GROUP 11 FRONT AXLE

1. REMOVAL FRONT AXLE

1) Pivot pin mounting bolt(1, M12)
   °§Tightening torque : 9.3° æ 1.9kgf°§m
   (67.3° æ 13.7lb°§ft)

2) Propeller mounting nut(2, M10)
   °§Tightening torque : 5.9° æ 0.6kgf°§m
   (42.7° æ 4.3lb°§ft)

3) Wheel nut(3, M20)
   °§Tightening torque : 60 $^{+0}_{-5}$ kgf°§m
   (434 $^{+0}_{-36}$lb°§ft)

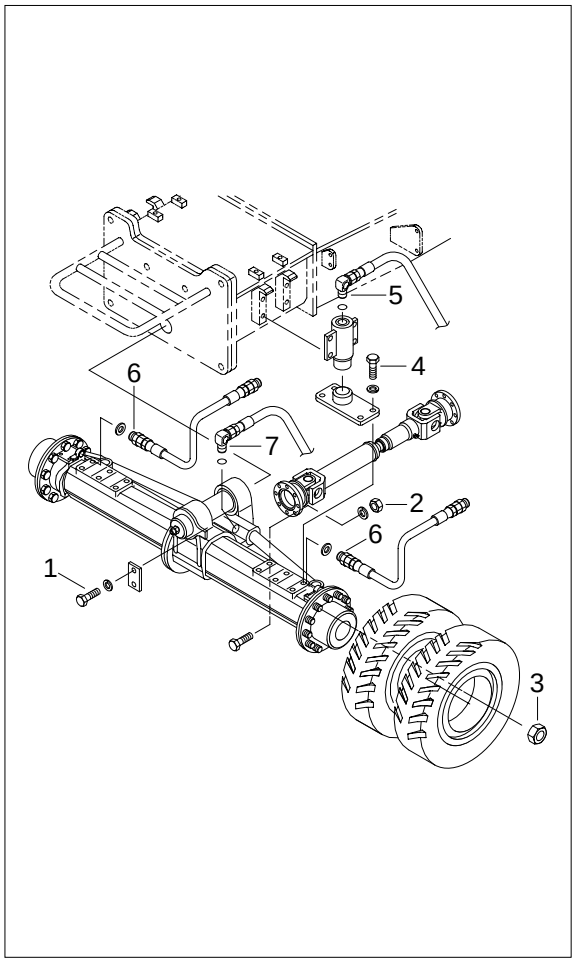
4) Oscillating cylinder supporting mounting bolt(4, M16)
   °§Tightening torque : 29.6° æ 3.2kgf°§m
   (214° æ 23.1lb°§ft)

5) Hose assy(5, PF 3/8)
   °§Tightening torque : 5.0kgf°§m(36.2lb°§ft)

6) Hose assy(6, PF 1/4)
   °§Tightening torque : 4.0kgf°§m(28.9lb°§ft)

7) Hose assy(7, PF 1/2)
   °§Tightening torque : 6.0kgf°§m(43.4lb°§ft)

8) Transmission weight : 502kg(1110lb)



2. GENERAL INSTRUCTIONS

1) GENERAL WORKING INSTRUCTIONS

(1) This manual has been developped for the skilled serviceman, trained by the ZF-Passau.

(2) During all operations, pay attention to cleanliness and skilled working.
Therefore, axle removed from the machine, must be cleaned prior to open them.

(3) We assume that the special tools, specified by ZF, will be used.
The special tools are available from ZF-Passau.

(4) After the disassembly, all components must be cleansed, especially corners, cavities and recesses of housing and covers.

(5) The old sealing compound must be carefully removed.

(6) Check lubricating holes, grooves and pipes for free passage. They must be free of residues, foreign material or protective compounds.

(7) The latter refers expecially to new parts.

(8) Parts which have been inevitably damaged in a disassembly operation, must be generally replaced by new ones, e.g. rotary seal rings, O-rings, U-section rings, cap boots, protective caps etc..

(9) Components such as roller bearings, thrust washers, synchronizing parts etc. which are subject to normal wear in automotive operation, must be checked by the skilled Serviceman.
He will decide if the parts can be reused.

(10) For the heating of bearings etc., hot plates, rod heaters or heating furnaces must be used.

(11) Never heat parts directly with the flame. An auxiliary solution would be to immerse the bearing in a vessel filled with oil, which is then heated with the flame.
In this way, damage to the bearings could be avoided.

(12) Ball bearings, covers, flanges and parts like that must be heated to about 90 to 100°C.

(13) Hot-mounted parts must be reset after cooling in order to assure a proper contact.

(14) Before pressing shafts, bearings etc. in position, both parts must be lubricated.

(15) During to reassembly, all specified adjustment values, testing specifications and tightening torque must be respected.

(16) After the repair, units are filled up with oil.

(17) After the oil filling, the oil level plugs and oil drain plugs must be tightened to the specified tightening torque.

2) IMPORTANT INSTRUCTIONS CONCERNING THE LABOUR SAFETY

(1) In principle, repairers are themselves responsible for the labour safety.

(2) The observance of all valid safety regulations and legal rules is a precondition to prevent damage to individuals and products during the maintenance and repair operations.

(3) Before starting the work, the repairers have to make themselves familiar with these regulations.

(4) The proper repair of these products requires especially trained personnel.

(5) The repairer himself is obliged to provide for the training.

3) LUBRICANT SPECIFICATIONS

(1) Gear oils with limited - slip additives.

(2) API GL-5

(3) MIL-L-2105D(SAE 85W-90, 85W-140 with LS-Additive)

4) BRAKE LINING WEARING TEST

(1) General

① The brake lining wearing test gives a limited information about the overall condition of the brake plate pack - without disassembly of the planetary carrier, resp. of the plates.

② The wearing test has to be carried out in case of the following criteria :
- In the course of the oil change intervals(min. once a year)
- Braking noises
- Reduced braking power
- Change of deceleration, of the brake fluid level as well as of the brake pressure
- In case of a general change of the brake performance.

③ Carry out the wearing test on both final drive sides.
- Permitted piston stroke max. : 5.2mm
- Piston stroke in new condition of the plate pack : 3.1-3.5mm

(2) Carry out the wearing test

① Turn the planetary carrier until screw plug A(M16 × 1.5) is in the upper position(12 o'clock position).
Now, remove the screw plug.

② Apply the brake(required brake pressure min. 40bar).

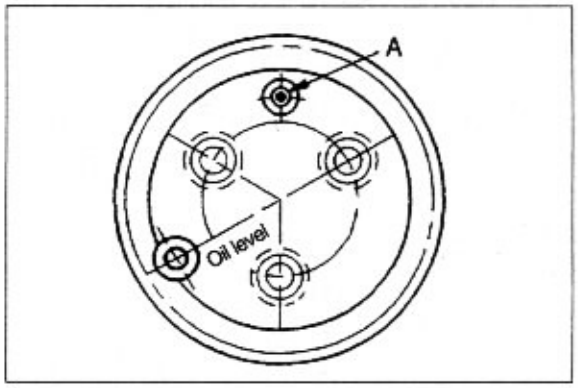
③ Screw measuring screw(M16 × 1.5) in until contact is obtained and tighten it with a torque of 1kg · m.

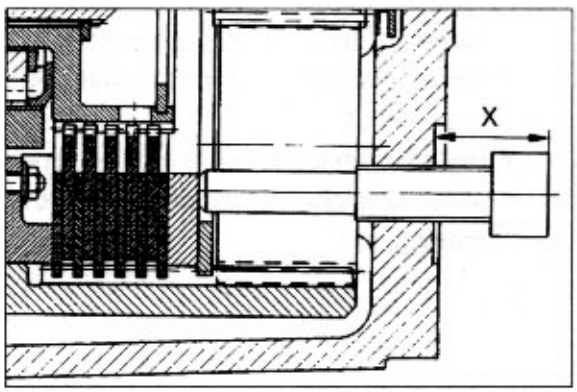
④ Determine dimension X according to the figure on the right.

⑤ Release the brake and equalize the plate clearance by resetting the measuring screw.
Torque limit 1kg · m.

⑥ Determine dimension Y according to the figure on the right.

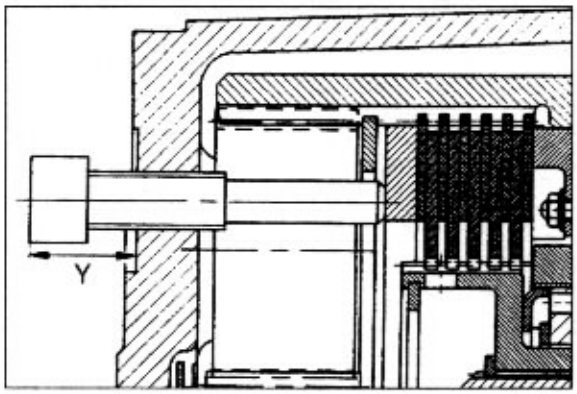
⑦ The difference of the two dimensions (X-Y) corresponds to the piston stroke (actual state).





(3) Result

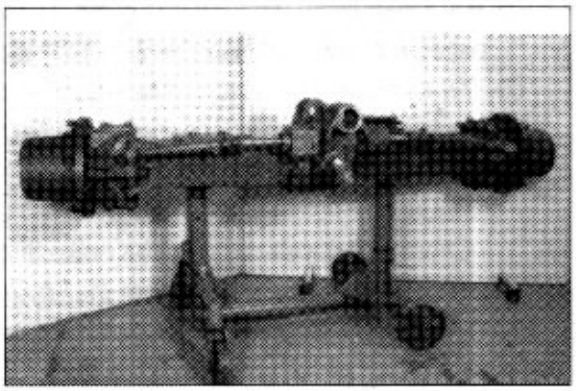
If the max. permitted piston stroke(5.0mm) is exceeded, the lining plates must be renewed on both final drive sides.



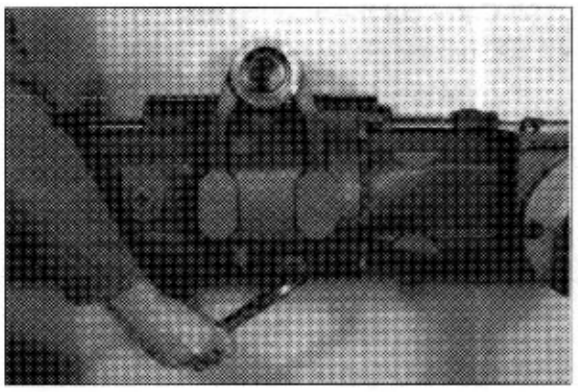
3. FINAL DRIVE DISASSEMBLY AND ASSEMBLY

1) DISASSEMBLY

The illustration on the right shows the complete axle on the assembly car.



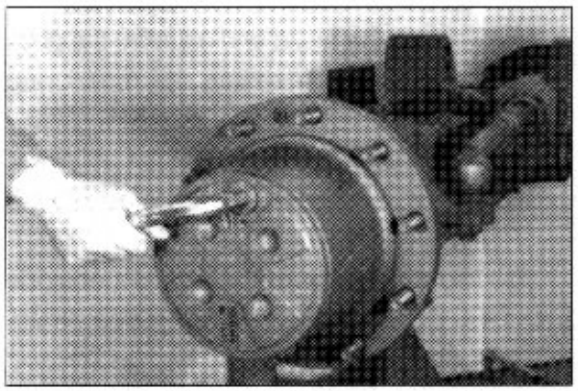
Drain oil from the axle housing.



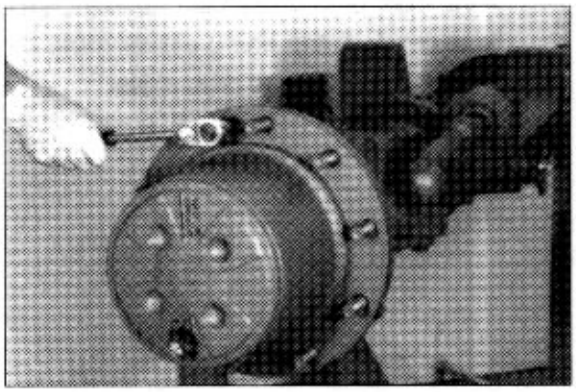
(1) Planetary carrier

① Screw out the screw plug carefully. Swivel planetary carrier through 180° and drain oil.

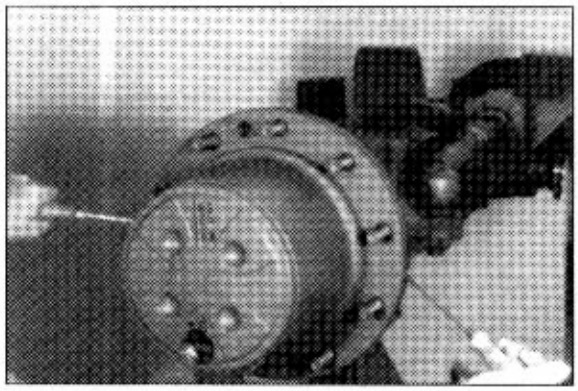
※ Pay attention to the position of the screw plug -12 o'clock position- during the opening.



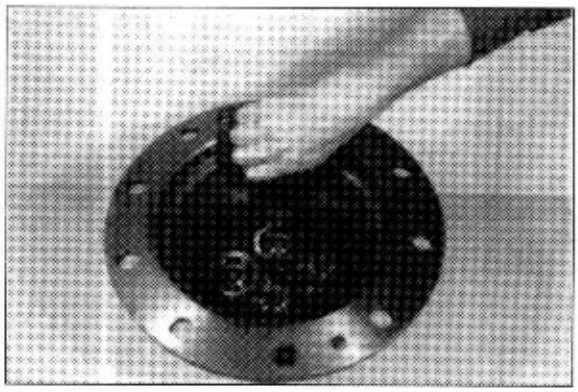
② Loosen the two socket head screws.



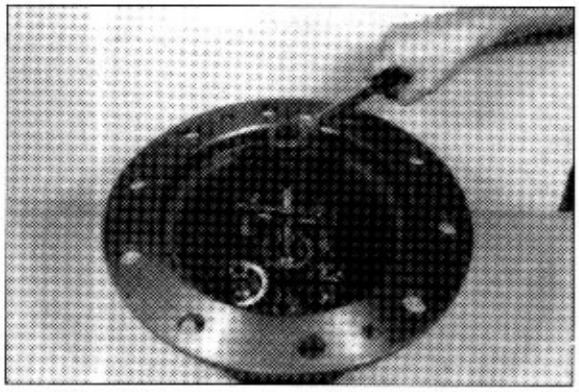
③ Separate planetary carrier from the hub.



④ Squeeze out circlip.

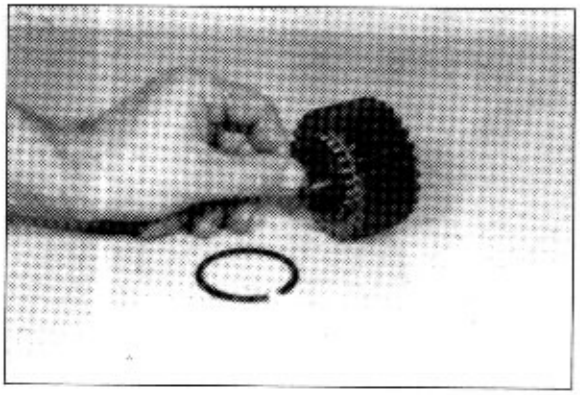


⑤ Pull off planetary gears.
If required, remove the thrust washer(for the sun gear shaft).



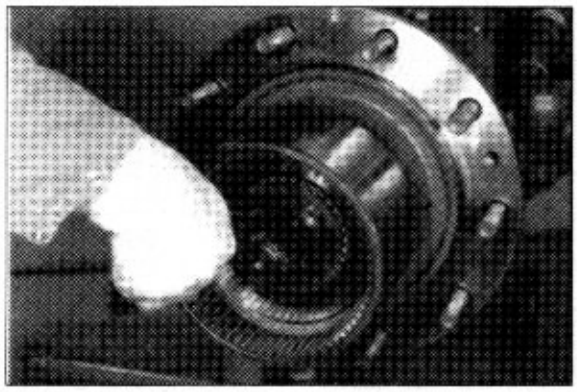
⑥ Squeeze out the angle rings and pull the complete bearing inner race out of the planetary gear.

※ Pay attention to the released rollers.

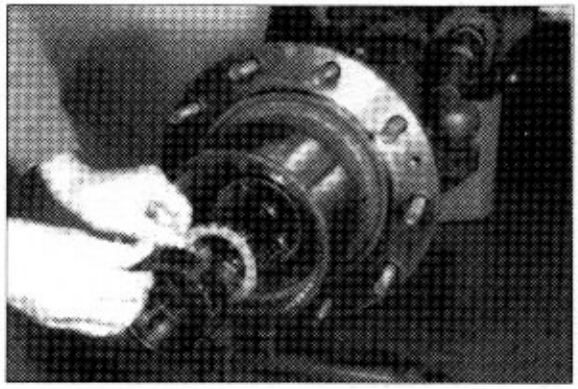


(2) Internal gear

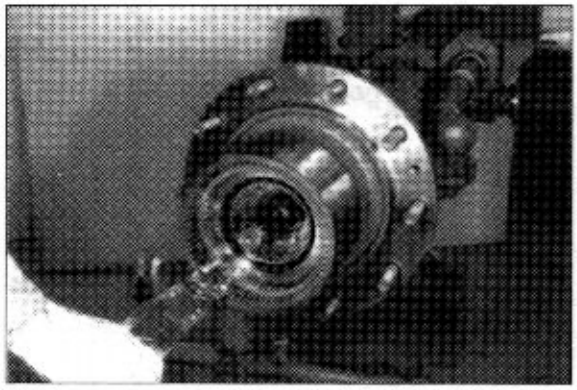
① Squeeze out circlip.



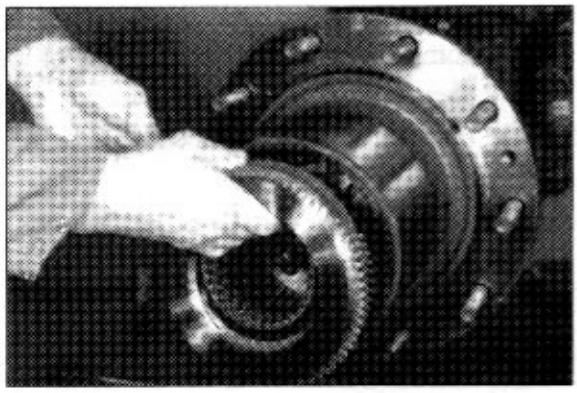
② Remove the plate carrier and the thrust washer installed behind it.



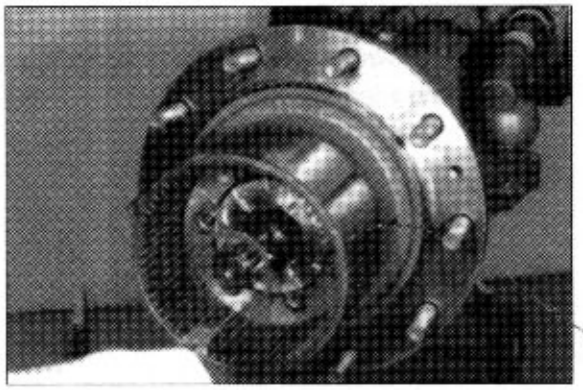
③ Squeeze out circlip.



④ Take backing plate and plate pack out of the internal gear.

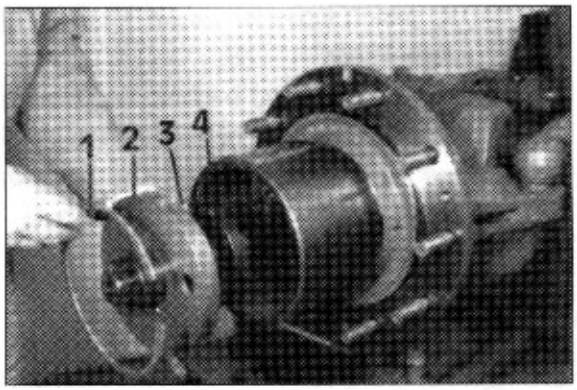


⑤ Squeeze out circlip(slotted nut).

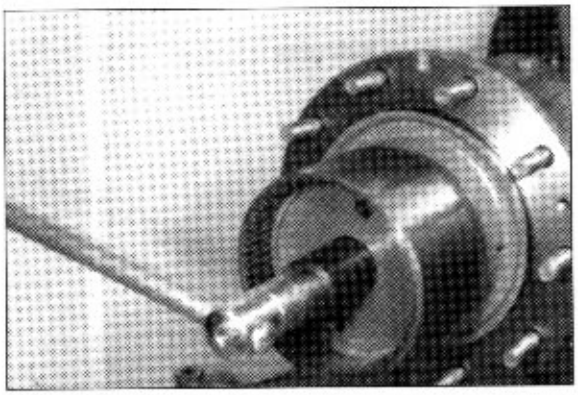


⑥ Assemble spacing ring(3) and centering disk(2) upon hook spanner(4), position and fix them by means of circlip(1).

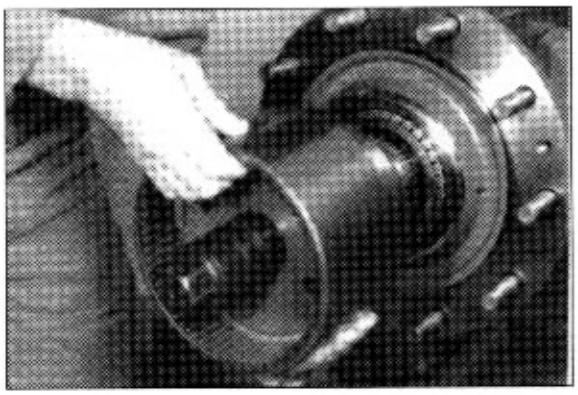
※ Pay attention to the exact engagement of the circlip.



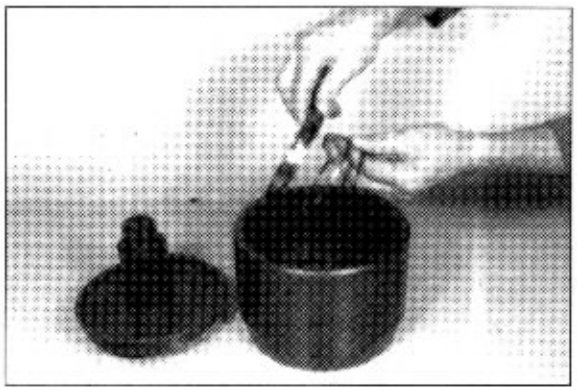
⑦ Loosen slotted nut.



⑧ Screw off slotted nut and separate complete internal gear from hub carrier.

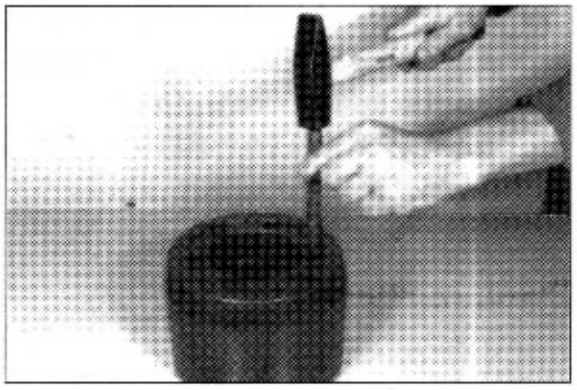


⑨ Remove hook spanner.
Lift slotted nut, angle ring and O-ring out of the internal gear.

