, this error occurs in the high/low speed gear handling system of the secondary transmission. When it occurs, first stop the vehicle and check that the air pressure of the whole vehicle meets the request. And then shift the gear lever left and right (high/low speed gear) in the neutral position. Observe if the double-H shift valve on the transmission upper cover produces crack exhaust sound. If without any response, it should check that the shift air piping relief valve is blocked or the air pressure outputs from the relief valve is too low, wash or replace the relief valve. When the gear lever shifts from the low speed gear to high speed gear, the double-H shift valve outlet continues to exhaust towards the external. It is obvious that the vehicle drives in low speed gear without high speed gear. Conversely, when the gear lever shifts from the high speed gear to low speed gear, the double-H shift valve outlet continues to exhaust towards the external. It is obvious that the vehicle drives in high speed gear without low speed gear. If it occurs, shift the gear lever left and right (high/low speed gear) in the neutral position repeatedly. In result, correct the problem. The O-ring of the double-H shift valve is not sealed tightly and it causes this problem. If shifting the gear lever repeatedly does not work, it indicates that the double-H shift valve or high/low speed gear cylinder is leaky. No matter any of them is leaky, it causes that there is only the high speed gear without the low speed gear or there is only the low speed gear without the high speed gear. It is simple to check for air leak. If the transmission has the low speed gear without the high speed gear, shift the gear lever from low speed gear to high speed gear and then remove the low speed gear shift cylinder intake connector 1 (As shown in Fig 2-12.) At this time, if the cylinder connector is leaky, it indicates that the shift cylinder is leaky. If the double-H shift valve outlet drains externally, it indicates that the double-H shift valve is leaky. In the same way, if the transmission has the high speed gear without the low speed gear, shift the gear lever to low speed gear and then remove the high speed gear shift cylinder intake connector 2 (As shown in Fig 2-12.). If it continues to drain externally, it indicates that the shift cylinder is leaky. If the double-H shift valve drains externally, it indicates that the double-H shift valve is leaky. The double-H shift valve malfunctions. Replace the whole valve without replaceable sealing ring. The high/low gearshift cylinder malfunctions. It is caused by that the large and small O-rings of the shift piston is worn and is not sealed tightly.

Please notice that the transmission has the high speed gear without the low speed gear, at the same time the double-H valve does not continue drain externally. It is caused by the leaky O-ring of shift lever. Replace the O-ring and it is ok.

4. Put into No Gears

It cannot put into any gears during driving and the shift lever is out of gear and in free state. It is caused by that the set pin on the shift shaft and rocker breaks. The rocker and the shift shaft are separated completely. The shift shaft does not work. For the old Fast transmission, the lock pin between the shift shaft and rocker is hollow spring taper pin. Because of the differences of thermal treatment, the hollow lock pin breaks often. It causes no gears malfunction. The recent Fast transmission adopts solid lock pin and in the way this error seldom occurs.

5. The Vehicle Cannot Start with Shifting Gear

Release the clutch with the start shift and the vehicle cannot start off normally. Once release the clutch, the engine stalls. This problem is as same as the fault that there is only high speed gear with low speed gear. In another word, because of the leaky double-H shift valve and high/low speed gear shift cylinder sealing ring or low shift circuit pressure, the secondary transmission cannot shift from the high speed gear to low speed gear. The vehicle starts off with high speed gear and it causes that the engine stalls. The solution is as same as the one for problems in the item 3..

6. Gears in Disorder

Because of the excessive wears of the shift rail interlock mechanism and shift zone lock, the gears are in disorder occasionally. With operating severely, it is easy to shift to two gears and it causes the gears in disorder.

7. Abnormal Noise of Transmission

There are many factors that they may cause the abnormal noise of the transmission. First check the position of abnormal noise with diagnostic. If the front of the transmission produces the abnormal noise, it indicates that the primary transmission or the secondary transmission has a fault.

The common noise includes several types. One of them is the knock noise or nibble sound. It is caused by that the teeth peel off or break with the strike or some teeth wear excessively. Also the broken bearing or excessive wears can produce the abnormal noise. This abnormal noise is obvious during running in low speed gear.

Another abnormal noise is the continue sound. It is a scream or roar. It is always caused by the rust of gear teeth surface or bearing. In a word, it is necessary to remove the transmission with abnormal noise for check and replace the excessive worn parts. When it needs to replace the gear for maintenance, replace the countershaft gear and the related output shaft gear in pairs.

If it is obvious that the abnormal noise producing from the secondary transmission output shaft and the output shaft flange move front and back at the same time. The problem is caused by that the secondary transmission output shaft double bearing is loose or damaged. So check and maintenance in time, or it may lead to a serious accident that the teeth break. Check and adjust the output shaft double bearing frequently in use.

Reinstall the transmission after it removes. If the transmission produces a heavy roar, it is evident that the transmission rotates abnormally. Do not assembly the transmission according to the request for mating teeth with re-installation. Generally, the output shaft and the countershaft cannot be installed like this. But if the gear wears excessively and the bearing is loose, one or more teeth displace and it can be installed. It rotates abnormally and produces large noise.

8. The Disassembled Transmission Does Not Rotate after Re-assembly

Obviously, do not install it according to the mating teeth procedure correctly. It does not rotate totally. This problem only exists in the old transmission.

The 16JS serial transmission designs fine teeth and the gear ratio range of the adjacent gears is small. Please take care of mating teeth during installation. Before installation, check the mating teeth mark carefully and install them in strict according with the mating teeth mark. Sometimes, the mating teeth are not precise and it can also be installed. After installation, the input shaft can also rotate several rounds but it will cause severe damage if the transmission assembled like this is installed in the vehicle with the engine running. With the installation of primary transmission countershaft, it is hard to align the countershaft to the bearing inner hole. It indicates that the mating teeth error during installation and check it carefully. After install the transmission, it needs to check that it rotates freely.

9. Transmission Overheating

Fast transmission allows the operation temperature is below 120°C. It is normal that the transmission is hot while driving in summer. But if the paint coating cracks by burns, the high temperature occurs. Take care to check it. There are many reasons for the transmission overheating. First excessive or lack of gear oil can cause overheating. Second, the abnormal wears of parts and the tight matching of the bearings can also cause overheating. It is caused by that the transmission runs in low speed gear with driving in high speed. The type of the transmission gear oil (especially, the viscosity) is not correct. The lubrication condition is bad that the transmission is overheating. The blocked transmission breather plug can cause the overheating and severe oil leak of the transmission from the input to the output end.

10. The PTO of Construction Truck Runs Abnormally and Cannot Shift to Neutral

It is mentioned above that Fast transmission secondary transmission countershaft takes off the power. So the transmission must shift to drive gear with PTO. When The PTO runs with the vehicle stopping, the secondary transmission must shift to the neutral gear. When the neutral lever shifts to the neutral position, the secondary transmission still runs in the low speed gear without the neutral gear. So first check if there is air flow in the shift cylinder connector (As shown in Figure 2-14.). Shift the neutral lever to the neutral position and remove the connector 6 and display no air pressure. It indicates that the neutral switch is blocked or damaged. If it displays enough air pressure, there is still no neutral gear and the double-H shift valve outlet continues to leak the air. It indicates that O-ring 7 of the neutral gear piston 4 is damaged or the sealing ring of high/low speed gear piston 9 is leaky (As shown in Figure 2-14.).

The shifting unit of the PTO is controlled by the electric PTO switch control solenoid. Turn on the switch and the solenoid is on. The compressed air enters into the PTO working cylinder and the working cylinder piston rod push the shifting unit of the PTO to link the PTO with the secondary transmission countershaft. Do not take off the power properly by the electro circuit, solenoid, air piping, and working cylinder errors. Check the electro circuit and air piping in order.

11. The Malfunction Is Caused by Gearshift Mechanism Air pipeline

It is mentioned above that RT11509C; 7JS; 8JS and 9JS serial transmission double-H shift air pipeline is easy to malfunction. 12JS serial high/low shift mechanism adopts the pre-selection valve control shift valve. The shift air piping control valve controls the air supply of the shift valve. If the high/low speed gear errors, check the 4 air piping elements of pre-selection valve, the neutral gear air piping control valve, shift gear and shift cylinder.

The primary transmission and the rear secondary transmission shift mechanism of 16JS serial transmission is the same as the common 9th transmission. So the malfunction diagnosis is similar to the one of the common 9th transmission. However, the half gear shift mechanism of the front secondary transmission is new. It consists of the pre-selection valve, the front secondary transmission shift gear, the front secondary transmission shift cylinder and the clutch switch valve. If the high/low half gear errors, check the 4 air piping elements mentioned above.

Table 9-1 Troubleshooting Table of Fast Transmission

Malfunction Types	Symptom	Repair Inspection	Replacement Standard
Gear Range Malfunction of Secondary transmission	High/low speed gear in Neutral of Secondary transmission	1. Leaky air filter	Replace the air filter
		2. Low pressure of air filter	Readjust the air filter Adjust the air pressure into the specified range
		3. The air filter is cracked	Replace the air filter and the related parts
		4. Hose or connector may be loose and leaky	Reinstall or replace the related parts
		5. The air pipe or connector is clamped flat	Reinstall or replace the related parts
		6. Combining teeth of synchronizer sleeve have taper	Replace the related parts
		7. Combining teeth of drive gear have taper	Replace the related parts
		8. Combining teeth of reducing gear have taper	Replace the related parts
		9.The output shaft distorts	Check the other damages and replace the related parts
		10.Because of the large pressure of the whole vehicle, the air filter malfunctions	Replace the related parts and adjust the air pressure of the whole vehicle
		11.Low pressure of the whole vehicle	Adjust the pressure
		12. Forks of high/low speed gear are worn	Replace the related parts
		13. The combination bearing is damaged	Replace the related parts and check the other damages
	Gear Range Malfunction of Secondary transmission	High/low speed gear in Neutral of Secondary transmission	Replace the air filter
		3. Low pressure of air filter	Readjust the air filter Adjust the air pressure into the specified range
		4. The air filter is cracked	Replace the air filter and the related parts
		5. Hose or connector may be loose and leaky	Reinstall or replace the related parts
		6. The air pipe or connector is clamped flat	Reinstall or replace the related parts
		7. The O-ring of shift cylinder is damaged	Replace the O-ring of cylinder
		8.Cylinder block and fork shaft are torn	Replace the related parts
		9. There is no lubricating oil in O-ring of cylinder and the piston is stuck	Reinstall and apply the lubricating oil
		10. There is excessive lubricating oil in O-ring of cylinder	Reinstall and apply the lubricating oil properly
		11. The double-H valve plug returns slowly	Replace the related parts
		12. Connection rod Mechanism of the whole vehicle shift falls off	Reinstall it

Table 9-1 (Continued)

