SECTION 3 STEYR PLANETARY REAR DRIVE AXLE

I. Basic Parameters

The STEYR 13-ton planetary rear axle is divided into the single rear axle and double axle. The double axle is comprised of primary drive axle located at the front of rear axle(through axle for short)and rear axle, and its reduction mode is the dual-ratio reduction of central primary conical gear pair reduction plus wheel planetary gear pair reduction. The basic parameters are shown in Table 8-5. The appearance is shown in Fig. 8-6.

Table 8-5 Basic performance parameters of STEYR 13-ton wheeled double reduction axle

Items	Parameters
Rated axle load/technically allowable maximum axle load	13000/16000
Maximum input rpm	3500
Gear ratio	4.42，4.8，5.73，6.72，7.49，8.4，9.4
Brake type	Pneumatic cam drum brake
Brake size (mm)	Φ420 x 185
Standard wheel track	1800/1850*
Leaf spring center distance of single rear axle	950/1010*
Leaf spring center distance of double axle	980/1020*
Tyre specifications	11.00-20,12.00-20
Wheel alignment method	Wheel rim center hole alignment
Lubricating oil quantity (l) for rear axle final gear	5
Lubricating oil quantity (l) for forward rear axle final gear	8.3
Lubricating oil quantity (l) for wheel final gear	2

The sizes with * are used for HOWO series truck.

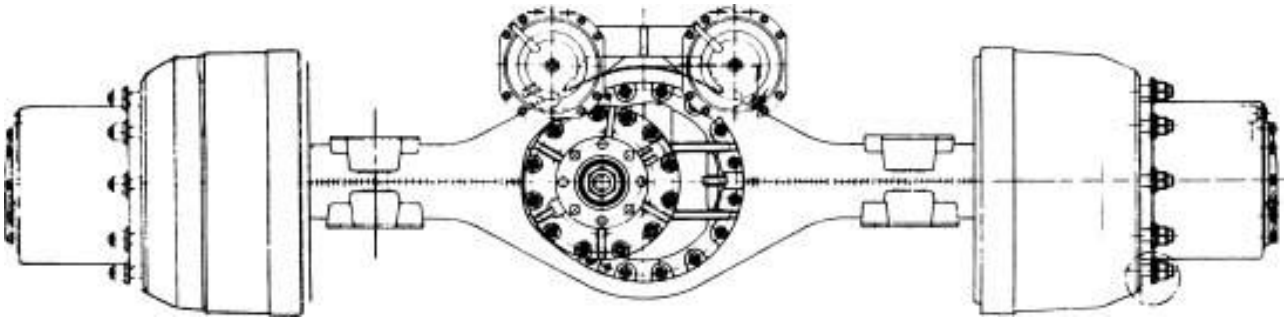


Fig.8-6

II. Structure of drive rear-axle

Fig. 8-7 shows the structure of the drive rear-axle final gear,Fig. 8-8 is the final gear exploded view,Fig. 8-9 shows the structure of the drive rear-axle wheel reductor and Fig. 8-10 is the wheel reductor exploded view.

- As shown in Figs. 8-7 and 8-8,the power from drive shaft is transmitted to drive gear shaft 5 through drive flange 1 and then to the differential through driven gear 20. The differential consists of cross shaft 19, four planetary gears 18 and two half-axle gear 17 and 23 as well as two differential half-casings 15 and 21. The coupling bolt connects the two differential casings 15 and 21 integrally, therefore, when differential casing rotates, the cross piece rotates simultaneously, the planetary gear rotates round the sun gear, and at the same time drives the left and right half-axle gears 17 and 23 to rotate,thus the power is transmitted in an equal torque to left and right wheels by the left and right two half-axles. During the truck turning, the steering inner wheel should rotate by fewer turns than steering outer wheel,due to the balance relation of the torque,the planetary gear not only rotates round the sun gear, but also rotates on its cross shaft,so that the two half-axle gears will have a deferential, that is, how much the steering inner wheel is rotating less, and how much the steering outer wheel is rotating more to reach the function of the differential, hence ensuring the balance of truck during turning.

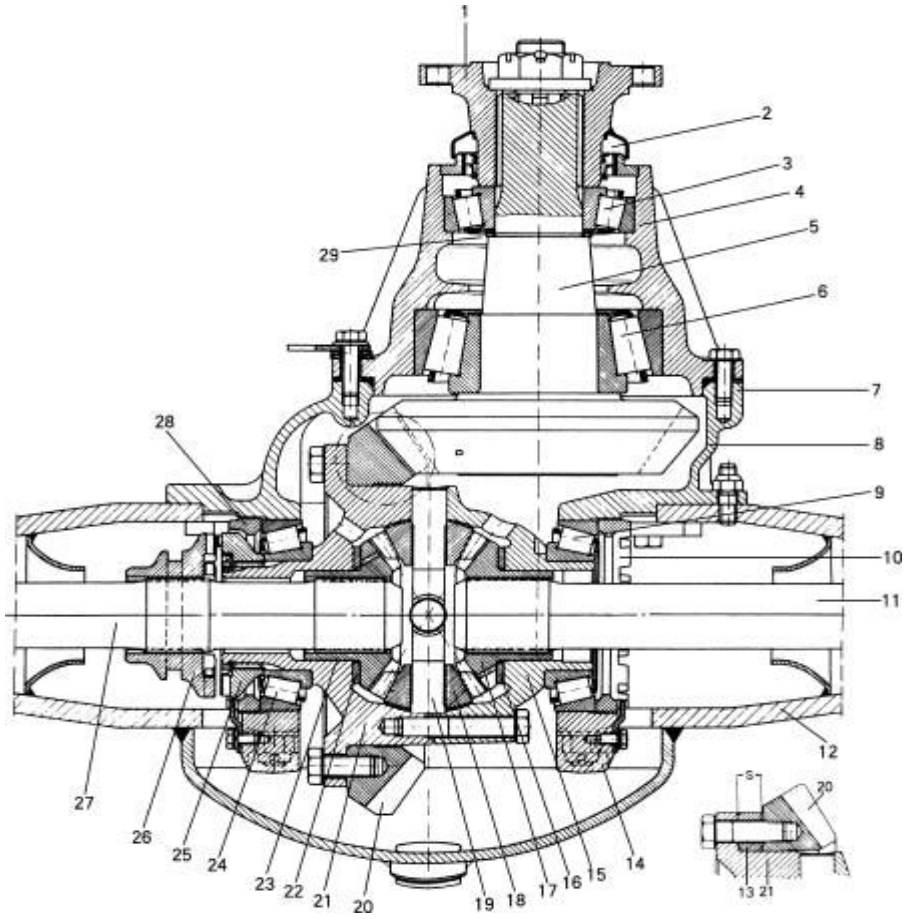


Fig. 8-7 Drive axle final gear structure diagram

1. Drive flange 2. Oil seal 3. Rive gear outer bearing 4. Drive gear hub 5. Drive gear shaft 6. Drive gear inner bearing 7. Adjusting washer 8. Final gear hub 9. Differential right bearing 10. Differential right bearing adjusting nut 11. Right half-axle 12. Axle case 13. Driven gear washer 14. Differential bearing cover 15. Differential right half-casing 16. Right half-axle gear thrust washer 17. Right half-axle gear 18. Planetary gear and spherical washer 19. Cross shaft 20. Driven gear 21.differential left half-casing 22. Left half-axle gear thrust washer 23. Left half-axle gear 24. Differential left bearing 25. Differential lock engagement sleeve 26. Differential lock engagement sleeve 27. Left half-axle 28. Differential left bearing adjusting nut 29. Adjusting washer

Drive gear shaft 5 is mounted in drive gear hub 4,which is supported by inner and outer conical roller bearings 3 and 6. In order to ensure the pre-tightening of bearings, the inner race of bearing 3 and shaft shoulder of shaft 5 are provided with adjusting washer 29. In assembling, select the washer with a proper thickness,so that after assembling the drive gear shaft with housing (two conical bearings are completely compressed tightly),the rotating torque of shaft casing 4 shall be within the range of 1.0-2.0Nm. If the rotating torque is too big, increase the thickness of washer accordingly; otherwise, decrease the thickness of washer accordingly(see the steering drive axle).

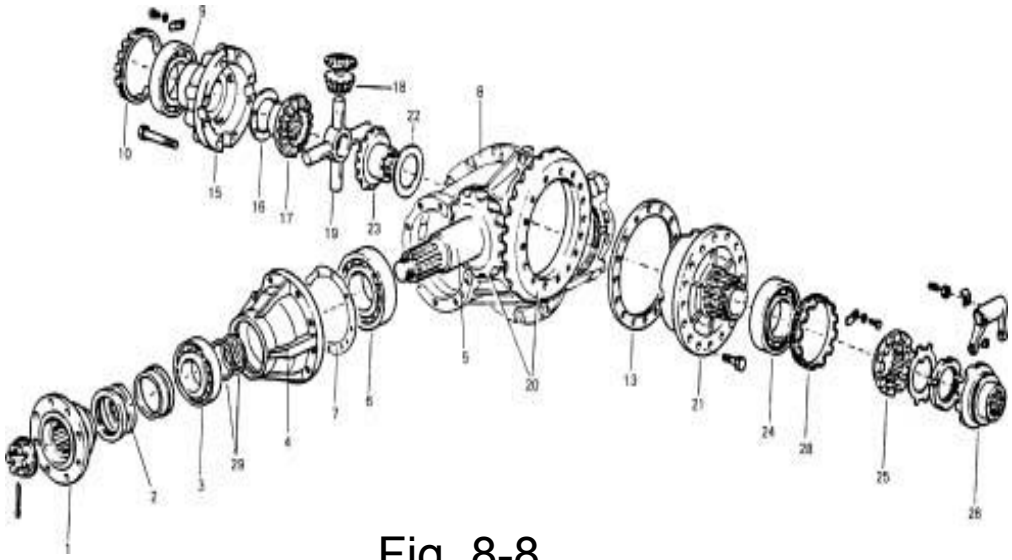
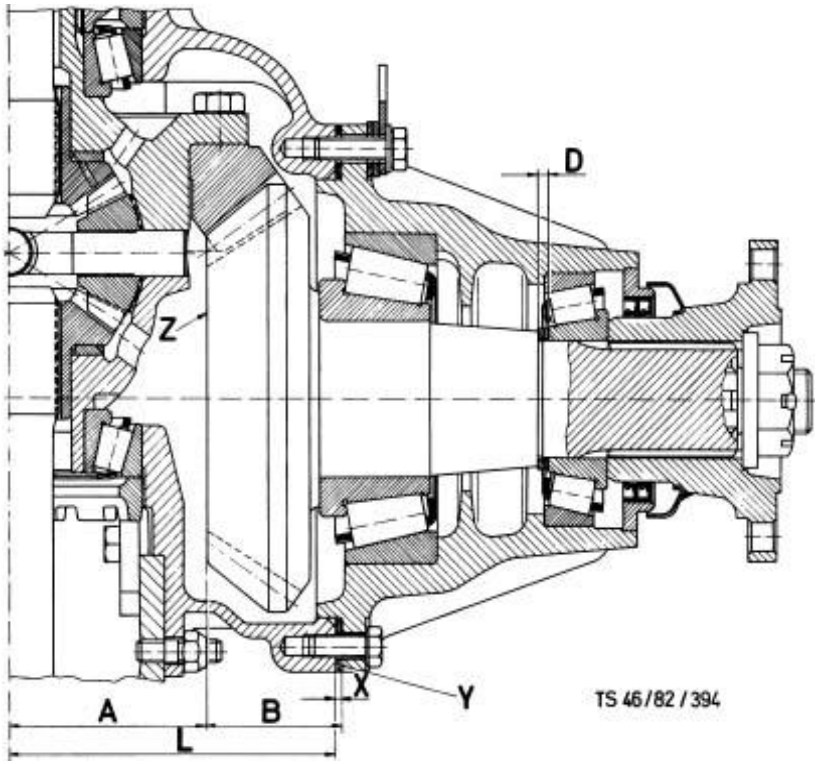


Fig. 8-8

The spherical back of differential planetary gear is provided with standard spherical washer. The back of each half-axle gear has thrust washers 16 and 22, which have different standard thicknesses and can be selected. When installing, select the thrust washer with suitable thickness, so that running clearance between planetary gear and two half-axle gears will be within the range of 0.18-0.22mm(see the steering drive axle).

Two conical roller bearings 9 and 24 support the differential on the bearing seat of the final gear housing and bearing cover. In order to ensure the pre-tightening of bearing, the bearing seat and bearing cover are provided respectively with adjusting washers 10 and 28. When installing, adjust the tightening of the nut to make the rotating torque of differential assembly in the final gear seat hole within the range of 1.5-4.0Nm.

The drive and driven gears of the final gear are ground in pairs when machining, so in assembling, shall be assembled in pairs,and the same while replacing the gear. In order to ensure the engagement clearance of gear and reasonable engagement of tooth face,in assembling, it is required to calculate and adjust the washer's thickness between the drive gear hub and differential casing,select a proper washer for installation. As to how to calculate and select washer, see the steering drive axle. For the adjusting parameters of rear axle conical gear pair, see Fig. 8-9 and Table 8-6.



$$X=(A\pm Z)+B-(L\pm Y)$$

A/L= basic dimensions
B=measured value using depth gauge
‘Z’ Deviation of basic dimensions ‘A’ on drive conical gear, which is in 1/100mm.
‘Y’ Deviation of basic dimensions ‘L’ on final gear housing, which is in 1/100mm.

Fig. 8-9 Adjusting washer thickness calculation diagram

Table 8-6

i=	4,42	4,80	5,73	6,72	7,49	8,40	9,49
A	102	102	102	102	106	106	106
L	170	170	170	170	170	170	170

The left half-axle and differential casings of the drive rear-axle are installed with differential lock device. The differential lock engagement sleeve 2 5 is fixed on the differential casing using a fixing nut. Differential lock engagement sleeve 26 is supported on the left half-axle spline. When the truck is traveling on the muddy road and wheel on one side is slipping, operate the differential lock switch to make the compressed air communicate to the differential lock slave cylinder piston through the solenoid valve,and the differential lock slave cylinder piston's push rod will make the engagement sleeve 26 and engagement sleeve 25 engaged through the shifter fork, so that the half-axle and differential casing become integral, and in other words, left and right half-axles are integrated to enable the truck to smoothly drive out of the muddy road.

The drive rear-axle uses the wheel planetary reductor to enhance the gear ratio and reduce the dimensions of central final gear, thus increasing the ground clearance of chassis and improving the crossing ability of truck.
As shown in Fig. 8-10 and Fig. 8-11, the half-axle1 is combined with sun gear 25 through a spline,there are four planetary gears 4 around the sun gear 25,with witch the inner gear ring 5 is engaged outside planetary gear 4, and inner gear ring 5 is also connected with gear ring shaft sleeve 7 that is fixed on axle case axle tube. When half-axle rotates, sun gear 25 rotates simultaneously, thus driving planetary gear 4 to rotate. However, geared ring 5 engaged by the planetary gear 4 remains fixed, and therefore, it forces the planetary gear not only to revolve on its own axis but also revolve round the sun gear,thus pushing planetary gear 4 not only to rotate on its own axis, but also rotate round the axle center. And therefore it pushes planetary axial journal 6 to rotate through planetary gear shaft 3 and further driving hub 21 and brake drum13 to rotate together. The gear ratio of wheel reductor is only related with teeth number of sun gear Z1 and teeth number of geared ring Z2, as there is a big difference between the teeth number of geared ring and teeth number of sun gear , and their gear ratio I= Z2/Z1+1,so the reduction ratio is relatively big.

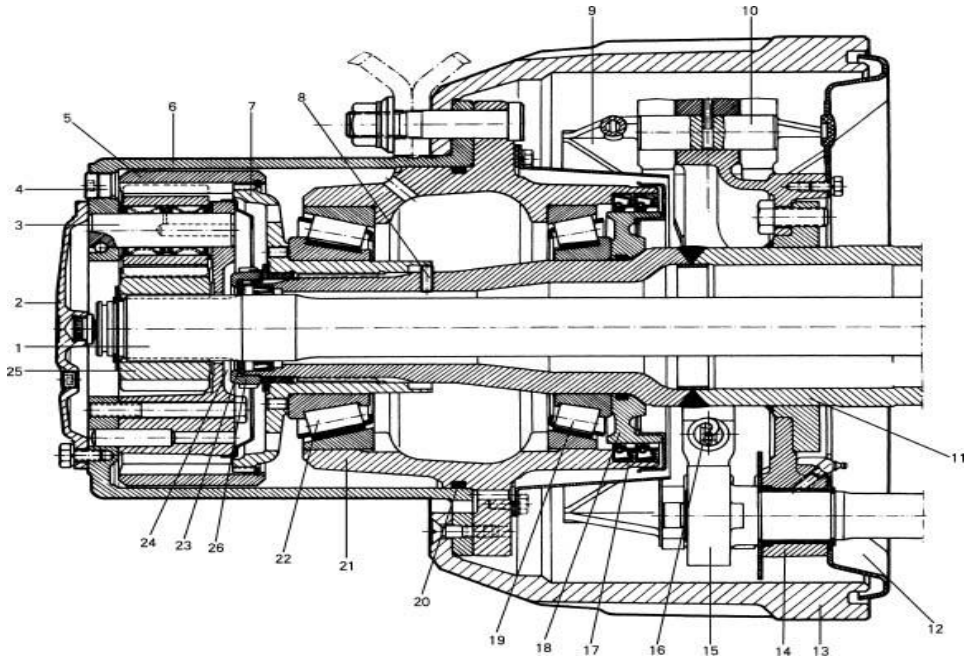


Fig. 8-10 Structure of wheel reductor

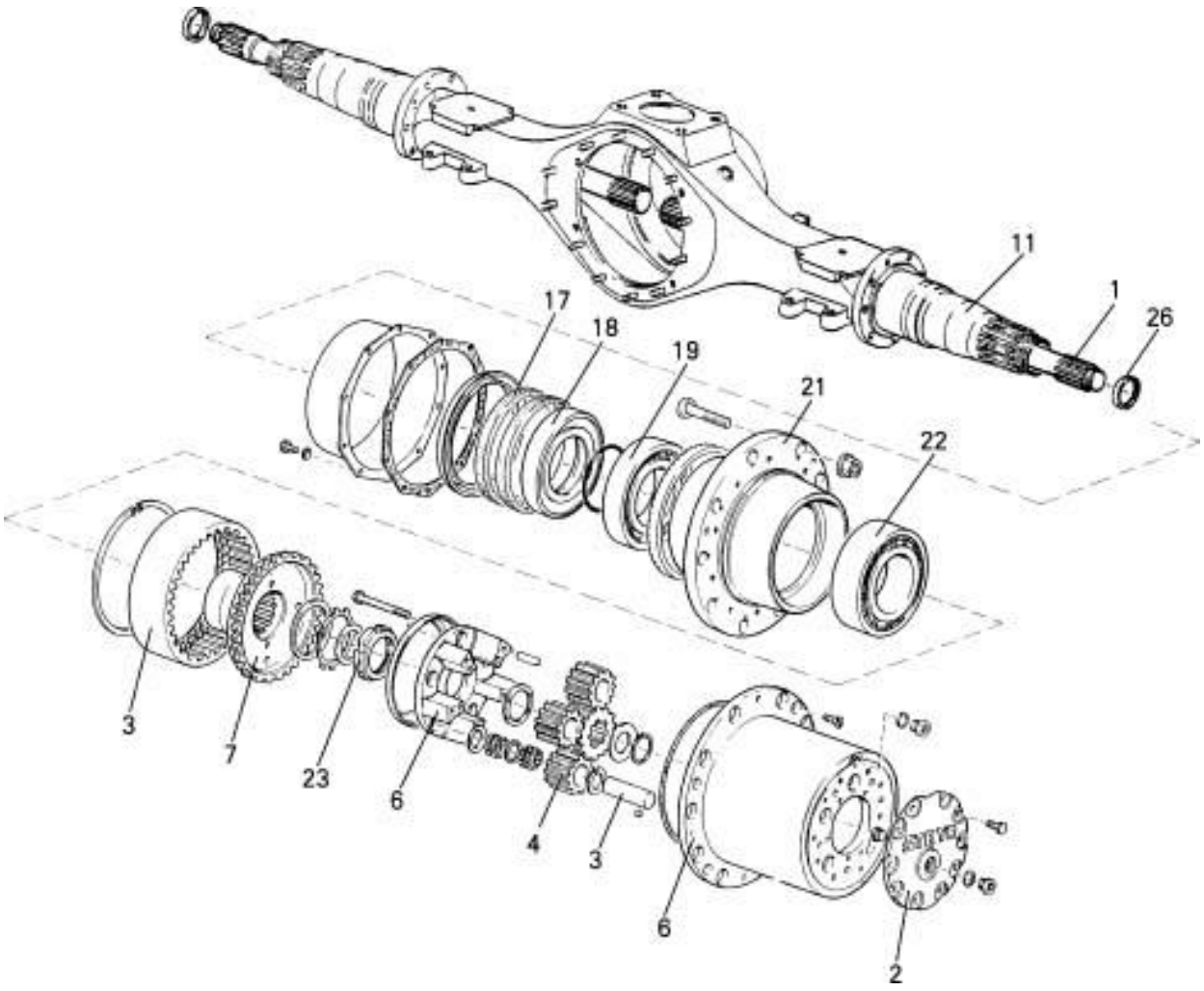


Fig. 8-11

1. Half-axle 2. Axial journal end cover 3. Planetary gearshift 4. Planetary gear 5. Gear ring 6.Planetary carrier axial journal 7. Gear ring shaft sleeve 8. Vent 9. Brake shoe 10.Brake shoe dowel pin 11. Axle case axle tube 12. Brake disc 13. Brake drum 14. Brake shoe carrier 15. Brake camshaft 16. Spring 17. Hub oil seal 18. Oil seal shaft sleeve 19. Hub inner bearing 20. Hub seal ring 21.Hub 22. Hub outer bearing 23. Axial journal nut 24. Washer 25. Sun gear 26. Half-axle oil seal

The pre-tightening force of hub bearing is ensured via the axial journal nut 23. In order to ensure the stability of axial journal nut, there is a washer 24 at the inner shoulder of axial journal nut and end face of axle case axle tube. In assembling, torque the axial journal nut to 300-400N.M, and then use a filler gauge to measure the clearance from the inner shoulder of axial journal nut to the end face of axle case axle tube, and reinstall with washer of proper thickness selected. The pre-tightening torque of hub bearing is 7-9 Nm, and in order to ensure the rotating drag torque, first pre-tighten the axial journal nut using 300-400 Nm, then loosen again by light tapping using a wood hammer, and after that tighten again the lock nut with a torque of 7-9 Nm.

The drive axle wheel brake mechanism uses the conventional structure, and in maintenance, it is required that the circumferential diameter of the brake friction pad is 0.2mm greater than the diameter of brake drum. The diameter of new brake drum is ϕ420±0.1mm,and the maximum allowable wearing diameter of the brake drum is ϕ422±0.1mm.

The final gear structure of drive rear-axle is the same as that of steering drive axle, the wheel reductor - -structure is basically the same, and completely the same as the wheel reduction and brake of the drive-through axle. And therefore, for the removal, installation, operation, maintenance and troubleshooting, see the steering drive axle.

Drive-through axle wheel reductor and brake structure is the same as that of rear axle, and also the same as that of steering drive axle,the central reductor is provided with an additional thru shaft type drive unit on the basis of rear axle and steering drive axle final gear, which is used to transmit the power from forward rear axle to rear axle, so the stress shall be put on analyzing the structure, removal, and installation of drive forward rear axle below.

III Structure of drive-through axle is shown in Fig. 8-12,Fig. 8-13 is drive-through axle exploded view.

As shown in Fig. 8-12, the power is transmitted from the drive shaft to input drive flange 1,and through the spline shaft and hole, drive the input shaft 38 to rotate. The input shaft 38 actually is a front half-casing of interaxial differential,which is connected with the rear half-casing of differential using coupling bolt 35 to form an integral piece. The interaxial differential is also provided with cross shaft planetary gear and is engaged with two conical gears similar to half-axle gear,driving two conical gears 3 and 8 to rotate together. The front conical gear 3 is connected with the thru shaft 11 of drive rear-axle through spline, thus transmitting the power to the rear drive axle. The half-axle gear 8 is linked with forward rear axle drive shaft sleeve 9 through spline. And shaft sleeve 9 is also is linked with drive cylindrical gear 10 through spline,hence transmitting the power to the drive conical gear shaft 29 through driven cylindrical gear 30,and then driven by the drive and driven conical gears, the power is transmitted to the forward rear axle left and right half-axle through interwheel differentia l17.

There are two differentials in the drive-through axle,and one is the interwheel differential,which is to accomplish the function of left and right wheel automatic differentials while a truck is turning. The other is interaxial differential,which plays the function of automatic differentials between forward rear axle and rear axle when a truck is traveling on the ragged road or turning. When a truck is traveling on the ragged road, the forward rear axle and rear axle are different in spot speed. If the forward rear axle and rear axle are the connection of complete rigid drive, then in any instance, the forward rear axle and rear axle wheel are the same in the rotating speed, resulting in movement interference,which not only consumes power but also causes tyre wearing failure, and even damage to the parts. With help of the interaxial differential,it will automatically adjust the rotating speed of forward rear axle and rear axle to completely adapt to the needs of road surface.