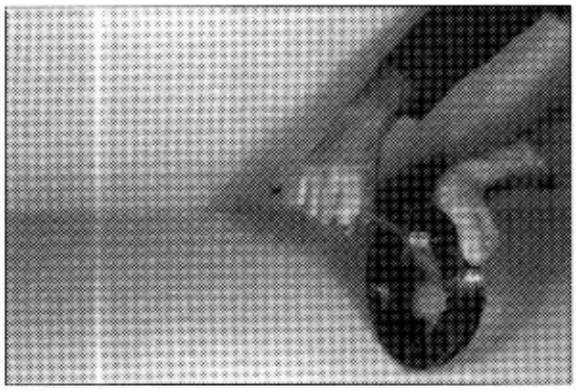


⑩ Tap piston loose and drive it out of the internal gear.

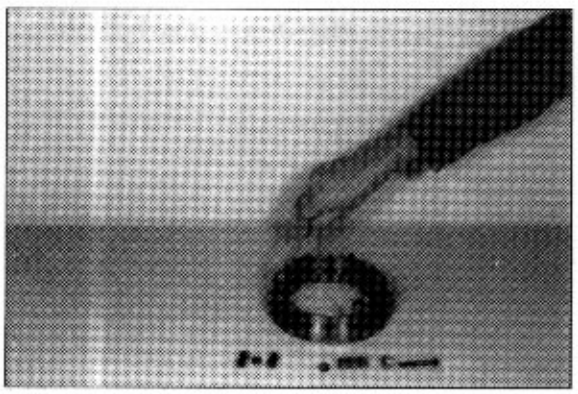
※ Grooved rings and back up rings will be damaged in course of the piston removal. Use new grooved rings and back up rings.



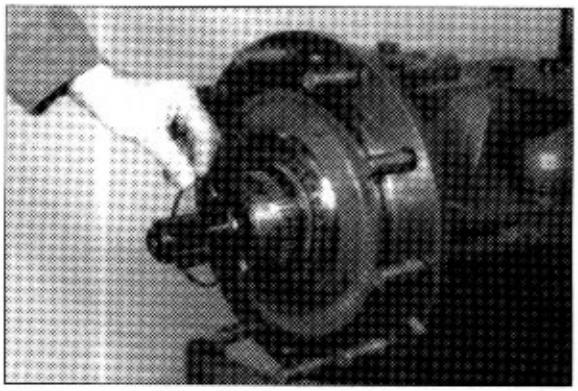
⑪ Loosen lock nuts.



⑫ Loosen all hex head screws, resp. socket head screws.
Remove compression springs, spring cages and the released supporting disk.

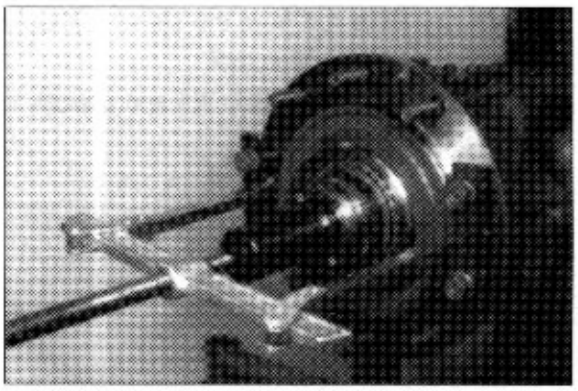


⑬ Remove O-ring.



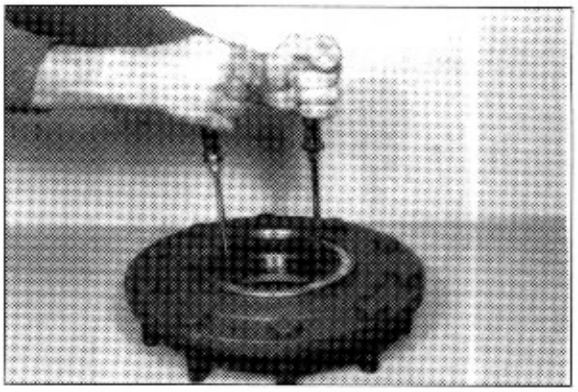
(3) Hub

① Pull hub from steering knuckle hull.
Pay attention to the released bearing inner race and the spacing ring.
Take O-ring out of the hub.

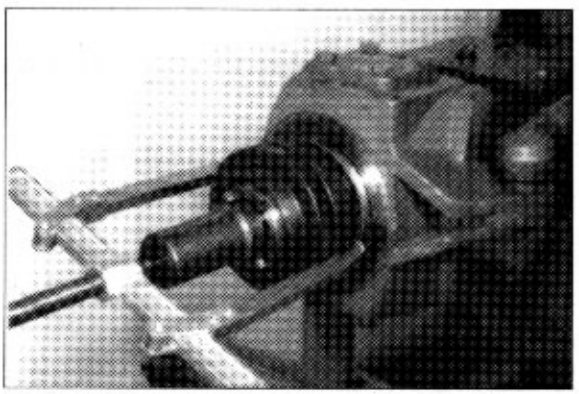


② Pry out sealing ring and remove the bearing inner race.
If necessary, drive the two bearing outer races out of the hub.

※ If the bearing inner race remains on the neck of the steering knuckle hull, this one must be disassembled as described as figure(③).

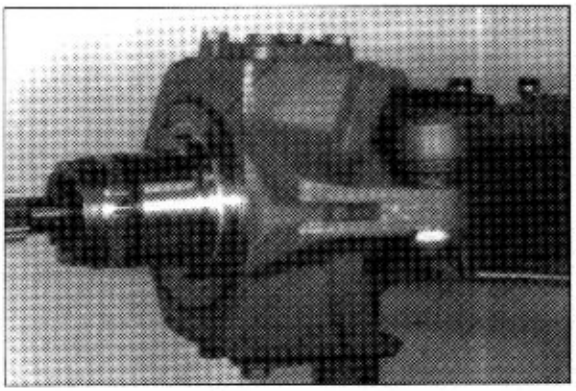


③ Pull bearing inner race from the neck of the steering knuckle hull and pry off shaft seal.

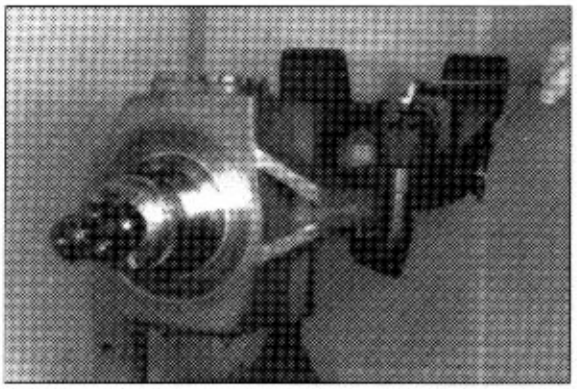


(4) Steering knuckle hull

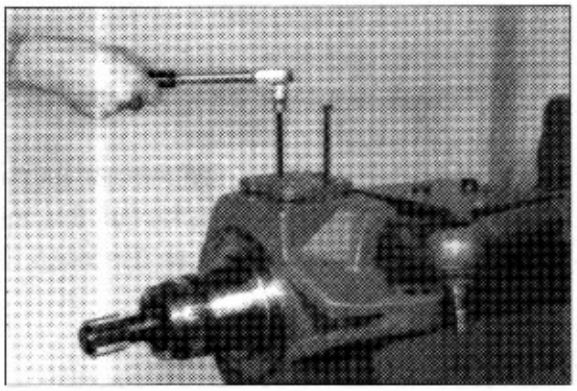
① Remove cotter pin.
Loosen castle nut for some threads only.



② Loosen tie rod from the steering knuckle hull, using ejection tool.
Now, screw off castle nut and unhook tie rod.

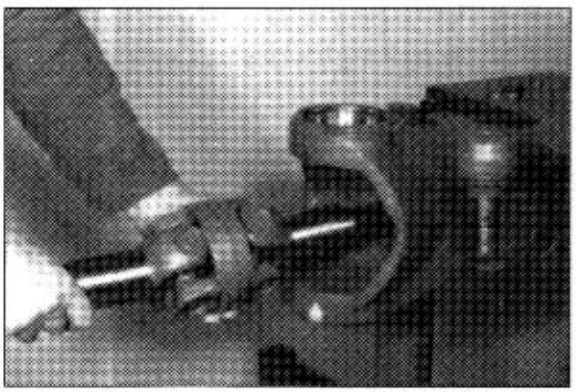


③ Loosen hex head screws and screw back-off screws in.

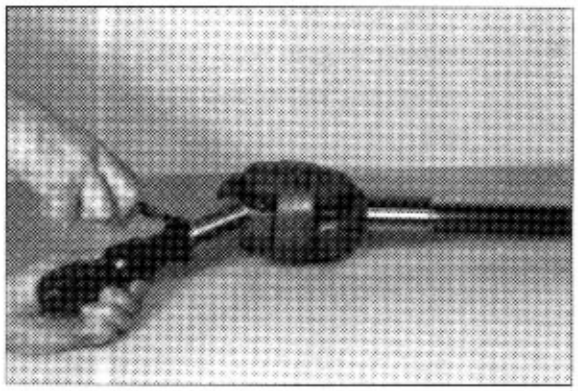


(5) Double-joint shaft

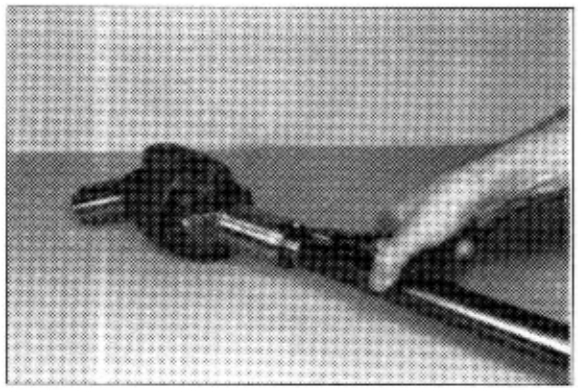
① Take the double-joint shaft out of the axle housing.



② Expand circlip and pull sun-gear shaft out of the double-joint shaft.

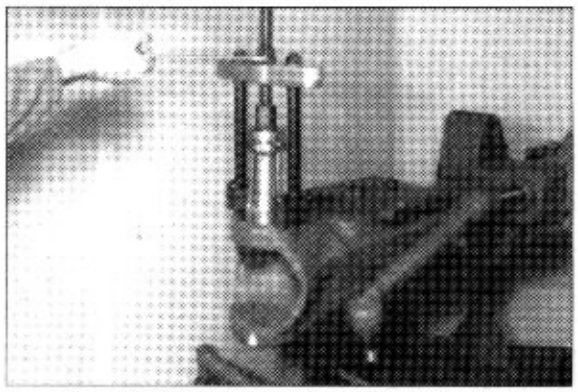


③ Expand circlip and remove stub shaft.

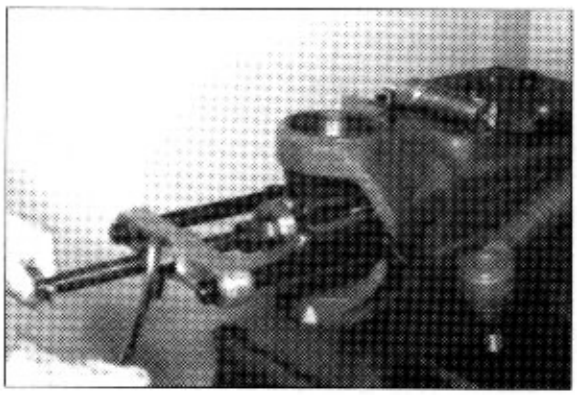


(6) Axle housing

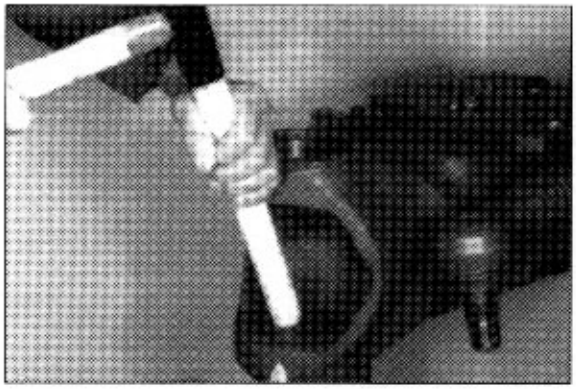
① Pull bearing outer race out of the steering knuckle bores.



② Pull the shaft seal and the sleeve installed behind it out of the bore.



③ In the case of versions - with traversing steering knuckle bore - drive the cover, if necessary, out of the steering knuckle bore.

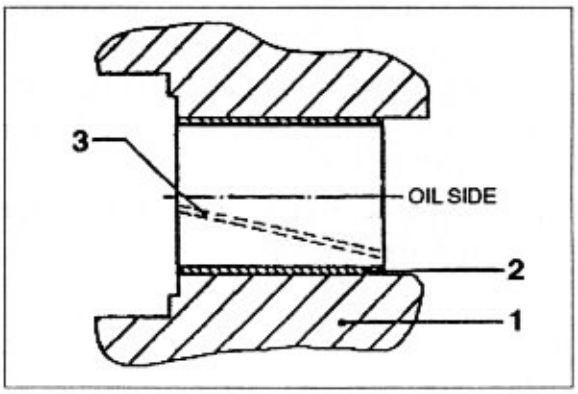


2) REASSEMBLY

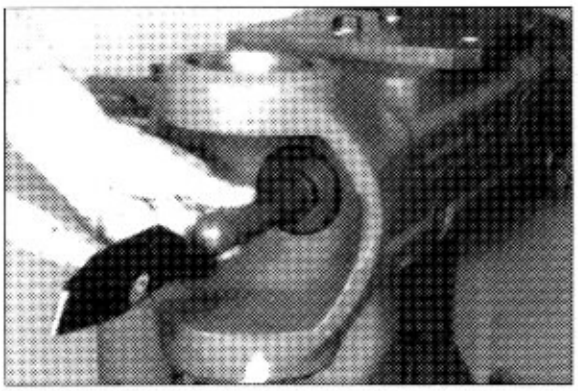
(1) Axle housing and double-joint shaft

① Reference Draft
(Sectional position vertical)

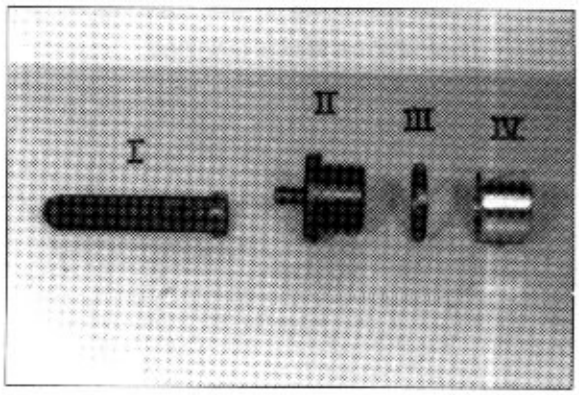
1 Axle housing
2 Sleeve
3 Lubricating groove



② Drive in the sleeve - inner lubricating groove(3) showing downward towards the axle center - until it is flush(see also Draft ①).

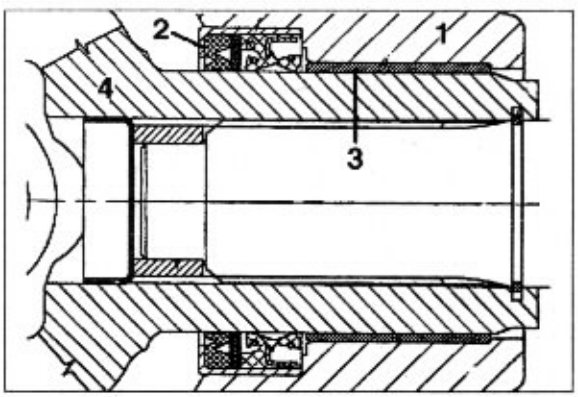


Ⅰ Handle
Ⅱ Driver
Ⅲ Ring
Ⅳ Sleeve



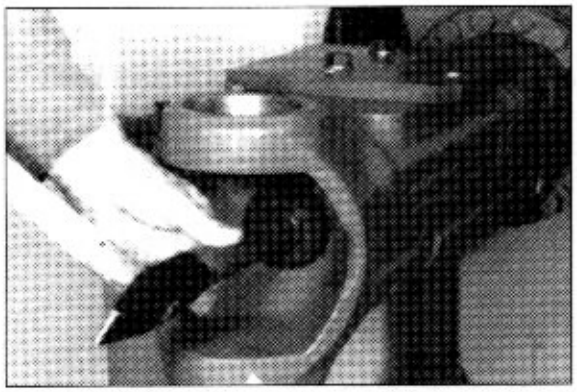
③ Reference Draft

1 Axle housing
2 Shaft seal
3 Sleeve
4 Double-joint shaft

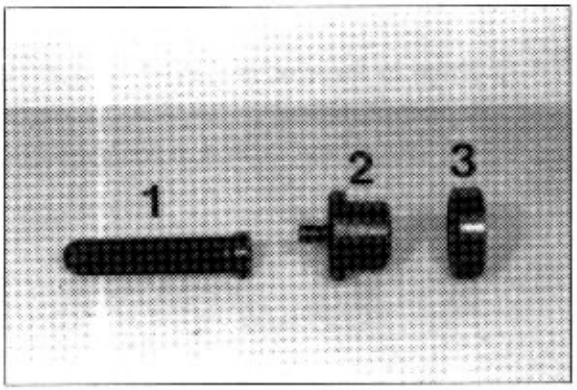


④ Cover shaft seal on the outer diameter with loctite(Type-No. 574) and insert it until contact is obtained.

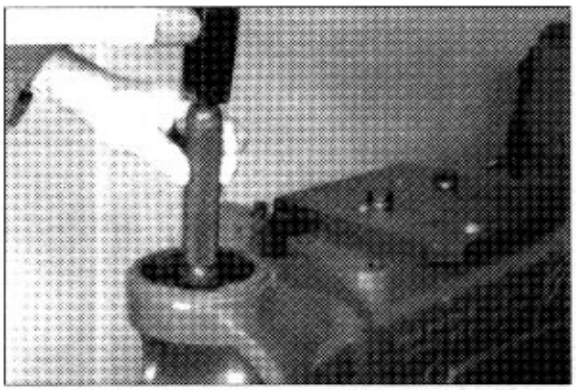
※ Pay attention to the installation position. Sealing lip must face the oil chamber(see Draft ③).
Grease shaft seal in the zone of the dust lip and sealing lip.



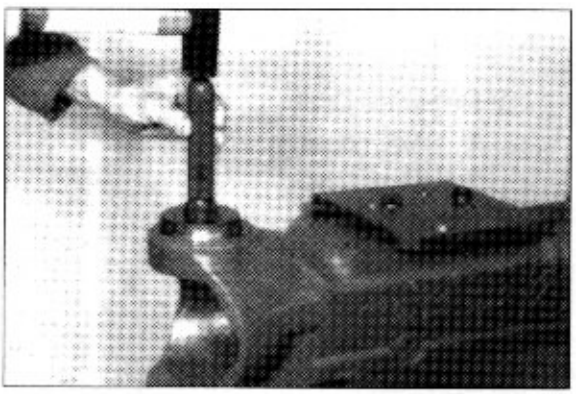
1 Handle
2 Driver
3 Shaft seal



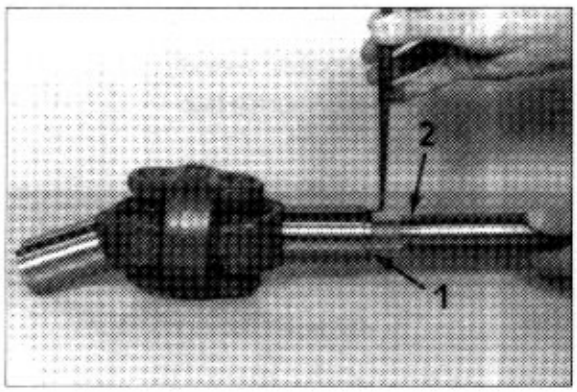
⑤ If necessary, according to the version, insert the cover in the steering knuckle bore until contact is obtained.



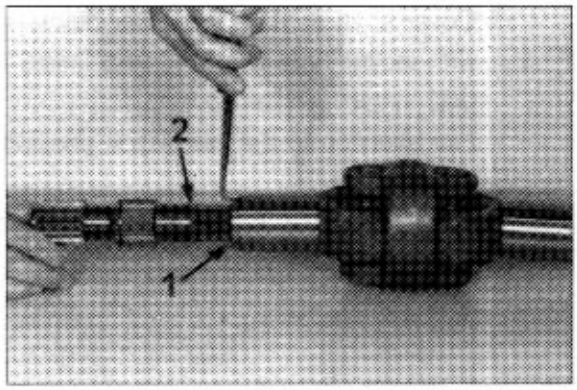
⑥ Place undercooled bearing outer races against shoulder until contact is obtained.



⑦ Insert circlip(Arrow 1), assemble stub shaft into the double-joint until the circlip engages in the annular groove(2).

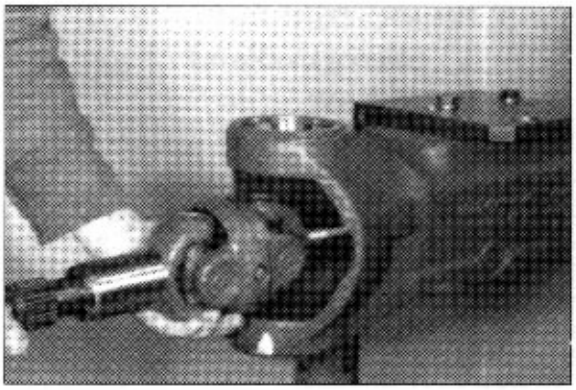


⑧ Insert circlip(Arrow 1).
Assemble the sun-gear shaft until the circlip engages in the annular groove(Arrow 2).



⑨ Introduce the complete double-joint shaft into the axle housing until the stub shaft splines are received in the differential.

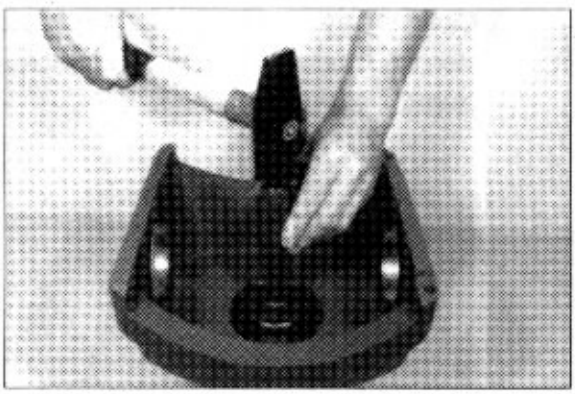
※ Pay attention to the sealing elements.



(2) Steering knuckle hull

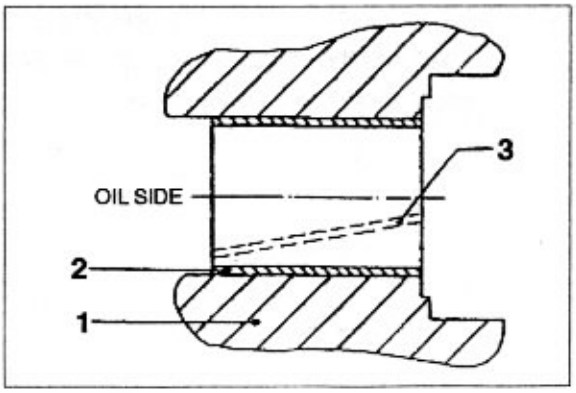
① Drive the sleeve in until it is flush(see also Draft ②).

※ Pay attention to the installation position of the sleeve.
The inner lubricating groove(3) must show, in the installed steering knuckle hull, downward and towards the oil chamber.