Malfunction Types	Symptom	Repair Inspection	Replacement Standard
Gear Range Malfunction of Secondary transmission	No high/low speed gear zone	1. The high /low speed gear forks are installed in reverse	Reinstall it
		2. Install the Synchronizer in reverse	Reinstall it
		3. The nuts of cylinder piston are loose	Reinstall it
		4. The fork shaft of high /low speed gear cylinder piston is rust and seized	Reinstall it
		5. Because of the large pressure of the whole vehicle, the air filter malfunctions	Readjust the pressure of the whole vehicle and check the air filter and adjust the pressure into the specified range
		6. the spring of synchronizer is damaged	Replace the related parts
		7. The synchronizer high speed gear taper ring upper lock pin is broken	Replace the related parts
		8. The synchronizer low speed gear taper ring upper lock pin is broken	Replace the related parts
		9. The synchronizer high speed gear taper ring is broken	Replace the related parts
		10. The synchronizer low speed gear taper ring is broken	Replace the related parts
		11. The double-H valve plug is installed in the handling mechanism and the stroke of it cannot be reached	Readjust or replace the related parts
		12. The double-H valve plug is stuck	Replace the H valve
		13. The double-H valve plug is worn	Replace the H valve
		14. The double-H valve retaining screws are loose	Reinstall them
		15. The double-H valve end plastic cap is damaged	Replace the related parts
	Primary transmission in neutral or out of the gear	1 The fork is worn	Replace the fork and related parts
		2. The self-lock spring becomes weak	Replace the self-lock spring
		3. The self-lock spring is left during installation	Reinstall the self-lock spring
		4. The gear leaves the mating position because of the distortion of the shaft	Check the other damages, replace the related parts and mate the gear against
		5. Combining teeth or throw into gear sliding bush have tape	Replace the related parts
		6. The sliding bush fork packet is worn and the gear is not shifted in position	Replace the related parts
		7. The Input shaft and the engine pilot bearing are not concentric	Replace the related parts
		8. Driving on a bumpy road , the handling mechanism connecting rod is wiggled too large	Adjust the handling mechanism connecting rod and reduce the wiggle amount
		9. the taper face of Synchronizer throw into gear is worn	Replace the related parts
		10. The fork shaft shift gate is worn excessively	Replace the related parts
	Hard shifting or impossible to shift of the primary transmission	1. The fork shaft is distorted	Replace the related parts
		2. There are burs in the hole of fork shaft	Grinding the hole of fork shaft
		3. The lock spring is too hard	Replace the related parts
		4. The shift gear mechanism case is cracked	Replace the related parts
		5. The spindle is distorted	Check the other damages and replace the related parts
		6. The shift counter bore is large	Grinding the counter bore
		7. The rotation angle of head around the fork shaft is large	Replace the related parts
		8. The clearance of primary transmission synchronizer taper ring is large	Replace the related parts
9. The friction material of synchronizer is worn early		Replace the related parts	
10. The hollow spring lock of the reverse control block comes off		Reinstall it	
11. The fork is broken		Replace the related parts	
12. The fork is worn		Replace the related parts	
13. The fork is distorted		Replace the related parts	

Table 9-1 (Continued)

Malfunction Types	Malfunction Symptom	Repair Inspection	Replacement Standard	
Gear Zone Malfunction of Secondary transmission	Hard shifting or impossible to shift of the primary transmission	11. The reverse lock spring is hard	Replace the related parts	
		12. the leverage ratio of the transmission shift is low (the shift rocker is short)	Replace the related parts, or readjust the leverage ratio	
		13. The third and fourth shift head is upward	Replace the related parts	
		14. The shift connection rod mechanism is operated improperly	Reinstall it and perform the troubleshooting	
		15. The shift booster is leaky	Replace the related parts	
		16. The shift booster is broken down	Replace the shift booster	
		17. The stop ring comes off	Reinstall it	
		18. There is a malfunction in the clutch and the release mechanism	Replace the related parts	
		19. Input shaft nut is loose	Reinstall it and replace the related parts	
	impossible to shift	1. The spindle is distorted	Check the other damages and replace the related parts	
		2. One shift Synchronizer of the primary transmission is burn	Replace the related parts	
		3. The hex key of the spindle is broken and one gear of it displaces	Replace the related parts	
		4. The shift counter bore is clamped in the head	Draw the counter bore out and reinstall it	
		5. The shift counter bore get out of the pocket	Reinstall it	
		6. The fork lock screw is loose	Reinstall it	
		7. The stop ring takes off	Reinstall it	
		8. There is a malfunction in shift connection rod mechanism of the whole vehicle	Reinstall it and perform the troubleshooting	
		9. Miss to install the adjust pad and spline pad	Reinstall the missing parts and replace the related parts	
	The shift is not in order	1. Miss to install the interlock pin	Reinstall the related parts	
		2. Miss to install the interlock ball	Reinstall the related parts	
		3. The hex key of the spindle is broken and one gear of it displaces	Replace the related parts and reinstall it	
		4. The fork lock screw is loose	Reinstall it	
		5. Upper cover assembly case is cracked	Replace the related parts	
		6. The input shaft nut is loose	Reinstall it and replace the related parts	
No reverse or high speed gear	1. There is a malfunction in shift connection rod mechanism of the whole vehicle	Reinstall it and perform the troubleshooting		
The speed is high in reverse or the engine stalls in start	1. The connection of high/low speed gear duct is not proper	Reinstall it		
Air piping have a fault	The transmission air piping have a fault	No high speed gear zone	1. The double-H valve plug cannot be compressed completely	Replace the double-H valve plug
			2. The breather plug of low speed gear cannot vent	Wash the breather plug
			3. The gas pipe cannot vent smoothly or the pre-selection valve is leaky	Reinstall it and replace the related parts
			4. There is blowhole in the cylinder block	Replace the related parts
			5. Because of the large pressure of the whole vehicle, the air filter malfunctions	Readjust the air pressure of the whole vehicle, check the air filter with the air pressure into the specified range
			6. The high/low speed gear indicator is loose, leaky or missing	Reinstall it and replace the related parts
	No low speed gear zone	1. The double-H valve plug cannot stretch properly	Replace the related parts	
		2. The breather plug of high speed gear cannot vent	Wash the breather plug	
		3. The pre-selection valve cannot ventilate	Replace the related parts	
		4. The middle position cylinder is always ventilated	Replace the O-ring of the cylinder	

Table 9-1 (Continued)

Malfunction Types	Malfunction Symptom	Repair Inspection	Replacement Standard	
Air piping have a fault	The transmission's air piping have a fault	5. There is blowhole in the cylinder block	Replace the related parts	
		6. Because of the large pressure of the whole vehicle, the air filter malfunctions	Readjust the air pressure of the whole vehicle, check the air filter with the air pressure into the specified range	
		The double-H valve plug is always ventilated	1. The O-ring of shift cylinder is damaged	Replace the O-ring of the cylinder
			2. The double-H valve is blown by	Replace the double-H valve
		The double-H valve plug is not ventilated	3. The O-ring of the middle position cylinder is damaged	Replace the O-ring of the cylinder
			1. The breather plug is blocked	Wash the breather plug
		The high/low speed gear cannot be shifted	1. The double-H valve does not work	Replace the double-H valve
			2. the air filter (without venting and with low air pressure)	Replace the air filter or adjust the air filter into the specified range according to the specific condition
			3. the cylinder is stuck	Reinstall it
			4. the air pressure does not reach into the air filter	Check the gas pipe
	5. The breather plug does not vent		Wash the breather plug	
	The high/low speed gear is shifted slowly	1. The air piping system's pressure is low	Adjust the air piping's pressure into the specified range	
		2. The double-H valve breather plug exhausts slowly	Wash the breather plug or replace the double-H valve	
		3. The air filter is leaky	Replace the air filter	
		4. The gas pipe cannot vent smoothly	5. Reinstall it or replace the related	
	The air pipe connector is leaky	1. Hose or connector is loose and leaky. The connector is cracked	Reinstall it or replace the related parts	
	PTO's air piping have a fault	Do not take off the power during the vehicle stops	1. The middle position cylinder does not vent	Check if the whole vehicle solenoid fails
			2. the air filter (with high outlet pressure or without gas)	Adjust or replace the air filter
			3. The O-ring of the middle position cylinder is damaged	Replace the O-ring of the cylinder
			4. PTO does not engage the gear or do completely	Remove or and check the PTO
			5. PTO cylinder exhaust port is blocked	Wash the breather plug
			6. The electrical control of the whole vehicle PTO fails	Replace the related parts
		Do not take off the power during driving	1. The middle position cylinder always vents	Replace the O-ring of the cylinder
2. PTO does not engage the gear or do completely			Remove or and check the PTO	
3. PTO cylinder exhaust port is blocked			Wash the breather plug	
4. The electrical control of the whole vehicle PTO fails			Replace the related parts	
Air leak	1. The O-ring of the cylinder is damaged	Replace the O-ring of the cylinder		
	2. the cylinder is stretched	Replace the related parts		
The pressure switch is leaky	1. The switch have a fault	Replace the switch		
Oil leak	There is an oil leak in the adjoining plane of bottom PTO window cover	1. The housing casting is defective (blowhole, loose)	Replace the housing	
		2. Miss to install the paper pad or it is damaged	Replace the paper pad	
		3. Miss to apply the sealant or apply it unevenly	Reapply it	
		4. The set screw is loose or it runs away	Reinstall it	
	There is an oil leak in the output shaft of PTO	1. The oil seal is damaged	Replace the oil seal	
		2. The working surface of flange and oil seal is worn	Replace the related parts	
		3. The working surface of output shaft and oil seal is worn	Replace the related parts	
		4. The flange screw of PTO is loose	Reinstall it	

Table 9-1 (Continued)

Malfunction Types	Malfunction Symptom	Repair Inspection	Replacement Standard
Oil leak		5. The small driving shaft of PTO swings largely	Replace the related parts
	There is an oil leak in the odometer drive	1. The oil seal or O-ring is damaged	Replace the related parts
	There is an oil leak in the drain plug or oil surface sight glass plug	1. Miss to apply the sealant or apply it unevenly	Reapply it
		2. The plug is not tightened	Reinstall it
	There is an oil leak in the double-H valve breather plug	1. The O-ring of the cylinder is damaged	Replace the O-ring of the cylinder
		2. The double-H valve is not sealed properly	Replace the double-H valve
	There is an oil leak in the shift rocker arm	1. The oil seal is damaged	Replace the oil seal
		2. The compressed air enters into the transmission	Replace the O-ring of the cylinder
	There is an oil leak in the joint surface of the rear bearing cover and the rear cover	1. The casing casting is defective	Replace the related parts
		2. Miss to install the paper pad or it is damaged	Replace the paper pad
		3. Miss to apply the sealant or apply it unevenly	Reapply it
		4. The oil level is too high	Drain the excessive gear oil
		5. The output shaft bearing is damaged	Replace the related parts
		6. The set screw is loose or it runs away	Reinstall it
	There is an oil leak in the joint surface of the clutch casing and the primary transmission	1. The casing casting is defective (blowhole, loose)	Replace the casing
		2. Miss to install the paper pad or it is damaged	Replace the paper pad
		3. Miss to apply the sealant or apply it unevenly	Replace the paper pad
		4. The set screw is loose or it runs away	Reinstall it
	There is an oil leak in the joint surface of the PTO	1. The casing casting is defective (blowhole, loose)	Replace the casing
		2. Miss to install the paper pad or it is damaged	Replace the paper pad
		3. Miss to apply the sealant or apply it unevenly	Replace the paper pad
		4. The set screw is loose or it runs away	Reinstall it
	There is an oil leak in input shaft of PTO	1. The O-ring is damaged	Replace the O-ring
		1. The casing casting is defective (blowhole, loose)	Replace the casing
		2. Miss to install the paper pad or it is damaged	Replace the paper pad
		3. Miss to apply the sealant or apply it unevenly	Replace the paper pad
There is an oil leak in the joint surface of the welding shaft bearing cover and the rear cover	4. The set screw is loose or it runs away	Reinstall it	
	1. The casing casting is defective (blowhole, loose)	Replace the casing	
	2. Miss to install the copper pad	Reinstall it	
	3. Miss to apply the sealant or apply it unevenly	Reapply it	
There is an oil leak in the joint surface of the pressure switch and the handling device	4. The vent hole is blocked	Clean away the contamination in the vent hole	
	5. The switch is loose or the screw runs away	Reinstall it	
	6. There is an oil leak in the pressure switch	Replace the related parts	
	1. The O-ring of the cylinder is damaged	Replace the O-ring of the cylinder	
There is an oil leak in the joint surface of the upper cover and the primary transmission	1. The casing casting is defective (blowhole, loose)	Replace the casing	
	2. Miss to install the paper pad or it is damaged	Replace the paper pad	
	3. Miss to apply the sealant or apply it unevenly	Reapply it	
	4. The compressed air enters into the transmission	Replace the related O-ring	
	5. The breather plug is blocked	Wash the breather plug	
	6. The set screw is loose or it runs away	Reinstall it	
There is an oil leak in the joint surface of the double-H and the upper cover	1. The casing casting is defective (blowhole, loose)	Replace the casing	
	2. Miss to install the paper pad or it is damaged	Replace the paper pad	
	3. Miss to apply the sealant or apply it unevenly	Reapply it	
	4. The compressed air enters into the transmission	Replace the related O-ring	

Table 9-1 (Continued)

