1. REMOVAL TRANSMISSION

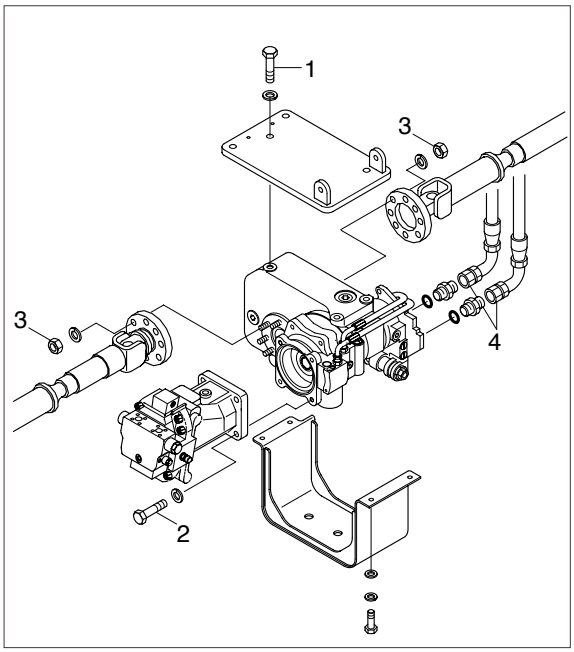
1) Transmission mounting bolt(1, M20)
   · Tightening torque : 44±2kgf · m
   (318±14lbf · ft)

2) Travel motor mounting bolt(2, M12)
   · Tightening torque : 12.2±1.3kgf · m
   (88±9.4lbf · ft)

3) Propeller shaft mounting nut(3, M10)
   · Tightening torque : 5.9 ±0.6kgf · m
   (42.7 ±4.3lbf · ft)

4) Hose assy(4, PF3/8)
   · Tightening torque : 5kg · m(36.2lbf · ft)

5) Transmission weight : 110kg(243lb)



2. GENERAL INSTRUCTIONS

1) GENERAL WORKING INSTRUCTIONS

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

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

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

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

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

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

(7) The latter refers especially to new parts.

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

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

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

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

Ball bearings, covers, flanges and parts like that must be heated to about 90 to 100$_{\circ}$C.

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

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

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

After the repair, units are filled up with oil.

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

2) IMPORTANT INSTRUCTIONS CONCERNING THE LABOUR SAFETY

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

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

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

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

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

3) LUBRICANT SPECIFICATIONS

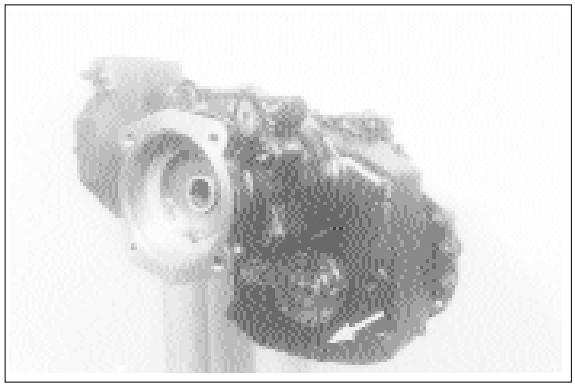
(1) API GL-5

(2) SAE 10W-30, 15W-40

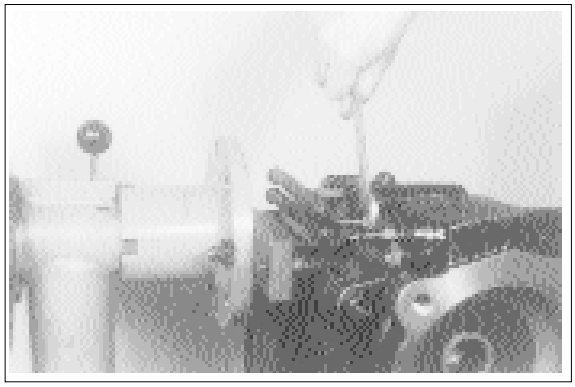
3. DISASSEMBLY

1) REMOVE RELEASE DEVICE AND VALVE INSERTS

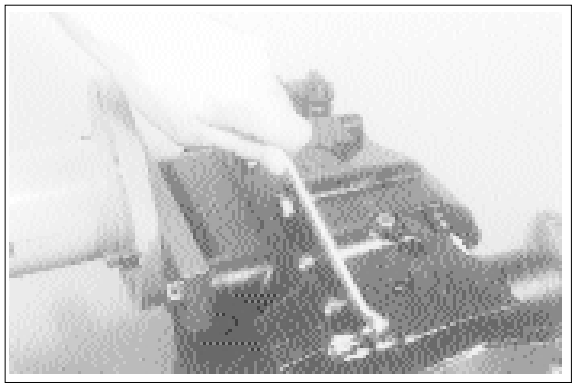
(1) Fasten transmission on the assembly car. Loosen screw plug(Arrow) and drain oil.



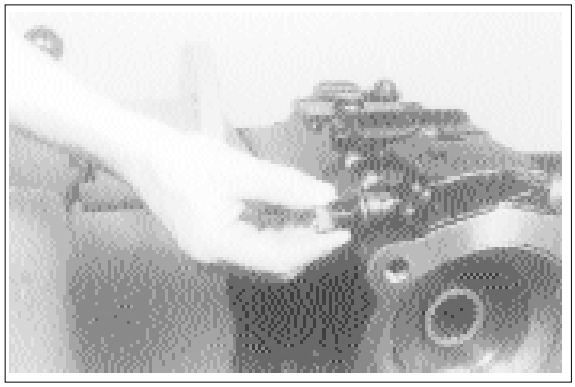
(2) Remove both hose pipes.



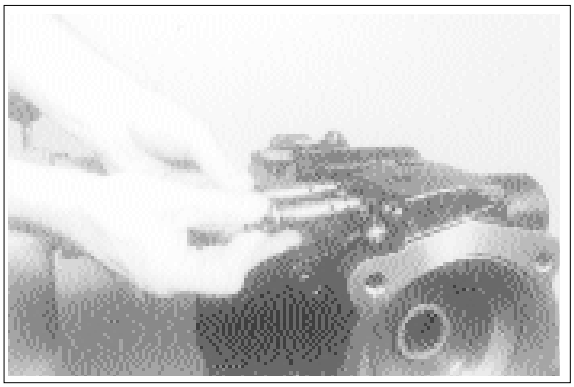
(3) Remove all bleed valves(See arrows). Bleed valves are differently arranged at version, horizontal installation(See page 179 (21)).



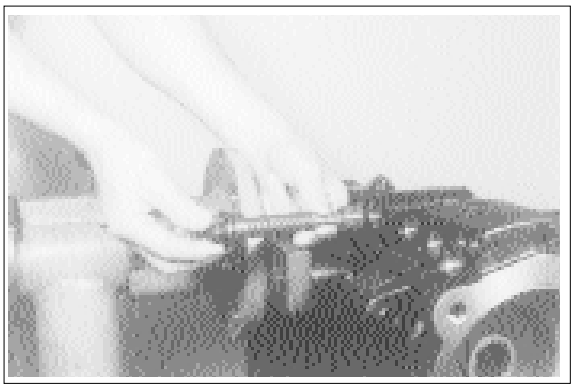
(4) Remove connecting piece out of the input casing.



(5) Remove valve insert on the input casing and on the gearbox housing.



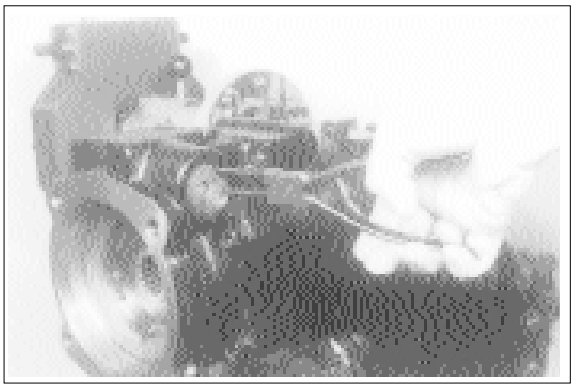
(6) Loosen screw plug, pull compression spring along with spool out of the bore.



(7) Screw spool in for about a half turn and squeeze circlip out.

※ Special tool

Set of external pliers 5870 900 015



(8) Unscrew spool and remove profiled section ring(See arrow).

(9) Remove all screw plugs on the input casing and the gearbox housing.

2) REMOVE BRAKE

(1) Tilt housing 90°.
Loosen socket head screws equally and separate input casing from gearbox housing.

※ Input casing is under spring preload.

(2) Press cup spring(See arrow) down and squeeze circlip out.
Now, remove supporting shim and cup springs.

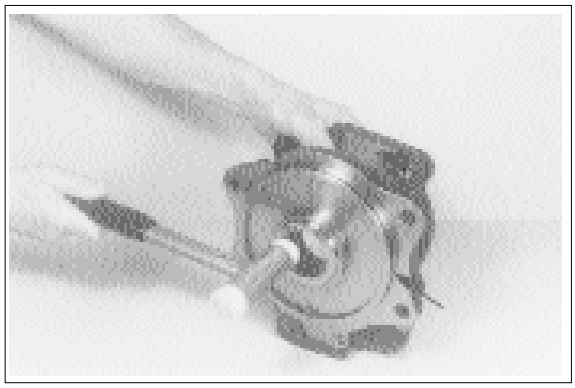
※ Special tool

Assembly jig	5870 345 087
Set of internal pliers	5870 900 013

(3) Tap piston loose and drive it out of the input casing.
Now, remove both piston sealings and O-ring(See arrow).

※ Special tool

Plastic mallet	5870 280 003



(4) Remove axial bearing and pressure piece.

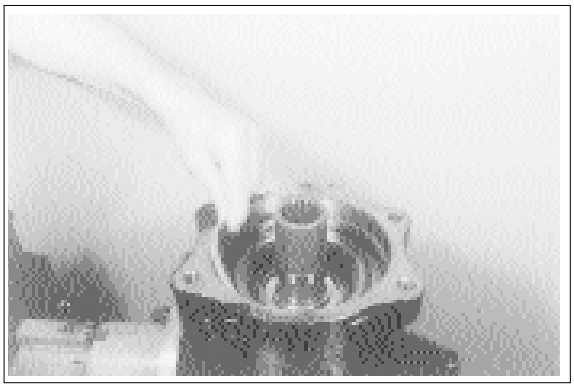
(5) Remove cup springs and compression spring.

(6) Pry piston out of the housing.

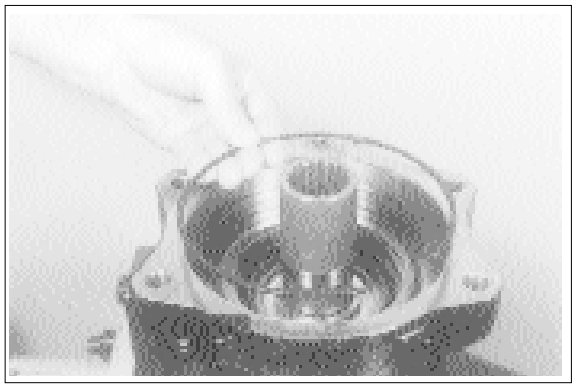
※ Special tool

Resetting device 5870 400 001

(7) Remove piston sealing.



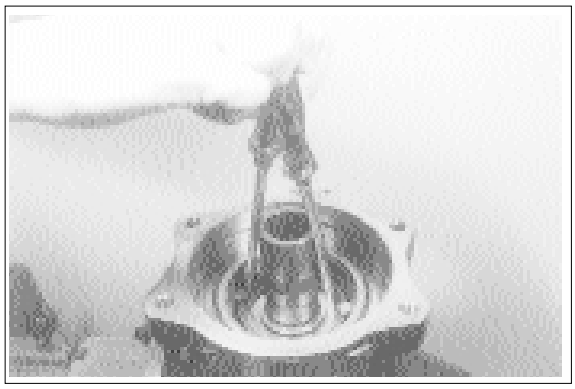
(8) Squeeze snap ring out.



(9) Pry disk out of the housing.

※ Special tool

Resetting device 5870 400 001



(10) Remove O-ring and gasket(See arrows) from the disk.

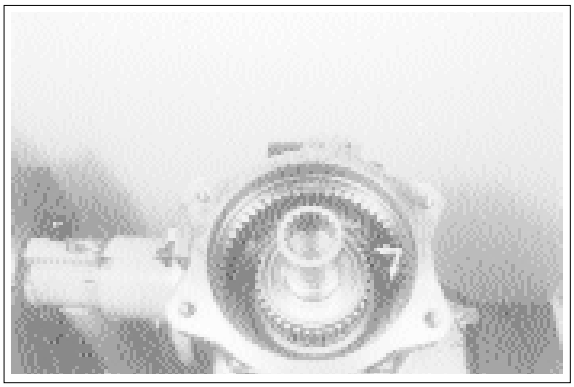
(11) Remove plate pack and end shims out of the housing.

3) REMOVE AND DISASSEMBLE CLUTCH

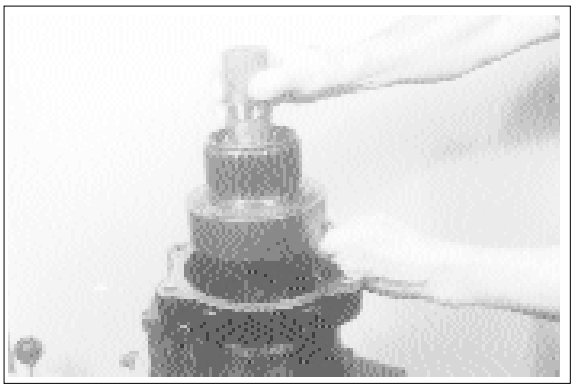
(1) Squeeze circlip out(See arrow).

※ Special tool

Clamping pliers 5870 900 021



(2) Pull drive shaft complete with clutch out of the housing.



(3) Fasten drive shaft in a vise and remove intermediate plate.

※ Use protective jaws.

(4) Squeeze snap ring out and remove disk.

(5) Remove plate pack out of the internal gear.

(6) Remove end shim.

4) DISASSEMBLE PLANETARY GEAR TRAIN

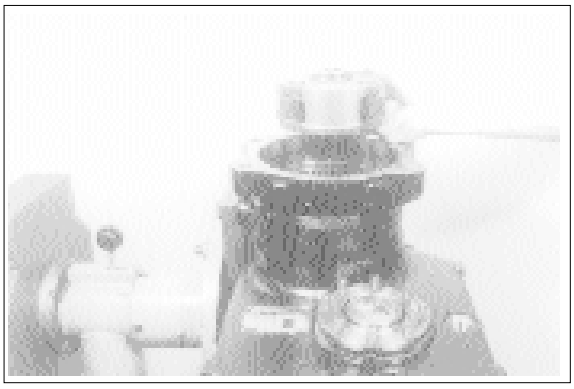
(1) Squeeze outer circlip out and remove internal gear.

※ Special tool
Set of external pliers 5870 900 015

(2) Squeeze circlip out, pull off ball bearing and remove circlip, lying under it.

※ Special tool
Set of external pliers 5870 900 015

(3) Remove planet carrier out of the housing.



(4) Remove axial needle cage out of the planet carrier.

(5) Squeeze circlip out.

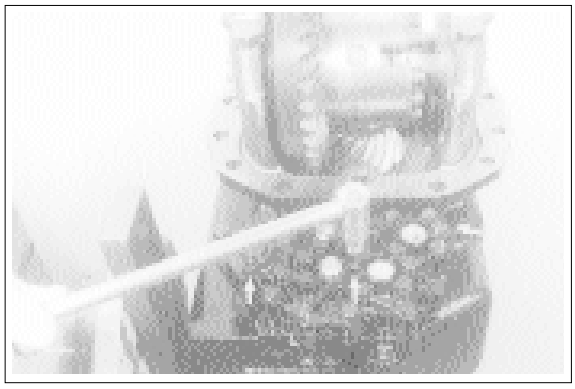
※ Special tool

Set of external pliers 5870 900 013

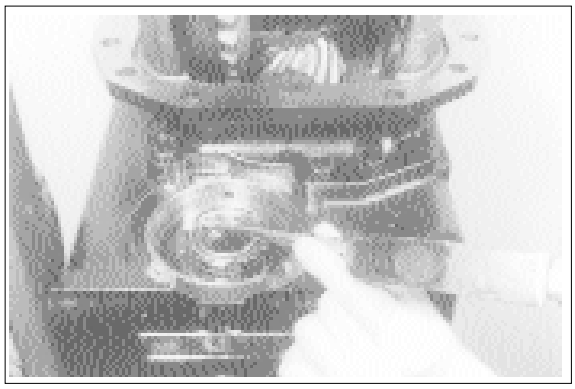
(6) Press planet shaft out and remove released components.