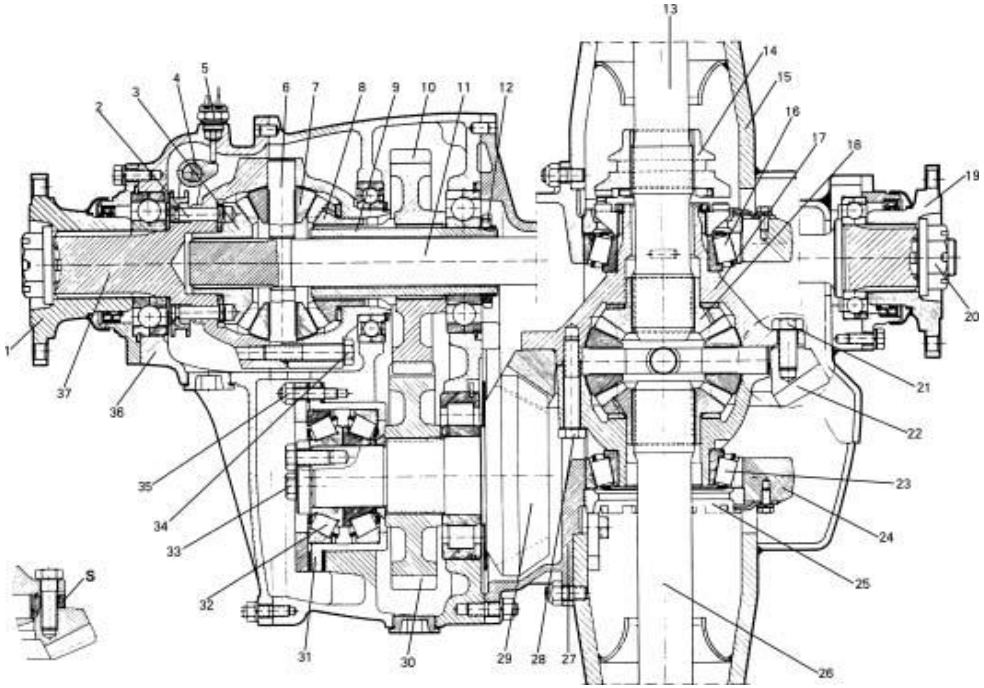
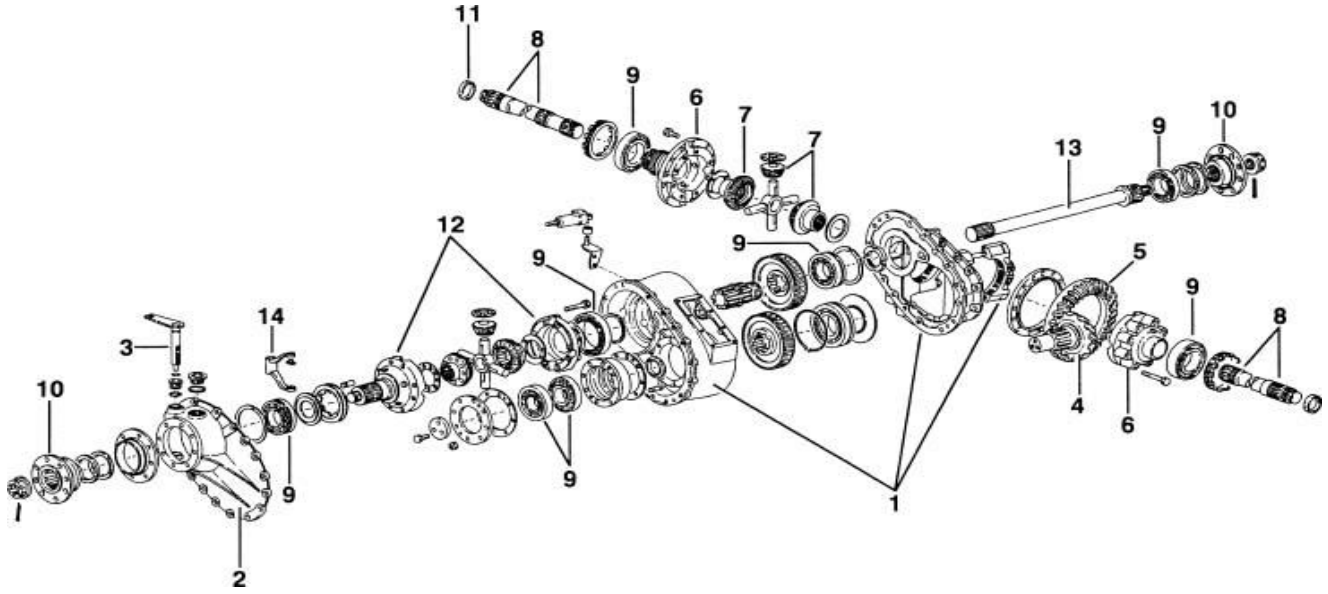


Fig. 8-12 Drive forward rear axle structure diagram

1. Input drive flange 2. Interaxial differential lock 3. Rear axle drive conical gear 4. Interaxial differential lock shifter fork 5. Interaxial differential lock indicator switch 6. Interaxial differential lock cross shaft 7. Planetary gear 8. Forward rear axle drive conical gear 9. Forward rear axle drive shaft sleeve 10. Drive cylindrical gear 11. Thru shaft 12. Lock nut 13. Right half-axle 14. Differential engagement sleeve 15. Axle case 16. Differential right bearing 17. Differential left bearing 18. Right half-axle gear 20. Output flange 21. Driven gear fixing bolt 22. Driven conical gear 23. Differential left bearing 24. Bearing stressed top 25. Bearing axial adjusting nut 26. Left half-axle 27. Final gear hub 28. Differential casing coupling bolt 29. Drive conical gear and shaft 30. Driven cylindrical gear 31. Transition box housing 32. Drive gear bearing housing 33. Drive gear bearing 34. Drive gear resting baffle bolt 35. Interaxial differential casing coupling bolt 36. Cover plate fixing bolt 37. Input shaft casing 38. Input shaft 39. Driven gear

Fig. 8-13 Drive forward rear axle exploded view



1. Drive-through axle transition box and final gear as well as differential bearing stressed top 2. Input shaft casing 3. Interaxial(shaft)differential lock control shaft 4. Final gear drive conical gear 5. Driven conical gear 6. Differential casing 7. Planetary and half-axle gear 8. Half-axle 9.Differential supporting bearing 10. Input flange 11. Half-axle sun gear clip 12. Interaxial(shaft)differential casing 13. Thru shaft 14. Interaxial(shaft)differential lock shifter fork

In case after interwheel differential lock being engaged,both drive-through axle left and right wheels are slipping and the rear axle wheel is not moving, or the rear axle wheel is slipping and drive-through axle wheel is not moving, truck is unable to travel, then it is necessary to engage the interaxial differential lock. With the interaxial differential lock switch pressed down, the solenoid valve is open, and the compressed air comes into the interaxial differential lock slave cylinder, which pushes the piston push rod to make the differential lock shifter fork 4 push the differential lock 2 to be inserted into the pin hole of front conical gear,thus locking the differential casing and conical gear. The differential plays no longer the differential role, thru shaft 11 and drive gear collar 9 have completely become a rigid link, and at this time, the drive-through axle, rear axle, left half-axle, right half-axle completely become a rigid integral piece, all wheels rotating at a constant speed. Truck will smoothly drive out of the trouble road surface. Once truck is driven out of the trouble road surface, the interaxial and interwheel differential locks are all disengaged immediately.

Caution: On the hard and fine running road surface or when turning at big angle, it is prohibited to use differential lock,otherwise it will cause damage to drive components.

IV. Features of Removal and Installation and Precautions

1. Drive-through axle final gear

Prior to assembling, clean the exterior, and blow with compressed air, and drain lubricating oil from the axle case transmission gearbox while hot.
Remove the spring brake cylinder and brake chamber hose, differential lock slave cylinder air inlet pipe and indicator light connecting wire.
Screw off the fixing bolts of transmission gearbox,and separate the transmission gearbox and final gear hub using hammer and crowbar. Draw the transmission gearbox out using trolley and put it on the special stand for removal and installation of drive-through axle's transition box.
Prior to loosening the nut,fix flange using the flange disk removal wrench to prevent rotation,screw out the fixing nut. Pull out the coupling flange using a puller.
Screw off the bolts of transmission gearbox front cover, and take out the front cover and interaxial differential.

After removing different kinds of washers and lock pins, store them properly and remember the original assembled positions.
The thru shaft may be removed in advance from the rear of the drive-through axle.
Prior to removal of final gear driven gear and interwheel differential, it is necessary to draw the two rear-axle half-axles a little out.
The half-axles on the right side of drive-through axle and left side of rear axle are provided with interwheel differential lock skid lock sleeve, and when taking the half-axle on that side, it is allowed to draw out within 140mm,otherwise, the skid lock sleeve of differential lock may drop down, preventing the final gear assembly from being taken out. In minor repair or truck maintenance where no axle disassembling is to be made, if it is required to draw out the half-axles,be sure to lock first the differential lock to prevent the lock sleeve from dropping. To prevent the lock sleeve from dropping, fix the differential lock rocker arm on the connecting position using an iron wire before drawing half-axles out. Otherwise, the installation of lock sleeve will be very difficult in case the skid lock sleeve drops.

2. Assembling and adjusting of final gear

Fix the drive gear shaft on bench vice, fit the oil deflector disc and pay attention to the direction.
After heating the cylindrical bearing inner race on the heating plate to 80 degrees, slip it over the shaft.
Install the bearing and drive gear,pay attention to the direction of two cylindrical gears, that is , the full spline side of driven cylindrical gear should face the input end of axle,it is prohibited to install it reversely.
Fill both conical bearings with grease, install them in bearing seat as per the correct procedure, and slip the bearing seat conical bearing over the shaft.
Fit the end cover of drive conical gear shaft,and tighten the three screws with tightening torque of 190N.M, using torque wrench.
Install the adjusting washer with thickness of about 2.5mm, then the compression plate, and temporarily tighten the nut using a little bit torque.

A . Check and adjust the conical roller bearing pre-tightening force of drive conical gear shaft:
Excessive big pre-tightening force of conical roller bearing will cause bearing to become overheated during operation, accelerate wearing and even be damaged. Excessive small pre-tightening force will also make the bearing buzz and shorten its service life. In assembling and adjusting, ensure the rolling drag is within the range of 0.2-0.5Nm. In measuring,the drag value can be obtained by winding the drive conical gear bearing seat with a rope for several turns and pulling it tangentially. The axles with different gear ratios will have different drags. With main drive that has gear ratio of 5.73 as an example, the drive conical gear outside diameter is 180mm,then corresponding pulling force of the spring balance should be 6-28N.
For the corresponding rolling drag of conical roller bearing with different main gear ratios, see Table 8-7.

Table 8-7

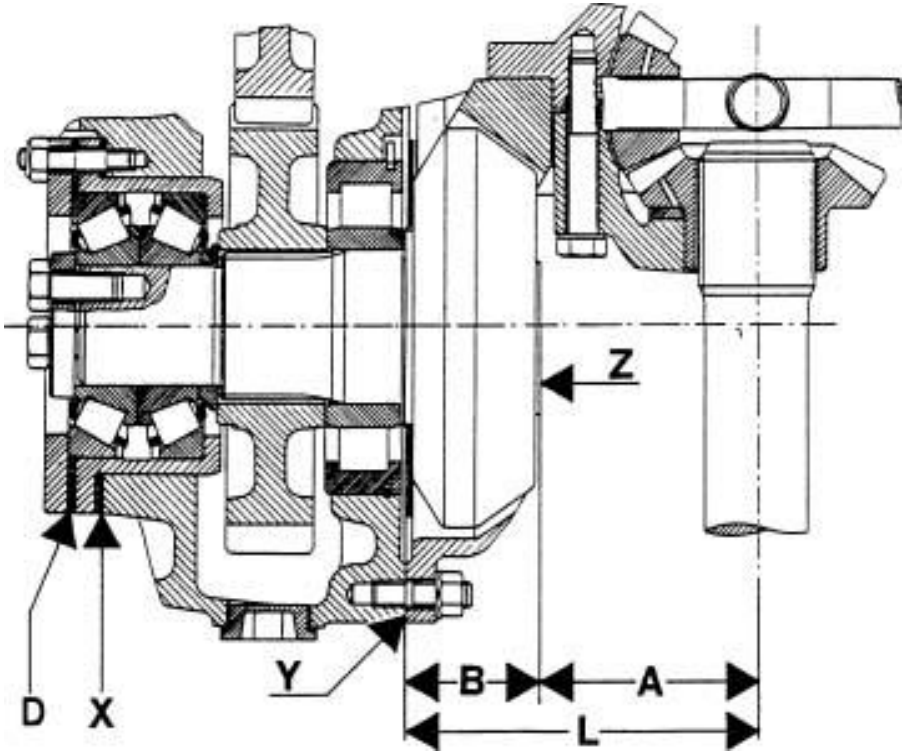
Main gear ratio	4.8	5.73	6.72	7.49	8.40	9.49
Drive conical gear outside diameter	180	180	160	152	138	125
Rolling drag N	6–26	6–26	6.5–31	7–33	7.5–36	8–40

Notes:
a. The drive conical gear outside diameter in Table 8-7 is in mm.
b. The rolling drag is in N.
c. The upper limit of drag value is applicable to new bearings,and the lower limit of drag value is applicable to old bearings.

If the drag value measured is improper, it can be adjusted by replacing and adjusting thickness of washer. There are several kinds of thicknesses of adjusting washer, when decreasing the thickness of washer, the drag increases, and reversely, the clearance decreases. The position of D is shown in Fig. 8-14.
After adjusting,remove and install them in center casings respectively.When putting the bearing seat into center casing, the hole on bearing seat should be communicated with the groove on the casing.

B. Adjustment of installation distance:
The installation distance adjusting area of drive-through axle,which is different from that of front and rear axles, is adjusted by changing the thickness X of washer between bearing seat and drive-through axle housing as shown in Fig. 8-14.
The thickness X of washer is also obtained by calculation, and the formula for calculation is as follows:
$X=(A\pm Z)+B-(L\pm Y)$
Where:
A--Theoretic installation distance
Z--Correction value of A,which is marked on the end face of drive conical gear,to the accuracy of 0.01mm,with corresponding positive and negative signs.
B--The distance from the end face of drive conical gear to the contact area of the bearing seat, which is measured using the depth gauge after installation of drive conical gear assembly and proper adjustment of pre-tightening of bearing.
L--Theoretic installation distance from the center line of driven conical gear to reductor housing front surface
Y--Correction value of L,which is printed on the end face of bearing,to the accuracy of 0.01mm,with corresponding positive and negative signs

Fig. 8-14



A and L are theoretic dimensions, which can be found in Table 8-8.

Gear ratio	4.42	4.80	5.73	6.72	7.49	8.40	9.49
A	102	102	102	102	106	106	106
L	160	160	160	160	160	160	160

Example for calculation:
If:A=102
- -Z=+0.2
B=60.22
L=160
Y=-0.08
Then:X=(102+0.2)+60.22-(160-0.08)
=2.5mm
The adjusting washer has four kinds of thicknesses,and in order to form the total thickness obtained by calculation,thicker washer should be selected. In this example, it is recommended to select two washers with thicknesses of 1mm, one washer with thickness of 0.4mm and one washer with thickness of 0.1mm.

C. For the adjustment of conical gear pair engagement trace, see the steering drive axle.

3. Main points for repairing brake

(1) When assembling the new friction pads, only friction pads made of same materials are allowed on the same axle
(2) After assembling and replacing friction pads or shoe, the brake shoe friction pads must be surface trimmed on the axle by using the appropriate machining tool so as to enable the new friction pads to reach the best brake contact area and break-in time to be as short as possible.

A. It is required that the trimmed dimensions of the brake shoe friction pads are 0.0-0.2mm smaller than the brake drum inside diameter.
For example:The brake drum inside diameter of new truck is 420±0.1mm,and in this case, after trimming the brake shoe friction pads, the dimensions are 419.8±0.2mm. For maintenance of in-use vehicles, the brake drum inside diameter is allowed to be machined maximum to 422±0.1mm.

B. When trimming the brake shoe friction pads on axles,it is, in principle, carried out according to the following procedures:
--The radius of brake drum and brake shoe friction pad must match(under braking state).
--The brake shoe friction pads on the same axle must be trimmed together.
--The hub bearing must be accurately adjusted.
--On condition that the most accurate measurement is made on the brake shoe to make its diameter about 0.2-0.3mm greater than the inside diameter of brake drum. And then trim the brake shoe friction pad to make it 0.2mm smaller than the inside diameter of brake drum.
--During trimming, all the lining surface of friction pad must be trimmed. If it was not trimmed for the fist time, then the second trim and even the third trim should be made.
--The higher the surface accuracy of trimmed brake shoe friction pad, the better the performance of the friction pads.

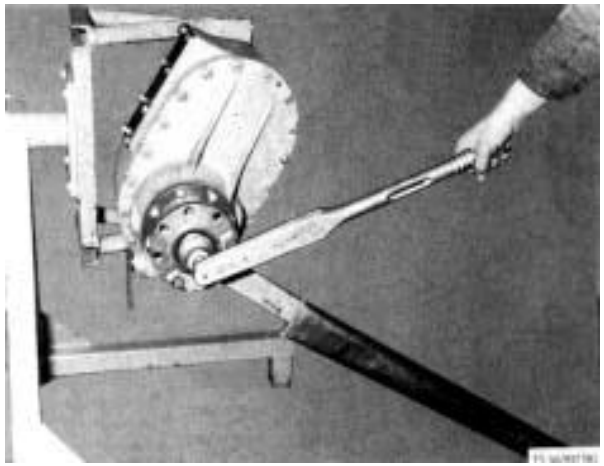
4. Other parts

Washer X and washer D are the washers for different uses, which are the same in shape and their mounting positions are near. And therefore when removing and installing, don't mix them.
When tightening the round nut of hollow spline shaft, it is required to use a retainer, and then torque it to 300 Nm using a special wrench. It is best to replace it with the new round nut in each removal.
In case the bearing inner race and shaft are tight fit, it is required to heat it to 80 degrees.
Two half-casings of differential must be correctly installed according to the marks made before removal.

Pay attention to the assembling direction of locking mechanism of interwheel differential, drive-through axle is on the right side of differential and rear axle is on the left side of differential.
The locking mechanism of interaxial differential should slide front and back smoothly, the sliding of locking pin in the pinhole should be free from sticking.
After installing the differential, first move the locking rocker arm to check if the differential lock is in good operation.
The contact area of the casing should be coated with plane sealant.

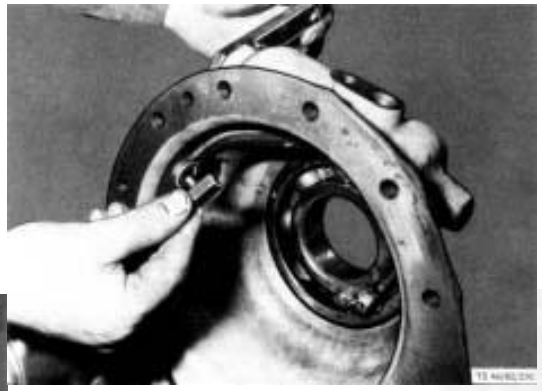
V. Removal and Installation of drive-through axle

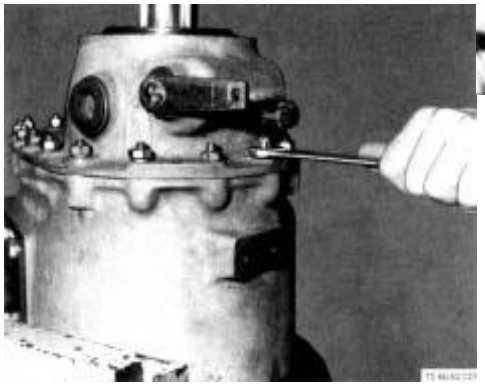
(I) Removal of drive-through axle

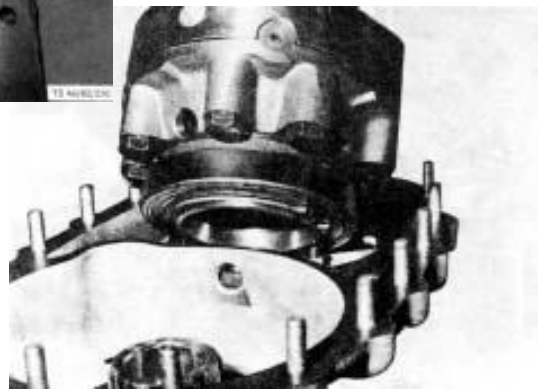


1. Install the drive-through axle middle section on the turnover fixture, and remove the input flange nut using the special tool.

2. Pull out the input flange using the puller.







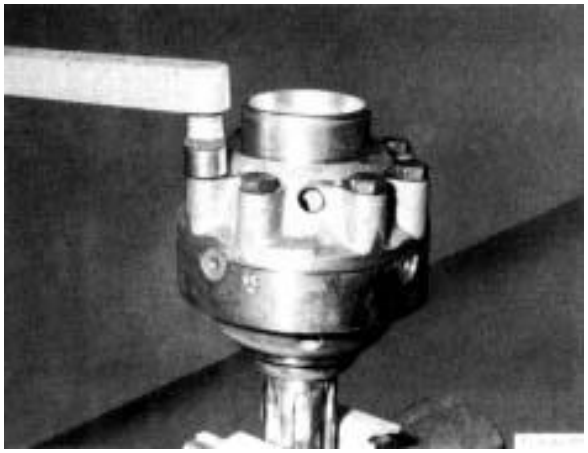
3. Remove the input bearing cover,and then remove the interaxial differential casing from drive-through axle middle section assembly.

4. Remove the interaxial differential lock shifter fork and shifter fork shaft. Take the interaxial differential assembly out of the transition box.

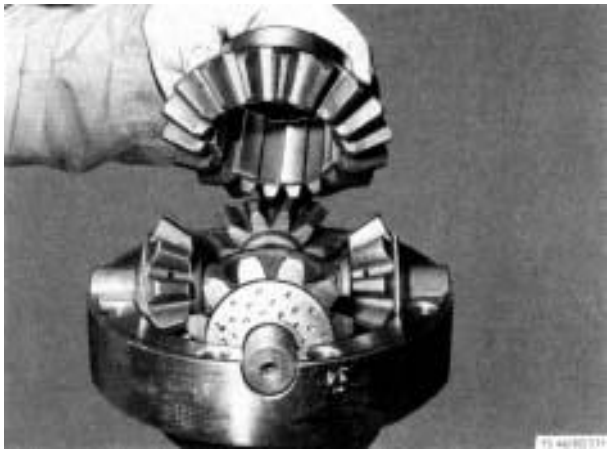
A. Removing the interaxial differential

a. Take the differential lock out of differential. Remove the differential supporting bearing using the puller.

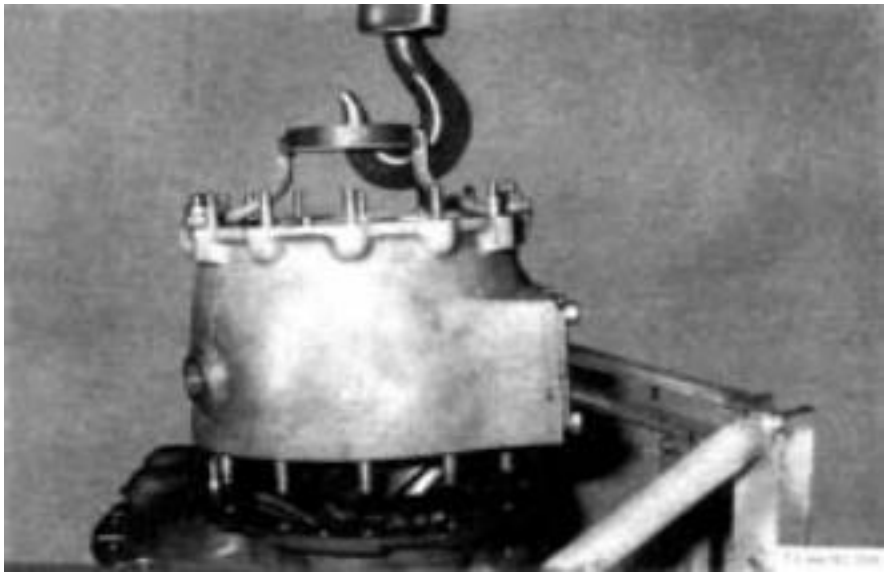
b. Check for the assembling marks on the differential casing. In their absence, it is required to put assembling marks on the two differential casings.



c. Remove the coupling bolts from differential casing.