Malfunction Types	Malfunction Symptom	Repair Inspection	Replacement Standard
Oil leak	There is an oil leak in the joint surface of the double-H and the upper cover	5. The breather plug is blocked	Wash the breather plug
		6. The set screw is loose or it runs away	Reinstall it
	There is an oil leak in the joint surface of the double-H valve and the double-H casing	1. The casing casting is defective (blowhole, loose)	Replace the casing
		2. Miss to install the paper pad or it is damaged	Replace the paper pad
		3. Miss to apply the sealant or apply it unevenly	Reapply it
		4. The oil level is too high	Drain the excessive gear oil
		5. The breather plug is blocked	Wash the breather plug
		6. The set screw is loose or it runs away	Reinstall it
	There is an oil leak in the joint surface of the rear cover and the primary transmission	1. The casing casting is defective (blowhole, loose)	Replace the casing
		2. Miss to install the paper pad or it is damaged	Replace the paper pad
		3. Miss to apply the sealant or apply it unevenly	Reapply it
		4. The compressed air enters into the transmission	Replace the related O-ring
		5. The breather plug is blocked	Wash the breather plug
		6. The set screw is loose or it runs away	Reinstall it
	There is an oil leak in the joint surface of the input shaft bearing cover and the primary transmission	1. The casing casting is defective (blowhole, loose)	Replace the casing
		2. Miss to install the paper pad or it is damaged	Replace the paper pad
		3. Miss to apply the sealant or apply it unevenly	Reapply it
		4. The oil level is too high	Drain the excessive gear oil
		5. The breather plug is blocked	Wash the breather plug
		6. The set screw is loose or it runs away	Reinstall it
	There is an oil leak in the joint surface of the brakes	1. The casing casting is defective (blowhole, loose)	Replace the casing
		2. Miss to install the paper pad or it is damaged	Replace the paper pad
		3. Miss to apply the sealant or apply it unevenly	Reapply it
		4. The oil level is too high	Drain the excessive gear oil
		5. The breather plug is blocked	Wash the breather plug
		6. The set screw is loose or it runs away	Reinstall it
	There is an oil leak in the input shaft oil seal	1. The oil seal is damaged	Replace the oil seal
		2. The working surface of the input shaft and oil seal is worn	Replace the related parts
3. The oil level is too high		Drain the excessive gear oil	
4. The compressed air enters into the transmission cavity		Replace the related O-ring	
5. The runout of the input shaft bearing is large		Replace the related parts	
6. The oil return hole is blocked		Reinstall it and clear the oil return hole	
There is an oil leak in the transmission output shaft oil seal	1. The input shaft and engine pilot bearing are not concentric	Replace the related parts	
	1. The oil seal is damaged	Replace the related parts	
	2. The working surface of the flange and oil seal is worn	Replace the related parts	
	3. The oil level is too high	Drain the excessive gear oil	
	4. The compressed air enters into the transmission	Replace the related O-ring	
	5. The runout of the output shaft bearing is large	Replace the related parts	
	6. The oil return hole is blocked	Reinstall it and clear the oil return hole	
	7. Do not adjust the balance of the propeller shaft completely and it causes the vibration	Adjust the balance of the propeller shaft	
	8. The rear bearing cover and the rear cover are not concentric	Replace the related parts	
9. The flange circumference and inner splined hole are not concentric	Replace the related parts		

Table 9-1 (Continued)

Malfunction Types	Malfunction Symptom	Repair Inspection	Replacement Standard
Oil leak	There is an oil leak in the transmission output shaft oil seal	10. The rear nut is loose	Reinstall it
	There is an oil leak in the transmission breather plug	1. The compressed air enters into the transmission	Replace the related O-ring
		2. The oil level is too high	Drain the excessive gear oil
	There is an oil leak in the pressure switch	1. The pressure switch is defective	Replace the related parts
Unusual noise of the transmission	Large noise of the transmission	1. The gear is affected by the distorted shaft and runs away from the mating position	Check the other damages and replace the related parts
		2. The gear is cracked or the teeth have burs	Replace the related parts
		3. The tolerance of the main shaft gear is too large	Replace the related parts
		4. The secondary transmission intermediate shaft front bearing cone takes off	Reinstall the bearing cone and replace the related parts
		5. Do not lubricate the bearing properly	Replace the related parts
		6. The oil level is too low	Replace the related parts and check it
		7. The lubrication is bad in quality	Add the lubrication
		8. Do not change the lubrication in time	Change the lubrication
		9. Mix to use different lubrication	Change the lubrication
		10. Do not adjust the balance of the propeller shaft completely and it causes the vibration	Adjust the balance of the propeller shaft
		11. The gear surface is pitted and peels off	Adjust the balance of the propeller shaft
		12. The bearing does not work	Replace the related parts
		13. The rear cover casing bearing hole is large	Replace the related parts
		14. The output shaft nut is loose	Retighten it and replace the related parts
		15. The adjust pad and spline pad are worn	Replace the related parts
		16. The input shaft nut is loose	Retighten it and replace the related parts
	The gear on the transmission breaks	1. It is caused by the overloading	Replace the related parts
		2. The gear misses to mesh	Replace the related parts
		3. Improper lubrication causes that the gear misses to mesh	Replace the related parts
		4. An improper operation (for example, shift to a low speed gear suddenly during driving uphill with heavy load)	Replace the related parts
		5. The long key of output shaft breaks	
	It produces noise with the transmission in neutral	1. The tolerance of the main shaft gear is too large	Replace the related parts
		2. Engine idles roughly	Adjust the engine idle
		3. The clutch disc spine wears and the pilot bearing and pressure plate faults	Replace the related parts
		4. The gear clearance of the main shaft is large	Readjust it
		5. The joint part of the transmission output shaft end and the secondary transmission drive gear wears	Replace the related parts
		6. It causes by the resonance	Eliminate the resonance
		7. The fork is against the sleeve	Reassembly it
		8. The neutral position of the head is not correct	Reassembly it
		9. The gear cracks	Replace the related parts
10. Miss to install the guide sleeve and it wears and cracks		Reinstall it or replace the related parts	
It produces noise with high/low speed gear shifting	1. It produces noise with shifting from high to low speed gear and high speed gear synchronizer taper ring friction material wears abnormally	Replace the related parts	
	2. It produces noise with shifting from low to high speed gear and low speed gear synchronizer taper ring friction material wears abnormally	Replace the related parts	

Table 9-1 (Continued)

Malfunction Types	Malfunction Symptom	Repair Inspection	Replacement Standard	
Unusual noise of the transmission	It produces noise with high/low speed gear shifting	3. one or more lock pins on the high speed gear synchronizer taper ring is loose	Replace the related parts	
		4. one or more lock pins on the low speed gear synchronizer taper ring is loose	Replace the related parts	
		5.The air pipe is flatted and the air flow is blocked	Fix it or replace the related parts	
		6.The air filter pressure is low	Replace the air filter	
	It produces noise with the transmission linked	1. The input shaft bearing cover breaks	Replace the input shaft bearing cover	
		2. The release bearing is damaged	Replace the related parts	
		3. The speed difference between the adjacent gears is large and out of step	Operate it correctly	
		4. The clutch does not disengage and is wrapped	Adjust the clutch	
	It produces noise with the low speed gear zone	1.Miss to weld the welding shaft or sealing-off occurs	Replace the related parts	
		2. The welding shaft gear and the reduction gear is pitted	Replace the related parts	
		3. The drive gear stop collar takes off	Reinstall it	
	It produces noise with the high speed gear zone	1. The drive gear is pitted	Replace the related parts	
		2.It is caused by the rear axle faults	Troubleshoot the rear axle faults	
	The transmission is overheating		1. The gear leaves the mating position because of the distortion of the shaft	Check the other damages and replace the related parts
			2.The bearing does not work	Replace the related parts
			3. The oil level is low	Add the lubrication
			4. The oil level is high	Drain the excessive gear oil
			5. The lubrication is bad in quality	Change the lubrication and replace the related parts
			6. Do not change the lubrication in time	Change the lubrication and replace the related parts
			7. Mix to use different lubrication	Change the lubrication and replace the related parts
8.The operating angle of the transmission is over 12°			Operate the transmission correctly and apply more lubrication	
9.The vehicle speed is always below 32km/h and too low			Operate the transmission correctly	
10. The engine speed is too high			Drive correctly	
11.The air blow around the transmission is blocked			Verify that the air blow around the transmission is fluency	
12.The engine exhaust system is too near the transmission			Eliminate the interference for the transmission	
13. The ambient temperature is high			Cool down by free or force	
14.Drive with overloading and over-speed			Drive correctly	
a mechanical malfunction of PTO	Hard shifting or impossible to shift of PTO	1.The set screw of cylinder piston is loose or it runs away	Reinstall the set screw	
		2. The fine pitch screw of PTO is loose or it runs away	Reinstall or replace the set screw	
		3. install the throw into gear sliding bush in reverse	Reinstall it	
		4.PTO fork lock screw is loose. runs away or breaks	Reinstall or replace the set screw	
		5.The return spring material in the cylinder is defective	Replace the return spring	
		6. The cylinder turns to rust and the piston is stuck	Replace the related parts or reinstall them	
		7. The electrical control of the whole vehicle PTO fails	Replace the related parts	
The whole vehicle instrument panel displays nothing or errors	The odometer passivity is broken	1. It is caused by externally occasional factors	Replace the related parts and check the other causes	
		2. There are problems in the quality of the main shaft rear bearing cover	Replace the related parts	
		3.The strength of the odometer passivity is not enough	Replace the related parts	

Table 9-1 (Continued)

Malfunction Types	Malfunction Symptom	Repair Inspection	Replacement Standard
The whole vehicle instrument panel displays nothing or errors	The odometer passivity is broken	Mismatch the activity and passivity of odometer	Reinstall the correct parts
		the activity and passivity of odometer cooperate properly	Reinstall them
	The related parts of the whole vehicle circuit fails		
others	Casing cracks	1. It is caused by the casting itself	Replace the casing
		2. The thread hole position in the support is not correct	Replace the casing and the related parts
		3. It is caused by the resonance	Eliminate the resonance and replace the casing
		4. The engine mount is damaged	Replace the related parts and the casing
		5. Do not adjust the balance of the propeller shaft completely	Adjust the balance of the propeller shaft and replace the casing
		6. It is caused by occasional factors	Replace the casing, check the other damages
	The input shaft is burn	1. Do not clear the burs away	Replace the related parts
		2. There are sundries between the input shaft and bearing cover	Replace the related parts
		3. The release unit is broken	Replace the related parts
		4. The input shaft bearing is burn	Replace the related parts
	The input shaft bearing cover is broken	1. The release unit is broken	Replace the related parts
		2. The parts have errors	Replace the related parts
		3. There are no lubrication in the release bearing seat	Replace the related parts
		4. The clutch housing release fork shaft copper bush wears	Replace the related parts
	The input shaft breaks	1. The release unit is broken	Replace the related parts
		2. The machining parts have errors	Replace the related parts
		3. It is caused by occasional factors	Replace the related parts
		4. The brake is not released	Replace the related parts and release the brake
		5. It is shifted to an unreasonable gear	Drive correctly
	The other occasional factors cause the transmission damaged	1. The output shaft wears	Replace the related parts
		2. The output shaft breaks	Replace the related parts
		3. The output shaft burns through	Replace the related parts
		4. The flange moves	Replace the related parts
		5. The flange hole deforms	Replace the related parts
	The other occasional factors cause the transmission damaged completely		Replace the assembly and check the other damages
	the whole vehicle neural, reverse, and high/low speed gear display nothing or errors	1. There are burs in the pressure switch control pin hole	Grind the control pin
		2. The pressure indicator switch fails	Replace the related parts
		3. The related parts of the whole vehicle circuit fails	Replace the related parts
The bearing fails	1. The holder is damaged	Replace the related parts	
	2. There is a pressure mark	Replace the related parts	
	3. Slipping occurs between mating surface	Replace the related parts	
	4. It is burn	Replace the related parts	
	5. It cracks	Replace the related parts	
	6. It wears	Replace the related parts	
	7. It abrades	Replace the related parts	

Section 10 Use and Maintenance of Fast Transmission

The special requirements for the use and maintenance should be noticed as the construction features of Fast transmission

1. Use and Maintenance

Firstly, the attention should be paid to the requirements for starting off and shifting gears when the operation is performed. As there are the clutch brake, the clutch pedal should be depressed until resistance becomes obvious before starting off and shifting gears, and the pedal is depressed continuously to turn on the brake switching valve (the spring of brake switching valve is set rigidly, so the operator can have a obvious feel), then the gear will be shifted before the brake begins to operate. Otherwise, the clutch may not be detached. If you do not feel that the clutch is not detached when the gear is shifted in the first time but the gear cannot be shifted, the teeth of sliding sleeve just touch the ones of gear at this moment. The clutch pedal is required to be raised once at this moment, and then you should depress the clutch pedal as required. Therefore, the gears will be easily shifted. It is not necessary to use clutch brake when the vehicle is moving.