5) REMOVE, RESPECTIVELY DEMOUNT SPUR GEAR DRIVE(Output gear) **AND SHIFT INTERLOCK**

(1) Tilt housing 180°.
Loosen socket head screws(3EA, see arrows) and separate shift interlock from gearbox housing.



(2) Unlock slotted nut.

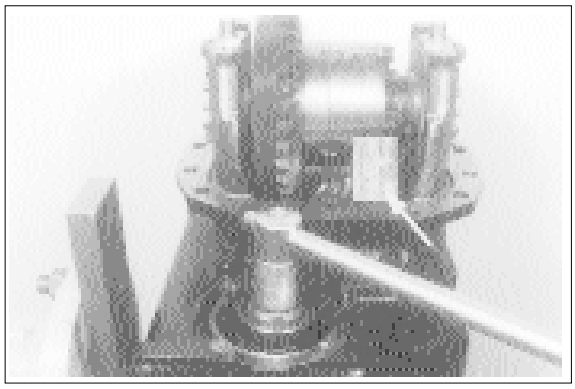


(3) Support differential by means of block(See arrow) and loosen slotted nut.

※ By supporting the differential, the loosening of the slotted nut becomes possible.

※ Special tool

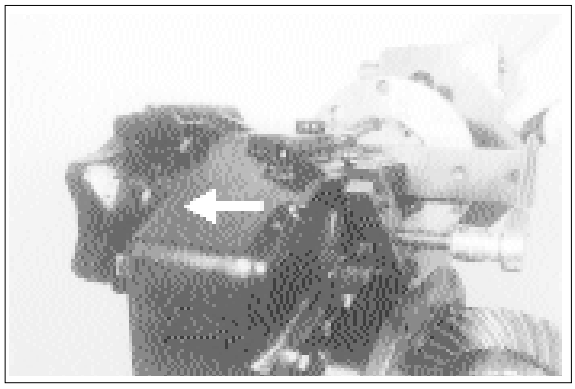
Hook spanner	5870 401 024
Centering punch	5870 912 024



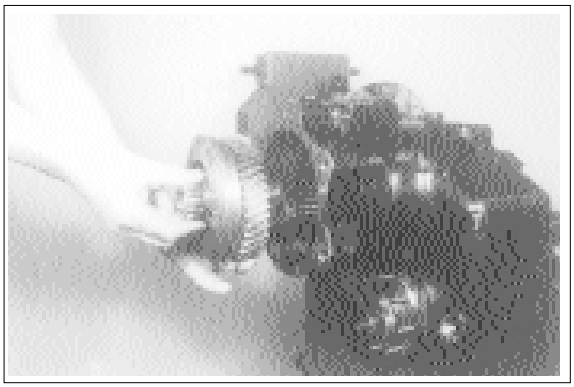
(4) Press helical gear along with cover out of the housing bore(Direction of arrow), using special device, and remove released bearing inner race.

※ Special tool

Puller device	5870 000 017



(5) Take helical gear complete with cover out of the housing.



(6) Make circlip free by tapping slightly onto the disk, lying behind it.

(7) Squeeze circlip out and remove released disk.

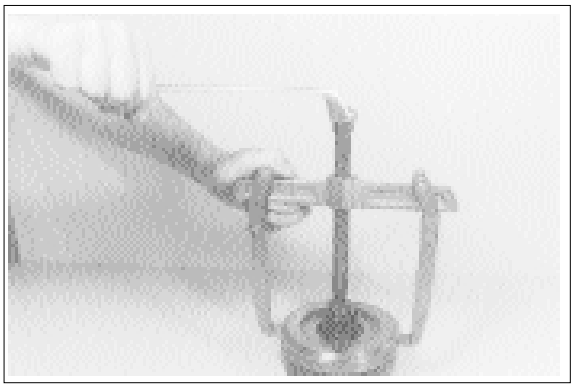
※ Special tool

Set of internal pliers 5870 900 013

(8) Pull cover from helical gear, using two leg puller.

※ Special tool

Tow leg puller 5870 970 003



(9) Pry oil baffle out of the cover and remove released bearing inner race as well as bearing outer race.

※ Special tool

Resetting device 5870 400 001

6) DISASSEMBLE SHIFT INTERLOCK

(1) Loosen all hexagon head screws and separate cover as well as gasket from the housing.

(2) Remove screen filter out of the housing.

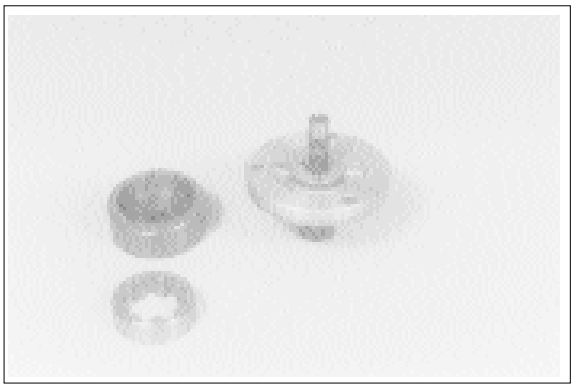
(3) Loosen hexagon head screws.

(4) Separate pump cover from housing.

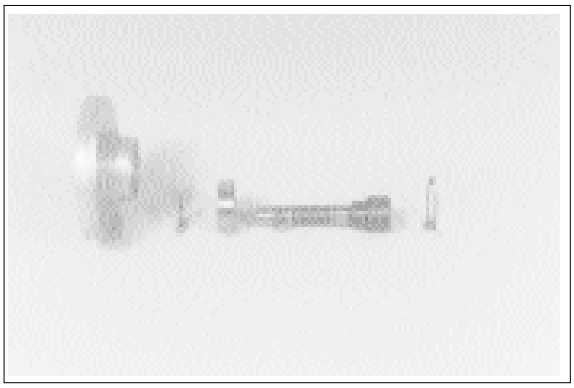
(5) Pull internal rotor from pump shaft and remove released ball.

(6) Pull control housing along with outer rotor the pump shaft.

※ Pay attention to released balls and compression springs.



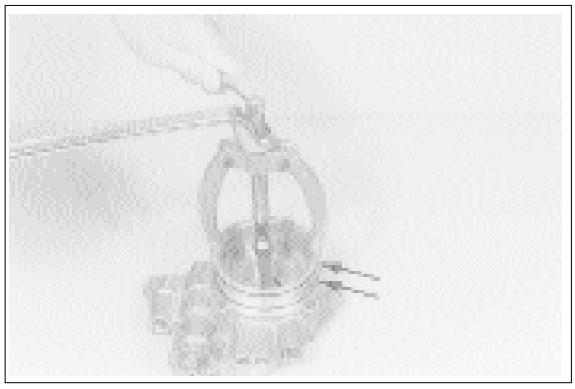
(7) Remove pump shaft, see figure on the right.



(8) Pull needle sleeve out of the housing bore and remove O-ring(See arrows).

※ Special tool

Internal puller	5870 300 030
Counter support	5870 300 011



(9) Remove check valves and piston.

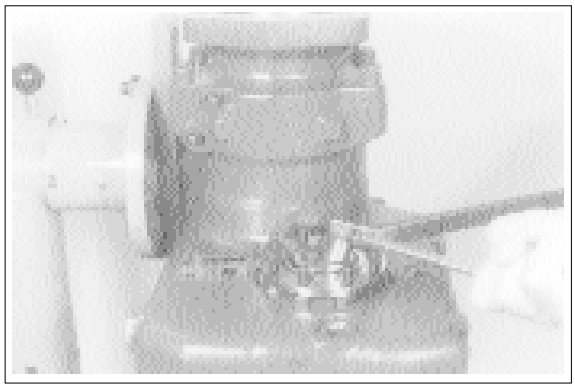
※ Mark installation position of the single check valves.

7) DISASSEMBLE OUTPUT

(1) Loosen hexagon head screws and remove output flange.

※ Special tool

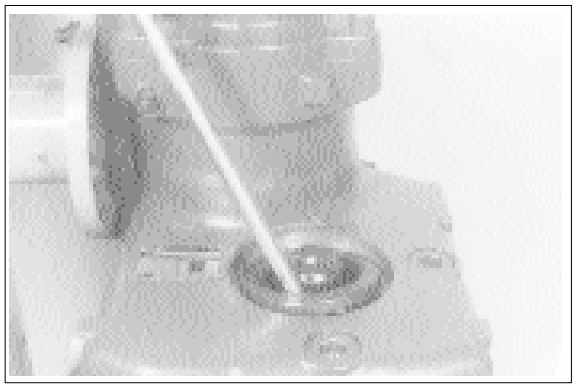
Clamping yoke	5870 240 250



(2) Pry shaft seal out of the housing bore.

※ Special tool

Crow bar	5870 345 071

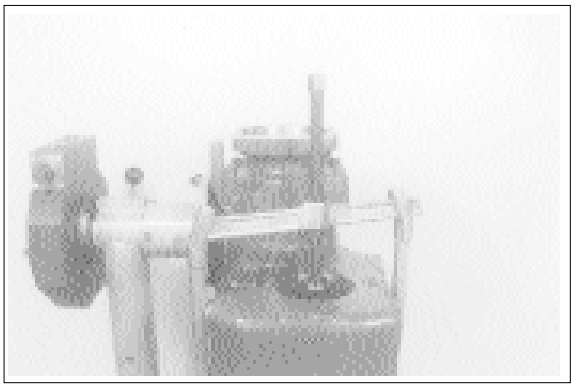


(3) Apply two-leg puller on the gearbox housing.

※ The two-leg puller is needed to push the output gear and the cover later out of the housing(See page 7-157 (7)).

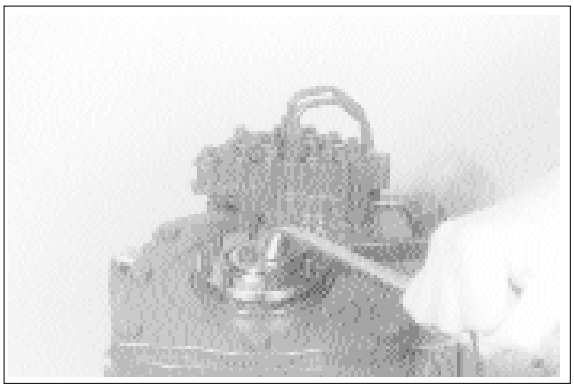
※ Special tool

Two-leg puller 5870 970 006



(4) Tilt housing 180°.

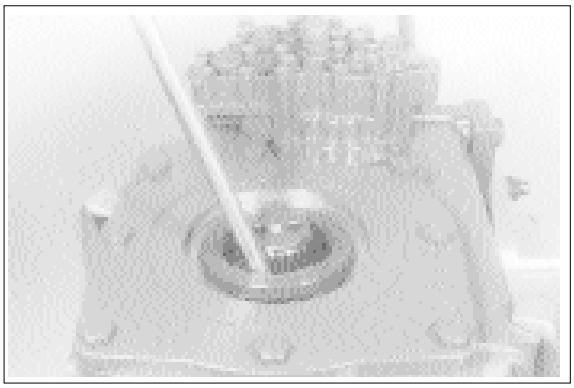
Loosen hexagon head screws and remove output flange.



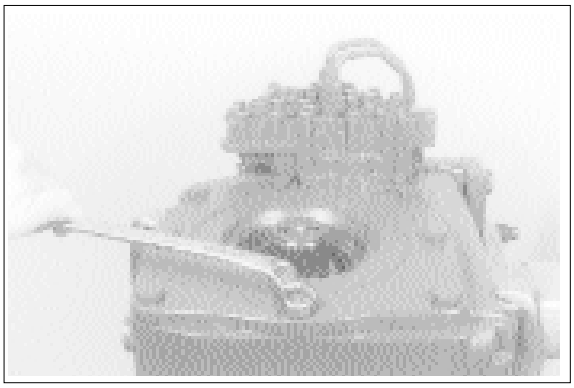
(5) Pry shaft seal out of the cover.

※ Special tool

Crwo bar 5870 345 071



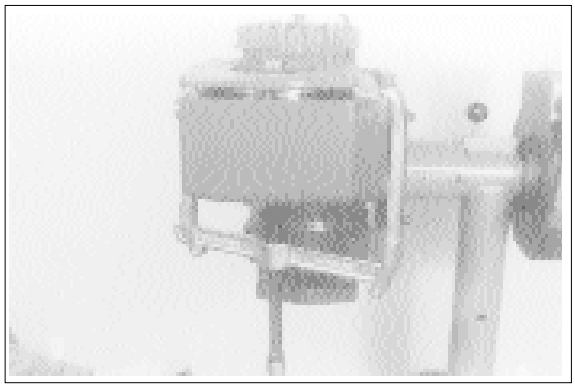
(6) Loosen hexagon head screws.



(7) Push output gear along with cover out of the housing, using two-leg puller.

※ Special tool

Two-leg puller 5870 970 006

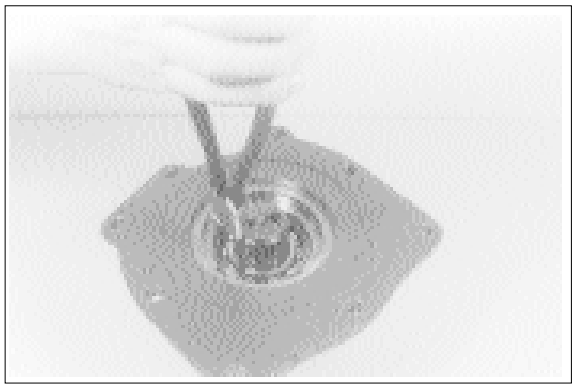


(8) Lift the cover along with output gear out of the housing and remove two-leg puller.

(9) Squeeze circlip out.

※ Special tool

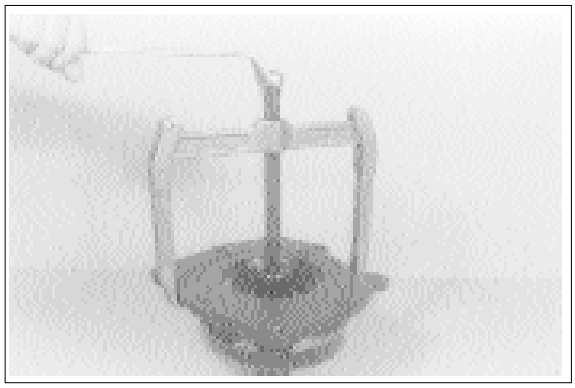
Set of internal pliers 5870 900 013



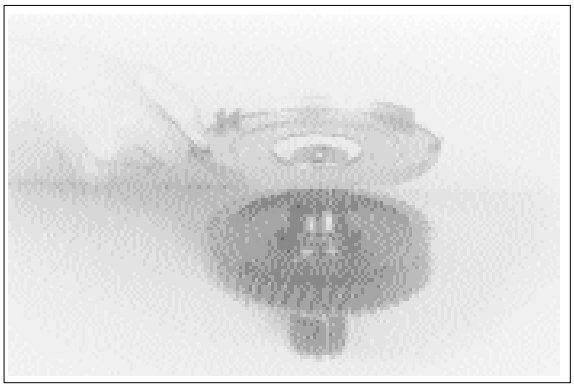
(10) Pull cover by means of two-leg puller from the output gear.