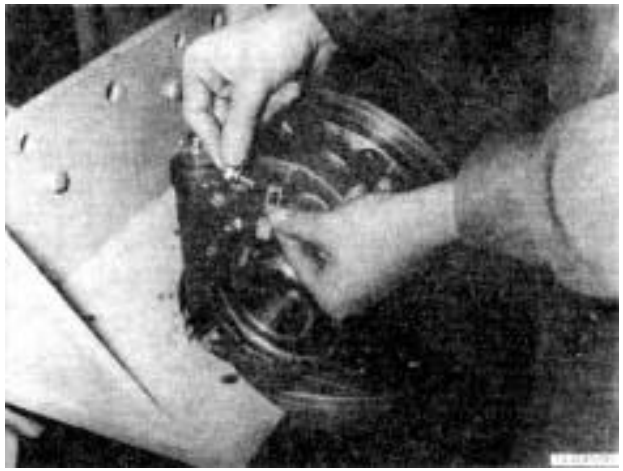


d. Take out the half-axle gear and planetary gear. In removal, the half-axle gear and thrust washer shall be placed in pairs to prevent mixing in reassembling.

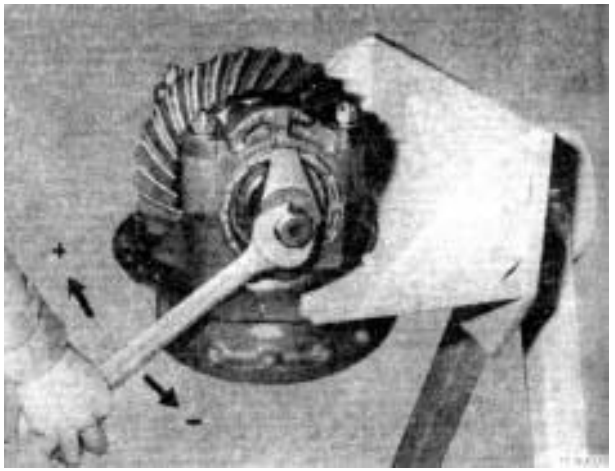


e. Remove the flare nut between the transition box and final gear hub,and remove transition box and final gear hub.

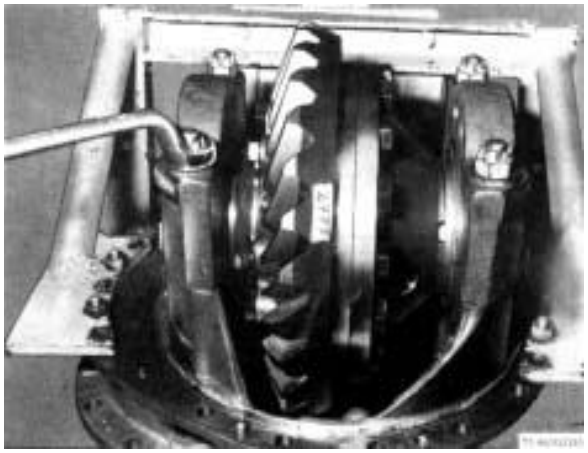
B. Removing the interwheel differential



a. Remove the locking plate of adjusting nut.



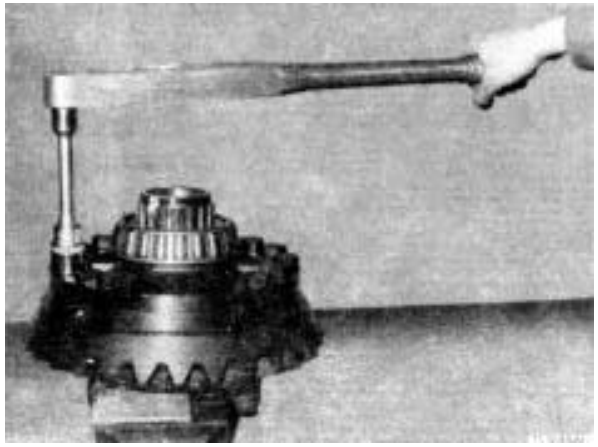
b. Remove the adjusting nut of bearing using the wrench for differential bearing adjusting nut.



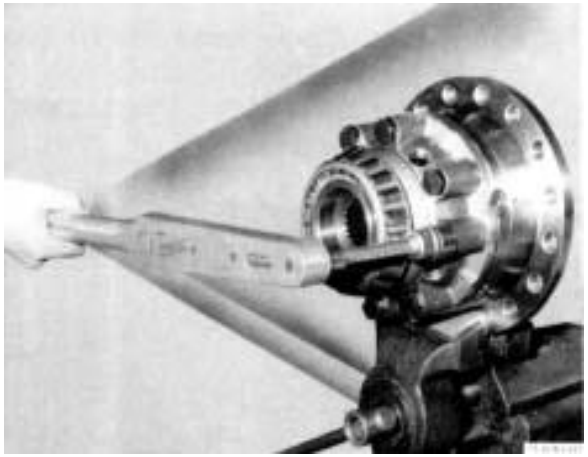
c. Remove the bearing cover,and take out differential assembly. Prior to removing the cover, make pairing marks on the corresponding cover and bearing seat to prevent any errors in reassembling.

d. Release the locking plate of differential lock engagement sleeve and screw off the fixing nut.

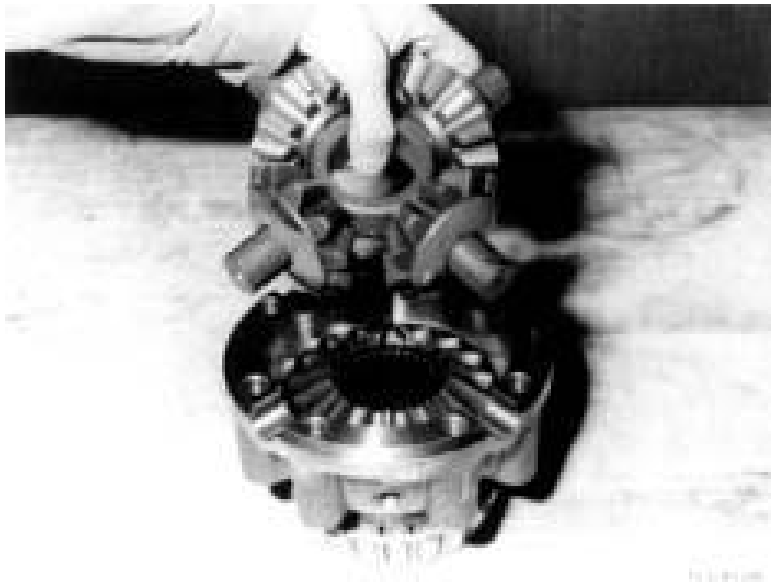
e. Take out the differential lock engagement sleeve.



f. Remove the coupling bolts from driven gear and differential casing,separate the driven gear and base ring from the differential

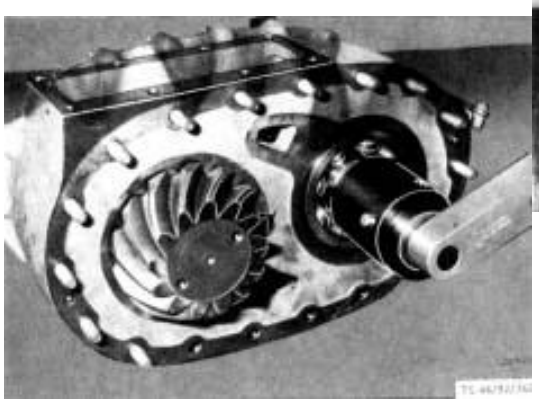


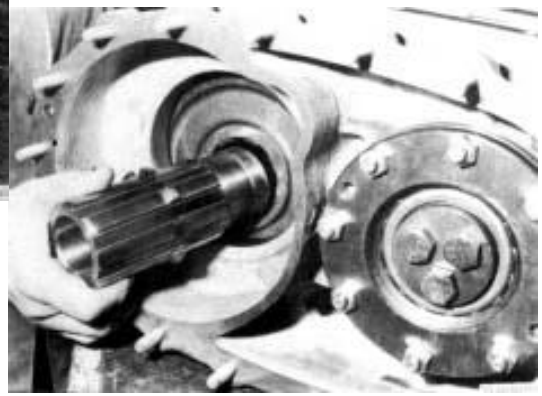
g. Remove the coupling bolt from differential casing. Prior to removal, check the two half-differential casings for assembling marks. In their absence,make assembling marks on them to prevent mixing in reassembling.



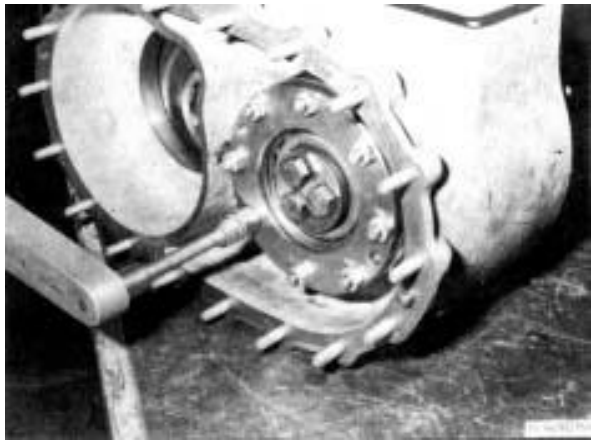
h. Take out the half-axle gear, thrust washer, planetary gear and cross shaft. In removal, pay attention to keep the half-axle gear and thrust washer in pairs,planetary gear and spherical washer in pairs to prevent mixing in reassembling.
Prior to removal, assembling marks should also be made on planetary gear and cross shaft for matching purpose in reassembling.

C. Removing the transition box



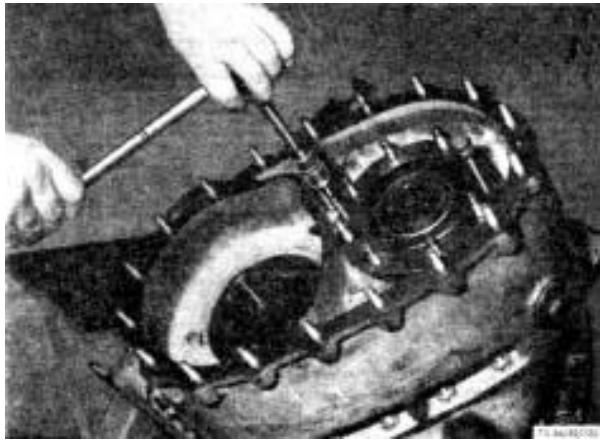


b. Remove the fixing nut from shaft sleeve,and take shaft sleeve and supporting bearing out of transition box.

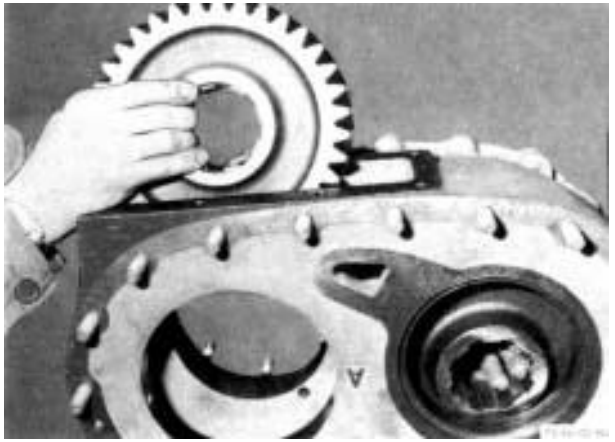


c. Remove the drive gear shaft bearing cover.

d. Remove the drive gear shaft baffle.

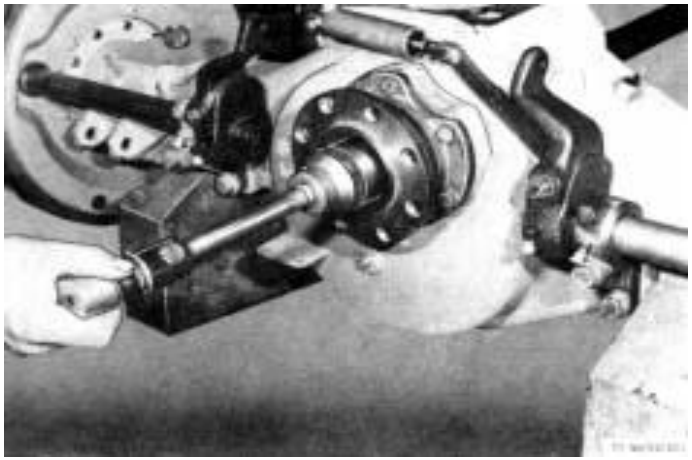


e. Push the drive gear shaft bearing shell together with two conical roller bearings out of transition box using two M10×85mm bolts, and then draw out the drive gear shaft.

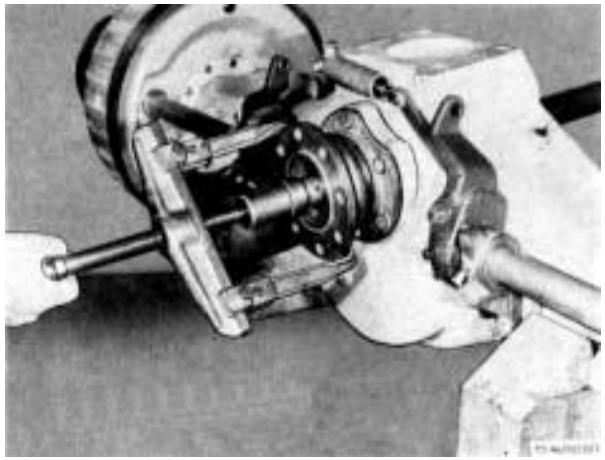


f. Take the drive and driven cylindrical gears out of transition box.

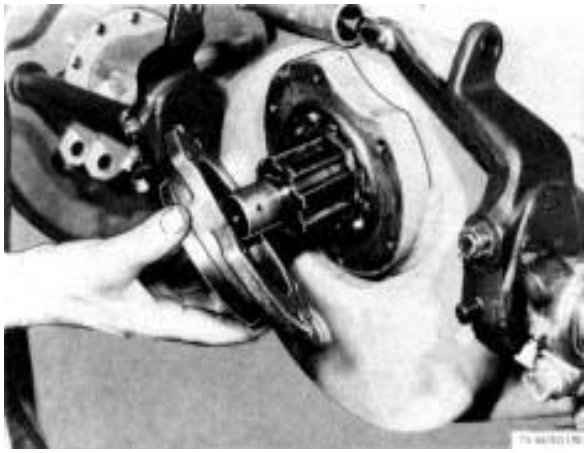
D. Removing the thru shaft



a. Remove the fixing nut from thru shaft output flange.



b. Remove the drive flange using the puller.



c. Remove the thru shaft bearing end cover.

d. Remove the thru shaft from the axle case.

E. Removing the forward rear axle wheel reductor(omitted)
The drive-through axle wheel reductor and the steering drive axle are same in structure,for the detail of removal procedure, see the steering drive axle.

(II) Assembling the drive-through axle

A. Assembling the drive-through axle transition box

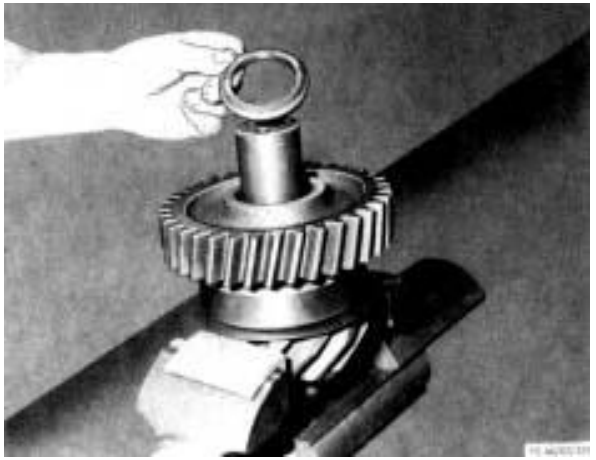
(1) Put the oil catching plate in the drive gear.

(2) Heat bearing inner race to 80℃ and press it into the drive gear shaft.

(3) After cooling the bearing inner race,put the outer race and roller in it.

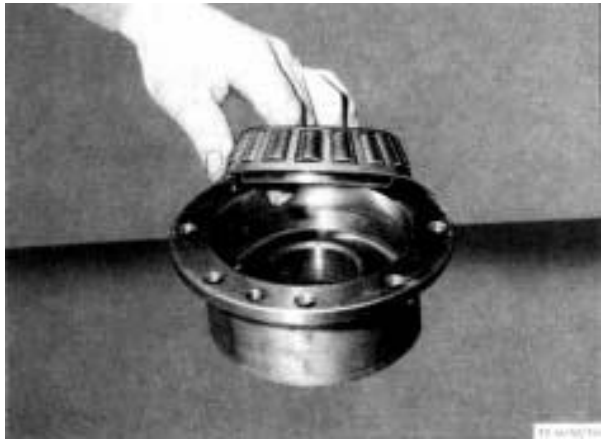
(4) Put washers in the drive gear shaft.

(5) Preinstall the drive gear in the drive gear shaft.

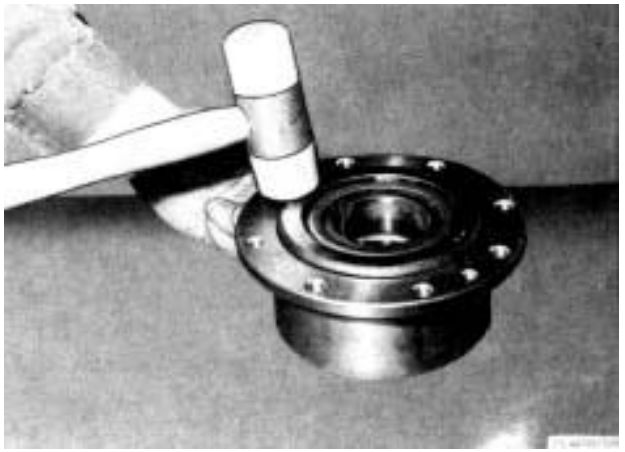


(6) Put the spacer ring in the drive gear shaft.

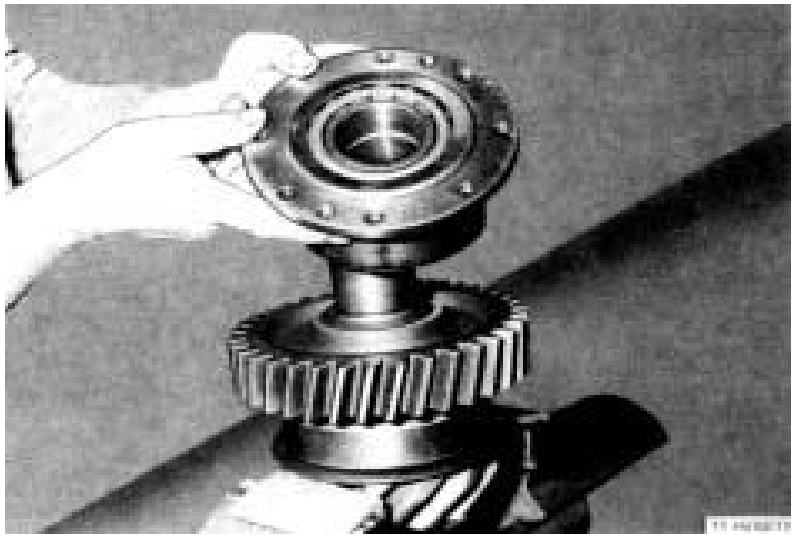
(7) Put the drive shaft bearing outer race into the bearing shell.



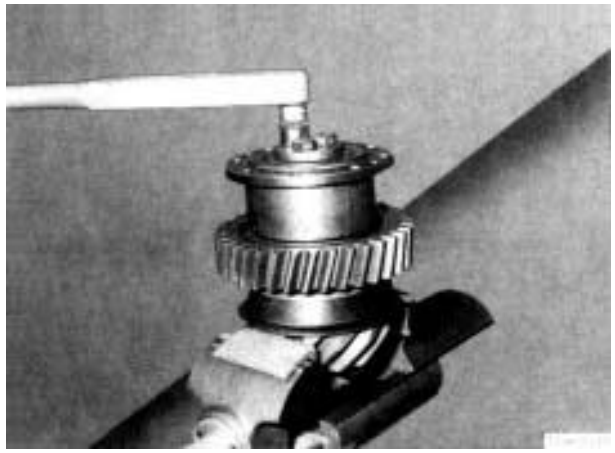
(8) Install the inner race of drive gear shaft internal and external bearings in the bearing shell.



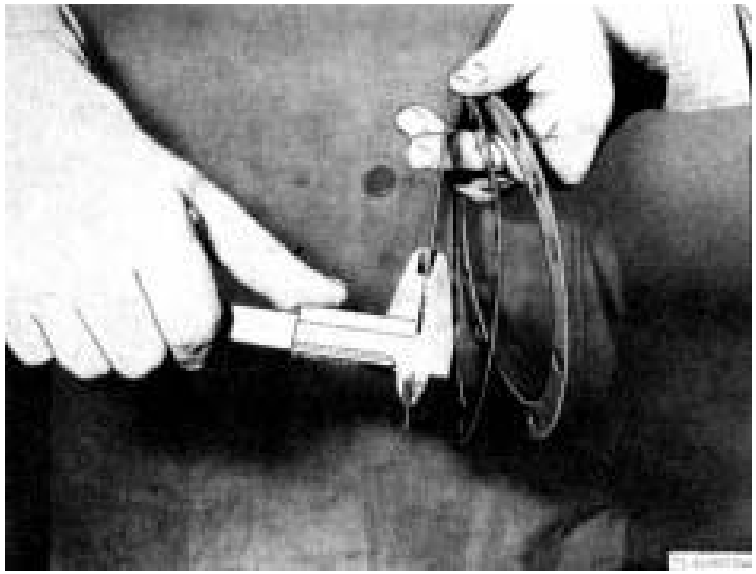
(9) Install the external bearing outer race in the bearing shell.



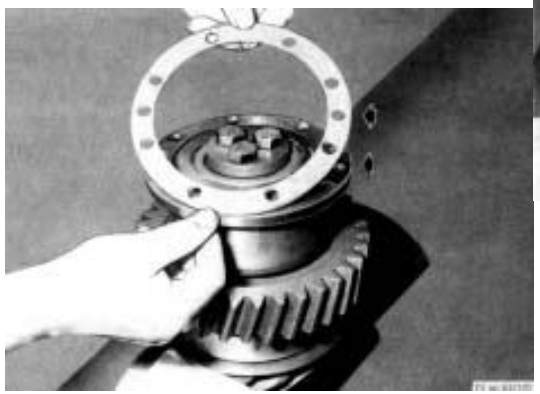
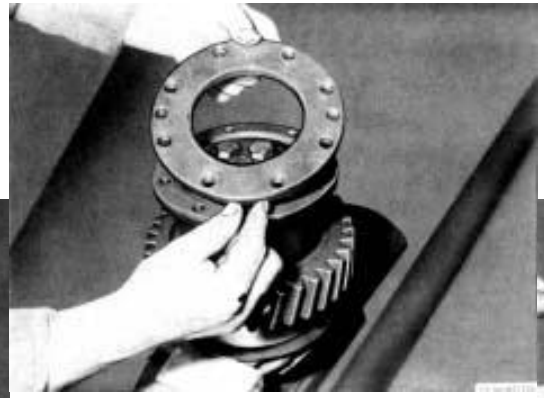
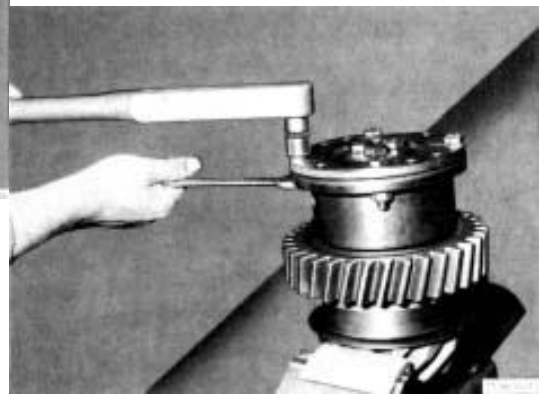
(10) Install the bearing shell in the drive gear shaft.



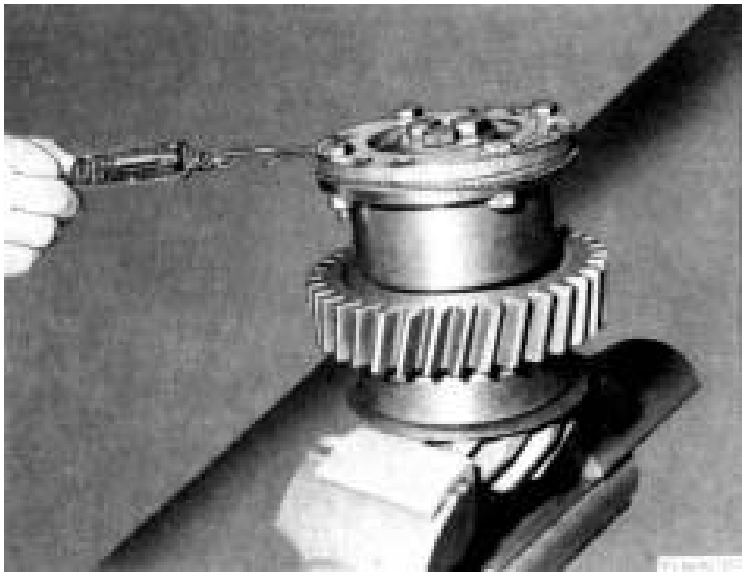
(11) Install the drive gear shaft baffle in and pre-tighten the three fixing bolts with torque of 195Nm.



