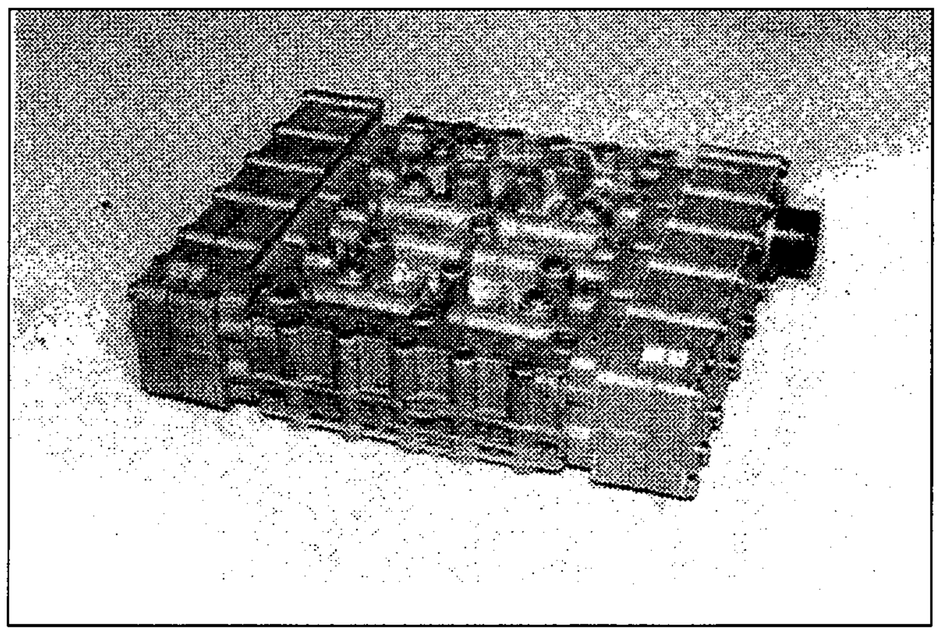
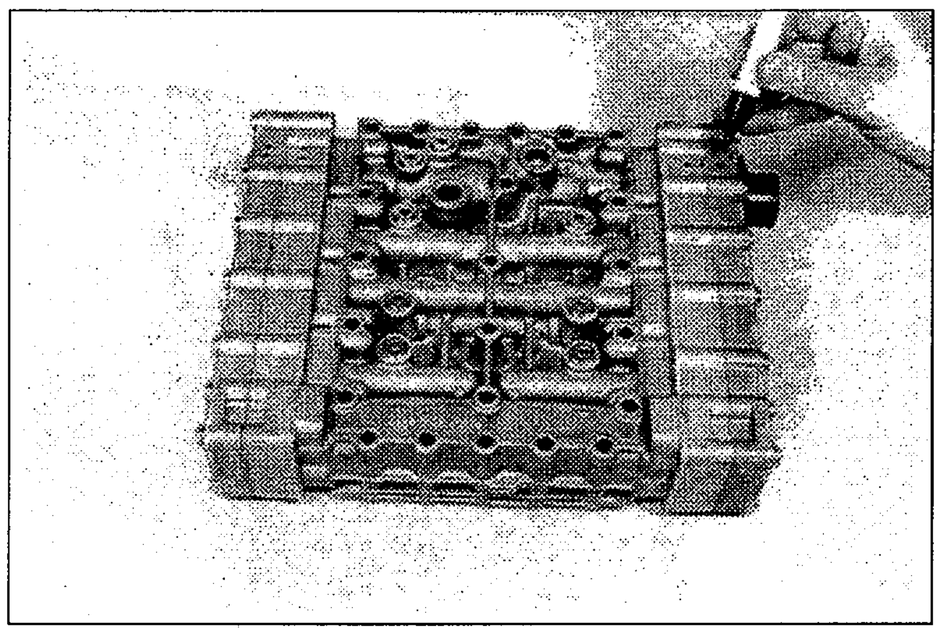
1. CONTROL VALVE

1) DISASSEMBLY

(1) Illustration on the right shows the complete control unit.



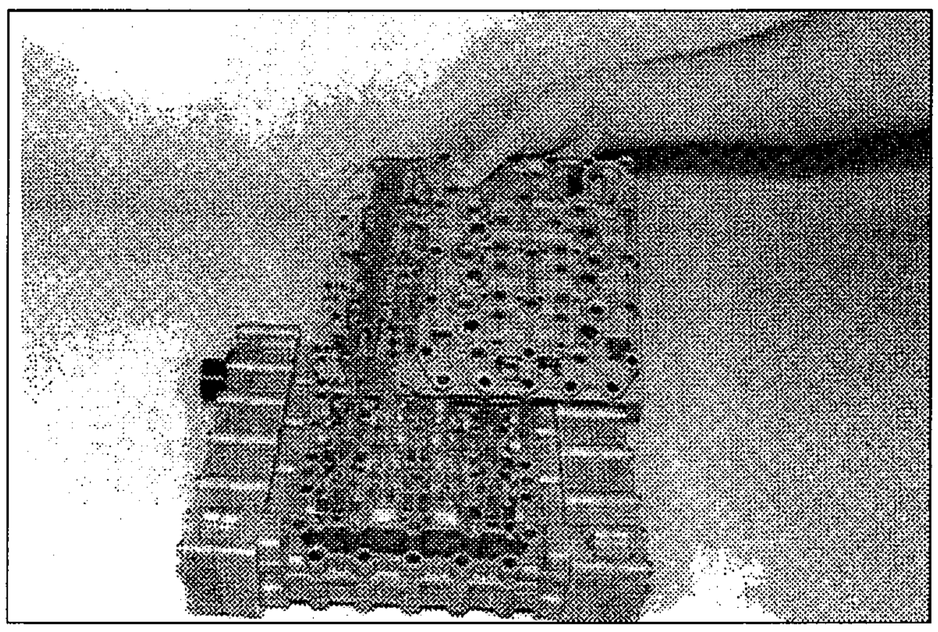
(2) Mark the installation position of the different covers, the housing and cable harness with the valve housing.



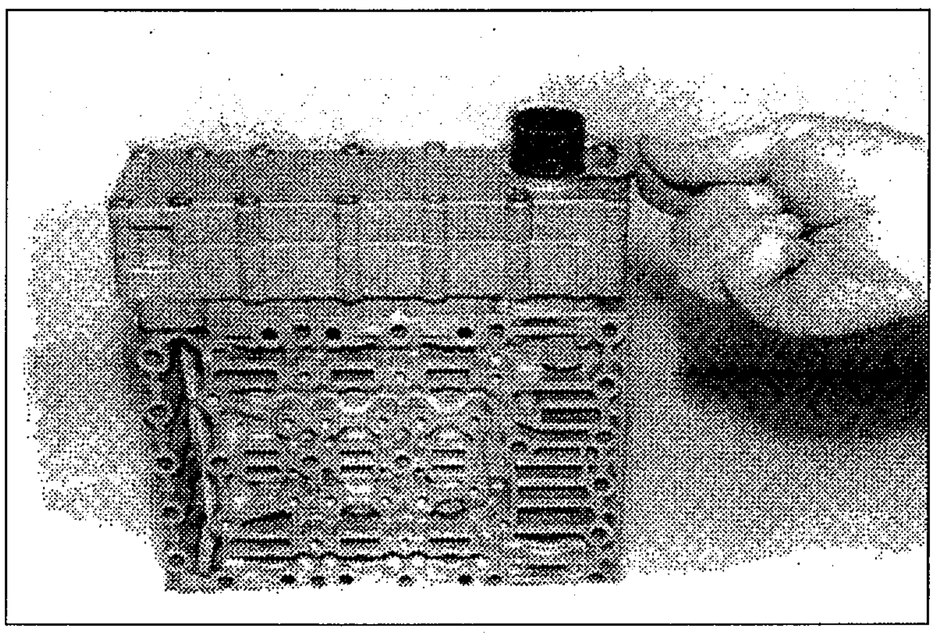
(3) Loosen socket head screws.
Separate duct plate, 1st gasket, intermediate plate and 2nd gasket from the valve housing.

※ Special tool

Box spanner	5873 042 002



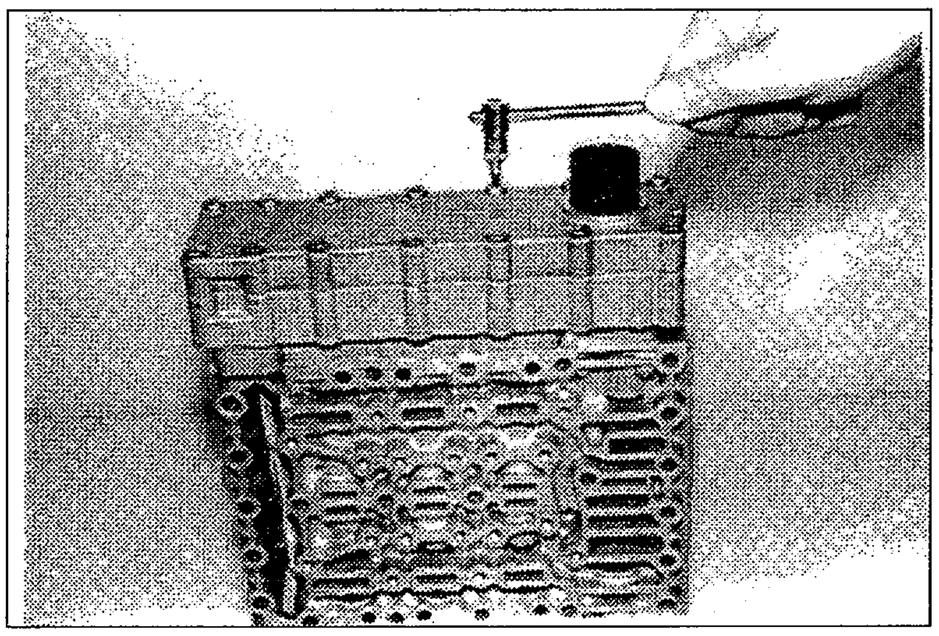
(4) Remove retaining clip.



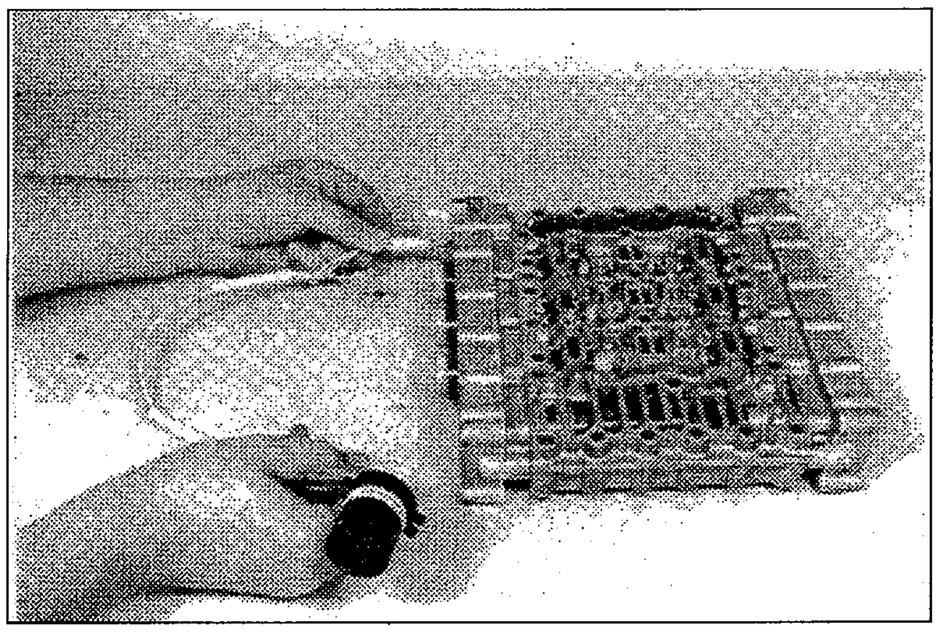
(5) Loosen socket head screws.
Separate cover from housing and cable harness.

※ Special tool

Box spanner	5873 042 002



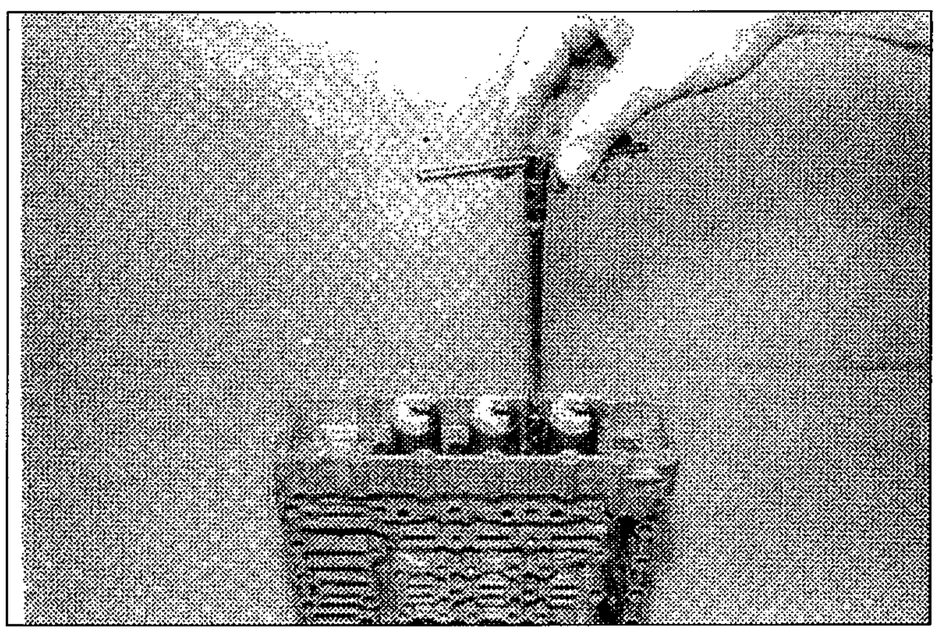
(6) Disassemble opposite cover.
Disconnect pressure regulator and remove cable harness.



(7) Loosen socket head screws, remove fixing plate and pressure regulators(3EA).

※ Special tool

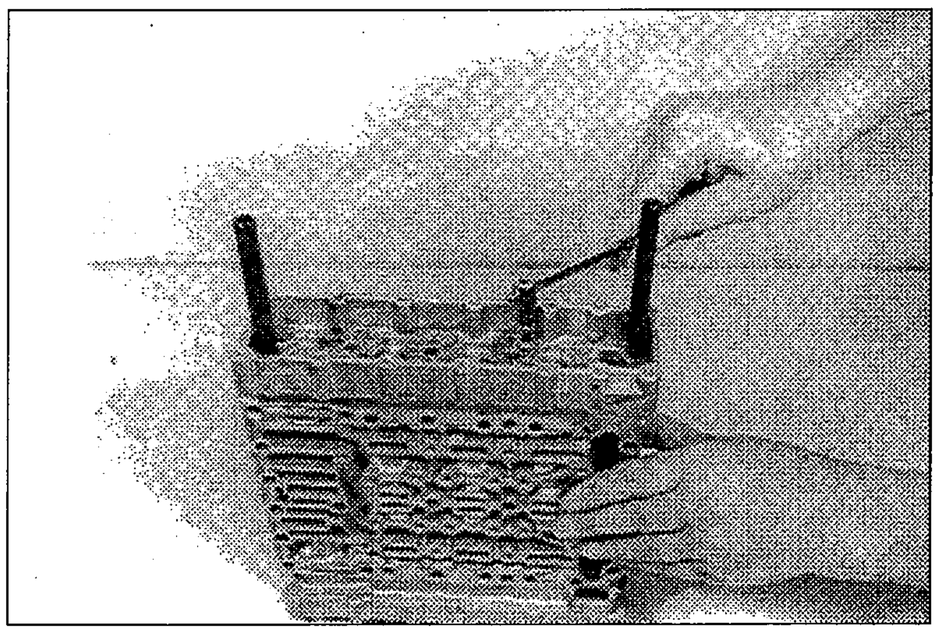
Box spanner	5873 042 002



(8) Loosen two socket head screws and locate housing provisionally, using adjusting screws(Housing is under spring preload).
Now, loosen remaining socket head screws.

※ Special tool

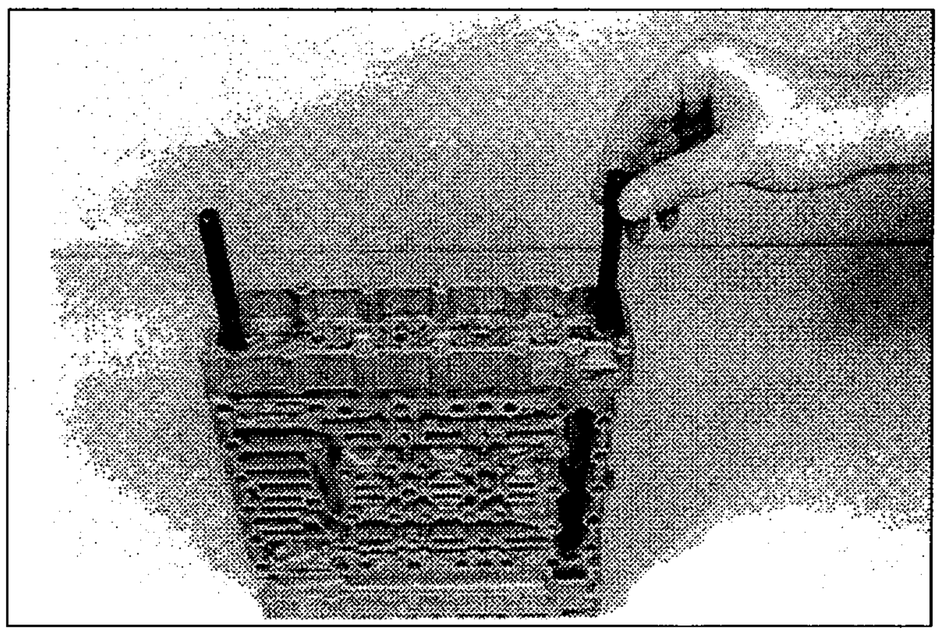
Box spanner	5873 042 002
Adjusting screws	5870 204 036



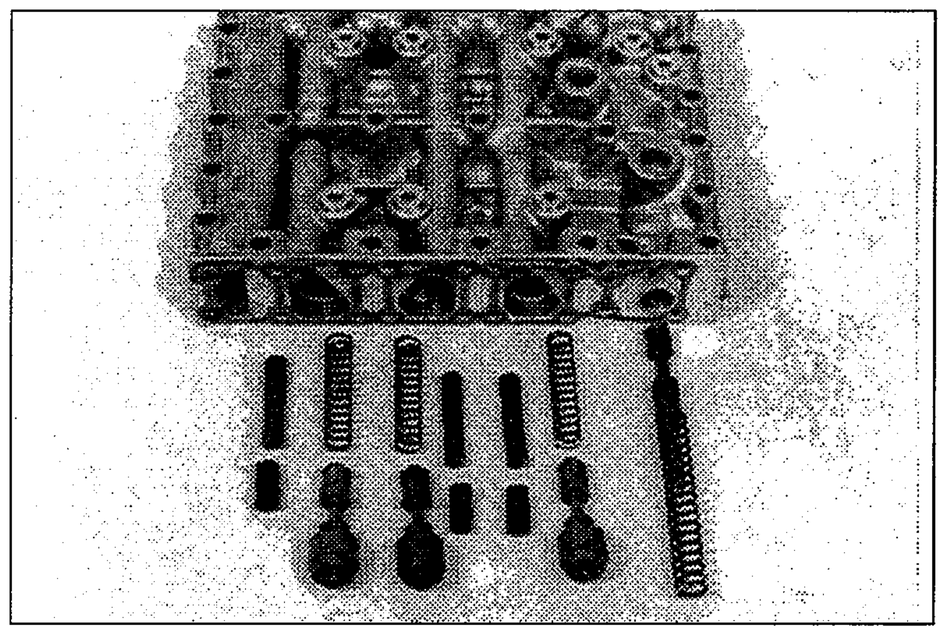
(9) Separate housing from valve housing by loosening the adjusting screws uniformly.

※ Special tool

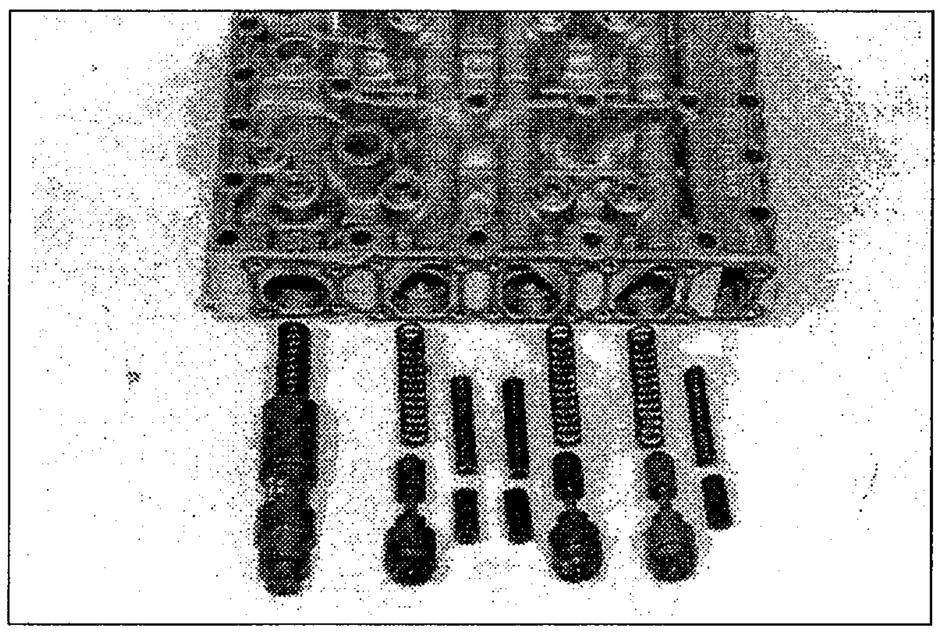
Adjusting screws 5870 204 036



(10) Remove components.



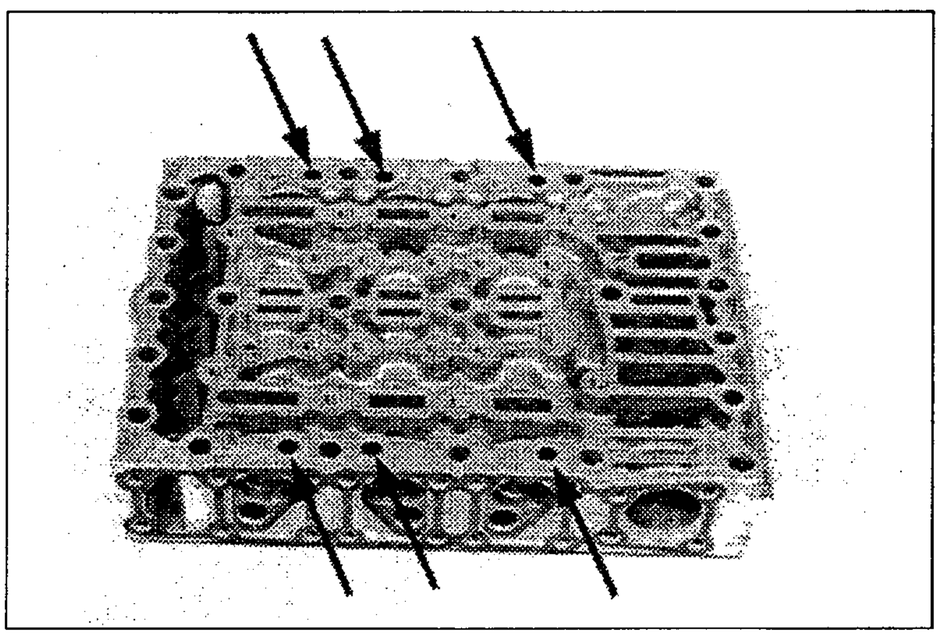
(11) Remove opposite pressure regulators, housing as well as components accordingly.



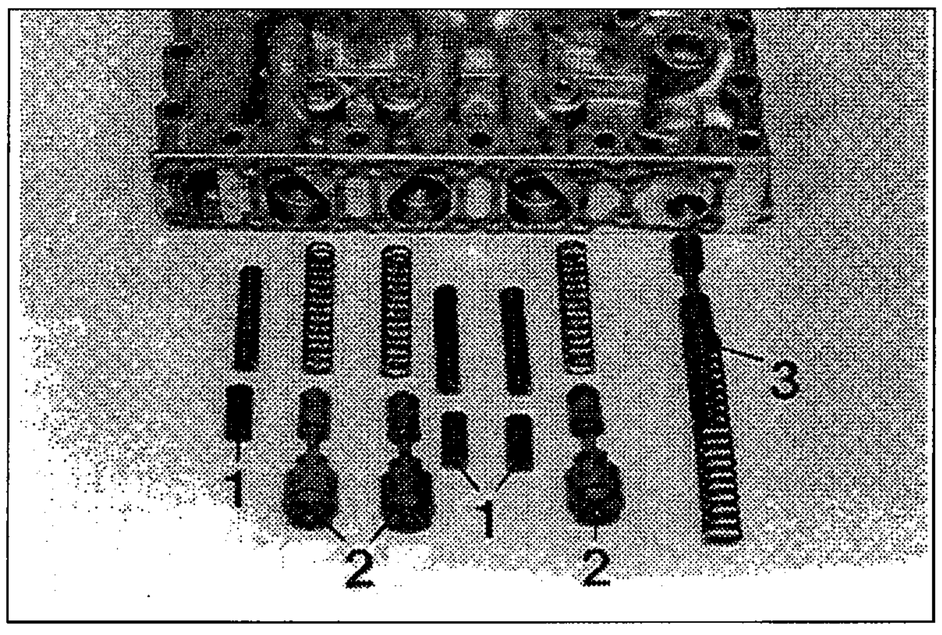
2) ASSEMBLY

※ Check all components for damage and renew if necessary.
Prior to the installation, check free travel of all moving parts in the housing.
Spools can be exchanged individually.
Oil the components prior to the assembly.
Insert diaphragms with the concave side showing upward until contact is obtained.

※ Installation position, see arrows.

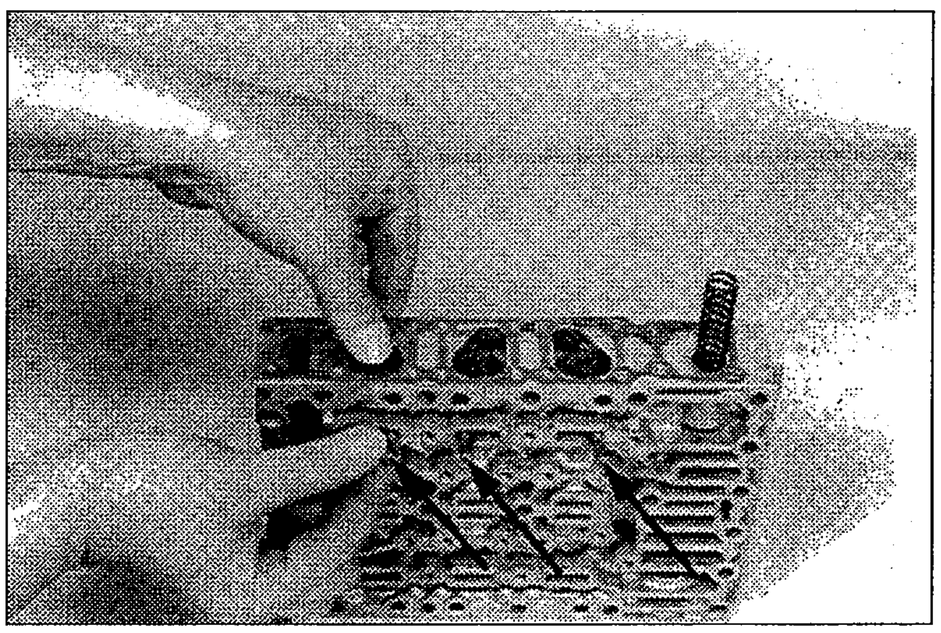


(1) Illustration on the right shows the following components.
1 Vibration damper
2 Follow-on slide
3 Pressure reducing valve



(2) Install components according to figure (1).

※ Preload compression spring of the follow-on slides and locate spool provisionally by means of cylindrical pins ø 5.0mm (Assembly aid), see arrows.

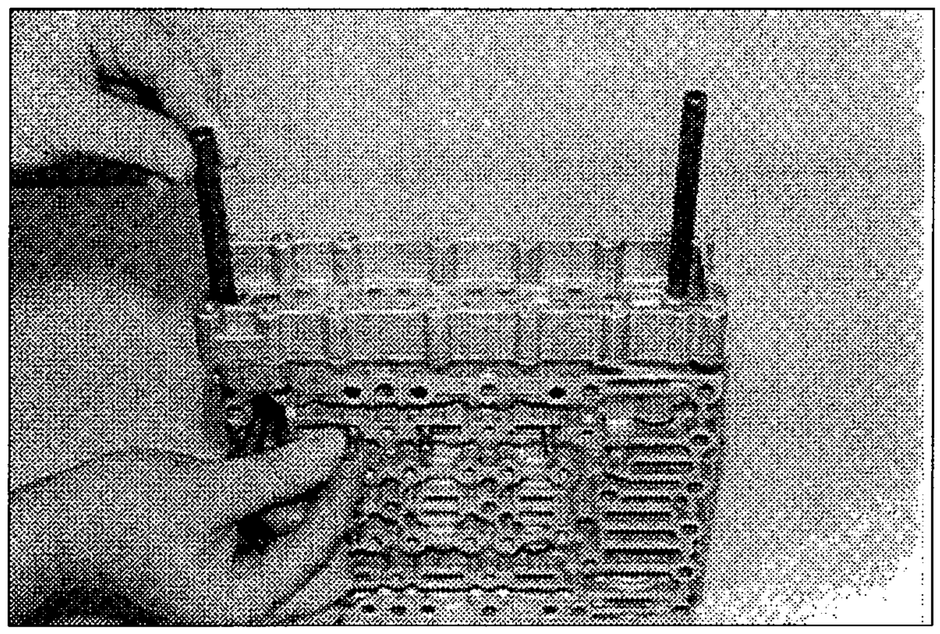


(3) Install two adjusting screws.
Assemble gasket(Arrow 1) and housing cover. Now, position the housing cover uniformly, using adjusting screws, until contact is obtained and remove cylindrical pins(Assembly aid) again(See the next figure).

※ Pay attention to the different housing covers.
Install recess ø 15mm (Arrow 2), facing the spring of the pressure reducing valve.

※ Special tool

Adjusting screws	5870 204 036

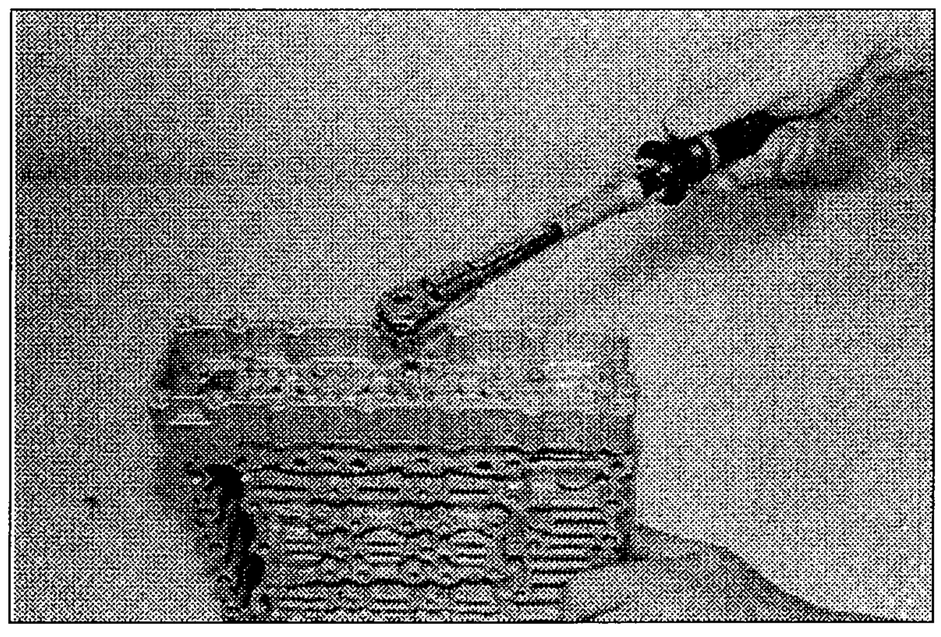


(4) Fasten housing cover by means of socket head screws.

· Torque limit : 0.56kgf · m(4.06lbf · ft)

※ Special tool

Box spanner 5873 042 002



(5) Introduce pressure regulators and fix by means of fixing plates and socket head screws.

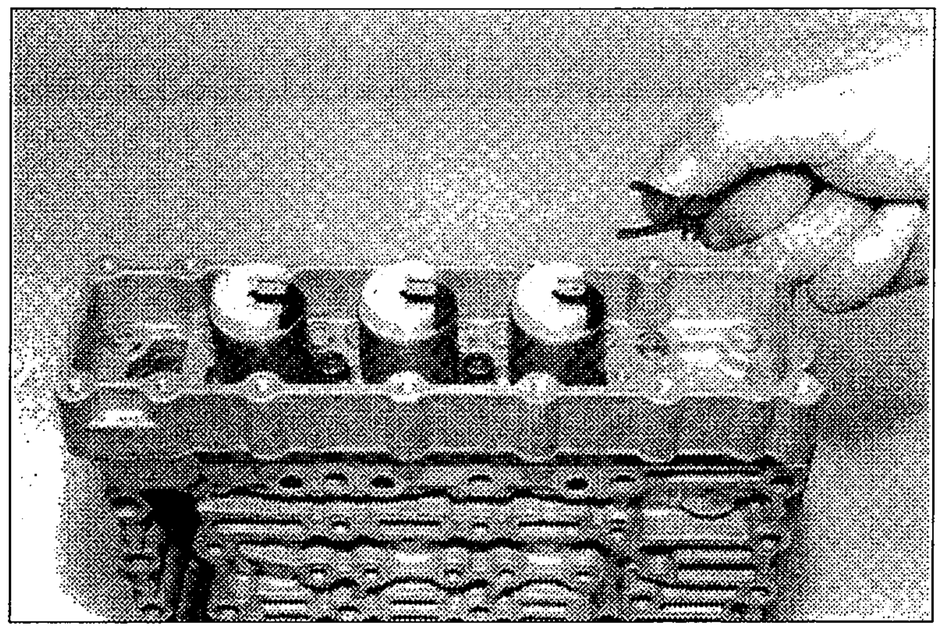
※ Install fixing plate, with the claw showing downward.

※ Pay attention to the radial installation position of the pressure regulators, see figure.

· Torque limit : 0.56kgf · m(4.06lbf · ft)

※ Special tool

Box spanner 5873 042 002



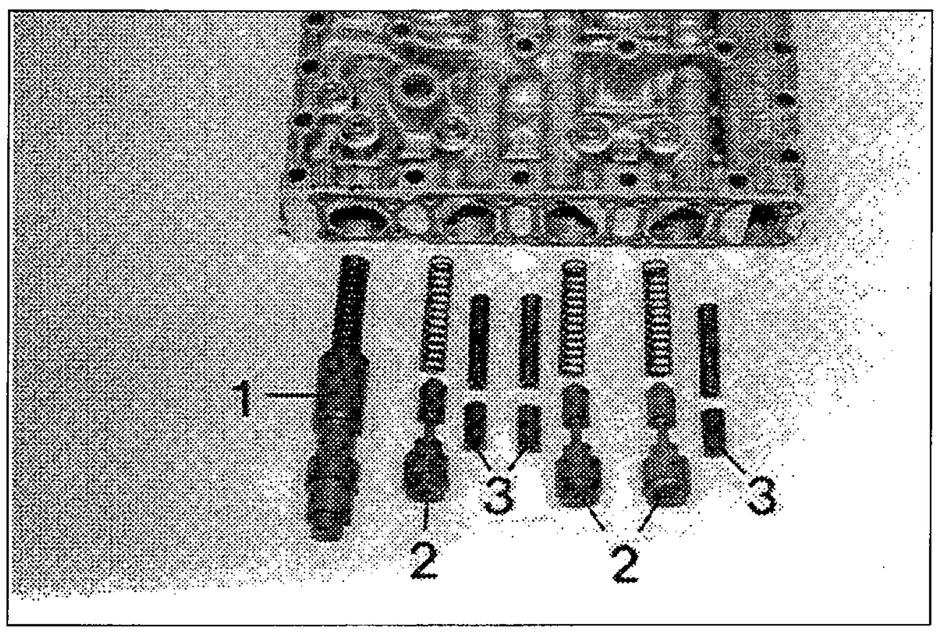
Pre assemble opposite side

(6) Illustration on the right shows the following components.

1 Main pressure valve

2 Follow on slide

3 Vibration damper



(7) Install components according to figure (6).
Preload compression springs of the follow-on slides and locate spool provisionally by means of cylindrical pins ø 5.0mm (Assembly aid), see arrows.
Install two adjusting screws.
Assemble gasket(Arrow 1) and housing cover, and position them uniformly against shoulder, using adjusting screws.

※ Pay attention to the different housing covers-install the recess ø 19mm(Arrow 2), facing the main pressure valve.

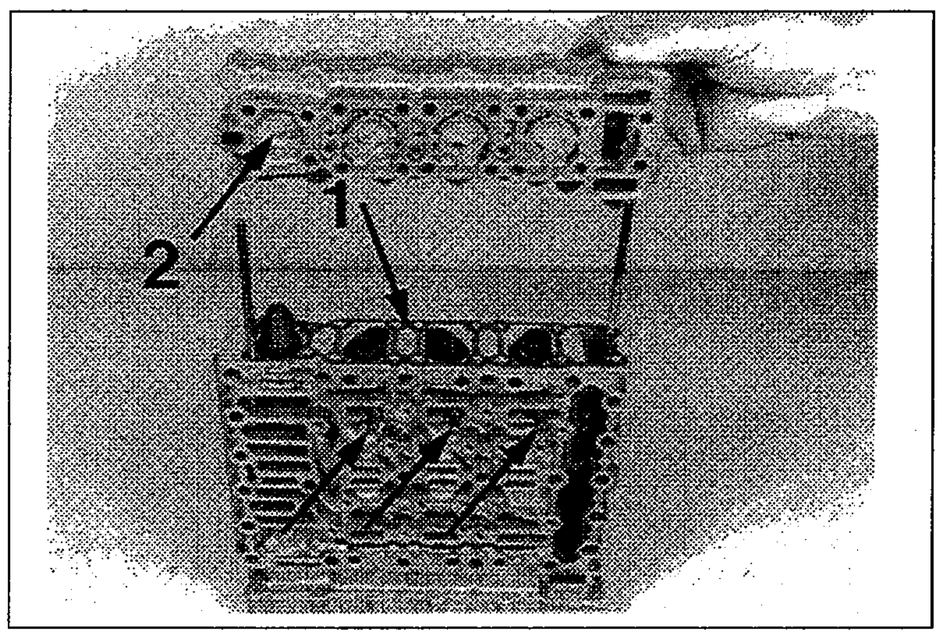
Now, fasten housing cover by means of socket head screws.

· Torque limit : 0.56kgf · m(4.06lbf · ft)

Remove cylindrical pins(Assembly aid) again.

※ Special tool

Adjusting screws	5870 204 036
Box spanner	5873 042 002



(8) Introduce pressure regulators and fix by means of fixing plates and socket head screws.

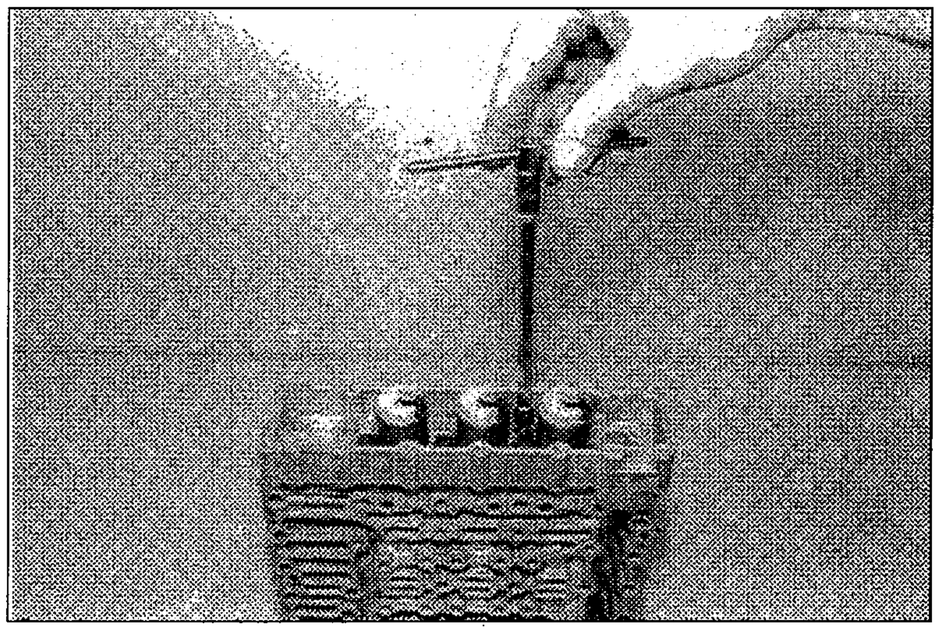
※ Install fixing plates, with the claw showing downward.

※ Pay attention to the radial installation position of the pressure regulators, see figure.

· Torque limit : 0.56kgf · m(4.06lbf · ft)

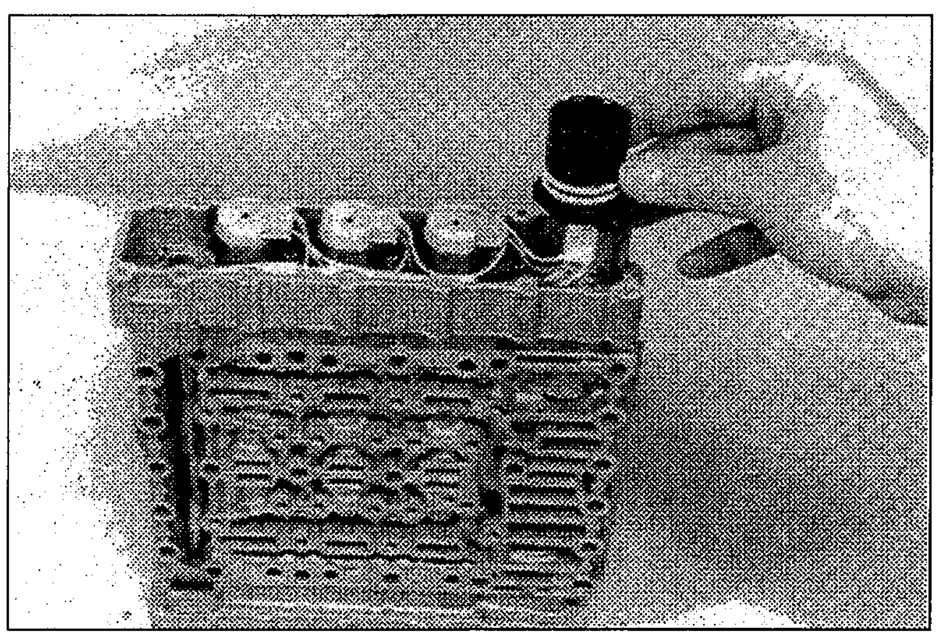
※ Specail tool

Box spanner	5873 042 002



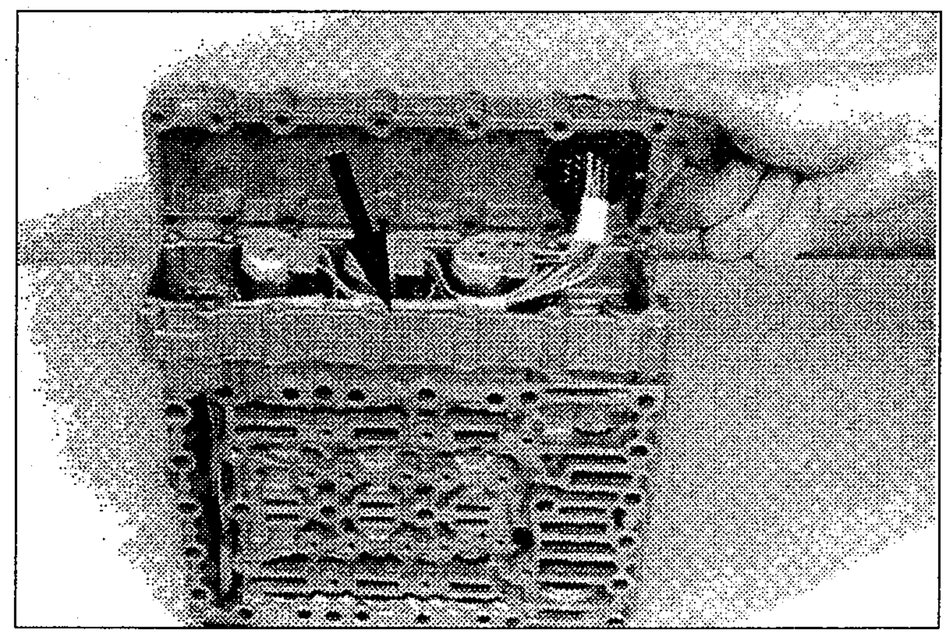
(9) Introduce cable harness and connect pressure regulators(6EA).

※ Pay attention to the installation position of the cable harness, ass also markings (See figure(2), page 3-74).

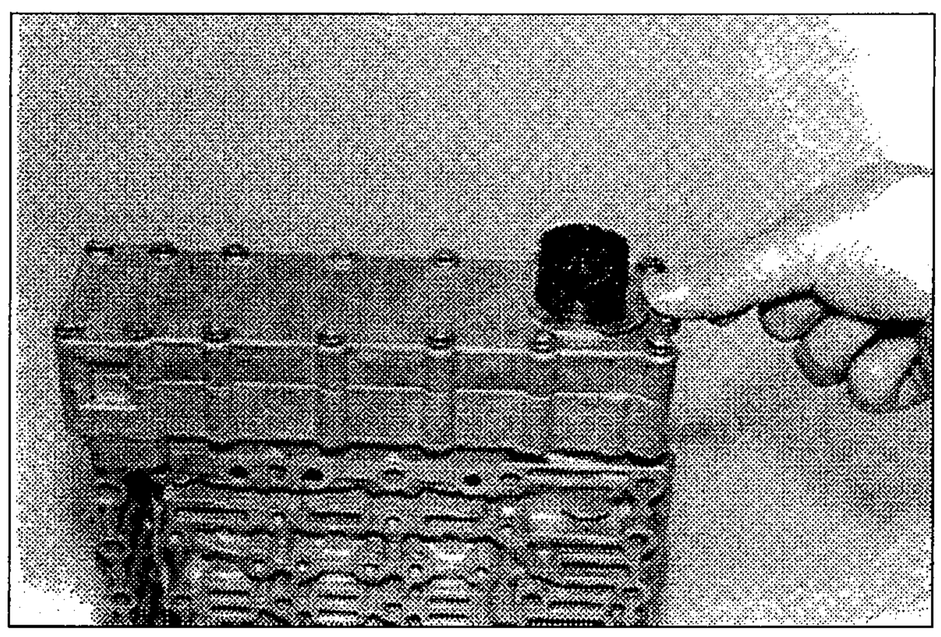


(10) Introduce female connector against shoulder, with the groove facing the guide nose of the cover.
Install gasket(Arrow) and fasten cover by means of socket head screws.
· Torque limit : 0.56kgf · m(4.06lbf · ft)

※ Special tool
Box spanner 5873 042 002



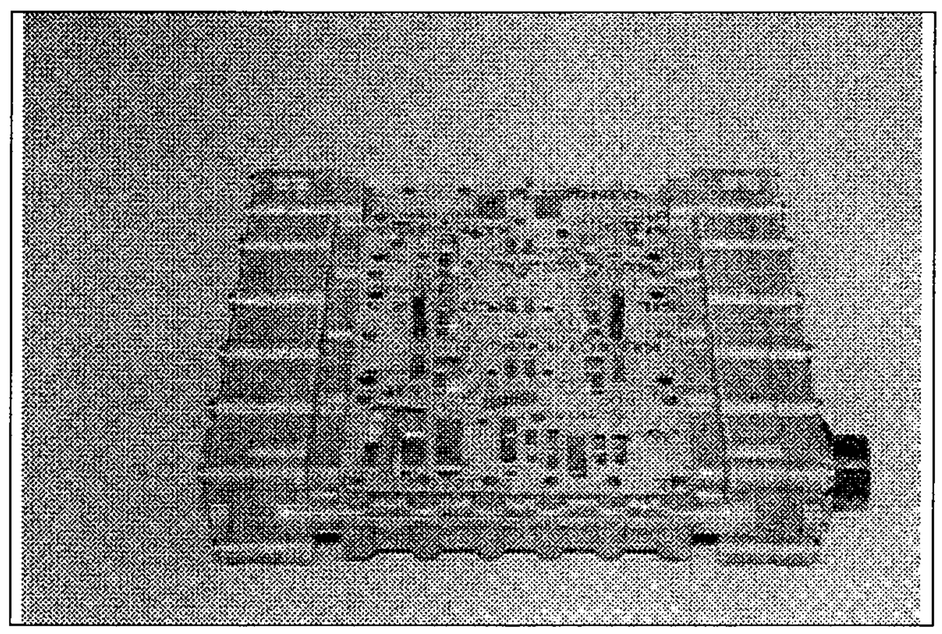
(11) Fix female connector by means of retaining clamp, see figure.
Install opposite cover.



(12) Install two adjusting screws and mount gasket Ⅰ.

※ Pay attention to the different gaskets, see on the right figure and (15).

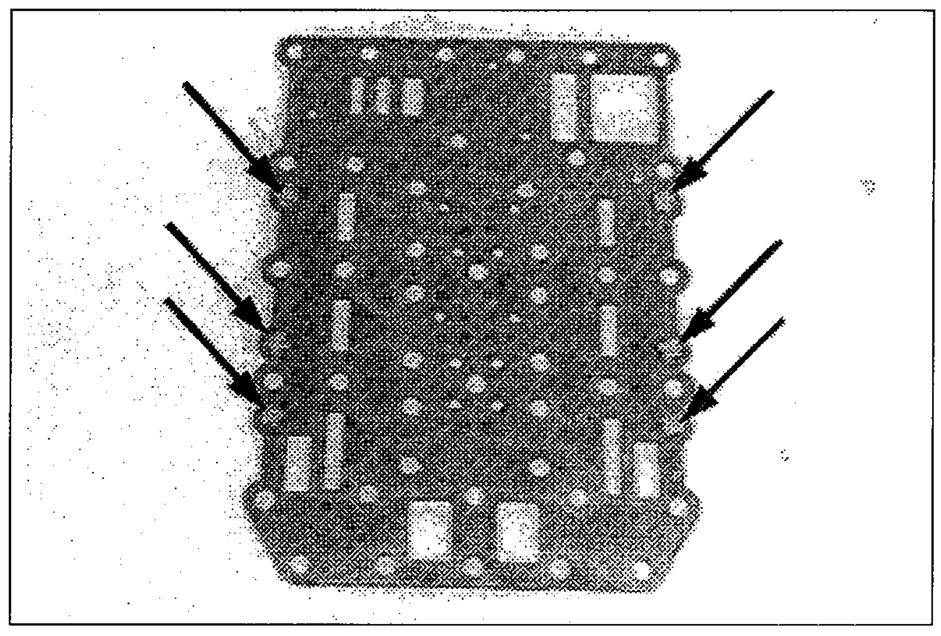
※ Special tool
Adjusting screws 5870 204 063



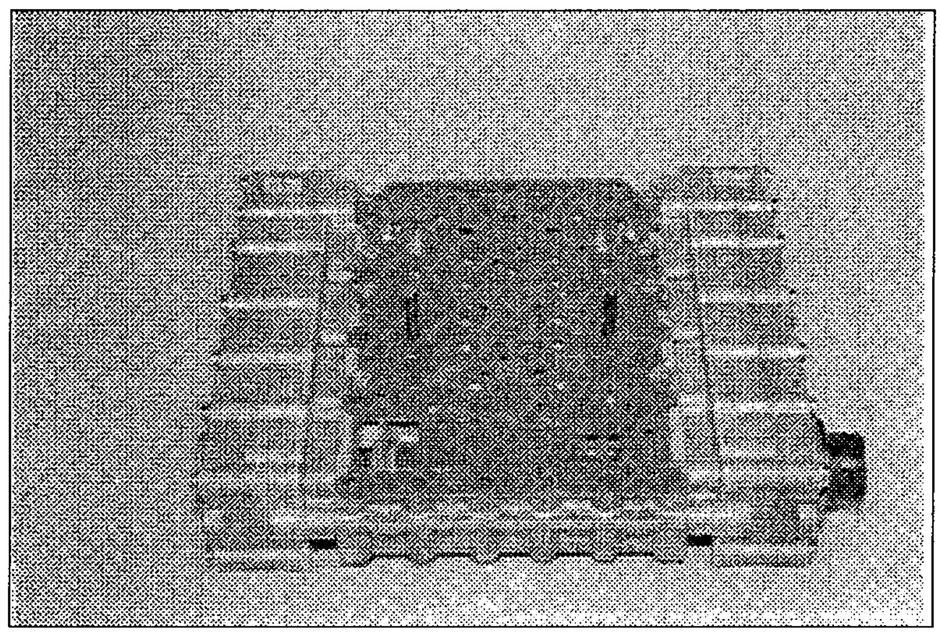
Intermediate plate-Version with screens

(13) Insert screens(6EA) flush mounted into the bore of the intermediate plate, see arrow.

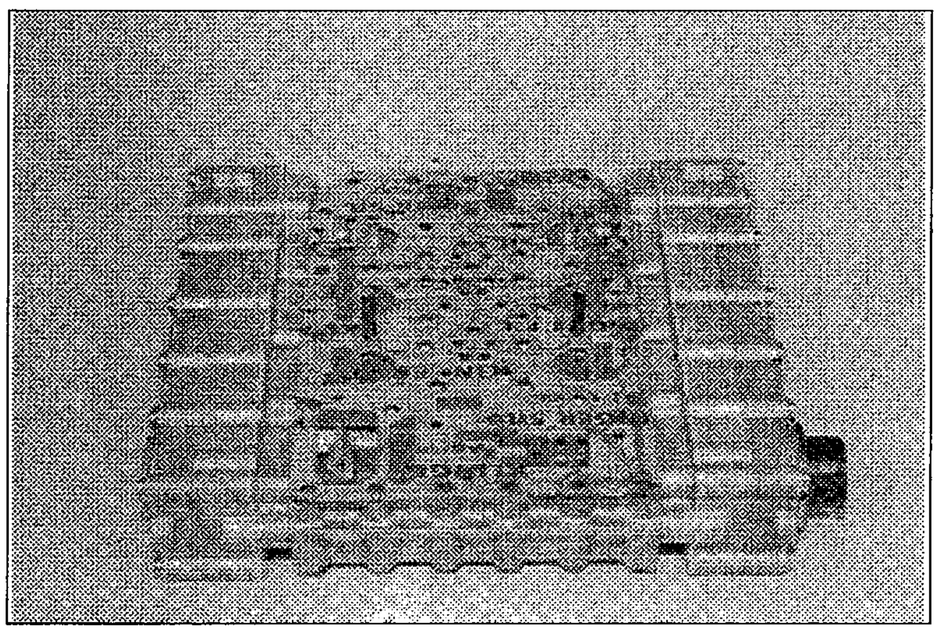
※ Pay attention to the installation position-screens are showing upward(Facing the duct plate).



(14) Mount intermediate plate, with the screens showing upward.



(15) Mount gasket Ⅱ.

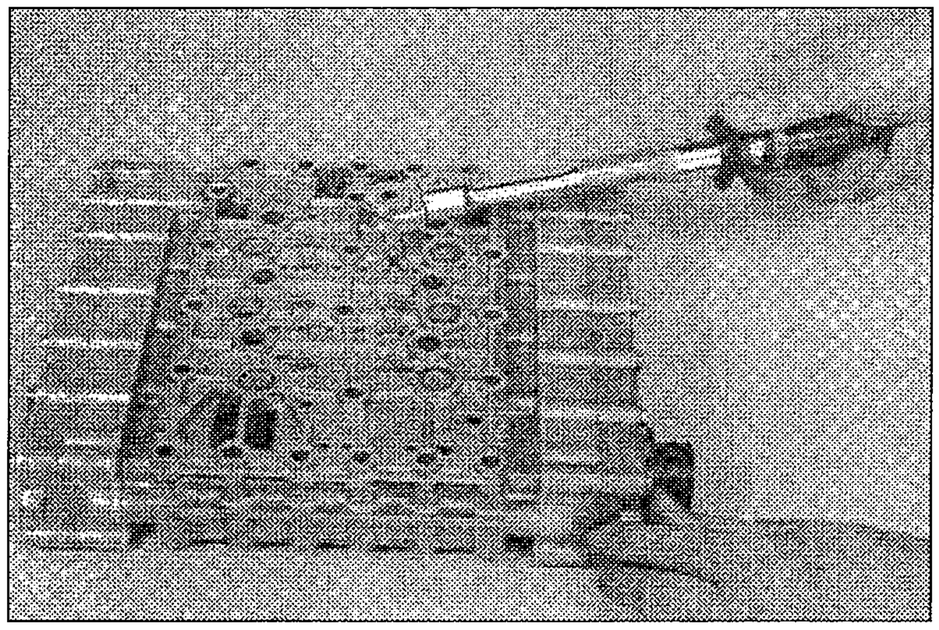


(16) Mount duct plate and fasten it uniformly by means of socket head screws.

· Torque limit : 0.97kgf · m(7.0lbf · ft)

※ Special tool

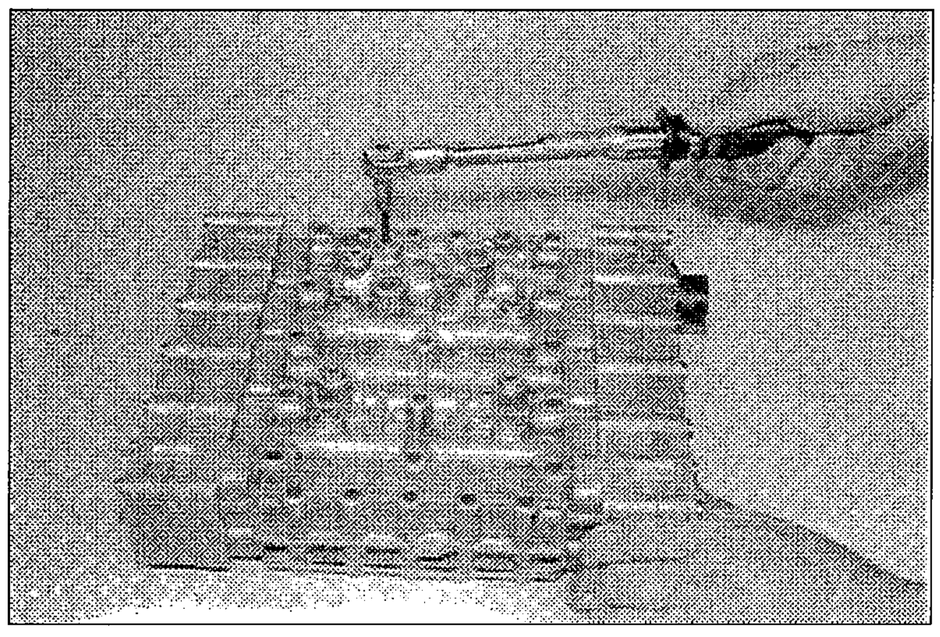
Box spanner 5873 042 002



(17) Equip screw plugs(8EA) with new O-rings and install them.

· Torque limit : 0.56kgf · m(4.06lbf · ft)

※ The installation of the hydraulic control unit is described, starting from page 3-154.



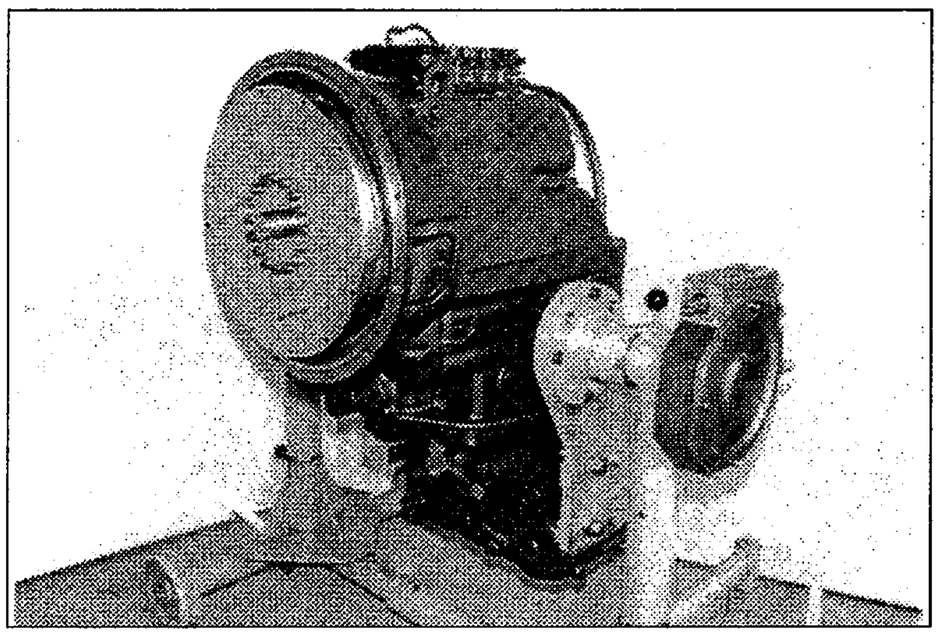
2. GEARBOX

1) DISASSEMBLY

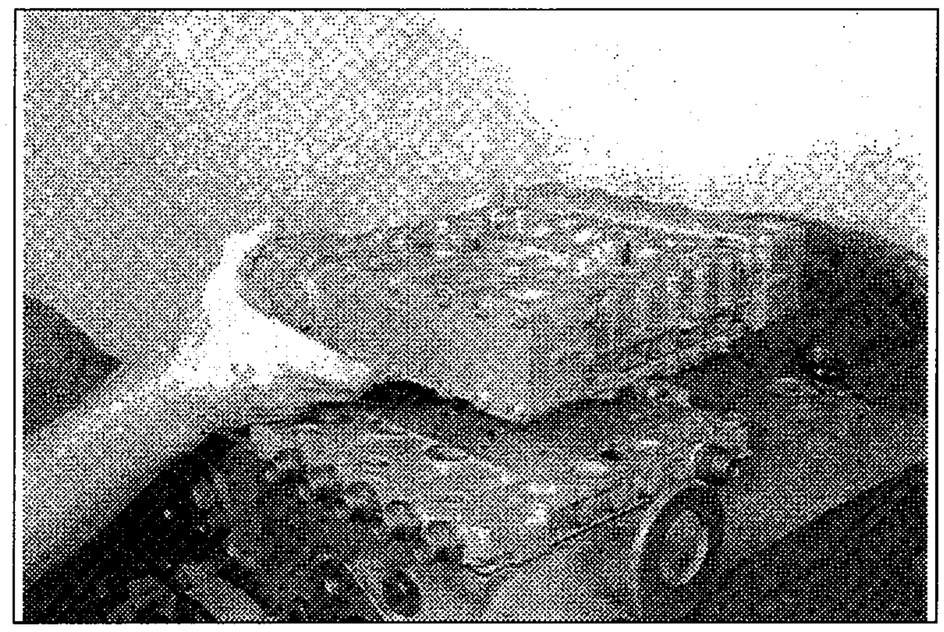
Fasten transmission on assembly car.

※ Special tool

Assembly car	5870 350 000
Clamping bracket	5870 350 071



Disassemble complete shift control, remove pressure lines and duct plate.

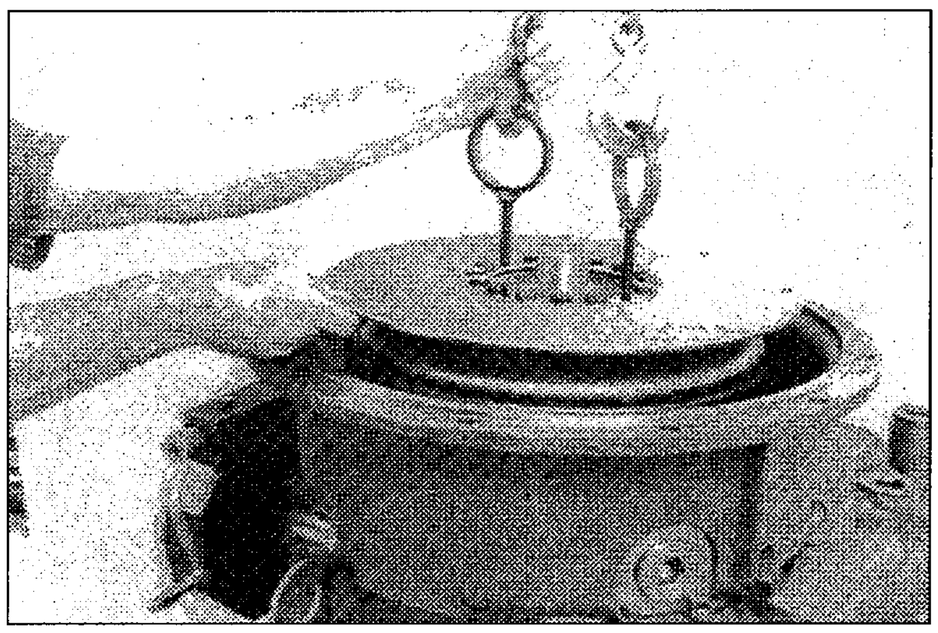


(1) Converter-input

① Separate torque converter from transmission, using lifting device.

※ Special tool

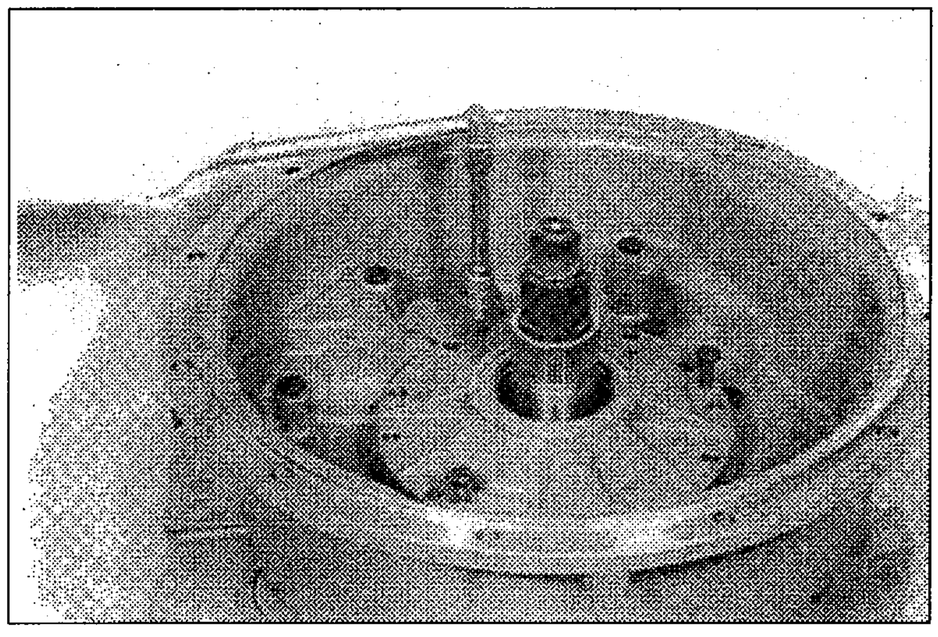
Set of eye bolts	5870 240 002



② Loosen screw connection.
Separate bearing cover from converter bell, using forcing screws(3EA).

※ Special tool

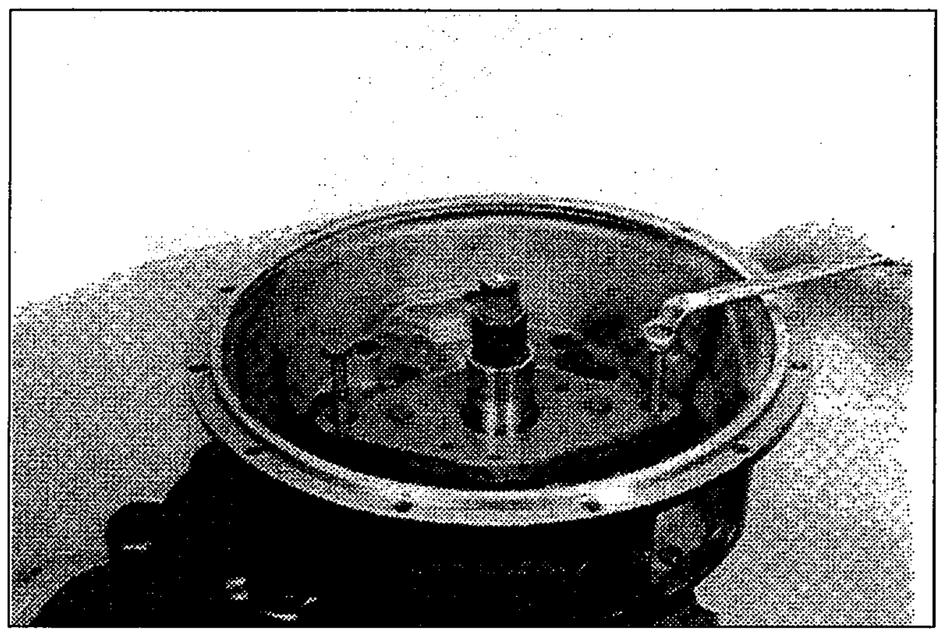
Forcing screws(M10)	5870 204 005



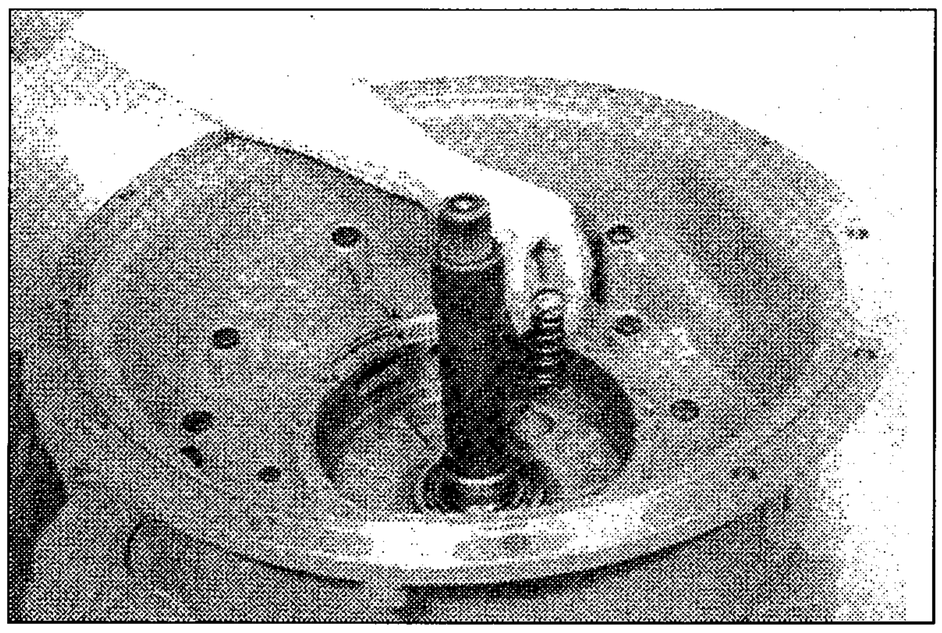
③ Pull oil feed flange out of the converter bell, using special device.

※ Special tool

Puller device 5870 000 089



④ Remove converter safety valve (Composed of ball, spring and disk).

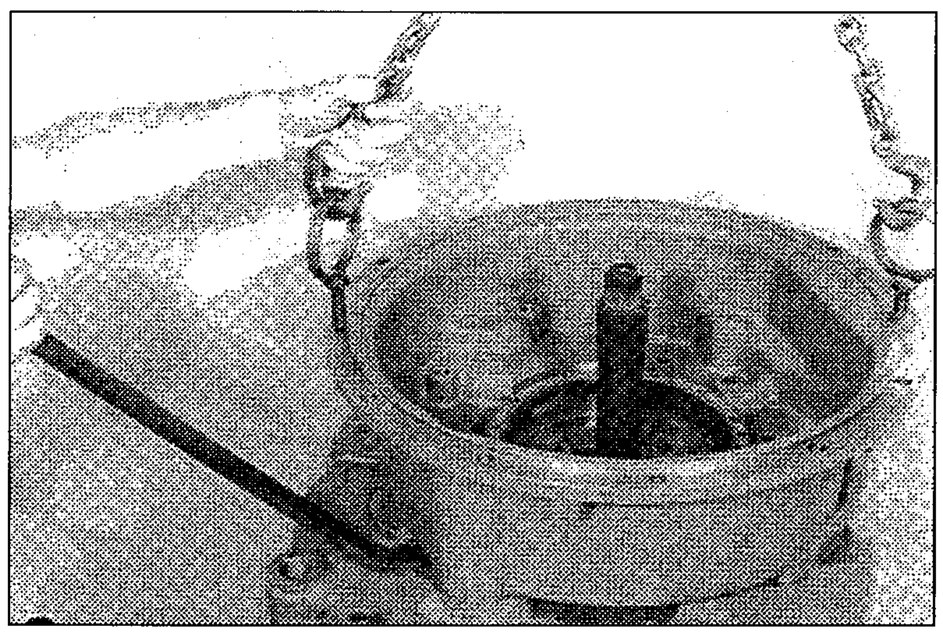


⑤ Separate converter bell from gearbox housing, using lifting device and pry bar.

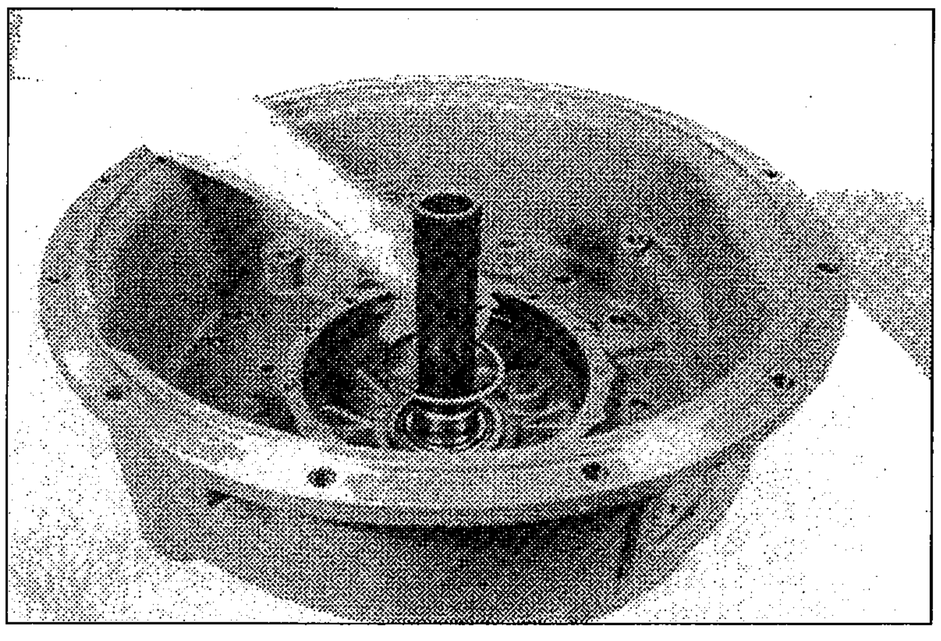
※ Special tool

Set of eye bolts 5870 204 002

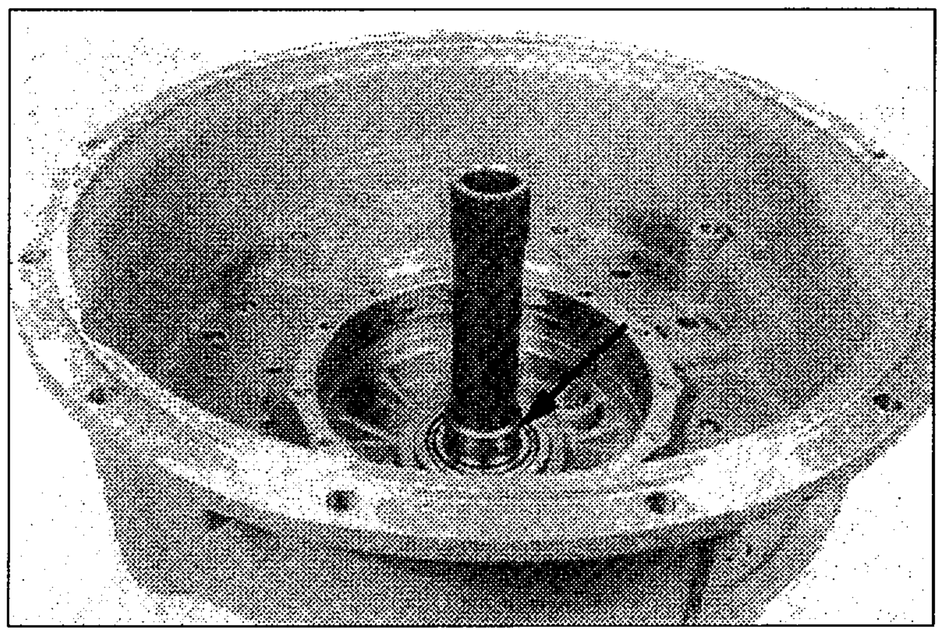
Pry bar 5870 345 036



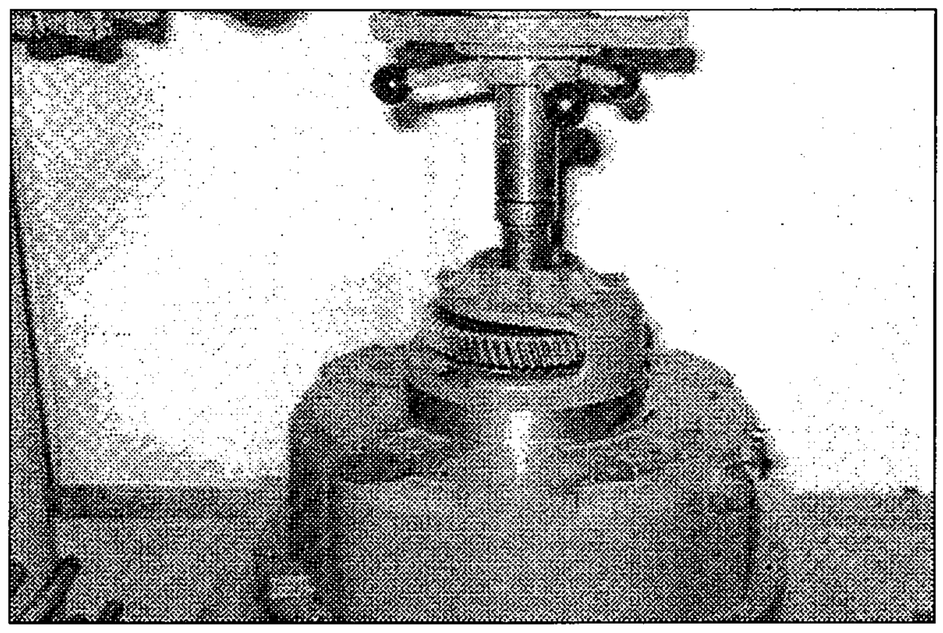
⑥ Remove shim.



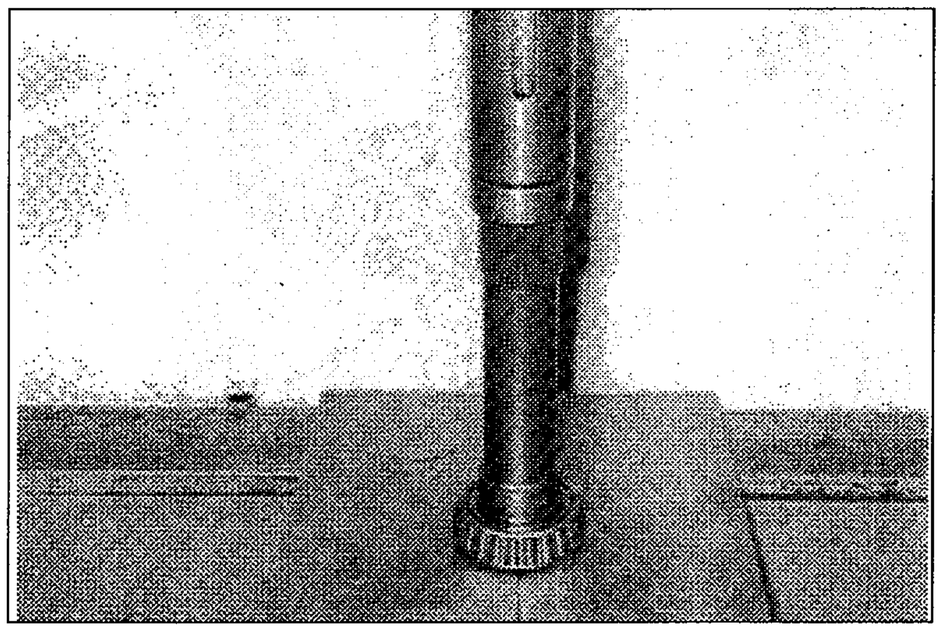
⑦ Remove rectangular ring(Arrow).



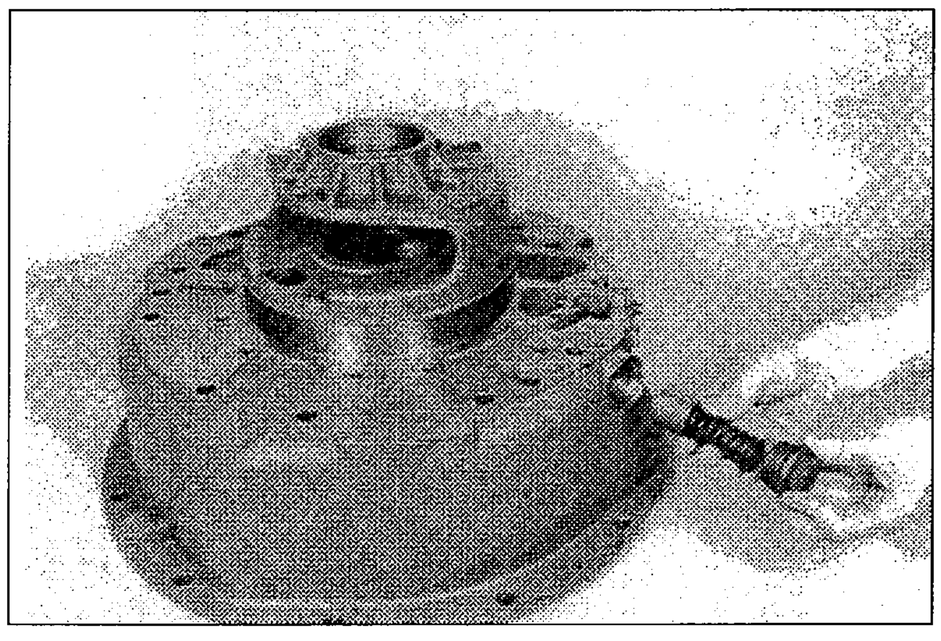
⑧ Press drive shaft out of the spur gear bearing.
Remove released bearing inner race and spur gear.
If necessary, drive bearing outer race out of the housing bores.



⑨ Press bearing inner race from drive shaft.

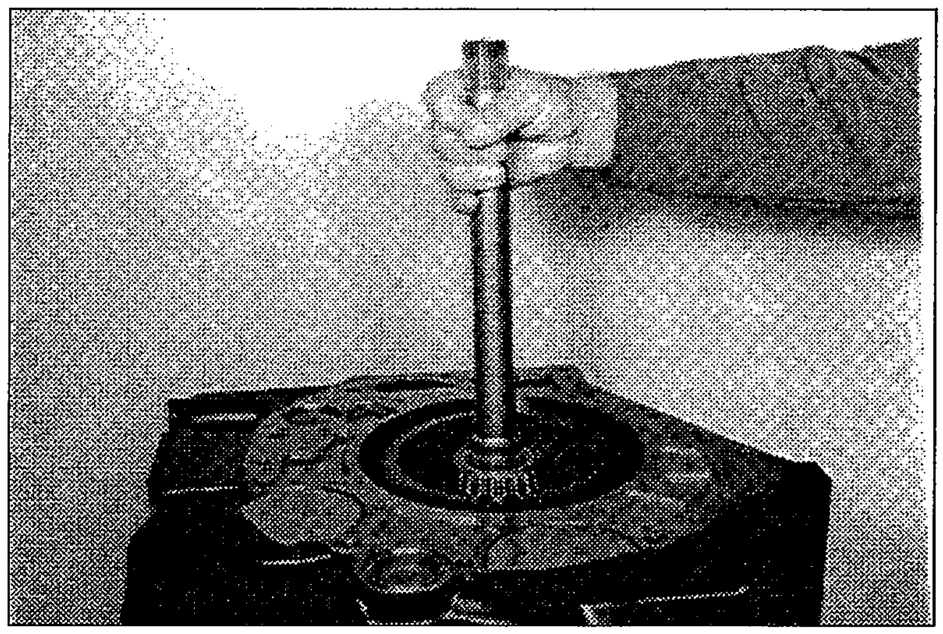


⑩ Remove converter pressure valve.

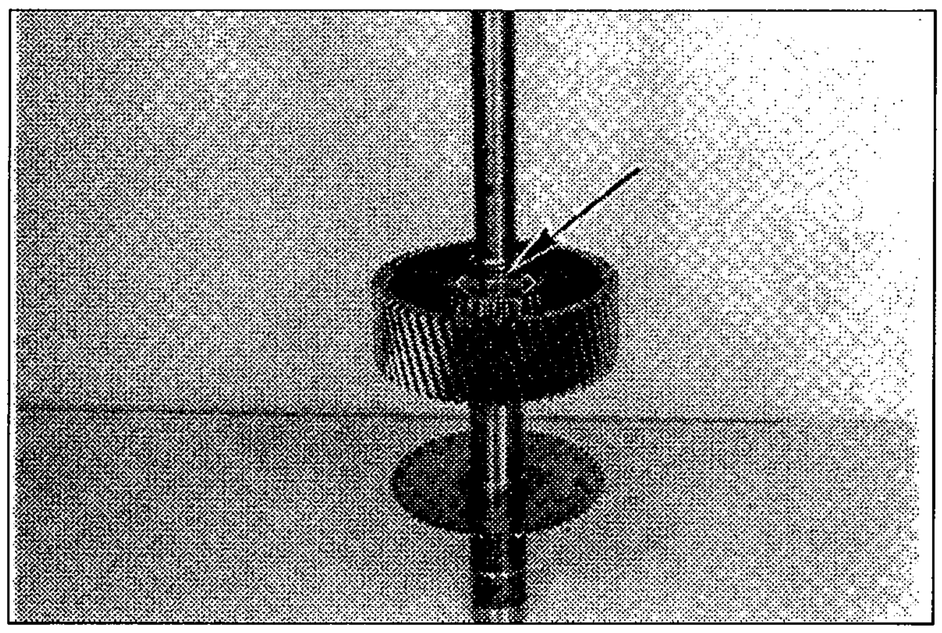


(2) Drive shaft, pump, power take-off

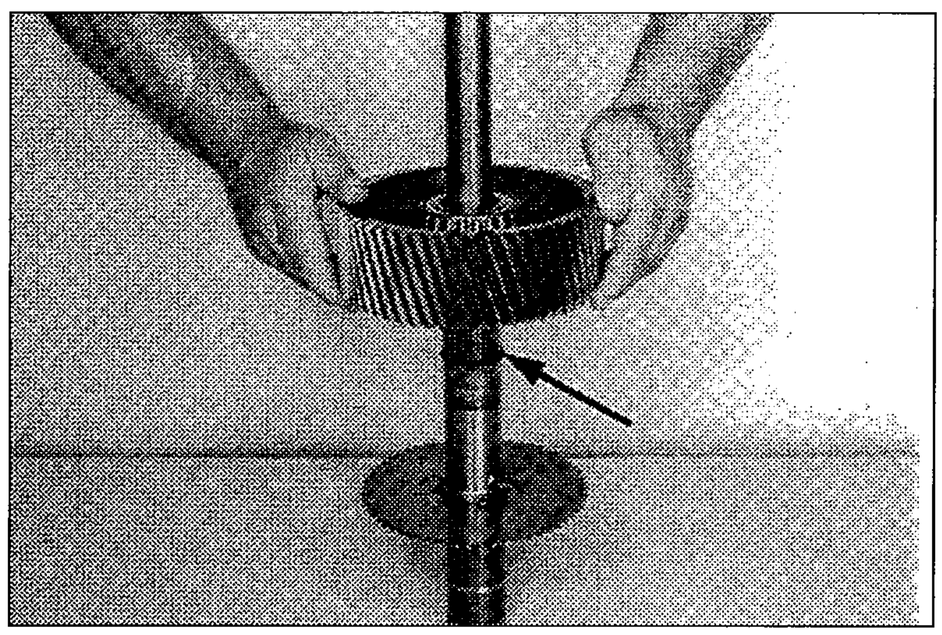
① Pull complete drive shaft out of the gearbox housing(Pump).



② Remove rectangular ring(Arrow).



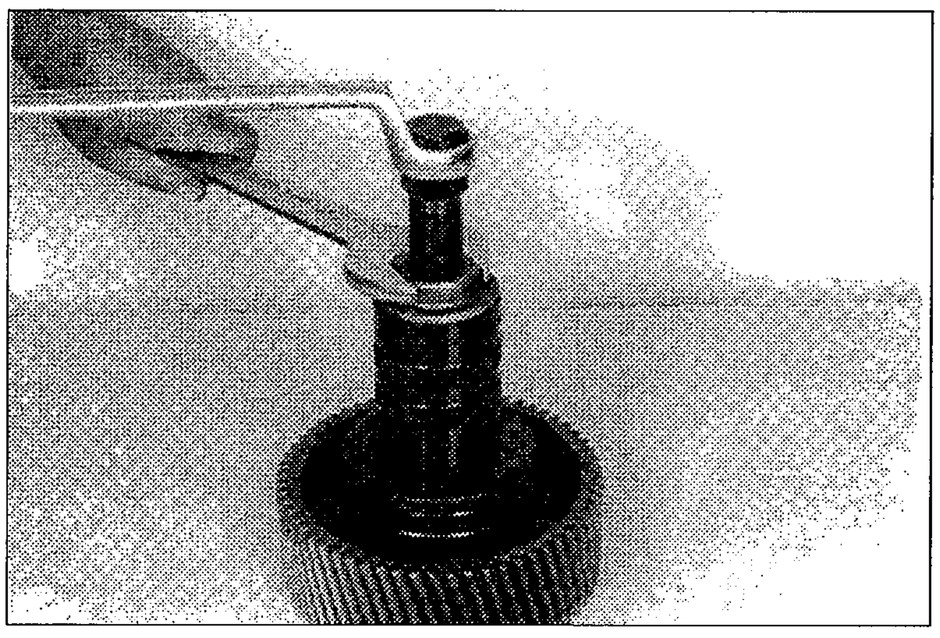
③ Separate spur gear from shaft and squeeze circlip(Arrow) out.



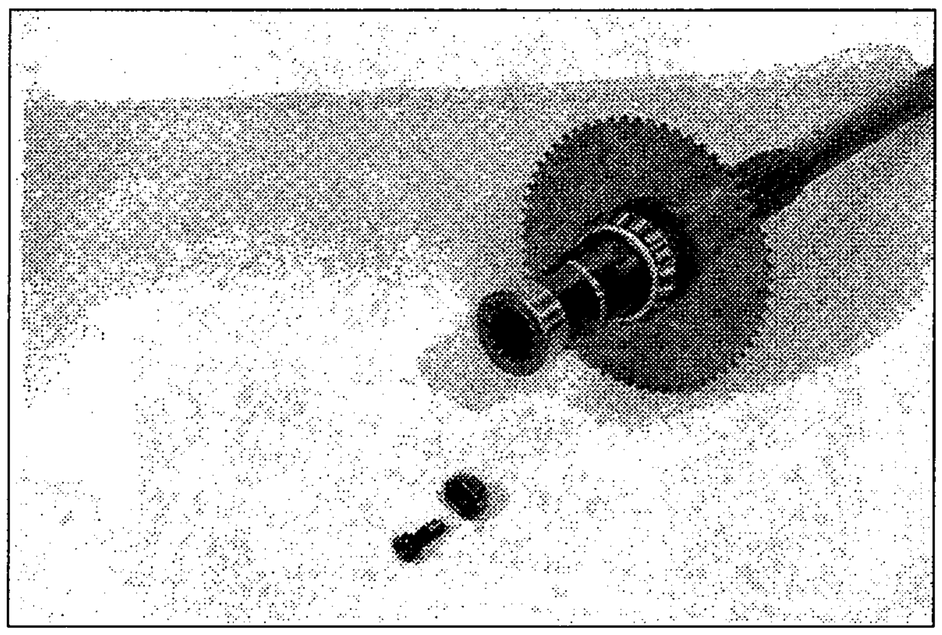
④ Pull bearing inner race from spur gear.