※ Special tool

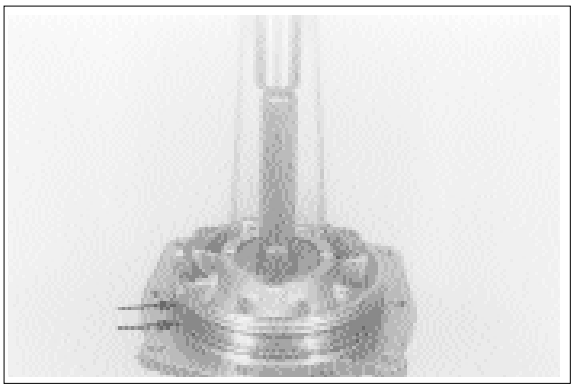
Two-leg puller 5870 970 012



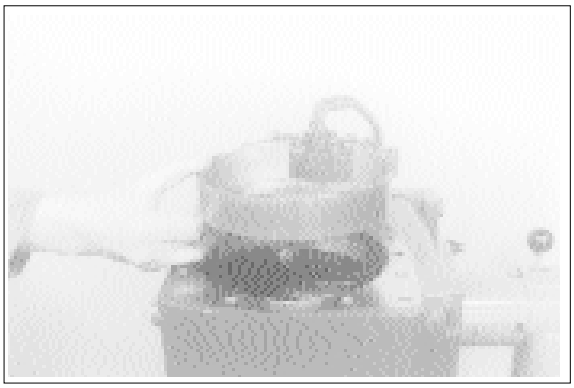
(11) Remove oil baffle plate.



(12) Press ball bearing out of the cover and remove O-rings(See arrows).



(13) Remove screening plate out of the gearbox housing and drive ball bearing, lying behind it out of the housing bore.



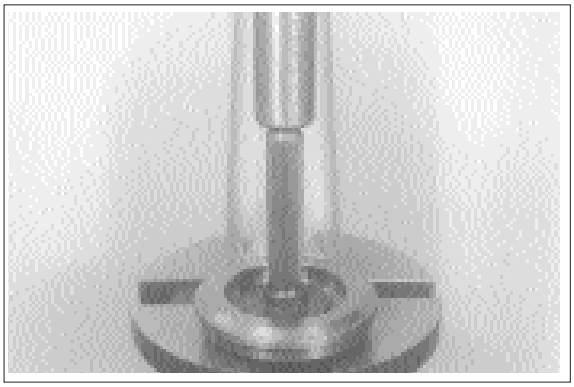
4. REASSEMBLY

1) REASSEMBLE AND INSTALL SPUR GEAR DRIVE

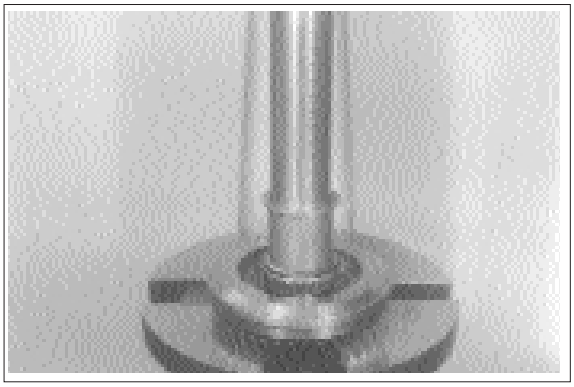
(1) Press bearing outer race into the cover until contact is obtained.

※ Special tool

Driver	5870 058 018
Handle	5870 260 002



(2) Assemble cover on the helical gear and press bearing inner race against shoulder.



(3) Assemble disk and fix it by means of circlip.

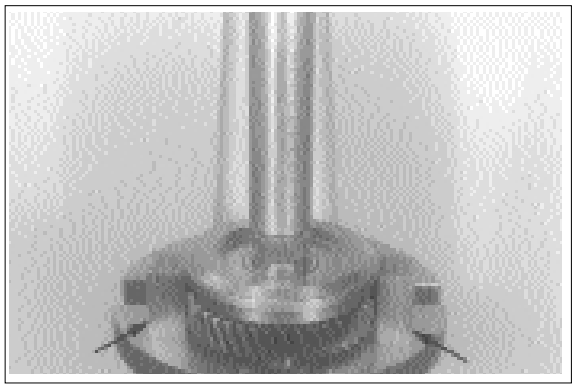
(4) Press oil baffle into the cover until contact is obtained.

(5) Support cover by means of blocks(See arrows) and press helical gear down until the play of disk and circlip is eliminated.

※ In order to be able to carry out an exact bearing adjustment of the spur gear drive, it is necessary to position the roller bearing **playfree** on the disk, respectively on the circlip until contact is obtained.

※ Special tool

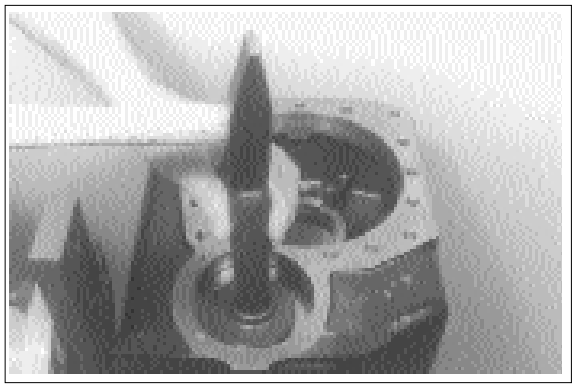
Magnetic blocks	5870 450 003



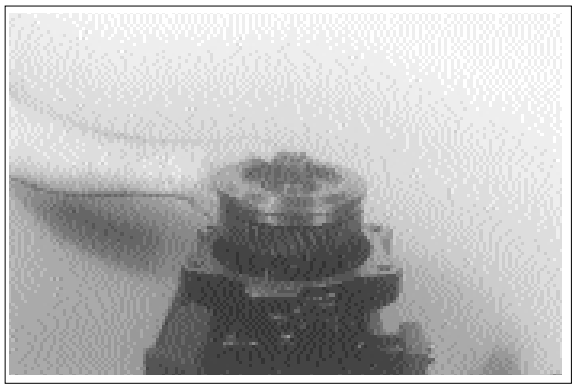
(6) Insert bearing outer race into the gearbox housing until contact is obtained.

※ Special tool

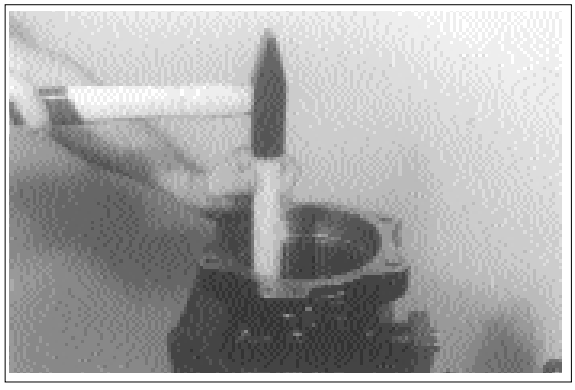
Driver	5870 058 018
Handle	5870 260 002



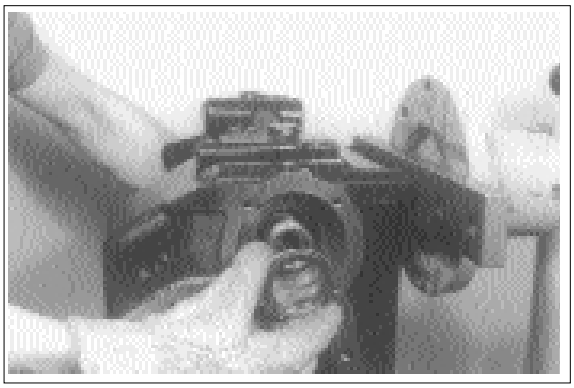
(7) Tilt housing 180°.
Insert helical gear into the gearbox housing.



(8) Position cover along with helical gear by tapping until contact in the housing is obtained.

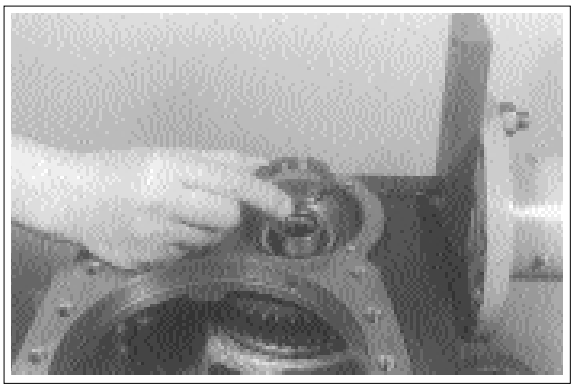


(9) Heat bearing inner race and assemble it on the helical gear until contact is obtained.



2) ADJUST ROLLING MOMENT OF THE SPUR GEAR DRIVE

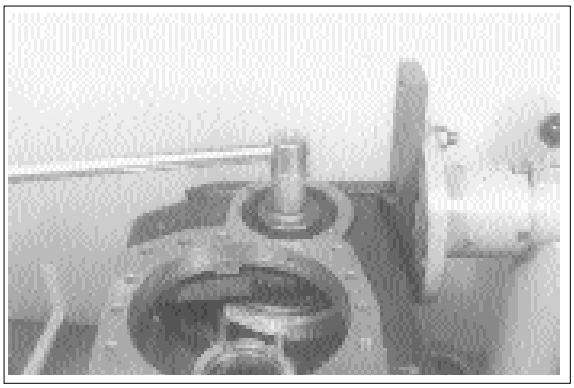
(1) Screw on the first slotted nut, with the chamfer facing the helical gear (Downward).

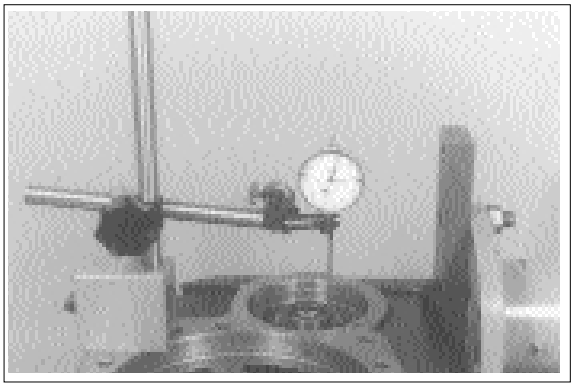


(2) Support helical gear by means of soft flat irons(See arrow) and tighten first slotted nut until a provisional axial play of the spur gear bearing of 0.1~0.12㎜ is obtained.

※ Special tool

Hook spanner	5870 401 024
Centering punch	5870 912 024
Magnetic stand	5870 200 055
Dial indicator	5870 200 057

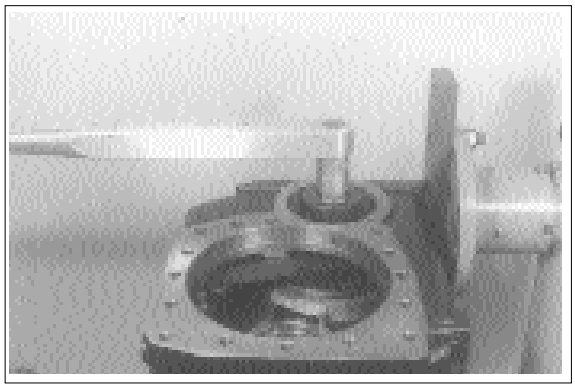




(3) Tighten the second slotted nut, with the locking collar showing upward.
· Tightening torque : 51kgf · m(368.9lbf · ft)
We know from experience, that at the tightening of the second slotted nut with 51kgf · m(368.9lbf · ft), the required rolling moment of the spur gear bearing is achieved.

※ Special tool

Hook spanner	5870 401 024
Centering punch	5870 912 024

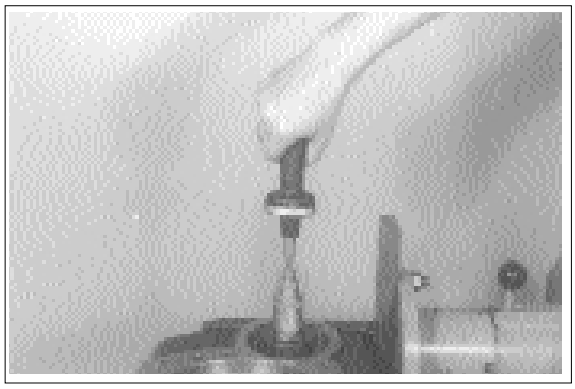


(4) Check rolling moment of the spur gear bearing.
Bearing rolling moment in the actual case e.g. 0.1kgf · m(0.7lbf · ft).

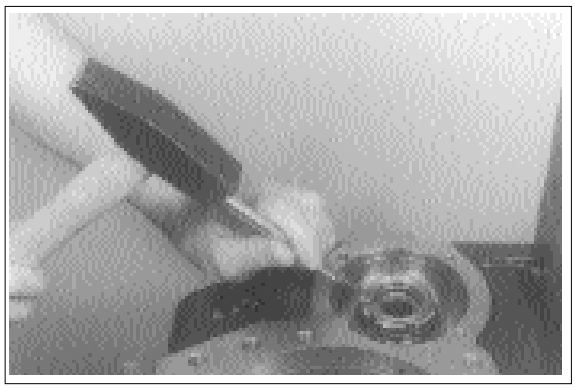
※ Any necessary corrections have to be carried out with the first slotted nut(See page 7-158, 159)

※ Special tool

Torque controlled screwer	5870 203 021

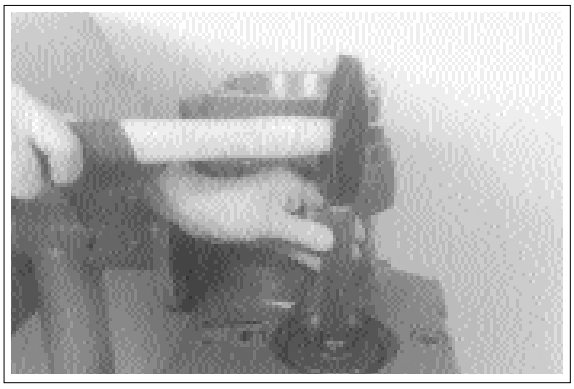


(5) Secure second slotted nut by caulking.



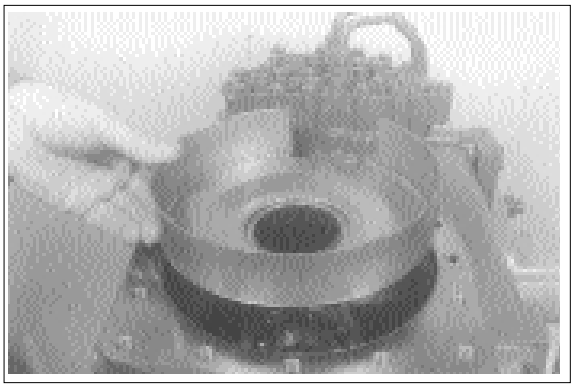
3) INSTALL OUTPUT

(1) Insert ball bearing into the housing bore until contact is obtained.

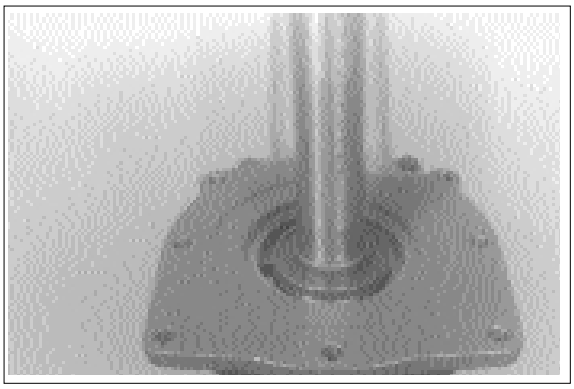


(2) Insert screening plate until contact is obtained.

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



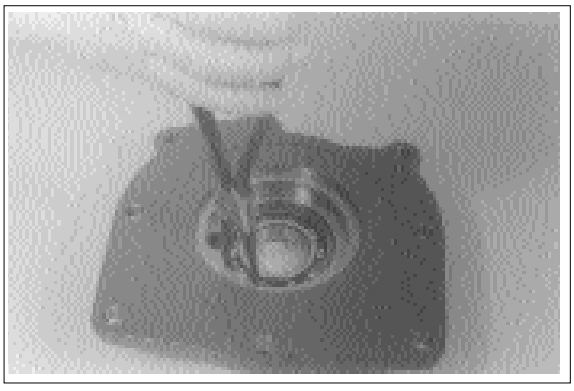
(3) Press ball bearing into the cover until contact is obtained.



(4) Fix ball bearing by means of circlip.