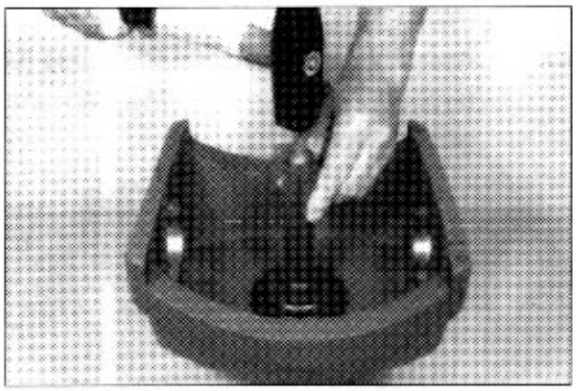
② Reference Draft
(Sectional position vertical)

1 Steering knuckle hull
2 Liner
3 Lubricating groove



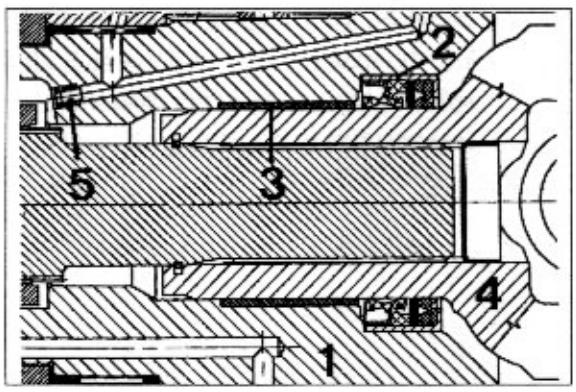
③ Cover shaft seal on the outer diameter with loctite(Type-No. 574) and install it until contact is obtained.

※ Pay attention to the installation position, see Draft ④.
Grease the shaft seal in the zone of the dust lip and sealing lip.

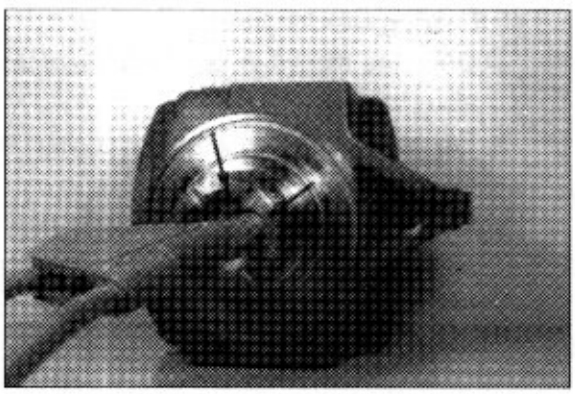


④ Reference Draft

1 Steering knuckle hull
2 Shaft seal
3 Sleeve
4 Double-joint shaft
5 Screw plug

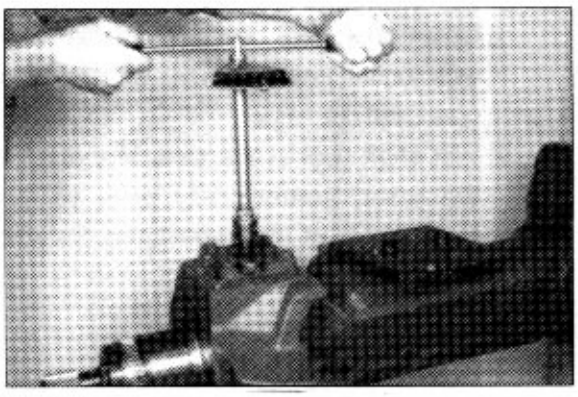


⑤ Close the two bores(see Arrows) in the steering knuckle hull by means of screw plugs(5), (see also Draft ④).



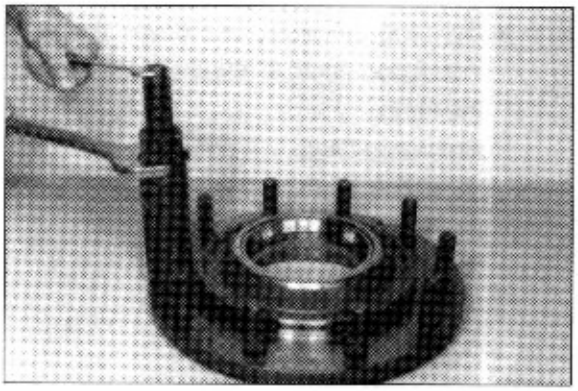
(3) Check rolling resistance of the steering knuckle bearing (aim at the upper value)

① Bearing rolling moment : 4.1-5.1kg · m (29.7-36.9 lb · ft)



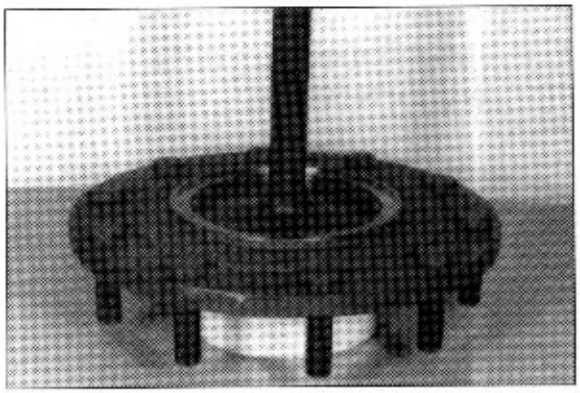
(4) Hub-wheel bearing

① Pull in wheel studs.



② Insert the two undercooled bearing outer races in the hub and place them against shoulder.

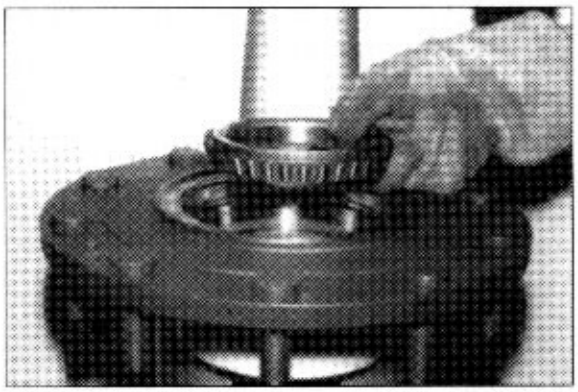
※ Do not support the hub on the wheel studs.



(5) Mount hub

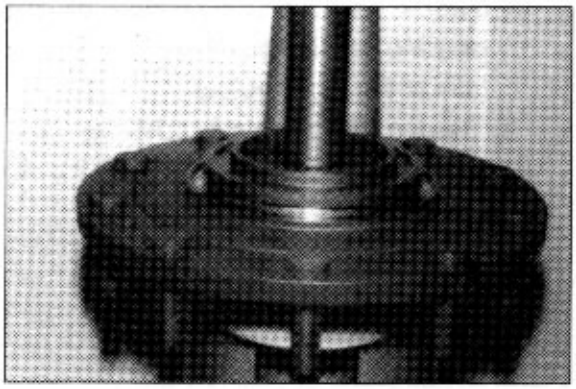
① Insert heated bearing inner race.

※ Pay attention to the different bearing inner ring sizes.
To avoid an excessive cooling down of the bearing inner race, the reassembly of the shaft seal, resp. the assembling of the hub must be carried out immediately after the insertion of the bearing inner race.



② Cover shaft seal on the outer diameter with loctite(Type-No. 574) and install it (see Draft ③).

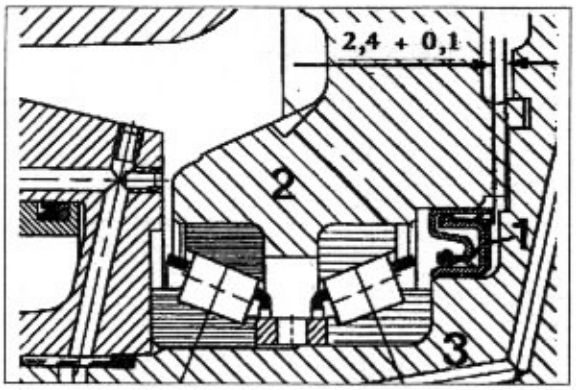
※ Wet shaft seal in the zone of the inner diameter, immediately prior to the reassembly of the hub(Figure ④) with spirit.



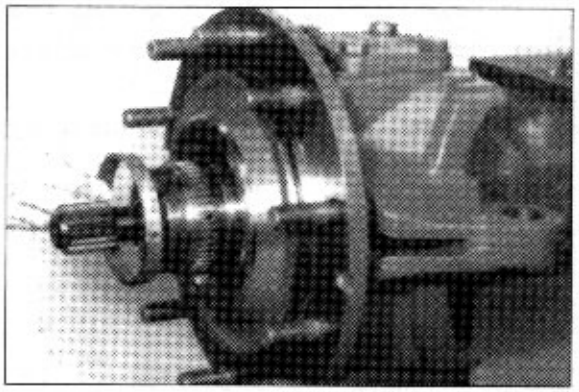
※ By using the prescribed driver, the exact installation depth is obtained(see Draft on the right).

③ Reference Draft

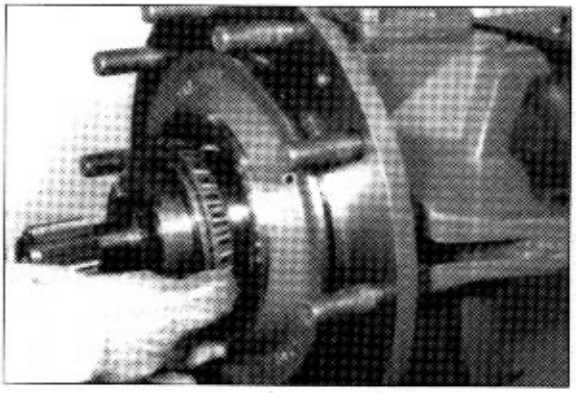
1 Shaft seal
2 Hub
3 Steering knuckle hull



④ Assemble pre-assembled hub and determined spacing ring (e.g. s = 14.50 mm).



⑤ Fix the hub by means of the heated bearing inner race.



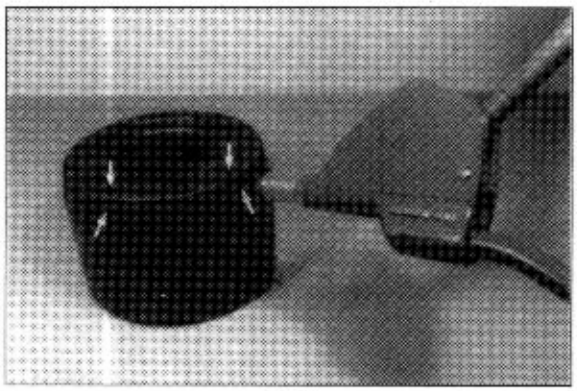
(6) Internal gear

One-piece internal gear :

Piston reset / socket head screws

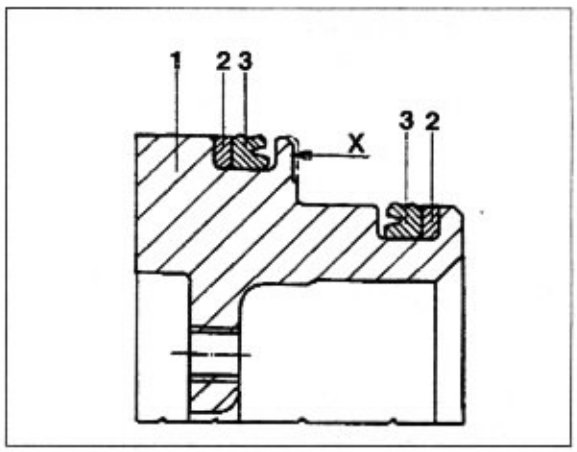
※ For the following reassembly, the use of the assembly help is recommended.

① Close bores(see Arrows) by means of screw plugs.



② Heat the two back-up rings in an oil bath and insert them in the piston recesses. Install grooved rings.

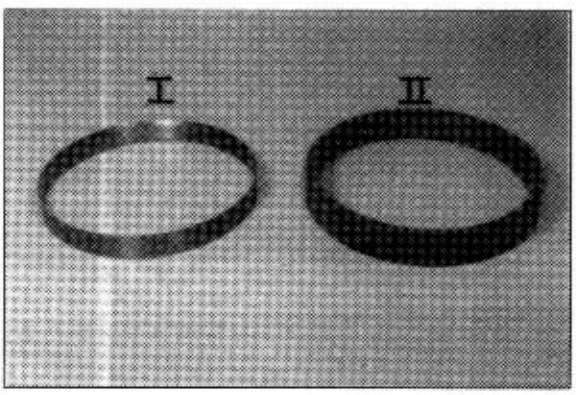
※ Pay attention to the installation position, see draft on the right.



Reference Draft

1 Piston
2 Back-up rings
3 Grooved rings
X Pressure chamber

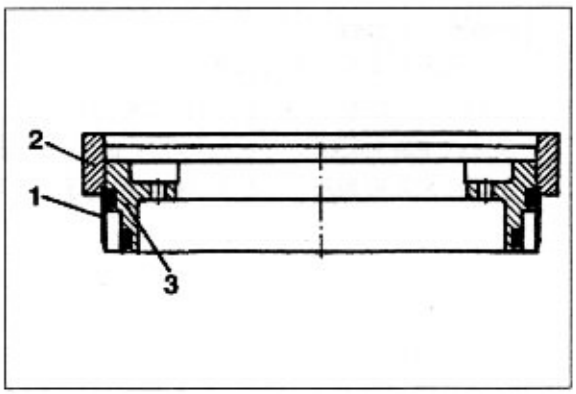
③ The illustrated assembly help facilitates, resp. assures a correct reassembly of the prescribed piston.



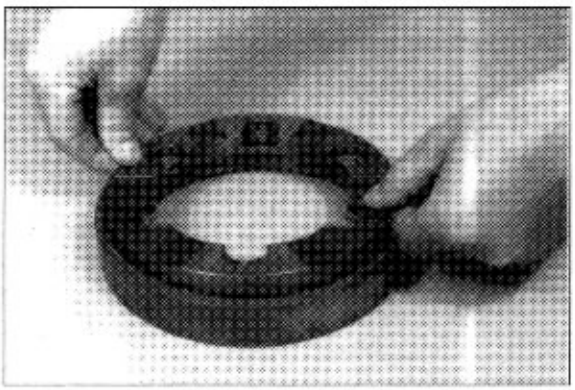
④ After the cooling down, oil the back-up ring and the grooved ring(use W-10 oils).

Reference Draft

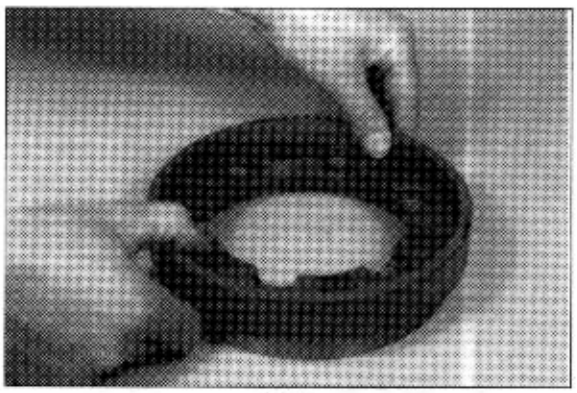
1 Assembly help / part Ⅰ
2 Assembly help / part Ⅱ
3 Piston



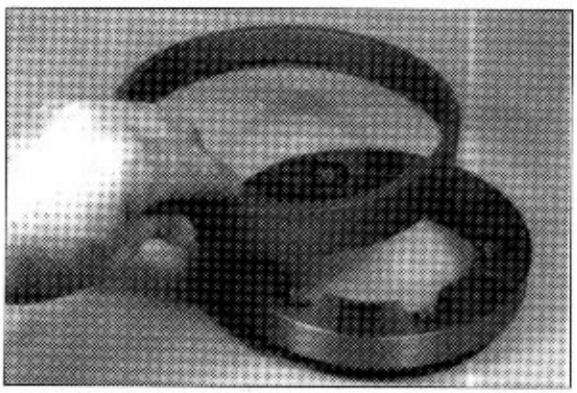
⑤ Insert piston(3) in the assembly help / part Ⅱ.



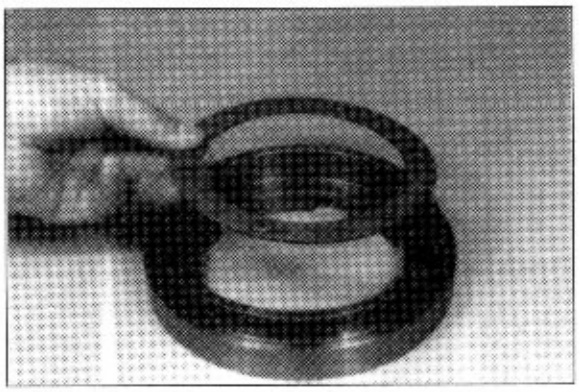
⑥ Place assembly help / part Ⅱ upon part Ⅰ and press piston through.



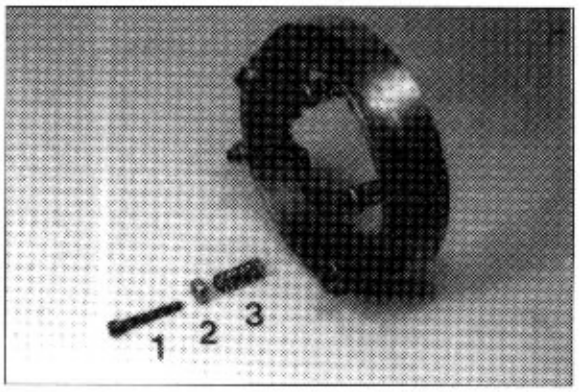
⑦ Take off assembly help / part Ⅱ.



⑧ Insert the supporting disk into the piston.

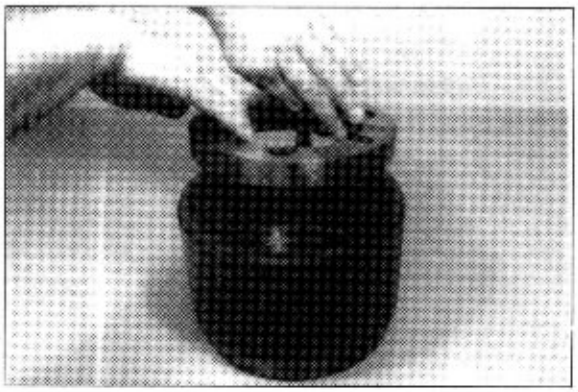


⑨ Assemble spring cage(2) and compression spring(3) upon the socket head screws(1), and screw them into the piston.



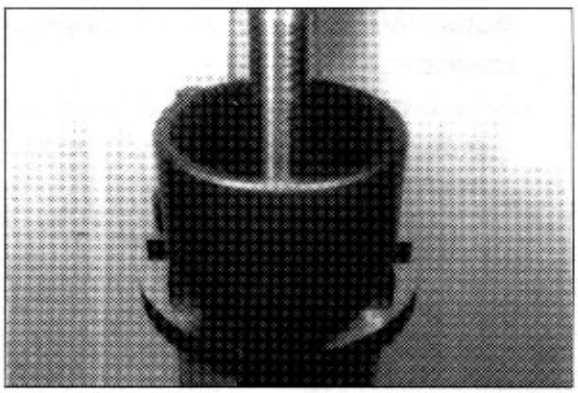
⑩ Assemble the assembly help / part I (with the inserted piston) in the internal gear.

※ Pay attention to the radial installation position of the piston.



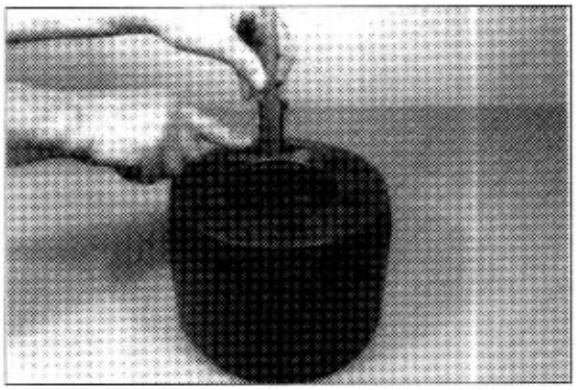
⑪ Press piston carefully against shoulder. Now, take the assembly help / part I out of the internal gear.

※ To avoid the shearing off, resp. tipping of the grooved rings, install the piston with utmost care(by means of a hand press).



⑫ Adjust dimension "X" = 3.75 - 4.25mm, bearing contact / internal gear to the screw head - see draft ⑬.

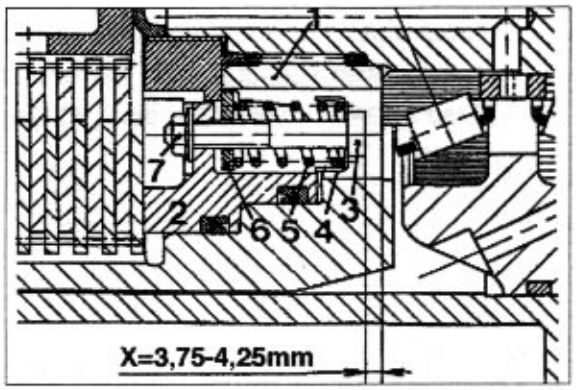
※ Pay attention to the exact piston contact in the internal gear.



⑬ Reference Draft

Dimension "X" = 3.75 - 4.25mm.

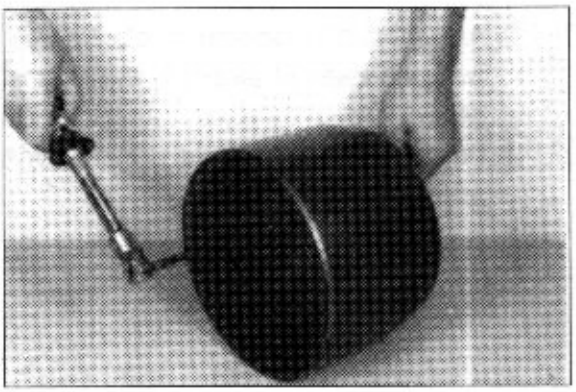
1 Internal gear
2 Piston
3 Socket head screw
4 Spring cage
5 Compression spring
6 Supporting disk
7 Lock nut



⑭ Check socket head screws by means of lock nut.

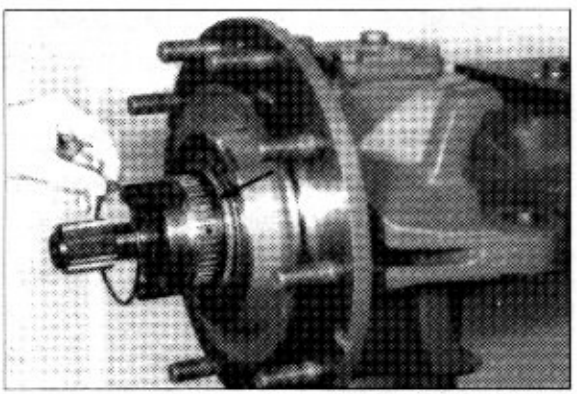
Tightening torque : 1.1kg · m (8.0 lb · ft)

※ Secure lock nut additionally with loctite(Type-No. 242).



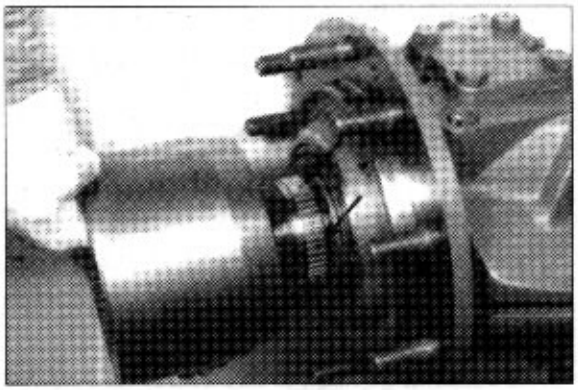
Mount Internal gear on the steering knuckle hull

⑮ Oil O-ring and insert it in the annular groove of the steering knuckle hull(Arrow).