※ Special tool

Grab sleeve(Super)	5873 001 020
Basic set	5873 001 000



⑤ Loosen socket head screw and remove it along with clamping plate.

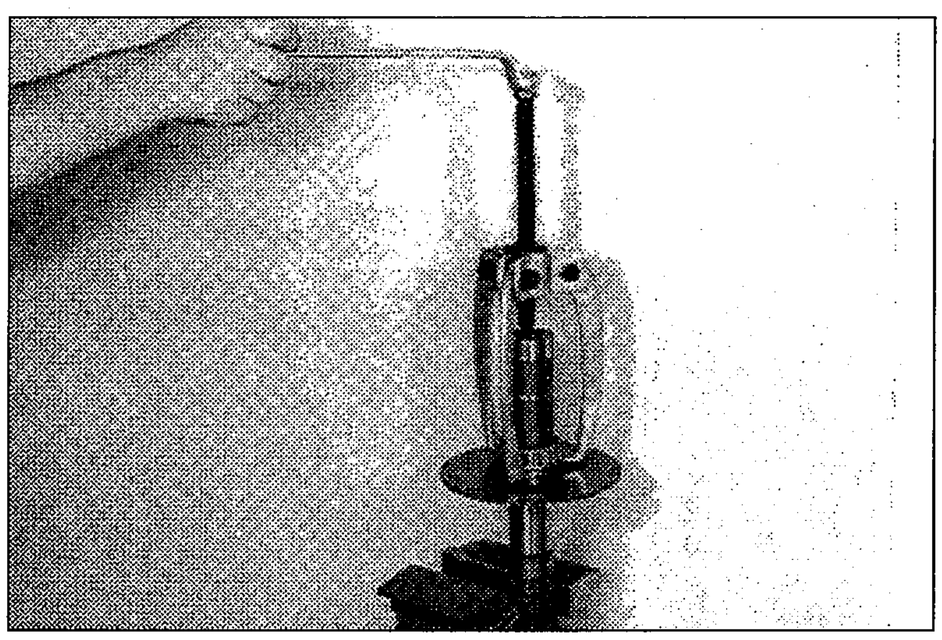


⑥ Pull bearing inner race and driver from the shaft.

※ Support puller on the end face/drive shaft. Pay attention to released shim.

※ Special tool

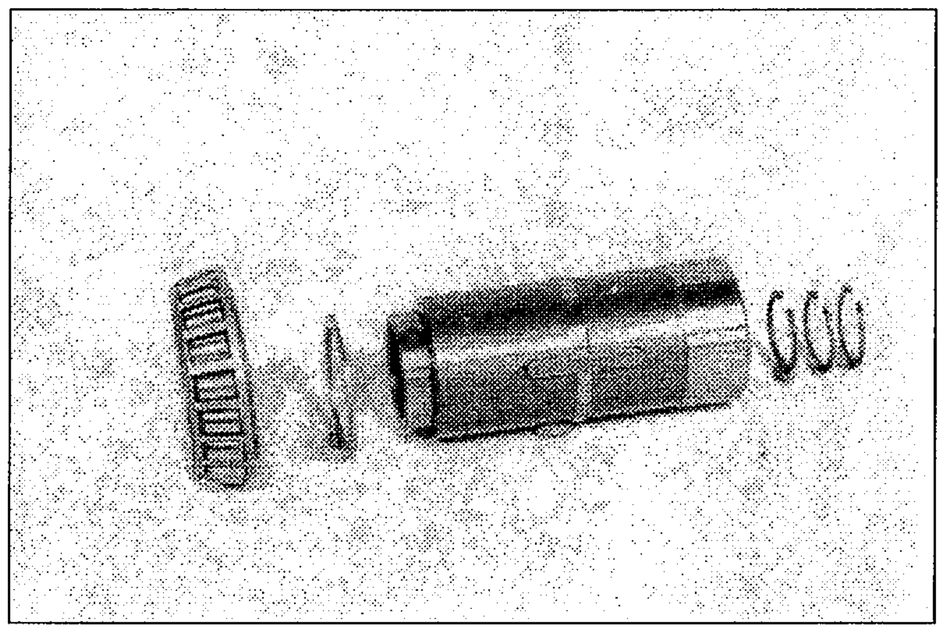
Three-leg puller 5870 971 002



⑦ Separate bearing inner race from driver.

※ Pay attention to released shim.

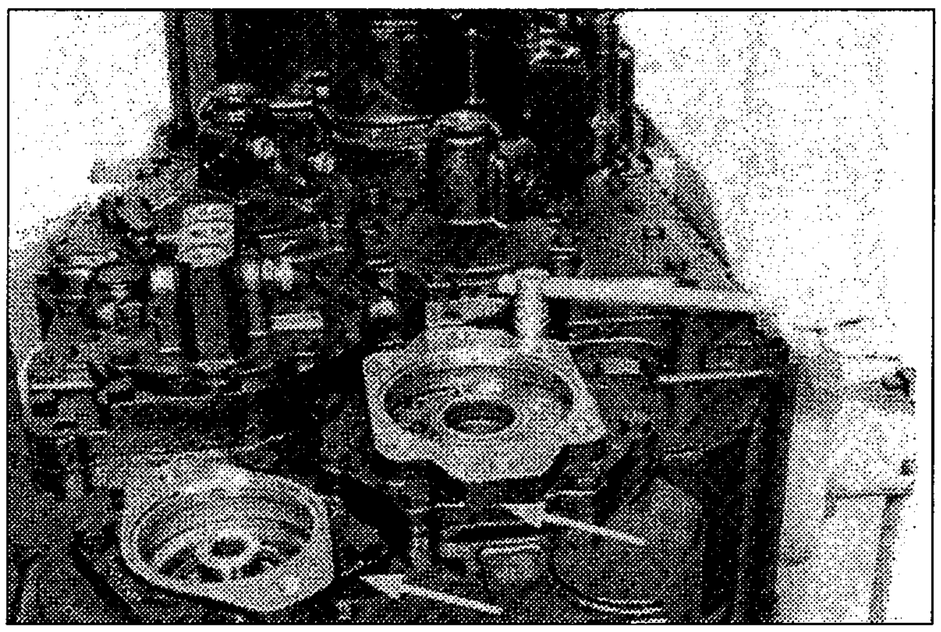
Squeeze circlips(3EA) out.



(3) Transmission pump

① Tilt gearbox housing 180°.

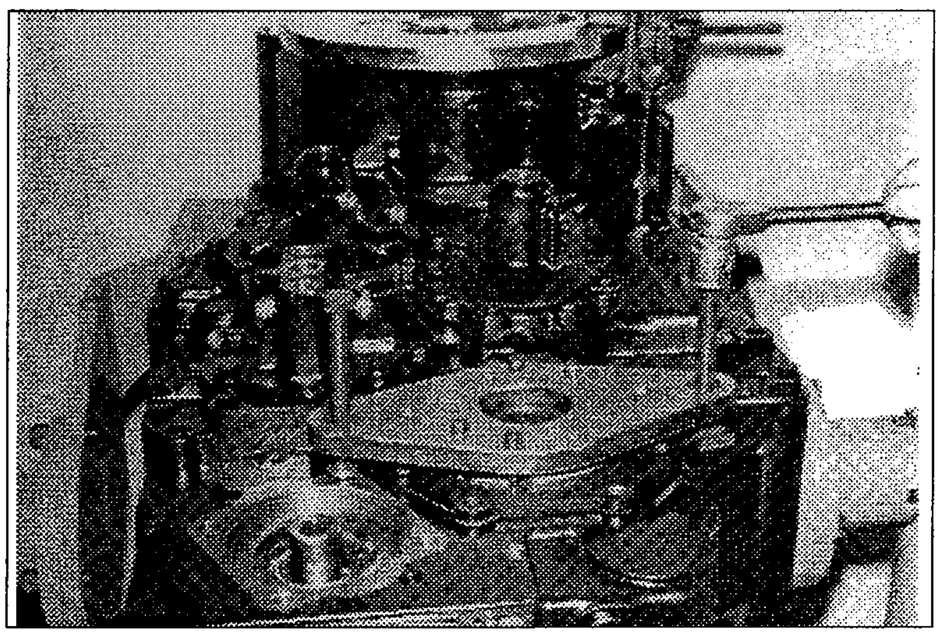
Loosen hexagon head screws and remove both pump flanges(Arrows).



② Loosen socket head screws(M8) and position puller device.
Pull transmission pump out of the housing bore.

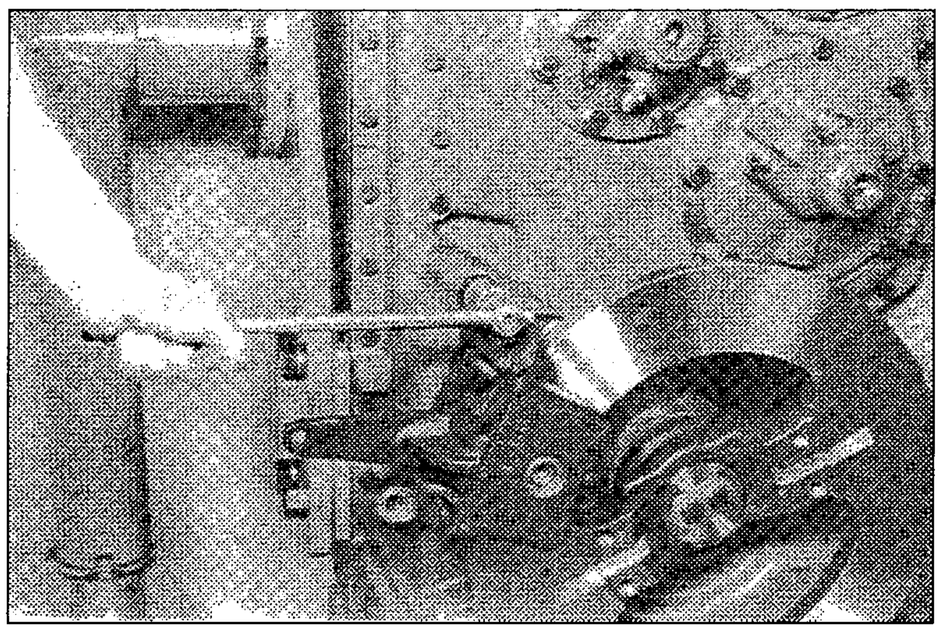
※ Tapping on the housing face is a help during the extraction operation.

※ Special tool
Puller device 5870 000 089

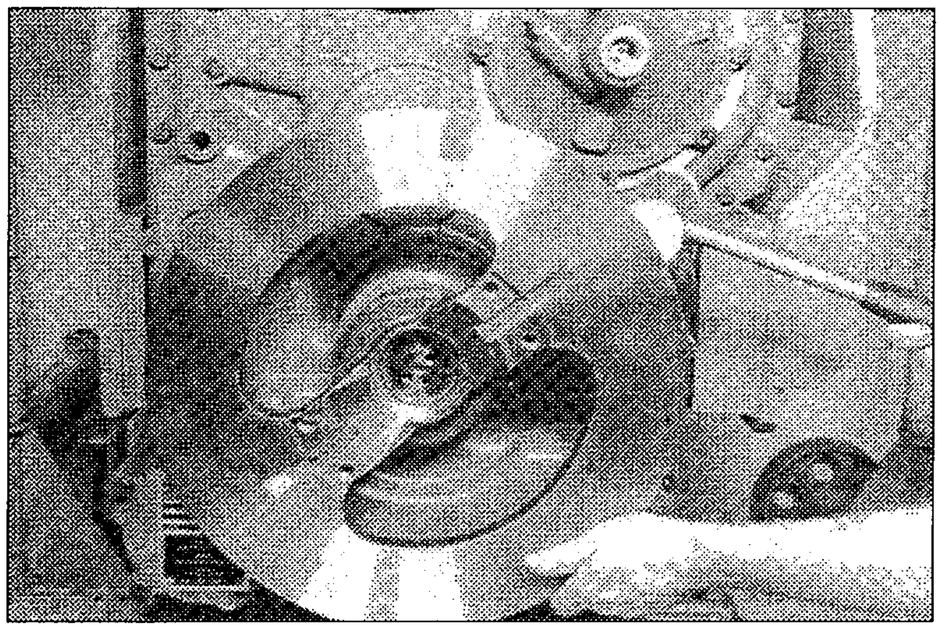


(4) Output-laysaft assembly

① Loosen screw connection and remove brake caliper.

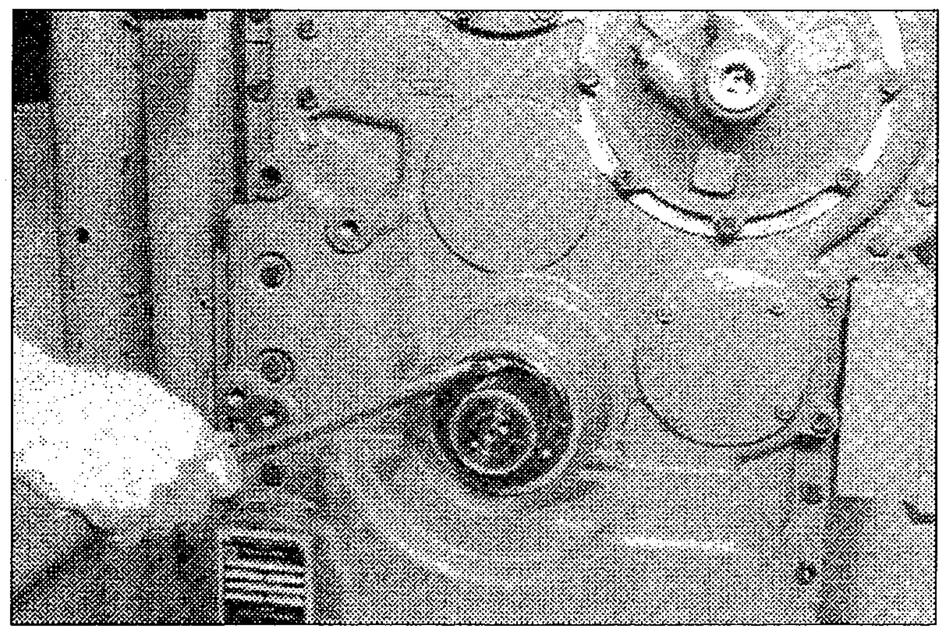


② Unlock and loosen hexagon head screws, tap brake disk loose and separate it from output shaft.



③ Pry shaft seal out of the housing bore.

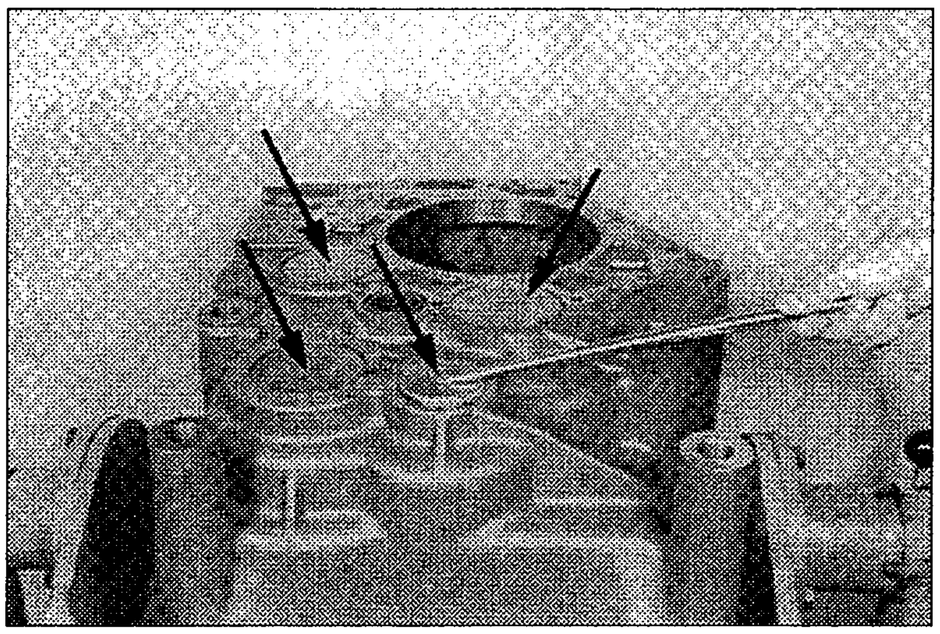
※ Special tool
Crow bar 5870 345 071



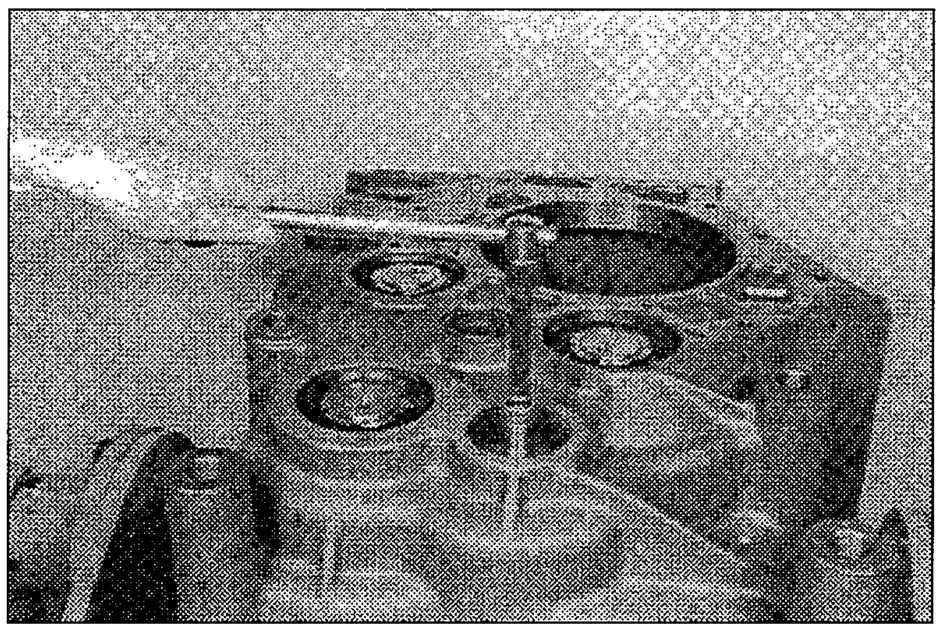
④ Tilt gearbox housing.
Remove sealing covers(Arrows).

※ Special tool

Crow bar	5870 345 071



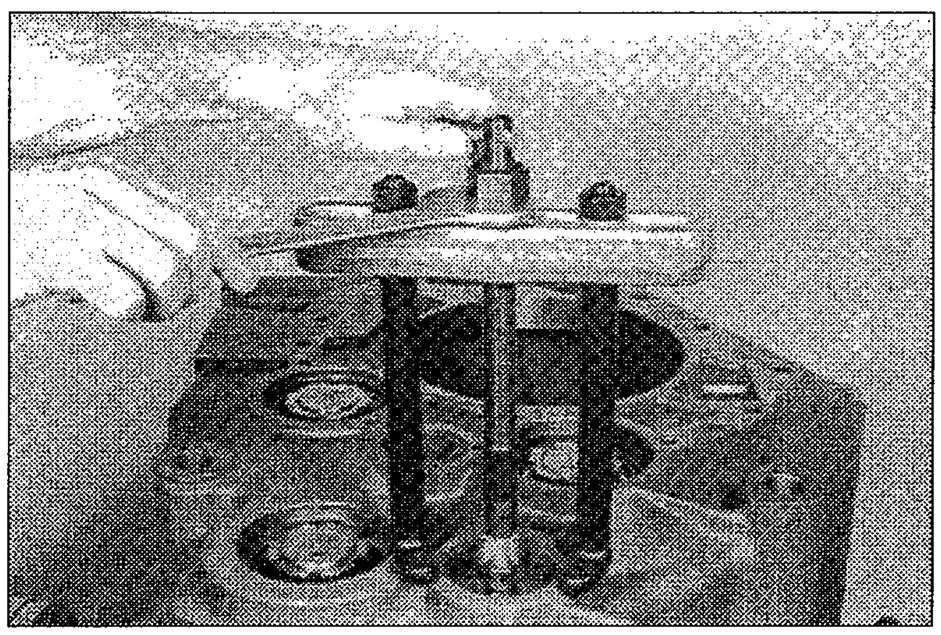
⑤ Loosen hexagon head screws.



⑥ Pull idler shaft by means of puller out of the housing bore.

※ Special tool

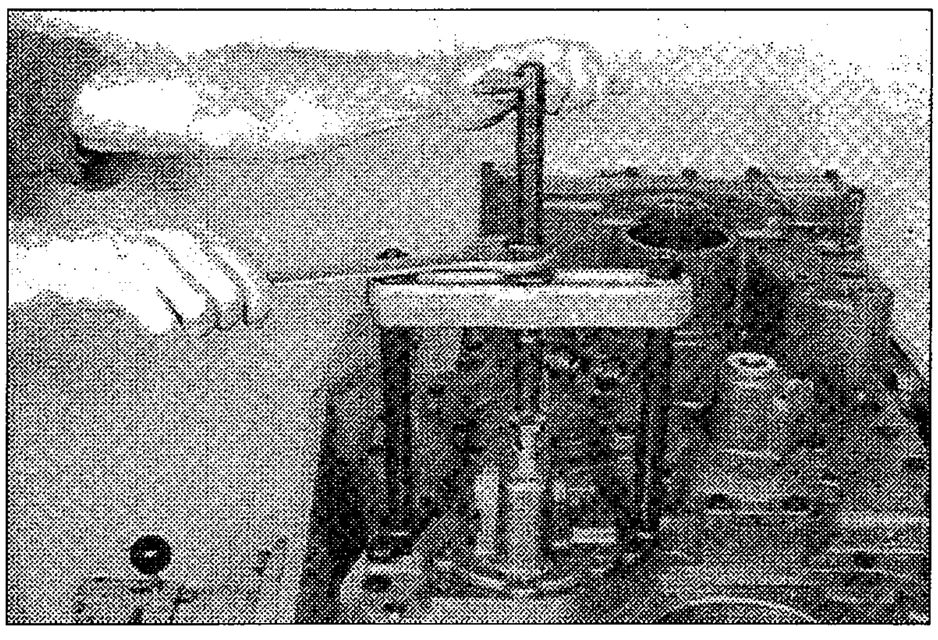
Counter support	5870 300 020
Set screw	5870 204 048



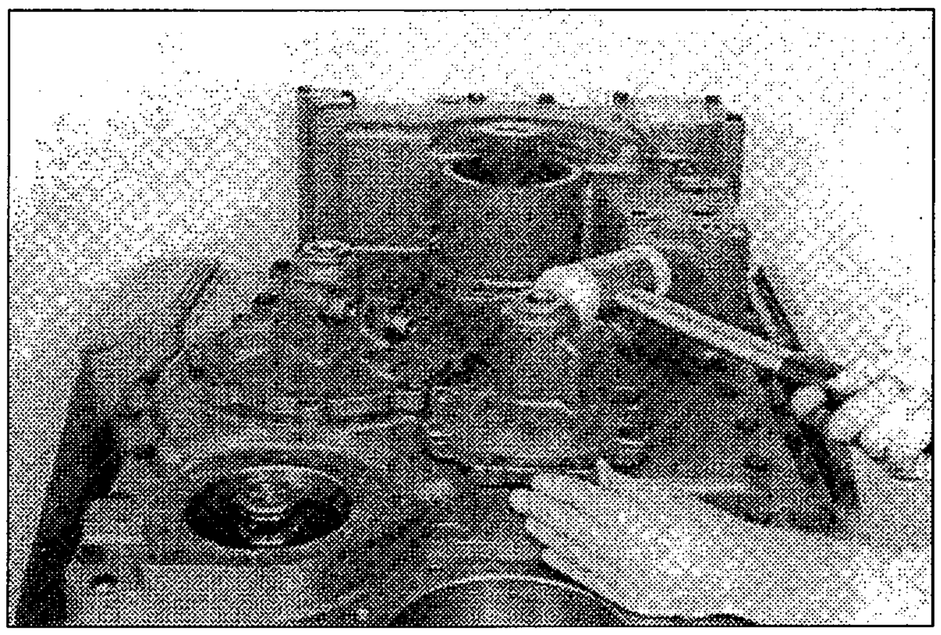
⑦ Tilt gearbox housing 180°.
Loosen hexagon head screws and pull bearing cover K1/KV out of the housing bore.

※ Special tool

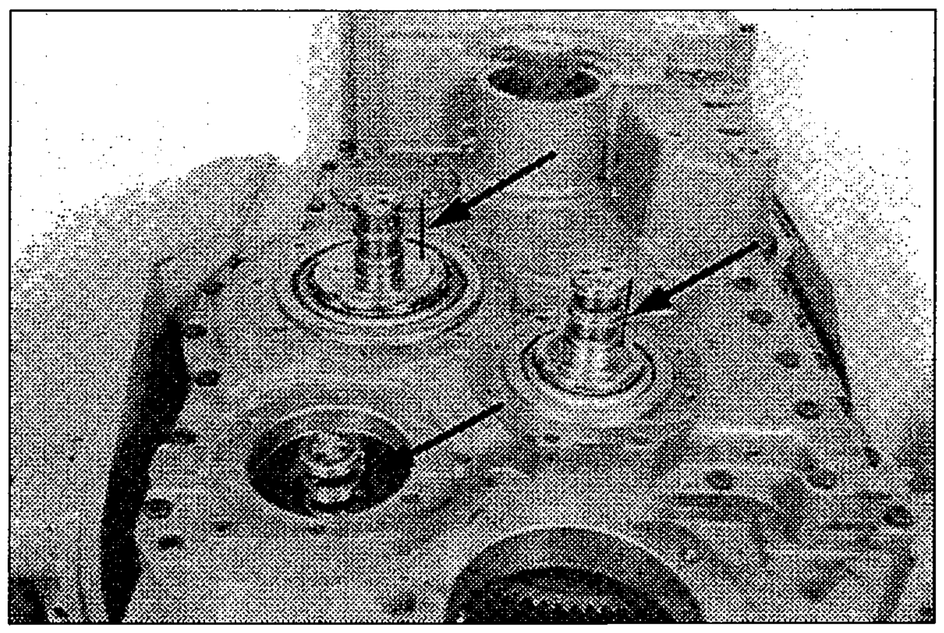
Counter support	5870 300 020
Threaded insert	5870 204 042



⑧ Loosen hexagon head screws and remove bearing cover KR/K2 and K3/K4.



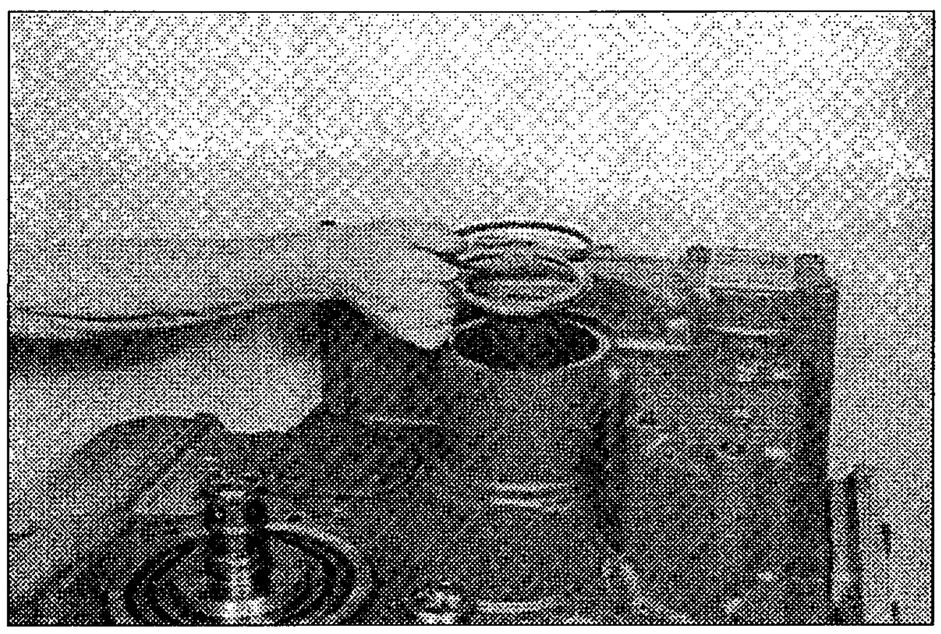
⑨ Squeeze rectangular rings(3 pieces/axle) out, see arrows.



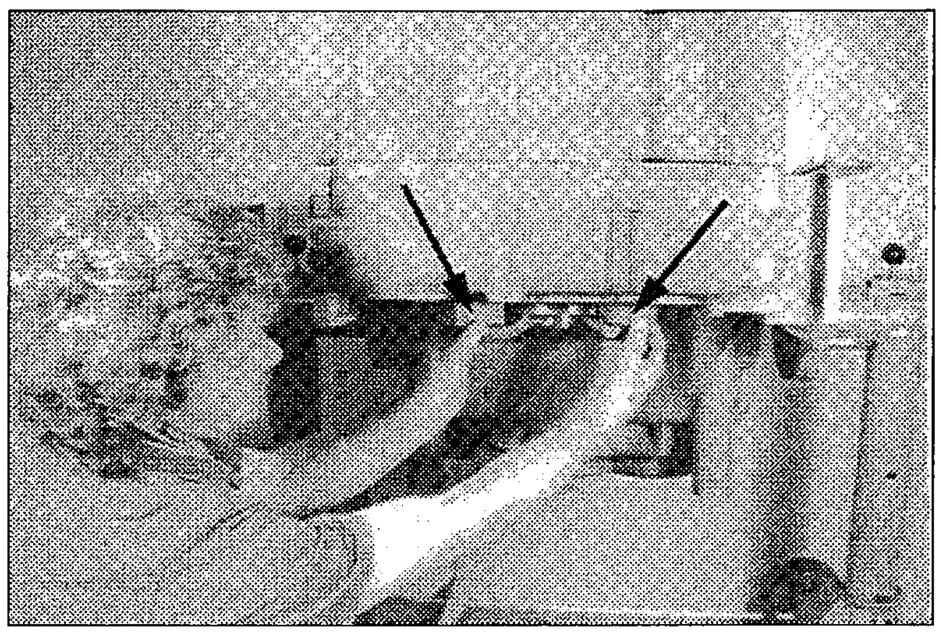
⑩ Squeeze circlip out and remove released washers.

※ Special tool

Set of external pliers 5870 900 015



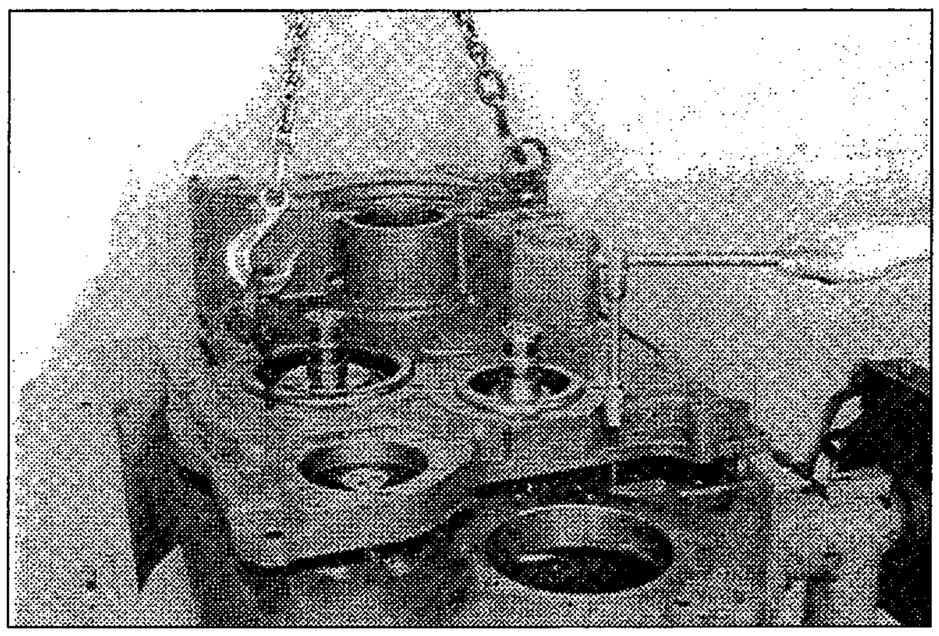
⑪ Support output flange against gearbox housing, see arrows.



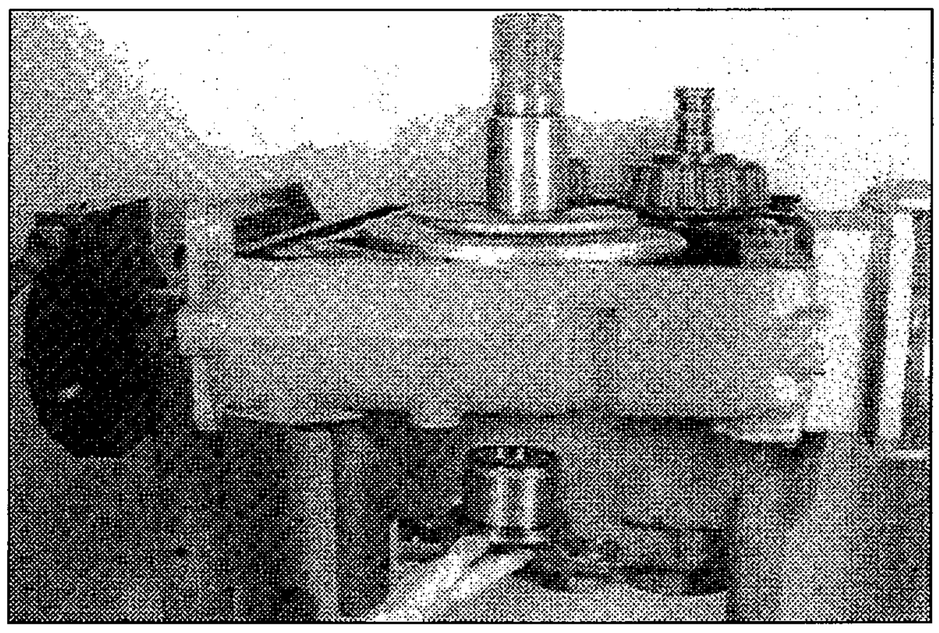
⑫ Loosen hexagon head screws and separate housing cover from gearbox housing, using forcing screws and lifting device.

※ Special tool

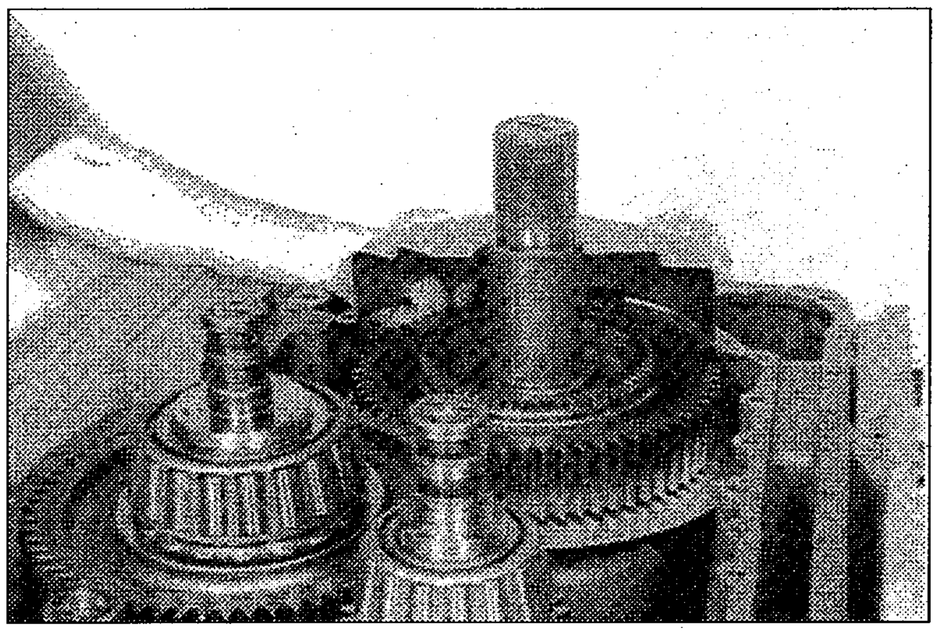
Forcing screws(M10)	5870 204 005
Set of eye bolts	5870 204 002



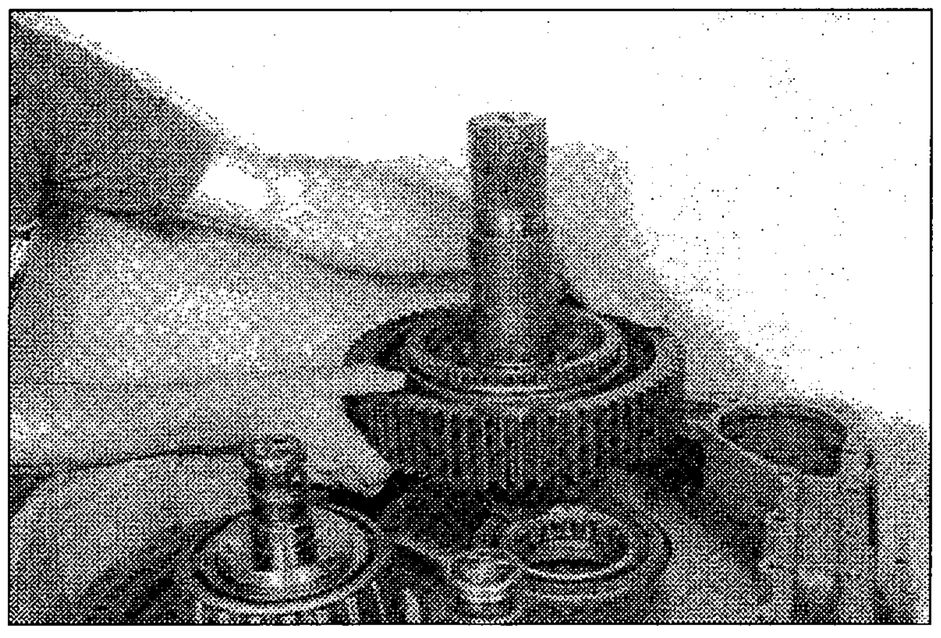
⑬ Unlock and loosen hexagon head screws. Remove output flange and pry shaft seal out of the housing bore.



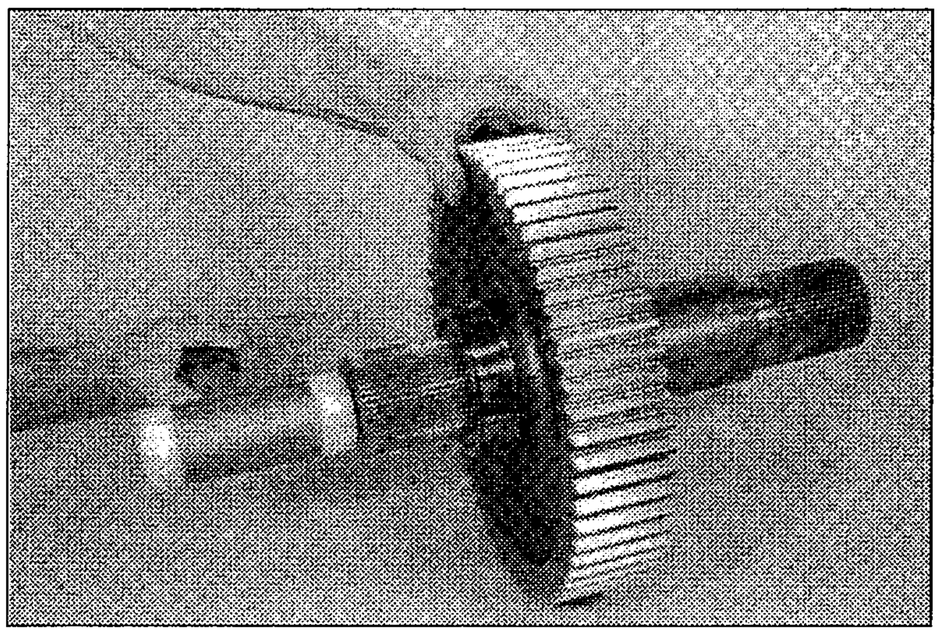
⑭ Loosen hexagon head screws and remove oil baffle.



⑮ Remove output gear along with shaft.



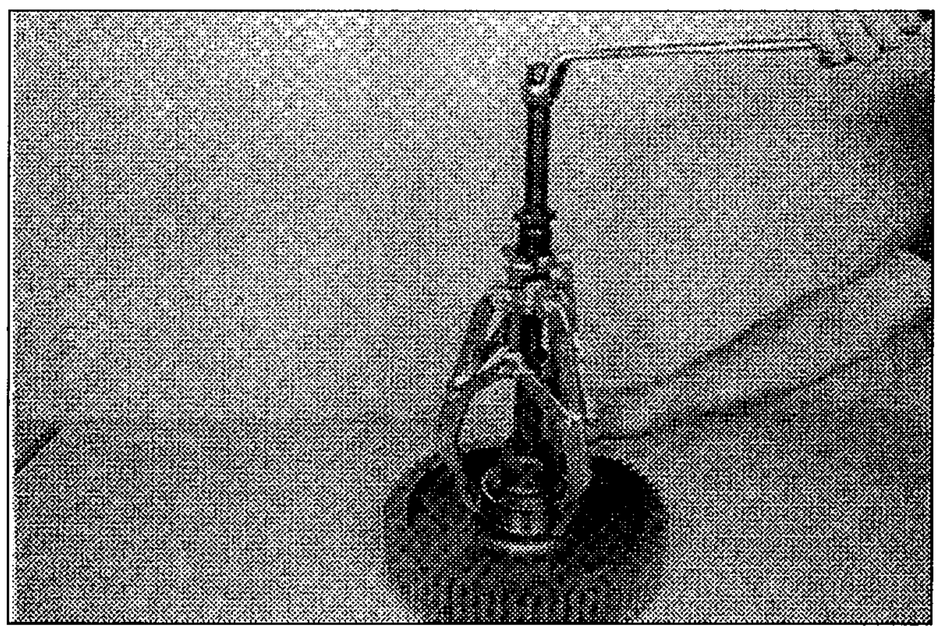
⑯ Separate output shaft from spur gear.



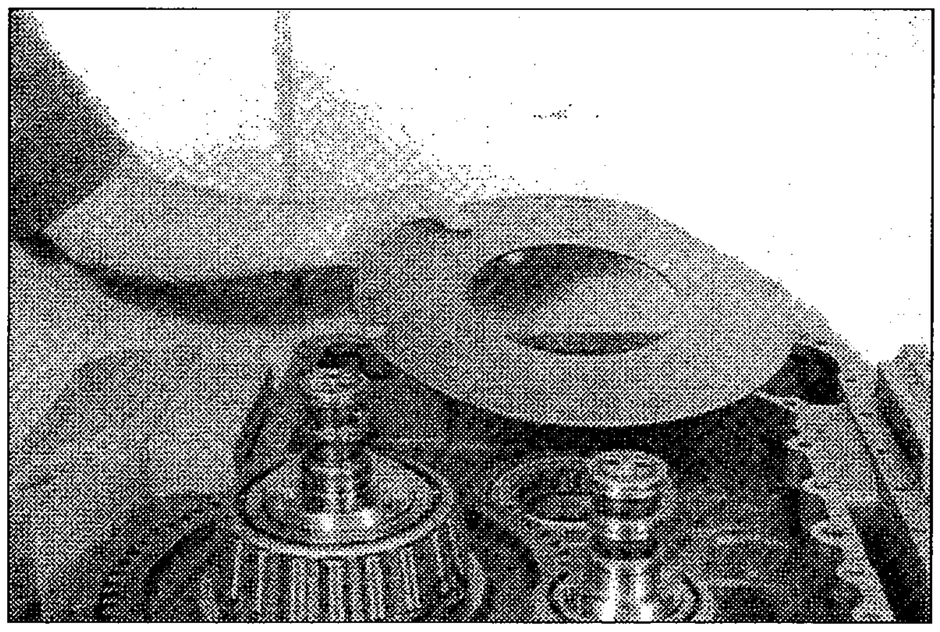
⑰ Pull bearing inner race from output gear.

※ Special tool

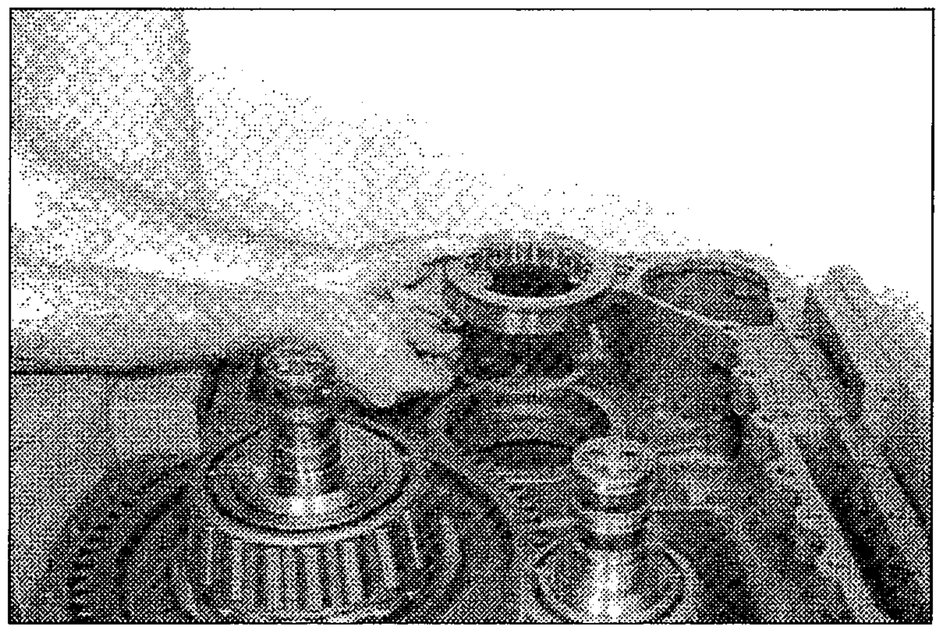
Three-leg puller 5870 971 003



⑱ Remove plate.



⑲ Drive roller bearing out of the housing bore and remove it.



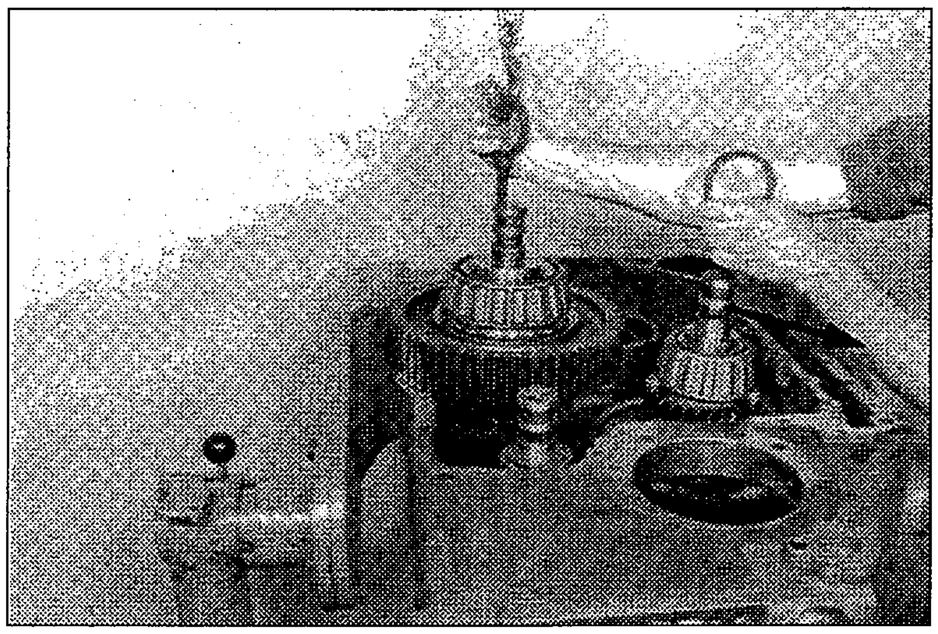
(5) Disassemble clutches and layshaft gear

① Remove clutches K3/K4, KR/K2 and KV/K1 by means of lifting device.

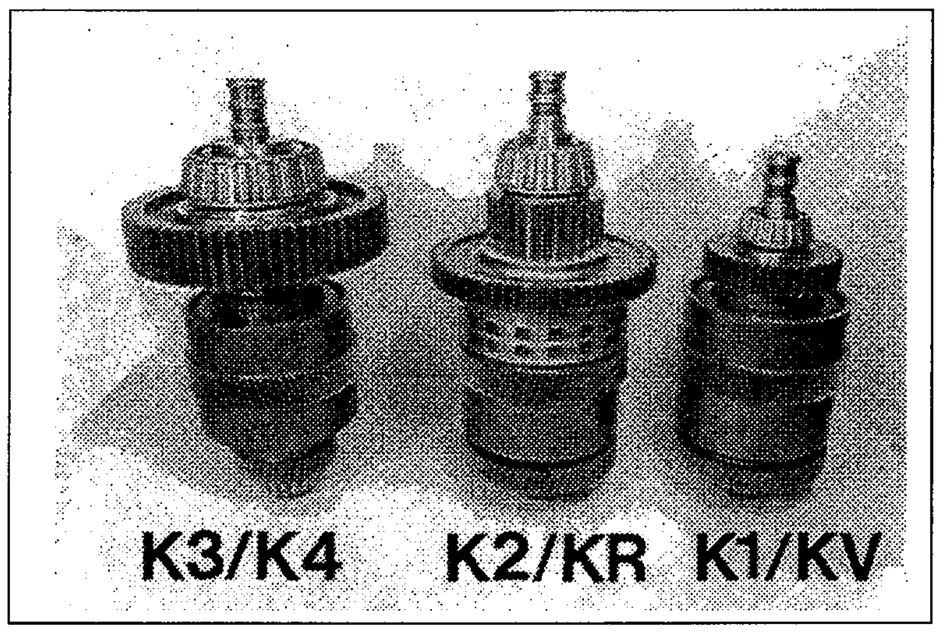
※ At the removal of the clutch K3/K4, displace clutch KR/K2 in direction of arrow, see figure on the right.

※ Special tool

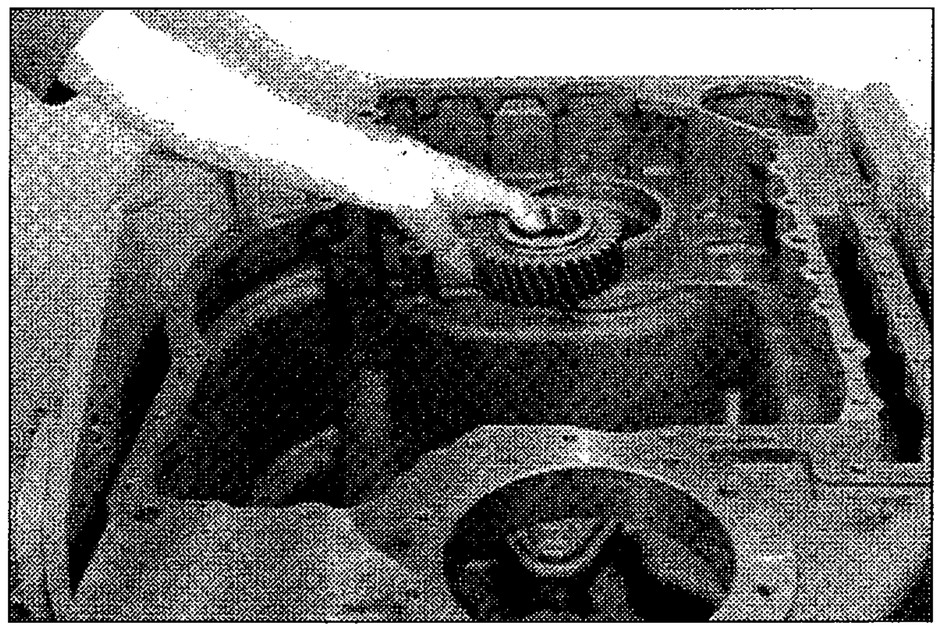
Set of eye bolts 5870 204 002



② Illustration on the right shows the clutches in removed condition.

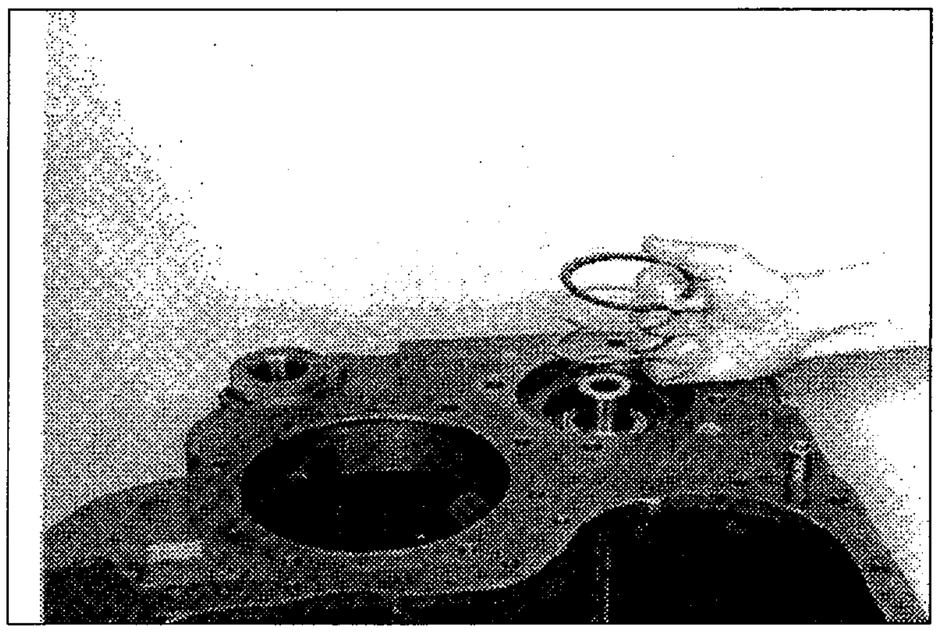


③ Remove layshaft gear.



(6) Disassemble power take-off Ⅱ

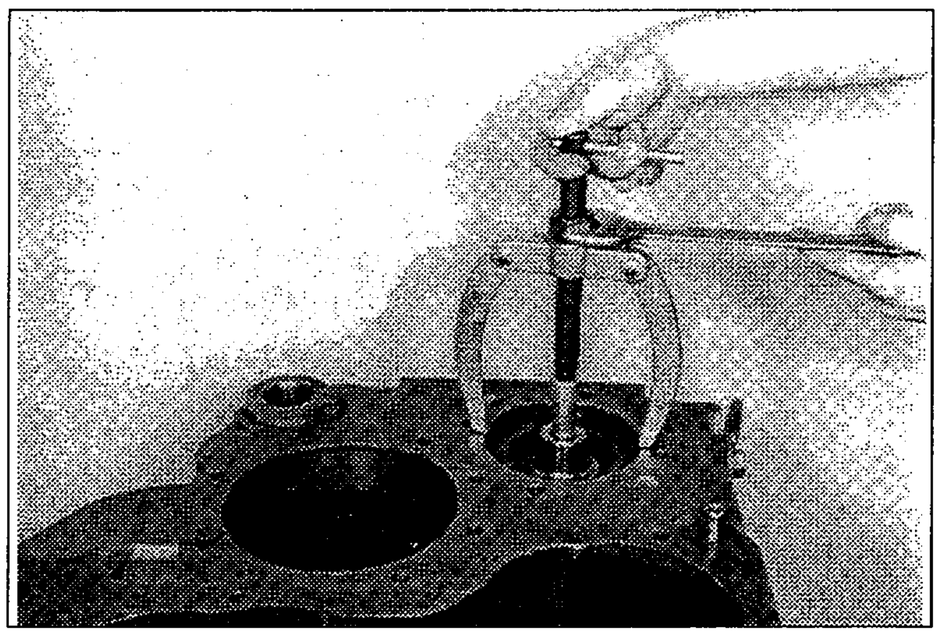
① Squeeze circlip out and remove shim.



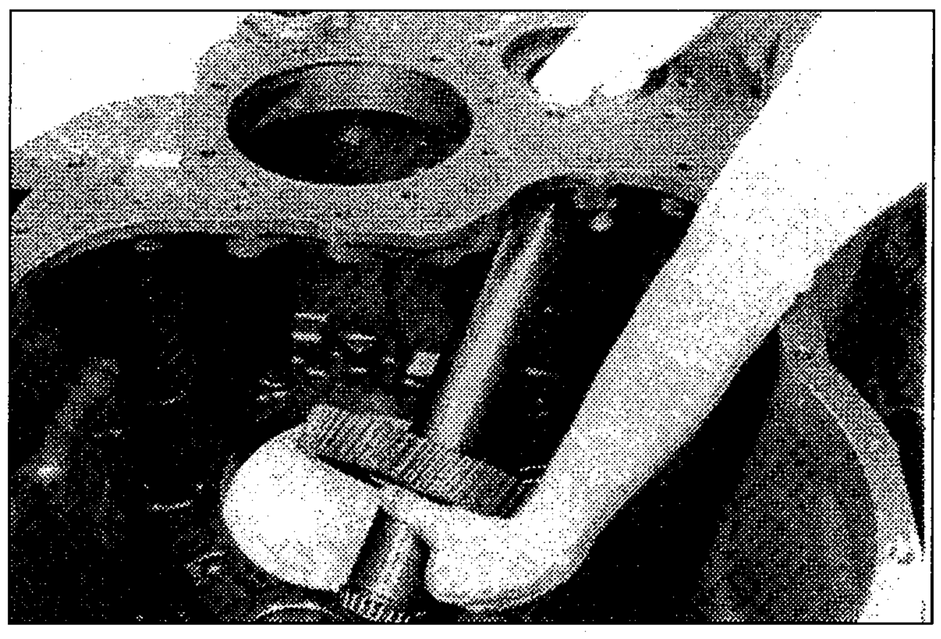
② Pull Pto-shaft by means of internal puller out of the housing bore until the bearing outer race is released.

※ Special tool

Internal puller	5870 300 006
Counter support	5870 300 003



③ Take shaft out of the housing.

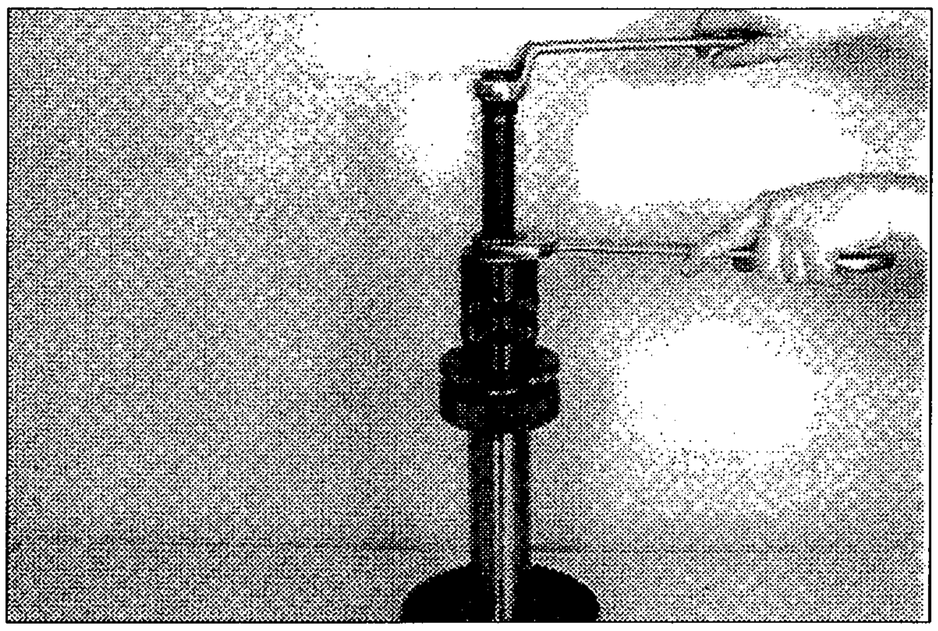


④ Pull bearing inner race from shaft(Figure on the right).
Press opposite bearing inner race from the shaft.

※ The separation of shaft and gear is not possible(Shrink fit).

※ Special Tool

Grab sleeve(Super)	5873 001 020
Grab sleeve(Super)	5873 001 027
Basic set	5873 001 000



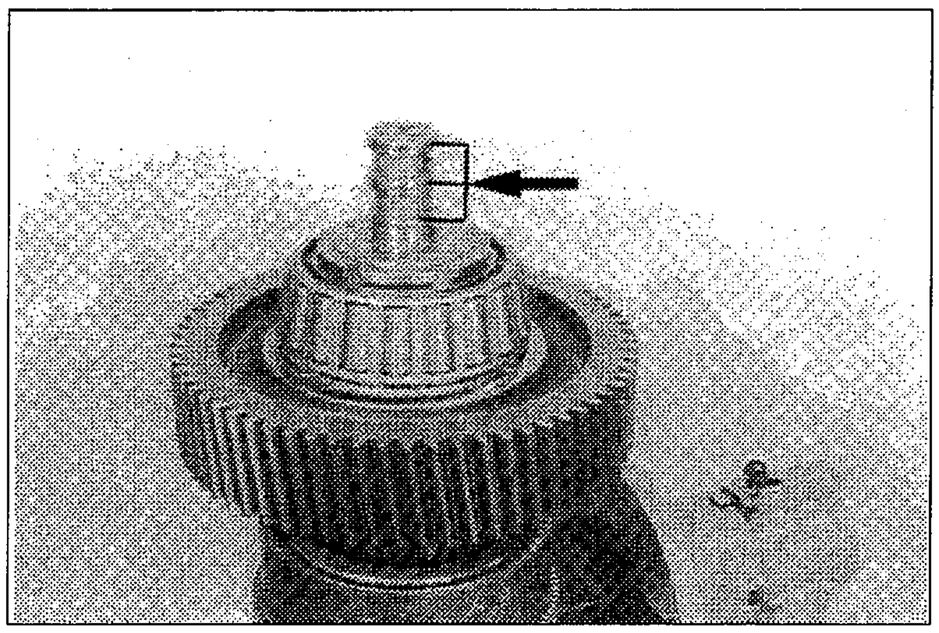
(7) Disassemble clutches

Clutch-K3/K4

① Locate clutch by means of special device.
Remove rectangular rings(3EA, see arrow)

※ Special tool

Clamping ring	5870 654 022

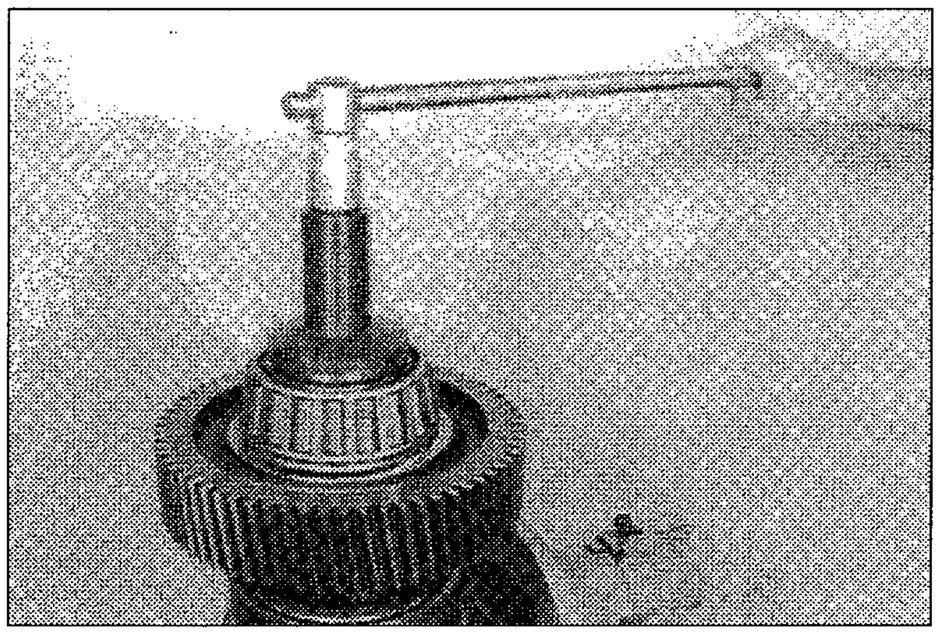


② Loosen slotted nut.

※ Slotted nut is secured with loctite.
To prevent the damage of the thread, heat slotted nut prior to loosen it(About 120℃).

※ Special tool

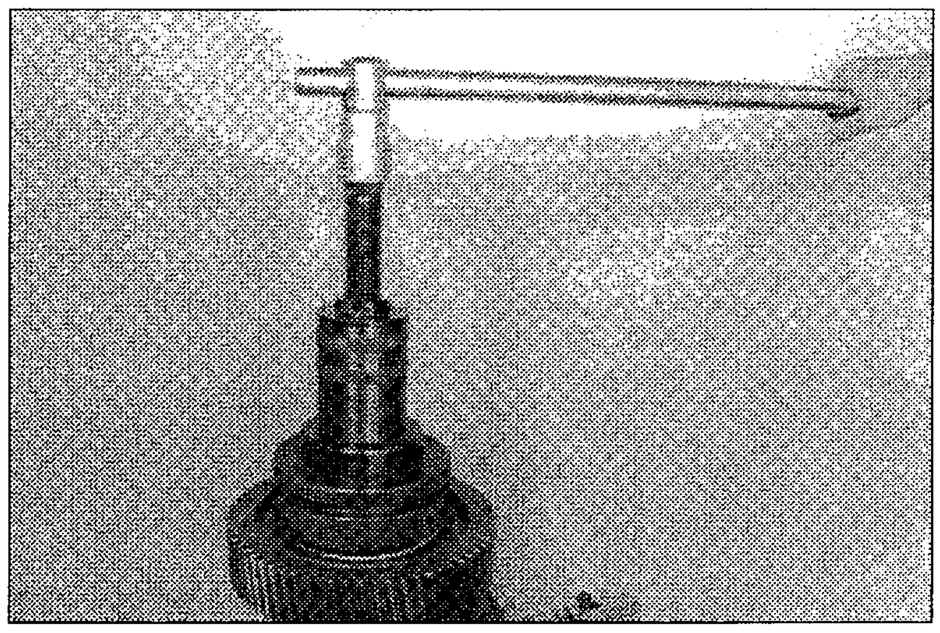
Hook spanner	5870 401 110
Hot-air blower 220V	5870 221 500
Hot-air blower 110V	5870 221 501



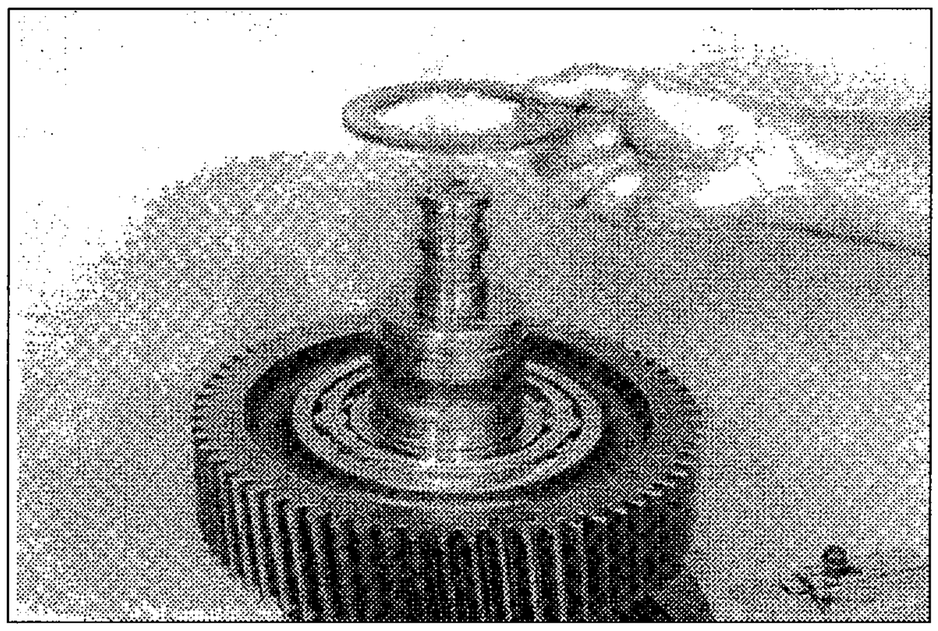
③ Pull off tapered roller bearing.

※ Special tool

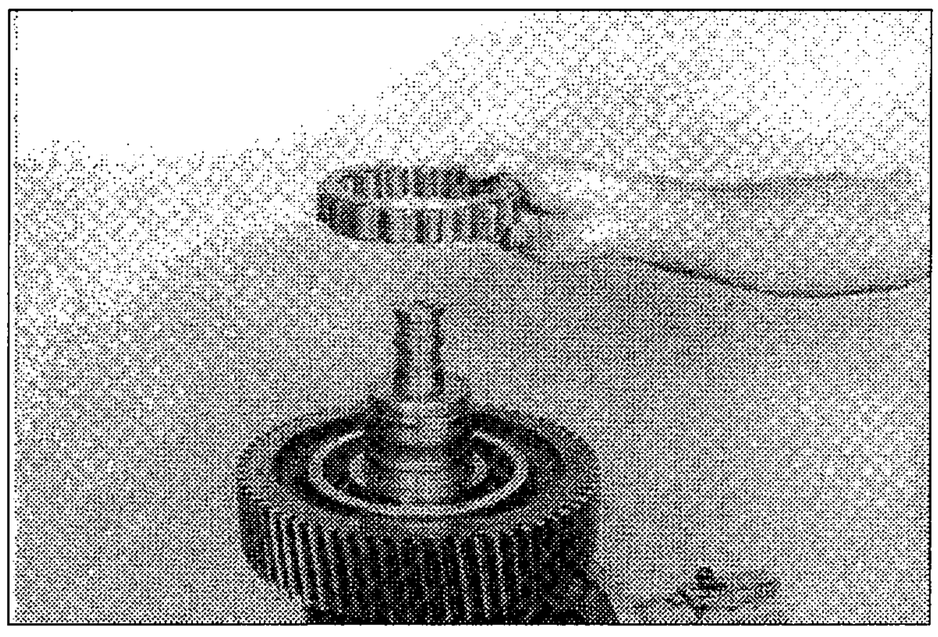
Grab sleeve	5870 003 030
Reducer	5870 003 011
Basic set	5870 002 001



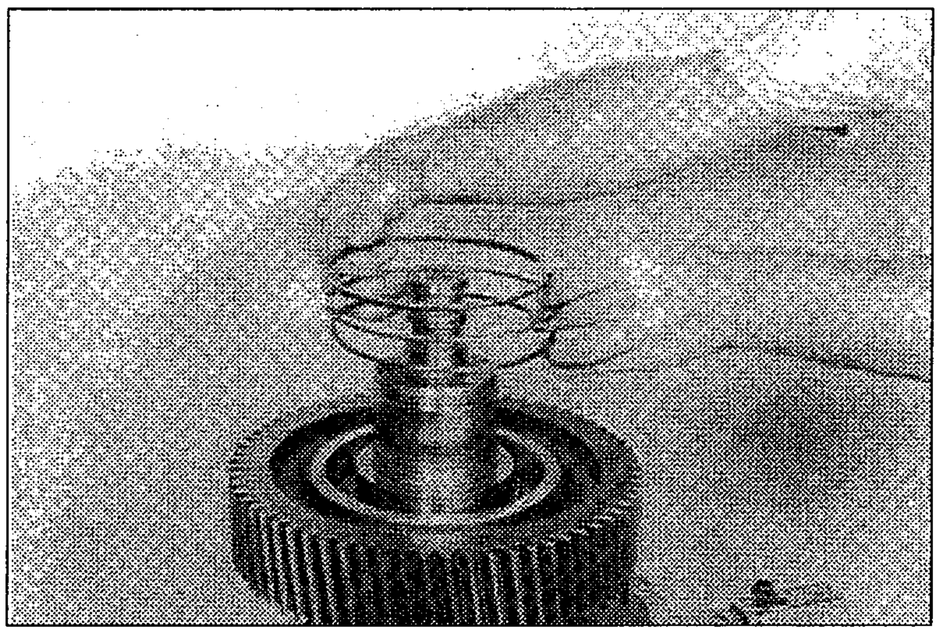
④ Remove flanged disk.



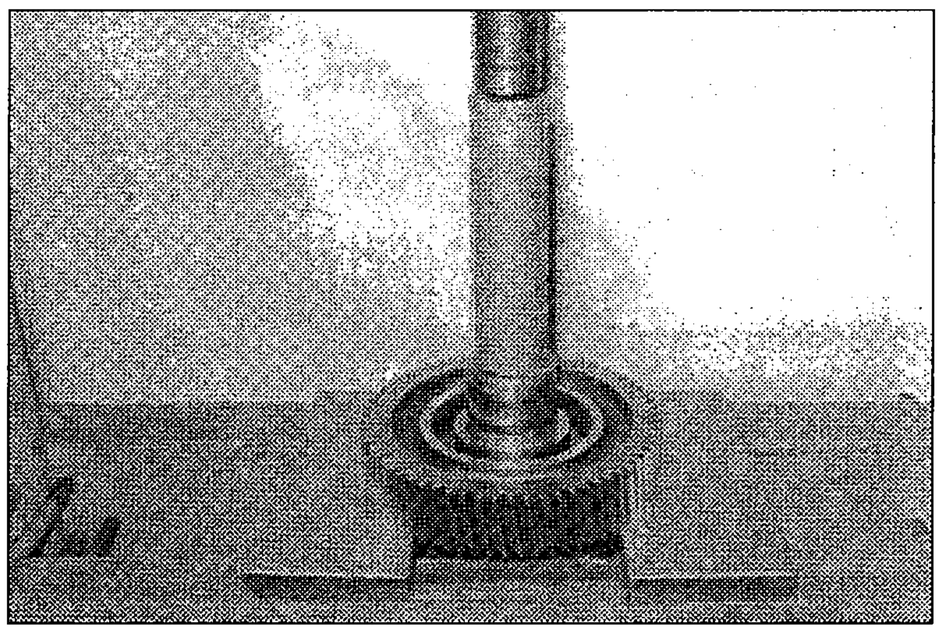
⑤ Remove upper roller bearing.



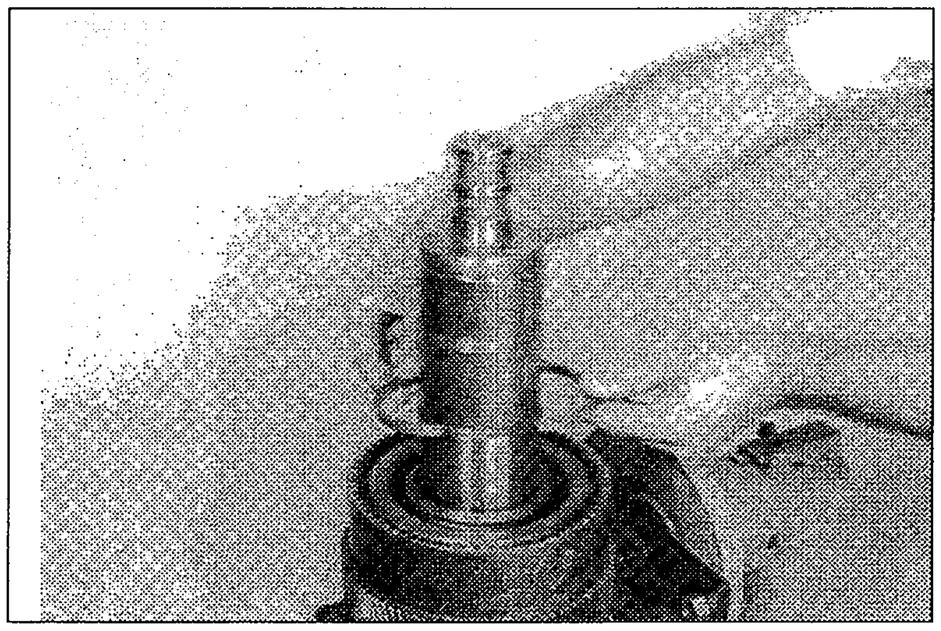
⑥ Remove angle ring, squeeze snap ring out and remove thrust ring.



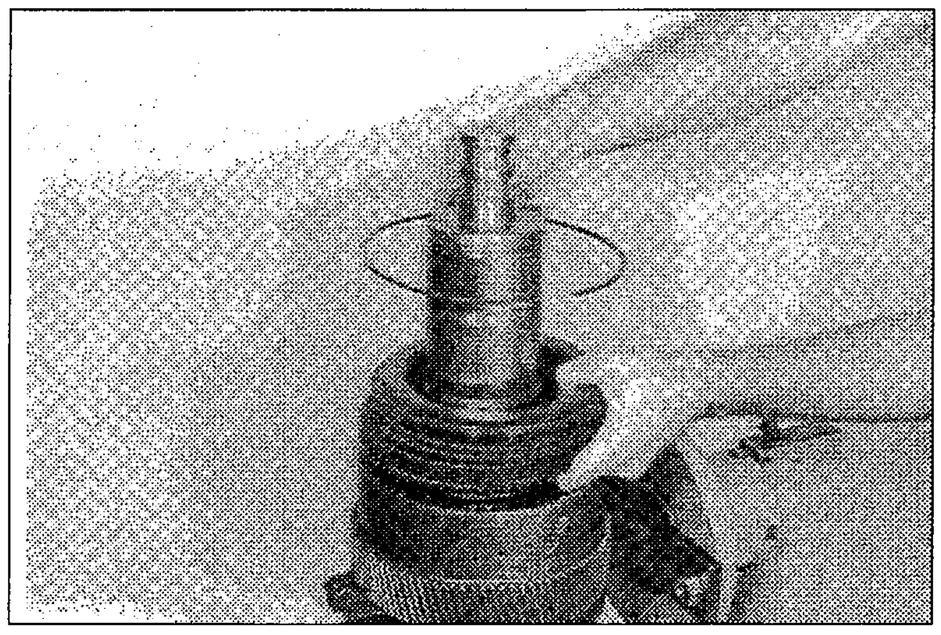
⑦ Press spur gear K3 from plate carrier and remove released roller bearing.



⑧ Remove split ring.



⑨ Squeeze snap ring out and remove complete **plate pack K3.**

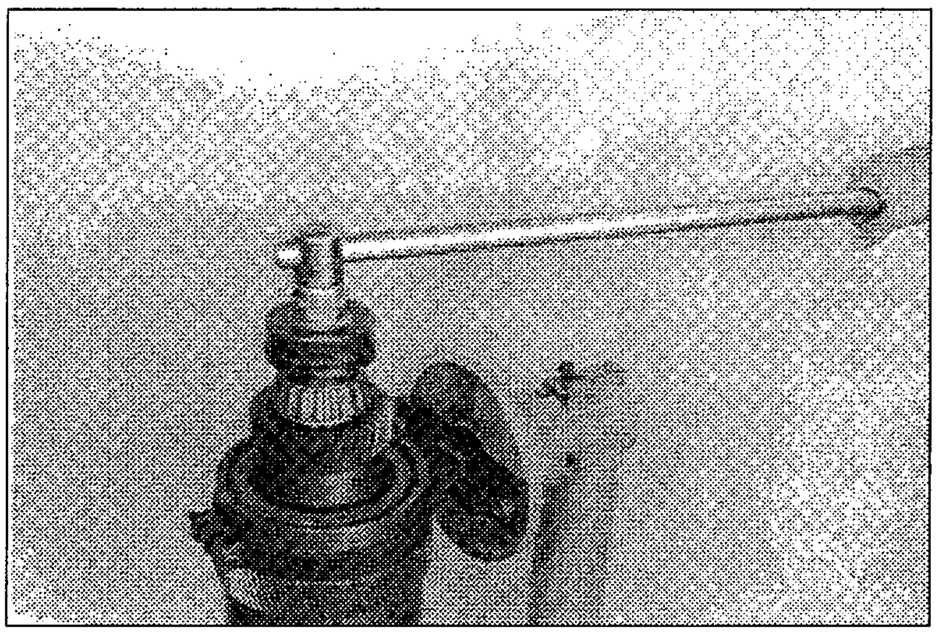


⑩ Tilt clutch 180°.
Loosen slotted nut.

※ Slotted nut is secured with loctite.
To prevent the damage of the thread, heat slotted nut prior to loosen it(About 120°C).

※ Special tool

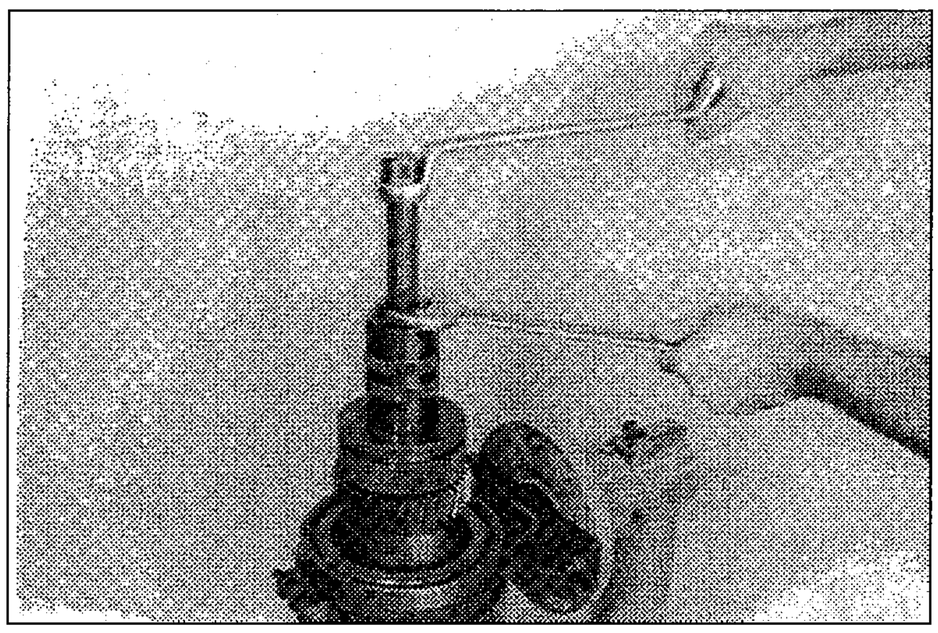
Hook spanner	5870 401 115
Hook spanner	5870 401 118



⑪ Pull off tapered roller bearing.

※ Special tool

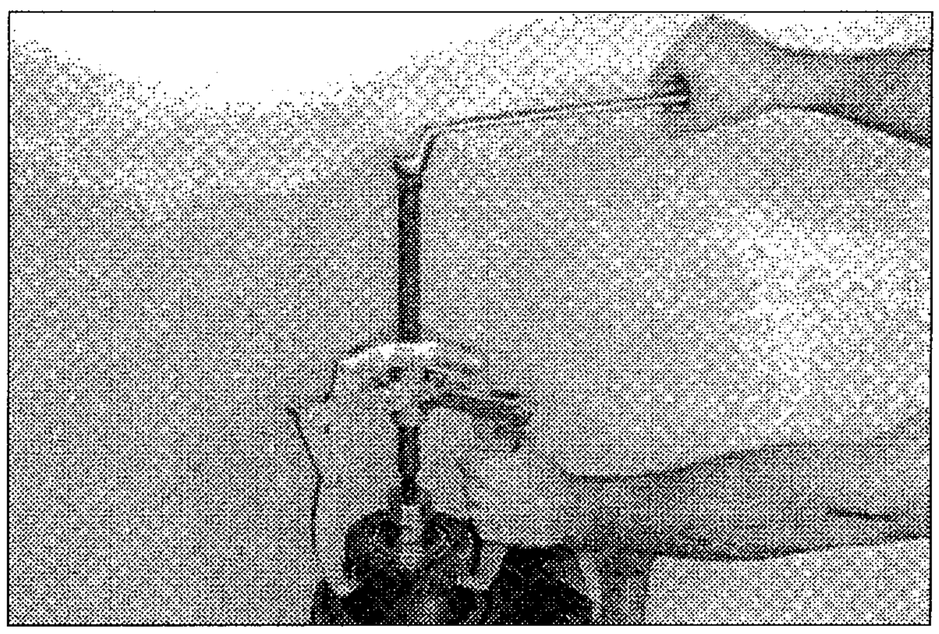
Grab sleeve	5873 001 037
Basic set	5873 001 000



⑫ Pull spur gear K4 from plate carrier.

※ Special tool

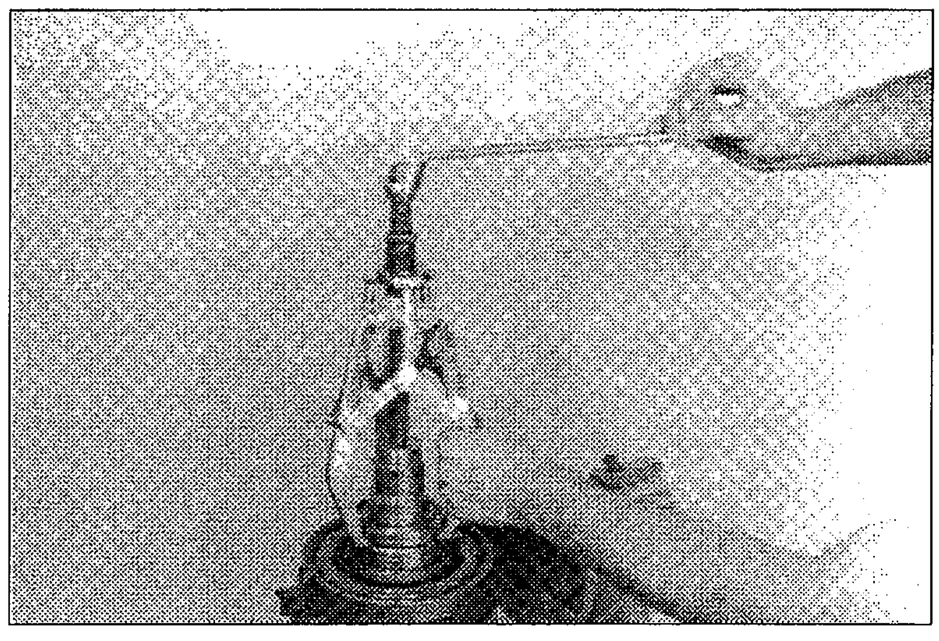
Three-leg puller	5870 971 003



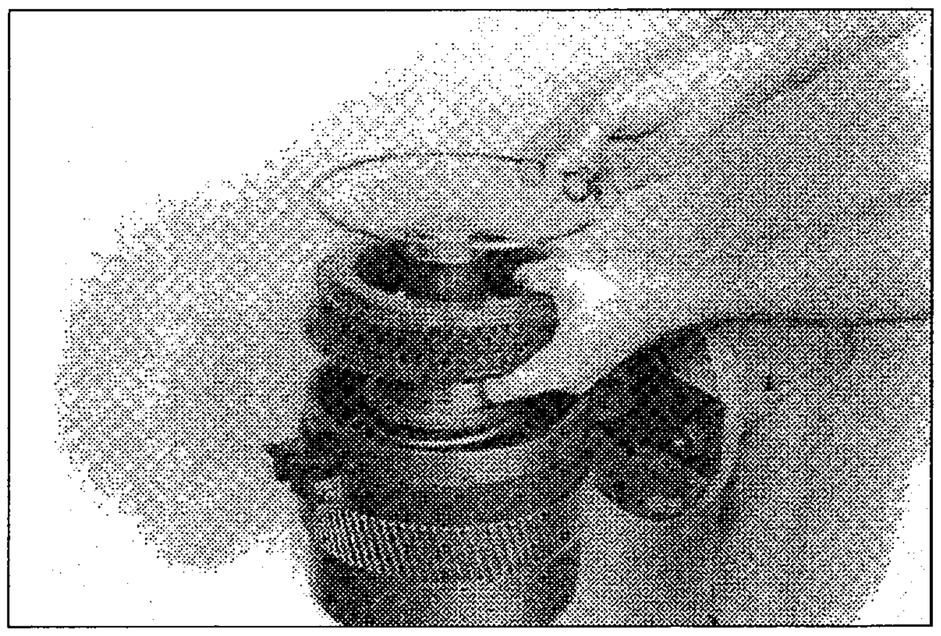
⑬ Remove oil feed ring and pull ball bearing from plate carrier.

※ Special tool

Three-leg puller	5870 971 002



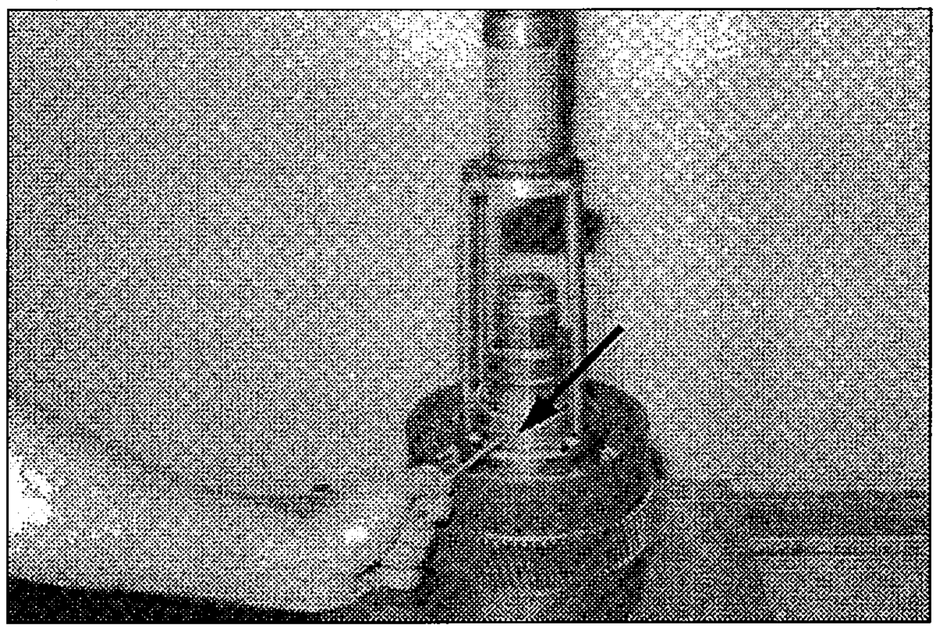
⑭ Squeeze snap ring out and remove complete plate pack K4.



⑮ Preload compression spring by means of special device.
Squeeze snap ring(Arrow) out and remove released components.
Now, separate piston from plate carrier, using compressed air.
Disassemble opposite piston accordingly.

※ Special tool

Pressure piece	5870 345 072



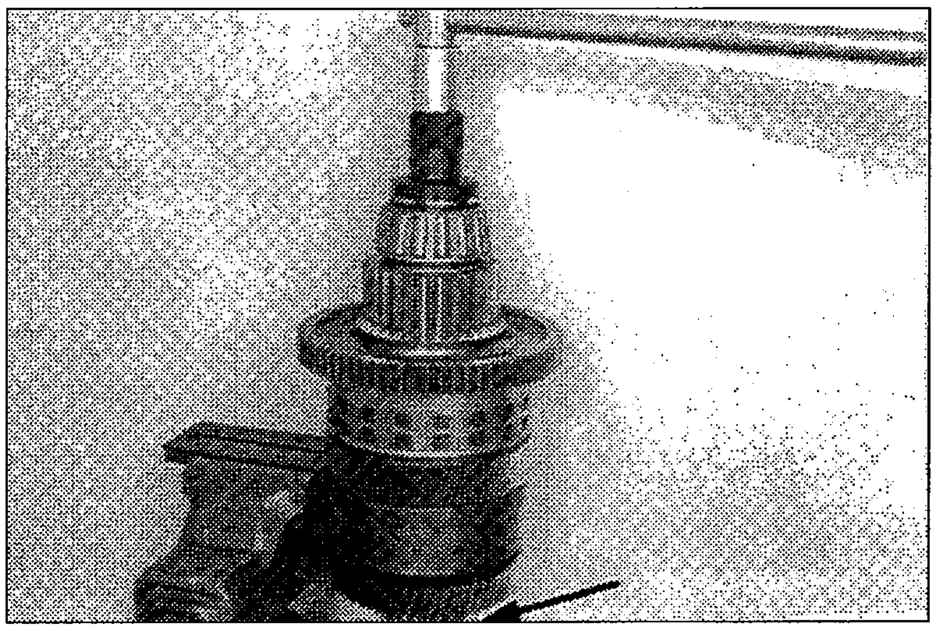
Clutch KR/K2

⑯ Locate clutch by means of special device and loosen slotted nut.
Loosen opposite slotted nut(Arrow) accordingly.

※ The slotted nuts are secured with loctite-heat prior to loosen them.