※ Special tool

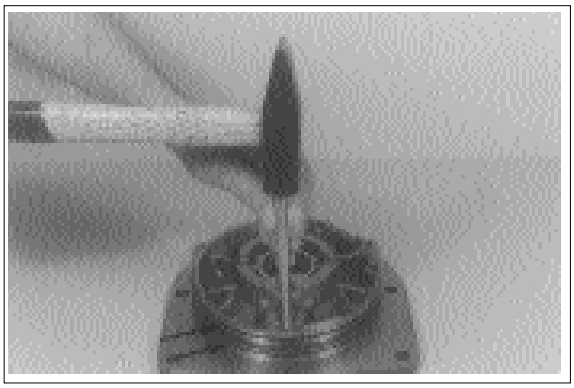
Set of internal pliers 5870 900 013



(5) Install sealing cover flush-mounted into the cover bore, insert O-rings(See arrows) into the annular grooves and grease them.

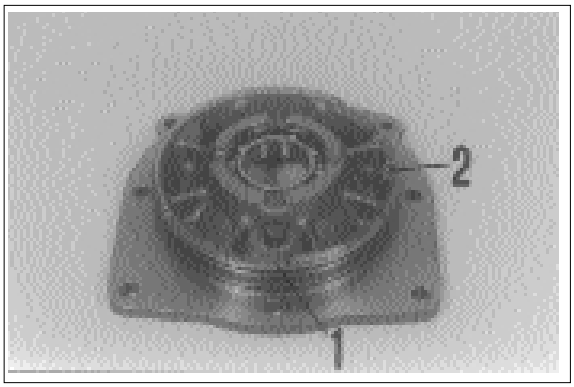
※ Wet contact face of screw plug with loctite (Type No.243).

※ Pay attention to the arrangement of the sealing cover(See below figure(6)).



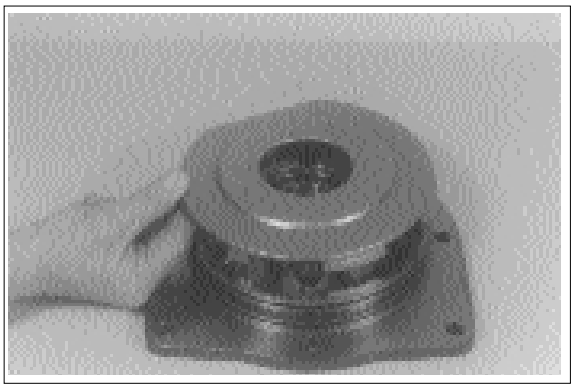
(6) Illustration on the left shows the arrangement of the sealing cover at horizontal, respectively vertical installation of the transmission.

1 Arrangement at horizontal installation
2 Arrangement at vertical installation

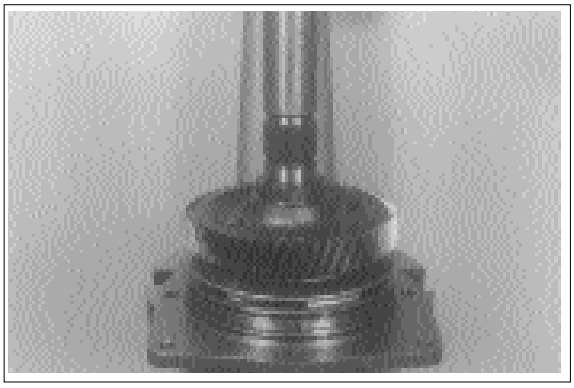


(7) Install oil baffle plate.

※ Pay attention to the radial installation position, see figure on the right.
Make oil baffle adhere with grease on the cover.

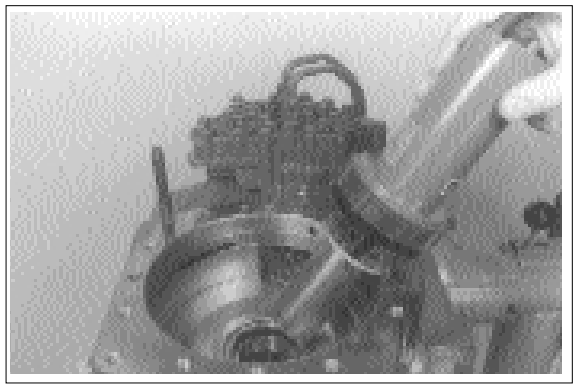


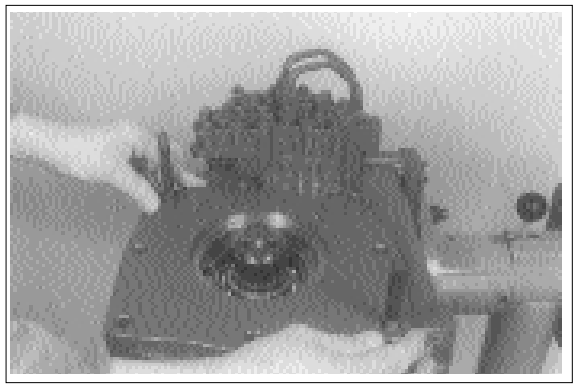
(8) Press output gear into the cover, with the short side showing downward, until contact is obtained.



(9) Install two adjusting screws.
Heat ball bearing(Figure right) and introduce cover along with output gear until contact is obtained.(Figure down)

※ Special tool
Adjusting screws 5870 204 021



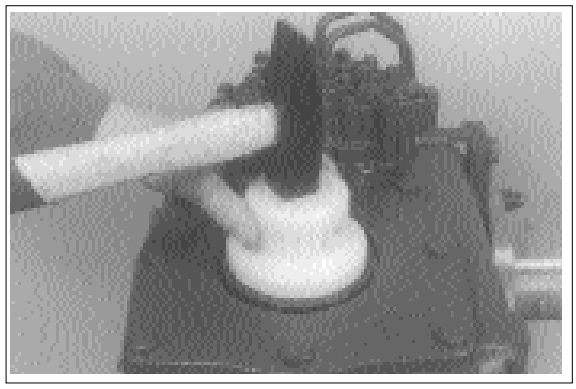


(10) Fasten cover by means of hexagon head screws.
· Tightening torque : 8kgf · m(57.9lbf · ft)

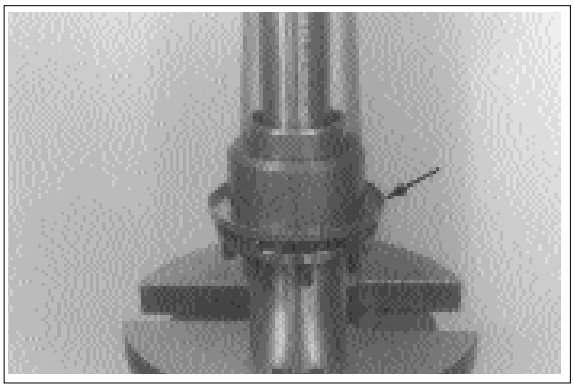
(11) Install shaft seal, with the sealing lip facing the oil chamber.

※ By application of the prescribed driver, the exact installation position is achieved.
Wet outer diameter of shaft seal immediately prior to the reassembly with spirit.
Fill cavity between sealing lip and dust lip with grease.

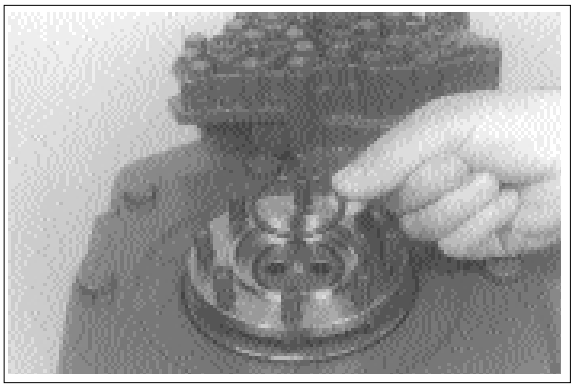
※ Special tool
Driver 5870 048 209



(12) Insert hexagon head screws into the bores of the output flange and press deflector plate(See arrow) against shoulder.
Preassemble opposite output flange accordingly.



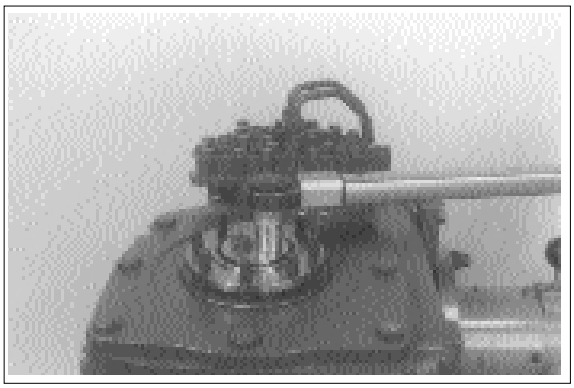
(13) Assemble output flange.
Grease O-ring and insert it into the gap of output flange/output gear.



(14) Mount disk and fix the output flange by means of hexagon head screws.
· Tightening torque : 4.7kgf · m(34.0lbf · ft)

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

※ Special tool
Clamping yoke 5870 240 025



(15) Tilt housing 180°.
Insert shaft seal, with the sealing lip facing the oil chamber.

※ By application of the prescribed driver, the exact installation position is achieved.
Wet outer diameter of shaft seal immediately prior to the reassembly with spirit.
Fill cavity between sealing lip and dust lip with grease.

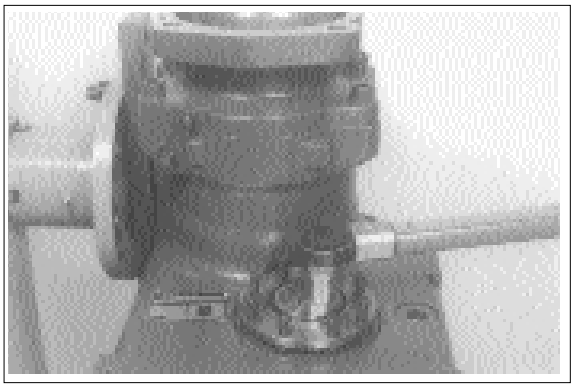
※ Special tool
Driver 5870 048 209

(16) Grease O-ring and insert it into the gap of the output flange/output gear.

(17) Mount disk and fix the output flange by means of hexagon head screws.
· Tightening torque : 4.7kgf · m(34.0lbf · ft)

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

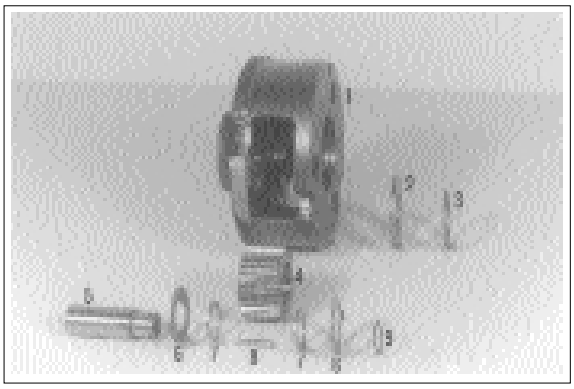
※ Special tool
Clamping yoke 5870 240 025



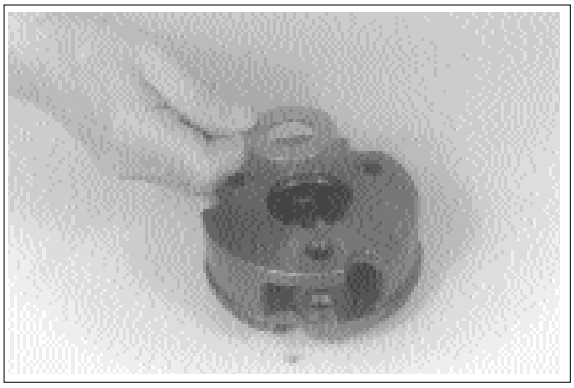
4) PREASSEMBLE AND INSTALL PLANETARY GEAR TRAIN

(1) Illustration on the left shows the installation position of the components.

1 Planet carrier
2 Disk
3 Axial needle cage
4 Planetary gear
5 Planet shaft
6 Thrust washers
7 Intermediate disks
8 Bearing needle
9 Circlip

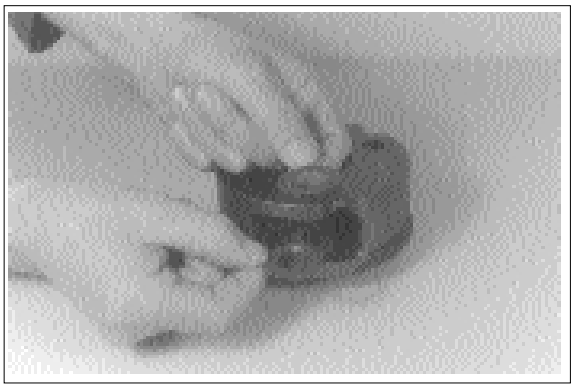


(2) Insert disk(Item 2) into the planet carrier.

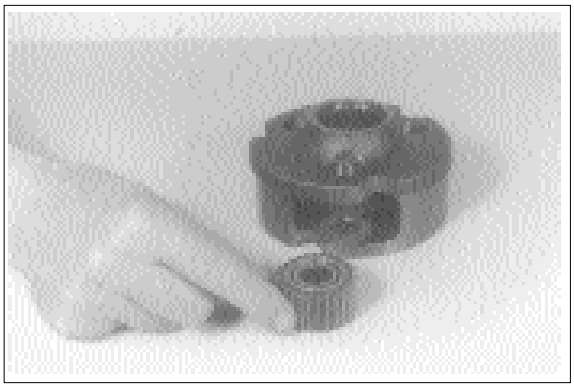


(3) Make both thrust washers(Item 6) adhere with grease in the planet carrier.

※ Pay attention to the position of the noses.

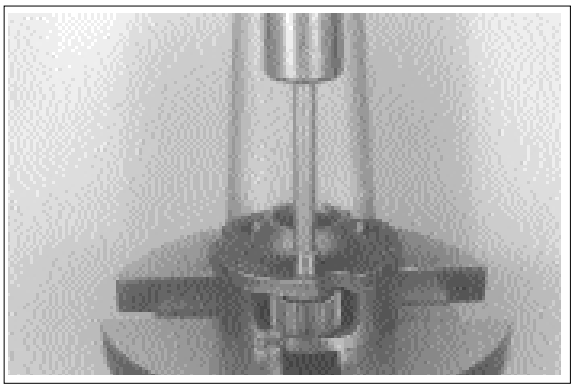


(4) Make the bearing needles(Item 8) and the intermediate disks(Item 7) adhere with grease in the planetary gear.
Now, insert planetary gear into planet carrier and carry out central alignment.



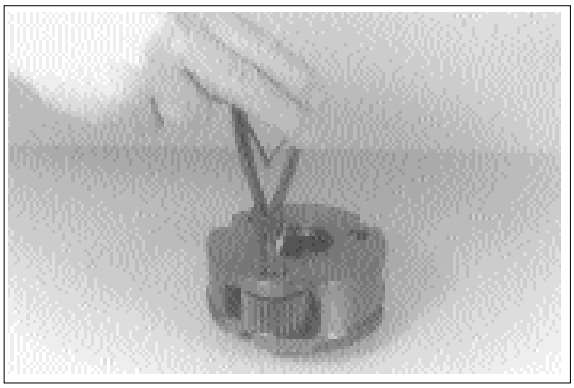
(5) Press planet shafts against shoulder.

※ At the pressing in of the planet shafts, pay attention to the free movement of the thrust washers.

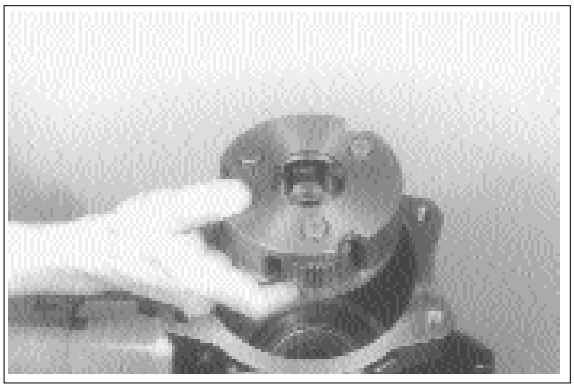


(6) Fix planet shafts by means of circlip.