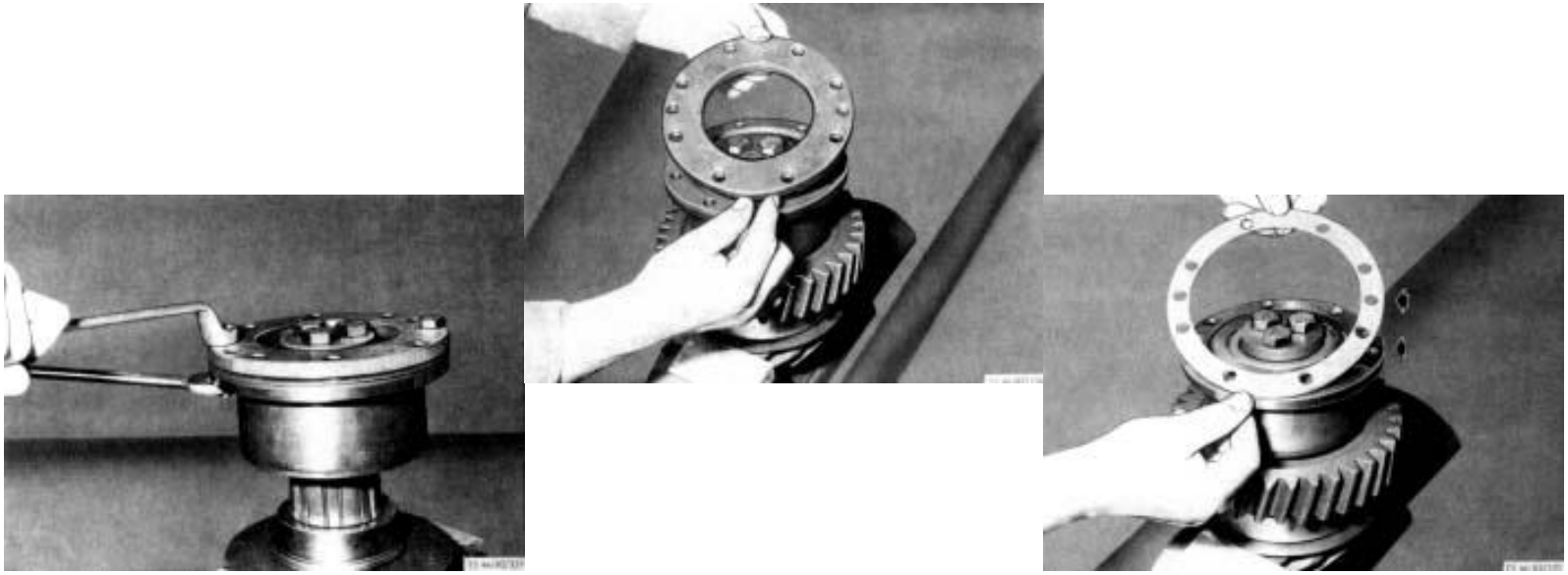
(12) Select adjusting washer with suitable thickness. The standard thickness of adjusting washer is 0.1, 0.15, 0.4 and 1.0mm.

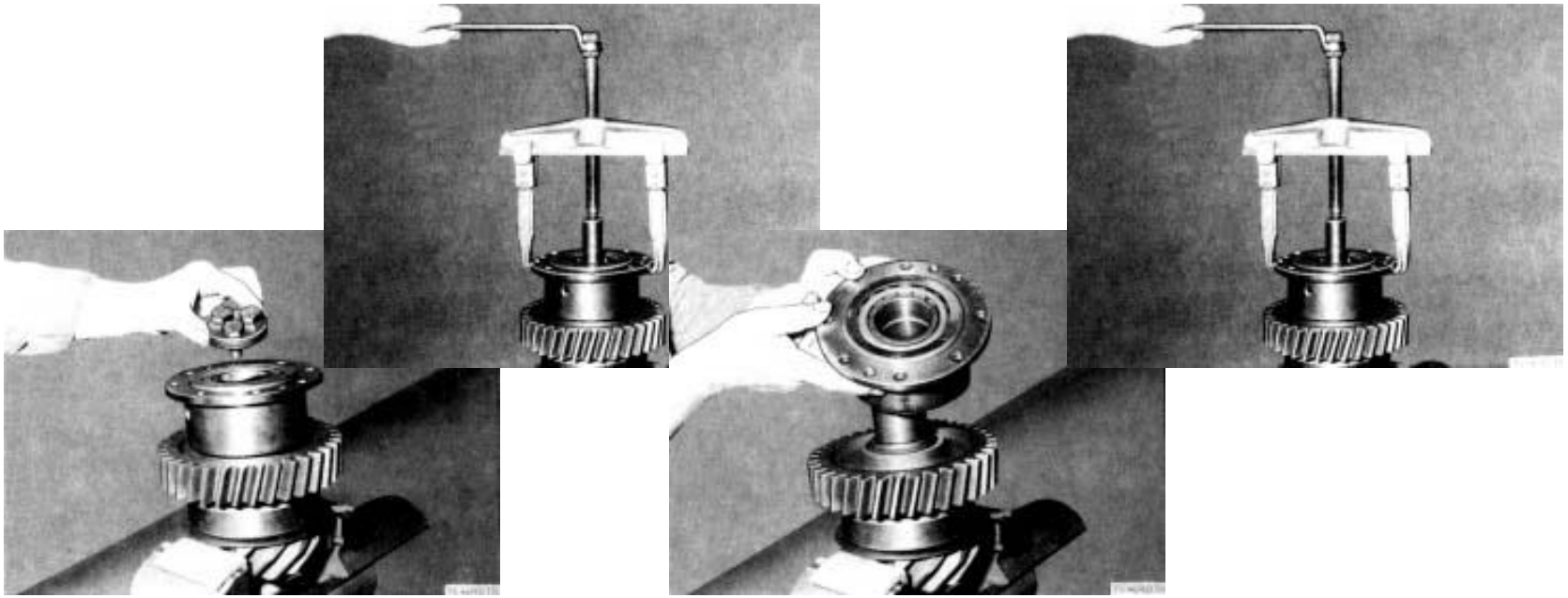
(13) Pre-install the washer and cover plate simultaneously on the bearing.



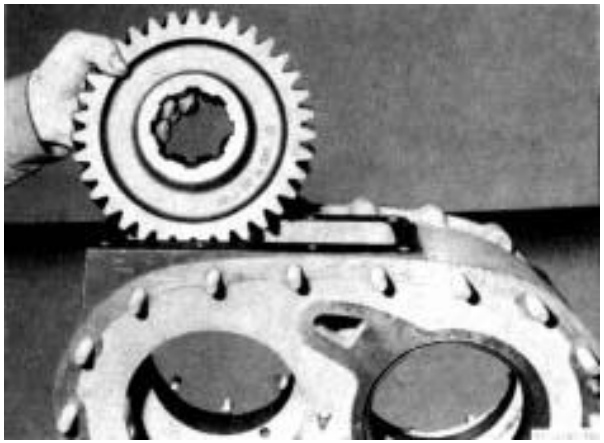
(14) Measure the drag torque with a spring balance, which should be within the range of 0.5-2.5 Nm, and the pulling force reading of spring balance is about 0.6-2.9kg. If not up to the standard, it is necessary to adjust the thickness of adjusting washer. If the drag torque is too big, decrease the thickness of adjusting washer, and vice versa.

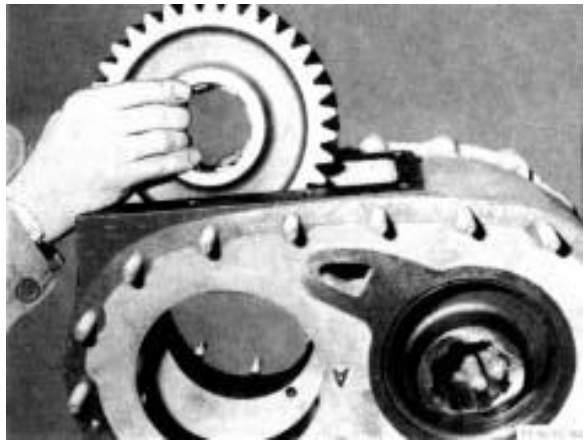


(15) Disassemble again drive gear assembly, and store the selected washer properly.

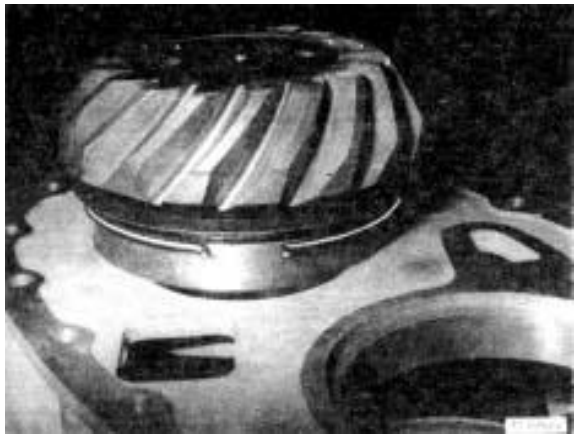


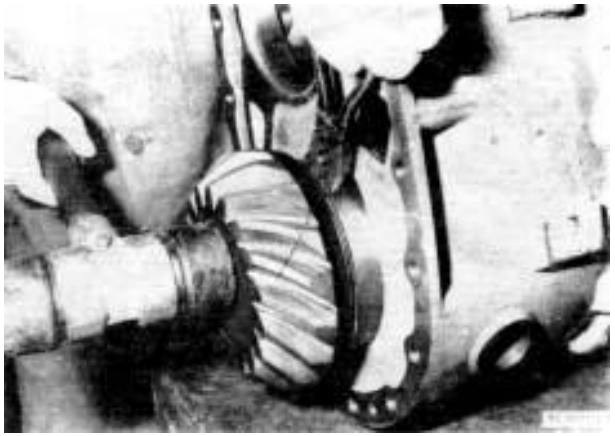
(16) Completely disassemble the drive gear shaft.



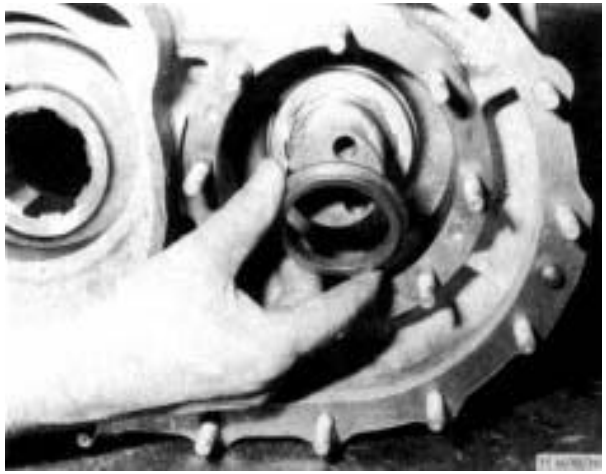


(17) Install two cylindrical drive gears in the transition box.

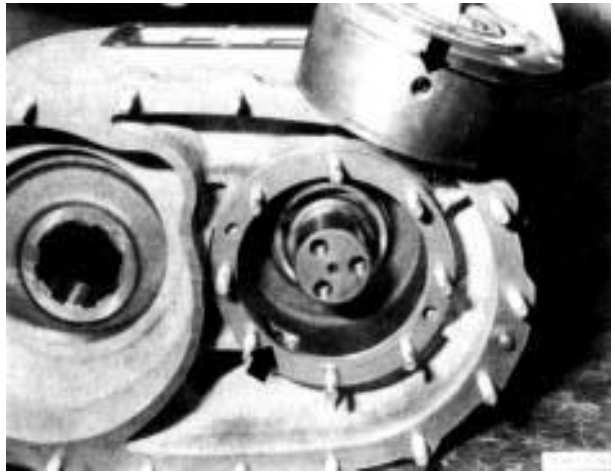




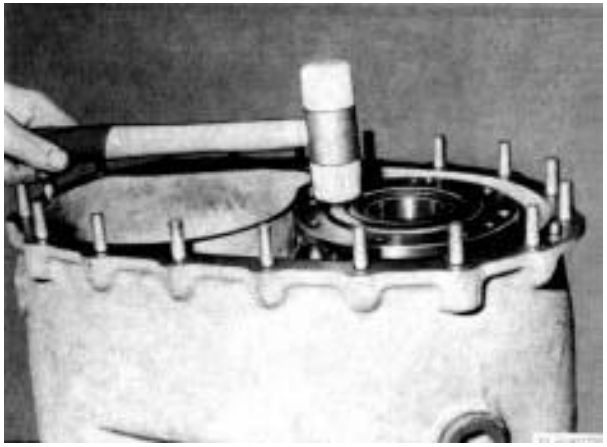
(18) Put the bearing locating clip in the bearing groove,tightly grip the clip using the hand vice, and carefully put the drive gear shaft bearing into the transition box.



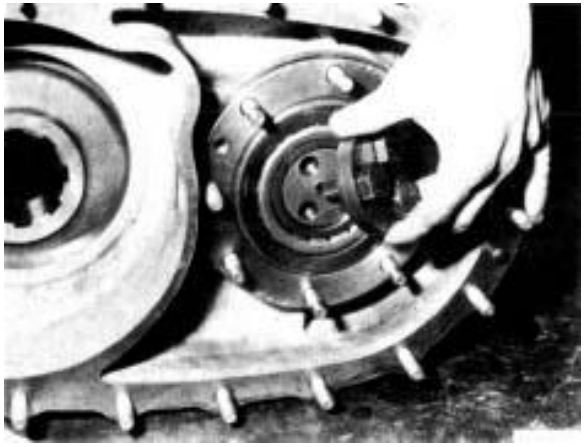
(19) Put the spacer ring again in drive gear shaft.



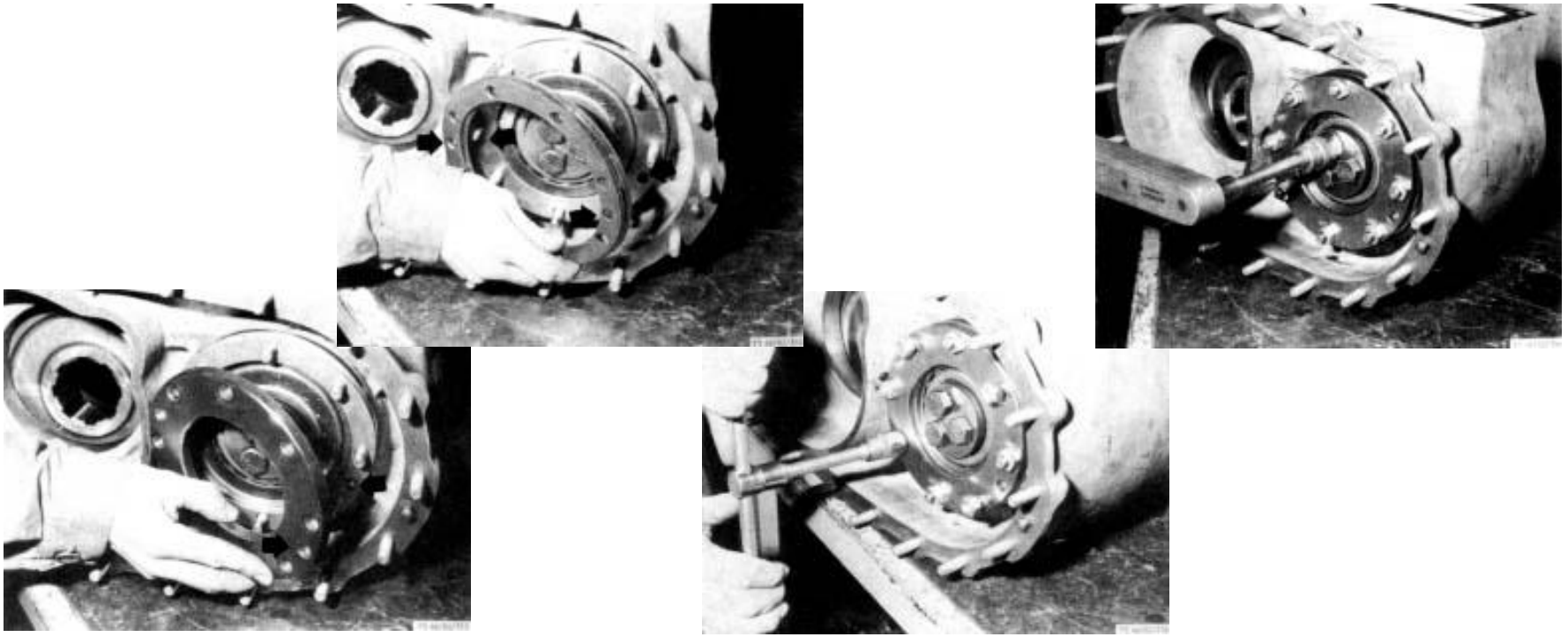
(20) Reinstall the bearing in drive gear shaft,pay attention to the installation position of bearing shell oil hole.



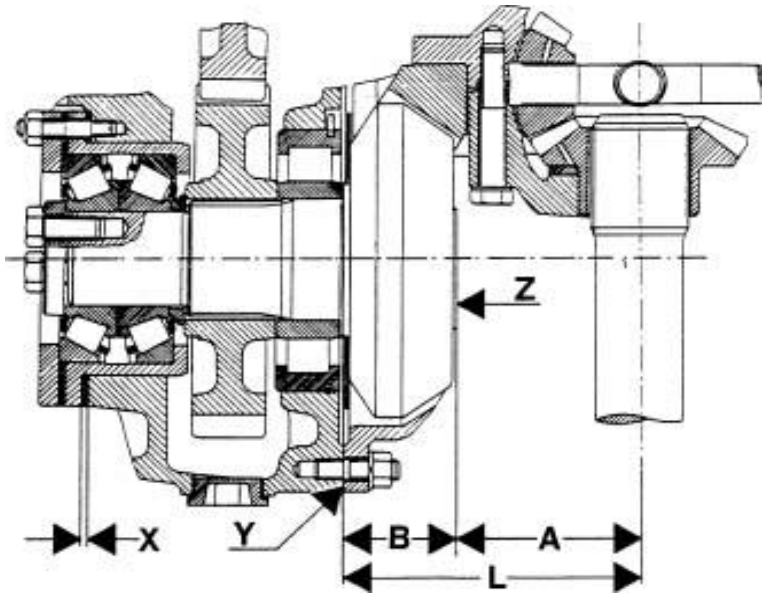
(21) Tap lightly using a wood hammer to mount the bearing shell into the drive gear shaft.



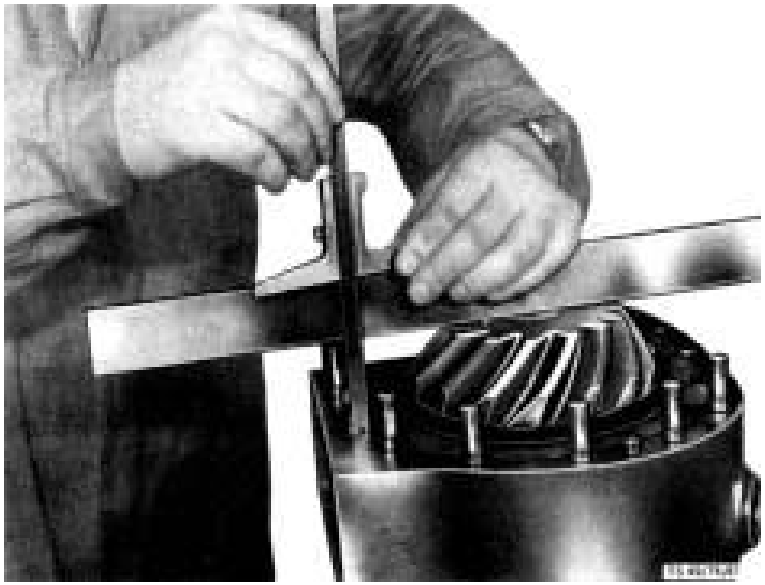
(22) Reinstall the locating baffle in the gear shaft.



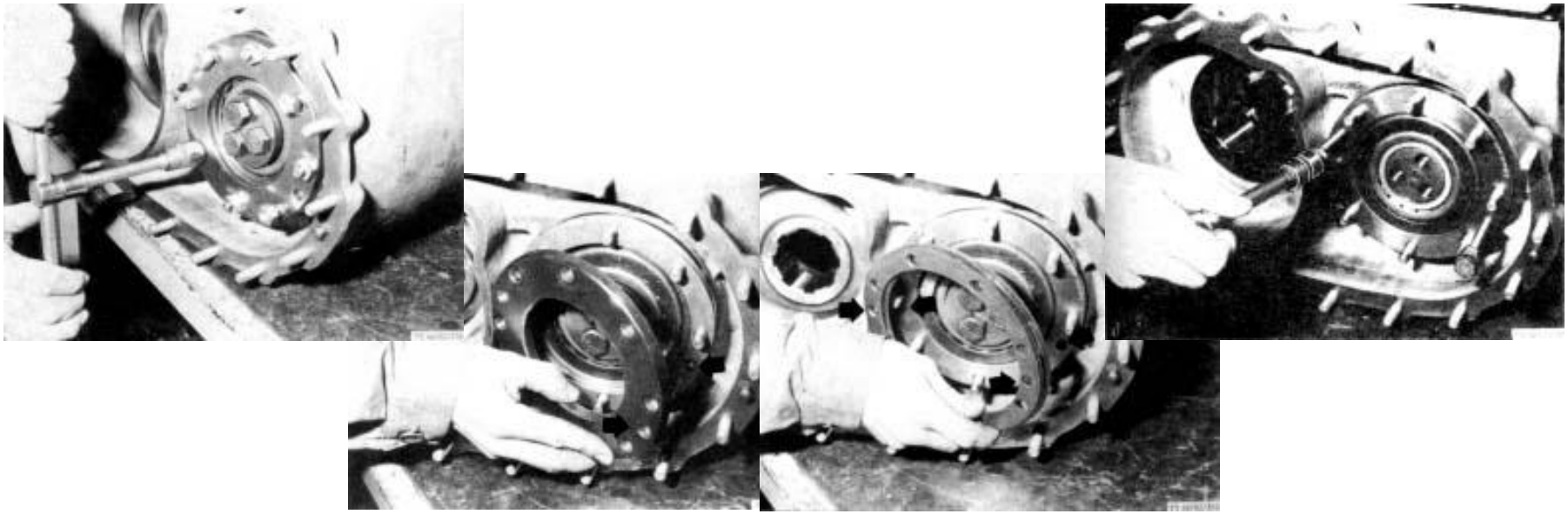
(23) Reinstall the adjusting washer and cover plate in the bearing shell,and tighten the bearing shell fixing bolt.
Tighten the fixing bolt of drive shaft baffle with torque of 180N.M.



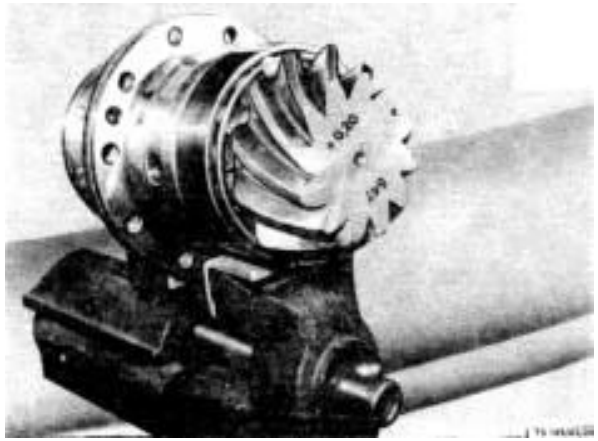
The thickness value X of adjusting washer for drive gear bearing shell and transition box:
X=(A±Z)+B-(L±Y)
where: A--The theoretic value of the distance from the drive gear end face to the center line of driven gear shaft.
B--The value measured from the end face of drive gear to the faying surface of the final drive gear (which is measured using the depth gauge at the time when the washer is not installed).
L--The theoretic value of the distance from the faying surface of the final drive gear to the center line of axle housing.
Z--Actual deviation amount of A value (which is printed on the end face of drive gear).
Y--Actual deviation amount of L value (which is printed on the faying surface of the final drive gear).
For example:Forward rear axle of total gear ratio i=4.8, 5.73 and 6.72, among them:
A=102mm B=160mm



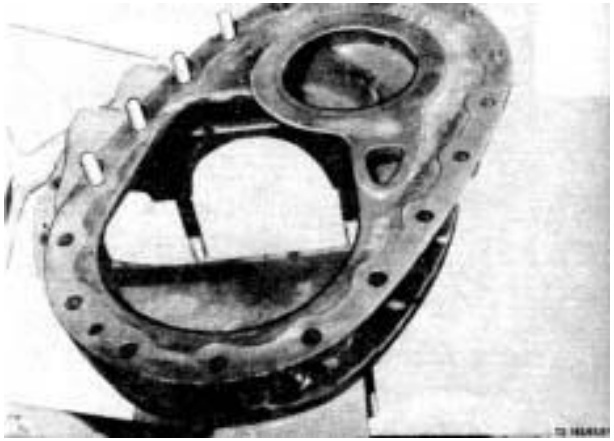
(24) Measure the distance B from the end face of drive gear to the faying surface using the depth gauge. For example, the actual measured distance B=60mm.