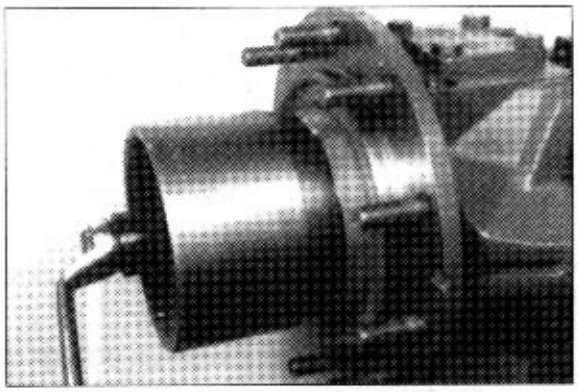


⑯ Assemble internal gear.

※ Pay attention to the exact overlapping of the oil supply holes(see Arrows) of the steering knuckle hull, resp. internal gear splines.

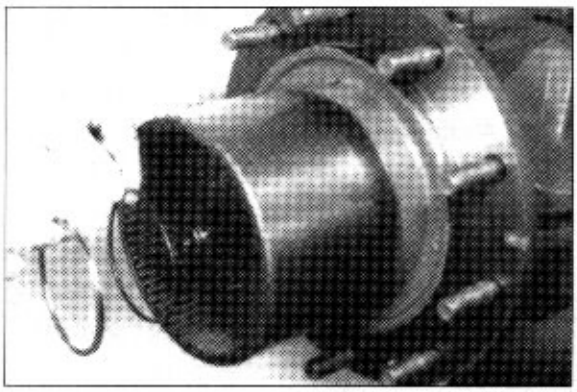


⑰ Place internal gear by means of slotted nut over the O-ring until contact on the bearing inner race is obtained.
Now, remove slotted nut again.

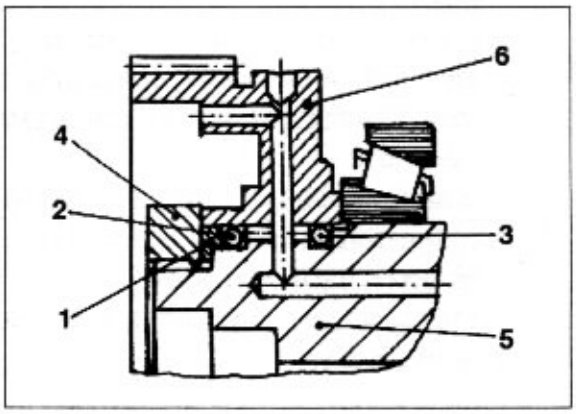


⑱ Insert O-ring evenly in the gap of the steering knuckle hull and the internal gear.
Install subsequently angle ring and pull it by means of slotted nut against shoulder.

※ Cover O-ring and angle ring amply with grease.
Pay attention to the installation position,(see Draft ⑲).



⑲ Unscrew slotted nut again and check O-ring(if damaged), resp. angle ring seat.

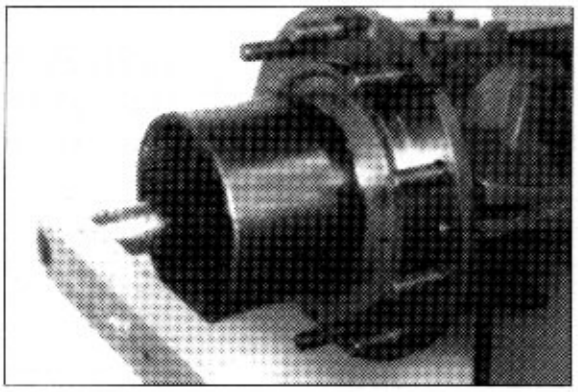


Reference Draft

1 Angle ring
2 O-ring
3 O-ring
4 Slotted nut
5 Steering knuckle hull
6 Internal gear

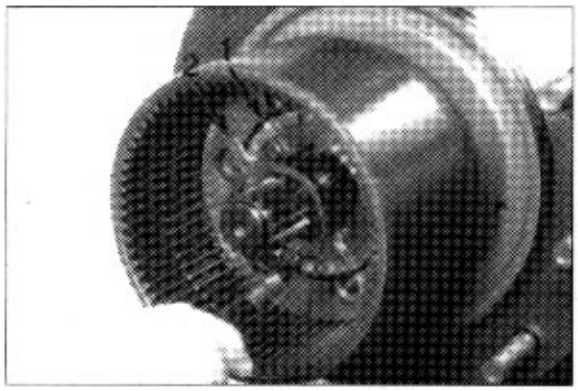
⑳ Cover threads of slotted nut with lubricant(Type Molypaul M11) and tighten slotted nut finally.
Tightening torque : 158^{+51}kg · m
(1143^{+369} lb · ft)

※ Aim at the conformity of slotted nut / Pocket of the steering knuckle hull, starting with the lower tightening torque 158kg · m.
During the tightening, make several full revolutions of the hub in both senses.



㉑ Fix slotted nut by means of circlip (tongue).
The tolerance range of the tightening torque has been selected in such a way that a matching position of the recesses of slotted nut and steering knuckle hull(Arrow 1) can be obtained.

※ Pay attention to the installation position of the circlip.
The tongue(Arrow 2) must be positioned in one of the upper recesses(Arrow 1).



(7) Multi-disk drive

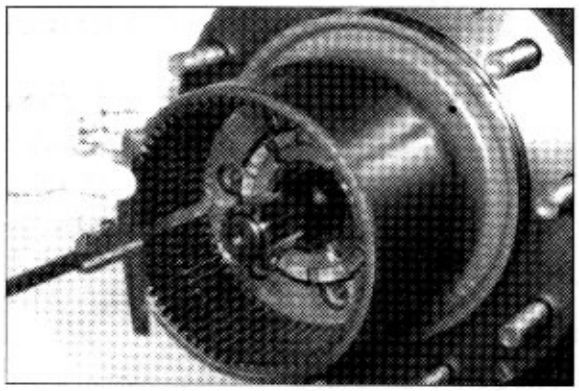
Adjust piston travel

Piston travel = 3.0 - 4.0mm

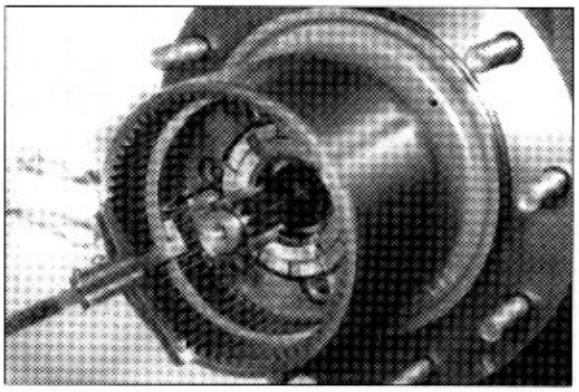
※ We know from experience that the required piston travel is obtained by installing 5 outer plates of the thickness s = 2.50mm and 1 outer plate of s =2.00mm.
However, in case of exceptions, a correction may become necessary. Therefore, a measuring of the piston travel(**Example B**) must be absolutely carried out.
In case of deviations from the prescribed piston travel, correct by means of corresponding outer plate(s).
The correct performance of the multi-disk brake is assured.

① Determine dimension I from the end face / internal gear to the plane surface / piston.
Dimension I e.g. : 89.70mm

※ Pay attention to a correct piston contact in the internal gear.

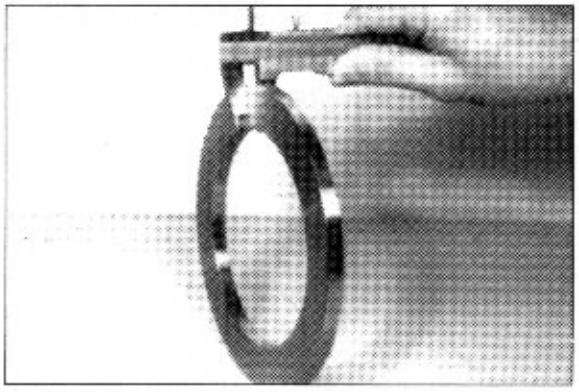


② Engine circlip and place it on the outer face of the recess(direction of Arrow) against shoulder.
Measure dimension II from the end face/ internal gear to the inner surface of the circlip.
Dimension II e.g. : 45.40mm
Now, remove circlip again.



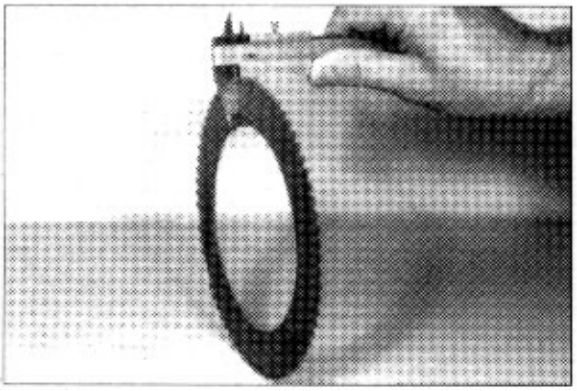
③ Determine dimension III (Thickness of the backing plate).

Dimension III e.g.	9.00mm
Example A	
Dimension I	89.70mm
Dimension II	- 45.40mm
Difference	= 44.30mm
Dimension III	- 9.00mm
Gives Dimension X	35.30mm



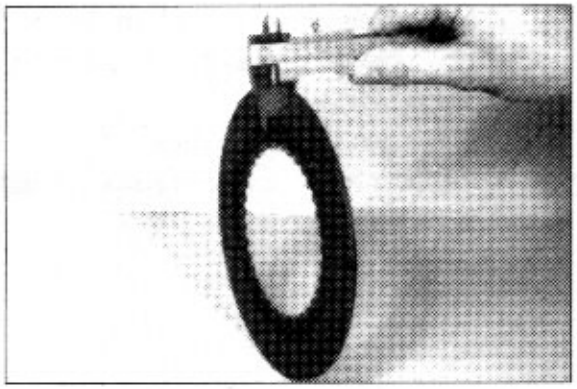
④ Determine total height of the plate pack.

※ The plate thickness has to be measured on the single plate-not on the total plate pack.
The undulation of the outer plate may not affect the measuring result.



⑤ The inner plates have a constant thickness of s = 3.50mm.

5 Outer plates s = 2.50mm =12.50mm
1 Outer plate s = 2.00mm = 2.00mm
5 Inner plates s = 3.50mm =17.50mm
Gives the total height = Dimension Y = 32.00mm

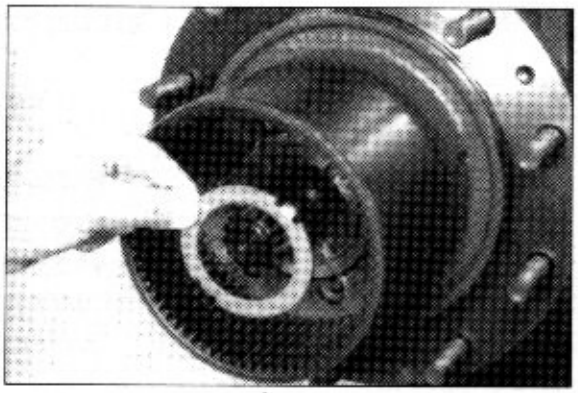


Example B

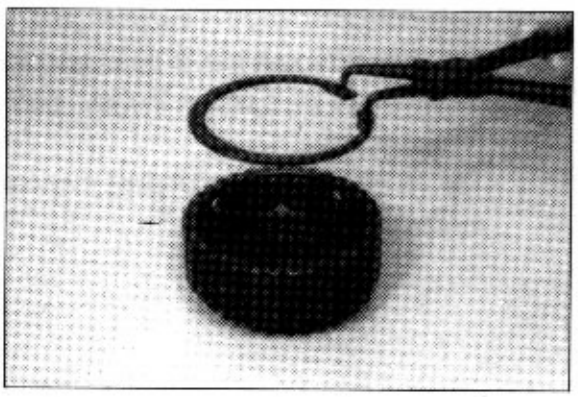
Dimension X	35.30mm
Dimension Y	-32.00mm
Difference = Piston travel	= 3.30mm

※ If the required piston travel is not obtained, correct by means of corresponding outer plate(s)
(s = 2.00mm, s = 2.50mm, s = 3.00mm).

⑥ Make thrust washer(with the two tongues in the free groove / steering knuckle hull) adhere with grease.



⑦ Engage circlip in the plate carrier.



⑧ Assemble the plate carrier upon the sun-gear shaft and fix it by means of circlip. Now, place the sun-gear shaft along with the plate carrier against shoulder(thrust washer).

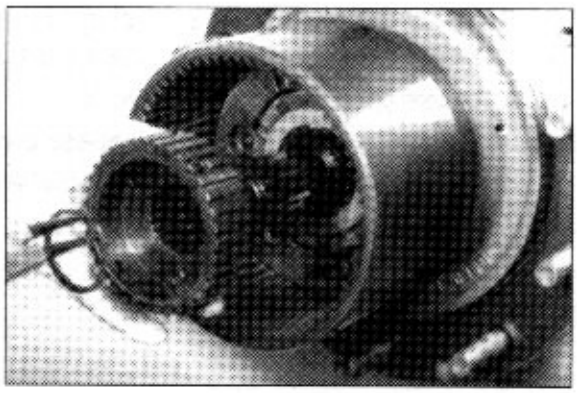


Plate arrangement

To assure a correct plate arrangement, the undulated outer plater are marked by suppression of several teeth.

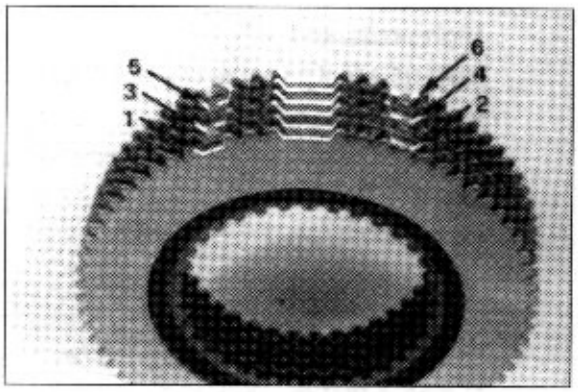
Figure ⑨ show the correct arrangement of the outer plates.

Great tooth spaces(2 teeth missing) must be central in line.

Small tooth space (1 tooth missing, see Arrows) lies alternating to the left(outer plate 1, 3 and 5), resp. to the right (outer plate 2, 4, resp. 6).

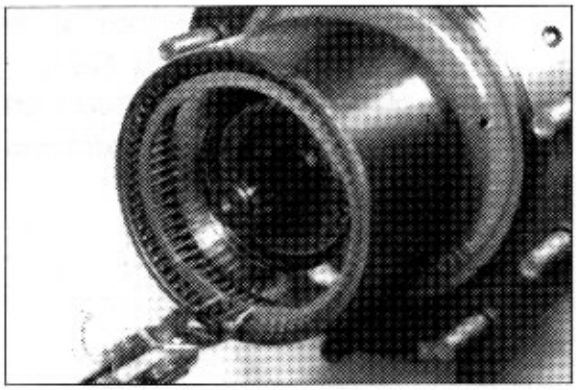
※ Between two outer plates, there must be always one coated (inner) plate installed.

⑨ Plate arrangement 5 Coated plates.



⑩ Install the plate pack according to the prescribed arrangement and fix it by means of backing plate and circlip.

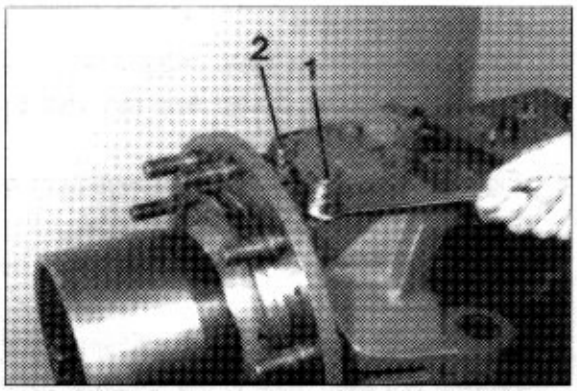
※ If outer plates of different thickness are assembled, install the thinner plates externally in the pack.



Check tightness of the brake hydraulic system

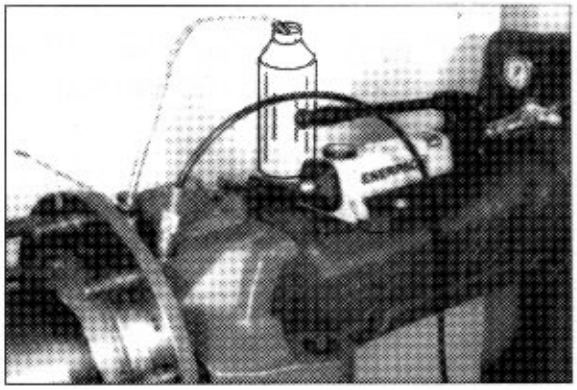
Install pressure port(1) and breather(2) (use new sealing rings).

⑪



⑫ Bleed and test the brake system.

※ Before starting the test, actuate the brake hydraulic system several times(10 times at least), and bleed it at the same time.



High-pressure test :

Build up a test pressure of p = 120 bar.
Close the shut-off valve.
During a test duration of 5 minutes, a pressure drop of max. 2% (p = 117 bar) is permitted.

Low -pressure test :

Reduce the test pressure to p = 5 bar.
During a test duration of 5 minutes, no pressure drop may occur.

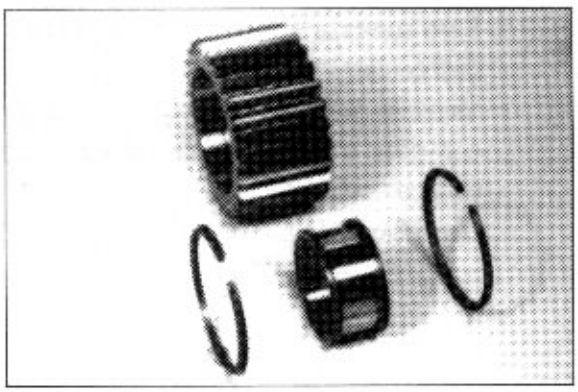
Test media :

Motor Oils SAE 10-W, corresponds to MIL-L2104 C, MIL-L 45 152, API-CC, CD, SC, SD, SE, AFT-Oils Type A-Suffic A Dexron of Ⅱ D.

(8) Planetary gears

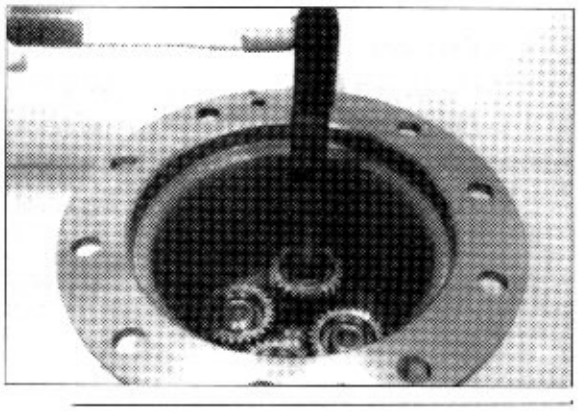
① Install components, as illustrated in the figure on the right, into the planetary gear.

※ Make cylindrical rollers adhere with grease on the bearing inner race.
Offset side(small diameter) of the angle rings is always facing the outside.

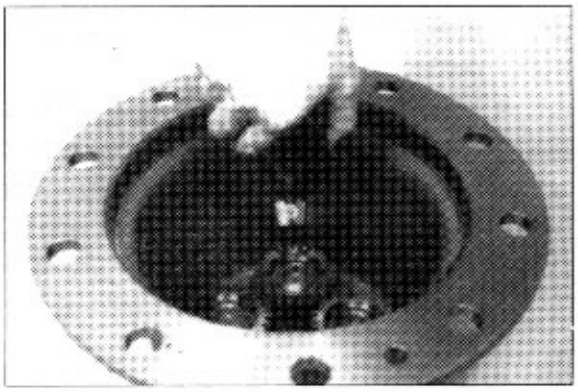


② Heat the bearing inner race of the pre-assembled planetary gear and place it against shoulder.

※ Large radius on the bearing inner race is facing the planetary carrier(downward).



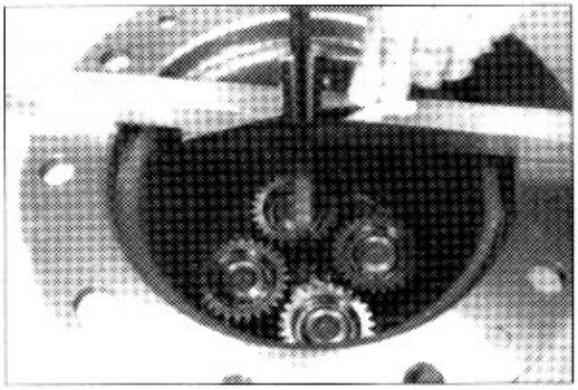
③ Fix planetary gears by means of circlips.



Adjust end play of the Sun-gear shaft 0.3-0.6mm (Figure ④-⑦)

④ Determine dimension I from the flange-mounted surface / planetary carrier to the locating face / thrust washer.

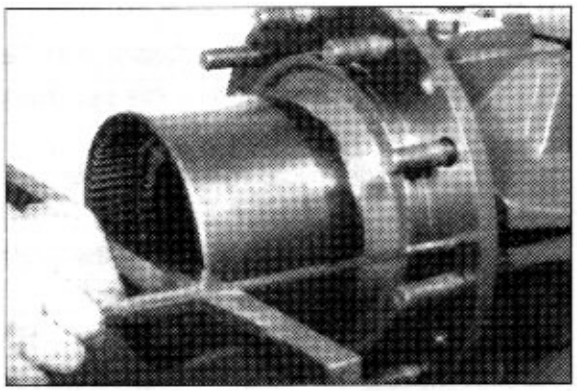
※ Dimension I e.g. : 199.10mm



⑤ Slide sun-gear shaft, resp. plate carrier in until contact is obtained.

※ Measure dimension Ⅱ from the end face / sun-gear shaft to the flange-mounted surface / hub

Dimension Ⅱ e.g. : 196.60mm

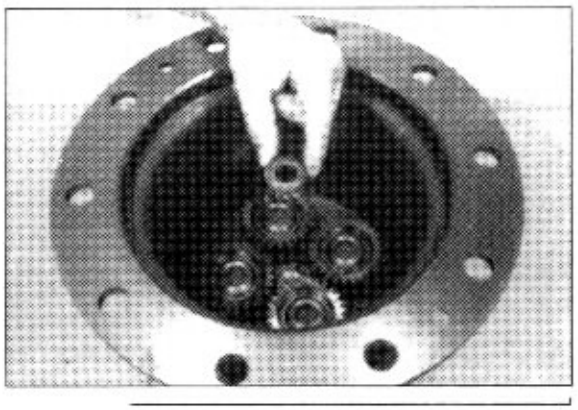


Example

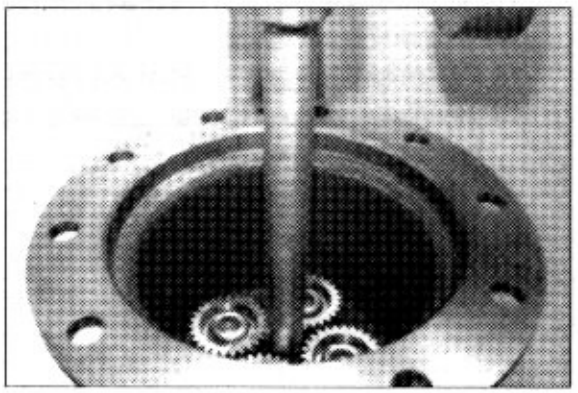
Dimension Ⅰ	199.10mm
Dimension Ⅱ	-199.60mm
Difference	= 2.50mm
Required end play e.g.	- 0.50mm
Difference = Thickness of thrust washer e.g. s =	2.00mm

⑥ Insert thrust washer in the planetary carrier.