If the vehicle is not equipped with the clutch brake, the gears can also be shifted smoothly after a moment that the clutch is depressed while starting off.

The allowable working temperature of Fast transmission is 120 as stated above, so it is a normal phenomena that the working temperature of this transmission is higher than the one of others. It doesn't matter if the oil is not lacked. If you find the transmission overheated, please verify the cause. The vent hole of transmission should be inspected regularly for its easy pass. Otherwise, it could cause overheating and oil leakage.

As the gear shift operation is performed on both the primary transmission and secondary transmission when the transmission is switch from High to Low, the attention should be paid to the operation: there will be intervals during the operation when the gears are shifted from high to low or low to high, that is: push the shift lever from low speed gear zone towards high speed gear zone, stop a minute and then push it to high speed gear zone. This operation can also be stated as this: first, secondary transmission is switched from low to high, and then the gear shift should be performed on the primary transmission and vice versa. If the gear is shifted quickly from low to high and the clutch is raised unexpectedly, it can easily cause the teeth to be crashed.

Avoid decelerating the vehicle by shifting low speed gear as much as possible when the vehicle is moving downhill. Especially, the gear cannot be shifted suddenly into low speed gear zone to decelerate the vehicle when the vehicle is moving in high speed gear zone, such operation can always cause the synchronizer of secondary transmission to be burned.

The coast must not be performed on the vehicle by neutral position or stall while the vehicle is moving, and the coast operation which is performed by idling or neutral gear is not suggested commonly, just the same as common transmission. If the vehicle need to be towed away in a high speed at the long distance for the reason that there is a malfunction in the engine, the joint flange connecting the propeller shaft and drive axle must be removed. Otherwise, it will cause the output shaft and spline gasket of transmission to be burned heavily.

2. Transmission Oil

Fast transmission is featured by heavy duty and large torque. Therefore, the added gear oil is API GL-5 grade or above and the viscosity brand number is SAE85W/90. The new oil should be added to the new vehicle when driving for 2000-2500 kilometers, and such oil changing operation should be performed when the vehicle is operating.

Section 11 Repair Special Tool for Fast Transmission

1. Fast Transmission Tool Set (TZ-FL00)

Fast transmission tool set is the matched tool which is necessary for removing and installing the transmission, it consists:

1) Wrench for Input Shaft Nut (TZ-FL01)

The lock nut of Fast transmission input shaft is a hexagon nut whose across flat is 70 mm, and the special nut wrench is required when such nut is removed or installed during its repair as shown in the Figure 1a.

When using, two gears should be first shifted at the same time, or the input shaft of transmission should be fixed by other methods. Then, pass the wrench socket through the input shaft, and remove or install it by turning socket collet as shown in the Figure 1b.



Figure 2a Front bearing Extractor of Countershaft of Primary Transmission

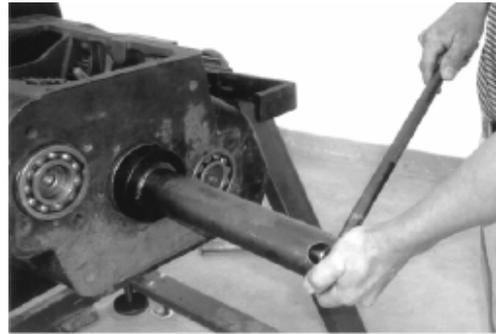


Figure 2b Remove The Front Bearing of Countershaft of Primary Transmission by Using Extractor

The left hand thread is for input shaft nut, and the attention should be paid when removing or installing. This nut wrench can be universally used for all series of transmission.

2) Front Bearing Extractor of Countershaft of Primary Transmission (TZ-FL02)

This gear should be pulled out when disassembling the transmission or changing the front bearing (370309Y) of countershaft of primary transmission, and the front bearing extractor of countershaft of primary transmission is required to be used at this moment as shown in the Figure 2a.

When the front bearing of countershaft of primary transmission is removed, tap the front end of primary transmission housing first by using copper bar to move the shaft outside a little. Remove the snap ring by using circlip pliers. Attach the front ring notch of extractor to the snap ring notch of bearing as shown in the Figure 2b. Tighten the extractor screw by turning it, and the bearing can be pulled out smoothly. This extractor can be universally used for all series of transmission.



Figure 2a Front bearing Extractor of Countershaft of Primary Transmission

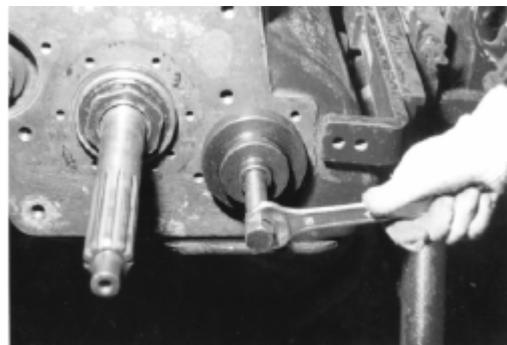


Figure 2b Remove The Front Bearing of Countershaft of Primary Transmission by Using Extractor

3) Front Bearing Extractor of Countershaft of Secondary Transmission (TZ-FL03)

When disassembling Fast transmission which has a secondary transmission, the front bearings on the 2 countershafts of the secondary transmission should be first removed after the secondary transmission

assembly is detached from primary transmission.

As this bearing cone is on the countershaft of secondary transmission, the special extractor should be used when this bearing is removed as shown in the Figure 3a.

Firstly, place the main body of extractor into the bearing slightly as shown in the Figure 3b, and then place the main body upwards as shown in the Figure 3c. Turn the extractor inner ring into the main body as shown in the Figure 3d. At this moment, the extractor functions as a whole body which is formed by the bearing cone and bearing. At last, turn the reverse shaft extractor into the main rod of main body, and struck the heavy hammer of extractor backwards to pull out the bearing smoothly

The front bearing model of countershaft of secondary transmission for RT11509, 7JS, 8JS, 9JS series transmission is 42307E, and the model for 12JS and 16JS series transmission is 42308E. Therefore, they cannot be replaced each other for use, and we have prepared 2 sets in the special tools.



Figure 3a Front Bearing Extractor of Countershaft of Secondary Transmission

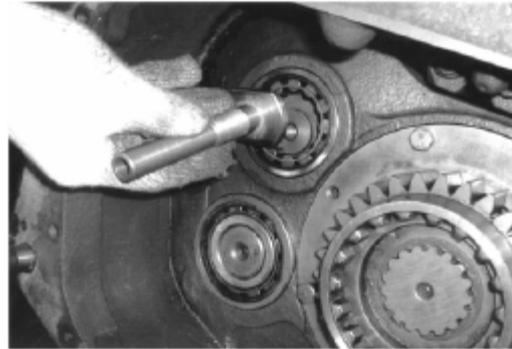


Figure 3a Front Bearing Extractor of Countershaft of Secondary Transmission

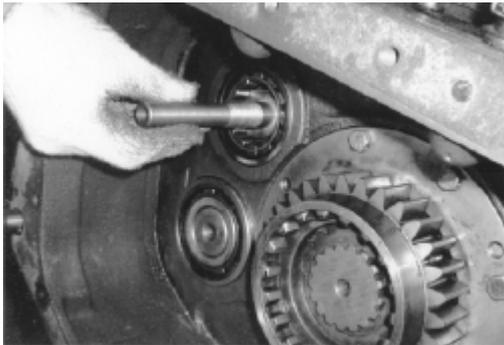


Figure 3c Place The Main Body of Extractor Upright

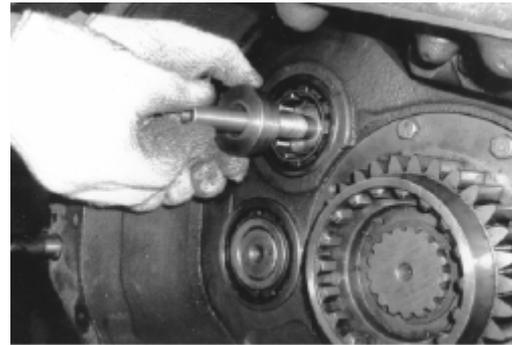


Figure 3d Turn The Inner Ring of Extractor into Bearing

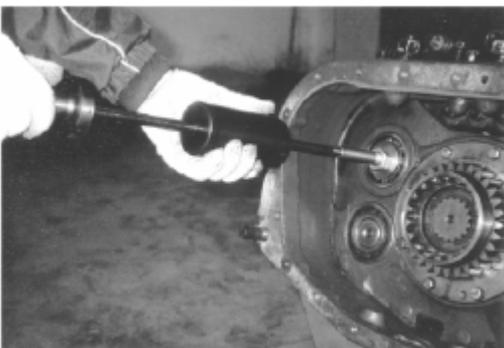


Figure 3e Pull Out The Bearing by Using Reverse Shaft Extractor

4) Secondary Transmission Shackle (TZ-FL04)

When the primary transmission and secondary transmission are detached, it is preferred to use the secondary transmission shackle as shown in the Figure 4a.

When the secondary transmission sub-assembly is removed, all joint bolts connecting the secondary transmission housing and primary transmission housing should be removed, and then pry the secondary transmission housing backwards by using crow bar, and set the secondary transmission shackle to the middle position on the upper side of secondary transmission housing by using 2 bolts as shown in the Figure 4b, and the shackle should be attached to the crane securely. At last, the secondary transmission is detached from primary transmission by using crow bar.

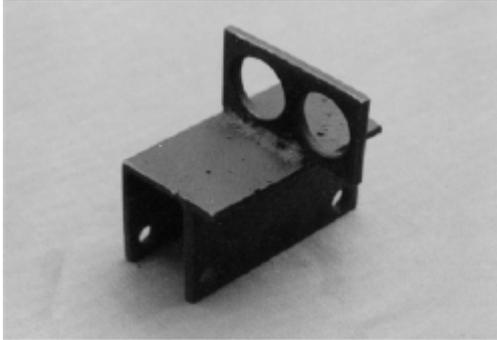


Figure 4a Secondary Transmission Hanger

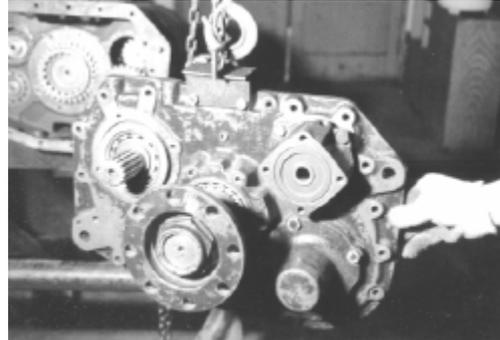


Figure 4b Remove or Install Secondary Transmission Sub-assembly by Using Secondary Transmission Hanger

When the secondary transmission sub-assembly is installed, the secondary transmission sub-assembly is lifted to the position which is parallel with primary transmission by the secondary transmission shackle, and the secondary transmission is attached to the primary transmission under the condition that the front end of 2 countershafts of secondary transmission is inserted into the front bearing of countershaft of secondary transmission. This tool can be universally used for all series of transmission.

5) Pliers for Removing the Rear Bearing of Countershaft (TZ-FL05)

As shown in the Figure 5a, the matched tools of Fast transmission consist of reverse shaft extractor, and the bearing pliers can be used in conjunction with the sliding rod and sliding head of flange nut socket combination (sliding rod and sliding head). This combination totally includes 6 parts: sliding rod, sliding end, pliers head, pliers end, punch hammer and handle.