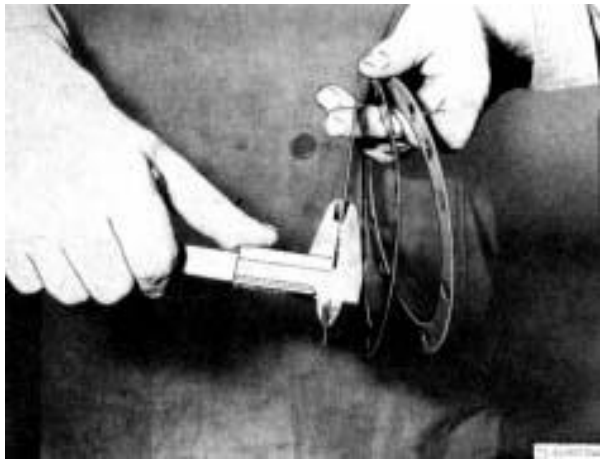
(25) Remove the drive gear shaft baffle, cover plate and adjusting washer. Push the bearing shell out using two M10×85mm bolts.



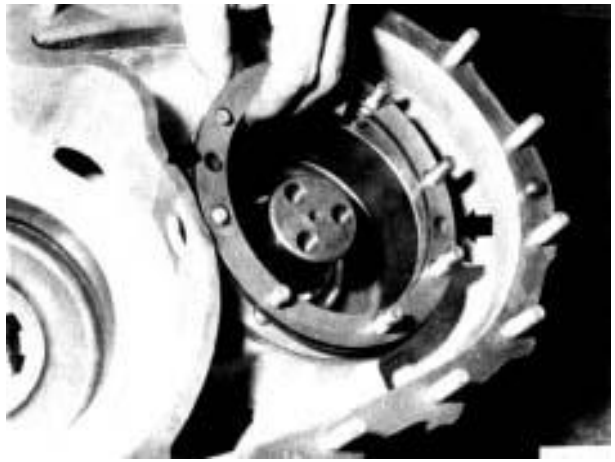
(26) Check the marks Z=+0.20mm on drive gear end face.



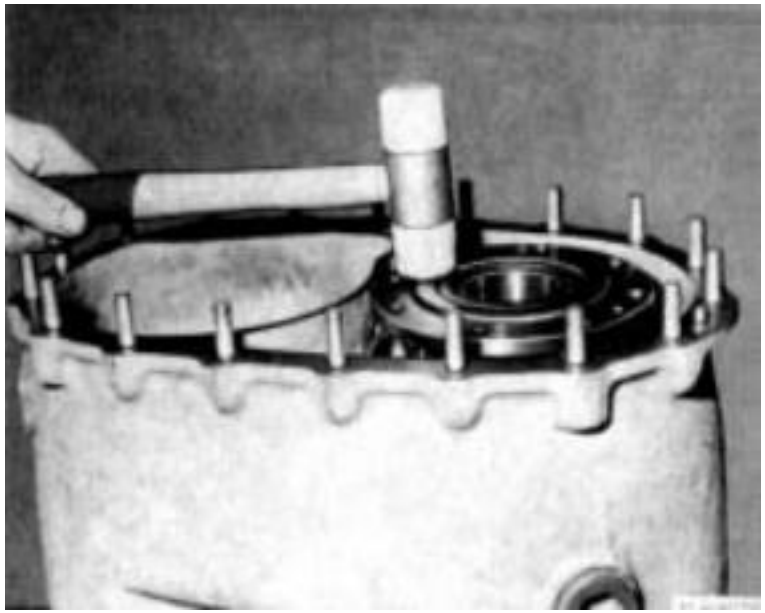
(27) Check the marks Y=-0.7mm on transition box casing. Calculate the thickness of adjusting washer:X=(A±Z)+B-(L±Y)=(102+0.20)+60-(160-0.7)=2.27mm



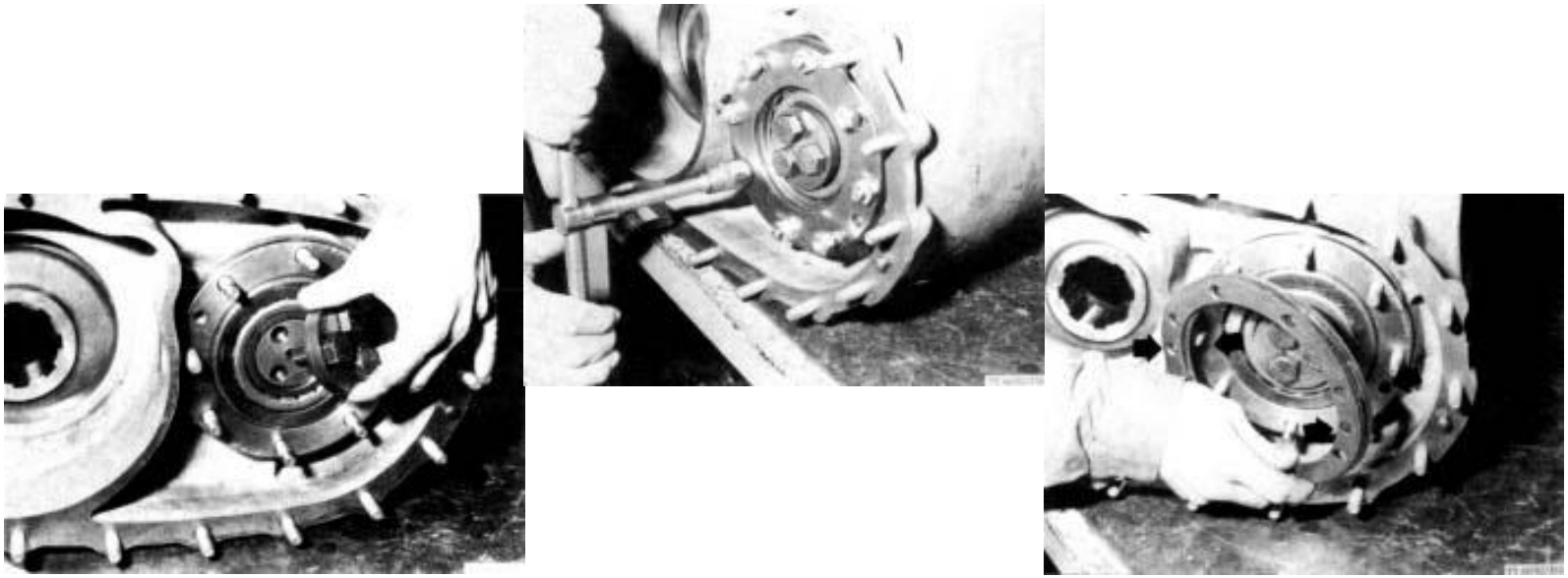
(28) Select the adjusting washer with thickness of 2.27mm.



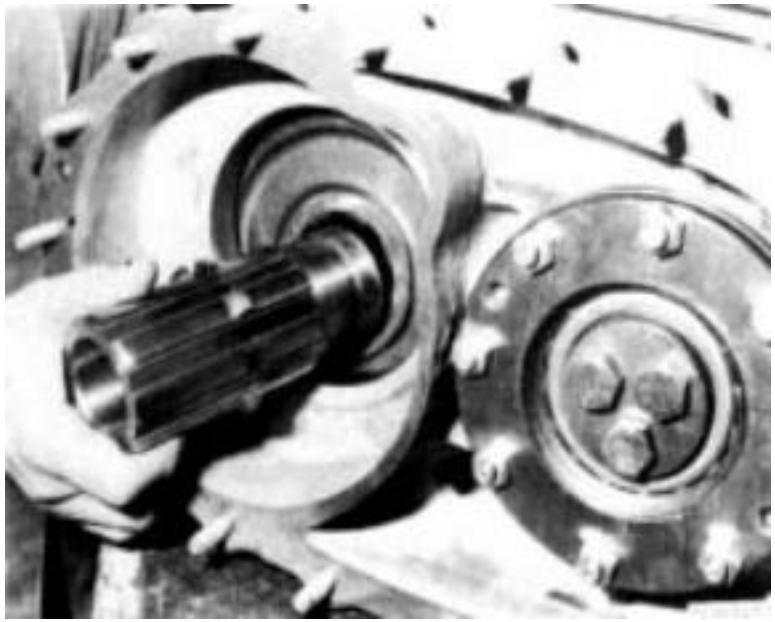
(29) Put the adjusting washer in the transition box.



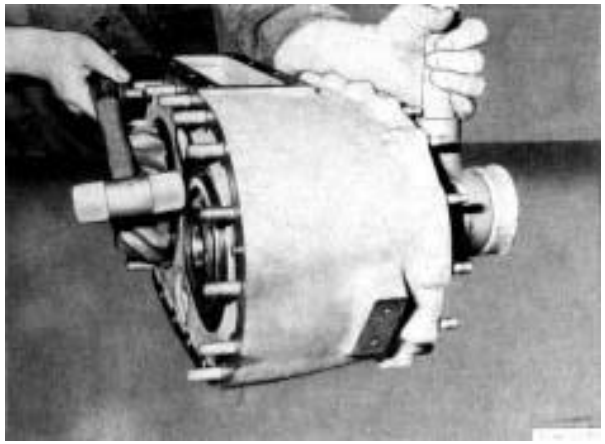
(30) Reinstall the bearing shell in the drive gear shaft and transition box.



(31) Reinstall the baffle, bearing pre-tightening washer and cover plate on bearing shell,and tighten fixing bolts,and torque three bolts of the baffle to 180N.M.

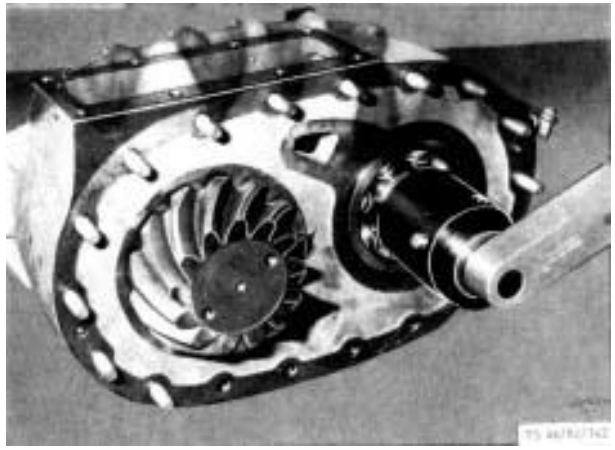


(32) Install the drive shaft sleeve in the transition box.

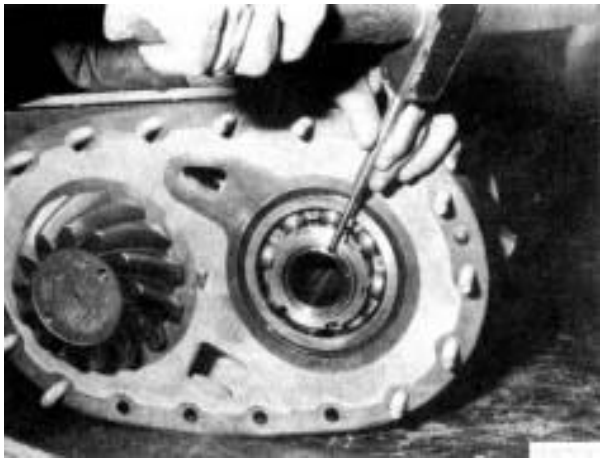


(33) Install the bearing in the transition box.

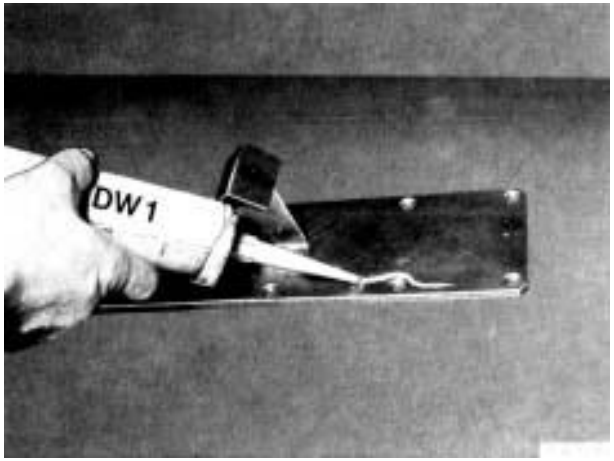
(34) Install the lock nut on the drive shaft sleeve.



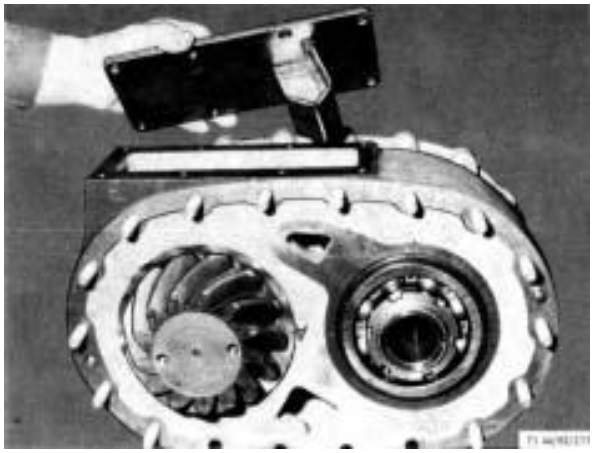
(35) Tighten the lock nut with torque of 300N.M.

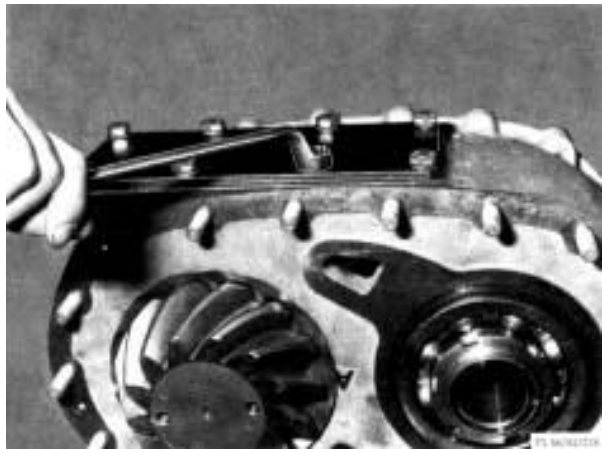


(36) Lock the lock nut using a punching head.



(37) Coat the faying surface of transition box cover plate with Loctite 587 plane sealant.

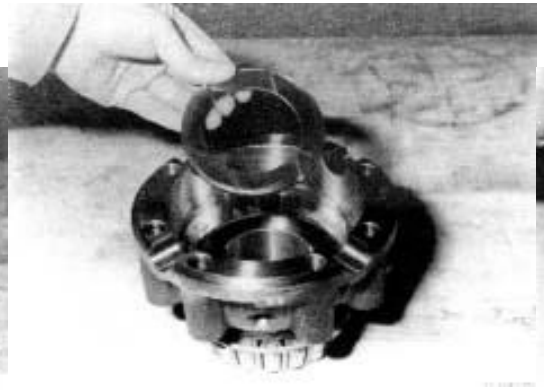
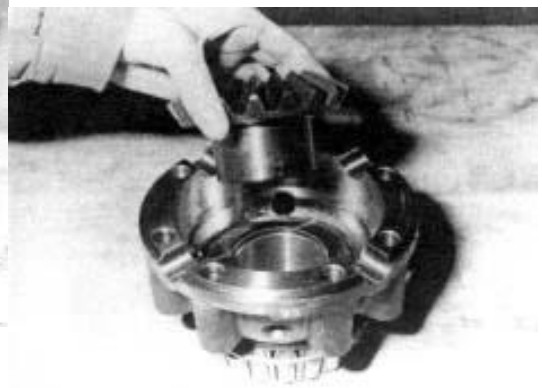
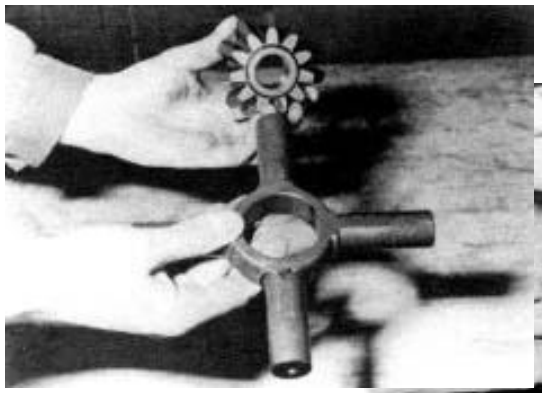
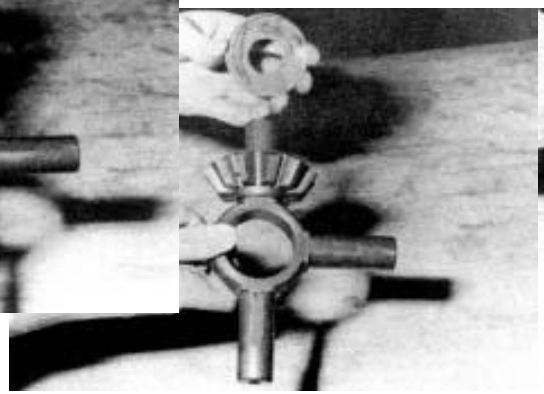
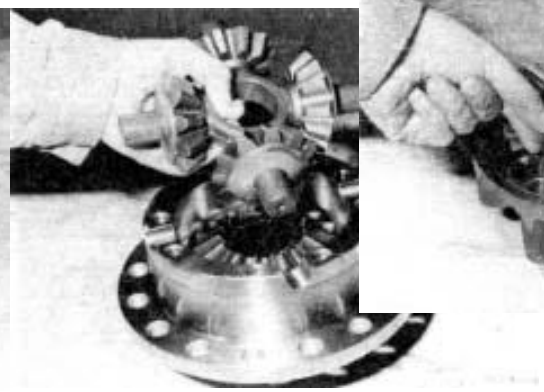
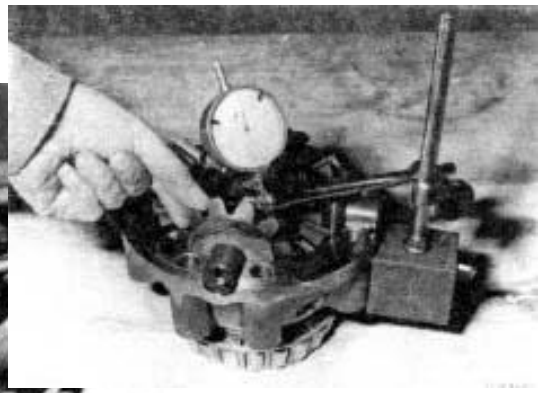




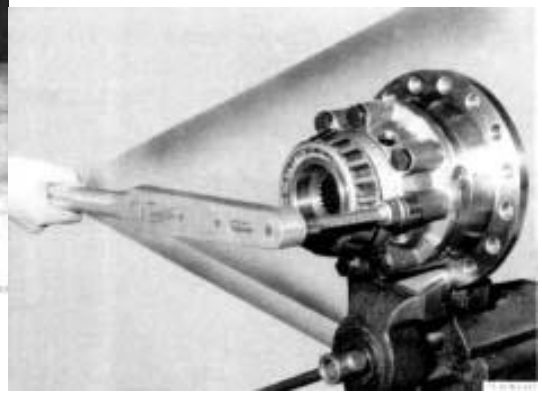
(38) Install the cover plate on the transition box and tighten the coupling bolt.

B. Assembling the drive-through axle interwheel differential.(For the detailed assembling procedure of drive-through axle differential, see the assembling of steering drive axle differential).

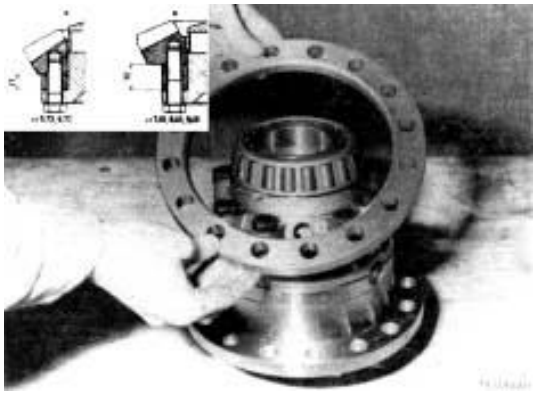
(1) Heat the differential bearing to 80℃ and install them on the two half-differential casings respectively.
Install the planetary gear and spherical washer in the cross shaft. Select the suitable half-axle thrust washer to ensure the running clearance is within the range of 0.1-0.2mm.
The standard thickness of half-axle thrust washer is 4.9, 5.0, 5.1, 5.2, 5.3mm,pay attention to assemble with the side that has oil groove facing the half-axle gear.

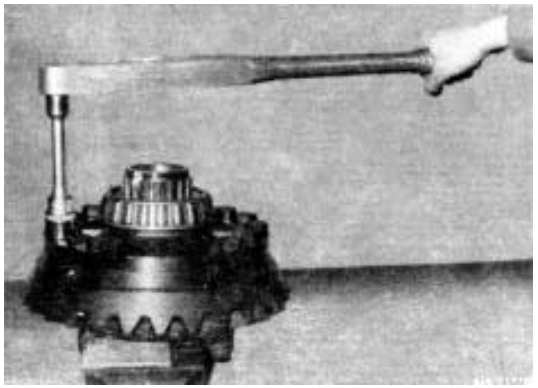












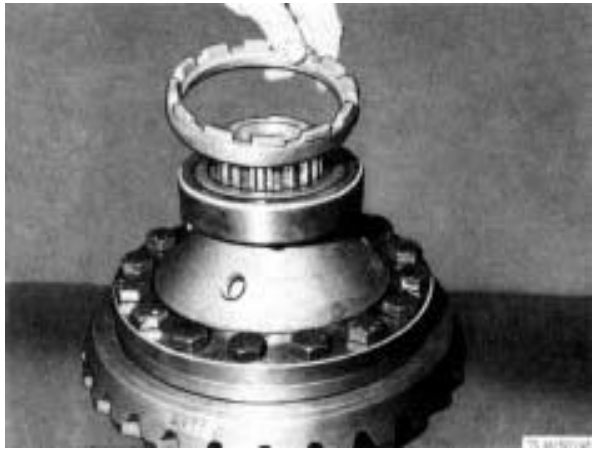
(2)Assemble the two half- differential casings in pair according to the assembling marks made prior to removal, and tighten the coupling bolts with torque of 195Nm(coat the threaded part with Loctite 262 thread-locking sealant).





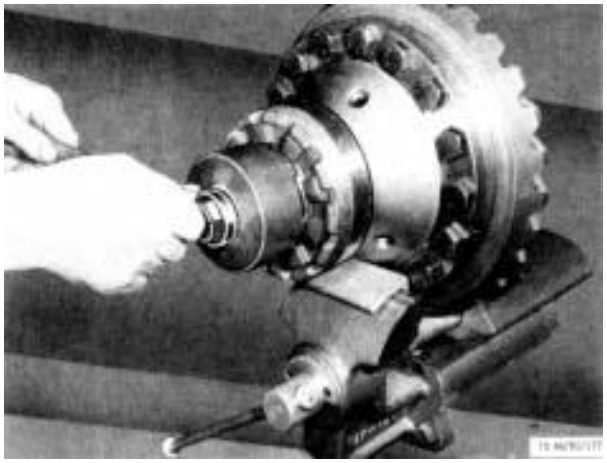
(3)Install the base ring and driven gear on the differential,and tighten the coupling bolts with torque of 325Nm (coat the threaded part with Loctite 262 thread-locking sealant).

(4)Install the bearing outer race of the differential lock end.