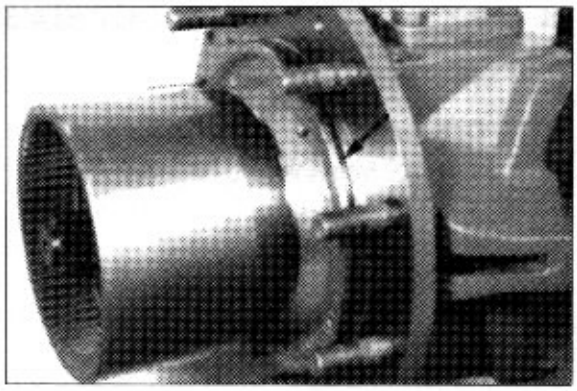
※ If the thrust washer has only one phosphatized surface, it must be installed with this surface facing the sun-gear shaft.



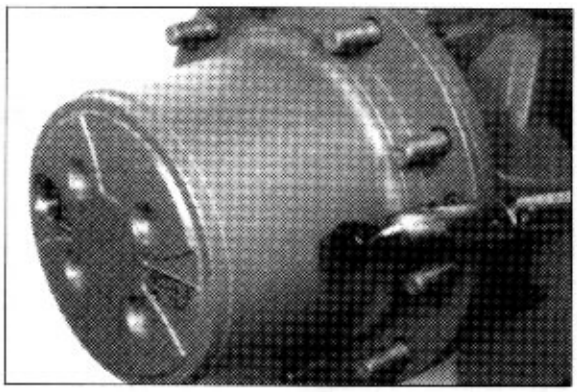
⑦ According to the version - press in thrust washer - resp. in case of an unfavorable tolerance disposition, caulk(4 points).



⑧ Grease the O-ring and insert it in the annular groove of the hub.

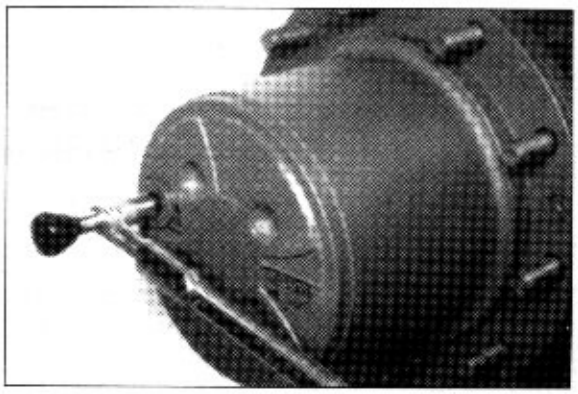


⑨ Assemble the planetary carrier and fasten it by means of socket head screws.
Tightening torque :
M10 / 8.8 - 3.3kg · m (23.9 lb · ft)
M12 / 8.8 - 5.6kg · m (40.5 lb · ft)



⑩ Employ new O-ring for the screw plug and screw it in.

※ Before the axle is put into service, pay attention to the lubrication and maintenance instructions, page 204.

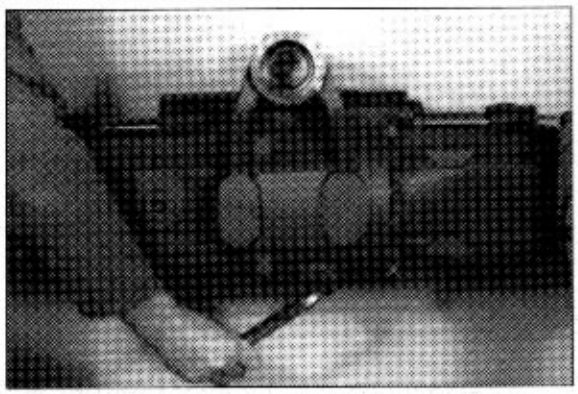


4. DRIVE UNIT / DIFFERENTIAL DISASSEMBLY AND ASSEMBLY

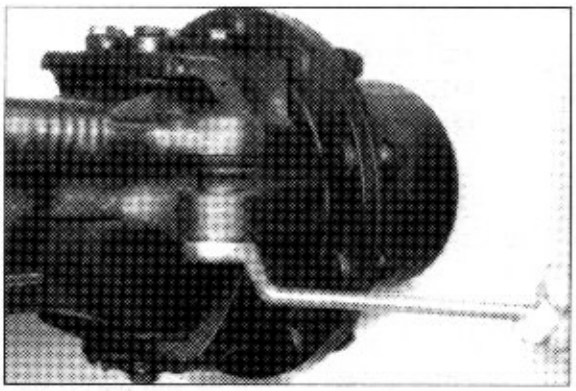
1) DISASSEMBLY

(1) Differential

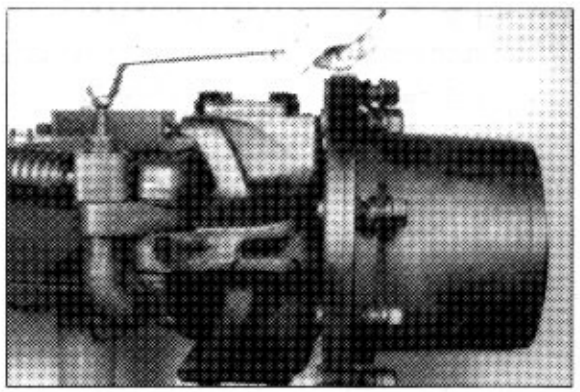
① Drain oil from the axle housing.



② Remove cotter pin, loosen castle nut for some threads.

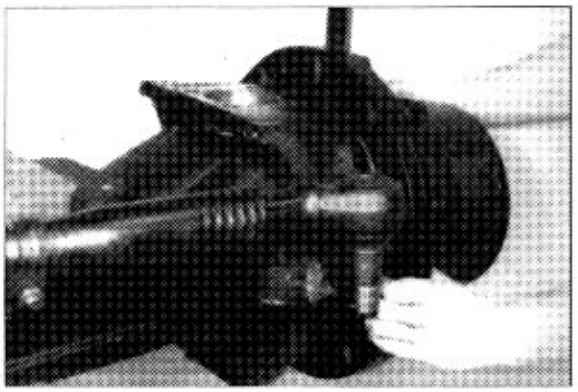


③ Loosen tie rod by means of ejection tool. Now, screw off castle nut and unhook tie rod.

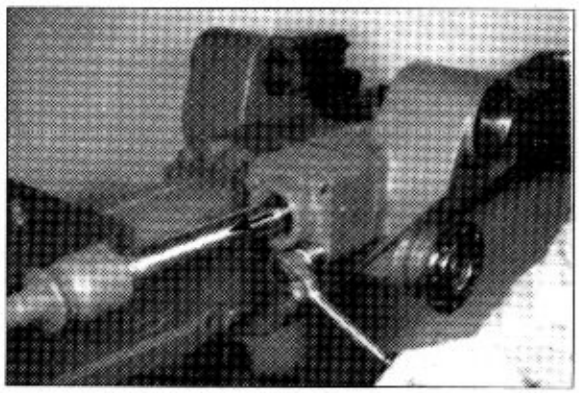


④ Remove bearing pin and separate the two final drives from the axle housing.

※ Pay attention, on the upper bearing pin, to the released shim.

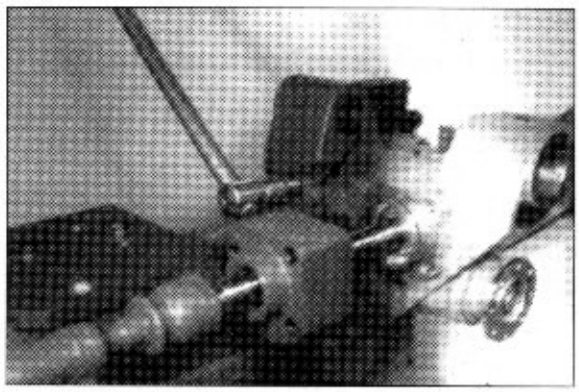


⑤ Loosen hex head screws of the guide. Displace guide on the piston rod(see Arrows).

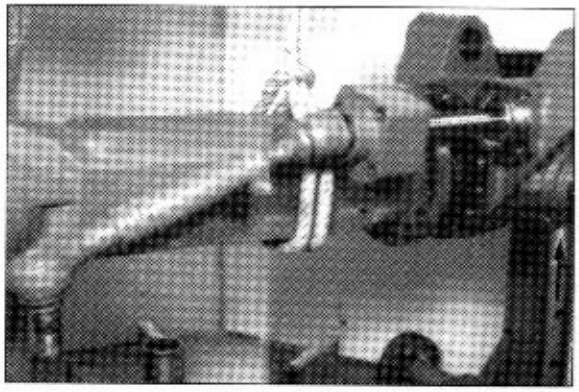


⑥ Loosen hex head screws and reamed bolt(see Arrow).

※ If a ground anchoring of the assembly car is not possible, the axle housing part Ⅰ must be secured by means of a support(see Figure ⑦ -Arrow).

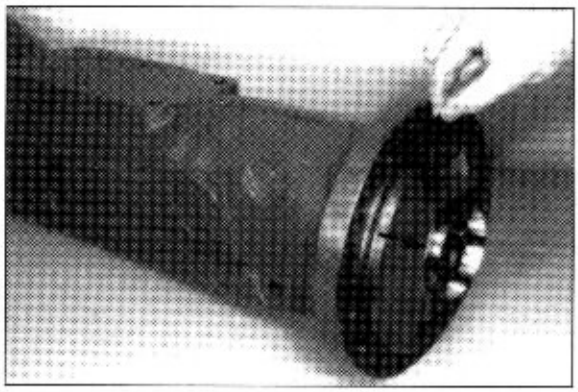


⑦ Separate axle housing part Ⅱ from part Ⅰ.

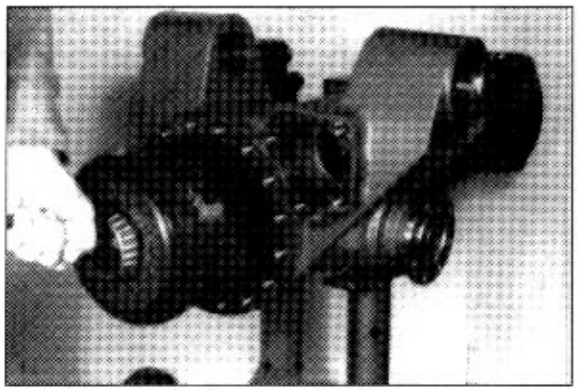


⑧ Remove O-ring and drive the bearing outer race(see Arrow) out of the axle housing bore.

※ Pay attention to the released shim.

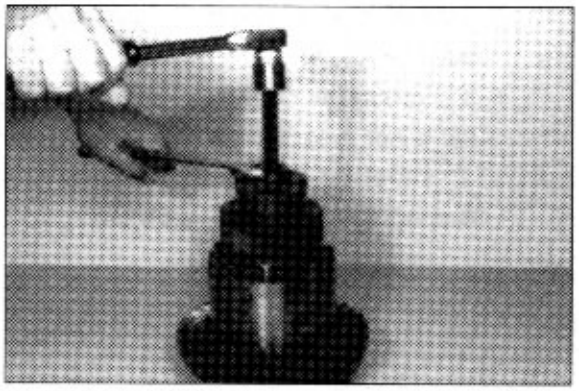


⑨ Lift the complete differential case out of the axle housing.

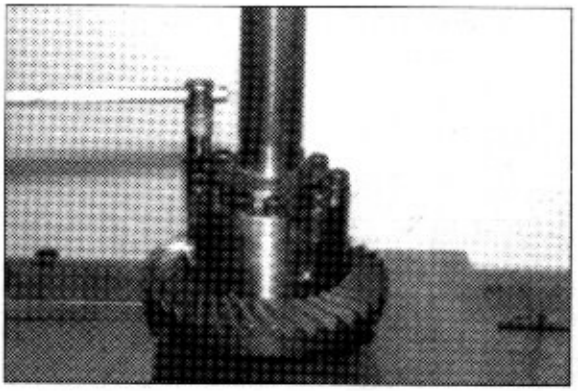


(2) Differential

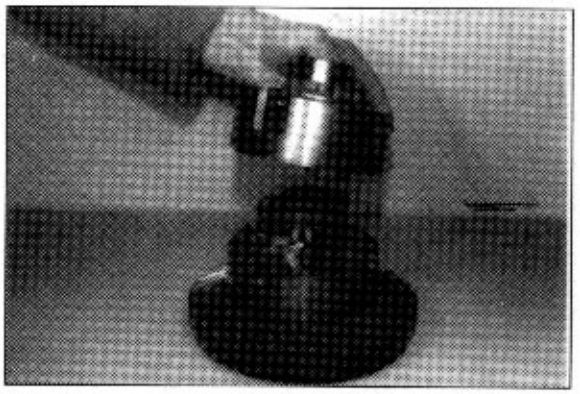
① Pull off the two tapered roller bearings.



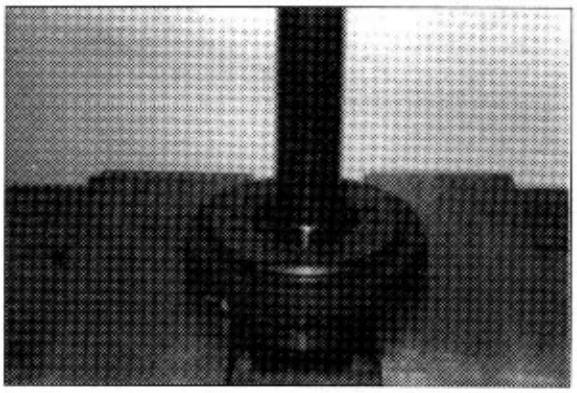
② Loosen socket head screws.



③ Take off differential case half / part Ⅱ and remove the released components.

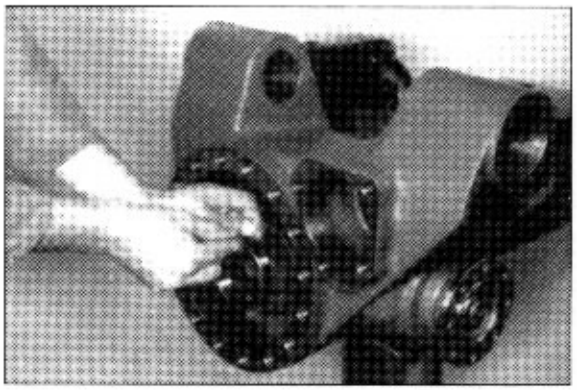


④ Press crown wheel from differential case half part Ⅰ.



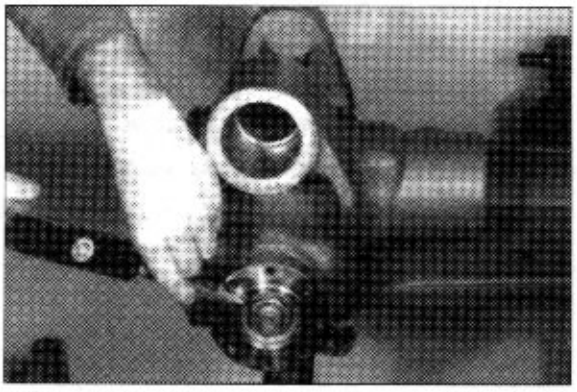
⑤ Remove bearing outer race from axle housing / part Ⅰ.

※ Pay attention to the released shim.

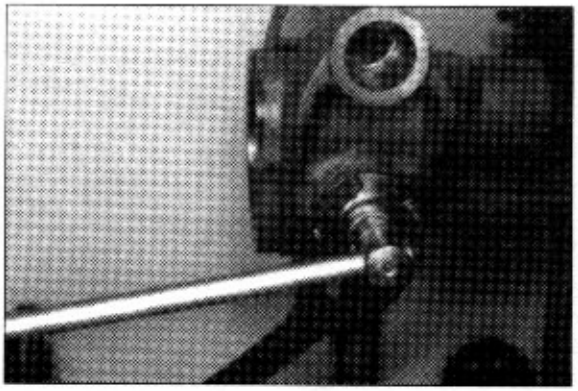


(3) Remove drive pinion

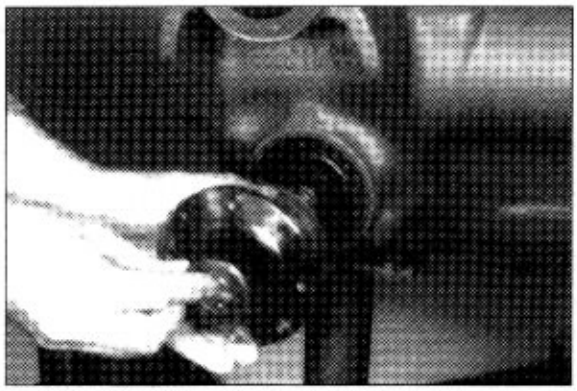
① Remove lock plate.



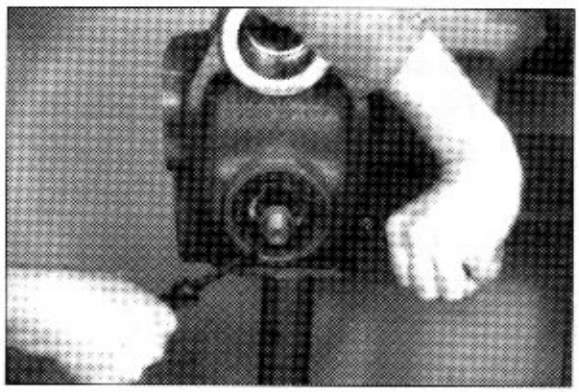
② Loosen hex nut.



③ Pull off disk and drive flange.

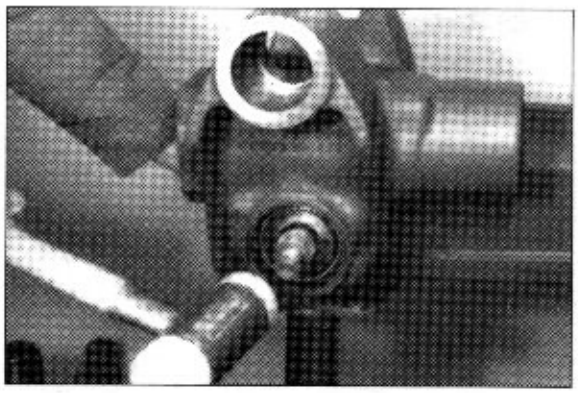


④ Pry out shaft seal.

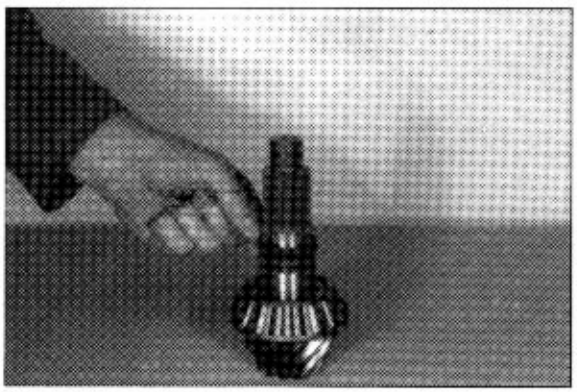


⑤ Remove drive pinion.

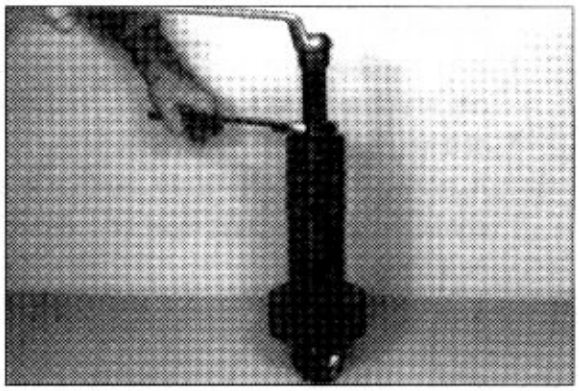
※ If the pinion bearing should not be renewed, pay attention that during the driving out of the drive pinion, the outer bearing inner race is always held against shoulder to avoid this damage of the bearing.



⑥ Remove spacing ring.

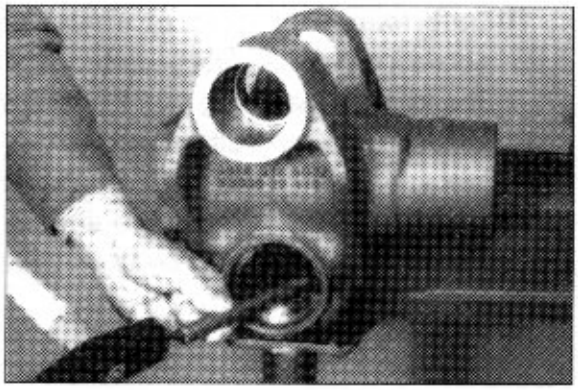


⑦ Pull bearing inner race from drive pinion.

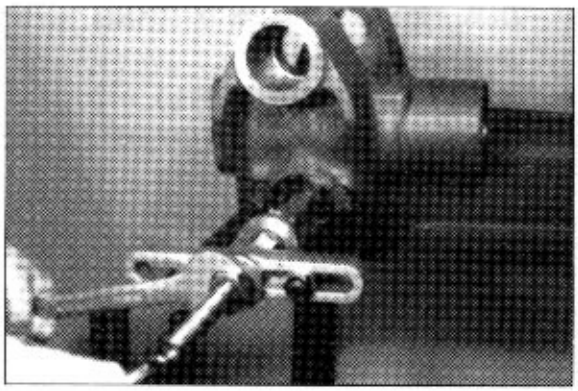


⑧ Drive the bearing outer race out of the inner bearing bore.

※ Pay attention to the released spacing washer.



⑨ Pull the bearing outer race out of the outer bearing bore.



2) Reassembly

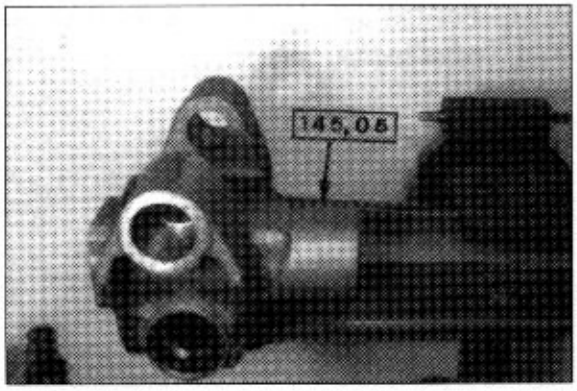
※ If a complete crown wheel set is installed, pay attention to the same mating numbers of drive pinion and crown wheel.
If crown wheel or drive pinion are damaged, the two parts must be renewed as a set.

(1) Determine thickness of shim - to obtain a correct contact pattern

※ The following measuring operations have to be carried out with utmost precision.
Inexact messurings bring along a faulty contact pattern and require another disassembly and reassembly of the drive pinion.