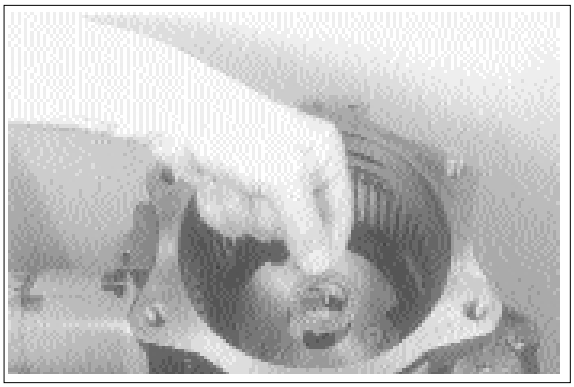
※ Special tool
Set of external pliers 5870 900 015



(7) Insert planet carrier into the gearbox housing and assemble it upon the helical gear until contact is obtained.



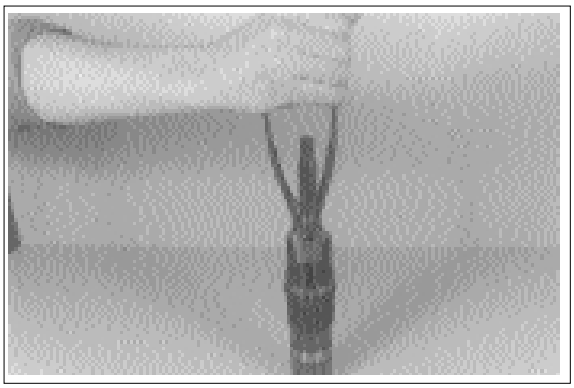
(8) Make axial needle cage(Item 3) adhere with grease in the planet carrier.



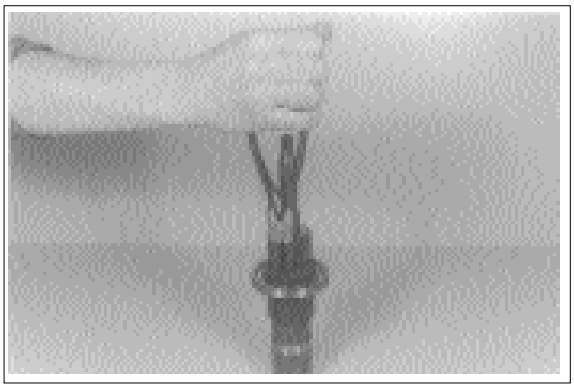
(9) Engage the first circlip into the lower annular groove of the drive shaft.

※ Special tool

Set of external pliers 5870 900 015



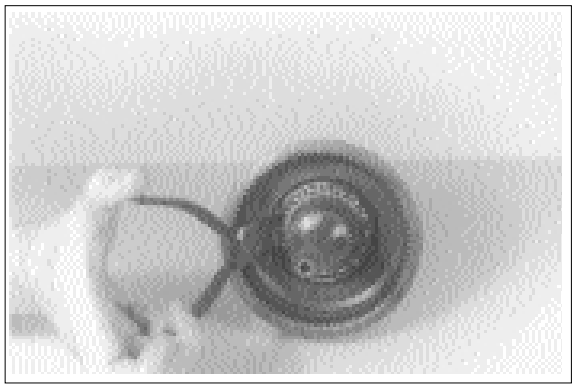
(10) Assemble ball bearing until contact on the first circlip is obtained and fix it by means of the second circlip.



(11) Introduce drive shaft into the internal gear and fix it by means of circlip.

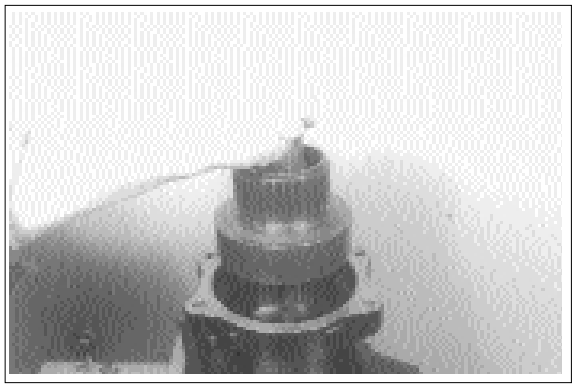
※ Special tool

Set of internal pliers 5870 900 013



(12) Introduce drive shaft complete with internal gear into the planet carrier.

※ Pay attention to the axial needle cage (See page 7-169 (8)).

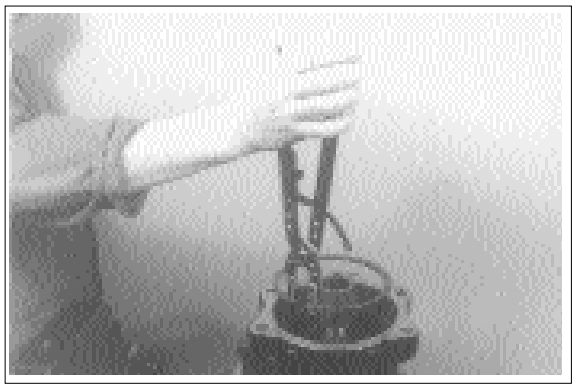


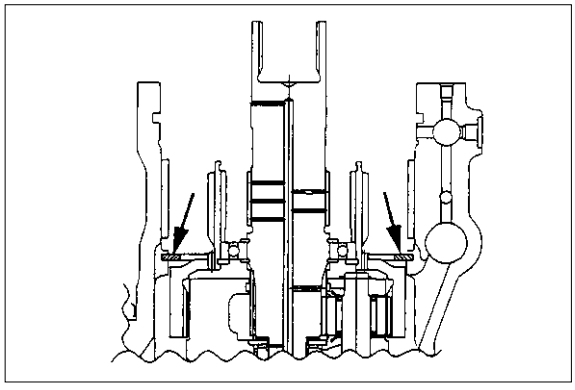
5) REASSEMBLE MULTI DISK BRAKE

(1) Engage circlip into the provided annular in the gearbox housing(See draft).

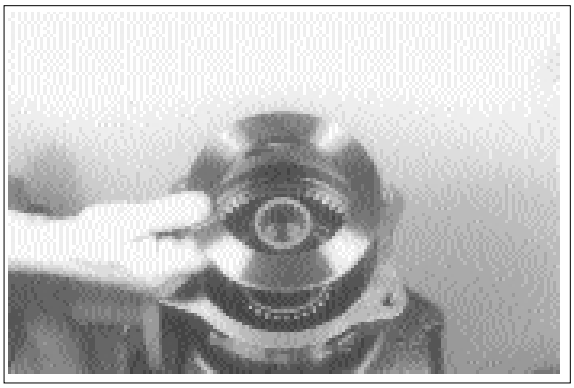
※ Special tool

Clamping pliers 5870 900 021



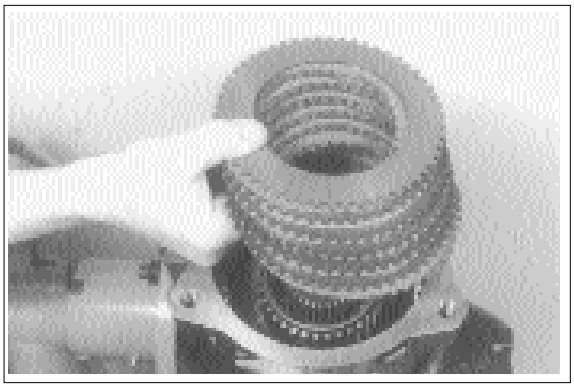


(2) Insert the first end shim into the gearbox housing.

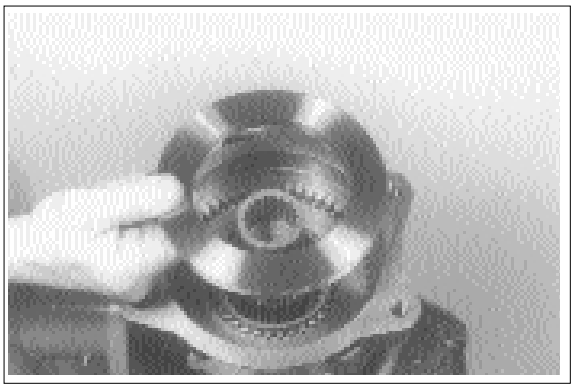


(3) Reassemble alternately outer and inner plates, starting with one outer plate.

※ Number and stacking of inner and outer plates, see also corresponding spare parts list.



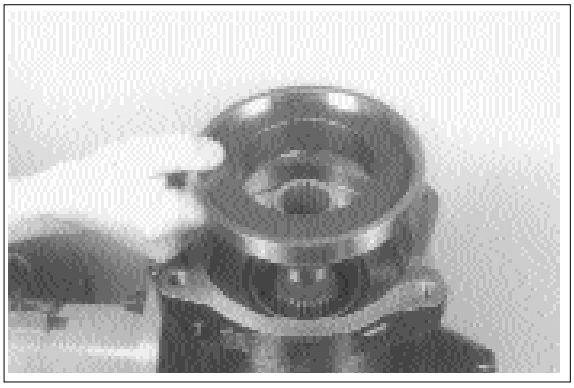
(4) Insert the second end shim.



(5) Insert piston into the housing until contact on the end shim is obtained.

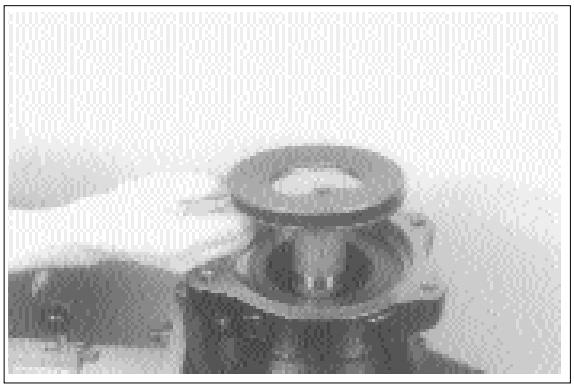
· Determine piston stroke : $1.3^{+0.3}$mm

※ For the measuring operation do not install sealing elements for the moment.



(6) Insert cup springs.

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



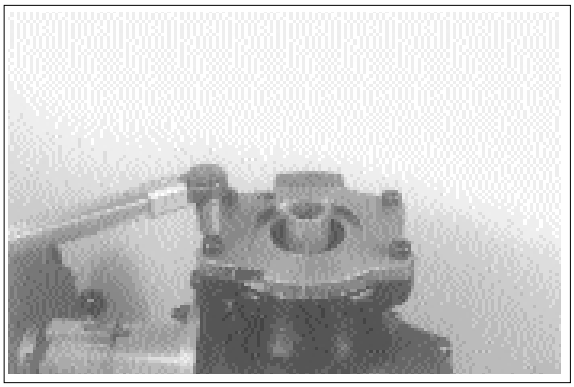
(7) Assemble measuring cover and pull it evenly against shoulder, using 4 socket head screws.

· Tightening torque : 12.7kgf · m(91.9lbf · ft)

※ For the exact adjustment of the piston stroke, it is absolutely necessary to use the measuring cover.

※ Special tool

Measuring cover	5870 200 095



(8) Determine dimension Ⅰ from the plane face of the measuring cover to the plane face of the piston.

· Determine Ⅰ e.g. 31.48mm

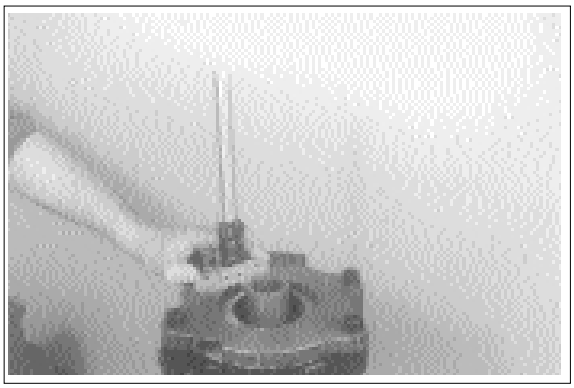
※ Special tool

Digital depth gauge	5870 200 072

Example E

Determine Ⅰ e.g.	31.48mm
Production dimension	- 18.00mm
Measuring cover	
Difference = Dimension **X**	13.48mm

※ The production dimension is incised on the measuring cover.



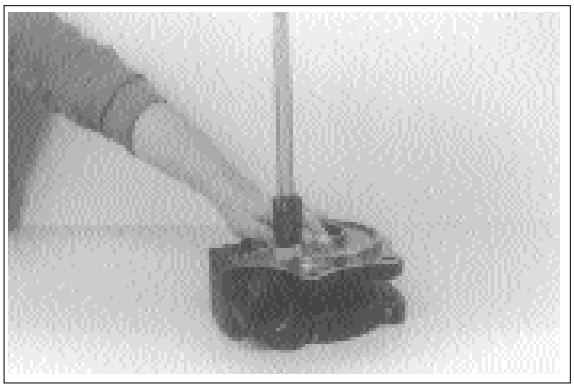
(9) Measure dimension **Y** from the contact face of the input casing to the mounting face.
· Determine **Y** e.g. 12.00mm

※ Special tool
Digital depth gauge 5870 200 072

Example F

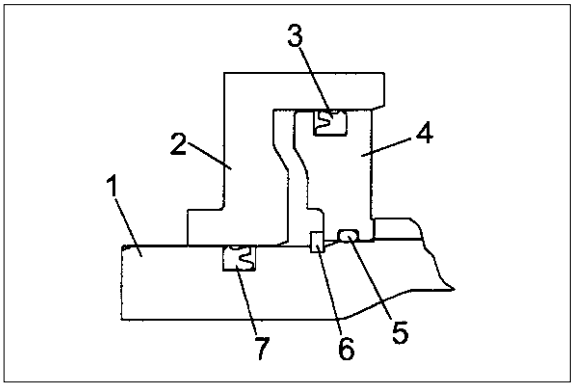
Dimension **X**	13.48mm
Dimension **Y**	- 12.00mm
※ Difference = Piston stroke	1.48mm

Any necessary corrections have to be carried out with a corresponding outer
※ plate(s=2.8/3.0 or 3.2mm).
Now, remove measuring cover and demount piston again.

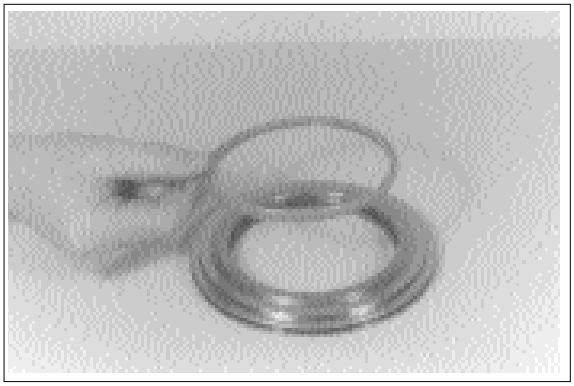


(10) The draft on the right shows the installation position of the disk, of the piston as well as of their sealing elements.

1 Gearbox housing
2 Piston
3 Gasket
4 Disk
5 O-ring
6 Snap ring
7 Gasket



(11) Insert gasket into the annular groove of the disk, with the sealing lip showing upward.



(12) Install O-ring(See arrow) and insert disk into the housing until contact is obtained.
※ Pay attention to the installation position, See 2nd up (10).
Oil O-ring and gasket prior to install the disk.

95W3TM120

(13) Fix disk by means of snap ring.

95W3TM121

(14) Insert gasket into the annular groove of the housing, with the sealing lip showing downward.

※ Grease sealing lip.

※ Piston and cup springs of the multi disk brake are going to be installed only after the installation of the clutch(See page 7-178, (14)~(16)).

95W3TM122

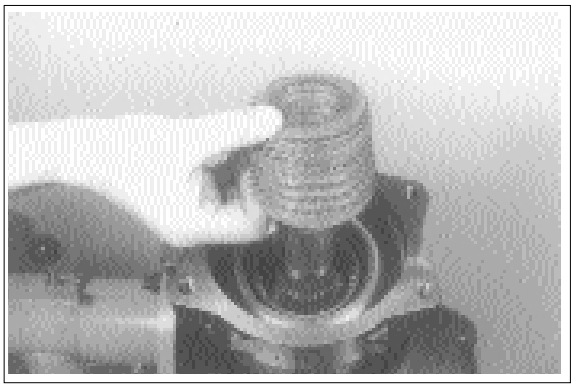
6) INSTALL CLUTCH AND INPUT CASING

(1) Assemble end shim and position it in the internal gear until contact is obtained.