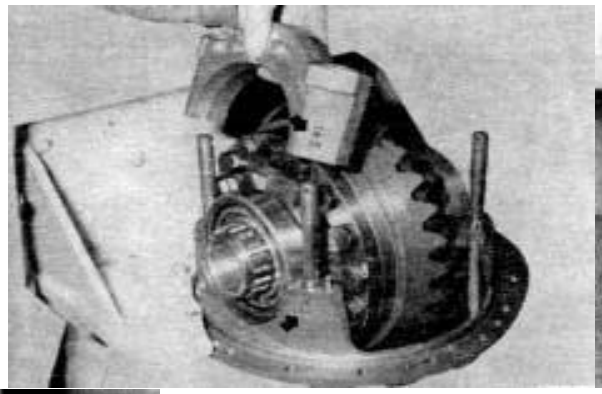
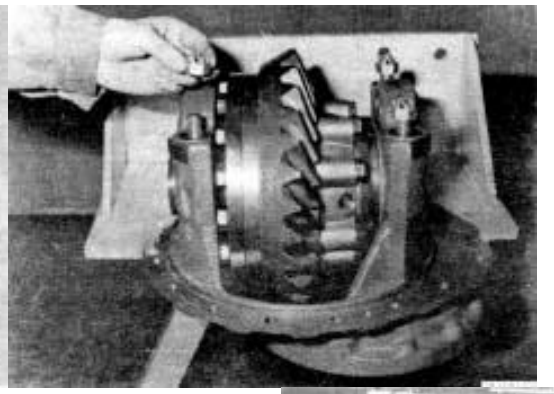
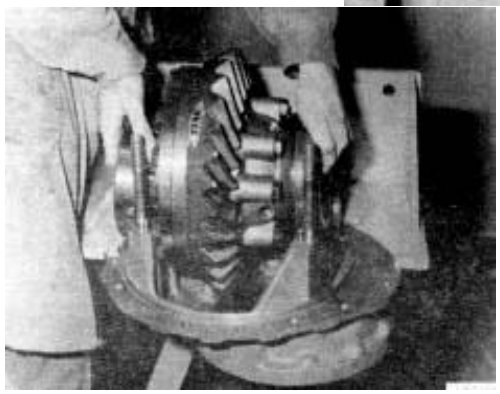
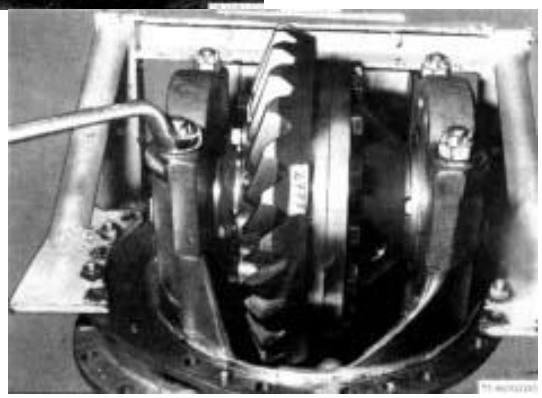
(5)Install the differential adjusting nut on the differential.

(6)Install the differential lock engagement sleeve and nut locking plate on the differential shaft sleeve.

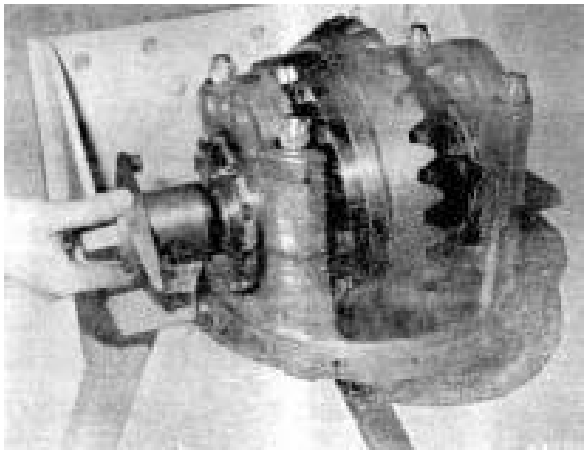


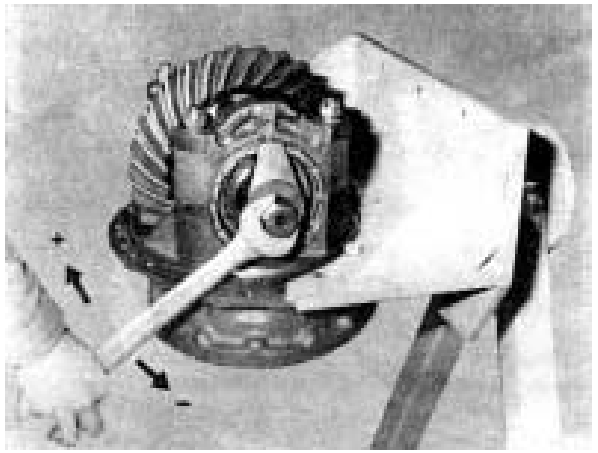
(7)Install the differential lock fixing nut using the differential lock nut wrench,tighten with the torque of 200N.M.

(8)Lock the differential lock engagement sleeve nut using the locking plate.

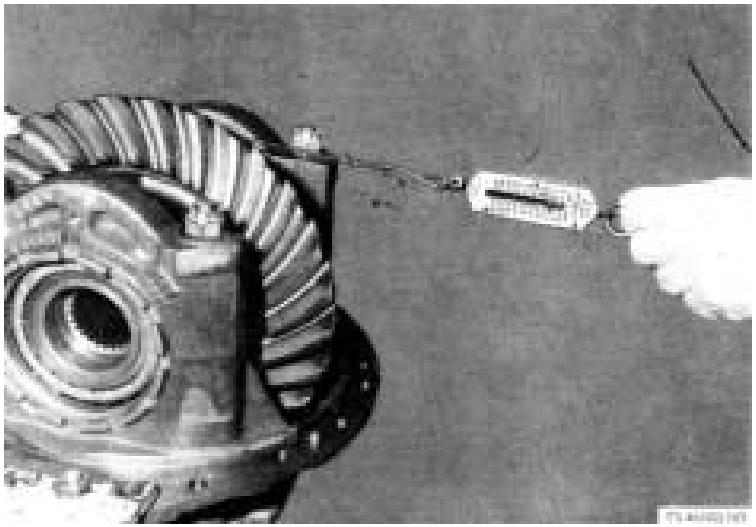





(9)Install the differential assembly in the support of the final gear casing,pay attention that the shoe cover and shoe seat should be installed in pair according to marks,and tighten the shoe cover nut with the torque of 210N.M.

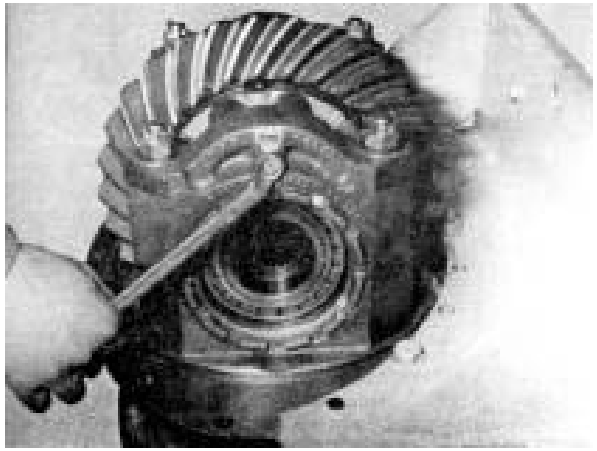


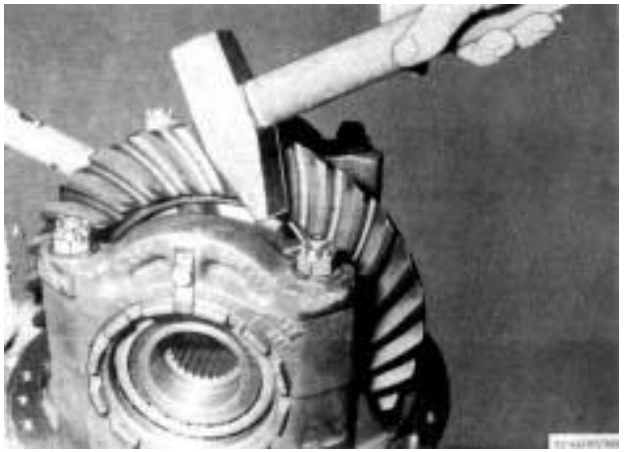


(10)Tighten the nuts on both sides with the torque of 1.5-4Nm using the differential nut wrench.

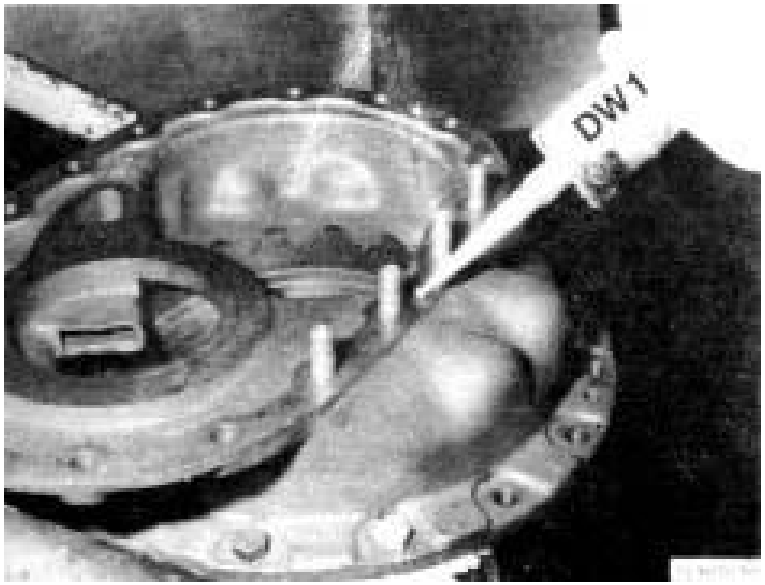


(11)The pulling force measured on the spring balance should be 12~32Nm.

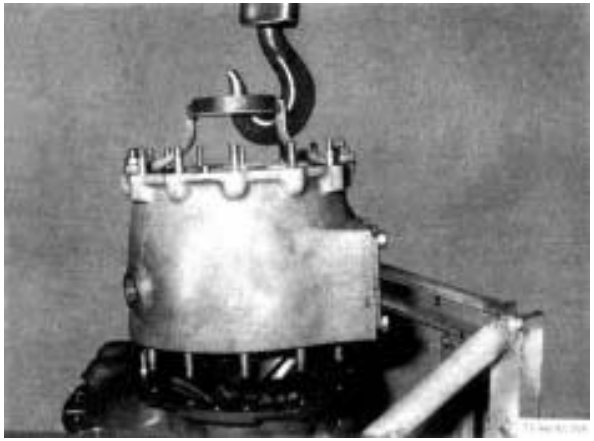


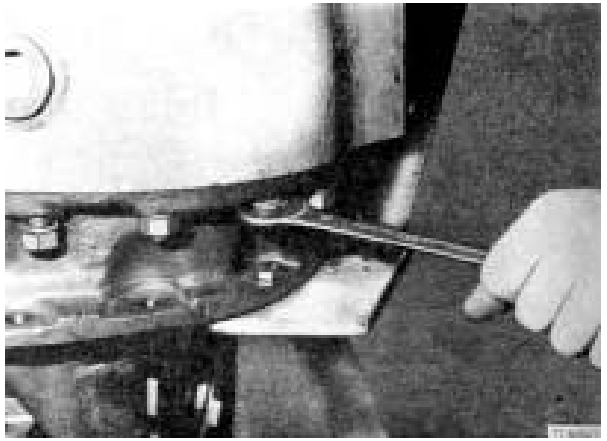


(12)Lock the bearing nut with locking plate, and lock the shoe cover nut using cotter pin.

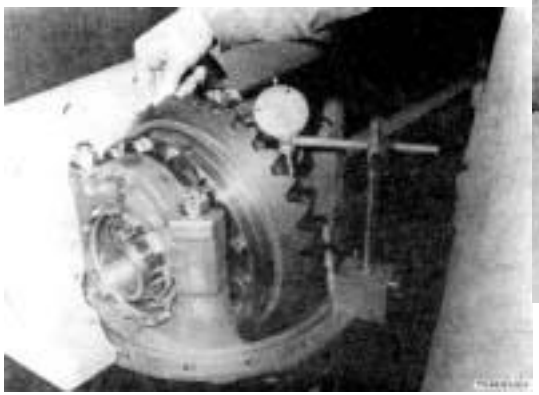
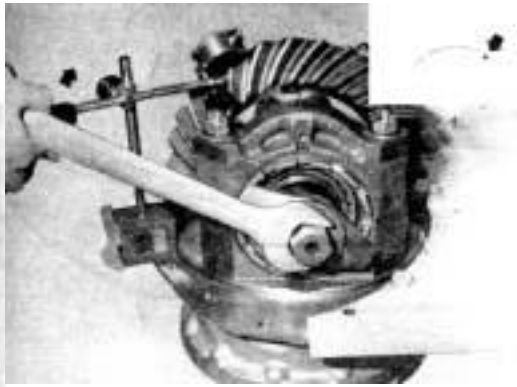


(13)Coat the faying surface of final gear casing and transition box casing with Loctite 587 plane sealant.

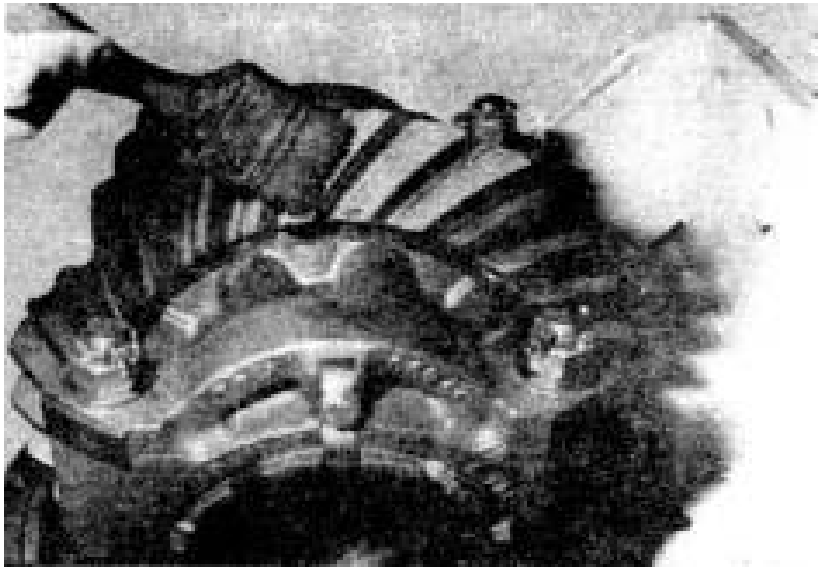




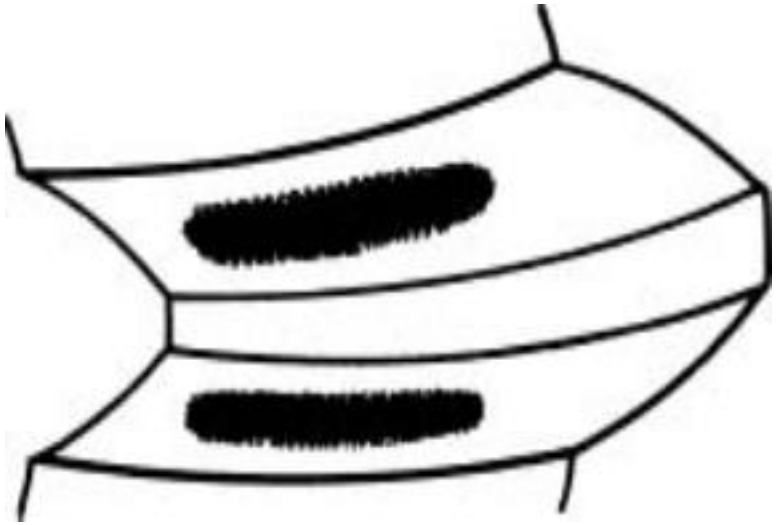
(14)Lift the transition box into the final gear housing,and tighten the coupling bolts.


(15)Check clearance of drive and driven conical gear should be 0.3-0.4mm. If the clearance is not up to the standard ,then adjust the left and right positions of driven gear to reach the requirements. In adjusting, pay attention that the rotating angles of left and right nuts forward or backward must be synchronized and the same in order to keep the bearing prestressing.
After adjusting, lock the locking plate nut.



(16)Check and adjust the engagement marks.
With the red lead dye applied on the tooth face, repeatedly rotate the gear to check their contact trace on the tooth face.



Correct contact trace of tooth face.

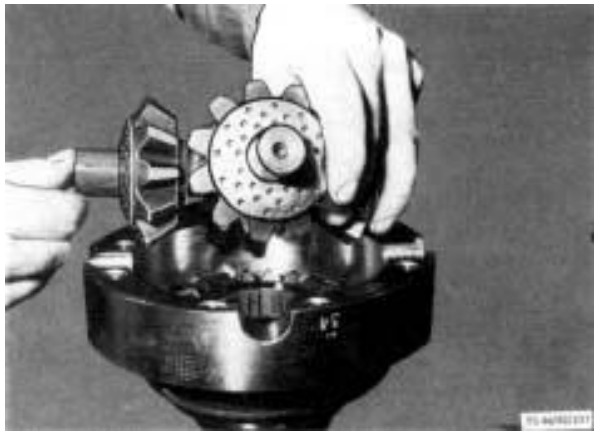
If the tooth tip is in contact,decrease the X thickness of adjusting washer.

If the tooth root is in contact,increase the X thickness of adjusting washer.

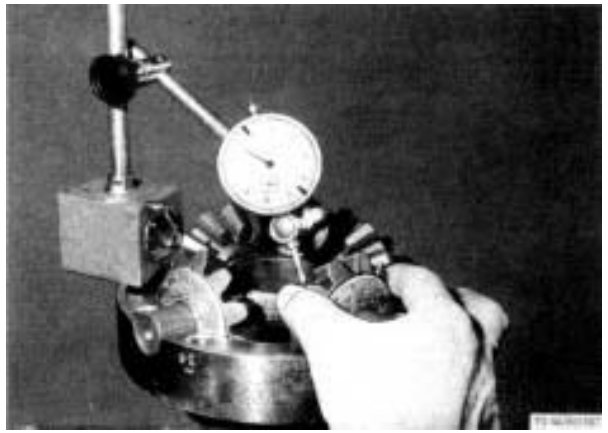
C. Assembling the drive-through axle interaxial differential

(1)Put the half-axle gear washer in differential casing.

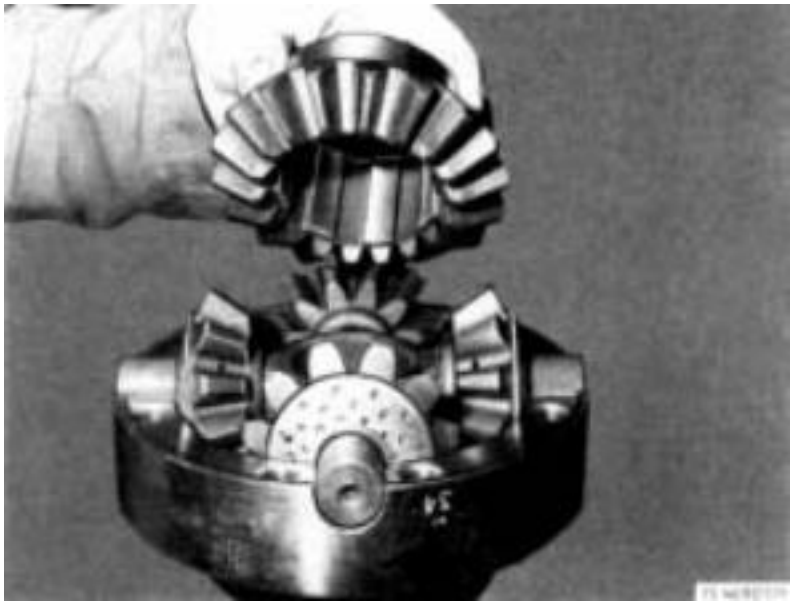
(2)Put the half-axle gear in differential casing.



(3)Put the planetary gear and cross shaft assembly in differential casing.



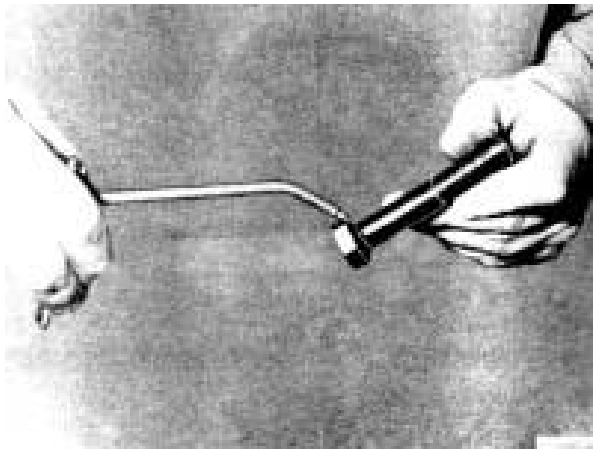
(4)Measure the running clearance,adjust the thickness of half-axle gear washers to make the running clearance within the range of 0.18-0.22mm.
The standard thickness of adjusting washer is 4.9, 5.0, 5.1, 5.2, 5.3mm.

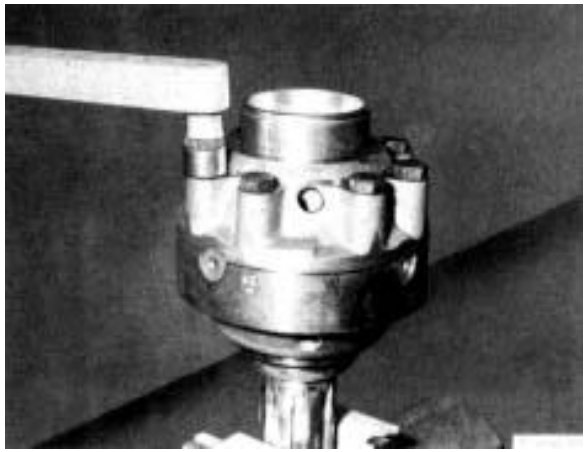


(5)Install the other end half-axle gear.

(6)Install the selected half-axle gear thrust washer of the other end.

(7)Install the other half-differential casing according to the assembling marks.

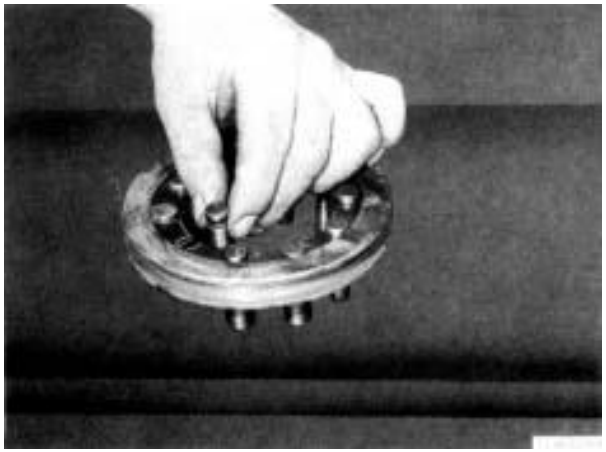




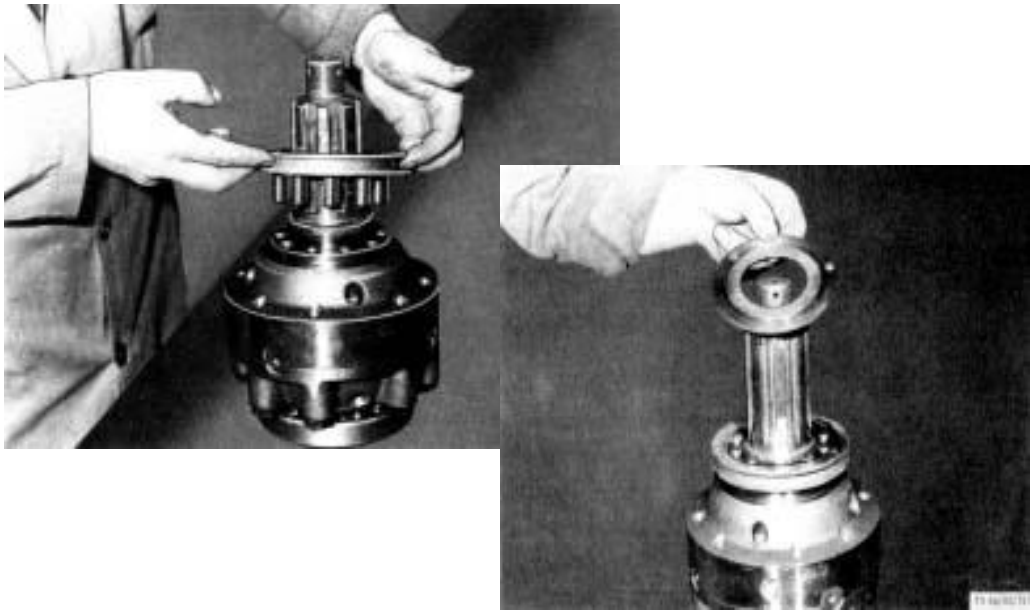
(8)Coat the coupling bolt with Loctite 262 thread sealant,and torque it to 210N.M.

(9)Heat the differential bearing to 80°Cand install the differential shaft shoulder.