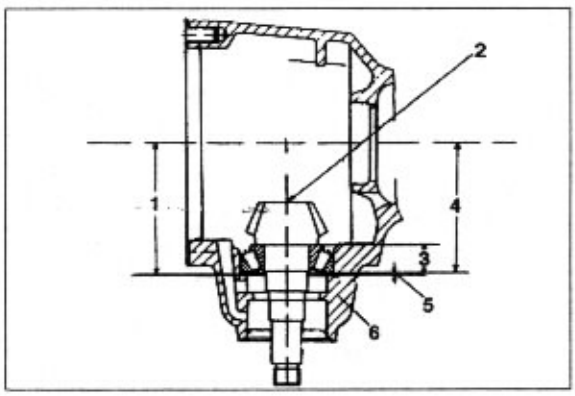
Determination of shim thickness "with" given dimension I
(on the axle housing / part I)

① Read dimension I from the axle housing / part I .
Dimension I e.g. : 145.05mm

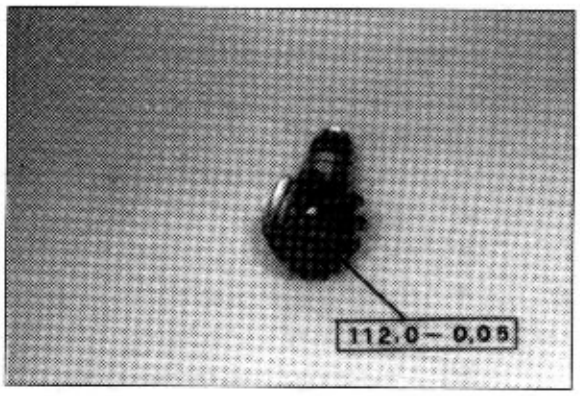


② Reference Draft

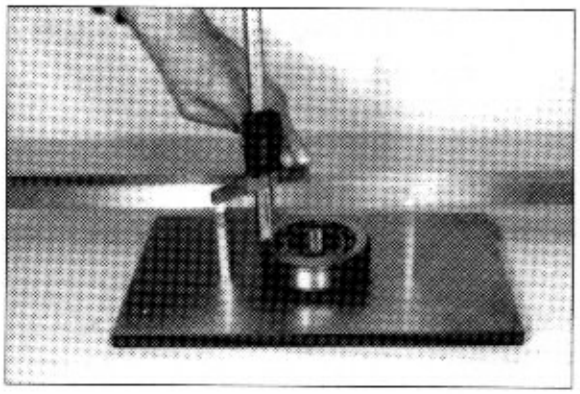
1 Dimension I
2 Dimension II (Pinion dimension)
3 Dimension III (Bearing width)
4 Dimension X
5 Shim
6 Axle housing



③ Read dimension Ⅰ (Pinion dimension).
Dimension Ⅰ e.g.(112.0 $^{-0.05}$) = 111.95mm



④ Determine dimension Ⅲ (Bearing width).
Dimension Ⅲ e.g. : 32.05mm



Example A

Dimension Ⅰ	111.95mm
Dimension Ⅲ	+32.05mm
Gives Dimension "X"	144.00mm

Example B

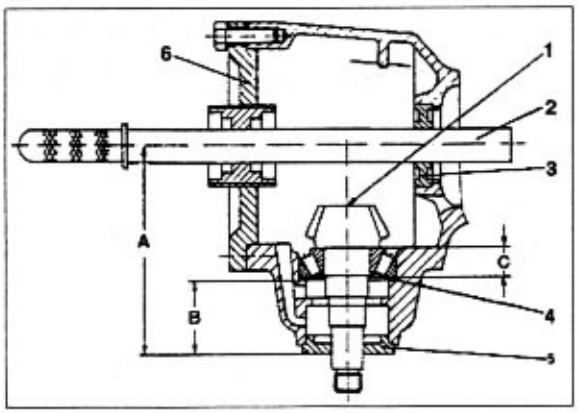
Dimension Ⅰ	145.05mm
Dimension Ⅱ	-144.00mm

Difference =Thickness of shims = 1.05mm

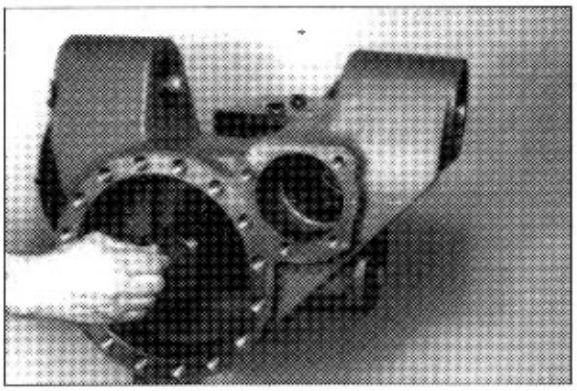
Determination of shim thickness "without" definition of dimension I , (on the axle housing / part I)

⑤ Reference Draft

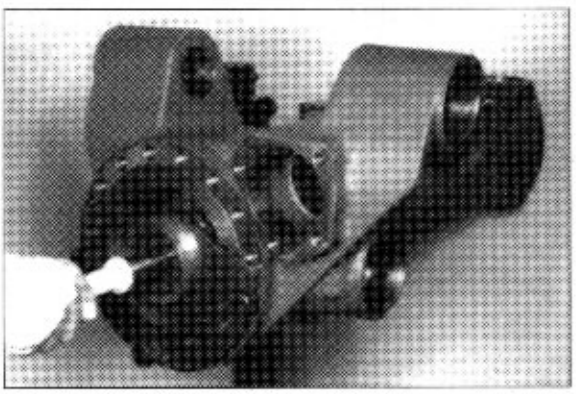
1 Pinion dimension and mating number
2 Measuring shaft
3 Adjusting piece
4 Shim
5 Gauge ring
6 Measuring cover, centering ring



⑥ Insert adjusting piece(3) in the bore of axle housing / part I (Differential bearings).

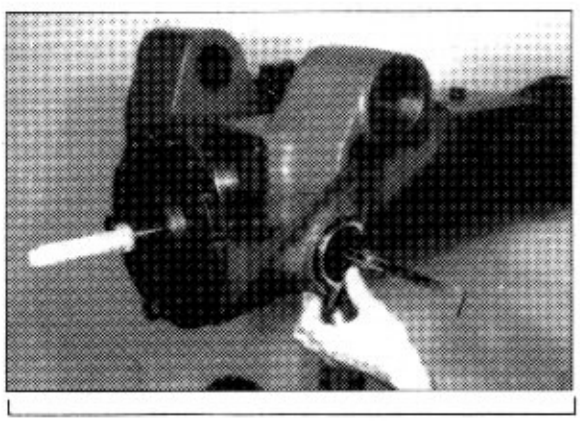


⑦ Push centering ring upon measuring cover(6), place it against shoulder and fasten it by means of hex head screws. introduce measuring shaft(2) into the bore of the adjusting piece(3) until the location is obtained.

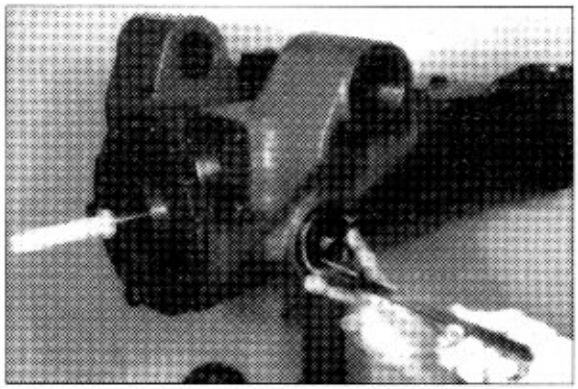


⑧ Position gauge ring(5) on the locating face of the outer bearing inner race against shoulder.
Determine dimension A from the plane surface of the gauge ring(5) to the center/measuring shaft(2) (see Draft ⑤).

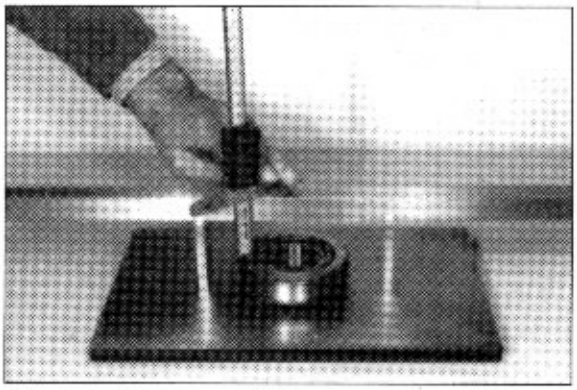
Determined dimension e.g.	208.85mm
1/2 ⌀ mensuring shaft	+15.00mm
Gives dimension "A" e.g.	223.85mm



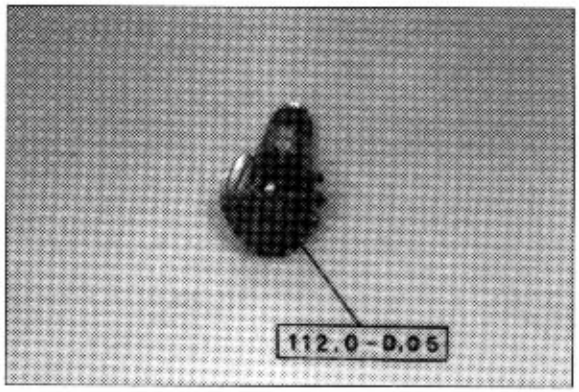
⑨ Measure dimension B from the plane surface / gauge ring(5) to the locating face of the inner bearing outer race(see Draft ⑤).
Dimension B e.g. : 78.80mm
Now, remove measuring device.



⑩ Determine dimension C (Bearing width).
Dimension C e.g. : 32.05mm



⑪ Read pinion dimension(1).
Pinion dimension e.g.
(112.0 $^{-0.5}$) = 111.95mm

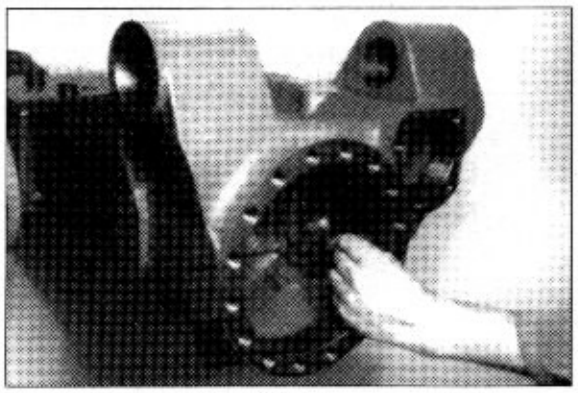


Example

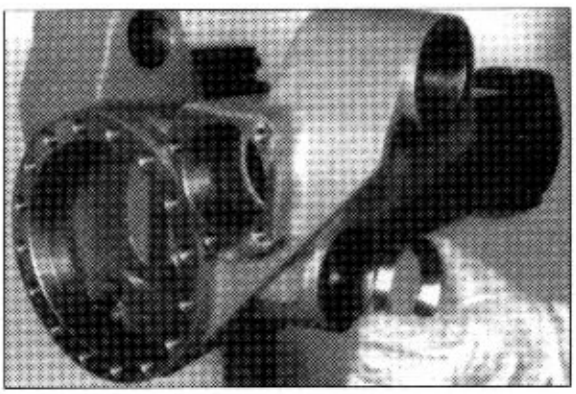
Dimension A	223.85mm
Dimension B + Dimension C	
(78.80 + 32.05)	- 110,85mm
Gives	113.00mm
Pinion dimension	- 111.95mm
Difference = Shim thickness	s = 1.05mm

(2) Install drive pinion

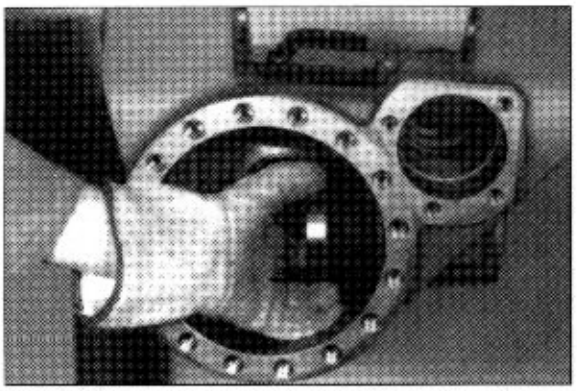
① Insert determined shim e.g. s = 1.05mm.



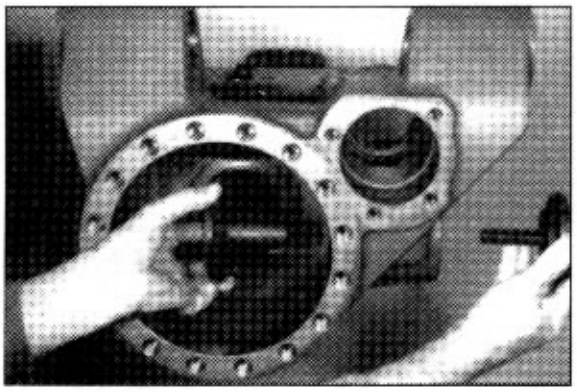
② Undercool and insert outer bearing ou race.



③ Undercool and insert inner bearing ou race.

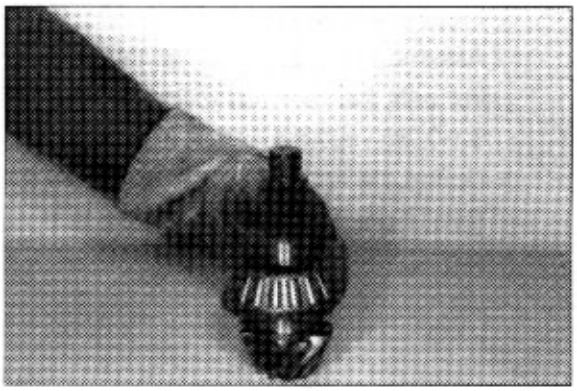


④ Position the two bearing outer rac against shoulder, using special device.



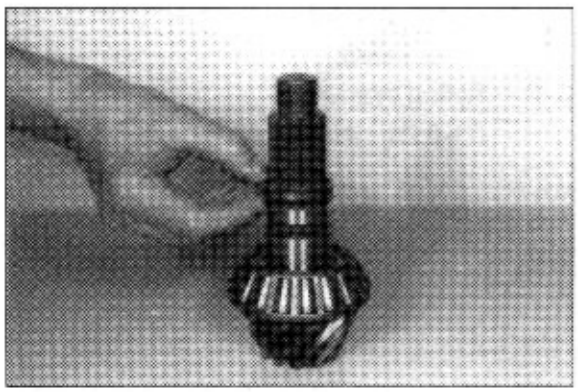
⑤ Heat tapered roller bearing and replac
firmly against shoulder.

※ Reset the bearing after the cooling dov



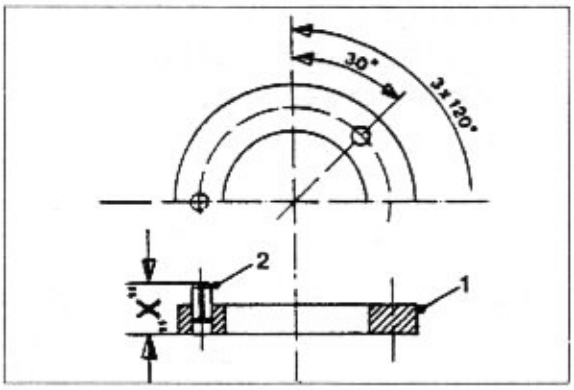
Adjust rolling moment of the drive pinion bearing 0.1- 0.2kg · m(0.7-1.4 lb · ft)

⑥ Assemble gauge ring.
Shape and description of the gauge ring, see Draft ③.

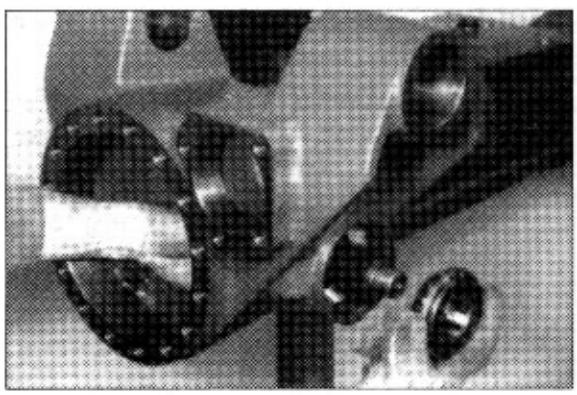


⑦ Reference Draft
1 Gauge ring
2 Roll pins(3EA)

※ Dimension "X" = Thickness of the spacing ring.

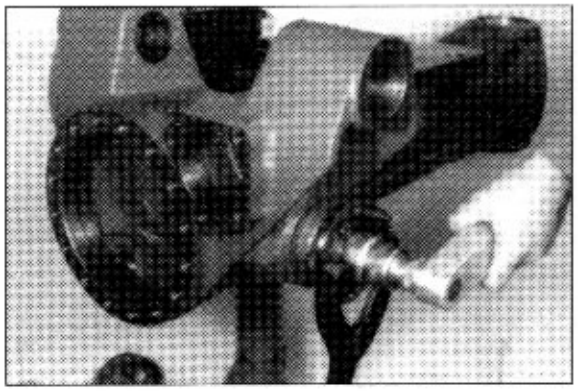


⑧ Insert pre-assembled drive pinion and assemble the heated bearing inner race until contact is obtained.

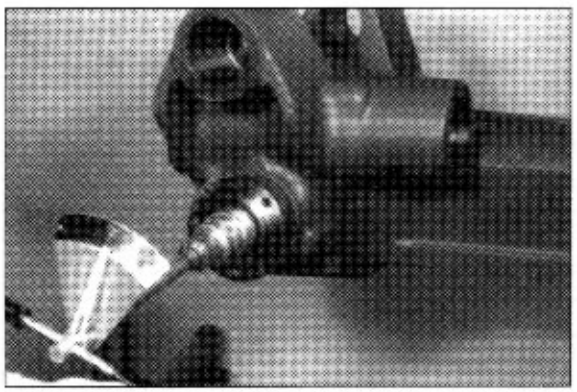


⑨ Install drive flange.
Assemble the disk and tighten the hex nut until the required rolling moment of 0.1-0.2kg · m(0.7-1.4 lb · ft) is obtained.

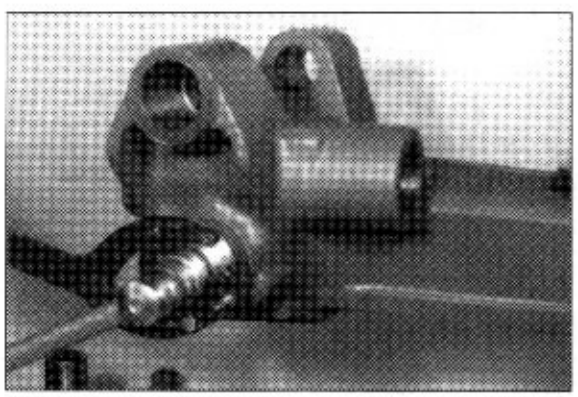
※ During the tightening, make several full revolutions of the drive pinion in both senses.



⑩ Check the rolling moment(aim at the upper value).
Rolling moment :
0.1-0.2kg · m(0.7-1.4 lb · ft)

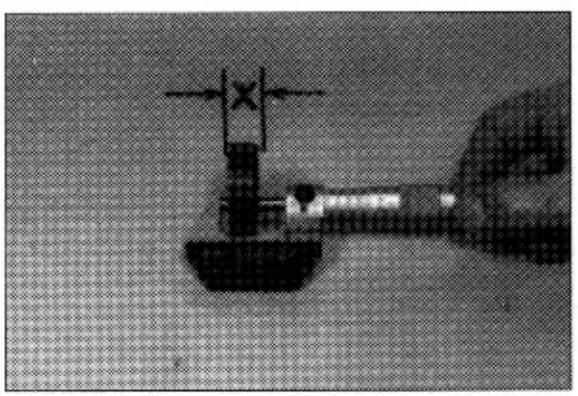


⑪ Loosen hex nut.
Pull off disk and drive flange.
Remove drive pinion again.

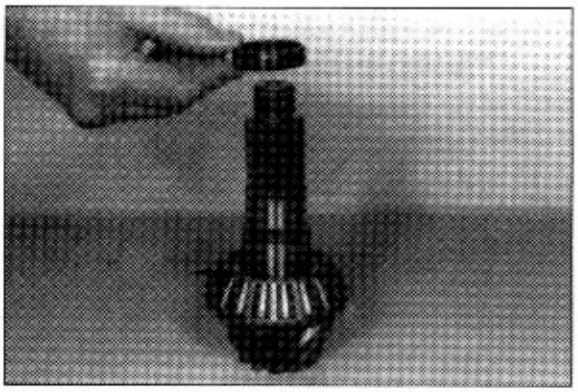


⑫ Remove gauge ring from drive pinion and determine dimension "X"
(see also Draft ⑦).
Dimension "X" e.g. s = 11.45mm

※ Dimension "X" corresponds to the thickness of the spacing ring to be installed.

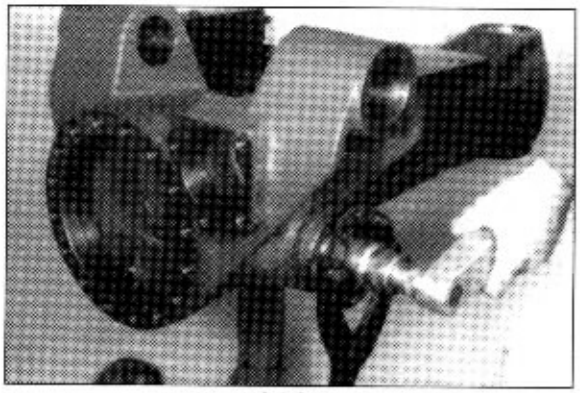


⑬ Assemble instead of the gauge ring the determined spacing ring
(e.g. s = 11.45mm).

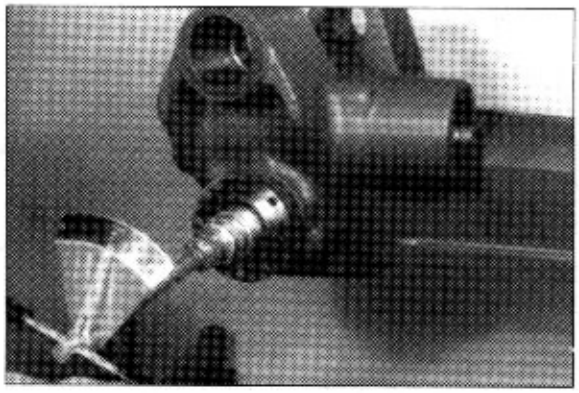


⑭ Install pinion again.
Assemble drive flange and disk and tighten hex nut.
Tightening torque : 43.8kg · m(316.8lb · ft)

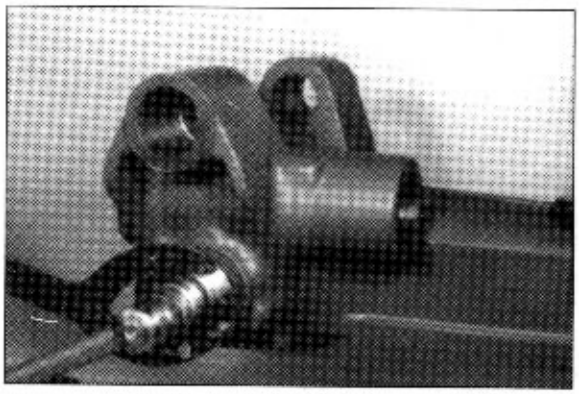
※ During the tightening, make several full revolutions of the drive pinion in both senses.



※ Check rolling moment again.
If the required rolling moment
(0.1- 0.2kg · m) is not obtained, correct by means of a corresponding spacing ring.

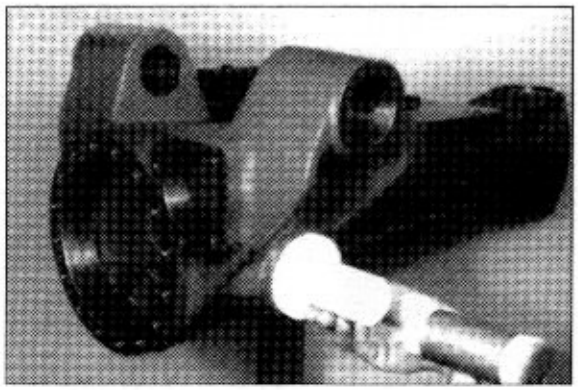


⑮ Loosen hex nut.
Pull off disk and drive flange.

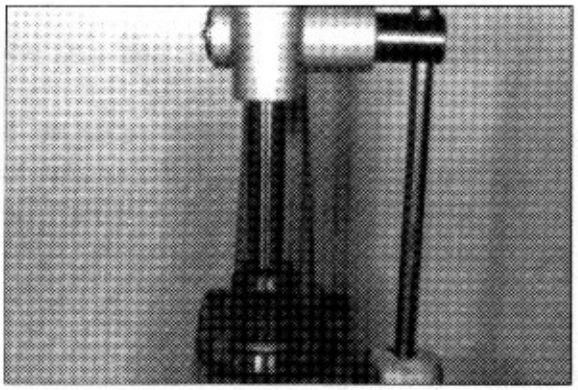


⑯ Install shaft seal and grease it in the zone sealing lip / dust lip.