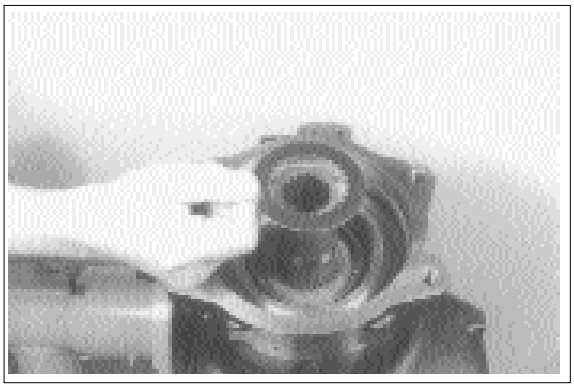
95W3TM123

(2) Install alternately inner and outer plates, starting with one inner plate.

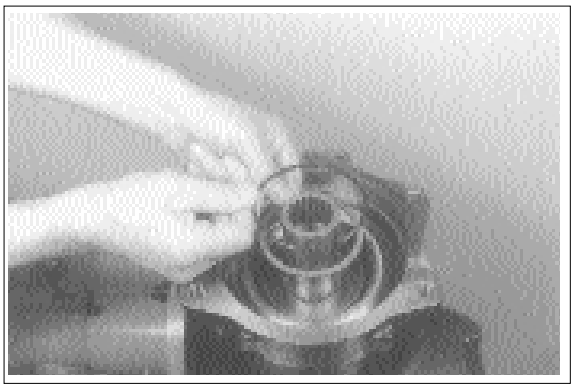
※ Number and stacking of inner and outer plates, see also corresponding spare parts list.



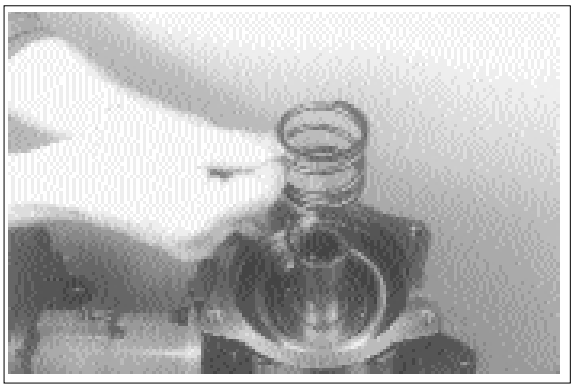
(3) Assemble inner plate(Without lining).



(4) Insert disk into internal gear and fix it by means of snap ring.



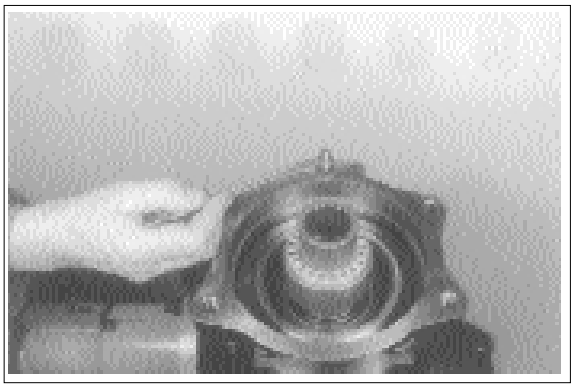
(5) Assemble intermediate disk and compression spring.

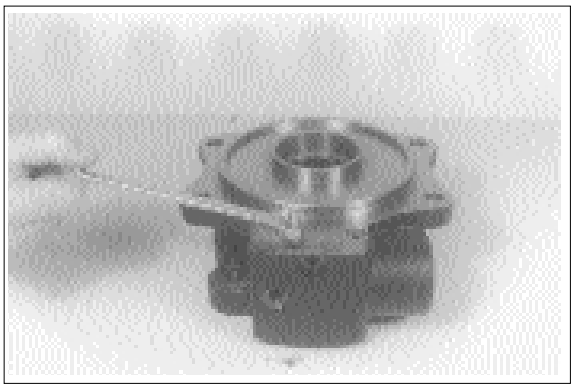


(6) Assemble pressure piece and axial roller ring.

(7) If a new gearbox housing, respectively input casing is used, install shear-off plug.

※ Insert shear-off plug with loctite(Type No.262).

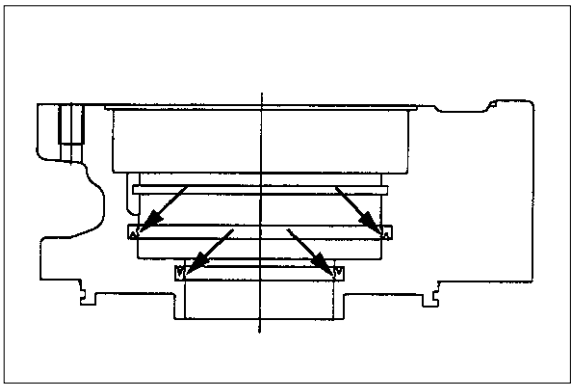




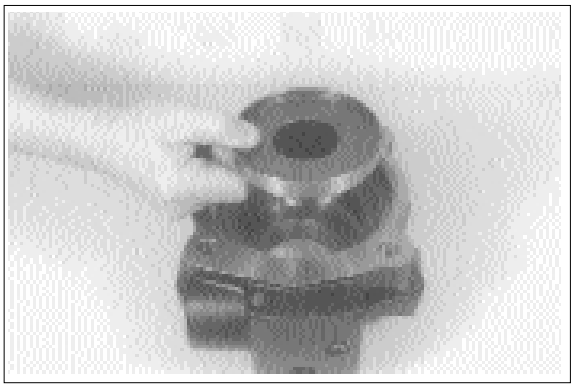
(8) Insert gaskets into the annular grooves of the input casing.

※ Grease sealing lip.

※ Pay attention to the installation position, see draft.

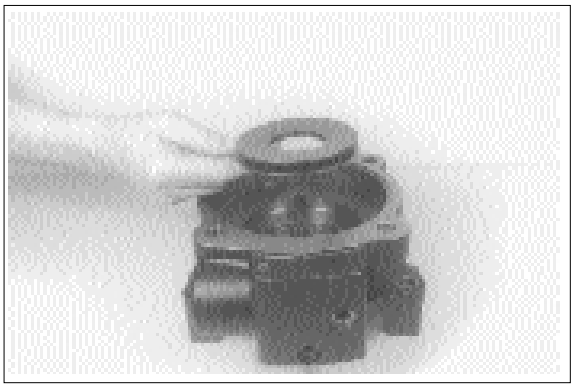


(9) Put housing on blocks and insert piston into the housing until contact is obtained.



(10) Insert cup springs.

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

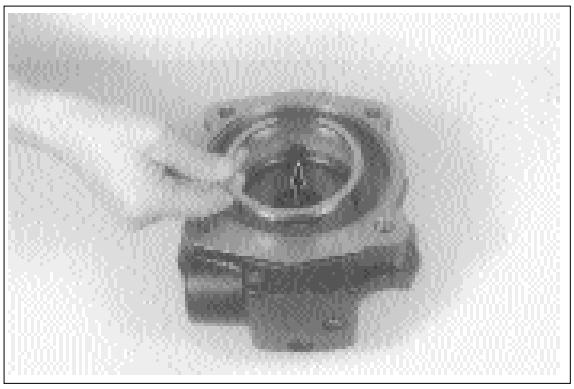


(11) Insert measuring ring, with the aperture facing the groove(See arrow).

※ Measuring ring will be removed again after the determination of the piston stroke (See page 7-181(22),(23)).

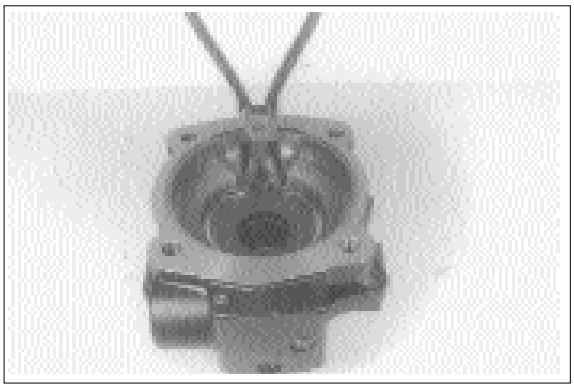
※ Special tool

Measuring ring 5870 200 096

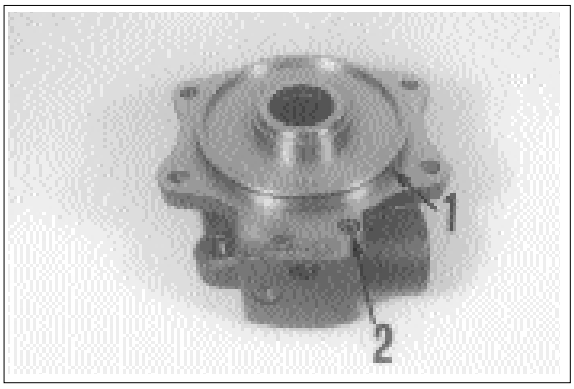


(12) Fix measuring ring by means of circlip.

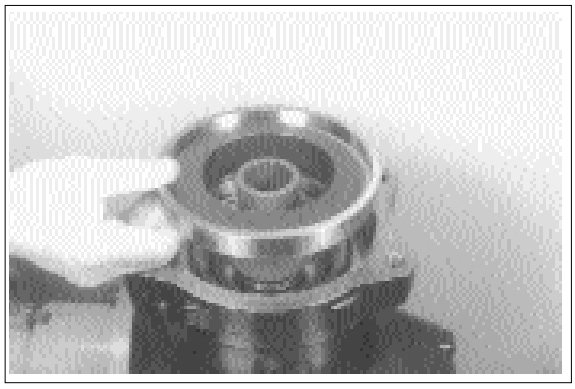
※ Pay attention to the installation position, see figure on the right.



(13) Insert O-ring(Arrow 1) into the annular groove of the input casing and grease it. Make O-ring(Arrow 2) adhere with grease in the countersinking.

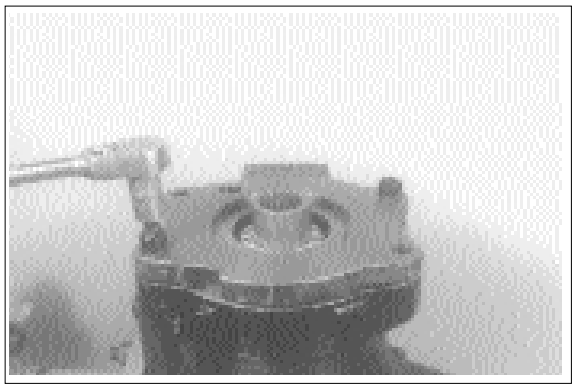


(14) Insert piston into the gearbox housing.



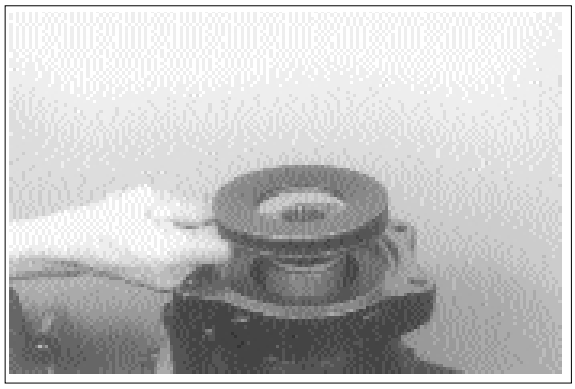
(15) Position piston by means of measuring cover as well as socket head screws evenly against shoulder.
Now, remove measuring cover again.

※ Special tool
Measuring cover 5870 200 095



(16) Insert both cup springs and carry out centric alignment.

※ Pay attention to the installation, see figure on the right.

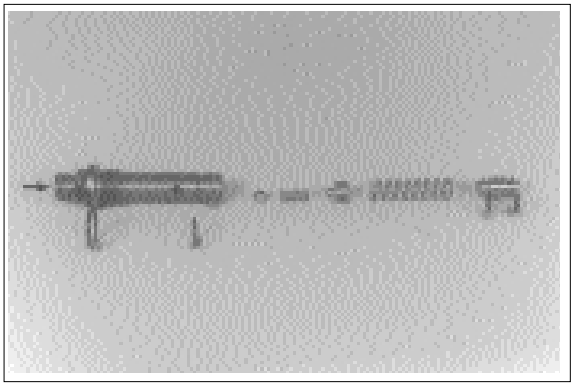


(17) Assemble input casing and pull it evenly against shoulder, using socket head screws.

· Tightening torque : 12.7kgf · m(91.9lbf · ft)

(18) Equip screw plugs(See arrows) with new O-rings and install them.
· Tightening torque : 2.5kgf · m(18.1lbf · ft)

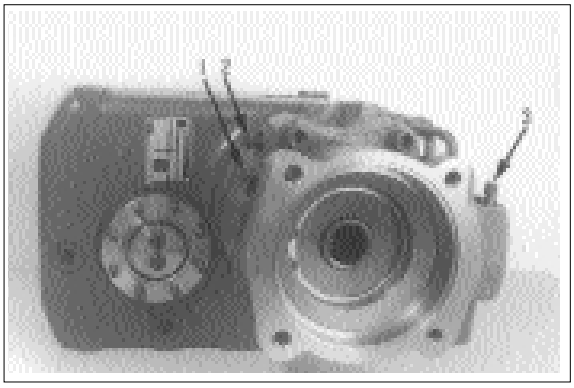
(19) Illustration on the right shows the components of the valve insert.
※ If the old valve insert are installed, clean orifice(Bore, see arrow).



(20) Install pre-assembled valve inserts into the input casing and gearbox housing.
· Tightening torque : 3.6kgf · m(26.0lbf · ft)

(21) Install breather valves(See arrows).
Illustration on the right shows the arrangement of the breather valves at vertical installation of the transmission.

1 Breather clutch
2 Bleeder brake
3 Bleeder release device

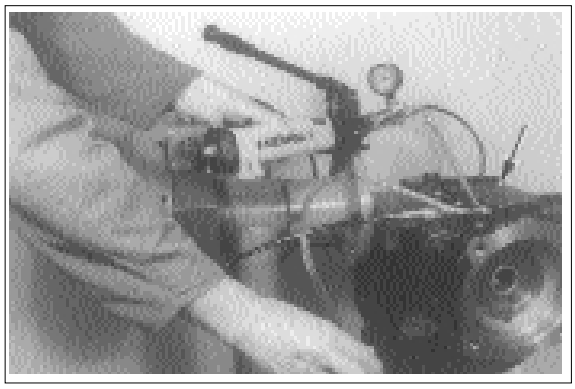


(22) Check leak tightness and function of the clutch

① Install screw plug(See arrow).
Vent piston chamber by repeated filling.
Build up test pressure p=35bar and close connection to the HP-pump by means of stop valve.
During test period of 3 minutes, a pressure drop is not permitted.

※ Special tool

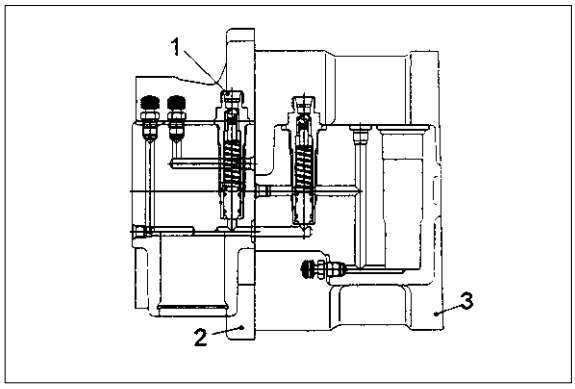
HD pump	5870 287 007
DKO socket	5870 950 143



② Illustration on the right shows the connection position of the HP-pump.

1 Connection HP-pump
2 Input casing
3 Gearbox housing

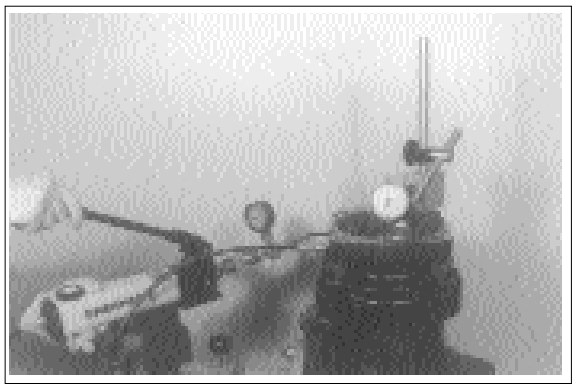
※ The corresponding breather for the venting of the piston chamber of the clutch, see page 7-179 (21).