As shown in the Figure 5b, the pliers used for removing the rear bearing of countershaft can be obtained by assembling the pliers head and pliers end to sliding rod. The pliers rod is held by hands when using it, the pliers head is aligned with the bearing inner and outer rings of secondary bearing, and tap the pliers end by using hammer to remove the bearing.

This tool can be universally used for all series of transmission.

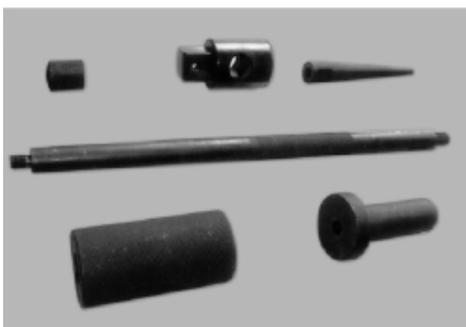


Figure 5a Tool Combination



Figure 5b Remove The Rear Bearing of Secondary Transmission by Using Pliers

6) The Extractor of Reverse Shaft (TZ-FL06)

As shown in the Figure 6a, install the sliding rod and extractor handle by connecting them, and insert the punch hammer into sliding rod, so that the reverse shaft extractor is obtained. Fast transmission has 2 reverse shafts. The reverse shaft must be removed if the reverse gear will be removed. Firstly, the

secondary transmission assembly is detached from the primary transmission. And then the front bearing of countershaft of secondary transmission is removed by using extractor. As show in the Figure 6b, the M12 millimeter screw rod of reverse shaft extractor should be turned into reverse shaft at last, and knock them back by using punch hammer, so that the reverse shaft will be removed easily. This tool can be universally used for all series of transmission.

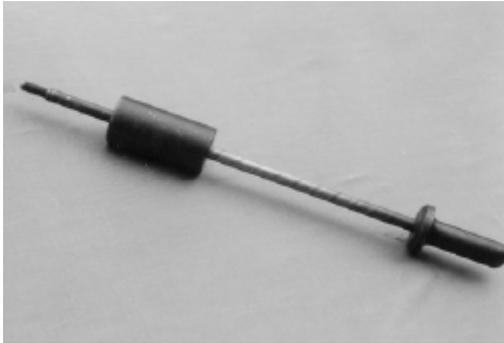


Figure 6a Reverse Shaft Extractor

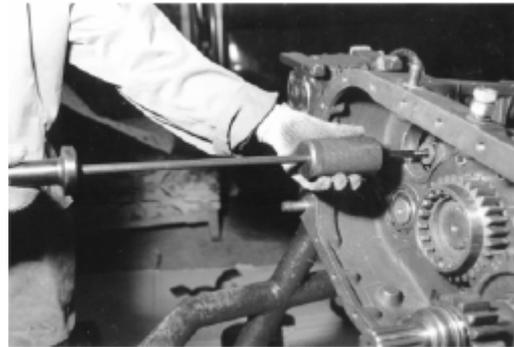


Figure 6b Remove The Reverse Shaft by Using Reverse Shaft Extractor

7) Hook Type Positioning Sleeve Extractor (TZ-FL07)

To position it to the propeller shaft precisely, one positioning sleeve is installed in the flange inner hole of Fast transmission output flange. There are 2 types of positioning sleeves. One is the old positioning sleeve with 2 M6 millimeter screw hole. This kind of positioning sleeve can be pulled out by using common pushing plate. Because this kind of positioning sleeve has not been used, such sleeve is not contained in this set of tools and it should be purchased if necessary.

The new positioning sleeve must be pulled out by using special hook type extractor as shown in the Figure 7a.



Figure 7a Hook Type Positioning Sleeve Extractor



Figure 7b Remove The Positioning Sleeve by Extractor

As shown in the Figure 7b, place the hook type positioning sleeve slightly into the positioning sleeve hole, and set the extractor uprights until the hook head of extractor is attached exactly to the notch of positioning sleeve. Turn the front M12 mm screw rod of reverse shaft extractor into the extractor, and knock them back by using punch hammer, so that the positioning sleeve will be pulled out easily. This tool can be universally used for all series of transmission.

8) The Awl for Installing Positioning Ring (TZ-FL08)

Turn the positioning ring in a certain angle while the gears are installed on the output shaft (output shaft). A special awl will be used as shown in the Figure 8a.

As shown in the Figure 8b, after the gears of positioning sleeve are attached, the positioning sleeve is turned in an angle and pushed by special awl to the position where the through key is located. This tool can be universally used for all series of transmission.

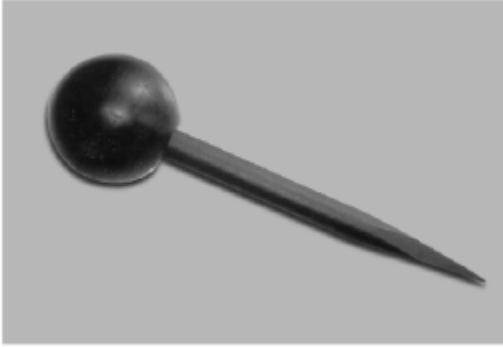


Figure 8a The Awl for Installing Positioning Ring



Figure 8b Turn The Positioning Ring in A Certain Angle by Using Awl

9) Flange Nut Socket (TZ-FL09)

The flange is normally set on the output shaft of transmission with a larger torque by using flange nut. The special powerful socket must be used while removing or installing the flange nut as the positioning inner hole of flange is smaller as shown in the Figure 9a.

As shown in the Figure 9b, the socket is set on the flange nut, and then the removal and installation operation are performed by using sliding rod, sliding head and jack lever. This flange nut can also be removed or installed by using pneumatic wrench (commonly known as jackhammer).

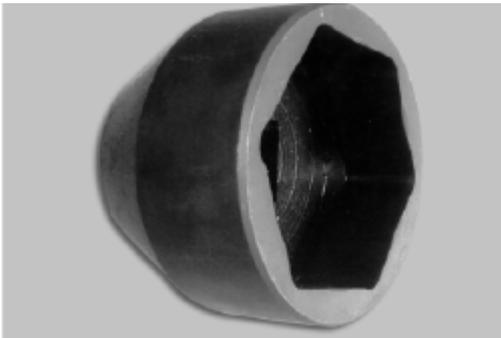


Figure 9a Flange Nut Socket



Figure 9b Flange Nut is Removed or Installed by Using Special Socket

As the flange nut is locked with a larger torque before its shipment, the jack lever is always required when the nut is removed by hands, and it is not easy to be removed. As the space is limited, it is very difficult to remove or install the flange nut on the whole vehicle.

As shown in the Figure 9c, labor-saving wrench of flange nut (TZ-FL13) consists of frame, torque booster and other parts. The torque booster is a torque converter of 1:5 scales. When using, the flange nut socket should be attach to the flange nut, and then the frame is fixed on the flange by using 2 flange nuts. The output end of torque booster is inserted into the flange nut socket and frame, and the nut can be removed easily by using the sliding rod, sliding head, and ratchet wrench and jack lever as shown in the Figure 9d.

This set of labor-saving wrench can be used for the flanges with different sizes ($\phi 165$ to $\phi 180$) and the flange with teeth end. If the socket collet is changed with different sizes of collet and it can also be used to remove the input flange nut of various drive shaft. This tool can be universally used for all series of transmission.

The matched tool of Fast transmission does not contain this set of labor-saving wrench, and it should be purchased if necessary.

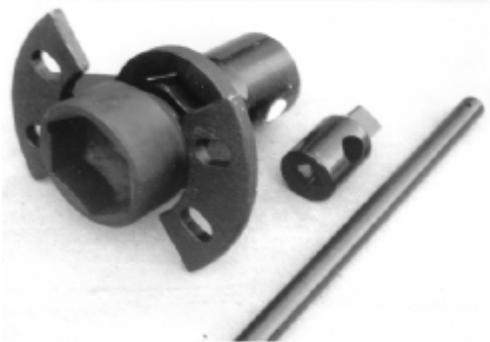


Figure 9c Labor-saving Wrench of Flange Nut



Figure 9d Remove or Install The Flange Nut by Using Labor-saving Wrench

10) Clamping Fixture for Installing Output Shaft (TZ-FL10)

One clamping fixture for installing output shaft is required when the output shaft assembly is installed during repair as shown in the Figure 10a. The clamping fixture for installing output shaft includes of the main body of clamping fixture and a piece of round magnet.

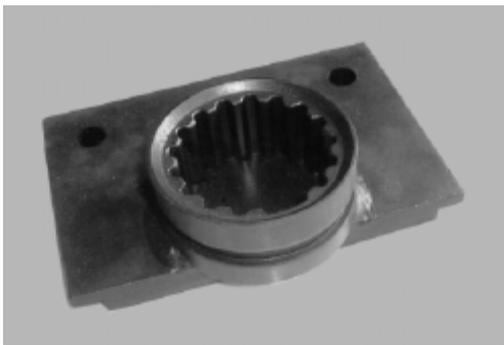


Figure 10a Clamping Fixture for Installing Output Shaft

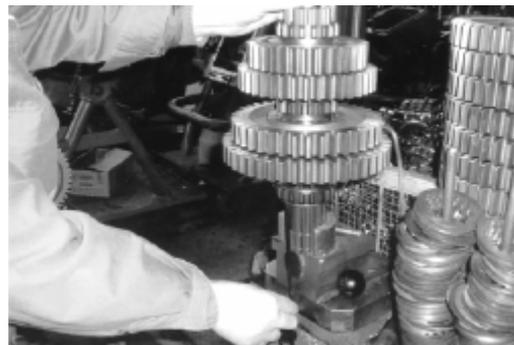


Figure 10b Install The Output Shaft by Using Clamping Fixture

Firstly, the main body of clamping fixture should be fixed on the working table or in a vise by using 2 bolts. Then, the output shaft is inserted into the clamping fixture with its output end downwards, and it is stood upright. The gears, corresponding clearance adjusting shim and positioning washer are installed in the order. The through key should be moved upwards to the respective position after each of positioning washer is installed, and the through key is positioned by the round magnet located on the end surface of clamping fixture. This tool can be universally used for all series of transmission.

II. Rear Bearing Extractor of Countershaft of Secondary Transmission

When the countershaft bearing (310 model) of secondary transmission is required to be removed and replaced without disassembling the transmission, the clamping spring for positioning the bearing is removed, and then the rear end of transmission should be tapped by using copper bar to move the gear outwards a little. At this time, the front ring notch of extractor can be clamped in the notch of bearing clamping spring. Tighten the extractor bolt to remove the bearing smoothly as shown in the Figure 11b. This tool can be universally used for all series of transmission.

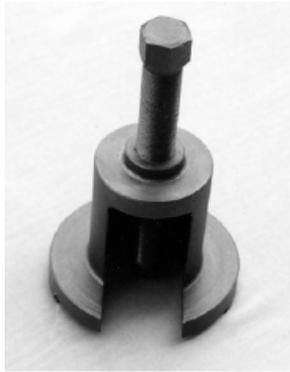


Figure 11a Bearing Extractor of Countershaft of Secondary Transmission

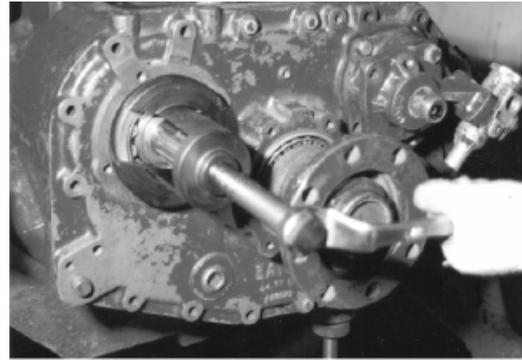


Figure 11b Pull The Countershaft Bearing of Secondary Transmission by Using Extractor

III Dismountable Roll-over Stand of Fast transmission

When the transmission is removed or installed during its repair, a working stand which can turn in 360° angle is called the dismountable roll-over stand.

The roll-over stand is specially used for Fast transmission as shown in the Figure 12b.