※ By using the prescribed driver, the exact installation depth is obtained.
If the outer diameter of the shaft seal is
a) Rubber-coated-wet with spirit / water mixture(1:1)
b) Metallic-cover with sealing compound loctite(Type-No. 574).

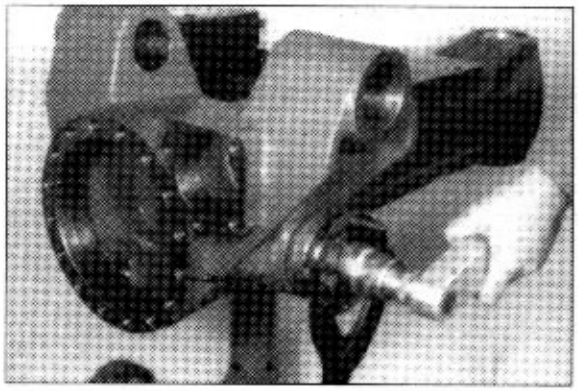


⑰ Press shield upon the drive flange until contact is obtained, if necessary, insert hex head screws in the drive flange prior to this step.



⑱ Assemble drive flange and disk and fasten finally by means of hex nut.
Tightening torque : 43.8kg · m(316.8lb · ft)

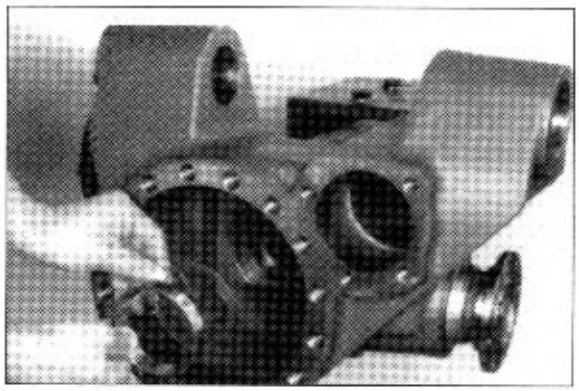
※ Carry out securing of the hex nut-after the contact pattern has been taken.



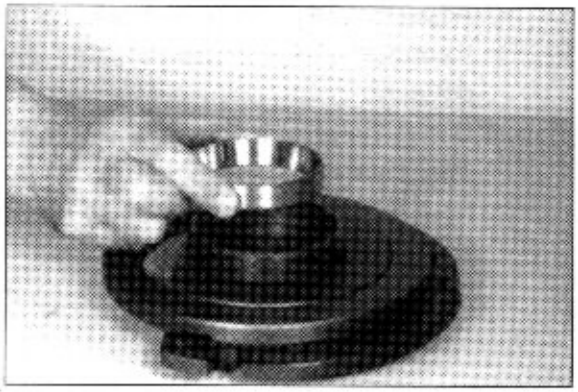
(3) Determine and adjust backlash of the crown wheel set and bearing preload of the differential

① Backlash : 0.15-0.25mm
Bearing rolling moment :
0.1- 0.2kg · m(0.7-1.4lb · ft)

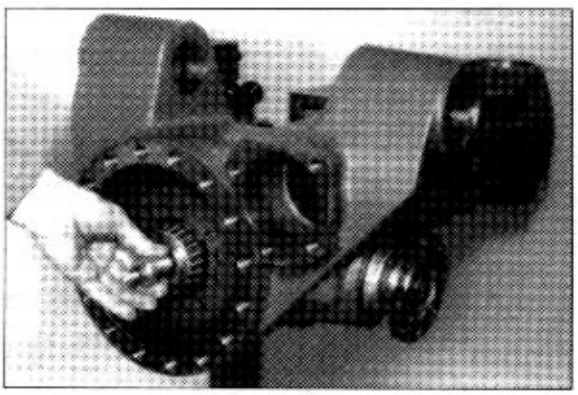
② Insert shim e.g. s = 170mm(empirical value) in the bearing bore(axle housing / part Ⅰ) and install subsequently bearing outer race.



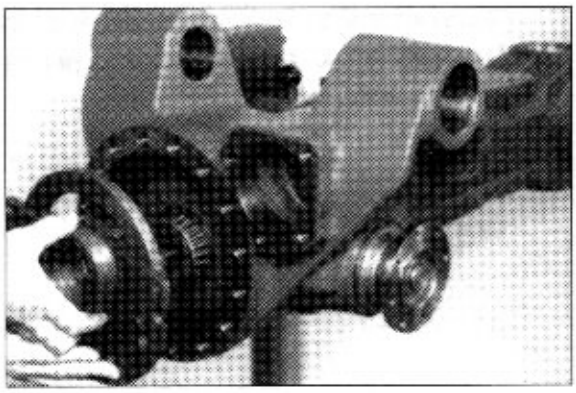
③ Insert crown-wheel side bearing outer race in the measuring device.



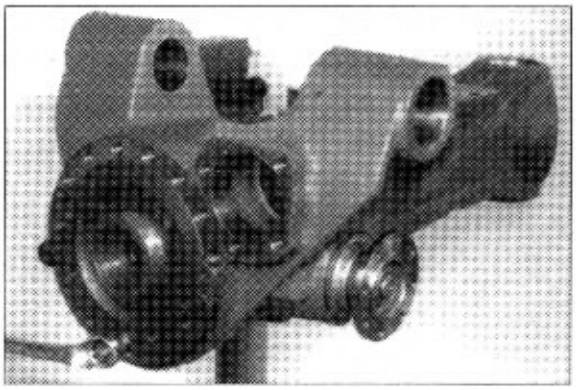
④ Insert differential in the axle housing and install clamping segment into the stub shaft bore of the differential.



⑤ Fix the differential by means of measuring cover.

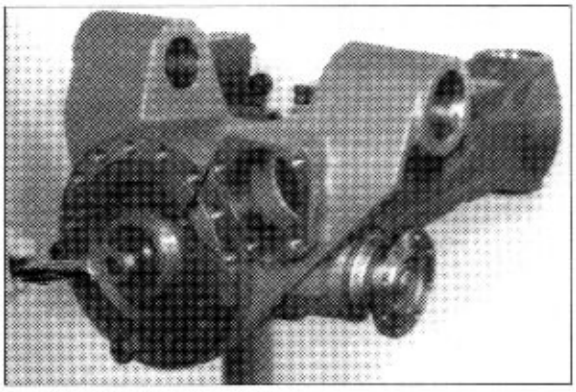


⑥ Fasten special device by means of hex head screws.



⑦ Adjust the differential by application of the threaded spindle free of play and pressure.

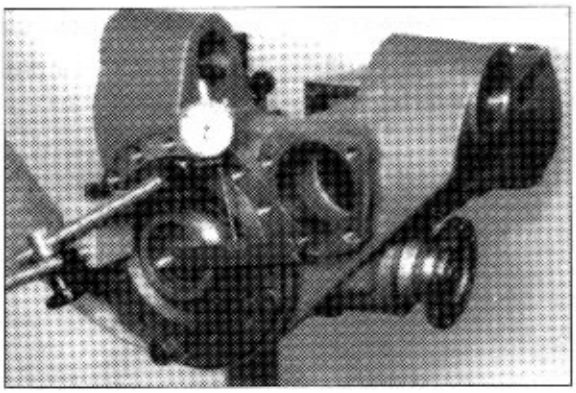
※ During the adjustment, make several full revolutions of the drive pinion.
Now, fix the threaded spindle by means of locking screw(see Arrow).



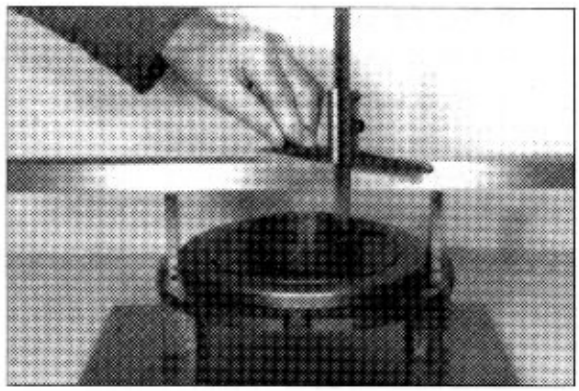
Check Backlash

⑧ Mount straightedge on the clamping segment. Apply dial indicator right-angled(position = outer diameter / crown wheel) on the straight edge and check backlash.
Backlash : 0.15-0.25mm

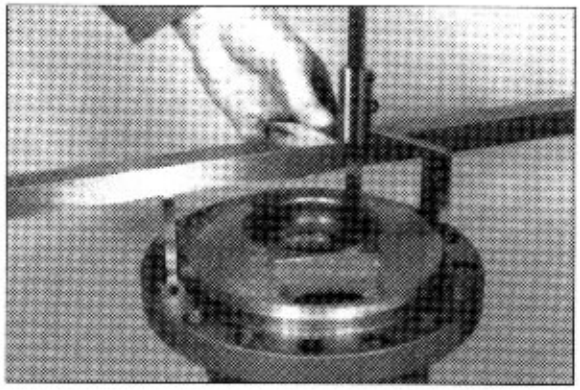
※ In case of deviations from the required backlash, correct by means of a corresponding shim(see Figure ②).



⑨ After termination of the backlash adjustment, remove the measuring device again.
Determine dimension Ⅰ from the flange-mounted surface to the locating face / bearing outer race.
Dimension Ⅰ e.g. : 16.55mm



⑩ Measure dimension Ⅱ from the flange-mounted surface of the axle housing / part Ⅱ to the locating face/ bearing outer race.
Dimension Ⅱ e.g. : 13.90mm
※ With various axle types, the dimension Ⅱ can be greater than dimension Ⅰ .
Change the example accordingly.

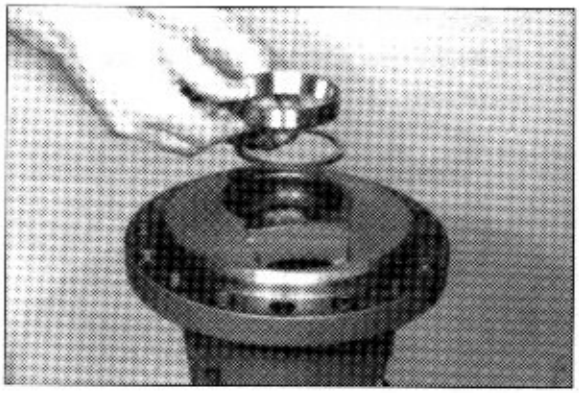


Example

Dimension Ⅰ	16.55mm
Dimension Ⅱ	-13.90mm
Difference	2.65mm
Required bearing preload	+0.10mm
Gives shim thickness	s = 2.75mm

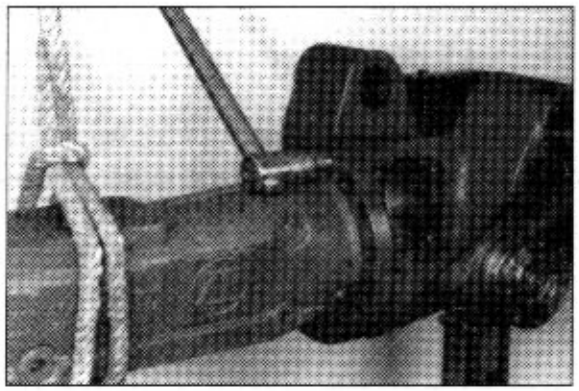
※ With a bearing preload of 0.10mm, the required rolling moment of 0.1-0.4kg · m is obtained.

⑪ Insert the determined shim(s) e.g. s = 2.75mm into the axle housing / part Ⅱ and install subsequently the bearing outer race until contact is obtained.



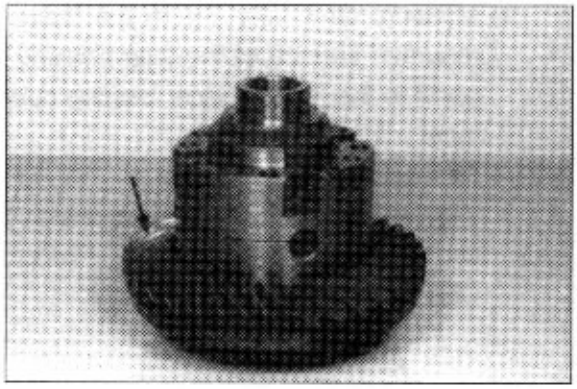
(4) Check contact pattern

① Wet some tooth flanks of the crown wheel with gear-marking compound.
Screw in two adjusting screws.
Fasten axle housing/ part Ⅱ provisionally by means of hex head screws.
Roll the crown wheel several times to and fro over the drive pinion.

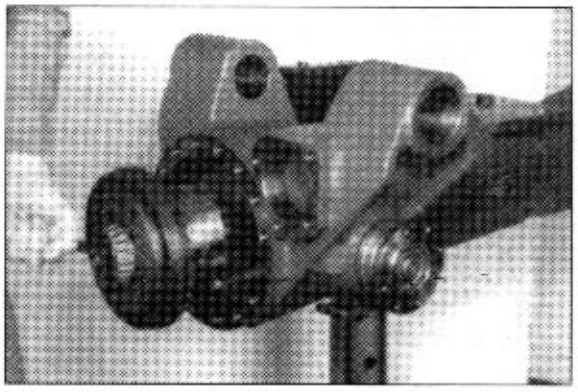


② Remove differential.

※ In case of a greater contact pattern deviation, a measuring error has been made during the determination of the shim(Figure ①, page 244), which must be absolutely corrected.

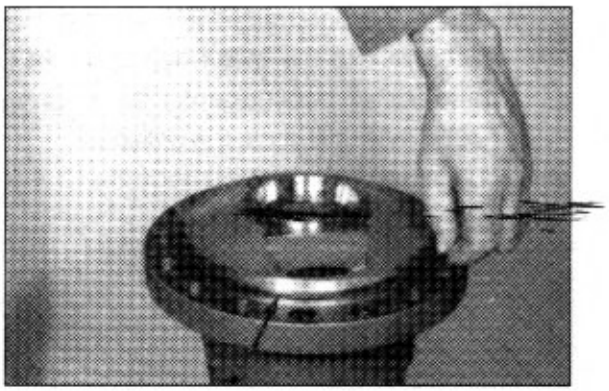


③ Install differential again.

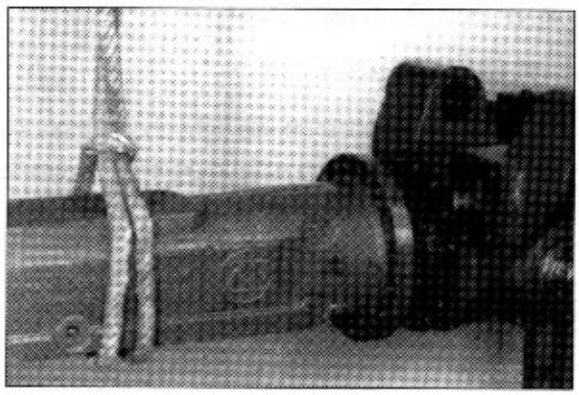


(5) Axle bolting

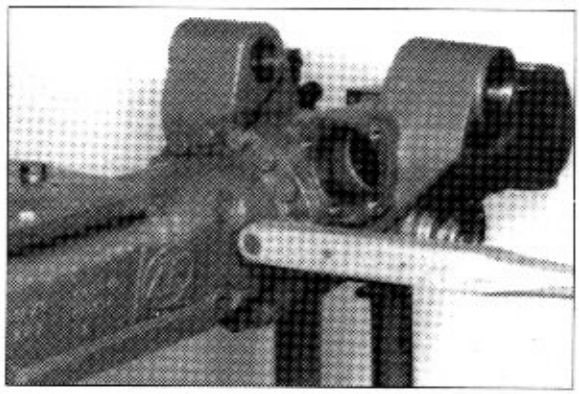
① Insert new O-ring in the annular groove (arrow).



② Combine the axle housing / part Ⅱ with part Ⅰ.

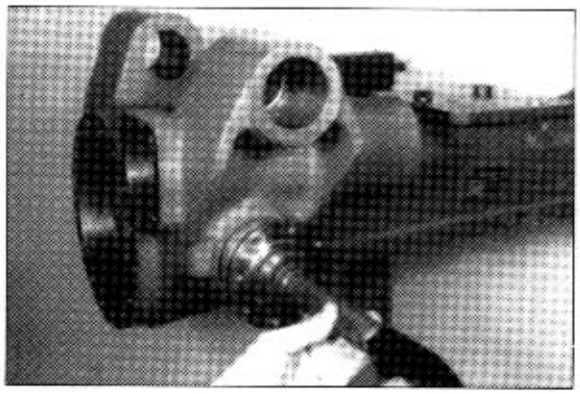


③ Fasten axle housing / part Ⅱ by means of hex head screws(with washers).
Pay attention to the installation position of the reamed bolt(1EA), see Arrow.
Tightening torque : 41.8kg · m(302.3lb · ft)

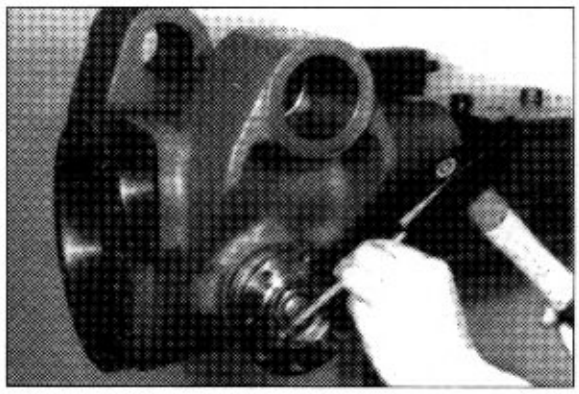


Secure drive pinion bolting

④ Drive lock plate upon the hex nut.



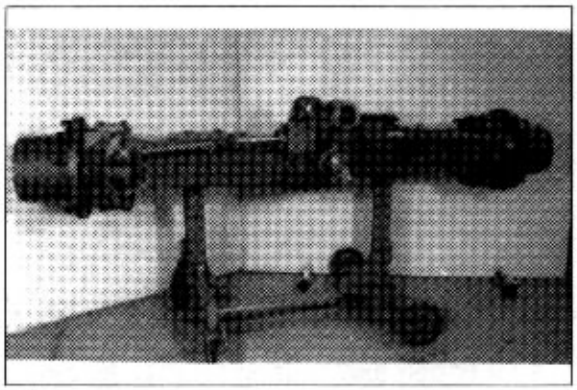
⑤ Caulk lock plate.



3. STEERING ASSEMBLY

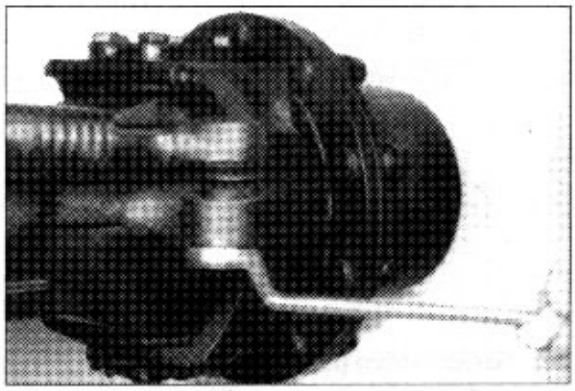
1) DISASSEMBLY

The illustration on the right shows the total view of the axle with integrated hydraulic steering assembly.

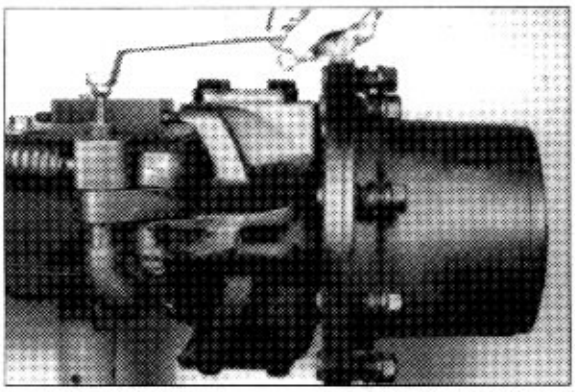


(1) Remove tie rod

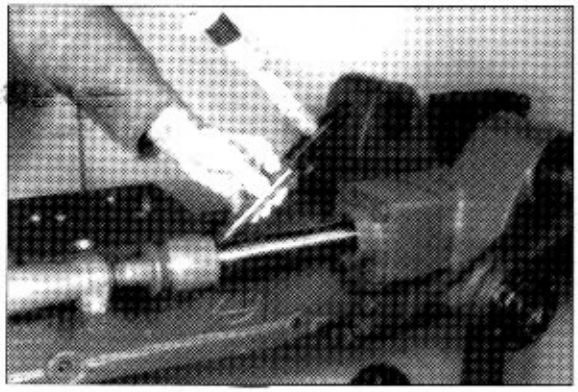
① Remove cotter pin, loosen castle nut for some threads.



② Loosen tie rod by means of ejection tool. Now, unscrew castle nut and unhook tie rod.

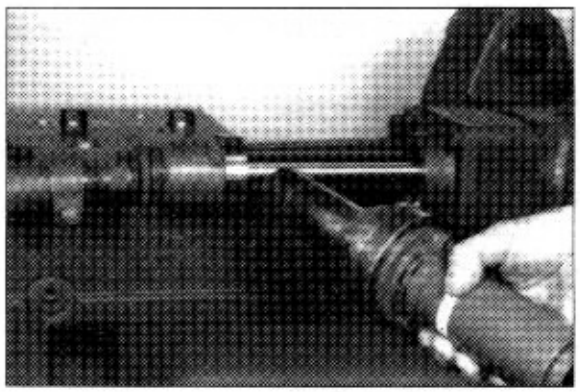


③ If necessary(according to the version), unlock the bolting piston rod / tie rod.

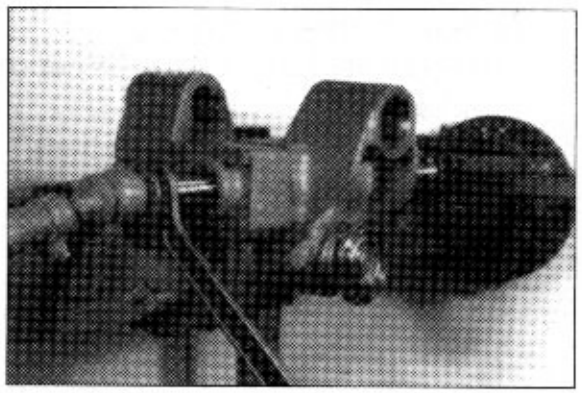


Version-tie rod "with" stop ring for the steering lock

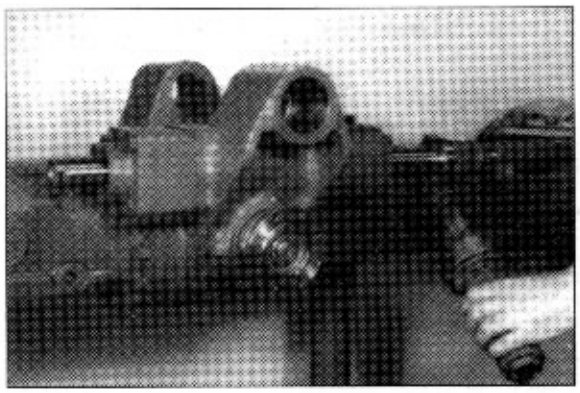
④ Heat piston rod in the zone of the bolting piston rod / thrust bearing.