※ Special tool

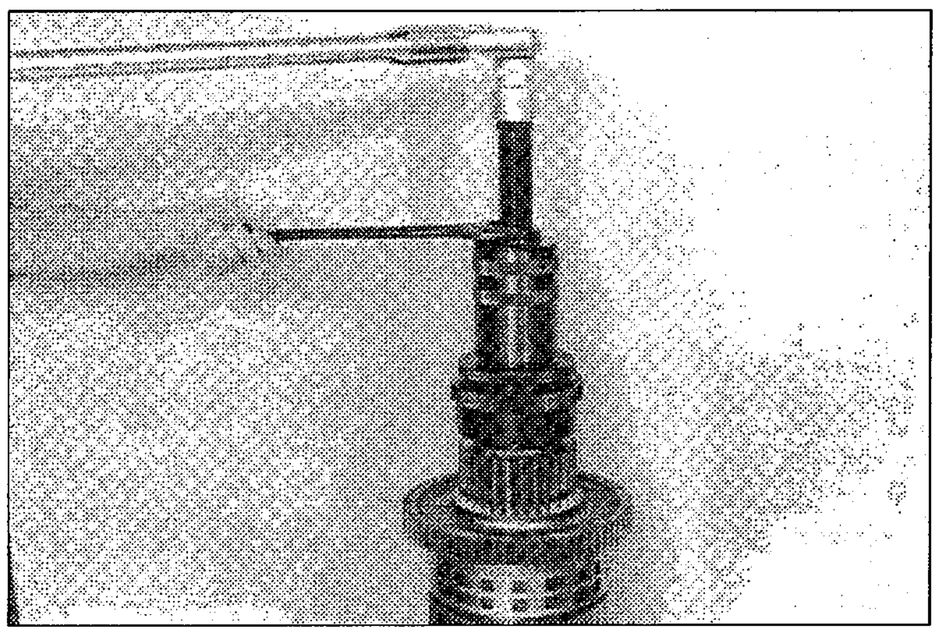
Clamping ring	5870 654 022
Hook spanner	5870 401 099
Hook spanner	5870 401 118
Hook spanner	5870 401 115



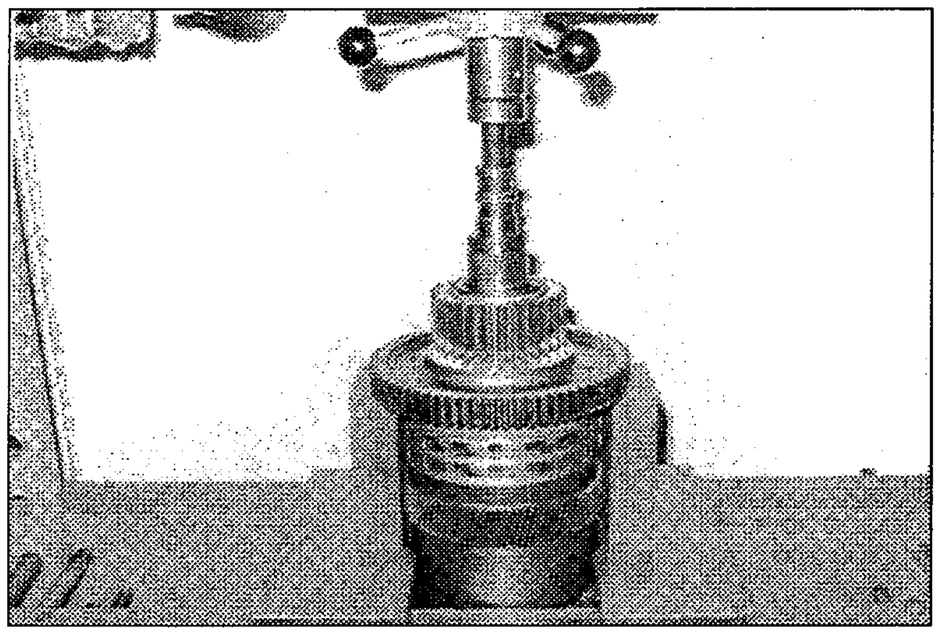
⑰ Pull off tapered roller bearing.

※ Special tool

Grab sleeve(Super)	5873 002 039
Basic set	5873 002 001



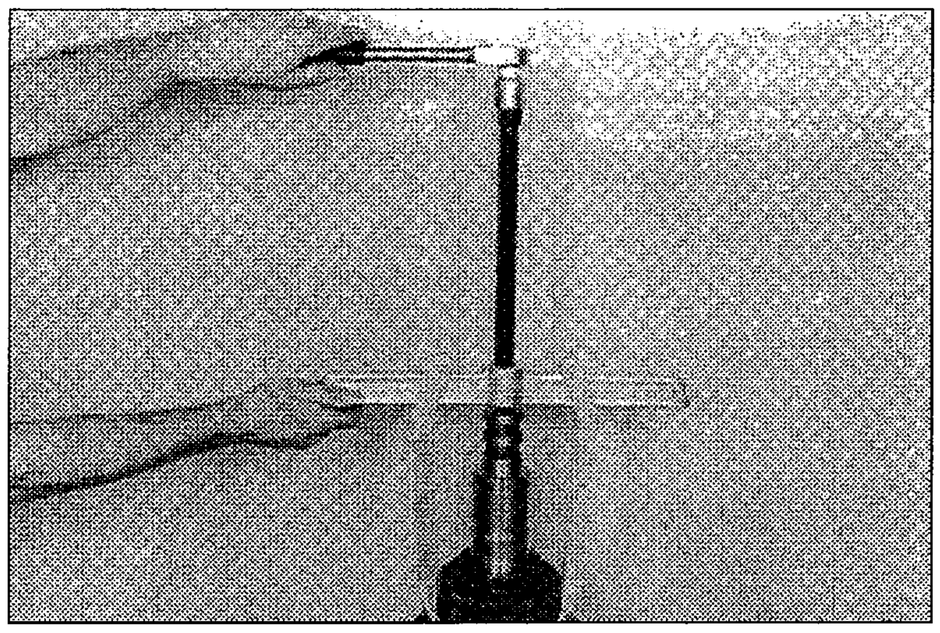
⑱ Press spur gear K2 from the shaft.
Remove released shim and bush.



⑲ Pull off tapered roller bearing.

※ Special tool

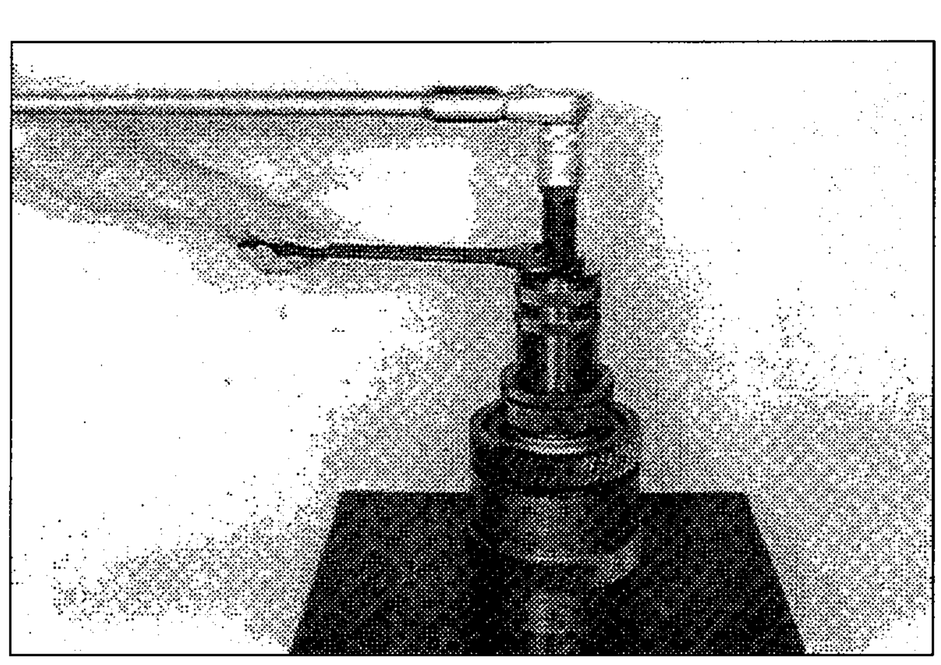
Grab sleeve(Super)	5873 002 038
Basic set	5873 002 001



⑳ On the opposite side, pull off tapered roller bearing.

※ Special tool

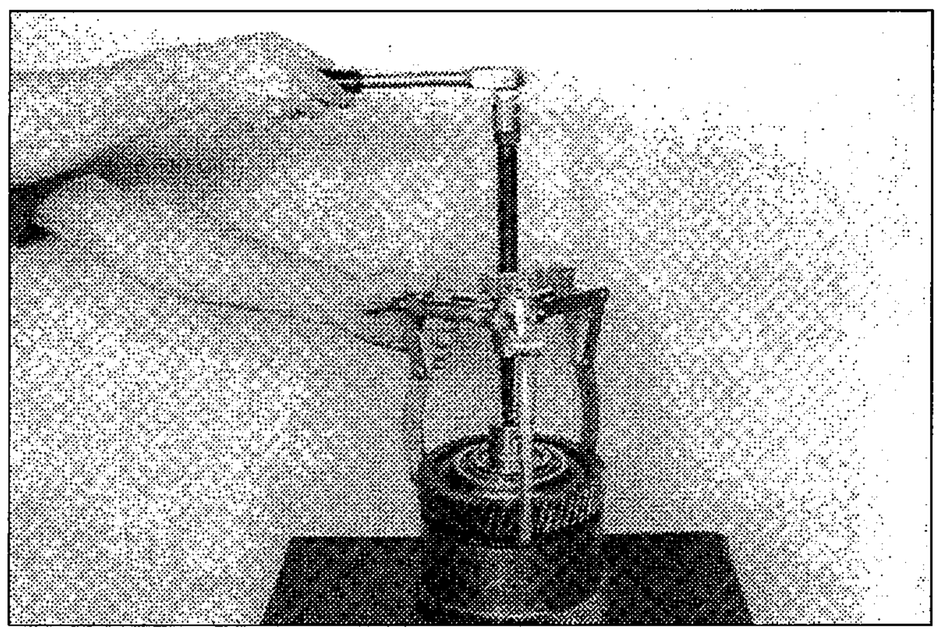
Grab sleeve(Super)	5873 002 038
Basic set	5873 002 001



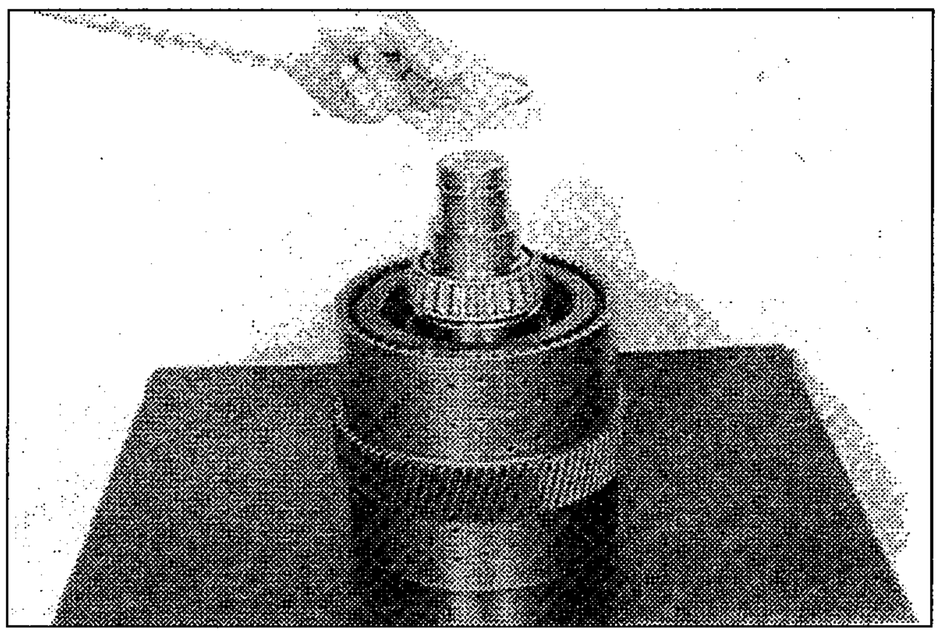
㉑ Pull spur gear KR from the shaft.
Remove released bearing inner race, disassemble both bearing outer races and circlip.

※ Special tool

Three-leg puller	5870 971 003



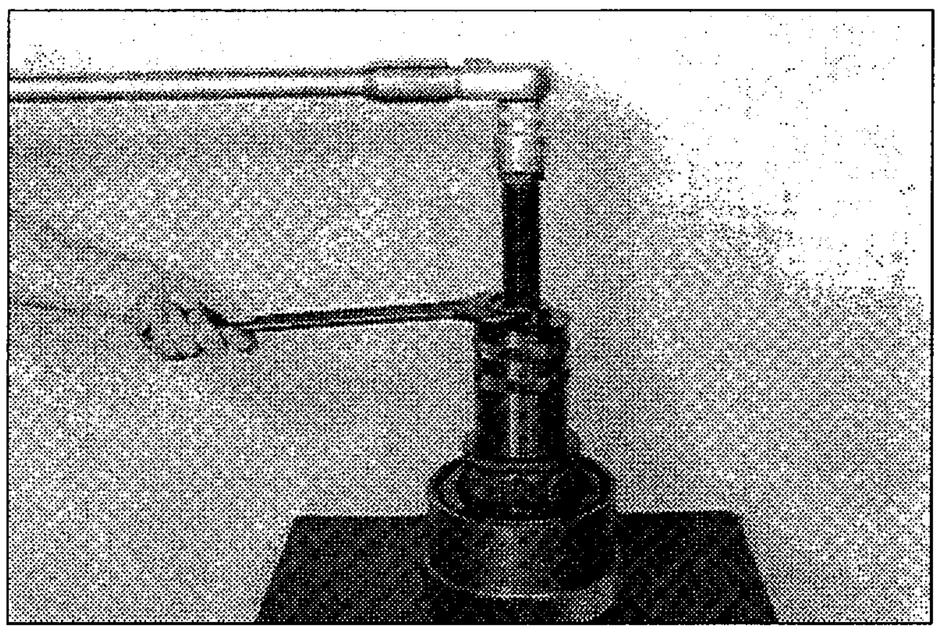
㉒ Remove adjusting ring.



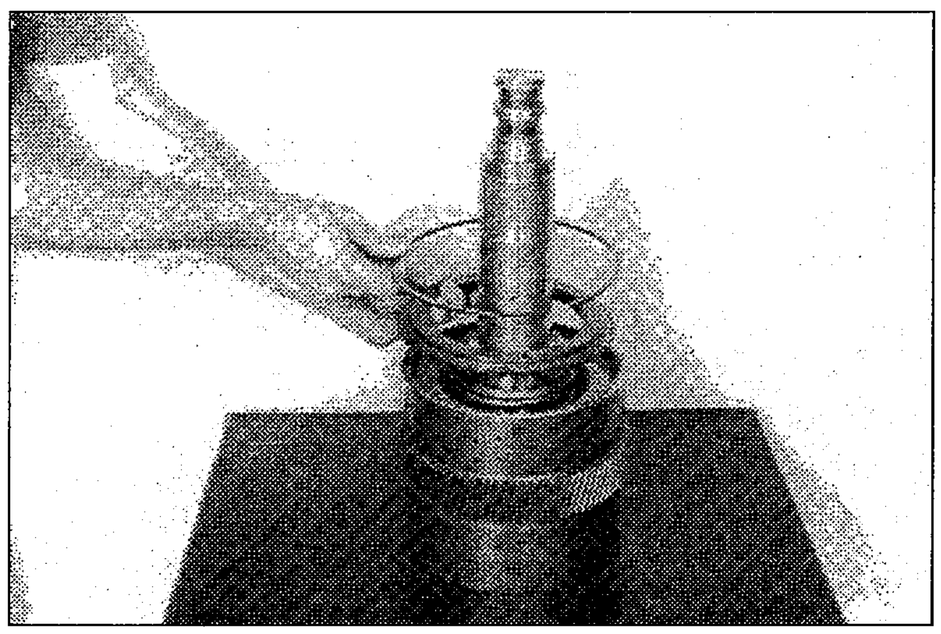
㉓ Pull off tapered roller bearing(Spur gear bearing).

※ Special tool

Grab sleeve(Super)	5873 002 035
Basic set	5873 002 001



㉔ Disassemble plate packs KR and K2 as well as compression springs and piston (Accordingly as at clutch K3/K4).



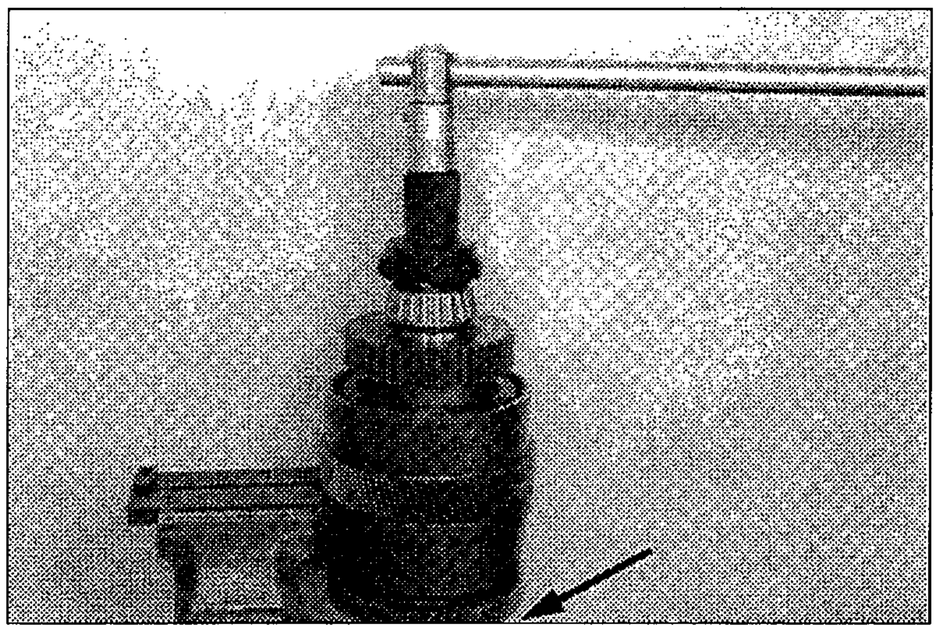
Clutch KV/K1

㉕ Locate clutch by means of special device and loosen slotted nut.
Loosen opposite slotted nut(Arrow) accordingly.

※ The slotted nuts are secured with loctite-heat prior to loosen them.

※ Special tool

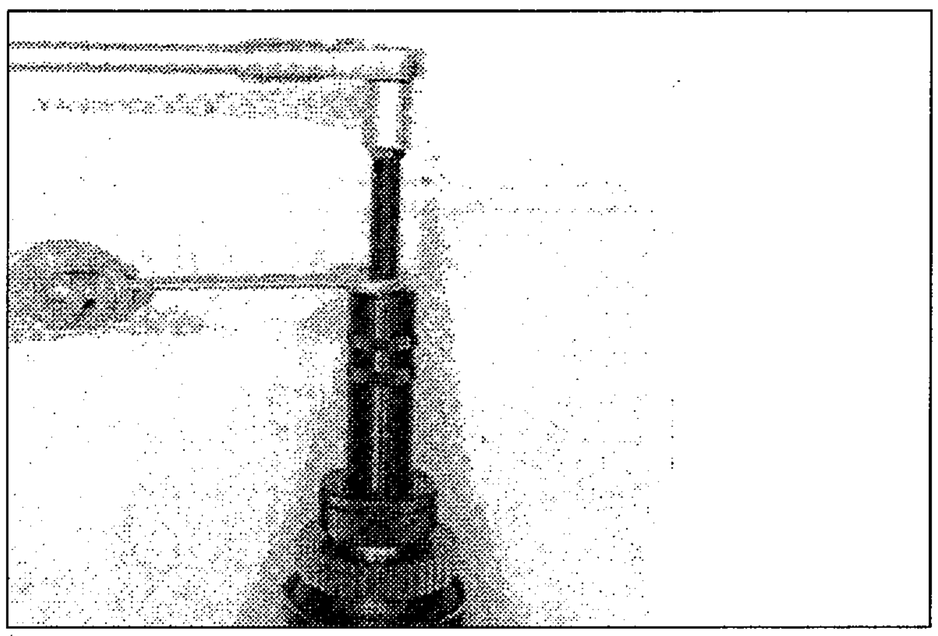
Clamping ring	5870 654 022
Hook spanner	5870 401 118
Hook spanner	5870 401 115



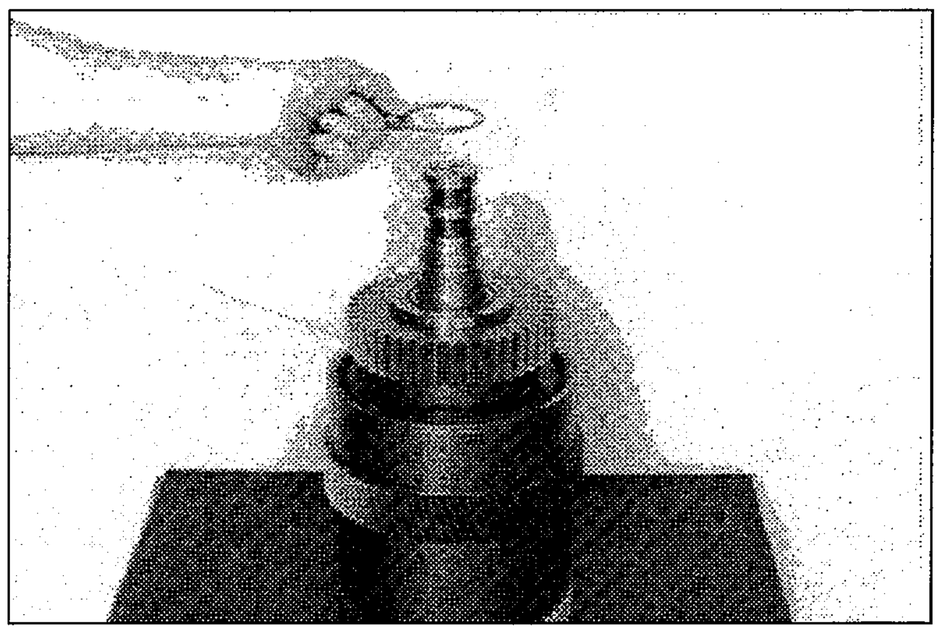
㉖ Pull off tapered roller bearing.

※ Special tool

Grab sleeve(Super)	5873 001 023
Basic set	5873 001 000



㉗ Remove shim.

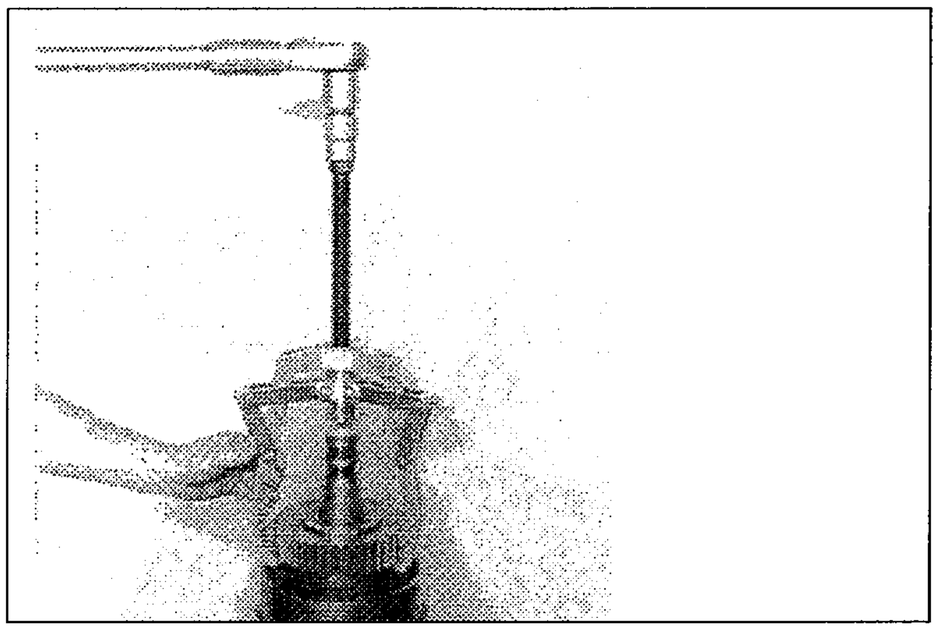


㉘ Pull off spur gear K1.

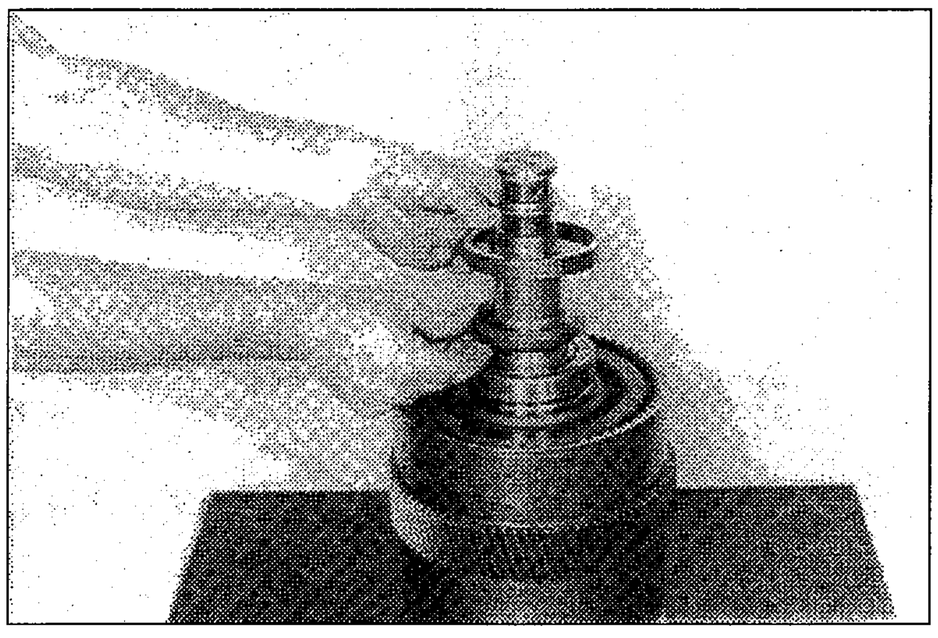
Now, squeeze circlip out and drive ball bearing out of the spur gear bore.

※ Special tool

Three-leg puller	5870 971 003



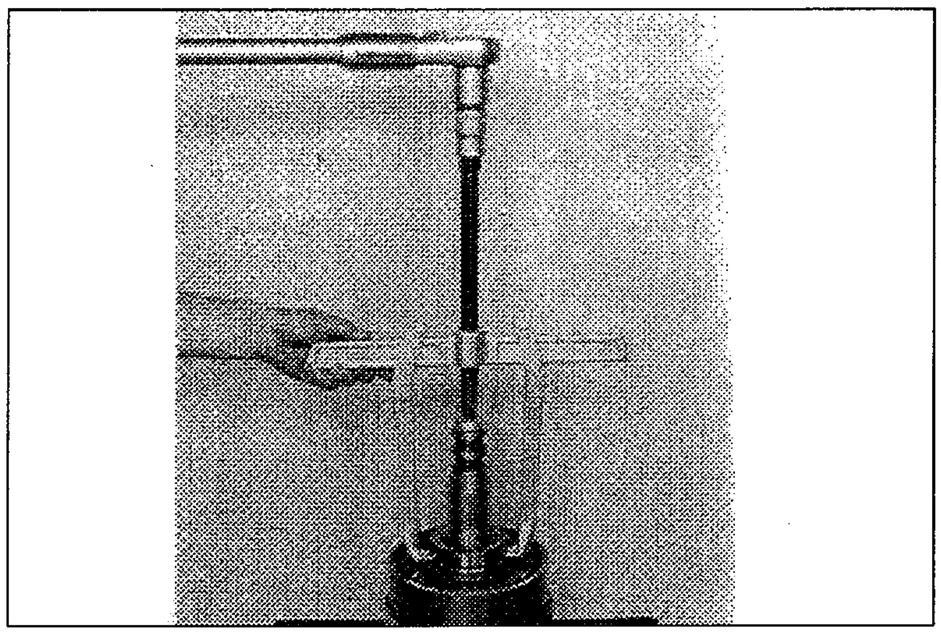
㉙ Remove both rings.



㉚ Pull off second ball bearing(Spur gear bearing).

※ Special tool

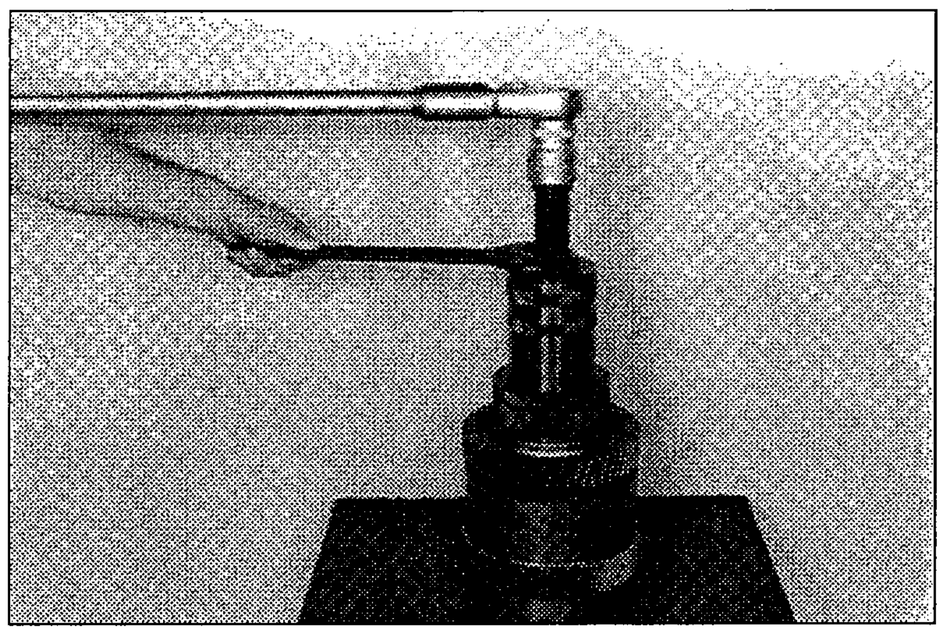
Two-leg puller	5870 970 006



㉛ On the opposite side, pull off tapered roller bearing.

※ Special tool

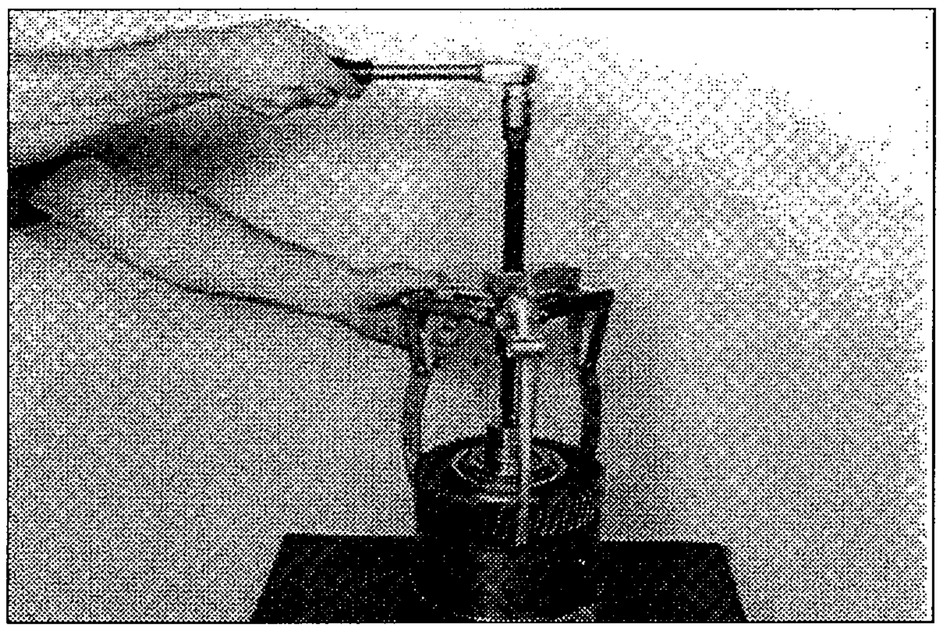
Grab sleeve(Super)	5873 001 037
Basic set	5873 001 000



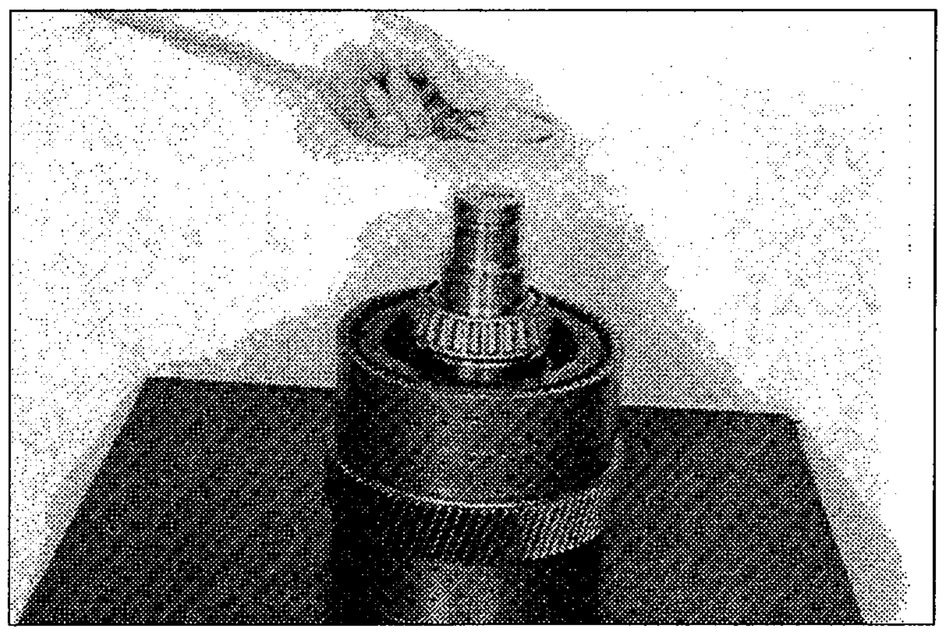
㉜ Pull spur gear KV from the shaft.
Remove released bearing inner race, disassemble both bearing outer races and circlip.

※ Special tool

Three-leg puller	5870 971 003



㉝ Remove adjusting ring.



㉞ Pull off tapered roller bearing(Spur gear bearing).

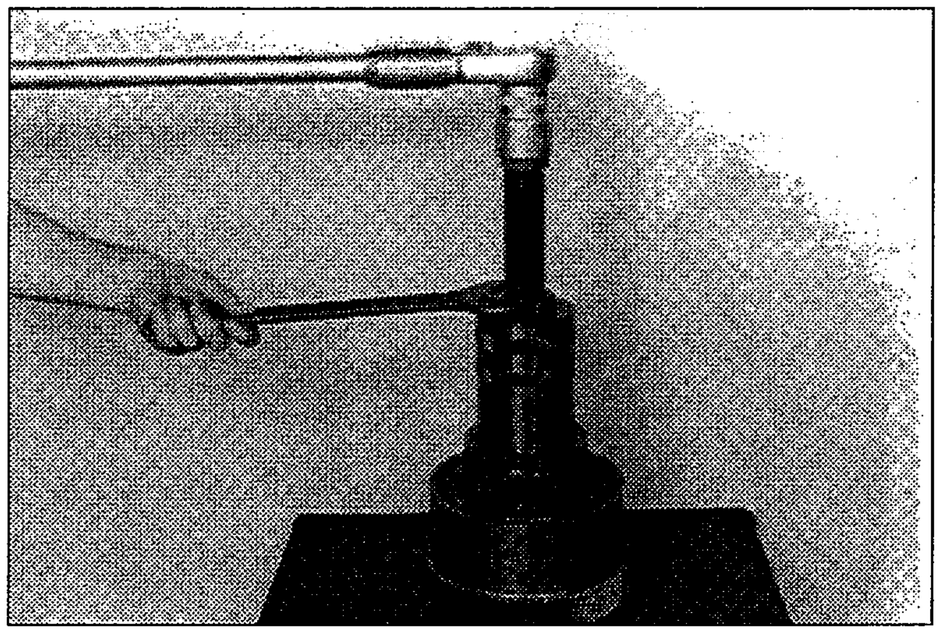
※ Special tool

Grab sleeve(Super)	5873 002 035
Basic set	5873 002 001

Now, remove plate pack KV and K1 as well as compression springs and piston (Accordingly as at clutch K3/K4).

※ Special tool

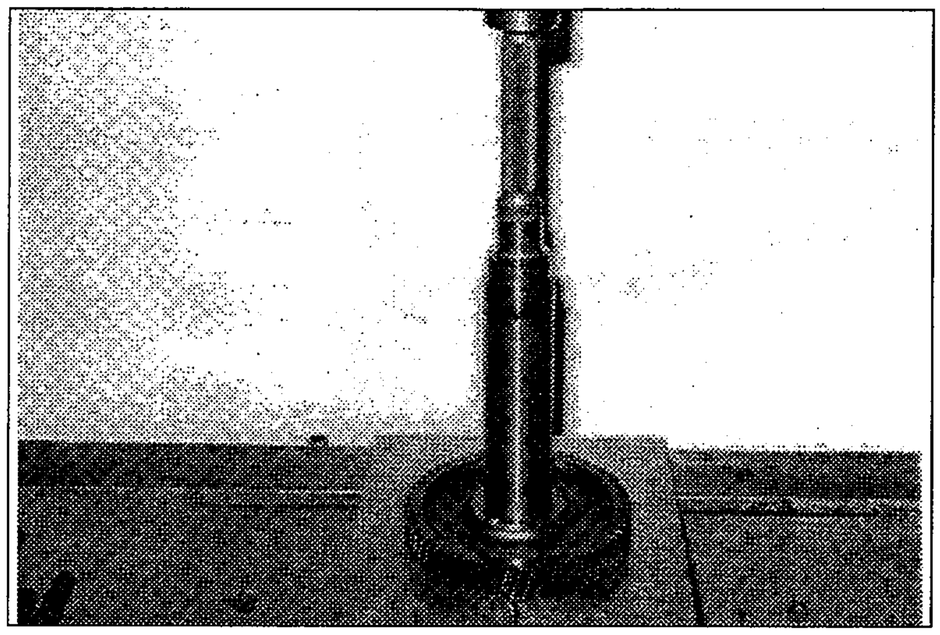
Pressure piece	5870 345 072



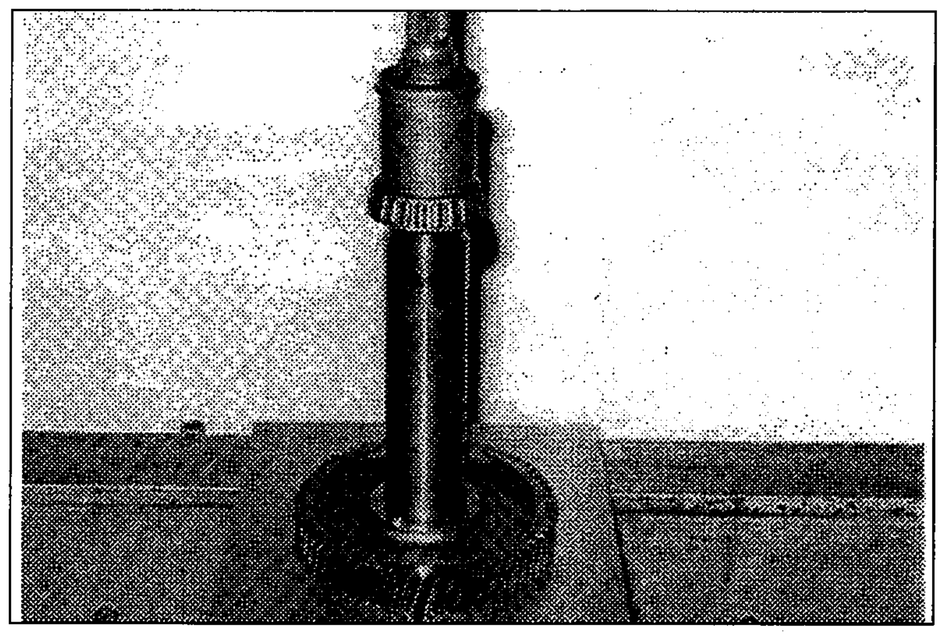
2) REASSEMBLY

(1) Power take-off Ⅱ

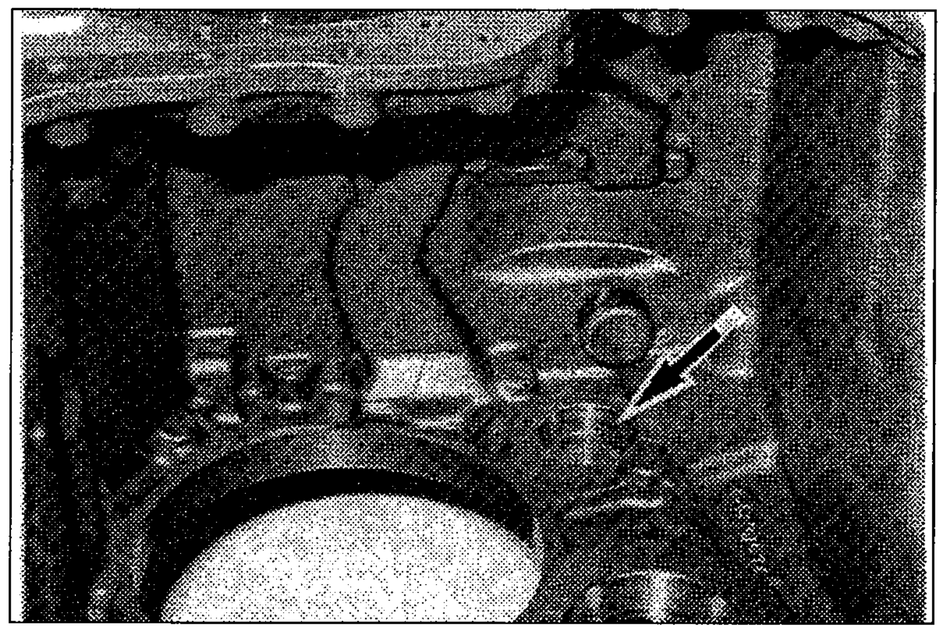
① Undercool shaft(About 80°C), heat gear (About 120°C) and assemble, respectively press it against shoulder.



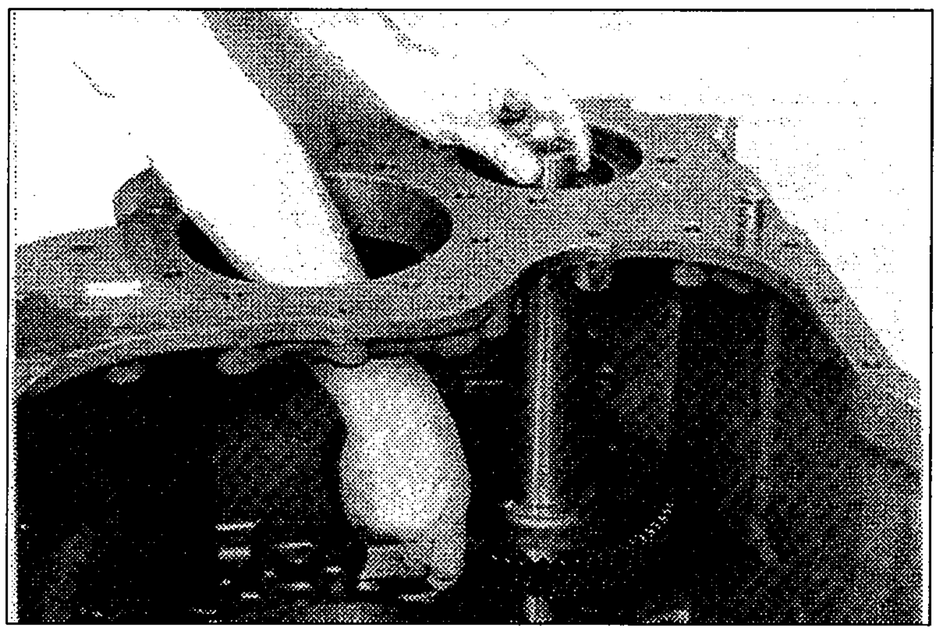
② Press bearing inner race against shoulder.
Press opposite bearing inner race against shoulder until contact is obtained.



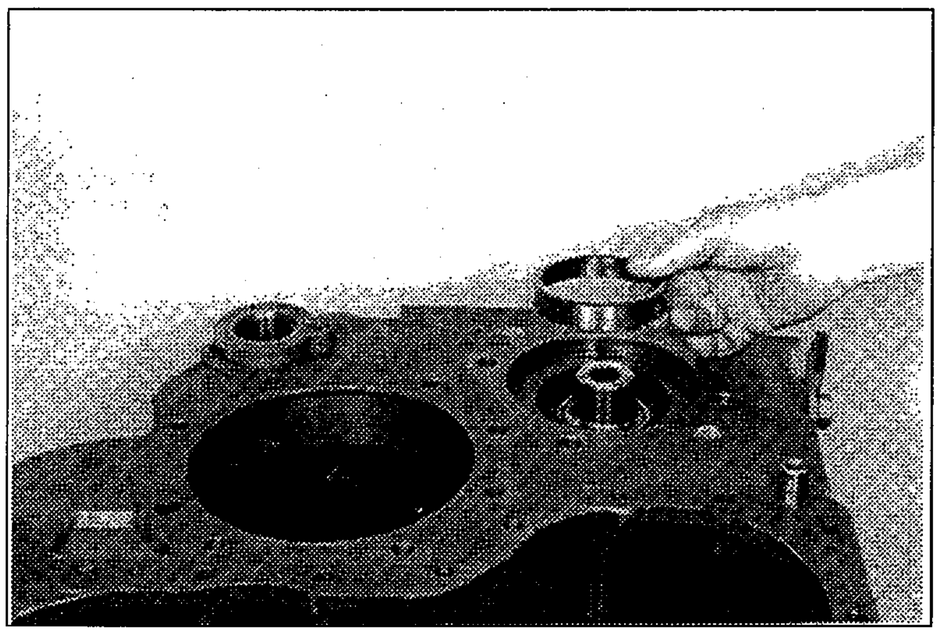
③ Insert bearing outer race(Arrow) into the housing bore until contact is obtained.



④ Position preassembled Pto-shaft in the housing.



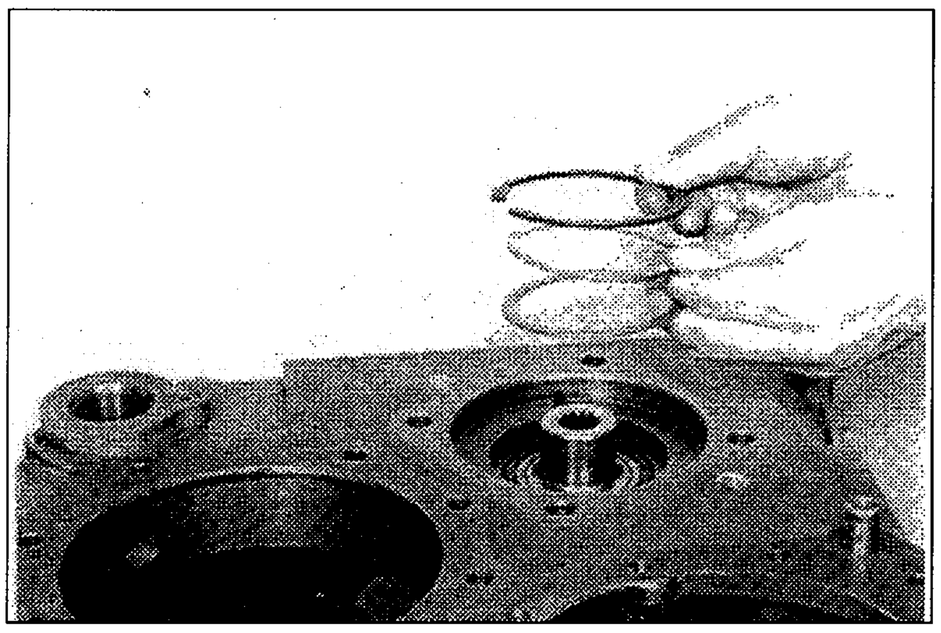
⑤ Insert bearing outer race until contact is obtained-bearing must be playfree.



⑥ Adjust Pto-bearing playfree, using disk and circlip.

※ Special tool

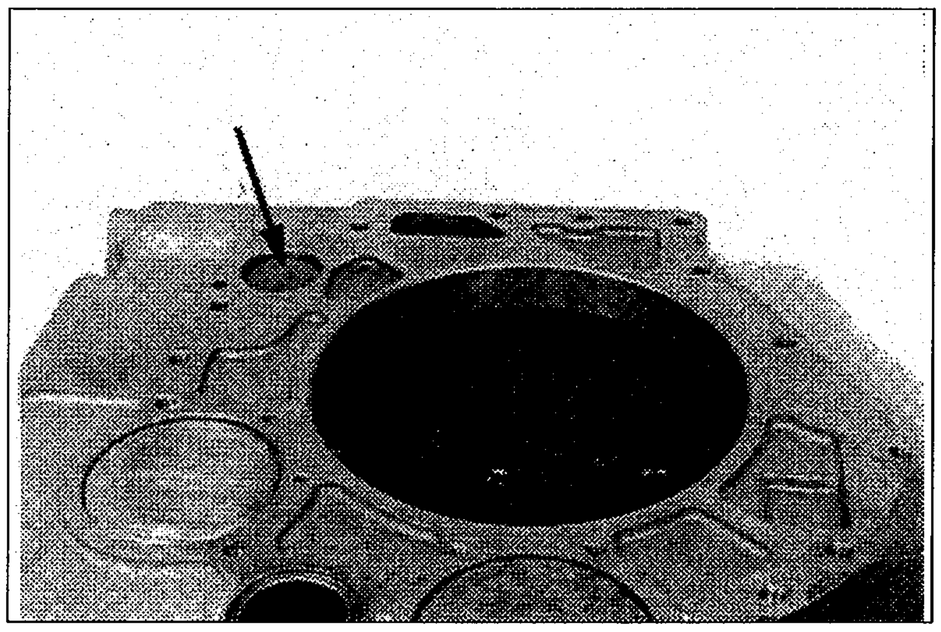
Set of pliers 5870 900 013



⑦ Tilt gearbox housing 180°.
Insert sealing disk(Arrow) into the housing bore until contact is obtained.

※ Cover contact surfaces with loctite(Type No.262).

※ Do not damage the centric orifice hole ø0.8mm at the installation of the sealing disk.



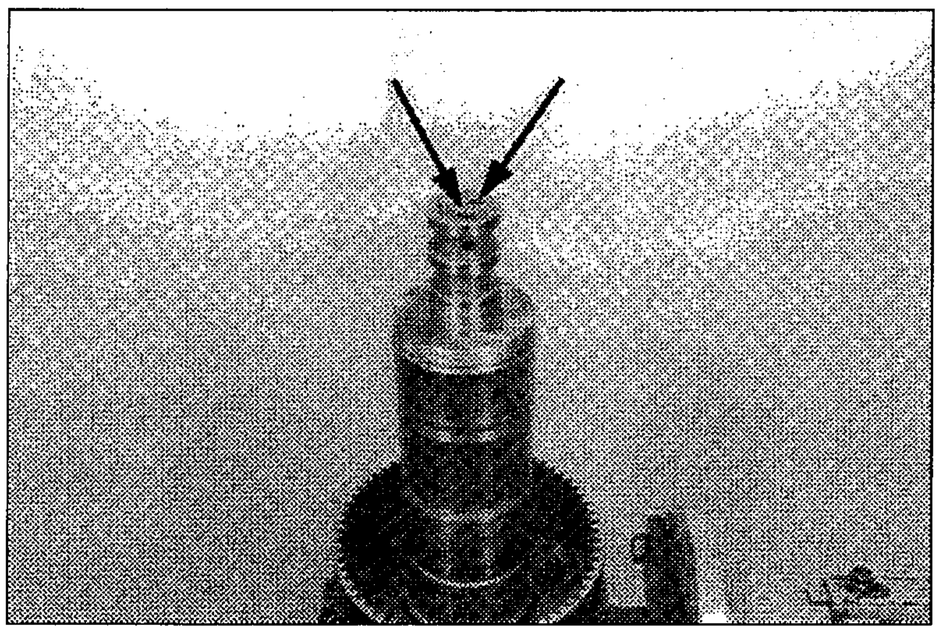
(2) Multi disk clutch K3/K4

① Fix plate carrier by means of clamping ring.
Close both bores(Arrows) by means of set screws.

※ Insert set screws with loctite(Type No.262).

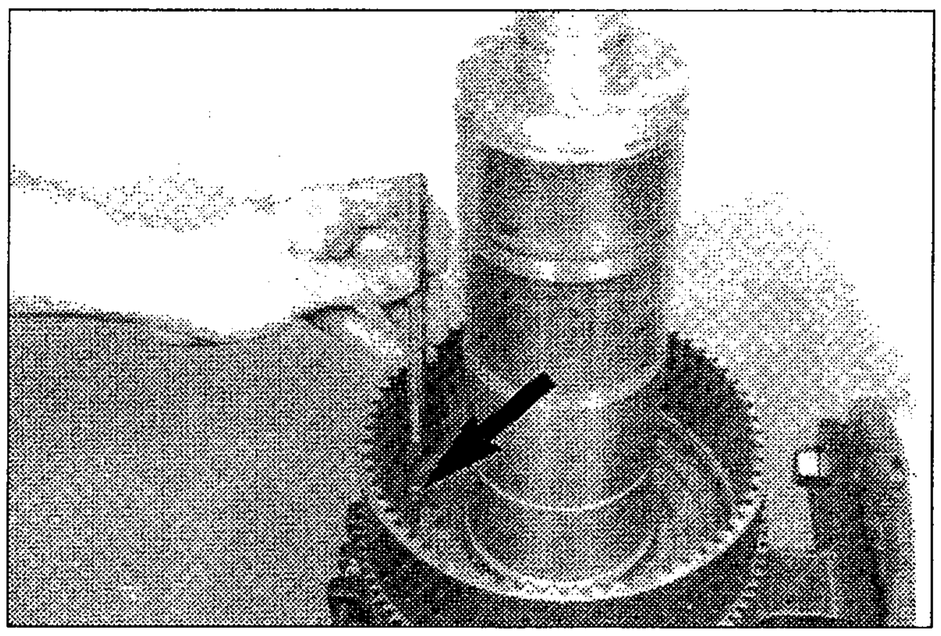
※ Special tool

Clamping ring 5870 654 022

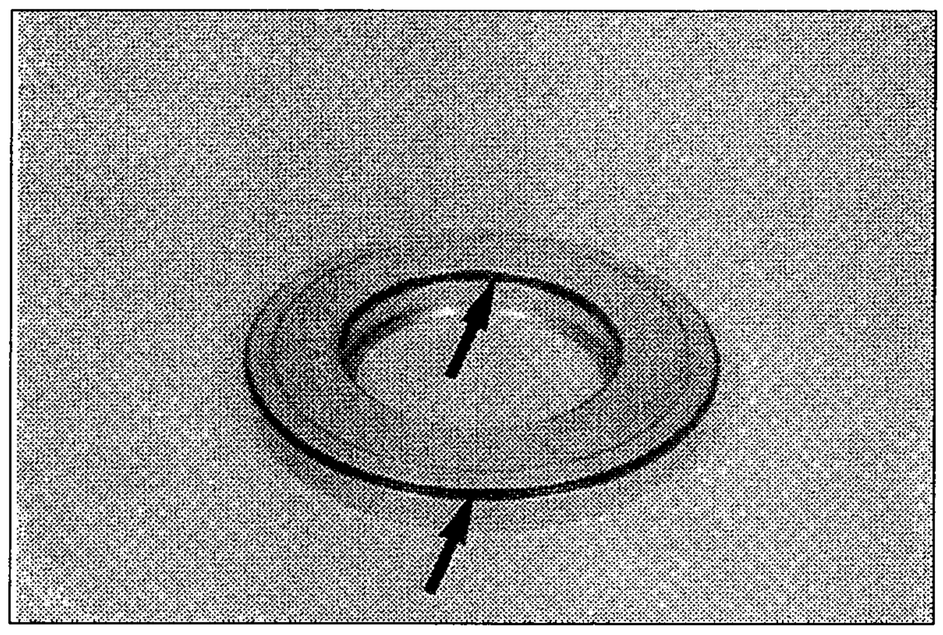


Clutch K3

② Insert purge valve(Arrow) until contact is obtained.

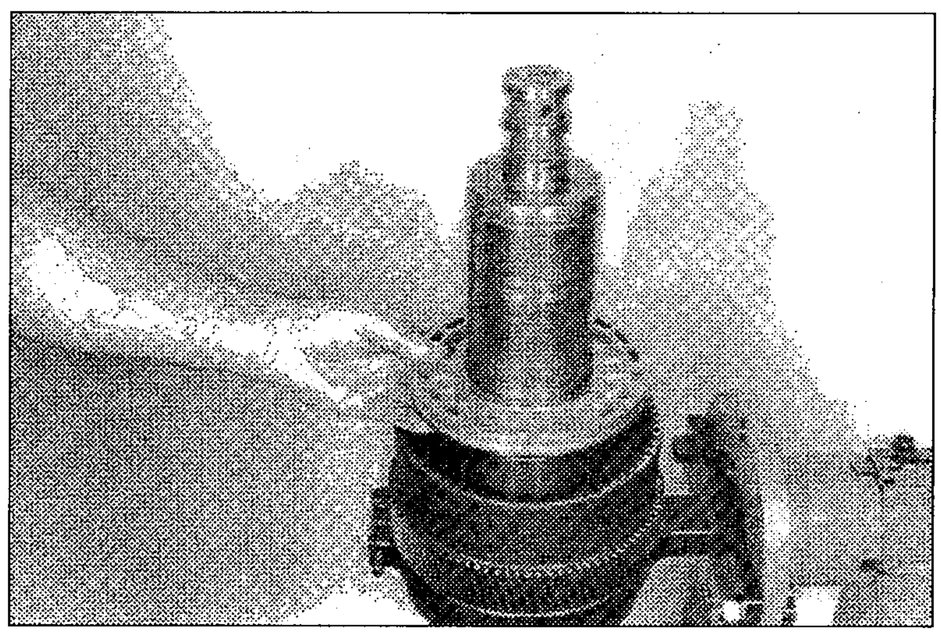


③ Insert both O-ring scrollfree into the ring grooves of the piston, see arrows.

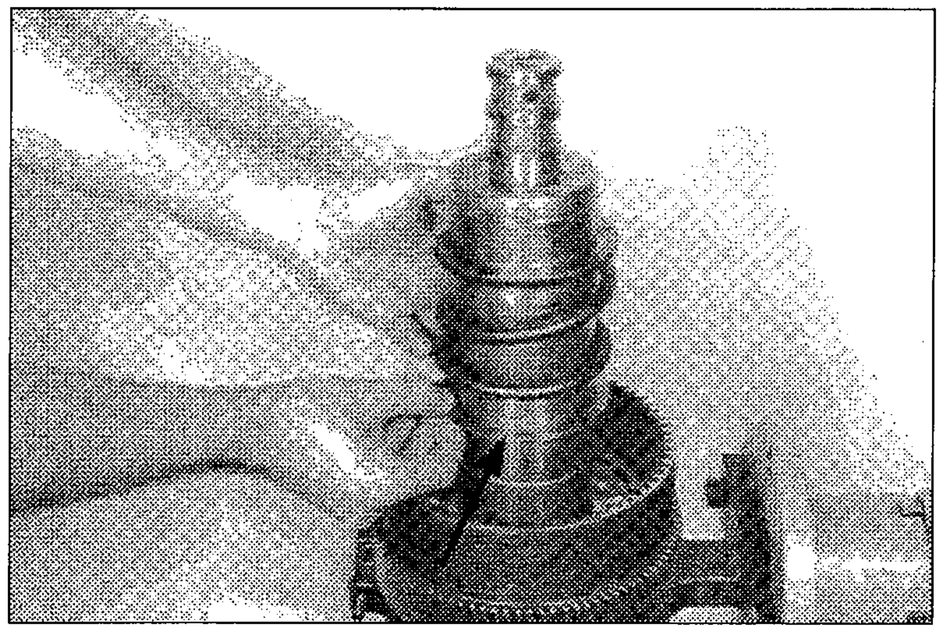


④ Oil O-rings and piston race, and insert piston until contact is obtained.

※ Pay attention to the installation position of the piston, see figure.



⑤ Install disk(Arrow) and compression spring.



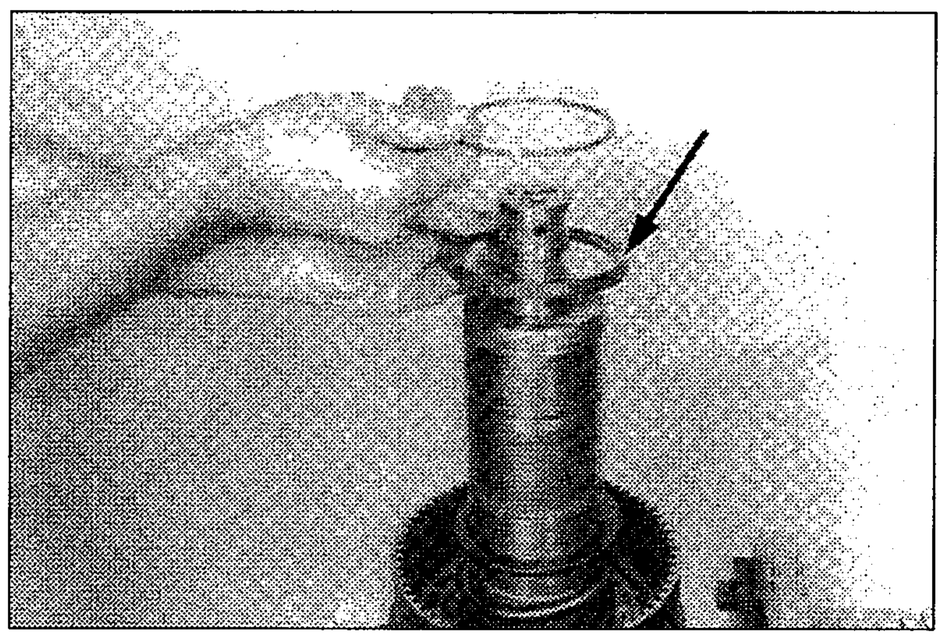
⑥ Lay guide ring upon the compression spring and assemble snap ring(Figure on the right).

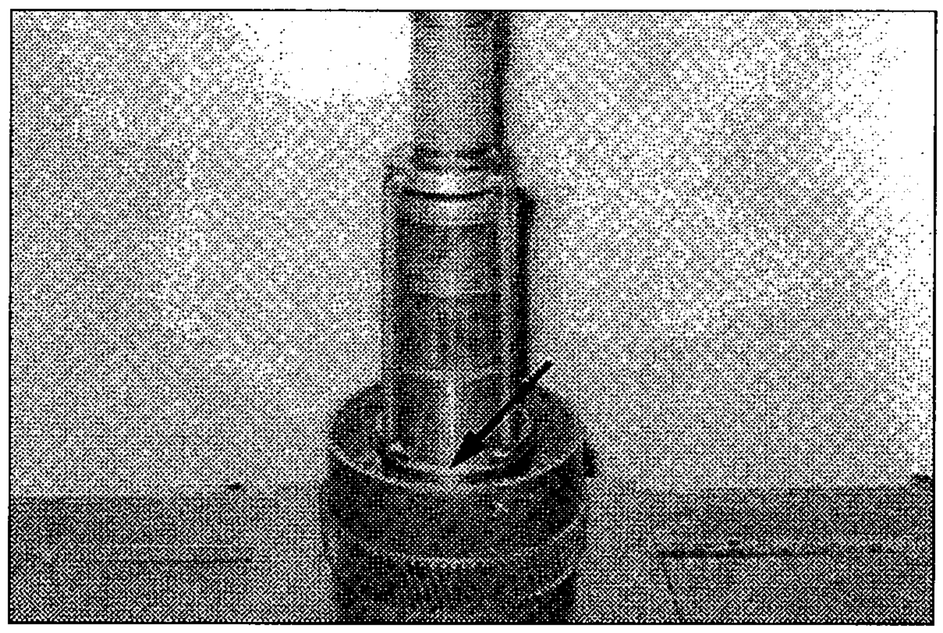
※ Pay attention to the installation position of the guide ring install chamfer(Arrow) showing upward.

Now, preload compression spring by means of special device and fix it by engaging the snap ring(Arrow), see figure.

※ Special tool

Pressure piece 5870 345 072





General instructions for the plate installation

In principle, the stacking of the outer and inner plates has to be carried out alternately.

The piston side has to be started with a one sided coated outer plate.

At clutch KR and KV, a one sided coated outer plate has to be additionally installed on the end shim side. The uncoated side must be always installed facing the piston, respectively the end shim.

At plates with different thickness(Inner plates), the thinner plates must be installed on the end shim side.

The respective clutch side can be identified on the length of the plate carrier, see draft/ dimension **X**.

Install plate pack K3, see draft as well as figure(⑦), Example **A**:

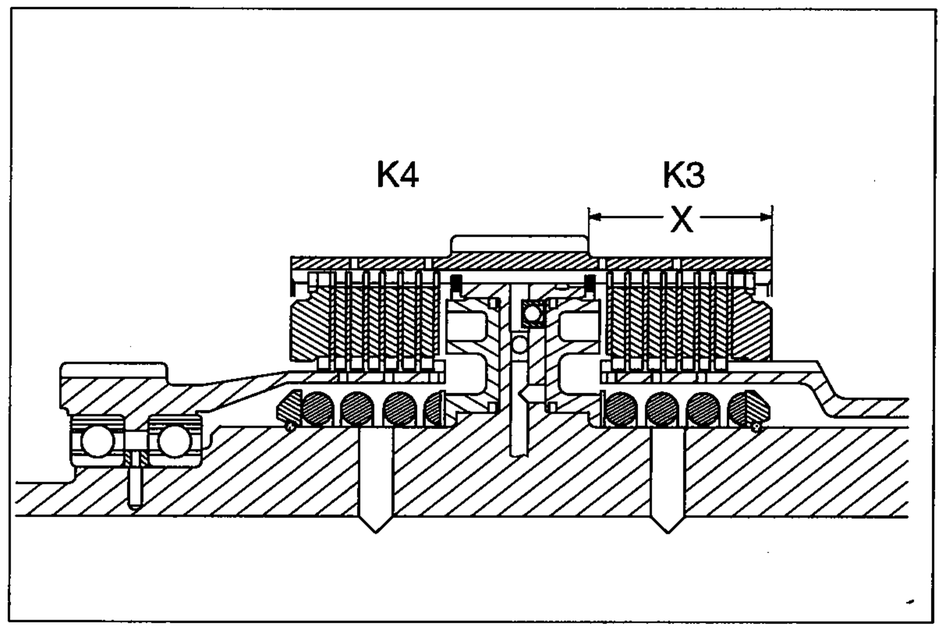
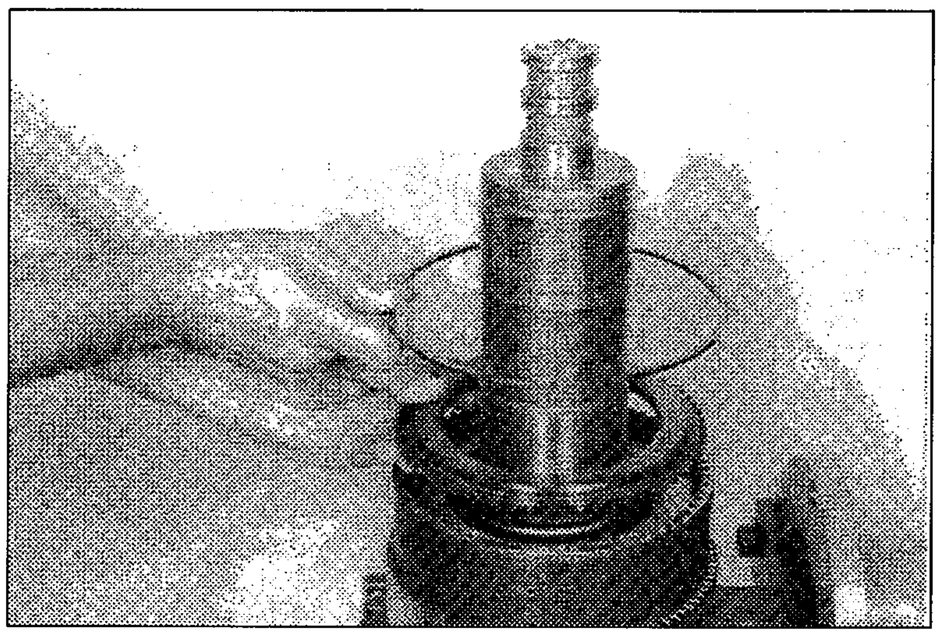


Plate arrangement K3(Long plate carrier side):
Active number of the friction surface = 14

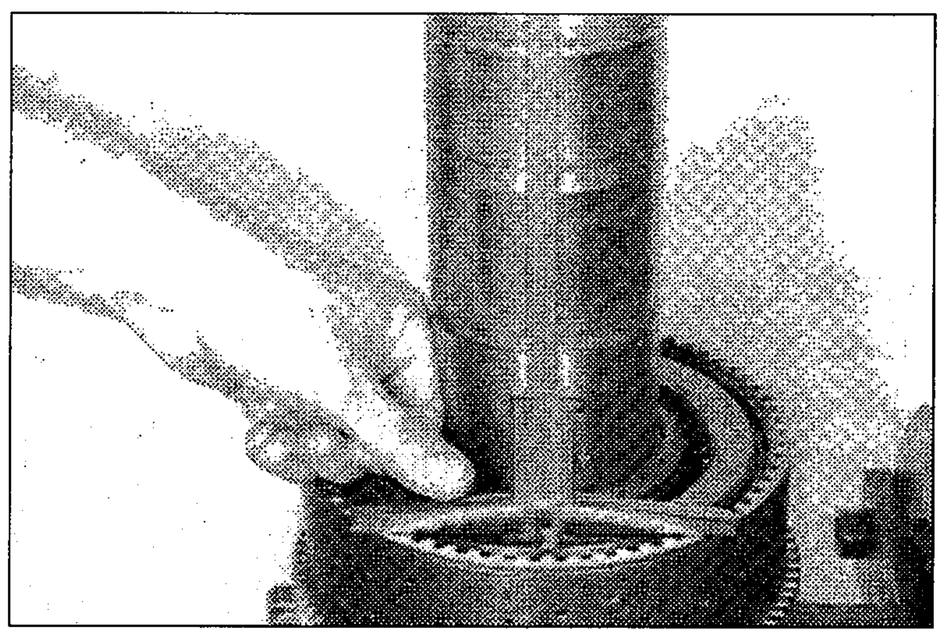
1 Outer plate(One sided coated)	
7 Outer plates	s = 2.5mm
3 Inner plates	s = 3.5mm
3 Inner plate	s = 3.0mm
1 Inner plate(Optional)	s = 2.0~4.0mm

⑦ Install plate pack, mount end shim and fix it by means of snap ring.

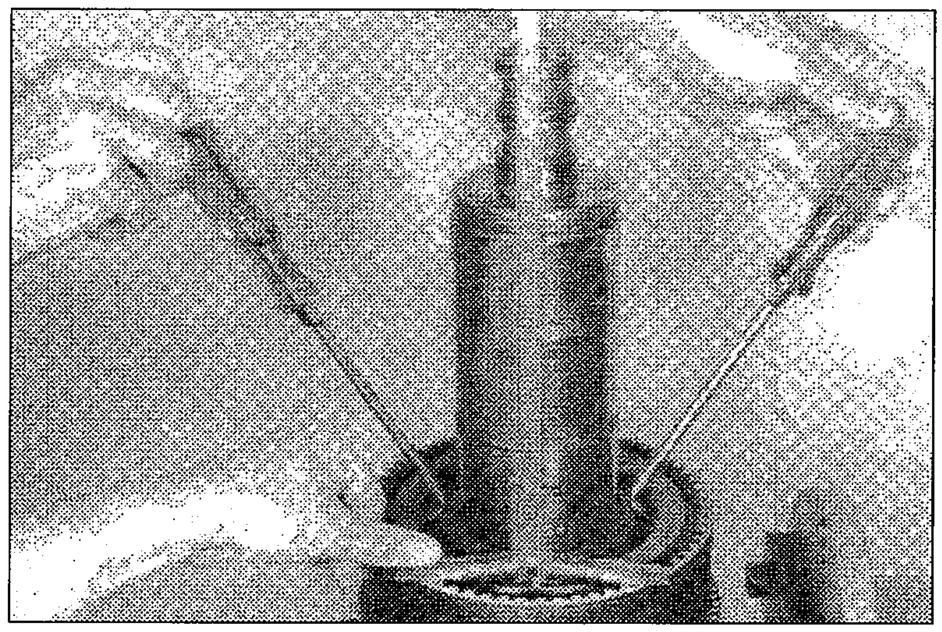


Check plate clearance K3 = 2.2~2.4mm
(See figure, Example A):

⑧ Determine dimension Ⅰ from the end face of the plate carrier to the end shim.
- Dimension Ⅰ e.g. 2.40mm



⑨ Position end shim against snap ring (Toward upward) until contact is obtained and determine dimension Ⅱ.
- Dimension Ⅱ e.g. 0.20mm



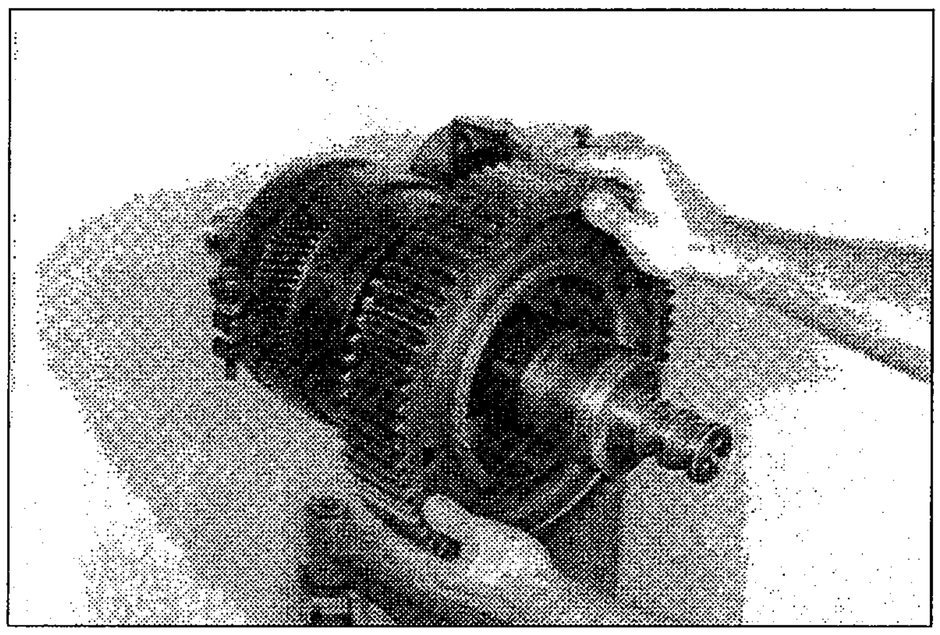
Example A

Dimension Ⅰ e.g.	2.40mm
Dimension Ⅱ e.g.	- 0.20mm
Difference = Plate clearance	2.20mm

※ In case of a deviation from the required plate clearance, correction can be carried out with corresponding inner plate (Optional s=2.0~4.0mm) or with different snap rings(Figure ⑦).
Pay attention to the note, page 3-106.

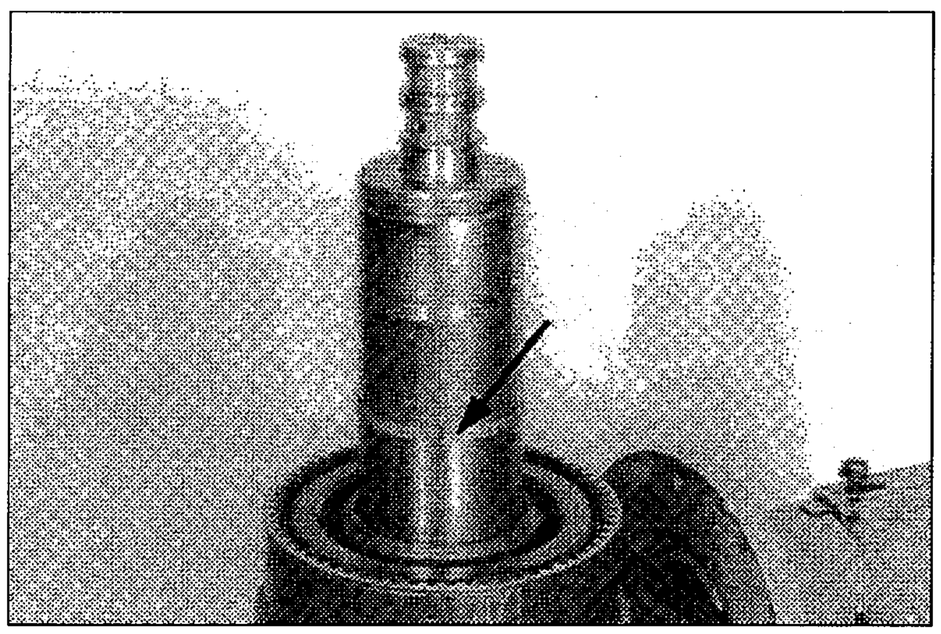
⑩ Tilt clutch into horizontal position and introduce spur gear K3 until all inner plates are accommodated.

※ This step will facilitate the later spur gear installation.
Now, tilt clutch again into vertical position and pull spur gear carefully out of the plate pack.



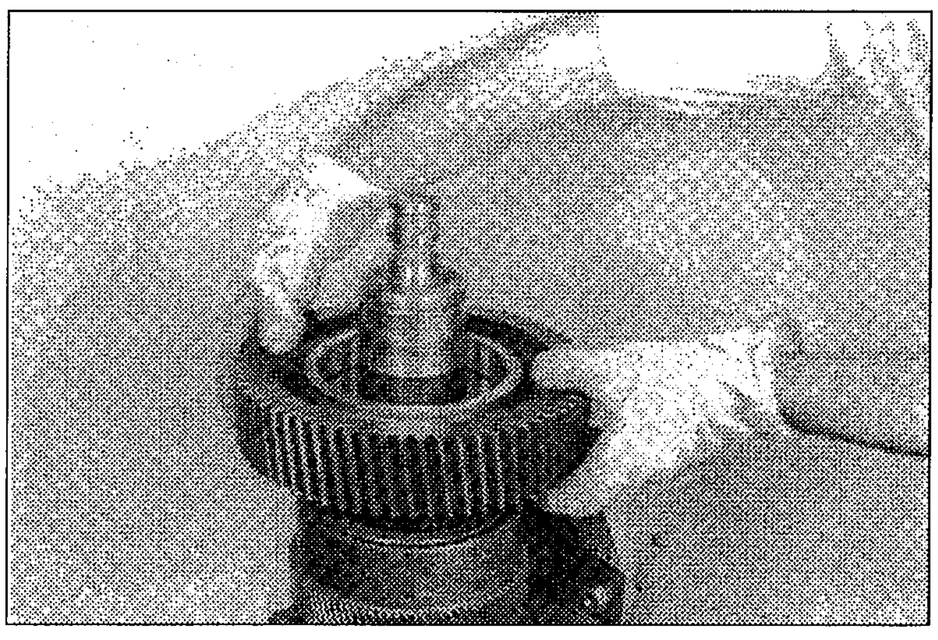
⑪ Insert split ring(Arrow) with grease into the recess.

※ Pay attention to the exact contact of the split ring in the bottom of the recess.

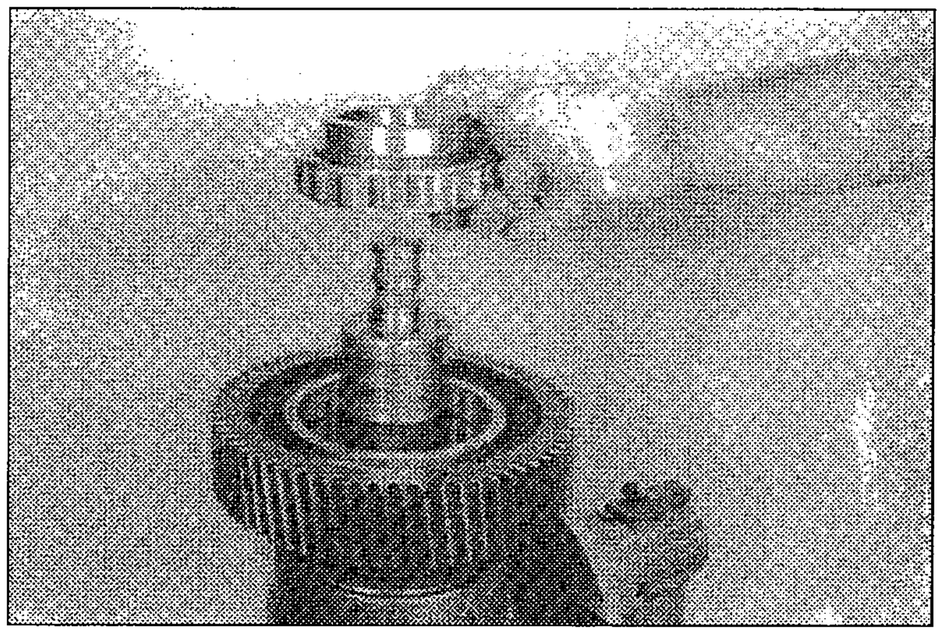


※ Carry out the following steps of figure ⑫ and ⑬ immediately in chronological order to prevent a cooling down of the heated components.
Heat bearing bore of spur gear(Figure ⑬) as well as bearing inner race of the roller bearing(Figure ⑭) to about 120°C.

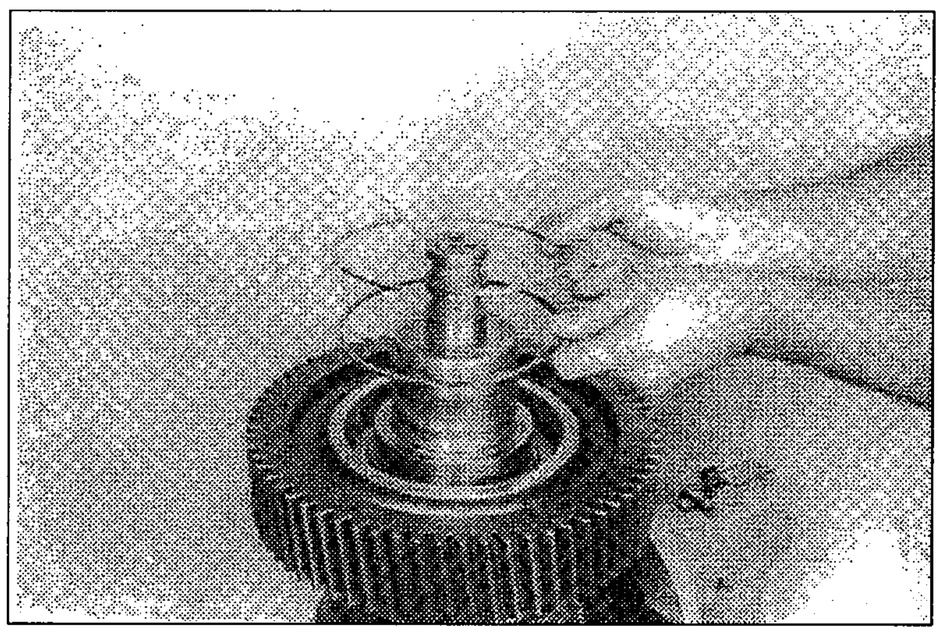
⑫ Introduce heated spur gear until all inner plates are accommodated.



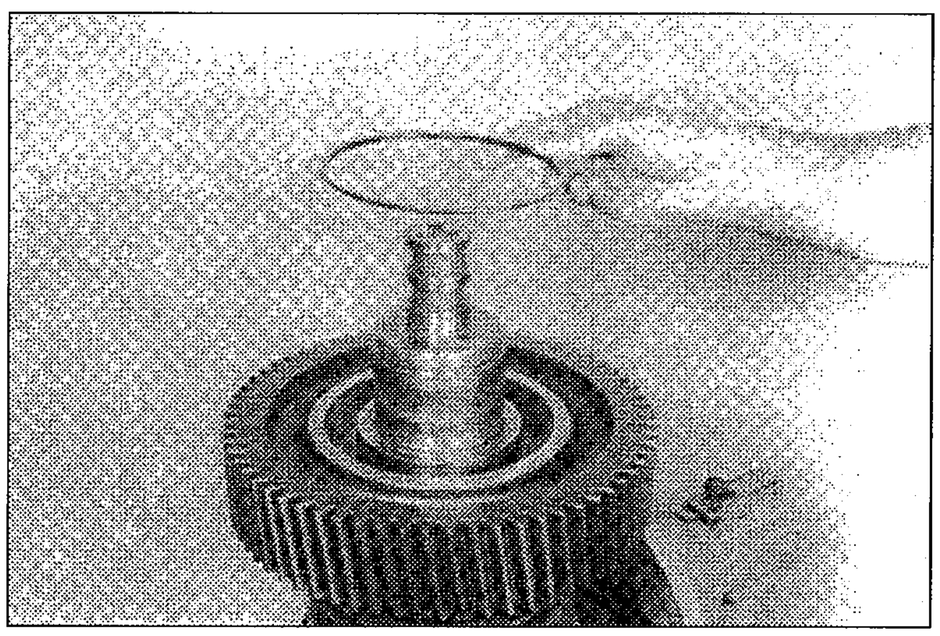
⑬ Insert heated bearing inner race until contact is obtained.



⑭ Introduce disk, lift spur gear slightly and squeeze snap ring into the annular groove of the spur gear.

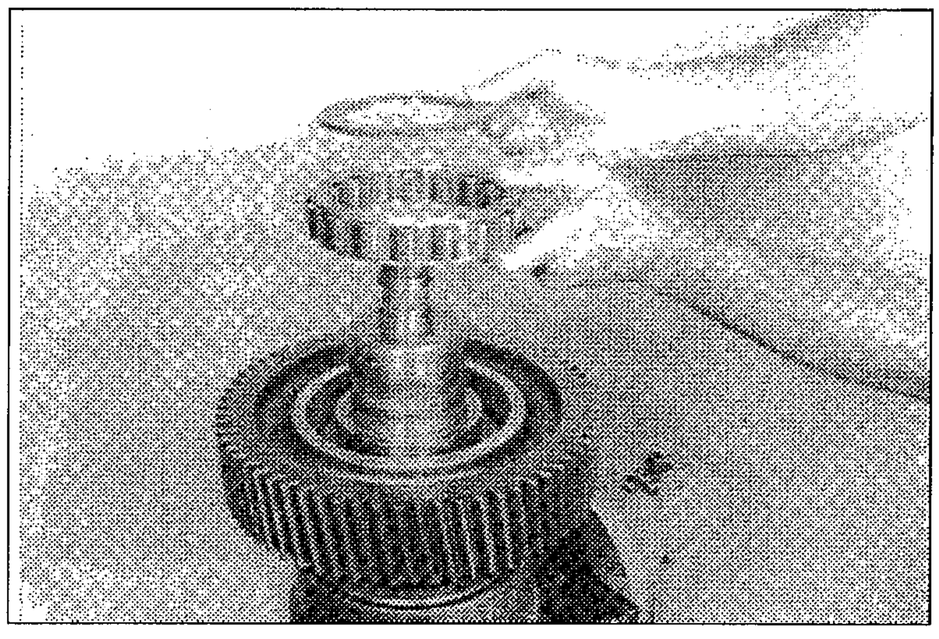


⑮ Install angle ring, with the stepped face facing the snap ring.

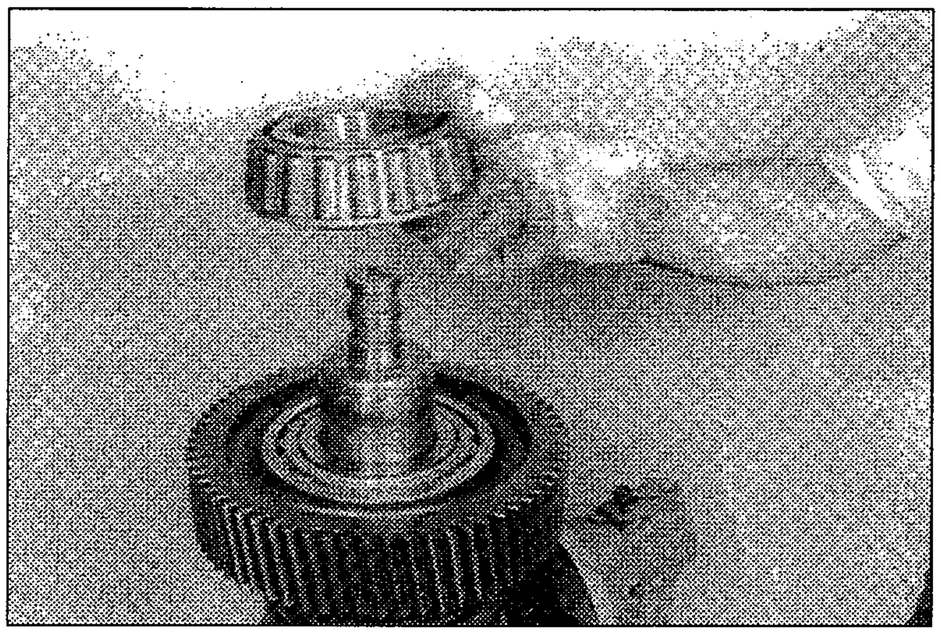


⑯ Introduce bearing inner race and mount flange disk.

※ Install flanged disk, with the chamfer on the inner diameter showing upward.



⑰ Heat bearing inner race and place it against shoulder.



Clutch K4

Install purge valve, piston and compression spring accordingly as at clutch K3(Figure ②~⑥/page 3-105, 106).
Install plate pack K4 and check plate clearance.

Plate arrangement K4(Short plate carrier side)

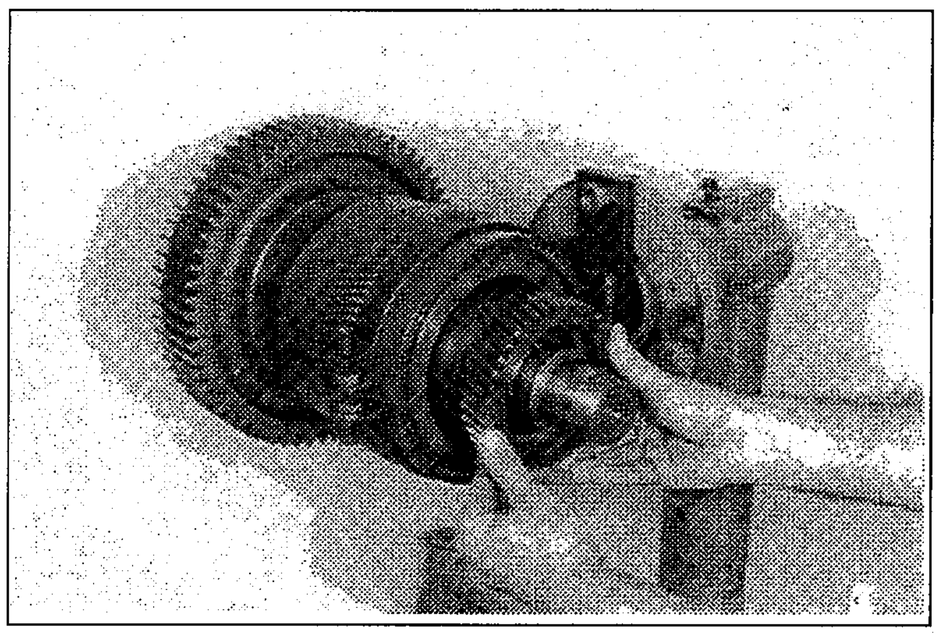
Active number of the friction surfaces = 12

1 Outer plate(One sided coated)	
6 Outer plates	s = 2.5mm
4 Inner plates	s = 3.5mm
1 Inner plate	s = 3.0mm
1 Inner plate(Optional)	s = 2.0~4.0mm

※ Pay attention to the general instructions for the plate installation and draft/ page 3-106.
Check plate clearance K4 = 2.2~2.4mm accordingly as at clutch K3, see page 3-107.

⑱ Tilt clutch into horizontal position and introduce spur gear K4 until all inner plates are accommodated.