The oil drain screw plug of transmission is removed and hoisted to the roll-over stand. The support screw of roll-over stand is turned into the screw hole of oil drain screw plug of transmission, and the screw rod is locked by using standby cap.

The turn-knobs on both sides of positioning plate are tightened securely by turning them. The front end of transmission housing is pulled securely by using the bending plates of positioning plates on both sides, and then the bending plates are locked. Therefore, the transmission can be fixed securely on the roll-over stand to turn it over for removing or installing. This device can be universally used for all series of transmission.

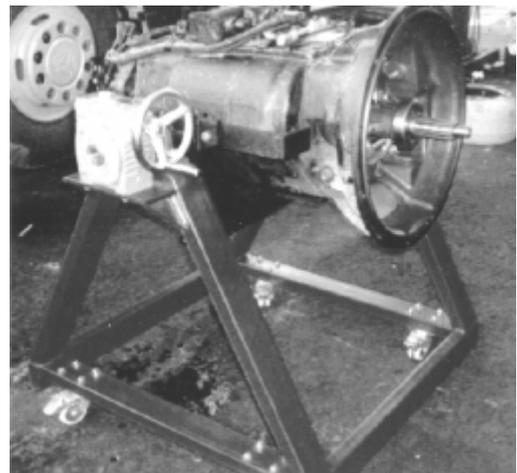


Figure 12b Remove and Install Fast Transmission by Using Special Roll-over Stand of Fast Transmission

V Hydraulic Tow Truck of transmission (TZ-G03)

The cross (commonly known as round girder) is always located under the transmission of heavy vehicle. Therefore, if such device is not used, the transmission cannot be easily removed from the whole vehicle, and it is difficult to install the transmission assembly to the vehicle (it is not easy to change the friction lining of clutch). The hydraulic tow truck of transmission is used for solving such problem. The hydraulic tow truck of transmission is shown in the Figure 13a.

As shown in the Figure 13b, the hydraulic car consists of frame, support plate, cylinder and pump. The support plate can be raised to the maximum of 0.8 m by cylinder when the shift lever of cylinder is turned to the "Raise" position to press the pump lever.

The angle of support plate can be adjusted. The support plate should be raised to a certain height while using, and then inserted into the gap between the cross and transmission bottom. The angle of support plate can be adjusted to the same as the slant angle of transmission bottom by turning the draw bars on both sides. The pump lever is pressed to make the support plate held firmly on the transmission bottom, so the transmission is held. The joint box connecting the clutch housing and engine are removed. The tow truck is pushed backwards together with transmission to remove the transmission. The tow truck is pushed together with transmission after the friction lining of clutch are changed when necessary, and then the installation can be performed.



Fig. 13a Gearbox hydraulic trailer



Fig. 13b Gearbox hydraulic trailer

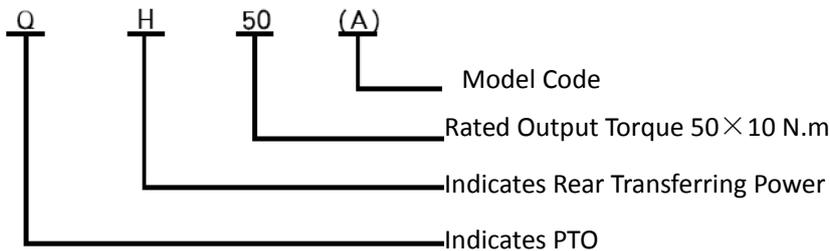
Chapter II PTO

In addition to providing the drive force that can realize the gear ratio to the vehicle, the transmission can provide the power to the additional devices of special vehicle (such as concrete mixer lorry, tipper and refueling truck), and such device that can transfer the power to the additional device is called as PTO. According to the special requirements for special vehicle, the double-countershaft series transmission produced by Fast company can provide various PTO such as front (F60, QQ60, QQ60A series), rear (QH50, QH70 series), side (QC40, QC40A, QC40B series) and bottom (QD60, QD50 series) type PTO, so that front transferring power (also known as clutch transferring power), rear transferring power (known as the rear transferring power from countershaft of secondary transmission), side transferring power (the power transferred from countershaft of primary transmission) or bottom transferring power can be transferred to the transmission.

Ouman heavy trucks are always equipped with QH50 and QH70 series rear PTO.

Section 1 Construction Character and Working Principal of QH50 and QH70 Series PTO

The model meaning of QH50 and QH70 series PTO is as following:



QH50 or QH70 PTO is rear PTO, and is installing on the extension countershaft on the rear side of secondary transmission of Fast transmission. The power is acquired from the extension countershaft of secondary transmission of transmission by the hollow spline shaft of PTO, and passed through the input and output driver gear. The power is output by the output flange. For the performance parameters, please see the table 1-1.

Table 1-1 Performance Parameters for QH50 and QH70 Series PTO

Model	Input Speed (rpm)	Output Torque (N.m)	Structure Type	Output Steering and Engine	Speed Ratio	Installation Position
QH50	2600	500	Single pneumatic operation of 2 Shafts	Same	0.818	Lower right
QH50A	2600	500		Same	0.818	Upper left
QH50B	2600	500		Same	0.538	Lower left
QH50C	2600	500		Same	0.538	Upper right
QH70	2600	700	Double pneumatic operation of 2 Shafts	Same	0.8	Lower right
QH70A	2600	700		Opposite	1.0	Lower right
QH70C	2600	700		Same	0.8	Upper left

The input gear of this OPT engages with the sliding sleeve to form a reversed taper teeth, preventing the gears stripped. PTO transfers the power by shifting the gear pneumatically. The transmission equipped with a PTO will transfer the power in neutral position because a high or low speed gear shift cylinder is installed on the transmission, and its working principles have been stated in details in the section 2 of chapter 1.

Fast transmission can transfer the power when the vehicle moves or stops. If the power is transferred when the vehicle moves (for example, the tipper dumps the soil while repairing the road, and the tipping bucket will dump the soil when the vehicle moves, so that the soil is laid on the road surface levelly), the clutch pedal is depressed first, the shift lever is turned to lower gear, the pneumatic solenoid of PTO is turned on, and the neutral switch keeps on OFF position to make the PTO transferred the power. Then the clutch pedal is raised slowly, and the vehicle will acquire the power while moving.

The clutch pedal is depressed first when the vehicle acquires the power during its stop, and then the neutral switch of gear shift cylinder and PTO solenoid switch are turned on. Therefore, the extension countershaft of secondary transmission is engaged with PTO to transfer the power, and the control air

pressure of neutral switch makes the shift shaft of gear shift cylinder in neutral position, so that the secondary transmission of transmission will be in neutral position. The shift lever is shifted to one gear of low speed gear zone, and the clutch pedal is raised slowly. At this time, the vehicle will acquire the power during its stop.

Section 2 Working Principle of PTO Pneumatic Operation System

The pneumatic operation system of QH50 series PTO is single action type while QH70 series PTO is double action type.

The pneumatic chart of pneumatic operation system equipped with neutral switch is shown in the Figure 2-1, and the pneumatic chart of pneumatic operation system not equipped with neutral switch is shown in the Figure 2-2.

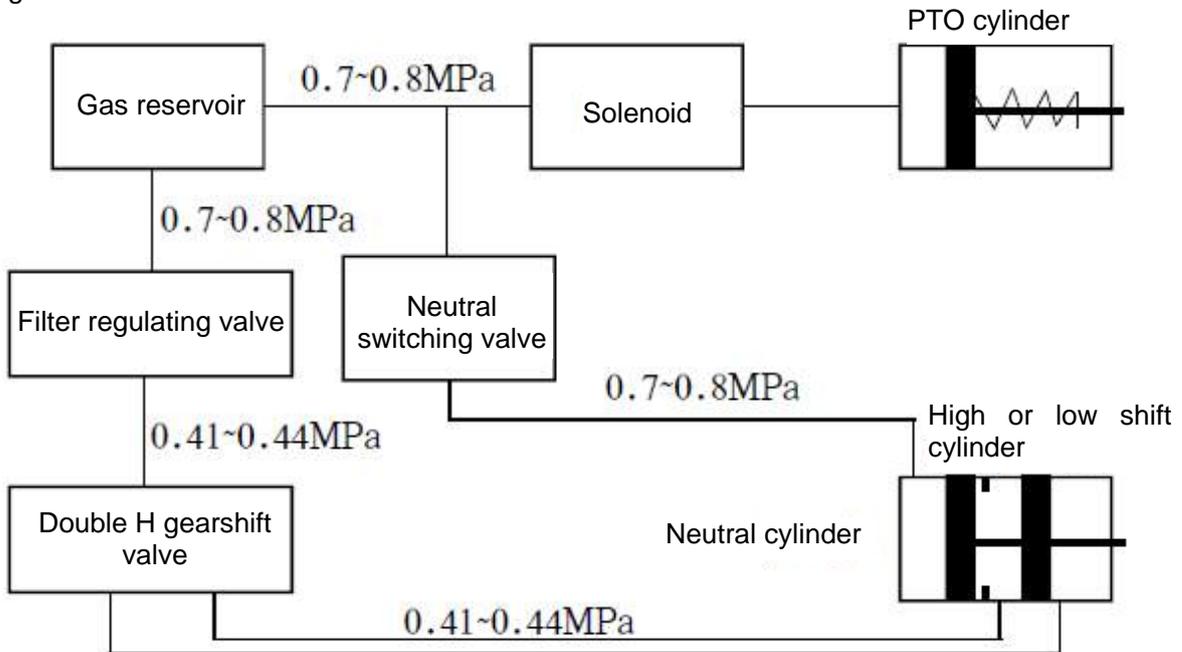


Figure 2-1 The Pneumatic Chart of Operation System of QH50 Series PTO Equipped with Neutral Switch

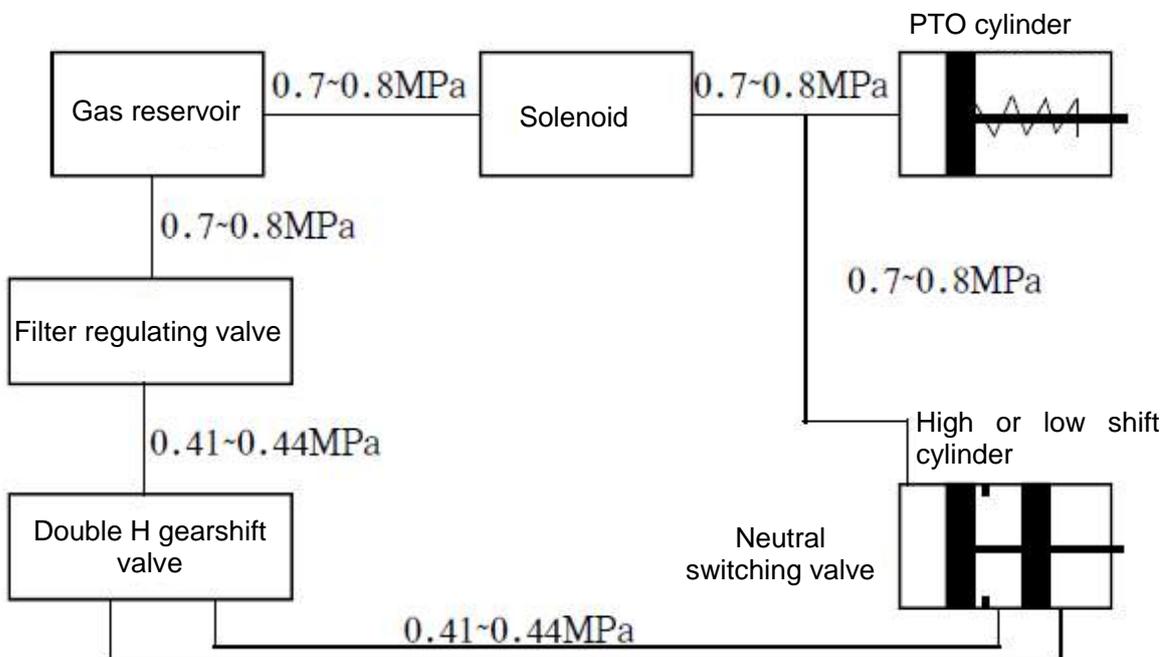


Figure 2-2 The Pneumatic Chart of Operation System of QH50 Series PTO Not Equipped With Neutral Switch

As shown in the Figure 2-1, the 0.7-0.8 MPa compressed air is supplied respectively from gas reservoir to the filter regulating valve of transmission, neutral switching valve and PTO solenoid. The compressed air is reduced to 0.41-0.44 MPa by passing through the filter regulating valve, and supplied to the double-H gear shift valve of transmission. When the vehicle moves normally with the low speed gear of transmission, the double-H shift gear valve transfers 0.41-0.44 MPa compressed air to the right side of high or low shift cylinder piston, the compressed air on the left side of piston is released by passing through double-H gear shift valve, the gear shift piston moves left, and the secondary transmission is shifted in low speed gear while operating the transmission. When the shift lever is pushed into high speed gear zone, double-H gear shift valve shifts the direction, the high or low speed gear cylinder piston moves right to push the secondary transmission, and the gear of secondary transmission is shifted to indirect gear (that is high speed gear).