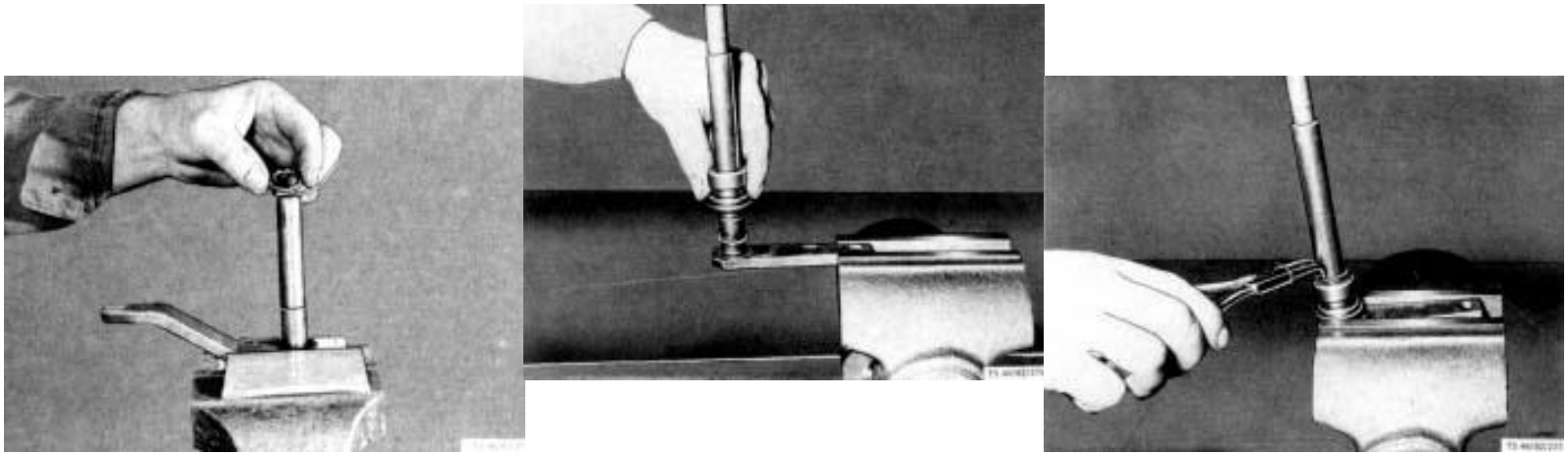
(10)Position the bearing using clip.



(11)Install the differential lock pin on the sliding sleeve.

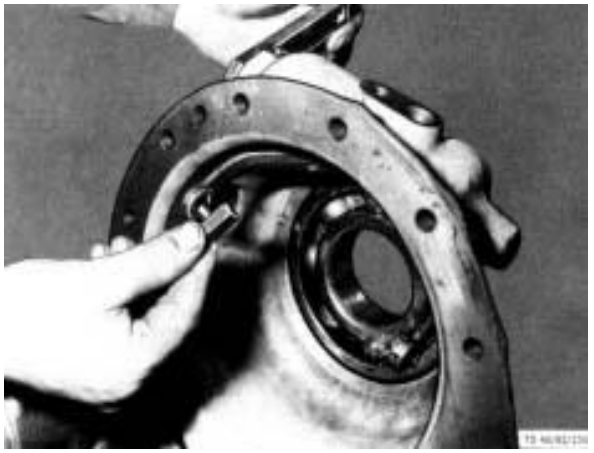


(12)Install the differential lock on the differential,and fit the baffle .

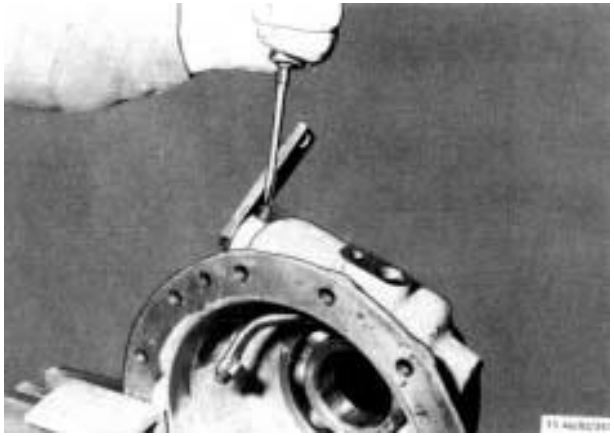


(13)Put the seal ring and shaft sleeve in shifter fork shaft,and locate the shaft sleeve using the clip.

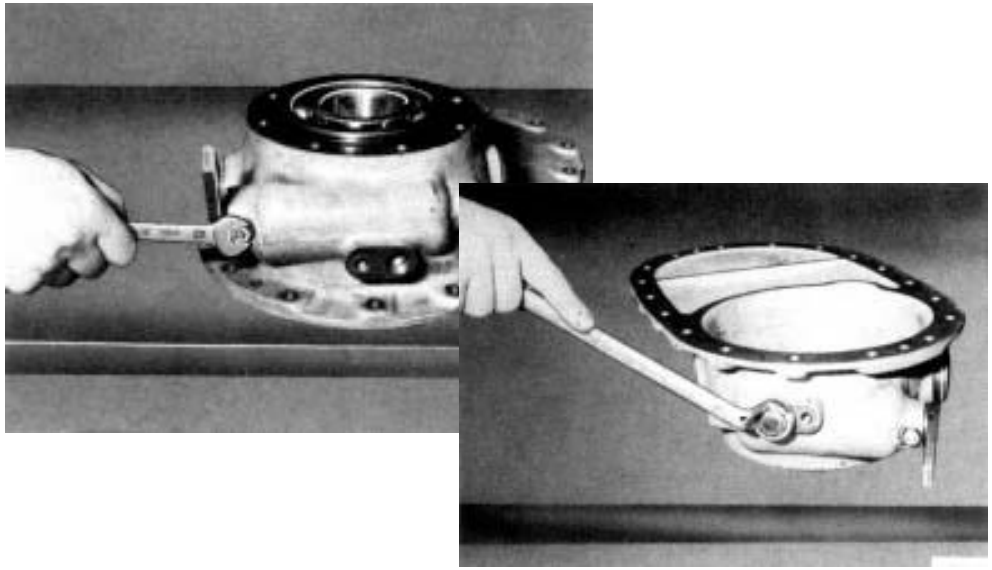
(14)Install the shifter fork and shifter fork shaft on the differential casing.



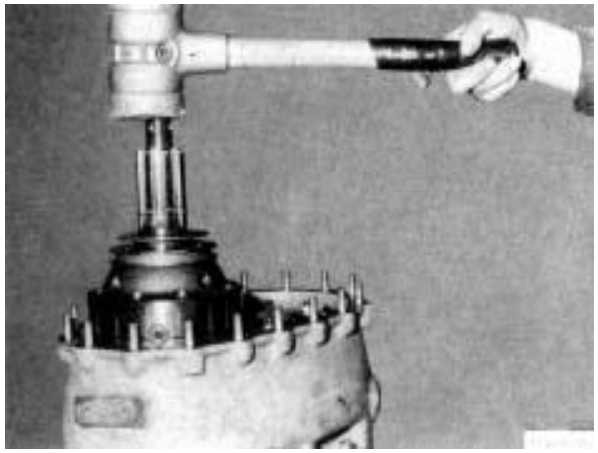
(15)Install the sliding block on shifter fork.



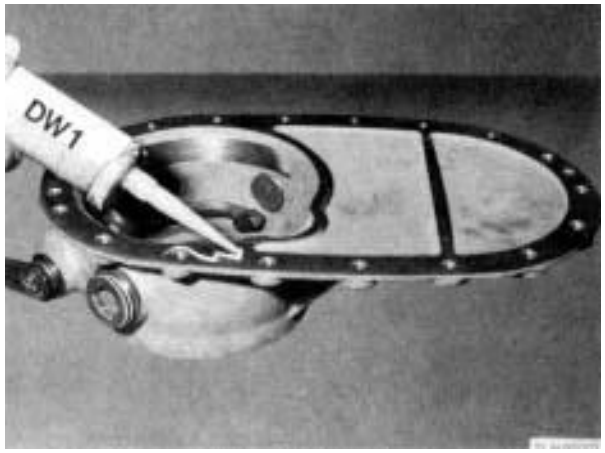
(16)Screw in the dowel pin.



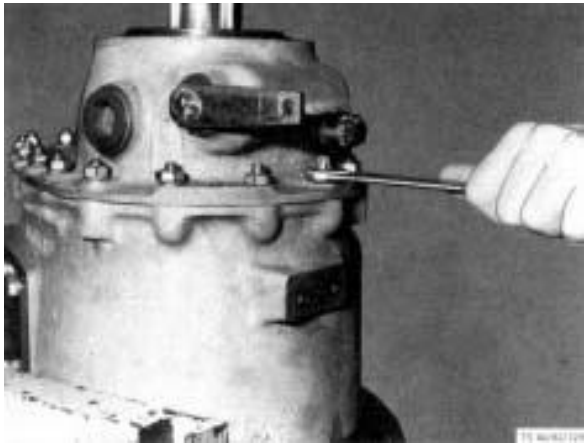
(17)Tighten the nut of dowel pin. Install the differential lock indicator light switch.



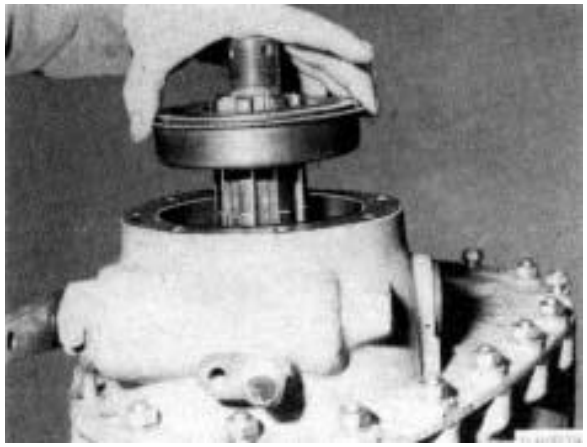
(18)Install the interaxial differential assembly in the transition box.



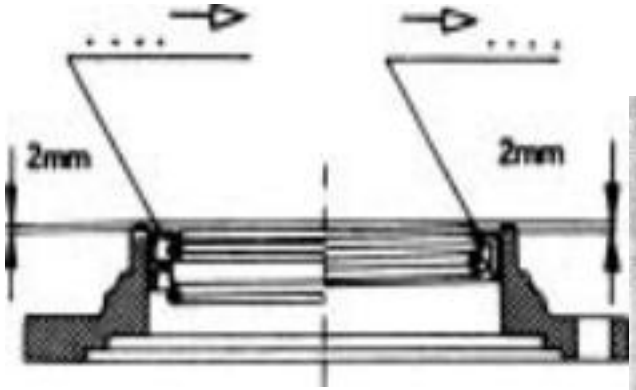
(19)Coat the differential casing faying surface with Loctite 587 plane sealant.

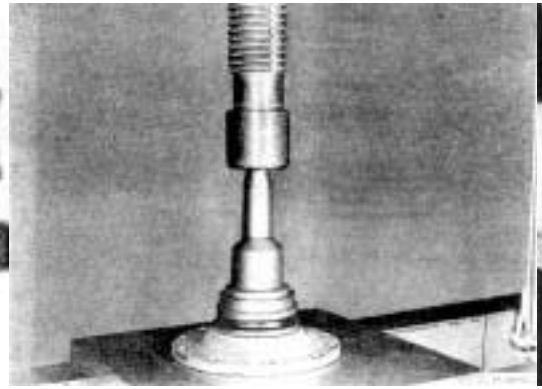


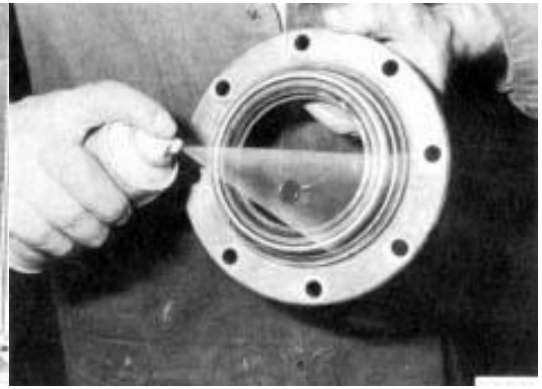
(20)Install the differential casing on the transition box,and tighten the coupling bolts.



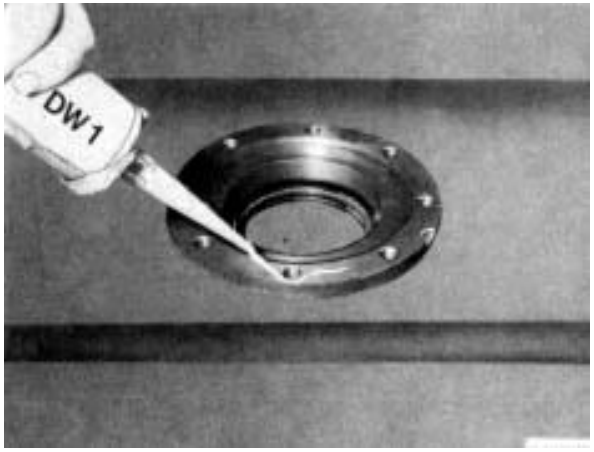
(21)Install the clip in bearing,put bearing in the differential casing.



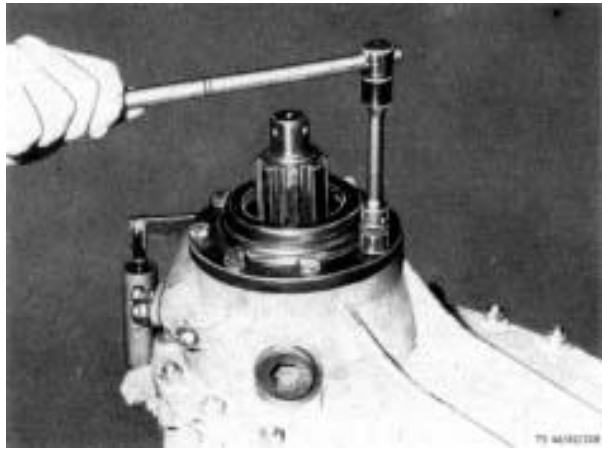




(22)Press the oil seal into bearing cover,and spray coat it with lubricating oil.

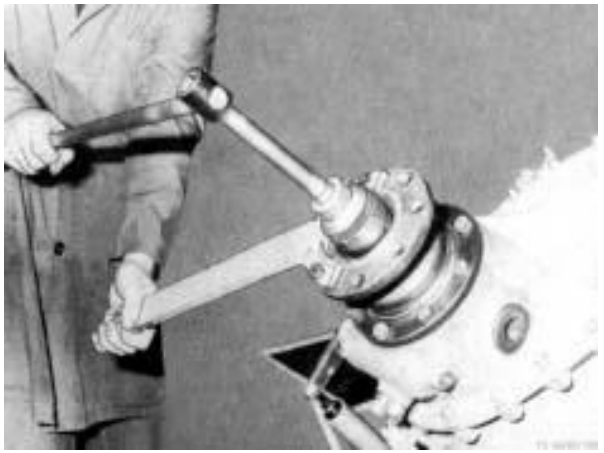


(23)Coat the bearing cover end face with Loctite 587 plane sealant.

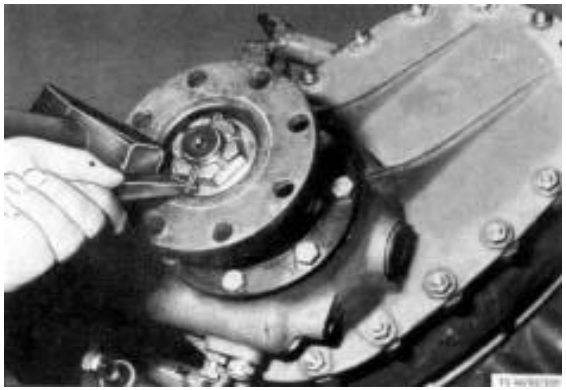


(24)Install the bearing cover on the differential casing, and tighten the coupling bolts.

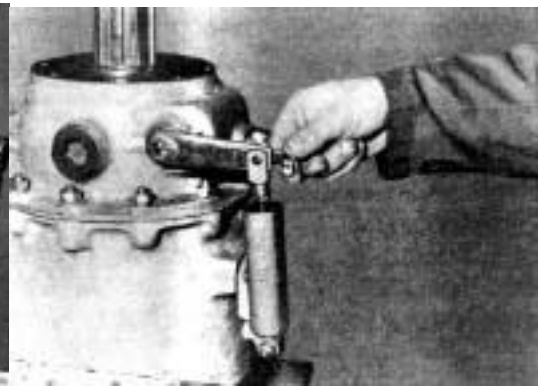
(25)Heat the drive flange and install it in the input shaft.



(26)Torque the flange fixing nut to 750-800N.M.

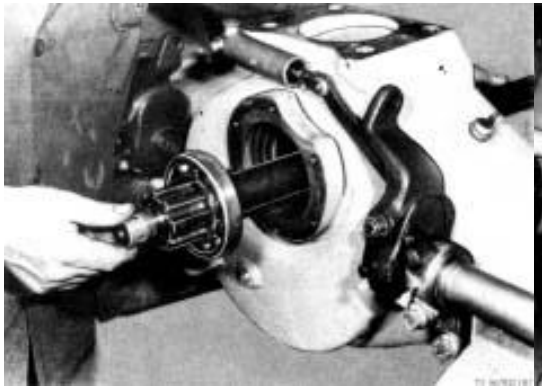


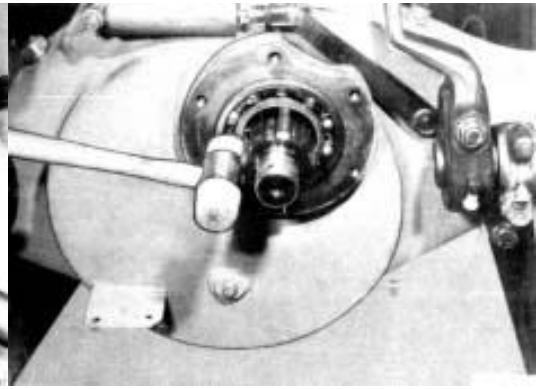
(27)Inset and install the cotter pin onto the drive flange fixing nut.



(28)Install the oil filling plug on differential casing. Install the differential lock slave cylinder.

D. Assembling the drive-through axle thru shaft

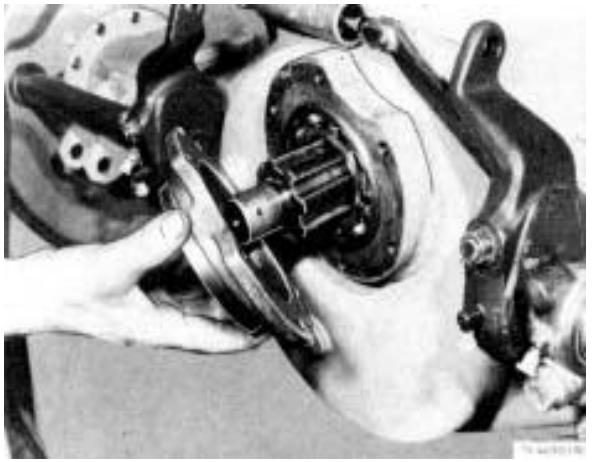




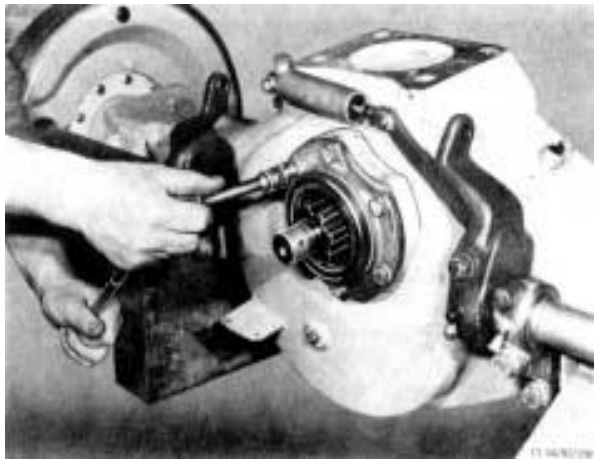
(1)Heat the thru shaft bearing to 80℃ and install it in the thru shaft.

(2)Drive the thru shaft together bearing into the axle case of the forward rear axle.

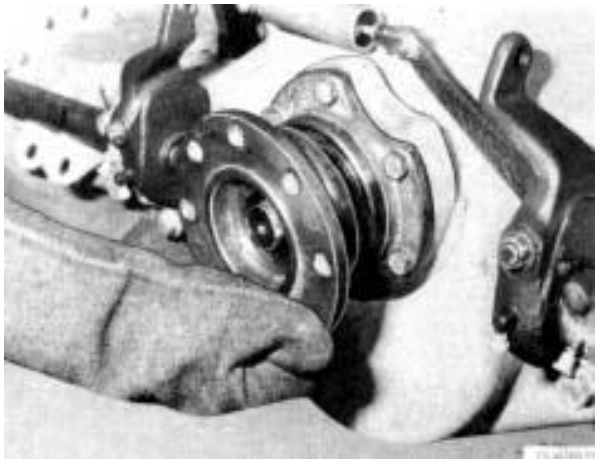
(3)Press the oil seal into the bearing cover.



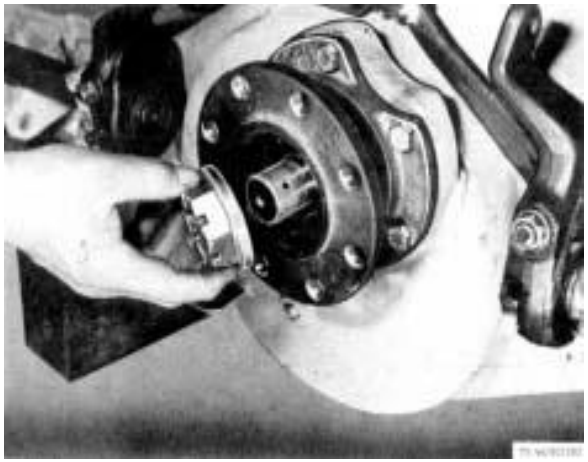
(4)Coat the axle case bearing cover faying surface with Loctite 587 plane sealant.

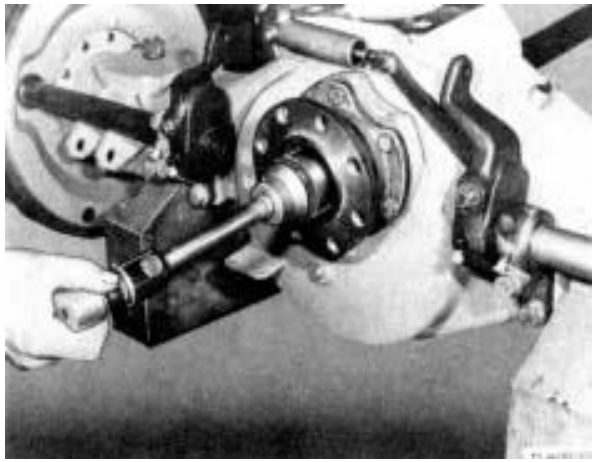


(5)Install the bearing cover,and tighten the coupling bolts.

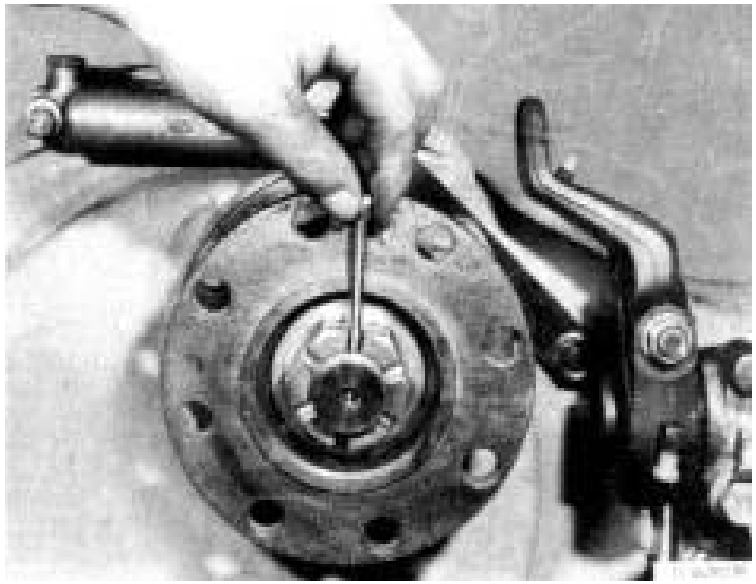


(6)Heat the drive flange and install it on thru shaft spline shaft.



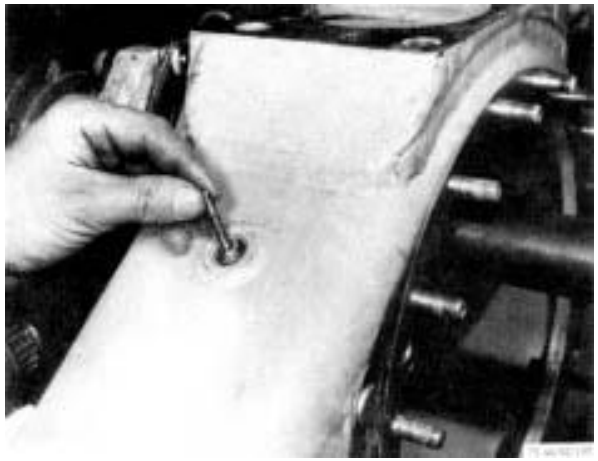


(7)Install the flange fixing nut,and torque the nut to 750-800N.M.