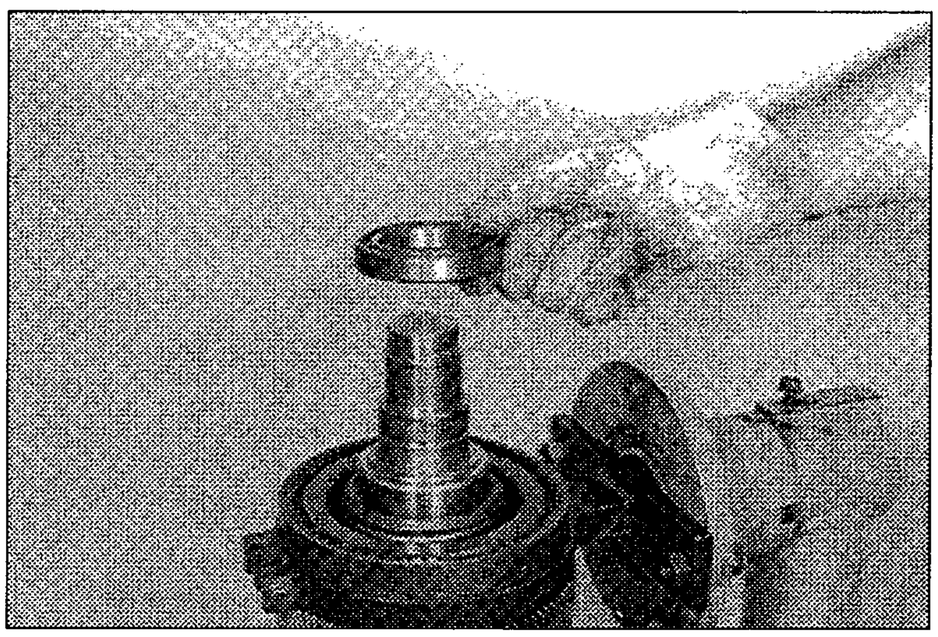
※ This step will facilitate the later reassembly of the spur gear.
Now, tilt clutch again into vertical position and pull spur gear carefully out of the plate pack.



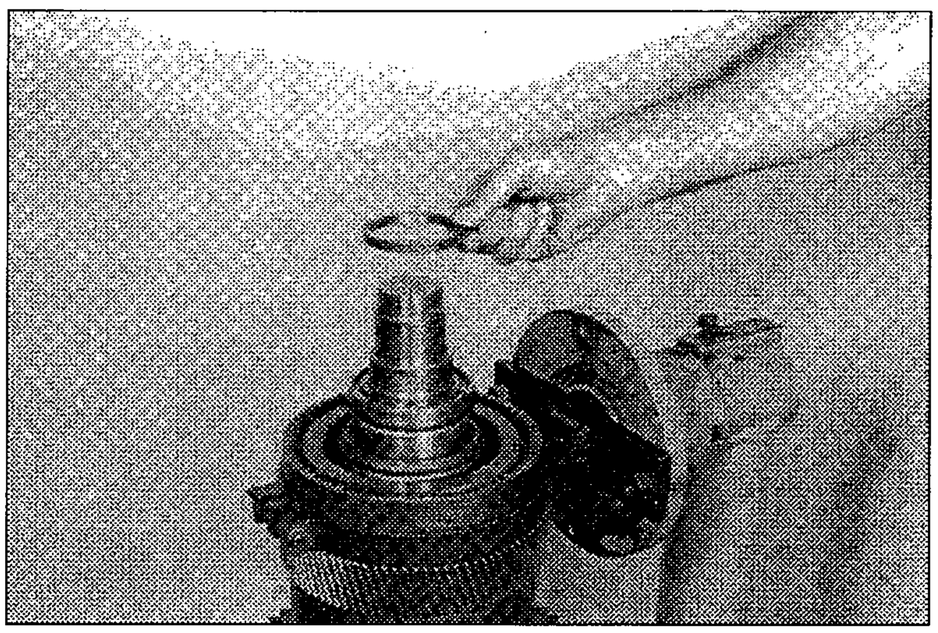
⑲ **Spur gear K4**

The following steps(Figure ⑲~㉒) are describing the reassembly of the spur gear bearing K4, version with ball bearing.
At the version with tapered roller bearing, the reassembly has to be carried out accordingly as at spur gear KR.
In this connection, pay attention to steps of figure((1)~(10)/page 3-115~117).
Heat ball bearing and assemble it until contact is obtained, see figure .

※ Prior to install the spur gear(Figure ⑳), cool ball bearing down to room temperature.

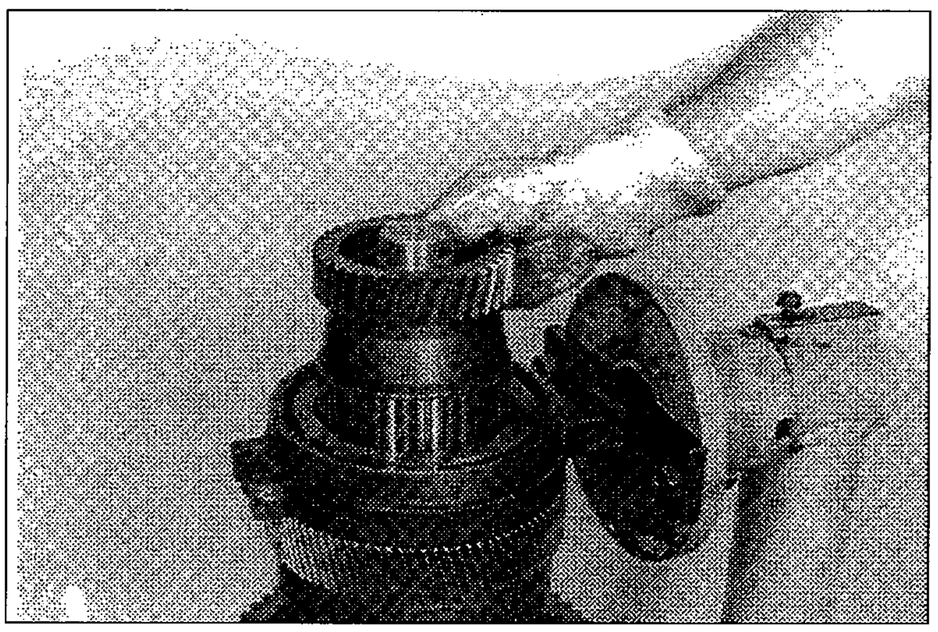


⑳ Mount oil feed ring(Figure on the right).

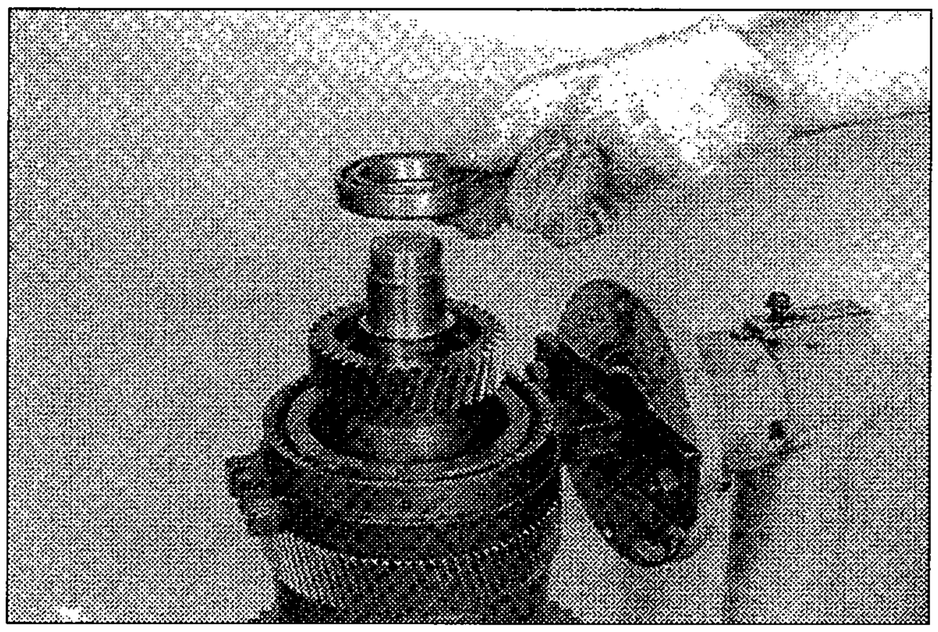


※ Carry out steps of figure ㉑ and ㉒ in immediate sequence, to prevent a cooling down of the components.
Heat bearing bore of the spur gear (Figure ㉑) and ball bearing(Figure ㉒) to about 120℃.

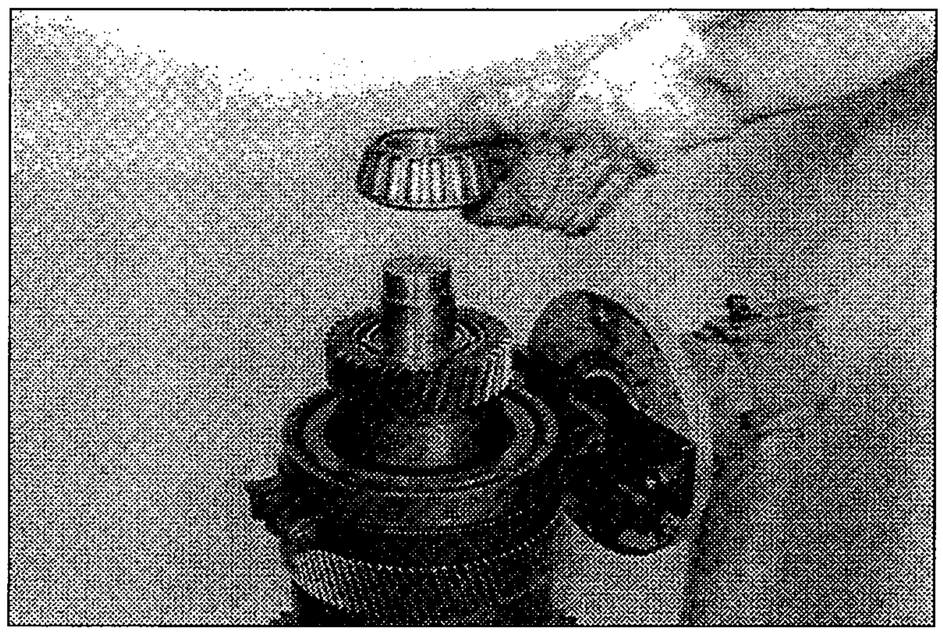
㉑ Introduce heated spur gear until all inner plates are accommodated.



㉒ Insert heated ball bearing until contact is obtained.



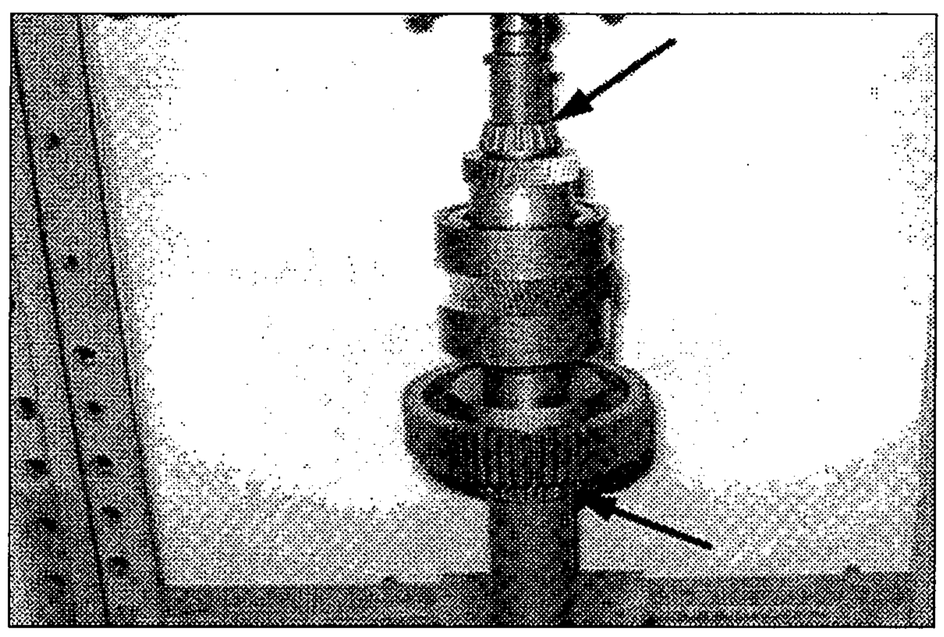
㉓ Heat tapered roller bearing and assemble it until contact is obtained.



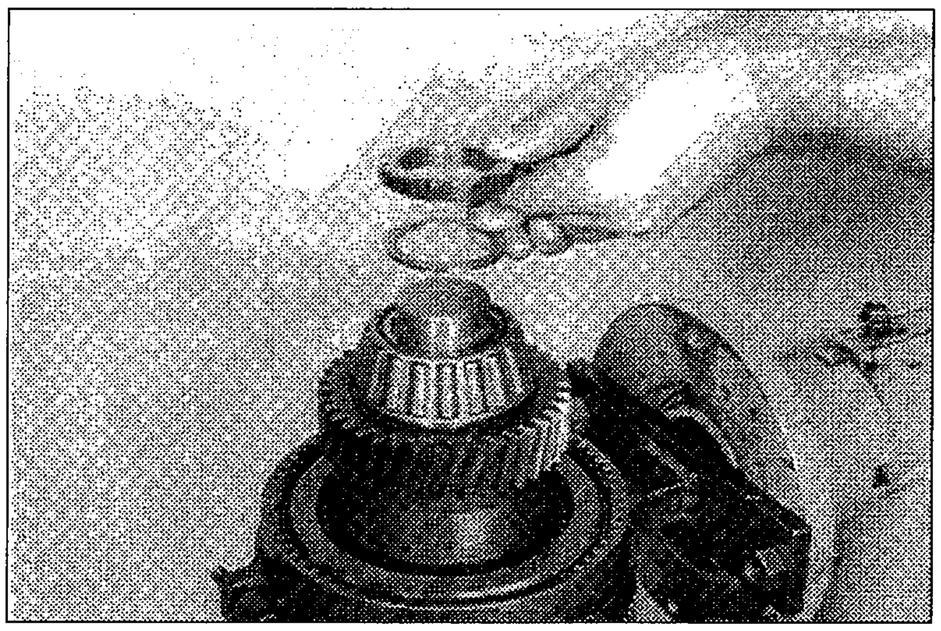
㉔ Preload complete clutch pack through both bearing inner races(Arrows) with 100000N(10ton).
In this way, the exact contact of the components, respectively the setting of the complete bearing is ensured.

※ Special tool

Pressure pieces	5870 506 096



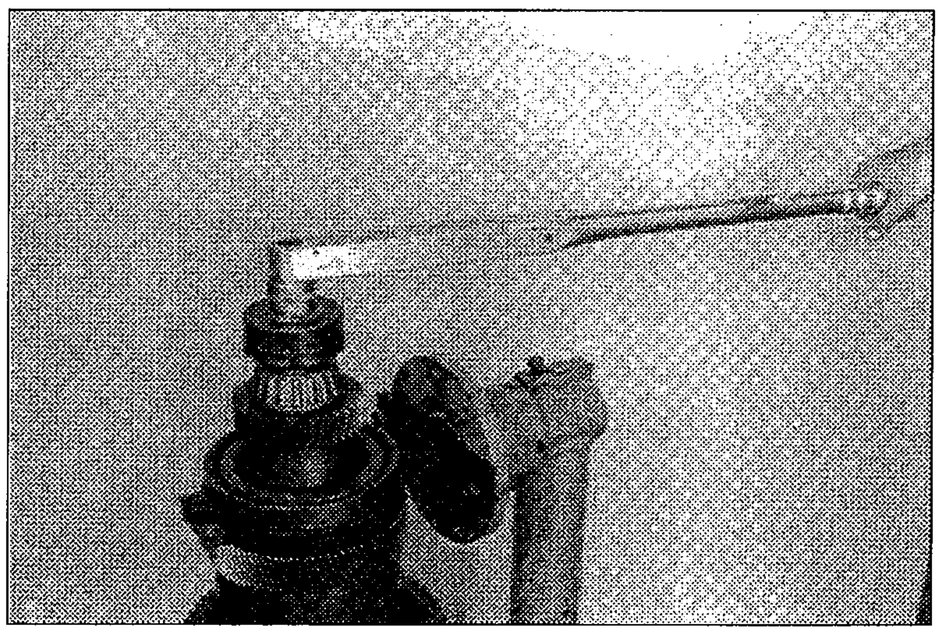
㉕ Mount disk.
Wet thread of the slotted nut with loctite (Type No.262) and install slotted nut with the chamfer showing downward(Figure on the right).



㉖ Tighten slotted nut.
· Torque limit : 56kgf · m(550Nm)

※ Special tool

Hook spanner	5870 401 115
Hook spanner	5870 401 118



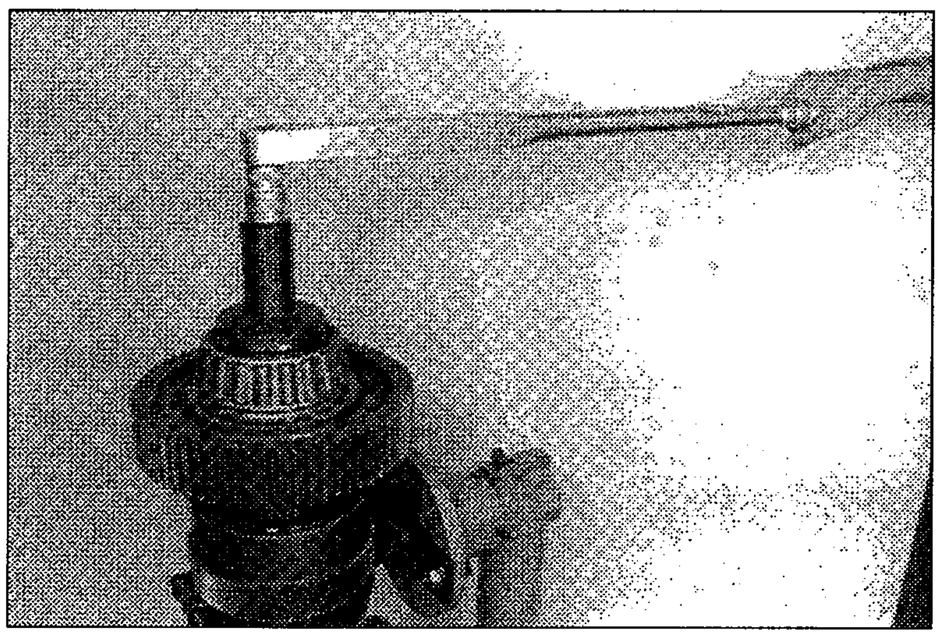
Tilt clutch 180° (K3 side).

㉗ Wet thread of the slotted nut with loctite (Type No.262) and install slotted nut with the chamfer showing downward.

· Torque limit : 82kgf · m(800Nm)

※ Special tool

Hook spanner 5870 401 110

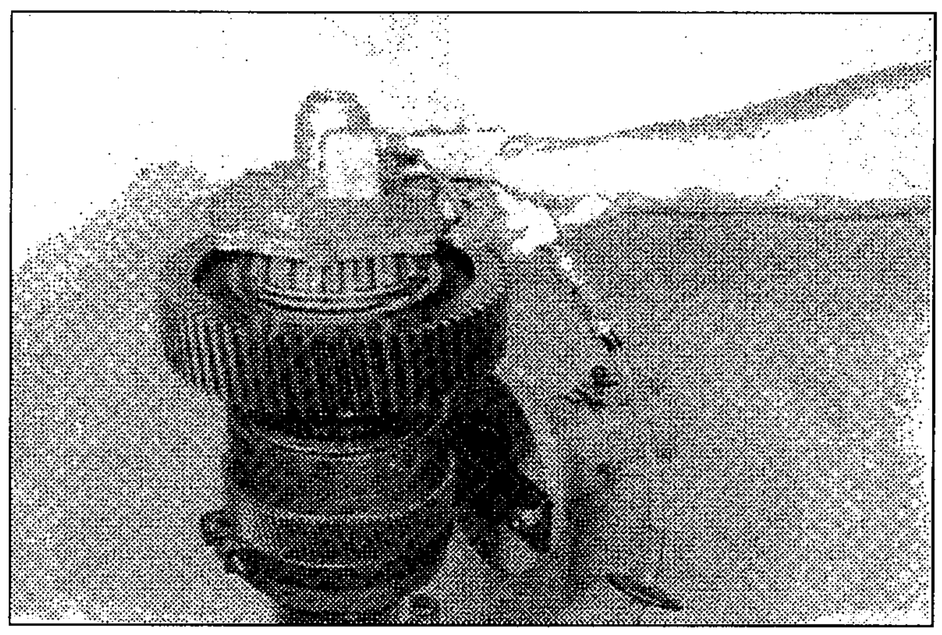


Check function of the clutches by means of compressed air

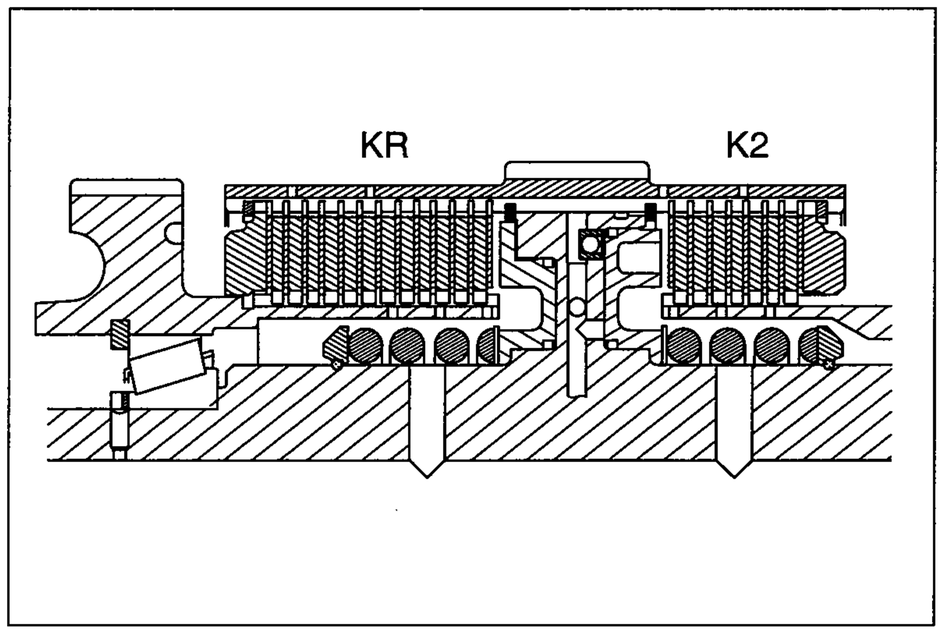
㉘ For this purpose, squeeze rectangular rings in, engage them and assemble bearing cover.

※ At correctly installed components, the closing, respectively opening of the clutches is clearly audible.

Now, remove bearing cover again.



3) PREASSEMBLE MULTI DISK CLUTCH KR/K2



Install purge valves, piston and compression spring(Each clutch side 1 set of the components) accordingly as at multi-disk clutch K3(Figure ②~⑥/page 3-105, 106).
Install plate pack KR and K2 check plate clearance, see also right draft.

Plate arrangement KR(Long plate carrier side):
Active number of the friction surfaces = 24

2 Outer plate(One sided coated)
11 Outer plates s = 2.5mm
11 Inner plates s = 2.5mm
1 Inner plate(Optional) s = 2.0~4.0mm

※ Pay attention to the general instructions for the plate installation, page 3-106.
Check plate clearance KR = 2.8~3.0mm accordingly as at clutch K3, see page 3-107.

Plate arrangement K2(Short plate carrier side):
Active number of the friction surfaces = 24

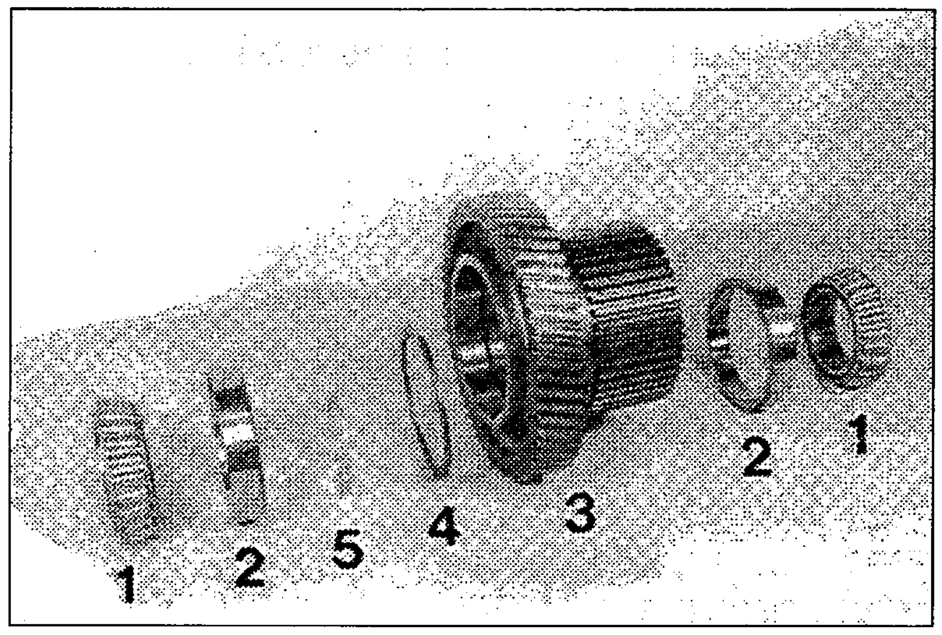
1 Outer plate(One sided coated)
7 Outer plates s = 2.5mm
3 Inner plates s = 3.5mm
3 Inner plates s = 3.0mm
1 Inner plate(Optional) s = 2.0~4.0mm

※ Pay attention to the general instructions for the plate installation, page 3-106.
Check plate clearance K2 = 2.2~2.4mm accordingly as at clutch K3, see page 3-107.

(1) Spur gear KR

Components:

1 Bearing inner race
2 Bearing outer race
3 Spur gear
4 Circlip
5 Adjusting ring(Optional)

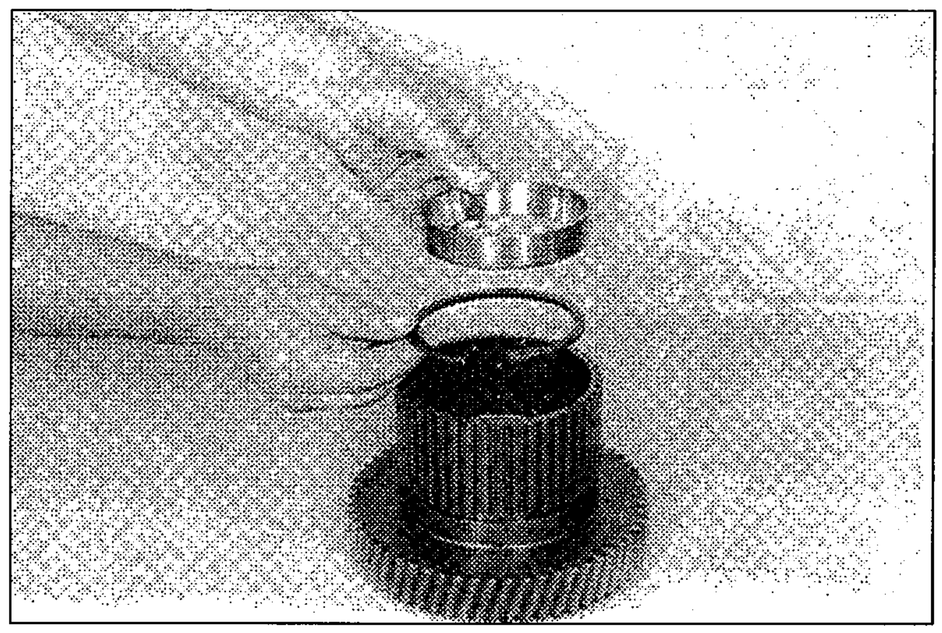


(2) Determine axial play of the spur gear bearing 0.03~0.08mm(Example B):

Squeeze circlip(4) in and place bearing outer race(2) against shoulder.

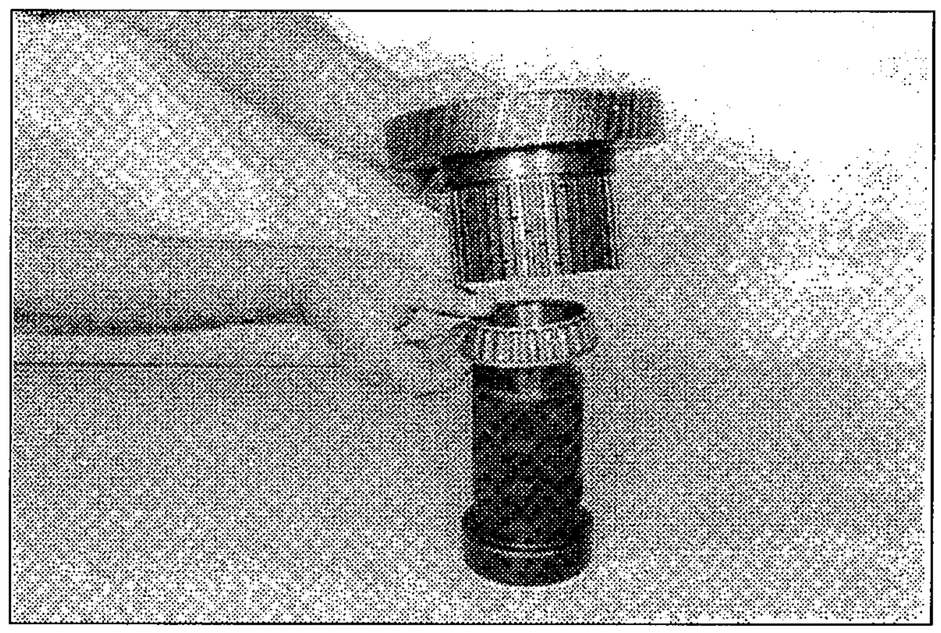
※ Special tool

Driver	5870 058 021
Handle	5870 260 002



(3) Place spur gear upon the bearing inner race.

※ Support bearing inner race.

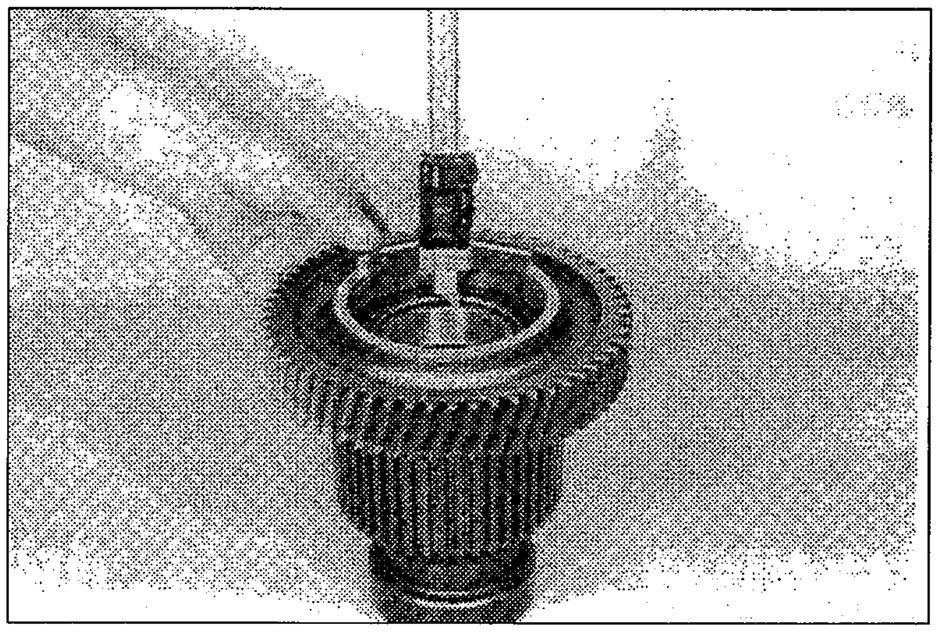


(4) Measure dimension I from the end face of the bearing inner race.

· Dimension I e.g. 24.95mm

※ Special tool

Digital depth gauge	5870 200 072

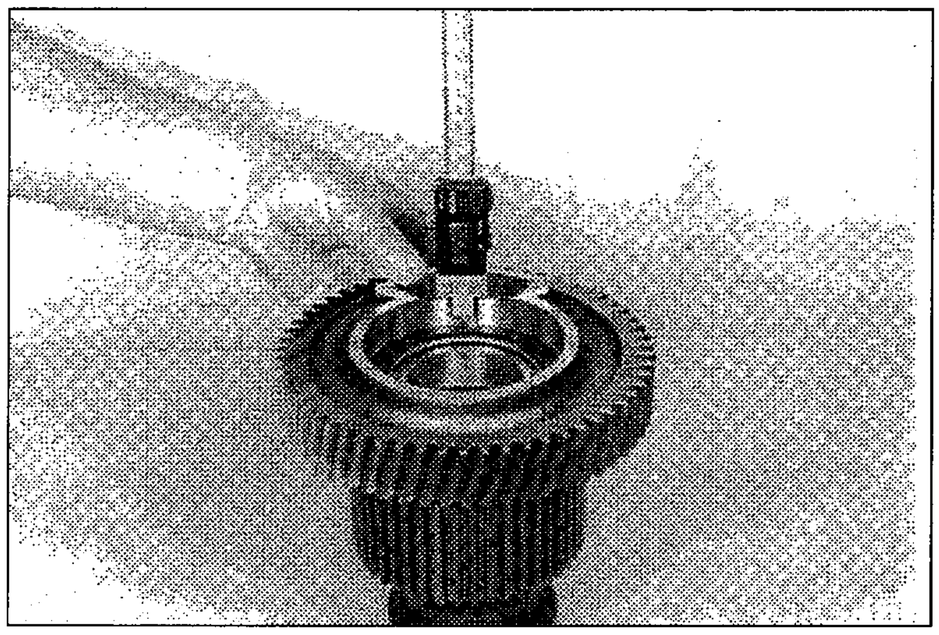


(5) Measure dimension Ⅱ from the end face of the circlip.

· Dimension Ⅱ e.g. 20.85mm

※ Special tool

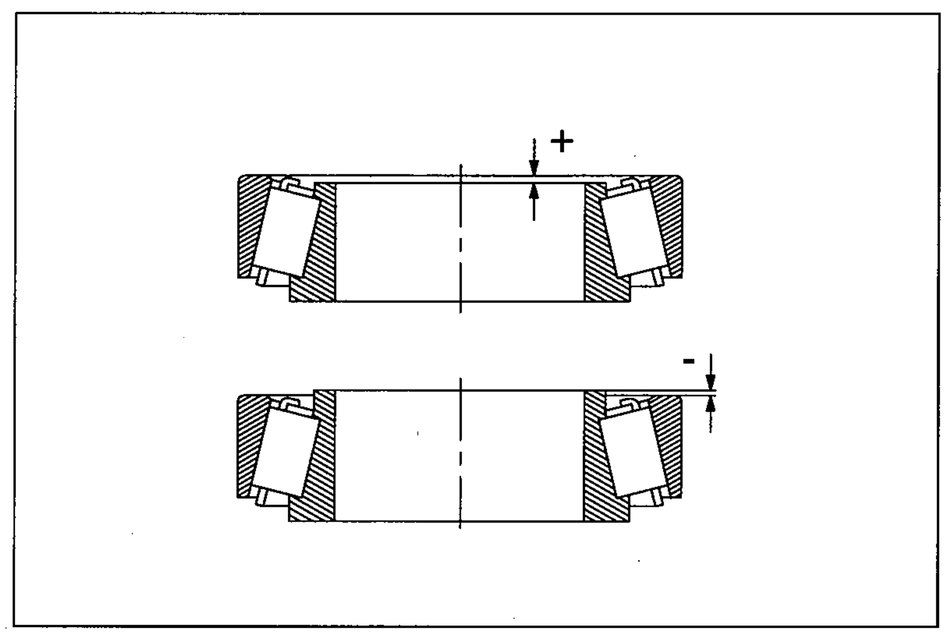
Digital depth gauge 5870 200 072



(6) Determine differential dimension from bearing outer race to bearing inner race on the upper tapered rolled bearing.

※ The draft on the right shows two tapered roller bearings with different measuring results.

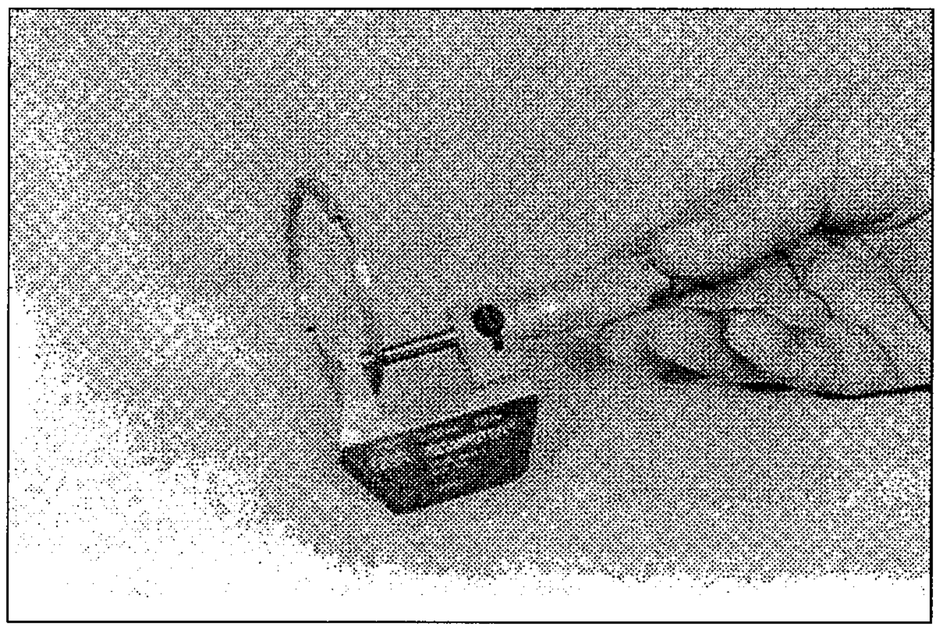
· Dimension Ⅲ (Differential dimension) in the actual case e.g. ..... + 0.15mm



Example B

Dimension Ⅰ	24.95mm
Dimension Ⅱ	- 20.85mm
Intermediate result	4.10mm
Dimension Ⅲ	+ 0.15mm
※ Result = Differential dimension - Zero	4.25mm
Required axial play(0.03-0.08)	+ 0.05mm
Result = Adjusting ring	s = 4.30mm

Select adjusting ring with corresponding thickness.



(7) Check axial play

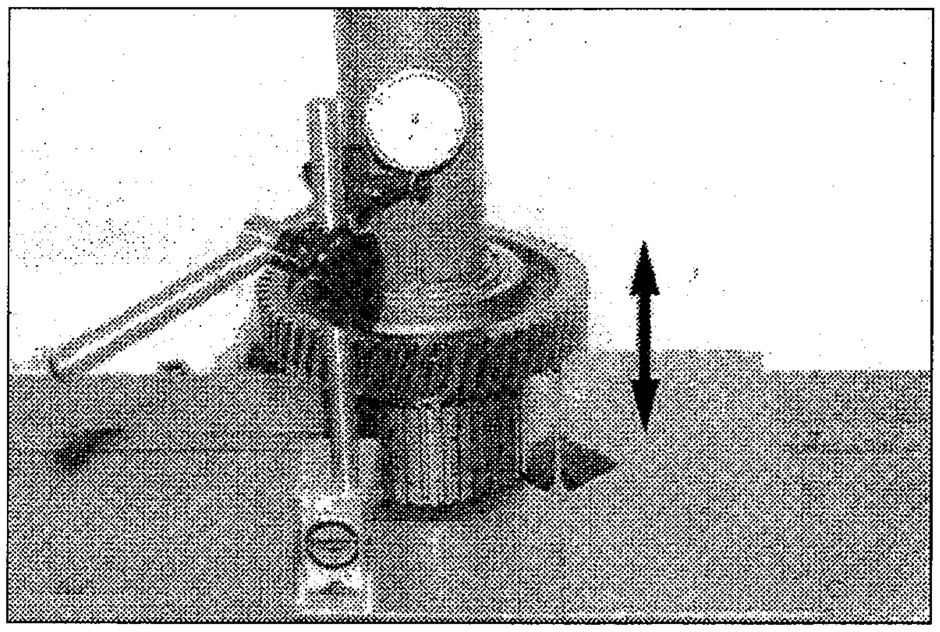
Install upper bearing outer race.

Insert adjusting ring e.g. s = 4.30mm and bearing inner race.

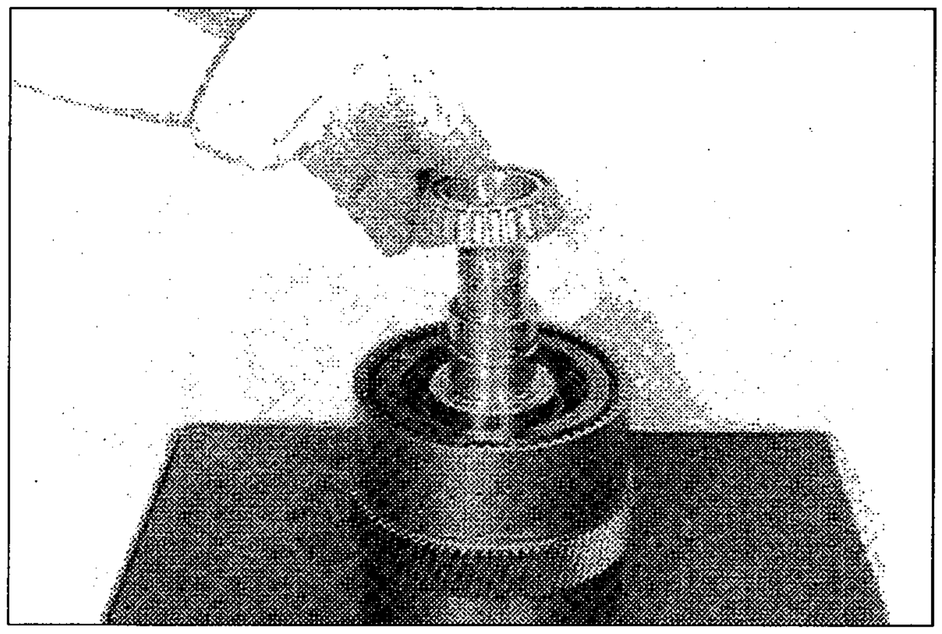
Preload spur gear bearing with about 50000N(5ton).

Determine axial play.

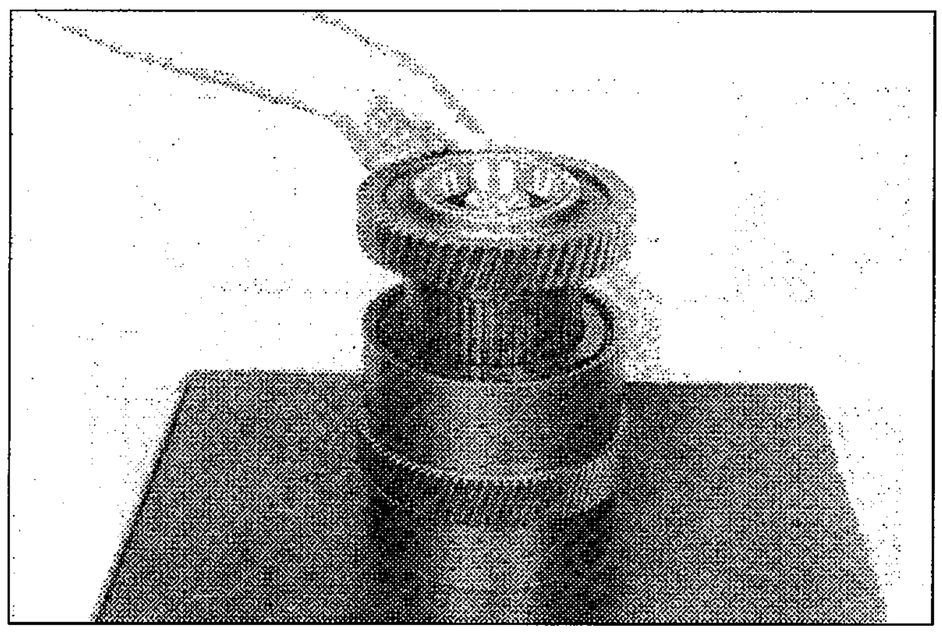
※ At deviations from the required axial play 0.03~0.08mm, correct with corresponding adjusting ring.



(8) Heat lower tapered roller bearing and assemble it until contact is obtained.



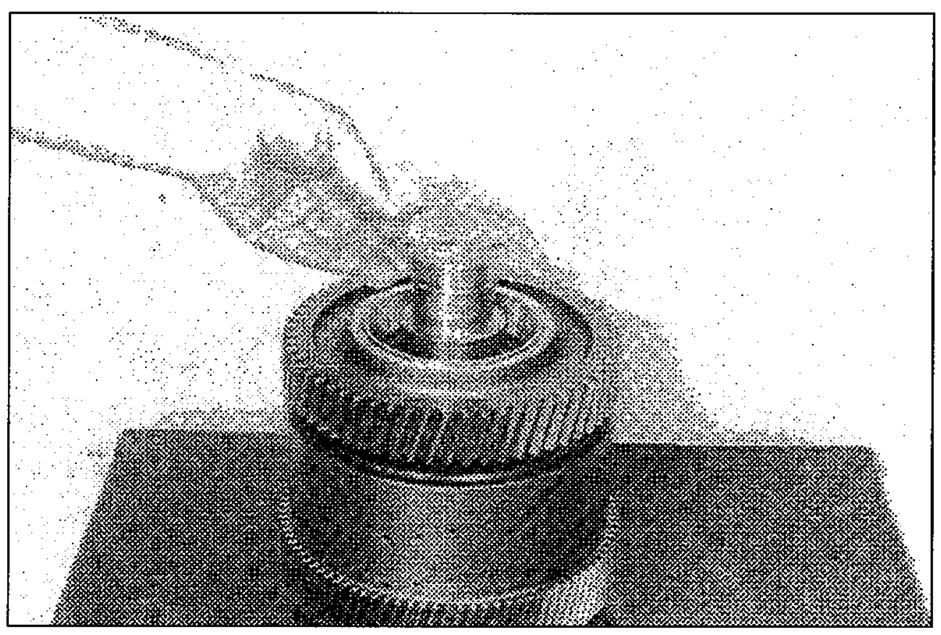
(9) Introduce spur gear KR into the preassembled plate carrier until all inner plates are accommodated.



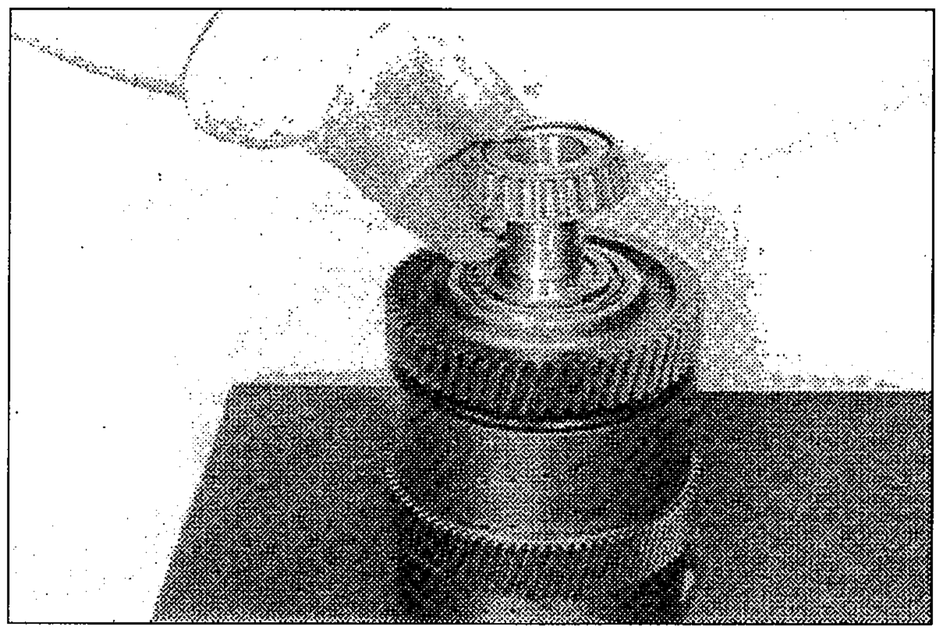
(10) **Assemble adjusting ring e.g. s=4.30mm** (See Example B):

※ Pay attention to the installation position oil feed grooves are showing upward.

Now, heat upper bearing inner race(Spur gear bearing) and assemble it until contact is obtained.



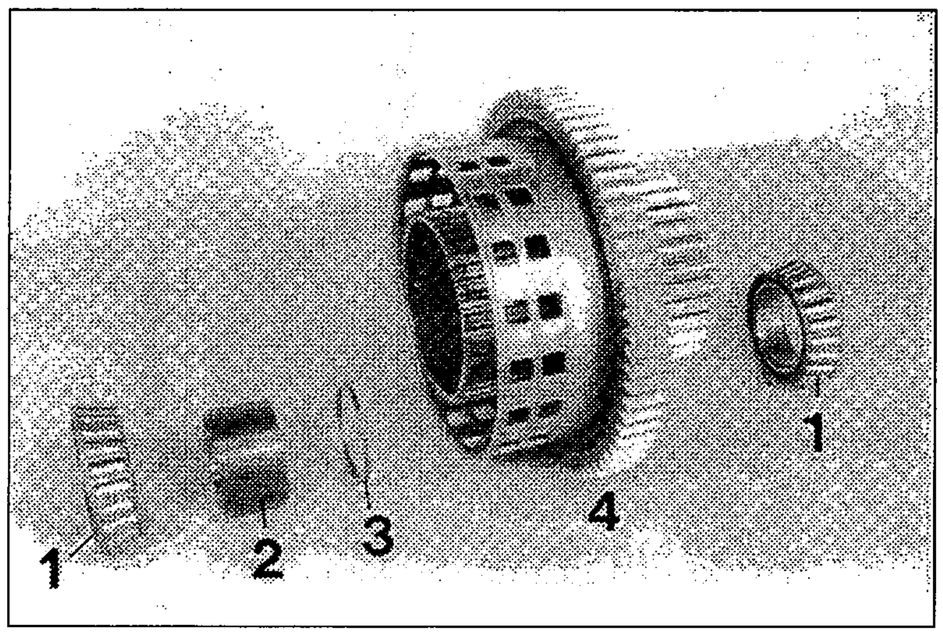
(11) Heat bearing inner race(Clutch bearing) and assemble it until contact is obtained.



(12) **Spur gear K2**

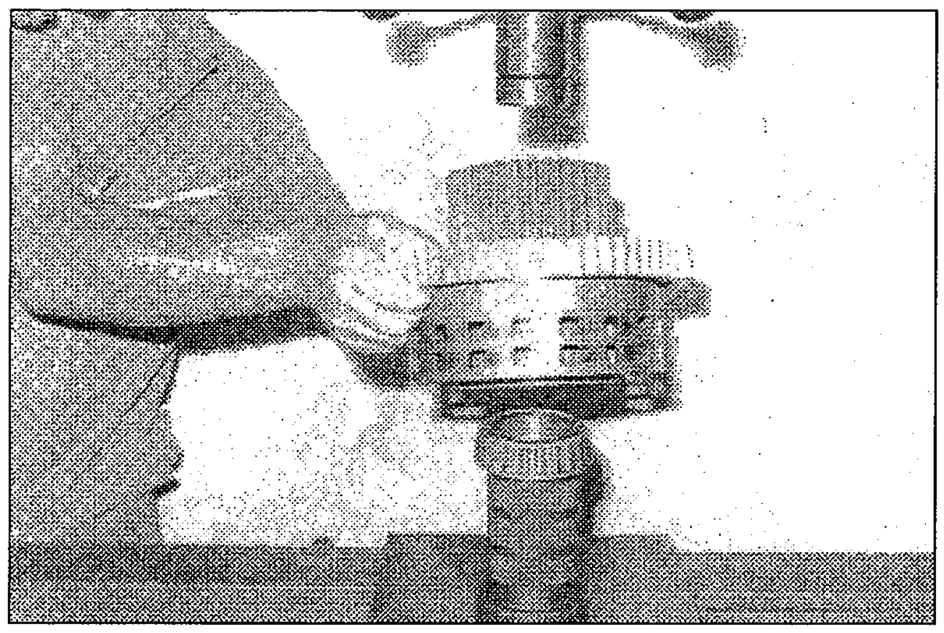
Components:

1 Tapered roller bearing
2 Bush
3 Shim
4 Spur gear

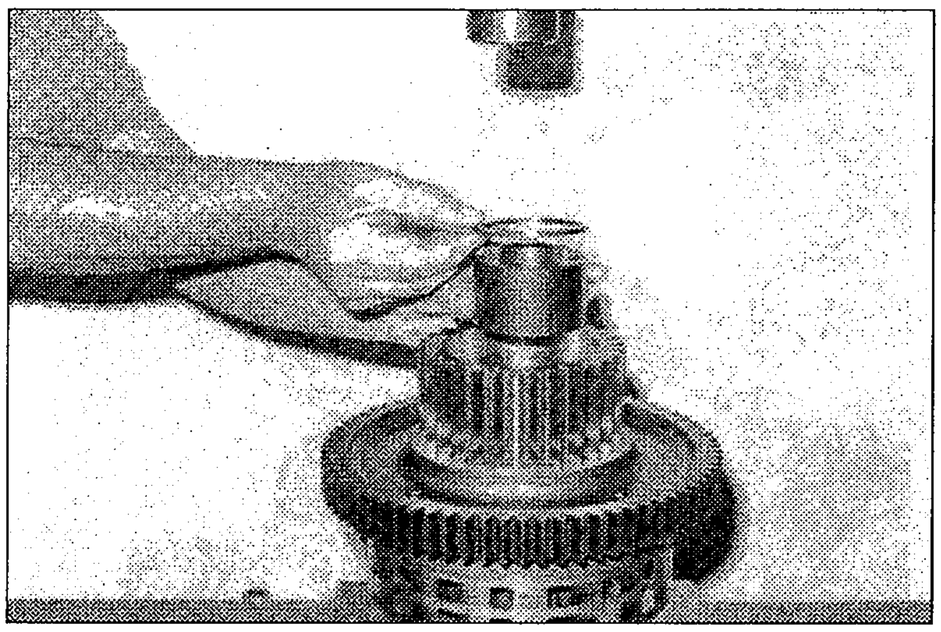


(13) **Adjust axial play of the spur gear bearing 0.05~0.15mm**(Figure (13)~(16)):
Place spur gear upon the bearing inner race.

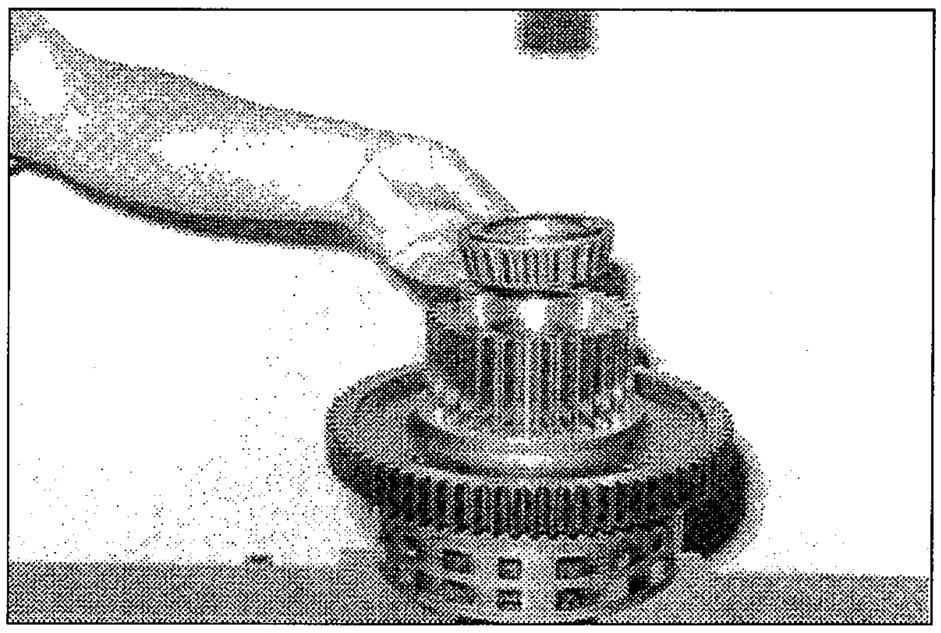
※ Support bearing inner race.



(14) Introduce bush as well as shim(s=3.80mm/ empirical value) and align it centrically.



(15) Install upper tapered roller bearing.

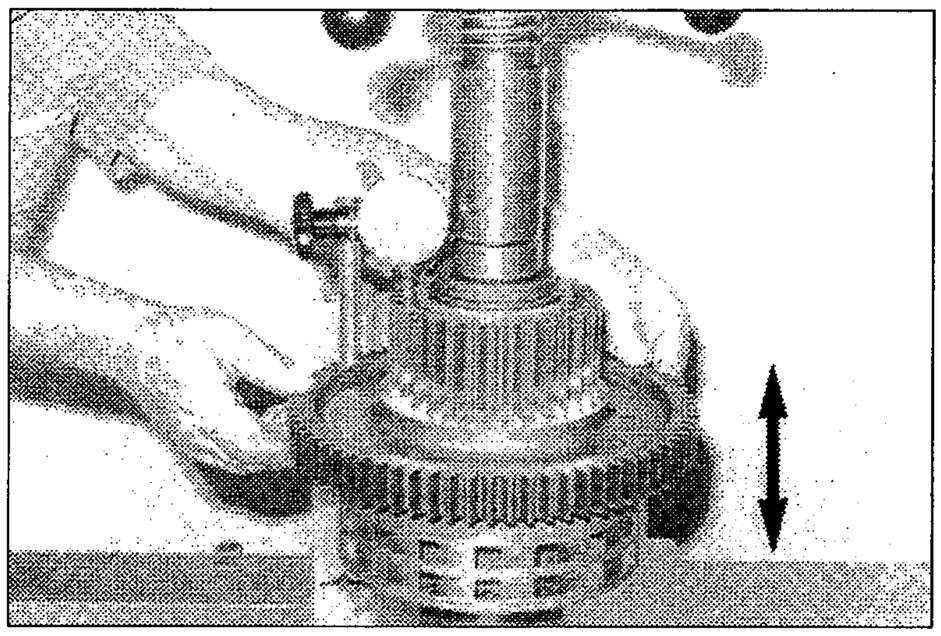


(16) Preload spur gear bearing with about 50000N(5ton) and determine axial play.

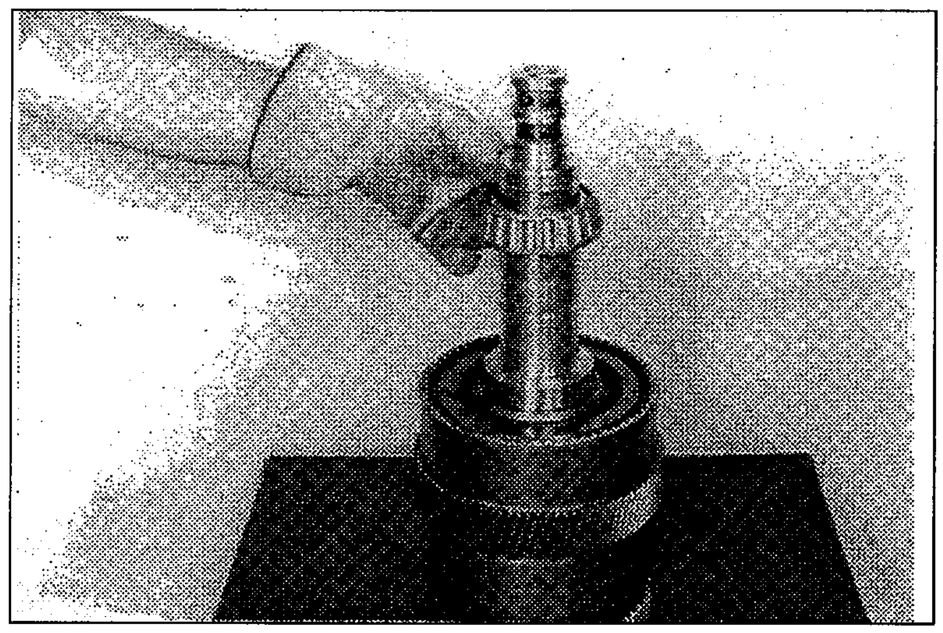
※ At a deviation from the required axial play 0.05~0.15mm, correct with corresponding shim(Figure (12)/page 3-118).

※ Special tool

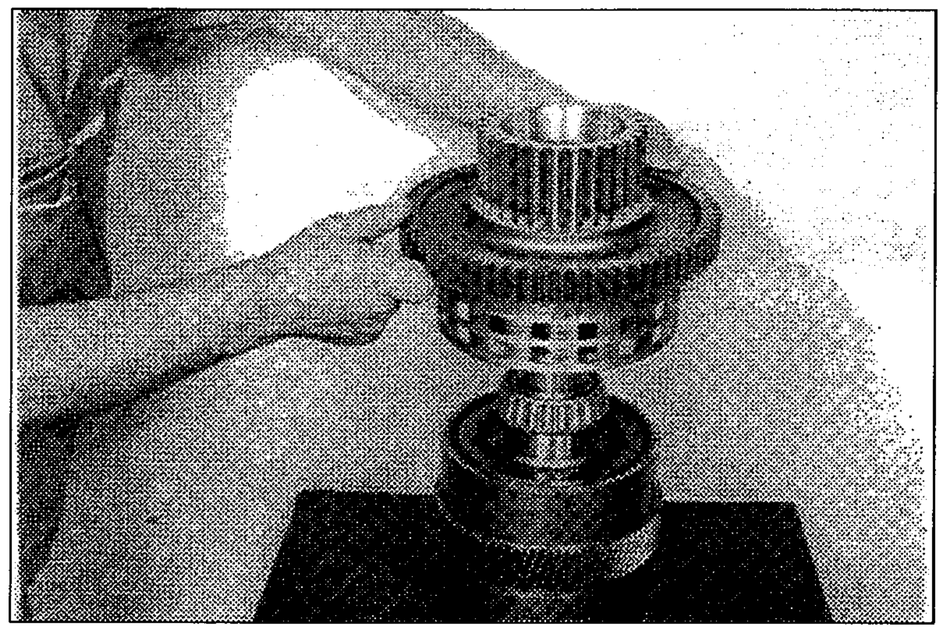
Magnetic stand	5870 200 055
Dial indicator	5870 200 057



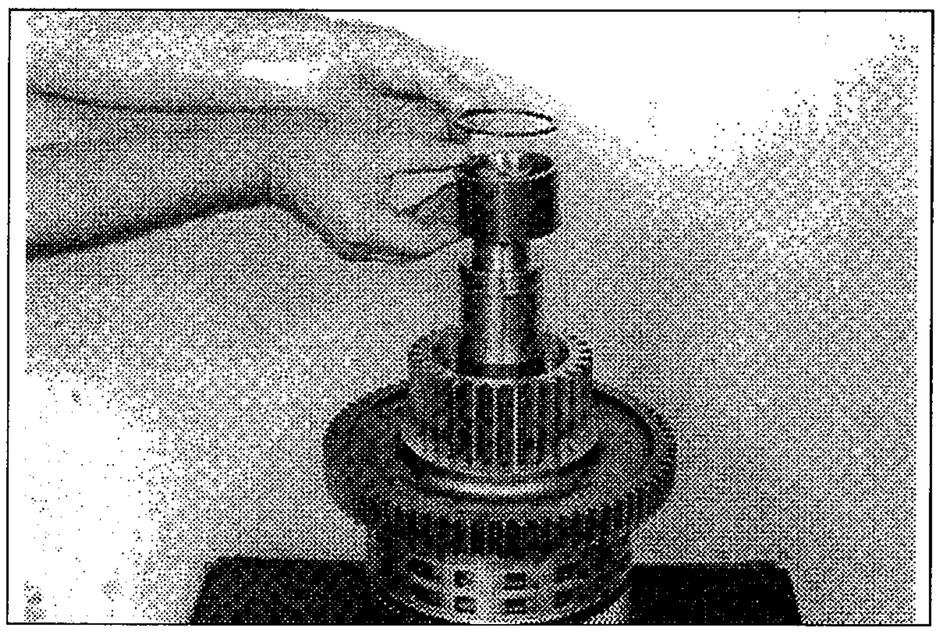
(17) Heat bearing inner race and assemble it until contact is obtained.



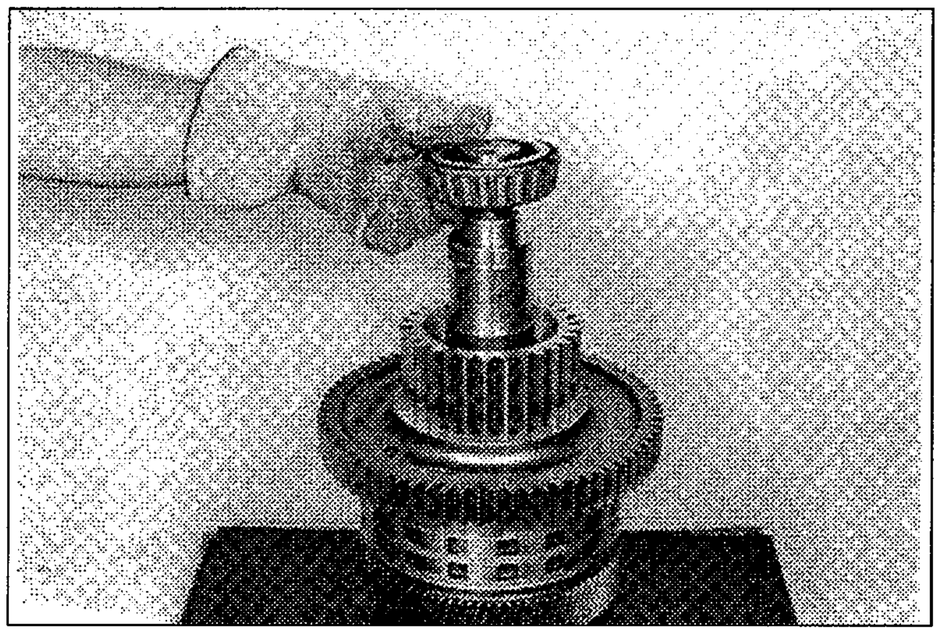
(18) Introduce spur gear K2 until all inner plates are accommodated.



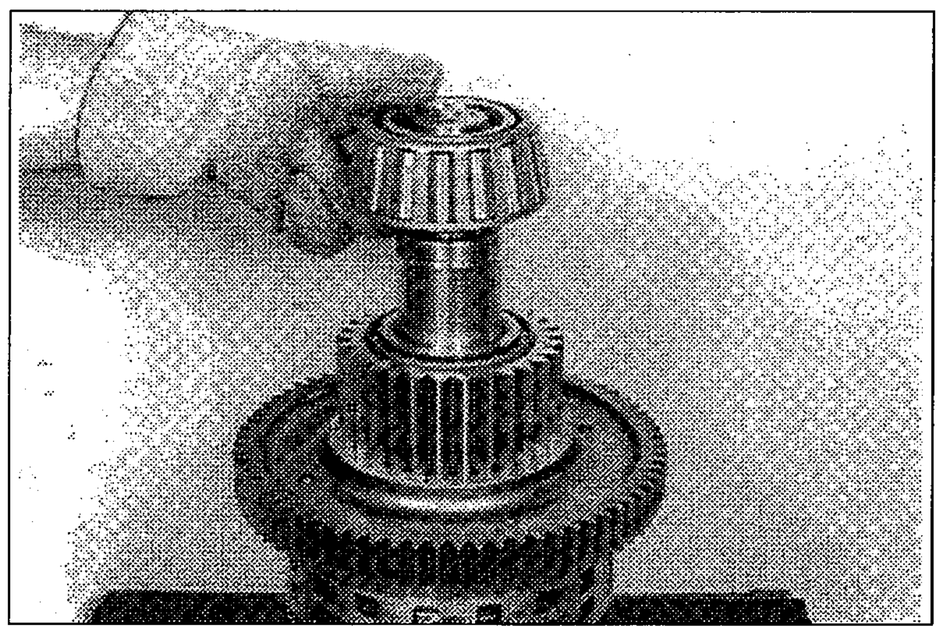
(19) Install bush and corresponding shim.



(20) Heat second tapered roller bearing of the spur gear bearing and assemble it until contact is obtained.



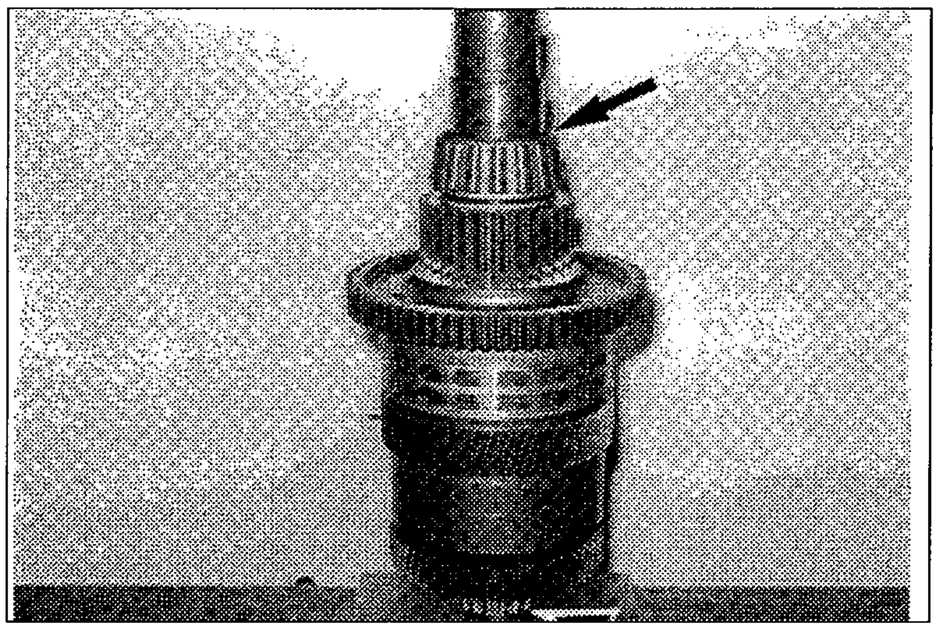
(21) Heat bearing inner race(Clutch bearing) and place it against shoulder.



(22) Proload complete clutch pack through both bearing inner race(Arrows) with 100000N(10ton).
In this way, an exact contact of the components, respectively the settling of the complete bearing is ensured.

※ Special tool

Pressure pieces	5870 506 096

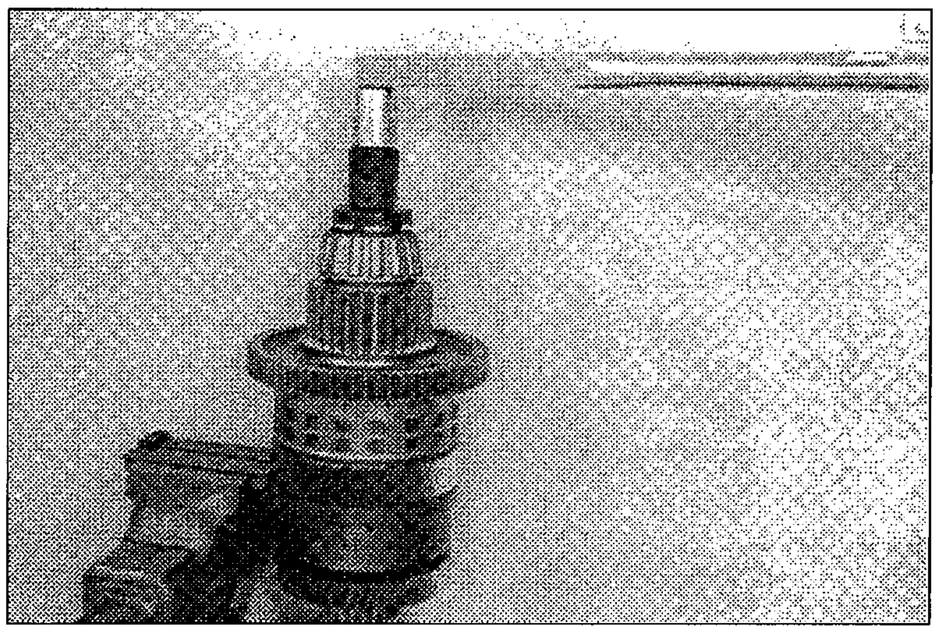


(23) Install and tighten both slotted nuts.
· Torque limit : 82kgf · m(800Nm)

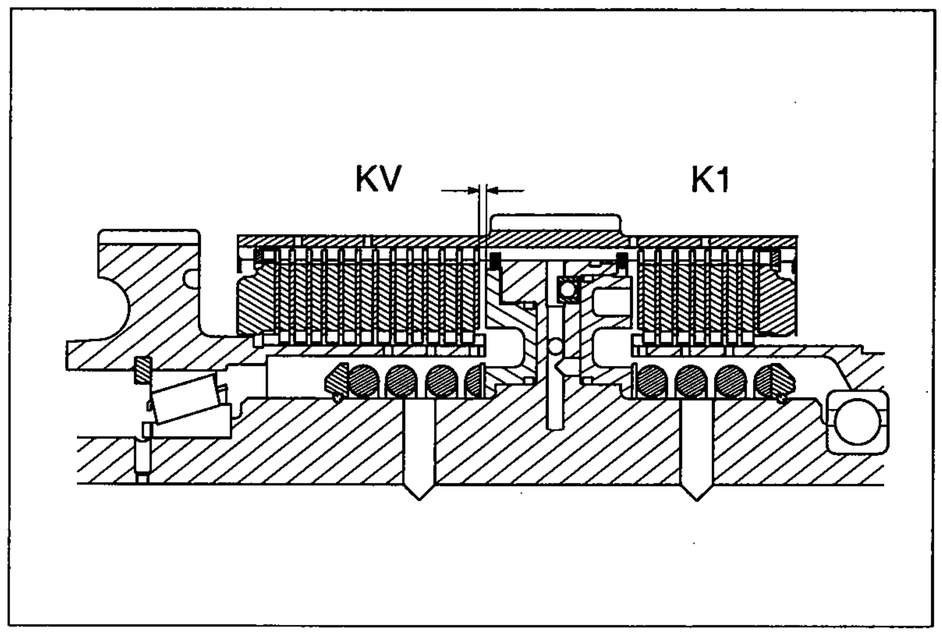
※ Pay attention to the installation position of the slotted nuts, chamfer is always facing the bearing inner race.
Secure slotted nuts with loctite(Type No.262).

※ Special tool

Clamping ring	5870 654 022
Hook spanner	5870 401 099
Hook spanner	5870 401 118
Hook spanner	5870 401 115



4) PREASSEMBLE MULTI DISK CLUTCH KV/K1



Install purge valves, piston and compression spring(Each clutch side 1 set of the components) accordingly as at multi-disk clutch K3(Figure ②~⑥/page 3-105, 106).
Install plate pack KV and K1 and check plate clearance, see also right draft.

Plate arrangement KV(Long plate carrier side):
Active number of the friction surfaces = 24

2 Outer plate(One sided coated)
11 Outer plates s = 2.5mm
11 Inner plates s = 2.5mm
1 Inner plate(Optional) s = 2.0~4.0mm

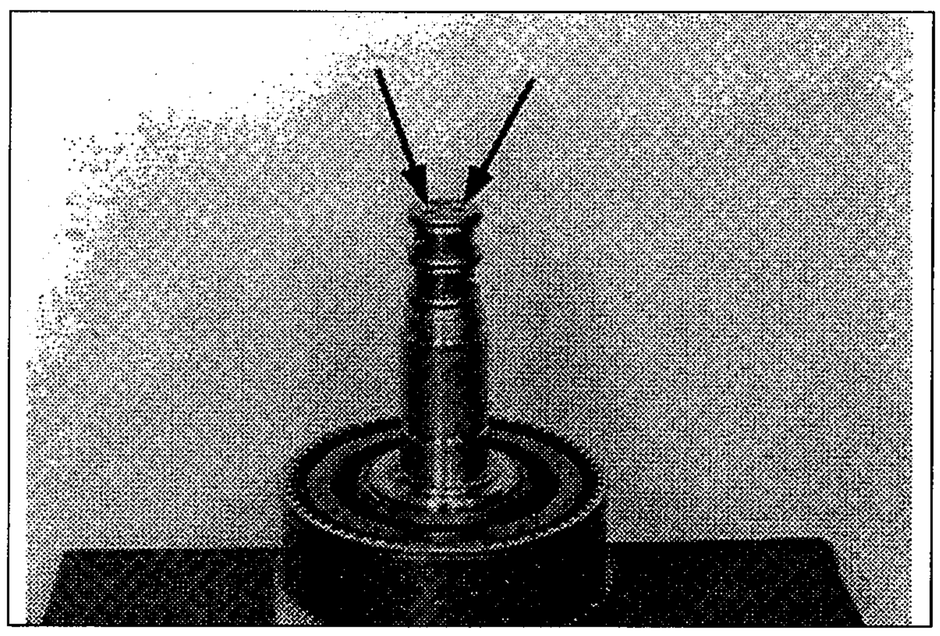
※ Pay attention to the general instructions for the plate installation, page 3-106.
Check plate clearance KV = 2.8~3.0mm accordingly as at clutch K3, see page 3-107.

Plate arrangement K1(Short plate carrier side):
Active number of the friction surfaces = 14

1 Outer plate(One sided coated)
7 Outer plates s = 2.5mm
3 Inner plates s = 3.5mm
3 Inner plates s = 3.0mm
1 Inner plate(Optional) s = 2.0~4.0mm

※ Pay attention to the general instructions for the plate installation, page 3-106.
Check plate clearance K1 = 2.2~2.4mm accordingly as at clutch K3, see page 3-107.

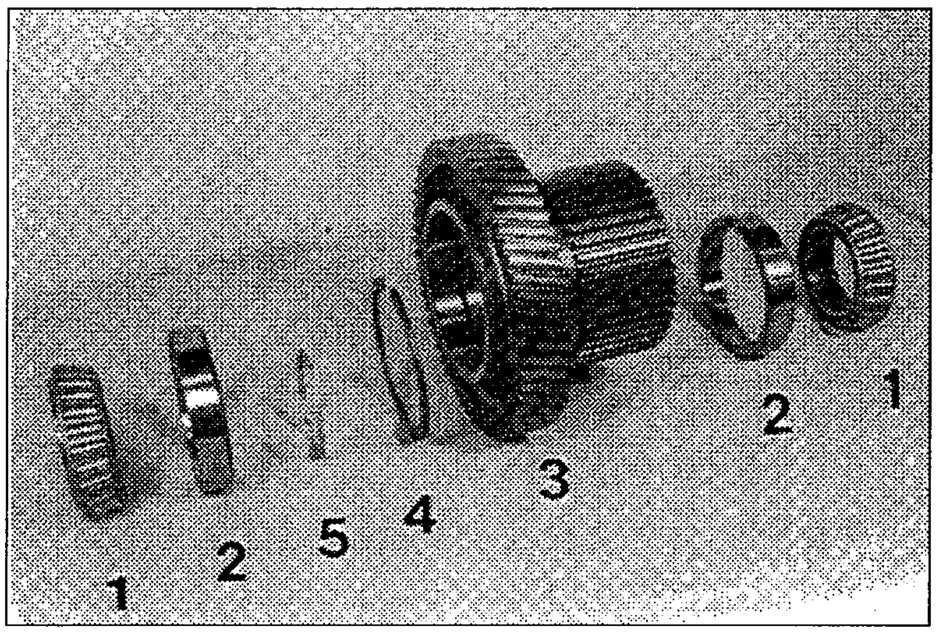
(1) Close both bores(Arrows) by means of set screws.
※ Insert set screws with loctite(Type No.262).



(1) Spur gear-KV

Components:

1 Bearing inner race
2 Bearing outer race
3 Spur gear
4 Circlip
5 Ring(Optional)

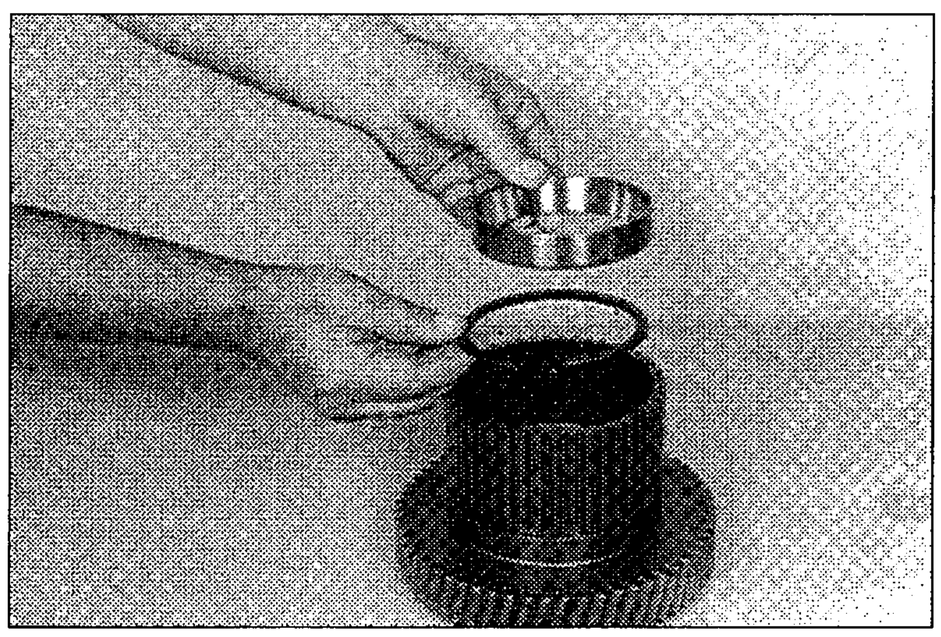


(2) Determine axial play of the spur gear bearing 0.03~0.08mm(Example C):

Squeeze circlip(4) in and place bearing outer race(2) against shoulder.

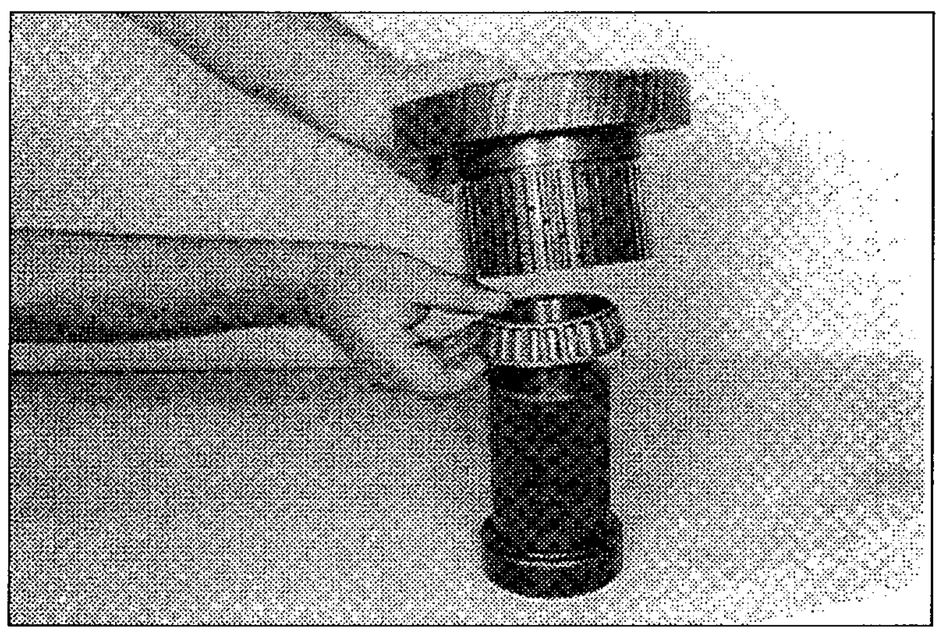
※ Special tool

Driver	5870 058 021
Handle	5870 260 002



(3) Place spur gear upon the bearing inner race.

※ Support bearing inner race.

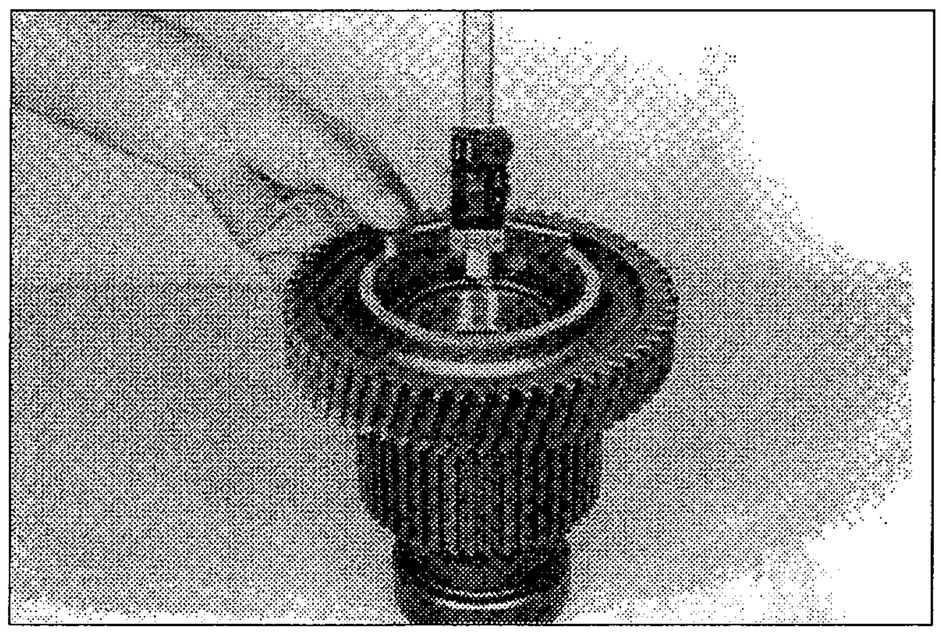


(4) Measure dimension I from the end face of the bearing inner race.

· Dimension I e.g. 24.95mm

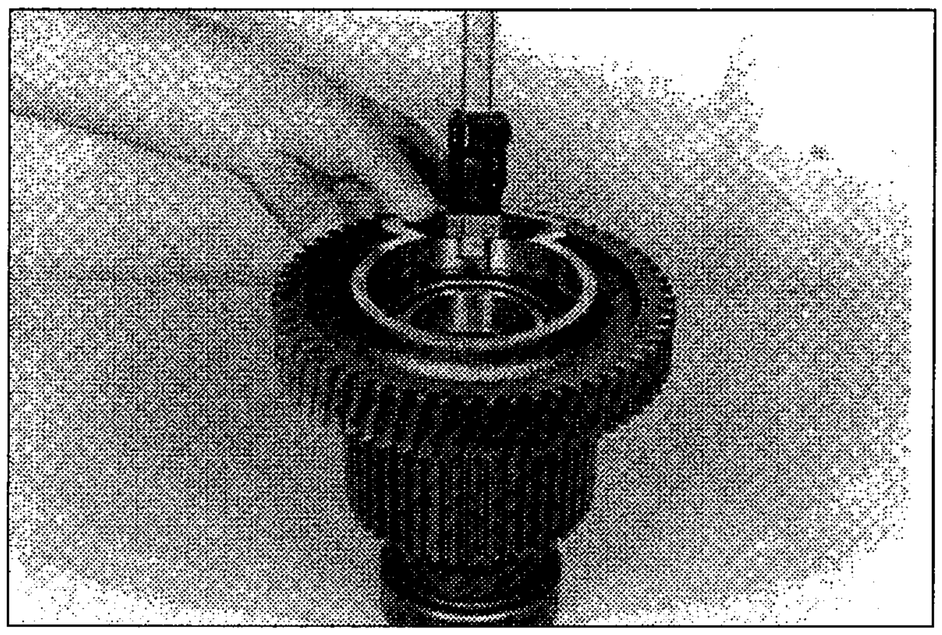
※ Special tool

Digital depth gauge	5870 200 072



(5) Determine dimension Ⅱ from the end face of the circlip.
- Dimension Ⅱ e.g. 20.85mm

※ Special tool
Digital depth gauge 5870 200 072



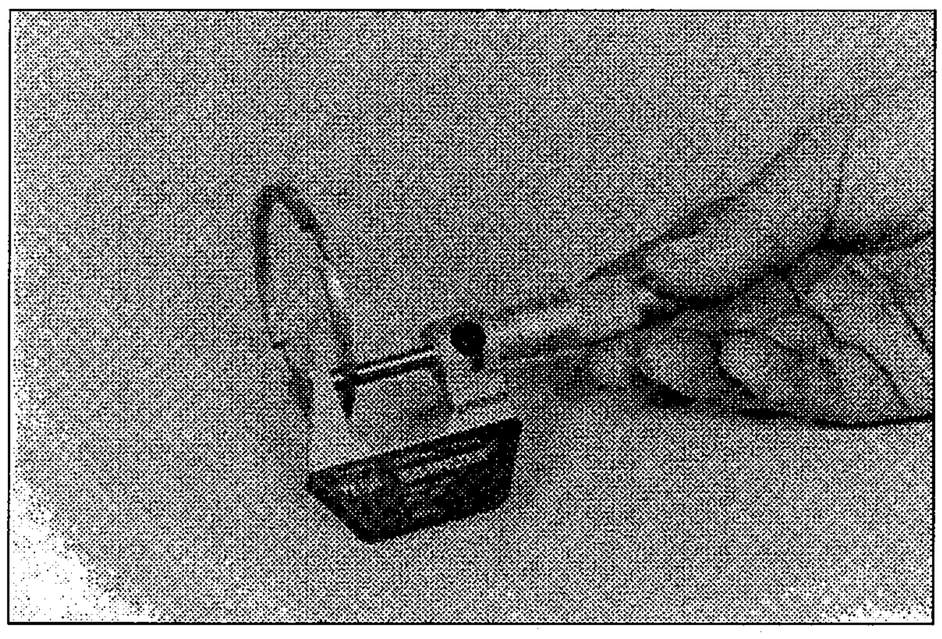
(6) Determine differential dimension from bearing outer race to bearing inner race on the upper tapered roller bearing.

※ The draft on the right shows two tapered roller bearings with different measuring results.
- Dimension Ⅲ (Differential dimension) in the actual case e.g. .....+ 0.15mm

Example C

Dimension Ⅰ	24.95mm
Dimension Ⅱ	- 20.85mm
Result A	4.10mm
Dimension Ⅲ	+ 0.15mm
※ Result = Differential dimension - Zero	4.25mm
Required axial play(0.03-0.08)	+ 0.05mm
Result = Adjusting ring	s = 4.30mm

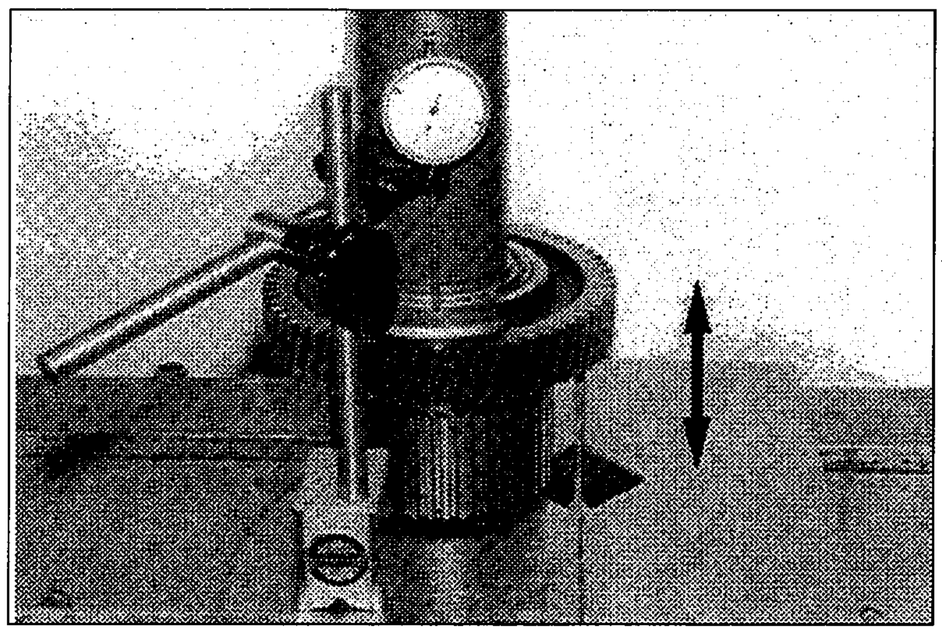
Select adjusting ring with corresponding thickness.