If the vehicle needs to acquire the power while stopping, the clutch should be depressed first, the transmission is shifted to low speed gear, the solenoid switch is turned on to open the solenoid, so the compressed air will come into PTO cylinder to turn on PTO. At the same time, the neutral switch air valve is turned on to pass 0.7-0.8 MPa compressed air into neutral cylinder, so that the neutral piston moves towards right side. As the compressed air is 0.7-0.8 MPa in neutral cylinder while the compressed air is 0.41-0.44 MPa in low speed gear cylinder, the piston of high or low speed gear cylinder is limited to the middle position of neutral gear, and the secondary transmission of transmission is in the neutral position. At this moment, the clutch pedal is raised slowly, and the vehicle will acquire the transferred power while stopping. When the operation is finished, keep in mind that the neutral switching valve and PTO solenoid should be turned off again. Otherwise, the vehicle cannot move.

If the vehicle needs to acquire the power while moving, the neutral switching valve is not necessary to be turned off, and the secondary transmission of transmission is still in the low position, so that the vehicle will acquire the power while moving.

The operation air line without neutral switching valve is shown in the Figure 2-2, and the vehicle cannot acquire the power by such operation air line while moving because the secondary transmission of transmission will be in low position if the PTO solenoid is turned on and the PTO is working.

The operation cylinder of QH50 series PTO is a single action type, and PTO will function when the compressed air is passed into PTO cylinder. The push rod of PTO cylinder picks off PTO and stops working by using the return spring when the solenoid switch turns off and the compressed air of cylinder is discharged.

The operation air line of QH70 series PTO is shown in the Figure 2-3. Comparing the Figure 2-3 with 2-2, we can find that the cylinder of QH70 series PTO is a double action type, and the PTO gears are shifted by the differential pressure between 0.7-0.8 MPa and 0.41-0.44 MPa which functions on the cylinder piston. However, the PTO can be picked off when the piston will return if the piston is pushed by 0.41-0.44 MPa compressed air from the filter regulator.

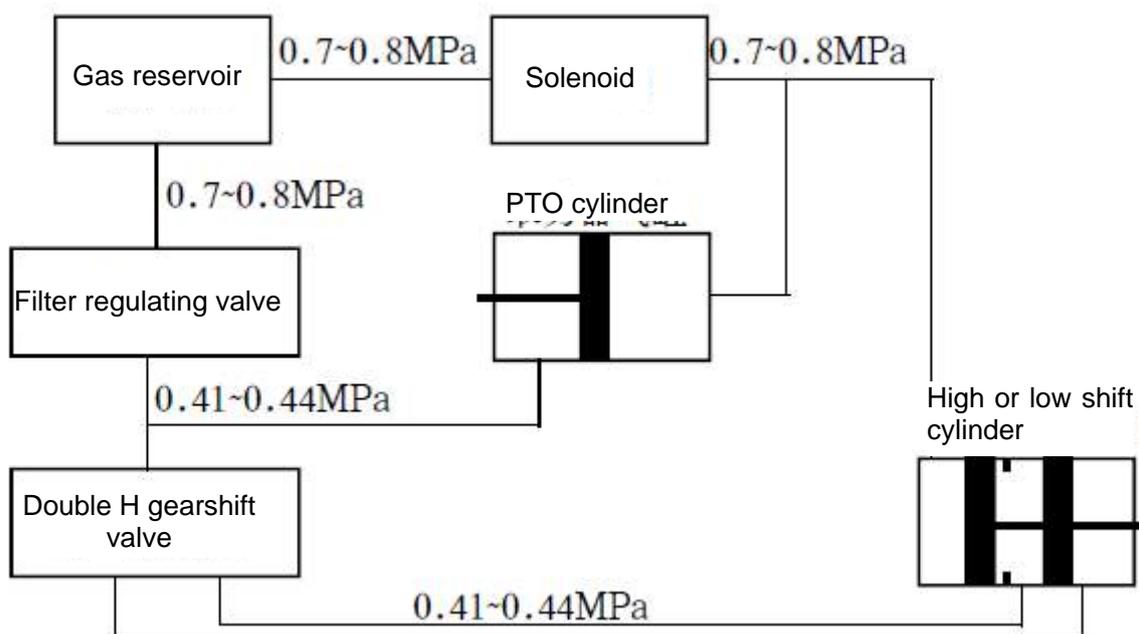
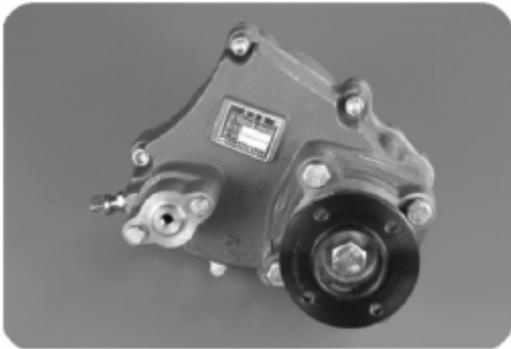


Figure 2-3 Operation System Air Route of QH70 Series PTO

Section 3 Removal and Installation of QH50 Series PTO

1) Removal of QH50 Series PTO



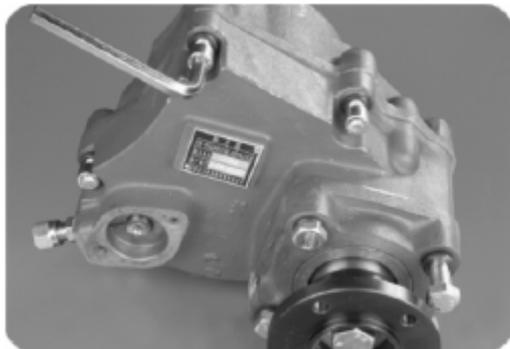
(1) QH50 series PTO.



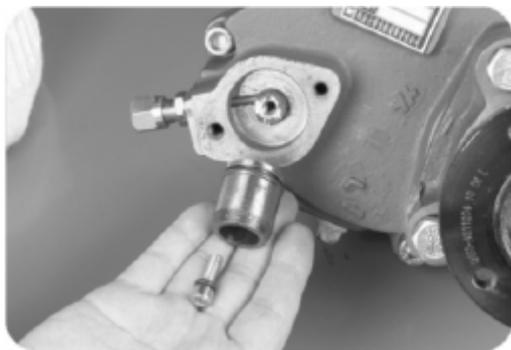
(4) Remove 2 bolts on the outside of PTO bearing mount.



(2) Remove 2 bolts on PTO cylinder, and take off PTO cylinder and return spring.



(5) Remove 5 Hex Socket Bolts on the PTO housing.



(3) Remove the hexagonal bolts in the piston, and take off the piston.



(6) Tap the PTO housing slightly to detach these 2 housings.



(7) Take out the PTO input shaft set.
II Installation of QH50 Series PTO

(3) Attach the PTO sliding sleeve with its short teeth of engaged teeth downwards to the hollow shaft.



(4) Install the sliding sleeve in position, and engage the sliding sleeve with the engaged teeth of input shaft gear.



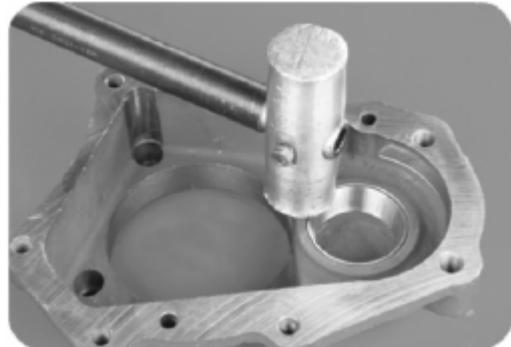
(1) Attach the loop support spring to the hollow shaft notch.



(5) Clean the PTO output shaft and flange set.

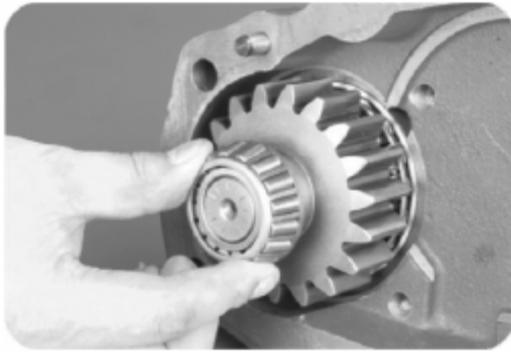


(2) Stand the input gear with its engaged teeth up, and attach it to the hollow shaft.



(6) Install the bearing outer ring of output shaft into the PTO housing hole.





(7) Install the bearing outer ring which is on another side into the bearing hole of PTO cover housing, and install the output shaft assembly.



(8) Install 4 bolts of output shaft bearing mount, and tighten the 2 short bolts which are on the inner side.



(9) Install the output flange and seal baffle, and tighten the flange bolts.



(10) Insert the PTO fork into the sliding sleeve, and install the input shaft assembly.



(11) Assemble 2 housings, tighten 5 inner hexagonal bolts which are on the housing, and apply grease to the seal ring of cylinder piston.

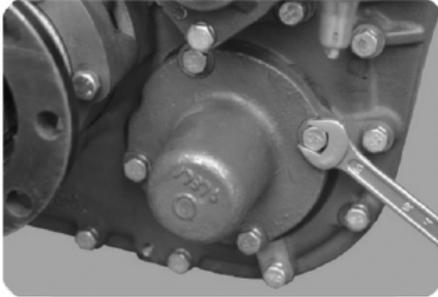


(12) Install the piston into push rod, and tighten the inner hexagonal bolt which is in the piston.

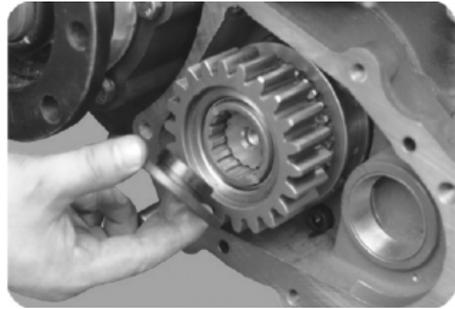


(13) Install the return spring into the piston, attach the cylinder and tighten 2 cylinder bolts. And install the accessory such as PTO indicator switch and breather plug finally. The installation of PTO is finished here.

(III) Install PTO on The Transmission Assembly



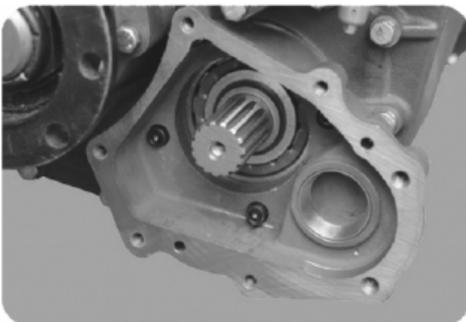
1. Remove the extension countershaft cover of secondary transmission of transmission



3. Attach the input shaft assembly of PTO to the extension countershaft.



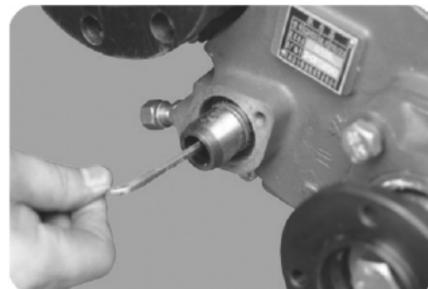
4. Install the pressing plate, apply LOCTITE 242 adhesive to the fine threads, and tighten the bolt.