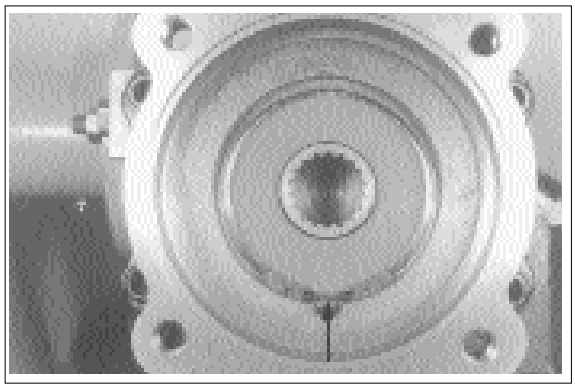


(23) Determine piston stroke of the clutch $1.8^{+0.6}$mm

① Apply dial indicator through the aperture of the circlip and the measuring ring on the piston(See arrow).
Build up test pressure 35bar and read piston stroke of the clutch on the dial indicator.

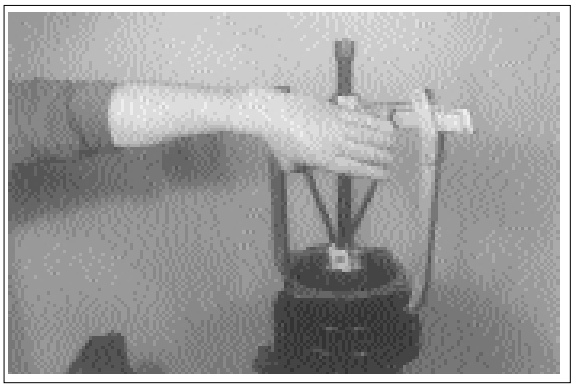
※ Any necessary corrections of the piston stroke have to be carried out with corresponding outer plate(s=1.2/1.4/1.6 or 1.8㎜, page 7-174 (2)).



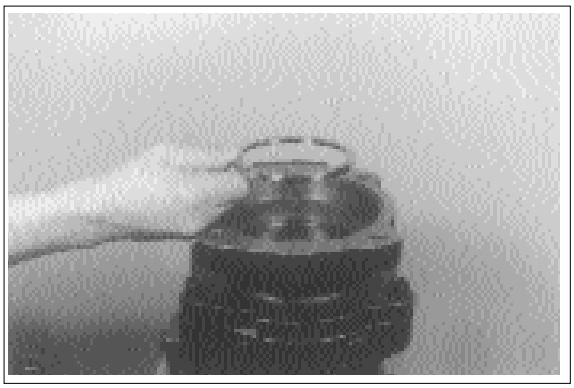


② Press by means of two-leg puller against the cup spring, squeeze circlip out and remove measuring ring(See page 7-177 (11)).

※ By the pressure applied on the cup springs, the circlip will be relaxed.



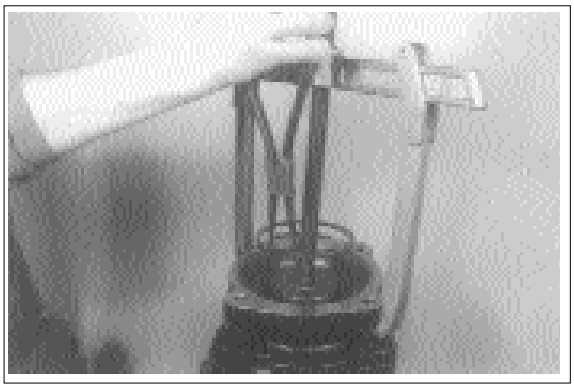
③ Carry out centric alignment of the cup springs and insert supporting disk.



④ Insert circlip into the input casing.
Preload cup springs by means of two-leg puller and engage circlip.
Now, remove two-leg puller.

※ Special tool

Two-leg puller	5870 970 003
Set of internal pliers	5870 900 013

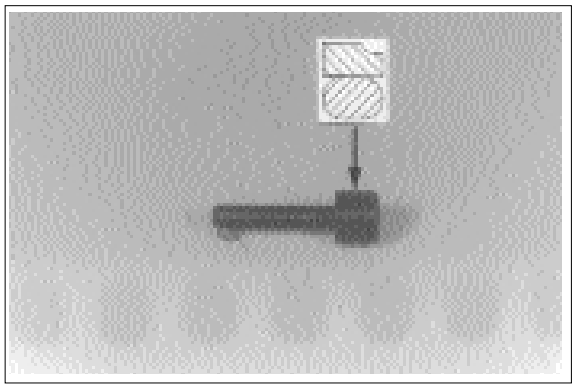


7) INSERT CIRCLIP INTO THE INPUT CASING

(1) Insert gasket(Composed of O-ring and ring) into the annular ring groove of the piston and grease it.

※ Use installer.
Pay attention to the installation position, see figure on the right.

※ Special tool
Installer 5870 651 054

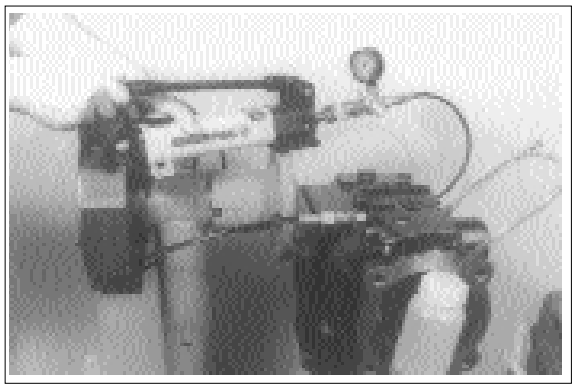


(2) Insert pre-assembled piston and spring into the housing bore and fix by means of screw plug.
· Tightening torque : 10.2kgf · m(73.8lbf · ft)
Install screw plugs(See arrow).
· Tightening torque : 2.5kgf · m(18.1lbf · ft)

※ Equip screw plugs with new O-rings.

(3) Vent the piston chamber by repeated filling.
Build up test pressure p=35bar and close connection to HP-pump by means of stop valve.

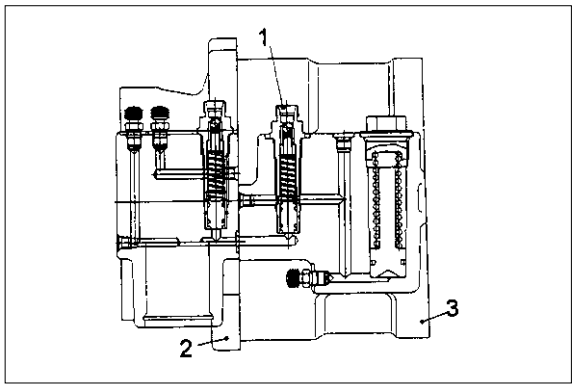
※ During a test period of 3 minutes, a pressure drop is not permitted.



(4) Illustration on the right shows the connection position of the HP-pump.

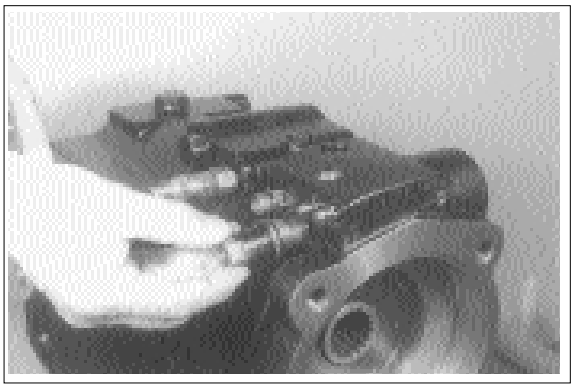
1 Connection HP-pump
2 Input casing
3 Gearbox housing

※ The corresponding breather for the venting of the piston chamber of the brake, see page 7-179 (21).



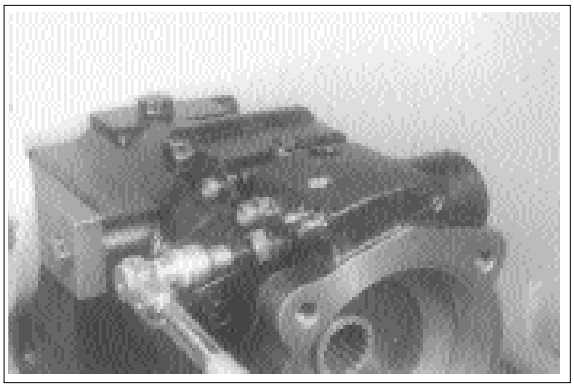
(5) Install connecting piece.
· Tightening torque : 3.6kgf · m(26.0lbf · ft)

※ Equip connecting piece with new O-rings (3EA).



(6) Install screw plug.
· Tightening torque : 2.5kgf · m(18.1lbf · ft)

※ Install new O-ring.

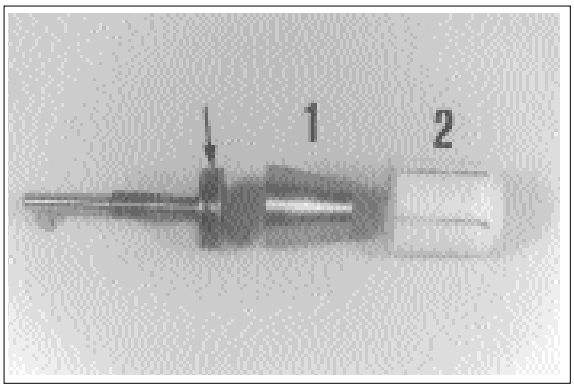


8) INSTALL RELEASE DEVICE AND CHECK FUNCTION, RESPECTIVELY LEAK TIGHTNESS

(1) Assemble profiled section ring(See arrow) upon the installer(Part 1) and press it by means of (Part 2) into the ring groove of the piston.

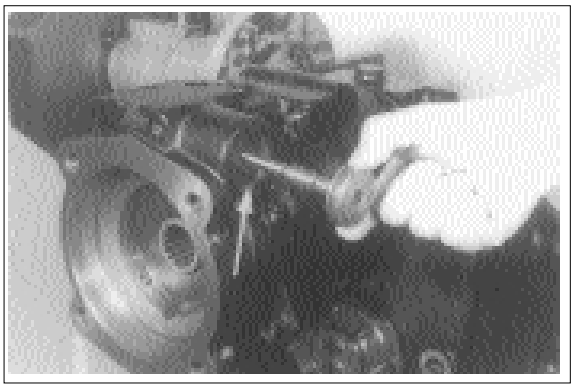
※ Grease profiled section ring.

※ Special tool
Installer 5870 651 069



(2) Insert piston into the input casing, respectively screw it in until the recess (See arrow) is free.

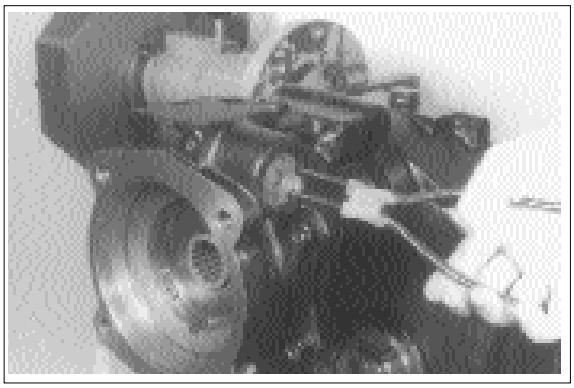
※ The profiled section ring in the piston will be accommodated when screw into the housing.



(3) Squeeze circlip in and turn back the piston until contact on the circlip is obtained.

※ Special tool

Set of external pliers 5870 900 015

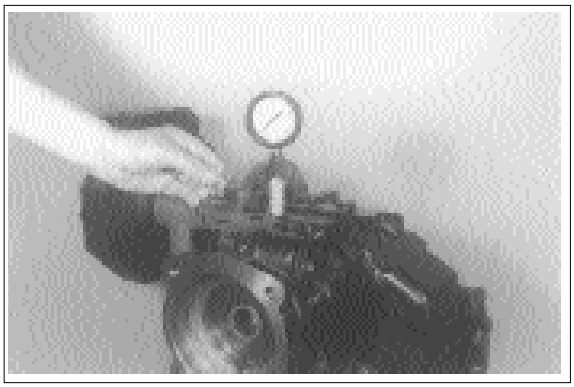


(4) Install pressure gauge and connecting piece for HP-pump.

Measuring point clutch or brake.

※ Special tool

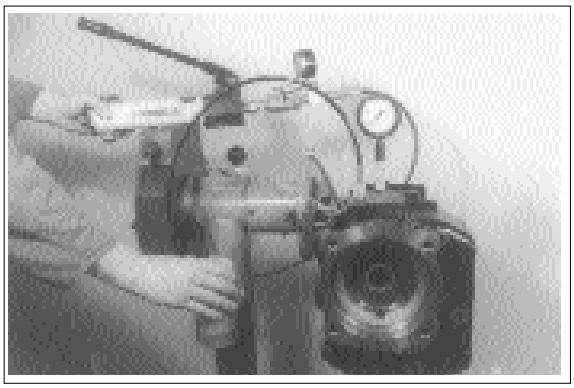
HP pump	5870 287 007
Pressure gauge	5870 511 034
Connection G 1/4"	5870 950 106
Minimess coupling	5870 950 101
Minimess coupling	5870 207 939



(5) Vent the piston chamber by respected filling.

Now, close bleeder and remove HP-pump along with connecting piece again.

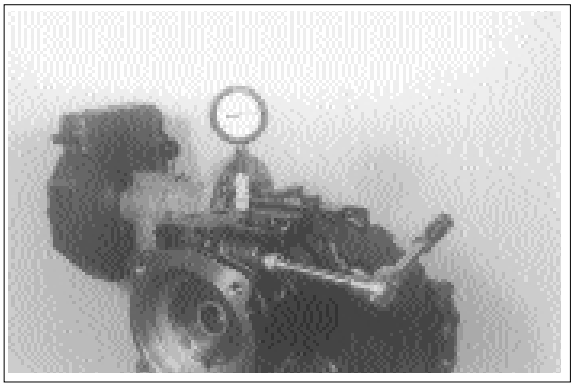
※ The corresponding breather for the venting of the piston chamber of the release device, see page 7-179 (21).



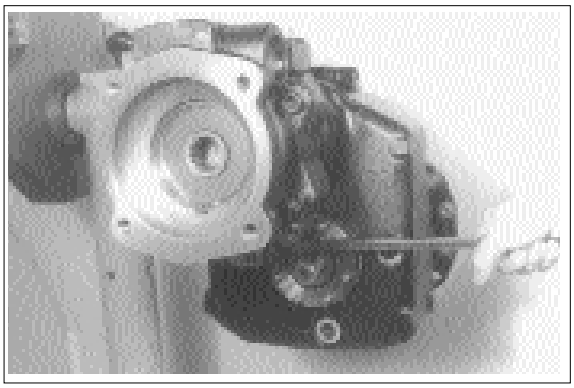
(6) Screw in the piston in one move until contact is obtained.

※ The pressure in clutch and brake must not be below 30bar, and can rise up to 50bar for a short moment.

※ Prior to actuate the release device, the piston chambers of the clutch(Page 7-180(22)) and the brake(Page 7-182 (3)) must be completely vented.

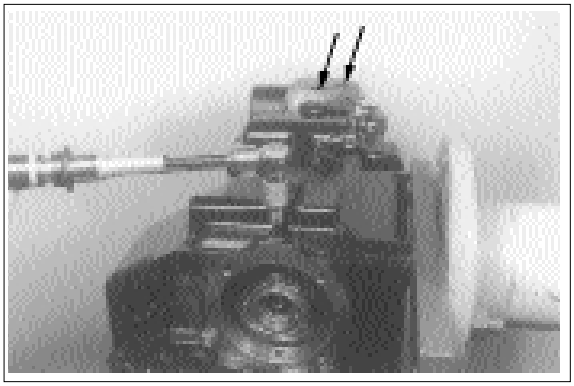


(7) After the actuation of the release device, it must be possible to rotate the output flange freely.
Now, turn back the piston again until contact on the circlip is obtained and remove pressure gauge.