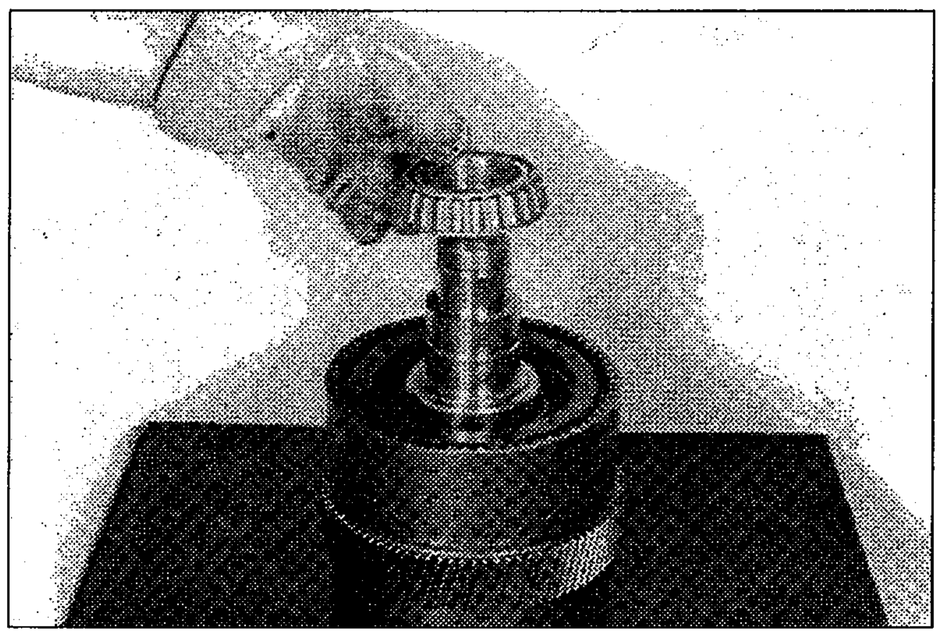
(7) Check axial play

Install upper bearing outer race.
Insert adjusting ring e.g. s = 4.30mm and bearing inner race.
Preload spur gear bearing with about 50000N(5ton).
Determine axial play.

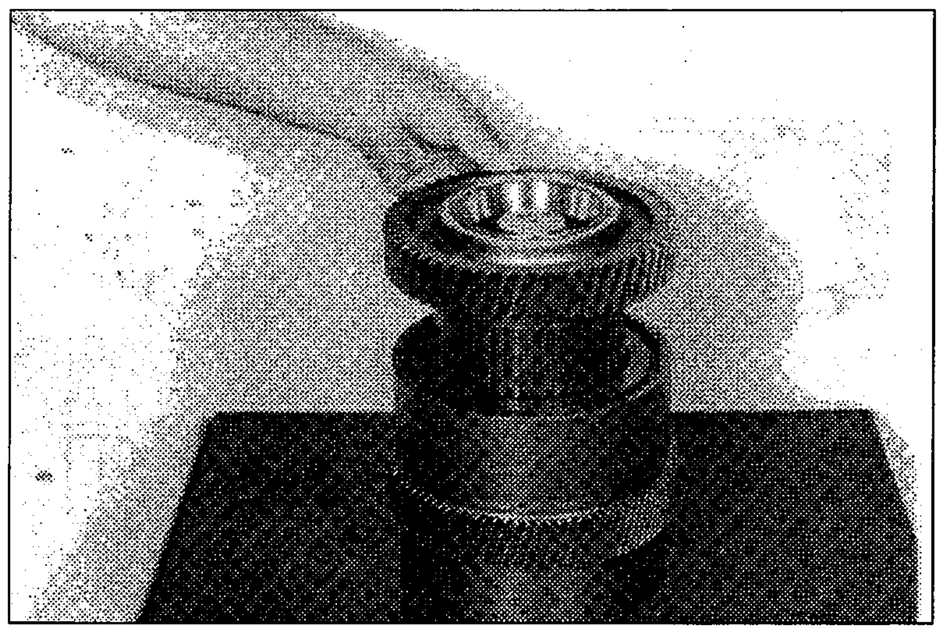
※ At deviations from the required axial play 0.03~0.08mm, correct with corresponding adjusting ring.



(8) Heat lower bearing inner race and assemble it until contact is obtained.

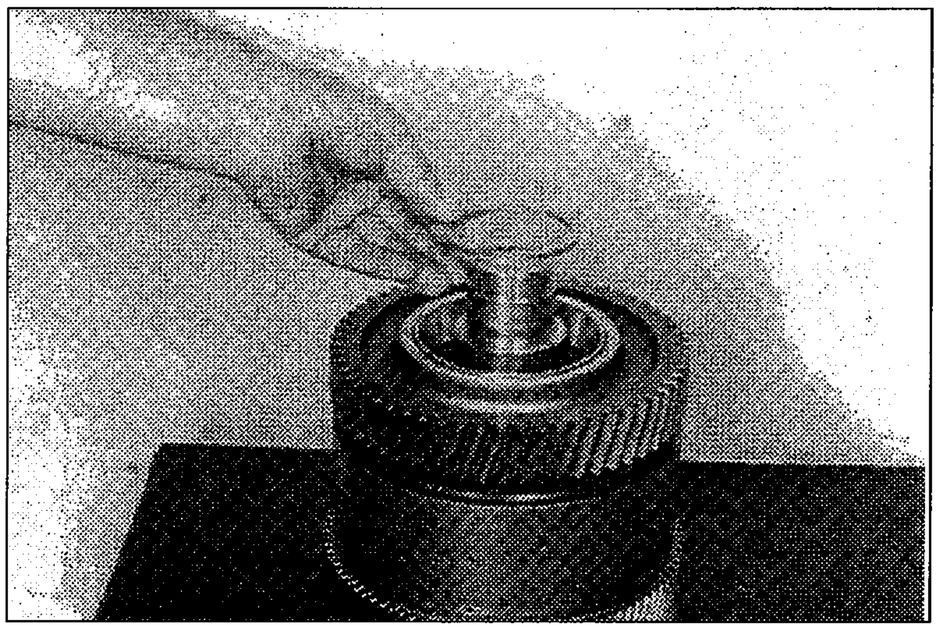


(9) Introduce spur gear KR into the preassembled plate carrier until all inner plates are accommodated.

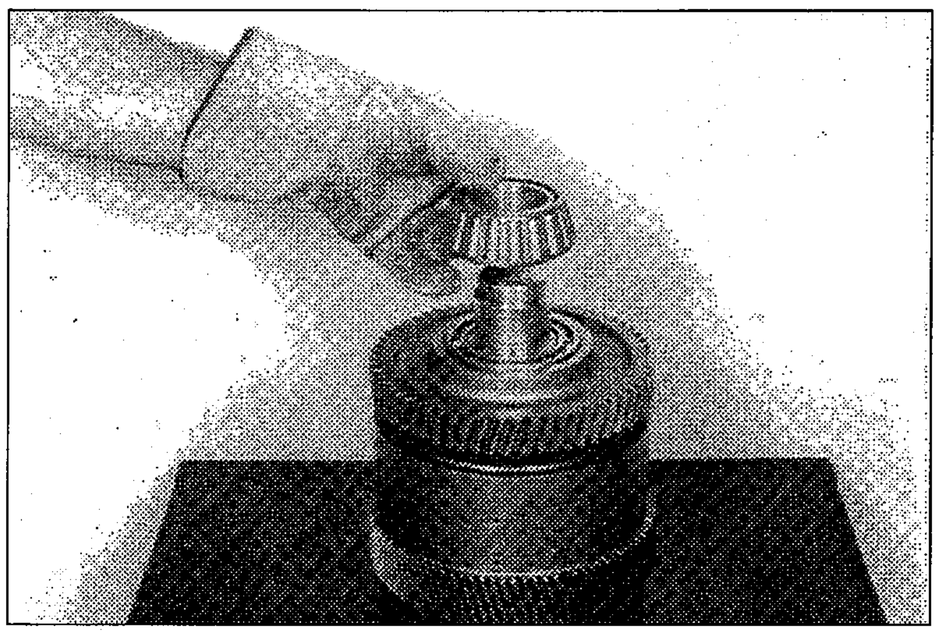


(10) Assemble adjusting ring e.g. s=4.30mm (See Example C).

※ Pay attention to the installation position oil feed grooves are showing upward.
Now, heat upper bearing inner race(Spur gear bearing) and assemble it until contact is obtained.

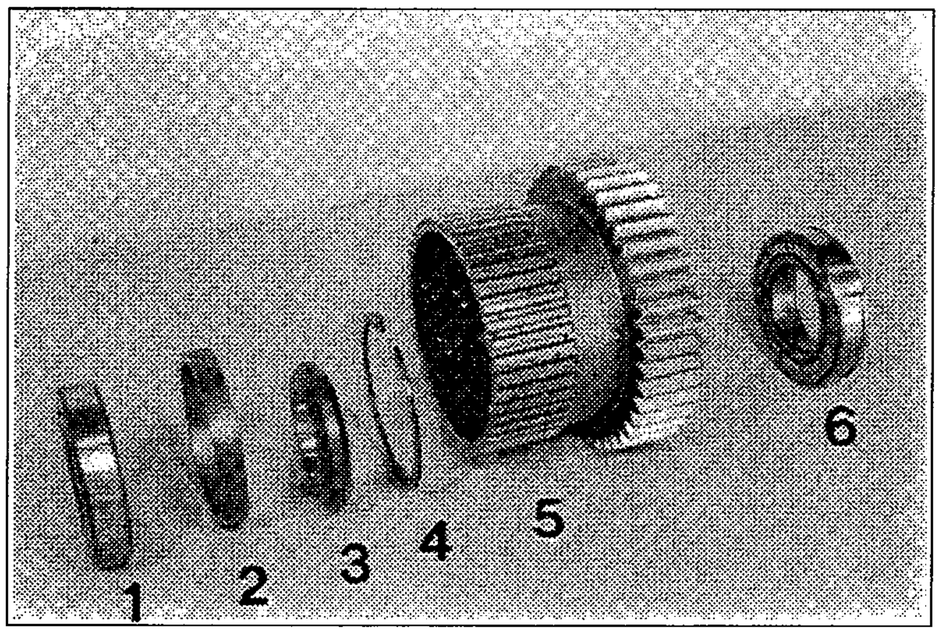


(11) Heat bearing inner race(Clutch bearing) and assemble it until contact is obtained.



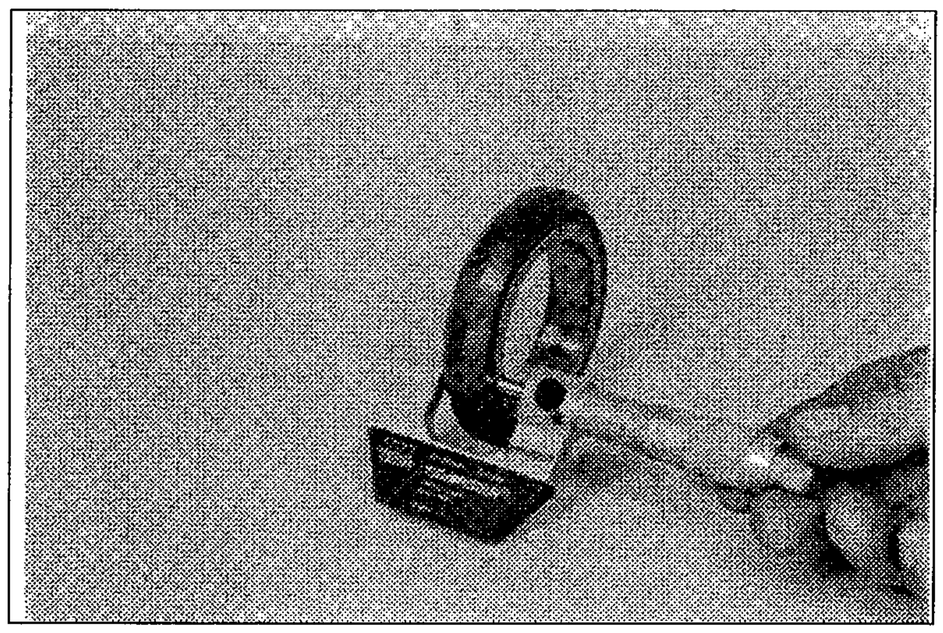
(12) Spur gear K1

1 Ball bearing
2 Ring(Optional)
3 Splash ring
4 Circlip
5 Spur gear
6 Ball bearing



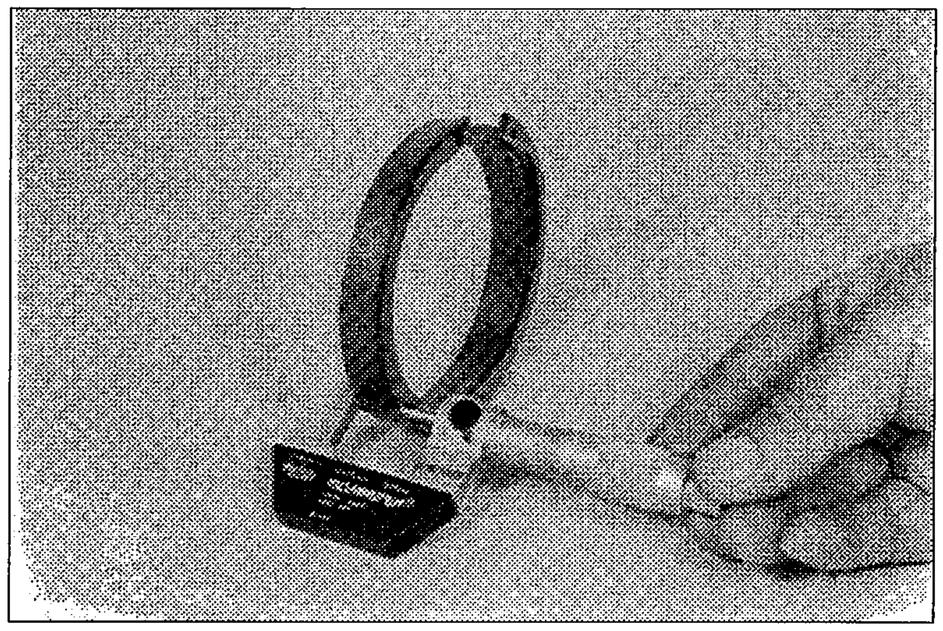
(13) Adjust axial play of the spur gear bearing 0.01~0.04mm

· Determine thickness of splash ring(3) e.g. s=17.15mm

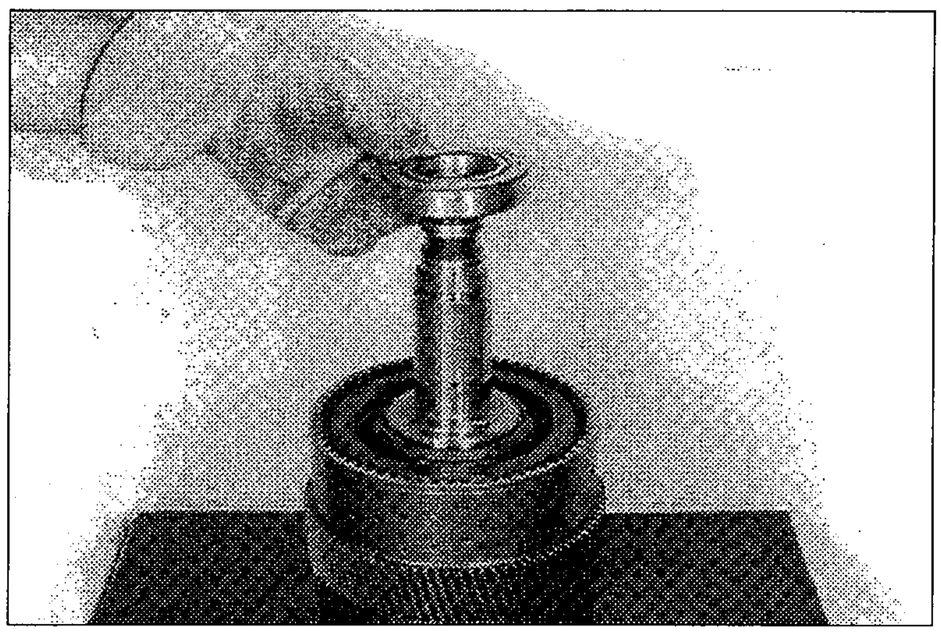


※ Total dimension of circlip 4 and ring 2 (Optional) must be selected 0.01~0.04mm thinner.

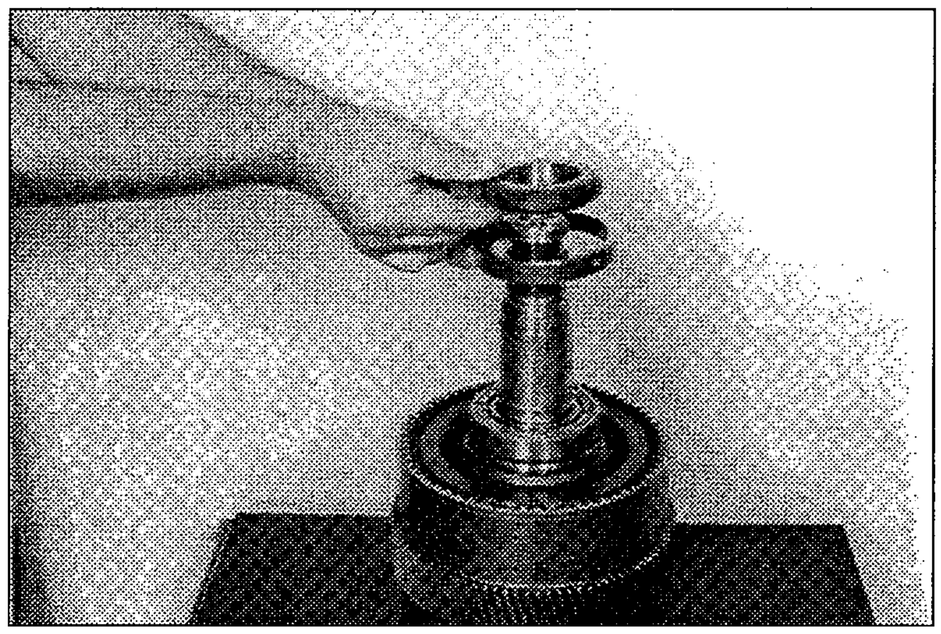
· Total dimension of circlip and ring therefore 17.14~17.11mm



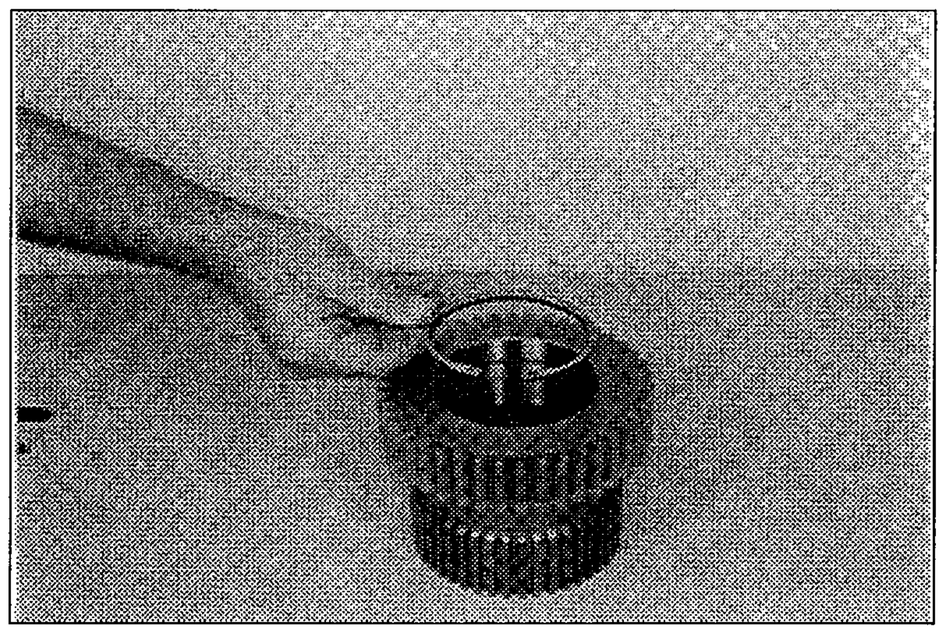
(14) Heat ball bearing and assemble it until contact is obtained.
Now, cool ball bearing down to room temperature, to allow the later installation of the spur gear(Figure (17)/page 3-126).



(15) Assemble ring(Optional) and splash ring.

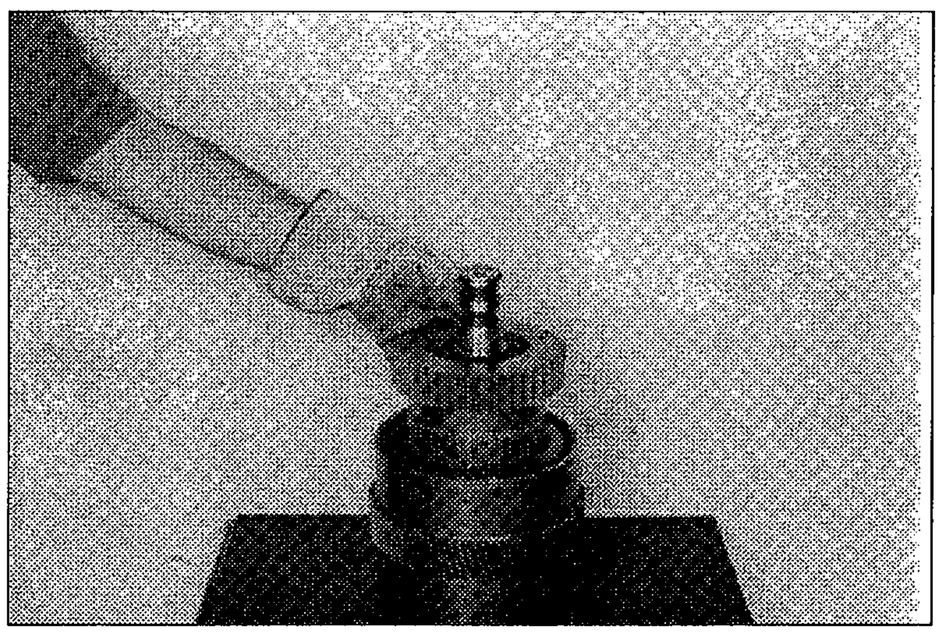


(16) Squeeze circlip into the annular groove of the spur gear.

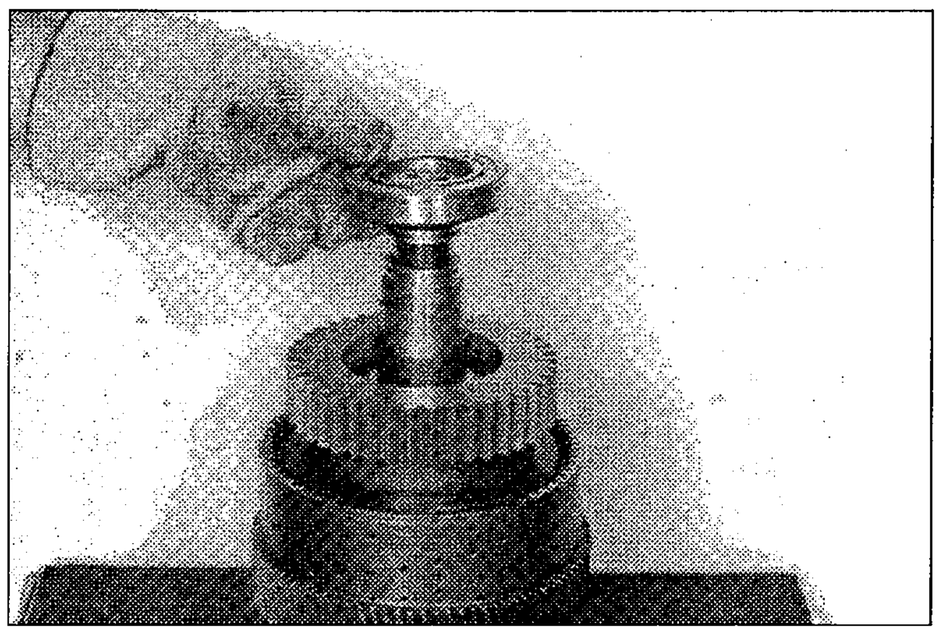


※ Carry out steps of figure (17) and (18) in immediate sequence to prevent the cooling down of the components.

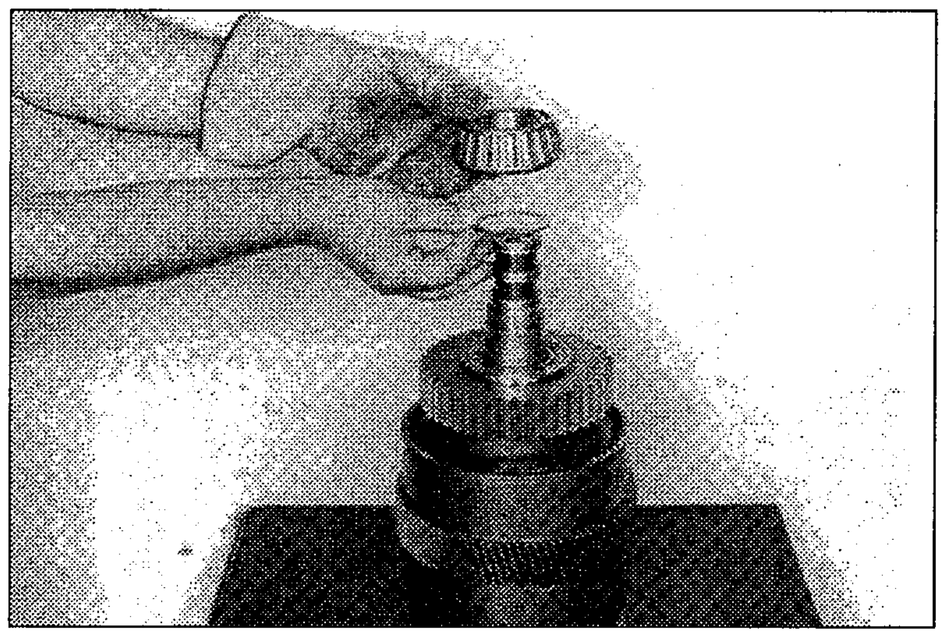
(17) Heat bearing bores of the spur gear (Figure on the right) and ball bearing (Figure (18)).
Introduce spur gear until all inner plates are accommodated.



(18) Introduce heated ball bearing until contact is obtained.



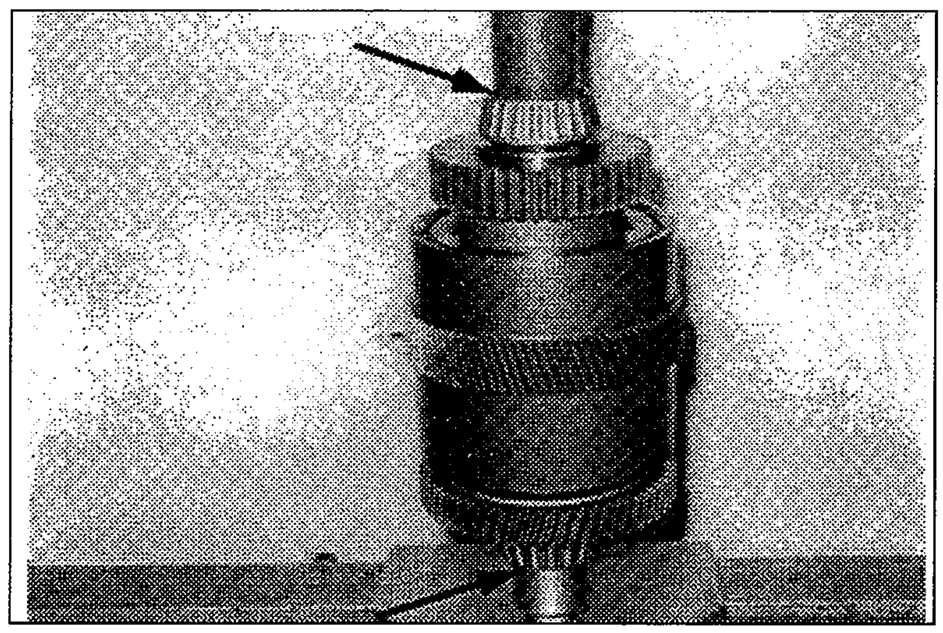
(19) Assemble spacer(s=1.50mm).
Heat tapered roller bearing and place it against shoulder.



(20) Preload complete clutch pack through both bearing inner races(Arrows) with 100000N(10ton).
In this way, an exact contact of the components, respectively the settling of the complete bearing is ensured.

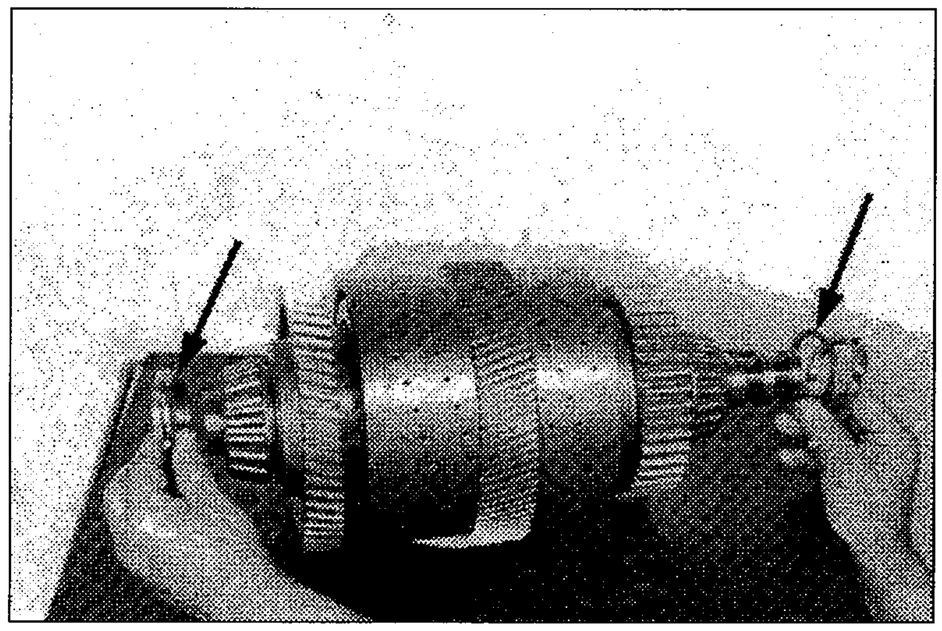
※ Special tool

Pressure pieces	5870 506 096



(21) Fix clutch pack by means of disks(Arrows) and slotted nuts.

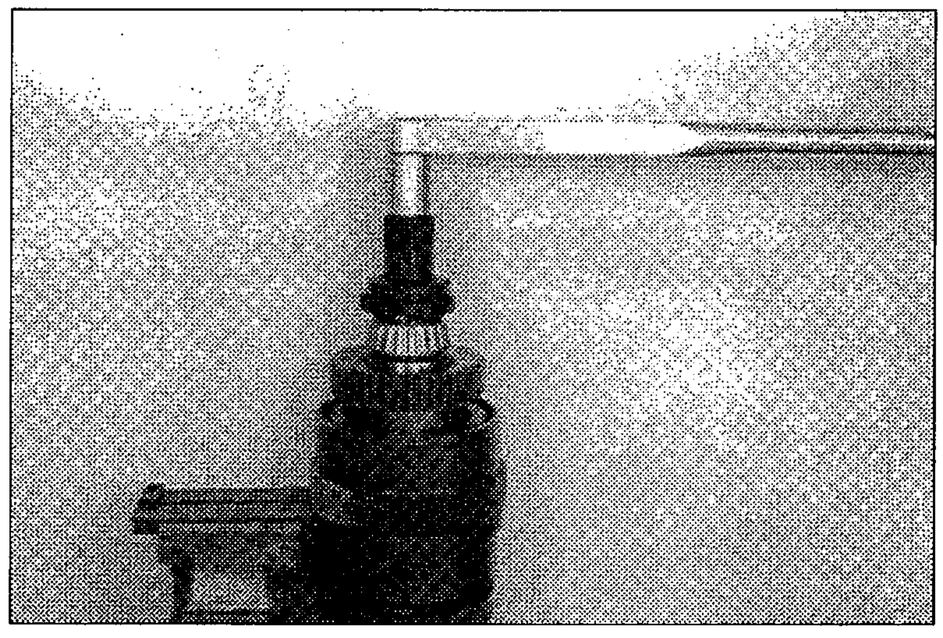
※ Pay attention to the installation position of the slotted nuts, chamfer is always facing the bearing inner race.
Wet thread of the slotted nuts with loctite (Type No.262).



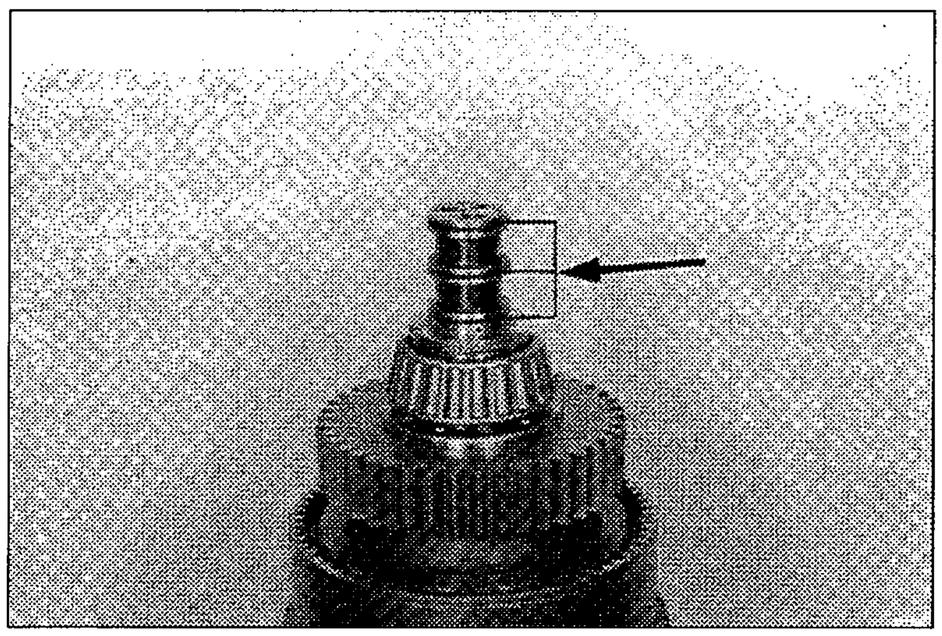
(22) Tighten both slotted nuts.
· Torque limit : 56kgf · m(550Nm)

※ Special tool

Clamping ring	5870 654 022
Hook spanner	5870 401 118
Hook spanner	5870 401 115

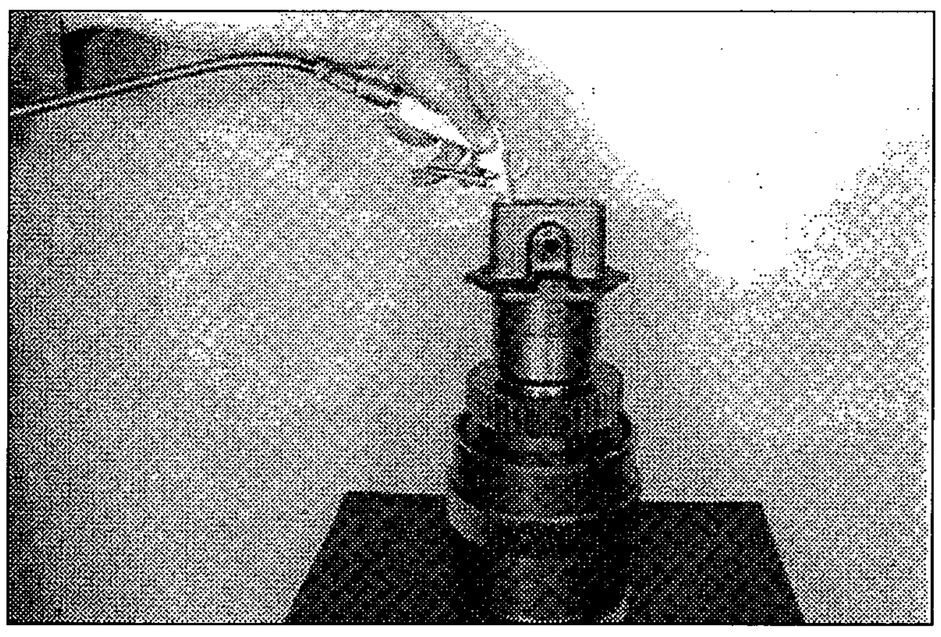


(23) Squeeze in and engage rectangular ring (3EA, See arrows).



(24) Assemble bearing cover and check function of the clutches by means of compressed air.

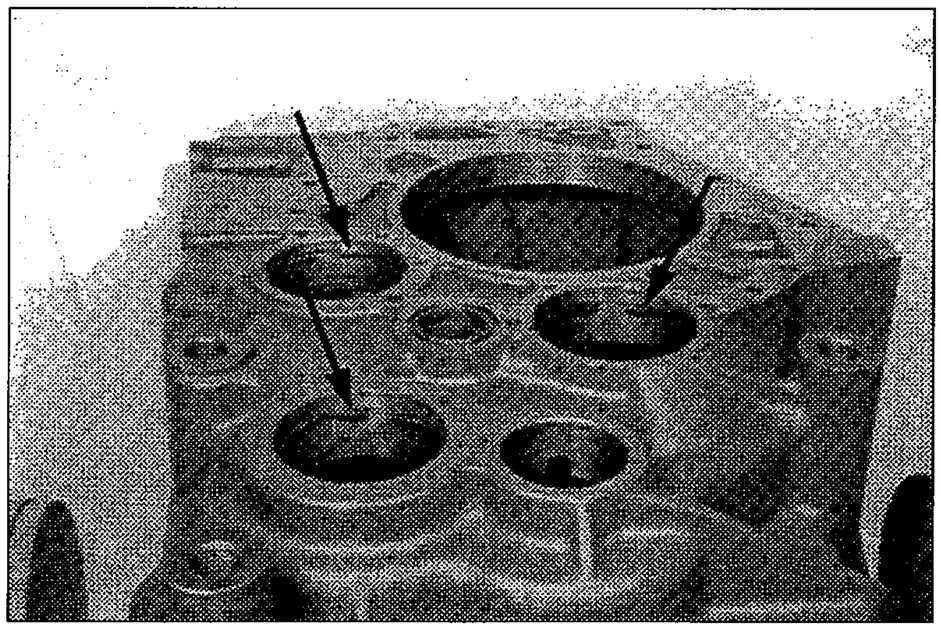
※ At correctly installed components, the closing, respectively opening of the clutches is clearly audible.
Now, remove bearing cover again.



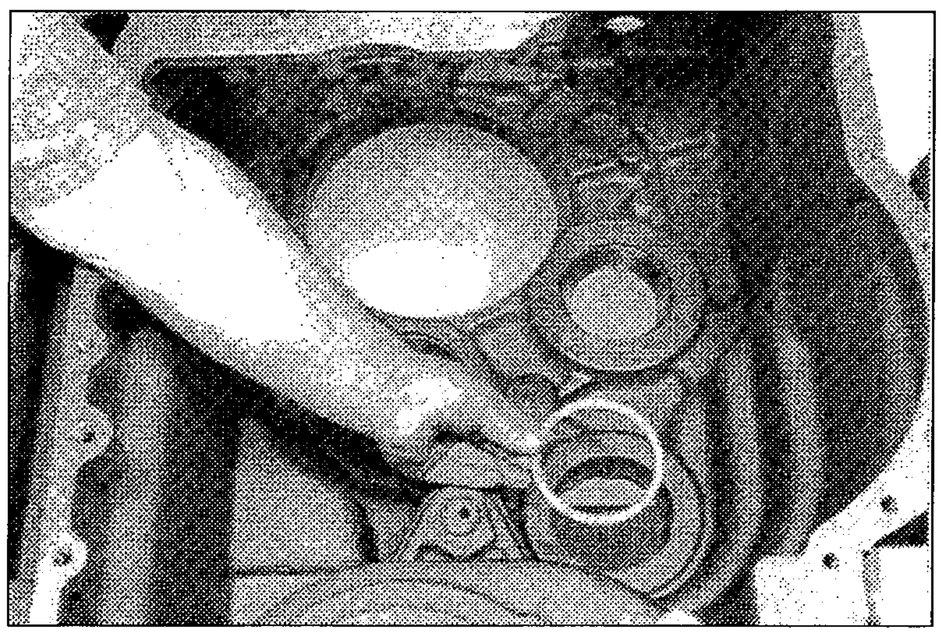
5) INSTALL MULTI DISK CLUTCHES, LAYSHAFT GEAR AND OUTPUT GEAR

(1) Squeeze circlips in, see arrows.

※ Special tool
Set of external snap ring pliers
5870 900 015



(2) Introduce spacer ring.

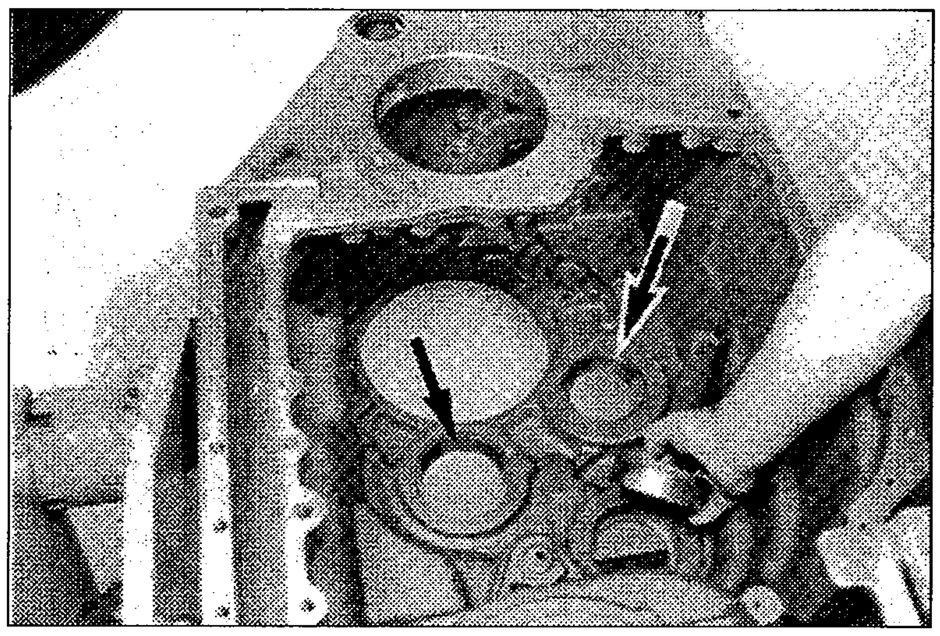


(3) Insert bearing outer race until contact is obtained.

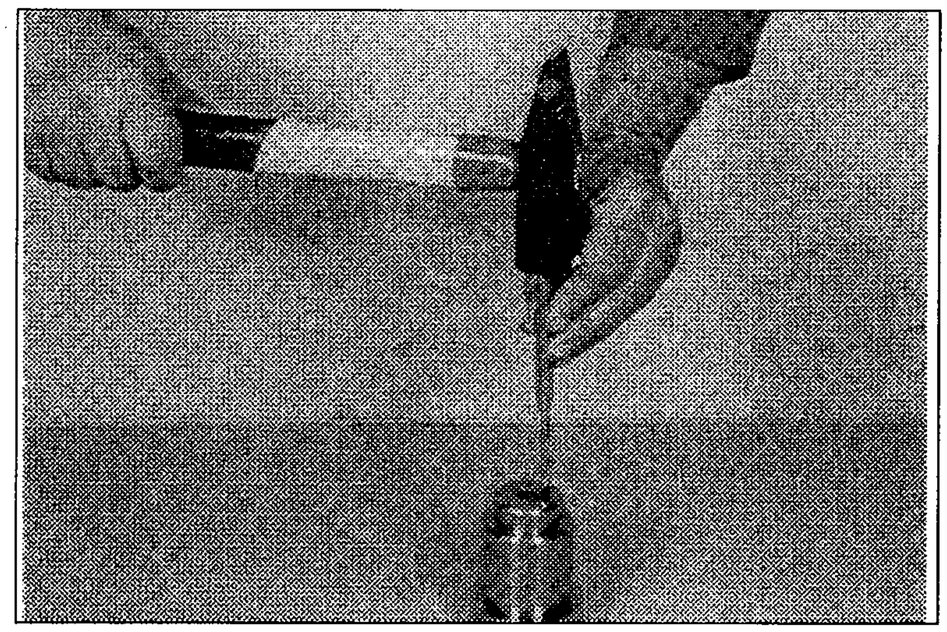
※ Install spacer rings, respectively bearing outer races of clutch KR/K2 and KV/K1 accordingly, see arrows.

※ Special tool

Driver	5870 058 078
Driver	5870 058 050
Handle	5870 260 002

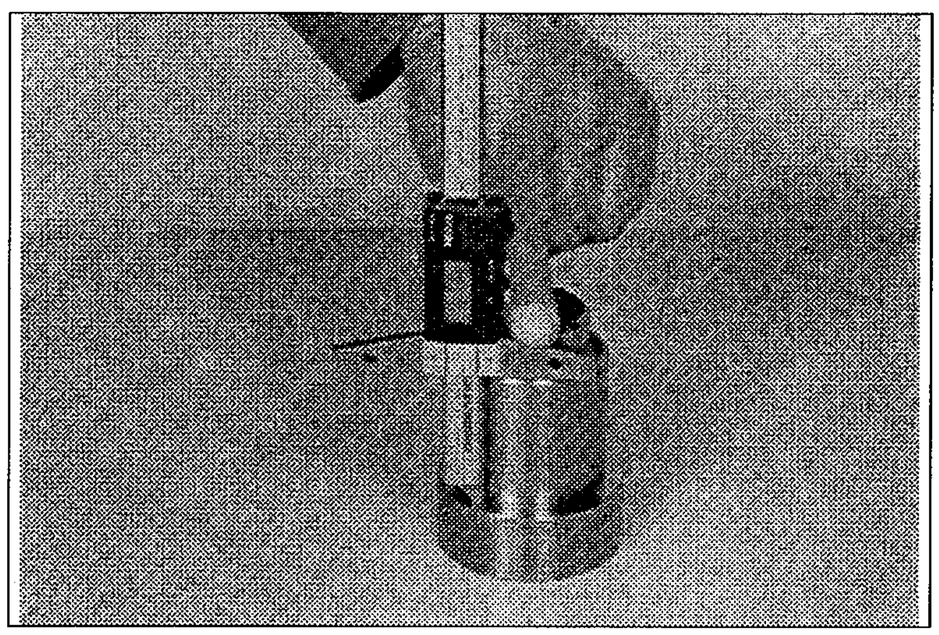


(4) Install roll pin.



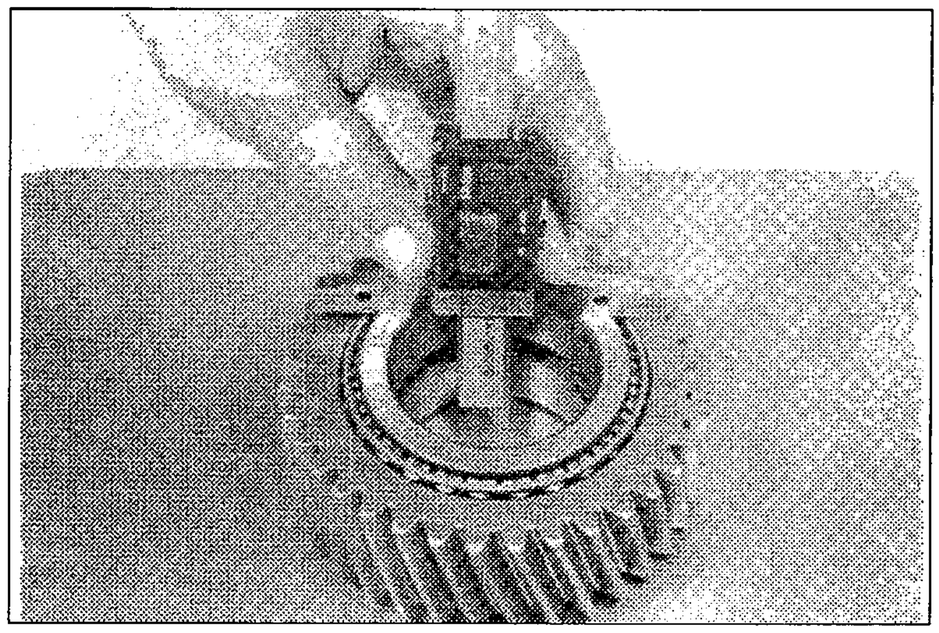
(5) **Adjust axial play of the layshaft gear bearing = 0.0~0.05mm**(Example D):
Determine dimension Ⅰ, see figure.

· Dimension Ⅰ e.g. 57.10mm



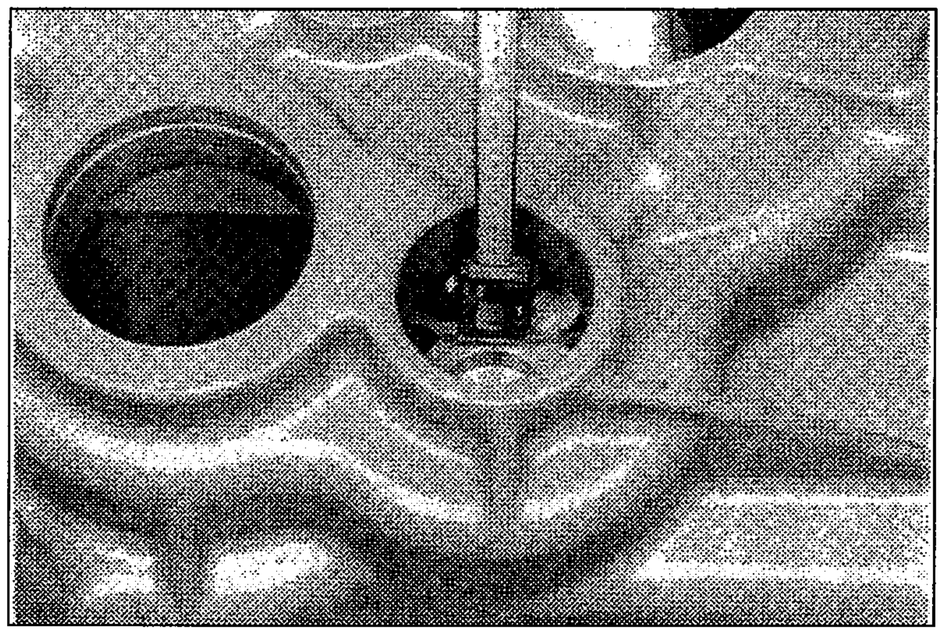
(6) Install both bearing inner races and determine dimension Ⅱ (Total height of the layshaft bearing).

· Dimension Ⅱ e.g. 53.95mm



(7) Determine dimension Ⅲ from the contact face of the bearing inner race to the contact face of the axle.

· Dimension Ⅲ e.g. 0.60mm



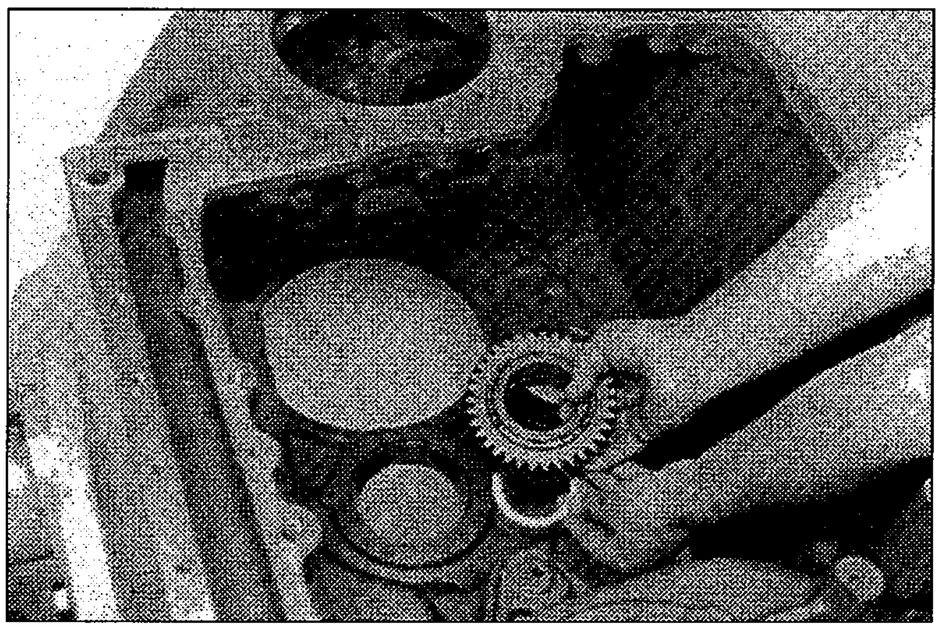
Example D

Dimension Ⅱ	53.95mm
Dimension Ⅲ	+ 0.60mm
Intermediate result A	54.55mm
Dimension Ⅰ	57.10mm
Intermediate result A	- 54.55mm
Result = Differential dimension - Zero	
	2.55mm

※ At a required axial play of 0.0~0.05mm, the shim has therefore to be selected thinner for max 0.05mm.
Shim thickness therefore 2.55~2.50mm

(8) Position shim and layshaft gear.

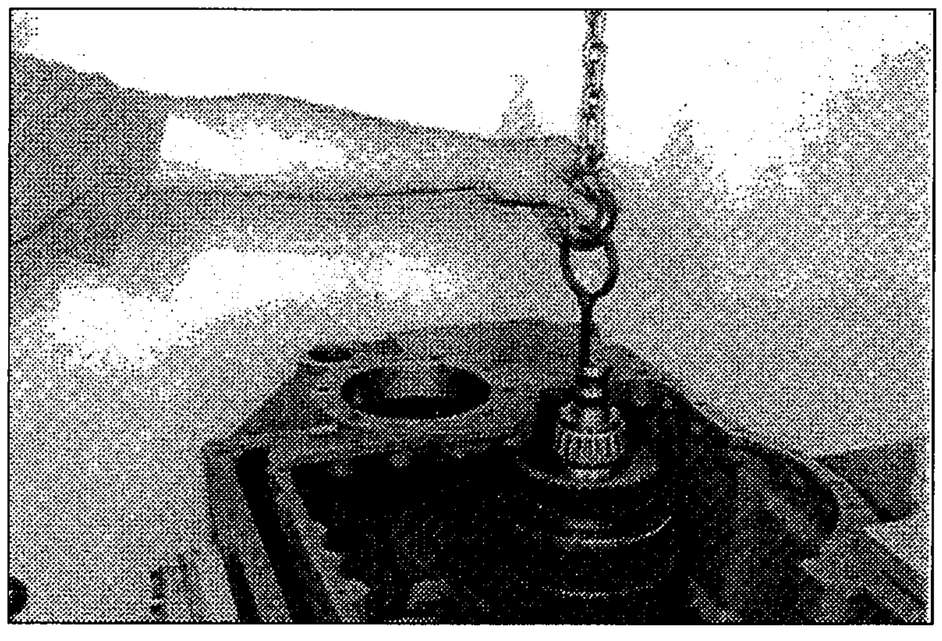
※ The fixing of the layshaft gear can be carried out only after the installation of the clutch.



(9) Position clutch KV/K1 by means of lifting device.

※ Special tool

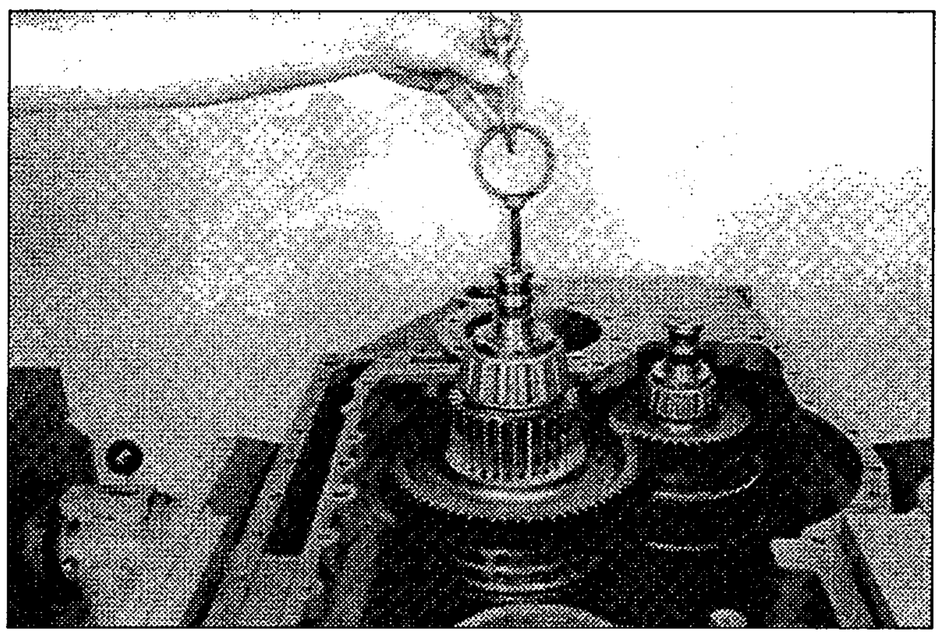
Set of eye bolts 5870 204 002



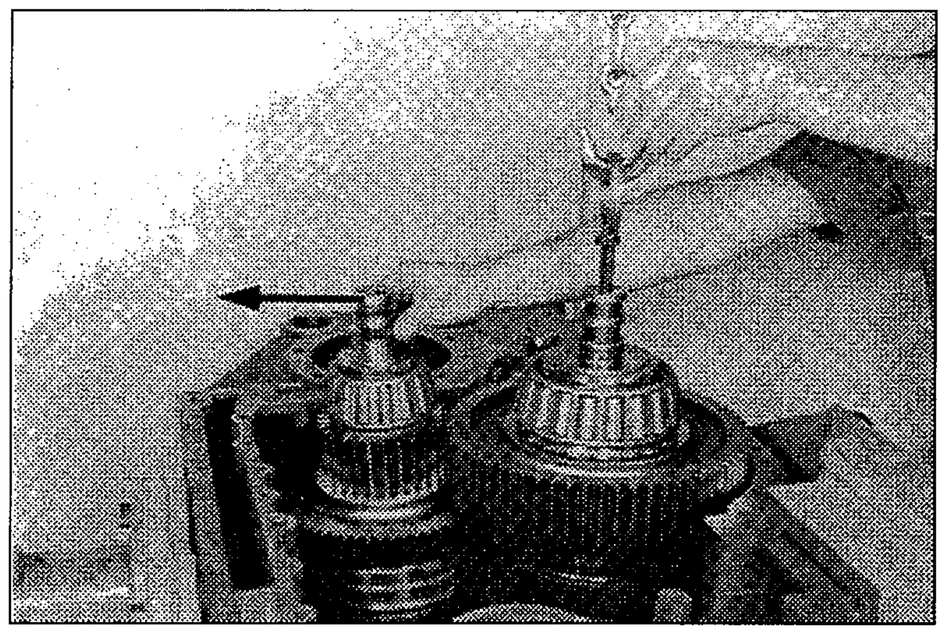
(10) Install clutch KR/K2.

※ Special tool

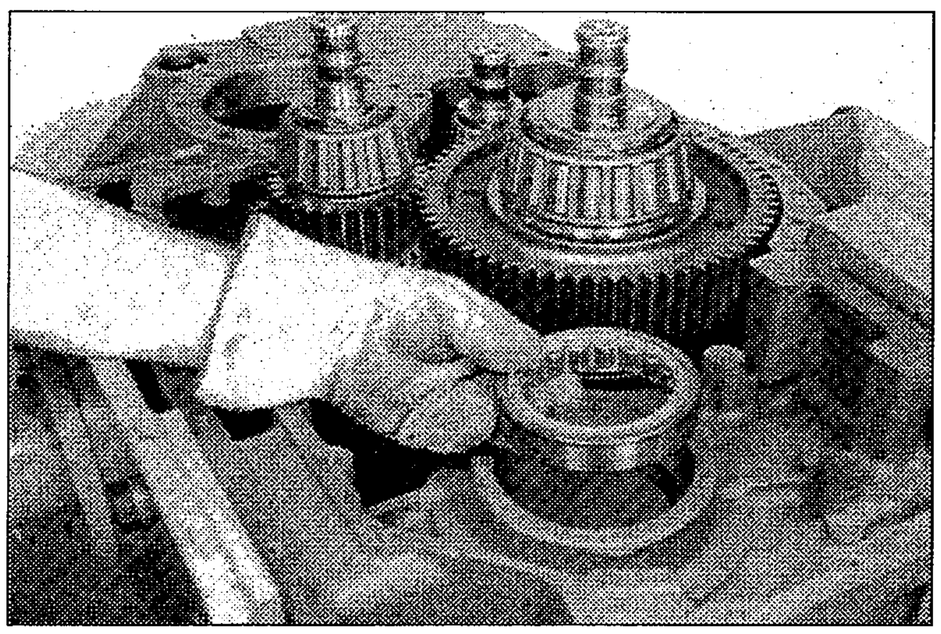
Set of eye bolts 5870 204 002



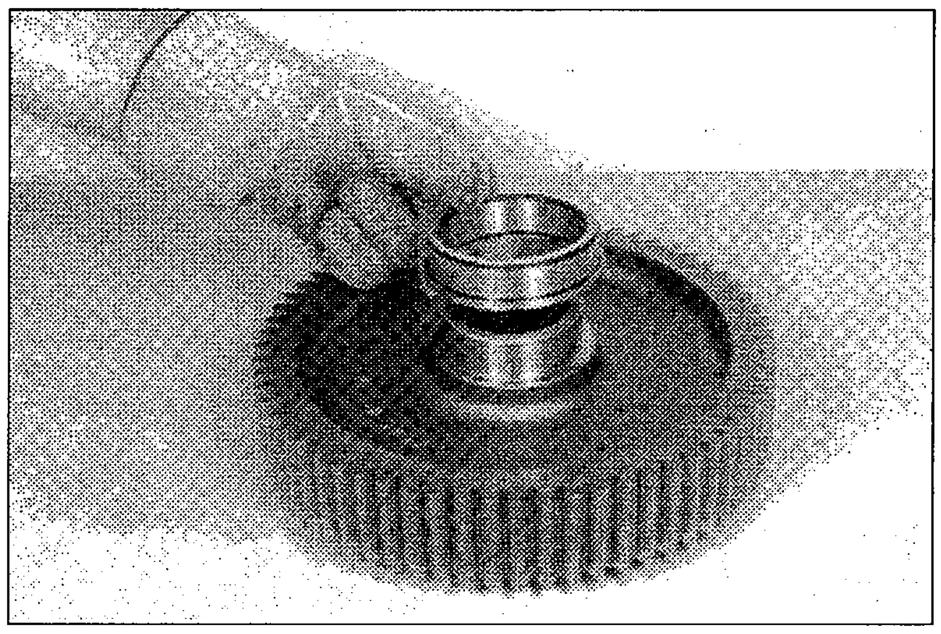
(11) Displace clutch KR/K2 in direction of arrow and position clutch K3/K4.



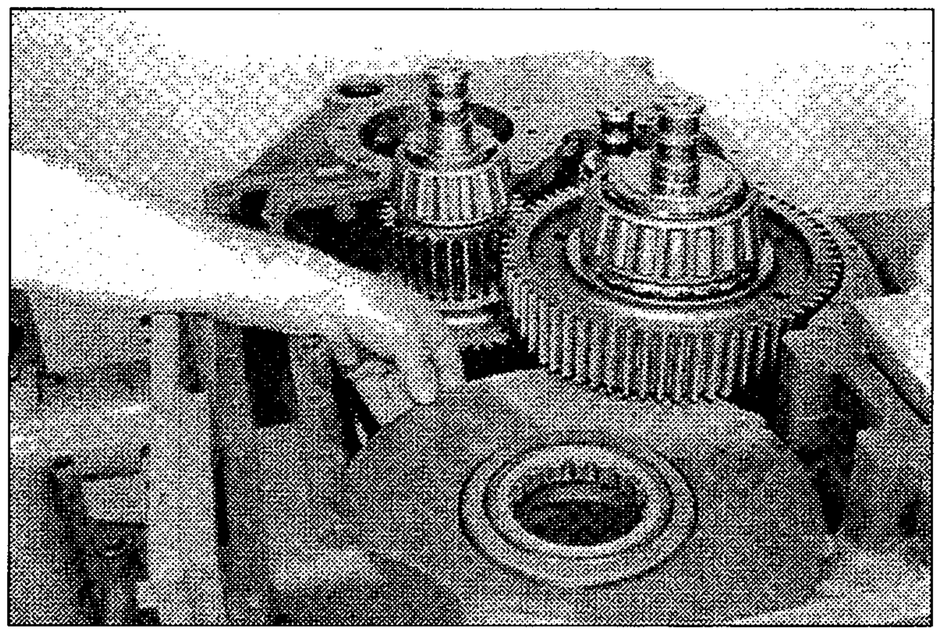
(12) Undercool bearing outer race and insert it into the housing bore until contact is obtained.



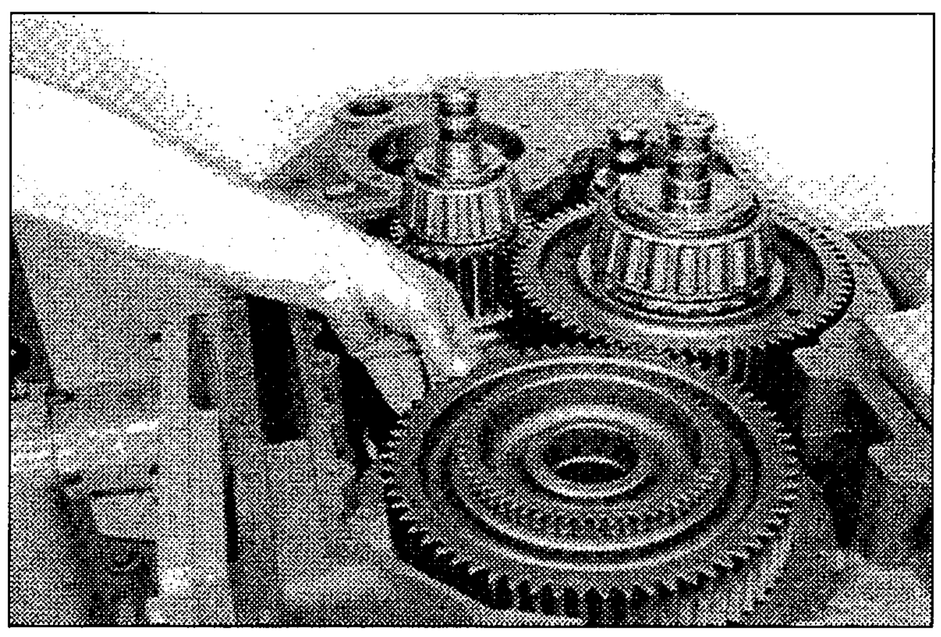
(13) Heat bearing inner race and assemble it until contact is obtained.



(14) Position oil baffle.

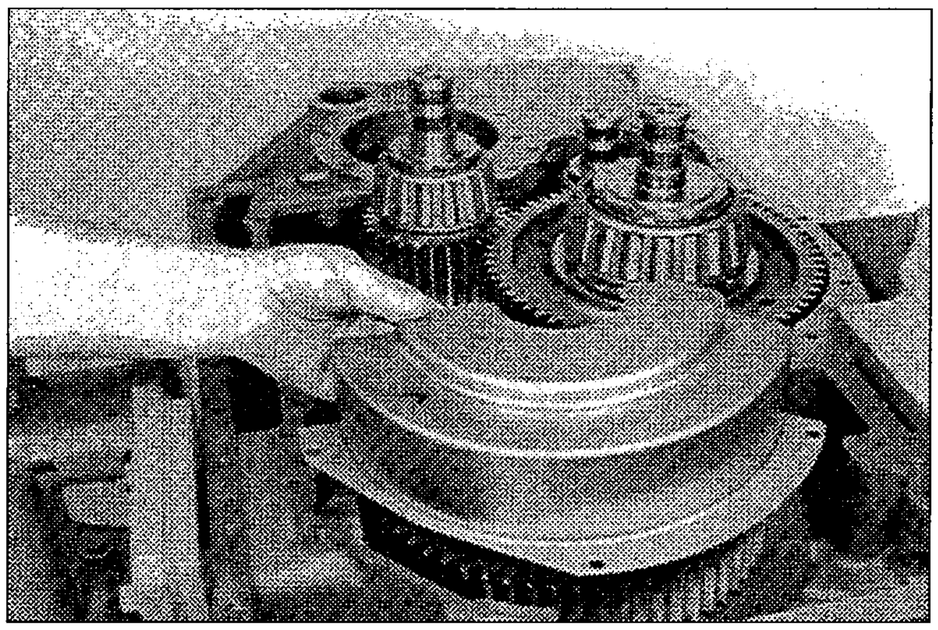


(15) Install output gear.



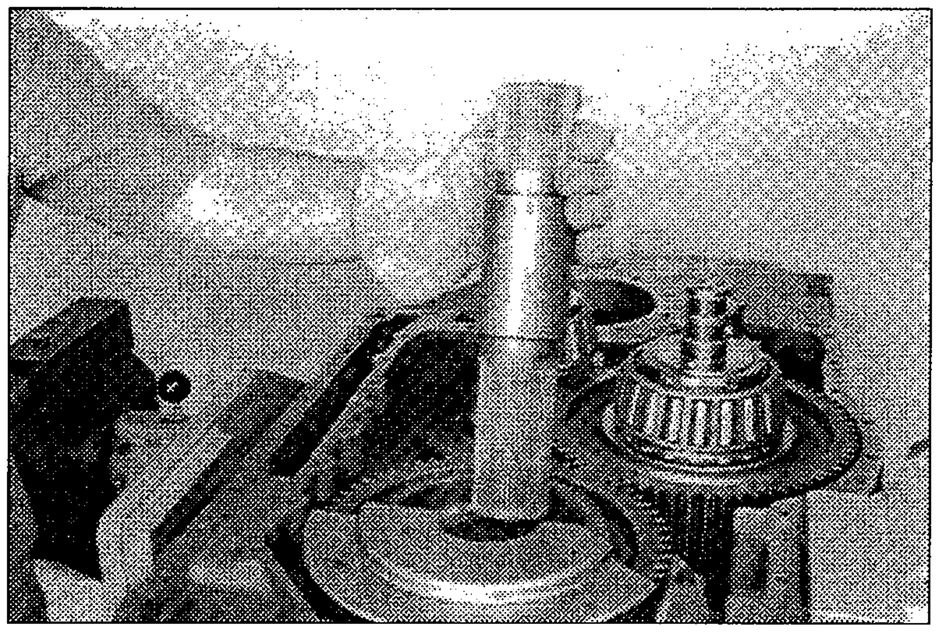
(16) Insert second oil baffle and fasten both plates by means of hexagon head screws (Mount plain washers).
- Torque limit(M8/8.8) : 2.3kgf · m(23Nm)

※ Secure hexagon head screws with loctite (Type No.262).



(17) Undercool output shaft and introduce it until contact is obtained.

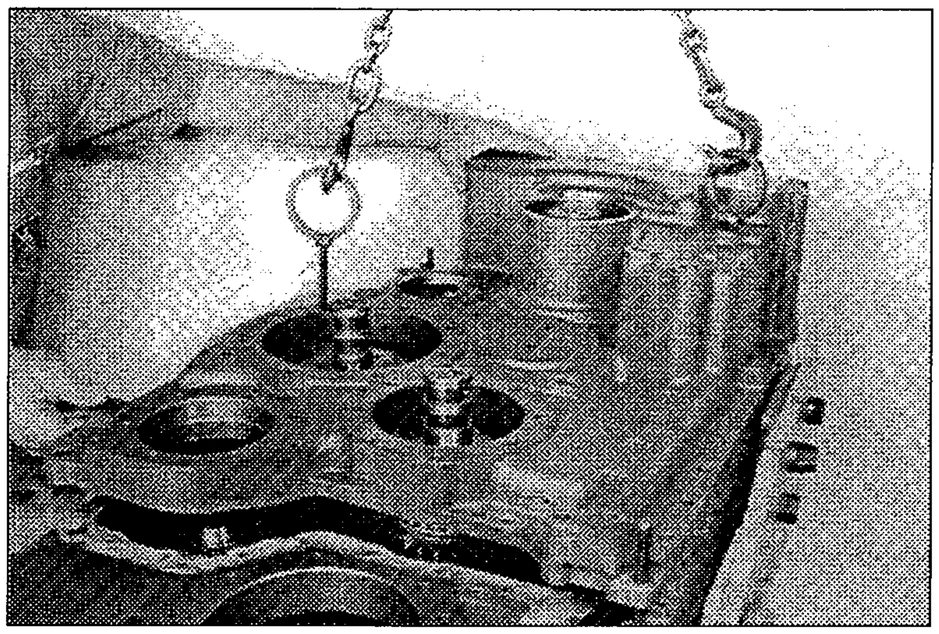
※ Pay attention to the installation position, see figure.



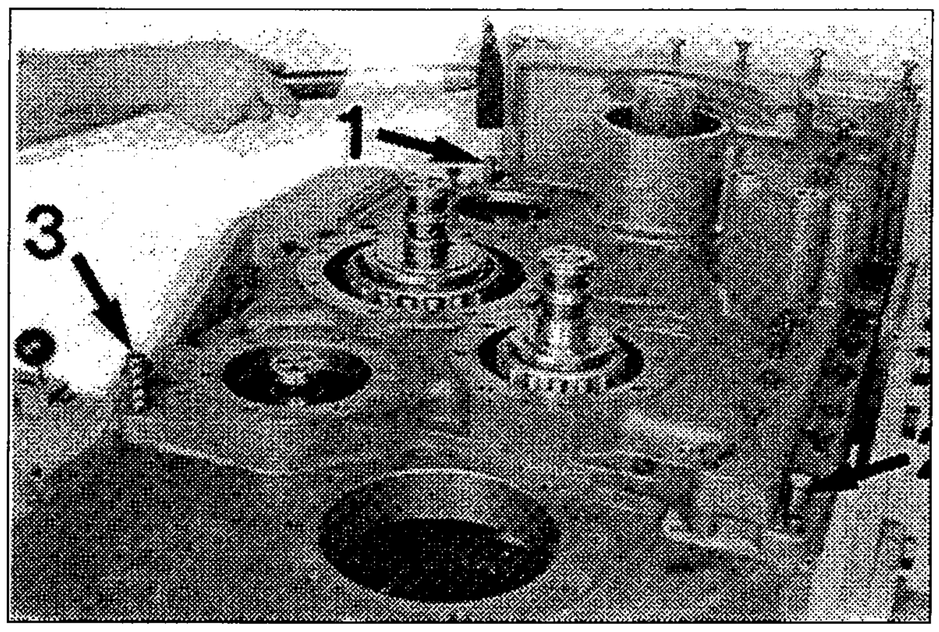
(18) Wet mounting face with sealing compound (Loctite, type No.574).
Install two adjusting screws and position housing cover by means of lifting device on the gearbox housing until contact is obtained.

※ Special tool

Set of eye bolts	5870 204 002
Adjusting screws(M10)	5870 204 007



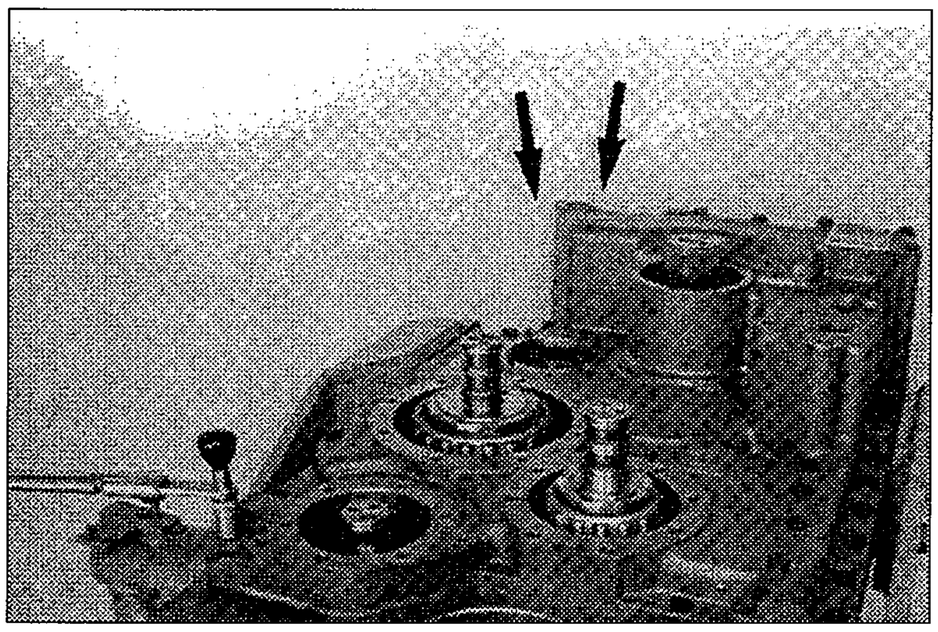
(19) Install both cylindrical pins(Arrow 1 and 2) and roll pin(Arrow 3).



(20) Fasten housing cover by means of socket head screws(2 pieces) and hexagon head screws.

· Torque limit(M10/8.8) : 4.7kgf · m(46Nm)

※ Pay attention to the position of the two socket head screws, see arrows.

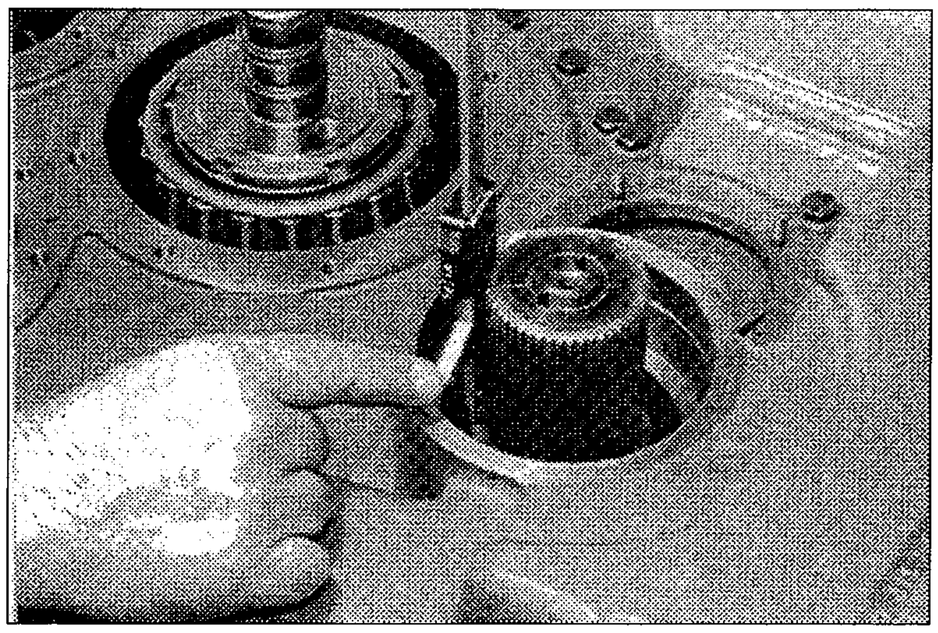


(21) Adjust axial play of the output bearing = 0.3~0.5mm(Figure (21)~(23))
Determine dimension Ⅰ from the plane face/housing to the end face/output shaft.

· Dimension Ⅰ e.g. ····· 53.20mm

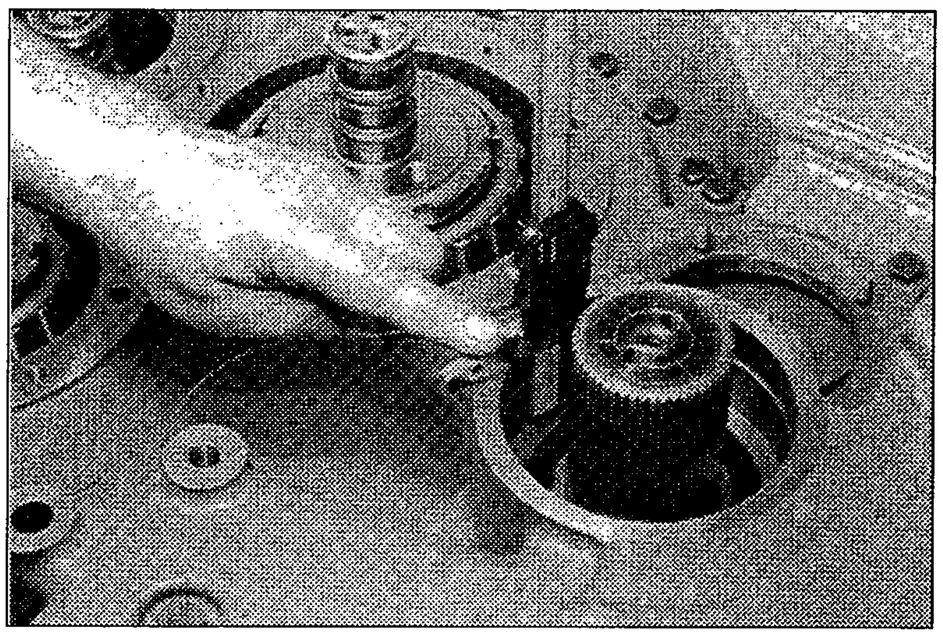
※ Special tool

Digital depth gauge	5870 200 072



(22) Measure dimension Ⅱ from the plane face/housing to the contact face of the ball bearing.

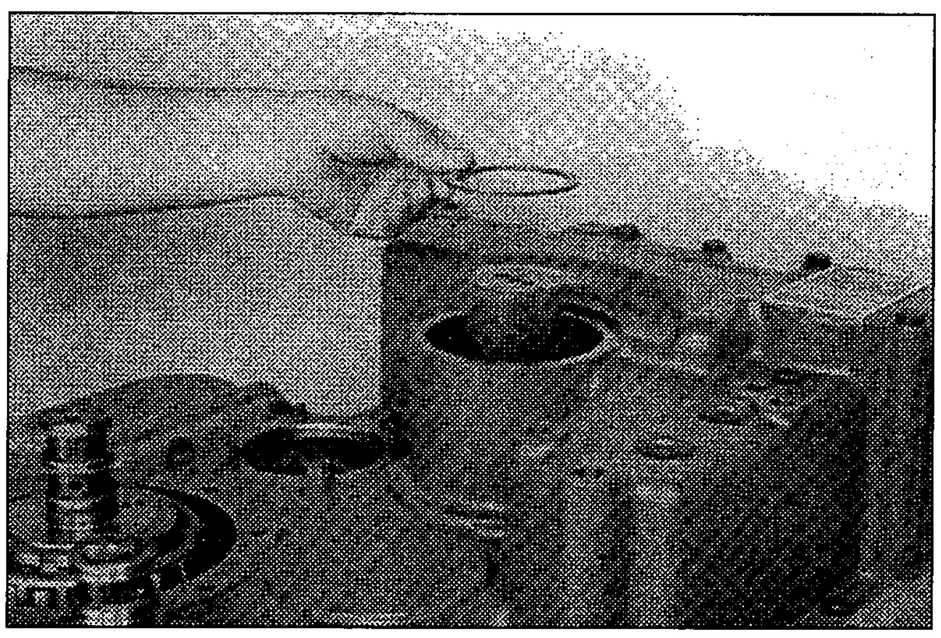
· Dimension Ⅱ e.g. 50.40mm



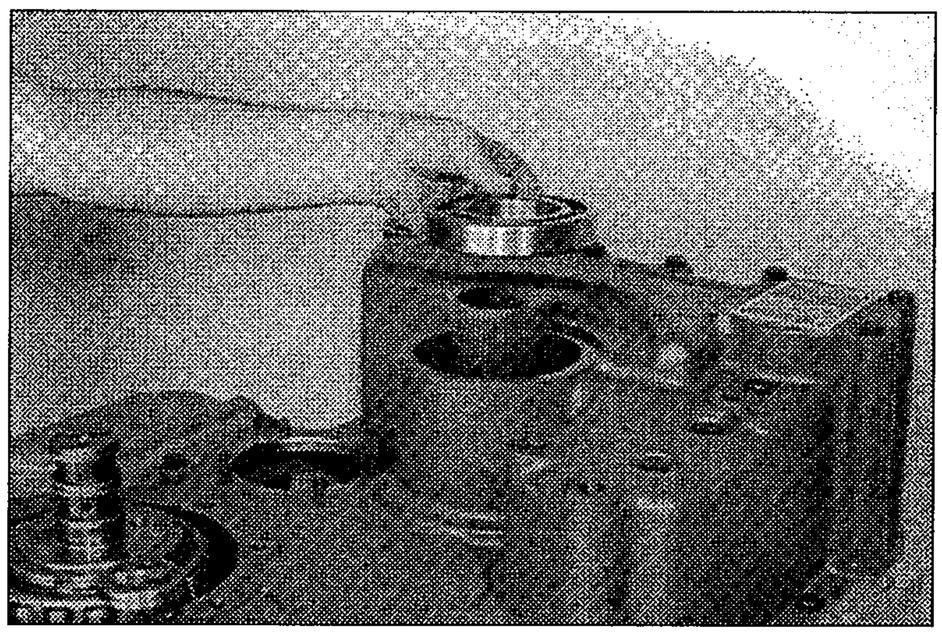
Example E

Dimension Ⅰ	53.20mm
Dimension Ⅱ	- 50.40mm
Difference	= 2.80mm
Required axial play(0.3~0.5)	
	e.g. - 0.40mm
Gives shim	s = 2.40mm

(23) Assemble shim(e.g. s = 2.40mm).



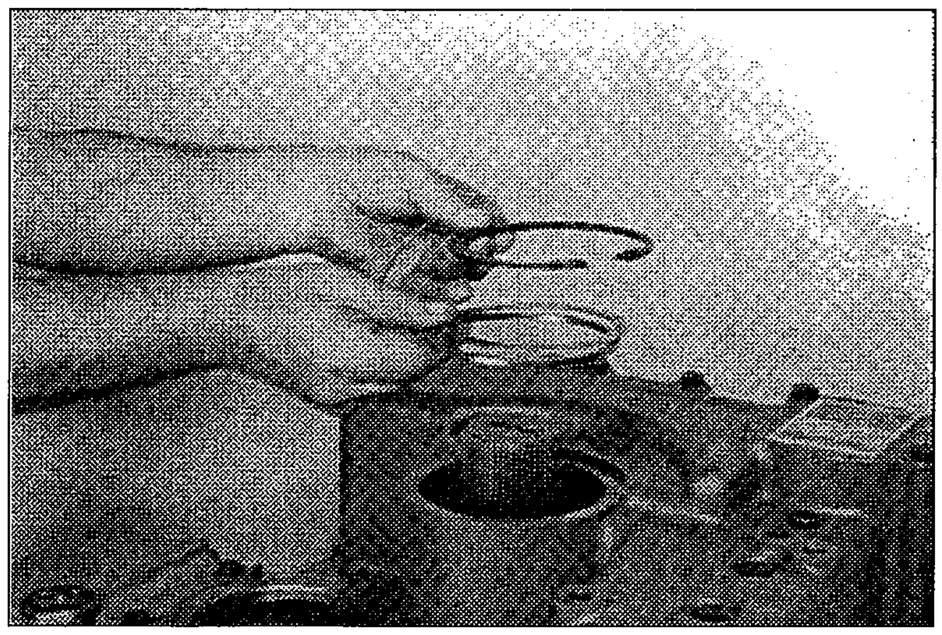
(24) Insert ball bearing until contact is obtained.



(25) Fix ball bearing by means of disk(s=4.00mm), shim(Optional) and circlip playfree.

※ Special tool

Set of external snap ring pliers 5870 900 021



(26) Install shaft seal, with the sealing lip showing downward.

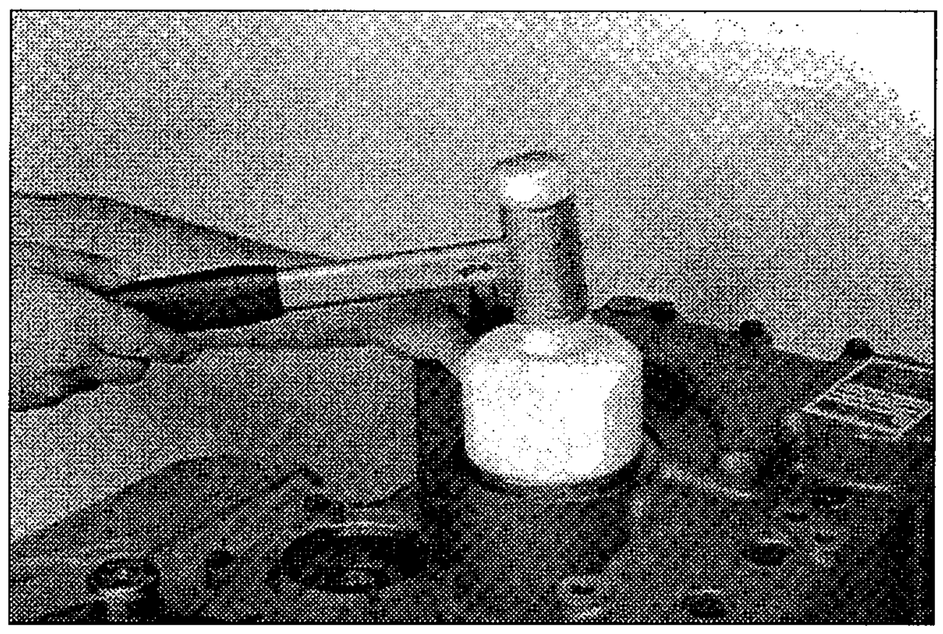
※ At the use of the prescribed driver, the exact installation depth is obtained.

Cover outer diameter with sealing compound(Loctite, type No.574).

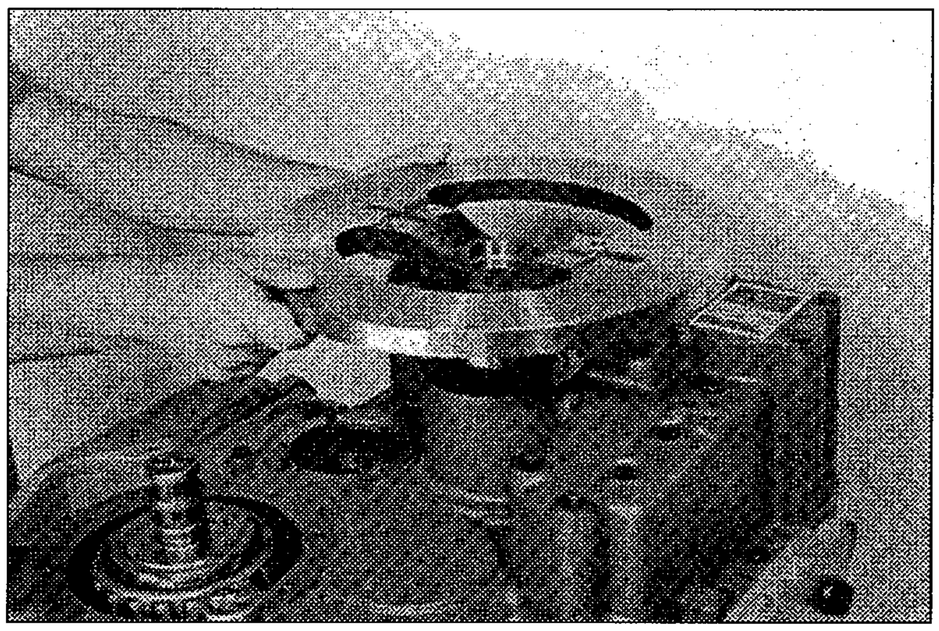
Grease sealing lip.

※ Special tool

Driver 5870 048 150



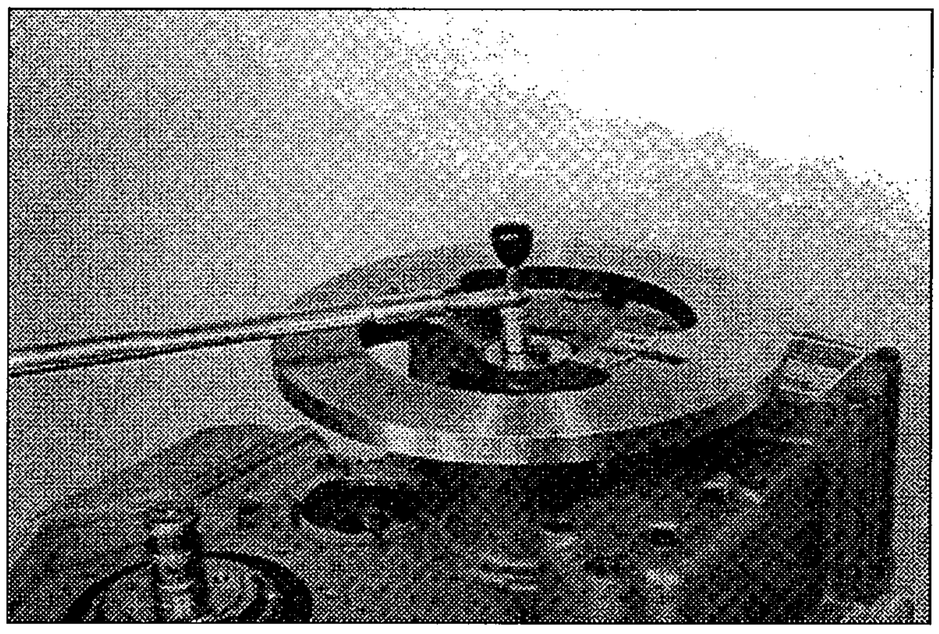
(27) Assemble output flange.