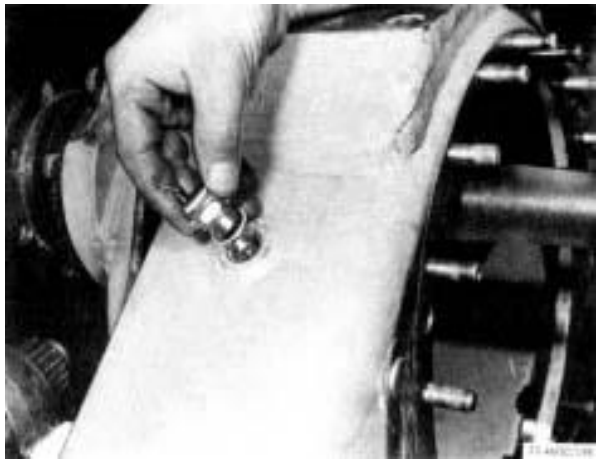


(8)Lock the nut with cotter pin.

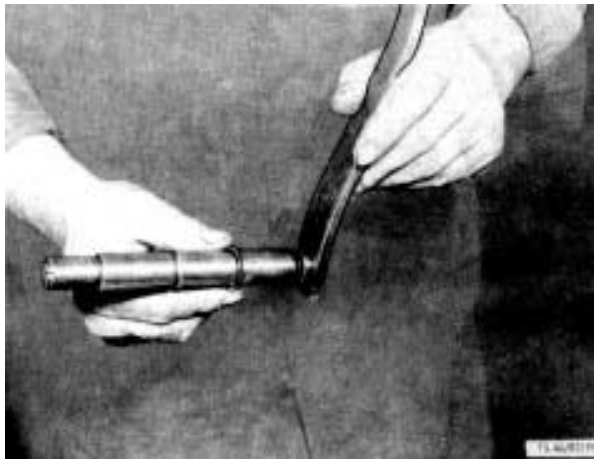
E. Assembling the interwheel differential lock



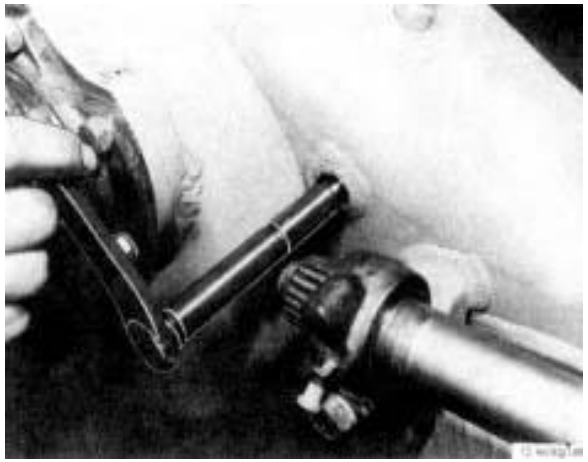
(1)Install the indicator light tappet in the axle case.



(2)Install differential lock indicator light switch.

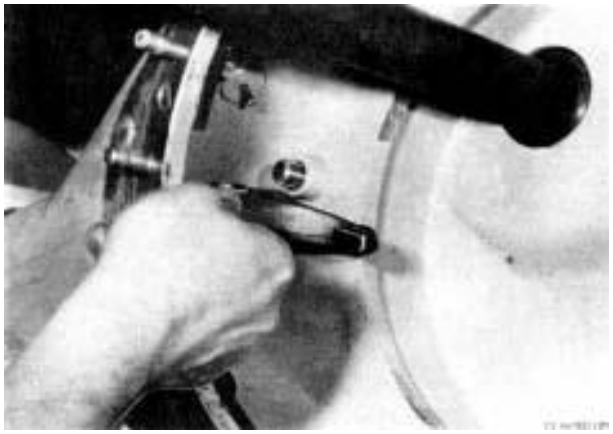


(3)Install the seal ring on the differential lock shifter fork shaft.

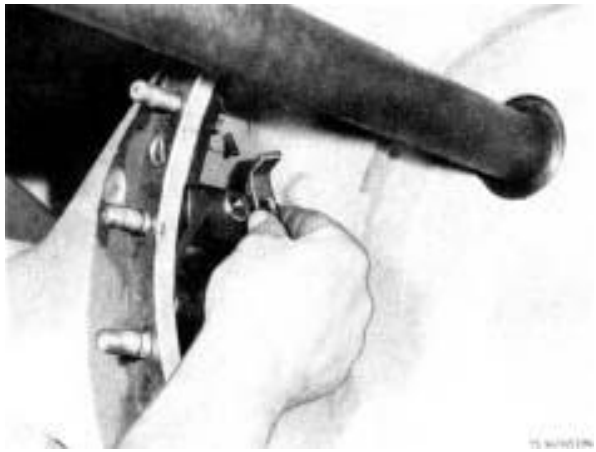


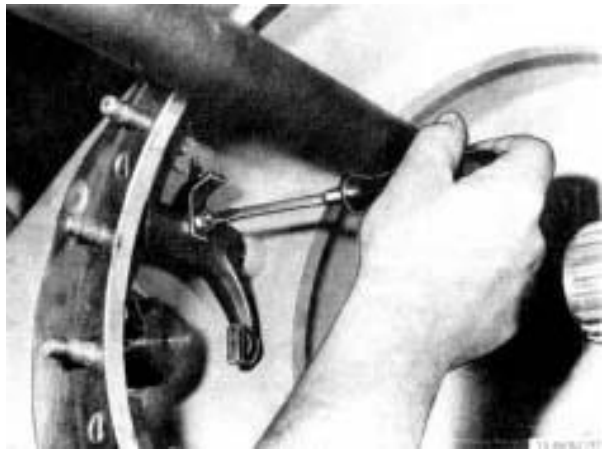
(4)Insert the differential lock shifter fork shaft into the axle case.

(5)Install the shifter fork slide block on the shifter fork.

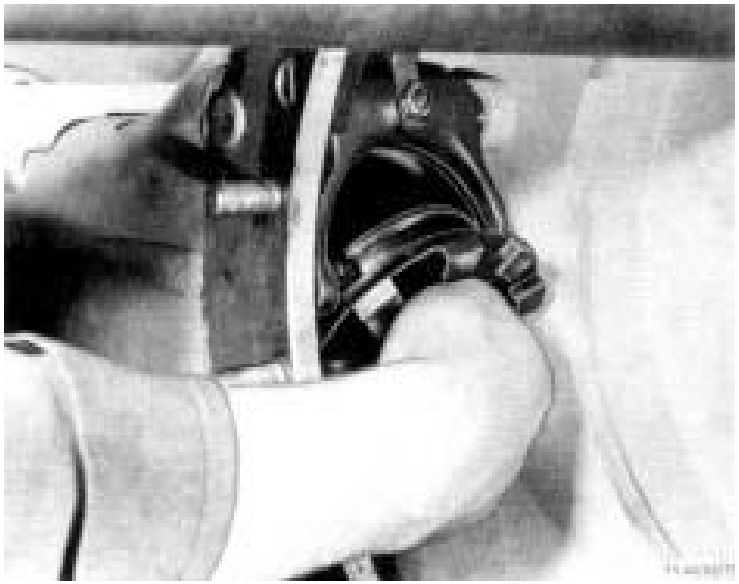


(6)Install the shifter fork on the shifter fork shaft.

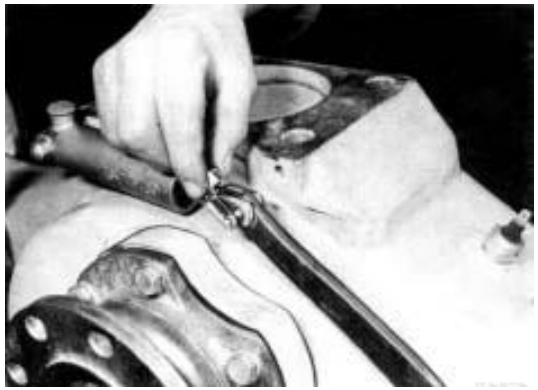




(7)Install the differential lock indicator light sting on the shifter fork.



(8)Install the engagement sleeve in shifter fork,and pass the half-axle through engagement sleeve shaft hole.



(9)Link the differential lock slave cylinder with shifter fork rod.
Coat the faying surface of axle case and final gear hub with Loctite 587 plane sealant,lift the forward rear axle transition box assembly and install in the axle case,and tighten the coupling bolts.
During lifting process, continuously rotate the thru shaft,so that it can be smoothly inserted into half-axle gear spline hole of interaxial differential.
The assembling of wheel reductor is the dame as the steering drive axle,see the section "Assembling of Steering Drive Axle Wheel Reductor ".
Insert the left and right half-axles in spline holes of differential left and right half-axle gears,and install the cover of axial journal on the axial journal planetary carrier.

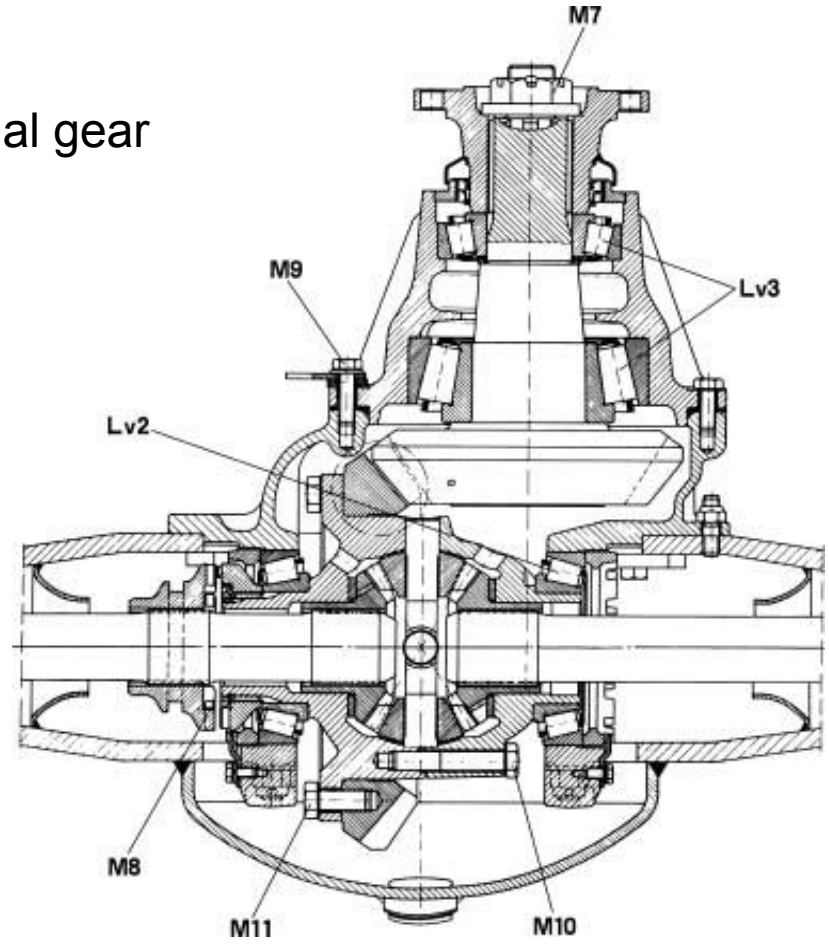
VI. Tightening Torques of Main Bolts and Nuts:

1. For the tightening torques of main bolts of the rear axle final gear, see Table 8-9 and Fig. 8-15.

Areas	Tightening Torque Nm
Drive gear shaft flange locknut M7	750~800
Differential casing bearing adjusting nut M8	200
Final gear hub bolt M9	110
Differential casing bolt M10	195
Driven gear fixing bolt M11	325

Table 8-9

Fig. 8-15 Rear axle final gear

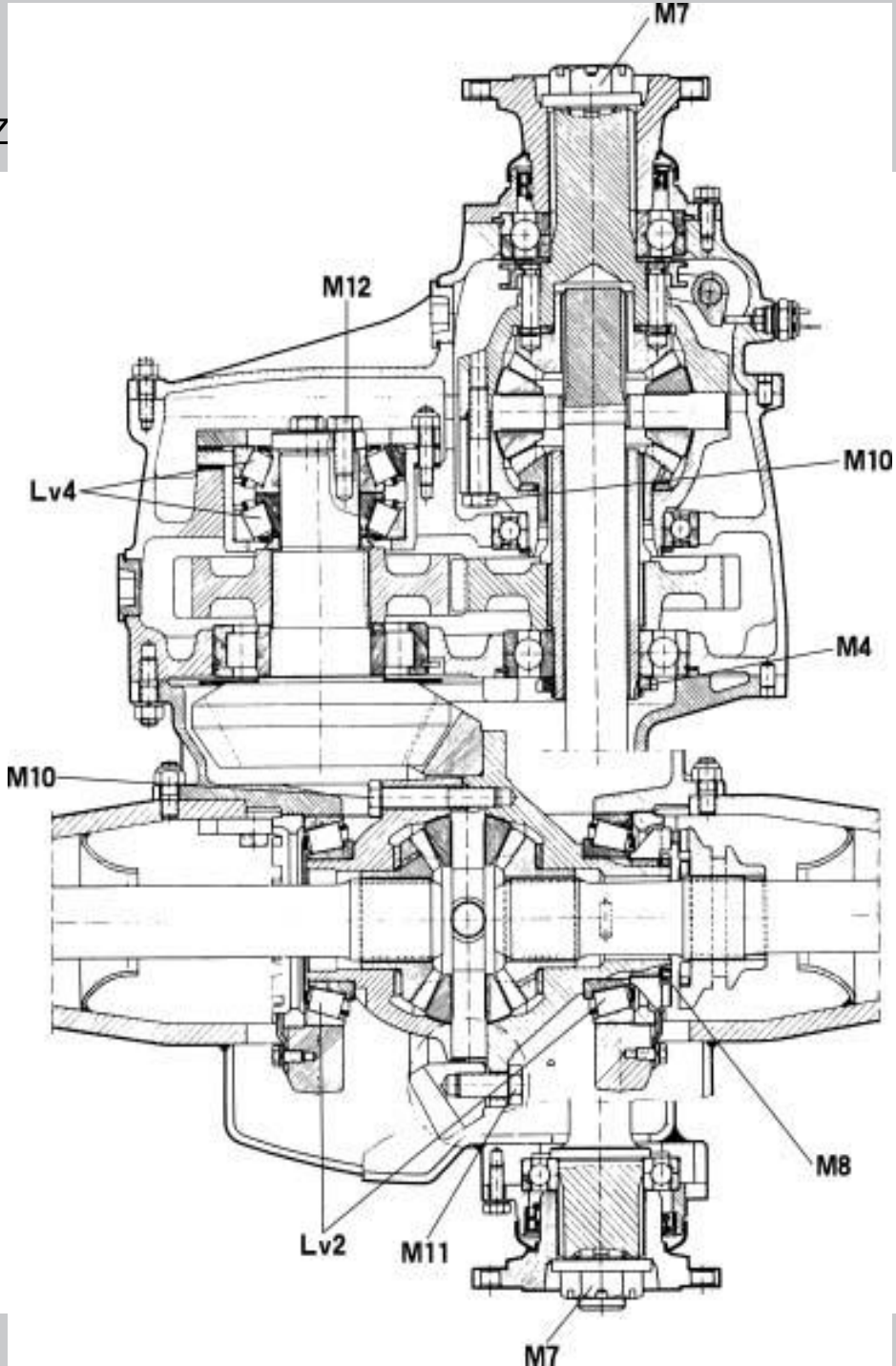


2. For the tightening torques of main bolts of the drive-through axle final gear, see Table 8-10 and Fig. 8-16

Areas	Tightening Torque Nm
Drive conical gear shaft end cover plate lock bolt M12	180
Driven conical gear fixing bolt M11	325
Interwheel differential casing bolt M10	195
Differential casing bearing adjusting nut M8	200
Output flange lock nut M7	750~800
Shaft sleeve bearing lock nut M4	295

Table 8-10

Fig. 8-16 Drive-through axle final gear



3. For the tightening torques of main bolts of the wheel reductor, see Table 8-11 and Fig. 8-17

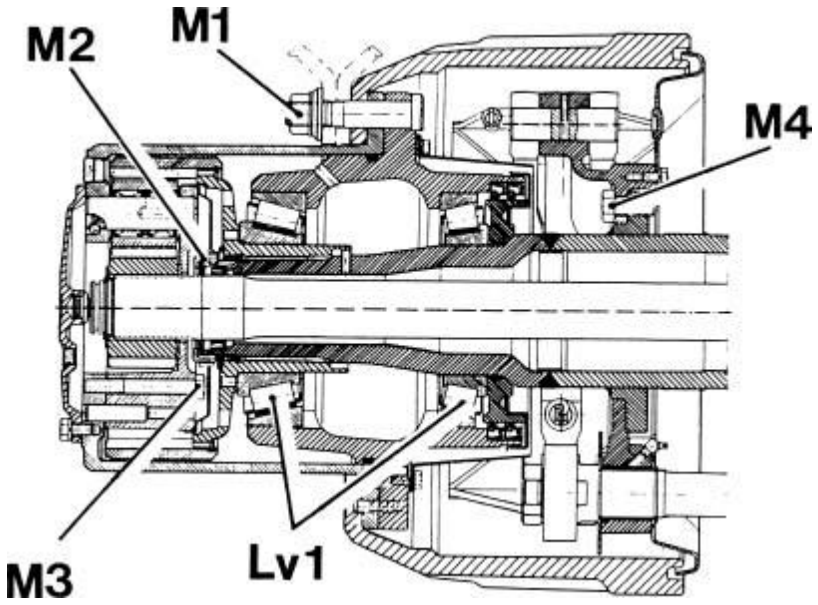


Fig. 8-17 Wheel reductor

Table 8-11

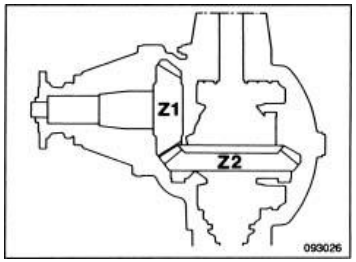
Areas	Tightening Torque N.M
Brake back plate coupling bolt M4	195
Planetary carrier cove plate coupling bolt M3	119
Axial journal nut M2	300-400
Wheel bolt M1	550-600

VII. Main Data

1. Gear ratio of rear axle and number of teeth of drive gear is shown in Table 8-12

I=	4,42	4,80	5,73	6,72	7,49	8,40	9,49
Z1	26	21	17	15	13	12	11
Z2	33	29	28	29	28	29	30

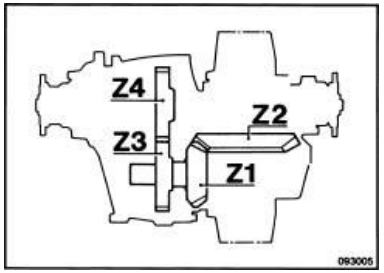
Table 8-12



I:Gear ratio
Z1:Number of teeth of drive conical gear
Z2:Number of teeth of driven conical gear

2. Gear ratio of drive-through axle and number of teeth of drive gear is shown in Table 8-13

I=	4,42	4,80	5,73	6,72	7,49	8,40	9,49
Z1	17	17	17	15	13	12	11
Z2	28	28	28	29	28	29	30
Z3	27	26	35	35	35	35	35
Z4	35	31	35	35	35	35	35



I=Gear ratio
Z1= Number of teeth of drive conical gear
Z2= Number of teeth of driven conical gear
Z3, Z4= Number of teeth of cylindrical gear
Wheel-hub I=3.478, sun gear Z=23,planetary wheel Z=16,inner gear ring Z=57

(III)For gear clearance and bearing pre-tightening torque, see Table 8-14,Fig. 8-14, 8-15 and 8-16

Items	Standard
Running clearance of drive and driven gear	0.3～0.4mm
Running clearance of half-axle gear and planetary gear	0.18～0.22mm
Running clearance of wheel reductor planetary gear	0.15～0.30mm
Running clearance of drive-through axle cylindrical gear	0.16～0.32mm
Axial clearance of brake arm	0.5mm
Travel of brake arm (brake clearance)	20～40mm
Rotating torque LV1 after pre-tightening of hub bearing	6.6-8.6N.M
Rotating torque LV3 after pre-tightening of drive gear shaft bearing	1.0～2.0N.M
Rotating torque LV2 after pre-tightening of differential casing supporting bearing	1.5～4.0N.M
Rotating torque LV4 after pre-tightening of drive-through axle drive conical gear shaft	0.5～2.5N.M

Table 8-14

VIII. Common Troubles and Remedies

Common troubles of drive axle are normally abnormal sound and overheating, and for the details, see the steering drive axle

1. Sound due to excessive big gear engagement clearance

In truck driving, at the moment of speed changing or when the speed is unstable, the axles give out heavy impact sounds "Click, Click”. When the speed is relatively stable, the sound diminishes or disappears.

These phenomena are mostly caused by excessive large engagement clearance of drive and driven conical gear,which may recover by adjusting or replacing gears.

2. Sound due to excessive small gear engagement clearance or abnormal engagement

In truck driving, the axles give out a continuous gear clutching sound, and the sound frequency increases as truck speed is increasing. After retarding the throttle, the sound decreases accordingly. After truck stopping, the sound stops immediately.

These phenomena are mostly caused by excessive small engagement clearance of drive and driven conical gear or improper adjustment of engagement trace,and in many cases, it occurs after major repair or replacement of gears, which may recover by readjustment.

3、Sound of differential

In most cases, the sound of differential occurs when truck is turning, the left and right wheels play a differential role,planetary gear and half-axle gear engagement is improper or caused by impact. It normally is a clear "Geta, Geta” sound,and in severe cases, drive axles are accompanied with slight shaking phenomenon.In diagnosis checking,brake the rear wheel of either side, jack up wheels of the other side using jack, start the engine, engage a gear and raise the clutch, and at this moment, the differential mechanism always plays a differential role,if the sound increases obviously, mostly it is the sound of differential.

When sound of differential occurs, if the sound is light, and diminishes gradually with increasing of mileage, then operation may go on. If the sound becomes more and more serious, then disassemble it immediately, trace the cause and remove the trouble.

4. Bearing sound

The from drive axle inner bearing is mostly a very mixed and disorderly "Huala Huala" sound,the greater the speed, the louder the sound, and the sound gives out both in acceleration and deceleration. This kind of sound is mostly caused by improper adjustment of pre-tightening of bearing or bearing burning due to lack of oil. Normally disassemble and check in time, and no operation shall continue.

5. Overheating of drive axle

Overheating of drive axle means the axle being heated to above 60℃ after certain mileage the truck has covered.

Main causes of overheating are excessive bearing assembling pre-tightening force,drive and driven gear engagement clearance that is too small or lack of lubricating oil and so on.

6. Poor operation of differential lock

Poor operation of differential lock means that when there is no locking differential, the differential is in locking state, or when the driver locks differential according to the operation procedure, wheels on both sides of differential still fail to play a role of differential.

This kind of failure is very dangerous. In case the differential fails to lock, the truck will slip when driving on the road surface with small adhesion, as a result, the ability of truck to cross the muddy, snow-covered and icy road becomes low and no proper effectiveness can be realized. If the differential state fails to recover, the consequence will be more serious. When the truck is traveling on a ragged road or turning, although the path of wheels on both sides driving on differential is not equal in length, both wheels have equal rotating speed, which will certainly cause wheels to slide and speed up the wearing of tyres. When the truck is traveling with heavy load at high speed, it will cause damage to the parts in the axles, hence in the event the above trouble occurs, it is required to check and remove the trouble immediately.

The checking method is as follows:

(1) Check the operation of interwheel differential lock

When truck is parking on a smooth road surface, jack up the front, mid and rear wheels on one side, put the parking brake (hand brake) control valve handle in the driving position(i.e. brake release position),don't turn on the differential lock switch, use hands to rotate the wheels on the side that is jacked up, they should rotate smoothly, otherwise, it shows that the interwheel differential lock is in the locking state, the trouble should be removed.

Start the engine and when the pressure reaches 7 bars and above, turn on the interwheel differential lock switch,and then rotate the front, mid and rear wheels on the side that is jacked up, the wheels should not be able to rotate. Check that the interwheel differential lock indicator light should be lit. These phenomena indicate the interwheel differential lock is in locking state, otherwise, it shows that the interwheel differential lock fails to lock. Trace the cause and remove the trouble.

(2) Check the operation of interaxial differential lock

Jack up the forward rear axle and rear axle,set the hand brake control valve handle in driving position(i.e. brake release position),turn on the interwheel differential lock switch to put interwheel differential lock in locking state, and then rotate the wheel of forward rear axle or rear axle with hands,it should rotate smoothly, otherwise, it shows that it is not allowed to release the locking mechanism of interaxial differential.

Start the engine and when the pressure reaches 7 bars and above, turn on the interwheel and interaxial differential lock switch,rotate the wheel of forward rear axle or first axle, the wheel should not be able to rotate. Check that the interaxial differential lock indicator light should be lit. These phenomena indicate the interaxial differential lock is in locking state, otherwise, it shows that the interaxial differential lock fails to lock. Trace the cause and remove the trouble.