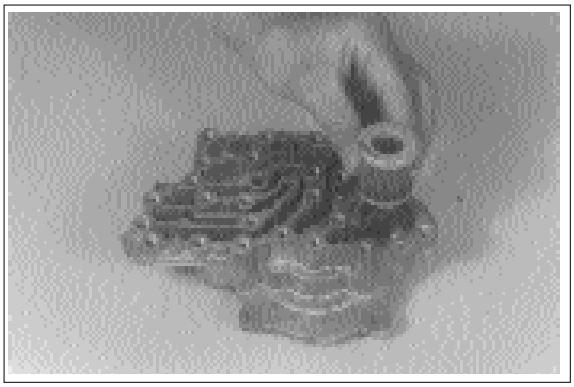
(8) Install screw plugs(See arrows).
· Tightening torque : 2.5kgf · m(18.1lbf · ft)

※ Equip screw plugs with new O-rings.



9) PRE-ASSEMBLE AND REMOVE SHIFT INTERLOCK

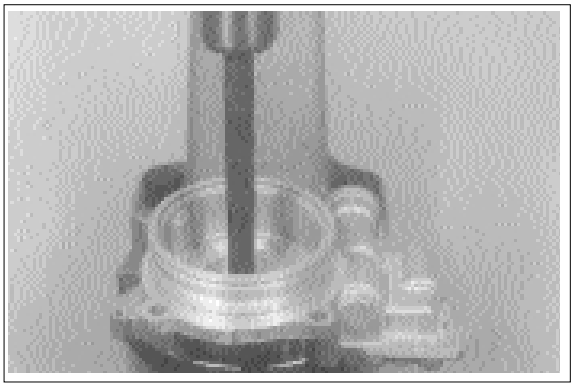
(1) Insert screen filter into the housing, with the smaller diameter showing downward.



(2) Install needle sleeve.

※ By application of the prescribed drift, the required installation depth of $0.2^{+0.5}$mm is achieved.
Install needle sleeve with the reinforced shell facing the press in tool.

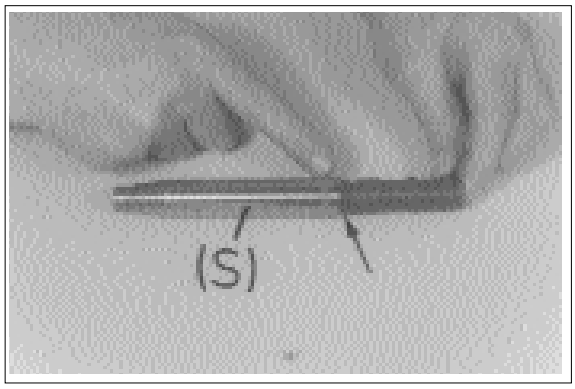
※ Special tool
Drift 5870 705 003



(3) Install gasket(Composed of plastic ring and O-ring)

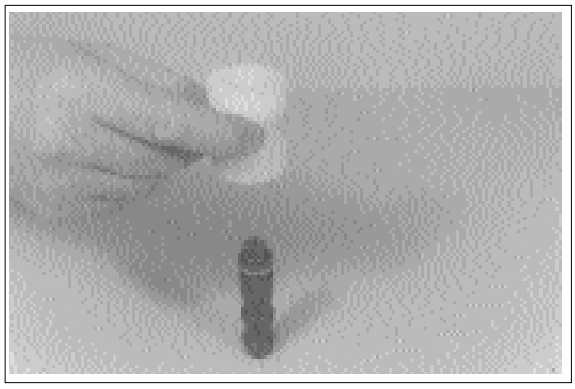
① Insert O-ring(See arrow) into the ring groove of the piston.
Guide plastic ring by means of installer (S) upon the piston and position it on the O-ring.

※ Special tool
Installer 5870 651 055

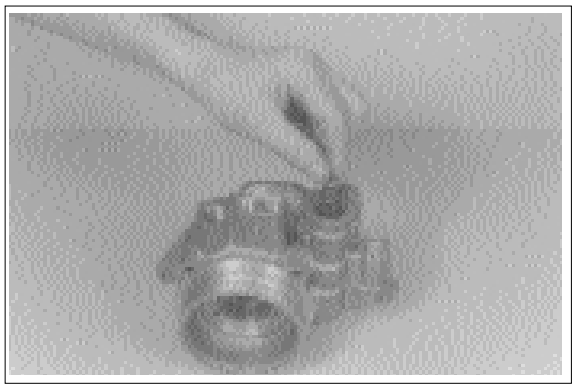


② Calibrate plastic ring by means of bush.

※ Special tool
Calibrating mandrel 5870 651 056



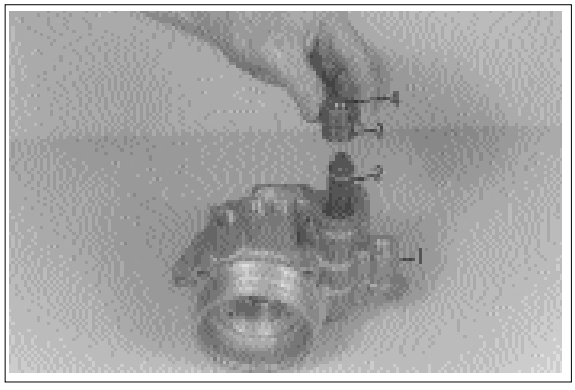
(4) Insert compression spring until contact in the centering on the hole bottom is obtained.



(5) Insert piston into the housing and fix it by means of screw plug.

1 Housing
2 Piston
3 Screw plug(M24 × 1.5)
· Tightening torque : 5.1kgf · m(36.9lbf · ft)
4 Screw plug(M10 × 1)
· Tightening torque : 2.0kgf · m(14.5lbf · ft)

※ Equip screw plugs with new O-rings.
Install components according to the figure on the right.

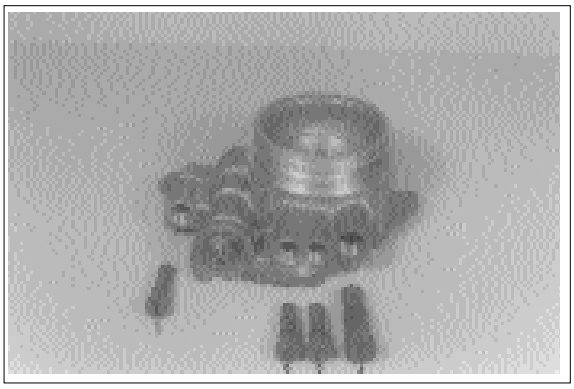


※ Pay attention to the installation position of the different check valves.

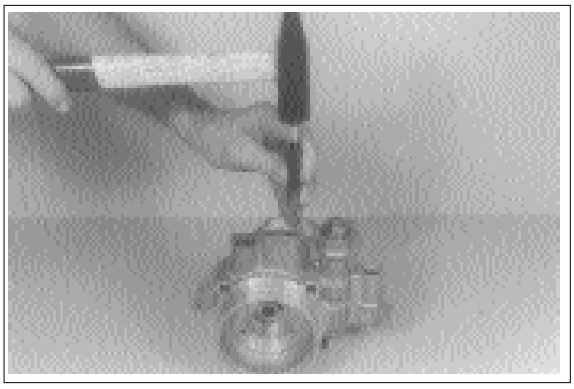
1 Check valve(Cpmpl.)
2 Check valve(Cpmpl.)
3 Check valve(Cpmpl.)
4 Pressure limiting valve(Cpmpl.)

· Tightening torque : 1.0kgf · m(7.2lbf · ft)

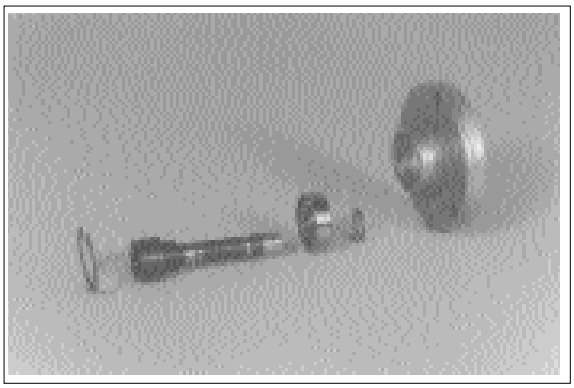
※ Equip all check valves as well as the pressure limiting valve with new O-rings.



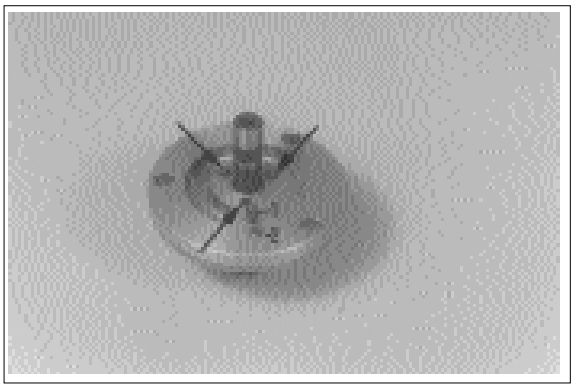
(6) Secure check valves and pressure limiting valve with two center punch marks each.



(7) Install pump cover according to the figure on the right.

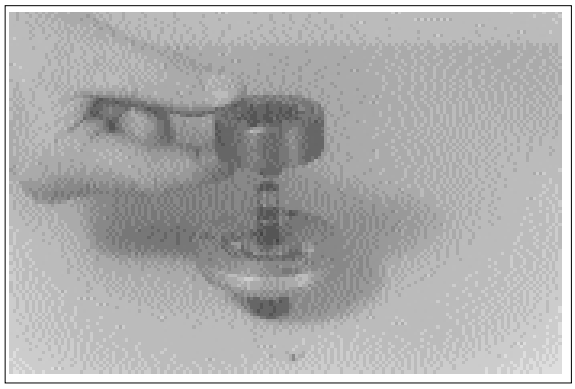


(8) Insert compression springs(1) and balls(2) with grease into the bores(Arrows) of the pump cover.



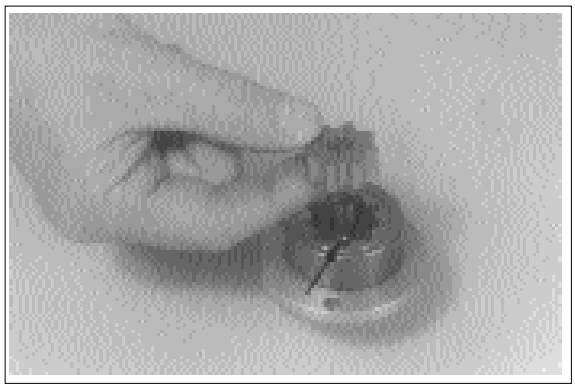
(9) Assemble control unit along with outer rotor.

※ The rotor set(Composed of control housing, outer rotor and internal rotor) must be exchanged only completely.



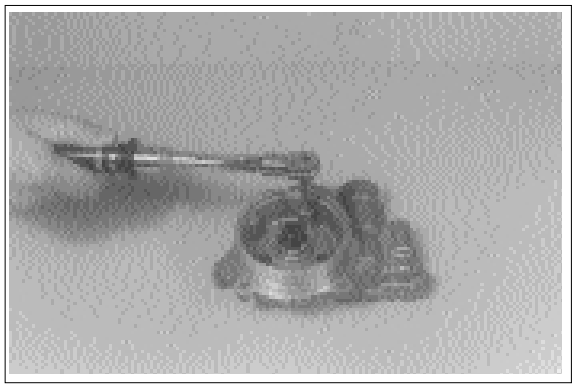
(10) Insert ball with grease into the countersinking of the pump shaft(See arrow) and assemble internal rotor.
The engagement of the internal rotor is realized with the ball.

※ Pay attention to the exact installation position.

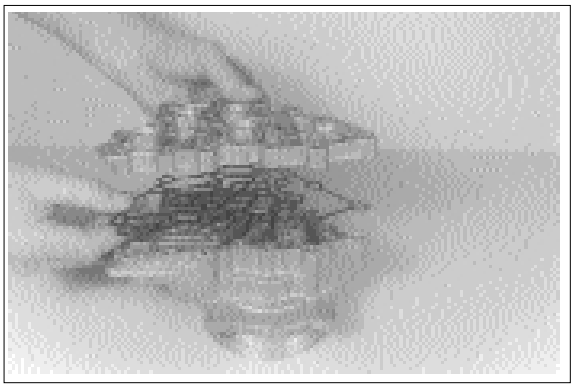


(11) Insert pre-assembled pump cover into the housing bore.

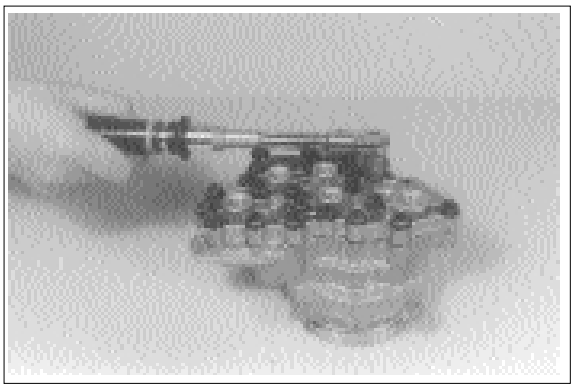
(12) Fasten pump cover by means of hexagon head screws.
· Tightening torque : 0.97kgf · m(7.0lbf · ft)



(13) Lay gasket and cover upon the housing.

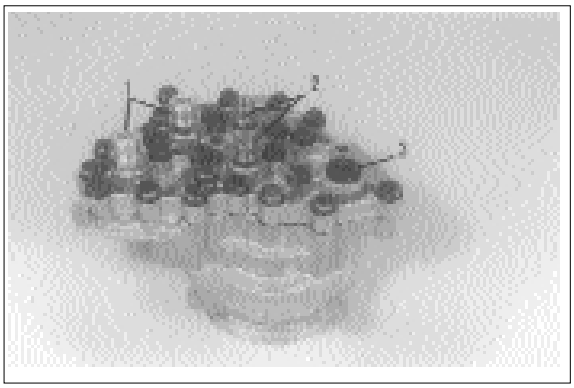


(14) Fasten cover by means of hexagon head screws and plain washer.
- Tightening torque : 2.3kgf · m(16.6lbf · ft)

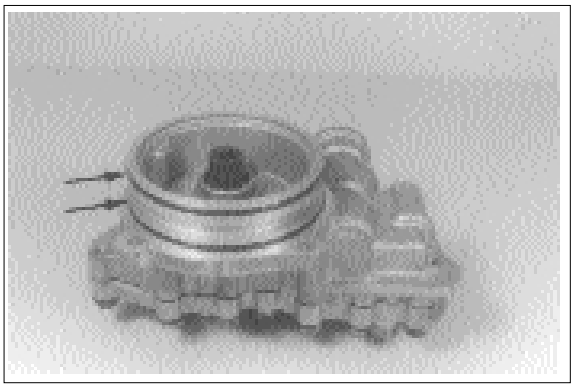


(15) Install both adapters(1), both screw-in sleeves(2) as well as screw plug(3).

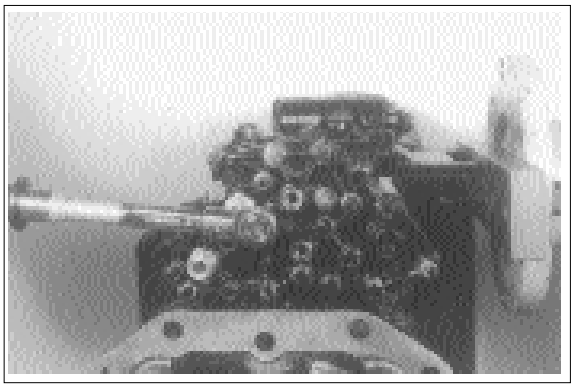
※ Use new O-rings.
- Tightening torque : 2.5kgf · m(18.1lbf · ft) (Adapter)
- Tightening torque : 3.6kgf · m(26.0lbf · ft) (Screw-in sleeve)
- Tightening torque : 3.6kgf · m(26.0lbf · ft) (Screw plug)



(16) Insert O-rings(See arrows) into the annular grooves of the housing and grease them.



(17) Introduce shift interlock into the gearbox housing and fasten it by means of socket head screws and plain washers.
· Tightening torque : 2.3kgf · m(16.6lbf · ft)



(18) Install hose lines(See arrows) according to the figure on the right.

※ Prior to put the transmission into service, fill in oil according to the lubrication instructions, see **Operator's manual**.