(28) Wet contact face of the disk with sealing compound.

Mount disk and fasten output flange by means of hexagon head screws.

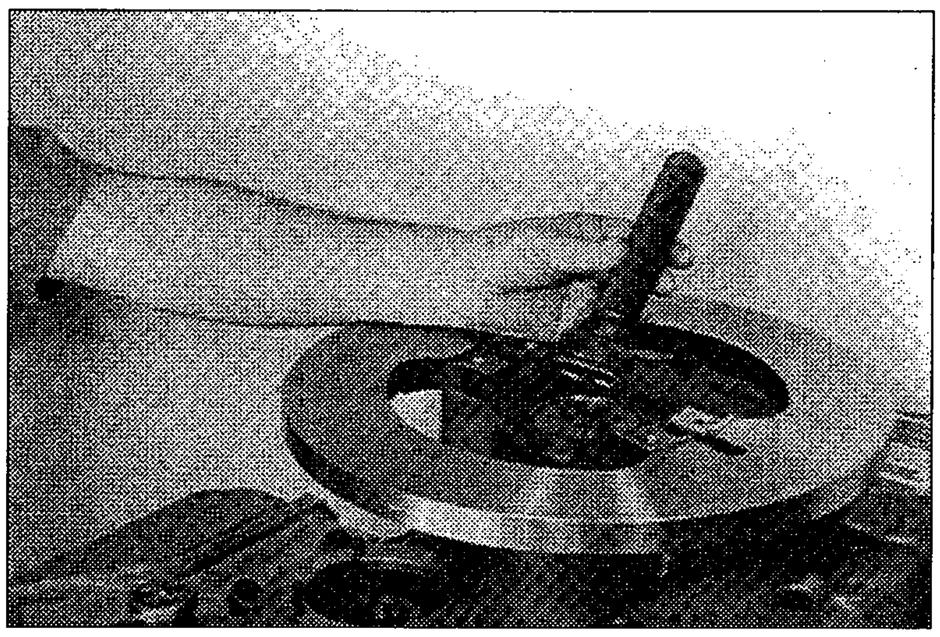
· Torque limit(M10/8.8) : 4.7kgf · m(46Nm)



(29) Fix hexagon head screws by means of lock plate.

※ Special tool

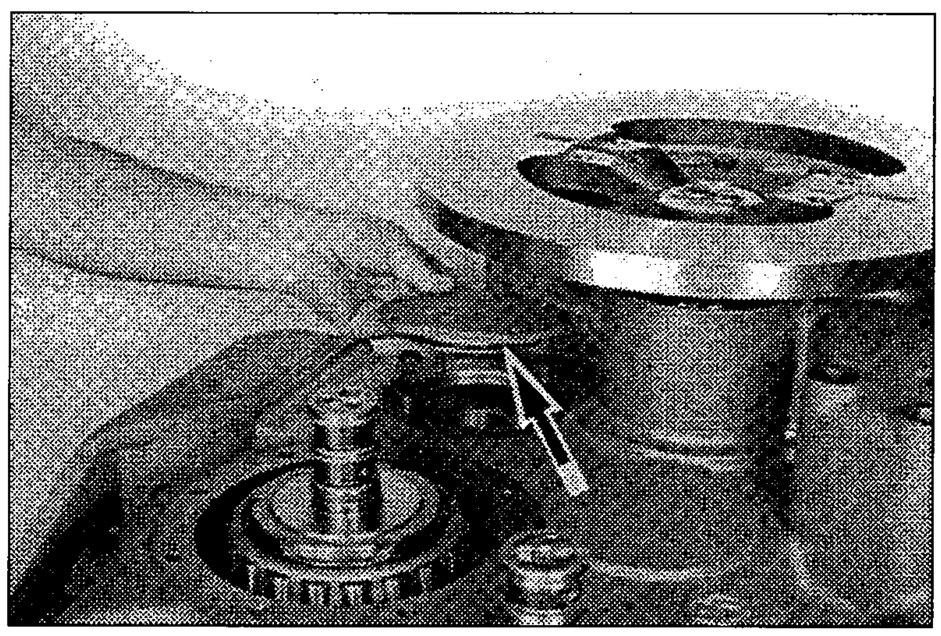
Driver	5870 057 009
Handle	5870 260 002



(30) If necessary, install studs, insert O-ring into the annular groove(Arrow) and fasten cover by means of hexagon nuts.

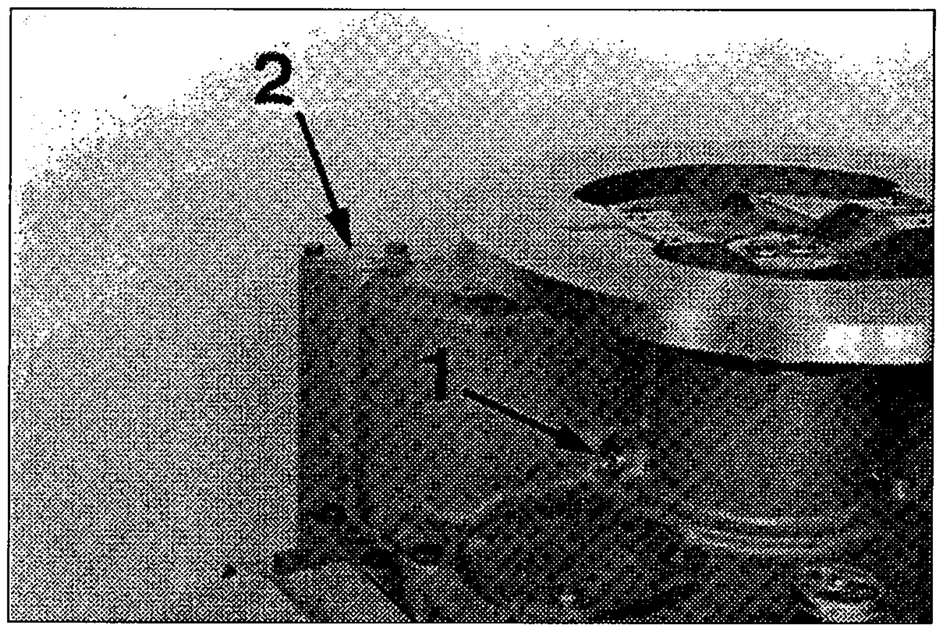
· Torque limit(M8/8.8) : 2.3kgf · m(23Nm)

※ Insert studs with loctite(Type No.262).



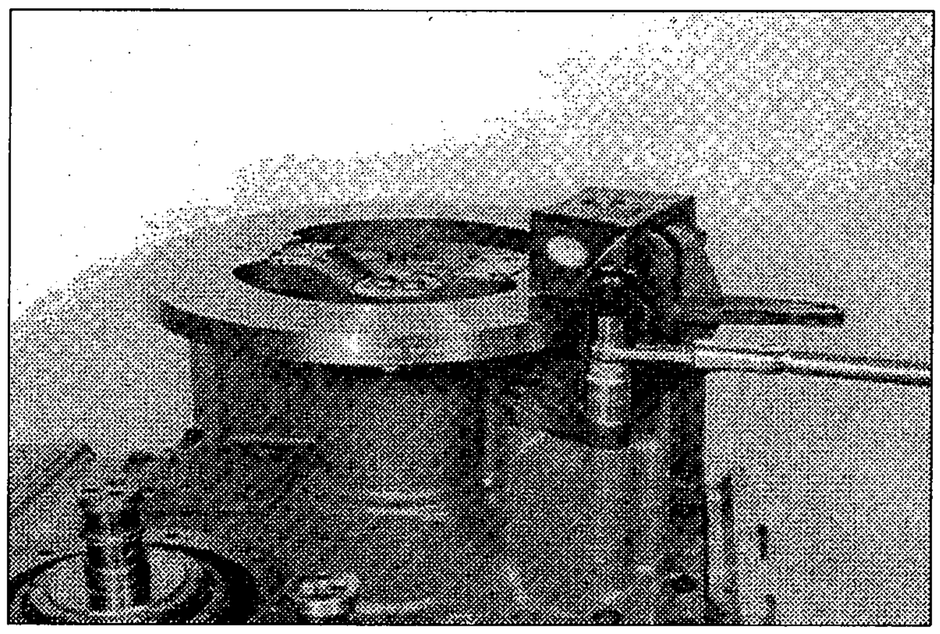
(31) Install screws plug(Arrow 1).
Mount gasket and fasten cover(Arrow 2) by means of hexagon head screws.

· Torque limit(M8/8.8) : 2.3kgf · m(23Nm)

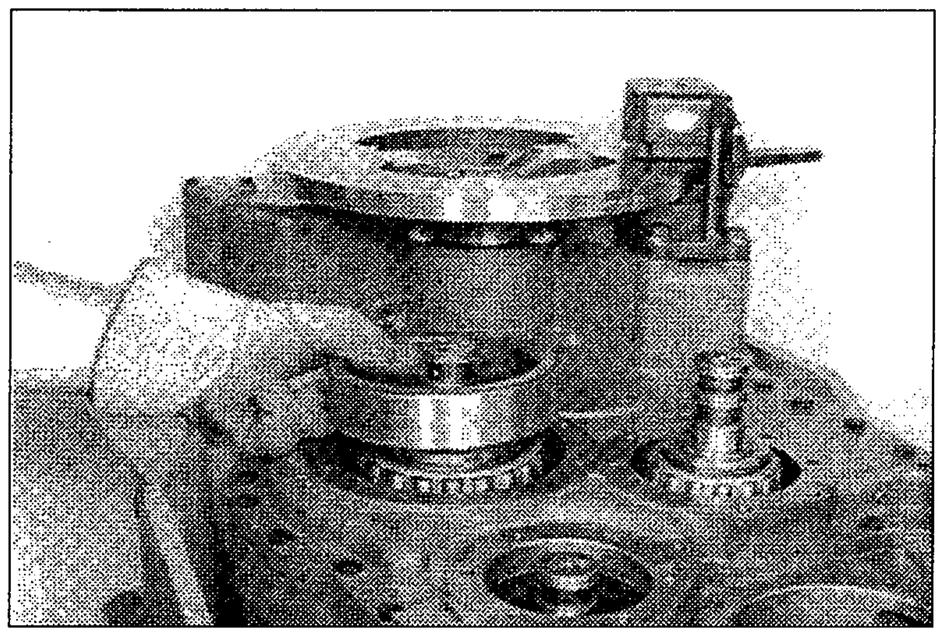


(32) Fasten brake assembly(According to the version) on the housing, using hexagon head screws.

· Torque limit(M14/10.9) : 18.9kgf · m (185Nm)

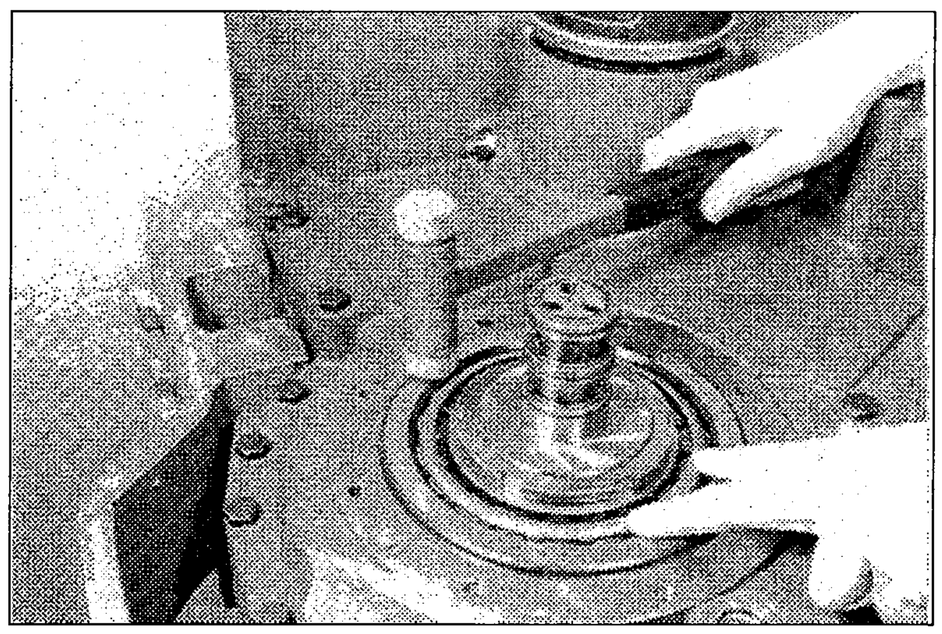


(33) Undercool bearing outer race(Clutchs K3/K4 and KR/K2) and insert them into the housing bores until contact is obtained.



(34) **Adjust bearing preload-Clutch K3/K4 = 0.15~0.20mm**(Figure (34)~(36))
Align clutched centrically by rotating the output flange and place bearing outer race carefully against shoulder.

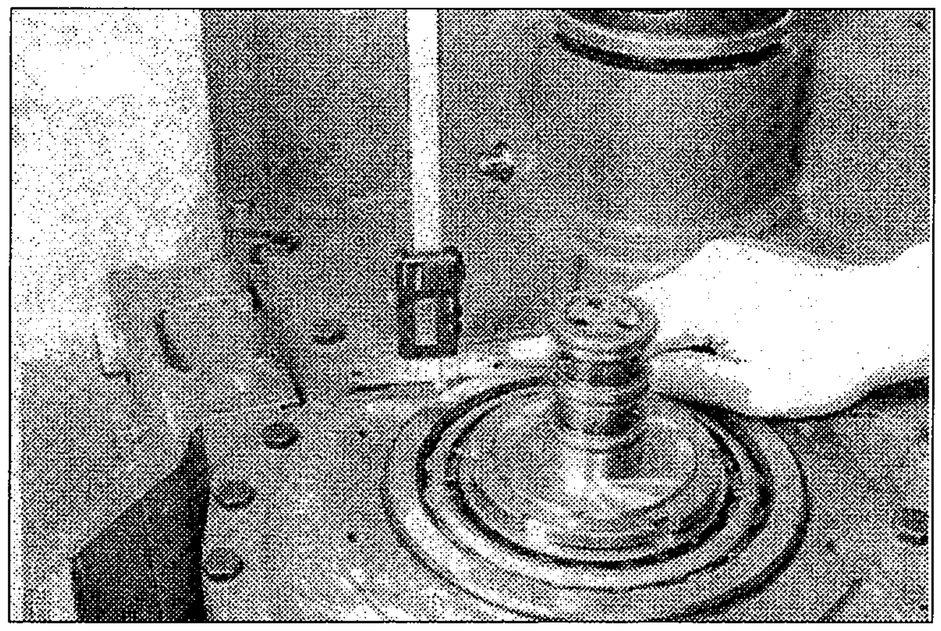
※ Bearing must not be preloaded - Bearing cage, respectively bearing rollers are still easy to be moved.



(35) Determine dimension Ⅰ from the bearing outer race to the mounting face.

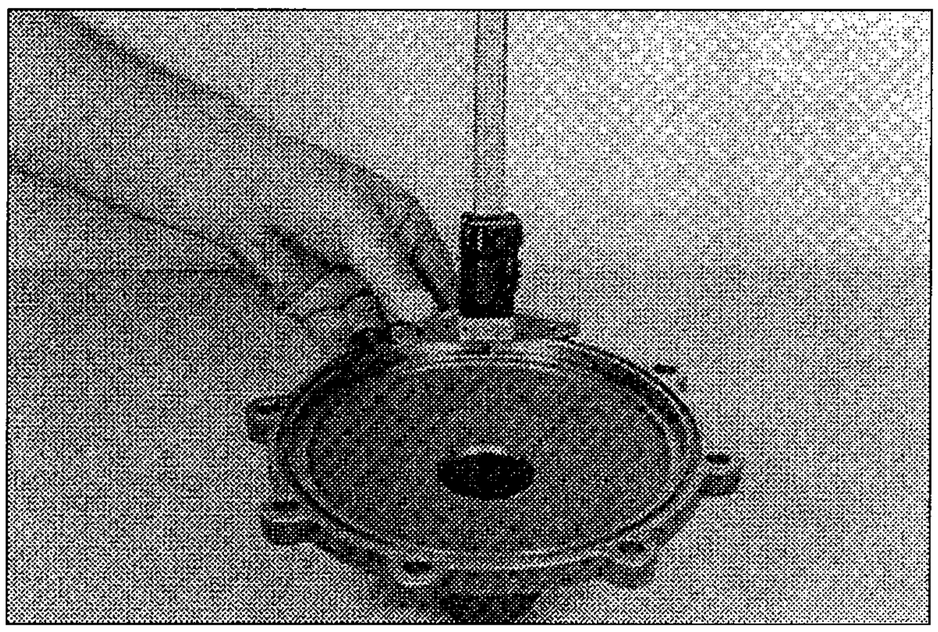
· Dimension Ⅰ e.g. 5.70mm

※ Apply several measuring points and determine the average.



(36) Measure dimension Ⅱ from the mounting face/cover to the contact face/bearing outer race.

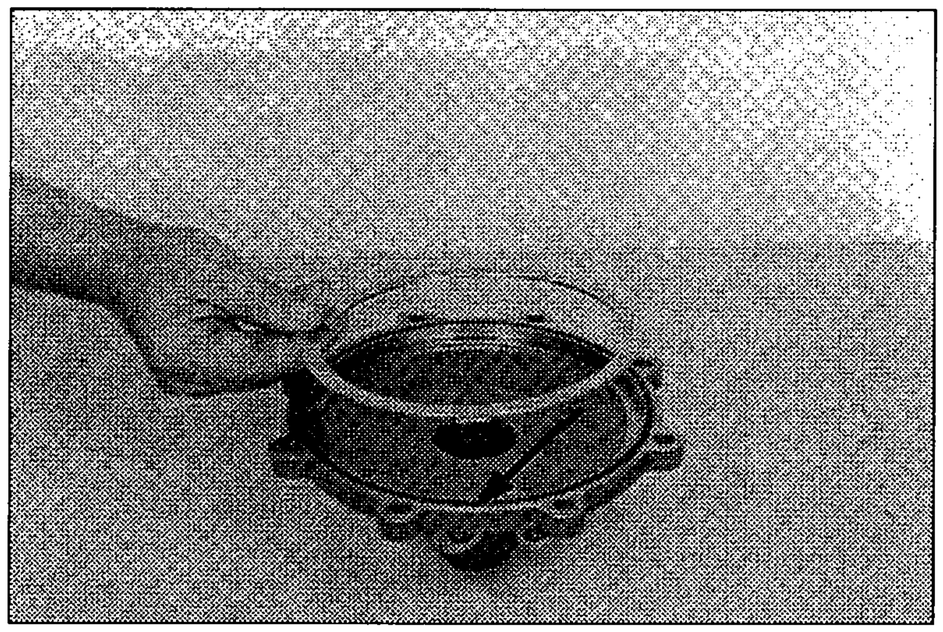
· Dimension Ⅱ e.g. 7.13mm



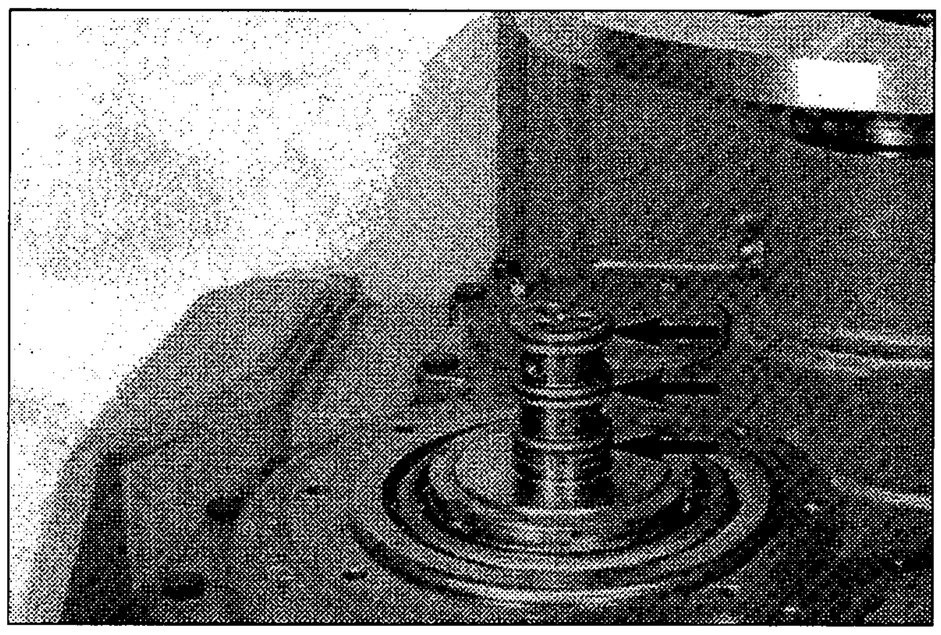
Example F

Dimension Ⅱ	7.13mm
Dimension Ⅰ	- 5.70mm
Difference	= 1.43mm
Required bearing preload(0.15~0.20)	e.g.+ 0.17mm
Result = Shim	s = 1.60mm

(37) Insert shim(e.g. s=1.60mm) with grease into the bearing cover.
Insert O-ring into the annular groove (Arrow) and grease it.

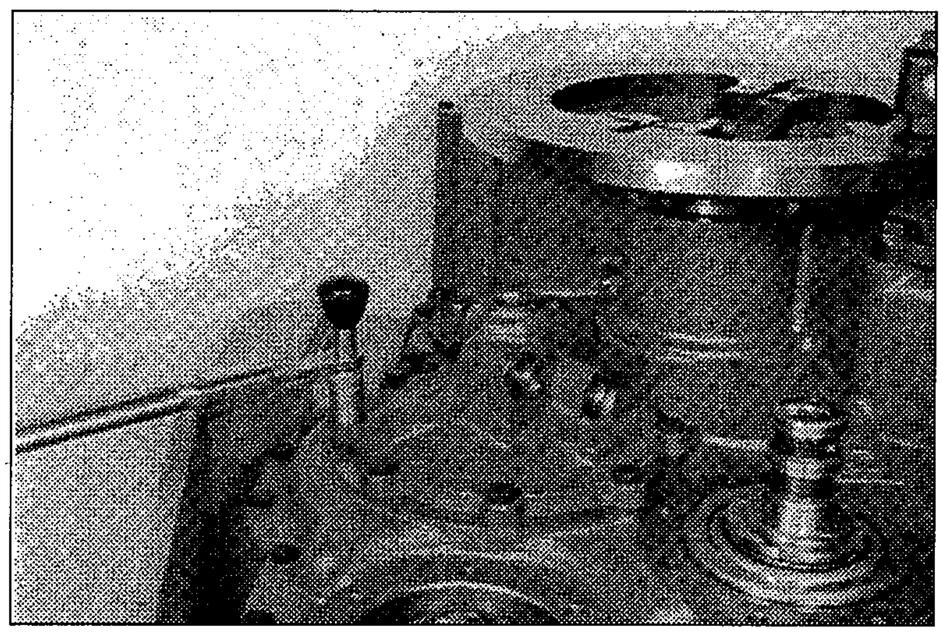


(38) Squeeze rectangular rings(3 pieces, see arrows) in and engage them.
Now, grease rectangular rings and align them centrically.



(39) Pull cover by means of hexagon head screws uniformly against shoulder.
· Torque limit(M10/8.8) : 4.7kgf · m(46Nm)

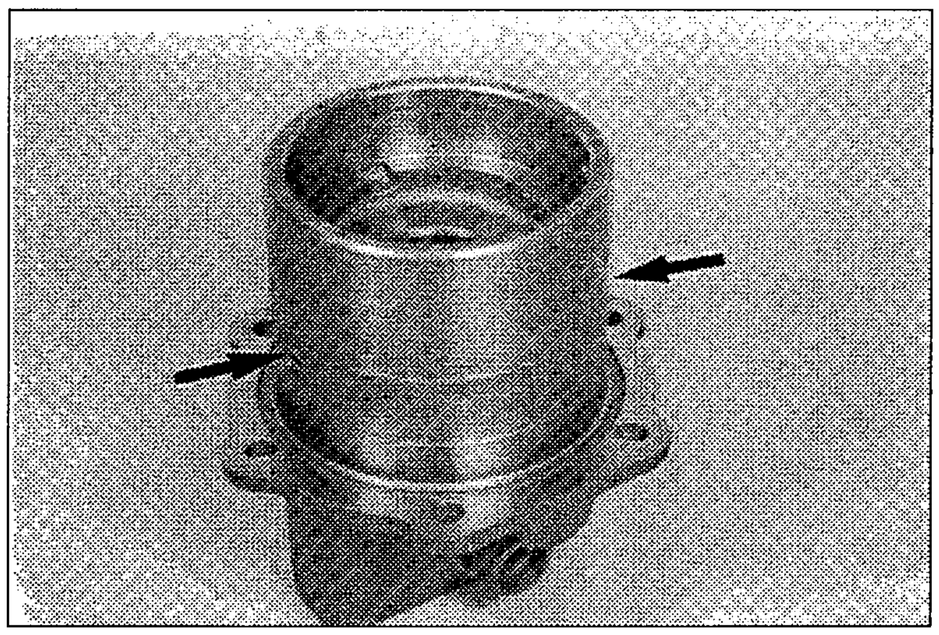
※ Special tool
Adjusting screws(M10) 5870 204 007



Mounting bearing cover-KR/K2 accordingly.
Bearing preload KR/K2 = 0.20~0.25mm

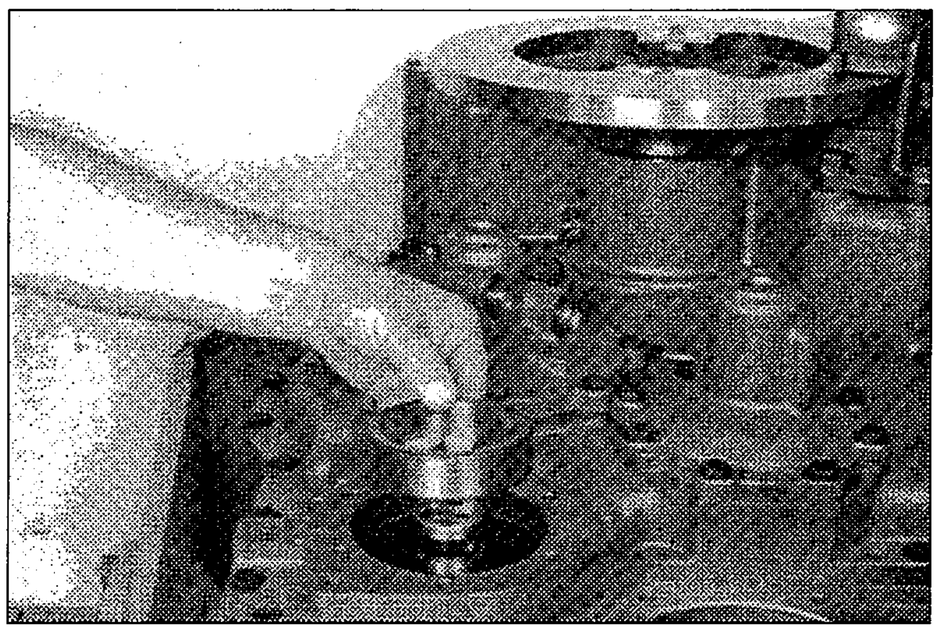
(40) Close both bores of the bearing cover - KV/K1 by means of slotted plug.

※ Insert slotted plug with loctite(Type No.262).



(41) **Adjust bearing preload- Clutch KV/K1 = 0.15~0.20mm**(Example G)

Install bearing outer race.



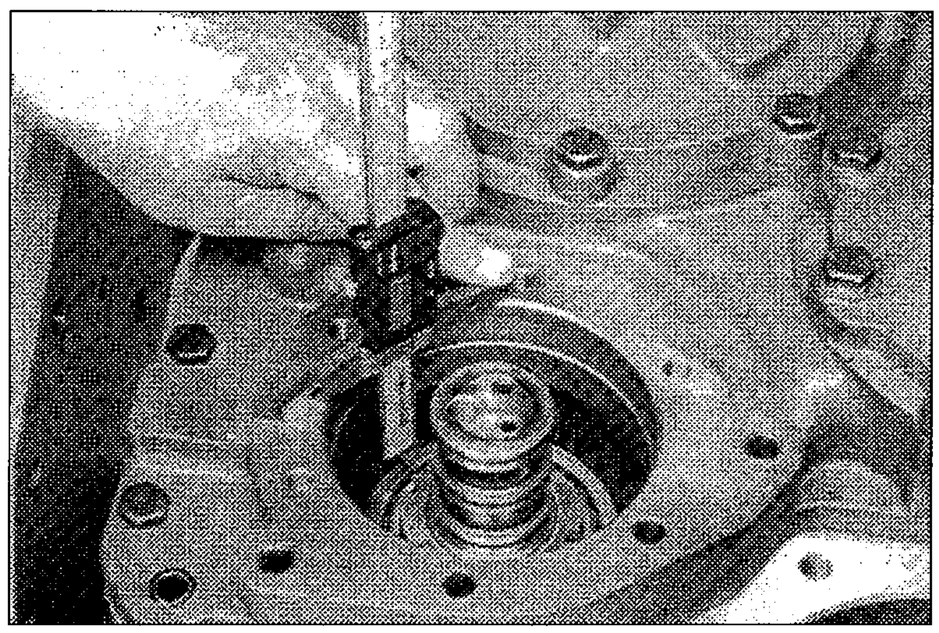
(42) Press the bearing outer race uniformly on and determine the dimension Ⅰ from the mounting face to the bearing outer race.

· Dimension Ⅰ e.g. 64.95mm

※ Special tool

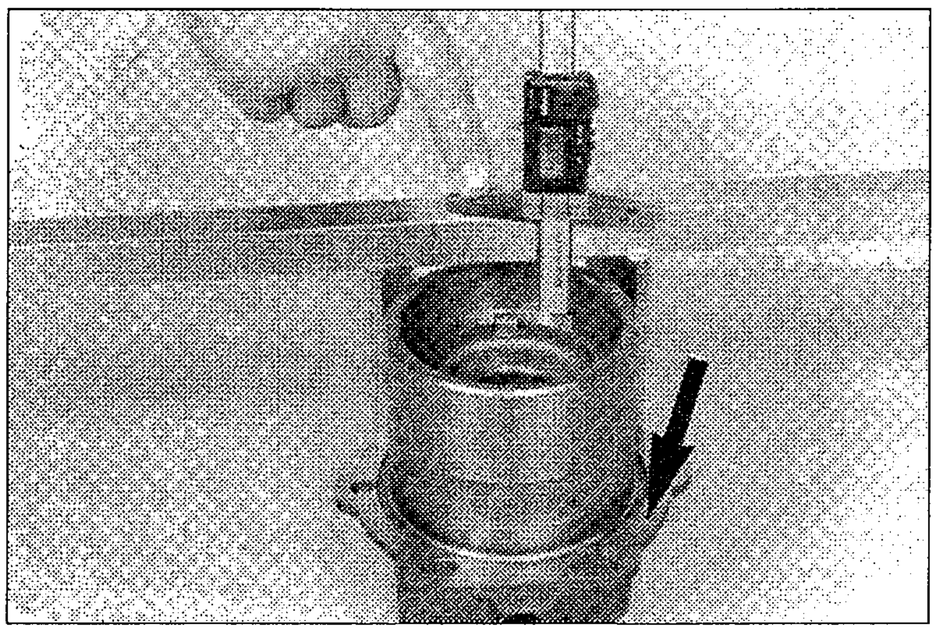
Digital depth gauge 5870 200 072

※ Apply several measuring points and determine the average.



(43) Measure dimension Ⅱ from the mounting face of the cover(Arrow) to the contact face/bearing outer race.

· Dimension Ⅱ e.g. 63.90mm



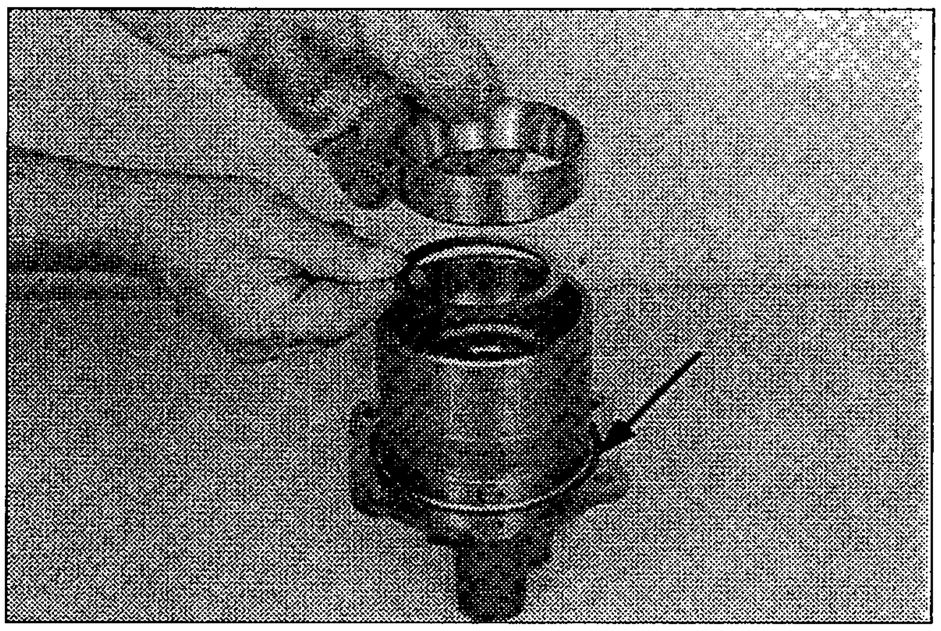
Example G

Dimension Ⅰ	64.95mm
Dimension Ⅱ	- 63.90mm
Difference	= 1.05mm
Required bearing preload(0.15~0.20)	
	e.g. + 0.15mm
Result = Shim	s = 1.20mm

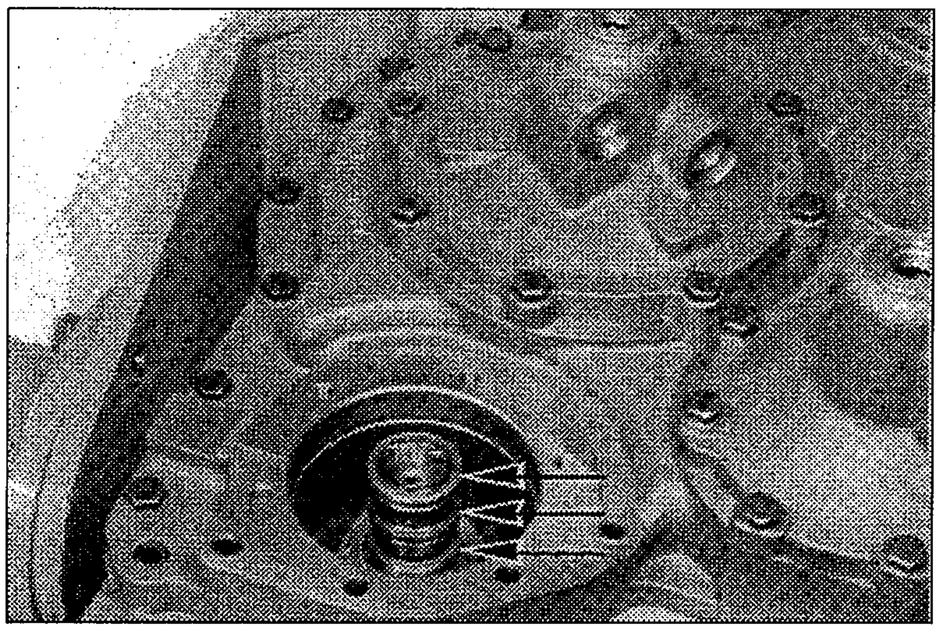
(44) Install shim(e.g. s=1.20mm).
Undercool bearing outer race and insert it until contact is obtained.
Insert O-ring into the annular groove (Arrow) and grease it.

※ Special tool

Driver	5870 058 051
Handle	5870 260 002



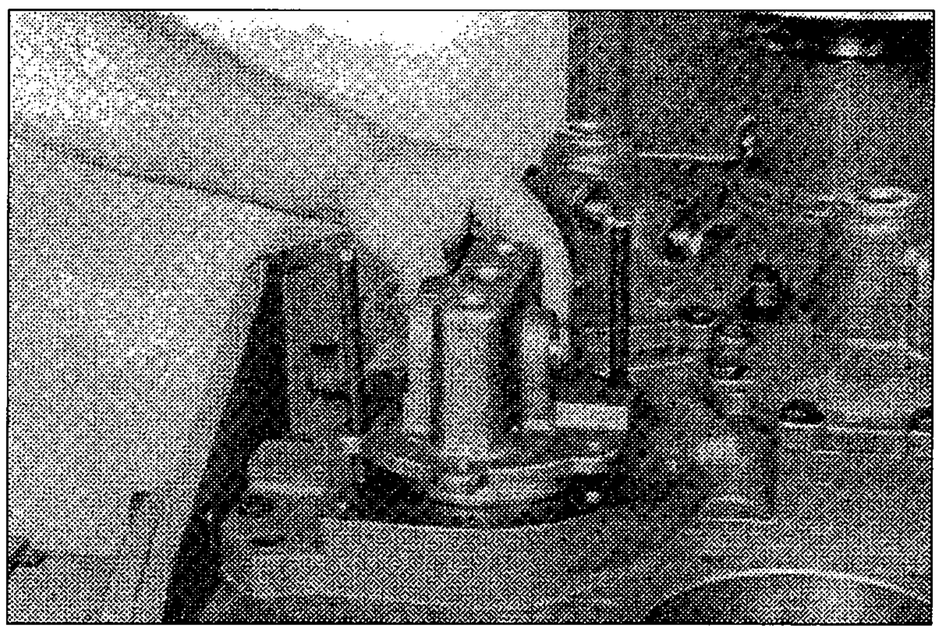
(45) Squeeze rectangular rings(3 pieces) into the annular grooves of the clutch shaft (Arrow) and engage them.
Now, grease rectangular rings and align them centrically.



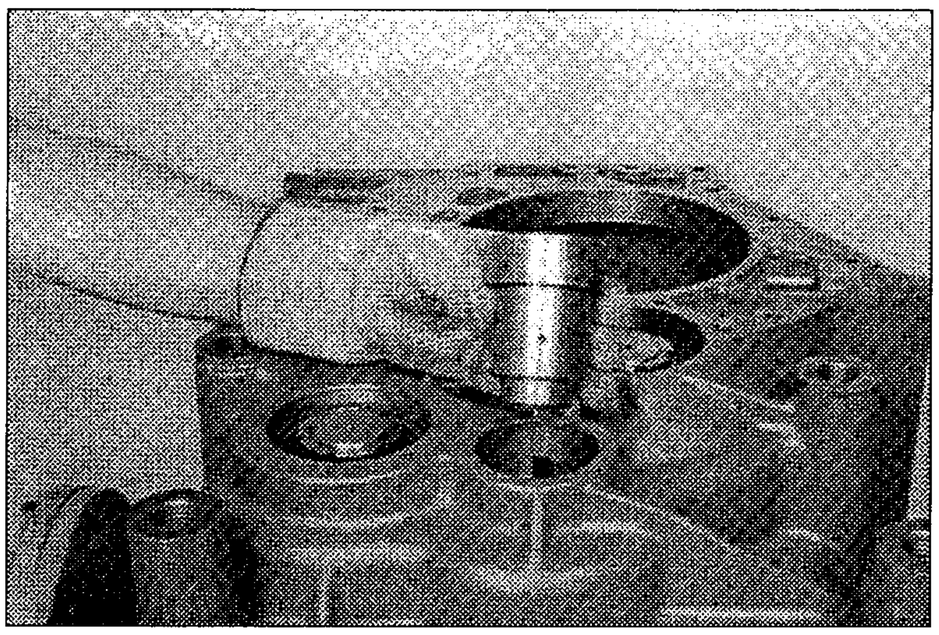
(46) Install two adjusting screws, introduce bearing cover and pull it uniformly against shoulder, using hexagon head screws.
· Torque limit(M10/8.8) : 4.7kgf · m(46Nm)

※ Special tool

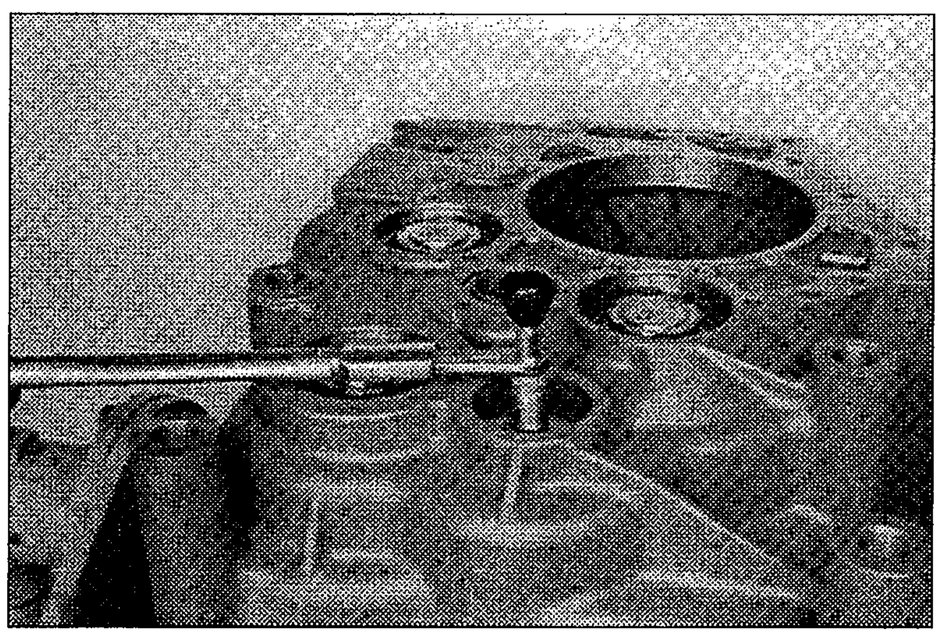
Adjusting screws(M10)	5870 204 007



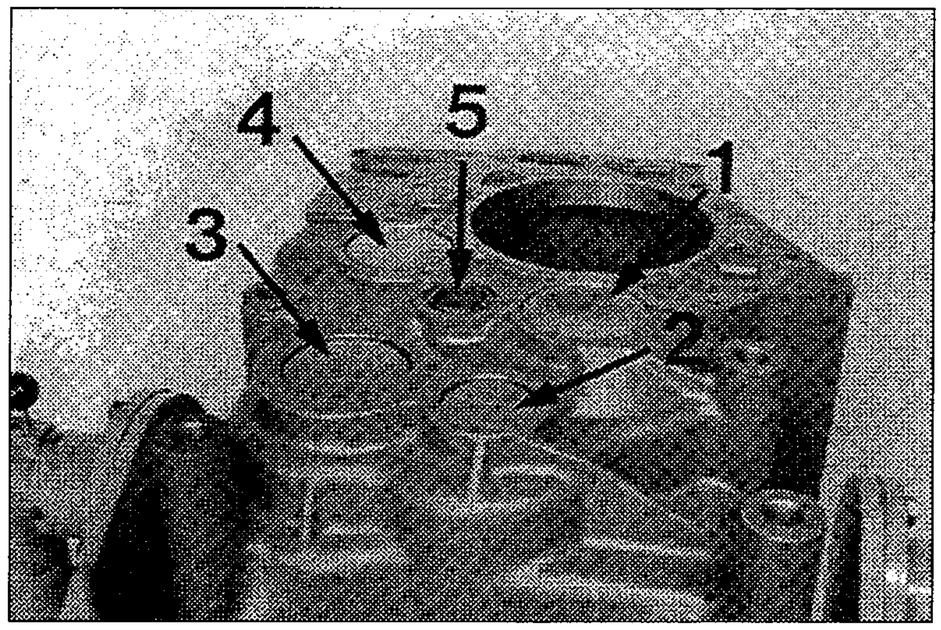
(47) Tilt housing 180°.
Align layshaft gear and shim centrically, undercool preassembled bolt and insert it until contact is obtained.
※ Pay attention to the overlapping of the roll pin with the bore in the housing.



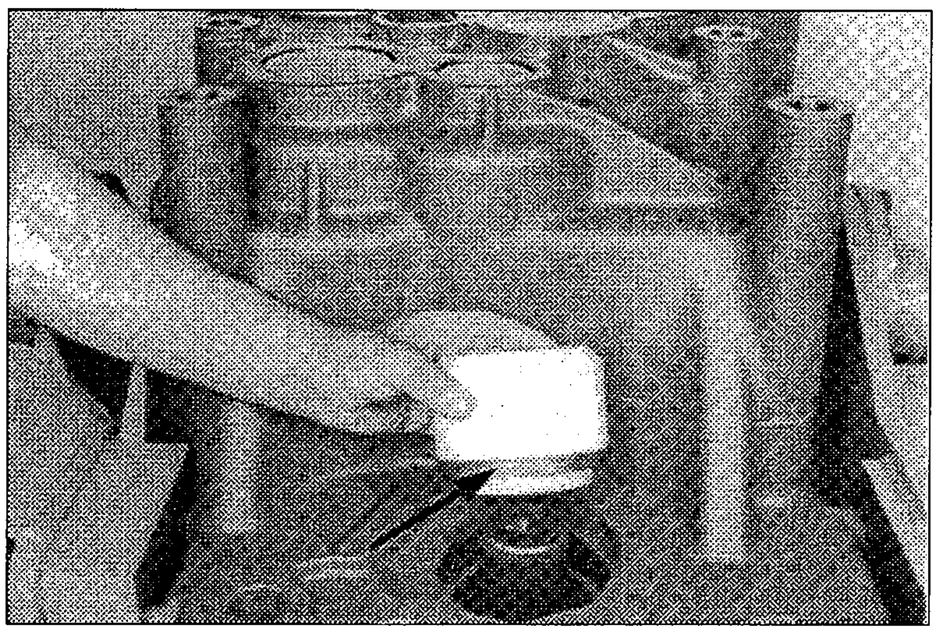
(48) Fix bolt axially by means of hexagon head screws.
· Torque limit(M10/8.8) : 4.7kgf · m(46Nm)
※ Wet thread of hexagon head screw with Loctite(Type No.243).



(49) Drive in the sealing covers(1,2,3 and 4) flush mounted, with the end face showing downward.
Install sealing cover(5), with the recess showing upward.
※ Wet sealing surface with loctite(Type No. 262).



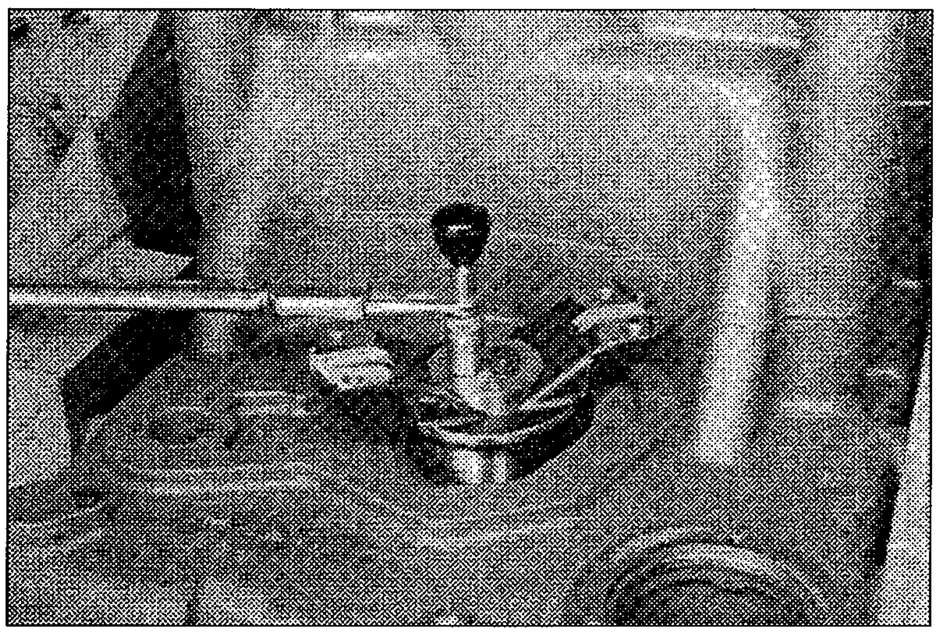
(50) Install shaft seal(Arrow), with the sealing lip showing downward.
※ At the use of the prescribed driver, the exact installation position is obtained.
Cover outer diameter with sealing compound(Loctite, type No.574).
Grease sealing lip.
※ Special tool
Driver 5870 048 150



(51) Assemble output flange.

Wet contact face of the disk with sealing compound(Loctite, type No.574) and fix output flange by means of hexagon head screws.

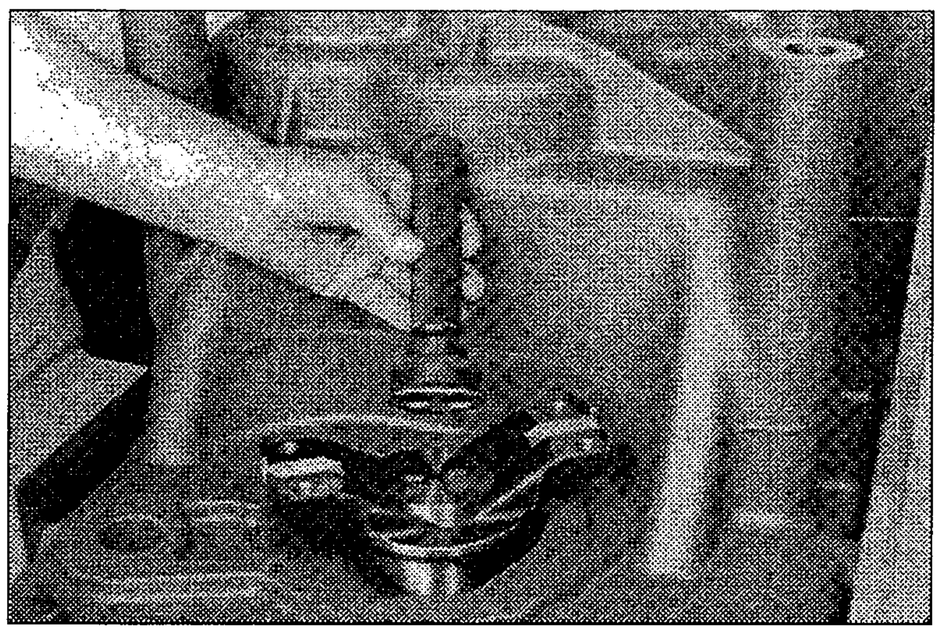
· Torque limit(M10/8.8) : 4.7kgf · m(46Nm)



(52) Fix hexagon head screws by means of lock plate.

※ Special tool

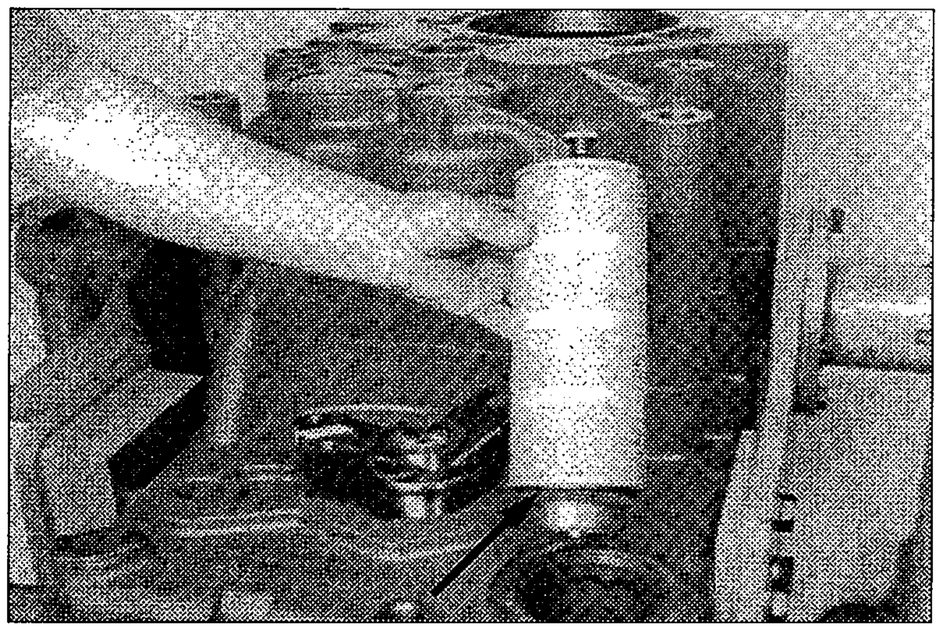
Driver	5870 057 009
Handle	5870 260 002



6) INSTALL FILTER

(1) Mount filter(Complete)

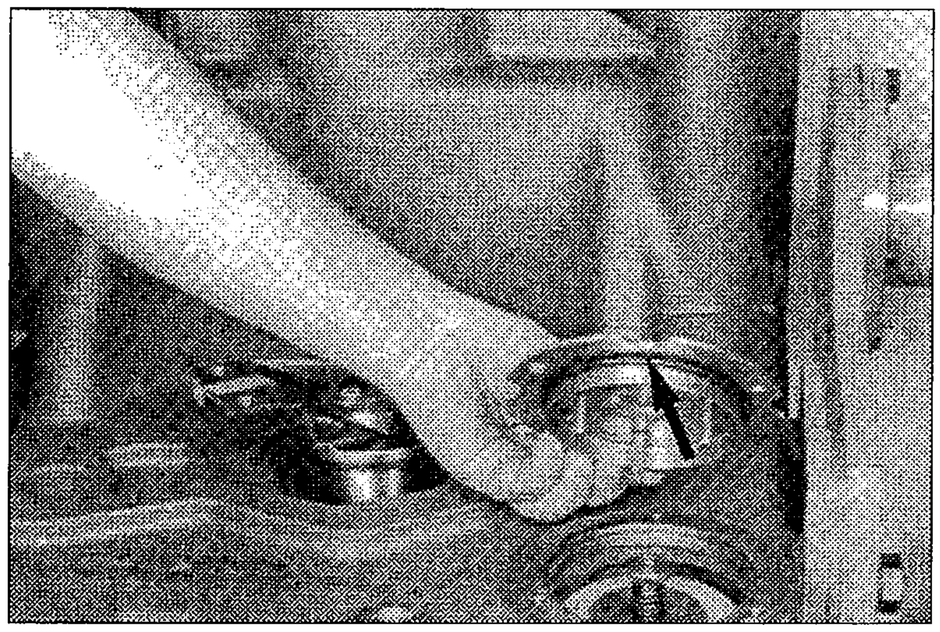
※ Grease sealing ring(Arrow).



(2) Fasten cover by means of hexagon head screws(Mount plain washers).

※ Install new O-ring(Arrow).

· Torque limit(M8/8.8) : 2.3kgf · m(23Nm)

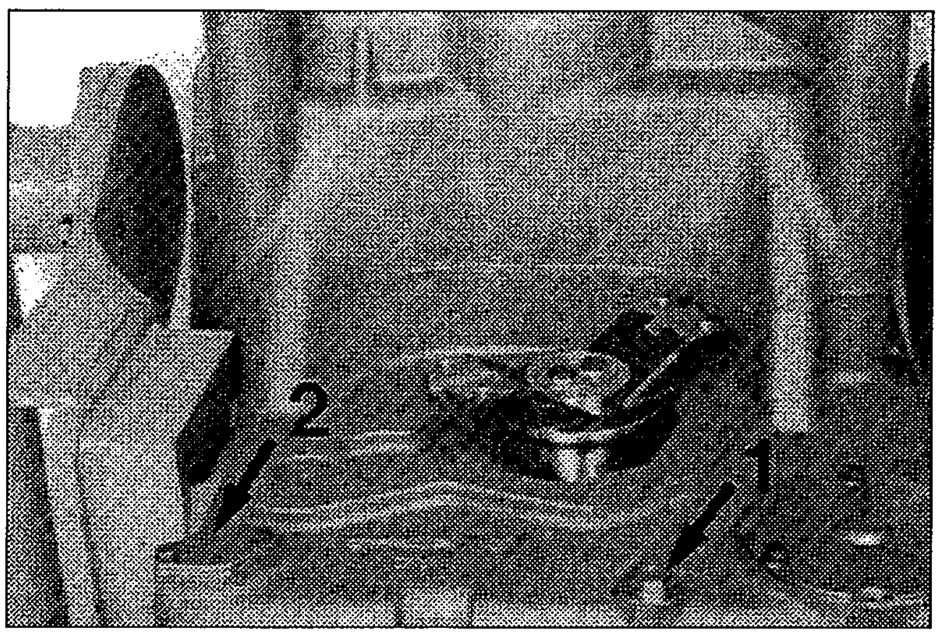


(3) Equip screw plug(Arrow 1) with new O-ring and install it.

※ Mount gasket and fasten cover plate by means of hexagon head screws, see arrow 2.

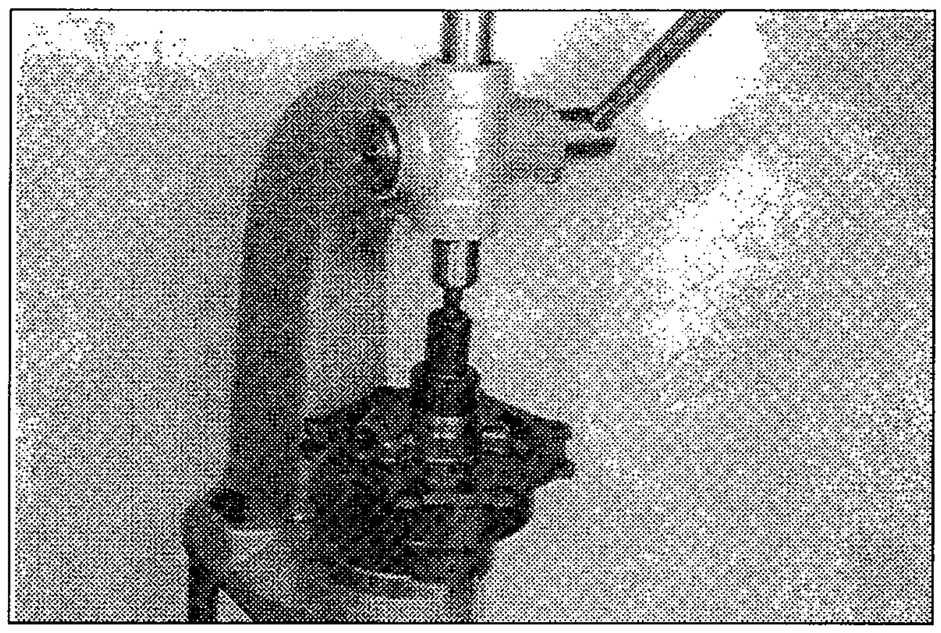
· Torque limit(Screw plug / M22×1.5)
: 6.1kgf · m(60Nm)

· Torque limit(M8/8.8) : 2.3kgf · m(23Nm)



7) HYDRAULIC PUMP

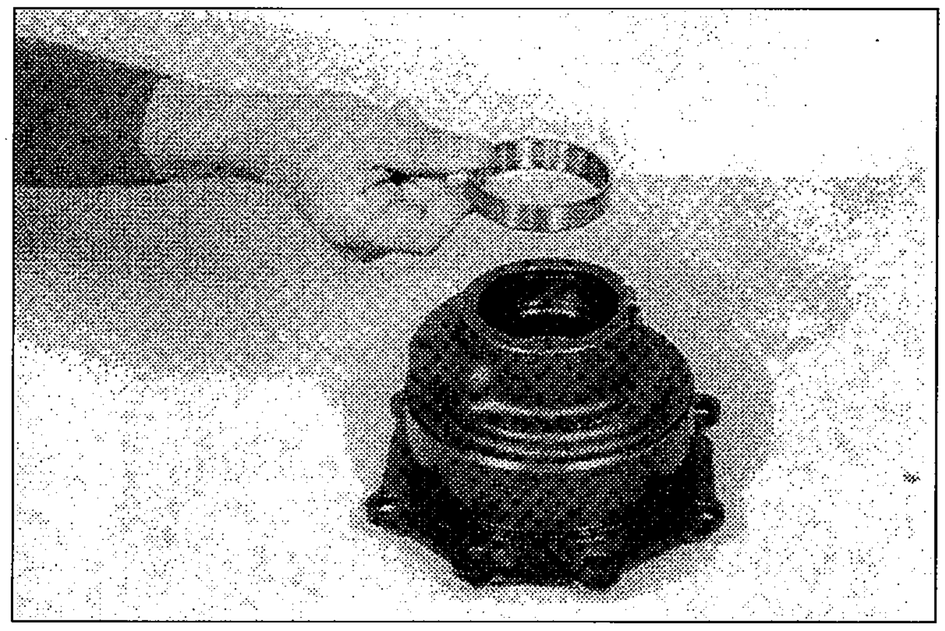
(1) Press needle sleeve in, with the reinforced shell facing the press-in tool until contact is obtained.



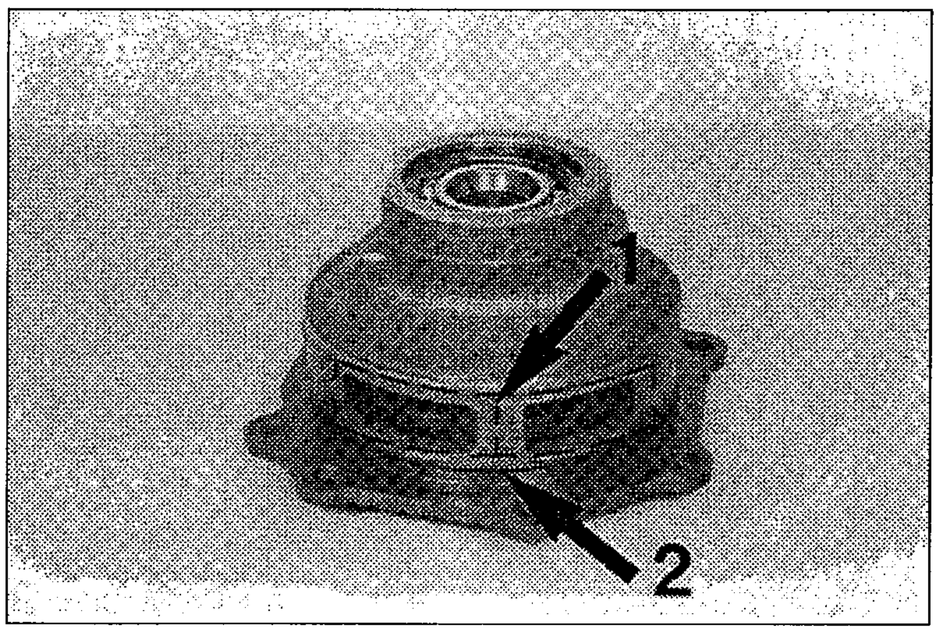
(2) Insert bearing outer race until contact is obtained.

※ Special tool

Driver	5870 058 084
Handle	5870 260 002



(3) Undercool pump-about -80°C.
Clean area of suction and pressure port (Arrow 1) again and wet it with loctite (Type No.262).
Assemble and oil O-ring(Arrow 2).

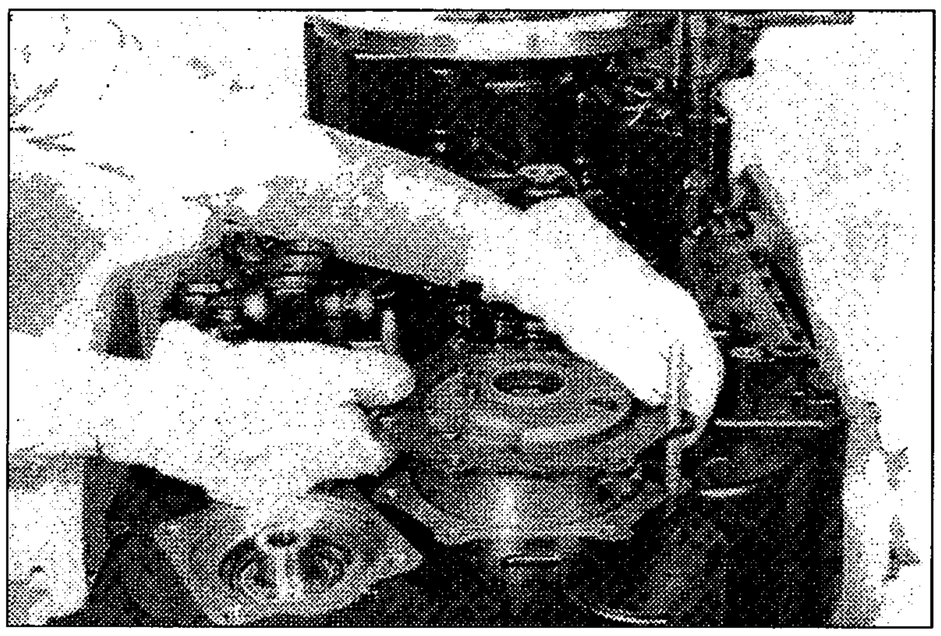


(4) Install two adjusting screws and introduce pump until contact is obtained.

※ Pay attention to the radial installation position.

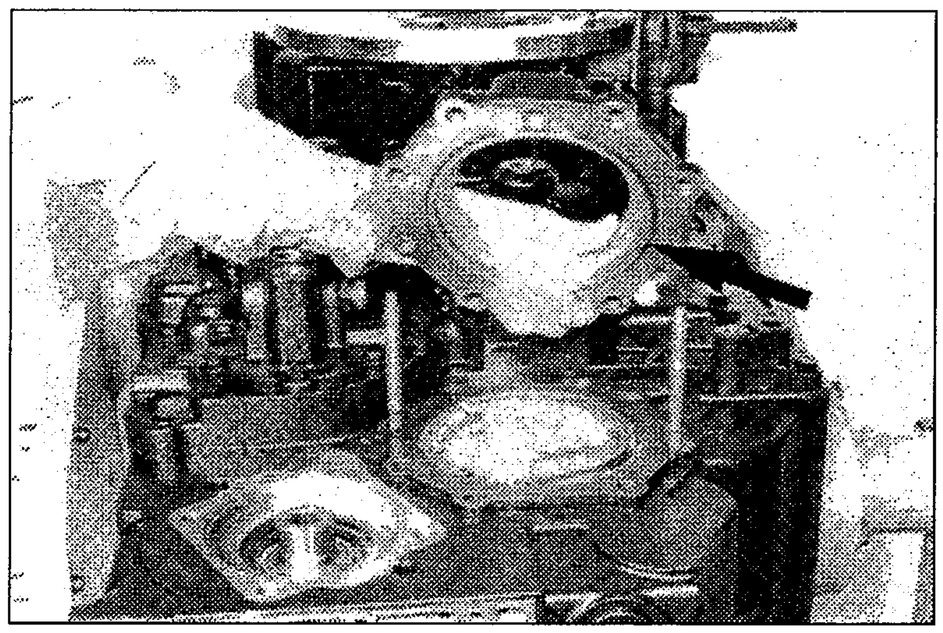
※ Special tool

Adjusting screw 5870 204 021



(5) Install O-ring(Arrow) and fasten pump flange, respectively pump by means of hexagon head screws.

· Torque limit(M12/8.8) : 8.1kgf · m(79Nm)



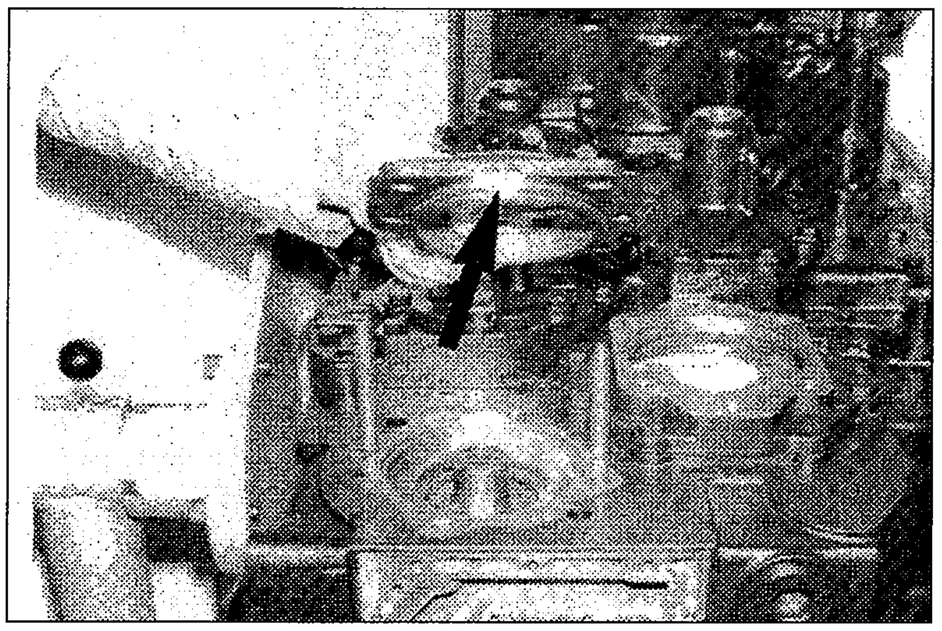
(6) Insert O-ring(Arrow) into the annular groove of the pump flange(Power take-off) and oil it.

Mount two adjusting screws and fasten flange by means of hexagon head screws.

· Torque limit(M14/8.8) : 12.7kgf · m (125Nm)

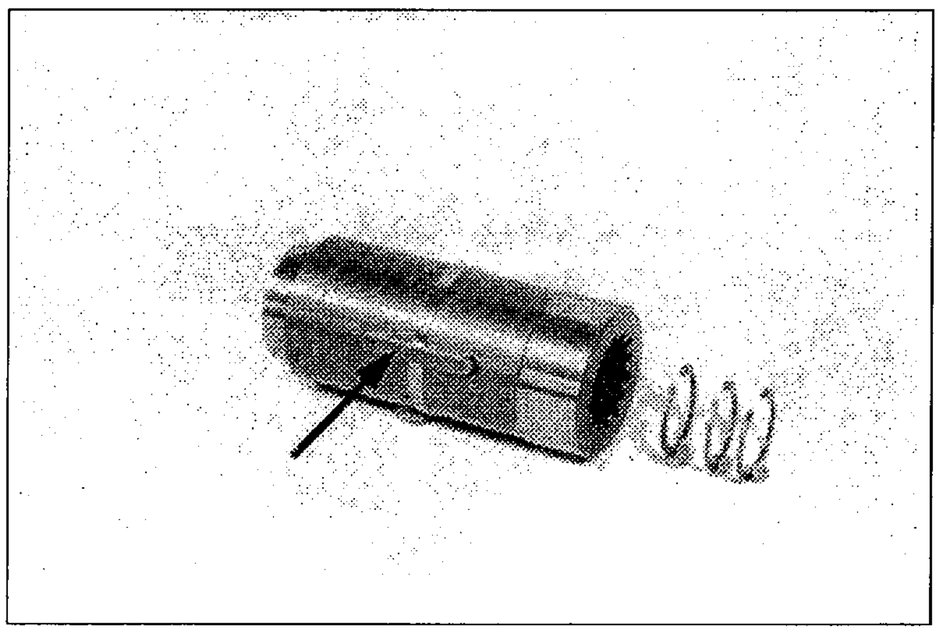
※ Special tool

Adjusting screw 5870 204 022

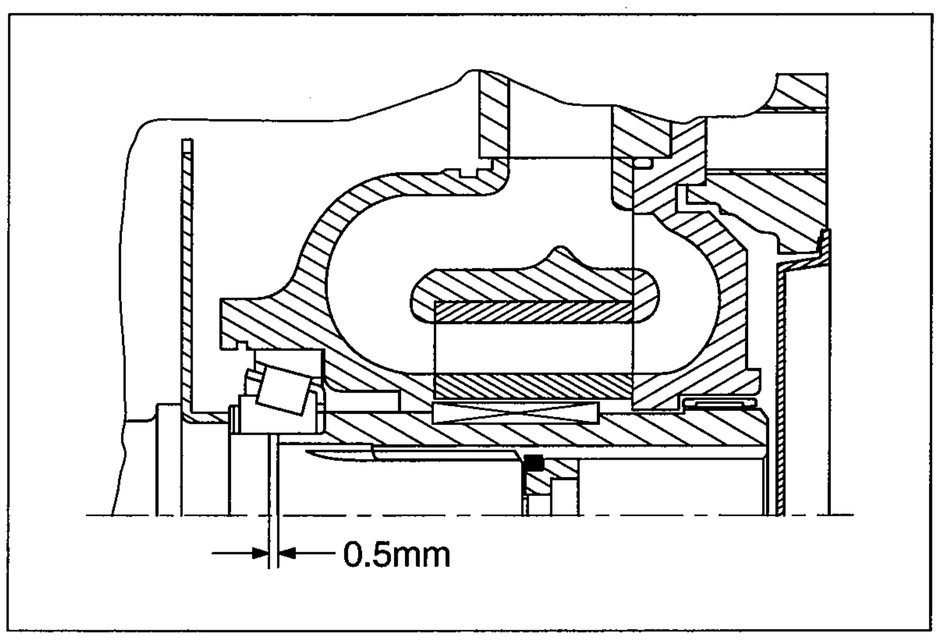


8) DRIVE SHAFT(Power take-off pump)

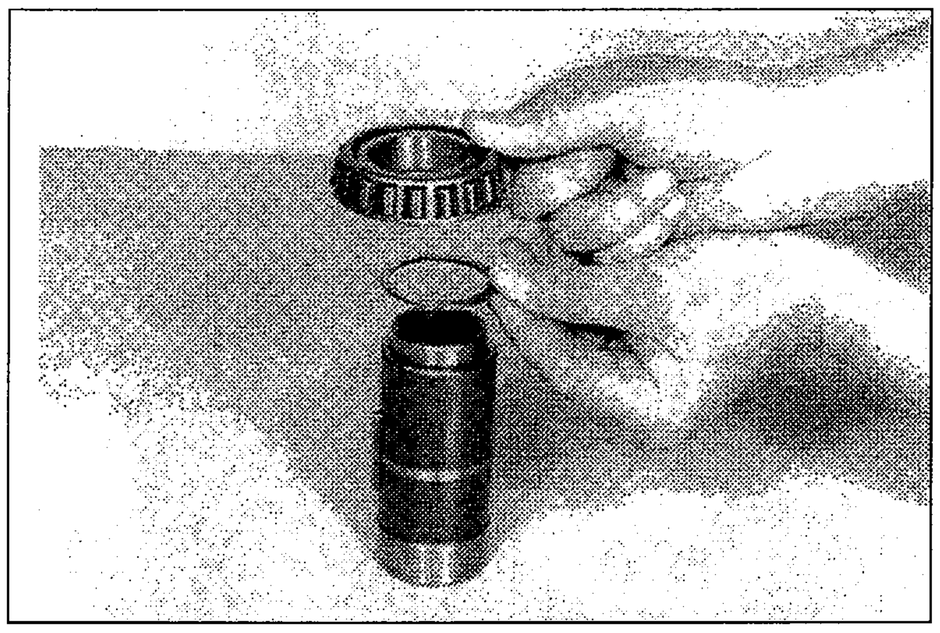
(1) Squeeze V-rings(3EA) into the recess of the driver(Internal gearing). Mount fitting key(Arrow).



(2) Adjust gap = 0.5mm(Driver - Drive shaft) (Figure (2)~(6)).

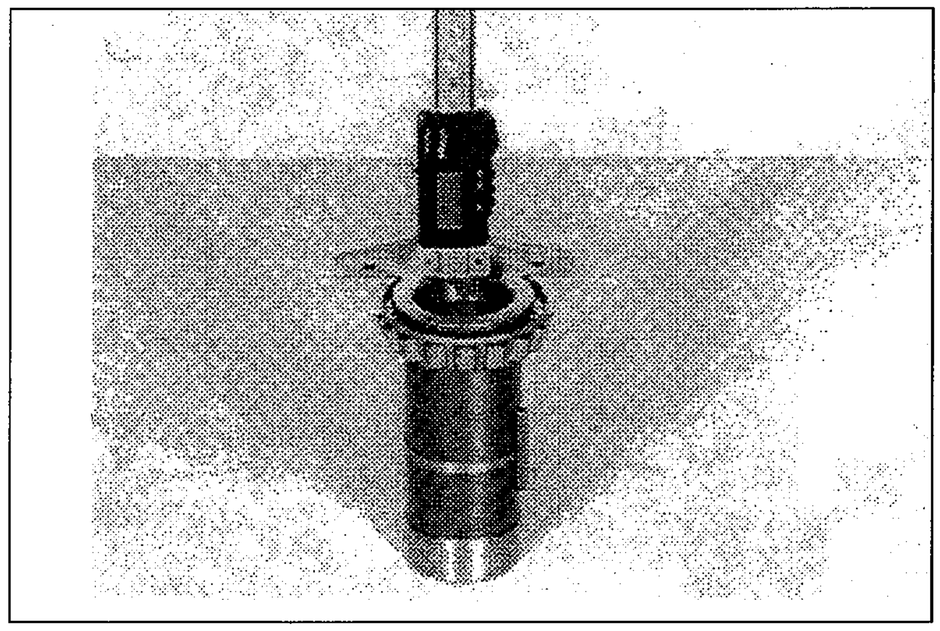


(3) Assemble disk s=1.90mm and place bearing inner race against shoulder.



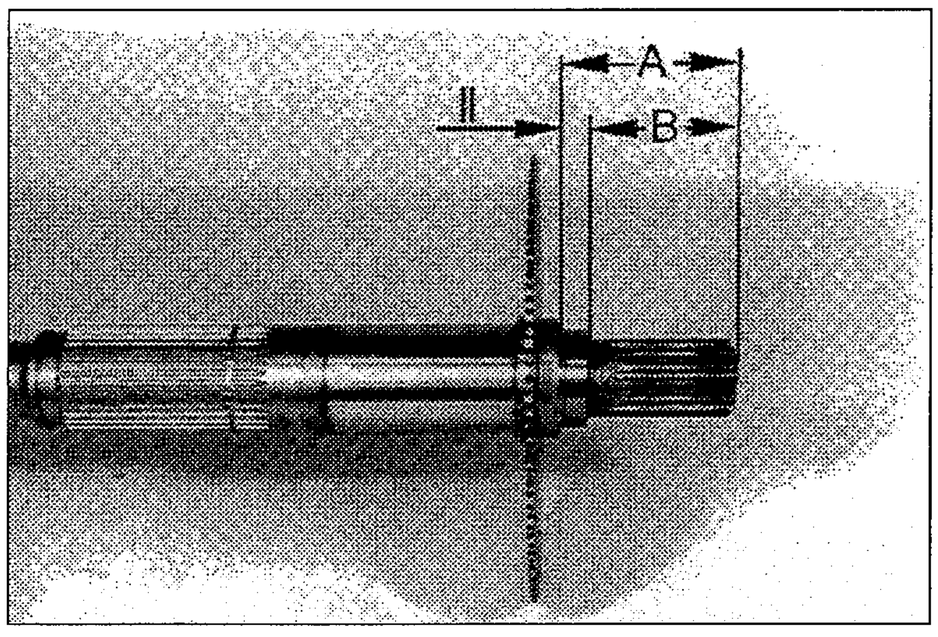
(4) Determine dimension Ⅰ from the bearing inner race to the end face/driver.

· Dimension Ⅰ e.g. 9.60mm



(5) Determine dimension Ⅱ (A-B).

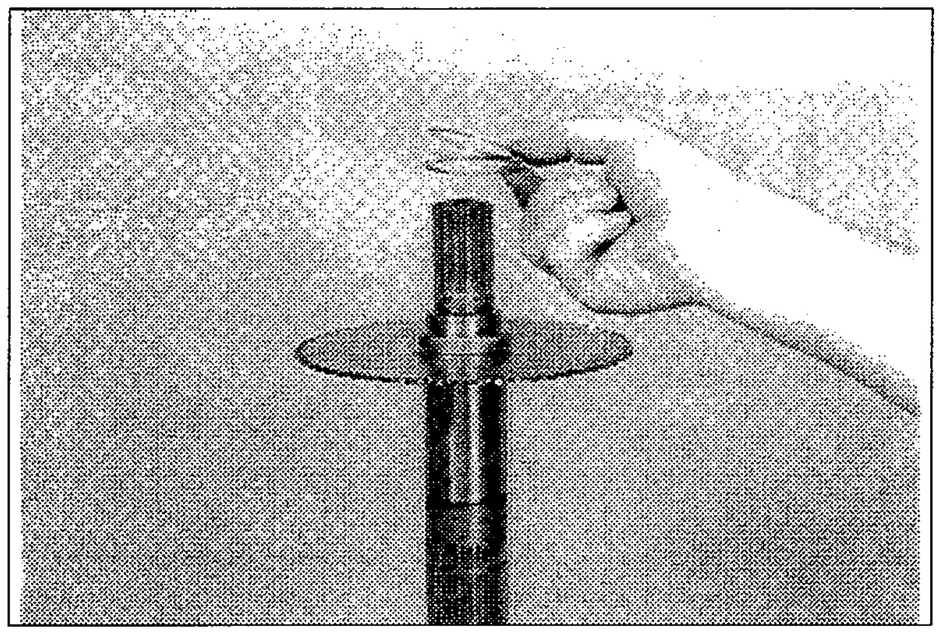
· Dimension Ⅱ e.g. 10.60mm



Example H

Dimension Ⅱ	10.60mm
Dimension Ⅰ	- 9.60mm
Difference	1.00mm
Required gap	+ 0.50mm
Gives shim(s)	s = 1.50mm

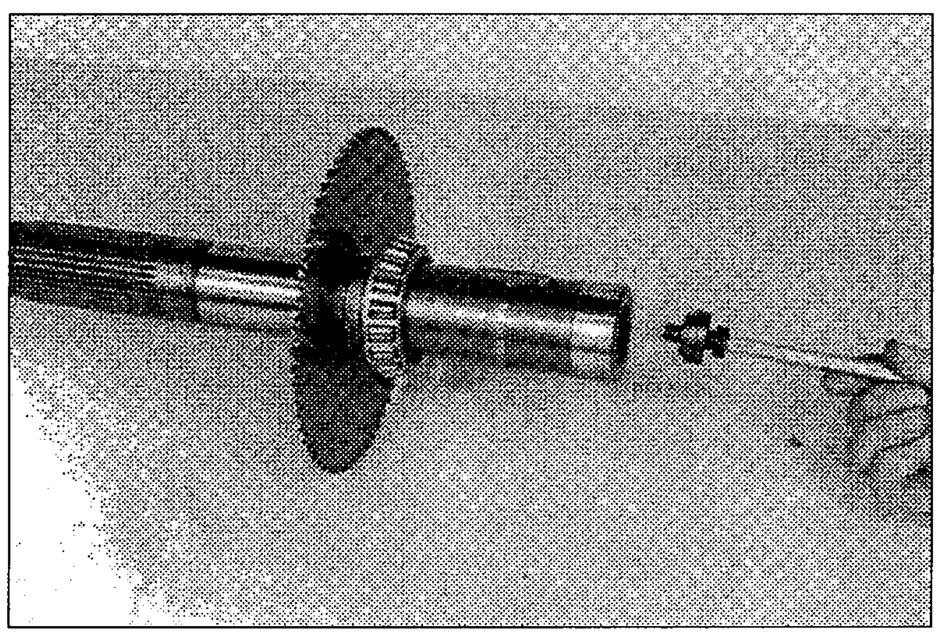
(6) Assemble shim e.g.=1.50mm and position driver, respectively bearing inner race against shoulder.



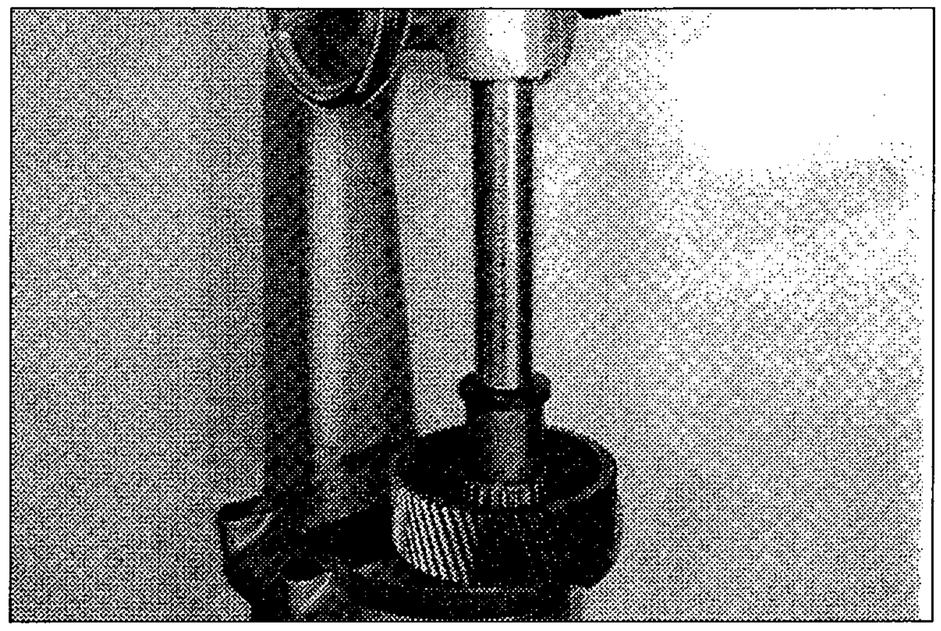
(7) Fix driver by means of clamping disk and socket head screw.

※ Insert socket head screw with loctite(Type No.242).

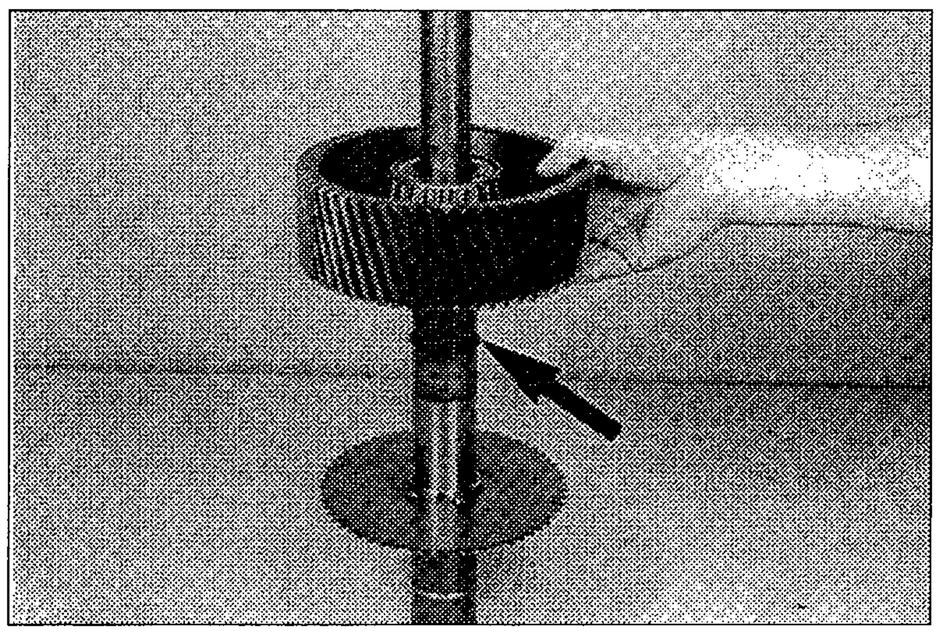
· Torque limit(M10/8.8 DIN 6912)
: 3.3kgf · m(32Nm)



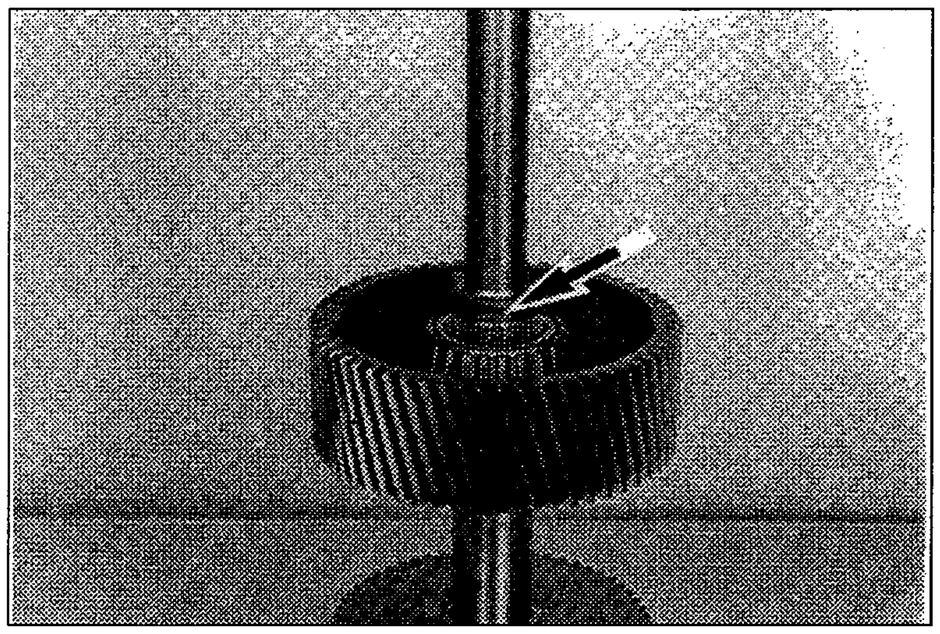
(8) Press bearing inner race upon the collar of the drive gear power take-off.



(9) Squeeze circlip in(Arrow) and assemble drive gear.

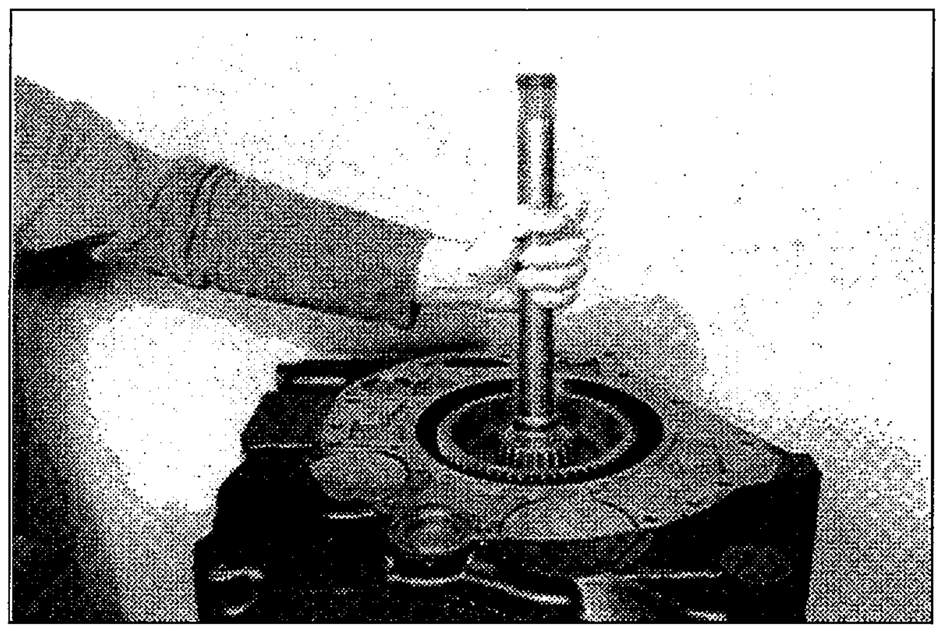


(10) Squeeze in and engage rectangular ring (Arrow).



(11) Introduce preassembled drive shaft until contact is obtained.

※ Pay attention to the overlapping of fitting key / fitting key groove.



(12) **Adjust axial play of the drive shaft bearing = 0.0~0.05mm**(Figure (12)~(14)).

Mount gasket.