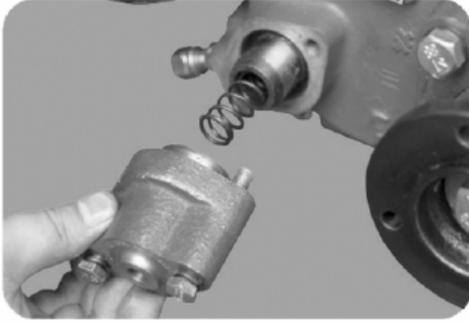
2. Connect the front cover housing of PTO to the secondary transmission housing of transmission, and tighten the joint bolts.



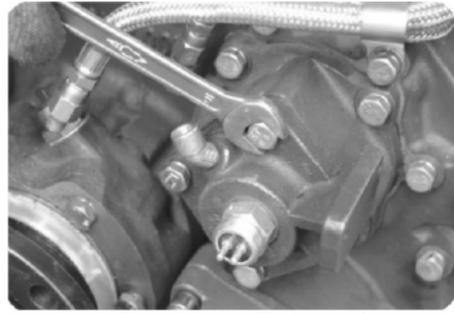
5. Install the PTO rear cover assembly, and tighten the set bolts.



6. Apply grease to the seal ring of cylinder piston, and tighten the joint bolt connecting the piston and push rod.



7. Install the return spring in the piston, install the PTO cylinder, and tighten 2 cylinder bolts.



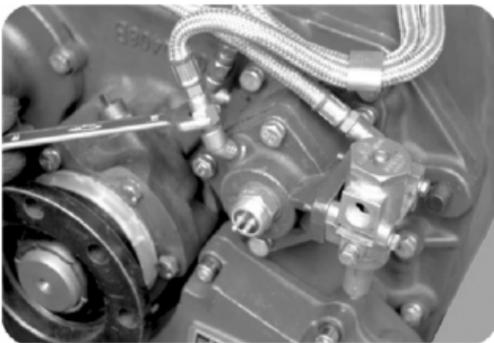
1. Remove 4 bolts on the cylinder cover, and take off the cylinder cover.



8. Install the PTO indicator switch and breather joint
(IV) Attach Neutral Cylinder to Gearshift Cylinder of Transmission.



3. Install the neutral cylinder set to the PTO cylinder body, and note that the set ring inside the neutral cylinder should not be missed while installing.

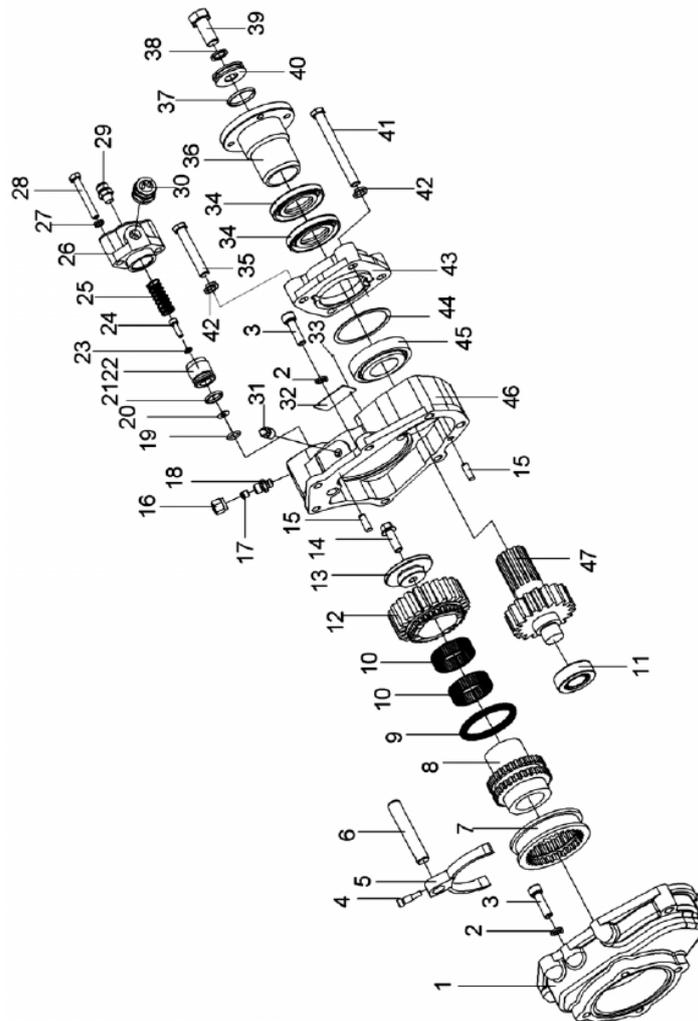


1. Attach the neutral cylinder to the gear shift cylinder of original Fast transmission, and first remove the air duct joint on the gear shift cylinder cover of secondary transmission and the pressure regulating valve of filter.



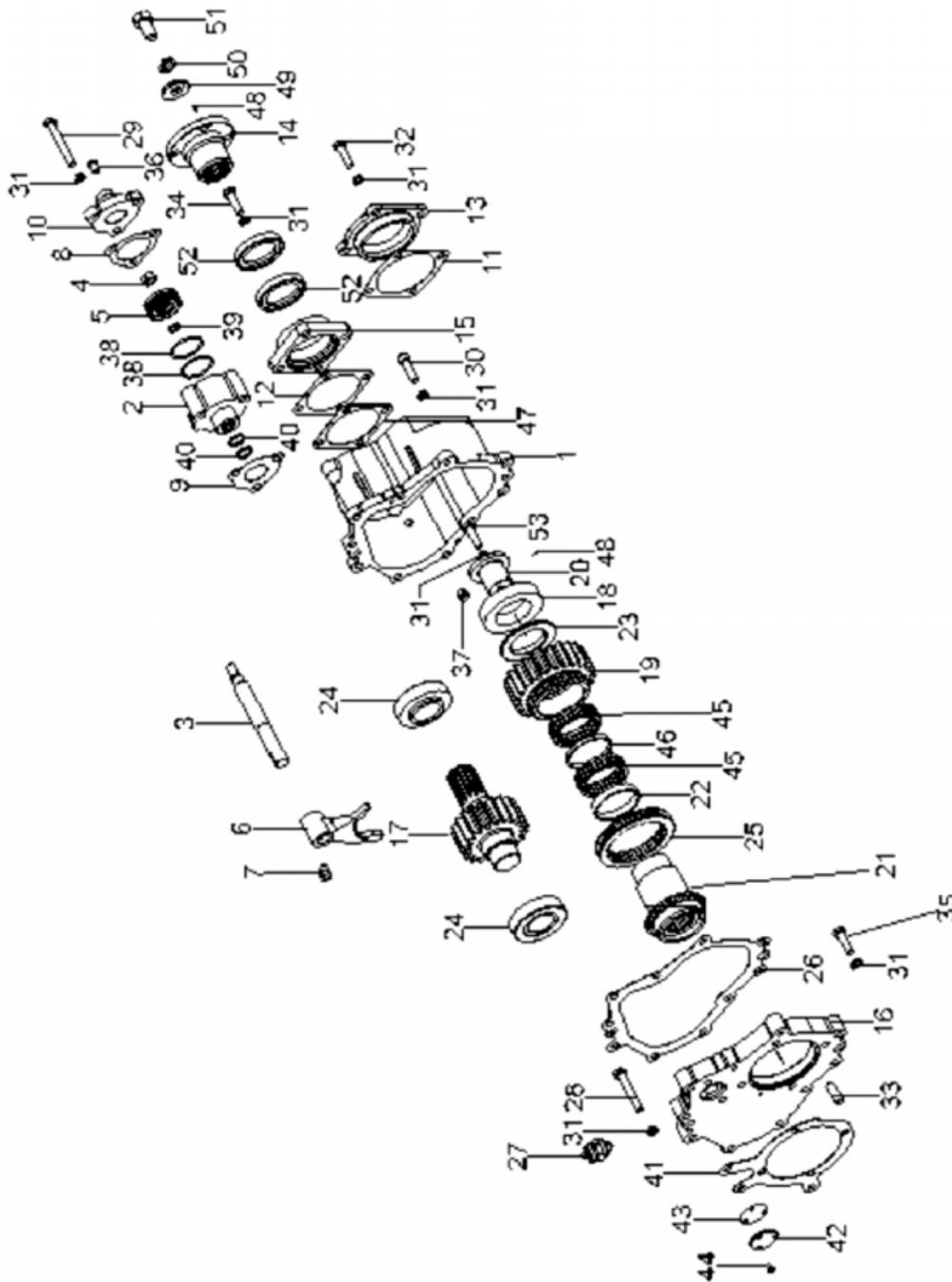
4. Install the air duct line and pressure regulating valve of filter.

There is a little difference in the structure between the QH70 series PTO and QH50 series, the removal and installation procedures are basically the same. The component exploded view of QH50 and QH70 series PTO are shown separately in the Figure 3-1 and 3-2.



1. PTO Housing 4. Fork positioning screw 5. Fork 6. Fork shaft 7. Sliding sleeve 8. Hollow shaft 9. Support spring 10. Needle roller bearing 11. Cylindrical roller bearing 12. Input bearing 13. Input bearing race 14. Positioning lock bolt 15. Positioning pin 19,21. O-ring 22. Piston 25. Return spring 26. Cylinder housing 29. PTO Cylinder joint 30. PTO Indicator switch 31. Breather plug 34. Oil seal 36. Output flange 37. O-ring 40. Seal baffle 43. Bearing cover 44. Adjusting shim 45. Cylindrical roller bearing 46 PTO cover 47. Output gear shaft

Figure 4-1 Component Exploded View of QH50 Series PTO



1. PTO Housing 2. Cylinder block 3. Fork shaft 4. Piston 6. Fork 7. Stopper screw 8. Cylinder cover gasket 9. Cylinder gasket 10. Cylinder cover 11. End cover shim 12. Adjusting shim 13. End cover 14. Output flange 15. Bearing cover 16. Side cover 17. Output gear shaft 18. Bearing 4211 19. Input gear 20. Sleeve 21. Hollow shaft 22. Bearing spacer 23. Bearing baffle 24. Cylindrical roller bearing 25. Sliding sleeve 26. Side cover gasket 27. Indicator switch 33. Cylindrical pin 38.39.40. O-ring 41. Gasket 42. Cover 43. Cover gasket 45. Needle roller bearing 49. Baffle 52. Oil seal

Figure 4-2 Component Exploded View of QH70 Series PTO

Section 4 PTO Use and Common Problems Troubleshooting

I. Precautions While Using PTO:

Pay attention to adding and changing lubricants (the model number of lubricant is the same as one of transmission) in time, the new lubricate should be and added each time the working hours is 500 hours.

II. Common Problems trouble-shooting

1. Oil Leakage

We should observe whether the oil leakage is occurred on the fitting surface or shaft journal. The adhesive is not applied if the oil leakage occurred on the fitting surface, and the oil leakage of shaft journal is occurred mainly on the oil seal. The LOCTITE 510 adhesive for flat surface should be applied to the fitting surface of housing flat surface while installing.

2. Gear Cannot Be Shifted in Place or Gear Cannot Be Shifted into Neutral for PTO

When PTO cannot be engaged or released, we should check the air line for leakage or blocking, the positioning screw of gear shift fork for loose, the positioning bolt of piston for loose or peel off, the return spring for broken or inactive, and the fork or sliding sleeve for deformed. Change the deteriorated genuine parts.

3. Abnormal Noise of PTO

Check the driven gear of PTO for corrosive pitting or tooth broken, the bearing for corrosive pitting broken, the each joint bolt for loose.

4. PTO Indicator Is Not Displayed or Illuminated Always

Check the circuit and plug for loose or open, the indicator switch for damaged, the indicator switch for correct installation, and the problem can be solved by adding or removing the shims if the position of indicator switch is found incorrect.