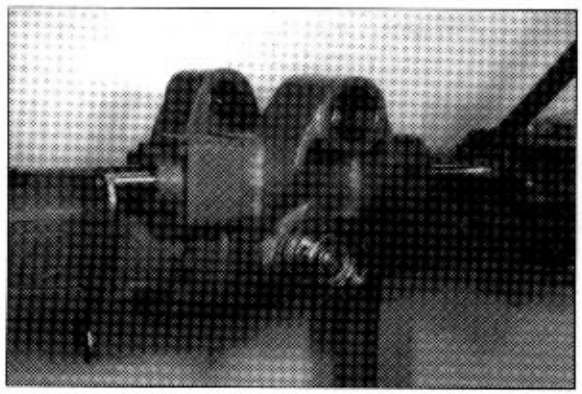
⑤ Loosen bolting and separate the complete tie rod from the piston rod. Now, pull off stop ring.



⑥ Heat the second bolting of piston rod / axial joint.



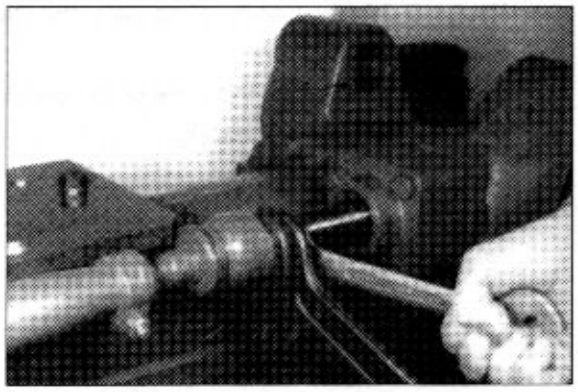
⑦ Remove second tie rod and stop ring.



Version-tie rod "without" stop ring for the steering lock

⑧ Heat bolting piston rod / axial joint.
Loosen bolting and remove complete tie rod.

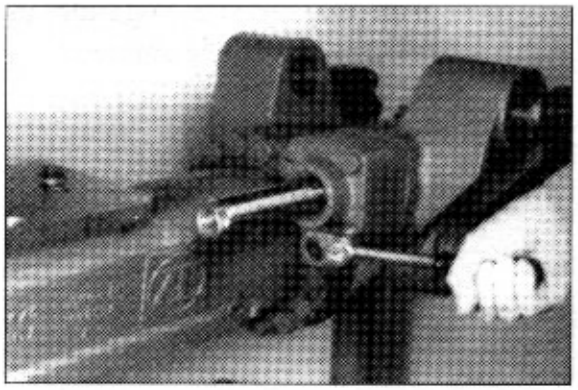
※ Disassemble second tie rod accordingly.



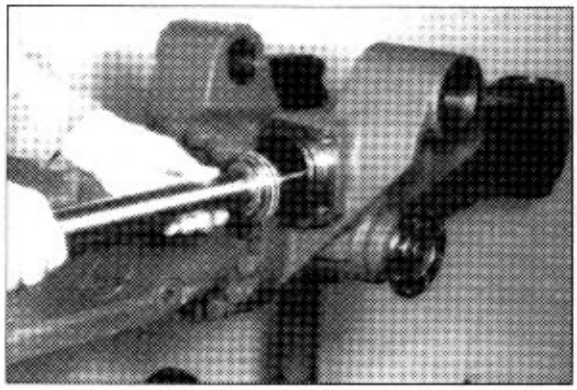
(2) Remove piston and cylinder

① Loosen hex head screws and pull off guide Ⅱ.
If necessary, remove sealing elements.

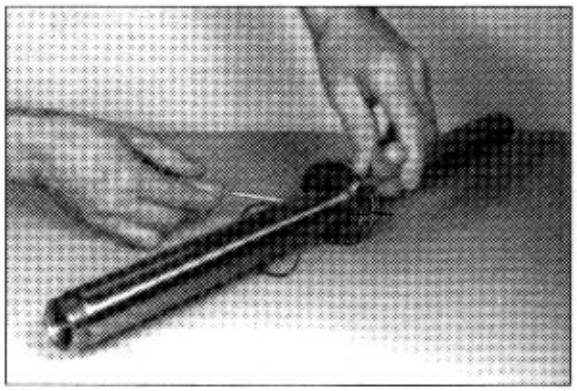
※ Pay attention to the released shim.



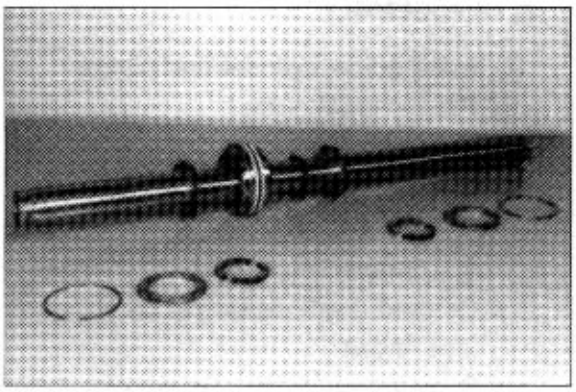
② Pull piston rod out of the cylinder.



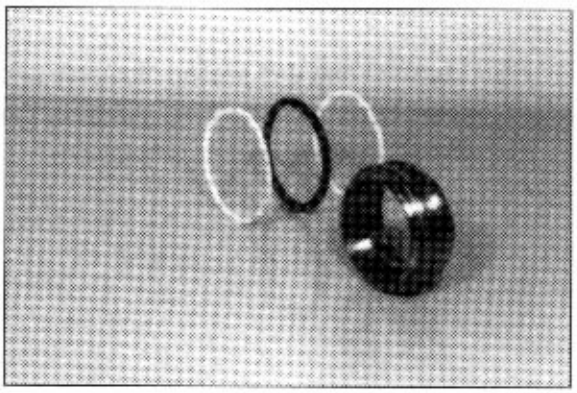
③ Remove snap ring, circlip and split ring.



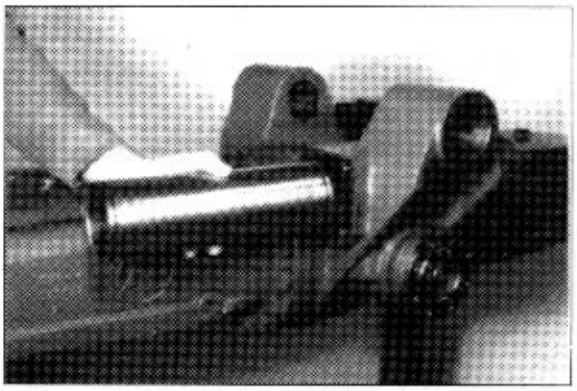
④ Remove piston and remaining components.



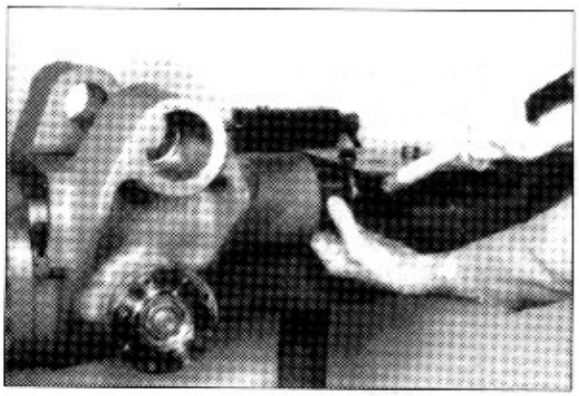
⑤ Take scraper rings and sealing ring from the piston.



⑥ Pull cylinder out of the housing.
Remove O-rings.



⑦ Drive guide I out of the housing.
If necessary, remove sealing elements.



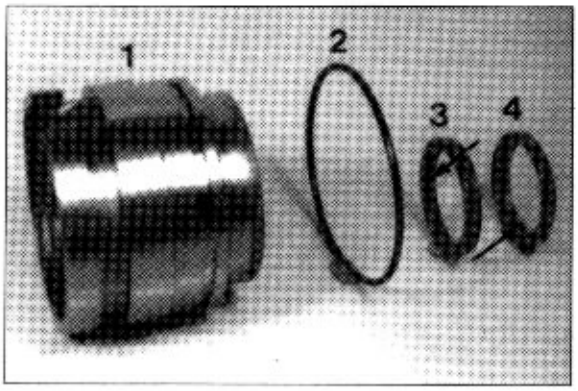
2) REASSEMBLY

(1) Install guide, cylinder and piston

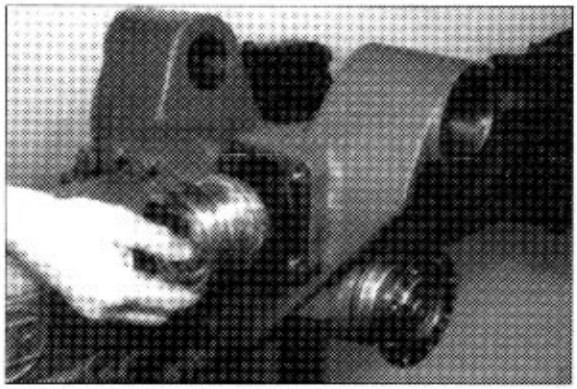
① Pre-assemble guide Ⅰ.

1 Guide
2 O-ring
3 Grooved ring
4 Scraper ring

※ Grooved ring(3)-sealing lip shows inward (see Arrow).
Scraper ring(4)-dust lip shows outward (see Arrow).

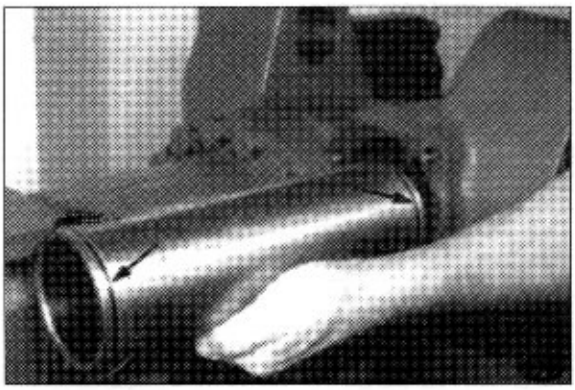


② Grease O-ring and sealing elements and insert the pre-assembled guide in the steering box until contact is obtained.



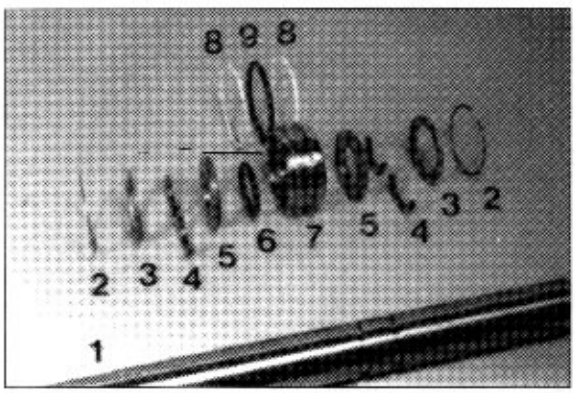
③ Grease O-ring (see Arrow) and insert it in the annular groove.
Introduce cylinder and reset it until contact is obtained.

※ Pay attention to the different diameters of the O-rings.

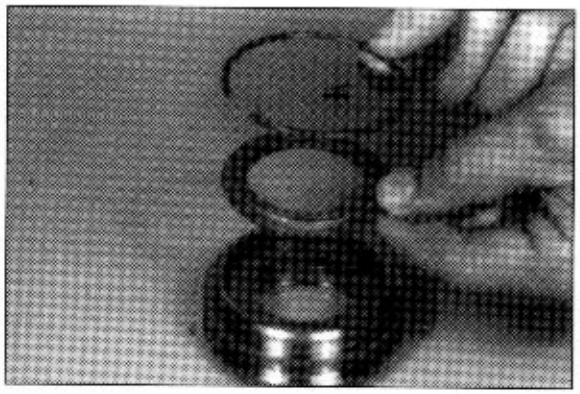


④ Sealing and locking elements of piston / piston rod.

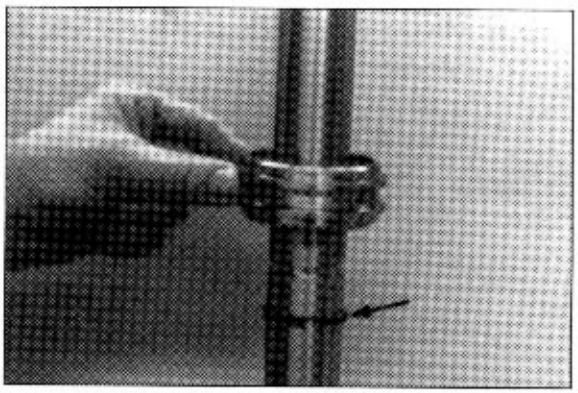
1 Piston rod
2 Snap ring
3 Circlip
4 Split ring
5 Disk
6 O-ring
7 Piston
8 Scraper ring
9 Sealing ring



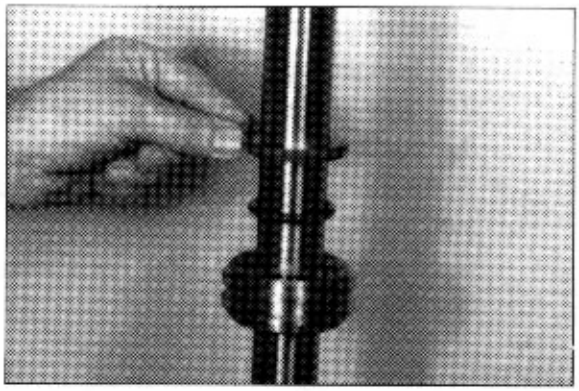
⑤ Lay disk(5) into the piston.
Install subsequently circlip(3) and fix it by means of snap ring(2).



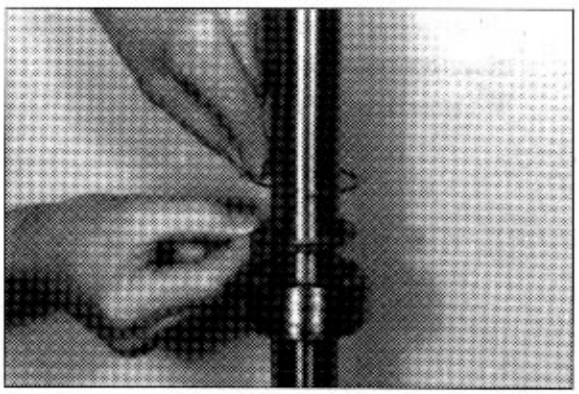
⑥ Insert split ring(4) in the annular groove of the piston rod(see Arrow) and assemble the piston.



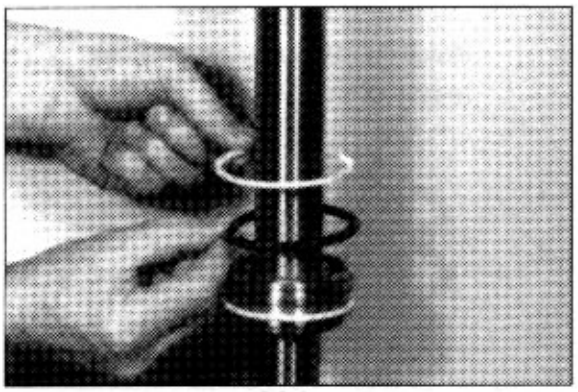
⑦ Grease O-ring(6), mount it along with disk(5) carefully over the second annular groove into the piston.



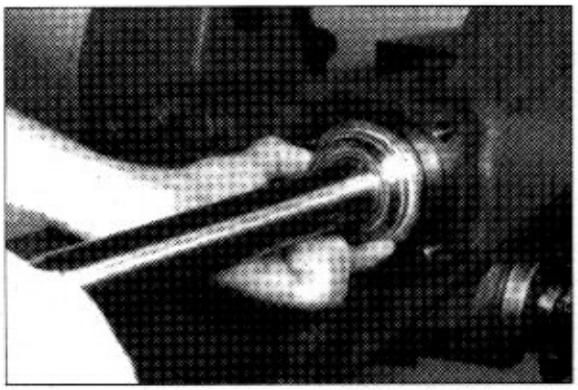
⑧ Insert split ring(4), fix it by means of circlip (3) and snap ring(2).



⑨ Assemble scraper ring(8) and sealing ring(9) upon the piston.
Grease sealing elements.

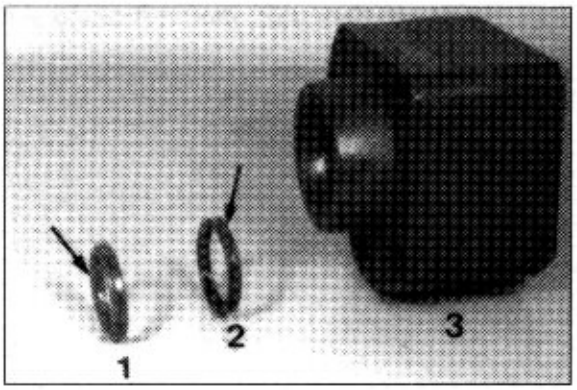


⑩ Introduce complete piston rod into the cylinder.



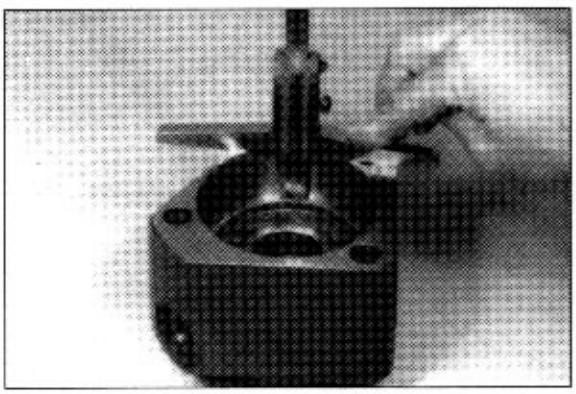
⑪ Pre-assemble guide Ⅱ.
1 Scraper ring
2 Grooved ring
3 guide

※ Scraper ring(1)-dust lip shows outward (see Arrow).
Grooved ring(2)-sealing lip shows inward(see Arrow).



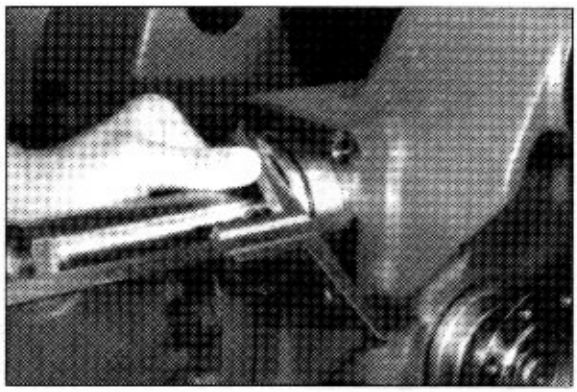
Determination of the spacing washer / steering cylinder

⑫ Dimension "A" e.g. : 32.05mm



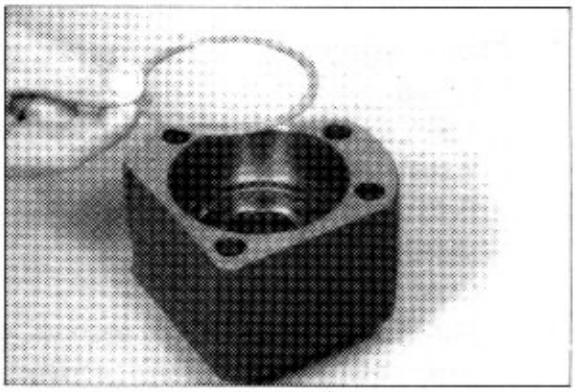
⑬ Slide cylinder in until contact is obtained and measure dimension "B" from the end face / cylinder to the flange-mounted surface / axle housing.
Dimension "B" e.g. : 30.90mm

※ Pay attention to the contact of guide and cylinder.

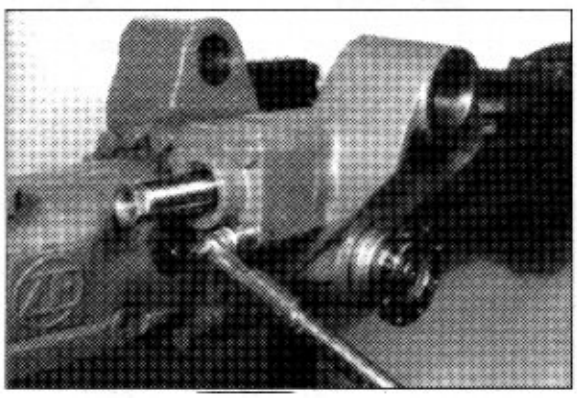


Dimension "A"	32.05mm
Dimension "B"	-30.90mm
Difference = Shim thickness	s = 1.15mm

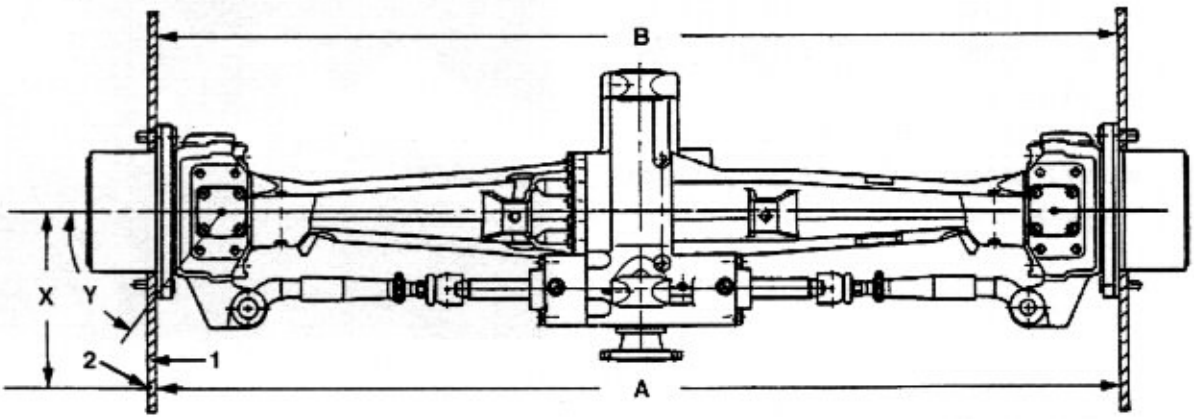
⑭ Make determined shim(e.g. s = 1.15mm) adhere with grease.
Grease sealing elements of the guide.



⑮ Assemble pre-assembled guide upon piston rod and fasten it by means of hex head screws.
Tightening torque(M14/10.9) :
18.9kg · m(136.7lb · ft)



Adjust toe-in resp. toe-out



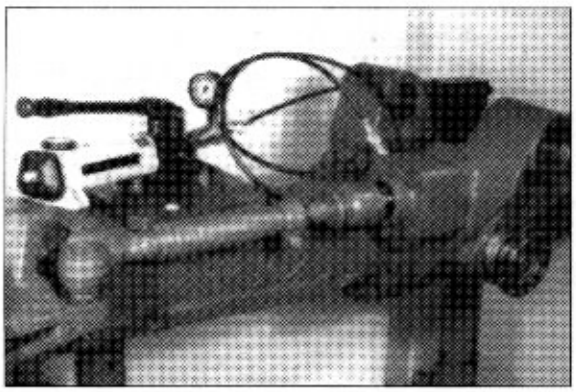
1 = Straightedge 2 = Marking notch Y = Steering lock

① Determine dimension A, starting from the marking notches of the straightedges.
Now, turn the two wheel hubs through 180° and determine dimension B.
Adjust the track, according to the indications of the manufacturer of the vehicle by axial displacement of the tie rods.

※ During the track adjustment, the distance of the straightedges(track) must be modified on the two tie rods in the same way.
Dimension "X" (see Draft) corresponds to the distance "wheel center to rim flange".

Check tightness of the steering assembly

② Check tightness of the steering assembly in both steering directions.
Build up the test pressure of p = 180 bar (bleed the pressure chamber).
Close shut-off valve.
During a test duration of 20 seconds, a pressure drop of max. 5 bar is permitted.



Test media : Motor oils SAE 10 W MIL-L 2104C, MIL-L 46152

※ Before the axle is put into service, pay attention to the lubrication and maintenance.