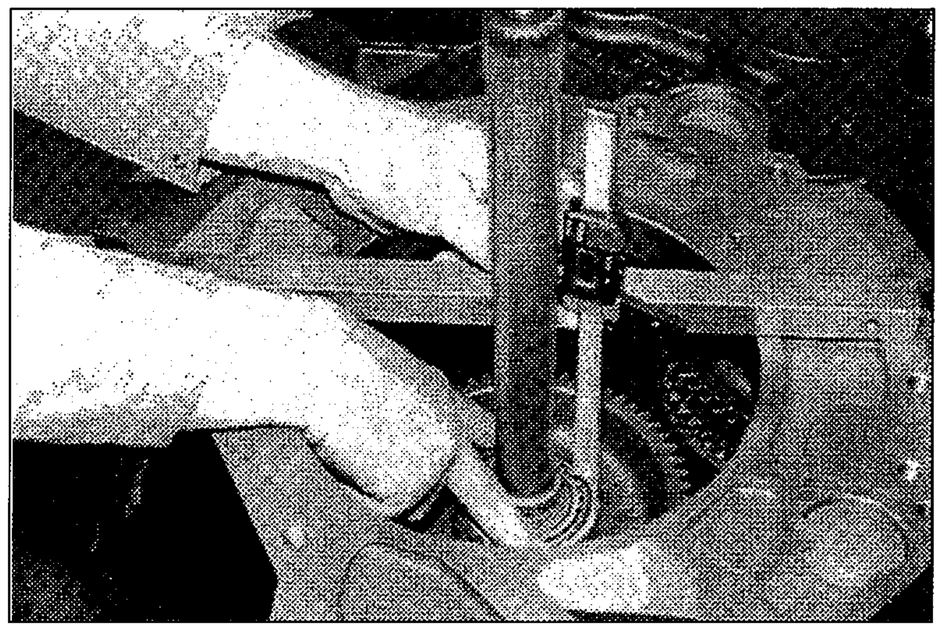
Mount bearing outer race, press it uniformly on and determine dimension Ⅰ from the mounting face(Gasket) to the bearing outer race.

· Dimension Ⅰ e.g. 129.55mm

※ Apply several measuring points and determine the average.

※ Special tool

Straightedge	5870 200 022
Digital depth gauge	5870 200 072

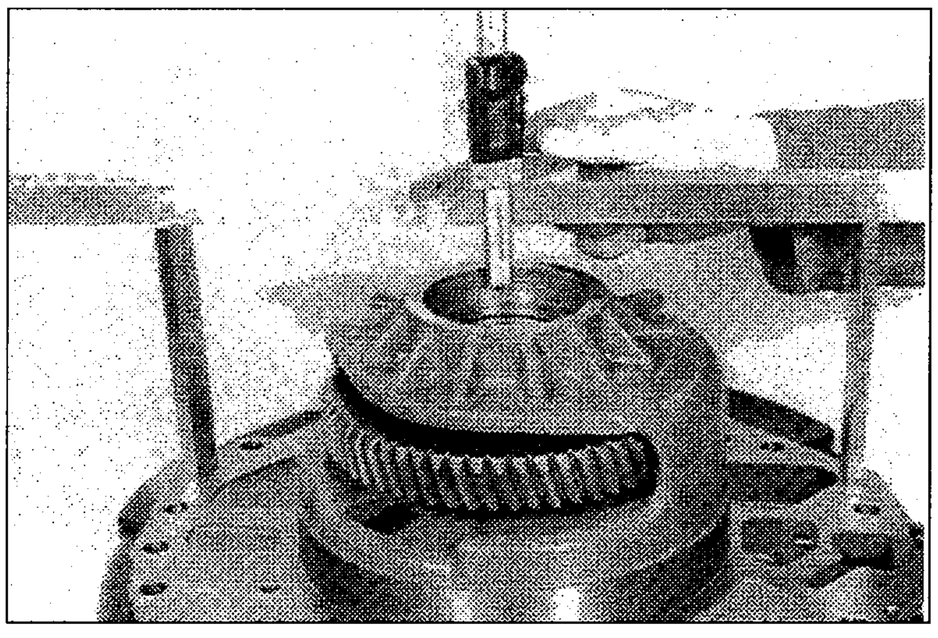


(13) Measure dimension Ⅱ from the mounting face/converter bell to the contact face/ bearing outer race.

· Dimension Ⅱ e.g. 127.43mm

※ Special tool

Gauge blocks	5870 200 080

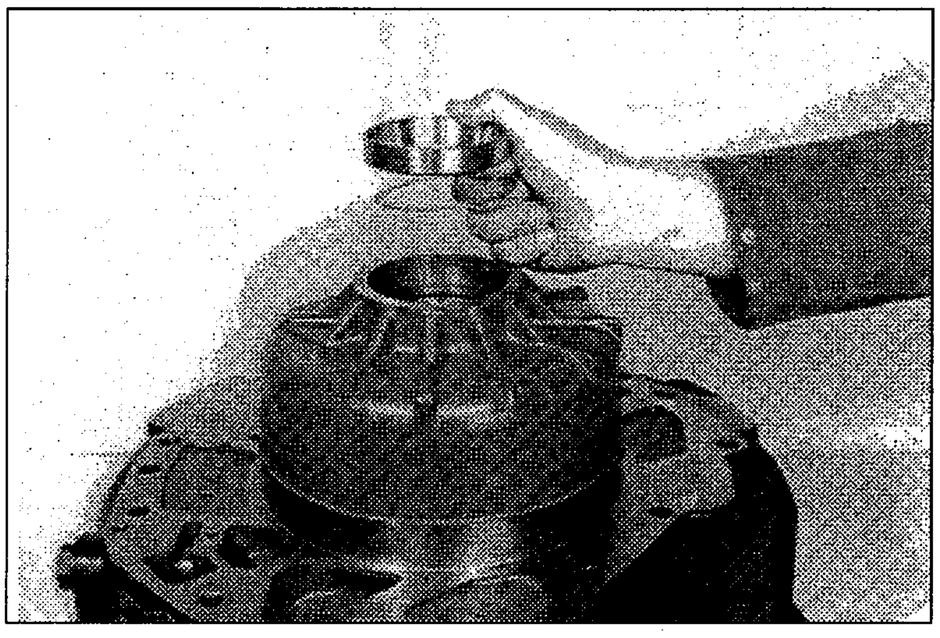


Example J

Dimension Ⅰ	129.55mm
Dimension Ⅱ	- 127.43mm
Difference	2.12mm
Axial play(0.0~0.05) e.g.	- 0.02mm
Gives shim	s = 2.10mm

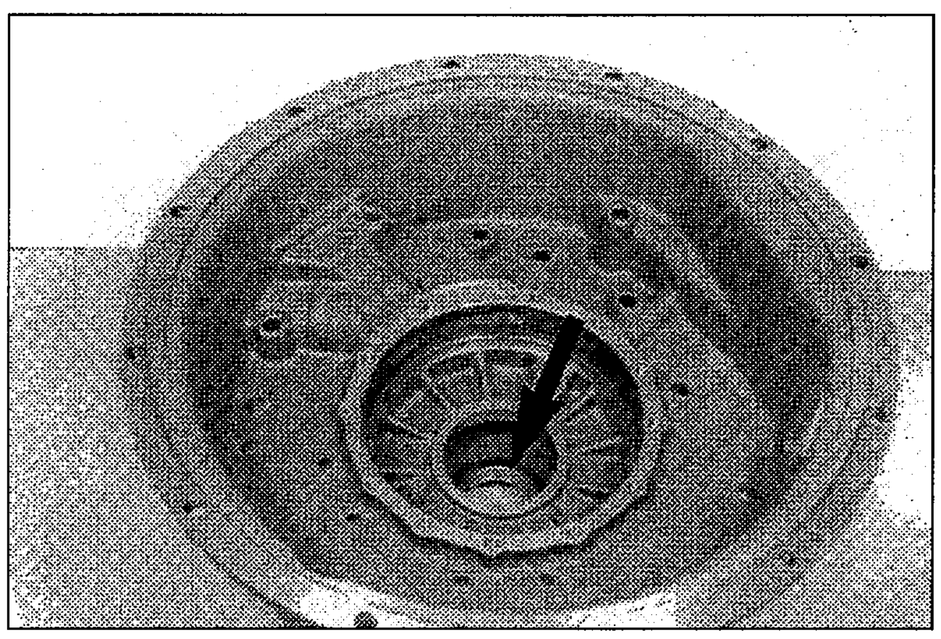
※ Shims are available in 0.05mm gradation.

(14) Insert shim e.g. s=2.10mm and position bearing outer race against shoulder.

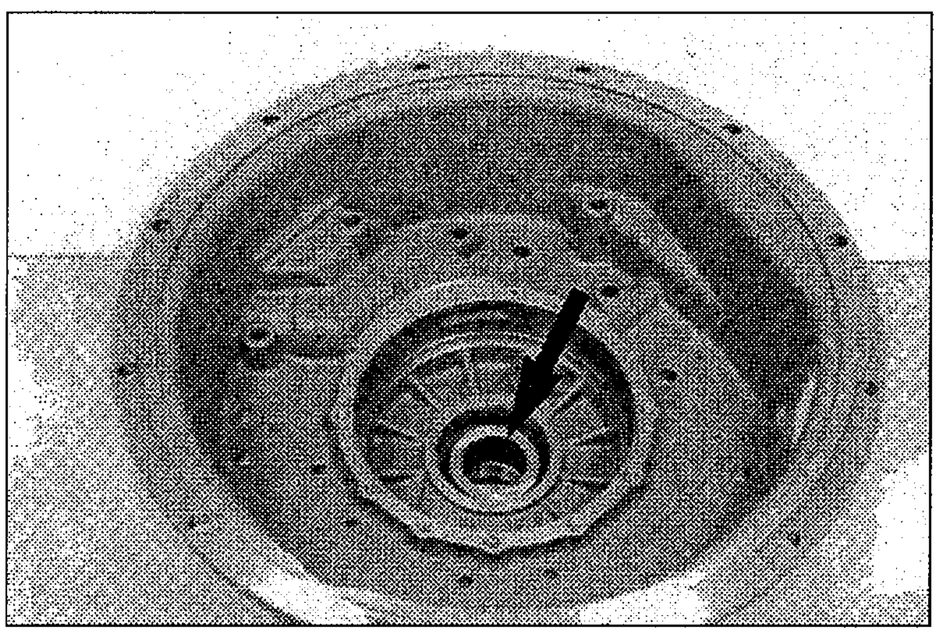


9) INPUT-CONVERTER BELL

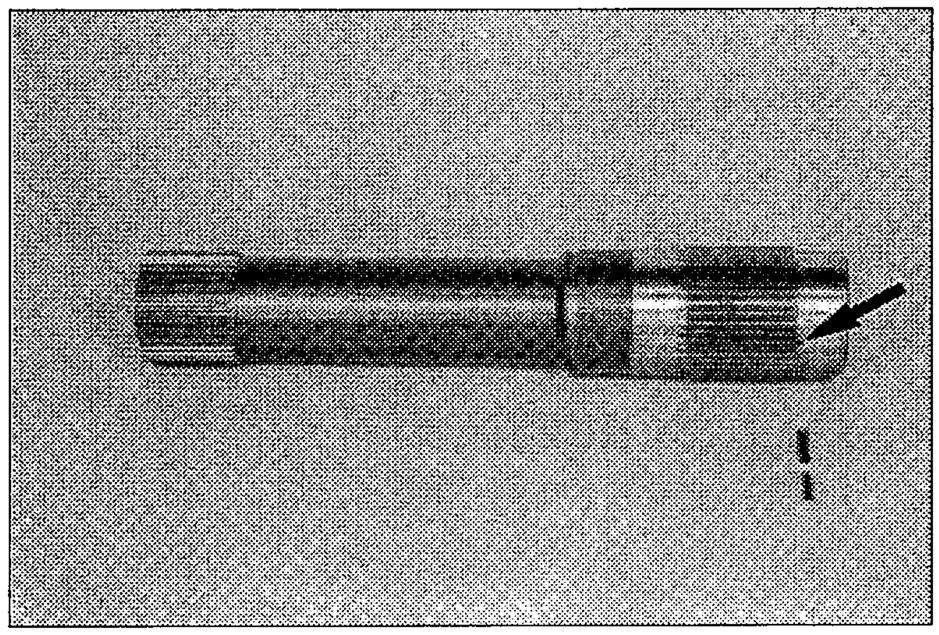
(1) Insert bearing outer race into the housing bore until contact is obtained and install bearing inner race, see arrow.



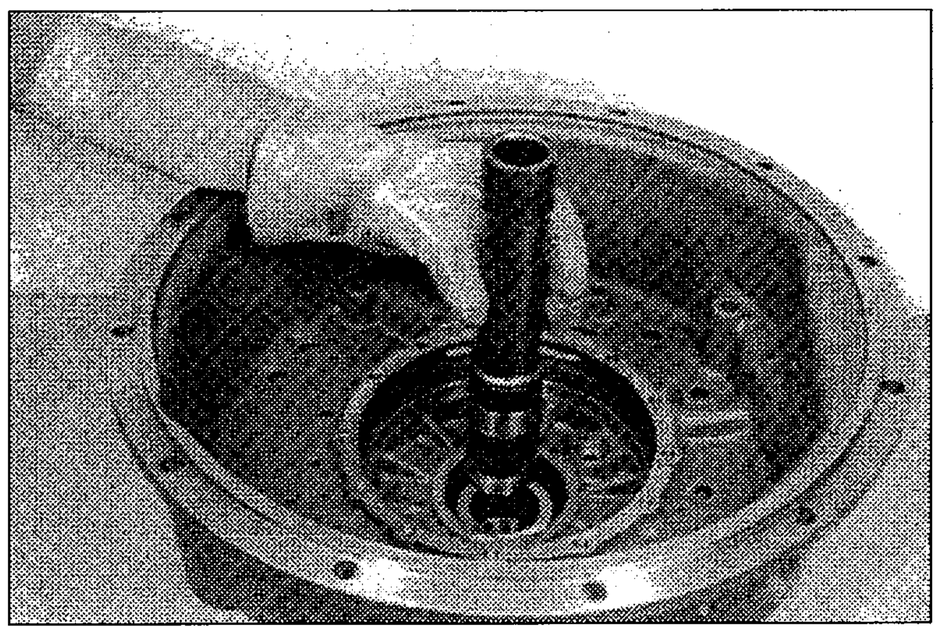
(2) Introduce spur gear(Arrow), starting from the side, with the long collar showing upward, and position it.



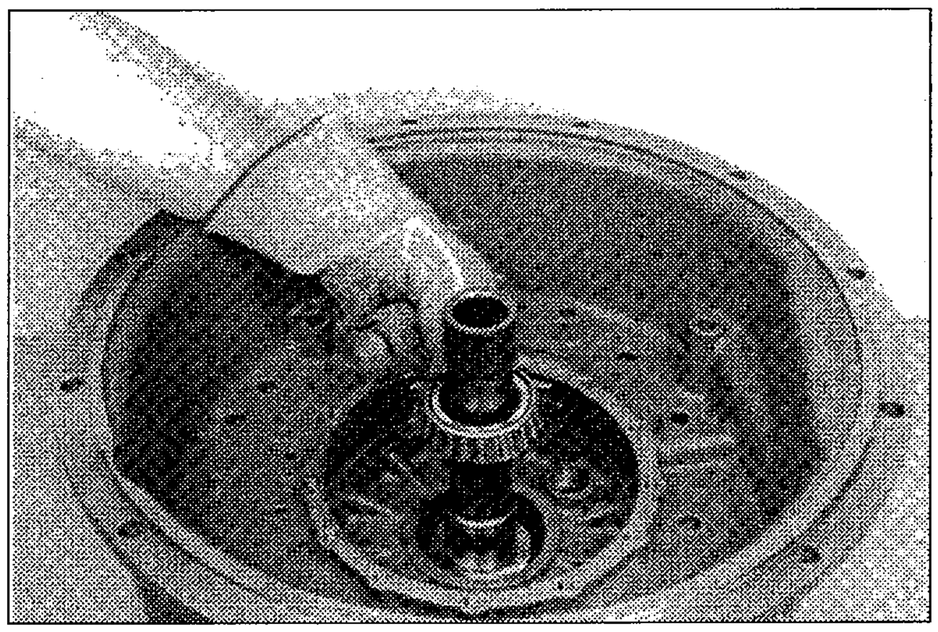
(3) Insert both roll pins(ø 2.5 and ø 1.5mm) flush mounted into the bore(Arrow) of the drive shaft.



(4) Undercool drive shaft and introduce it until contact is obtained.

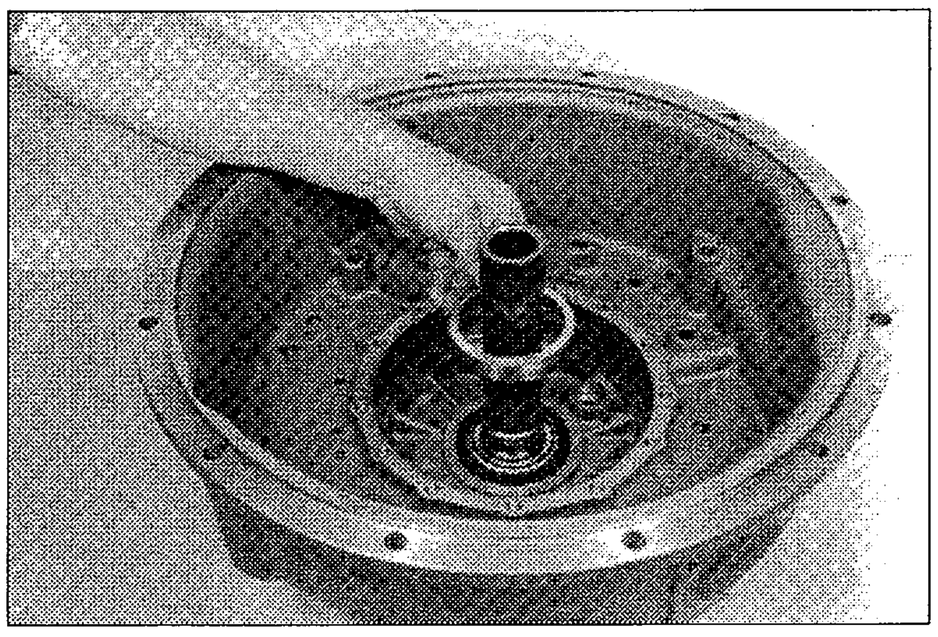


(5) Heat bearing inner race and assemble it until contact is obtained.



(6) Place bearing outer race against shoulder.

※ Spur gear bearing must be playfree.



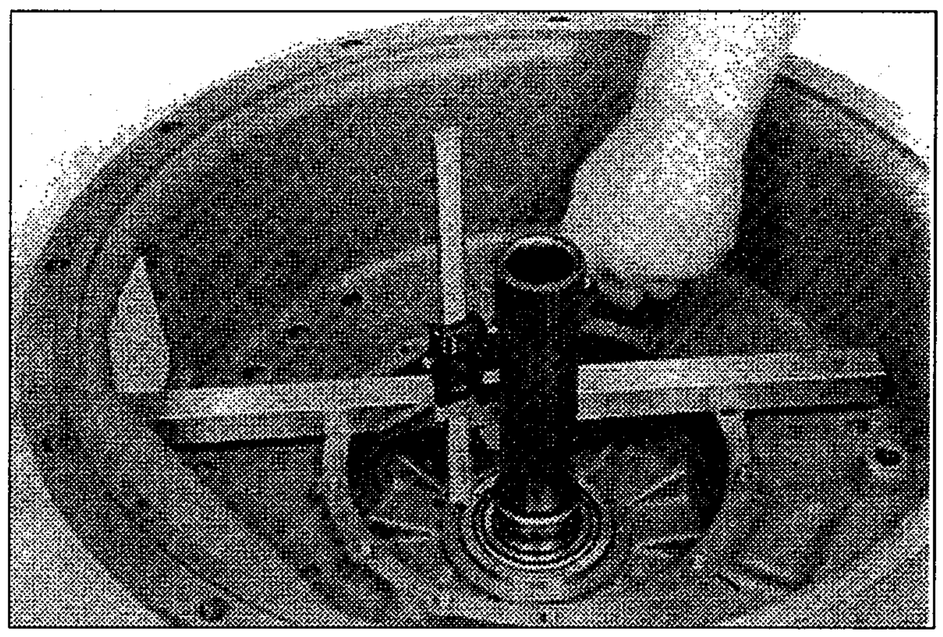
Adjust bearing preload of drive gear bearing 0.0~0.07mm(Example K)

(7) Measure dimension Ⅰ from the mounting face to the bearing outer race.

· Dimension Ⅰ e.g. 62.10mm

※ Special tool

Straightedge	5870 200 022
Digital depth gauge	5870 200 072

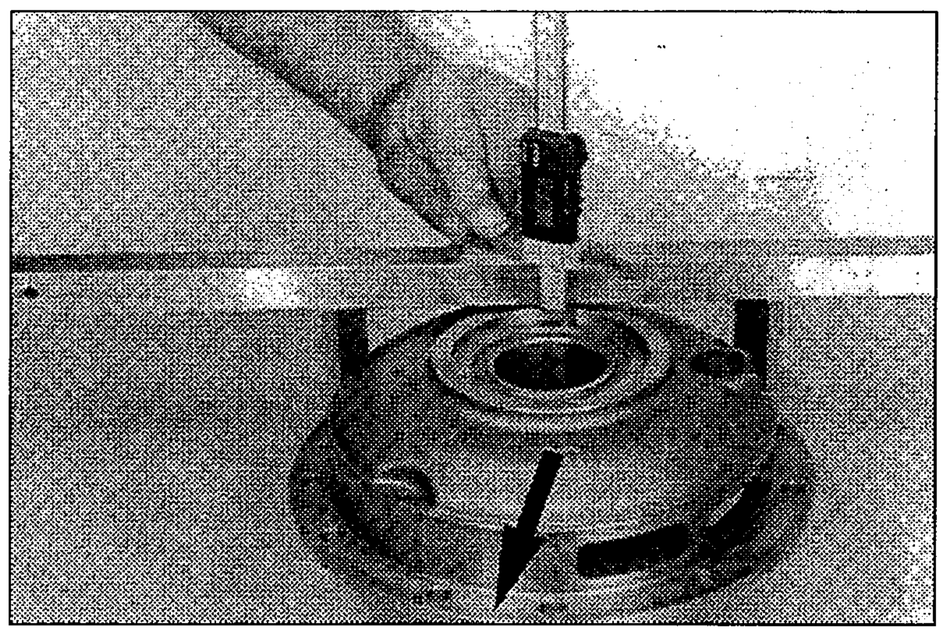


(8) Mount gasket(Arrow) and determine dimension Ⅱ from the mounting face to the contact face of the bearing outer race.

· Dimension Ⅱ e.g. 60.85mm

※ Special tool

Gauge blocks	5870 200 067
Straightedge	5870 200 022



Example K

Dimension Ⅰ	62.10mm
Dimension Ⅱ	- 60.85mm
Difference	1.25mm
Bearing preload(0.0~0.07)	e.g.+ 0.05mm
Gives shim	s = 1.30mm

※ Reassembly of the shim, see figure(12).

(9) Insert needle bearing until contact is obtained.

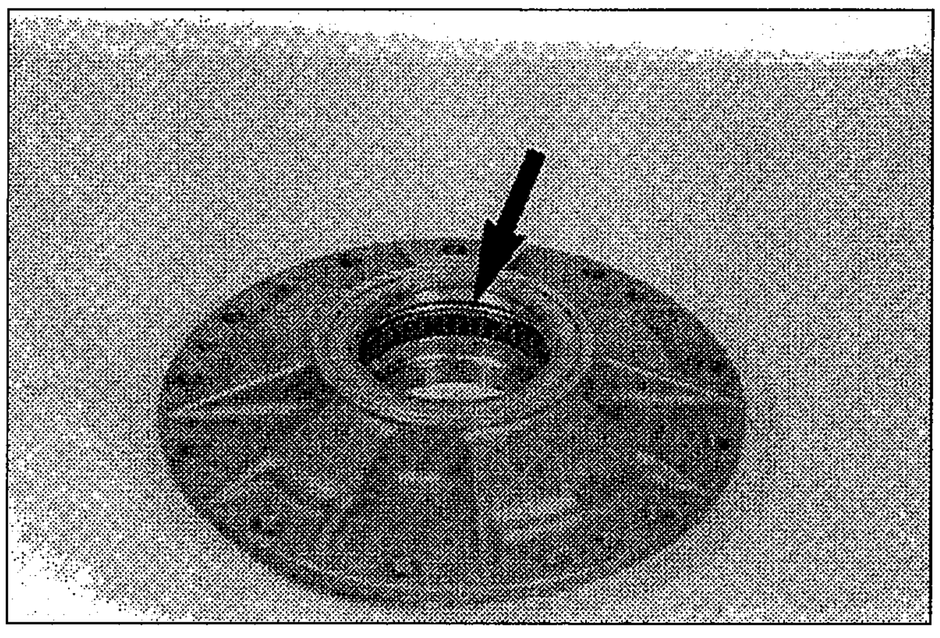
Install shaft seal flush mounted, with the sealing lip showing downward.

※ Wet outer diameter of shaft seal with sealing compound(Loctite, type No.574).

Grease sealing lip.

※ Special tool

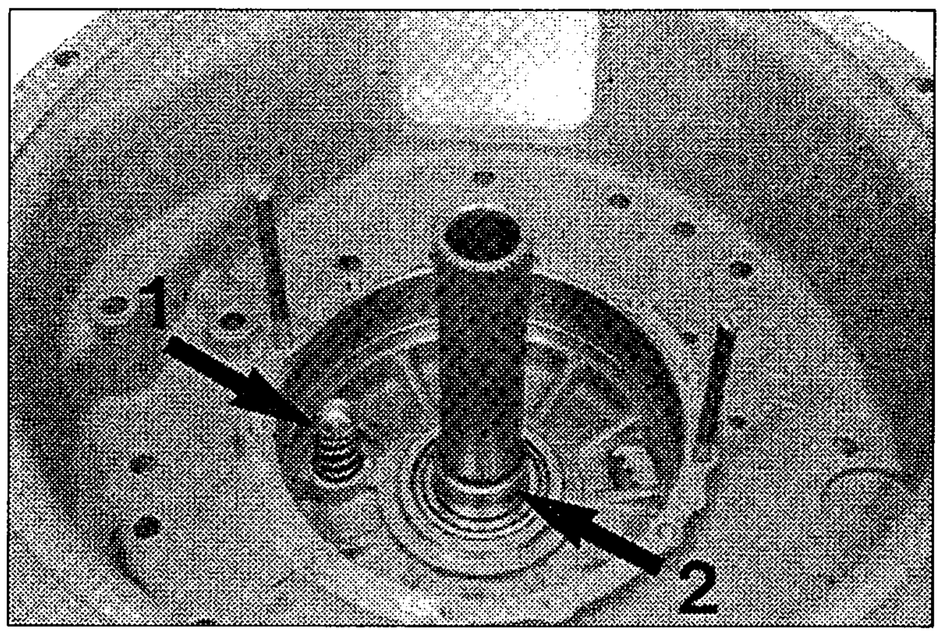
Driver	5870 055 031
Handle	5870 260 002



(10) Install two adjusting screws and mount gasket.
Install converter safety valve, composed of disk, compression spring and ball(Arrow 1).
Squeeze rectangular ring into the annular groove of the drive shaft and engage it (Arrow 2).
Now, grease rectangular ring and align it centrically.

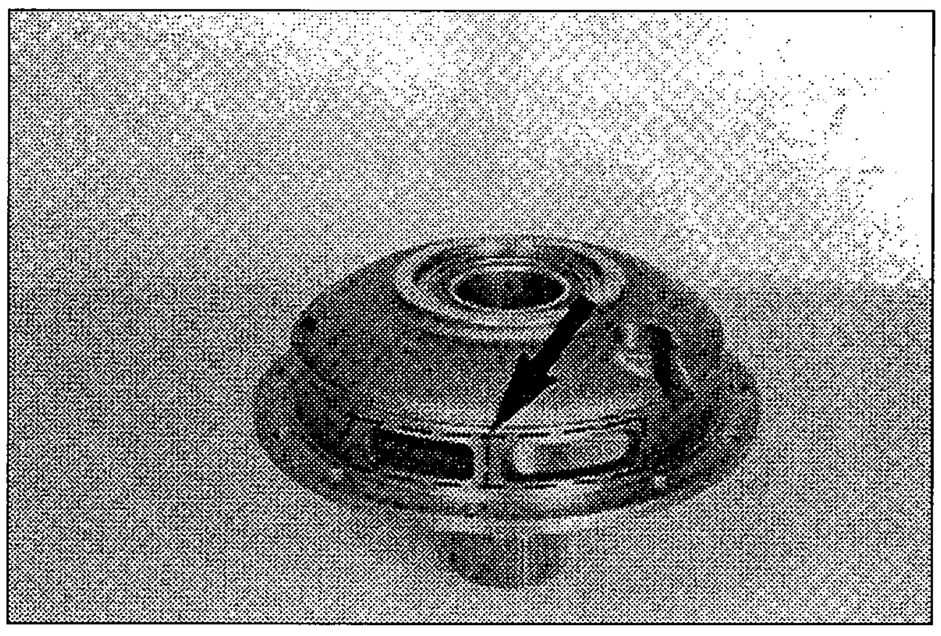
※ Special tool

Adjusting screws(M12)	5870 204 021

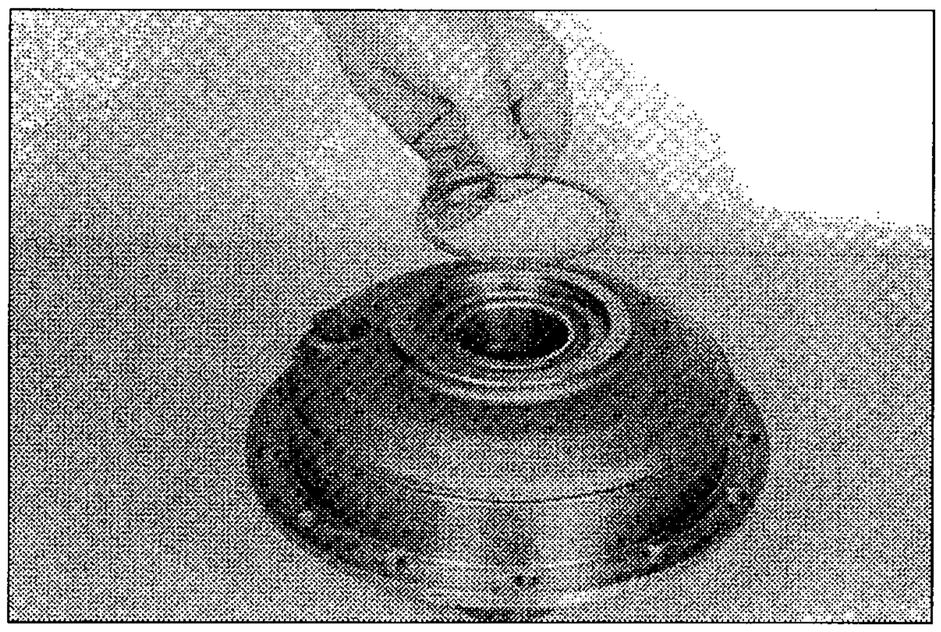


※ Carry out the following steps(Figure (11)~(14)) immediately within short chronological order.

(11) Undercool oil feed flange about -80°C.
Clean area of suction and pressure port (Arrow) again and wet it with loctite(Type No.241).



(12) Make shim e.g. s=1.30mm(See example K) adhere with grease in the bearing bore.

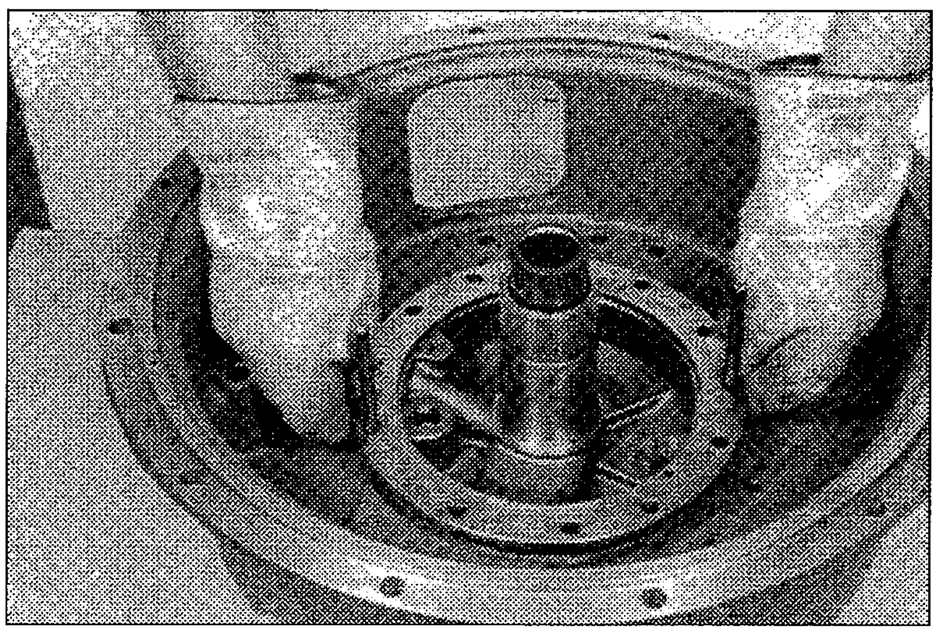


(13) Introduce oil feed flange until contact is obtained.

※ Pay attention to the radial installation position.

※ Special tool

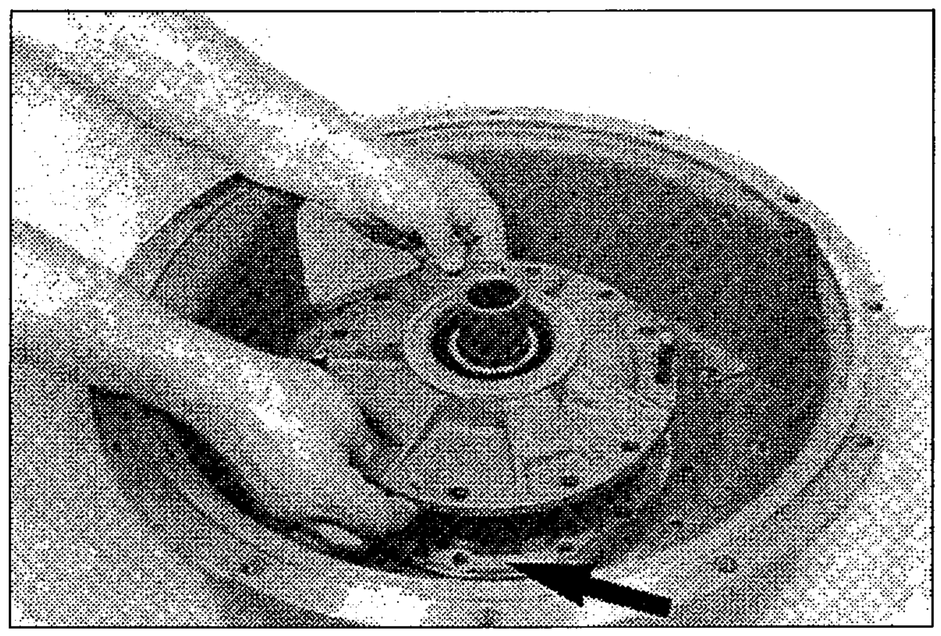
Adjusting screws	5870 204 007



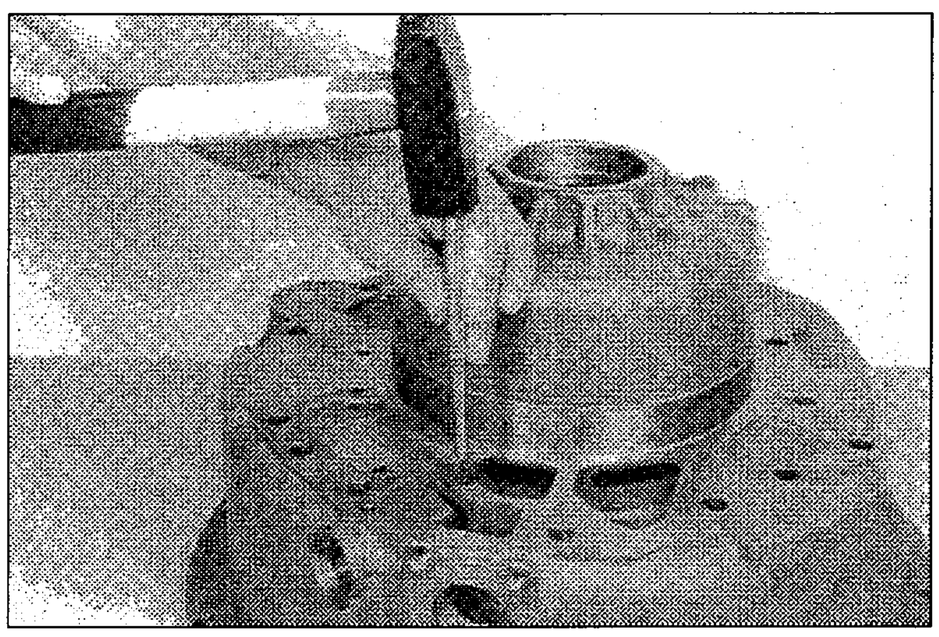
(14) Mount gasket(Arrow) and install bearing cover.

· Torque limit(M10/8.8) : 4.7kgf · m(46Nm)

※ Pay attention to the radial installation position.



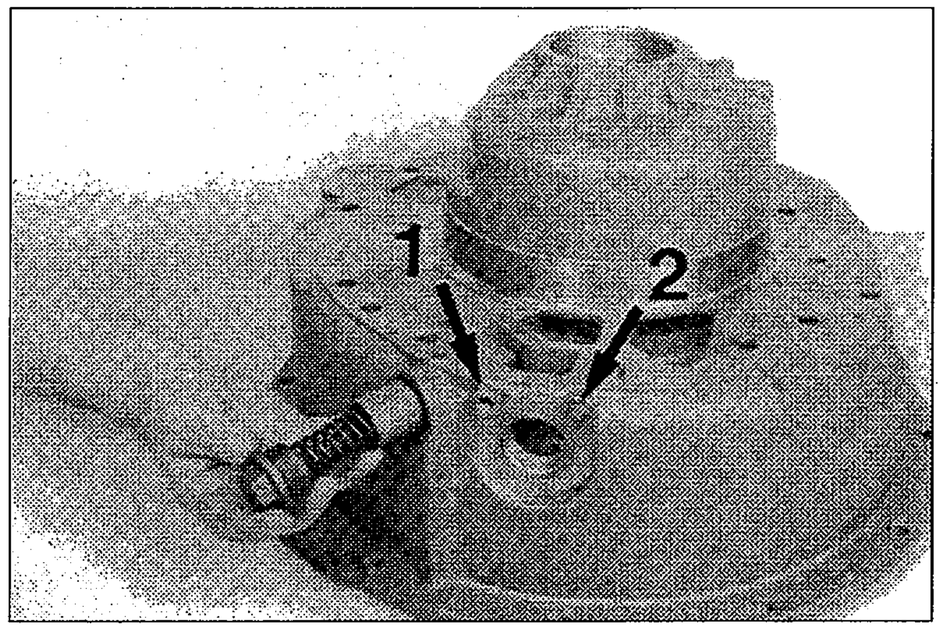
(15) Insert roll pin until contact is obtained.



(16) Install converter pressure valve.

Install temperature sensor(Arrow 1) and screw plug(Arrow 2).

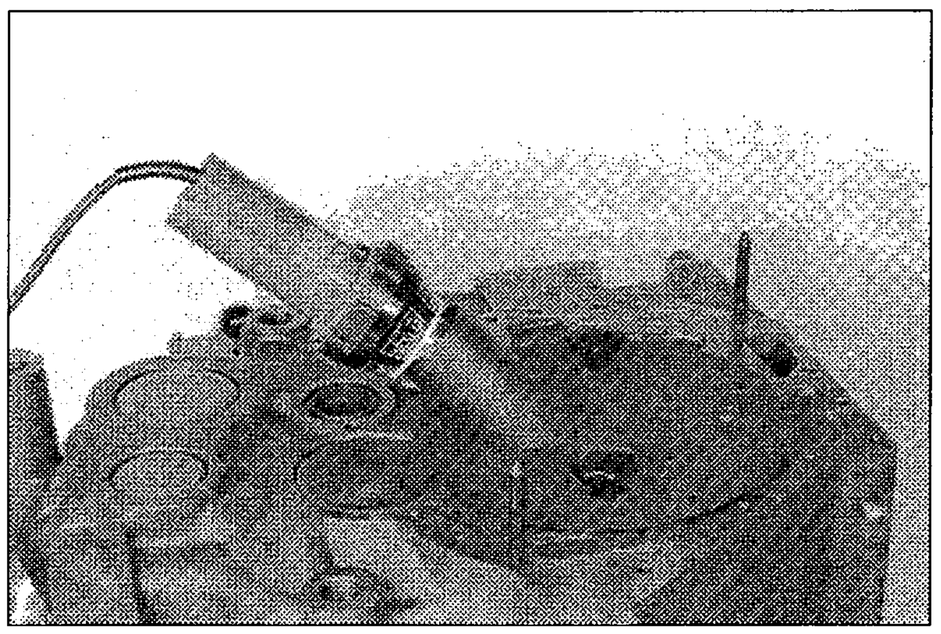
※ Install new O-rings each time.



(17) Heat housing bore(About 120℃).

※ Special tool

Preheating sleeve	5870 801 003
Hot air blower(220V)	5870 221 500
Hot air blower(110V)	5870 221 501

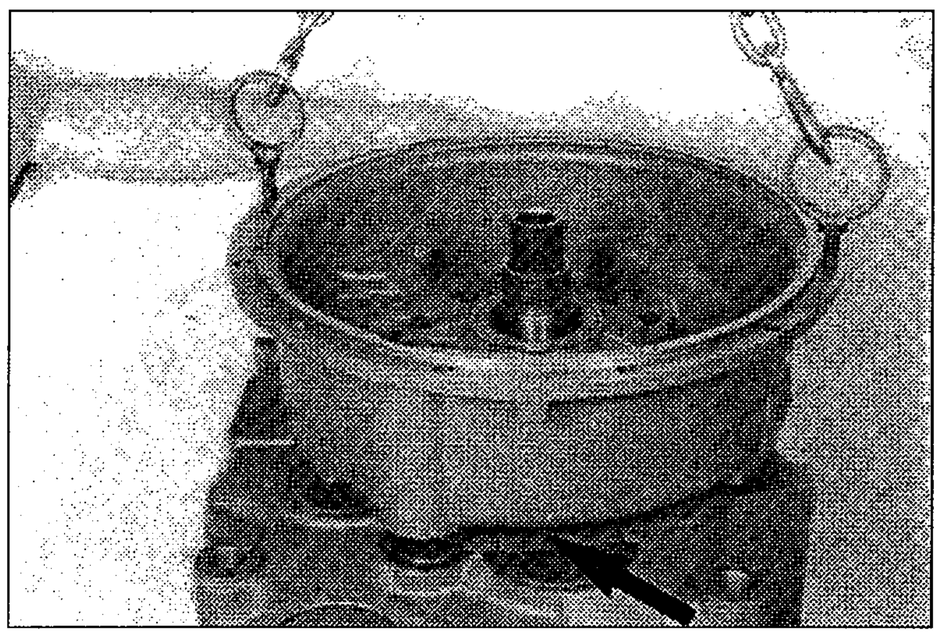


(18) Install two adjusting screws and mount gasket(Arrow 1).
Introduce converter bell by means of lifting device until contact is obtained and fasten it by means of hexagon head screws.

※ Pay attention to the radial installation position.
Slight rotary motions of the drive shaft will facilitate the insertion.

- Torque limit(M8/10.9) : 3.5kgf · m(34Nm)
- Torque limit(M12/10.9) : 11.7kgf · m (115Nm)

※ Special tool
Adjusting screws(M12) 5870 204 021

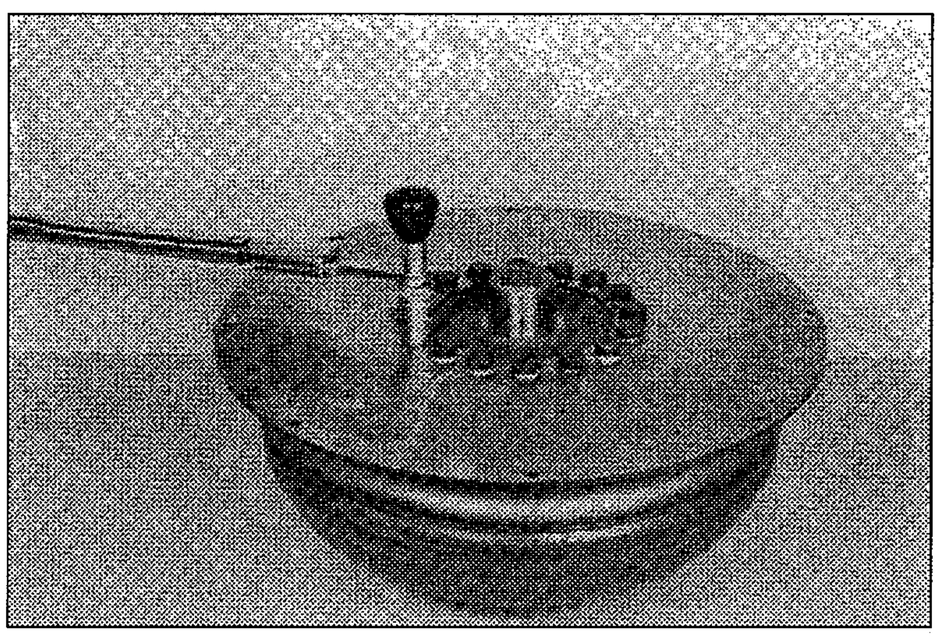


10) CONVERTER

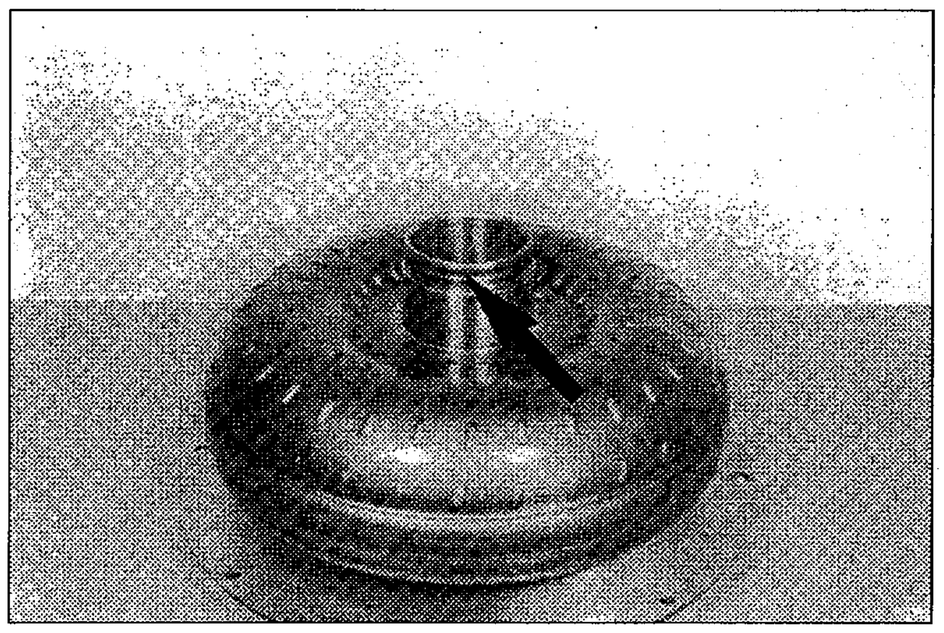
(1) Fasten diaphragms(3EA) on the converter, using hexagon head screws(Mount plain washers).

※ Insert hexagon head screws with loctite (Type No.243).

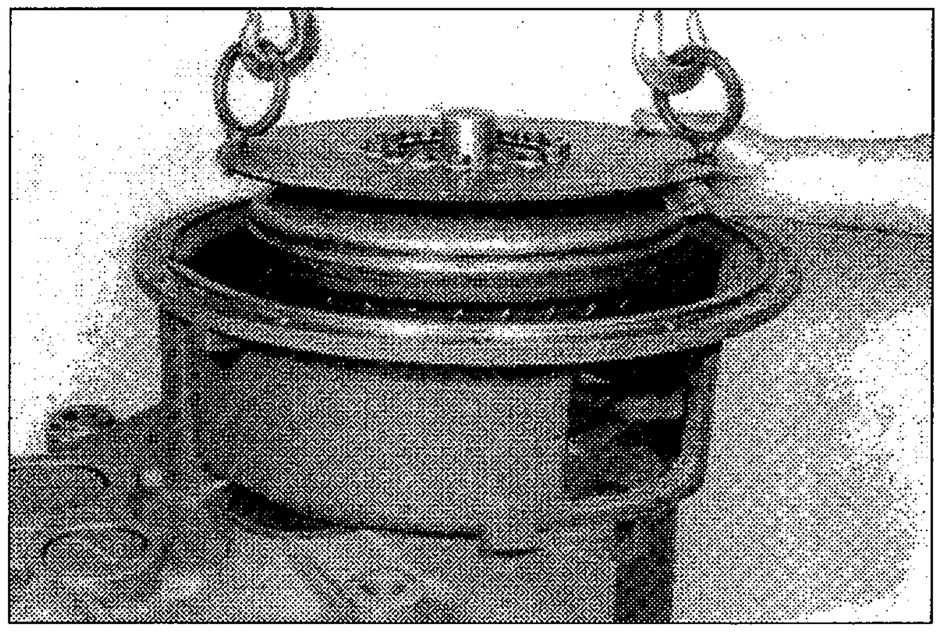
- Torque limit(M10/8.8) : 4.7kgf · m(46Nm)



(2) Squeeze in and engage rectangular ring (Arrow).
Now, grease rectangular ring and align it centrically.

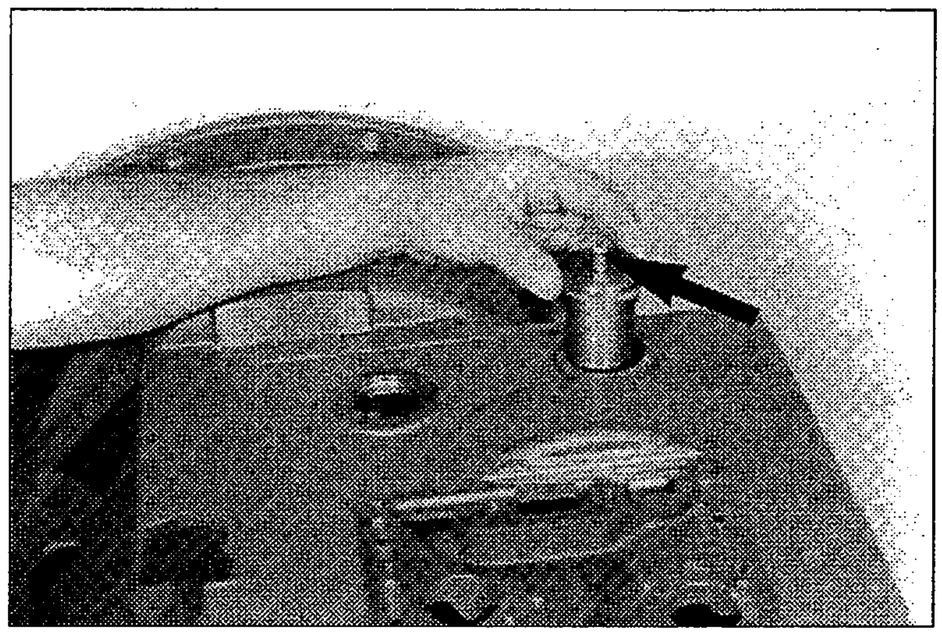


(3) Introduce converter by means of lifting device until contact is obtained.

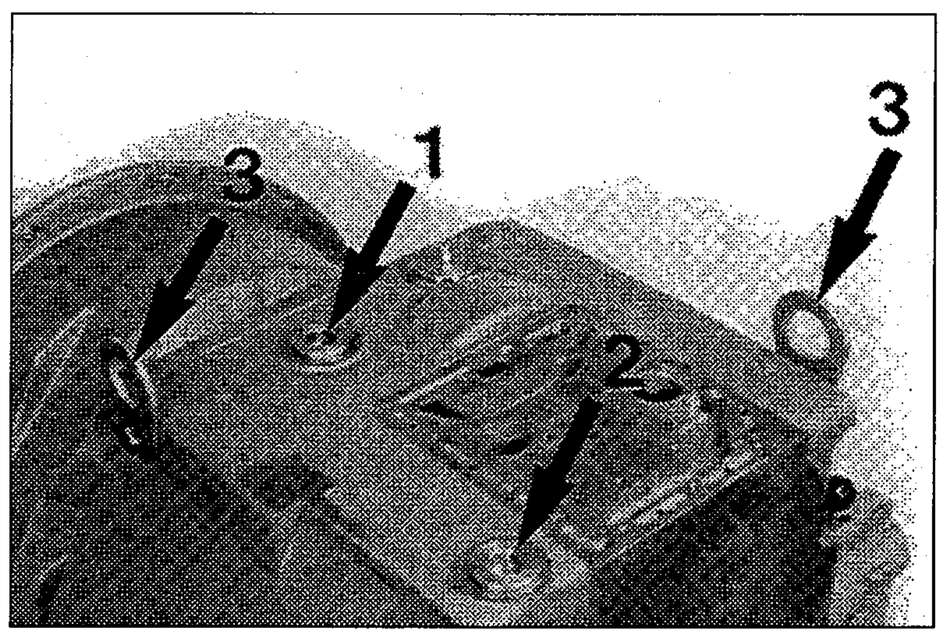


(4) Tilt transmission 90°.
Install breather(Arrow).
Insert pot flush mounted to the housing surface.

※ Wet sealing surface with loctite(Type No. 262).



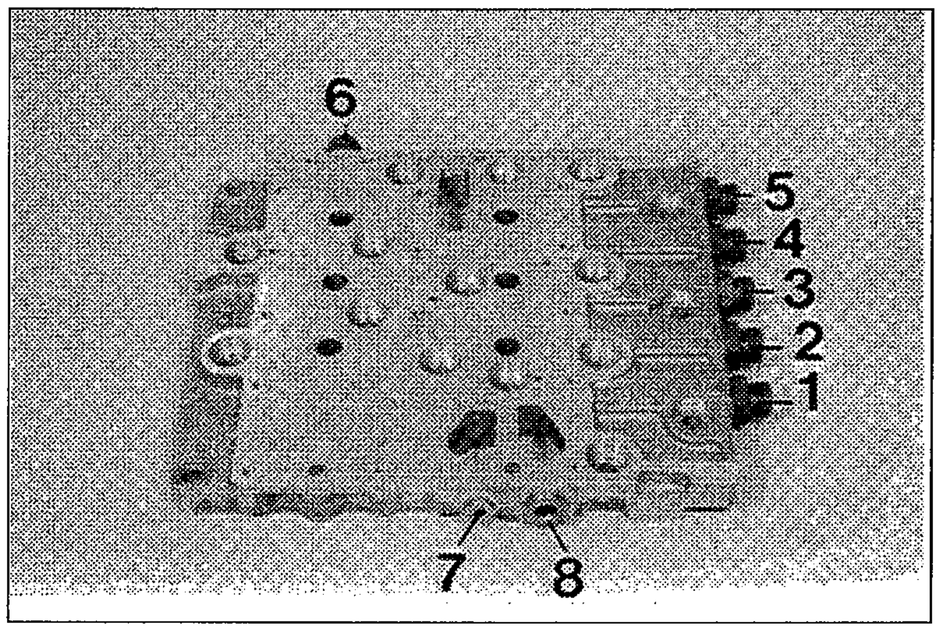
(5) Equip screw plugs(1 and 2) with new O-ring and install them.
Install both fixing plates(Arrow 3).
- Torque limit(Screw plug M42×2)
  : 14.8kgf · m(145Nm)
- Torque limit(M16/8.8)
  : 19.9kgf · m(195Nm)



11) MOUNT HYDRAULIC CONTROL UNIT

(1) Preassemble and mount plate(Figure (1)~(5)).
Equip fitting(1~6) with new O-rings and install them.

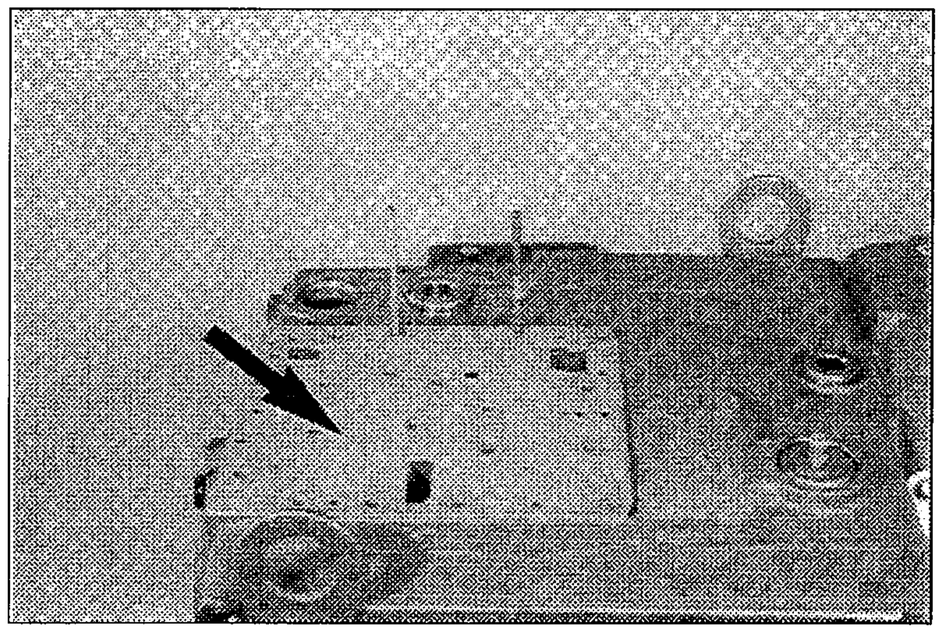
※ Install screw plugs(7 and 8).
Install new O-rings each time.



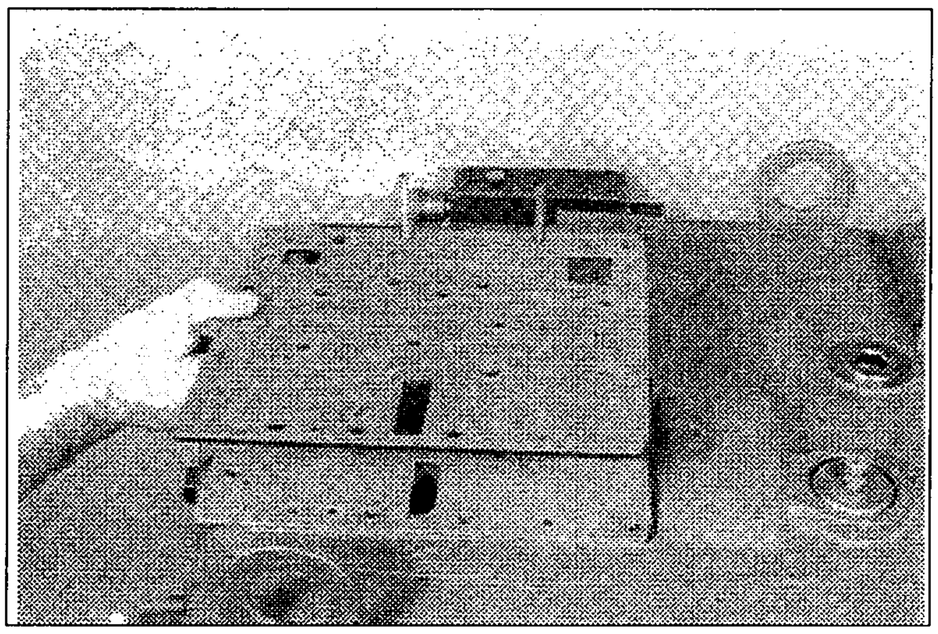
(2) Install two adjusting screws(M6) and mount housing gasket.

※ At the following steps(Figure(2)~(6), pay attention to the installation positions of the different gaskets.

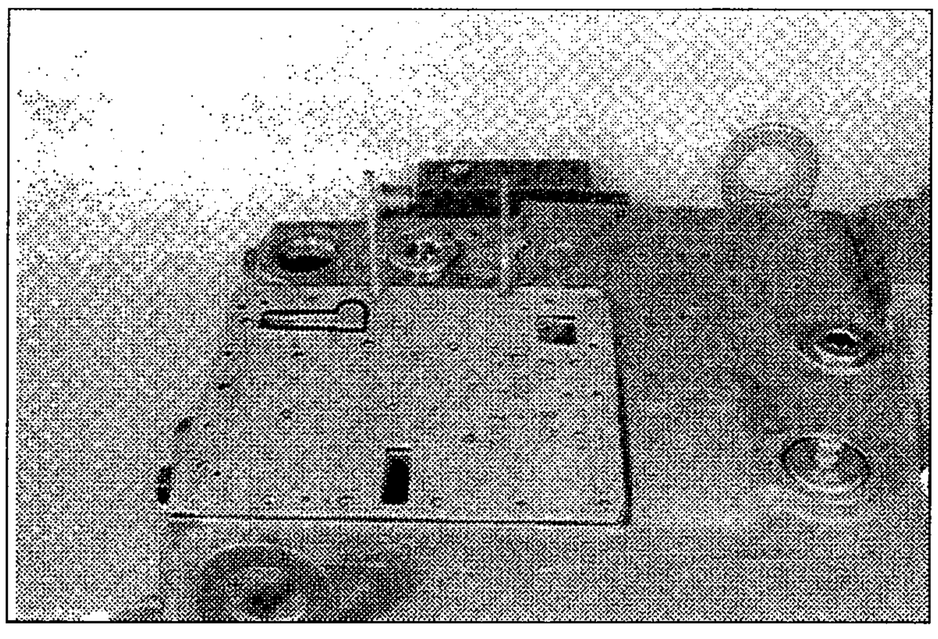
※ Special tool
Adjusting screws 5870 204 063



(3) Mount intermediate plate.

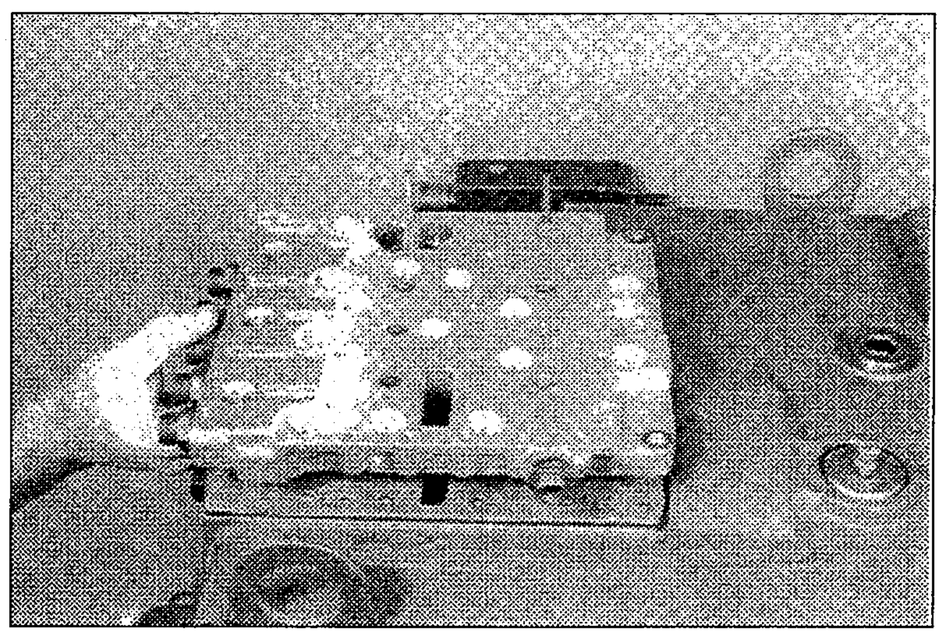


(4) Mount 2nd gasket.

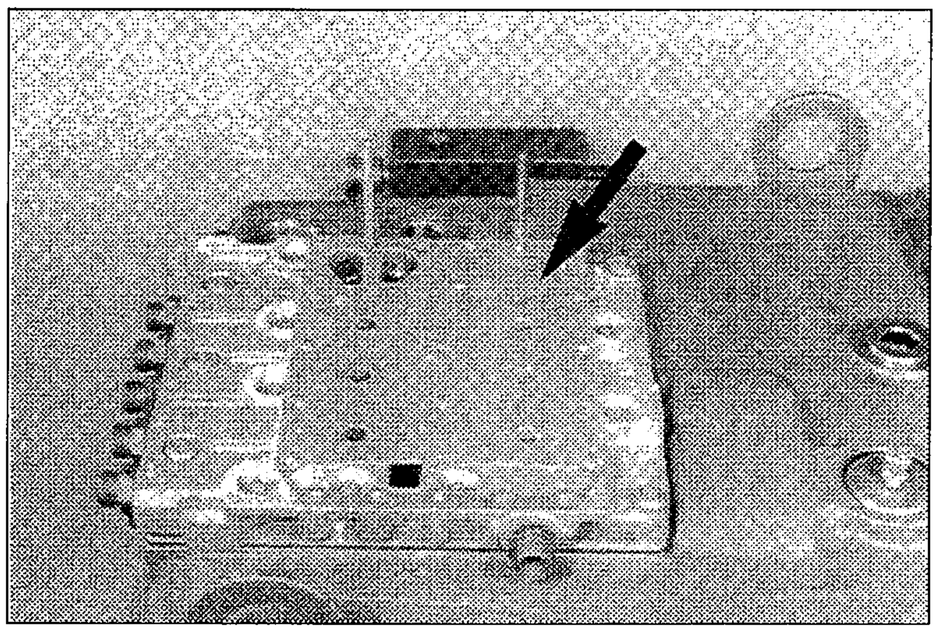


(5) Mount plate and fasten it uniformly by means of socket head screws.

· Torque limit : 2.3kgf · m(23Nm)



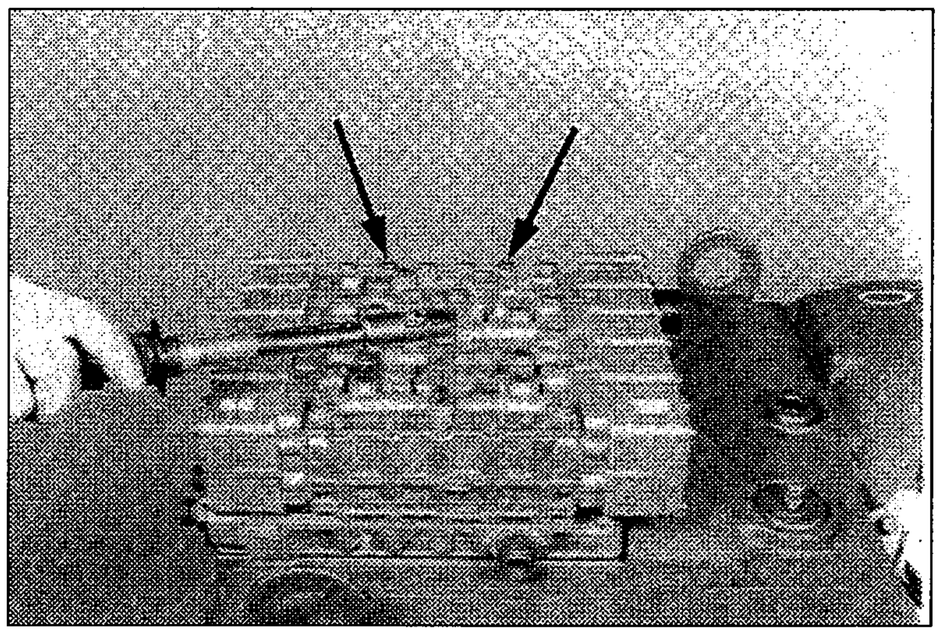
(6) Mount gasket.



(7) Assemble complete control unit and fasten it uniformly by means of socket head screw (2 × M6 × 105 and 21 × M6 × 80mm).

※ Pay attention to the position of the two socket head screws M6 × 105, see arrows.

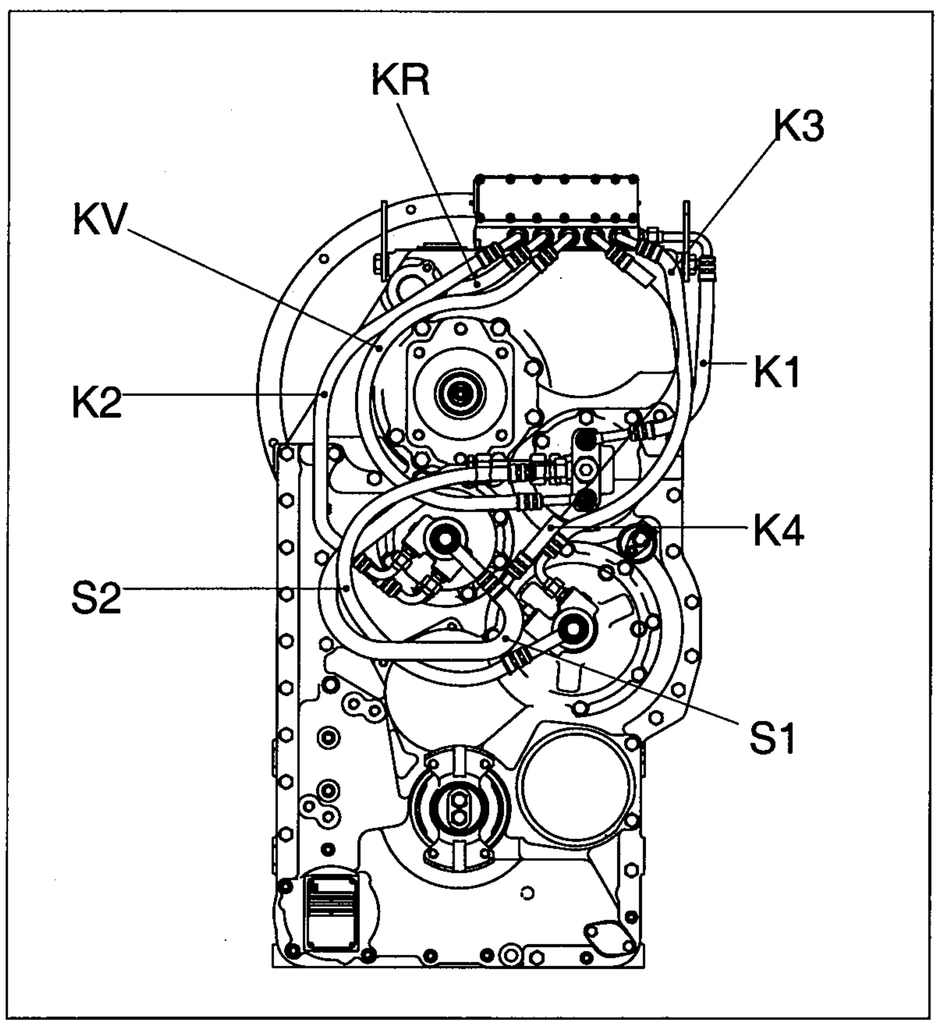
· Torque limit : 0.97kgf · m(9.5Nm)



(8) Install pressure lines according to the following draft.

Ref. draft

KV = Hydraulic line	Clutch KV
KR = Hydraulic line	Clutch KR
K1 = Hydraulic line	Clutch K1
K2 = Hydraulic line	Clutch K2
K3 = Hydraulic line	Clutch K3
K4 = Hydraulic line	Clutch K4
S1 = Lubricating oil line	Clutch KR/K2
S2 = Lubricating oil line	Clutch K4/K3



12) INDUCTIVE TRANSMITTER AND SPEED SENSOR

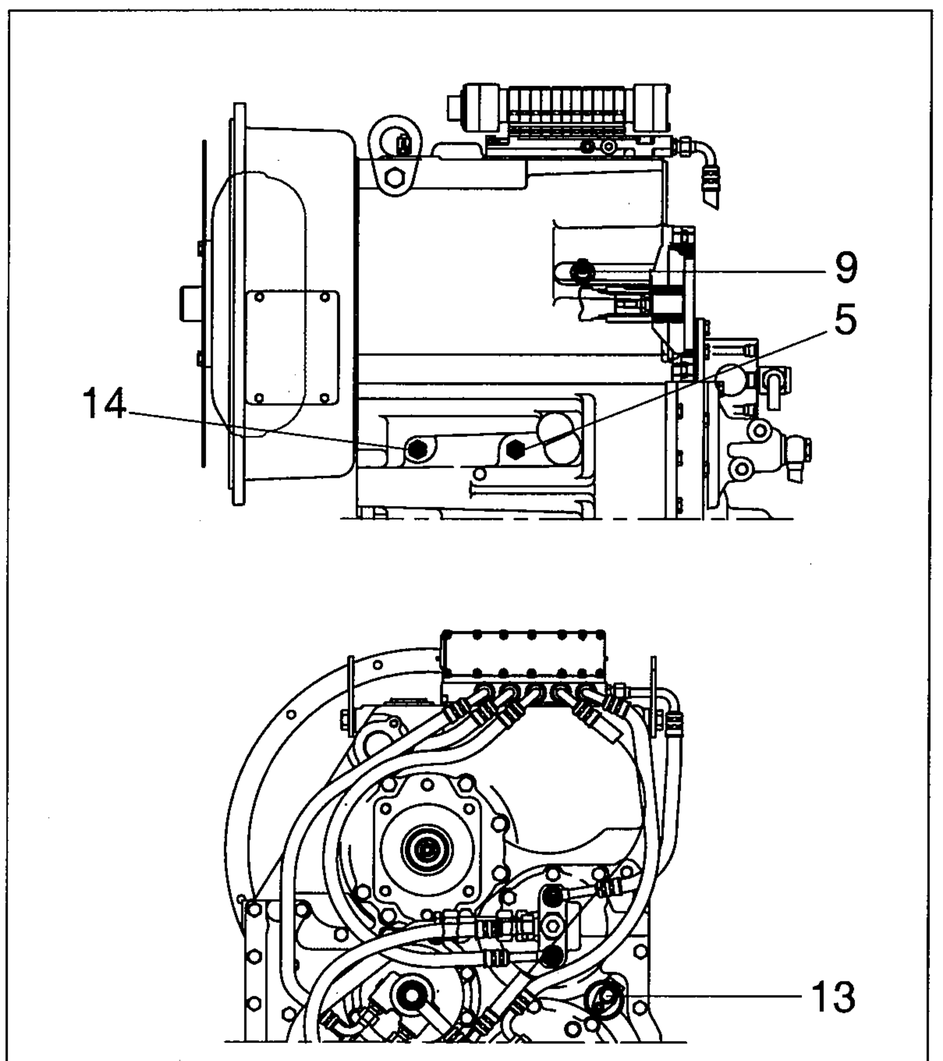
(1) The following drafts show the installation position of the single inductive transmitters and the speed sensor.

5 = Inductive transmitters
n Central gear train

9 = Inductive transmitters
n Engine

14 = Inductive transmitters
n Turbine

13 = Speed sensor
n Output and speedometer



(2) Setting-Inductive transmitter

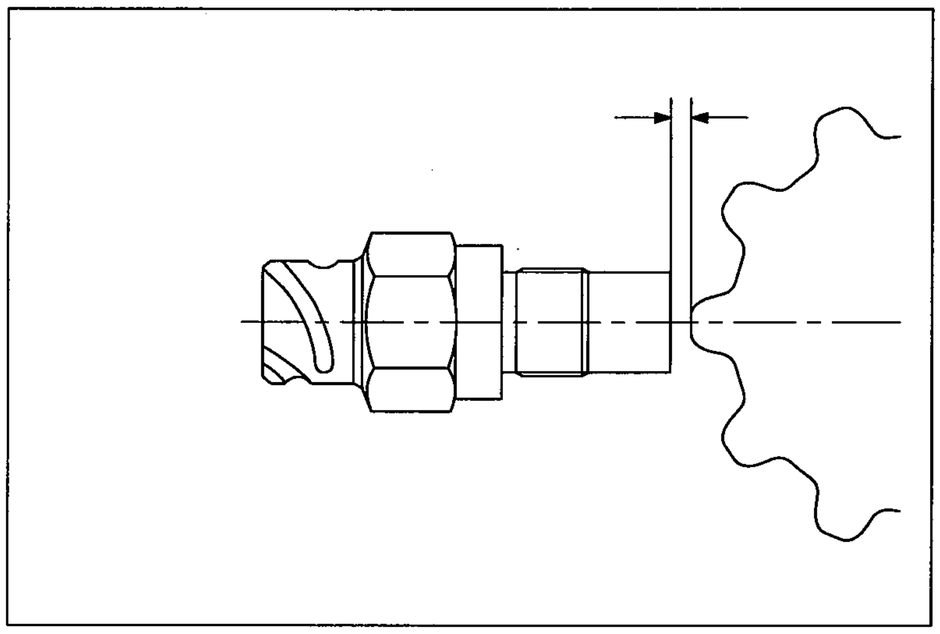
The following figures are describing the reassembly, respectively the setting of the inductive transmitter n Engine(9).

The reassembly of the inductive transmitters n Turbine(14) and n Central gear train(5) has to be carried out accordingly.

※ Pay attention to the different setting dimensions.

Setting dimension corresponds to the distance between contact face-Inductive transmitter and tooth tip, see figure.

Setting dimension - Inductive transmitter n Engine(9) and n Turbine(14) = $0.5^{+0.3}$mm
Setting dimension - Inductive transmitter n Central gear train(5) = $0.3^{\pm 0.1}$mm

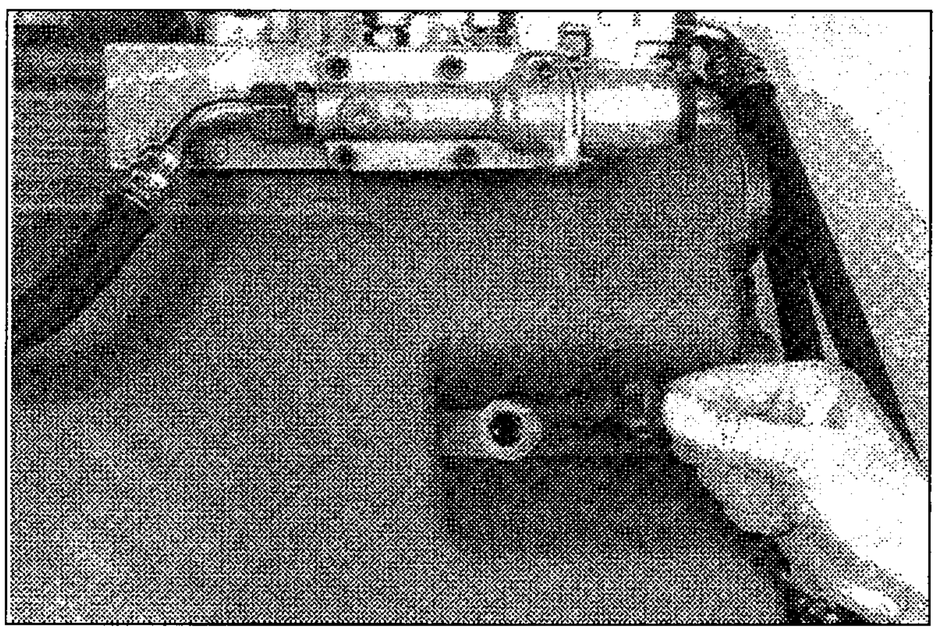


(3) Turn counting disk radially until one tooth tip is situated centrally to the inductive transmitter hole.

Insert measuring pin until the end face has got contact on the tooth tip, respectively the circlip on the screw in face of the housing.

※ Special tool

Measuring pin	5870 200 040

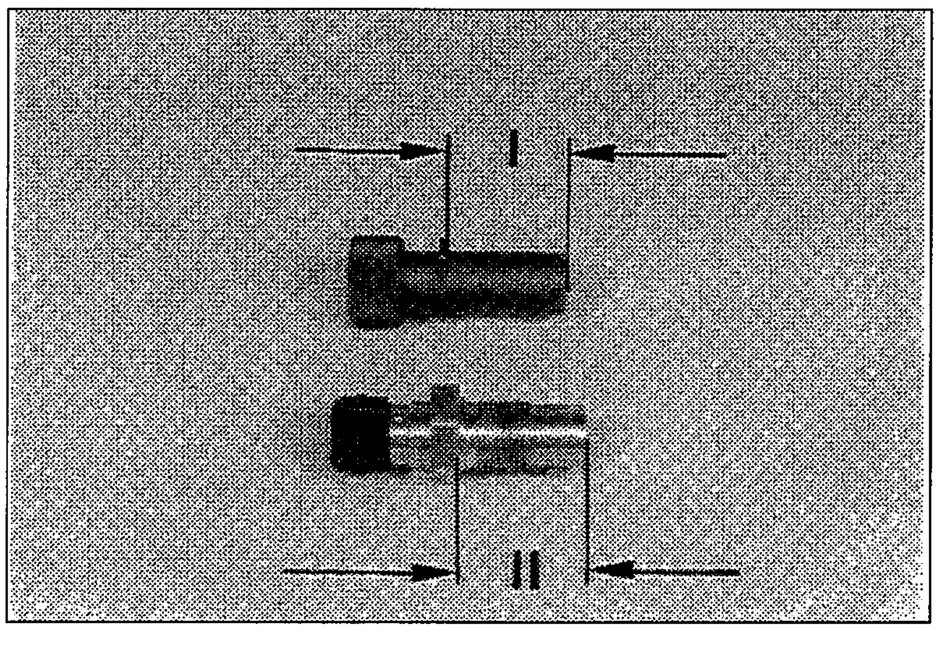


(4) Remove measuring pin and measure dimension Ⅰ from the end face/measuring pin to the circlip.

· Dimension Ⅰ e.g. 30.10mm

Measure dimension Ⅱ from the contact face - inductive transmitter to the contact face.

· Dimension Ⅱ e.g. 30.00mm



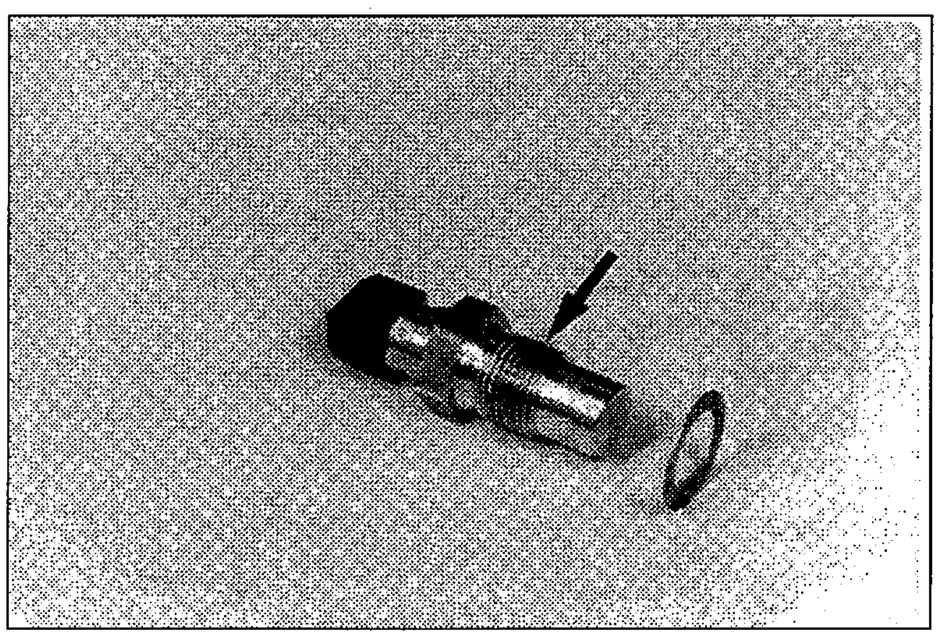
Example L_1

Dimension Ⅰ	30.10mm
Required gap($0.5^{+0.3}$mm)e.g.	- 0.60mm
Gives installation dimension	29.50mm

Example L_2

Dimension Ⅱ	30.00mm
Installation dimension	- 29.50mm
Difference = Shim	s = 0.50mm

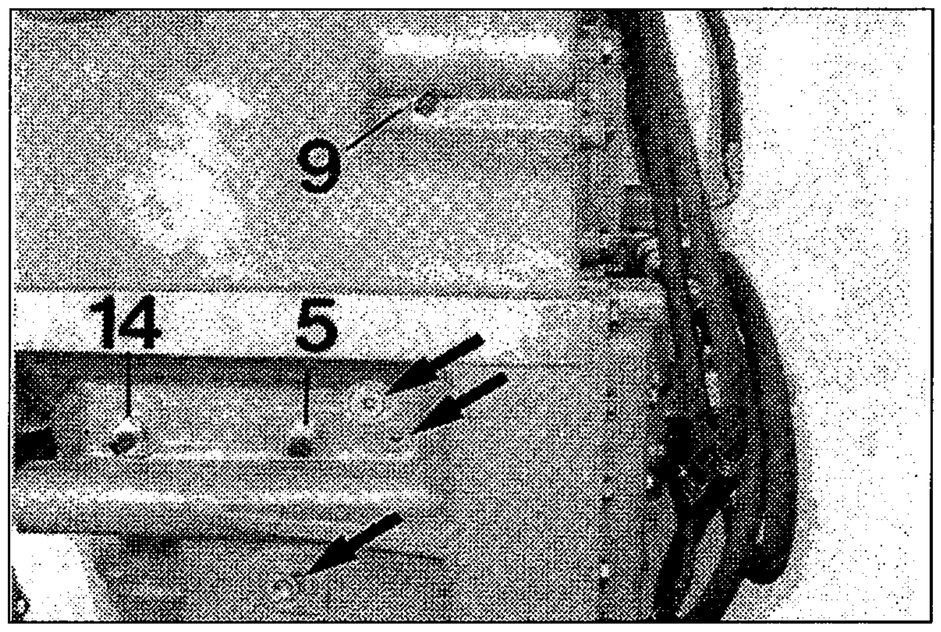
(5) Assemble corresponding shim and wet thread(Arrow) with loctite(Type No.574).



(6) Install inductive transmitter n Engine(9), n Turbine(14) and n Central gear train(5).
- Torque limit : 3.1kgf · m(30Nm)

Now, install screw plugs(Arrows).

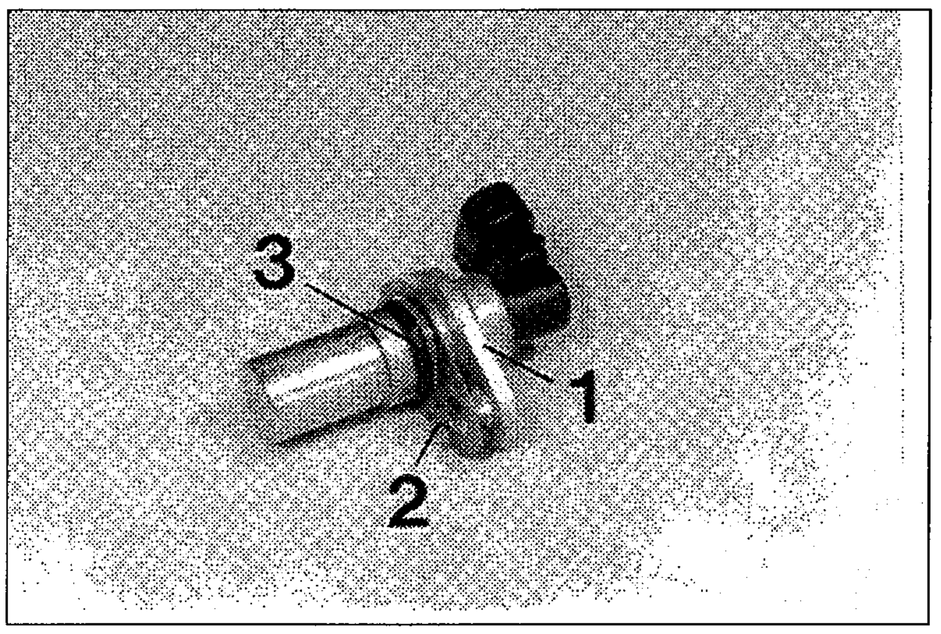
※ Equip screw plugs with new O-rings.
- Torque limit(M26 × 1.5) : 8.2kgf · m (80Nm)
- Torque limit(M18 × 1.5) : 5.1kgf · m (50Nm)



(7) Speed sensor(Hall sensor) n Output and speedometer

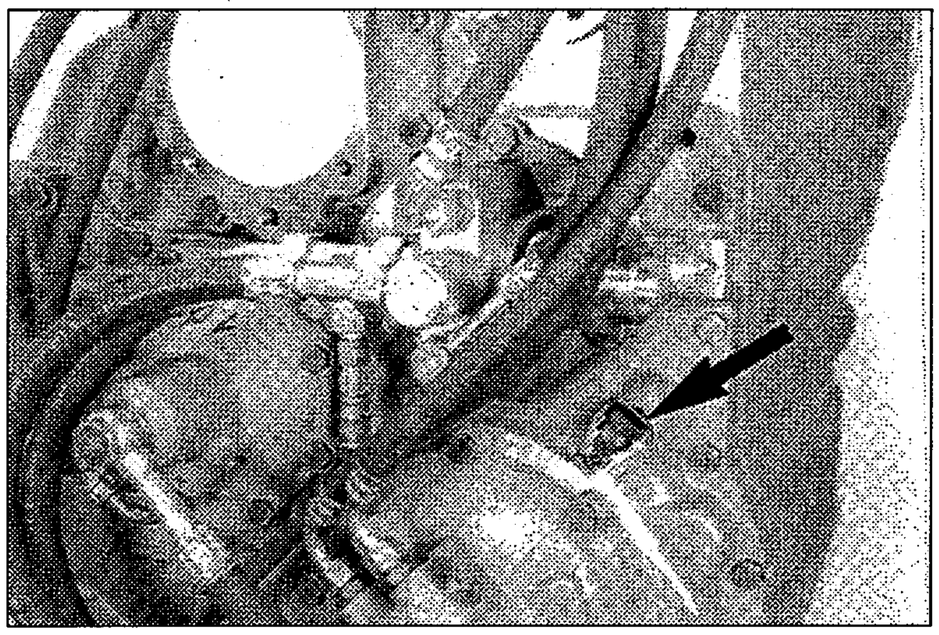
Illustration on the right shows the speed sensor 13.

1 Speed sensor
2 Plate
3 O-ring



(7) Grease O-ring and fasten speed sensor (Arrow) by means of socket head screw.
 · Torque limit(M8/8.8) : 2.3kgf · m(23Nm)

※ Prior to the commissioning of the transmission, carry out the oil filling according to the operating instructions.



3. AXLE

1) GENERAL INSTRUCTIONS

Before starting operations for disassembling, overhauling and reassembling the following points should be borne in mind.

(1) Cleaning components

△ **Never use gasoline, solvents or other inflammable fluids to clean components. Use approved commercial solvents that are uninflammable and non-toxic.**

① Maximum cleanness is recommended when working on an assembly, consequently, all components should be thoroughly cleaned before reassembly.

② Ambient where operations are carried out should be dust free and as clean as possible.

③ Make sure that tools and equipment are at hand, particularly those listed and shown in this manual. Components that have been misplaced may be cause of failures on assembly operations as well as chips or foreign matters.

④ When overhauling the assembly we suggest to replace the following parts with new ones:

- Seal rings
- Gaskets
- O-ring
- Threaded rings with notched collar
- Any component damaged during disassembly

⑤ In case of failure and breaking inside of assembly, all ducts and casings should be duly cleaned up so as to remove all material left to prevent further damage after assembling components.

⑥ In order to heat bearings use proper heating plates, pipings or suitable ovens.
Never heat parts by using a torch. Oil bath, heated by a torch, may be used to warm up components.

⑦ Lubricate all sections concerned when reassembling shafts, bearings, etc.

⑧ When mounting heat fitted components make sure of their proper position after they cooled off.

⑨ Lubricate O-ring seals before installing them in relevant seats to prevent kinking during assembly, such a position would impair proper sealing.

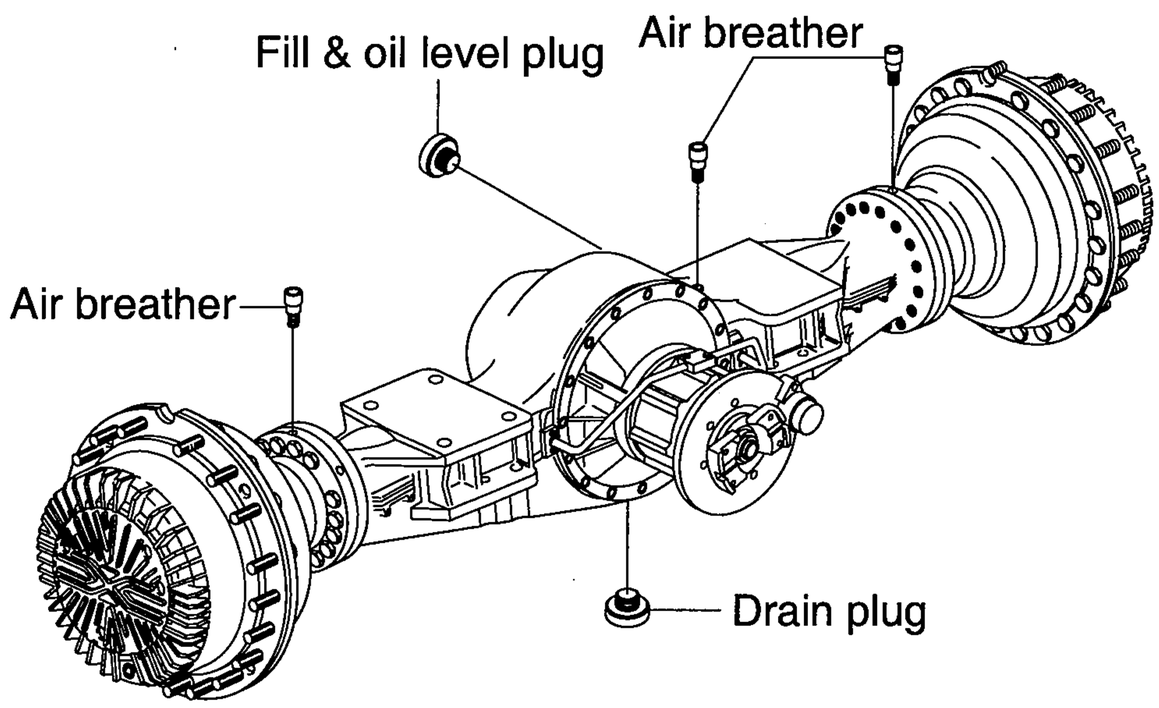
(2) Assembling leakproof components

Use of proper sealing compounds is recommended when assembling matched parts to be sealed against fluid leakages(Oil or water) and no sealing gasket is used.

Best results are reached, with said compounds, if matching surfaces are duly cleaned and degreased prior a uniform coat is spread all over the contact area.

We suggests the following sealing compounds:

- RHODORSIL CAF 1
- LOCTITE PLASTIC GASKET
- SILASTIC 732 RTV



※ Use only **genuine spare parts** to warrant proper operations and prevent interchangeability problems.

2) TIGHTENING TORQUES

(1) Front

No.	Item	Torque	
		kgf · m	lbf · ft
1	Screws fixing sleeves to axle case	94.8±4.6	664±33.2
2	Screws securing bevel ring gear to differential case	91.8±4.6	664±33.2
3	Screws fixing differential half-cases	22.4±1.1	162±8.1
4	Screws securing differential caps	66.3±3.3	480±24.0
5	Screws securing differential to axle case	33.7±1.7	244±12.2
6	Screw securing pinion support	-	-
7	Screws fixing side gear carrier to wheel hub	7.1±0.4	51.4±2.6
8	Screws fixing side cover	3.6±0.2	26±1.3
9	Standard backlash of bevel gear set	0.30 ~ 0.41mm	

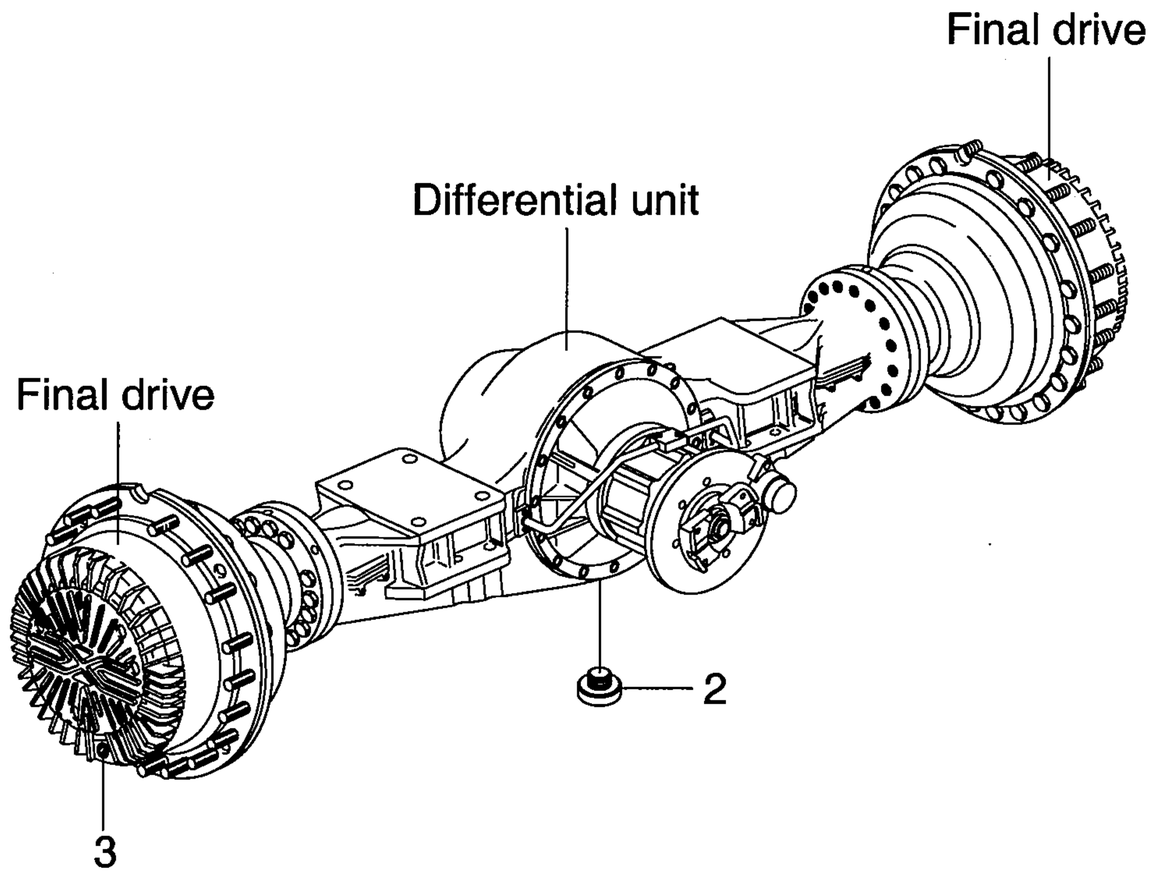
(2) Rear

No.	Item	Torque	
		kgf · m	lbf · ft
1	Screws fixing sleeves to axle case	91.8±4.6	664±33.2
2	Screws securing bevel ring gear to differential case	49.0±2.5	354±17.7
3	Screws fixing differential half-cases	12.2±0.6	88.2±4.4
4	Screws securing differential caps	66.3±3.3	480±24.0
5	Screws securing differential to axle case	33.7±1.7	244±12.2
6	Screw securing pinion support	-	-
7	Screws fixing side gear carrier to wheel hub	7.1±0.4	51.4±2.6
8	Screws fixing side cover	3.6±0.2	26±1.3
9	Standard backlash of bevel gear set	0.25 ~ 0.33mm	

3) DISASSEMBLING AND ASSEMBLING AXLE UNITS

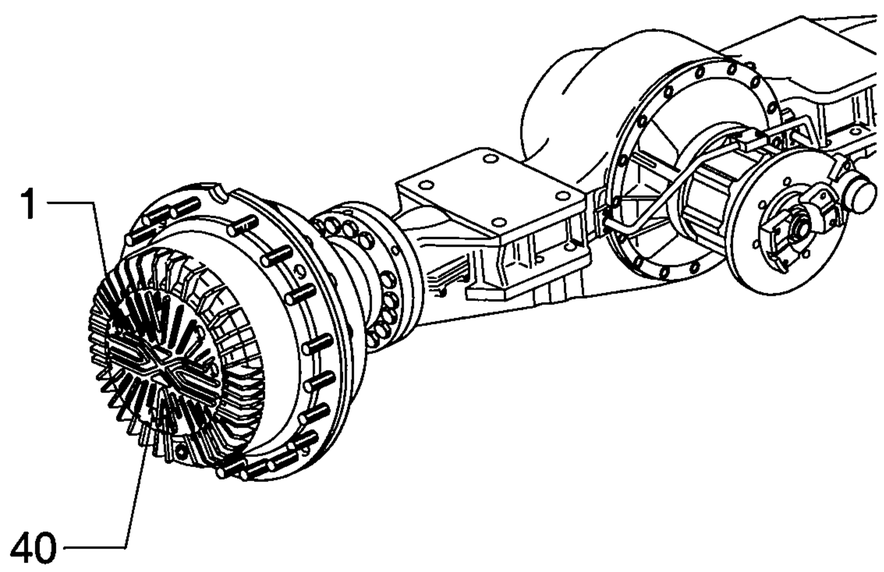
⚠ **Lift and handle all heavy components by using proper equipment.**
Make sure that assemblies or components be held up by proper slings close to the unit to be lifted.

Location of oil filling and draining plugs on axle casing and side final drives.



- Oil drain
  Drain oil from central section thru plug 2.
  Drain oil from side final drives thru plug 3.

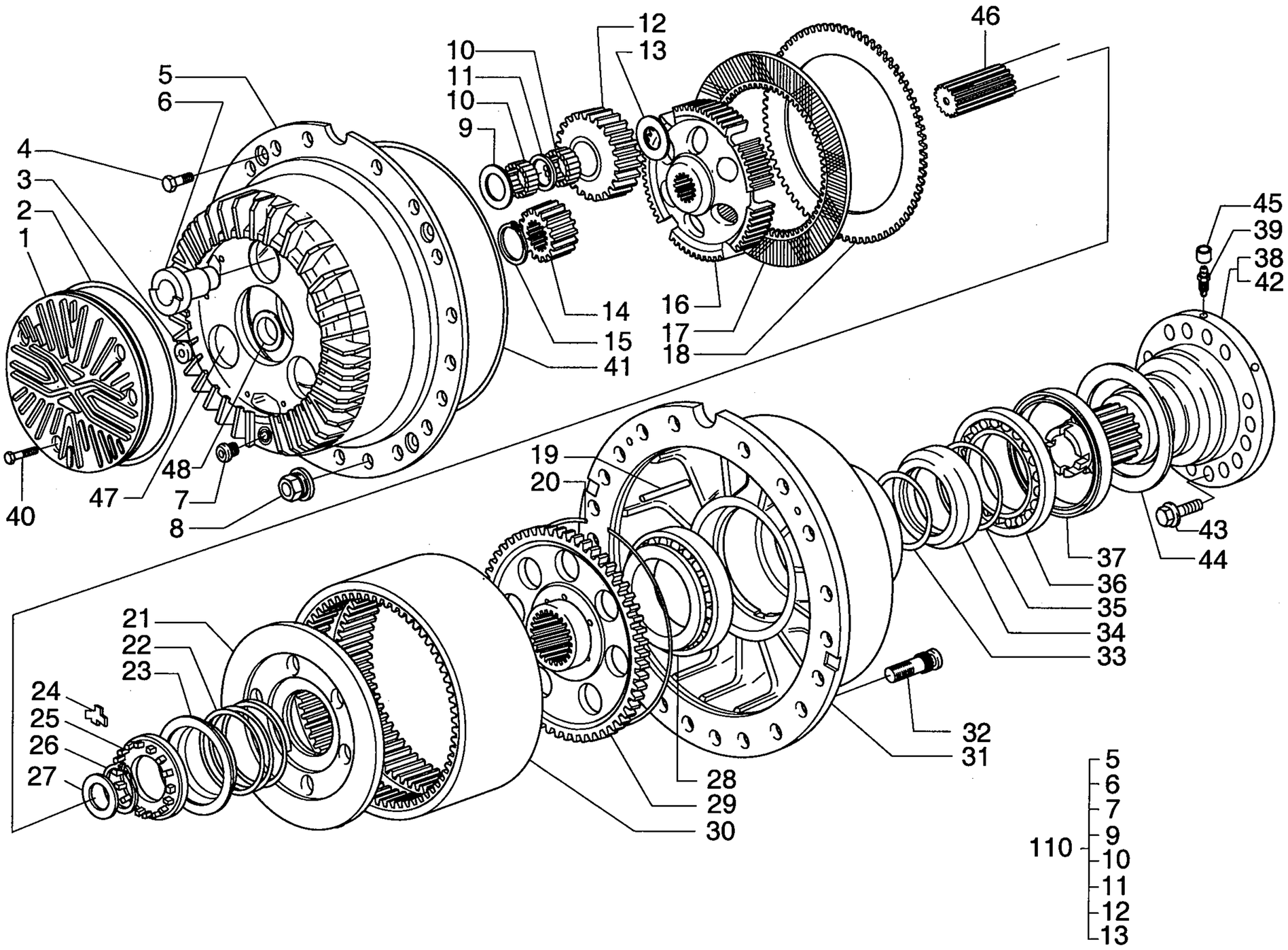
4) DISASSEMBLING SIDE FINAL DRIVES



(1) Remove final drive cover releasing the six screws(40).

※ Cover(1) is provided with three threaded holes for puller screws.

DISASSEMBLING SIDE FINAL DRIVES



(2) Remove O-ring seal(2).

(3) Pull out axle shaft backing plate(3) using puller screw.

(4) Undo screws(4) fixing side gear carrier(5) to wheel hub(31).

(5) Suitably support side gear carrier(5), pry it off to separate carrier from wheel hub(31).

(6) Pull out side gear carrier assy(5).

(7) Remove lockring(15) retaining sun gear(14) on wheel shaft(46).

(8) Pull out sun gear(14).

(9) Remove disk carrier hub(16) along with thrust washer(27) resting against wheel hub sleeve.

(10) Remove solid and lined disks(17,18) of brake.

(11) Remove wheel shaft(46).

(12) Pull out lockring(26), securing ring nut(25) and lock plates(24).

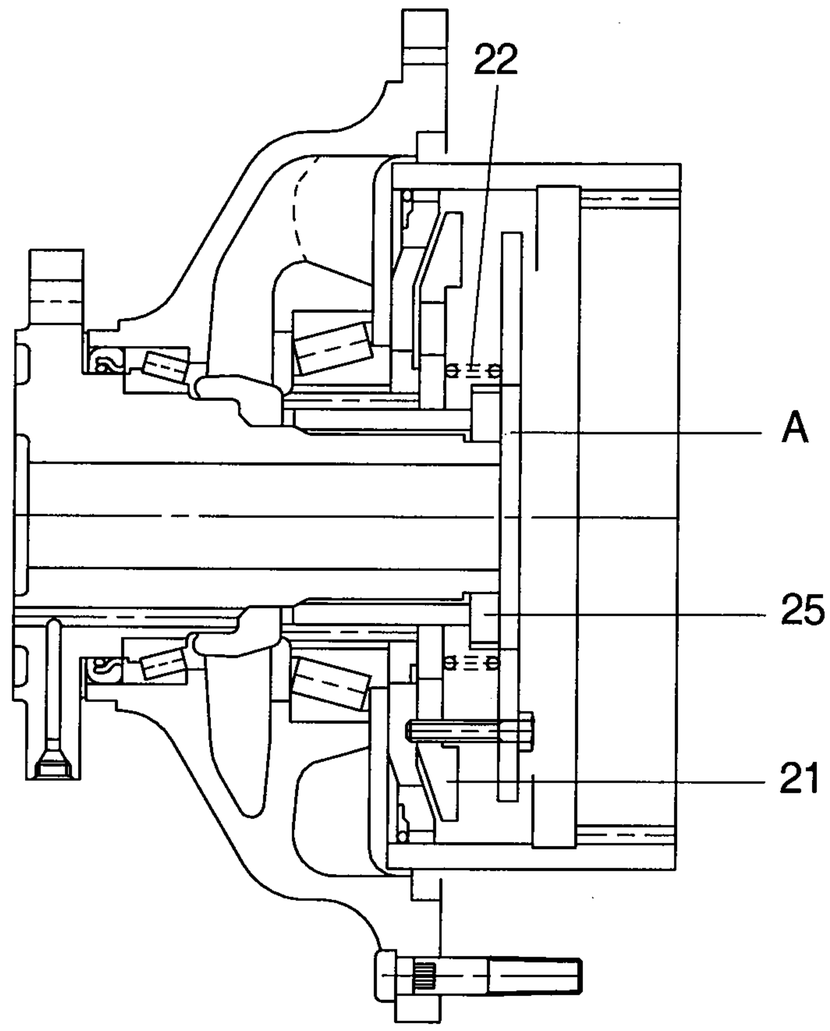
(13) Remove lock plates(24).

(14) Install the specific spring retainer.
Secured thru the three threaded holes of disk pressure plates(21) - to compress brake return spring(22) and allow ring nut (25) removal.

(15) Unlock and turn out ring nut(25) from sleeve(38).

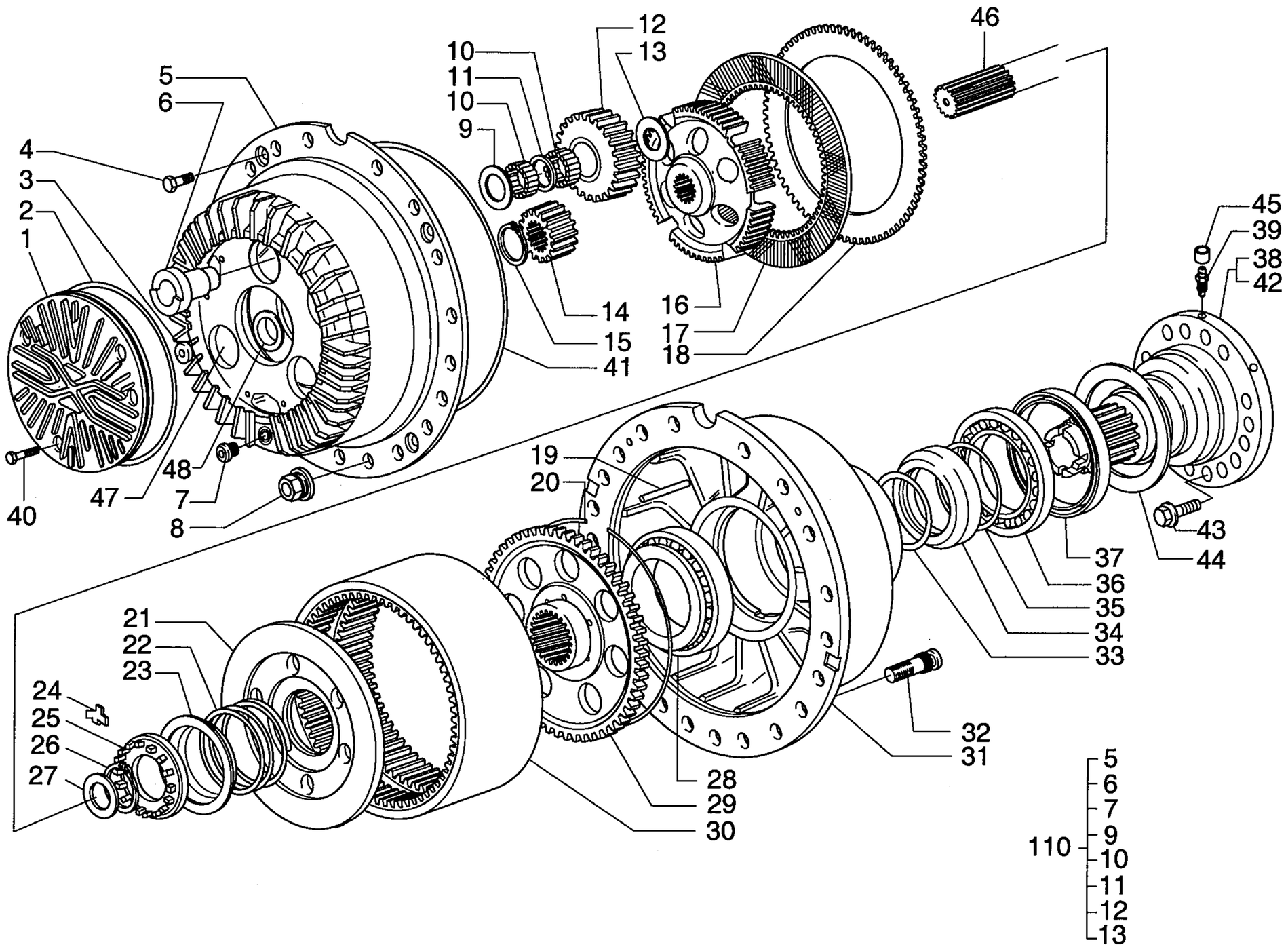
(16) Remove pressure plate(21) along brake return spring retainer.

Spring retainer installed



A	Spring retainer
21	Pressure plate
22	Return spring
25	Ring nut

DISASSEMBLING SIDE FINAL DRIVES



(17) Suitably support wheel hub(31) and pull out ring gear unit(30) and relevant support(29).

(18) Pick up the six rods(19) located in relevant seats on ring gear support(29).

(19) Pry off lockring(20) from ring gear(30) by using a screwdriver.

(20) Disassemble ring gear support(29) from ring gear(30).

(21) Should replacement of outer wheel bearing(28) inner race be mandatory, old part can be removed by a proper puller or by a remover that can be inserted in the specific holes of ring gear support (29).

(22) Remove retainer of brake unit spring, disassemble spring(22), retaining cup(23) and pressure plate(21).

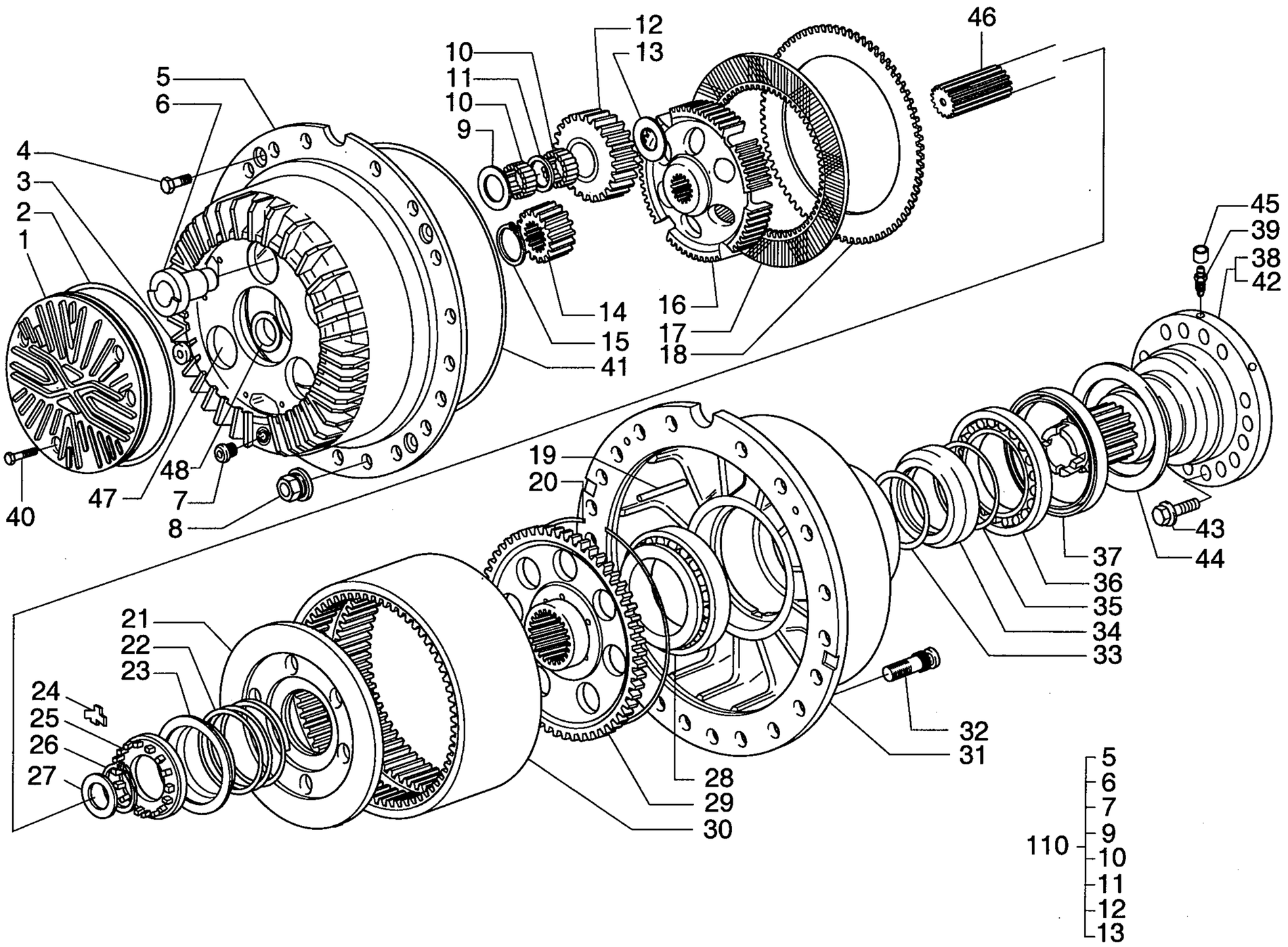
(23) Remove brake actuating piston(34) from wheel hub sleeve(38) by compressed air thru brake oil ducting.

(24) Remove and replace the two O-ring seals(33 and 35) in relevant seats on brake actuating piston.

(25) Pull out the complete wheel hub(31).

(26) Remove O-ring seal(41).

DISASSEMBLING SIDE FINAL DRIVES



(27) Pry off from wheel hub(31), seal(37) and remove inner race with roller cage of inner wheel bearing (36).

(28) Push out, by a proper remover, outer races of outer and inner wheel bearings(28 and 37) from hub(31).

(29) Should sleeve(38) be damaged, it can be removed by undoing relevant fixing screws(43). At reassembly, smear proper sealing compound on axle case joining flange and tighten screws with a torque of : See tightening torque No.1

(30) Mark side gear pins(6), various components and seats(47) for identification of original position at reassembly.

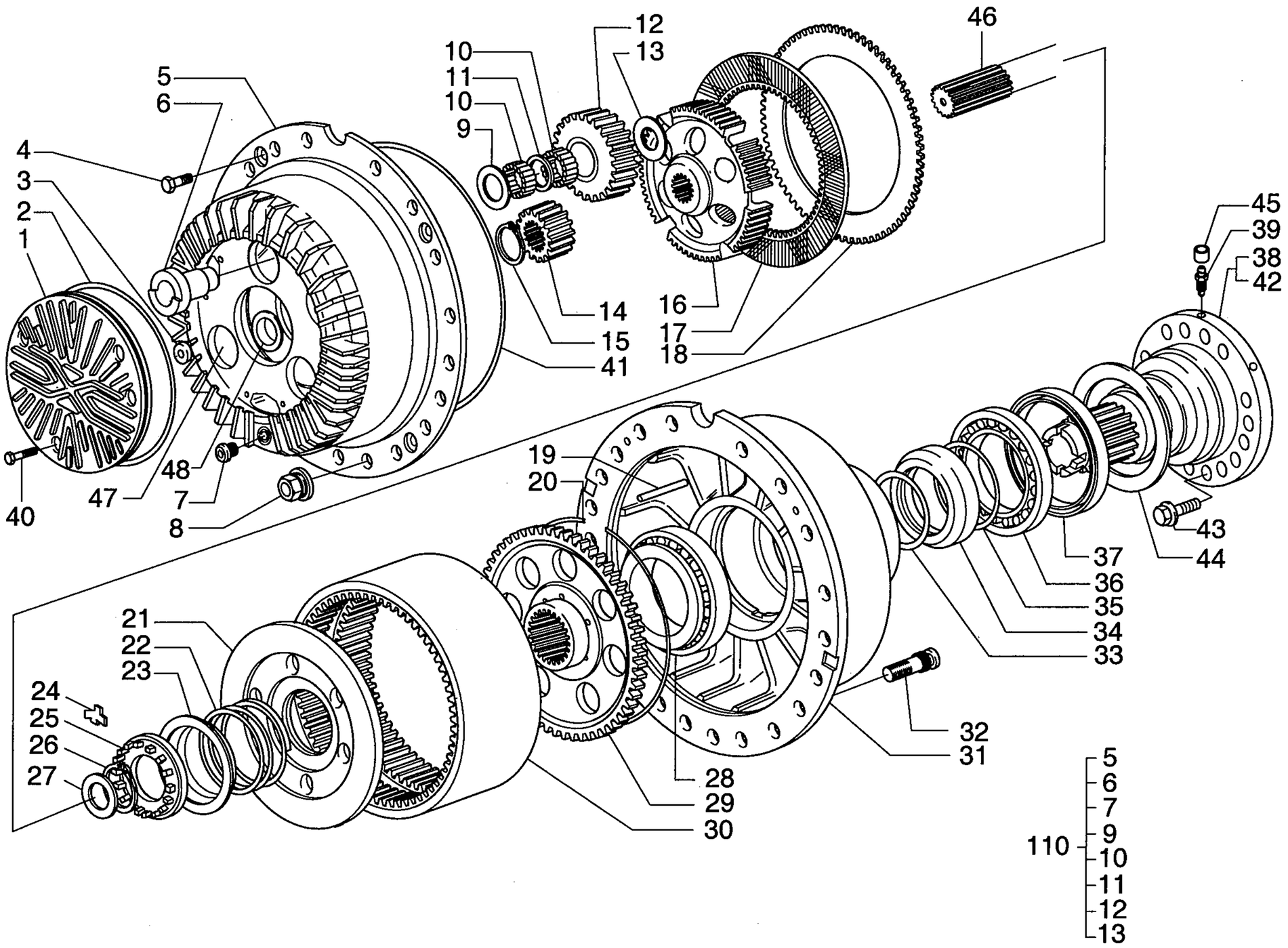
(31) Arrange side gear carrier(5) on wooden blocks and push out pins(6) with a proper remover.

(32) Pick up all needle rollers(10,11).

(33) It is important to keep matched needle rollers and thrust washers(9) with relevant pin(6), this is consequent to predetermined assembly tolerance limits.

(34) Remove side gears(12) and relevant thrust washers(13) no gear can be removed prior having released all of them.

5) ASSEMBLING SIDE FINAL DRIVE



(1) Reinstall wheel hub(31), first fit outer races of wheel inner and outer bearings(36 and 28), make sure they rest against relevant seats. Position inner race with roller cage of wheel inner side bearing(36) before fitting lip seal(37).

(2) Refit O-ring seal(41).

(3) Support suitably wheel hub(31) during the assembling stage to prevent seal damages, then, fit wheel inner bearing(36) in sleeve(38).

(4) Lubricate seals(33 and 35) on piston(34), insert it at travel end on wheel hub sleeve(38).

(5) Fit inner race of wheel outer bearing(28) on ring gear support(29), by heating equipment or proper installer ; then, mount support(29) in ring gear(30) and secure by lockring(20).

(6) Mount ring gear and support unit(30 and 29) on sleeve(38).

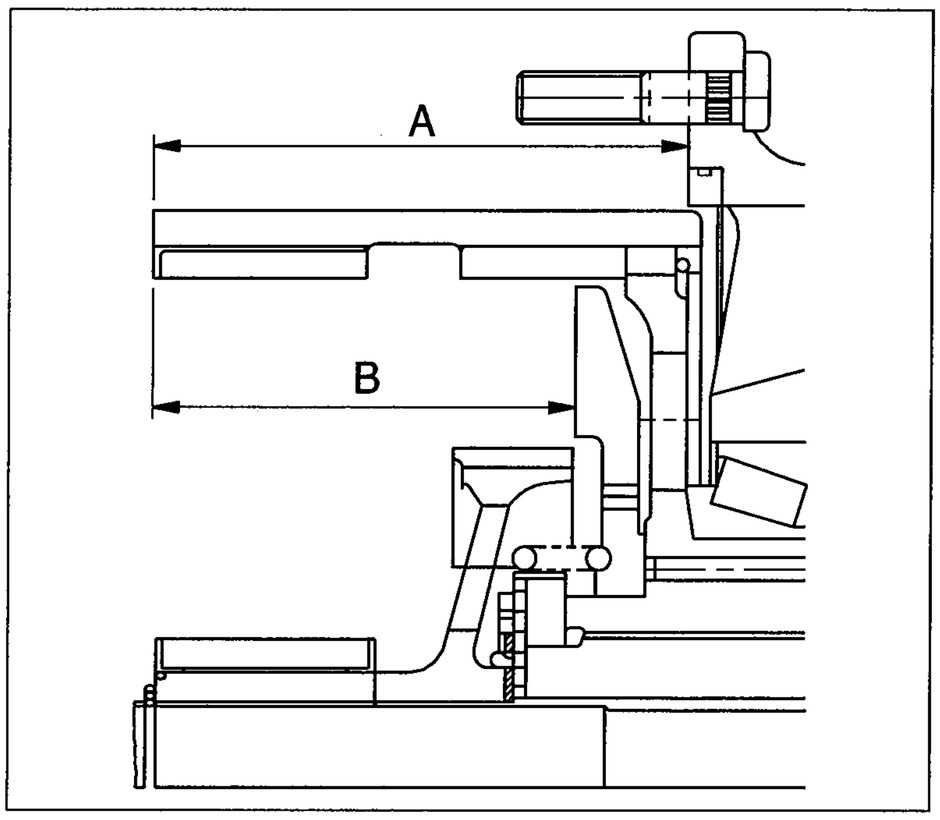
(7) Fit the six rods(19) in relevant seats on ring gear support(29).

(8) Install the spring retainer(Figure at page 3-140) and compress spring(22) with relevant retaining cup(23) on pressure plate(21).

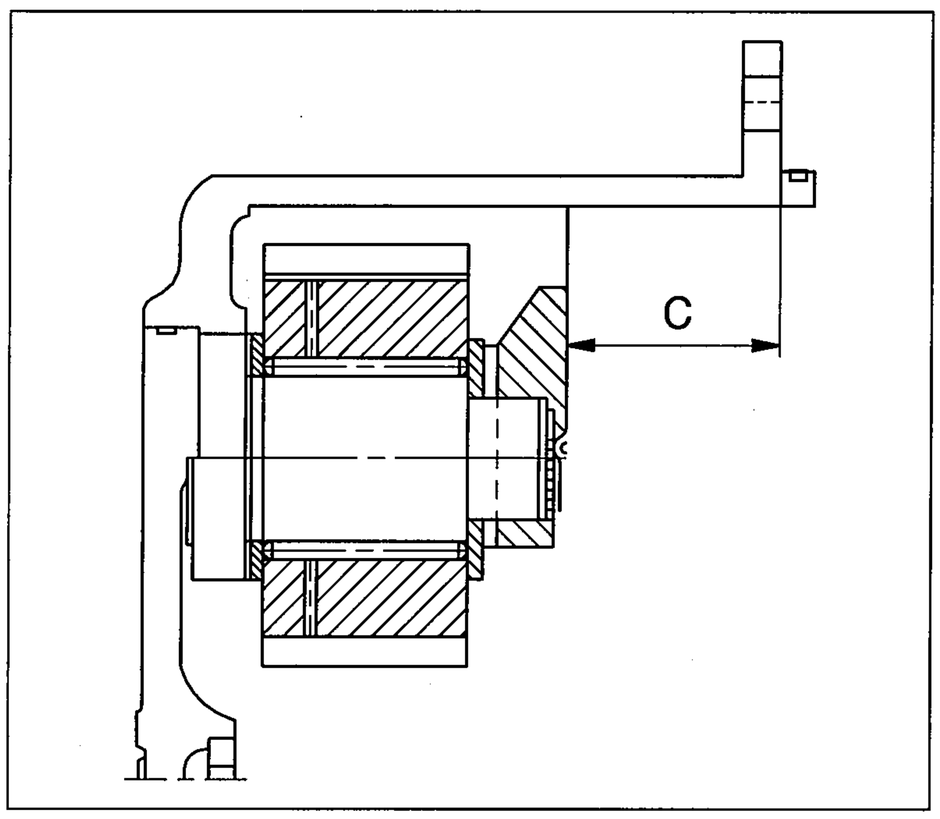
(9) Mount the pressure plate-spring assembly on ring gear support(29).

※ Determining the space available to form the brake disk pack

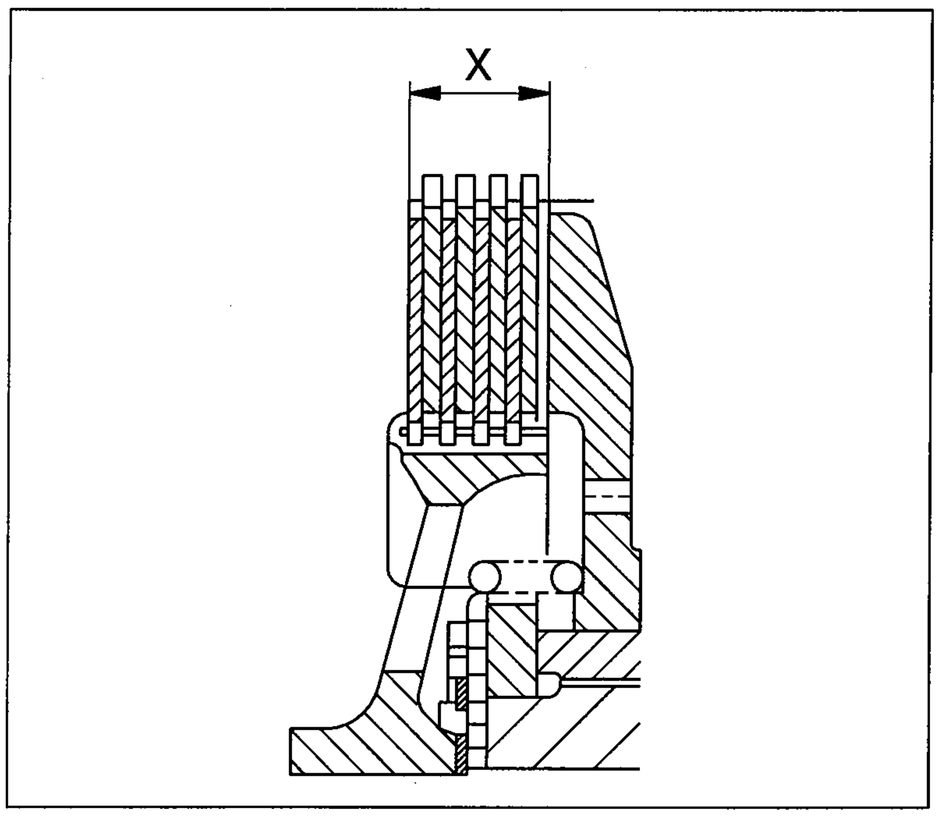
Record depth from seating surface of side gear carrier on wheel hub to outer edge of ring gear, identify said value as **A**.
Record depth from ring gear outer edge to brake pressure plate, identify said value as **B**. Subtract the value recorded from value **A** recorded on previous step, identify it a **D**.
i.e. : **A - B = D**



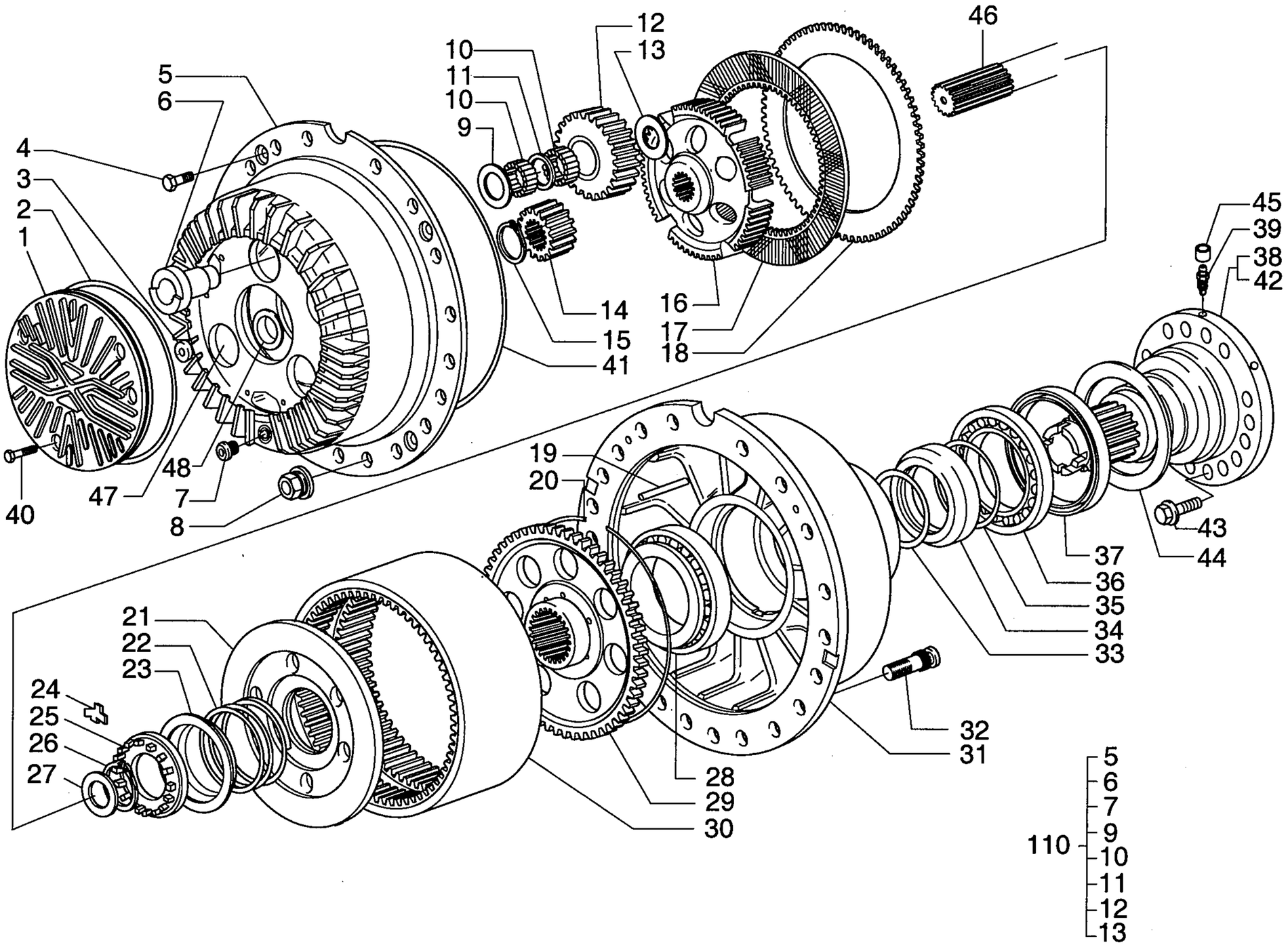
Record depth from disk reaction face to outer edge of side gear carrier.
Value recorded as **C** should be subtracted from value **D** previously recorded.
i.e. : **C + D = X**
This is the space available to form the brake disk pack.



Forming the disk pack
Computing thickness of disk pack(Solid + lined ones) it is necessary to subtract the clearance of 1mm for each brake disk plus the total thickness of the lined disks from the space available for the remaining clearance with solid disks(Outer teeth) of proper thickness with a tolerance of ± 0.25mm.



ASSEMBLING SIDE FINAL DRIVE



(10) Hand screw ring nut(25) on wheel hub sleeve(38).

(11) Tighten ring nut(25) by the proper wrench so as to reach the prescribed pre-load for wheel bearings and corresponding to a revolving torque of 1.5-3.1kgf · m(10.8-22.4lbf · ft) checking alignment for the lockplates(24).

※ To prevent wrong recording of torque values, it is advisable to seat bearing properly before checks by revolving repeatedly the wheel hub.

(12) Remove spring retainer compressing brake actuator return spring.
Insert lockplates(24), securing ring nut(25) and fit lockring(26).

(13) Side gear carrier(5).

※ Arrange the three side gears(12) in proper carrier seat.

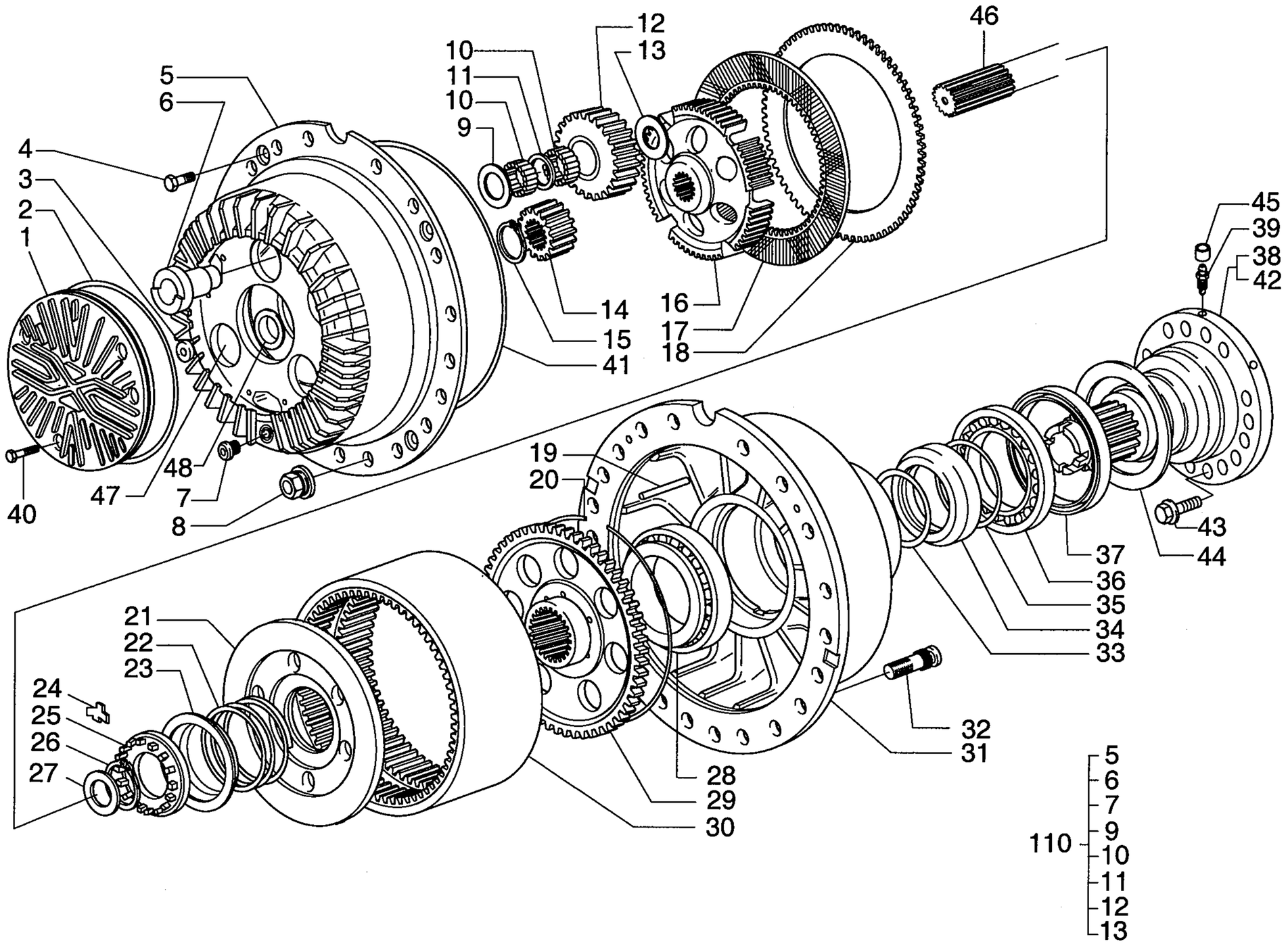
※ Two rows of needle rollers of the same selection class should be used for replacement in each single side gear pin.

(14) Insert outer thrust washers(13), smear with grease pin lower portion(Head end) and position the first row of needle rollers, fit spacer, smear with grease pin upper portion and position the second row of needle rollers(10,11).

(15) Position outer thrust washers(9) of side gear on side gear carrier and aline holes.

(16) Insert and force fit complete pins(6) and avoid any bump or knock that could cause roller fall.

ASSEMBLING SIDE FINAL DRIVE



(17) Insert wheel shaft(46).

(18) Insert thrust washer(48).

(19) Mount disk carrier hub(16) on wheel shaft(46).

(20) Mount alternately solid disks and lined disks.

※ Insert a solid disk(Outer teeth) facing the pressure plate(27).

(21) Insert sun gear(14) and secure with lockring(15).

(22) Mount the side gear carrier assembly (5) on side gear unit and secure on wheel hub(31) locking fixing screws(4) with a tightening torque of : See tightening torque No.7.

(23) Force fit wheel shaft backing plate(3).

(24) Mount O-ring seal(2) on edge.

(25) Rotate and aline pins (6) to allow mounting of cover(1) which act also as pin lock to prevent their rotation.

(26) Fit side final drive cover(1).

(27) Smear fixing screws(40) with sealing compound, then, lock with a tightening torque of : See tightening torque No.7.

6) DISASSEMBLING AND ASSEMBLING DIFFERENTIAL UNIT

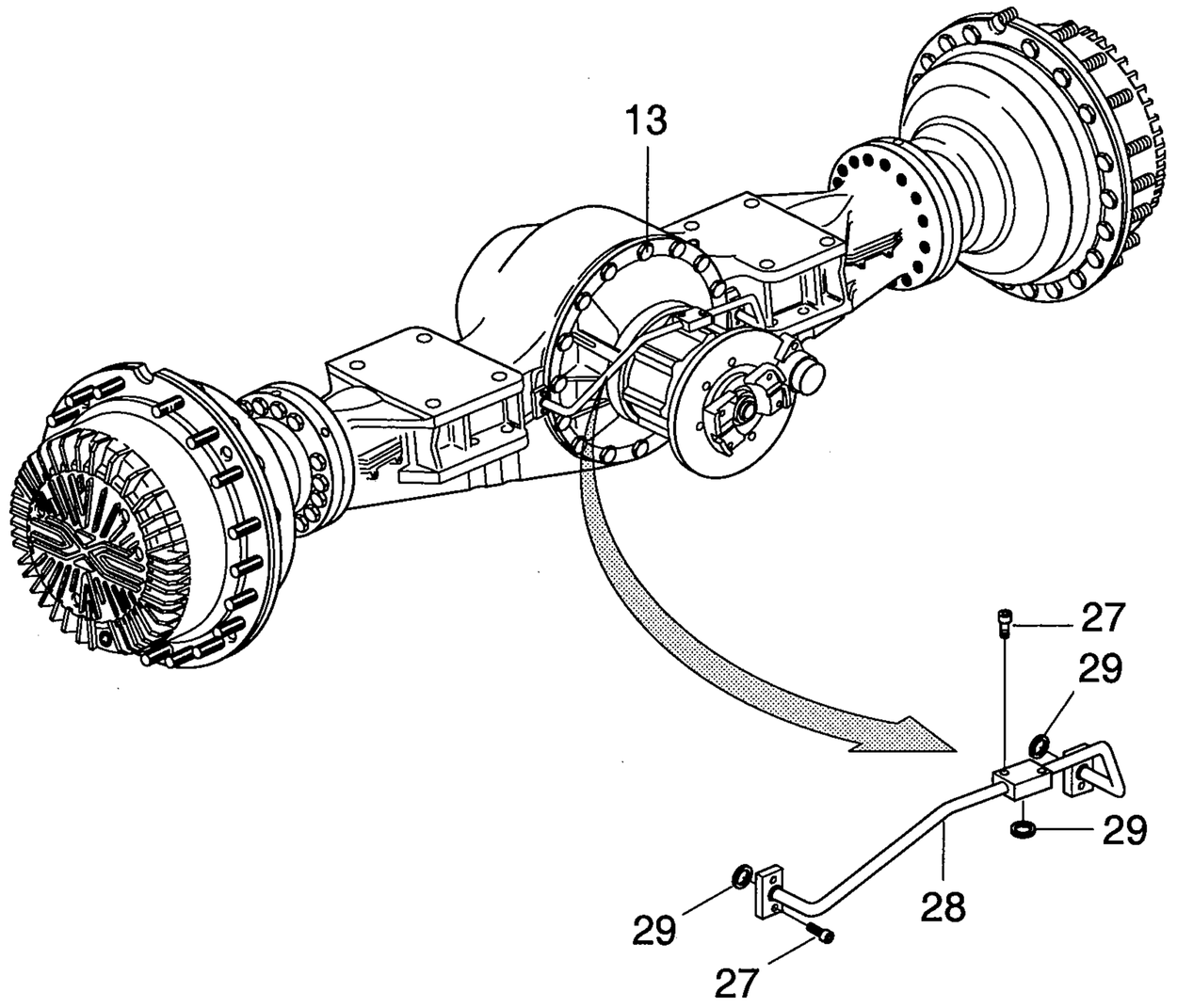
(1) Disassembly

① Front axle

Release and remove the sixes screws(27) secure the outer recirculation piping(28) and the three seals(29).

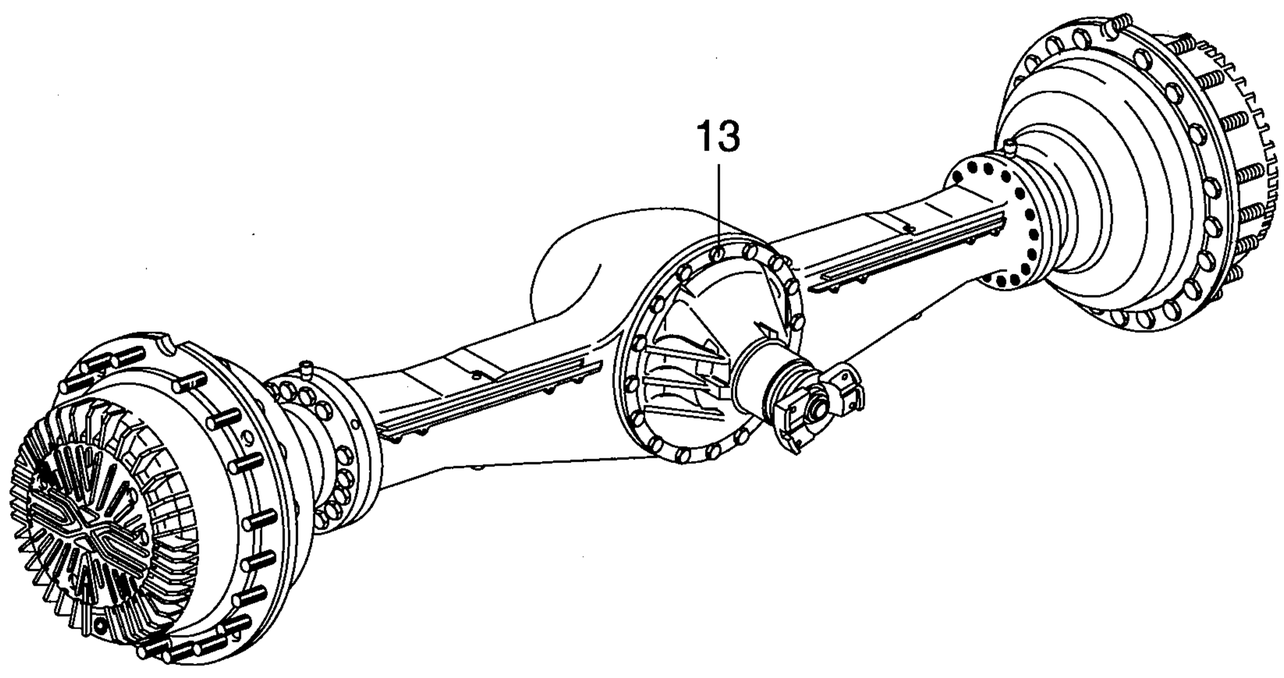
Check wear condition of components and replace as required.

Unlock and undo screws(13) retaining differential unit then, remove it from axle case.



② Rear axle

Unlock and undo screws(13) retaining differential unit then, remove it from axle case.



(2) Assembly

① Front axle

Clean thoroughly matching surfaces, apply sealing compound and mount differential unit on axle case, lock the screws(13) with a tightening torque of see : Tightening torque No.5.

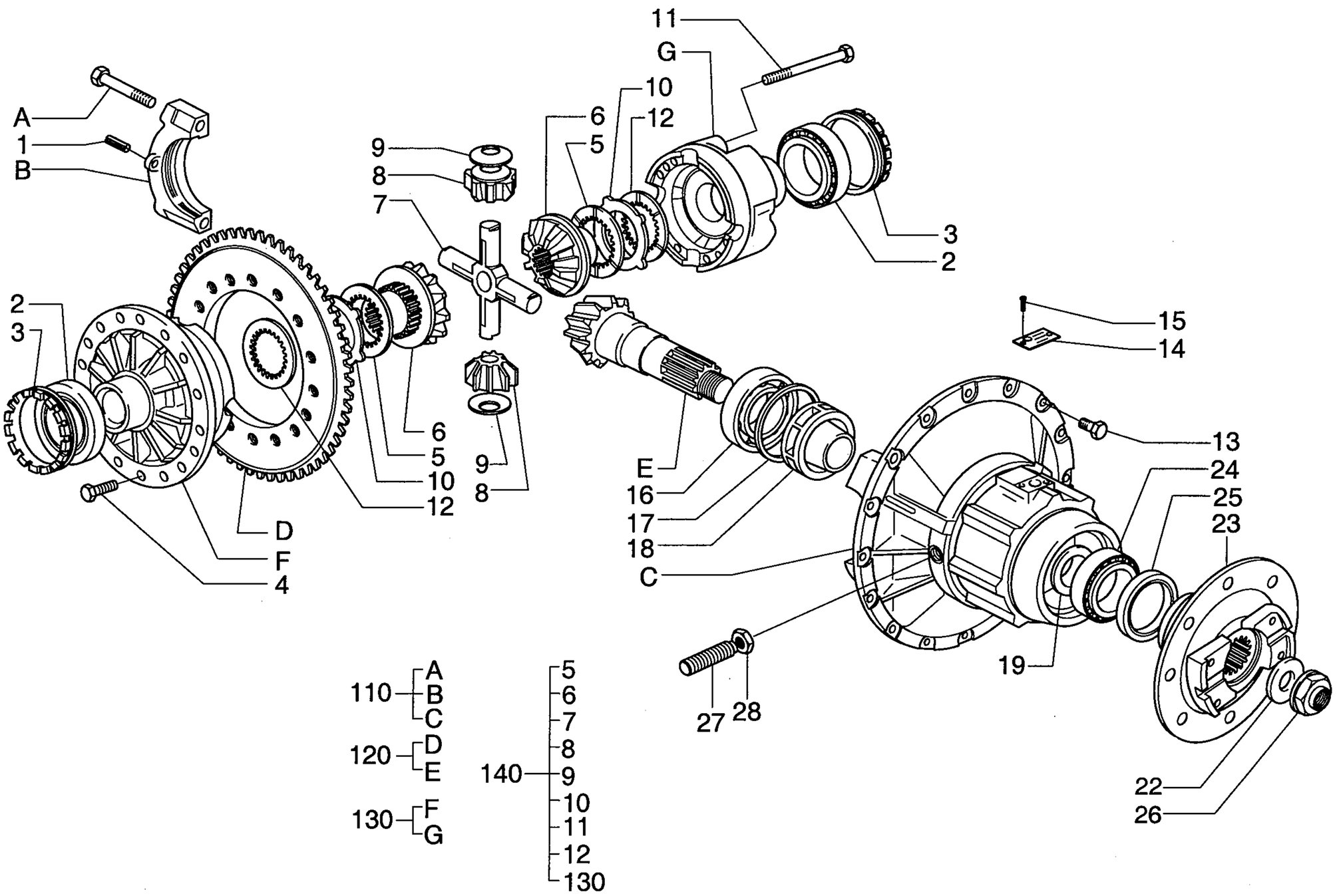
Refit outer oil recirculation piping(28) with relevant seals(29).

Secure items with the six screws(27).

② Rear axle

Clean thoroughly matching surfaces, apply sealing compound and mount differential unit on axle case, lock the screw(13) with a tightening torque of see : Tightening torque No.5.

DISASSEMBLING DIFFERENTIAL UNIT



(1) Hammer out spring pins(1) locking slotted rings(3) and release then.

(2) Mark caps(B) to match parts at reassembly.

(3) Release fixing screws(A) and remove caps(B) and relevant threaded rings(3).

(4) Remove differential case unit from support(C).

(5) Straighten locking notches on pinion nut collar(26), position reaction tool on drive flange to unlock nut(26), release pinion nut, remove drive flange(23) from pinion shank along with washer(22).

(6) Pry off seal(25) from drive flange.

(7) Remove bevel pinion(E) from differential support(C), hammer pinion shank with a proper remover, care not to damage threads.

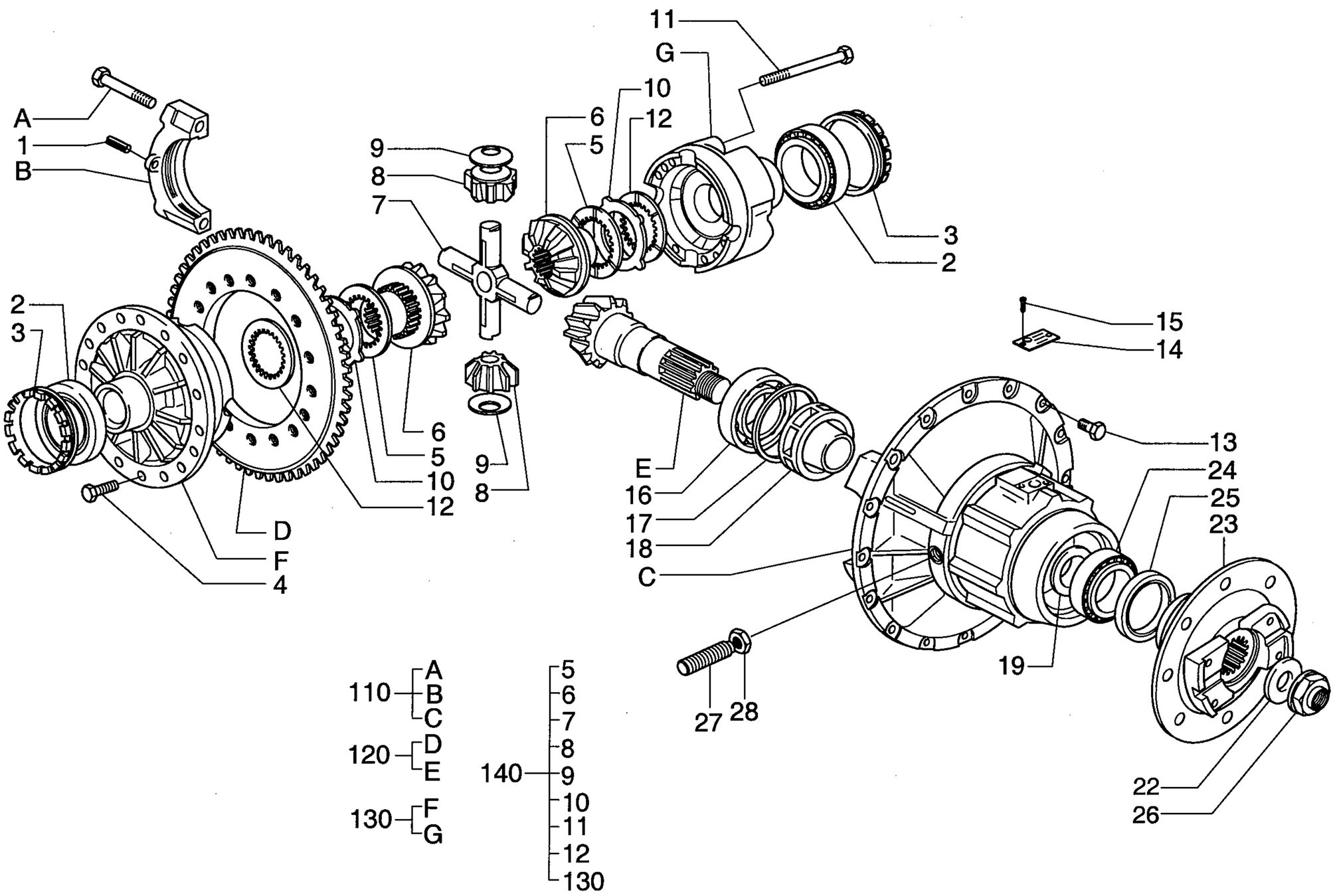
(8) Pick up inner race of pinion shank bearing(24).

(9) Remove from differential support(C) outer races of outer and inner pinion bearings(24 and 16). Pick up shims(17) for pinion axial position adjustment.

(10) Remove impeller(18) and shims(17) for bearing pre-load adjustment; Remove inner race of pinion underhead bearing(16) by using a proper puller.

(11) Mark differential half-cases(F and G) for reference at reassembly.

DISASSEMBLING DIFFERENTIAL UNIT



(12) Remove fixing screws(11) and separate half-cases(F and G).

(13) Have a visual and dimensional check of wear on sun and side gears(6 and 8) relevant thrust washers(5 and 9) and spider(7).

(14) Remove bearings(2) from half-cases(F and G) by a proper puller.

(15) Fit inner races of differential bearings(2) on half-cases(F and G).

※ This operation should be carried out by heating equipment or proper installer.

(16) Clamp ring gear(D) in a vise fitted with soft caps and remove screws(4) securing ring gear(D) to case(F).

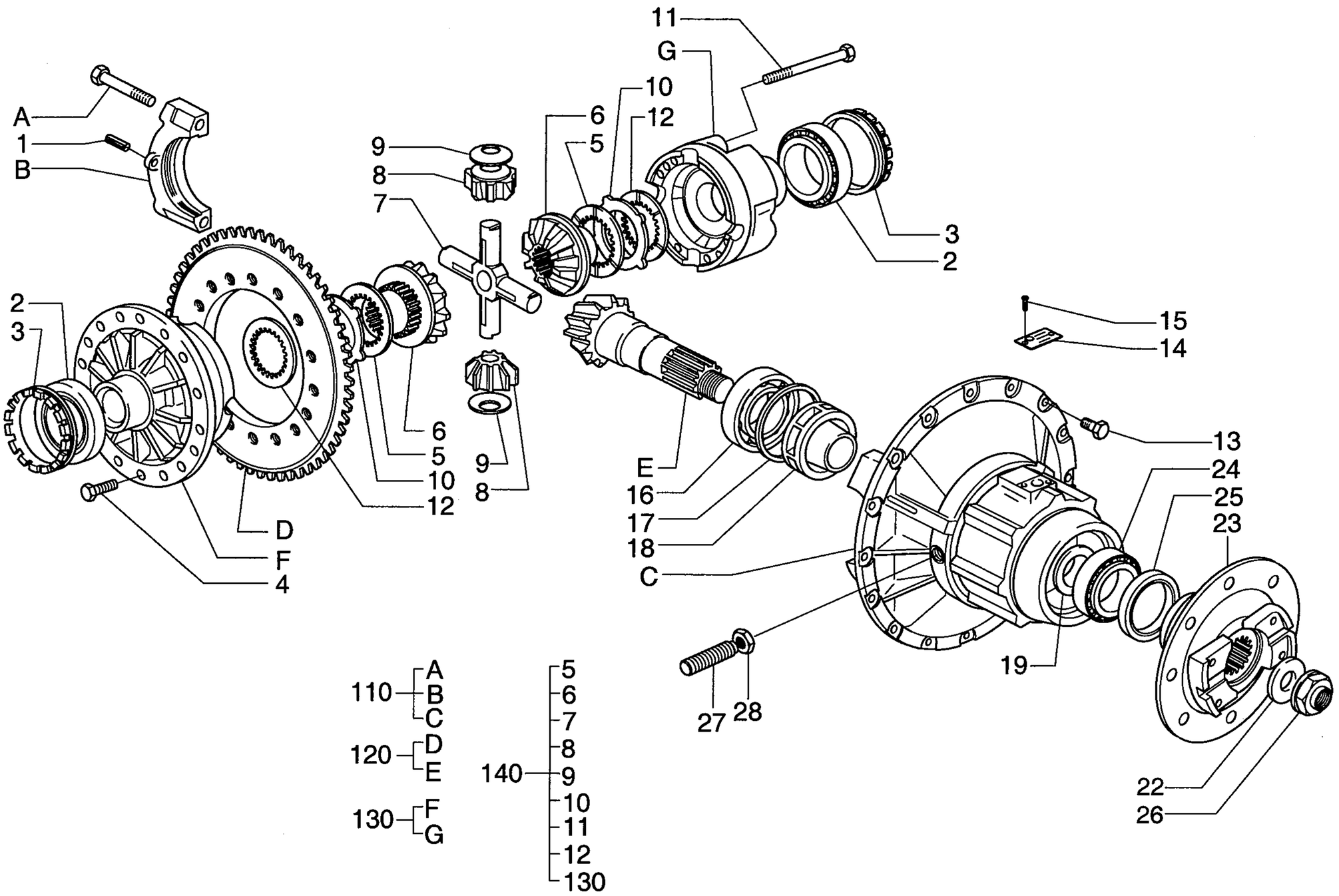
(18) Mount bevel ring gear(D) on case(F) lock relevant fixing screws(4) with a tightening torque of : See tightening torque No. 2

(18) Position differential components in relevant seats, then, join half-cases(F and G) matching reference marked prior disassembly.

(19) Mount and lock half-cases fixing screws(11) with a tightening torque of : See tightening torque No.3.

7) ASSEMBLING DIFFERENTIAL UNIT

Determining thickness of adjustment shims(Axial position of bevel pinion) : See clause 8, 9.



(1) Press fit inner race of inner(Underhead) bearing(16) on pinion by heating equipment or proper installer.

(2) Position shim(17), computed as per clause 9 at page 3-180, in its seat and press fit outer races of inner(Underhead) and outer bearings(16 and 24) of pinion.

(3) Fit impeller(18) on pinion for bearing pre-load adjustment; Then, mount inner race of pinion outer bearing(24).

※ To facilitate proper pre-load computation, it is advisable to mount as many shims as required to warrant a pinion end play and not a pre-load(That could be excessive) on bearings.

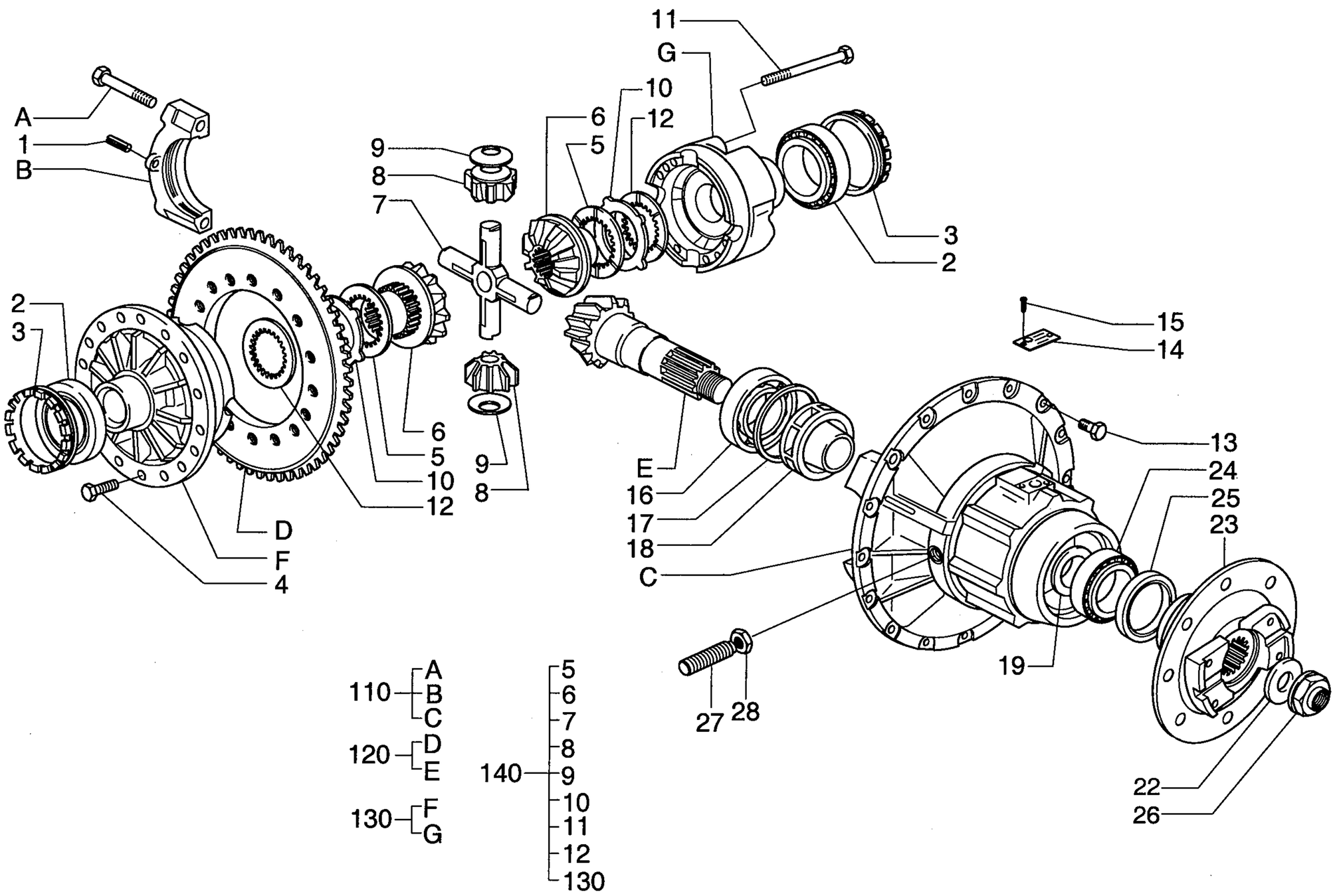
(4) Fit drive flange(23) on pinion(E), position the specific reaction screw and tighten nut(26) with a torque of 58.2~64.3kgf · m(421~465lbf · ft).

※ Check pinion end play by means of a dial gauge; then, disassemble parts and change shims so as to eliminate all end play and reach the intended pre-load.

※ Reassemble components, check that proper pre-load of bearing be corresponding to a revolving torque(No seal installed) of 0.02~0.04kgf · m(0.14~0.29lbf · ft).

(5) As the prescribed pre-load of bearings as been reached remove drive flange(23) and fit lip seal (25) in relevant seat.

ASSEMBLING DIFFERENTIAL UNIT



(6) Remount drive flange again and tighten a specified above.

(7) Position differential assembly with ring gear on support(C) ; Insert ring nut(3) and adjust temporarily backlash.

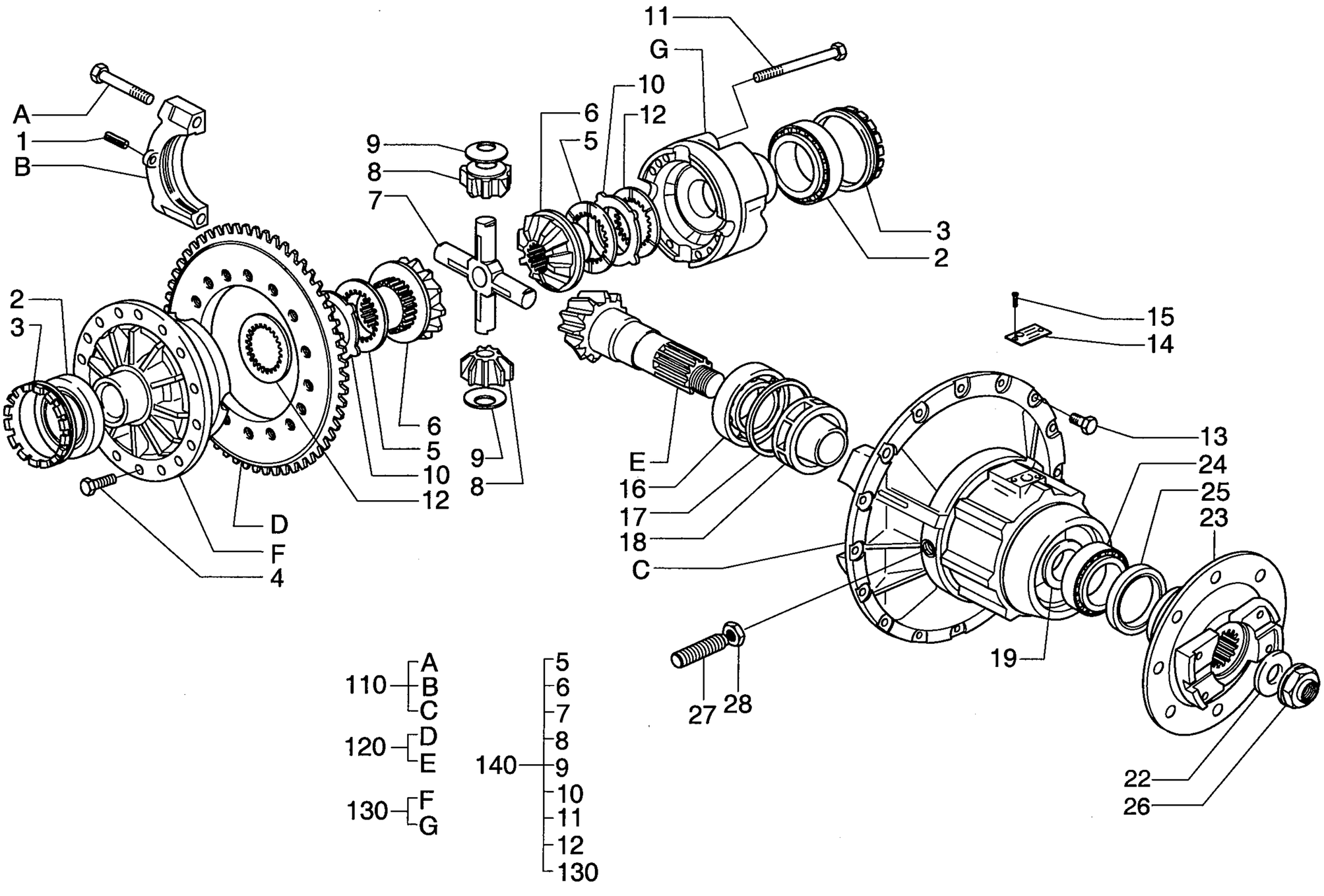
(8) Mount caps(B), minding not to invert position and lock screws(A) fixing support to differential with a torque of : See tightening torque No.4.

※ Check differential end play by a dial gauge.

※ Screw in a ring nut so as to have a notch alined against the slot of lock plate and actuate the opposite nut up to eliminate end play.

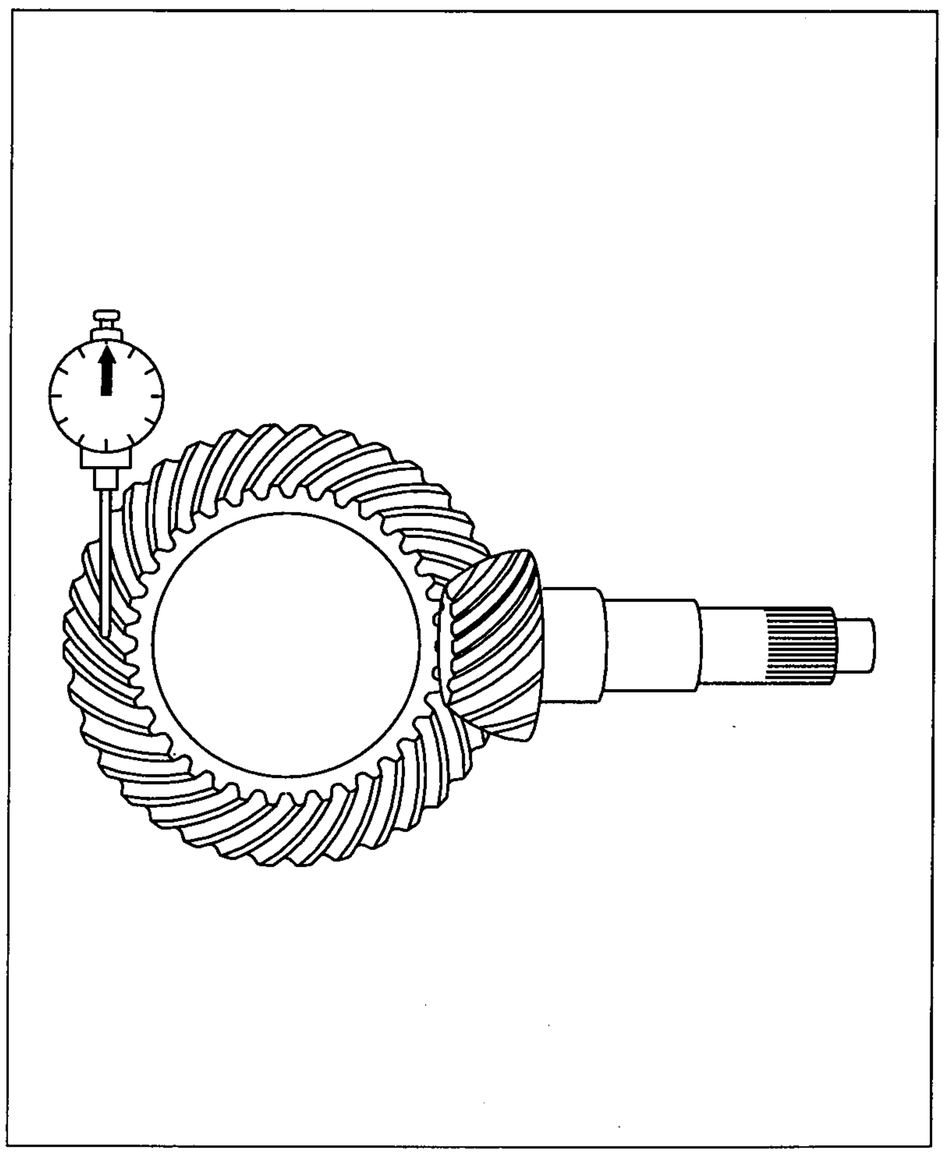
※ As such a condition has been reached go on with bearing pre-load by screwing in ring nut further one more notch.

ASSEMBLING DIFFERENTIAL UNIT



(9) Position a dial gauge perpendicular the ring gear(D) tooth(See figure) and check that, with pinion steady, backlash be of : See tightening torque No.9, otherwise rotate both ring nuts(3), displacing them of a same number of notches and nearing ring gear to pinion if backlash is excessive and moving away on the contrary.

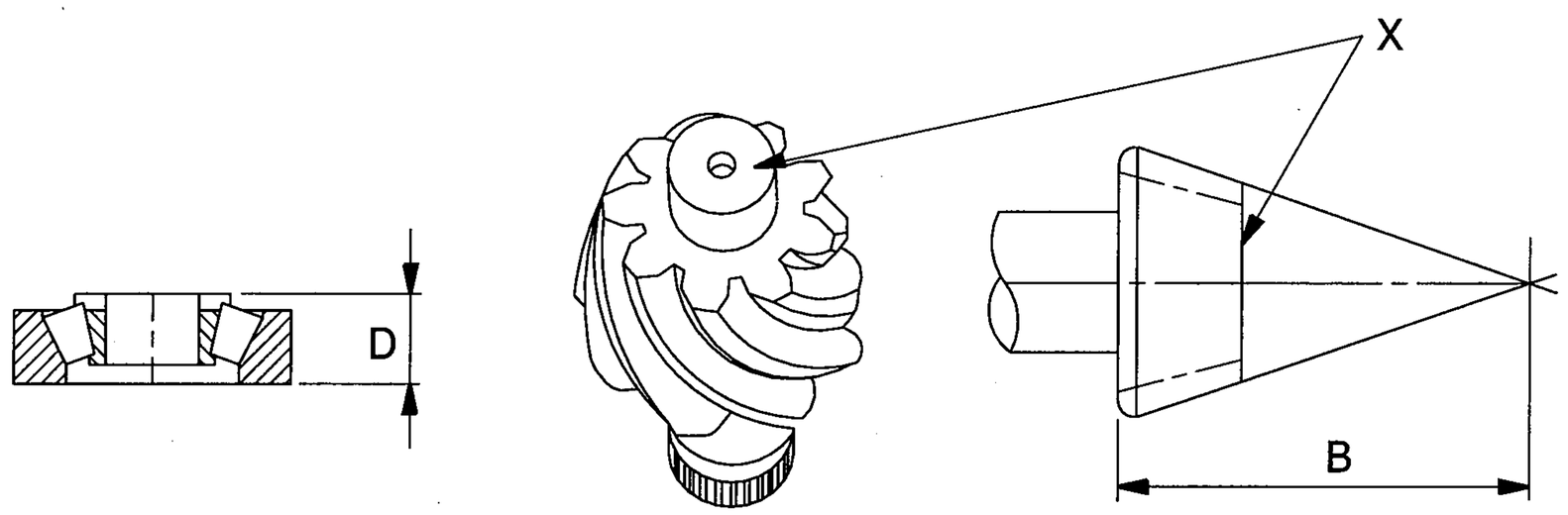
※ Brush red lead on some ring gear teeth, rotate to mesh pinion and ring gear repeatedly so as to make evident tooth contact. Proper and correct tooth contact marks are visible on a new bevel gear set as a result of an optimum contact approached on the tester, consequently, a proper axial position of pinion against ring gear will emphasize remarking of previous tester contact marking.



(10) Fit spring pins (1) to lock differential ring nuts.

(11) Make two lock notches on pinion nut collar(26).

8) DETERMINING THICKNESS OF ADJUSTMENT SHIMS(Front axle)



(1) Some dimensions should be recorded before starting reassembly of bevel pinion to determine thickness of spacer to be fitted between inner(Underhead) pinion bearing and backing of relevant seat in differential support.
Record dimension from ring gear axis to seat of inner(Underhead) pinion bearing(That will be identified as **A**).
Example : In our case **A** = 290.6mm

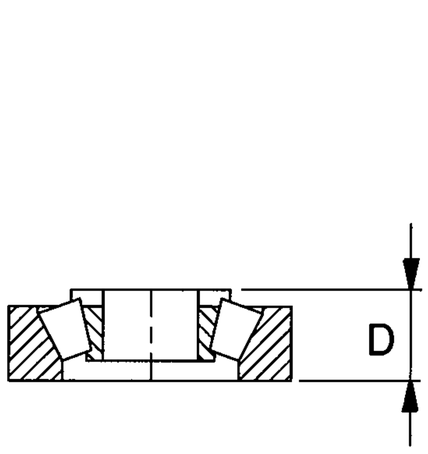
(2) A number **X** prefixed by symbol ± is marked on bevel pinion face.
Said value, expressed in tenth of millimeter, indicate the deviation from the theoretical distance from pinion underhead to ring gear axis :
i.e. : + 1 = 0.1mm
Consequently, the true distance(Identified as **B**) will be :
B = 231.7 ± Deviation
In our case : **B** = 231.7 + 0.1 = 231.8mm

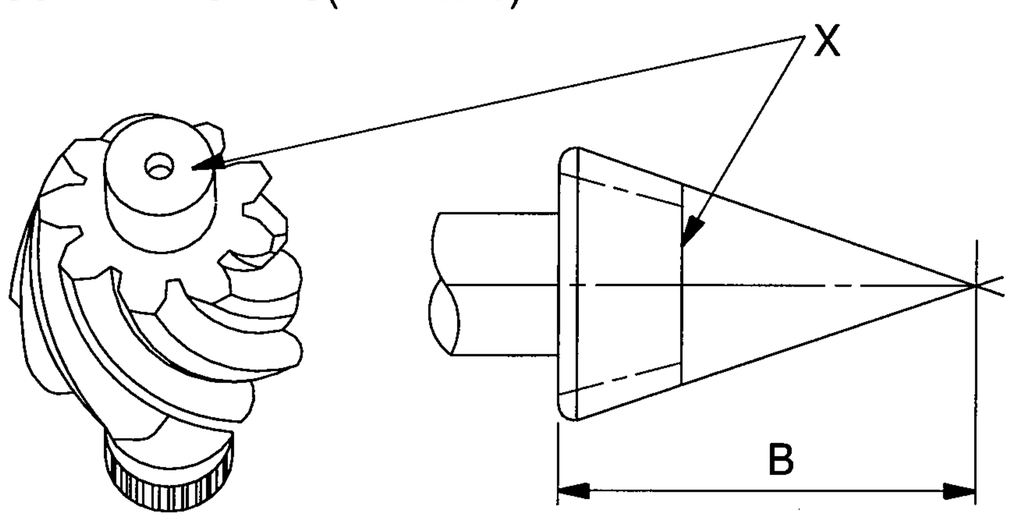
(3) Measure thickness of pinion head bearing and identify as **D**.
Example : In our case **D** = 54.85mm

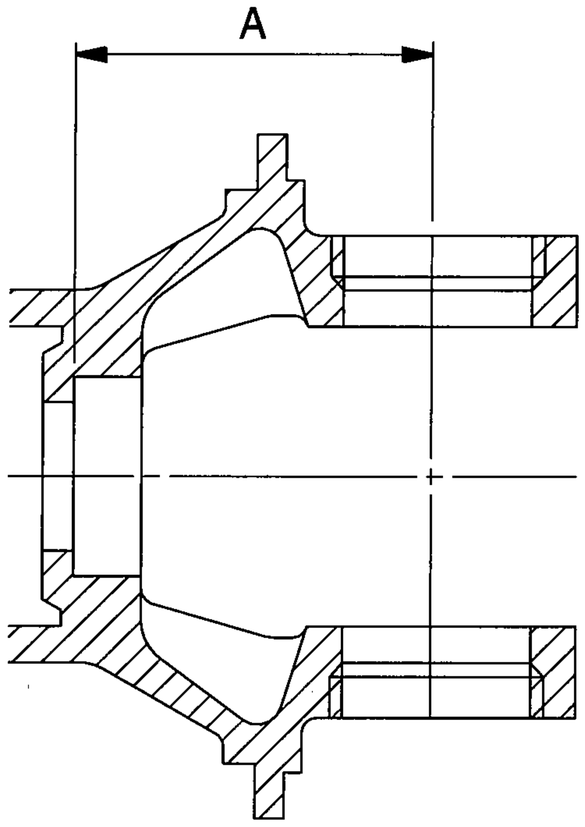
(4) Compute thickness of shim **S** for proper axial position of bevel pinion :
S = A - (B + D)
Example : In our case **S** = 290.6 - (238.1 + 54.85) = 3.95mm

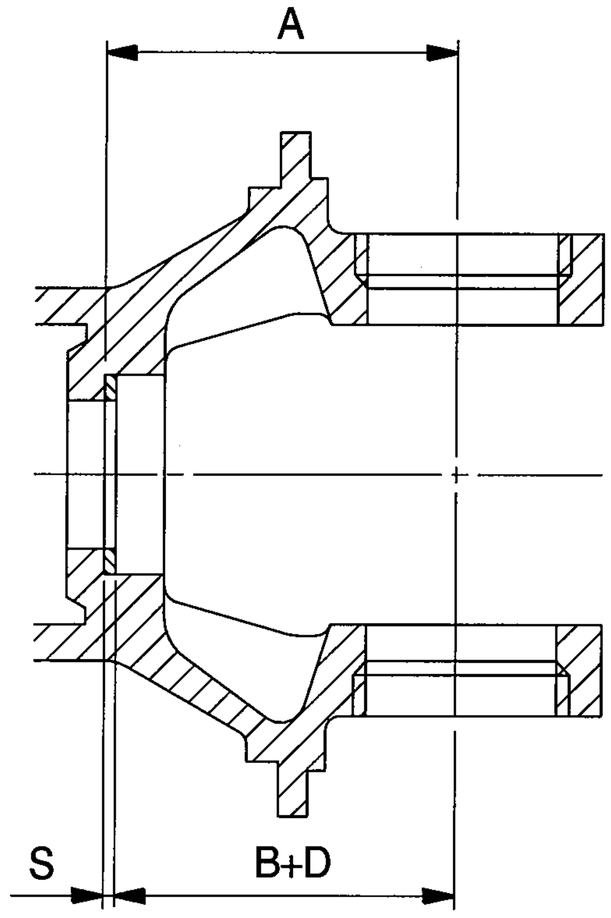
(5) Increase by 0.05mm the computed thickness value to compensate subsequent bearing pre-load.
Round off to the nearest tenth of millimeter to the computed thickness value :
i.e. : 4.02 rounded off = 4mm
3.88 rounded off = 3.9mm

9) DETERMINING THICKNESS OF ADJUSTMENT SHIMS(Rear axle)









(1) Some dimensions should be recorded before starting reassembly of bevel pinion to determine thickness of spacer to be fitted between inner(Underhead) pinion bearing and backing of relevant seat in differential support.
Record dimension from ring gear axis to seat of inner(Underhead) pinion bearing(That will be identified as **A**).
Example : In our case **A** = 266.1㎜

(2) A number **X** prefixed by symbol ± is marked on bevel pinion face.
Said value, expressed in tenth of millimeter, indicate the deviation from the theoretical distance from pinion underhead to ring gear axis :
i.e. : + 1 = 0.1㎜
Consequently, the true distance(Identified as **B**) will be :
B = 208 ± Deviation
In our case : **B** = 208+ 0.1 = 208.1㎜

(3) Measure thickness of pinion head bearing and identify as **D**.
Example : In our case **D** = 54.15㎜

(4) Compute thickness of shim **S** for proper axial position of bevel pinion :
S = A - (B + D)
Example : In our case **S** = 266.1 - (208.1 + 54.15) = 3.85㎜

(5) Increase by 0.05mm the computed thickness value to compensate subsequent bearing pre-load.
Round off to the nearest tenth of millimeter to the computed thickness value :
i.e. : 4.02 rounded off = 4㎜
3.88 rounded off = 3.9㎜